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A Professional Corporation

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**Lions Trans INC.
4005 N CR 1000 E
Brownsburg, Indiana 46112**

Drainage Narrative and Calculations

October 3, 2025

Revision 0

Moench Engineering, P.C.
4000 Clarks Creek Road
Plainfield, Indiana 46168

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Drainage Narrative

1.0 Project Scope

The proposed project involves the development of a truck maintenance facility that will include 42 stalls for truck and trailer parking, a 900 square foot office building (30 ft × 30 ft), and a 2,860 square foot maintenance building (130 ft × 22 ft) located along the southern boundary of the property. In addition, a detention pond will be constructed to manage and control stormwater runoff generated by the site improvements.

The project site is located at 4005 N CR 1000 E, Brownsburg, Indiana 46112. The parcel is not currently subject to zoning restrictions. The proposed development will result in approximately 2 acres of land disturbance. Stormwater from the site will discharge to the existing offsite storm sewer network located along CR 400 N, which ultimately conveys flow to a tributary downstream of the property.

2.0 Rainfall Information

Table 1. Rainfall Intensities (Hendricks County 2016)

Rainfall Intensities for Various Return Periods and Storm Durations						
<i>Duration</i>	<i>Intensity (Inches/Hour)</i>					
	<i>Return Period (Years)</i>					
	2	5	10	25	50	100
5 min	5.57	6.7	7.58	8.76	9.68	10.6
10 min	4.35	5.2	5.85	6.7	7.34	7.98
15 min	3.54	4.26	4.8	5.52	6.06	6.61
30 min	2.37	2.92	3.33	3.89	4.33	4.77
1 hr	1.46	1.83	2.12	2.53	2.85	3.19
2 hr	0.851	1.08	1.25	1.51	1.72	1.95
3 hr	0.603	0.762	0.893	1.08	1.24	1.41
6 hr	0.359	0.455	0.535	0.65	0.747	0.853
12 hr	0.211	0.263	0.306	0.368	0.418	0.473
24 hr	0.126	0.155	0.178	0.21	0.236	0.262

Table 2. Rainfall Depths (Hendricks County 2016)

Rainfall Depths for Various Return Periods							
<i>Duration</i>	<i>Depth (Inches)</i>						
	<i>Return Period (Years)</i>						
	1	2	5	10	25	50	100
24 Hrs.	2.51	3.02	3.72	4.28	5.04	5.66	6.3

The resulting intensity is then used in the Rational Method equation to determine peak runoff:

$$Q = CiA$$

Rainfall intensity and depth data used in the hydrologic analyses were obtained from the Hendricks County Stormwater Technical Standards Manual (2016). These values form the basis for both Rational Method peak runoff calculations and hydrograph development for the project's watershed, ensuring consistency with county stormwater design requirements.

3.0 Existing Conditions

The project site is currently an undeveloped grassy area with scattered overgrowth. Land use surrounding the parcel includes residential properties to the south, agricultural land and manufactured homes to the west, minor commercial development to the north beyond the highway, and railroad tracks to the east.

The existing watershed area encompasses approximately 3.02 acres, consisting entirely of pervious cover. Under current conditions, stormwater runoff generally drains to the east and south.

Runoff coefficients (C values) were assigned based on land cover characteristics in accordance with the *Hendricks County Stormwater Technical Standards Manual* (Hendricks County 2016). A value of C = 0.20 was applied for pervious land cover. Using the Rational Method, the time of concentration (tc) was calculated to be 52.0 minutes for the site. The corresponding peak flow rates for existing conditions are summarized below:

Table 3. Existing Conditions

Return Period	2-year	5-year	10-year	25-year	50-year	100-year
Runoff	0.979 cfs	1.223 cfs	1.411 cfs	1.676 cfs	1.882 cfs	2.099 cfs

4.0 Proposed Conditions

As outlined in the project scope, the proposed development consists of a truck maintenance facility including 42 stalls for truck and trailer parking, a 900 square foot office building (30 ft × 30 ft), and a 2,860 square foot maintenance building (130 ft × 22 ft).

Under proposed conditions, the total site area remains 3.02 acres, consisting of approximately 1.02 acres of pervious surface, 1.91 acres of impervious asphalt pavement, and 0.09 acres of roof area.

Hydrologic analysis was performed using the Rational Method. The time of concentration (tc) was calculated to be 9 minutes. Runoff coefficients (C values) were assigned based on land cover characteristics consistent with the *Hendricks County Stormwater Technical Standards Manual* (Hendricks County 2016). Values applied include C = 0.20 for pervious surfaces, C = 0.93 for asphalt pavement, and C = 0.95 for roof areas. The weighted C value was calculated as follows:

$$\frac{(1.02 \text{ acres} \times 0.20) + (1.91 \text{ acres} \times 0.93) + (0.09 \text{ acres} \times 0.95)}{3.02 \text{ acres}} = 0.68$$

The resulting peak runoff flow rates for the proposed site conditions are summarized below:

Table 4. Proposed Conditions

Return Period	2-year	5-year	10-year	25-year	50-year	100-year
Watershed A	9.293 cfs	11.23 cfs	12.69 cfs	14.63 cfs	16.13 cfs	17.61 cfs

The runoff flowrates increased due to the addition of pervious surface and removal of impervious surface. The percentage increase is as follows:

Table 5. Percentage Increase in Runoff

Return Period	2-year	5-year	10-year	25-year	50-year	100-year
% Increase	849%	818%	799%	773%	757%	739%

Stormwater runoff from the proposed improvements will be conveyed to the northwest corner of the site, where a retention pond will be constructed to provide the required storage volume. The post-development peak discharge was limited by restricting the 0-10 year storms to 0.2 cfs per acre of the site (0.604 cfs) and the 11–100-year storms to 0.4 cfs per acres of the site (1.208 cfs). These values produced more restrictive conditions compared to the proposed 100-year peak flow to the existing 10-year peak flow. This analysis determined a required detention volume of 8,826 cubic feet. To meet this requirement, a 9,522 cubic foot retention pond will be installed in the northeast corner of the site.

4.1 Stormwater Conveyance

Stormwater runoff generated from the proposed improvements will be collected and conveyed to the site’s retention facility. The grading plan directs surface runoff by sheet flow and shallow swales to a series of inlets along the eastern and central portions of the property. These inlets are connected by a storm sewer system that conveys flow westward to the retention pond located in the northwest corner of the site.

- Inlet 1: Connects to 290 linear feet (LF) of 18-inch RCP at a 0.37% slope, discharging into Inlet 2.
- Inlet 2: Connects to 165 LF of 24-inch RCP at a 0.50% slope, discharging directly into the retention pond.

Inlet capacity was then checked using the orifice flow equation, incorporating the reduced effective open area (50% of manufacturer-provided open area). This ensures the inlet can maintain adequate capacity under both design flow and partial clogging conditions, in compliance with the requirements of the Manual. The discharge coefficient, C, will be 0.60, gravity acceleration, g, is 32.2 ft/sec², and ponding height, h is 0.5 ft, and the 10-year flow will be used. The orifice equation is as follows:

Inlet Structure 1:

$$Q = CA\sqrt{2gh}$$

$$5.08 \text{ cfs} = (0.6)A\sqrt{2(32.2 \text{ ft/sec}^2) 0.5 \text{ ft}}$$

$$A = 1.49 \text{ ft}^2$$

$$2A = 3.0 \text{ ft}^2 \text{ (Clogging Condition)}$$

Inlet Structure 2 :

$$Q = CA\sqrt{2gh}$$

$$5.69 \text{ cfs} = (0.6)A\sqrt{2(32.2 \text{ ft/sec}^2) 0.5 \text{ ft}}$$

$$A = 1.67 \text{ ft}^2$$

$$2A = 3.3 \text{ ft}^2 \text{ (Clogging Condition)}$$

To capture and convey runoff from the site into Inlet Structure 1, a square Neenah Grate Inlet 3287-5 (3.2 square feet of opening area) or equivalent will be installed. To capture and convey runoff from the site into Inlet Structure 2, a square Neenah Grate Inlet 3808-1 (5.2 square feet of opening area) or inlet with 3.3 square foot or greater opening should be installed. Calculations verifying pipe capacity and inlet capture are provided in Appendix B.

A forebay should be installed at the pond inlet for water quality treatment, capturing sediment and floatables before flows enter the main basin. The required volume is 726 cubic feet, with supporting calculations in Appendix B.

4.2 Detention Pond and Outlet Structure

The detention pond is equipped with a multi-stage outlet box designed to restrict discharge per Hendricks County release requirements:

- Low-flow outlet: 4-inch diameter orifice at pond bottom, sized for the 2-year storm (0.604 cfs).
- Intermediate outlet: 5-inch diameter orifice at Elev. 867.00 ft, passing flows up to the 100-year storm (1.208 cfs).
- Overflow weir: Crest at Elev. 867.89 ft (0.11 ft below TOB), conveying emergency flows \geq 100-year (17.61 cfs). The required outlet area calculations are as follows:

$$Q = CA\sqrt{2gh}$$

$$17.61 \text{ cfs (100 year peak flow)} = (0.6)A\sqrt{2(32.2 \text{ ft/sec}^2) 0.5 \text{ ft}}$$

$$A = 10.67 \text{ ft}^2$$

The pipe leaving the detention pond is sized to handle this 100-year flow, assuming a slope of 0.30%, a Manning's n of 0.013, the minimum diameter will be determined using Manning's Equation as follows:

$$Q \text{ (Volumetric Flow)} = \frac{1.49}{\text{Manning's } n} * (\text{Area}) * (\text{Hydraulic Radius})^{2/3} \sqrt{\text{Slope}}$$

$$17.61 \text{ cfs} = \frac{1.49}{0.013} * \left(\frac{\pi D^2}{4} \right) * (D/4)^{2/3} \sqrt{0.0030}$$

$$D = 27 \text{ inches}$$

Under the assumed conditions, the minimum discharge pipe diameter is 27 inches. The outlet pipe network extends west from the detention pond and connects to the existing storm sewer system along CR 400 N. This existing network serves as the only feasible drainage outlet from the property and conveys stormwater offsite toward the unnamed tributary downstream.

The stormwater management system—including inlets, storm sewers, forebay, detention pond, multi-stage outlet structure, and downstream piping—is designed to control post-development flows in compliance with Hendricks County Stormwater Standards.

5.0 Summary

The proposed development at 4005 N CR 1000 E, Brownsburg, Indiana will consist of a truck maintenance facility including 42 truck/trailer parking stalls, a 900 square foot office building, and a 2,860 square foot maintenance building. The project will disturb approximately 2 acres and convert a predominantly pervious 3.02-acre parcel into a mix of impervious asphalt, building roof, and limited vegetated cover. Hydrologic analysis using rainfall data from the Hendricks County Stormwater Technical Standards Manual (2016) indicates a significant increase in runoff under proposed conditions, with the 100-year peak flow rising from 2.10 cfs to 17.61 cfs.

To mitigate this increase, a comprehensive stormwater management system has been designed. Runoff will be collected by inlets and storm sewers, routed through a forebay for pretreatment, and detained within a pond sized to provide 9,522 cubic feet of storage volume. A multi-stage outlet structure will restrict discharges to 0.604 cfs for the 2- through 10-year storms and 1.208 cfs for the 11- through 100-year storms, meeting Hendricks County release rate requirements. The system reduces post-development peak discharge to below pre-development rates, providing both quantity control and water quality treatment.

Appendix A – Rational Equation Hydrographs

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	0.979	1	52	3,056	----	----	----	Existing
2	Rational	9.293	1	9	5,018	----	----	----	Proposed
Lions Trucking Hydrograps_09042025_cwb.gpr					Return Period: 2 Year			Friday, 10 / 3 / 2025	

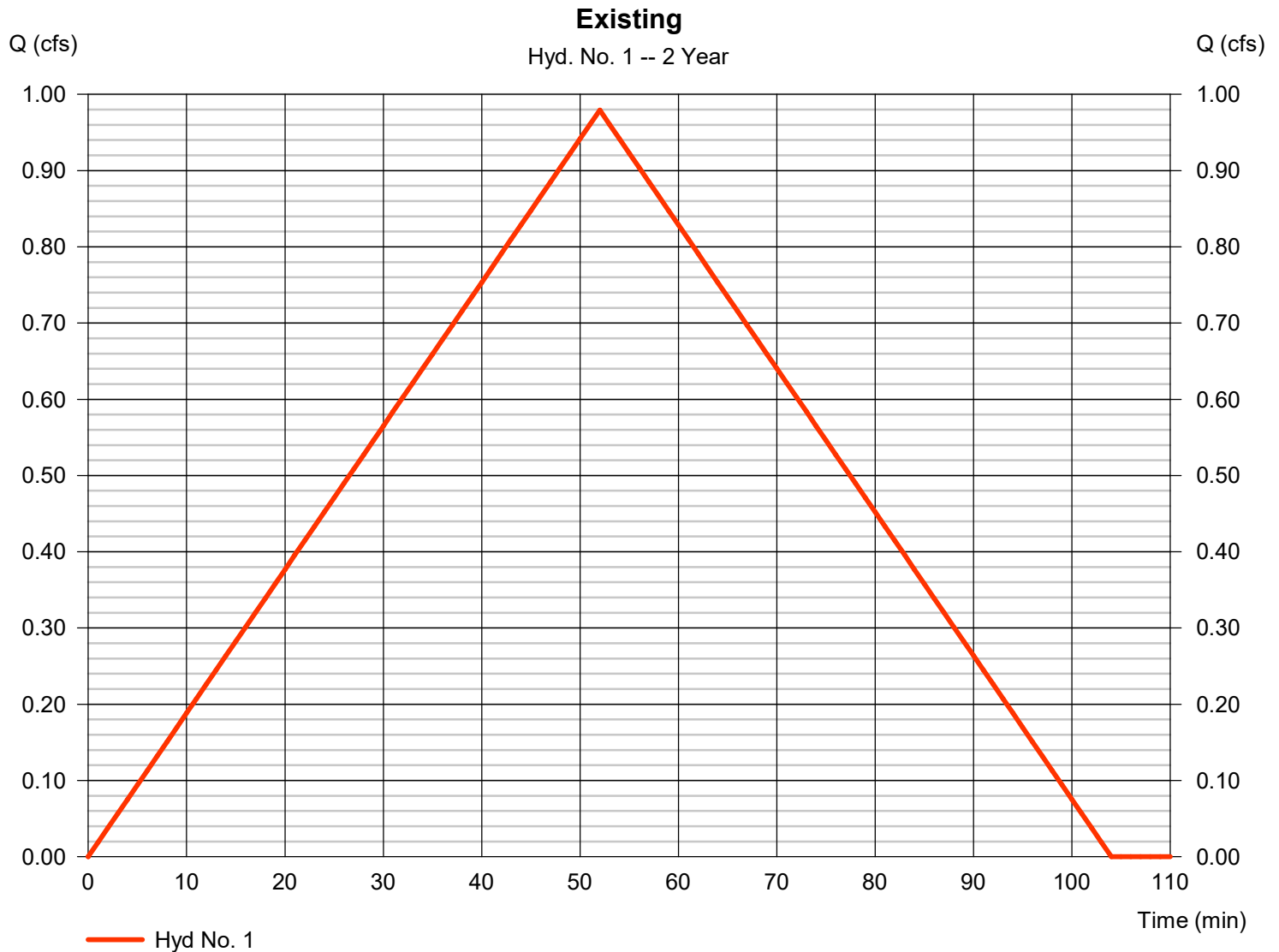
Hydrograph Report

Hyd. No. 1

Existing

Hydrograph type	= Rational	Peak discharge	= 0.979 cfs
Storm frequency	= 2 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 3,056 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.2*
Intensity	= 1.622 in/hr	Tc by TR55	= 52.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.020 x 0.20)] / 3.020



TR55 Tc Worksheet

Hyd. No. 1

Existing

<u>Description</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>Totals</u>
Sheet Flow				
Manning's n-value	= 0.170	0.011	0.011	
Flow length (ft)	= 300.0	0.0	0.0	
Two-year 24-hr precip. (in)	= 3.02	0.00	0.00	
Land slope (%)	= 0.41	0.00	0.00	
Travel Time (min)	= 50.60	+ 0.00	+ 0.00	= 50.60
Shallow Concentrated Flow				
Flow length (ft)	= 70.00	0.00	0.00	
Watercourse slope (%)	= 0.41	0.00	0.00	
Surface description	= Unpaved	Paved	Paved	
Average velocity (ft/s)	=1.03	0.00	0.00	
Travel Time (min)	= 1.13	+ 0.00	+ 0.00	= 1.13
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				52.00 min

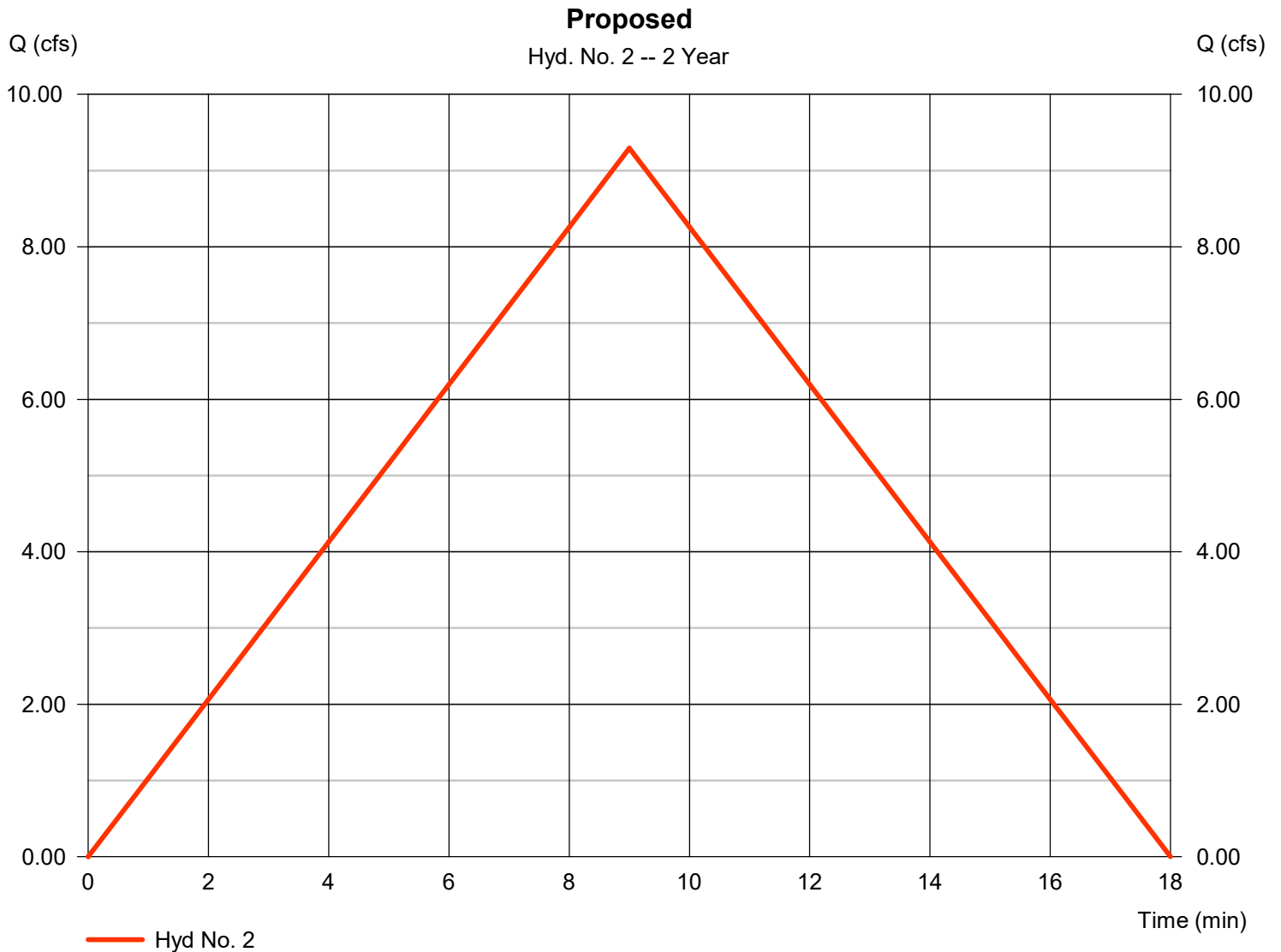
Hydrograph Report

Hyd. No. 2

Proposed

Hydrograph type	= Rational	Peak discharge	= 9.293 cfs
Storm frequency	= 2 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 5,018 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.68*
Intensity	= 4.525 in/hr	Tc by TR55	= 9.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(1.020 x 0.20) + (1.910 x 0.93) + (0.090 x 0.95)] / 3.020



TR55 Tc Worksheet

Hyd. No. 2

Proposed

<u>Description</u>	<u>A</u>		<u>B</u>		<u>C</u>		<u>Totals</u>
Sheet Flow							
Manning's n-value	= 0.011		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 3.02		0.00		0.00		
Land slope (%)	= 0.37		0.00		0.00		
Travel Time (min)	= 5.90	+	0.00	+	0.00	=	5.90
Shallow Concentrated Flow							
Flow length (ft)	= 242.00		0.00		0.00		
Watercourse slope (%)	= 0.37		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=1.24		0.00		0.00		
Travel Time (min)	= 3.26	+	0.00	+	0.00	=	3.26
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							9.00 min

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.223	1	52	3,816	----	----	----	Existing
2	Rational	11.23	1	9	6,063	----	----	----	Proposed
Lions Trucking Hydrograps_09042025_cwb.gpr					Return Period: 5 Year			Friday, 10 / 3 / 2025	

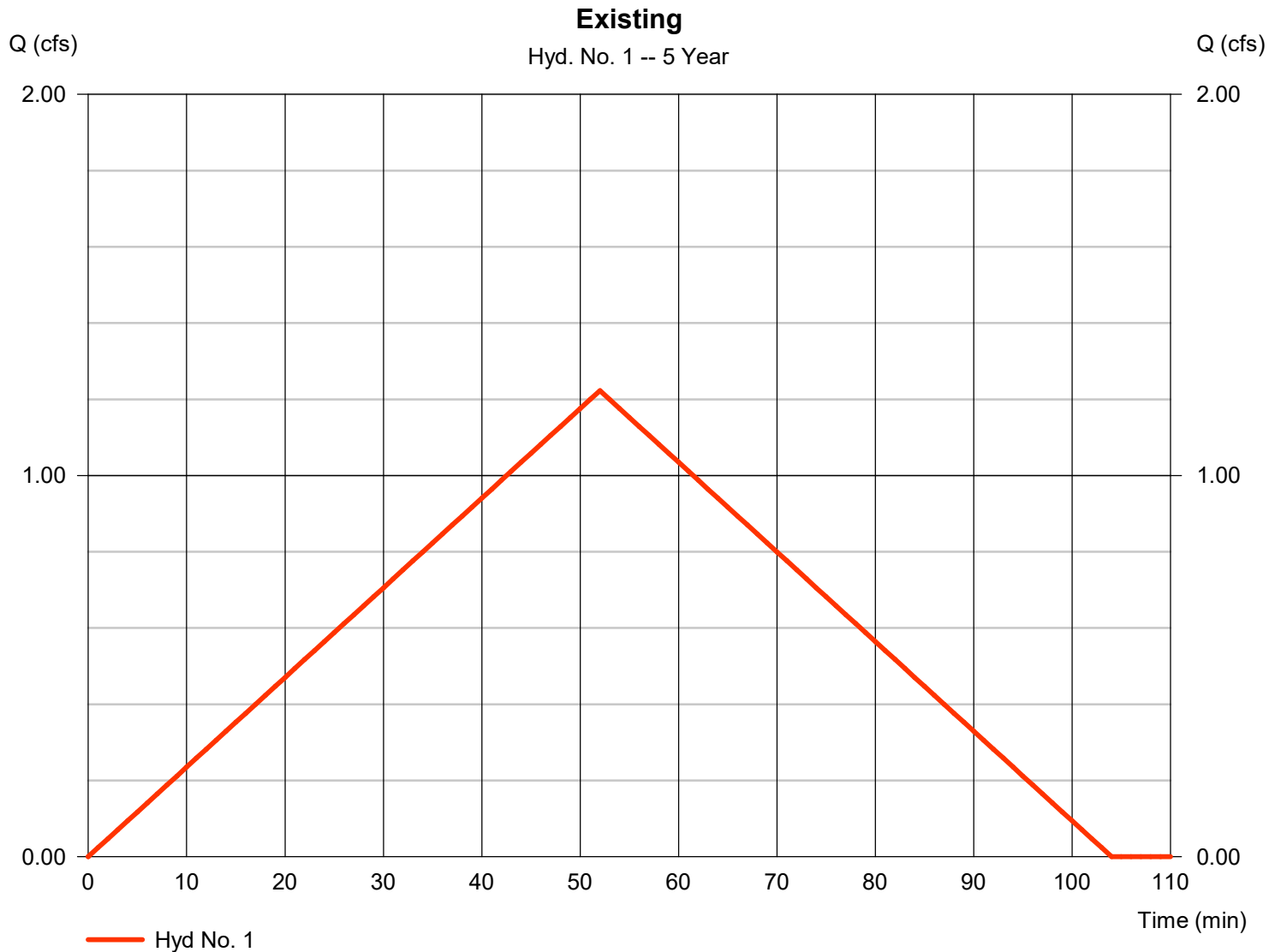
Hydrograph Report

Hyd. No. 1

Existing

Hydrograph type	= Rational	Peak discharge	= 1.223 cfs
Storm frequency	= 5 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 3,816 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.2*
Intensity	= 2.025 in/hr	Tc by TR55	= 52.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.020 x 0.20)] / 3.020



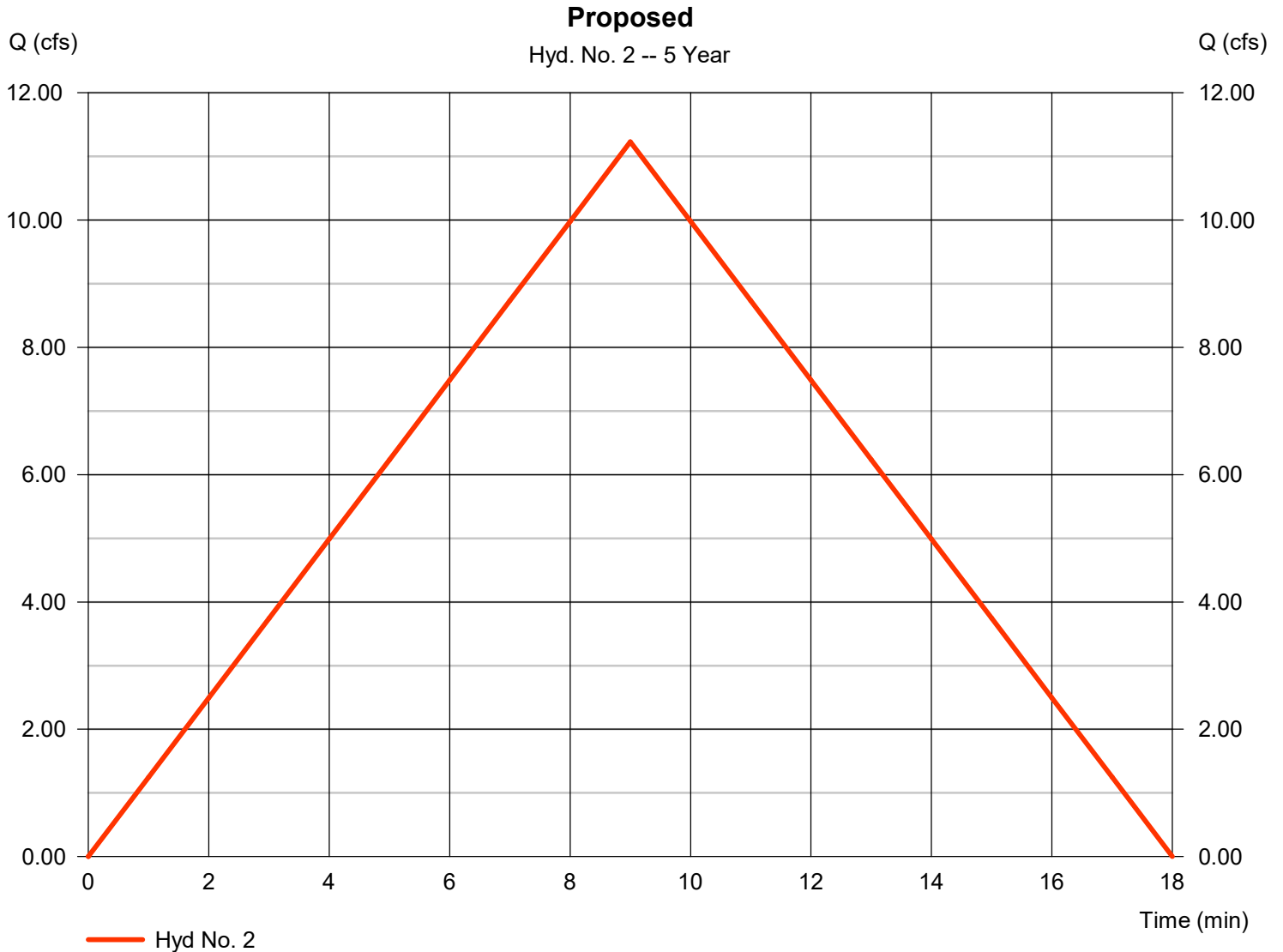
Hydrograph Report

Hyd. No. 2

Proposed

Hydrograph type	= Rational	Peak discharge	= 11.23 cfs
Storm frequency	= 5 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 6,063 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.68*
Intensity	= 5.468 in/hr	Tc by TR55	= 9.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(1.020 x 0.20) + (1.910 x 0.93) + (0.090 x 0.95)] / 3.020



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.411	1	52	4,403	----	----	----	Existing
2	Rational	12.69	1	9	6,850	----	----	----	Proposed
Lions Trucking Hydrograpjs_09042025_cwb.gpr					Return Period: 10 Year			Friday, 10 / 3 / 2025	

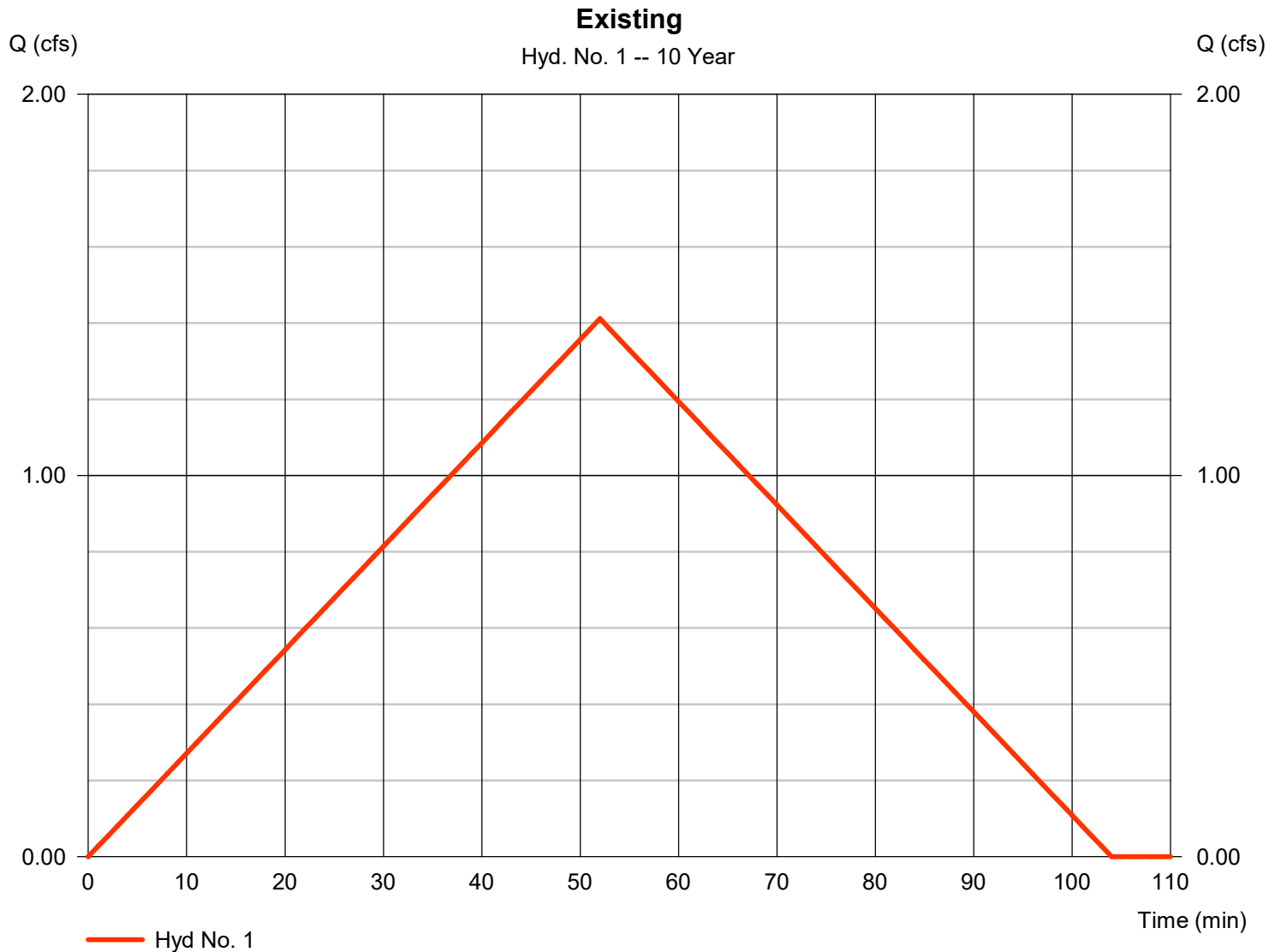
Hydrograph Report

Hyd. No. 1

Existing

Hydrograph type	= Rational	Peak discharge	= 1.411 cfs
Storm frequency	= 10 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 4,403 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.2*
Intensity	= 2.337 in/hr	Tc by TR55	= 52.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.020 x 0.20)] / 3.020



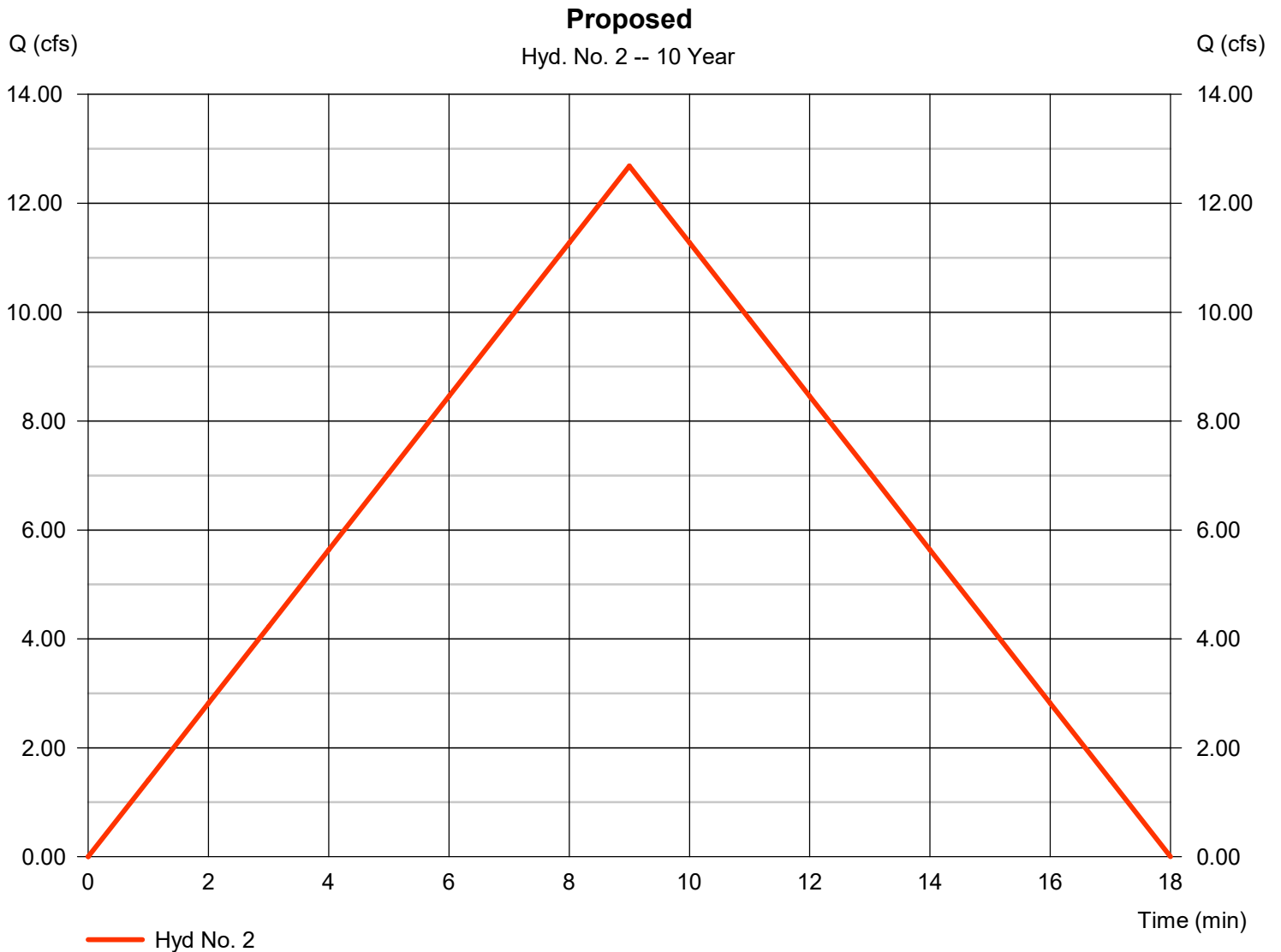
Hydrograph Report

Hyd. No. 2

Proposed

Hydrograph type	= Rational	Peak discharge	= 12.69 cfs
Storm frequency	= 10 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 6,850 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.68*
Intensity	= 6.177 in/hr	Tc by TR55	= 9.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(1.020 x 0.20) + (1.910 x 0.93) + (0.090 x 0.95)] / 3.020



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.676	1	52	5,228	----	----	----	Existing
2	Rational	14.63	1	9	7,898	----	----	----	Proposed
Lions Trucking Hydrograps_09042025_cwb.gpr					Return Period: 25 Year			Friday, 10 / 3 / 2025	

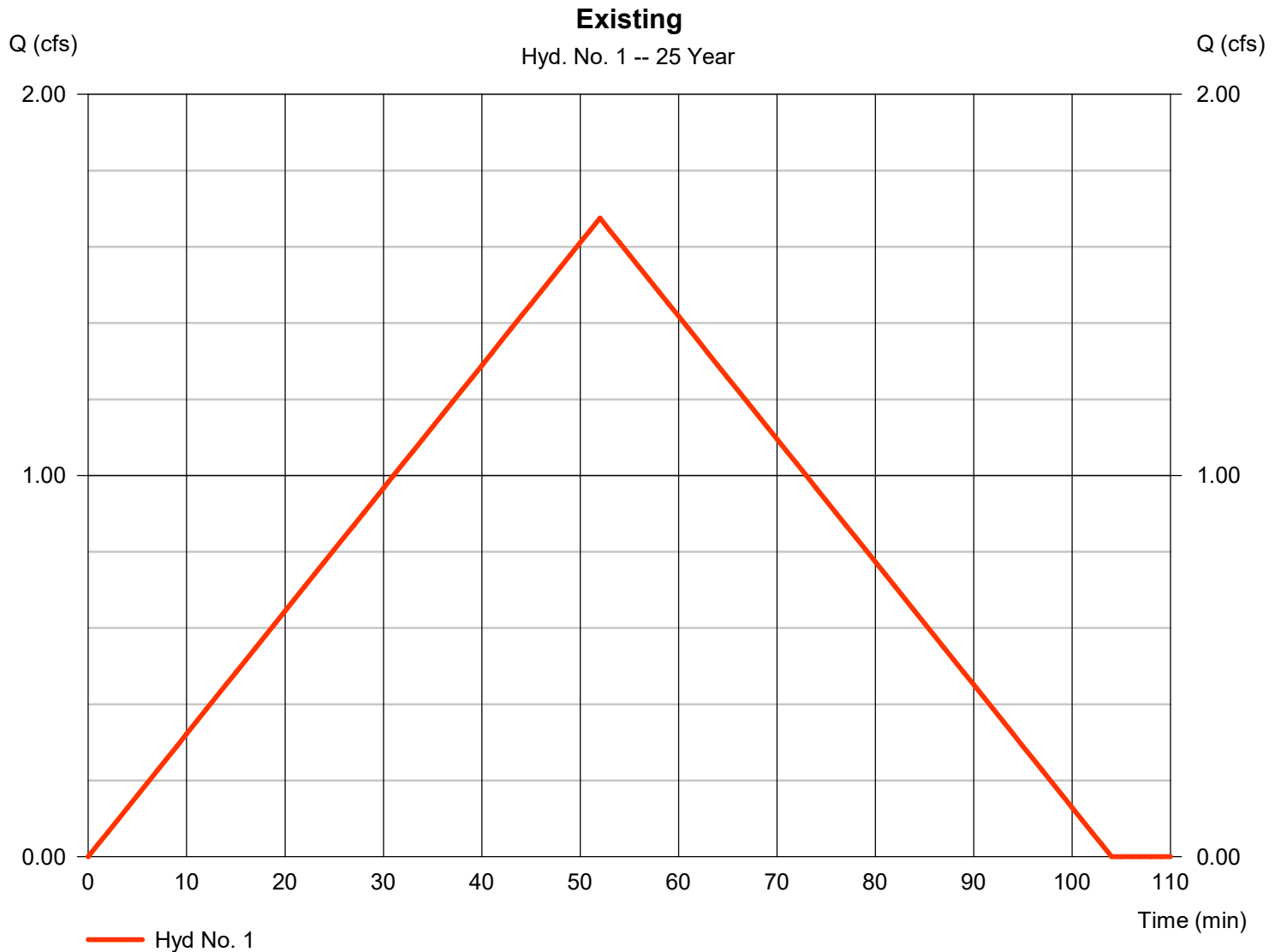
Hydrograph Report

Hyd. No. 1

Existing

Hydrograph type	= Rational	Peak discharge	= 1.676 cfs
Storm frequency	= 25 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 5,228 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.2*
Intensity	= 2.774 in/hr	Tc by TR55	= 52.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.020 x 0.20)] / 3.020



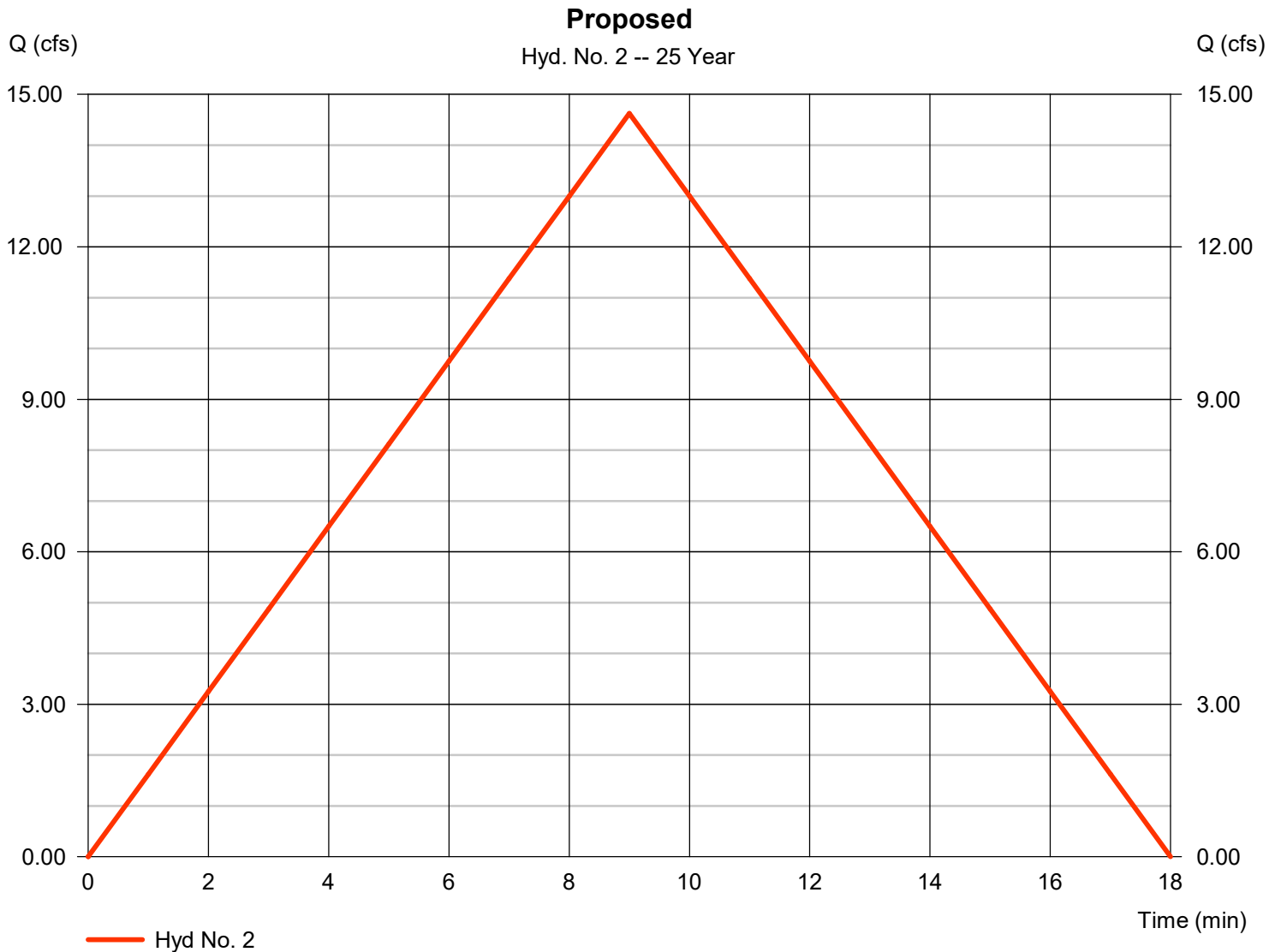
Hydrograph Report

Hyd. No. 2

Proposed

Hydrograph type	= Rational	Peak discharge	= 14.63 cfs
Storm frequency	= 25 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 7,898 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.68*
Intensity	= 7.122 in/hr	Tc by TR55	= 9.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(1.020 x 0.20) + (1.910 x 0.93) + (0.090 x 0.95)] / 3.020



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.882	1	52	5,873	-----	-----	-----	Existing
2	Rational	16.13	1	9	8,713	-----	-----	-----	Proposed
Lions Trucking Hydrograps_09042025_cwb.gpr					Return Period: 50 Year			Friday, 10 / 3 / 2025	

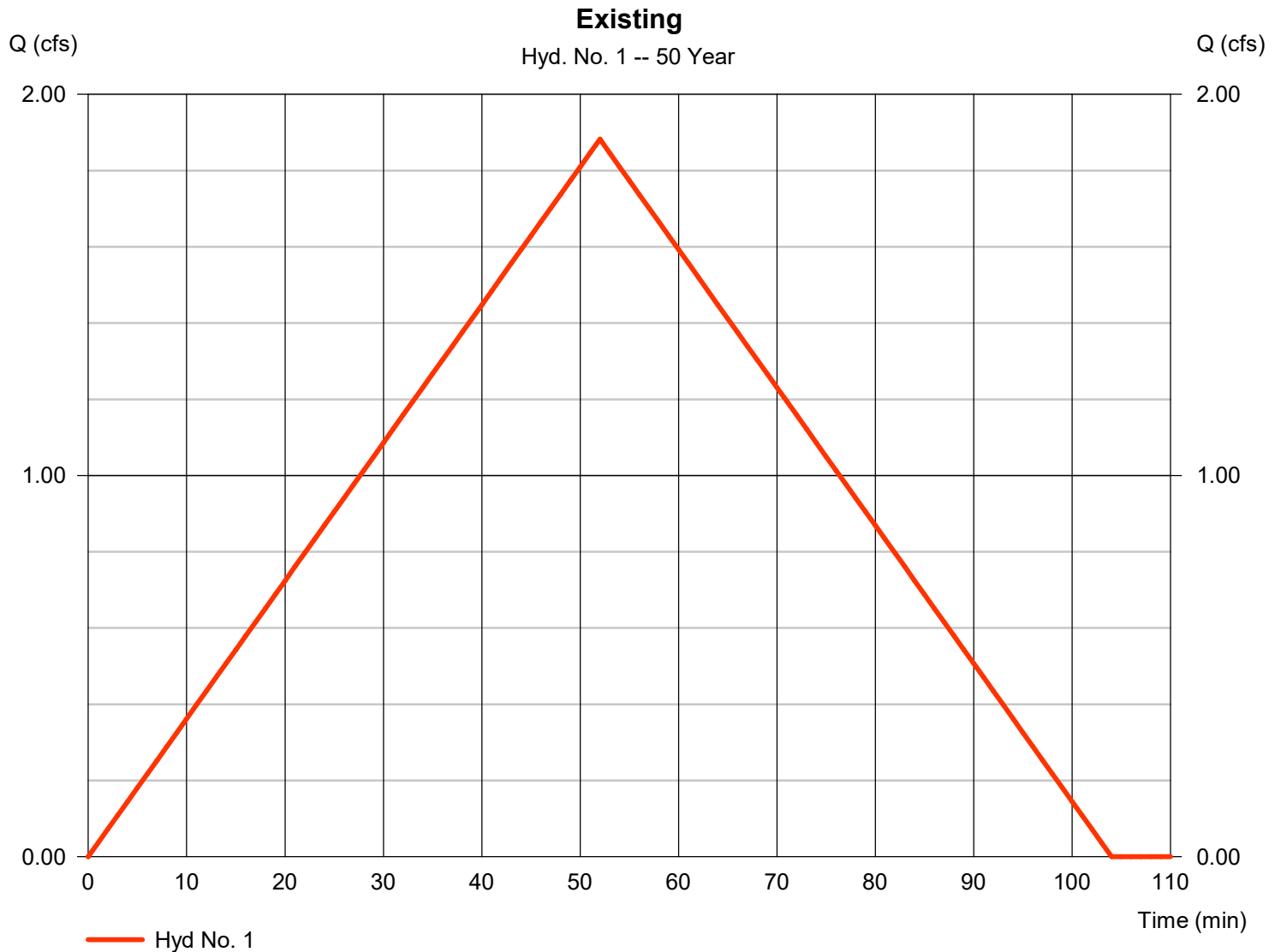
Hydrograph Report

Hyd. No. 1

Existing

Hydrograph type	= Rational	Peak discharge	= 1.882 cfs
Storm frequency	= 50 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 5,873 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.2*
Intensity	= 3.117 in/hr	Tc by TR55	= 52.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.020 x 0.20)] / 3.020



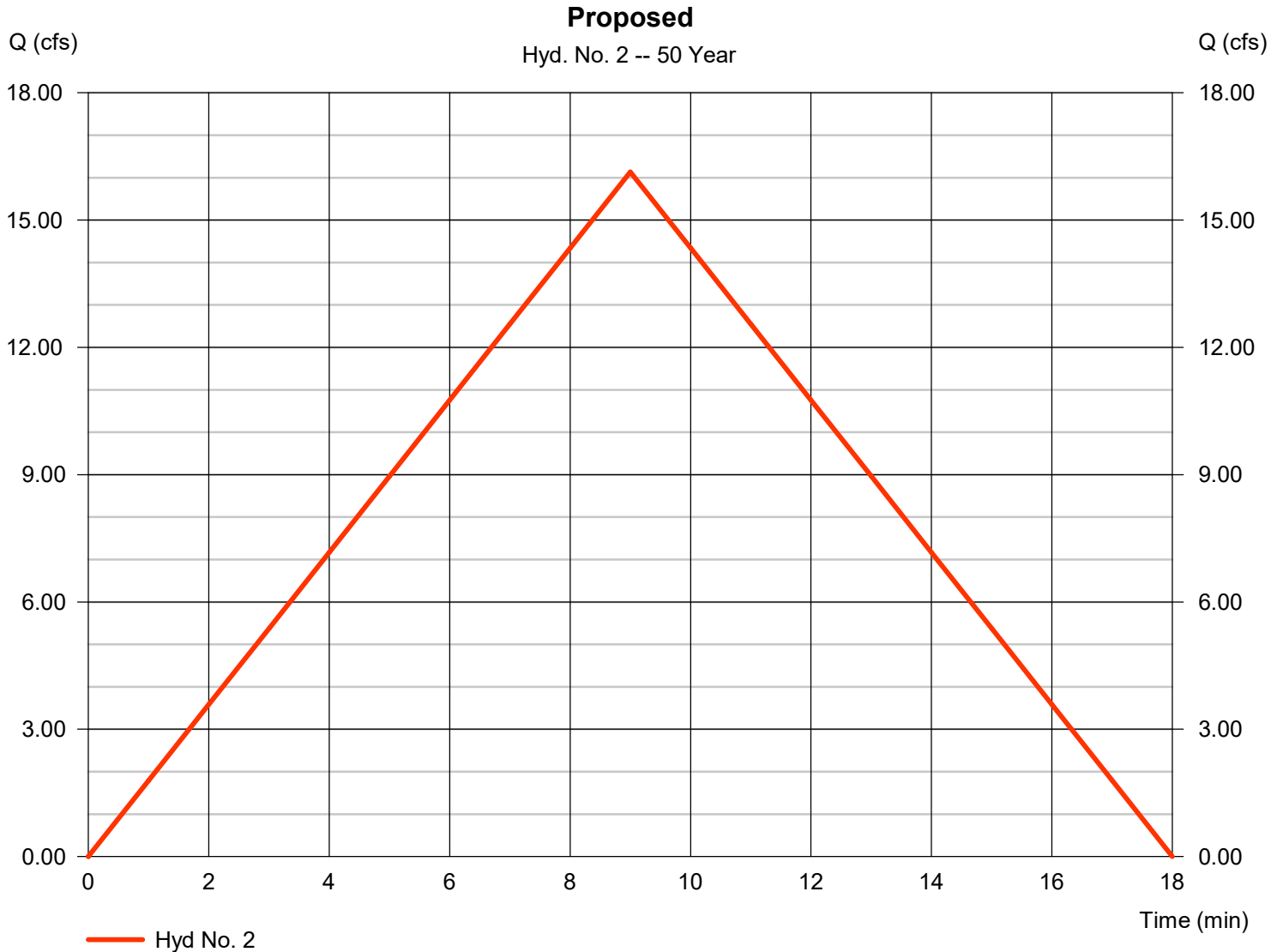
Hydrograph Report

Hyd. No. 2

Proposed

Hydrograph type	= Rational	Peak discharge	= 16.13 cfs
Storm frequency	= 50 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 8,713 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.68*
Intensity	= 7.857 in/hr	Tc by TR55	= 9.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(1.020 x 0.20) + (1.910 x 0.93) + (0.090 x 0.95)] / 3.020



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	2.099	1	52	6,549	-----	-----	-----	Existing
2	Rational	17.61	1	9	9,511	-----	-----	-----	Proposed
Lions Trucking Hydrograps_09042025_cwb.gpr					Return Period: 100 Year			Friday, 10 / 3 / 2025	

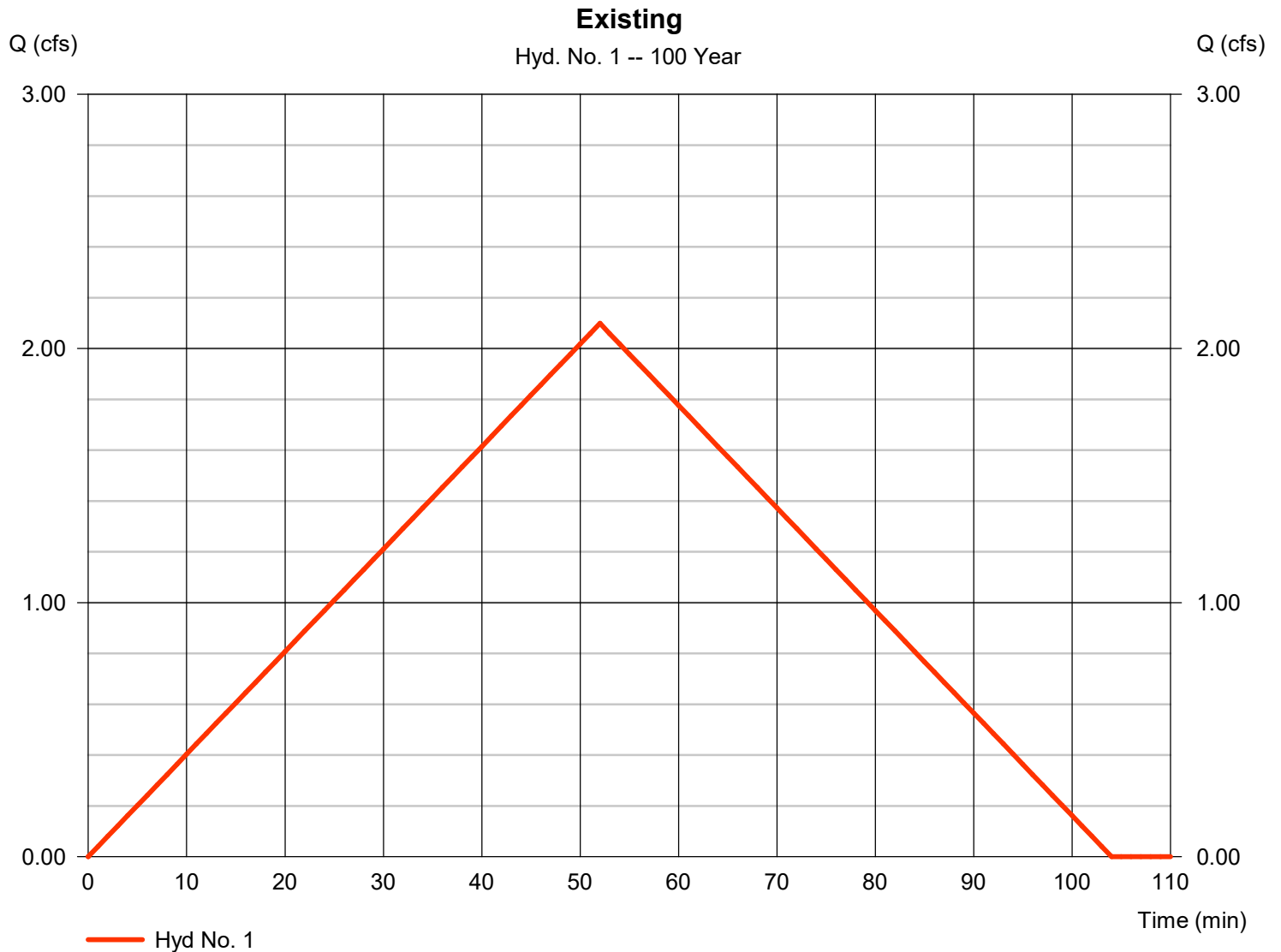
Hydrograph Report

Hyd. No. 1

Existing

Hydrograph type	= Rational	Peak discharge	= 2.099 cfs
Storm frequency	= 100 yrs	Time to peak	= 52 min
Time interval	= 1 min	Hyd. volume	= 6,549 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.2*
Intensity	= 3.475 in/hr	Tc by TR55	= 52.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(3.020 x 0.20)] / 3.020



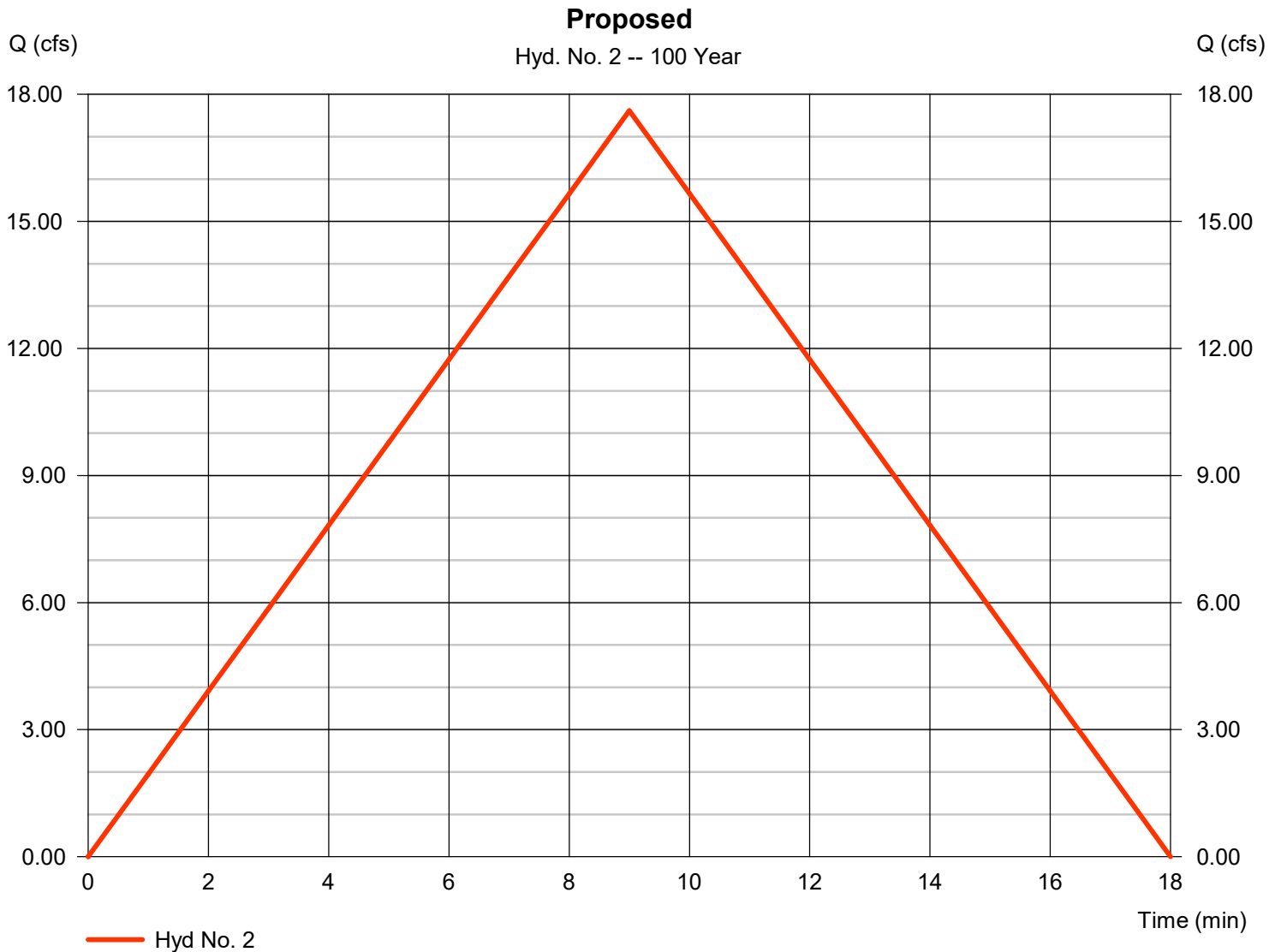
Hydrograph Report

Hyd. No. 2

Proposed

Hydrograph type	= Rational	Peak discharge	= 17.61 cfs
Storm frequency	= 100 yrs	Time to peak	= 9 min
Time interval	= 1 min	Hyd. volume	= 9,511 cuft
Drainage area	= 3.020 ac	Runoff coeff.	= 0.68*
Intensity	= 8.577 in/hr	Tc by TR55	= 9.00 min
IDF Curve	= Lions Trucking IDF.IDF	Asc/Rec limb fact	= 1/1

* Composite (Area/C) = [(1.020 x 0.20) + (1.910 x 0.93) + (0.090 x 0.95)] / 3.020



Appendix B – Pipe and Orifice Calculations

MOENCH ENGINEERING, P.C.

STORM SEWER DESIGN - RATIONAL METHOD

10-YEAR RAINFALL INTENSITY:HENDRICKS CNTY DCAM EQUATION

MANNING ROUGHNESS COEFFICIENT = 0.013 RCP

PROJ.: 21346
DESC: Lion Trans Inc.

DATE: 9/30/2025
ENGR: C. Brown

LINE DESIG.	FROM STR. NO.	TO STR. NO.	PIPE LENGTH (FT)	C	A (ACRE)	C x A	SUM OF CA	Tc (MIN)	Tcum (MIN)	I (IN/HR)	Q (CFS)	PIPE DIA. (IN)	PIPE GRADE (%)	PIPE CAP. (CFS)	FULL VEL. (FPS)	TRAV. TIME (MIN)	RIM ELEV. UPSTM.	RIM ELEV. DNSTM.	INVERT ELEV. UPSTM.	INVERT ELEV. DNSTM.	PIPE COVER UPSTM.	PIPE COVER DNSTM.
New Line	INLET1	INLET2	290	0.72	1.27	0.91	0.91	5.0	5.00	5.57	5.081	18	0.37	6.390	3.62	1.3	870.56	869.99	868.06	866.99	0.79	1.29
	INLET2	END3	165	0.67	1.75	1.17	2.08	5.0	6.34	5.17	10.770	24	0.50	15.996	5.09	0.5	869.99		866.99	866.16	0.75	

Calculations for Outlet Orifice Size

$$Q = C_d \cdot A_o \cdot \sqrt{2 \cdot g \cdot h}$$

A_o = Area of Orifice, C_d = Coefficient of Orifice, Q = Flow, g = gravity constant, h = height of water above

We know Q , and need to solve for A_o

$$A_o = Q / (C_d \cdot \sqrt{2 \cdot g \cdot h})$$

INLET 1

$$Q = 5.081$$

$$C_d = 0.6$$

$$g = 32.2$$

$$h = 0.5$$

$$A_o = 1.49 \quad \text{Square Feet}$$

INLET 2

$$Q = 5.689$$

$$C_d = 0.6$$

$$g = 32.2$$

$$h = 0.5$$

$$A_o = 1.67 \quad \text{Square Feet}$$

solving for d in circular pipe: $d = \sqrt{4 \cdot A_o / \pi}$

$$d = 1.38 \quad \text{feet}$$

$$d = 16.55 \quad \text{inches (Pipe diameter in inches)}$$

Calculations for Outlet Orifice Size

$$Q = C_d \cdot A_o \cdot \text{SQRT}(2 \cdot g \cdot h)$$

A_o = Area of Orifice, C_d = Coefficient of Orifice, Q = Flow, g = gravity constant, h = height of water above

We know Q , and need to solve for A_o

$$A_o = Q / (C_d \cdot \text{SQRT}(2 \cdot g \cdot h))$$

$$Q = 17.61$$

$$C_d = 0.62$$

$$g = 32.2$$

$$h = 0.11$$

$$A_o = 10.67 \quad \text{Square Feet}$$

solving for d in circular pipe: $d = \text{SQRT}(4 \cdot A_o / \pi)$

$$d = 3.69 \quad \text{feet}$$

$$d = 44.24 \quad \text{inches (Pipe diameter in inches)}$$

Appendix C – Water Quality Calculations

Water Quality Calculations

Project Name: **Lion's Trucking**
 Project Job #: **21346**

Water Quality Volume

$$WQv = ((P)(Rv)(A))/12$$

P= 1" of Rainfall

Rv = Volumetric Flow Rate = 0.05 + 0.009 (I)

I = percent of impervious area

A = Area in acres

Total Site (acres)	3.02	Percent -Impervious Area (%)	66.23
Total Impervious Area (acres)	2	Volumetric Flow Rate	0.65
Prop. Time of Conc. (min)	9.00	Water Quality Volume (ac-ft)	0.16
		Water Quality Volume (ft3)	7082.13
*Forebay Volume is included in overall req. volume		Forebay (ac-ft)	0.02
		Forebay (ft3)	726.00

Water Quality Curve Number

$$WQ \text{ Curve Number} = \frac{1000}{[10+5P+10Qa- 10*(\text{sqrt}(Qa^2+1.25*Qa*P))]}$$

P = 1" (rainfall for water quality storm event)

Qa = runoff volume, in inches = 1" * Rv = Rv (inches)

Rv = volumetric runoff coefficient

WQ Curve Number = **96.22** * Check with CBBEL WQ-CN Graph

Water Quality Runoff Rate

TR-20 Method

* Design Criteria different for City of Indianapolis

Input Data

* Indy

Dimensionless Hydrograph:	SCS Type II Distribution	Huff 1st quartile
Curve Number:	96.22	98
Area:	3.02	3.02
Rainfall:	1.00	0.30
Time of Concentration:	9.00	9.00

Area for TR-20 calculated runoff

* Utilize Peak Discharge for WQ Structure BMP

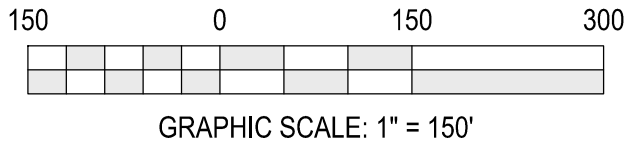
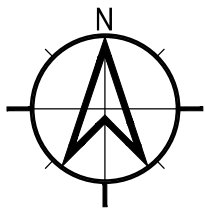
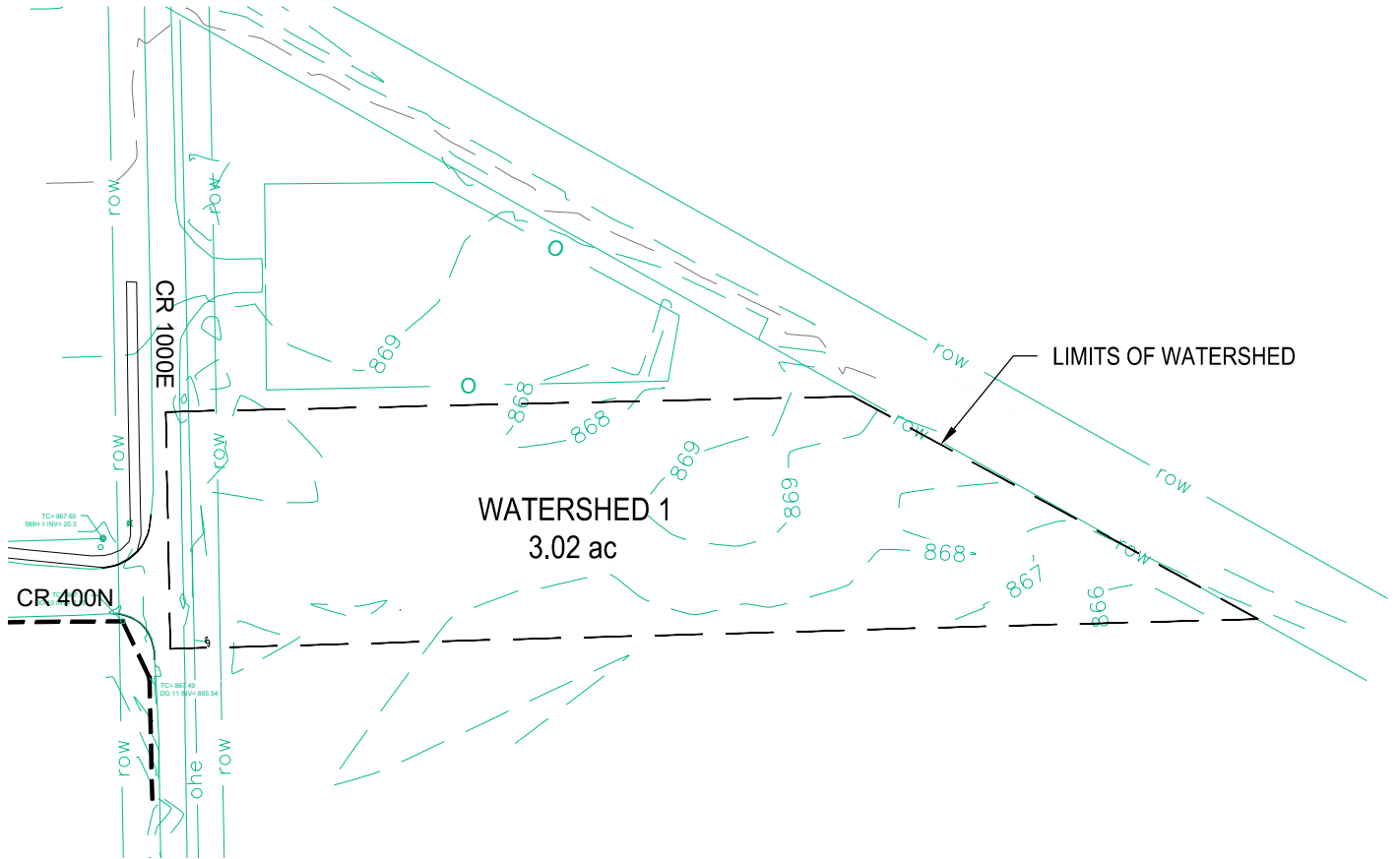
SCS Method	
Given Input Data:	Computed Results:
Description	Peak discharge, qp 1.5871 cfs
Drainage area 1.5540 ac	Peak Time, Tp 717.5407 min
Runoff curve number, CN 97	Peak rate factor 484
Time of concentration, Tc 5.0000 min	Constant, K 0.7500
Dimensionless Hydrograph scsdim	Runoff Volume 0.6923 in
Rainfall 1.0000 in 1.0849 cfs-hrs
Distribution Curve tr20t2: Type 2, 24 hrs 0.0897 acft

Req. AquaShield Aqua-Swirl (per City of Indy WQ Flowrate Standards in Stormwater Manual)

AS-10

Appendix D – Stage Storage/Discharge Table

Appendix E – Existing Watershed

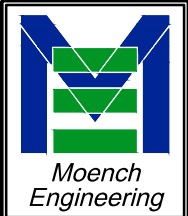


NOTE
PERVIOUS SURFACE = 2.97 ac (131,401 sf)
IMPERVIOUS SURFACE = 0.05 ac (2,144 sf)

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Lion Transfer Inc.
 4005 N. County Road 1000 E
 Brownsburg, Indiana 46122
 Hendricks County, Lincoln Township
EXISTING WATERSHED MAP

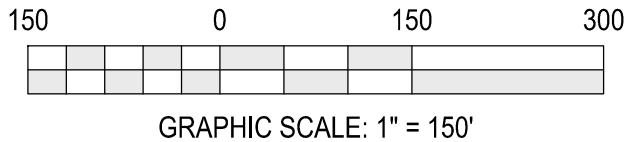
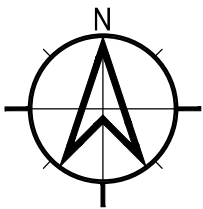
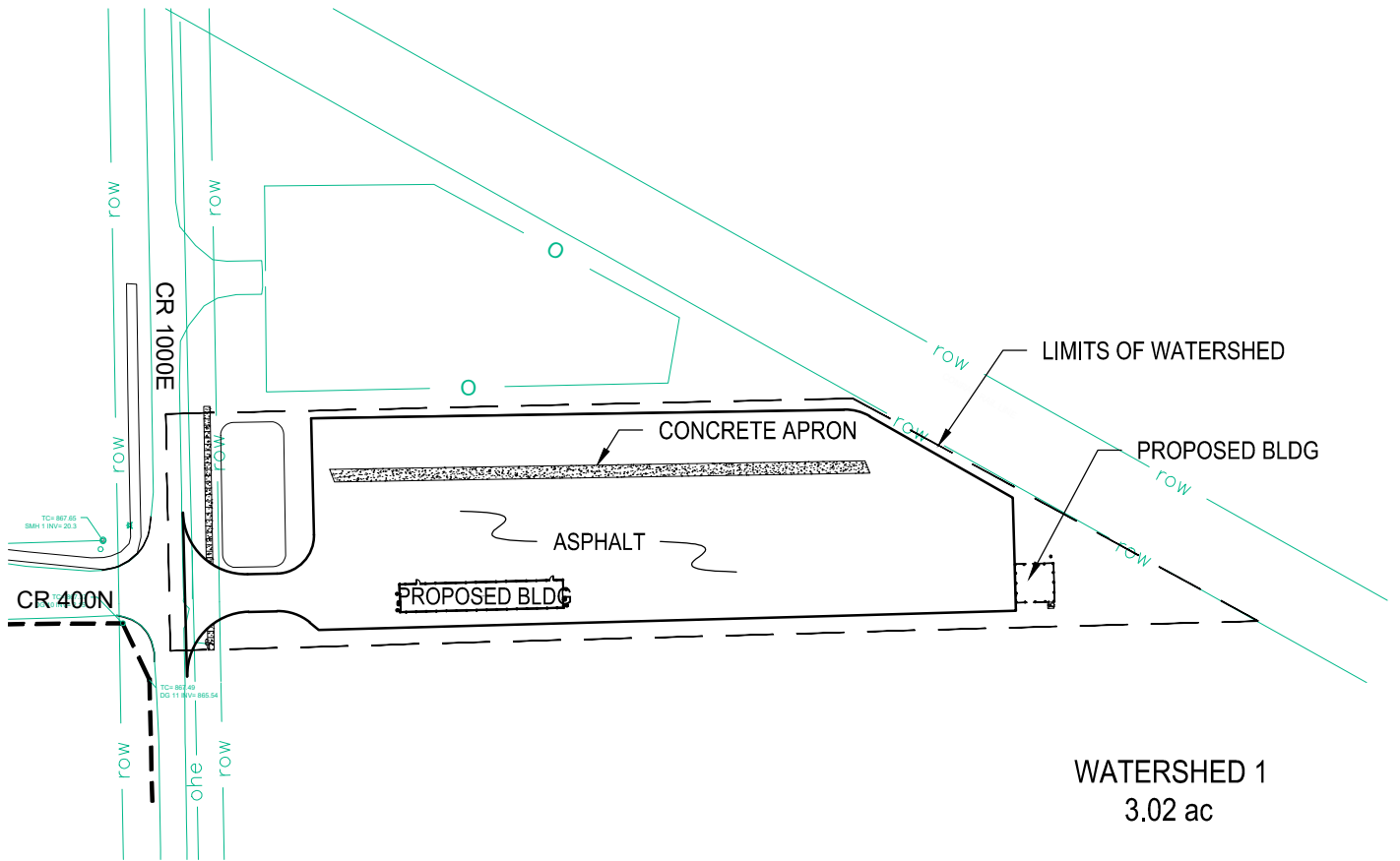
Drawn By:
 JBF
 Checked By:
 BEM
 Project No.
 21346
 Date:
 6/20/24



4000 Clarks Creek Road
 Plainfield, Indiana 46168
 Phone (317) 837-2767

Sheet Number:
WSE

Appendix F – Proposed Watershed

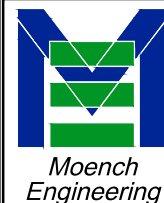


NOTE
PERVIOUS SURFACE = 0.77 ac (33,488 sf)
IMPERVIOUS SURFACE = 2.17 ac (94,492 sf)
IMPERVIOUS ROOF AREA = 0.08 ac (3,760 sf)

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Lion Transfer Inc.
 4005 N. County Road 1000 E
 Brownsburg, Indiana 46122
 Hendricks County, Lincoln Township
PROPOSED WATERSHED MAP

Drawn By:
 JBF
 Checked By:
 BEM
 Project No.
 21346
 Date:
 6/20/24



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