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12-22-23

**DRAINAGE REPORT
FOR**

TIDAL WAVE AUTO SPA

Rolesville, North Carolina

December 22, 2023

Prepared for:

SHJ Development LLC
124 E Thompson St.
Thomaston, GA 30286

NORTH CAROLINA
PROFESSIONAL
SEAL
048282
12/22/23
ENGINEER
TOMMIE L. LITTLE

Prepared by:
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NCBEL # C-2466

SW SEAMONWHITESIDE

EXECUTIVE SUMMARY

Introduction

The proposed project includes the development of 1 car wash facility building, vacuum equipment building, associated parking areas, and necessary infrastructure. The project will sit on a 1.92 acre property subdivided from a larger 3.80 acre parcel defined as Wake County PIN 1758479244.

Existing Site Conditions

Existing Use
The property currently exist as a vacant lost composed primarily of woods.

Watersheds, Buffers, and Flood Plains
The proposed project is located within the Lower Neuse River watershed. There are no floodplains on the site. The property is located in Flood Zone X, an area of minimal flood hazard.

Soils
Based on the North Carolina Department of Environmental Quality (NCDEQ) Wake County 1970 Soil Map for the site, the soils located within the project area are defined as LwB and LwC. The Wake County 1970 Soil Survey Map for the site is included in the Appendix of this report.

Drainage
In the existing condition the site drains to three points of interest (POI) along the northwest property boundary. POI 1 collects the most drainage from the site via overland flow. POI 1 and POI 2 collect the remainder of the drainage also via overland flow. Runoff from POI 2 discharges into the existing catch basin on the southbound lane of Grand Park Drive. Runoff from POI 3 discharges into the catch basin on the northside of the water tower access road in existing conditions.

Proposed Site Conditions

Improvements
The proposed improvements to the site are the development of a car wash building, associated parking areas, and associated infrastructure.

Drainage
Runoff from the proposed buildings and site impervious areas will be conveyed to an underground detention system via three curb inlets. All new proposed impervious area will drain to the underground detention and be treated for water quality.

Existing Stormwater Management

Existing Quality and Detention
The site is currently vacant with no on site stormwater management.

Proposed Stormwater Management

Proposed Quality and Detention

All existing and proposed drainage areas are being evaluated at the Points of Interest described in the Drainage Section of this report above. Existing and Proposed Drainage Basins are shown along with the corresponding Points of Interest on the Pre- and Post-Development Maps included in Appendix.

Curve number and time of concentration calculations are included in Appendix.

The pre-developed and post developed flow rates and volume calculations were performed with Hydroflow Hydrographs using an SCS Methodology and a 24-hour hydrograph (based on NOAA Atlas 15 depths) as described in the NCDEQ stormwater design manual. A summary of the results is shown in the Table below:

An ADS StormTech underground detention system is proposed to reduce the post-development flow and mitigate the nitrogen export due to the increase in impervious areas. The proposed system will store the runoff as the outlet control structure releases the runoff at a lower flow rate than pre-developed conditions. The Wake County Hybrid Stormwater Tool was used to determine the system mitigates the nitrogen export to below the states maximum. The detention system storage sizing calculations are included in the Appendix.

A summary of the pre-development and post development runoff flows for POI 1 and the bypass drainage areas are shown in the Table below:

Pre and Post Development Runoff Summary						
Design Storm	Pre Development			Post Development		
	POI 1	POI 2	POI 3	POI 1	POI 2	POI 3
1 Year	0.173	0.042	0.106	0.093	0.034	0.049
2 Year	0.402	0.104	0.263	0.108	0.079	0.115
10 Year	1.293	0.361	0.908	0.911	0.253	0.360

The Wake County Hybrid Stormwater Tool was used to determine the ADS StormTech underground detention system mitigates the nitrogen export to below the states maximum. Infiltration through the existing Wedowee-Urban Land (WgB) soil will be used for water quality treatment. According to the USGS soil survey, WgB soil has an infiltration rate pf 0.57 to 1.98 in/hr. The most conservative value infiltration rate, 0.57 in/hr, was used in the Hydroflow Hydrographs model for peak discharge calculations. The detention system storage sizing and Wake County Hybrid Stormwater Tool calculations are included in the Appendix.

A summary of the pre-development and post development nitrogen loading rates from the site are shown in the Table below:

POI 1 Pre and Post Development Nitrogen Loading Summary		
Pre-Developed Loading (lb/ac/yr)	Post-Developed Loading (lb/ac/yr)	Post BMP Loading (lb/ac/yr)
1.16	9.58	1.07

Erosion Control

Erosion and sediment control measures during construction will be accomplished using temporary and permanent best management practices (BMPs). Temporary best management practices include the utilization of a silt fence, inlet protection, and temporary seeding during construction. Permanent best management practices include the permanent seeding and stabilization of the site.

Stormwater Conveyance

The stormwater conveyance pipe system was designed to convey the 10-year, 24-hour storm event and checked with the 25-year, 24 hour storm event. The pipe modeling software, Hydraflow Storm Sewers, has been used for the design of the proposed storm drainage pipes and inlets for the site (stormwater conveyance system). Storm Sewers utilizes the Rational Method based on the 10-year, 24-hour storm event.

DEVELOPMENT DRAINAGE MAPS

0 10 20 40
SCALE: 1" = 20'

SEAMONWHITESIDE
MOUNT PLEASANT, SC
843.884.1667
GREENVILLE, SC
864.298.0534
SUMMERVILLE, SC
843.972.0710
SPARTANBURG, SC
864.272.1272
CHARLOTTE, NC
980.312.5450
WWW.SEAMONWHITESIDE.COM

NORTH CAROLINA SEAMON, WHITESIDE & ASSOCIATES, INC. NO. C-2466 CERTIFICATE OF AUTHORIZATION

NORTH CAROLINA PROFESSIONAL SEAL 048282 ENGINEER TOMMIE L. LITTLE 10/25/23

TIDAL WAVE AUTO SPA

ROLESVILLE, NC

SW+ PROJECT:	10772
DATE:	10/30/23
DRAWN BY:	CPE
CHECKED BY:	DWJ

REVISION HISTORY

PRE DEVELOPMENT DRAINAGE MAP

SEAMONWHITESIDE

MOUNT PLEASANT, SC
843.884.1667
GREENVILLE, SC
864.298.0534
SUMMERVILLE, SC
843.972.0710
SPARTANBURG, SC
864.272.1272
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REVISION HISTORY

POST DEVELOPMENT DRAINAGE MAP

CURVE NUMBER CALCULATIONS

Soil Conservation Service Drainage Runoff Curve Number

Project: TWAS Rolesville @ Main St
Municipality: Rolesville/ Wake County

CPE
Job# 10772

Pre-Development

PRE BASIN 1

Cover Type	Soil Group	Soil Condtion	C N Factor	Acres	Acre x Factor
WOODS	B	FAIR	*60.00*	0.83	49.80
GRAVEL	B	FAIR	*85.00*	0.04	3.40
			Sub-total	0.87	53.20

PRE BASIN 1 Net SCS Curve Number = 61

PRE BASIN 2

Cover Type	Soil Group	Soil Condtion	C N Factor	Acres	Acre x Factor
WOODS	B	FAIR	*60.00*	0.22	13.20
GRASS (FAIR CONDITION)	B	FAIR	*61.00*	0.12	7.32
			Sub-total	0.34	20.52

PRE BASIN 2 Net SCS Curve Number = 60

PRE BASIN 3

Cover Type	Soil Group	Soil Condtion	C N Factor	Acres	Acre x Factor
WOODS	B	FAIR	*60.00*	0.57	34.20
GRASS (FAIR CONDITION)	B	FAIR	*61.00*	0.22	13.42
			Sub-total	0.79	47.62

PRE BASIN 3 Net SCS Curve Number = 60

Soil Conservation Service Drainage Runoff Curve Number

Project: TWAS Rolesville @ Main St
Municipality: Rolesville/ Wake County

CPE
Job# 10772

Post-Development

POST DA 1 (BMP)

Cover Type	Soil Group	Soil Condtion	C N Factor	Acres	Acre x Factor
PAVED PARKING	B	FAIR	*98.00*	1.29	126.42
GRASS (FAIR CONDITION)	B	FAIR	*61.00*	0.30	18.30
			Sub-total	1.59	144.72

POST DA 1 (BMP) Net SCS Curve Number = 91

POST DA 2

Cover Type	Soil Group	Soil Condtion	C N Factor	Acres	Acre x Factor
GRASS (FAIR CONDITION)	B	FAIR	*61.00*	0.17	10.37
			Sub-total	0.17	10.37

POST DA 2 Net SCS Curve Number = 61

POST DA 3

Cover Type	Soil Group	Soil Condtion	C N Factor	Acres	Acre x Factor
GRASS (FAIR CONDITION)	B	FAIR	*61.00*	0.22	13.42
			Sub-total	0.22	13.42

POST DA 3 Net SCS Curve Number = 61

TIME OF CONCENTRATION CALCULATIONS

Time of Concentration Calculations
Pre-Development

Project: TWAS Rolesville @ S Main St
Municipality: Rolesville/Wake County

CPE
Job# 10772

Mannings Roughness Coefficient (Sheet Flow)

Meadow	0.24	Smooth Earth	0.022	Smooth Conc.	0.012
Lawn	0.41	Smooth Clay	0.016	Asphalt	0.013
Farm Field	0.12	Drainage Ditch	0.04	RCP Pipe	0.012
Woods	0.6	Stream, Best	0.04	CMP Pipe	0.022
Fallow Earth	0.05	Stream, Worst	0.15	PVC Pipe	0.011

Pre Basin 1

Sheet Flow

Tc = {0.007 * [(L* n)^0.8] / [P2^0.5 * s^0.4]}*60

Kinematic Wave/Sheet Flow

Tc 1

Length =	100	L (ft)
Mannings	0.6	
rainfall	2.86	i
slope	0.04	s (ft/ft)
Tc 1 =	18.72	

Shallow Conc. Flow

$T_t = L/(60*V)$

$(V_{unpaved}=16.1345s^{0.5}\quad V_{paved}=20.3282s^{0.5})$

Tc 2

Paved?	N	
Length =	70.91	L (ft)
Slope =	0.02	s (ft/ft)
Velocity =	2.28	V (ft/s)
T_t 2 =	0.52	min.

Channel Flow

$T_t = L/(60*V)$

(Assume 2 ft/s for typ. lowcountry channels & pipes, otherwise use Manning's formula)

Tc 3

Length	0	L (ft)
Velocity =	0	V (ft/s)
T_t 3 =	0.00	min.

Total T_c = 19 min.

Pre Basin 2

Sheet Flow

Tc = {0.007 * [(L* n)^0.8] / [P2^0.5 * s^0.4]}*60

Kinematic Wave/Sheet Flow

Tc 1

Length =	100	L (ft)
Mannings	0.6	
rainfall	2.86	i
slope	0.013	s (ft/ft)
Tc 1 =	26.22	

Shallow Conc. Flow

$T_t = L/(60*V)$

$(V_{unpaved}=16.1345s^{0.5}\quad V_{paved}=20.3282s^{0.5})$

Tc 2

Paved?	N	
Length =	63.48	L (ft)
Slope =	0.013	s (ft/ft)
Velocity =	1.84	V (ft/s)
T_t 2 =	0.58	min.

Channel Flow

$T_t = L/(60*V)$

(Assume 2 ft/s for typ. lowcountry

Tc 3

Length	0	L (ft)
Velocity =	0	V (ft/s)
T_t 3 =	0.00	min.

Total T_c = 27 min.

Pre Basin 3

Sheet Flow			Shallow Conc. Flow			Channel Flow		
Tc = {0.007 * [(L* n)^0.8] / [P2^0.5 * s^0.4]}*60			$T_t = L/(60*V)$			$T_t = L/(60*V)$		
Kinematic Wave/Sheet Flow			($V_{unpaved}=16.1345s^{0.5}$ $V_{paved}=20.3282s^{0.5}$)			(Assume 2 ft/s for typ. lowcountry		
	Tc 1			*Tc 2*			*Tc 3*	
Length =	100	L (ft)	Paved?	N				
Mannings	0.6		Length =	104	L (ft)			
rainfall	2.86	i	Slope =	0.04	s (ft/ft)	Length	0	L (ft)
slope	0.019	s (ft/ft)	Velocity =	3.23	V (ft/s)	Velocity =	0	V (ft/s)
Tc 1 =	23.40		T_t 2 =	0.54	min.	T_t 3 =	0.00	min.

Total T_c = 24 min.

Time of Concentration Calculations
Post-Development

Project: TWAS Rolesville @ S Main St
Municipality: Rolesville/Wake County

CPE
Job# 10772

Mannings Roughness Coefficient (Sheet Flow)

Meadow	0.24	Smooth Earth	0.022	Smooth Conc.	0.012
Lawn	0.41	Smooth Clay	0.016	Asphalt	0.013
Farm Field	0.12	Drainage Ditch	0.04	RCP Pipe	0.012
Woods	0.6	Stream, Best	0.04	CMP Pipe	0.022
Fallow Earth	0.05	Stream, Worst	0.15	PVC Pipe	0.011

Post Basin 1A (BMP)

Sheet Flow

Tc = {0.007 * [(L* n)^0.8] / [P2^0.5 * s^0.4]}*60

Kinematic Wave/Sheet Flow

Tc 1

Length =	100	L (ft)
Mannings	0.013	
rainfall	2.68	i
slope	0.016	s (ft/ft)
Tc 1 =	2.54	

Shallow Conc. Flow

$T_t = L/(60*V)$

($V_{unpaved}=16.1345s^{0.5}$ $V_{paved}=20.3282s^{0.5}$)

Tc 2

Paved?	Y	
Length =	96.31	L (ft)
Slope =	0.02	s (ft/ft)
Velocity =	2.87	V (ft/s)
T_t 2 =	0.56	min.

Channel Flow

$T_t = L/(60*V)$

(Assume 2 ft/s for typ. lowcountry

Tc 3

Length	0	L (ft)
Velocity =	0	V (ft/s)
T_t 3 =	0.00	min.

Total T_c = 3 min.

SeamonWhiteside
Civil Engineering Dept.

Post Basin 2

Sheet Flow			Shallow Conc. Flow			Channel Flow		
Tc = {0.007 * [(L* n)^0.8] / [P2^0.5 * s^0.4]}*60			T_t = L/(60*V)			T_t = L/(60*V)		
Kinematic Wave/Sheet Flow			($V_{unpaved}$=16.1345$s^{0.5}$ V_{paved}=20.3282$s^{0.5}$)			(Assume 2 ft/s for typ. lowcountry		
	Tc 1			*Tc 2*			*Tc 3*	
Length =	75.2	L (ft)	Paved?	Y				
Mannings	0.41		Length =	0	L (ft)			
rainfall	2.68	i	Slope =	0	s (ft/ft)	Length	0	L (ft)
slope	0.01	s (ft/ft)	Velocity =	0.00	V (ft/s)	Velocity =	0	V (ft/s)
Tc 1 =	19.53		T_t 2 =	0.00	min.	T_t 3 =	0.00	min.
						Total T_c =	**20**	**min.**

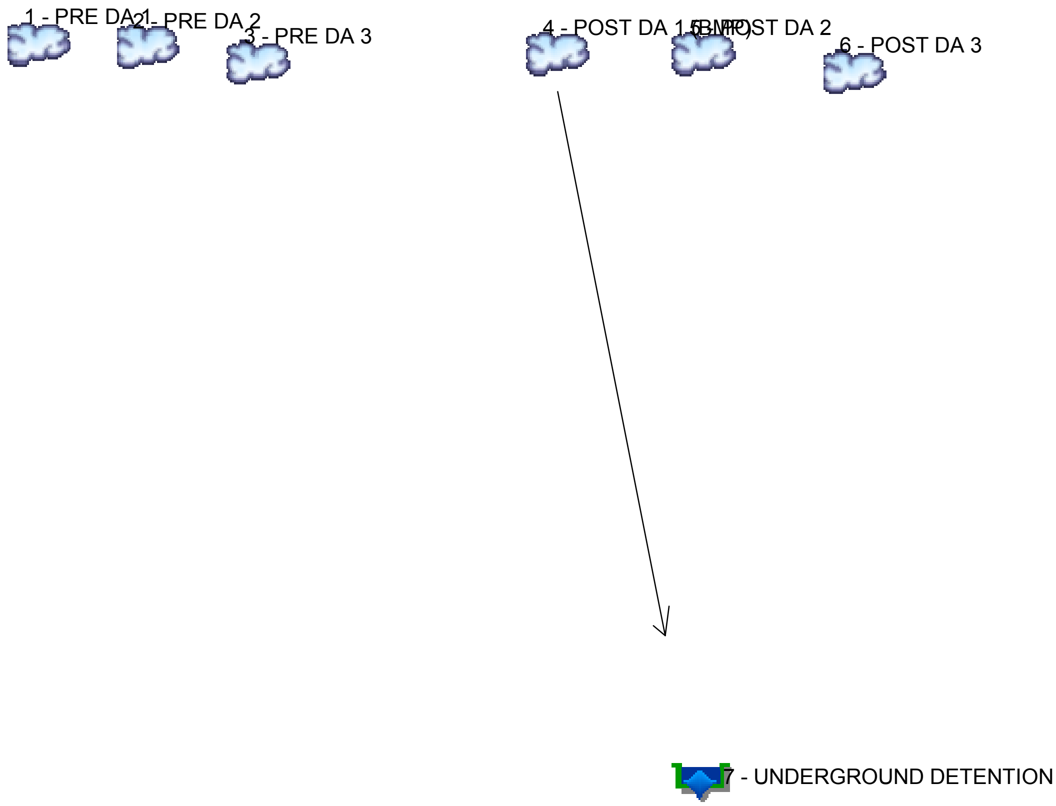
Post Basin 3

Sheet Flow			Shallow Conc. Flow			Channel Flow		
Tc = {0.007 * [(L* n)^0.8] / [P2^0.5 * s^0.4]}*60			T_t = L/(60*V)			T_t = L/(60*V)		
Kinematic Wave/Sheet Flow			($V_{unpaved}$=16.1345$s^{0.5}$ V_{paved}=20.3282$s^{0.5}$)			(Assume 2 ft/s for typ. lowcountry		
	Tc 1			*Tc 2*			*Tc 3*	
Length =	100	L (ft)	Paved?	N				
Mannings	0.41		Length =	91.31	L (ft)			
rainfall	2.68	i	Slope =	0.027	s (ft/ft)	Length	0	L (ft)
slope	0.04	s (ft/ft)	Velocity =	2.65	V (ft/s)	Velocity =	0	V (ft/s)
Tc 1 =	15.29		T_t 2 =	0.57	min.	T_t 3 =	0.00	min.
						Total T_c =	**16**	**min.**

PEAK ATTENUATION CALCULATIONS (1-, 2-, 10-, 24-HR EVENTS)

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2



Project: Storage Model LARGE.gpw	Tuesday, 10 / 31 / 2023

1-YEAR 24-HOUR STORM EVENT

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.173	2	728	989	------	------	------	PRE DA 1
2	SCS Runoff	0.042	2	736	351	------	------	------	PRE DA 2
3	SCS Runoff	0.106	2	734	803	------	------	------	PRE DA 3
4	SCS Runoff	5.058	2	716	10,503	------	------	------	POST DA 1 (BMP)
5	SCS Runoff	0.034	2	728	193	------	------	------	POST DA 2
6	SCS Runoff	0.049	2	726	244	------	------	------	POST DA 3
7	Reservoir	0.093	2	956	10,458	4	388.82	7,285	UNDERGROUND DETENTION

Storage Model LARGE.gpw	Return Period: 1 Year	Tuesday, 10 / 31 / 2023

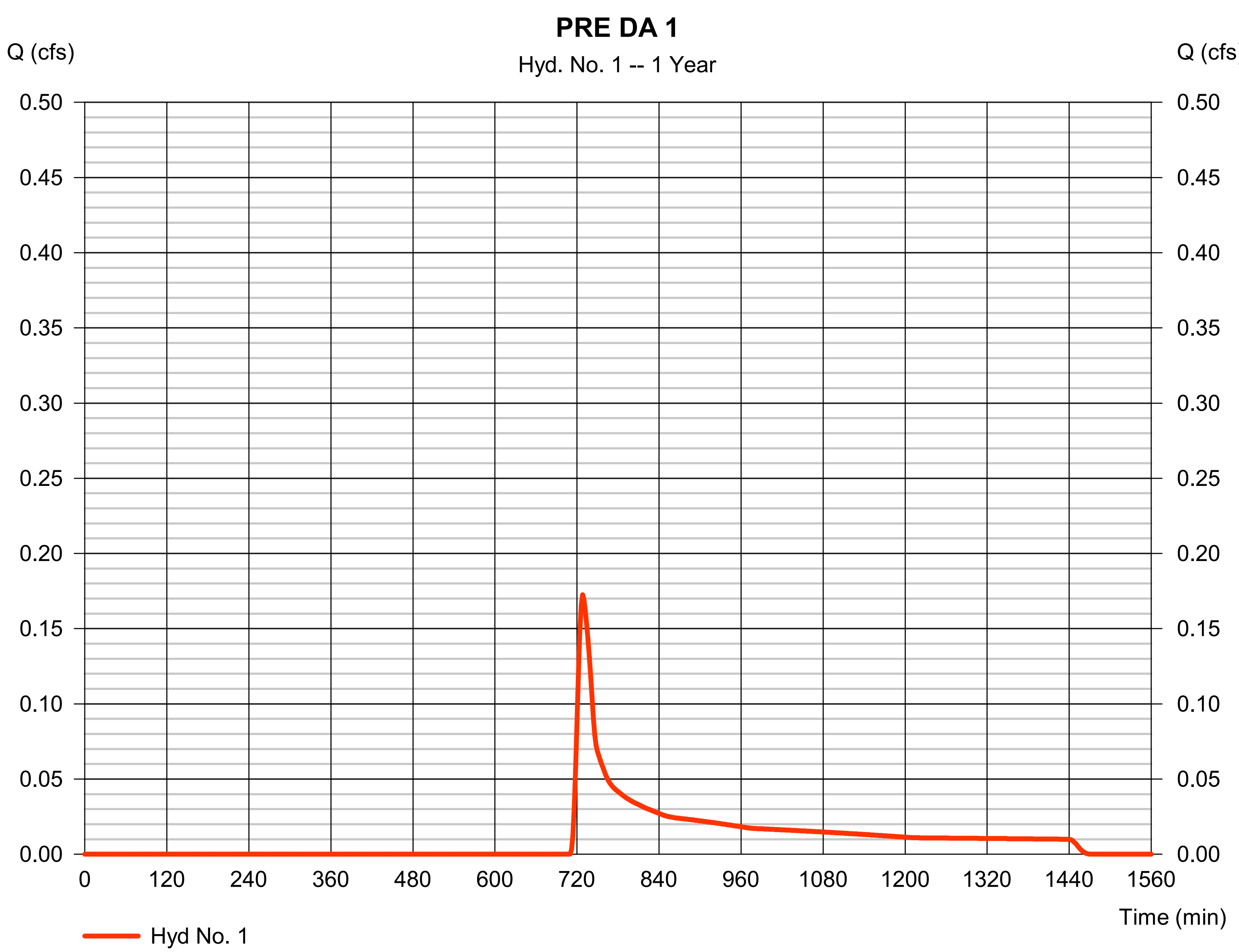
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 1

PRE DA 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.173 cfs
Storm frequency	= 1 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 989 cuft
Drainage area	= 0.870 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 19.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



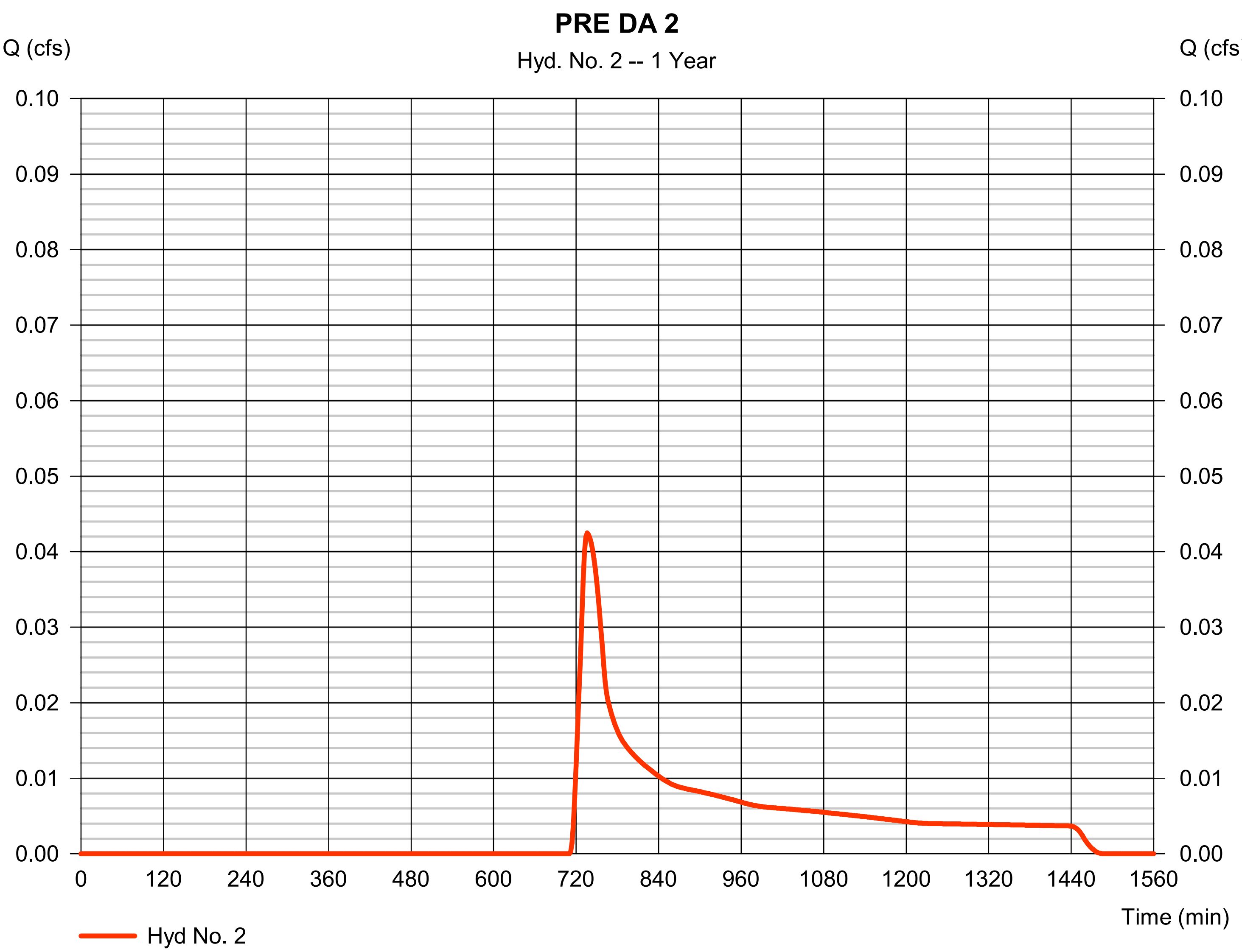
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 2

PRE DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.042 cfs
Storm frequency	= 1 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 351 cuft
Drainage area	= 0.340 ac	Curve number	= 60
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 27.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



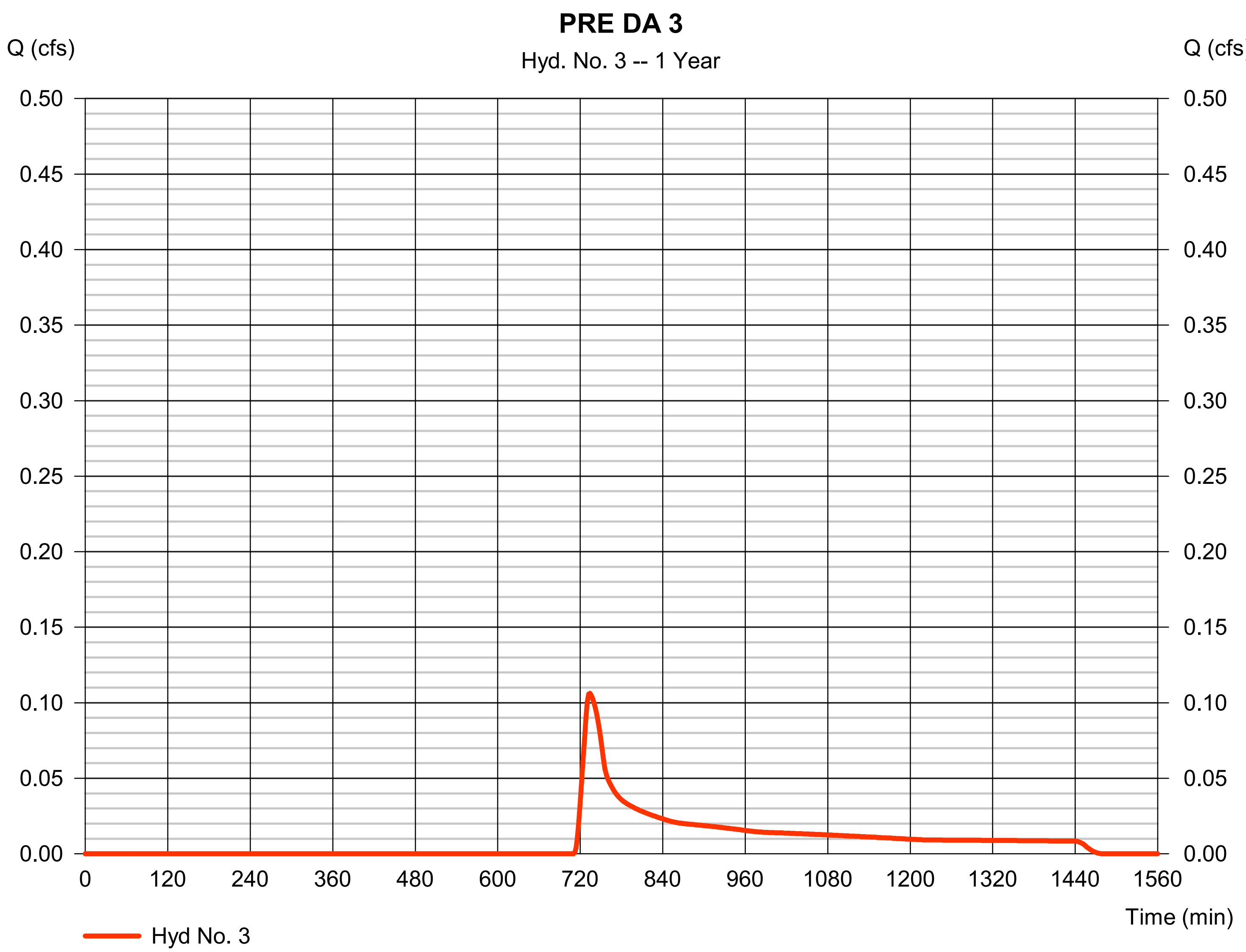
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 — Tuesday, 10 / 31 / 2023

Hyd. No. 3

PRE DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.106 cfs
Storm frequency	= 1 yrs	Time to peak	= 734 min
Time interval	= 2 min	Hyd. volume	= 803 cuft
Drainage area	= 0.790 ac	Curve number	= 60
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



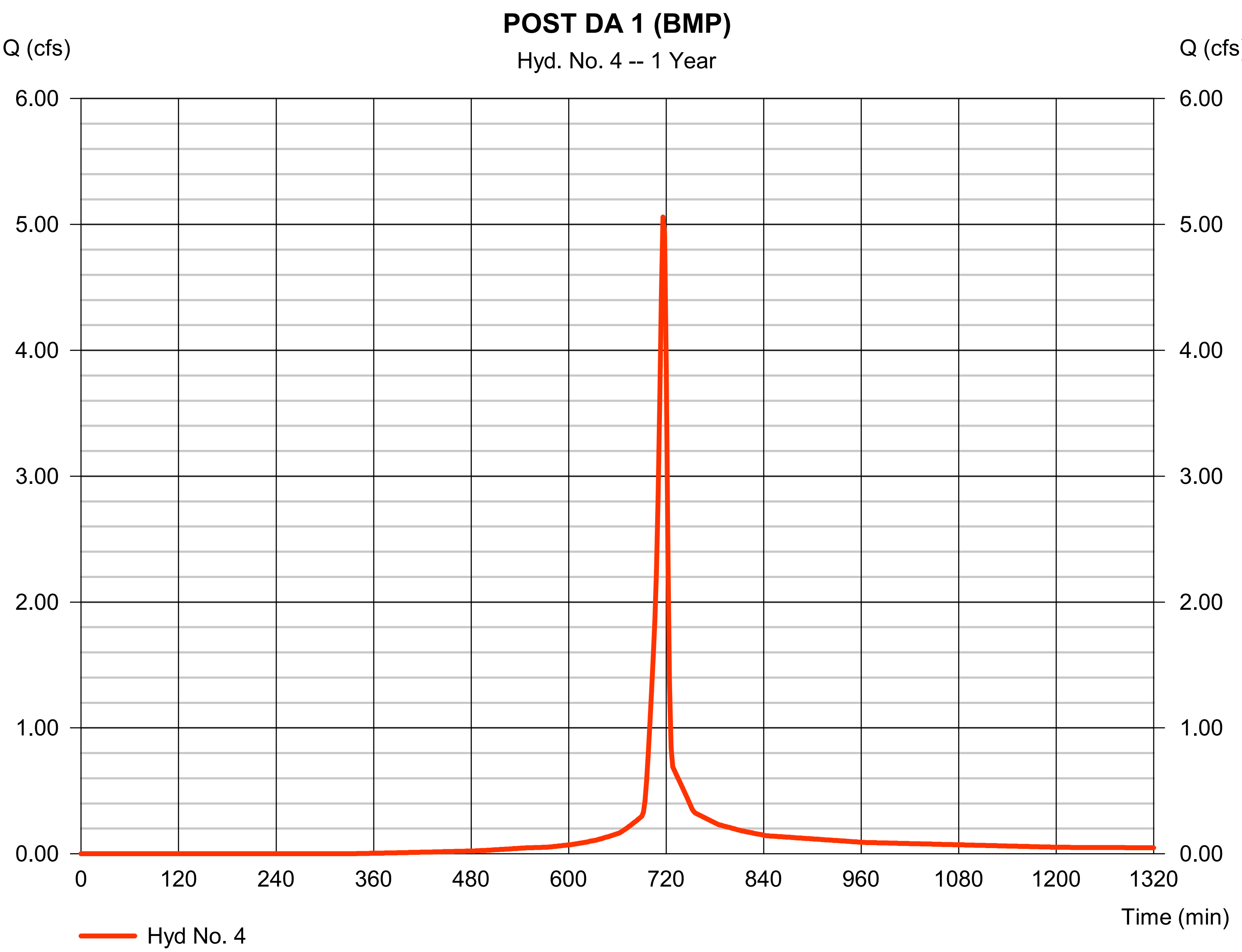
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 4

POST DA 1 (BMP)

Hydrograph type	= SCS Runoff	Peak discharge	= 5.058 cfs
Storm frequency	= 1 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 10,503 cuft
Drainage area	= 1.590 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



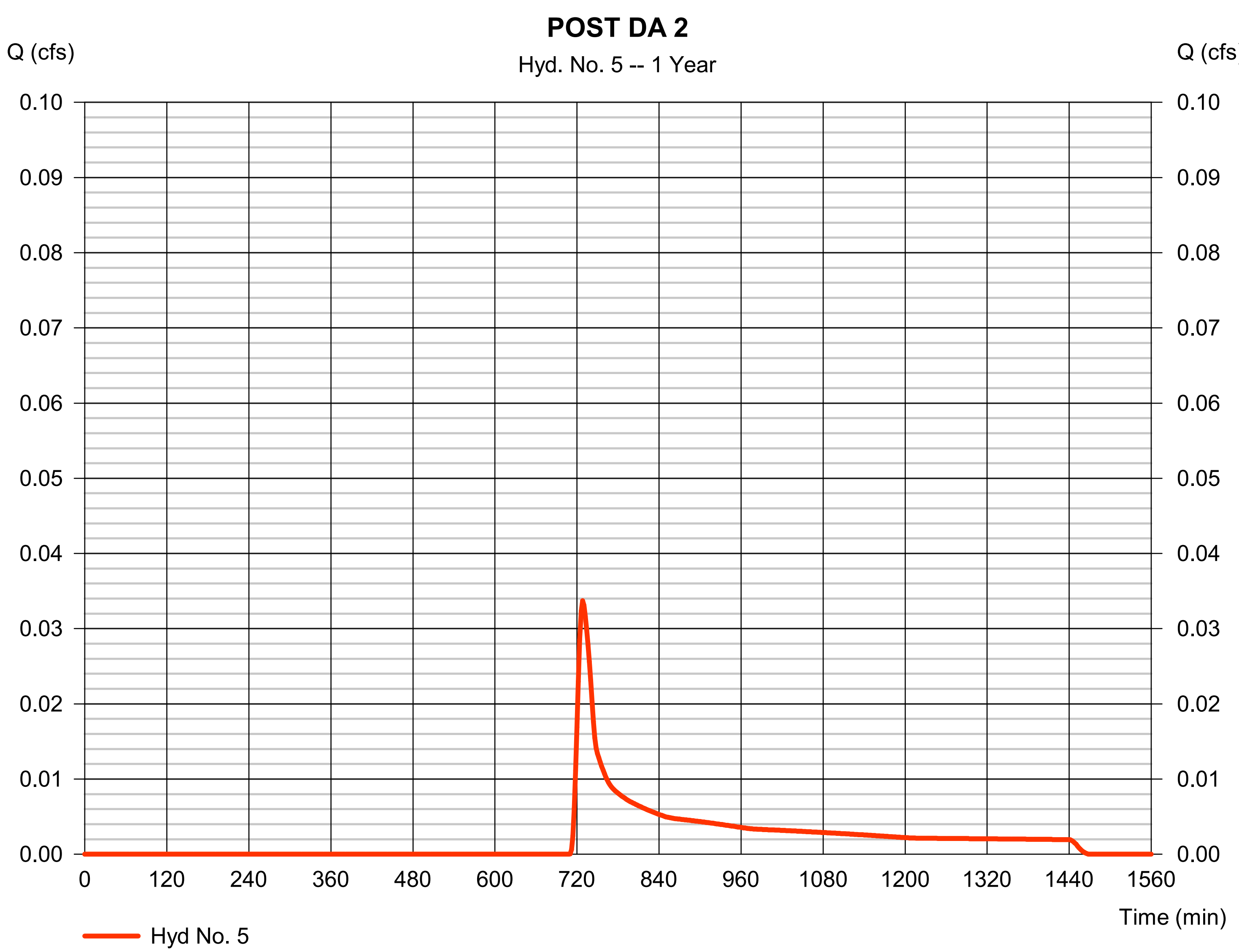
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 — Tuesday, 10 / 31 / 2023

Hyd. No. 5

POST DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.034 cfs
Storm frequency	= 1 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 193 cuft
Drainage area	= 0.170 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



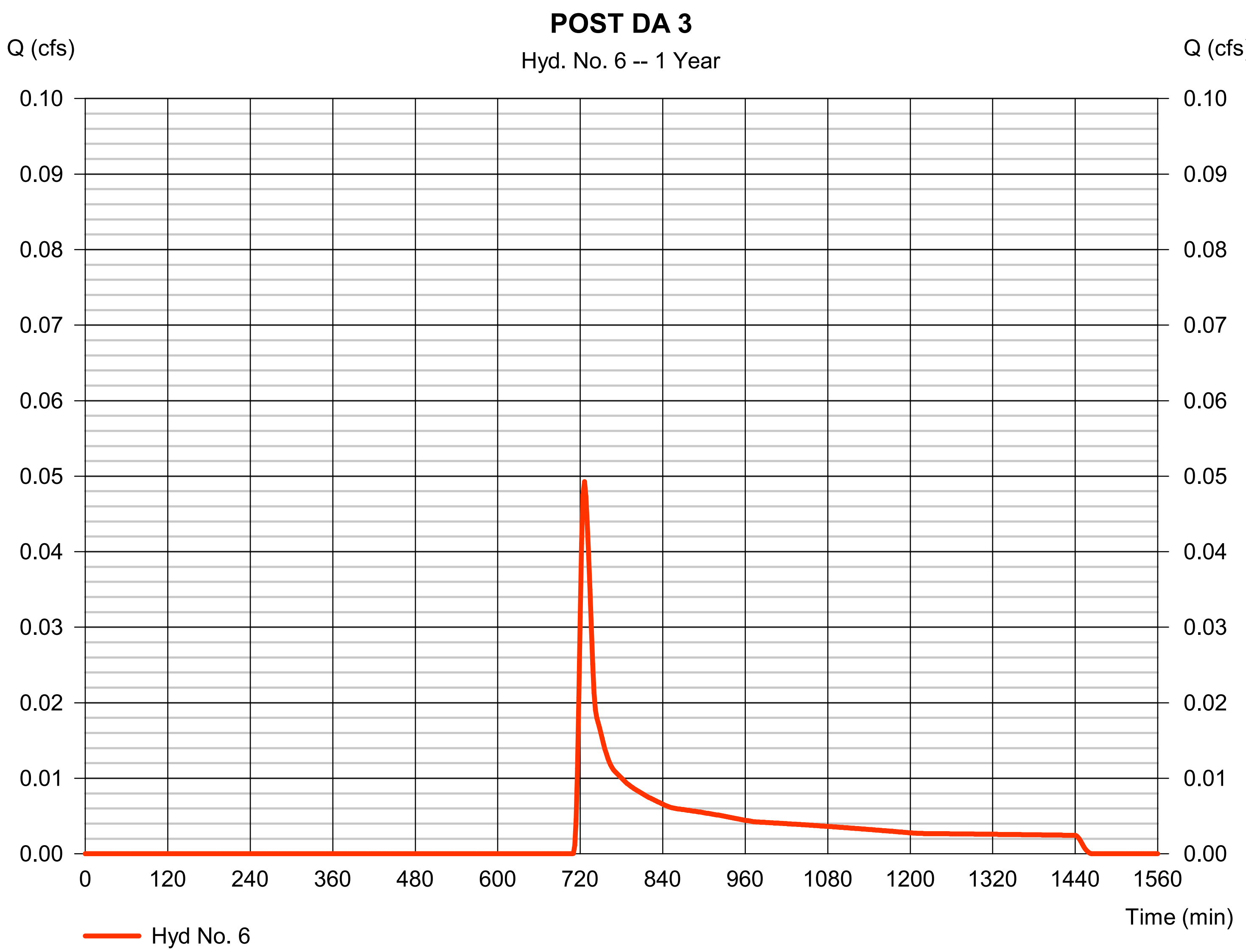
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 — Tuesday, 10 / 31 / 2023

Hyd. No. 6

POST DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.049 cfs
Storm frequency	= 1 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 244 cuft
Drainage area	= 0.220 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.00 min
Total precip.	= 2.86 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

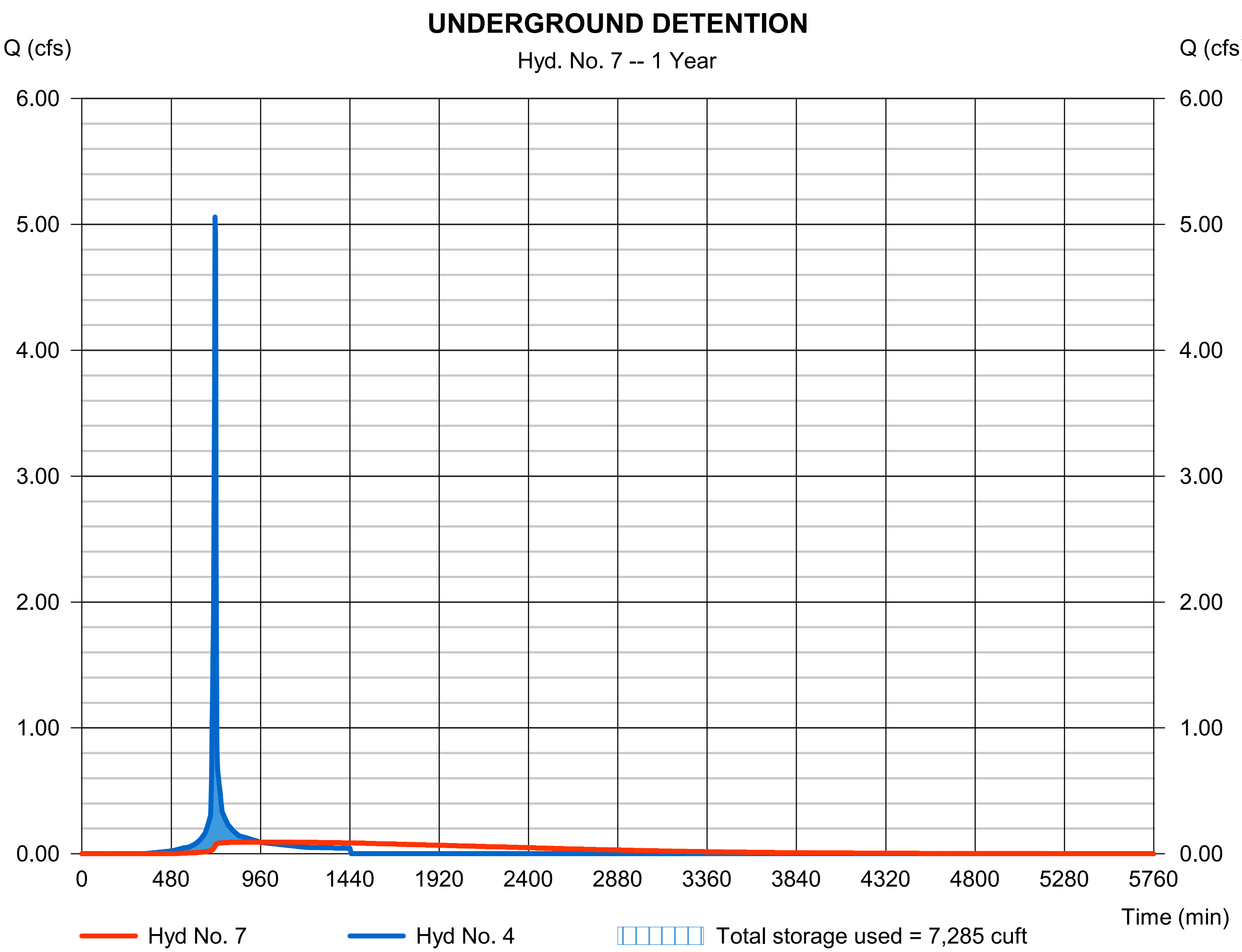
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 7

UNDERGROUND DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 0.093 cfs
Storm frequency	= 1 yrs	Time to peak	= 956 min
Time interval	= 2 min	Hyd. volume	= 10,458 cuft
Inflow hyd. No.	= 4 - POST DA 1 (BMP)	Max. Elevation	= 388.82 ft
Reservoir name	= UNDER GROUND DETENTION	Max. Storage	= 7,285 cuft

Storage Indication method used.



2-YEAR 24-HOUR STORM EVENT

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.402	2	728	1,738	------	------	------	PRE DA 1
2	SCS Runoff	0.104	2	734	629	------	------	------	PRE DA 2
3	SCS Runoff	0.263	2	732	1,439	------	------	------	PRE DA 3
4	SCS Runoff	6.413	2	716	13,494	------	------	------	POST DA 1 (BMP)
5	SCS Runoff	0.079	2	728	340	------	------	------	POST DA 2
6	SCS Runoff	0.115	2	724	429	------	------	------	POST DA 3
7	Reservoir	0.108	2	982	13,441	4	389.10	9,579	UNDERGROUND DETENTION

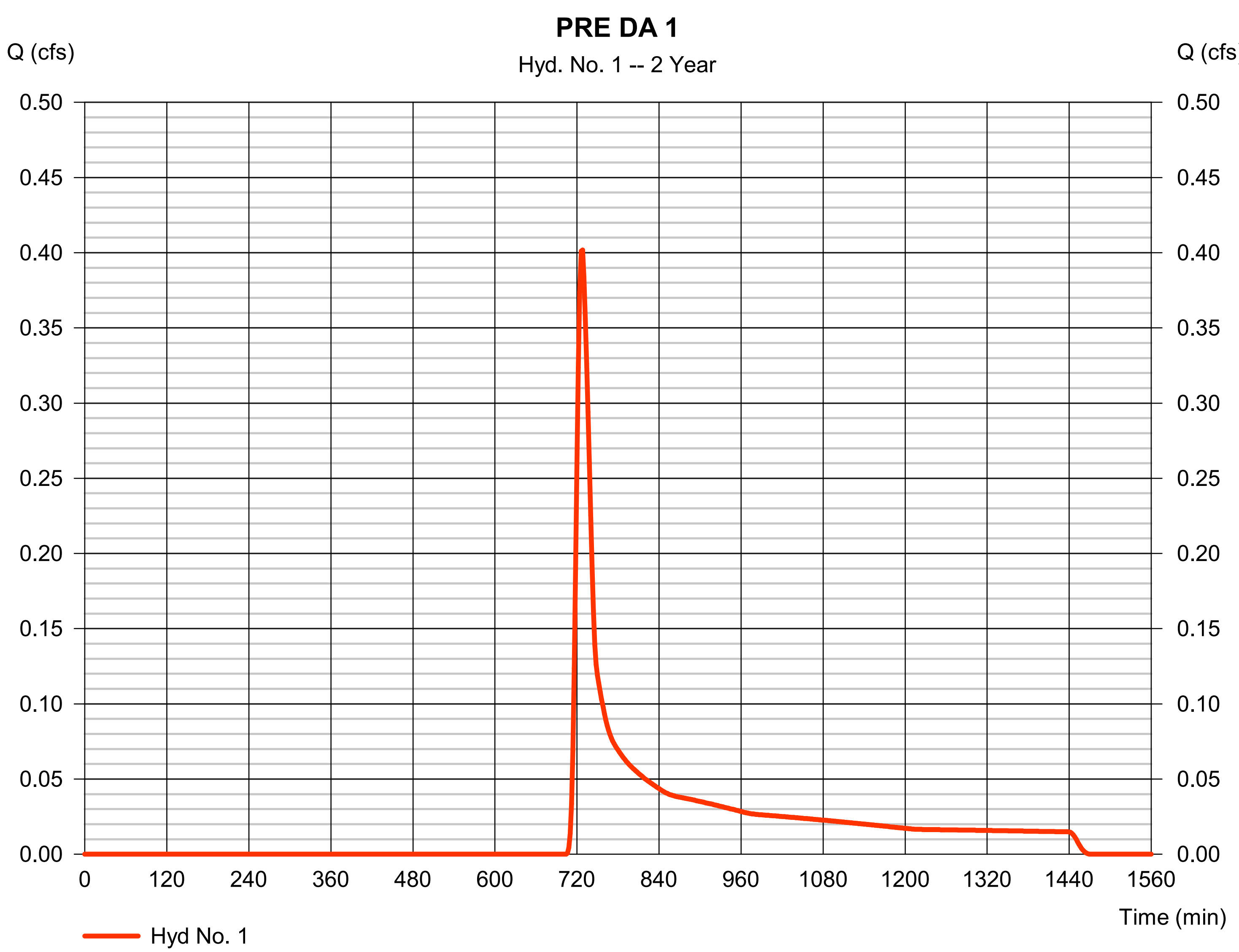
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 — Tuesday, 10 / 31 / 2023

Hyd. No. 1

PRE DA 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.402 cfs
Storm frequency	= 2 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 1,738 cuft
Drainage area	= 0.870 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 19.00 min
Total precip.	= 3.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



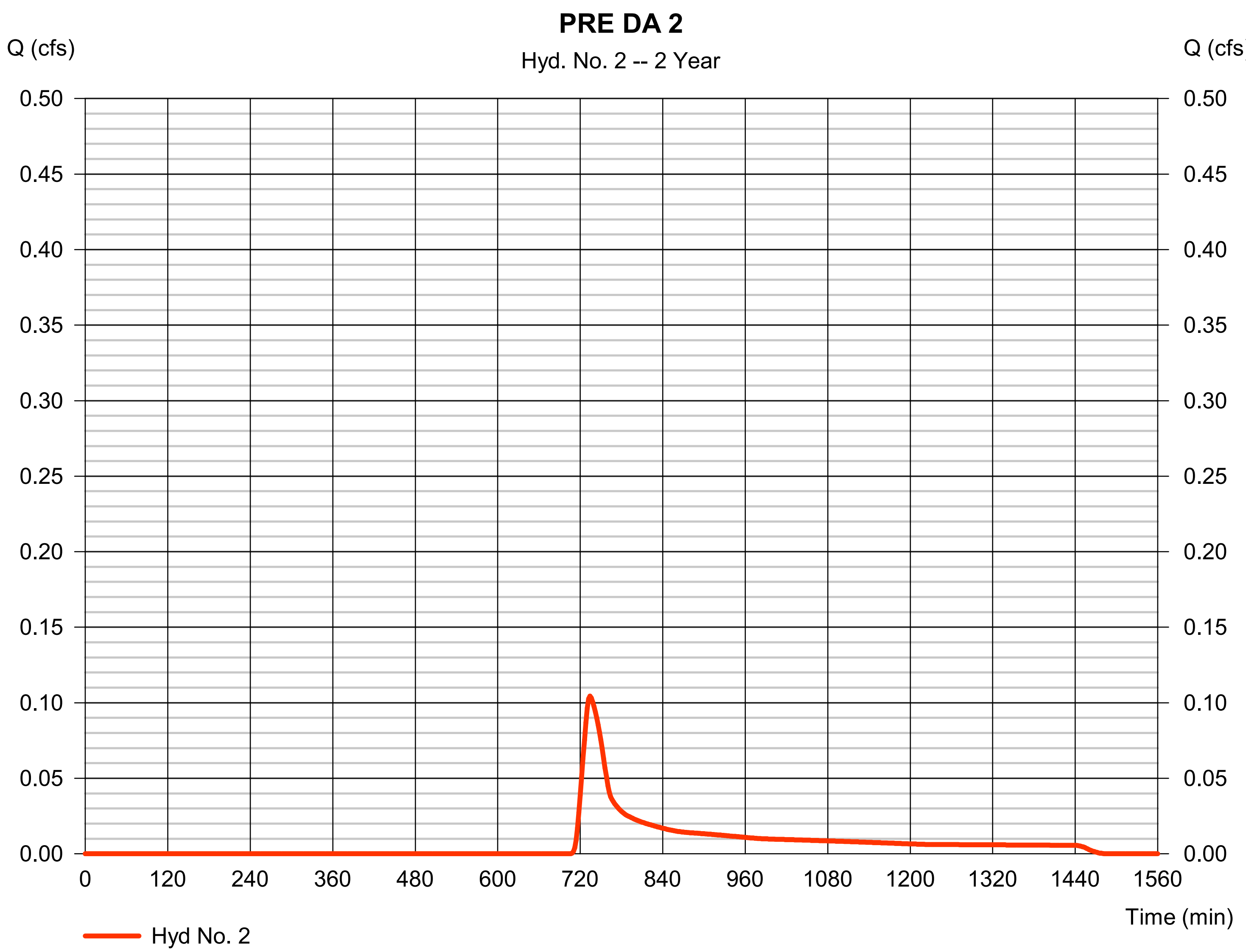
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 2

PRE DA 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.104 cfs
Storm frequency	=	2 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	629 cuft
Drainage area	=	0.340 ac	Curve number	=	60
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	27.00 min
Total precip.	=	3.45 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



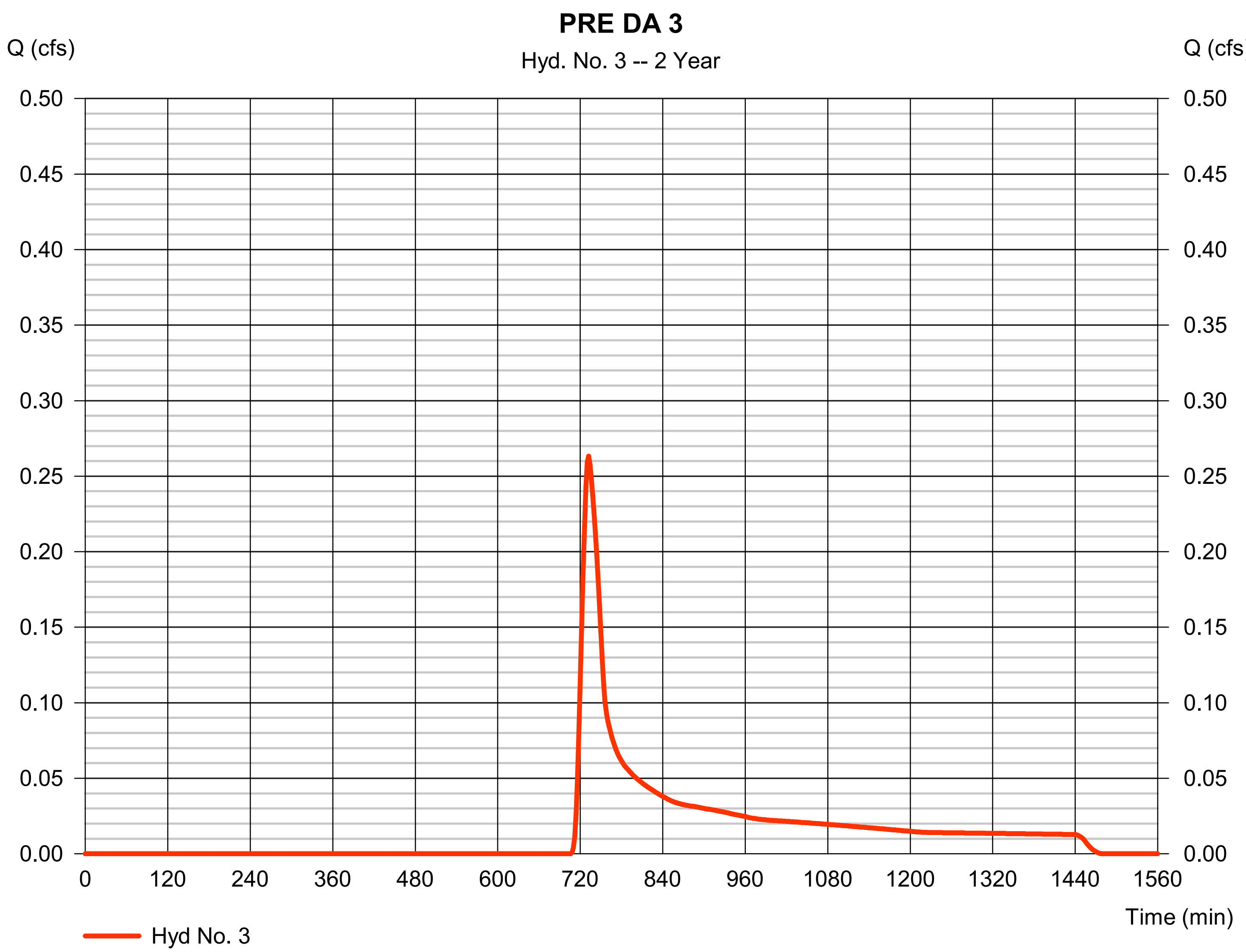
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 3

PRE DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.263 cfs
Storm frequency	= 2 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 1,439 cuft
Drainage area	= 0.790 ac	Curve number	= 60
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.00 min
Total precip.	= 3.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



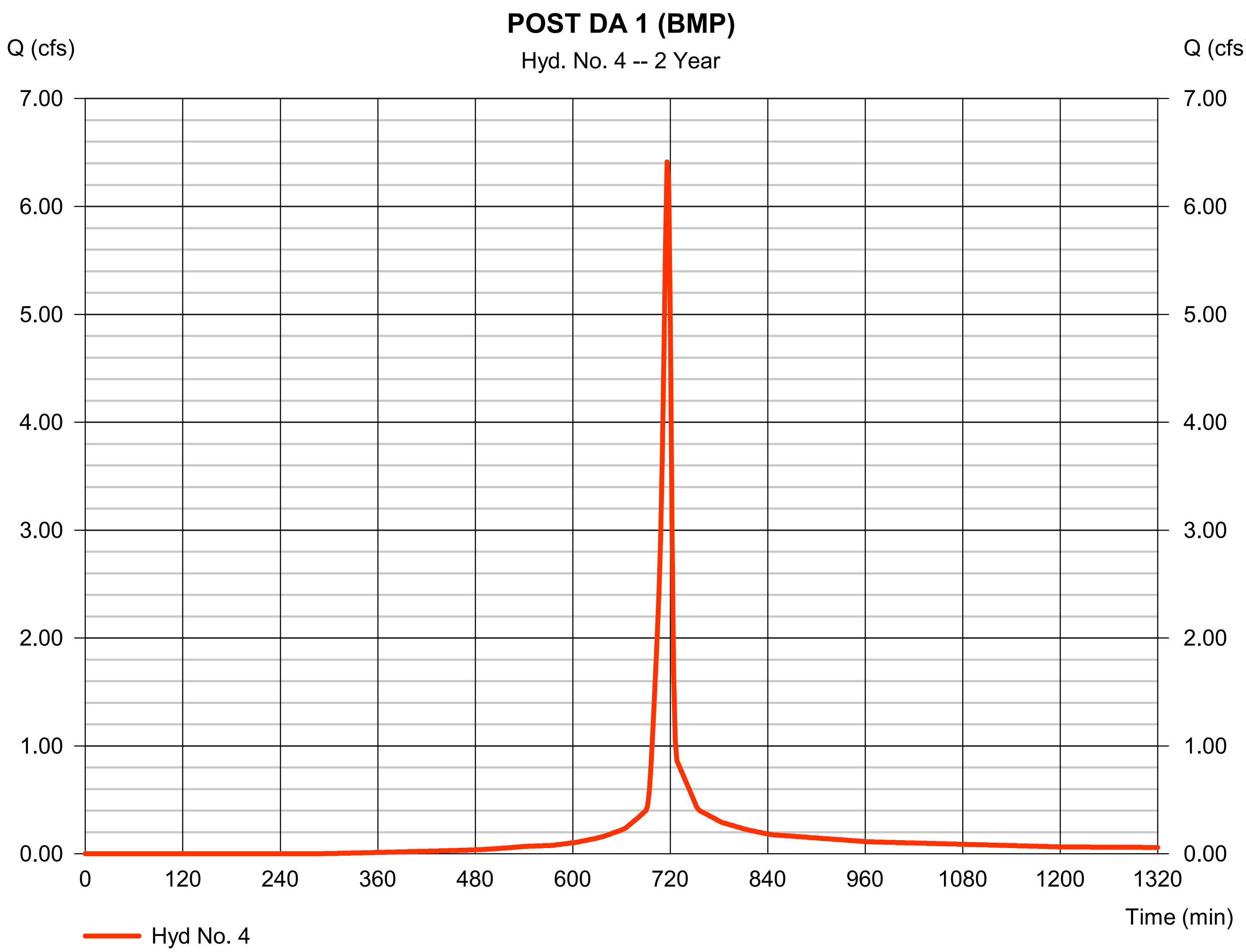
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 4

POST DA 1 (BMP)

Hydrograph type	= SCS Runoff	Peak discharge	= 6.413 cfs
Storm frequency	= 2 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 13,494 cuft
Drainage area	= 1.590 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



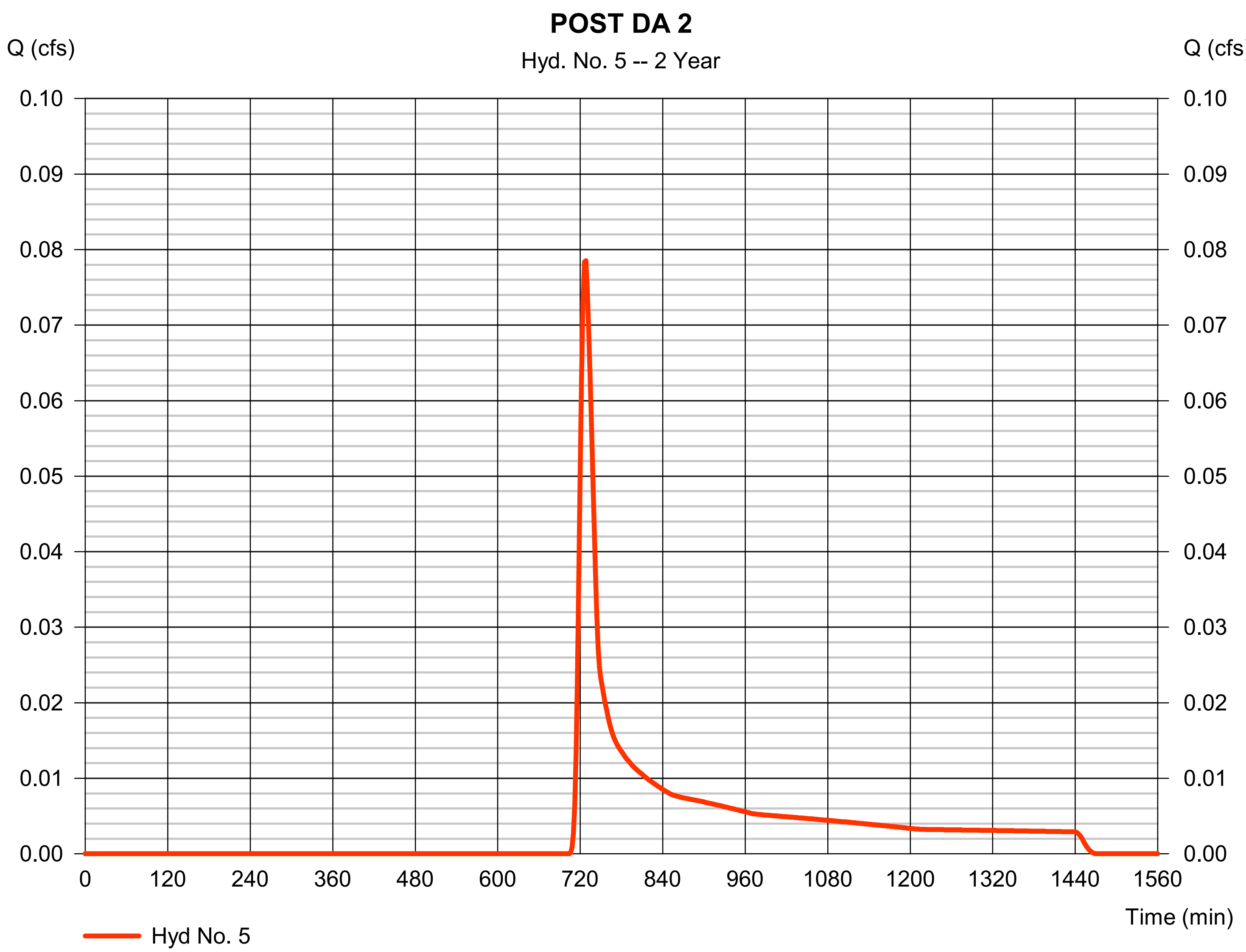
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 5

POST DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.079 cfs
Storm frequency	= 2 yrs	Time to peak	= 728 min
Time interval	= 2 min	Hyd. volume	= 340 cuft
Drainage area	= 0.170 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.00 min
Total precip.	= 3.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



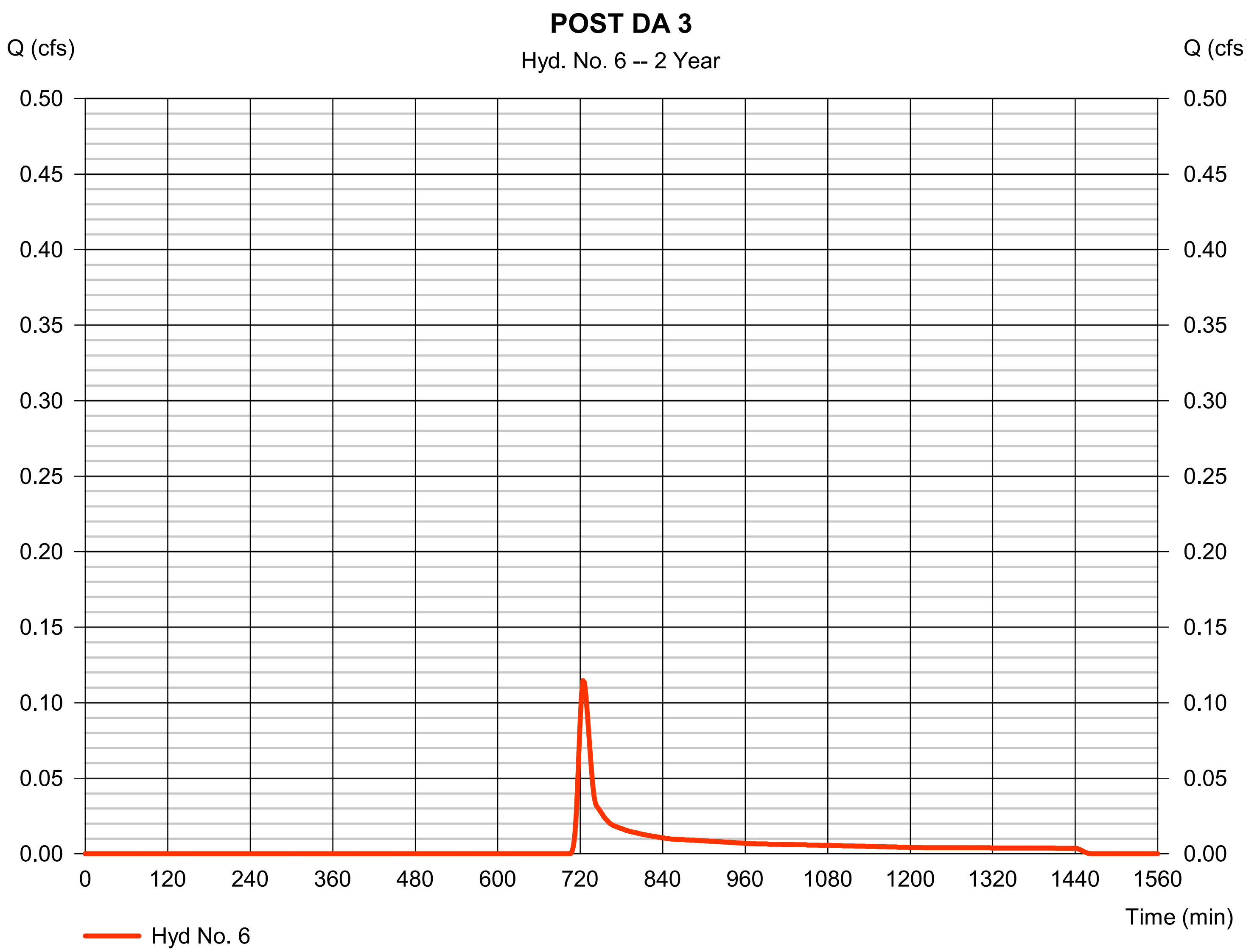
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 6

POST DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.115 cfs
Storm frequency	= 2 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 429 cuft
Drainage area	= 0.220 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.00 min
Total precip.	= 3.45 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

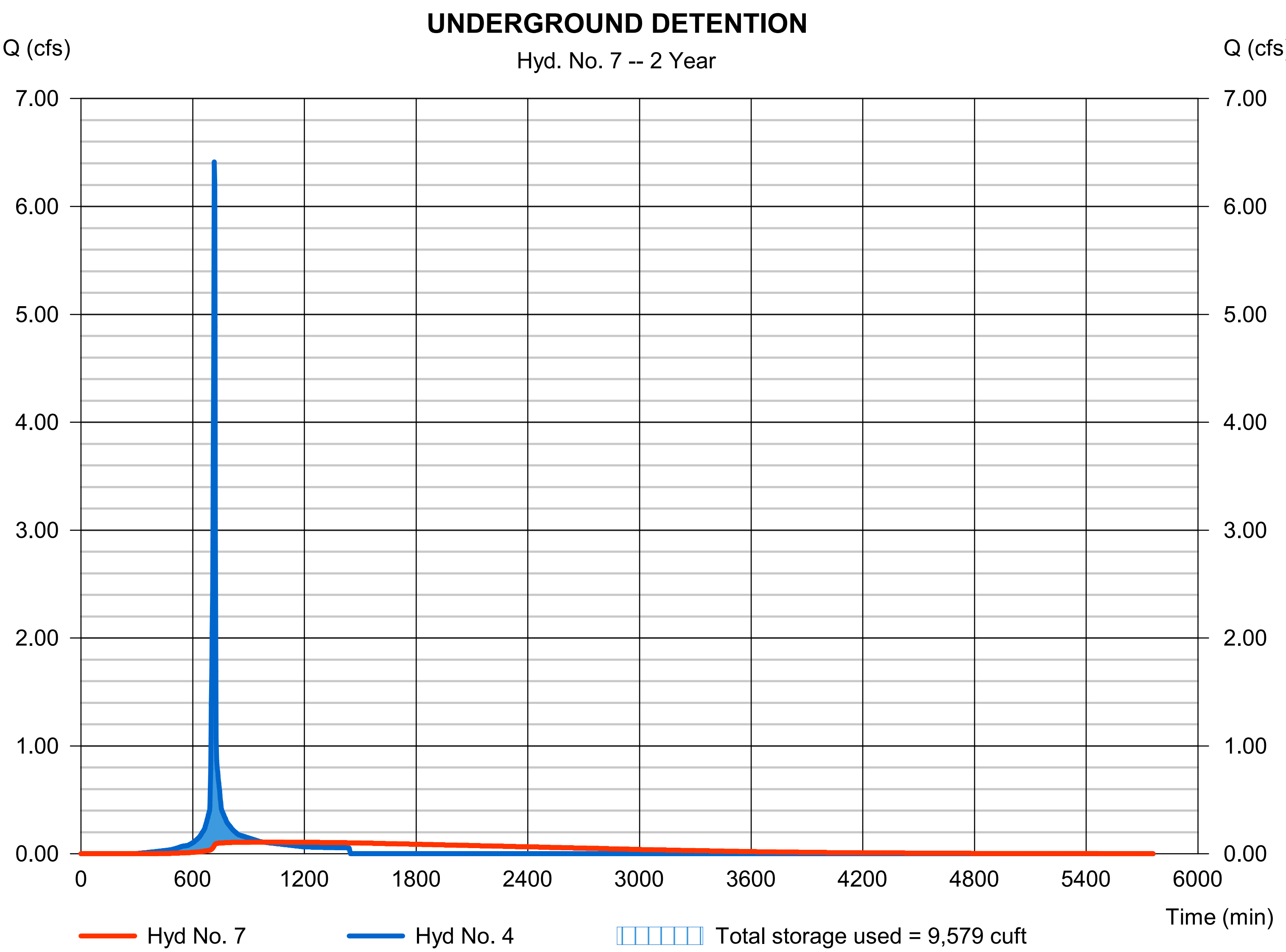
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 7

UNDERGROUND DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 0.108 cfs
Storm frequency	= 2 yrs	Time to peak	= 982 min
Time interval	= 2 min	Hyd. volume	= 13,441 cuft
Inflow hyd. No.	= 4 - POST DA 1 (BMP)	Max. Elevation	= 389.10 ft
Reservoir name	= UNDER GROUND DETENTION	Max. Storage	= 9,579 cuft

Storage Indication method used.



10-YEAR 24-HOUR STORM EVENT

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	1.293	2	726	4,400	------	------	------	PRE DA 1
2	SCS Runoff	0.361	2	732	1,635	------	------	------	PRE DA 2
3	SCS Runoff	0.908	2	730	3,739	------	------	------	PRE DA 3
4	SCS Runoff	10.04	2	716	21,757	------	------	------	POST DA 1 (BMP)
5	SCS Runoff	0.253	2	726	860	------	------	------	POST DA 2
6	SCS Runoff	0.360	2	724	1,085	------	------	------	POST DA 3
7	Reservoir	0.911	2	744	21,675	4	389.48	12,723	UNDERGROUND DETENTION

Storage Model LARGE.gpw	Return Period: 10 Year	Tuesday, 10 / 31 / 2023

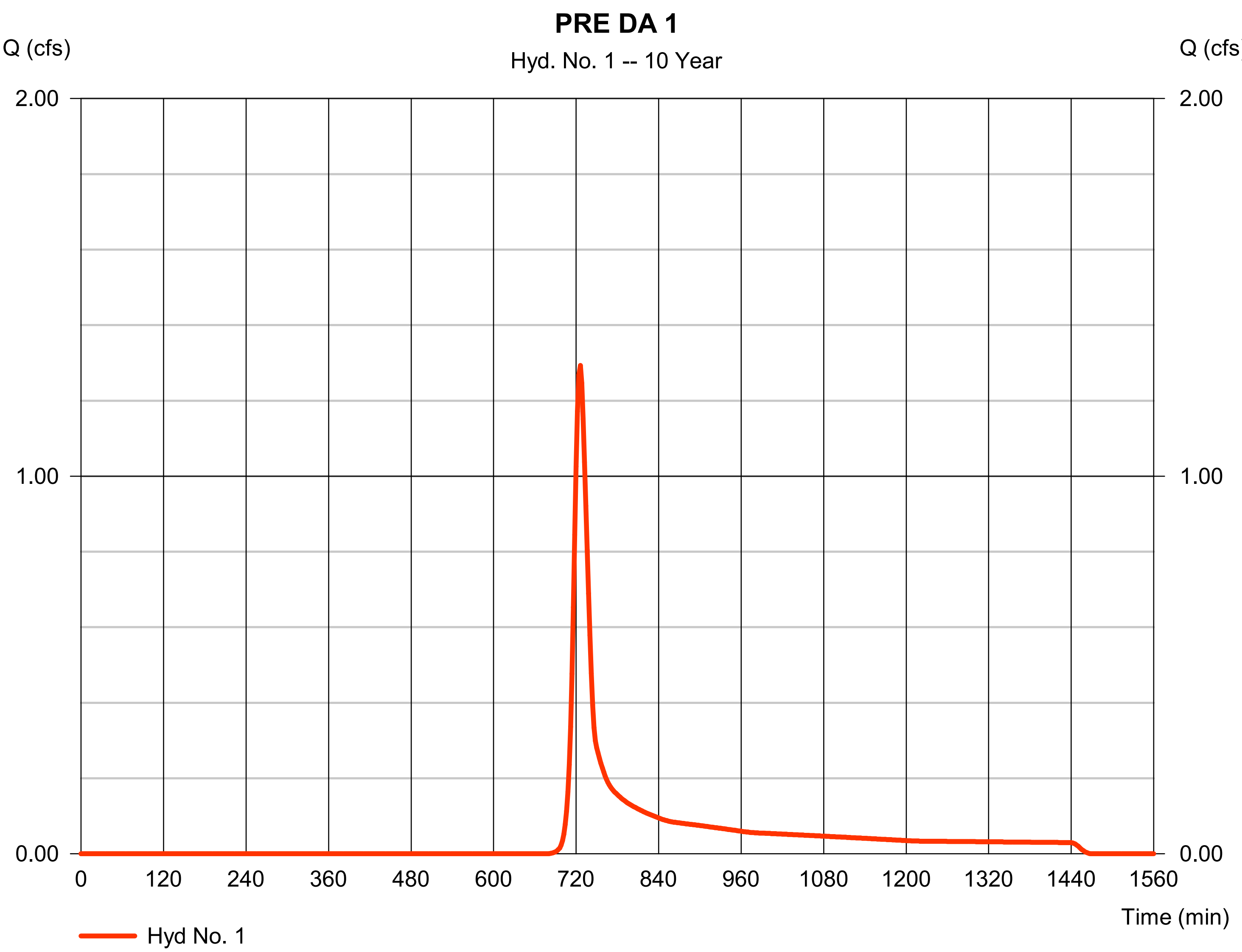
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 1

PRE DA 1

Hydrograph type	= SCS Runoff	Peak discharge	= 1.293 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 4,400 cuft
Drainage area	= 0.870 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 19.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



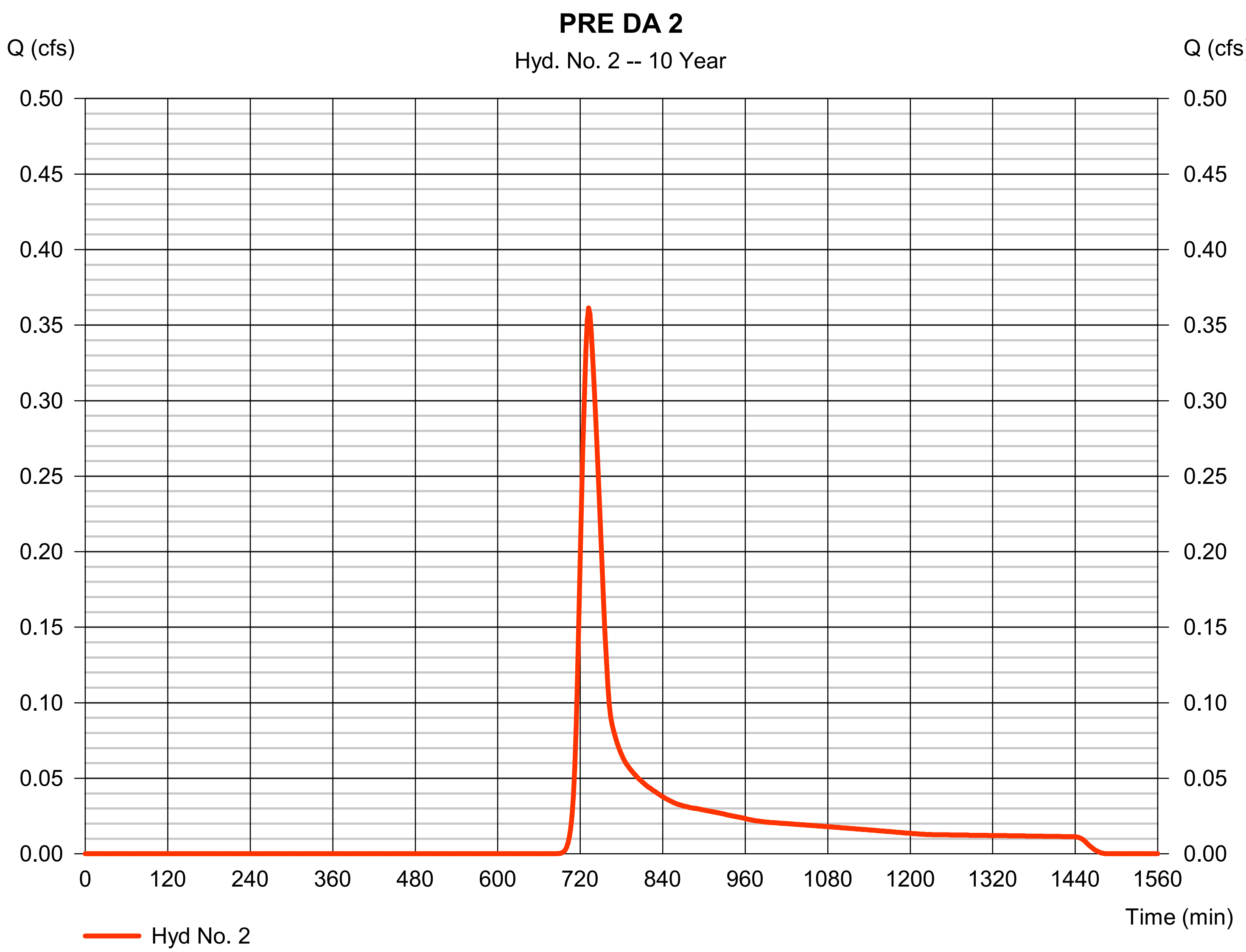
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 2

PRE DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.361 cfs
Storm frequency	= 10 yrs	Time to peak	= 732 min
Time interval	= 2 min	Hyd. volume	= 1,635 cuft
Drainage area	= 0.340 ac	Curve number	= 60
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 27.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



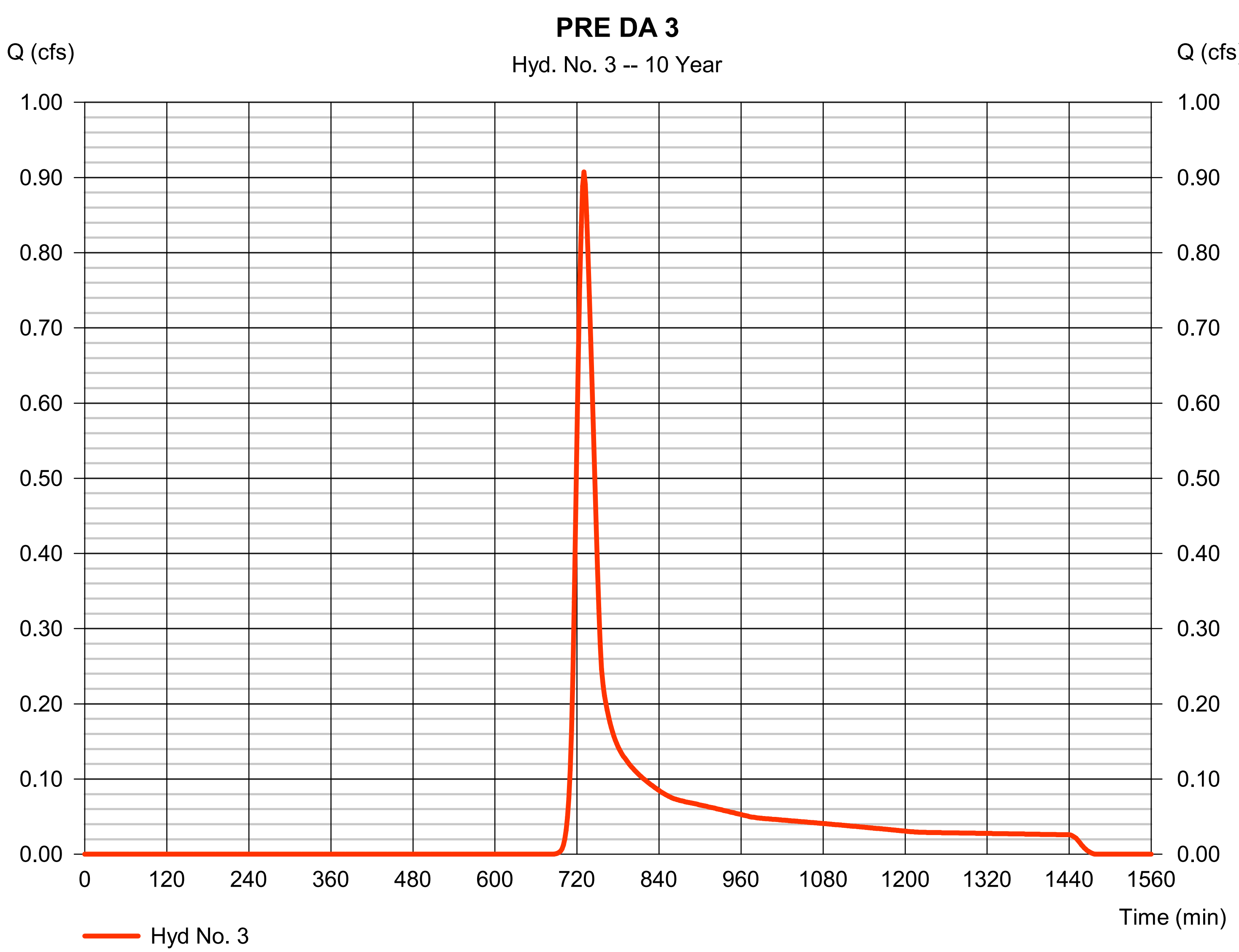
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 3

PRE DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.908 cfs
Storm frequency	= 10 yrs	Time to peak	= 730 min
Time interval	= 2 min	Hyd. volume	= 3,739 cuft
Drainage area	= 0.790 ac	Curve number	= 60
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 24.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



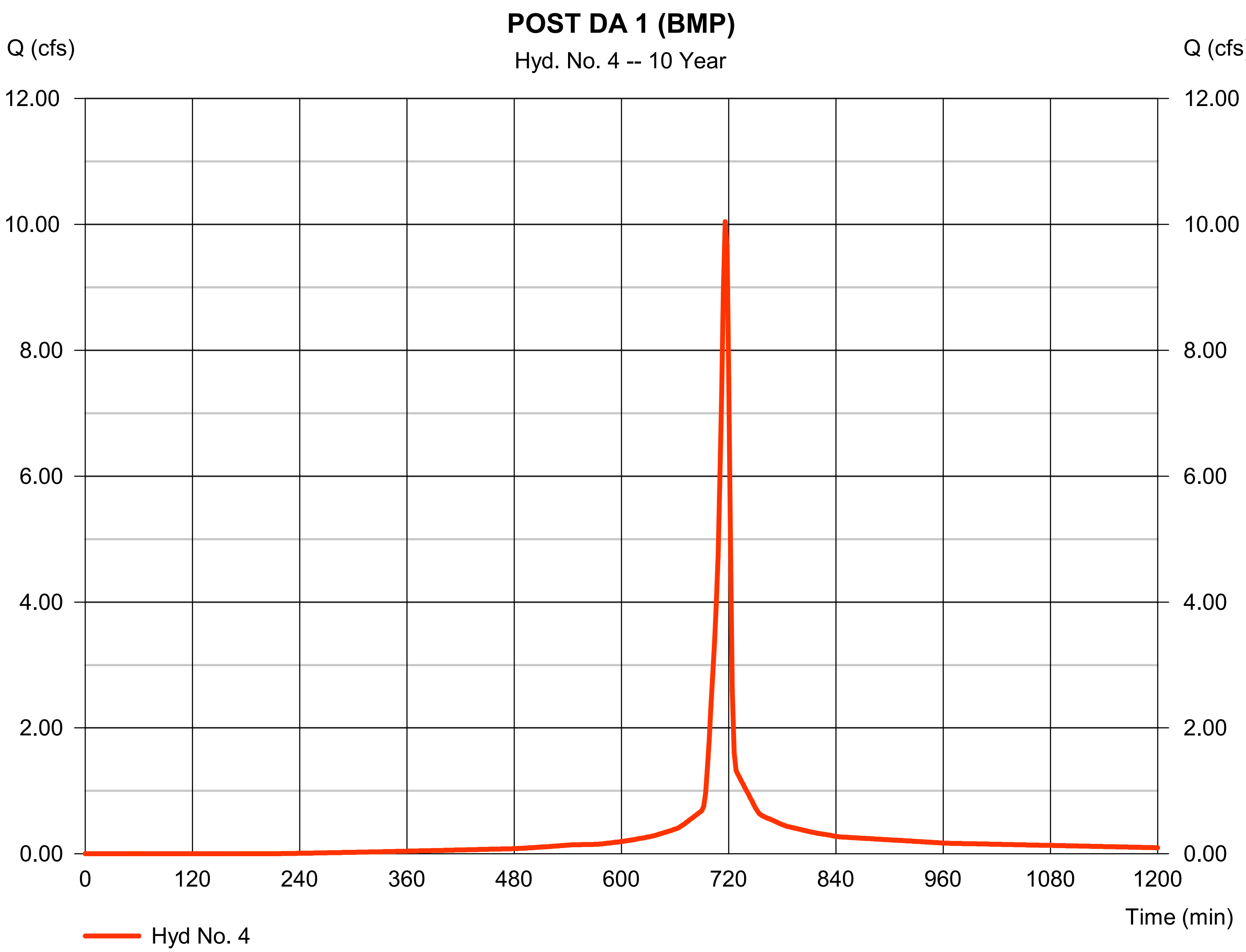
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 4

POST DA 1 (BMP)

Hydrograph type	= SCS Runoff	Peak discharge	= 10.04 cfs
Storm frequency	= 10 yrs	Time to peak	= 716 min
Time interval	= 2 min	Hyd. volume	= 21,757 cuft
Drainage area	= 1.590 ac	Curve number	= 91
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



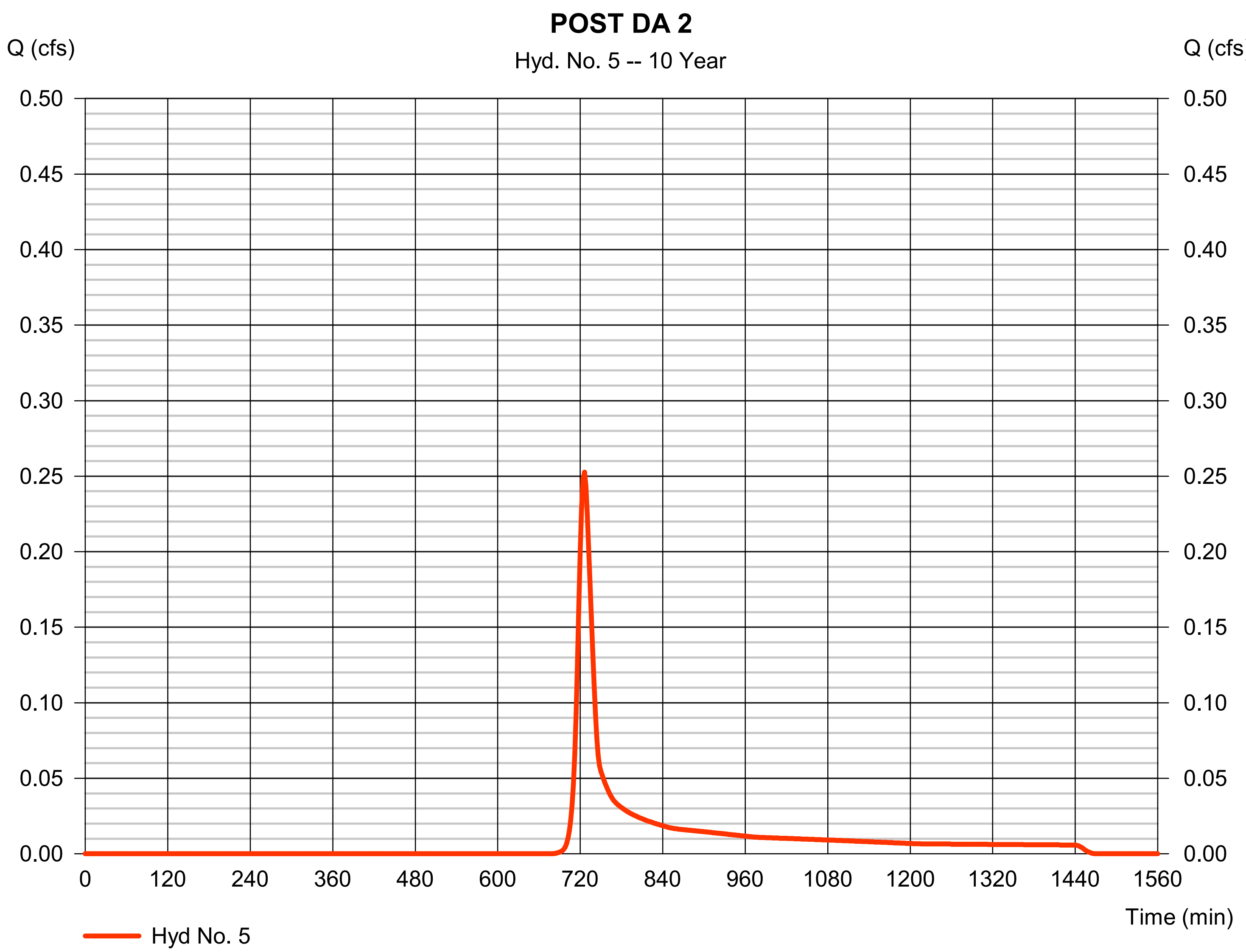
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 5

POST DA 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.253 cfs
Storm frequency	= 10 yrs	Time to peak	= 726 min
Time interval	= 2 min	Hyd. volume	= 860 cuft
Drainage area	= 0.170 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 20.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



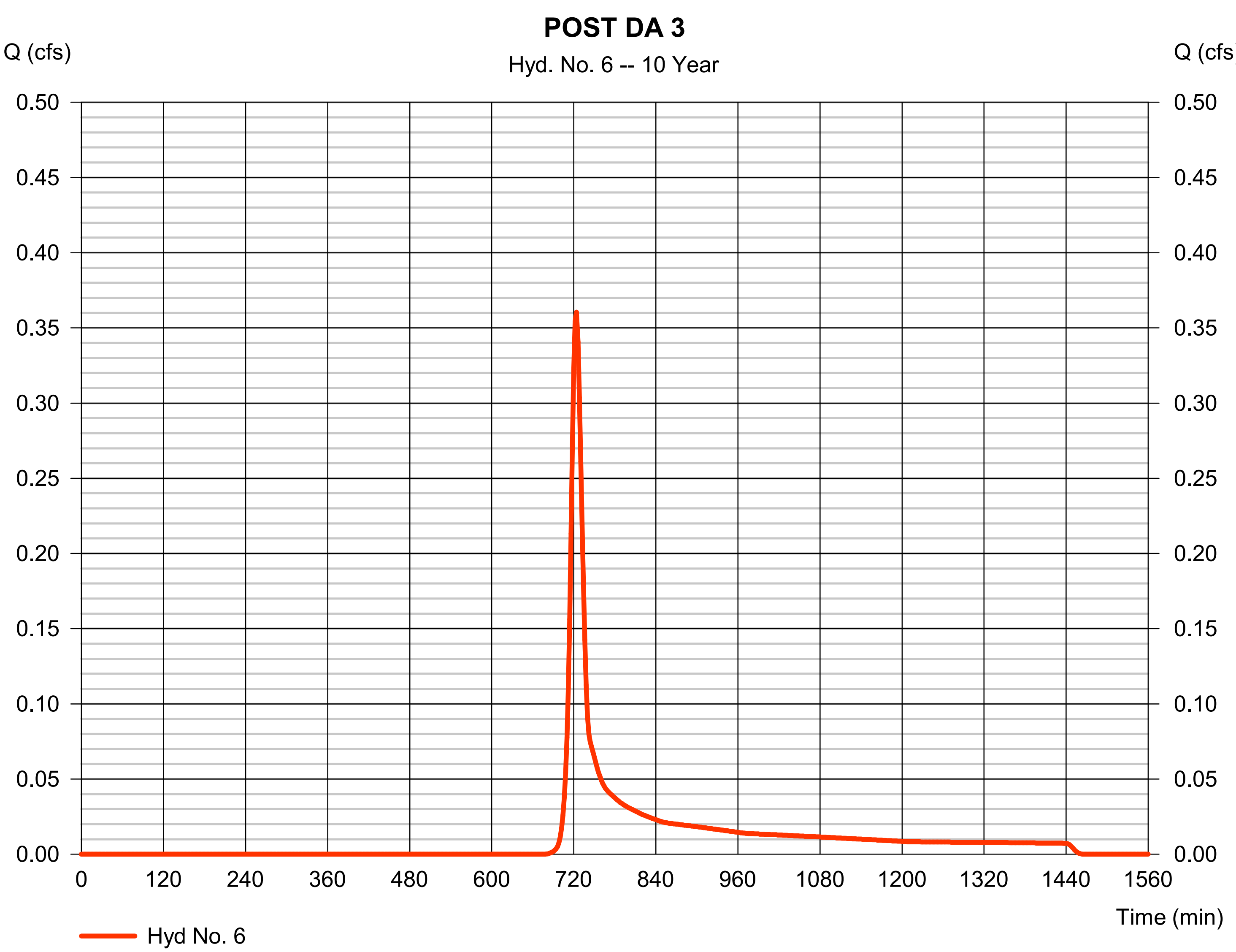
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 6

POST DA 3

Hydrograph type	= SCS Runoff	Peak discharge	= 0.360 cfs
Storm frequency	= 10 yrs	Time to peak	= 724 min
Time interval	= 2 min	Hyd. volume	= 1,085 cuft
Drainage area	= 0.220 ac	Curve number	= 61
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 16.00 min
Total precip.	= 5.04 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484



Hydrograph Report

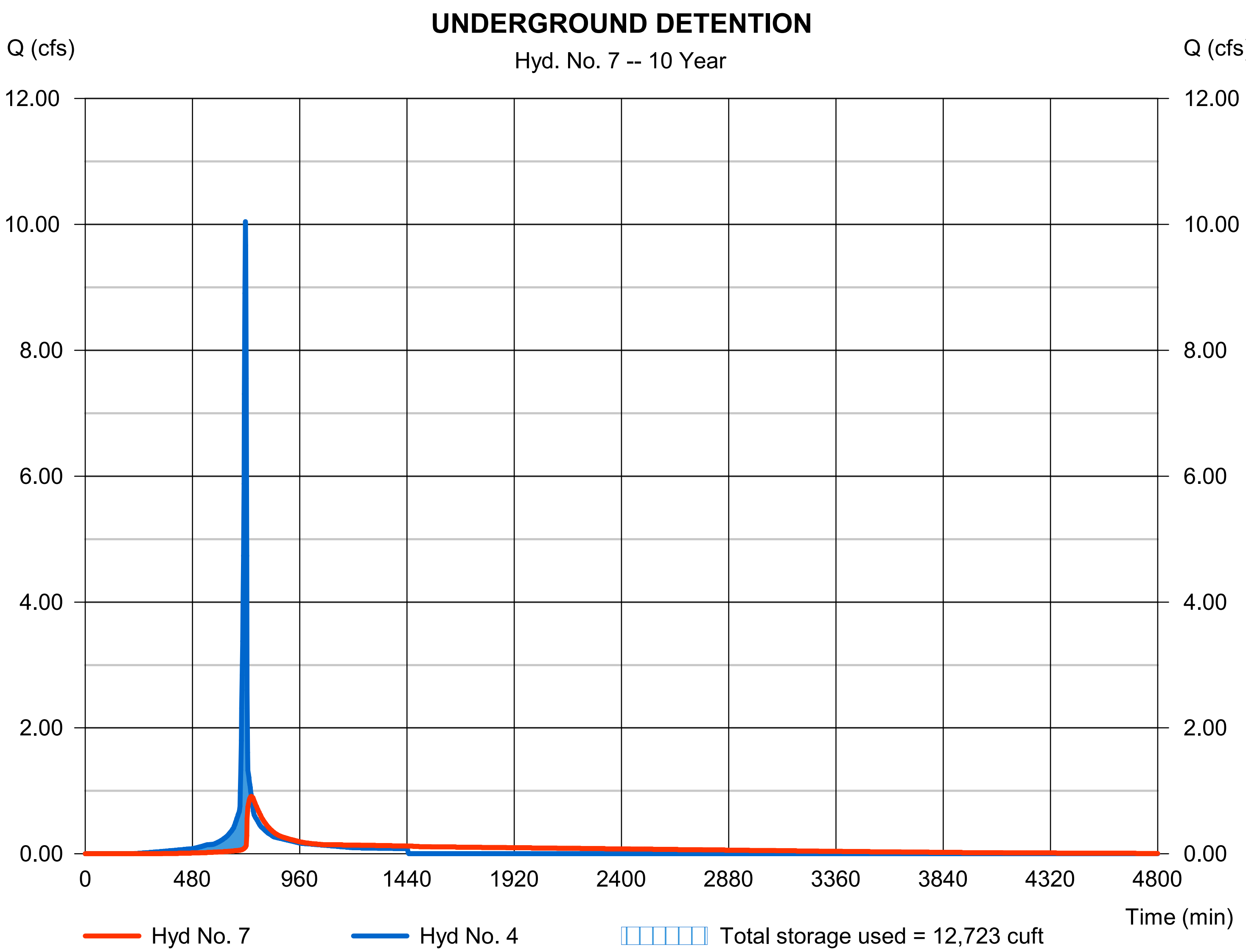
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® 2019 by Autodesk, Inc. v2019.2 Tuesday, 10 / 31 / 2023

Hyd. No. 7

UNDERGROUND DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 0.911 cfs
Storm frequency	= 10 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 21,675 cuft
Inflow hyd. No.	= 4 - POST DA 1 (BMP)	Max. Elevation	= 389.48 ft
Reservoir name	= UNDER GROUND DETENTION	Max. Storage	= 12,723 cuft

Storage Indication method used.



HYDRAFLOW STORM SEWERS CALCULATIONS

Storm Sewer Tabulation

Station		Len	Drng Area		Rnoff coeff	Area x C		Tc		Rain (I)	Total flow	Cap full	Vel	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr	Total		Incr	Total	Inlet	Syst					Size	Slope	Dn	Up	Dn	Up	Dn	Up	
		(ft)	(ac)	(ac)	(C)			(min)	(min)	(in/hr)	(cfs)	(cfs)	(ft/s)	(in)	(%)	(ft)	(ft)	(ft)	(ft)	(ft)	(ft)	
1	End	6.003	0.24	0.24	0.95	0.22	0.22	6.0	6.0	7.0	1.56	4.56	1.73	15	0.50	390.24	390.27	391.11	391.11	391.76	393.85	A5 - A6
2	End	16.379	0.49	0.49	0.95	0.47	0.47	6.0	6.0	7.0	3.27	4.51	3.22	15	0.49	389.71	389.79	390.70	390.73	391.23	393.94	A1 - A2
3	End	16.373	0.64	0.64	0.95	0.61	0.61	6.0	6.0	7.0	4.24	4.51	3.91	15	0.49	389.52	389.60	390.56	390.62	391.04	393.36	A3 - A4
4	End	83.086	0.18	0.18	0.97	0.17	0.17	6.0	6.0	7.0	1.22	7.92	2.30	15	1.50	388.77	390.02	389.61	390.45	390.29	394.56	A7 - A8
5	End	46.882	0.18	0.21	0.97	0.17	0.20	6.0	7.3	6.6	5.35	7.46	3.80	18	0.50	386.10	386.34	387.30	387.38	387.90	391.97	A9 - A10
6	5	193.728	0.00	0.03	0.00	0.00	0.03	6.0	6.4	6.9	4.20	4.57	4.16	15	0.50	386.59	387.56	387.58	388.48	391.97	394.81	A10 - A11
7	6	33.883	0.03	0.03	0.93	0.03	0.03	6.0	6.2	6.9	4.20	4.57	3.92	15	0.50	387.56	387.73	388.60	388.72	394.81	394.41	A11 - A12
8	7	45.782	0.00	0.00	0.00	0.00	0.00	6.0	6.0	0.0	4.00	4.57	3.67	15	0.50	387.73	387.95	388.81	388.95	394.41	389.47	A12 - A13

Project File: 10.26.2023 Storm Sewers.stm | Number of lines: 8 | Run Date: 10/26/2023

NOTES:Intensity = 86.72 / (Inlet time + 15.30) ^ 0.82; Return period =Yrs. 10 ; c = cir e = ellip b = box

WAKE COUNTY
HYBRID
STORMWATER TOOL
CALCULATIONS

WAKE COUNTY
NORTH CAROLINA

SITE DATA

Project Information	
Project Name:	**TIDAL WAVE AUTO SPA**
Permit No (if known):	
Applicant:	SHJ DEVELOPMENT LLC
Applicant Contact Name:	PARKER EVANS
Applicant Contact Number:	(864) 612-6101
Contact Email:	PEVANS@SEAMONWHITESIDE.COM
Last Modified Date:	Friday, October 27, 2023
Site Data:	
River Basin:	Neuse
Regulatory Watershed:	N/A
Physiographic/Geologic Region:	Piedmont
Type of Development (Select from Dropdown menu):	Non-Residential
Zoning:	General Business
Total Site Area (Ac):	1.98
Existing Lake/Pond Area (Ac):	0.00
Proposed Disturbed Area (Ac):	0.00
Proposed Impervious Surface Area from DA Sheets (acre):	1.29
Percent Built Upon Area (BUA):	65%
Is the proposed project a site expansion?	No
Number of Drainage Areas on Site (Points of Analysis):	3
Annual Rainfall (in):	45.41
One-year, 24-hour rainfall (in):	3.00
Two-year, 24-hour rainfall (in):	3.60
Proposed Residential Stormwater Details (if applicable):	
Site Square Footage:	86,249
Total Acreage in Lots:	
Lot Square Footage:	
Number of Lots:	
Average Lot Size (SF):	
Proposed Impervious Surface Area from DA sheets (SF):	56,192
Proposed Impervious Surface Area Devoted to Lots (SF):	
Total Impervious Surface Area Devoted to Roads (SF):	
Other Impervious Surface Area (SF):	

Project Name: TIDAL WAVE AUTO SPA

DRAINAGE AREA 1
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT								POST-DEVELOPMENT							
Drainage Area (Acres)=	0.87								1.59							
Site Acreage within Drainage=	0.87								1.59							
One-year, 24-hour rainfall (in)=	3.00															
Land Use (acres) by Soil Group:	**A Soils**		**B Soils**		**C Soils**		**D Soils**		**A Soils**		**B Soils**		**C Soils**		**D Soils**	
Commercial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot			0.04								1.29					
Roof																
Open/Landscaped											0.30					
Industrial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped																
Transportation	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
High Density (interstate, main)																
High Density (Grassed Right-of-ways)																
Low Density (secondary, feeder)																
Low Density (Grassed Right-of-ways)																
Rural																
Rural (Grassed Right-of-ways)																
Sidewalk																
Misc. Pervious	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Managed pervious (Open Space)																
Unmanaged (pasture)																
Woods (not on lots)			0.83													
Residential	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Roadway																
Grassed Right-of-ways																
Driveway																
Parking lot																
Roof																
Sidewalk (Includes Patios)																
Lawn																
Managed pervious (Open Space)																
Woods (on lots)																
Land Taken up by BMP																
JURISDICTIONAL LANDS	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland																
Riparian buffer (Zone 1 only)																
Open water																
Totals (Ac)=	0.00	0.00	0.87	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.59	0.00	0.00	0.00	0.00	0.00

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc
Sheet Flow		
Length (ft)=	100.00	100.00
Slope (ft/ft)=	0.04	0.02
Surface Cover:	Woods	Paved, Gravel, or Bare Soil
n-value=	0.40	0.011
T_t (hrs)=	0.26	0.02
Shallow Flow		
Length (ft)=	70.91	96.31
Slope (ft/ft)=	0.02	0.02
Surface Cover:	Unpaved	Paved
Average Velocity (ft/sec)=	2.28	2.87
T_t (hrs)=	0.01	0.01
Channel Flow 1		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=	0.00	0.00
Average Velocity (ft/sec)=	0.00	0.00
T_t (hrs)=	0.00	0.00
Tc (hrs)=	0.32	0.08
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Site Impervious Surface Area (Ac) =	0.04	1.29
Lot Impervious Surface Area (Ac) =	0.00	0.00
1-year, 24-hour storm (Peak Flow)		
Volume of runoff (ft^3) =	989	13,361
Volume change (ft^3) =	12,372	
Runoff (inches) = Q*=	0.3131	2.3148
Peak Discharge (cfs)= Q=	0.1214	6.1124
Composite Curve Number (DA)=	57	91
Composite Curve Number (Site only)=	57	91

DISCONNECTED IMPERVIOUS - Credit given only to residential development with drainage area with less than 30% impervious	
Percent Disconnected Impervious Credit (Residential Only) =	
Disconnected impervious area (Ac) =	0.00
Drainage Area $CN_{adjusted}$=	91
Site Only $CN_{adjusted}$=	91

Post-development peak flow exceeds pre-development peak flow for this DA!

Project Name: TIDAL WAVE AUTO SPA

DRAINAGE AREA 2
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT								POST-DEVELOPMENT							
Drainage Area (Acres)=	0.34								0.17							
Site Acreage within Drainage=	0.34								0.17							
One-year, 24-hour rainfall (in)=	3.00															
Land Use (acres) by Soil Group:	**A Soils**		**B Soils**		**C Soils**		**D Soils**		**A Soils**		**B Soils**		**C Soils**		**D Soils**	
Commercial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped											0.17					
Industrial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped																
Transportation	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
High Density (interstate, main)																
High Density (Grassed Right-of-ways)																
Low Density (secondary, feeder)																
Low Density (Grassed Right-of-ways)																
Rural																
Rural (Grassed Right-of-ways)																
Sidewalk																
Misc. Pervious	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Managed pervious (Open Space)			0.12													
Unmanaged (pasture)																
Woods (not on lots)			0.22													
Residential	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Roadway																
Grassed Right-of-ways																
Driveway																
Parking lot																
Roof																
Sidewalk (Includes Patios)																
Lawn																
Managed pervious (Open Space)																
Woods (on lots)																
Land Taken up by BMP																
JURISDICTIONAL LANDS	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland																
Riparian buffer (Zone 1 only)																
Open water																
Totals (Ac)=	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00

SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc
Sheet Flow		
Length (ft)=	100.00	75.20
Slope (ft/ft)=	0.01	0.01
Surface Cover:	Woods	Grass
n-value=	0.40	0.240
T_t (hrs)=	0.45	0.24
Shallow Flow		
Length (ft)=	63.48	
Slope (ft/ft)=	0.01	
Surface Cover:	Unpaved	
Average Velocity (ft/sec)=	1.61	0.00
T_t (hrs)=	0.01	0.00
Channel Flow 1		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=	0.00	0.00
Average Velocity (ft/sec)=	0.00	0.00
T_t (hrs)=	0.00	0.00
Tc (hrs)=	0.46	0.33
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Site Impervious Surface Area (Ac) =	0.00	0.00
Lot Impervious Surface Area (Ac) =	0.00	0.00
1-year, 24-hour storm (Peak Flow)		
Volume of runoff (ft^3) =	308	225
Volume change (ft^3) =	-82	
Runoff (inches) = Q*=	0.2493	0.3651
Peak Discharge (cfs)= Q=	0.0316	0.0386
Composite Curve Number (DA)=	57	61
Composite Curve Number (Site only)=	57	61

DISCONNECTED IMPERVIOUS - Credit given only to residential development with drainage area with less than 30% impervious	
Percent Disconnected Impervious Credit (Residential Only) =	
Disconnected impervious area (Ac) =	0.00
Drainage Area $CN_{adjusted}$=	61
Site Only $CN_{adjusted}$=	61

Post-development peak flow exceeds pre-development peak flow for this DA!

Project Name: TIDAL WAVE AUTO SPA

DRAINAGE AREA 3
STORMWATER PRE-POST CALCULATIONS

LAND USE & SITE DATA	PRE-DEVELOPMENT								POST-DEVELOPMENT							
Drainage Area (Acres)=	0.79								0.22							
Site Acreage within Drainage=	0.79								0.22							
One-year, 24-hour rainfall (in)=	3.00															
Land Use (acres) by Soil Group:	**A Soils**		**B Soils**		**C Soils**		**D Soils**		**A Soils**		**B Soils**		**C Soils**		**D Soils**	
Commercial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped											0.22					
Industrial	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Parking lot																
Roof																
Open/Landscaped																
Transportation	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
High Density (interstate, main)																
High Density (Grassed Right-of-ways)																
Low Density (secondary, feeder)																
Low Density (Grassed Right-of-ways)																
Rural																
Rural (Grassed Right-of-ways)																
Sidewalk																
Misc. Pervious	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Managed pervious (Open Space)			0.22													
Unmanaged (pasture)																
Woods (not on lots)			0.57													
Residential	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Roadway																
Grassed Right-of-ways																
Driveway																
Parking lot																
Roof																
Sidewalk (Includes Patios)																
Lawn																
Managed pervious (Open Space)																
Woods (on lots)																
Land Taken up by BMP																
JURISDICTIONAL LANDS	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland																
Riparian buffer (Zone 1 only)																
Open water																
Totals (Ac)=	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00

Project Name: TIDAL WAVE AUTO SPA

DRAINAGE AREA 1
BMP CALCULATIONS

DRAINAGE AREA 1 - BMP DEVICES AND ADJUSTMENTS				
DA1 Site Acreage=	1.59			
DA1 Off-Site Acreage=	0.00			
Total Required Storage Volume for Site TCN Requirement (ft^3)=				
Will site use underground water harvesting?	Yes	Enter % volume reduction in decimal form=	0.91	Note: Supporting information/details should be submitted to demonstrate water usage.

ENTER AREA TREATED BY BMP

Land Use (acres)	Sub-DA1(a) (Ac)		Sub-DA1(b) (Ac)		Sub-DA1(c) (Ac)		Sub-DA1(d) (Ac)		Sub-DA1(e) (Ac)	
Commercial	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Parking lot	1.29									
Roof										
Open/Landscaped	0.30									
Industrial	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Parking lot										
Roof										
Open/Landscaped										
Transportation	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
High Density (interstate, main)										
High Density (Grassed Right-of-ways)										
Low Density (secondary, feeder)										
Low Density (Grassed Right-of-ways)										
Rural										
Rural (Grassed Right-of-ways)										
Sidewalk										
Misc. Pervious	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Managed pervious										
Unmanaged (pasture)										
Woods (not on lots)										
Residential	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site	Site	Off-site
Roadway										
Grassed Right-of-ways										
Driveway										
Parking lot										
Roof										
Sidewalk										
Lawn										
Managed pervious										
Woods (on lots)										
Land Taken up by BMP										
JURISDICTIONAL LANDS	Site	Off-site	Site	Offsite	Site	Offsite	Site	Offsite	Site	Offsite
Natural wetland										
Riparian buffer (Zone 1 only)										
Totals (Ac)=	1.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Sub-DA1(a) BMP(s)

Device Name (As Shown on Plan)	Device Type	Water Quality Volume (c.f.)	Inflow N EMC (mg/L)	Total Inflow N (lb/ac/yr)	Inflow P EMC (mg/L)	Total Inflow P (lb/ac/yr)	Outflow N EMC (mg/L)	Total Outflow N (lb/ac/yr)	Outflow P EMC (mg/L)	Total Outflow P (lb/ac/yr)	Provided Volume Managed (c.f.)
UNDERGROUND DETENTION	Water Harvesting	4,503	1.45	11.64	0.16	1.31	1.45	1.05	0.16	0.12	8,330
Outflow Total Nitrogen (lb/ac/yr)=		1.05					Outflow Total Phosphorus (lb/ac/yr)=		0.12		

Sub-DA1(b) BMP(s)

WAKE COUNTY
NORTH CAROLINA

Project Name: TIDAL WAVE AUTO SPA

DA SITE SUMMARY
BMP CALCULATIONS

BMP SUMMARY						
DRAINAGE AREA SUMMARIES						
DRAINAGE AREA:	DA1	DA2	DA3	DA4	DA5	DA6
Post-Development (1-year, 24-hour storm)						
Peak Flow (cfs)= $Q_{1\text{-year}}$ =	6.11	0.04	0.07			
Post-Development with BMPs (1-year, 24-hour storm)						
% Impervious =	**65%**					
Volume Managed (CF)=	8,330					
Post BMP Peak Discharge (cfs)= $Q_{1\text{-year}}$=	3.70	0.04	0.07			
Have Target Curve Number Requirements been met?	N/A					
Pre Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	1.16					
Total Phosphorus (lb/ac/yr)=	N/A					
Post Development Nitrogen and Phosphorus Load						
Total Nitrogen (lb/ac/yr)=	9.58					
Total Phosphorus (lb/ac/yr)=	N/A					
Post-BMP Nitrogen Loading						
Outflow Total Nitrogen (lb/ac/yr)=	1.07					
Outflow Total Phosphorus (lb/ac/yr)=	0.14					
Has site met the Target?	YES					
Has site met requirements for offsetting?	YES					

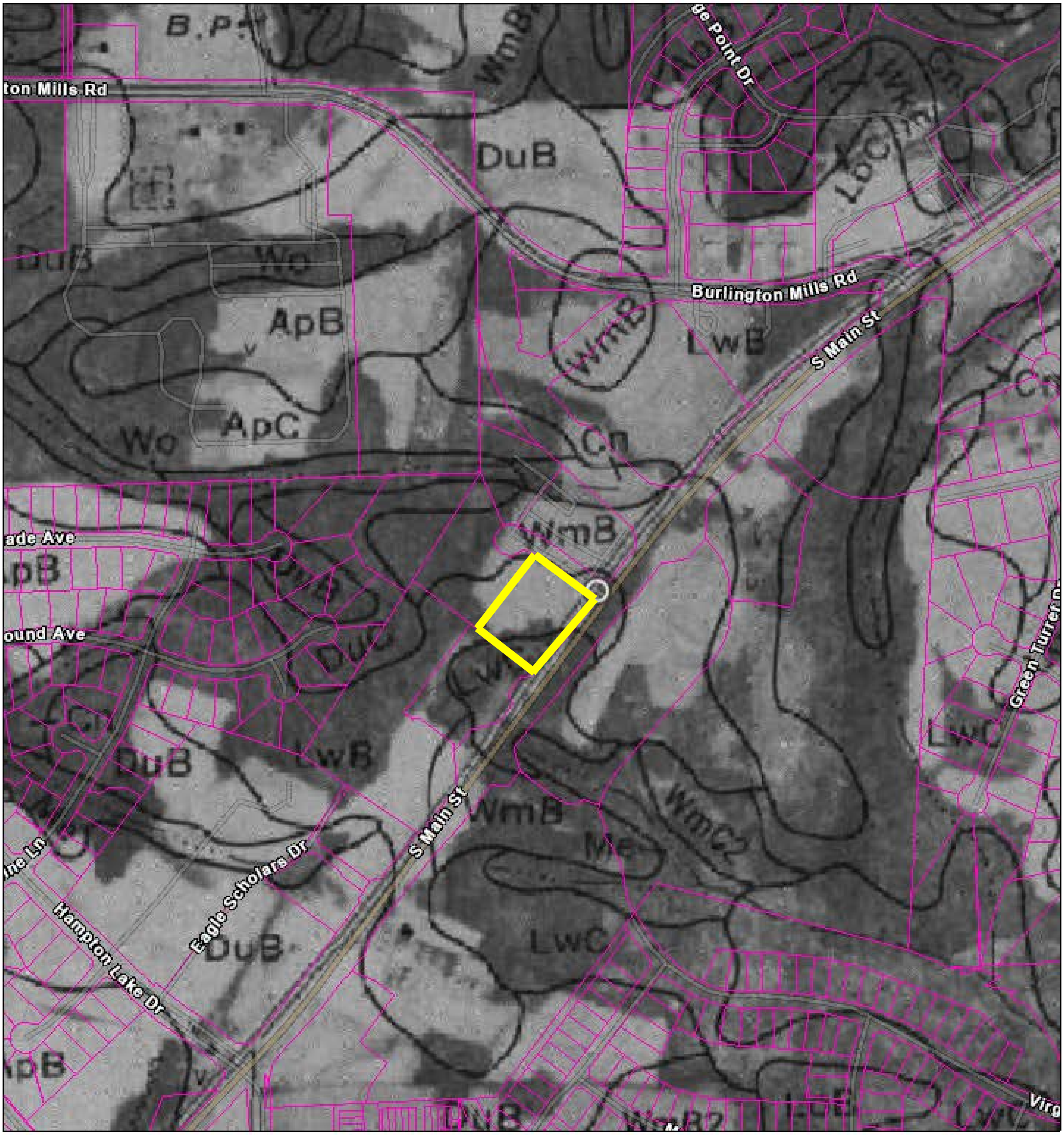
SITE FLOW	PRE-DEVELOPMENT T_c	POST-DEVELOPMENT Tc
Sheet Flow		
Length (ft)=	100.00	100.00
Slope (ft/ft)=	0.02	0.04
Surface Cover:	Woods	Grass
n-value=	0.40	0.240
T_t (hrs)=	0.34	0.17
Shallow Flow		
Length (ft)=	104.00	91.31
Slope (ft/ft)=	0.04	0.03
Surface Cover:	Unpaved	Unpaved
Average Velocity (ft/sec)=	3.23	2.79
T_t (hrs)=	0.01	0.01
Channel Flow 1		
Length (ft)=		
Slope (ft/ft)=		
Cross Sectional Flow Area (ft^2)=		
Wetted Perimeter (ft)=		
Channel Lining:		
n-value=		
Hydraulic Radius (ft)=	0.00	0.00
Average Velocity (ft/sec)=	0.00	0.00
T_t (hrs)=	0.00	0.00
Tc (hrs)=	0.35	0.18
RESULTS	**PRE-DEVELOPMENT**	**POST-DEVELOPMENT**
Site Impervious Surface Area (Ac) =	0.00	0.00
Lot Impervious Surface Area (Ac) =	0.00	0.00
1-year, 24-hour storm (Peak Flow)		
Volume of runoff (ft^3) =	681	292
Volume change (ft^3) =	-389	
Runoff (inches) = Q*=	0.2373	0.3651
Peak Discharge (cfs)= Q=	0.0803	0.0694
Composite Curve Number (DA)=	57	61
Composite Curve Number (Site only)=	57	61

DISCONNECTED IMPERVIOUS - Credit given only to residential development with drainage area with less than 30% impervious	
Percent Disconnected Impervious Credit (Residential Only) =	
Disconnected impervious area (Ac) =	0.00
Drainage Area $CN_{adjusted}$=	61
Site Only $CN_{adjusted}$=	61

REFERENCES

SOIL MAP

ArcGIS Web Map



12/18/2023, 7:15:28 PM

North Carolina Parcels (Polygons) - Parcels

255 - 1

Major River Basins

NC Counties

1:6,843

0 0.04 0.09 0.18 mi

0 0.07 0.15 0.3 km

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FEMA FLOOD MAP

National Flood Hazard Layer FIRMette

FEMA

78°28'55"W 35°54'56"N

78°28'18"W 35°54'26"N

Feet 0 250 500 1,000 1,500 2,000

1:6,000

Basemap Imagery Source: USGS National Map 2023

Legend

SEE FIS REPORT FOR DETAILED LEGEND AND INDEX MAP FOR FIRM PANEL LAYOUT

SPECIAL FLOOD HAZARD AREAS
- Without Base Flood Elevation (BFE) *Zone A, V, A99*
- With BFE or Depth *Zone AE, AO, AH, VE, AR*
- Regulatory Floodway

OTHER AREAS OF FLOOD HAZARD
- 0.2% Annual Chance Flood Hazard, Areas of 1% annual chance flood with average depth less than one foot or with drainage areas of less than one square mile *Zone X*
- Future Conditions 1% Annual Chance Flood Hazard *Zone X*
- Area with Reduced Flood Risk due to Levee. See Notes. *Zone X*
- Area with Flood Risk due to Levee *Zone D*

OTHER AREAS
- NO SCREEN Area of Minimal Flood Hazard *Zone X*
- Effective LOMRs
- Area of Undetermined Flood Hazard *Zone D*

GENERAL STRUCTURES
- Channel, Culvert, or Storm Sewer
- Levee, Dike, or Floodwall

OTHER FEATURES
- B 20.2 17.5 Cross Sections with 1% Annual Chance Water Surface Elevation
- 8 Coastal Transect
- 513 Base Flood Elevation Line (BFE)
- Limit of Study
- Jurisdiction Boundary
- Coastal Transect Baseline
- Profile Baseline
- Hydrographic Feature

MAP PANELS
- Digital Data Available
- No Digital Data Available
- Unmapped

N

The pin displayed on the map is an approximate point selected by the user and does not represent an authoritative property location.

This map complies with FEMA's standards for the use of digital flood maps if it is not void as described below. The basemap shown complies with FEMA's basemap accuracy standards

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/19/2023 at 9:49 AM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

This map image is void if the one or more of the following map elements do not appear: basemap imagery, flood zone labels, legend, scale bar, map creation date, community identifiers, FIRM panel number, and FIRM effective date. Map images for unmapped and unmodernized areas cannot be used for regulatory purposes.

USGS QUAD MAP

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

The National Map
US Topo

ROLESVILLE QUADRANGLE
NORTH CAROLINA
7.5-MINUTE SERIES

Produced by the United States Geological Survey
North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid:Universal Transverse Mercator, Zone 17S

This map is not a legal document. Boundaries may be generalized for this map scale. Private lands within government reservations may not be shown. Obtain permission before entering private lands.

Imagery........NAIP, July 2020 - July 2020
Roads........ U.S. Census Bureau, 2016
Names........GNIS, 1980 - 2022
Hydrography........National Hydrography Dataset, 2001 - 2021
Contours........National Elevation Dataset, 2008
Boundaries........Multiple sources; see metadata file 2019 - 2021

Wetlands........FWS National Wetlands Inventory Not Available

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the National Geospatial Program US Topo Product Standard.

QUADRANGLE LOCATION

ADJOINING QUADRANGLES
1 Grissom
2 Franklinton
3 Louisburg
4 Wake Forest
5 Bunn West
6 Raleigh East
7 Knightdale
8 Zebulon

ROAD CLASSIFICATION
Expressway
Secondary Hwy
Ramp
Local Connector
Local Road
4WD
Interstate Route
US Route
State Route

ROLESVILLE, NC
2022

PRECIPITATION DEPTHS PER NOAA ATLAS 15

NOAA Atlas 14, Volume 2, Version 3
Location name: Rolesville, North Carolina, USA*
Latitude: 35.9246°, Longitude: -78.4558°
Elevation: 432 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.84** (4.43-5.29)	**5.62** (5.15-6.13)	**6.40** (5.87-6.98)	**7.19** (6.58-7.85)	**7.98** (7.27-8.70)	**8.62** (7.81-9.38)	**9.18** (8.27-10.0)	**9.67** (8.66-10.6)	**10.2** (9.08-11.2)	**10.7** (9.44-11.7)
10-min	**3.86** (3.54-4.22)	**4.49** (4.12-4.91)	**5.12** (4.70-5.59)	**5.75** (5.26-6.27)	**6.36** (5.80-6.94)	**6.86** (6.22-7.48)	**7.29** (6.57-7.94)	**7.67** (6.87-8.36)	**8.09** (7.19-8.83)	**8.44** (7.44-9.24)
15-min	**3.22** (2.95-3.52)	**3.77** (3.45-4.11)	**4.32** (3.96-4.72)	**4.85** (4.44-5.29)	**5.38** (4.90-5.86)	**5.79** (5.25-6.31)	**6.14** (5.54-6.69)	**6.45** (5.78-7.04)	**6.78** (6.03-7.41)	**7.06** (6.22-7.73)
30-min	**2.21** (2.02-2.41)	**2.60** (2.38-2.84)	**3.07** (2.81-3.35)	**3.51** (3.21-3.83)	**3.98** (3.63-4.34)	**4.36** (3.95-4.75)	**4.70** (4.24-5.12)	**5.02** (4.50-5.48)	**5.40** (4.80-5.90)	**5.72** (5.04-6.26)
60-min	**1.38** (1.26-1.50)	**1.63** (1.50-1.78)	**1.97** (1.80-2.15)	**2.29** (2.09-2.50)	**2.65** (2.41-2.89)	**2.95** (2.68-3.22)	**3.24** (2.92-3.53)	**3.52** (3.15-3.84)	**3.87** (3.44-4.23)	**4.18** (3.68-4.57)
2-hr	**0.805** (0.732-0.887)	**0.957** (0.874-1.05)	**1.17** (1.06-1.28)	**1.37** (1.24-1.50)	**1.61** (1.46-1.76)	**1.83** (1.64-2.00)	**2.03** (1.81-2.22)	**2.24** (1.98-2.45)	**2.51** (2.20-2.74)	**2.75** (2.40-3.02)
3-hr	**0.568** (0.516-0.629)	**0.676** (0.617-0.746)	**0.827** (0.753-0.913)	**0.979** (0.888-1.08)	**1.16** (1.05-1.28)	**1.33** (1.19-1.46)	**1.49** (1.32-1.64)	**1.66** (1.47-1.82)	**1.89** (1.65-2.07)	**2.10** (1.81-2.31)
6-hr	**0.341** (0.311-0.377)	**0.406** (0.372-0.448)	**0.498** (0.454-0.548)	**0.590** (0.537-0.648)	**0.704** (0.636-0.771)	**0.808** (0.725-0.883)	**0.911** (0.810-0.995)	**1.02** (0.898-1.11)	**1.17** (1.02-1.27)	**1.30** (1.12-1.42)
12-hr	**0.200** (0.183-0.220)	**0.238** (0.219-0.261)	**0.293** (0.268-0.321)	**0.349** (0.319-0.383)	**0.420** (0.380-0.458)	**0.485** (0.436-0.527)	**0.550** (0.489-0.598)	**0.621** (0.546-0.674)	**0.718** (0.622-0.779)	**0.808** (0.689-0.878)
24-hr	**0.119** (0.110-0.128)	**0.143** (0.134-0.155)	**0.180** (0.168-0.194)	**0.210** (0.195-0.226)	**0.250** (0.231-0.269)	**0.282** (0.260-0.303)	**0.314** (0.289-0.339)	**0.349** (0.319-0.376)	**0.396** (0.360-0.427)	**0.433** (0.393-0.468)
2-day	**0.069** (0.064-0.074)	**0.083** (0.077-0.089)	**0.103** (0.096-0.111)	**0.119** (0.111-0.129)	**0.141** (0.131-0.152)	**0.159** (0.147-0.171)	**0.177** (0.163-0.191)	**0.195** (0.179-0.211)	**0.221** (0.201-0.239)	**0.241** (0.219-0.261)
3-day	**0.048** (0.045-0.052)	**0.058** (0.054-0.062)	**0.072** (0.067-0.078)	**0.084** (0.078-0.090)	**0.099** (0.092-0.106)	**0.111** (0.103-0.119)	**0.123** (0.114-0.132)	**0.136** (0.125-0.146)	**0.154** (0.140-0.166)	**0.168** (0.152-0.181)
4-day	**0.038** (0.036-0.041)	**0.046** (0.043-0.049)	**0.057** (0.053-0.061)	**0.066** (0.061-0.070)	**0.077** (0.072-0.083)	**0.087** (0.080-0.093)	**0.097** (0.089-0.103)	**0.107** (0.098-0.114)	**0.120** (0.110-0.129)	**0.131** (0.119-0.141)
7-day	**0.025** (0.024-0.027)	**0.030** (0.028-0.032)	**0.037** (0.034-0.039)	**0.042** (0.039-0.045)	**0.050** (0.046-0.053)	**0.055** (0.051-0.059)	**0.061** (0.057-0.066)	**0.068** (0.062-0.072)	**0.076** (0.070-0.082)	**0.083** (0.076-0.089)
10-day	**0.020** (0.019-0.021)	**0.024** (0.022-0.025)	**0.029** (0.027-0.031)	**0.033** (0.031-0.035)	**0.038** (0.035-0.041)	**0.042** (0.039-0.045)	**0.046** (0.043-0.050)	**0.051** (0.047-0.054)	**0.056** (0.052-0.061)	**0.061** (0.056-0.066)
20-day	**0.013** (0.012-0.014)	**0.016** (0.015-0.017)	**0.019** (0.018-0.020)	**0.021** (0.020-0.022)	**0.024** (0.023-0.026)	**0.027** (0.025-0.029)	**0.029** (0.027-0.031)	**0.032** (0.030-0.034)	**0.035** (0.033-0.038)	**0.038** (0.035-0.041)
30-day	**0.011** (0.010-0.012)	**0.013** (0.012-0.014)	**0.015** (0.014-0.016)	**0.017** (0.016-0.018)	**0.019** (0.018-0.020)	**0.021** (0.019-0.022)	**0.023** (0.021-0.024)	**0.024** (0.023-0.026)	**0.027** (0.025-0.028)	**0.028** (0.026-0.030)
45-day	**0.009** (0.009-0.010)	**0.011** (0.010-0.011)	**0.012** (0.012-0.013)	**0.014** (0.013-0.015)	**0.015** (0.015-0.016)	**0.017** (0.016-0.018)	**0.018** (0.017-0.019)	**0.019** (0.018-0.020)	**0.021** (0.019-0.022)	**0.022** (0.020-0.023)
60-day	**0.008** (0.008-0.009)	**0.010** (0.009-0.010)	**0.011** (0.010-0.012)	**0.012** (0.011-0.013)	**0.013** (0.013-0.014)	**0.014** (0.014-0.015)	**0.015** (0.014-0.016)	**0.016** (0.015-0.017)	**0.018** (0.016-0.019)	**0.018** (0.017-0.020)

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

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

Please refer to NOAA Atlas 14 document for more information.

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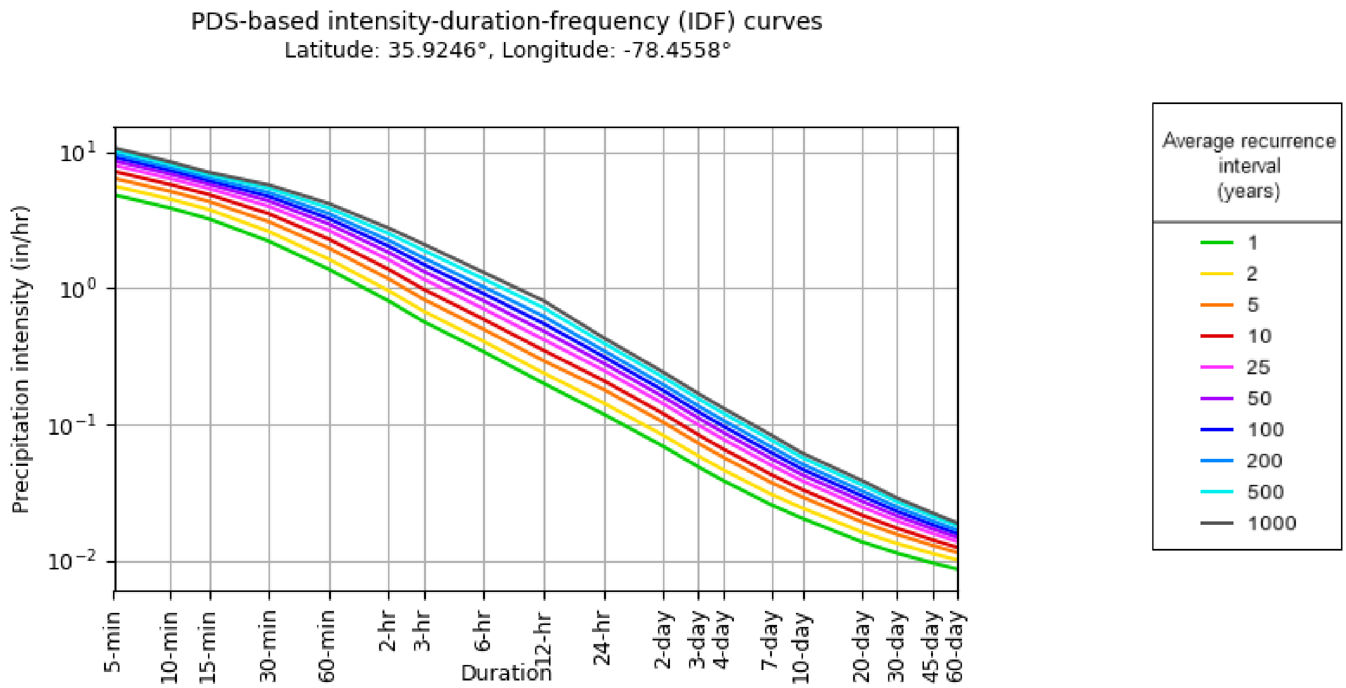
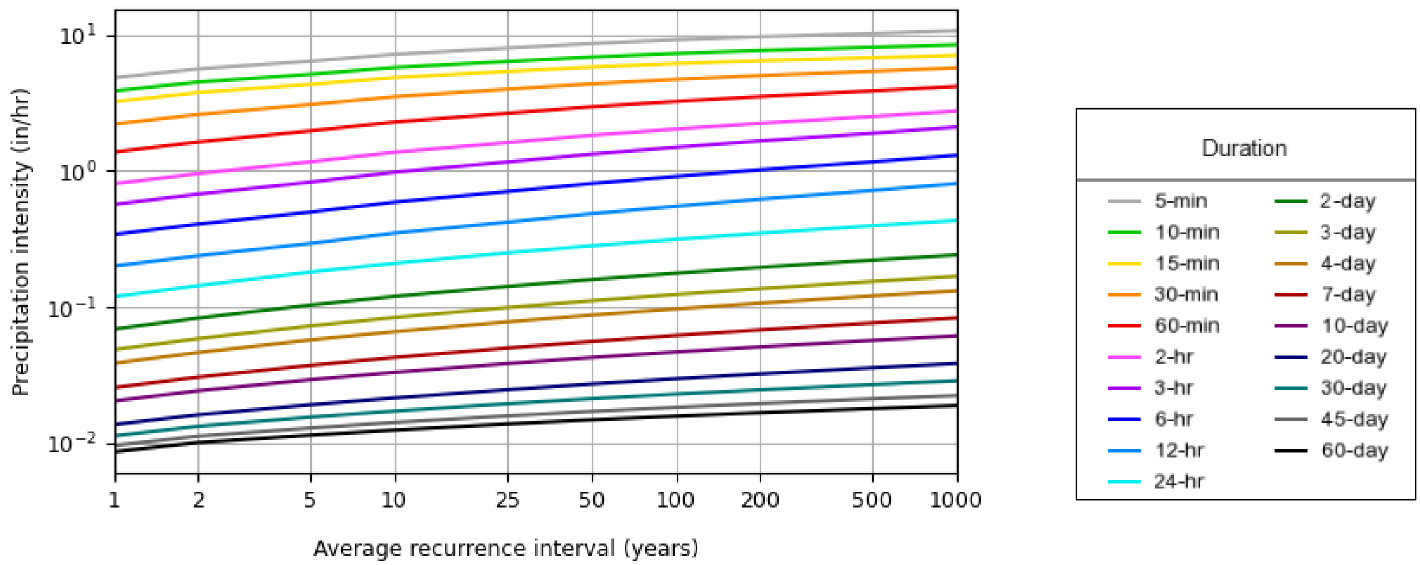
PF graphical





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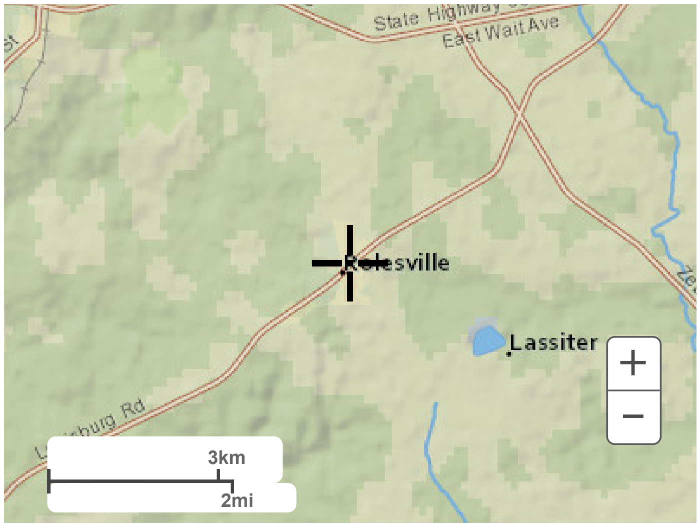
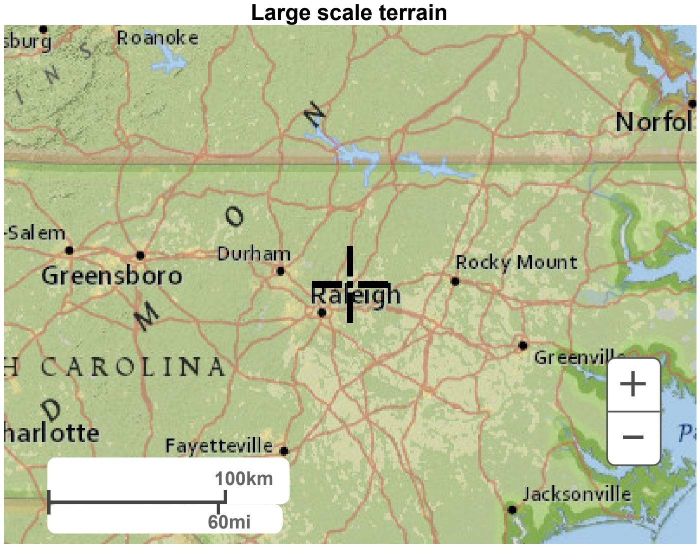
Maps & aerials

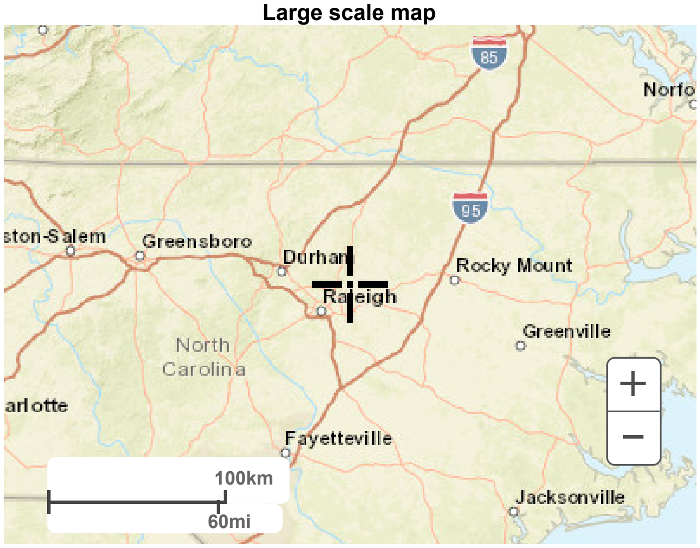
Small scale terrain



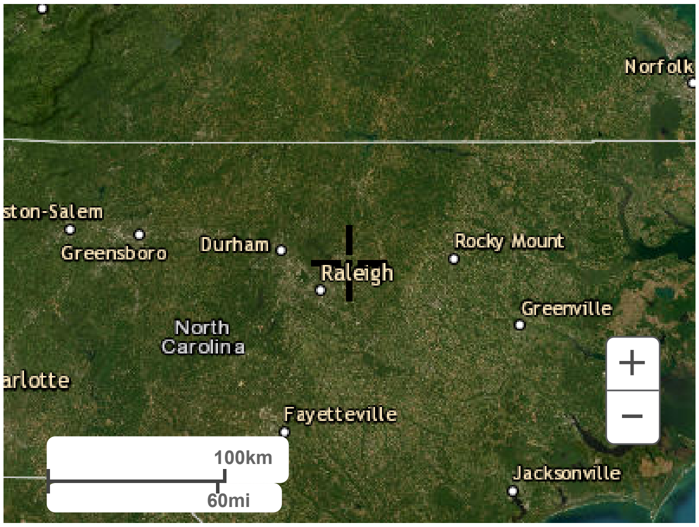
Large scale terrain



Large scale map



Large scale aerial



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Isolator™ Row O&M Manual

StormTech® Chamber System for Stormwater Management

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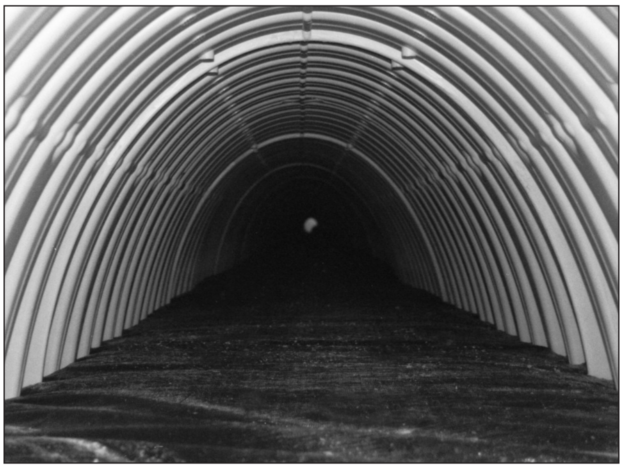
1.0 The Isolator™ Row

1.1 INTRODUCTION

An important component of any Stormwater Pollution Prevention Plan is inspection and maintenance. The StormTech Isolator Row is a patented technique to inexpensively enhance Total Suspended Solids (TSS) removal and provide easy access for inspection and maintenance.



Looking down the Isolator Row from the manhole opening, woven geotextile is shown between the chamber and stone base.

1.2 THE ISOLATOR™ ROW

The Isolator Row is a row of StormTech chambers, either SC-310, SC-740, DC-780 or MC-3500 models, that is surrounded with filter fabric and connected to a closely located manhole for easy access. The fabric-wrapped chambers provide for settling and filtration of sediment as storm water rises in the Isolator Row and ultimately passes through the filter fabric. The open bottom chambers and perforated sidewalls allow storm water to flow both vertically and horizontally out of the chambers. Sediments are captured in the Isolator Row protecting the storage areas of the adjacent stone and chambers from sediment accumulation.

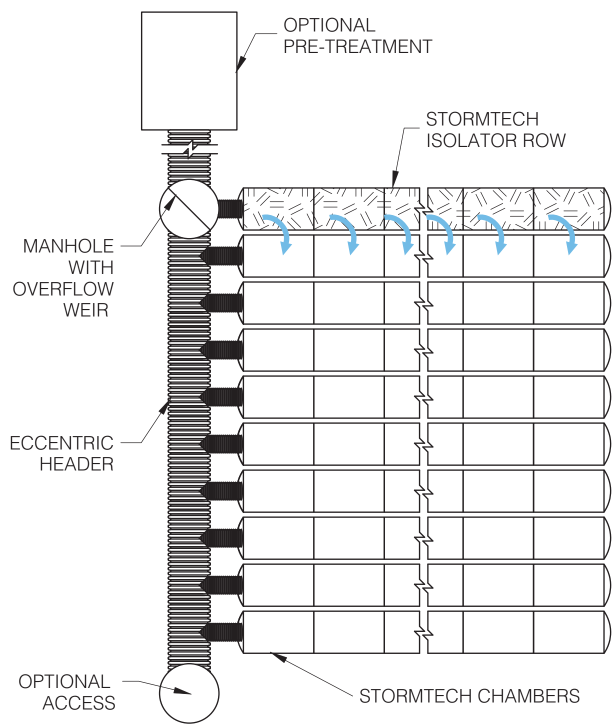
Two different fabrics are used for the Isolator Row. A woven geotextile fabric is placed between the stone and the Isolator Row chambers. The tough geotextile provides a media for storm water filtration and provides a durable surface for maintenance operations. It is also designed to prevent scour of the underlying stone and remain intact during high pressure jetting. A non-woven fabric is placed over the chambers to provide a filter media for flows passing through the perforations in the sidewall of the chamber.

The Isolator Row is typically designed to capture the "first flush" and offers the versatility to be sized on a volume basis or flow rate basis. An upstream manhole not only provides access to the Isolator Row but typically includes a high flow weir such that storm water flowrates or volumes that exceed the capacity of the Isolator Row overtop the over flow weir and discharge through a manifold to the other chambers.

The Isolator Row may also be part of a treatment train. By treating storm water prior to entry into the chamber system, the service life can be extended and pollutants such as hydrocarbons can be captured. Pre-treatment best management practices can be as simple as deep sump catch basins, oil-water separators or can be innovative storm water treatment devices. The design of the treatment train and selection of pretreatment devices by the design engineer is often driven by regulatory requirements. Whether pretreatment is used or not, the Isolator Row is recommended by StormTech as an effective means to minimize maintenance requirements and maintenance costs.

Note: See the StormTech Design Manual for detailed information on designing inlets for a StormTech system, including the Isolator Row.

StormTech Isolator Row with Overflow Spillway
(not to scale)



2.0 Isolator Row Inspection/Maintenance

2.1 INSPECTION

The frequency of Inspection and Maintenance varies by location. A routine inspection schedule needs to be established for each individual location based upon site specific variables. The type of land use (i.e. industrial, commercial residential), anticipated pollutant load, percent imperviousness, climate, etc. all play a critical role in determining the actual frequency of inspection and maintenance practices.

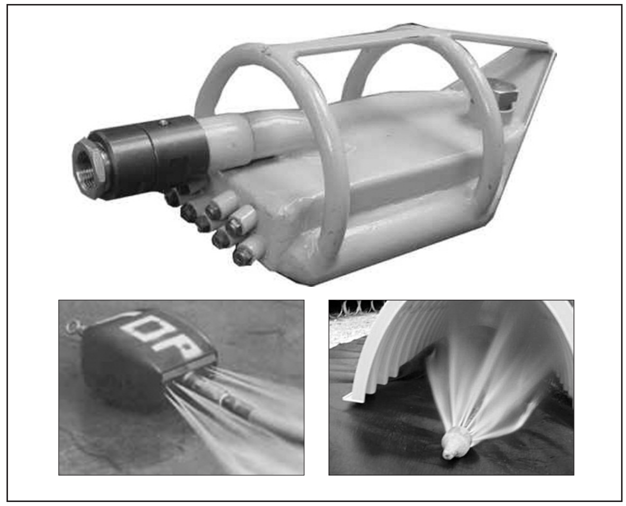
At a minimum, StormTech recommends annual inspections. Initially, the Isolator Row should be inspected every 6 months for the first year of operation. For subsequent years, the inspection should be adjusted based upon previous observation of sediment deposition.

The Isolator Row incorporates a combination of standard manhole(s) and strategically located inspection ports (as needed). The inspection ports allow for easy access to the system from the surface, eliminating the need to perform a confined space entry for inspection purposes.

If upon visual inspection it is found that sediment has accumulated, a stadia rod should be inserted to determine the depth of sediment. When the average depth of sediment exceeds 3 inches throughout the length of the Isolator Row, clean-out should be performed.

2.2 MAINTENANCE

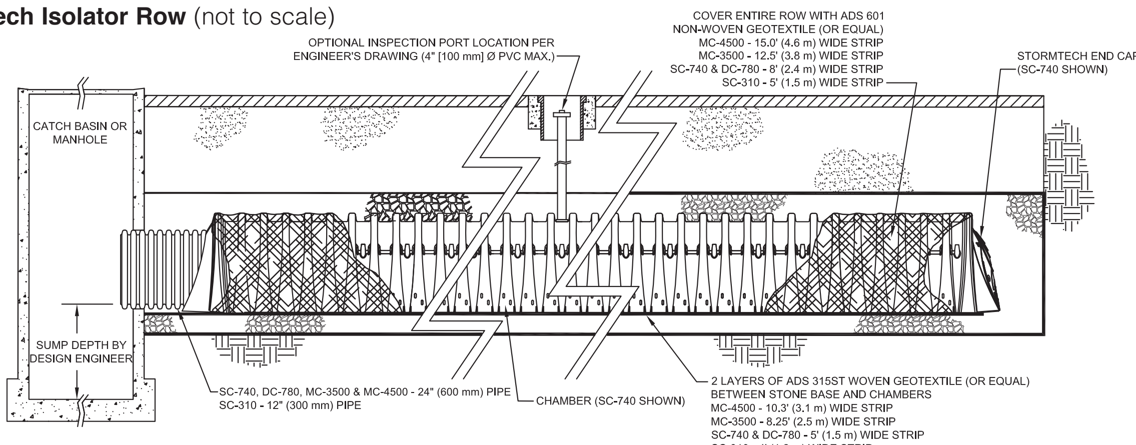
The Isolator Row was designed to reduce the cost of periodic maintenance. By “isolating” sediments to just one row, costs are dramatically reduced by eliminating the need to clean out each row of the entire storage bed. If inspection indicates the potential need for maintenance, access is provided via a manhole(s) located on the end(s) of the row for cleanout. If entry into the manhole is required, please follow local and OSHA rules for a confined space entries.



Examples of culvert cleaning nozzles appropriate for Isolator Row maintenance. (These are not StormTech products.)

Maintenance is accomplished with the JetVac process. The JetVac process utilizes a high pressure water nozzle to propel itself down the Isolator Row while scouring and suspending sediments. As the nozzle is retrieved, the captured pollutants are flushed back into the manhole for vacuuming. Most sewer and pipe maintenance companies have vacuum/JetVac combination vehicles. Selection of an appropriate JetVac nozzle will improve maintenance efficiency. Fixed nozzles designed for culverts or large diameter pipe cleaning are preferable. Rear facing jets with an effective spread of at least 45” are best. Most JetVac reels have 400 feet of hose allowing maintenance of an Isolator Row up to 50 chambers long. **The JetVac process shall only be performed on StormTech Isolator Rows that have AASHTO class 1 woven geotextile (as specified by StormTech) over their angular base stone.**

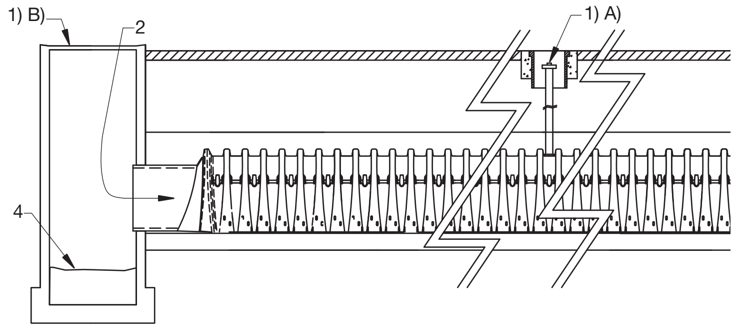
StormTech Isolator Row (not to scale)



Note: For many applications, the non-woven geotextile over the DC-780, MC-3500 and MC-4500 Isolator Row chambers can be eliminated or substituted with the AASHTO Class 1 woven geotextile. Contact your StormTech representative for assistance.

3.0 Isolator Row Step By Step Maintenance Procedures

StormTech Isolator Row (not to scale)



Step 1) Inspect Isolator Row for sediment

A) Inspection ports (if present)

i. Remove lid from floor box frame

ii. Remove cap from inspection riser

iii. Using a flashlight and stadia rod, measure depth of sediment and record results on maintenance log.

iv. If sediment is at, or above, 3 inch depth proceed to Step 2. If not proceed to step 3.

B) All Isolator Rows

i. Remove cover from manhole at upstream end of Isolator Row

ii. Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry
2. Follow OSHA regulations for confined space entry if entering manhole

iii. If sediment is at or above the lower row of sidewall holes (approximately 3 inches) proceed to Step 2. If not proceed to Step 3.

Step 2) Clean out Isolator Row using the JetVac process

A) A fixed culvert cleaning nozzle with rear facing nozzle spread of 45 inches or more is preferable

B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required

Step 3) Replace all caps, lids and covers, record observations and actions

Step 4) Inspect & clean catch basins and manholes upstream of the StormTech system

Sample Maintenance Log

Date	Stadia Rod Readings: Fixed point to chamber bottom (1)	Stadia Rod Readings: Fixed point to top of sediment (2)	Sediment Depth (1) - (2)	Observations/Actions	Inspector
3/15/01	6.3 ft.	none		New installation. Fixed point is CI frame at grade	djm
9/24/01		6.2	0.1 ft.	Some grit felt	sm
6/20/03		5.8	0.5 ft.	Mucky feel, debris visible in manhole and in Isolator row, maintenance due	rv
7/7/03	6.3 ft.		0	System jetted and vacuumed	djm

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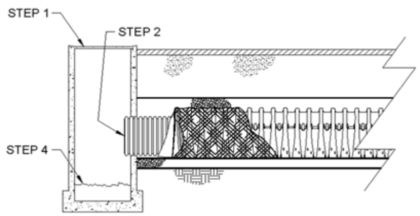
Isolator Row Inspection Maintenance



<u>Step 1)</u> Inspect Isolator Row for sediment

A) Remove cover from manhole at upstream end of Isolator Row

B) Using a flashlight, inspect down Isolator Row through outlet pipe

1. Mirrors on poles or cameras may be used to avoid a confined space entry
2. Follow OSHA regulations for confined space entry if entering manhole

C) If sediment is approximately 3 inches, proceed to Step 2. If not, proceed to Step 3.

<u>Step 2)</u> Clean out Isolator Row using JetVac process

A) A fixed culvert cleaning nozzle with rear facing nozzle spread of at least 45 inches or more is preferable

B) Apply multiple passes of JetVac until backflush water is clean

C) Vacuum manhole sump as required

<u>Step 3)</u> Replace all caps, lids, and covers, record observations and actions

<u>Step 4)</u> Inspect and clean basins and manholes upstream of the Isolator Row

Additional Notes:

1. Inspect every 6 months during the first year of operation. Adjust the inspection interval based on previous observations of sediment accumulation and high water elevations.

2. Conduct jetting and vactoring only when inspection shows that maintenance is necessary.

DATE	OBSERVATIONS / RECOMMENDATIONS	INTIALS