PRELIMINARY STORMWATER MANAGEMENT STUDY

MONROE MANOR

EAST OF DE SOTO ROAD, BETWEEN BELLERIVE COURT & HOLIDAY DRIVE
LANSING, LEAVENWORTH COUNTY, KANSAS

SMH CONSULTANTS

Prepared for:
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CONTENTS

INTRODUCTION

SMH Consultants (SMH) has provided a preliminary stormwater management study for the proposed Monroe Manor development in Lansing, Kansas. The purpose of this plan is to assess potential impacts arising from the development of single-family residential lots with associated infrastructure and to propose necessary mitigative measures.

The development is located East of De Soto Road between Bellerive Court and Holiday Drive in Lansing, Leavenworth County, Kansas. The site is in the Missouri Watershed. The site is bordered on all sides by residential properties.

The following resources were referenced in evaluating the drainage impacts of the proposed development: **City of Lansing, Design Criteria for Storm Drainage Facilities; United States Department of Agriculture, Urban Hydrology for Small Watersheds, TR-55; United States Department of Agriculture, Web Soil Survey** and **Hydraflow Hydrographs Extensions Software**, as developed by Autodesk. The existing site has been previously studied three times. First in the **Fairway Estates Subdivision Drainage Calculation Sheets** prepared by Cook, Flatt and Strobel Engineers, P.A. dated May 1995. Secondly, in the **Fairway Estates Phase II Lake Re-Study** prepared by George Butler Associates, Inc. dated September 24, 1999. Most recently the property was studied in the **Final Drainage Memo – Fairway Estates Drainage Study – Phase 5 & 6** prepared by Napier Engineering, LLC dated August 2, 2018. The existing drainage reports for the site and surrounding sites can be found in Exhibits 1 through 3 of the Appendix.

METHODOLOGY

The design methodology used to analyze the impacts of the proposed improvements is based on the City of Lansing Engineering Design Criteria. The Rational method was used for all drainage calculations besides for the Stormwater Detention portion of the project, as recommended by the Design Criteria for areas requiring Storm Detention Facilities. The Design Criteria for Storm Drainage Facilities does not detail the SCS method, so the urban Hydrology for Small Watersheds, TR-55 design guide, was utilized in addition to the Design Criteria for Storm Drainage Facilities for this drainage analysis.

The onsite soils consist primarily of Grundy silty clay loam with slopes ranging from 3 to 7 percent, eroded, Sharpsburg silty clay loam, with slopes ranging from 4 to 8 percent, eroded and Vinland Sibleyville complex, with slopes ranging from 5 to 12 percent. A Custom Soil Resource Report for the proposed site, obtained from Web Soil Survey (accessed March 25, 2025) is included in Exhibit 4 of the Appendix. See Figure 1 in the appendix section for a pre-development soils map.

Drainage Characteristics were delineated based on pre-development and proposed topographic information from survey data. The pre- and post-development site generally flows to one of four directions. The primary directions of flow are Southwest to an existing Drainage Channel on the East side of De Soto Road, Northeast to an existing wet detention basin located offsite, South to an existing dry detention basin or Southeast to an existing Drainage Channel located West of Valley Drive. All drainage areas flow via an unnamed tributary to Sevenmile Creek, which eventually flows into the Missouri River, near Wolcott Road and McIntyre Road.

Figures 1 and 2 provide pre-development and post-development drainage characteristics. These figures and maps represent the data used to make determinations on sizes and locations of inlet structures, pipes and detention facilities.

Pre-and post-development conditions were analyzed using the 24-hour Type II SCS method for the 2-, 10- and 100-year storm events. Rainfall depths were determined using NOAA 14 Point Precipitation Frequency Estimate, included in Exhibit 5 of the appendix, with rainfall depths of 3.54, 5.26, and 8.34 inches, respectively. Weighted Curve numbers were determined by land usage per TR-55 Table 2.2a. Lag Time was calculated using 35 of the calculated time of concentration. Drainage Characteristics can be found in Table 1 below.

Table 1 – Drainage Characteristics

Basin	Area (Acres)	"C" Value	Curve Number	Longest Flow Path	Slope (%)	Time of Concentration (Min.)	Lag Time (3/5 T_c)
Pre-Development							
1	93.76	0.45	81.45	2,872	3.17	15	9.24
2	14.13	0.31	80.71	1,576	5.57	10	5.82
3	1.57	0.30	79.41	1,246	4.07	11	6.56
4	22.40	0.30	80.62	1,887	4.08	11	6.88
5	7.17	0.30	80.01	1,924	4.43	11	6.41
Post-Development							
1	93.64	0.45	82.35	2,872	3.17	15	9.20
2	14.36	0.54	89.62	1,590	5.14	7	4.49
3	0.80	0.54	79.41	1,140	3.39	8	5.06
4	18.13	0.54	89.62	448	3.79	8	4.82
5	2.88	0.54	89.62	1,924	4.08	9	5.60
6	9.22	0.54	89.62	686	4.21	8	4.62

PRE-DEVELOPMENT DRAINAGE CONDITIONS

The existing site consists of an undeveloped agricultural land, primarily consisting of pasture and heavily wooded treed areas. The existing site can be split into five basins.

Drainage Basin 1 generally consists of existing residential developments and pasture, and generally flows South through an existing 8'X6' existing Storm Sewer Box under De Soto Road, near the Northwest corner of the project site to an existing Drainage Ditch located on the East Side of De Soto Road. This existing Drainage ditch flows to Point of Concentration #1, an existing 7' CMP pipe under Holiday Drive, which continues South along an existing Drainage Ditch to an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 2 generally consists of existing pasture, with a small portion being an existing residential development, and generally flows Southwest to Point of Concentration #1, an existing 7' CMP pipe under Holiday Drive, which continues South along an existing Drainage Ditch to an

unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 3 generally consists of existing pasture residential developments, and generally flows Southeast to Point of Concentration #3, located at the intersection of Pebble Beach Drive and Holiday Drive, which eventually flows into an existing dry detention basin located South of Holiday Drive and West of Fairlane Street. The existing dry detention basin outlets South to an unnamed tributary via underground storm sewer system which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 4 generally consists of existing pasture, and generally flows Northeast to Point of Concentration #4, an existing wet detention basin located between Pebble Beach Drive and Oakmont Drive. The existing wet detention basin outlets northeast to another wet detention basin located offsite, which discharges into an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 5 generally consists of existing pasture, and generally flows Southeast to Point of Concentration #5, an existing concrete channel located between Valley Drive and Caraway Place. The existing concrete channel which flows South via an underground storm sewer system to an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

The pre-development site runoff flows are summarized in Table 2 below. Pre-Development Hydrographs can be found in Exhibit 6.

Table 2 – Pre-Development Drainage Conditions			
	2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
Point of Concentration #1	154.85	228.47	446.25
Point of Concentration #3	1.90	2.79	5.45
Point of Concentration #4	27.06	39.86	77.75
Point of Concentration #5	8.66	12.76	24.89

POST-DEVELOPMENT DRAINAGE CONDITIONS

The proposed development area is 45.27 acres and at full build out will include 194 single family homes, with an average density of 4 lots per acre and average lot size of approximately 0.25 acre. Generally, the proposed development will follow existing flow patterns. The post development site can be split into six primary basins.

Drainage Basin 1 generally consists of existing residential homes, pasture and a small portion of proposed residential properties, and generally flows south through an existing 8’X6’ existing Storm Sewer Box under De Soto Road, near the Northwest corner of the project site to an existing Drainage Ditch located on the East Side of De Soto Road. This existing Drainage ditch flows to Point of Concentration #1, an existing 7’ CMP pipe under Holiday Drive, which continues South along an existing Drainage Ditch to an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 2 generally consists of proposed residential properties and generally flows Southwest via underground storm sewer and overland flow to Point of Concentration #1, an existing 7' CMP pipe under Holiday Drive. This existing drainage ditch travels South to an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 3 generally consists of proposed residential properties, and generally flows Southeast to Point of Concentration #3, located at the intersection of Pebble Beach Drive and Holiday Drive, which eventually flows into an existing dry detention basin located South of Holiday Drive and West of Fairlane Street. The existing dry detention basin outlets South to an unnamed tributary via underground storm sewer system which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 4 consists of proposed residential properties, and generally flows Northeast via underground storm sewers into a proposed dry detention basin on the north side of the site. This detention basin will outflow to Point of Concentration #4. The proposed detention basin will reduce the peak flow rate of the drainage basin to be equal to or less than existing conditions. The existing wet detention basin outlets northeast to an other wet detention basin located offsite, which discharges into an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 5 generally consists of proposed residential properties, and generally flows Southeast to Point of Concentration #5, an existing concrete channel located between Valley Drive and Caraway Place. The existing concrete channel which flows South via an underground storm sewer system to an unnamed tributary which flows into Sevenmile Creek, which eventually flows into the Missouri River, Southeast of Lansing.

Drainage Basin 6 consists of proposed residential properties and generally flows northeast to an existing storm sewer system located on Oakmont Drive. According to the previous studies completed in 1999 and 2018, prepared by George Butler Associates, Inc. and Napier Engineering, respectively, from the project site of Monroe Manor, 9.10 acres needs to be redirected from entering the pond to the underground storm sewer system located on Oakmont Drive. The 2018 study shows an existing design capacity of 36.79 ft^3/s. When performing the analysis SMH determined that 9.22 acres could be diverted to the existing storm sewer while not exceeding the existing capacity. The proposed dry detention basin will allow water to outflow from the existing wet detention basin before water from Monroe Manor reaches the existing wet detention basin.

The proposed dry detention basin will be utilized for stormwater detention. The detention basin characteristics are summarized in Table 3 below. By utilizing the proposed dry detention basin, the proposed development has reduced the site's existing condition peak discharge rates as seen in Table 4. Post-Development Hydrographs can be found in Exhibit 6.

Table 3 – Detention Basin Characteristics	
Attribute	
Tributary Area (Acres)	18.13
Total Facility Storage (ft^3)	89,021
Greatest Depth of Facility (ft)	7.0
100-Year Peak Storage Volume (ft^3)	52,429
Ponding Depth (ft)(W.S. Elev.)	
2-Year	2.28
10-Year	3.25
100-Year	4.91
Discharge Rates (cfs)	
2-Year	37.92
10-Year	67.23
100-Year	103.24
Outlet Structure	48” Pipe

Table 4 –Post-Development Drainage Conditions			
	2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
Point of Concentration #1	145.44	214.60	419.22
Point of Concentration #3	2.01	2.97	5.78
Point of Concentration #4	21.95	35.13	71.68
Point of Concentration #5	6.87	10.13	19.74
To Existing Oakmont Storm Sewer System	23.18	34.17	66.58

Table 5 – Drainage Improvements			
	2-Year (cfs)	10-Year (cfs)	100-Year (cfs)
Point of Concentration #1			
Pre-Development	154.85	228.47	446.25
Post-Development	145.44	214.60	419.22
Point of Concentration #3			
Pre-Development	1.90	2.79	5.45
Post-Development	2.01	2.97	5.78
Point of Concentration #4			
Pre-Development	27.06	39.86	77.75
Post-Development	21.95	35.13	71.68
Point of Concentration #5			
Pre-Development	8.66	12.76	24.89
Post-Development	6.87	10.13	19.74

SUMMARY

In summary, post-development stormwater peak flow rates at all Point of Concentrations shall be equal to or less than pre-development stormwater flow rates leaving the development. The Final Stormwater Management Study and analysis will be completed at the Final Plat and Final Construction Documents submittal.

LEGEND

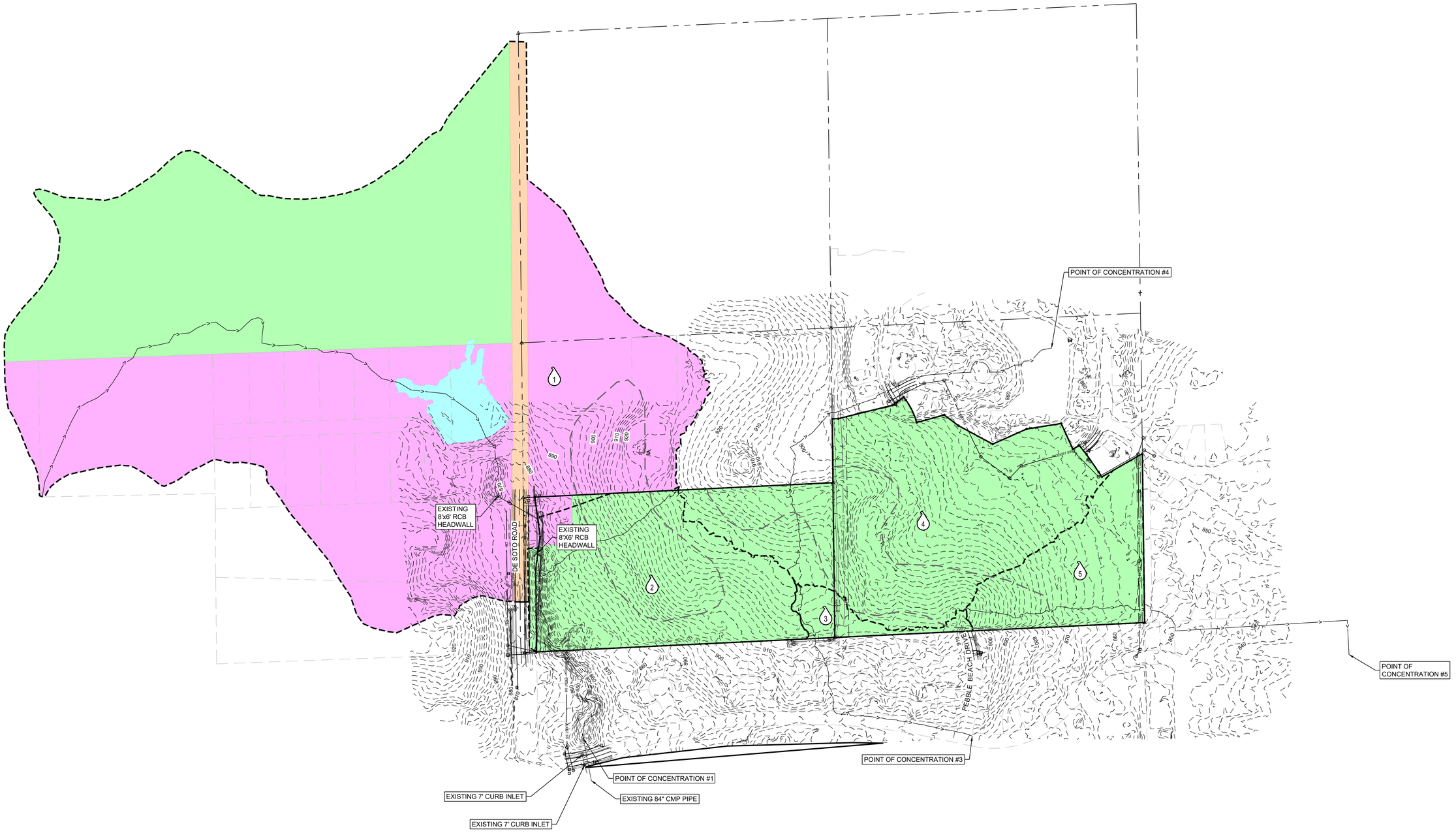
- HYDROLOGICAL SOIL GROUP BOUNDARY
- DRAINAGE BOUNDARY
- (##) DRAINAGE BASIN NUMBER

TABLE 1 - PRE-DEVELOPMENT CALCULATIONS

MAP ID	SITE	AREA (SF)	AREA (ACRES)	RATIONAL C-VALUE	CURVE NUMBER	LONGEST FLOW PATH (FT)	MAX OVERLAND FLOW DISTANCE (FT)	HIGH POINT	LOW POINT	AVERAGE SLOPE	INLET TIME (MIN)	SHALLOW TRAVEL TIME (MIN)	CHANNEL FLOW (MIN)	TIME OF CONCENTRATION (MIN)	LAG TIME (3/5 TC)
1	TO EXISTING 8'X6' RCB	4,084,273	93.76	0.45	81.45	2,872	100	953.00	862.00	3.17%	8.01	4.62	2.77	15	9.24
2	TO EXISTING 7' CMP	615,614	14.13	0.31	80.71	1,576	100	931.08	843.30	5.57%	8.06	1.64	0.00	10	5.82
3	TO SOUTH EXISTING DRY DETENTION BASIN	68,177	1.57	0.30	79.41	1,246	100	930.33	879.68	4.07%	9.02	1.91	0.00	11	6.56
4	NORTH TO EXISTING POND	975,738	22.40	0.30	80.62	1,887	100	931.57	854.60	4.08%	9.01	2.46	0.00	11	6.88
5	SOUTHEAST TO EXISTING DRAINAGE CHANNEL	312,311	7.17	0.30	80.01	1,924	100	913.14	828.00	4.43%	8.77	1.91	0.00	11	6.41

LAND COVER SUMMARY

COVER	AREA (ACRES)
RESIDENTIAL (SINGLE FAMILY)	50.64
UNDEVELOPED AREAS/OPEN SPACE	82.02
WET DETENTION BASIN	2.17
IMPERVIOUS	3.79
TOTAL	138.62



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MONROE MANOR

PROGRESS DOCUMENTS - NOT FOR CONSTRUCTION

LANSING, KANSAS

PRE-DEVELOPMENT DRAINAGE MAP

REVISION DATE		REVISION DESCRIPTION
00/00/00		(DESCRIPTION)

NORTH

200' 100' 0' 200'
SCALE: 1" = 200'

PROJECT #: 2501-0018
CHECKED BY: BCG
DRAWN BY: JMT

DATE: 06/11/2025

SHEET # FIG. 1

TOTAL SHEETS 2

LEGEND

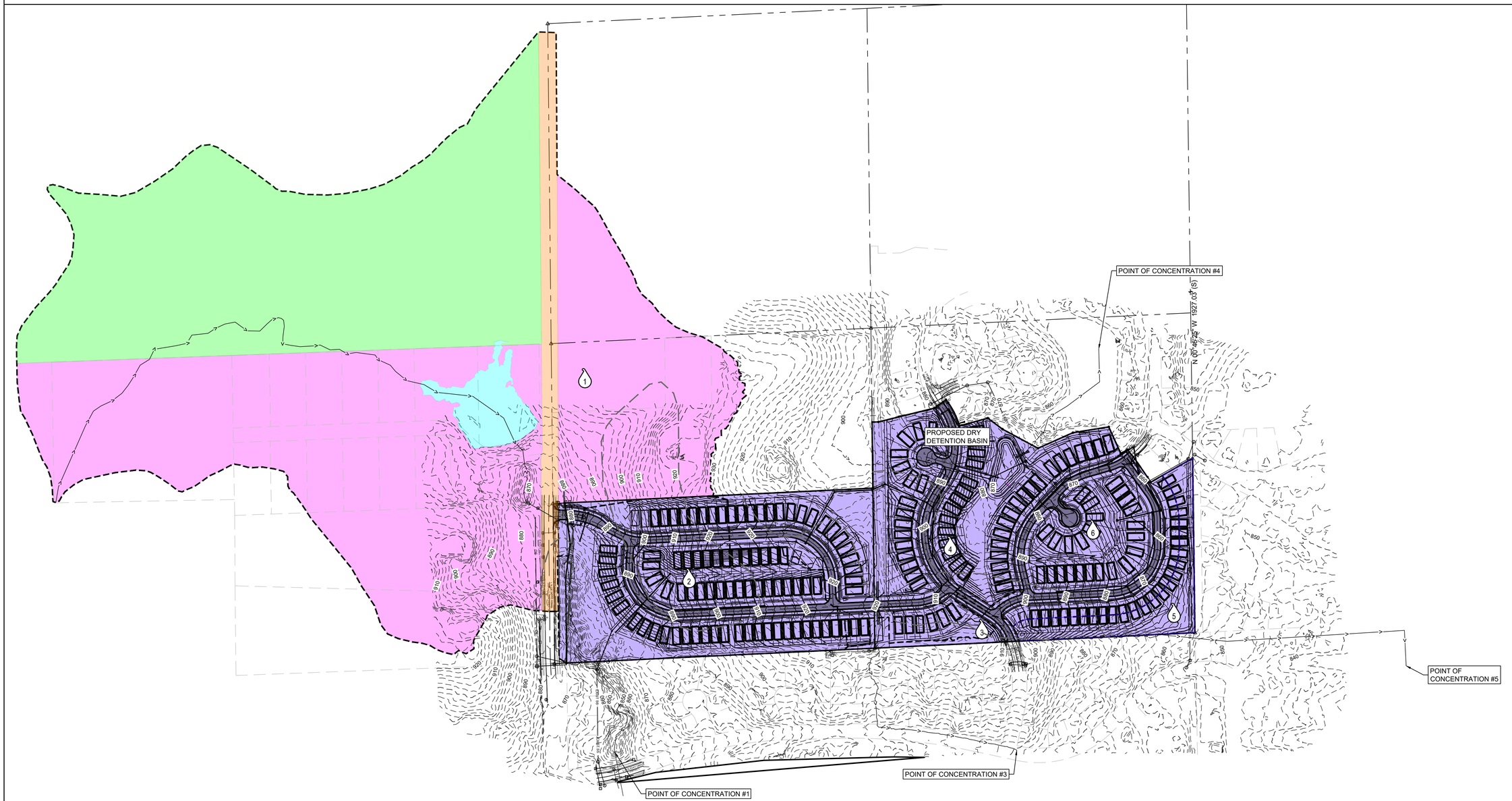
- HYDROLOGICAL SOIL GROUP BOUNDARY
- DRAINAGE BOUNDARY
- (##) DRAINAGE BASIN NUMBER

TABLE 2 - POST-DEVELOPMENT CALCULATIONS

MAP ID	SITE	AREA (SF)	AREA (ACRES)	RATIONAL C-VALUE	CURVE NUMBER	LONGEST FLOW PATH (FT)	MAX OVERLAND FLOW DISTANCE (FT)	HIGH POINT	LOW POINT	AVERAGE SLOPE	INLET TIME (MIN)	SHALLOW TRAVEL TIME (MIN)	CHANNEL FLOW (MIN)	TIME OF CONCENTRATION (MIN)	LAG TIME (3/5 TC)
1	TO WEST DRAINAGE DITCH	4,078,889	93.64	0.45	82.35	2,872	100	953.00	862.00	3.17%	7.95	4.62	2.77	15	9.20
2	TO WEST DRAINAGE DITCH (THROUGH DEVELOPMENT)	625,668	14.36	0.54	89.62	1,590	100	925.00	843.30	5.14%	5.83	1.66	0.00	7	4.49
3	TO SOUTH EXISTING DRY DETENTION BASIN	34,962	0.80	0.54	79.41	1,140	100	918.29	879.68	3.39%	6.70	1.73	0.00	8	5.06
4	NORTH TO EXISTING POND	789,665	18.13	0.54	89.62	448	100	925.00	908.00	3.79%	6.45	0.58	1.00	8	4.82
5	SOUTHEAST TO EXISTING DRAINAGE CHANNEL	125,463	2.88	0.54	89.62	1,924	100	906.50	828.00	4.08%	6.30	3.04	0.00	9	5.60
6	NORTH TO EXISTING STORM SEWER	401,497	9.22	0.54	89.62	686	100	908.78	879.92	4.21%	6.23	0.98	0.48	8	4.62

LAND COVER SUMMARY

COVER	AREA (ACRES)
RESIDENTIAL (EXISTING)	50.13
RESIDENTIAL (PROPOSED)	45.81
UNDEVELOPED AREAS/OPEN SPACE	36.72
WET DETENTION BASIN	2.17
IMPERVIOUS	3.79
TOTAL	138.62



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PROGRESS DOCUMENTS - NOT FOR CONSTRUCTION

LANSING, KANSAS

REVISION DATE		REVISION DESCRIPTION
00/00/00		(DESCRIPTION)

POST-DEVELOPMENT DRAINAGE MAP

NORTH

200' 100' 0' 200'
SCALE: 1" = 200'

PROJECT #: 2501-0018
CHECKED BY: BCG
DRAWN BY: JMT

DATE: 06/11/2025

SHEET # FIG. 2

TOTAL SHEETS 2

COOK, FLATT & STROBEL
ENGINEERS, P.A.

FAIRWAY ESTATES SUBDIVISION
LANSING, KANSAS

Drainage Calculation Sheets

May, 1995

Prepared By:

Cook, Flatt and Strobel
Engineers,P.A.

Charles R. Peavler, P.E.

Fairway Estates Subdivision
Phase I
Lansing, Kansas

Enclosed are the calculation sheets for the referenced project. The drainage area map is included in the construction documents. The sheets are grouped as follows:

Offsite and Miscellaneous Flowrates	A-1 thru A-7
Inlet and Sewer Sizing	B-1 thru B-2
Channel Sizing	C-1 thru C-4
Total Watershed Flowrates	D-1 thru D-2
10 Year Hydrograph (Total Watershed)	E-1 thru E-3
100 Year Hydrograph (Total Watershed)	F-1 thru F-3
Outlet Structure	G-1 thru G-7
10 Year Flood Routing	H-1 thru H-4
100 Year Flood Routing	I-1 thru I-4
Outlet Pipe Sizing	J-1 thru J-1

All flowrates are based on the rational method. All inlets and storm sewers are designed in accordance with the City of Lansing design criteria. Enclosed systems are designed for a 10 year flowrate and open channels are designed for a 25 year storm with the capacity to pass the 100 year storm.
The pond storm routing was performed using "Pond 2" software. The detention pond has an outlet structure with a lower weir based on a 10 year inflow and a higher weir that passes the 100 year storm inflow hydrograph.

Summary of Storm Detention Calculations:

Normal Pool Elevation =	852.00
11 Foot Lower Weir Elevation =	852.00
20 Foot Upper Weir Elevation =	855.00
Minimum Floor Elevation =	858.00
Maximum Allowable Pool Elevation =	857.00
10 Year Undeveloped Flowrate =	309.1 cfs (max. release rate)
10 Year Developed Flowrate =	385.6 cfs (inflow rate)
100 Year Developed Flowrate =	701.1 cfs
10 Year Peak Outflow =	156.2 cfs
10 Peak Elevation =	854.94
100 Year Peak Outflow =	379.5 cfs
100 Peak Elevation =	856.42

Fairway Estates Subdivision

Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "A"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	22.4	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	22.4	total	0.50

22.4 Total Acres c= 0.50 (composite)
c x A= 11.2

Inlet Time:

D	S	C	Ti (min)	Say
300	1.5	0.5	16.4	15.0
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
1500	10	2.5

Time of Concentration:
Tc = 18 min.

Flowrate:

10 Year Return Period		K= 1.00		
Intensity =	4.76 "/hr.			
K x c =	0.50		Quantity =	53.3 cfs
25 Year Return Period		K= 1.10		
Intensity =	5.52 "/hr.			
K x c =	0.55		Quantity =	68.0 cfs
50 Year Return Period		K= 1.20		
Intensity =	6.16 "/hr.			
K x c =	0.60		Quantity =	82.8 cfs
100 Year Return Period		K= 1.25		
Intensity =	6.77 "/hr.			
K x c =	0.63		Quantity =	94.8 cfs

Fairway Estates Subdivision

Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "B"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	8	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	8	total	0.50

8.0 Total Acres c= 0.50 (composite)
c x A= 4

Inlet Time:

D	S	C	Ti (min)	Say
300	3	0.5	13.0	13.0
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
1050	10	1.8

Time of Concentration:
Tc = 14.8 min.

Flowrate:

10 Year Return Period		K=	1.00		
Intensity =	5.21	"/hr.			
K x c =	0.50			Quantity =	20.9 cfs
25 Year Return Period		K=	1.10		
Intensity =	6.05	"/hr.			
K x c =	0.55			Quantity =	26.6 cfs
50 Year Return Period		K=	1.20		
Intensity =	6.94	"/hr.			
K x c =	0.60			Quantity =	33.3 cfs
100 Year Return Period		K=	1.25		
Intensity =	7.63	"/hr.			
K x c =	0.63			Quantity =	38.1 cfs

Fairway Estates Subdivision

Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "C"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	38.2	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	38.2	total	0.50

38.2 Total Acres c= 0.50 (composite)
c x A= 19.1

Inlet Time:

D	S	C	Ti (min)	Say
300	6.5	0.5	10.1	10.1
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
1300	10	2.2

Time of Concentration:
Tc = 12.3 min.

Flowrate:

10 Year Return Period		K=	1.00	
Intensity =	5.64 "/hr.			
K x c =	0.50		Quantity =	107.6 cfs
25 Year Return Period		K=	1.10	
Intensity =	6.54 "/hr.			
K x c =	0.55		Quantity =	137.3 cfs
50 Year Return Period		K=	1.20	
Intensity =	7.50 "/hr.			
K x c =	0.60		Quantity =	172.0 cfs
100 Year Return Period		K=	1.25	
Intensity =	8.24 "/hr.			
K x c =	0.63		Quantity =	196.8 cfs

Fairway Estates Subdivision

Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "D"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	15.5	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	15.5	total	0.50

15.5 Total Acres c= 0.50 (composite)
c x A= 7.75

Inlet Time:

D	S	C	Ti (min)	Say
300	7	0.5	9.8	9.8
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
425	10	0.7

Time of Concentration:
Tc = 10.6 min.

Flowrate:

10 Year Return Period		K=	1.00	
Intensity =	5.96 "/hr.			
K x c =	0.50		Quantity =	46.2 cfs
25 Year Return Period		K=	1.10	
Intensity =	6.92 "/hr.			
K x c =	0.55		Quantity =	59.0 cfs
50 Year Return Period		K=	1.20	
Intensity =	7.94 "/hr.			
K x c =	0.60		Quantity =	73.8 cfs
100 Year Return Period		K=	1.25	
Intensity =	8.72 "/hr.			
K x c =	0.63		Quantity =	84.5 cfs

Fairway Estates Subdivision
Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "S"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	2.3	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	2.3	total	0.50

2.3 Total Acres c= 0.50 (composite)
c x A= 1.15

Inlet Time:

D	S	C	Ti (min)	Say
200	7	0.5	8.0	8.0
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
350	10	0.6

Time of Concentration:
Tc = 8.6 min.

Flowrate:

10 Year Return Period		K= 1.00		
Intensity =	6.38 "/hr.			
K x c =	0.50		Quantity =	7.3 cfs
25 Year Return Period		K= 1.10		
Intensity =	7.40 "/hr.			
K x c =	0.55		Quantity =	9.4 cfs
50 Year Return Period		K= 1.20		
Intensity =	8.50 "/hr.			
K x c =	0.60		Quantity =	11.7 cfs
100 Year Return Period		K= 1.25		
Intensity =	9.34 "/hr.			
K x c =	0.63		Quantity =	13.4 cfs

Fairway Estates Subdivision
Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "B+E"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	13	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	13	total	0.50

13.0 Total Acres c= 0.50 (composite)
c x A= 6.5

Inlet Time:

D	S	C	Ti (min)	Say
300	3	0.5	13.0	13.0
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
1930	10	3.2

Time of Concentration:
Tc = 16.2 min.

Flowrate:

10 Year Return Period		K= 1.00		
Intensity =	5.00 "/hr.			
K x c =	0.50		Quantity =	32.5 cfs
25 Year Return Period		K= 1.10		
Intensity =	5.79 "/hr.			
K x c =	0.55		Quantity =	41.4 cfs
50 Year Return Period		K= 1.20		
Intensity =	6.65 "/hr.			
K x c =	0.60		Quantity =	51.9 cfs
100 Year Return Period		K= 1.25		
Intensity =	7.31 "/hr.			
K x c =	0.63		Quantity =	59.4 cfs

Fairway Estates Subdivision
Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Area "I"

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	1.2	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	1.2	total	0.50

1.2 Total Acres c= 0.50 (composite)
c x A= 0.6

Inlet Time:

D	S	C	Ti (min)	Say
200	5	0.5	9.0	9.0
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
170	7	0.4

Time of Concentration:
Tc = 9.4 min.

Flowrate:

10 Year Return Period		K= 1.00		
Intensity =	6.21 "/hr.			
K x c =	0.50		Quantity =	3.7 cfs
25 Year Return Period		K= 1.10		
Intensity =	7.20 "/hr.			
K x c =	0.55		Quantity =	4.8 cfs
50 Year Return Period		K= 1.20		
Intensity =	8.27 "/hr.			
K x c =	0.60		Quantity =	6.0 cfs
100 Year Return Period		K= 1.25		
Intensity =	9.08 "/hr.			
K x c =	0.63		Quantity =	6.8 cfs

Fairway Estates

Lansing, Kansas

CP 4/27/
CF&S
f: fairway

INLETS

Struct.	Area	Contrib. Area (Ac.)	Run. Coef. (c)	Inlet Dist. (ft.)	Basin Slope (%)	(5-15) Inlet Time (min.)	Travel Length (ft.)	Travel Vel. (fps)	Travel Time (min.)	Time Con. (min.)	Freq. Factor (K)	Rainfall Inten. ("/hr.)	Runoff (cfs)	Sum Runoff (cfs)	Gutter Slope (%)	Spread (ft.)	Inlet Size (ft.)	Inlet Cap. (cfs)	Inter. 80% (cfs)	Bypass (cfs)	Bypass to
CI 2-4	G	2.4	0.50	290	5.5%	10.5	320	7.0	0.8	11.2	1	5.83	7.0	7.0	3.0%	10.5	5	7.2	5.8	1.2	CI 2-3
CI 2-3	M	2.9	0.50	300	4.5%	11.4	400	7.0	1.0	12.3	1	5.62	8.1	9.4	3.0%	11.0	8	9.4	7.5	0.6	CI 7-4
CI 2-2	F	1.3	0.80	250	3.0%	5.8	540	7.0	1.3	7.2	1	6.72	7.0	7.0	3.0%	10.5	5	7.2	5.8	1.2	CI 6-3
CI 7-4	N	2.7	0.50	300	6.7%	10.0	350	7.0	0.8	10.8	1	5.91	8.0	8.6	2.7%	11.2	5	7.4	5.9	2.1	CI 6-2
CI 7-3	O	0.8	0.50	130	5.0%	7.2	275	7.0	0.7	7.9	1	6.56	2.6	2.6	(sag)	gutter	5	15.0	12.0	0.0	-
CI 7-2	P	0.6	0.50	100	3.0%	7.5	350	7.0	0.8	8.3	1	6.45	1.9	1.9	(sag)	gutter	5	15.0	12.0	0.0	-
CI 5-3	K	1.1	0.50	200	3.0%	10.6	320	7.0	0.8	11.4	1	5.80	3.2	3.2	(sag)	gutter	5	15.0	12.0	0.0	-
CI 5-2	L	0.6	0.50	100	3.0%	7.5	360	7.0	0.9	8.4	1	6.44	1.9	1.9	(sag)	gutter	5	15.0	12.0	0.0	-
CI 6-3	Q	0.7	0.80	100	5.0%	5.0	370	7.0	0.9	5.9	1	7.09	4.0	5.2	(sag)	gutter	5	15.0	12.0	0.0	-
CI 6-2	R	0.7	0.80	100	5.0%	5.0	370	7.0	0.9	5.9	1	7.09	4.0	6.0	(sag)	gutter	5	15.0	12.0	0.0	-
FI 3-2	H	1.3	0.50	300	4.0%	11.8	375	7.0	0.9	12.7	1	5.55	3.6	3.6	(sag)	-	4	-	-	-	-
GI 4-2	J	0.7	0.80	100	5.0%	3.2	370	7.0	0.9	4.1	1	7.66	4.3	4.3	(sag)	-	4	-	-	-	-

STORM SEWERS

Struct.	Struct.	Pipe Flow (cfs)	Pipe Size (in.)	Pipe Slope (%)	Vel. (fps)	Pipe Cap. (cfs)	Top Elev.	Open (elev.)	Pipe Elev. (out)	"h" V2/2g	Hyd. Grad. (elev.)	Inlet Freeb. (ft.)
CI 2-4	CI 2-3	7.0	15	3.00%	9.1	11.2	877.41	876.03	872.90	1.30	875.45	0.58
CI 2-3	CI 2-2	16.4	21	1.25%	7.4	17.7	867.17	865.79	862.40	0.85	865.00	0.79
CI 2-2	FE 2-1	23.4	24	1.20%	7.9	24.8	867.17	865.79	861.68	0.97	864.65	1.14
CI 7-4	CI 7-3	8.6	15	2.00%	7.5	9.2	862.68	861.30	858.50	0.86	860.61	0.69
CI 7-3	CI 7-2	11.2	18	2.00%	8.4	14.9	861.50	860.12	857.00	1.10	859.60	0.52
CI 2-2	FE 2-1	13.1	18	2.00%	8.4	14.9	861.50	860.12	853.54	1.10	856.14	3.98
FE 5-4	CI 5-3	112.9	36	3.57%	17.9	126.3	-	-	-	-	-	-
CI 5-3	CI 5-2	116.1	42	1.50%	12.8	123.5	864.01	862.63	856.00	2.56	862.06	0.57
CI 5-2	FE 5-1	118.0	48	0.77%	10.1	126.3	864.01	862.63	855.55	1.57	861.12	1.51
FE 6-4	CI 6-3	237.2	54	1.50%	15.2	241.4	-	-	-	-	-	-
CI 6-3	CI 6-2	242.4	60	0.90%	12.6	247.8	862.41	861.03	853.24	2.47	860.71	0.32
CI 6-2	FE 6-1	248.4	60	1.00%	13.3	261.0	862.41	861.03	852.70	2.75	860.45	0.58
FI 3-2	FE 3-1	3.6	15	3.00%	9.1	11.2	875.00	875.00	870.00	1.30	872.55	2.45
GI 4-2	FE 4-1	111.9	42	1.50%	12.8	123.5	875.50	875.50	866.80	2.56	872.86	2.64
MH 1-3	MH 1-2	53.6	36	1.00%	9.5	66.8	886.00	886.00	878.65	1.39	883.04	2.96
MH 1-2	FE 1-1	53.6	36	0.70%	7.9	55.9	882.50	882.50	877.17	0.97	881.14	1.36

COOK, FLATT AND STROBEL
ENGINEERS, P.A.

Subject Fairway Estates Sheet No. 1 of 1
Job No.
By CP Date Chkd By Date

Size FI 3-2 L = 4' min.

$Q = C L H^{3/2}$

$C = 2.67$

$Q = 3.6$ cfs

$3.6 = 2.67(4) H^{3/2}$

$H^{3/2} = 0.3371$

$H = 0.48'$ ok

Size GI 4-2

try 4'x4' $P = 8'(.8) = 6.4'$

$A = 4'(.8) = 3.2^{\#}$

$Q = 4.3$ cfs

$P \rightarrow d = 0.37'$ o/c

$A \rightarrow d = < 0.37'$

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: felch25

Comment: Tract A Channel (25yr)

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0080 ft/ft
Discharge.....	109.40 cfs

Computed Results:

Depth.....	1.54 ft
Velocity.....	4.84 fps
Flow Area.....	22.59 sf
Flow Top Width...	19.26 ft
Wetted Perimeter.	19.76 ft
Critical Depth...	1.34 ft
Critical Slope...	0.0134 ft/ft
Froude Number....	0.79 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: felch25

Comment: Tract A Channel (25yr)

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0087 ft/ft
Discharge.....	109.40 cfs

Computed Results:

Depth.....	1.51 ft
Velocity.....	4.99 fps
Flow Area.....	21.93 sf
Flow Top Width...	19.06 ft
Wetted Perimeter.	19.55 ft
Critical Depth...	1.34 ft
Critical Slope...	0.0134 ft/ft
Froude Number....	0.82 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: felch100

Comment: Tract A Channel (100yr)

Solve For Depth

Given Input Data:

Bottom Width.....	10.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0087 ft/ft
Discharge.....	154.20 cfs

Computed Results:

Depth.....	1.81 ft
Velocity.....	5.51 fps
Flow Area.....	27.97 sf
Flow Top Width...	20.87 ft
Wetted Perimeter.	21.46 ft
Critical Depth...	1.64 ft
Critical Slope...	0.0127 ft/ft
Froude Number....	0.84 (flow is Subcritical)

Open Channel Flow Module, Version 3.21 (c) 1990
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: bch100

Comment: Tract B Channel (100yr)

Solve For Depth

Given Input Data:

Bottom Width.....	8.00 ft
Left Side Slope..	3.00:1 (H:V)
Right Side Slope.	3.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0060 ft/ft
Discharge.....	210.20 cfs

Computed Results:

Depth.....	2.53 ft
Velocity.....	5.34 fps
Flow Area.....	39.37 sf
Flow Top Width...	23.16 ft
Wetted Perimeter.	23.98 ft
Critical Depth...	2.12 ft
Critical Slope...	0.0121 ft/ft
Froude Number....	0.72 (flow is Subcritical)

Fairway Estates Subdivision
Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Watershed Pre-development

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	92.1	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	64.2	unimproved	0.30
0	total	ERR	156.3	total	0.42

156.3 Total Acres c= 0.42 (composite)
c x A= 65.31

Inlet Time:

D	S	C	Ti (min)	Say
300	5	0.42	12.5	12.5
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
3400	10	5.7

Time of Concentration:
Tc = 18.2 min.

Flowrate:

10 Year Return Period		K=	1.00	
Intensity =	4.73	"/hr.		
K x c =	0.42		Quantity =	309.1 cfs
25 Year Return Period		K=	1.10	
Intensity =	5.49	"/hr.		
K x c =	0.46		Quantity =	394.5 cfs
50 Year Return Period		K=	1.20	
Intensity =	6.30	"/hr.		
K x c =	0.50		Quantity =	493.9 cfs
100 Year Return Period		K=	1.25	
Intensity =	6.92	"/hr.		
K x c =	0.52		Quantity =	565.3 cfs

Fairway Estates Subdivision

Lansing, Kansas

CP 4/28/95
C,F&S
f: fairway

Watershed Post-development

Areas:

Acres	Surface	"C"	Acres	Surface	"C"
0	pavement	0.85	156.3	residential	0.50
0	roof	0.90	0	commercial	0.80
0	turf	0.15	0	unimproved	0.30
0	total	ERR	156.3	total	0.50

156.3 Total Acres c= 0.50 (composite)
c x A= 78.15

Inlet Time:

D	S	C	Ti (min)	Say
300	5	0.50	11.0	11.0
(300 max.)			(5 to 15 min.)	

Travel Time:

L	V	Tt (min)
3400	10	5.7

Time of Concentration:
Tc = 16.7 min.

Flowrate:

10 Year Return Period		K=	1.00	
Intensity =	4.93 "/hr.			
K x c =	0.50		Quantity =	385.6 cfs
25 Year Return Period		K=	1.10	
Intensity =	5.72 "/hr.			
K x c =	0.55		Quantity =	492.1 cfs
50 Year Return Period		K=	1.20	
Intensity =	6.57 "/hr.			
K x c =	0.60		Quantity =	616.1 cfs
100 Year Return Period		K=	1.25	
Intensity =	7.22 "/hr.			
K x c =	0.63		Quantity =	705.1 cfs

Executed 04-29-1995 10:36:48
Constructed file:
FAIR10 .HYD

Input Data for Hydrograph

VOLUME = 465,034 cu.ft. = 10.68 ac-ft

Warning: Right side of hydrograph truncated. Hydrograph volume incomplete.

Time (hrs)	Flow (cfs)
0.00	0.0
0.28	385.6
0.67	0.0

Executed 04-29-1995 10:36:48
Constructed file:
FAIR10 .HYD

File Summary for Constructed Hydrograph

VOLUME = 465,034 cu.ft. = 10.68 ac-ft

Warning: Right side of hydrograph truncated. Hydrograph volume incomplete.

Time (hrs)	Flow (cfs)
0.00	0.0
0.02	22.9
0.03	45.7
0.05	68.6
0.07	91.4
0.08	114.3
0.10	137.2
0.12	160.0
0.13	182.9
0.15	205.7
0.17	228.6
0.18	251.5
0.20	274.3
0.22	297.2
0.23	320.0
0.25	342.9
0.27	365.8
0.28	383.4
0.30	367.0
0.32	350.6
0.33	334.2
0.35	317.8
0.37	301.4
0.38	284.9
0.40	268.5
0.41	252.1
0.43	235.7
0.45	219.3
0.46	202.9
0.48	186.5
0.50	170.1
0.51	153.6
0.53	137.2
0.55	120.8
0.56	104.4
0.58	88.0
0.60	71.6
0.61	55.2

Executed 04-29-1995 10:36:48
Constructed file:
FAIR10 .HYD

File Summary for Constructed Hydrograph

VOLUME = 465,034 cu.ft. = 10.68 ac-ft

Warning: Right side of hydrograph truncated. Hydrograph volume incomplete.

Time (hrs)	Flow (cfs)
0.63	38.8
0.65	22.3
0.66	5.9

>>>>>>>>>>>>>>>>> WARNING MESSAGES <<<<<<<<<<<<<<<<<

Peak flow in hydrograph does not match peak flow input point.

Executed 04-29-1995 10:44:14
Constructed file:
FAIR100 .HYD

Input Data for Hydrograph

VOLUME = 850,351 cu.ft. = 19.52 ac-ft

Warning: Right side of hydrograph truncated. Hydrograph volume incomplete.

Time (hrs)	Flow (cfs)
0.00	0.0
0.28	705.1
0.67	0.0

Executed 04-29-1995 10:44:14
Constructed file:
FAIR100 .HYD

File Summary for Constructed Hydrograph

VOLUME = 850,351 cu.ft. = 19.52 ac-ft

Warning: Right side of hydrograph truncated. Hydrograph volume incomplete.

Time (hrs)	Flow (cfs)
0.00	0.0
0.02	41.8
0.03	83.6
0.05	125.4
0.07	167.2
0.08	209.0
0.10	250.8
0.12	292.6
0.13	334.4
0.15	376.2
0.17	418.0
0.18	459.8
0.20	501.6
0.22	543.4
0.23	585.2
0.25	627.0
0.27	668.8
0.28	701.1
0.30	671.1
0.32	641.1
0.33	611.1
0.35	581.1
0.37	551.1
0.38	521.1
0.40	491.0
0.41	461.0
0.43	431.0
0.45	401.0
0.46	371.0
0.48	341.0
0.50	311.0
0.51	281.0
0.53	250.9
0.55	220.9
0.56	190.9
0.58	160.9
0.60	130.9
0.61	100.9

Executed 04-29-1995 10:44:14
Constructed file:
FAIR100 .HYD

File Summary for Constructed Hydrograph

VOLUME = 850,351 cu.ft. = 19.52 ac-ft

Warning: Right side of hydrograph truncated. Hydrograph volume incomplete.

Time (hrs)	Flow (cfs)
0.63	70.9
0.65	40.9
0.66	10.8

>>>>>>>>>>>>>>>>> WARNING MESSAGES <<<<<<<<<<<<<<<<<

Peak flow in hydrograph does not match peak flow input point.

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

Outlet Structure File: FAIR2 .STR
Planimeter Input File: FAIR .VOL
Rating Table Output File: FAIR2 .PND

Min. Elev.(ft) = 852 Max. Elev.(ft) = 857.1 Incr.(ft) = .25

Additional elevations (ft) to be included in table:
* *

****
SYSTEM CONNECTIVITY
****

Structure	No.	Q Table		Q Table
WEIR-VR	1		->	1
WEIR-VR	2	+ 1	->	3

Outflow rating table summary was stored in file:
FAIR2 .PND

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

>>>>>> Structure No. 1 <<<<<<
(Input Data)

WEIR-VR
Weir - Vertical Rectangular

E1 elev.(ft)?	852
E2 elev.(ft)?	857.1
Weir coefficient?	2.98
Weir elev.(ft)?	852
Length (ft)?	11
Contracted/Suppressed (C/S)?	C

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

>>>>>> Structure No. 2 <<<<<<
(Input Data)

WEIR-VR
Weir - Vertical Rectangular

E1 elev.(ft)?	852
E2 elev.(ft)?	857.1
Weir coefficient?	2.98
Weir elev.(ft)?	855.0
Length (ft)?	20
Contracted/Suppressed (C/S)?	C

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

***** COMPOSITE OUTFLOW SUMMARY ****

Elevation (ft)	Q (cfs)	Contributing Structures
852.00	0.0	1
852.25	4.1	1
852.50	11.5	1
852.75	21.0	1
853.00	32.2	1
853.25	44.8	1
853.50	58.6	1
853.75	73.5	1
854.00	89.3	1
854.25	106.1	1
854.50	123.7	1
854.75	142.0	1
855.00	161.0	1 +2
855.25	188.1	1 +2
855.50	221.9	1 +2
855.75	260.2	1 +2
856.00	302.2	1 +2
856.25	347.3	1 +2
856.50	395.2	1 +2
856.75	445.6	1 +2
857.00	498.4	1 +2
857.10	0.0	

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

Outflow Rating Table for Structure #1
WEIR-VR Weir - Vertical Rectangular

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages
852.00	0.0	H =0.0
852.25	4.1	H =.25
852.50	11.5	H =.5
852.75	21.0	H =.750
853.00	32.2	H =1.0
853.25	44.8	H =1.25
853.50	58.6	H =1.5
853.75	73.5	H =1.75
854.00	89.3	H =2.0
854.25	106.1	H =2.25
854.50	123.7	H =2.5
854.75	142.0	H =2.75
855.00	161.0	H =3.0
855.25	180.7	H =3.25
855.50	201.0	H =3.5
855.75	221.8	H =3.75
856.00	243.2	H =4.0
856.25	265.0	H =4.25
856.50	287.3	H =4.5
856.75	310.0	H =4.75
857.00	333.2	H =5.0
857.10	0.0	E = or > E2=857.1

C = 2.98 L (ft) = 11
H (ft) = Table elev. - Invert elev. (852 ft)
Q (cfs) = C * (L-.2H) * (H**1.5) -- Contracted Weir

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

Outflow Rating Table for Structure #2
WEIR-VR Weir - Vertical Rectangular

***** INLET CONTROL ASSUMED *****

Elevation (ft)	Q (cfs)	Computation Messages
852.00	0.0	E < Inv.El.= 855
852.25	0.0	E < Inv.El.= 855
852.50	0.0	E < Inv.El.= 855
852.75	0.0	E < Inv.El.= 855
853.00	0.0	E < Inv.El.= 855
853.25	0.0	E < Inv.El.= 855
853.50	0.0	E < Inv.El.= 855
853.75	0.0	E < Inv.El.= 855
854.00	0.0	E < Inv.El.= 855
854.25	0.0	E < Inv.El.= 855
854.50	0.0	E < Inv.El.= 855
854.75	0.0	E < Inv.El.= 855
855.00	0.0	H =0.0
855.25	7.4	H =.25
855.50	21.0	H =.5
855.75	38.4	H =.750
856.00	59.0	H =1.0
856.25	82.3	H =1.25
856.50	107.8	H =1.5
856.75	135.6	H =1.75
857.00	165.2	H =2.0
857.10	0.0	E = or > E2=857.1

C = 2.98 L (ft) = 20
H (ft) = Table elev. - Invert elev. (855 ft)
Q (cfs) = C * (L-.2H) * (H**1.5) -- Contracted Weir

Outlet Structure File: FAIR2 .STR

POND-2 Version: 5.14 S/N: 1220510459
Date Executed: Time Executed:

Outflow Rating Table 3
Table 3 = 1 + 2

Elevation (ft)	Q (cfs)	Contributing Structures
852.00	0.0	1
852.25	4.1	1
852.50	11.5	1
852.75	21.0	1
853.00	32.2	1
853.25	44.8	1
853.50	58.6	1
853.75	73.5	1
854.00	89.3	1
854.25	106.1	1
854.50	123.7	1
854.75	142.0	1
855.00	161.0	1 +2
855.25	188.1	1 +2
855.50	221.9	1 +2
855.75	260.2	1 +2
856.00	302.2	1 +2
856.25	347.3	1 +2
856.50	395.2	1 +2
856.75	445.6	1 +2
857.00	498.4	1 +2
857.10	0.0	-

****
* *
* Fairway Estates *
* 10 Year Routing *
* *
* *
* *
****

Inflow Hydrograph: FAIR10 .HYD
Rating Table file: FAIR2 .PND

----INITIAL CONDITIONS----
Elevation = 852.00 ft
Outflow = 0.00 cfs
Storage = 0 cu-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (cu-ft)	2S/t (cfs)	2S/t + O (cfs)
852.00	0.0	0	0.0	0.0
852.25	4.1	27,167	754.6	758.7
852.50	11.5	54,794	1522.1	1533.6
852.75	21.0	82,886	2302.4	2323.4
853.00	32.2	111,447	3095.7	3127.9
853.25	44.8	140,479	3902.2	3947.0
853.50	58.6	169,989	4721.9	4780.5
853.75	73.5	199,977	5554.9	5628.4
854.00	89.3	230,451	6401.4	6490.7
854.25	106.1	261,412	7261.4	7367.5
854.50	123.7	292,865	8135.1	8258.8
854.75	142.0	324,813	9022.6	9164.6
855.00	161.0	357,261	9923.9	10084.9
855.25	188.1	390,213	10839.2	11027.3
855.50	221.9	423,671	11768.6	11990.5
855.75	260.2	457,641	12712.2	12972.4
856.00	302.2	492,126	13670.2	13972.4
856.25	347.3	527,129	14642.5	14989.8
856.50	395.2	562,655	15629.3	16024.5
856.75	445.6	598,709	16630.8	17076.4
857.00	498.4	635,292	17647.0	18145.4

Time increment (t) = 1.2 min.

Pond File: FAIR2 .PND
Inflow Hydrograph: FAIR10 .HYD
Outflow Hydrograph: OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (min)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.0	0.00	-----	0.0	0.0	0.00	852.00
1.2	22.90	22.9	22.7	22.9	0.12	852.01
2.4	45.70	68.6	90.3	91.3	0.49	852.03
3.6	68.60	114.3	202.4	204.6	1.11	852.07
4.8	91.40	160.0	358.4	362.4	1.96	852.12
6.0	114.30	205.7	558.0	564.1	3.05	852.19
7.2	137.20	251.5	800.4	809.5	4.59	852.27
8.4	160.00	297.2	1082.9	1097.6	7.34	852.36
9.6	182.90	342.9	1404.9	1425.8	10.47	852.47
10.8	205.70	388.6	1764.2	1793.5	14.63	852.58
12.0	228.60	434.3	2159.5	2198.5	19.50	852.71
13.2	251.50	480.1	2588.8	2639.6	25.40	852.85
14.4	274.30	525.8	3050.6	3114.6	32.01	853.00
15.6	297.20	571.5	3542.5	3622.1	39.80	853.15
16.8	320.00	617.2	4063.0	4159.7	48.32	853.31
18.0	342.90	662.9	4610.5	4725.9	57.70	853.48
19.2	365.80	708.7	5183.1	5319.2	68.07	853.66
20.4	383.40	749.2	5774.2	5932.3	79.07	853.84
21.6	367.00	750.4	6344.7	6524.6	89.95	854.01
22.8	350.60	717.6	6861.8	7062.3	100.25	854.16
24.0	334.20	684.8	7327.3	7546.6	109.64	854.30
25.2	317.80	652.0	7742.9	7979.3	118.18	854.42
26.4	301.40	619.2	8110.6	8362.1	125.79	854.53
27.6	284.90	586.3	8431.8	8696.9	132.55	854.62
28.8	268.50	553.4	8708.4	8985.2	138.37	854.70
30.0	252.10	520.6	8942.4	9229.0	143.33	854.77
31.2	235.70	487.8	9135.2	9430.2	147.48	854.82
32.4	219.30	455.0	9288.6	9590.2	150.79	854.87
33.6	202.90	422.2	9404.3	9710.8	153.28	854.90
34.8	186.50	389.4	9483.7	9793.7	154.99	854.92
36.0	170.10	356.6	9528.4	9840.3	155.95	854.93
37.2	153.60	323.7	9539.7	9852.1	156.19	854.94
38.4	137.20	290.8	9519.0	9830.5	155.75	854.93
39.6	120.80	258.0	9467.7	9777.0	154.64	854.92
40.8	104.40	225.2	9387.1	9692.9	152.91	854.89
42.0	88.00	192.4	9278.4	9579.5	150.57	854.86
43.2	71.60	159.6	9142.7	9438.0	147.64	854.82
44.4	55.20	126.8	8981.2	9269.5	144.17	854.78
45.6	38.80	94.0	8794.8	9075.2	140.19	854.73
46.8	22.30	61.1	8584.3	8855.9	135.76	854.66
48.0	5.90	28.2	8350.9	8612.5	130.85	854.60

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: FAIR2 .PND
Inflow Hydrograph: FAIR10 .HYD
Outflow Hydrograph: OUT .HYD

Starting Pond W.S. Elevation = 852.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	383.40 cfs
Peak Outflow	=	156.19 cfs
Peak Elevation	=	854.94 ft

***** Summary of Approximate Peak Storage *****

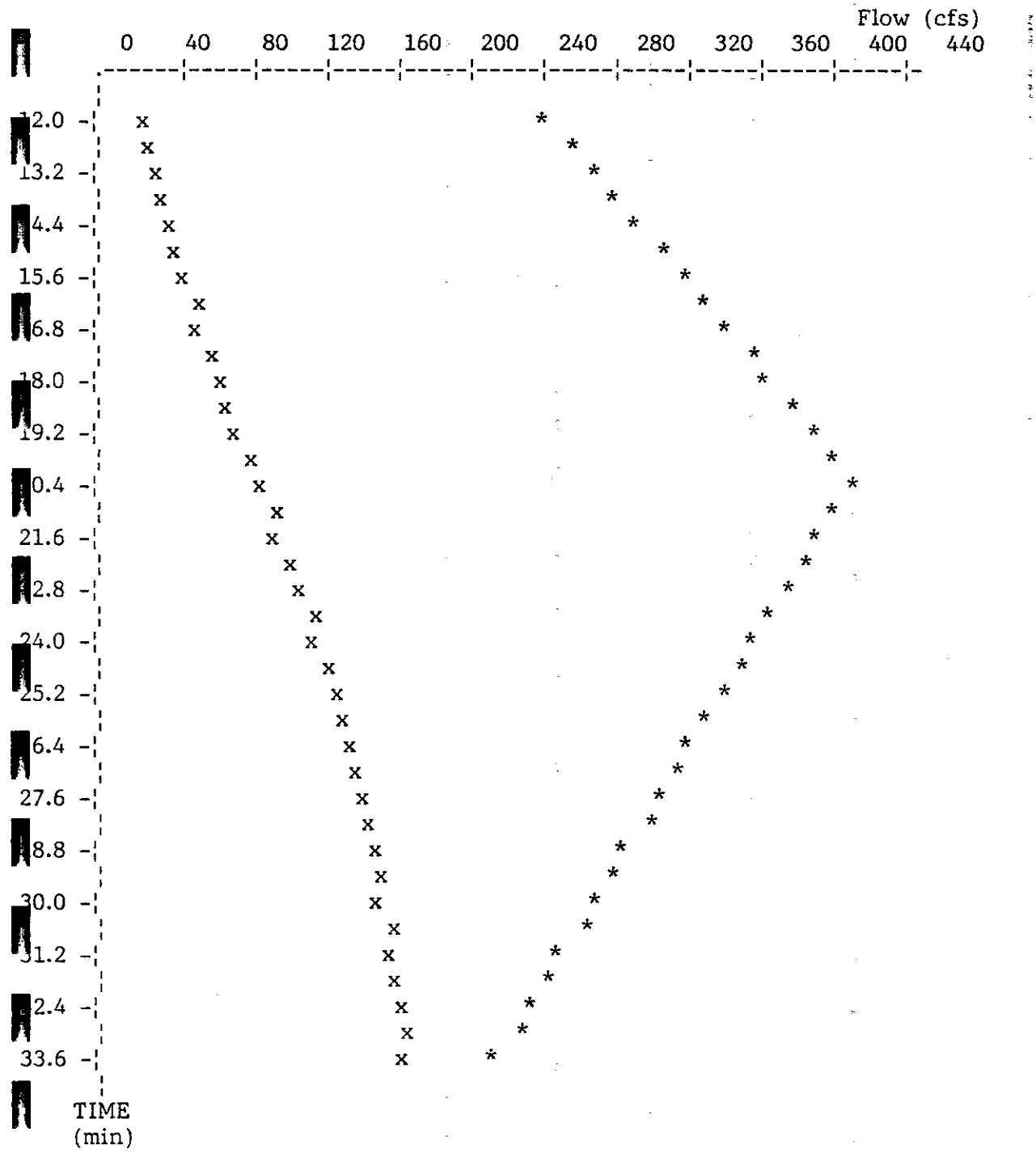
Initial Storage	=	0 cu-ft
Peak Storage From Storm	=	349,054 cu-ft
Total Storage in Pond	=	349,054 cu-ft

Warning: Inflow hydrograph truncated on right side.

Pond File: FAIR2 .PND
Inflow Hydrograph: FAIR10 .HYD
Outflow Hydrograph: OUT .HYD

EXECUTED: 05-01-1995
15:15:15

Peak Inflow = 383.40 cfs
Peak Outflow = 156.19 cfs
Peak Elevation = 854.94 ft



* File: FAIR10 .HYD Qmax = 383.4 cfs
x File: OUT .HYD Qmax = 156.2 cfs

****
* *
* Fairway Estates *
* 100 Year Routing *
* *
* *
* *
****

Inflow Hydrograph: FAIR100 .HYD
Rating Table file: FAIR2 .PND

----INITIAL CONDITIONS----
Elevation = 852.00 ft
Outflow = 0.00 cfs
Storage = 0 cu-ft

GIVEN POND DATA			INTERMEDIATE ROUTING COMPUTATIONS	
ELEVATION (ft)	OUTFLOW (cfs)	STORAGE (cu-ft)	2S/t (cfs)	2S/t + O (cfs)
852.00	0.0	0	0.0	0.0
852.25	4.1	27,167	754.6	758.7
852.50	11.5	54,794	1522.1	1533.6
852.75	21.0	82,886	2302.4	2323.4
853.00	32.2	111,447	3095.7	3127.9
853.25	44.8	140,479	3902.2	3947.0
853.50	58.6	169,989	4721.9	4780.5
853.75	73.5	199,977	5554.9	5628.4
854.00	89.3	230,451	6401.4	6490.7
854.25	106.1	261,412	7261.4	7367.5
854.50	123.7	292,865	8135.1	8258.8
854.75	142.0	324,813	9022.6	9164.6
855.00	161.0	357,261	9923.9	10084.9
855.25	188.1	390,213	10839.2	11027.3
855.50	221.9	423,671	11768.6	11990.5
855.75	260.2	457,641	12712.2	12972.4
856.00	302.2	492,126	13670.2	13972.4
856.25	347.3	527,129	14642.5	14989.8
856.50	395.2	562,655	15629.3	16024.5
856.75	445.6	598,709	16630.8	17076.4
857.00	498.4	635,292	17647.0	18145.4

Time increment (t) = 1.2 min.

Pond File: FAIR2 .PND
Inflow Hydrograph: FAIR100 .HYD
Outflow Hydrograph: OUT .HYD

INFLOW HYDROGRAPH		ROUTING COMPUTATIONS				
TIME (min)	INFLOW (cfs)	I1+I2 (cfs)	2S/t - O (cfs)	2S/t + O (cfs)	OUTFLOW (cfs)	ELEVATION (ft)
0.0	0.00	-----	0.0	0.0	0.00	852.00
1.2	41.80	41.8	41.3	41.8	0.23	852.01
2.4	83.60	125.4	164.9	166.7	0.90	852.05
3.6	125.40	209.0	369.9	373.9	2.02	852.12
4.8	167.20	292.6	655.3	662.5	3.58	852.22
6.0	209.00	376.2	1018.1	1031.5	6.71	852.34
7.2	250.80	459.8	1456.0	1477.9	10.97	852.48
8.4	292.60	543.4	1965.2	1999.4	17.10	852.65
9.6	334.40	627.0	2542.7	2592.2	24.74	852.83
10.8	376.20	710.6	3185.0	3253.3	34.13	853.04
12.0	418.00	794.2	3888.6	3979.2	45.33	853.26
13.2	459.80	877.8	4649.6	4766.4	58.37	853.50
14.4	501.60	961.4	5464.7	5611.0	73.19	853.74
15.6	543.40	1045.0	6330.3	6509.7	89.66	854.01
16.8	585.20	1128.6	7243.1	7458.9	107.90	854.28
18.0	627.00	1212.2	8200.0	8455.3	127.67	854.55
19.2	668.80	1295.8	9198.1	9495.8	148.84	854.84
20.4	701.10	1369.9	10218.2	10568.0	174.89	855.13
21.6	671.10	1372.2	11174.7	11590.4	207.86	855.40
22.8	641.10	1312.2	12004.4	12486.9	241.26	855.63
24.0	611.10	1252.2	12712.3	13256.6	272.13	855.82
25.2	581.10	1192.2	13305.8	13904.5	299.35	855.98
26.4	551.10	1132.2	13792.3	14438.0	322.84	856.11
27.6	521.10	1072.2	14181.0	14864.5	341.75	856.22
28.8	491.00	1012.1	14479.7	15193.1	356.71	856.30
30.0	461.00	952.0	14696.2	15431.7	367.76	856.36
31.2	431.00	892.0	14838.2	15588.2	375.00	856.39
32.4	401.00	832.0	14912.6	15670.2	378.80	856.41
33.6	371.00	772.0	14925.7	15684.6	379.46	856.42
34.8	341.00	712.0	14883.1	15637.7	377.29	856.41
36.0	311.00	652.0	14790.0	15535.1	372.54	856.38
37.2	281.00	592.0	14651.1	15382.0	365.46	856.34
38.4	250.90	531.9	14470.5	15183.0	356.24	856.30
39.6	220.90	471.8	14251.9	14942.3	345.20	856.24
40.8	190.90	411.8	13998.0	14663.7	332.85	856.17
42.0	160.90	351.8	13711.9	14349.8	318.93	856.09
43.2	130.90	291.8	13396.6	14003.7	303.59	856.01
44.4	100.90	231.8	13052.9	13628.4	287.75	855.91
45.6	70.90	171.8	12683.1	13224.7	270.79	855.81
46.8	40.90	111.8	12288.3	12794.9	253.27	855.70
48.0	10.80	51.7	11869.0	12340.0	235.53	855.59

********** SUMMARY OF ROUTING COMPUTATIONS **********

Pond File: FAIR2 .PND
Inflow Hydrograph: FAIR100 .HYD
Outflow Hydrograph: OUT .HYD

Starting Pond W.S. Elevation = 852.00 ft

***** Summary of Peak Outflow and Peak Elevation *****

Peak Inflow	=	701.10 cfs
Peak Outflow	=	379.46 cfs
Peak Elevation	=	856.42 ft

***** Summary of Approximate Peak Storage *****

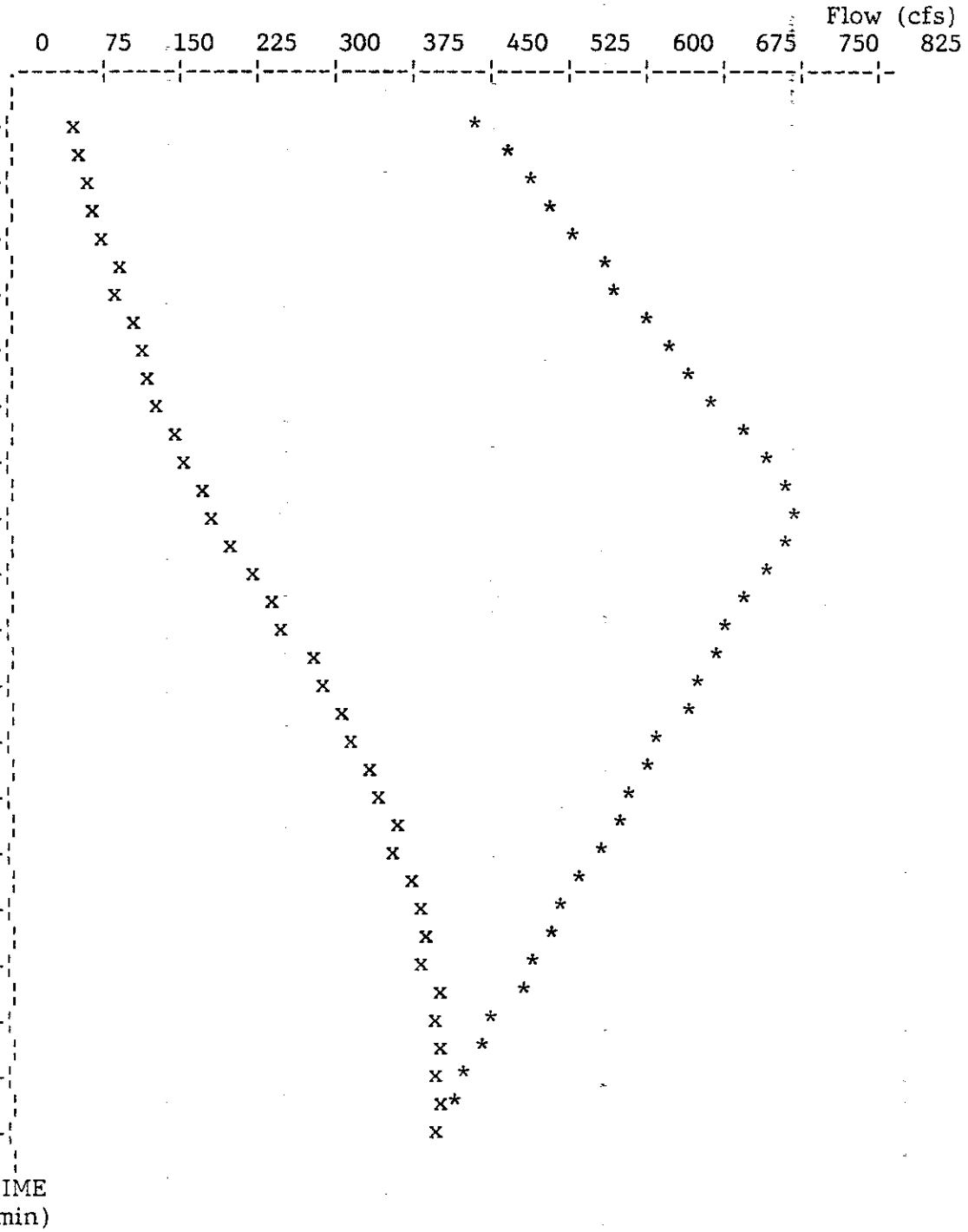
Initial Storage	=	0 cu-ft
Peak Storage From Storm	=	550,981 cu-ft
Total Storage in Pond	=	550,981 cu-ft

Warning: Inflow hydrograph truncated on right side.

Pond File: FAIR2 .PND
Inflow Hydrograph: FAIR100 .HYD
Outflow Hydrograph: OUT .HYD

EXECUTED: 05-01-1995
15:07:30

Peak Inflow = 701.10 cfs
Peak Outflow = 379.46 cfs
Peak Elevation = 856.42 ft



* File: FAIR100 .HYD Qmax = 701.1 cfs
x File: OUT .HYD Qmax = 379.5 cfs

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: Outpipe

Comment: Pond Outlet Pipe

Solve For Actual Depth

Given Input Data:

Diameter.....	8.00 ft
Slope.....	0.0025 ft/ft
Manning's n.....	0.013
Discharge.....	379.46 cfs

Computed Results:

Depth.....	5.57 ft
Velocity.....	10.15 fps
Flow Area.....	37.39 sf
Critical Depth....	4.95 ft
Critical Slope....	0.0035 ft/ft
Percent Full.....	69.67 %
Full Capacity.....	456.04 cfs
QMAX @.94D.....	490.56 cfs
Froude Number.....	0.79 (flow is Subcritical)

FAIRWAY ESTATES
PHASE II

LAKE RE-STUDY

September 24, 1999

GBA NO. 8813

LESLIE G. BARNT
LICENSED
13358
KANSAS
PROFESSIONAL ENGINEER
9/28/99

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Engineers · Architects

GBA GEORGE BUTLER ASSOCIATES, INC.

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http://www.gbutler.com

September 24, 1999

Mr. William Schrandt
Director of Public Works
City of Lansing
Lansing, KS 66043

SUBJECT: Fairway Estates Lake Study

Dear Mr. Schrandt:

We are submitting for your review and approval, a "Lake Re-Study" for Fairway Estates. We were compelled to conduct our own study of the Fairway Estates Lake after field investigations conducted by our firm revealed the following:

1. The existing outlet box was not constructed in accordance with plans prepared by Cook, Flatt and Strobel (dated July 10, 1995.) More specifically, the outlet box was constructed with no "lower" 5 foot weir as shown on those plans.

2. The existing home on Lot 37 was found to have a lowest finish floor elevation below the 100 year pool as calculated by Cook, Flatt and Strobel.

Typically, City of Lansing storm design criteria requires the analysis for drainage areas less than 200 acres to be completed using the Rational Method. In order to review the drainage data more quickly, we utilized the HEC-1 program to conduct our detailed drainage study. To obtain similar results to the rational method using the HEC-1 program, we increased the curve number and percent impervious to obtain results similar to those obtained using the rational method and as published in the previous drainage report by Cook, Flatt and Strobel. City of Lansing Technical Specifications and Design Criteria call for a curve number of 83 and a percent impervious of 35% for single-family developments. We modified the curve number to 90 and the percent impervious to 45%. We utilized the areas and time of concentrations from the previous study and modified as necessary to incorporate into the HEC-1 analysis. Using this methodology, we believe we have obtained results comparable to the conservatism of the rational method. The storm duration used was 6 hours and rainfall depths for the 2, 10, 25, 50 and 100-year events were taken from Technical Paper 40 (TP-40).

The drainage area being routed to the lake is approximately 142 acres. Our study takes into account the two existing on-site detention facilities upstream. Thus, stage/storage and stage/discharge were included in the routing for our re-study. There are also two detention facilities upstream and off site which were **not included** within our analysis.

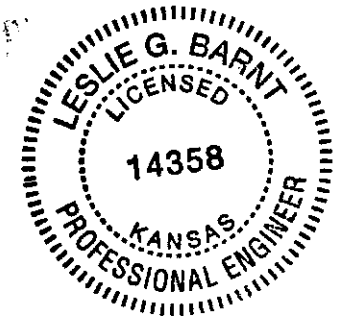
The following modifications are being proposed to maintain a 100-year storm event below the lowest existing finish floor elevation of 858.32.

- Re-route 14.7 acres of drainage area to bypass the lake from the south to the east .
- Existing lake outlet box will be being upsized from 8.5'x4' to 10'x10'.
- Provide an emergency spillway at Elevation 857.0 with 10 foot flat bottom ditch.
- Provide an additional 7,200± sq. ft. surface area to the lake.

According to the owner, since the construction of the lake in 1995, no flooding has occurred within any of the constructed homes. By not taking into account off-site detention upstream and increasing the curve number and percent impervious to a higher number than what is typically used, we feel we have an analysis that is very conservative in nature. Should you have any questions or comments please feel free to call me or Harland Russell at (913) 492-0400.

Respectfully yours,

GEORGE BUTLER ASSOCIATES, INC.



Leslie G. Barnt, P.E.
Project Engineer

Harland T. Russell
Project Manager

cc: Ed Schlagel, P.E. Lansing City Engineer
Brad Burton, P.E. George Butler Associates

O:\Proj\8813\schrandt1.wpd

ELEVATION (ft)	AREA (acres)	AVERAGE AREA (acres)	VOLUME (acre-ft)	ACCUMULATIVE VOLUME (acre-ft)	TYPE OF STORAGE (1)
854.8	2.664			0.000	
		2.691	0.538		
855.0	2.718			0.538	
		2.786	1.393		
855.5	2.853			1.931	
		2.918	1.459		
856.0	2.983			3.390	
		3.062	1.531		
856.5	3.141			4.921	
		3.219	1.610		
857.0	3.297			6.530	
		3.395	1.697		
857.5	3.492			8.228	
		3.589	1.795		
858.0	3.686			10.022	
		3.824	1.912		
858.5	3.961			11.934	
		4.098	2.049		
859.0	4.235			13.983	

(1) At the given Elevation and Below

10'X10
' Riser w/ 72" CSP
Hydraulic Calculations w/10 foot Emergency Spillway @ Elevation 857

Elevation	H_1	L_T	Q_W	Q_O	H_2	Q_P	$Q_{cont.}$	$H_{E.S.}$	$Q_{E.S.}$	$Q_{total.}$
854.8	0.0	40.0	0.0	0.0	6.3	262.6	0.0			0.0
855.0	0.2	39.8	10.7	172.3	6.5	266.7	10.7			10.7
855.5	0.7	39.4	69.3	322.3	7.0	276.8	69.3			69.3
856.0	1.2	39.0	154.0	422.0	7.5	286.5	154.0			154.0
856.5	1.7	38.6	256.9	502.2	8.0	295.9	256.9			256.9
857.0	2.2	38.2	374.3	571.3	8.5	305.0	305.0	0.0	0.0	305.0
857.5	2.7	37.8	503.6	632.9	9.0	313.8	313.8	0.5	9.5	323.3
858.0	3.2	37.4	643.0	689.1	9.5	322.4	322.4	1.0	26.5	348.9
858.5	3.7	37.0	790.9	740.9	10.0	330.8	330.8	1.5	48.1	378.9
859.0	4.2	36.6	946.1	789.4	10.5	339.0	339.0	2.0	73.3	412.3

H_1	The depth of water above 10'x10' box.
L_T	The true length of the 10'x10' box weir ($L_T = (L - n*0.1*H_1)$
Q_w	Weir Flow over Box, $Q_W = 3.0 L_T H_1^{3/2}$
Q_O	Orifice Flow in Box, $Q_o = 0.6*A*(2*g*H_1)^{1/2}$, assumed also 20% clogging factor for grate over box.
H_2	The depth of water above crown of pipe at outlet.
Q_P	Pipe Flow of 72" CMP $Q_p = A_p(2*g*H_2/k_e + k_o + (29.1*n^2 L_p/R^{4/3}))^{1/2}$
$Q_{cont.}$	Controlling flow between weir, orifice and pipe.
$H_{E.S.}$	The depth of water above invert of Emergency Spillway.
$Q_{E.S.}$	Flow through Emergency Spillway. C factor of 2.7 was used in formula
$Q_{total.}$	Accumlative Flow from Principal and Emergency Spillways.

(1) At the given Elevation and Below

APPENDICES

```
1**************************************
*                                    *
*  FLOOD HYDROGRAPH PACKAGE  (HEC-1) *
*        SEPTEMBER 1990              *
*         VERSION 4.0                *
*                                    *
* RUN DATE  09/10/1999  TIME  14:10:45 *
*                                    *
**************************************
```

```
**************************************
*                                    *
*  U.S. ARMY CORPS OF ENGINEERS      *
*  HYDROLOGIC ENGINEERING CENTER     *
*       609 SECOND STREET            *
*    DAVIS, CALIFORNIA 95616         *
*       (916) 756-1104               *
*                                    *
**************************************
```

```
X     X  XXXXXXX   XXXXX          X
X     X  X        X     X        XX
X     X  X        X                X
XXXXXXX  XXXX     X        XXXXX   X
X     X  X        X                X
X     X  X        X     X          X
X     X  XXXXXXX   XXXXX          XXX
```

THIS PROGRAM REPLACES ALL PREVIOUS VERSIONS OF HEC-1 KNOWN AS HEC1 (JAN 73), HEC1GS, HEC1DB, AND HEC1KW.

THE DEFINITIONS OF VARIABLES -RTIMP- AND -RTIOR- HAVE CHANGED FROM THOSE USED WITH THE 1973-STYLE INPUT STRUCTURE.
THE DEFINITION OF -AMSKK- ON RM-CARD WAS CHANGED WITH REVISIONS DATED 28 SEP 81. THIS IS THE FORTRAN77 VERSION
NEW OPTIONS: DAMBREAK OUTFLOW SUBMERGENCE , SINGLE EVENT DAMAGE CALCULATION, DSS:WRITE STAGE FREQUENCY,
DSS:READ TIME SERIES AT DESIRED CALCULATION INTERVAL LOSS RATE:GREEN AND AMPT INFILTRATION
KINEMATIC WAVE: NEW FINITE DIFFERENCE ALGORITHM


```
LINE          ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

    1         ID   FAIRWAY ESTATES DEVELOPMENT (P.N. 8813.00)
    2         ID   LAKE ELEVATIONS FOR IMPACTS TO DEVELOPMENT (LEAVENWORTH, KS)
    3         ID   HEC-1 6-HOUR DURATION STORM
    4         ID   2,25,50,6 100 STORM EVENTS
    5         ID   FILE NAME "8813EX15.DAT" ALTERNATIVE 2 (KEEPING POOL ELEV @ 854.8)
    6         ID   PROPOSED SYSTEM 10'X10' BOX W/72" CSP @ ELEV 854.80
    7         ID   AREA REDUCED BY 14.65 ACRES DUE TO BEING ROUTED AWAY AND DOWNSTREAM OF LAKE
    8         ID   EMERGENCY SPILLWAY AT 857.0 (10' RECTANGULAR CHANNEL)
              * **********
              * **********
              *  ( 8 hrs)(60min/hr)/2min interval= 240 ordinates + 1 to get 241 ordinates
              *  2 hrs were added to 6 hr duration to allow hydrograph to close.
    9         IT       2       0       1     241
   10         IO       3       0
   11         IN      15
              *            2-YR   10-YR   25-YR   50-YR   100-YR
   12         JR    PREC   0.095   0.142   0.168   0.186   0.212
              * **********
              * WATERSHED A
              * **********

   13         KK       A
   14         KM   RUNOFF FOR A
   15         BA   0.057
   16         PB    27.4
   17         PC       0       2       4       6       9      12      15      19      27      46
   18         PC      62      68      72      76      79      82      85      87      90      92
   19         PC      94      96      98      99     100
   20         LS       0      90      45
   21         UD    0.18
              * **********
              * **********

   22         KK   DET-A
   23         KM   STORAGE/DISCHARGE FOR DETENTION A
   24         KO       3       0
   25         RS       1    ELEV
   26         SV   0.000   0.071   0.147   0.231   0.323   0.426   0.544
   27         SE   863.0   863.5   864.0   864.5   865.0   865.5   866.0
   28         SQ       0     1.6     8.4    18.4    24.6    29.6    33.8
   29         SE   863.0   863.5   864.0   864.5   865.0   865.5   866.0
   30         SS   863.0
   31         ST   866.0      80     3.0     1.5
              * **********
              * **********
              * WATERSHED B
              * **********

   32         KK       B
   33         KM   RUNOFF FOR B
```

```
                34          BA   0.077
                35          PB    27.4
                36          LS       0       90       45
                37          UD    0.12
                            * **********
                            * **********
1                                                HEC-1 INPUT                                                PAGE  2

           LINE             ID.....1.....2.....3.....4.....5.....6.....7.....8.....9.....10

                38          KK   COMB1
                39          KM   COMBINE RUNOFF FROM DETENTION A AND B
                40          HC       2
                            * **********
                            * **********

                41          KK   DET-B
                42          KM   STORAGE/DISCHARGE FOR DETENTION B
                43          KO       3       0
                44          RS       1    ELEV
                45          SV   0.000   0.039   0.093   0.152   0.218   0.291   0.373   0.475   0.610   0.785
                46          SV   1.011   1.286   1.611   2.008
                47          SE   858.1   858.5   859.0   859.5   860.0   860.5   861.0   861.5   862.0   862.5
                48          SE   863.0   863.5   864.0   864.5
                49          SQ       0     6.1    20.5    39.8    62.9    89.2   109.0   121.0   135.0     145
                50          SQ     150     165     170     180
                51          SE   858.1   858.5   859.0   859.5   860.0   860.5   861.0   861.5   862.0   862.5
                52          SE   863.0   863.5   864.0   864.5
                53          SS   858.1
                54          ST   864.5      85     3.0     1.5
                            * **********
                            * WATERSHED C
                            * **********

                55          KK       C
                56          KM   RUNOFF FOR C
                57          BA   0.088
                58          PB    27.4
                59          LS       0       90       45
                60          UD    0.21
                            * **********
                            * **********

                61          KK   COMB2
                62          KM   COMBINE RUNOFF FROM DETENTION B AND C
                63          HC       2
                            * **********
                            * **********

                64          KK    LAKE
                65          KM   STORAGE/DISCHARGE FOR LAKE
                66          KO       3       0
                67          RS       1    ELEV
                68          SV   0.000   0.538   1.931   3.390   4.921   6.530   8.228  10.022  11.934  13.983
                69          SE   854.8   855.0   855.5   856.0   856.5   857.0   857.5   858.0   858.5   859.0
                70          SQ       0    10.7    69.3   154.0   256.9   305.0   323.3   348.9   378.9   412.3
                71          SE   854.8   855.0   855.5   856.0   856.5   857.0   857.5   858.0   858.5   859.0
                72          SS   854.8
                73          ST   859.0     100     3.0     1.5
                74          ZZ
1*****************************************
*                                       *
*   FLOOD HYDROGRAPH PACKAGE  (HEC-1)   *
*          SEPTEMBER 1990               *
*           VERSION 4.0                 *
*                                       *
*  RUN DATE  09/10/1999  TIME  14:10:45 *
*                                       *
*****************************************

*****************************************
*                                       *
*    U.S. ARMY CORPS OF ENGINEERS       *
*    HYDROLOGIC ENGINEERING CENTER      *
*          609 SECOND STREET            *
*       DAVIS, CALIFORNIA 95616         *
*           (916) 756-1104              *
*                                       *
*****************************************

  FAIRWAY ESTATES DEVELOPMENT (P.N. 8813.00)
  LAKE ELEVATIONS FOR IMPACTS TO DEVELOPMENT (LEAVENWORTH, KS)
  HEC-1 6-HOUR DURATION STORM
  2,25,50,& 100 STORM EVENTS
  FILE NAME "8813EX15.DAT" ALTERNATIVE 2 (KEEPING POOL ELEV @ 854.8)
  PROPOSED SYSTEM 10'X10' BOX W/72" CSP @ ELEV 854.80
  AREA REDUCED BY 14.65 ACRES DUE TO BEING ROUTED AWAY AND DOWNSTREAM OF LAKE
  EMERGENCY SPILLWAY AT 857.0 (10' RECTANGULAR CHANNEL)

 10 IO          OUTPUT CONTROL VARIABLES
                      IPRNT          3  PRINT CONTROL
                      IPLOT          0  PLOT CONTROL
                      QSCAL          0.  HYDROGRAPH PLOT SCALE
```

```
 IT          HYDROGRAPH TIME DATA
                   NMIN            2  MINUTES IN COMPUTATION INTERVAL
                  IDATE       1    0  STARTING DATE
                  ITIME         0001  STARTING TIME
                     NQ          241  NUMBER OF HYDROGRAPH ORDINATES
                 NDDATE       1    0  ENDING DATE
                 NDTIME         0801  ENDING TIME
                  ICENT           19  CENTURY MARK

               COMPUTATION INTERVAL      .03 HOURS
                   TOTAL TIME BASE     8.00 HOURS

        ENGLISH UNITS
             DRAINAGE AREA          SQUARE MILES
             PRECIPITATION DEPTH    INCHES
             LENGTH, ELEVATION      FEET
             FLOW                   CUBIC FEET PER SECOND
             STORAGE VOLUME         ACRE-FEET
             SURFACE AREA           ACRES
             TEMPERATURE            DEGREES FAHRENHEIT

 JP          MULTI-PLAN OPTION
                 NPLAN            1  NUMBER OF PLANS

 JR          MULTI-RATIO OPTION
                RATIOS OF PRECIPITATION
                .09       .14       .17       .19       .21

*** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** *** ***

            **************
            *            *
 13 KK      *        A   *
            *            *
            **************
                      RUNOFF FOR A

 11 IN          TIME DATA FOR INPUT TIME SERIES
                    JXMIN           15  TIME INTERVAL IN MINUTES
                   JXDATE       1    0  STARTING DATE
                   JXTIME            1  STARTING TIME

               SUBBASIN RUNOFF DATA

 15 BA          SUBBASIN CHARACTERISTICS
                    TAREA         .06  SUBBASIN AREA

               PRECIPITATION DATA

 16 PB               STORM       27.40  BASIN TOTAL PRECIPITATION

 17 PI            INCREMENTAL PRECIPITATION PATTERN
                    .27       .27       .27       .27       .27       .27       .27       .27       .27       .27
                    .27       .27       .27       .27       .27       .27       .27       .27       .27       .27
                    .27       .27       .33       .40       .40       .40       .40       .40       .40       .40
                    .40       .40       .40       .40       .40       .40       .40       .40       .40       .40
                    .40       .40       .40       .40       .40       .53       .53       .53       .53       .53
                    .53       .53       .80      1.07      1.07      1.07      1.07      1.07      1.07      1.07
                   2.53      2.53      2.53      2.53      2.53      2.53      2.53      2.33      2.13      2.13
                   2.13      2.13      2.13      2.13      2.13       .80       .80       .80       .80       .80
                    .80       .80       .67       .53       .53       .53       .53       .53       .53       .53
                    .53       .53       .53       .53       .53       .53       .53       .47       .40       .40
                    .40       .40       .40       .40       .40       .40       .40       .40       .40       .40
                    .40       .40       .40       .40       .40       .40       .40       .40       .40       .40
                    .27       .27       .27       .27       .27       .27       .27       .33       .40       .40
                    .40       .40       .40       .40       .40       .27       .27       .27       .27       .27
                    .27       .27       .27       .27       .27       .27       .27       .27       .27       .27
                    .27       .27       .27       .27       .27       .27       .27       .27       .27       .27
                    .27       .27       .27       .27       .27       .13       .13       .13       .13       .13
                    .13       .13       .13       .13       .13       .13       .13       .13       .13       .13

 20 LS          SCS LOSS RATE
                    STRTL         .22  INITIAL ABSTRACTION
                   CRVNBR       90.00  CURVE NUMBER
                    RTIMP       45.00  PERCENT IMPERVIOUS AREA

 21 UD          SCS DIMENSIONLESS UNITGRAPH
                    TLAG         .18  LAG

                                                  ***

                                              UNIT HYDROGRAPH
                                          29 END-OF-PERIOD ORDINATES
                11.       33.       68.      110.      134.      140.      132.      114.       91.       65.
```

49.	38.	29.	22.	17.	13.	10.	7.	5.	4.
3.	2.	2.	1.	1.	1.	1.	0.	0.	

TOTAL RAINFALL = 27.40, TOTAL LOSS = .71, TOTAL EXCESS = 26.69

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW	6-HR	24-HR	72-HR	8.00-HR
+ 681.	2.40	(CFS)	163.	123.	123.	123.
		(INCHES)	26.586	26.691	26.691	26.691
		(AC-FT)	81.	81.	81.	81.

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION A
FOR PLAN 1, RATIO = .09

TOTAL RAINFALL = 2.60, TOTAL LOSS = .54, TOTAL EXCESS = 2.06

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW	6-HR	24-HR	72-HR	8.00-HR
+ 54.	2.50	(CFS)	13.	9.	9.	9.
		(INCHES)	2.055	2.064	2.064	2.064
		(AC-FT)	6.	6.	6.	6.

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION A
FOR PLAN 1, RATIO = .14

TOTAL RAINFALL = 3.89, TOTAL LOSS = .59, TOTAL EXCESS = 3.30

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW	6-HR	24-HR	72-HR	8.00-HR
+ 86.	2.43	(CFS)	20.	15.	15.	15.
		(INCHES)	3.285	3.300	3.300	3.300
		(AC-FT)	10.	10.	10.	10.

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION A
FOR PLAN 1, RATIO = .17

TOTAL RAINFALL = 4.60, TOTAL LOSS = .61, TOTAL EXCESS = 3.99

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW	6-HR	24-HR	72-HR	8.00-HR
+ 104.	2.43	(CFS)	24.	18.	18.	18.
		(INCHES)	3.976	3.994	3.994	3.994
		(AC-FT)	12.	12.	12.	12.

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION A
FOR PLAN 1, RATIO = .19

TOTAL RAINFALL = 5.10, TOTAL LOSS = .62, TOTAL EXCESS = 4.48

PEAK FLOW (CFS)	TIME (HR)	MAXIMUM AVERAGE FLOW	6-HR	24-HR	72-HR	8.00-HR
+ 117.	2.43	(CFS)	27.	21.	21.	21.
		(INCHES)	4.458	4.477	4.477	4.477
		(AC-FT)	14.	14.	14.	14.

CUMULATIVE AREA = .06 SQ MI

***   ***   ***   ***   ***

HYDROGRAPH AT STATION A
FOR PLAN 1, RATIO = .21

TOTAL RAINFALL = 5.81, TOTAL LOSS = .63, TOTAL EXCESS = 5.18

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 135.	2.43		32.	24.	24.	24.
		(INCHES)	5.155	5.177	5.177	5.177
		(AC-FT)	16.	16.	16.	16.

CUMULATIVE AREA = .06 SQ MI

*** ***

```
        **************
        *            *
22 KK   *    DET-A   *
        *            *
        **************
```

STORAGE/DISCHARGE FOR DETENTION A

```
24 KO       OUTPUT CONTROL VARIABLES
                 IPRNT          3  PRINT CONTROL
                 IPLOT          0  PLOT CONTROL
                 QSCAL         0.  HYDROGRAPH PLOT SCALE

        HYDROGRAPH ROUTING DATA

25 RS       STORAGE ROUTING
                 NSTPS          1  NUMBER OF SUBREACHES
                  ITYP       ELEV  TYPE OF INITIAL CONDITION
                RSVRIC        .00  INITIAL CONDITION
                     X        .00  WORKING R AND D COEFFICIENT
```

26 SV	STORAGE	.0	.1	.1	.2	.3	.4	.5
27 SE	ELEVATION	863.00	863.50	864.00	864.50	865.00	865.50	866.00
28 SQ	DISCHARGE	0.	2.	8.	18.	25.	30.	34.
29 SE	ELEVATION	863.00	863.50	864.00	864.50	865.00	865.50	866.00

```
30 SS       SPILLWAY
                  CREL     863.00  SPILLWAY CREST ELEVATION
                 SPWID        .00  SPILLWAY WIDTH
                  COQW        .00  WEIR COEFFICIENT
                  EXPW       1.50  EXPONENT OF HEAD

31 ST       TOP OF DAM
                 TOPEL     866.00  ELEVATION AT TOP OF DAM
                DAMWID      80.00  DAM WIDTH
                  COQD       3.00  WEIR COEFFICIENT
                  EXPD       1.50  EXPONENT OF HEAD
```

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.07	.15	.23	.32	.43	.54
OUTFLOW	.00	1.60	8.40	18.40	24.60	29.60	33.80
ELEVATION	863.00	863.50	864.00	864.50	865.00	865.50	866.00

***   ***   ***   ***   ***

HYDROGRAPH AT STATION DET-A
FOR PLAN 1, RATIO = .09

PEAK OUTFLOW IS 53. AT TIME 2.50 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 53.	2.50		12.	9.	9.	9.
		(INCHES)	2.037	2.064	2.064	2.064
		(AC-FT)	6.	6.	6.	6.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
1.	2.47	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
866.18	2.50	864.22	862.15	862.15	862.15

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DET-A
FOR PLAN 1, RATIO = .14

PEAK OUTFLOW IS 86. AT TIME 2.47 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 86.	2.47	20.	15.	15.	15.
		(INCHES) 3.269	3.300	3.300	3.300
		(AC-FT) 10.	10.	10.	10.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
1.	2.40	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
866.35	2.47	864.53	862.40	862.40	862.40

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DET-A
FOR PLAN 1, RATIO = .17

PEAK OUTFLOW IS 104. AT TIME 2.43 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 104.	2.43	24.	18.	18.	18.
		(INCHES) 3.960	3.994	3.994	3.994
		(AC-FT) 12.	12.	12.	12.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
1.	2.40	0.	0.	0.	0.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
866.43	2.43	864.69	862.52	862.52	862.52

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DET-A
FOR PLAN 1, RATIO = .19

PEAK OUTFLOW IS 117. AT TIME 2.43 HOURS

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 117.	2.43	27.	21.	21.	21.
		(INCHES) 4.439	4.476	4.476	4.476
		(AC-FT) 13.	14.	14.	14.

PEAK STORAGE	TIME		6-HR	MAXIMUM AVERAGE STORAGE 24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)					
1.	2.40		0.	0.	0.	0.

PEAK STAGE	TIME		6-HR	MAXIMUM AVERAGE STAGE 24-HR	72-HR	8.00-HR
+ (FEET)	(HR)					
866.48	2.43		864.80	862.60	862.60	862.60

CUMULATIVE AREA = .06 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DET-A
FOR PLAN 1, RATIO = .21

PEAK OUTFLOW IS 135. AT TIME 2.43 HOURS

PEAK FLOW	TIME		6-HR	MAXIMUM AVERAGE FLOW 24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 135.	2.43		32.	24.	24.	24.
		(INCHES)	5.140	5.180	5.180	5.180
		(AC-FT)	16.	16.	16.	16.

PEAK STORAGE	TIME		6-HR	MAXIMUM AVERAGE STORAGE 24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)					
1.	2.40		0.	0.	0.	0.

PEAK STAGE	TIME		6-HR	MAXIMUM AVERAGE STAGE 24-HR	72-HR	8.00-HR
+ (FEET)	(HR)					
866.55	2.43		864.96	862.72	862.72	862.72

CUMULATIVE AREA = .06 SQ MI

*** ***

```
              **************
              *            *
32 KK         *     B      *
              *            *
              **************
```

RUNOFF FOR B

SUBBASIN RUNOFF DATA

34 BA SUBBASIN CHARACTERISTICS
TAREA .08 SUBBASIN AREA

PRECIPITATION DATA

35 PB STORM 27.40 BASIN TOTAL PRECIPITATION

17 PI INCREMENTAL PRECIPITATION PATTERN

.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.33	.40	.40	.40	.40	.40	.40	.40
.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
.40	.40	.40	.40	.40	.53	.53	.53	.53	.53
.53	.53	.80	1.07	1.07	1.07	1.07	1.07	1.07	1.07
2.53	2.53	2.53	2.53	2.53	2.53	2.53	2.33	2.13	2.13
2.13	2.13	2.13	2.13	2.13	.80	.80	.80	.80	.80
.80	.80	.67	.53	.53	.53	.53	.53	.53	.53
.53	.53	.53	.53	.53	.53	.53	.47	.40	.40
.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
.27	.27	.27	.27	.27	.27	.27	.33	.40	.40
.40	.40	.40	.40	.40	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.13	.13	.13	.13	.13
.13	.13	.13	.13	.13	.13	.13	.13	.13	.13

36 LS SCS LOSS RATE

STRTL	.22	INITIAL ABSTRACTION
CRVNBR	90.00	CURVE NUMBER
RTIMP	45.00	PERCENT IMPERVIOUS AREA

37 UD SCS DIMENSIONLESS UNITGRAPH
TLAG .12 LAG

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UNIT HYDROGRAPH
20 END-OF-PERIOD ORDINATES

38.	123.	233.	272.	250.	196.	124.	83.	57.	38.
26.	17.	12.	8.	5.	4.	3.	2.	1.	0.

TOTAL RAINFALL = 27.40, TOTAL LOSS = .71, TOTAL EXCESS = 26.69

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 972.	2.30	220.	166.	166.	166.
		(INCHES) 26.618	26.691	26.691	26.691
		(AC-FT) 109.	110.	110.	110.

CUMULATIVE AREA = .08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION B
FOR PLAN 1, RATIO = .09

TOTAL RAINFALL = 2.60, TOTAL LOSS = .54, TOTAL EXCESS = 2.06

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 76.	2.33	17.	13.	13.	13.
		(INCHES) 2.058	2.064	2.064	2.064
		(AC-FT) 8.	8.	8.	8.

CUMULATIVE AREA = .08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION B
FOR PLAN 1, RATIO = .14

TOTAL RAINFALL = 3.89, TOTAL LOSS = .59, TOTAL EXCESS = 3.30

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 122.	2.33	27.	20.	20.	20.
		(INCHES) 3.289	3.300	3.300	3.300
		(AC-FT) 14.	14.	14.	14.

CUMULATIVE AREA = .08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION B
FOR PLAN 1, RATIO = .17

TOTAL RAINFALL = 4.60, TOTAL LOSS = .61, TOTAL EXCESS = 3.99

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 148.	2.33	33.	25.	25.	25.
		(INCHES) 3.982	3.994	3.994	3.994
		(AC-FT) 16.	16.	16.	16.

CUMULATIVE AREA = .08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION B
FOR PLAN 1, RATIO = .19

TOTAL RAINFALL = 5.10, TOTAL LOSS = .62, TOTAL EXCESS = 4.48

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			

+ 166.	2.33		37.	28.	28.	28.
		(INCHES)	4.463	4.477	4.477	4.477
		(AC-FT)	18.	18.	18.	18.

CUMULATIVE AREA = .08 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION B
FOR PLAN 1, RATIO = .21

TOTAL RAINFALL = 5.81, TOTAL LOSS = .63, TOTAL EXCESS = 5.18

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 193.	2.33		43.	32.	32.	32.
		(INCHES)	5.162	5.177	5.177	5.177
		(AC-FT)	21.	21.	21.	21.

CUMULATIVE AREA = .08 SQ MI

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          *            *
 38 KK    *    COMB1   *
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COMBINE RUNOFF FROM DETENTION A AND B

40 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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HYDROGRAPH AT STATION COMB1
FOR PLAN 1, RATIO = .09

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 126.	2.50		29.	22.	22.	22.
		(INCHES)	2.044	2.064	2.064	2.064
		(AC-FT)	15.	15.	15.	15.

CUMULATIVE AREA = .13 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION COMB1
FOR PLAN 1, RATIO = .14

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 205.	2.37		47.	36.	36.	36.
		(INCHES)	3.273	3.300	3.300	3.300
		(AC-FT)	23.	24.	24.	24.

CUMULATIVE AREA = .13 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION COMB1
FOR PLAN 1, RATIO = .17

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 249.	2.37		57.	43.	43.	43.
		(INCHES)	3.963	3.994	3.994	3.994
		(AC-FT)	28.	29.	29.	29.

CUMULATIVE AREA = .13 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION COMB1
FOR PLAN 1, RATIO = .19

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	8.00-HR
(CFS)	(HR)				
		(CFS)			
279.	2.37	64.	48.	48.	48.
		(INCHES) 4.443	4.476	4.476	4.476
		(AC-FT) 32.	32.	32.	32.

CUMULATIVE AREA = .13 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION COMB1
FOR PLAN 1, RATIO = .21

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW 6-HR	24-HR	72-HR	8.00-HR
(CFS)	(HR)				
		(CFS)			
323.	2.37	74.	56.	56.	56.
		(INCHES) 5.142	5.178	5.178	5.178
		(AC-FT) 37.	37.	37.	37.

CUMULATIVE AREA = .13 SQ MI

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41 KK
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* *
* DET-B *
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STORAGE/DISCHARGE FOR DETENTION B

43 KO OUTPUT CONTROL VARIABLES
IPRNT 3 PRINT CONTROL
IPLOT 0 PLOT CONTROL
QSCAL 0. HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

44 RS STORAGE ROUTING
NSTPS 1 NUMBER OF SUBREACHES
ITYP ELEV TYPE OF INITIAL CONDITION
RSVRIC .00 INITIAL CONDITION
X .00 WORKING R AND D COEFFICIENT

45 SV	STORAGE	.0	.0	.1	.2	.2	.3	.4	.5	.6	.8
		1.0	1.3	1.6	2.0						
47 SE	ELEVATION	858.10	858.50	859.00	859.50	860.00	860.50	861.00	861.50	862.00	862.50
		863.00	863.50	864.00	864.50						
49 SQ	DISCHARGE	0.	6.	21.	40.	63.	89.	109.	121.	135.	145.
		150.	165.	170.	180.						
51 SE	ELEVATION	858.10	858.50	859.00	859.50	860.00	860.50	861.00	861.50	862.00	862.50
		863.00	863.50	864.00	864.50						

53 SS SPILLWAY
CREL 858.10 SPILLWAY CREST ELEVATION
SPWID .00 SPILLWAY WIDTH
COQW .00 WEIR COEFFICIENT
EXPW 1.50 EXPONENT OF HEAD

54 ST TOP OF DAM
TOPEL 864.50 ELEVATION AT TOP OF DAM
DAMWID 85.00 DAM WIDTH
COQD 3.00 WEIR COEFFICIENT
EXPD 1.50 EXPONENT OF HEAD

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COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.04	.09	.15	.22	.29	.37	.47	.61	.79
OUTFLOW	.00	6.10	20.50	39.80	62.90	89.20	109.00	121.00	135.00	145.00
ELEVATION	858.10	858.50	859.00	859.50	860.00	860.50	861.00	861.50	862.00	862.50

STORAGE	1.01	1.29	1.61	2.01
OUTFLOW	150.00	165.00	170.00	180.00
ELEVATION	863.00	863.50	864.00	864.50

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HYDROGRAPH AT STATION DET-8
FOR PLAN 1, RATIO = .09

PEAK OUTFLOW IS 121. AT TIME 2.57 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 121.	2.57		29.	22.	22.	22.
		(INCHES)	2.042	2.064	2.064	2.064
		(AC-FT)	15.	15.	15.	15.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)					
0.	2.57		0.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)					
861.51	2.57		859.16	857.13	857.13	857.13

CUMULATIVE AREA = .13 SQ MI

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HYDROGRAPH AT STATION DET-8
FOR PLAN 1, RATIO = .14

PEAK OUTFLOW IS 172. AT TIME 2.60 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 172.	2.60		47.	36.	36.	36.
		(INCHES)	3.271	3.300	3.300	3.300
		(AC-FT)	23.	24.	24.	24.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)					
2.	2.60		0.	0.	0.	0.

PEAK STAGE	TIME		MAXIMUM AVERAGE STAGE			
			6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)					
864.11	2.60		859.74	857.56	857.56	857.56

CUMULATIVE AREA = .13 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION DET-8
FOR PLAN 1, RATIO = .17

PEAK OUTFLOW IS 236. AT TIME 2.57 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 236.	2.57		57.	43.	43.	43.
		(INCHES)	3.962	3.994	3.994	3.994
		(AC-FT)	28.	29.	29.	29.

PEAK STORAGE	TIME		MAXIMUM AVERAGE STORAGE			
			6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)					
2.	2.53		0.	0.	0.	0.

```
 PEAK STAGE    TIME                                  MAXIMUM AVERAGE STAGE
                                            6-HR        24-HR       72-HR       8.00-HR
+   (FEET)     (HR)
    864.83     2.57                       860.01      857.77      857.77      857.77

                           CUMULATIVE AREA =      .13 SQ MI

        ***             ***              ***              ***              ***

                            HYDROGRAPH AT STATION    DET-B
                              FOR PLAN 1, RATIO =  .19

 PEAK OUTFLOW IS       272. AT TIME   2.50 HOURS

  PEAK FLOW      TIME                                MAXIMUM AVERAGE FLOW
                                            6-HR        24-HR       72-HR       8.00-HR
+   (CFS)       (HR)
                               (CFS)
+      272.     2.50                         64.          48.         48.          48.
                             (INCHES)      4.443        4.478       4.478        4.478
                              (AC-FT)        32.          32.         32.          32.

 PEAK STORAGE    TIME                              MAXIMUM AVERAGE STORAGE
                                            6-HR        24-HR       72-HR       8.00-HR
+  (AC-FT)      (HR)
         2.     2.50                          0.           0.          0.           0.

  PEAK STAGE     TIME                                MAXIMUM AVERAGE STAGE
                                            6-HR        24-HR       72-HR       8.00-HR
+   (FEET)      (HR)
    864.97      2.50                      860.16      857.88      857.88      857.88

                           CUMULATIVE AREA =      .13 SQ MI

        ***             ***              ***              ***              ***

                            HYDROGRAPH AT STATION    DET-B
                              FOR PLAN 1, RATIO =  .21

 PEAK OUTFLOW IS       319. AT TIME   2.43 HOURS

  PEAK FLOW      TIME                                MAXIMUM AVERAGE FLOW
                                            6-HR        24-HR       72-HR       8.00-HR
+   (CFS)       (HR)
                               (CFS)
+      319.     2.43                         74.          56.         56.          56.
                             (INCHES)      5.142        5.180       5.180        5.180
                              (AC-FT)        37.          37.         37.          37.

 PEAK STORAGE    TIME                              MAXIMUM AVERAGE STORAGE
                                            6-HR        24-HR       72-HR       8.00-HR
+  (AC-FT)      (HR)
         3.     2.43                          0.           0.          0.           0.

  PEAK STAGE     TIME                                MAXIMUM AVERAGE STAGE
                                            6-HR        24-HR       72-HR       8.00-HR
+   (FEET)      (HR)
    865.13      2.43                      860.36      858.03      858.03      858.03

                           CUMULATIVE AREA =      .13 SQ MI


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              *            *
  55 KK       *      C     *
              *            *
              **************
                             RUNOFF FOR C

                  SUBBASIN RUNOFF DATA

  57 BA             SUBBASIN CHARACTERISTICS
                          TAREA        .09  SUBBASIN AREA

                    PRECIPITATION DATA

  58 PB                   STORM        27.40  BASIN TOTAL PRECIPITATION

  17 PI               INCREMENTAL PRECIPITATION PATTERN
```

.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.33	.40	.40	.40	.40	.40	.40	.40
.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
.40	.40	.40	.40	.40	.53	.53	.53	.53	.53
.53	.53	.80	1.07	1.07	1.07	1.07	1.07	1.07	1.07
2.53	2.53	2.53	2.53	2.53	2.53	2.53	2.33	2.13	2.13
2.13	2.13	2.13	2.13	2.13	.80	.80	.80	.80	.80
.80	.80	.67	.53	.53	.53	.53	.53	.53	.53
.53	.53	.53	.53	.53	.53	.53	.47	.40	.40
.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
.40	.40	.40	.40	.40	.40	.40	.40	.40	.40
.27	.27	.27	.27	.27	.27	.27	.33	.40	.40
.40	.40	.40	.40	.40	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.27	.27	.27	.27	.27
.27	.27	.27	.27	.27	.13	.13	.13	.13	.13
.13	.13	.13	.13	.13	.13	.13	.13	.13	.13

59 LS SCS LOSS RATE

STRTL	.22	INITIAL ABSTRACTION
CRVNBR	90.00	CURVE NUMBER
RTIMP	45.00	PERCENT IMPERVIOUS AREA

60 UD SCS DIMENSIONLESS UNITGRAPH

TLAG	.21 LAG

***

UNIT HYDROGRAPH
33 END-OF-PERIOD ORDINATES

12.	35.	71.	120.	161.	184.	187.	177.	158.	133.
102.	78.	61.	49.	39.	30.	24.	19.	15.	12.
9.	7.	6.	4.	4.	3.	2.	2.	1.	1.
1.	1.	0.							

TOTAL RAINFALL = 27.40, TOTAL LOSS = .71, TOTAL EXCESS = 26.69

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 1028.	2.47	251.	189.	189.	189.
		(INCHES) 26.570	26.691	26.691	26.691
		(AC-FT) 125.	125.	125.	125.

CUMULATIVE AREA = .09 SQ MI

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HYDROGRAPH AT STATION C
FOR PLAN 1, RATIO = .09

TOTAL RAINFALL = 2.60, TOTAL LOSS = .54, TOTAL EXCESS = 2.06

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 81.	2.50	19.	15.	15.	15.
		(INCHES) 2.053	2.064	2.064	2.064
		(AC-FT) 10.	10.	10.	10.

CUMULATIVE AREA = .09 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION C
FOR PLAN 1, RATIO = .14

TOTAL RAINFALL = 3.89, TOTAL LOSS = .59, TOTAL EXCESS = 3.30

PEAK FLOW	TIME	MAXIMUM AVERAGE FLOW			
		6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)	(CFS)			
+ 131.	2.50	31.	23.	23.	23.
		(INCHES) 3.283	3.300	3.300	3.300
		(AC-FT) 15.	15.	15.	15.

CUMULATIVE AREA = .09 SQ MI

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HYDROGRAPH AT STATION C

FOR PLAN 1, RATIO = .17

TOTAL RAINFALL = 4.60, TOTAL LOSS = .61, TOTAL EXCESS = 3.99

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 158.	2.50		38.	28.	28.	28.
		(INCHES)	3.974	3.994	3.994	3.994
		(AC-FT)	19.	19.	19.	19.

CUMULATIVE AREA = .09 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION C
FOR PLAN 1, RATIO = .19

TOTAL RAINFALL = 5.10, TOTAL LOSS = .62, TOTAL EXCESS = 4.48

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 177.	2.50		42.	32.	32.	32.
		(INCHES)	4.455	4.477	4.477	4.477
		(AC-FT)	21.	21.	21.	21.

CUMULATIVE AREA = .09 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION C
FOR PLAN 1, RATIO = .21

TOTAL RAINFALL = 5.81, TOTAL LOSS = .63, TOTAL EXCESS = 5.18

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 205.	2.50		49.	37.	37.	37.
		(INCHES)	5.152	5.177	5.177	5.177
		(AC-FT)	24.	24.	24.	24.

CUMULATIVE AREA = .09 SQ MI

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              *            *
 61 KK        *   COMB2    *
              *            *
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COMBINE RUNOFF FROM DETENTION B AND C

63 HC HYDROGRAPH COMBINATION
ICOMP 2 NUMBER OF HYDROGRAPHS TO COMBINE

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*** *** *** *** ***

HYDROGRAPH AT STATION COMB2
FOR PLAN 1, RATIO = .09

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 202.	2.53		49.	37.	37.	37.
		(INCHES)	2.046	2.064	2.064	2.064
		(AC-FT)	24.	24.	24.	24.

CUMULATIVE AREA = .22 SQ MI

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HYDROGRAPH AT STATION COMB2
FOR PLAN 1, RATIO = .14

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 300.	2.53		78.	59.	59.	59.
		(INCHES)	3.275	3.300	3.300	3.300
		(AC-FT)	39.	39.	39.	39.

CUMULATIVE AREA = .22 SQ MI

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HYDROGRAPH AT STATION COMB2
FOR PLAN 1, RATIO = .17

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 393.	2.53		95.	72.	72.	72.
		(INCHES)	3.966	3.994	3.994	3.994
		(AC-FT)	47.	47.	47.	47.

CUMULATIVE AREA = .22 SQ MI

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HYDROGRAPH AT STATION COMB2
FOR PLAN 1, RATIO = .19

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 449.	2.50		106.	80.	80.	80.
		(INCHES)	4.447	4.477	4.477	4.477
		(AC-FT)	53.	53.	53.	53.

CUMULATIVE AREA = .22 SQ MI

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HYDROGRAPH AT STATION COMB2
FOR PLAN 1, RATIO = .21

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 523.	2.47		123.	93.	93.	93.
		(INCHES)	5.146	5.179	5.179	5.179
		(AC-FT)	61.	61.	61.	61.

CUMULATIVE AREA = .22 SQ MI

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           *            *
64 KK      *    LAKE    *
           *            *
           **************
```

STORAGE/DISCHARGE FOR LAKE

66 KO OUTPUT CONTROL VARIABLES

IPRNT	3	PRINT CONTROL
IPLOT	0	PLOT CONTROL
QSCAL	0.	HYDROGRAPH PLOT SCALE

HYDROGRAPH ROUTING DATA

67 RS STORAGE ROUTING

NSTPS	1	NUMBER OF SUBREACHES
ITYP	ELEV	TYPE OF INITIAL CONDITION
RSVRIC	.00	INITIAL CONDITION
X	.00	WORKING R AND D COEFFICIENT

68 SV	STORAGE	.0	.5	1.9	3.4	4.9	6.5	8.2	10.0	11.9	14.0

69 SE	ELEVATION	854.80	855.00	855.50	856.00	856.50	857.00	857.50	858.00	858.50	859.00
70 SQ	DISCHARGE	0.	11.	69.	154.	257.	305.	323.	349.	379.	412.
71 SE	ELEVATION	854.80	855.00	855.50	856.00	856.50	857.00	857.50	858.00	858.50	859.00

72 SS SPILLWAY

CREL	854.80	SPILLWAY CREST ELEVATION
SPWID	.00	SPILLWAY WIDTH
COQW	.00	WEIR COEFFICIENT
EXPW	1.50	EXPONENT OF HEAD

73 ST TOP OF DAM

TOPEL	859.00	ELEVATION AT TOP OF DAM
DAMWID	100.00	DAM WIDTH
COQD	3.00	WEIR COEFFICIENT
EXPD	1.50	EXPONENT OF HEAD

***

COMPUTED STORAGE-OUTFLOW-ELEVATION DATA

(INCLUDING FLOW OVER DAM)

STORAGE	.00	.54	1.93	3.39	4.92	6.53	8.23	10.02	11.93	13.98
OUTFLOW	.00	10.70	69.30	154.00	256.90	305.00	323.30	348.90	378.90	412.30
ELEVATION	854.80	855.00	855.50	856.00	856.50	857.00	857.50	858.00	858.50	859.00

*** *** *** *** ***

HYDROGRAPH AT STATION LAKE
FOR PLAN 1, RATIO = .09

PEAK OUTFLOW IS 178. AT TIME 2.67 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 178.	2.67		48.	37.	37.	37.
		(INCHES)	2.019	2.060	2.060	2.060
		(AC-FT)	24.	24.	24.	24.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
4.	2.67	1.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
856.12	2.67	855.29	853.40	853.40	853.40

CUMULATIVE AREA = .22 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION LAKE
FOR PLAN 1, RATIO = .14

PEAK OUTFLOW IS 268. AT TIME 2.70 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 268.	2.70		77.	59.	59.	59.
		(INCHES)	3.242	3.296	3.296	3.296
		(AC-FT)	38.	39.	39.	39.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
5.	2.70	2.	1.	1.	1.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
856.61	2.70	855.48	853.55	853.55	853.55

CUMULATIVE AREA = .22 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION LAKE
FOR PLAN 1, RATIO = .17

PEAK OUTFLOW IS 307. AT TIME 2.70 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 307.	2.70		94.	71.	71.	71.
		(INCHES)	3.929	3.990	3.990	3.990
		(AC-FT)	47.	47.	47.	47.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
7.	2.70	2.	2.	2.	2.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
857.05	2.70	855.61	853.64	853.64	853.64

CUMULATIVE AREA = .22 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION LAKE
FOR PLAN 1, RATIO = .19

PEAK OUTFLOW IS 322. AT TIME 2.73 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 322.	2.73		105.	80.	80.	80.
		(INCHES)	4.407	4.472	4.472	4.472
		(AC-FT)	52.	53.	53.	53.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
8.	2.73	3.	2.	2.	2.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
857.46	2.73	855.71	853.72	853.72	853.72

CUMULATIVE AREA = .22 SQ MI

*** *** *** *** ***

HYDROGRAPH AT STATION LAKE
FOR PLAN 1, RATIO = .21

PEAK OUTFLOW IS 353. AT TIME 2.73 HOURS

PEAK FLOW	TIME		MAXIMUM AVERAGE FLOW			
			6-HR	24-HR	72-HR	8.00-HR
+ (CFS)	(HR)					
		(CFS)				
+ 353.	2.73		122.	93.	93.	93.
		(INCHES)	5.101	5.172	5.172	5.172
		(AC-FT)	60.	61.	61.	61.

PEAK STORAGE	TIME	MAXIMUM AVERAGE STORAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (AC-FT)	(HR)				
10.	2.73	3.	2.	2.	2.

PEAK STAGE	TIME	MAXIMUM AVERAGE STAGE			
		6-HR	24-HR	72-HR	8.00-HR
+ (FEET)	(HR)				
858.08	2.73	855.86	853.84	853.84	853.84

CUMULATIVE AREA = .22 SQ MI

1

PEAK FLOW AND STAGE (END-OF-PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND, AREA IN SQUARE MILES
TIME TO PEAK IN HOURS

OPERATION	STATION	AREA	PLAN		RATIOS APPLIED TO PRECIPITATION RATIO 1 .09	RATIO 2 .14	RATIO 3 .17	RATIO 4 .19	RATIO 5 .21
HYDROGRAPH AT									
+	A	.06	1	FLOW	54.	86.	104.	117.	135.
				TIME	2.50	2.43	2.43	2.43	2.43
ROUTED TO									
+	DET-A	.06	1	FLOW	53.	86.	104.	117.	135.
				TIME	2.50	2.47	2.43	2.43	2.43
			** PEAK STAGES IN FEET **						
			1	STAGE	866.18	866.35	866.43	866.48	866.55
				TIME	2.50	2.47	2.43	2.43	2.43
HYDROGRAPH AT									
+	B	.08	1	FLOW	76.	122.	148.	166.	193.
				TIME	2.33	2.33	2.33	2.33	2.33
2 COMBINED AT									
+	COMB1	.13	1	FLOW	126.	205.	249.	279.	323.
				TIME	2.50	2.37	2.37	2.37	2.37
ROUTED TO									
+	DET-B	.13	1	FLOW	121.	172.	236.	272.	319.
				TIME	2.57	2.60	2.57	2.50	2.43
			** PEAK STAGES IN FEET **						
			1	STAGE	861.51	864.11	864.83	864.97	865.13
				TIME	2.57	2.60	2.57	2.50	2.43
HYDROGRAPH AT									
+	C	.09	1	FLOW	81.	131.	158.	177.	205.
				TIME	2.50	2.50	2.50	2.50	2.50
2 COMBINED AT									
+	COMB2	.22	1	FLOW	202.	300.	393.	449.	523.
				TIME	2.53	2.53	2.53	2.50	2.47
ROUTED TO									
+	LAKE	.22	1	FLOW	178.	268.	307.	322.	353.
				TIME	2.67	2.70	2.70	2.73	2.73
			** PEAK STAGES IN FEET **						
			1	STAGE	856.12	856.61	857.05	857.46	858.08
				TIME	2.67	2.70	2.70	2.73	2.73

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION DET-A
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	.00	863.00	866.00
STORAGE	0.	0.	1.
OUTFLOW	0.	0.	34.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.09	866.18	.18	1.	53.	.40	2.50	.00
.14	866.35	.35	1.	86.	.73	2.47	.00
.17	866.43	.43	1.	104.	.90	2.43	.00
.19	866.48	.48	1.	117.	1.00	2.43	.00
.21	866.55	.55	1.	135.	1.33	2.43	.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION DET-B
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	.00	858.10	864.50
STORAGE	0.	0.	2.
OUTFLOW	0.	0.	180.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.09	861.51	.00	0.	121.	.00	2.57	.00

.14	864.11	.00	2.	172.	.00	2.60	.00
.17	864.83	.33	2.	236.	.30	2.57	.00
.19	864.97	.47	2.	272.	.40	2.50	.00
.21	865.13	.63	3.	319.	.50	2.43	.00

1 SUMMARY OF DAM OVERTOPPING/BREACH ANALYSIS FOR STATION LAKE
(PEAKS SHOWN ARE FOR INTERNAL TIME STEP USED DURING BREACH FORMATION)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	.00	854.80	859.00
STORAGE	0.	0.	14.
OUTFLOW	0.	0.	412.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.09	856.12	.00	4.	178.	.00	2.67	.00
.14	856.61	.00	5.	268.	.00	2.70	.00
.17	857.05	.00	7.	307.	.00	2.70	.00
.19	857.46	.00	8.	322.	.00	2.73	.00
.21	858.08	.00	10.	353.	.00	2.73	.00

*** NORMAL END OF HEC-1 ***

Curve
Plotted Curves for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	dfjg
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Mannings Coefficient	0.040	
Channel Slope	0.056000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	135.00	cfs

Input Data			
	Minimum	Maximum	Increment
Bottom Width	2.00	6.00	0.50 ft

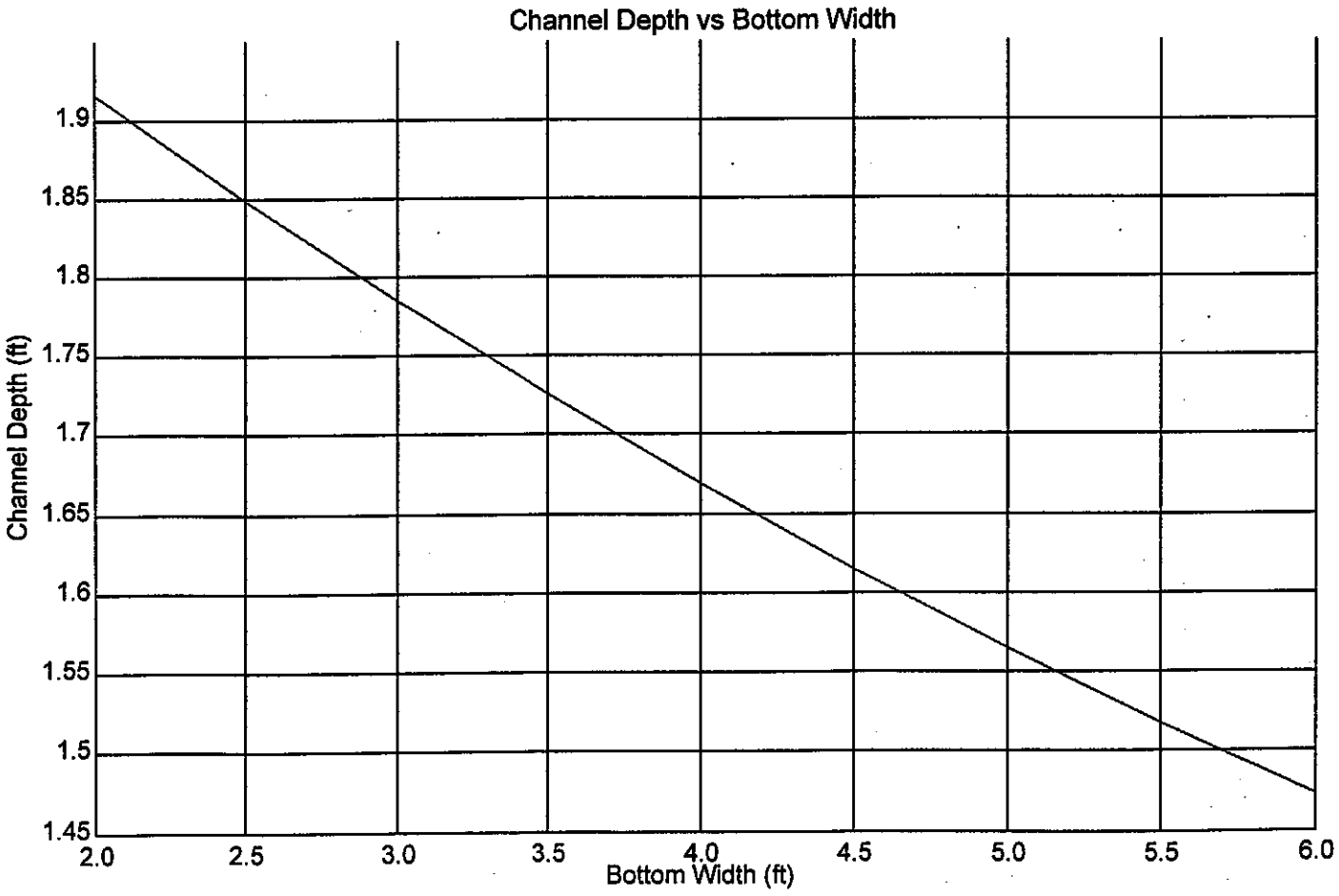


Table
Rating Table for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	asfd
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Constant Data		
Channel Slope	0.056000	ft/ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	6.00	ft
Discharge	135.00	cfs

Input Data			
	Minimum	Maximum	Increment
Mannings Coefficient	0.030	0.050	0.005

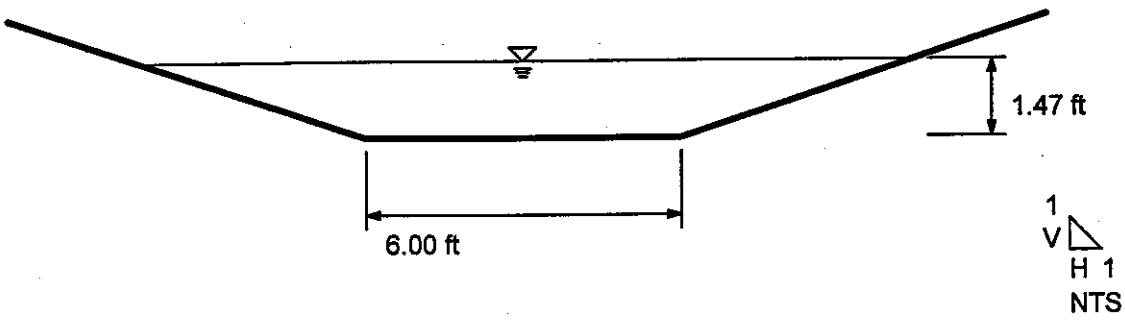
Rating Table

Mannings Coefficient	Depth (ft)	Velocity (ft/s)
0.030	1.27	10.83
0.035	1.38	9.69
0.040	1.47	8.80
0.045	1.56	8.08
0.050	1.65	7.49

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	dfjg
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Section Data		
Mannings Coefficient	0.040	
Channel Slope	0.056000	ft/ft
Depth	1.47	ft
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	6.00	ft
Discharge	135.00	cfs



NAPIER
ENGINEERING, LLC
207 South 5th Street
Leavenworth, KS 66048

Rev. – August 2, 2018

Jeff Rupp
Director of Public Works
City of Lansing
730 First Terrace, Suite 3
(913) 727-2400
jrupp@lansing.ks.us

RE: Final Drainage Memo – Fairway Estates Drainage Study– Phase 5 & 6

Two drainage studies for the Fairway Estates Subdivision (all phases) have been presented to the City of Lansing. The original drainage study and report was prepared by Cook, Flatt and Strobel Engineers, P.A. (May 11, 1995) and a lake restudy was prepared by George Butler Associates, Inc. (GBA) (September 24, 1999).

The following modifications were proposed by GBA in the Lake Restudy form 1999 in order to alleviate future drainage issues:

1. Re-route 14.7 acres of drainage to bypass the lake from the south to the east.
2. Upsize the existing lake outlet box from 8.5'x4' to 10'x10'.
3. Provide an emergency spillway at Elevation 857.0 with a 10-foot flat bottom ditch.
4. Provide an additional 7,200 sq. ft. surface are to the lake.

Items 2 through 4 have been built or installed.

For item #1 - approximately 5.54 acres of drainage from Phase 2 has been redirected according to GBA construction documents. The GBA documents indicated that an additional 9.04 acres from our future phase would also be redirected, for a lump sum total of 14.58 acres. We have estimated that approximately 9.10 acres of drainage will be redirected from the proposed phase for a total of 14.64 acres. This amount substantially meets the requirement of item #1 of 14.7 acres.

The 9.10 acres of drainage area flows to an existing 30" HDPE storm line that has a design capacity of 36.79 cubic feet per second (cfs) (GBA – 1999). The runoff from the 9.10 acres for the 10-year design storm is 27.66 cfs (C=1.0; Tc=10 min). The existing down stream pipe has the capacity to convey the runoff from the 9.10 acres.

Storm drainage detention for all land in the Fairway Estates has been provided by the detention basin built and modified in Fairway Estates 1st Plat.

In addition, the owner plans on installing a series of storm water quality features to treat the runoff from the Phase 5 & 6. These will be in the proposed Tract B. The main purpose will be to intercept and treat 2-year design storms and keep sediment from entering the lake.

Summary – The existing lake built in Fairway Estates 1st Plat will adequately handle the additional runoff generated by Phase 5 and 6 of Fairway Estates. Please refer to the original drainage studies submitted by Cook, Flatt and Strobel Engineers, P.A, and George Butler Associates, Inc.

Please feel free to contact me for additional information at (913) 682-8600.

Sincerely,

Brett Napier

Brett A. Napier, P.E.

Drainage Area to
Existing Structure (30" RCP)
DA = 9.10 Ac.

BELLERIVE COURT
ACE COURT
PEBBLE BEACH DR
BIRDIE CIRCLE
OAKMONT DR
OAKMONT CIRCLE
MEADOW LANE
EAGLE COURT
EAGLE DRIVE
FAIRWAY ESTATES FOURTH PLAT
TRACT A 22,481 sf
TRACT B 72,284 sf
THE MAPLES OF WOODLAND HILLS
WILLOWS OF WOODLAND HILLS
COUNTRY CLUB ADDITION
UNPLATTED LAWSON, MARK A 901 KANE DR LANSING, KS 66043
UNPLATTED SCHNEIDER,CECILIA T & SCHNEIDER,JAMES D 26731 147TH ST LEAVENWORTH, KS 66048
GREATLIFE KANSAS CITY LLC 913 SE 29TH TOPEKA, KS 66605
SANITARY SEWER BY OTHERS
20' LAN DEL WATER ESMT TO BE ABANDONED
Fnd. 1/2" Rebar at the Southeast corner of the Southwest 1/4 of Sec. 13-09-22

1"=60'

Sheet - 4

Drainage Area Exhibit

2017-66
Fairway Estates
5th Plat

Final Development Plan

PREPARED FOR:
REILLY DEVELOPMENT, LLC
C/O MIKE REILLY
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Date of Preparation:
August 3, 2018

Revised Date:
-
-
-
-

1st Submittal

BRETT A. NAPIER
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KANSAS
PROFESSIONAL ENGINEER

United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Leavenworth County, Kansas

March 25, 2025

Preface

Soil surveys contain information that affects land use planning in survey areas. They highlight soil limitations that affect various land uses and provide information about the properties of the soils in the survey areas. Soil surveys are designed for many different users, including farmers, ranchers, foresters, agronomists, urban planners, community officials, engineers, developers, builders, and home buyers. Also, conservationists, teachers, students, and specialists in recreation, waste disposal, and pollution control can use the surveys to help them understand, protect, or enhance the environment.

Various land use regulations of Federal, State, and local governments may impose special restrictions on land use or land treatment. Soil surveys identify soil properties that are used in making various land use or land treatment decisions. The information is intended to help the land users identify and reduce the effects of soil limitations on various land uses. The landowner or user is responsible for identifying and complying with existing laws and regulations.

Although soil survey information can be used for general farm, local, and wider area planning, onsite investigation is needed to supplement this information in some cases. Examples include soil quality assessments (http://www.nrcs.usda.gov/wps/portal/nrcs/main/soils/health/) and certain conservation and engineering applications. For more detailed information, contact your local USDA Service Center (https://offices.sc.egov.usda.gov/locator/app?agency=nrcs) or your NRCS State Soil Scientist (http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/contactus/?cid=nrcs142p2_053951).

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

The National Cooperative Soil Survey is a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local agencies. The Natural Resources Conservation Service (NRCS) has leadership for the Federal part of the National Cooperative Soil Survey.

Information about soils is updated periodically. Updated information is available through the NRCS Web Soil Survey, the site for official soil survey information.

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Contents

How Soil Surveys Are Made

Soil surveys are made to provide information about the soils and miscellaneous areas in a specific area. They include a description of the soils and miscellaneous areas and their location on the landscape and tables that show soil properties and limitations affecting various uses. Soil scientists observed the steepness, length, and shape of the slopes; the general pattern of drainage; the kinds of crops and native plants; and the kinds of bedrock. They observed and described many soil profiles. A soil profile is the sequence of natural layers, or horizons, in a soil. The profile extends from the surface down into the unconsolidated material in which the soil formed or from the surface down to bedrock. The unconsolidated material is devoid of roots and other living organisms and has not been changed by other biological activity.

Currently, soils are mapped according to the boundaries of major land resource areas (MLRAs). MLRAs are geographically associated land resource units that share common characteristics related to physiography, geology, climate, water resources, soils, biological resources, and land uses (USDA, 2006). Soil survey areas typically consist of parts of one or more MLRA.

The soils and miscellaneous areas in a survey area occur in an orderly pattern that is related to the geology, landforms, relief, climate, and natural vegetation of the area. Each kind of soil and miscellaneous area is associated with a particular kind of landform or with a segment of the landform. By observing the soils and miscellaneous areas in the survey area and relating their position to specific segments of the landform, a soil scientist develops a concept, or model, of how they were formed. Thus, during mapping, this model enables the soil scientist to predict with a considerable degree of accuracy the kind of soil or miscellaneous area at a specific location on the landscape.

Commonly, individual soils on the landscape merge into one another as their characteristics gradually change. To construct an accurate soil map, however, soil scientists must determine the boundaries between the soils. They can observe only a limited number of soil profiles. Nevertheless, these observations, supplemented by an understanding of the soil-vegetation-landscape relationship, are sufficient to verify predictions of the kinds of soil in an area and to determine the boundaries.

Soil scientists recorded the characteristics of the soil profiles that they studied. They noted soil color, texture, size and shape of soil aggregates, kind and amount of rock fragments, distribution of plant roots, reaction, and other features that enable them to identify soils. After describing the soils in the survey area and determining their properties, the soil scientists assigned the soils to taxonomic classes (units). Taxonomic classes are concepts. Each taxonomic class has a set of soil characteristics with precisely defined limits. The classes are used as a basis for comparison to classify soils systematically. Soil taxonomy, the system of taxonomic classification used in the United States, is based mainly on the kind and character of soil properties and the arrangement of horizons within the profile. After the soil

scientists classified and named the soils in the survey area, they compared the individual soils with similar soils in the same taxonomic class in other areas so that they could confirm data and assemble additional data based on experience and research.

The objective of soil mapping is not to delineate pure map unit components; the objective is to separate the landscape into landforms or landform segments that have similar use and management requirements. Each map unit is defined by a unique combination of soil components and/or miscellaneous areas in predictable proportions. Some components may be highly contrasting to the other components of the map unit. The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The delineation of such landforms and landform segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, onsite investigation is needed to define and locate the soils and miscellaneous areas.

Soil scientists make many field observations in the process of producing a soil map. The frequency of observation is dependent upon several factors, including scale of mapping, intensity of mapping, design of map units, complexity of the landscape, and experience of the soil scientist. Observations are made to test and refine the soil-landscape model and predictions and to verify the classification of the soils at specific locations. Once the soil-landscape model is refined, a significantly smaller number of measurements of individual soil properties are made and recorded. These measurements may include field measurements, such as those for color, depth to bedrock, and texture, and laboratory measurements, such as those for content of sand, silt, clay, salt, and other components. Properties of each soil typically vary from one point to another across the landscape.

Observations for map unit components are aggregated to develop ranges of characteristics for the components. The aggregated values are presented. Direct measurements do not exist for every property presented for every map unit component. Values for some properties are estimated from combinations of other properties.

While a soil survey is in progress, samples of some of the soils in the area generally are collected for laboratory analyses and for engineering tests. Soil scientists interpret the data from these analyses and tests as well as the field-observed characteristics and the soil properties to determine the expected behavior of the soils under different uses. Interpretations for all of the soils are field tested through observation of the soils in different uses and under different levels of management. Some interpretations are modified to fit local conditions, and some new interpretations are developed to meet local needs. Data are assembled from other sources, such as research information, production records, and field experience of specialists. For example, data on crop yields under defined levels of management are assembled from farm records and from field or plot experiments on the same kinds of soil.

Predictions about soil behavior are based not only on soil properties but also on such variables as climate and biological activity. Soil conditions are predictable over long periods of time, but they are not predictable from year to year. For example, soil scientists can predict with a fairly high degree of accuracy that a given soil will have a high water table within certain depths in most years, but they cannot predict that a high water table will always be at a specific level in the soil on a specific date.

After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

identified each as a specific map unit. Aerial photographs show trees, buildings, fields, roads, and rivers, all of which help in locating boundaries accurately.

Soil Map

The soil map section includes the soil map for the defined area of interest, a list of soil map units on the map and extent of each map unit, and cartographic symbols displayed on the map. Also presented are various metadata about data used to produce the map, and a description of each soil map unit.

Custom Soil Resource Report
Soil Map

Map Scale: 1:4,380 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 200 400 800 1200

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Leavenworth County, Kansas
Survey Area Data: Version 19, Sep 5, 2024

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

Date(s) aerial images were photographed: Aug 30, 2022—Sep 16, 2022

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
7211	Bremer silty clay loam, rarely flooded	1.5	3.1%
7254	Grundy silty clay loam, 3 to 7 percent slopes, eroded	17.4	36.9%
7302	Martin silty clay loam, 3 to 7 percent slopes	1.1	2.4%
7542	Sharpsburg silty clay loam, 4 to 8 percent slopes, eroded	13.8	29.2%
7659	Vinland-Sibleyville complex, 5 to 12 percent slopes	13.4	28.4%
Totals for Area of Interest		**47.2**	**100.0%**

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however, onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Leavenworth County, Kansas

7211—Bremer silty clay loam, rarely flooded

Map Unit Setting

National map unit symbol: 20hy2
Elevation: 500 to 1,400 feet
Mean annual precipitation: 31 to 47 inches
Mean annual air temperature: 43 to 66 degrees F
Frost-free period: 175 to 215 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Bremer and similar soils: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bremer

Setting

Landform: Flood plains
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Silty and clayey alluvium

Typical profile

Ap - 0 to 9 inches: silty clay loam
BA - 9 to 13 inches: silty clay loam
Bt - 13 to 34 inches: silty clay
BC - 34 to 50 inches: silty clay loam
C - 50 to 60 inches: silty clay loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: About 12 to 24 inches
Frequency of flooding: Rare
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: R106XY065NE - Wet Subirrigated
Hydric soil rating: Yes

Minor Components

Judson

Percent of map unit: 5 percent
Landform: Terraces

Ecological site: R107XB008MO - Loamy Footslope Savanna
Hydric soil rating: No

7254—Grundy silty clay loam, 3 to 7 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2v90d
Elevation: 730 to 1,700 feet
Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 205 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Grundy, eroded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Grundy, Eroded

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silty clay loam
BA - 6 to 11 inches: silty clay loam
Btg1 - 11 to 17 inches: silty clay
Btg2 - 17 to 42 inches: silty clay
BC - 42 to 51 inches: silty clay loam
C - 51 to 79 inches: silty clay loam

Properties and qualities

Slope: 3 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 9 to 16 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 1 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R106XY074NE - Clayey Upland
Hydric soil rating: No

Minor Components

Pawnee, eroded

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R106XY074NE - Clayey Upland
Hydric soil rating: No

Sharpsburg, eroded

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

Shelby, eroded

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

7302—Martin silty clay loam, 3 to 7 percent slopes

Map Unit Setting

National map unit symbol: 2v8zn
Elevation: 730 to 1,700 feet
Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 205 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Martin and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Martin

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Colluvium derived from limestone and shale

Typical profile

Ap - 0 to 6 inches: silty clay loam
BA - 6 to 14 inches: silty clay loam
Bt1 - 14 to 19 inches: silty clay
Bt2 - 19 to 56 inches: silty clay
BC - 56 to 65 inches: silty clay loam
C - 65 to 79 inches: silty clay loam

Properties and qualities

Slope: 3 to 7 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 17 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 7.8 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

Minor Components

Pawnee

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Crest
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY074NE - Clayey Upland
Hydric soil rating: No

Elmont

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

Vinland

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

7542—Sharpsburg silty clay loam, 4 to 8 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2q4rx
Elevation: 980 to 1,660 feet
Mean annual precipitation: 28 to 39 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 158 to 203 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sharpsburg, eroded, and similar soils: 85 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sharpsburg, Eroded

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess

Typical profile

Ap - 0 to 6 inches: silty clay loam
A - 6 to 10 inches: silty clay loam
Bt1 - 10 to 14 inches: silty clay loam
Bt2 - 14 to 46 inches: silty clay loam

BC - 46 to 58 inches: silty clay loam
C - 58 to 79 inches: silty clay loam

Properties and qualities

Slope: 4 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 45 to 50 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 2 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: High (about 9.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R106XY075NE - Loamy Upland
Forage suitability group: Loam (G106XY100NE)
Other vegetative classification: Loam (G106XY100NE)
Hydric soil rating: No

Minor Components

Sarcoxie, eroded

Percent of map unit: 8 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Other vegetative classification: Loam (G106XY100NE)
Hydric soil rating: No

Shelby, eroded

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Other vegetative classification: Loam (G106XY100NE)
Hydric soil rating: No

Grundy, eroded

Percent of map unit: 2 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear

Ecological site: R106XY074NE - Clayey Upland
Other vegetative classification: Clayey Subsoil (G106XY210NE)
Hydric soil rating: No

7659—Vinland-Sibleyville complex, 5 to 12 percent slopes

Map Unit Setting

National map unit symbol: 2yrvv
Elevation: 730 to 1,700 feet
Mean annual precipitation: 28 to 40 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 160 to 205 days
Farmland classification: Not prime farmland

Map Unit Composition

Vinland and similar soils: 45 percent
Sibleyville and similar soils: 40 percent
Minor components: 15 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Vinland

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Sandy and silty residuum weathered from shale

Typical profile

A - 0 to 8 inches: silt loam
Bw - 8 to 12 inches: silty clay loam
C - 12 to 16 inches: silty clay loam

Properties and qualities

Slope: 5 to 10 percent
Depth to restrictive feature: 15 to 18 inches to paralithic bedrock
Drainage class: Somewhat excessively drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 3.4 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 6e

Hydrologic Soil Group: D
Ecological site: R106XY031NE - Shallow Savannah
Hydric soil rating: No

Description of Sibleyville

Setting

Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Residuum weathered from sandstone and shale

Typical profile

A - 0 to 6 inches: loam
BA - 6 to 10 inches: loam
Bt - 10 to 29 inches: clay loam
BC - 29 to 35 inches: clay loam
Cr - 35 to 79 inches: bedrock

Properties and qualities

Slope: 4 to 12 percent
Depth to restrictive feature: 33 to 36 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.60 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Moderate (about 6.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

Minor Components

Shelby

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

Elmont

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope

Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

Martin

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R106XY075NE - Loamy Upland
Hydric soil rating: No

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NOAA Atlas 14, Volume 8, Version 2
Location name: Lansing, Kansas, USA*
Latitude: 39.261°, Longitude: -94.9182°
Elevation: 886 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

Sanja Perica, Deborah Martin, Sandra Pavlovic, Ishani Roy, Michael St. Laurent, Carl Trypaluk, Dale Unruh, Michael Yekta, Geoffery Bonnin

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**4.74** (3.79-6.02)	**5.62** (4.48-7.13)	**7.07** (5.63-9.00)	**8.32** (6.58-10.6)	**10.1** (7.72-13.2)	**11.5** (8.57-15.1)	**13.0** (9.30-17.2)	**14.5** (9.94-19.5)	**16.5** (10.9-22.6)	**18.2** (11.6-25.0)
10-min	**3.47** (2.78-4.42)	**4.11** (3.28-5.22)	**5.17** (4.12-6.59)	**6.09** (4.82-7.76)	**7.39** (5.65-9.64)	**8.42** (6.28-11.0)	**9.49** (6.81-12.6)	**10.6** (7.27-14.3)	**12.1** (7.97-16.6)	**13.3** (8.50-18.3)
15-min	**2.82** (2.26-3.59)	**3.34** (2.67-4.24)	**4.21** (3.35-5.36)	**4.95** (3.92-6.31)	**6.01** (4.59-7.83)	**6.85** (5.10-8.98)	**7.72** (5.54-10.3)	**8.62** (5.92-11.6)	**9.85** (6.48-13.5)	**10.8** (6.91-14.9)
30-min	**1.99** (1.59-2.53)	**2.36** (1.88-3.00)	**2.98** (2.37-3.79)	**3.52** (2.78-4.49)	**4.28** (3.28-5.59)	**4.90** (3.65-6.43)	**5.53** (3.97-7.35)	**6.19** (4.25-8.35)	**7.10** (4.67-9.71)	**7.80** (4.99-10.7)
60-min	**1.30** (1.04-1.65)	**1.56** (1.24-1.98)	**1.99** (1.59-2.54)	**2.37** (1.87-3.02)	**2.90** (2.21-3.78)	**3.32** (2.47-4.35)	**3.75** (2.69-4.98)	**4.20** (2.88-5.66)	**4.81** (3.16-6.58)	**5.29** (3.38-7.27)
2-hr	**0.803** (0.650-1.01)	**0.969** (0.784-1.22)	**1.25** (1.01-1.57)	**1.49** (1.19-1.87)	**1.82** (1.41-2.35)	**2.09** (1.58-2.71)	**2.36** (1.72-3.10)	**2.65** (1.84-3.53)	**3.04** (2.03-4.11)	**3.34** (2.16-4.54)
3-hr	**0.602** (0.491-0.748)	**0.730** (0.595-0.909)	**0.946** (0.767-1.18)	**1.13** (0.910-1.41)	**1.39** (1.08-1.77)	**1.59** (1.21-2.05)	**1.80** (1.32-2.35)	**2.02** (1.42-2.67)	**2.31** (1.56-3.11)	**2.54** (1.66-3.44)
6-hr	**0.363** (0.300-0.446)	**0.440** (0.363-0.540)	**0.569** (0.467-0.700)	**0.680** (0.555-0.837)	**0.836** (0.660-1.06)	**0.961** (0.740-1.22)	**1.09** (0.809-1.40)	**1.22** (0.869-1.60)	**1.40** (0.958-1.87)	**1.54** (1.03-2.07)
12-hr	**0.214** (0.179-0.259)	**0.255** (0.213-0.309)	**0.326** (0.271-0.395)	**0.388** (0.320-0.471)	**0.476** (0.381-0.595)	**0.547** (0.428-0.688)	**0.621** (0.468-0.793)	**0.699** (0.505-0.907)	**0.806** (0.559-1.06)	**0.891** (0.600-1.18)
24-hr	**0.125** (0.105-0.149)	**0.147** (0.124-0.175)	**0.185** (0.156-0.221)	**0.219** (0.183-0.262)	**0.267** (0.217-0.329)	**0.306** (0.243-0.380)	**0.347** (0.266-0.438)	**0.391** (0.286-0.501)	**0.451** (0.317-0.588)	**0.498** (0.341-0.654)
2-day	**0.072** (0.061-0.084)	**0.084** (0.071-0.098)	**0.104** (0.089-0.123)	**0.122** (0.103-0.144)	**0.147** (0.121-0.179)	**0.168** (0.135-0.206)	**0.189** (0.147-0.236)	**0.212** (0.158-0.269)	**0.243** (0.174-0.314)	**0.268** (0.186-0.348)
3-day	**0.052** (0.045-0.061)	**0.060** (0.052-0.070)	**0.074** (0.064-0.086)	**0.086** (0.073-0.101)	**0.103** (0.086-0.124)	**0.117** (0.095-0.142)	**0.132** (0.103-0.163)	**0.147** (0.110-0.185)	**0.168** (0.121-0.216)	**0.185** (0.130-0.239)
4-day	**0.042** (0.036-0.049)	**0.048** (0.042-0.056)	**0.058** (0.051-0.068)	**0.068** (0.058-0.079)	**0.081** (0.067-0.097)	**0.091** (0.074-0.110)	**0.102** (0.080-0.126)	**0.114** (0.086-0.143)	**0.130** (0.094-0.166)	**0.143** (0.101-0.184)
7-day	**0.028** (0.025-0.033)	**0.032** (0.028-0.037)	**0.038** (0.034-0.044)	**0.044** (0.038-0.051)	**0.052** (0.044-0.061)	**0.058** (0.048-0.069)	**0.065** (0.051-0.079)	**0.072** (0.055-0.089)	**0.081** (0.059-0.103)	**0.089** (0.063-0.113)
10-day	**0.023** (0.020-0.026)	**0.025** (0.022-0.029)	**0.030** (0.027-0.035)	**0.035** (0.030-0.040)	**0.041** (0.034-0.048)	**0.045** (0.038-0.054)	**0.050** (0.040-0.061)	**0.055** (0.043-0.068)	**0.062** (0.046-0.079)	**0.068** (0.049-0.086)
20-day	**0.015** (0.013-0.017)	**0.017** (0.015-0.019)	**0.020** (0.018-0.023)	**0.023** (0.021-0.026)	**0.027** (0.023-0.031)	**0.030** (0.025-0.035)	**0.033** (0.027-0.040)	**0.037** (0.028-0.044)	**0.041** (0.030-0.051)	**0.044** (0.032-0.055)
30-day	**0.012** (0.011-0.013)	**0.014** (0.012-0.015)	**0.016** (0.015-0.018)	**0.019** (0.017-0.021)	**0.022** (0.019-0.025)	**0.024** (0.020-0.028)	**0.026** (0.022-0.031)	**0.029** (0.022-0.035)	**0.032** (0.024-0.039)	**0.034** (0.025-0.042)
45-day	**0.010** (0.009-0.011)	**0.011** (0.010-0.012)	**0.013** (0.012-0.015)	**0.015** (0.013-0.017)	**0.017** (0.015-0.019)	**0.019** (0.016-0.022)	**0.021** (0.017-0.024)	**0.022** (0.017-0.026)	**0.024** (0.018-0.029)	**0.025** (0.019-0.032)
60-day	**0.008** (0.008-0.009)	**0.010** (0.009-0.010)	**0.011** (0.010-0.012)	**0.013** (0.011-0.014)	**0.014** (0.013-0.016)	**0.016** (0.013-0.018)	**0.017** (0.014-0.020)	**0.018** (0.014-0.021)	**0.019** (0.015-0.024)	**0.020** (0.015-0.025)

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

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

Please refer to NOAA Atlas 14 document for more information.

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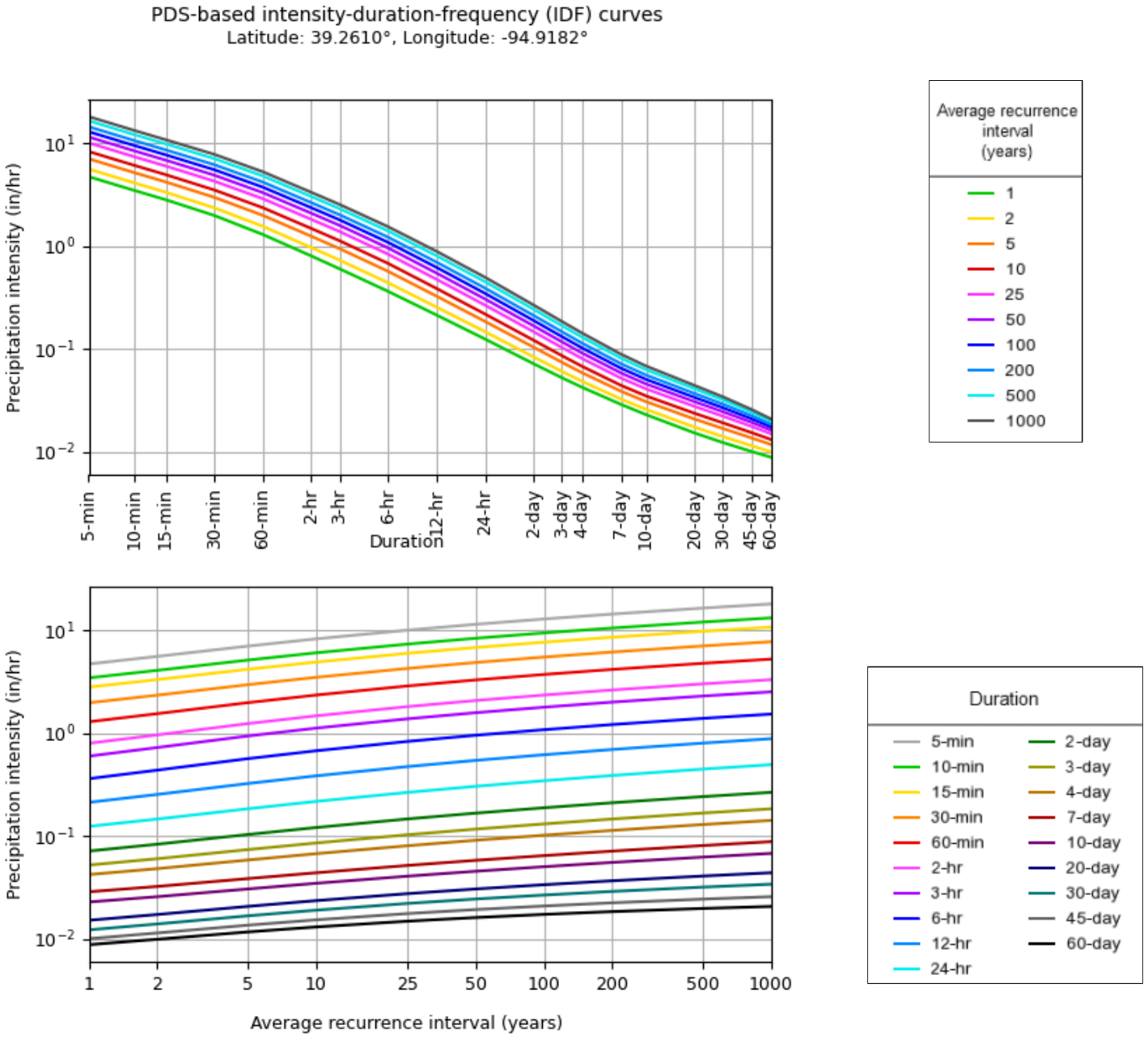
PF graphical



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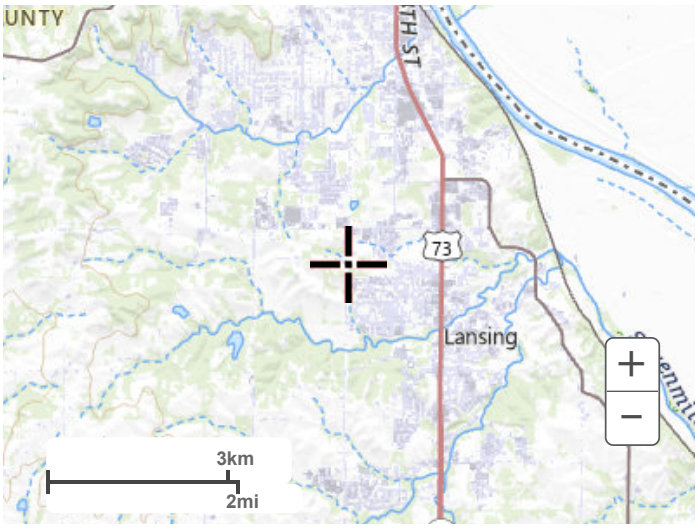
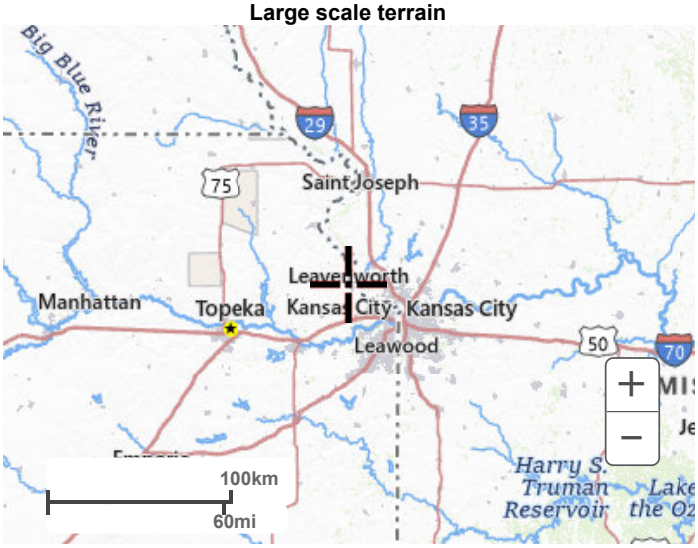
Maps & aerials

Small scale terrain



Large scale terrain



Large scale map

Large scale aerial

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Silver Spring, MD 20910
Questions?: HDSC.Questions@noaa.gov

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

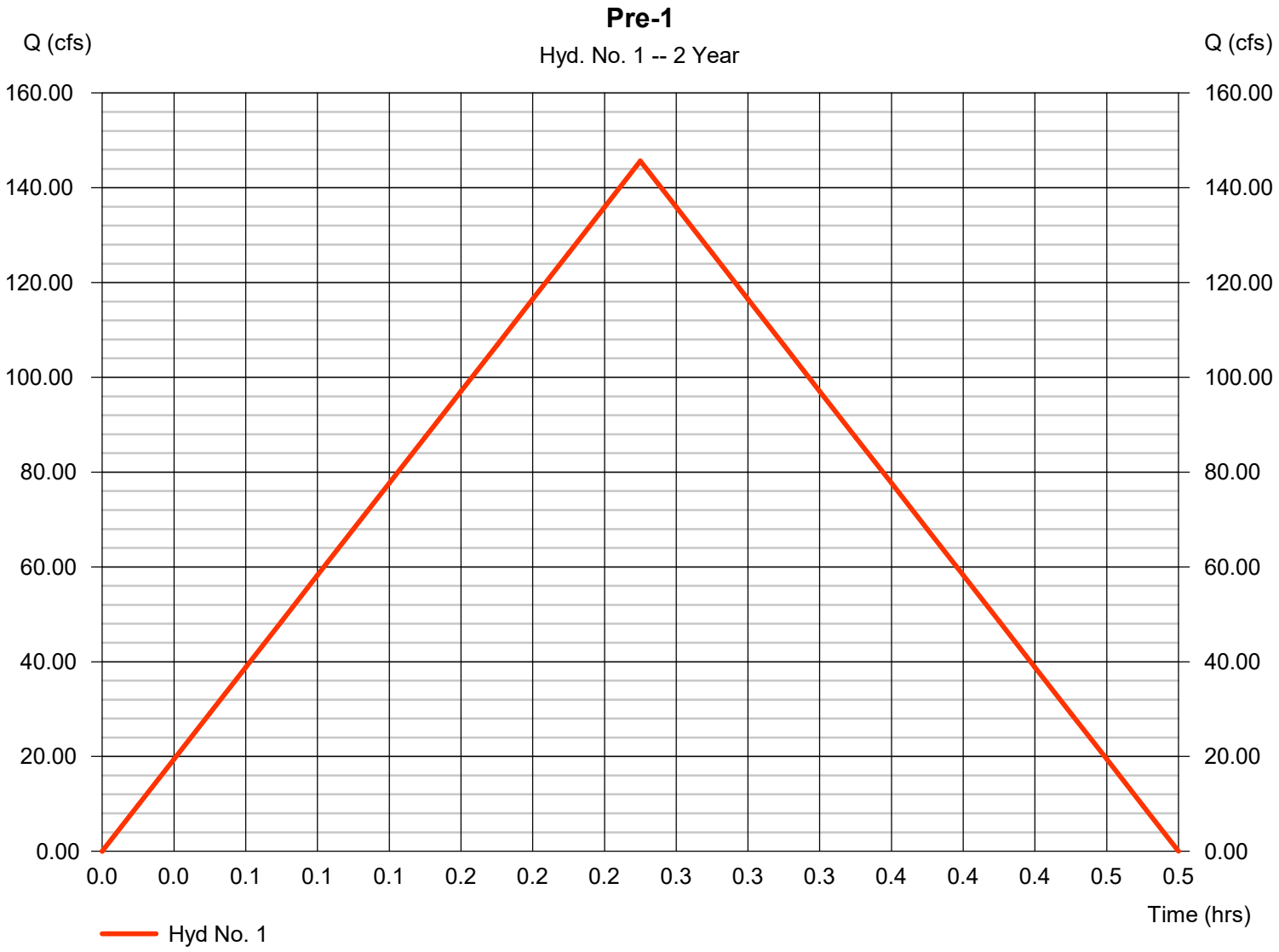
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	145.63	1	15	131,066	------	------	------	Pre-1
2	Rational	18.45	1	10	11,070	------	------	------	Pre-2
3	Rational	1.897	1	11	1,252	------	------	------	Pre-3
4	Rational	27.06	1	11	17,860	------	------	------	Pre-4
5	Rational	8.662	1	11	5,717	------	------	------	Pre-5
6	Combine	154.85	1	15	142,136	1, 2,	------	------	Pre-POC #1
7	Rational	145.44	1	15	130,899	------	------	------	Post-1
8	Rational	38.21	1	7	16,048	------	------	------	Post-2
9	Rational	2.012	1	8	966	------	------	------	Post-3
10	Rational	45.59	1	8	21,882	------	------	------	Post-4
11	Reservoir	21.95	1	12	21,874	10	868.67	13,116	Pond Rational - Post 4
12	Rational	6.874	1	9	3,712	------	------	------	Post-5
13	Rational	23.18	1	8	11,128	------	------	------	Post-6
14	Combine	145.44	1	15	146,947	7, 8,	------	------	POC #1
15	SCS Runoff	37.04	2	720	84,842	------	------	------	Pre 4
16	SCS Runoff	49.82	2	716	102,205	------	------	------	Post 4
17	Reservoir	37.92	2	720	102,197	16	869.28	18,952	Pond SCS - Post 4

Hydrograph Report

Hyd. No. 1

Pre-1

Hydrograph type	=	Rational	Peak discharge	=	145.63 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	131,066 cuft
Drainage area	=	93.760 ac	Runoff coeff.	=	0.45
Intensity	=	3.452 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

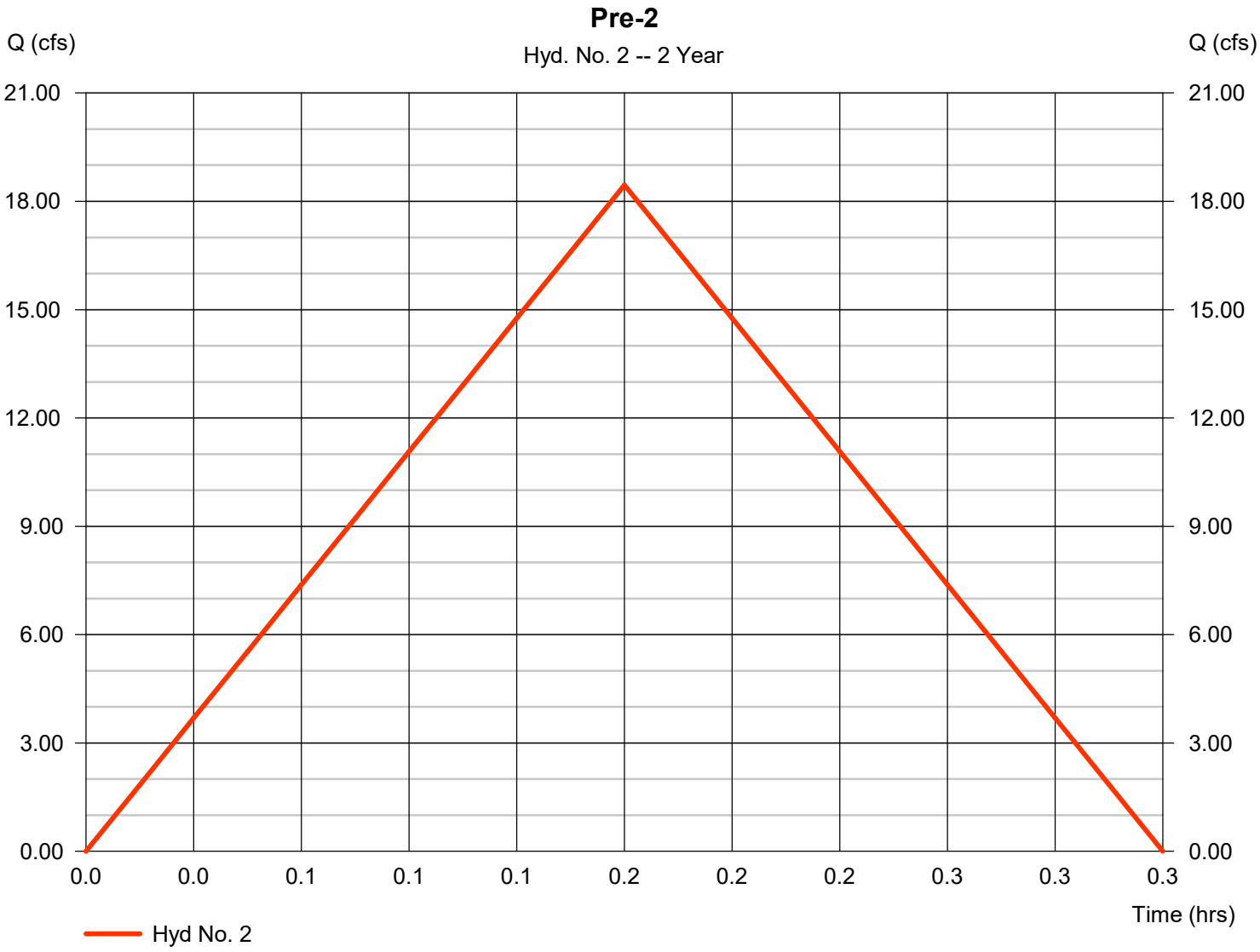


Hydrograph Report

Hyd. No. 2

Pre-2

Hydrograph type	=	Rational	Peak discharge	=	18.45 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.17 hrs
Time interval	=	1 min	Hyd. volume	=	11,070 cuft
Drainage area	=	14.130 ac	Runoff coeff.	=	0.31
Intensity	=	4.212 in/hr	Tc by User	=	10.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

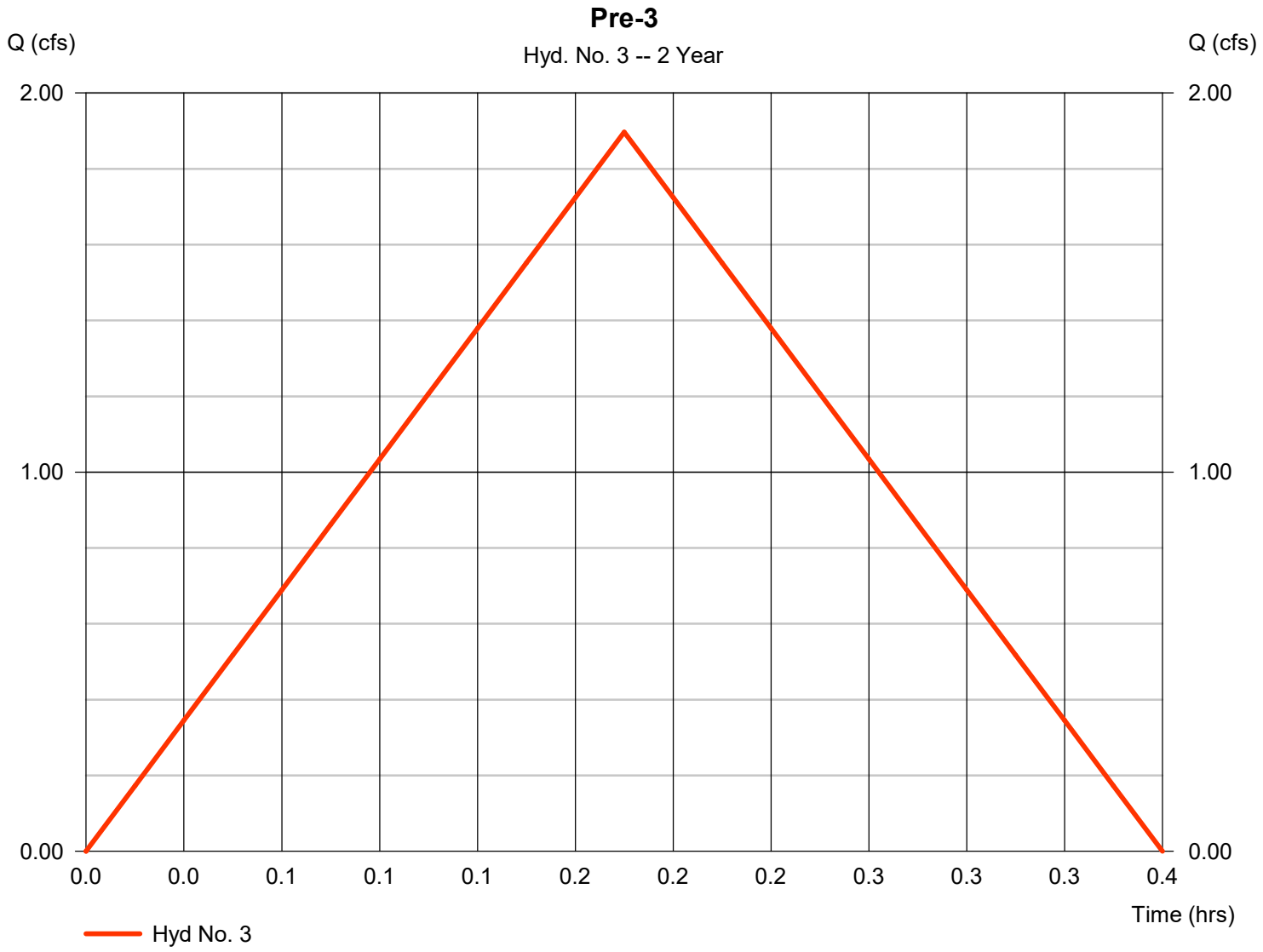


Hydrograph Report

Hyd. No. 3

Pre-3

Hydrograph type	=	Rational	Peak discharge	=	1.897 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	1,252 cuft
Drainage area	=	1.570 ac	Runoff coeff.	=	0.3
Intensity	=	4.027 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

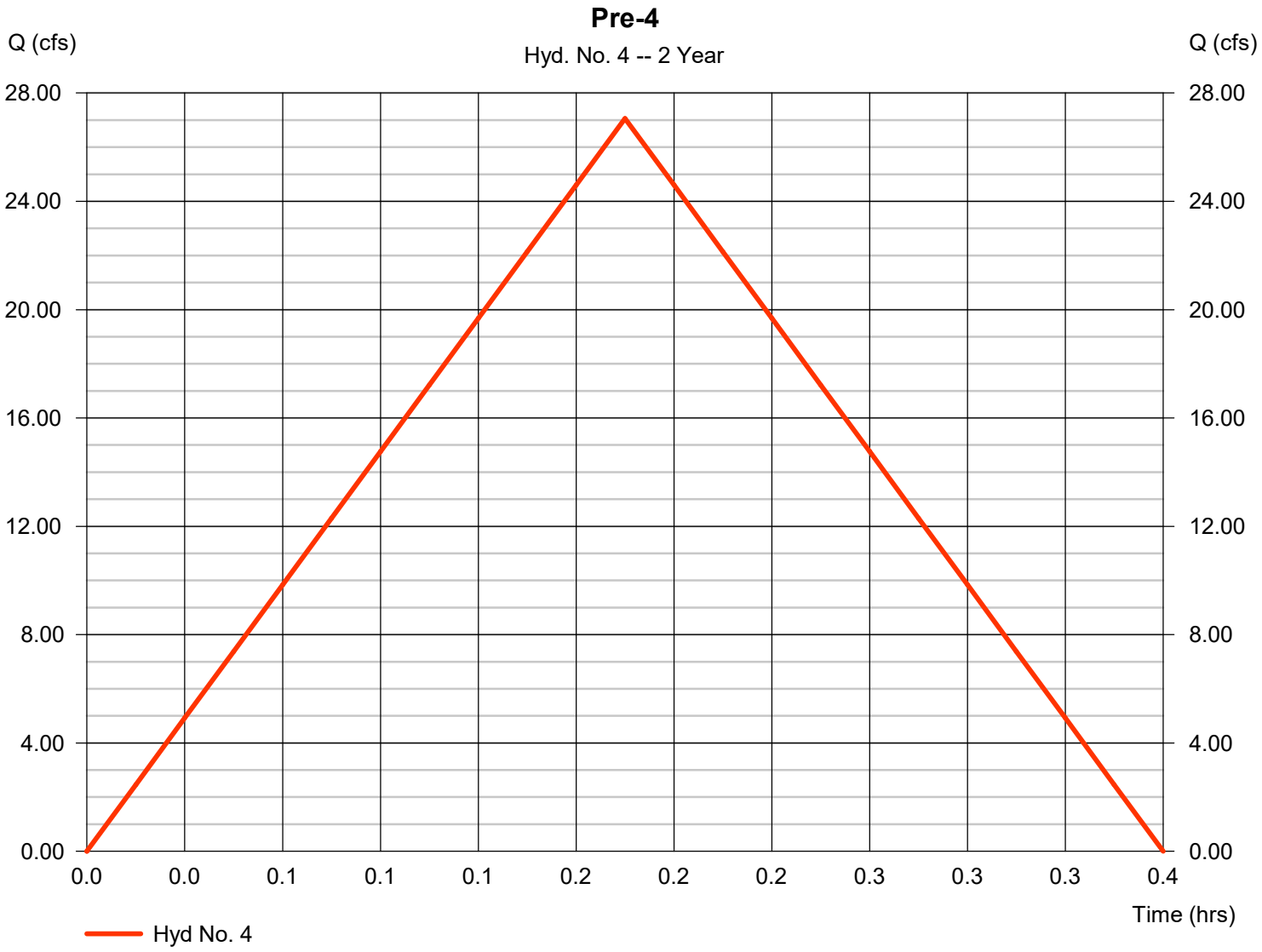


Hydrograph Report

Hyd. No. 4

Pre-4

Hydrograph type	=	Rational	Peak discharge	=	27.06 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	17,860 cuft
Drainage area	=	22.400 ac	Runoff coeff.	=	0.3
Intensity	=	4.027 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rise/Dip fact	=	1/1

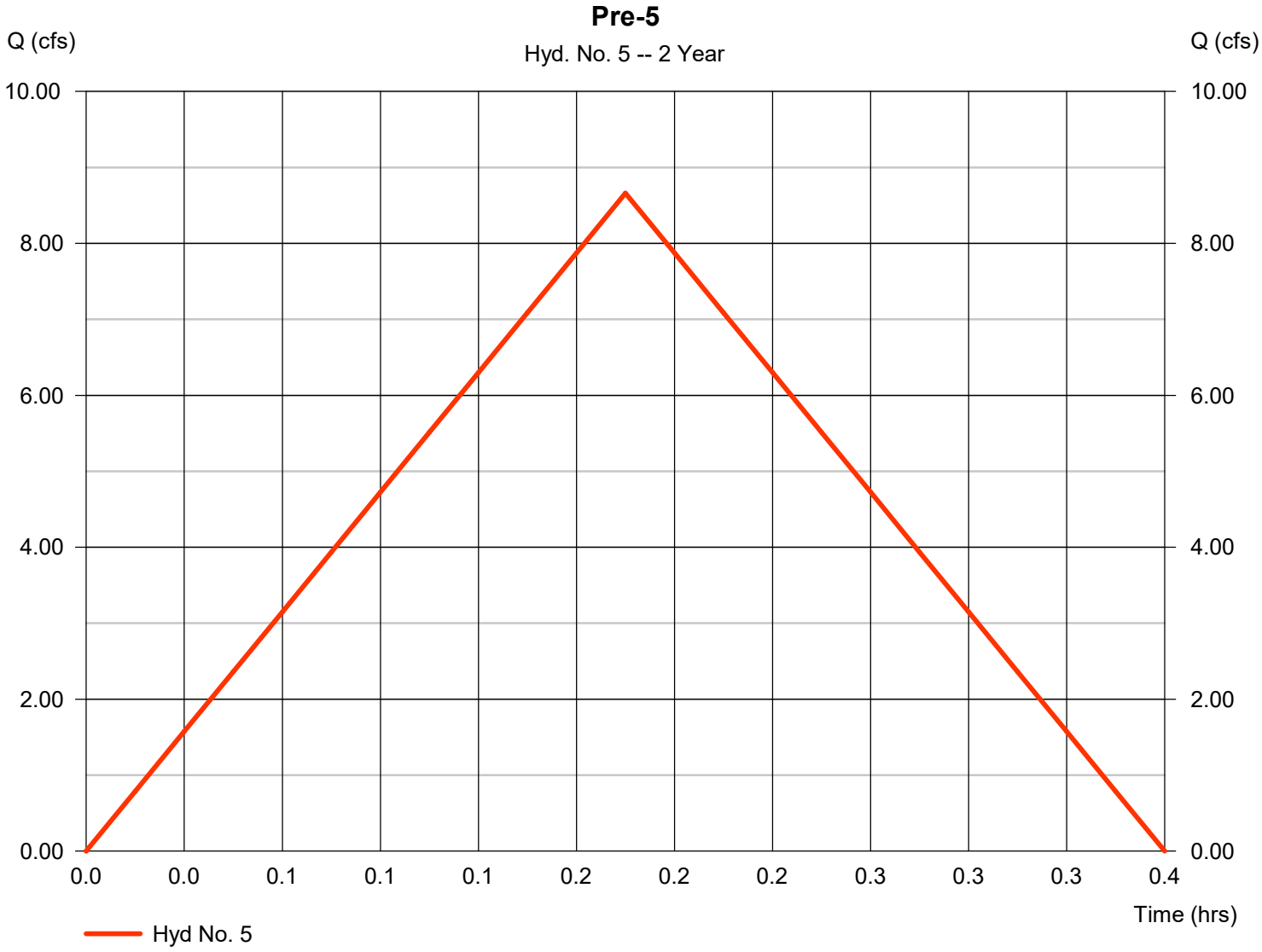


Hydrograph Report

Hyd. No. 5

Pre-5

Hydrograph type	=	Rational	Peak discharge	=	8.662 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	5,717 cuft
Drainage area	=	7.170 ac	Runoff coeff.	=	0.3
Intensity	=	4.027 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

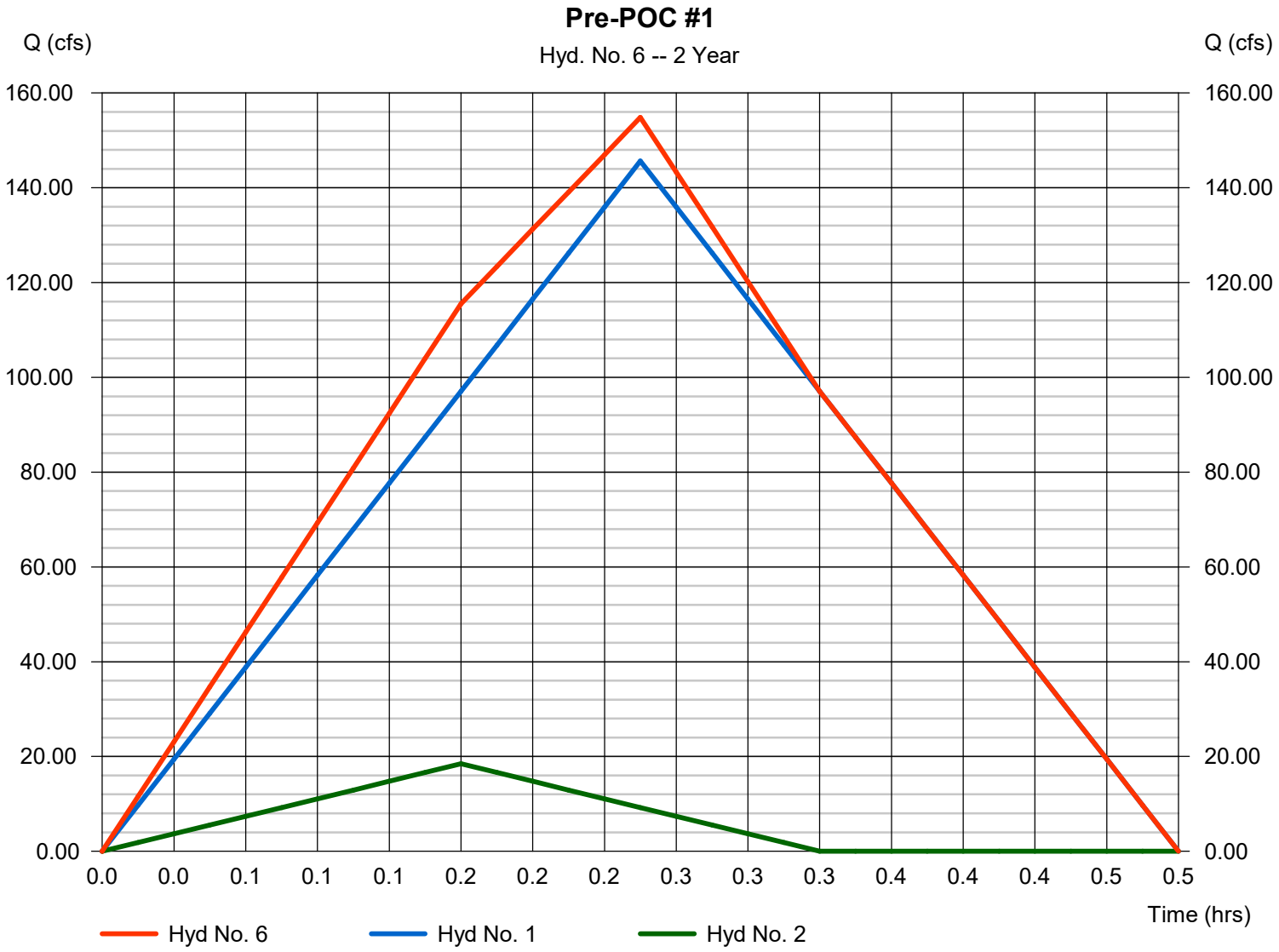


Hydrograph Report

Hyd. No. 6

Pre-POC #1

Hydrograph type	=	Combine	Peak discharge	=	154.85 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	142,136 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	107.890 ac

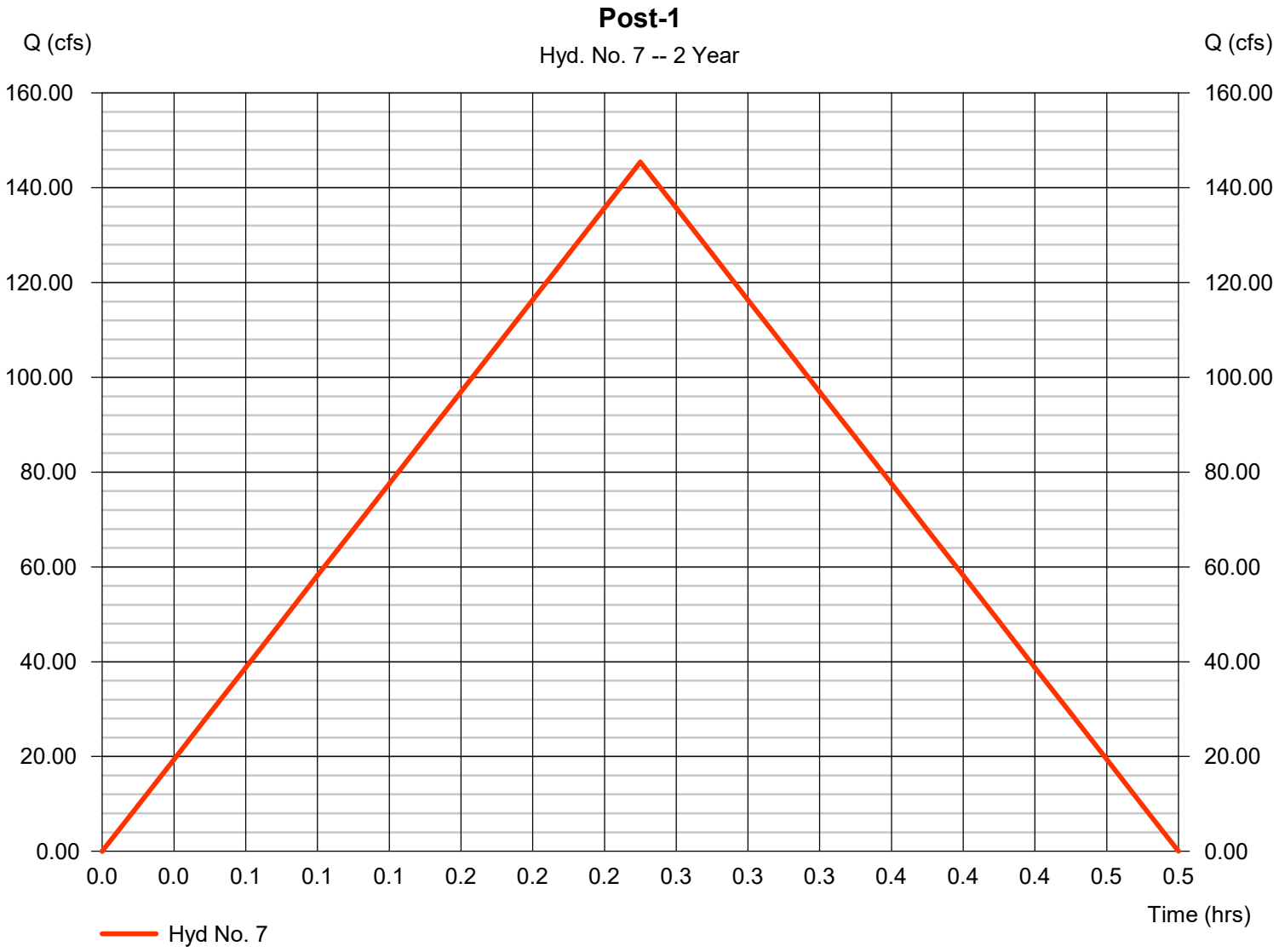


Hydrograph Report

Hyd. No. 7

Post-1

Hydrograph type	=	Rational	Peak discharge	=	145.44 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	130,899 cuft
Drainage area	=	93.640 ac	Runoff coeff.	=	0.45
Intensity	=	3.452 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

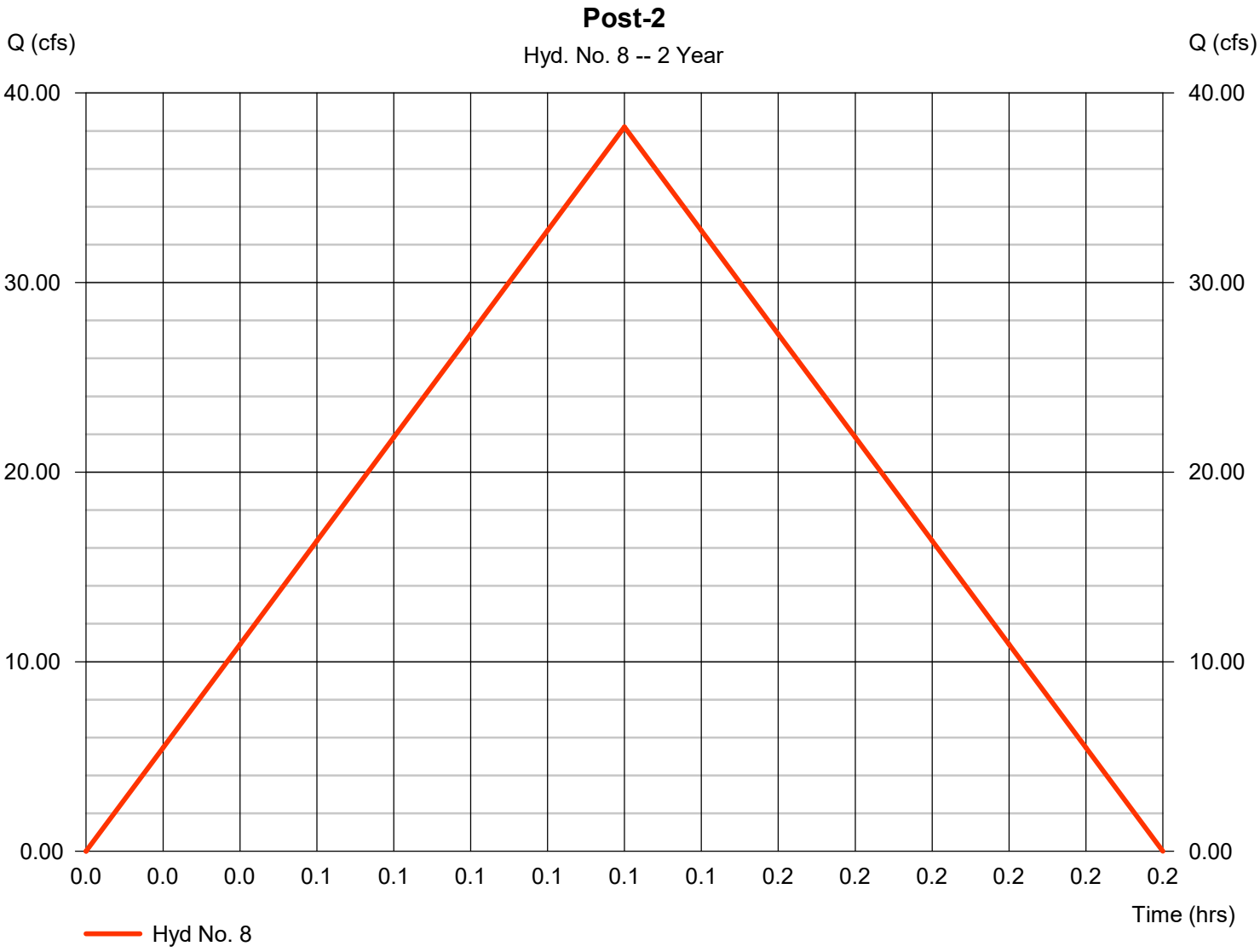


Hydrograph Report

Hyd. No. 8

Post-2

Hydrograph type	=	Rational	Peak discharge	=	38.21 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.12 hrs
Time interval	=	1 min	Hyd. volume	=	16,048 cuft
Drainage area	=	14.360 ac	Runoff coeff.	=	0.54
Intensity	=	4.927 in/hr	Tc by User	=	7.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

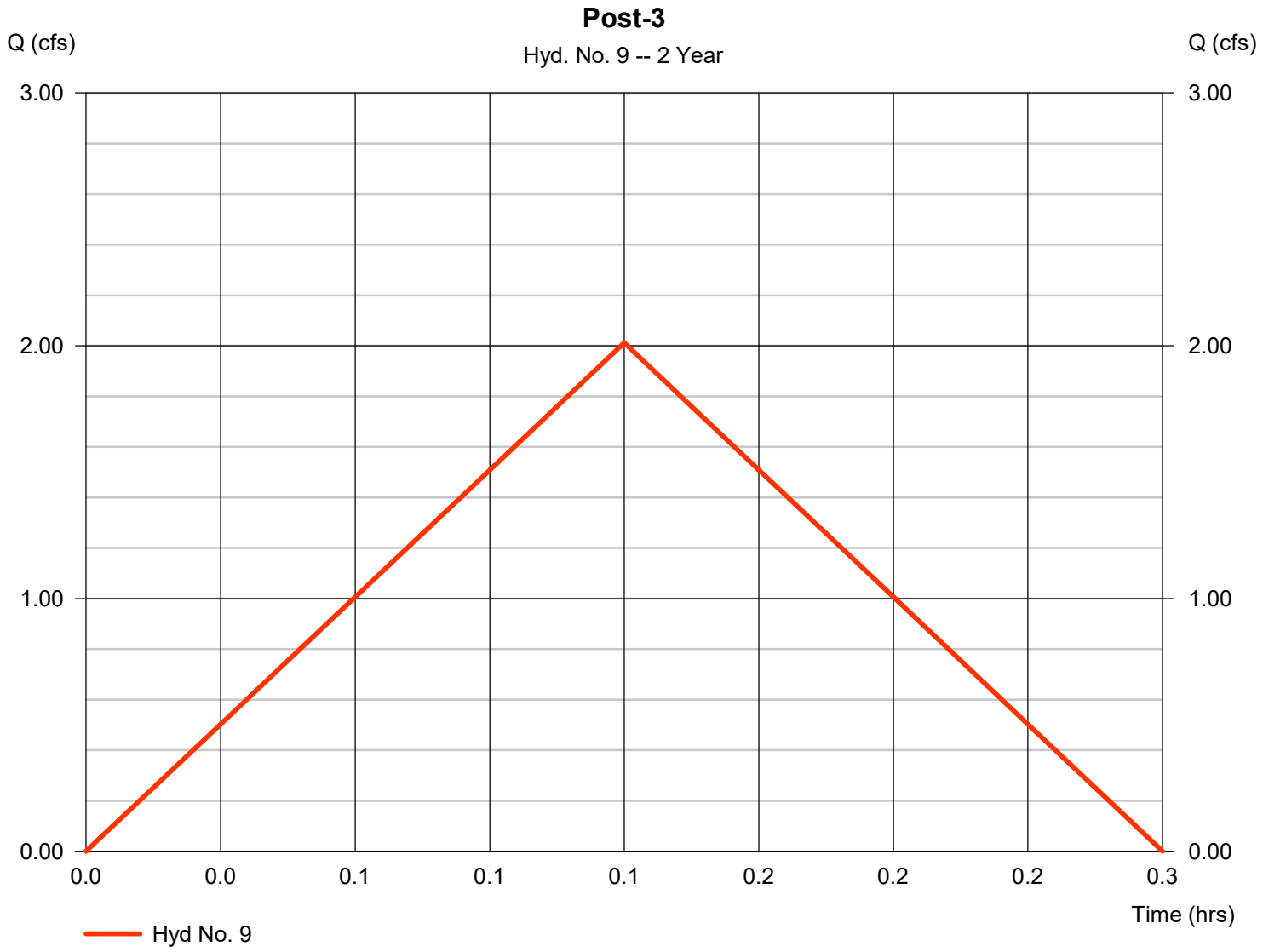


Hydrograph Report

Hyd. No. 9

Post-3

Hydrograph type	=	Rational	Peak discharge	=	2.012 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	966 cuft
Drainage area	=	0.800 ac	Runoff coeff.	=	0.54
Intensity	=	4.656 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rise/Clmb fact	=	1/1

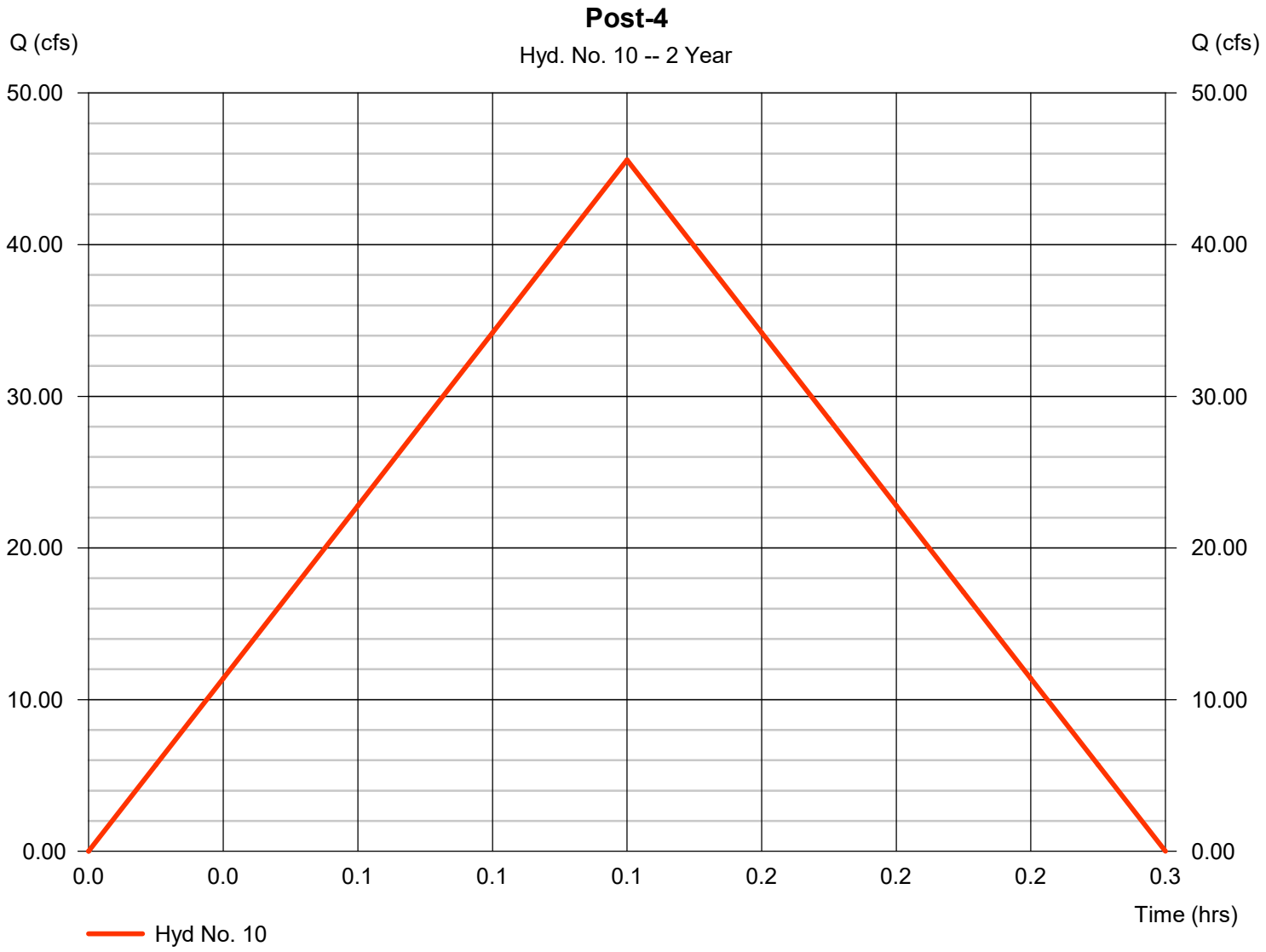


Hydrograph Report

Hyd. No. 10

Post-4

Hydrograph type	=	Rational	Peak discharge	=	45.59 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	21,882 cuft
Drainage area	=	18.130 ac	Runoff coeff.	=	0.54
Intensity	=	4.656 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1



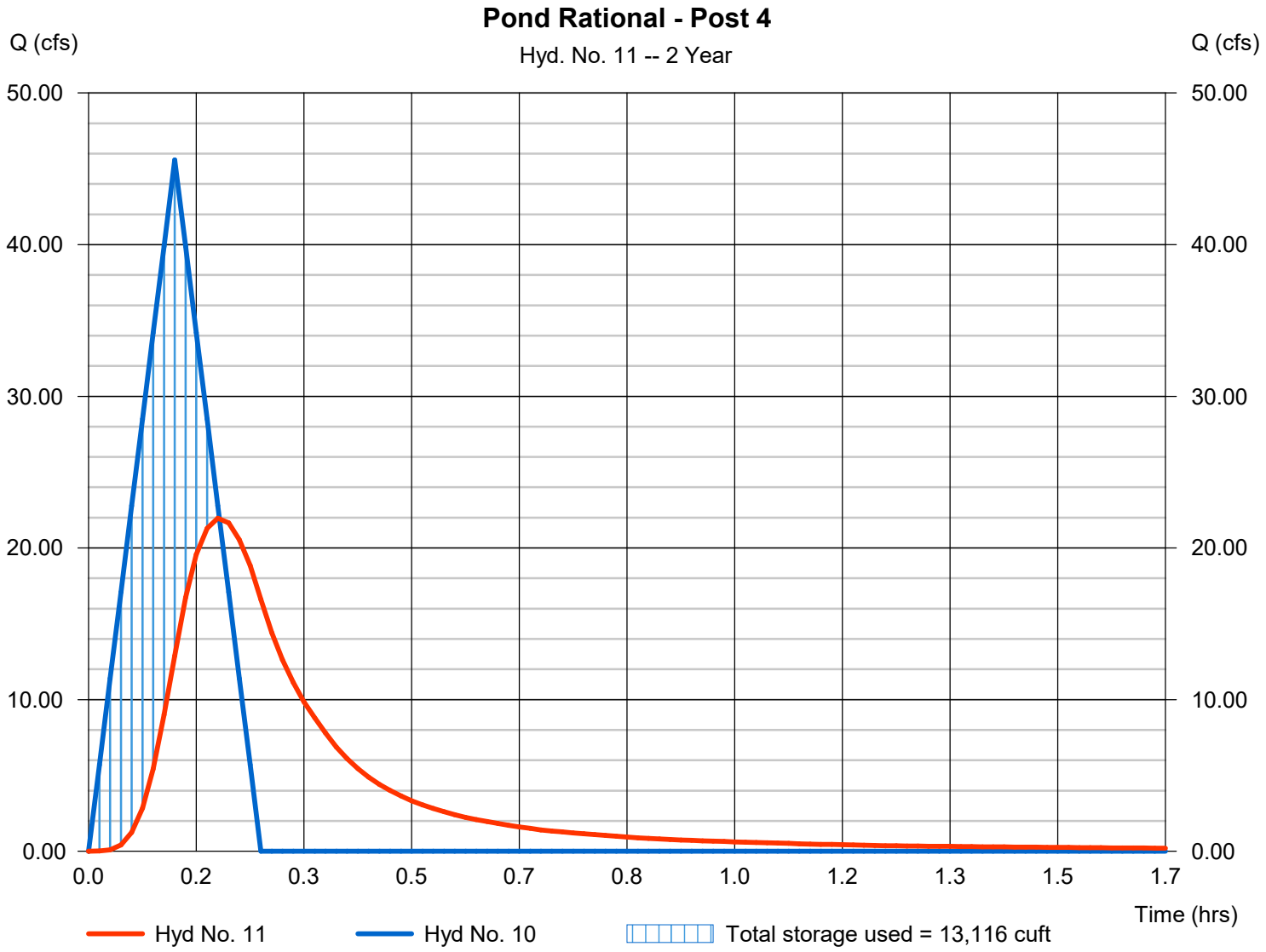
Hydrograph Report

Hyd. No. 11

Pond Rational - Post 4

Hydrograph type	=	Reservoir	Peak discharge	=	21.95 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.20 hrs
Time interval	=	1 min	Hyd. volume	=	21,874 cuft
Inflow hyd. No.	=	10 - Post-4	Max. Elevation	=	868.67 ft
Reservoir name	=	Small Pond	Max. Storage	=	13,116 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Small Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 867.00 ft. Voids = 95.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	867.00	6,679	0	0
1.00	868.00	8,408	7,166	7,166
2.00	869.00	10,239	8,857	16,024
3.00	870.00	12,170	10,644	26,668
4.00	871.00	14,201	12,526	39,194
5.00	872.00	16,333	14,504	53,698
6.00	873.00	18,566	16,577	70,275
7.00	874.00	20,899	18,746	89,021

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	Inactive	0.00	0.00
Span (in)	= 48.00	48.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 867.00	867.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 2.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

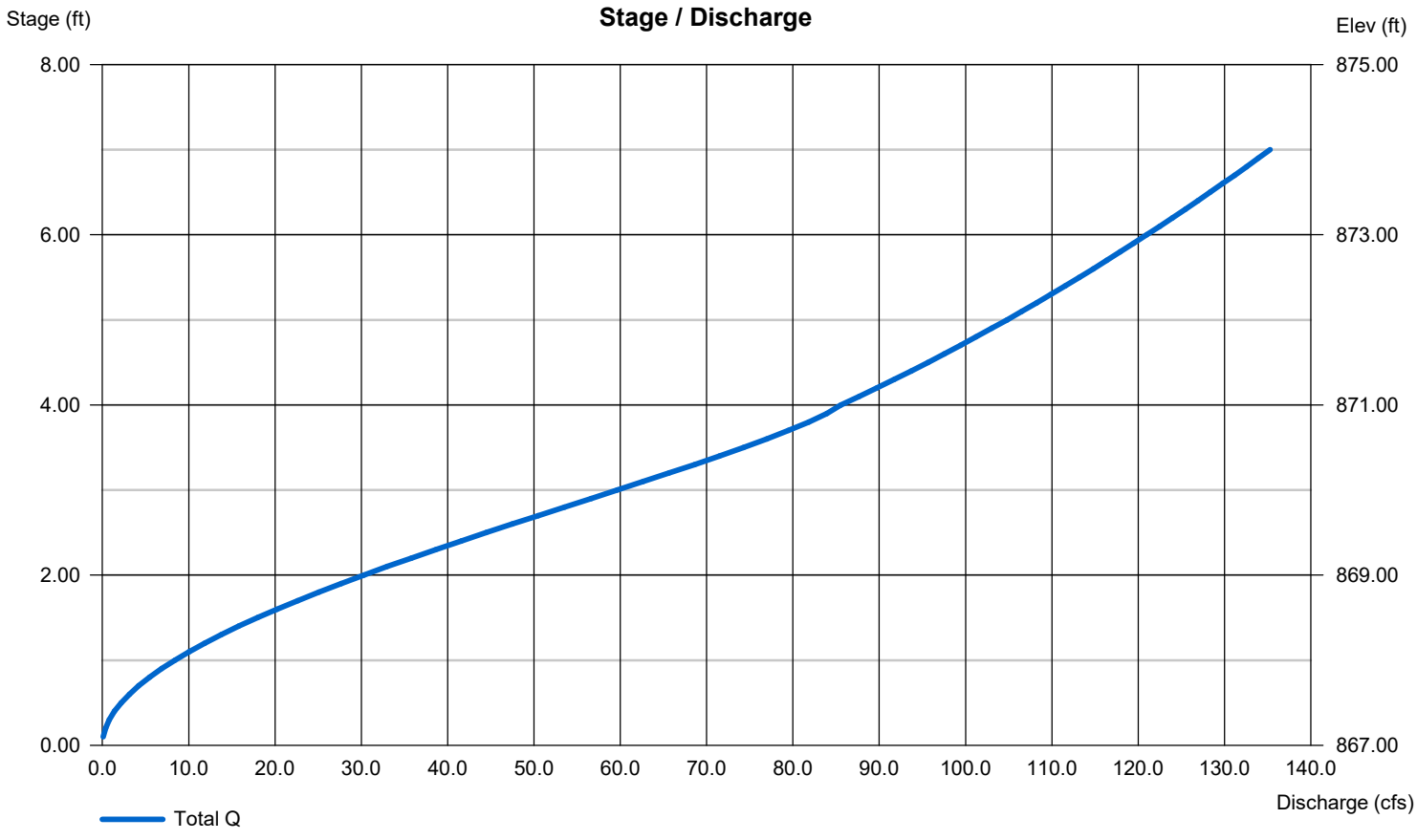
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 872.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

TW Elev. (ft) = 0.00

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

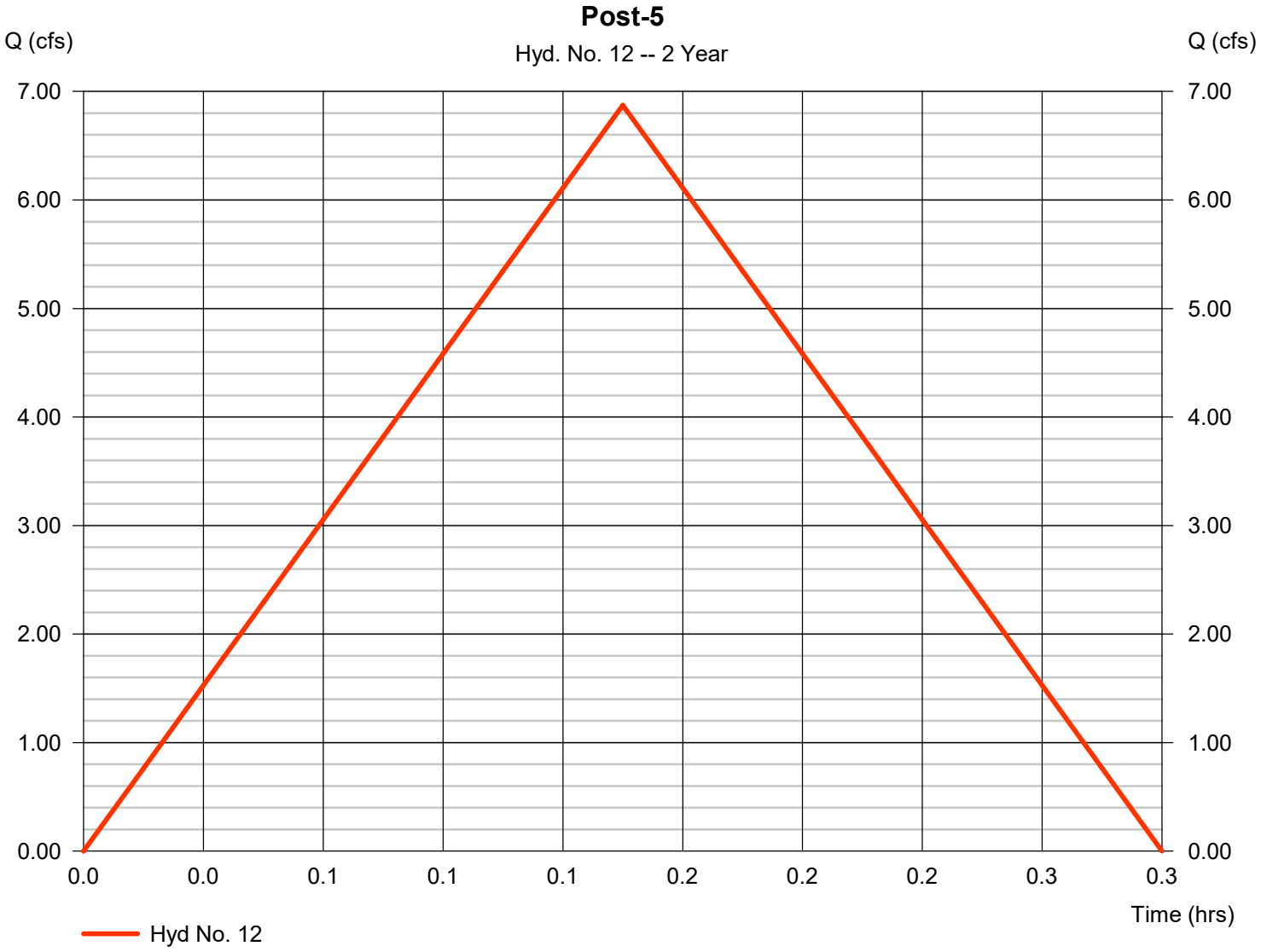


Hydrograph Report

Hyd. No. 12

Post-5

Hydrograph type	=	Rational	Peak discharge	=	6.874 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.15 hrs
Time interval	=	1 min	Hyd. volume	=	3,712 cuft
Drainage area	=	2.880 ac	Runoff coeff.	=	0.54
Intensity	=	4.420 in/hr	Tc by User	=	9.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

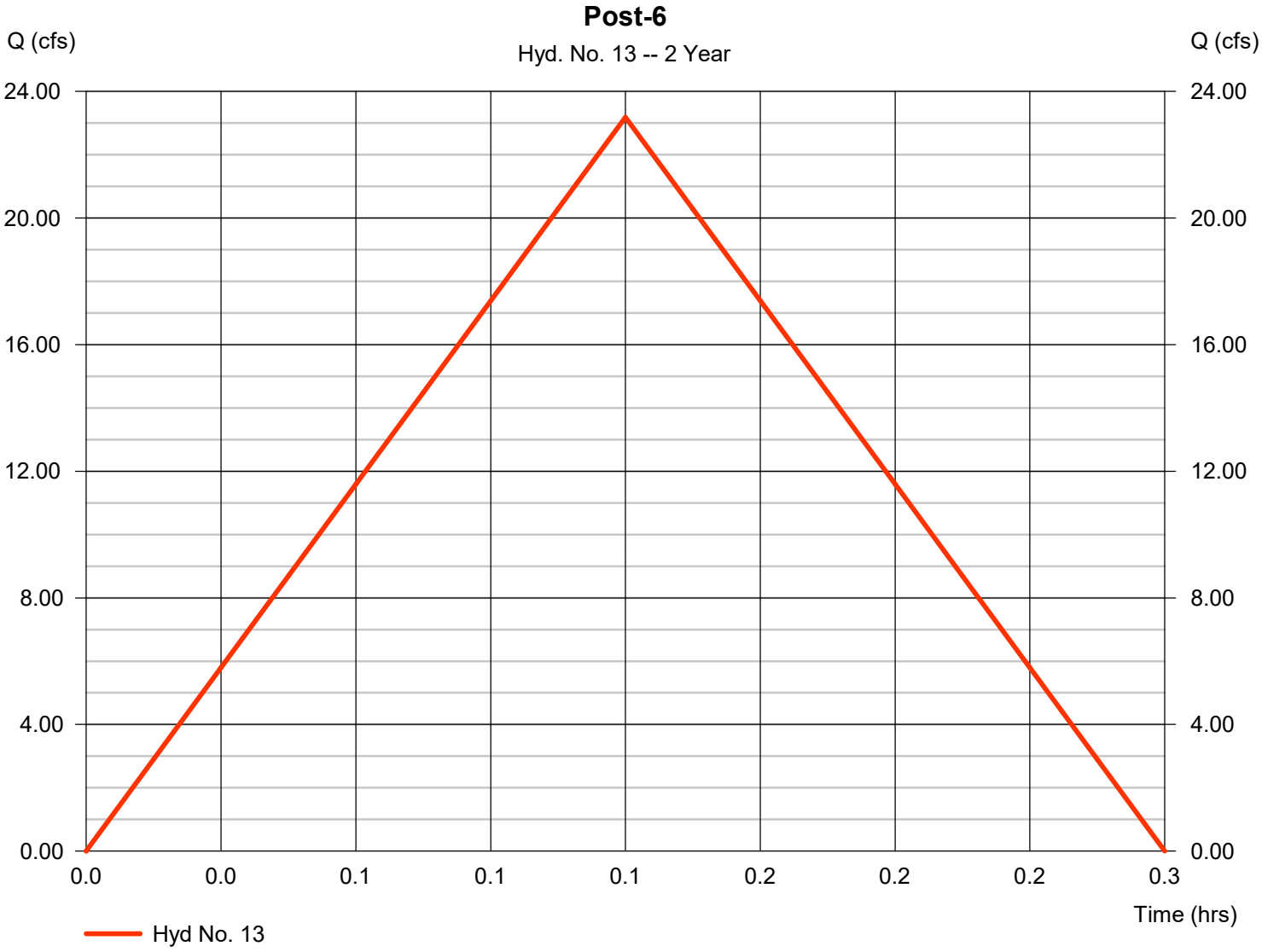


Hydrograph Report

Hyd. No. 13

Post-6

Hydrograph type	=	Rational	Peak discharge	=	23.18 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	11,128 cuft
Drainage area	=	9.220 ac	Runoff coeff.	=	0.54
Intensity	=	4.656 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1

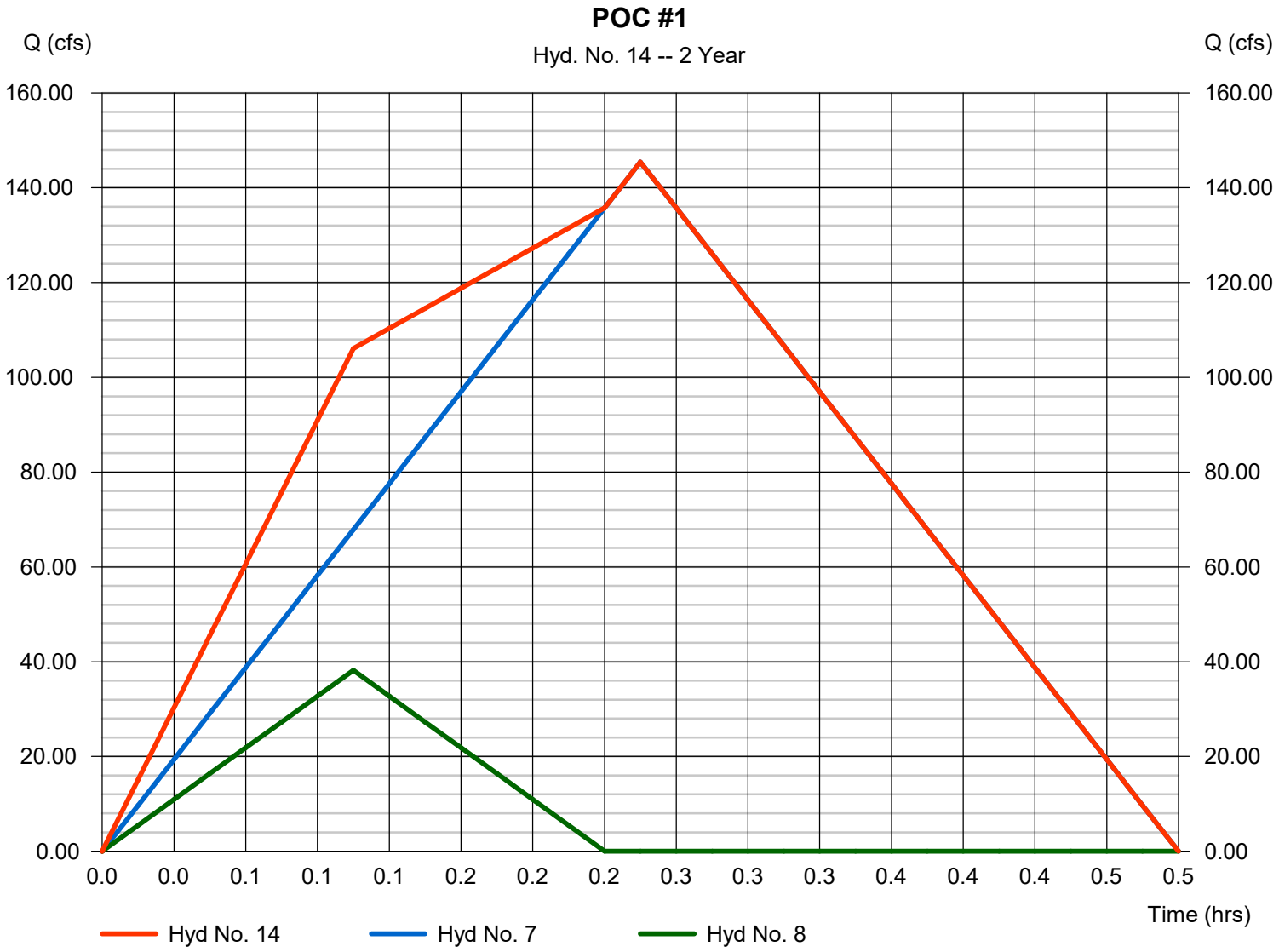


Hydrograph Report

Hyd. No. 14

POC #1

Hydrograph type	=	Combine	Peak discharge	=	145.44 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	146,947 cuft
Inflow hyds.	=	7, 8	Contrib. drain. area	=	108.000 ac

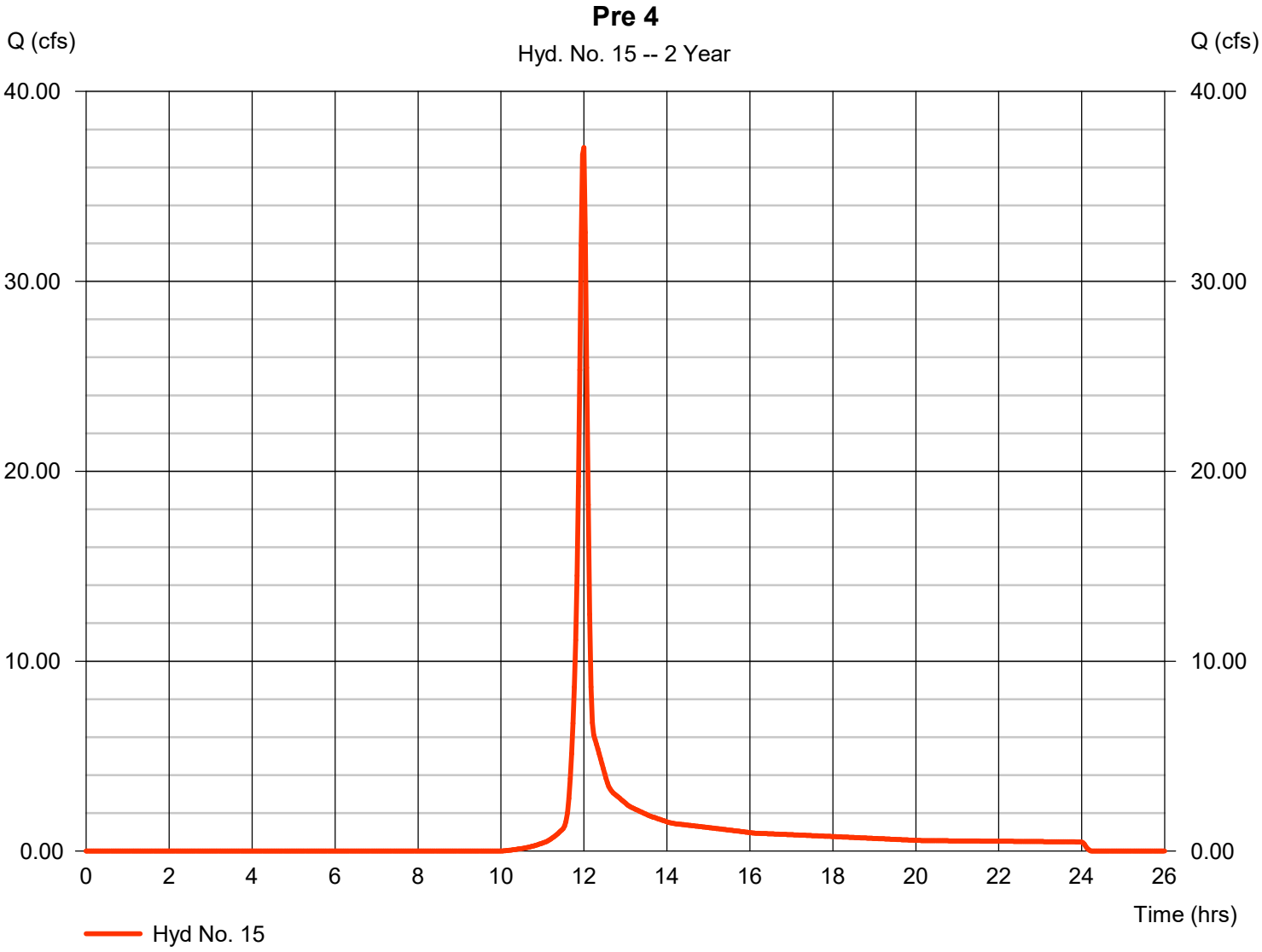


Hydrograph Report

Hyd. No. 15

Pre 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	37.04 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	84,842 cuft
Drainage area	=	22.400 ac	Curve number	=	81
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.88 min
Total precip.	=	2.64 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

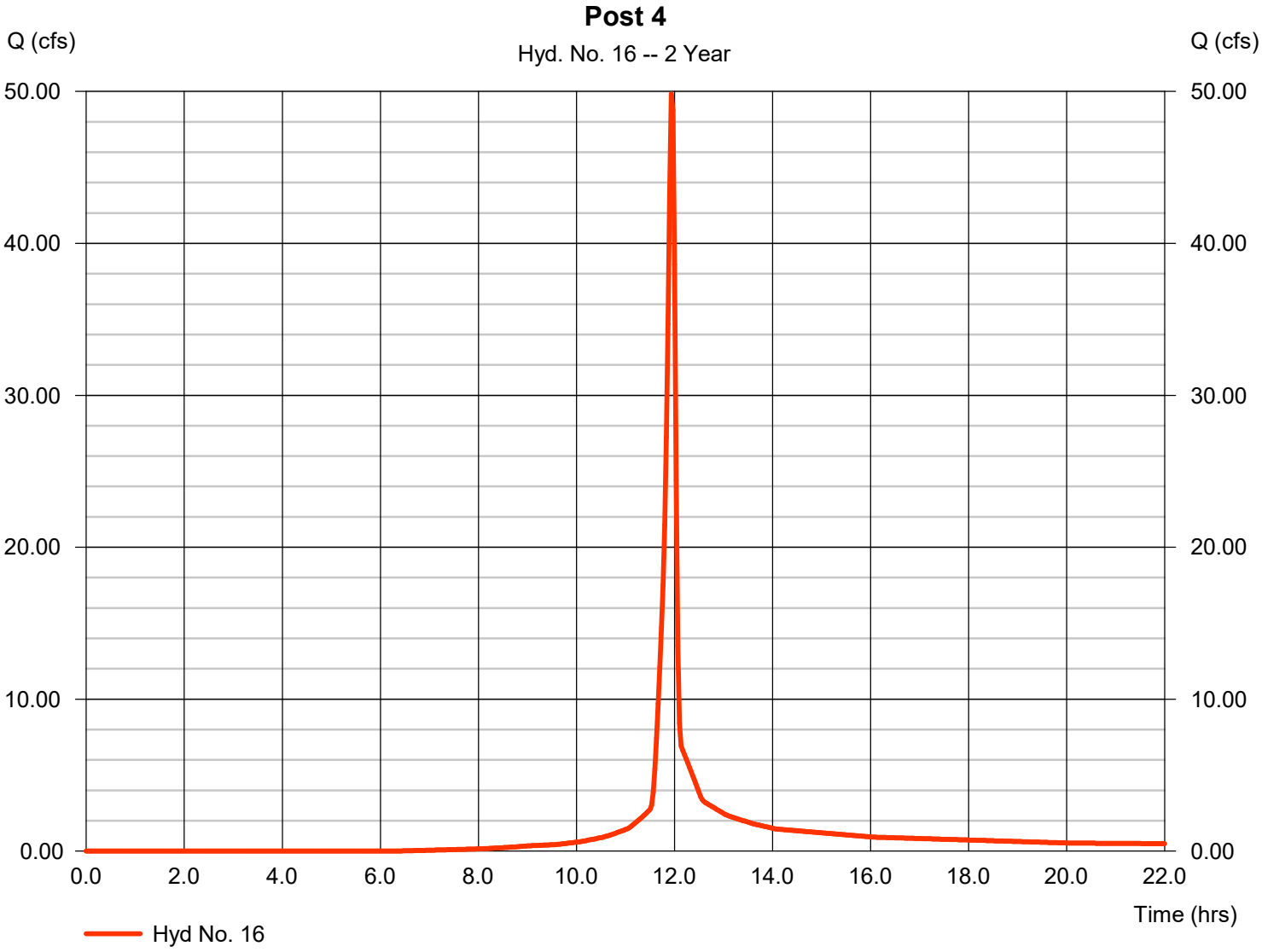


Hydrograph Report

Hyd. No. 16

Post 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	49.82 cfs
Storm frequency	=	2 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	102,205 cuft
Drainage area	=	18.130 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	4.82 min
Total precip.	=	2.64 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



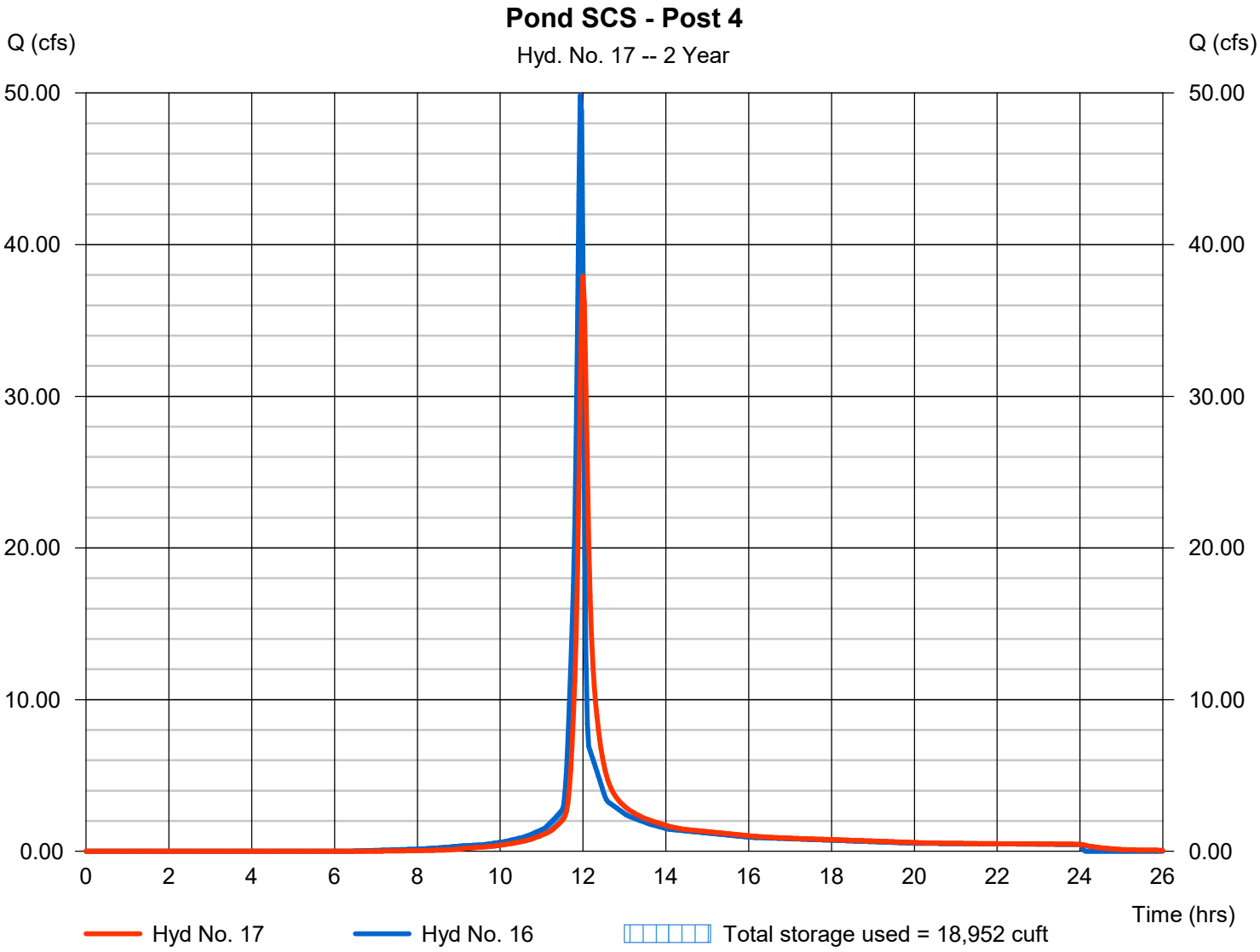
Hydrograph Report

Hyd. No. 17

Pond SCS - Post 4

Hydrograph type	=	Reservoir	Peak discharge	=	37.92 cfs
Storm frequency	=	2 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	102,197 cuft
Inflow hyd. No.	=	16 - Post 4	Max. Elevation	=	869.28 ft
Reservoir name	=	Small Pond	Max. Storage	=	18,952 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Small Pond

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 867.00 ft. Voids = 95.00%

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	867.00	6,679	0	0
1.00	868.00	8,408	7,166	7,166
2.00	869.00	10,239	8,857	16,024
3.00	870.00	12,170	10,644	26,668
4.00	871.00	14,201	12,526	39,194
5.00	872.00	16,333	14,504	53,698
6.00	873.00	18,566	16,577	70,275
7.00	874.00	20,899	18,746	89,021

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	Inactive	0.00	0.00
Span (in)	= 48.00	48.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 867.00	867.00	0.00	0.00
Length (ft)	= 100.00	0.00	0.00	0.00
Slope (%)	= 2.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

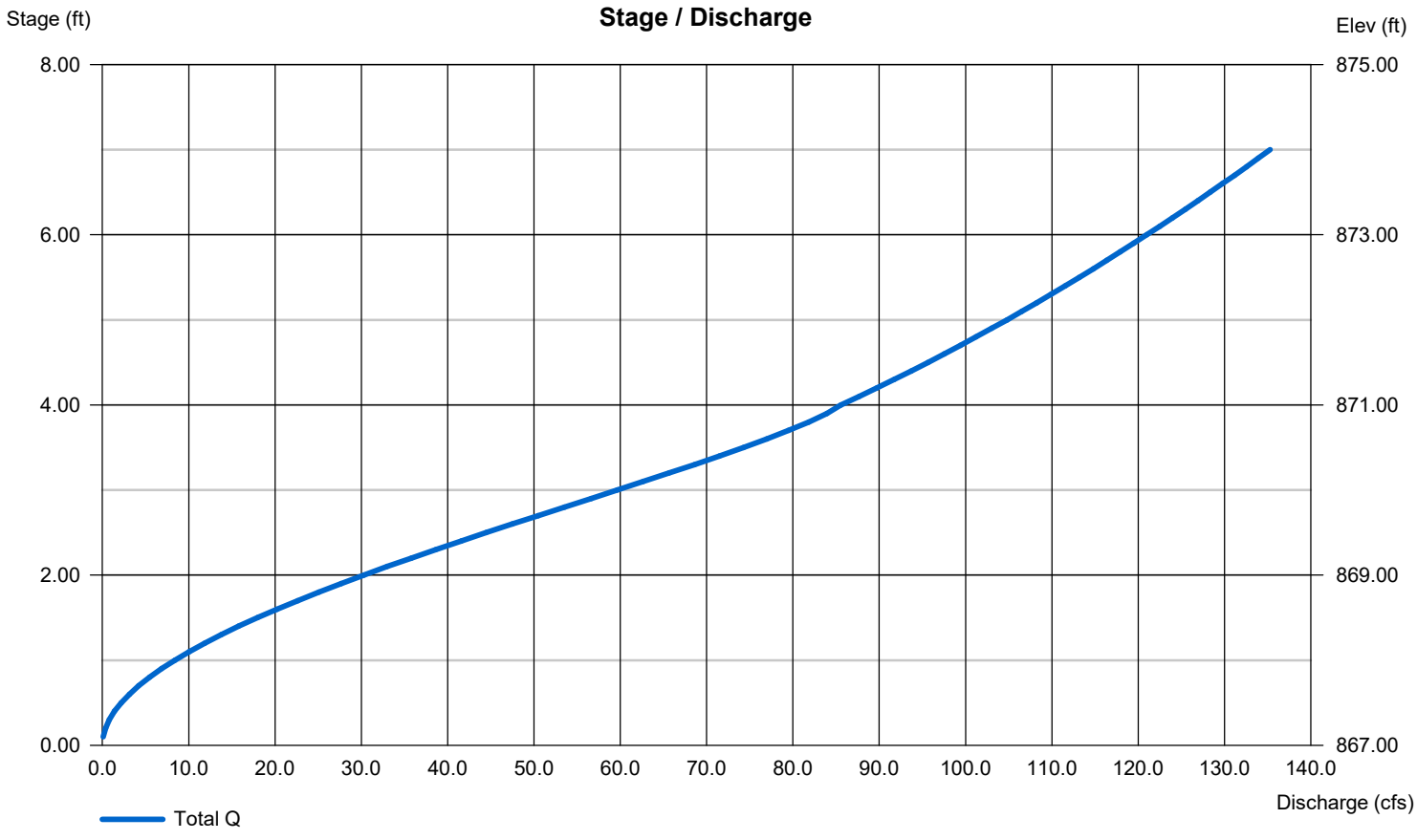
Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	Inactive	0.00	0.00	0.00
Crest El. (ft)	= 872.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Wet area)

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 Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

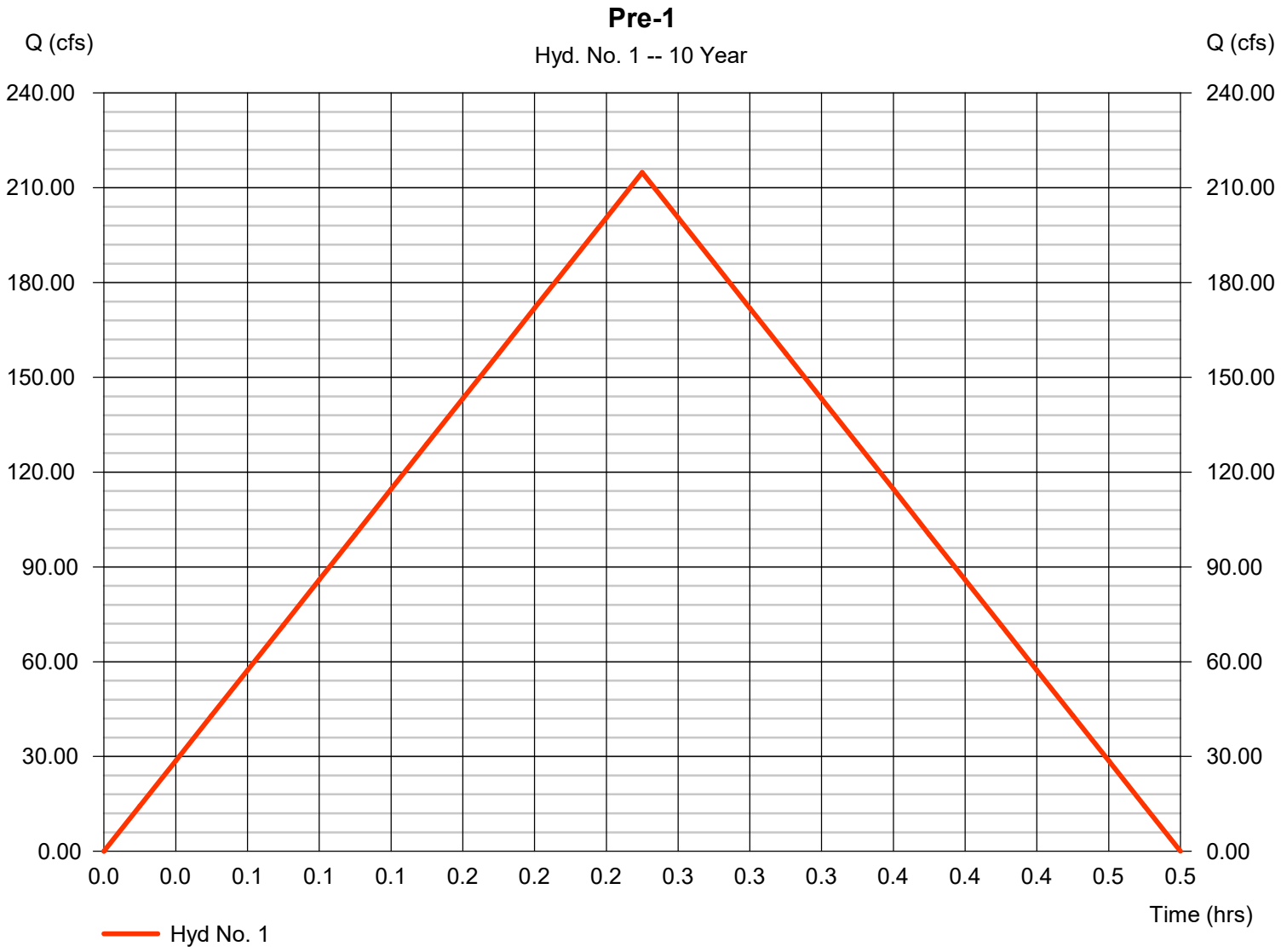
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	214.88	1	15	193,390	------	------	------	Pre-1
2	Rational	27.18	1	10	16,306	------	------	------	Pre-2
3	Rational	2.794	1	11	1,844	------	------	------	Pre-3
4	Rational	39.86	1	11	26,309	------	------	------	Pre-4
5	Rational	12.76	1	11	8,421	------	------	------	Pre-5
6	Combine	228.47	1	15	209,696	1, 2,	------	------	Pre-POC #1
7	Rational	214.60	1	15	193,143	------	------	------	Post-1
8	Rational	56.37	1	7	23,675	------	------	------	Post-2
9	Rational	2.965	1	8	1,423	------	------	------	Post-3
10	Rational	67.19	1	8	32,252	------	------	------	Post-4
11	Reservoir	35.13	1	12	32,244	10	869.18	17,906	Pond Rational - Post 4
12	Rational	10.13	1	9	5,469	------	------	------	Post-5
13	Rational	34.17	1	8	16,402	------	------	------	Post-6
14	Combine	214.60	1	15	216,817	7, 8,	------	------	POC #1
15	SCS Runoff	77.46	2	718	177,298	------	------	------	Pre 4
16	SCS Runoff	87.23	2	716	184,209	------	------	------	Post 4
17	Reservoir	67.23	2	720	184,201	16	870.25	29,839	Pond SCS - Post 4

Hydrograph Report

Hyd. No. 1

Pre-1

Hydrograph type	=	Rational	Peak discharge	=	214.88 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	193,390 cuft
Drainage area	=	93.760 ac	Runoff coeff.	=	0.45
Intensity	=	5.093 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1



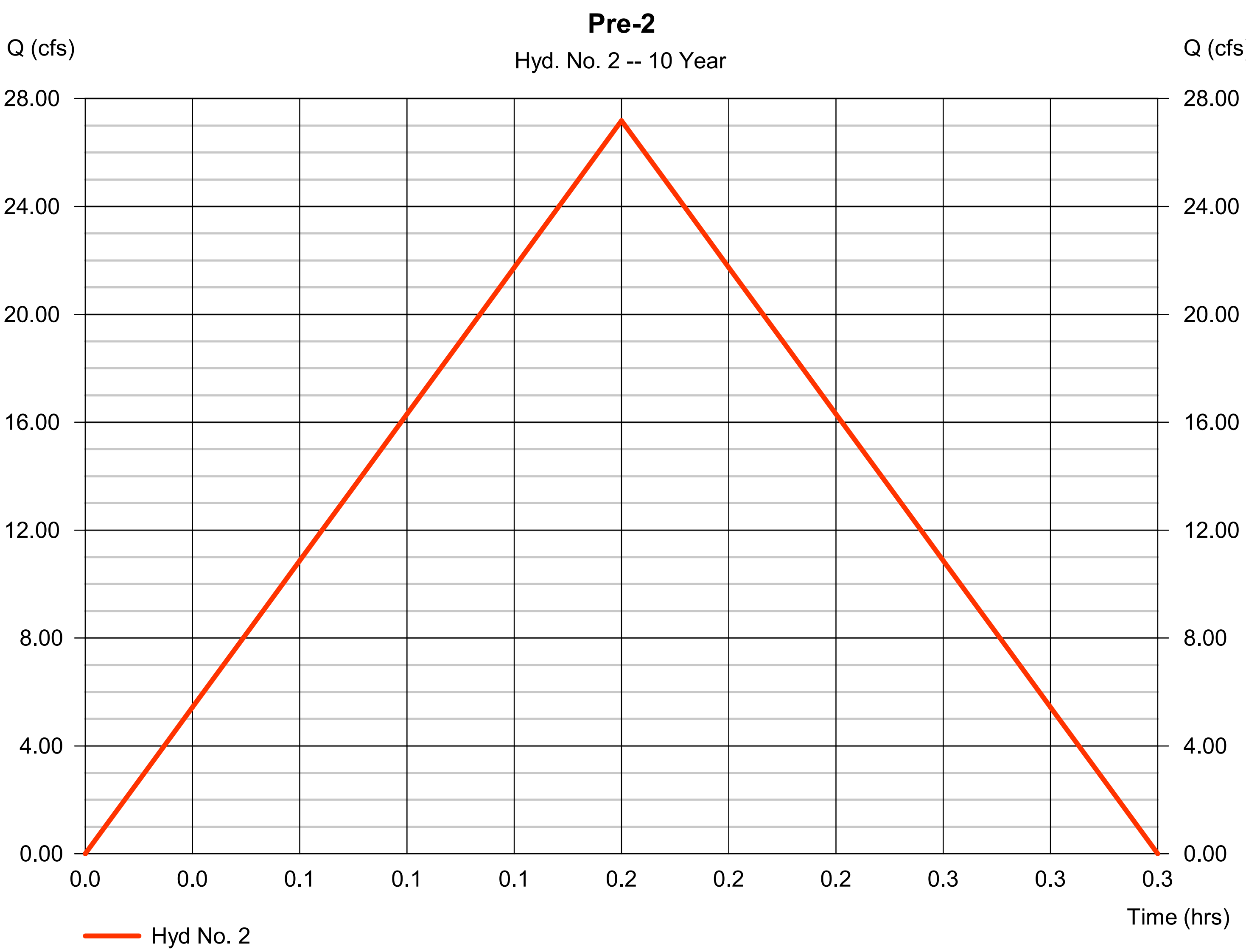
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025 Wednesday, 06 / 11 / 2025

Hyd. No. 2

Pre-2

Hydrograph type	= Rational	Peak discharge	= 27.18 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.17 hrs
Time interval	= 1 min	Hyd. volume	= 16,306 cuft
Drainage area	= 14.130 ac	Runoff coeff.	= 0.31
Intensity	= 6.204 in/hr	Tc by User	= 10.00 min
IDF Curve	= Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	= 1/1

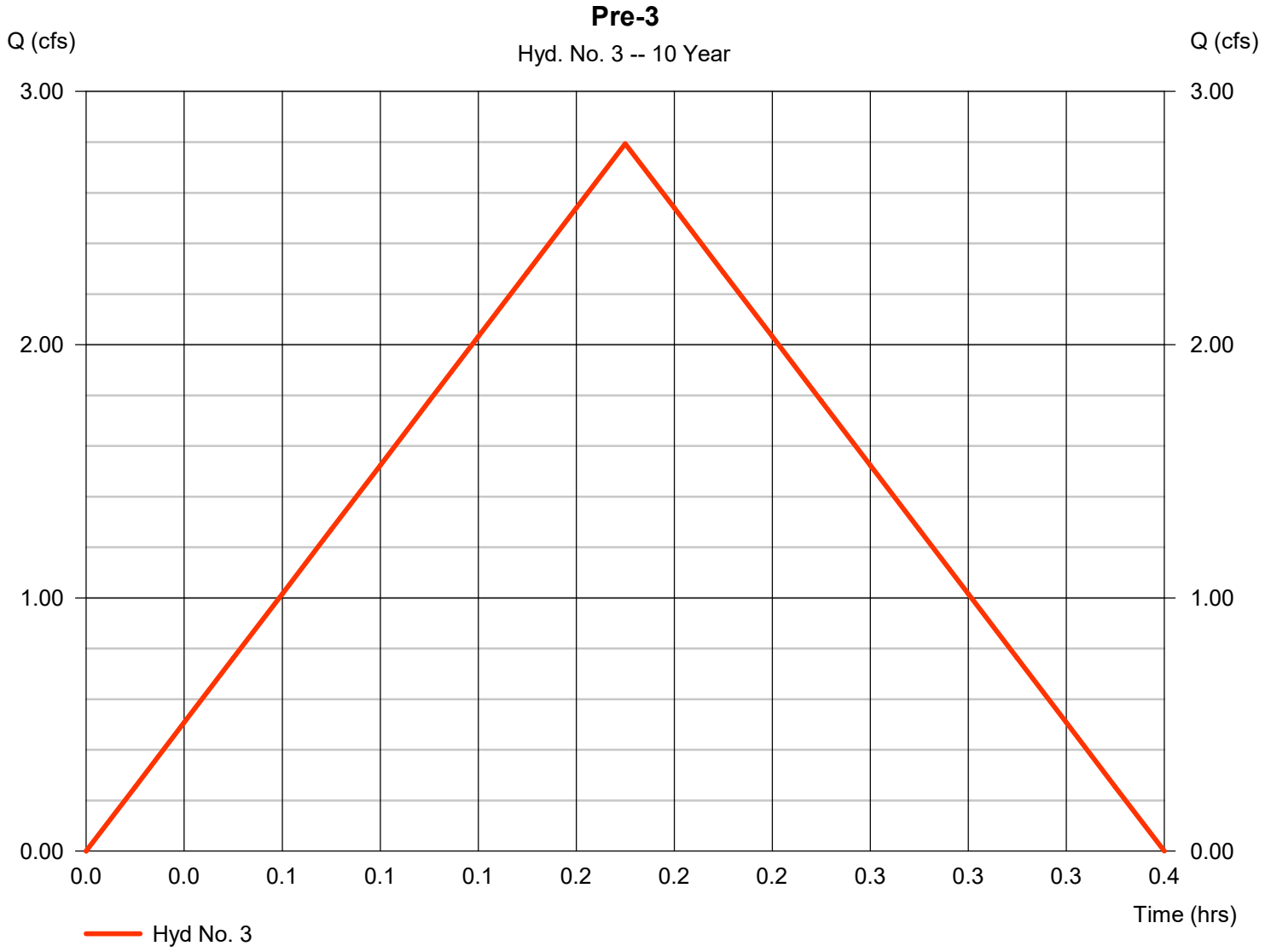


Hydrograph Report

Hyd. No. 3

Pre-3

Hydrograph type	=	Rational	Peak discharge	=	2.794 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	1,844 cuft
Drainage area	=	1.570 ac	Runoff coeff.	=	0.3
Intensity	=	5.932 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1

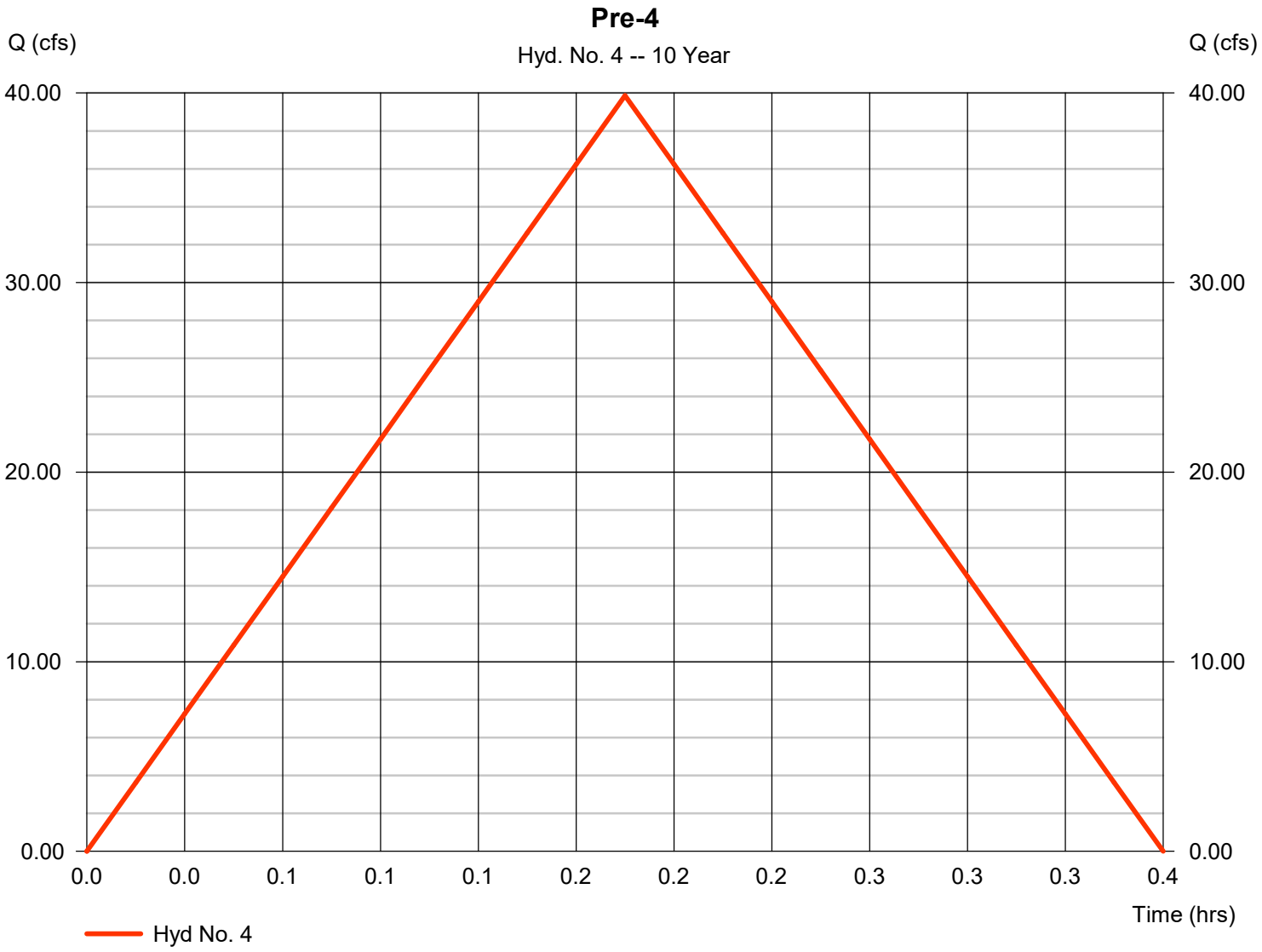


Hydrograph Report

Hyd. No. 4

Pre-4

Hydrograph type	=	Rational	Peak discharge	=	39.86 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	26,309 cuft
Drainage area	=	22.400 ac	Runoff coeff.	=	0.3
Intensity	=	5.932 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1

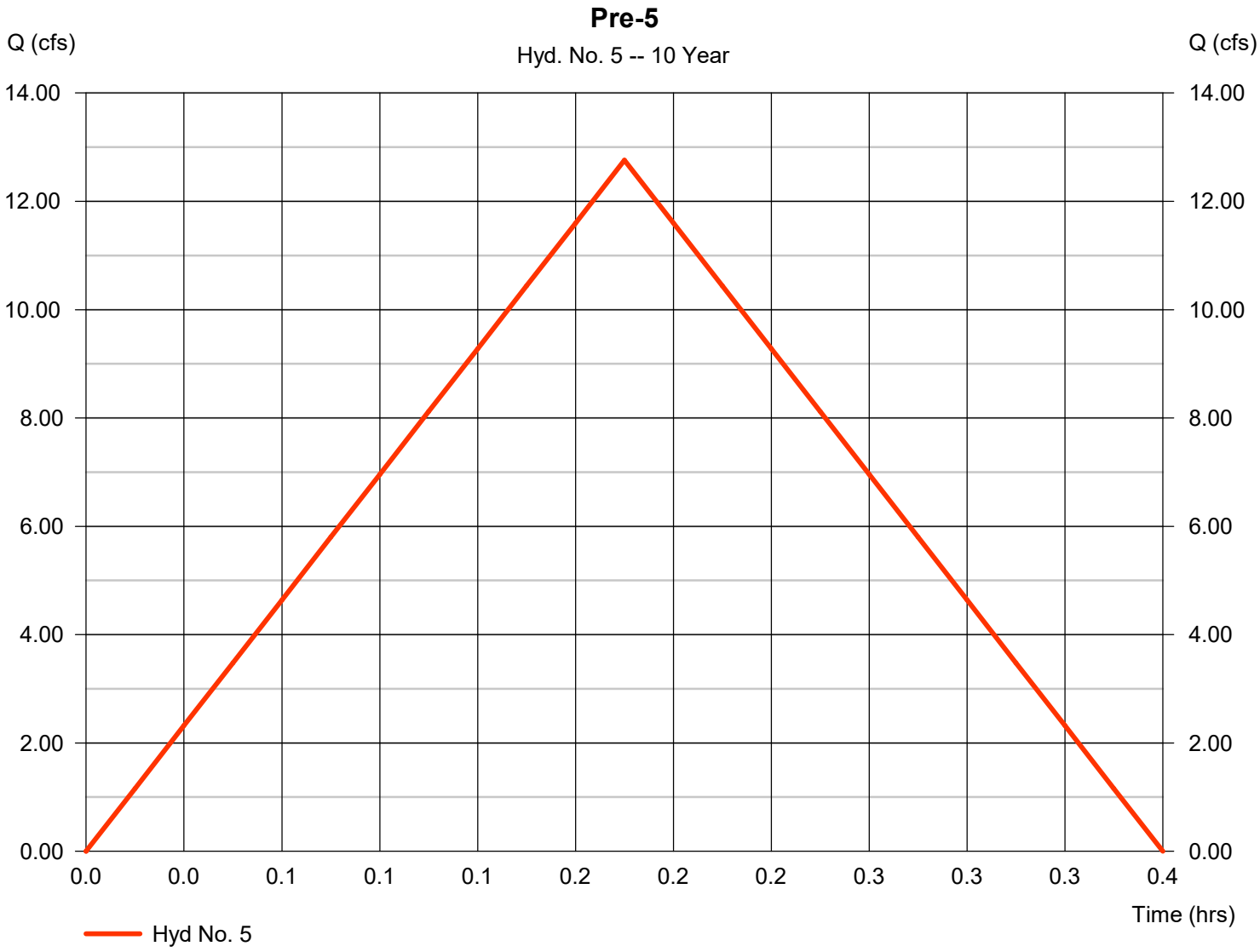


Hydrograph Report

Hyd. No. 5

Pre-5

Hydrograph type	=	Rational	Peak discharge	=	12.76 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	8,421 cuft
Drainage area	=	7.170 ac	Runoff coeff.	=	0.3
Intensity	=	5.932 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1

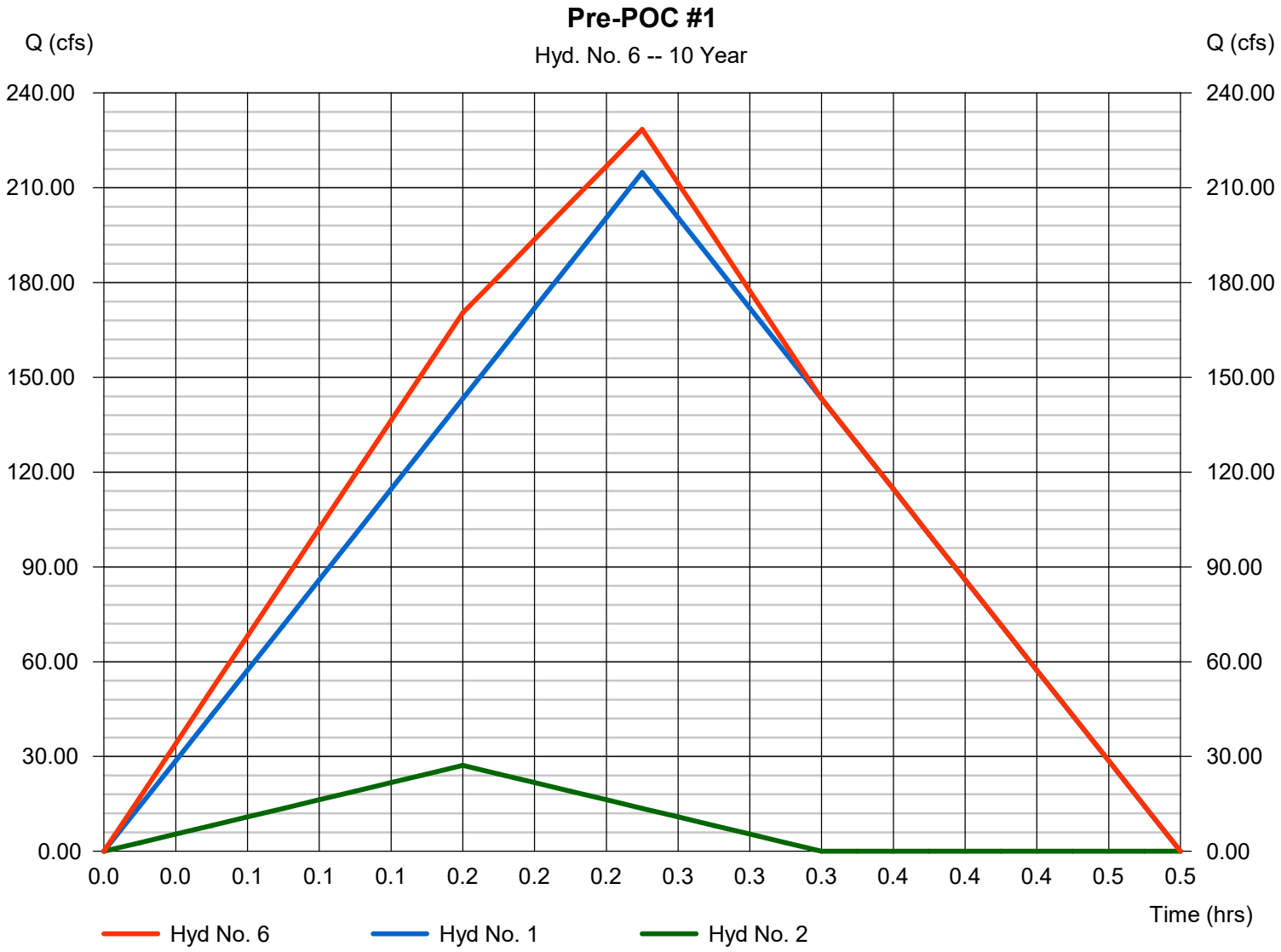


Hydrograph Report

Hyd. No. 6

Pre-POC #1

Hydrograph type	=	Combine	Peak discharge	=	228.47 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	209,696 cuft
Inflow hyds.	=	1, 2	Contrib. drain. area	=	107.890 ac

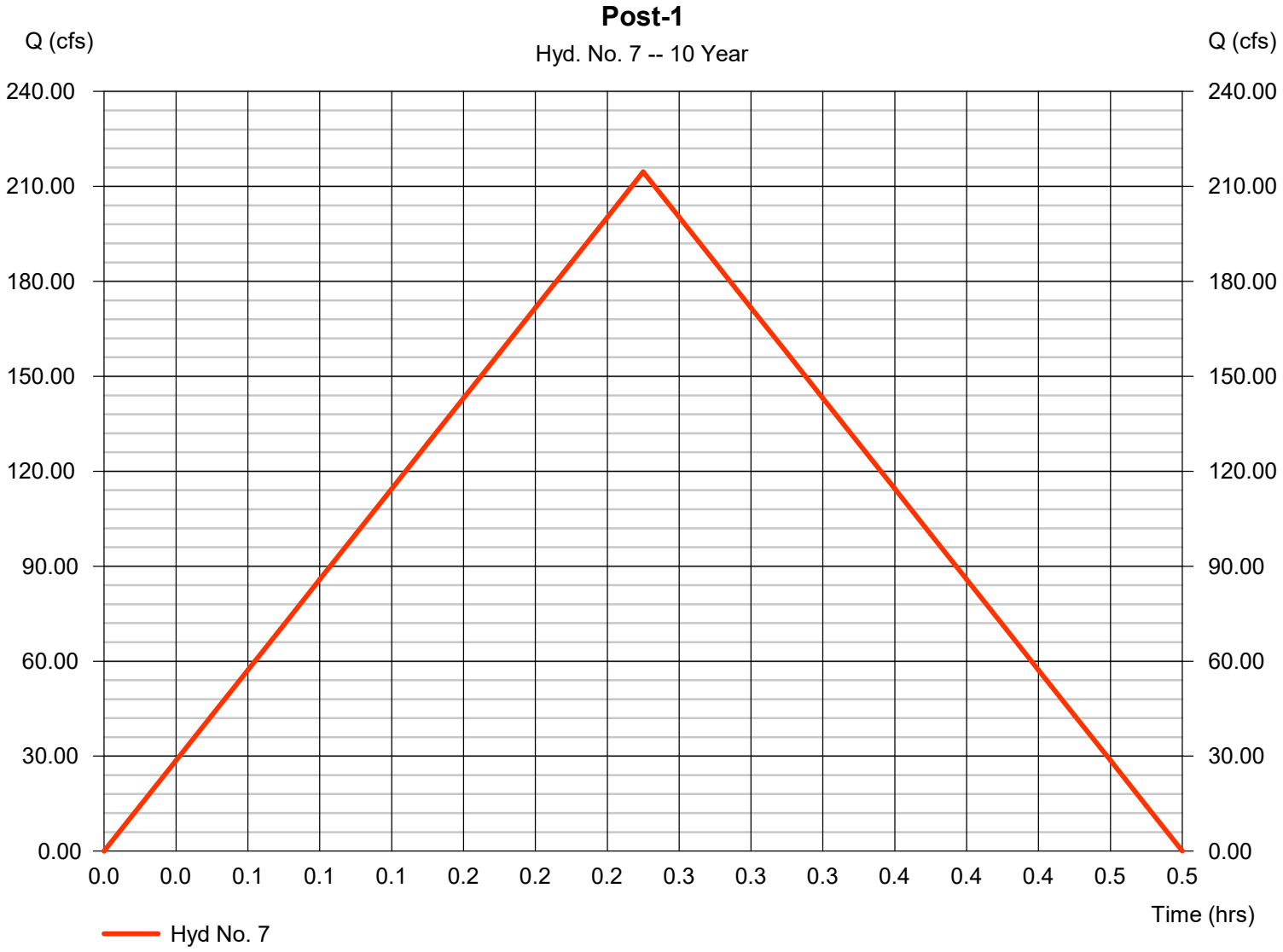


Hydrograph Report

Hyd. No. 7

Post-1

Hydrograph type	=	Rational	Peak discharge	=	214.60 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	193,143 cuft
Drainage area	=	93.640 ac	Runoff coeff.	=	0.45
Intensity	=	5.093 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

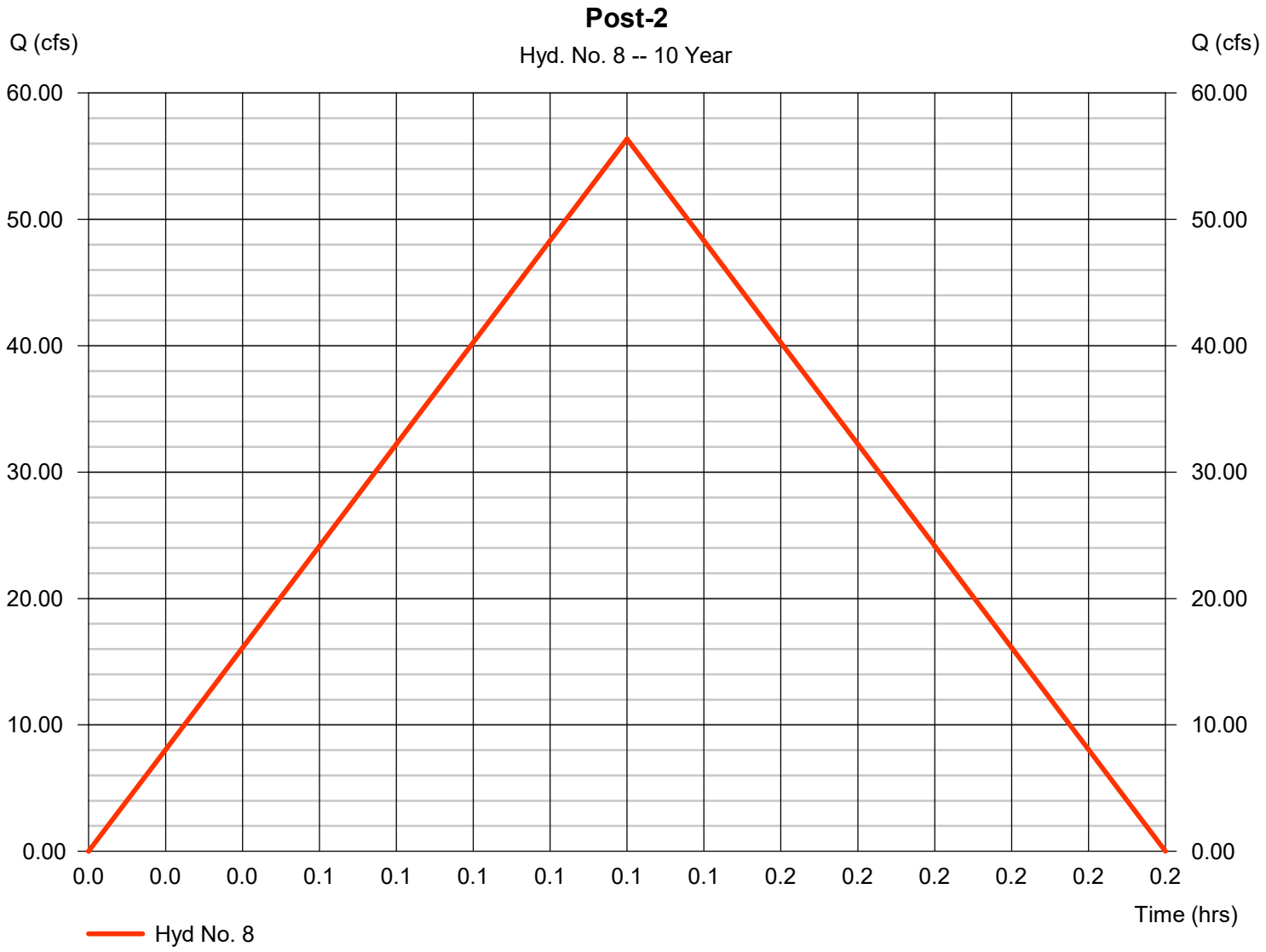


Hydrograph Report

Hyd. No. 8

Post-2

Hydrograph type	=	Rational	Peak discharge	=	56.37 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.12 hrs
Time interval	=	1 min	Hyd. volume	=	23,675 cuft
Drainage area	=	14.360 ac	Runoff coeff.	=	0.54
Intensity	=	7.269 in/hr	Tc by User	=	7.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1

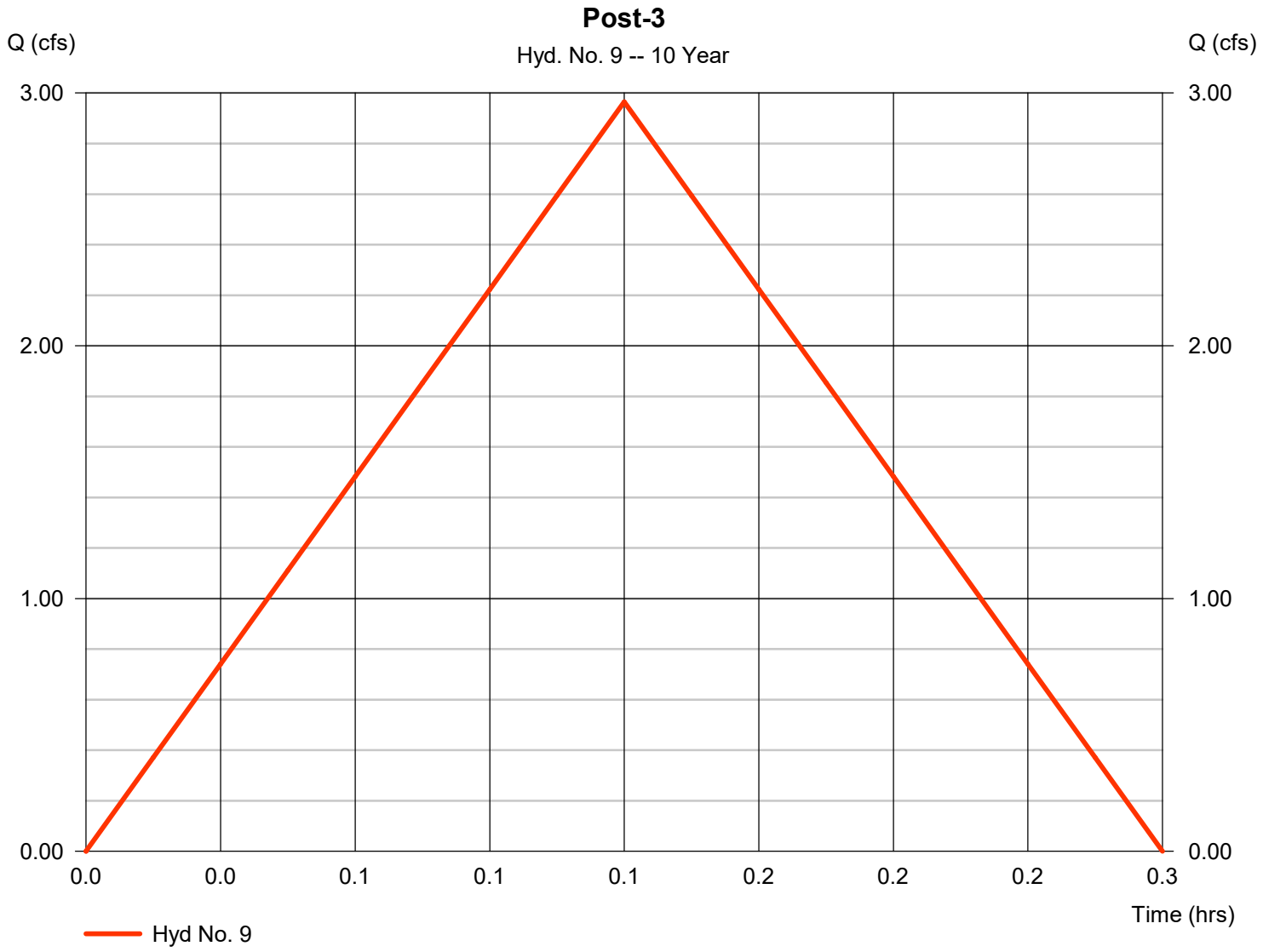


Hydrograph Report

Hyd. No. 9

Post-3

Hydrograph type	=	Rational	Peak discharge	=	2.965 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	1,423 cuft
Drainage area	=	0.800 ac	Runoff coeff.	=	0.54
Intensity	=	6.863 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rise/Dip fact	=	1/1

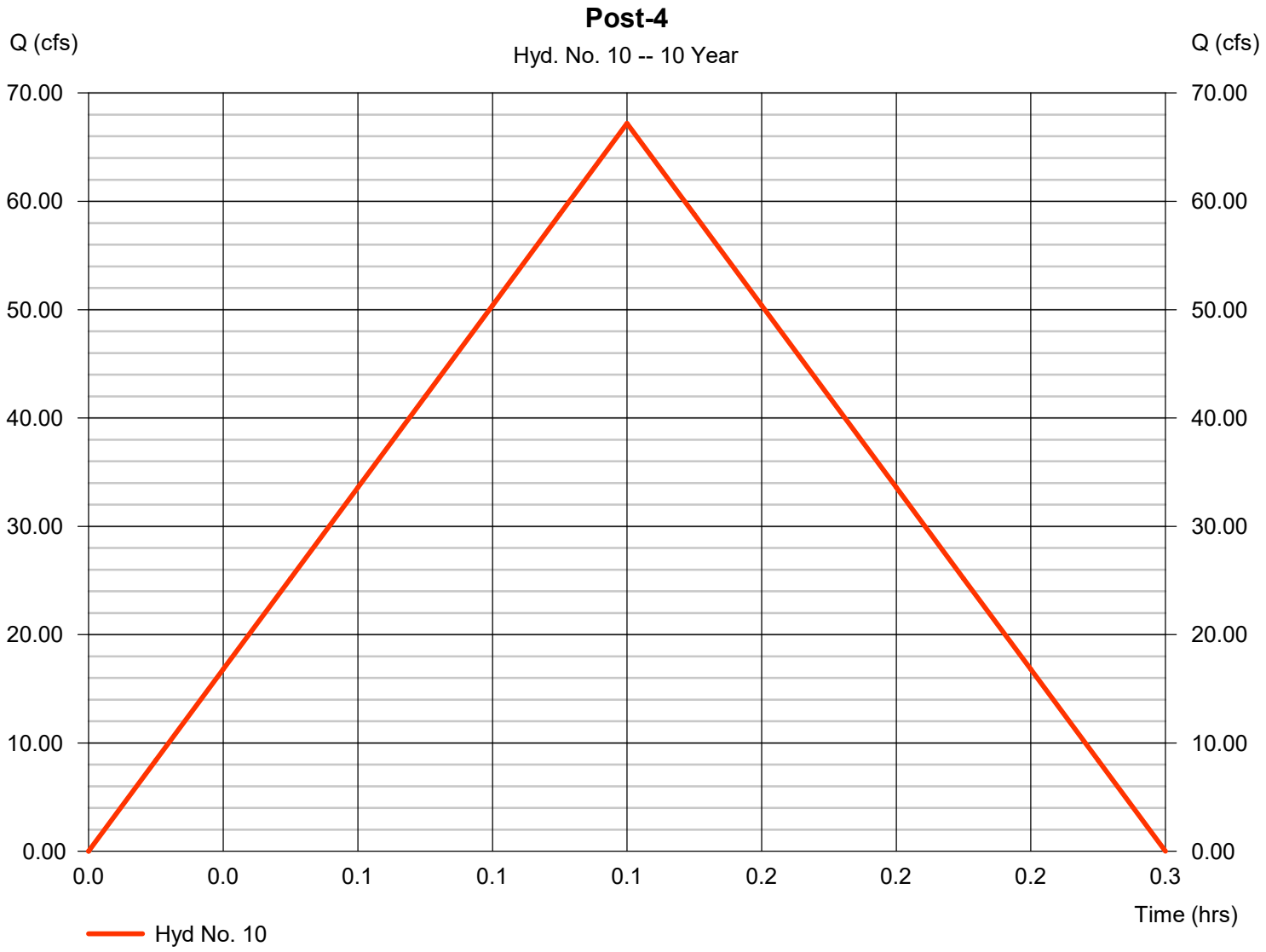


Hydrograph Report

Hyd. No. 10

Post-4

Hydrograph type	=	Rational	Peak discharge	=	67.19 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	32,252 cuft
Drainage area	=	18.130 ac	Runoff coeff.	=	0.54
Intensity	=	6.863 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Value.idf	Asc/Rise/Climb fact	=	1/1



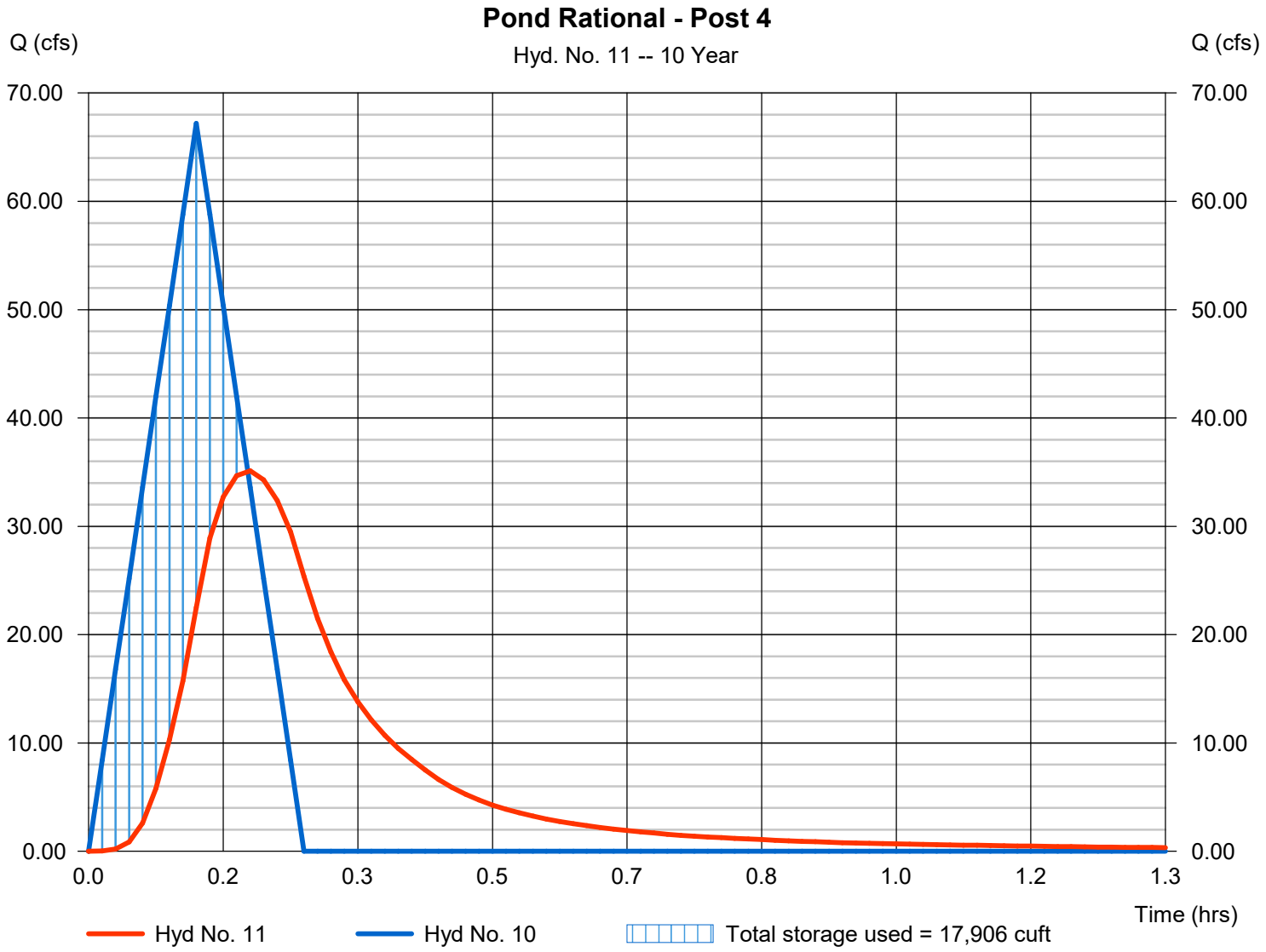
Hydrograph Report

Hyd. No. 11

Pond Rational - Post 4

Hydrograph type	=	Reservoir	Peak discharge	=	35.13 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.20 hrs
Time interval	=	1 min	Hyd. volume	=	32,244 cuft
Inflow hyd. No.	=	10 - Post-4	Max. Elevation	=	869.18 ft
Reservoir name	=	Small Pond	Max. Storage	=	17,906 cuft

Storage Indication method used.

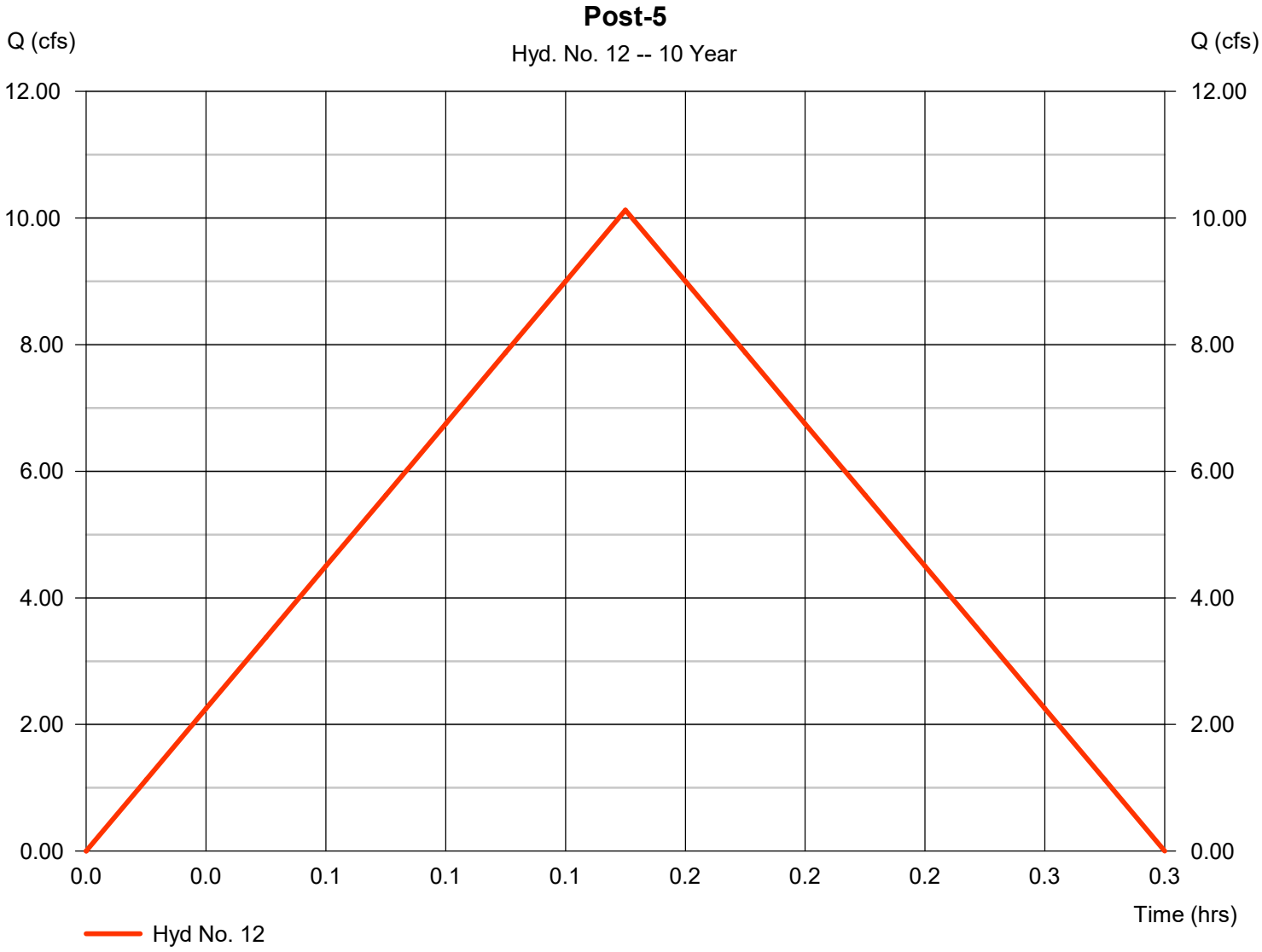


Hydrograph Report

Hyd. No. 12

Post-5

Hydrograph type	=	Rational	Peak discharge	=	10.13 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.15 hrs
Time interval	=	1 min	Hyd. volume	=	5,469 cuft
Drainage area	=	2.880 ac	Runoff coeff.	=	0.54
Intensity	=	6.512 in/hr	Tc by User	=	9.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rec limb fact	=	1/1

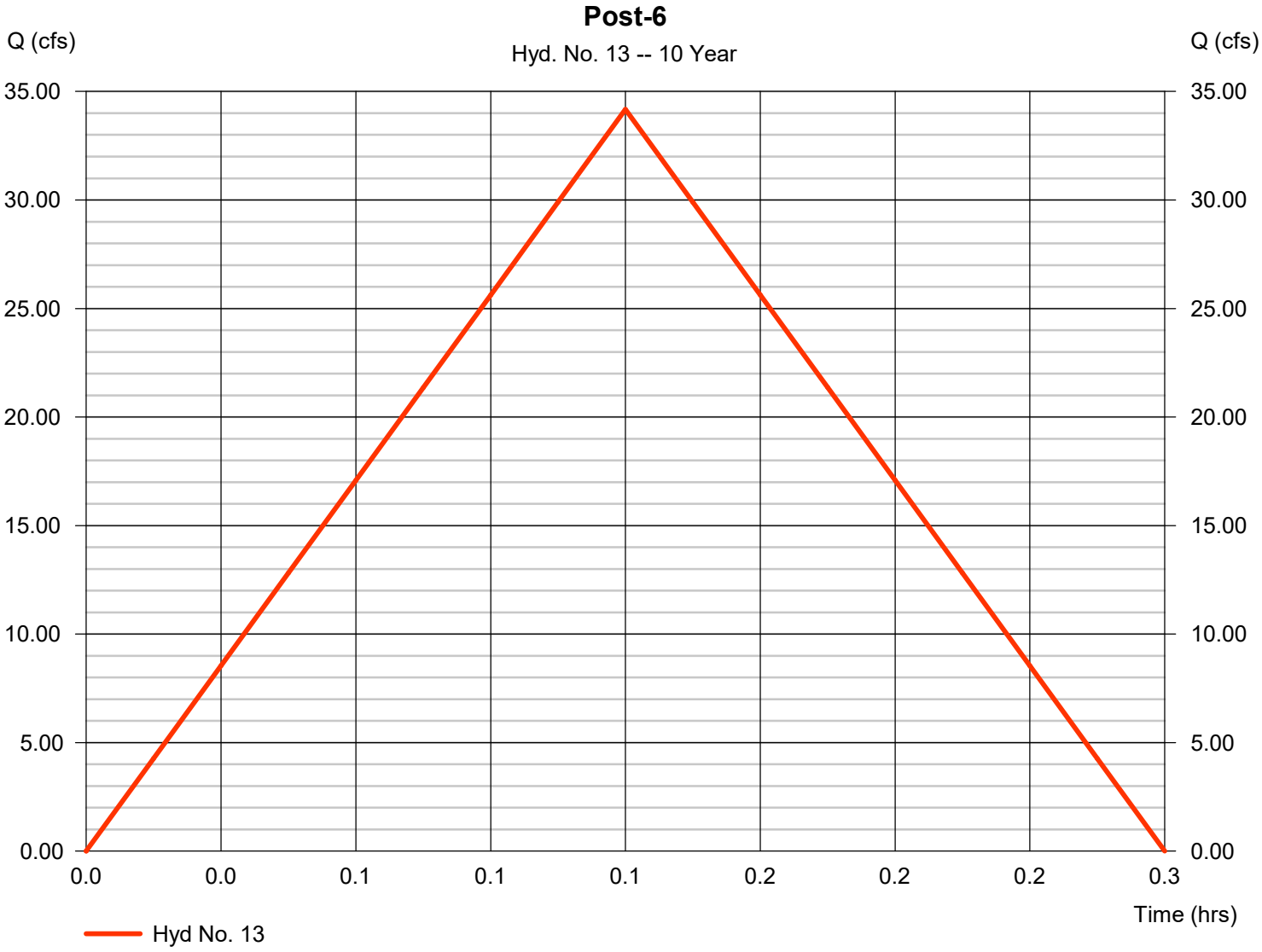


Hydrograph Report

Hyd. No. 13

Post-6

Hydrograph type	=	Rational	Peak discharge	=	34.17 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	16,402 cuft
Drainage area	=	9.220 ac	Runoff coeff.	=	0.54
Intensity	=	6.863 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Value.idf	Asc/Rise/Climb fact	=	1/1

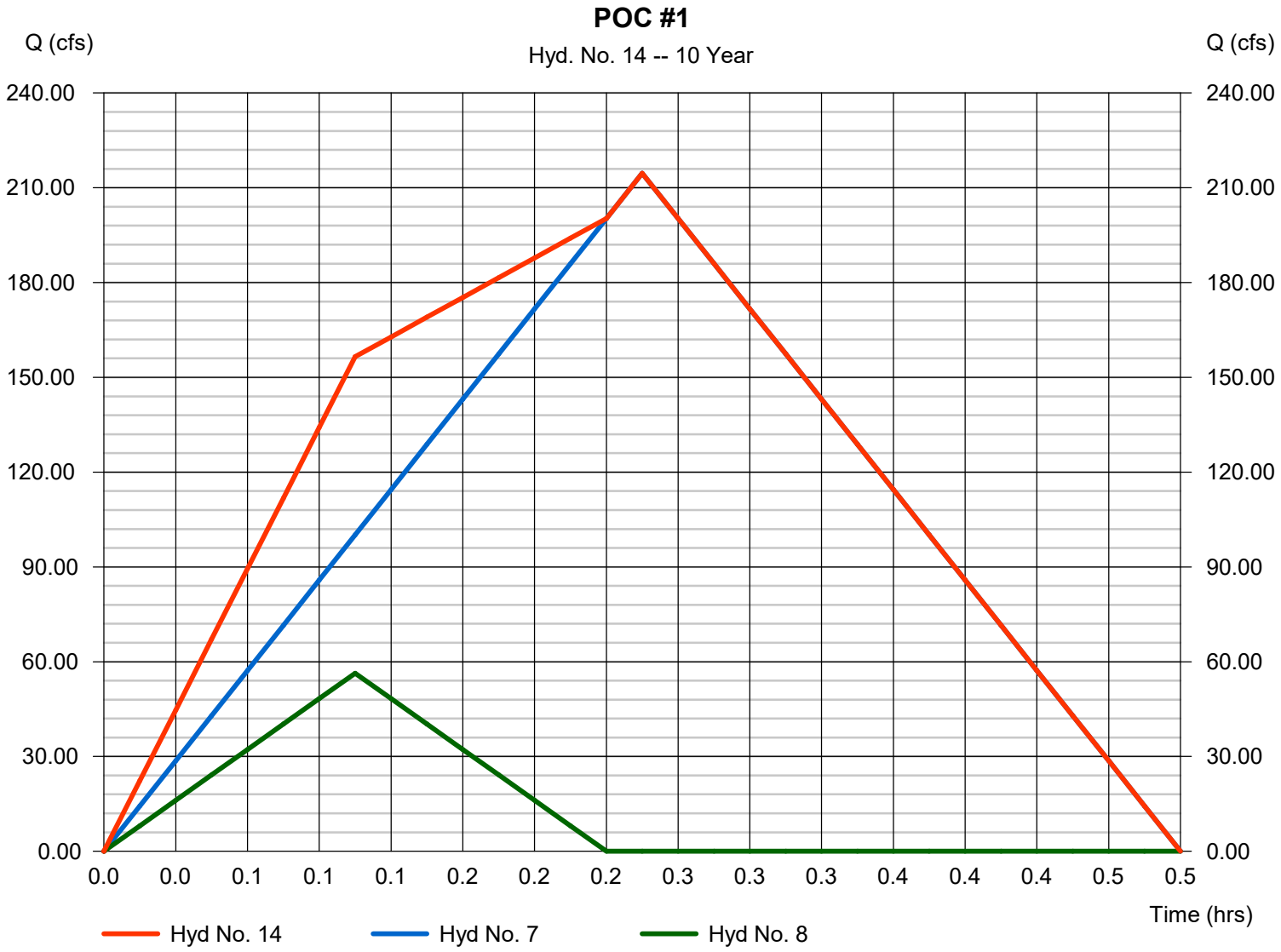


Hydrograph Report

Hyd. No. 14

POC #1

Hydrograph type	=	Combine	Peak discharge	=	214.60 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	216,817 cuft
Inflow hyds.	=	7, 8	Contrib. drain. area	=	108.000 ac

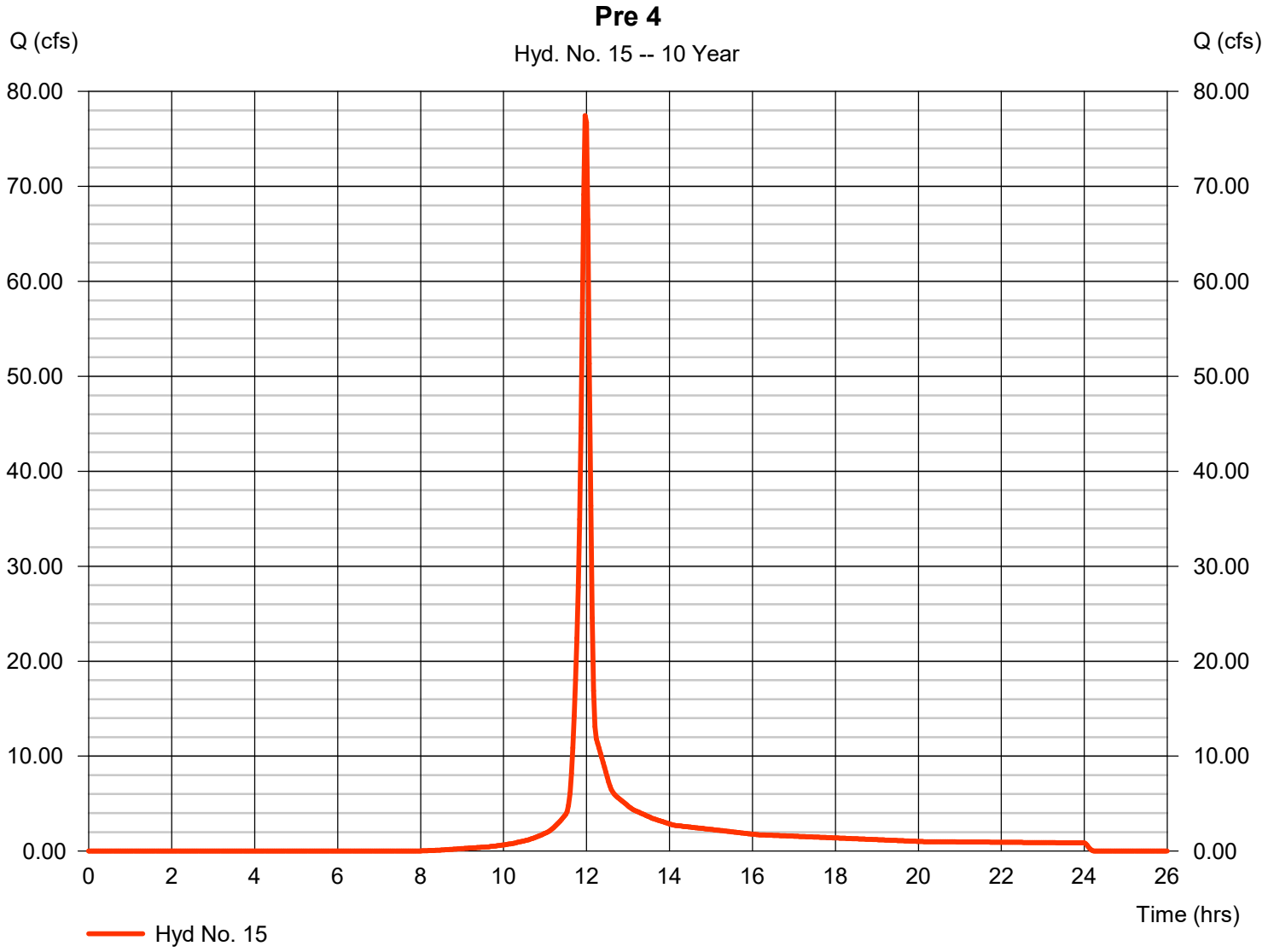


Hydrograph Report

Hyd. No. 15

Pre 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	77.46 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	177,298 cuft
Drainage area	=	22.400 ac	Curve number	=	81
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.88 min
Total precip.	=	4.07 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

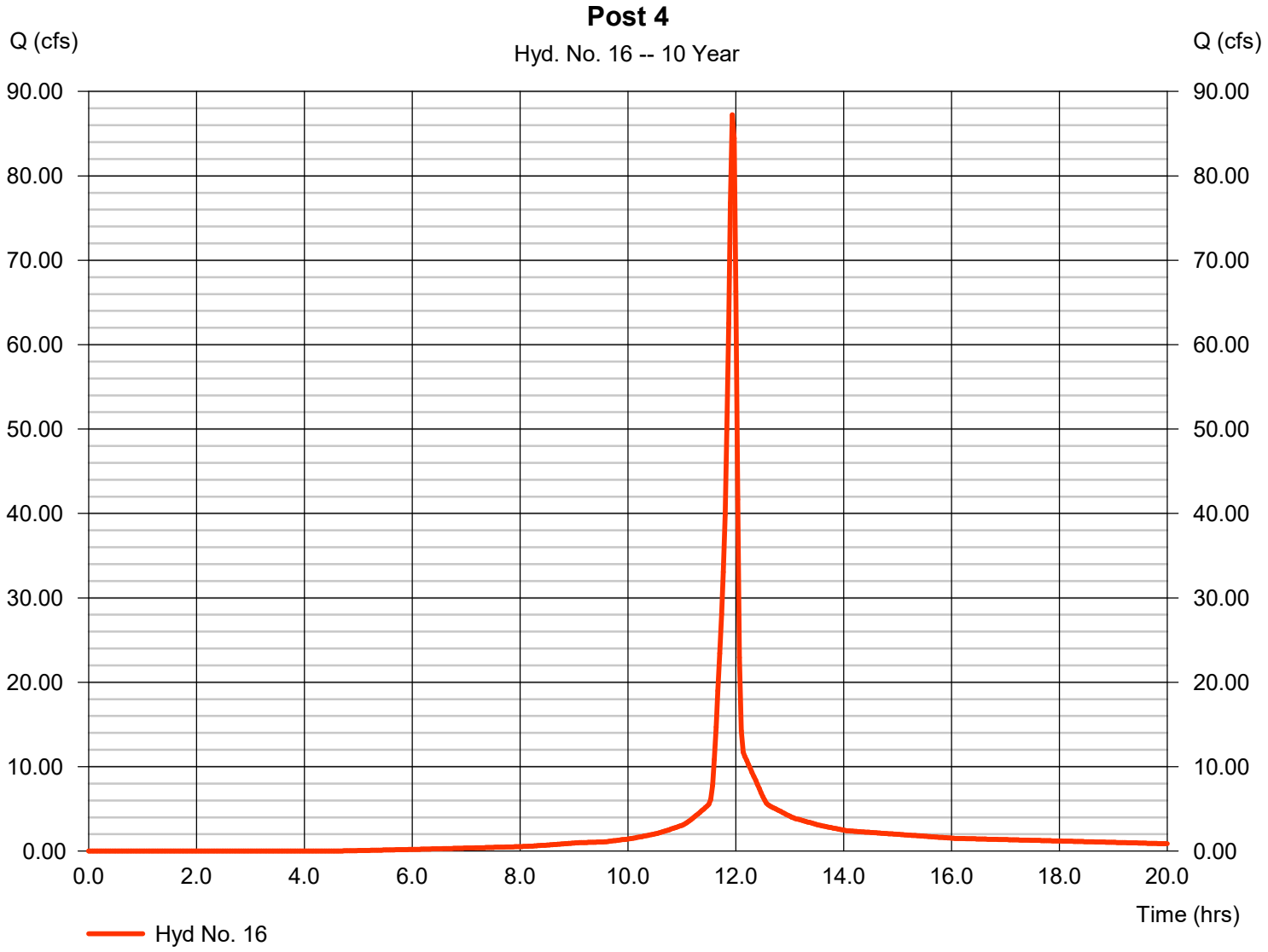


Hydrograph Report

Hyd. No. 16

Post 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	87.23 cfs
Storm frequency	=	10 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	184,209 cuft
Drainage area	=	18.130 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	4.82 min
Total precip.	=	4.07 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



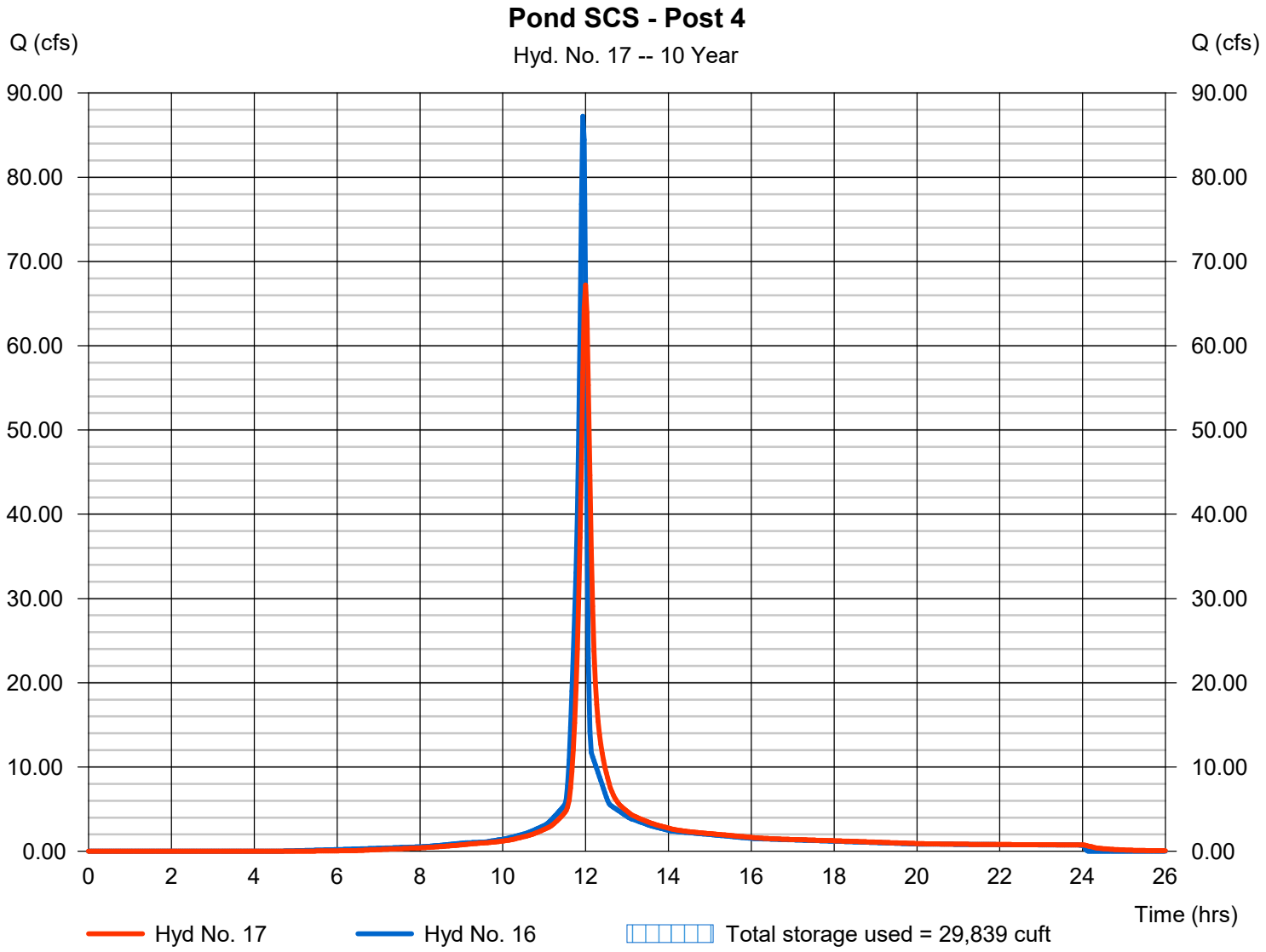
Hydrograph Report

Hyd. No. 17

Pond SCS - Post 4

Hydrograph type	=	Reservoir	Peak discharge	=	67.23 cfs
Storm frequency	=	10 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	184,201 cuft
Inflow hyd. No.	=	16 - Post 4	Max. Elevation	=	870.25 ft
Reservoir name	=	Small Pond	Max. Storage	=	29,839 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2025

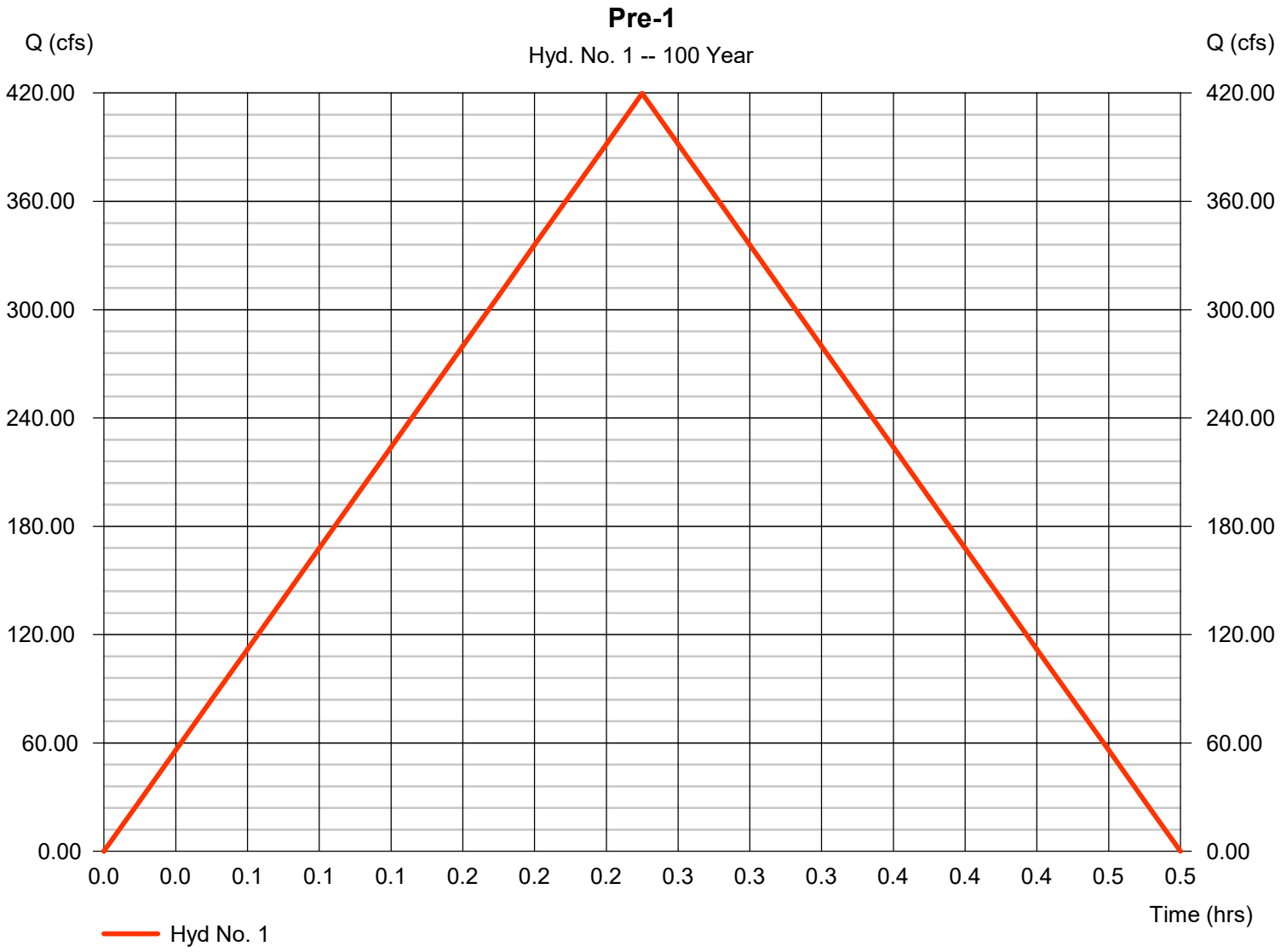
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	419.75	1	15	377,779	------	------	------	Pre-1
2	Rational	52.99	1	10	31,792	------	------	------	Pre-2
3	Rational	5.449	1	11	3,597	------	------	------	Pre-3
4	Rational	77.75	1	11	51,315	------	------	------	Pre-4
5	Rational	24.89	1	11	16,425	------	------	------	Pre-5
6	Combine	446.25	1	15	409,571	1, 2,	------	------	Pre-POC #1
7	Rational	419.22	1	15	377,296	------	------	------	Post-1
8	Rational	109.81	1	7	46,122	------	------	------	Post-2
9	Rational	5.777	1	8	2,773	------	------	------	Post-3
10	Rational	130.93	1	8	62,846	------	------	------	Post-4
11	Reservoir	71.68	1	12	62,838	10	870.41	31,767	Pond Rational - Post 4
12	Rational	19.74	1	9	10,659	------	------	------	Post-5
13	Rational	66.58	1	8	31,960	------	------	------	Post-6
14	Combine	419.22	1	15	423,418	7, 8,	------	------	POC #1
15	SCS Runoff	152.50	2	718	355,309	------	------	------	Pre 4
16	SCS Runoff	151.04	2	716	330,895	------	------	------	Post 4
17	Reservoir	103.24	2	720	330,887	16	871.91	52,429	Pond SCS - Post 4

Hydrograph Report

Hyd. No. 1

Pre-1

Hydrograph type	=	Rational	Peak discharge	=	419.75 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	377,779 cuft
Drainage area	=	93.760 ac	Runoff coeff.	=	0.45
Intensity	=	9.949 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

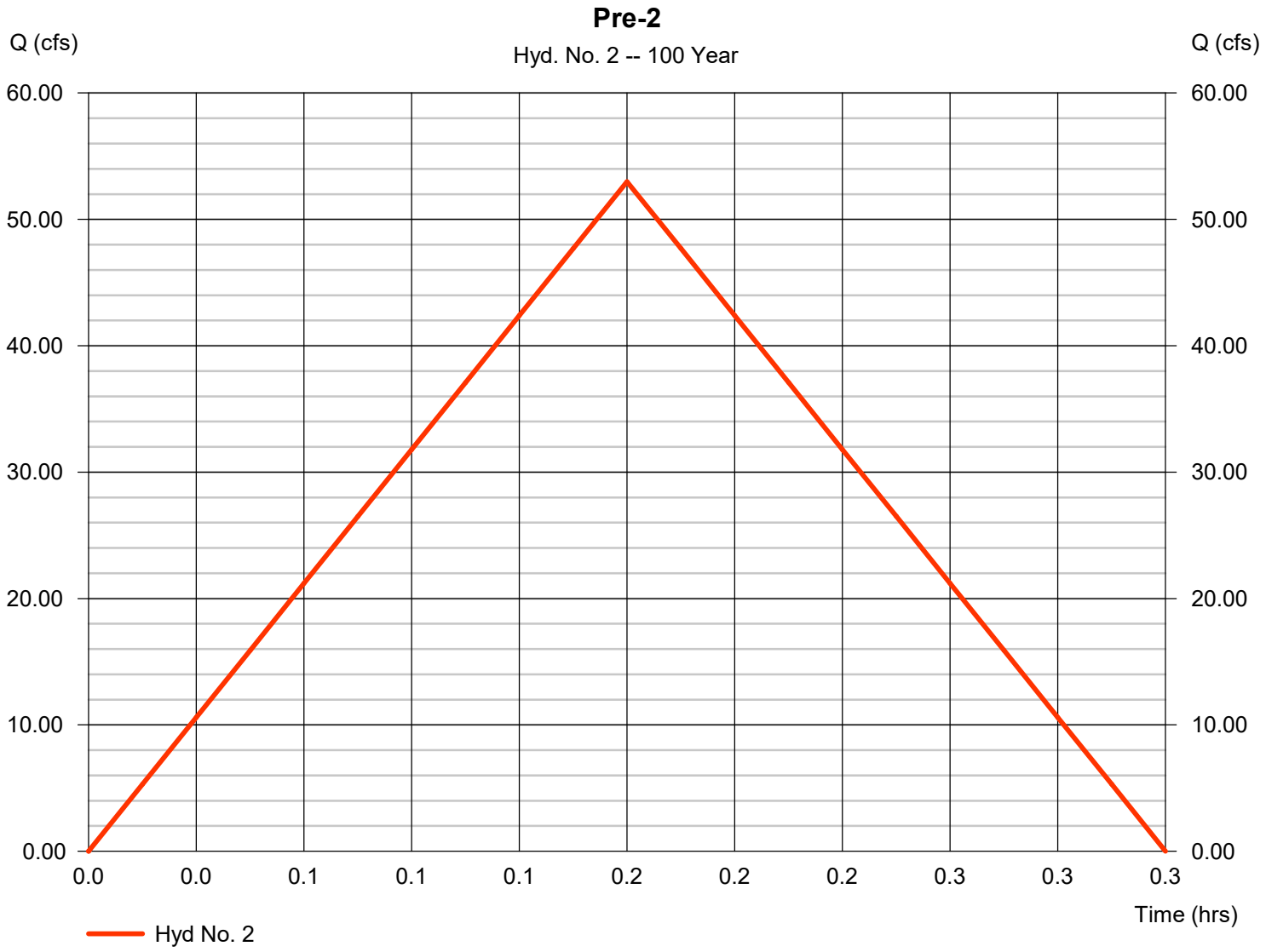


Hydrograph Report

Hyd. No. 2

Pre-2

Hydrograph type	=	Rational	Peak discharge	=	52.99 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.17 hrs
Time interval	=	1 min	Hyd. volume	=	31,792 cuft
Drainage area	=	14.130 ac	Runoff coeff.	=	0.31
Intensity	=	12.097 in/hr	Tc by User	=	10.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

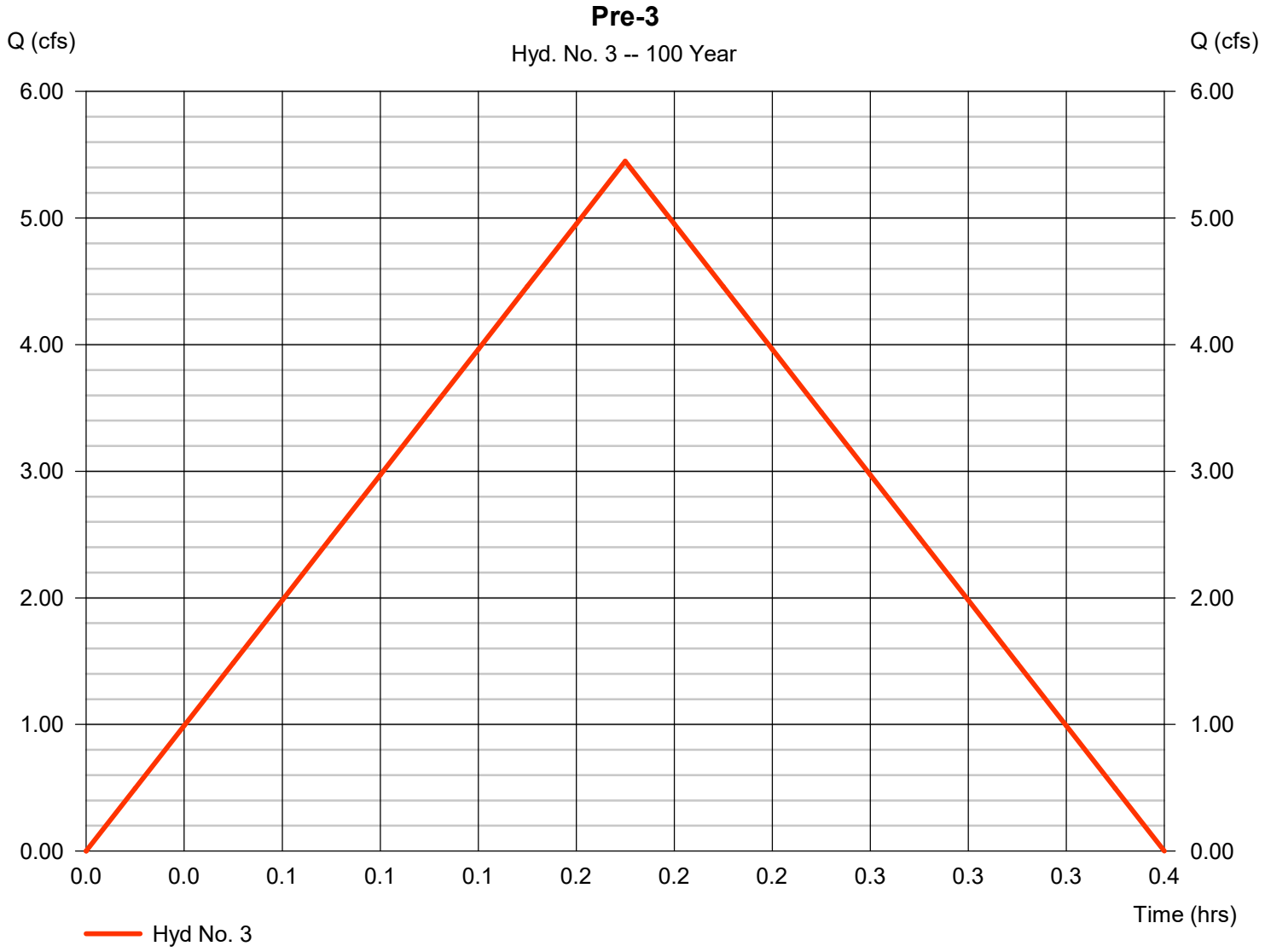


Hydrograph Report

Hyd. No. 3

Pre-3

Hydrograph type	=	Rational	Peak discharge	=	5.449 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	3,597 cuft
Drainage area	=	1.570 ac	Runoff coeff.	=	0.3
Intensity	=	11.570 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rise/Dur fact	=	1/1

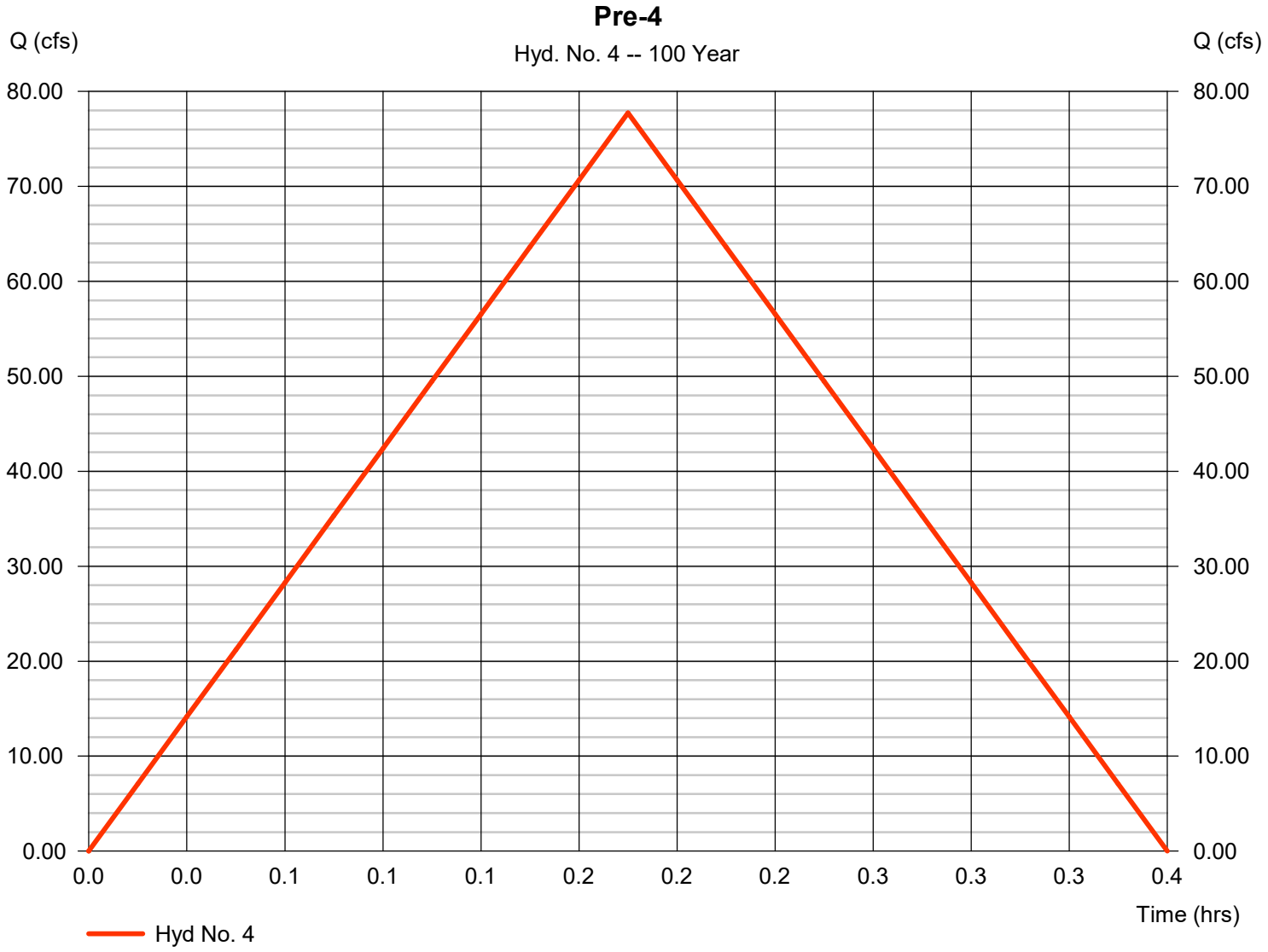


Hydrograph Report

Hyd. No. 4

Pre-4

Hydrograph type	=	Rational	Peak discharge	=	77.75 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	51,315 cuft
Drainage area	=	22.400 ac	Runoff coeff.	=	0.3
Intensity	=	11.570 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rise/Climb fact	=	1/1

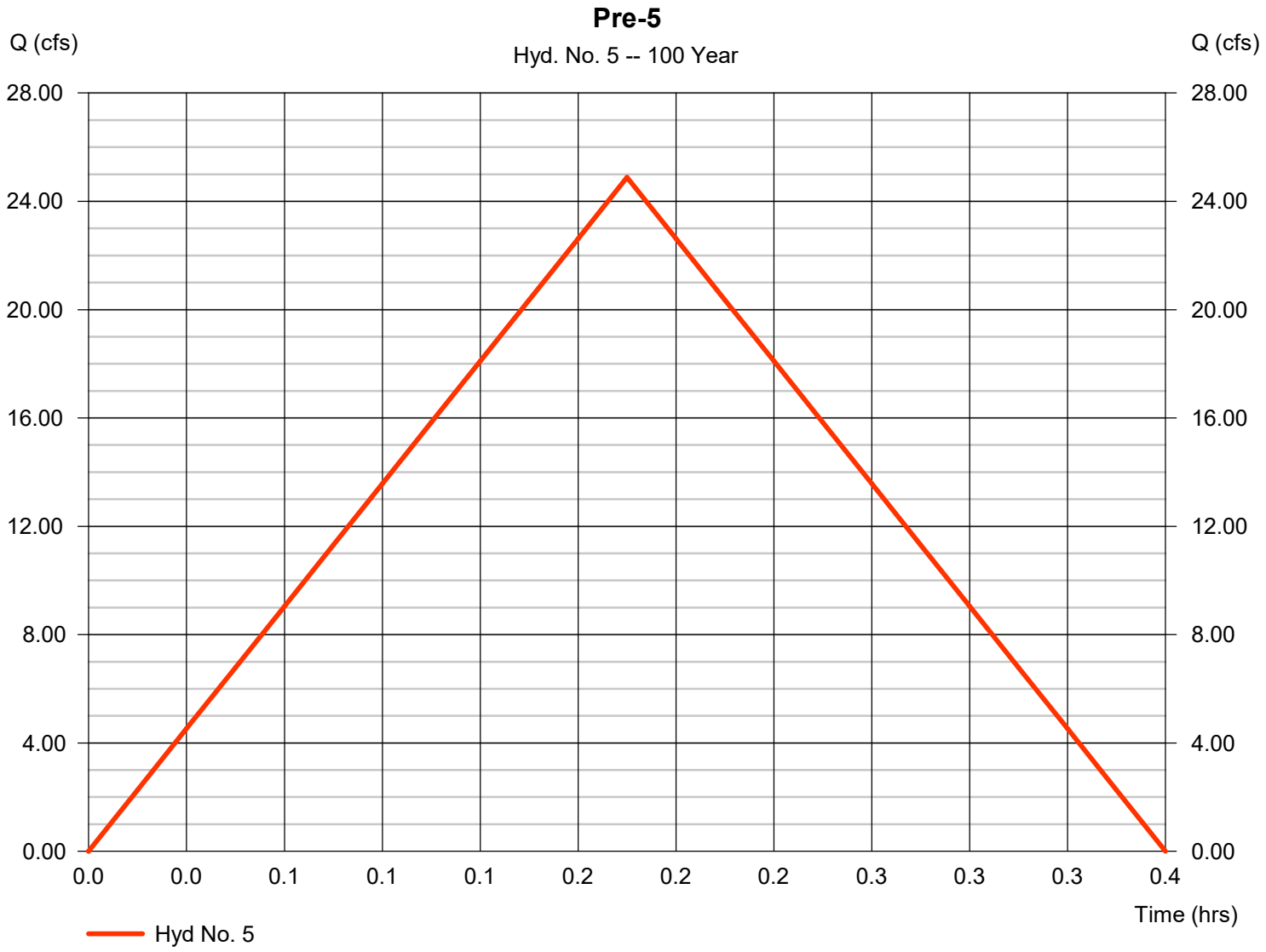


Hydrograph Report

Hyd. No. 5

Pre-5

Hydrograph type	=	Rational	Peak discharge	=	24.89 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.18 hrs
Time interval	=	1 min	Hyd. volume	=	16,425 cuft
Drainage area	=	7.170 ac	Runoff coeff.	=	0.3
Intensity	=	11.570 in/hr	Tc by User	=	11.00 min
IDF Curve	=	Lansing, Kansas - With K-Value.idf	Asc/Rise/Clmb fact	=	1/1

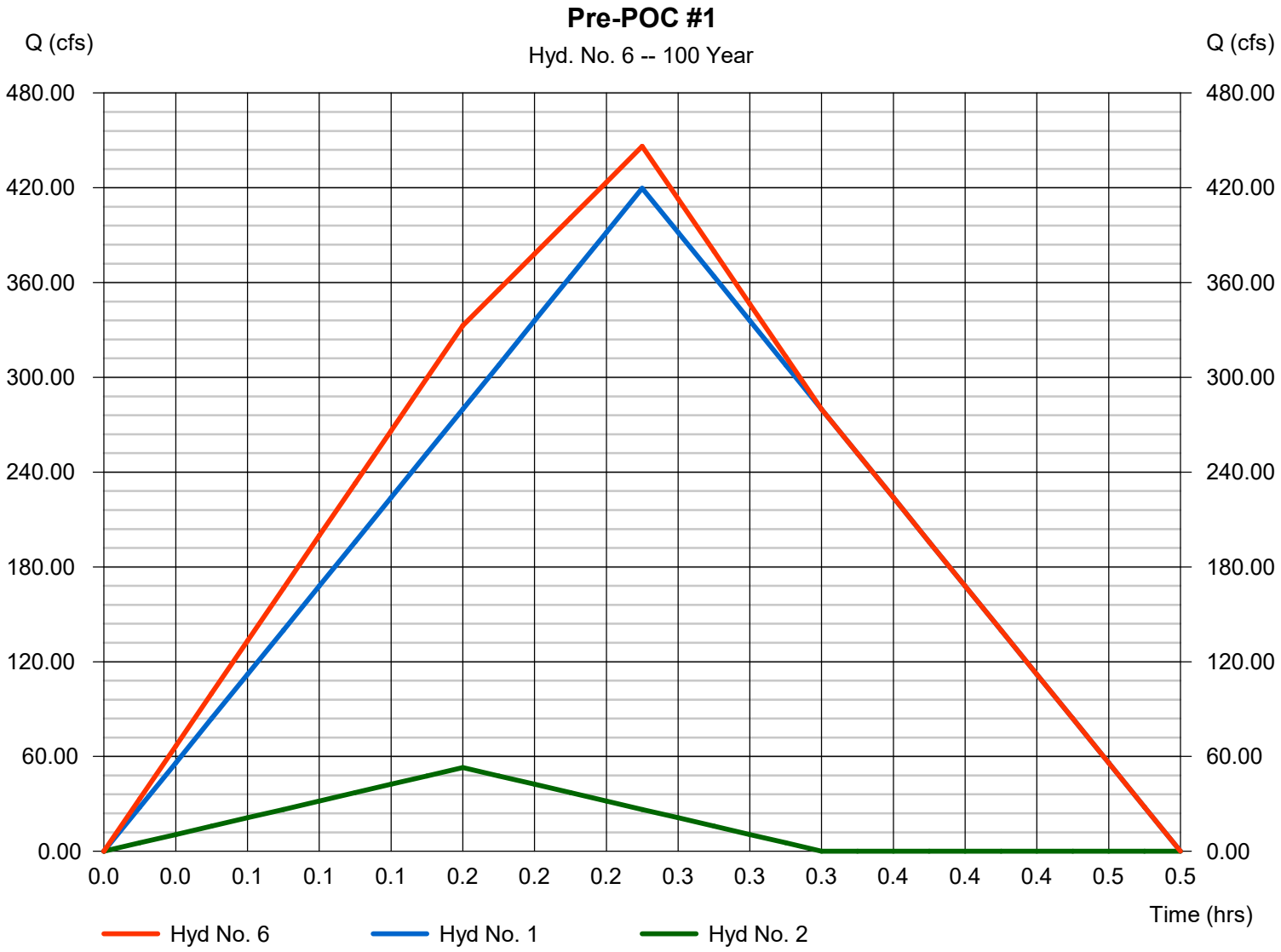


Hydrograph Report

Hyd. No. 6

Pre-POC #1

Hydrograph type	= Combine	Peak discharge	= 446.25 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 409,571 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 107.890 ac

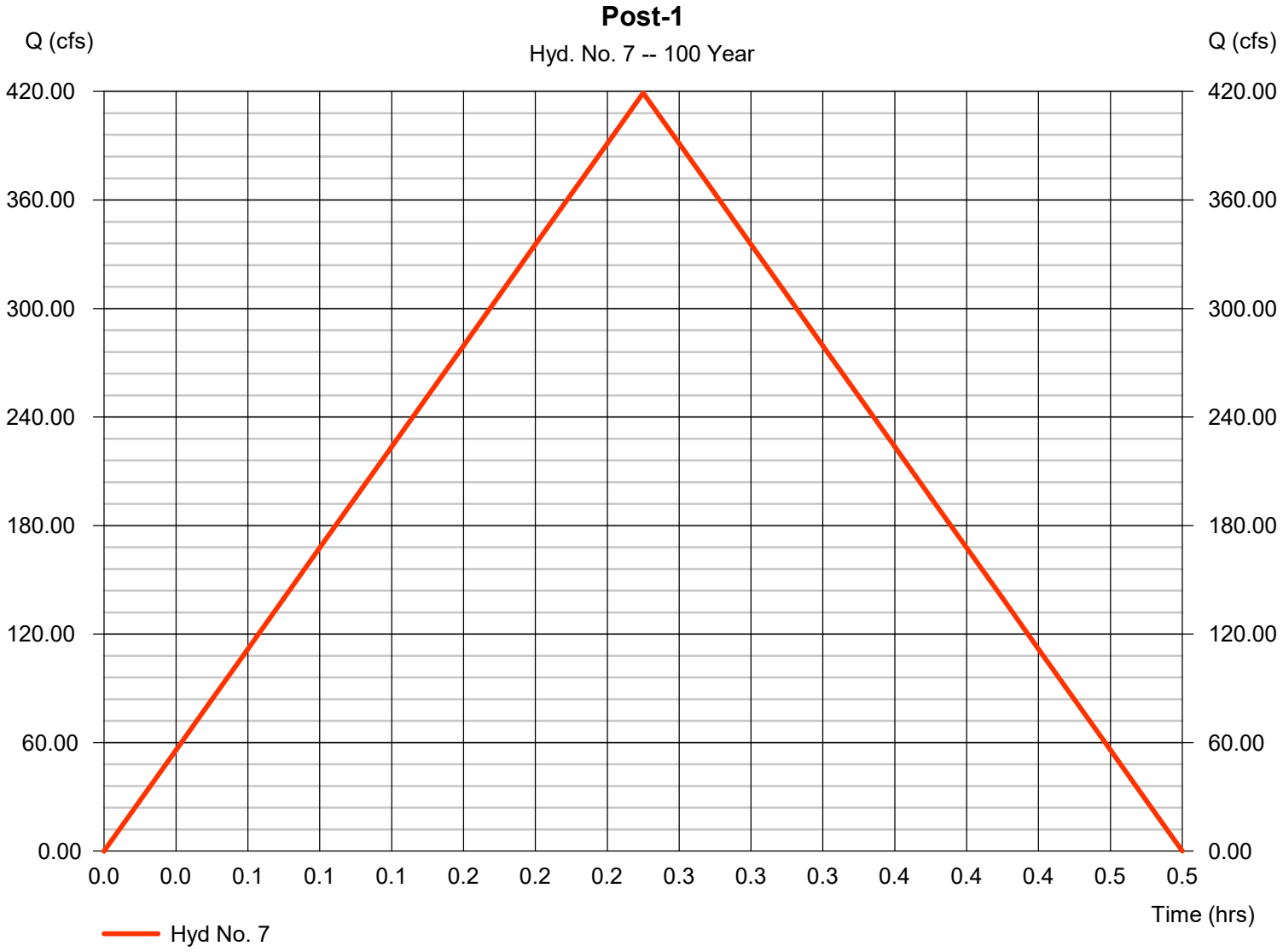


Hydrograph Report

Hyd. No. 7

Post-1

Hydrograph type	=	Rational	Peak discharge	=	419.22 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	377,296 cuft
Drainage area	=	93.640 ac	Runoff coeff.	=	0.45
Intensity	=	9.949 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

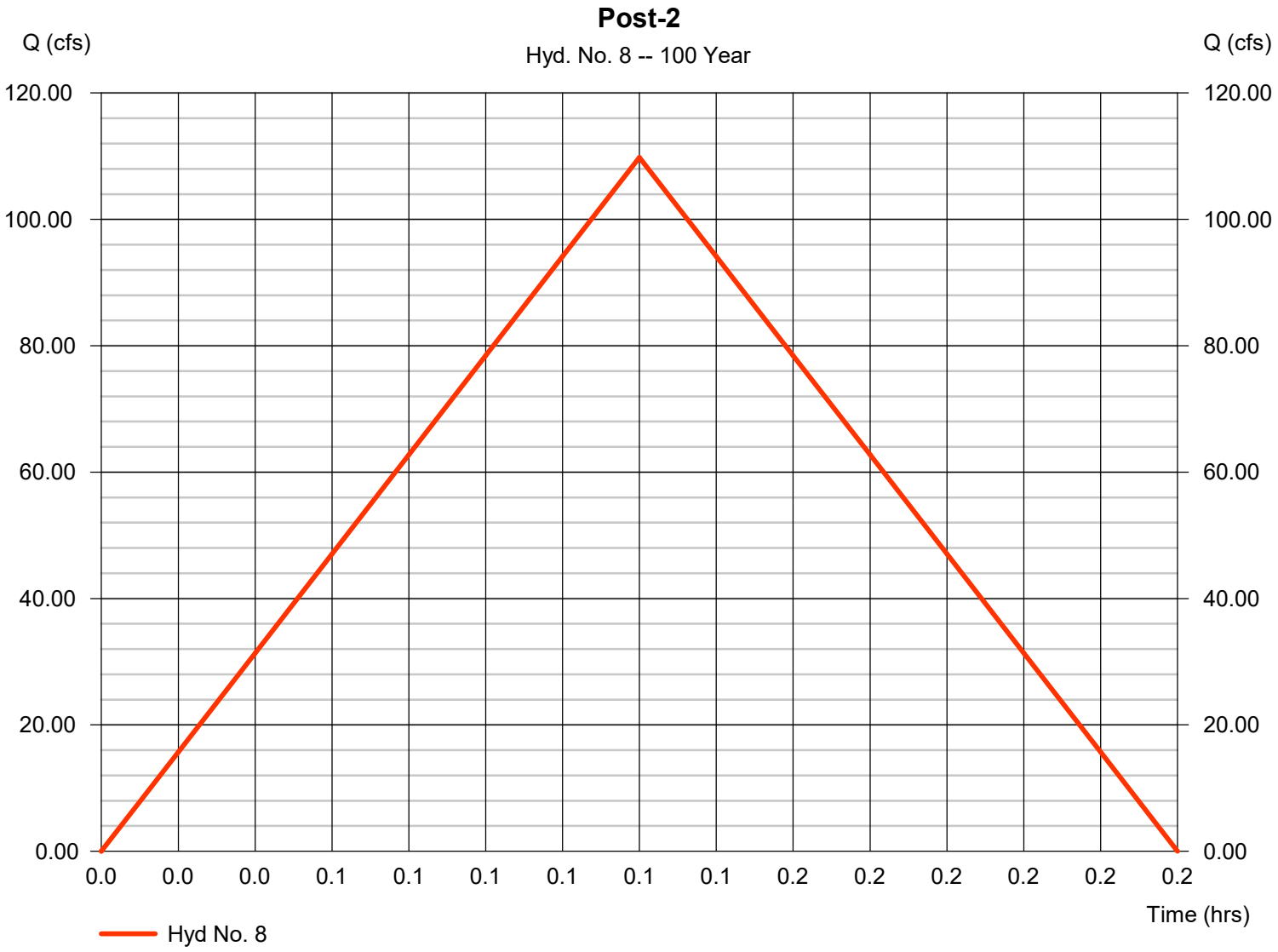


Hydrograph Report

Hyd. No. 8

Post-2

Hydrograph type	=	Rational	Peak discharge	=	109.81 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.12 hrs
Time interval	=	1 min	Hyd. volume	=	46,122 cuft
Drainage area	=	14.360 ac	Runoff coeff.	=	0.54
Intensity	=	14.161 in/hr	Tc by User	=	7.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1

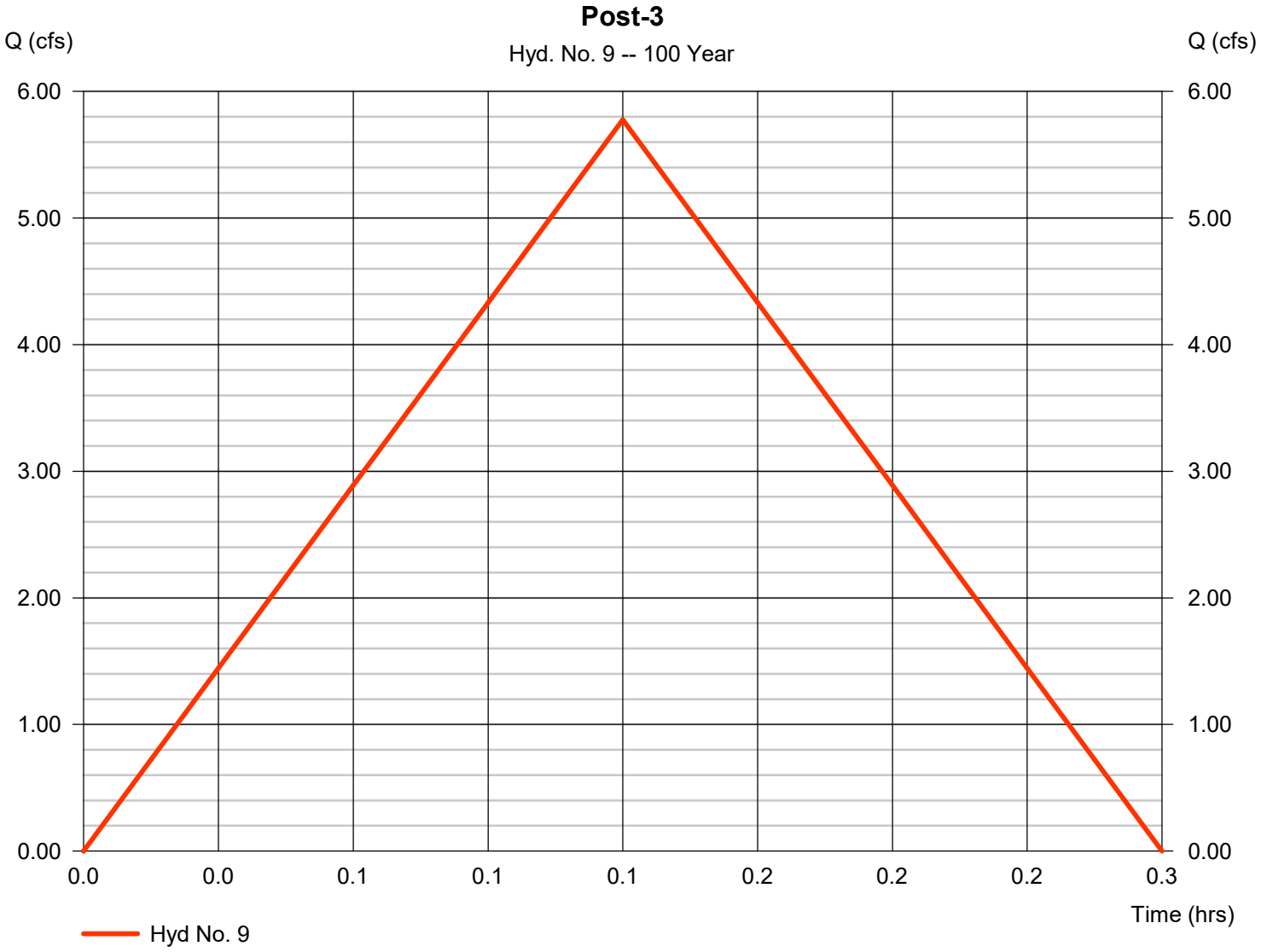


Hydrograph Report

Hyd. No. 9

Post-3

Hydrograph type	=	Rational	Peak discharge	=	5.777 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	2,773 cuft
Drainage area	=	0.800 ac	Runoff coeff.	=	0.54
Intensity	=	13.373 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Value.idf	Asc/Rise/Clmb fact	=	1/1

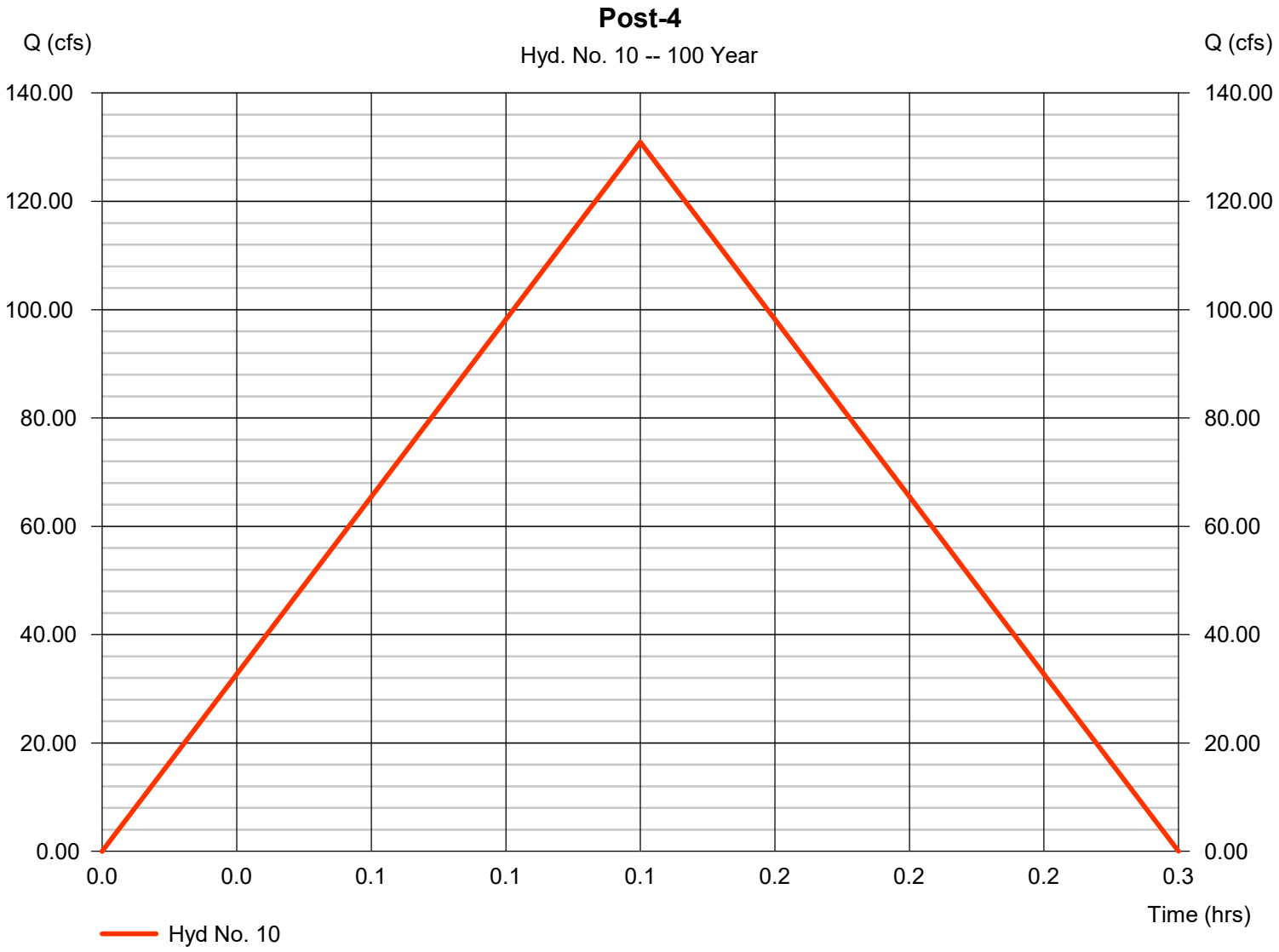


Hydrograph Report

Hyd. No. 10

Post-4

Hydrograph type	=	Rational	Peak discharge	=	130.93 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	62,846 cuft
Drainage area	=	18.130 ac	Runoff coeff.	=	0.54
Intensity	=	13.373 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Values 2025.IDF	Asc/Rec limb fact	=	1/1



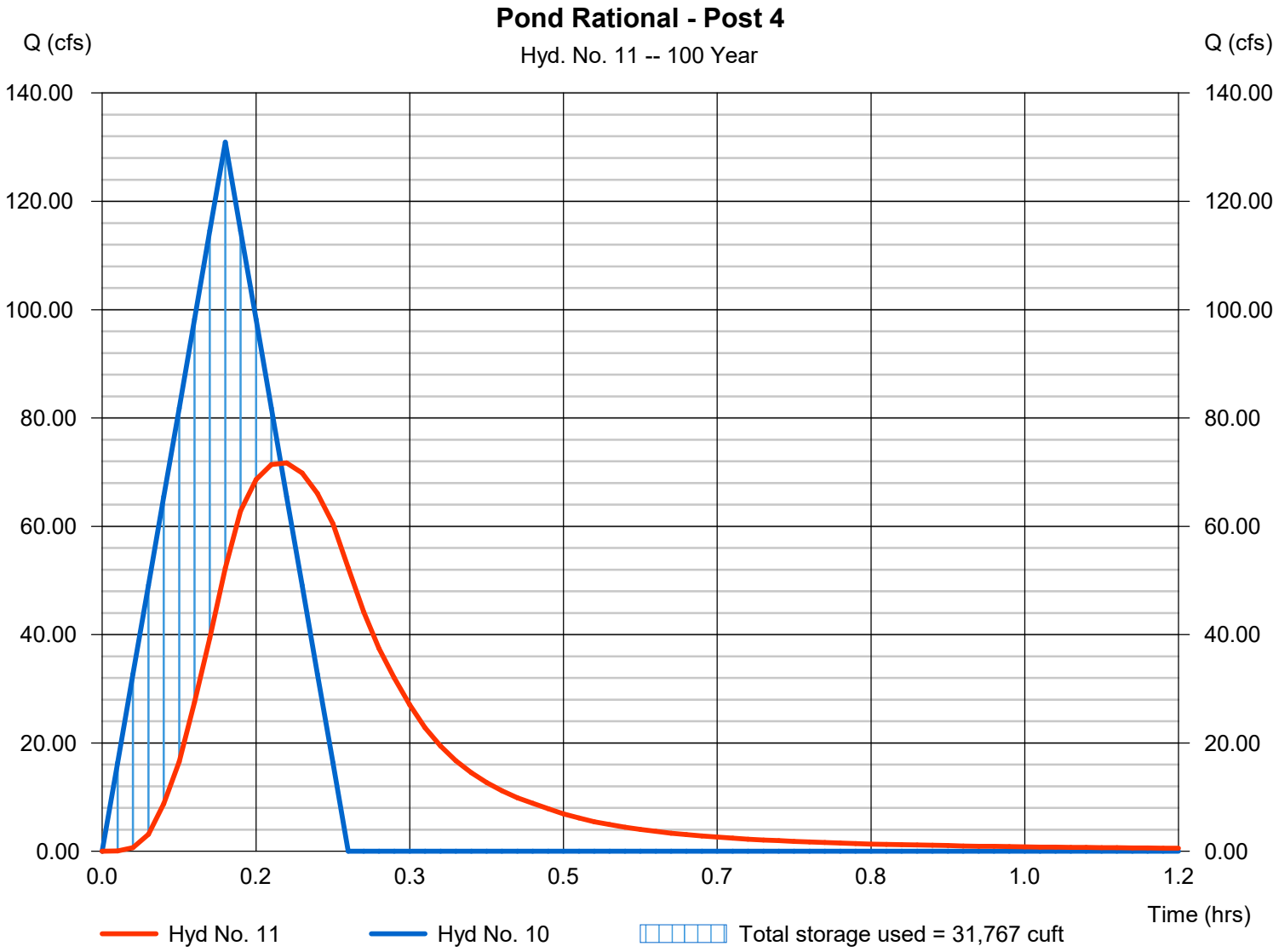
Hydrograph Report

Hyd. No. 11

Pond Rational - Post 4

Hydrograph type	=	Reservoir	Peak discharge	=	71.68 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.20 hrs
Time interval	=	1 min	Hyd. volume	=	62,838 cuft
Inflow hyd. No.	=	10 - Post-4	Max. Elevation	=	870.41 ft
Reservoir name	=	Small Pond	Max. Storage	=	31,767 cuft

Storage Indication method used.

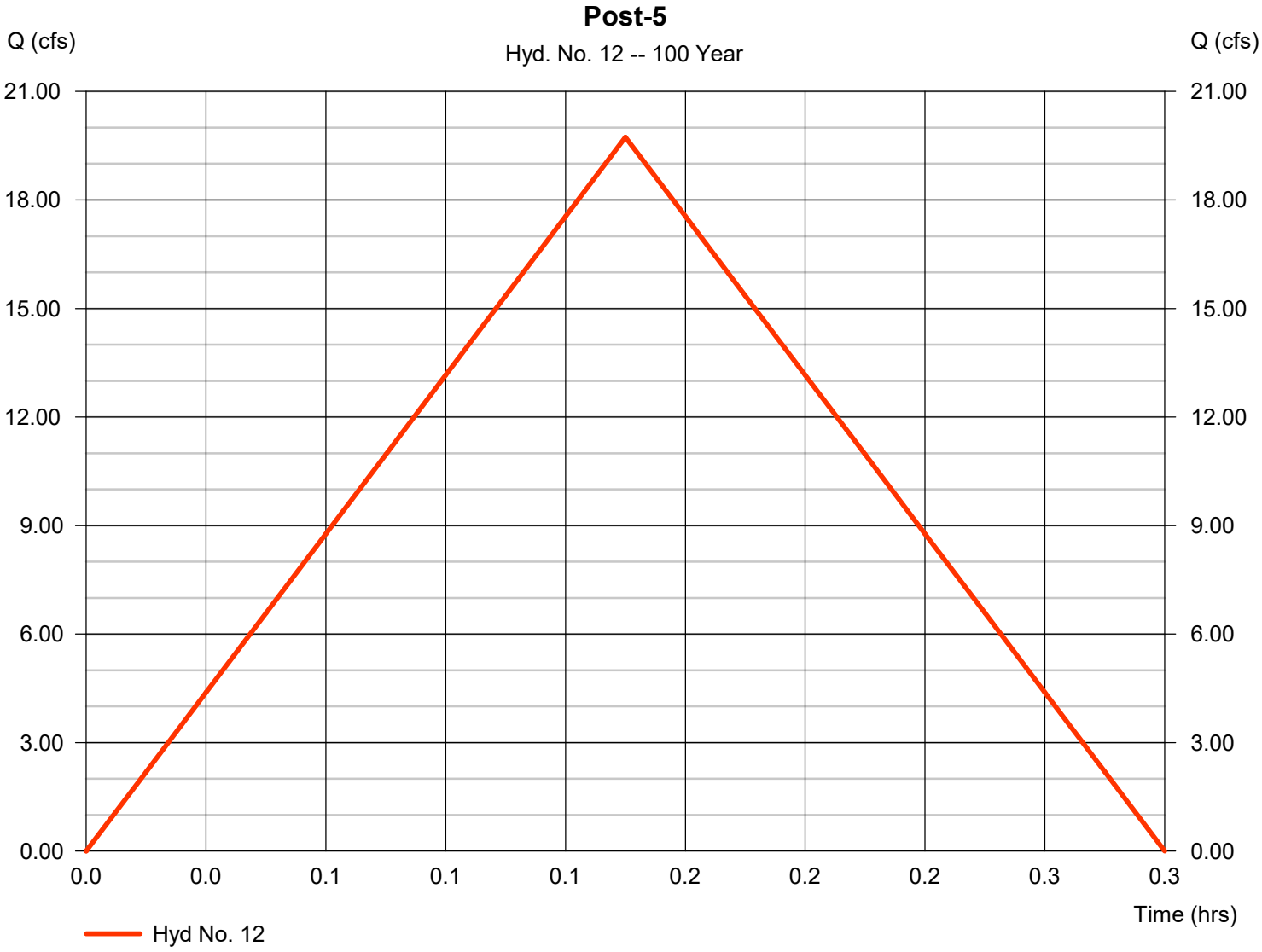


Hydrograph Report

Hyd. No. 12

Post-5

Hydrograph type	=	Rational	Peak discharge	=	19.74 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.15 hrs
Time interval	=	1 min	Hyd. volume	=	10,659 cuft
Drainage area	=	2.880 ac	Runoff coeff.	=	0.54
Intensity	=	12.692 in/hr	Tc by User	=	9.00 min
IDF Curve	=	Lansing, Kansas - With K-Value 2025.IDF	Asc/Rise/Dip fact	=	1/1

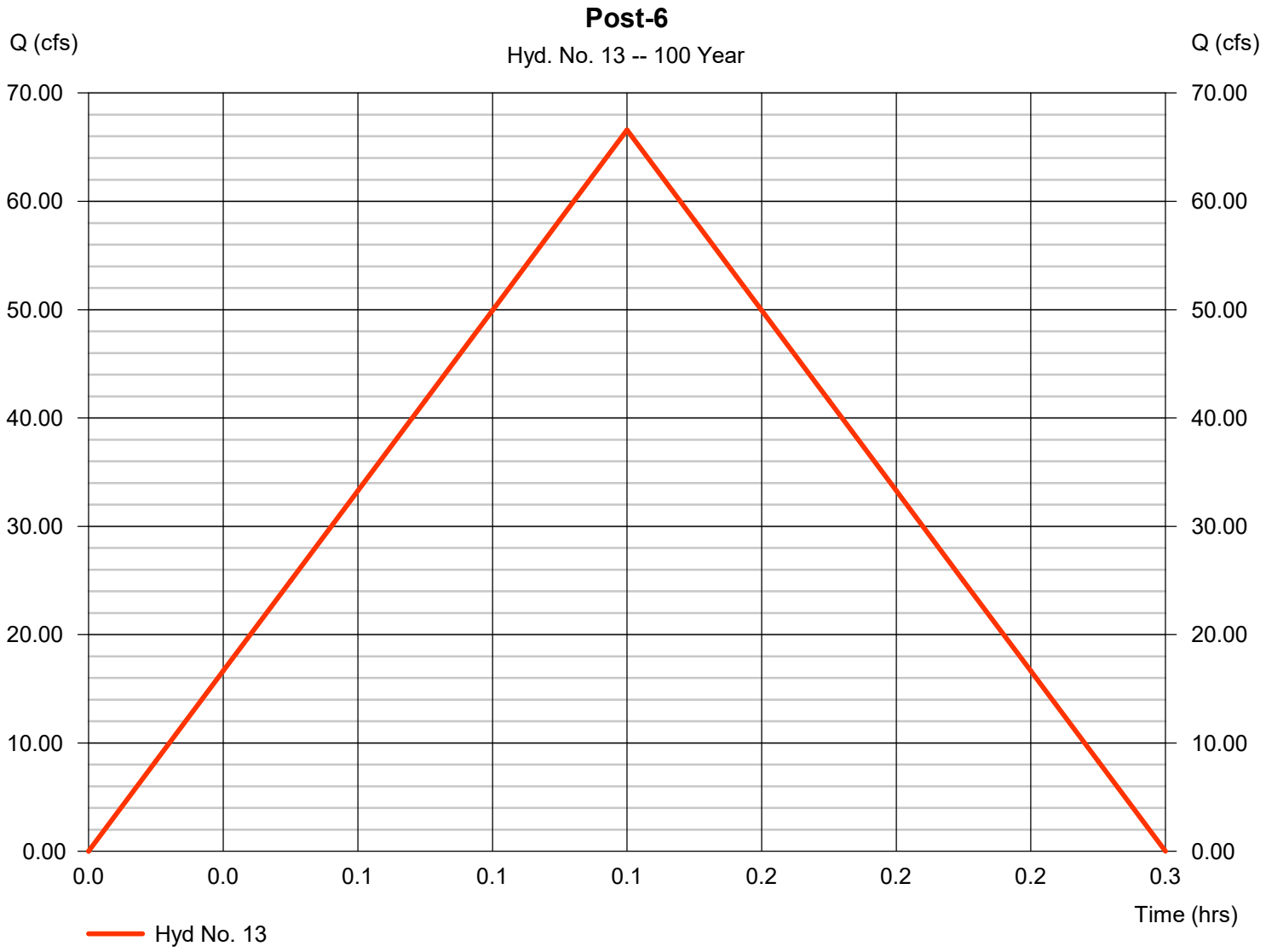


Hydrograph Report

Hyd. No. 13

Post-6

Hydrograph type	=	Rational	Peak discharge	=	66.58 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.13 hrs
Time interval	=	1 min	Hyd. volume	=	31,960 cuft
Drainage area	=	9.220 ac	Runoff coeff.	=	0.54
Intensity	=	13.373 in/hr	Tc by User	=	8.00 min
IDF Curve	=	Lansing, Kansas - With K-Value.idf	Asc/Rise/Clmb fact	=	1/1

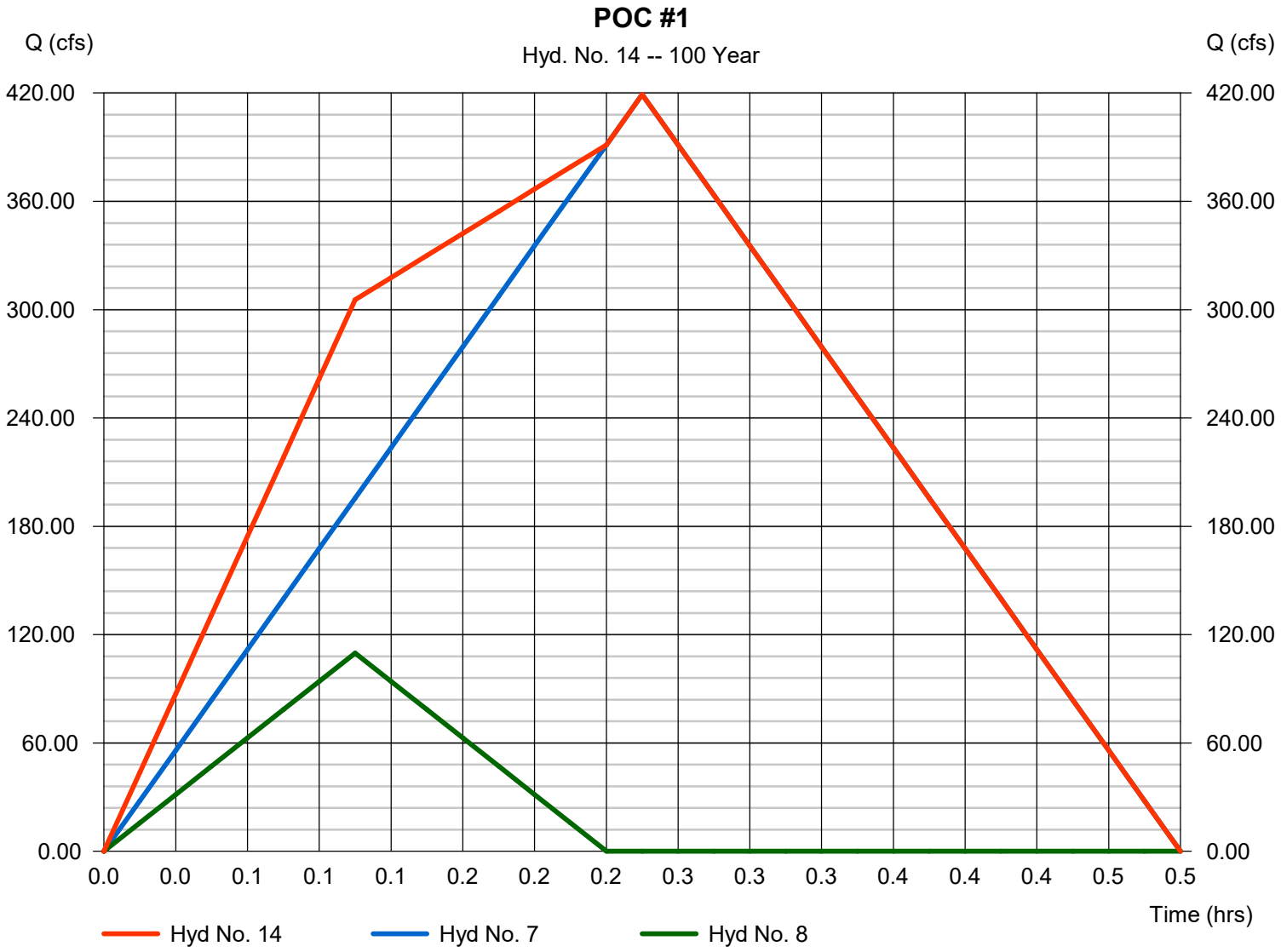


Hydrograph Report

Hyd. No. 14

POC #1

Hydrograph type	=	Combine	Peak discharge	=	419.22 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	423,418 cuft
Inflow hyds.	=	7, 8	Contrib. drain. area	=	108.000 ac

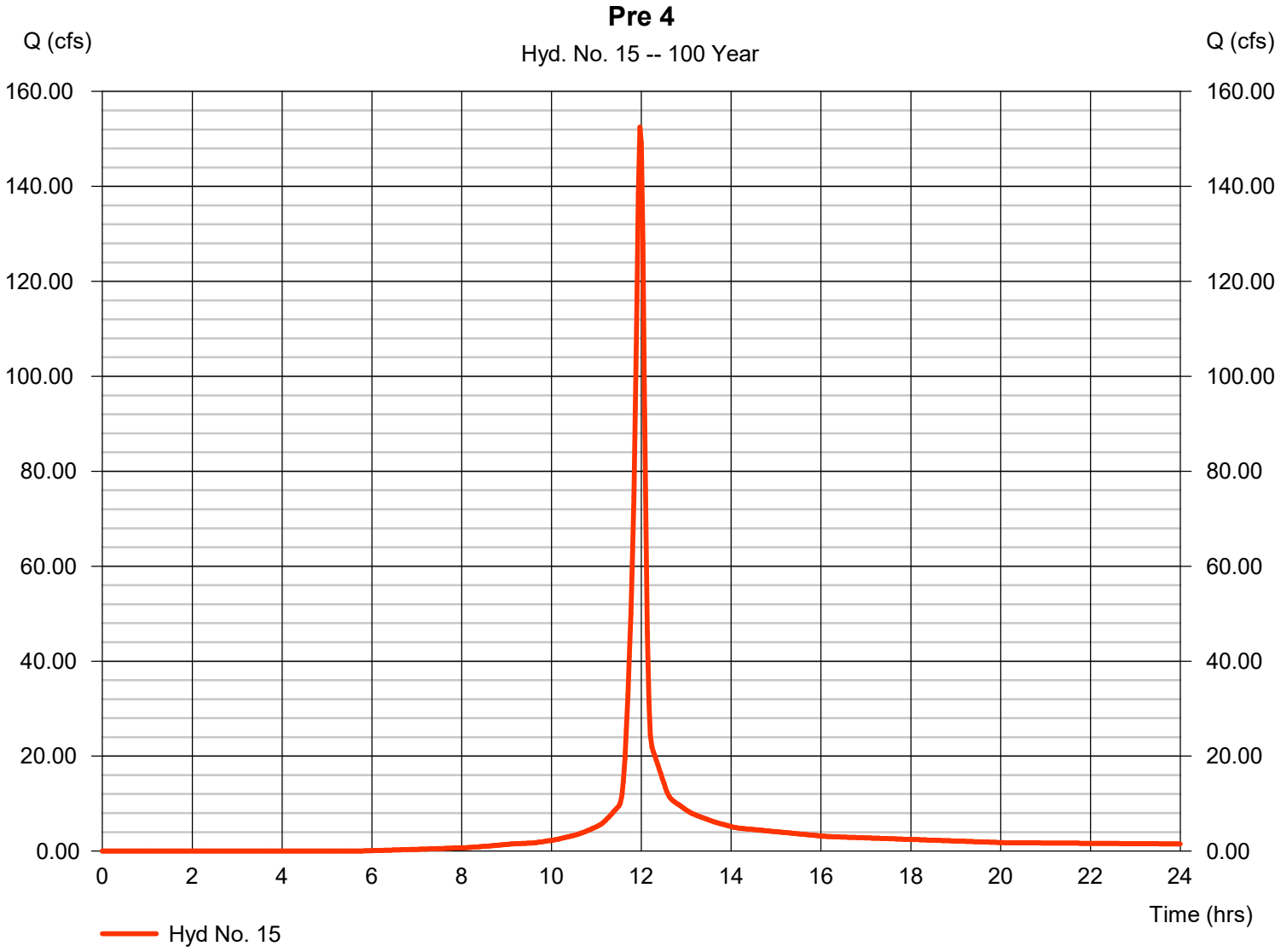


Hydrograph Report

Hyd. No. 15

Pre 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	152.50 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.97 hrs
Time interval	=	2 min	Hyd. volume	=	355,309 cuft
Drainage area	=	22.400 ac	Curve number	=	81
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.88 min
Total precip.	=	6.53 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

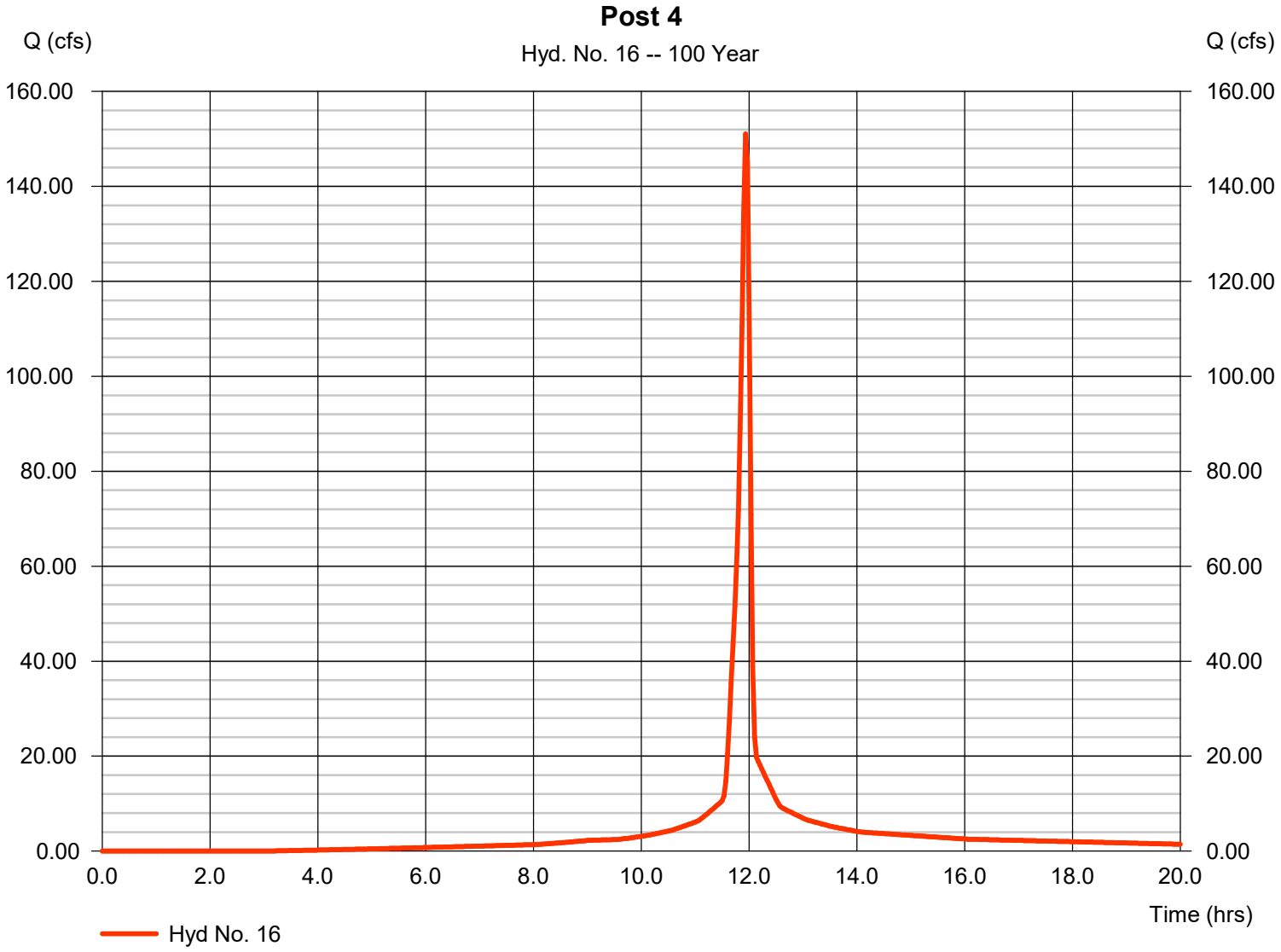


Hydrograph Report

Hyd. No. 16

Post 4

Hydrograph type	=	SCS Runoff	Peak discharge	=	151.04 cfs
Storm frequency	=	100 yrs	Time to peak	=	11.93 hrs
Time interval	=	2 min	Hyd. volume	=	330,895 cuft
Drainage area	=	18.130 ac	Curve number	=	90
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	4.82 min
Total precip.	=	6.53 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Report

Hyd. No. 17

Pond SCS - Post 4

Hydrograph type	=	Reservoir	Peak discharge	=	103.24 cfs
Storm frequency	=	100 yrs	Time to peak	=	12.00 hrs
Time interval	=	2 min	Hyd. volume	=	330,887 cuft
Inflow hyd. No.	=	16 - Post 4	Max. Elevation	=	871.91 ft
Reservoir name	=	Small Pond	Max. Storage	=	52,429 cuft

Storage Indication method used.