Stormwater Drainage Study

Willamette University

Softball Field Improvements

Site Address:

605 14th Street SE, Salem OR 97302

Associated Permit No.: TBD

REGISTERED PROFESSIONAL ENGINEER
74512PE
Digital Signature
OREGON
JUNE 11, 2008
GEOFF T. LARSEN
EXPIRES 12/31/26

Mazzetti Project No. 023-000175
Prepared by: Mikael Shields, PE
Reviewed by: Geoff Larsen, PE
(541) 686-8478

March 24, 2025

TABLE OF CONTENTS

Appendix A: Stormwater Figures and Exhibit Drawings

EX-1: Softball Topographic Survey
EX-2: Softball Field Pre-development Storm Drain Basin Map
EX-3: Softball Field Post-development Storm Drain Basin Map

Appendix B: Hydrograph Summary Reports

Softball Field Hydrograph Reports

Appendix C: Stormwater Conveyance Calculations

To be completed at final design

Appendix D: Site Information

NRCS Soil Map and Description
NRCS Hydrologic Soil Group
FEMA Flood Insurance Rate Map

Appendix E: Geotechnical Reports

July 7, 2023 Geotechnical Report
September 2, 2024 Geotechnical Report Addendum 1

Appendix F: Operations and Maintenance

To be completed at final design

Appendix G: UIC Information

DEQ Email Correspondence

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INTRODUCTION

This report is a summary of the stormwater management approach and design for the proposed Willamette University Softball Field Improvements project. This report outlines the applicable stormwater regulatory requirements and summarizes the design methodology and calculations for the proposed stormwater facilities. The proposed stormwater management systems are designed in accordance with the current City of Salem Code Salem Revised Code (SRC) Chapter 71 and Administrative Rules (AR) Division 004.

PROJECT OVERVIEW AND DESCRIPTION

Project Scope and Proposed Improvements

Willamette University intends to convert the existing natural turf softball field to synthetic turf. The softball field is located at 605 14th Street SE, Salem, OR 97301 on the Willamette University campus, Tax lots 2300 and 2403, Map 073W26CB. The softball field area is approximately 1.25 acres.

Figure 1 - Vicinity map

The softball field development will include new infield and outfield synthetic turf, warning track, and field lights around the perimeter of the facility. New fencing and netting will be included to supplement existing fencing to remain. The existing dugout structures, locker room, hitting cage, and maintenance building will remain. Existing concrete paving around the perimeter of the backstop and bleacher area will remain. The project will include new stormwater conveyance, treatment, and management facilities as described below.

Existing Conditions

The existing project site consists of a natural turf softball field with gravel and limited concrete paving around the bleacher area. The outfield areas are natural turf (grass) with a cinder warning track at the outer perimeter. The infield area consists of a mix of bare soil, natural turf, and cinders. Existing improvements include dugout structures, locker rooms, an indoor hitting cage, and maintenance building with a guttered and piped drainage collection system that connects to an existing pipe that runs northwest and connects to the public storm drain system in 14th Street.

Description of the Drainage Basin

The softball field is in the Mill Creek Basin, Subbasin MI-SD-086. Drainage from the site enters a private system located in the parking lot to the north. From here, runoff is conveyed to a 10-inch pipe on the east side of 14th Street SE, then to a 42-inch pipe at the intersection of Mill Street SE. The 42-inch pipe runs west and increases to a 60-inch pipe that ultimately discharges to Shelton Ditch on the east side of Church Street. Shelton Ditch drains to Pringle Creek that flows into the Willamette River to the west at Riverfront Park. City maps indicate that a portion of the softball field is in the Salem administrative floodway and will require a floodplain development permit. See Appendix D- For Floodplain information.

Proposed Conditions

The project includes the replacement of the existing natural turf field with a synthetic turf field and drainage system. The project will also include a new concrete pad for bicycle parking racks, and new protective fencing and netting. The existing concrete and gravel surfacing drainage patterns will remain unchanged. Existing dugouts, locker rooms, hitting cage, and maintenance building will remain intact.

The new field will include a synthetic turf surface that will be underlain by an open graded rock reservoir allowing infiltration/retention for stormwater treatment and flow control. The field system will include a series of flat perforated pipes to distribute water through the system.

Drainage from the field and a majority of existing impervious surfaces will be routed through a new Green Stormwater Infrastructure (GSI) stormwater soakage trench and retention facility for stormwater treatment and flow control. Runoff from the outfield area will be managed by a surface infiltration/retention facility located under the synthetic turf. Runoff from the infield synthetic turf, existing concrete pavement and dugout roof will be managed by a soakage trench reservoir (UIC) located in the infield area. Due to routing constraints, some existing impervious surface area will be treated / detained in exchange for not treating / detaining new impervious surface area. See Analysis section below for further discussion.

Existing Tree and Native Vegetation Impacts

The project will have limited impacts to existing trees and native vegetation except for the natural grass field turf. All existing trees will be retained and protected during construction.

Green Storm Water Infrastructure (GSI) Implementation

As outlined in the Green Stormwater Infrastructure (GSI) Analysis section below, the project meets the requirements for the Discretionary Approach to achieving MEF.

Regulatory Permits Required

Stormwater related permits include Erosion Control Permits from the City of Salem and the Department of Environmental Quality (DEQ). The new stormwater retention infiltration trench will be registered through DEQ as an Underground Injection Control (UIC).

Identification of the 100-Year Storm Escape Route

Stormwater runoff for the 100-year storm is contained within the proposed stormwater facilities. The project does not substantively alter existing grades or impact overland conveyance. The existing maintenance building is located within a raised area, allowing flows to be conveyed overland around the perimeter of the building in the event of extreme storm events or system blockages.

STORMWATER REGULATORY REQUIREMENTS

Overview

The stormwater regulatory requirements for the project are governed by City of Salem AR Division 004 and SRC Chapter 71. The project will be designed as a Large Project (impervious area greater than 10,000 square feet). Large Projects are required to provide both flow control and treatment facilities using GSI to the Maximum Extent Feasible (MEF). For background and context, the approach for stormwater management of the synthetic turf field has been coordinated with the City of Salem Public Works Department. As part of the Pre-Application Conference (AP23-34), the City recommended that the synthetic turf field be designed as a pervious pavement (from a stormwater management standpoint), and indicated that traditional GSI would not be required. Through more recent coordination with the City's Engineering team, the City has expressed concerns about the pervious pavement approach and has requested a more active design approach to demonstrate that stormwater treatment and detention requirements are addressed. A similar approach was used and ultimately approved for a recent synthetic turf field replacement project at the Willamette University Baseball Field (Permit Number 24-120869).

The system will consist of two reservoirs separated by a rock check dam. The outfield reservoir (SIF-1) will accept runoff from the outfield area and fully infiltrates all design storms. The infield reservoir (UIC-1) will accept runoff from the infield area, left field bullpen synthetic turf area, right field dugout roof, and the existing concrete pavement around the backstop area. The following demonstrates compliance with applicable treatment and detention design criteria.

Outfield Reservoir (SIF-1) – Surface Infiltration Facility Design Requirements

To demonstrate compliance with the treatment and detention requirements, the synthetic turf outfield is designed to meet the requirements / intent of Salem AR Subsection 4.6 Retention Systems. Although Section 4.6 is geared toward subsurface Underground Injection Control (UIC) systems, the proposed outfield retention system is classified as a surface infiltration system and is a non-UIC system.

Description

The outfield cross-section will remain pervious throughout the extents of the field and will be constructed with a 6" open graded gravel storage reservoir beneath the field section. Since the field surface (and subgrade) is constructed with a mild slope , the gravel storage reservoir will be separated using a rock check dam to ensure infiltration through the subgrade is maximized. The outfield reservoir will accept runoff from the outfield area and fully infiltrates all design storms. Refer to Figure 2.0 below, and the Permit Drawings for a detail of the check dam.

To accurately represent the infiltration and storage behavior of the rock reservoirs, the reservoir is modeled as a triangular aggregate-filled reservoir with a slope on one side and a vertical wall (check dam) on the other side. The check dam is placed at the downstream edge of the outfield (low point). This is a conservative simplification of the actual reservoir shape.

The synthetic turf field will be constructed with a series of flat perforated pipes at the top of the storage reservoir to provide resiliency and redistribution of flows in areas where localized infiltration rates are lower than the design infiltration rate. The flat pipes also serve as a conveyance mechanism for extreme storms and facilitate emergency overflow. The outfield reservoir is designed to infiltrate all design storms. Modeling results indicate a maximum stage (storage elevation) of approximately 1" for the 100-year design storm.

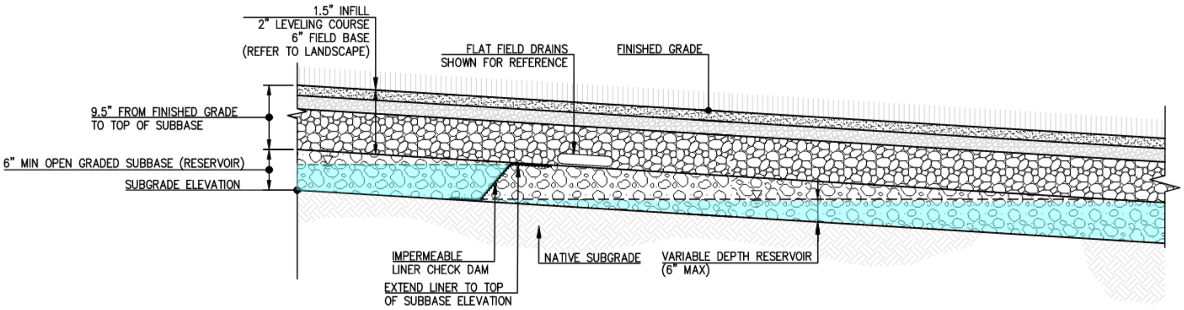


Figure 2.0 – Outfield Reservoir Cross Section

Infield Reservoir (UIC-1) Underground Injection Control (UIC) Design Requirements

The Infield Reservoir will be designed and registered with DEQ as A UIC. The Infield Reservoir will accept flow from the synthetic turf infield area and practice area along left field. Runoff from the existing concrete surfaces behind the backstop and the right field dugout roof area will sheet flow into the Infield Reservoir. An overflow pipe in Manhole 1 that leads to the existing piped storm drain system in the parking lot will serve as an overflow for higher storm events. Modeling results indicate a maximum stage (storage elevation) of approximately 162.02 for the 100-year design storm which results in approximately 14" of freeboard below the lowest field elevation.

Description

The infield cross-section will be constructed with a 6" open graded gravel storage reservoir beneath the field section. The system will include a 3' wide infiltration trench and includes the area of the infield as additional infiltration area.

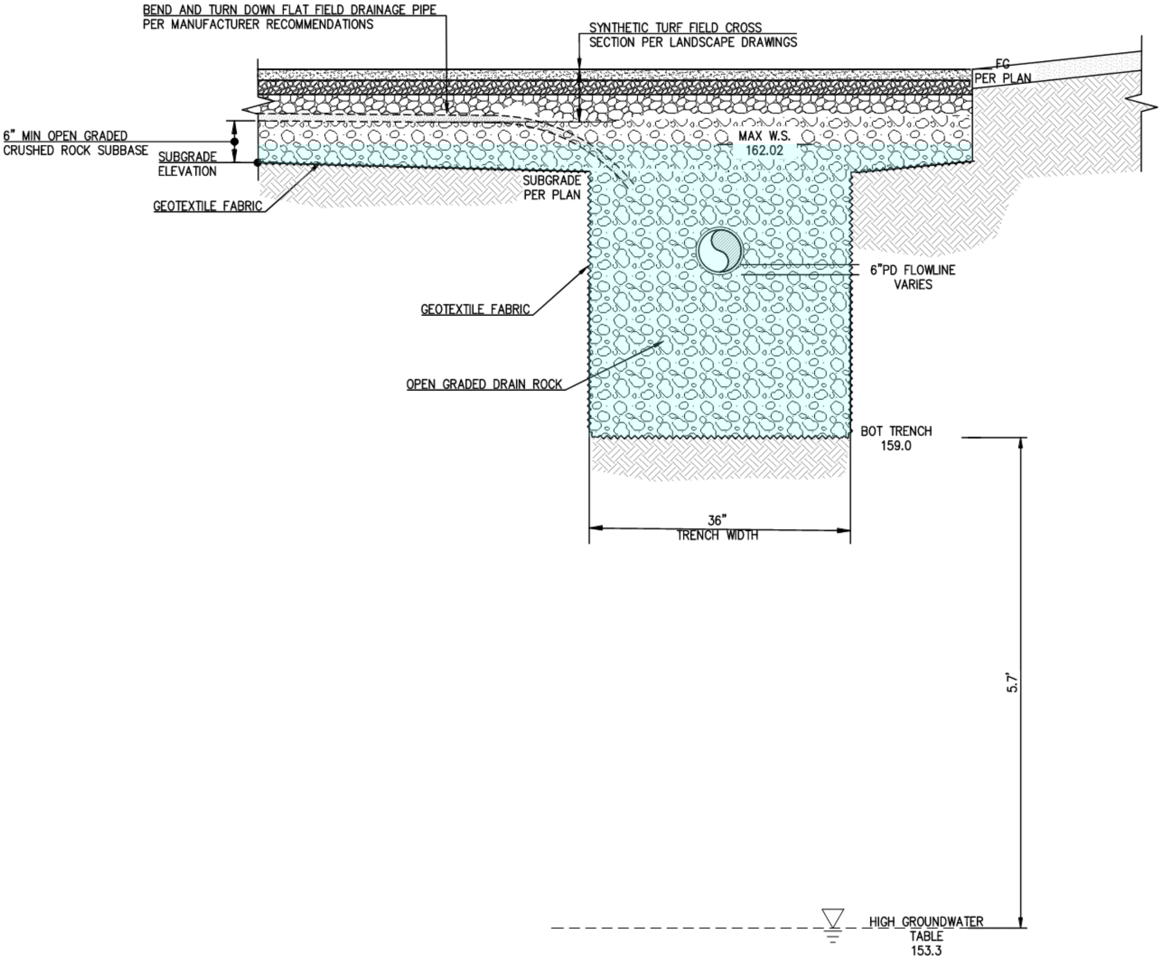


Figure 2.1 – Infield Reservoir (UIC) Cross Section

Soil Suitability

Subsection 4.6(1) requires a measured infiltration rate of 0.5 inches per hour or greater in the immediate vicinity of the facility.

The proposed Outfield and Infield infiltration facilities use a design infiltration rate of 3.6 inches per hour which was obtained by taking the average of five measured infiltration rates in the vicinity of the field area and applying a factor of safety of two. See Geotechnical Report in Appendix E for professional infiltration testing results.

Setbacks

Subsection 4.6(2) requires a 5-foot setback from property lines, a minimum 10-foot setback from building foundations and a 100-foot setback from slopes 20 percent or greater.

The infiltration facilities are located greater than 5-feet from all property lines and greater than 10-feet from any building foundation. There are no slopes greater than 20 percent with 100-feet of the infiltration facilities.

Sizing Criteria

Subsection 4.6(3) requires use of the Rational Method or hydrograph method for hydrology calculation and required storage capacity to be determined by subtracting the volume of water that can infiltrate out of the facility within the required drawdown period. The infiltration rate is greater than two inches per hour allowing the 100-year storm event to be used as the design storm.

Hydrology calculations were performed using the hydrograph method with required storage capacity determined by subtracting the volume of water that can infiltrate out of the facility within the required drawdown period. The design infiltration rate is 3.6 inches per hour and the facility retains up to the 2-year storm event without overflow. An overflow to an approved point of discharge is provided.

Treatment

Treatment of runoff from the synthetic turf field will be addressed through infiltration and filtration through the native soil. Since stormwater from the field is infiltrated, there is no discharge of stormwater to the City of Salem stormwater system for the water quality storm event. The underlying groundwater is sufficiently deep to provide treatment prior to infiltrated stormwater reaching the groundwater. The proposed Infield Reservoir infiltration system is classified as a UIC and will be registered with DEQ. The proposed UIC meets the treatment and groundwater separation requirements of the OAR 340-044-0018(3)(a)(G) & (H). Specifically, the bottom of the reservoir will be placed greater than 5’ above the seasonal high groundwater table, which is recognized by DEQ as an adequate filtration layer to protect groundwater. The actual separation between the subgrade and the seasonal high groundwater is approximately 5.7’. Recent coordination with DEQ Underground Injection Control (UIC) staff was conducted to address concerns about adequate treatment of runoff from the synthetic turf field surface. DEQ’s UIC regulations are in place to ensure that stormwater runoff disposed of through infiltration systems is treated sufficiently to protect groundwater. DEQ has confirmed through email communication that the proposed infiltration system would meet DEQ treatment requirements. Refer to Appendix G for email communication with DEQ.

Salem AR Subsection 4.6(4) recommends a pretreatment structure as may be required by DEQ, depending on the impervious area being served, prior to discharging to the facility. Pre-treatment is not proposed for this facility. The proposed synthetic turf cross-section is self-filtering and inherently prevents migration of surface material into the underlying reservoir. The infill and synthetic turf system is designed with a backing system to prevent infill material from migrating below the turf backing.

METHODOLOGY

Depth to Groundwater

Based on the Geotechnical Report provided by NV5 Engineering, groundwater was encountered at approximately 10.0 feet below the ground surface. The Geotechnical Engineer has indicated that the investigation was performed in late spring, which is expected to be a worst-case condition for determining high groundwater levels. The Geotechnical reports are found in Appendix E.

Description of Soil Types and Wetlands

The Natural Resources Conservation Service (NRCS) soil mapping indicates the soils at the baseball field are classified as: Clackamas gravelly loam - Hydrologic Soil Group B, and Salem gravelly silt loam – Hydrologic Soil Group C/D

See Appendix D for a copy of the NRCS maps and soil information.

A geotechnical exploration was conducted at the site by NV5. Geotechnical reports are found in Appendix E.

No wetlands were found at the site. There are no known hazardous materials located at the site.

ANALYISIS

Computational Methods and Software Utilized

The site was modeled using Hydraflow Hydrographs Extension for Autodesk Civil 3D. Computational Methods included the Santa Barbara Urban Hydrograph Method for hydrology and Hazen-Williams for hydraulics. Refer to Appendix B for Hydraflow Hydrograph Report. Note that the 1-yr design storm event in the report represents the Water Quality storm event and the 3-yr design storm event represents ½ of the 2-Year storm event.

Design Assumptions

The stormwater management facilities for this project are designed under the current City of Salem Revised Code (SRC) Chapter 71 and City of Salem Administrative Rules (AR) Division 004. All curve numbers and design storms were taken from the AR Division 004.

Design Storms

Water quality and flow control facilities are designed to manage the design storms specified in the current City of Salem Revised Code (SRC) Chapter 71 and City of Salem Administrative Rules (AR) Division 004.

Table 1: Rainfall Data / Design Storms

Recurrence Interval	24-hr Rainfall Depth
WQ Storm	1.38 inches
½ of 2-Year	1.10 inches
2-Year	2.2 inches
5-Year	2.7 inches
10-Year	3.2 inches
25-Year	3.6 inches
50-Year	4.1 inches
100-Year	4.4 inches

Stormwater Flow Control and Treatment Offsetting Areas

The project is required to provide treatment and detention for the new and redeveloped impervious surfaces. The project will create or redevelop approximately 0.002 acres of new impervious surface. Due to routing constraints, approximately 0.314 acres of existing impervious surface areas will be treated / detained through SIF-1 in exchange for not treating / detaining and bypassing 0.002 acres of new impervious surfaces. These areas are summarized in the tables on Exhibit 3 in Appendix A.

Flow Control and Conveyance

As required by the Stormwater Code all private on-site development shall meet the flow control and conveyance requirements. The stormwater management approach proposes to provide flow control and conveyance for all new and existing impervious surfaces.

Table 2: Pre vs. Post Construction Flow Rates

Facility ID	Peak Flow Rate (cfs)							
	½ of the 2 Year Storm		2 Year Storm		10 Year Storm		100 Year Storm	
Project Site	Pre	Post	Pre	Post	Pre	Post	Pre	Post
Softball	0.012	0	0.041	0.006	0.133	0.062	0.289	0.094

Stormwater Treatment

As required by the Stormwater Code, treatment facilities were provided for all new and replaced impervious surfaces.

Treatment_Technology

The new and replaced impervious surfaces and synthetic field turf areas will be treated via City of Salem approved GSI Retention System stormwater facility. Refer to Table 4 for facility inflow information.

Pre- and Post-development Basin Area Tables and Maps

Refer to Table 3 and Appendix A for Pre-development and Post-development Basin Area Tables and Maps.

Table 3: Private Catchment and Facility

(shows each catchment on proposed site as well as proposed facility)

Catchment/ Facility ID	Source (Roof/Road/Other)	Impervious Area (Acres)	Pervious Area (Acres)	Ownership (Public/Private)	Facility Type	Facility Size (ft^2)	Curve Number
Predevelopment							
1E	Field	0	1.041	Private	-	-	72
1E.1	Roof	0.005	0	Private	-		98
1E.2	Concrete	0.027	0	Private	-		98
1E.3	Gravel	0.057	0	Private	-		91
Total	--	0.089	1.041	Private	-		--
Post-Development-Infield Reservoir (UIC-1)							
2B	Synthetic Turf	0.299	0	Private	UIC[1]	--	98[4]
2C	Concrete	0.027	0	Private	UIC[1]	--	98
2D	Gravel	0.057	0	Private	UIC[1]	--	91
2E	Roof	0.005	0	Private	UIC[1]	--	98
Total	--	0.388	0	Private	UIC[1]	11,492	--
Post-Development – Outfield Reservoir (SIF-1)							
2A	Synthetic Turf	0.742	0	Private	SIF[2]	--	98[4]
Total	--	0.742	0	Private	SIF[2]	5,968	--
Proposed Areas Bypassed Around Stormwater Facilities							
3	Concrete	0.002	0	Private	Bypass[3]	--	98
Total	--	0.002	0	Private	Bypass[3]	--	--

1. Infield Reservoir Underground Injection Control (UIC).
2. Outfield Reservoir Surface Infiltration Facility (SIF).
3. Runoff from Basin 3 will bypass around stormwater facilities to discharge directly to existing storm drain.
4. A curve number of 98 is used for synthetic turf areas as a conservative simplification to reflect that some runoff is direct into the reservoir below.

Table 4: Stormwater Treatment Facility Sizing

Storm Facility ID	Contributing Area, A	T_c, (min)	WQ Flow Rate, Q (cfs)[1]	Contributing Basins
SIF-1	0.742	5	0.222	2A
UIC-1	0.385	5	0.107	2B,2C,2D,2E

1. The Water Quality (WQ) Storm Event is 1.38 inches in 24 hours.

GREEN STORMWATER INFRASTRUCTURE (GSI) ANALYSIS

All projects are required to utilize GSI to address flow control and treatment to the Maximum Extent Feasible (MEF). This project meets the GSI requirement as demonstrated in Subsection 4E.4(a), Runoff from the new and replaced impervious surfaces flow into one or more locations that have been set aside for installation of GSI and the locations have a total area of at least ten percent of the total new plus replaced impervious surface area. GSI is utilized to address stormwater treatment and flow control for runoff from the all existing pavement and building roof areas within the development area.

Professional infiltration testing was conducted at the site in accordance with AR 004 4.2(I)(2). Infiltration test results are included in the geotechnical reports found in Appendix E.

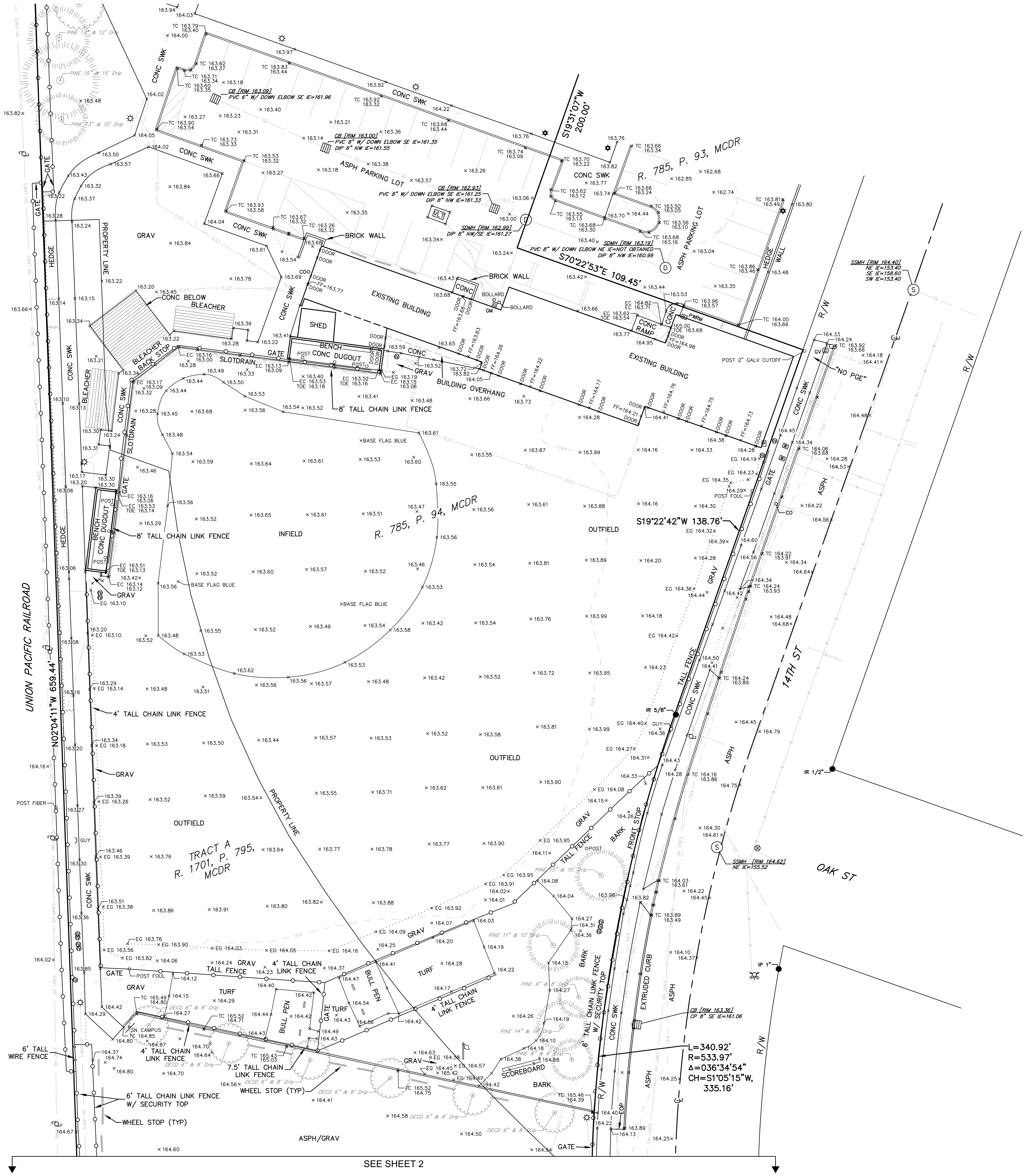
Stormwater Treatment—Source Control

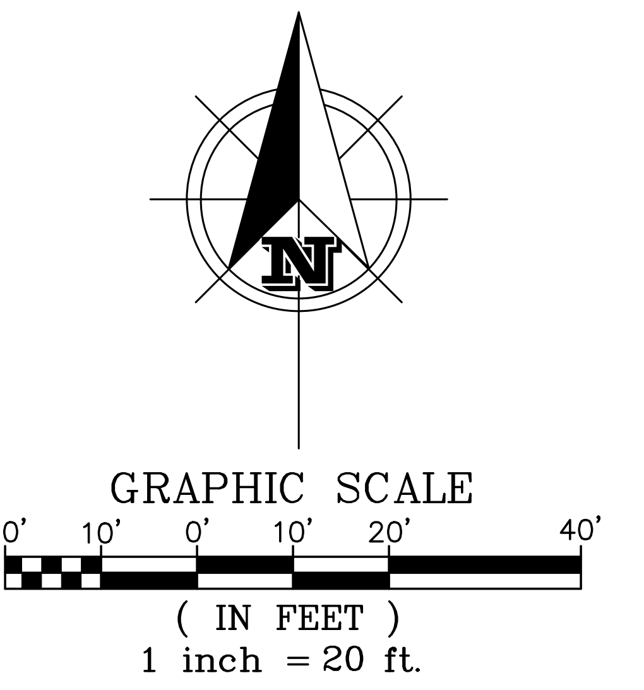
The City of Salem requires source control for specific activities or uses within a site that has a potential for pollution-generating activities as defined in SRC 71. There are no known pollution-generating activities as defined by SRC 71 on this site.

APPENDIX A

- **EX-1: Topographic Survey**
- **EX-2: Pre-Development Basin Map**
- **EX-3: Post-Development Basin Map**

TOPOGRAPHIC SURVEY





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SPECIFIC UTILITY POSITIONS INDICATED ON THE GROUND SURFACE PROVIDED BY LOCATION SERVICES MAY VARY DUE TO UNDERGROUND DETECTION CAPABILITIES.

BENCHMARK UTILIZED:
CITY OF SALEM: DEAN

ELEV: 183.46' NGVD 29

LOCATED AT BUSH BARN ENTRANCE, E OF HIGH ST,
252 E OF E CURB HIGH ST,
IN N CONC CURB OF HIGH ST ENTRANCE TO BUSH BARN,
49.5 E OF A LIGHT POLE, 45.7 W OF LIGHT POLE

ABBREVIATIONS

ASPH	ASPHALT	IRR	IRRIGATION
AD	AREA DRAIN	IE	INVERT ELEVATION
ASSY	ASSEMBLY	JB	JUNCTION BOX
BLDG, BLD	BUILDING	LP	LIGHT POLE
BW	BOTTOM OF WALL	M	METER, MAIN
CATV	CABLE TELEVISION	MB	MAILBOX
CB	CATCH BASIN	MH	MANHOLE
CO	CLEAN-OUT	OH	OVER-HEAD
CONC	CONCRETE	P/L, ℙ	PROPERTY LINE
CL, ℄	CENTERLINE	PP	POWER POLE
DIP	DUCTILE IRON PIPE	PVC	POLYVINYL CHLORIDE
EG	EDGE OF GRAVEL	PWR	POWER
EOP, EP	EDGE OF PAVEMENT	R, RAD	RADIUS
ELEV	ELEVATION	ROW, R/W	RIGHT-OF-WAY
EX, EXIST	EXISTING	SS	SANITARY SEWER
FDC	FIRE DEPT. CONNECTOR	SD	STORM DRAIN
FT	FEET	SVC	SERVICE
FF	FINISH FLOOR	SWK, S/W	SIDEWALK
FG	FINISH GRADE	TC	TOP OF CURB
FH	FIRE HYDRANT	TEL	TELEPHONE
FI	FIELD INLET	TR	TRANSFORMER
FM	FORCE MAIN	TS	TRAFFIC SIGNAL
GRAV	GRAVEL	TW	TOP OF WALL
GM	GAS METER	TYP	TYPICAL
GP	GATE POST	UG, U/G	UNDER GROUND
GS	GROUND SHOT	UTIL	UTILITY
GV	GAS VALVE	VLT	VAULT
HC	HANDICAP	W/	WITH
HDPE	HIGH-DENSITY POLYETHYLENE	WM	WATER METER
HYD	HYDRANT	WLM	WETLANDS MARKER
IR	IRON ROD	YPC	YELLOW PLASTIC CAP
IP	IRON PIPE		

SYMBOLS

AD	AREA DRAIN		SIGN POST
or ▥	CATCH BASIN	PED○	PEDESTAL
CO○	CLEANOUT	▭	MAIL BOX
	FIRE HYDRANT	(IV)	IRRIGATION VALVE
GV(G)	GAS VALVE	☼	LIGHT POLE
WV⊗	WATER VALVE		UTILITY/POWER POLES
G P W	GAS/POWER/WATER METER	TP	TEST PIT
DS○	DOWN SPOUT	●	MONUMENT FOUND
(T)	MANHOLE TELEPHONE		
(D)	MANHOLE STORM DRAIN		
(S)	MANHOLE SANITARY SEWER		

TREES – *TREENAME* DIAMETER (INCHES)/DRIP RADIUS (FEET)
NOTE: DIAMETER MEASURED AT BREAST HEIGHT

LINE TYPES

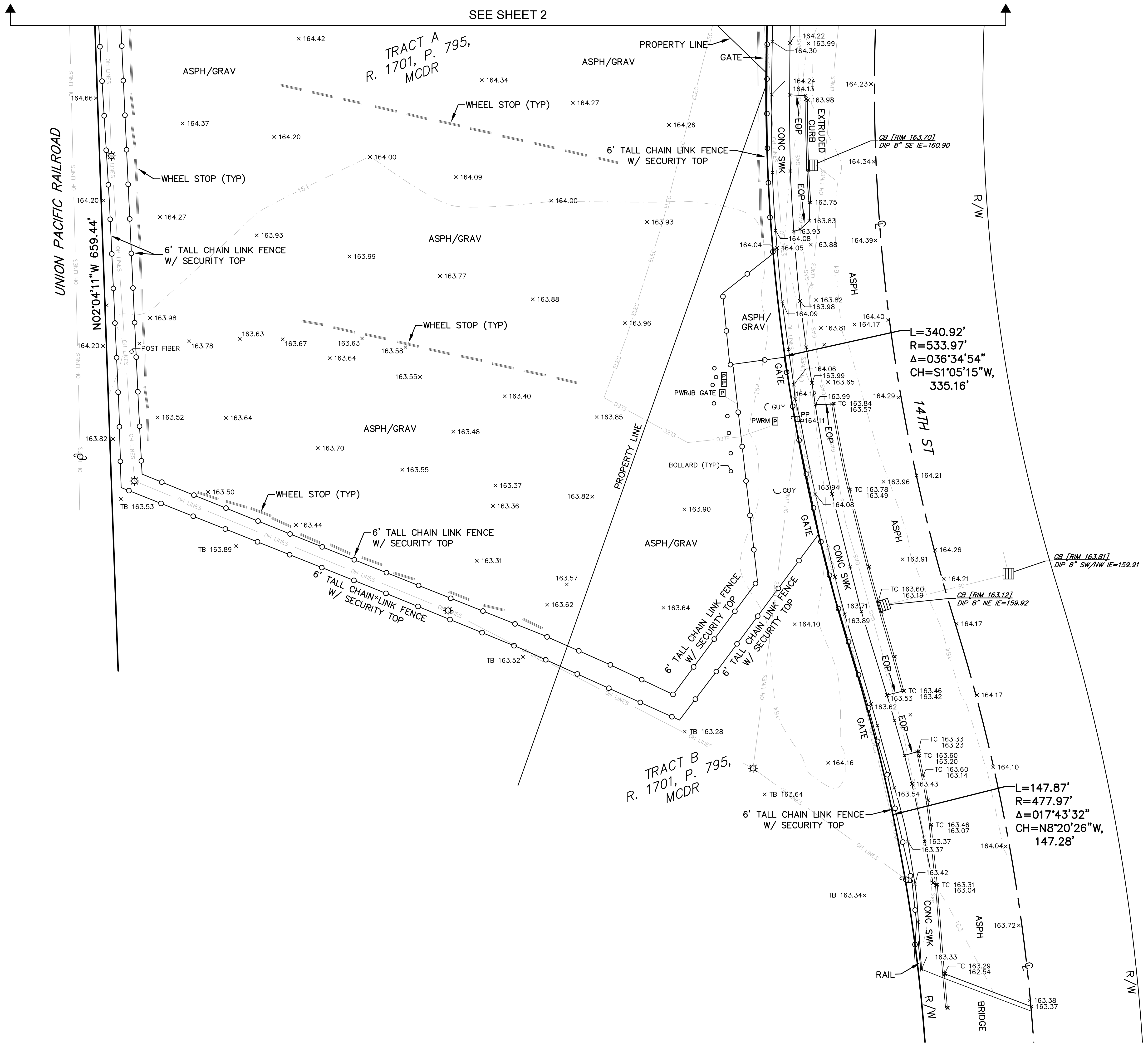
CATV LINE	— CATV — CATV — CATV —
COMMUNICATION LINE	— COM — COM — COM —
EASEMENT LINE	— — — — — —
FENCE LINE	—o—o—o—o—
FIBER OPTIC LINE	— FOC — FOC — FOC —
GAS LINE	— GAS — GAS — GAS —
EDGE OF GRAVEL LINE	···············
OVERHEAD LINE	— OH LINES — OH LINES —
PHONE LINE	— PH — PH — PH —
POWER LINE	— ELEC — ELEC — ELEC —
SANITARY SEWER LINE	— SS — SS — SS —
STORM DRAIN LINE	— SD — SD — SD —
WATER LINE	— W — W — W —

BARKER
SURVEYING

REGISTERED
PROFESSIONAL
LAND SURVEYOR
OREGON
JANUARY 10, 2023
BRAD ROBERT HARRIS
96889PLS
EXPIRES: 6/30/2025

SURVEY FOR	WILLAMETTE UNIVERSITY	
LOCATION:	14TH ST SOFTBALL FIELD	
SW 1/4 SECTION 26 T7S, R3W, W.M.		CITY OF SALEM MARION COUNTY, OREGON
SCALE: 1"=20'	**BARKER SURVEYING** 3657 KASHMIR WAY SE SALEM, OREGON 97317 PHONE (503) 588-8800 FAX (503) 363-2469 EMAIL: GREG@BARKERWILSON.COM	SHEET 1 OF 2
DATE: 8/7/2023		
DRAWN BY: RJC		JOB NUMBER: 42407

TOPOGRAPHIC SURVEY



GRAPHIC SCALE

20' 10' 0' 10' 20' 40'

(IN FEET)

1 inch = 20 ft.

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EOP, EP	EDGE OF PAVEMENT	R, RAD	RADIUS
ELEV	ELEVATION	ROW, R/W	RIGHT–OF–WAY
EX, EXIST	EXISTING	SS	SANITARY SEWER
FDC	FIRE DEPT. CONNECTOR	SD	STORM DRAIN
FT	FEET	SVC	SERVICE
FF	FINISH FLOOR	SWK, S/W	SIDEWALK
FG	FINISH GRADE	TC	TOP OF CURB
FH	FIRE HYDRANT	TEL	TELEPHONE
FI	FIELD INLET	TR	TRANSFORMER
FM	FORCE MAIN	TS	TRAFFIC SIGNAL
GRAV	GRAVEL	TW	TOP OF WALL
GM	GAS METER	TYP	TYPICAL
GP	GATE POST	UG, U/G	UNDER GROUND
GS	GROUND SHOT	UTIL	UTILITY
GV	GAS VALVE	VLT	VAULT
HC	HANDICAP	W/	WITH
HDPE	HIGH–DENSITY POLYETHYLENE	WM	WATER METER
HYD	HYDRANT	WLM	WETLANDS MARKER
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CO○	CLEANOUT	▭	MAIL BOX
☼	FIRE HYDRANT	(IV)	IRRIGATION VALVE
GV(G)	GAS VALVE	☼	LIGHT POLE
WV⊗	WATER VALVE	○	UTILITY/POWER POLES
G P W	GAS/POWER/WATER METER	TP ◓	TEST PIT
DS○	DOWN SPOUT	●	MONUMENT FOUND
Ⓣ	MANHOLE TELEPHONE		
Ⓓ	MANHOLE STORM DRAIN		
Ⓢ	MANHOLE SANITARY SEWER		

TREES – *TREENAME* DIAMETER (INCHES)/DRIP RADIUS (FEET)
NOTE: DIAMETER MEASURED AT BREAST HEIGHT

LINE TYPES

CATV LINE	CATV
COMMUNICATION LINE	COM
EASEMENT LINE	— — —
FENCE LINE	o—o—o
FIBER OPTIC LINE	FOC
GAS LINE	GAS
EDGE OF GRAVEL LINE	
OVERHEAD LINE	OH LINES
PHONE LINE	PH
POWER LINE	ELEC
SANITARY SEWER LINE	SS
STORM DRAIN LINE	SD
WATER LINE	W

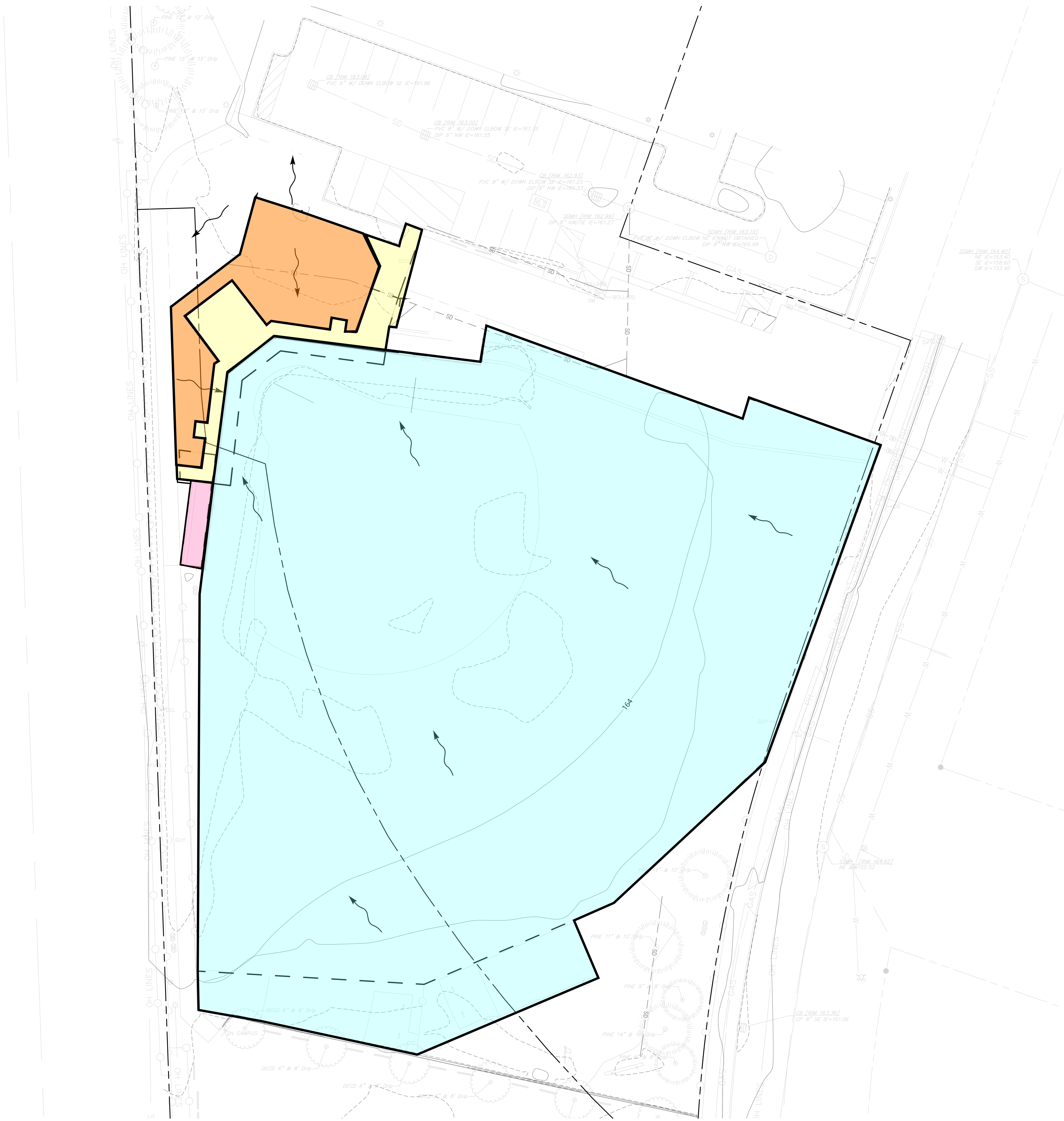
BARKER
SURVEYING

REGISTERED
PROFESSIONAL
LAND SURVEYOR
OREGON
JANUARY 10, 2023
BRAD ROBERT HARRIS
96889PLS
EXPIRES: 6/30/2025

SURVEY FOR	WILLAMETTE UNIVERSITY	
LOCATION:	14TH ST SOFTBALL FIELD	
SW 1/4 SECTION 26 T7S, R3W, W.M.		CITY OF SALEM MARION COUNTY, OREGON
SCALE: 1"=20'	BARKER SURVEYING 3657 KASHMIR WAY SE SALEM, OREGON 97317 PHONE (503) 588–8800 FAX (503) 363–2469 EMAIL: GREG@BARKERWILSON.COM	SHEET 2 OF 2
DATE: 8/7/2023		
DRAWN BY: RJC		JOB NUMBER: 42407

M:\Mazzetti\Projects\23\Engineering\023-000175 - Willamette Univ Baseball-Softball Fields\04 Dwgs\CAD Project\Civil\DWG_LAND USE\EX1-SOFTBALL_PRE_DEV_MAP.dwg

MIKAEL SHIELDS 3/21/2025 2:33 PM



EXISTING BASIN AREAS

BASIN		AREA		CN	DESCRIPTION
		SF	AC		
🟦	1E	45,358	1.041	72	EXISTING FIELD
🟪	1E.1	222	0.005	98	EXISTING DUGOUT
🟨	1E.2	1,179	0.027	98	EXISTING CONCRETE
🟧	1E.3	2,477	0.057	91	EXISTING GRAVEL
	TOTAL	**49,236**	**1.130**		

1 PRE-DEVELOPMENT BASIN MAP

PLAN SCALE
0 20' 40'
SCALE: 1"= 20'

N

CAMERON McCARTHY
Landscape Architecture & Planning
160 E Broadway, Eugene, OR 97401
133 SW 2nd Avenue, Ste. 410, Portland, OR 97204
541-485-7385
www.cameronmccarthy.com

MAZZETTI
940 Willamette Street, Suite 310
Eugene, OR 97401
TEL: 541.686.8478
www.mazzetti.com
Project Number: 023-000175

BEARCAT SOFTBALL
FIELD IMPROVEMENTS

WILLAMETTE UNIVERSITY
605 14th Street SE, Salem, OR 97301

STAMP

FOR INFORMATION ONLY

Checked: GTL
Drawn By: MDS
Checked:
Project #: 023-000175
Date: 03.24.2025

Rev. #: Date:

LAND USE

SHEET TITLE
PRE-DEVELOPMENT
BASIN MAP

SHEET #
EX-2

M:\Mazzetti\Projects\23\Engineering\023-000175 - Willamette Univ Baseball-Softball Fields\04 Dwgs\CAD Project\Civil\DWG_LAND USE\Softball\EX3-SOFTBALL_POST_DEV_MAP.dwg

MIKAEL SHIELDS

3/25/2025 9:35 AM

PROPOSED BASIN AREAS

BASIN		AREA		CN	DESCRIPTION
		SF	AC		
🟦	2A	32,317	0.742	98	OUTFIELD
🟪	2B	13,041	0.299	98	INFIELD
🟨	2C	1,179	0.027	98	EXISTING CONCRETE
🟧	2D	2,482	0.057	91	EXISTING GRAVEL
▨	2E	222	0.005	98	EXISTING DUGOUT
🟥	3	96	0.002	98	IMPERVIOUS BYPASS
	TOTAL	**49,337**	**1.132**		

1 POST-DEVELOPMENT BASIN MAP

PLAN SCALE
0 20' 40'
SCALE: 1"= 20'

N

CAMERON McCARTHY
Landscape Architecture & Planning
160 E Broadway, Eugene, OR 97401
133 SW 2nd Avenue, Ste. 410, Portland, OR 97204
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605 14th Street SE, Salem, OR 97301

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Checked:
Project #: 023-000175
Date: 03.24.2025

Rev. #: Date:

LAND USE

SHEET TITLE
POST-DEVELOPMENT
BASIN MAP

SHEET #
EX-3

APPENDIX B

- **Softball Field Hydrograph Reports**

Hydraflow Table of Contents

10 - Year

100 - Year

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	SBUH Runoff	------	0.007	0.026	0.003	-------	0.092	-------	-------	0.224	1E Pre-Development - Field
2	SBUH Runoff	------	0.001	0.003	0.001	-------	0.004	-------	-------	0.005	1E.1 Pre-Development - Roof
3	SBUH Runoff	------	0.008	0.014	0.006	-------	0.020	-------	-------	0.028	1E.2 Pre-Development - Concrete
4	SBUH Runoff	------	0.008	0.019	0.005	-------	0.033	-------	-------	0.050	1E.3 Pre-Development - Gravel
5	Combine	2, 3, 4	0.018	0.035	0.012	-------	0.056	-------	-------	0.083	Non-Field Total
6	Combine	1, 5	0.018	0.041	0.012	-------	0.133	-------	-------	0.289	Total Pre-Development
8	SBUH Runoff	------	0.222	0.372	0.170	-------	0.553	-------	-------	0.768	Basin 2A Outfield
9	Reservoir	8	0.000	0.000	0.000	-------	0.000	-------	-------	0.000	Outfield - Reservoir
11	SBUH Runoff	------	0.089	0.150	0.068	-------	0.223	-------	-------	0.310	Basin 2B Infield
12	SBUH Runoff	------	0.008	0.014	0.006	-------	0.020	-------	-------	0.028	Basin 2C- Existing Concrete
13	SBUH Runoff	------	0.008	0.019	0.005	-------	0.033	-------	-------	0.050	Basin 2D - Existing Gravel
14	SBUH Runoff	------	0.001	0.003	0.001	-------	0.004	-------	-------	0.005	Basin 2E - Existing Dugout
15	Combine	11, 12, 13, 14	0.107	0.185	0.080	-------	0.279	-------	-------	0.393	Basin 1A, 1B, 1E, 2B
16	Reservoir	15	0.000	0.006	0.000	-------	0.061	-------	-------	0.094	Infield UIC
18	SBUH Runoff	------	0.001	0.001	0.000	-------	0.001	-------	-------	0.002	Basin 3 - Impervious Bypass
20	Combine	9, 16, 18,	0.001	0.006	0.000	-------	0.062	-------	-------	0.096	Post Development

Hydrograph Summary Report

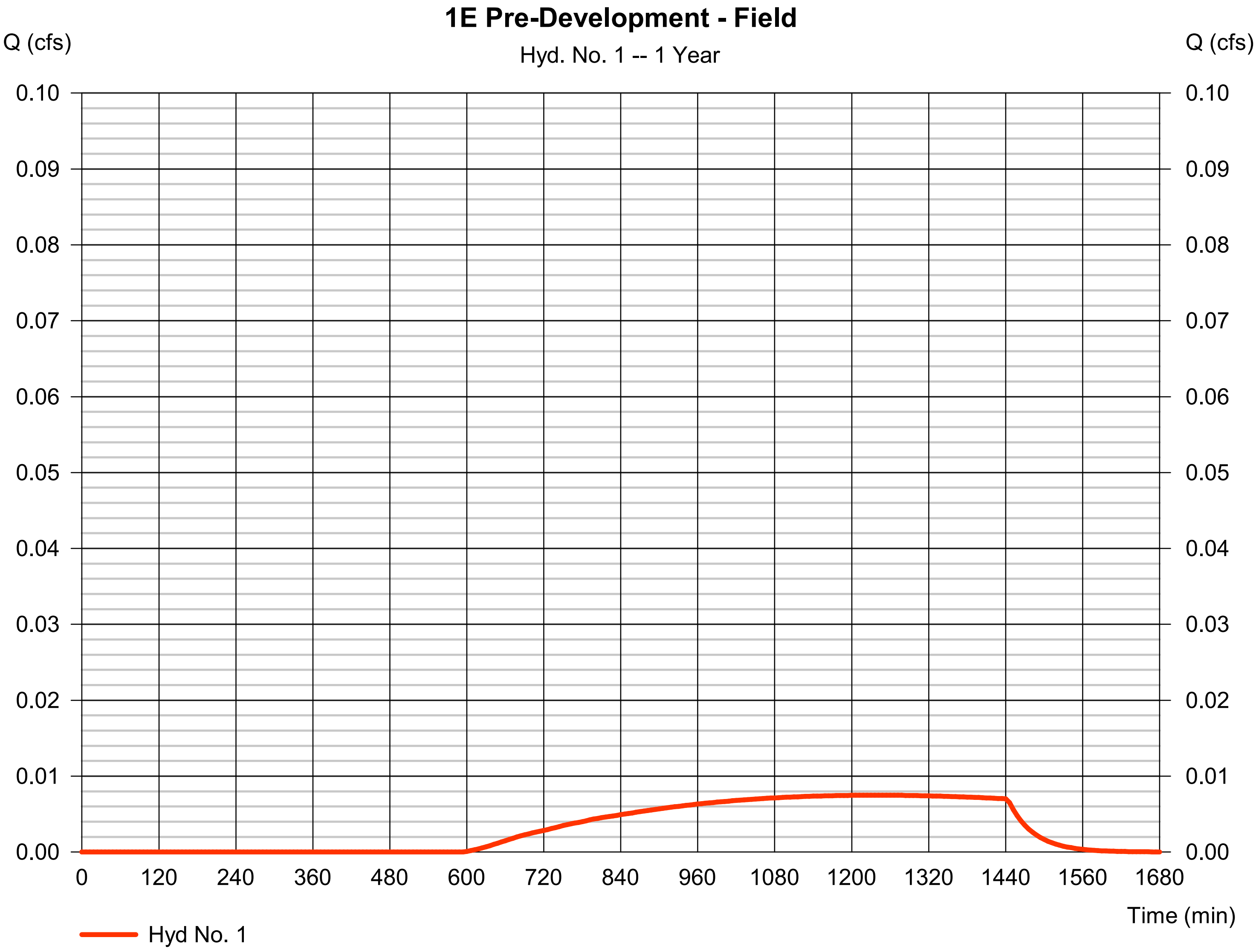
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.007	6	1236	305	------	------	------	1E Pre-Development - Field
2	SBUH Runoff	0.001	6	474	21	------	------	------	1E.1 Pre-Development - Roof
3	SBUH Runoff	0.008	6	474	114	------	------	------	1E.2 Pre-Development - Concrete
4	SBUH Runoff	0.008	6	480	133	------	------	------	1E.3 Pre-Development - Gravel
5	Combine	0.018	6	480	268	2, 3, 4	------	------	Non-Field Total
6	Combine	0.018	6	480	573	1, 5	------	------	Total Pre-Development
8	SBUH Runoff	0.222	6	474	3,130	------	------	------	Basin 2A Outfield
9	Reservoir	0.000	6	486	0	8	100.01	13.1	Outfield - Reservoir
11	SBUH Runoff	0.089	6	474	1,261	------	------	------	Basin 2B Infield
12	SBUH Runoff	0.008	6	474	114	------	------	------	Basin 2C- Existing Concrete
13	SBUH Runoff	0.008	6	480	133	------	------	------	Basin 2D - Existing Gravel
14	SBUH Runoff	0.001	6	474	21	------	------	------	Basin 2E - Existing Dugout
15	Combine	0.107	6	474	1,529	11, 12, 13, 14	------	------	Basin 1A, 1B, 1E, 2B
16	Reservoir	0.000	6	420	0	15	159.10	230	Infield UIC
18	SBUH Runoff	0.001	6	474	8	------	------	------	Basin 3 - Impervious Bypass
20	Combine	0.001	6	474	8	9, 16, 18,	------	------	Post Development

Hydrograph Report

Hyd. No. 1

1E Pre-Development - Field

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.007 cfs
Storm frequency	= 1 yrs	Time to peak	= 1236 min
Time interval	= 6 min	Hyd. volume	= 305 cuft
Drainage area	= 1.041 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 39.40 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

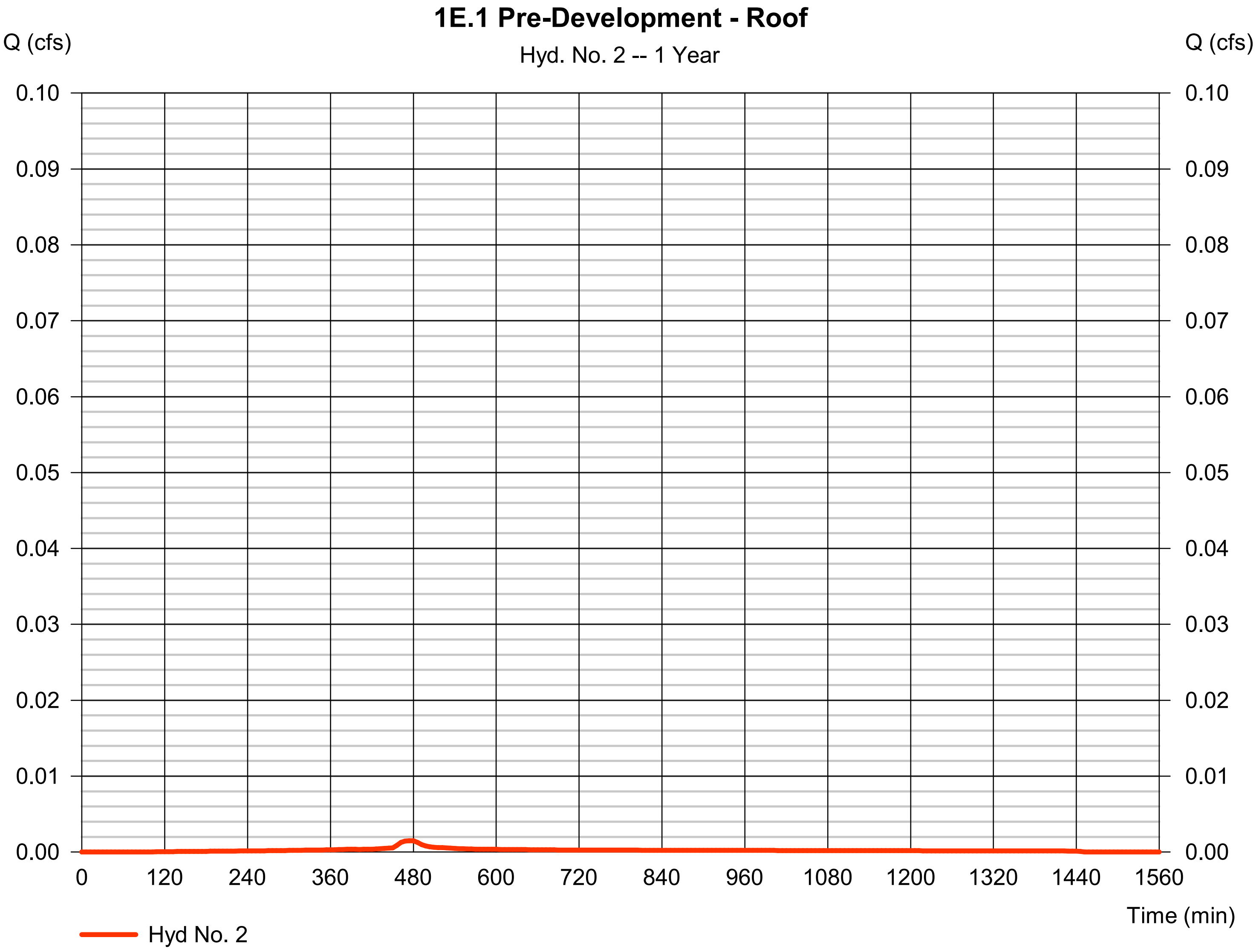


Hydrograph Report

Hyd. No. 2

1E.1 Pre-Development - Roof

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 21 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



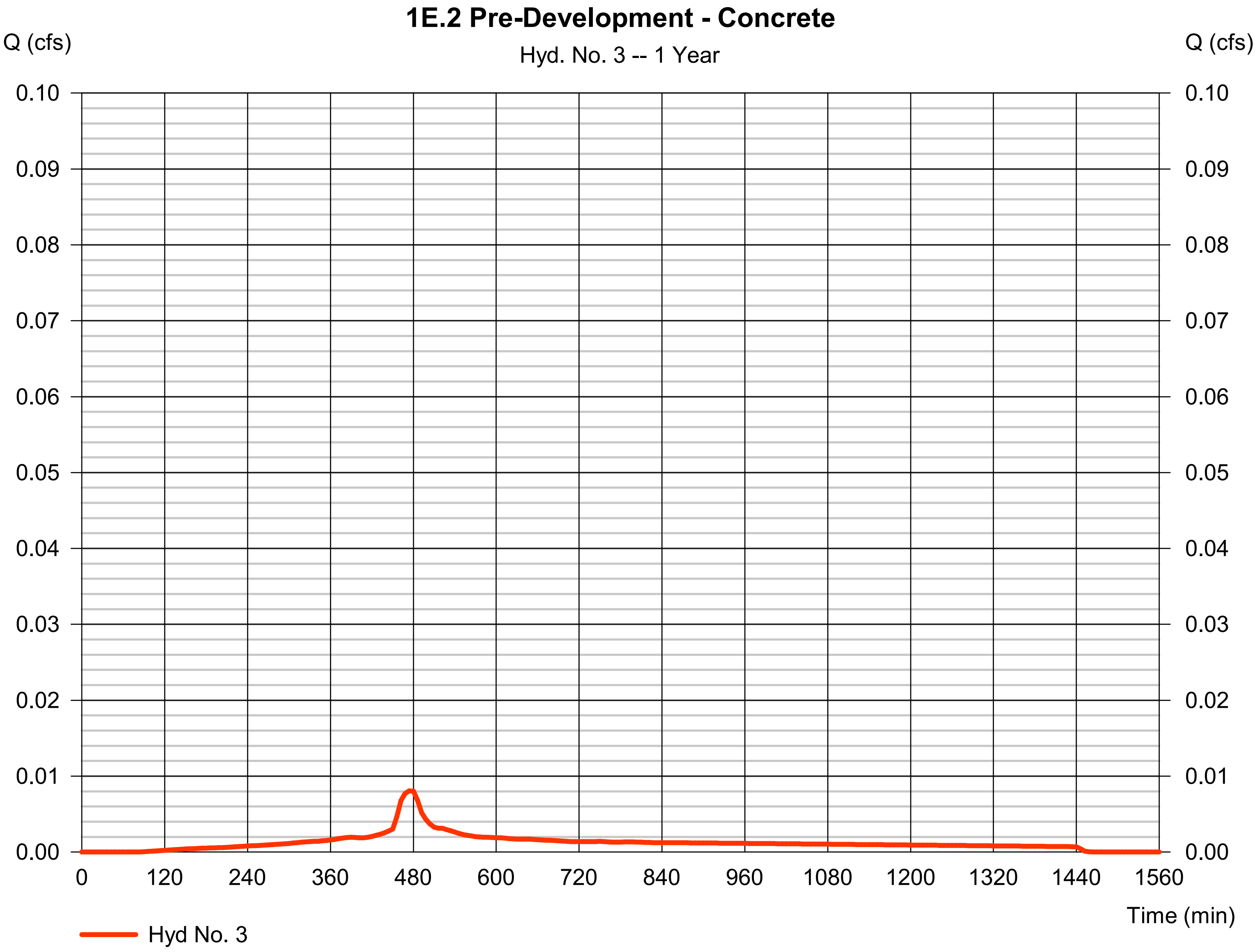
Hydrograph Report

Hyd. No. 3

1E.2 Pre-Development - Concrete

Hydrograph type = SBUH Runoff
Storm frequency = 1 yrs
Time interval = 6 min
Drainage area = 0.027 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 1.38 in
Storm duration = 24 hrs

Peak discharge = 0.008 cfs
Time to peak = 474 min
Hyd. volume = 114 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



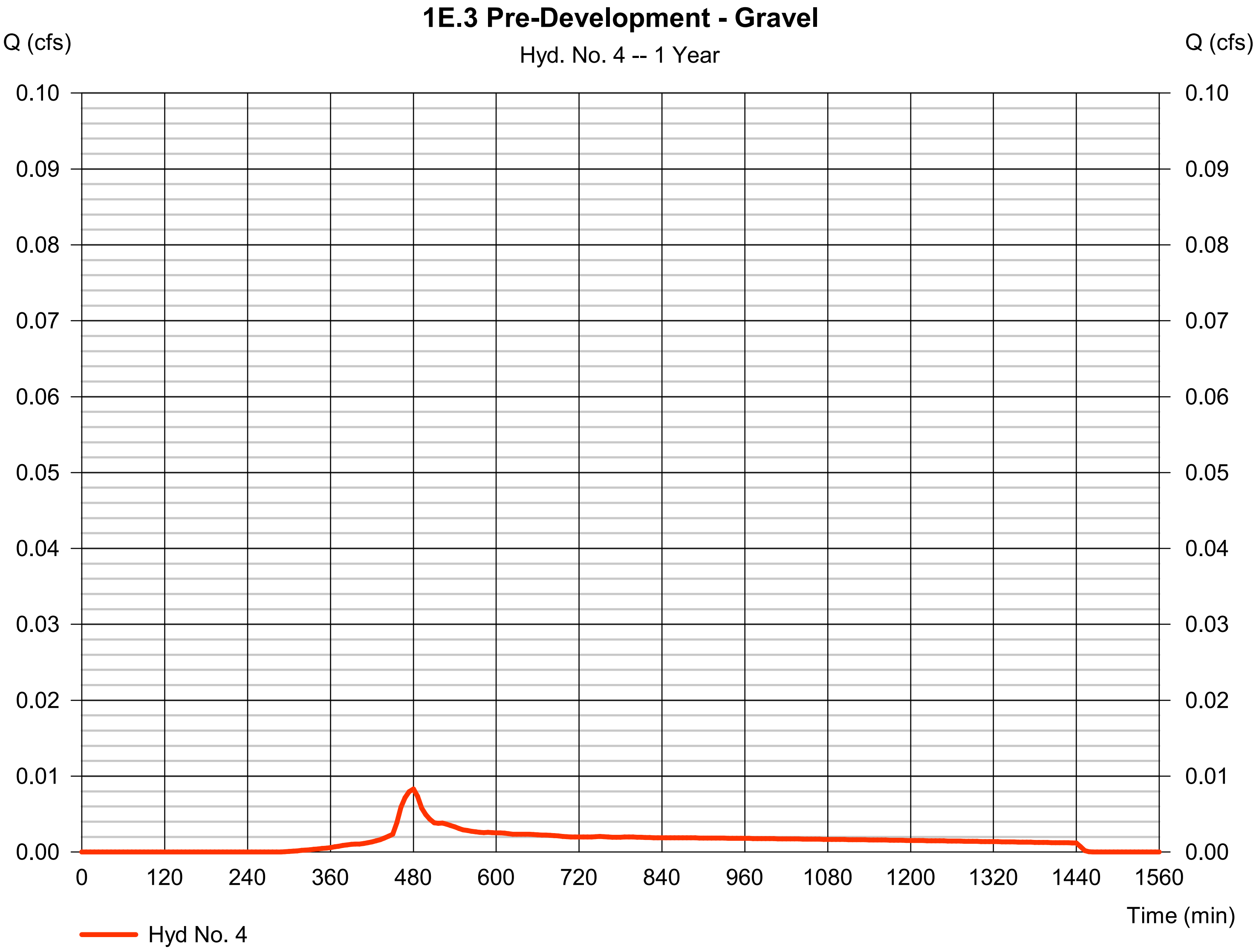
Hydrograph Report

Hyd. No. 4

1E.3 Pre-Development - Gravel

Hydrograph type = SBUH Runoff
Storm frequency = 1 yrs
Time interval = 6 min
Drainage area = 0.057 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 1.38 in
Storm duration = 24 hrs

Peak discharge = 0.008 cfs
Time to peak = 480 min
Hyd. volume = 133 cuft
Curve number = 91
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a

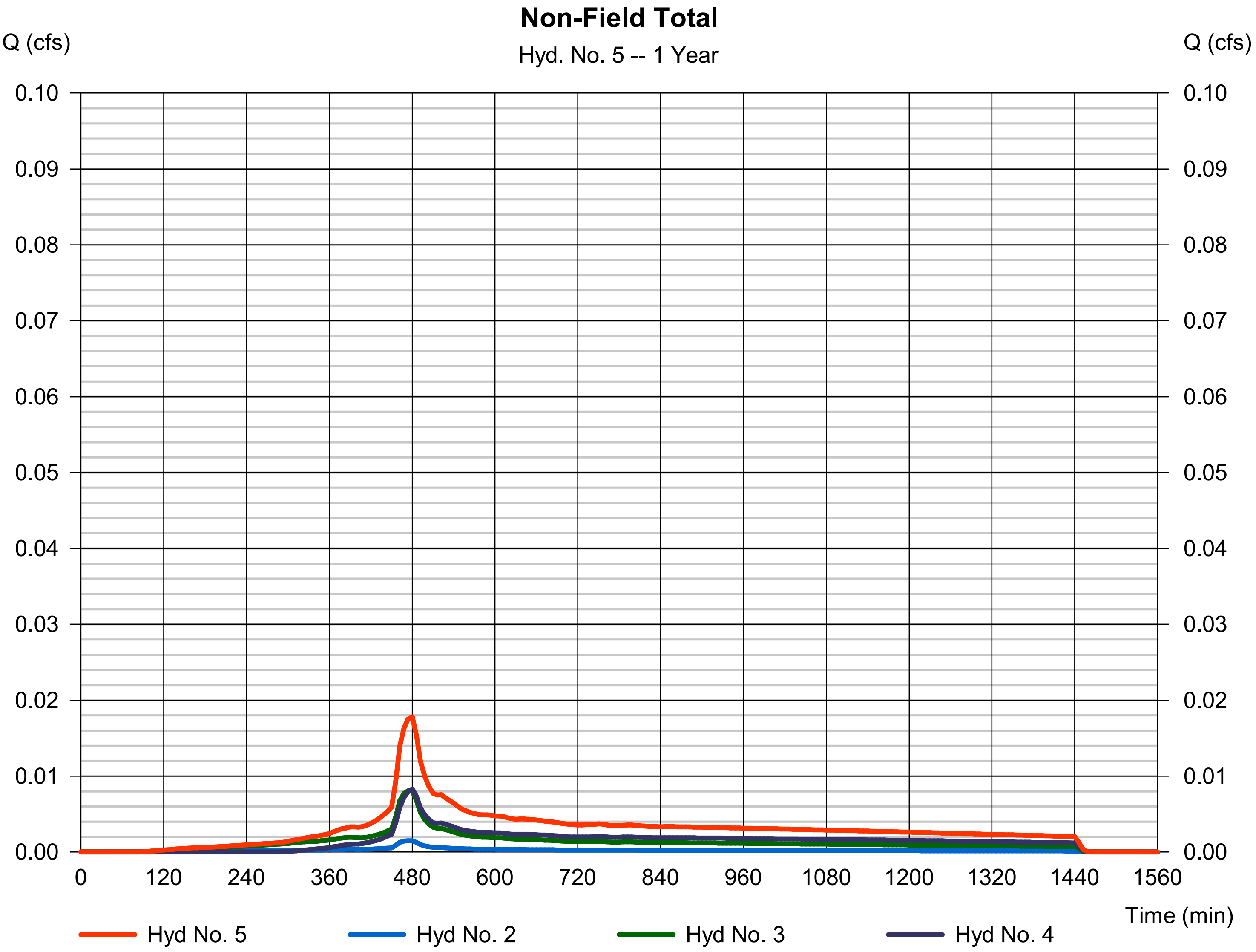


Hydrograph Report

Hyd. No. 5

Non-Field Total

Hydrograph type	= Combine	Peak discharge	= 0.018 cfs
Storm frequency	= 1 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 268 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 0.089 ac

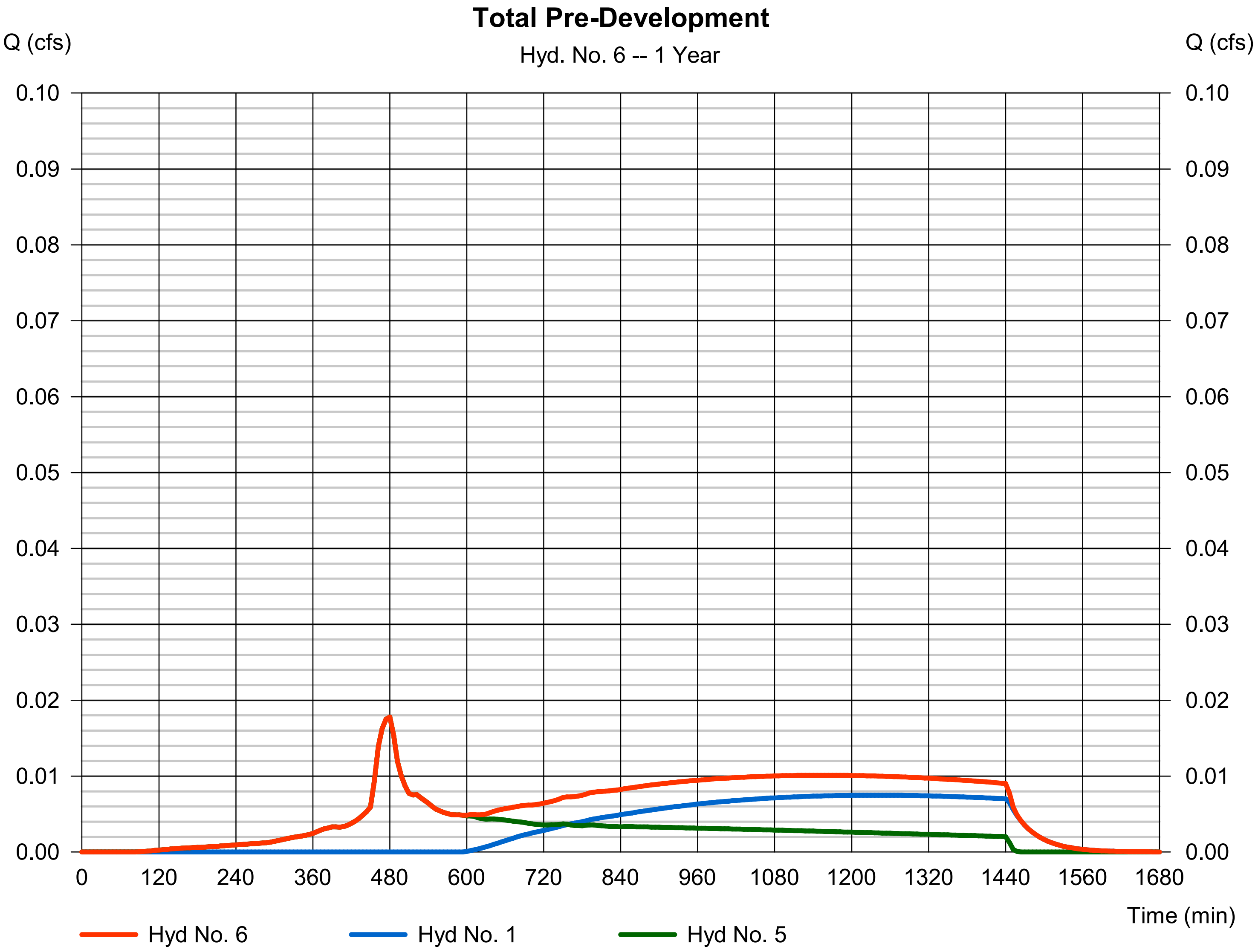


Hydrograph Report

Hyd. No. 6

Total Pre-Development

Hydrograph type	= Combine	Peak discharge	= 0.018 cfs
Storm frequency	= 1 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 573 cuft
Inflow hyds.	= 1, 5	Contrib. drain. area	= 1.041 ac



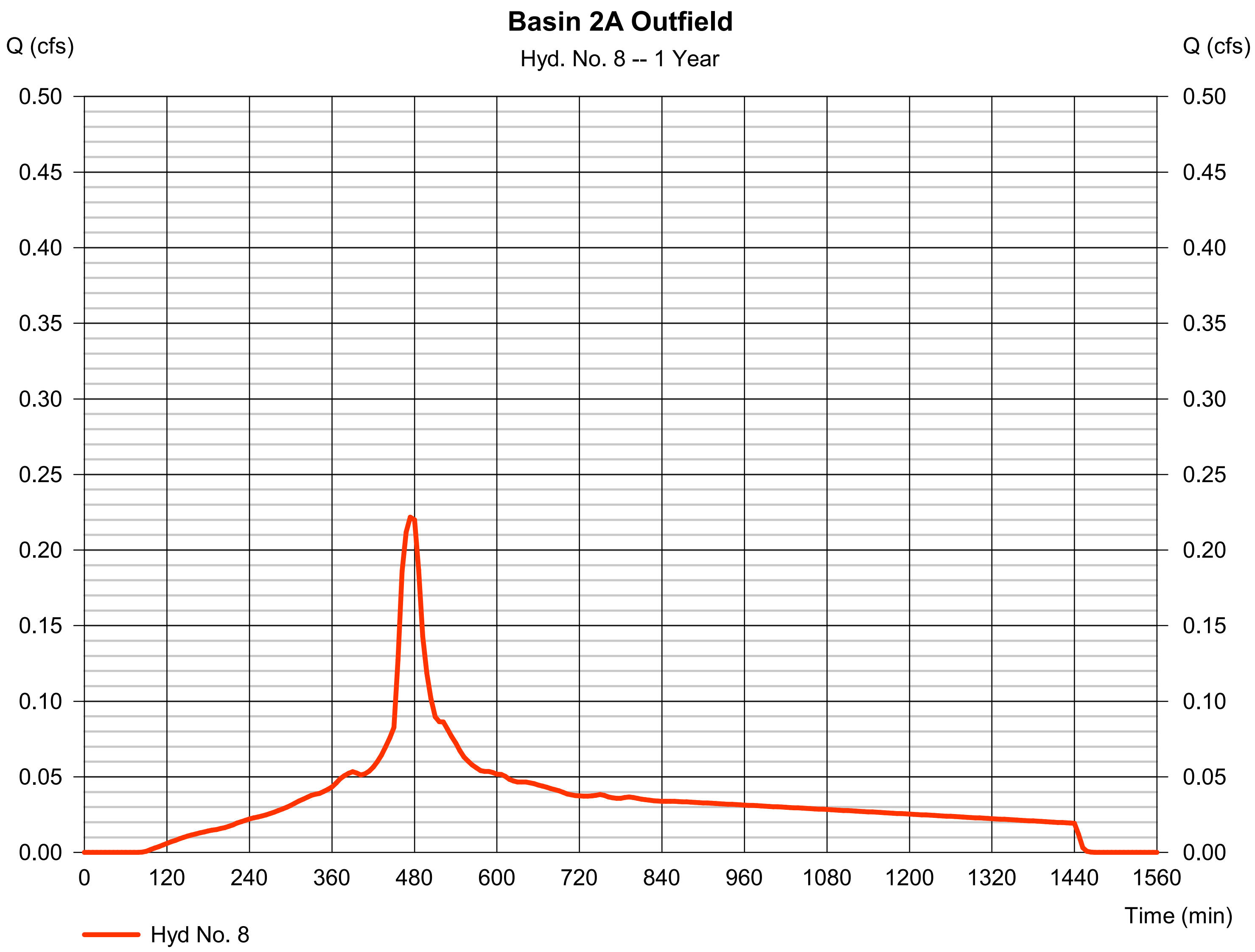
Hydrograph Report

Hyd. No. 8

Basin 2A Outfield

Hydrograph type = SBUH Runoff
Storm frequency = 1 yrs
Time interval = 6 min
Drainage area = 0.742 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 1.38 in
Storm duration = 24 hrs

Peak discharge = 0.222 cfs
Time to peak = 474 min
Hyd. volume = 3,130 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Tuesday, 03 / 25 / 2025

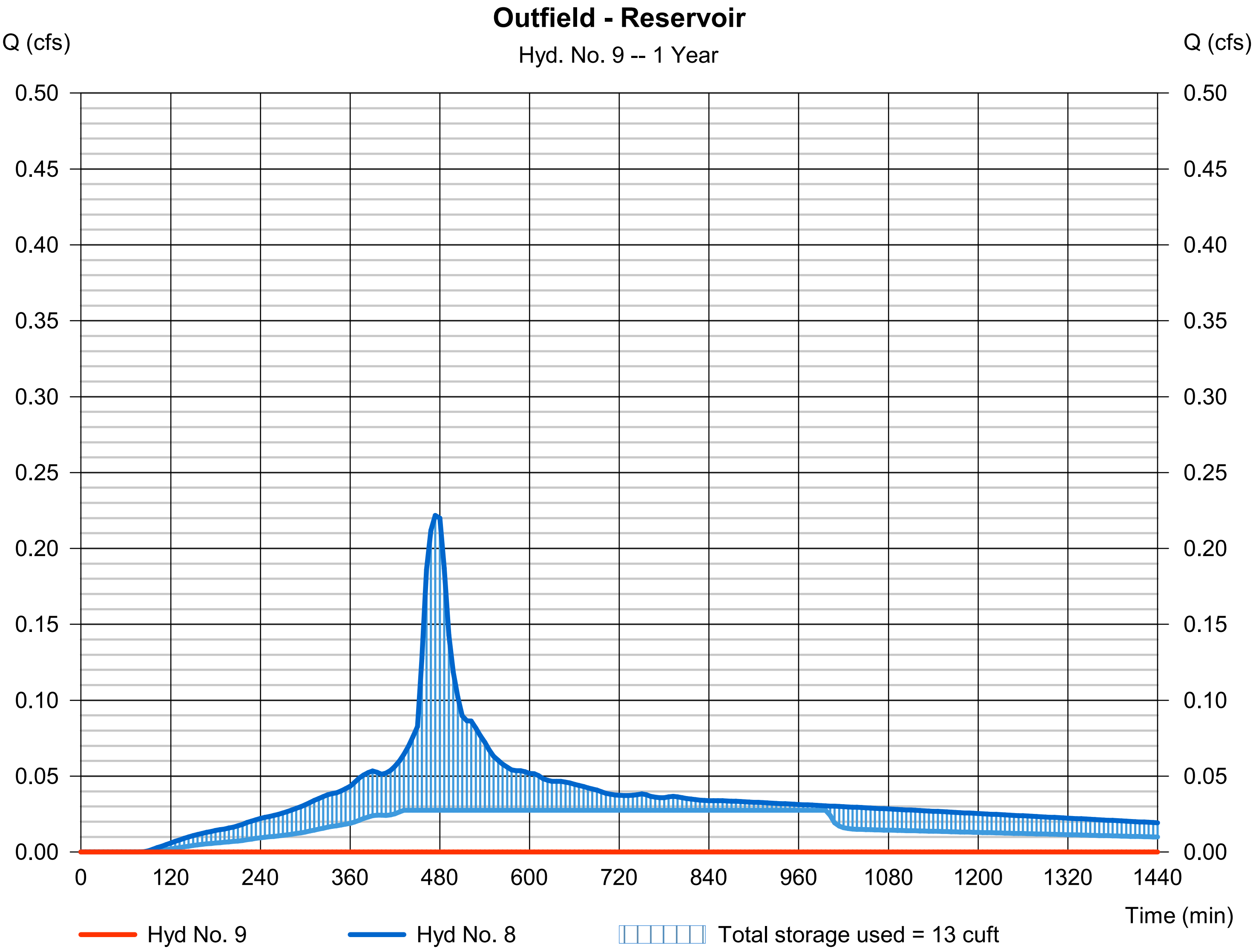
Hyd. No. 9

Outfield - Reservoir

Hydrograph type = Reservoir
Storm frequency = 1 yrs
Time interval = 6 min
Inflow hyd. No. = 8 - Basin 2A Outfield
Reservoir name = Outfield Res

Peak discharge = 0.000 cfs
Time to peak = 486 min
Hyd. volume = 0 cuft
Max. Elevation = 100.01 ft
Max. Storage = 13 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Tuesday, 03 / 25 / 2025

Pond No. 1 - Outfield Res

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 100.00 ft. Voids = 30.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	02	0	0
0.01	100.01	2,040	3	3
0.10	100.10	20,400	303	306
0.20	100.20	40,800	918	1,224
0.30	100.30	61,200	1,530	2,754
0.40	100.40	81,600	2,142	4,896
0.50	100.50	102,000	2,754	7,650
0.60	100.60	122,400	3,366	11,016

Culvert / Orifice Structures

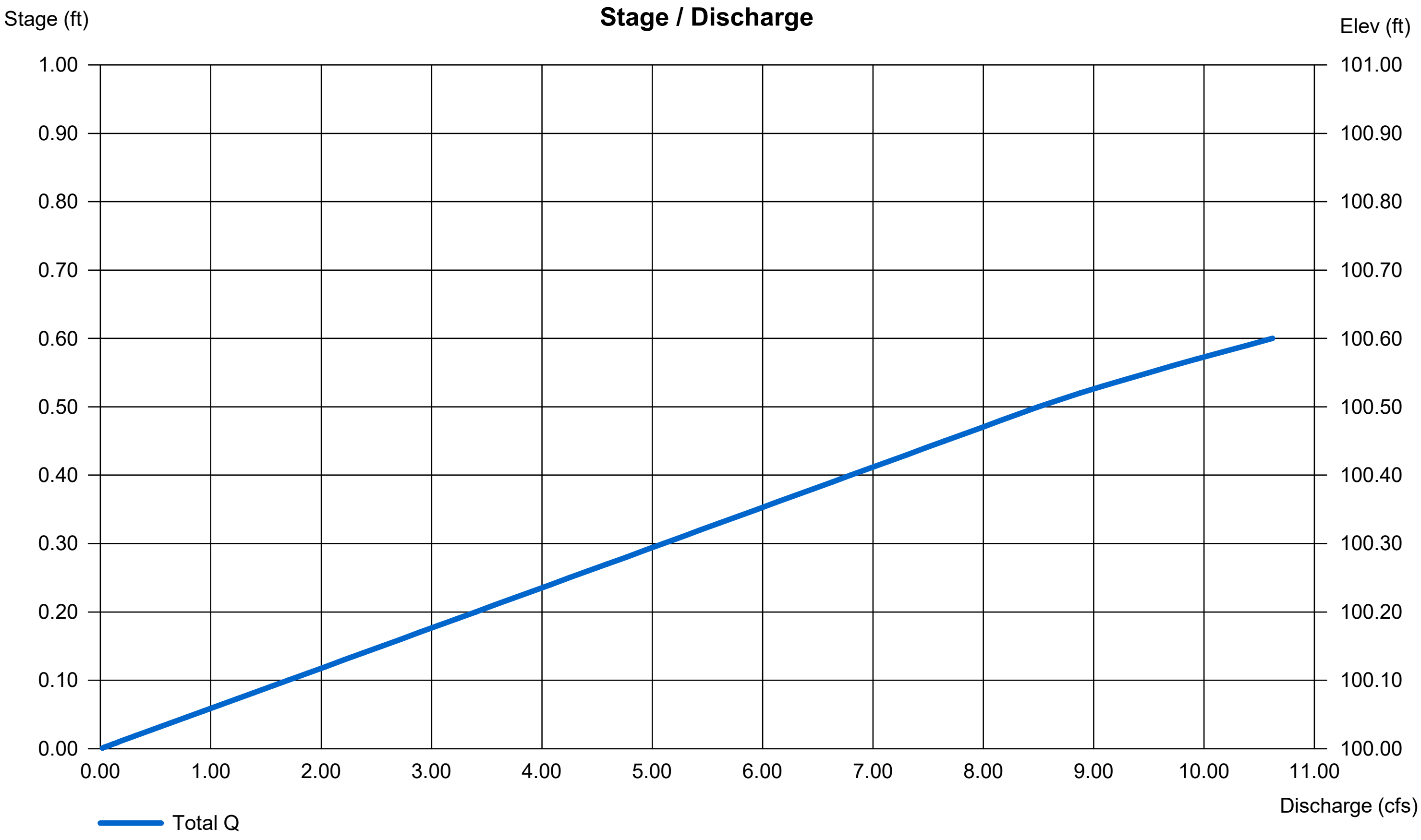
	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 0.00	0.00	0.00	0.00
Span (in)	= 0.00	0.00	0.00	0.00
No. Barrels	= 0	0	0	0
Invert El. (ft)	= 0.00	0.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 4.00	0.00	0.00	0.00
Crest El. (ft)	= 100.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 3.600 (by Contour)
TW Elev. (ft) = 0.00

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

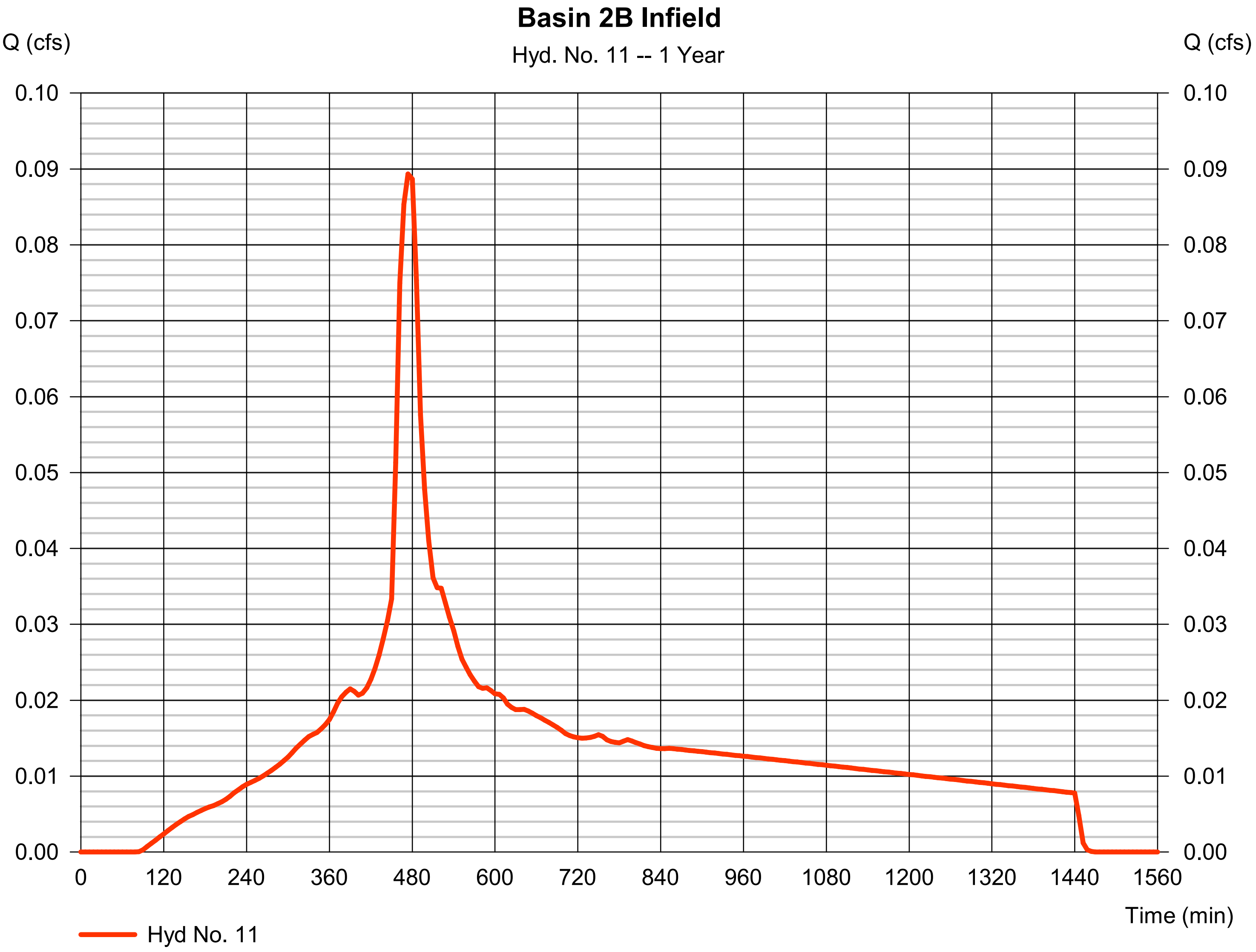


Hydrograph Report

Hyd. No. 11

Basin 2B Infield

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.089 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 1,261 cuft
Drainage area	= 0.299 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

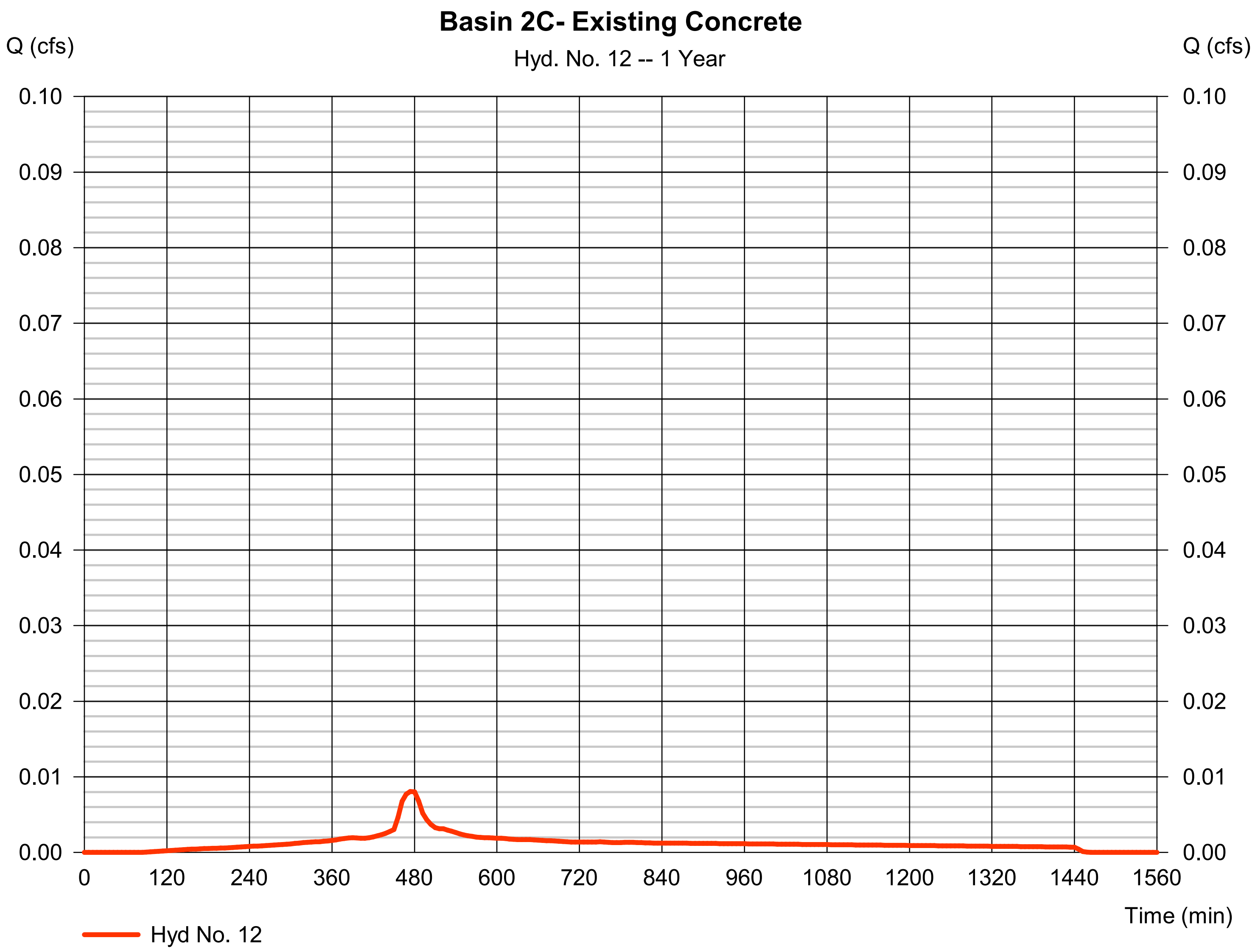


Hydrograph Report

Hyd. No. 12

Basin 2C- Existing Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.008 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 114 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

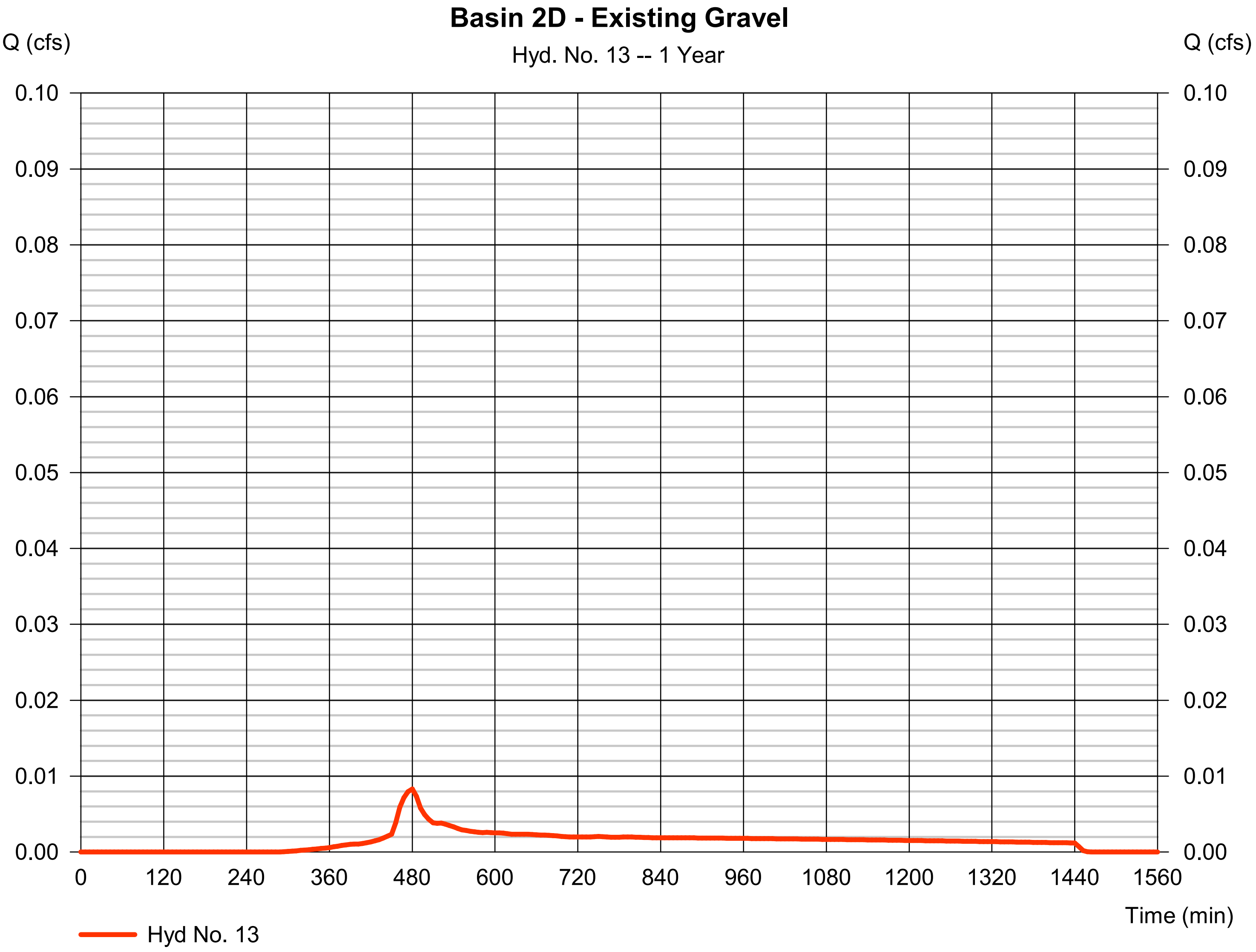


Hydrograph Report

Hyd. No. 13

Basin 2D - Existing Gravel

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.008 cfs
Storm frequency	= 1 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 133 cuft
Drainage area	= 0.057 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



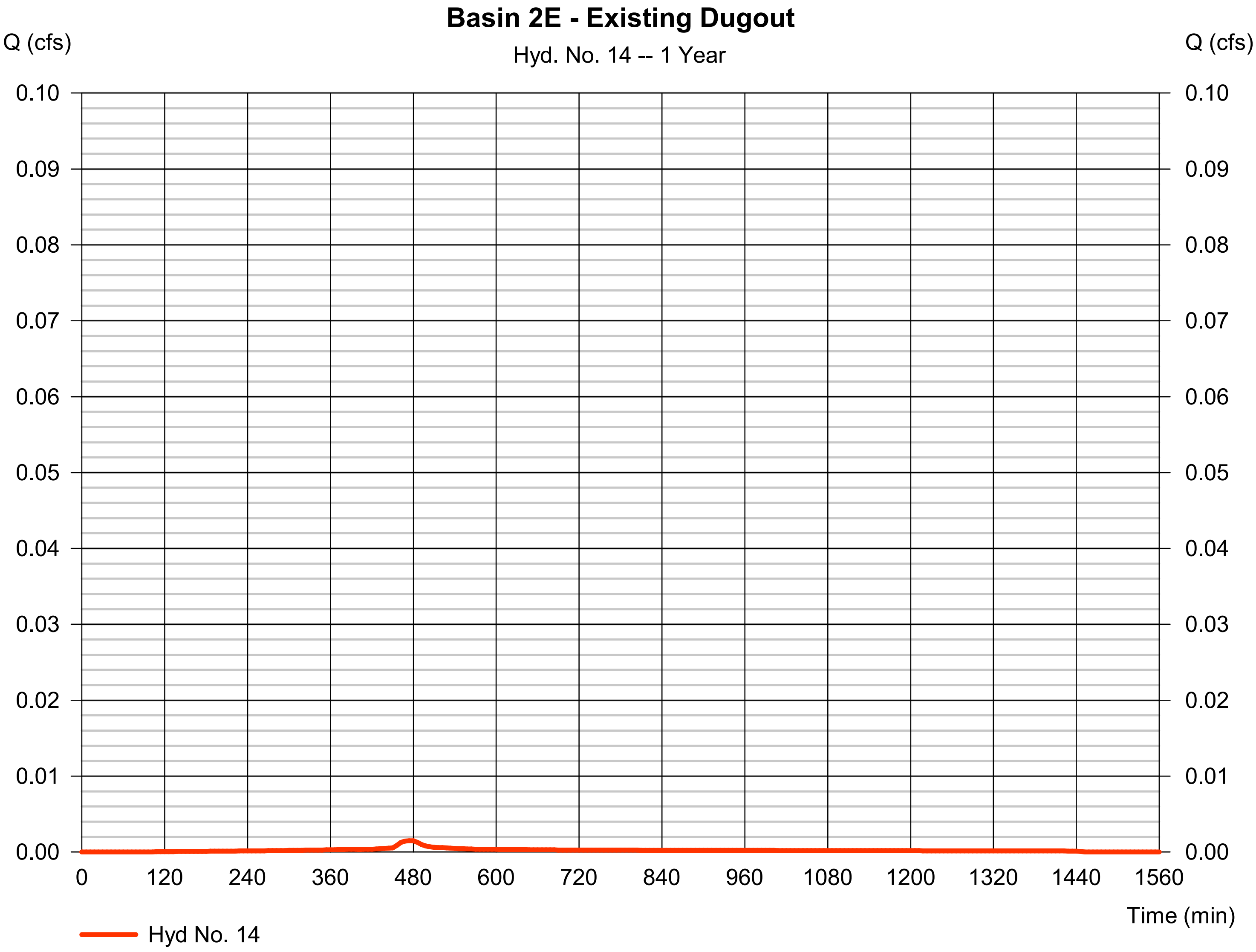
Hydrograph Report

Hyd. No. 14

Basin 2E - Existing Dugout

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 21 cuft
Drainage area	= 0.005 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.005



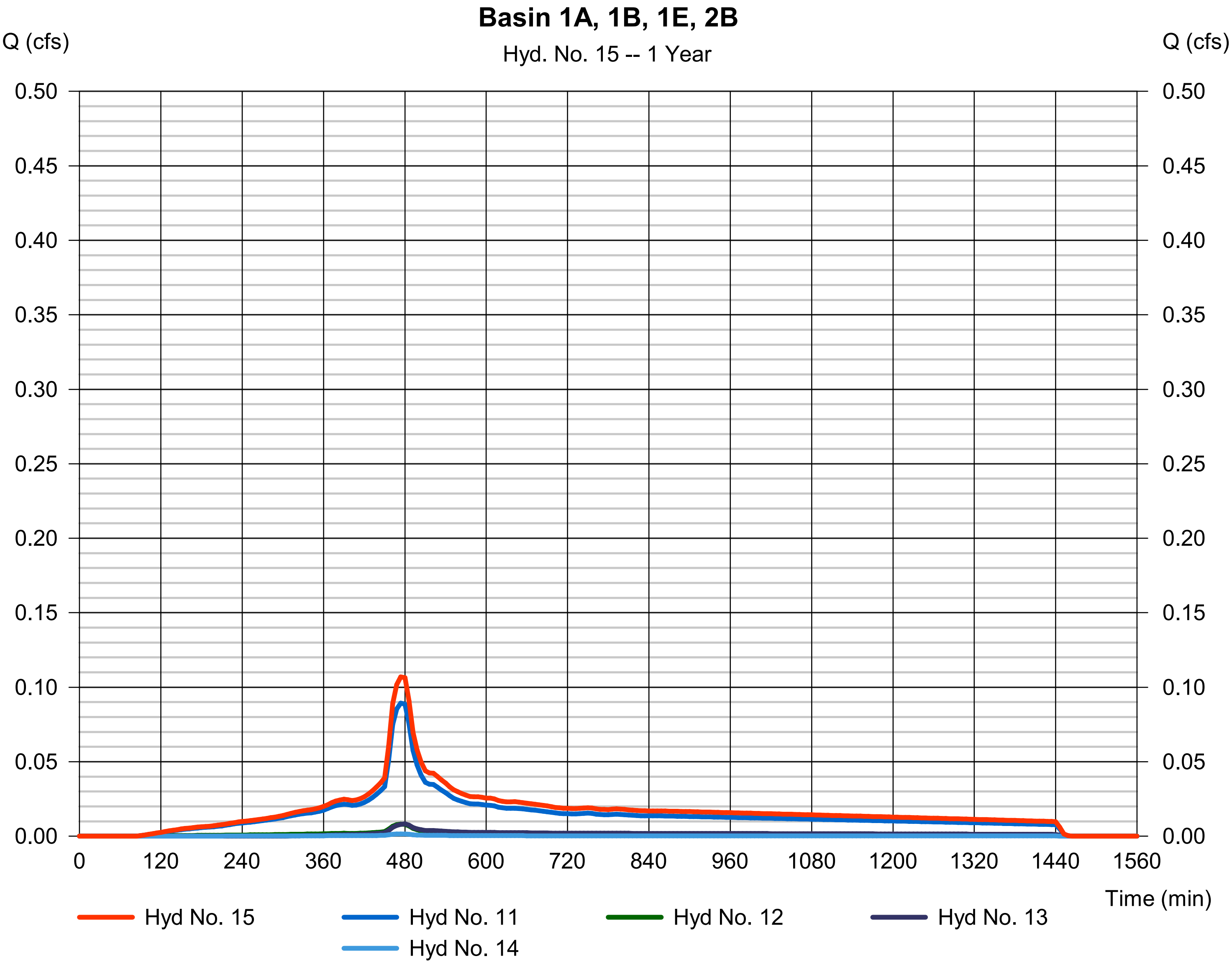
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Tuesday, 03 / 25 / 2025

Hyd. No. 15

Basin 1A, 1B, 1E, 2B

Hydrograph type	= Combine	Peak discharge	= 0.107 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 1,529 cuft
Inflow hyds.	= 11, 12, 13, 14	Contrib. drain. area	= 0.388 ac



Hydrograph Report

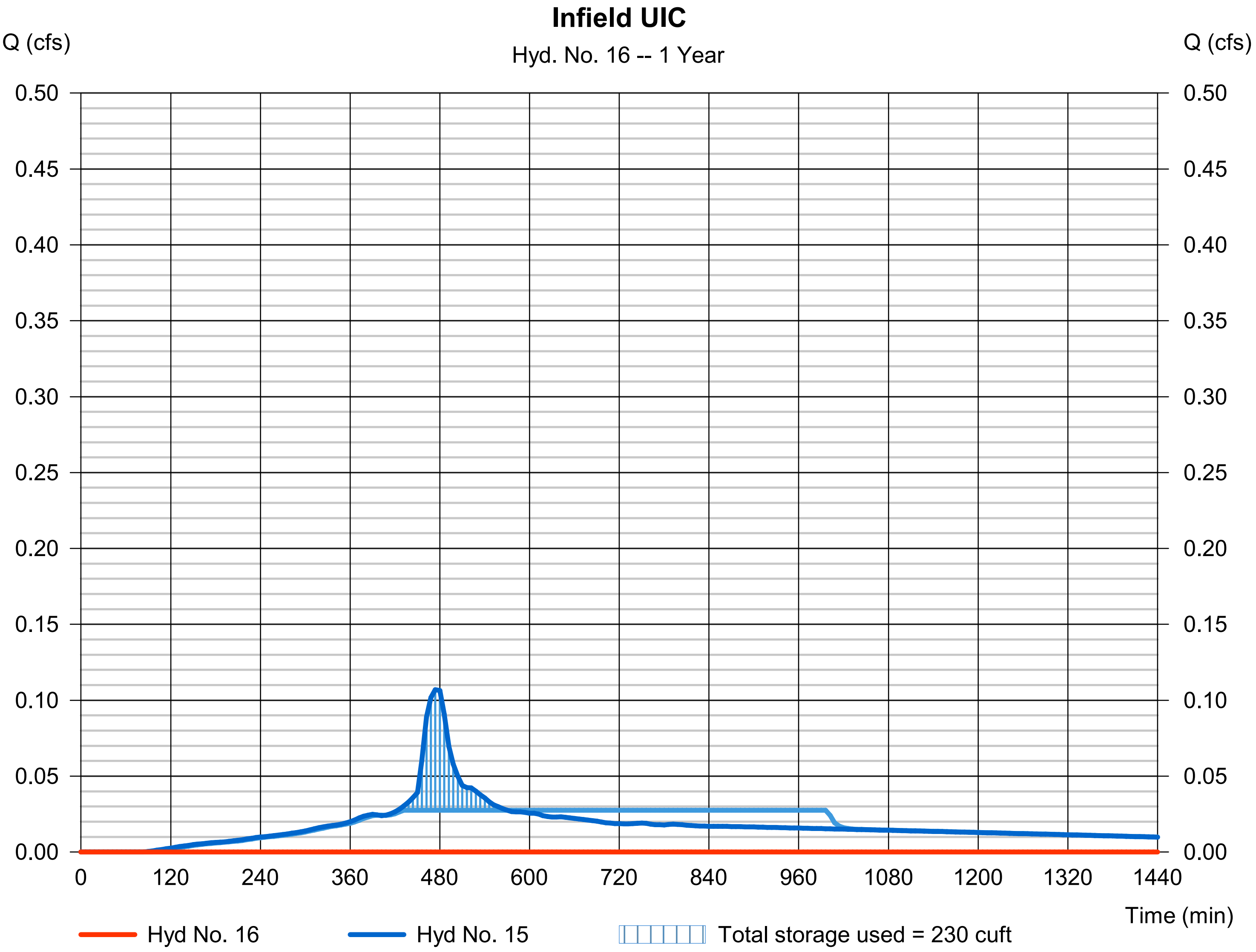
Hyd. No. 16

Infield UIC

Hydrograph type = Reservoir
Storm frequency = 1 yrs
Time interval = 6 min
Inflow hyd. No. = 15 - Basin 1A, 1B, 1E, 2B
Reservoir name = Infiltration Trench

Peak discharge = 0.000 cfs
Time to peak = 420 min
Hyd. volume = 0 cuft
Max. Elevation = 159.10 ft
Max. Storage = 230 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Pond No. 10 - Infiltration Trench

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 159.00 ft. Voids = 40.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	159.00	330	0	0
0.10	159.10	330	13	13
0.90	159.90	330	106	119
1.00	160.00	330	13	132
1.25	160.25	330	33	165
1.60	160.60	330	46	211
2.10	161.10	330	66	277
2.20	161.20	330	13	290
2.40	161.40	330	26	317
2.80	161.80	330	53	370
3.00	162.00	2,750	108	477
3.10	162.10	5,500	162	639
3.20	162.20	11,492	333	971
3.30	162.30	11,492	460	1,431
3.40	162.40	11,492	460	1,891

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 6.00	Inactive	Inactive	0.00
Span (in)	= 6.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 161.84	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

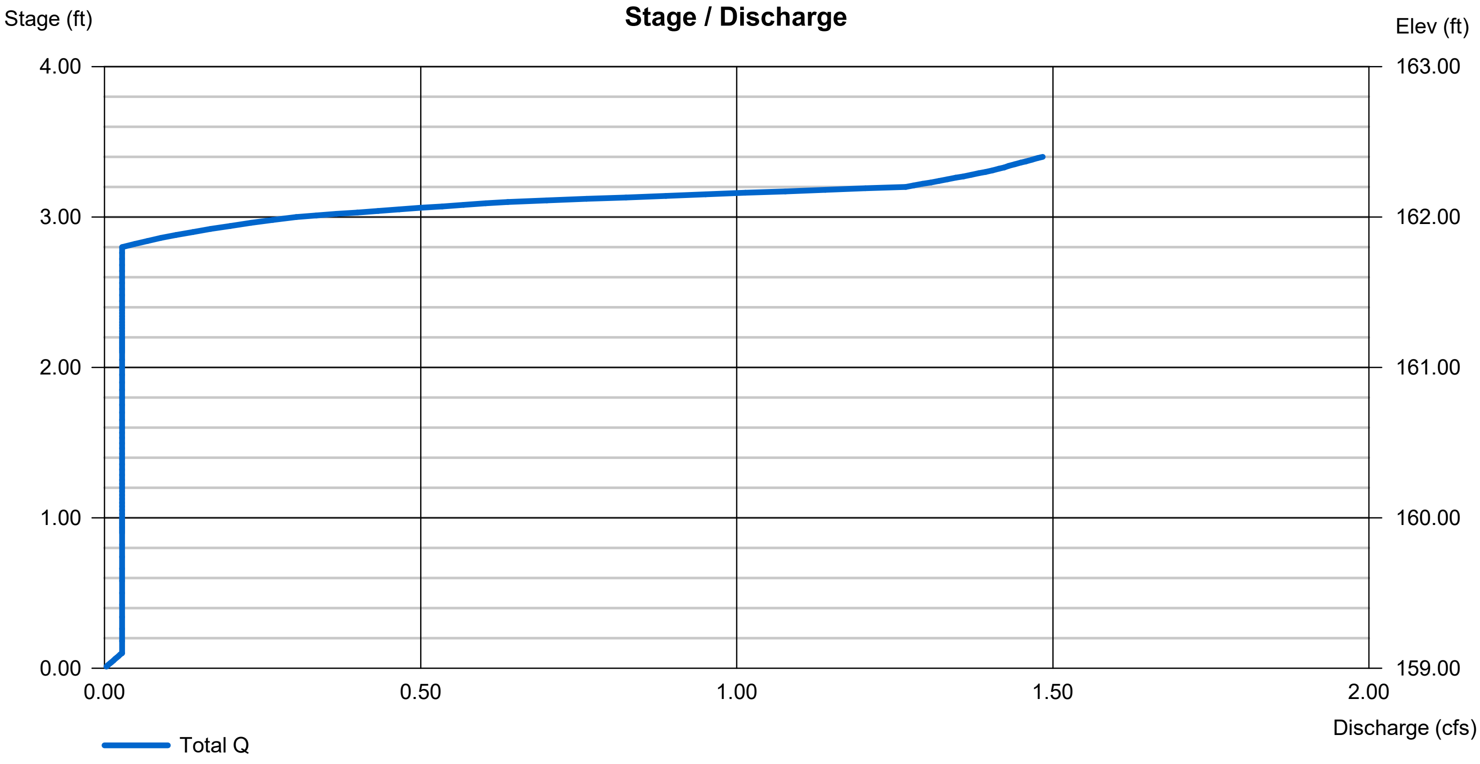
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	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	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 3.600 (by Contour)

TW Elev. (ft) = 0.00

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



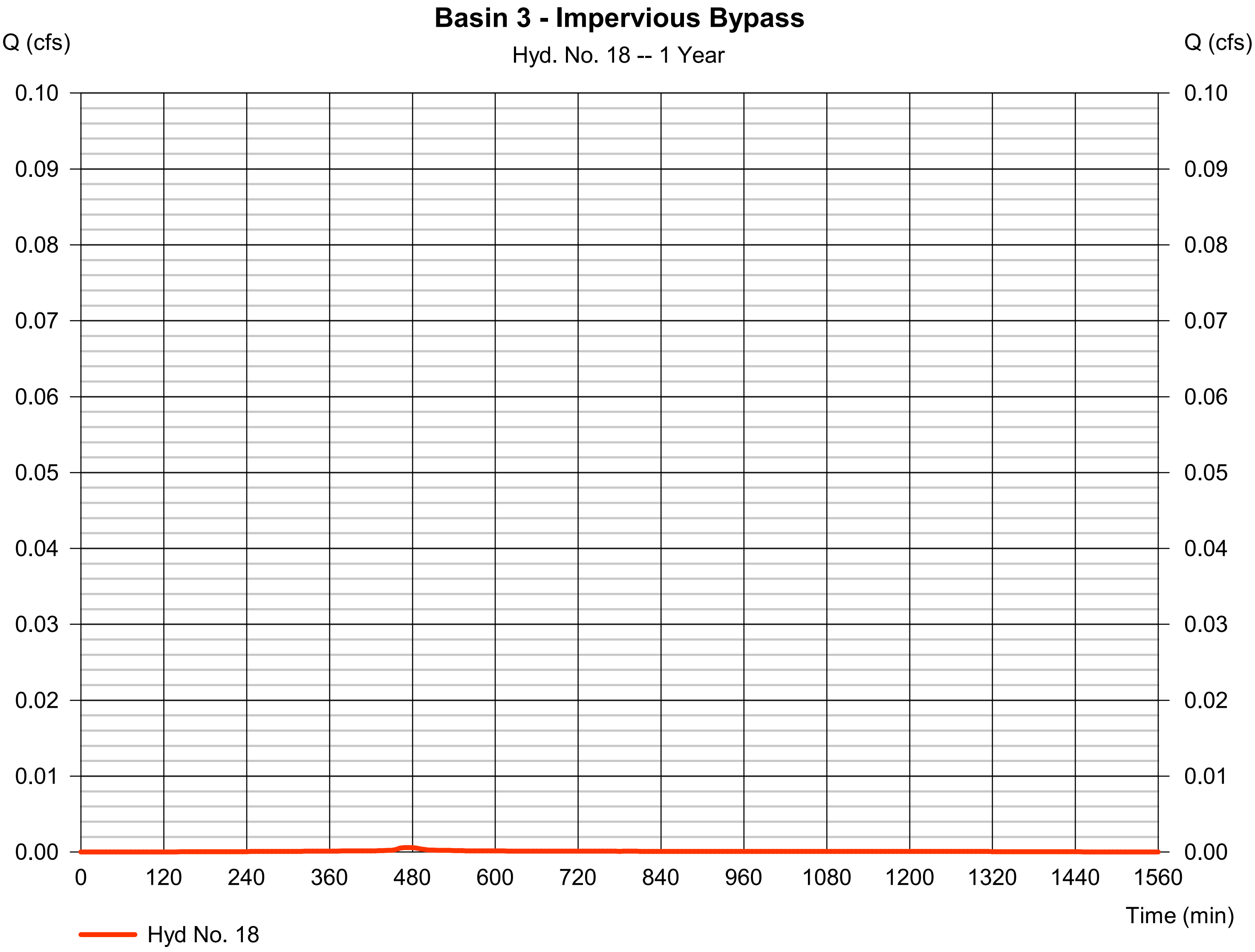
Hydrograph Report

Hyd. No. 18

Basin 3 - Impervious Bypass

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 8 cuft
Drainage area	= 0.002 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.38 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.002



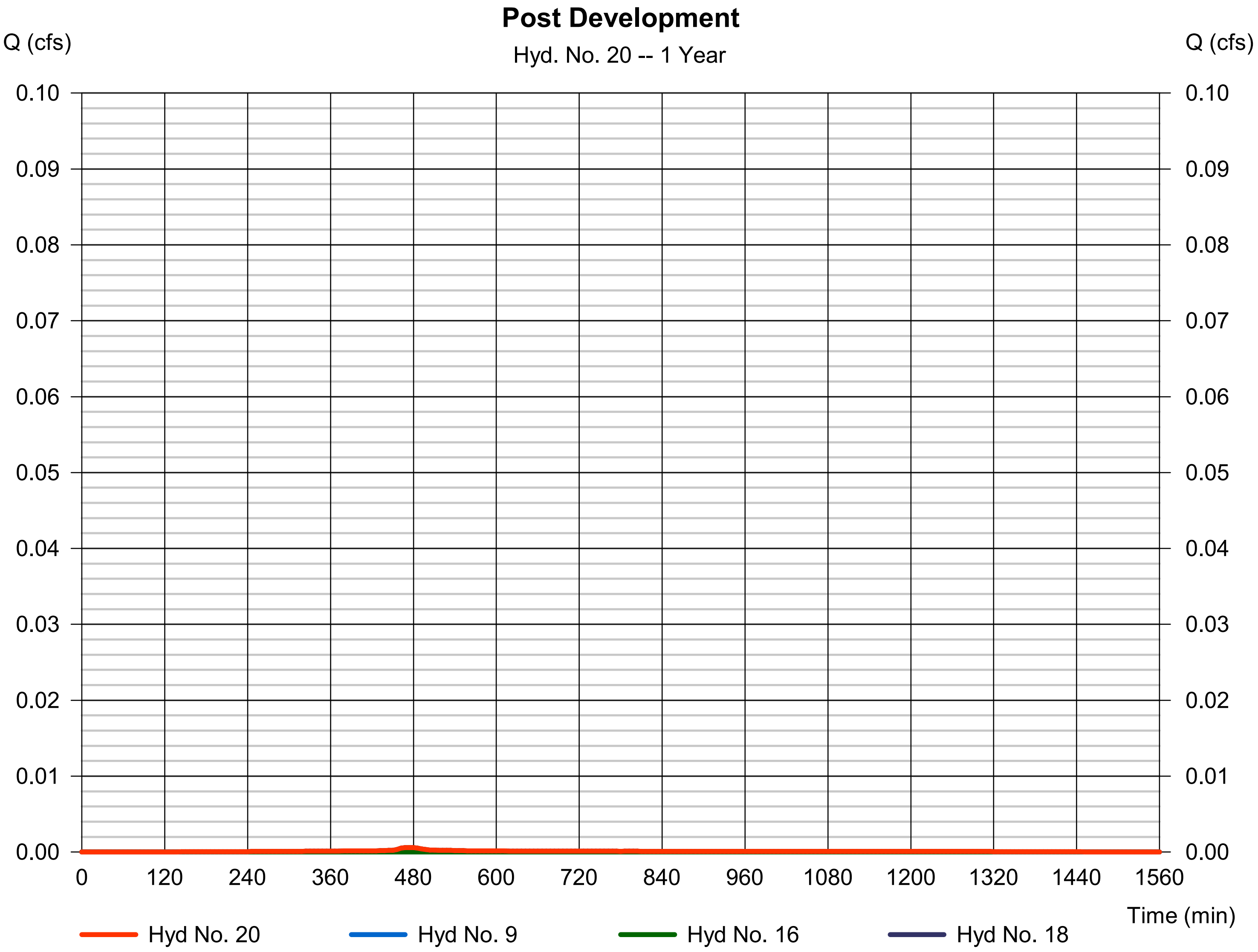
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Tuesday, 03 / 25 / 2025

Hyd. No. 20

Post Development

Hydrograph type	= Combine	Peak discharge	= 0.001 cfs
Storm frequency	= 1 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 8 cuft
Inflow hyds.	= 9, 16, 18	Contrib. drain. area	= 0.002 ac



Hydrograph Summary Report

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	SBUH Runoff	0.026	6	1002	1,439	------	------	------	1E Pre-Development - Field
2	SBUH Runoff	0.003	6	474	36	------	------	------	1E.1 Pre-Development - Roof
3	SBUH Runoff	0.014	6	474	193	------	------	------	1E.2 Pre-Development - Concrete
4	SBUH Runoff	0.019	6	480	277	------	------	------	1E.3 Pre-Development - Gravel
5	Combine	0.035	6	480	506	2, 3, 4	------	------	Non-Field Total
6	Combine	0.041	6	480	1,946	1, 5	------	------	Total Pre-Development
8	SBUH Runoff	0.372	6	474	5,313	------	------	------	Basin 2A Outfield
9	Reservoir	0.000	6	414	0	8	100.02	42.6	Outfield - Reservoir
11	SBUH Runoff	0.150	6	474	2,141	------	------	------	Basin 2B Infield
12	SBUH Runoff	0.014	6	474	193	------	------	------	Basin 2C- Existing Concrete
13	SBUH Runoff	0.019	6	480	277	------	------	------	Basin 2D - Existing Gravel
14	SBUH Runoff	0.003	6	474	36	------	------	------	Basin 2E - Existing Dugout
15	Combine	0.185	6	474	2,648	11, 12, 13, 14	------	------	Basin 1A, 1B, 1E, 2B
16	Reservoir	0.006	6	492	6	15	161.88	414	Infield UIC
18	SBUH Runoff	0.001	6	474	14	------	------	------	Basin 3 - Impervious Bypass
20	Combine	0.006	6	492	21	9, 16, 18,	------	------	Post Development

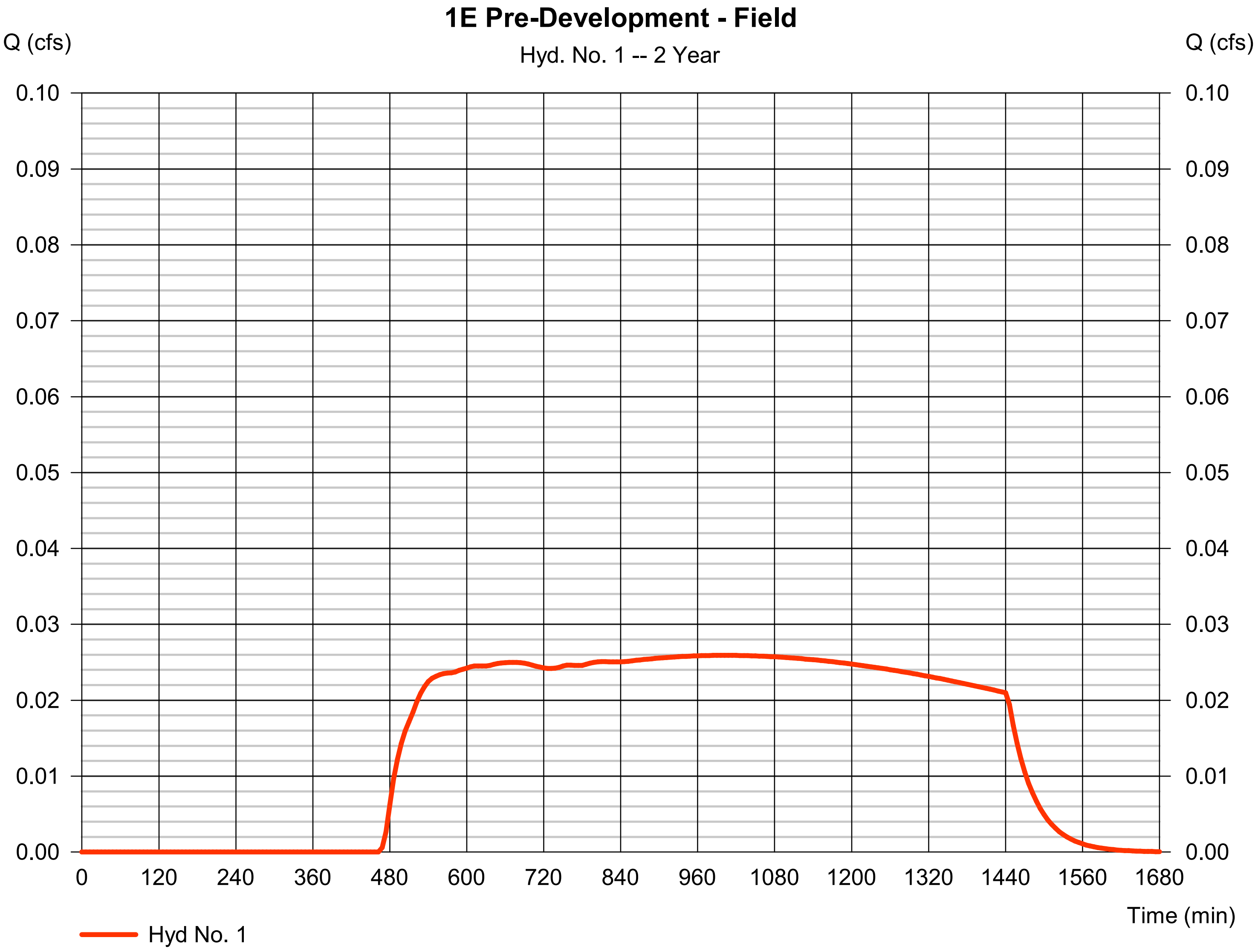
Hydrograph Report

Hyd. No. 1

1E Pre-Development - Field

Hydrograph type = SBUH Runoff
Storm frequency = 2 yrs
Time interval = 6 min
Drainage area = 1.041 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 2.20 in
Storm duration = 24 hrs

Peak discharge = 0.026 cfs
Time to peak = 1002 min
Hyd. volume = 1,439 cuft
Curve number = 72
Hydraulic length = 0 ft
Time of conc. (Tc) = 39.40 min
Distribution = Type IA
Shape factor = n/a

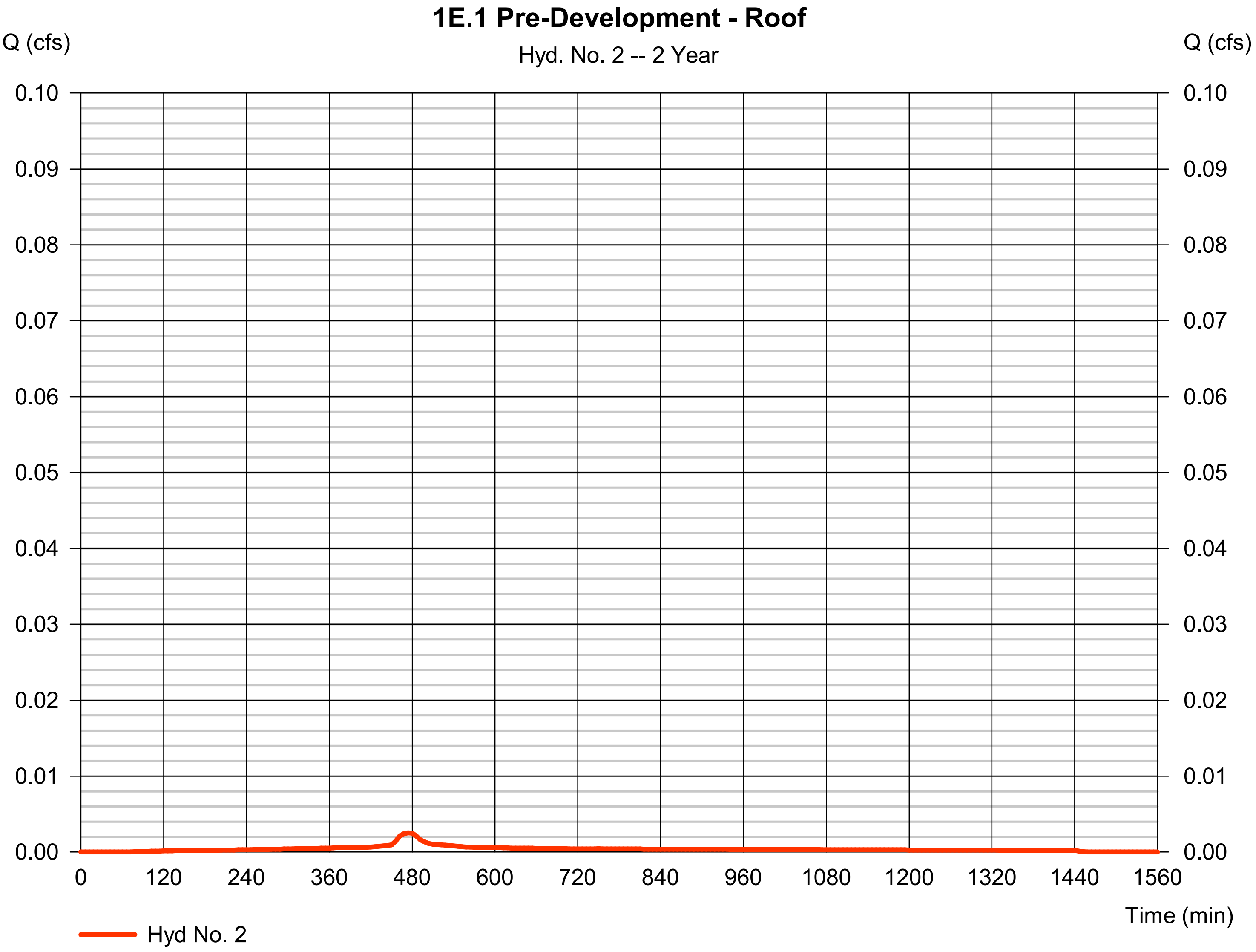


Hydrograph Report

Hyd. No. 2

1E.1 Pre-Development - Roof

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.003 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 36 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

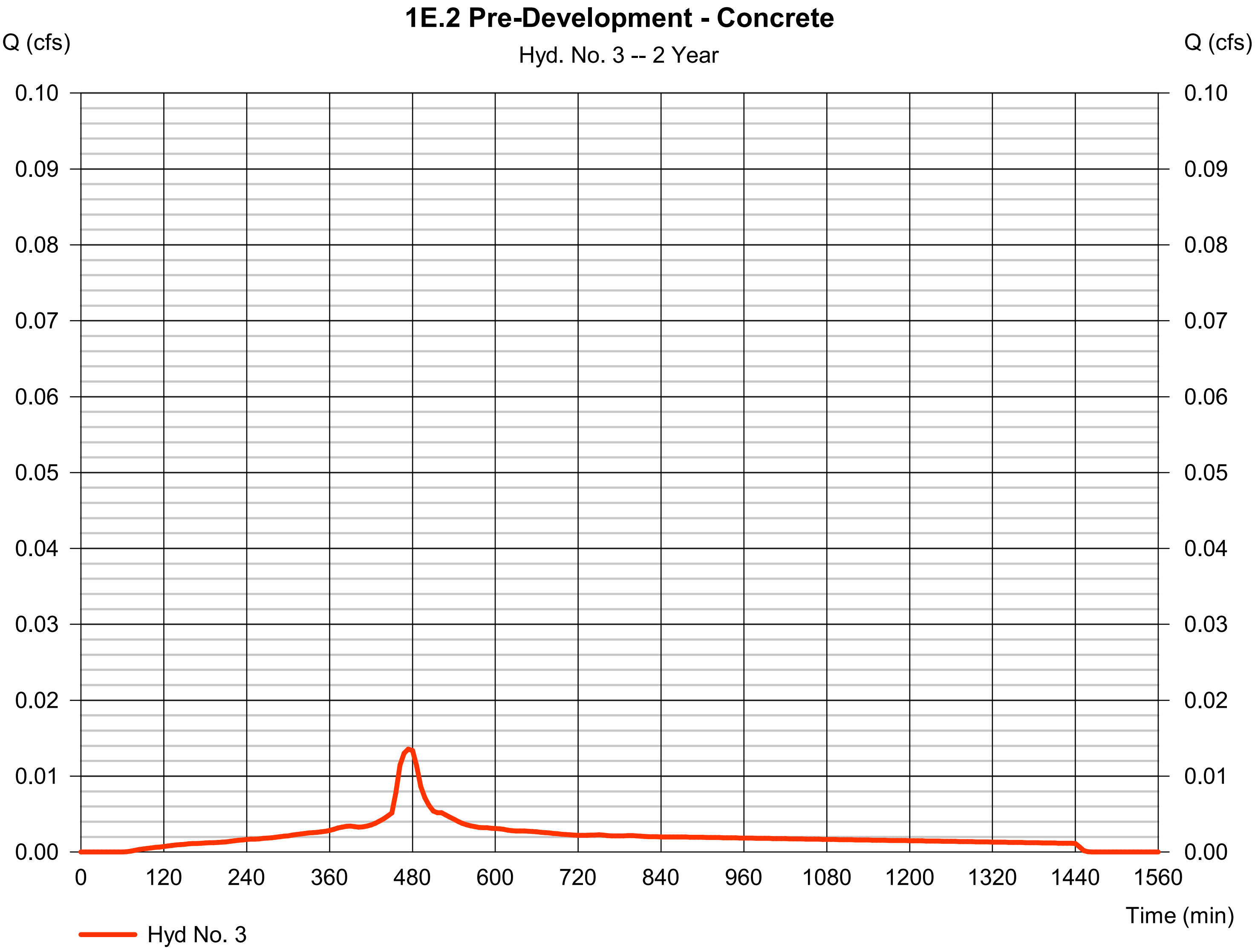


Hydrograph Report

Hyd. No. 3

1E.2 Pre-Development - Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.014 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 193 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

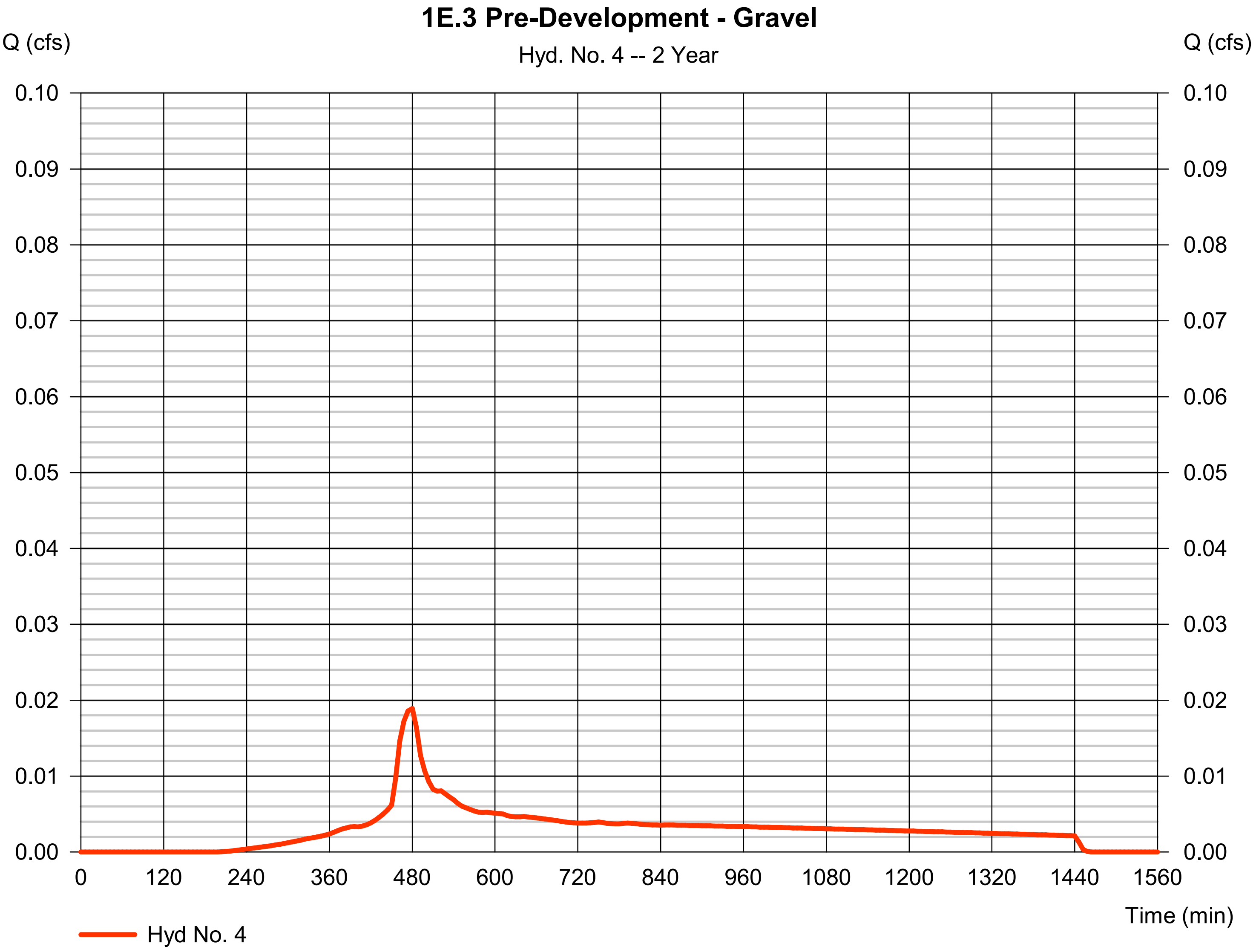


Hydrograph Report

Hyd. No. 4

1E.3 Pre-Development - Gravel

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.019 cfs
Storm frequency	= 2 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 277 cuft
Drainage area	= 0.057 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



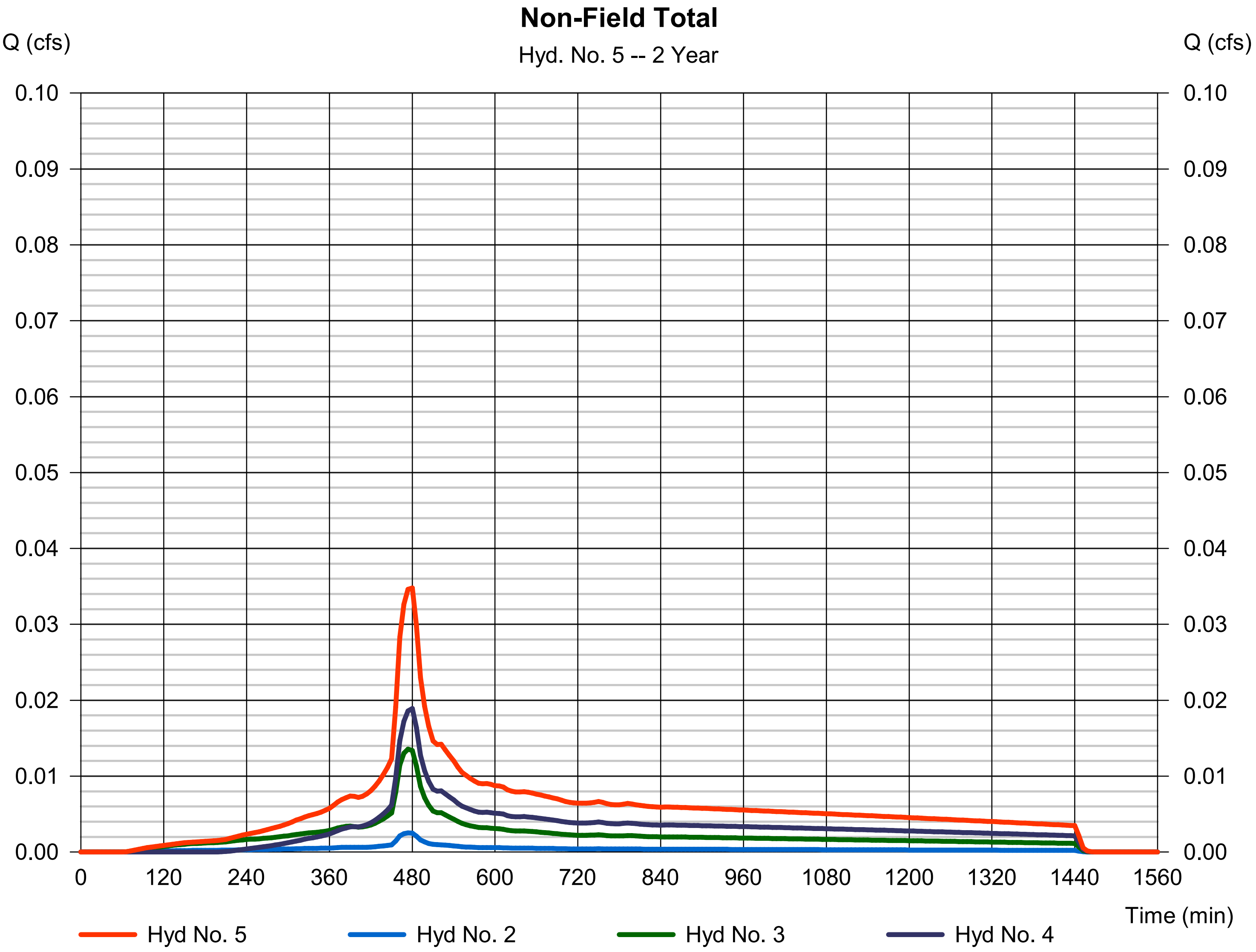
Hydrograph Report

Hyd. No. 5

Non-Field Total

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 6 min
Inflow hyds. = 2, 3, 4

Peak discharge = 0.035 cfs
Time to peak = 480 min
Hyd. volume = 506 cuft
Contrib. drain. area = 0.089 ac



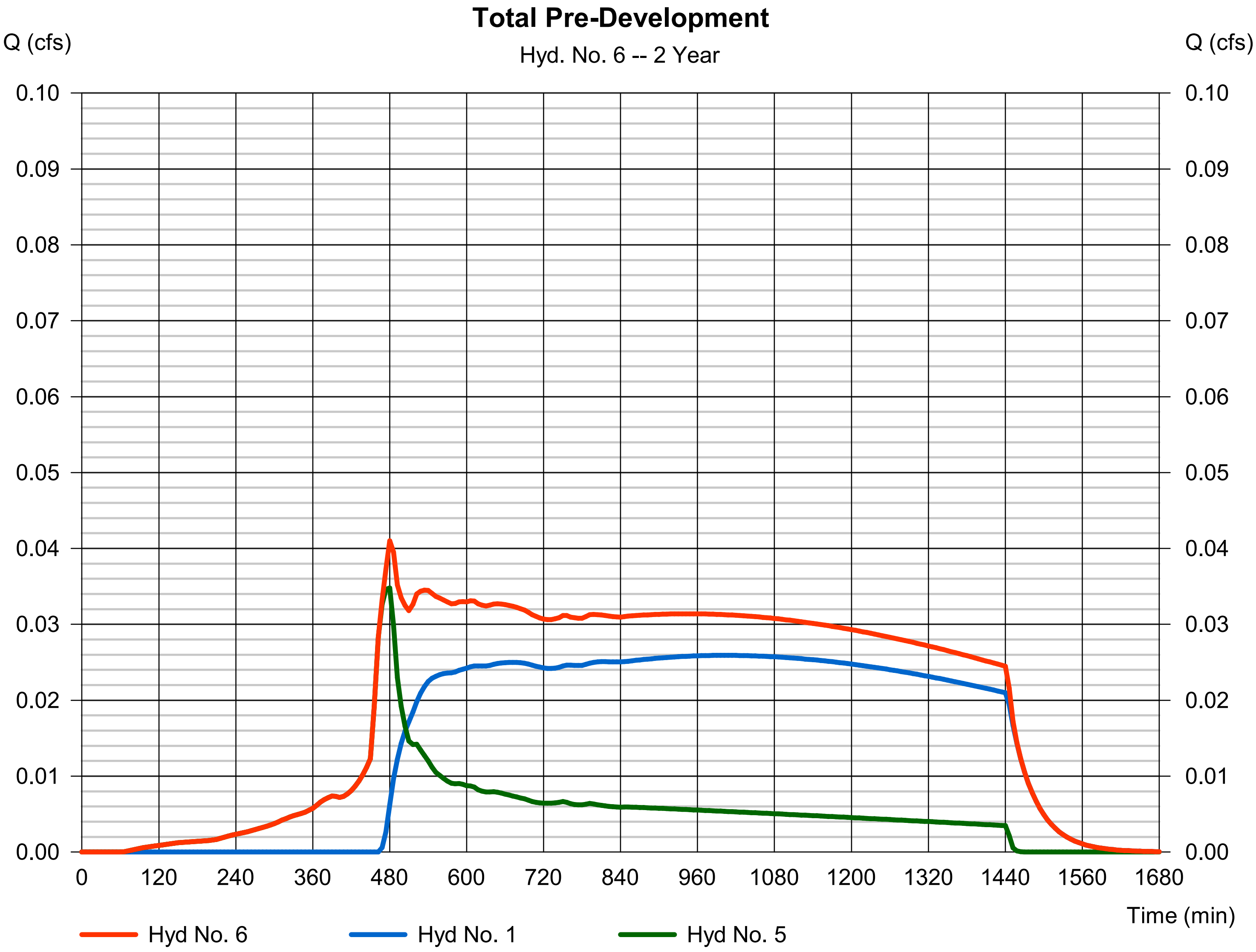
Hydrograph Report

Hyd. No. 6

Total Pre-Development

Hydrograph type = Combine
Storm frequency = 2 yrs
Time interval = 6 min
Inflow hyds. = 1, 5

Peak discharge = 0.041 cfs
Time to peak = 480 min
Hyd. volume = 1,946 cuft
Contrib. drain. area = 1.041 ac

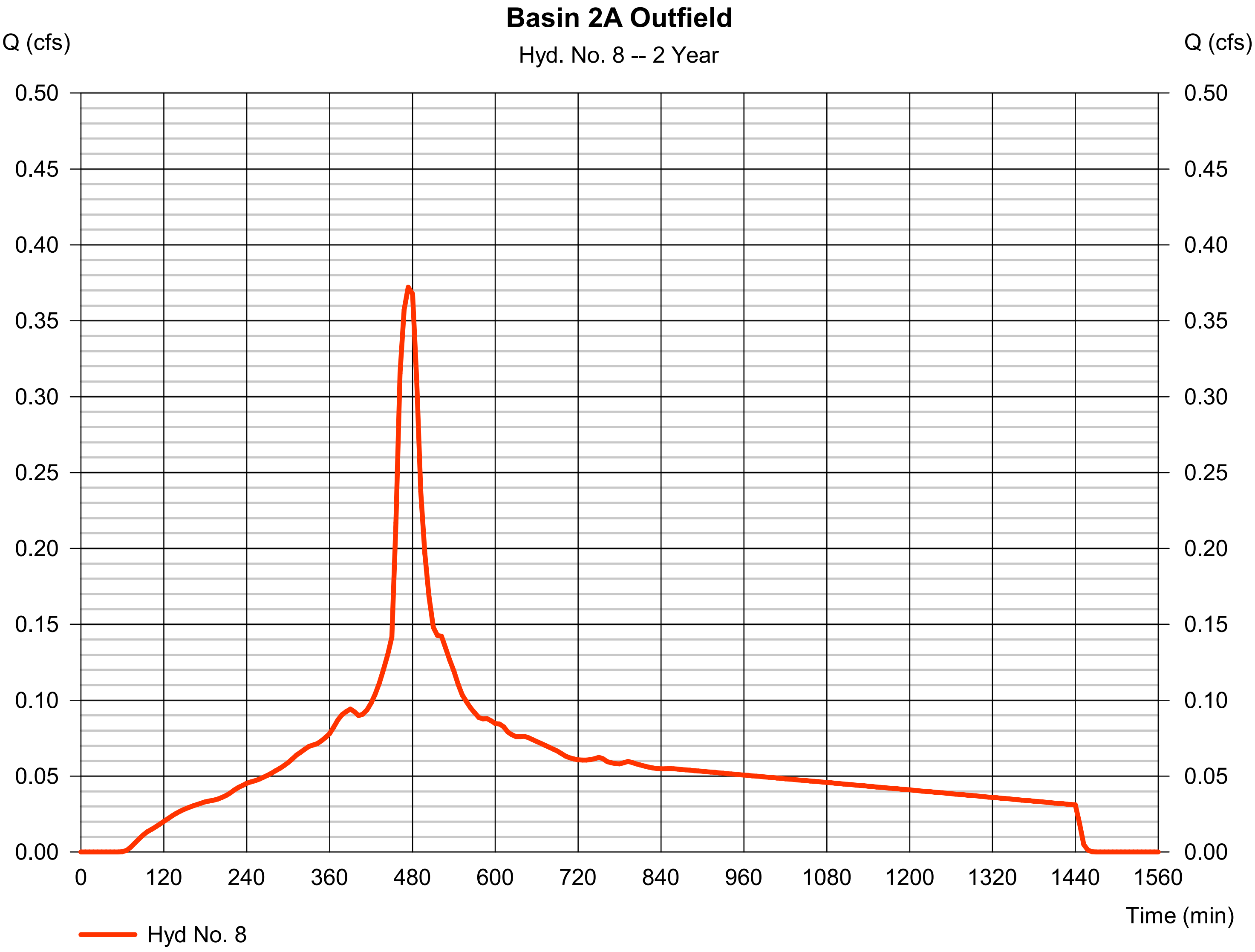


Hydrograph Report

Hyd. No. 8

Basin 2A Outfield

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.372 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 5,313 cuft
Drainage area	= 0.742 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

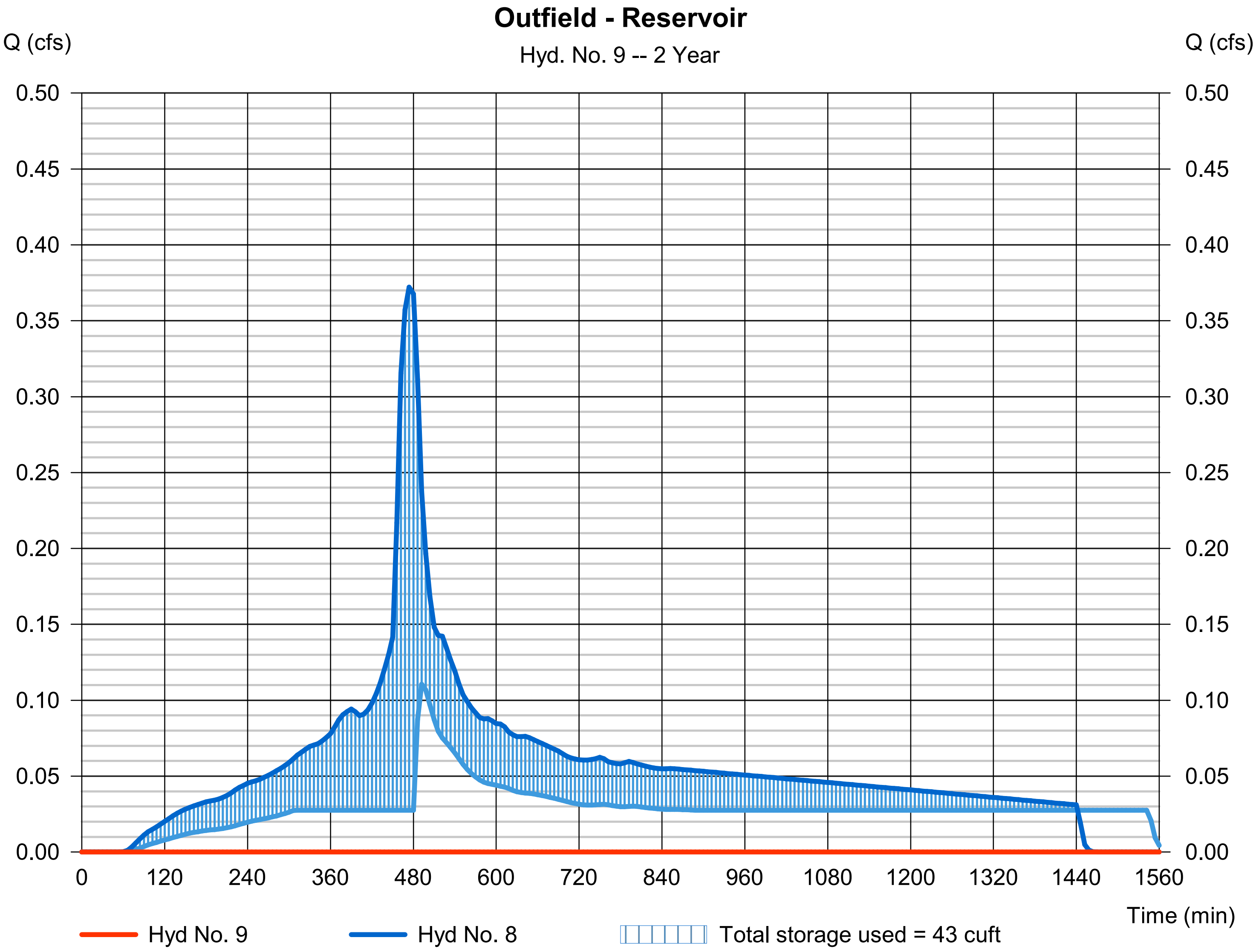
Hyd. No. 9

Outfield - Reservoir

Hydrograph type = Reservoir
Storm frequency = 2 yrs
Time interval = 6 min
Inflow hyd. No. = 8 - Basin 2A Outfield
Reservoir name = Outfield Res

Peak discharge = 0.000 cfs
Time to peak = 414 min
Hyd. volume = 0 cuft
Max. Elevation = 100.02 ft
Max. Storage = 43 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



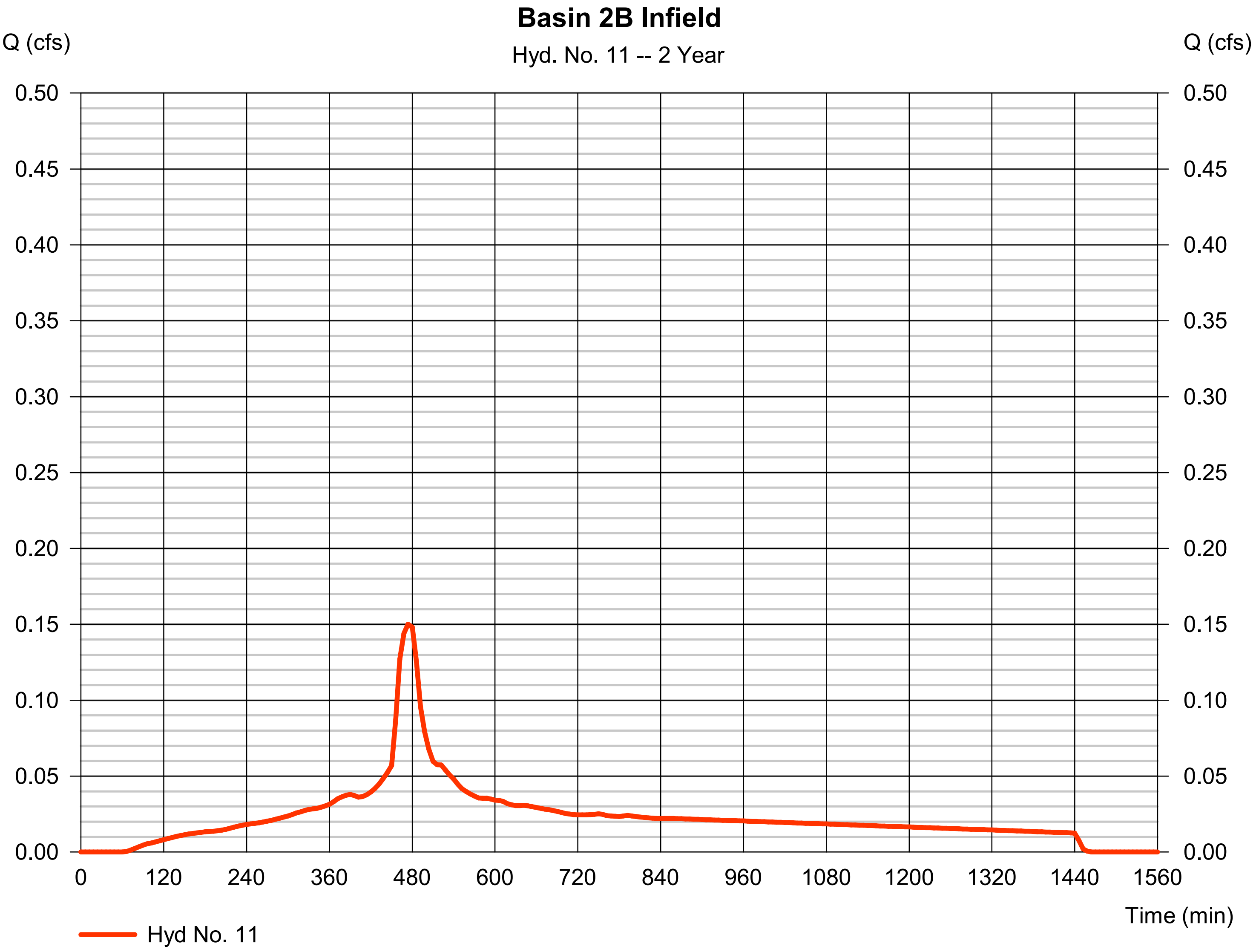
Hydrograph Report

Hyd. No. 11

Basin 2B Infield

Hydrograph type = SBUH Runoff
Storm frequency = 2 yrs
Time interval = 6 min
Drainage area = 0.299 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 2.20 in
Storm duration = 24 hrs

Peak discharge = 0.150 cfs
Time to peak = 474 min
Hyd. volume = 2,141 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a

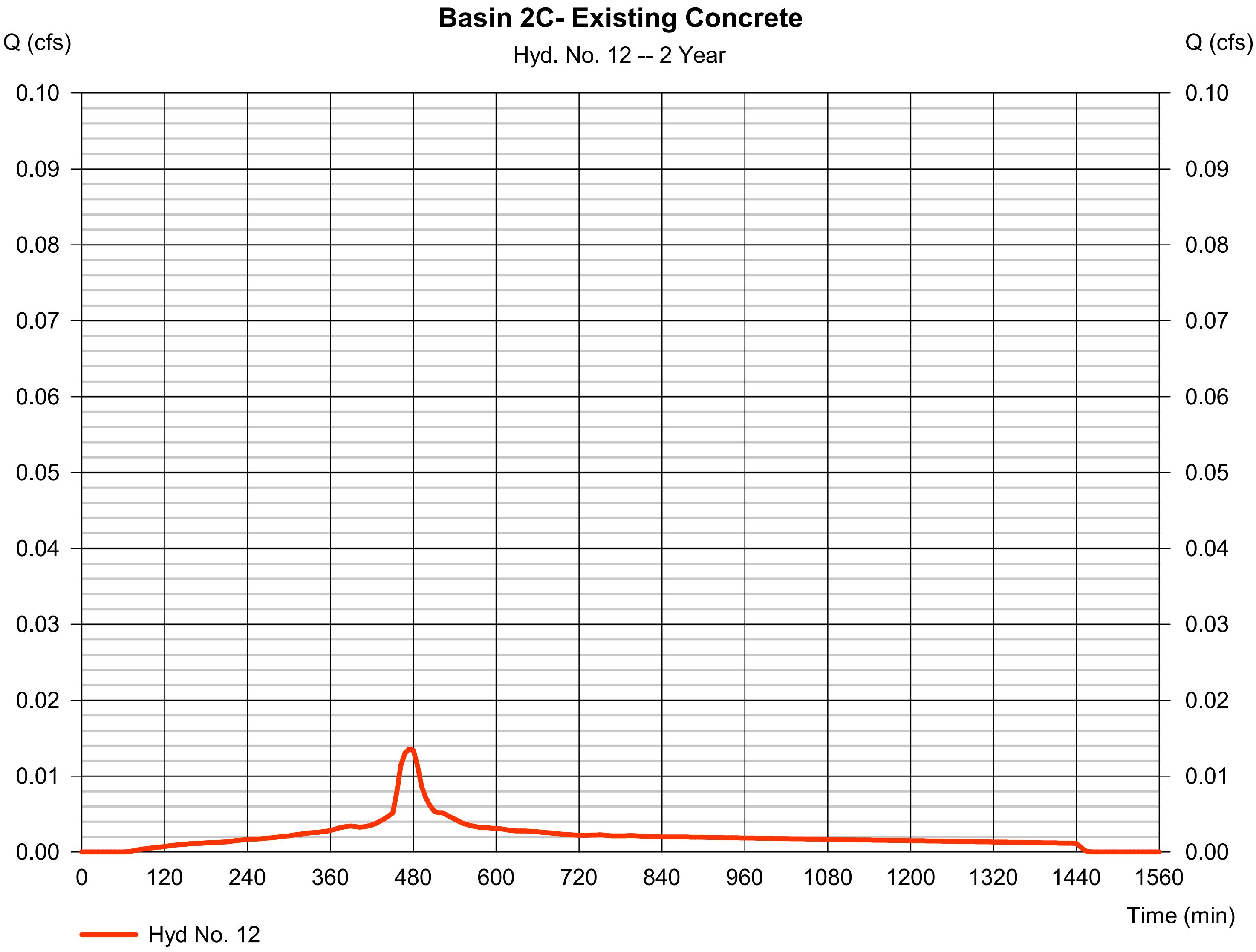


Hydrograph Report

Hyd. No. 12

Basin 2C- Existing Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.014 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 193 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

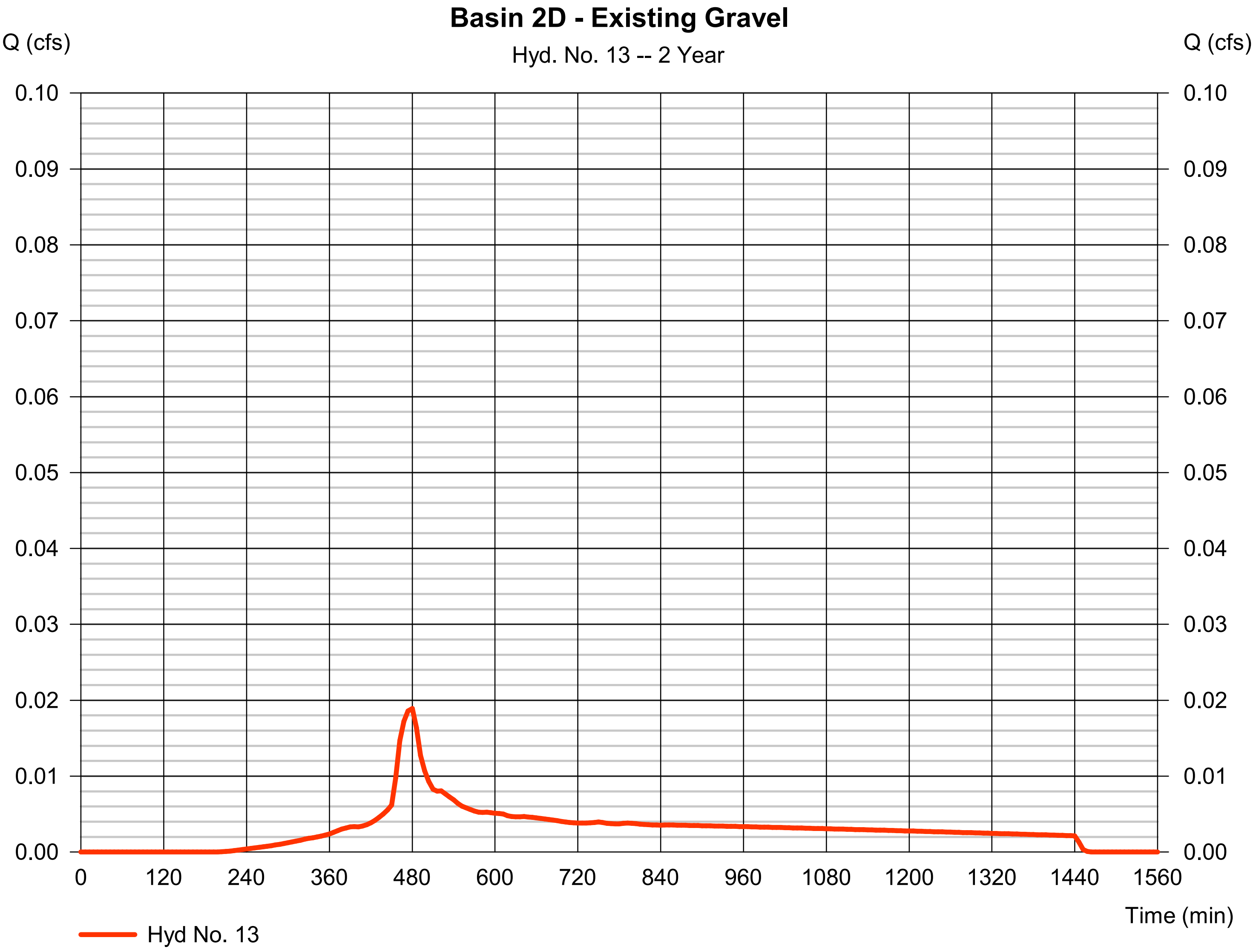


Hydrograph Report

Hyd. No. 13

Basin 2D - Existing Gravel

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.019 cfs
Storm frequency	= 2 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 277 cuft
Drainage area	= 0.057 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



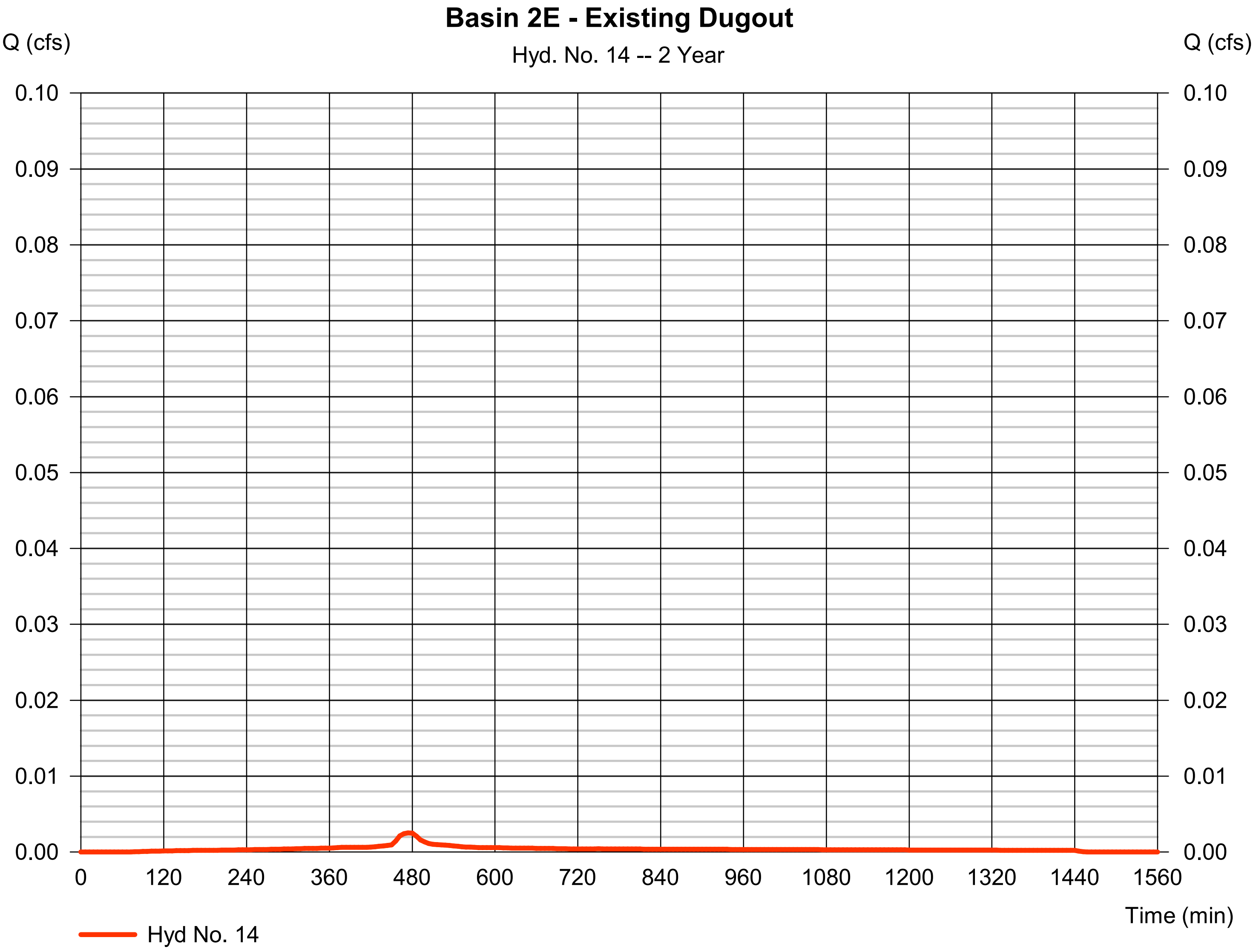
Hydrograph Report

Hyd. No. 14

Basin 2E - Existing Dugout

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.003 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 36 cuft
Drainage area	= 0.005 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.005

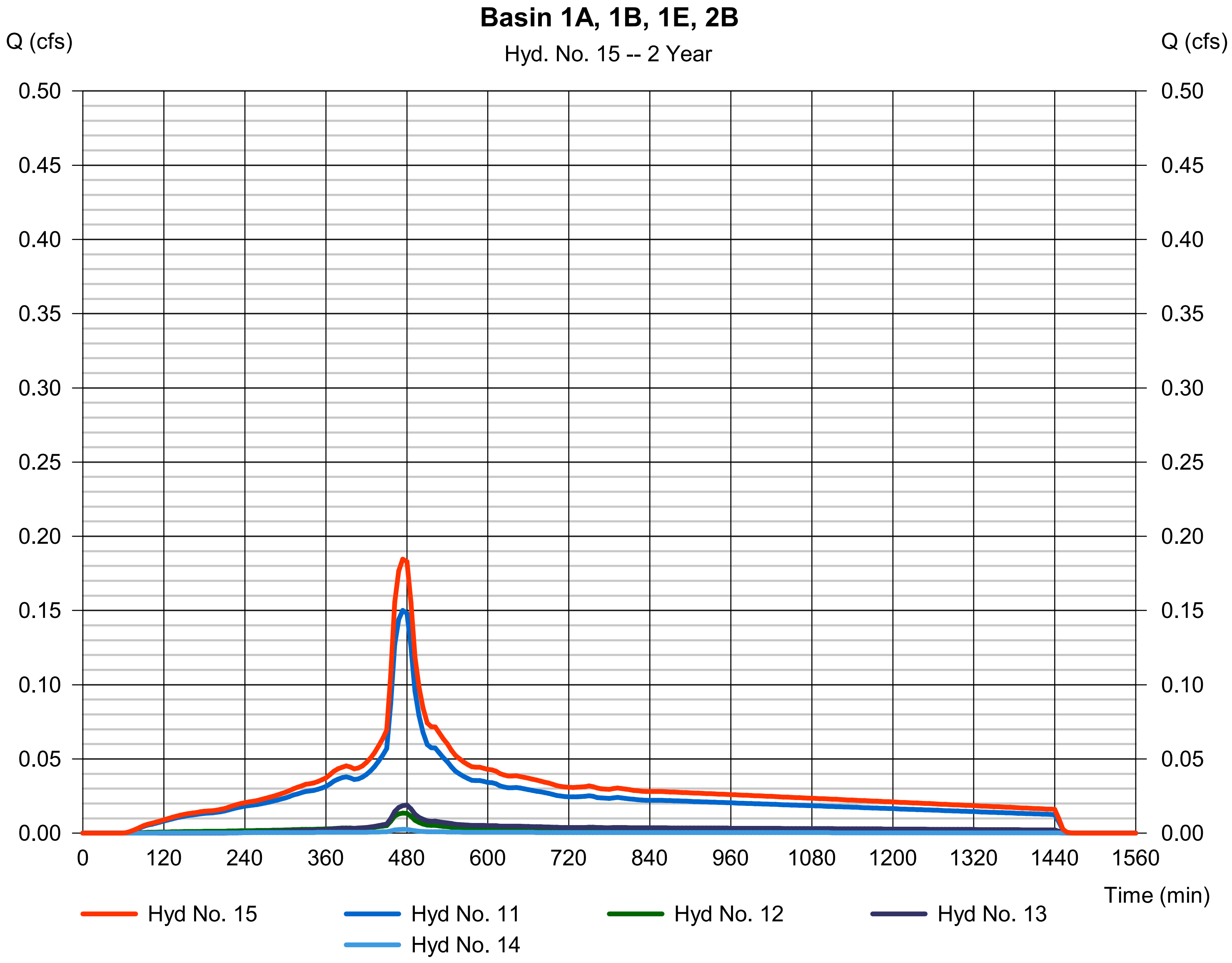


Hydrograph Report

Hyd. No. 15

Basin 1A, 1B, 1E, 2B

Hydrograph type	= Combine	Peak discharge	= 0.185 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 2,648 cuft
Inflow hyds.	= 11, 12, 13, 14	Contrib. drain. area	= 0.388 ac



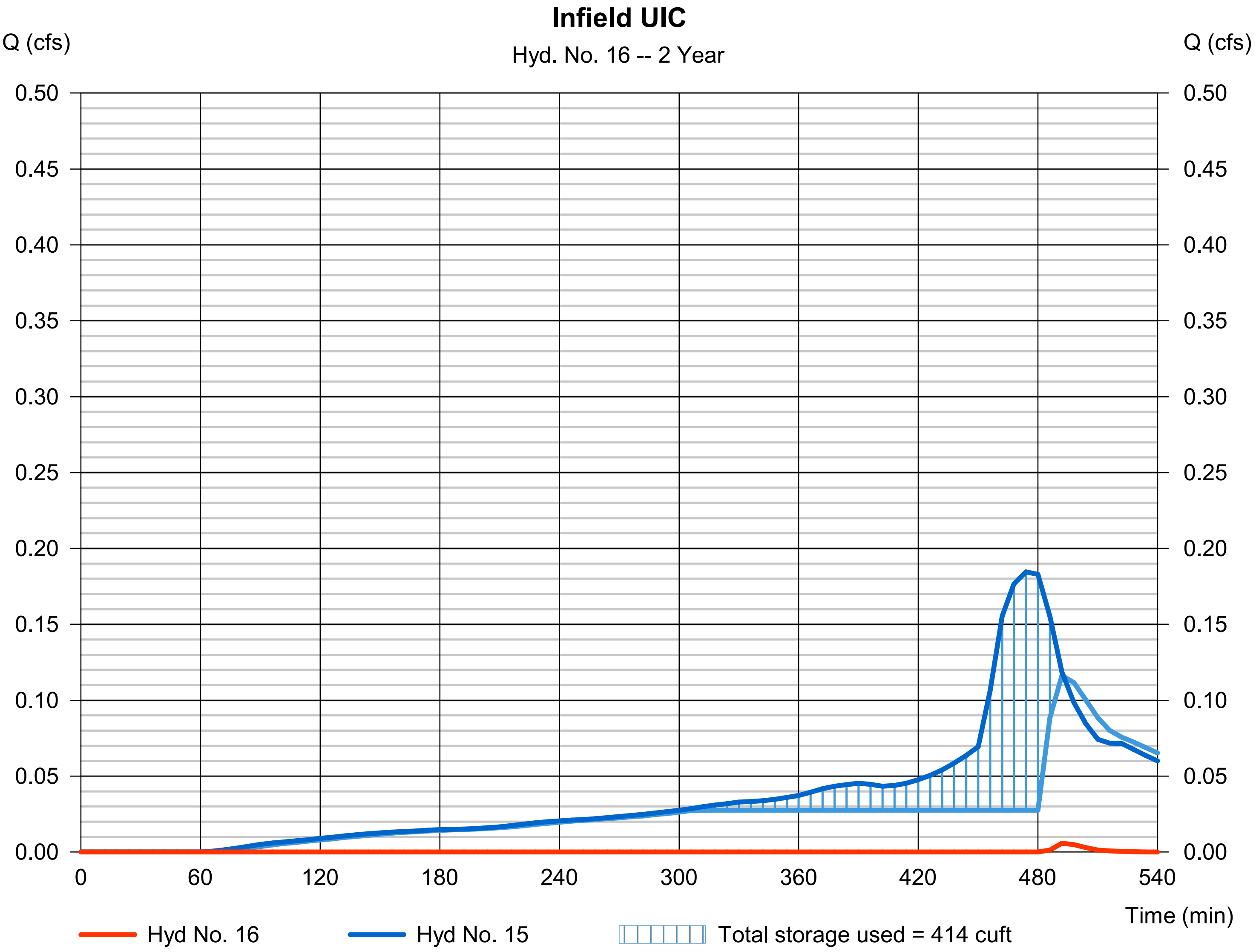
Hydrograph Report

Hyd. No. 16

Infield UIC

Hydrograph type	= Reservoir	Peak discharge	= 0.006 cfs
Storm frequency	= 2 yrs	Time to peak	= 492 min
Time interval	= 6 min	Hyd. volume	= 6 cuft
Inflow hyd. No.	= 15 - Basin 1A, 1B, 1E, 2B	Max. Elevation	= 161.88 ft
Reservoir name	= Infiltration Trench	Max. Storage	= 414 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



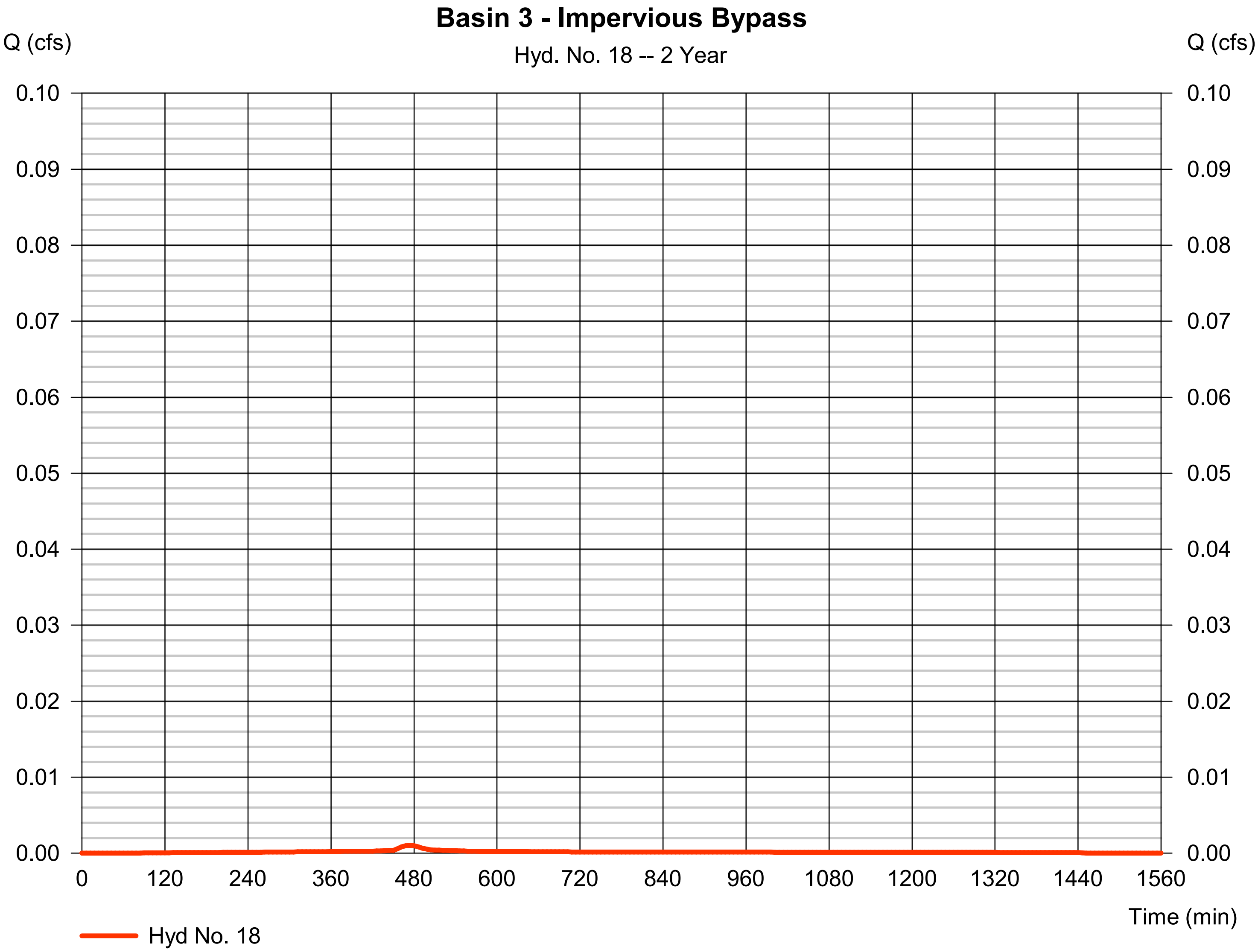
Hydrograph Report

Hyd. No. 18

Basin 3 - Impervious Bypass

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 14 cuft
Drainage area	= 0.002 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.002

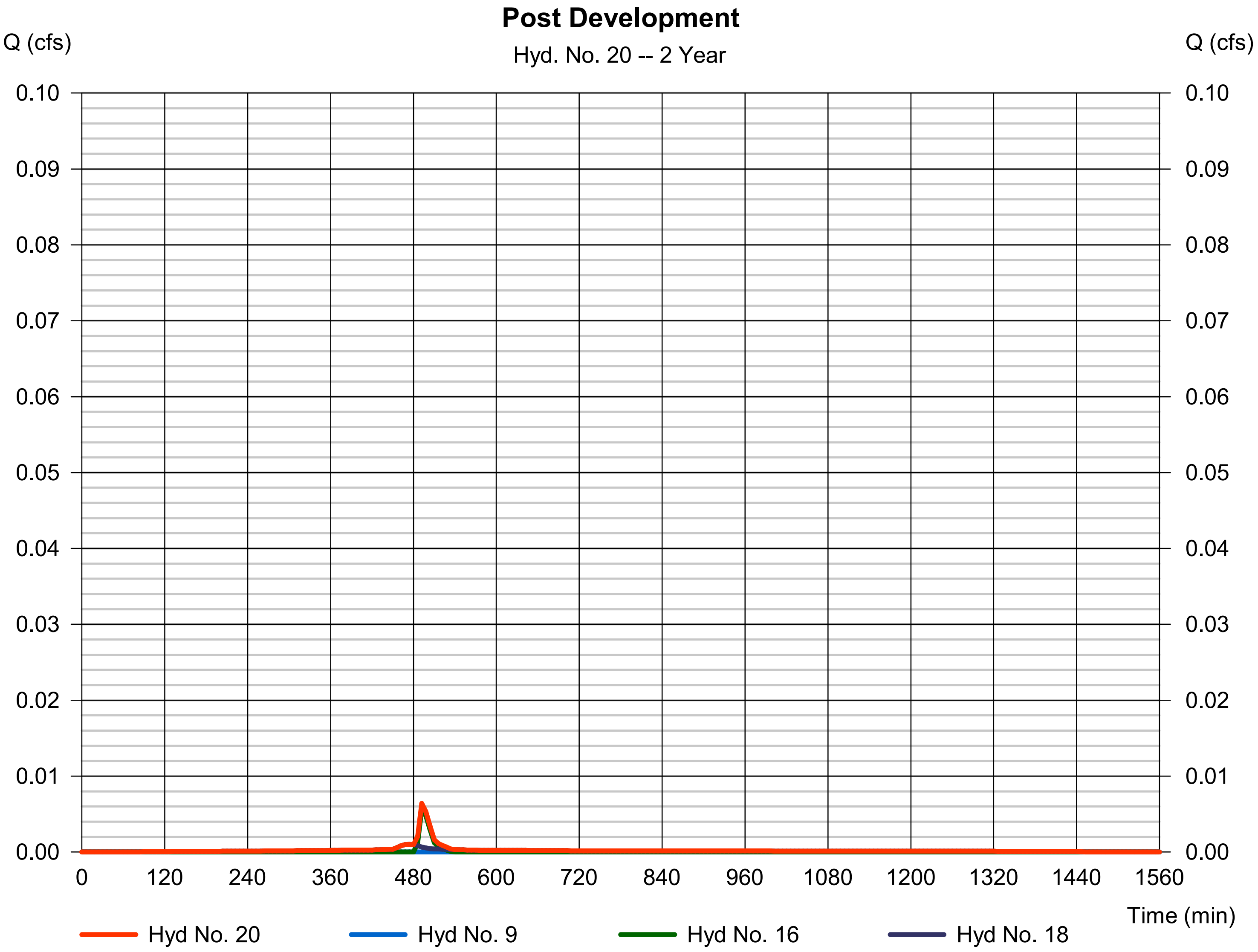


Hydrograph Report

Hyd. No. 20

Post Development

Hydrograph type	= Combine	Peak discharge	= 0.006 cfs
Storm frequency	= 2 yrs	Time to peak	= 492 min
Time interval	= 6 min	Hyd. volume	= 21 cuft
Inflow hyds.	= 9, 16, 18	Contrib. drain. area	= 0.002 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

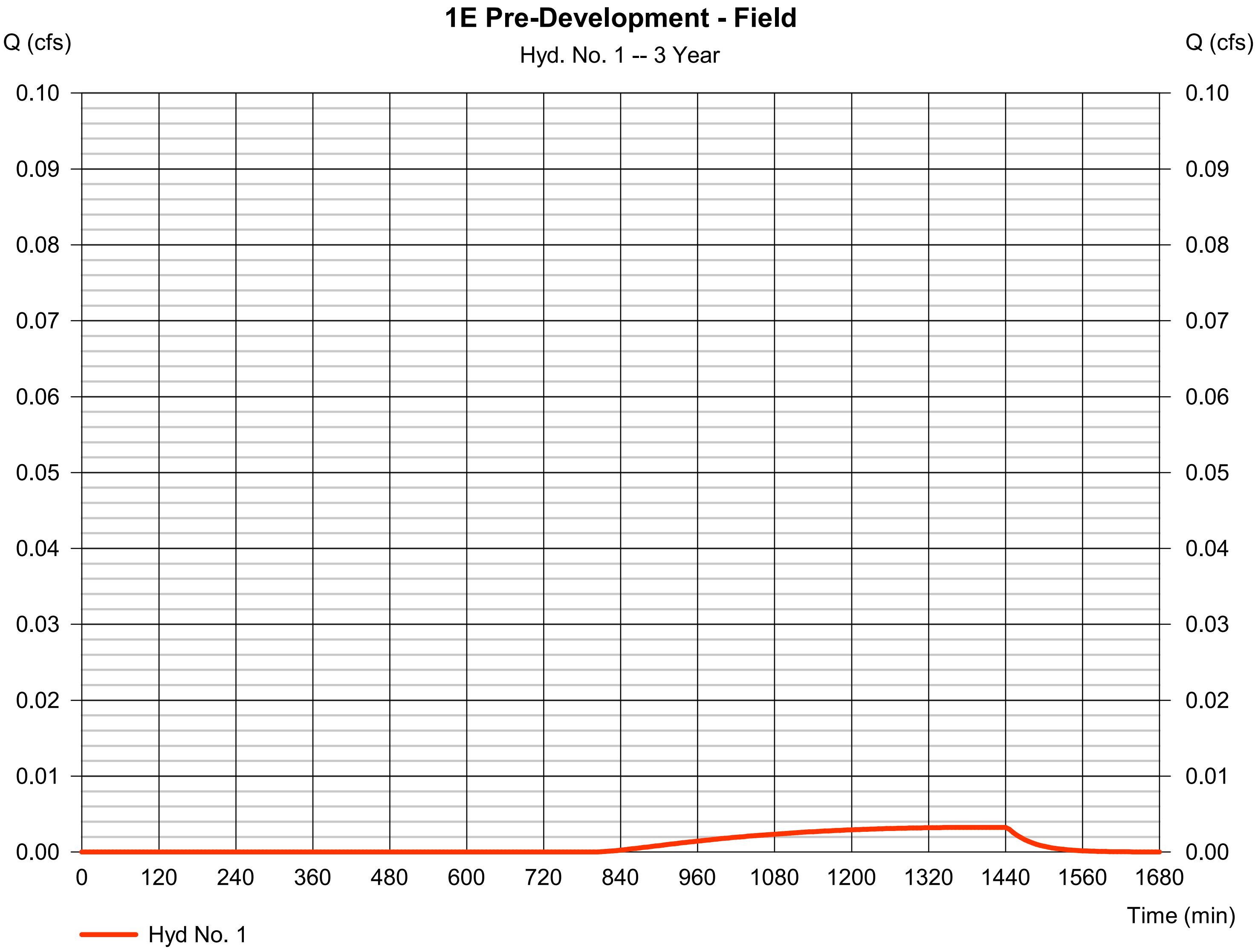
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.003	6	1392	93	------	------	------	1E Pre-Development - Field
2	SBUH Runoff	0.001	6	474	16	------	------	------	1E.1 Pre-Development - Roof
3	SBUH Runoff	0.006	6	474	87	------	------	------	1E.2 Pre-Development - Concrete
4	SBUH Runoff	0.005	6	480	89	------	------	------	1E.3 Pre-Development - Gravel
5	Combine	0.012	6	480	192	2, 3, 4	------	------	Non-Field Total
6	Combine	0.012	6	480	285	1, 5	------	------	Total Pre-Development
8	SBUH Runoff	0.170	6	474	2,392	------	------	------	Basin 2A Outfield
9	Reservoir	0.000	6	516	0	8	100.01	3.05	Outfield - Reservoir
11	SBUH Runoff	0.068	6	474	964	------	------	------	Basin 2B Infield
12	SBUH Runoff	0.006	6	474	87	------	------	------	Basin 2C- Existing Concrete
13	SBUH Runoff	0.005	6	480	89	------	------	------	Basin 2D - Existing Gravel
14	SBUH Runoff	0.001	6	474	16	------	------	------	Basin 2E - Existing Dugout
15	Combine	0.080	6	474	1,156	11, 12, 13, 14	------	------	Basin 1A, 1B, 1E, 2B
16	Reservoir	0.000	6	324	0	15	159.10	130	Infield UIC
18	SBUH Runoff	0.000	6	474	6	------	------	------	Basin 3 - Impervious Bypass
20	Combine	0.000	6	474	6	9, 16, 18,	------	------	Post Development

Hydrograph Report

Hyd. No. 1

1E Pre-Development - Field

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.003 cfs
Storm frequency	= 3 yrs	Time to peak	= 1392 min
Time interval	= 6 min	Hyd. volume	= 93 cuft
Drainage area	= 1.041 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 39.40 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

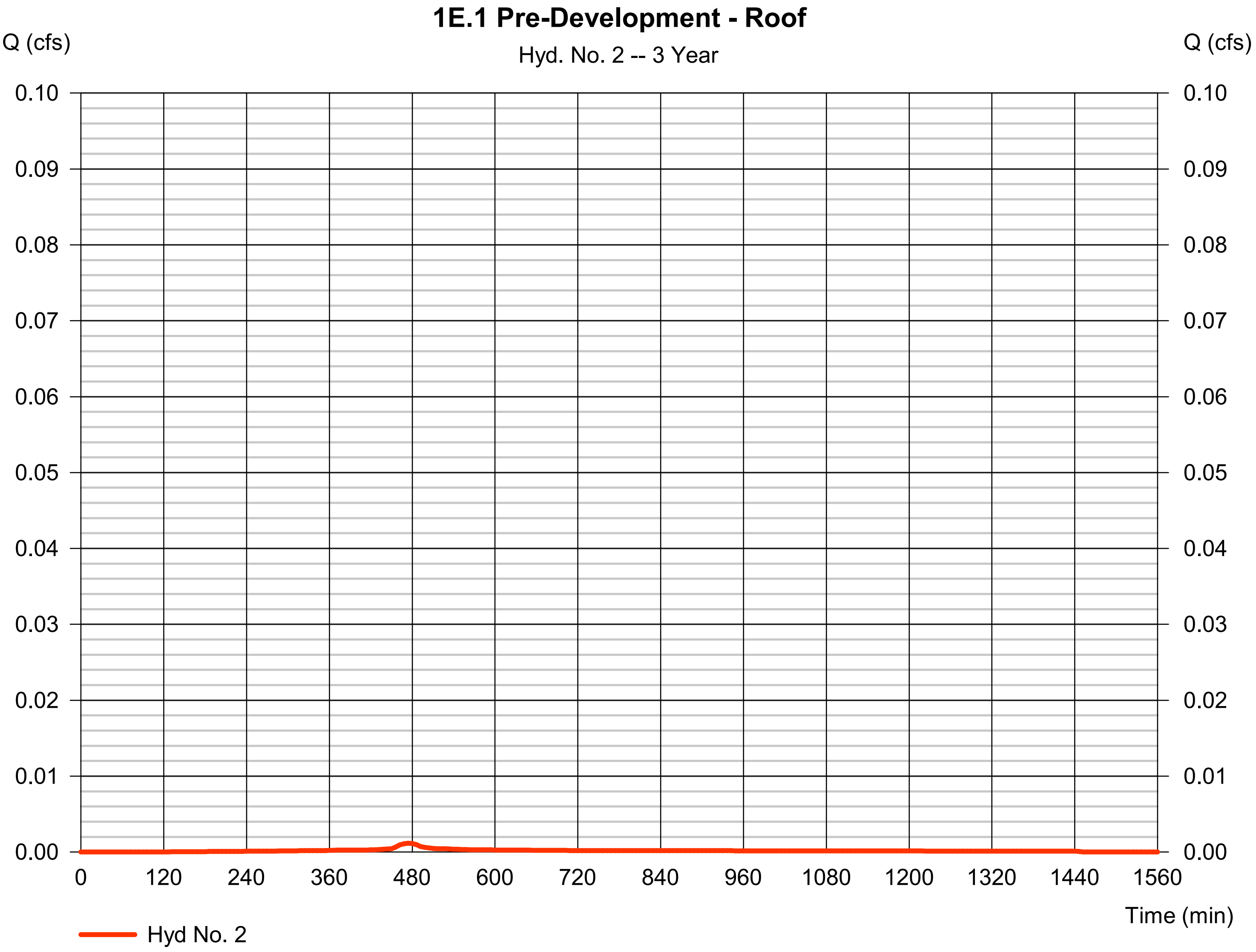


Hydrograph Report

Hyd. No. 2

1E.1 Pre-Development - Roof

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 16 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

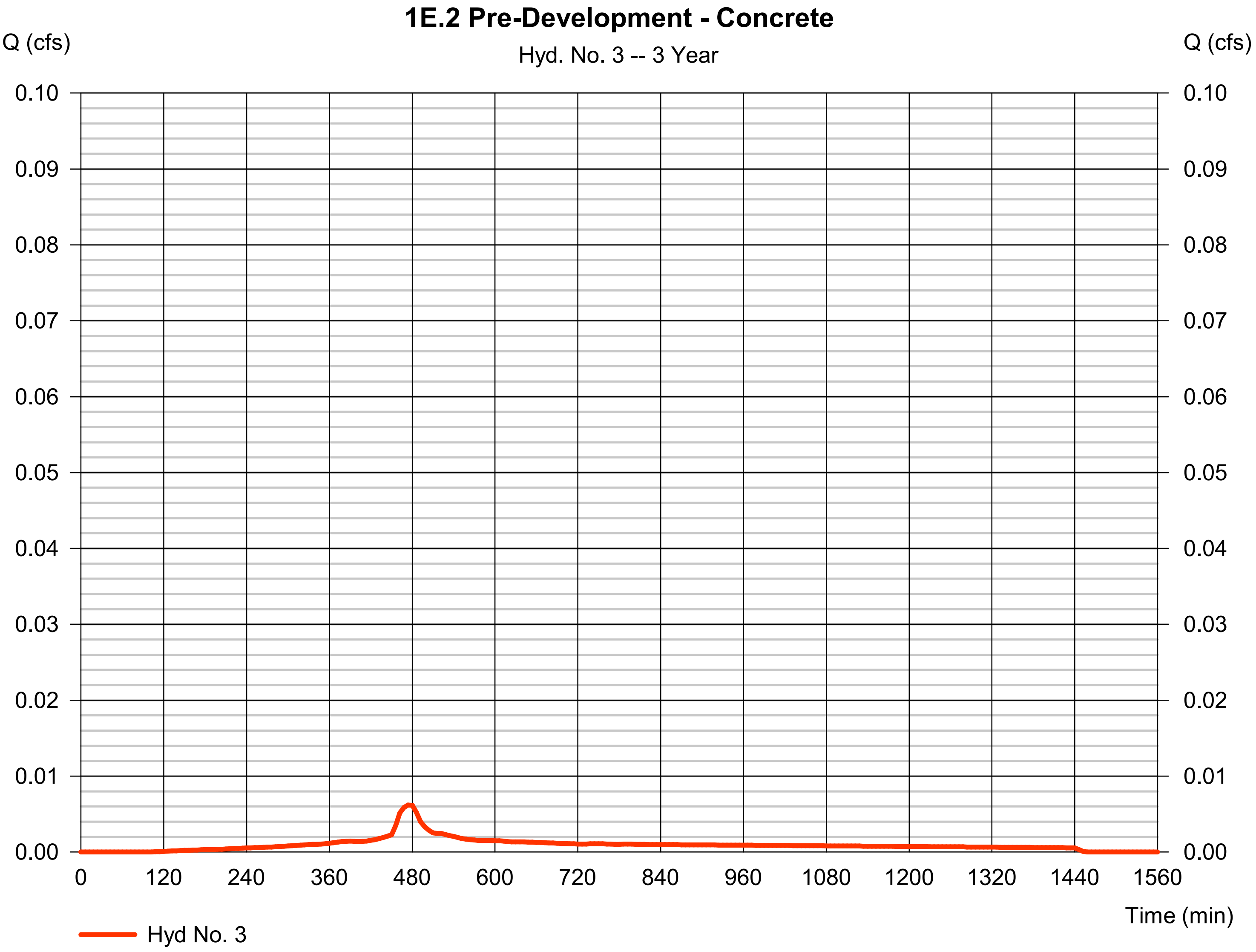


Hydrograph Report

Hyd. No. 3

1E.2 Pre-Development - Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.006 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 87 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



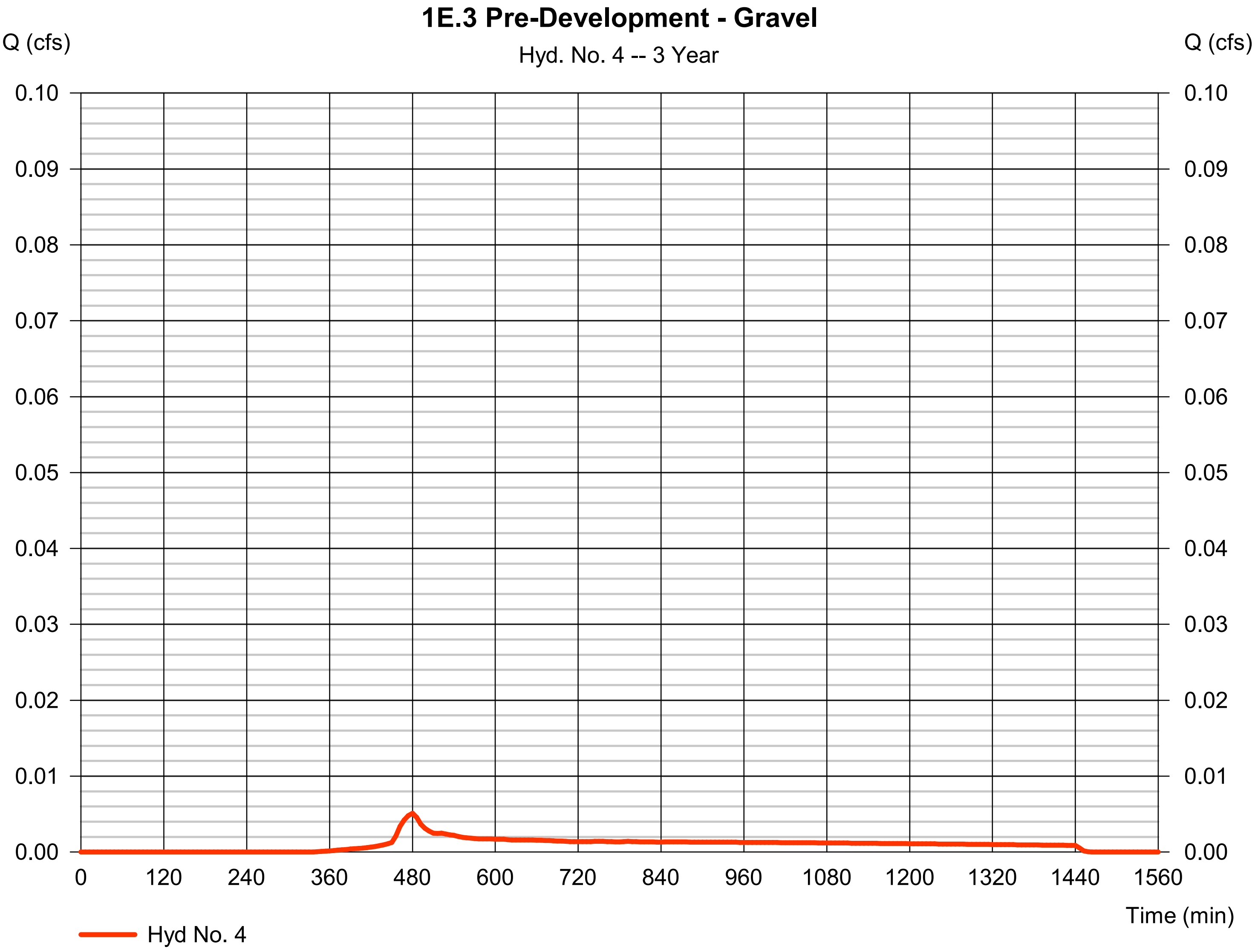
Hydrograph Report

Hyd. No. 4

1E.3 Pre-Development - Gravel

Hydrograph type = SBUH Runoff
Storm frequency = 3 yrs
Time interval = 6 min
Drainage area = 0.057 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 1.10 in
Storm duration = 24 hrs

Peak discharge = 0.005 cfs
Time to peak = 480 min
Hyd. volume = 89 cuft
Curve number = 91
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a

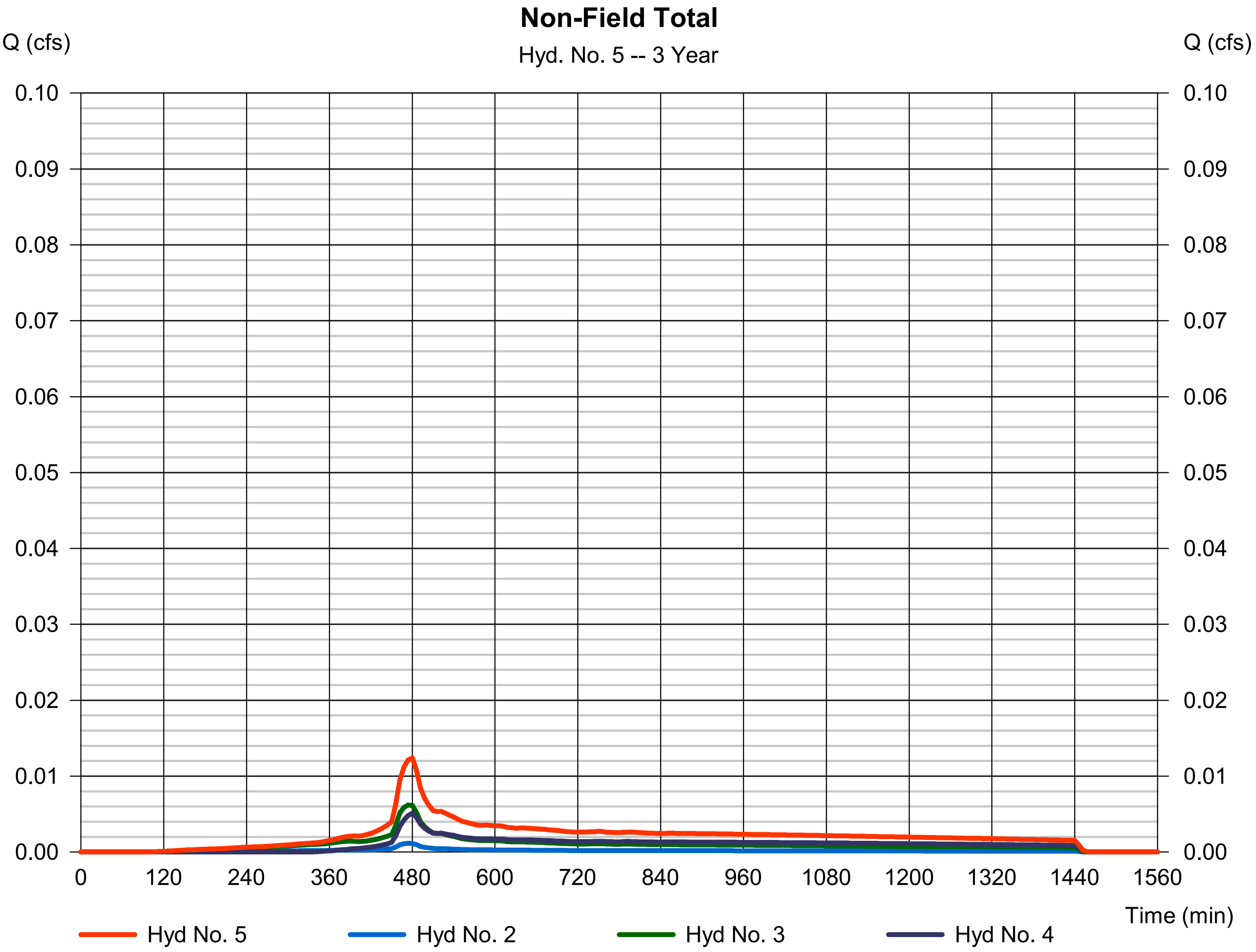


Hydrograph Report

Hyd. No. 5

Non-Field Total

Hydrograph type	= Combine	Peak discharge	= 0.012 cfs
Storm frequency	= 3 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 192 cuft
Inflow hyds.	= 2, 3, 4	Contrib. drain. area	= 0.089 ac

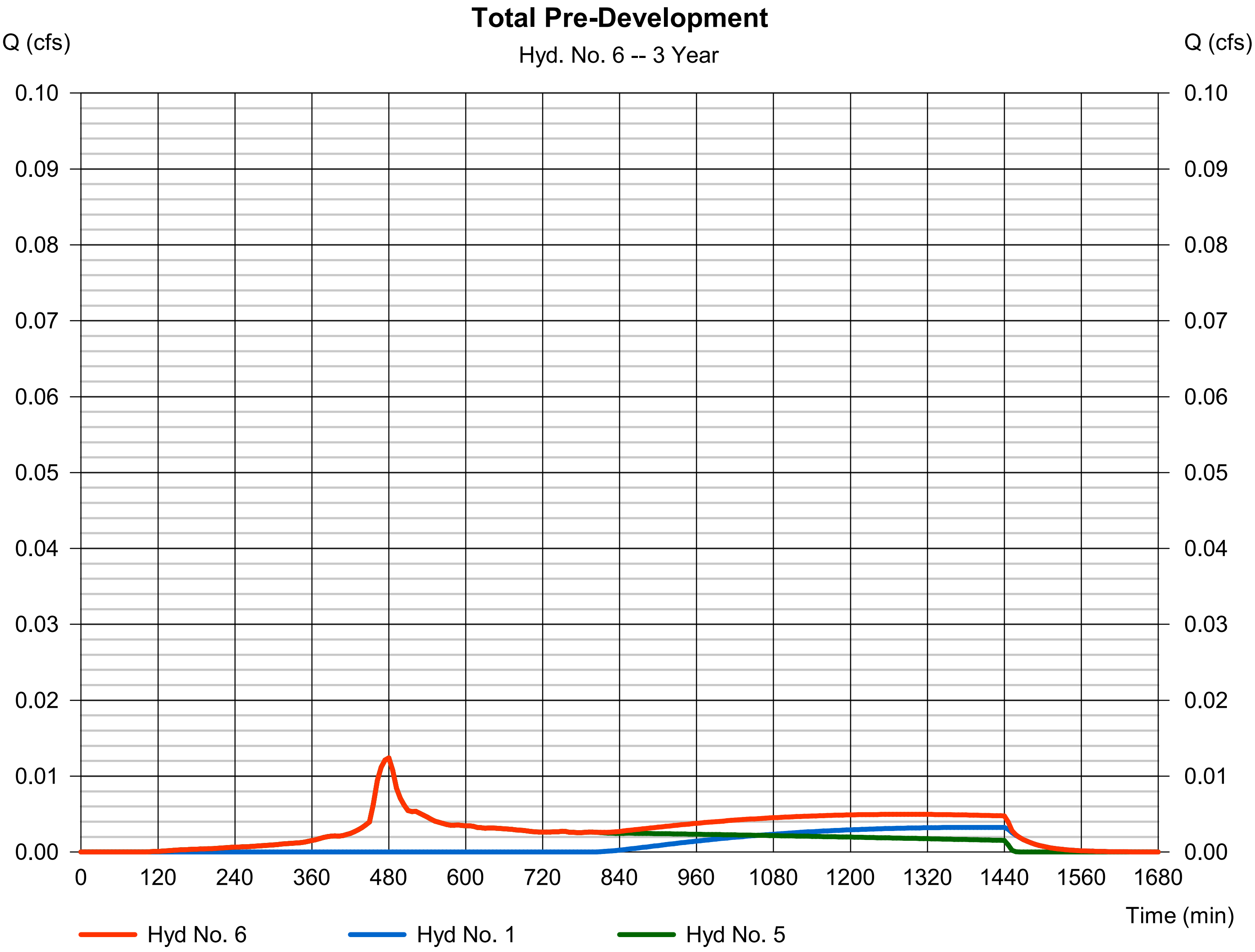


Hydrograph Report

Hyd. No. 6

Total Pre-Development

Hydrograph type	= Combine	Peak discharge	= 0.012 cfs
Storm frequency	= 3 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 285 cuft
Inflow hyds.	= 1, 5	Contrib. drain. area	= 1.041 ac

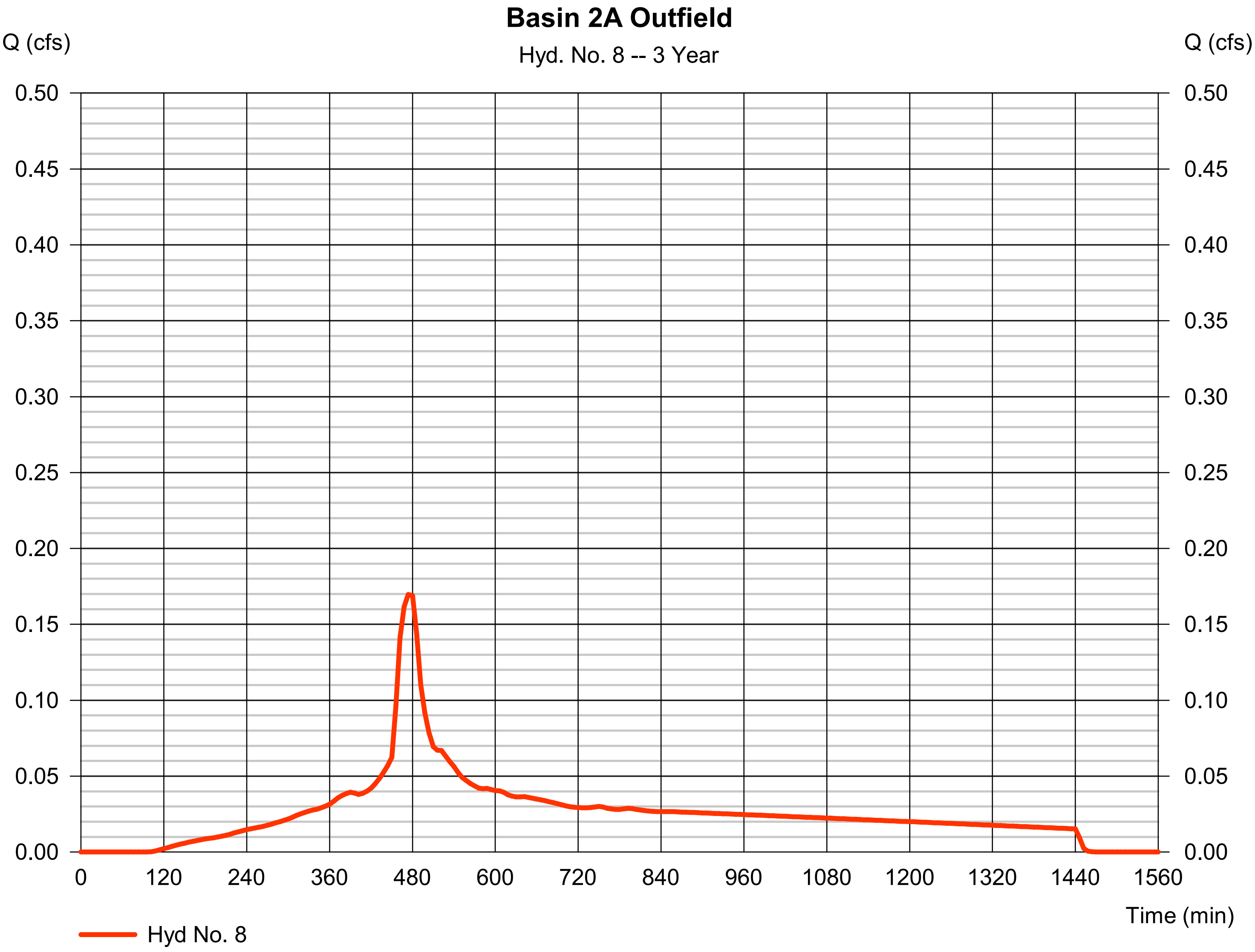


Hydrograph Report

Hyd. No. 8

Basin 2A Outfield

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.170 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 2,392 cuft
Drainage area	= 0.742 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



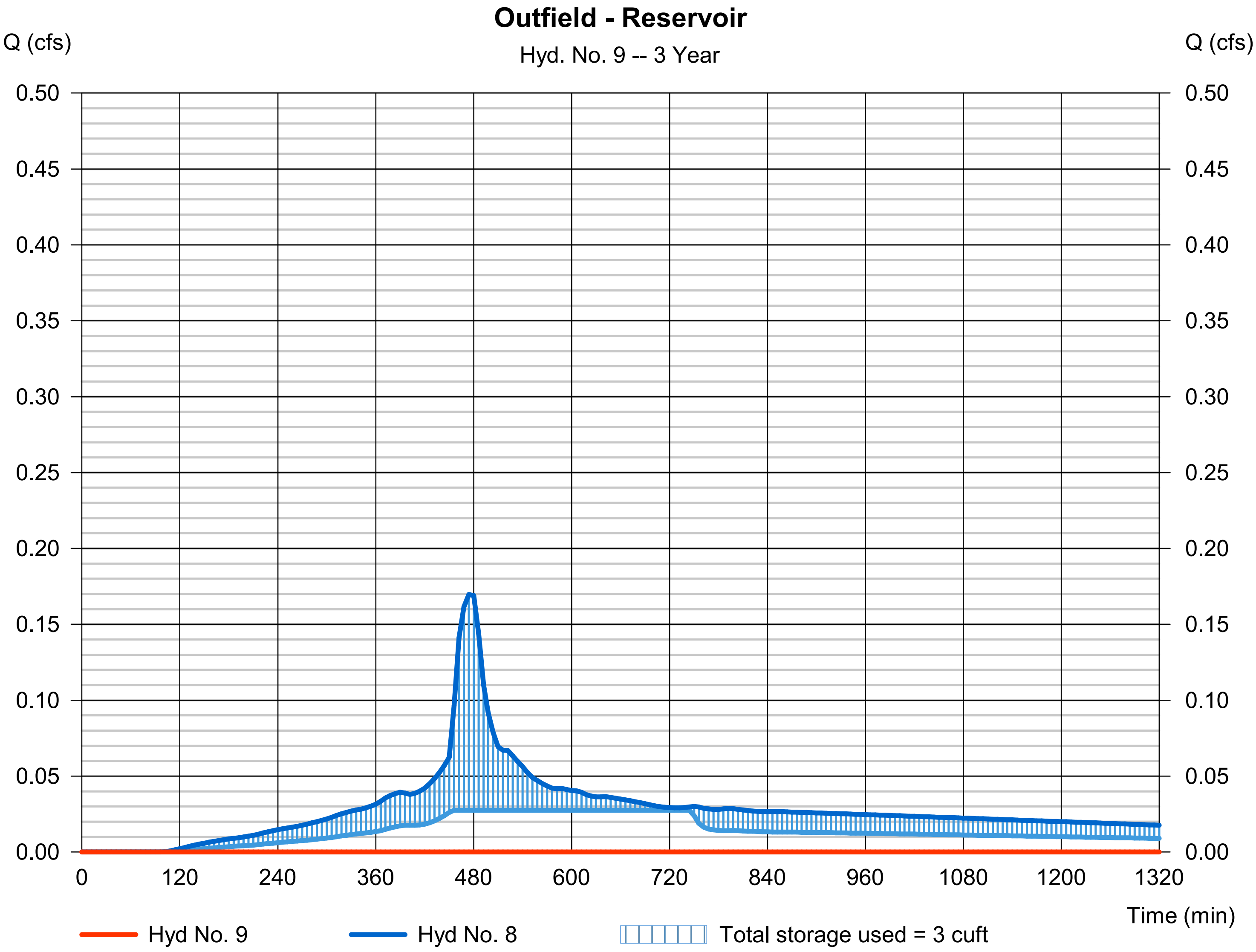
Hydrograph Report

Hyd. No. 9

Outfield - Reservoir

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 3 yrs	Time to peak	= 516 min
Time interval	= 6 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 8 - Basin 2A Outfield	Max. Elevation	= 100.01 ft
Reservoir name	= Outfield Res	Max. Storage	= 3 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



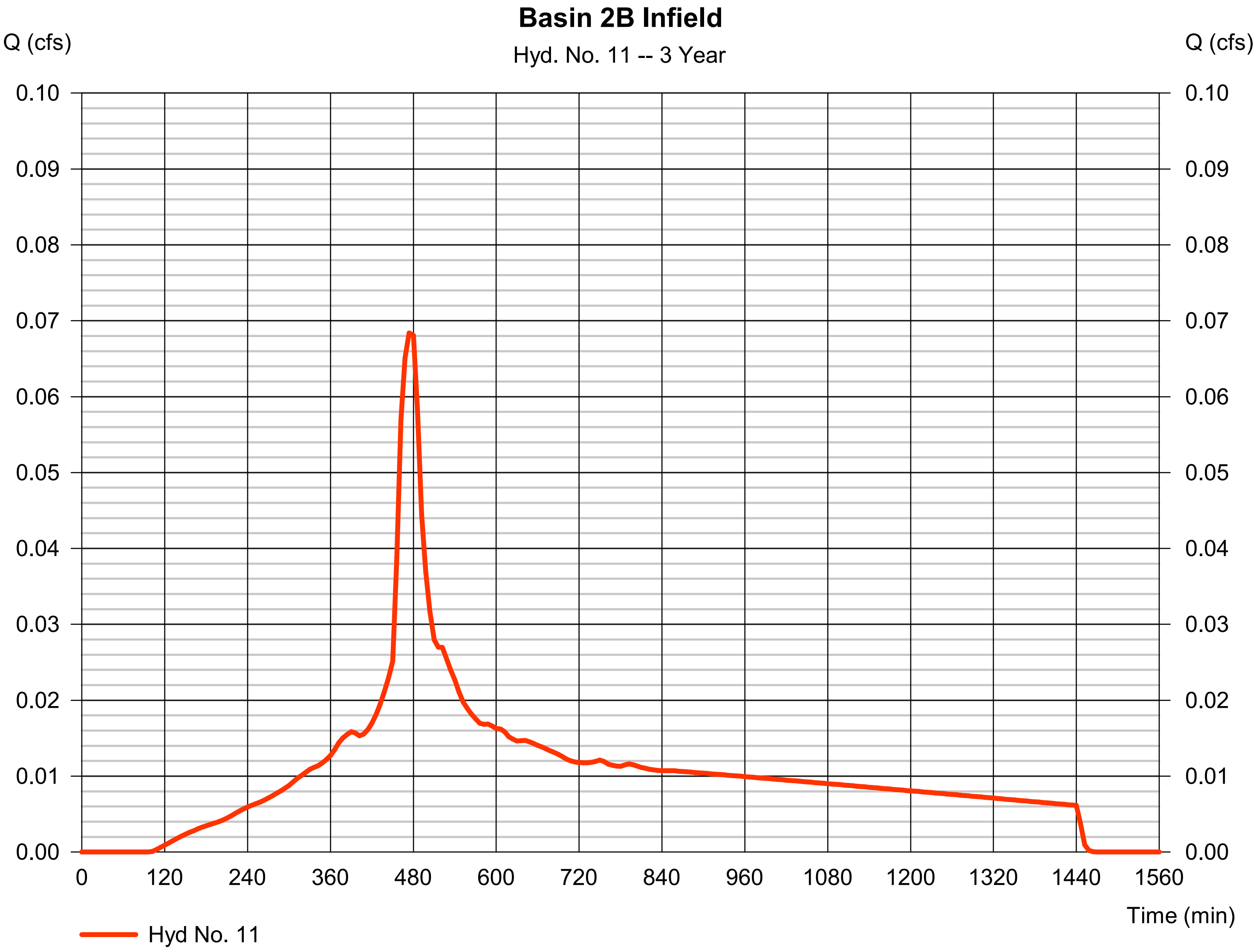
Hydrograph Report

Hyd. No. 11

Basin 2B Infield

Hydrograph type = SBUH Runoff
Storm frequency = 3 yrs
Time interval = 6 min
Drainage area = 0.299 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 1.10 in
Storm duration = 24 hrs

Peak discharge = 0.068 cfs
Time to peak = 474 min
Hyd. volume = 964 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a

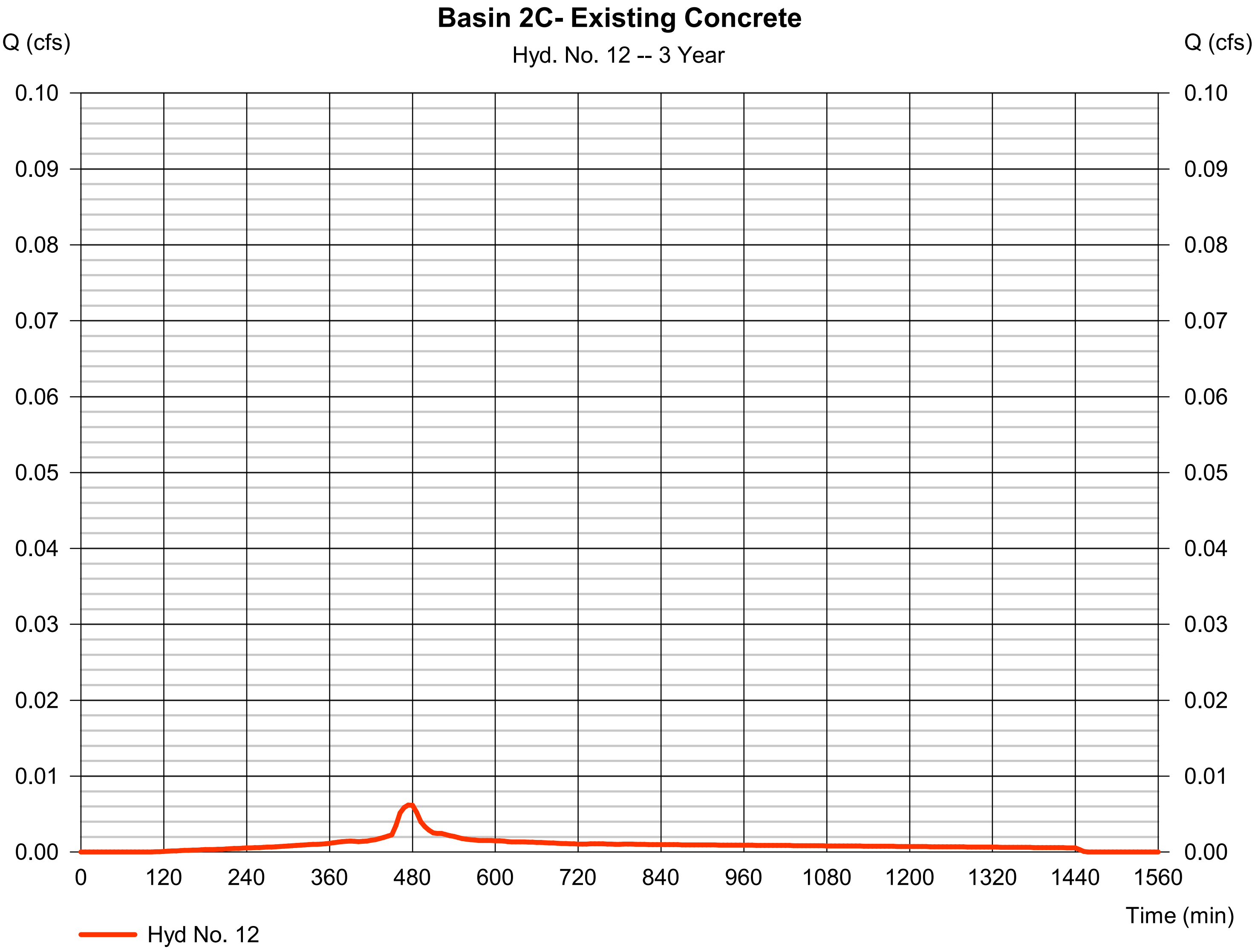


Hydrograph Report

Hyd. No. 12

Basin 2C- Existing Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.006 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 87 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



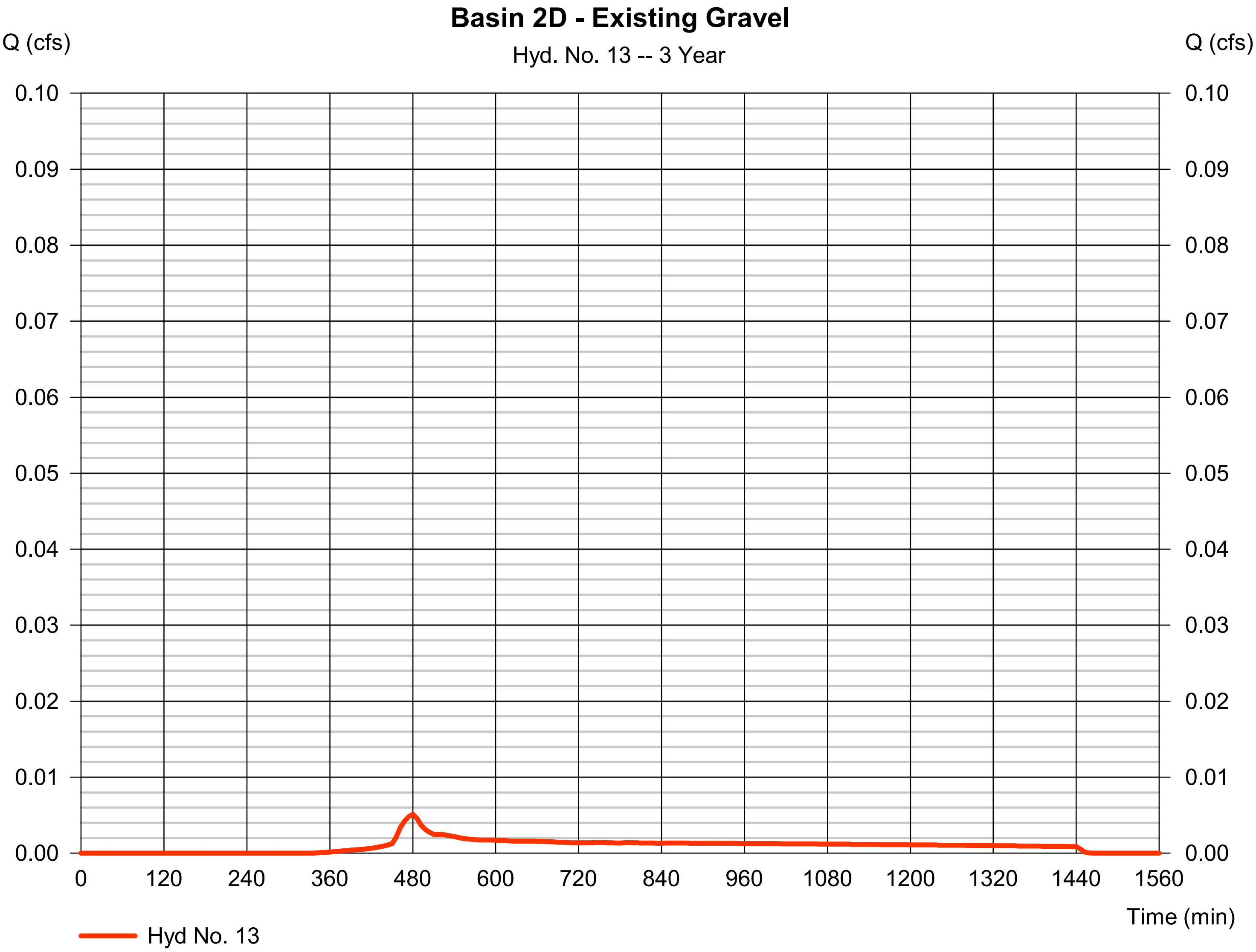
Hydrograph Report

Hyd. No. 13

Basin 2D - Existing Gravel

Hydrograph type = SBUH Runoff
Storm frequency = 3 yrs
Time interval = 6 min
Drainage area = 0.057 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 1.10 in
Storm duration = 24 hrs

Peak discharge = 0.005 cfs
Time to peak = 480 min
Hyd. volume = 89 cuft
Curve number = 91
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



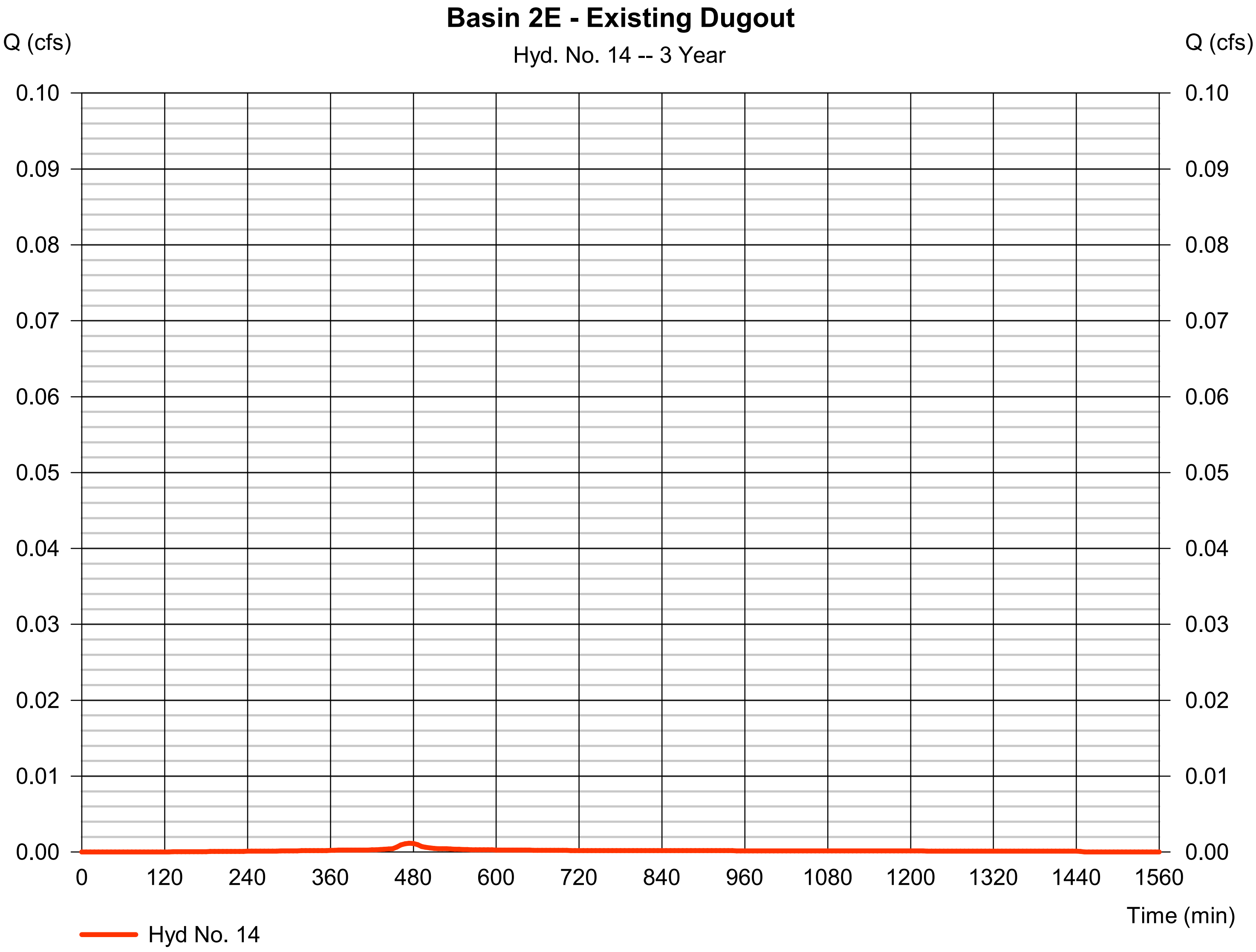
Hydrograph Report

Hyd. No. 14

Basin 2E - Existing Dugout

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 16 cuft
Drainage area	= 0.005 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.005

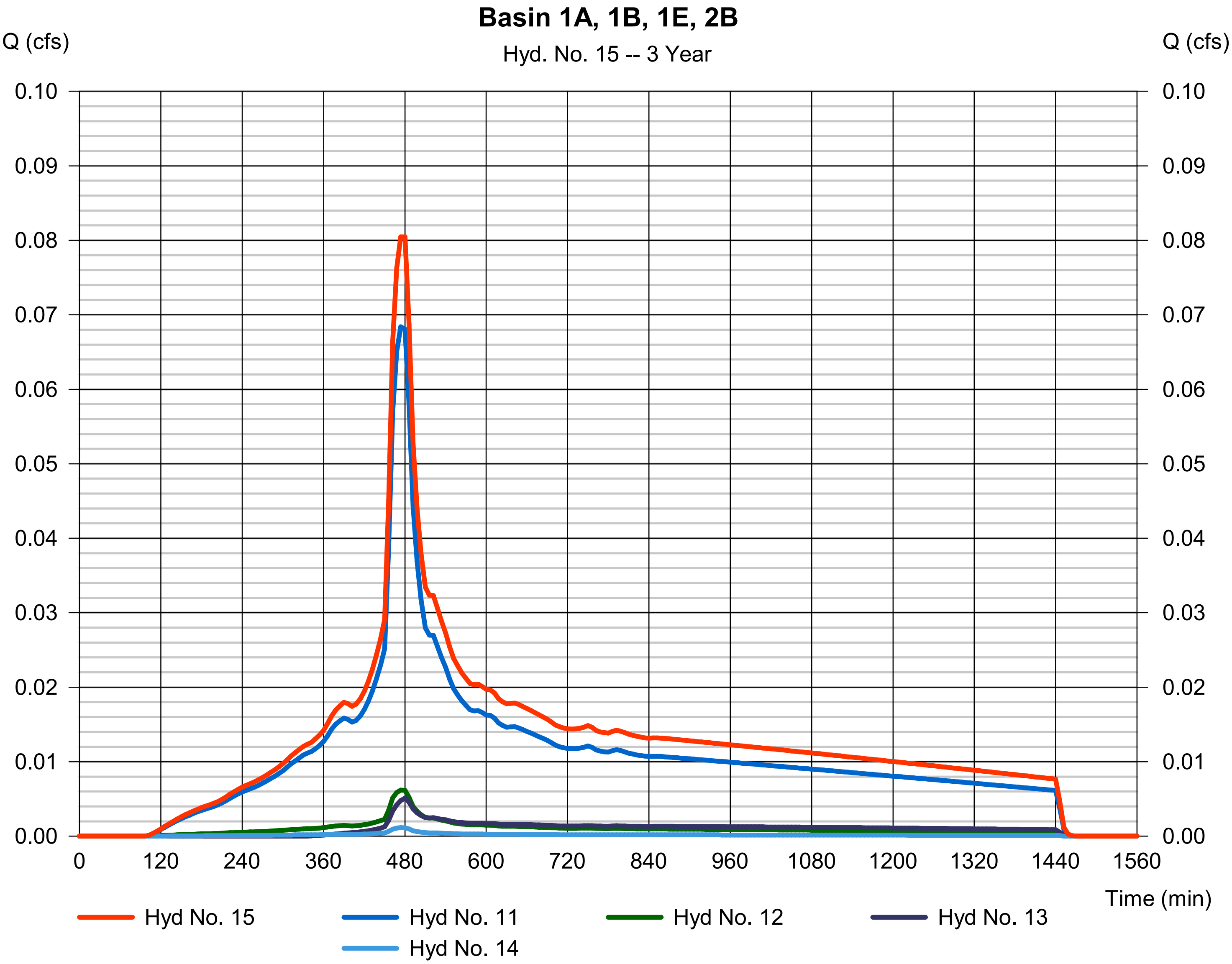


Hydrograph Report

Hyd. No. 15

Basin 1A, 1B, 1E, 2B

Hydrograph type	= Combine	Peak discharge	= 0.080 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 1,156 cuft
Inflow hyds.	= 11, 12, 13, 14	Contrib. drain. area	= 0.388 ac



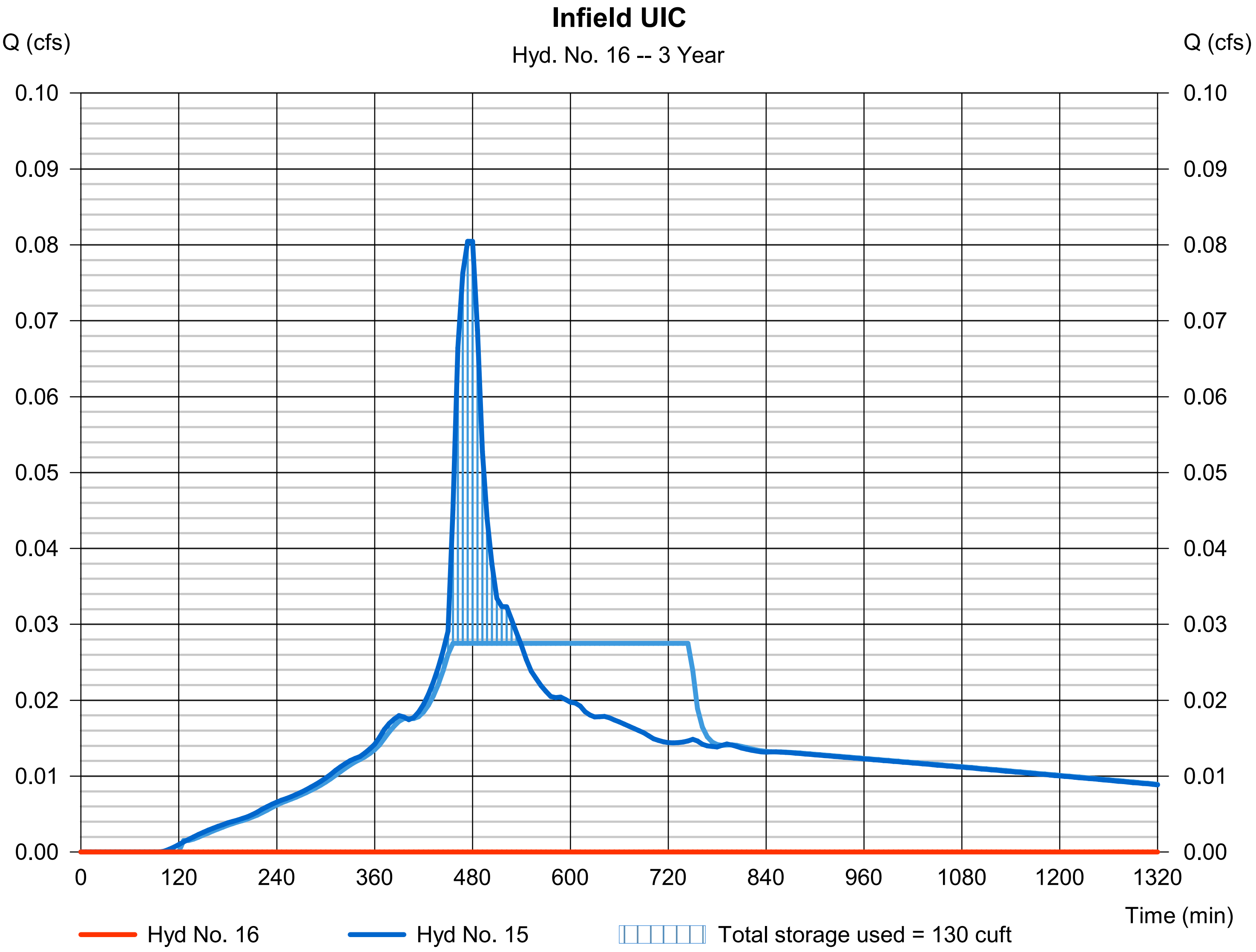
Hydrograph Report

Hyd. No. 16

Infield UIC

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 3 yrs	Time to peak	= 324 min
Time interval	= 6 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 15 - Basin 1A, 1B, 1E, 2B	Max. Elevation	= 159.10 ft
Reservoir name	= Infiltration Trench	Max. Storage	= 130 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



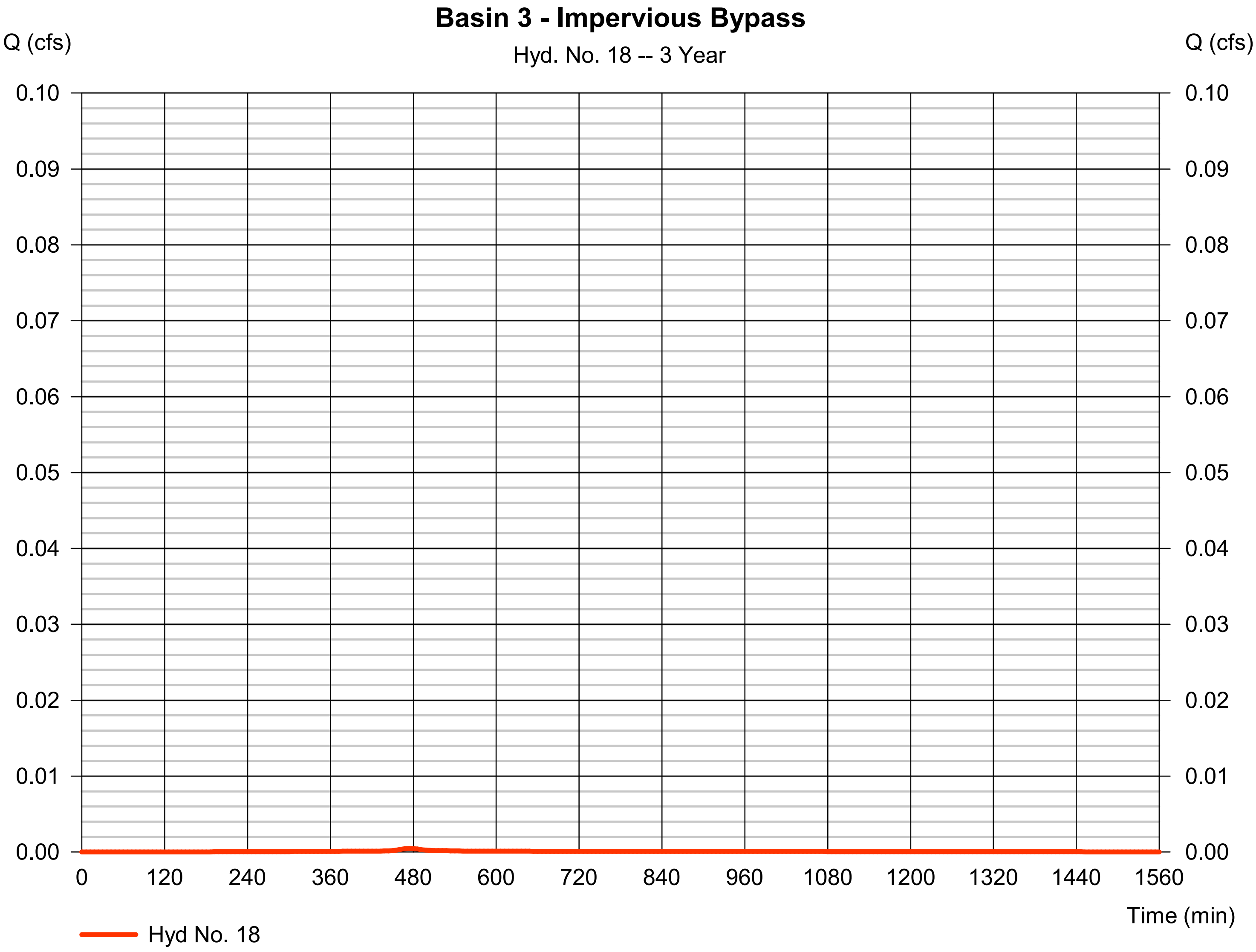
Hydrograph Report

Hyd. No. 18

Basin 3 - Impervious Bypass

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 3 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 6 cuft
Drainage area	= 0.002 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 1.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.002



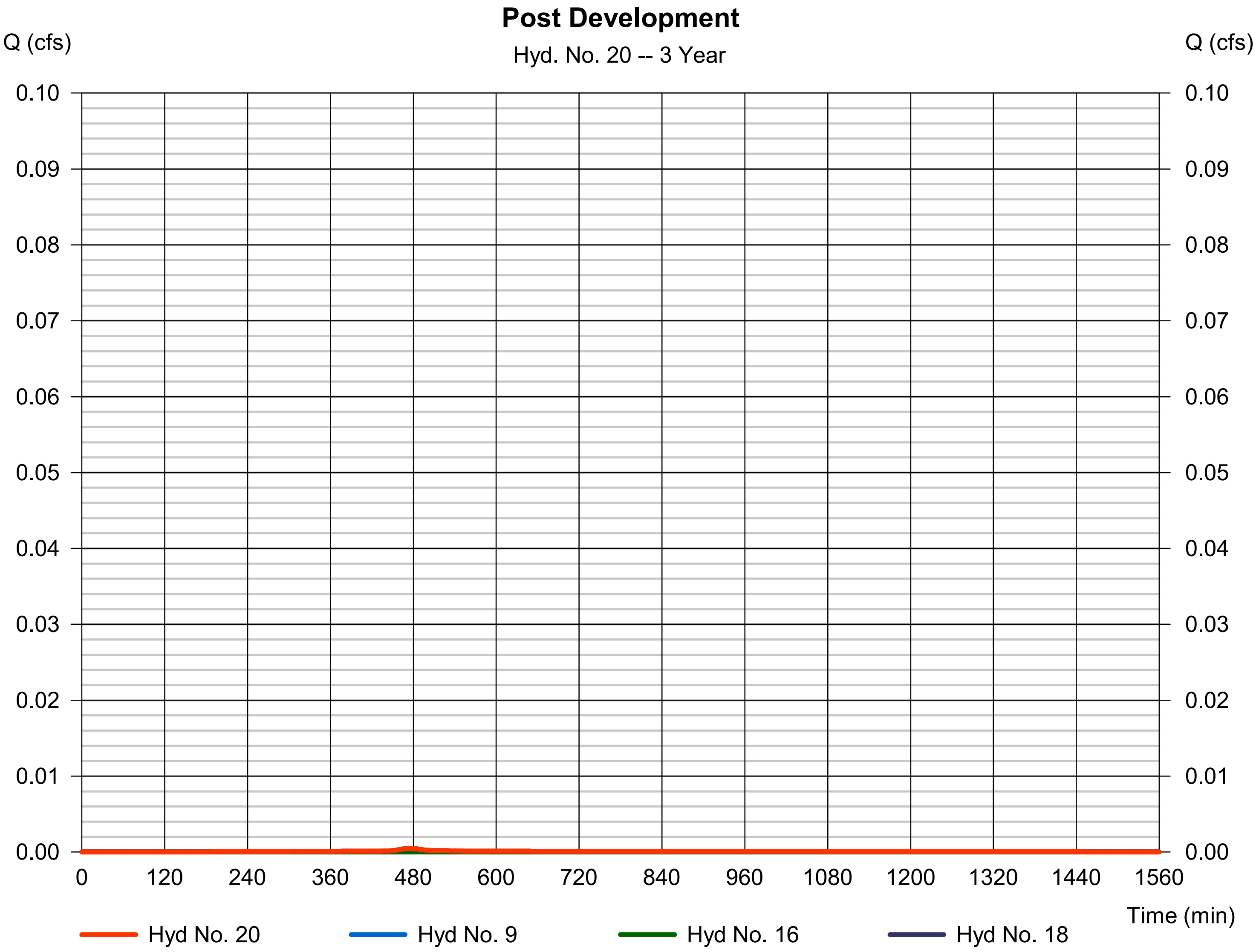
Hydrograph Report

Hyd. No. 20

Post Development

Hydrograph type = Combine
Storm frequency = 3 yrs
Time interval = 6 min
Inflow hyds. = 9, 16, 18

Peak discharge = 0.000 cfs
Time to peak = 474 min
Hyd. volume = 6 cuft
Contrib. drain. area = 0.002 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

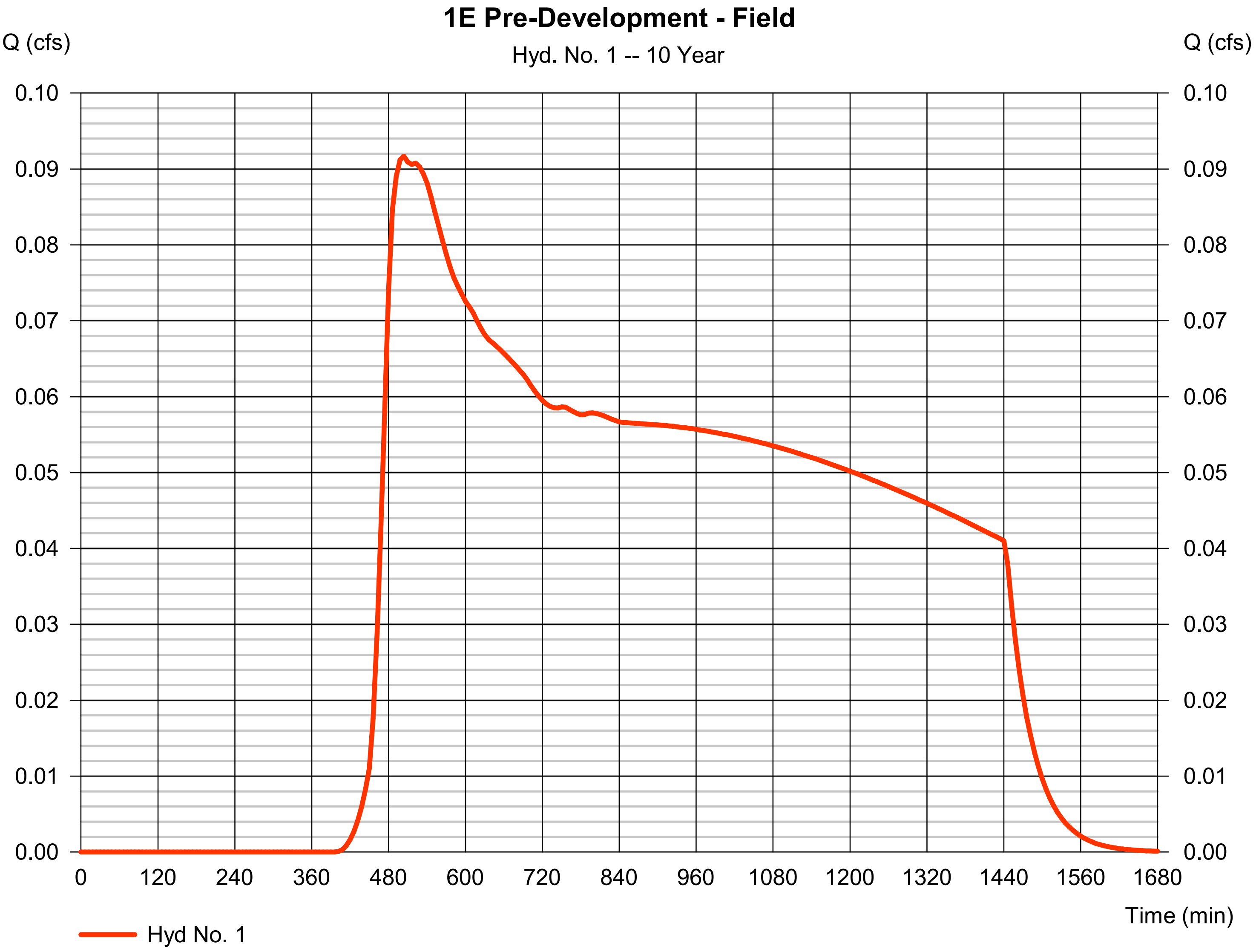
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SBUH Runoff	0.092	6	504	3,513	------	------	------	1E Pre-Development - Field
2	SBUH Runoff	0.004	6	474	54	------	------	------	1E.1 Pre-Development - Roof
3	SBUH Runoff	0.020	6	474	291	------	------	------	1E.2 Pre-Development - Concrete
4	SBUH Runoff	0.033	6	480	467	------	------	------	1E.3 Pre-Development - Gravel
5	Combine	0.056	6	474	812	2, 3, 4	------	------	Non-Field Total
6	Combine	0.133	6	486	4,325	1, 5	------	------	Total Pre-Development
8	SBUH Runoff	0.553	6	474	7,993	------	------	------	Basin 2A Outfield
9	Reservoir	0.000	6	738	0	8	100.03	78.1	Outfield - Reservoir
11	SBUH Runoff	0.223	6	474	3,221	------	------	------	Basin 2B Infield
12	SBUH Runoff	0.020	6	474	291	------	------	------	Basin 2C- Existing Concrete
13	SBUH Runoff	0.033	6	480	467	------	------	------	Basin 2D - Existing Gravel
14	SBUH Runoff	0.004	6	474	54	------	------	------	Basin 2E - Existing Dugout
15	Combine	0.279	6	474	4,033	11, 12, 13, 14	------	------	Basin 1A, 1B, 1E, 2B
16	Reservoir	0.061	6	480	124	15	161.98	468	Infield UIC
18	SBUH Runoff	0.001	6	474	22	------	------	------	Basin 3 - Impervious Bypass
20	Combine	0.062	6	480	145	9, 16, 18,	------	------	Post Development

Hydrograph Report

Hyd. No. 1

1E Pre-Development - Field

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.092 cfs
Storm frequency	= 10 yrs	Time to peak	= 504 min
Time interval	= 6 min	Hyd. volume	= 3,513 cuft
Drainage area	= 1.041 ac	Curve number	= 72
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 39.40 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

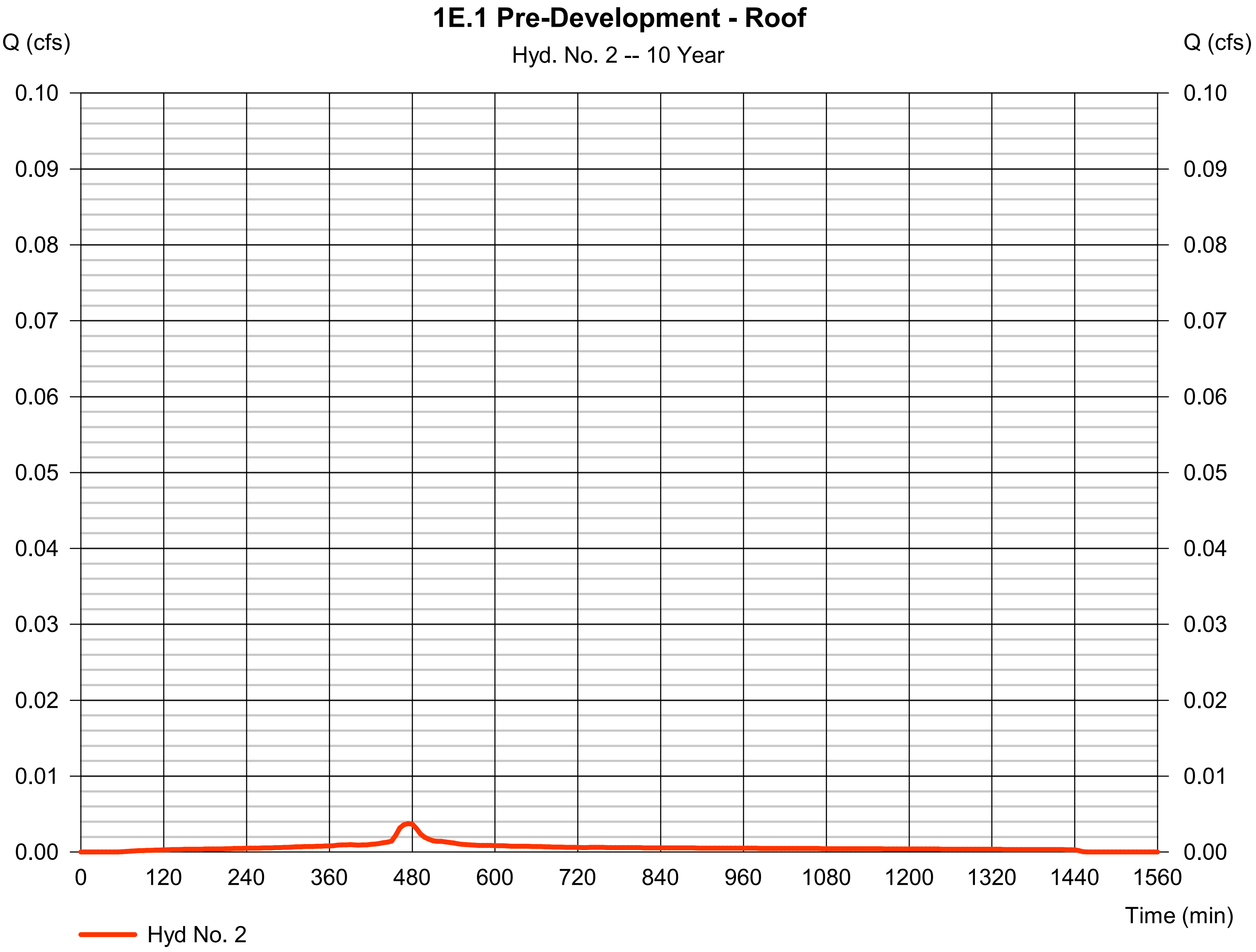


Hydrograph Report

Hyd. No. 2

1E.1 Pre-Development - Roof

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.004 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 54 cuft
Drainage area	= 0.005 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

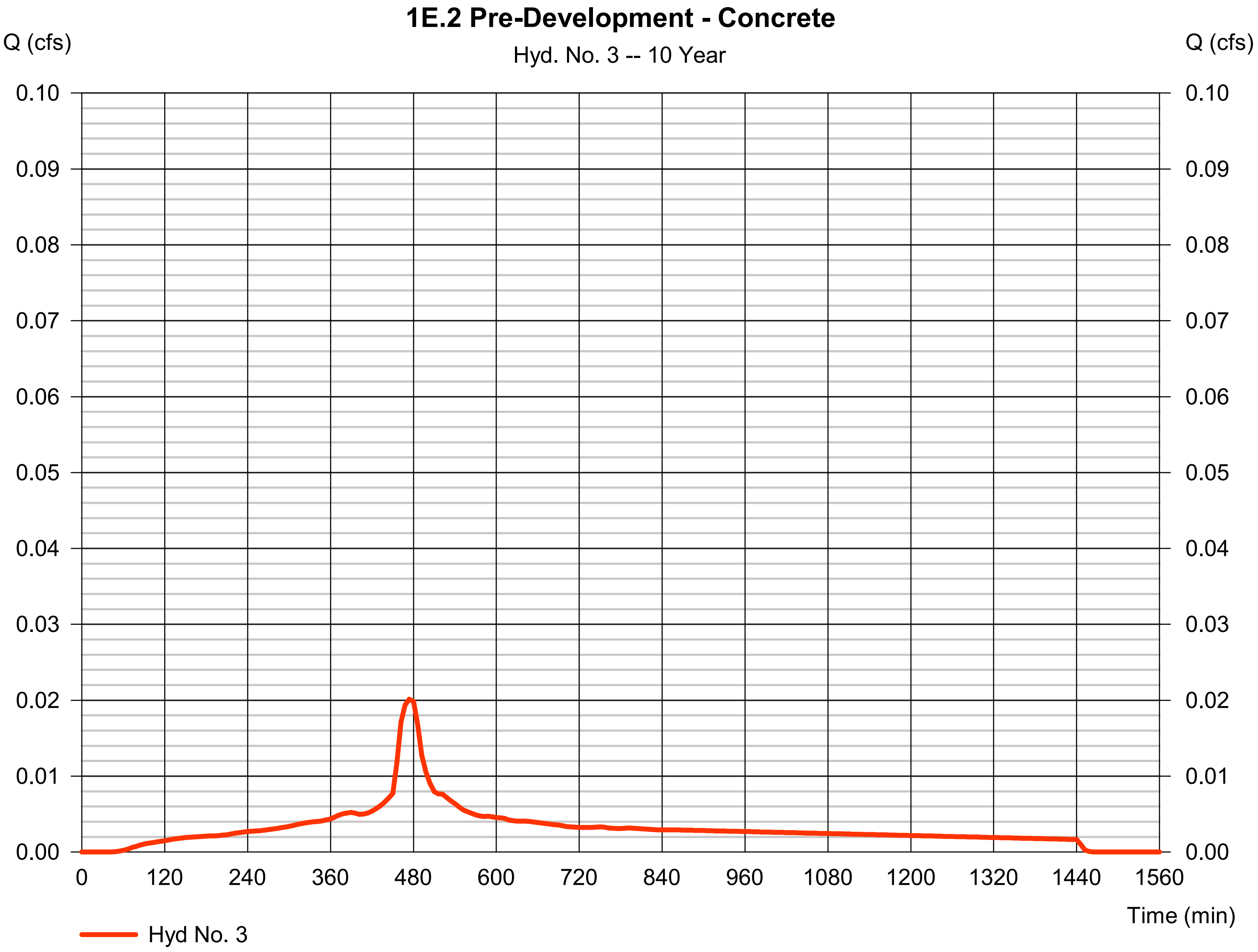


Hydrograph Report

Hyd. No. 3

1E.2 Pre-Development - Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.020 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 291 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



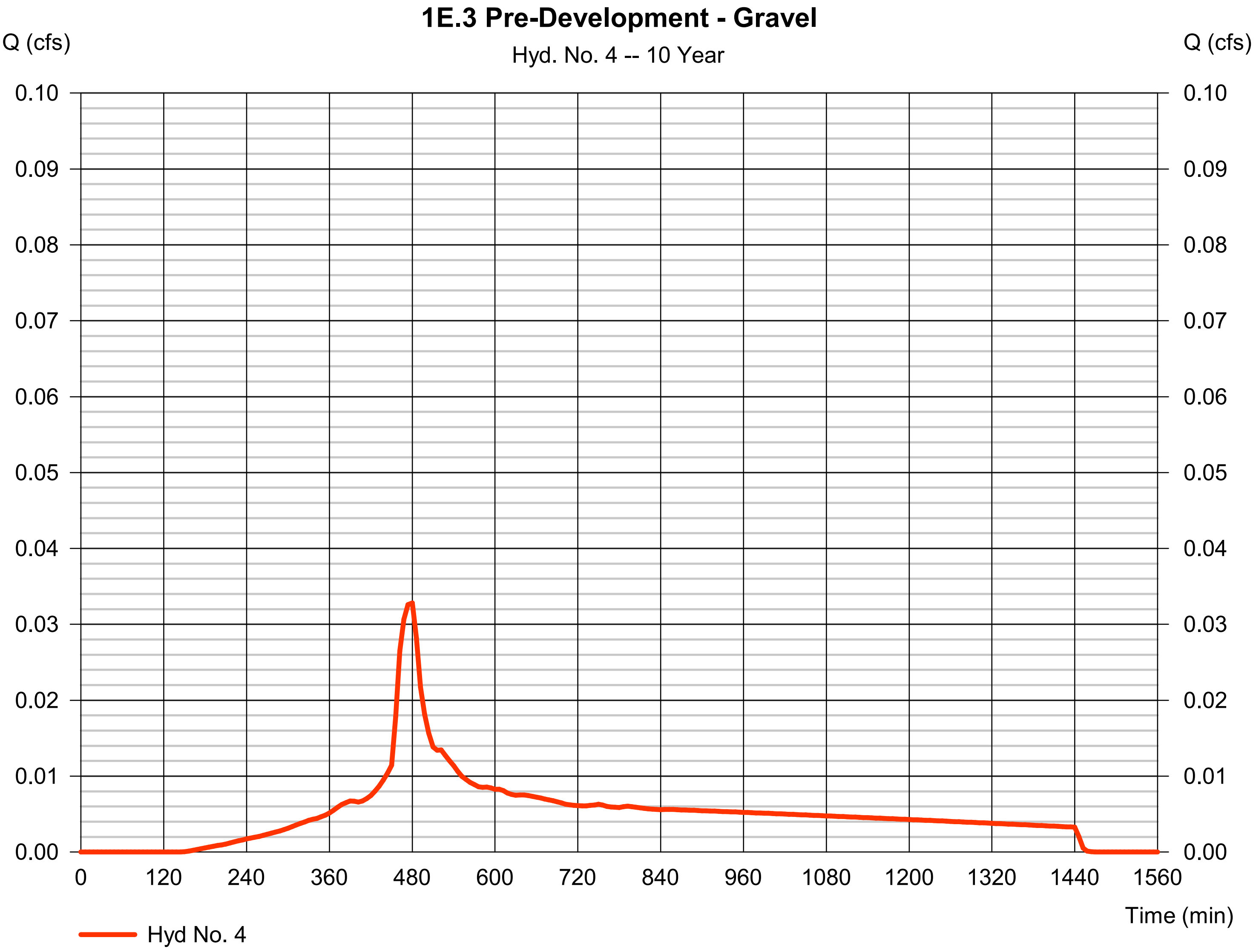
Hydrograph Report

Hyd. No. 4

1E.3 Pre-Development - Gravel

Hydrograph type = SBUH Runoff
Storm frequency = 10 yrs
Time interval = 6 min
Drainage area = 0.057 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 3.20 in
Storm duration = 24 hrs

Peak discharge = 0.033 cfs
Time to peak = 480 min
Hyd. volume = 467 cuft
Curve number = 91
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



Hydrograph Report

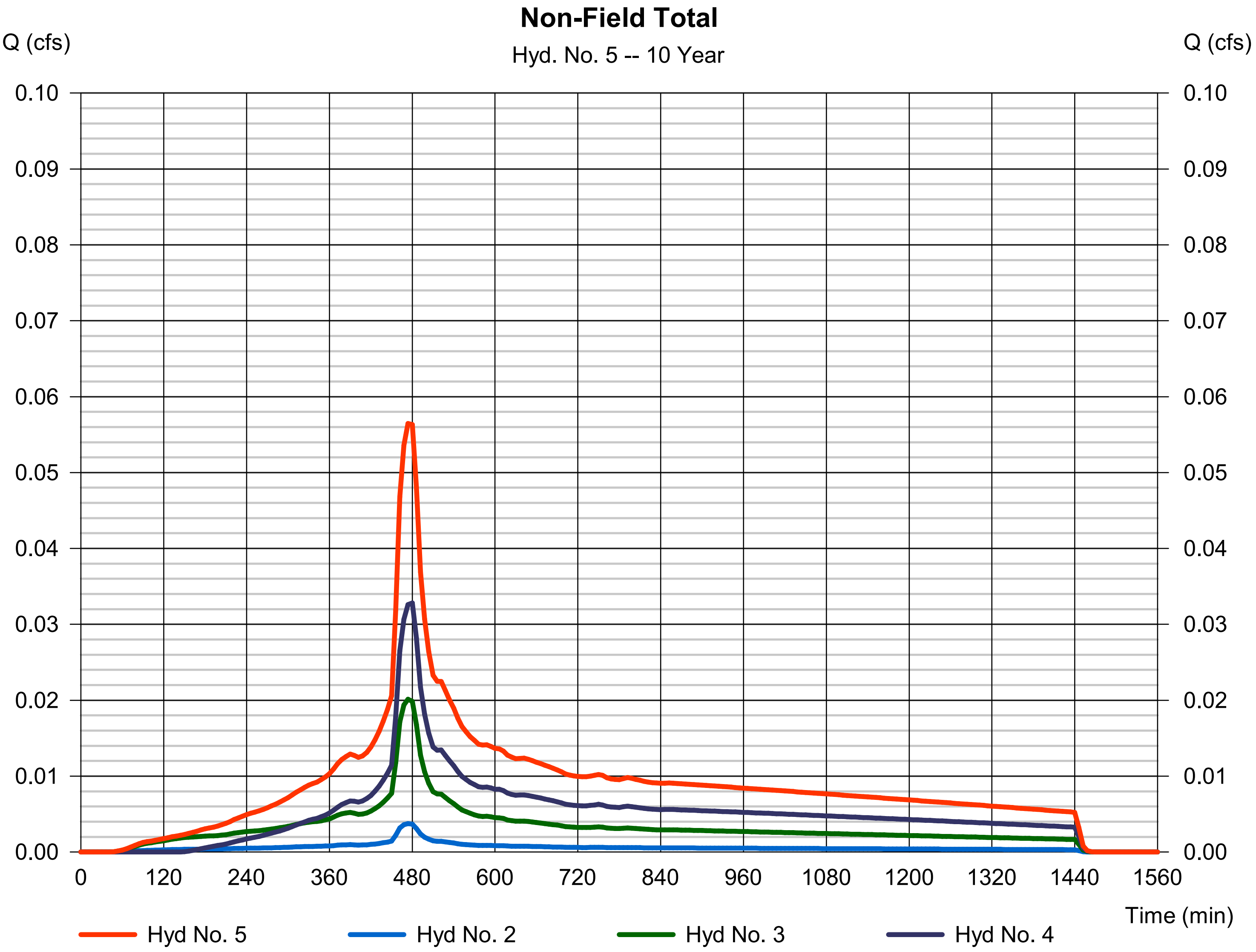
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Tuesday, 03 / 25 / 2025

Hyd. No. 5

Non-Field Total

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 6 min
Inflow hyds. = 2, 3, 4

Peak discharge = 0.056 cfs
Time to peak = 474 min
Hyd. volume = 812 cuft
Contrib. drain. area = 0.089 ac

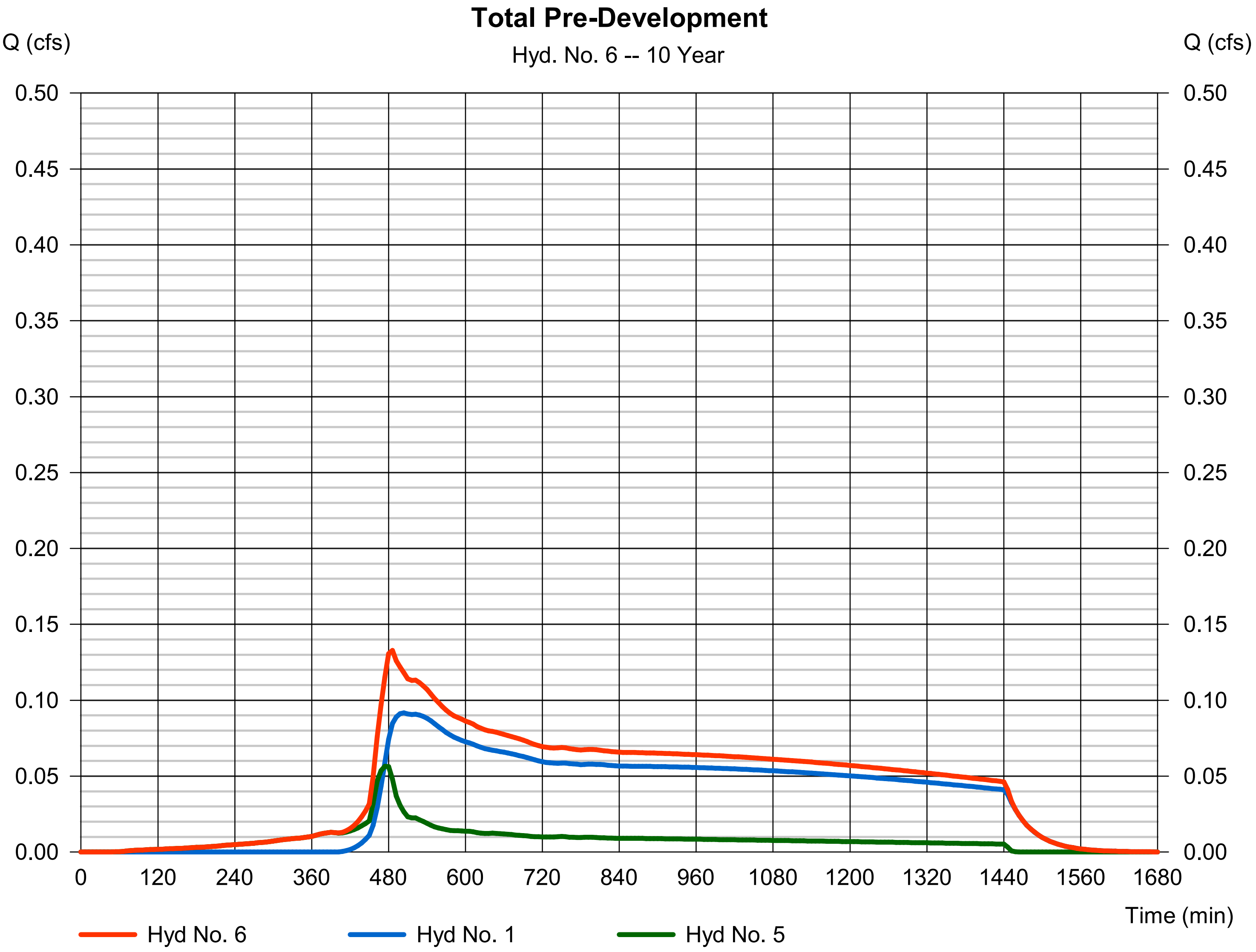


Hydrograph Report

Hyd. No. 6

Total Pre-Development

Hydrograph type	= Combine	Peak discharge	= 0.133 cfs
Storm frequency	= 10 yrs	Time to peak	= 486 min
Time interval	= 6 min	Hyd. volume	= 4,325 cuft
Inflow hyds.	= 1, 5	Contrib. drain. area	= 1.041 ac



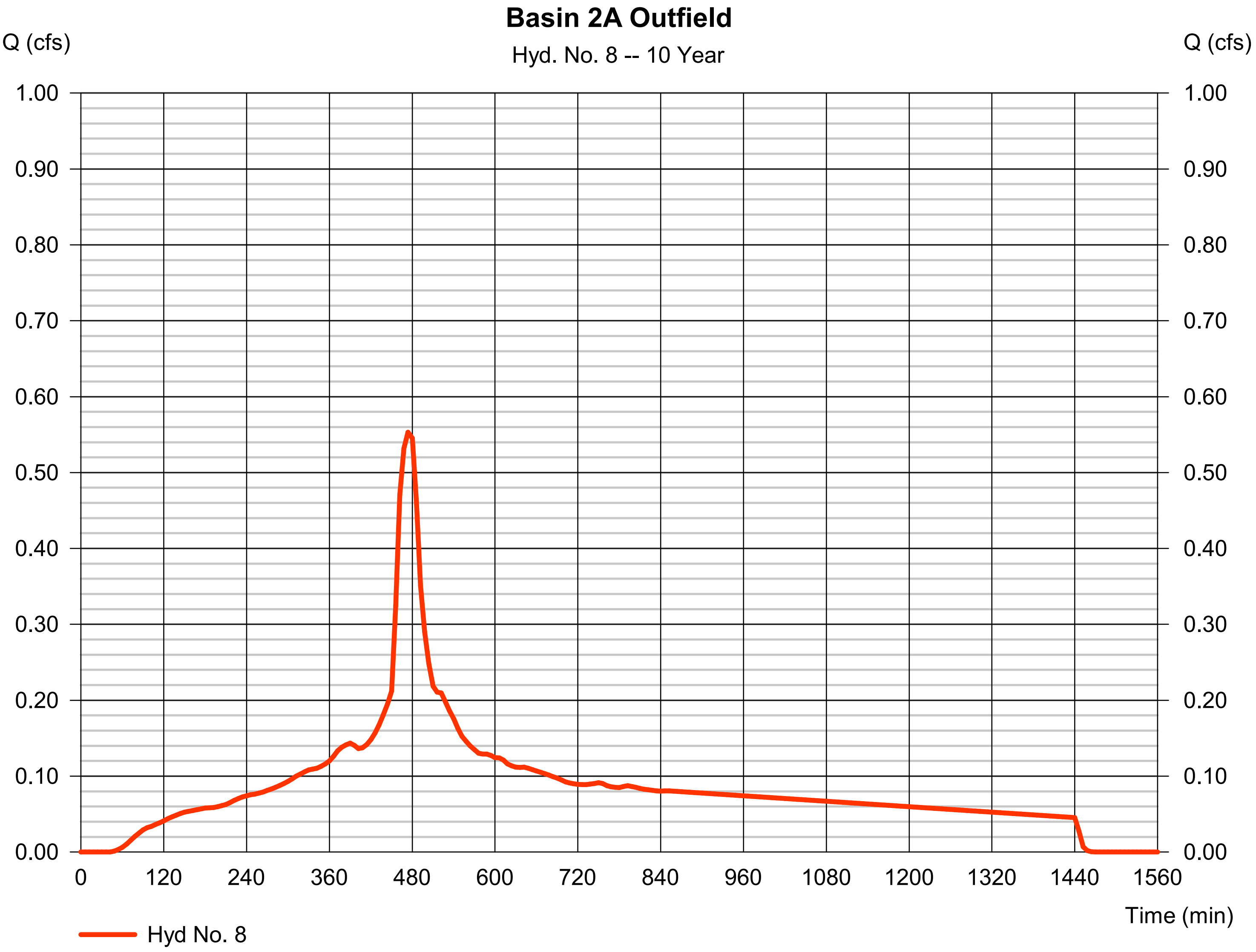
Hydrograph Report

Hyd. No. 8

Basin 2A Outfield

Hydrograph type = SBUH Runoff
Storm frequency = 10 yrs
Time interval = 6 min
Drainage area = 0.742 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 3.20 in
Storm duration = 24 hrs

Peak discharge = 0.553 cfs
Time to peak = 474 min
Hyd. volume = 7,993 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



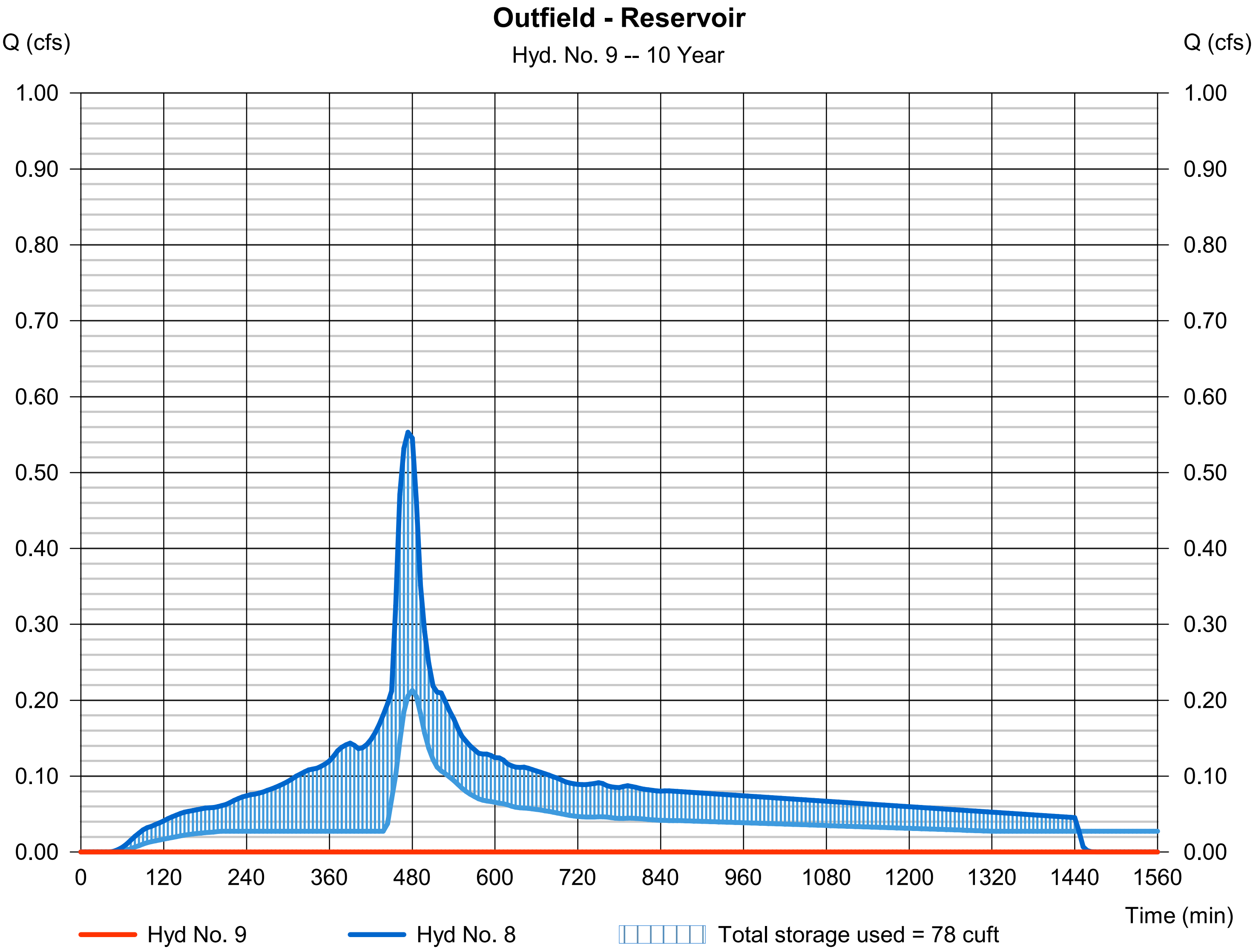
Hydrograph Report

Hyd. No. 9

Outfield - Reservoir

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 10 yrs	Time to peak	= 738 min
Time interval	= 6 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 8 - Basin 2A Outfield	Max. Elevation	= 100.03 ft
Reservoir name	= Outfield Res	Max. Storage	= 78 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

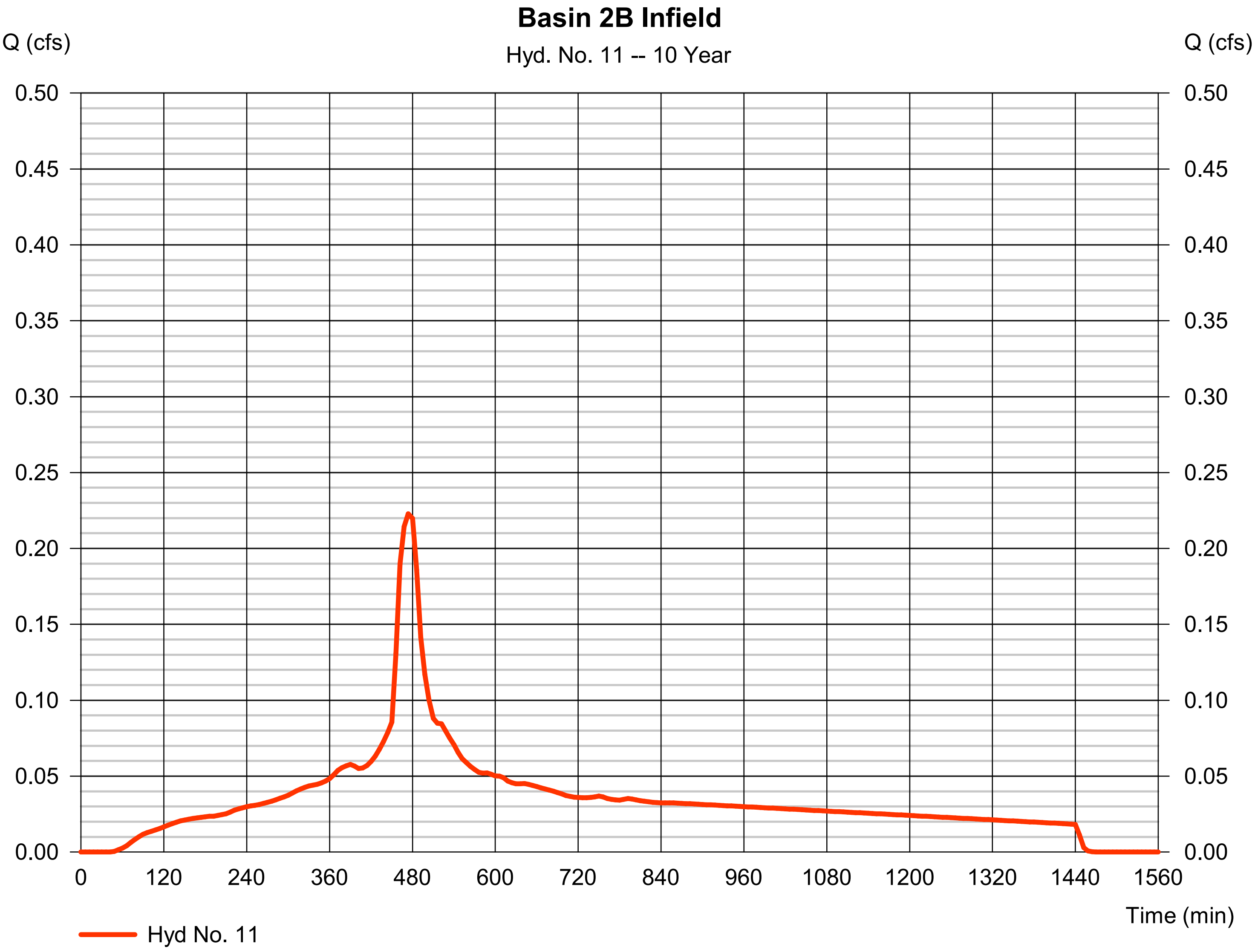


Hydrograph Report

Hyd. No. 11

Basin 2B Infield

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.223 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 3,221 cuft
Drainage area	= 0.299 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



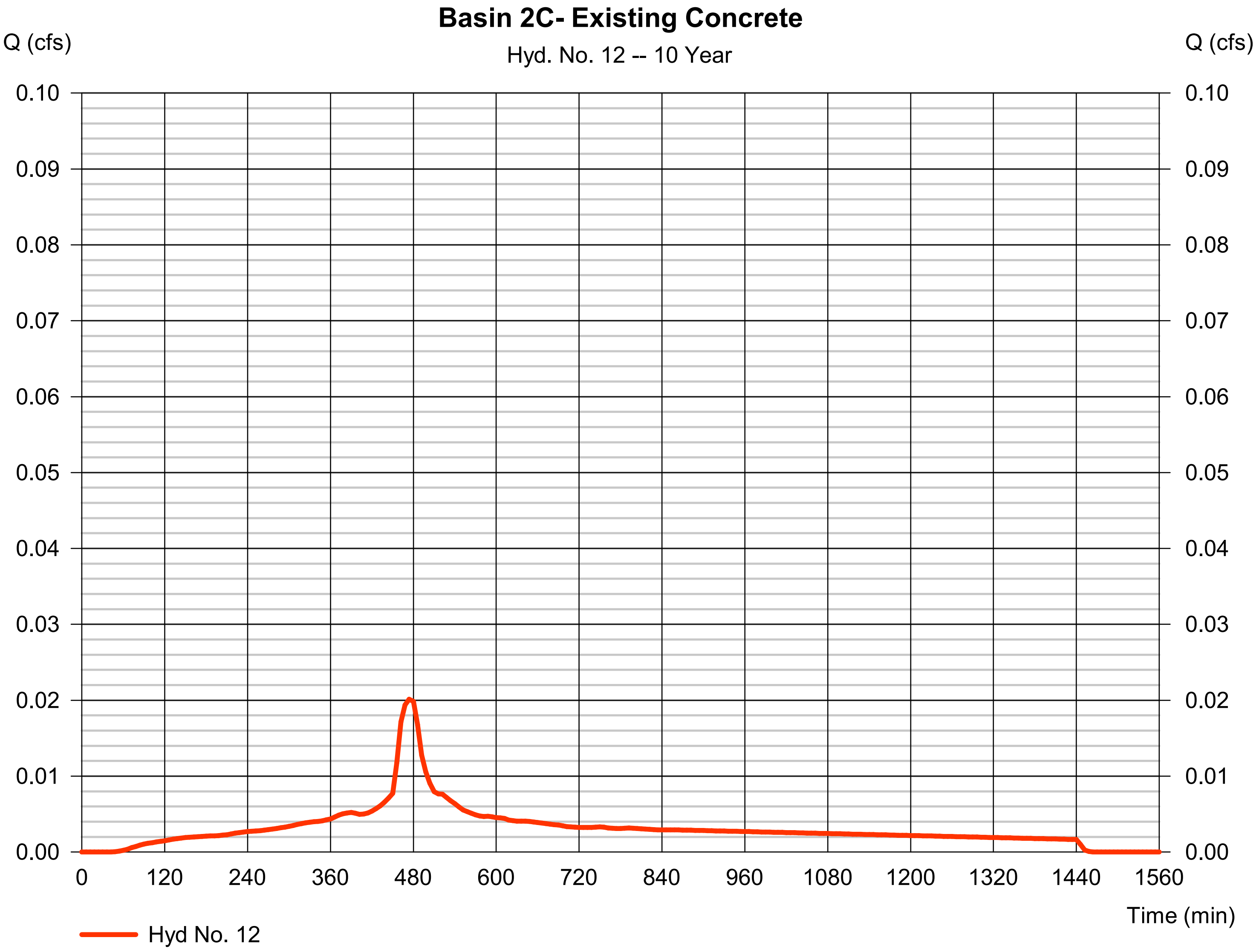
Hydrograph Report

Hyd. No. 12

Basin 2C- Existing Concrete

Hydrograph type = SBUH Runoff
Storm frequency = 10 yrs
Time interval = 6 min
Drainage area = 0.027 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 3.20 in
Storm duration = 24 hrs

Peak discharge = 0.020 cfs
Time to peak = 474 min
Hyd. volume = 291 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a

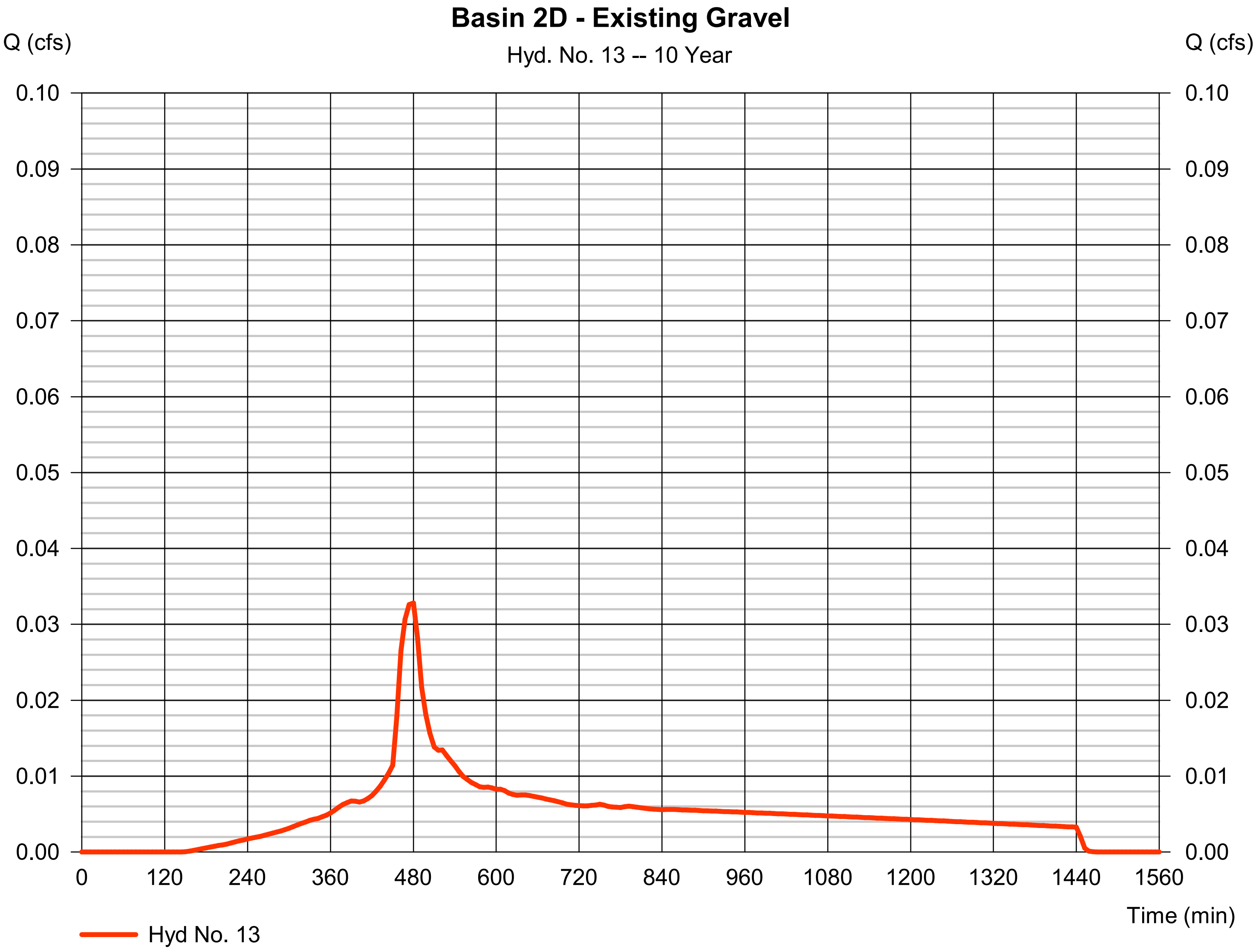


Hydrograph Report

Hyd. No. 13

Basin 2D - Existing Gravel

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.033 cfs
Storm frequency	= 10 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 467 cuft
Drainage area	= 0.057 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



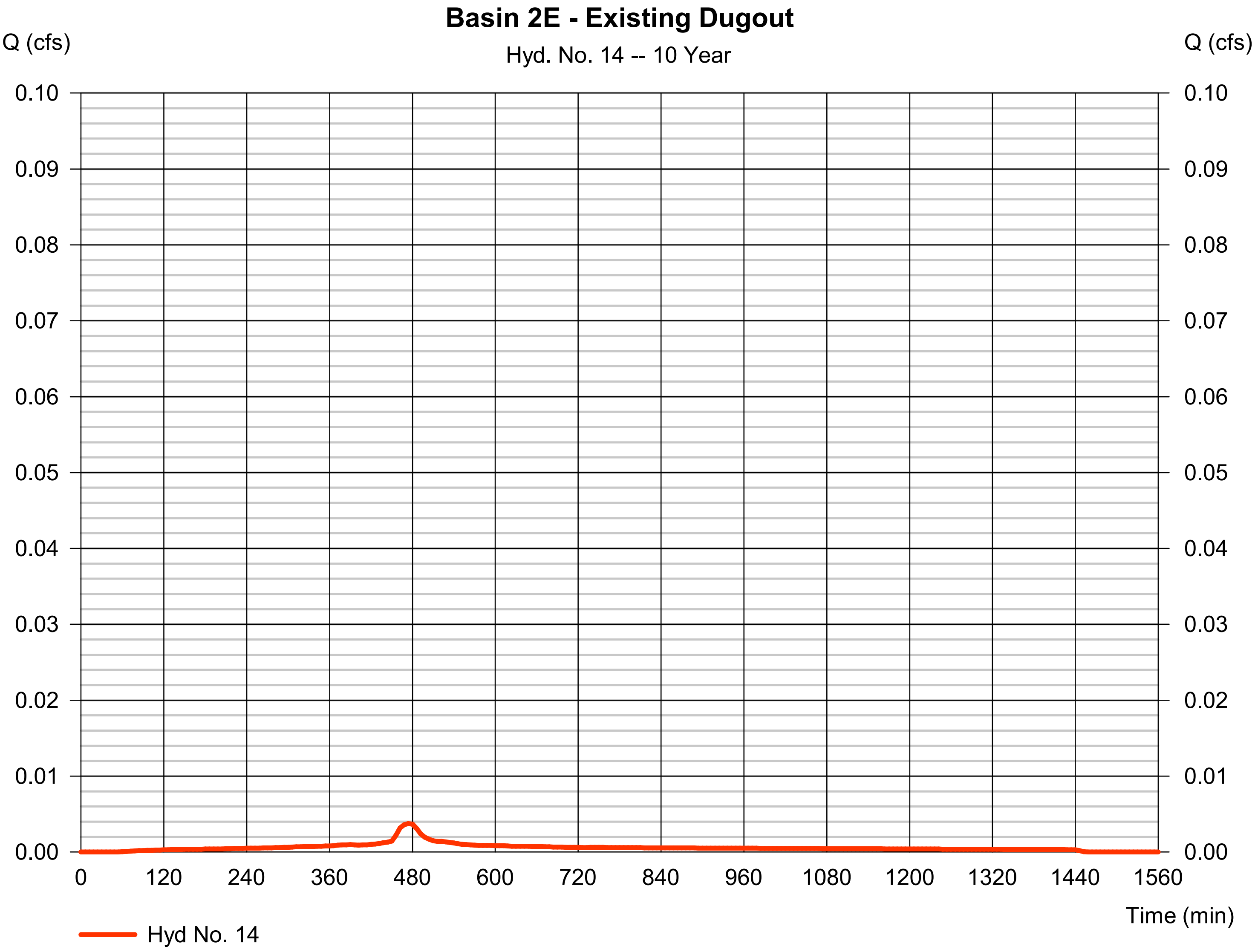
Hydrograph Report

Hyd. No. 14

Basin 2E - Existing Dugout

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.004 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 54 cuft
Drainage area	= 0.005 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.005

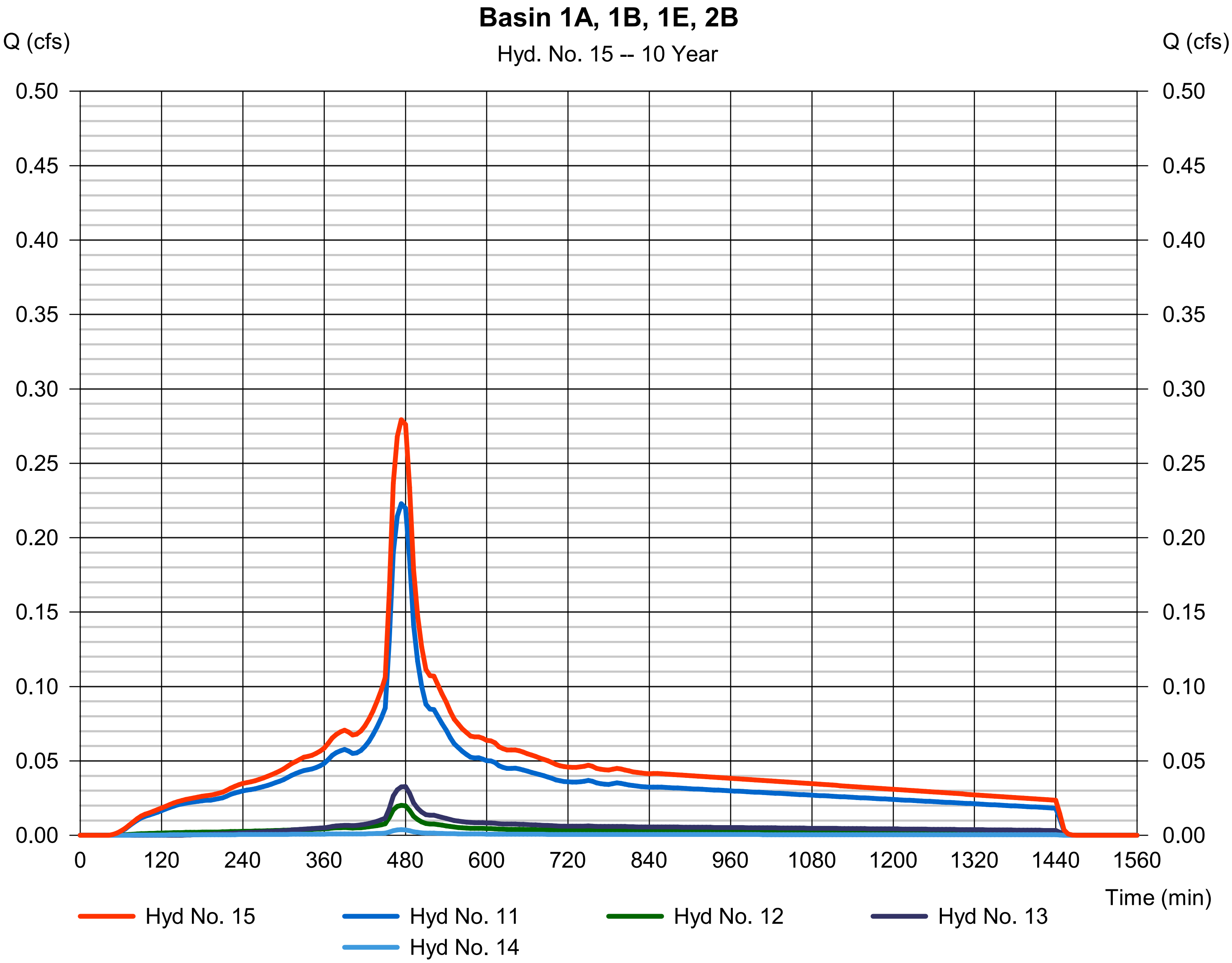


Hydrograph Report

Hyd. No. 15

Basin 1A, 1B, 1E, 2B

Hydrograph type	= Combine	Peak discharge	= 0.279 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 4,033 cuft
Inflow hyds.	= 11, 12, 13, 14	Contrib. drain. area	= 0.388 ac



Hydrograph Report

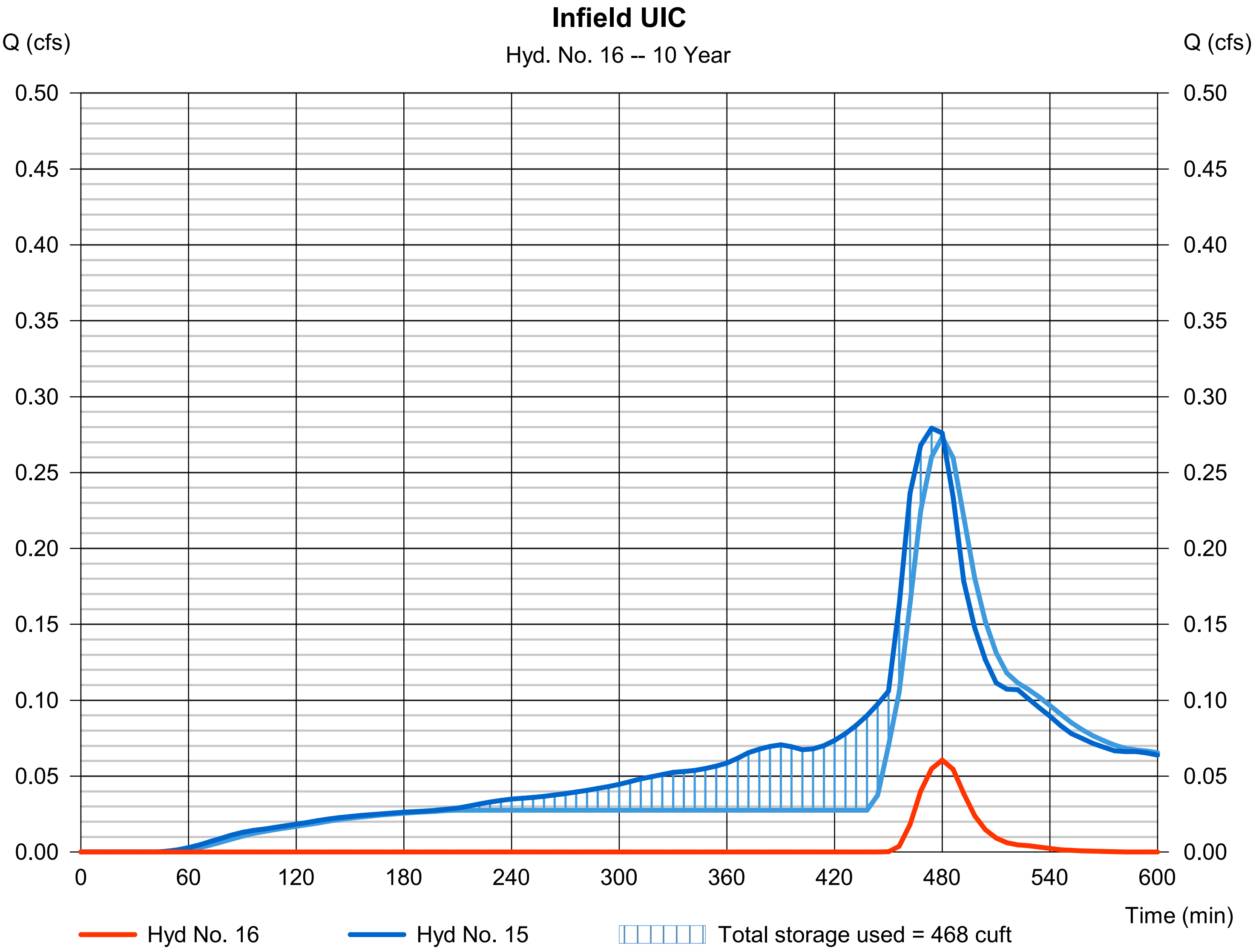
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023 Tuesday, 03 / 25 / 2025

Hyd. No. 16

Infield UIC

Hydrograph type	= Reservoir	Peak discharge	= 0.061 cfs
Storm frequency	= 10 yrs	Time to peak	= 480 min
Time interval	= 6 min	Hyd. volume	= 124 cuft
Inflow hyd. No.	= 15 - Basin 1A, 1B, 1E, 2B	Max. Elevation	= 161.98 ft
Reservoir name	= Infiltration Trench	Max. Storage	= 468 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



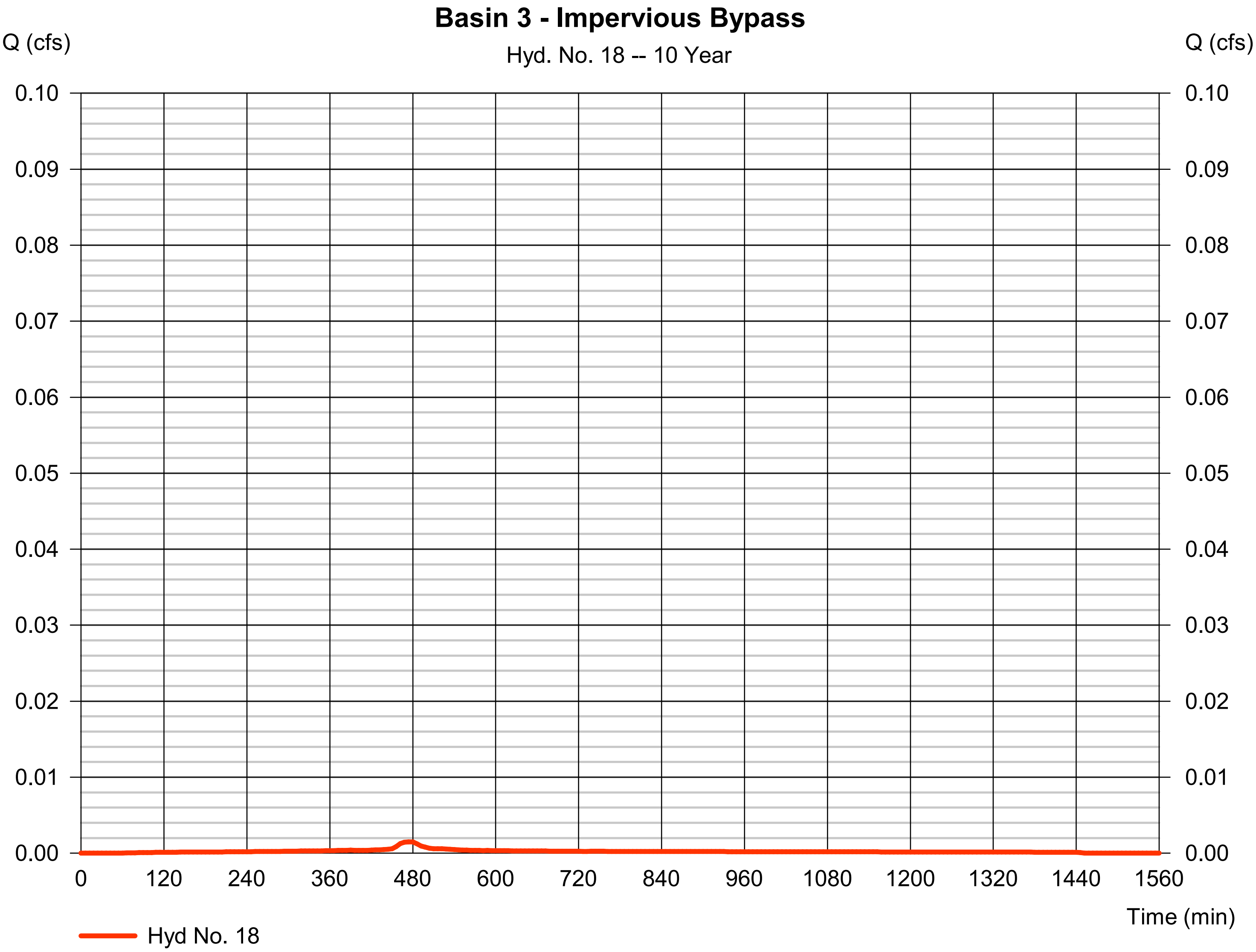
Hydrograph Report

Hyd. No. 18

Basin 3 - Impervious Bypass

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.001 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 22 cuft
Drainage area	= 0.002 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.20 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.002



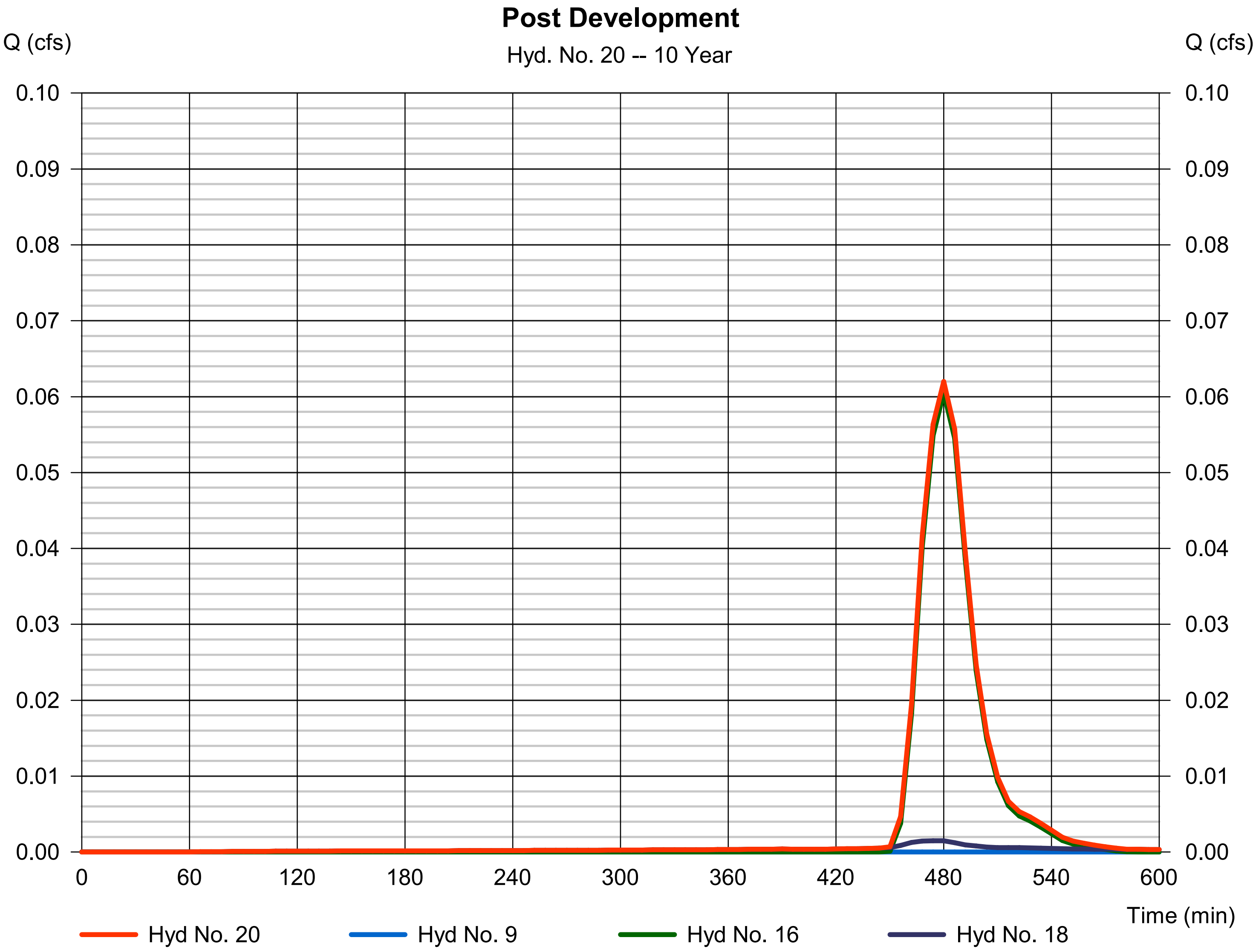
Hydrograph Report

Hyd. No. 20

Post Development

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 6 min
Inflow hyds. = 9, 16, 18

Peak discharge = 0.062 cfs
Time to peak = 480 min
Hyd. volume = 145 cuft
Contrib. drain. area = 0.002 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2023

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	SBUH Runoff	0.224	6	492	6,601	------	------	------	1E Pre-Development - Field
2	SBUH Runoff	0.005	6	474	76	------	------	------	1E.1 Pre-Development - Roof
3	SBUH Runoff	0.028	6	474	408	------	------	------	1E.2 Pre-Development - Concrete
4	SBUH Runoff	0.050	6	474	704	------	------	------	1E.3 Pre-Development - Gravel
5	Combine	0.083	6	474	1,188	2, 3, 4	------	------	Non-Field Total
6	Combine	0.289	6	486	7,788	1, 5	------	------	Total Pre-Development
8	SBUH Runoff	0.768	6	474	11,216	------	------	------	Basin 2A Outfield
9	Reservoir	0.000	6	474	0	8	100.04	120	Outfield - Reservoir
11	SBUH Runoff	0.310	6	474	4,520	------	------	------	Basin 2B Infield
12	SBUH Runoff	0.028	6	474	408	------	------	------	Basin 2C- Existing Concrete
13	SBUH Runoff	0.050	6	474	704	------	------	------	Basin 2D - Existing Gravel
14	SBUH Runoff	0.005	6	474	76	------	------	------	Basin 2E - Existing Dugout
15	Combine	0.393	6	474	5,707	11, 12, 13, 14	------	------	Basin 1A, 1B, 1E, 2B
16	Reservoir	0.094	6	480	283	15	162.02	513	Infield UIC
18	SBUH Runoff	0.002	6	474	30	------	------	------	Basin 3 - Impervious Bypass
20	Combine	0.096	6	480	313	9, 16, 18,	------	------	Post Development

250323_Softball.gpw	Return Period: 100 Year	Tuesday, 03 / 25 / 2025

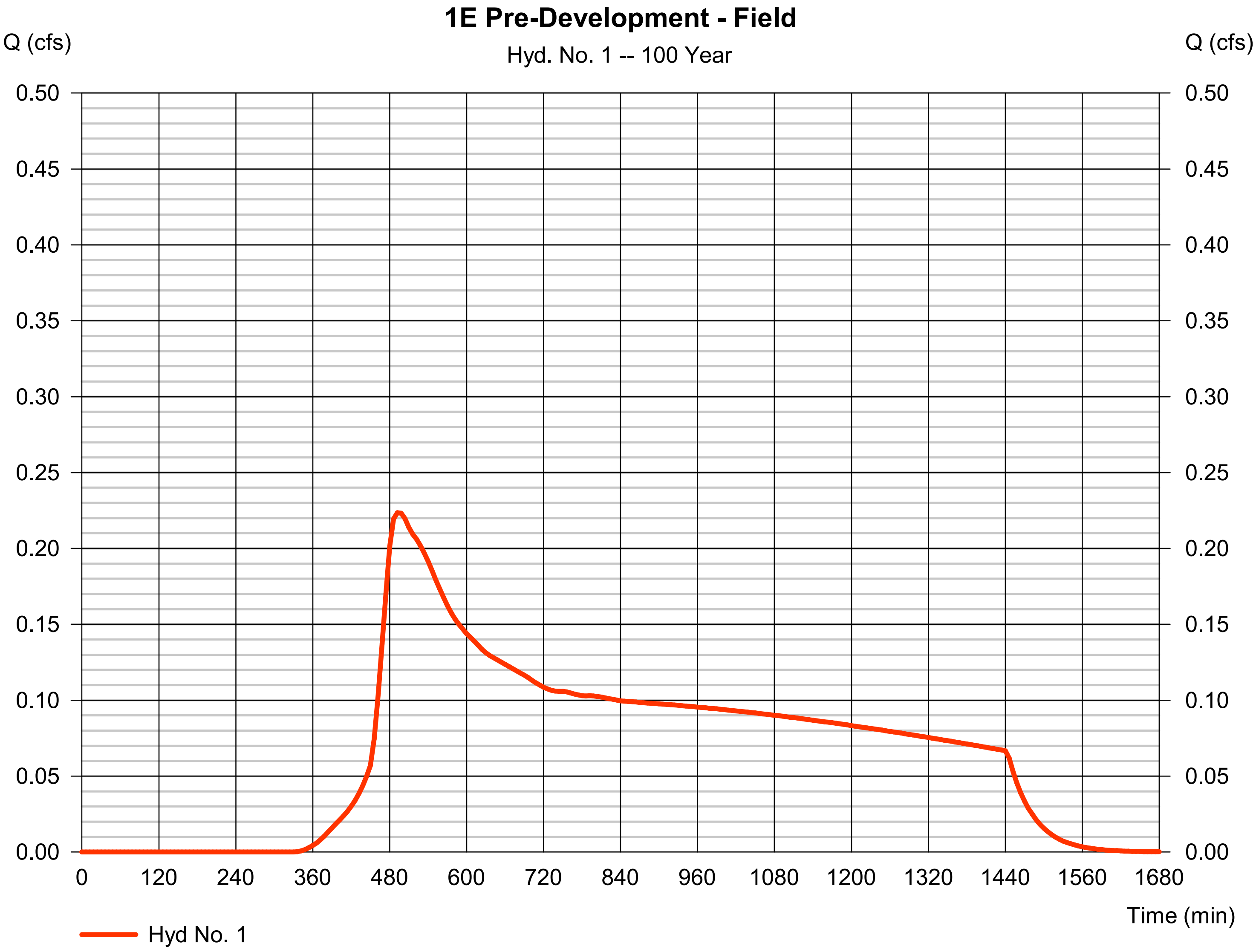
Hydrograph Report

Hyd. No. 1

1E Pre-Development - Field

Hydrograph type = SBUH Runoff
Storm frequency = 100 yrs
Time interval = 6 min
Drainage area = 1.041 ac
Basin Slope = 0.0 %
Tc method = TR55
Total precip. = 4.40 in
Storm duration = 24 hrs

Peak discharge = 0.224 cfs
Time to peak = 492 min
Hyd. volume = 6,601 cuft
Curve number = 72
Hydraulic length = 0 ft
Time of conc. (Tc) = 39.40 min
Distribution = Type IA
Shape factor = n/a



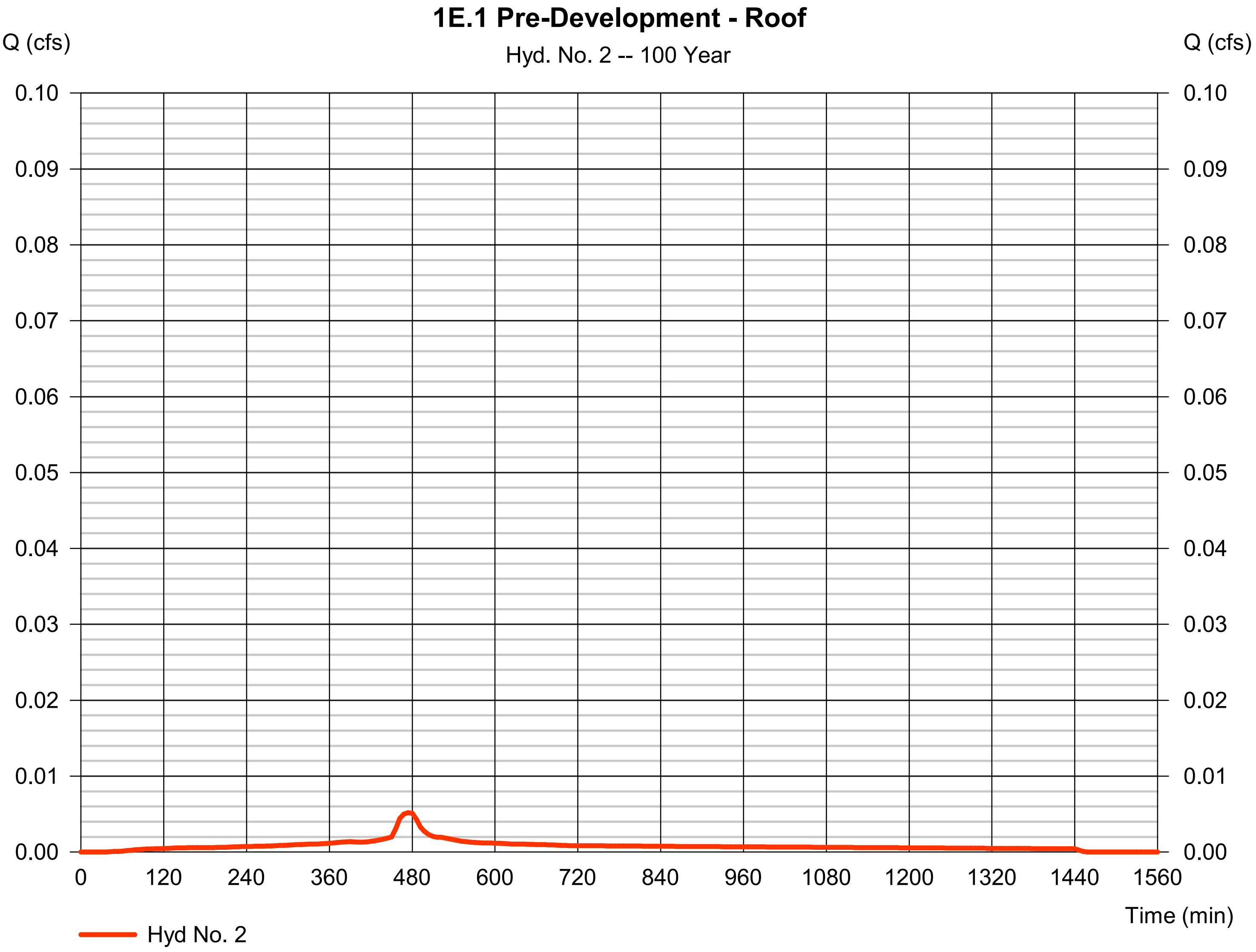
Hydrograph Report

Hyd. No. 2

1E.1 Pre-Development - Roof

Hydrograph type = SBUH Runoff
Storm frequency = 100 yrs
Time interval = 6 min
Drainage area = 0.005 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 4.40 in
Storm duration = 24 hrs

Peak discharge = 0.005 cfs
Time to peak = 474 min
Hyd. volume = 76 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



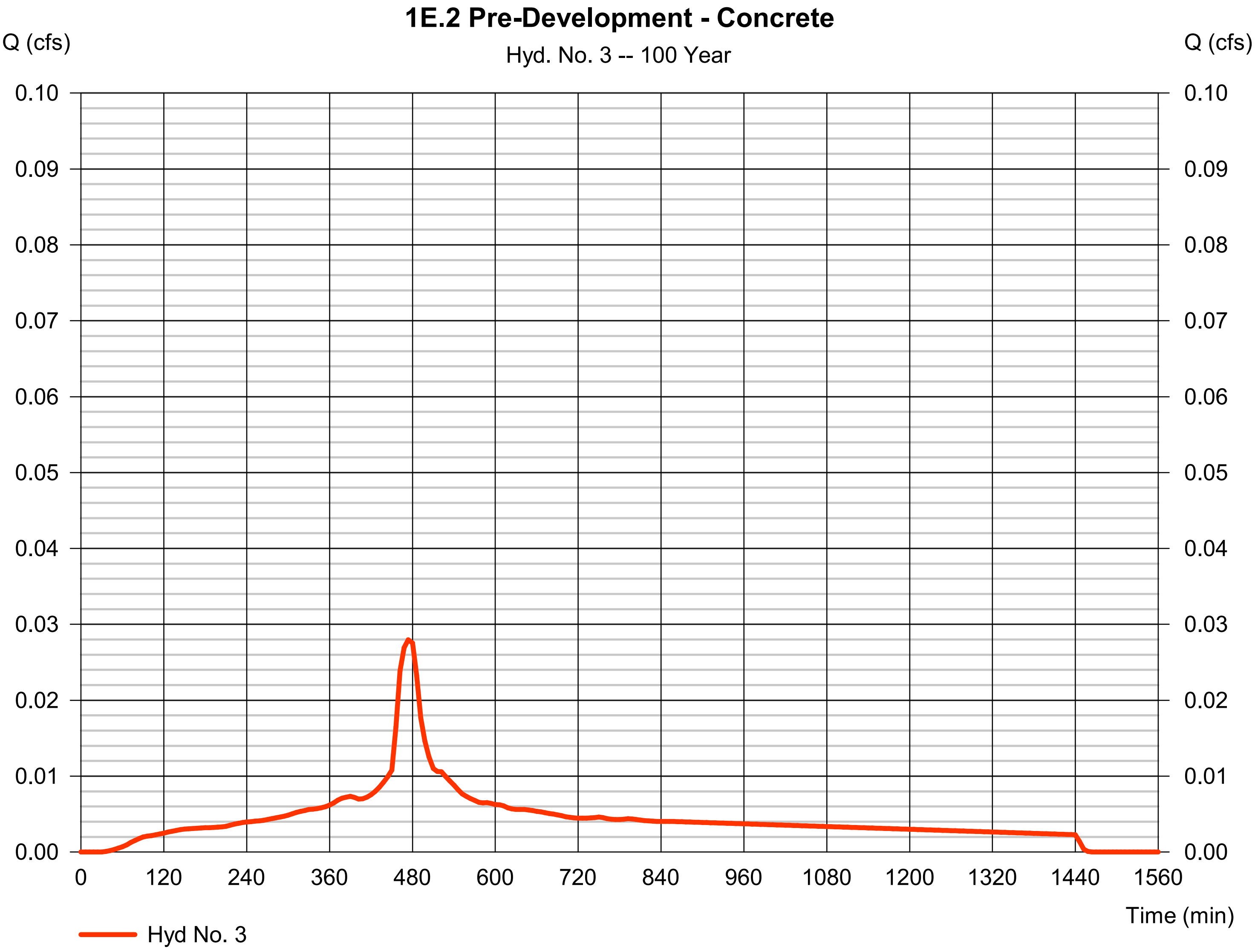
Hydrograph Report

Hyd. No. 3

1E.2 Pre-Development - Concrete

Hydrograph type = SBUH Runoff
Storm frequency = 100 yrs
Time interval = 6 min
Drainage area = 0.027 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 4.40 in
Storm duration = 24 hrs

Peak discharge = 0.028 cfs
Time to peak = 474 min
Hyd. volume = 408 cuft
Curve number = 98
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



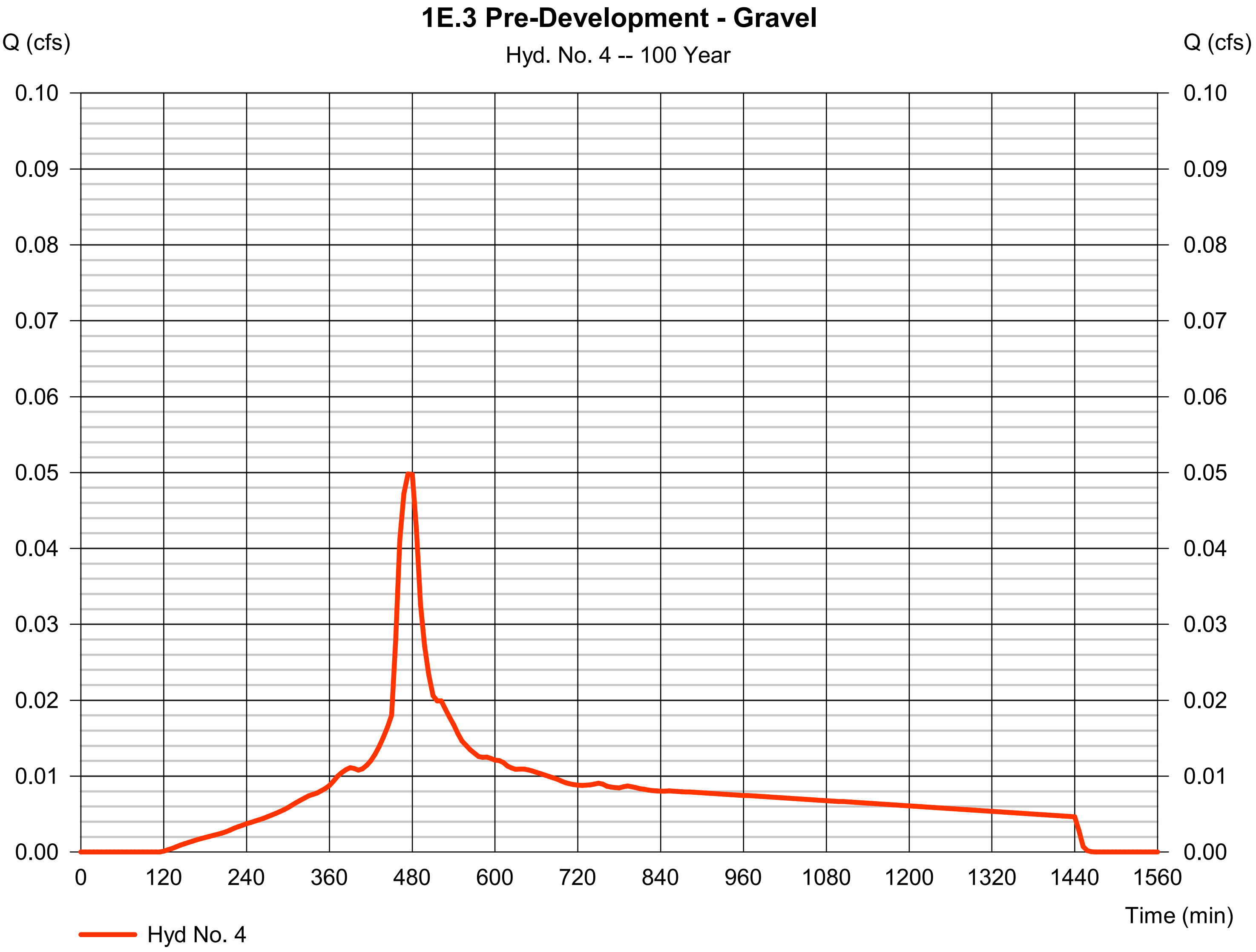
Hydrograph Report

Hyd. No. 4

1E.3 Pre-Development - Gravel

Hydrograph type = SBUH Runoff
Storm frequency = 100 yrs
Time interval = 6 min
Drainage area = 0.057 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 4.40 in
Storm duration = 24 hrs

Peak discharge = 0.050 cfs
Time to peak = 474 min
Hyd. volume = 704 cuft
Curve number = 91
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



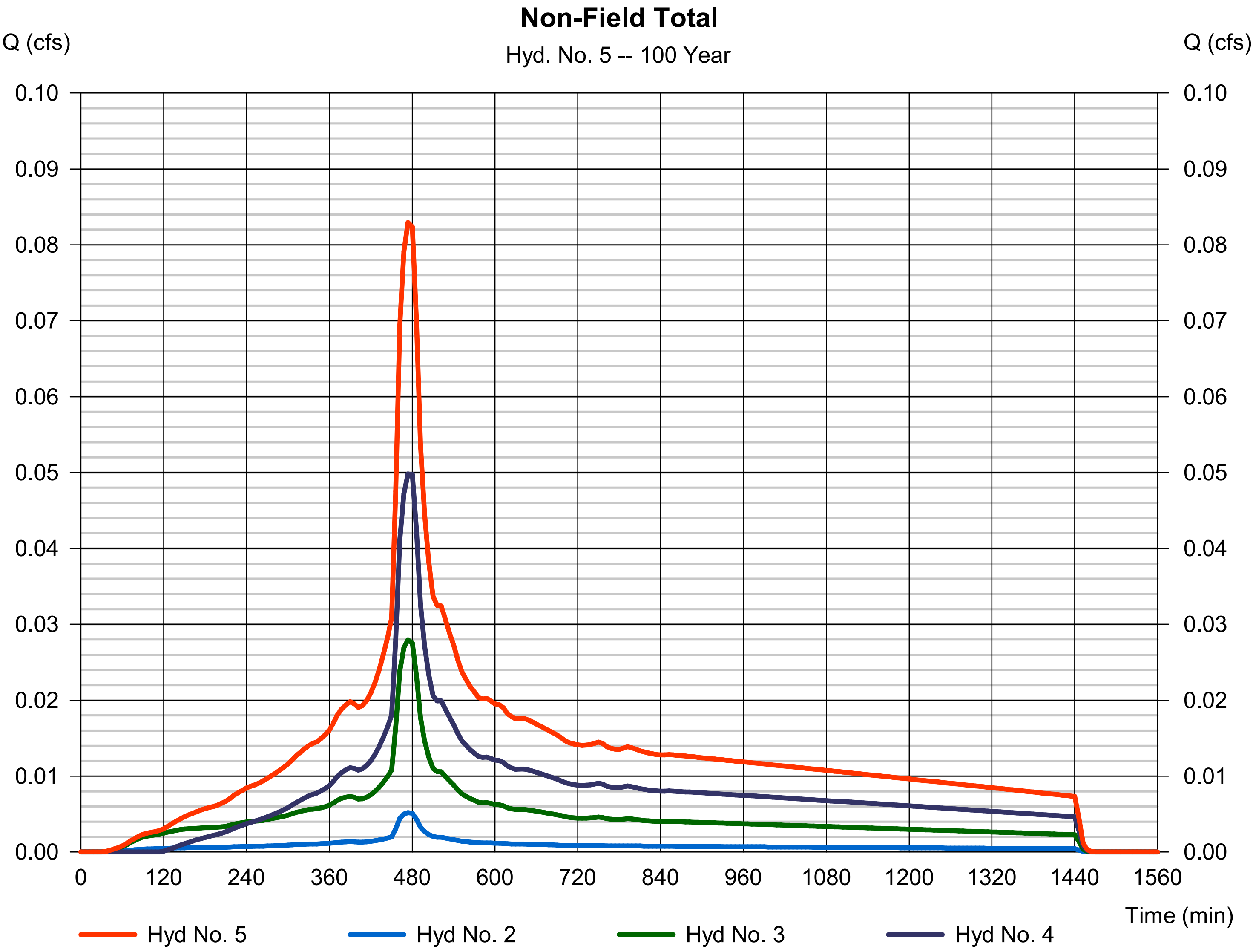
Hydrograph Report

Hyd. No. 5

Non-Field Total

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyds. = 2, 3, 4

Peak discharge = 0.083 cfs
Time to peak = 474 min
Hyd. volume = 1,188 cuft
Contrib. drain. area = 0.089 ac

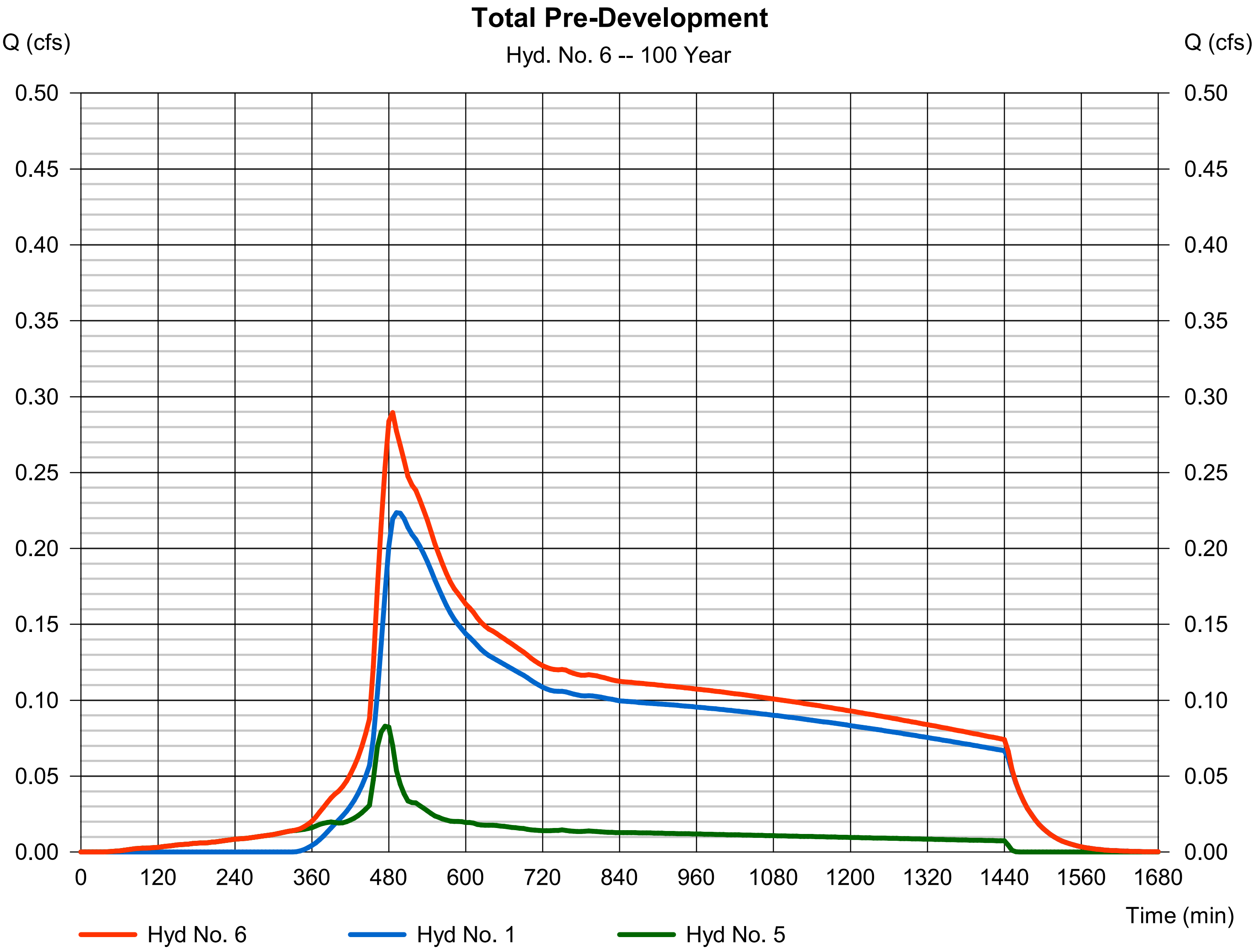


Hydrograph Report

Hyd. No. 6

Total Pre-Development

Hydrograph type	= Combine	Peak discharge	= 0.289 cfs
Storm frequency	= 100 yrs	Time to peak	= 486 min
Time interval	= 6 min	Hyd. volume	= 7,788 cuft
Inflow hyds.	= 1, 5	Contrib. drain. area	= 1.041 ac

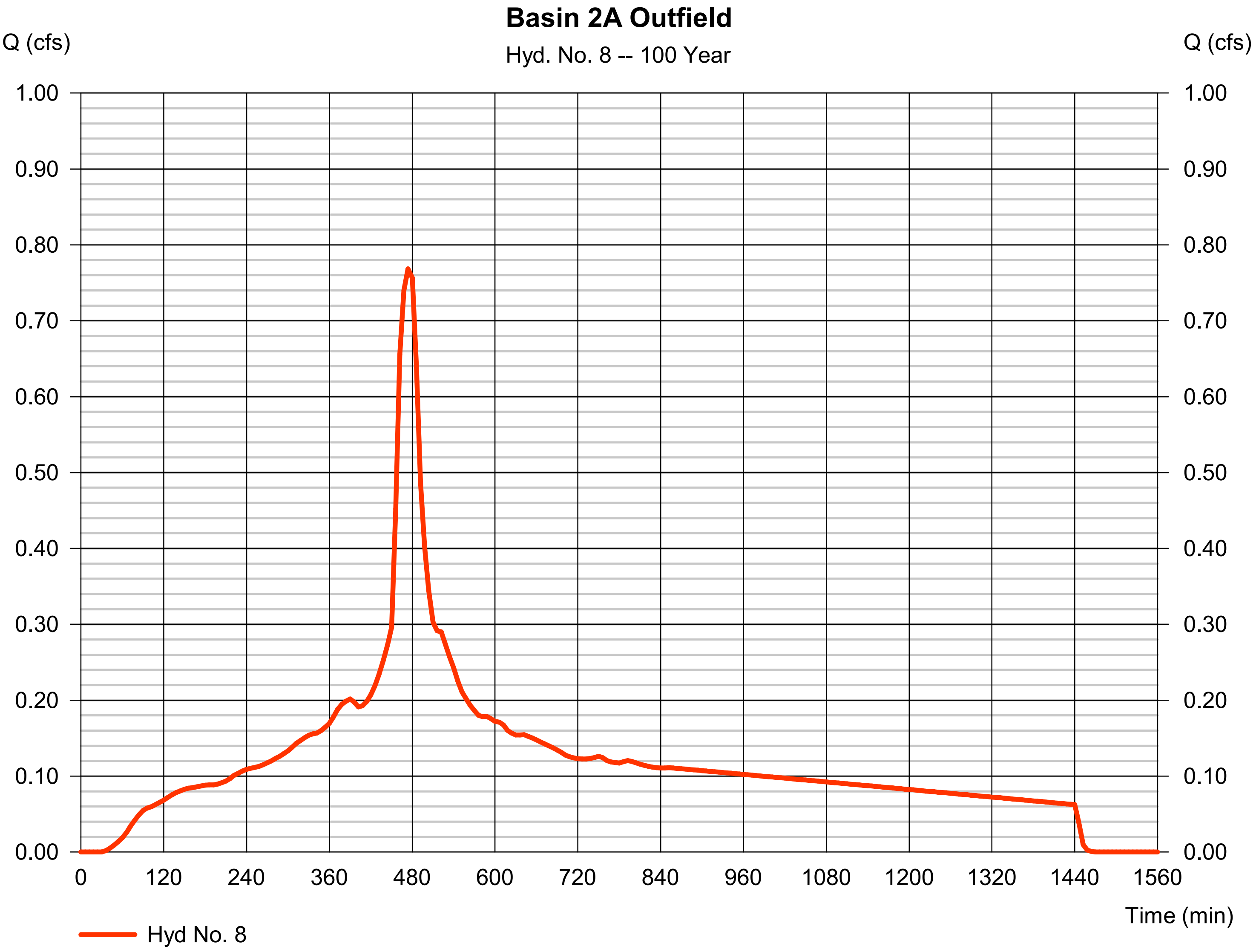


Hydrograph Report

Hyd. No. 8

Basin 2A Outfield

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.768 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 11,216 cuft
Drainage area	= 0.742 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.40 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



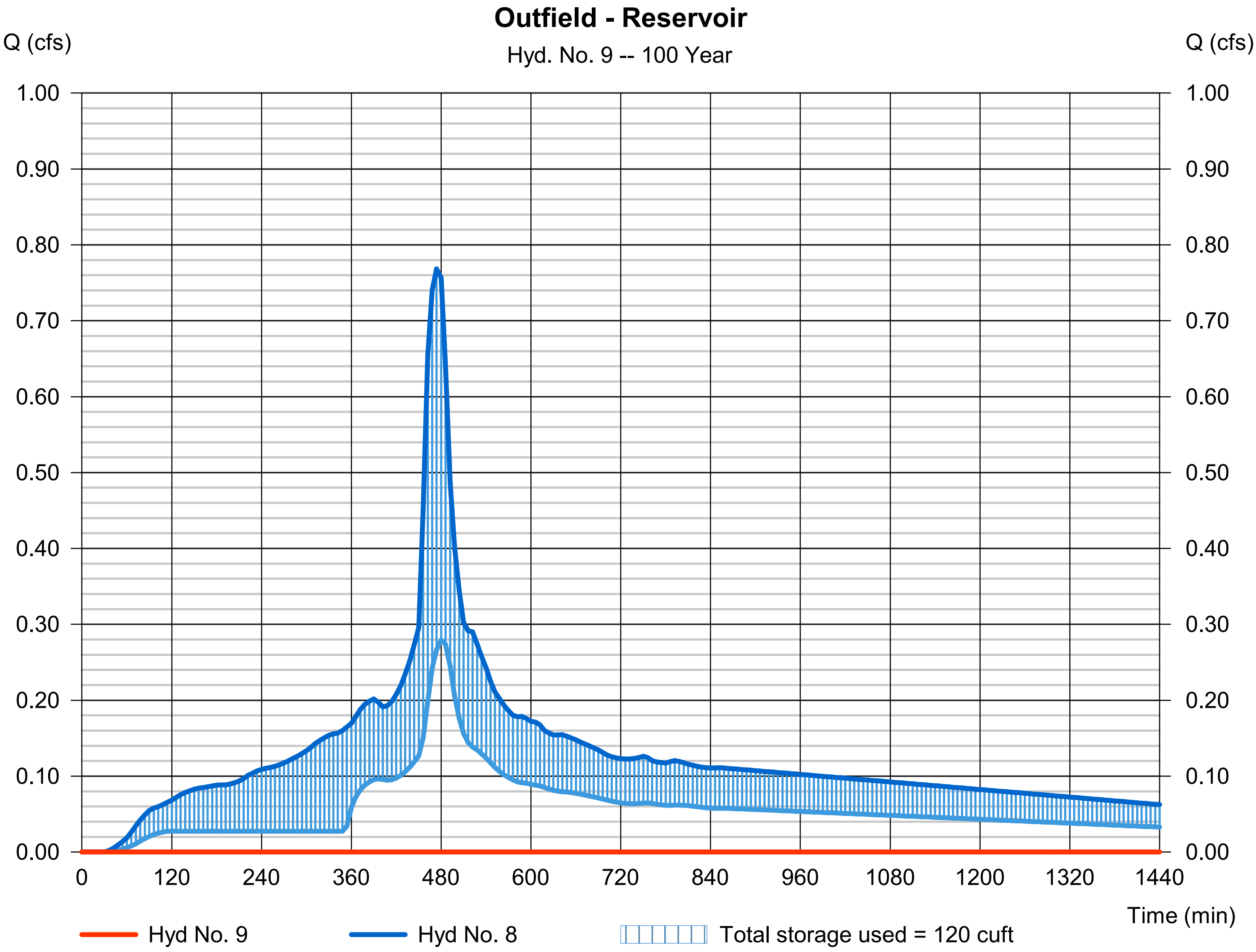
Hydrograph Report

Hyd. No. 9

Outfield - Reservoir

Hydrograph type	= Reservoir	Peak discharge	= 0.000 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 0 cuft
Inflow hyd. No.	= 8 - Basin 2A Outfield	Max. Elevation	= 100.04 ft
Reservoir name	= Outfield Res	Max. Storage	= 120 cuft

Storage Indication method used. Exfiltration extracted from Outflow.

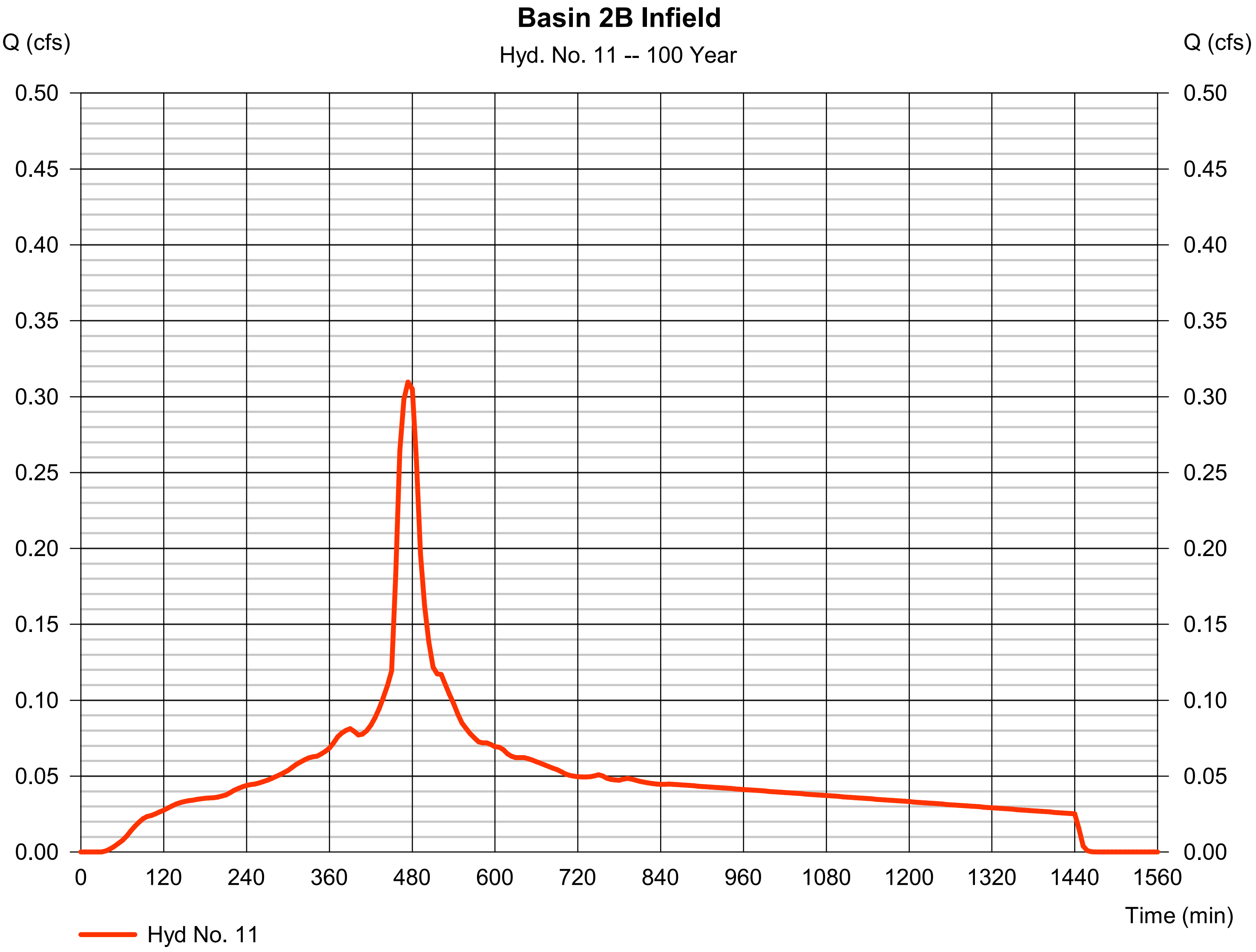


Hydrograph Report

Hyd. No. 11

Basin 2B Infield

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.310 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 4,520 cuft
Drainage area	= 0.299 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.40 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

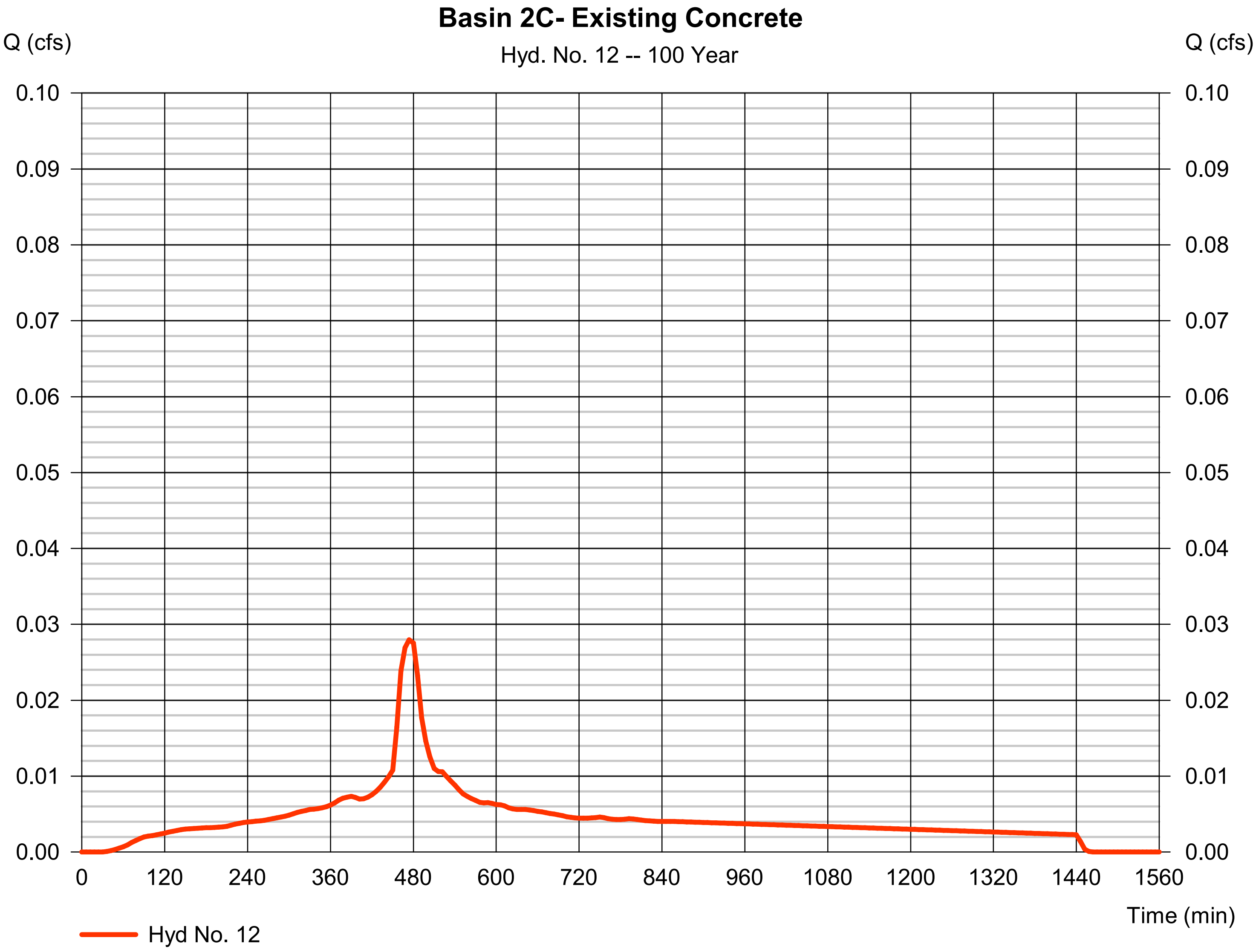


Hydrograph Report

Hyd. No. 12

Basin 2C- Existing Concrete

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.028 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 408 cuft
Drainage area	= 0.027 ac	Curve number	= 98
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.40 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



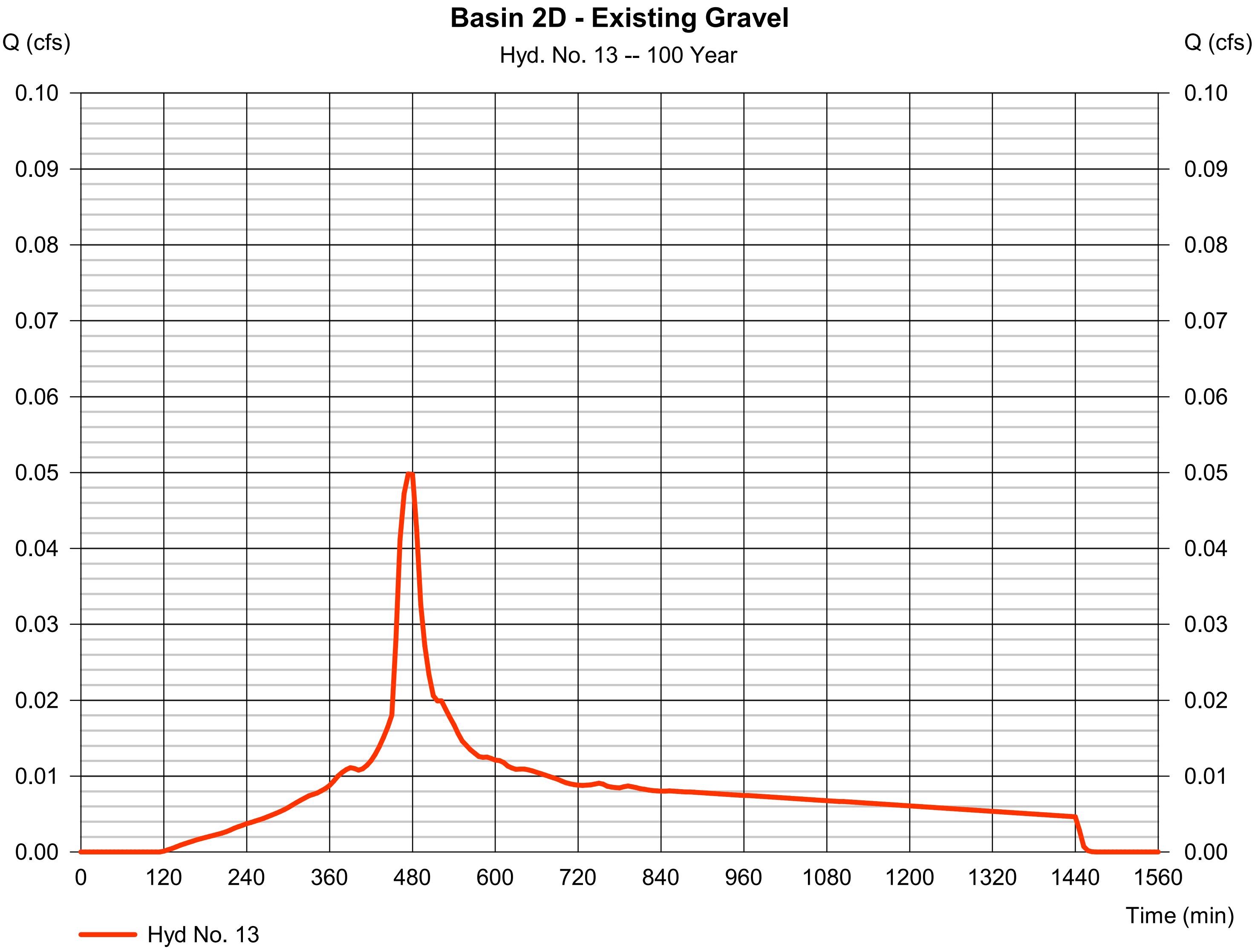
Hydrograph Report

Hyd. No. 13

Basin 2D - Existing Gravel

Hydrograph type = SBUH Runoff
Storm frequency = 100 yrs
Time interval = 6 min
Drainage area = 0.057 ac
Basin Slope = 0.0 %
Tc method = User
Total precip. = 4.40 in
Storm duration = 24 hrs

Peak discharge = 0.050 cfs
Time to peak = 474 min
Hyd. volume = 704 cuft
Curve number = 91
Hydraulic length = 0 ft
Time of conc. (Tc) = 5.00 min
Distribution = Type IA
Shape factor = n/a



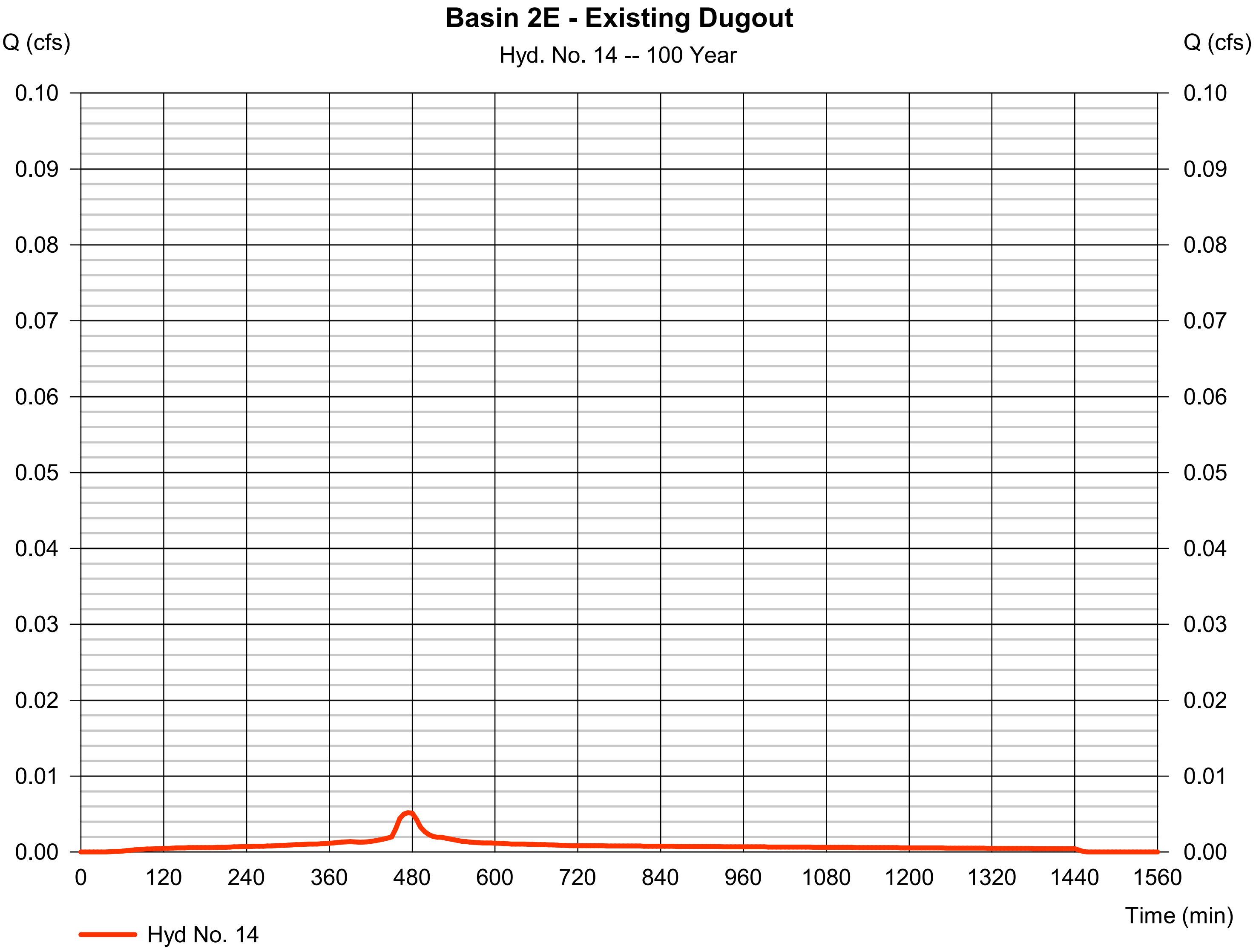
Hydrograph Report

Hyd. No. 14

Basin 2E - Existing Dugout

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.005 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 76 cuft
Drainage area	= 0.005 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.40 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.005

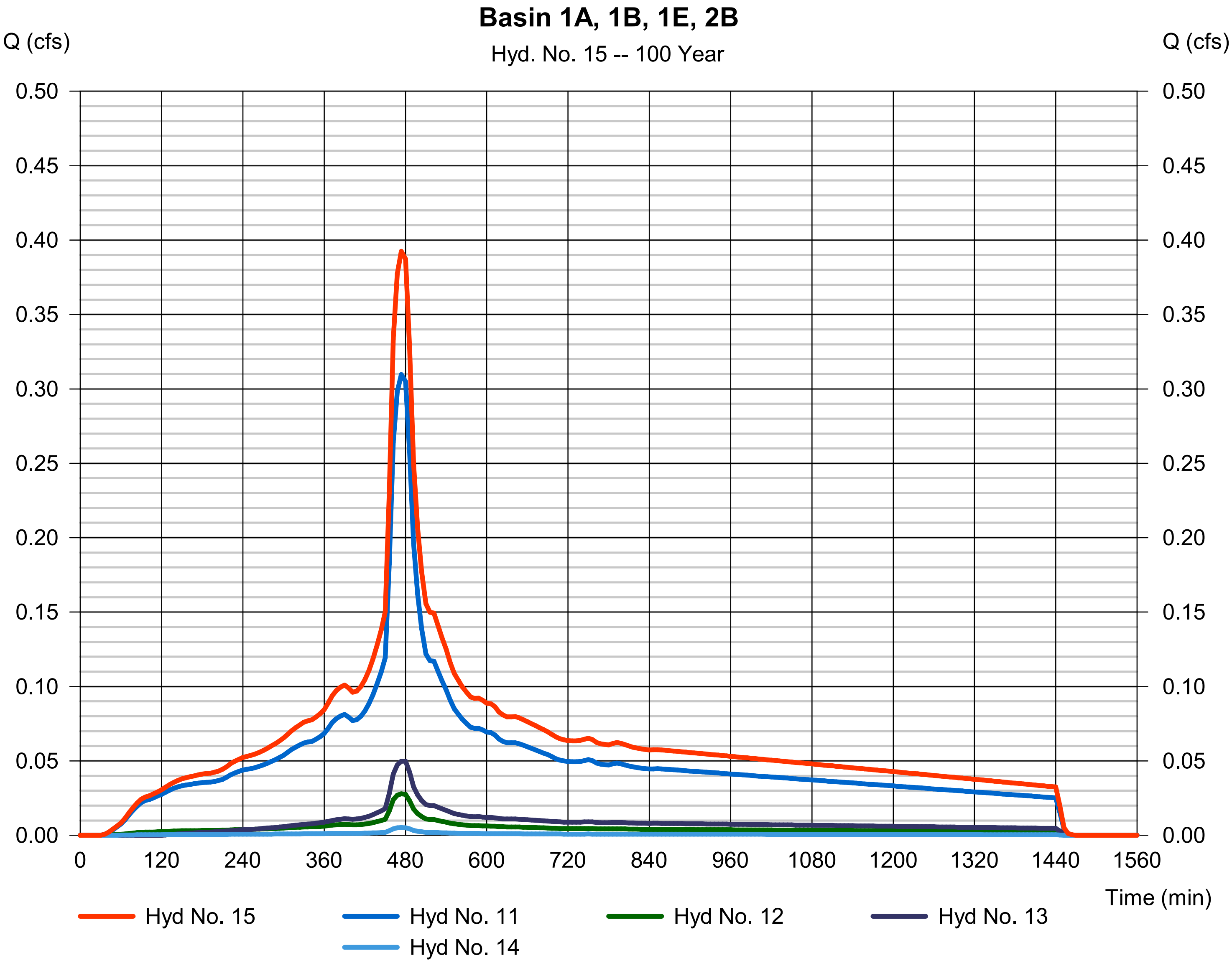


Hydrograph Report

Hyd. No. 15

Basin 1A, 1B, 1E, 2B

Hydrograph type	= Combine	Peak discharge	= 0.393 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 5,707 cuft
Inflow hyds.	= 11, 12, 13, 14	Contrib. drain. area	= 0.388 ac



Hydrograph Report

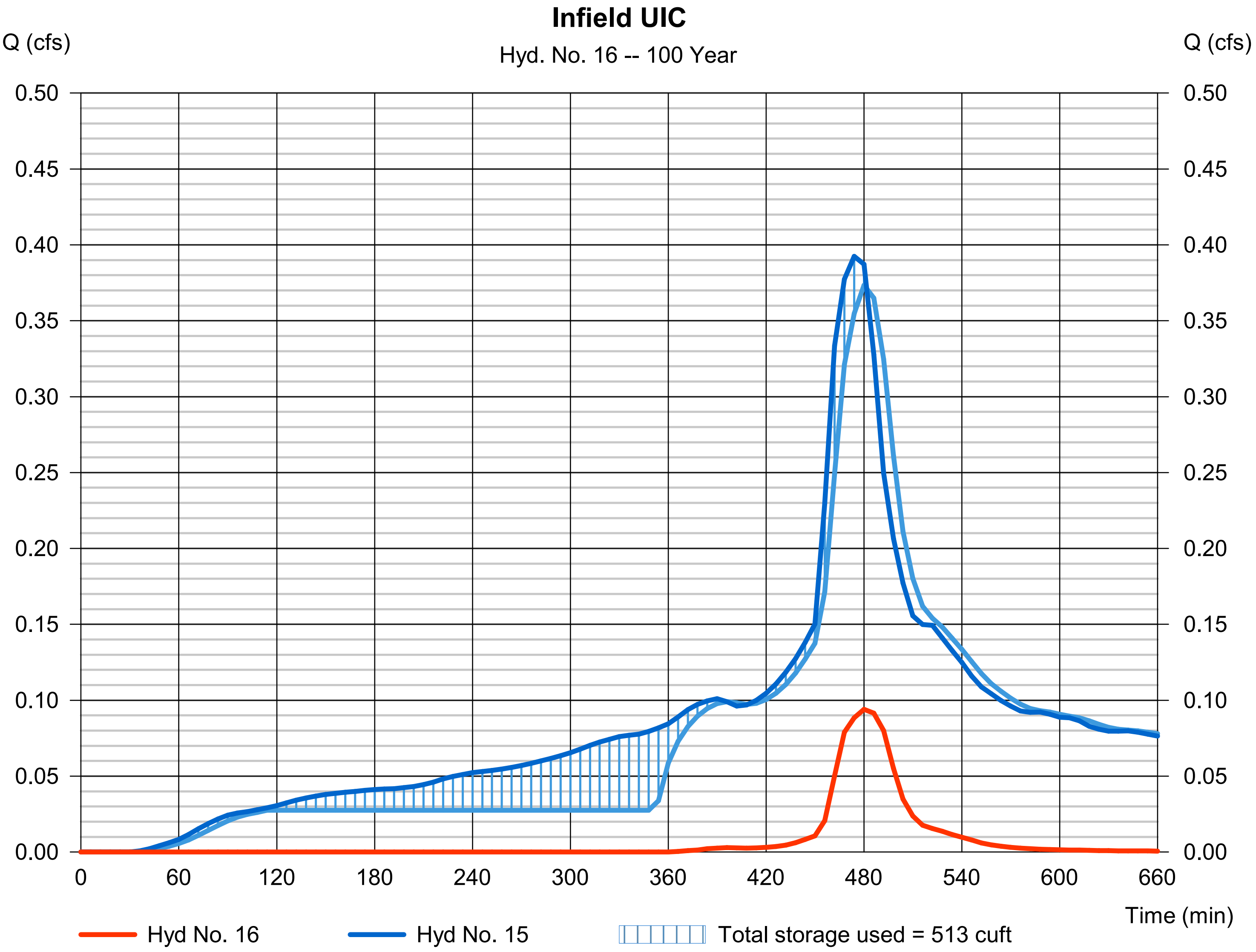
Hyd. No. 16

Infield UIC

Hydrograph type = Reservoir
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyd. No. = 15 - Basin 1A, 1B, 1E, 2B
Reservoir name = Infiltration Trench

Peak discharge = 0.094 cfs
Time to peak = 480 min
Hyd. volume = 283 cuft
Max. Elevation = 162.02 ft
Max. Storage = 513 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



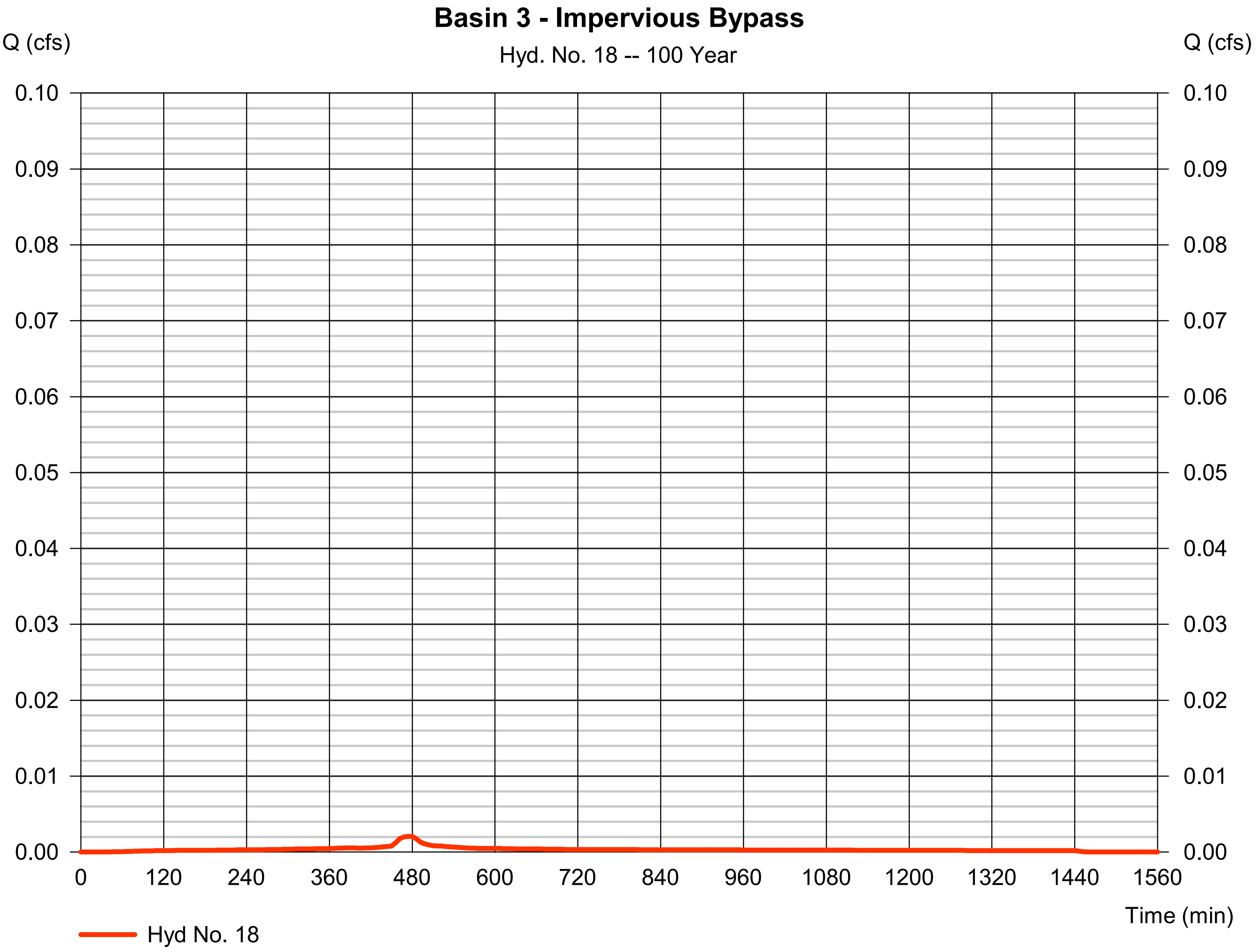
Hydrograph Report

Hyd. No. 18

Basin 3 - Impervious Bypass

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.002 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 6 min	Hyd. volume	= 30 cuft
Drainage area	= 0.002 ac	Curve number	= 98*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.40 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(0.110 x 98) + (0.072 x 72)] / 0.002



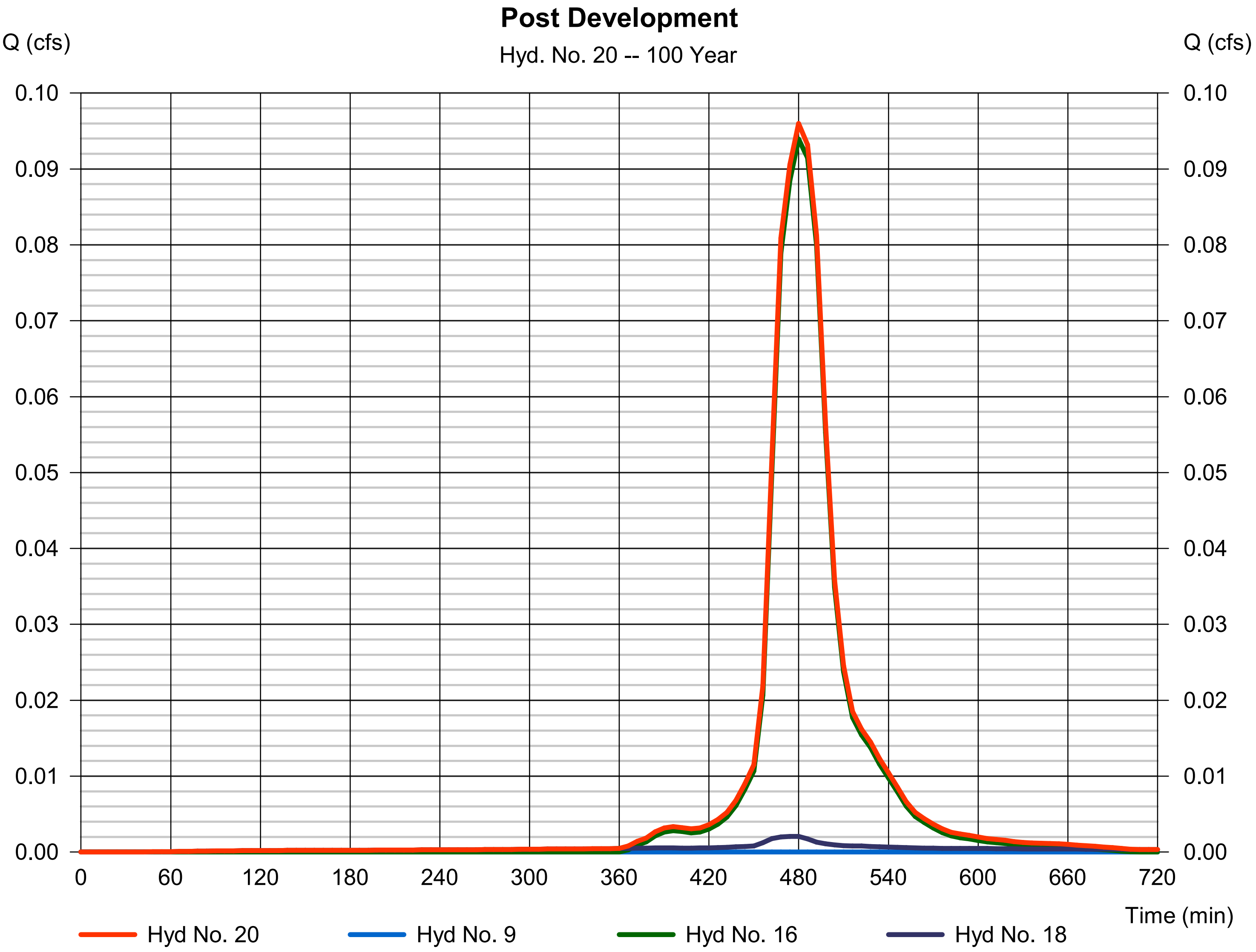
Hydrograph Report

Hyd. No. 20

Post Development

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 6 min
Inflow hyds. = 9, 16, 18

Peak discharge = 0.096 cfs
Time to peak = 480 min
Hyd. volume = 313 cuft
Contrib. drain. area = 0.002 ac



APPENDIX C

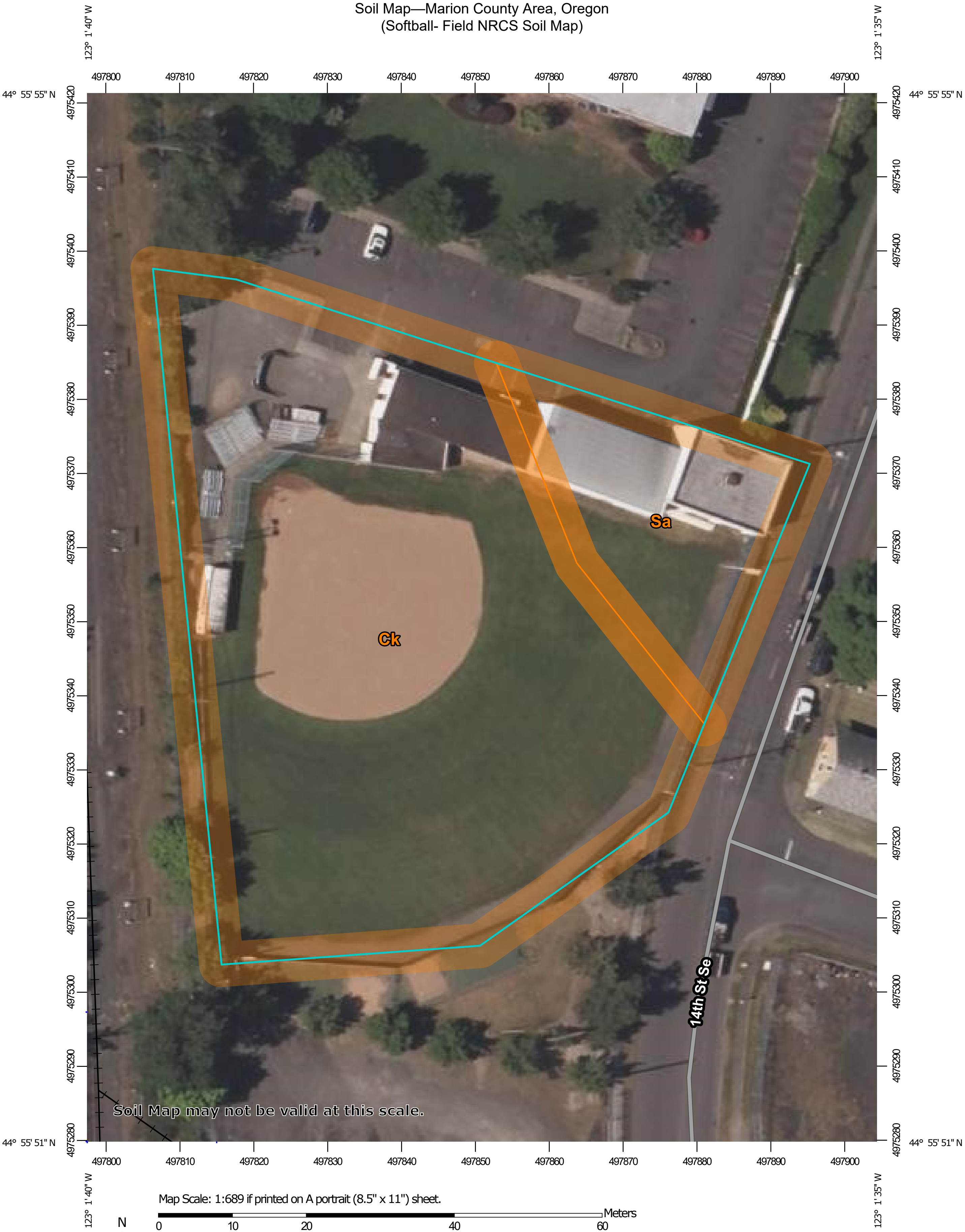
- **Stormwater Conveyance Calculations**

To Be Completed at Final Design

APPENDIX D

- **NRCS Soil Map and Description**
- **NRCS Hydrologic Soil Group**
- **FEMA Flood Insurance Rate Map**

Soil Map—Marion County Area, Oregon
(Softball- Field NRCS Soil Map)



Map Scale: 1:689 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

Marion County Area, Oregon

Ck—Clackamas gravelly loam

Map Unit Setting

National map unit symbol: 24nz
Elevation: 170 to 800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Clackamas and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clackamas

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly mixed alluvium

Typical profile

H1 - 0 to 15 inches: gravelly loam
H2 - 15 to 24 inches: gravelly clay loam
H3 - 24 to 60 inches: extremely gravelly clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Hydric soil rating: No

Minor Components

Courtney

Percent of map unit: 8 percent
Landform: Terraces
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

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 1:20,000.

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: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

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

Date(s) aerial images were photographed: May 17, 2023—Jun 3, 2023

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.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
Ck	Clackamas gravelly loam	1.2	83.1%
Sa	Salem gravelly silt loam	0.2	16.9%
Totals for Area of Interest		**1.4**	**100.0%**

Marion County Area, Oregon

Ck—Clackamas gravelly loam

Map Unit Setting

National map unit symbol: 24nz
Elevation: 170 to 800 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Clackamas and similar soils: 85 percent
Minor components: 8 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Clackamas

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Gravelly mixed alluvium

Typical profile

H1 - 0 to 15 inches: gravelly loam
H2 - 15 to 24 inches: gravelly clay loam
H3 - 24 to 60 inches: extremely gravelly clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 6 to 18 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 4.8 inches)

Interpretive groups

Land capability classification (irrigated): 3w
Land capability classification (nonirrigated): 3w
Hydrologic Soil Group: C/D
Ecological site: R002XC005OR - High Flood Plain Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)

Hydric soil rating: No

Minor Components

Courtney

Percent of map unit: 8 percent
Landform: Terraces
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

Hydrologic Soil Group and Surface Runoff

This table gives estimates of various soil water features. The estimates are used in land use planning that involves engineering considerations.

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 four hydrologic soil groups are:

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.

Surface runoff refers to the loss of water from an area by flow over the land surface. Surface runoff classes are based on slope, climate, and vegetative cover. The concept indicates relative runoff for very specific conditions. It is assumed that the surface of the soil is bare and that the retention of surface water resulting from irregularities in the ground surface is minimal. The classes are negligible, very low, low, medium, high, and very high.

Report—Hydrologic Soil Group and Surface Runoff

Absence of an entry indicates that the data were not estimated. The dash indicates no documented presence.

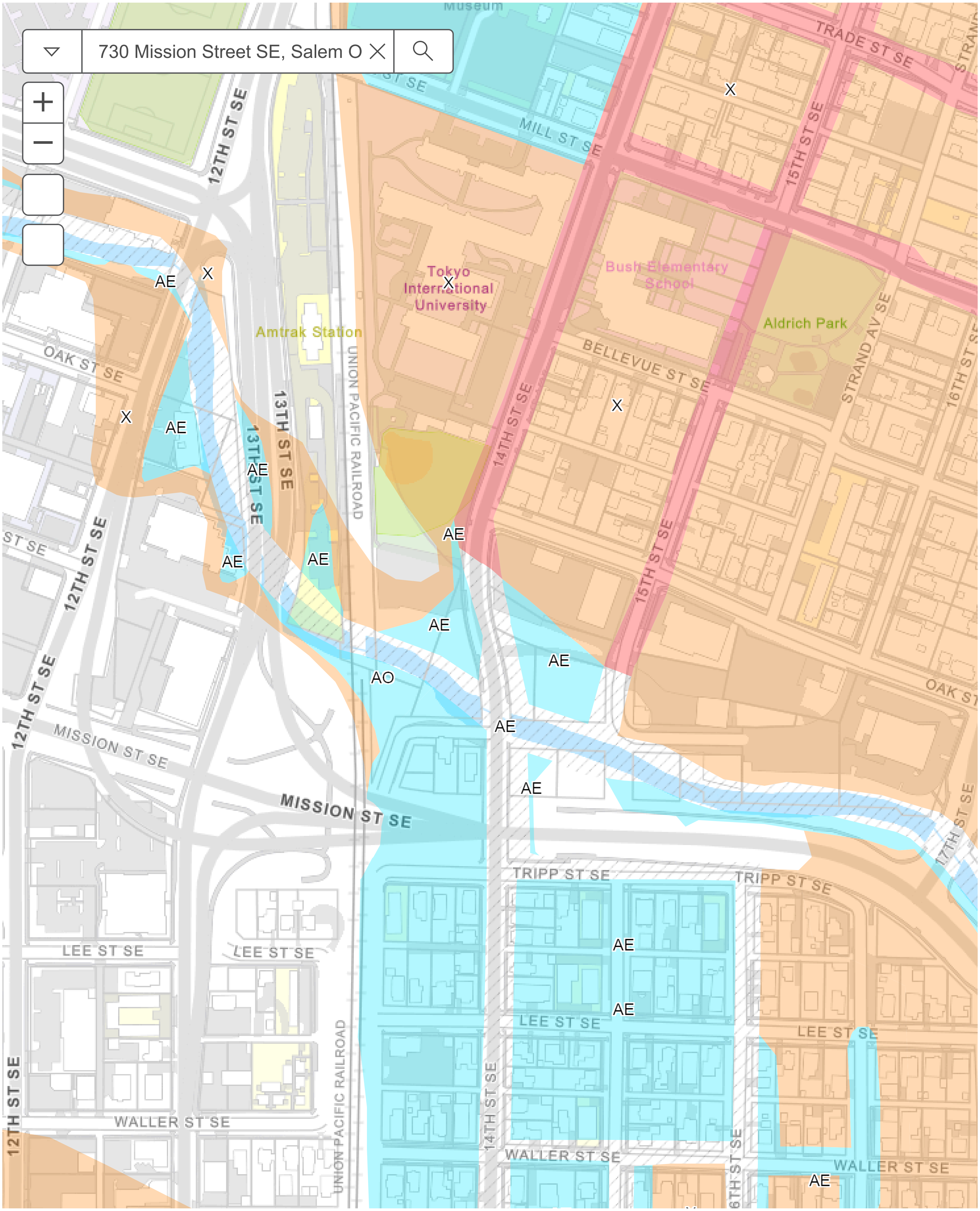
Hydrologic Soil Group and Surface Runoff–Marion County Area, Oregon			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
Ck—Clackamas gravelly loam			
Clackamas	85	—	C/D

Hydrologic Soil Group and Surface Runoff–Marion County Area, Oregon			
Map symbol and soil name	**Pct. of map unit**	**Surface Runoff**	**Hydrologic Soil Group**
Sa—Salem gravelly silt loam			
Salem	90	—	B

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 22, Aug 30, 2024

100 & 500 Year FEMA Flood Zones



APPENDIX E

- **NV5 Geotechnical Report**
- **NV5 Geotechnical Report Addendum**

July 7, 2023

Willamette University
900 State Street
Salem, OR 97301

Attention: Mark Mazurier

Report of Geotechnical Engineering Services
Willamette University Softball Field Improvements
501 14th Street SE
Salem, Oregon
Project: WillUniv-16-01

INTRODUCTION

NV5 is pleased to submit this report of geotechnical engineering services for the proposed Willamette University softball field improvements located at 501 14th Street SE in Salem, Oregon. We understand the proposed improvements will include installation of synthetic turf and on-site stormwater disposal systems for the softball field. In addition, new safety netting will be installed in a portion of the outfield. We assume that netting poles will be supported by intermediate foundations.

Our services for this project were conducted in accordance with our proposal dated September 30, 2022. Figure 1 shows the site vicinity relative to the surrounding features. Figure 2 shows the softball field area and our approximate exploration locations.

PURPOSE AND SCOPE

The purpose of our scope was to explore subsurface conditions at the site and provide geotechnical recommendations for the proposed field improvements. Our specific scope of services is summarized as follows:

- Reviewed geotechnical and geologic information provided for the site and information from our in-house project files for projects in the site vicinity.
- Coordinated our field explorations, including utility locates and scheduling subcontractors and NV5 field staff.

- Explored subsurface soil and groundwater conditions for the proposed improvements by conducting the following explorations and testing:
    - Drilled five borings depths between 5.5 and 9 feet below ground surface (BGS) using a trailer-mounted drill rig.
    - Performed four infiltration tests at depths between 1 foot and 4 feet BGS.
- Classified the material encountered in the explorations, maintained a detailed log of each exploration, and collected samples at representative intervals.
- Conducted the following laboratory testing program:
    - Thirteen moisture content determinations in general accordance with American Society for Testing and Materials (ASTM) D2216
    - Four particle-size analyses in general accordance with ASTM D1140 or ASTM C117
- Provided recommendations for site preparation, grading and drainage, stripping depths, fill type for imported material, compaction criteria, trench excavation and backfill, use of on-site soil, and wet/dry weather earthwork.
- Provided geotechnical design parameters for safety netting pole foundations.
- Provided recommendations for managing identified groundwater conditions that may affect the performance of structures or pavement.
- Provided recommendations for American Society of Civil Engineers (ASCE) 7-16 seismic coefficients and evaluated the risk of liquefaction and lateral spreading at the site.
- Prepared this geotechnical engineering report summarizing the results of our geotechnical evaluation.

SITE CONDITIONS

GEOLOGIC SETTING

The site is located along the southern margin of the Northern Willamette Valley physiographic province. The Willamette Valley is bound by the Coast Range to the west and the Cascade Range to the east. The geologic profile in the vicinity of the site consists of approximately 65 feet of fluvial gravel deposits underlain by older fluvial terrace deposits that extend to a depth of approximately 160 to 170 feet BGS.

The near-surface geologic unit is mapped as late-Pleistocene Age (36,000 to 10,000 years before present) Linn gravel (Qlg) that consists of fine to coarse fluvial gravel (Bela, 1981; Yeats et al., 1991). The Linn gravel is underlain by the middle Pleistocene Age (36,000 to 30,000 years before present) high terrace deposits (Qth) that consist of semi-consolidated deposits of sand, silt, and clay forming a broad, flat terrace along the Willamette River. The upper portion (10 to 30 feet) of the terrace is comprised of silt deposits. The middle Miocene Age (16 million to 6 million years before present) Columbia River Basalt Group (Tcr) underlies the terrace deposits and forms the basement geologic unit at this site (Bela, 1981; Yeats et al., 1991; Gannett and Caldwell, 1998).

SURFACE CONDITIONS

The softball field is located on the Willamette University campus. The field is surrounded by university buildings and an asphalt concrete (AC)-paved parking lot to the north, a gravel parking lot to the south, the Salem Amtrak Station to the west, and 14th Street SE to the east. The ground surface of the softball field is relatively flat, with surface elevations ranging from 167 to 168 mean sea level based on topography available on Google Earth. The infield is bare, with exposed soil, and the outfield is covered with grass.

SUBSURFACE CONDITIONS

General

Subsurface conditions at the field were explored by drilling five borings (B-1 through B-5) to depths between 5.5 and 9 feet BGS. The approximate exploration locations are shown on Figure 2. The exploration logs and laboratory testing results are presented in the Attachment. Subsurface conditions generally consist of undocumented sand and gravel fill overlying native gravel to the maximum depth explored. A 3-inch-thick root zone was encountered at the ground surface. The following sections present descriptions of the soil units encountered.

Undocumented Fill

Undocumented fill was encountered below the root zone to depths between 1 foot and 6 feet BGS in all of the borings at the site. The undocumented fill consists of sand with varying amounts of silt and silty gravel with sand. The sand fill generally overlies the gravel fill. Sand particles are fine to medium grained. Standard penetration test (SPT) results indicate the sand is very loose to medium dense and the gravel is loose. Laboratory testing of the fill soil indicates moisture contents of 7 to 20 percent and fines contents between 15 and 17 percent at the time of our explorations.

Silt

A single layer of sandy silt was encountered in boring B-5 at a depth of 5 feet BGS. The silt layer is 6 inches thick and SPT results indicate the silt is soft.

Gravel

Native gravel with silt and sand was encountered below the undocumented fill in all of the borings at the site. The gravel is generally rounded to subrounded. Although not encountered in our explorations, it is likely that cobbles exist in the gravel unit. SPT results indicate that the gravel is medium dense to very dense. Laboratory testing indicates moisture contents between 8 and 14 percent at the time of our explorations. Fines content analysis of one native gravel sample indicates a fines content of 11 percent.

Groundwater

Groundwater was not encountered in the borings performed within the softball field. Regional groundwater is mapped at depths between 7 and 15 feet BGS. The depth to groundwater may fluctuate in response to seasonal changes, changes in surface topography, and other factors not observed in this study.

INFILTRATION TESTING

Infiltration testing was conducted to evaluate the feasibility of on-site stormwater disposal in borings B-2 through B-5 at depths between 1 foot and 4 feet BGS. Testing was conducted using the encased falling head method in the borings using either a PVC pipe or an open hole method. A representative soil sample was collected below the infiltration test depths for particle-size analysis after infiltration testing.

Table 1 summarizes the infiltration testing results and fines content determinations. The exploration logs and results of particle-size analysis are presented in the Attachment.

Table 1. Infiltration Testing Results

Exploration	Depth (feet BGS)	Soil Description	Fines Content[1] (percent)	Observed Infiltration Rate[2] (in/hr)
B-2	4	GRAVEL with silt and sand (GP-GM)	11	9.1
B-3	2	Silty SAND (SM) – Fill	17	4.6
B-4	1.5	Silty SAND (SM) – Fill	15	7.2
B-5	1	Silty SAND (SM) – Fill	15	8.8

1. Fines content – material passing the U.S. Standard No. 200 sieve
2. In-situ infiltration rate observed in the field

in/hr: inches per hour

CONCLUSIONS AND RECOMMENDATIONS

SEISMIC DESIGN

Seismic Design Parameters

Based on our knowledge of local geology, the native gravel layer encountered at depths between 1 foot and 6 feet BGS likely extends to bedrock or to a depth of at least 100 feet BGS. Based on this assumption, the soil profile is consistent with Site Class C in accordance with ASCE 7-16. The values presented in Table 2 can be used to compute design levels of ground shaking.

Table 2. Seismic Design Parameters

Parameter	Short Period (T_s)	1 Second Period (T_1)
MCE Spectral Acceleration, S	S_s = 0.822 g	S_1 = 0.413 g
Site Class	C	
Site Coefficient, F	F_a = 1.2	F_v = 1.5
Adjusted Spectral Acceleration, S_M	S_{MS} = 0.986 g	S_{M1} = 0.619 g
Design Spectral Response Acceleration Parameters, S_D	S_{DS} = 0.658 g	S_{D1} = 0.413 g

g: gravitational acceleration (32.2 feet/second^2)

MCE: maximum considered earthquake

Liquefaction
Liquefaction is a phenomenon caused by a rapid increase in pore water pressure that reduces the effective stress between soil particles to near zero. The excessive buildup of pore water pressure results in the sudden loss of shear strength in a soil. Granular soil, which relies on interparticle friction for strength, is susceptible to liquefaction until the excess pore pressures can dissipate. Sand boils and flows observed at the ground surface after an earthquake are the result of excess pore pressures dissipating upwards, carrying soil particles with the draining water. In general, loose, saturated sand soil with low silt and clay content is the most susceptible to liquefaction. Low plasticity, sandy silt may be moderately susceptible to liquefaction under relatively higher levels of ground shaking.

Based on the depth to groundwater and the medium dense to very dense gravel present at the site, liquefaction is not considered a hazard.

Lateral Spreading
Lateral spreading is a liquefaction-related seismic hazard and occurs on gently sloping or flat sites underlain by liquefiable sediment adjacent to an open face, such as a riverbank. Liquefied soil adjacent to an open face can flow toward the open face, resulting in lateral ground displacement.

Based on the soil conditions, site topography, and distance from an open face, lateral spreading is not considered a hazard at the site.

INFILTRATION SYSTEMS

The infiltration testing results presented in Table 1 can be used to design stormwater disposal facilities. The infiltration rates shown in Table 1 are short-term field rates and factors of safety have not been applied. Appropriate correction factors should be applied by the project civil engineer to determine long-term infiltration parameters. From a geotechnical perspective, we recommend a minimum factor of safety of 2 be applied to the field infiltration rates presented in Table 1 to account for soil variability. The infiltration system design engineer should determine the appropriate remaining correction factor values to account for maintenance, vegetation, siltation, etc.

It is important to establish on-site stormwater disposal systems near the locations and depths where the testing was performed in order to rely on the tested field rates. The actual infiltration rates of installed systems can vary from the values presented in Table 1. We recommend the design infiltration values for the stormwater disposal system be confirmed by field testing completed during installation. The results of the field testing might necessitate that the system be enlarged to achieve the design infiltration rate.

The infiltration flow rate of a disposal system will diminish over time as suspended solids and precipitates in the stormwater slowly clog the void spaces between the soil particles. Eventually, the infiltration system may fail and will need to be replaced. We recommend the infiltration system include an overflow that is connected to a suitable discharge point. Finally, infiltration systems will cause localized high groundwater levels; therefore, the infiltration system should not be located near basement walls, retaining walls, or other embedded structures, unless these are specifically designed to account for the resulting hydrostatic pressure. The infiltration system should not be located on sloping ground, unless it is approved by a geotechnical engineer.

TURF FIELD

We anticipate that the playing field will consist of synthetic turf material. The turf should be installed in accordance with the manufacturer's recommendations over a drainage layer as discussed in the "Drainage" section. Subgrade should be prepared in accordance with the "Site Preparation" section. The greatest demand on the subgrade will be during construction when earthwork equipment performs grading work. Subgrade protection will be critical to the long-term performance of the field, especially during the wet season. Cement amendment of the subgrade could be considered for subgrade protection during construction, especially during wet weather construction. Not only will cement-amended subgrade provide protection during original construction, it will also provide subgrade protection if the turf needs to be replaced in the future.

DRAINAGE

The turf base can consist of aggregate base or drain rock as discussed in the "Structural Fill" section. Subsurface drainpipes should be installed within the aggregate base course to convey water to the stormwater disposal system. In general, a minimum 6-inch-thick layer of drainage aggregate in conjunction with drainage lines (AdvanEdge or similar installed in a herringbone arrangement with a spacing of approximately 15 feet center-to-center) is required to convey water to perimeter drains. However, the thickness of the aggregate base course for the turf field will likely be controlled by subgrade support during construction. It may be necessary to increase the aggregate base layer to 12 inches during the wet season to support repeated construction traffic. Alternatively, the subgrade below the drainage layer can be cement amended instead of increasing aggregate thickness, as discussed in the "Subgrade Protection" section. We note that cement-amended soil has very low permeability and will preclude direct stormwater infiltration.

The turf drainage system should be capable of handling flow from high groundwater that could occur during periods of extreme precipitation. If a drainage shock pad is used (such as the Brock PowerBase), then a reduced thickness of drainage aggregate can be used in conjunction with a stabilized subgrade.

FOUNDATION SUPPORT

We recommend that the safety netting supports be established on intermediate foundations to resist overturning moments. We recommend that drilled concrete piers be used for deep foundation support. Recommendations for drilled piers are presented below.

Drilled Pier Foundations

A drilled pier foundation system will likely consist of concrete piers drilled open-hole into the native gravel. We recommend that drilled piers be embedded at least 5 feet below finished grade and proportioned using a net allowable end bearing pressure of 5 kips per square foot. We expect that the depth of foundations will be determined based on lateral loads, torsion, and uplift capacity. Uplift capacity is derived from side friction and the weight of the pier. We recommend that side friction be computed using a uniform adhesion value of 300 pounds per square foot. This value includes a safety factor of 2.0. The dead weight of the pier can be added to the frictional capacity without reducing by a safety factor.

We estimate that settlement of drilled piers due to static loading will be ½ inch or less, provided the pier excavation is prepared in accordance with the “Construction Considerations” section. This estimate does not include elastic compression of the piers, which is also expected to be small, or potential liquefaction-induced settlement.

Lateral Resistance Design Parameters

Lateral response of pier foundations should be estimated using the LPILE computer software program, or similar. The recommended soil parameters for development of p-y curves and use with LPILE are presented in Table 3. If a passive resistance value is used for design of deep foundations, we recommend using a value of 300 pounds per cubic foot (pcf) in the sand/gravel fill material and 375 pcf in the native gravel material, provided that up to 1 inch of lateral displacement is acceptable at the top of the foundation.

Table 3. LPILE Input Parameters

Depth (feet BGS)	LPILE Soil Type	Unit Weight (pcf)	Friction Angle, ϕ	Static Soil Modulus, k (pci)
0 to 4	Sand (Reese)	115	30	30
Greater than 4	Sand (Reese)	130	40	250

pci: pounds per cubic inch

Construction Considerations

The base of the excavated pier cavity should be relatively free of excess debris resulting from pier excavation. This may require a cleanout barrel or bucket to be turned at the base of the excavation when the desired design depths are achieved.

We recommend careful observation of the drilled pier foundation installation be conducted by qualified personnel to verify that subsurface soil conditions are as anticipated. Drilled piers should be installed with suitable alignment tolerances. Drilled piers with steel reinforcement cages should be installed with a vertical alignment within 5 percent of plumb. Lateral alignment should be within tolerances determined by the design team.

The base of the excavated pier cavity should be relatively free of excess debris resulting from pier excavation. This will require a cleanout barrel or bucket to be turned at the base of the excavation when the desired design depths are achieved. Cobbles in the sand soil may lead to difficult drilled pier excavations as they have the potential to “roll” around the auger and cause belling or caving of the pier sidewalls. A core barrel, mud bucket, or other enclosed auger has proved successful on other jobs for removing cobbles and boulders from pier excavations.

If a pier is poured in the "wet," concrete must be placed at the bottom of the pier cavity using a tremie pipe. If water is not present in an excavation, concrete may be placed using the "free fall" method, provided a centralizer is used to ensure that the concrete does not contact the rebar cage on its flight to the pier bottom and "separation" of the concrete is prevented.

SITE PREPARATION

Stripping

The existing root zone should be stripped and removed from all improvement areas. Based on our explorations, the root zone thickness is approximately 3 inches, although greater stripping depths may be required to remove localized zones of loose or organic soil. The actual stripping depth should be based on field observations at the time of construction. Stripped material should be transported off site for disposal or as required by the project specifications. Given the moisture-sensitive subgrade, special construction procedures will likely be required to protect the subgrade as discussed below.

Subgrade Protection

Earthwork planning, regardless of the time of year, should include considerations for minimizing subgrade disturbance. Therefore, we recommend the following considerations to assist in protecting the subgrade from damage and the associated risk of repair or reconstruction of the subgrade and drainage layer.

- To the extent possible, construction traffic should be track-mounted vehicles.
- Heavy construction traffic should only be allowed on the field after subgrade protection measures are in place. During the dry season, subgrade protection can likely be accomplished with a minimum of 6 inches of aggregate base. During the wet season, this thickness may need to be increased to 12 inches or the subgrade below the aggregate base should be cement amended in accordance with the "Cement Amendment" section.
- Grading should be completed with track-mounted equipment, with finished grading kept to a minimum with lightweight graders.
- Compaction should be completed using maximum 3-foot rollers and carefully monitored such that vibration does not damage the subgrade soil.

We note that these procedures will also be required if the turf is replaced at later date.

Subgrade Evaluation

A member of our geotechnical staff should observe exposed structural subgrade after stripping and site cutting have been completed to determine if there are areas of unsuitable or unstable soil. Our representative should observe a proof roll of structural fill, pavement, and field subgrade with a fully loaded dump truck or similar heavy, rubber tire construction equipment to identify soft, loose, or unsuitable areas. In areas not accessible to proof rolling equipment, the subgrade should be evaluated by probing. Areas identified as soft, unstable, or otherwise unsuitable should be over-excavated and replaced with compacted material recommended for structural fill. Areas that appear too wet or soft to support proof rolling or compaction equipment should be evaluated by probing and prepared in accordance with the "Subgrade Protection" section.

EXCAVATION

General

Conventional earthmoving equipment in proper working conditions should generally be capable of making necessary excavations for site cuts and utilities in the on-site soil. Excavation difficulty will increase in the native gravel. Vertical excavation sidewalls will likely experience caving in the sand and gravel soil. Open excavation techniques may be used, provided the walls of the excavation are cut at a slope of 1.5 horizontal to 1 vertical and groundwater seepage is not present. In lieu of large and open cuts, approved temporary shoring may be used for excavation support. A variety of shoring systems are available; consequently, we recommend that the contractor be responsible for selecting the appropriate system.

If box shoring is used, it should be understood that box shoring is a safety feature used to protect workers and does not prevent caving. Caving of the sidewalls may occur. The presence of caved material will limit the ability to properly backfill and compact the trenches. The contractor should be prepared to fill voids between the box shoring and the sidewalls of the trenches with sand or gravel before caving occurs.

Excavations should be made in accordance with applicable Occupational Safety and Health Administration and state regulations. While this report describes certain approaches to excavation, the contractor should be responsible for selecting excavation methods, dewatering, monitoring the excavations for safety, and providing shoring as required to protect personnel and adjacent utilities and structures.

Dewatering

Groundwater was not observed within the borings. Groundwater could rise during periods of persistent wet weather. For shallow excavations less than approximately 10 feet BGS, it should be possible to remove groundwater encountered by pumping from a sump. Removed water should be routed to a suitable discharge point. While we have described certain approaches to excavation dewatering, it is the contractor's responsibility to select the dewatering methods.

TEMPORARY DRAINAGE

In addition to the erosion control measures (see “Erosion Control” section) during mass grading at the site, the contractor should be made responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface. During rough and finished grading of the site, the contractor should keep all prepared subgrade free of water.

EROSION CONTROL

The site contains predominantly coarse-grained material, but in some areas, the fine-grained soil at this site is eroded easily by wind and water; therefore, erosion control measures should be carefully planned and in place before construction begins, if necessary. Measures that can be employed to reduce erosion include the use of silt fences, hay bales, buffer zones of natural growth, sedimentation ponds, and granular haul roads. All erosion control methods should be in accordance with local jurisdiction standards. During earthwork at the site, the contractor should be responsible for temporary drainage of surface water as necessary to prevent standing water and/or erosion at the working surface.

MATERIALS

Structural Fill

General

Fill should be placed on subgrade that has been prepared in conformance with the "Site Preparation" section. A variety of material may be used as structural fill at the site. However, all material used as structural fill should be free of organic material or other unsuitable material and should meet the specifications provided in 2021 Oregon Standard Specifications for Construction (OSSC) 00330 (Earthwork), OSSC 00400 (Drainage and Sewers), and OSSC 02600 (Aggregates), depending on the application. A brief characterization of some of the acceptable materials and our recommendations for their use as structural fill are provided below. Fill should be compacted as described in the "Fill Placement and Compaction" section.

On-Site Soil

The on-site material should generally be suitable for use as general structural fill, provided it is properly moisture conditioned; free of debris, organic material, and particles over 8 inches in diameter; and meets the specifications provided in OSSC 00330.12 (Borrow Material). The undocumented sand fill is generally suitable for use as structural fill during periods of dry weather and possibly during light precipitation. The sand will be difficult to compact during the wet season when it becomes saturated. The on-site gravel (native and fill) is rounded to subrounded. When rounded particles are touching, they will tend to roll during compaction, making it difficult to achieve compaction standards. The on-site gravel should be crushed to have at least two fractured faces or adequately nested in a sand/gravel matrix to minimize contact between rounded sides.

Imported Granular Material

Imported granular material used as structural fill should be pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.14 (Selected Granular Backfill) or OSSC 00330.15 (Selected Stone Backfill). The imported granular material should also be angular, should be fairly well graded between coarse and fine material, should have less than 6 percent by dry weight passing the U.S. Standard No. 200 sieve, and should have at least two fractured faces.

Aggregate Base Rock

Imported granular material used as base rock should consist of ¾- or 1½-inch-minus material (depending on the application) and meet the requirements in OSSC 00641 (Aggregate Subbase, Base, and Shoulders). The aggregate should have at least two mechanically fractured faces. In addition, the aggregate should have less than 6 percent by dry weight passing the U.S. Standard No. 200 sieve.

Trench Backfill

Trench backfill placed beneath, adjacent to, and for at least 12 inches above utility lines (i.e., the pipe zone) should consist of well-graded granular material with a maximum particle size of 1½ inches and less than 10 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.13 (Pipe Zone Material). Within roadway alignments, the remainder of the trench backfill up to the subgrade elevation should consist of well-graded granular material with a maximum particle size of 2½ inches and less than

10 percent by dry weight passing the U.S. Standard No. 200 sieve and should meet the specifications provided in OSSC 00405.14 (Trench Backfill; Class B, C, or D).

Outside of structural improvement areas (e.g., roadway alignments or building pads), trench backfill placed above the pipe zone may consist of general fill material that is free of organic material and material over 6 inches in diameter and meets the specifications provided in OSSC 00405.14 (Trench Backfill; Class A, B, C, or D).

Stabilization Material

Stabilization material at the field will help provide a stable base for construction of the turf during dry weather. If soft areas are identified during construction, subgrade stabilization can be achieved using 12 to 24 inches of stabilization material or 12 inches of cement-amended subgrade. The stabilization material should consist of 4- or 6-inch-minus pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the specifications provided in OSSC 00330.15 (Selected Stone Backfill). The material should have a maximum particle size of 6 inches, should have less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and should have at least two mechanically fractured faces. The material should be free of organic material and other deleterious material. Stabilization material should be placed in lifts between 12 and 24 inches thick and compacted to a firm condition.

Drain Rock

Drain rock should consist of angular, granular material with a maximum particle size of 2 inches and should meet the specifications provided in OSSC 00430.11 (Granular Drain Backfill Material). The material should be free of roots, organic material, and other unsuitable material; should have less than 2 percent by dry weight passing the U.S. Standard No. 200 sieve (washed analysis); and should have at least two mechanically fractured faces. Drain rock should be compacted to a well-keyed, firm condition.

Geotextile Fabric

Subgrade Geotextile

Subgrade geotextile should conform to OSSC Table 02320-4 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

Drainage Geotextile

Drainage geotextile should conform to Type 2 material of OSSC Table 02320-1 and OSSC 00350 (Geosynthetic Installation). A minimum initial aggregate base lift of 6 inches is required over geotextiles.

Cement Amendment

General

In order to stabilize the subgrade if earthwork occurs during the wet season, an experienced contractor may be able to amend the on-site soil with portland cement to obtain suitable support properties. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities.

Subgrade Stabilization

We recommend a target strength for cement-amended subgrade subbase (below aggregate base) soil of 150 pounds per square inch. Successful use of soil amendment depends on use of correct techniques and equipment, soil moisture content, and the amount of cement added to the soil. The recommended percentage of cement is based on soil moisture contents at the time of placing the structural fill. Based on our experience, 6 percent cement by weight of dry soil is generally satisfactory when the soil moisture content does not exceed approximately 25 percent. If the soil moisture content is in the range of 25 to 35 percent, 7 to 9 percent by weight of dry soil is recommended. It is difficult to accurately predict field performance due to the variability in soil response to cement amendment. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Moreover, depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content. The amount of cement used during amendment should be based on an assumed soil dry unit weight of 110 pcf. For preliminary design purposes, we recommend a minimum of 6 percent cement. It may be possible to reduce this to 5 percent if work occurs during the dry season. It may be necessary to inject water into the sand fill during the tilling process if the material has a low moisture content. It is not possible to amend soil during heavy or continuous rainfall. Work should be completed during suitable conditions.

We recommend cement-spreading equipment be equipped with balloon tires to reduce rutting and disturbance of the fine-grained soil. A static sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds should be used for initial compaction of the fine-grained soil. A smooth-drum roller with a minimum applied linear force of 700 pounds per inch should be used for final compaction.

A minimum curing time of four days is required between amendment and construction traffic access. Construction traffic should not be allowed on unprotected, cement-amended subgrade. To protect the cement-amended surfaces from abrasion or damage, the finished surface should be covered with 4 to 6 inches of imported granular material.

Cement amendment should not be attempted when the air temperature is below 40 degrees Fahrenheit or during moderate to heavy precipitation. Cement should not be placed when the ground surface is saturated or standing water exists.

Other Considerations

Portland cement-amended soil is hard and has low permeability. This soil does not drain well and it is not suitable for planting. Future planted areas should not be cement amended, if practical, or accommodations should be made for drainage and planting. The field drainage system must be constructed over the cement-amended soil since cement-amended soil will be essentially impermeable.

Specification Recommendations

We recommend that the following comments be included in the specifications for the project:

- In general, cement amendment is not recommended during the cold weather (temperatures less than 40 degrees Fahrenheit) or during steady rainfall.
- Mixing Equipment
    - Use a pulverizer/mixer capable of uniformly mixing the cement into the soil to the design depth. Blade mixing will not be allowed.
    - Pulverize the soil-cement mixture such that 100 percent by dry weight passes a 1-inch sieve and a minimum of 70 percent passes a No. 4 sieve, exclusive of gravel or stone retained on these sieves. If water is required, the pulverizer should be equipped to inject water to a tolerance of ¼ gallon per square foot of surface area.
    - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the pulverizer/mixer vehicle. If subgrade is disturbed, the tilling/amendment depth shall extend the full depth of the disturbance.
    - Multiple "passes" of the tiller will likely be required to adequately blend the cement and soil mixture.
- Spreading Equipment
    - Use a spreader capable of distributing the cement uniformly on the ground to within 5 percent variance of the specified application rate.
    - Use machinery that will not disturb the subgrade, such as using low-pressure "balloon" tires on the spreader vehicle. If subgrade is disturbed, the tilling/amendment depth shall extend the full depth of the disturbance.
- Compaction Equipment
    - Use a static, sheepsfoot or segmented pad roller with a minimum static weight of 40,000 pounds for initial compaction of fine-grained soil (silt and clay) or an alternate approved by the geotechnical engineer.

FILL PLACEMENT AND COMPACTION

Fill soil should be compacted at a moisture content that is within 3 percent of optimum. The maximum allowable moisture content varies with the soil gradation and should be evaluated during construction. Fill and backfill material should be placed in uniform, horizontal lifts and compacted with the appropriate equipment. The maximum lift thickness will vary depending on the material and compaction equipment used, but should generally not exceed the loose thicknesses provided in Table 4. Fill material should be compacted in accordance with the compaction criteria provided in Table 5.

Table 4. Recommended Uncompacted Lift Thickness

Compaction Equipment	Recommended Uncompacted Lift Thickness (inches)		
	Fine-Grained Soil	Granular and Crushed Rock Maximum Particle Size ≤ 1½ Inches	Crushed Rock Maximum Particle Size > 1½ Inches
Hand tools: Plate compactor and jumping jack	4 to 8	4 to 8	Not recommended
Rubber tire equipment	6 to 8	10 to 12	6 to 8
Light roller	8 to 10	10 to 12	8 to 10
Heavy roller	10 to 12	12 to 18	12 to 16
Hoe pack equipment	12 to 16	18 to 24	18 to 24

The table above is based on our experience and is intended to serve only as a guideline. The information provided in this table should not be included in the project specifications.

Table 5. Compaction Criteria

Fill Type	Compaction Requirements in Structural Zones		
	Percent Maximum Dry Density Determined by ASTM D1557		
	0 to 2 Feet Below Subgrade (percent)	Greater Than 2 Feet Below Subgrade (percent)	Pipe Zone (percent)
Area fill (granular)	95	95	–
Area fill (fine grained)	92	92	--
Aggregate bases	95	95	–
Trench backfill[1]	95	92	90[1]
Retaining wall backfill	95[2]	92[2]	–

1. Trench backfill above the pipe zone in non-structural areas should be compacted to 85 percent or as recommended by the pipe manufacturer.
2. Should be reduced to 90 percent within a horizontal distance of 3 feet from the retaining wall.

OBSERVATION OF CONSTRUCTION

Satisfactory foundation and earthwork performance depends to a large degree on quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface exploration. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to detect if subsurface conditions change significantly from those anticipated.

We recommend that NV5 be retained to observe earthwork activities, including stripping, proof rolling of the subgrade and repair of soft areas, footing subgrade preparation, final proof rolling of the subgrade and base rock, and AC placement and compaction, and performing laboratory compaction and field moisture-density testing.

LIMITATIONS

We have prepared this report for use by Willamette University and members of the design and construction teams for the proposed development. The data and report can be used for estimating purposes, but our report, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations indicate soil conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The site development plans and design details were not finalized at the time this report was prepared. When the design has been finalized and if there are changes in the site grades, location, or configuration; design loads; or type of construction, the conclusions and recommendations presented may not be applicable. If design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor’s methods, techniques, sequences, or procedures, except as specifically described in this report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this report was prepared. No warranty or other conditions, express or implied, should be understood.

◆ ◆ ◆

We appreciate the opportunity to be of service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

NV5

Staci Butler

Staci R. Butler, G.I.T.
Technical Specialist

Zane M. Rogers, P.E.
Project Engineer

Scott

Scott McDevitt, P.E., G.E.
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
63094
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JULY 11, 2000
SCOTT P. McDEVITT
EXPIRES: 12/31/24

cc: Matt Koehler, Cameron McCarthy

SRB:ZMR:SPM:kt
Attachments
One copy submitted
Document ID: WillUniv-16-01-070723-geolr.docx

REFERENCES

ASCE, 2016. *Minimum Design Loads and Associated Criteria for Buildings and Other Structures.* ASCE Standard ASCE/SEI 7-16.

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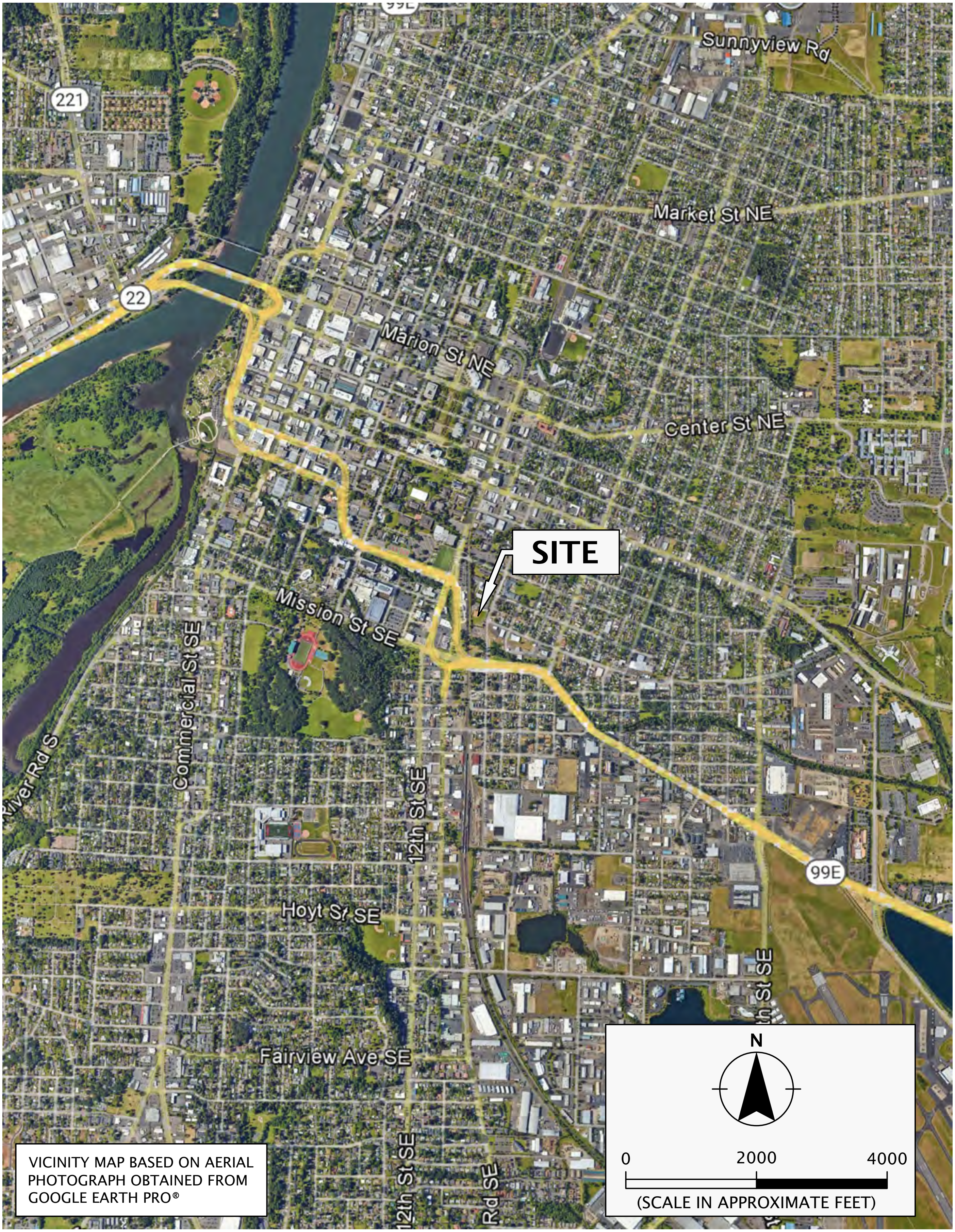
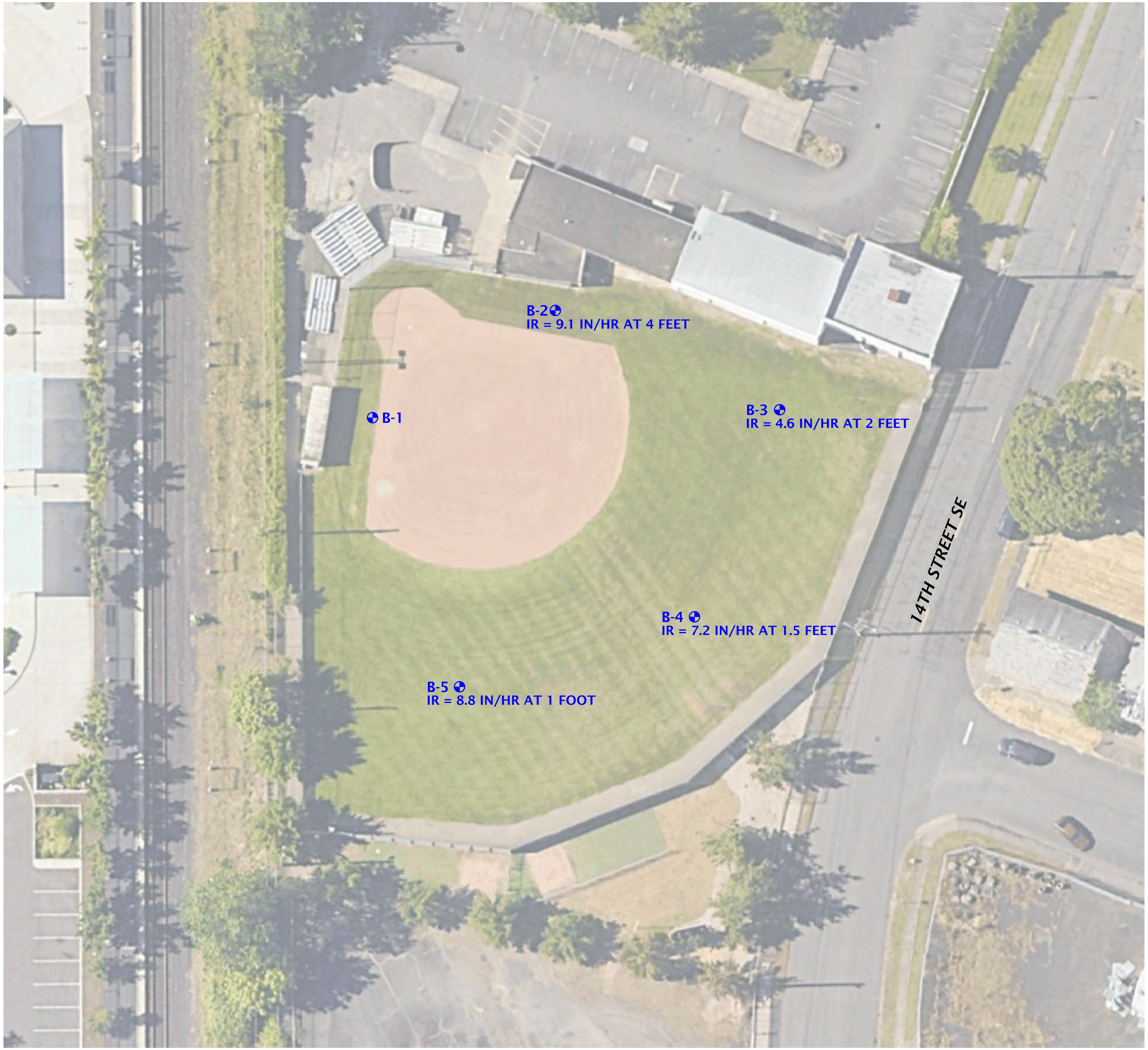
FIGURES



VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

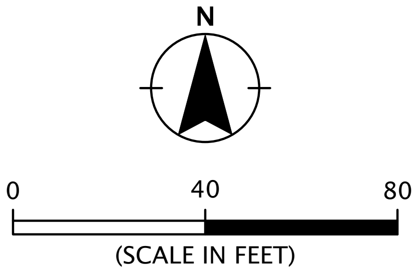
WILLUNIV-16-01	**VICINITY MAP**	
JULY 2023	WILLAMETTE UNIVERSITY SOFTBALL FIELD SALEM, OR	**FIGURE 1**

Printed By: aday | Print Date: 7/5/2023 3:51:07 PM
File Name: J:\S-Z\WillUniv\WillUniv-16\WillUniv-16-01\Figures\CAD\WillUniv-16-01-VM01.dwg | Layout: FIGURE 1



LEGEND:

B-1 ●	BORING
IR = 9.1 IN/HR AT 4 FEET	UNFACTORED INFILTRATION RATE



SITE PLAN BASED ON AERIAL PHOTOGRAPH DATED
JUNE 25, 2022, OBTAINED FROM GOOGLE EARTH PRO.

FIGURE 2

SITE PLAN

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

WILLUNIV-16-01

JULY 2023

NV5

Printed By: aday | Print Date: 7/5/2023 3:51:10 PM
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ATTACHMENT

ATTACHMENT

FIELD EXPLORATIONS

GENERAL

We explored subsurface conditions at site by drilling five borings (B-1 through B-5) to depths between 5.5 and 9 feet BGS. Drilling services were provided by Dan J. Fisher Excavating, Inc. on May 31, 2023, using a trailer-mounted drill rig and solid-stem auger drilling techniques. The exploration logs are presented in this attachment.

The approximate exploration locations are shown on Figure 2. The locations were determined in the field by pacing or measuring from existing site features. This information should be considered accurate only to the degree implied by the methods used.

SOIL SAMPLING

Disturbed soil samples were collected from the drilled borings using 1½- and 3-inch-inside-diameter, split-spoon SPT samplers in general accordance with ASTM D1586. Each sampler was driven into the soil with a 140-pound hammer free falling 30 inches. Each sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler 12 inches is recorded on the exploration logs, unless otherwise noted. Representative disturbed samples of soil were collected from the drill cuttings. Sampling methods and intervals are shown on the exploration logs.

The hammer used to conduct the SPTs was lifted using a rope and cathead system. The hammer was raised using two wraps of the rope around the cathead.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the “Exploration Key” (Table A-1) and “Soil Classification System” (Table A-2), which are presented in this attachment. The exploration logs indicate the depths at which the soils or their characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications.

MOISTURE CONTENT

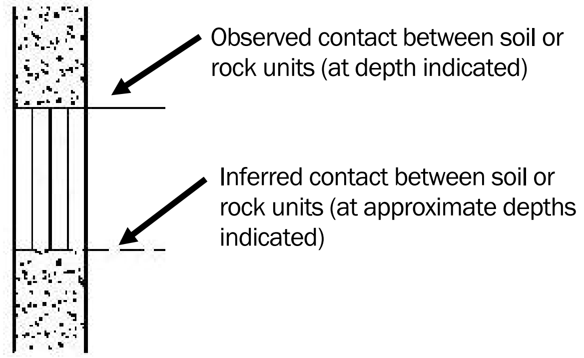
The natural moisture content of select soil samples was determined in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to soil in a test sample and is expressed as a percentage. The test results are presented in this attachment.

PARTICLE-SIZE ANALYSIS

Particle-size analysis was performed on select soil samples general accordance with ASTM D1140. This test is a quantitative determination of the amount of material finer than the U.S. Standard No. 200 sieve expressed as a percentage of soil weight. The test results are presented in this attachment.

SYMBOL	SAMPLING DESCRIPTION
◫	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test (SPT) with recovery
◧	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery
▤	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery
▦	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery
⧅	Location of sample collected using 3-inch-outside diameter California split-spoon sampler and 140-pound hammer with recovery
⊠	Location of grab sample
▮	Rock coring interval
▽	Water level during drilling
▼	Water level taken on date shown

Graphic Log of Soil and Rock Types



GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torvane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
NP	Non-Plastic	kPa	Kilopascal
OC	Organic Content		

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

NIV5

EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOIL

Relative Density	Standard Penetration Test (SPT) Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very loose	0 – 4	0 – 11	0 – 4
Loose	4 – 10	11 – 26	4 – 10
Medium dense	10 – 30	26 – 74	10 – 30
Dense	30 – 50	74 – 120	30 – 47
Very dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOIL

Consistency	Standard Penetration Test (SPT) Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 – 4	3 – 6	2 – 5	0.25 – 0.50
Medium stiff	4 – 8	6 – 12	5 – 9	0.50 – 1.0
Stiff	8 – 15	12 – 25	9 – 19	1.0 – 2.0
Very stiff	15 – 30	25 – 65	19 – 31	2.0 – 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SAND WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOIL			PT	PEAT

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.

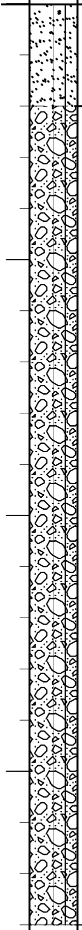
Percent	Silt and Clay In:		Percent	Sand and Gravel In:	
	Fine-Grained Soil	Coarse-Grained Soil		Fine-Grained Soil	Coarse-Grained Soil
< 5	trace	trace	< 5	trace	trace
5 – 12	minor	with	5 – 15	minor	minor
> 12	some	silty/clayey	15 – 30	with	with
			> 30	sandy/gravelly	Indicate %

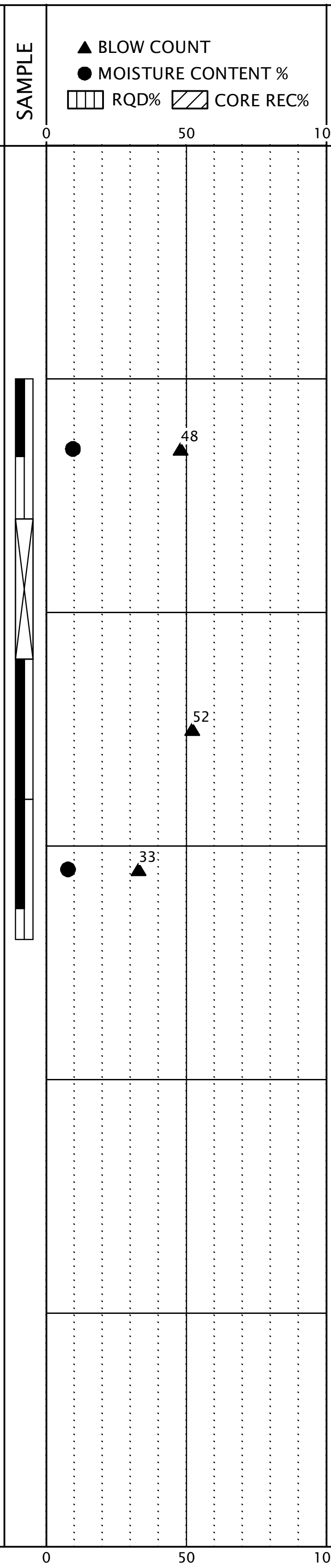
NIV5

SOIL CLASSIFICATION SYSTEM

TABLE A-2

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	INSTALLATION AND COMMENTS
0.0	Loose, brown SAND with silt (SP-SM); moist, sand is fine to medium (3-inch-thick root zone) - **FILL**.		Relative density inferred based on drilling speed.
	Dense, gray to brown GRAVEL with silt and sand (GP-GM); moist, gravel is rounded to subrounded.	1.0	
2.5			
5.0	very dense, gray to brown with red and yellow mottles at 5.5 feet		
	dense at 7.0 feet		
7.5			
	Exploration terminated at a depth of 9.0 feet due to refusal. SPT completed using two wraps with a cathead.	9.0	Surface elevation was not measured at the time of exploration.
10.0			
12.5			
15.0			





DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: S. Butler
COMPLETED: 05/31/23

BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches

NV5

WILLUNIV-16-01

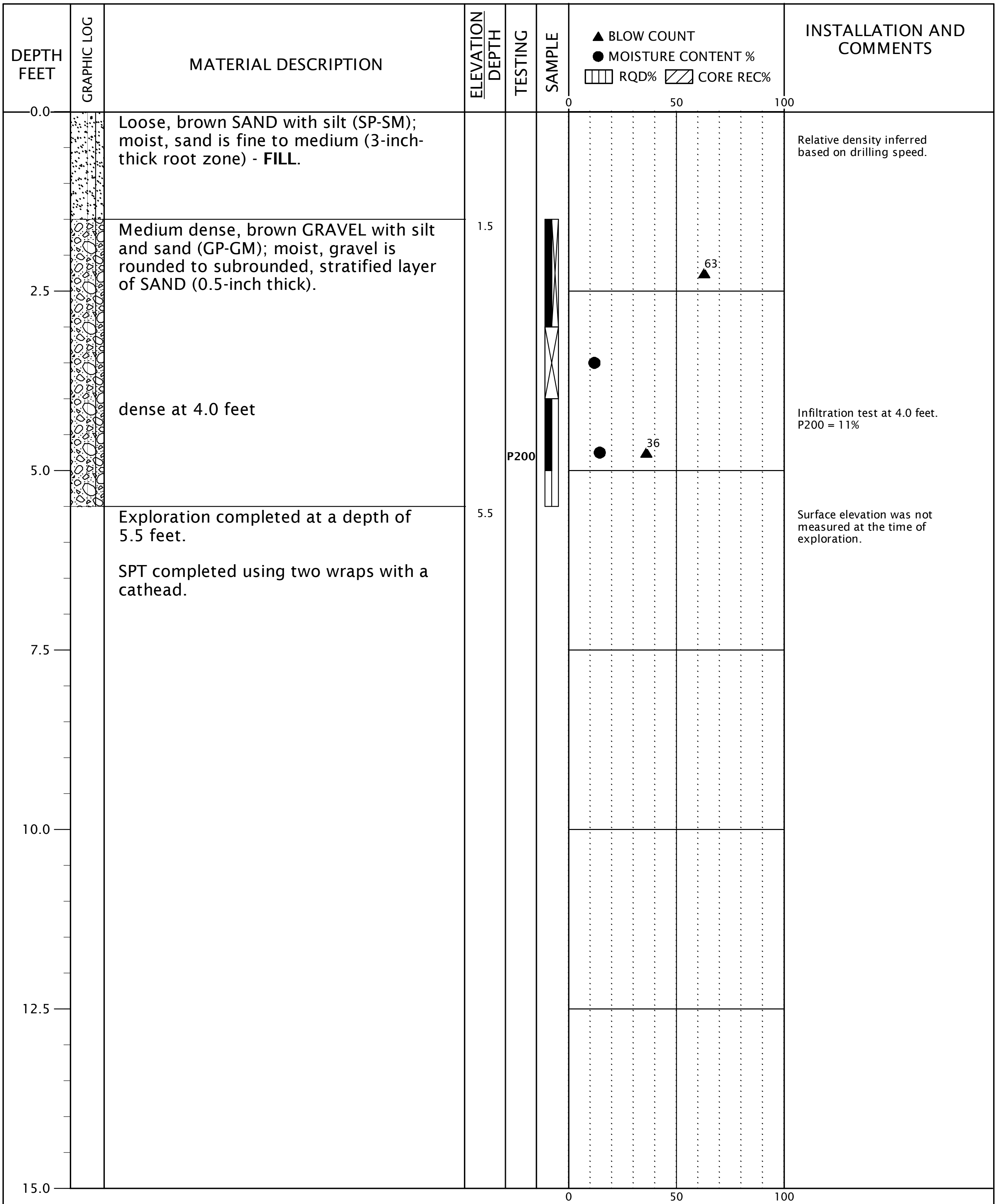
JULY 2023

BORING B-1

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-1

BORING LOG - NV5 - 1 PER PAGE WILLUNIV-16-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 7/5/23:KT



Loose, brown SAND with silt (SP-SM); moist, sand is fine to medium (3-inch-thick root zone) - **FILL**.

Relative density inferred based on drilling speed.

Medium dense, brown GRAVEL with silt and sand (GP-GM); moist, gravel is rounded to subrounded, stratified layer of SAND (0.5-inch thick).

dense at 4.0 feet

Infiltration test at 4.0 feet.
P200 = 11%

Exploration completed at a depth of 5.5 feet.

SPT completed using two wraps with a cathead.

Surface elevation was not measured at the time of exploration.

DRILLED BY: Dan J. Fischer Excavating, Inc.
LOGGED BY: S. Butler
COMPLETED: 05/31/23

BORING METHOD: solid-stem auger (see document text)
BORING BIT DIAMETER: 4 inches

WILLUNIV-16-01

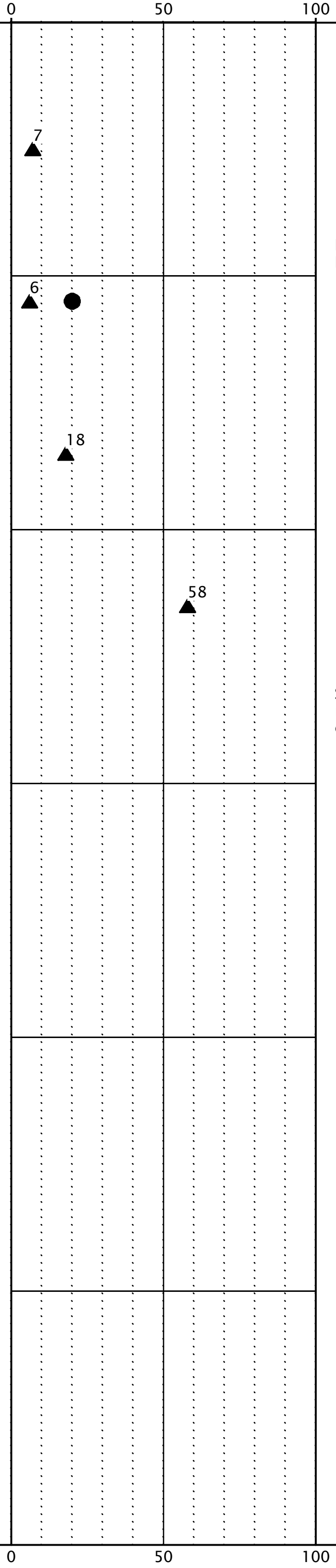
JULY 2023

BORING B-2

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % ▥ RQD% ▨ CORE REC%	INSTALLATION AND COMMENTS
0.0		Very loose, brown SAND with silt (SP-SM), trace gravel; moist, sand is fine to medium (3-inch-thick root zone) - **FILL**.					
		Loose, brown, silty GRAVEL with sand (GM); moist - **FILL**.	1.5				
		Loose, brown, silty SAND (SM), trace gravel; moist - **FILL**.	2.0				Infiltration test at 2.0 feet. P200 = 17%
2.5				P200			
		medium dense at 3.5 feet					
		Medium dense, brown to gray with yellow mottled GRAVEL with silt and sand (GP-GM); moist, gravel is rounded to subrounded. very dense at 5.0 feet	4.0				
5.0							
		Exploration completed at a depth of 6.5 feet. SPT completed using two wraps with a cathead.	6.5				Surface elevation was not measured at the time of exploration.
7.5							
10.0							
12.5							
15.0							



DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: S. Butler

COMPLETED: 05/31/23

BORING METHOD: solid-stem auger (see document text)

BORING BIT DIAMETER: 4 inches

WILLUNIV-16-01

JULY 2023

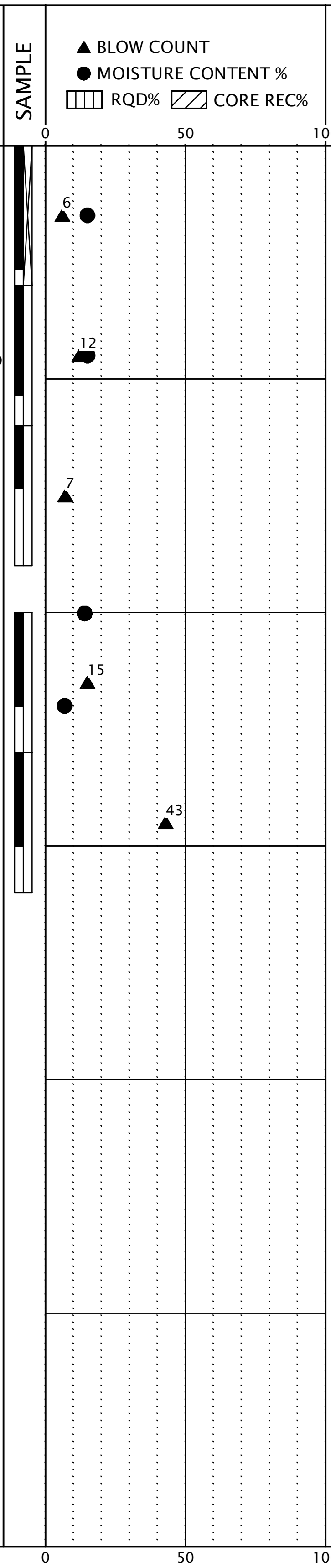
BORING B-3

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-3

BORING LOG - NV5 - 1 PER PAGE WILLUNIV-16-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 7/5/23:KT

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
0.0	Very loose, brown, silty SAND (SM); moist (3-inch-thick root zone) - **FILL**.			
	medium dense at 1.5 feet			Infiltration test at 1.5 feet. P200 = 15%
	trace gravel; stratified bed of black SILT (0.5 inch thick) at 2.0 feet		P200	
2.5				
	loose at 3.0 feet			
5.0	medium dense at 5.0 feet			
	Dense, gray to brown with yellow mottled GRAVEL with silt and sand (GP-GM); moist.	6.0		
7.5				
	Exploration completed at a depth of 8.0 feet. SPT completed using two wraps with a cathead.	8.0		Surface elevation was not measured at the time of exploration.
10.0				
12.5				
15.0				



DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: S. Butler

COMPLETED: 05/31/23

BORING METHOD: solid-stem auger (see document text)

BORING BIT DIAMETER: 4 inches

NV5

WILLUNIV-16-01

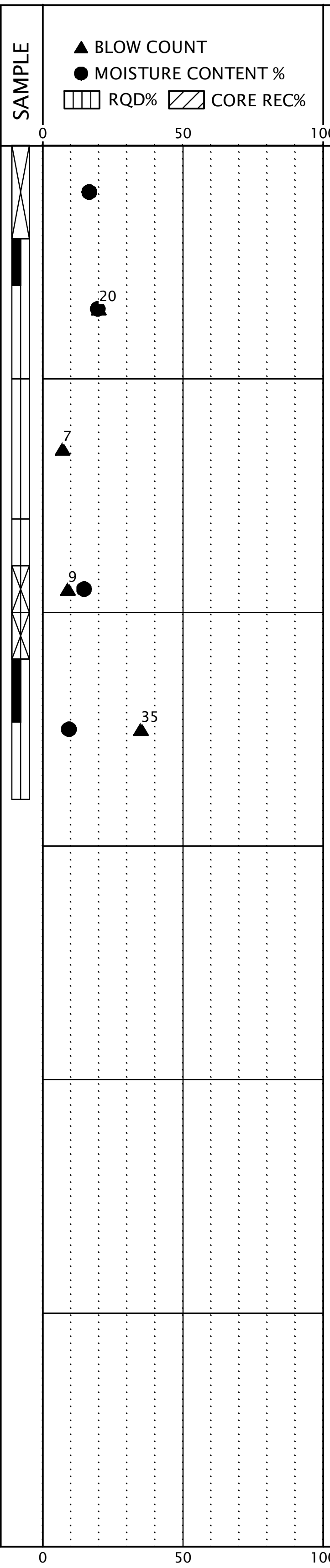
JULY 2023

BORING B-4

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-4

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
0.0	Medium dense, brown, silty SAND (SM); moist (3-inch-thick root zone) - **FILL**.		P200	Infiltration test at 1.0 foot. P200 = 15%
2.5	Loose, dark brown, silty GRAVEL with sand (GM); moist - **FILL**.	2.2		
5.0	Soft, brown, sandy SILT (ML); moist.	5.0		
	Dense, gray-brown GRAVEL with silt and sand (GP-GM); moist, gravel is rounded to subrounded.	5.5		
7.5	Exploration completed at a depth of 7.0 feet. SPT completed using two wraps with a cathead.	7.0		Surface elevation was not measured at the time of exploration.
10.0				
12.5				
15.0				



DRILLED BY: Dan J. Fischer Excavating, Inc.

LOGGED BY: S. Butler

COMPLETED: 05/31/23

BORING METHOD: solid-stem auger (see document text)

BORING BIT DIAMETER: 4 inches

NV5

WILLUNIV-16-01

JULY 2023

BORING B-5

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-5

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-1	2.5		9							
B-1	7.0		8							
B-2	3.0		12							
B-2	4.0		14				11			
B-3	2.0		20				17			
B-4	0.0		15							
B-4	1.5		15				15			
B-4	5.0		14							
B-4	6.0		7							
B-5	0.0		17							
B-5	1.0		20				15			
B-5	4.5		15							
B-5	5.5		9							

LAB SUMMARY - GDI-NV5 WILLUNIV-16-01-B1_5.GPJ GDI_NV5.GDT PRINT DATE: 7/5/23:KT

NV5

WILLUNIV-16-01

JULY 2023

SUMMARY OF LABORATORY DATA

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-6

MEMORANDUM

To:	Mark Mazurier	From:	Staci Butler, G.I.T. Hayden D. Gluck, P.E.
Company:	Willamette University	Date:	September 4, 2024
Address:	900 State Street Salem, OR 97301		
cc:	Matt Koehler, Cameron McCarthy		
Project No.:	WillUniv-16-01		
RE:	Addendum 1 Additional Geotechnical Engineering Services Willamette University Softball Field Improvements 501 14th Street SE Salem, Oregon		

INTRODUCTION

NV5 provided geotechnical recommendations for several sites on the Willamette University Campus in the past, including the softball field in a report dated July 2023.[1] The report included information related to site development and on-site disposal of stormwater. This addendum provides additional infiltration test results, soil and groundwater exploration data, and laboratory test results.

SCOPE OF SERVICES

The purpose of our scope was to explore subsurface conditions at an additional location on-site to inform additional geotechnical recommendations for design and construction of stormwater facilities. The specific scope of our services is summarized as follows:

- Coordinated and managed the field explorations, including public and private utility locates and scheduling subcontractors and NV5 field staff.
- Drilled one boring to a depth of 15.2 feet below ground surface (BGS).
- Performed one infiltration test at a depth of 2.5 feet BGS in an area requested by the civil engineer.
- Reported the measured infiltration rate observed during the testing.
- Collected soil samples for laboratory testing and maintained a log of subsurface conditions encountered in the explorations.
- Performed the following laboratory tests on samples collected from the explorations:

---

[1] NV5, 2023. *Report of Geotechnical Engineering Services; Willamette University Softball Field Improvements; 501 14th Street SE; Salem, Oregon*, dated July 7, 2023. Project: WillUniv-16-01

  - Four moisture content determinations in general accordance with ASTM D2216
  - Three particle-size analyses in general accordance with ASTM D1140 or ASTM C117
- Prepared this addendum to our geotechnical report summarizing the results of our additional subsurface investigation.

SITE CONDITIONS

SURFACE CONDITIONS

Based on correspondence with the civil engineer, the anticipated stormwater facility is in the area of the existing Willamette University Softball Field. A detailed description of site surface conditions is presented in our July 2023 geotechnical report.

SUBSURFACE CONDITIONS

We previously explored subsurface conditions at the site by drilling five borings (B-1 through B-5) to depths between 5.5 and 9 feet BGS. We recently explored subsurface conditions at the site by drilling one additional boring (B-6) to a depth of 15.2 feet BGS. The approximate exploration location is shown on Figure 1. A description of the current field explorations and laboratory testing program, the exploration logs, and laboratory testing results are presented in the Attachment.

We encountered a 12-inch-thick layer of aggregate base rock at the surface in boring B-6. Underlying the aggregate base, we encountered a 4-foot-thick layer of brown-gray silty gravel fill.

Below the fill layer, gravel was encountered to a depth of 15.2 feet BGS. The gravel is silty and has varying proportions of sand. Standard penetration test (SPT) results indicate the gravel is very dense. Laboratory testing results of select samples indicate moisture contents of 7 to 14 percent and fines contents of 12 to 16 percent at the time of exploration.

Groundwater was observed at 10.5 feet BGS at the time of exploration. U.S. Geological Survey mapping and our experience with projects completed in the site vicinity indicate that groundwater is approximately 5 to 15 feet BGS. The depth to groundwater is expected to fluctuate in response to seasonal changes, changes in surface topography, and other factors not observed in the site vicinity.

INFILTRATION TESTING

Infiltration testing was conducted in boring B-6 to evaluate the feasibility and assist in design of on-site stormwater disposal facilities. Infiltration testing was conducted in the 4.25-inch-inside diameter hollow-stem augers in general accordance with the encased falling head test procedure. A representative soil sample was collected below the infiltration test depth for fines content determination. The boring was terminated at 15.2 feet BGS due to drilling refusal.

Table 1 summarizes the infiltration testing result and fines content determination. The exploration log and laboratory test results are presented in the Attachment.

Table 1. Infiltration Testing Results

Exploration	Depth (feet BGS)	Casing Diameter (inches)	Soil Description	Fines Content[1] (percent)	Observed Infiltration Rate[2] (inches per hour)
B-6	2.5	4.25	Silty GRAVEL - FILL	13	6.1

1. Fines content – material passing the U.S. Standard No. 200 sieve
2. In-situ infiltration rate observed in the field

The infiltration rates presented in Table 1 are unfactored. Correction factors should be applied to the measured infiltration rates to account for soil variations and the potential for long-term clogging due to siltation and buildup of organic material.

STORMWATER INFILTRATION SYSTEMS

Based on the results of additional infiltration testing, subsurface exploration data, and laboratory test results, recommendations for stormwater infiltration systems remain consistent with information published in our July 2023 geotechnical report.

LIMITATIONS

We have prepared this addendum for use by Willamette University and members of the design and construction team for the proposed project. The data and addendum can be used for estimating purposes, but our addendum, conclusions, and interpretations should not be construed as a warranty of the subsurface conditions and are not applicable to other sites.

Soil explorations indicate soil conditions only at specific locations and only to the depths penetrated. The soil explorations do not necessarily reflect soil strata or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary. In addition, if design changes are made, we should be retained to review our conclusions and recommendations and to provide a written evaluation or modification.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in this addendum for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with the generally accepted practices in this area at the time this addendum was prepared. No warranty or other conditions, express or implied, should be understood.

◆ ◆ ◆

We appreciate being of continued service to you on this project. Please call if you have questions concerning this addendum.

SRB:HDG
Attachments
One copy submitted
Document ID: WillUniv-16-01-090324-geoa.docx

REGISTERED PROFESSIONAL ENGINEER
87461PE
OREGON
NOVEMBER 13, 2018
HAYDEN DAVIS GLUCK
EXPIRES: 06/30/25

FIGURES

VICINITY MAP BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®

NV5	WILLUNIV-16-01	**VICINITY MAP**	
	SEPTEMBER 2024	WILLAMETTE UNIVERSITY SOFTBALL FIELD SALEM, OR	**FIGURE 1**

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File Name: \\nv5.com\shares\ORWIL\S-Z\WillUniv\willuniv-16\willuniv-16-01\Figures\CAD\Softball Infilt\WillUniv-16-01-VM01.dwg | Layout: FIGURE 1

SITE F
JUNE

ATTACHMENT

MEMORANDUM

ATTACHMENT

FIELD EXPLORATIONS

GENERAL

Subsurface conditions were explored by drilling one boring (B-6) to depths of 15.2 feet BGS. Drilling services were provided by Western States Soil Conservation, Inc. of Hubbard, Oregon, on July 24, 2024, using a truck-mounted drill rig with hollow-stem auger. The exploration log is presented in this attachment.

The approximate exploration locations are shown on Figure 1. The locations were determined in the field by pacing or measuring from existing site features. This information should be considered accurate only to the degree implied by the methods used.

A member of our geology staff observed the explorations and collected representative samples of the various soils encountered in the explorations for geotechnical laboratory testing.

SOIL SAMPLING

Disturbed soil samples were collected from the borings using 1½- and 3-inch-inside diameter, split-spoon SPT samplers in general accordance with ASTM D1586. Each sampler was driven into the soil with a 140-pound hammer free falling 30 inches. Each sampler was driven a total distance of 18 inches. The number of blows required to drive the sampler 12 inches is recorded on the exploration logs, unless otherwise noted. Disturbed samples were collected from the split barrel for subsequent classification and index testing. Sampling methods and intervals are shown on the exploration logs.

The average efficiency of the automatic SPT hammer used by Western States Soil Conservation, Inc. was 80.4 percent. The calibration testing results are presented at the end of this attachment.

SOIL CLASSIFICATION

The soil samples were classified in the field in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this attachment. The exploration logs indicate the depths at which the soil characteristics change, although the change actually could be gradual. If the change occurred between sample locations, the depth was interpreted. Classifications are shown on the exploration logs.

LABORATORY TESTING

CLASSIFICATION

The soil samples were classified in the laboratory to confirm field classifications. The laboratory classifications are shown on the exploration logs if those classifications differed from the field classifications.

MEMORANDUM

MOISTURE CONTENT

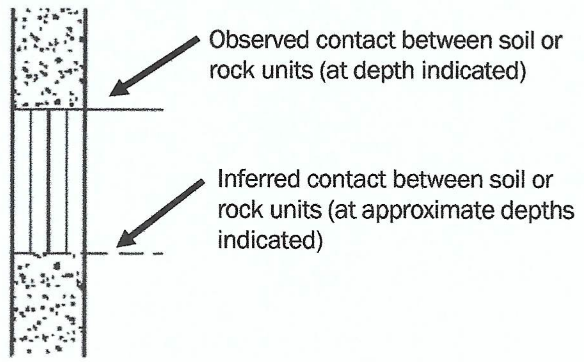
The natural moisture content of select soil samples was determined in general accordance with ASTM D2216. The natural moisture content is a ratio of the weight of the water to dry soil in a test sample and is expressed as a percentage. The test results are presented in this attachment.

PARTICLE-SIZE ANALYSIS

Particle-size analysis was performed on select soil samples in general accordance with ASTM C117 or ASTM D1140. This test is a quantitative determination of the amount of material finer than the U.S. Standard No. 200 sieve expressed as a percentage of soil weight. The test results are presented in this attachment.

SYMBOL	SAMPLING DESCRIPTION
▯	Location of sample collected in general accordance with ASTM D1586 using Standard Penetration Test (SPT) with recovery
▮	Location of sample collected using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D1587 with recovery
▥	Location of sample collected using Dames & Moore sampler and 300-pound hammer or pushed with recovery
▥	Location of sample collected using Dames & Moore sampler and 140-pound hammer or pushed with recovery
⧗	Location of sample collected using 3-inch-outside diameter California split-spoon sampler and 140-pound hammer with recovery
⊠	Location of grab sample
▓	Rock coring interval
∇	Water level during drilling
▼	Water level taken on date shown

Graphic Log of Soil and Rock Types



Observed contact between soil or rock units (at depth indicated)

Inferred contact between soil or rock units (at approximate depths indicated)

GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	P	Pushed Sample
CBR	California Bearing Ratio	PP	Pocket Penetrometer
CON	Consolidation	P200	Percent Passing U.S. Standard No. 200 Sieve
DD	Dry Density		
DS	Direct Shear	RES	Resilient Modulus
HYD	Hydrometer Gradation	SIEV	Sieve Gradation
MC	Moisture Content	TOR	Torvane
MD	Moisture-Density Relationship	UC	Unconfined Compressive Strength
NP	Non-Plastic	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

NV5

EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOIL			
Relative Density	**Standard Penetration Test (SPT) Resistance**	**Dames & Moore Sampler (140-pound hammer)**	**Dames & Moore Sampler (300-pound hammer)**
Very loose	0 - 4	0 - 11	0 - 4
Loose	4 - 10	11 - 26	4 - 10
Medium dense	10 - 30	26 - 74	10 - 30
Dense	30 - 50	74 - 120	30 - 47
Very dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOIL				
Consistency	**Standard Penetration Test (SPT) Resistance**	**Dames & Moore Sampler (140-pound hammer)**	**Dames & Moore Sampler (300-pound hammer)**	**Unconfined Compressive Strength (tsf)**
Very soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 - 6	2 - 5	0.25 - 0.50
Medium stiff	4 - 8	6 - 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 - 25	9 - 19	1.0 - 2.0
Very stiff	15 - 30	25 - 65	19 - 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOIL (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVEL (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVEL WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SAND (<5% fines)	SW or SP	SAND
		SAND WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SAND WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOIL (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOIL			PT	PEAT

MOISTURE CLASSIFICATION	
Term	**Field Test**
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

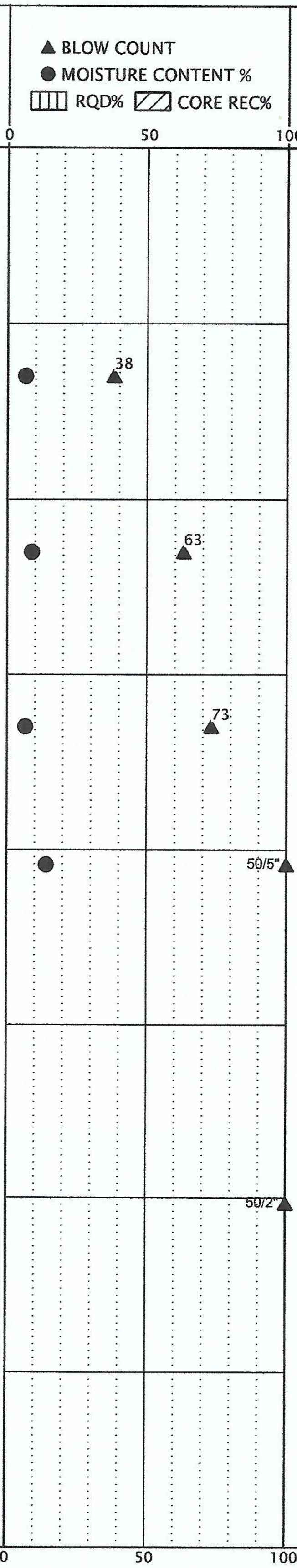
ADDITIONAL CONSTITUENTS					
Secondary granular components or other materials such as organics, man-made debris, etc.					
Percent	**Silt and Clay In:**		**Percent**	**Sand and Gravel In:**	
	Fine-Grained Soil	**Coarse-Grained Soil**		**Fine-Grained Soil**	**Coarse-Grained Soil**
< 5	trace	trace	< 5	trace	trace
5 - 12	minor	with	5 - 15	minor	minor
> 12	some	silty/clayey	15 - 30	with	with
			> 30	sandy/gravelly	Indicate %

NV5

SOIL CLASSIFICATION SYSTEM

TABLE A-2

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	INSTALLATION AND COMMENTS
0.0	AGGREGATE BASE (12.0 inches).			
	Dense, brown-gray, silty GRAVEL (GM); dry, gravel is fine to coarse and angular - **FILL**.	1.0		
2.5			P200	Infiltration test at 2.5 feet. P200 = 13%
5.0	Very dense, brown-gray GRAVEL with silt and sand (GP-GM); moist, gravel is angular, sand is fine - **FILL**.	5.0	P200	P200 = 16%
7.5			P200	P200 = 12%
10.0	without sand; wet at 10.0 feet			Driller Comment: Sample refusal at 10.0 feet. ⊻ 10.5 feet, during drilling
12.5				
15.0	Exploration terminated at a depth of 15.2 feet due to refusal. Hammer efficiency factor is 80.4 percent.	15.2		Driller Comment: Sample refusal at 15.0 feet. Surface elevation was not measured at the time of exploration.
17.5				
20.0				



DRILLED BY: Western States Soil Conservation, Inc.
LOGGED BY: I. Gergalo
COMPLETED: 07/24/24

BORING METHOD: hollow-stem auger (see document text)
BORING BIT DIAMETER: 6 inches

NV5

WILLUNIV-16-01

AUGUST 2024

BORING B-6

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-7

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
B-6	2.5		7				13			
B-6	5.0		9				16			
B-6	7.5		7				12			
B-6	10.0		14							

LAB SUMMARY - GDI-NV5 WILLUNIV-16-01-B6.GPJ GDI_NV5.GDT PRINT DATE: 29/8/24:SP

NV5

WILLUNIV-16-01

AUGUST 2024

SUMMARY OF LABORATORY DATA

WILLAMETTE UNIVERSITY SOFTBALL FIELD
SALEM, OR

FIGURE A-8

APPENDIX F

- **Operations and Maintenance**

To Be Completed at Final Design

APPENDIX G

- **DEQ Email Correspondence**

From: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>
Sent: Thursday, March 20, 2025 6:40 AM
To: Mikael Shields
Cc: Geoff Larsen; WEBERLING Kevin * DEQ; CAVINESS Lizz * DEQ
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hello Mikael,

This system appears to remain a UIC. Any subsurface piping intended to convey and infiltrate fluid in the subsurface, vertically or laterally is considered an "assemblage of piping" and is a UIC.

This can seem counterintuitive. Kevin and I worked on a project under a soccer stadium where vertical pipes were entirely buried, but designed to move water from one elevation to another. These are classified as "dewatering wells", and after confirming we realized they are in fact, UICs.

Regarding Geoff's question: Understood – thank you for reviewing. The main thing we were wanting to double check with you is that the 5' separation from seasonal high groundwater and the filtration through that 5' of native soil fully address any treatment requirements and satisfies the rule authorization criteria (OAR 340-044-0018(3)(a)(G)). Can you please confirm?

Confirmed.

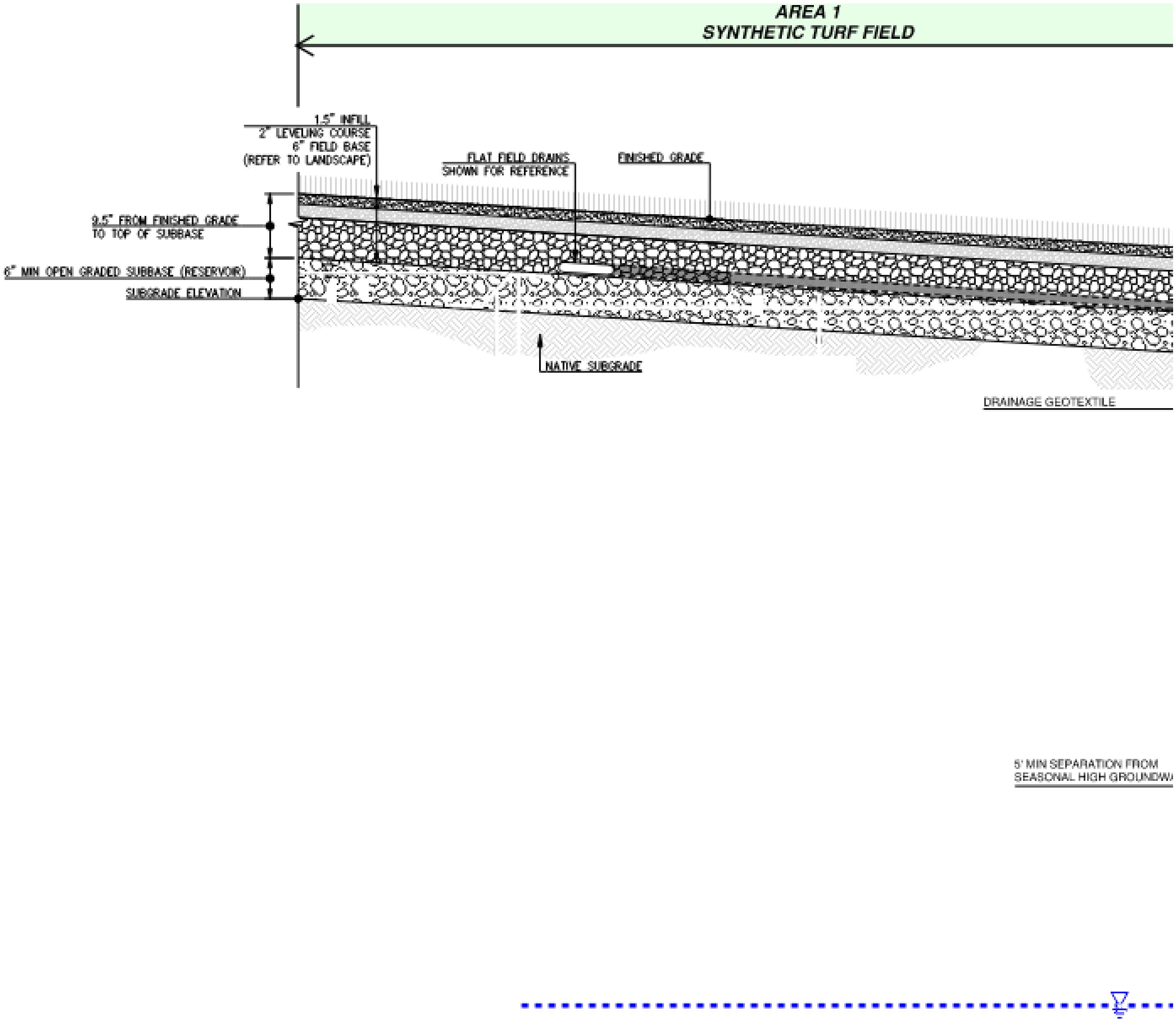
If you'd like to have a teams meeting to discuss any of this system, we are happy to meet probably Monday or Tuesday is best next week.

Thank you,

Derek

From: Mikael Shields <mshields@mazzetti.com>
Sent: Wednesday, March 19, 2025 5:20 PM
To: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>
Cc: Geoff Larsen <glarsen@mazzetti.com>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Derek, I am following up on your previous response to Geoff regarding UIC registration for an infiltration system. The project is for Willamette University and is a replacement of the existing natural turf softball field with new synthetic turf. The project scope has changed slightly since we last corresponded, and we wanted to verify that what we are now proposing would <u>not</u> be classified as a UIC. Much of the new concrete pavement around the field has been removed from the project and the proposed infiltration trench would receive sheet flow from a limited amount of existing concrete pedestrian pavement and dugout roof areas that would sheet flow into the top of the infiltration trench. The field drainage system will still consist of a series of flat perforated drain pipes below the field surface leading to a circular perforated pipe around the field perimeter. Infiltration will occur throughout the field and within the perimeter perforated pipe trench. I have sketched a revised cross-section below for your reference.



Let me know if you require any additional information to evaluate and determine the classification of this proposed system. Thanks.

Mikael Shields, PE
Senior Civil Engineer
MAZZETTI
D: 541.335.8740

Mikael Shields, PE
Senior Civil Engineer

MAZZETTI
D: 541.335.8740

2023 Benefit Corporation Report: Real impact, Realized

From: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>
Sent: Monday, November 25, 2024 3:59 PM
To: Geoff Larsen <glarsen@mazzetti.com>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>; CAVINESS Lizz * DEQ <Lizz.CAVINESS@deq.oregon.gov>
Subject: Re: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Yes, confirmed.
Derek

From: Geoff Larsen <glarsen@mazzetti.com>
Sent: Monday, November 25, 2024 3:55:27 PM
To: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>; CAVINESS Lizz * DEQ <Lizz.CAVINESS@deq.oregon.gov>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hi Derek,

Understood – thank you for reviewing. The main thing we were wanting to double check with you is that the 5' separation from seasonal high groundwater and the filtration through that 5' of native soil fully address any treatment requirements and satisfies the rule authorization criteria (OAR 340-044-0018(3)(a)(G)). Can you please confirm?

Thanks,
Geoff Larsen, PE (he/him/his)
Senior Associate, Senior Civil Engineer | Project Manager
MAZZETTI
D: 503.601.5968

2023 Benefit Corporation Report: Real impact, Realized

From: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>
Sent: Monday, November 25, 2024 11:00 AM
To: Geoff Larsen <glarsen@mazzetti.com>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>; CAVINESS Lizz * DEQ <Lizz.CAVINESS@deq.oregon.gov>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hi Geoff,

Thank you for the clarification. This sounds like a moderate risk UIC due to the paved areas and dugouts that go directly into the pipe. I think since it is one pipe/assemblage you can likely register as one UIC.

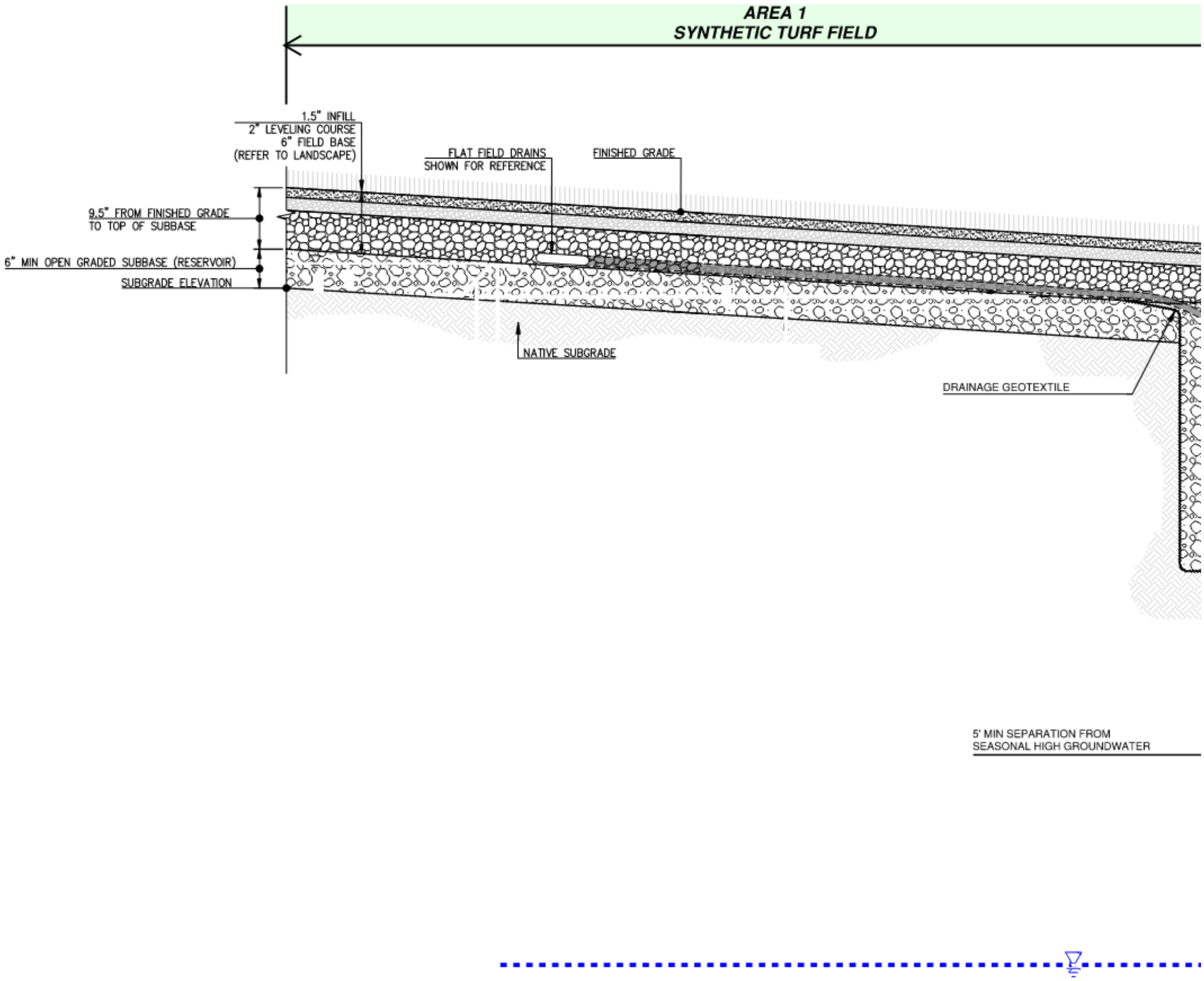
Thank you,

Derek

From: Geoff Larsen <glarsen@mazzetti.com>
Sent: Monday, November 25, 2024 10:11 AM
To: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hi Derek,

Most of the area draining to the infiltration system is the synthetic turf field. There is some pedestrian pavement around the perimeter of the field that sheet drains into the field, entering directly over the infiltration trench. There are also some smaller areas of pedestrian pavement and the dugout roofs that will be piped directly into the perforated pipe in the infiltration trench. Our plan was to include a sedimentation manhole for that piped drainage. Please see updated cross section below to illustrate.



Please let me know if you need any additional information on this.

Thanks,
Geoff Larsen, PE (he/him/his)
Senior Associate, Senior Civil Engineer | Project Manager
MAZZETTI
D: 503.601.5968

2023 Benefit Corporation Report: Real impact, Realized

From: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>
Sent: Friday, November 22, 2024 3:27 PM
To: Geoff Larsen <glarsen@mazzetti.com>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hello Geoff,

Kevin and I discussed your question. Question: does all of the water infiltrate from surface down (through the turf) in this design, including the roof drains, (meaning the roof drains drain onto the turf, then infiltrate)? If this is entirely surficial infiltration down to the piping you wouldn't need to register as UIC at all. If the roof drains (or any catch basins, etc.) drain into subsurface drain rock/soil you would need to register as a UIC.

I am about out of time today, but back Monday and Tuesday next week if you have more questions for us.

Thank you,

Derek

From: Geoff Larsen <glarsen@mazzetti.com>
Sent: Friday, November 22, 2024 7:58 AM
To: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hi Derek and Kevin,

Thank your for taking a look at this. Please let me know if it would help to set up a Zoom / Teams call to share additional background or details.

Thank you,
Geoff Larsen, PE (he/him/his)
Senior Associate, Senior Civil Engineer | Project Manager
MAZZETTI
D: 503.601.5968

2023 Benefit Corporation Report: Real impact, Realized

From: SANDOZ Derek * DEQ <Derek.SANDOZ@deq.oregon.gov>
Sent: Thursday, November 21, 2024 6:43 AM
To: Geoff Larsen <glarsen@mazzetti.com>; WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>
Subject: RE: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hello Geoff,

I do think we have approved systems like this in the past. Kevin and I will connect, and let you know if we have any questions or if this sounds OK.

Thank you,

Derek

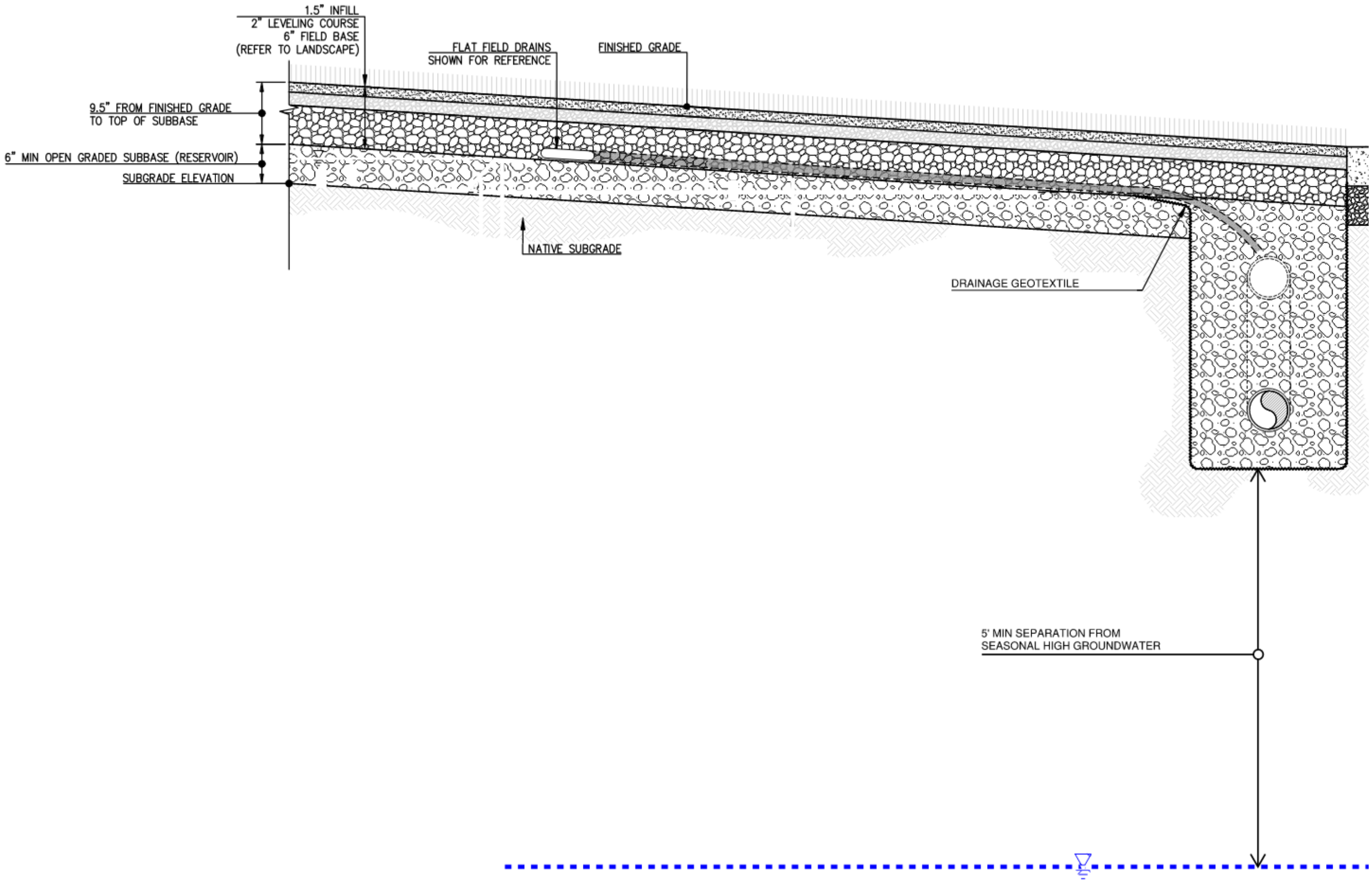
From: Geoff Larsen <glarsen@mazzetti.com>
Sent: Wednesday, November 20, 2024 5:37 PM
To: WEBERLING Kevin * DEQ <Kevin.WEBERLING@deq.oregon.gov>; SANDOZ Derek * DEQ

<Derek.SANDOZ@deq.oregon.gov>
Cc: Mikael Shields <mshields@mazzetti.com>
Subject: Rule Authorized UIC Registration for Willamette University Synthetic Turf Softball Field

Hi Derek and Kevin,

We have a project in Salem that we are getting ready to submit a UIC registration application for. The project is for Willamette University and is a replacement of the existing natural turf softball field with new synthetic turf. The drainage system will consist of series of flat perforated drain pipes below the field surface leading to a circular perforated pipe around the field perimeter. Infiltration will occur throughout the field and within the perimeter perforated pipe trench. Runoff from some impervious areas around the field perimeter (pedestrian areas and dugout roofs) will also drain into the field for infiltration. I have sketched a cross-section below for your reference.

Based on similar projects that we have registered in recent years, we understand stormwater runoff from the field and adjacent pedestrian surfaces is considered a low risk of pollution and the filtration in the native soil will be sufficient to address the rule authorization criteria (OAR 340-044-0018(3)(a)(G)), provided we maintain at least 5' of separation from the seasonal high groundwater. However, City public works staff have raised the question and we wanted to double check with you. Can you please confirm or let us know if further discussion is needed. We would be happy to set up a Zoom / Teams call to discuss and give you more information about the project.



Thanks much,

Geoff Larsen, PE (he/him/his)
Senior Associate, Senior Civil Engineer | Project Manager
MAZZETTI
D: 503.601.5968

2023 Benefit Corporation Report: Real impact, Realized