MACKENZIE.

PRELIMINARY STORMWATER REPORT

To
Clean Water Services

For
Fujimi Facility Expansion
11200 SW Leveton Dr
Tualatin, OR 97062

Dated
September 18, 2023

Project Number
2210148.00

MACKENZIE
Since 1960

RiverEast Center | 1515 SE Water Avenue, Suite 100, Portland, OR 97214
T 503.224.9560 | F 503.228.1285 | www.mcknze.com

TABLE OF CONTENTS

Figures

Tables

Appendices

I. PROJECT OVERVIEW AND DESCRIPTION

The proposed Fujimi Expansion project is located at 11200 SW Leveton Drive in Tualatin, Oregon. The project consists of expanding the current building's footprint, extending the passengar car parking lot to align with the building expansion, collect stormwater runoff from new impervious areas, and associated landscaping. The total parcel area is 13.0 acres and improvements will be focused on a 1.15 acre subset in the southeast corner of the property.

Existing Conditions

The existing property is an operational advanced technology campus covering 13.0 acres. The campus has been slowly developing from the initial Architectural Review (AR) conducted in 1993 (AR 93-0036). Subsequence ARs occurred in 1995 (AR 95-0013), 1997 (AR 97-0004), 1998 (AR 98-0005), 1999 (AR 99-0001), 2001 (AR 01-0011), and 2003 (AR 03-0008). There are multiple stormwater facilities located in the southern portion of the property: west basin, east basin, west swale, and east swale. Currently, 64% of the property has been developed with buildings, paved vehicular access, and functional stormwater management facility, see Figure below.

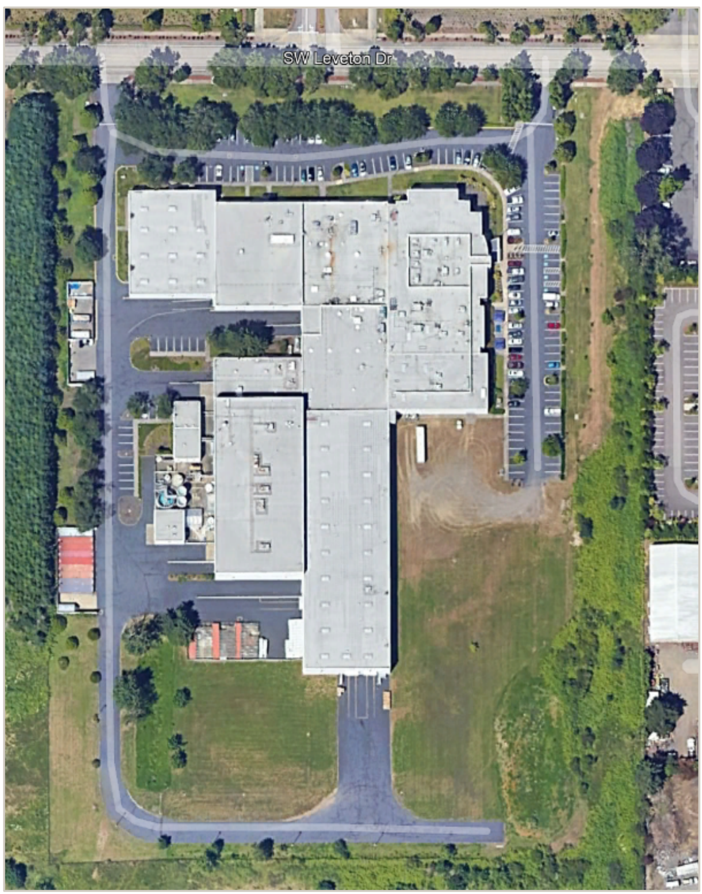


Figure 1: Vicinity Map

An analysis of the Web Soil Survey shows the majority of soil is categorized as Hydrologic Soil Group of B, see Figure below. The existing infrastructure on the property directs stormwater runoff to either the southwestern or southeastern corners of the property via overland flow as well as catch basins with piped underground conveyance. Using the southern truck dock as a north-south reference for the entire property, land to the west of the dock and including the dock, flow to the west basin and land to the east discharges to the east basin. The truck dock can also be used as a reference for the two swales south of the southern drive aisle; land to the southwest of the drive flows to the west swale and land to the southeast of the drive flow to the east swale. All four stormwater management areas ultimately discharge to the wetland property south of the existing parcel. Outfalls to the wetland were constructed and permitted in 1999.

Tables — Hydrologic Soil Group — Summary By Map Unit

Summary by Map Unit — Washington County, Oregon (OR067)

Summary by Map Unit — Washington County, Oregon (OR067)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10	Chehalis silt loam, occasional overflow	B	8.9	62.2%
13	Cove silty clay loam	D	1.0	6.8%
21B	Hillsboro loam, 3 to 7 percent slopes	B	3.6	25.0%
21D	Hillsboro loam, 12 to 20 percent slopes	B	0.9	6.0%
Totals for Area of Interest			**14.3**	**100.0%**

Description — Hydrologic Soil Group

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

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

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

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

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

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

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

Figure 2: Web Soil Survey

For the expansion improvement a geotechnical engineer, Columbia West Engineering, Inc., was hired to perform infiltration tests on existing soils and determine groundwater elevations. Relevant sections from their report, “Geotechnical Site Investigations, Fujimi Expansion, Tualatin, Oregon, May 26, 2023” have been added to the appendix. Groundwater was encountered at the test pit closest to the existing east stormwater facility at approximately 4’ below surface. The infiltration rate as performed in the same test pit was field measured at 3.0”/hr approximately 2’ below the ground surface. Existing topographic survey indicate ground surface elevation of approximately 132.5’ at the test location.

Proposed Improvements

The proposed improvements include a two-story expansion and associated parking covering approximately 1.15 acres. The additional impervious area will be directed to the existing east stormwater management facility that was sized in 2006 to cover future expansions.

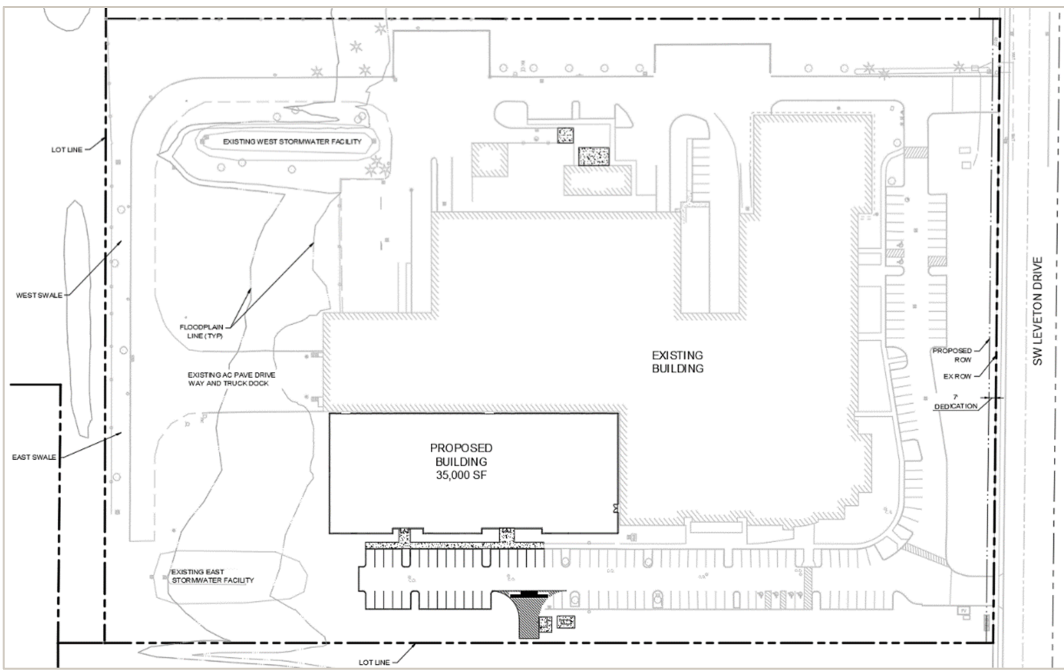


Figure 3: Site Plan

II. BASIS OF DESIGN

The Basis of Design for Stormwater Quality and Flow Control, as determined by the Clean Water Services (CWS) Design and Construction Standards for Sanitary Sewer and Surface Water Management, December 2019, is as follows:

- **Project Classification**: Per CWS 2019 Section 4.03.2, unless specifically waived in writing by the District, a Hydromodification Assessment is required of all activities. Section 4.03.3 describes the Hydromodification Assessment Methodology. Risk Level is determined using the Hydromodification Planning Tool available on CWS's GIS website and following the discharge point ¼ mile downstream. The Development Class is also determined through the CWS's GIS website and identifying the project site location. Project Size Category is determined by calculating the aera of proposed new and/or modified impervious surface.

  Risk Level = Low
  Development Class = Developed Area
  Project Size = Medium
  Category = 2

<table>
<tr><th colspan="4">Table 1: CWS Table 4-2: Hydromodification Approach Project Category Table</th></tr>
<tr><th>Development Class/Risk Level</th><th>Small Project
1,000 – 12,000 SF</th><th>Medium Project
>12,000 – 80,000 SF</th><th>Large Project
> 80,000 SF</th></tr>
<tr><td>Expansion /High</td><td rowspan="6">Category 1</td><td rowspan="2">Category 3</td><td rowspan="4">Category 3</td></tr>
<tr><td>Expansion/ Moderate</td></tr>
<tr><td>Expansion/ Low</td><td>Category 2</td></tr>
<tr><td>Developed/ High</td><td>Category 3</td></tr>
<tr><td>Developed/ Moderate</td><td rowspan="2">Category 2</td><td rowspan="2">Category 2</td></tr>
<tr><td>Developed/ Low</td></tr>
</table>

- **Detention:** Per CWS 2019 Section 4.08.06.c, facilities requiring hydromodification approach shall be designed such that the post-development runoff rates from the site do not exceed the pre-development runoff rates in Table 4-7 (recreated as Table 1, below)

Table 2: Flow Control Targets

Post-Development Peak Flow Rate	Pre-Development Peak Flow Rate Target
2-year, 24-hour	50% of 2-year, 24-hour
5-year, 24-hour	5-year, 24-hour
10-year, 24-hour	10-year, 24-hour

- **Water Quality:** Per CWS 2019, Section 4.04.1, owners of new develop and other activities which create or modify 1,000 square feet or greater of impervious surface, or increase the amount of stormwater runoff or pollution leaving the site, are required to implement or fund permanent water quality approaches to reduce contaminants entering the storm and surface water system.
- **Conveyance:** Per CWS 2019, Section 5.05.2, design of the storm conveyance system shall provide a minimum 1 foot of freeboard between the hydraulic grade line and the top of structure or finished grade above pipe for 25-year post development peak rate of runoff.
- **Calculation Methods:** Per CWS 2019, Section 5.04.2.b, Computational Methods for Runoff Calculations unless an alternative method is approved by the District or City in writing, calculation of storm runoff used for conveyance design shall be based on one of the following methods with the limitations on use of each listed:
    - Rational Method
    - Santa Barbara Urban Hydrology
    - TR-55
    - Stormwater Management Model (SWMM)

III. ANALYSIS

Methodology

The previous improvements to the campus were permitted and constructed to the relevant code requirements at the time of permitting. The proposed improvements will be directed to the existing east stormwater facility originally designed in 2001 and improved in 2006. During the improvements to the east stormwater facility in 2006, the designer at the time assumed a full campus build-out and incorporated the additional impervious area into their calculation; however that design not anticipate hydromodification requirements. Since then, the detention requirements changed but the treatment requirements remained the same. Therefore, the analysis proceeded with the assumption the existing development of the drainage area (Area A) will fall under requirements at the time of permitting (CWS 2004) and the new impervious area (Area B) will fall under current requirements (CWS 2019). See Appendix for Basin Map - Stormwater Management exhibit.

The calculations below propose to adjust the existing outlet control structure to maintain peak-matching flows for the existing development, and provide hydromodification for the new development through the use of the existing east stormwater facility. This facility is a combination water quality and water quantity detention pond adhering to the requirements set forth in CWS 2019 Section 4.09.2.

The rainfall rates used for calculations are presented in the table below.

Table 3: Precipitation Rates	
Storm Event	**24-HR Precipitation (inches)**
2-year	2.5
5-year	3.10
10-year	3.45
25-year	3.90
100-year	4.50

Water Quality

As mentioned previously, the water quality requirements between the CWS 2004 manual and the current CWS 2019 manual are identical and equations are presented below. For detailed water quality calculations, refer to the Appendix.

$$Water\ Quality\ Volume\ \ (cf) = \frac{0.36\ (in)\ \times\ Area\ (sf)}{12\ (\frac{in}{ft})}$$

$$Water\ Quality\ Flow\ \ (cfs) = \frac{Water\ Quality\ Volume\ (cf)}{14{,}400\ seconds}$$

Or

$$Water\ Quality\ Flow\ \ (cfs) = \frac{0.36\ (in) \times Area\ (sf)}{12\ \left(\frac{in}{ft}\right) \times 4hr \times 60\,\frac{min}{hr} \times 60\,\frac{sec}{min}}$$

The water quality volume is provided in the detention pond with a catch basin inlet set at the bottom of the pond. Within the catch basin an orifice plate over the outlet; the orifice is sized according to limit the outflow during the water quality event to the flow determined by the Water Quality Flow equation. For detailed orifice sizing calculation, refer to the Appendix.

Water Quantity & Flow Control

Flow control will be provided for this project for the existing development (Area A) and hydromodification will be provided for the proposed development (Area B) using peak-flow matching from the Santa Barbara Unit Hydrograph (SBUH) method as performed by the AutoCAD extension Hydraflow Hydrographs. Detention will be combined with treatment within the east detention pond and therefore consideration for storage volumes will occur above the water quality elevation.

Table 4: Stage Storage Summary

Contour (ft)	Area (ft^2)	Volume (ft^3)	Cumulative Volume
133.48	2,780	0	0
134	4,252	1,824	1,824
135	5,728	4,971	6,795
136	7,319	6,507	13,302
136.46	7,841	3,486	16,788

Both Area A and Area B are the only runoff sources for the east detention pond. Area A post-development runoff will be detained to pre-development rates according to the 2004 CWS standards: 2-year, 5-year, and 10-year. Area B post-development runoff will be detained to the 2019 CWS Hydromodification standard: 50% of the 2-year, 5-year, and 10-year.

The pre-development flow rate for the 2-year, 5-year, and 10-year will be accumulated to create a weighted average of pre-development flow rates to limit the post-development peak flow rates as shown in Appendix. The existing baffle wall in the existing overflow structure will be modified with new orifice elevations and sizes to adhere to the post-development peak flow rates determined.

A section of the facility as well as a detail depicting the necessary modifications to the control structure will be provided at permit submission.

Calculations show the maximum elevation of a 25-year storm event will be 135.03 while the top of pond is 136.46 which provides more than the required 12” of freeboard at the 25-year event. The inclusion of the water quality catch basin at the bottom of the pond as discussed in the previous section, coupled with the 1.5” design infiltration rate using the field measured infiltration rate provided by the geotechnical engineer with a factor of safety of 2 applied, will allow this detention pond facility to completely drain.

The existing east detention basin has a top of facility elevation of approximately 136’. During a large rain event, the pond will overtop and flow overland to the wetlands to the south where the south property line has an elevation of approximately 130’. The building finished floor is at approximately 138’ and will not experience flooding.

Conveyance

Detailed conveyance calculations can be found in the Appendices based on the 25-year storm and rational method.

IV. ENGINEERING CONCLUSIONS

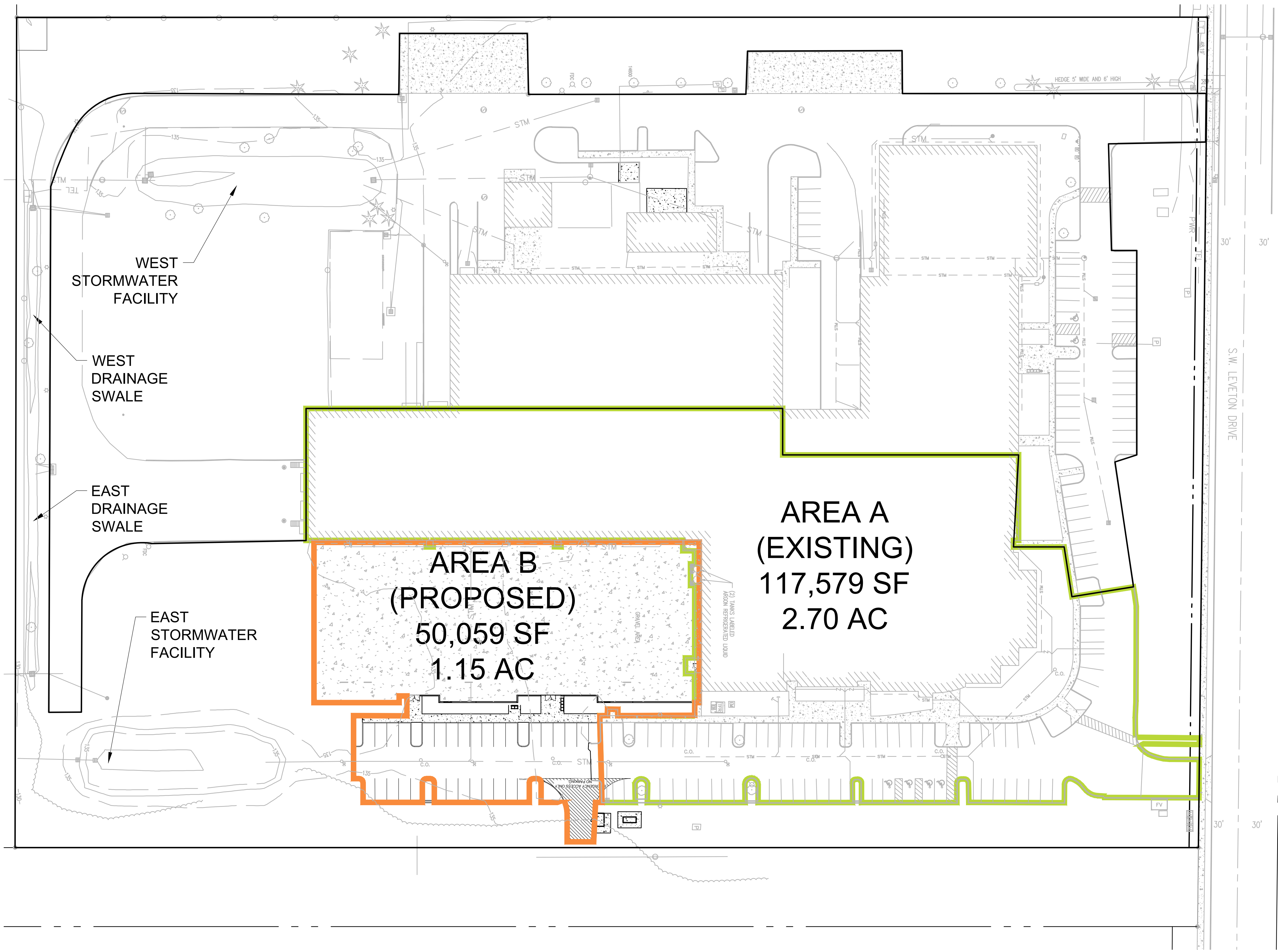
Based on compliance with the Clean Water Services (CWS) Design and Construction Standards for Sanitary Sewer and Surface Water Management, December 2019:

- **Detention** provides to restrict the flow from post-development storm events to no more than the cumulative flow from the pre-developed storm events.
- **Water quality** provides treatment for the calculated water quality volume.
- **Conveyance** was designed for a **25-year storm** frequency using the Rational Method.

Therefore, the design for Fujimi Expansion adheres to the Clean Water Services's design requirements.

APPENDIX A

BASIN MAP – STORMWATER MANAGEMENT



STORMWATER MANAGEMENT APPROACH

1. PROPERTY WAS DEVELOPED INITIALLY IN 1993 (AR 93-0036) WITH SUBSEQUENT EXPANSIONS IN 1995 (AR 95-0013), 1997 (AR 97-0004), 1998 (AR 98-005), 2001 (AR 01-0011), 2003 (AR 03-0008) AND 2006.
2. THE WEST STORMWATER FACILITY WAS DEVELOPED IN 1993 AND DESIGNED FOR TREATMENT ONLY; NO DETENTION.
3. THE EAST STORMWATER FACILITY WAS DESIGNED IN 2001 BY VLMK, WITH ADDITIONAL IMPERVIOUS AREA CONTRIBUTING IN 2006 VERIFIED BY MACKENZIE (FORMERLY GROUP MACKENZIE AT THE TIME OF THE REPORT); CONTRIBUTING RUNOFF HAS BEEN LABELED "A". THE EAST STORMWATER FACILITY IS A COMBINATION OF TREATMENT AND DETENTION ACCORDING TO CWS DESIGN AND CONSTRUCTION STANDARDS FOR SANITARY SEWER AND SURFACE WATER MANAGEMENT, 2004.
4. THE WEST AND EAST DRAINAGE SWALES WERE DESIGNED 2006 BY MACKENZIE ACCORDING TO CWS DESIGN AND CONSTRUCTION STANDARDS FOR SANITARY SEWER AND SURFACE WATER MANAGEMENT, 2004.
5. THE CURRENT DESIGN EFFORT WILL BE INCREASING THE IMPERVIOUS AREA ROUTED TO THE EAST STORMWATER FACILITY ONLY; CONTRIBUTING RUNOFF HAS BEEN LABELED "B". NO CHANGES IN DISCHARGE ARE PROPOSED TO THE WEST STORMWATER FACILITY, THE WEST DRAINAGE SWALE NOR THE EAST DRAINAGE SWALE.
6. THE WATER QUALITY REQUIREMENT FROM 2004 MATCHES CURRENT (2019) WATER QUALITY REQUIREMENT.
   WQV (CF) = 0.36*AREA/12
   WQF (CFS) = WQV/14,400
   THE ADDITIONAL IMPERVIOUS AREA DIRECTED TOWARDS THE EAST POND WILL ADHERE TO WATER QUALITY REQUIREMENTS.
7. THE EXISTING AREA A POST-DEVELOPMENT RUNOFF TO THE EAST STORMWATER FACILITY HAS BEEN DETAINED TO PRE-DEVELOPMENT RATES ACCORDING TO THE 2004 STANDARDS (2-YEAR, 5-YEAR, AND 10-YEAR)
8. THE PROPOSED AREA B POST-DEVELOPMENT RUNOFF TO THE EAST STORMWATER FACILITY WILL BE DETAINED TO THE PRE-DEVELOPMENT RATES ACCORDING TO THE 2019 STANDARDS (50% OF 2-YEAR, 5-YEAR, AND 10-YEAR)

DESCRIPTION	PRE-DEVELOP FLOW (CFS)	CUMULATIVE PRE-DEVELOP FLOW (CFS)	POST-DEVELOP PEAK OUTFLOW (CFS)
A: EXISTING 2-YEAR	0.984	1.039	0.656
B: PROPOSED 50% 2-YEAR	0.055		
A: EXISTING 5-YEAR	1.265	1.457	0.693
B: PROPOSED 5-YEAR	0.192		
A: EXISTING 10-YEAR	1.429	1.674	0.717
B: PROPOSED 10-YEAR	0.245		

FUJIMI - FACILITY EXPANSION
BASIN MAP - STORMWATER MANAGEMENT

August 15, 2023
Job # 2210148.00

SCALE: 1"=80'
0 40 80

Portland 503.224.9560 Vancouver 360.695.7879 Seattle 206.749.9993
www.mcknze.com
Architecture • Interiors
Planning • Engineering
MACKENZIE

APPENDIX B

WATER QUALITY CALCULATIONS

Impervious Area Summary

Existing Conditions	
Existing Pervious Area:	1.33 ac
Existing Impervious Area:	2.52 ac
Total Drainage Basin Area:	3.85 ac

Proposed Conditions	
New Impervious Area:	1.08 ac
Modified Impervious Area:	0.02 ac
New Pervious Area:	0.00 ac
Total Drainage Basin Area:	3.85 ac

Determine Water Quality Treatment Area

Existing Impervious Area = 2.52 ac
Modified Existing Impervious Area= 0.02 ac
New Impervious Area = 1.08 ac

Per Section 4.08.1.d, when modification results in the permanent removal of 1,000 SF or greater of impervious surface, the treatment approach shall be sized for three times the replaced impervious surface, in addition to the new impervious surface.

$Area_{WQ}$ = 3.66 ac (159,243 sf)

Determine Water Quality Volume

$$WQV = \frac{0.36 \times A}{12}$$

WQV = 4,777 cf

Stormwater Detention Pond Narrative

The existing stormwater treatment and detention pond will be evaluated for its ability to treat and detain the new impervious area in addition to the existing impervious. One foot of freeboard will be provided above the 25 year storm pond elevation.

Water Quality Depth

Contour	Area	Incremental Storage	Total Storage
131.82	1014	0	0
132	1133	1073.5	1073.5
133	2866	1999.5	3073
134	4252	3559	6632
135	5728	4990	11622
136	7319	6523.5	18145.5
136.46	7841	7580	25725.5

Storage Elevation =

133.48

Water Quality Orifice Sizing

Water Quality Flow: 0.33 cfs
Water Quality Elevation: 133.48 ft
Water Quality Storage Depth: 1.66 ft

$$D = 24\sqrt{\frac{Q}{C \cdot \pi \cdot \sqrt{2 \cdot g \cdot {}^{2}/_{3} H}}}$$

Water Quality Orifice Size: 3.41 in

MACKENZIE.
DESIGN DRIVEN | CLIENT FOCUSED

Fujimi Facility Expansion
Water Quality Volume Calculation
Project No. 2210148.00
BY: NKB DATE: 7/25/2023

APPENDIX C

WATER QUANTITY CALCULATIONS

Pre-Development Area Summaries

	Curve Number	A Pre 2001	B Pre 2001
Pervious Area:	79	2.70 ac	1.15 ac
Impervious Area:	98	0.00 ac	0.00 ac
Total Drainage Basin Area:	--	2.70 ac	1.15 ac
Time of Concentration:	--	35 min	35 min

Post-Development Area Summaries

	Curve Number	A Post2001	B Post2023
Pervious Area:	61	0.20 ac	0.06 ac
Impervious Area:	98	2.50 ac	1.09 ac
Total Drainage Basin Area:	--	2.70 ac	1.15 ac
Time of Concentration:	--	5 min	5 min

Determine Water Quantity Peak Flow Matching

Level	Description	SBUH Flow	Pre-Development Cumulative Flow	Post-Development Outflow
1	A: 2-year Pre B: 50% 2-year Pre	0.984 0.055	1.039 cfs	0.656 cfs
2	A: 5-year Pre B: 5-year Pre	1.265 0.192	1.457 cfs	0.693 cfs
3	A: 10-year Pre B: 10-year Pre	1.429 0.245	1.674 cfs	0.717 cfs

Top of Existing Pond Elevation =	136.46	
25-year Storm Elevation =	135.03	
Freeboard =	1.43	(12" min)

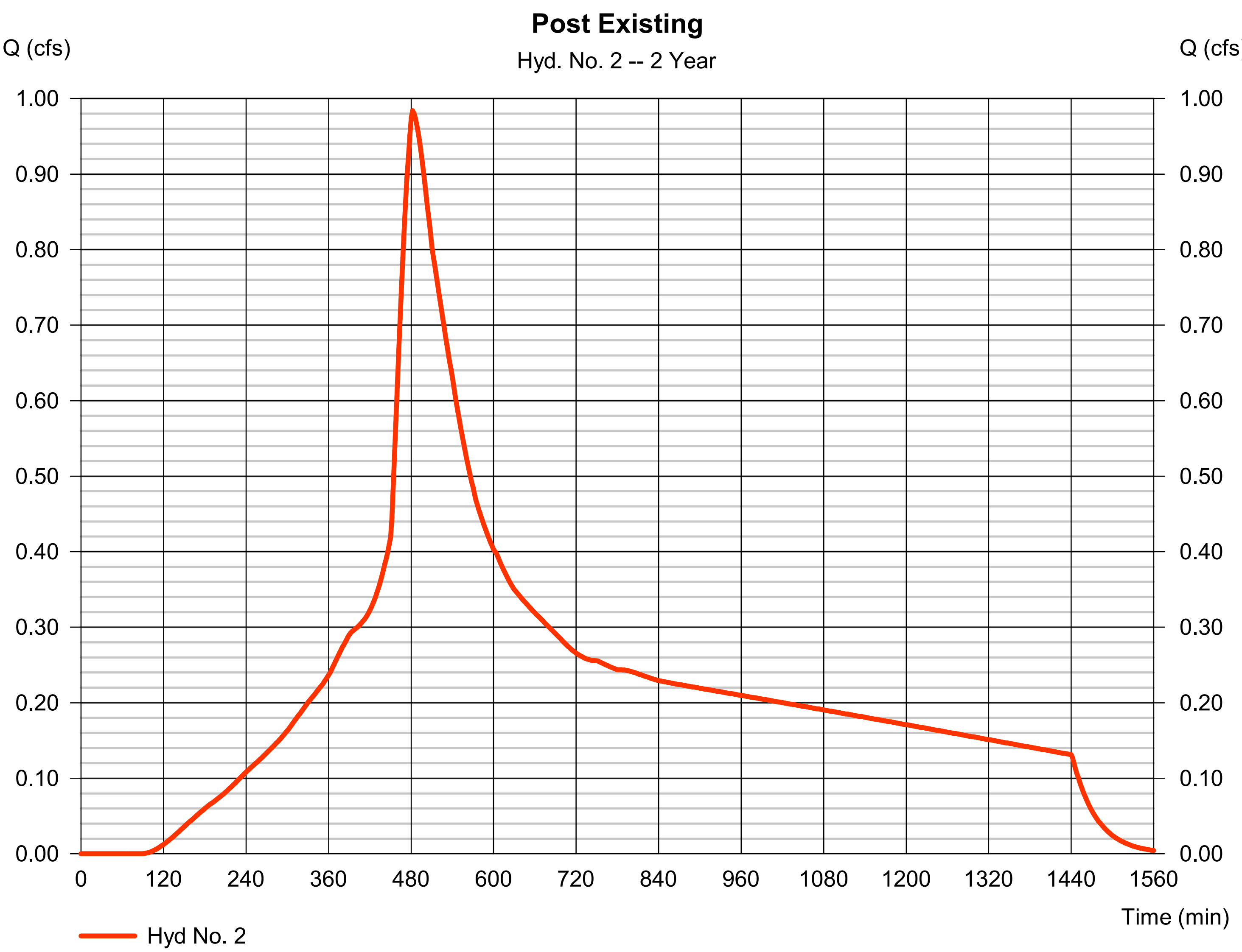
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 2

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.984 cfs
Storm frequency	= 2 yrs	Time to peak	= 482 min
Time interval	= 2 min	Hyd. volume	= 20,203 cuft
Drainage area	= 2.700 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



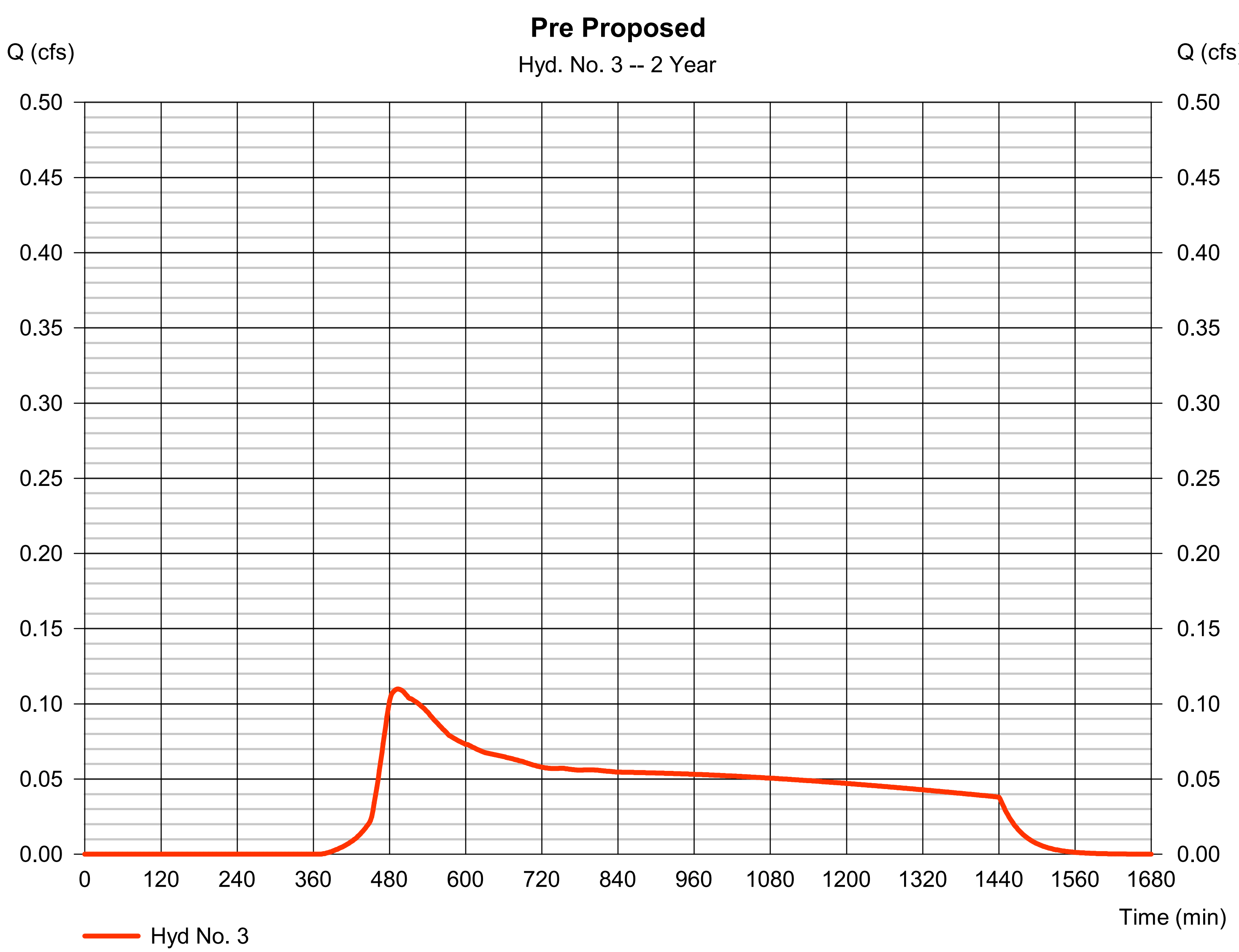
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 3

Pre Proposed

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.110 cfs
Storm frequency	= 2 yrs	Time to peak	= 494 min
Time interval	= 2 min	Hyd. volume	= 3,496 cuft
Drainage area	= 1.150 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

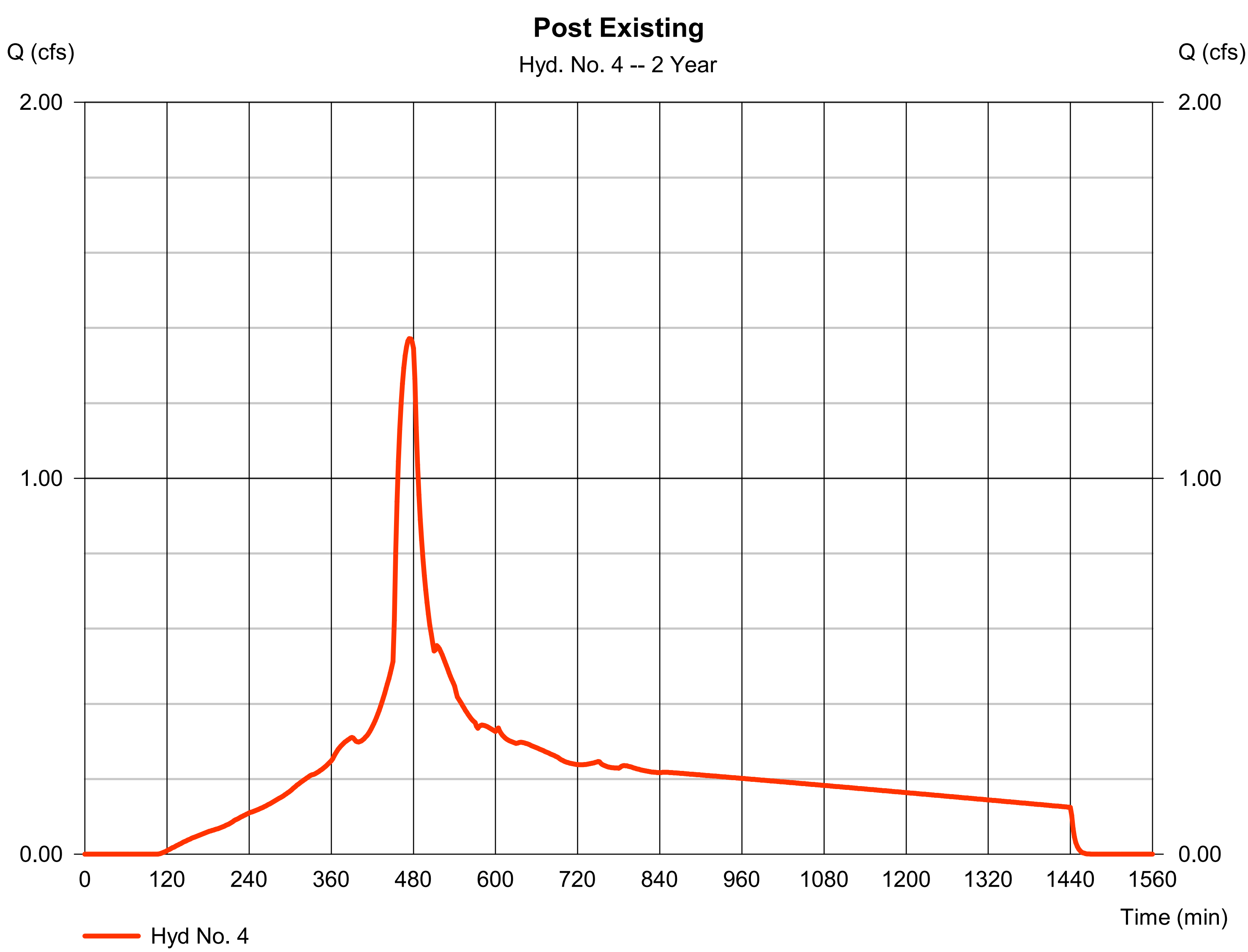
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 4

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.372 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 19,242 cuft
Drainage area	= 2.700 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.500 x 98) + (0.200 x 61)] / 2.700



Hydrograph Report

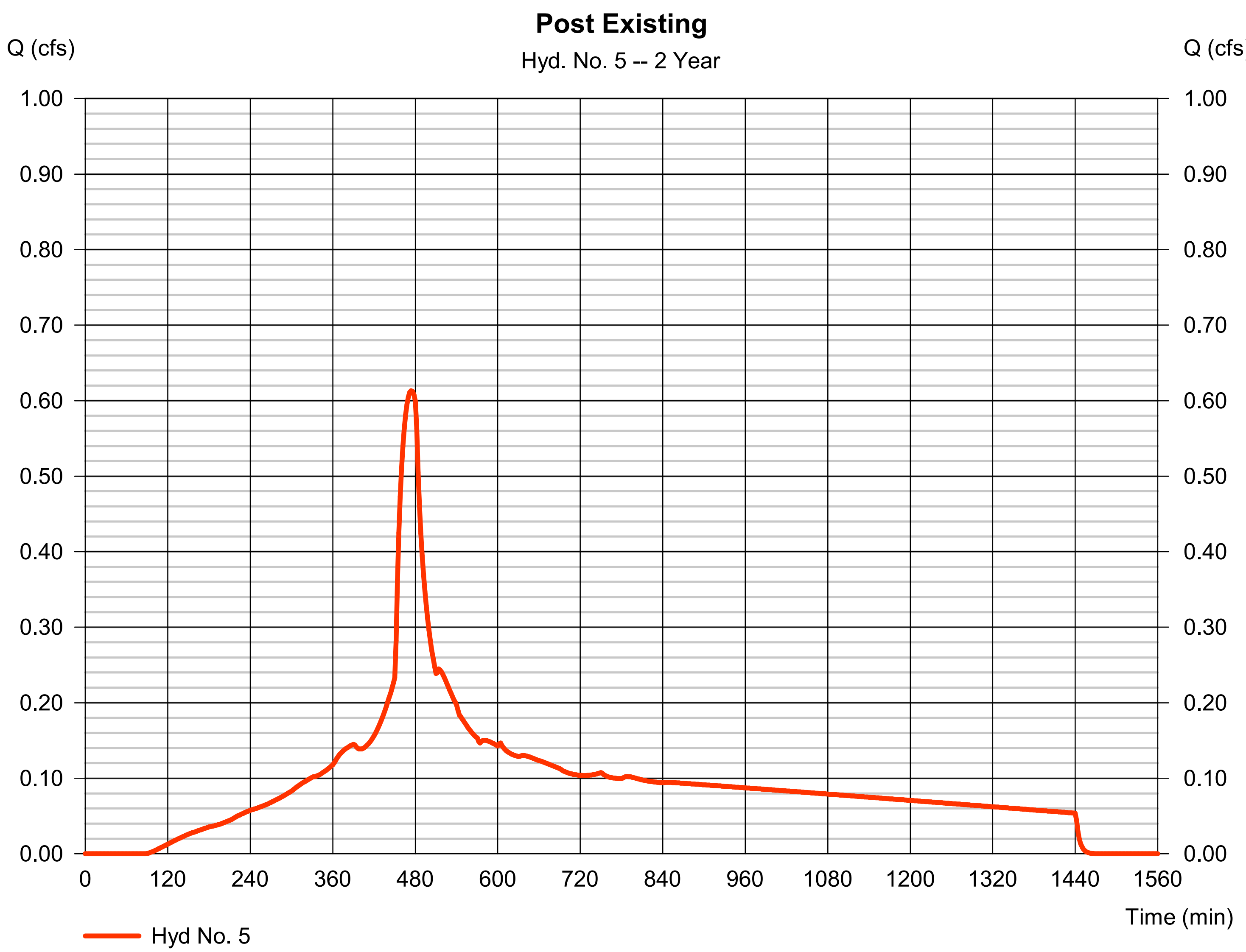
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 5

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.613 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 8,605 cuft
Drainage area	= 1.150 ac	Curve number	= 96*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 2.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.090 x 98) + (0.060 x 61)] / 1.150



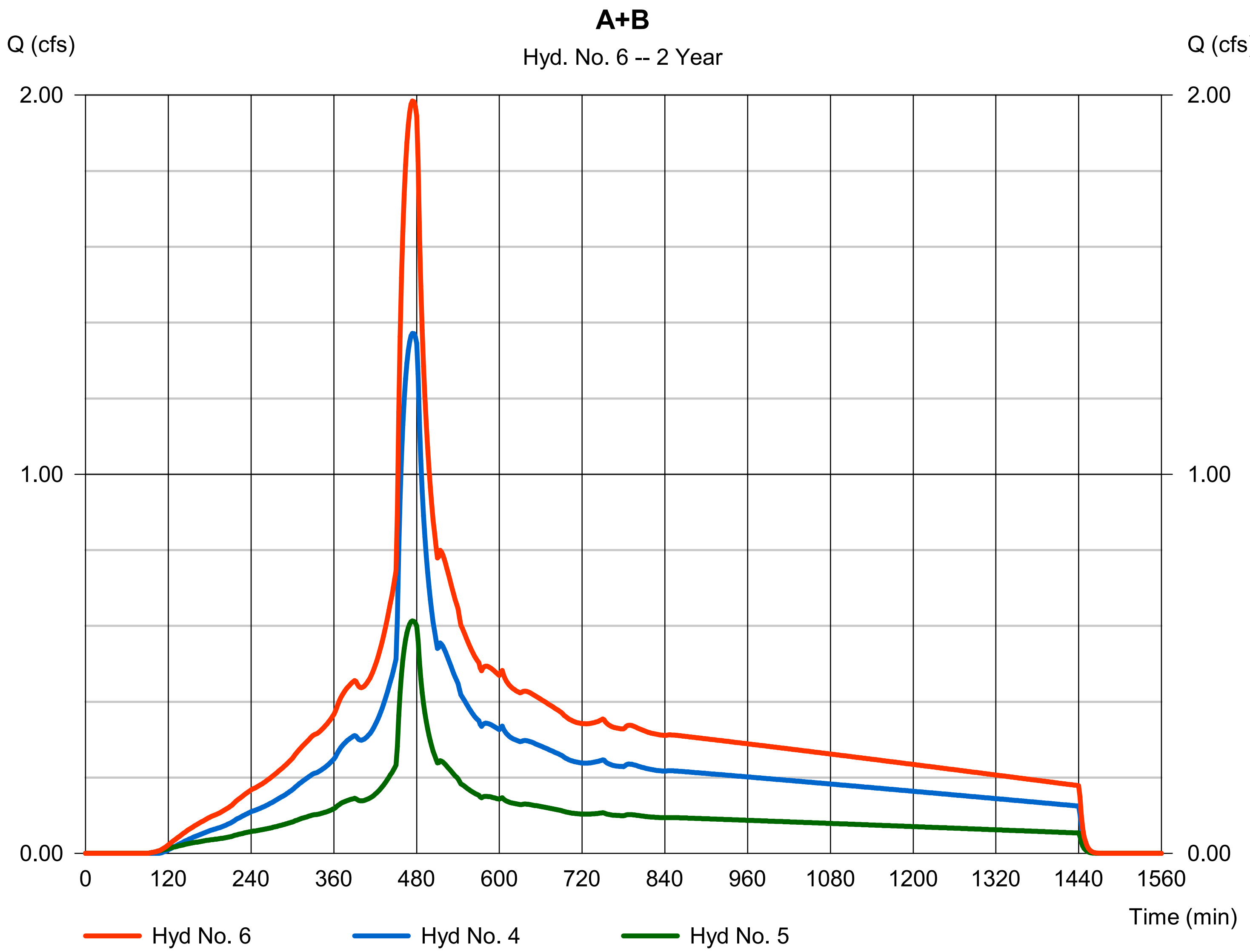
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 6

A+B

Hydrograph type	= Combine	Peak discharge	= 1.985 cfs
Storm frequency	= 2 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 27,847 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 3.850 ac



Hydrograph Report

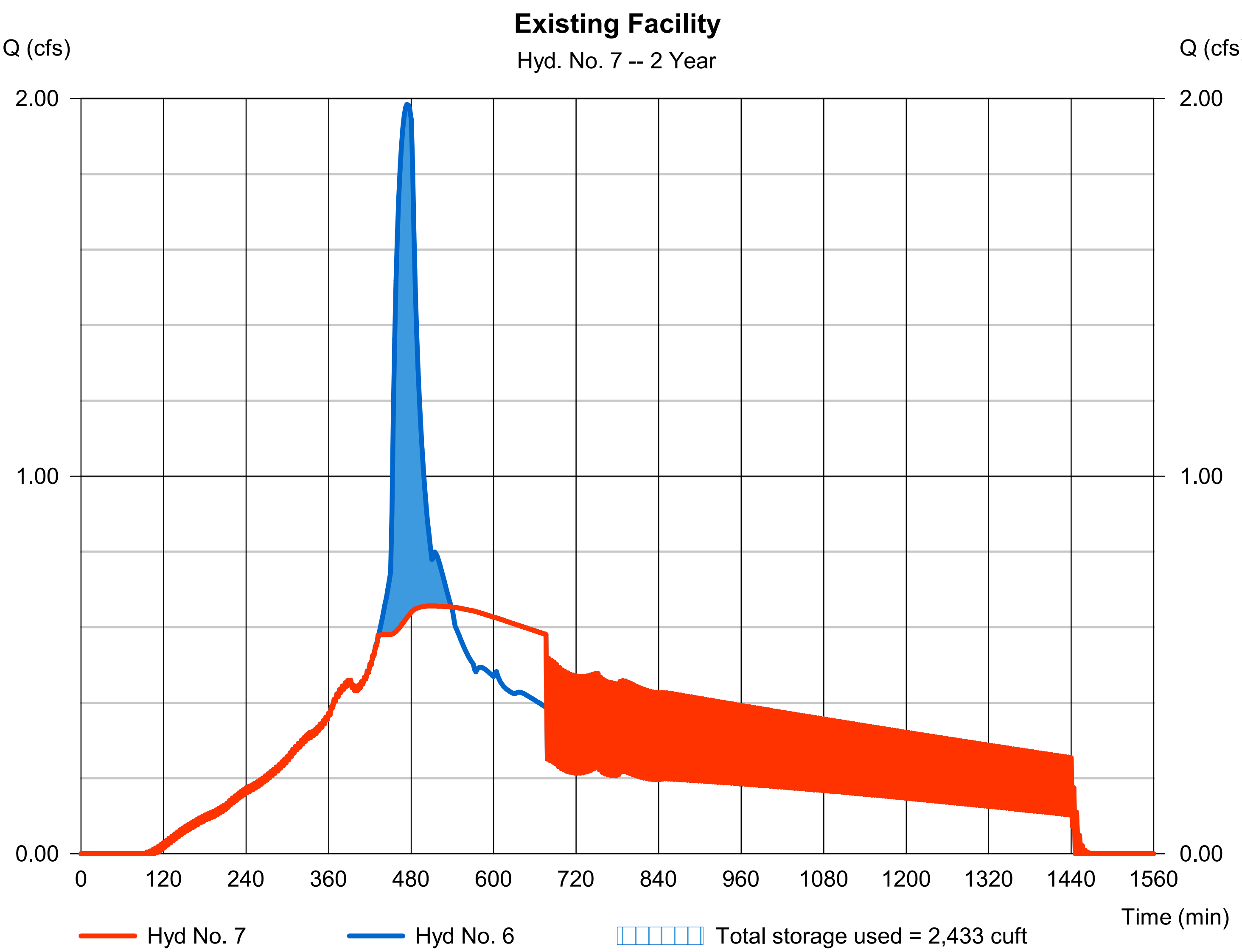
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 7

Existing Facility

Hydrograph type	= Reservoir	Peak discharge	= 0.656 cfs
Storm frequency	= 2 yrs	Time to peak	= 508 min
Time interval	= 2 min	Hyd. volume	= 25,977 cuft
Inflow hyd. No.	= 6 - A+B	Max. Elevation	= 134.12 ft
Reservoir name	= Existing Extended Wet Basin	Max. Storage	= 2,433 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



Pond Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Pond No. 1 - Existing Extended Wet Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 131.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	131.00	00	0	0
2.47	133.47	00	0	0
2.48	133.48	2,780	9	9
3.00	134.00	4,252	1,815	1,824
4.00	135.00	5,728	4,971	6,795
5.00	136.00	7,319	6,507	13,302
5.46	136.46	7,841	3,486	16,788

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 3.80	3.81	0.00	0.00
Span (in)	= 3.80	3.81	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 134.96	131.00	0.00	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

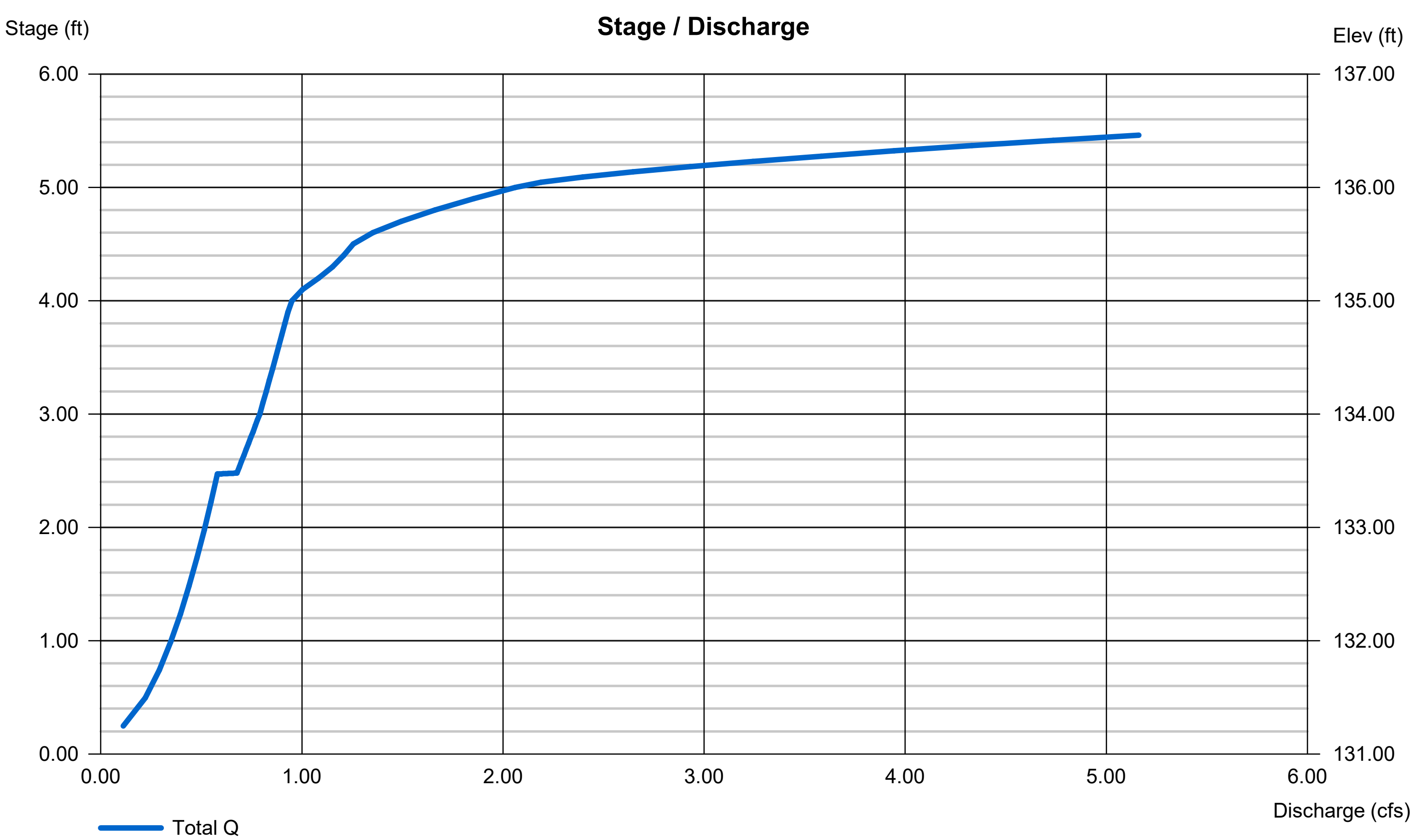
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 0.00	0.52	2.00	0.00
Crest El. (ft)	= 0.00	135.50	136.02	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= ---	Rect	Rect	---
Multi-Stage	= No	No	No	No

Exfil.(in/hr) = 1.500 (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).



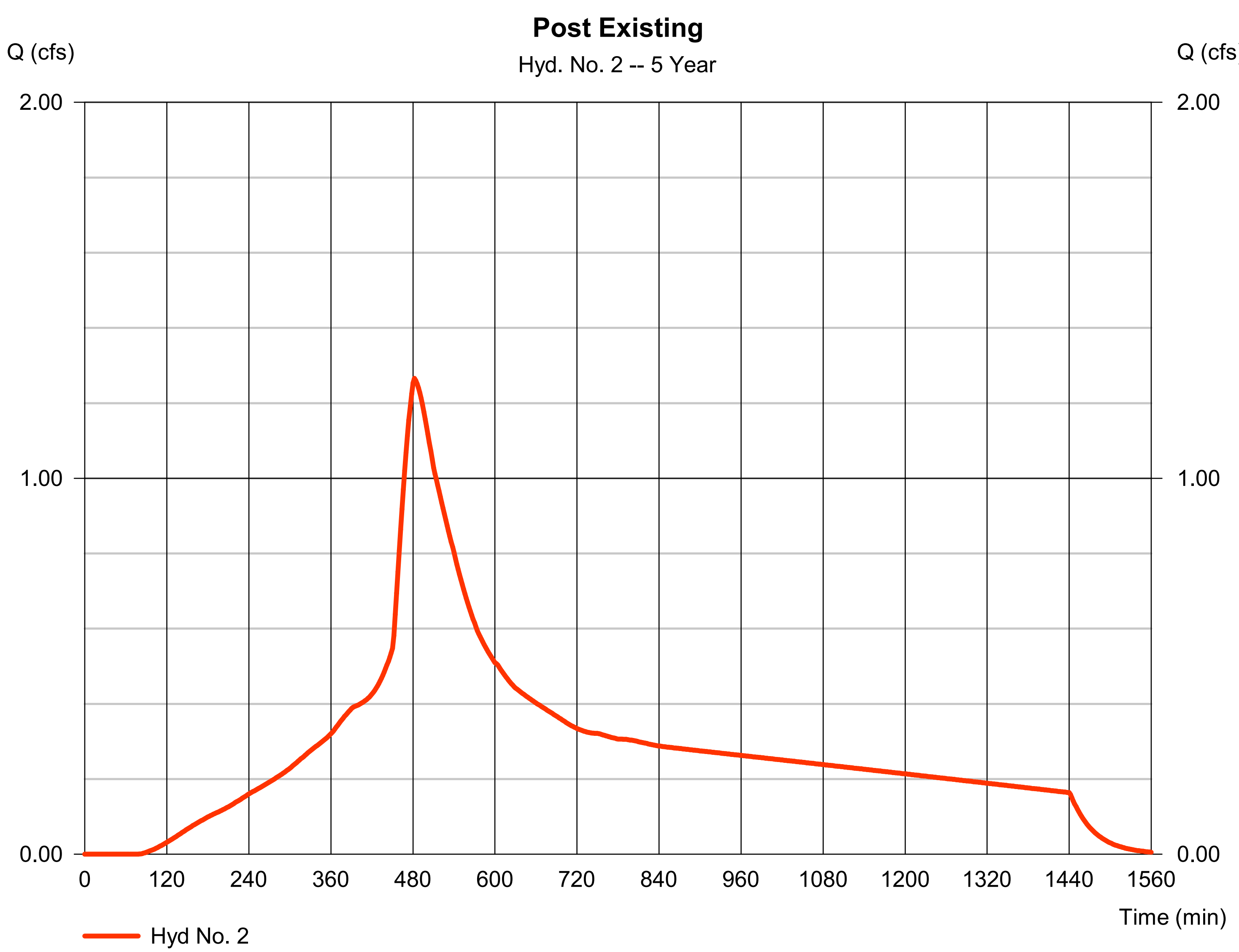
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 2

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.265 cfs
Storm frequency	= 5 yrs	Time to peak	= 482 min
Time interval	= 2 min	Hyd. volume	= 25,978 cuft
Drainage area	= 2.700 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



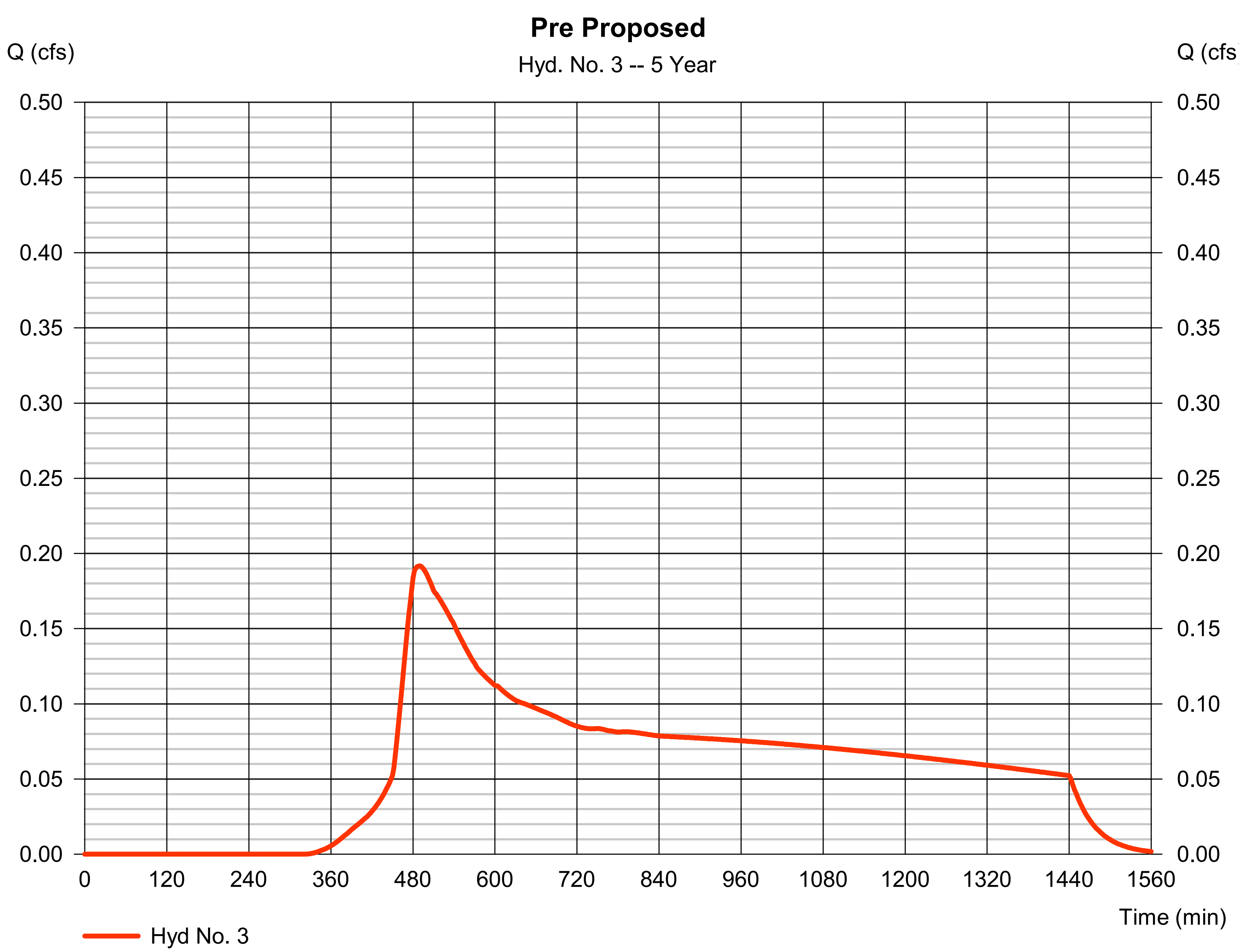
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 3

Pre Proposed

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.192 cfs
Storm frequency	= 5 yrs	Time to peak	= 490 min
Time interval	= 2 min	Hyd. volume	= 5,269 cuft
Drainage area	= 1.150 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

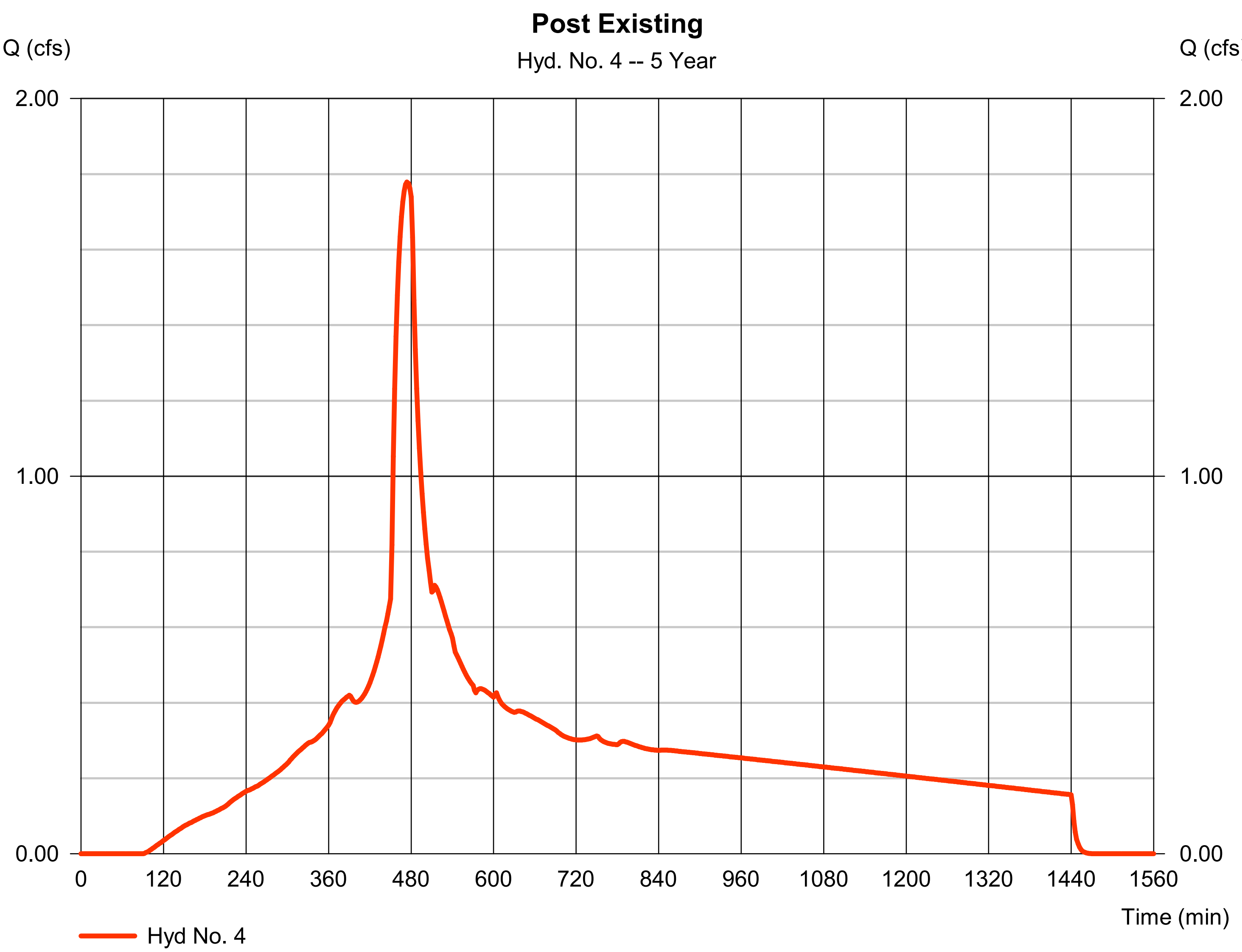
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 4

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.779 cfs
Storm frequency	= 5 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 24,964 cuft
Drainage area	= 2.700 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.500 x 98) + (0.200 x 61)] / 2.700



Hydrograph Report

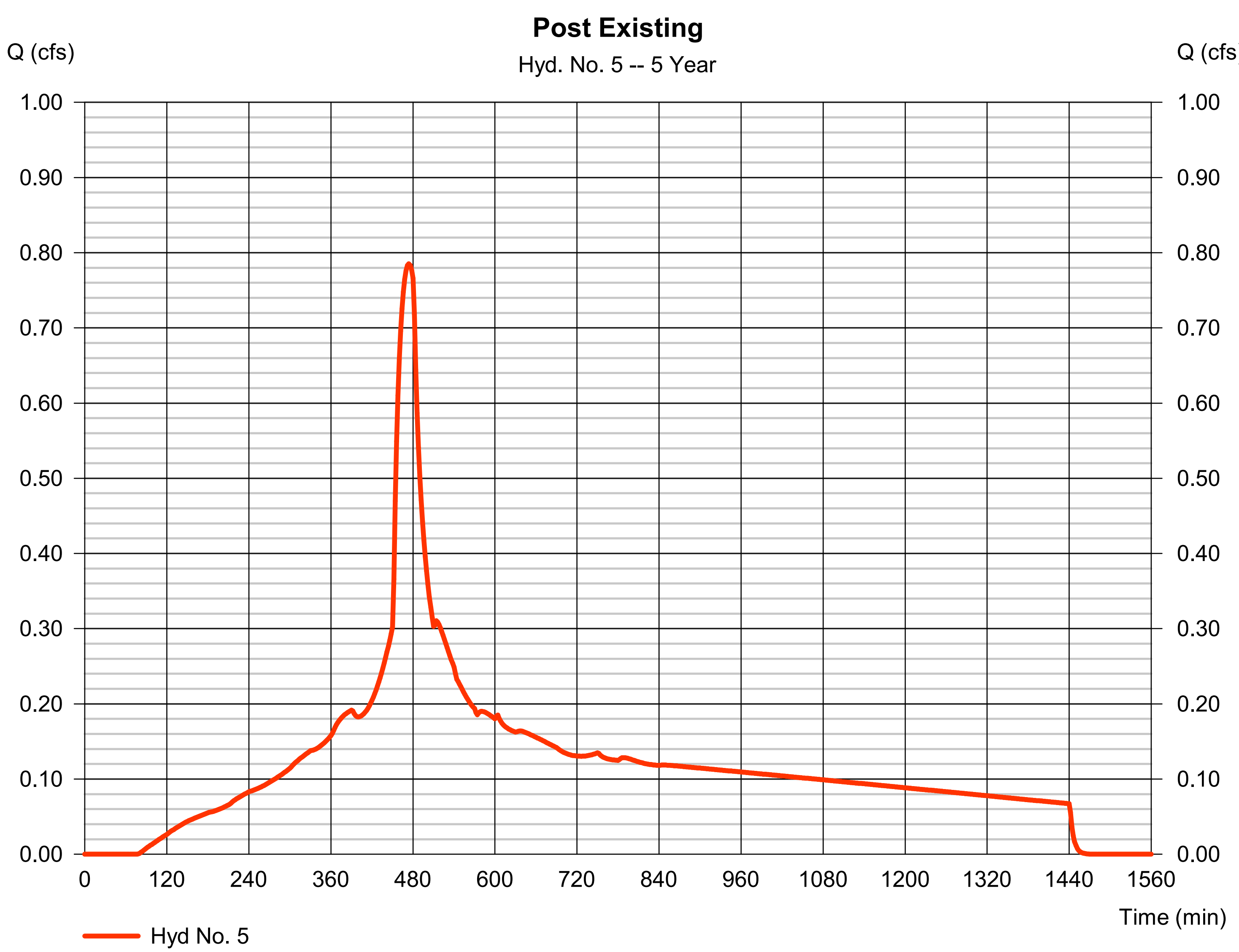
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 5

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.785 cfs
Storm frequency	= 5 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 11,065 cuft
Drainage area	= 1.150 ac	Curve number	= 96*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.10 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.090 x 98) + (0.060 x 61)] / 1.150



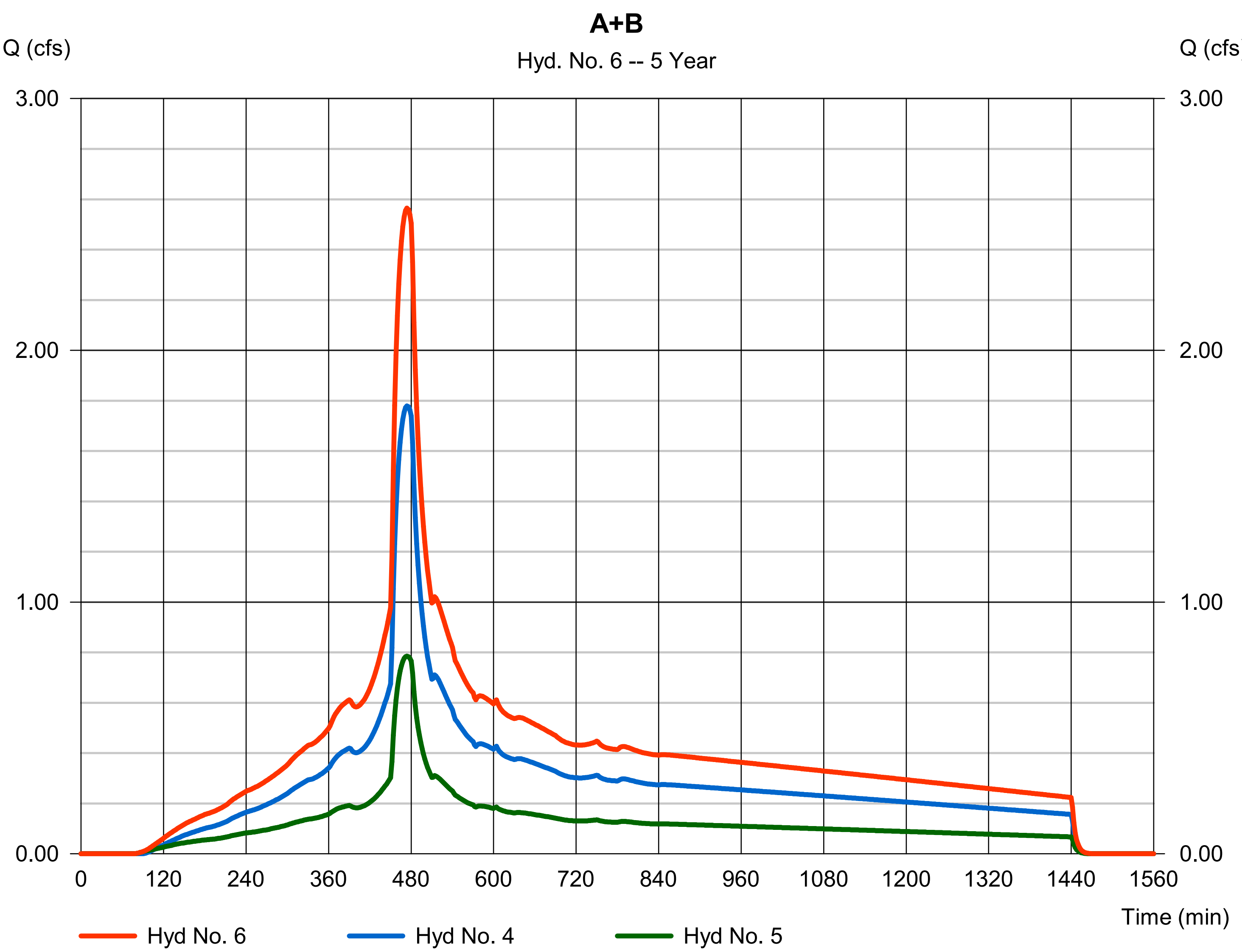
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 6

A+B

Hydrograph type	= Combine	Peak discharge	= 2.565 cfs
Storm frequency	= 5 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 36,029 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 3.850 ac



Hydrograph Report

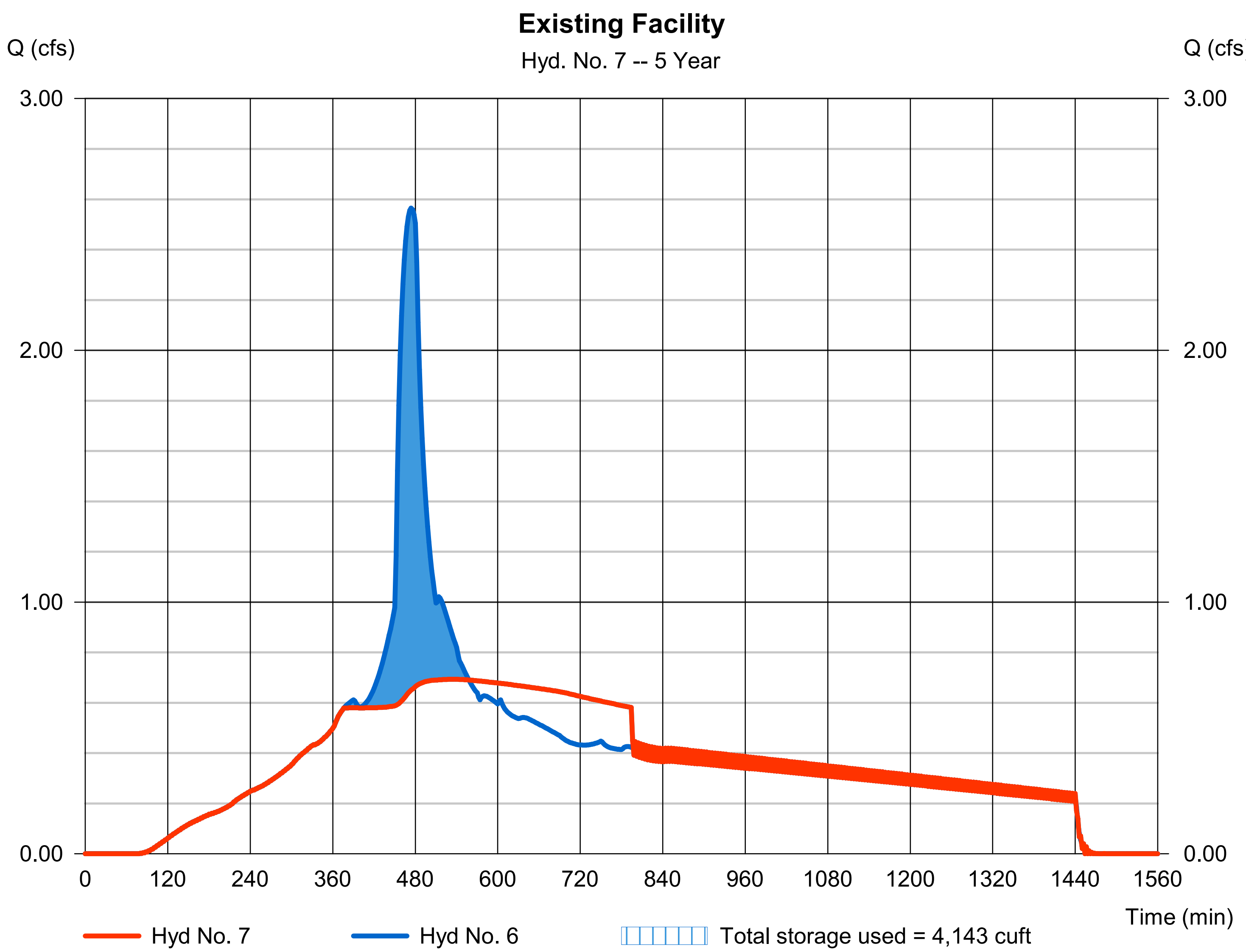
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 7

Existing Facility

Hydrograph type	= Reservoir	Peak discharge	= 0.693 cfs
Storm frequency	= 5 yrs	Time to peak	= 534 min
Time interval	= 2 min	Hyd. volume	= 32,743 cuft
Inflow hyd. No.	= 6 - A+B	Max. Elevation	= 134.47 ft
Reservoir name	= Existing Extended Wet Basin	Max. Storage	= 4,143 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



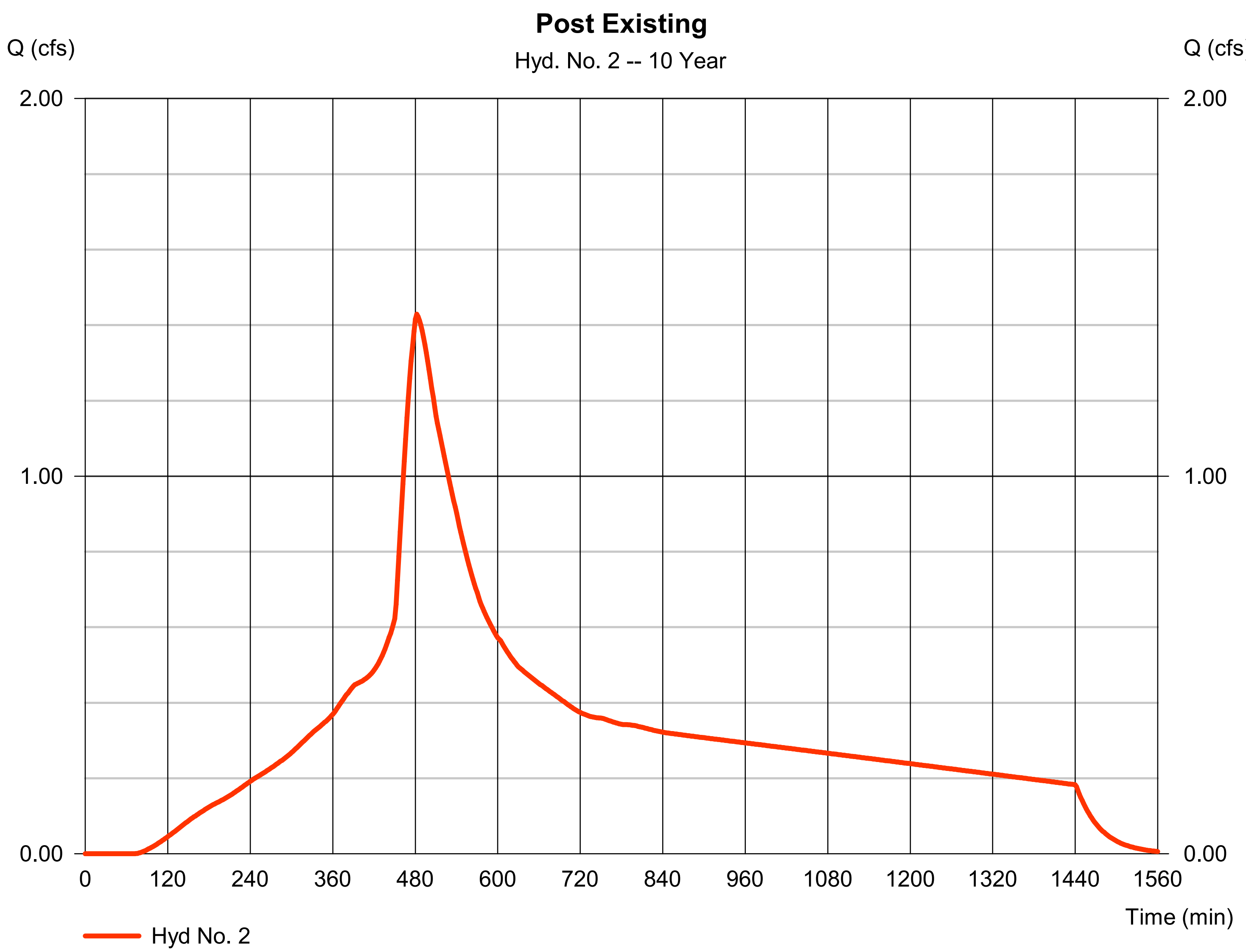
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 2

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.429 cfs
Storm frequency	= 10 yrs	Time to peak	= 482 min
Time interval	= 2 min	Hyd. volume	= 29,363 cuft
Drainage area	= 2.700 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



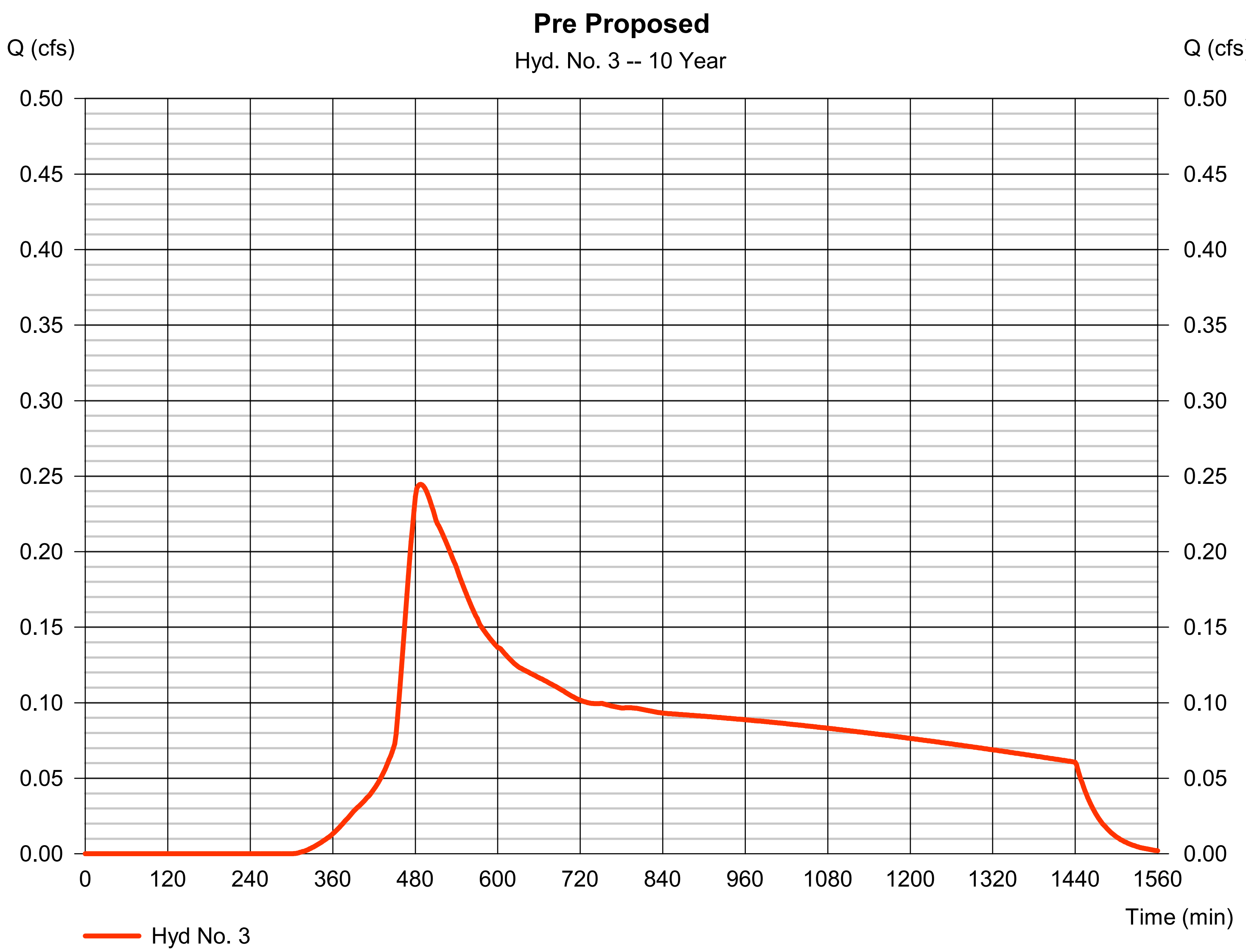
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 3

Pre Proposed

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.245 cfs
Storm frequency	= 10 yrs	Time to peak	= 488 min
Time interval	= 2 min	Hyd. volume	= 6,375 cuft
Drainage area	= 1.150 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 3.45 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

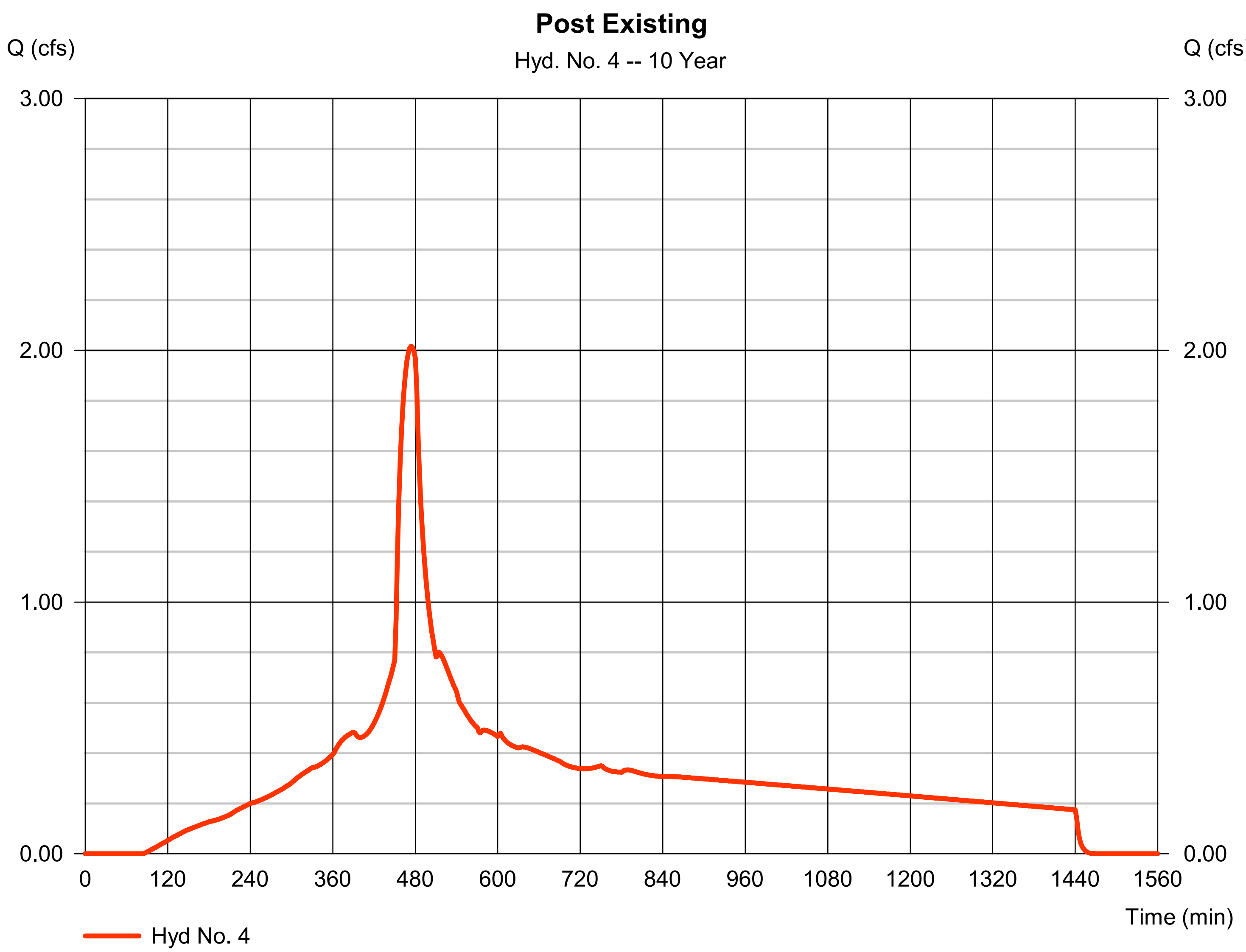
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 4

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 2.016 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 28,325 cuft
Drainage area	= 2.700 ac	Curve number	= 95*
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 IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.500 x 98) + (0.200 x 61)] / 2.700



Hydrograph Report

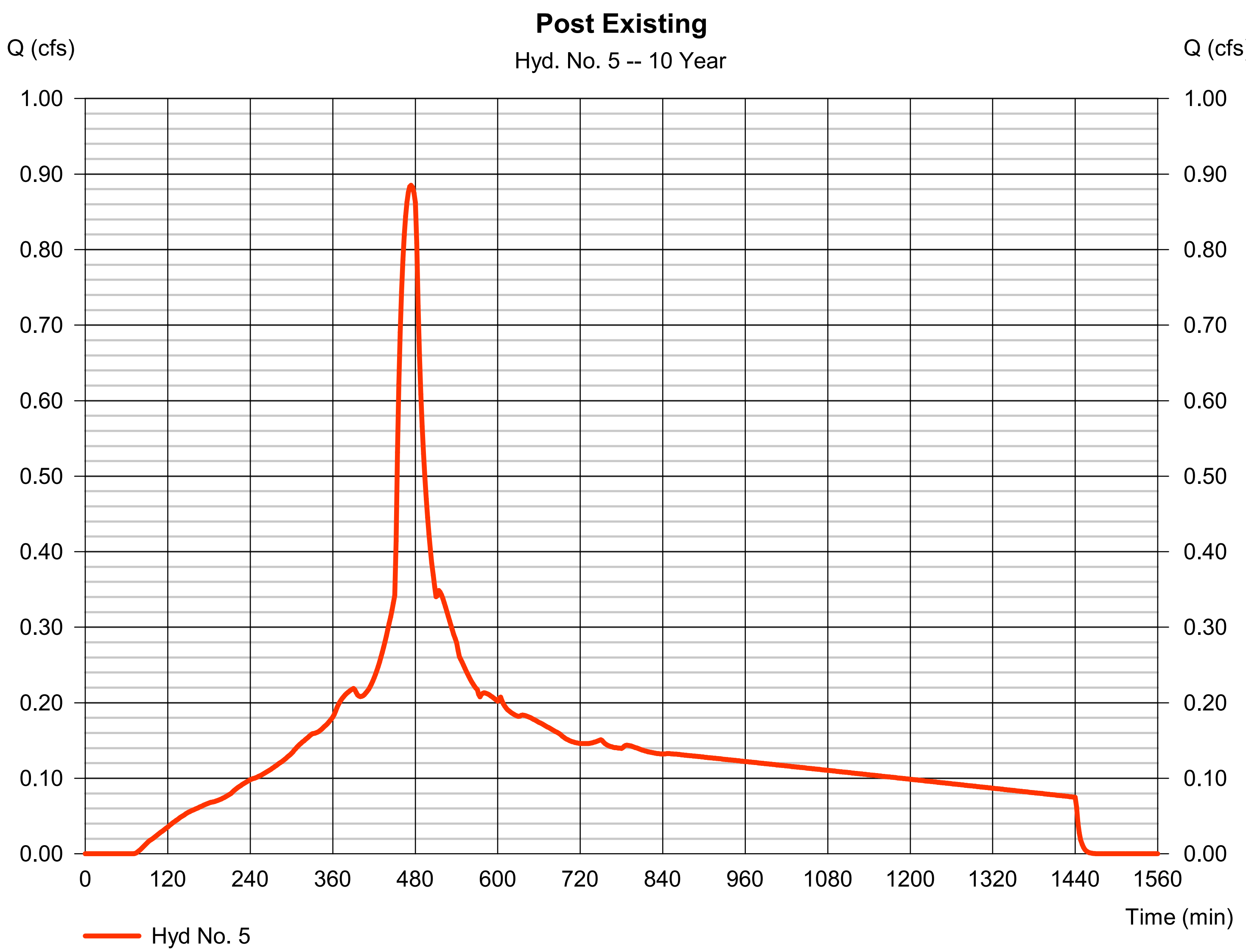
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 5

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.885 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 12,506 cuft
Drainage area	= 1.150 ac	Curve number	= 96*
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 IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.090 x 98) + (0.060 x 61)] / 1.150



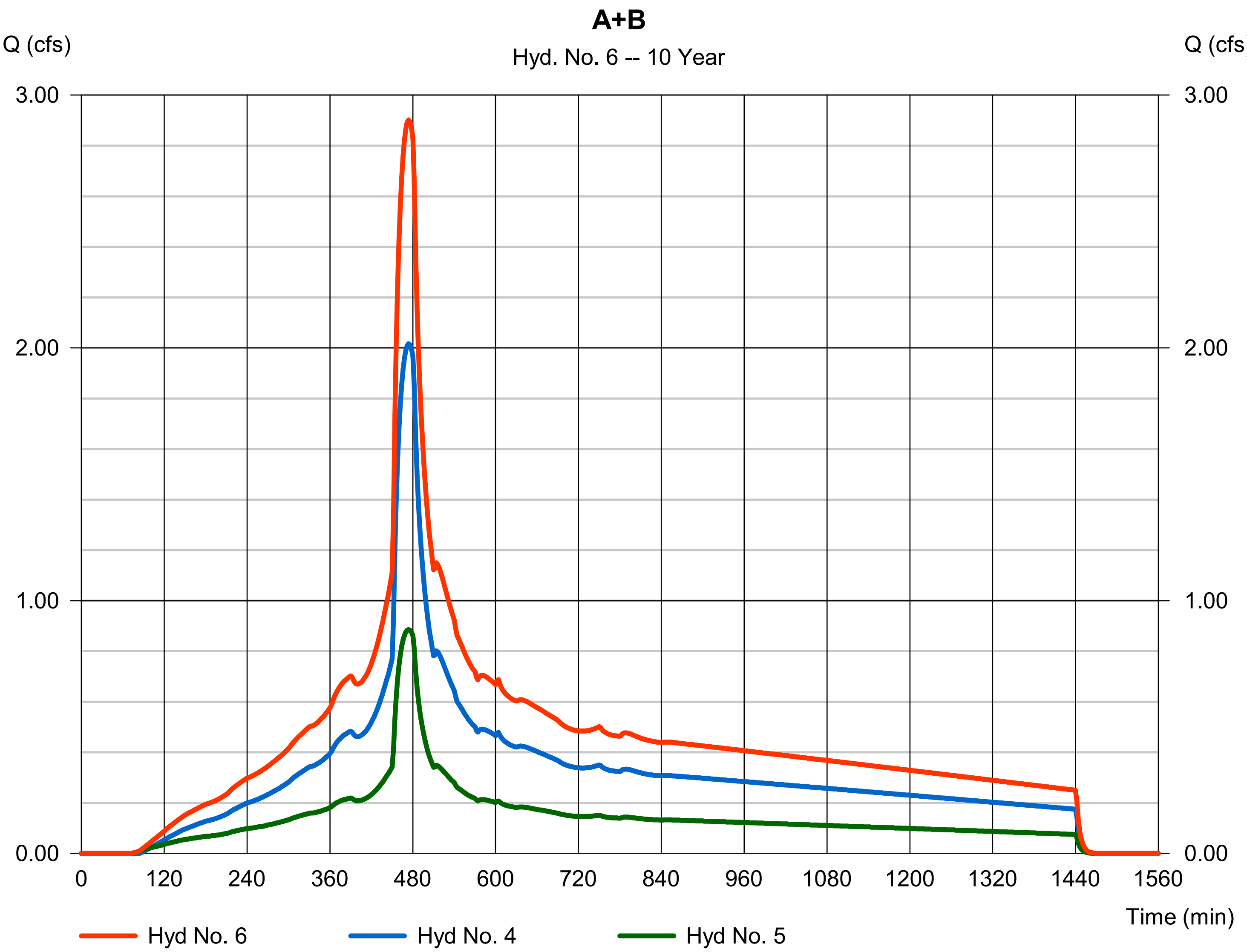
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 | Tuesday, 09 / 12 / 2023

Hyd. No. 6

A+B

Hydrograph type	= Combine	Peak discharge	= 2.901 cfs
Storm frequency	= 10 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 40,831 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 3.850 ac



Hydrograph Report

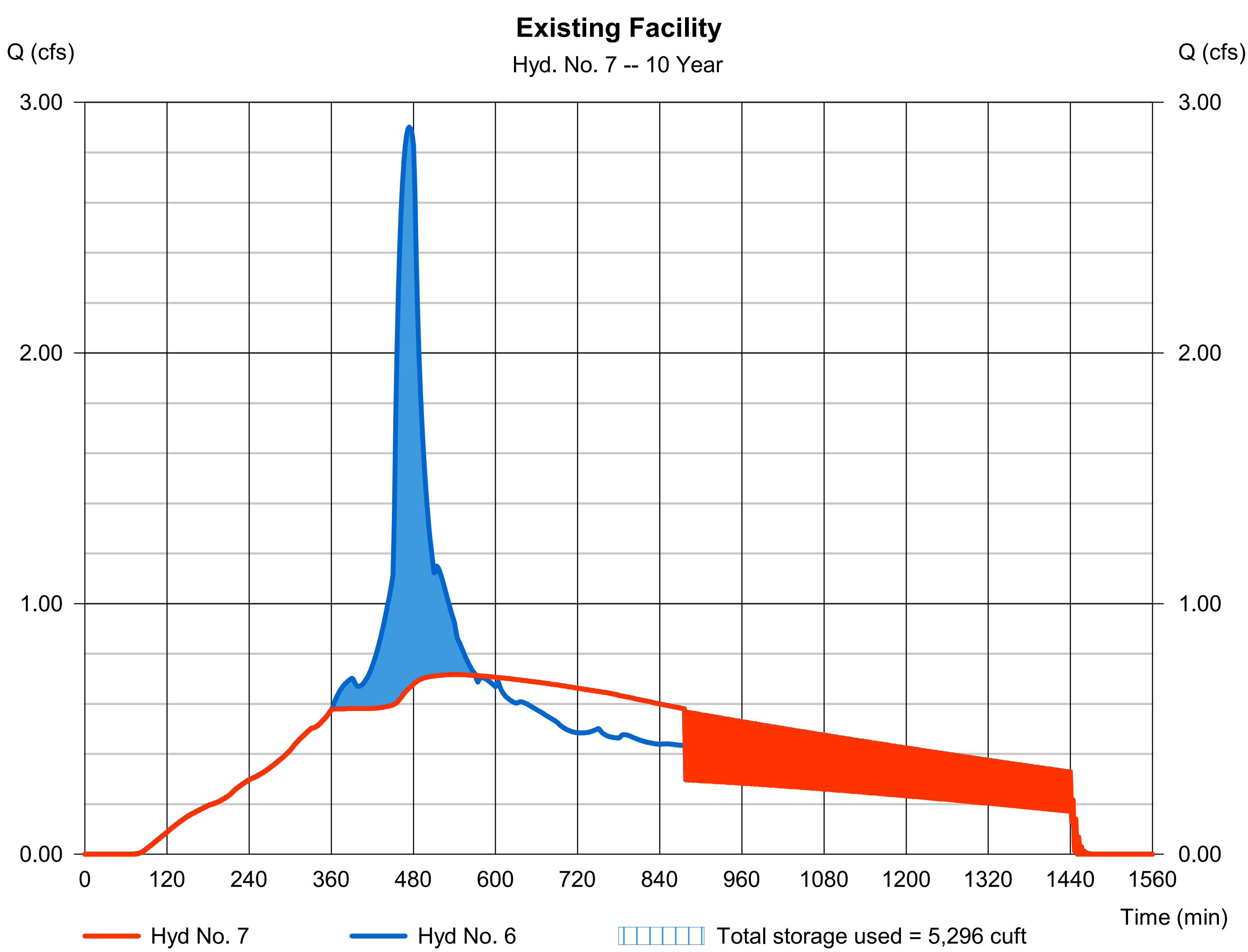
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 7

Existing Facility

Hydrograph type	= Reservoir	Peak discharge	= 0.717 cfs
Storm frequency	= 10 yrs	Time to peak	= 542 min
Time interval	= 2 min	Hyd. volume	= 36,390 cuft
Inflow hyd. No.	= 6 - A+B	Max. Elevation	= 134.70 ft
Reservoir name	= Existing Extended Wet Basin	Max. Storage	= 5,296 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



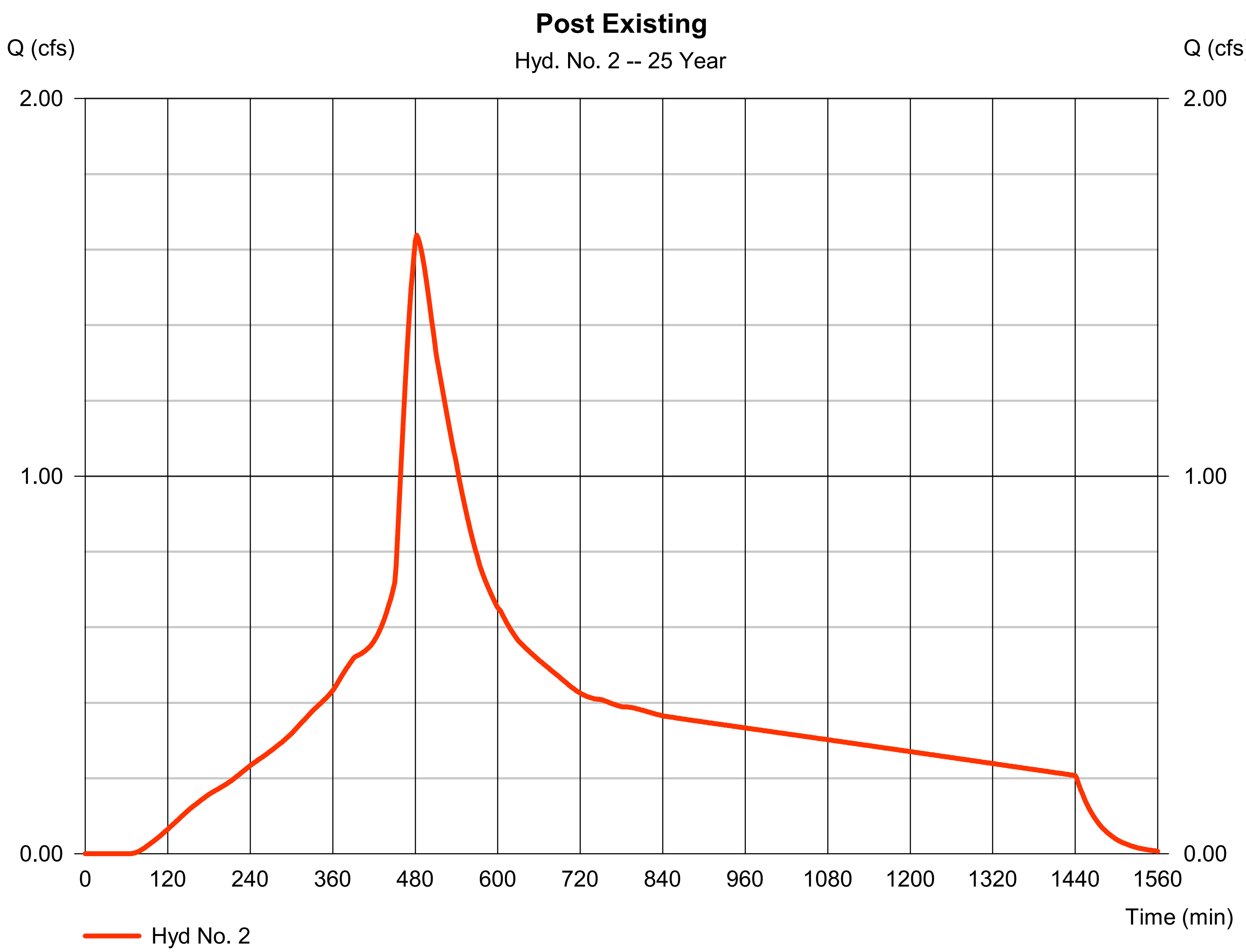
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 2

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.638 cfs
Storm frequency	= 25 yrs	Time to peak	= 482 min
Time interval	= 2 min	Hyd. volume	= 33,725 cuft
Drainage area	= 2.700 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

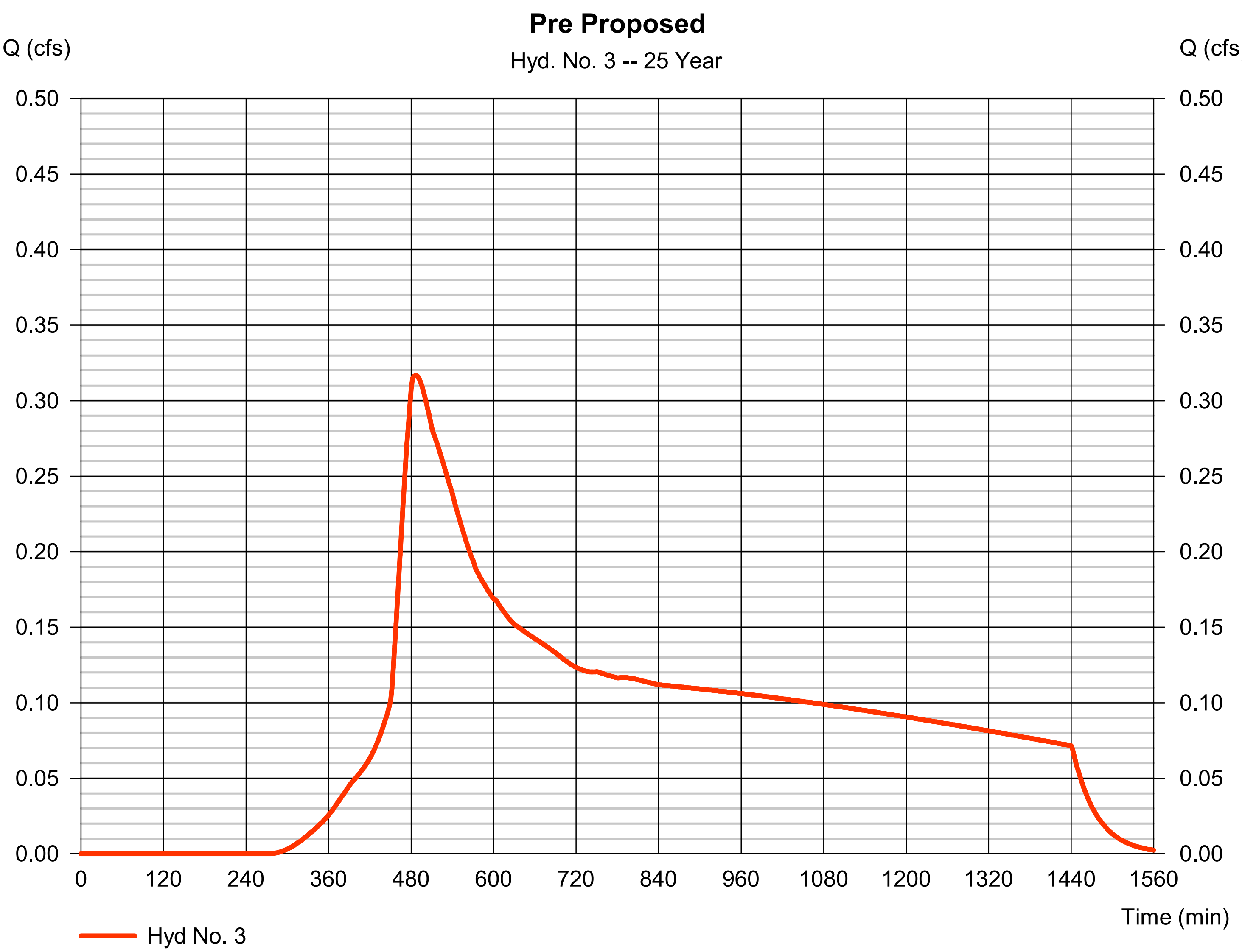


Hydrograph Report

Hyd. No. 3

Pre Proposed

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.317 cfs
Storm frequency	= 25 yrs	Time to peak	= 486 min
Time interval	= 2 min	Hyd. volume	= 7,859 cuft
Drainage area	= 1.150 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

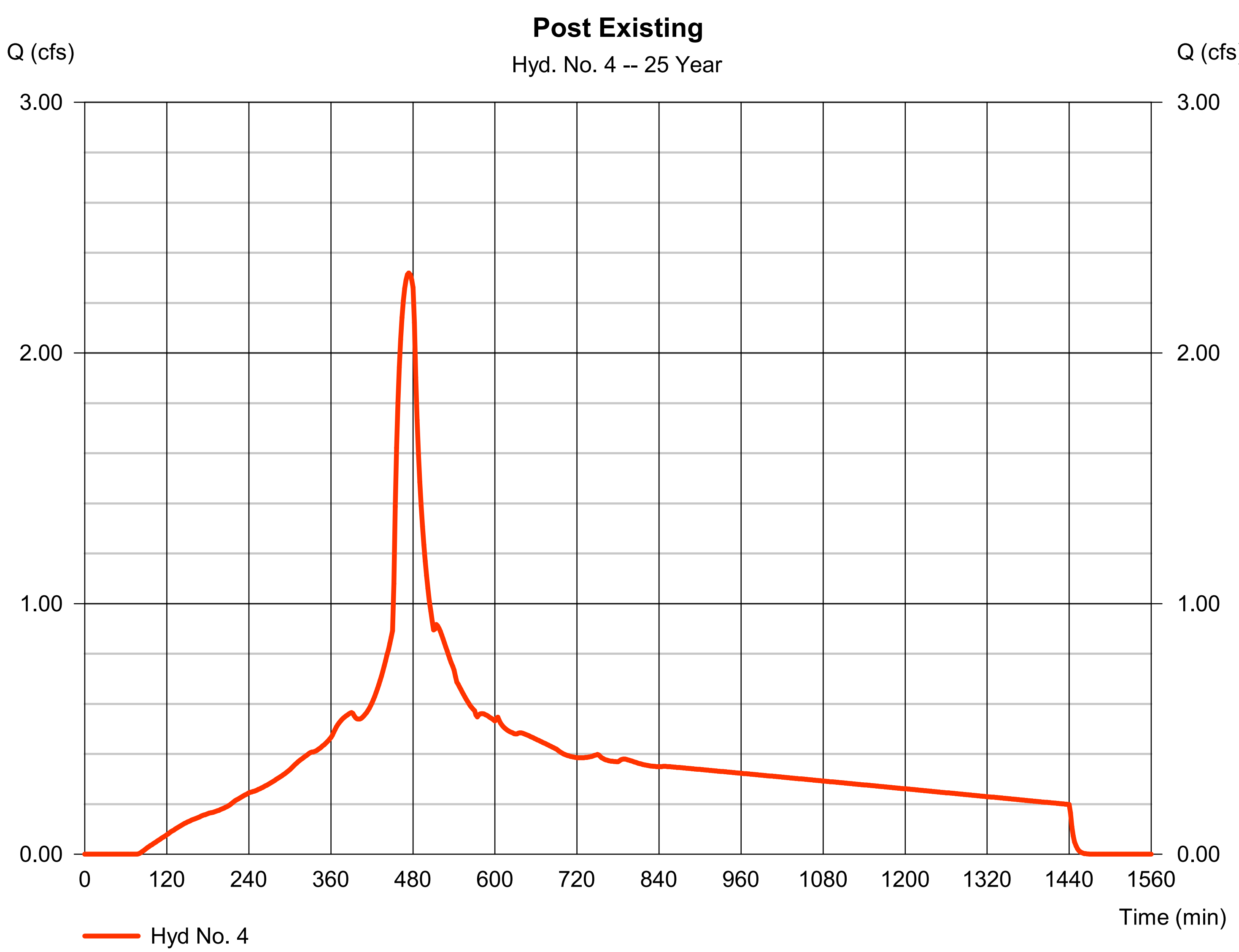
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 — Tuesday, 09 / 12 / 2023

Hyd. No. 4

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 2.319 cfs
Storm frequency	= 25 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 32,662 cuft
Drainage area	= 2.700 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.500 x 98) + (0.200 x 61)] / 2.700



Hydrograph Report

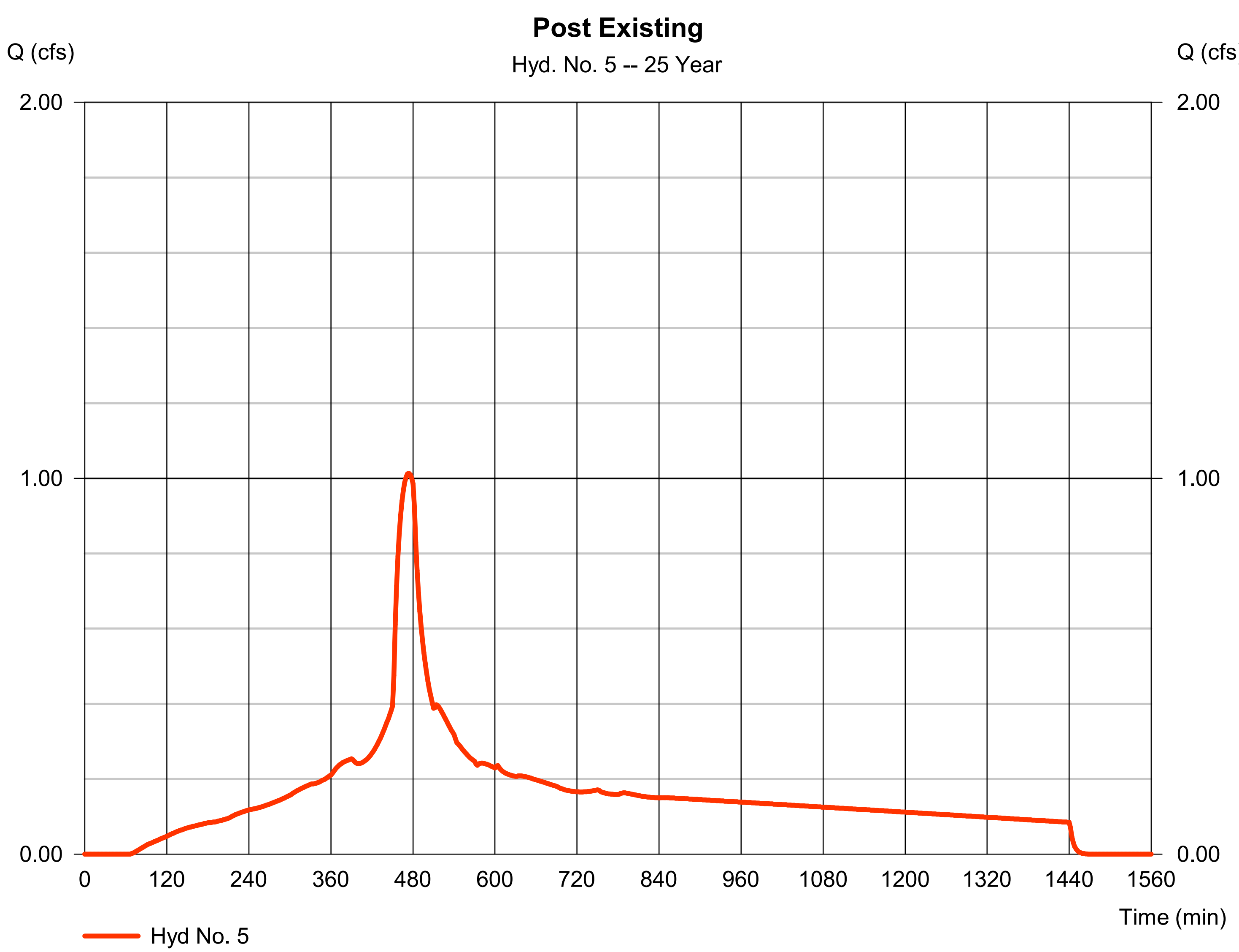
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 5

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.013 cfs
Storm frequency	= 25 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 14,365 cuft
Drainage area	= 1.150 ac	Curve number	= 96*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 3.90 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.090 x 98) + (0.060 x 61)] / 1.150



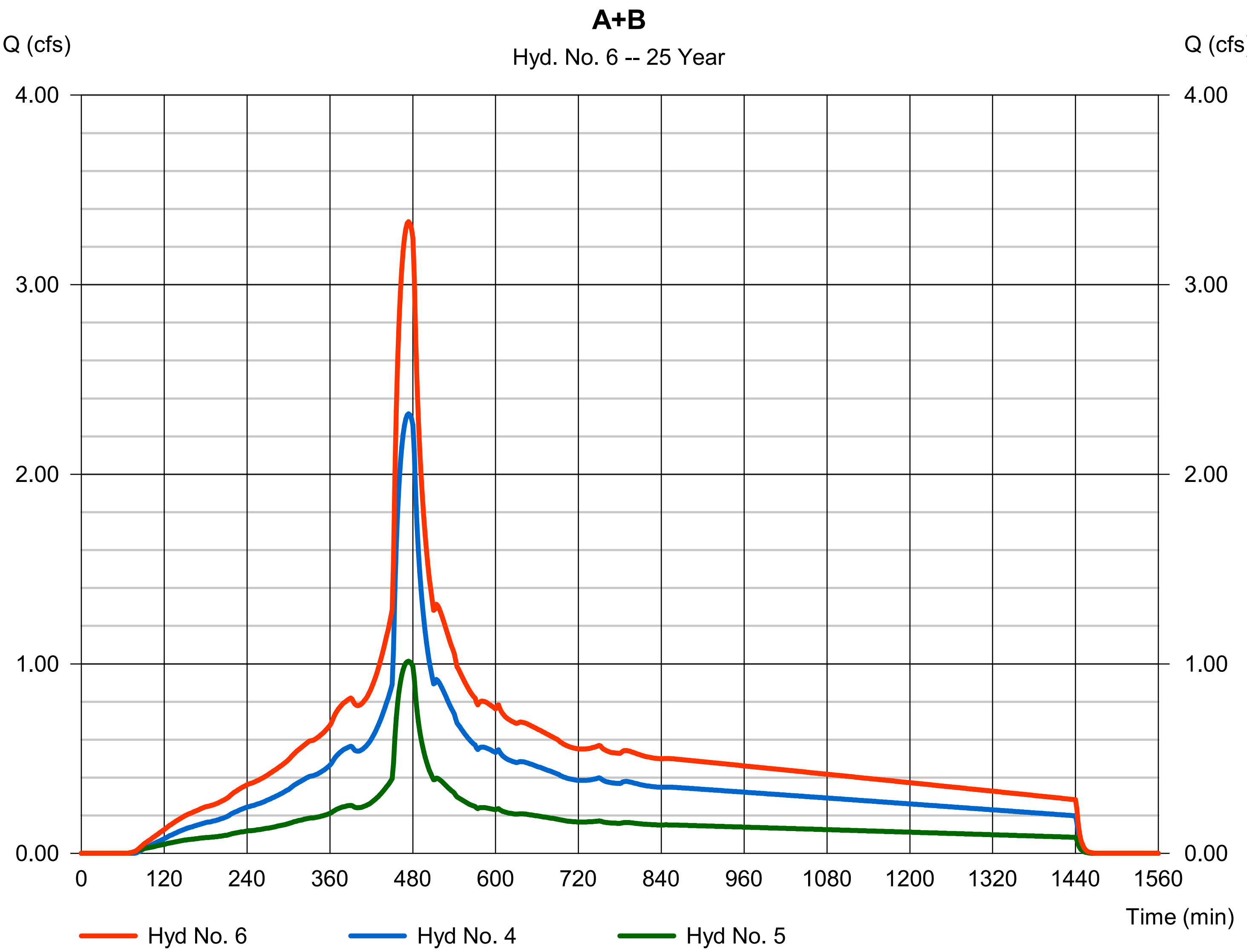
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 6

A+B

Hydrograph type	= Combine	Peak discharge	= 3.332 cfs
Storm frequency	= 25 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 47,027 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 3.850 ac



Hydrograph Report

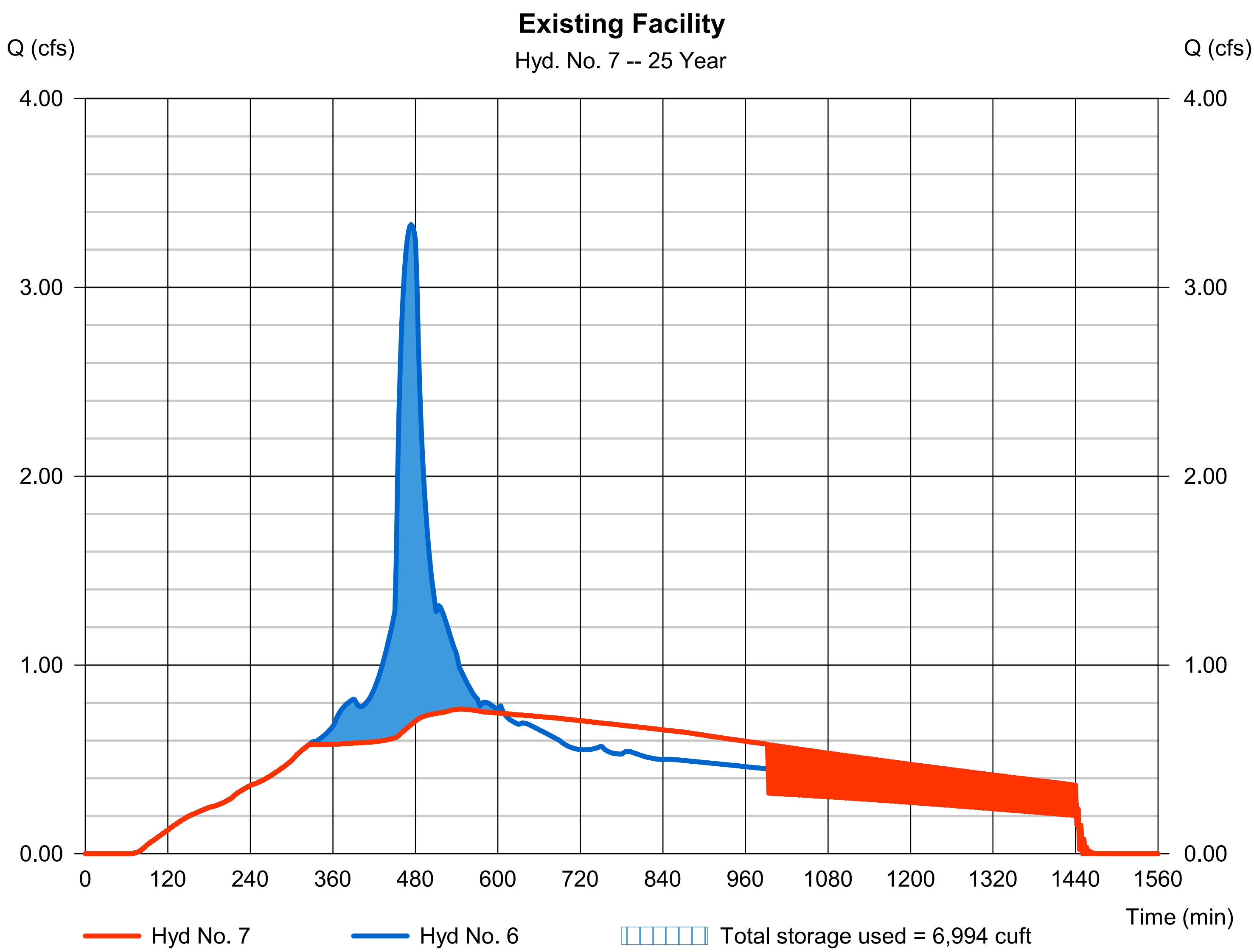
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 7

Existing Facility

Hydrograph type	= Reservoir	Peak discharge	= 0.766 cfs
Storm frequency	= 25 yrs	Time to peak	= 546 min
Time interval	= 2 min	Hyd. volume	= 40,998 cuft
Inflow hyd. No.	= 6 - A+B	Max. Elevation	= 135.03 ft
Reservoir name	= Existing Extended Wet Basin	Max. Storage	= 6,994 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



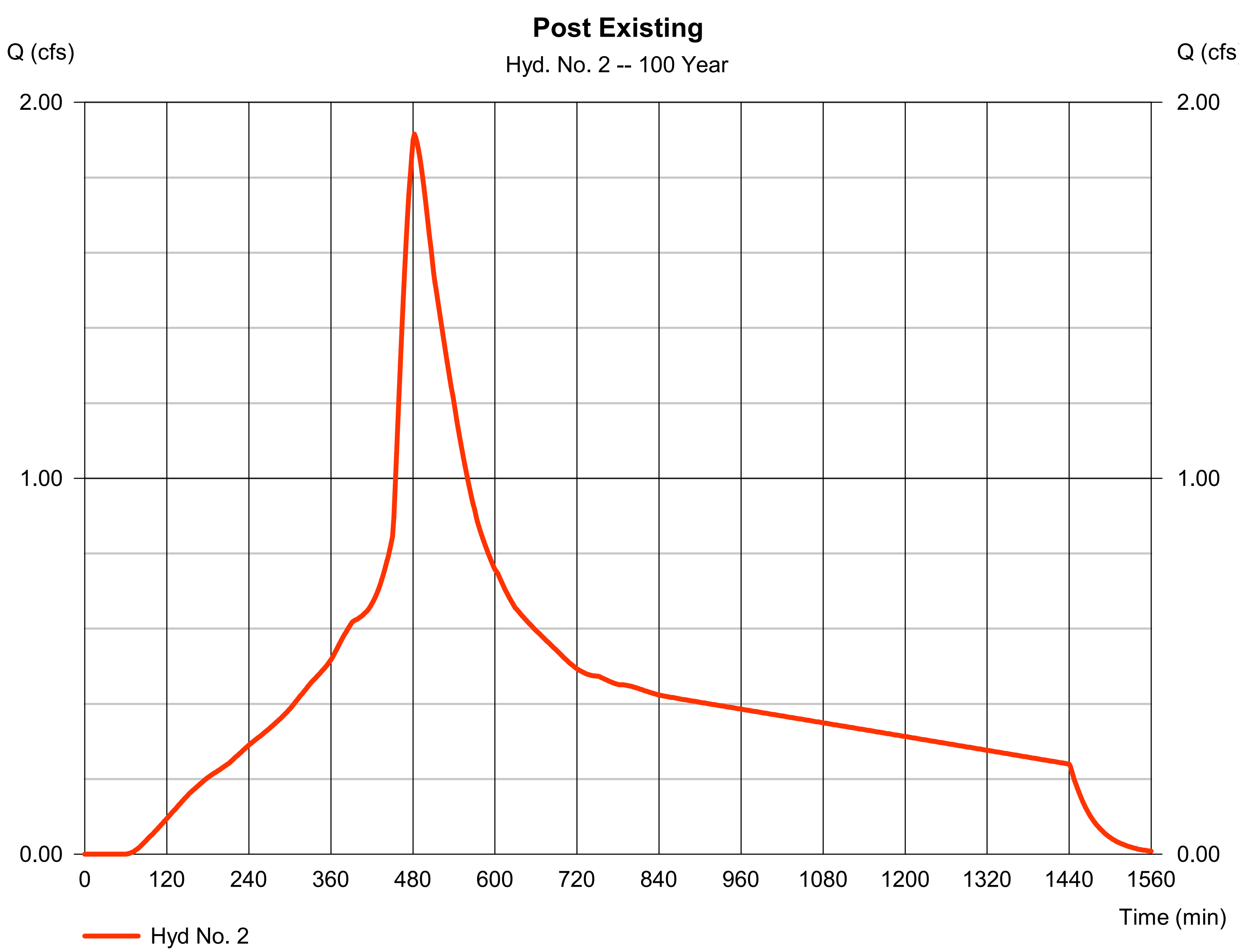
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 2

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.915 cfs
Storm frequency	= 100 yrs	Time to peak	= 482 min
Time interval	= 2 min	Hyd. volume	= 39,556 cuft
Drainage area	= 2.700 ac	Curve number	= 96
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 4.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



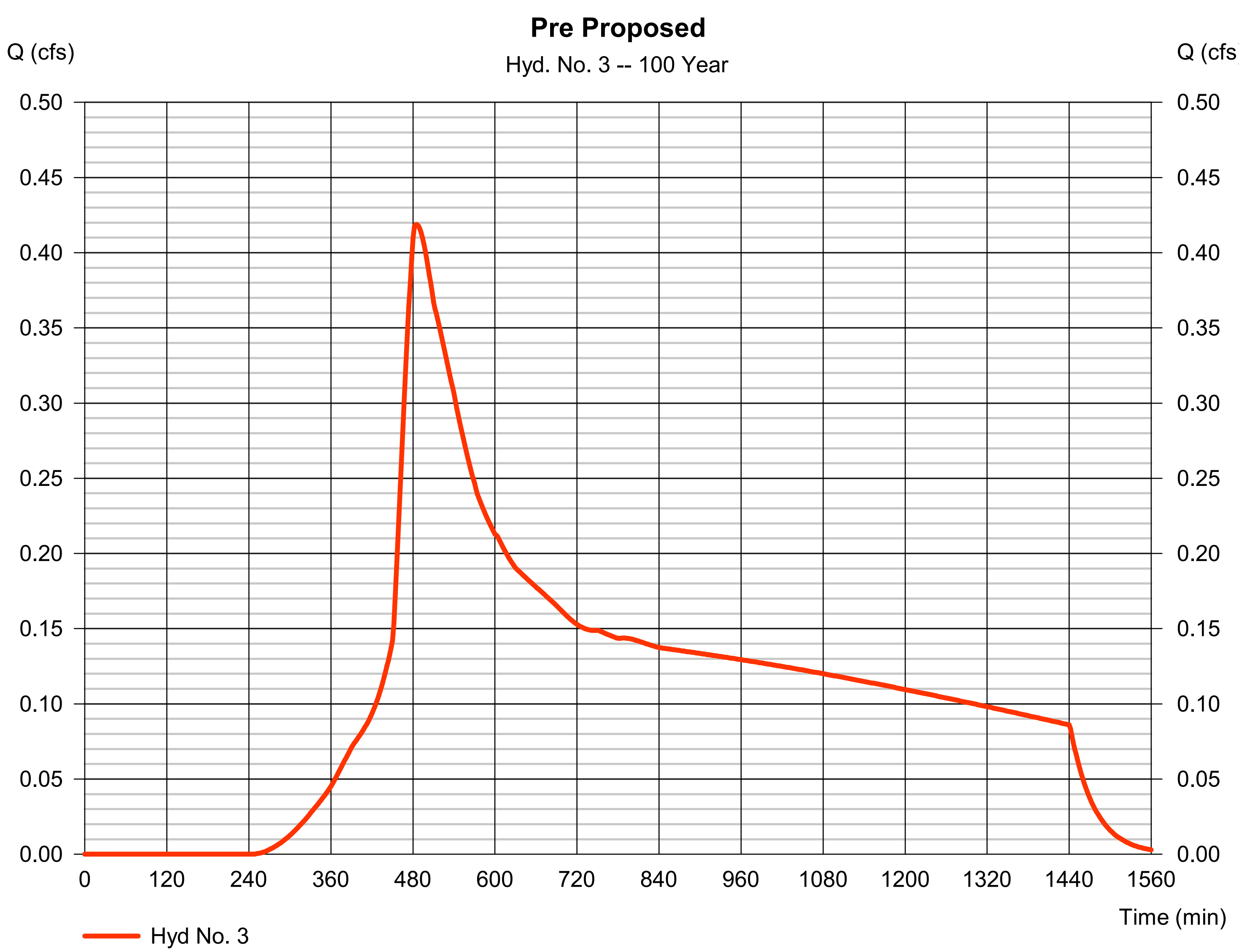
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 3

Pre Proposed

Hydrograph type	= SBUH Runoff	Peak discharge	= 0.419 cfs
Storm frequency	= 100 yrs	Time to peak	= 486 min
Time interval	= 2 min	Hyd. volume	= 9,921 cuft
Drainage area	= 1.150 ac	Curve number	= 79
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 35.00 min
Total precip.	= 4.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a



Hydrograph Report

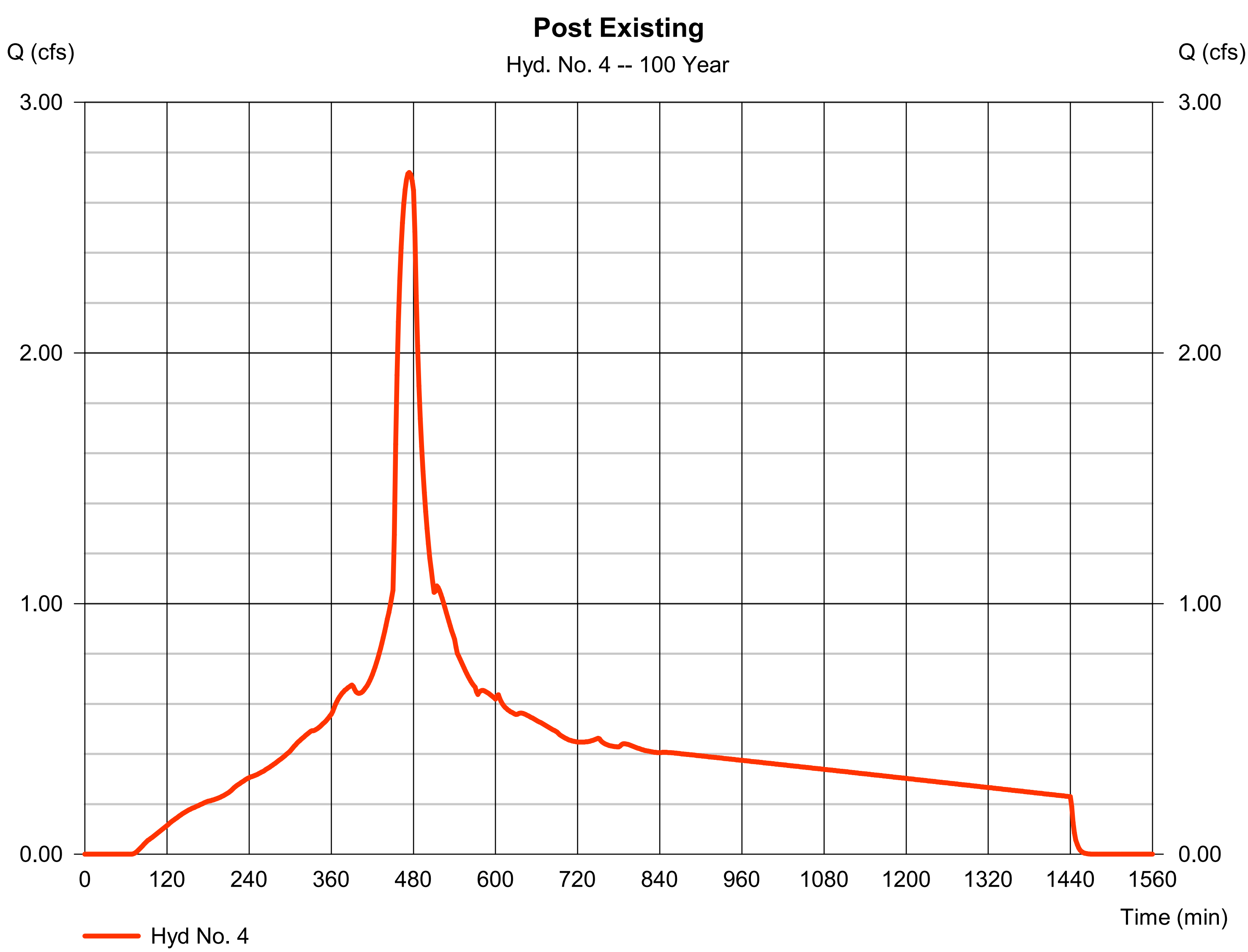
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 4

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 2.720 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 38,466 cuft
Drainage area	= 2.700 ac	Curve number	= 95*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(2.500 x 98) + (0.200 x 61)] / 2.700



Hydrograph Report

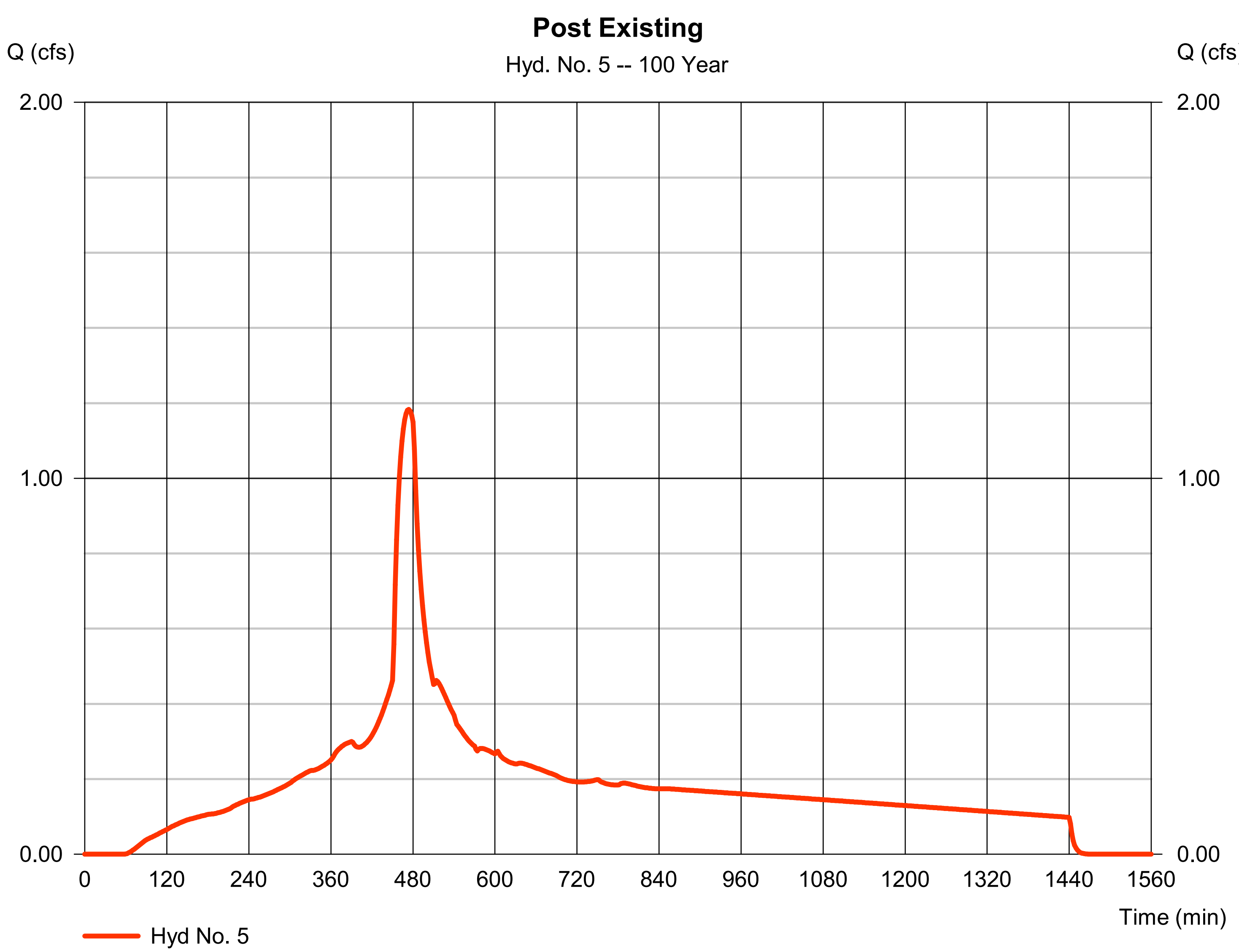
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 5

Post Existing

Hydrograph type	= SBUH Runoff	Peak discharge	= 1.183 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 16,848 cuft
Drainage area	= 1.150 ac	Curve number	= 96*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 5.00 min
Total precip.	= 4.50 in	Distribution	= Type IA
Storm duration	= 24 hrs	Shape factor	= n/a

* Composite (Area/CN) = [(1.090 x 98) + (0.060 x 61)] / 1.150



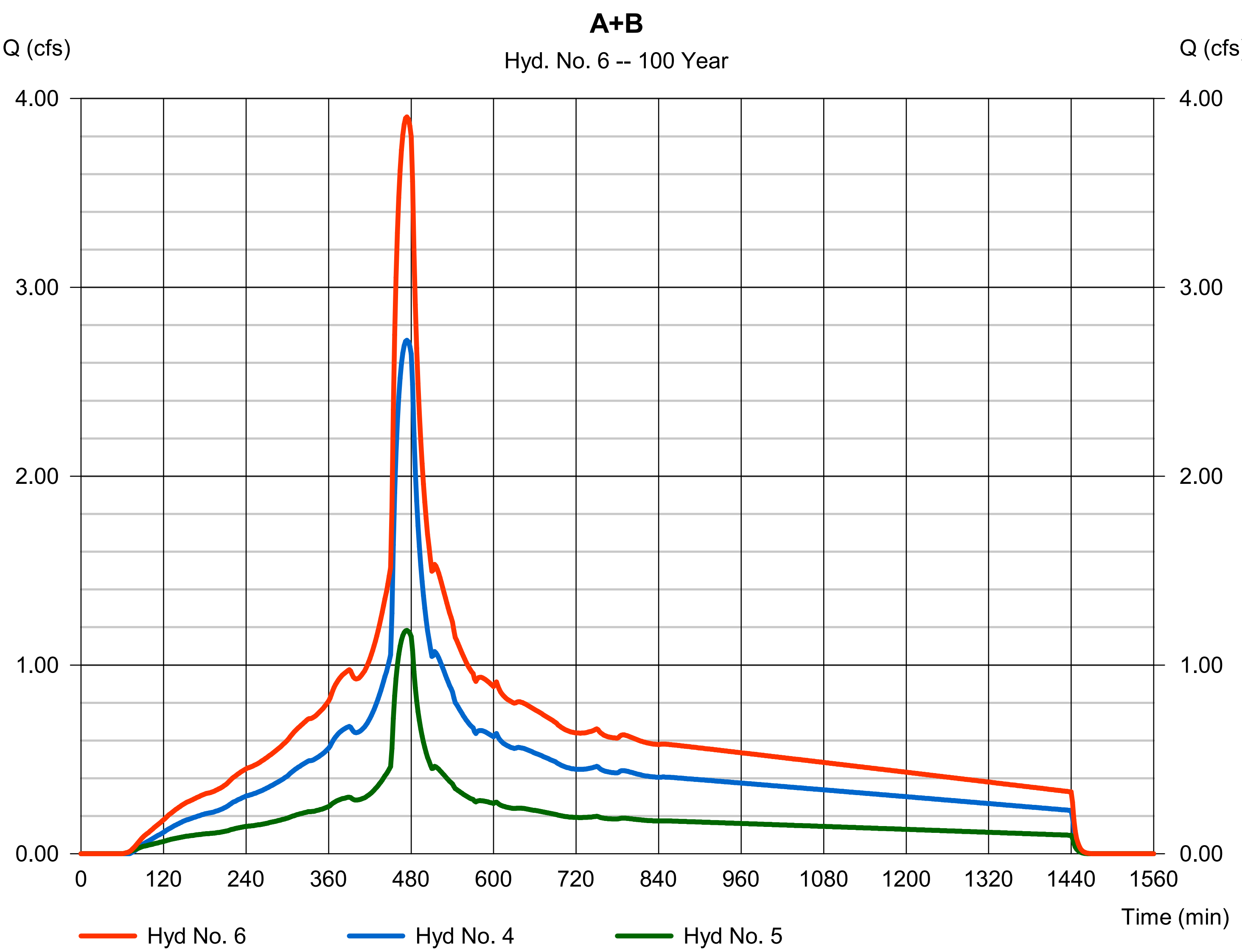
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 6

A+B

Hydrograph type	= Combine	Peak discharge	= 3.903 cfs
Storm frequency	= 100 yrs	Time to peak	= 474 min
Time interval	= 2 min	Hyd. volume	= 55,314 cuft
Inflow hyds.	= 4, 5	Contrib. drain. area	= 3.850 ac



Hydrograph Report

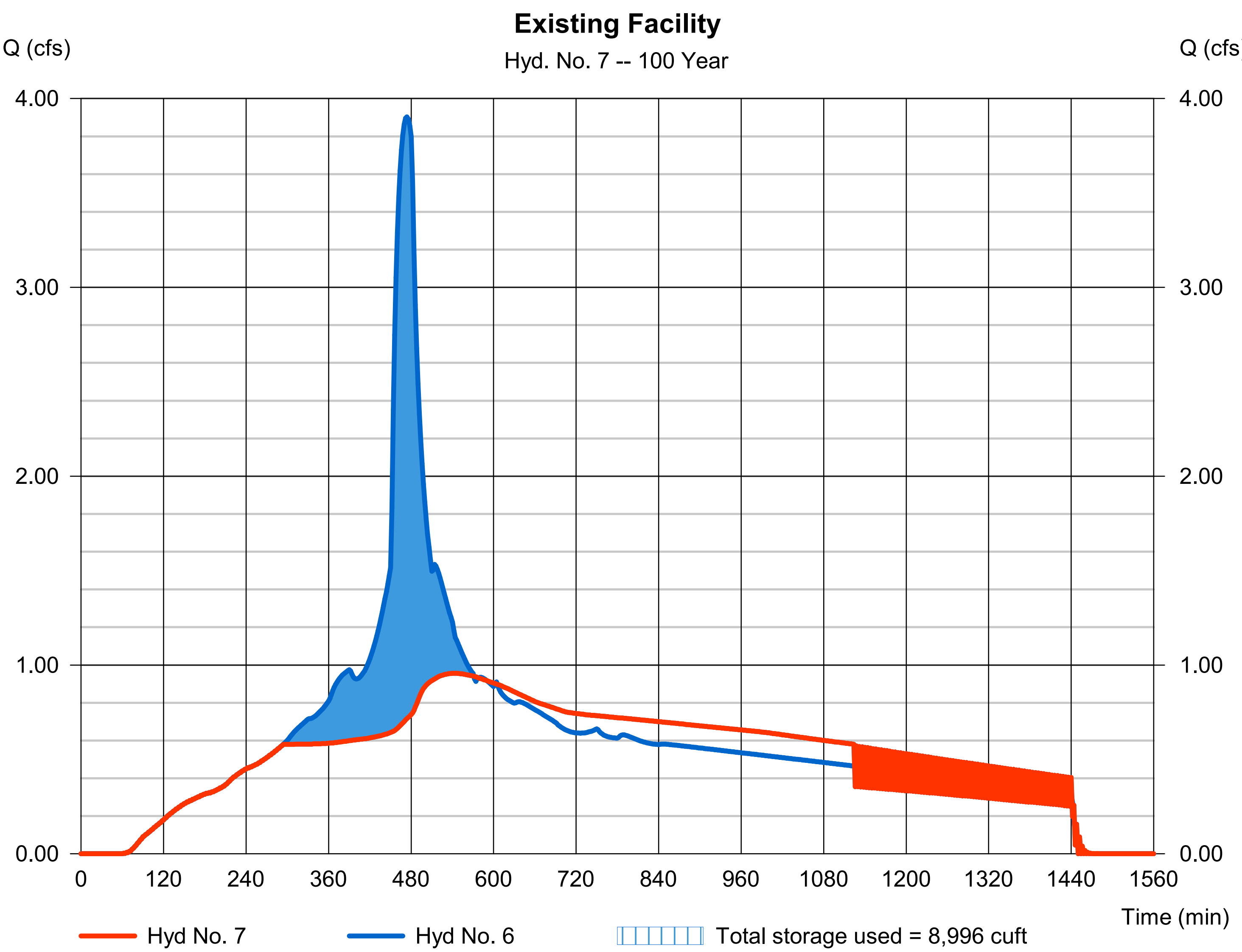
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021 Tuesday, 09 / 12 / 2023

Hyd. No. 7

Existing Facility

Hydrograph type	= Reservoir	Peak discharge	= 0.956 cfs
Storm frequency	= 100 yrs	Time to peak	= 542 min
Time interval	= 2 min	Hyd. volume	= 47,290 cuft
Inflow hyd. No.	= 6 - A+B	Max. Elevation	= 135.34 ft
Reservoir name	= Existing Extended Wet Basin	Max. Storage	= 8,996 cuft

Storage Indication method used. Exfiltration extracted from Outflow.



APPENDIX D

CONVEYANCE CALCULATIONS

PLACEHOLDER

APPENDIX E

OPERATIONS & MAINTENANCE MANUAL

PLACEHOLDER

APPENDIX F

RELEVANT SECTIONS OF GEOTECHNICAL REPORT

between 16 and 30 feet BGS. Interbeds of silt and clay were encountered within the sand unit in the CPTs. The CPTs were terminated in silt and clay at a depth of approximately 50.5 feet BGS. The silt is non-plastic and the clay exhibits low plasticity based on field classifications and laboratory test results. Laboratory testing indicates the moisture content of the silt and clay at the time of our explorations ranged between 19 and 36 percent. Fines content analysis of select silt sample indicates a fines content of 54 percent.

Underlying the topsoil, undocumented fill, or silt and clay is loose to medium dense, silty sand to sand with silt. In general, the sand becomes denser and contains less fines with depth. The sand extends to the depths explored of approximately 6.5 to 36.5 feet BGS in borings B-1 through B-7. Boring B-7 was terminated in sand at a depth of 21.5 feet BGS due to heaving/caving of sand below groundwater at a depth of 17.5 feet BGS. Also, heaving/caving of sand below groundwater was encountered in boring B-1 at a depth of 17 feet BGS. All explorations encountered sand. Laboratory testing of the sand indicates the moisture content ranged between 11 and 36 percent at the time of our explorations. Fines content analysis of select sand samples indicates a fines content of between 17 and 30 percent.

4.2.2 Groundwater

The depth of groundwater measurements at the time of exploration are shown in Table 1.

Table 1. Groundwater Depths Summary

Location	Measurement Date	Groundwater Depth (feet BGS)
B-1	05/10/23	11[1]
B-2	05/10/23	7[1]
B-3	05/10/23	4[1]
B-4	05/10/23	5[1]
B-5	05/10/23	10[1]
B-6	05/11/23	4[1]
B-7	05/11/23	9[1]
CPT-1	05/10/23	8[2]
CPT-2	05/10/23	6[2]

1. Groundwater depths were measured during drilling.
2. Groundwater depths were inferred from pore water pressure dissipation tests in the CPTs.

The depth to groundwater may fluctuate in response to seasonal changes, prolonged rainfall, changes in surface topography, and other factors not observed in this study. Perched groundwater zones are also likely in the upper soil at the site, particularly during extended periods of wet weather.

Seeps may become evident during site grading, primarily along slopes or in areas cut below existing grade. Structures, pavements, and drainage design should be planned accordingly.

4.3 Infiltration Testing

We understand stormwater infiltration systems are proposed for the development. The locations and configurations were preliminary at the time of this report. We conducted an infiltration test in borings B-2, B-5, and B-6 at depths between 2 and 5 feet BGS, as requested by Mackenzie. We note the depths of the tests were adjusted in the field to establish separation from observed groundwater levels. The infiltration testing procedures are described in Appendix A, and the results of the infiltration testing are described in Section 6.6.5, *Infiltration Systems*.

4.4 Corrosivity Testing

We tested two soil samples for corrosivity, which included tests for pH, chloride, sulfate, and resistivity testing. The results of corrosivity testing are presented in Appendix C and summarized in Table 2.

Table 2. Corrosivity Test Results

Boring	Depth (feet BGS)	pH	Chloride (mg/kg)	Sulfate (mg/kg)	Resistivity (ohm-cm)
B-1	2.5	5.40	2.05	37.2	6,300
B-1	5	5.96	0.577	24.5	6,000

FHWA (FHWA NHI-09-087, November 2009) states that soil with a measured resistivity value less than 700 ohm-cm is considered very corrosive. Values ranging between 700 and 2,000 ohm-cm are considered corrosive. Values ranging between 2,000 and 5,000 ohm-cm are considered moderately corrosive. Values ranging between 5,000 and 10,000 ohm-cm are considered mildly corrosive. Values above 10,000 ohm-cm indicate non-corrosive. pH values below 5 or above 10 are considered corrosive. Based on the resistivity results, the selected soil samples tested are considered mildly corrosive.

Our review of the American Concrete Institution publications indicates that the dissolved sulfate (SO_4) in water in parts per million of less than 150 classifies the severity as “Not Applicable” and an Exposure Class “S0.”

These tests indicate corrosivity only for the samples tested. Imported fill material should be tested to confirm that its corrosion potential is within acceptable limits. Interpretation of these corrosion results and corresponding construction recommendations should be provided by a corrosion specialist.

5.0 SEISMIC HAZARDS

5.1 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 silty sand and silt may be moderately susceptible to liquefaction under relatively higher levels of ground shaking. Liquefaction can cause seismically induced densification of subsurface soil, which can result drains should be constructed with a minimum slope of ½ percent. The drainpipe's invert elevation should be at least 18 inches below the elevation of the floor slab. Figure 4 presents a typical foundation drain detail.

6.6.2 Subdrains

Subdrains should be considered if portions of the site are cut below surrounding grades. Shallow groundwater or seeps should be conveyed via drainage channel or perforated pipe into an approved discharge. Recommendations for design and installation of perforated drainage pipe may be performed on a case-by-case basis by Columbia West during construction. Failure to provide adequate surface and sub-surface drainage may result in soil slumping or unanticipated settlement of structures exceeding tolerable limits. A typical perforated drainpipe trench detail is presented in Figure 5.

6.6.3 Drainage Mat

Site improvements construction in some areas may occur at or near the shallow groundwater table, particularly if work is conducted during wet-weather conditions. Dewatering may be necessary, and a drainage mat may be required to achieve sufficient elevation for fill placement. A typical drainage mat is shown on Figure 6. Columbia West should determine drainage mat location, extent, and thickness when subsurface conditions are exposed. Drainage mats may need to be constructed in conjunction with subdrains to convey captured water to an approved discharge location.

6.6.4 Under Slab Drainage

In addition to the recommendations for foundation drains, under slab drains may be necessary in all areas where the finished floor grade will be at or below existing grades. Floor slabs established at or below existing grades may encounter shallow groundwater conditions. Depending on the depth of the cut and depth to groundwater, a series of under slab drainage pipes may need to be installed. Figure 7 shows a typical under slab drainage detail.

6.6.5 Infiltration Systems

We understand stormwater infiltration systems are being considered for the proposed development. The locations and configurations were conceptual at the time of this report. The infiltration tests were performed to evaluate the infiltration potential for the proposed infiltration systems. The results of our field infiltration testing are presented in Table 9.

Table 9. Infiltration Testing Summary

Location	Depth (feet BGS)	Observed Infiltration Rate[1] (inches per hour)	Fines Content[2] (percent)	Soil Type at Test Depth
B-2	2.5	0.3[3]	46	Silty sand - Fill
B-5	2	5	18	Silty sand
B-5	5	5	30	Silty sand
B-6	2	3	54	Sandy silt

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

3. Infiltration test was conducted in silty sand fill, therefore this test should be ignored for design

The infiltration rates shown in Table 9 are short-term field rates and factors of safety have not been applied.

We recommend all infiltration systems be installed in the native silty sand and sandy silt (below fill) and be at least 2 feet deep. Also, we recommend a minimum separation of 5 feet between the bottom of the infiltration systems and the groundwater encountered as shallow as 4 feet BGS (see Table 1). The infiltration test in Boring B-2 was conducted in silty sand fill at a depth of 2.5 feet BGS, therefore this test should be ignored for design. We recommend the following unfactored field infiltration rates:

- For infiltration systems in the native silty sand, we recommend an unfactored field infiltration rate of 5 inches per hour.
- For infiltration systems in the native sandy silt, we recommend an unfactored field infiltration rate of 3 inches per hour.

We note that the variability in the observed infiltration rates is due to variability in fines content as presented in Table 9.

The recommended infiltration rates are measured rates and are unfactored. Correction factors should be applied to the recommended infiltration rates by the civil engineer during design to account for the degree of long-term maintenance and influent/pre-treatment control, as well as the potential for long-term clogging due to siltation and buildup of organic material, depending on the proposed length, location, and type of infiltration facility. We recommend a minimum factor of safety of at least 2 be applied to the recommended unfactored rates.

The actual depths and estimated infiltration rates can vary significantly from the values presented above. We recommend that the design infiltration values for the stormwater systems be confirmed by field testing completed during installation of the systems. The results of this field testing might necessitate that the stormwater system be enlarged to achieve the design infiltration rate.

7.0 CONSTRUCTION RECOMMENDATIONS

7.1 Site Preparation and Grading

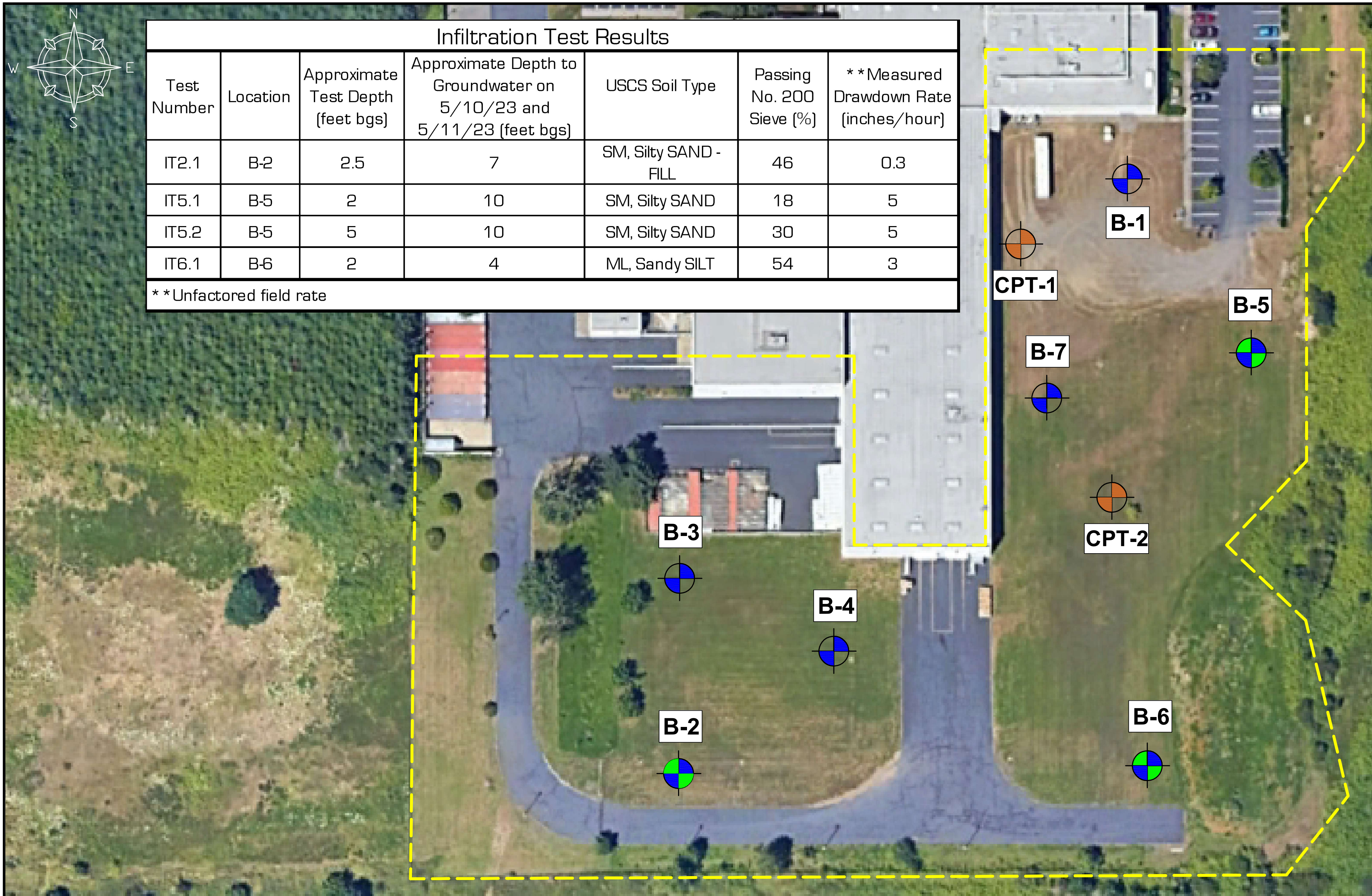
As discussed previously, the site is primarily covered with agricultural soil. The root zone for grass crops, when established, will likely extend 4 to 6 inches below existing grade. Outside of tilled areas, root zones approaching 12 inches may be present in areas of thick vegetation, trees, and shrubs. Vegetation, organic material, unsuitable fill, and deleterious material that may be encountered should be cleared from areas identified for structures and site grading. Vegetation, root zones, organic material, and debris should be removed from the site. Stripped topsoil should also be removed, or used only as landscape fill in nonstructural areas with slopes less than 25 percent. The post-construction maximum depth of landscape fill placed or spread at any location onsite should not exceed one foot.

The required stripping depth may increase in areas of existing fill, existing berms, disturbed soil, or thick vegetation. Actual stripping depths should be determined based upon visual observations made during construction when soil conditions are exposed.

Infiltration Test Results

Test Number	Location	Approximate Test Depth (feet bgs)	Approximate Depth to Groundwater on 5/10/23 and 5/11/23 (feet bgs)	USCS Soil Type	Passing No. 200 Sieve (%)	**Measured Drawdown Rate (inches/hour)
IT2.1	B-2	2.5	7	SM, Silty SAND - FILL	46	0.3
IT5.1	B-5	2	10	SM, Silty SAND	18	5
IT5.2	B-5	5	10	SM, Silty SAND	30	5
IT6.1	B-6	2	4	ML, Sandy SILT	54	3

**Unfactored field rate



APPROXIMATE LOCATION OF BORING

APPROXIMATE LOCATION OF BORING WITH INFILTRATION TEST

APPROXIMATE LOCATION OF CONE PENETRATION TEST

APPROXIMATE STUDY AREA

Geotechnical ▪ Environmental ▪ Special Inspections
Columbia West Engineering, Inc

Job No: 23145
Date: 05/23/23
Drawn: EMU
Checked: NAK

EXPLORATION LOCATION MAP
11200 SW LEVETON DRIVE

NOTES:
1. SITE LOCATION: 11200 SW LEVETON DRIVE, TUALATIN, OREGON.
2. SITE CONSISTS OF TAX PARCEL 2S1220000400 TOTALING APPROXIMATELY 13.0 ACRES.
3. AERIAL PHOTO SOURCED FROM GOOGLE EARTH.
4. EXPLORATION LOCATIONS ARE APPROXIMATE AND NOT SURVEYED.
5. BORINGS BACKFILLED WITH BENTONITE ON MAY 10 AND 11, 2023.
6. CONE PENETRATION TEST BACKFILLED WITH BENTONITE ON MAY 10, 2023.

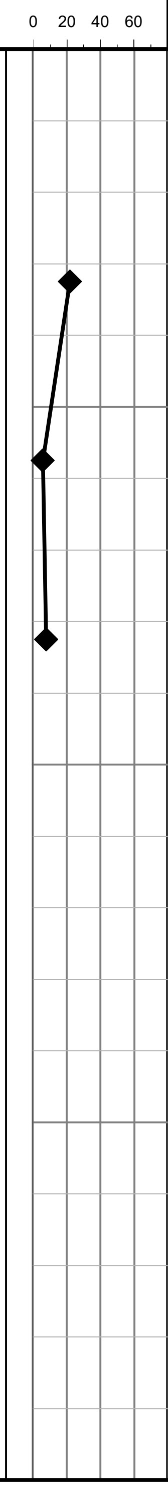
FIGURE 2

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

SOIL BORING LOG

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Fujimi Expansion	Fujimi Corporation		23145	B-2
PROJECT LOCATION Tualatin, Oregon	DRILLING CONTRACTOR Dan Fischer Exc	DRILL RIG Trailer Rig	ENGINEER EMU	PAGE NO. 1 of 1
BORING LOCATION See Figure 2	DRILLING METHOD Solid Stem Auger	SAMPLING METHOD SPT	START DATE 5/10/2023	START TIME 1055
REMARKS None		GROUNDWATER DEPTH 7 feet BGS	FINISH DATE 5/10/2023	FINISH TIME 1122



Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Drawdown Rate (in/hr)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0						12-inches of topsoil (6-inch root zone)					
1						FILL. Silty SAND with trace gravel, brown and black, moist, medium dense, silt is nonplastic, fine- to coarse-textured sand. Infiltration test performed at 2.5 feet.					
2.5–4	SPT B2.1	22						18	46		
5–6.5	SPT B2.2	6	SM			Silty SAND, brown, gray, and black, moist, loose, silt is nonplastic, fine- to coarse-textured sand.					
7			▼			Becomes wet at 7 feet. Becomes brown and gray at 7.5 feet.					
7.5–9	SPT B2.3	8						29			
9						Soil boring completed at 9 feet BGS. Groundwater encountered at 7 feet BGS on 5/10/23.					

Depth scale: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West Engineering, Inc

SOIL BORING LOG

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Fujimi Expansion	Fujimi Corporation		23145	B-5
PROJECT LOCATION: Tualatin, Oregon	DRILLING CONTRACTOR: Dan Fischer Exc	DRILL RIG: Trailer Rig	ENGINEER: EMU	PAGE NO.: 1 of 1
BORING LOCATION: See Figure 2	DRILLING METHOD: Solid Stem Auger	SAMPLING METHOD: SPT	START DATE: 5/10/2023	START TIME: 1215
REMARKS: None		GROUNDWATER DEPTH: 10 feet BGS	FINISH DATE: 5/10/2023	FINISH TIME: 1415

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Drawdown Rate (in/hr)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0						12-inches of topsoil (4-inch root zone)					
1			SM			Silty SAND, brown, moist, medium dense, silt is nonplastic, fine- to coarse-textured sand.					
2–3.5	SPT B5.1	12				Infiltration test performed at 2 feet.		11	18		
5–6.5	SPT B5.2	6				Becomes loose at 5 feet. Infiltration test performed at 5 feet.		16	30		
7.5–9	SPT B5.3	9									
10–11.5	SPT B5.4	8	▼			Becomes wet at 10 feet.		25			
15–16.5	SPT B5.5	12				Becomes medium dense at 15 feet.					
16.5						Soil boring completed at 16.5 feet BGS. Groundwater encountered at 10 feet BGS on 5/10/23.					
20											

11917 NE 95TH Street, Vancouver, Washington 98682
Phone: 360-823-2900
www.columbiawestengineering.com

Geotechnical ■ Environmental ■ Special Inspections
Columbia West
Engineering, Inc

SOIL BORING LOG

PROJECT NAME	CLIENT		PROJECT NO.	BORING NO.
Fujimi Expansion	Fujimi Corporation		23145	B-6
PROJECT LOCATION	**DRILLING CONTRACTOR**	**DRILL RIG**	**ENGINEER**	**PAGE NO.**
Tualatin, Oregon	Dan Fischer Exc	Trailer Rig	EMU	1 of 1
BORING LOCATION	**DRILLING METHOD**	**SAMPLING METHOD**	**START DATE**	**START TIME**
See Figure 2	Solid Stem Auger	SPT	5/11/2023	0755
REMARKS		**GROUNDWATER DEPTH**	**FINISH DATE**	**FINISH TIME**
None		4 feet BGS	5/11/2023	1115

Depth (ft)	Field ID + Sample Type	SPT N-value (uncorrected)	USCS Soil Type	AASHTO Soil Type	Graphic Log	LITHOLOGIC DESCRIPTION AND REMARKS	Drawdown Rate (in/hr)	Moisture Content (%)	Passing No. 200 Sieve (%)	Liquid Limit	Plasticity Index
0	Grab					8-inches of topsoil (4-inch root zone)					
	B6.1		ML			Sandy SILT, brown, moist, soft, silt is nonplastic, fine-textured sand.					
2	SPT					Infiltration test performed at 2 feet.					
		3						22	54		
	B6.2										
4			▼			Becomes wet at 4 feet.					
	SPT		SM			Silty SAND, brown, wet, loose, silt is nonplastic, fine- to coarse-textured sand.					
6		6						31			
	B6.3										
	SPT										
8		5									
	B6.4										
10						Soil boring completed at 9 feet BGS. Groundwater encountered at 4 feet BGS on 5/11/23.					
12											
14											
16											
18											
20											

SPT N-value scale: 0 20 40 60