

Drainage Report

For

Tomball ISD Transportation Facility Parking

Prepared for:



Location:

Tomball, Texas

Prepared By:



ARCHITECTURE · ENGINEERING · INTERIORS
LANDSCAPE · SURVEYING

LUFKIN · BRYAN · TYLER · WACO · GROESBECK

April 2026

GLS Job No. 364003
TBPELS Firm Registration #413

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Michael Holmes

4/2/2026

I. Introduction

This drainage report summarizes the findings and recommended improvements for the detention facilities in order to accommodate the proposed additions to the Tomball ISD Transportation Facility parking lot. Included are the calculations for the proposed detention basin that will replace the existing detention basins that are on site in addition to the additional detention volume required by the proposed additions. The detention basin and outlet were designed based on the City of Tomball Drainage Design Manual. Drainage calculations were performed using Rational Method to ensure that the fully-developed flow is equal to or less than the pre-developed flow for the 2-year, 5-year, 10-year, 25-year, 50-year, & 100-year storm events. The required detention volume calculations were performed using a rate of 0.75 Ac-ft./Ac for proposed impervious cover being added to the site. The rainfall intensity is based on Table 4 – Rational Method Intensity coefficients from the City of Tomball Minimum Standards for Stormwater Design. The precipitation frequency is based on the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14, Vol. 11, Ver. 2.0.

II. Site Location & Project Information

The site is located at 1055 Baker Drive in the City of Tomball, within Harris County, Texas.

The scope of this study was to determine the required volume needed to be detained for the proposed improvements of the site that primarily includes increased parking facilities. This study area includes two existing detention basins from earlier stages of development on the site.

The project proposes combining the two existing detention basins with the additional required detention volume needed for the new development on the site. This single proposed detention basin will then flow off the site near the southeast corner of the property and into the existing drainage system along Baker Drive.

III. Pre-Developed Flow Conditions

The site is currently partially developed as a bus transportation facility and parking area with two existing detention facilities. The proposed project plans to combine the current detention facilities with the additional required detention. Therefore, the pre-developed site runoff was used to determine the total volume required to be detained for the existing improvements already on the site, as well as the proposed improvements. In order to determine the pre-developed flow, we used data obtained from the Texas Geographic Information Office (TxGIO) along with google earth imagery from before 1988 when the first improvements were constructed on the site. These sources indicate that the pre-developed site was heavily wooded before construction in 1988. Using the pre-developed flow compared to the total proposed site flow, will give us the most accurate model for combining the detention facilities on the site.

The pre-developed flow was calculated to the point where the downstream most existing detention basin outfalls, near the southeastern property corner. The pre-developed flow at this location will be our study point to ensure that the proposed improvements do not increase flows downstream from our site.

The pre-developed area for Drainage Area No. 1 consists of 32.72 acres of undeveloped wooded property. Reference **Exhibit 1** for Pre-developed Drainage Area Map. Drainage Area No. 1 drains offsite near the southeastern property corner into a drainage channel.

Pre-Developed Conditions - Drainage Area No. 1 (Reference Exhibit 1)

- The drainage area is 32.72 acres
- The runoff coefficient of 0.3 was used for undeveloped wooded area
- The time of concentration is 74.5 minutes using the TR55 method
 - Sheet Flow (55.43 min)
 - Mannings N Value = 0.4
 - Flow Length = 300 ft
 - 2-year 24-hr rain = 4.85 in
 - Land Slope = 1.0%
 - Shallow Concentrated Flow (19.04 min)
 - Flow Length = 1,428'
 - Slope = 0.6%
 - Unpaved

Table 1: Pre-Developed Conditions – Drainage Area No. 1	
Storm Event	Flows (CFS)
2 Year	18.20
5 Year	22.61
10 Year	26.50
25 Year	31.89
50 Year	36.20
100 Year	40.87

IV. Proposed Flow Conditions

The proposed flow conditions were calculated to the same study point location where the existing flow condition was calculated. However, the proposed flow will be split into two separate flows going to this same location. Proposed Drainage Area No. 1 will be the improved areas on the site that will be routed through the proposed detention basin before being discharged and flowing to this study point. Drainage Area No. 2 will be the areas that do not drain into the detention basin, but by-pass the detention basin and flow directly to the study point. The combined flow from Drainage Area No. 1 and Drainage Area No. 2 at the study point will indicate that the flows leaving our site are less than or equal to the pre-developed flow rates for all storm events up to and including the 100-year storm event.

The proposed area for Drainage Area No. 1 consists 22.28 acres of impervious acres that will be routed to the proposed detention basin. Reference **Exhibit 2** for the Drainage Area Map – Proposed Conditions.

Proposed Conditions - Drainage Area No. 1 (Reference Exhibit 2)

- The drainage area is 22.28 acres
- The runoff coefficient used was 0.9 for impervious cover
- The time of concentration is 34.1 minutes using the TR55 method
 - Sheet Flow (20.76 min)
 - Mannings N Value = 0.4
 - Flow Length = 137 ft
 - 2-year 24-hr rain = 4.85 in
 - Land Slope = 2.43%
 - Shallow Concentrated Flow (13.38 min)
 - Flow Length = 1,154'
 - Slope = 0.5%
 - Paved

Table 2: Proposed Conditions – Drainage Area No. 1 – (To Pond)	
Storm Event	Flows (CFS)
2 Year	60.22
5 Year	73.95
10 Year	85.81
25 Year	101.64
50 Year	113.89
100 Year	126.80

The proposed area for Drainage Area No. 2 consists of 10.44 acres of undeveloped wooded area. Reference **Exhibit 2** for the Drainage Area Map – Proposed Conditions.

Proposed Conditions – Drainage Area No. 2 (Reference Exhibit 2)

- The drainage area is 10.44 acres
- The runoff coefficient used was 0.3 for undeveloped wooded area.
- The time of concentration is 70.1 min using the TR-55 method.
 - Sheet Flow (58.87 min)
 - Mannings N Value = 0.40
 - Flow Length = 300 ft
 - 2-year 24-hr rain = 4.85 in
 - Land Slope = 0.86%
 - Shallow Concentrated Flow (11.26 min)
 - Flow Length = 879'
 - Slope = 0.65%
 - Unpaved

Table 3: Proposed Conditions – Drainage Area No. 2 – (By-Pass)	
Storm Event	Flows (CFS)
2 Year	6.022
5 Year	7.472
10 Year	8.750
25 Year	10.52
50 Year	11.92
100 Year	13.45

V. Detention Basin

The site currently has two existing detention basins that are providing detention on this site. One basin was constructed during each previous phase of construction to detain the increase for that phase only. With the proposed improvements, we are proposing to combine the detention into one single basin for all of the existing improvements and the proposed improvements. We went back before the site was developed to get a pre-developed flow rate, and are using the pre-developed flow to ensure that we are releasing flows at less than or equal to the pre-developed flow rates.

The following requirements from the City of Tomball’s Minimum Standards for Stormwater Drainage Design were following:

- Detention facility shall enhance stormwater quality and reduce peak flows
- Tracts greater than 5 acres but less than 200 acres must provide 0.75 acre feet of detention volume per every one acre of impervious cover added to the site.
- Side slopes shall not exceed a 4 feet horizontal to 1 foot vertical (4:1) maximum slope.

- Ponds with lengths over 50 feet shall have a pilot channel.
- Lined (concrete) pilot channels shall have a minimum width of 6 feet, and minimum depth of 6 inches, with a minimum longitudinal slope of 0.002 feet per foot.
- The bottom slopes of the detention basin should be graded toward the pilot channel or outfall with a minimum slope of 1.0% minimum, 2.0% preferred.
- Ponds with a depth between 2 feet and 5 feet deep, shall have a 15 foot wide maintenance berm around the top of the basin.
- An emergency spillway shall be designed to flow storm events larger than the 100-year storm event. The emergency spillway should also be sized to pass the 100-year developed flow assuming that the primary outflow is obstructed. The spillway should be directed toward the public right of way or drainage easement.
- The basin shall have 1 foot of freeboard between the top of bank and the 100-year water surface elevation.

In addition to the above requirements, the detention basin will be an earthen basin, and shall be hydro-mulched seeded to establish vegetation to prevent erosion. A single 12" HDPE outfall pipe has been sized to flow the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year storm events at less than or equal to per-developed flow rates. Rock rip rap shall be installed on the outside of the basin berm at the emergency spillway to help prevent erosion. The spillway shall be constructed so that it flows toward the southeastern property corner, where all of the existing flow currently leaves the site, to flow toward Baker Drive. Reference **Exhibit 2** for the Drainage Area Map – Proposed Conditions.

Detention Basin Information (Reference Exhibit 2)

- The 100-year storm volume into the basin is 258,675 CF
- The basin detains 242,331 CF in the 100-year storm event
- The available storage in the basin is 776,478 CF
- The required storage for the basin is 727,921 CF (0.75 AF/AC)
- The top of basin elevation is 196.00
- The 100-year water surface elevation is 192.71
- The bottom of pond elevation (FL Out) is 189.25
- The outlet is 64 LF of 12" HDPE pipe flowing at 0.25% with an upstream flowline of 189.25
- The emergency spillway is 23 feet wide with a flowline elevation of 195.50, flowing 27.08 CFS when the W.S.E. reaches 196.00 the top of basin.

Table 4: Proposed Basin Routing – Drainage Area No. 1			
Storm Event	Flows (CFS)	W.S.E.	Detained Volume (CF)
2 Year	4.539	191.74	110,334
5 Year	4.887	192.01	137,311
10 Year	5.084	192.17	160,778
25 Year	5.336	192.38	192,211
50 Year	5.524	192.54	216,595
100 Year	5.716	192.71	242,331

VI. Detention Basin Summary

Table 5 illustrates that when the site is fully developed and the proposed recommendations are implemented that the flows off-site will be reduced in all storm events up to and including the 100-year storm event. Reference **Exhibit 3** for the Hydraflow Hydrograph Modeling results.

TABLE 5: ANALYSIS DETENTION POND - ROUTING

STORM EVENT	PRE-DEVELOPED FLOW- E1 (CFS)	POST DEVELOPED BYPASS FLOW (CFS)	POST DEVELOPED POND FLOW IN (CFS)	POST DEVELOPED POND FLOW OUT (CFS)	COMBINED POST DEVELOPED FLOW (BYPASS + POND OUTFLOW) (CFS)	DELTA (CFS)	VOLUME INTO BASIN (CUFT)	VOLUME DETAINED IN BASIN (CUFT)	WATER SURFACE ELEVATION (W.S.E.)
2 YR	18.20	6.022	60.22	4.539	10.55	-7.65	122,850	110,334	191.74
5 YR	22.61	7.472	73.95	4.887	12.35	-10.26	150,852	137,311	192.01
10 YR	26.50	8.750	85.81	5.084	13.83	-12.67	175,060	160,778	192.17
25 YR	31.89	10.52	101.64	5.336	15.84	-16.05	207,348	192,211	192.38
50 YR	36.20	11.92	113.89	5.524	17.44	-18.76	232,340	216,595	192.54
100 YR	40.87	13.45	126.80	5.716	19.16	-21.71	258,675	242,331	192.71

The proposed detention basin and outlet structure mitigate the increased runoff and allow full development of the site that drains to this newly configured combined pond.

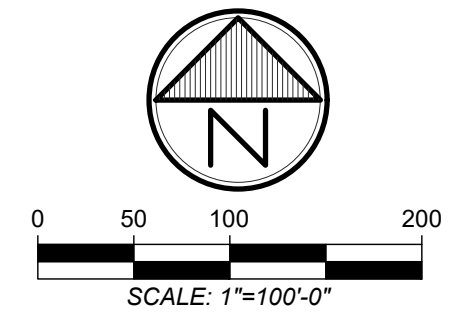
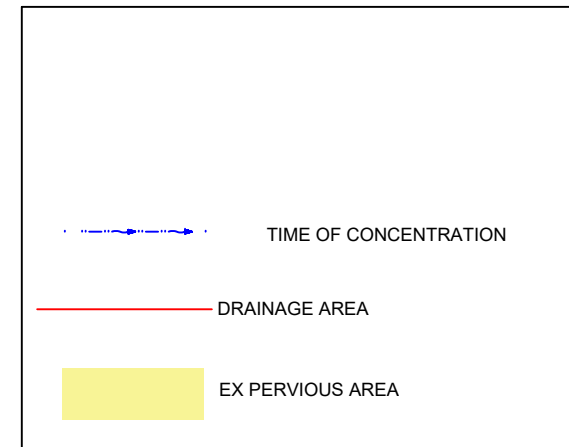
VII. Storm Sewer System

The existing improvements on the site currently drain to their respective basins via storm sewer systems. These existing systems will discharge directly into the proposed combined detention basin. There are minimum proposed changes to the existing storm sewer systems. One location we are swapping an existing grate inlet out for a curb inlet, and at another location we are replacing the pipe due to a slope issue. Other than those locations, there are no other proposed changes to the existing storm sewer systems.

The proposed improvements on the site will also drain to the proposed detention basin via proposed storm sewer systems. A series of low points and grate inlets in the proposed parking area will allow the runoff to enter the storm sewer system. The storm sewer system will convey the runoff to the detention basin, where it will be detained. These proposed storm sewer systems were modeled using the rational method for the 25-year storm event to ensure the system was adequately sized. The 100-year storm was also checked, to ensure that the storm water does not excessively back up on-site or run off-site to create any issues. Reference **Exhibit 4** for the Storm Sewer Models.

EXHIBIT 1
Drainage Area Map
Pre-Developed Conditions

DRAINAGE AREA NO. 1
 Rational Method Coefficient Values
 Existing Conditions to Pond C = 0.3
 Pervious Area = 32.72 ac (C = 0.3)
 Q=C x A x I



REVISIONS	DATE	BY	ISSUED
1		AJR	10/24/25
2		JIR	
3			
4			

Table 4 - Rational Method Intensity Coefficients

Coefficient	Region 1						
	50 % AEP 2-Year	20 % AEP 5-Year	10 % AEP 10-Year	4 % AEP 25-Year	2 % AEP 50-Year	1 % AEP 100-Year	0.2 % AEP 500-Year
e	0.7372	0.7058	0.6819	0.6446	0.6170	0.5870	0.5111
b (in.)	48.27	51.76	54.26	54.97	54.84	53.93	50.89
d (min.)	9.30	8.19	7.44	6.27	5.45	4.53	2.69

Precipitation Depth Parameters (Inches)

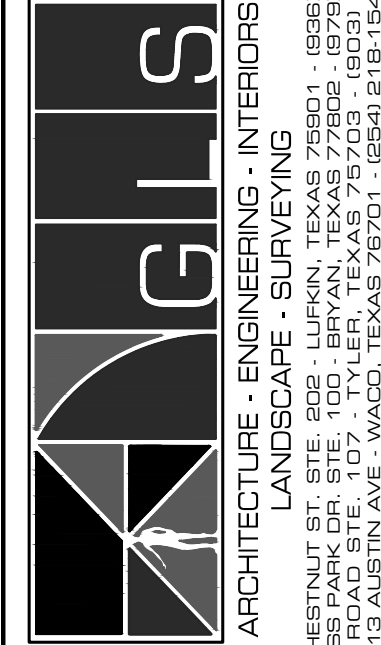
	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
6-HR	3.59	4.72	5.84	7.58	9.13	11.00
24-HR	4.85	6.53	8.26	11.00	13.6	16.5

DATA IS BASED ON NOAA ATLAS 14, VOLUME 11, VERSION 2 FOR TOMBALL, TEXAS
 LATITUDE:30.1067°, LONGITUDE:-95.6275°



DRAINAGE AREA NO. 1:
 Drainage Area = 32.72 Ac.
 Slope = 0.7%
 C & I = SEE TABLES ABOVE
 T.O.C Length = 1728'
 Tc = 74.5 Min.
 2yr Q = 18.20 cfs
 5yr Q = 22.61 cfs
 10yr Q = 26.50 cfs
 25yr Q = 31.89 cfs
 50yr Q = 36.20 cfs
 100yr Q = 40.87 cfs

FOR EXISTING CONDITIONS, THE DRAINAGE AREA WAS CONSIDERED 100% UNDEVELOPED(WOODED AREA) TO CALCULATE PRE-DEVELOPMENT FLOW CONDITIONS. BEFORE ANY DEVELOPMENTS TO THIS SITE. DETENTION BEING PROVIDED WILL ACCOUNT FOR ALL CURRENT EXISTING IMPROVEMENTS AND PROPOSED IMPROVEMENTS. THEREFORE, WE ARE TREATING THE MODEL AS A PRE-DEVELOPED TO POST DEVELOPED CONDITION. IMAGERY FROM THIS PREDEVELOPMENT(1988) TIME PERIOD WAS NOT AVAILABLE. IMAGERY SHOWN IS OBTAINED FROM 2026.



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Transportation Facility Improvements
 Tomball I.S.D.
 Tomball, Texas
DRAINAGE AREA MAP - EXISTING CONDITIONS

JOB NUMBER
364003
 SHEET NO.

1

EXHIBIT 2
Drainage Area Map
Proposed Conditions

Table 4 - Rational Method Intensity Coefficients

Coefficient	50 % AEP		20 % AEP		10 % AEP		4 % AEP		2 % AEP		1 % AEP		0.2 % AEP	
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year	Region 1						
e	0.7372	0.7058	0.6819	0.6446	0.6170	0.5870	0.5111							
b (in.)	48.27	51.78	54.26	54.97	54.84	53.93	50.89							
d (min.)	9.30	8.19	7.44	6.27	5.45	4.53	2.66							

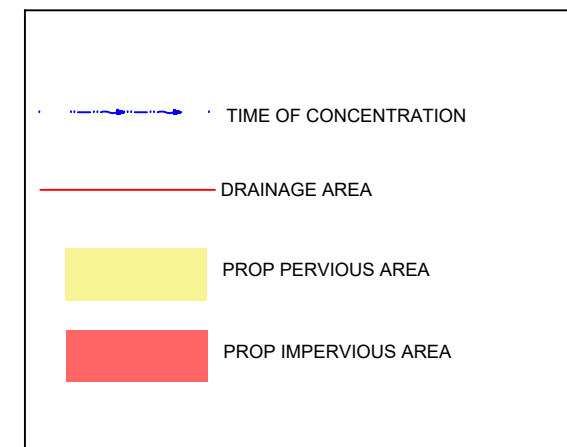


TABLE 5: ANALYSIS DETENTION POND - ROUTING

STORM EVENT	PRE-DEVELOPED FLOW-E1 (CFS)	POST DEVELOPED BYPASS FLOW (CFS)	POST DEVELOPED POND FLOW IN (CFS)	POST DEVELOPED POND FLOW OUT (CFS)	COMBINED POST DEVELOPED FLOW (BYPASS + POND OUTFLOW) (CFS)	DELTA (CFS)	VOLUME INTO BASIN (CUFT)	VOLUME DETAINED IN BASIN (CUFT)	WATER SURFACE ELEVATION (W.S.E.)
2 YR	18.20	6.022	60.22	4.539	10.55	-7.65	122,850	110,334	191.74
5 YR	22.61	7.472	73.95	4.887	12.35	-10.26	150,852	137,311	192.01
10 YR	26.50	8.750	85.81	5.084	13.83	-12.67	175,060	160,778	192.17
25 YR	31.89	10.52	101.64	5.336	15.84	-16.05	207,348	192,211	192.38
50 YR	36.20	11.92	113.89	5.524	17.44	-18.76	232,340	216,595	192.54
100 YR	40.87	13.45	126.80	5.716	19.16	-21.71	258,675	242,331	192.71

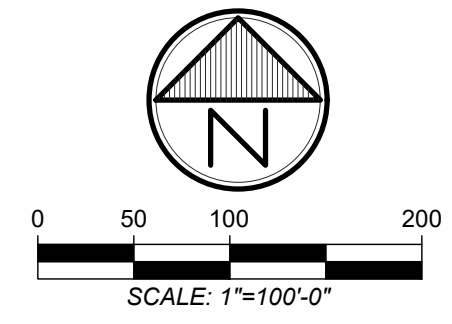
DETENTION BASIN STAGE-STORAGE

STAGE	ELEVATION	CONTOUR AREA (SQFT)	INCREMENTAL STORAGE (CUFT)	TOTAL STORAGE (CUFT)
0	189.25	0	0	0
0.75	190.00	7,032	2,637	2,637
1.75	191.00	57,552	32,292	34,929
2.75	192.00	144,900	101,226	136,156
3.75	193.00	152,449	148,675	284,830
4.75	194.00	160,008	156,229	441,059
5.75	195.00	167,687	163,848	604,907
6.75	196.00	175,457	171,572	776,478

REQUIRED DETENTION VOLUME CALCULATION

22.28 ACRES IMPERVIOUS COVER
 x 0.75 AC-FT / ACRE
 16.71 AC

16.71 AC
 x 43,560.00 CF/AC
 727,887.60 CF STORAGE REQUIRED



Precipitation Depth Parameters (Inches)

	2-YR	5-YR	10-YR	25-YR	50-YR	100-YR
6-HR	3.59	4.72	5.84	7.58	9.13	11.00
24-HR	4.85	6.53	8.26	11.00	13.6	16.5

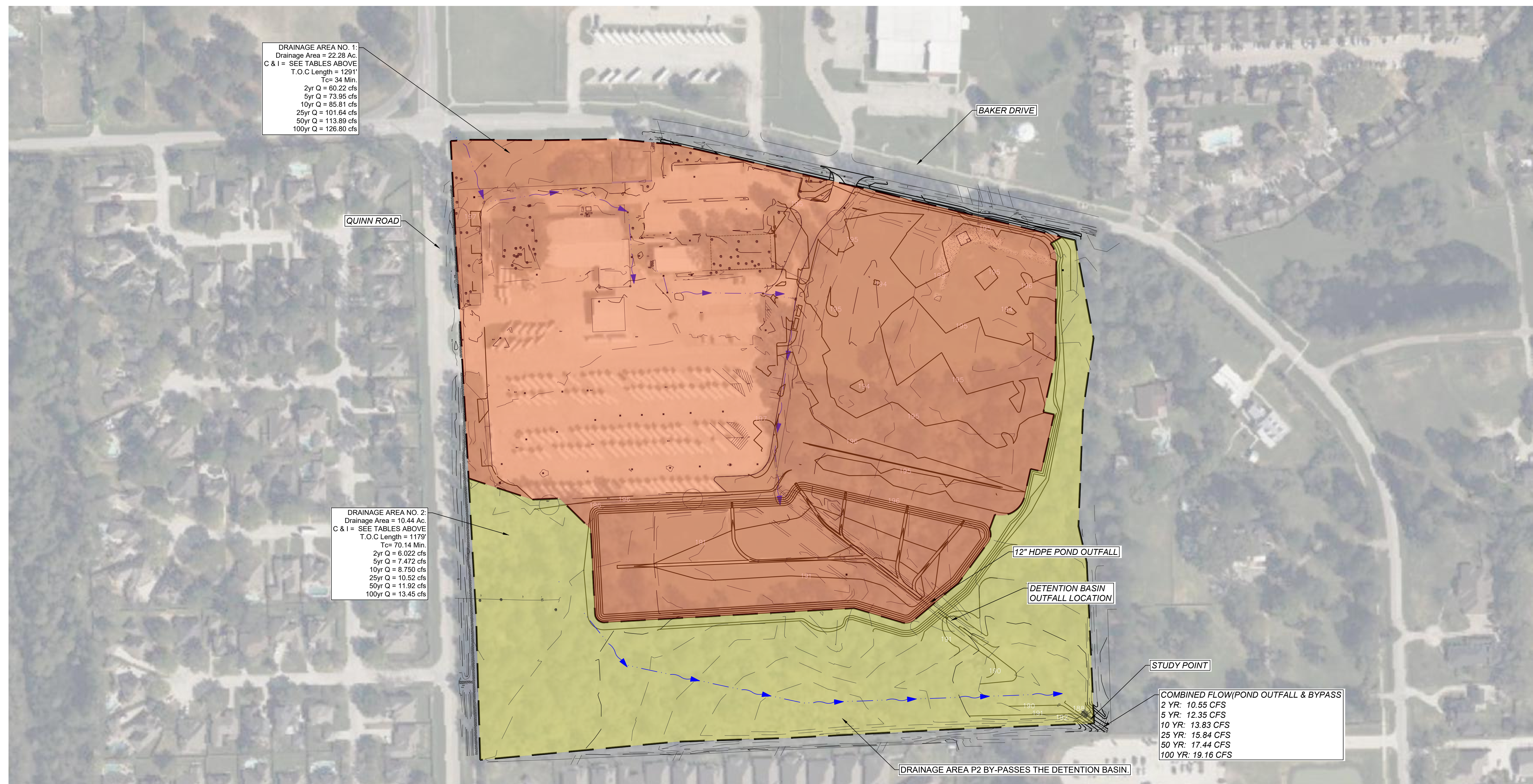
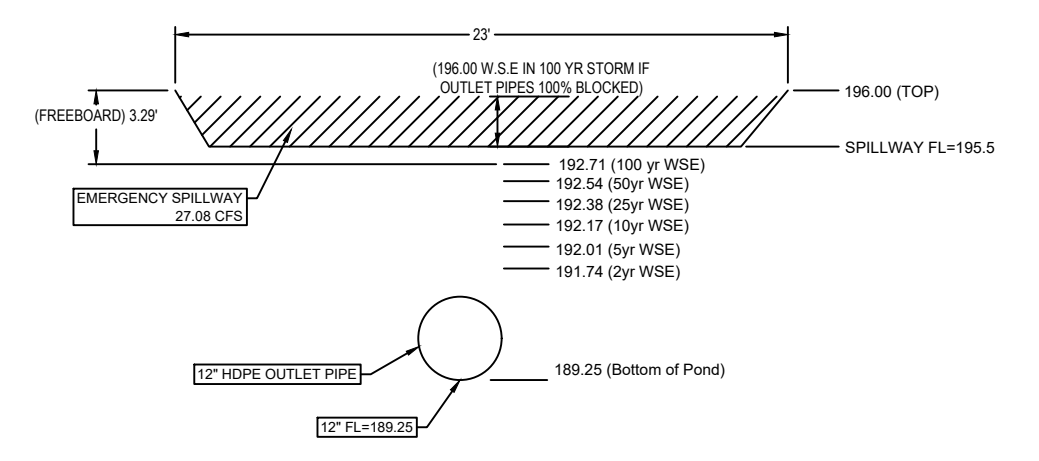
DATA IS BASED ON NOAA ATLAS 14, VOLUME 11, VERSION 2 FOR TOMBALL, TEXAS
 LATITUDE:30.1067°, LONGITUDE:-95.6275°

DRAINAGE AREA: NO. 1

Rational Method Coefficient Values
 Proposed Conditions to Pond = 0.90
 Impervious Area = 22.28 ac (C = 0.90)
 Q=C x A x I

DRAINAGE AREA: NO. 2

Rational Method Coefficient Values
 Proposed Conditions = 0.3
 Pervious Area = 10.44 ac (C = 0.3)
 Q=C x A x I



REVISIONS

NO.	DATE	DESCRIPTION
1		
2		
3		
4		

DRAWN BY: AJR, APP'D BY: JIR, ISSUED: 10/24/25

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 T.B.P.E.L.B. FIRM NO. 15115000

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Transportation Facility Improvements
 Tomball I.S.D.
 Tomball, Texas
 DRAINAGE AREA MAP- PROPOSED CONDITIONS

JOB NUMBER: 364003
 SHEET NO.:

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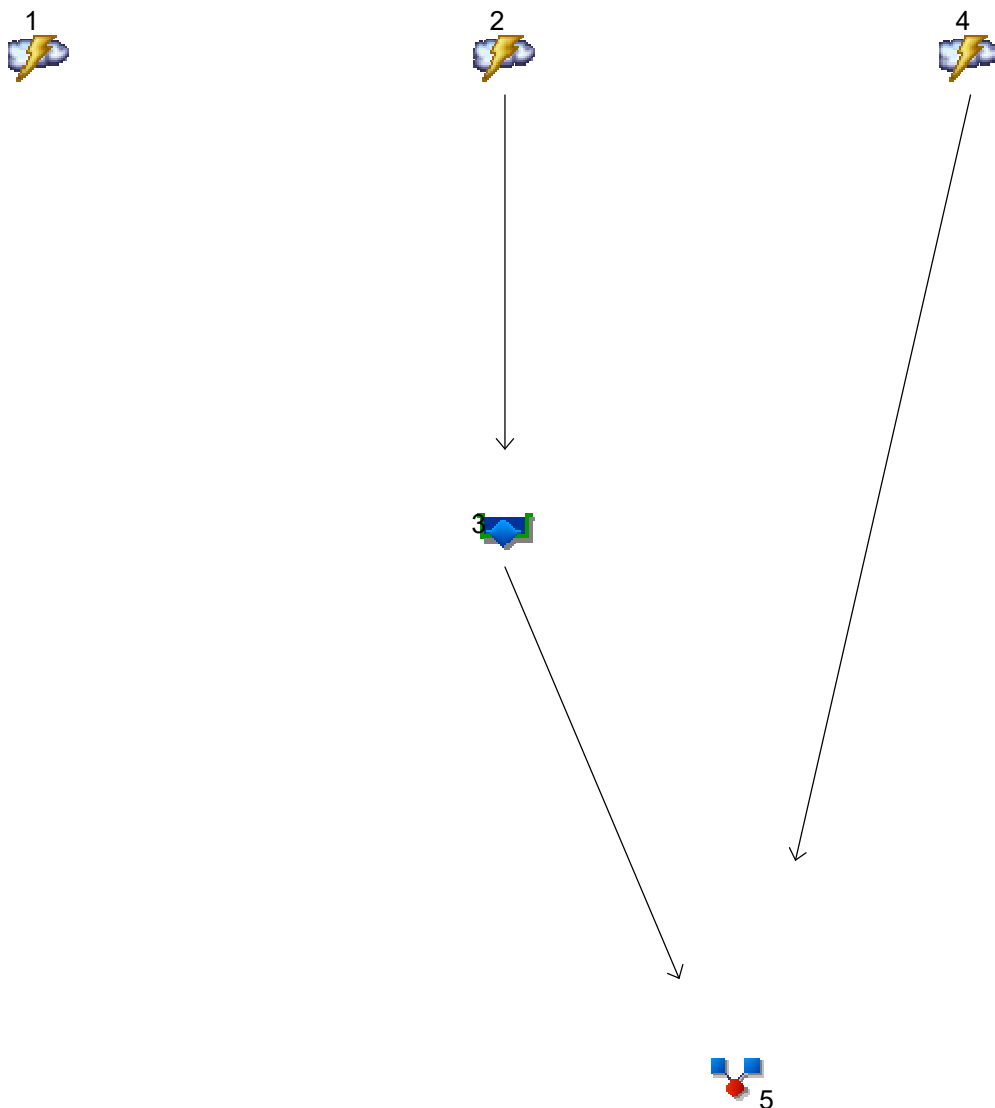
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Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026



Legend

Hyd. Origin	Description
1 Rational	Existing Pre-Developed
2 Rational	Proposed Drainage Area- 1 (To Pond)
3 Reservoir	Routed to Pond
4 Rational	Proposed Drainage Area- 2 (By-Pass)
5 Combine	Proposed Combined Flow (Offsite)

Hydrograph Return Period Recap

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	-----	-----	18.20	-----	22.61	26.50	31.89	36.20	40.87	Existing Pre-Developed
2	Rational	-----	-----	60.22	-----	73.95	85.81	101.64	113.89	126.80	Proposed Drainage Area- 1 (To Pond
3	Reservoir	2	-----	4.539	-----	4.887	5.084	5.336	5.524	5.716	Routed to Pond
4	Rational	-----	-----	6.022	-----	7.472	8.750	10.52	11.92	13.45	Proposed Drainage Area- 2 (By-Pass)
5	Combine	3, 4	-----	10.55	-----	12.35	13.83	15.84	17.44	19.16	Proposed Combined Flow (Offsite)

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

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	Rational	18.20	1	74	80,813	-----	-----	-----	Existing Pre-Developed	
2	Rational	60.22	1	34	122,850	-----	-----	-----	Proposed Drainage Area- 1 (To Pond	
3	Reservoir	4.539	1	65	122,837	2	191.74	110,334	Routed to Pond	
4	Rational	6.022	1	70	25,292	-----	-----	-----	Proposed Drainage Area- 2 (By-Pass)	
5	Combine	10.55	1	70	148,129	3, 4	-----	-----	Proposed Combined Flow (Offsite)	
Detention Pond Sizing_Revised.gpw					Return Period: 2 Year			Thursday, 04 / 2 / 2026		

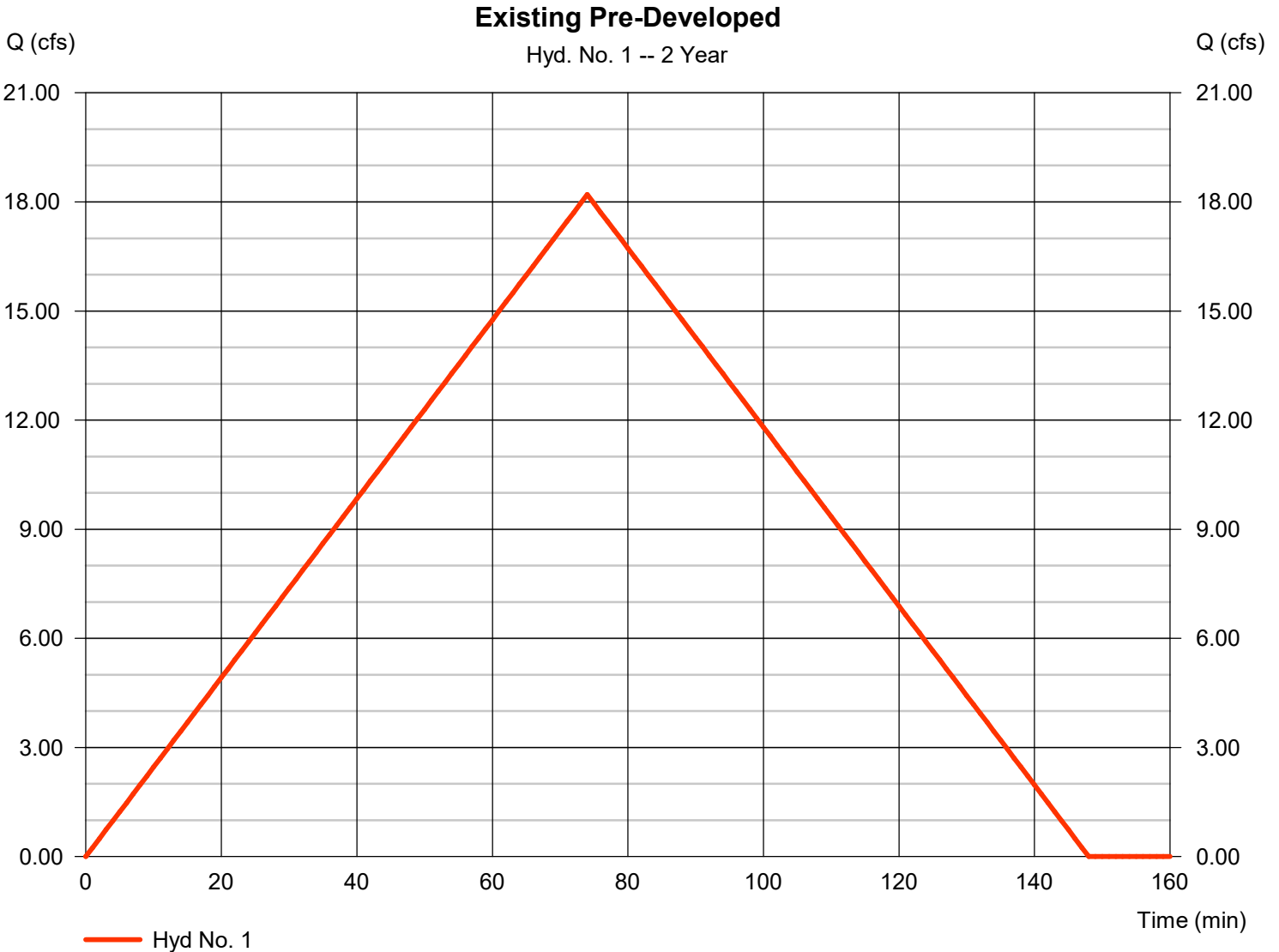
Hydrograph Report

Hyd. No. 1

Existing Pre-Developed

Hydrograph type	= Rational	Peak discharge	= 18.20 cfs
Storm frequency	= 2 yrs	Time to peak	= 74 min
Time interval	= 1 min	Hyd. volume	= 80,813 cuft
Drainage area	= 32.720 ac	Runoff coeff.	= 0.3*
Intensity	= 1.854 in/hr	Tc by TR55	= 74.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(32.716 x 0.30)] / 32.720



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Hyd. No. 1

Existing Pre-Developed

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.400	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 4.85	0.00	0.00	
Land slope (%)	= 1.00	0.00	0.00	
Travel Time (min)	= 55.43	+ 0.00	+ 0.00	= 55.43
Shallow Concentrated Flow				
Flow length (ft)	= 1428.00	0.00	0.00	
Watercourse slope (%)	= 0.60	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=1.25	0.00	0.00	
Travel Time (min)	= 19.04	+ 0.00	+ 0.00	= 19.04
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00	0.00	0.00	
Flow length (ft)	{{0}}0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				74.00 min

Hydrograph Report

Hyd. No. 2

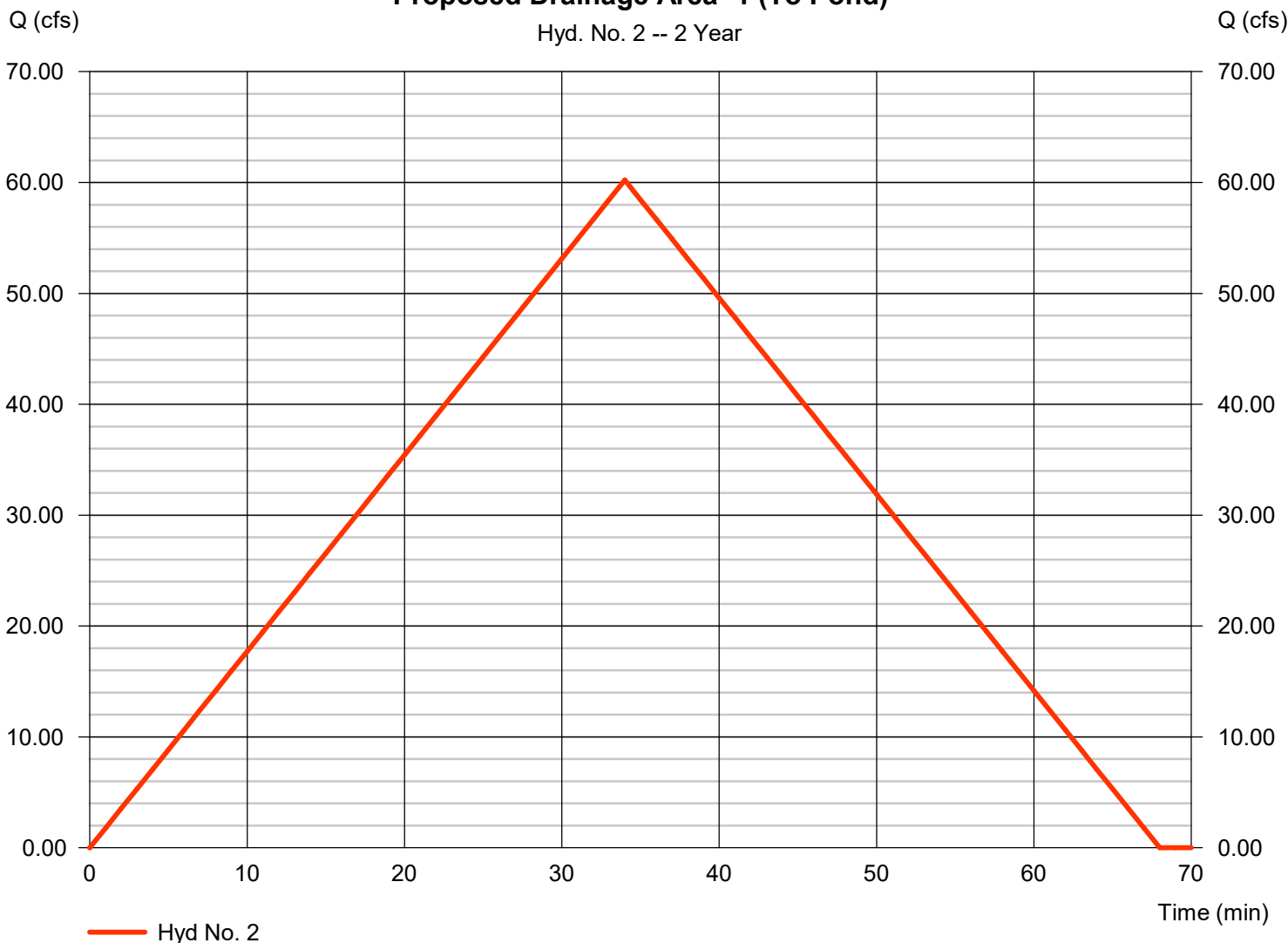
Proposed Drainage Area- 1 (To Pond)

Hydrograph type	= Rational	Peak discharge	= 60.22 cfs
Storm frequency	= 2 yrs	Time to peak	= 34 min
Time interval	= 1 min	Hyd. volume	= 122,850 cuft
Drainage area	= 22.280 ac	Runoff coeff.	= 0.9*
Intensity	= 3.003 in/hr	Tc by TR55	= 34.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(22.281 x 0.90)] / 22.280

Proposed Drainage Area- 1 (To Pond)

Hyd. No. 2 -- 2 Year



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Hyd. No. 2

Proposed Drainage Area- 1 (To Pond)

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.400	0.011	0.011	
Flow length (ft)	= 137.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 4.85	0.00	0.00	
Land slope (%)	= 2.43	0.00	0.00	
Travel Time (min)	= 20.76	+ 0.00	+ 0.00	= 20.76
Shallow Concentrated Flow				
Flow length (ft)	= 1154.00	0.00	0.00	
Watercourse slope (%)	= 0.50	0.00	0.00	
Surface description	= Paved	Paved	Paved	
Average velocity (ft/s)	=1.44	0.00	0.00	
Travel Time (min)	= 13.38	+ 0.00	+ 0.00	= 13.38
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00	0.00	0.00	
Flow length (ft)	{{0}}0.0	0.0	0.0	
Travel Time (min)	= 0.00	+ 0.00	+ 0.00	= 0.00
Total Travel Time, Tc				34.00 min

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

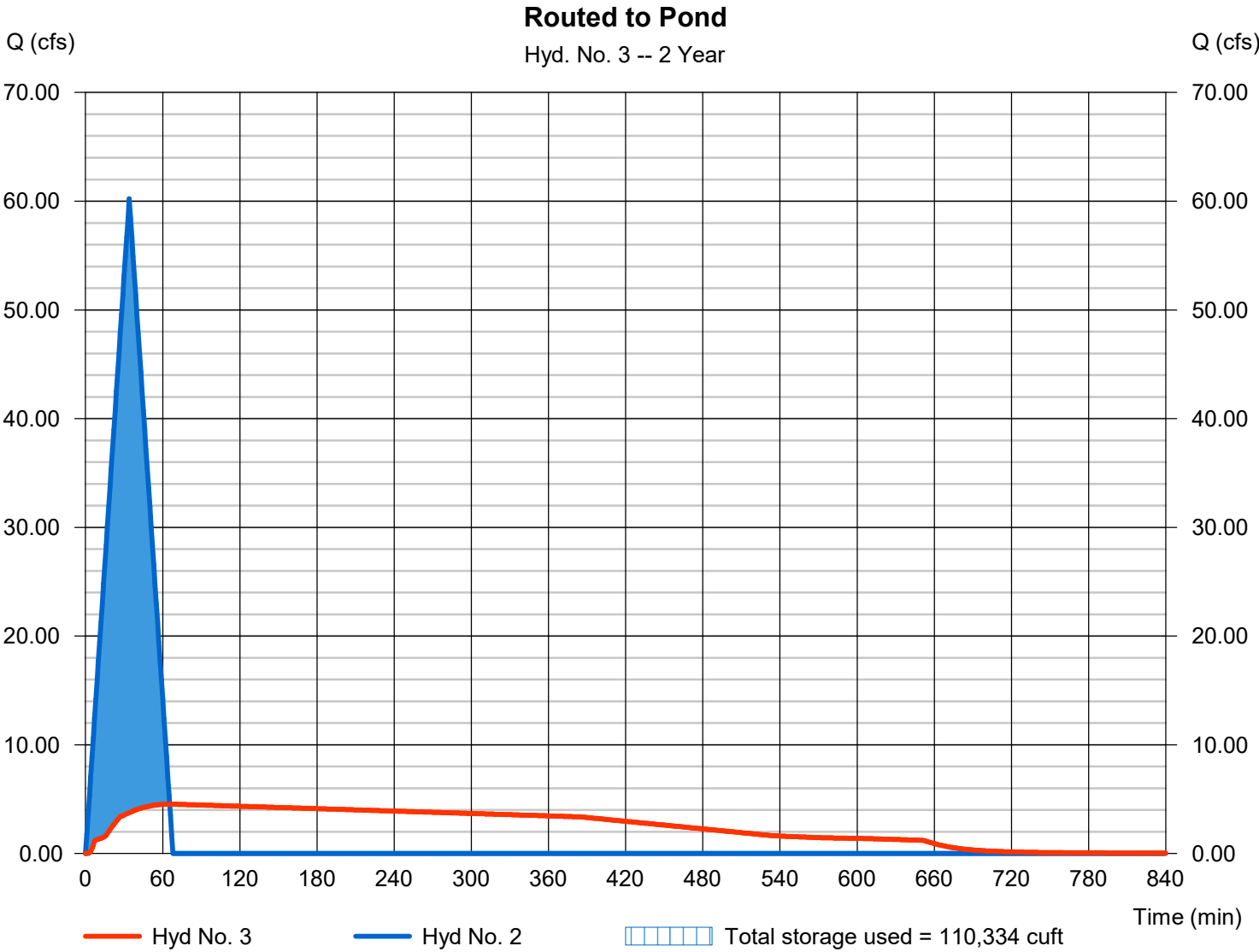
Thursday, 04 / 2 / 2026

Hyd. No. 3

Routed to Pond

Hydrograph type	= Reservoir	Peak discharge	= 4.539 cfs
Storm frequency	= 2 yrs	Time to peak	= 65 min
Time interval	= 1 min	Hyd. volume	= 122,837 cuft
Inflow hyd. No.	= 2 - Proposed Drainage Area-1 (Max. Flood)	Max. Flood	= 191.74 ft
Reservoir name	= Proposed Pond	Max. Storage	= 110,334 cuft

Storage Indication method used.



Pond No. 1 - Proposed Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Beginning Elevation = 189.25 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	189.25	00	0	0
0.75	190.00	7,032	2,637	2,637
1.75	191.00	57,552	32,292	34,929
2.75	192.00	144,900	101,226	136,156
3.75	193.00	152,449	148,675	284,830
4.75	194.00	160,008	156,229	441,059
5.75	195.00	167,687	163,848	604,907
6.75	196.00	175,457	171,572	776,478

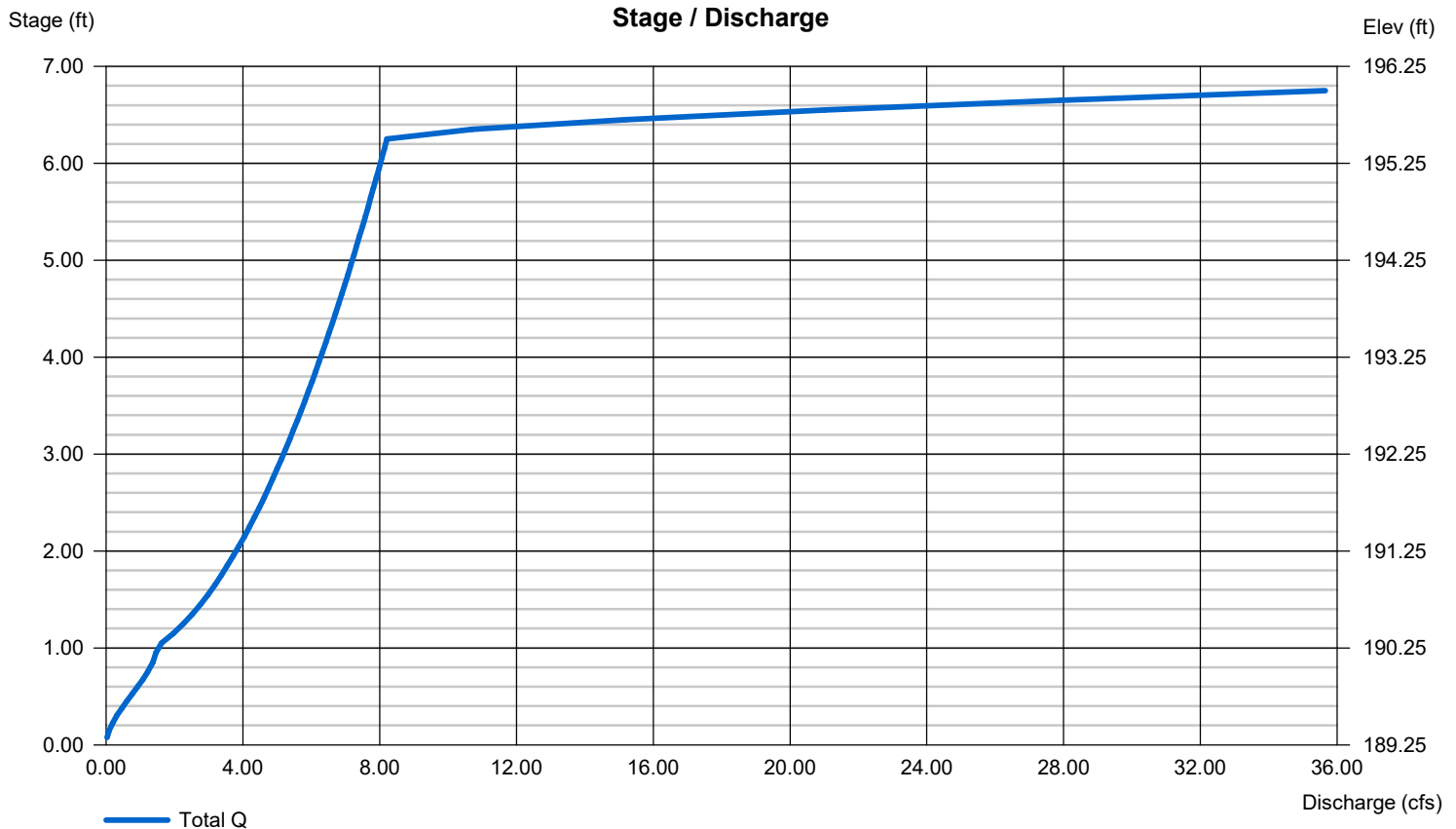
Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 12.00	0.00	0.00	0.00
Span (in)	= 12.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 189.25	0.00	0.00	0.00
Length (ft)	= 64.00	0.00	0.00	0.00
Slope (%)	= 0.25	0.00	0.00	n/a
N-Value	= .012	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 23.00	0.00	0.00	0.00
Crest El. (ft)	= 195.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= No	No	No	No
Exfil.(in/hr)	= 0.000 (by Contour)			
TW Elev. (ft)	= 0.00			

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



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

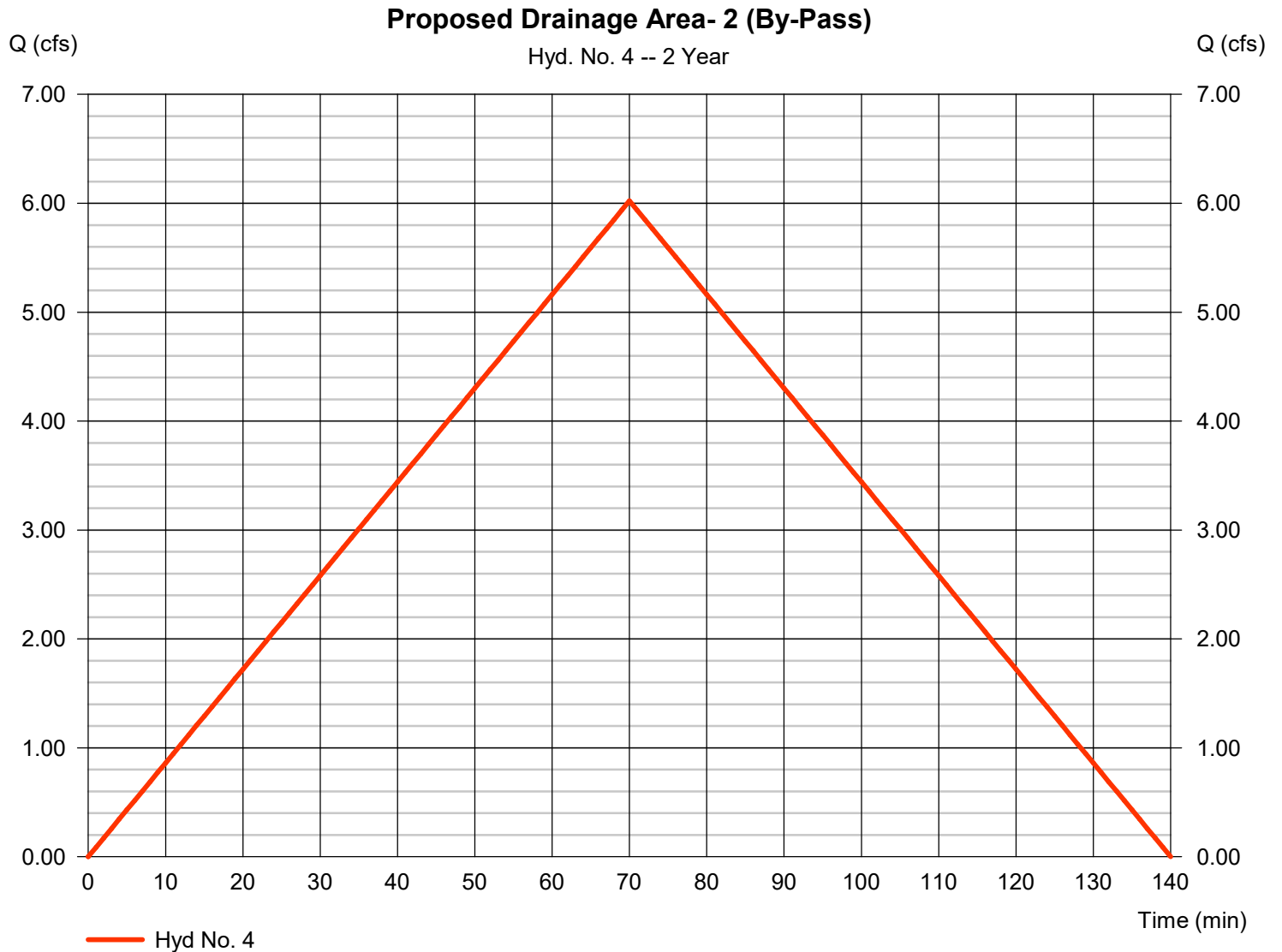
Thursday, 04 / 2 / 2026

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

Hydrograph type	= Rational	Peak discharge	= 6.022 cfs
Storm frequency	= 2 yrs	Time to peak	= 70 min
Time interval	= 1 min	Hyd. volume	= 25,292 cuft
Drainage area	= 10.440 ac	Runoff coeff.	= 0.3*
Intensity	= 1.923 in/hr	Tc by TR55	= 70.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(10.440 x 0.30)] / 10.440



TR55 Tc Worksheet

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow							
Manning's n-value	= 0.400		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 4.85		0.00		0.00		
Land slope (%)	= 0.86		0.00		0.00		
Travel Time (min)	= 58.87	+	0.00	+	0.00	=	58.87
Shallow Concentrated Flow							
Flow length (ft)	= 879.00		0.00		0.00		
Watercourse slope (%)	= 0.65		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.30		0.00		0.00		
Travel Time (min)	= 11.26	+	0.00	+	0.00	=	11.26
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00		0.00		0.00		
Flow length (ft)	{{0}}0.0		0.0		0.0		
Travel Time (min)	= 0.00	+	0.00	+	0.00	=	0.00
Total Travel Time, Tc							70.00 min

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 5

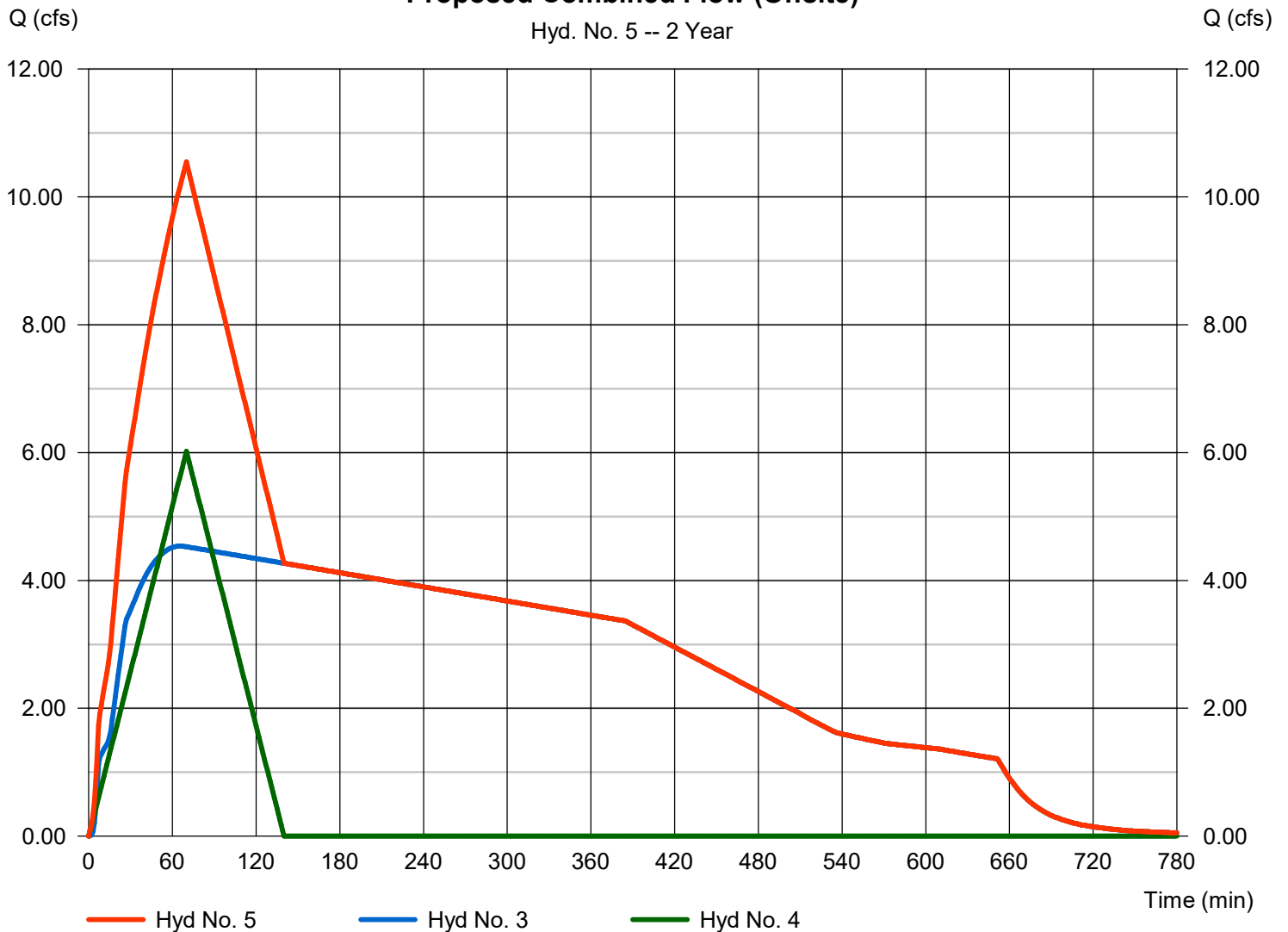
Proposed Combined Flow (Offsite)

Hydrograph type = Combine
 Storm frequency = 2 yrs
 Time interval = 1 min
 Inflow hyds. = 3, 4

Peak discharge = 10.55 cfs
 Time to peak = 70 min
 Hyd. volume = 148,129 cuft
 Contrib. drain. area = 10.440 ac

Proposed Combined Flow (Offsite)

Hyd. No. 5 -- 2 Year



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

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	Rational	22.61	1	74	100,373	-----	-----	-----	Existing Pre-Developed	
2	Rational	73.95	1	34	150,852	-----	-----	-----	Proposed Drainage Area- 1 (To Pond	
3	Reservoir	4.887	1	66	150,840	2	192.01	137,311	Routed to Pond	
4	Rational	7.472	1	70	31,381	-----	-----	-----	Proposed Drainage Area- 2 (By-Pass)	
5	Combine	12.35	1	70	182,221	3, 4	-----	-----	Proposed Combined Flow (Offsite)	
Detention Pond Sizing_ Revised.gpw					Return Period: 5 Year			Thursday, 04 / 2 / 2026		

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

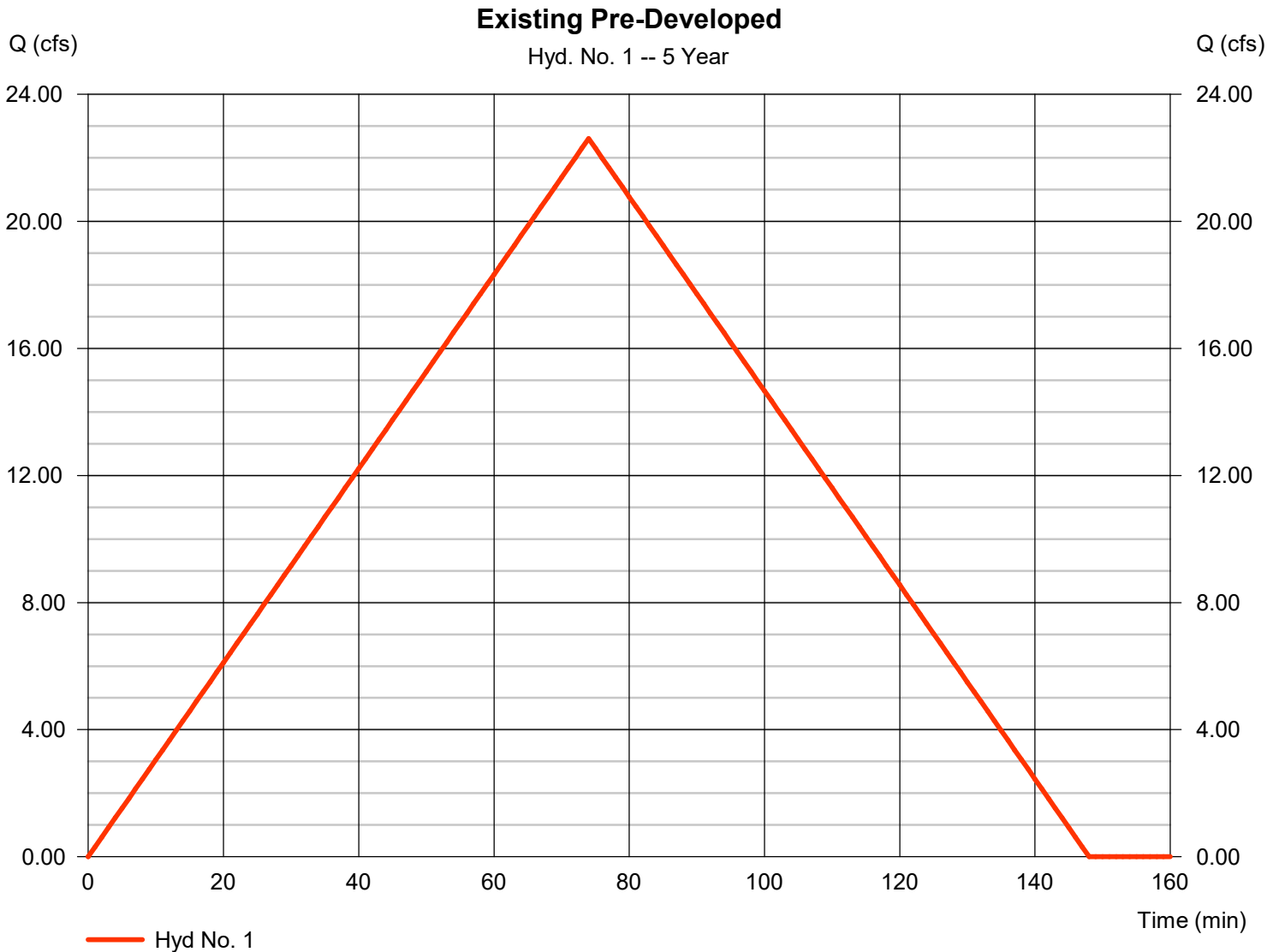
Thursday, 04 / 2 / 2026

Hyd. No. 1

Existing Pre-Developed

Hydrograph type	= Rational	Peak discharge	= 22.61 cfs
Storm frequency	= 5 yrs	Time to peak	= 74 min
Time interval	= 1 min	Hyd. volume	= 100,373 cuft
Drainage area	= 32.720 ac	Runoff coeff.	= 0.3*
Intensity	= 2.303 in/hr	Tc by TR55	= 74.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(32.716 x 0.30)] / 32.720



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 2

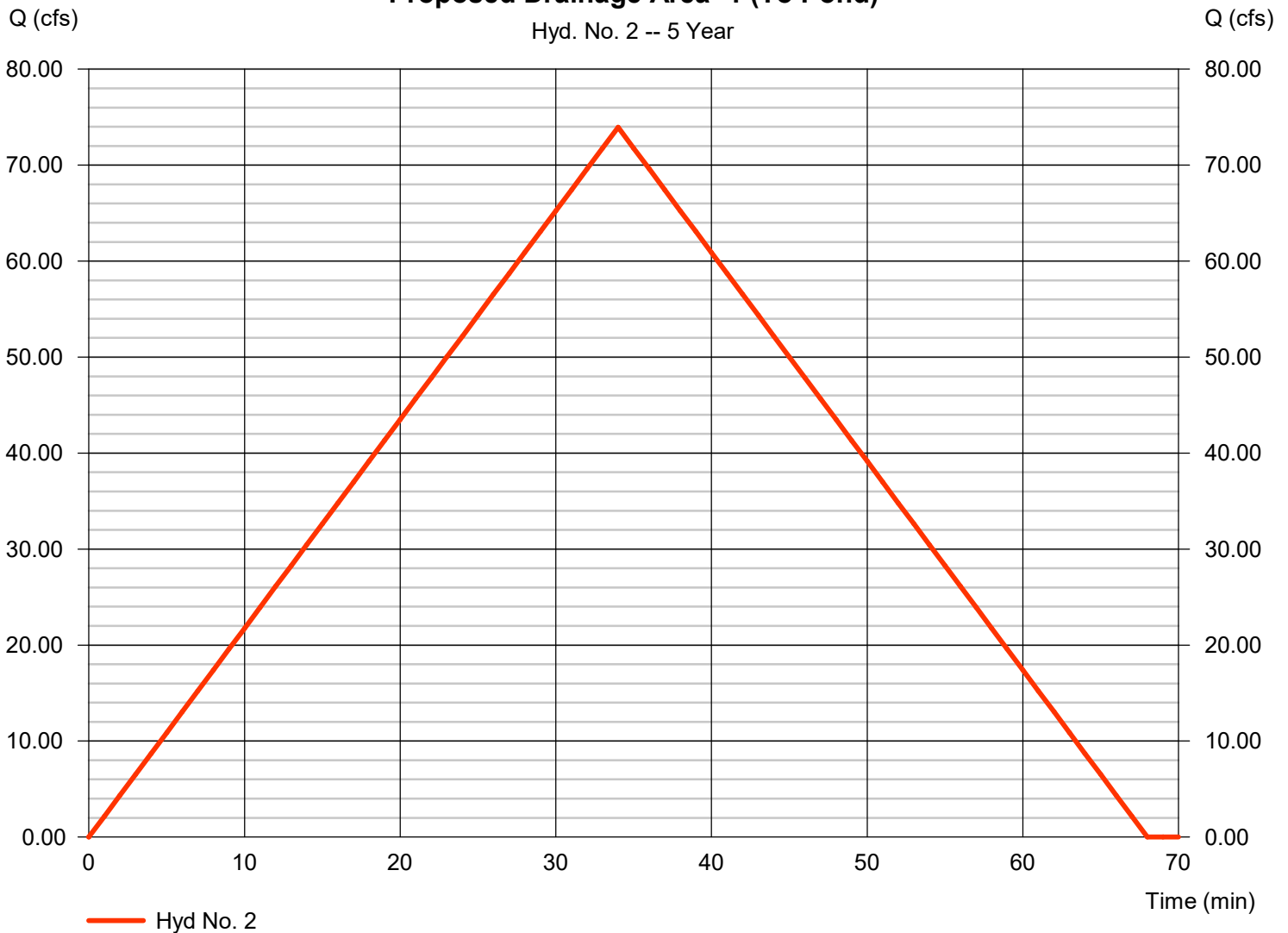
Proposed Drainage Area- 1 (To Pond)

Hydrograph type	= Rational	Peak discharge	= 73.95 cfs
Storm frequency	= 5 yrs	Time to peak	= 34 min
Time interval	= 1 min	Hyd. volume	= 150,852 cuft
Drainage area	= 22.280 ac	Runoff coeff.	= 0.9*
Intensity	= 3.688 in/hr	Tc by TR55	= 34.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(22.281 x 0.90)] / 22.280

Proposed Drainage Area- 1 (To Pond)

Hyd. No. 2 -- 5 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

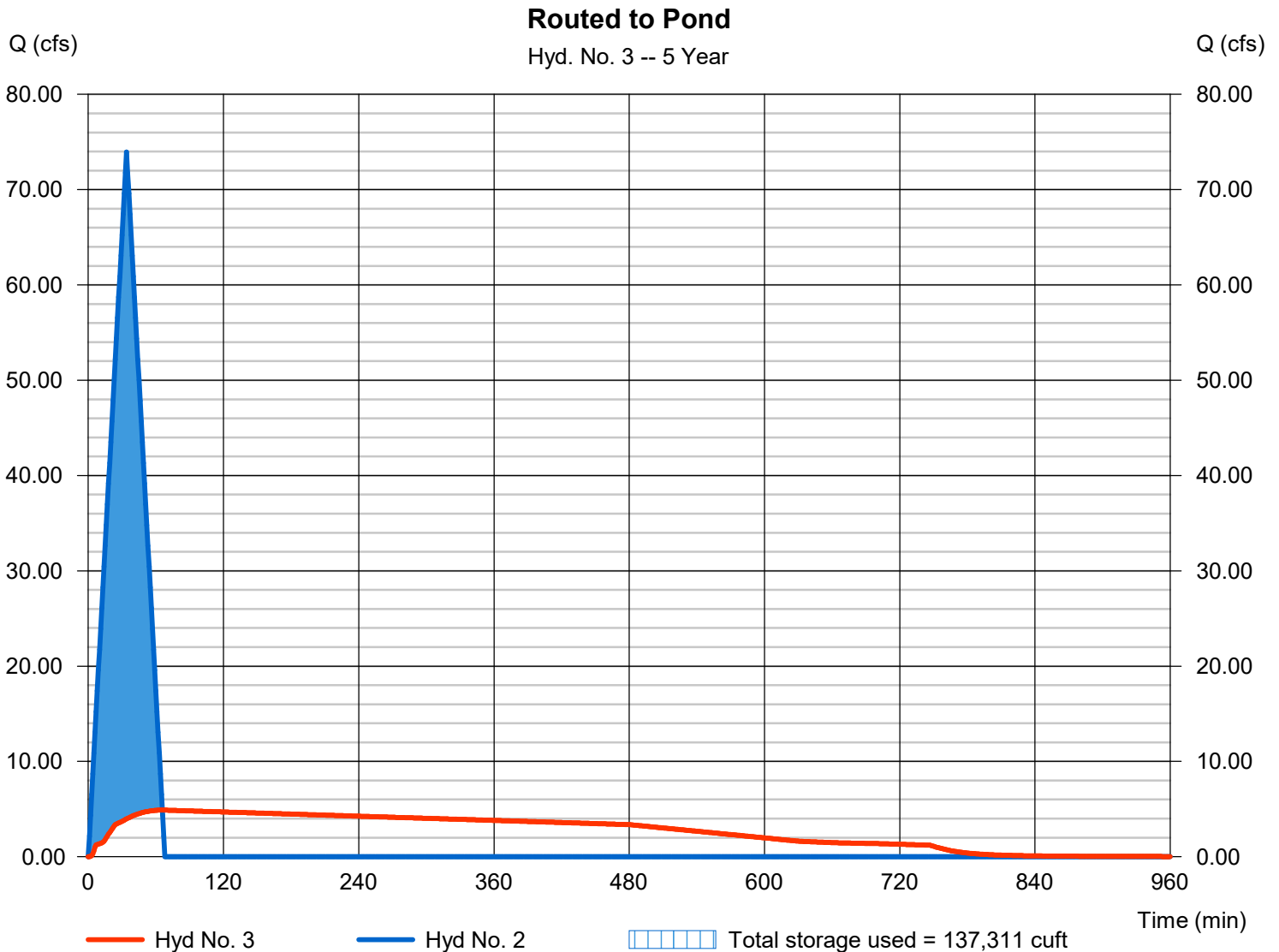
Thursday, 04 / 2 / 2026

Hyd. No. 3

Routed to Pond

Hydrograph type	= Reservoir	Peak discharge	= 4.887 cfs
Storm frequency	= 5 yrs	Time to peak	= 66 min
Time interval	= 1 min	Hyd. volume	= 150,840 cuft
Inflow hyd. No.	= 2 - Proposed Drainage Area-1 (Max. Flood)	Max. Flood	= 192.01 ft
Reservoir name	= Proposed Pond	Max. Storage	= 137,311 cuft

Storage Indication method used.



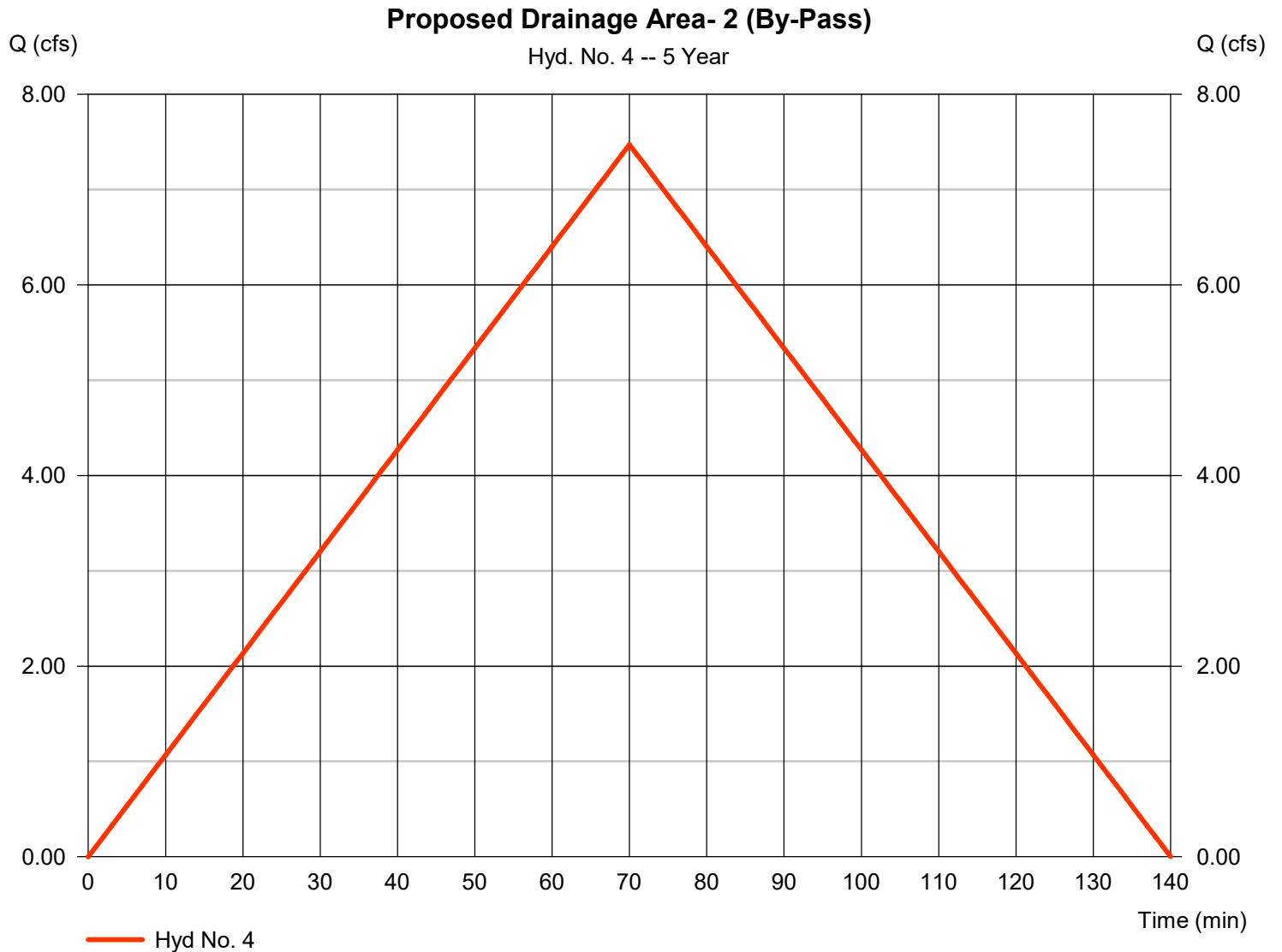
Hydrograph Report

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

Hydrograph type	= Rational	Peak discharge	= 7.472 cfs
Storm frequency	= 5 yrs	Time to peak	= 70 min
Time interval	= 1 min	Hyd. volume	= 31,381 cuft
Drainage area	= 10.440 ac	Runoff coeff.	= 0.3*
Intensity	= 2.386 in/hr	Tc by TR55	= 70.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(10.440 x 0.30)] / 10.440



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 5

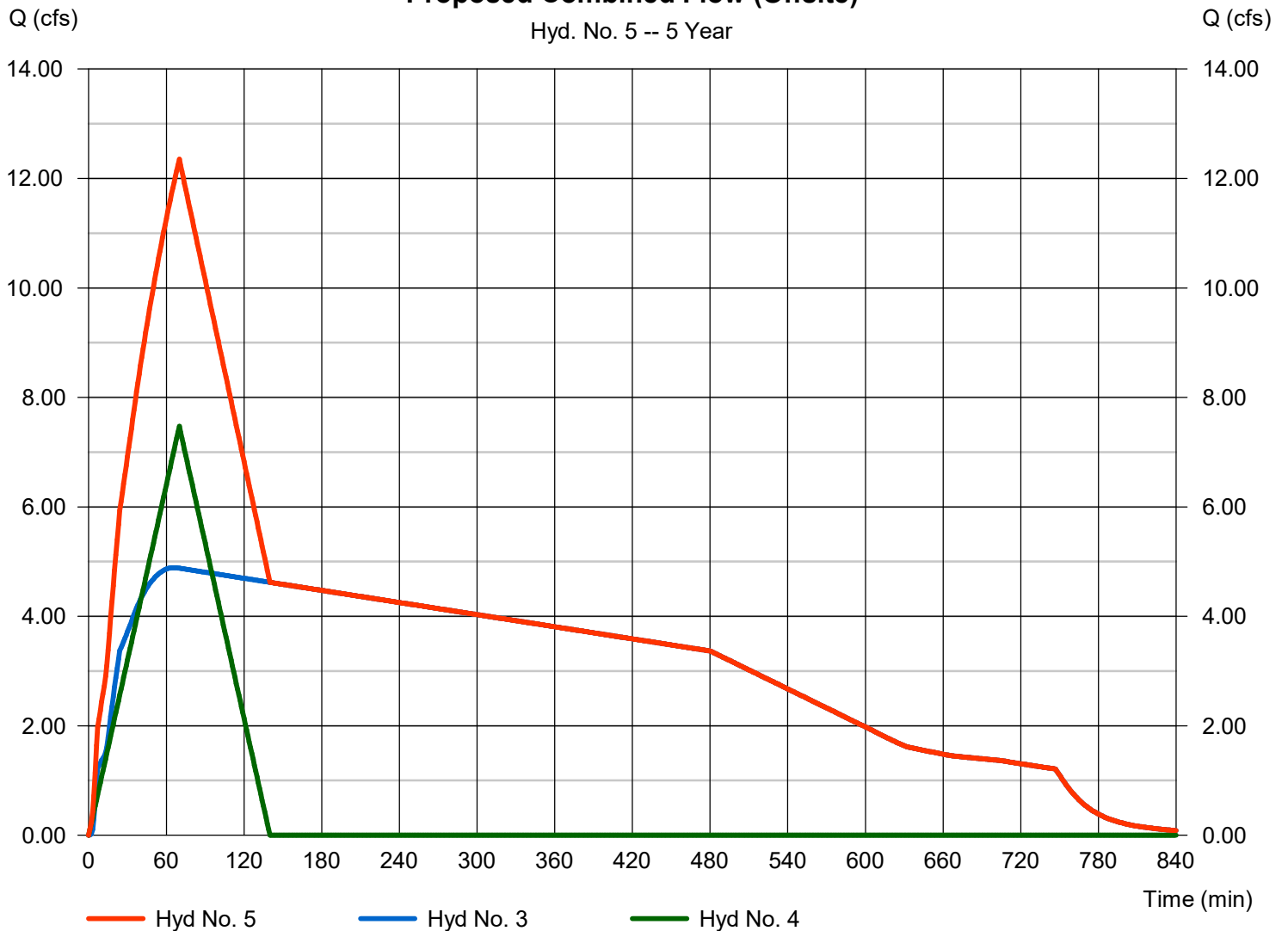
Proposed Combined Flow (Offsite)

Hydrograph type = Combine
Storm frequency = 5 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 12.35 cfs
Time to peak = 70 min
Hyd. volume = 182,221 cuft
Contrib. drain. area = 10.440 ac

Proposed Combined Flow (Offsite)

Hyd. No. 5 -- 5 Year



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

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	Rational	26.50	1	74	117,654	-----	-----	-----	Existing Pre-Developed	
2	Rational	85.81	1	34	175,060	-----	-----	-----	Proposed Drainage Area- 1 (To Pond	
3	Reservoir	5.084	1	66	175,048	2	192.17	160,778	Routed to Pond	
4	Rational	8.750	1	70	36,752	-----	-----	-----	Proposed Drainage Area- 2 (By-Pass)	
5	Combine	13.83	1	70	211,800	3, 4	-----	-----	Proposed Combined Flow (Offsite)	
Detention Pond Sizing_ Revised.gpw					Return Period: 10 Year			Thursday, 04 / 2 / 2026		

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

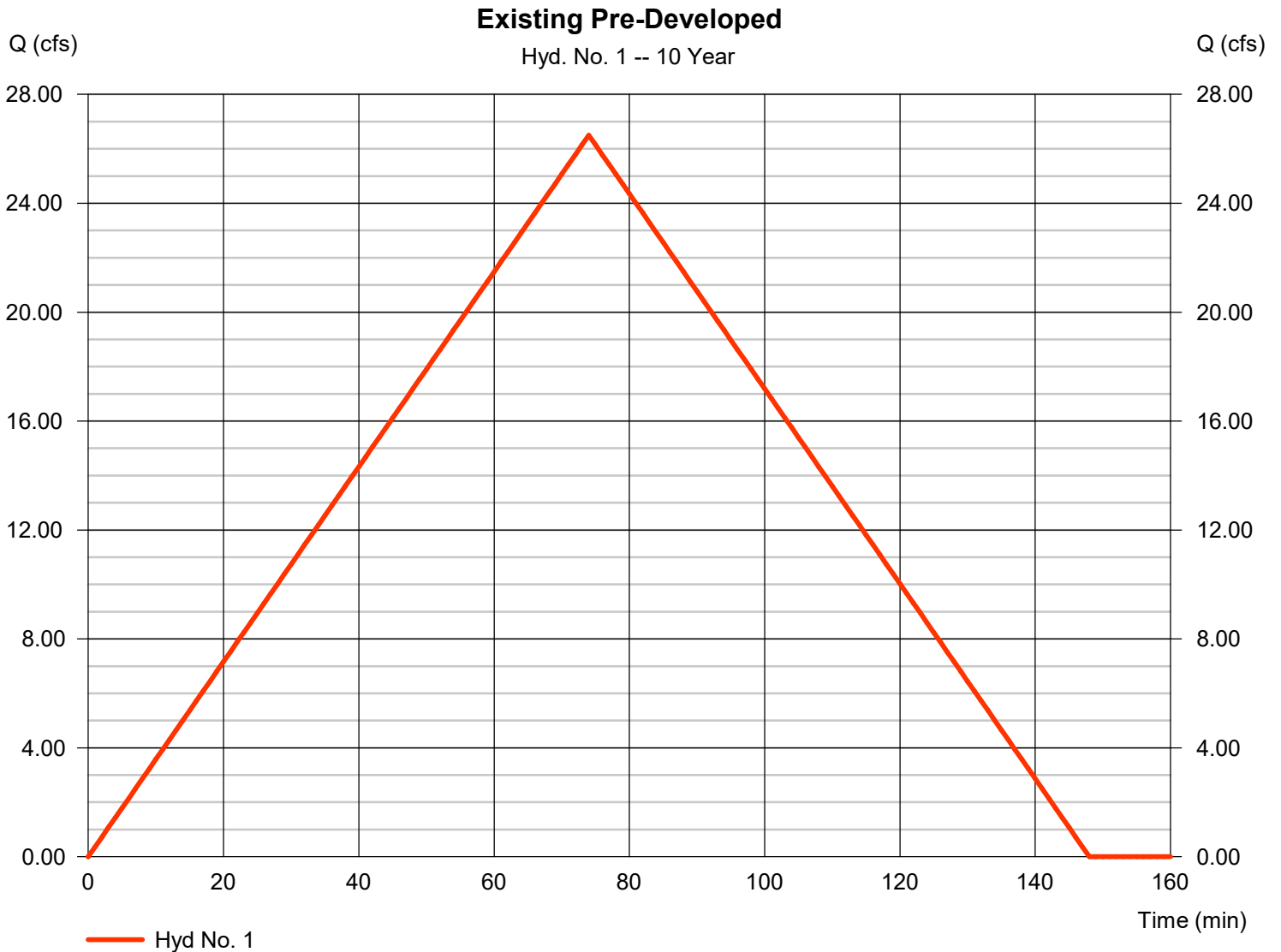
Thursday, 04 / 2 / 2026

Hyd. No. 1

Existing Pre-Developed

Hydrograph type	= Rational	Peak discharge	= 26.50 cfs
Storm frequency	= 10 yrs	Time to peak	= 74 min
Time interval	= 1 min	Hyd. volume	= 117,654 cuft
Drainage area	= 32.720 ac	Runoff coeff.	= 0.3*
Intensity	= 2.700 in/hr	Tc by TR55	= 74.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(32.716 x 0.30)] / 32.720



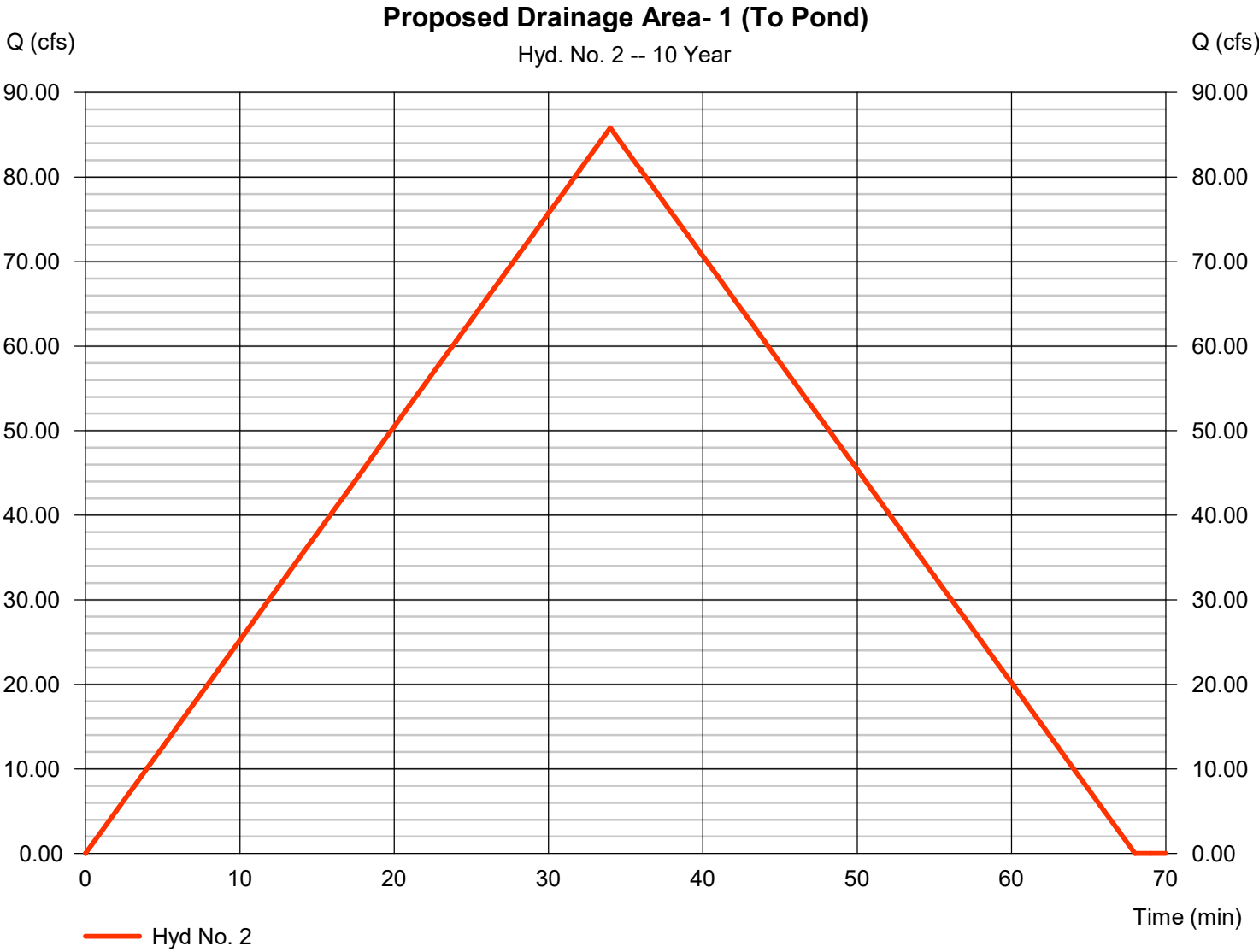
Hydrograph Report

Hyd. No. 2

Proposed Drainage Area- 1 (To Pond)

Hydrograph type	= Rational	Peak discharge	= 85.81 cfs
Storm frequency	= 10 yrs	Time to peak	= 34 min
Time interval	= 1 min	Hyd. volume	= 175,060 cuft
Drainage area	= 22.280 ac	Runoff coeff.	= 0.9*
Intensity	= 4.280 in/hr	Tc by TR55	= 34.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(22.281 x 0.90)] / 22.280



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

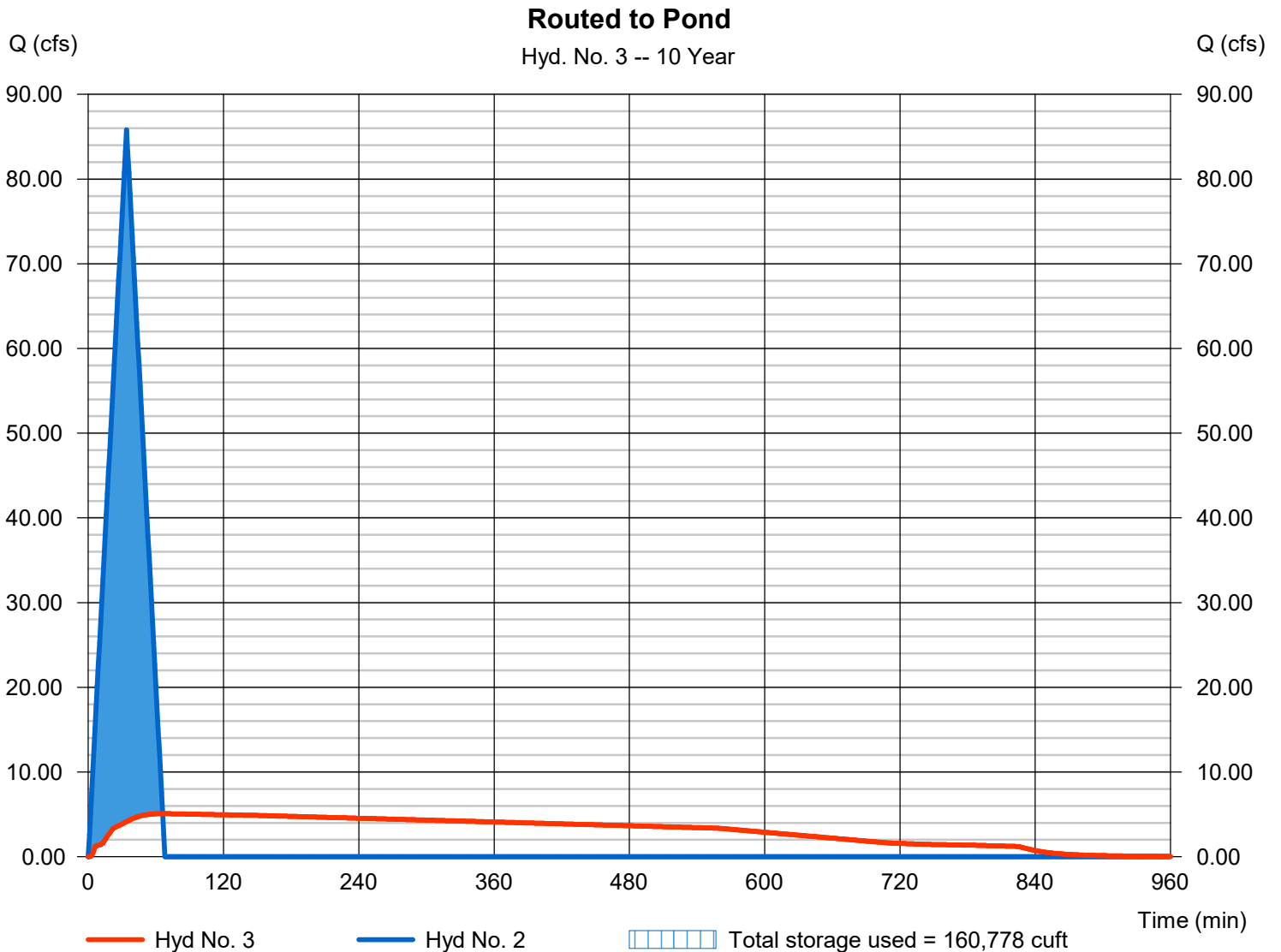
Thursday, 04 / 2 / 2026

Hyd. No. 3

Routed to Pond

Hydrograph type	= Reservoir	Peak discharge	= 5.084 cfs
Storm frequency	= 10 yrs	Time to peak	= 66 min
Time interval	= 1 min	Hyd. volume	= 175,048 cuft
Inflow hyd. No.	= 2 - Proposed Drainage Area-1 (Max. Flood)	Max. Flood elevation	= 192.17 ft
Reservoir name	= Proposed Pond	Max. Storage	= 160,778 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

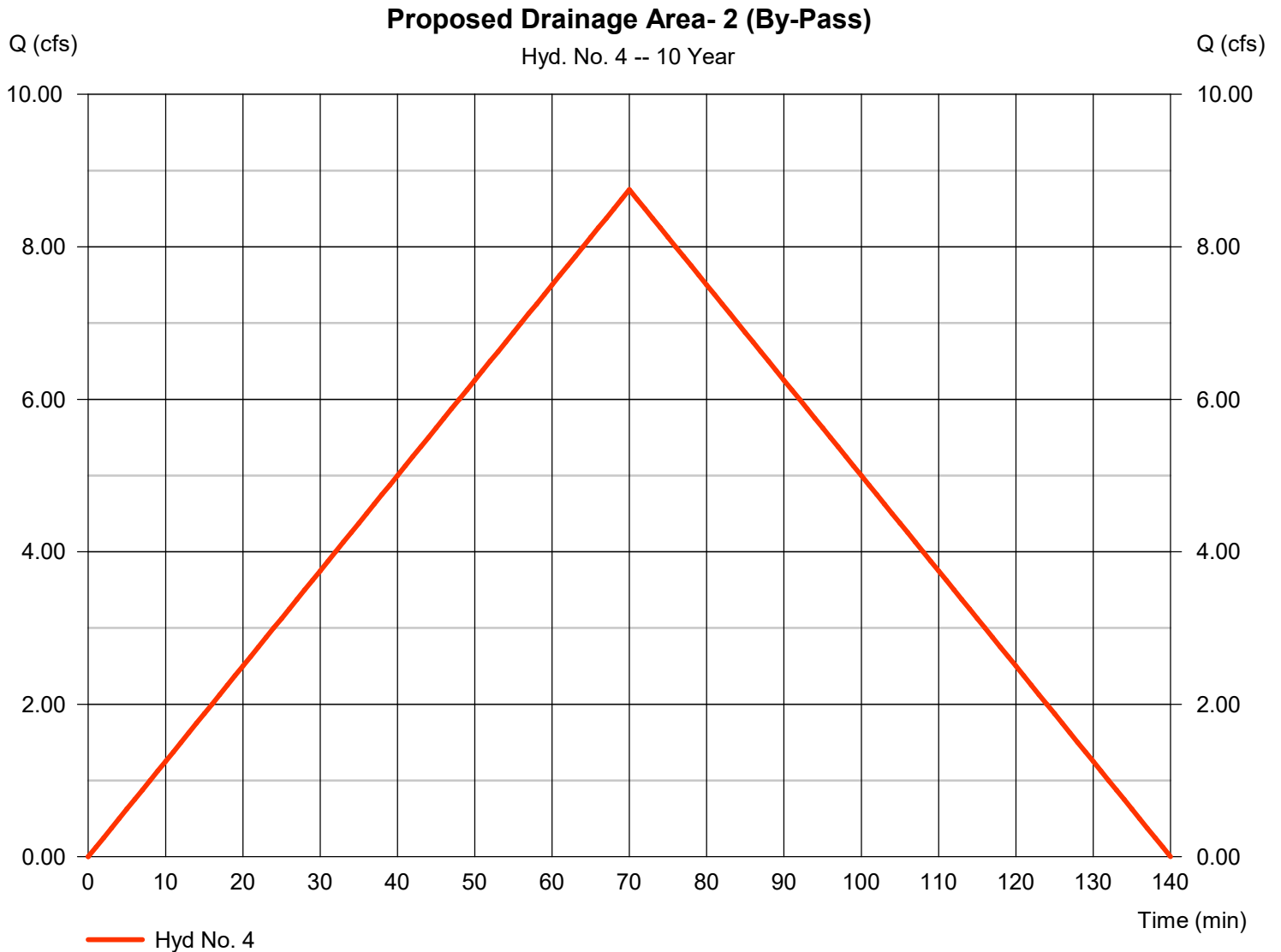
Thursday, 04 / 2 / 2026

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

Hydrograph type	= Rational	Peak discharge	= 8.750 cfs
Storm frequency	= 10 yrs	Time to peak	= 70 min
Time interval	= 1 min	Hyd. volume	= 36,752 cuft
Drainage area	= 10.440 ac	Runoff coeff.	= 0.3*
Intensity	= 2.794 in/hr	Tc by TR55	= 70.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(10.440 x 0.30)] / 10.440



Hydrograph Report

Hyd. No. 5

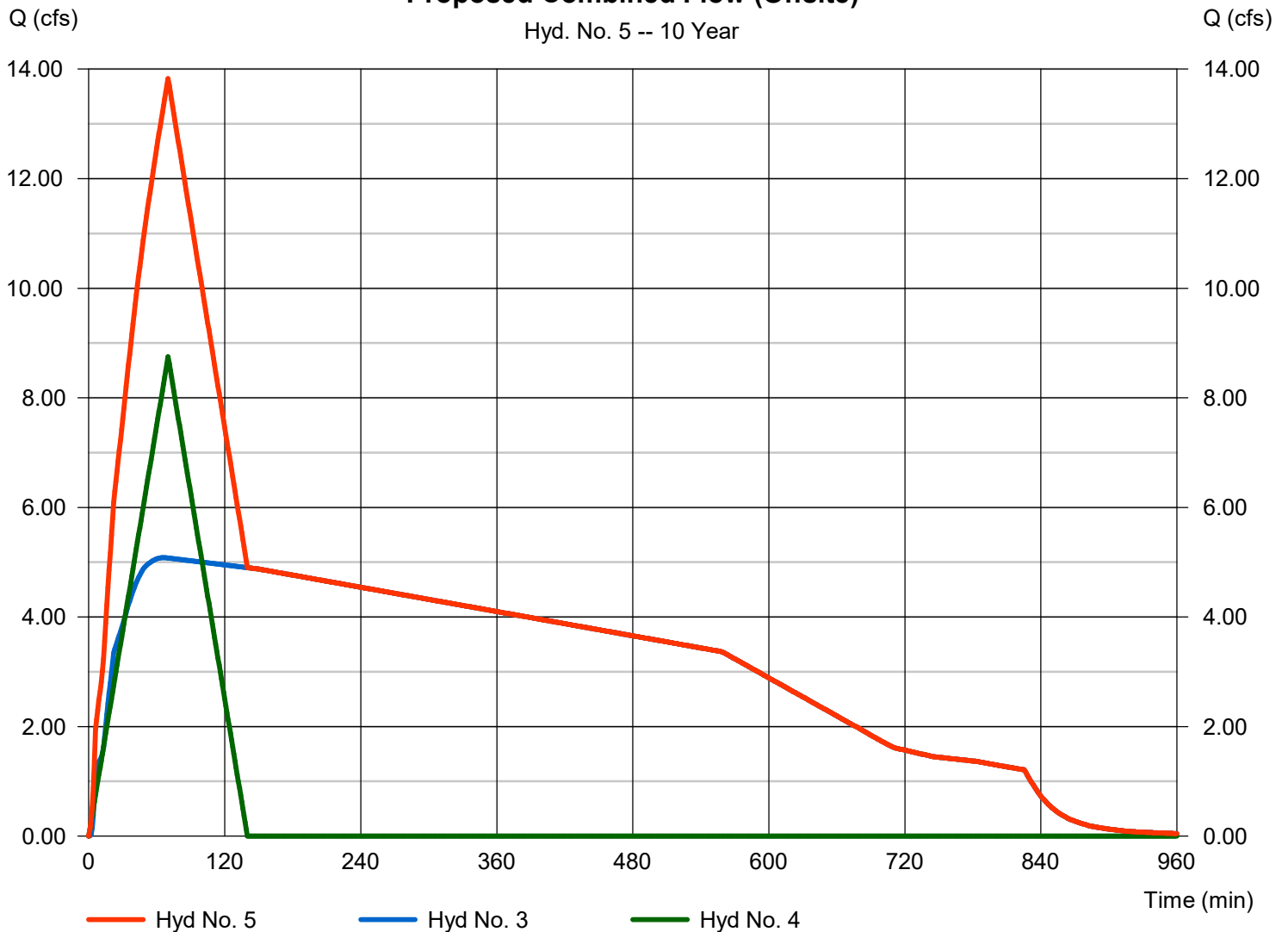
Proposed Combined Flow (Offsite)

Hydrograph type = Combine
Storm frequency = 10 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 13.83 cfs
Time to peak = 70 min
Hyd. volume = 211,800 cuft
Contrib. drain. area = 10.440 ac

Proposed Combined Flow (Offsite)

Hyd. No. 5 -- 10 Year



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

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	Rational	31.89	1	74	141,582	-----	-----	-----	Existing Pre-Developed	
2	Rational	101.64	1	34	207,348	-----	-----	-----	Proposed Drainage Area- 1 (To Pond	
3	Reservoir	5.336	1	66	207,336	2	192.38	192,211	Routed to Pond	
4	Rational	10.52	1	70	44,165	-----	-----	-----	Proposed Drainage Area- 2 (By-Pass)	
5	Combine	15.84	1	70	251,501	3, 4	-----	-----	Proposed Combined Flow (Offsite)	
Detention Pond Sizing_Revised.gpw					Return Period: 25 Year			Thursday, 04 / 2 / 2026		

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

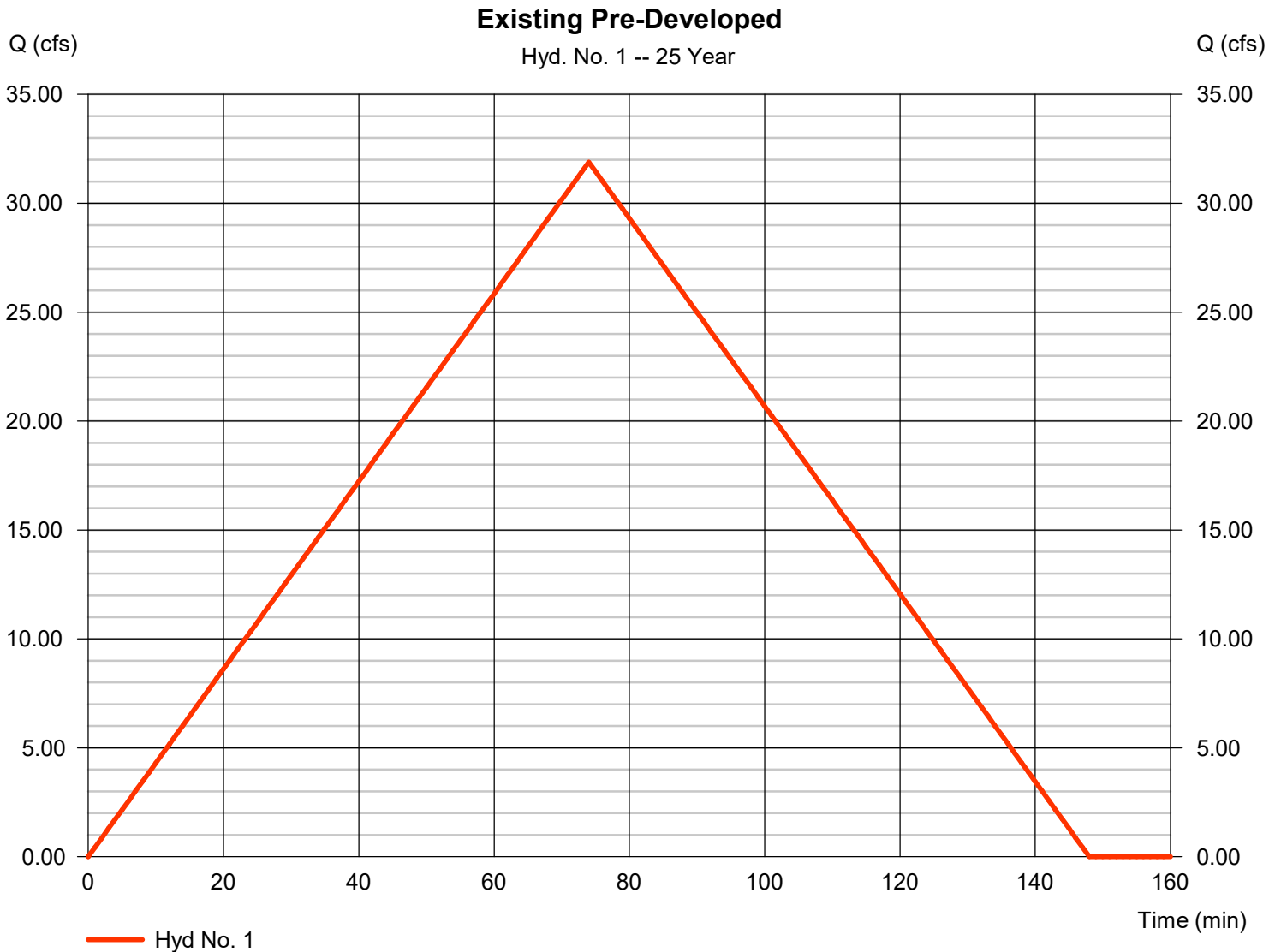
Thursday, 04 / 2 / 2026

Hyd. No. 1

Existing Pre-Developed

Hydrograph type	= Rational	Peak discharge	= 31.89 cfs
Storm frequency	= 25 yrs	Time to peak	= 74 min
Time interval	= 1 min	Hyd. volume	= 141,582 cuft
Drainage area	= 32.720 ac	Runoff coeff.	= 0.3*
Intensity	= 3.249 in/hr	Tc by TR55	= 74.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(32.716 x 0.30)] / 32.720



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 2

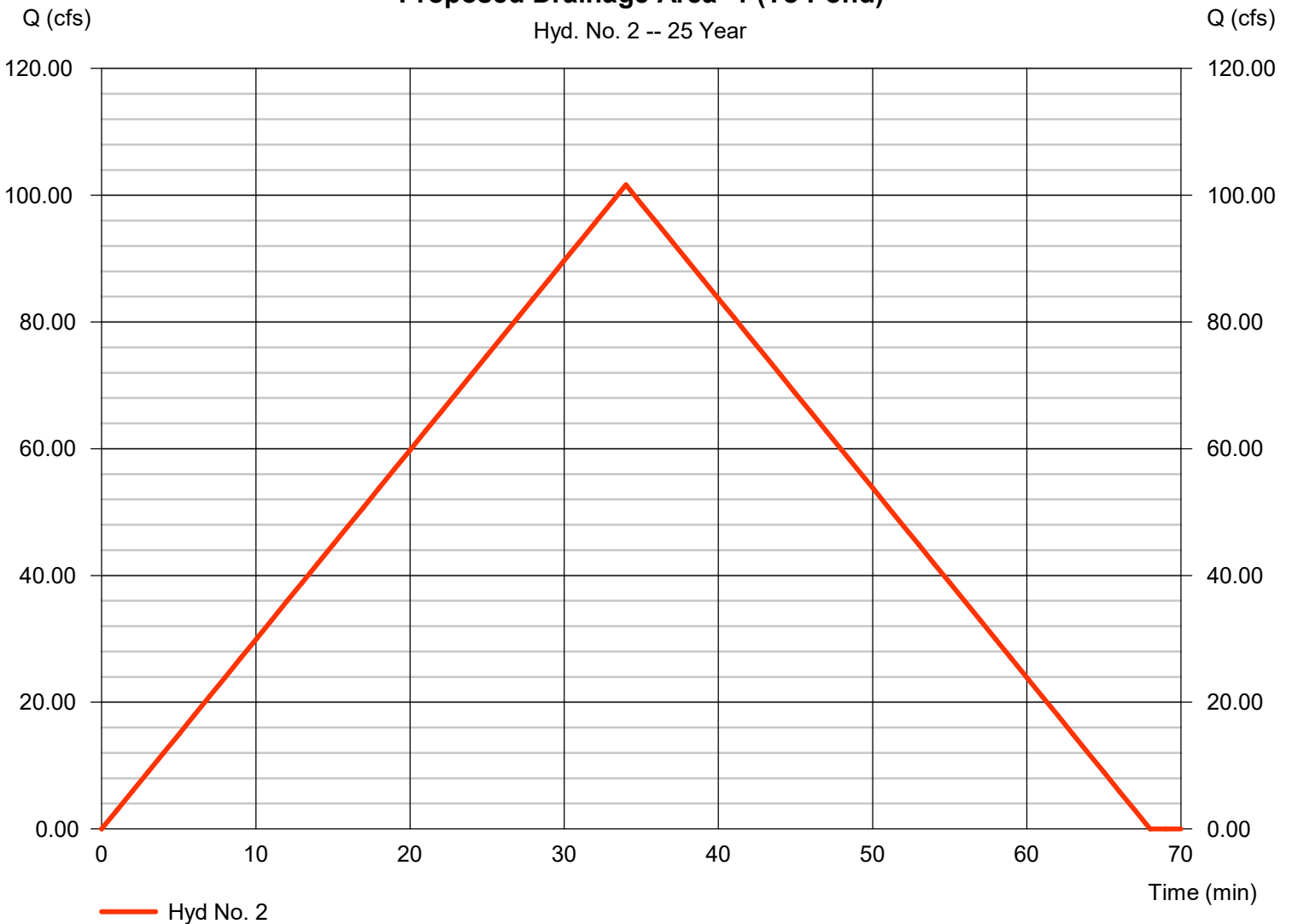
Proposed Drainage Area- 1 (To Pond)

Hydrograph type	= Rational	Peak discharge	= 101.64 cfs
Storm frequency	= 25 yrs	Time to peak	= 34 min
Time interval	= 1 min	Hyd. volume	= 207,348 cuft
Drainage area	= 22.280 ac	Runoff coeff.	= 0.9*
Intensity	= 5.069 in/hr	Tc by TR55	= 34.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(22.281 x 0.90)] / 22.280

Proposed Drainage Area- 1 (To Pond)

Hyd. No. 2 -- 25 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

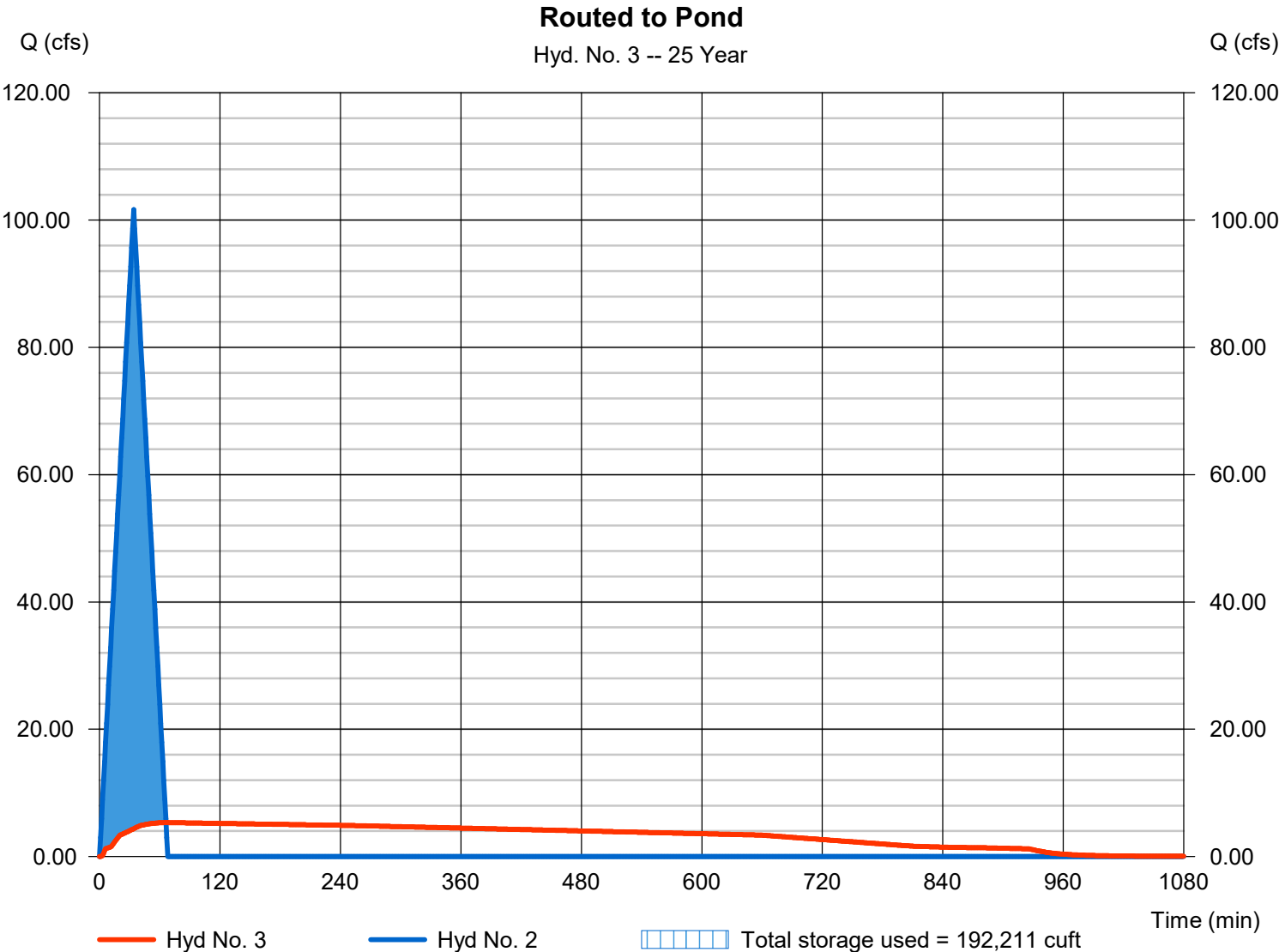
Thursday, 04 / 2 / 2026

Hyd. No. 3

Routed to Pond

Hydrograph type	= Reservoir	Peak discharge	= 5.336 cfs
Storm frequency	= 25 yrs	Time to peak	= 66 min
Time interval	= 1 min	Hyd. volume	= 207,336 cuft
Inflow hyd. No.	= 2 - Proposed Drainage Area-1 (Max. Flood)	Max. Flood elevation	= 192.38 ft
Reservoir name	= Proposed Pond	Max. Storage	= 192,211 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

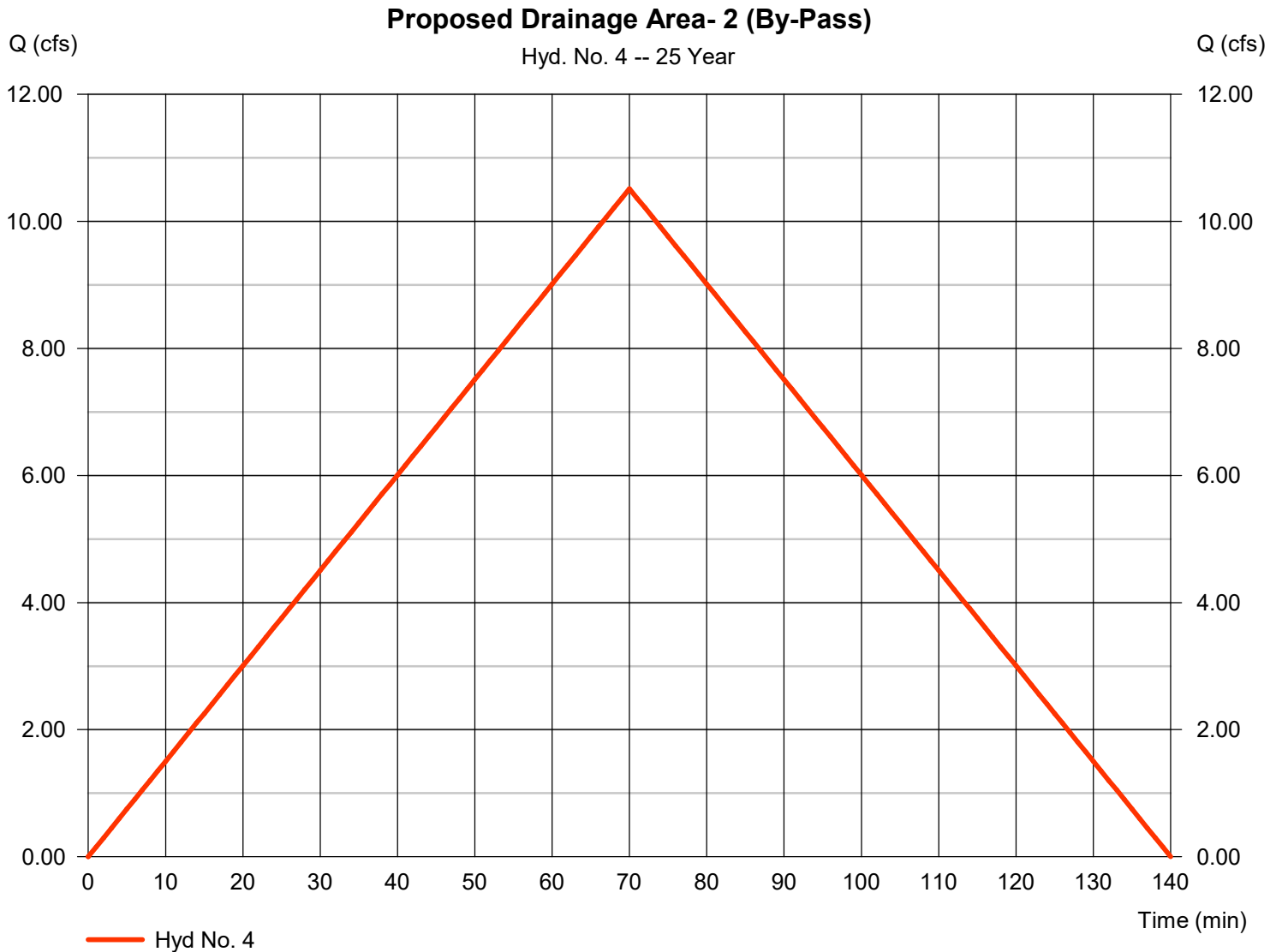
Thursday, 04 / 2 / 2026

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

Hydrograph type	= Rational	Peak discharge	= 10.52 cfs
Storm frequency	= 25 yrs	Time to peak	= 70 min
Time interval	= 1 min	Hyd. volume	= 44,165 cuft
Drainage area	= 10.440 ac	Runoff coeff.	= 0.3*
Intensity	= 3.357 in/hr	Tc by TR55	= 70.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(10.440 x 0.30)] / 10.440



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 5

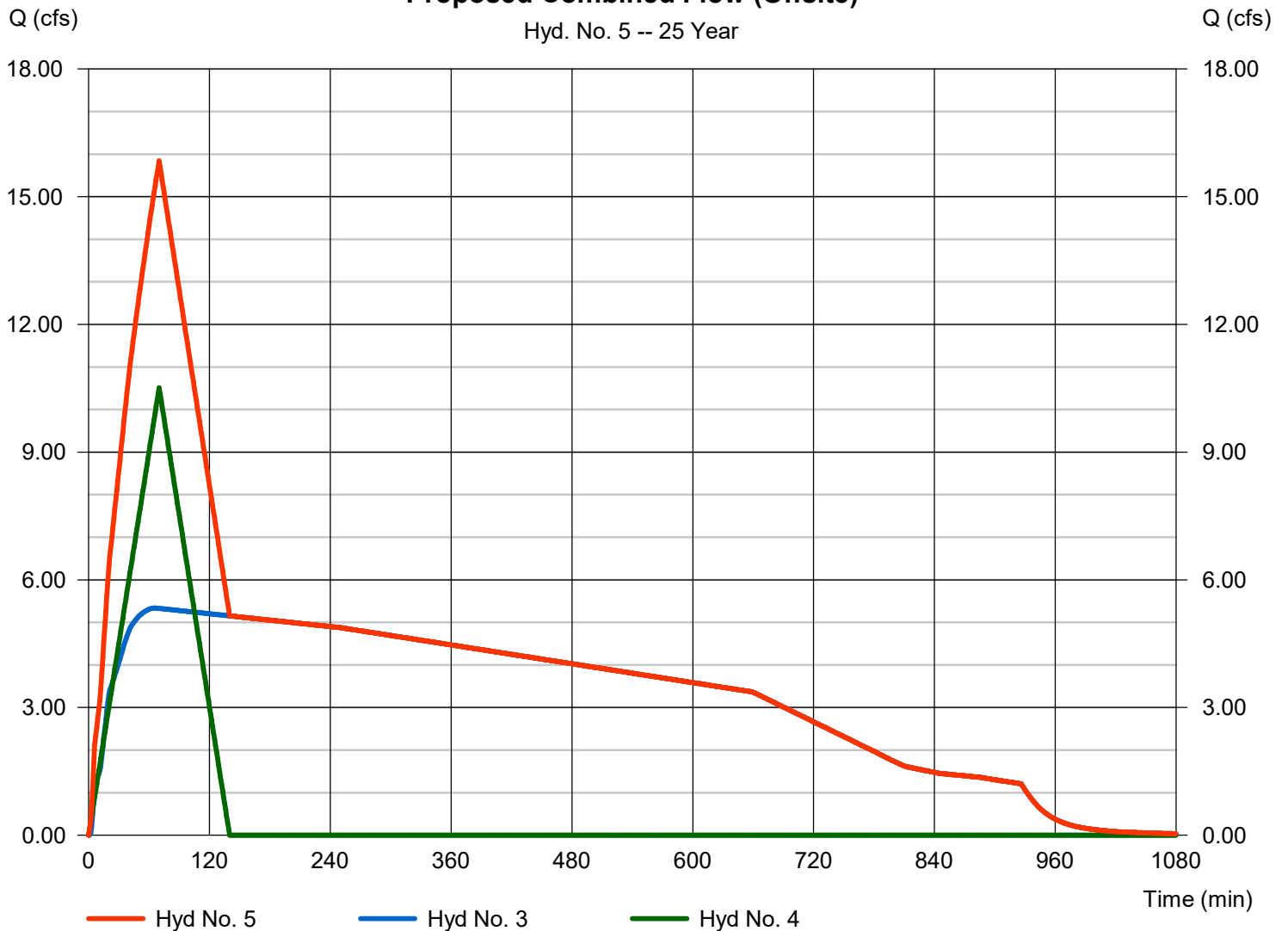
Proposed Combined Flow (Offsite)

Hydrograph type = Combine
Storm frequency = 25 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 15.84 cfs
Time to peak = 70 min
Hyd. volume = 251,501 cuft
Contrib. drain. area = 10.440 ac

Proposed Combined Flow (Offsite)

Hyd. No. 5 -- 25 Year



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

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	Rational	36.20	1	74	160,715	-----	-----	-----	Existing Pre-Developed	
2	Rational	113.89	1	34	232,340	-----	-----	-----	Proposed Drainage Area- 1 (To Pond	
3	Reservoir	5.524	1	66	232,328	2	192.54	216,595	Routed to Pond	
4	Rational	11.92	1	70	50,079	-----	-----	-----	Proposed Drainage Area- 2 (By-Pass)	
5	Combine	17.44	1	70	282,406	3, 4	-----	-----	Proposed Combined Flow (Offsite)	
Detention Pond Sizing_Revised.gpw					Return Period: 50 Year			Thursday, 04 / 2 / 2026		

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

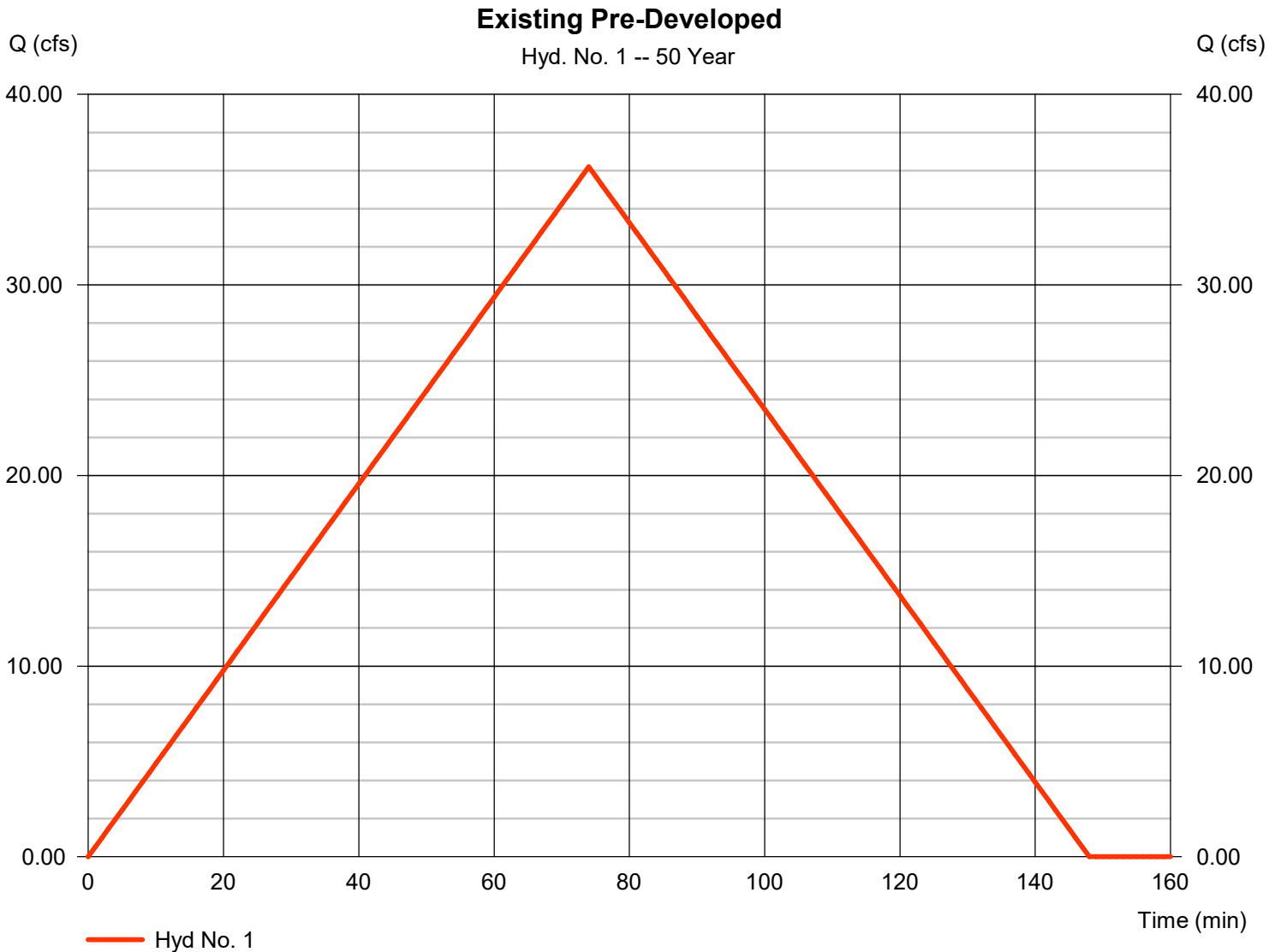
Thursday, 04 / 2 / 2026

Hyd. No. 1

Existing Pre-Developed

Hydrograph type	= Rational	Peak discharge	= 36.20 cfs
Storm frequency	= 50 yrs	Time to peak	= 74 min
Time interval	= 1 min	Hyd. volume	= 160,715 cuft
Drainage area	= 32.720 ac	Runoff coeff.	= 0.3*
Intensity	= 3.688 in/hr	Tc by TR55	= 74.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(32.716 x 0.30)] / 32.720



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 2

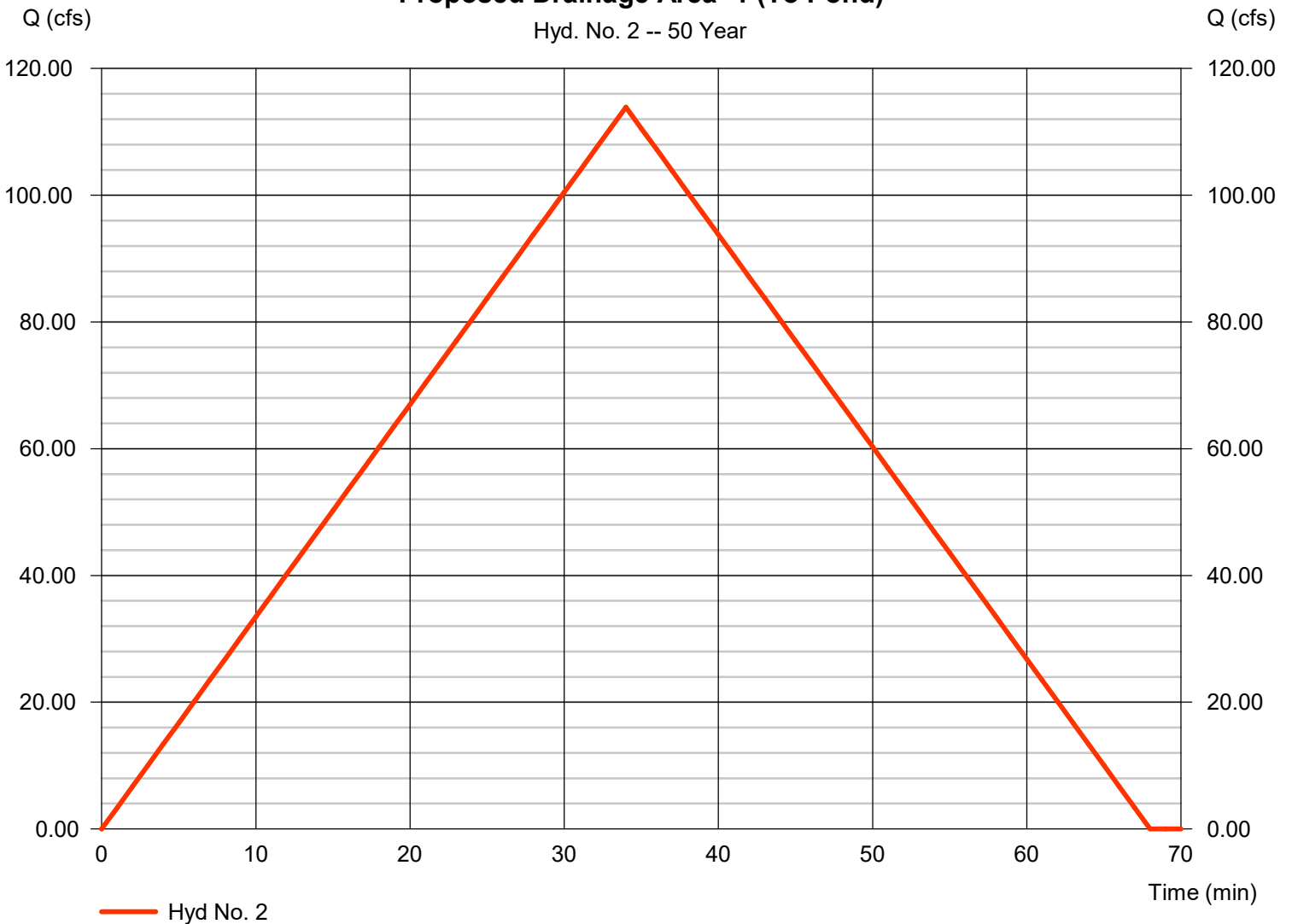
Proposed Drainage Area- 1 (To Pond)

Hydrograph type	= Rational	Peak discharge	= 113.89 cfs
Storm frequency	= 50 yrs	Time to peak	= 34 min
Time interval	= 1 min	Hyd. volume	= 232,340 cuft
Drainage area	= 22.280 ac	Runoff coeff.	= 0.9*
Intensity	= 5.680 in/hr	Tc by TR55	= 34.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(22.281 x 0.90)] / 22.280

Proposed Drainage Area- 1 (To Pond)

Hyd. No. 2 -- 50 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

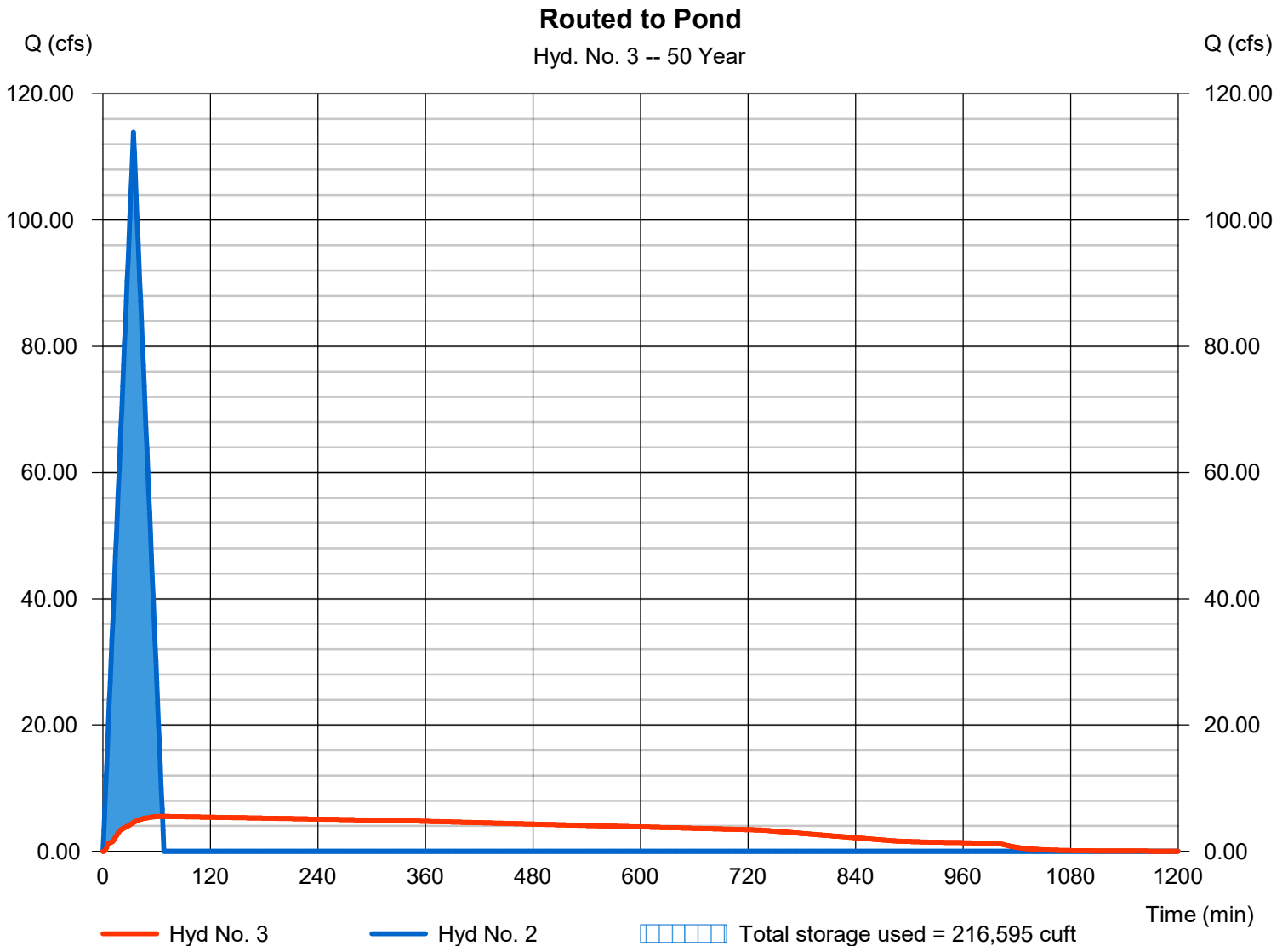
Thursday, 04 / 2 / 2026

Hyd. No. 3

Routed to Pond

Hydrograph type	= Reservoir	Peak discharge	= 5.524 cfs
Storm frequency	= 50 yrs	Time to peak	= 66 min
Time interval	= 1 min	Hyd. volume	= 232,328 cuft
Inflow hyd. No.	= 2 - Proposed Drainage Area-1 (Max. Flood)	Max. Flood elevation	= 192.54 ft
Reservoir name	= Proposed Pond	Max. Storage	= 216,595 cuft

Storage Indication method used.



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

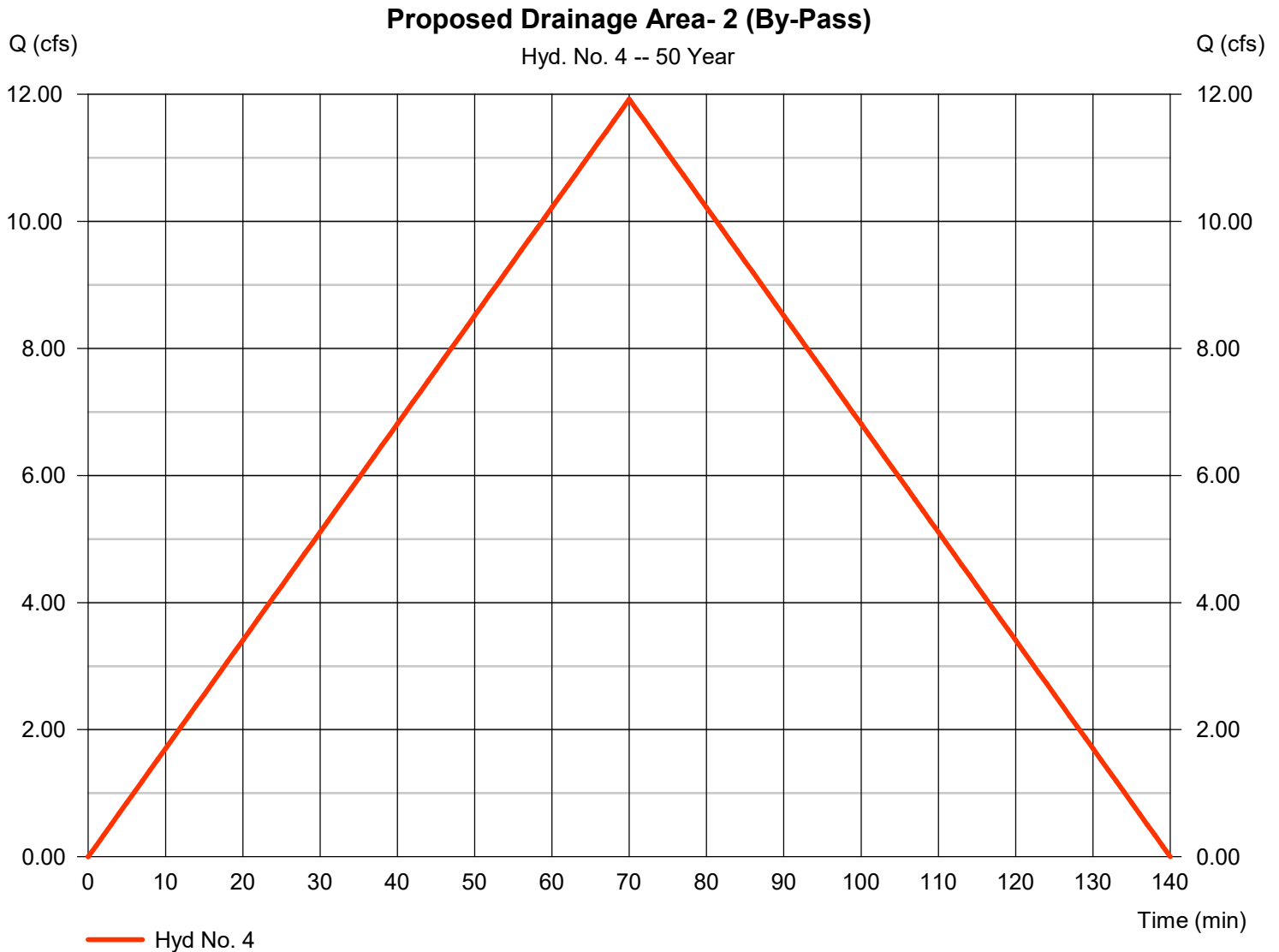
Thursday, 04 / 2 / 2026

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

Hydrograph type	= Rational	Peak discharge	= 11.92 cfs
Storm frequency	= 50 yrs	Time to peak	= 70 min
Time interval	= 1 min	Hyd. volume	= 50,079 cuft
Drainage area	= 10.440 ac	Runoff coeff.	= 0.3*
Intensity	= 3.807 in/hr	Tc by TR55	= 70.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(10.440 x 0.30)] / 10.440



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 5

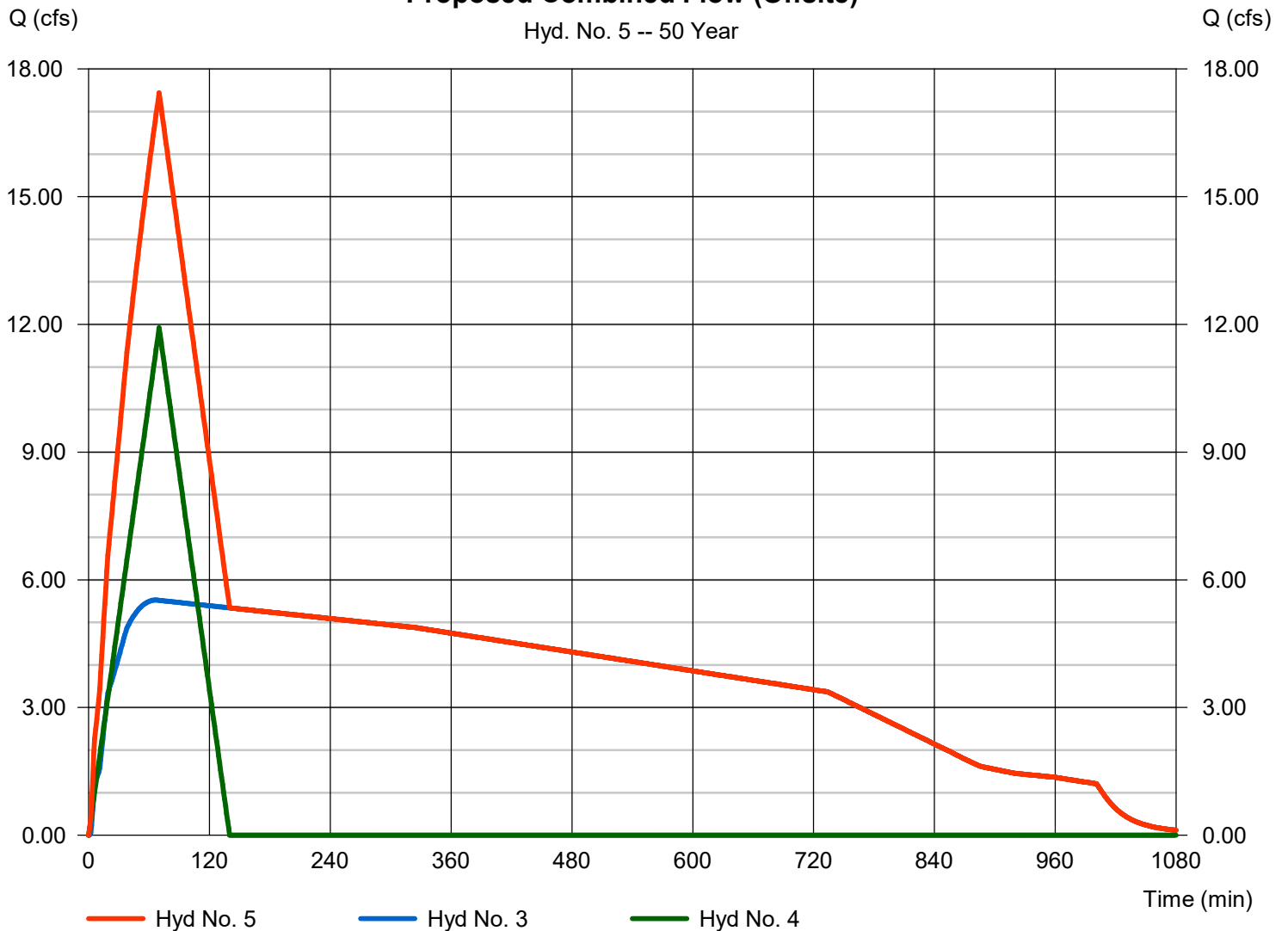
Proposed Combined Flow (Offsite)

Hydrograph type = Combine
Storm frequency = 50 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 17.44 cfs
Time to peak = 70 min
Hyd. volume = 282,406 cuft
Contrib. drain. area = 10.440 ac

Proposed Combined Flow (Offsite)

Hyd. No. 5 -- 50 Year



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

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	Rational	40.87	1	74	181,452	-----	-----	-----	Existing Pre-Developed	
2	Rational	126.80	1	34	258,675	-----	-----	-----	Proposed Drainage Area- 1 (To Pond	
3	Reservoir	5.716	1	66	258,662	2	192.71	242,331	Routed to Pond	
4	Rational	13.45	1	70	56,473	-----	-----	-----	Proposed Drainage Area- 2 (By-Pass)	
5	Combine	19.16	1	70	315,136	3, 4	-----	-----	Proposed Combined Flow (Offsite)	
Detention Pond Sizing_Revised.gpw					Return Period: 100 Year			Thursday, 04 / 2 / 2026		

Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

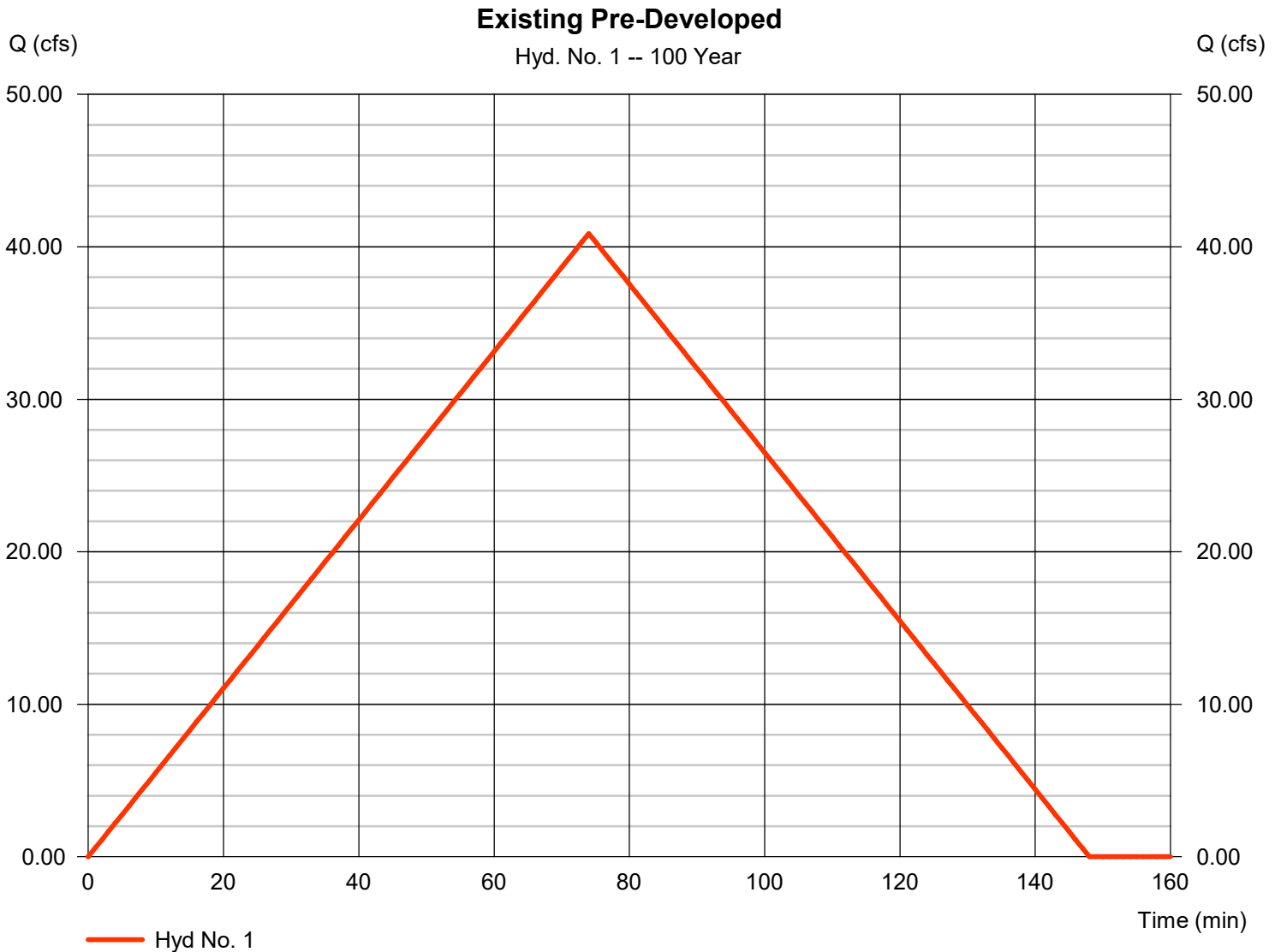
Thursday, 04 / 2 / 2026

Hyd. No. 1

Existing Pre-Developed

Hydrograph type	= Rational	Peak discharge	= 40.87 cfs
Storm frequency	= 100 yrs	Time to peak	= 74 min
Time interval	= 1 min	Hyd. volume	= 181,452 cuft
Drainage area	= 32.720 ac	Runoff coeff.	= 0.3*
Intensity	= 4.163 in/hr	Tc by TR55	= 74.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(32.716 x 0.30)] / 32.720



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

Thursday, 04 / 2 / 2026

Hyd. No. 2

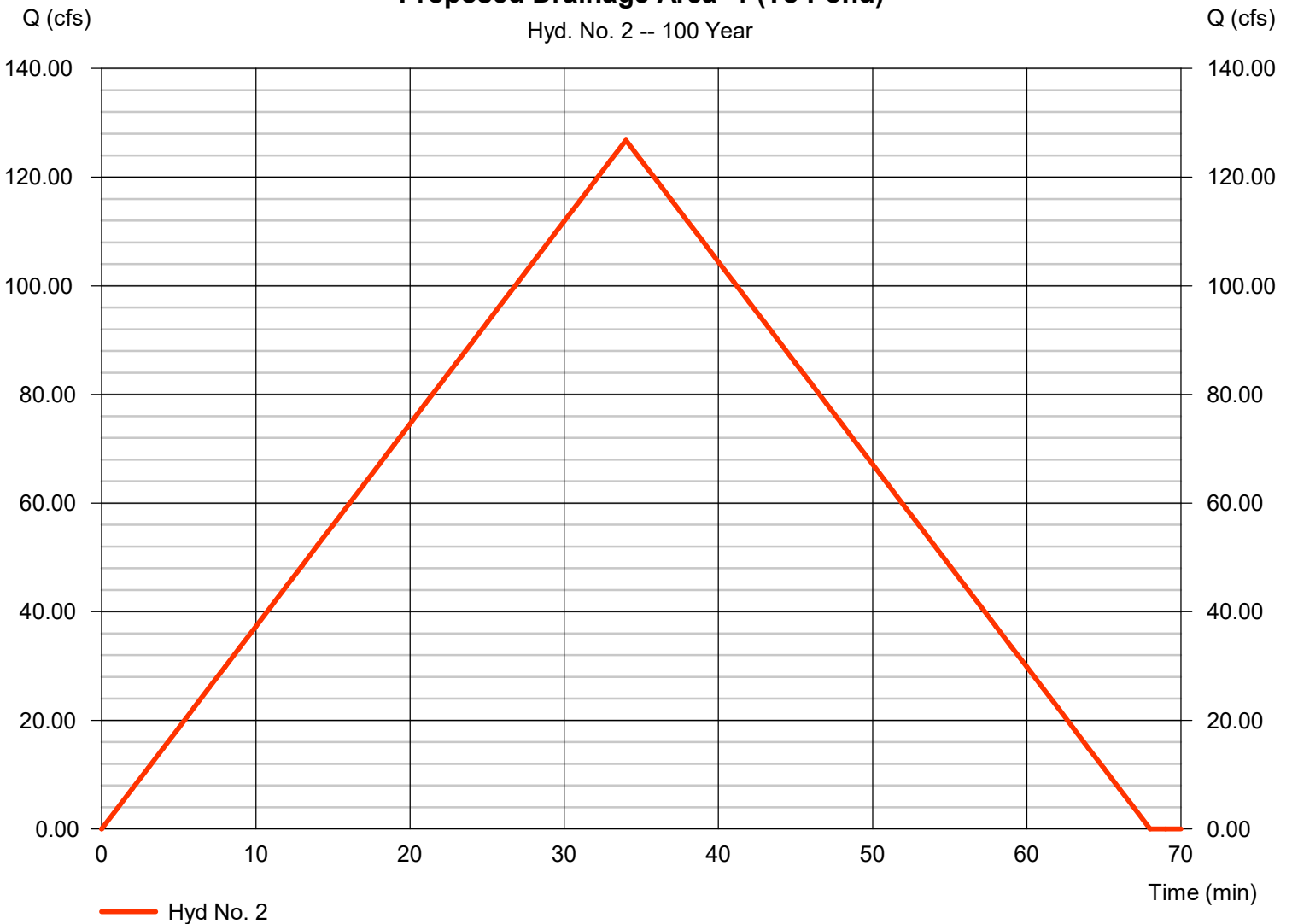
Proposed Drainage Area- 1 (To Pond)

Hydrograph type	= Rational	Peak discharge	= 126.80 cfs
Storm frequency	= 100 yrs	Time to peak	= 34 min
Time interval	= 1 min	Hyd. volume	= 258,675 cuft
Drainage area	= 22.280 ac	Runoff coeff.	= 0.9*
Intensity	= 6.324 in/hr	Tc by TR55	= 34.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(22.281 x 0.90)] / 22.280

Proposed Drainage Area- 1 (To Pond)

Hyd. No. 2 -- 100 Year



Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2026

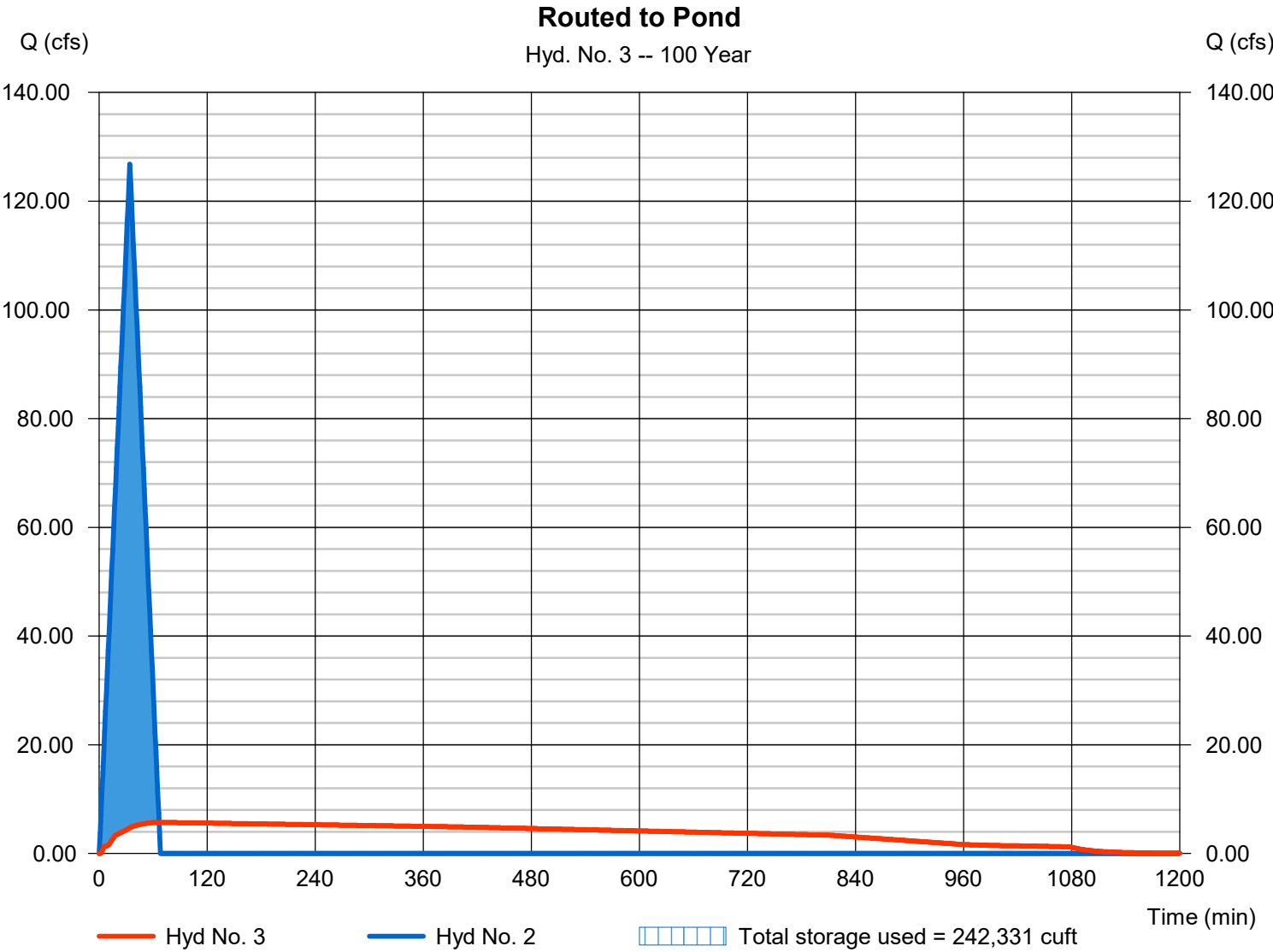
Thursday, 04 / 2 / 2026

Hyd. No. 3

Routed to Pond

Hydrograph type	= Reservoir	Peak discharge	= 5.716 cfs
Storm frequency	= 100 yrs	Time to peak	= 66 min
Time interval	= 1 min	Hyd. volume	= 258,662 cuft
Inflow hyd. No.	= 2 - Proposed Drainage Area-1 (Max. Flood)	Max. Flood elevation	= 192.71 ft
Reservoir name	= Proposed Pond	Max. Storage	= 242,331 cuft

Storage Indication method used.



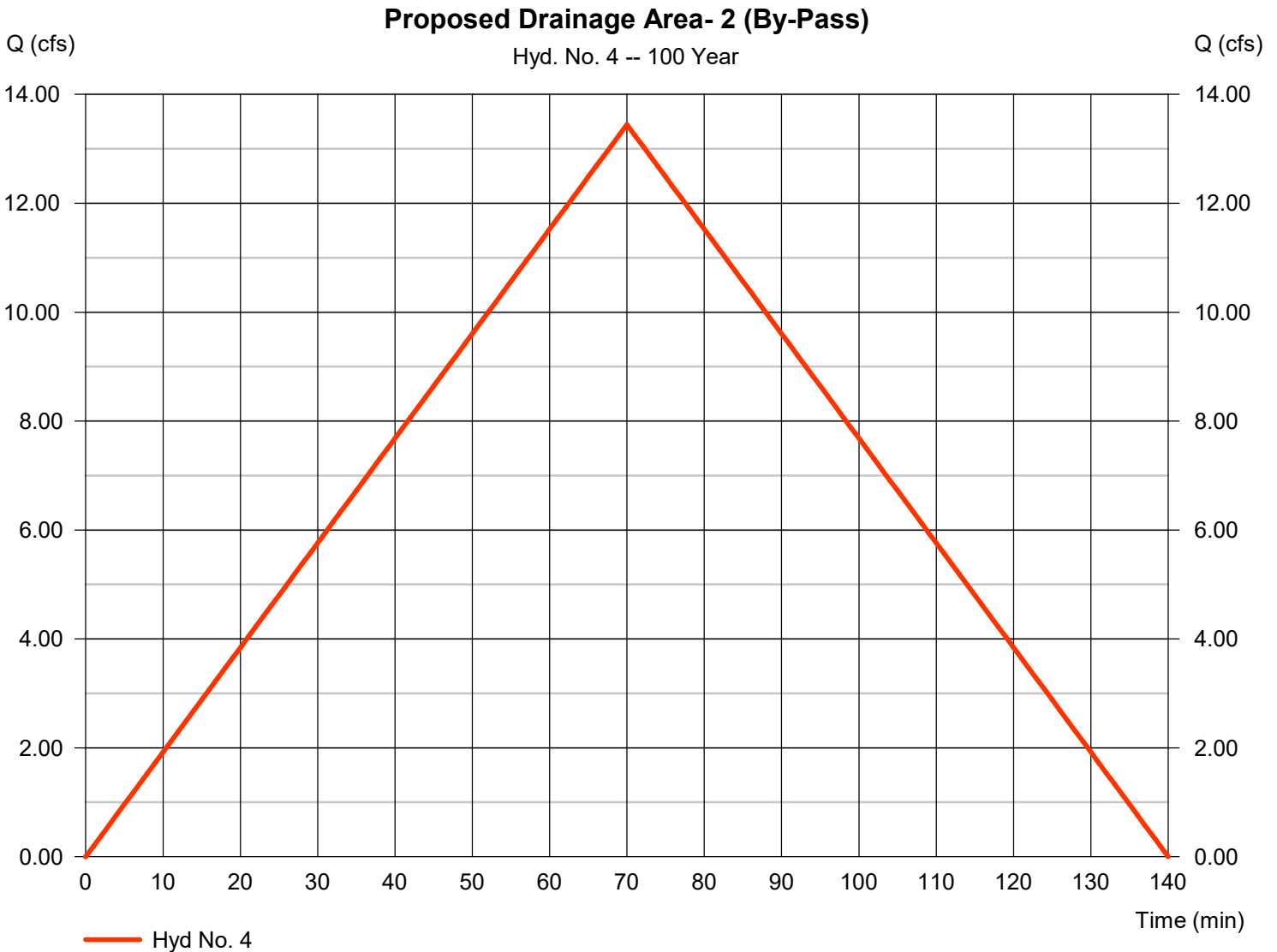
Hydrograph Report

Hyd. No. 4

Proposed Drainage Area- 2 (By-Pass)

Hydrograph type	= Rational	Peak discharge	= 13.45 cfs
Storm frequency	= 100 yrs	Time to peak	= 70 min
Time interval	= 1 min	Hyd. volume	= 56,473 cuft
Drainage area	= 10.440 ac	Runoff coeff.	= 0.3*
Intensity	= 4.293 in/hr	Tc by TR55	= 70.00 min
IDF Curve	= Rainfall IDF Curve_Tomball.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(10.440 x 0.30)] / 10.440



Hydrograph Report

Hyd. No. 5

Proposed Combined Flow (Offsite)

Hydrograph type = Combine
Storm frequency = 100 yrs
Time interval = 1 min
Inflow hyds. = 3, 4

Peak discharge = 19.16 cfs
Time to peak = 70 min
Hyd. volume = 315,136 cuft
Contrib. drain. area = 10.440 ac

Proposed Combined Flow (Offsite)

Hyd. No. 5 -- 100 Year

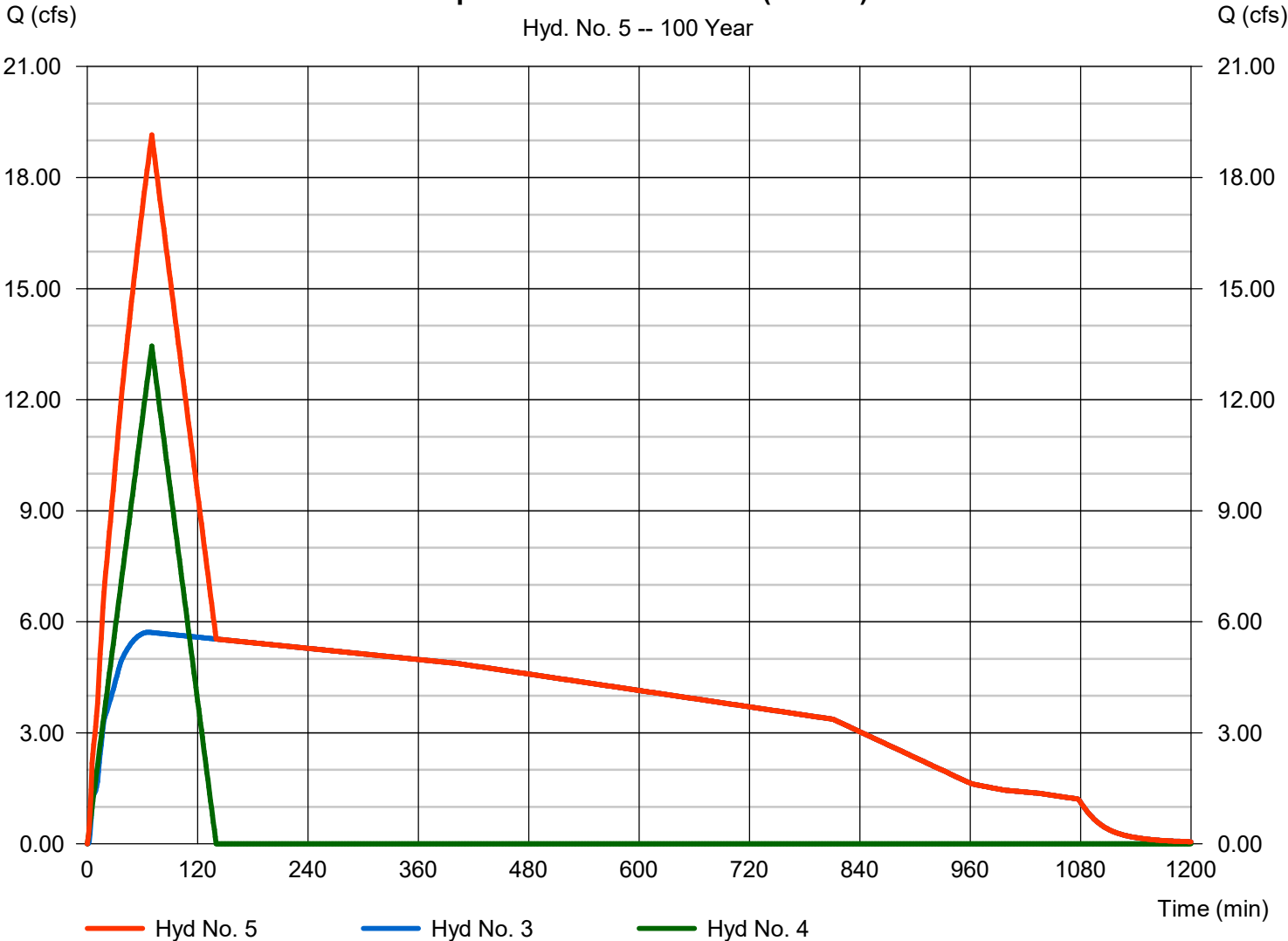
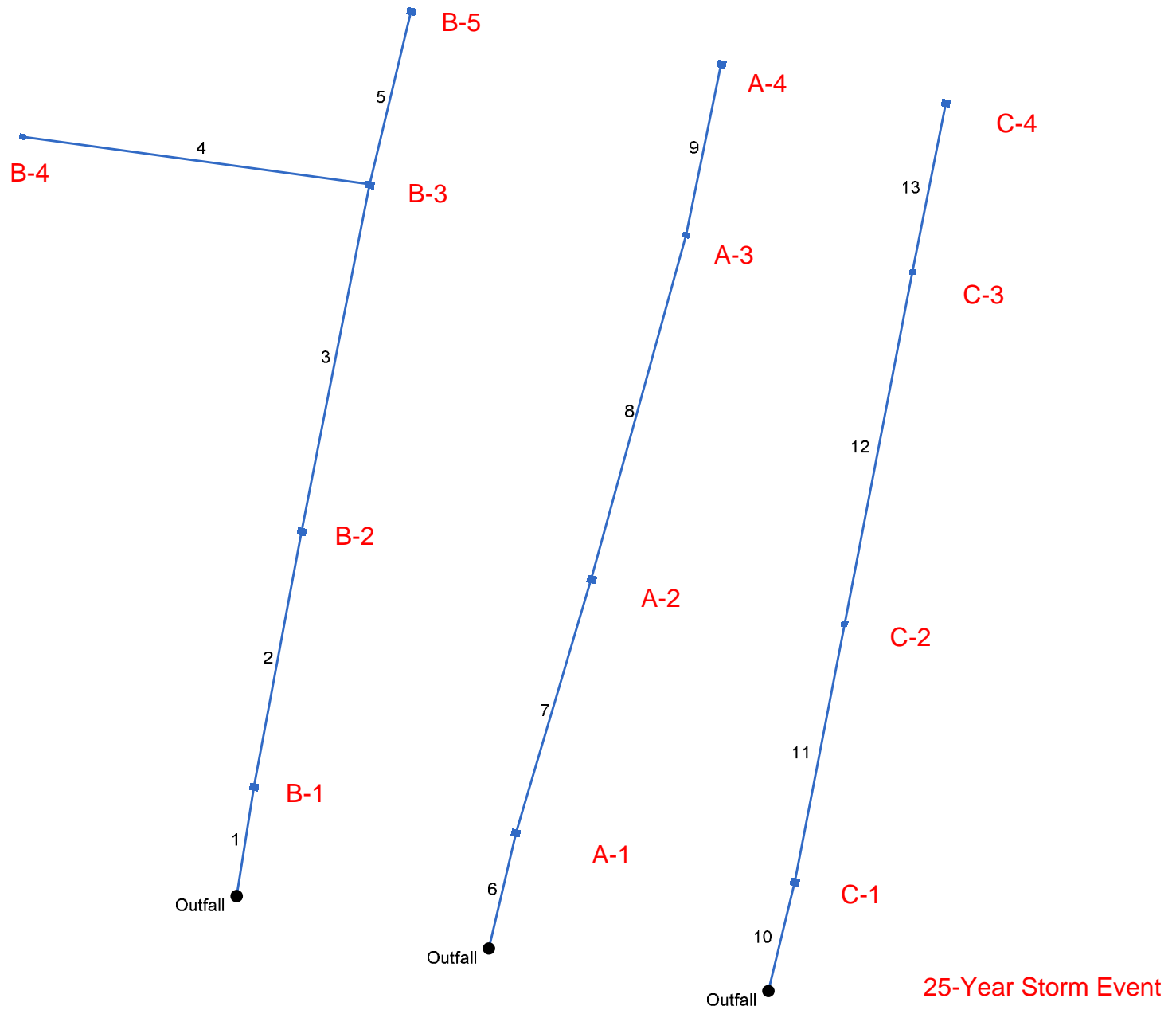


EXHIBIT 4
Hydraflow Storm
Sewer Results

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	67.000	0.42	3.28	0.90	0.38	2.95	10.0	14.3	7.8	23.08	15.35	4.70	30	0.12	189.80	189.88	192.72	192.90	195.42	195.59	Pipe - 5
2	1	158.000	1.37	2.86	0.90	1.23	2.57	10.0	13.7	8.0	20.51	15.41	4.18	30	0.12	189.98	190.17	193.07	193.41	195.59	193.90	Pipe 6
3	2	214.205	0.69	1.49	0.90	0.62	1.34	10.0	12.2	8.4	11.23	15.48	2.29	30	0.12	190.27	190.53	193.55	193.68	193.90	193.98	Pipe 7
4	3	172.000	0.28	0.28	0.90	0.25	0.25	10.0	10.0	9.1	2.29	6.49	1.30	18	0.33	191.25	191.81	193.80	193.87	193.98	194.27	Pipe 8
5	3	108.299	0.52	0.52	0.90	0.47	0.47	10.0	10.0	9.1	4.26	9.99	1.35	24	0.17	191.03	191.21	193.80	193.84	193.98	194.48	Pipe 9
6	End	72.479	0.17	1.85	0.90	0.15	1.67	10.0	13.5	8.0	13.36	15.66	2.72	30	0.12	189.80	189.89	192.72	192.79	195.42	195.59	Pipe - 1
7	6	158.672	0.87	1.68	0.90	0.78	1.51	10.0	12.8	8.2	12.40	10.11	3.95	24	0.17	190.39	190.66	192.84	193.25	195.59	194.37	Pipe 2
8	7	215.773	0.46	0.81	0.90	0.41	0.73	10.0	11.1	8.7	6.36	10.15	2.02	24	0.17	190.76	191.13	193.37	193.52	194.37	194.43	Pipe 3
9	8	105.925	0.35	0.35	0.90	0.32	0.32	10.0	10.0	9.1	2.86	5.64	1.62	18	0.25	191.63	191.89	193.55	193.62	194.43	194.46	pipe 4
10	End	67.802	0.19	2.02	0.90	0.17	1.82	10.0	13.5	8.0	14.58	15.26	2.97	30	0.12	189.80	189.88	192.72	192.79	194.38	195.32	Pipe 10
11	10	159.463	1.00	1.83	0.90	0.90	1.65	10.0	12.9	8.2	13.48	10.08	4.29	24	0.17	190.38	190.65	192.86	193.34	195.32	194.27	pipe 11
12	11	217.910	0.51	0.83	0.90	0.46	0.75	10.0	11.2	8.7	6.49	10.10	2.07	24	0.17	190.75	191.12	193.49	193.64	194.27	193.93	pipe 12
13	12	104.951	0.32	0.32	0.90	0.29	0.29	10.0	10.0	9.1	2.62	5.66	1.48	18	0.25	191.62	191.88	193.67	193.73	193.93	194.15	pipe 13

Project File: 364003_Tomball_Storm Sewer Sizing_REVISIED_MGH.stm

Number of lines: 13

Run Date: 4/2/2026

NOTES: Intensity = 54.97 / (Inlet time + 6.27) ^ 0.65; Return period = Yrs. 25 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter						Inlet			Byp Line No	
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)		Depr (in)
1	B-1	3.44	0.00	3.44	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.17	61.44	0.17	61.44	0.0	Off
2	B-2	11.21	0.00	11.21	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.38	130.38	0.38	130.38	0.0	Off
3	B-3	5.65	0.00	5.65	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.24	83.98	0.24	83.98	0.0	Off
4	B-4	2.29	0.00	2.29	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.16	56.10	0.16	56.10	0.0	Off
5	B-5	4.26	0.00	4.26	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.20	70.23	0.20	70.23	0.0	Off
6	A-1	1.39	0.00	1.39	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.09	35.42	0.09	35.42	0.0	Off
7	A-2	7.12	0.00	7.12	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.28	97.35	0.28	97.35	0.0	Off
8	A-3	3.77	0.00	3.77	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.22	76.94	0.22	76.94	0.0	Off
9	A-4	2.86	0.00	2.86	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.15	54.86	0.15	54.86	0.0	Off
10	C-1	1.56	0.00	1.56	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.10	37.84	0.10	37.84	0.0	Off
11	C-2	8.19	0.00	8.19	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.37	127.11	0.37	127.11	0.0	Off
12	C-3	4.17	0.00	4.17	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.24	82.21	0.24	82.21	0.0	Off
13	C-4	2.62	0.00	2.62	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.14	51.91	0.14	51.91	0.0	Off

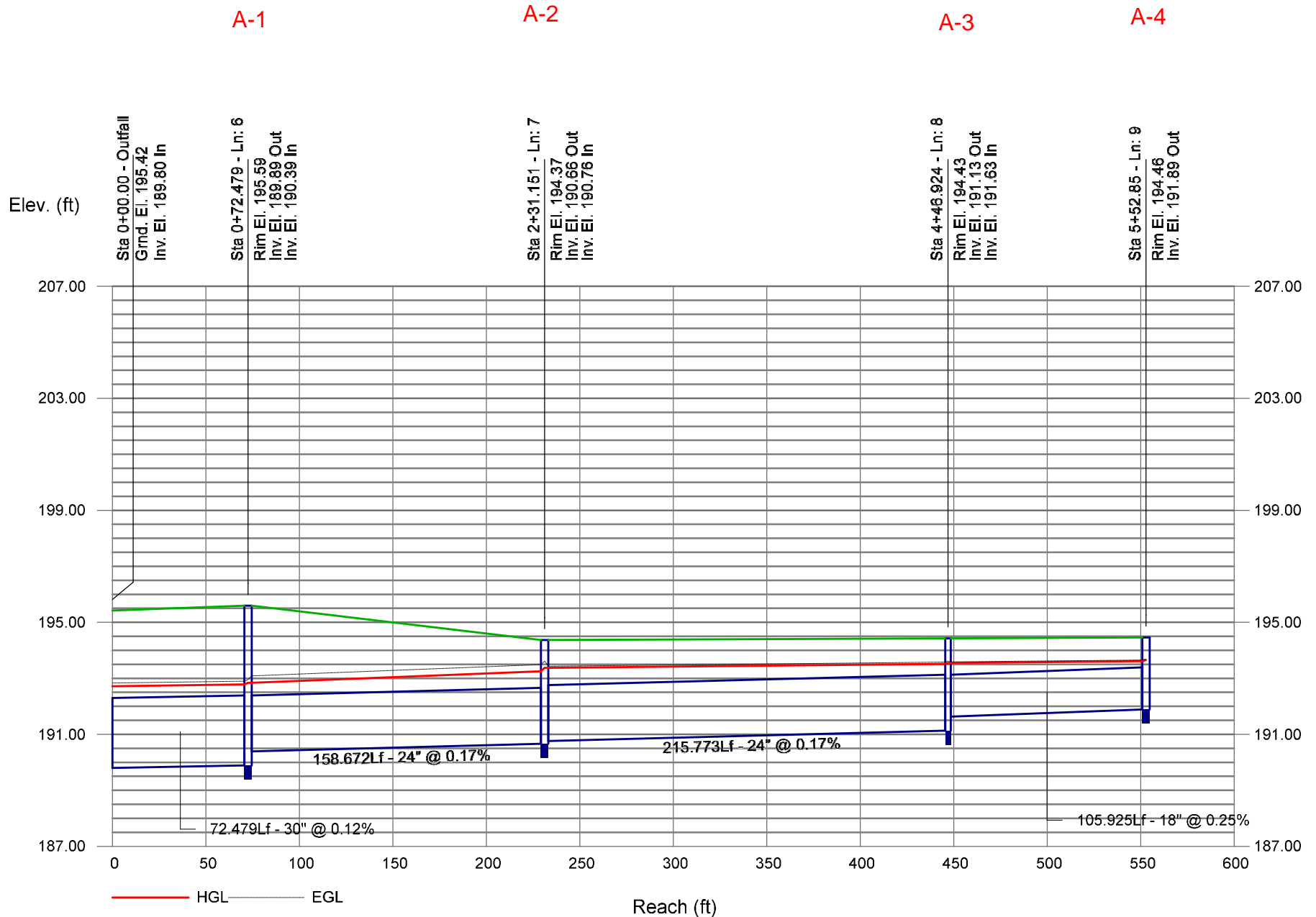
Project File: 364003_Tomball_Storm Sewer Sizing_REVISED_MGH.stm

Number of lines: 13

Run Date: 4/2/2026

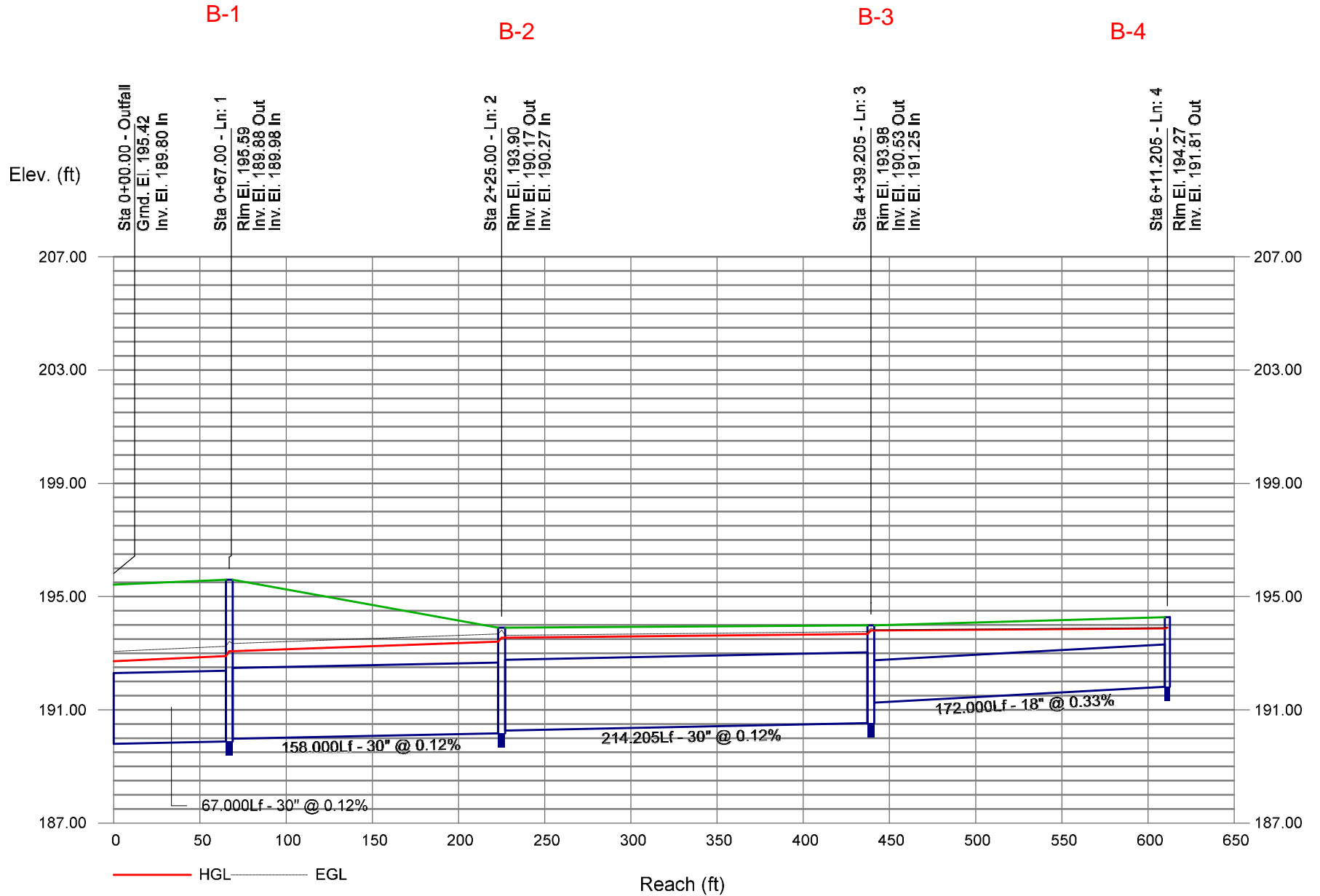
NOTES: Inlet N-Values = 0.016; Intensity = 54.97 / (Inlet time + 6.27) ^ 0.65; Return period = 25 Yrs.; * Indicates Known Q added. All curb inlets are throat.

Storm Sewer Profile



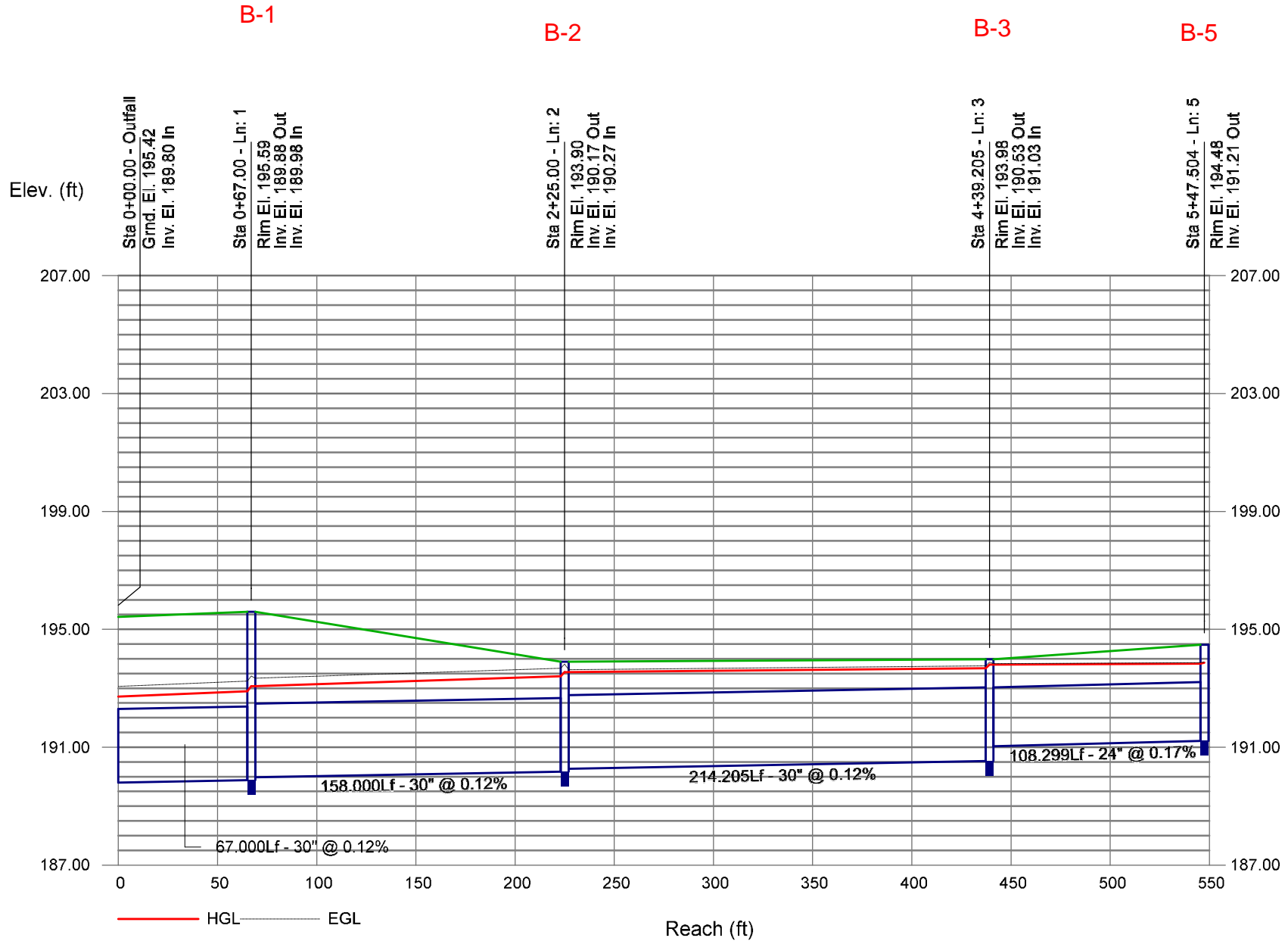
25-Year Storm Event

Storm Sewer Profile



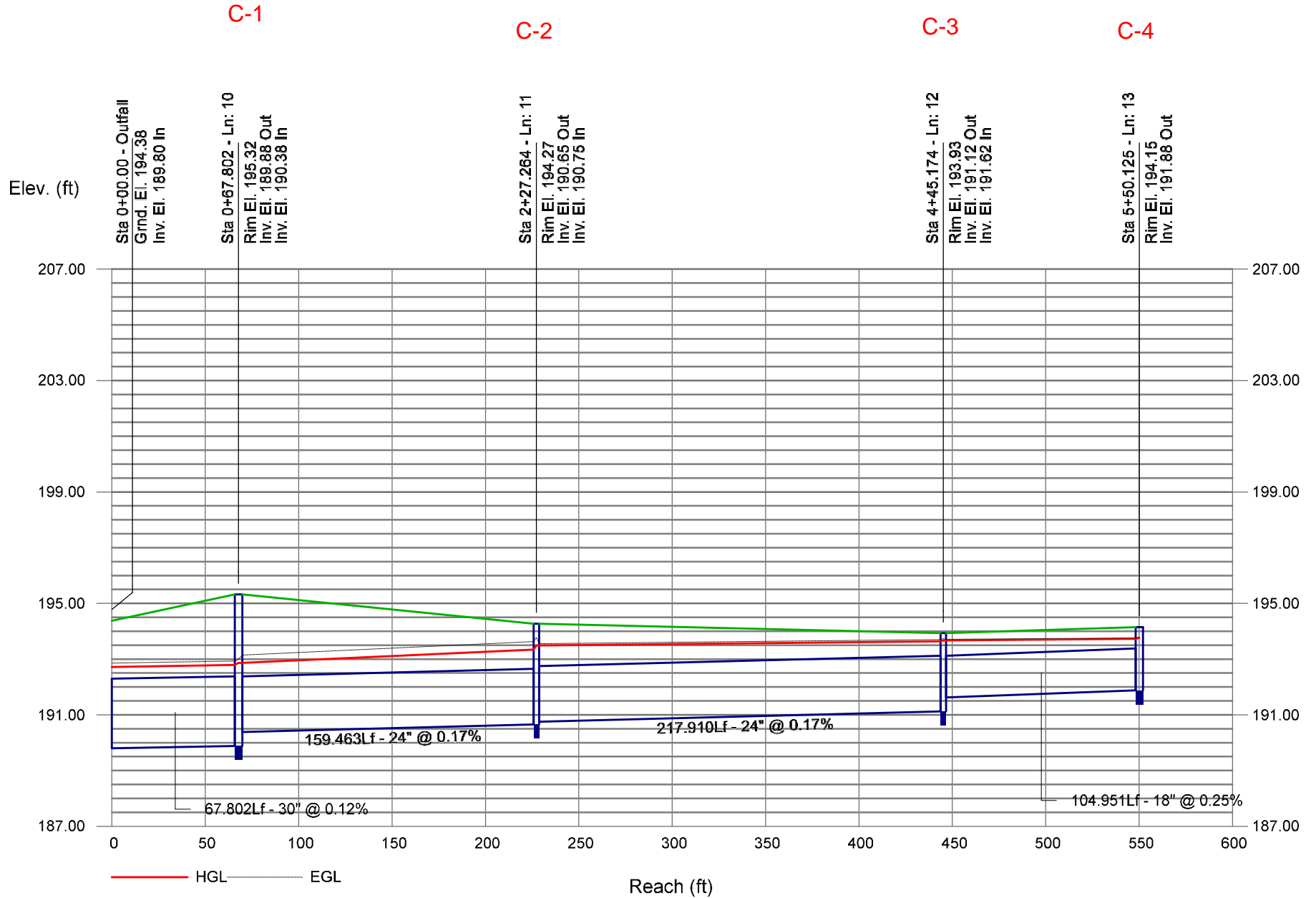
25-Year Storm Event

Storm Sewer Profile



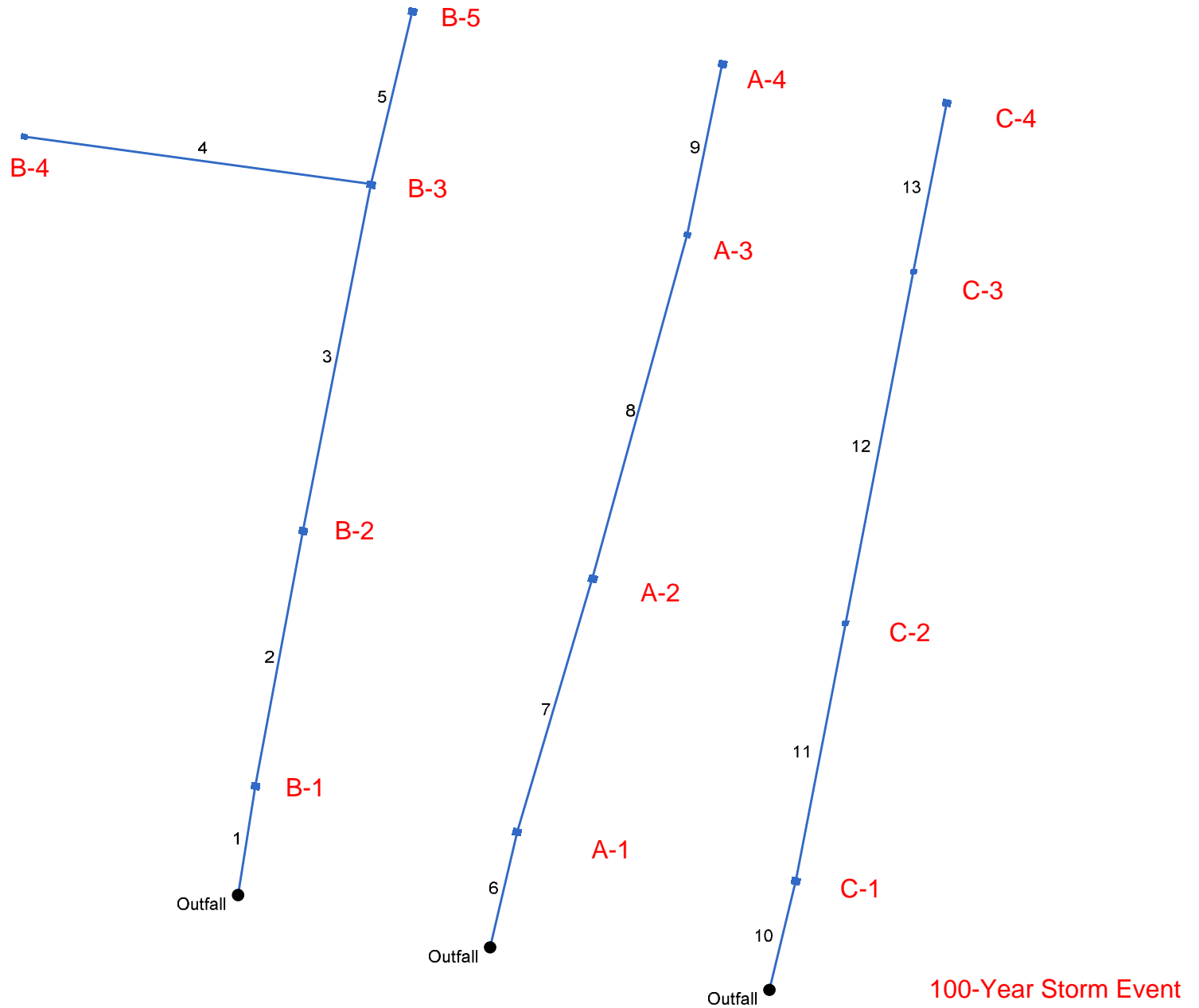
25-Year Storm Event

Storm Sewer Profile



25-Year Storm Event

Hydraflow Storm Sewers Extension for Autodesk® Civil 3D® Plan



Storm Sewer Tabulation

Station		Len (ft)	Drng Area		Rnoff coeff (C)	Area x C		Tc		Rain (l) (in/hr)	Total flow (cfs)	Cap full (cfs)	Vel (ft/s)	Pipe		Invert Elev		HGL Elev		Grnd / Rim Elev		Line ID
Line	To Line		Incr (ac)	Total (ac)		Incr	Total	Inlet (min)	Syst (min)					Size (in)	Slope (%)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	Dn (ft)	Up (ft)	
1	End	67.000	0.42	3.28	0.90	0.38	2.95	10.0	13.5	9.9	29.16	15.35	5.94	30	0.12	189.80	189.88	192.72	193.01	195.42	195.59	Pipe - 5
2	1	158.000	1.37	2.86	0.90	1.23	2.57	10.0	13.0	10.0	25.84	15.41	5.26	30	0.12	189.98	190.17	193.28	193.82	195.59	193.90	Pipe 6
3	2	214.205	0.69	1.49	0.90	0.62	1.34	10.0	11.8	10.5	14.04	15.48	2.86	30	0.12	190.27	190.53	194.03	194.25	193.90	193.98	Pipe 7
4	3	172.000	0.28	0.28	0.90	0.25	0.25	10.0	10.0	11.2	2.82	6.49	1.60	18	0.33	191.25	191.81	194.44	194.54	193.98	194.27	Pipe 8
5	3	108.299	0.52	0.52	0.90	0.47	0.47	10.0	10.0	11.2	5.25	9.99	1.67	24	0.17	191.03	191.21	194.44	194.49	193.98	194.48	Pipe 9
6	End	72.479	0.17	1.85	0.90	0.15	1.67	10.0	12.8	10.1	16.82	15.66	3.43	30	0.12	189.80	189.89	192.72	192.82	195.42	195.59	Pipe - 1
7	6	158.672	0.87	1.68	0.90	0.78	1.51	10.0	12.3	10.3	15.55	10.11	4.95	24	0.17	190.39	190.66	192.92	193.55	195.59	194.37	Pipe 2
8	7	215.773	0.46	0.81	0.90	0.41	0.73	10.0	10.9	10.8	7.89	10.15	2.51	24	0.17	190.76	191.13	193.74	193.97	194.37	194.43	Pipe 3
9	8	105.925	0.35	0.35	0.90	0.32	0.32	10.0	10.0	11.2	3.53	5.64	2.00	18	0.25	191.63	191.89	194.02	194.12	194.43	194.46	pipe 4
10	End	67.802	0.19	2.02	0.90	0.17	1.82	10.0	12.8	10.1	18.35	15.26	3.74	30	0.12	189.80	189.88	192.72	192.84	194.38	195.32	Pipe 10
11	10	159.463	1.00	1.83	0.90	0.90	1.65	10.0	12.4	10.3	16.91	10.08	5.38	24	0.17	190.38	190.65	192.94	193.70	195.32	194.27	pipe 11
12	11	217.910	0.51	0.83	0.90	0.46	0.75	10.0	11.0	10.8	8.07	10.10	2.57	24	0.17	190.75	191.12	193.93	194.17	194.27	193.93	pipe 12
13	12	104.951	0.32	0.32	0.90	0.29	0.29	10.0	10.0	11.2	3.23	5.66	1.83	18	0.25	191.62	191.88	194.22	194.30	193.93	194.15	pipe 13

Project File: 364003_Tomball_Storm Sewer Sizing_REVISIED_MGH.stm

Number of lines: 13

Run Date: 4/2/2026

NOTES: Intensity = 53.93 / (Inlet time + 4.53) ^ 0.59; Return period = Yrs. 100 ; c = cir e = ellip b = box

Inlet Report

Line No	Inlet ID	Q = CIA (cfs)	Q carry (cfs)	Q capt (cfs)	Q Byp (cfs)	Junc Type	Curb Inlet		Grate Inlet			Gutter						Inlet			Byp Line No	
							Ht (in)	L (ft)	Area (sqft)	L (ft)	W (ft)	So (ft/ft)	W (ft)	Sw (ft/ft)	Sx (ft/ft)	n	Depth (ft)	Spread (ft)	Depth (ft)	Spread (ft)		Depr (in)
1	B-1	4.24	0.00	4.24	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.20	70.03	0.20	70.03	0.0	Off
2	B-2	13.82	0.00	13.82	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.44	149.29	0.44	149.29	0.0	Off
3	B-3	6.96	0.00	6.96	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.28	95.95	0.28	95.95	0.0	Off
4	B-4	2.82	0.00	2.82	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.18	64.04	0.18	64.04	0.0	Off
5	B-5	5.25	0.00	5.25	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.23	80.14	0.23	80.14	0.0	Off
6	A-1	1.72	0.00	1.72	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.11	40.12	0.11	40.12	0.0	Off
7	A-2	8.78	0.00	8.78	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.32	111.32	0.32	111.32	0.0	Off
8	A-3	4.64	0.00	4.64	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.26	88.00	0.26	88.00	0.0	Off
9	A-4	3.53	0.00	3.53	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.18	62.47	0.18	62.47	0.0	Off
10	C-1	1.92	0.00	1.92	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.12	42.90	0.12	42.90	0.0	Off
11	C-2	10.09	0.00	10.09	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.43	145.68	0.43	145.68	0.0	Off
12	C-3	5.15	0.00	5.15	0.00	DrGrt	0.0	0.00	9.00	3.00	3.00	Sag	3.00	0.006	0.006	0.013	0.27	94.06	0.27	94.06	0.0	Off
13	C-4	3.23	0.00	3.23	0.00	DrGrt	0.0	0.00	16.00	4.00	4.00	Sag	4.00	0.006	0.006	0.013	0.17	59.08	0.17	59.08	0.0	Off

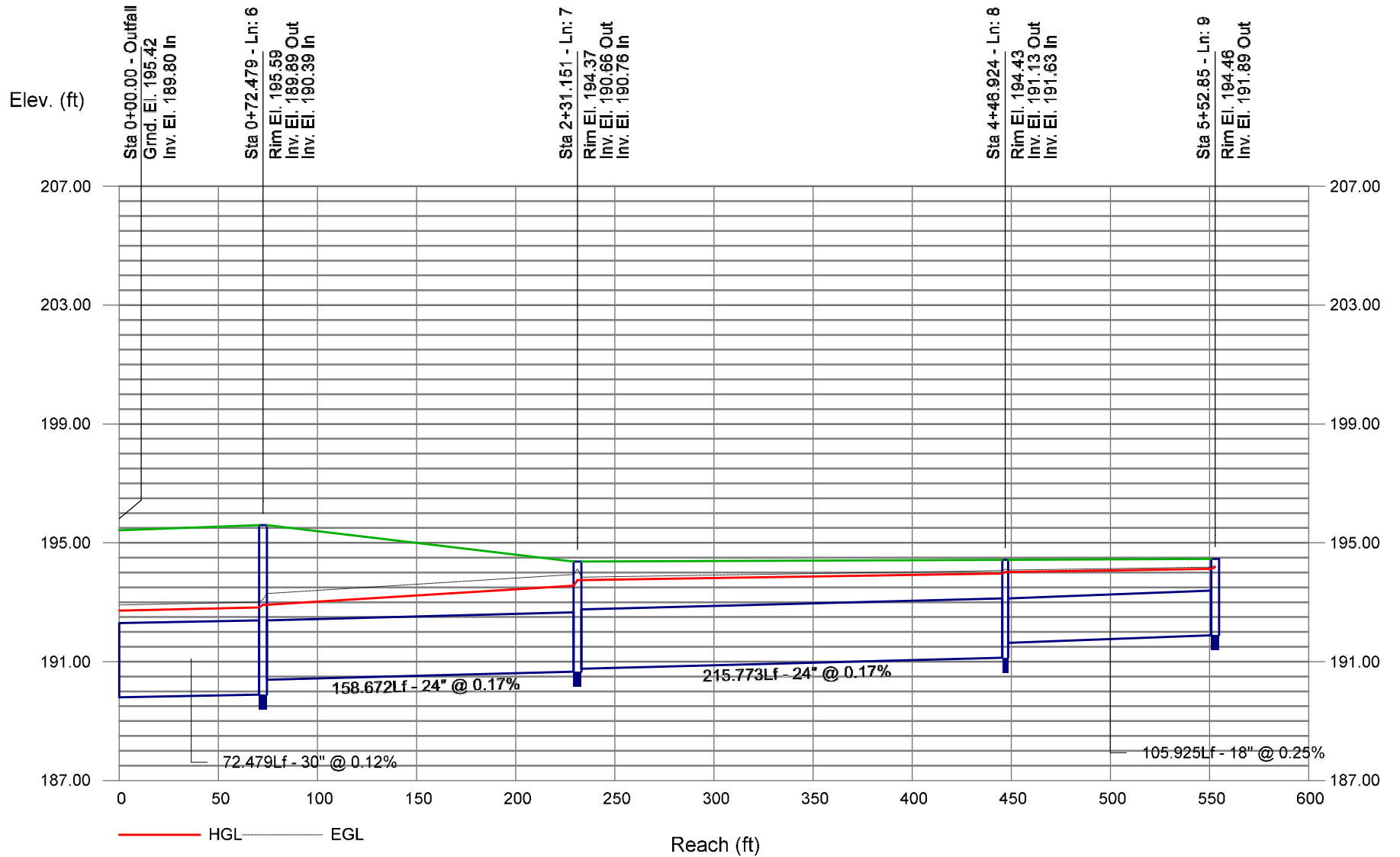
Project File: 364003_Tomball_Storm Sewer Sizing_REVISED_MGH.stm

Number of lines: 13

Run Date: 4/2/2026

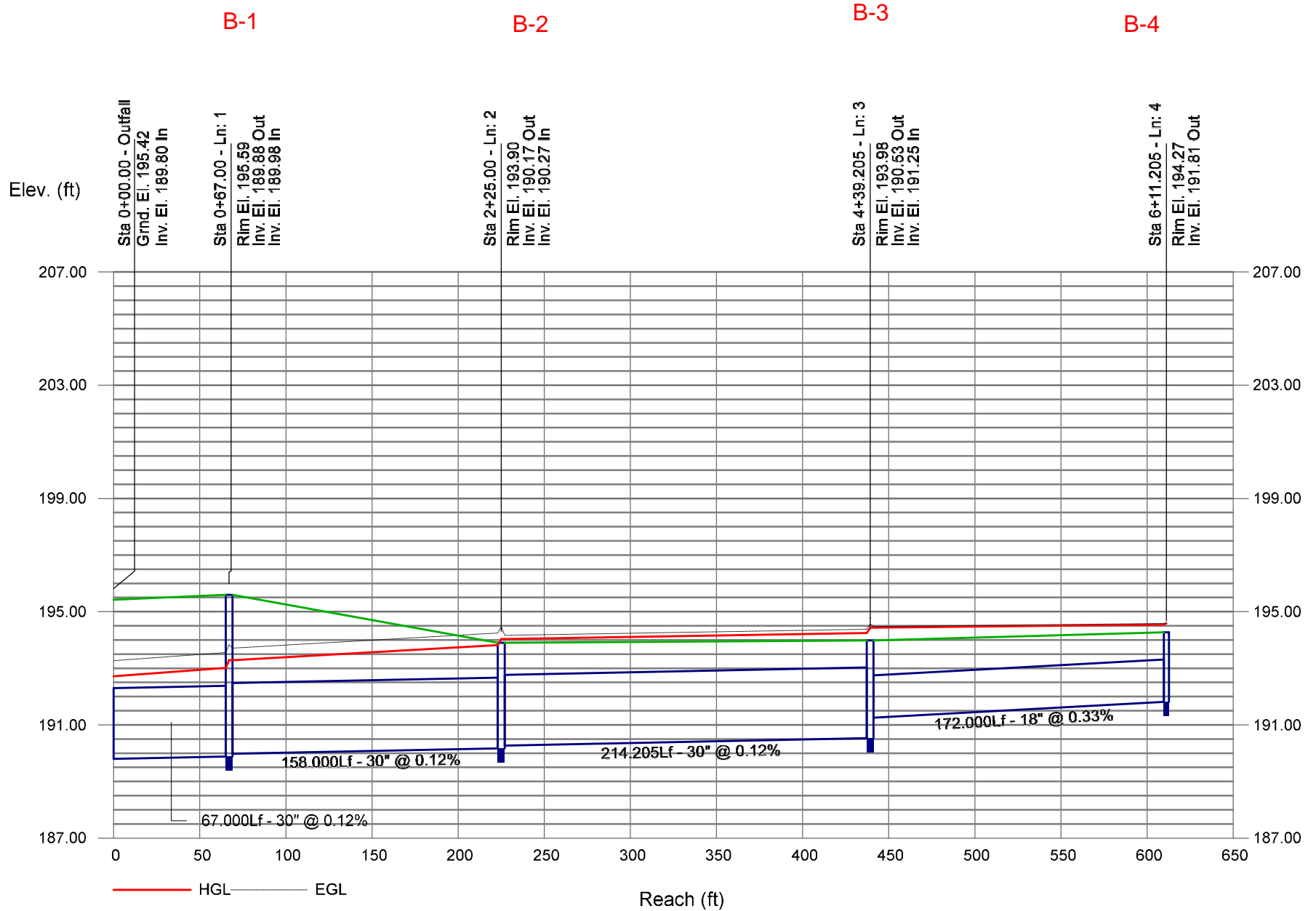
NOTES: Inlet N-Values = 0.016; Intensity = 53.93 / (Inlet time + 4.53) ^ 0.59; Return period = 100 Yrs. ; * Indicates Known Q added. All curb inlets are throat.

Storm Sewer Profile



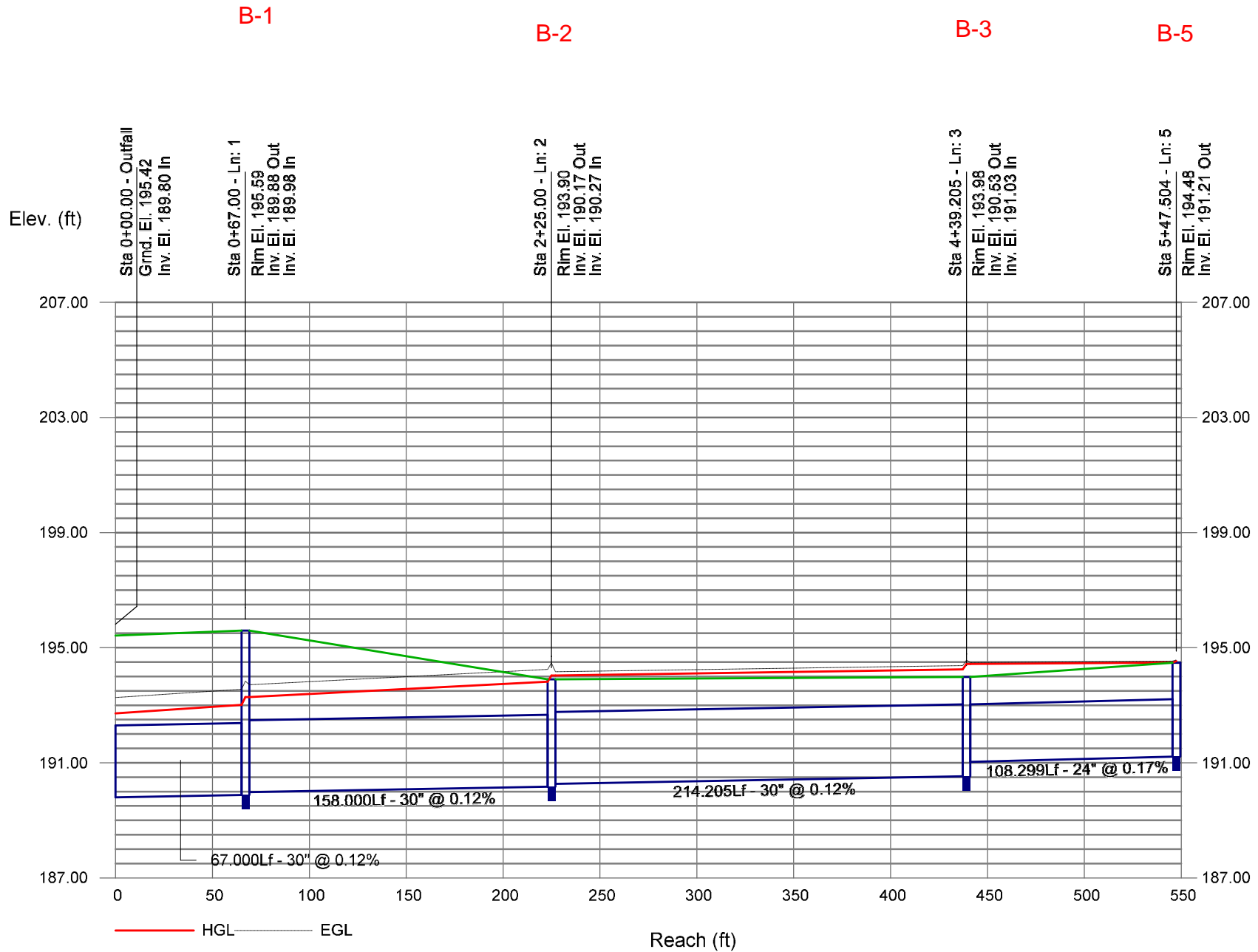
100-Year Storm Event

Storm Sewer Profile



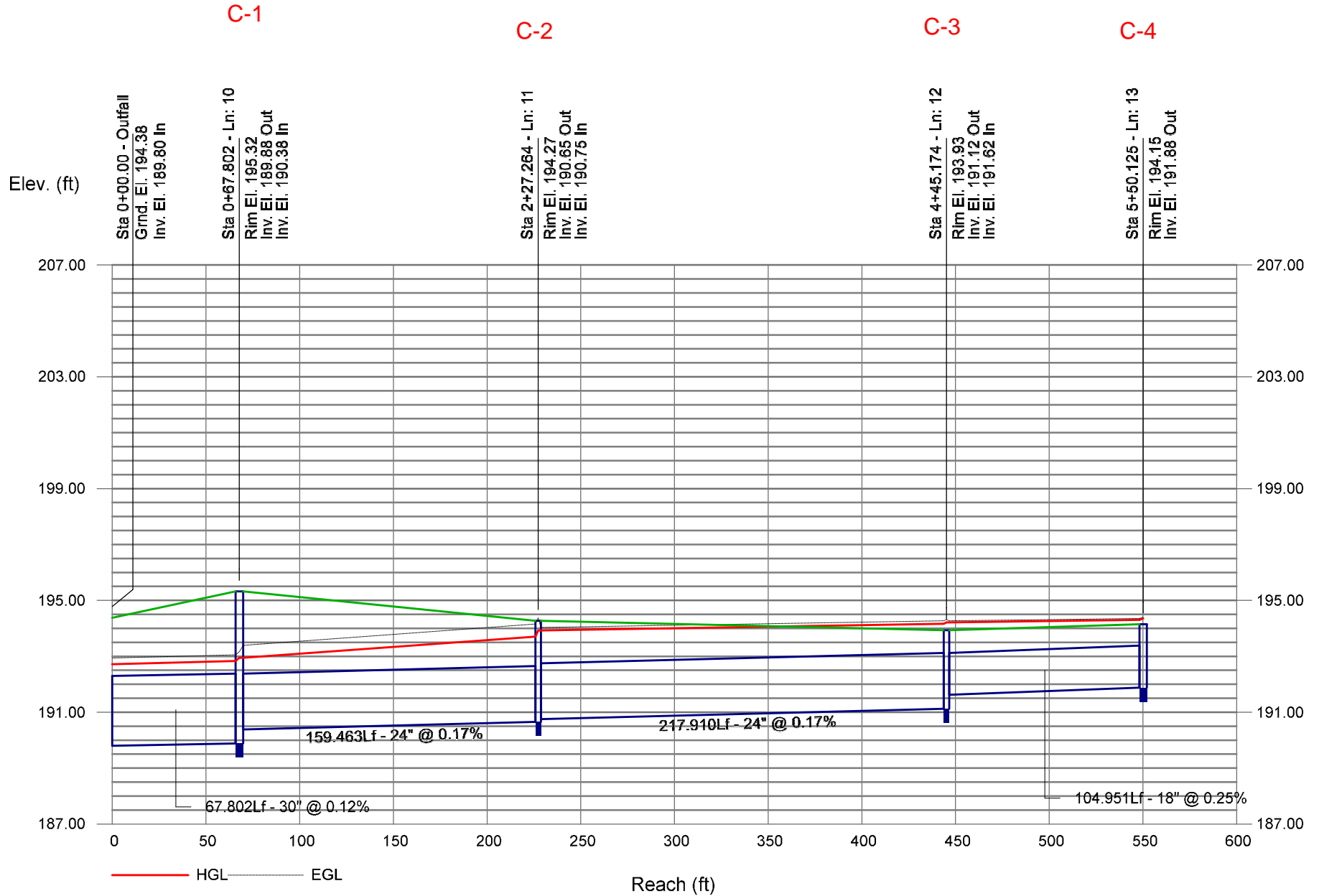
100-Year Storm Event

Storm Sewer Profile



100-Year Storm Event

Storm Sewer Profile



100-Year Storm Event

EXHIBIT 5
Rainfall Precipitation Data



NOAA Atlas 14, Volume 11, Version 2
Location name: Tomball, Texas, USA*
Latitude: 30.1067°, Longitude: -95.6275°
Elevation: 195 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

[PF_tabular](#) | [PF_graphical](#) | [Maps & aerials](#)

PF tabular

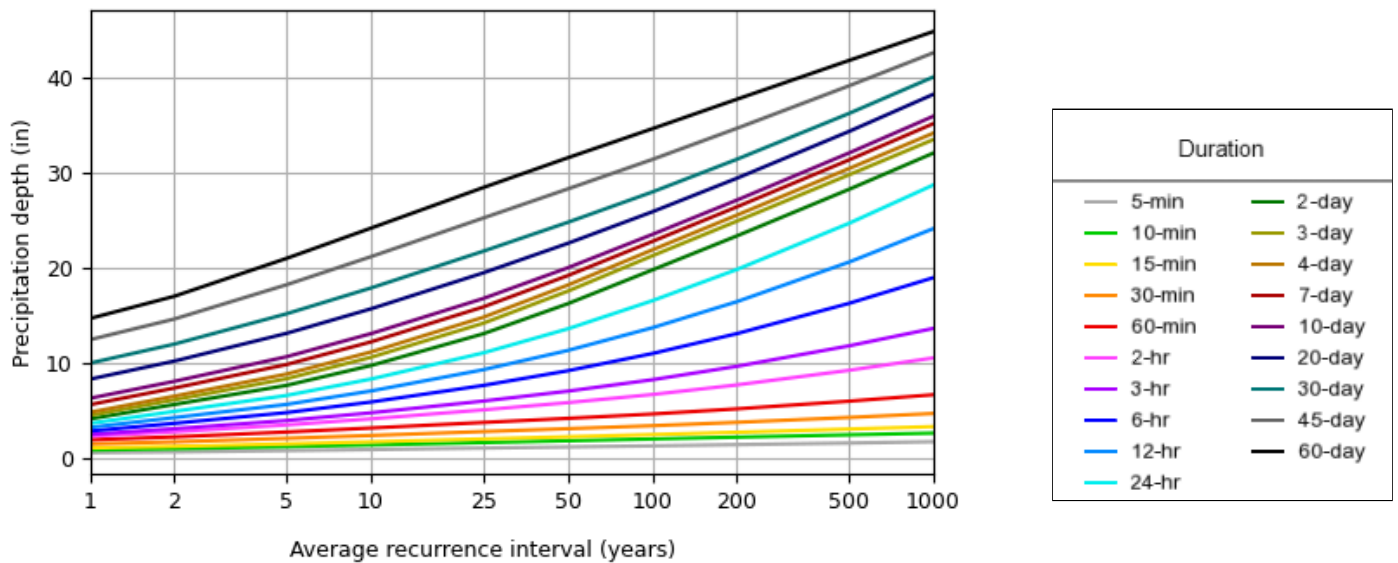
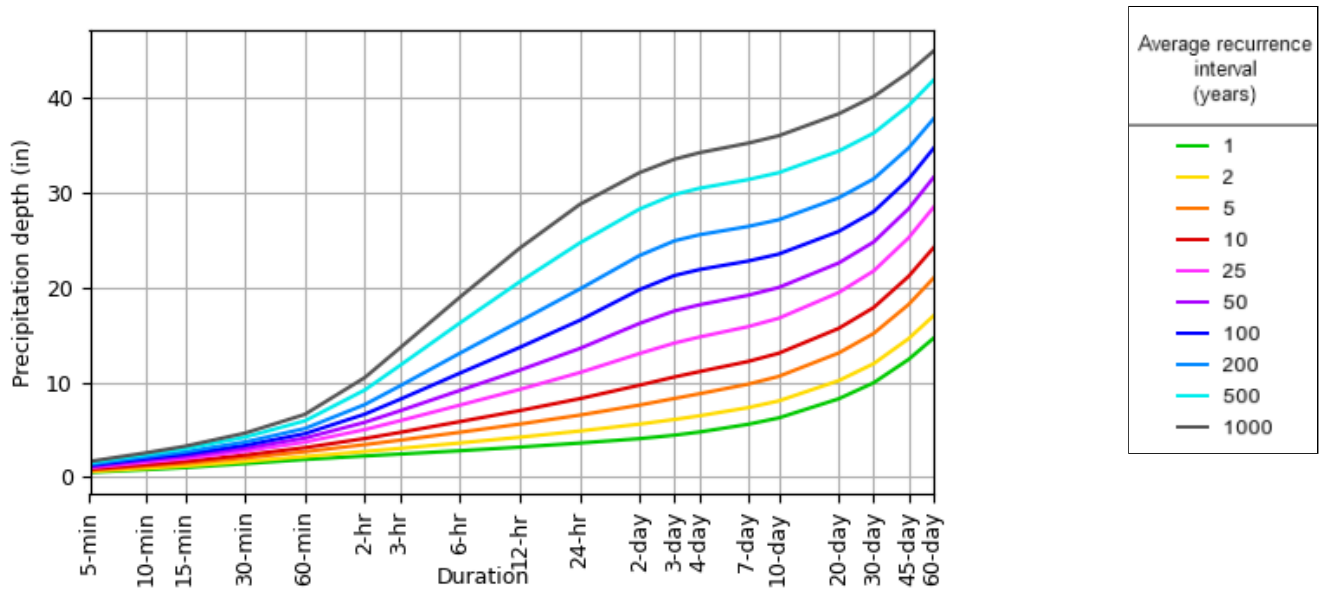
PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.489 (0.370-0.646)	0.572 (0.437-0.748)	0.708 (0.539-0.930)	0.820 (0.615-1.09)	0.974 (0.707-1.34)	1.09 (0.772-1.54)	1.21 (0.835-1.76)	1.34 (0.899-1.99)	1.51 (0.981-2.33)	1.65 (1.04-2.60)
10-min	0.775 (0.587-1.02)	0.909 (0.694-1.19)	1.13 (0.858-1.48)	1.31 (0.981-1.74)	1.56 (1.13-2.14)	1.75 (1.24-2.47)	1.94 (1.34-2.81)	2.13 (1.43-3.17)	2.38 (1.54-3.66)	2.56 (1.62-4.04)
15-min	0.986 (0.747-1.30)	1.15 (0.879-1.50)	1.42 (1.08-1.86)	1.64 (1.23-2.18)	1.94 (1.41-2.66)	2.17 (1.53-3.06)	2.40 (1.66-3.48)	2.64 (1.78-3.94)	2.98 (1.94-4.60)	3.24 (2.05-5.12)
30-min	1.41 (1.07-1.86)	1.63 (1.25-2.14)	2.00 (1.53-2.64)	2.31 (1.73-3.07)	2.72 (1.97-3.72)	3.02 (2.13-4.25)	3.34 (2.30-4.84)	3.69 (2.48-5.50)	4.21 (2.74-6.49)	4.63 (2.93-7.31)
60-min	1.85 (1.40-2.44)	2.16 (1.65-2.83)	2.67 (2.04-3.51)	3.10 (2.32-4.12)	3.68 (2.66-5.02)	4.11 (2.90-5.78)	4.57 (3.15-6.63)	5.12 (3.44-7.62)	5.92 (3.85-9.15)	6.61 (4.18-10.4)
2-hr	2.22 (1.69-2.92)	2.70 (2.04-3.45)	3.42 (2.60-4.45)	4.06 (3.06-5.39)	5.00 (3.65-6.83)	5.77 (4.10-8.11)	6.63 (4.59-9.57)	7.64 (5.15-11.3)	9.18 (5.98-14.1)	10.5 (6.66-16.5)
3-hr	2.42 (1.84-3.17)	3.02 (2.26-3.80)	3.88 (2.96-5.03)	4.70 (3.55-6.22)	5.93 (4.35-8.11)	6.98 (4.98-9.82)	8.19 (5.68-11.8)	9.60 (6.48-14.2)	11.8 (7.68-18.0)	13.6 (8.66-21.4)
6-hr	2.77 (2.12-3.62)	3.59 (2.66-4.42)	4.72 (3.60-6.07)	5.84 (4.43-7.69)	7.58 (5.60-10.4)	9.13 (6.57-12.8)	11.0 (7.63-15.7)	13.1 (8.84-19.2)	16.2 (10.6-24.8)	19.0 (12.1-29.7)
12-hr	3.16 (2.42-4.10)	4.19 (3.10-5.08)	5.58 (4.28-7.14)	7.00 (5.33-9.18)	9.24 (6.87-12.6)	11.3 (8.15-15.8)	13.7 (9.56-19.5)	16.4 (11.2-24.0)	20.6 (13.5-31.3)	24.1 (15.5-37.6)
24-hr	3.58 (2.76-4.63)	4.85 (3.58-5.80)	6.53 (5.02-8.30)	8.26 (6.32-10.8)	11.0 (8.25-15.0)	13.6 (9.86-19.0)	16.5 (11.6-23.5)	19.8 (13.5-28.9)	24.7 (16.3-37.4)	28.8 (18.5-44.7)
2-day	4.05 (3.13-5.21)	5.58 (4.11-6.61)	7.59 (5.86-9.60)	9.69 (7.44-12.6)	13.0 (9.87-17.8)	16.2 (11.9-22.7)	19.8 (13.9-28.0)	23.4 (16.0-33.9)	28.3 (18.7-42.5)	32.1 (20.7-49.7)
3-day	4.41 (3.43-5.67)	6.07 (4.51-7.21)	8.29 (6.42-10.5)	10.6 (8.12-13.7)	14.1 (10.7-19.3)	17.5 (12.9-24.5)	21.3 (15.0-30.1)	24.9 (17.1-36.0)	29.8 (19.7-44.7)	33.5 (21.7-51.8)
4-day	4.74 (3.69-6.08)	6.46 (4.83-7.71)	8.78 (6.82-11.1)	11.1 (8.57-14.4)	14.8 (11.2-20.1)	18.2 (13.4-25.3)	21.9 (15.5-30.9)	25.6 (17.5-36.9)	30.5 (20.2-45.6)	34.2 (22.2-52.8)
7-day	5.56 (4.34-7.09)	7.31 (5.56-8.83)	9.79 (7.63-12.3)	12.2 (9.42-15.7)	15.9 (12.0-21.4)	19.2 (14.1-26.5)	22.8 (16.2-32.0)	26.4 (18.2-38.1)	31.4 (20.9-46.9)	35.2 (22.9-54.1)
10-day	6.23 (4.87-7.94)	8.02 (6.16-9.76)	10.6 (8.30-13.3)	13.1 (10.1-16.8)	16.8 (12.7-22.4)	20.0 (14.7-27.5)	23.5 (16.7-33.0)	27.1 (18.8-39.0)	32.1 (21.4-47.9)	36.0 (23.5-55.2)
20-day	8.24 (6.47-10.5)	10.2 (7.95-12.5)	13.1 (10.3-16.4)	15.7 (12.2-20.1)	19.5 (14.7-25.8)	22.6 (16.6-30.8)	25.9 (18.5-36.2)	29.5 (20.5-42.3)	34.4 (23.1-51.2)	38.3 (25.1-58.6)
30-day	9.94 (7.82-12.6)	12.0 (9.45-14.8)	15.1 (12.0-19.0)	17.9 (13.9-22.8)	21.7 (16.4-28.6)	24.8 (18.2-33.6)	28.0 (20.0-39.0)	31.5 (21.9-45.1)	36.3 (24.4-53.9)	40.2 (26.3-61.2)
45-day	12.4 (9.79-15.7)	14.6 (11.6-18.2)	18.2 (14.5-22.8)	21.2 (16.6-27.0)	25.2 (19.1-33.1)	28.3 (20.8-38.3)	31.4 (22.5-43.7)	34.7 (24.3-49.6)	39.2 (26.5-58.1)	42.7 (28.0-65.0)
60-day	14.6 (11.6-18.4)	17.0 (13.6-21.3)	21.0 (16.7-26.3)	24.2 (18.9-30.7)	28.5 (21.5-37.3)	31.6 (23.3-42.6)	34.7 (24.9-48.2)	37.8 (26.4-54.0)	41.9 (28.3-62.0)	44.9 (29.6-68.3)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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PF graphical

PDS-based depth-duration-frequency (DDF) curves
 Latitude: 30.1067°, Longitude: -95.6275°



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Maps & aerials

Small scale terrain

Table 4 – Rational Method Intensity Coefficients

Coefficient	50 % AEP 2-Year	20 % AEP 5-Year	10 % AEP 10-Year	4 % AEP 25-Year	2 % AEP 50-Year	1 % AEP 100-Year	0.2 % AEP 500-Year
<i>Region 1</i>							
e	0.7372	0.7058	0.6819	0.6446	0.6170	0.5870	0.5111
b (in.)	48.27	51.78	54.26	54.97	54.84	53.93	50.89
d (min.)	9.30	8.19	7.44	6.27	5.45	4.53	2.69

TABLE IS FROM CITY OF TOMBALL MINIMUM
STANDARDS FOR STORMWATER DESIGN