MACRO STORM WATER DRAINAGE STUDY

TOWN CENTRE – FUTURE LOT 4
Site Acreage: 22.36 Acres

SW Quadrant Intersection of
NE Town Centre Blvd. & NE Independence Ave.
Lee's Summit, MO

PREPARED BY:

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 S.E. 30th Street Lee's Summit, MO 64082
816.623.9888 • engineeringsolutionskc.com

Matthew J. Schlicht, PE

Revision

Date	Comment	By

MACRO STORM WATER DRAINAGE STUDY

TOWN CENTRE – FUTURE LOT 4
Site Acreage: 22.36 Acres

SW Quadrant Intersection of
NE Town Centre Blvd. & NE Independence Ave.
Lee's Summit, MO

PREPARED BY:

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 S.E. 30th Street Lee's Summit, MO 64082
816.623.9888 • engineeringsolutionskc.com

Revision

Date	Comment	By

Matthew J. Schlicht, PE

TABLE OF CONTENTS

3. GENERAL INFORMATION

This storm study has been prepared to evaluate potential hydrologic and hydraulic issues related to the development of the proposed project and recommend improvements if necessary to mitigate any anticipated negative downstream impacts. The proposed project name is "Town Centre Future Lot 4" and encompasses 22.36 acres. The proposed project will consist of a new warehouse facility, parking lots, drive aisles and associated utility infrastructure. The proposed project is located south and east of NE Town Centre Boulevard and west of Independence Avenue. Lot 1A (proposed public storage) and Lot 3 (automotive detail center) of Lee's Summit Town Centre lie to the south of the proposed project. The existing site drains generally to the southeast and consists of good prairie/meadow land. The southeast corner of the property contains a dry detention basin which was designed to attenuate runoff from Lot 3 Lee's Summit Town Centre in addition to bypass runoff from portions of undeveloped land from Lots 1A, 1B, 1C and Tract A, Lee's Summit Town Centre to the west and portions of Town Centre Future Lot 4 to the north. The detention basin control structure connects to the public storm sewer system located along NE Independence Avenue. Lot 3 automotive detail center is complete and operational. Facilities for Lots 1A, 1B, 1C and Tract A, Lee's Summit Town Centre are currently either under review or unplanned. See Exhibit A for an aerial image of the proposed project site along with an aerial image of the surrounding area. The site is located in the NE 1/4, NW 1/4, Section 29, Township 48N, Range 31W, Lee's Summit, Jackson County, Missouri.

3.1 FEMA FLOODPLAIN DETERMINATION

The property is located in an Area of Minimal Flood Hazard, Zone X, according to FEMA Firm Map Number 29095C0430G, dated January 20, 2017.

See Exhibit B for a FIRMette which includes the proposed project site.

3.2 NRCS SOIL CLASSIFICATION

Soil classifications published by the United States Department of Agriculture/National Resources Conservation Service (USDA/NRCS) website for Jackson County, Missouri, Version 23, September 1, 2021. The existing site contains three major soil types:

10024	Greenton-Urban Land Complex, 5 to 9 Percent Slopes Hydrologic Soils Group (HSG): Type D
10136	Sibley-Urban Land Complex, 2 to 5 Percent Slopes HSG: Type C
30080	Greenton Silty Clay Loam, 5 to 9 Percent Slopes HSG: Type C/D

See Exhibit C for a detailed soils report of the proposed project site. Soil Group 30080 makes up approximately 5% of the soil on site all of which lies in the southwest corner of the site. This area is periphery to the project and will remain undeveloped. Soil Group 30080 will therefore not be used to determine overall site runoff coefficients nor curve numbers. The developable site consists of the following soil groups 10024 (17%) and 10136 (83%). The coverage percentages were adjusted to account for developable land only.

Per APWA 5600, 5602.3 Runoff Coefficients, Item A. Basis of Curve Number Coefficients: "All curve number coefficients in this section are values for Hydrologic Group "C" soils. For soils in other Hydrologic Groups, equivalent SCS Curve Numbers can be found in SCS Technical Release No. 55."

The following table includes excerpts from APWA Table 5602-3: Runoff Parameters.

Land Use/Zoning	Average Percent Impervious	Average Percent Pervious	Rational Method "C"	SCS Curve Number
Business Downtown	95	5	0.87	97
Business Neighborhood	85	15	0.81	94
Residential Single Family	35	65	0.51	82
Residential Multifamily	60	40	0.66	88
Industrial Heavy Area	80	20	0.78	93
Railroad Yard Areas	25	75	0.45	80
Impervious: Asphalt, Concrete, Roofs	100	0	0.90	98
Turfed	0	100	0.30	74

As discussed above 17% of the soil onsite consists of HSG Type D and 83% of HSG Type C. Due to the combination of soils onsite a weighted average will be used to determine the appropriate runoff coefficients/curve numbers for both existing and proposed conditions. For the purposes of this report Rational Method runoff coefficients will be utilized since a common regional basin is being proposed and previous projects which will contribute utilized the Rational Method for routing and peak discharge calculations.

The existing site is undeveloped and consists of good condition pasture, grassland or range. To account for the HSG Type D soil we consulted the SCS TR55 Manual. The curve number (CN) for Open space, good condition (grass cover > 75%) for HSG Type C soil is 74 which matches the above APWA Table for Turfed Land Use. The CN for HSG Type D soil in the same category is 80. The weighted CN for the existing condition is (CN = 80 x 0.17 + 74 x 0.83) 75.02. Based on the methodology the CN should be rounded to the nearest whole number 75 in this case.

As shown in the above table, runoff coefficients are directly related to the percentage of impervious area. For design purposes the minimum CN is 74 (0.30) and the maximum is 98 (0.90). To convert the CN to a runoff coefficient utilize the boundary conditions and interpolate between them. The percentage of impervious area may be found in the same fashion. The runoff coefficient for a CN of 75 may be determined by interpolating as follows:

98 0.90
75 C
74 0.30

$$\frac{98 - 75}{98 - 74} = \frac{0.90 - C}{0.90 - 0.30}$$

$$C = 0.90 - [(98 - 75) / (98 - 74) * (0.90 - 0.30)] = 0.325 = \underline{0.33}$$

The runoff coefficient for the existing condition is 0.33 due to the mix of soil types on the project. The City prefers the proposed condition runoff coefficient be based on land use therefore Business Neighborhood with a C=0.81 was selected. The runoff coefficient must be adjusted to account for the HSG Type D soil to be conservative. There are potential scenarios where Type D soils may be covered by impervious finishes in the proposed condition however as mentioned we will be conservative and remain consistent with the method by providing a composite runoff coefficient. To determine the soil adjusted proposed condition composite runoff

coefficient the existing condition composite runoff coefficient found earlier of 0.33 is substituted for the pervious component and multiplied by the appropriate percentage pervious per the given land use. The adjusted runoff coefficient is (C = 0.90 x 0.85 + 0.33 x 0.15) 0.815 or 0.82 rounded for the proposed condition.

4. METHODOLOGY

The proposed project currently has an active detention basin located in the southeast corner of the property. The basin was designed to attenuate runoff from the Automotive Detail Center located to the south of the basin and bypass attenuated runoff from the properties to the west such as Mega Storage and DBAT studied as part of Lot 1 – Lee's Summit Town Centre. Storm Studies for each Development were reviewed and their proposed hydrographs were replicated in Hydraflow. Both studies have been included in Exhibit D for reference. The Rational Method was utilized to develop hydrographs for both previous projects. To maintain consistency the Rational Method has been utilized in this study. A field topographic survey was completed to create the Existing Drainage Area Map. The study conforms to the requirements of the City of Lee's Summit, Missouri "Design and Construction Manual" and all applicable codes and criteria referred to therein.

Using the above criteria, the proposed site was evaluated using the Rational Method to calculate storm runoff volumes, peak rates of discharge, pre and post developed hydrographs and required storage volumes for detention facilities. The Rational Method was introduced in the United States in the 19th Century and has been in practice ever since for the design of pipes, inlets and detention ponds.

Hydraflow Hydrographs Extension for AutoCAD Civil 3D was utilized to model the various Rational Method stormwater rainfall runoff events. The following Standard Rational Method Hydrograph variables were utilized;

- Standard Rational Method used to create hydrographs, Qp = CiA
- Ascending Limb Factor (ALF) = 1, The ascending limb equals Tc x 1 (ALF)
- Receding Limb Factor (RLF) = 1, The receding limb equals Tc x 1 (RLF)
- Runoff Coefficients per APWA Table 5602-3 and Curve Numbers per SCS TR-55 (Tables 2-2a to 2-2c)

Time of Concentration has been calculated using the following formulas:

- Sheet Flow (Max. 100 LF): APWA 5602.5 Time Inlet, T_I = 1.8 * (1.1-C) * L^1/2 / S^1/3
- Shallow Concentrated Flow: SCS TR-55 Appendix F: Unpaved V=16.1345(S)^0.5
  Paved V=20.3282(S)^0.5
  Shallow Concentrated Travel Time (min): SCS TR-55 Eq-3-1, T_t = L / V x 60
- Channel Flow Improved: Manning's Equation (Full Flow)
  Channel Flow Unimproved: APWA 5602.7.A. Travel Time, Table 5602-6

Avg. Channel Slope (%)	Velocity (fps)
< 2	7
2 to 5	10
>5	15

5. EXISTING CONDITIONS ANALYSIS

The existing site is undeveloped and consists of good condition pasture, grassland or range. The site contains five sub-basins SW, NW, S, NE and SE all of which refer to their general geographic location. Each sub-basin will drain to and be calculated at a given Point of Interest (POI) identified with their respective sub-basin name. Sub-basin SW (1.95 acres) is located in the southwest corner of the property west of Lot 1 – Lee's Summit Town Centre Development. Sub-basin SW is isolated and will remain undeveloped. Sub-basin SW drains via sheet and shallow concentrated flow to NE Town Centre Boulevard where runoff is captured by an enclosed storm sewer system at POI SW. Sub-basin NW (2.15 acres) is located in the northwest corner of the property.

Sub-basin NW drains via sheet and shallow concentrated flow to NE Town Centre Boulevard where runoff is captured by an enclosed storm sewer system at POI NW. Sub-basin S (2.76 acres) is located in the southern portion of the property adjacent to the north property line of Lot 1 – Lee's Summit Town Centre. Sub-basin S drains via sheet and shallow concentrated flow to Lot 1 – Lee's Summit Town Centre where it will be captured and conveyed by a private enclosed storm sewer system and routed through private detention. Attenuated runoff from the Lot 1 – Lee's Summit Town Centre Development is conveyed via an open channel to the existing detention basin located in Sub-basin SE. The basin was designed to bypass the attenuated runoff. Sub-basin NE (10.13 acres) is located in the northeast corner of the property. Sub-basin NE drains east via sheet and shallow concentrated flow to NE Independence Avenue where runoff is captured by an enclosed storm sewer system at POI NE. Sub-basin SE (5.37 acres) is located in the southeast corner of the property. Sub-basin SE drains southeast via sheet and shallow concentrated flow to the existing detention basin. The automotive detail center located just south of the detention basin drains to the detention basin located in Sub-basin SE for attenuation. The Existing Drainage Area Map is located in Exhibit E.

The following tables summarize the results of the Existing Conditions analysis. Time of concentration calculations by sub-basin may be found in Exhibit F. A complete breakdown of hydrographs may be found in Exhibit G.

Table 5-1 Existing Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite C	Tc (min.)
SW	1.95	0.33	11.8
NW	2.15	0.33	9.0
S	2.76	0.33	11.0
NE	10.13	0.33	23.8
SE	5.37	0.33	12.1

Table 5-2 Existing Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
SW	2.66	3.70	6.61
NW	3.26	4.49	7.97
S	3.89	5.40	9.63
NE	9.92	14.18	25.81
SE	7.32	10.18	18.19

Per APWA 5608.4 and City of Lee's Summit criteria, post development peak discharge rates from the site shall not exceed those indicated below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
- 1% storm peak rate less than or equal to 3.0 cfs per site acre

Per City direction all onsite area is to be multiplied by the above factors to determine allowable peak release rates. Any offsite area contributing shall utilize its percentage of existing peak discharge which will be added to allowable onsite to determine the total allowable peak discharge at the point of interest.

Allowable Release Example Calculations: Sub-basin SW (2-Yr): (1.95 x 0.5) = 0.98 cfs

Table 5-3 Existing Conditions Sub-basin/Point of Interest Allowable Peak Discharge Release Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
SW	0.98	3.90	5.85
NW	1.08	4.30	6.45

S	1.38	5.52	8.28
NE	5.07	20.26	30.39
SE	2.69	10.74	16.11

The SW Sub-basin will not be developed due to its geometry and periphery location. The SW Sub-basin will not be evaluated any further in this report.

6. PROPOSED CONDITIONS ANALYSIS

The proposed warehouse facility, parking lot, drive aisles and associated utility infrastructure will be encompassed by Sub-basin SE which will drain to the expanded detention basin in the southeast corner of the property via overland flow and a private enclosed storm sewer network. The automotive detail center to the south of the detention basin will continue to drain to the basin. The expanded basin will continue to attenuate runoff from the automotive detail center to previously approved levels. Lot 1 – Lee's Summit Town Centre will continue to contribute post detained runoff to the expanded detention basin for bypass. Sub-basins' NW, S and NE are all periphery to the project and have been greatly reduced in size by the proposed improvements. The Proposed Drainage Area Map is located in Exhibit H.

The following tables summarize the results of the Proposed Conditions analysis.

Table 6-1 Proposed Conditions Sub-basin Data

Sub-basin	Area (ac.)	Composite C	Tc (min.)
NW	0.46	0.33	9.1
S	0.55	0.33	9.9
NE	1.00	0.82	7.9
SE	18.40	0.82	13.6

Table 6-2 Proposed Conditions Sub-basin/Point of Interest Peak Discharge Rates

Sub-basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
NW	0.70	0.96	1.71
S	0.80	1.11	1.98
NE	3.91	5.37	9.52
SE	58.42	81.71	146.63

As shown above in Table 6-2 Sub-basin SE will require detention to attenuate peak discharge rates below Allowable Release Rates as shown in Table 5-3 for Sub-basin SE. The Allowable Peak Discharge from the expanded SE Detention Basin accounts for the following; 4.02 acres from the neighboring Automotive Detail Center, 18.40 acres from Sub-basin SE along with bypass flow from Lot 1 – Lee's Summit Town Centre Development. The Hydraflow hydrograph that accounts for the combined flow as stated above is labeled "Lot 4 + ADC + Lot 1". See Table 6-3 below for Detention Basin SE allowable peak discharge rates.

Table 6-3 Detention Basin SE Allowable Peak Discharge Rates

Basin	Q2 (cfs)	Q10 (cfs)	Q100 (cfs)
SE	7.34	22.45	44.72

Q2 (Allowable) = 2.69 cfs + 2.01 cfs + 2.64 cfs = 7.34 cfs
Q10 (Allowable) = 10.74 cfs + 8.04 cfs + 3.67 cfs = 22.45 cfs
Q100 (Allowable) = 16.11 cfs + 12.06 cfs + 16.55 cfs = 44.72 cfs

6.1 DETENTION

An expansion of the existing single stage earthen detention basin is being proposed in Sub-basin SE to attenuate proposed peak discharge rates from Sub-basin SE and the existing automotive detail center to the south. The expanded basin will continue to bypass runoff from Lot 1 – Lee's Summit Town Centre. Following are a list of design parameters for the detention system.

Designation: Detention Basin SE
Type: Earthen Basin
Side Slopes: 3:1 Max.
Bottom Slope: 2% Min., Turf Lined
Basin Bottom Elevation: 977.50 @ Influent Pipe
Basin Top Berm Elevation: 988.00
Basin Volume: 735,467 cf @ 988.00
Control Structure: 5'x6' deep precast concrete box, with interior 6" baffle wall
Baffle Wall Orifices: (14) 1" Diameter on 4" Centers, FL=977.10 (Bottom Orifice)
(1) 2' Diameter Orifice, FL=982.50
Baffle Wall Crest Elevation: N/A
Control Structure Top Elevation: 986.50
Control Structure Overflow Weir Openings: N/A
Control Structure Influent Pipe: 36" HDPE, FL (In) = 977.50, FL (Out) = 977.20, L=34.00', S=0.88%
Control Structure Effluent Pipe: 42" HDPE, FL (In) = 977.00, FL (Out) = 976.75, L=15.00', S=1.33%
Emergency Spillway: Earthen Broad Crested Weir, Crest Elevation=986.50, Crest Length=175'
Consecutive 100-YR Q=152.70 cfs, Emergency Spillway HGL=986.98, Freeboard=1.02'
Emergency Spillway: Q=152.70 cfs
Control Structure Overflow: N/A

The Detention Basin Plan is located in Exhibit I. See Table 6-4 for a summary of detention basin data.

Table 6-4 Proposed Conditions Detention Basin Data

	Peak Q In (cfs)	Tp In (min.)	Peak Q Out (cfs)	Tp Out (min)	Peak W.S.E.	Max. Storage Vol. (cf)
Basin A						
2-Year	2.64	15	0.16	1033	979.52	58,404
10-Year	85.13	14	0.19	1244	979.74	81,606
100-Year	152.70	14	0.29	130	980.45	159,737

As shown in the table above all proposed peak flowrates have been attenuated. The detention basin cut material will be used for borrow on the build site.

Table 6-5 below provides a comparison of runoff data between Proposed and Existing Conditions in addition to Proposed Conditions and Allowable Release Rates at each Point of Interest.

Table 6-5 Point of Interest Discharge Comparison

Point of Interest	**Condition**	**Q2 (cfs)**	**Q10 (cfs)**	**Q100 (cfs)**
NW	Proposed	0.70	0.96	1.71
	Existing	3.26	4.49	7.97
	Difference	-2.56	-3.53	-6.26
	Allowable	1.08	4.30	6.45
	Difference	-0.38	-3.34	-4.74
S	Proposed	0.80	1.11	1.98

	Existing	3.89	5.40	9.63
	Difference	-3.09	-4.29	-7.65
	Allowable	1.38	5.52	8.28
	Difference	-0.58	-4.41	-6.30
NE	Proposed	3.91	5.37	9.52
	Existing	9.92	14.18	25.81
	Difference	-6.01	-8.81	-16.29
	Allowable	5.07	20.26	30.39
	Difference	-1.16	-14.89	-20.87
SE	Proposed	0.16	0.19	0.29
	Existing	7.32	10.18	18.19
	Difference	-7.16	-9.99	-17.90
	Allowable	2.69	10.74	16.11
	Difference	-2.53	-10.55	-15.82

Peak discharge rates at all POIs will be reduced below allowable for all design storms analyzed.

7. 40 HOUR EXTENDED DETENTION/INFILTRATION BMP

In addition to mitigation of peak flow rates, APWA Section 5608.4 also requires 40 hour extended detention of runoff from the local 90% mean annual event (1.37”/24-hour rainfall). The proposed detention facilities will release the water quality event over a period of 40-72 hours. The basin will be designed to provide extended detention for 22.42 acres total 4.02 acres from the neighboring automotive detail center and the remaining 18.40 acres from the proposed project site. See Exhibit J for 40 hour extended detention calculations for Basin SE.

8. CONCLUSIONS & RECOMMENDATIONS

This macro storm water drainage study reveals that the proposed development will not generate any negative downstream hydraulic impacts. The existing earthen detention basin serving the automotive detail center will be expanded to provide detention for the proposed development. The basin will be oversized to provide fill material for the build site. In conclusion, proposed peak discharge rates for all Points of Interest have been reduced below both existing and allowable release rates. The study is in conformance with all applicable City of Lee’s Summit standards and criteria therefore Engineering Solutions recommends approval of this macro storm water drainage study.

Exhibit A

Aerial Image
&
Aerial Image of Surrounding Area


NE Town Centre Blvd
NE Town Centre Blvd
NE Town Centre Blvd
NE Town Centre Blvd
PROJECT SITE
NE Independence Ave
NE Independence Ave
NE Town Centre Dr
NE Town Centre Dr
NE Town Centre Dr


PROJECT SITE
NE Colbern Rd
NW Colbern Rd
NE Colbern Rd
470
470
470
NE Rice Rd
E Independence Ave
Todd George Pkwy

Exhibit B

FEMA FIRMette

National Flood Hazard Layer FIRMette

94°22'17"W 38°57'22"N

94°21'40"W 38°56'54"N

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

1:6,000

Basemap: USGS National Map: Orthoimagery: Data refreshed October, 2020

Legend

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

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

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

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

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

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

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

N

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

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

The flood hazard information is derived directly from the authoritative NFHL web services provided by FEMA. This map was exported on 6/7/2022 at 3:21 PM and does not reflect changes or amendments subsequent to this date and time. The NFHL and effective information may change or become superseded by new data over time.

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

Exhibit C

NRCS Soil Classification Report

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 Jackson County, Missouri

Lot 4 - Town Centre

June 7, 2022

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.

The U.S. Department of Agriculture (USDA) prohibits discrimination in all its programs and activities on the basis of race, color, national origin, age, disability, and where applicable, sex, marital status, familial status, parental status, religion, sexual orientation, genetic information, political beliefs, reprisal, or because all or a part of an individual's income is derived from any public assistance program. (Not all prohibited bases apply to all programs.) Persons with disabilities who require

alternative means for communication of program information (Braille, large print, audiotape, etc.) should contact USDA's TARGET Center at (202) 720-2600 (voice and TDD). To file a complaint of discrimination, write to USDA, Director, Office of Civil Rights, 1400 Independence Avenue, S.W., Washington, D.C. 20250-9410 or call (800) 795-3272 (voice) or (202) 720-6382 (TDD). USDA is an equal opportunity provider and employer.

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: 1:3,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 45 90 180 270

Feet: 0 150 300 600 900

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: Jackson County, Missouri
Survey Area Data: Version 23, Sep 1, 2021

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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
10024	Greenton-Urban land complex, 5 to 9 percent slopes	3.6	16.0%
10136	Sibley-Urban land complex, 2 to 5 percent slopes	17.6	78.8%
30080	Greenton silty clay loam, 5 to 9 percent slopes	1.2	5.2%
Totals for Area of Interest		**22.4**	**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.

Jackson County, Missouri

10024—Greenton-Urban land complex, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2qky4
Elevation: 800 to 1,100 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Greenton and similar soils: 60 percent
Urban land: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Concave, convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

A - 0 to 16 inches: silty clay loam
Bt1 - 16 to 26 inches: silty clay loam
2Bt2 - 26 to 80 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
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 30 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 3.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: D
Ecological site: R109XY002MO - Loess Upland Prairie
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Across-slope shape: Concave, convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

10136—Sibley-Urban land complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql0j
Elevation: 720 to 1,080 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sibley and similar soils: 60 percent
Urban land: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sibley

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 65 inches: silty clay loam
C - 65 to 80 inches: silt loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 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: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R107BY002MO - Deep Loess Upland Prairie
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Across-slope shape: Convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9
Elevation: 640 to 1,120 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Greenton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
2Bt - 28 to 30 inches: silty clay
2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
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 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 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): None specified
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Exhibit D

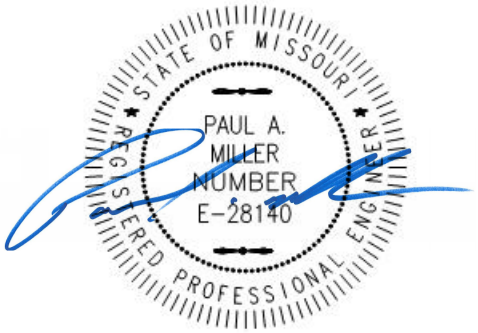
Detail Center Storm Report
&
Lot 1 – Lee's Summit Town Centre Macro Storm Report

Macro Storm Water Study
for:

Lot 1 – Lee's Summit Town Centre
Lee's Summit, MO 64064

Prepared for:
WHD Management, LLC
PO Box 1059
Lee's Summit, Missouri 64063

Prepared by:
Davidson Architecture & Engineering, LLC
Paul A. Miller, PE
4301 Indian Creek Parkway
Overland Park, Kansas 66207
913.451.9390 (phone)
913.451.9391 (fax)
www.davidsonae.com



11/02/2021

October 1st, 2021

Rev. 1: November 2nd, 2021

Table of Contents

List of Tables

List of Figures

Appendices

General Information

Lot 1 of the Lee's Summit Town Centre development is located at the northeast corner of NE Town Centre Blvd. and NE Town Centre Drive in Lee's Summit, MO. The site contains 11.61 acres of undeveloped grass pasture.

The site is located in the Northwest 1/4, Sec. 29-Twp. 48N. - Range. 31W. The development will contain a large self-storage facility and two separate pad sites. Refer to Appendix A for the site plan.

There are two different soil types represented on the project site, 10136-Sibley-Urban Land Complex and 30080-Greenton Silty Clay Loam, with 10136-Sibley-Urban Land Complex occupying the largest area at 9.50 acres. The hydrological soil group for 10136 is rated as C and the area is classified as Grass/Prairie land with 2 to 5 percent slopes. 30080- Greenton Silty Clay Loam represents 2.11 acres in the southwest corner of the site. The hydrological soil group for 30080 is rated as C/D and the area is classified as Grass/Prairie land with 5 to 9 percent slopes.

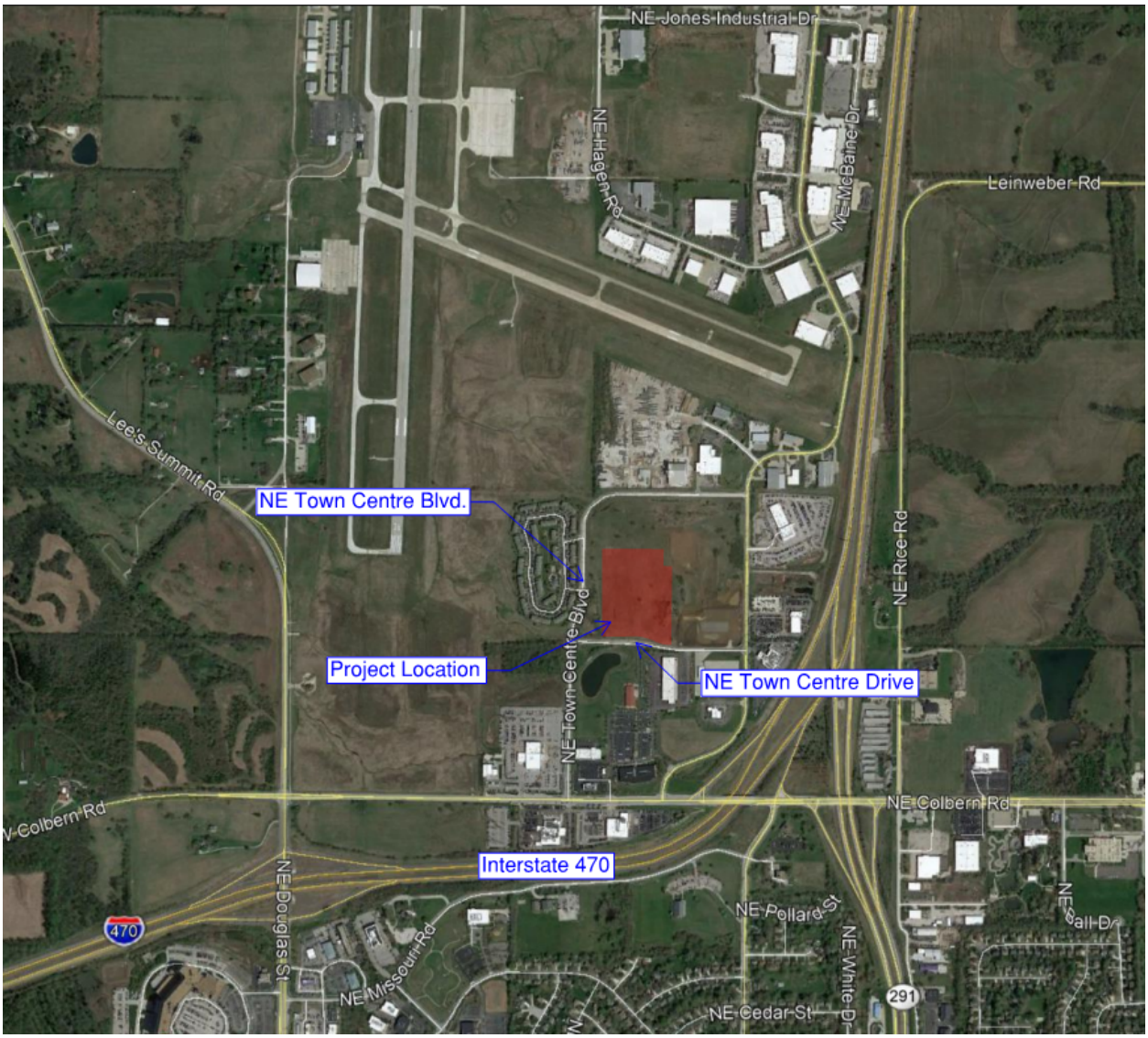


Figure 1. - Location Map (no scale)

Methodology

KCAPWA IDF curves were used to determine the rainfall intensity for the 2, 10, and 100-year storm events. Existing and proposed conditions were modeled and analyzed using Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2021 (Hydraflow). Hydrograph routing within Hydraflow used the Rational Method with depths of 3.71", 5.2", and 7.8" for the 50% (2-Yr), 10% (10-Yr), and 1% (100-Yr) storm events, respectively. This method is also used in SCS TR-55. Convolution is known as linear superpositioning, and means that each ordinate of the rainfall hyetograph is multiplied by each ordinate of the unit hydrograph, thus creating a series of hydrographs. These hydrographs are then summed to form the final runoff hydrograph. Rainfall frequencies were determined by using TECHNICAL PAPER NO.40, RAINFALL FREQUENCY ATLAS OF THE UNITED STATES, by the U.S. Department of Commerce, Weather Bureau. The October 2012 American Public Works Association BMP Manual was used for this storm study.

Existing Condition Analysis

The project site is located on the southwest corner of the Lee's Summit Town Centre development at the northeast corner of NE Town Centre Blvd. and NE Town Centre Dr. in Lee's Summit, MO. Lee's Summit Town Centre is located northwest of the Highway 291 and Interstate 470 interchange. The existing undeveloped site is 11.61 acres, with the entirety of the property being pervious.

Runoff from the site currently generally flows from the north to south and into a pond located on the east side of the property. A portion of the property in the southwest corner drains from east to west and down the sloped, moderately-wooded area into curb inlets located on NE Town Centre Dr. The site was analyzed as a greenfield site with a rational "c" value of 0.30.

Soils encountered on the site are 10136-Sibley-Urban land complex, 2 to 5 percent slopes, and 30080-Greenton Silty Clay Loam, 5 to 9 percent slopes. The Hydrologic Soil Groups of the encountered soils are C and C/D respectively (see Appendix A, Hydrologic Soil Group).

The site lies entirely outside of the 100-year floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) Map Panel No. 0430G, Map Number 29095C0430G Dated January 20, 2017, Note: This area is shown as being completely within zone X. The Flood Insurance Rate Map is included in Appendix A.

There are 3.35 acres of pervious area to the north of the property that currently drains onto the proposed site. The resulting drainage area for the site is approximately 14.96 acres of pervious area. The Existing Drainage Area Map, provided in Appendix A, depicts the existing drainage patterns for the site. Area A shown on this map currently sheet flows off the property to the west and eventually discharges into curb inlets near the intersection of NE Town Centre Dr. and NE Town Centre Blvd. Area B sheet flows across the site and discharges to the property to the east into a drainage swell that eventually discharges runoff into the existing detention basin on the neighboring property adjacent to NE Independence Ave.

The existing detention basin on the newly developed property to the east was sized to handle and detain the runoff from the existing pre-developed proposed site. The proposed site currently drains to a swale located just north of the neighboring property to the east, and into the existing detention basin to the east.

The existing site results in the following conditions:

Table 1 – Existing Site Runoff Hydraflow Results

Storm Event	Area A (cfs)	Area B (cfs)	Total Site Runoff (cfs)
2-Yr	1.79	14.87	16.66
10-Yr	2.50	20.76	23.26
100-Yr	3.77	31.27	35.04

Proposed Condition Analysis

The proposed development consists of the construction of a large self-storage complex and two separate buildings with their own parking lots. The improvements will increase impervious area on-site by approximately 8.21 acres. The remaining 3.40 pervious acres will be covered in grass or native vegetation that is either preserved or reestablished after land disturbance activities have been completed. The post development rational "c" values for the project site have been developed based on soil types and proposed conditions. The rational "c" values for the proposed development can be found on the Proposed Drainage Area Map located in Appendix A.

Table 2 below shows the increase in peak discharge rates for the 2, 10, and 100-year storm events due to the increase in impervious area.

Table 2 – Proposed Site Runoff Hydraflow Results – Without Detention

Storm Event	Post-Development Peak Flow (cfs)
2-Yr	35.58
10-Yr	49.67
100-Yr	74.83

In order to mitigate the increase in peak runoff rates from the site due to the increase in impervious area created by the proposed development, a private storm network is proposed to direct runoff to the proposed on-site detention basin located on the east side of the property. The Proposed Drainage Area Map, provided in Appendix A, depicts the proposed drainage patterns for the site. Areas 1 through 5 shown on the Proposed Drainage Area Map will flow into the private storm network structures and discharge into the proposed on-site detention basin. Area 6 will follow the existing drainage pattern of the site, flowing to the southwest corner of the site and eventually discharging into the existing public storm system near the intersection of NE Town Centre Blvd. and NE Town Centre Dr. Area 7 will flow offsite to the neighboring property to east, following the existing drainage patterns of the site.

Areas 6 and 7 on the Proposed Drainage Area Map will discharge at the same location and a rate less than the site's existing conditions. During the 100-year storm event, Existing Drainage Area A currently discharges 3.77 cfs to the curb inlets near the intersection of NE Town Centre Blvd. and NE Town Centre Dr. Proposed Drainage Area 6 will discharge 3.47 cfs to this same location. Area 7 on the Proposed Drainage Area Map is pervious, has the same rational "c" value, and follows the existing drainage patterns of the undeveloped site.

The detention basin has been designed to effectively capture and discharge the runoff from the contributing drainage area, per the requirements set by APWA Section 5601.5.A.4.a. Discharge from the detention basin will be controlled by a proposed outlet structure that will maintain release rates less than pre-developed conditions, while also maintaining water quality requirements specified in APWA Section 5608.4.C.1.b. Post-development peak discharge rates shall not exceed the requirements set by APWA Section 5608.4.C.1.a that are shown below:

- 50% storm peak rate less than or equal to 0.5 cfs per site acre
  - Site specific allowable release rate: 7.48 cfs
- 10% storm peak rate less than or equal to 2.0 cfs per site acre
  - Site specific allowable release rate: 29.92 cfs
- 1% storm peak rate less than or equal to 3.0 cfs per site acre
  - Site specific allowable release rate: 44.88 cfs

Discharge from the detention basin will be controlled by an outlet structure that discharges into an outlet pipe spanning from the detention basin's outlet structure to the existing drainage swale just north of the neighboring property to the east. For water quality considerations, the outlet structure will have an orifice placed at the bottom elevation of the pond to control the discharge from the detention basin to meet the minimum forty-hour extended detention requirement for comprehensive control. A weir will be placed just above the water surface elevation of the 90% mean annual event and discharge into the outlet pipe. The runoff from the outlet pipe will continue to the east in the existing drainage swale and eventually discharge into the existing detention basin on the neighboring property. This detention basin has been sized to handle the runoff for the peak storm events from both the proposed site in its existing, pre-developed conditions and the newly developed-neighboring property.

A spillway for the proposed on-site detention basin was designed using the 100-year water surface elevation of 1003.89. Simulating clogged outlet conditions and zero available storage in the detention basin, the spillway crest elevation was set 0.5' above the 100-year water surface elevation at 1004.39. One foot of freeboard is available above the 100-year water surface elevation in the spillway to the top of the berm at 1005.91. The spillway will allow overflow to drain over the proposed private road and into the drainage swale north of the neighboring property.

Approximately 93.7% (10.88 acres) of the site will undergo water quality via an onsite BMP. The proposed BMPs include the following: inlet filter baskets to extended dry detention in a BMP train, extended dry detention only, and preservation/establishment of native vegetation. Approximately 6.2% of the site shall go untreated and be allowed to flow offsite to the existing public storm sewer system along NE Town Centre Dr. to the south of the property.

9.46 acres of the site shall be pre-treated by inlet filter baskets before being discharged into the proposed on-site detention basin. 0.29 acres of grass or landscaping will drain directly to the proposed detention basin. 1.13 acres of the site will have native vegetation preserved or reestablished after land disturbance activities have been completed. The remaining 0.73 acres will be untreated and discharged off-site

Table 3 below shows the general conditions of the proposed stormwater detention basin.

Table 3 – Proposed Detention Basin Hydraflow Results

Storm Event (yr)		Detention Basin 1
2-Yr	Discharge (cfs)	0.235
	Max. Elevation (ft)	1002.21
	Total Storage (cf)	29,585
10-Yr	Discharge (cfs)	0.275
	Max. Elevation (ft)	1002.98
	Total Storage (cf)	41,362
100-Yr	Discharge (cfs)	14.33
	Max. Elevation (ft)	1003.89
	Total Storage (cf)	56,699

Table 4 below shows the total post-developed peak discharge rates from the site with the proposed private storm network and detention basin.

Table 4 – Proposed Site Runoff Hydraflow Results – With Detention				
Storm Event	Discharge from Detention Basin 1 - **Areas 1 - 5** (cfs)	Runoff to Offsite Public Storm System – **Area 6** (cfs)	Runoff to Neighboring Property – **Area 7** (cfs)	Total Post-Development Runoff – With Detention (cfs)
2-Yr	0.235	1.65	0.77	2.58
10-Yr	0.275	2.30	1.07	3.57
100-Yr	14.33	3.47	1.62	15.50

Note: "Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results."

Table 5 below displays the peak runoff rates for the existing pre-developed and post-developed conditions of the site.

Table 5 – Proposed Total Site Runoff Hydraflow Results			
Storm Event (yr)	Existing Site Runoff (cfs)	Total Post-Development Runoff – With Detention (cfs)	Net Reduction in Post-Developed Site Discharge (cfs)
2-Yr	16.66	2.58	14.08
10-Yr	23.26	3.57	19.69
100-Yr	35.04	15.50	19.54

Note: "Total Peak Qs will be less than the simple sum of the areas due to a difference in time to peak discharge. See Appendix C for Hydraflow results."

Storm Water Quality

The Mid-America Regional Council, Manual of Best Management Practices for Stormwater Quality, October 2012 requires the site to be designed to capture and treat the additional impervious runoff during the 90% mean annual storm (1.37"/24 hr) created by site improvements. The outlet structure from the detention basin will control discharge from the 90% mean annual event to the minimum forty-hour extended detention requirement for comprehensive control. The impervious area for the site has increased by 8.21 acres, requiring a value rating of 6.7. To address this requirement, a majority of the runoff from the site will be pre-treated through inlet filter baskets prior to being discharged into the extended dry detention basin. BMP worksheets 1A and 2 are included in Appendix B of this report. The combination of BMP trains, the extended dry detention basin, and the establishment/preservation of native vegetation will meet the required level of service for BMP's.

Summary

Lot 1 of the Lee's Summit Town Centre development is located at the northeast corner of NE Town Centre Blvd. and NE Town Centre Dr. in Lee's Summit, MO. The existing undeveloped site is 11.61 acres, with the entirety of the property being pervious. Runoff from the site currently generally flows from the north to south and into a pond located on the east side of the property. A portion of the property in the southwest corner drains from east to west and down the sloped areas into curb inlets located near the intersection of NE Town Centre Blvd. and NE Town Centre Dr.

The on-site increase in stormwater runoff will be directed to an on-site extended dry detention basin located on the east side of the property. The detention basin and the outlet structure will reduce overall post-developed stormwater runoff to below pre-developed conditions. 1.89 acres of the proposed site will discharge off-site to either the existing public storm sewer system or the existing detention basin on the newly-developed property to the east.

Conclusions and Recommendations

It has been concluded that an extended dry detention basin will be added to Lot 1 of the Lee's Summit Town Centre Development to reduce site runoff from the increase in impervious area. A new private storm sewer system will be added to convey the runoff into the on-site detention basin and eventually into the detention basin on the neighboring property to the east.

The addition of the on-site detention basin will reduce runoff to the downstream system and will meet the requirements set forth in APWA Section 5601 and 5608 for water quality and peak-runoff. Stormwater pretreatment BMP's for the site will be provided through the extended dry detention basin, as well as pre-treatment through inlet filter baskets. These treatment systems, along with the native vegetation to be established on the east, west, and south sides of the project will enhance the water quality LOS from the site's existing conditions. No waivers from the City of Lee's Summit's Design & Construction Manual (DCM) will be requested for the proposed development. No further reduction of storm water runoff or additional BMPs should be required for this project site. This project will cause no adverse impact to the downstream structures/system.

.

Appendix A

Local Benchmarks:

BM–1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM–2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Floodplain Note:

The site lies entirely with "Zone X", areas determined to be outside the 0.2% annual chance floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) no. 29095C0430G, Revision Date: January 20, 2017.

Fire Protection Notes:

a. Plans and specifications, in accordance with NFPA 24, for the private fire line shall be submitted for review and approval prior to installation.
b. Underground fire line installation including thrust blocks shall be inspected prior to being backfilled.
c. Hydrostatic testing and flushes shall be completed with the fire department as a witness

Utility Legend

existing
proposed

Linetypes

sanm / sans	sanitary main / sanitary service
	storm sewer (existing)
	storm sewer (solid wall, proposed)
stm	storm sewer (solid wall, proposed)
	storm sewer (perforated, proposed)
wtrm	water main
wtrf	water service (fire)
wtrd	water service (domestic)
wtri	water service (irrigation)
gasm	natural gas main
gass	natural gas service schematic
elpu	underground primary electric
elsu	underground secondary electric
elpo	overhead electric
datu	underground cable/phone/data
datsu	underground cable/phone/data service
	fence–chainlink
	fence–wood
	fence–barbed wire
	treeline

Symbols

- sanitary manhole
- service cleanout
- force main release valve
- rectangular structure
- circular structure
- fire hydrant
- water valve
- water meter
- backflow preventer
- natural gas meter
- service transformer (pad mount)
- primary switch gear
- light pole
- cable/phone/data junction box
- street light
- pedestrian street light
- electric pole
- guy wire
- end section

Property Legend

- right of way
- property lines
- easements
- setbacks

Grading Legend

- existing minor contour
- existing major contour
- proposed minor contour
- proposed major contour

Construction Legend

- concrete pavement
- standard asphalt
- heavy duty asphalt
- concrete sidewalk
- standard curb & gutter
- standard dry curb & gutter
- gravel
- retaining wall
- detention basin

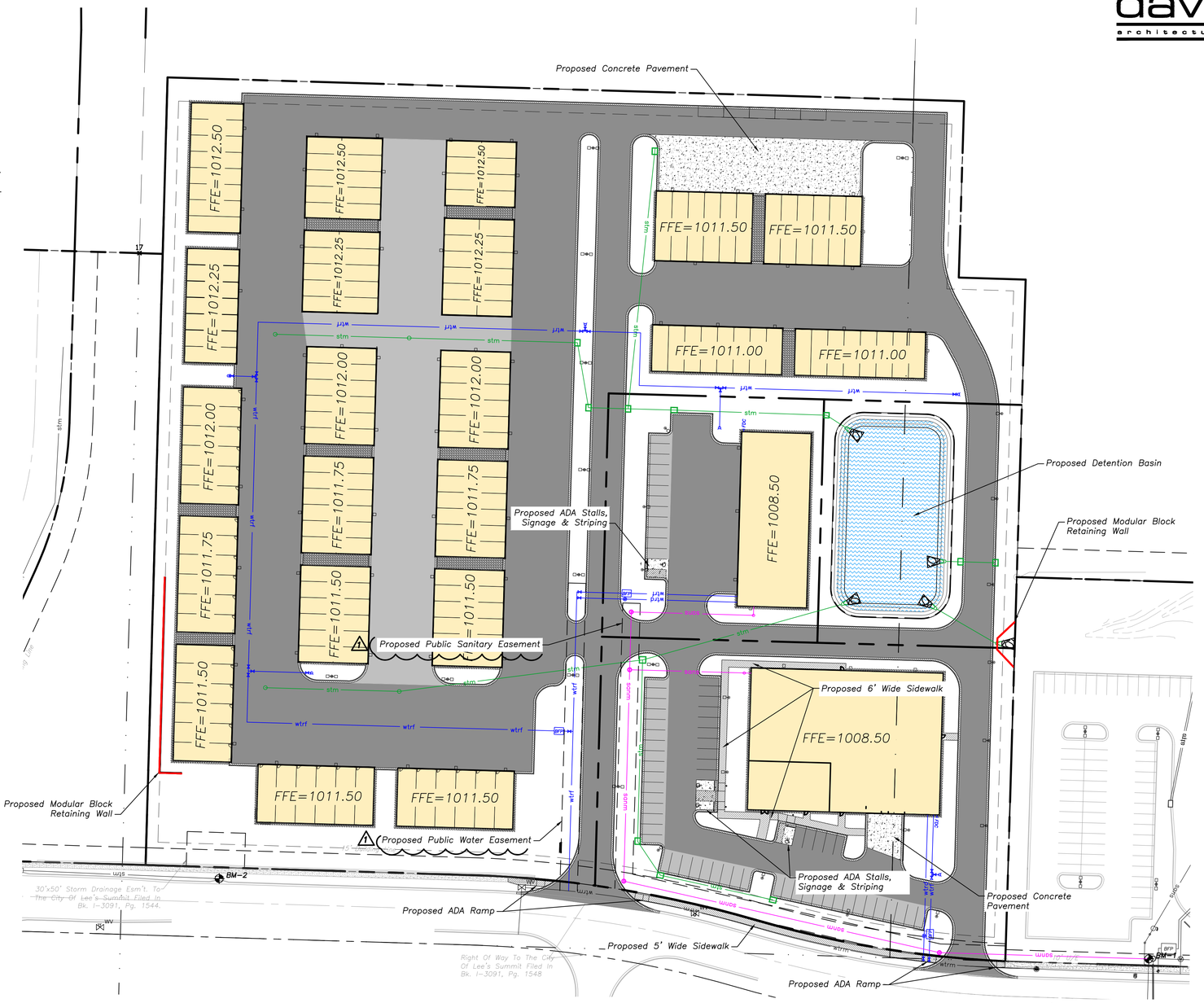
Utility Legend

sanm	existing sanitary main
wtrm	existing water main
stm	existing storm sewer
gasm	existing gas main
elpu	existing underground electric
elpo	existing overhead electric
datu	existing underground data
sanm	proposed sanitary main
sans	proposed sanitary service
wtrm	proposed water main
wtrf	proposed fire line
wtrd	proposed water service
stm	proposed storm sewer
gasm	proposed gas main
gass	proposed gas service
elpu	proposed underground primary electric
elsu	proposed underground secondary electric
elpo	proposed overhead electric
datu	proposed underground data

Americans with Disabilities Act (ADA) Notes:

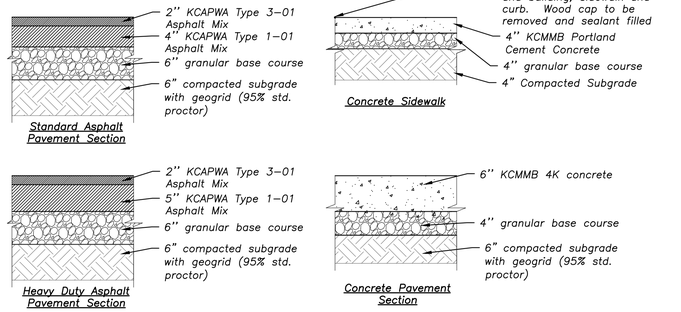
- The running and cross slopes for all sidewalks, accessible paths, ramps, designated parking stalls, etc., shall be in compliance with latest Federal ADA guidelines, in addition to any accessibility standards adopted by the governing municipality. Prior to installation/construction, if any discrepancies are found within the plans, the Engineer shall be notified.
- All ADA parking areas shall have NO slopes greater than 2% in any direction.

MISSOURI ONE CALL SYSTEM, INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!



north

1 Site Plan
scale: 1"=50'
0 25 50 100



davidson
architecture&engineering
4301 Indian Creek Parkway
Overland Park, KS 66207
phone: 913.451.9390
fax: 913.451.9391
www.davidsonae.com

Davidson Architecture & Engineering, LLC
License # 2010029713

STATE OF MISSOURI
PAUL A. MILLER
NUMBER E-28140
REGISTERED PROFESSIONAL ENGINEER
11/02/2021
Paul A. Miller
License # E-28140

a new development for
Town Centre Lot 1
520 NE Town Centre Drive
Lee's Summit, Missouri

data 10.01.2021
drawn by JMP
checked by PAM
revisions

11.02.2021	1

sheet number
C1.2
drawing type PDP & Rezoning
project number 20231

Map Scale: 1:1,650 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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: Jackson County, Missouri
Survey Area Data: Version 22, May 29, 2020

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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
10136	Sibley-Urban land complex, 2 to 5 percent slopes	8.3	81.8%
30080	Greenton silty clay loam, 5 to 9 percent slopes	1.9	18.2%
Totals for Area of Interest		**10.2**	**100.0%**

Jackson County, Missouri

10136—Sibley-Urban land complex, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql0j
Elevation: 720 to 1,080 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sibley and similar soils: 60 percent
Urban land: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sibley

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 65 inches: silty clay loam
C - 65 to 80 inches: silt loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 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: High (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C

Ecological site: R107BY002MO - Deep Loess Upland Prairie Amorpha canescens/Schizachyrium scoparium-Sporobolus heterolepis Leadplant/Little Bluestem-Prairie Dropseed
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Description of Urban Land

Setting

Landform: Interfluves
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Across-slope shape: Convex

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8
Hydric soil rating: No

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 22, May 29, 2020

Jackson County, Missouri

30080—Greenton silty clay loam, 5 to 9 percent slopes

Map Unit Setting

National map unit symbol: 2xjd9
Elevation: 640 to 1,120 feet
Mean annual precipitation: 35 to 41 inches
Mean annual air temperature: 50 to 57 degrees F
Frost-free period: 177 to 209 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Greenton and similar soils: 90 percent
Minor components: 10 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Greenton

Setting

Landform: Hillslopes
Landform position (two-dimensional): Shoulder
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Loess over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 12 inches: silty clay loam
Bt - 12 to 28 inches: silty clay
2Bt - 28 to 30 inches: silty clay
2C - 30 to 79 inches: silty clay

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: Very high
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 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 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): None specified

Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C/D
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: No

Minor Components

Sampsel

Percent of map unit: 10 percent
Landform: Hillslopes
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Ecological site: R109XY002MO - Loess Upland Prairie
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 22, May 29, 2020

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

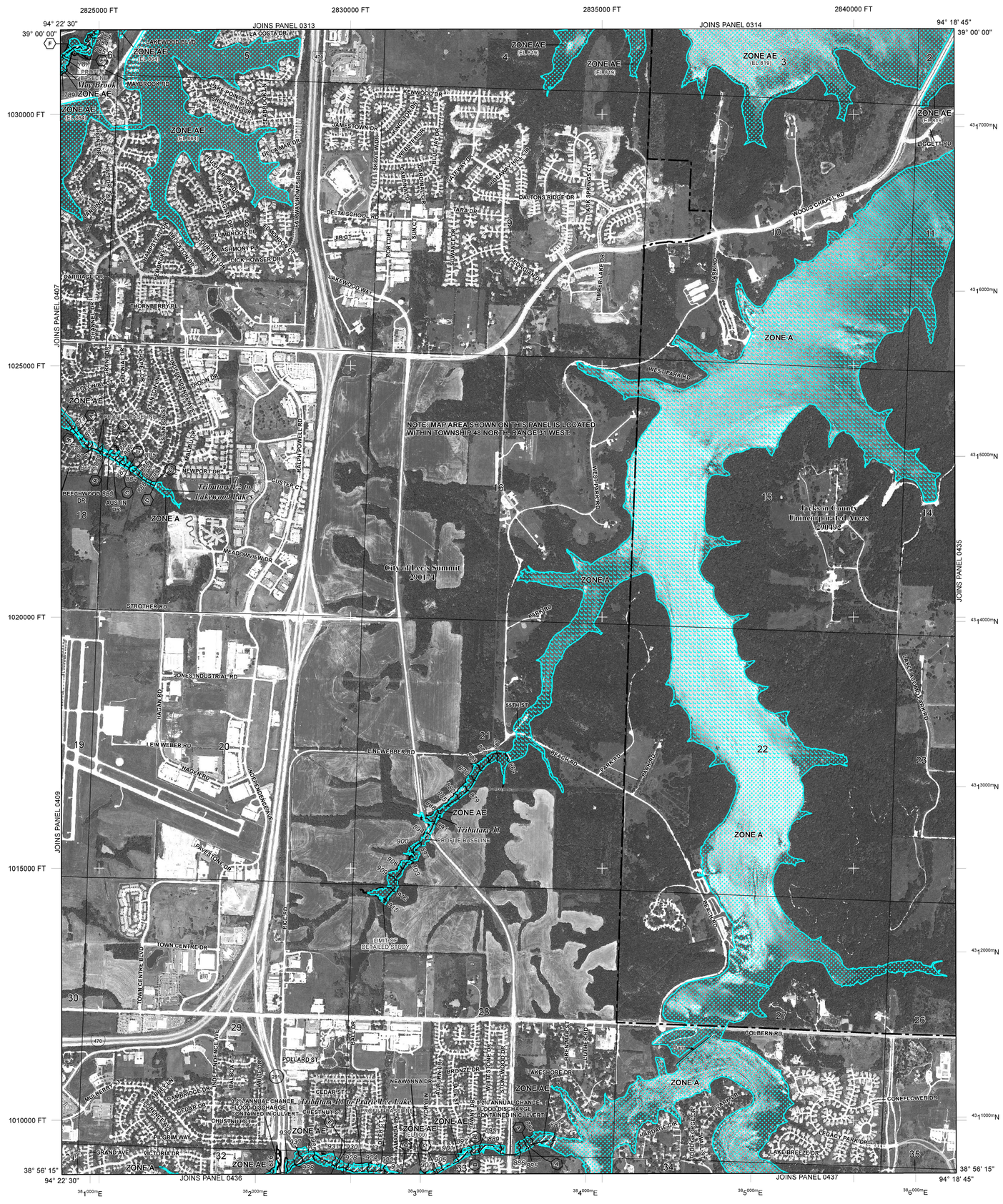
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% Annual Chance Floodplain Boundary
	0.2% Annual Chance Floodplain Boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 — 23	Transect line
	Culvert
	Bridge
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
3100000 FT	5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 29, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 20, 2017 - to change Special Flood Hazard Areas.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0430G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 430 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSON COUNTY	290492	0430	G
LEE'S SUMMIT, CITY OF	290174	0430	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0430G
MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

Local Benchmarks:

BM-1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM-2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Drainage Legend

- drainage area

Property Legend

- right of way
- property lines
- easements
- setbacks

Grading Legend

- existing minor contour
- existing major contour
- proposed minor contour
- proposed major contour

Utility Legend

- existing
- proposed

Linetypes

- sanm — sanitary main
- sans — sanitary service
- storm sewer (existing)
- storm sewer (solid wall, proposed)
- stm — storm sewer (solid wall, proposed)
- storm sewer (perforated, proposed)
- wtrm — water main
- wtrf — water service (fire)
- wtrd — water service (domestic)
- wtri — water service (irrigation)
- gasm — natural gas main
- gass — natural gas service schematic
- elpu — underground primary electric
- elsu — underground secondary electric
- elpo — overhead electric
- datu — underground cable/phone/data
- datsu — underground cable/phone/data service
- fence–chainlink
- fence–wood
- fence–barbed wire
- treeline

Symbols

- S — sanitary manhole
- co — service cleanout
- fmv — force main release valve
- rectangular structure
- circular structure
- fire hydrant
- wv — water valve
- M — water meter
- BFP — backflow preventer
- g — natural gas meter
- T — service transformer (pad mount)
- S — primary switch gear
- light pole
- C — cable/phone/data junction box
- street light
- pedestrian street light
- electric pole
- guy wire
- end section

1 *Existing Drainage Area Map*
scale: 1"=80'
0 40 80 160
north

Pre-Construction Impervious Area Calculations

		Square Feet	Acres
Area of Site		505,732	11.61
Impervious Area	▨	0	0
Pervious Area	▨	505,732	11.61

Q: 10 year 23.26 cfs
100 year 35.04 cfs

MISSOURI ONE CALL SYSTEM, INC.
1-800-344-7483
STOP-CALL BEFORE YOU DIG!

davidson
architecture & engineering

4301 Indian Creek Parkway
Overland Park, KS 66207
phone: 913.451.9390
fax: 913.451.9391
www.davidsonae.com

Davidson Architecture & Engineering, LLC
License # 2010029713

PAUL A. MILLER
NUMBER
E-28140
11/02/2021
Paul A. Miller
License # E-28140

a new development for
Town Centre Lot 1
520 NE Town Centre Drive
Lee's Summit, Missouri

date
10.01.2021
drawn by
JMP
checked by
PAM
revisions
11.02.2021 1

sheet number
C3.1
drawing type
PDP & Rezoning
project number
20231

Local Benchmarks:

BM–1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM–2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Drainage Legend

drainage area

Property Legend

right of way
property lines
easements
setbacks

Grading Legend

existing minor contour
existing major contour
proposed minor contour
proposed major contour

Utility Legend

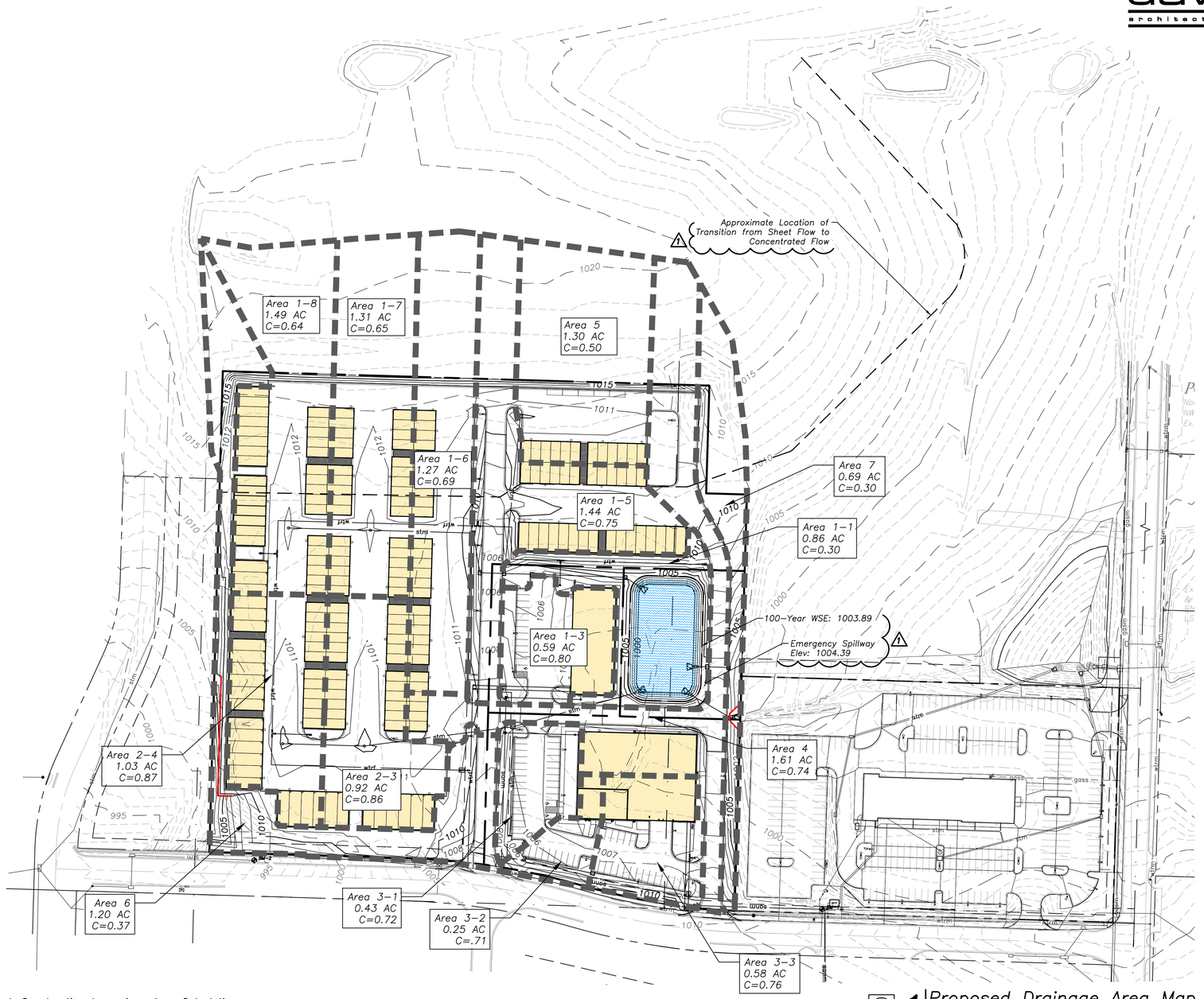
existing
proposed

Linetypes

sanm	sanitary main
sans	sanitary service
sts	storm sewer (existing)
stsw	storm sewer (solid wall, proposed)
stm	storm sewer (solid wall, proposed)
stp	storm sewer (perforated, proposed)
wtrm	water main
wtrf	water service (fire)
wtrd	water service (domestic)
wtri	water service (irrigation)
gasm	natural gas main
gass	natural gas service schematic
elpu	underground primary electric
elsu	underground secondary electric
elpo	overhead electric
datu	underground cable/phone/data
datsu	underground cable/phone/data service
	fence–chainlink
	fence–wood
	fence–barbed wire
	treeline

Symbols

- sanitary manhole
- service cleanout
- force main release valve
- rectangular structure
- circular structure
- fire hydrant
- water valve
- water meter
- backflow preventer
- natural gas meter
- service transformer (pad mount)
- primary switch gear
- light pole
- cable/phone/data junction box
- street light
- pedestrian street light
- electric pole
- guy wire
- end section



Post–Construction Impervious Area Calculations

	Square Feet	Acres
Area of Site	505,723	11.61
Impervious Area	366,377	8.21
Pervious Area	139,346	3.40

Q: 10 year 3.57 cfs
100 year 15.50 cfs

1 Proposed Drainage Area Map
scale: 1"=80'
north
0 40 80 160

davidson
architecture&engineering
4301 Indian Creek Parkway
Overland Park, KS 66207
phone: 913.451.9380
fax: 913.451.9381
www.davidsonae.com

Davidson Architecture & Engineering, LLC
License # 2010029713

STATE OF MISSOURI
PAUL A. MILLER
NUMBER E-28140
REGISTERED PROFESSIONAL ENGINEER
11/02/2021
Paul A. Miller
License # E-28140

Town Centre Lot 1

a new development for

520 NE Town Centre Drive
Lee's Summit, Missouri

date
10.01.2021
drawn by
JMP
checked by
PAM
revisions
11.02.2021 1

MISSOURI ONE CALL SYSTEM, INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!

sheet number
C3.2
drawing type
PDP & Rezoning
project number
20231

Local Benchmarks:

BM-1: (Sanitary Sewer Manhole, Center of Lid)
Elevation: 1006.88'
N: 1013449.78
E: 2826933.88

BM-2: (Storm Sewer Curb Inlet, Center of Lid)
Elevation: 994.34'
N: 1013518.71
E: 2826136.03

Grading Legend

- existing minor contour
- existing major contour
- proposed minor contour
- proposed major contour

Utility Legend

- existing
- proposed

Linetypes

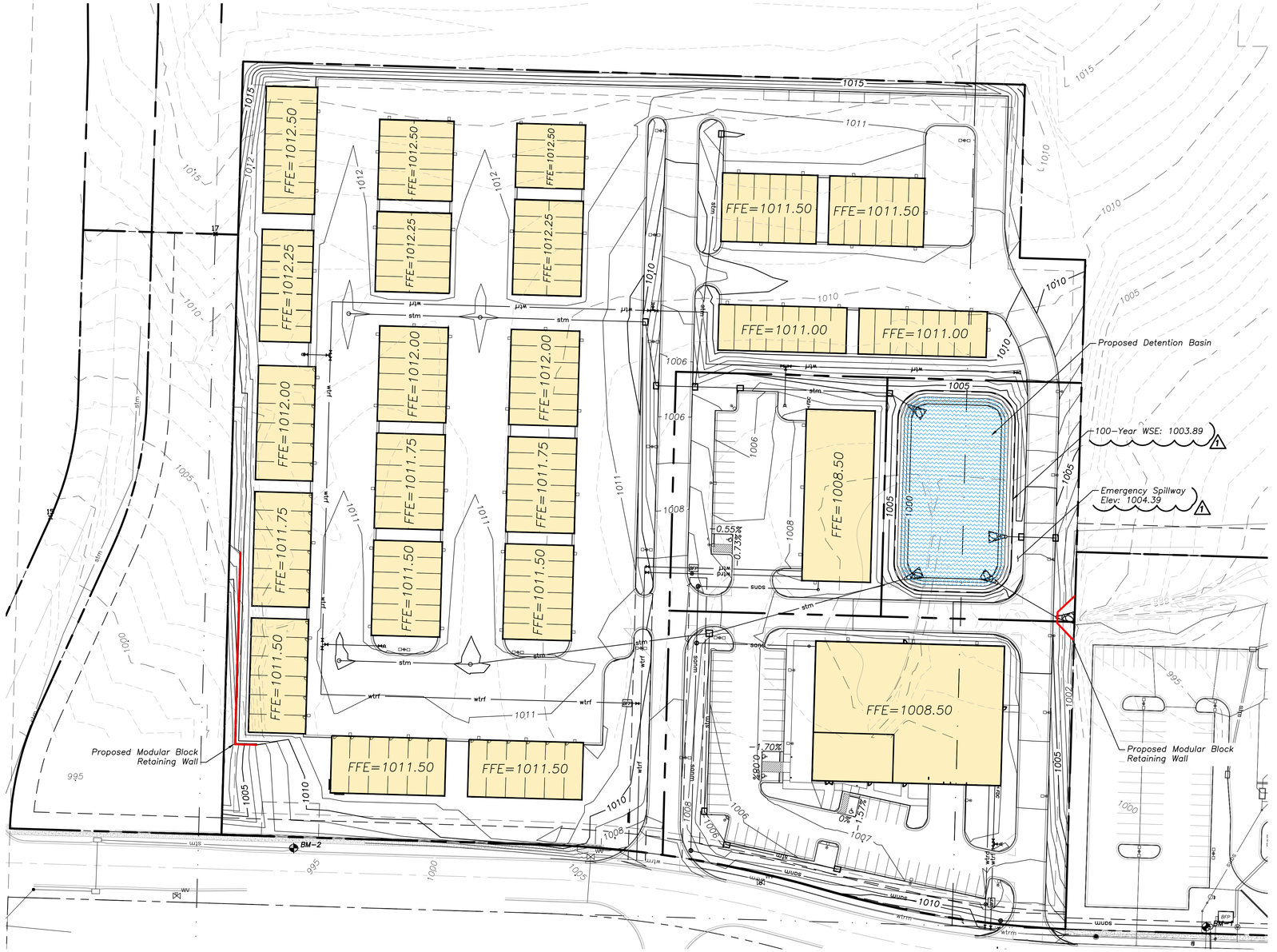
- sanm — sanitary main
- sans — sanitary service
- storm sewer (existing)
- storm sewer (solid wall, proposed)
- stm — storm sewer (solid wall, proposed)
- storm sewer (perforated, proposed)
- wtrm — water main
- wtrf — water service (fire)
- wtrd — water service (domestic)
- wtri — water service (irrigation)
- gasm — natural gas main
- gass — gass — natural gas service schematic
- elpu — underground primary electric
- elsu — underground secondary electric
- elpo — overhead electric
- datu — underground cable/phone/data
- datsu — underground cable/phone/data service
- fence-chainlink
- fence-wood
- fence-barbed wire
- treeline

Property Legend

- right of way
- property lines
- easements
- setbacks

Symbols

- S — sanitary manhole
- co — service cleanout
- fmv — force main release valve
- rectangular structure
- circular structure
- fire hydrant
- wv — water valve
- M — water meter
- BFP — backflow preventer
- natural gas meter
- T — service transformer (pad mount)
- S — primary switch gear
- light pole
- C — cable/phone/data junction box
- street light
- pedestrian street light
- electric pole
- guy wire
- end section



north

1 Grading Plan
scale: 1"=50'
0 25 50 100

davidson
architecture&engineering
4301 Indian Creek Parkway
Overland Park, KS 66207
phone: 913.451.9390
fax: 913.451.9391
www.davidsonae.com

Davidson Architecture & Engineering, LLC
License # 2010029713

STATE OF MISSOURI
PAUL A. MILLER
NUMBER E-28140
REGISTERED PROFESSIONAL ENGINEER
11/02/2021
Paul A. Miller
License # E-28140

a new development for
Town Centre Lot 1
520 NE Town Centre Drive
Lee's Summit, Missouri

date
10.01.2021
drawn by
JMP
checked by
PAM
revisions
11.02.2021 — 1

MISSOURI ONE CALL SYSTEM, INC. 1-800-344-7483 STOP-CALL BEFORE YOU DIG!

sheet number
C2.1
drawing type
PDP & Rezoning
project number
20231

Appendix B

WORKSHEET 1A: REQUIRED LEVEL OF SERVICE - UNDEVELOPED SITE

Project: Lee's Summit Town Centre - Lot 1 By: JMP
Location: Lee's Summit, Missouri Checked: PAM
Date: 11/1/2021

1. Runoff Curve Area

A. Predevelopment CN

Cover Description	Soil HSG	CN from Table 1	Area (ac.)	Product of CN x Area
Pervious Area	C/D	80	11.61	928.80
Impervious Area	D	98	0	0.00
				0.00
				0
		Totals:	11.61	928.8

Area-Weighted CN = total product/total area = **80.00**

B. Postdevelopment CN

Cover Description	Soil HSG[1]	CN from Table 1	Area (ac.)	Product of CN x Area
Pervious Area	C-D	80	3.2	256.00
Impervious Area	D	98	8.41	824.18
				0.00
				0
		Totals:	11.61	1080.18

[1] Postdevelopment CN is one HSG higher for all cover types except preserved vegetation, absent documentation showing how postdevelopment soil structure will be preserved.

Area-Weighted CN = total product/total area = **93.04**

C. Level of Service (LS) Calculation

Predevelopment CN:	80.00
Postdevelopment CN:	93.04
Difference:	13.04
LS Required (see new scale adopted by KCAPWA BMP Manual Addendum #1 Accepted November 10, 2016)	6.7

Change in CN	LS
17+	8
7 to 16	7
4 to 6	6
1 to 3	5
0	4
-7 to -1	3
-8 to -17	2
-18 to -21	1
-22 -	0

WORKSHEET 2: DEVELOP MITIGATION PACKAGE(S) THAT MEET THE REQUIRED LS

Project: Lee's Summit Town Centre - Lot 1 By: JMP
Location: Lee's Summit, Missouri Checked: PAM
Date: 11/1/2021

1. Required LS (from Table 1 or 1A or Worksheet 1 of 1A, as appropriate): **6.7**

Note: Various BMP's may alter CN of proposed development, and LS; recalculate both if applicable

2. Proposed BMP Option Package

Cover/BMP Description	Treatment Area	VR from Table 5 or 6	Product of VR x Area
Extended Dry Detention Basin	0.29	4	1.16
BMP Train - Flexstorm Inlet Filters to Extended Dry Detention	9.46	7	66.22
Drainage Offsite (Bypass Detention and/or Native Vegitation)	0.73	0	0
Native Vegitation Preserved or Established	1.13	9.25	10.4525
			0
			0
			0
TOTAL[2]:	11.61	**TOTAL:**	77.8325
		Weighted VR:	6.703919

[1] VR Calculated for Final BMP only in Treatment Train
[2] Total treatment area cannot exceed 100 percent of the actual site area
* Blank in redevelopment

Meets required LS (yes/no)? YES (If No, or if additional options are being tested, proceed below.)

3. Proposed BMP Option Package No. 2

Cover/BMP Description	Treatment Area	VR from Table 4.4 or 4.6[1]	Product of VR x Area
			0
			0
			0
			0
			0
			0
			0
TOTAL[2]:	0	**TOTAL:**	0
		***Weighted VR:**	0

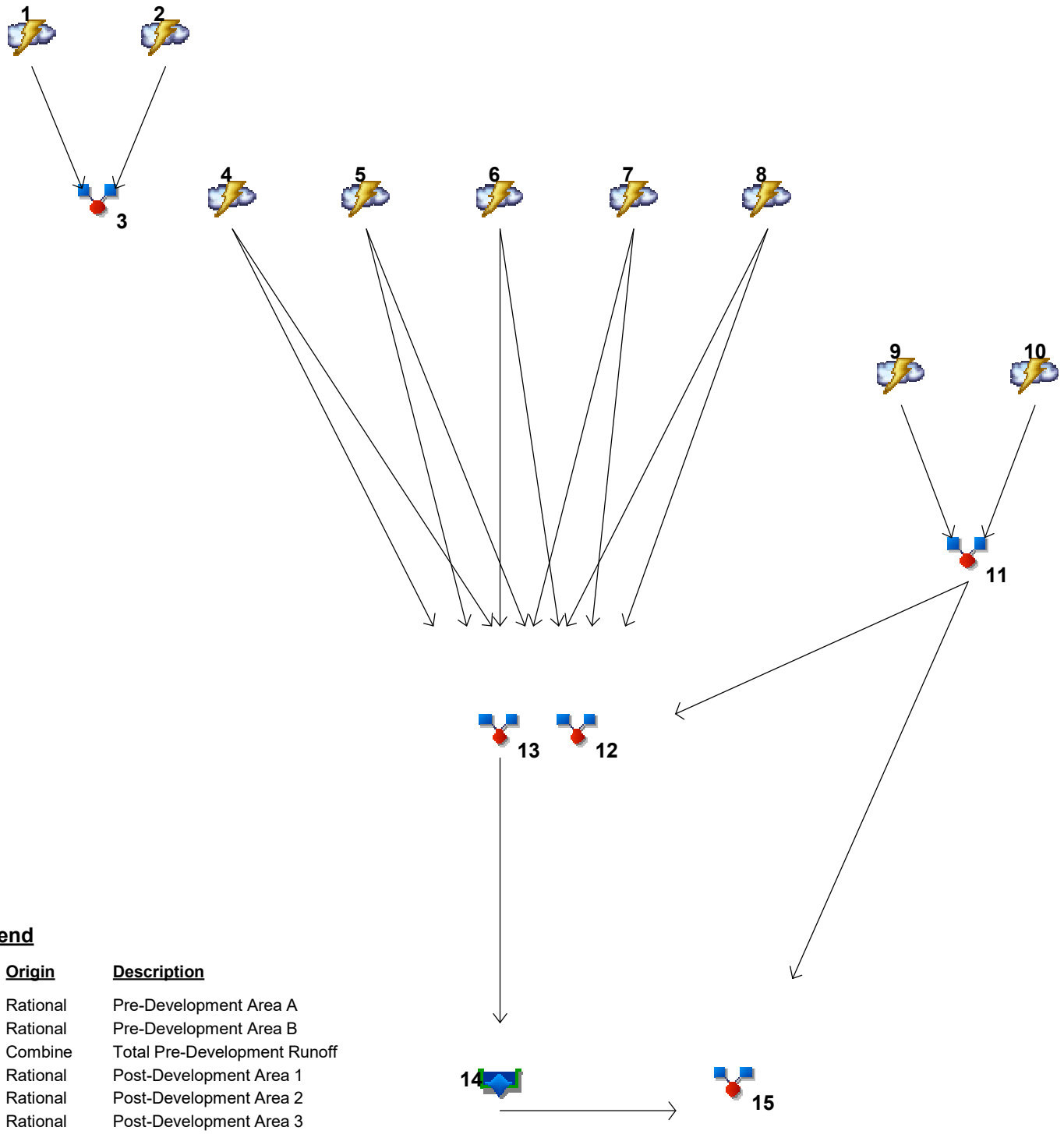
[1] VR Calculated for Final BMP only in Treatment Train
[2] Total treatment area cannot exceed 100 percent of the actual site area
* Blank in redevelopment

Meets required LS (yes/no)? NO (If No, or if additional options are being tested, move to next sheet.)

Appendix C

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	Pre-Development Area A
2	Rational	Pre-Development Area B
3	Combine	Total Pre-Development Runoff
4	Rational	Post-Development Area 1
5	Rational	Post-Development Area 2
6	Rational	Post-Development Area 3
7	Rational	Post-Development Area 4
8	Rational	Post- Development Area 5
9	Rational	Post-Development Area 6
10	Rational	Post-Development Area 7
11	Combine	Total Post-Development Offsite Runoff
12	Combine	Total Post-Development Runoff - No Detention
13	Combine	Post-Development Runoff to Detention
14	Reservoir	Detention Basin 1
15	Combine	Total Post-Development Runoff w/ Detention

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	1.410	1.793	-------	2.205	2.503	2.982	3.234	3.771	Pre-Development Area A
2	Rational	------	11.69	14.87	-------	18.28	20.76	24.73	26.82	31.27	Pre-Development Area B
3	Combine	1, 2	13.10	16.66	-------	20.49	23.26	27.71	30.05	35.04	Total Pre-Development Runoff
4	Rational	------	13.01	16.53	-------	20.33	23.09	27.50	29.83	34.78	Post-Development Area 1
5	Rational	------	4.979	6.329	-------	7.784	8.837	10.53	11.42	13.31	Post-Development Area 2
6	Rational	------	2.723	3.461	-------	4.256	4.832	5.757	6.244	7.279	Post-Development Area 3
7	Rational	------	3.479	4.422	-------	5.439	6.175	7.356	7.978	9.301	Post-Development Area 4
8	Rational	------	1.898	2.413	-------	2.967	3.369	4.013	4.353	5.075	Post- Development Area 5
9	Rational	------	1.296	1.648	-------	2.027	2.301	2.741	2.973	3.466	Post-Development Area 6
10	Rational	------	0.604	0.768	-------	0.945	1.073	1.278	1.386	1.616	Post-Development Area 7
11	Combine	9, 10	1.901	2.416	-------	2.972	3.374	4.019	4.359	5.082	Total Post-Development Offsite Runof
12	Combine	4, 5, 6, 7, 8, 11	27.99	35.58	-------	43.75	49.67	59.17	64.18	74.83	Total Post-Development Runoff - No
13	Combine	4, 5, 6, 7, 8,	26.09	33.16	-------	40.78	46.30	55.16	59.82	69.74	Post-Development Runoff to Detentio
14	Reservoir	13	0.209	0.235	-------	0.259	0.275	3.591	6.840	14.33	Detention Basin 1
15	Combine	11, 14	2.049	2.584	-------	3.157	3.572	4.235	7.480	15.50	Total Post-Development Runoff w/ De

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	1.793	1	15	1,614	------	------	------	Pre-Development Area A
2	Rational	14.87	1	15	13,379	------	------	------	Pre-Development Area B
3	Combine	16.66	1	15	14,993	1, 2	------	------	Total Pre-Development Runoff
4	Rational	16.53	1	15	14,881	------	------	------	Post-Development Area 1
5	Rational	6.329	1	15	5,696	------	------	------	Post-Development Area 2
6	Rational	3.461	1	15	3,115	------	------	------	Post-Development Area 3
7	Rational	4.422	1	15	3,980	------	------	------	Post-Development Area 4
8	Rational	2.413	1	15	2,171	------	------	------	Post- Development Area 5
9	Rational	1.648	1	15	1,483	------	------	------	Post-Development Area 6
10	Rational	0.768	1	15	692	------	------	------	Post-Development Area 7
11	Combine	2.416	1	15	2,175	9, 10	------	------	Total Post-Development Offsite Runof
12	Combine	35.58	1	15	32,018	4, 5, 6, 7, 8, 11	------	------	Total Post-Development Runoff - No
13	Combine	33.16	1	15	29,843	4, 5, 6, 7, 8,	------	------	Post-Development Runoff to Detentio
14	Reservoir	0.235	1	30	26,514	13	1002.21	29,585	Detention Basin 1
15	Combine	2.584	1	15	28,689	11, 14	------	------	Total Post-Development Runoff w/ De

Hydrograph Report

Hyd. No. 1

Pre-Development Area A

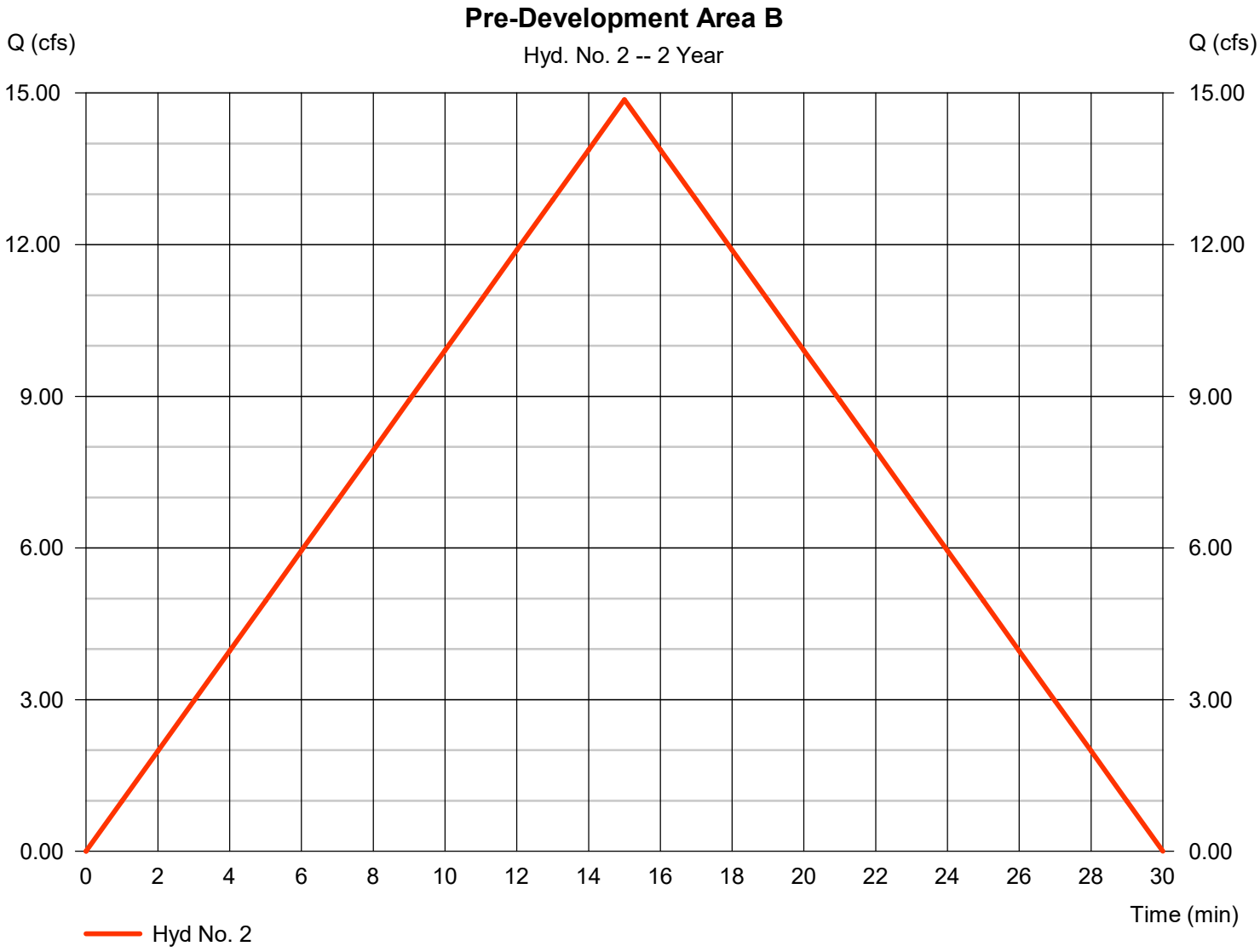
Hydrograph type	=	Rational	Peak discharge	=	1.793 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	1,614 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.3
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

Pre-Development Area B

Hydrograph type	=	Rational	Peak discharge	=	14.87 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	13,379 cuft
Drainage area	=	13.350 ac	Runoff coeff.	=	0.3
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

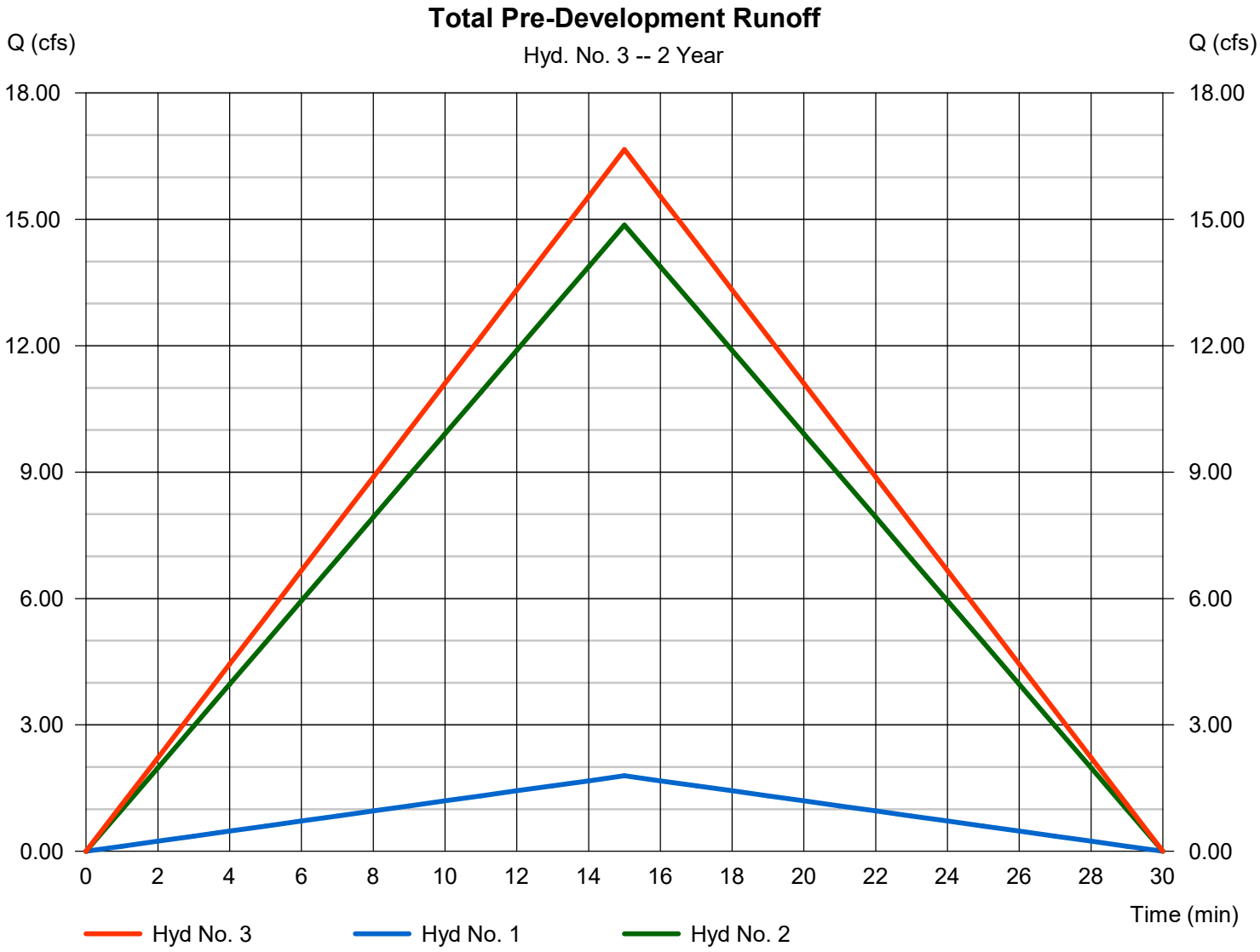


Hydrograph Report

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type	= Combine	Peak discharge	= 16.66 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 14,993 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.960 ac

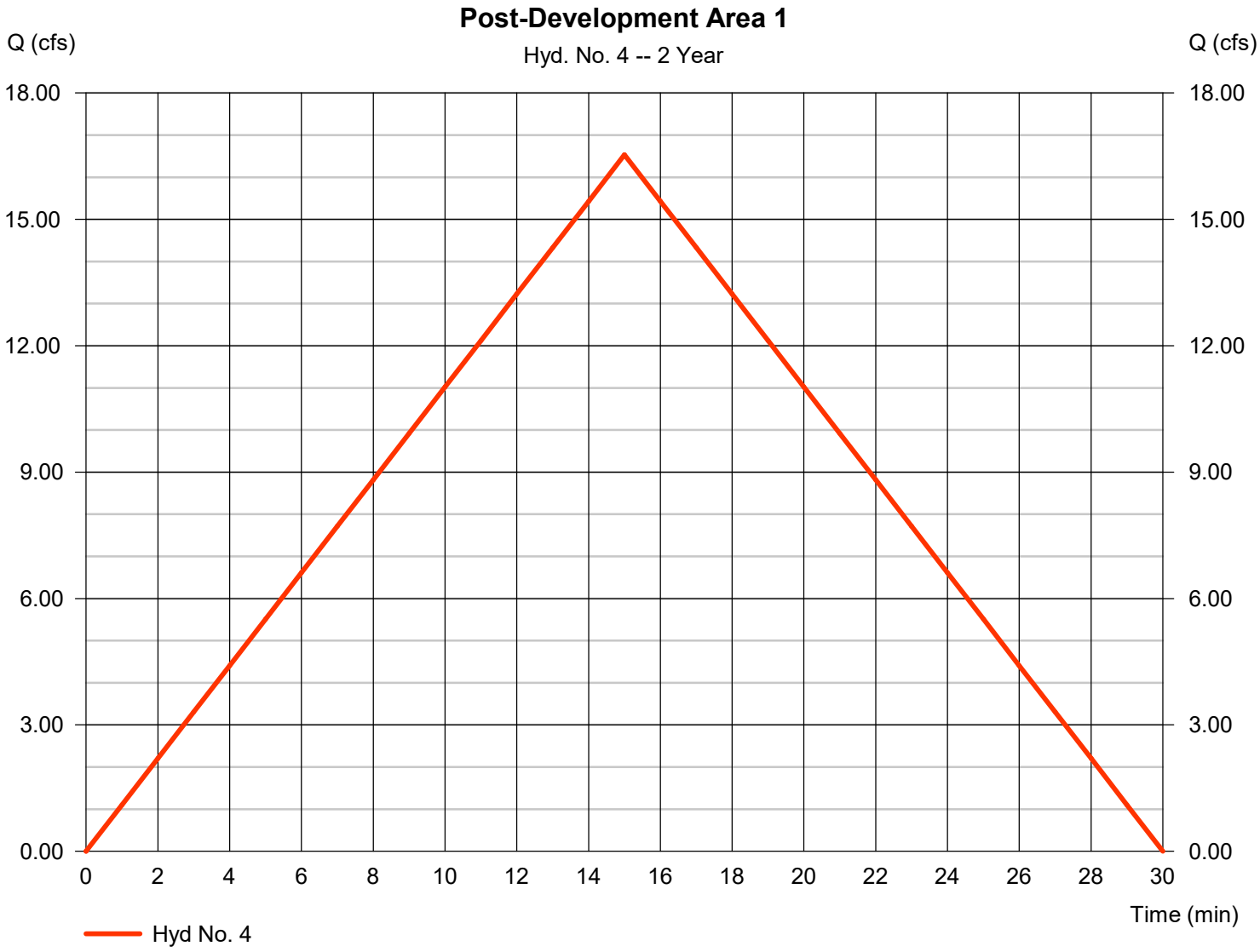


Hydrograph Report

Hyd. No. 4

Post-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	16.53 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	14,881 cuft
Drainage area	=	6.960 ac	Runoff coeff.	=	0.64
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

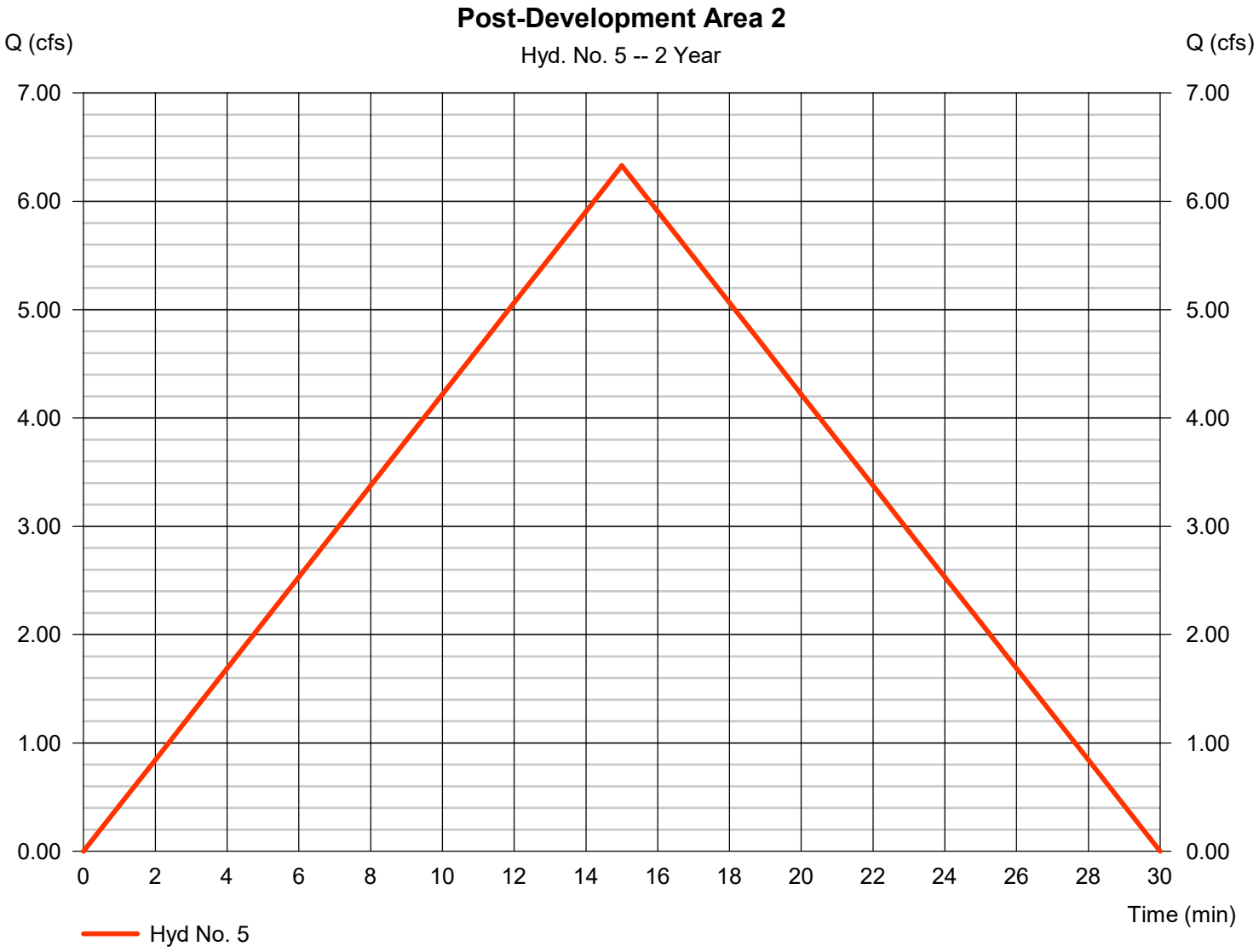


Hydrograph Report

Hyd. No. 5

Post-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	6.329 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	5,696 cuft
Drainage area	=	1.960 ac	Runoff coeff.	=	0.87
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

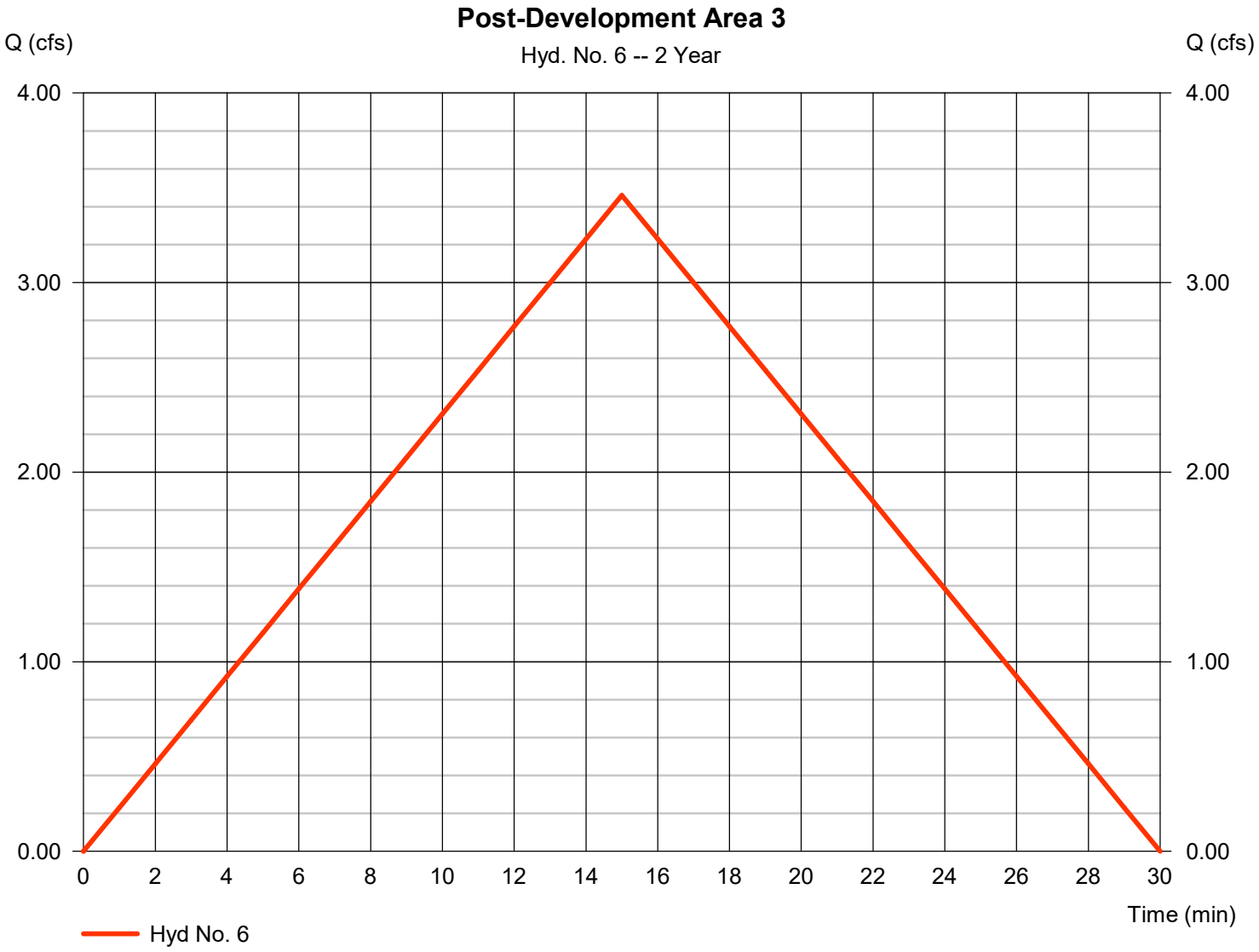


Hydrograph Report

Hyd. No. 6

Post-Development Area 3

Hydrograph type	=	Rational	Peak discharge	=	3.461 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,115 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.74
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

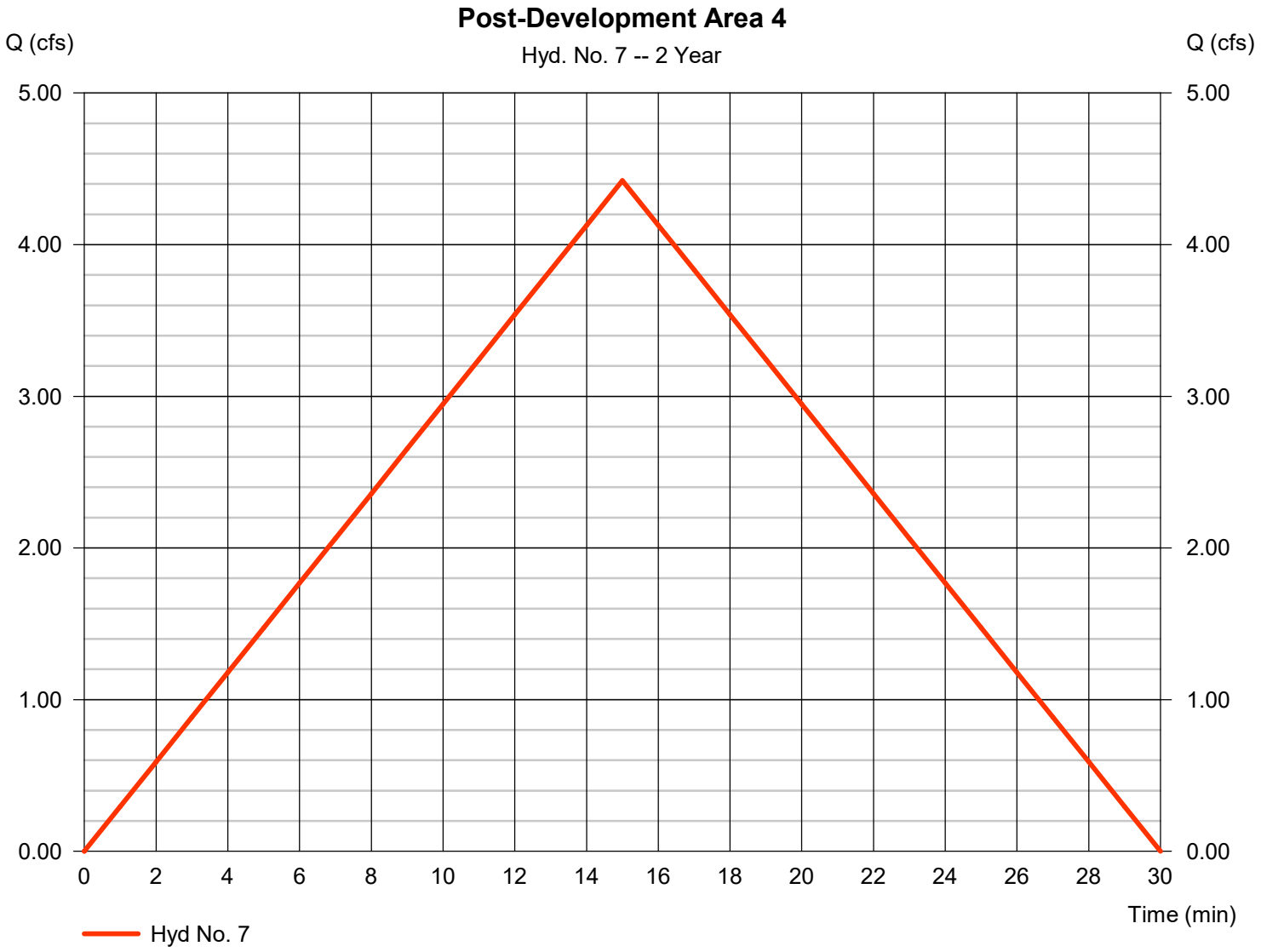


Hydrograph Report

Hyd. No. 7

Post-Development Area 4

Hydrograph type	= Rational	Peak discharge	= 4.422 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 3,980 cuft
Drainage area	= 1.610 ac	Runoff coeff.	= 0.74
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= Lenexa KS.IDF	Asc/Rec limb fact	= 1/1



Hydrograph Report

Hyd. No. 8

Post- Development Area 5

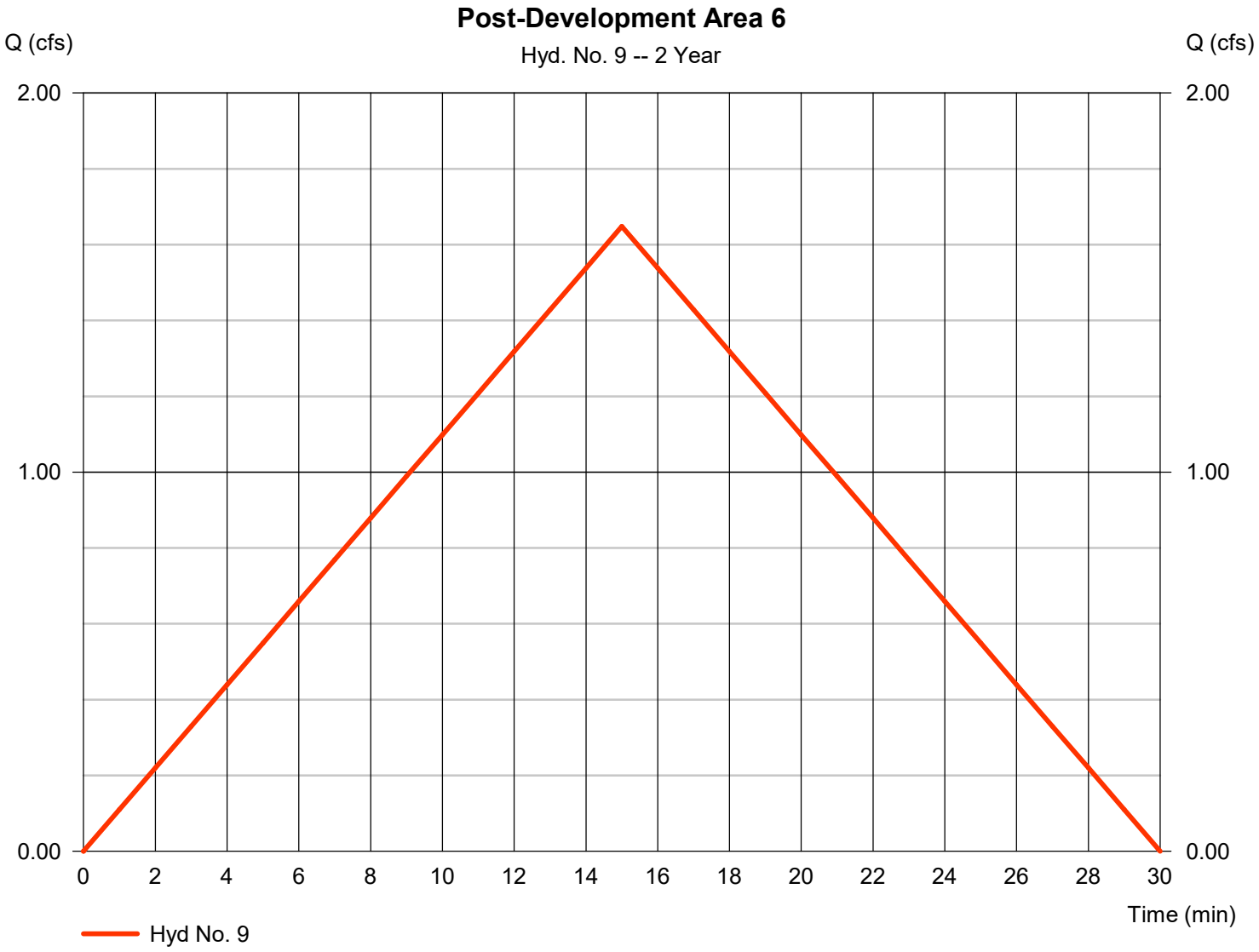
Hydrograph type	=	Rational	Peak discharge	=	2.413 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	2,171 cuft
Drainage area	=	1.300 ac	Runoff coeff.	=	0.5
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 9

Post-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	1.648 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	1,483 cuft
Drainage area	=	1.200 ac	Runoff coeff.	=	0.37
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

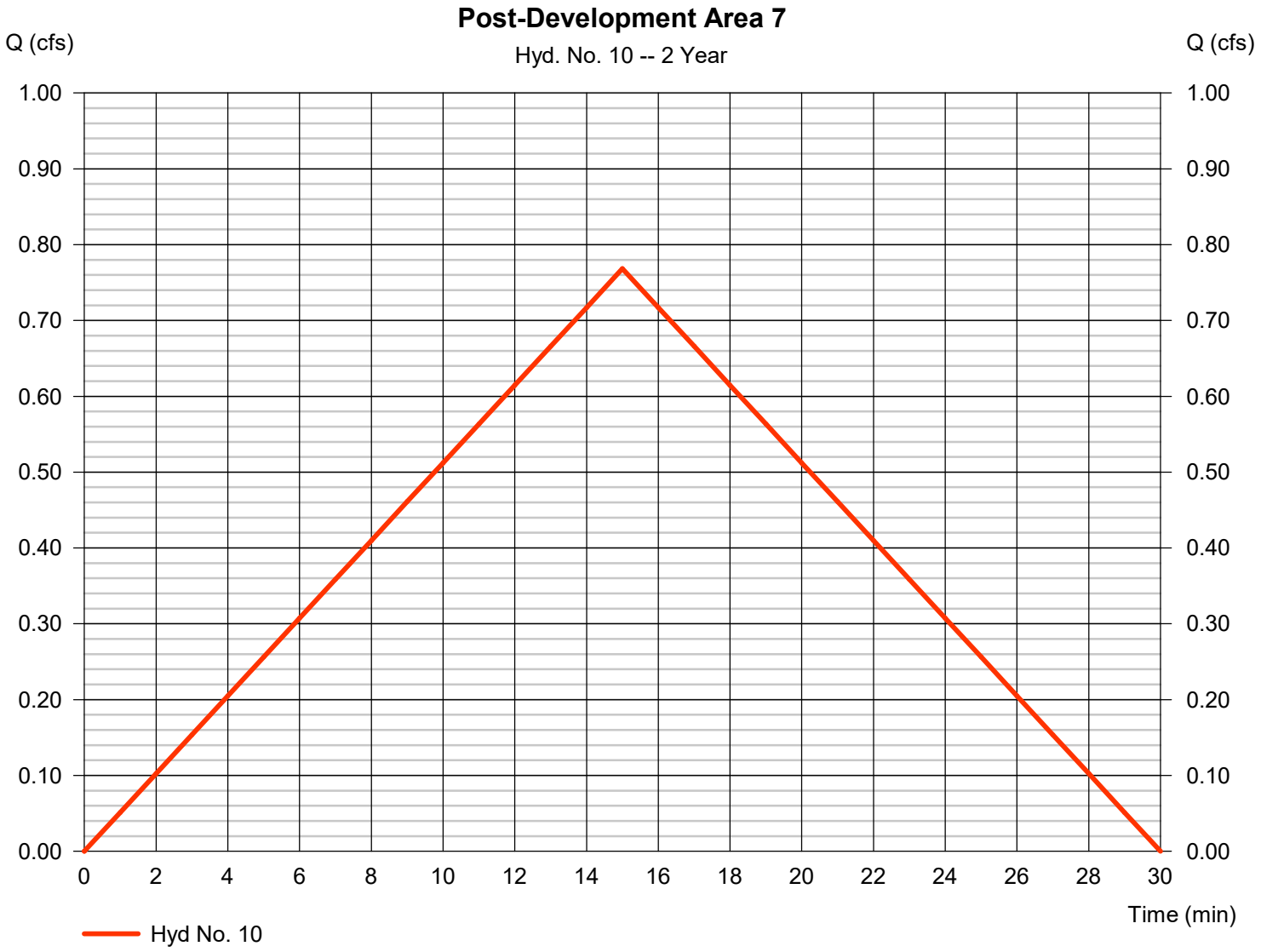


Hydrograph Report

Hyd. No. 10

Post-Development Area 7

Hydrograph type	=	Rational	Peak discharge	=	0.768 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	692 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	3.712 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

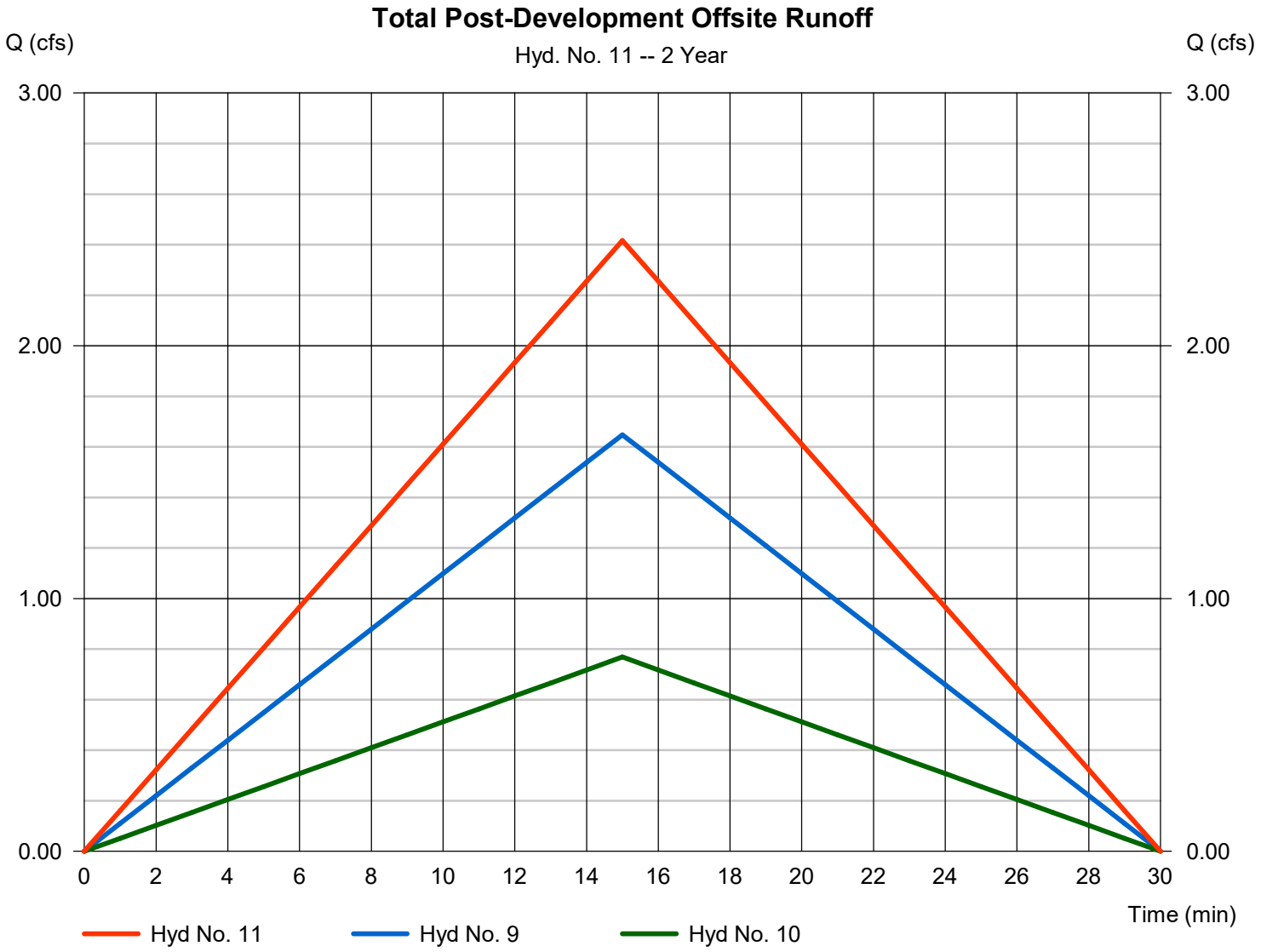


Hydrograph Report

Hyd. No. 11

Total Post-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 2.416 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 2,175 cuft
Inflow hyds.	= 9, 10	Contrib. drain. area	= 1.890 ac

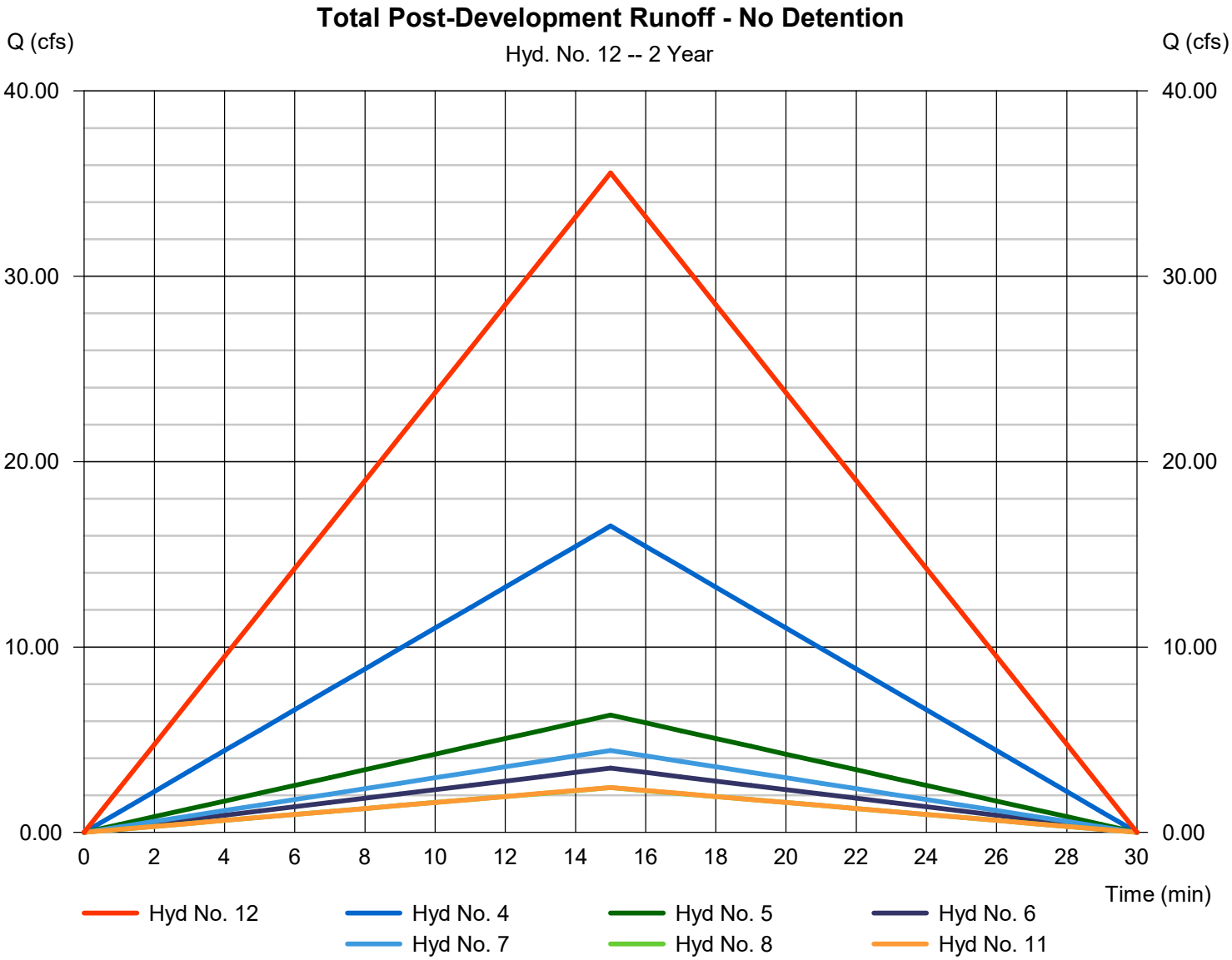


Hydrograph Report

Hyd. No. 12

Total Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 35.58 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 32,018 cuft
Inflow hyds.	= 4, 5, 6, 7, 8, 11	Contrib. drain. area	= 13.090 ac

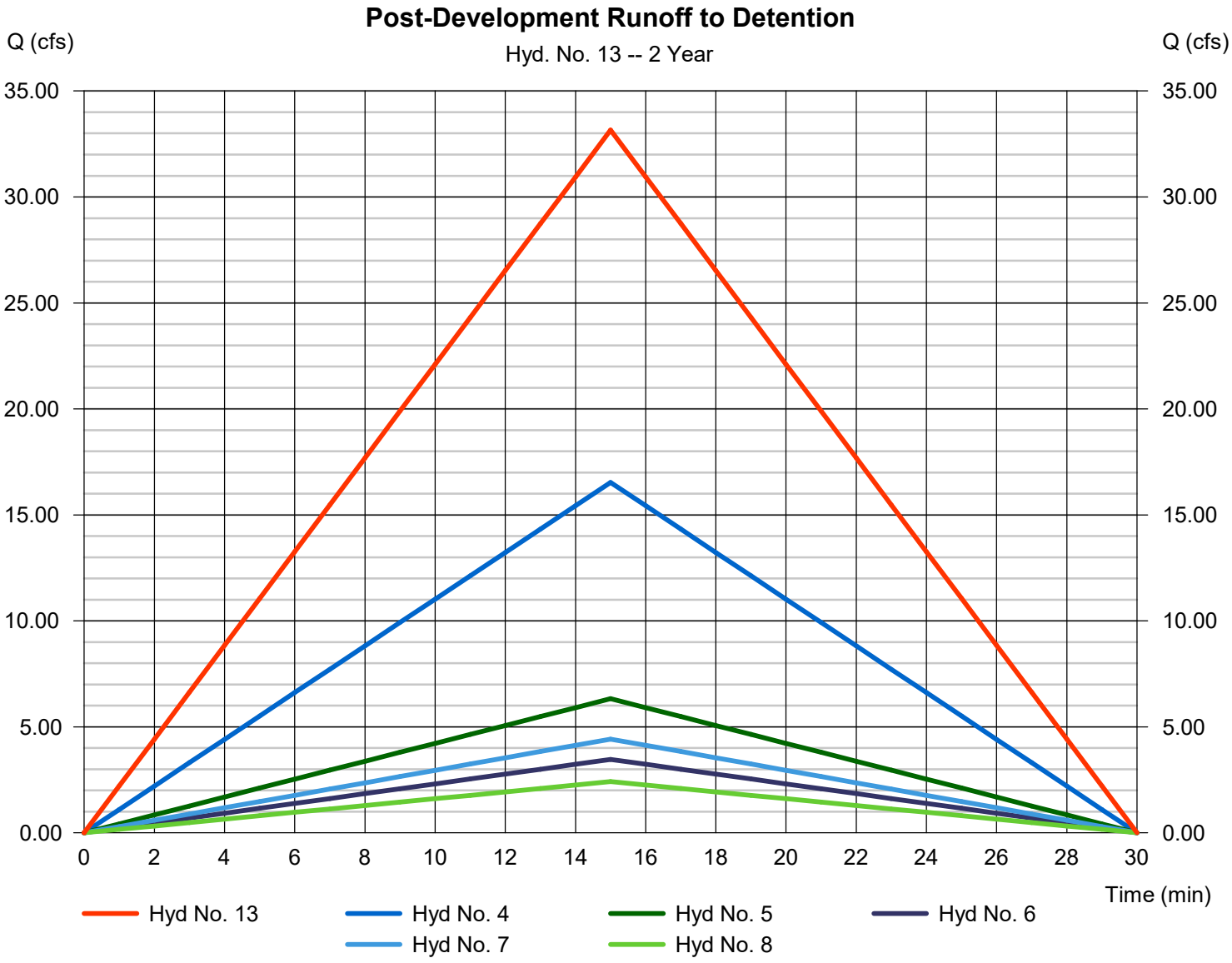


Hydrograph Report

Hyd. No. 13

Post-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 33.16 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 29,843 cuft
Inflow hyds.	= 4, 5, 6, 7, 8	Contrib. drain. area	= 13.090 ac



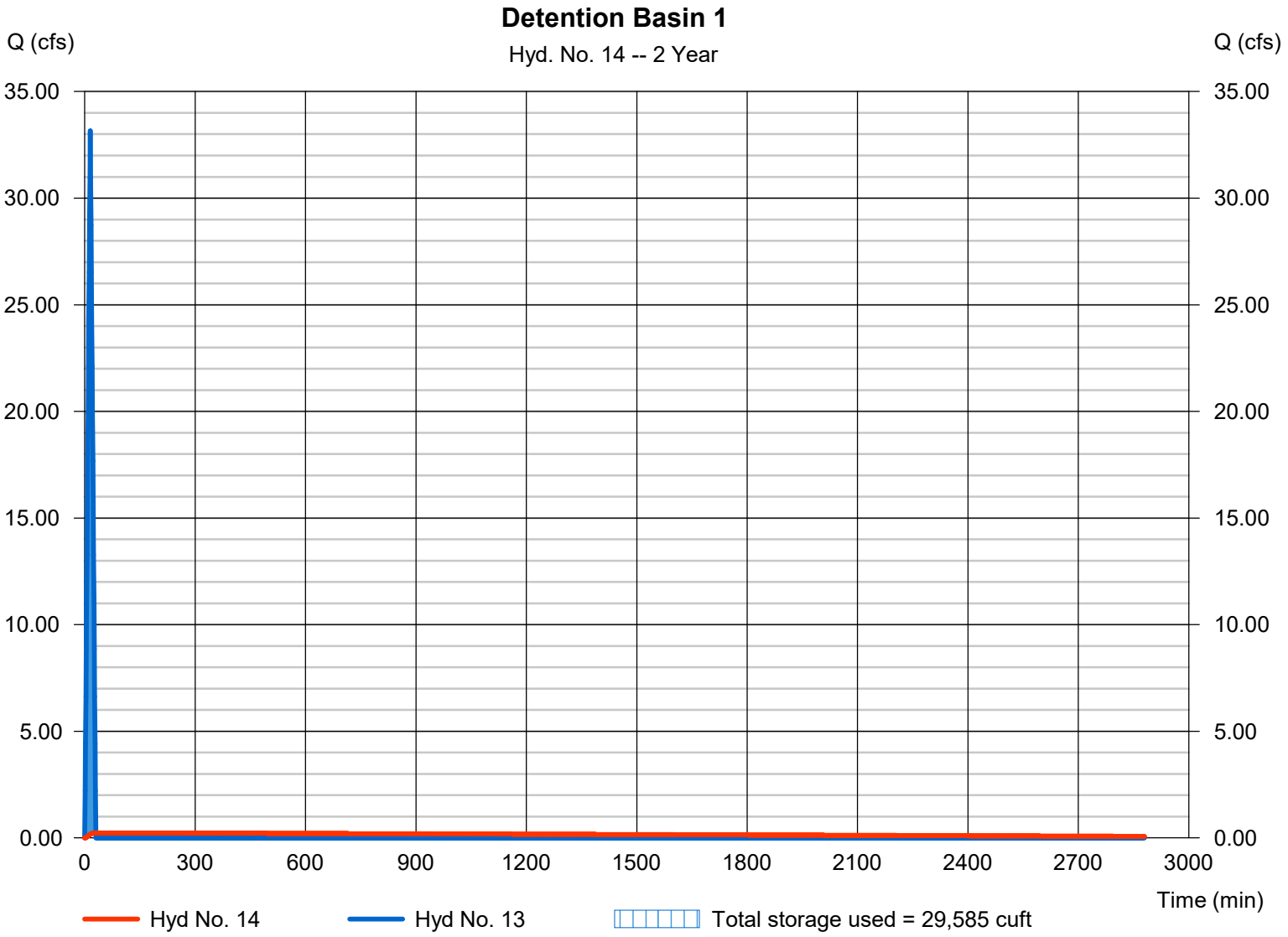
Hydrograph Report

Hyd. No. 14

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	0.235 cfs
Storm frequency	=	2 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	26,514 cuft
Inflow hyd. No.	=	13 - Post-Development Runoff to Detention	Max. Elevation	=	1002.21 ft
Reservoir name	=	Detention Basin	Max. Storage	=	29,585 cuft

Storage Indication method used.



Pond No. 1 - Detention Basin

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1000.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1000.00	11,836	0	0
1.00	1001.00	13,183	12,502	12,502
2.00	1002.00	14,586	13,877	26,379
3.00	1003.00	16,045	15,308	41,688
4.00	1004.00	17,561	16,796	58,483

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	2.50	Inactive	Inactive
Span (in)	= 30.00	2.50	0.00	1.50
No. Barrels	= 1	1	0	6
Invert El. (ft)	= 999.98	1000.00	0.00	1000.00
Length (ft)	= 58.75	0.10	0.00	5.80
Slope (%)	= 0.40	0.01	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 1003.10	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1000.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.10	1,250	1000.10	0.02 ic	0.02 ic	---	0.00	0.00	---	---	---	---	---	0.018
0.20	2,500	1000.20	0.05 ic	0.05 ic	---	0.00	0.00	---	---	---	---	---	0.051
0.30	3,751	1000.30	0.07 ic	0.07 ic	---	0.00	0.00	---	---	---	---	---	0.073
0.40	5,001	1000.40	0.10 ic	0.09 ic	---	0.00	0.00	---	---	---	---	---	0.089
0.50	6,251	1000.50	0.11 ic	0.10 ic	---	0.00	0.00	---	---	---	---	---	0.103
0.60	7,501	1000.60	0.13 ic	0.12 ic	---	0.00	0.00	---	---	---	---	---	0.115
0.70	8,752	1000.70	0.13 ic	0.13 ic	---	0.00	0.00	---	---	---	---	---	0.126
0.80	10,002	1000.80	0.14 ic	0.14 ic	---	0.00	0.00	---	---	---	---	---	0.136
0.90	11,252	1000.90	0.15 ic	0.15 ic	---	0.00	0.00	---	---	---	---	---	0.145
1.00	12,502	1001.00	0.16 ic	0.15 ic	---	0.00	0.00	---	---	---	---	---	0.153
1.10	13,890	1001.10	0.16 ic	0.16 ic	---	0.00	0.00	---	---	---	---	---	0.162
1.20	15,278	1001.20	0.18 ic	0.17 ic	---	0.00	0.00	---	---	---	---	---	0.169
1.30	16,665	1001.30	0.18 ic	0.18 ic	---	0.00	0.00	---	---	---	---	---	0.177
1.40	18,053	1001.40	0.18 ic	0.18 ic	---	0.00	0.00	---	---	---	---	---	0.185
1.50	19,441	1001.50	0.21 ic	0.19 ic	---	0.00	0.00	---	---	---	---	---	0.191
1.60	20,829	1001.60	0.21 ic	0.20 ic	---	0.00	0.00	---	---	---	---	---	0.198
1.70	22,216	1001.70	0.21 ic	0.20 ic	---	0.00	0.00	---	---	---	---	---	0.205
1.80	23,604	1001.80	0.21 ic	0.21 ic	---	0.00	0.00	---	---	---	---	---	0.211
1.90	24,992	1001.90	0.23 ic	0.22 ic	---	0.00	0.00	---	---	---	---	---	0.217
2.00	26,379	1002.00	0.23 ic	0.22 ic	---	0.00	0.00	---	---	---	---	---	0.223
2.10	27,910	1002.10	0.23 ic	0.23 ic	---	0.00	0.00	---	---	---	---	---	0.229
2.20	29,441	1002.20	0.23 ic	0.23 ic	---	0.00	0.00	---	---	---	---	---	0.234
2.30	30,972	1002.30	0.26 ic	0.24 ic	---	0.00	0.00	---	---	---	---	---	0.240
2.40	32,503	1002.40	0.26 ic	0.25 ic	---	0.00	0.00	---	---	---	---	---	0.245
2.50	34,033	1002.50	0.26 ic	0.25 ic	---	0.00	0.00	---	---	---	---	---	0.251
2.60	35,564	1002.60	0.26 ic	0.26 ic	---	0.00	0.00	---	---	---	---	---	0.256
2.70	37,095	1002.70	0.26 ic	0.26 ic	---	0.00	0.00	---	---	---	---	---	0.261
2.80	38,626	1002.80	0.29 ic	0.27 ic	---	0.00	0.00	---	---	---	---	---	0.266
2.90	40,157	1002.90	0.29 ic	0.27 ic	---	0.00	0.00	---	---	---	---	---	0.271
3.00	41,688	1003.00	0.29 ic	0.28 ic	---	0.00	0.00	---	---	---	---	---	0.276
3.10	43,367	1003.10	0.29 ic	0.28 ic	---	0.00	0.00	---	---	---	---	---	0.281
3.20	45,047	1003.20	0.91 ic	0.28 ic	---	0.00	0.63	---	---	---	---	---	0.910
3.30	46,726	1003.30	2.15 oc	0.27 ic	---	0.00	1.79	---	---	---	---	---	2.059
3.40	48,406	1003.40	3.63 oc	0.27 ic	---	0.00	3.28	---	---	---	---	---	3.549
3.50	50,085	1003.50	5.39 oc	0.26 ic	---	0.00	5.06	---	---	---	---	---	5.313
3.60	51,765	1003.60	7.41 oc	0.25 ic	---	0.00	7.06	---	---	---	---	---	7.312
3.70	53,445	1003.70	9.63 oc	0.24 ic	---	0.00	9.29	---	---	---	---	---	9.524

Continues on next page...

Detention Basin

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.80	55,124	1003.80	11.93 oc	0.22 ic	---	0.00	11.70	---	---	---	---	---	11.92
3.90	56,804	1003.90	14.49 oc	0.19 ic	---	0.00	14.30	---	---	---	---	---	14.49
4.00	58,483	1004.00	17.25 oc	0.19 ic	---	0.00	17.06	---	---	---	---	---	17.25

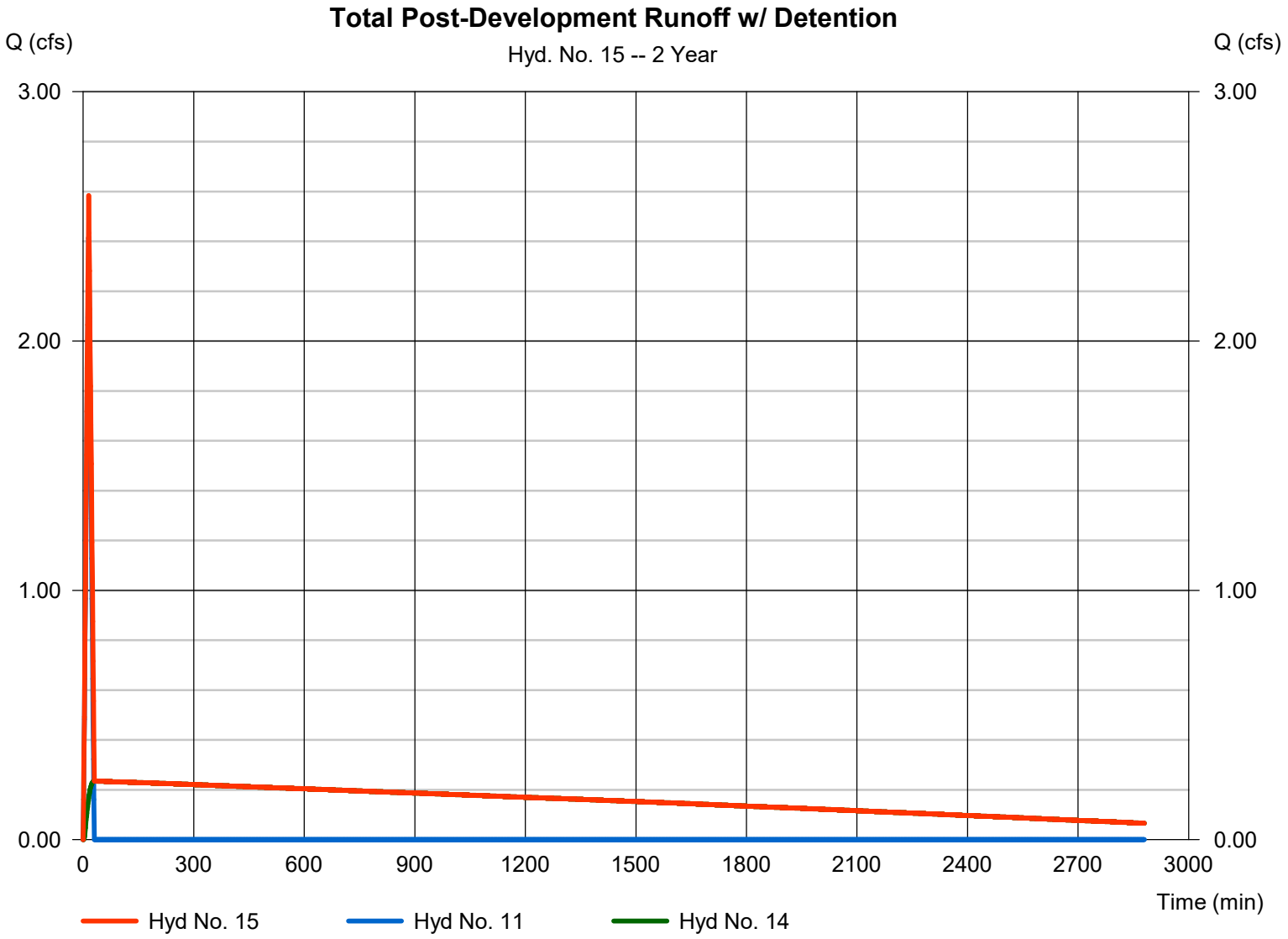
...End

Hydrograph Report

Hyd. No. 15

Total Post-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 2.584 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 28,689 cuft
Inflow hyds.	= 11, 14	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	2.503	1	15	2,253	------	------	------	Pre-Development Area A
2	Rational	20.76	1	15	18,681	------	------	------	Pre-Development Area B
3	Combine	23.26	1	15	20,934	1, 2	------	------	Total Pre-Development Runoff
4	Rational	23.09	1	15	20,777	------	------	------	Post-Development Area 1
5	Rational	8.837	1	15	7,954	------	------	------	Post-Development Area 2
6	Rational	4.832	1	15	4,349	------	------	------	Post-Development Area 3
7	Rational	6.175	1	15	5,557	------	------	------	Post-Development Area 4
8	Rational	3.369	1	15	3,032	------	------	------	Post- Development Area 5
9	Rational	2.301	1	15	2,071	------	------	------	Post-Development Area 6
10	Rational	1.073	1	15	966	------	------	------	Post-Development Area 7
11	Combine	3.374	1	15	3,036	9, 10	------	------	Total Post-Development Offsite Runof
12	Combine	49.67	1	15	44,705	4, 5, 6, 7, 8, 11	------	------	Total Post-Development Runoff - No
13	Combine	46.30	1	15	41,668	4, 5, 6, 7, 8,	------	------	Post-Development Runoff to Detentio
14	Reservoir	0.275	1	30	34,153	13	1002.98	41,362	Detention Basin 1
15	Combine	3.572	1	15	37,189	11, 14	------	------	Total Post-Development Runoff w/ De

Hydrograph Report

Hyd. No. 1

Pre-Development Area A

Hydrograph type	=	Rational	Peak discharge	=	2.503 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	2,253 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

Pre-Development Area B

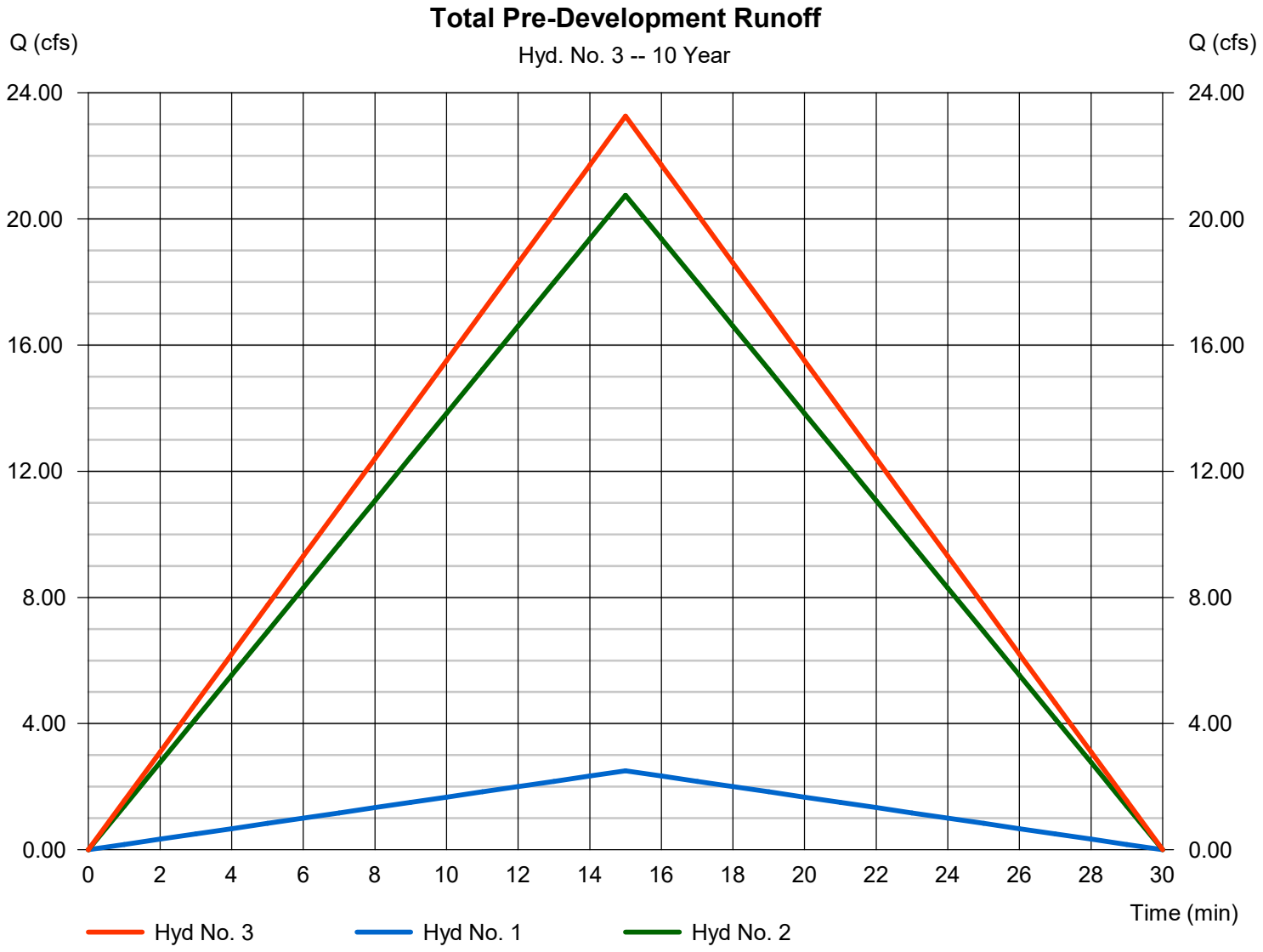
Hydrograph type	=	Rational	Peak discharge	=	20.76 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	18,681 cuft
Drainage area	=	13.350 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type	= Combine	Peak discharge	= 23.26 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 20,934 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.960 ac

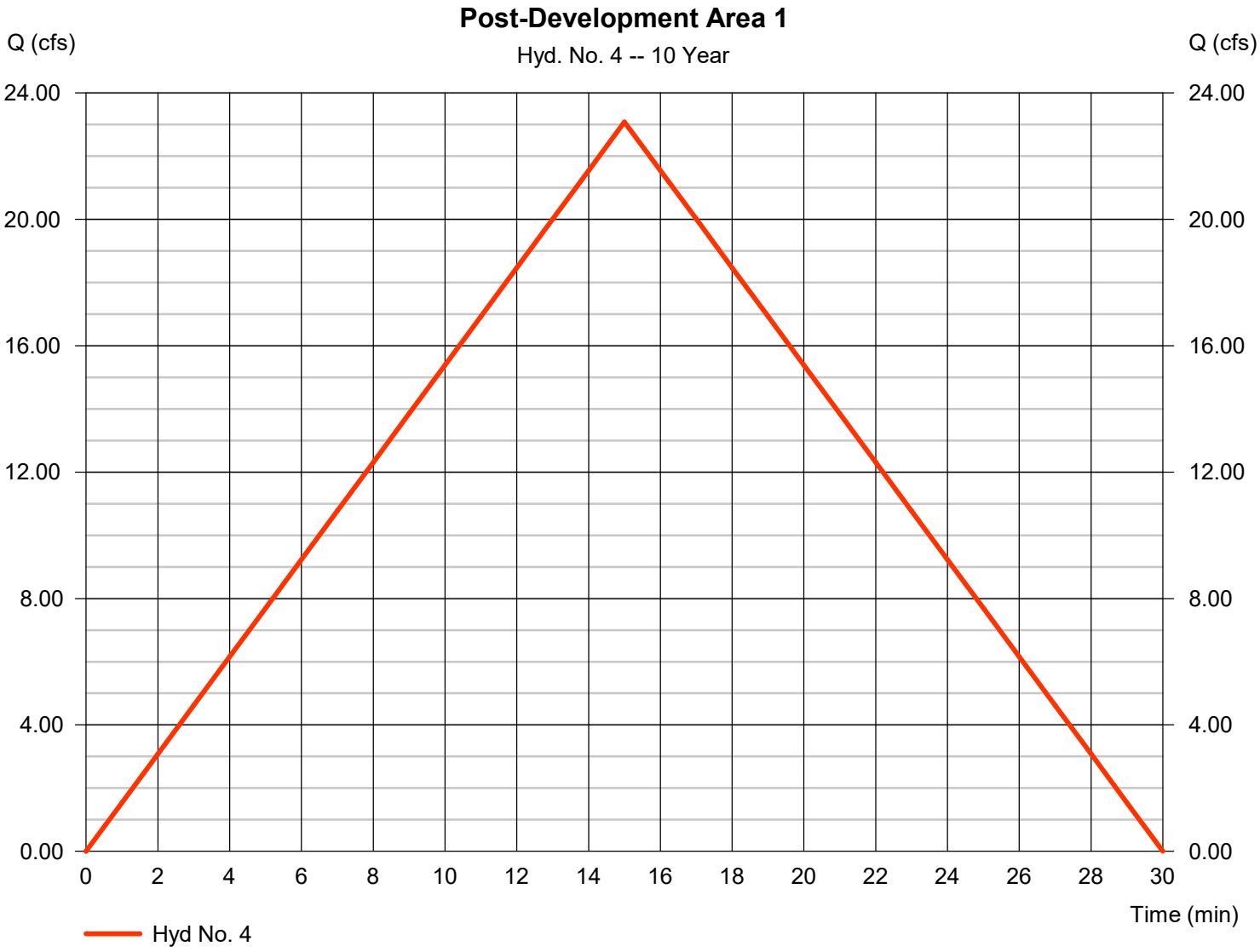


Hydrograph Report

Hyd. No. 4

Post-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	23.09 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	20,777 cuft
Drainage area	=	6.960 ac	Runoff coeff.	=	0.64
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

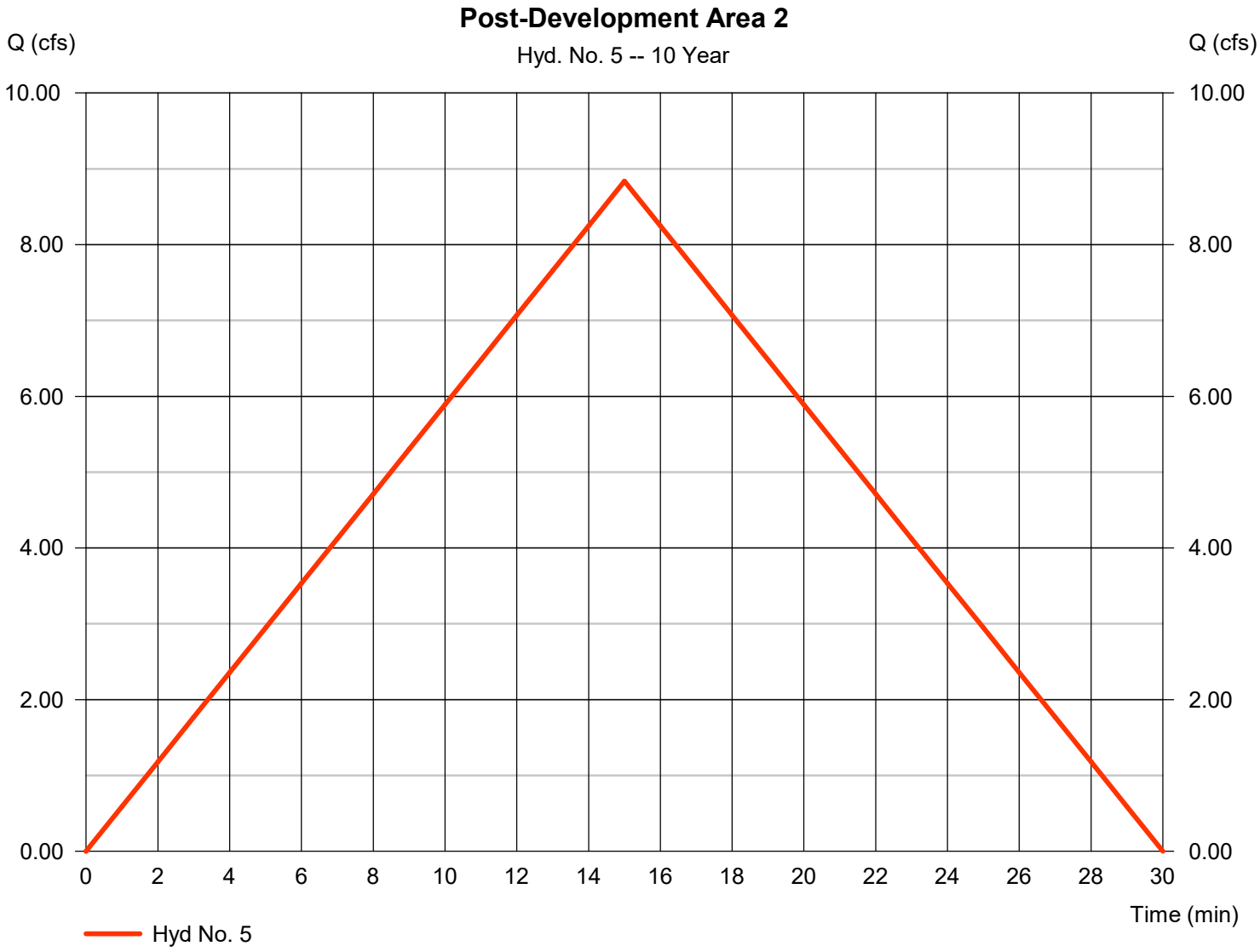


Hydrograph Report

Hyd. No. 5

Post-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	8.837 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	7,954 cuft
Drainage area	=	1.960 ac	Runoff coeff.	=	0.87
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 6

Post-Development Area 3

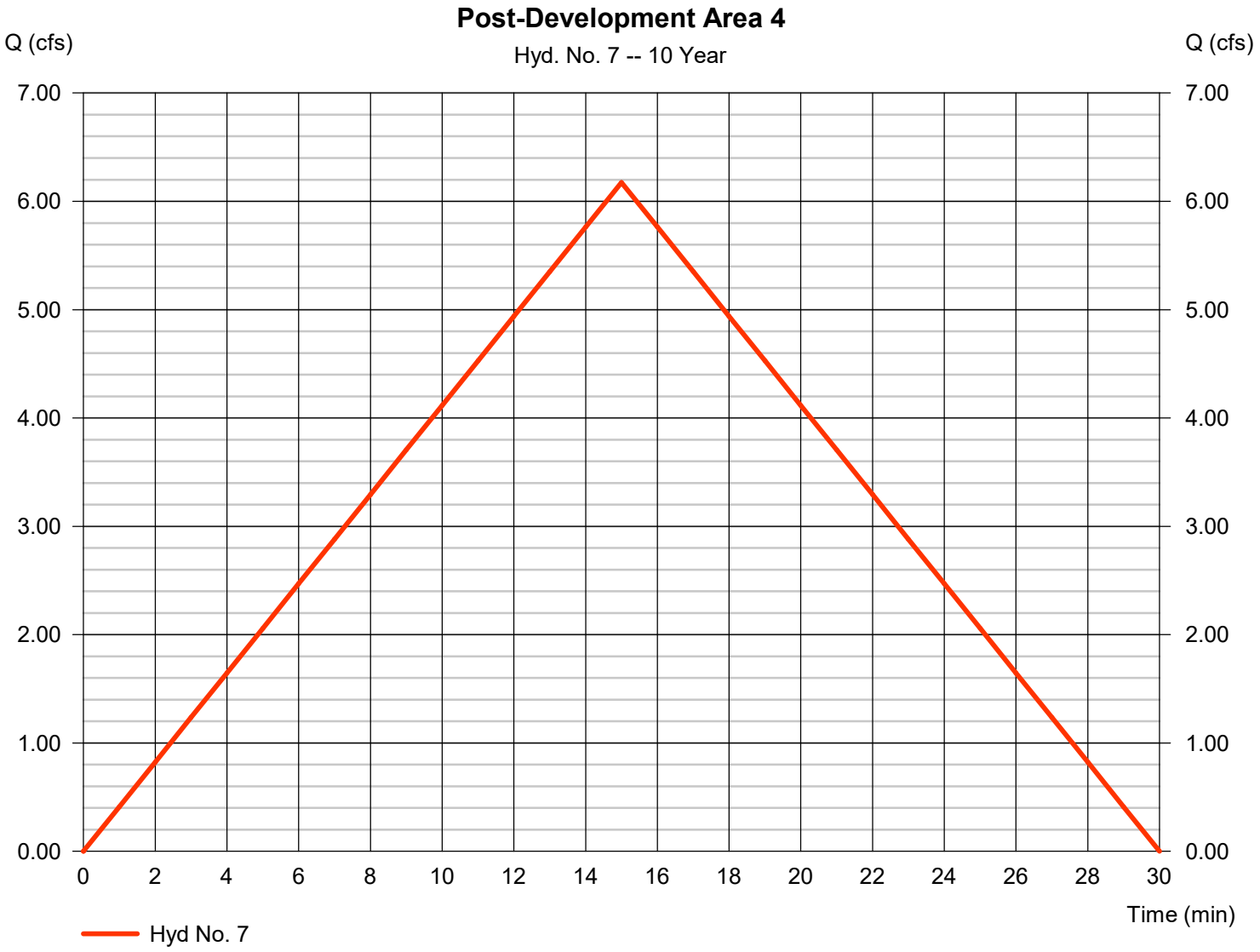
Hydrograph type	=	Rational	Peak discharge	=	4.832 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	4,349 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.74
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 7

Post-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	6.175 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	5,557 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.74
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 8

Post- Development Area 5

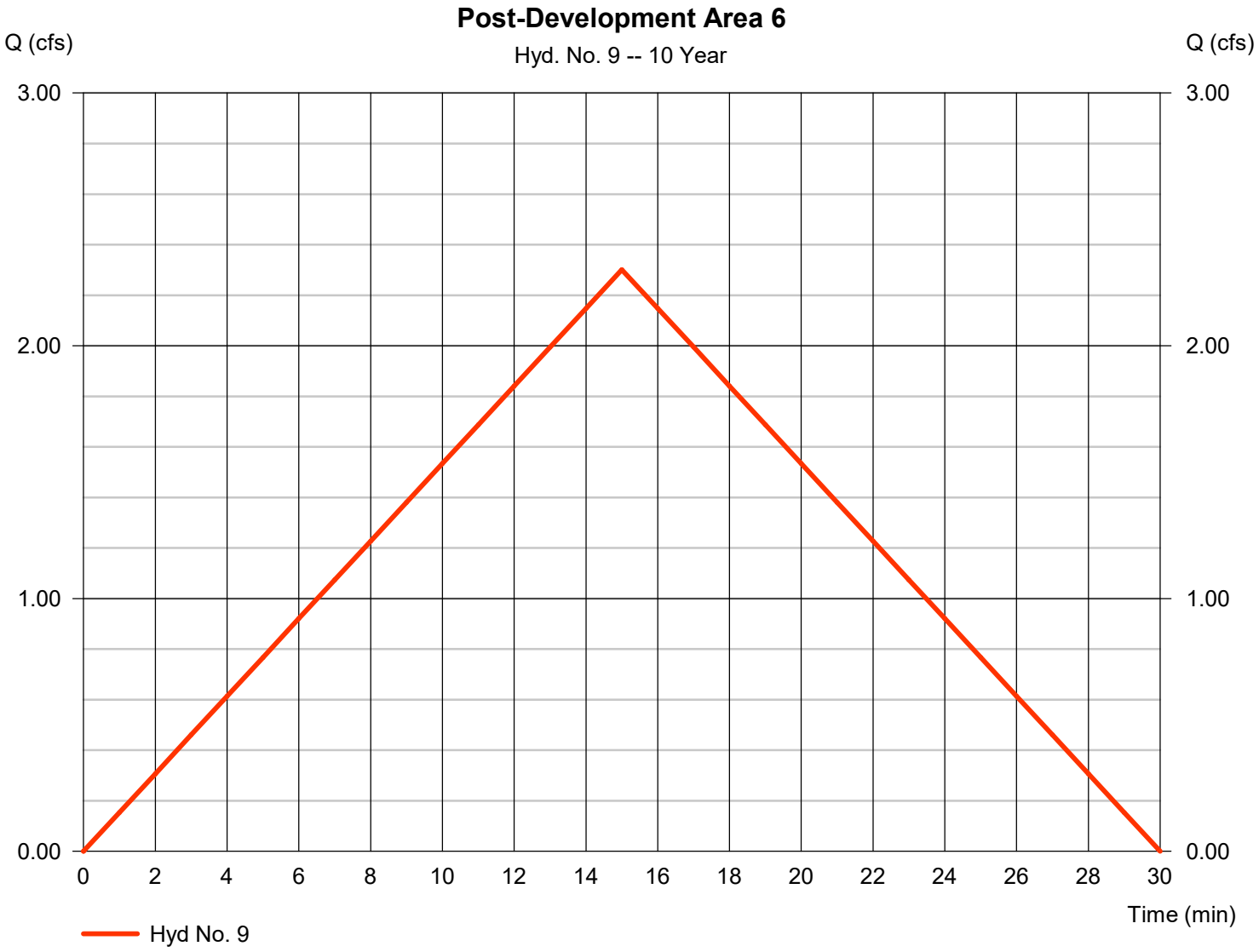
Hydrograph type	=	Rational	Peak discharge	=	3.369 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,032 cuft
Drainage area	=	1.300 ac	Runoff coeff.	=	0.5
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 9

Post-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	2.301 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	2,071 cuft
Drainage area	=	1.200 ac	Runoff coeff.	=	0.37
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

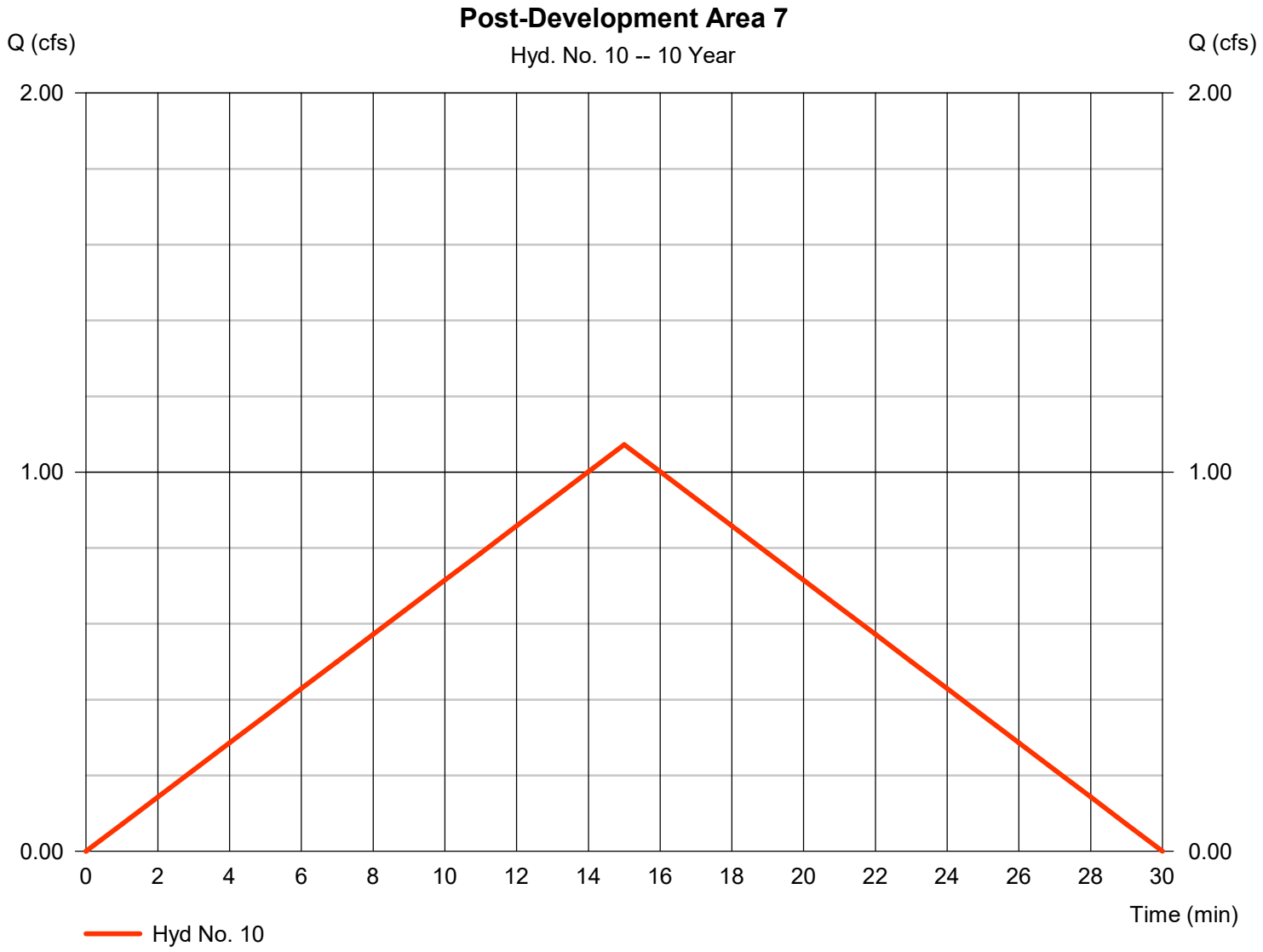


Hydrograph Report

Hyd. No. 10

Post-Development Area 7

Hydrograph type	=	Rational	Peak discharge	=	1.073 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	966 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	5.183 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

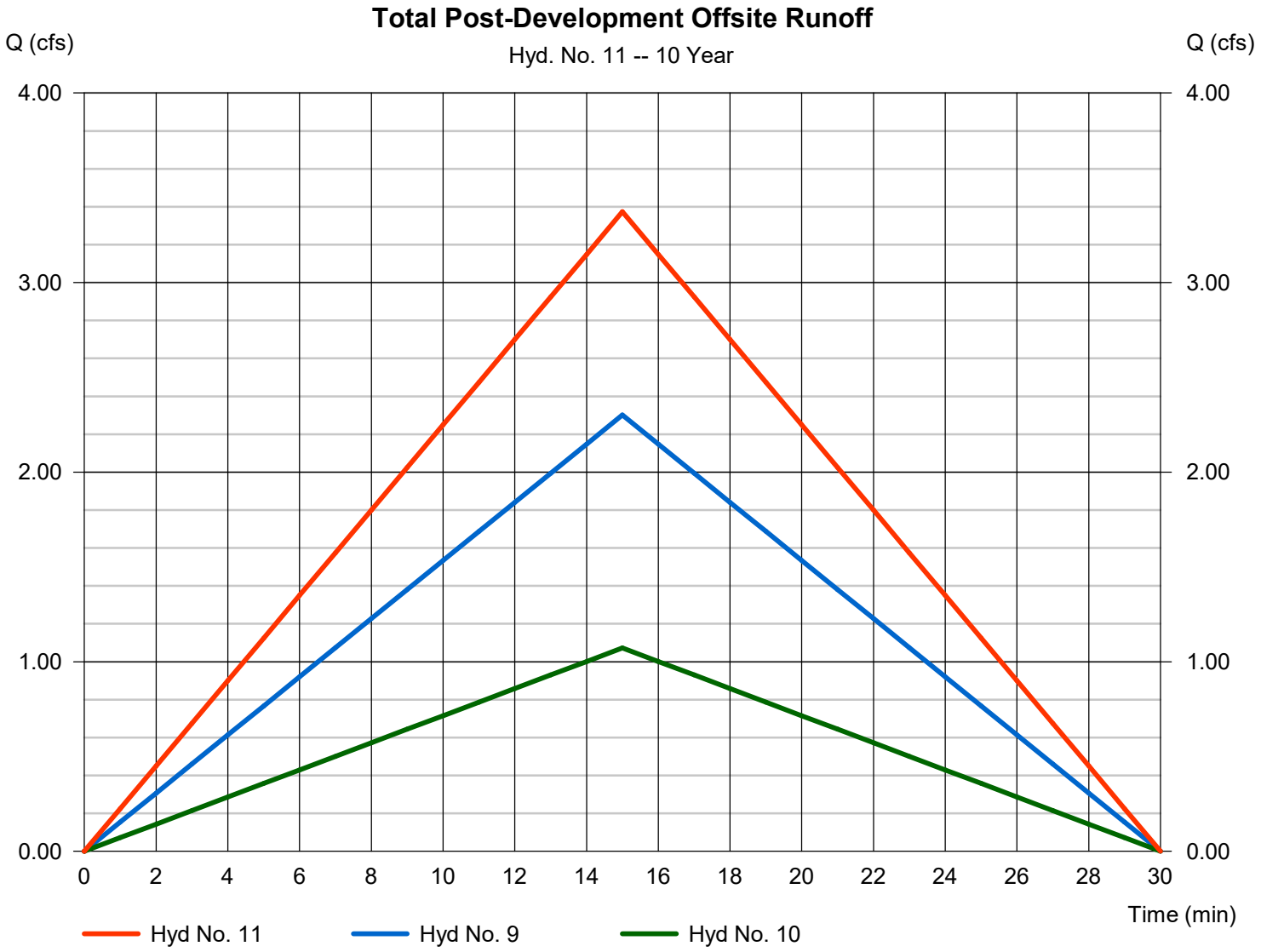


Hydrograph Report

Hyd. No. 11

Total Post-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 3.374 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 3,036 cuft
Inflow hyds.	= 9, 10	Contrib. drain. area	= 1.890 ac

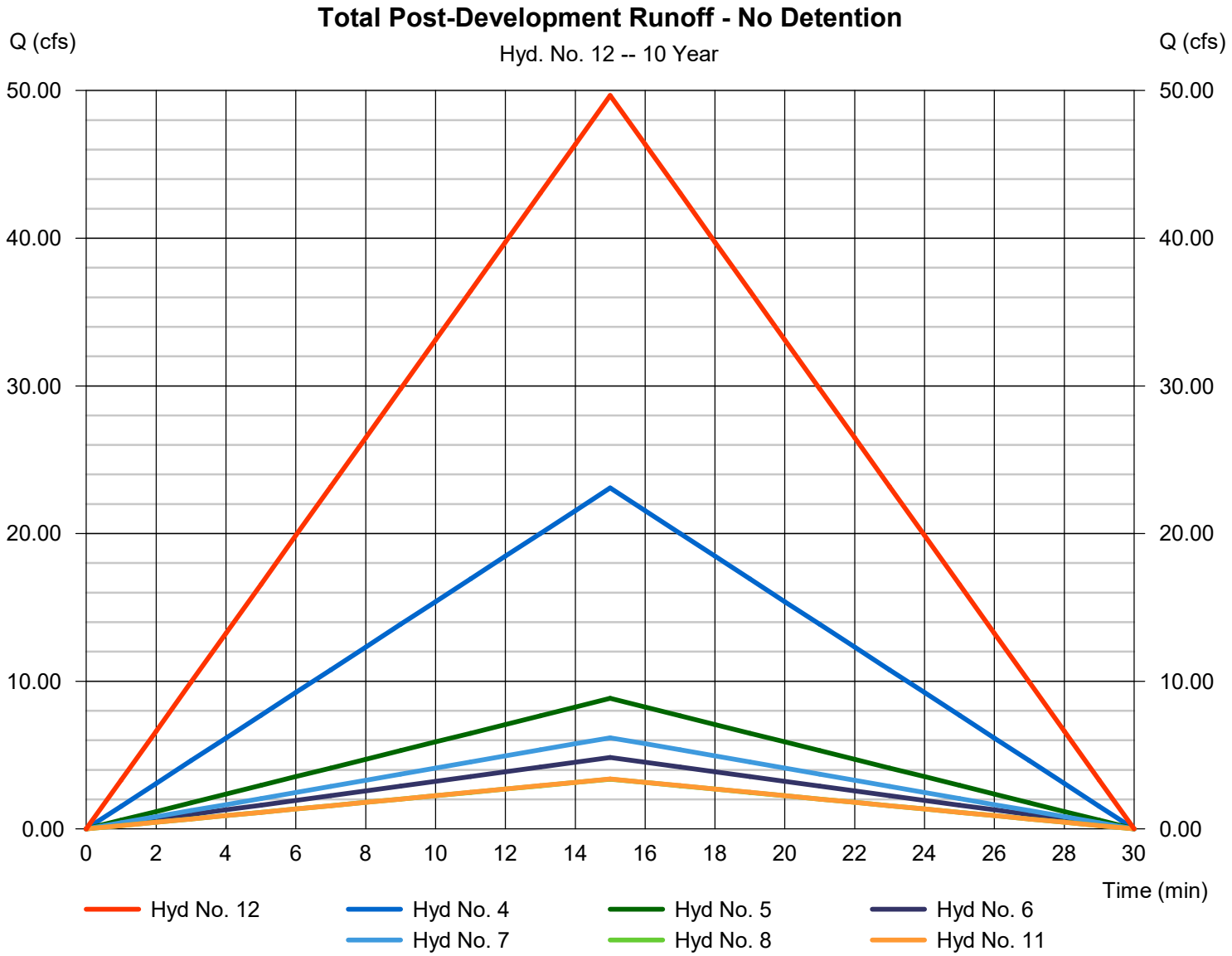


Hydrograph Report

Hyd. No. 12

Total Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 49.67 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 44,705 cuft
Inflow hyds.	= 4, 5, 6, 7, 8, 11	Contrib. drain. area	= 13.090 ac

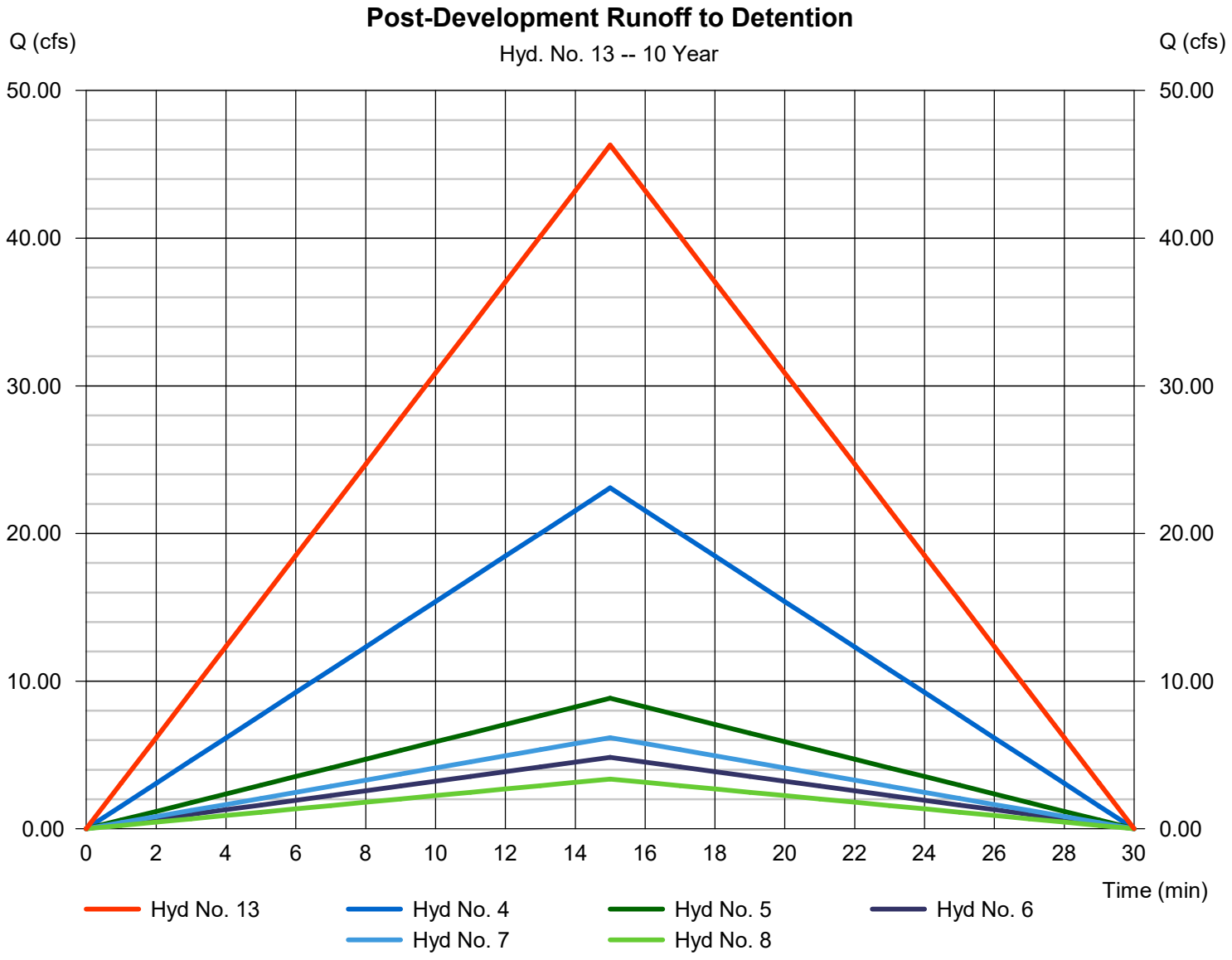


Hydrograph Report

Hyd. No. 13

Post-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 46.30 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 41,668 cuft
Inflow hyds.	= 4, 5, 6, 7, 8	Contrib. drain. area	= 13.090 ac



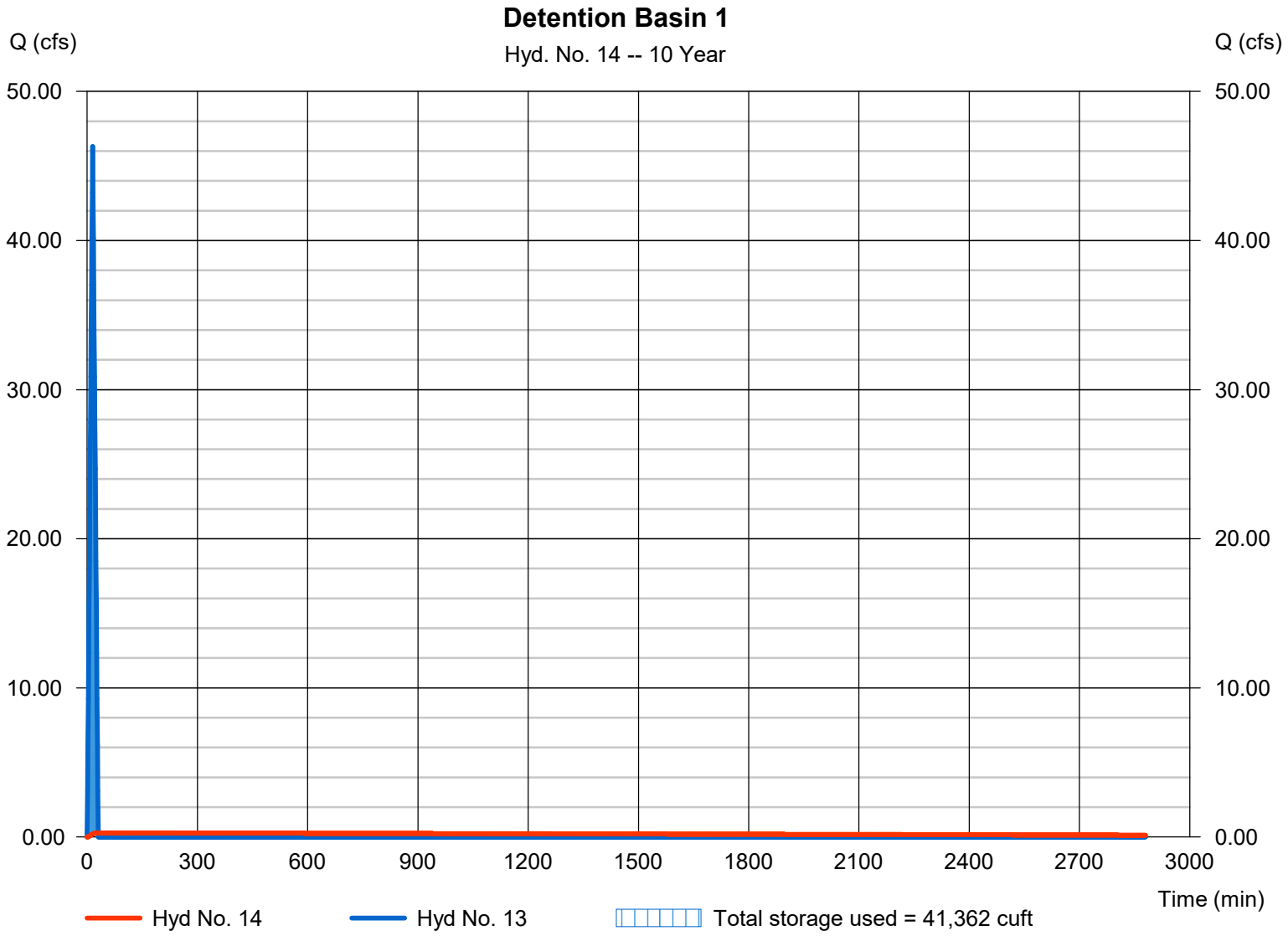
Hydrograph Report

Hyd. No. 14

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	0.275 cfs
Storm frequency	=	10 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	34,153 cuft
Inflow hyd. No.	=	13 - Post-Development Runoff to Detention	Max. Elevation	=	1002.98 ft
Reservoir name	=	Detention Basin	Max. Storage	=	41,362 cuft

Storage Indication method used.

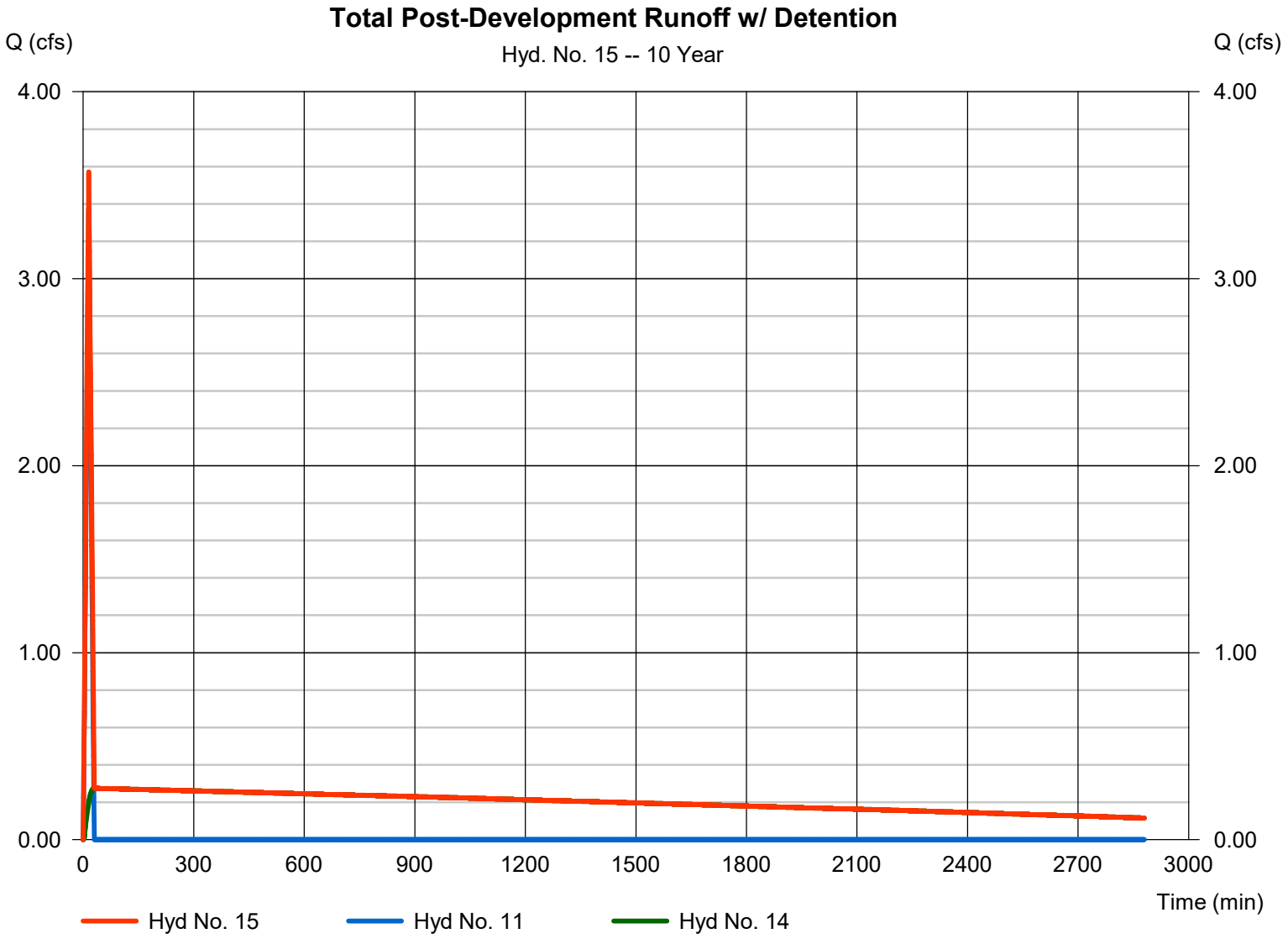


Hydrograph Report

Hyd. No. 15

Total Post-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 3.572 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 37,189 cuft
Inflow hyds.	= 11, 14	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	3.771	1	15	3,394	------	------	------	Pre-Development Area A
2	Rational	31.27	1	15	28,140	------	------	------	Pre-Development Area B
3	Combine	35.04	1	15	31,534	1, 2	------	------	Total Pre-Development Runoff
4	Rational	34.78	1	15	31,298	------	------	------	Post-Development Area 1
5	Rational	13.31	1	15	11,981	------	------	------	Post-Development Area 2
6	Rational	7.279	1	15	6,551	------	------	------	Post-Development Area 3
7	Rational	9.301	1	15	8,371	------	------	------	Post-Development Area 4
8	Rational	5.075	1	15	4,567	------	------	------	Post- Development Area 5
9	Rational	3.466	1	15	3,120	------	------	------	Post-Development Area 6
10	Rational	1.616	1	15	1,454	------	------	------	Post-Development Area 7
11	Combine	5.082	1	15	4,574	9, 10	------	------	Total Post-Development Offsite Runof
12	Combine	74.83	1	15	67,343	4, 5, 6, 7, 8, 11	------	------	Total Post-Development Runoff - No
13	Combine	69.74	1	15	62,769	4, 5, 6, 7, 8,	------	------	Post-Development Runoff to Detentio
14	Reservoir	14.33	1	27	53,638	13	1003.89	56,699	Detention Basin 1
15	Combine	15.50	1	26	58,212	11, 14	------	------	Total Post-Development Runoff w/ De

Hydrograph Report

Hyd. No. 1

Pre-Development Area A

Hydrograph type	=	Rational	Peak discharge	=	3.771 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,394 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

Pre-Development Area B

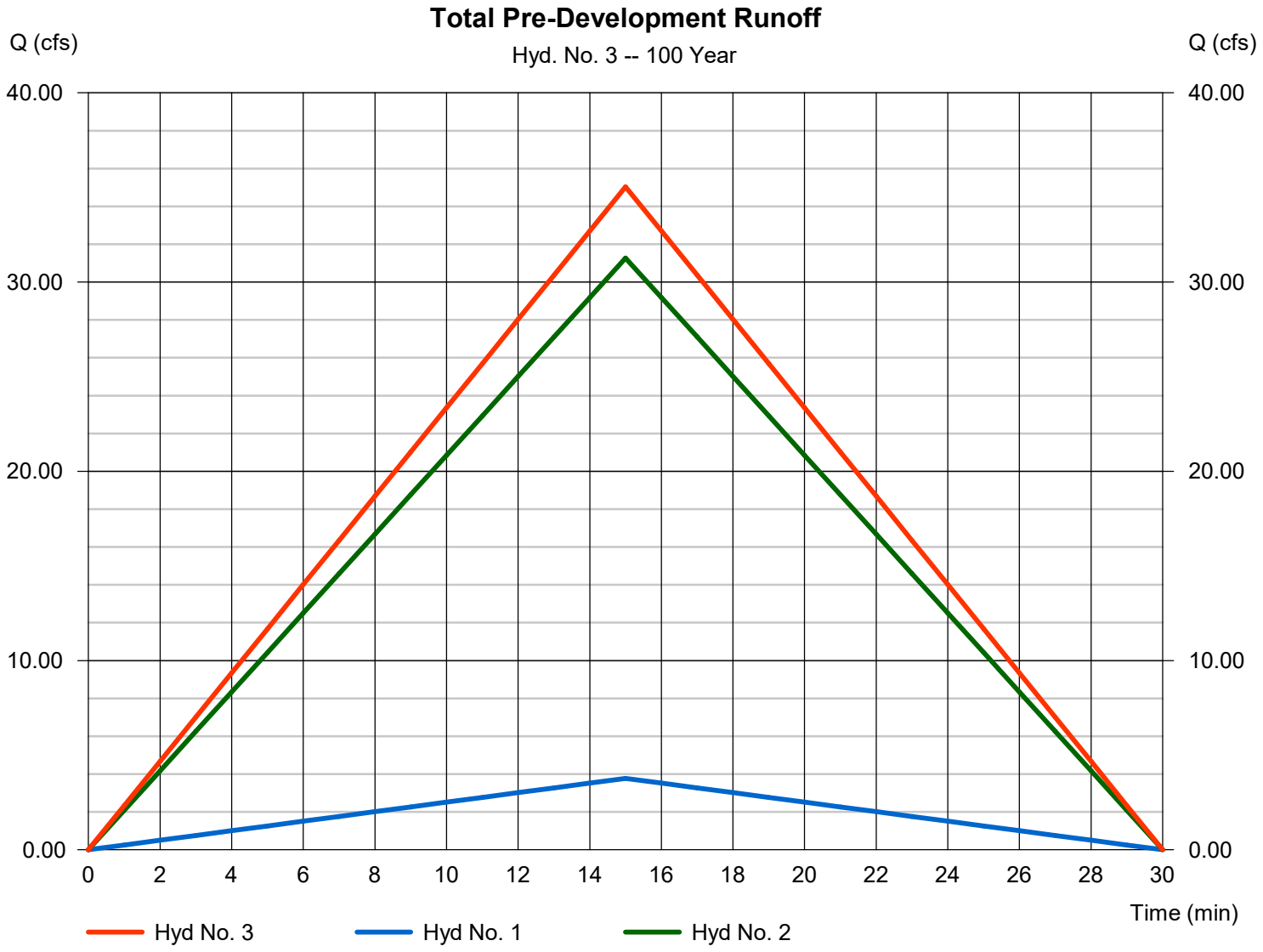
Hydrograph type	=	Rational	Peak discharge	=	31.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	28,140 cuft
Drainage area	=	13.350 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type	= Combine	Peak discharge	= 35.04 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 31,534 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 14.960 ac

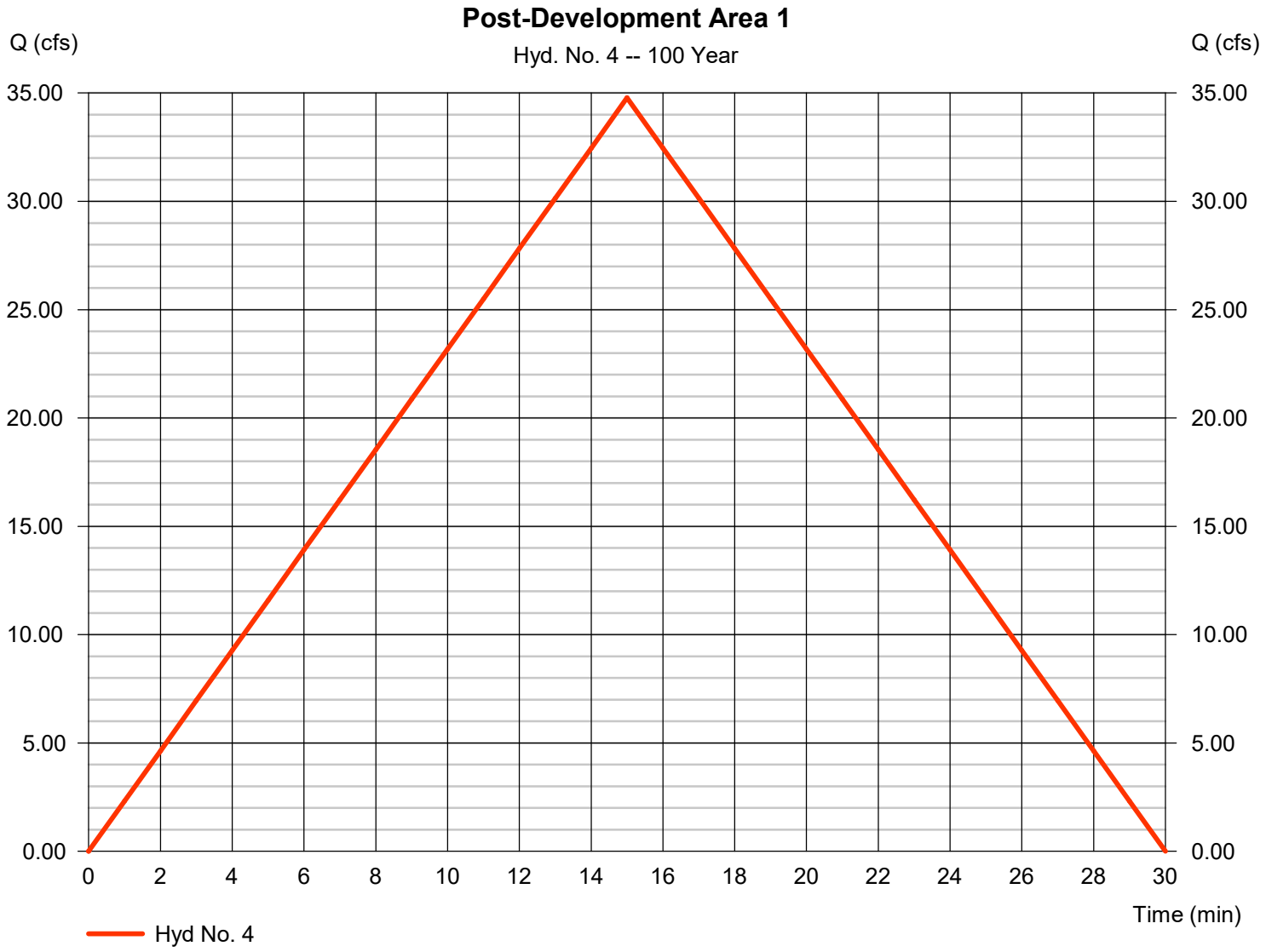


Hydrograph Report

Hyd. No. 4

Post-Development Area 1

Hydrograph type	=	Rational	Peak discharge	=	34.78 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	31,298 cuft
Drainage area	=	6.960 ac	Runoff coeff.	=	0.64
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

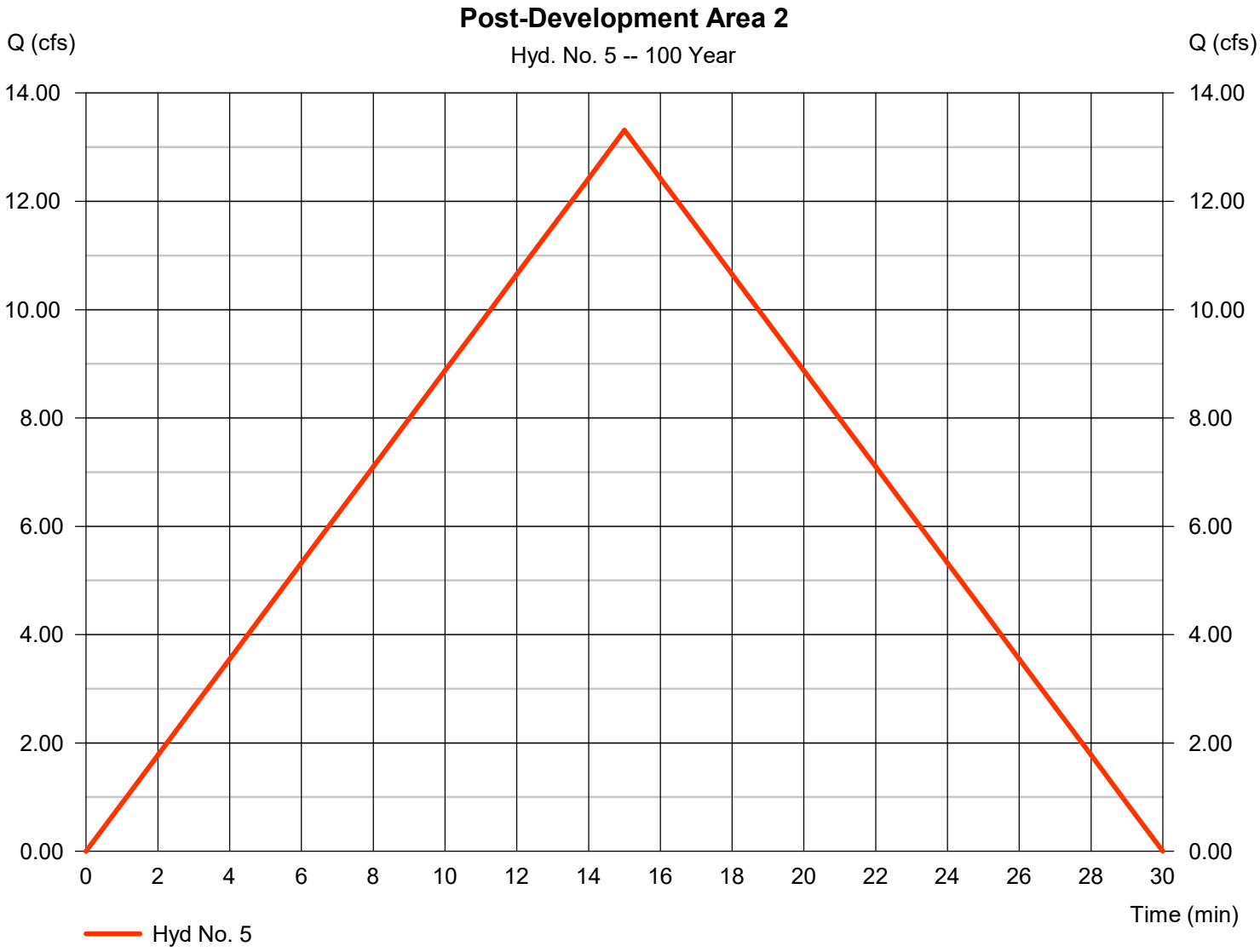


Hydrograph Report

Hyd. No. 5

Post-Development Area 2

Hydrograph type	=	Rational	Peak discharge	=	13.31 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	11,981 cuft
Drainage area	=	1.960 ac	Runoff coeff.	=	0.87
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

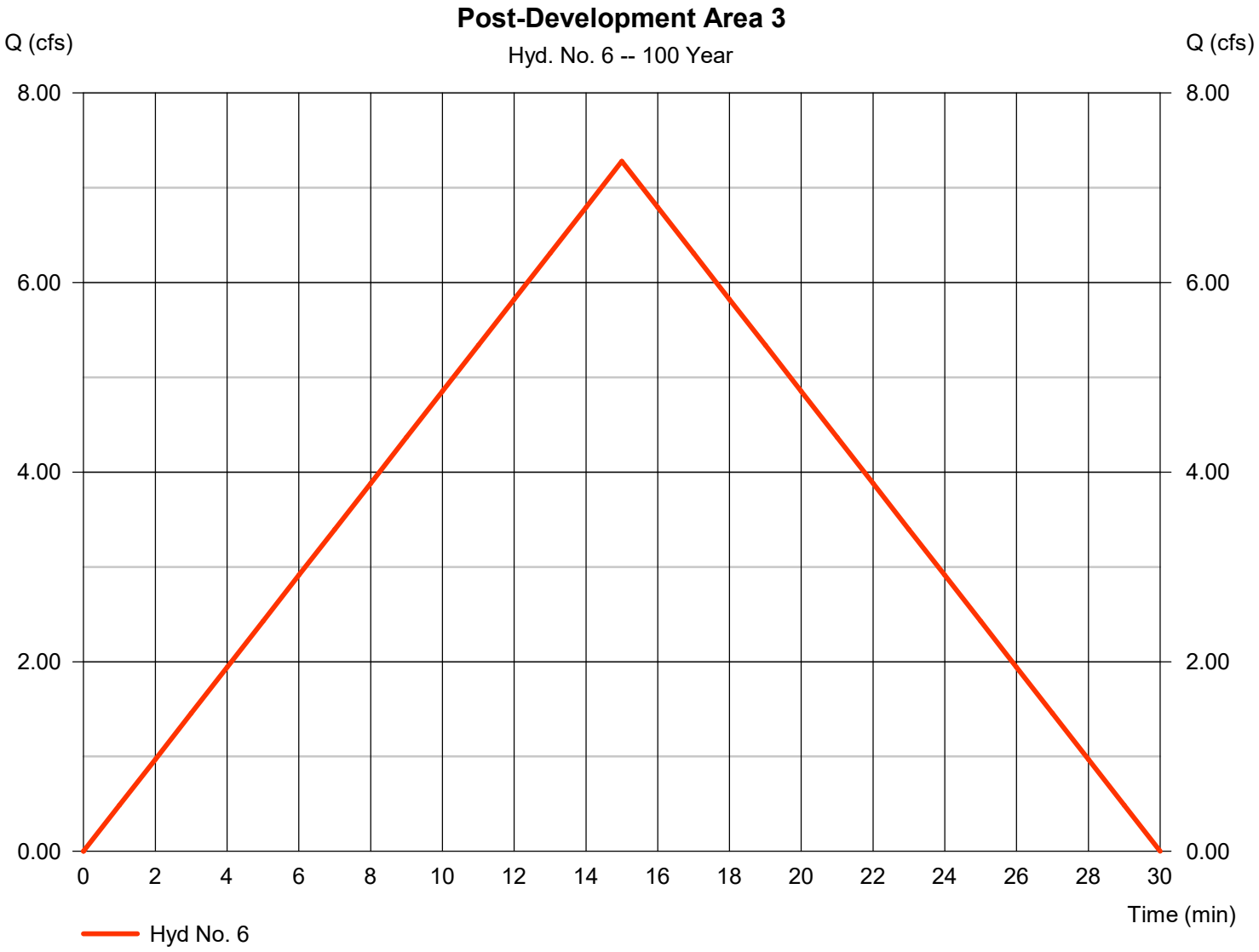


Hydrograph Report

Hyd. No. 6

Post-Development Area 3

Hydrograph type	=	Rational	Peak discharge	=	7.279 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	6,551 cuft
Drainage area	=	1.260 ac	Runoff coeff.	=	0.74
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

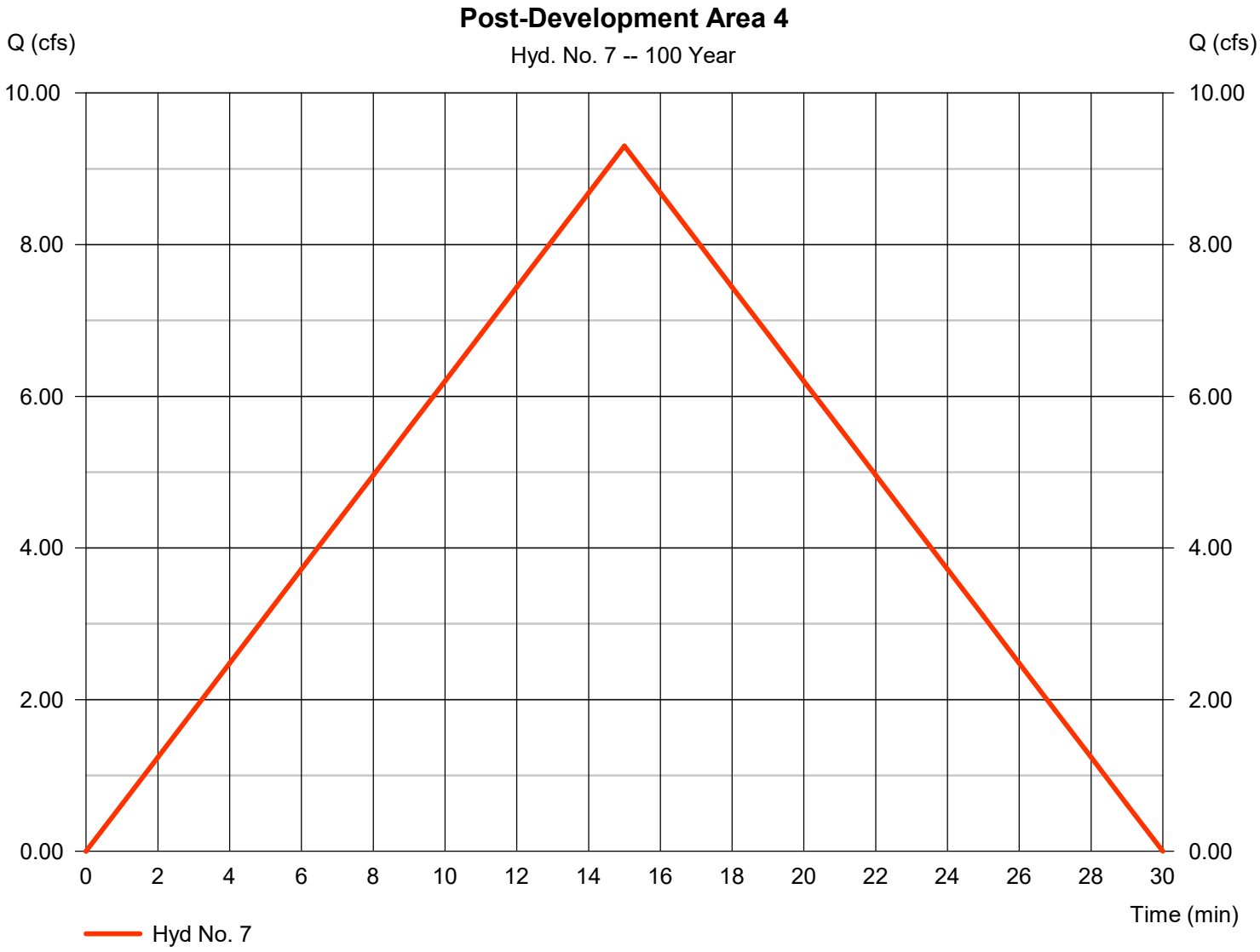


Hydrograph Report

Hyd. No. 7

Post-Development Area 4

Hydrograph type	=	Rational	Peak discharge	=	9.301 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	8,371 cuft
Drainage area	=	1.610 ac	Runoff coeff.	=	0.74
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

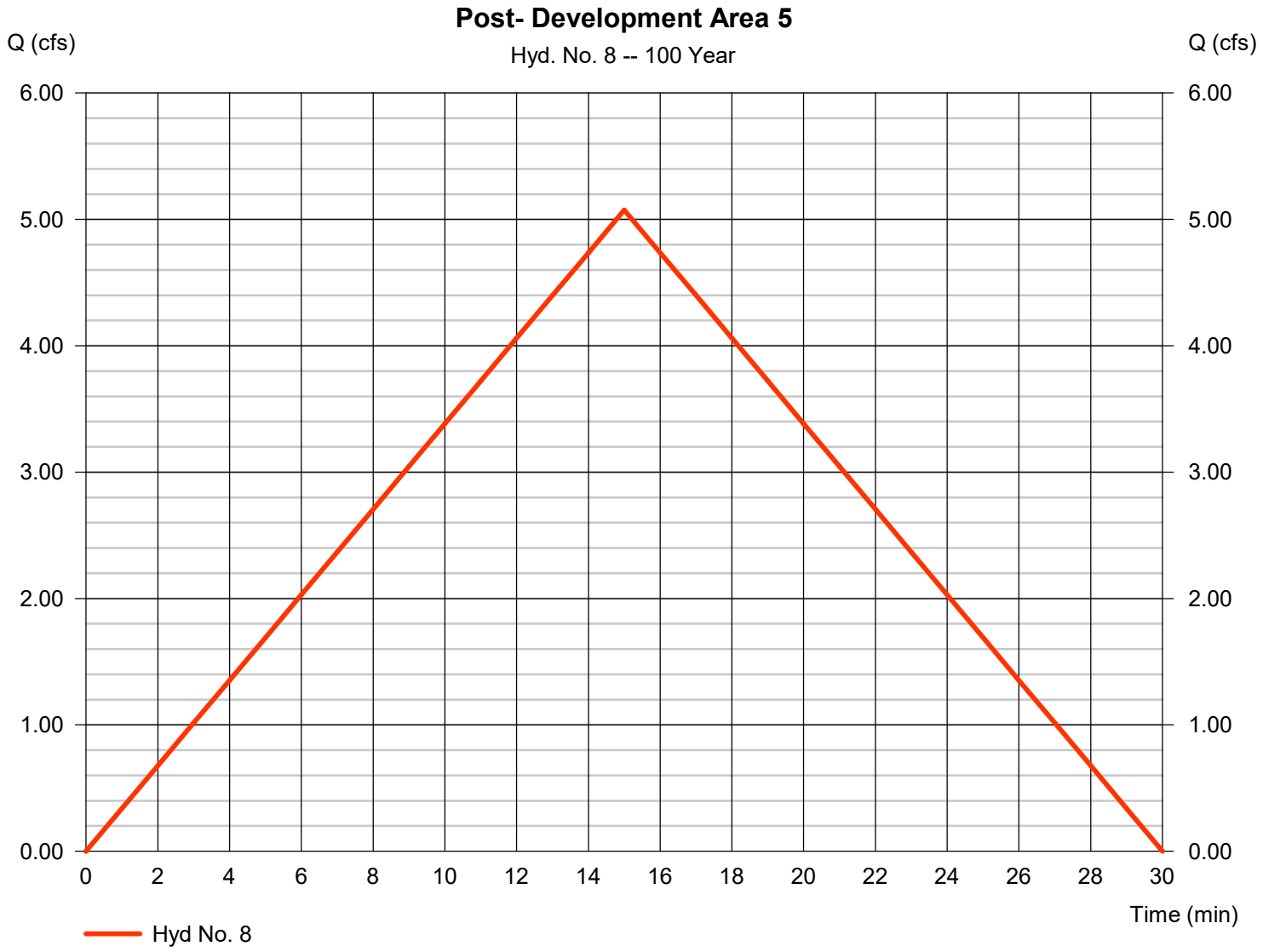


Hydrograph Report

Hyd. No. 8

Post- Development Area 5

Hydrograph type	=	Rational	Peak discharge	=	5.075 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	4,567 cuft
Drainage area	=	1.300 ac	Runoff coeff.	=	0.5
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

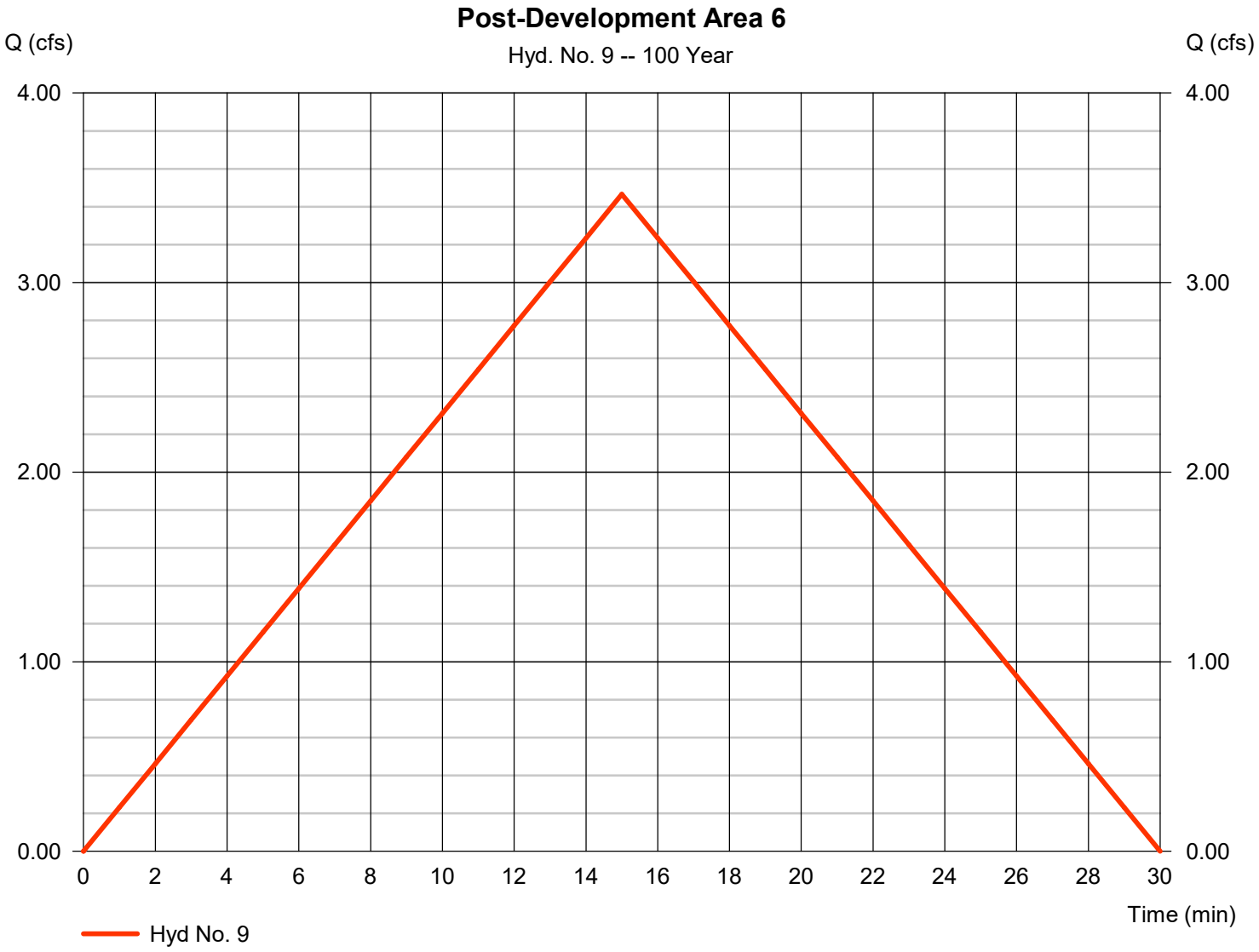


Hydrograph Report

Hyd. No. 9

Post-Development Area 6

Hydrograph type	=	Rational	Peak discharge	=	3.466 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,120 cuft
Drainage area	=	1.200 ac	Runoff coeff.	=	0.37
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

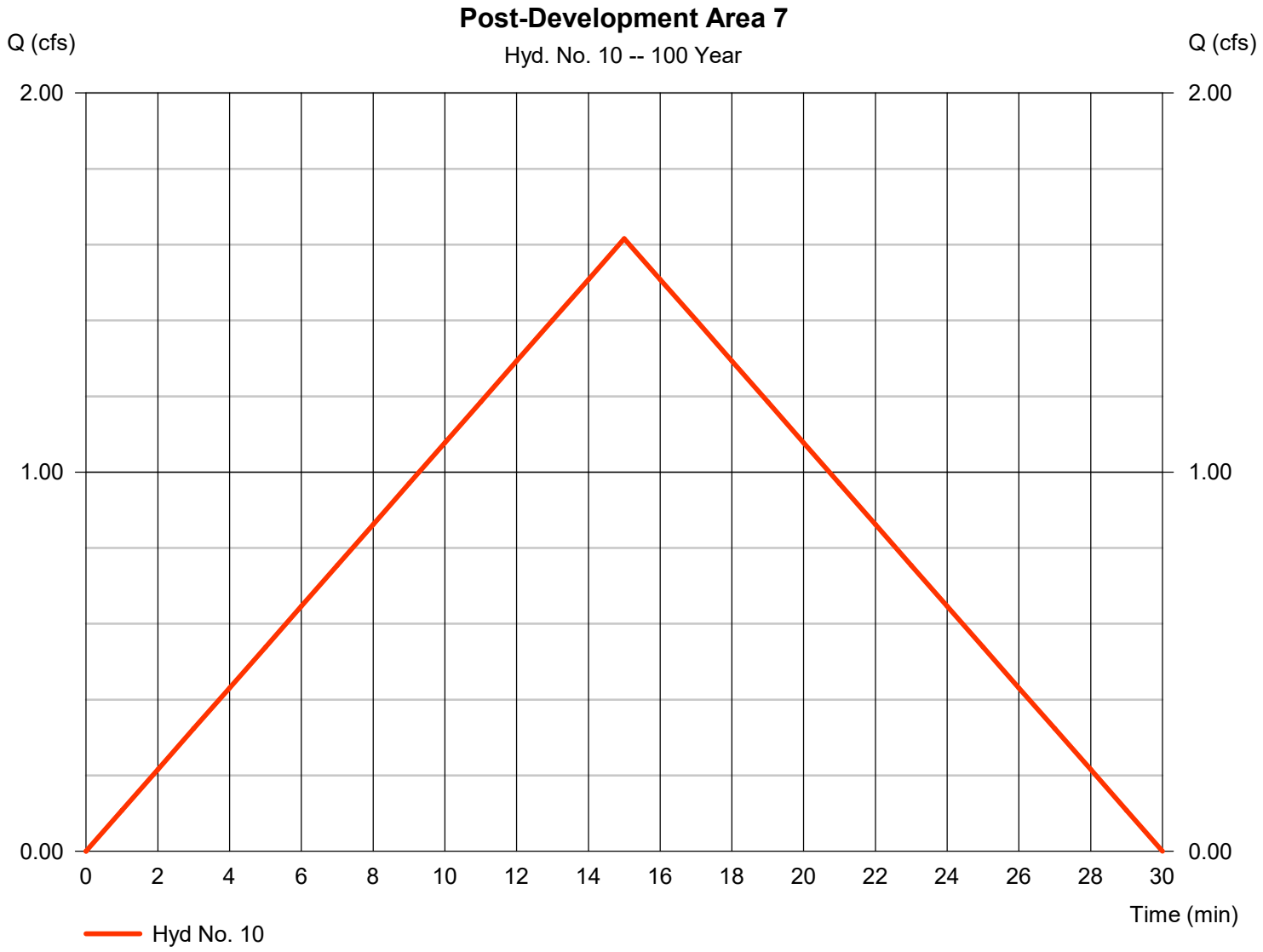


Hydrograph Report

Hyd. No. 10

Post-Development Area 7

Hydrograph type	=	Rational	Peak discharge	=	1.616 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	1,454 cuft
Drainage area	=	0.690 ac	Runoff coeff.	=	0.3
Intensity	=	7.807 in/hr	Tc by User	=	15.00 min
IDF Curve	=	Lenexa KS.IDF	Asc/Rec limb fact	=	1/1

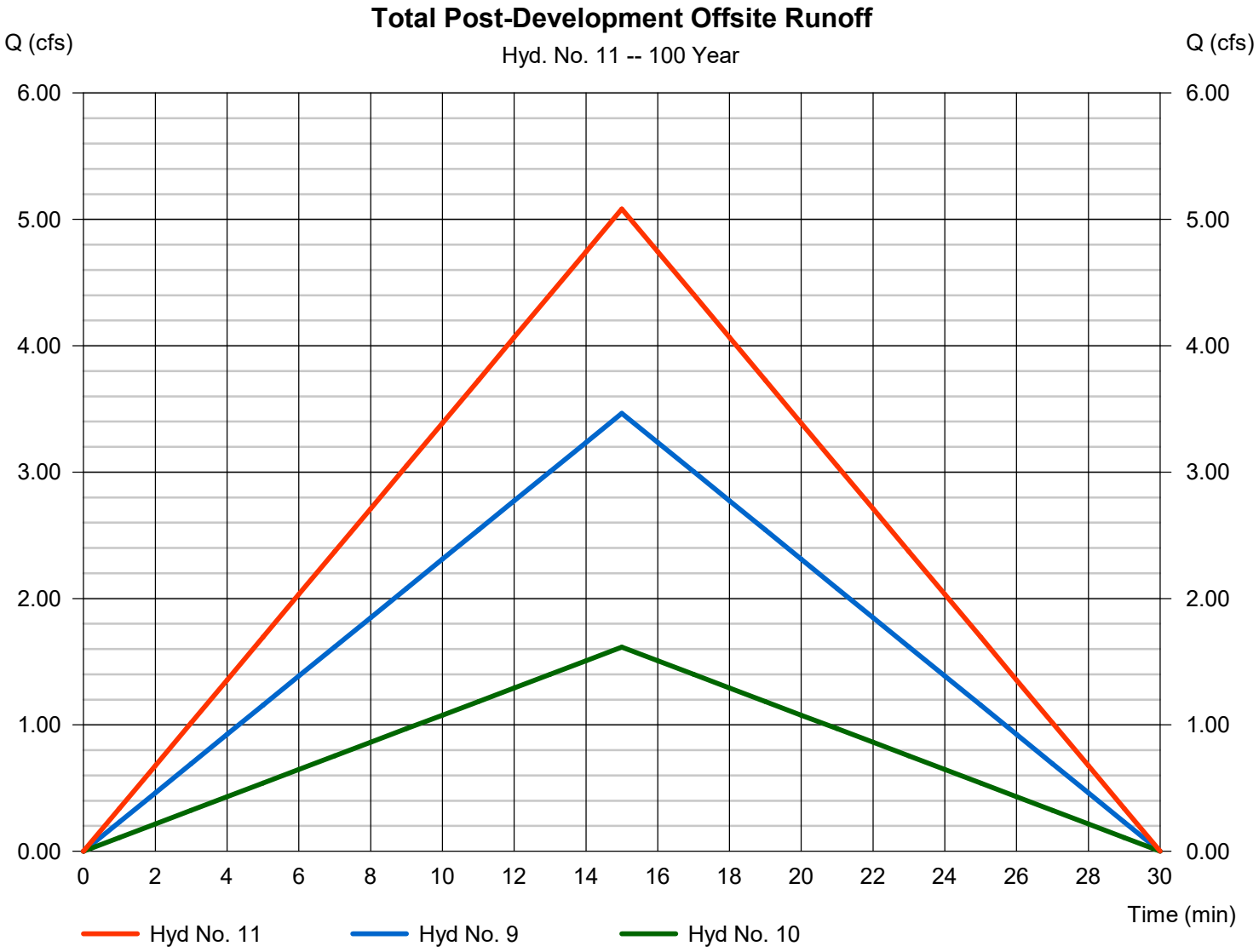


Hydrograph Report

Hyd. No. 11

Total Post-Development Offsite Runoff

Hydrograph type	= Combine	Peak discharge	= 5.082 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 4,574 cuft
Inflow hyds.	= 9, 10	Contrib. drain. area	= 1.890 ac

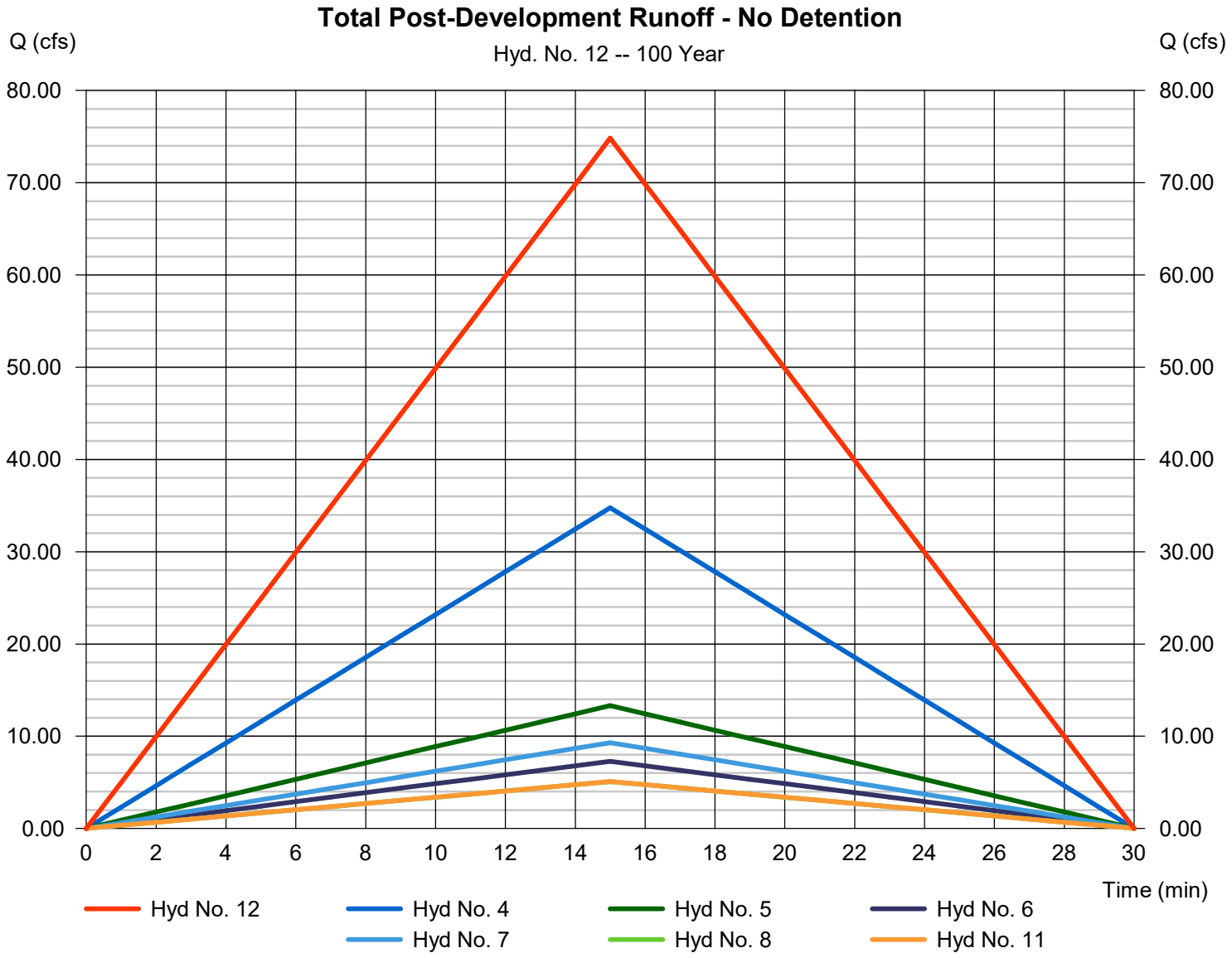


Hydrograph Report

Hyd. No. 12

Total Post-Development Runoff - No Detention

Hydrograph type	= Combine	Peak discharge	= 74.83 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 67,343 cuft
Inflow hyds.	= 4, 5, 6, 7, 8, 11	Contrib. drain. area	= 13.090 ac

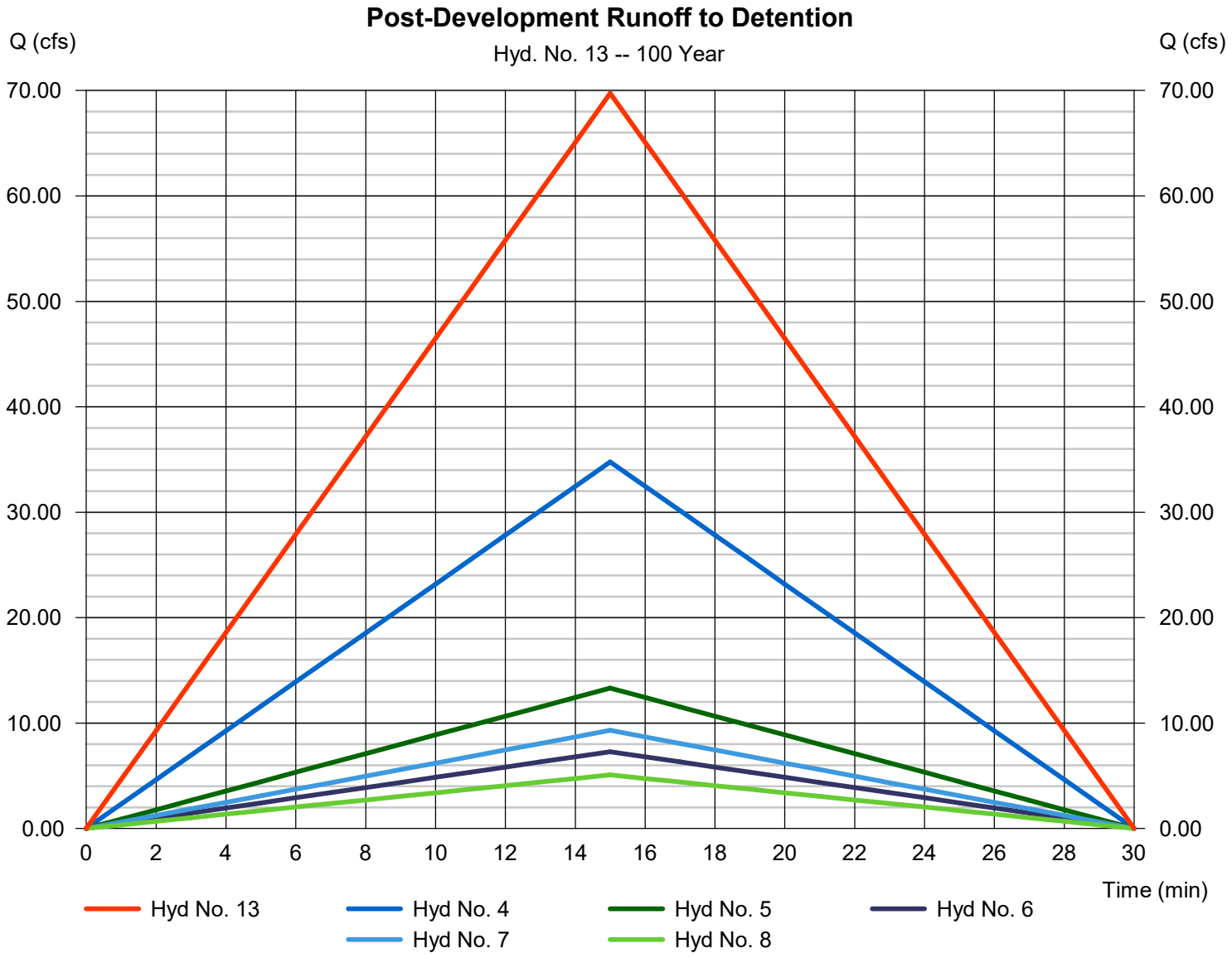


Hydrograph Report

Hyd. No. 13

Post-Development Runoff to Detention

Hydrograph type	= Combine	Peak discharge	= 69.74 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 62,769 cuft
Inflow hyds.	= 4, 5, 6, 7, 8	Contrib. drain. area	= 13.090 ac



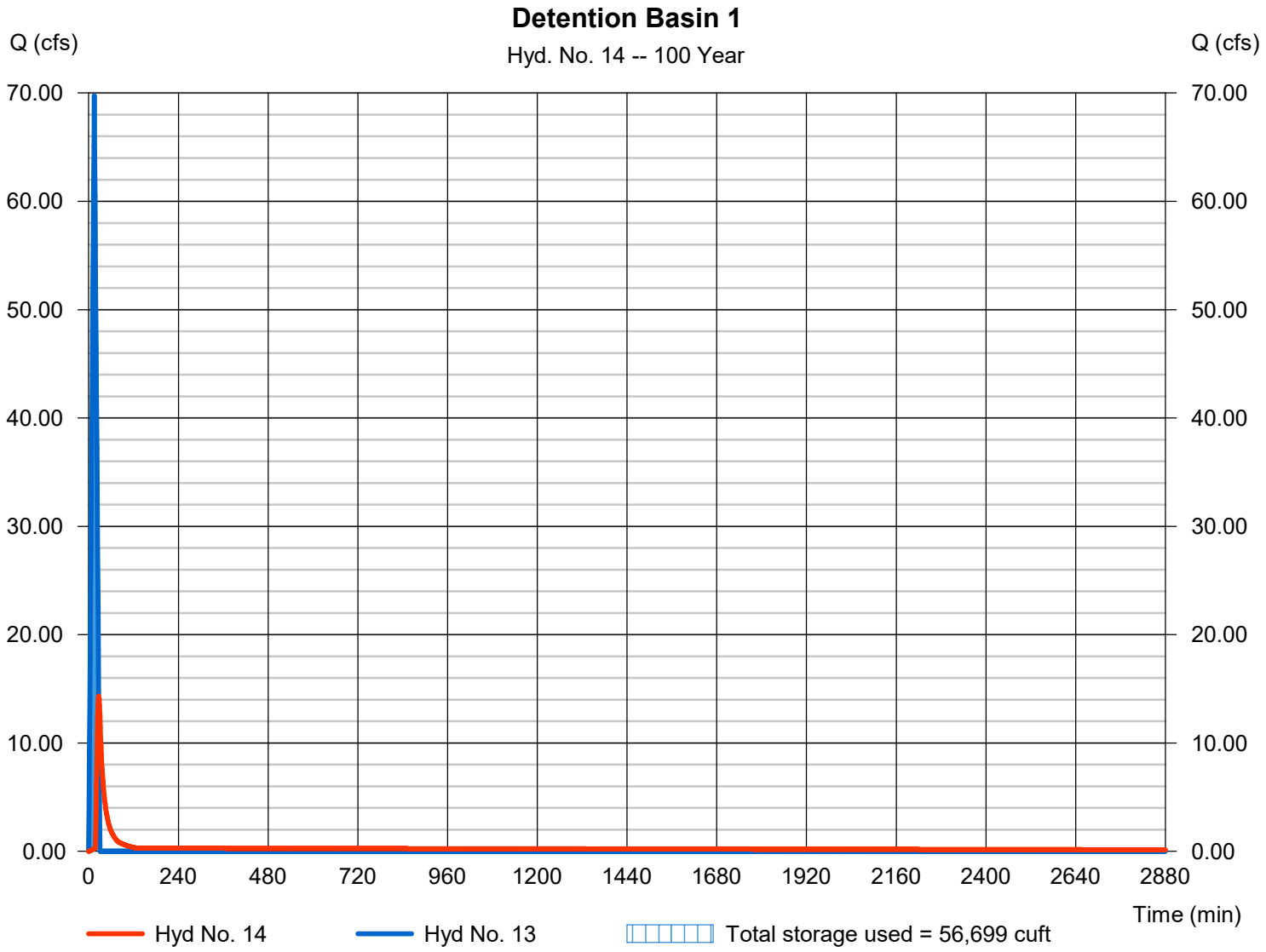
Hydrograph Report

Hyd. No. 14

Detention Basin 1

Hydrograph type	=	Reservoir	Peak discharge	=	14.33 cfs
Storm frequency	=	100 yrs	Time to peak	=	27 min
Time interval	=	1 min	Hyd. volume	=	53,638 cuft
Inflow hyd. No.	=	13 - Post-Development Runoff	Max. Elevation	=	1003.89 ft
Reservoir name	=	Detention Basin	Max. Storage	=	56,699 cuft

Storage Indication method used.

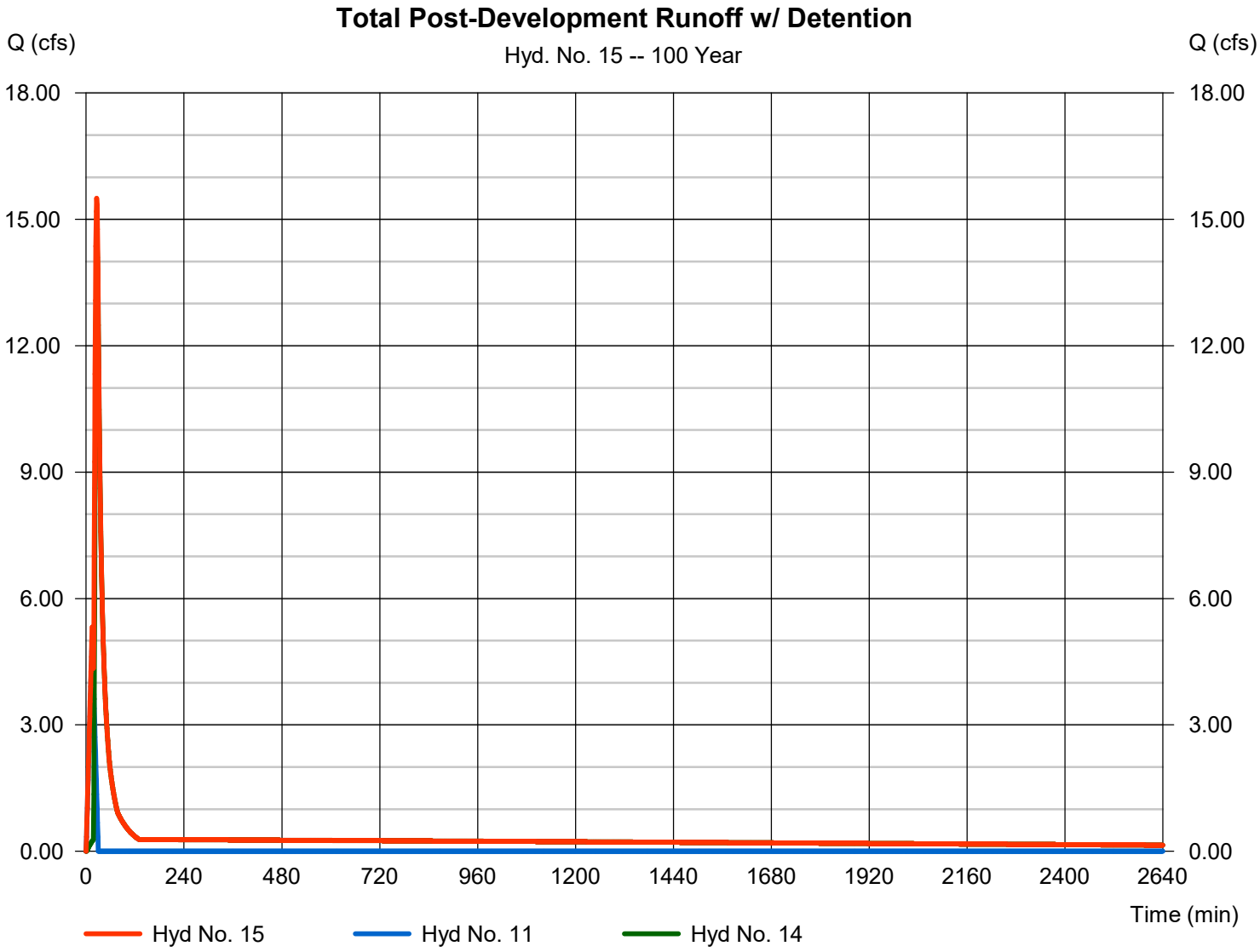


Hydrograph Report

Hyd. No. 15

Total Post-Development Runoff w/ Detention

Hydrograph type	= Combine	Peak discharge	= 15.50 cfs
Storm frequency	= 100 yrs	Time to peak	= 26 min
Time interval	= 1 min	Hyd. volume	= 58,212 cuft
Inflow hyds.	= 11, 14	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	--------
2	110.7137	16.5000	0.9842	--------
3	0.0000	0.0000	0.0000	--------
5	168.3971	19.5000	1.0189	--------
10	183.3473	19.2000	1.0096	--------
25	103.5313	15.9000	0.8218	--------
50	235.4014	19.9000	1.0020	--------
100	83.7894	6.1000	0.7783	--------

File name: Lenexa KS.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.51	7.14	6.17	5.46	4.90	4.46	4.10	3.79	3.54	3.31	3.12	2.95
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\DAE Civil\Hydraflow Storm Sewer\SCS 24-hr Rainfall.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.85	3.50	0.00	4.50	5.30	6.10	6.90	7.50
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	2.90	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

STORMWATER REPORT

Detail Center
Town Center Drive & Independence Avenue
Lee's Summit, Missouri 64064

Prepared For:

City of Lee's Summit
220 SE Green St
Lee's Summit, MO 64063

Prepared by:

DAVIDSON ARCHITECTURE & ENGINEERING, LLC
Skyler Martin, P.E.
4301 Indian Creek Parkway
Overland Park, Kansas 66207
913.451.9390 (phone)
913.451.9391 (fax)
www.davidsonae.com

Prepared: 02.20.2020
Revised: 03.23.2020
Revised: 06.19.2020
Revised: 11.05.2020
Project No. 19076

11/05/2020

Table of Contents

Appendices

Appendix A – Supporting Data

- Hydrological Soil Group
- FEMA FIRM
- Sheet C3.1 – Existing Drain Area Map
- Sheet C3.2 – Proposed Drain Area Map
- Sheet C3.3 – Storm Plan & Profile

Appendix B – Existing Conditions Hydraflow Hydrographs Output Data

Appendix C – Proposed Conditions Hydraflow Hydrographs Output Data

GENERAL INFORMATION

The proposed commercial development for Lee's Summit Town Center, LLC is located northwest of the intersection of Town Center Drive and Independence Avenue. The total area for the development is this property is approximately 5.57 acres.

The current site soil condition for this property is classified as "Greenton-Urban, 5 to 9 percent Slopes", with a Map Unit Symbol of '2qky4'. The hydrological soil group for this site is Class D. The site lies entirely within 'Zone X', areas determined to be outside the 0.2% annual chance floodplain as depicted on the FEMA Flood Insurance Rate Map (FIRM) no. 29095C0430G, Revision Date: January 20, 2017.

Figure 1 – Location Map (no scale)

METHODOLOGY

KCAPWA IDF curves were used to determine the rainfall intensity for 2, 10, and 100-year storm events. Hydraflow Hydrographs Extension for AutoCAD 2020 was used to determine runoff flow amounts for existing and proposed site conditions. Hydraflow computes the rational method runoff hydrographs by convoluting a rainfall hyetograph through a unit hydrograph. Convolution is known as linear superpositioning where each ordinate of the rainfall hyetograph is multiplied by each ordinate of the unit hydrograph, thus creating a series of hydrographs. These hydrographs are then summed to form the final runoff hydrograph.

EXISTING CONDITIONS

The existing project site location is 5.57 acres, with the entirety of the property being impervious area. Runoff from this site flows from the northwest of the property to east. For analysis the majority of the undeveloped area, encompassed by NE Town Center Boulevard was taken into consideration for runoff volume contribution. The resulting area is approximately 29.35 acres of impervious area. The area for the two existing ponds was added to the overall impervious area contributing to runoff. The total runoff, including the areas for the existing ponds will be takin into account for the detention ponds design.

An existing storm inlet at the east end of the property along NE Independence Avenue allows runoff to be conveyed east toward an existing dedicated drainage area. Refer to Sheet C3.1 “Existing Drainage Map” in Appendix A for the existing drainage patterns for the property.

Table 1 below shows the peak discharges for the 2, 10, and 100-year rainfall events. Refer to Appendix B for Complete Hydraflows Report and results for the existing site conditions.

Table 1 – Existing Site Runoff Hydraflow Results

Storm Event	Pre-developed Peak Flow (cfs)
2-Yr	35.95
10-Yr	50.20
100-Yr	75.61

PROPOSED CONDITIONS

The existing property will undergo development for a proposed commercial area for Lee's Summit Town Center LLC. The proposed development will increase the impervious area from 0.00 acres to 2.85 acres, with the remaining 29.35 acres as open grass area. Refer to sheet C3.2 "Proposed Drainage Map" in Appendix A for the proposed drainage patterns for the property. The runoff will be collected and conveyed to a detention pond where the existing storm inlet, at the eastern edge of the property, will further convey the runoff towards the existing dedicated drainage area.

Table 2 shows the increase in peak discharge rates for the 2, 10, and 100-year storms rainfall events, due to the increase in impervious area.

Table 2 – Proposed Site Runoff Hydraflow Results without Detention	
Storm Event	Pre-developed Peak Flow (cfs)
2-Yr	38.13
10-Yr	53.24
100-Yr	80.20

In order to mitigate the increase in discharge rates from the site due to the increase in impervious area created by the proposed development, two separate storm networks are proposed to direct runoff to the existing drainage area via the existing storm inlet at the east edge of the property.

Table 3 shows the resulting discharge rates for the 2, 10, and 100-year rainfall events with the proposed storm networks and detention pond.

Table 3 – Proposed Site Runoff Hydraflow Results with Detention	
Storm Event	Post-developed Peak Flow (cfs)
2-Yr	1.68
10-Yr	8.92
100-Yr	24.15

Hydraflow Hydrographs Extension for AutoCAD civil 3D was used to model the post developed site with the proposed storm system. A complete hydrograph can be found in Appendix C.

The above mentioned methodology was used to design the proposed detention pond to effectively capture and discharge the total runoff from the contributing drainage area, per the requirements set by APWA Section 5601.5.A.4.a. The discharge rates are controlled by a proposed storm structure to maintain release rates less than the rates indicated within APWA Section 5608.4.C.1. Elevations for different rainfall events were used to set outlet pipe inverts and storm structure openings to effectively discharge the collected runoff while meeting water quality requirements.

For water quality design consideration, a perforated riser is proposed to reach the water quality rainfall event elevation. Perforations within the riser allow for a controlled discharge from the detention pond through the proposed storm network, meeting the minimum forty-hour draw down.

Any overflow from the existing pond to the west will be collected and routed via a proposed earthen drainage swale to the north of the proposed development, and then to the detention pond. Outlet pipes convey storm water to existing infrastructure leading to an existing detention area to the east.

A spillway for the proposed detention pond was designed using the 100-yr water surface elevation of 985.87'. Manipulating the design within the Hydraflows program to simulate clogged conditions and zero available storage the spillway crest elevation was set 0.5' above the 100-yr water surface elevation at 986.37'. One foot of freeboard is available above the 100-yr water surface elevation to the top of the berm at 987'. The emergency spillway will allow the overflow to drain towards NE Independence Ave, and into the existing storm infrastructure.

SUMMARY

The proposed commercial development for Lee's Summit Town Center, LLC is located northwest of the intersection of Town Center Drive and Independence Avenue increases the amount of impervious area within the property. To account for the increase in runoff, storm networks and a detention basin have been designed to maintain the discharge rates below existing conditions flow rates.

Off-site contributions to runoff have been taken into account for the detention pond design. Outlet pipes and structures control peak discharge rates to less than that of existing conditions, while also meeting water quality requirements for the water quality rainfall event.

Table 4 below provides the discharge rates for the existing and post developed conditions for the 2, 10, and 100-year rainfall events for this site.

Table 4 – Total Runoff Volume Comparison

Storm Event (yr)	Pre-development Discharge (cfs)	Post-development Discharge (cfs)	Difference (cfs)
2	35.95	1.68	34.27
10	50.20	8.92	41.28
100	75.61	24.15	51.46

Appendix A

Supporting Data

Map Scale: 1:961 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 45 90 180 270

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: Jackson County, Missouri
Survey Area Data: Version 20, Sep 16, 2019

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

Date(s) aerial images were photographed: Sep 6, 2019—Nov 16, 2019

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
10024	Greenton-Urban land complex, 5 to 9 percent slopes	4.0	98.8%
10128	Sharpsburg-Urban land complex, 2 to 5 percent slopes	0.0	1.2%
Totals for Area of Interest		**4.0**	**100.0%**

NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) Report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS Report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study Report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study Report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Missouri State Plane West Zone (FIPS zone 2403). The **horizontal datum** was NAD 83, GRS 1980 spheroid. Differences in datum, spheroid, projection or UTM zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713- 3242**, or visit its website at http://www.ngs.noaa.gov.

Base map information shown on this FIRM was derived from the U.S.D.A Farm Service National Agriculture ImageryProgram (NAIP) dated 2014. Produced at scale of 1:24,000.

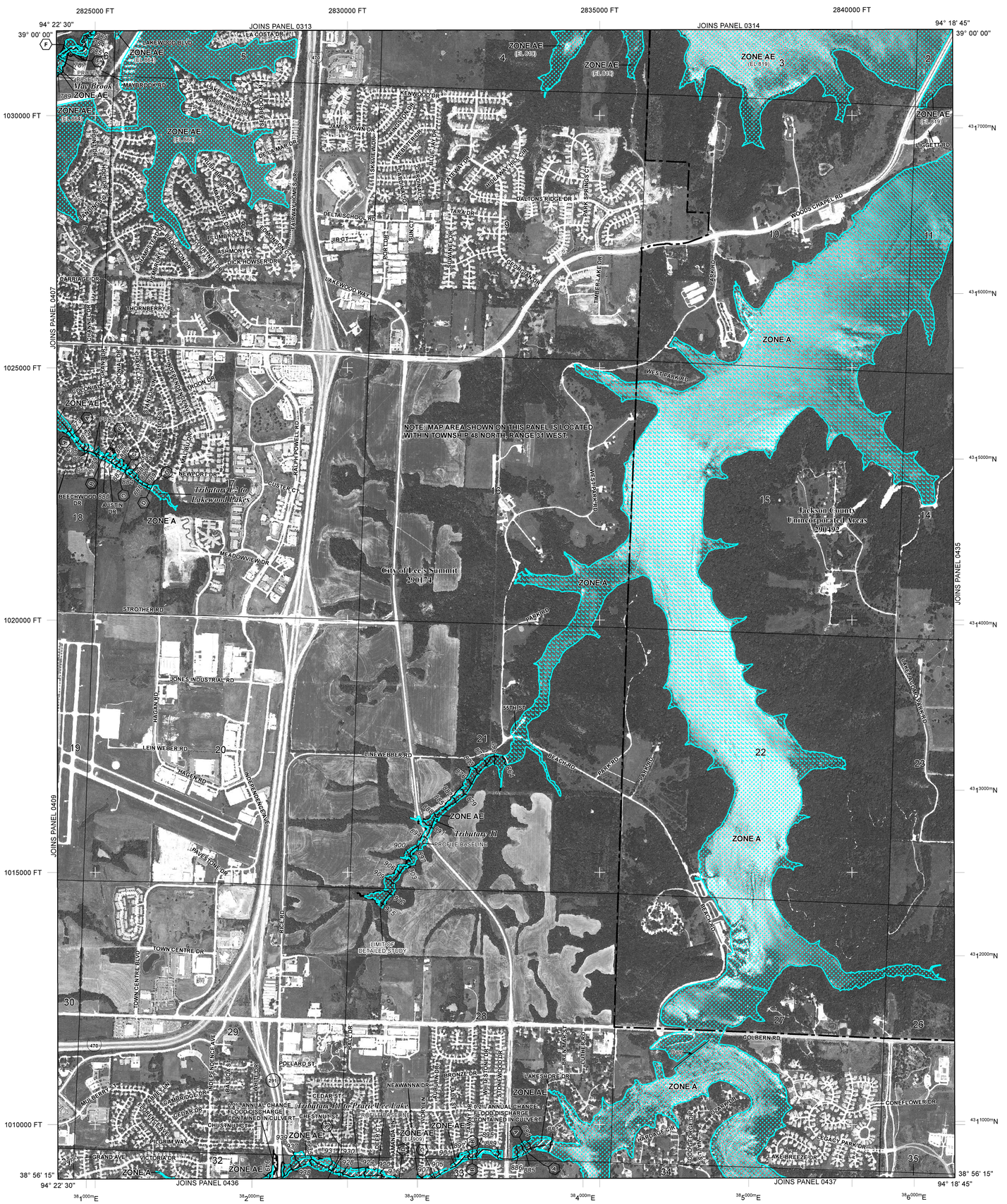
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

Based on updated topographic information, this map reflects more detailed and up-to-date **stream channel configurations and floodplain delineations** than those shown on the previous FIRM for this jurisdiction. As a result, the Flood Profiles and Floodway Data tables for multiple streams in the Flood Insurance Study Report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on the map. Also, the road to floodplain relationships for unrevised streams may differ from what is shown on previous maps.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.



LEGEND

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100-year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Special Flood Hazard Areas formerly protected from the 1% annual chance flood by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined.

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

	1% Annual Chance Floodplain Boundary
	0.2% Annual Chance Floodplain Boundary
	Floodway boundary
	Zone D boundary
	CBRS and OPA boundary
	Boundary dividing Special Flood Hazard Area Zones and boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths, or flood velocities.
513	Base Flood Elevation line and value; elevation in feet*
(EL 987)	Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

A — A	Cross section line
23 — 23	Transect line
	Culvert
	Bridge
45° 02' 08", 93° 02' 12"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83) Western Hemisphere
3100000 FT	5000-foot ticks: Missouri State Plane West Zone (FIPS Zone 2403), Transverse Mercator projection
DX5510 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
M1.5	River Mile

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
September 29, 2006

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
January 20, 2017 - to change Special Flood Hazard Areas.

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'
500 0 1000 2000 FEET
300 0 300 600 METERS

NFIP NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0430G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 430 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
JACKSON COUNTY	290492	0430	G
LEE'S SUMMIT, CITY OF	290174	0430	G

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
29095C0430G
MAP REVISED
JANUARY 20, 2017

Federal Emergency Management Agency

Appendix B

Existing Conditions Hydraflow Hydrograph Output Data

Hydraflow Table of Contents

19076.ExistingConditions.02.11.2020.gpw

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

Monday, 03 / 23 / 2020

Watershed Model Schematic

1

Legend

Hyd.	Origin	Description
1	Rational	Existing Conditions

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	28.28	35.95	-------	-------	50.20	-------	64.86	75.61	Existing Conditions

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

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	28.28	1	15	25,453	------	------	------	Existing Conditions

Hydrograph Report

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 28.28 cfs
Storm frequency	= 1 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 25,453 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 2.920 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

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	35.95	1	15	32,356	------	------	------	Existing Conditions

Hydrograph Report

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 35.95 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 32,356 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

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	50.20	1	15	45,176	------	------	------	Existing Conditions

Hydrograph Report

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 50.20 cfs
Storm frequency	= 10 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 45,176 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 5.183 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

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	75.61	1	15	68,053	------	------	------	Existing Conditions

Hydrograph Report

Hyd. No. 1

Existing Conditions

Hydrograph type	= Rational	Peak discharge	= 75.61 cfs
Storm frequency	= 100 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 68,053 cuft
Drainage area	= 29.350 ac	Runoff coeff.	= 0.33
Intensity	= 7.807 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	--------
2	110.7137	16.5000	0.9842	--------
3	0.0000	0.0000	0.0000	--------
5	168.3971	19.5000	1.0189	--------
10	183.3473	19.2000	1.0096	--------
25	103.5313	15.9000	0.8218	--------
50	235.4014	19.9000	1.0020	--------
100	83.7894	6.1000	0.7783	--------

File name: KCAPWA.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.51	7.14	6.17	5.46	4.90	4.46	4.10	3.79	3.54	3.31	3.12	2.95
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

Tc = time in minutes. Values may exceed 60.

Precip. file name: P:\DAE Civil\Hydraflow Storm Sewer\SCS Custom Water Quality.pcp

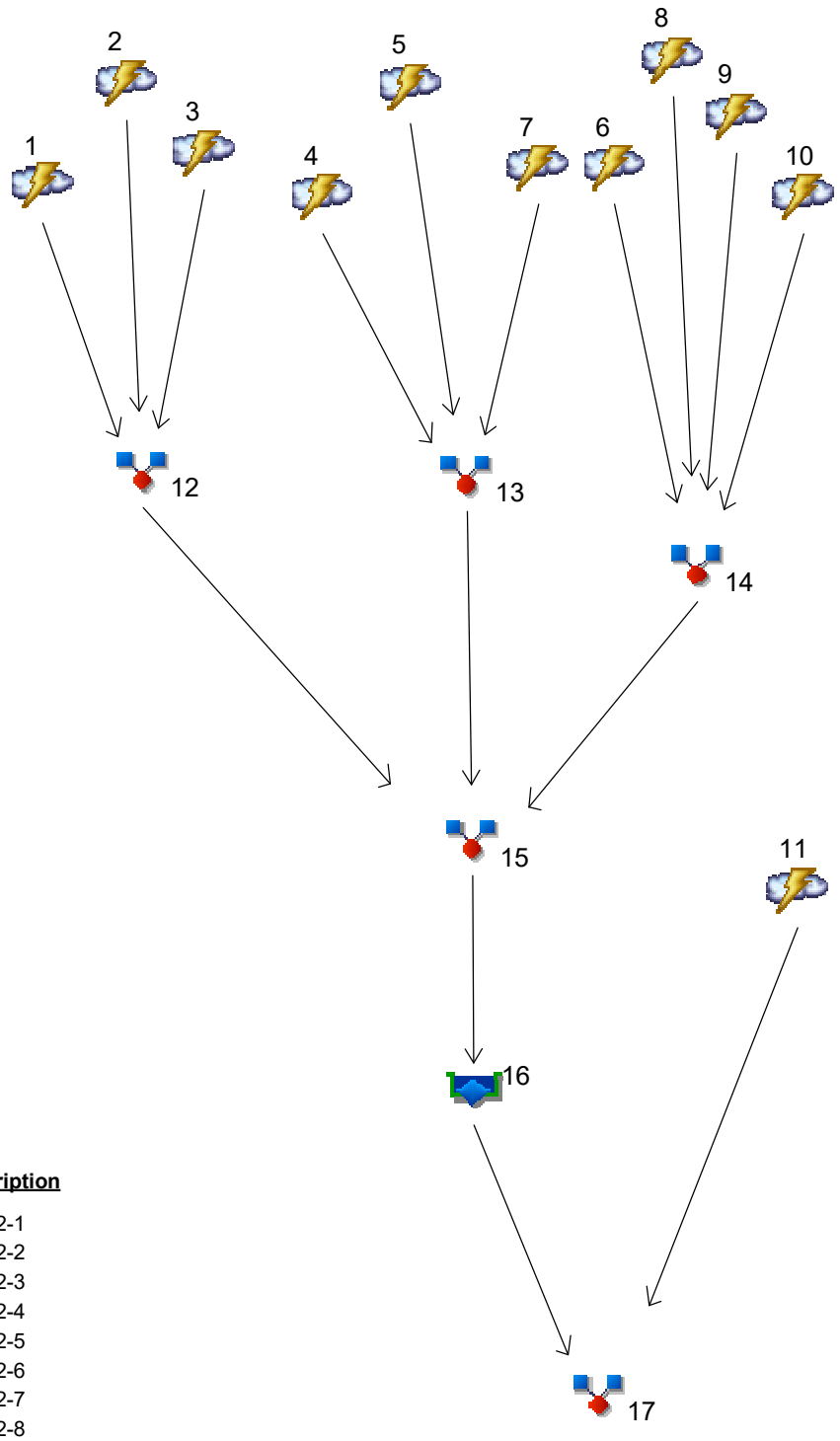
Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	1.37	3.50	0.00	4.50	5.30	6.10	6.90	7.50
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	2.90	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Appendix C

Proposed Conditions Hydraflow Output Data

Hydraflow Table of Contents

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	Rational	Area 2-1
2	Rational	Area 2-2
3	Rational	Area 2-3
4	Rational	Area 2-4
5	Rational	Area 2-5
6	Rational	Area 2-6
7	Rational	Area 2-7
8	Rational	Area 2-8
9	Rational	Area 2-9
10	Rational	Area 2-10
11	Rational	Area 2-11
12	Combine	Combined 1
13	Combine	Combined 2
14	Combine	Combined 3
15	Combine	TOTAL TO DETENTION
16	Reservoir	TOTAL DETENTION
17	Combine	TOTAL RUNOFF

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)								Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	8.217	10.45	-------	-------	14.58	-------	-------	21.97	Area 2-1
2	Rational	------	3.933	5.000	-------	-------	6.981	-------	-------	10.52	Area 2-2
3	Rational	------	10.09	12.83	-------	-------	17.91	-------	-------	26.98	Area 2-3
4	Rational	------	1.993	3.689	-------	-------	5.015	-------	-------	8.784	Area 2-4
5	Rational	------	0.368	0.681	-------	-------	0.926	-------	-------	1.622	Area 2-5
6	Rational	------	2.197	4.067	-------	-------	5.529	-------	-------	9.684	Area 2-6
7	Rational	------	1.285	2.378	-------	-------	3.233	-------	-------	5.663	Area 2-7
8	Rational	------	0.728	1.348	-------	-------	1.833	-------	-------	3.210	Area 2-8
9	Rational	------	0.631	1.168	-------	-------	1.587	-------	-------	2.780	Area 2-9
10	Rational	------	0.918	1.700	-------	-------	2.311	-------	-------	4.048	Area 2-10
11	Rational	------	0.450	0.832	-------	-------	1.132	-------	-------	1.982	Area 2-11
12	Combine	1, 2, 3,	22.24	28.27	-------	-------	39.48	-------	-------	59.47	Combined 1
13	Combine	4, 5, 7,	3.646	6.749	-------	-------	9.175	-------	-------	16.07	Combined 2
14	Combine	6, 8, 9,	4.474	8.283	-------	-------	11.26	-------	-------	19.72	Combined 3
15	Combine	10, 12, 13, 14	22.24	28.27	-------	-------	39.48	-------	-------	59.47	TOTAL TO DETENTION
16	Reservoir	15	0.000	0.000	-------	-------	0.000	-------	-------	0.093	TOTAL DETENTION
17	Combine	11, 16	0.450	0.832	-------	-------	1.132	-------	-------	1.982	TOTAL RUNOFF

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

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	8.217	1	15	7,395	------	------	------	Area 2-1
2	Rational	3.933	1	15	3,540	------	------	------	Area 2-2
3	Rational	10.09	1	15	9,082	------	------	------	Area 2-3
4	Rational	1.993	1	5	598	------	------	------	Area 2-4
5	Rational	0.368	1	5	110	------	------	------	Area 2-5
6	Rational	2.197	1	5	659	------	------	------	Area 2-6
7	Rational	1.285	1	5	385	------	------	------	Area 2-7
8	Rational	0.728	1	5	218	------	------	------	Area 2-8
9	Rational	0.631	1	5	189	------	------	------	Area 2-9
10	Rational	0.918	1	5	276	------	------	------	Area 2-10
11	Rational	0.450	1	5	135	------	------	------	Area 2-11
12	Combine	22.24	1	15	20,017	1, 2, 3,	------	------	Combined 1
13	Combine	3.646	1	5	1,094	4, 5, 7,	------	------	Combined 2
14	Combine	4.474	1	5	1,342	6, 8, 9,	------	------	Combined 3
15	Combine	22.24	1	15	22,453	10, 12, 13, 14	------	------	TOTAL TO DETENTION
16	Reservoir	0.000	1	n/a	0	15	982.69	22,453	TOTAL DETENTION
17	Combine	0.450	1	5	135	11, 16	------	------	TOTAL RUNOFF

Hydrograph Report

Hyd. No. 1

Area 2-1

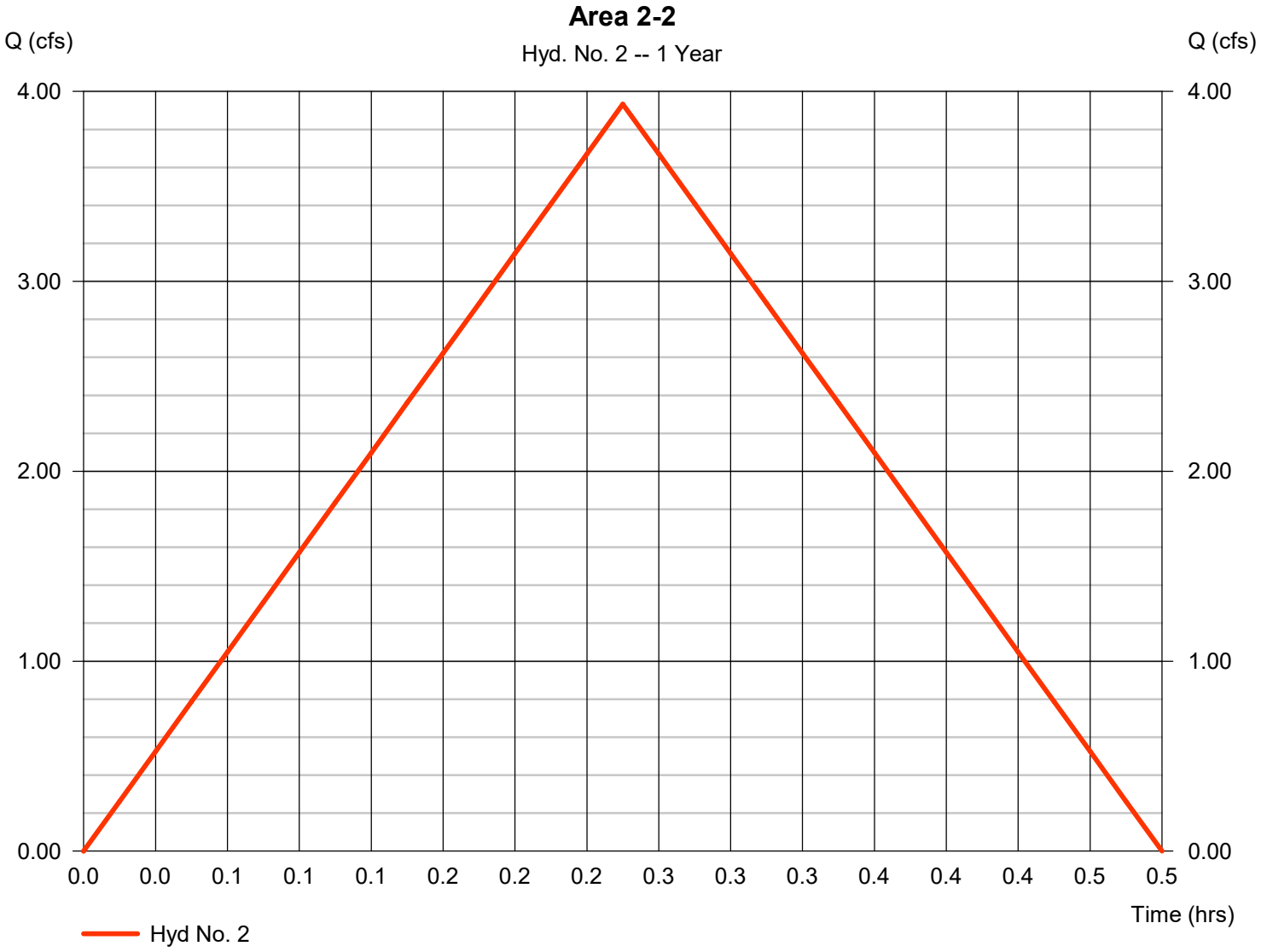
Hydrograph type	= Rational	Peak discharge	= 8.217 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 7,395 cuft
Drainage area	= 9.380 ac	Runoff coeff.	= 0.3
Intensity	= 2.920 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

Hydrograph Report

Hyd. No. 2

Area 2-2

Hydrograph type	= Rational	Peak discharge	= 3.933 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 3,540 cuft
Drainage area	= 4.490 ac	Runoff coeff.	= 0.3
Intensity	= 2.920 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

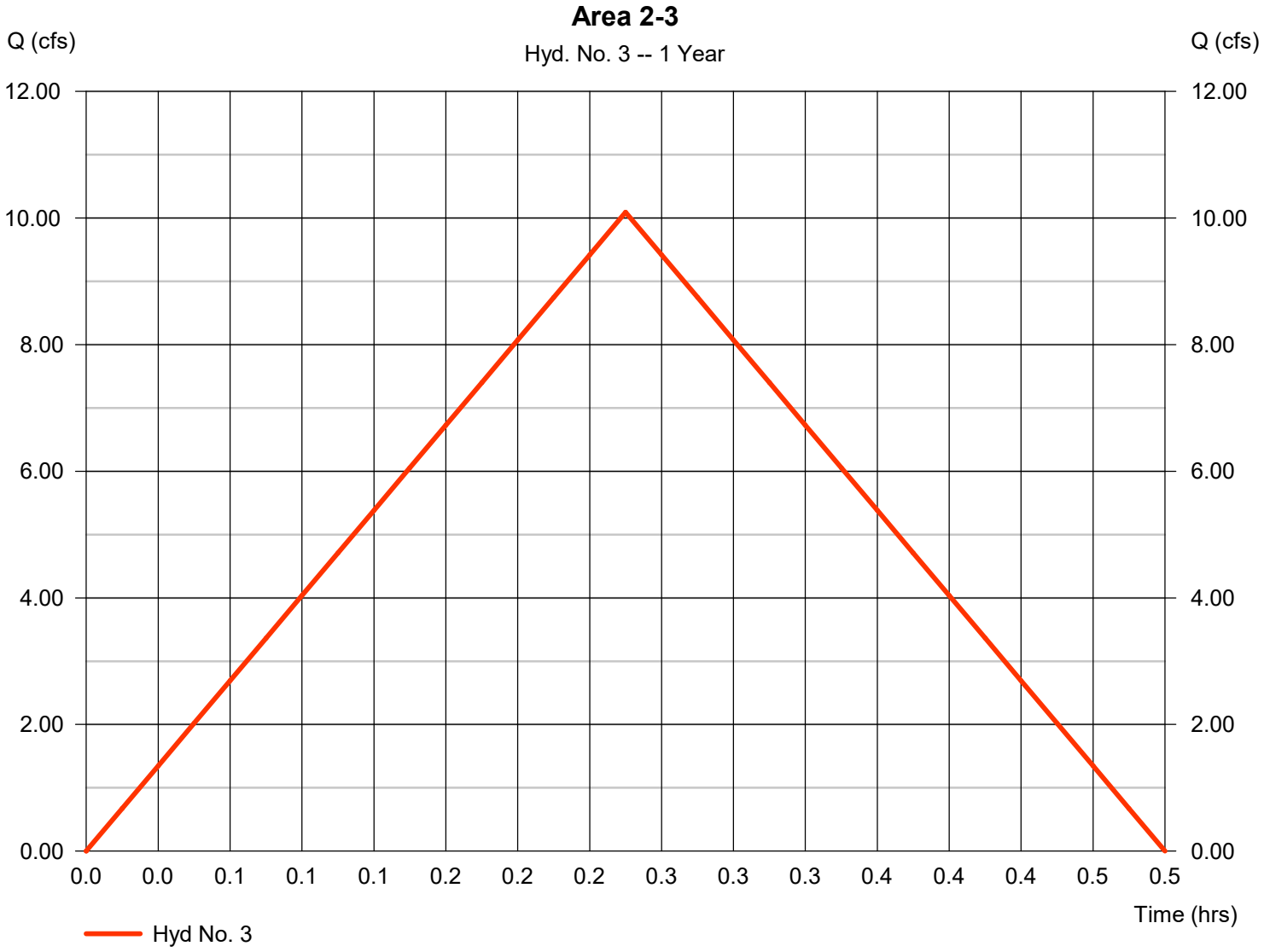


Hydrograph Report

Hyd. No. 3

Area 2-3

Hydrograph type	= Rational	Peak discharge	= 10.09 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 9,082 cuft
Drainage area	= 11.520 ac	Runoff coeff.	= 0.3
Intensity	= 2.920 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

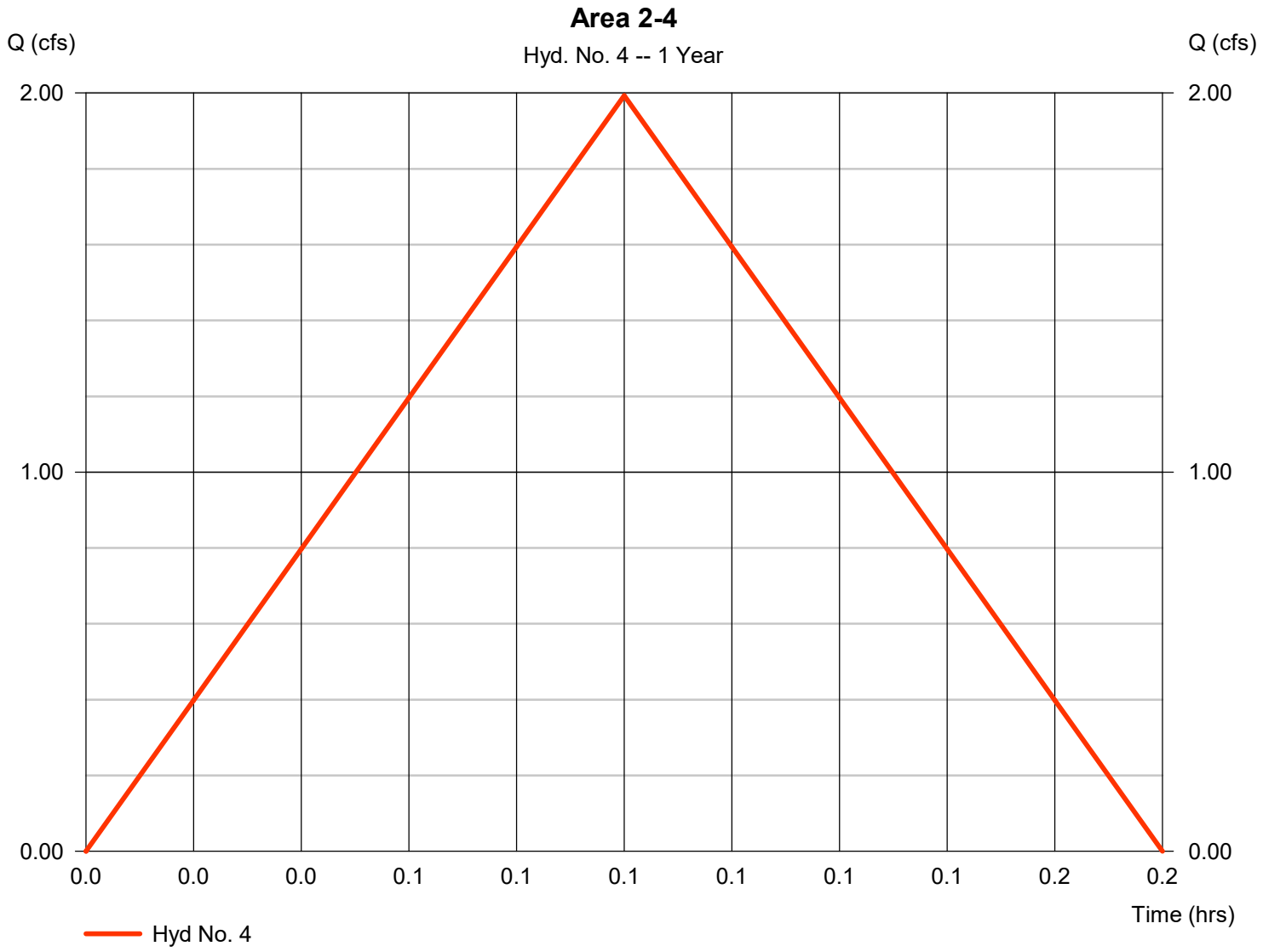


Hydrograph Report

Hyd. No. 4

Area 2-4

Hydrograph type	= Rational	Peak discharge	= 1.993 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 598 cuft
Drainage area	= 1.050 ac	Runoff coeff.	= 0.65
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

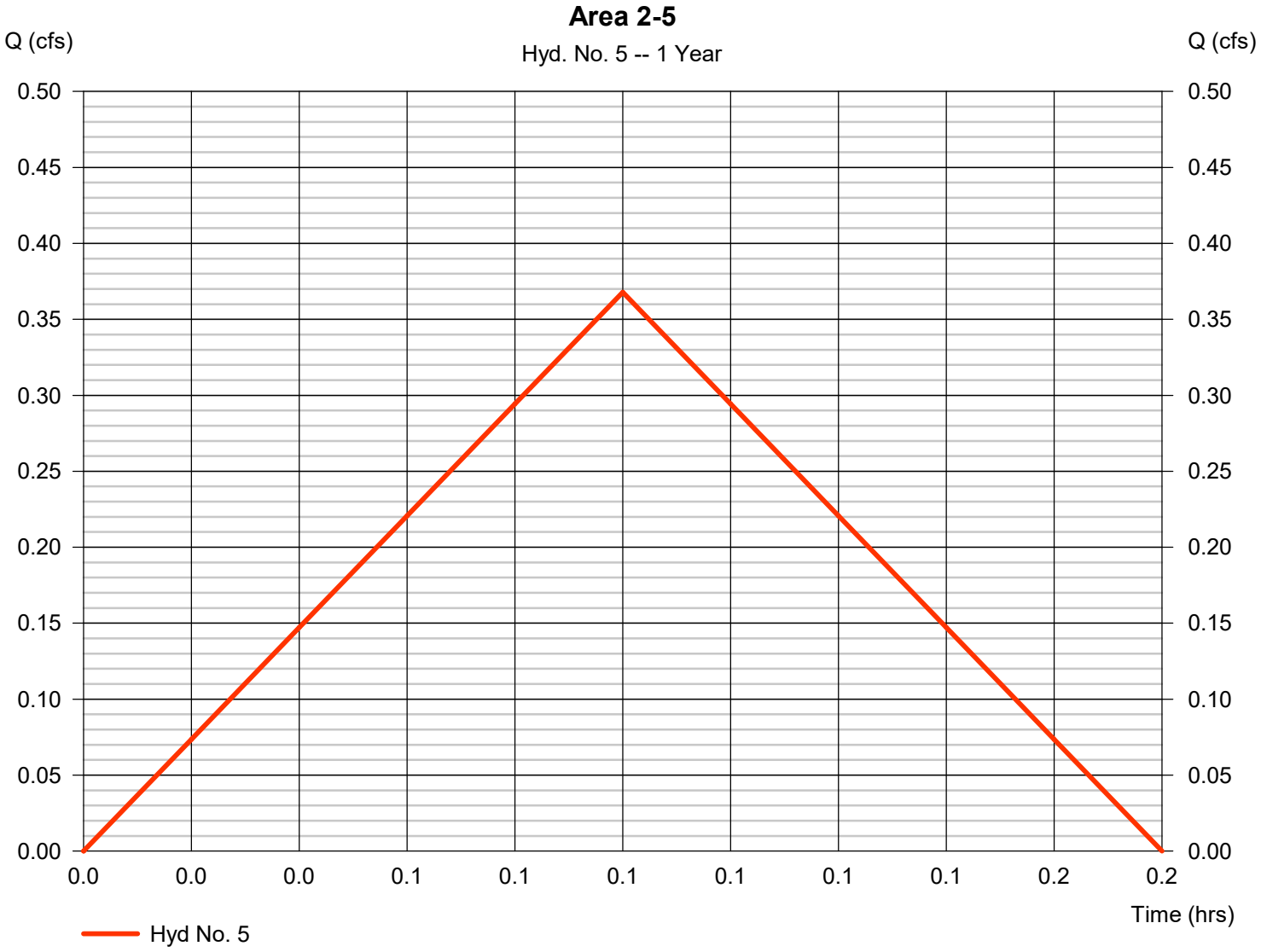


Hydrograph Report

Hyd. No. 5

Area 2-5

Hydrograph type	= Rational	Peak discharge	= 0.368 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 110 cuft
Drainage area	= 0.200 ac	Runoff coeff.	= 0.63
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

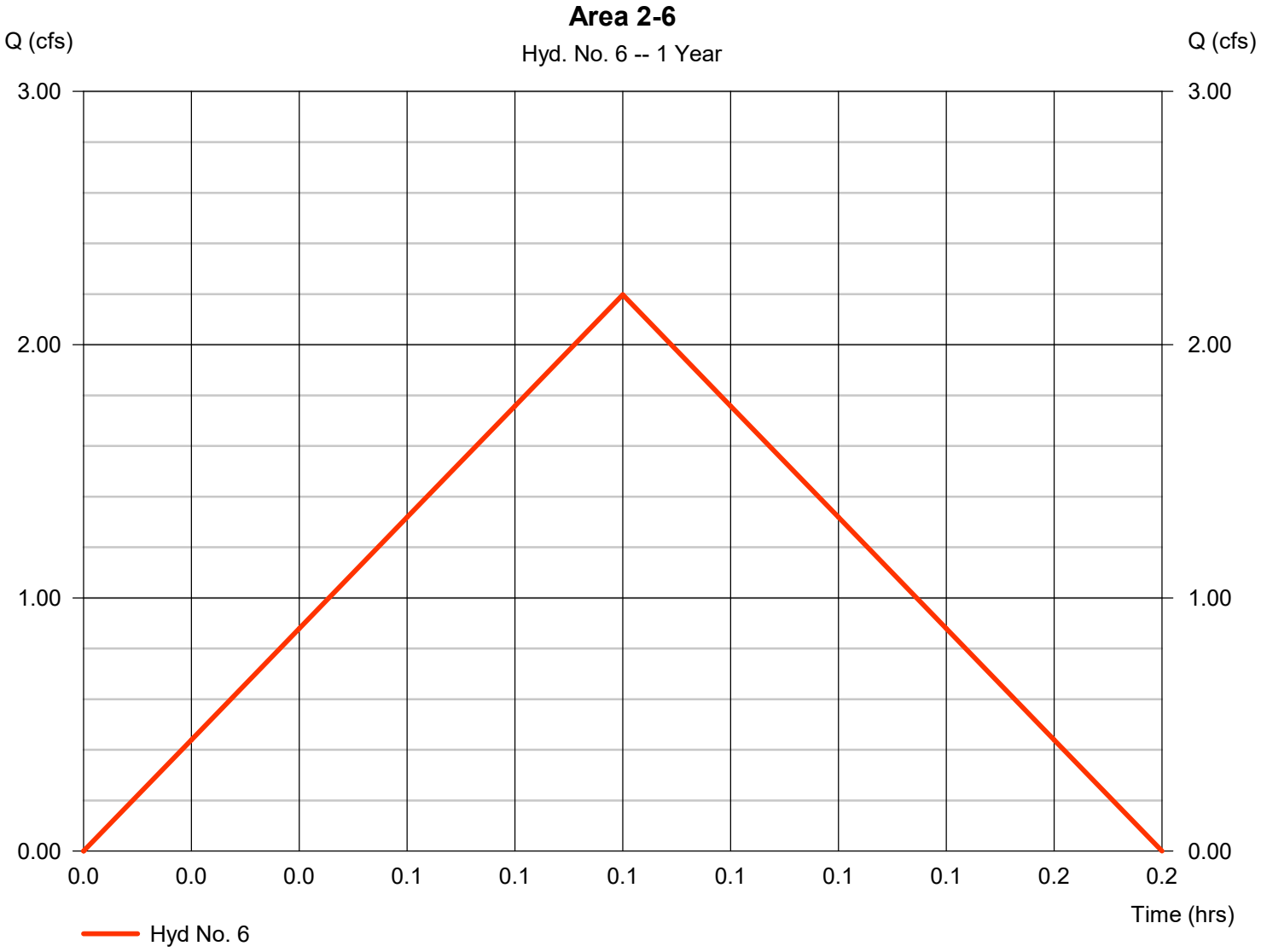


Hydrograph Report

Hyd. No. 6

Area 2-6

Hydrograph type	= Rational	Peak discharge	= 2.197 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 659 cuft
Drainage area	= 0.990 ac	Runoff coeff.	= 0.76
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

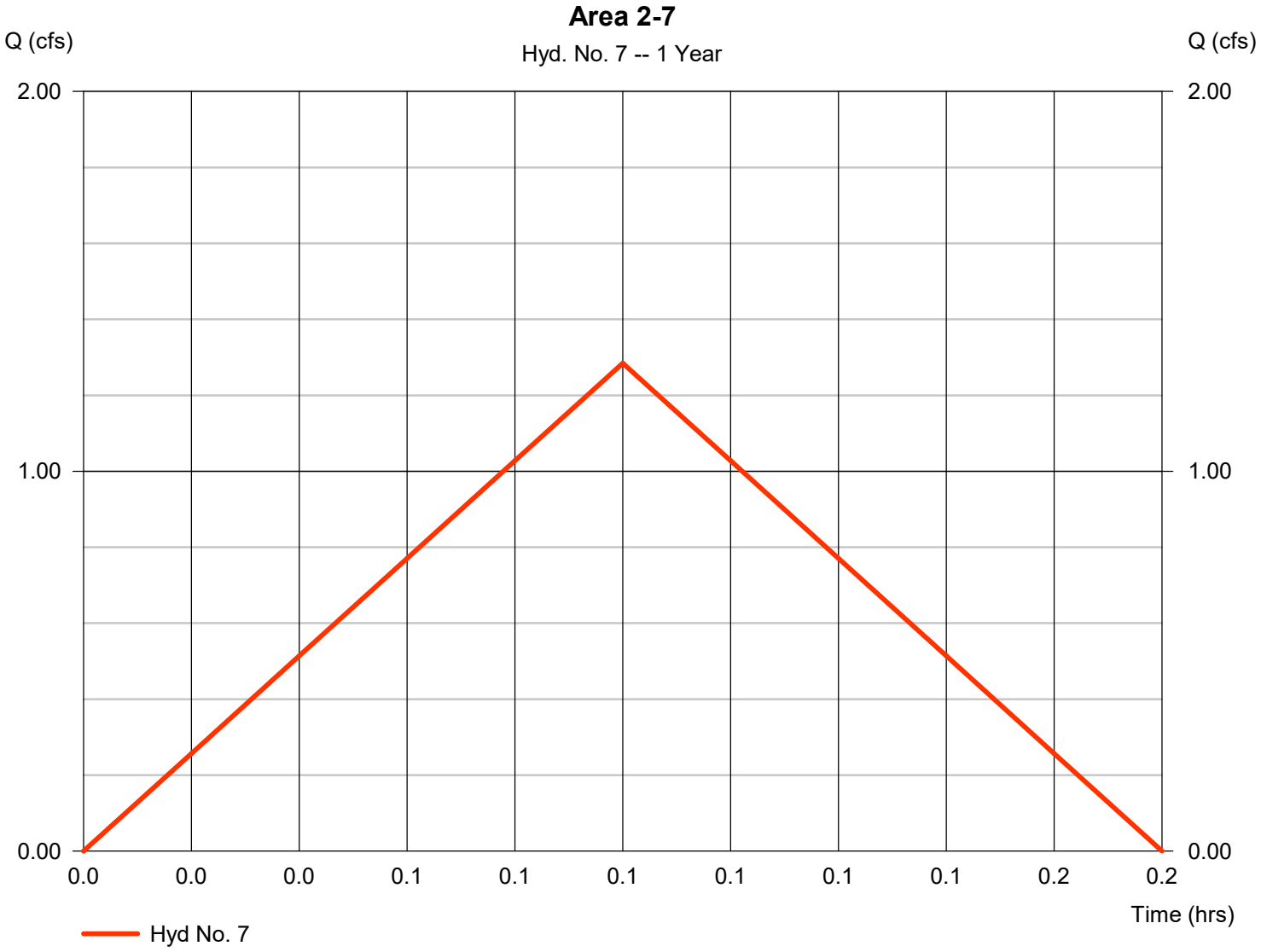


Hydrograph Report

Hyd. No. 7

Area 2-7

Hydrograph type	= Rational	Peak discharge	= 1.285 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 385 cuft
Drainage area	= 0.500 ac	Runoff coeff.	= 0.88
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

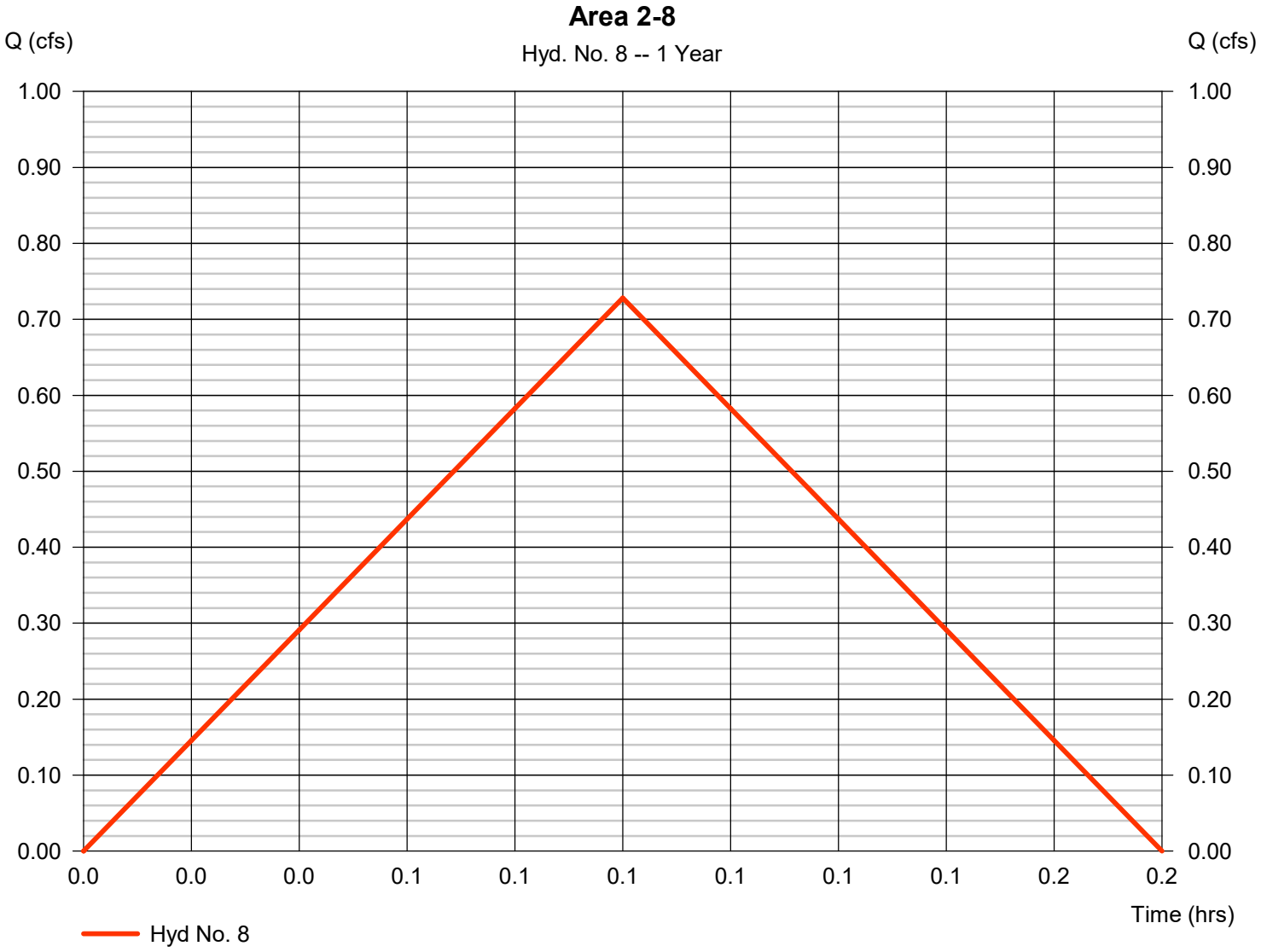


Hydrograph Report

Hyd. No. 8

Area 2-8

Hydrograph type	= Rational	Peak discharge	= 0.728 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 218 cuft
Drainage area	= 0.290 ac	Runoff coeff.	= 0.86
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

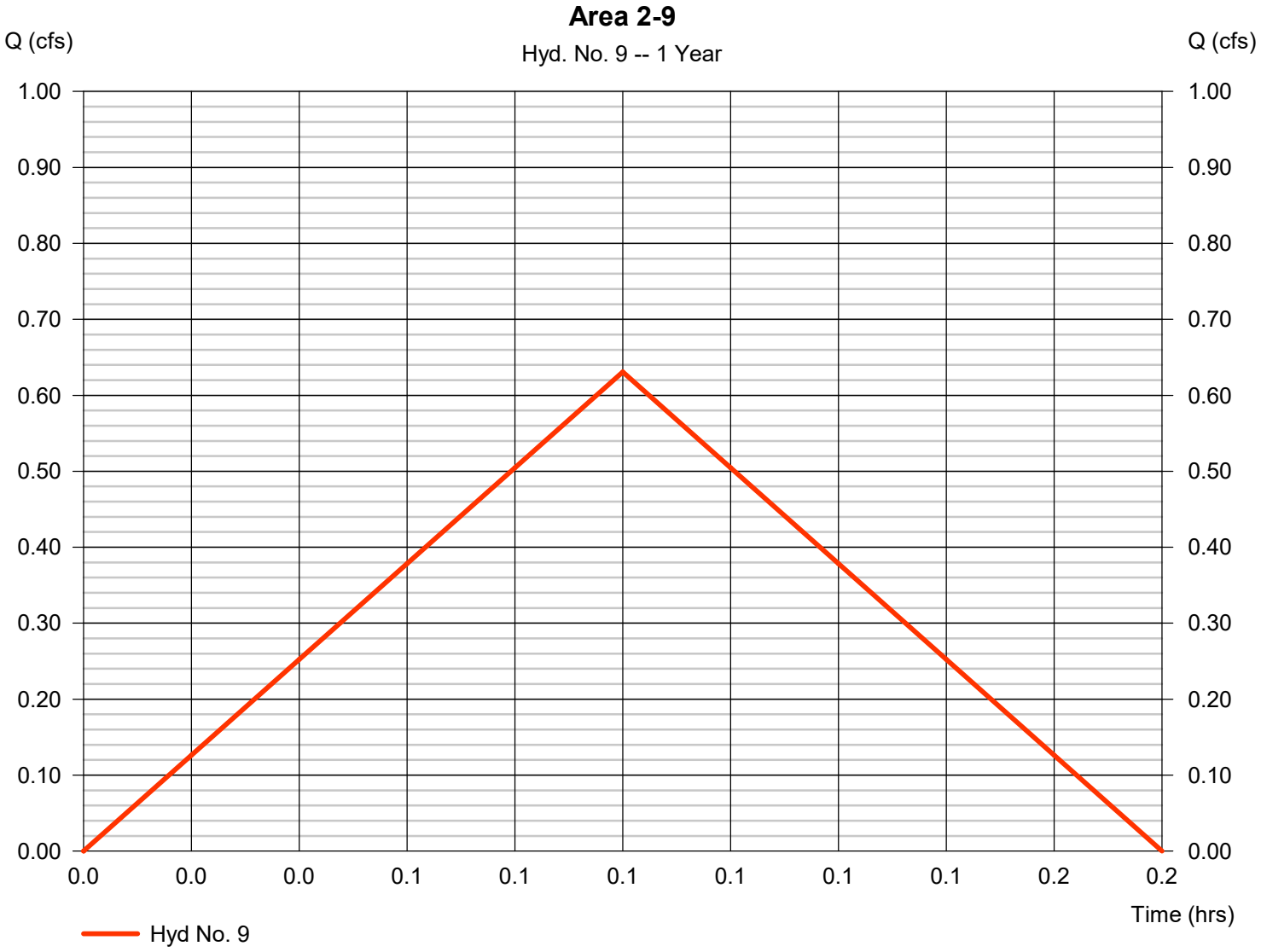


Hydrograph Report

Hyd. No. 9

Area 2-9

Hydrograph type	= Rational	Peak discharge	= 0.631 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 189 cuft
Drainage area	= 0.240 ac	Runoff coeff.	= 0.9
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

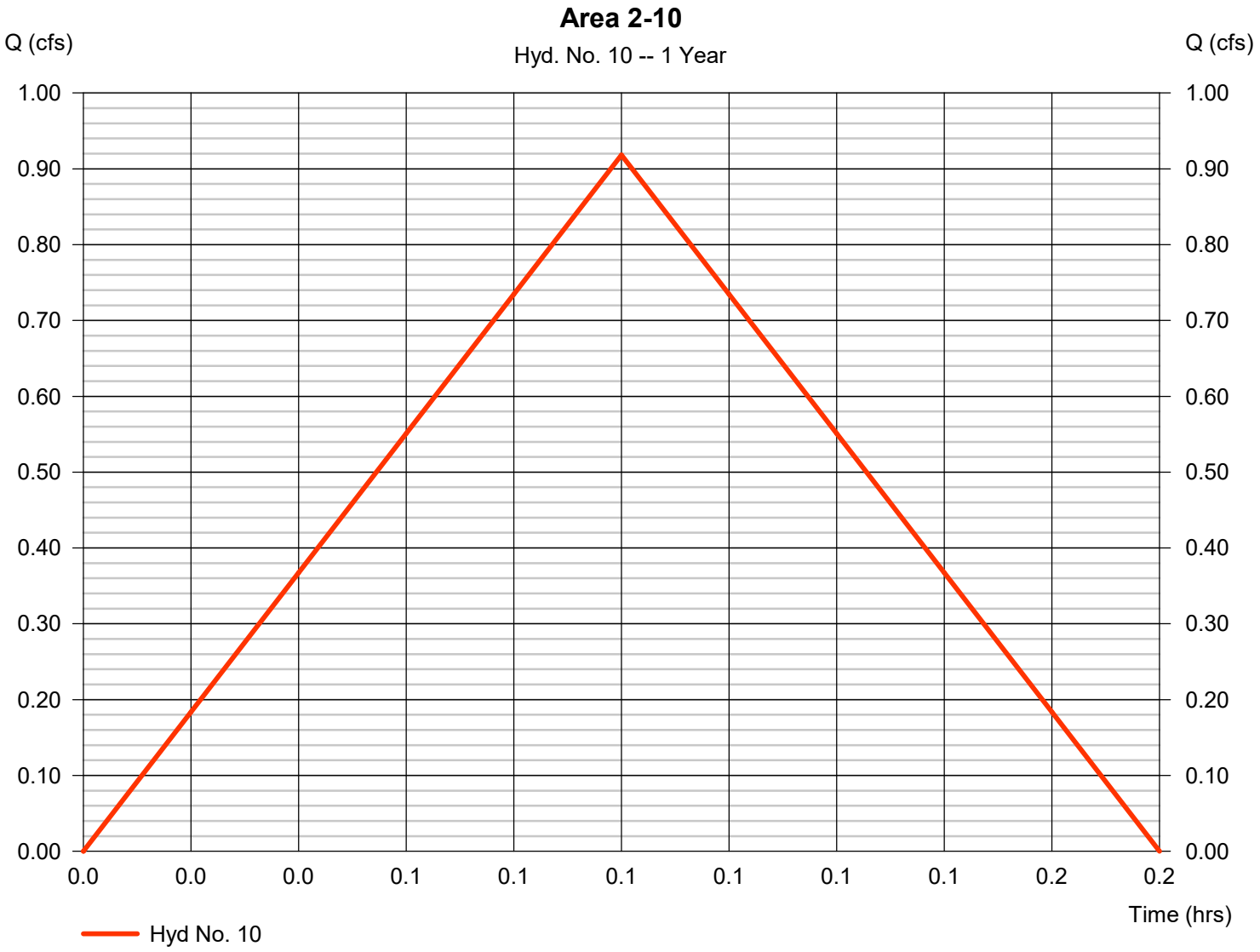


Hydrograph Report

Hyd. No. 10

Area 2-10

Hydrograph type	= Rational	Peak discharge	= 0.918 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 276 cuft
Drainage area	= 0.370 ac	Runoff coeff.	= 0.85
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

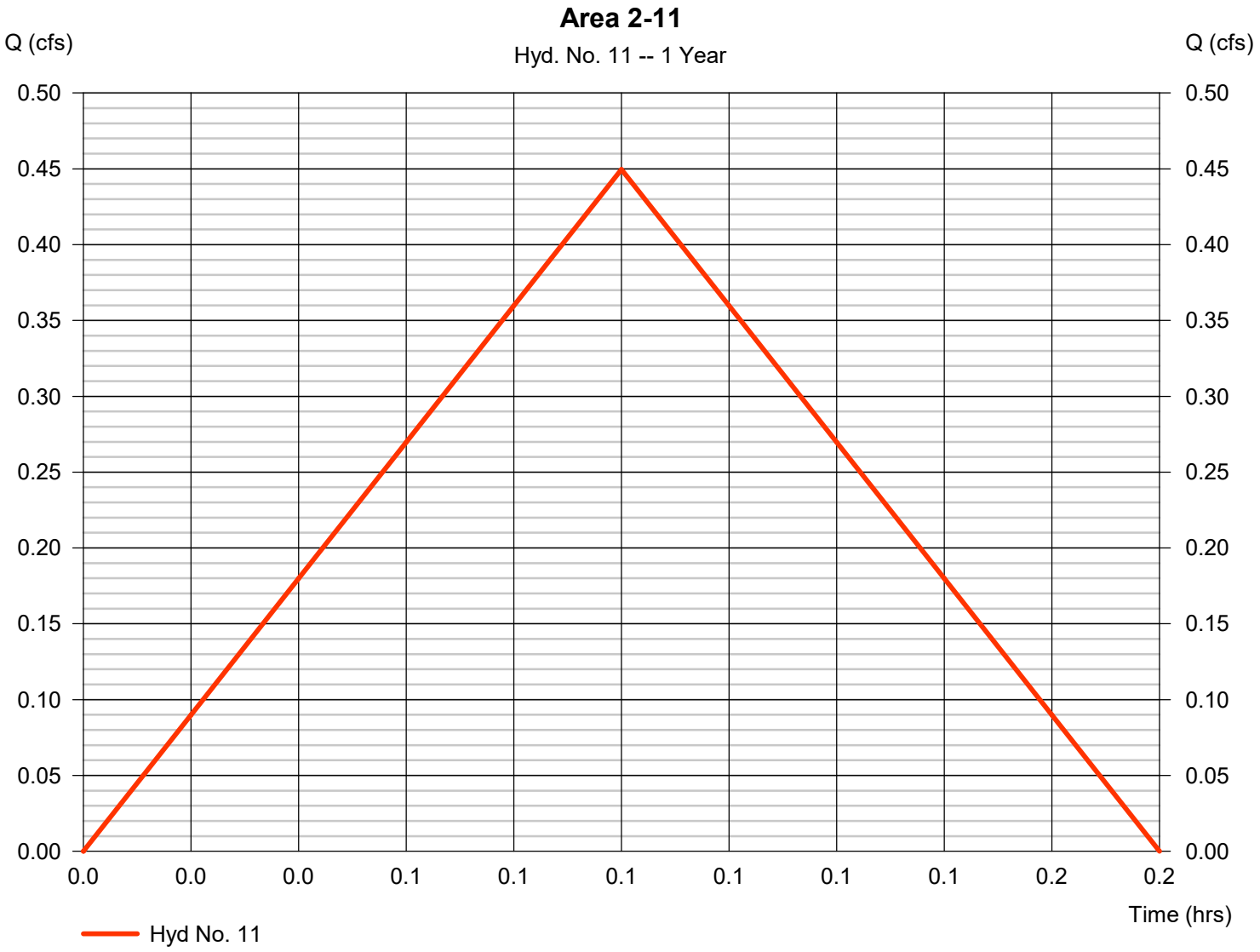


Hydrograph Report

Hyd. No. 11

Area 2-11

Hydrograph type	= Rational	Peak discharge	= 0.450 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 135 cuft
Drainage area	= 0.350 ac	Runoff coeff.	= 0.44
Intensity	= 2.920 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

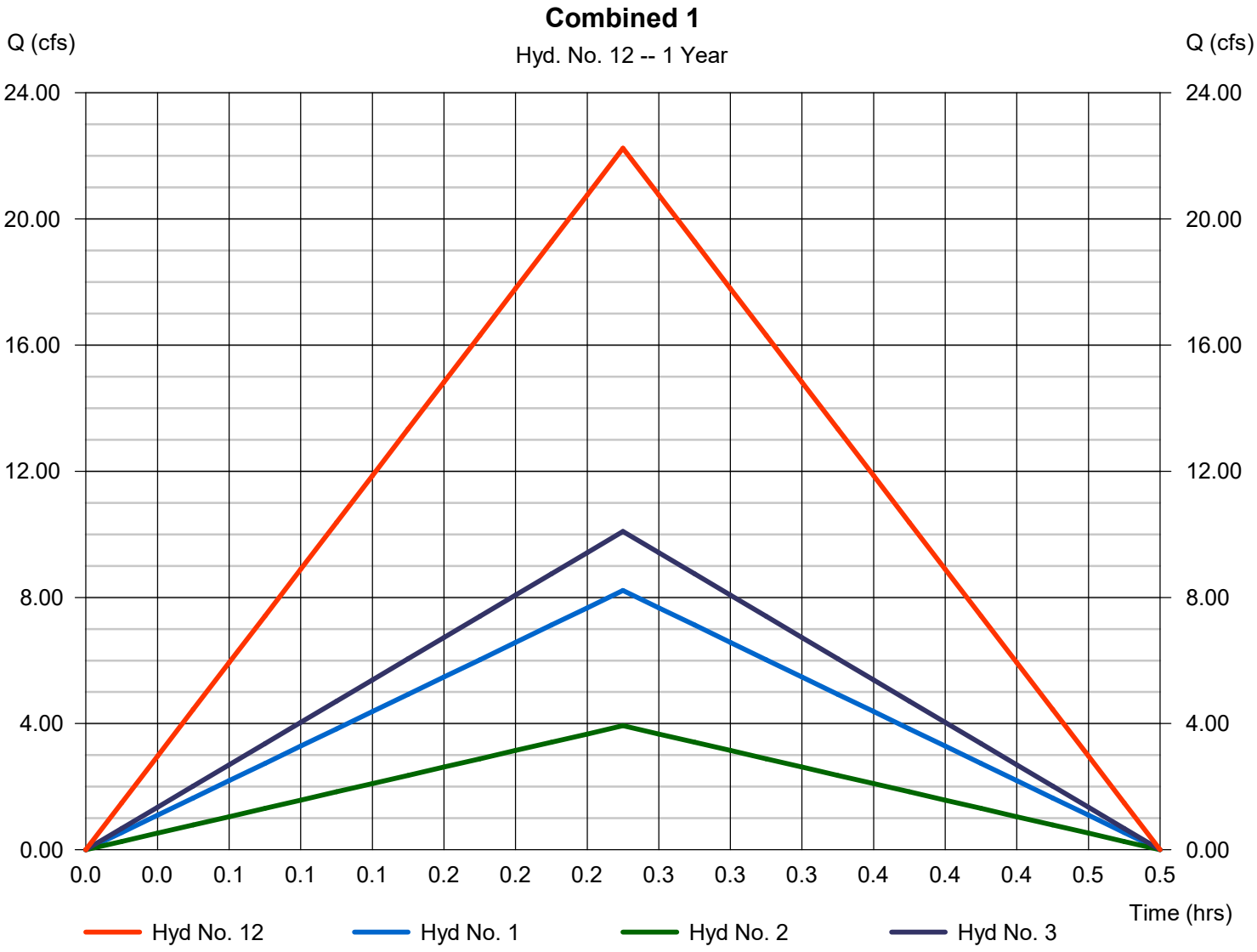


Hydrograph Report

Hyd. No. 12

Combined 1

Hydrograph type	=	Combine	Peak discharge	=	22.24 cfs
Storm frequency	=	1 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	20,017 cuft
Inflow hyds.	=	1, 2, 3	Contrib. drain. area	=	25.390 ac

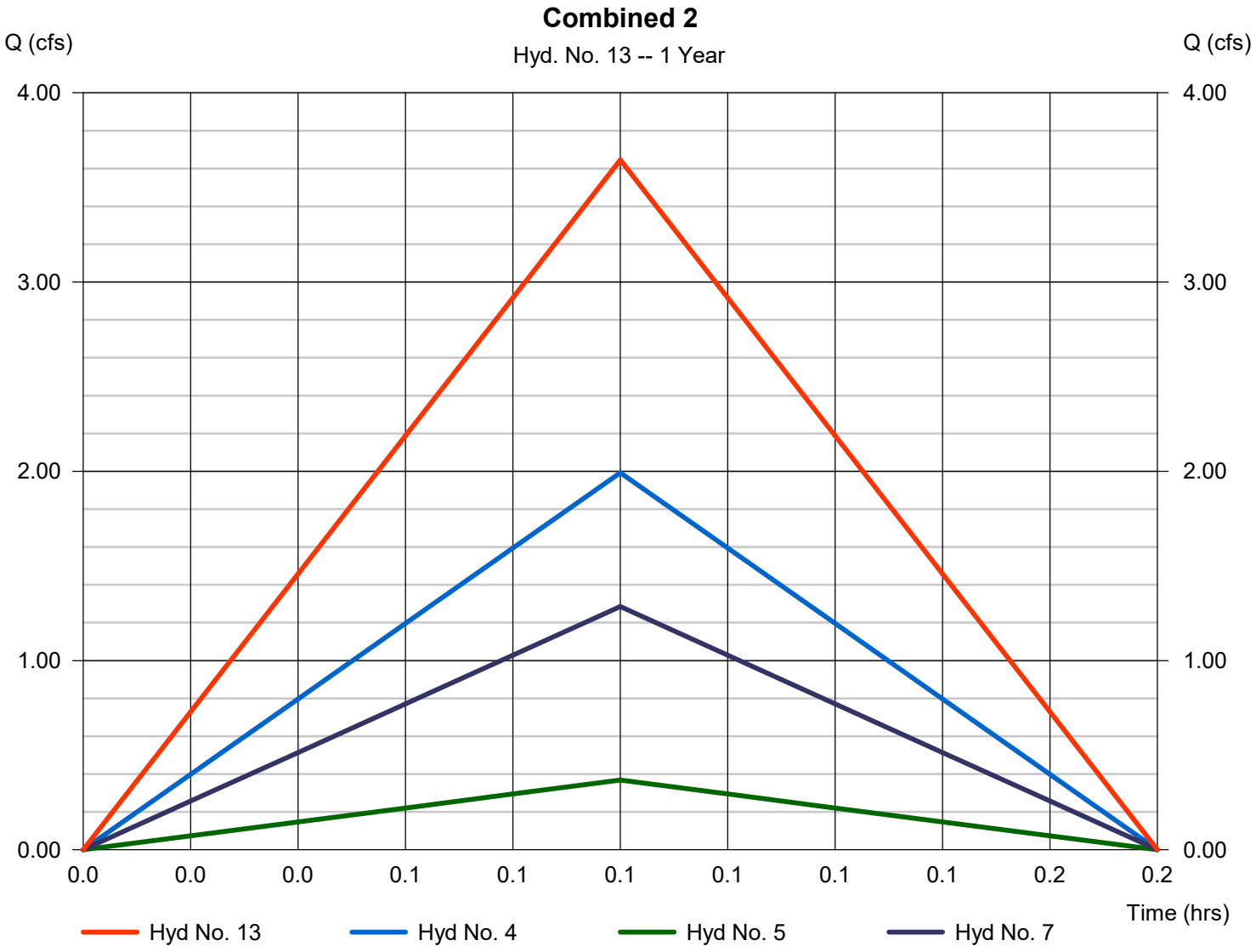


Hydrograph Report

Hyd. No. 13

Combined 2

Hydrograph type	= Combine	Peak discharge	= 3.646 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,094 cuft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 1.750 ac

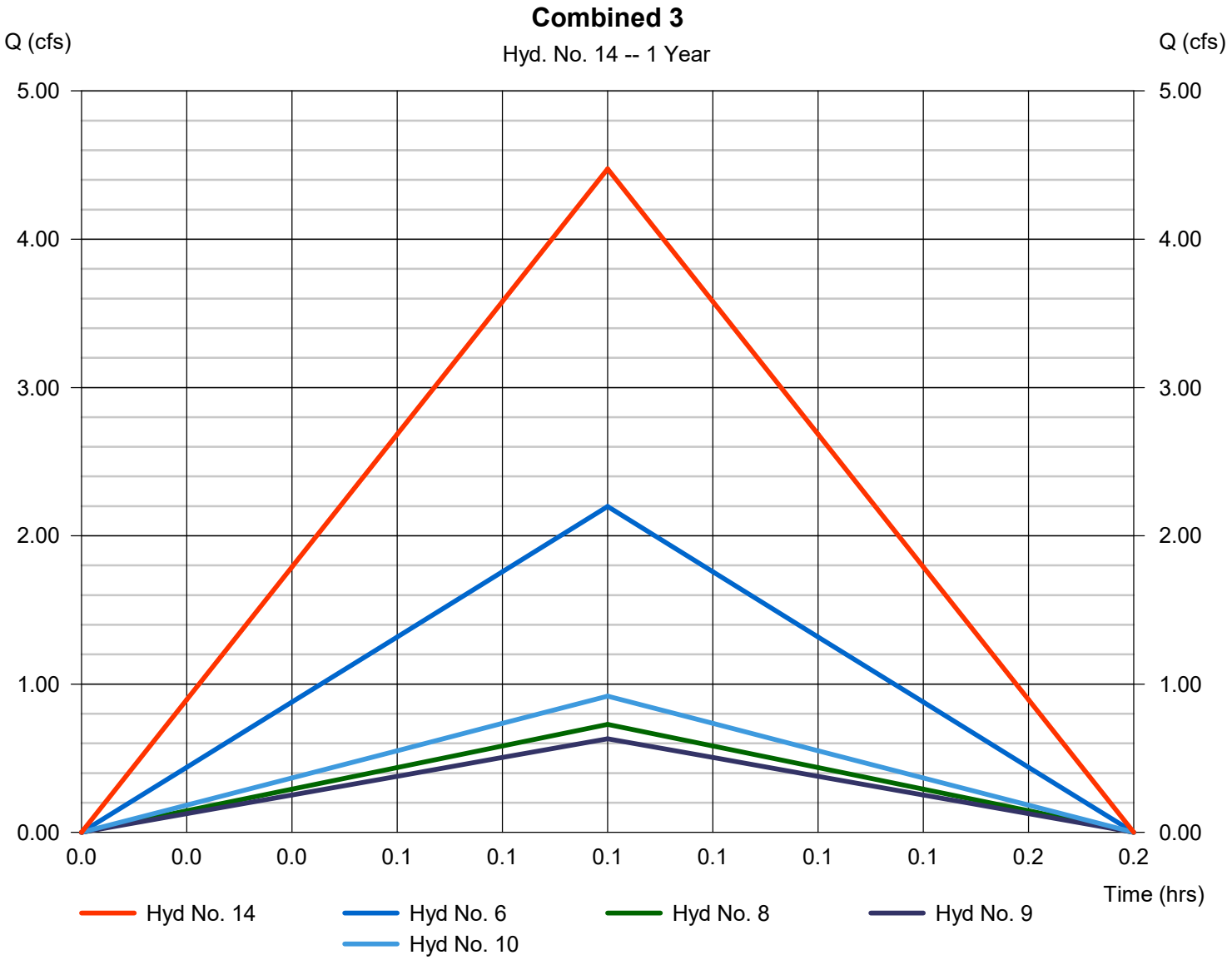


Hydrograph Report

Hyd. No. 14

Combined 3

Hydrograph type	= Combine	Peak discharge	= 4.474 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,342 cuft
Inflow hyds.	= 6, 8, 9, 10	Contrib. drain. area	= 1.890 ac

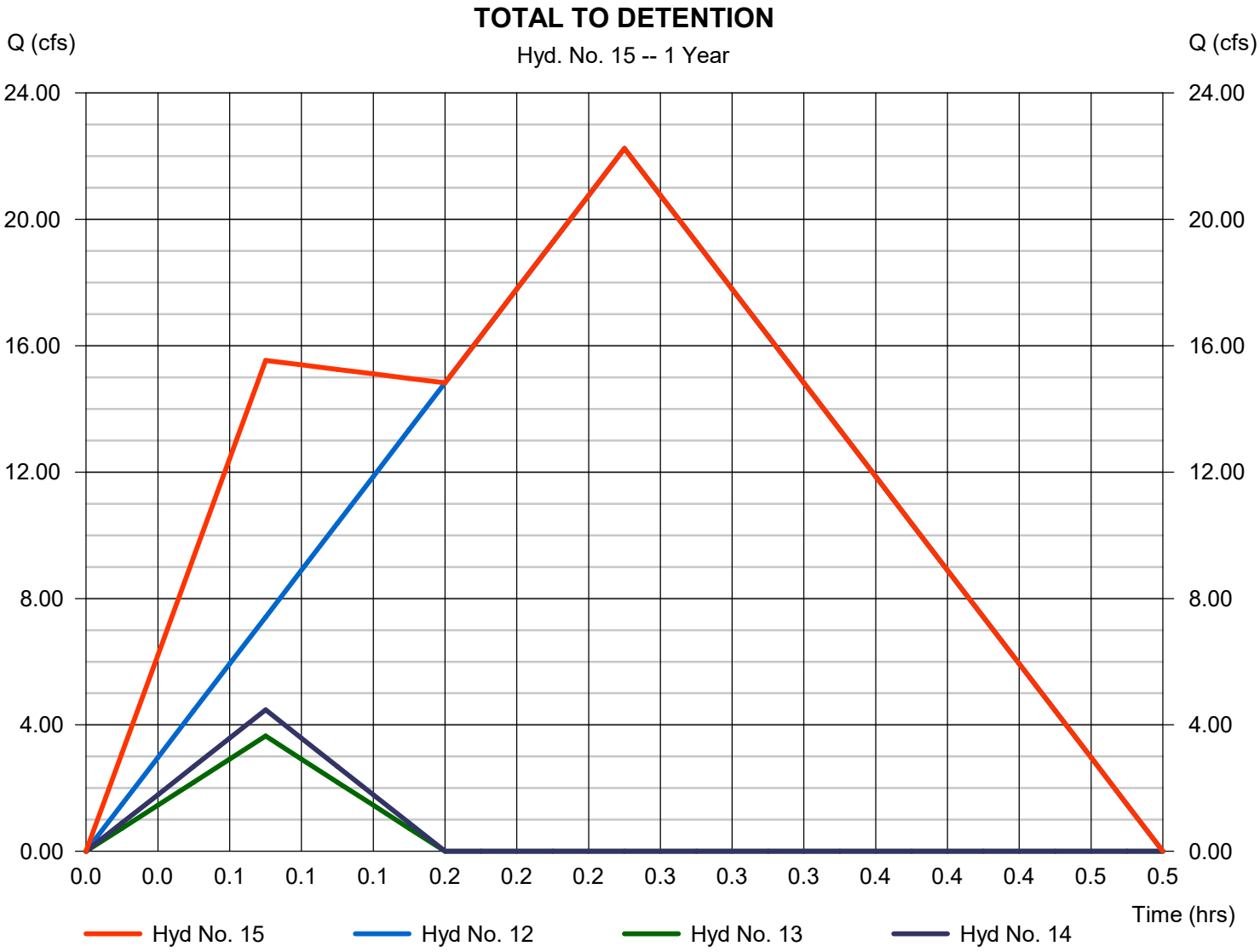


Hydrograph Report

Hyd. No. 15

TOTAL TO DETENTION

Hydrograph type	= Combine	Peak discharge	= 22.24 cfs
Storm frequency	= 1 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 22,453 cuft
Inflow hyds.	= 12, 13, 14	Contrib. drain. area	= 0.000 ac



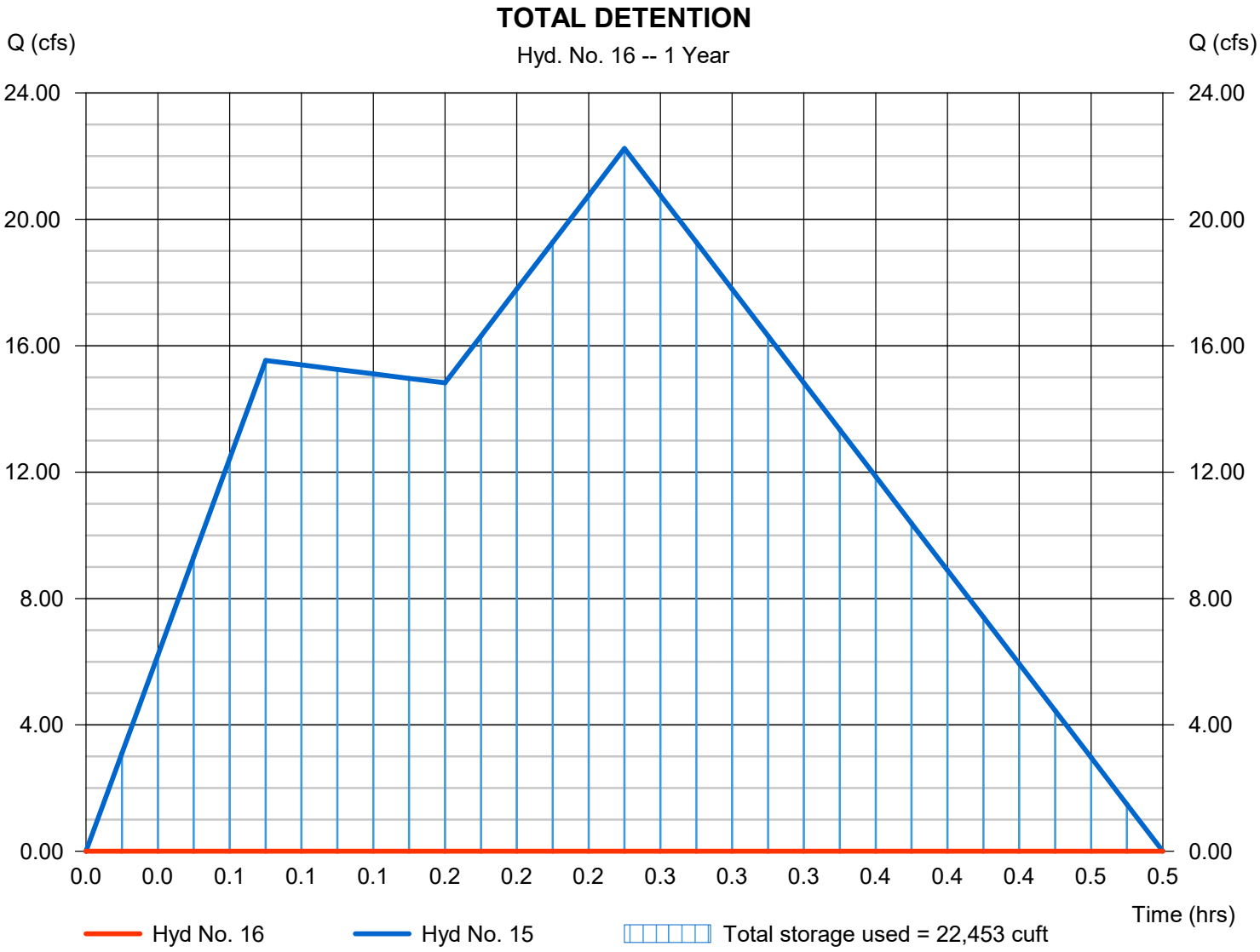
Hydrograph Report

Hyd. No. 16

TOTAL DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	1 yrs	Time to peak	=	n/a
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	15 - TOTAL TO DETENTION	Max. Elevation	=	982.69 ft
Reservoir name	=	Detention	Max. Storage	=	22,453 cuft

Storage Indication method used.



Pond No. 1 - Detention

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 977.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	977.00	803	0	0
1.00	978.00	1,645	1,199	1,199
2.00	979.00	2,795	2,195	3,394
3.00	980.00	3,493	3,137	6,531
4.00	981.00	5,097	4,269	10,800
5.00	982.00	7,032	6,038	16,838
6.00	983.00	9,333	8,155	24,993
7.00	984.00	12,041	10,657	35,650
8.00	985.00	15,215	13,596	49,246
9.00	986.00	18,928	17,036	66,282
10.00	987.00	23,407	21,126	87,408

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	Inactive	Inactive	Inactive
Span (in)	= 42.00	36.00	0.00	1.50
No. Barrels	= 1	1	0	6
Invert El. (ft)	= 977.00	983.00	0.00	977.00
Length (ft)	= 0.00	0.00	0.00	5.80
Slope (%)	= 0.00	0.00	0.00	n/a
N-Value	= .013	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 16.00	0.00	0.00	0.00
Crest El. (ft)	= 985.88	0.00	0.00	0.00
Weir Coeff.	= 2.60	3.33	3.33	3.33
Weir Type	= Broad	---	---	---
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).

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	977.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.10	120	977.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.20	240	977.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.30	360	977.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.40	480	977.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.50	599	977.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.60	719	977.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.70	839	977.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.80	959	977.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
0.90	1,079	977.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.00	1,199	978.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.10	1,418	978.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.20	1,638	978.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.30	1,857	978.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.40	2,077	978.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.50	2,296	978.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.60	2,516	978.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.70	2,735	978.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.80	2,955	978.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
1.90	3,174	978.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.00	3,394	979.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.10	3,707	979.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.20	4,021	979.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.30	4,335	979.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.40	4,648	979.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.50	4,962	979.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.60	5,276	979.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.70	5,590	979.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.80	5,903	979.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
2.90	6,217	979.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.00	6,531	980.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.10	6,958	980.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000

Continues on next page...

Detention

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.20	7,385	980.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.30	7,812	980.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.40	8,238	980.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.50	8,665	980.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.60	9,092	980.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.70	9,519	980.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.80	9,946	980.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
3.90	10,373	980.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.00	10,800	981.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.10	11,404	981.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.20	12,008	981.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.30	12,612	981.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.40	13,215	981.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.50	13,819	981.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.60	14,423	981.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.70	15,027	981.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.80	15,631	981.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
4.90	16,234	981.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.00	16,838	982.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.10	17,654	982.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.20	18,469	982.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.30	19,285	982.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.40	20,100	982.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.50	20,915	982.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.60	21,731	982.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.70	22,546	982.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.80	23,362	982.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
5.90	24,177	982.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.00	24,993	983.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.10	26,058	983.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.20	27,124	983.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.30	28,190	983.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.40	29,256	983.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.50	30,321	983.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.60	31,387	983.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.70	32,453	983.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.80	33,518	983.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
6.90	34,584	983.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.00	35,650	984.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.10	37,010	984.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.20	38,369	984.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.30	39,729	984.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.40	41,088	984.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.50	42,448	984.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.60	43,807	984.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.70	45,167	984.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.80	46,527	984.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
7.90	47,886	984.90	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.00	49,246	985.00	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.10	50,949	985.10	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.20	52,653	985.20	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.30	54,356	985.30	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.40	56,060	985.40	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.50	57,764	985.50	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.60	59,467	985.60	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.70	61,171	985.70	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.80	62,875	985.80	0.00	0.00	---	0.00	0.00	---	---	---	---	---	0.000
8.90	64,578	985.90	0.12 ic	0.00	---	0.00	0.12	---	---	---	---	---	0.116
9.00	66,282	986.00	1.79 ic	0.00	---	0.00	1.73	---	---	---	---	---	1.729
9.10	68,394	986.10	4.32 ic	0.00	---	0.00	4.29	---	---	---	---	---	4.292
9.20	70,507	986.20	7.70 ic	0.00	---	0.00	7.53	---	---	---	---	---	7.529
9.30	72,619	986.30	11.37 ic	0.00	---	0.00	11.32	---	---	---	---	---	11.32
9.40	74,732	986.40	15.81 ic	0.00	---	0.00	15.59	---	---	---	---	---	15.59
9.50	76,845	986.50	20.30 ic	0.00	---	0.00	20.30	---	---	---	---	---	20.30
9.60	78,957	986.60	25.82 ic	0.00	---	0.00	25.41	---	---	---	---	---	25.41
9.70	81,070	986.70	30.96 ic	0.00	---	0.00	30.88	---	---	---	---	---	30.88
9.80	83,182	986.80	36.75 ic	0.00	---	0.00	36.70	---	---	---	---	---	36.70
9.90	85,295	986.90	42.90 ic	0.00	---	0.00	42.84	---	---	---	---	---	42.84
10.00	87,408	987.00	49.42 ic	0.00	---	0.00	49.31	---	---	---	---	---	49.31

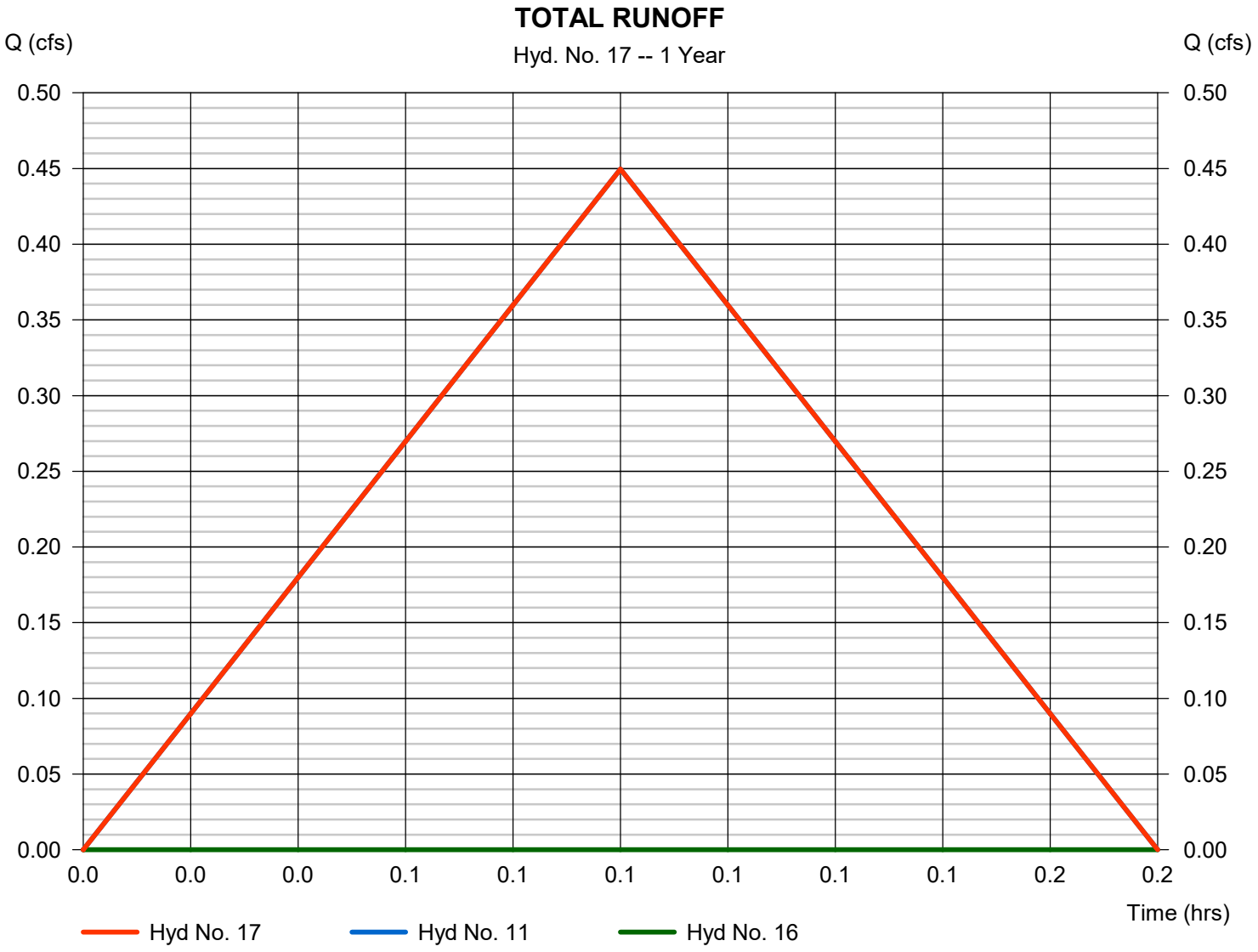
...End

Hydrograph Report

Hyd. No. 17

TOTAL RUNOFF

Hydrograph type	=	Combine	Peak discharge	=	0.450 cfs
Storm frequency	=	1 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	135 cuft
Inflow hyds.	=	11, 16	Contrib. drain. area	=	0.350 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

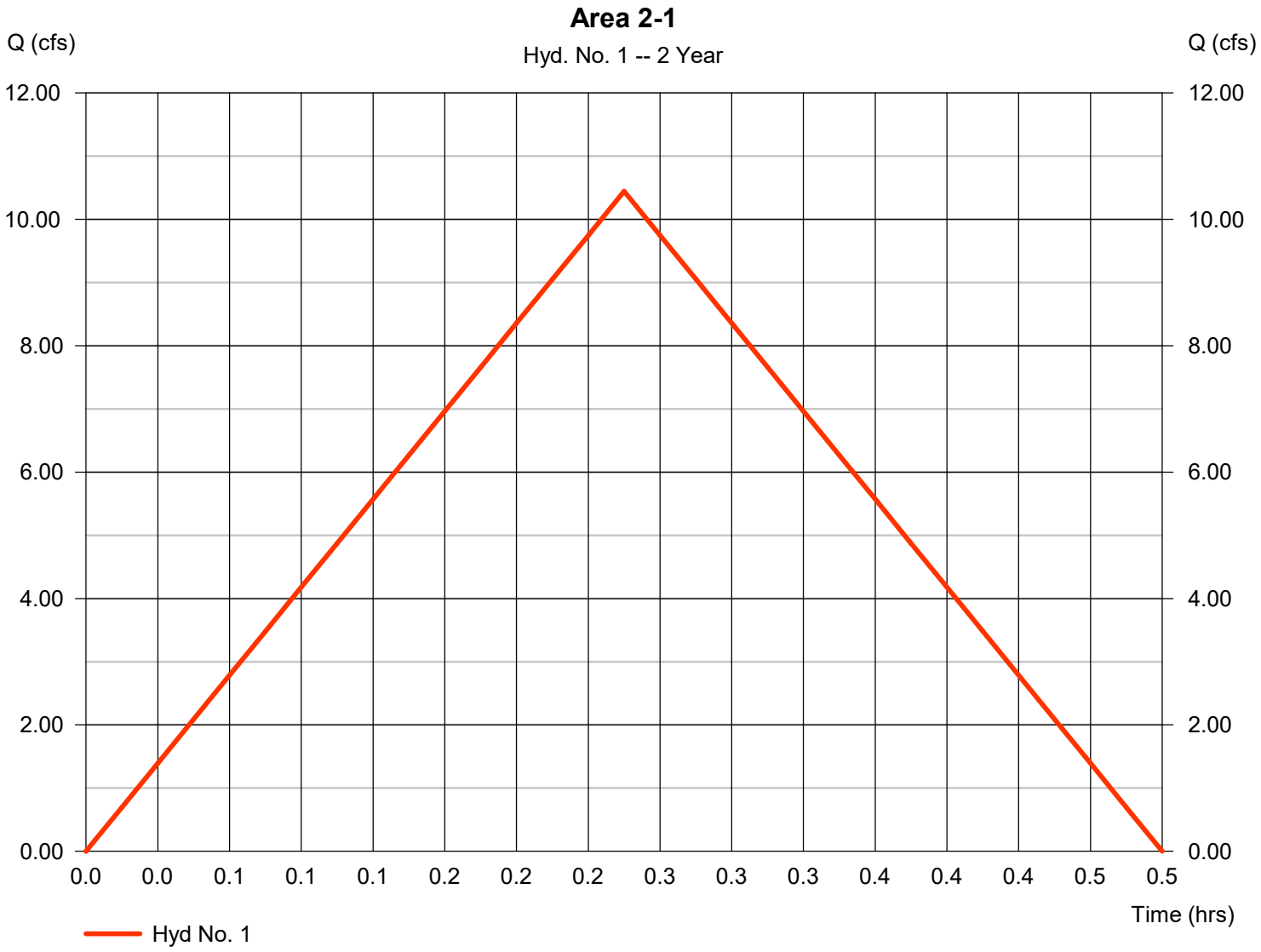
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	10.45	1	15	9,401	------	------	------	Area 2-1
2	Rational	5.000	1	15	4,500	------	------	------	Area 2-2
3	Rational	12.83	1	15	11,545	------	------	------	Area 2-3
4	Rational	3.689	1	5	1,107	------	------	------	Area 2-4
5	Rational	0.681	1	5	204	------	------	------	Area 2-5
6	Rational	4.067	1	5	1,220	------	------	------	Area 2-6
7	Rational	2.378	1	5	714	------	------	------	Area 2-7
8	Rational	1.348	1	5	404	------	------	------	Area 2-8
9	Rational	1.168	1	5	350	------	------	------	Area 2-9
10	Rational	1.700	1	5	510	------	------	------	Area 2-10
11	Rational	0.832	1	5	250	------	------	------	Area 2-11
12	Combine	28.27	1	15	25,446	1, 2, 3,	------	------	Combined 1
13	Combine	6.749	1	5	2,025	4, 5, 7,	------	------	Combined 2
14	Combine	8.283	1	5	2,485	6, 8, 9,	------	------	Combined 3
15	Combine	28.27	1	15	29,955	10, 12, 13, 14	------	------	TOTAL TO DETENTION
16	Reservoir	0.000	1	n/a	0	15	983.47	29,955	TOTAL DETENTION
17	Combine	0.832	1	5	250	11, 16	------	------	TOTAL RUNOFF

Hydrograph Report

Hyd. No. 1

Area 2-1

Hydrograph type	= Rational	Peak discharge	= 10.45 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 9,401 cuft
Drainage area	= 9.380 ac	Runoff coeff.	= 0.3
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

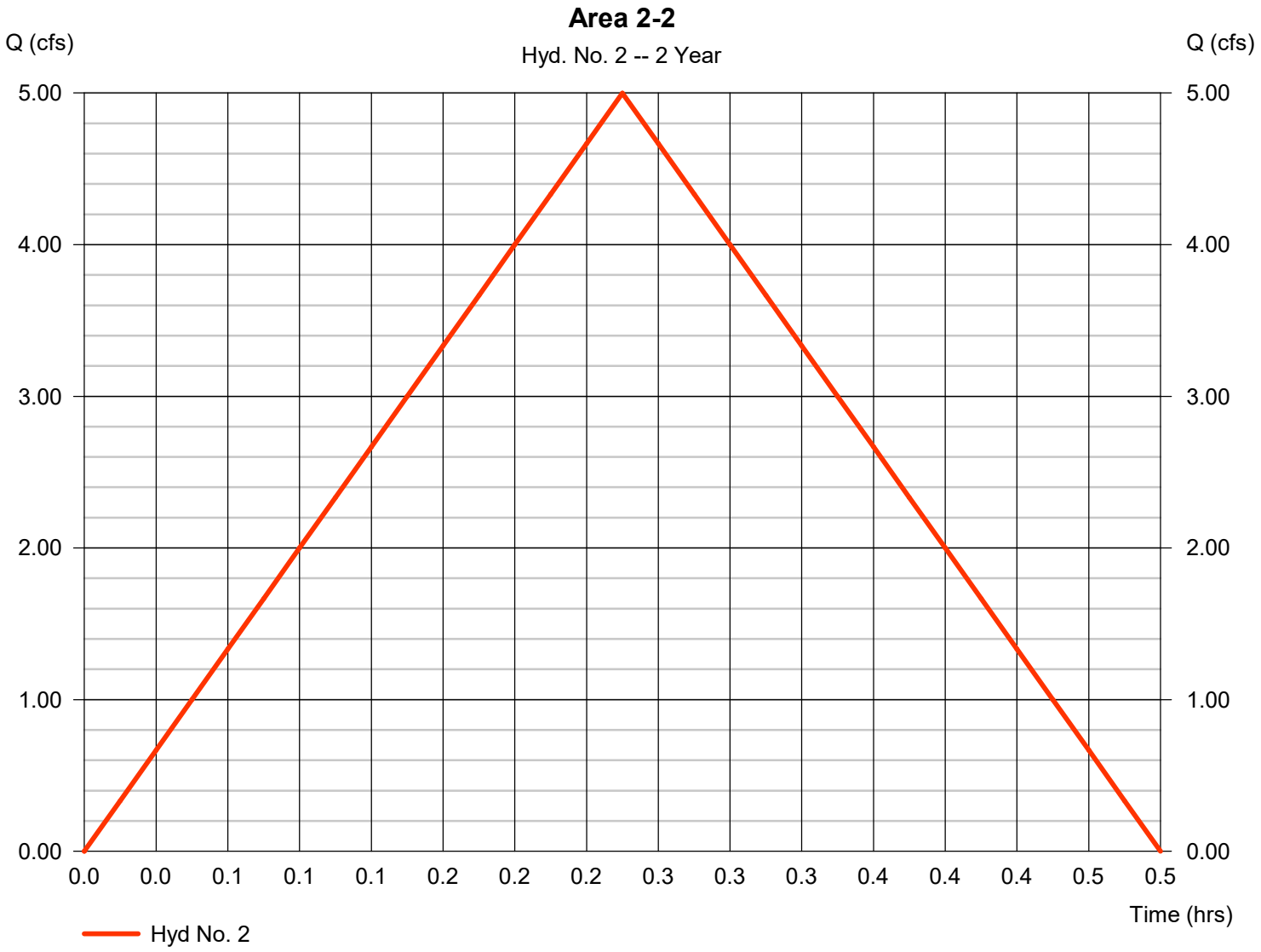


Hydrograph Report

Hyd. No. 2

Area 2-2

Hydrograph type	= Rational	Peak discharge	= 5.000 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 4,500 cuft
Drainage area	= 4.490 ac	Runoff coeff.	= 0.3
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

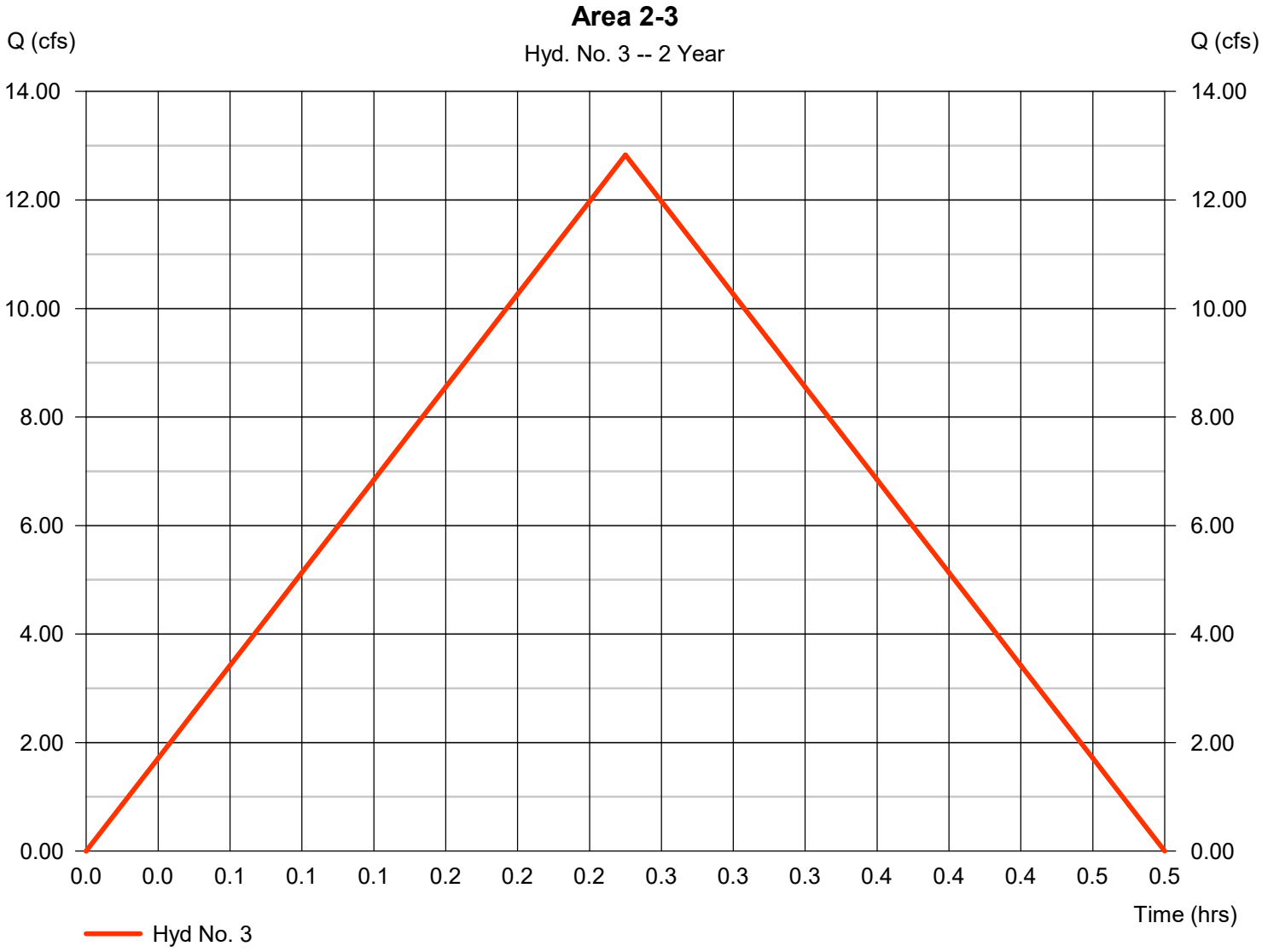


Hydrograph Report

Hyd. No. 3

Area 2-3

Hydrograph type	= Rational	Peak discharge	= 12.83 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 11,545 cuft
Drainage area	= 11.520 ac	Runoff coeff.	= 0.3
Intensity	= 3.712 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

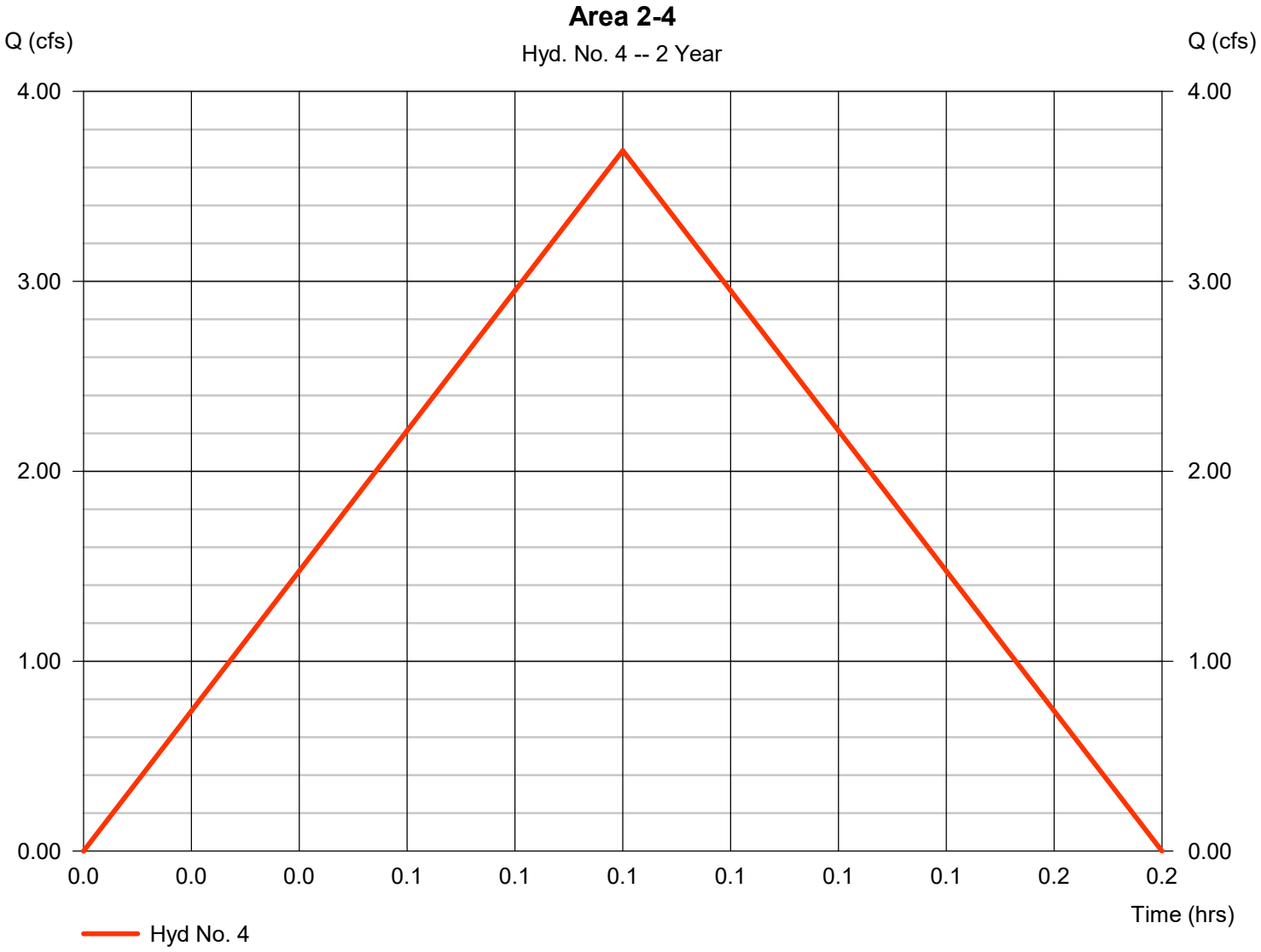


Hydrograph Report

Hyd. No. 4

Area 2-4

Hydrograph type	= Rational	Peak discharge	= 3.689 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,107 cuft
Drainage area	= 1.050 ac	Runoff coeff.	= 0.65
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

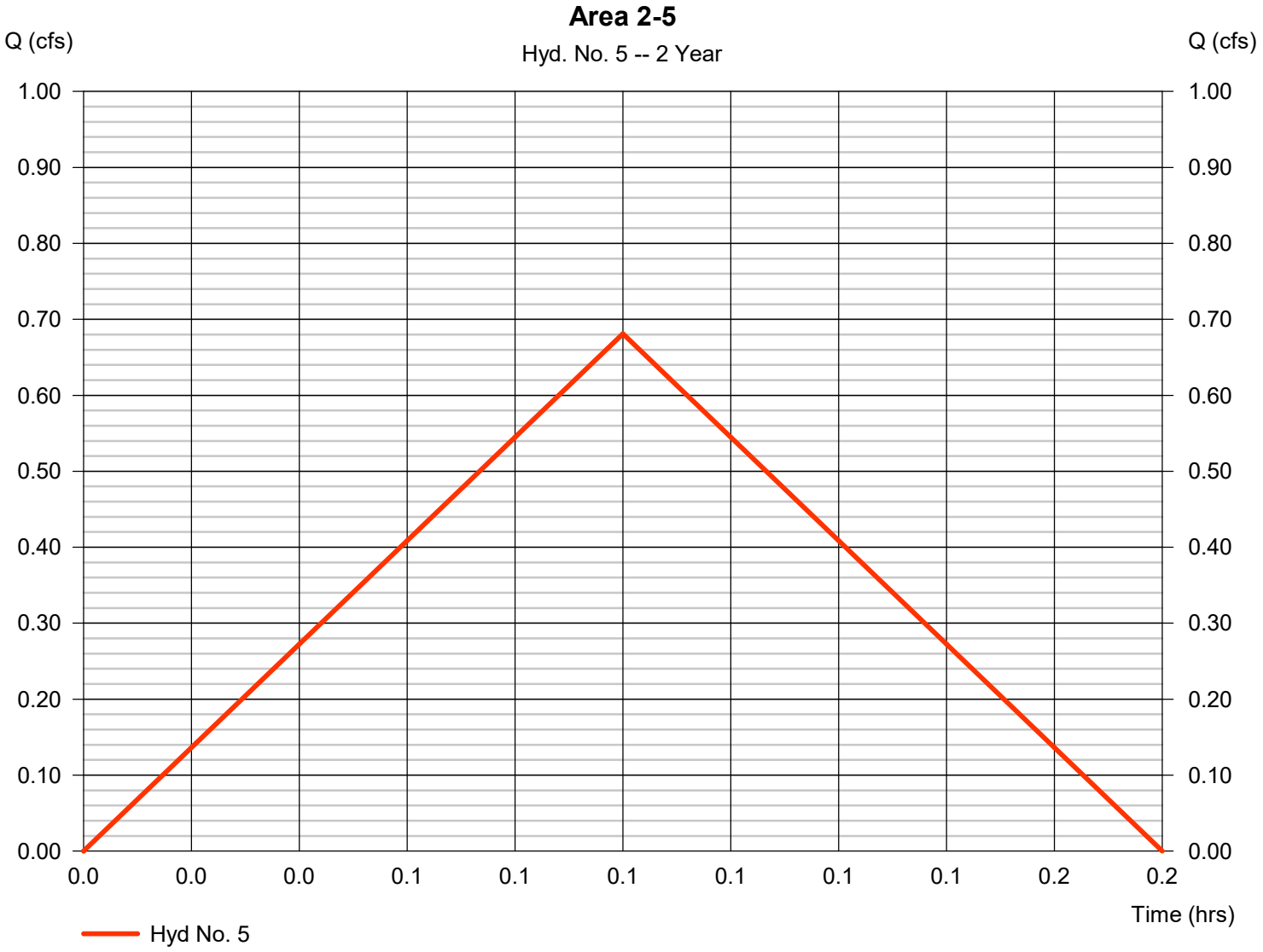


Hydrograph Report

Hyd. No. 5

Area 2-5

Hydrograph type	= Rational	Peak discharge	= 0.681 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 204 cuft
Drainage area	= 0.200 ac	Runoff coeff.	= 0.63
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

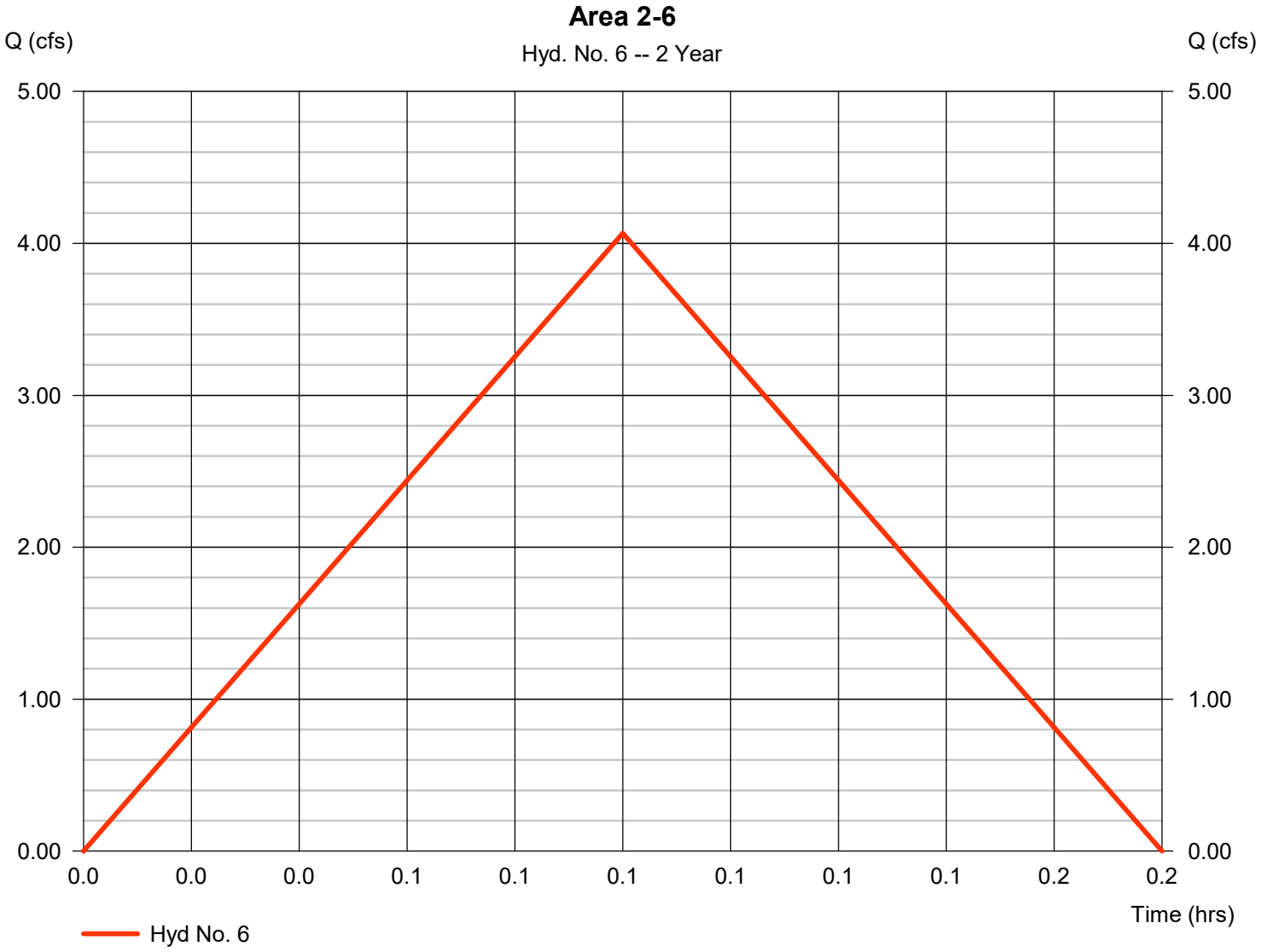


Hydrograph Report

Hyd. No. 6

Area 2-6

Hydrograph type	= Rational	Peak discharge	= 4.067 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,220 cuft
Drainage area	= 0.990 ac	Runoff coeff.	= 0.76
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

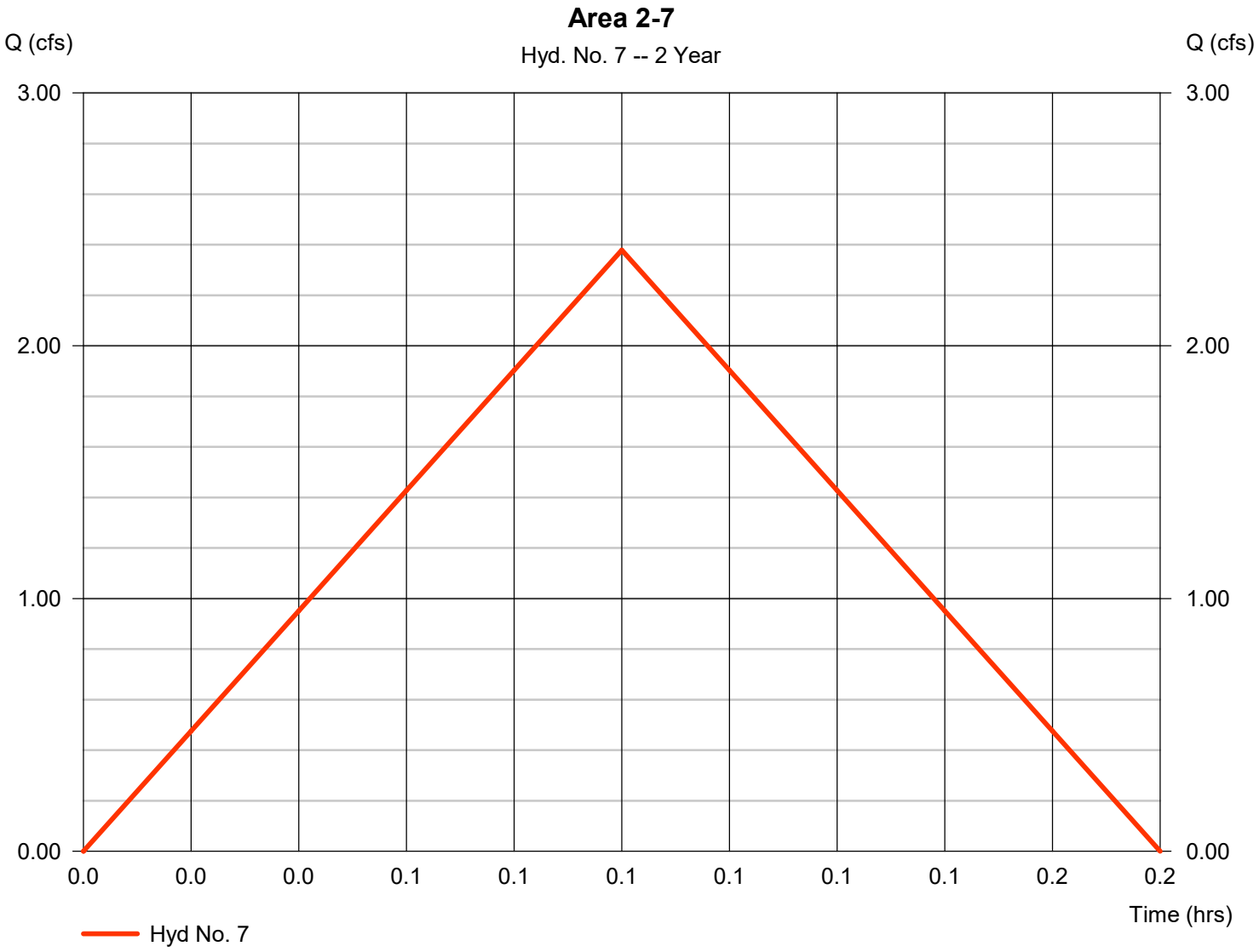


Hydrograph Report

Hyd. No. 7

Area 2-7

Hydrograph type	= Rational	Peak discharge	= 2.378 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 714 cuft
Drainage area	= 0.500 ac	Runoff coeff.	= 0.88
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

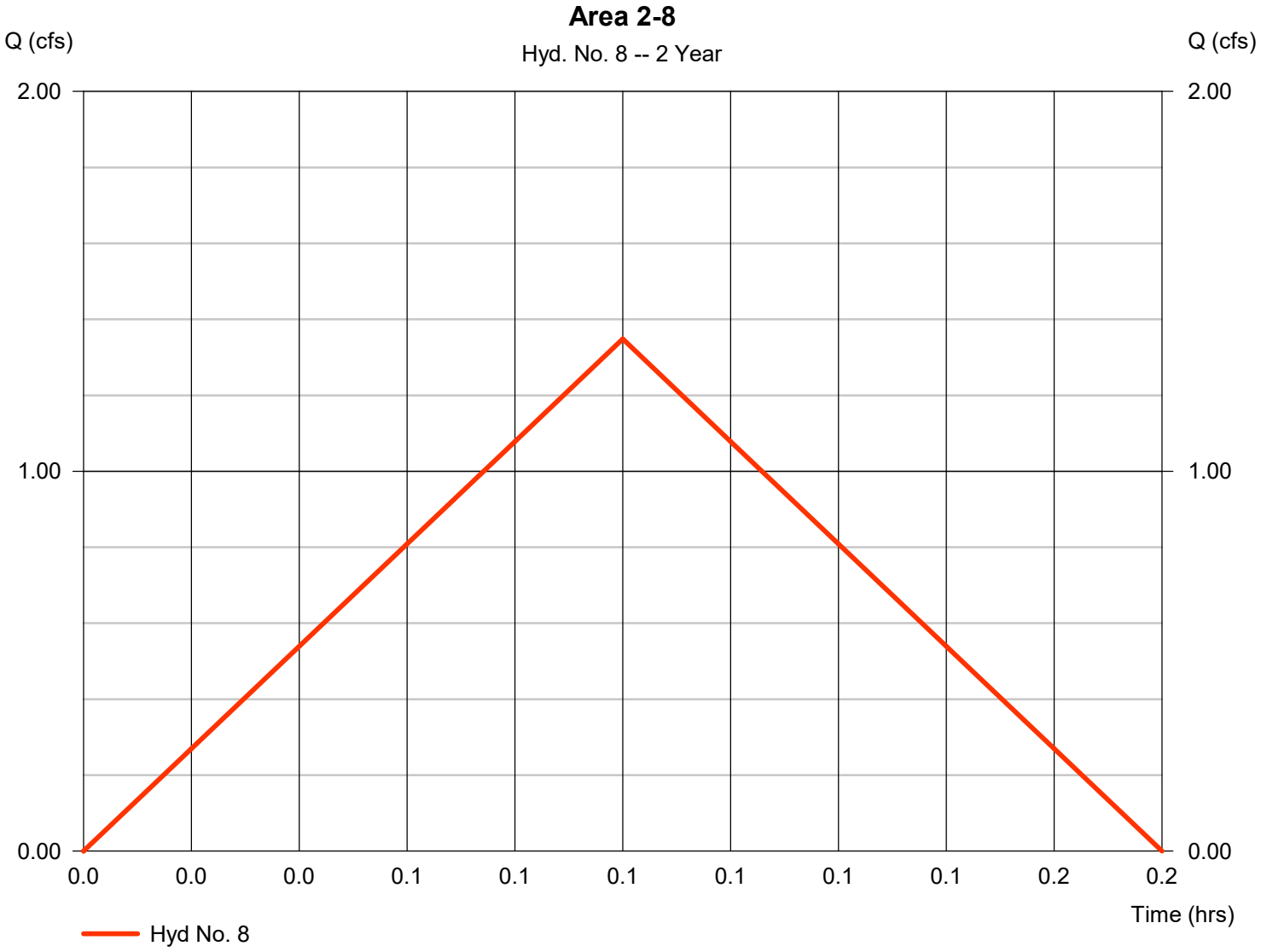


Hydrograph Report

Hyd. No. 8

Area 2-8

Hydrograph type	= Rational	Peak discharge	= 1.348 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 404 cuft
Drainage area	= 0.290 ac	Runoff coeff.	= 0.86
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

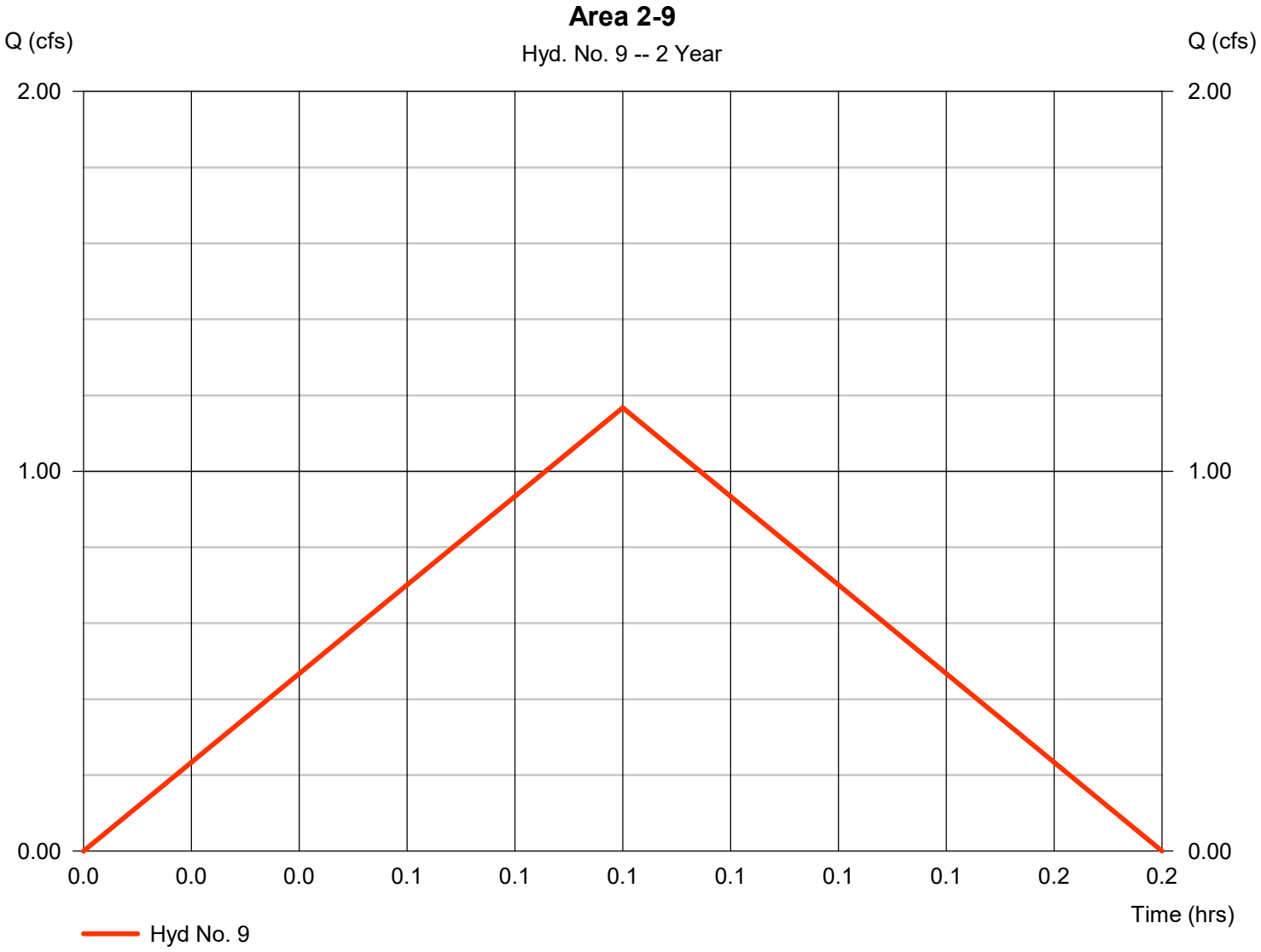


Hydrograph Report

Hyd. No. 9

Area 2-9

Hydrograph type	= Rational	Peak discharge	= 1.168 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 350 cuft
Drainage area	= 0.240 ac	Runoff coeff.	= 0.9
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

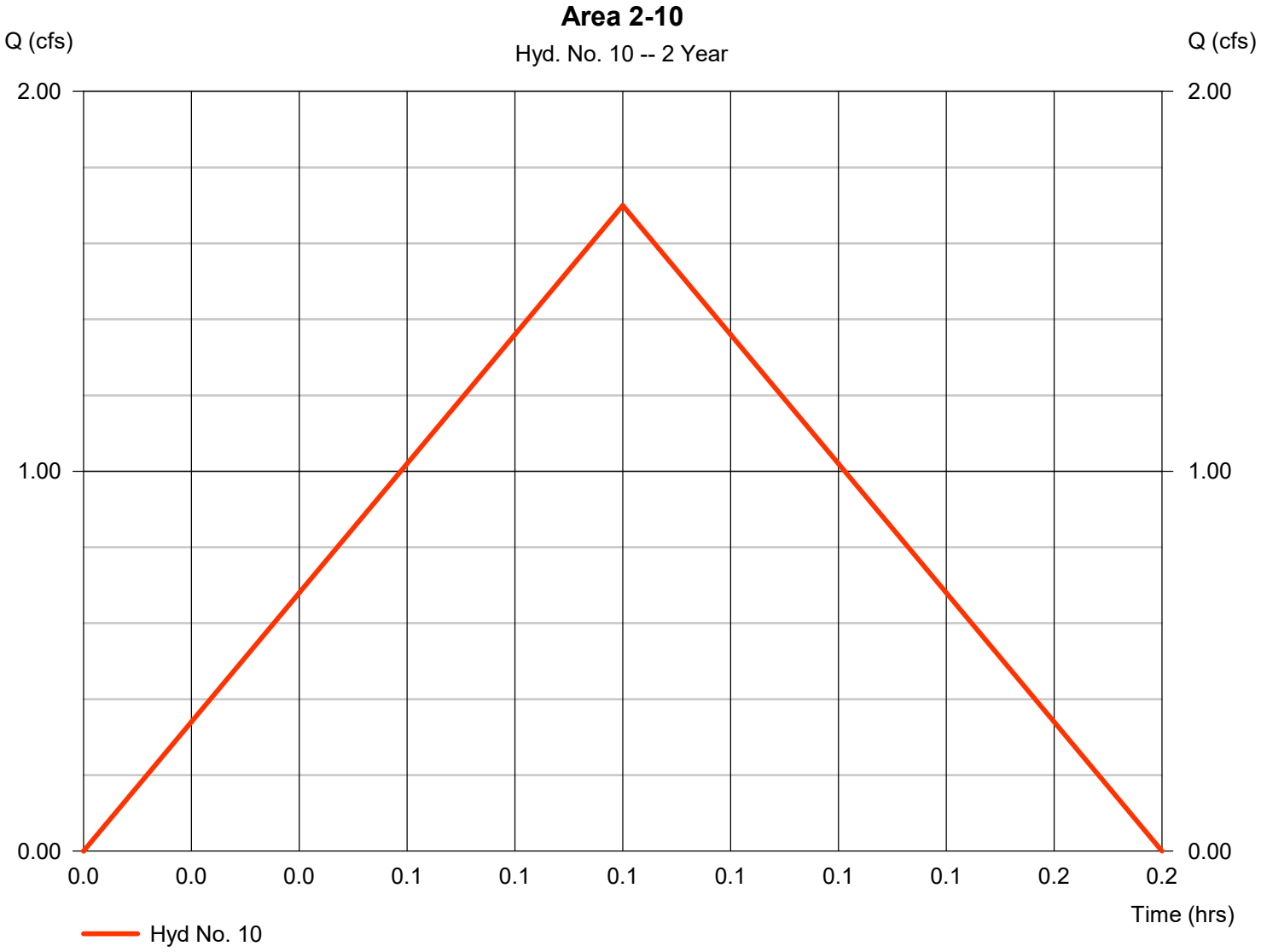


Hydrograph Report

Hyd. No. 10

Area 2-10

Hydrograph type	= Rational	Peak discharge	= 1.700 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 510 cuft
Drainage area	= 0.370 ac	Runoff coeff.	= 0.85
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

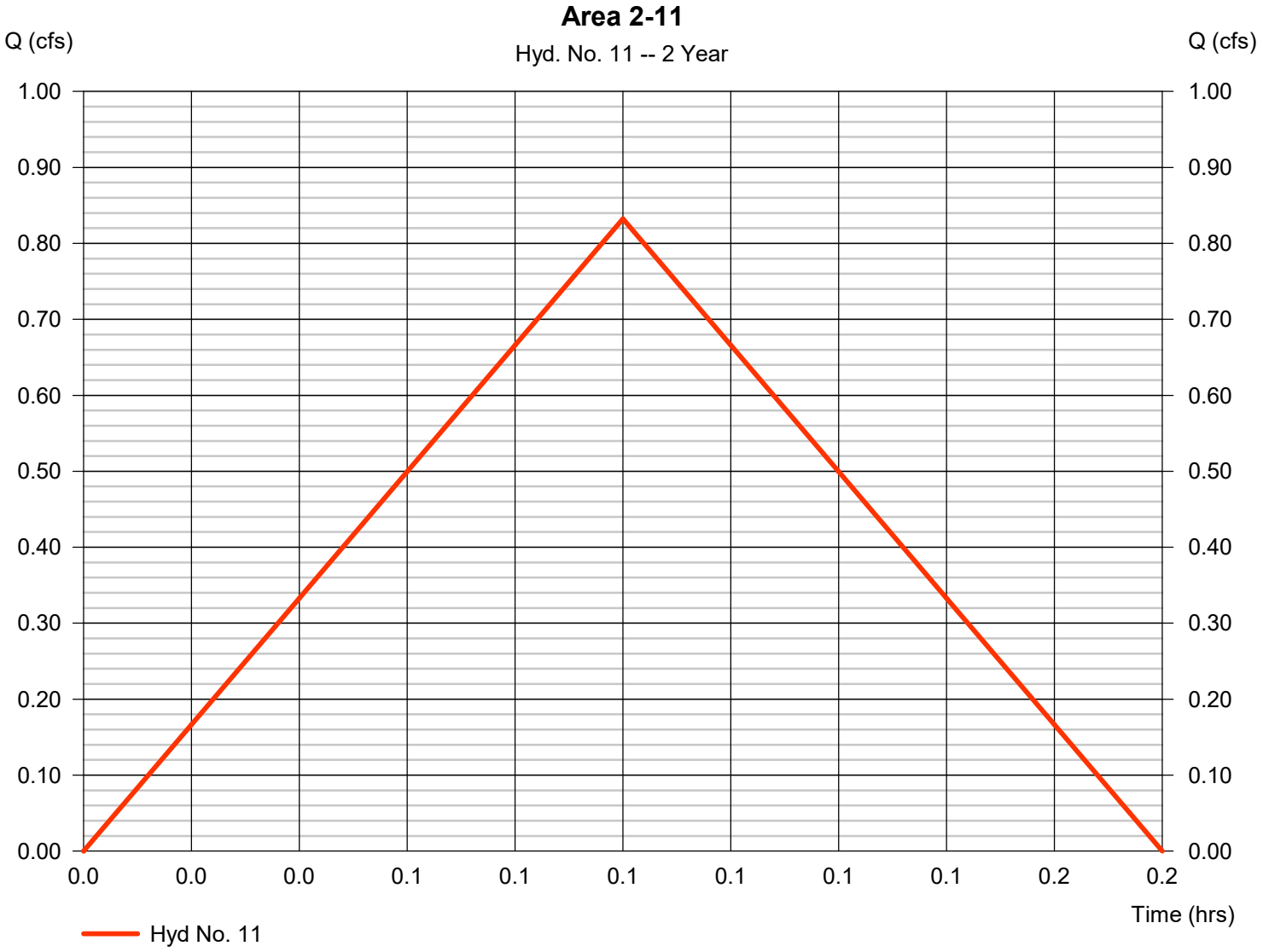


Hydrograph Report

Hyd. No. 11

Area 2-11

Hydrograph type	= Rational	Peak discharge	= 0.832 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 250 cuft
Drainage area	= 0.350 ac	Runoff coeff.	= 0.44
Intensity	= 5.406 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

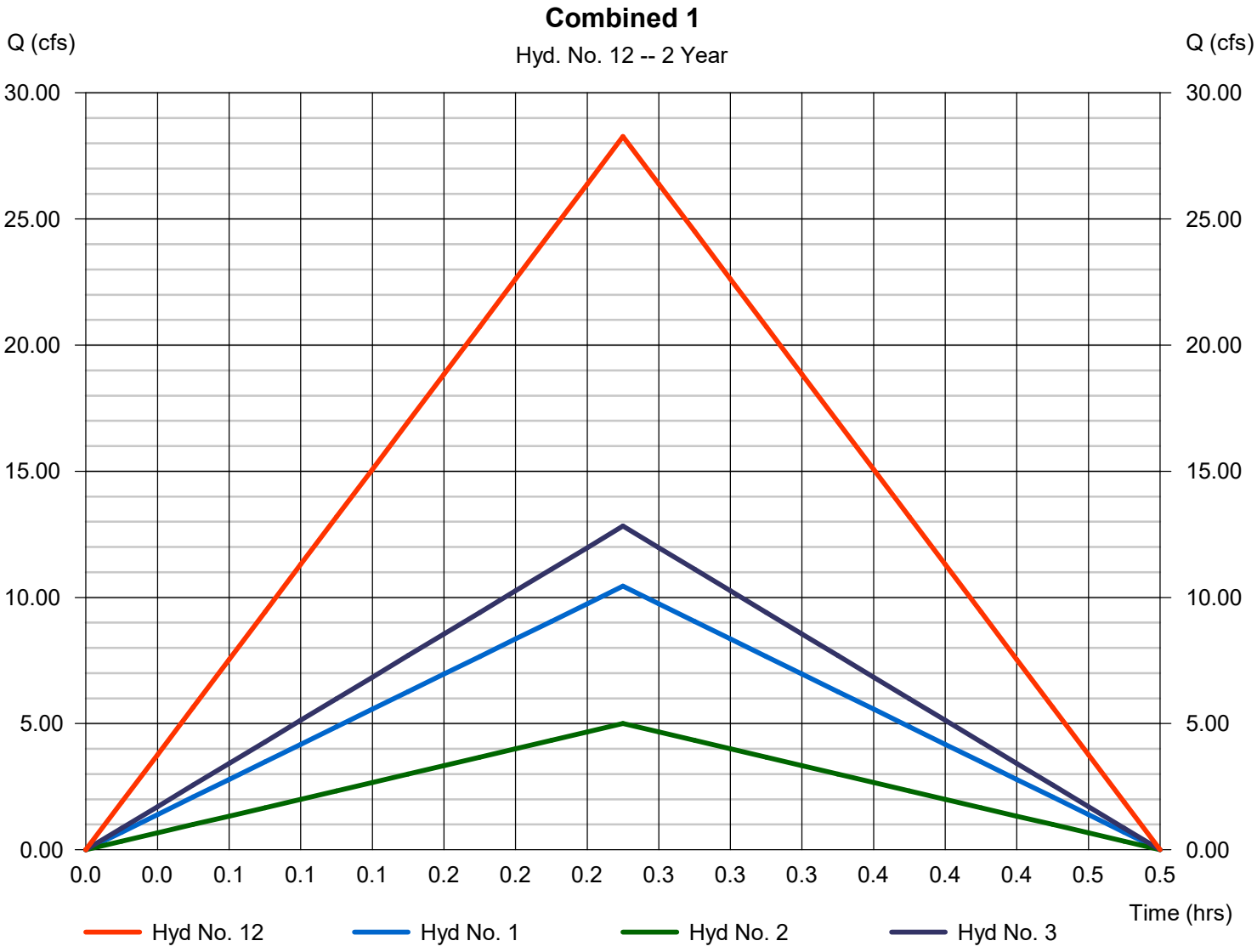


Hydrograph Report

Hyd. No. 12

Combined 1

Hydrograph type	=	Combine	Peak discharge	=	28.27 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	25,446 cuft
Inflow hyds.	=	1, 2, 3	Contrib. drain. area	=	25.390 ac

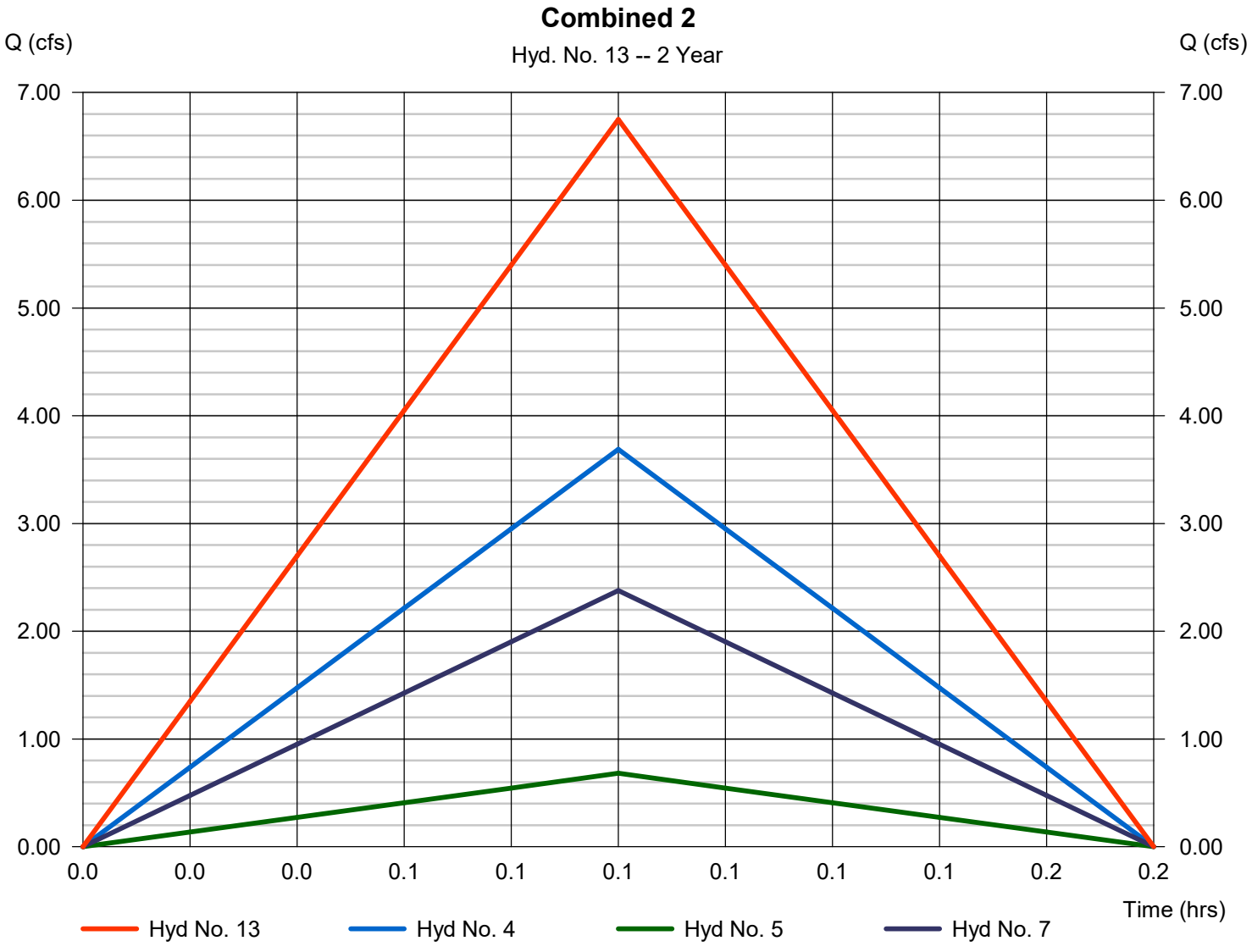


Hydrograph Report

Hyd. No. 13

Combined 2

Hydrograph type	= Combine	Peak discharge	= 6.749 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 2,025 cuft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 1.750 ac

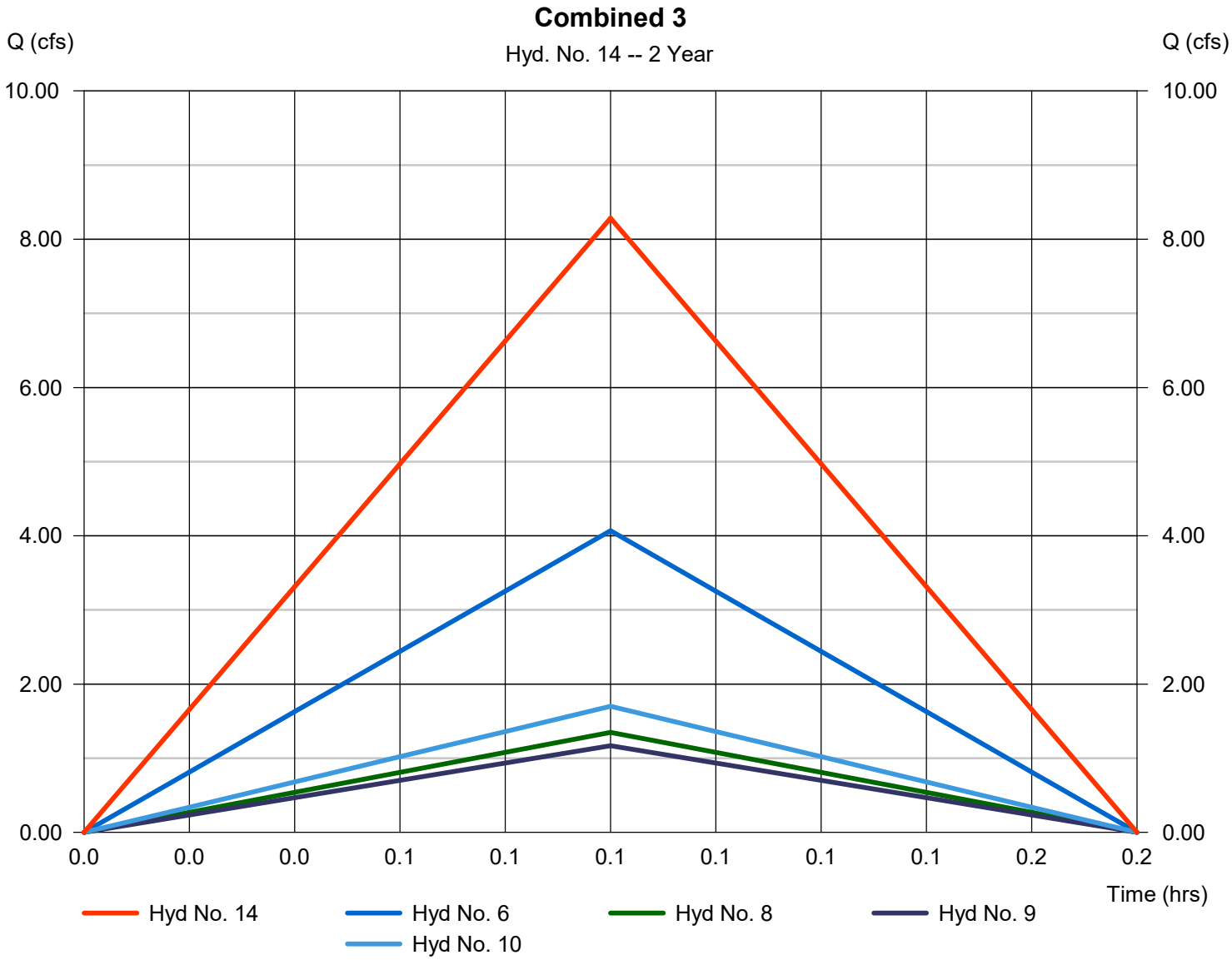


Hydrograph Report

Hyd. No. 14

Combined 3

Hydrograph type	= Combine	Peak discharge	= 8.283 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 2,485 cuft
Inflow hyds.	= 6, 8, 9, 10	Contrib. drain. area	= 1.890 ac

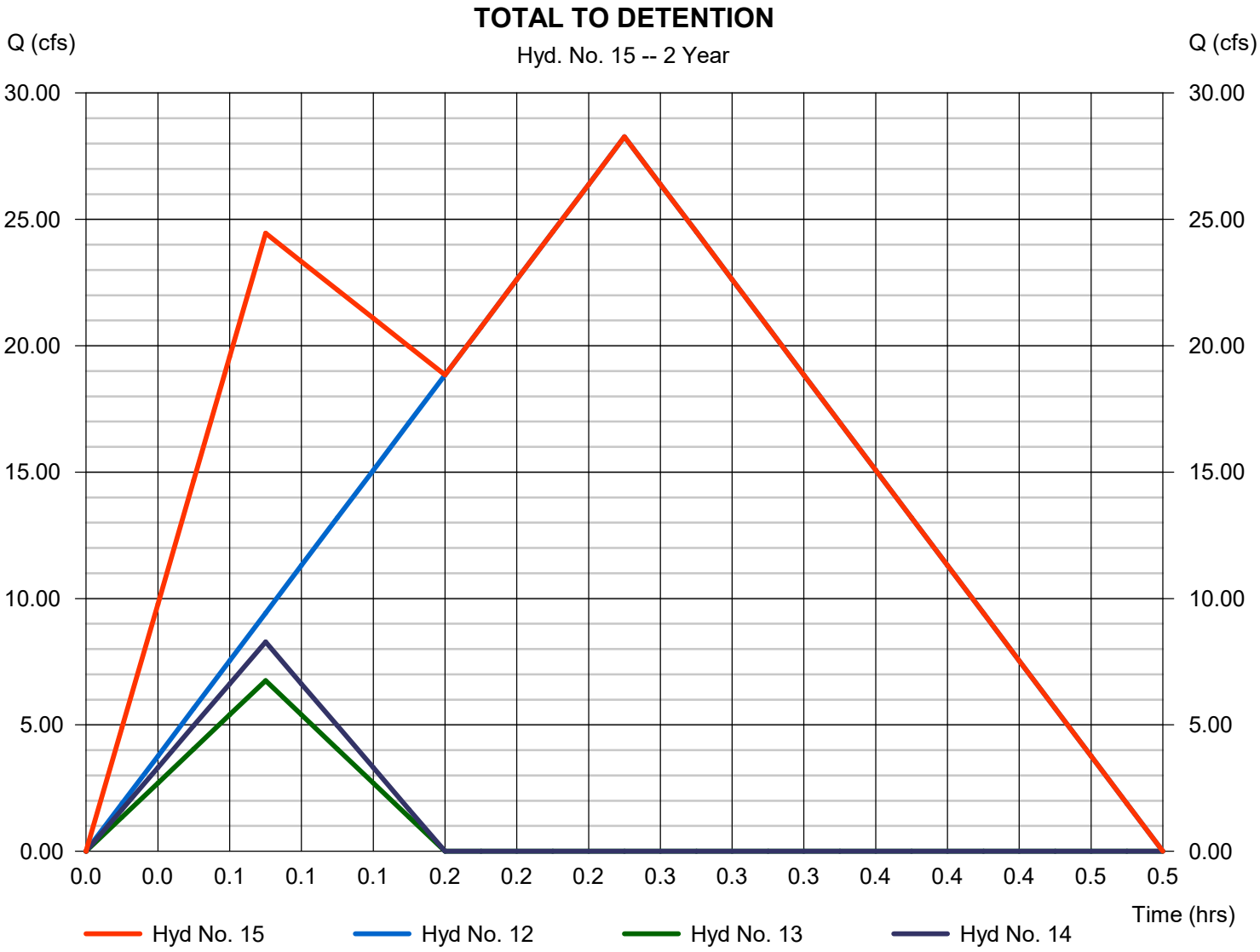


Hydrograph Report

Hyd. No. 15

TOTAL TO DETENTION

Hydrograph type	= Combine	Peak discharge	= 28.27 cfs
Storm frequency	= 2 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 29,955 cuft
Inflow hyds.	= 12, 13, 14	Contrib. drain. area	= 0.000 ac



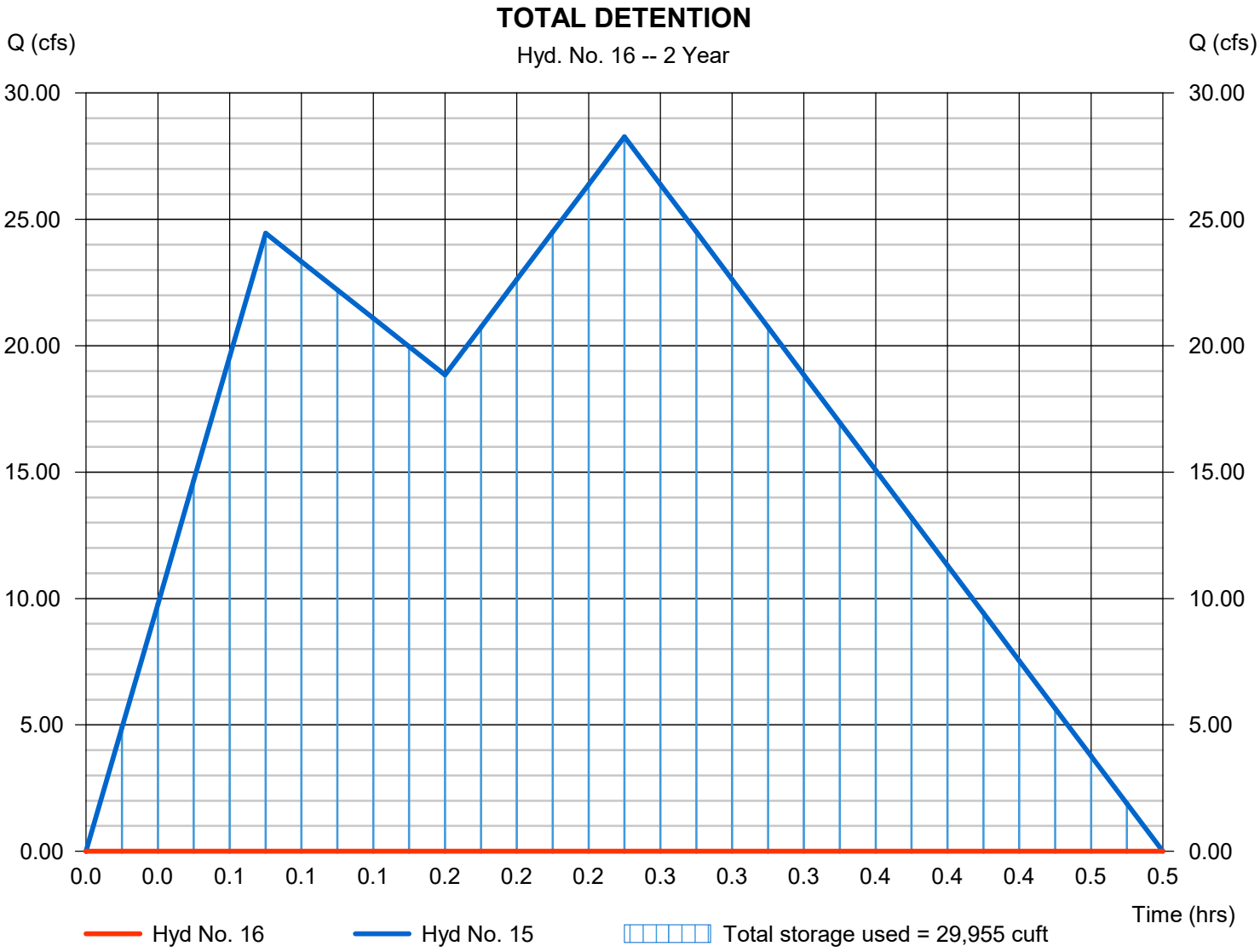
Hydrograph Report

Hyd. No. 16

TOTAL DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	2 yrs	Time to peak	=	n/a
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	15 - TOTAL TO DETENTION	Max. Elevation	=	983.47 ft
Reservoir name	=	Detention	Max. Storage	=	29,955 cuft

Storage Indication method used.

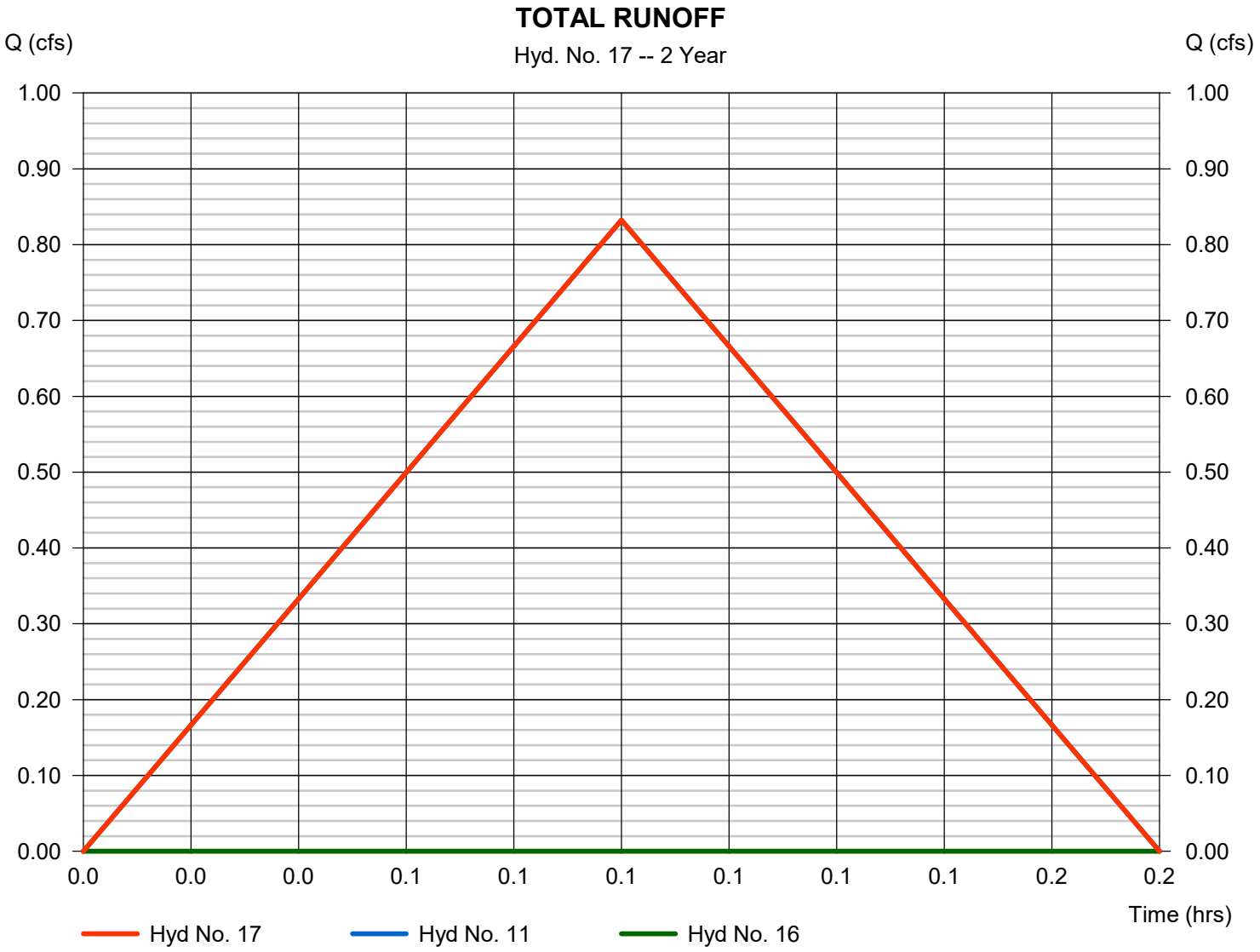


Hydrograph Report

Hyd. No. 17

TOTAL RUNOFF

Hydrograph type	=	Combine	Peak discharge	=	0.832 cfs
Storm frequency	=	2 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	250 cuft
Inflow hyds.	=	11, 16	Contrib. drain. area	=	0.350 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

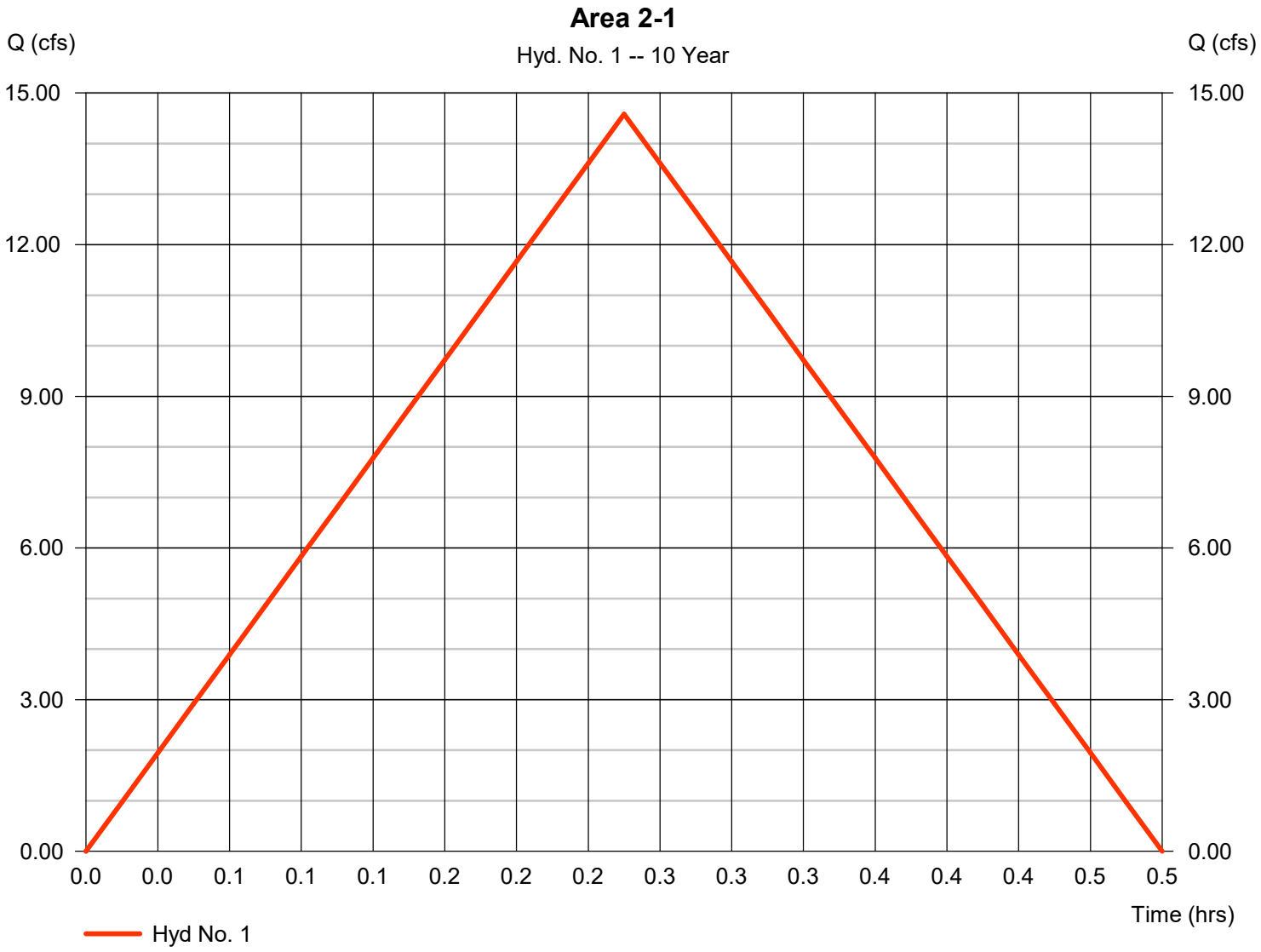
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	14.58	1	15	13,125	------	------	------	Area 2-1
2	Rational	6.981	1	15	6,283	------	------	------	Area 2-2
3	Rational	17.91	1	15	16,120	------	------	------	Area 2-3
4	Rational	5.015	1	5	1,505	------	------	------	Area 2-4
5	Rational	0.926	1	5	278	------	------	------	Area 2-5
6	Rational	5.529	1	5	1,659	------	------	------	Area 2-6
7	Rational	3.233	1	5	970	------	------	------	Area 2-7
8	Rational	1.833	1	5	550	------	------	------	Area 2-8
9	Rational	1.587	1	5	476	------	------	------	Area 2-9
10	Rational	2.311	1	5	693	------	------	------	Area 2-10
11	Rational	1.132	1	5	339	------	------	------	Area 2-11
12	Combine	39.48	1	15	35,528	1, 2, 3,	------	------	Combined 1
13	Combine	9.175	1	5	2,752	4, 5, 7,	------	------	Combined 2
14	Combine	11.26	1	5	3,378	6, 8, 9,	------	------	Combined 3
15	Combine	39.48	1	15	41,659	10, 12, 13, 14	------	------	TOTAL TO DETENTION
16	Reservoir	0.000	1	n/a	0	15	984.44	41,659	TOTAL DETENTION
17	Combine	1.132	1	5	339	11, 16	------	------	TOTAL RUNOFF

Hydrograph Report

Hyd. No. 1

Area 2-1

Hydrograph type	= Rational	Peak discharge	= 14.58 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 13,125 cuft
Drainage area	= 9.380 ac	Runoff coeff.	= 0.3
Intensity	= 5.183 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

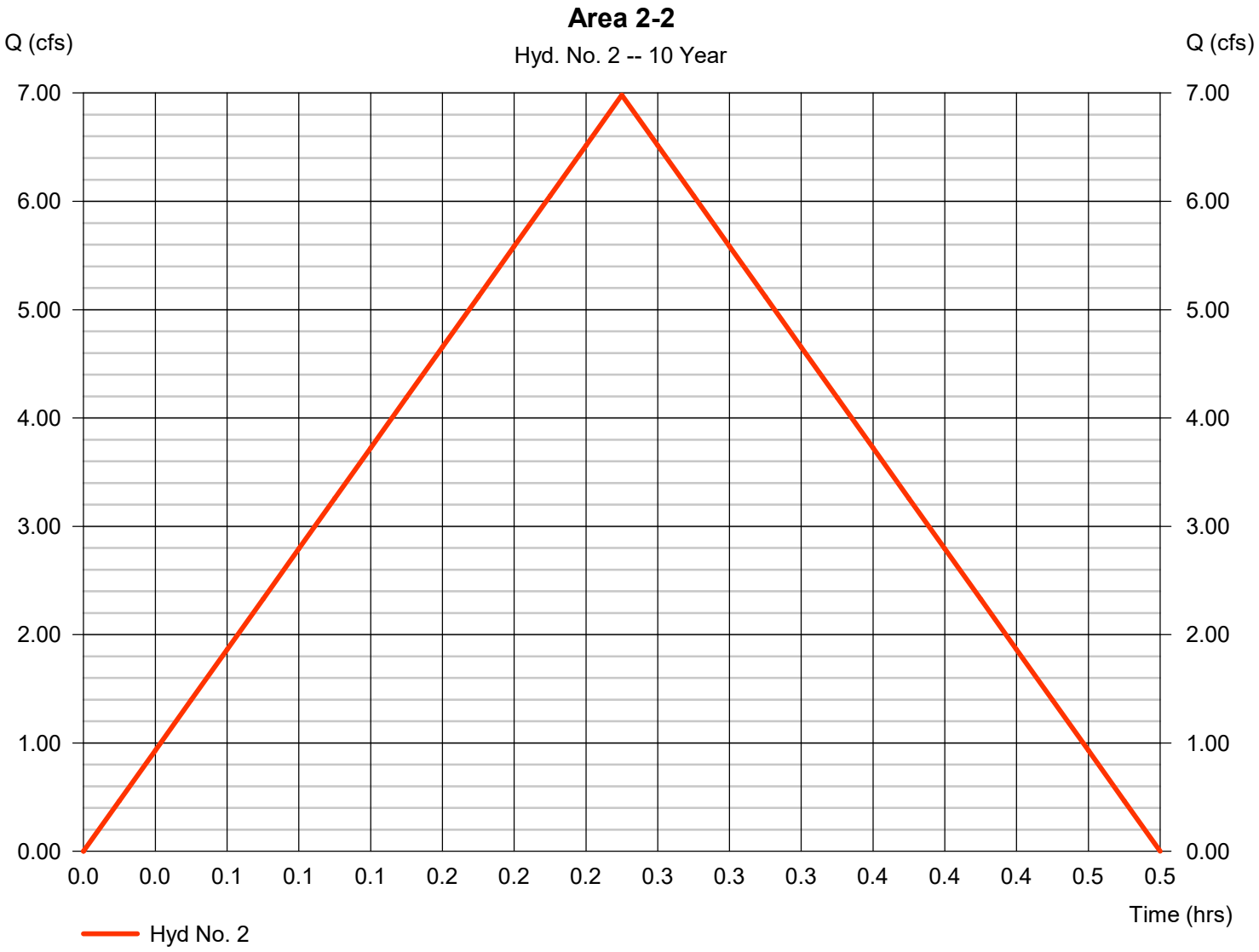


Hydrograph Report

Hyd. No. 2

Area 2-2

Hydrograph type	= Rational	Peak discharge	= 6.981 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 6,283 cuft
Drainage area	= 4.490 ac	Runoff coeff.	= 0.3
Intensity	= 5.183 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

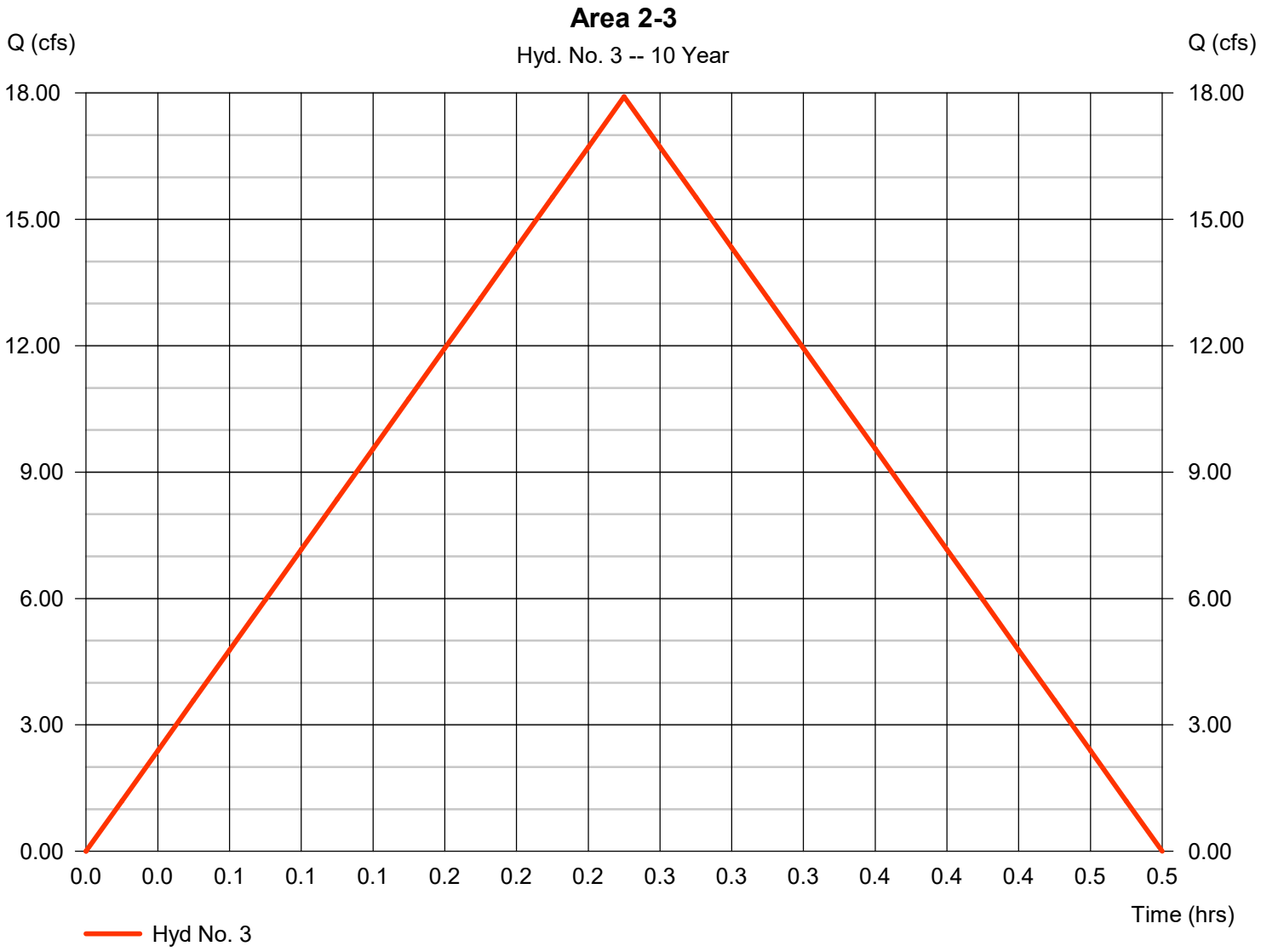


Hydrograph Report

Hyd. No. 3

Area 2-3

Hydrograph type	= Rational	Peak discharge	= 17.91 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 16,120 cuft
Drainage area	= 11.520 ac	Runoff coeff.	= 0.3
Intensity	= 5.183 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

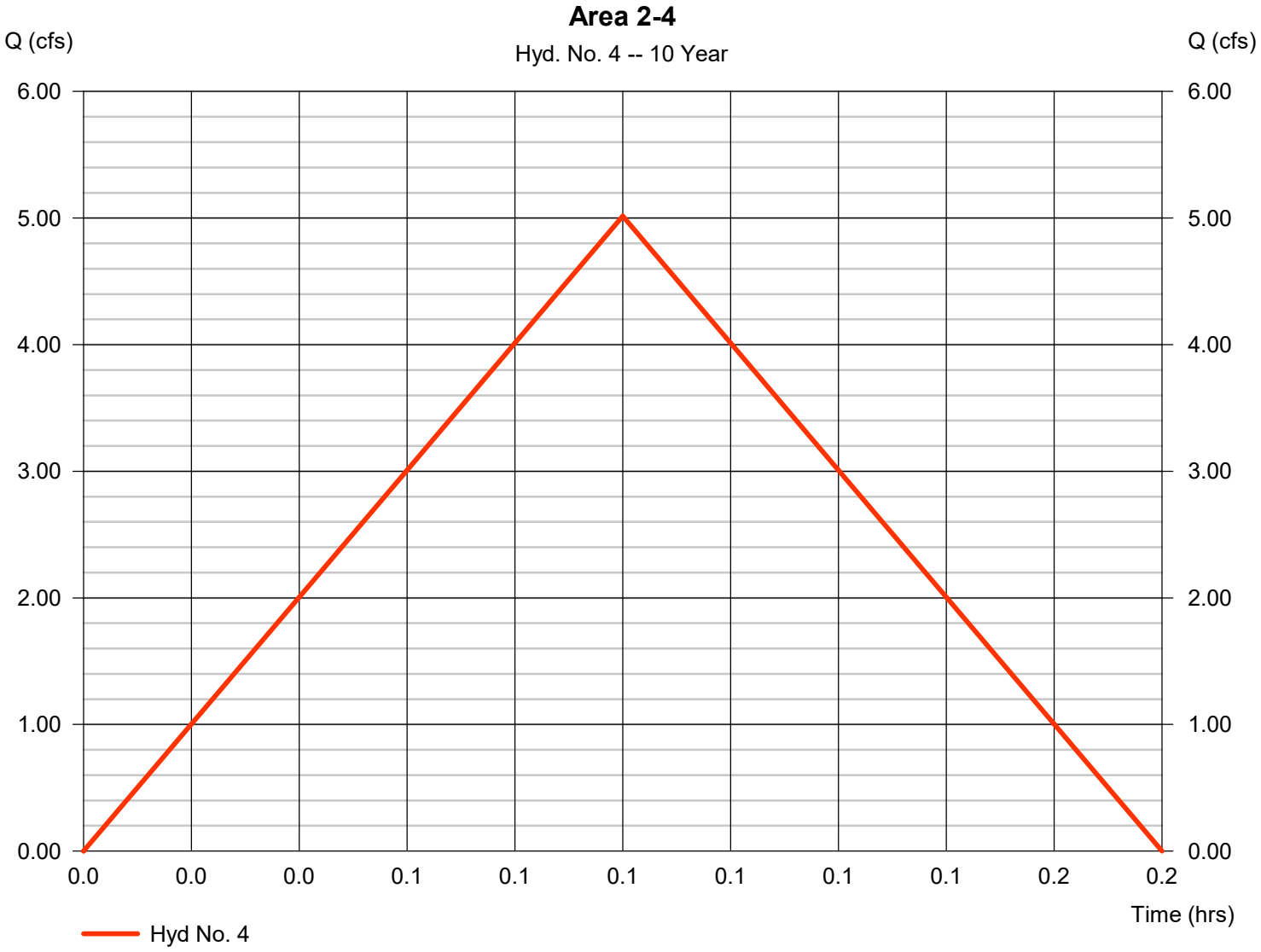


Hydrograph Report

Hyd. No. 4

Area 2-4

Hydrograph type	= Rational	Peak discharge	= 5.015 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,505 cuft
Drainage area	= 1.050 ac	Runoff coeff.	= 0.65
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

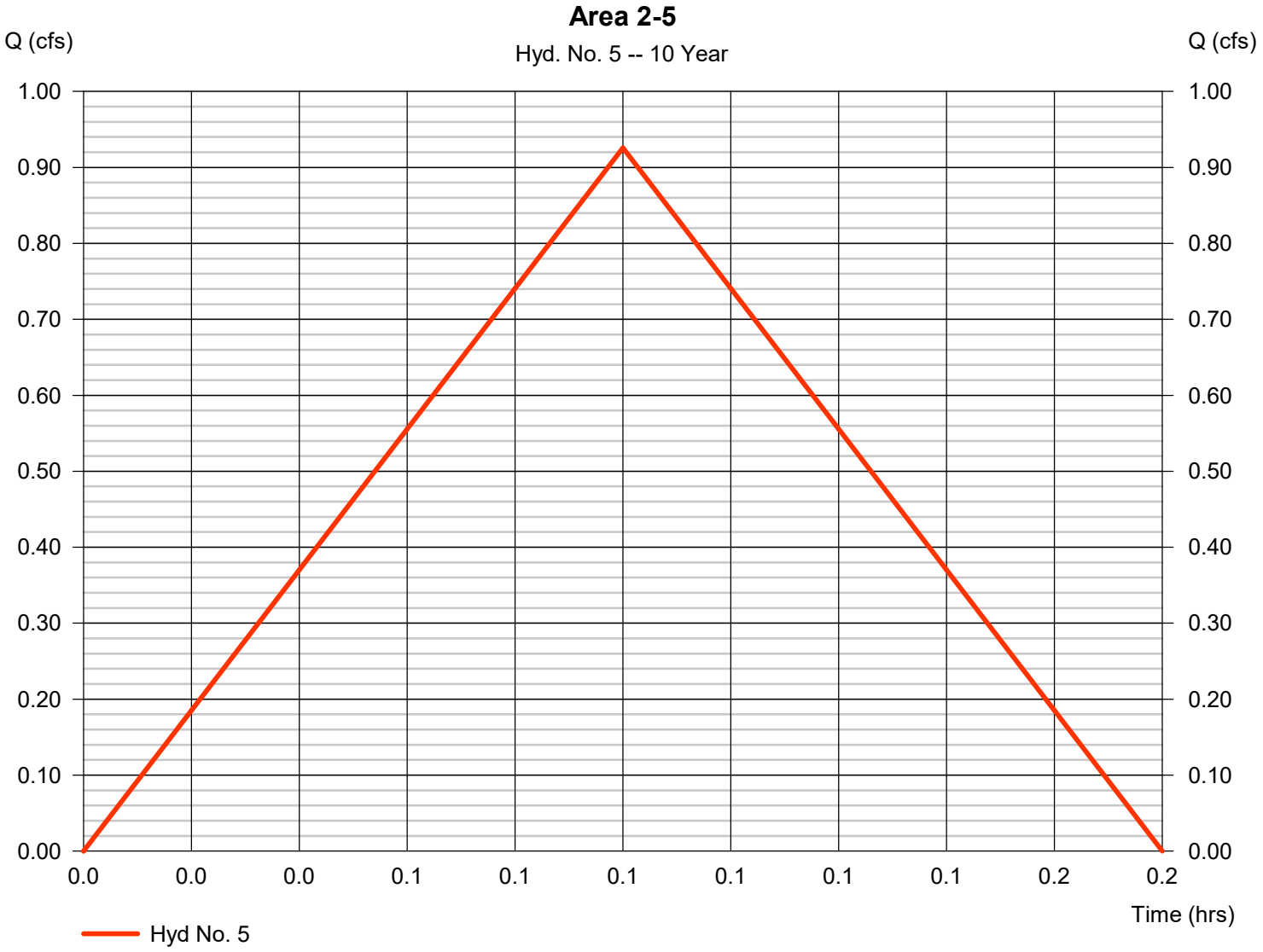


Hydrograph Report

Hyd. No. 5

Area 2-5

Hydrograph type	= Rational	Peak discharge	= 0.926 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 278 cuft
Drainage area	= 0.200 ac	Runoff coeff.	= 0.63
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

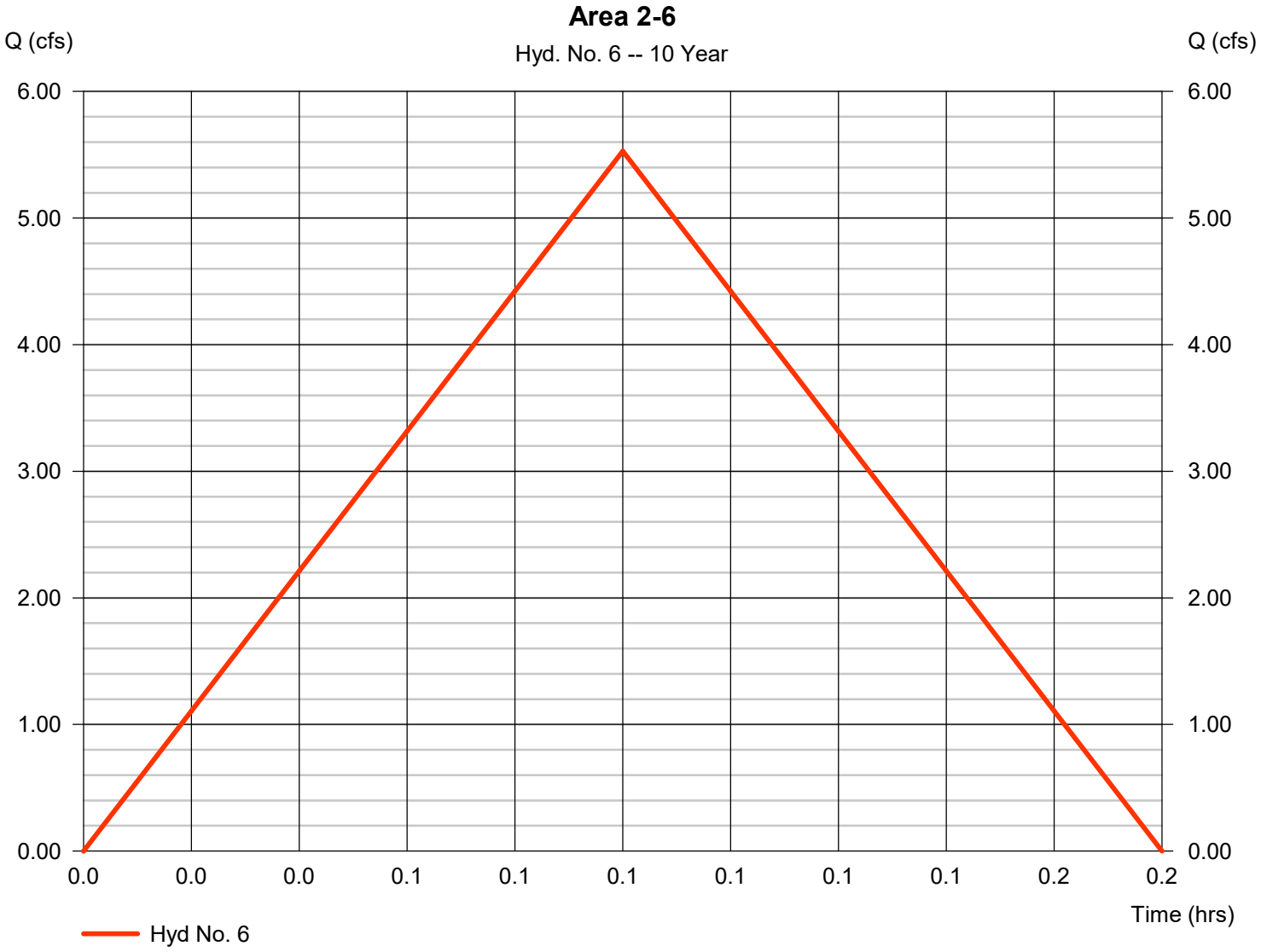


Hydrograph Report

Hyd. No. 6

Area 2-6

Hydrograph type	= Rational	Peak discharge	= 5.529 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,659 cuft
Drainage area	= 0.990 ac	Runoff coeff.	= 0.76
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

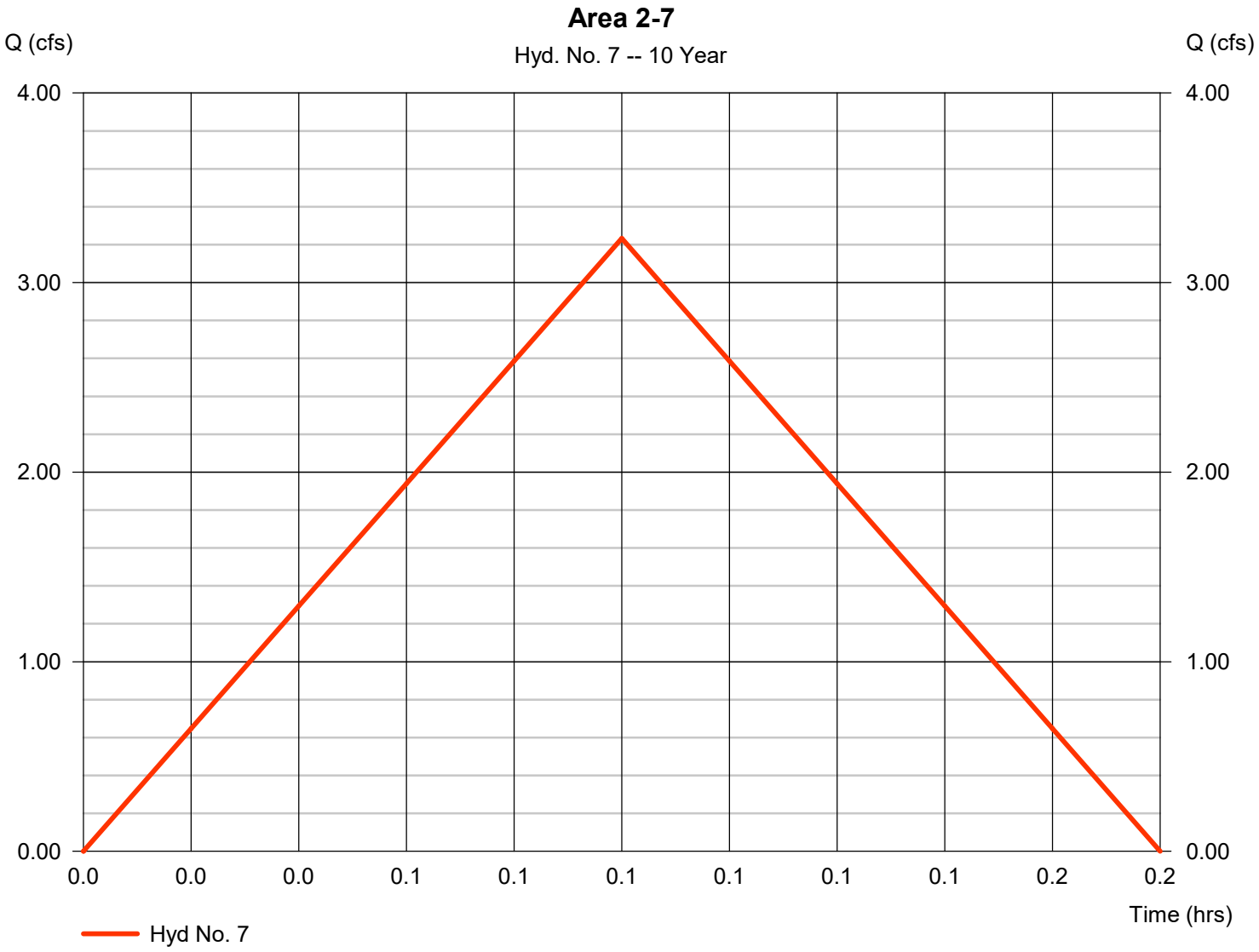


Hydrograph Report

Hyd. No. 7

Area 2-7

Hydrograph type	= Rational	Peak discharge	= 3.233 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 970 cuft
Drainage area	= 0.500 ac	Runoff coeff.	= 0.88
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

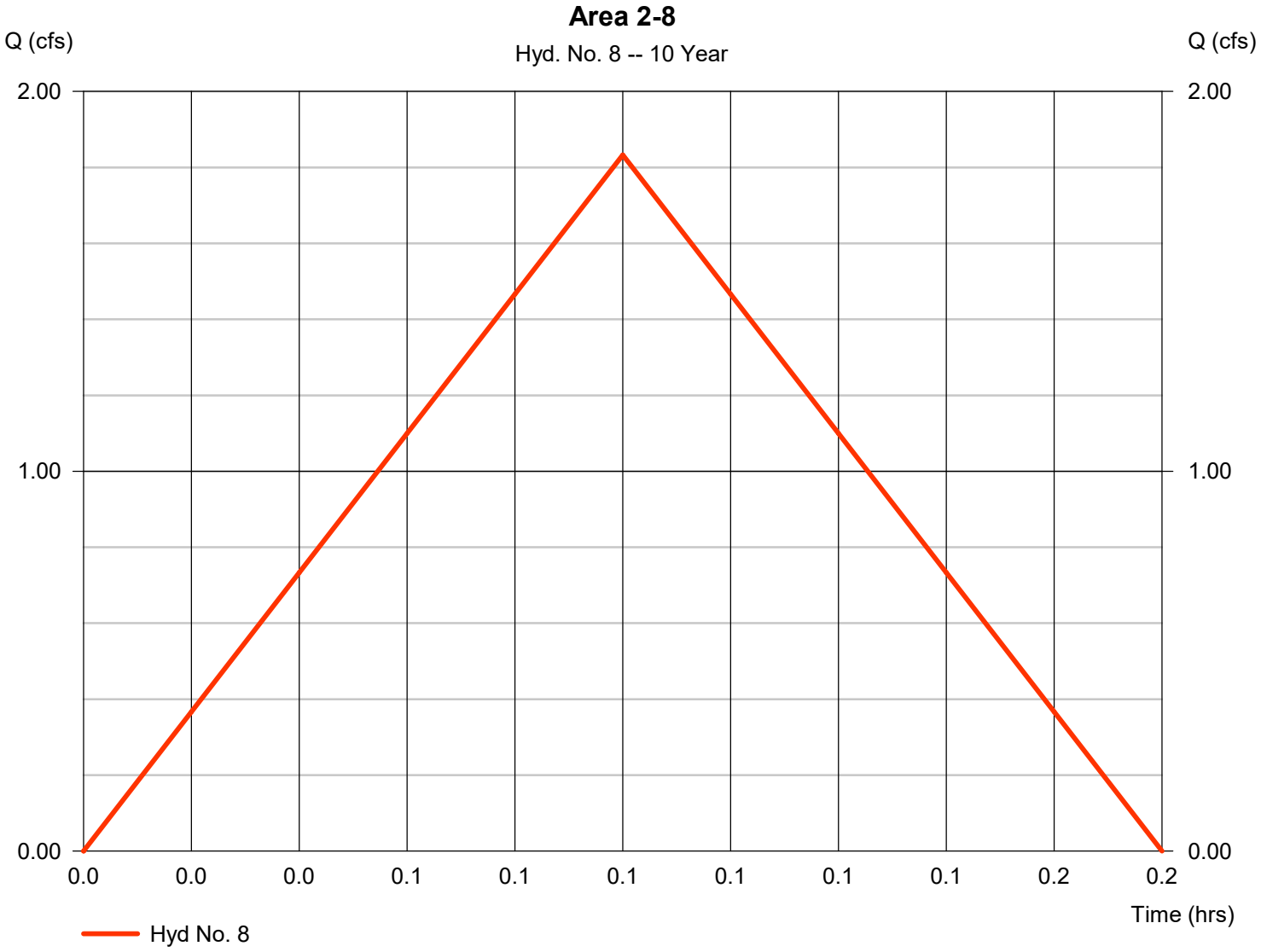


Hydrograph Report

Hyd. No. 8

Area 2-8

Hydrograph type	= Rational	Peak discharge	= 1.833 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 550 cuft
Drainage area	= 0.290 ac	Runoff coeff.	= 0.86
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

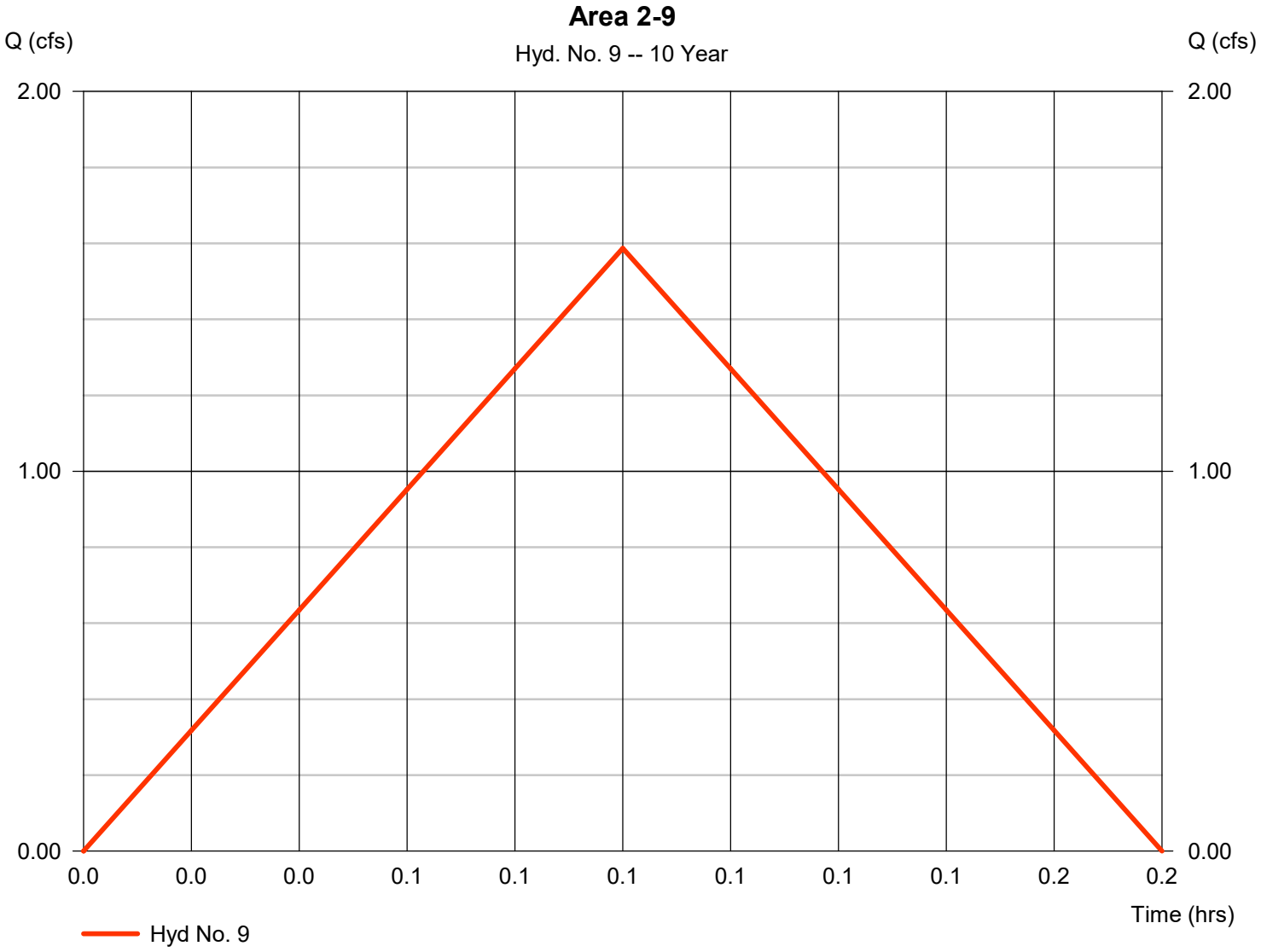


Hydrograph Report

Hyd. No. 9

Area 2-9

Hydrograph type	= Rational	Peak discharge	= 1.587 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 476 cuft
Drainage area	= 0.240 ac	Runoff coeff.	= 0.9
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

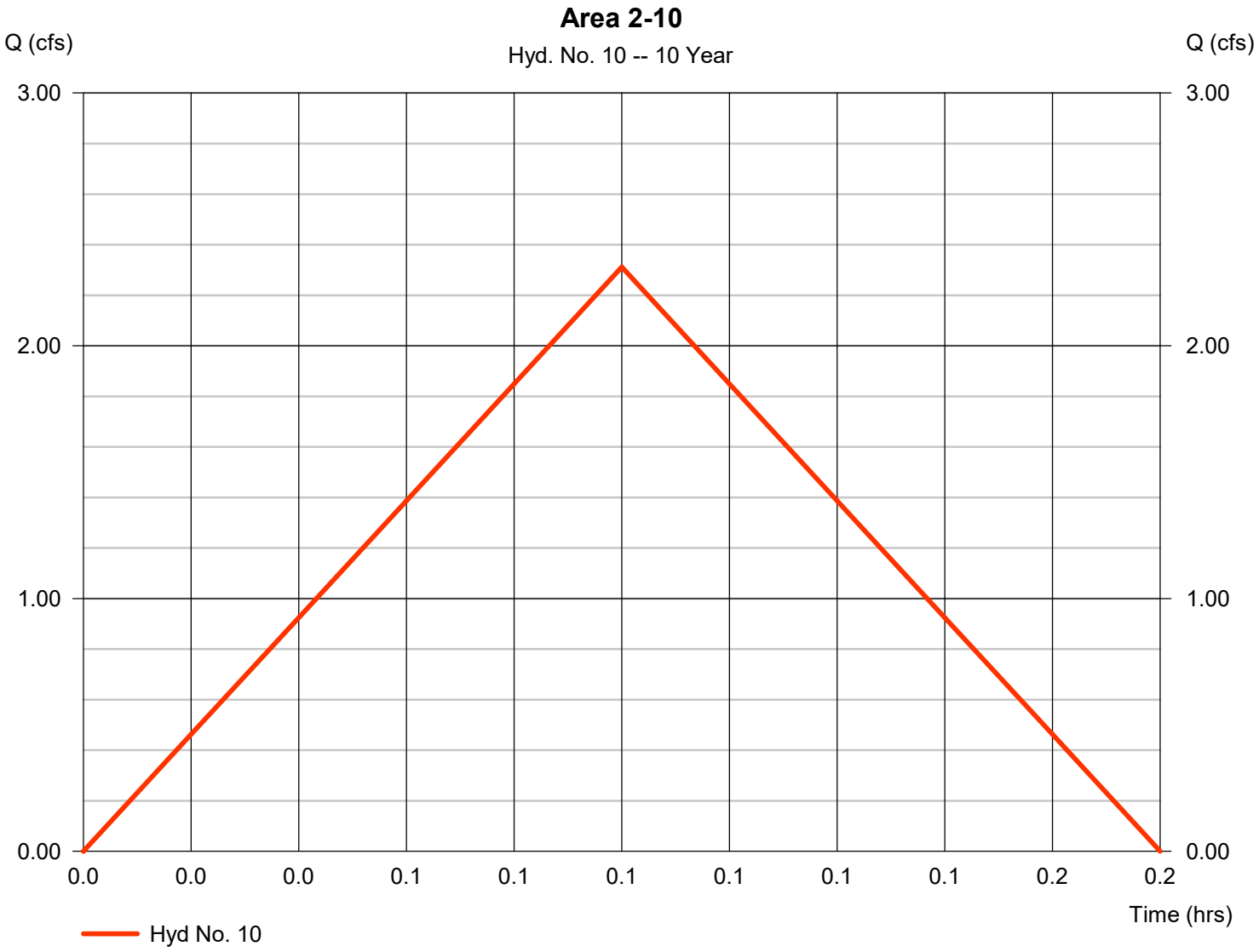


Hydrograph Report

Hyd. No. 10

Area 2-10

Hydrograph type	= Rational	Peak discharge	= 2.311 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 693 cuft
Drainage area	= 0.370 ac	Runoff coeff.	= 0.85
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

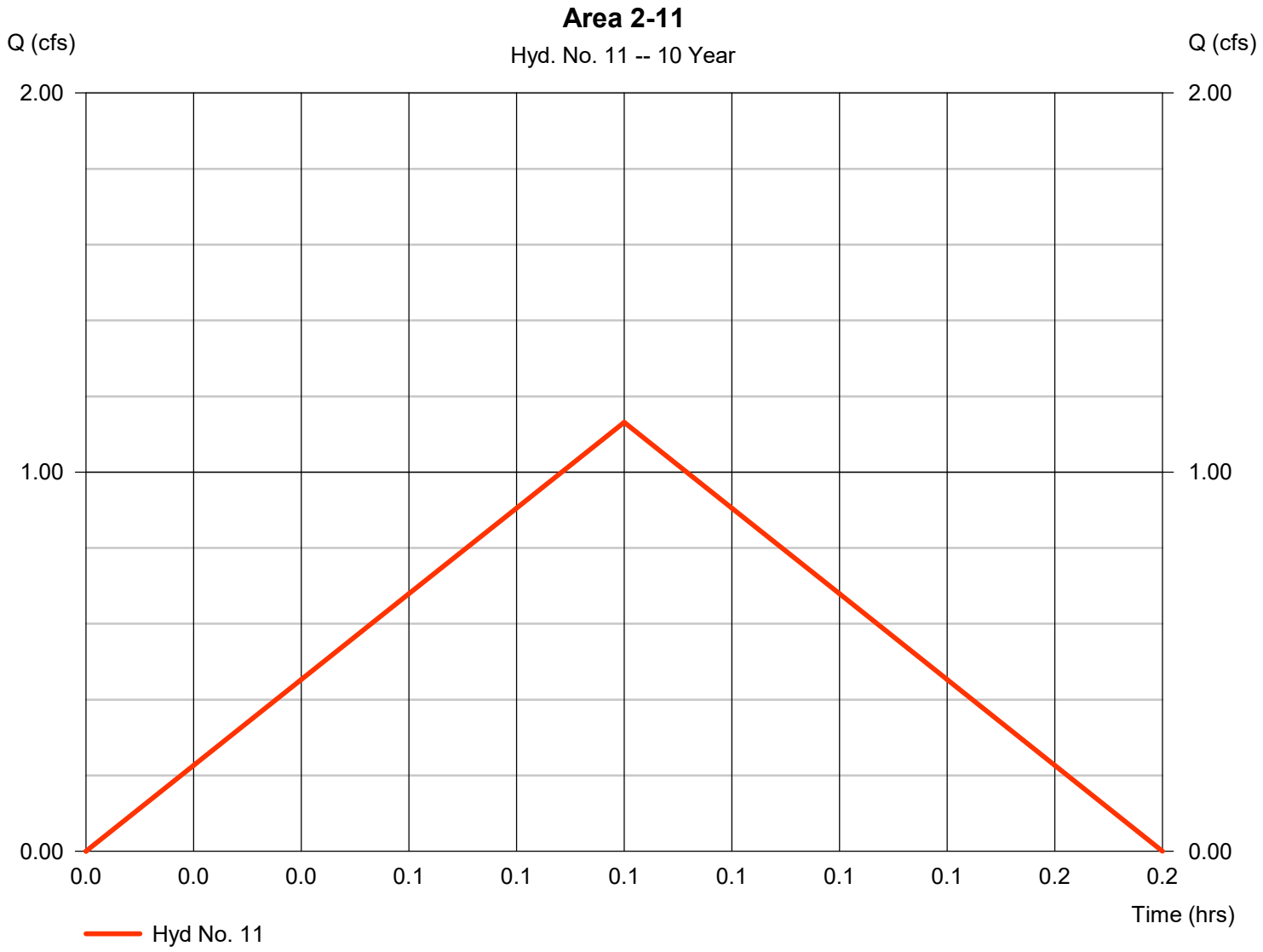


Hydrograph Report

Hyd. No. 11

Area 2-11

Hydrograph type	= Rational	Peak discharge	= 1.132 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 339 cuft
Drainage area	= 0.350 ac	Runoff coeff.	= 0.44
Intensity	= 7.348 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

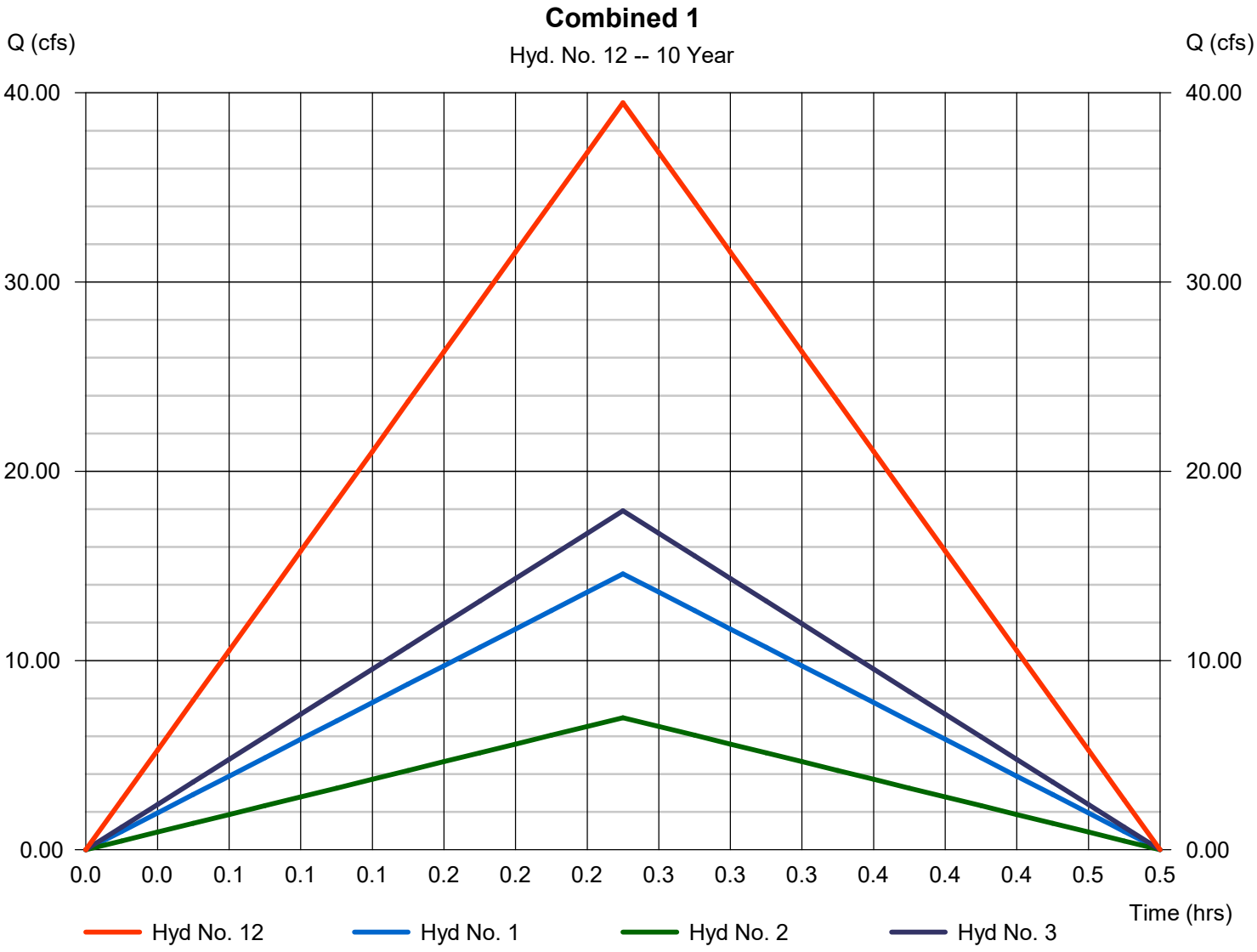


Hydrograph Report

Hyd. No. 12

Combined 1

Hydrograph type	=	Combine	Peak discharge	=	39.48 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	35,528 cuft
Inflow hyds.	=	1, 2, 3	Contrib. drain. area	=	25.390 ac

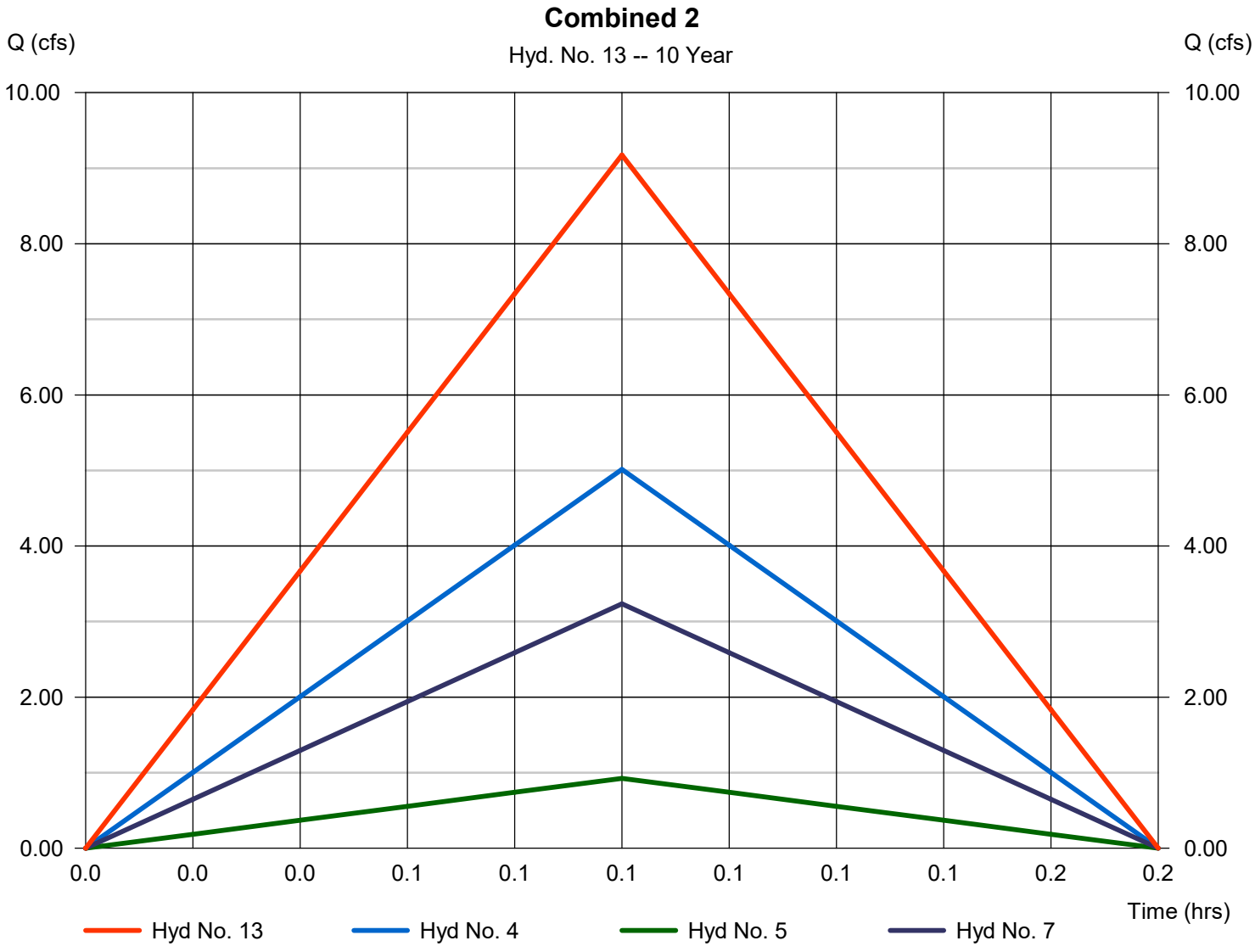


Hydrograph Report

Hyd. No. 13

Combined 2

Hydrograph type	= Combine	Peak discharge	= 9.175 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 2,752 cuft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 1.750 ac

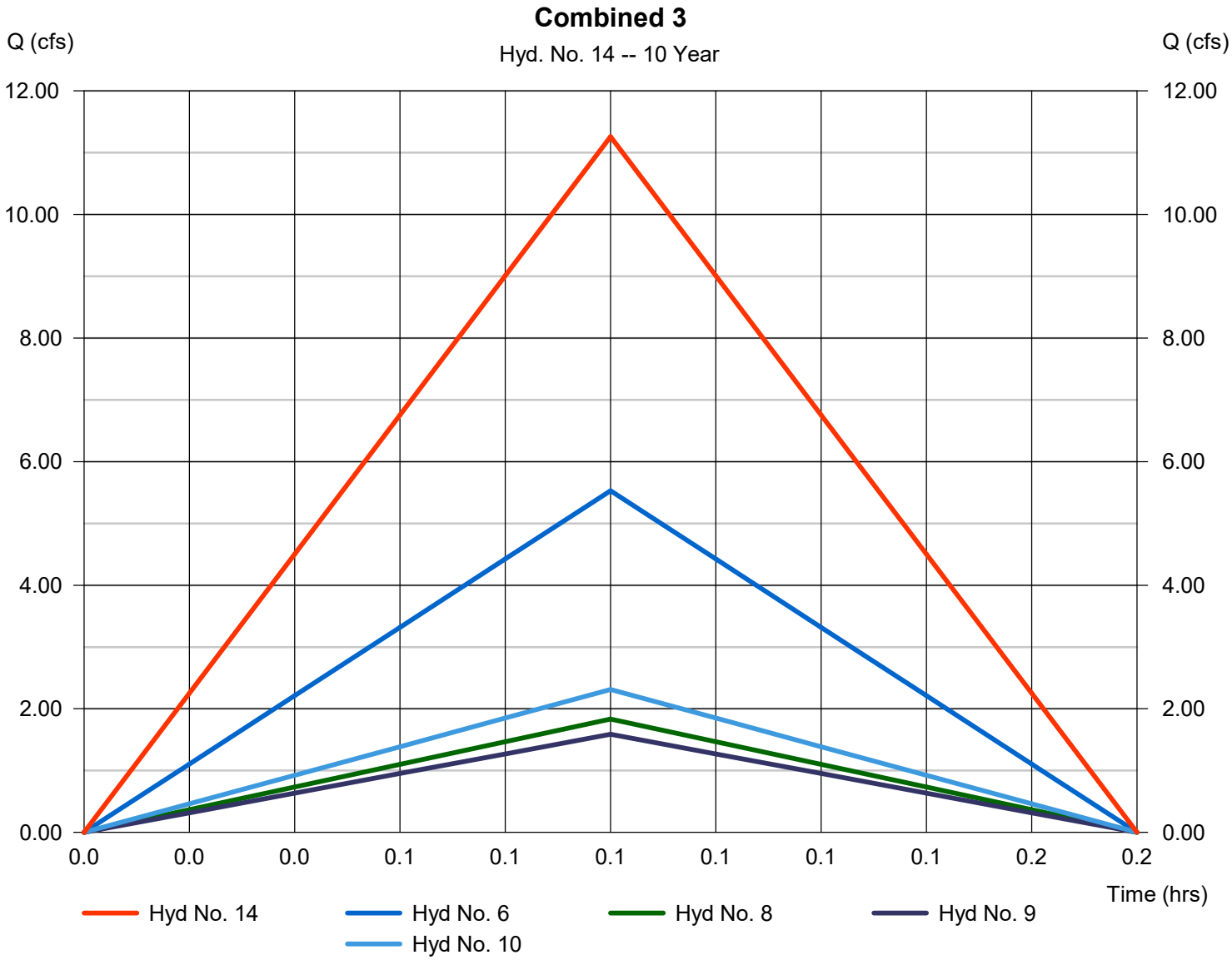


Hydrograph Report

Hyd. No. 14

Combined 3

Hydrograph type	= Combine	Peak discharge	= 11.26 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 3,378 cuft
Inflow hyds.	= 6, 8, 9, 10	Contrib. drain. area	= 1.890 ac

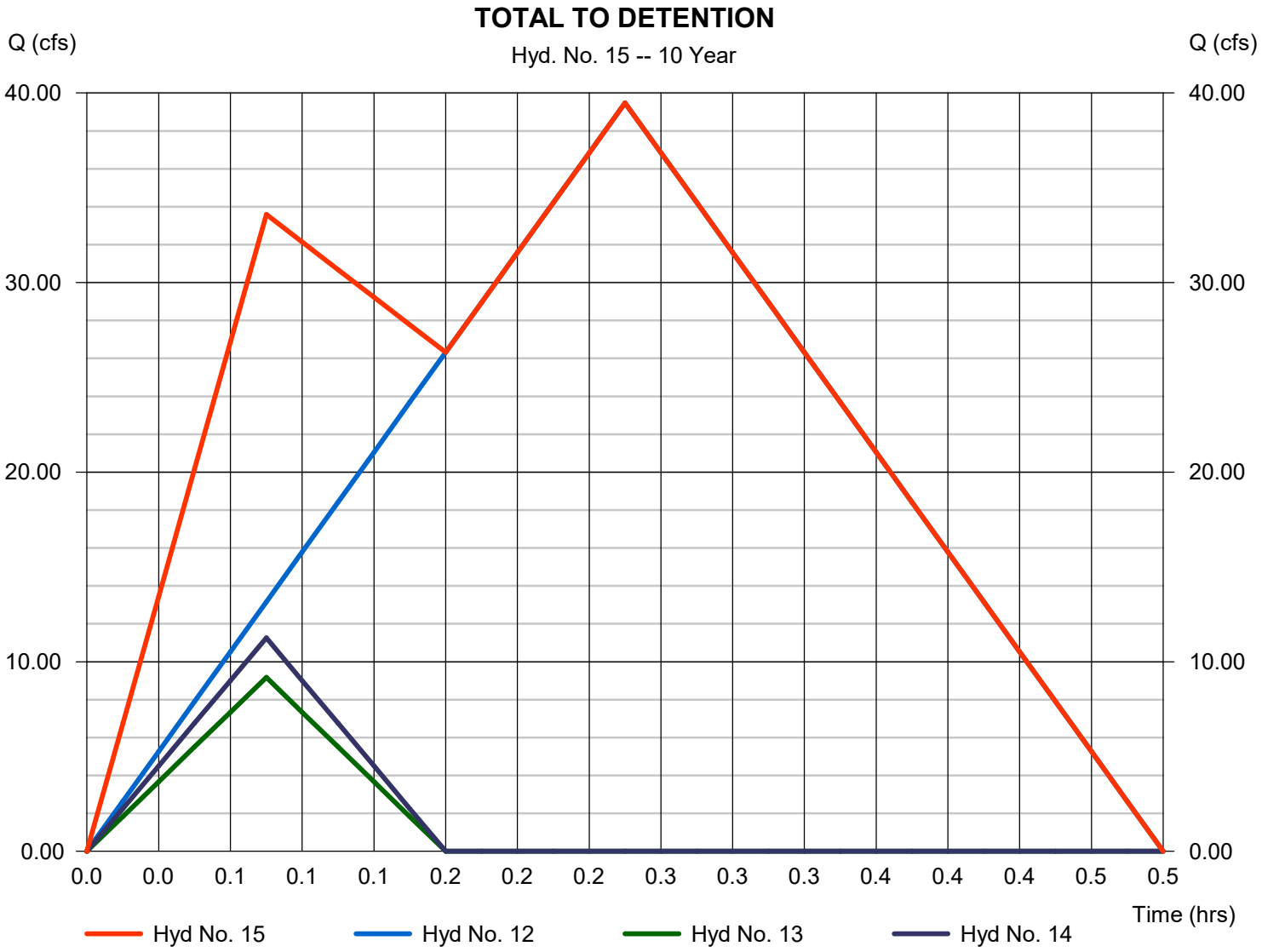


Hydrograph Report

Hyd. No. 15

TOTAL TO DETENTION

Hydrograph type	= Combine	Peak discharge	= 39.48 cfs
Storm frequency	= 10 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 41,659 cuft
Inflow hyds.	= 12, 13, 14	Contrib. drain. area	= 0.000 ac



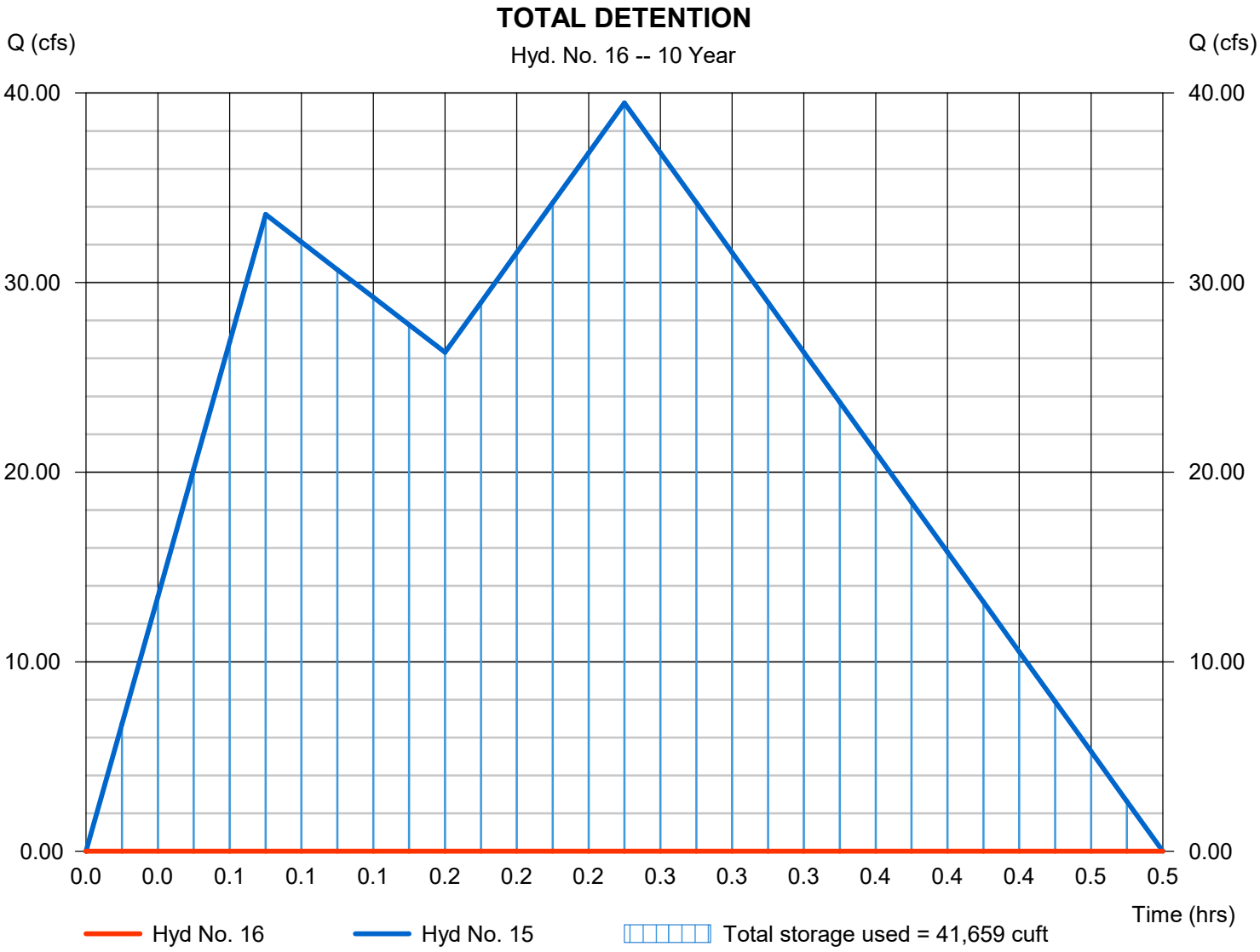
Hydrograph Report

Hyd. No. 16

TOTAL DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	0.000 cfs
Storm frequency	=	10 yrs	Time to peak	=	n/a
Time interval	=	1 min	Hyd. volume	=	0 cuft
Inflow hyd. No.	=	15 - TOTAL TO DETENTION	Max. Elevation	=	984.44 ft
Reservoir name	=	Detention	Max. Storage	=	41,659 cuft

Storage Indication method used.

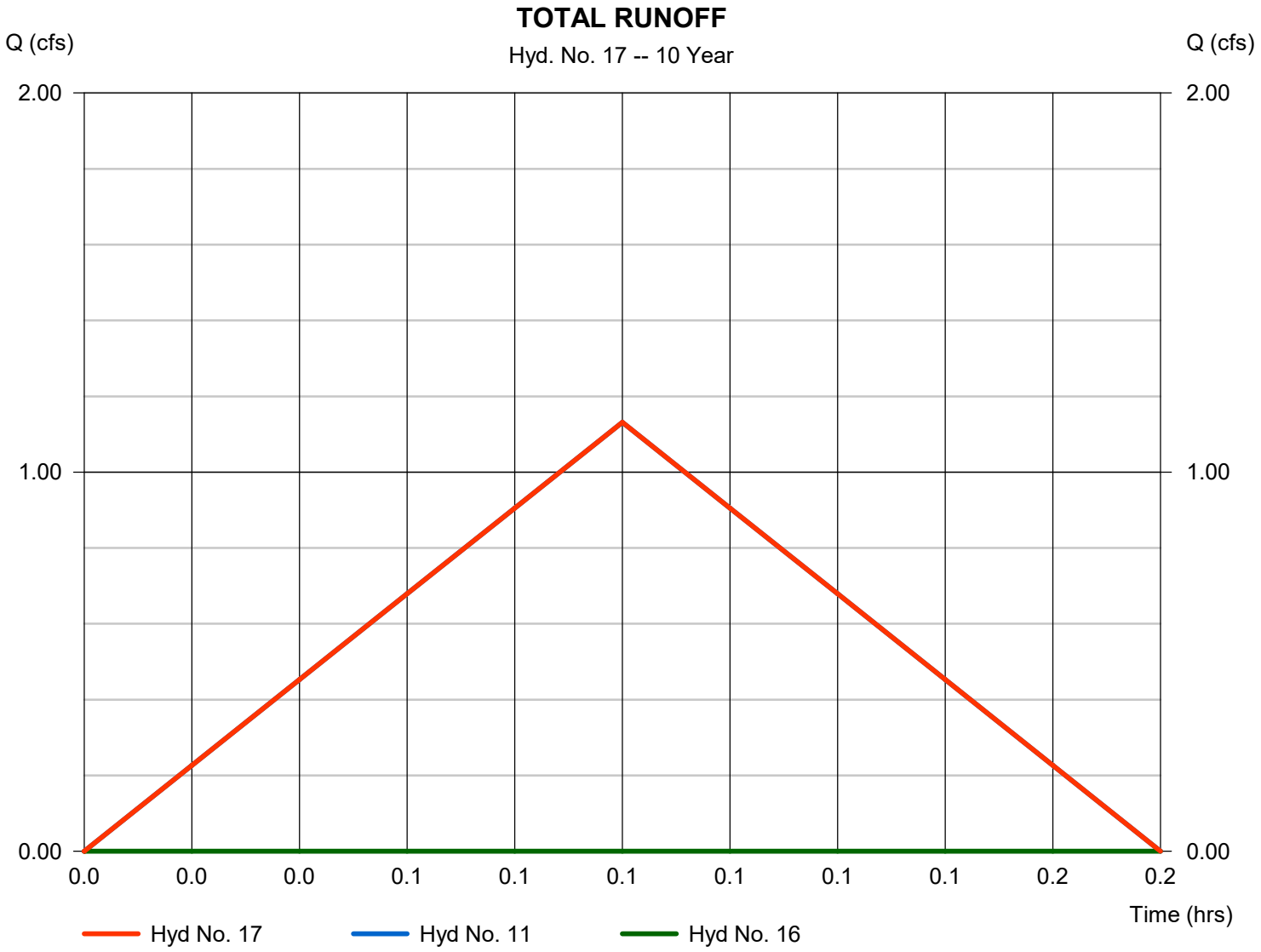


Hydrograph Report

Hyd. No. 17

TOTAL RUNOFF

Hydrograph type	=	Combine	Peak discharge	=	1.132 cfs
Storm frequency	=	10 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	339 cuft
Inflow hyds.	=	11, 16	Contrib. drain. area	=	0.350 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2020

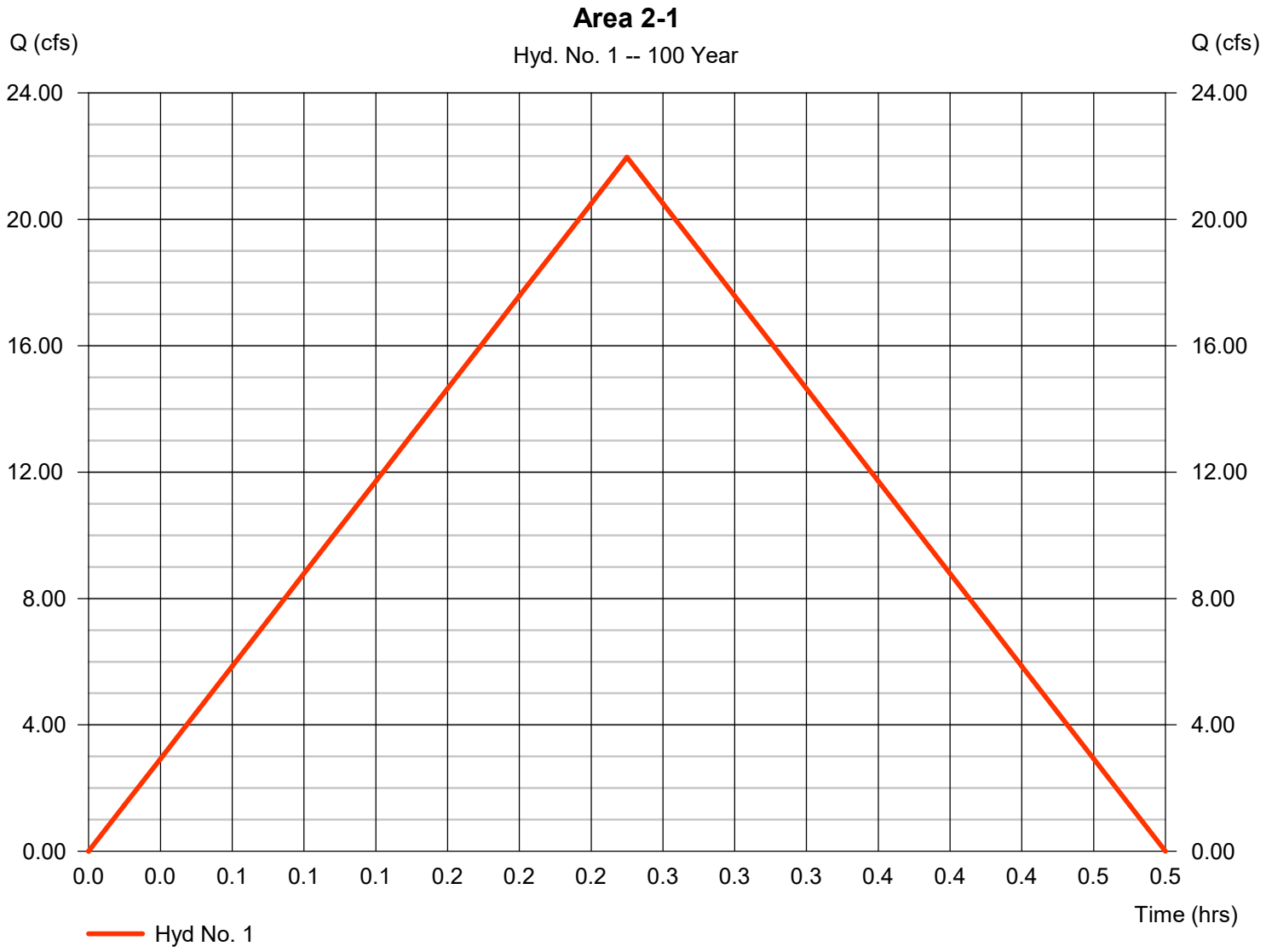
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	21.97	1	15	19,772	------	------	------	Area 2-1
2	Rational	10.52	1	15	9,464	------	------	------	Area 2-2
3	Rational	26.98	1	15	24,283	------	------	------	Area 2-3
4	Rational	8.784	1	5	2,635	------	------	------	Area 2-4
5	Rational	1.622	1	5	487	------	------	------	Area 2-5
6	Rational	9.684	1	5	2,905	------	------	------	Area 2-6
7	Rational	5.663	1	5	1,699	------	------	------	Area 2-7
8	Rational	3.210	1	5	963	------	------	------	Area 2-8
9	Rational	2.780	1	5	834	------	------	------	Area 2-9
10	Rational	4.048	1	5	1,214	------	------	------	Area 2-10
11	Rational	1.982	1	5	595	------	------	------	Area 2-11
12	Combine	59.47	1	15	53,519	1, 2, 3,	------	------	Combined 1
13	Combine	16.07	1	5	4,821	4, 5, 7,	------	------	Combined 2
14	Combine	19.72	1	5	5,917	6, 8, 9,	------	------	Combined 3
15	Combine	59.47	1	15	64,257	10, 12, 13, 14	------	------	TOTAL TO DETENTION
16	Reservoir	0.093	1	30	1,367	15	985.88	64,244	TOTAL DETENTION
17	Combine	1.982	1	5	1,962	11, 16	------	------	TOTAL RUNOFF

Hydrograph Report

Hyd. No. 1

Area 2-1

Hydrograph type	= Rational	Peak discharge	= 21.97 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 19,772 cuft
Drainage area	= 9.380 ac	Runoff coeff.	= 0.3
Intensity	= 7.807 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

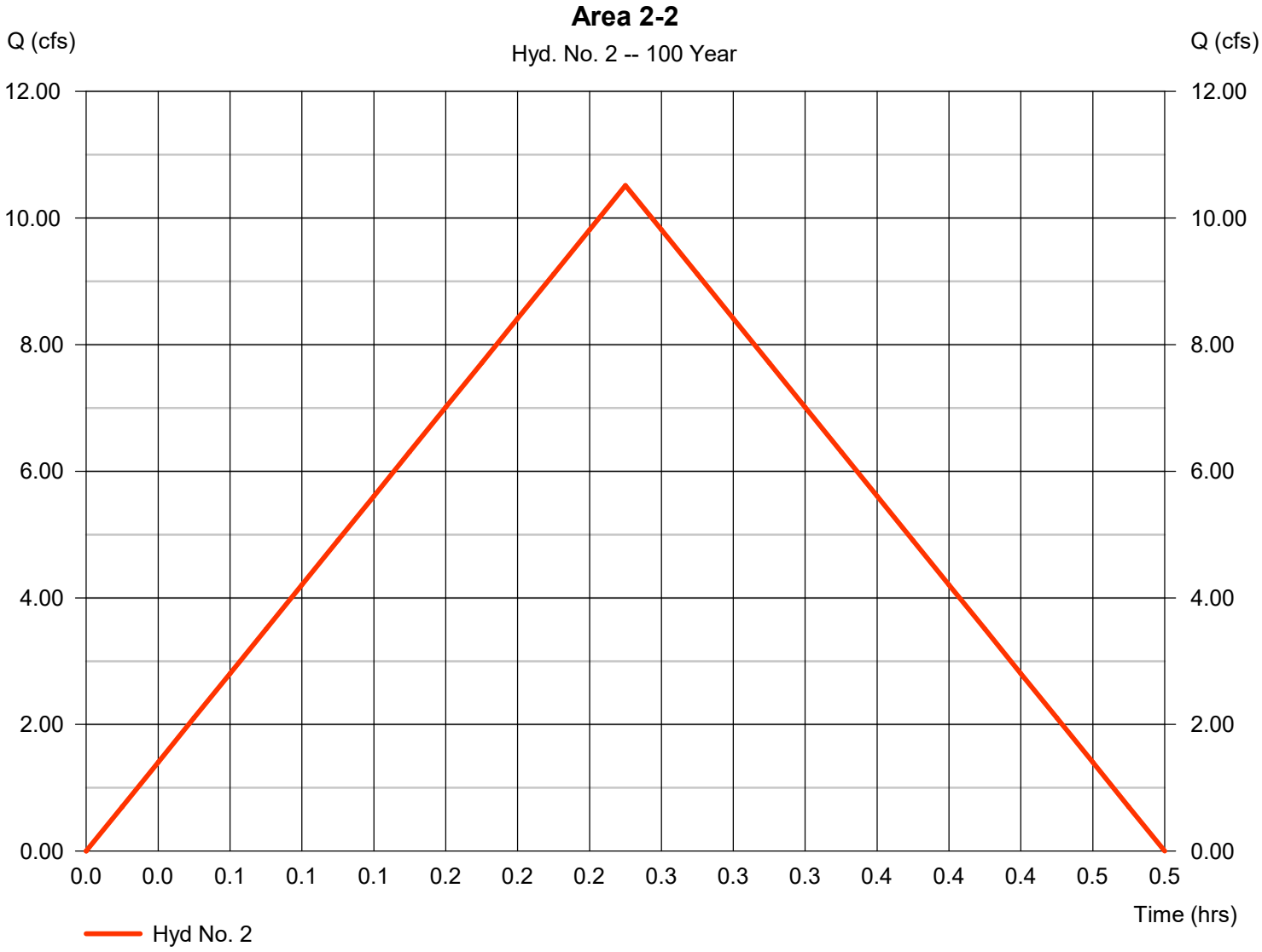


Hydrograph Report

Hyd. No. 2

Area 2-2

Hydrograph type	= Rational	Peak discharge	= 10.52 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 9,464 cuft
Drainage area	= 4.490 ac	Runoff coeff.	= 0.3
Intensity	= 7.807 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

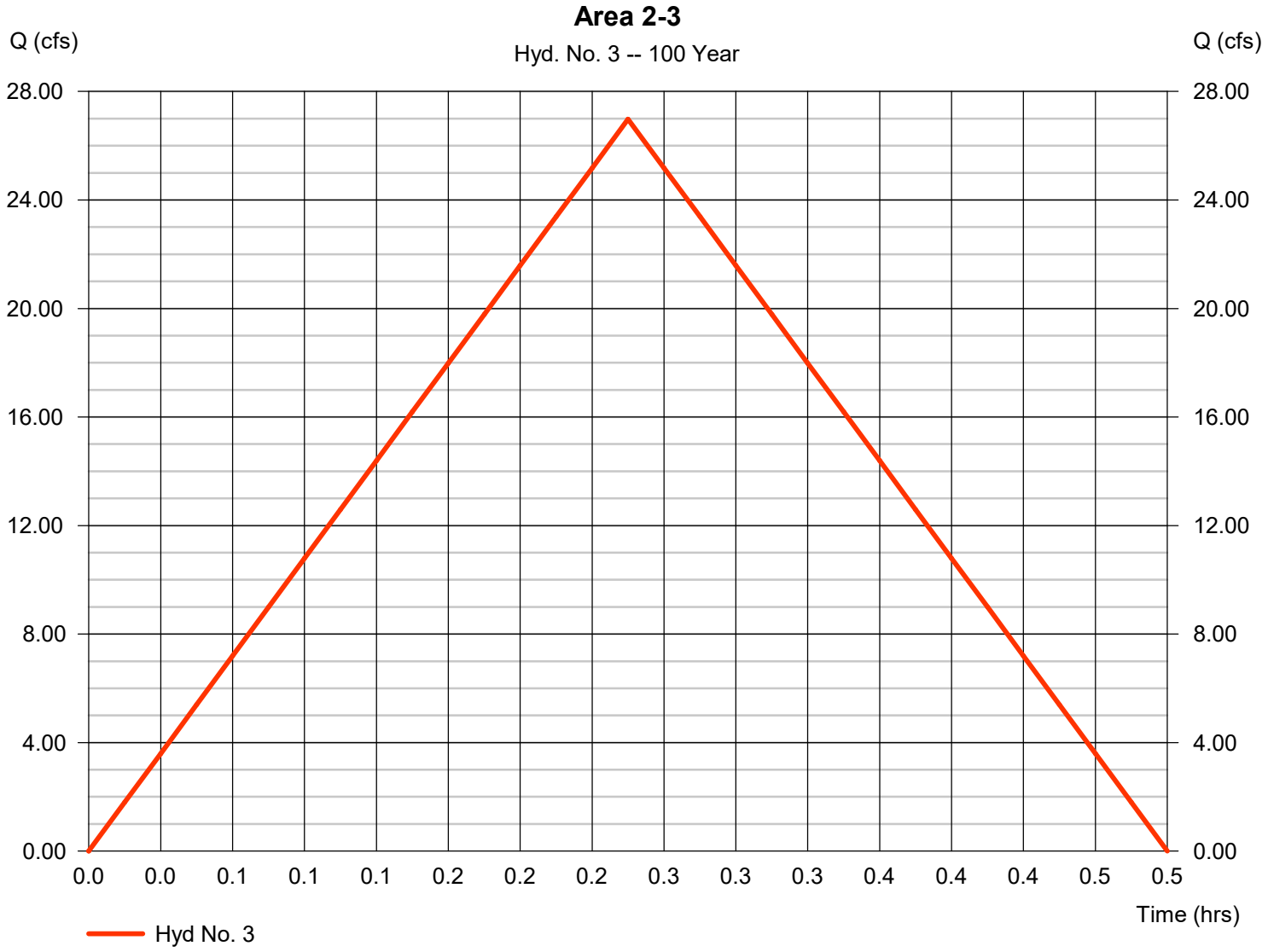


Hydrograph Report

Hyd. No. 3

Area 2-3

Hydrograph type	= Rational	Peak discharge	= 26.98 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 24,283 cuft
Drainage area	= 11.520 ac	Runoff coeff.	= 0.3
Intensity	= 7.807 in/hr	Tc by User	= 15.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

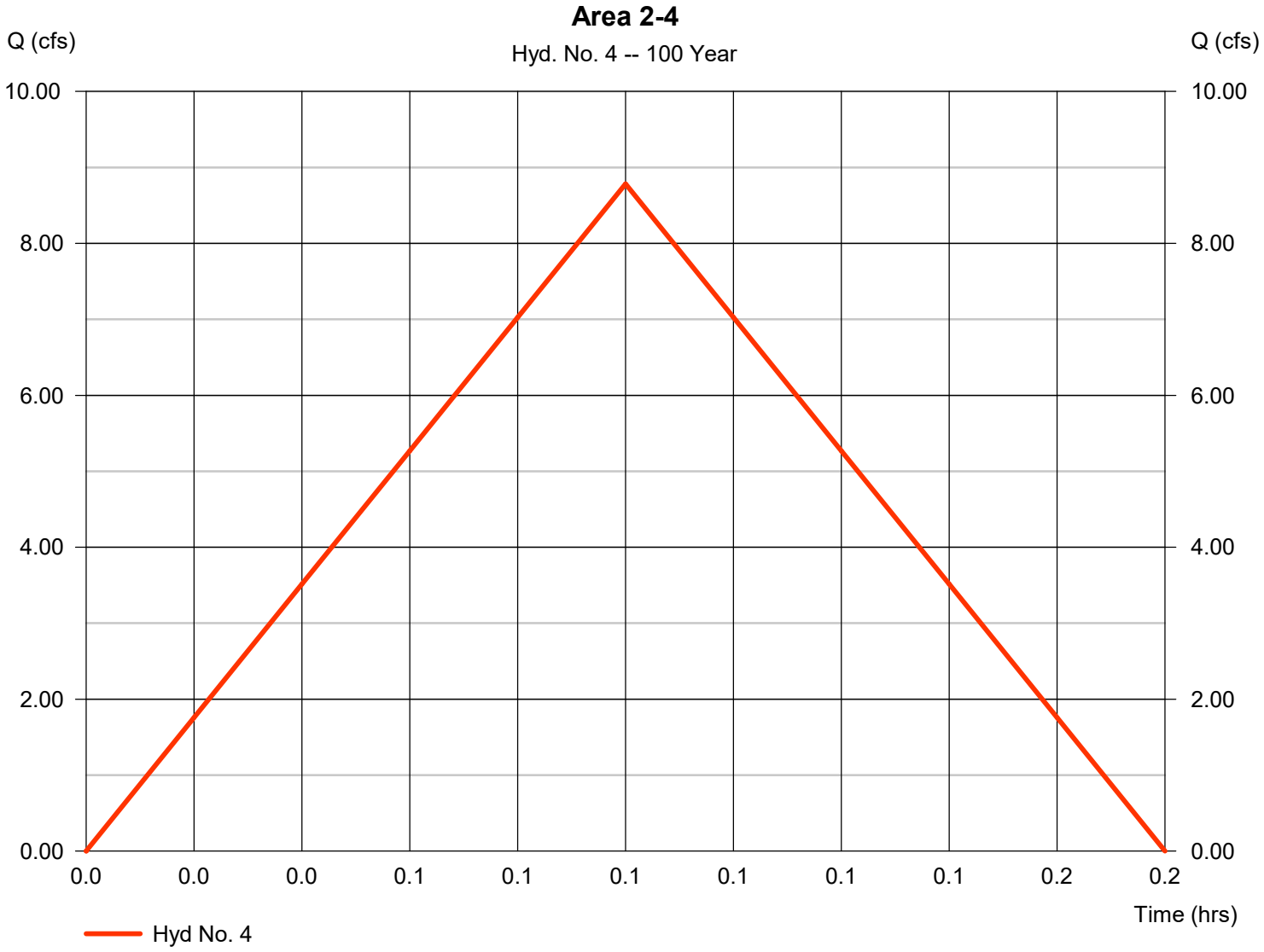


Hydrograph Report

Hyd. No. 4

Area 2-4

Hydrograph type	= Rational	Peak discharge	= 8.784 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 2,635 cuft
Drainage area	= 1.050 ac	Runoff coeff.	= 0.65
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

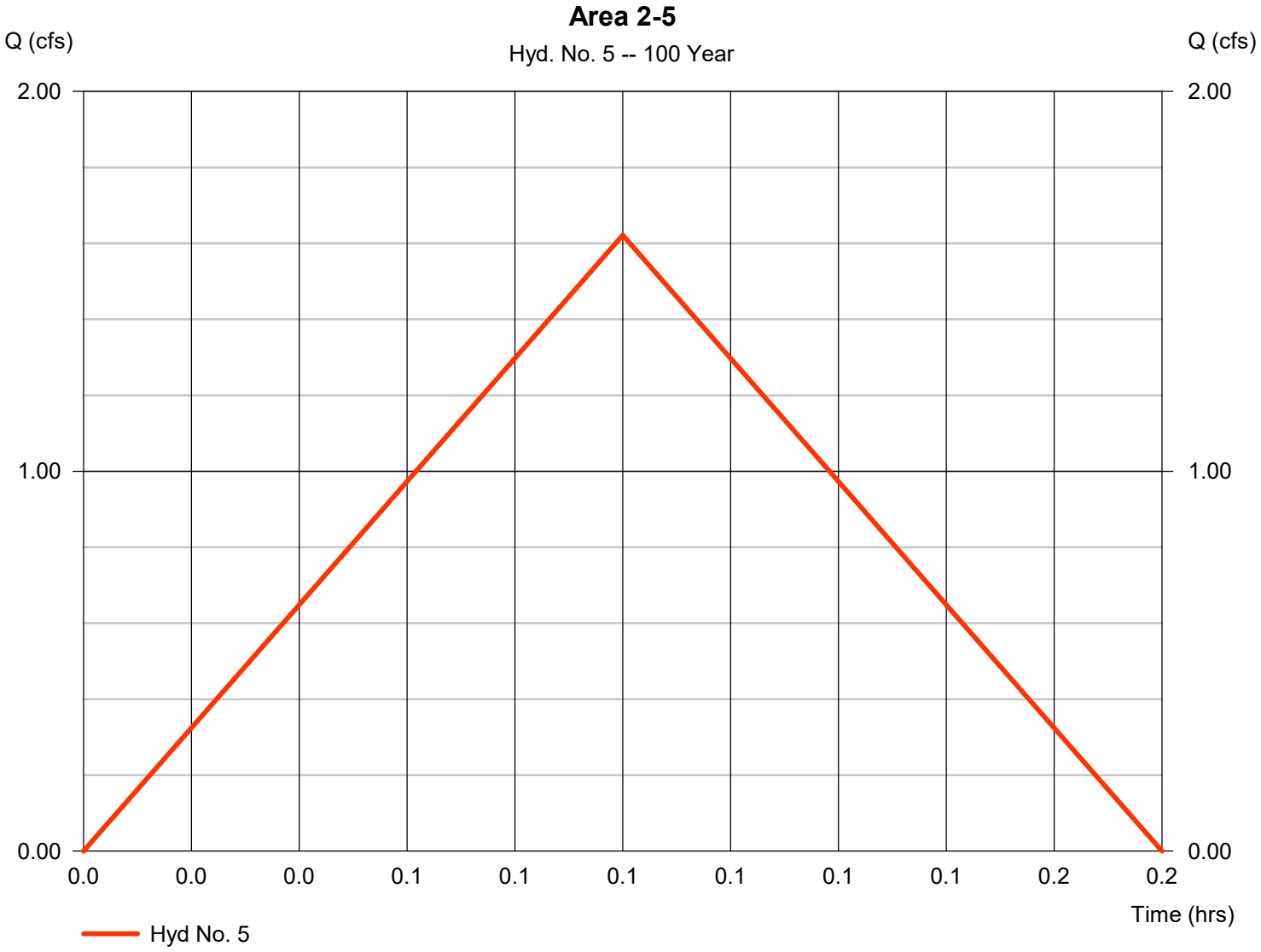


Hydrograph Report

Hyd. No. 5

Area 2-5

Hydrograph type	= Rational	Peak discharge	= 1.622 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 487 cuft
Drainage area	= 0.200 ac	Runoff coeff.	= 0.63
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

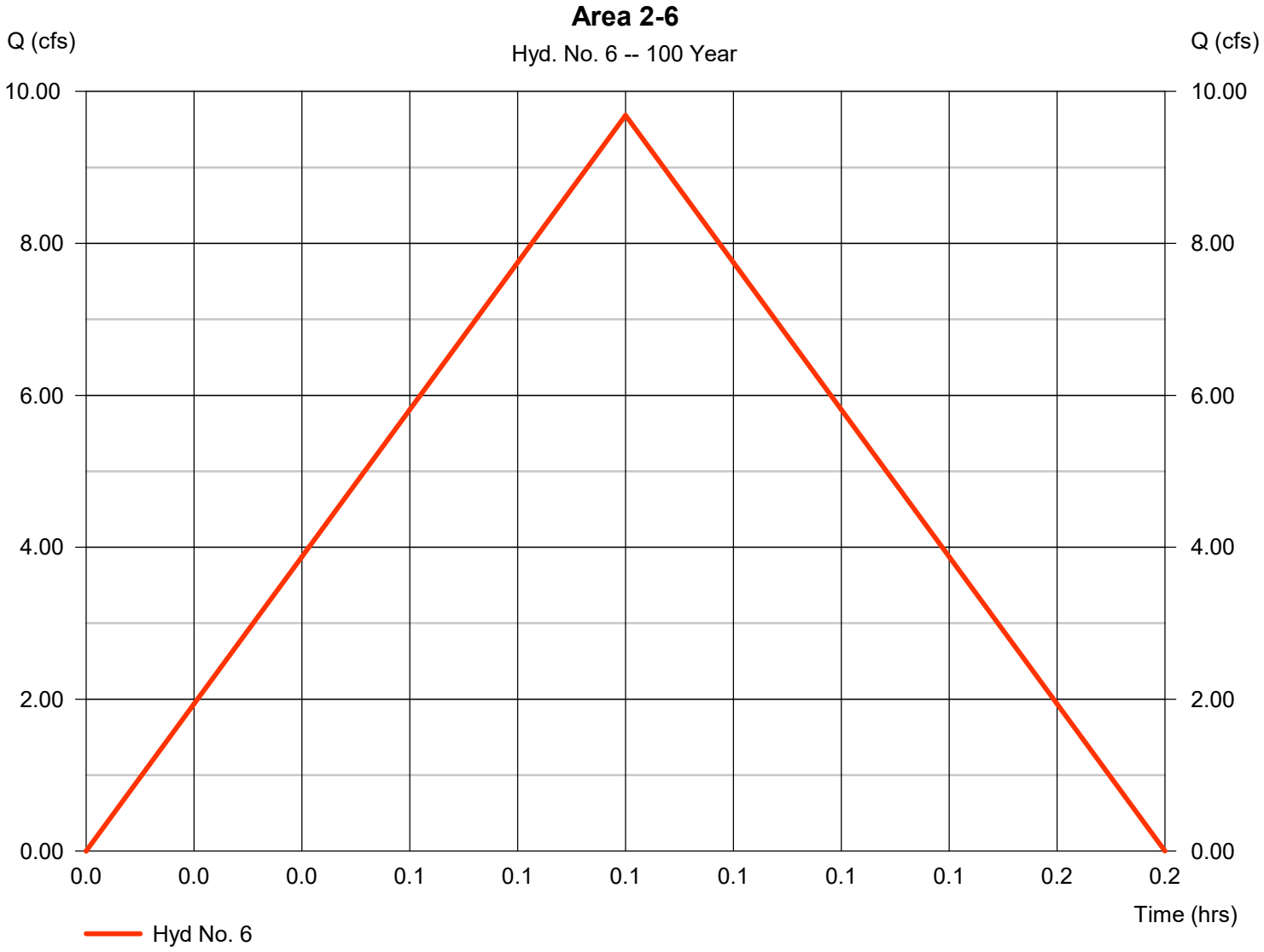


Hydrograph Report

Hyd. No. 6

Area 2-6

Hydrograph type	= Rational	Peak discharge	= 9.684 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 2,905 cuft
Drainage area	= 0.990 ac	Runoff coeff.	= 0.76
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

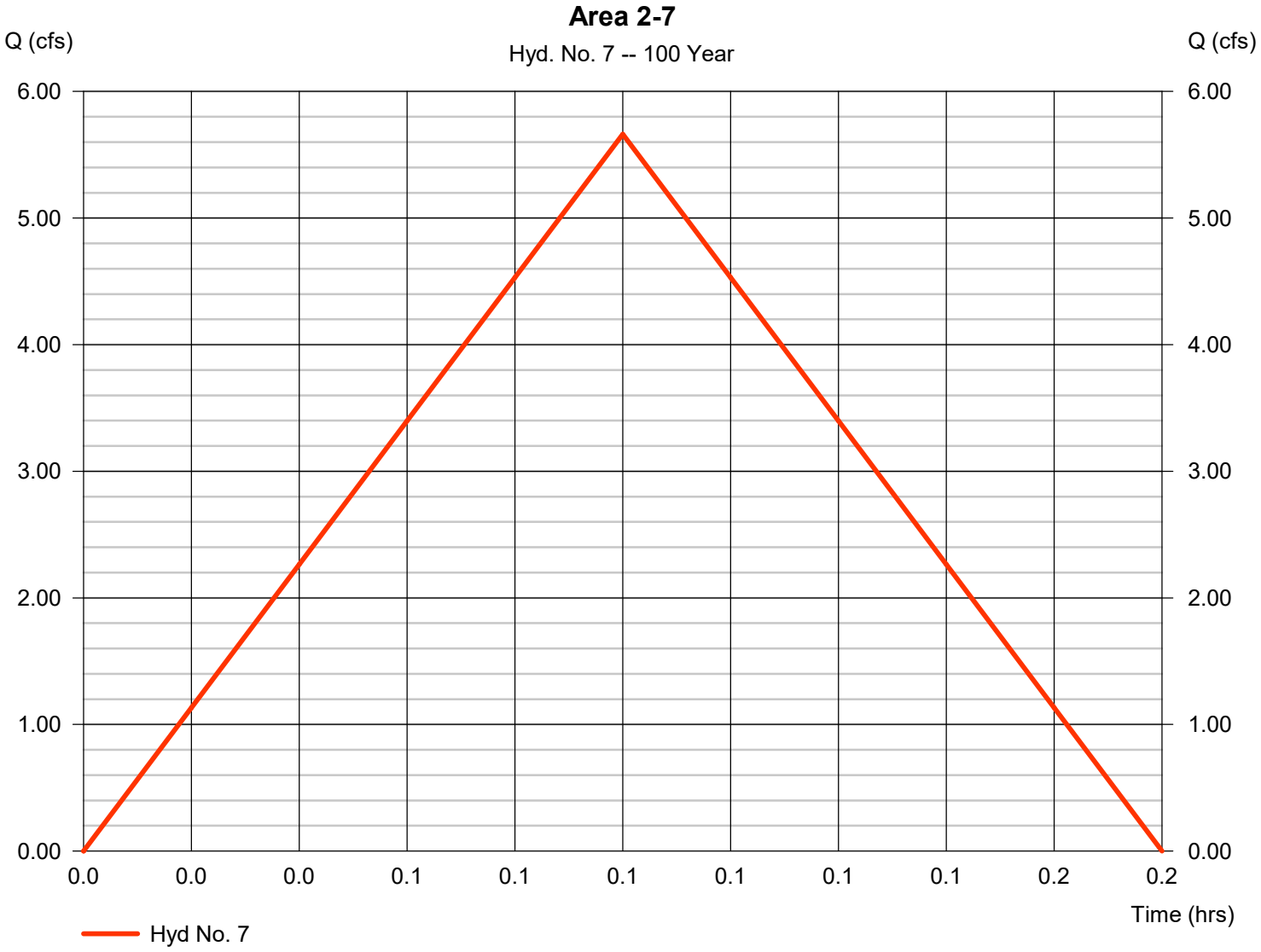


Hydrograph Report

Hyd. No. 7

Area 2-7

Hydrograph type	= Rational	Peak discharge	= 5.663 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,699 cuft
Drainage area	= 0.500 ac	Runoff coeff.	= 0.88
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

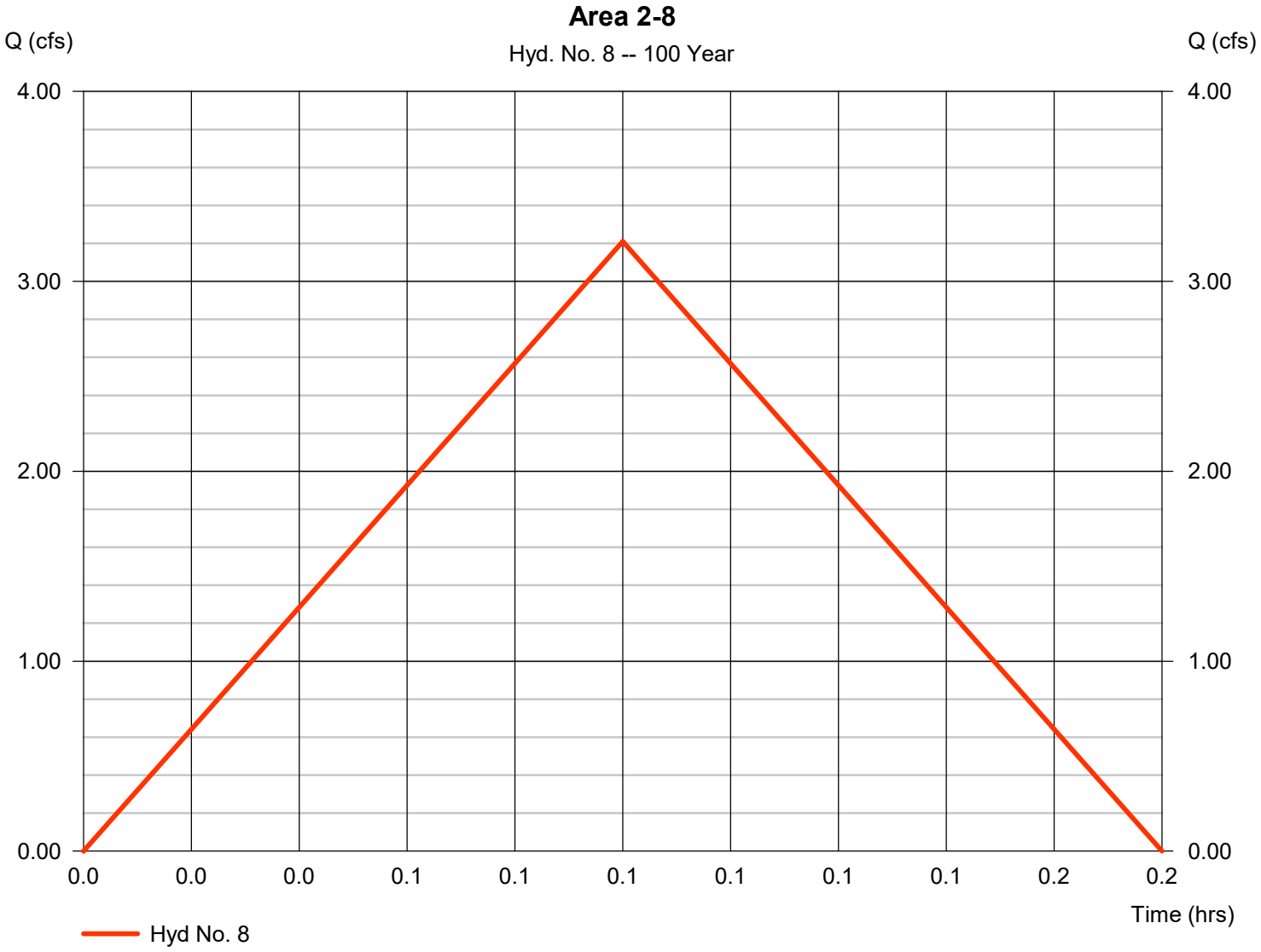


Hydrograph Report

Hyd. No. 8

Area 2-8

Hydrograph type	= Rational	Peak discharge	= 3.210 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 963 cuft
Drainage area	= 0.290 ac	Runoff coeff.	= 0.86
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

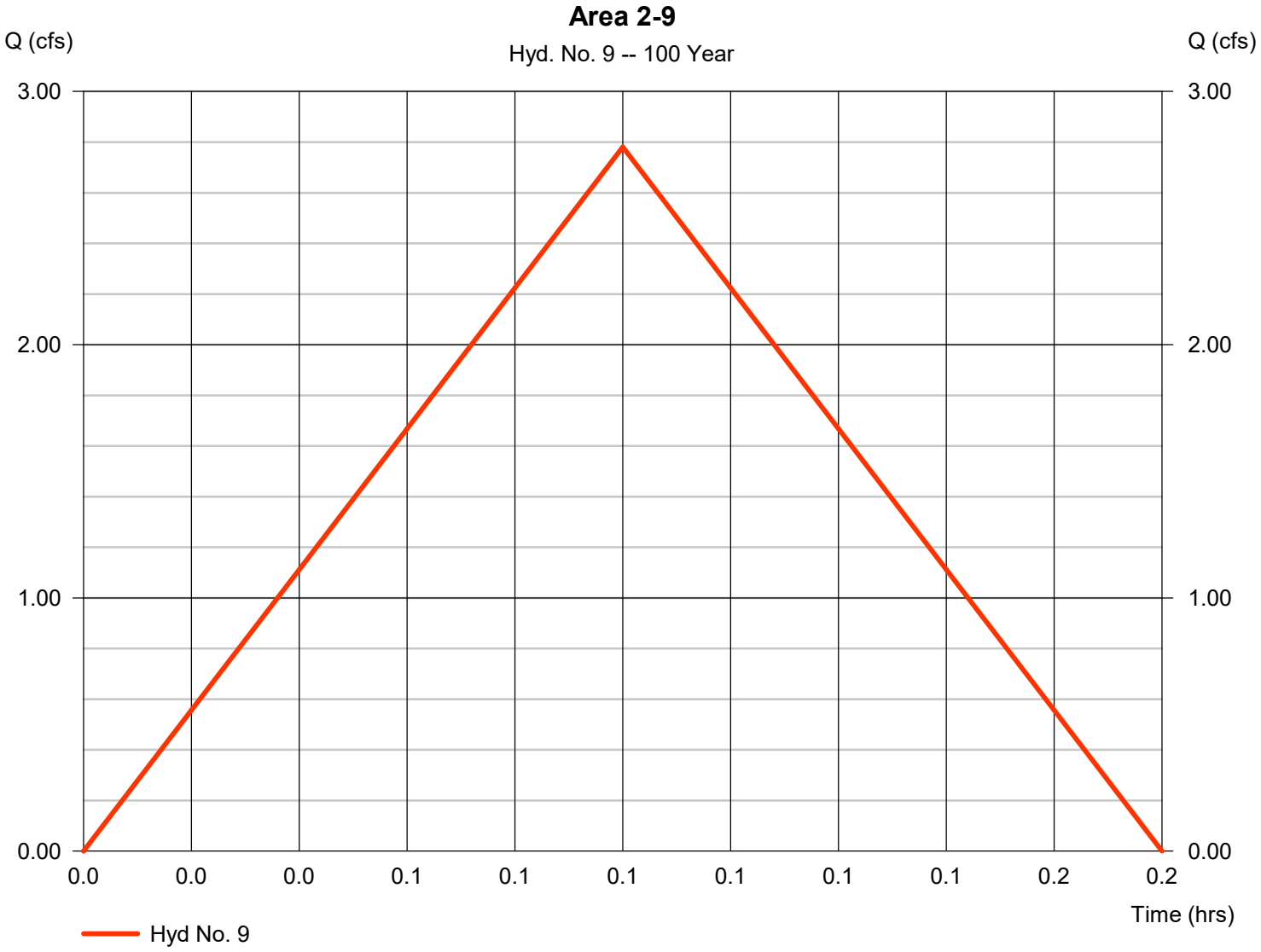


Hydrograph Report

Hyd. No. 9

Area 2-9

Hydrograph type	= Rational	Peak discharge	= 2.780 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 834 cuft
Drainage area	= 0.240 ac	Runoff coeff.	= 0.9
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

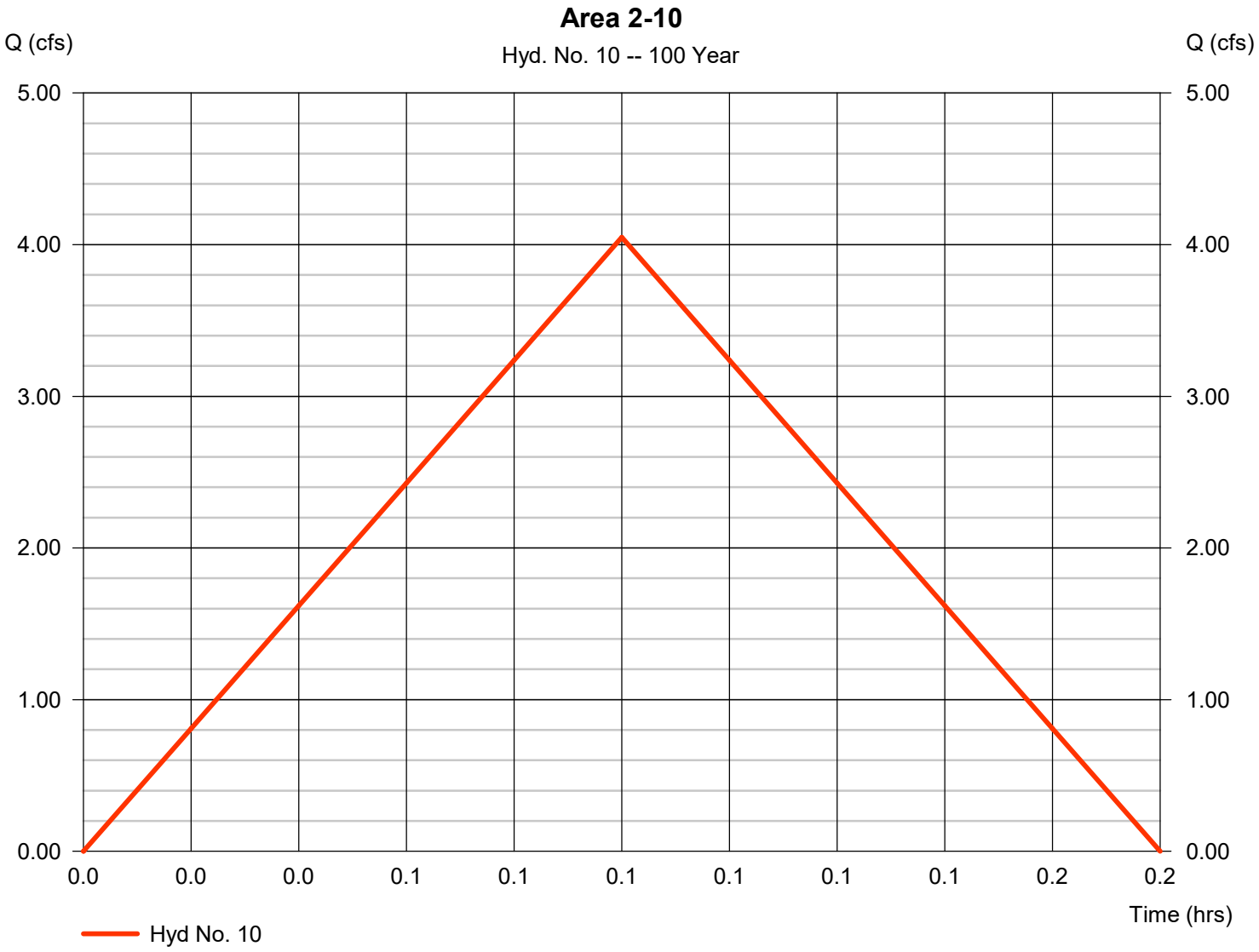


Hydrograph Report

Hyd. No. 10

Area 2-10

Hydrograph type	= Rational	Peak discharge	= 4.048 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 1,214 cuft
Drainage area	= 0.370 ac	Runoff coeff.	= 0.85
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

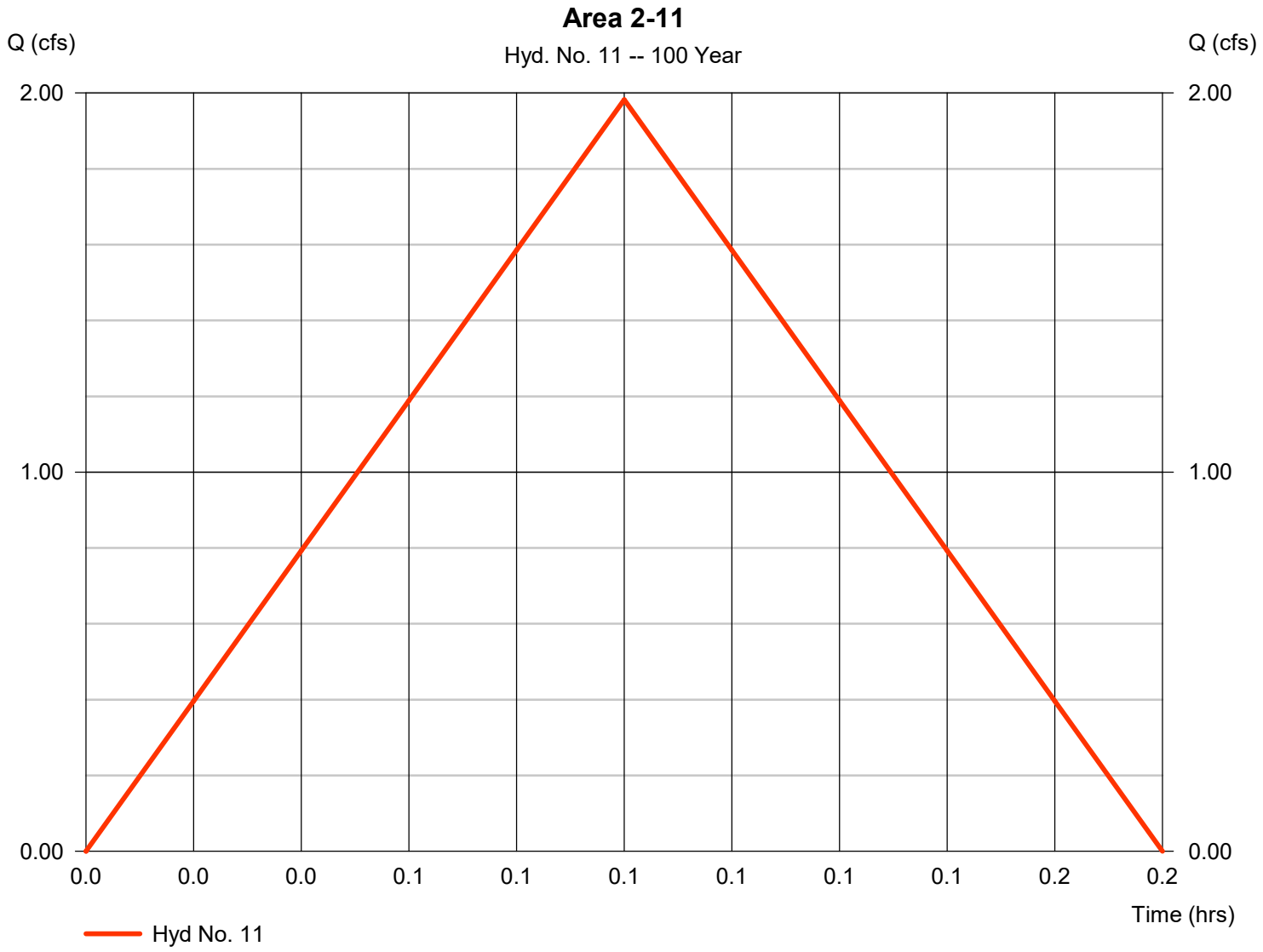


Hydrograph Report

Hyd. No. 11

Area 2-11

Hydrograph type	= Rational	Peak discharge	= 1.982 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 595 cuft
Drainage area	= 0.350 ac	Runoff coeff.	= 0.44
Intensity	= 12.871 in/hr	Tc by User	= 5.00 min
IDF Curve	= KCAPWA.IDF	Asc/Rec limb fact	= 1/1

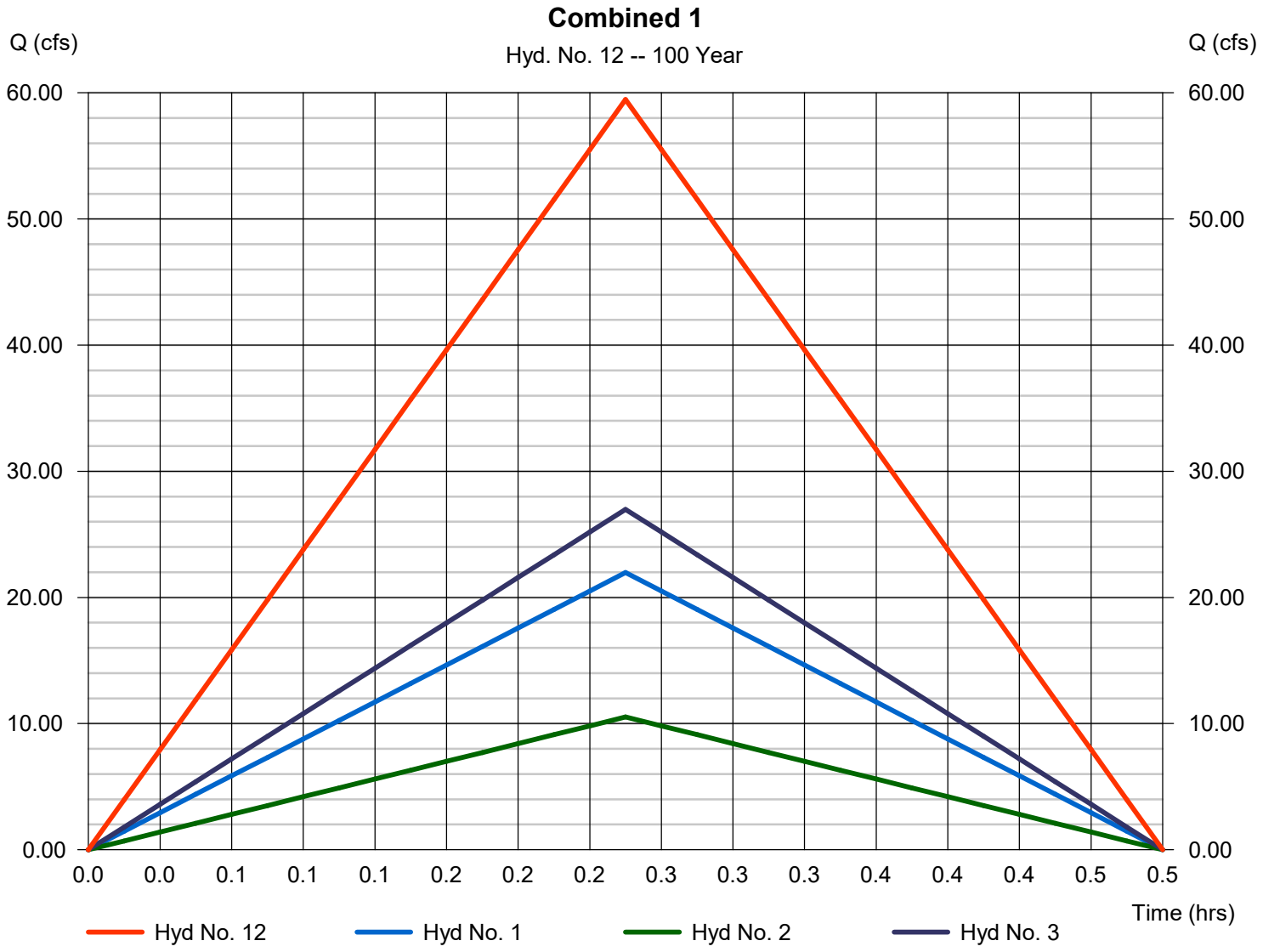


Hydrograph Report

Hyd. No. 12

Combined 1

Hydrograph type	=	Combine	Peak discharge	=	59.47 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.25 hrs
Time interval	=	1 min	Hyd. volume	=	53,519 cuft
Inflow hyds.	=	1, 2, 3	Contrib. drain. area	=	25.390 ac

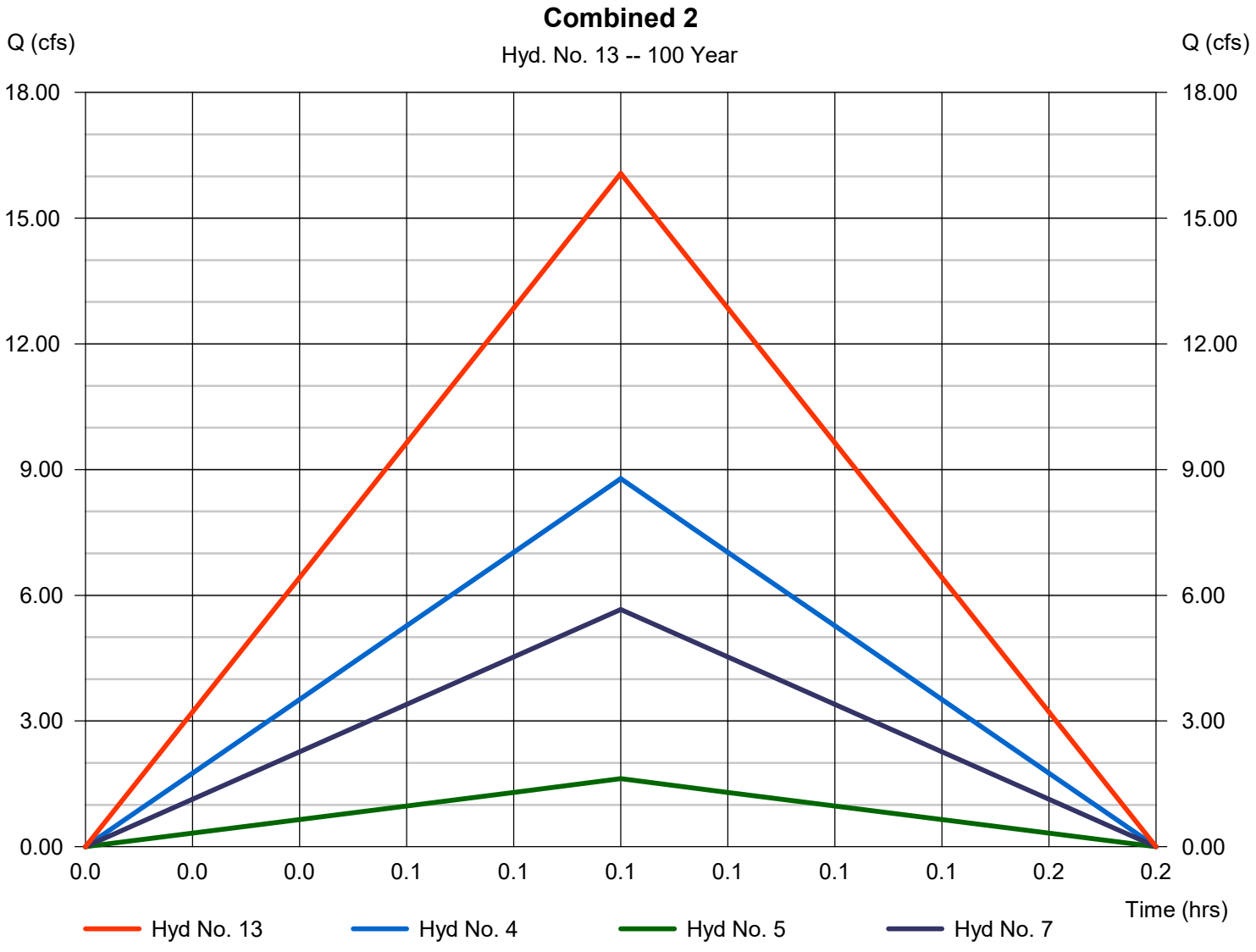


Hydrograph Report

Hyd. No. 13

Combined 2

Hydrograph type	= Combine	Peak discharge	= 16.07 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 4,821 cuft
Inflow hyds.	= 4, 5, 7	Contrib. drain. area	= 1.750 ac

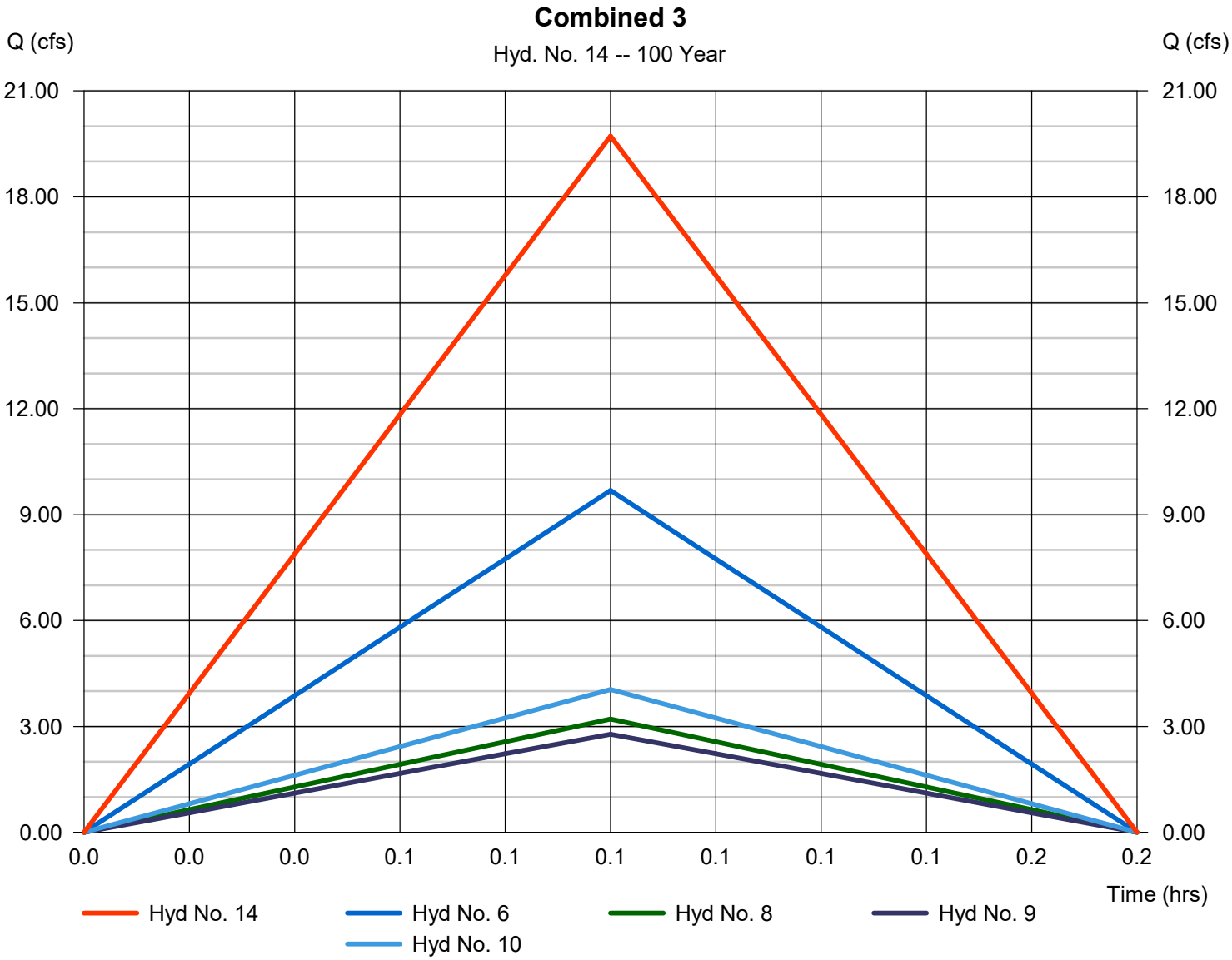


Hydrograph Report

Hyd. No. 14

Combined 3

Hydrograph type	= Combine	Peak discharge	= 19.72 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.08 hrs
Time interval	= 1 min	Hyd. volume	= 5,917 cuft
Inflow hyds.	= 6, 8, 9, 10	Contrib. drain. area	= 1.890 ac

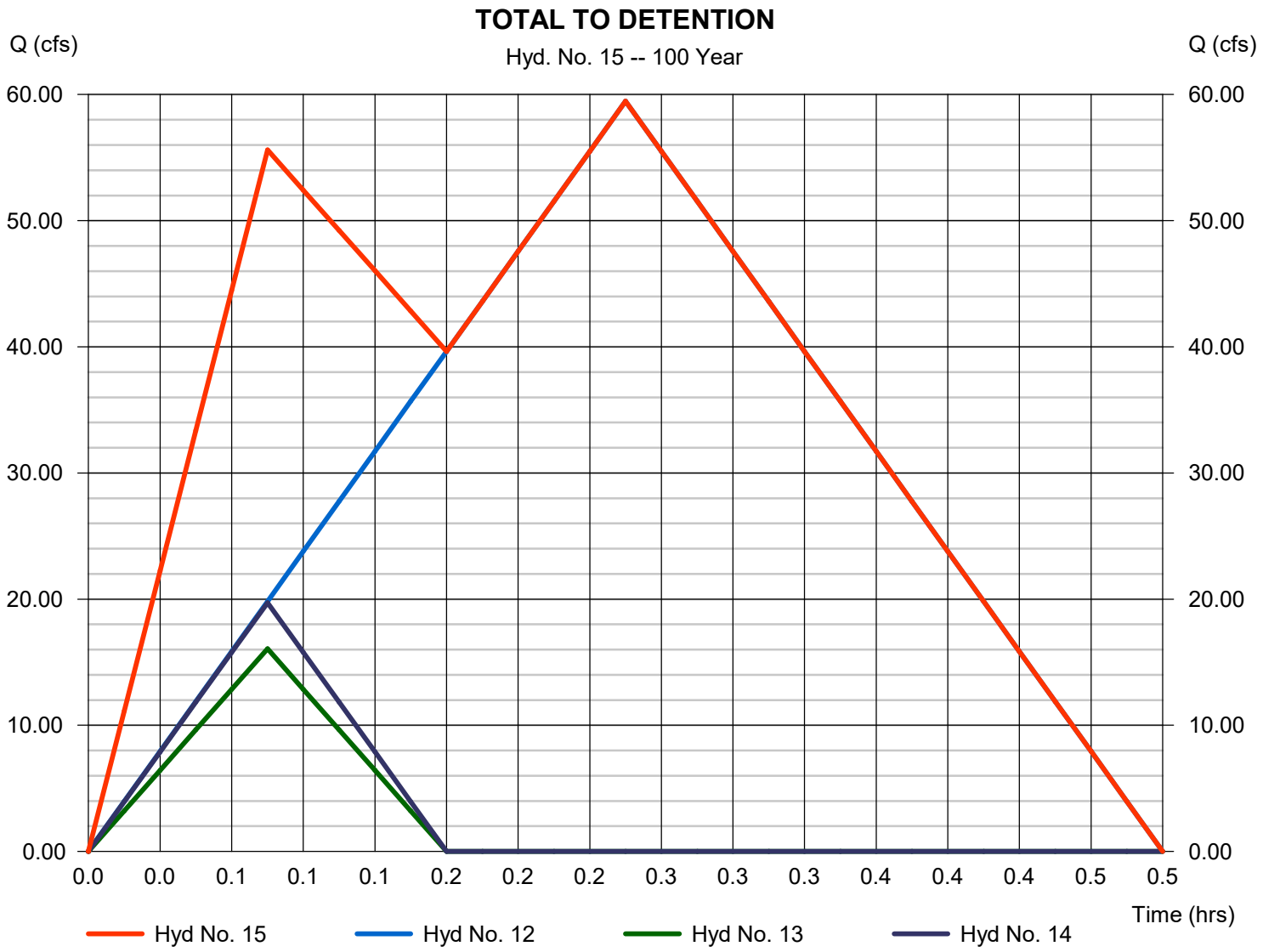


Hydrograph Report

Hyd. No. 15

TOTAL TO DETENTION

Hydrograph type	= Combine	Peak discharge	= 59.47 cfs
Storm frequency	= 100 yrs	Time to peak	= 0.25 hrs
Time interval	= 1 min	Hyd. volume	= 64,257 cuft
Inflow hyds.	= 12, 13, 14	Contrib. drain. area	= 0.000 ac



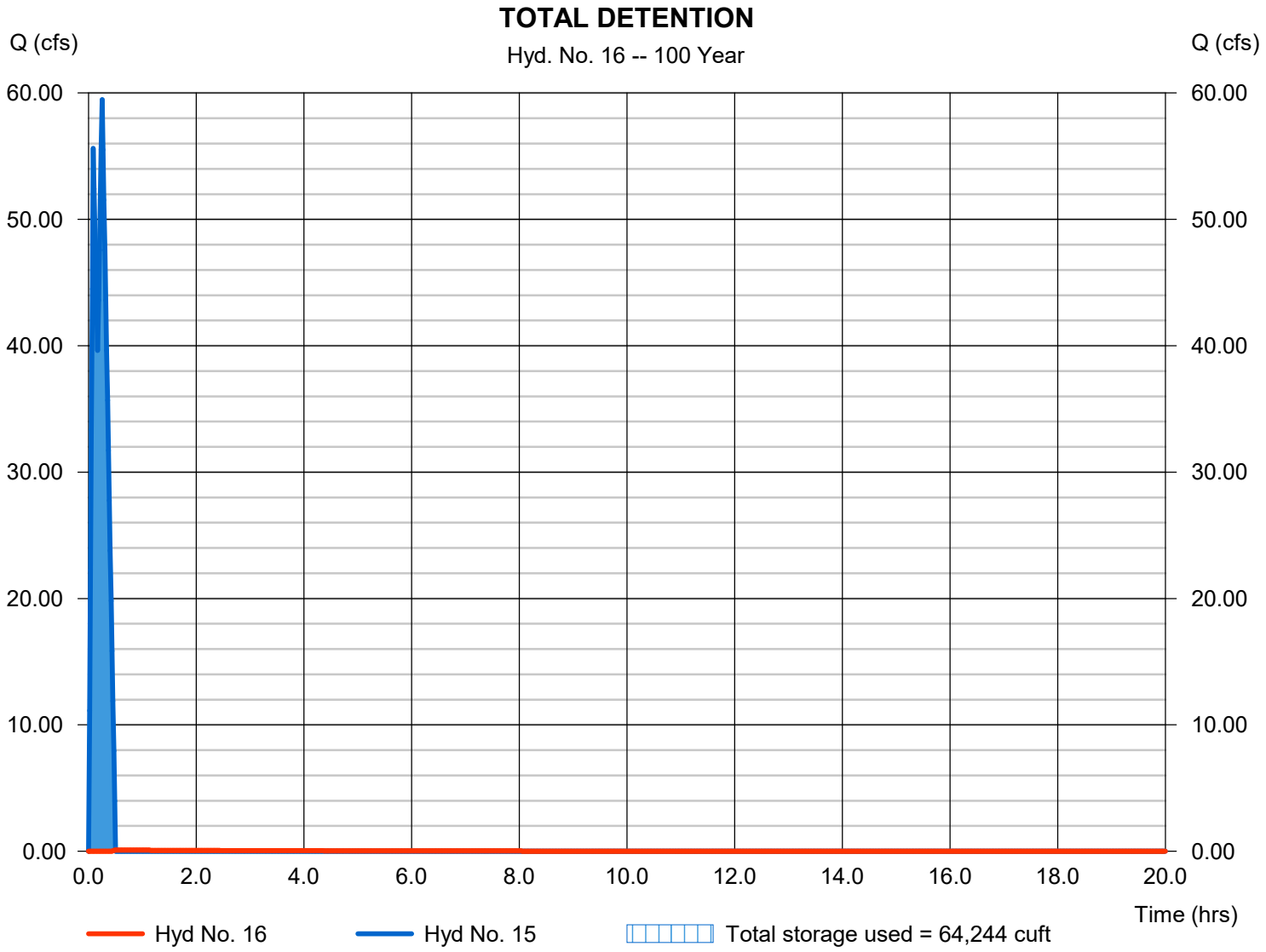
Hydrograph Report

Hyd. No. 16

TOTAL DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	0.093 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.50 hrs
Time interval	=	1 min	Hyd. volume	=	1,367 cuft
Inflow hyd. No.	=	15 - TOTAL TO DETENTION	Max. Elevation	=	985.88 ft
Reservoir name	=	Detention	Max. Storage	=	64,244 cuft

Storage Indication method used.

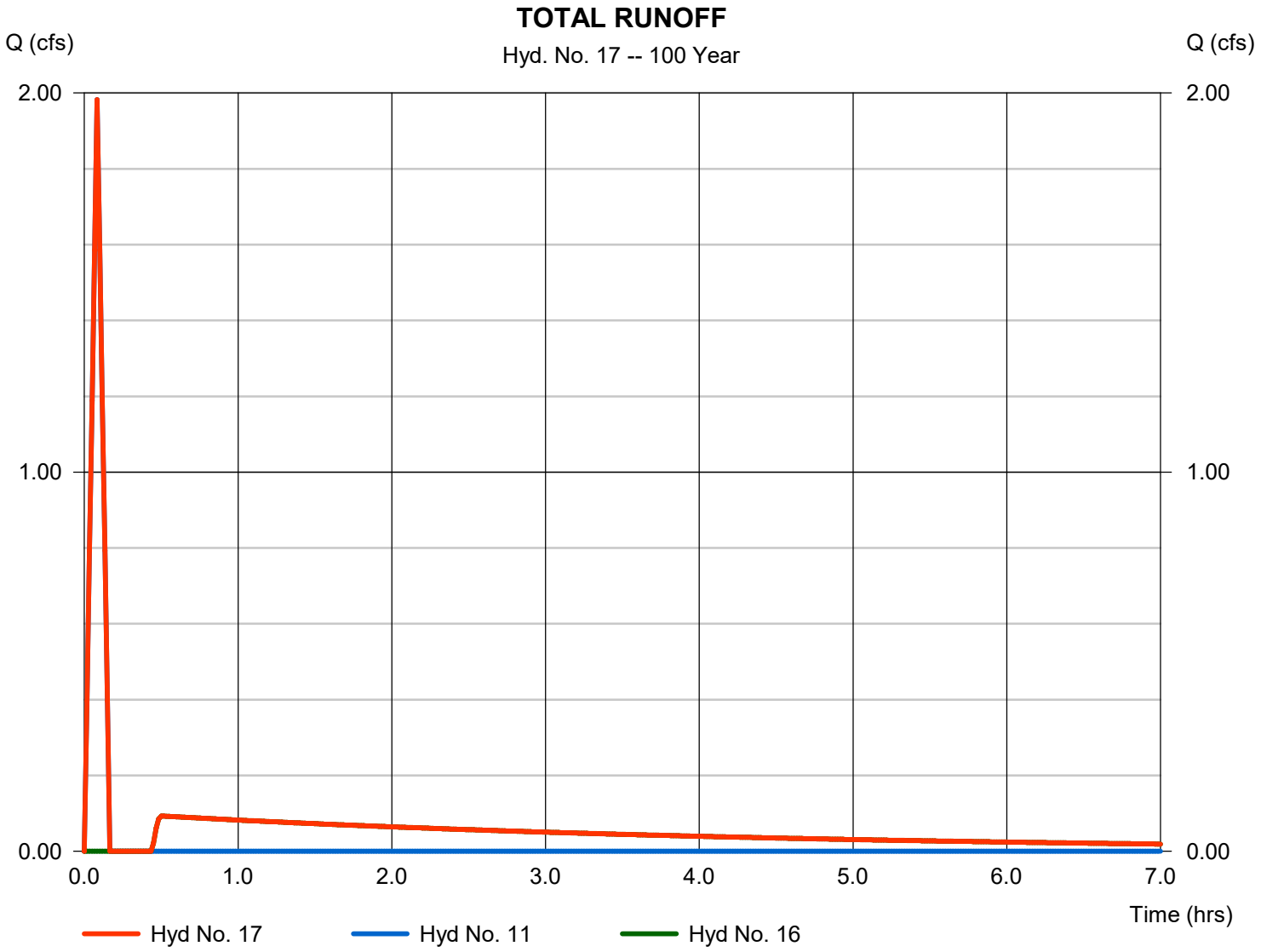


Hydrograph Report

Hyd. No. 17

TOTAL RUNOFF

Hydrograph type	=	Combine	Peak discharge	=	1.982 cfs
Storm frequency	=	100 yrs	Time to peak	=	0.08 hrs
Time interval	=	1 min	Hyd. volume	=	1,962 cuft
Inflow hyds.	=	11, 16	Contrib. drain. area	=	0.350 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	2.9200	0.1000	0.0000	--------
2	110.7137	16.5000	0.9842	--------
3	0.0000	0.0000	0.0000	--------
5	168.3971	19.5000	1.0189	--------
10	183.3473	19.2000	1.0096	--------
25	12318.8496	51.4998	1.8037	--------
50	235.4014	19.9000	1.0020	--------
100	83.7894	6.1000	0.7783	--------

File name: KCAPWA.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92	2.92
2	5.41	4.40	3.71	3.21	2.83	2.53	2.29	2.09	1.92	1.78	1.66	1.55
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.35	4.56	3.98	3.52	3.16	2.86	2.62	2.41	2.24	2.08	1.95
10	7.35	6.08	5.18	4.52	4.00	3.59	3.26	2.98	2.74	2.54	2.37	2.22
25	8.52	7.31	6.35	5.57	4.93	4.40	3.95	3.57	3.24	2.96	2.72	2.50
50	9.39	7.82	6.70	5.86	5.20	4.68	4.25	3.90	3.60	3.34	3.12	2.92
100	12.87	9.64	7.81	6.62	5.77	5.14	4.65	4.25	3.92	3.65	3.41	3.21

Tc = time in minutes. Values may exceed 60.

Precip. file name: bluesprings.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	2.90	3.50	0.00	4.50	5.30	6.10	6.80	7.70
SCS 6-Hr	0.00	2.65	0.00	3.30	3.45	4.50	5.10	5.70
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Exhibit E

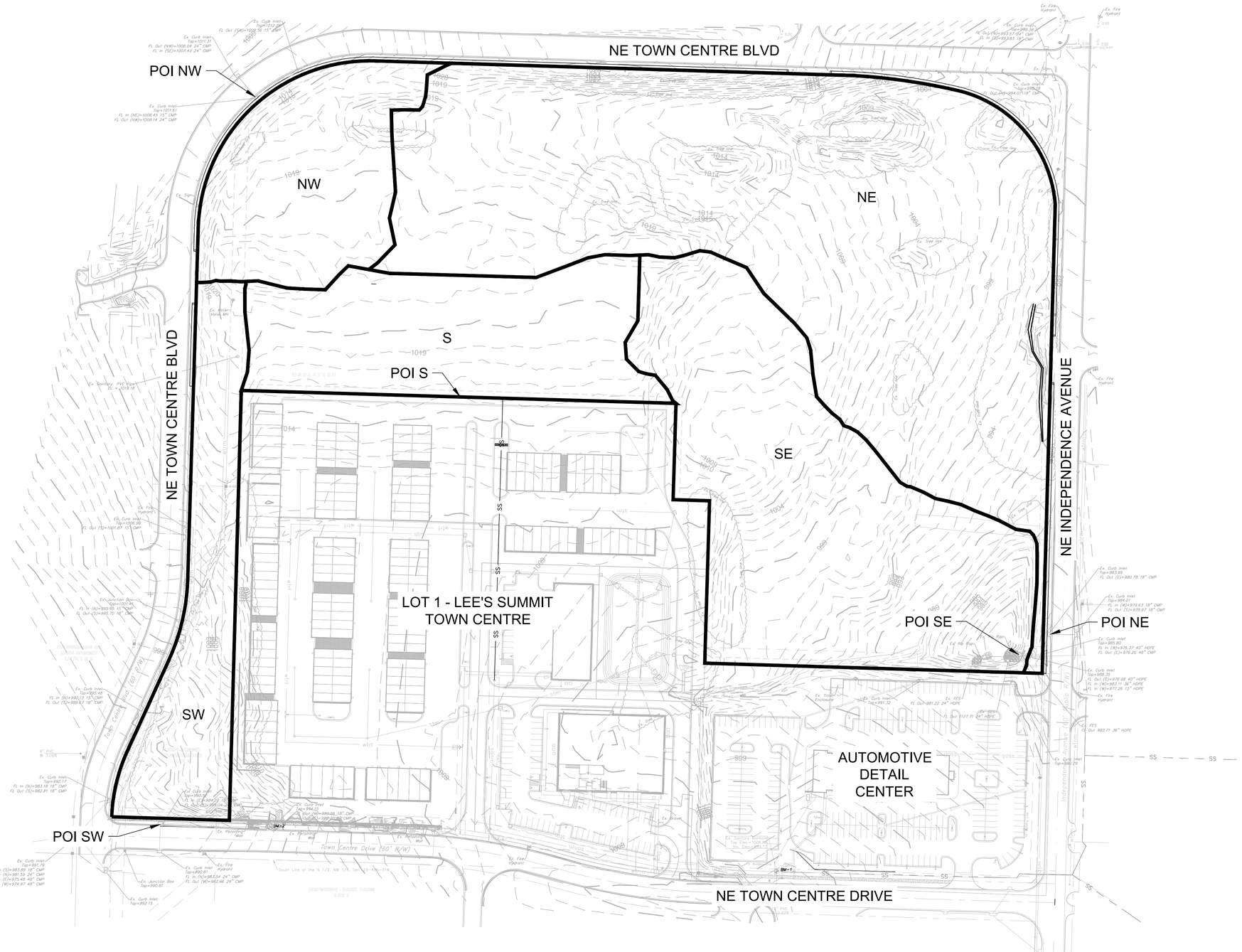
Existing Drainage Map

North

0 40' 80' 160'

EXISTING DRAINAGE MAP

SCALE: 1" = 80'



ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

TOWN CENTRE VACANT GROUND
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Project: TOWN CENTER, LSMO

Issue Date: June 6, 2022

Existing Drainage Map
Preliminary Plans for:
Town Centre Future Lot 4
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

Exhibit F

Time of Concentration Calculations

APWA STORM DRAINAGE "TC" COMPUTATIONS FOR : FUTURE LOT 4 - TOWN CENTRE

						Surface types:	Asph/Conc	Bus/Com	Dirt	Grass/Park	Lake	MultFam	SnglFam	Undev	Other											
		yellow areas are self computing				SURFACE CODES	A	B	D	G	L	M	S	U	Z											
		overwrite if necessary				"C" Values	0.90	0.87	0.60	0.30	0.90	0.66	0.51	0.3				TC COMPUTATION								
							Overwrite Length - DnElev or Slope				SURFACE	P=Paved		Overwrite Slope or Elevations												K
			TOTAL WATERSHED				if necessary				CODE	U=Unpaved		if necessary			Cal	Used	Cal	Cal					1.25
							OVERLAND FLOW - 100' MAX				P	CHANNEL FLOW - FIRST REACH					Overland	Min 5	Channel	Channel	Total				
AREA	TOTAL	TOTAL	WTRSHD	UP	DN	SURFACE	"C"	OVRLND	UP	DN	SLOPE	or	CHANNEL	UP	DN	SLOPE	VELOCITY	Flow	Max 15	One	Two		Intensity	Intensity	CFS	CFS	AREA
ID	SQ.FT.	ACRES	LENGTH	ELEV	ELEV	CODE	VALUE	LENGTH	ELEV	ELEV	%	U	LENGTH	ELEV	ELEV	%	F/S	T(I)	T(I)	T(T)	T(T)	T© 10	10 I	100 I	10 Q	100 Q	ID
EX.																											EX.
SW	84947.62	1.95	911.00	1020.00	990.62	Z	0.33	100.0	1020.0	1014.70	5.3	P	811.0	1014.7	990.6	2.97	3.5	7.9	7.9	3.9	0.0	11.8	5.7	8.1	3.68	6.52	SW
NW	93612.90	2.15	405.00	1024.00	1011.61	Z	0.33	100.0	1024.0	1016.00	8.0	P	305.0	1016.0	1011.6	1.44	2.4	6.9	6.9	2.1	0.0	9.0	6.3	8.9	4.46	7.88	NW
S	120157.75	2.76	228.00	1022.00	1015.50	Z	0.33	100.0	1022.0	1019.50	2.5	U	128.0	1019.5	1015.5	3.13	2.9	10.2	10.2	0.7	0.0	11.0	5.9	8.3	5.35	9.47	S
NE	441208.60	10.13	1869.00	1022.00	984.00	Z	0.33	100.0	1022.0	1020.00	2.0	U	1769.0	1020.0	984.0	2.04	2.3	11.0	11.0	12.8	0.0	23.8	4.4	6.2	14.65	25.70	NE
SE	234024.98	5.37	985.00	1022.00	983.71	Z	0.33	100.0	1022.0	1015.00	7.0	U	885.0	1015.0	983.7	3.54	3.0	7.2	7.2	4.9	0.0	12.1	5.7	8.0	10.04	17.78	SE
PROP.																											PROP.
SW	85383.13	1.96	911.00	1020.00	990.62	Z	0.33	100.0	1020.0	1014.70	5.3	P	811.0	1014.7	990.6	2.97	3.5	7.9	7.9	3.9	0.0	11.8	5.7	8.1	3.70	6.55	SW
NW	19835.93	0.46	389.00	1021.00	1011.61	Z	0.33	84.0	1021.0	1016.00	6.0	P	305.0	1016.0	1011.6	1.44	2.4	7.0	7.0	2.1	0.0	9.1	6.3	8.9	0.94	1.66	NW
S	23958.20	0.55	144.00	1021.00	1016.50	Z	0.33	100.0	1021.0	1018.00	3.0	U	44.0	1018.0	1016.5	3.41	3.0	9.6	9.6	0.2	0.0	9.9	6.1	8.6	1.11	1.96	S
NE	43470.17	1.00	698.00	1006.00	984.00	Z	0.82	100.0	1006.0	1001.50	4.5	P	598.0	1001.5	984.0	2.93	3.5	3.1	5.0	2.9	0.0	7.9	6.6	9.3	5.37	9.46	NE
SE	801304.65	18.40	1623.00	1020.00	982.00	Z	0.82	27.0	1020.0	1019.00	3.7	P	1596.0	1019.0	982.0	2.32	3.1	1.7	5.0	8.6	0.0	13.6	5.4	7.7	81.49	144.55	SE

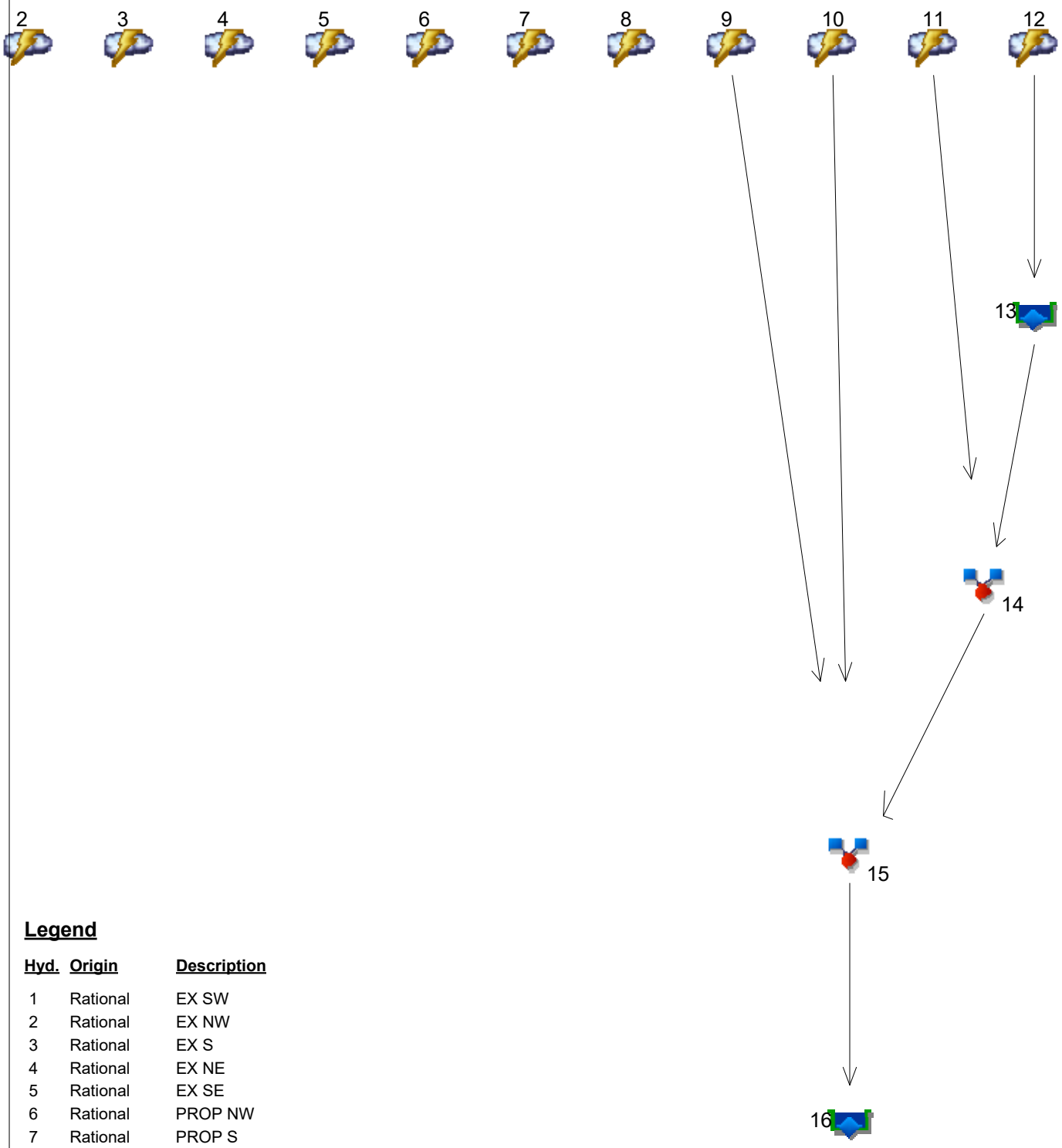
Exhibit G

Complete Hydraflow Report
Emergency Spillway Analysis

Hydraflow Table of Contents

Watershed Model Schematic

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021



Legend

Hyd.	Origin	Description
1	Rational	EX SW
2	Rational	EX NW
3	Rational	EX S
4	Rational	EX NE
5	Rational	EX SE
6	Rational	PROP NW
7	Rational	PROP S
8	Rational	PROP NE
9	Rational	PROP SE
10	Rational	ADC
11	Rational	LOT 1 FREE RELEASE
12	Rational	LOT 1 DETAINED
13	Reservoir	LOT 1 ROUTED
14	Combine	LOT 1 TO SE DETENTION
15	Combine	LOT 4 + ADC + LOT 1
16	Reservoir	SE POND ROUTED

Hydrograph Return Period Recap

Hyd. No.	Hydrograph type (origin)	Inflow hyd(s)	Peak Outflow (cfs)							Hydrograph Description
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
1	Rational	------	-------	2.657	-------	-------	3.696	-------	-------	6.607	EX SW
2	Rational	------	-------	3.256	-------	-------	4.488	-------	-------	7.971	EX NW
3	Rational	------	-------	3.890	-------	-------	5.395	-------	-------	9.626	EX S
4	Rational	------	-------	9.921	-------	-------	14.18	-------	-------	25.81	EX NE
5	Rational	------	-------	7.316	-------	-------	10.18	-------	-------	18.19	EX SE
6	Rational	------	-------	0.697	-------	-------	0.960	-------	-------	1.705	PROP NW
7	Rational	------	-------	0.803	-------	-------	1.110	-------	-------	1.977	PROP S
8	Rational	------	-------	3.910	-------	-------	5.371	-------	-------	9.515	PROP NE
9	Rational	------	-------	58.42	-------	-------	81.71	-------	-------	146.63	PROP SE
10	Rational	------	-------	17.82	-------	-------	24.21	-------	-------	42.51	ADC
11	Rational	------	-------	2.485	-------	-------	3.484	-------	-------	6.263	LOT 1 FREE RELEASE
12	Rational	------	-------	28.02	-------	-------	39.30	-------	-------	70.64	LOT 1 DETAINED
13	Reservoir	12	-------	0.217	-------	-------	0.254	-------	-------	15.03	LOT 1 ROUTED
14	Combine	11, 13	-------	2.638	-------	-------	3.666	-------	-------	16.55	LOT 1 TO SE DETENTION
15	Combine	9, 10, 14	-------	60.88	-------	-------	85.13	-------	-------	152.70	LOT 4 + ADC + LOT 1
16	Reservoir	15	-------	0.160	-------	-------	0.188	-------	-------	0.285	SE POND ROUTED

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

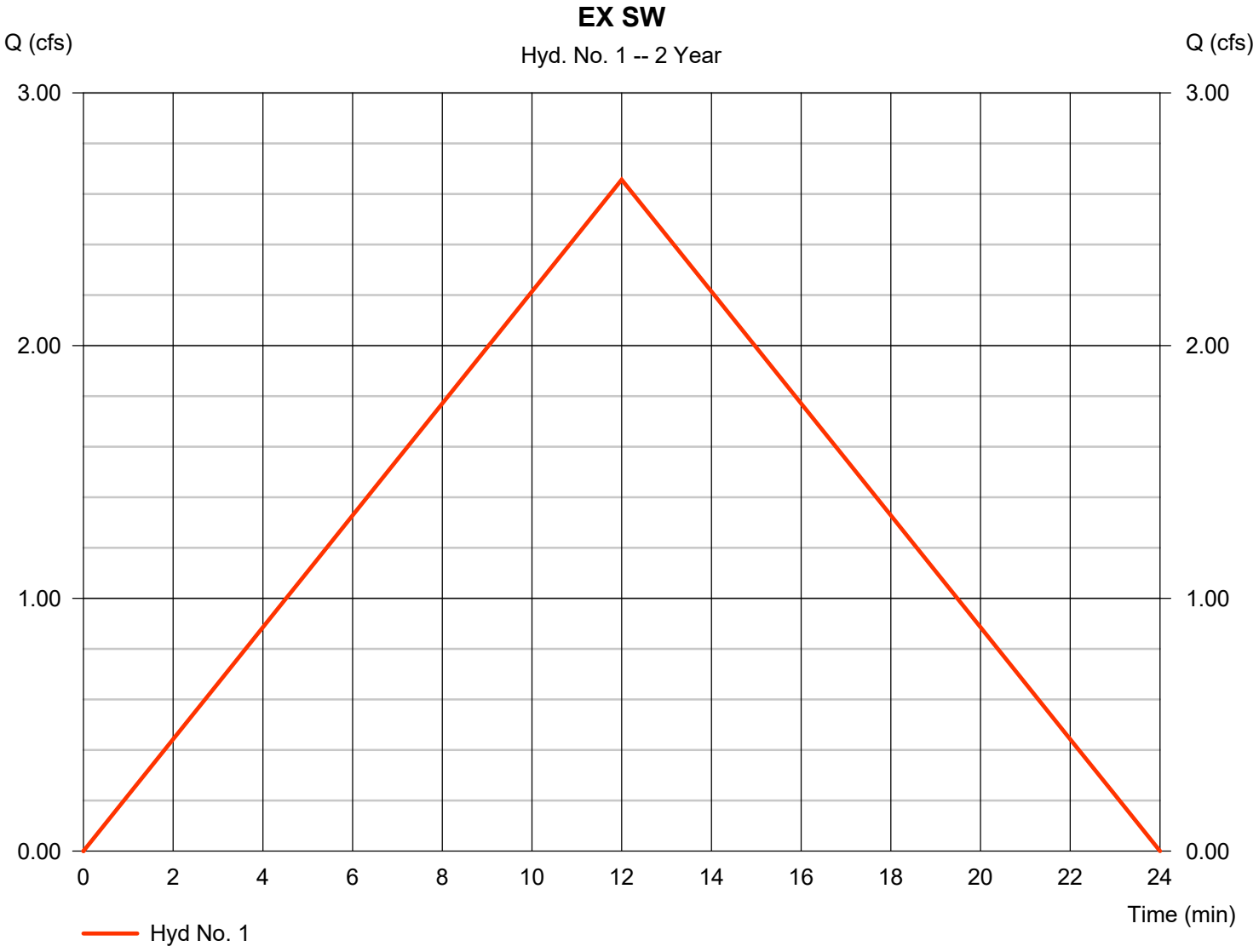
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	2.657	1	12	1,913	------	------	------	EX SW
2	Rational	3.256	1	9	1,758	------	------	------	EX NW
3	Rational	3.890	1	11	2,567	------	------	------	EX S
4	Rational	9.921	1	24	14,286	------	------	------	EX NE
5	Rational	7.316	1	12	5,268	------	------	------	EX SE
6	Rational	0.697	1	9	376	------	------	------	PROP NW
7	Rational	0.803	1	10	482	------	------	------	PROP S
8	Rational	3.910	1	8	1,877	------	------	------	PROP NE
9	Rational	58.42	1	14	49,074	------	------	------	PROP SE
10	Rational	17.82	1	5	5,345	------	------	------	ADC
11	Rational	2.485	1	15	2,236	------	------	------	LOT 1 FREE RELEASE
12	Rational	28.02	1	15	25,222	------	------	------	LOT 1 DETAINED
13	Reservoir	0.217	1	30	23,007	12	1001.90	24,986	LOT 1 ROUTED
14	Combine	2.638	1	15	25,243	11, 13	------	------	LOT 1 TO SE DETENTION
15	Combine	60.88	1	14	79,662	9, 10, 14	------	------	LOT 4 + ADC + LOT 1
16	Reservoir	0.160	1	1033	27,357	15	979.52	58,404	SE POND ROUTED

Hydrograph Report

Hyd. No. 1

EX SW

Hydrograph type	=	Rational	Peak discharge	=	2.657 cfs
Storm frequency	=	2 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	1,913 cuft
Drainage area	=	1.950 ac	Runoff coeff.	=	0.33
Intensity	=	4.129 in/hr	Tc by User	=	12.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

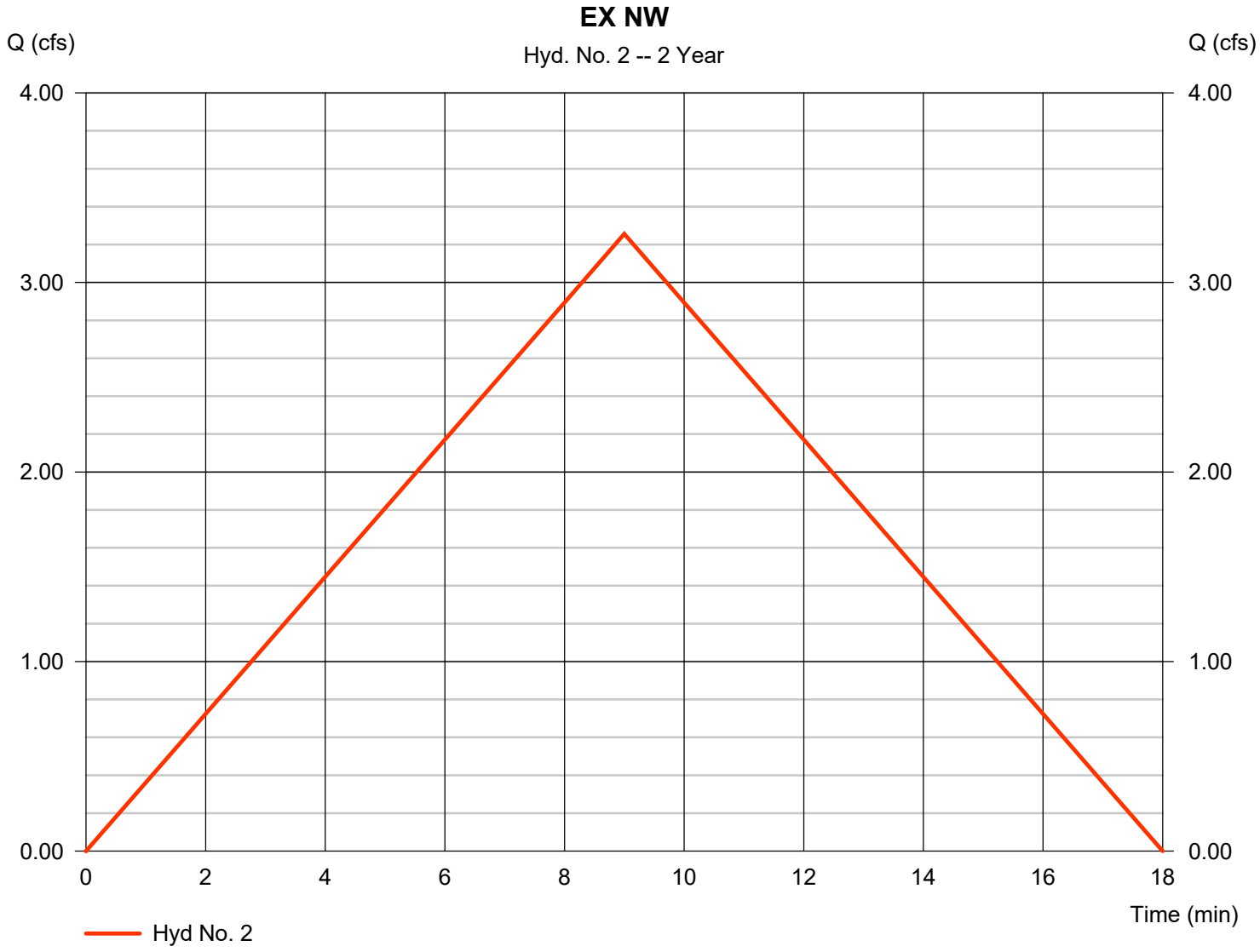


Hydrograph Report

Hyd. No. 2

EX NW

Hydrograph type	=	Rational	Peak discharge	=	3.256 cfs
Storm frequency	=	2 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	1,758 cuft
Drainage area	=	2.150 ac	Runoff coeff.	=	0.33
Intensity	=	4.589 in/hr	Tc by User	=	9.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

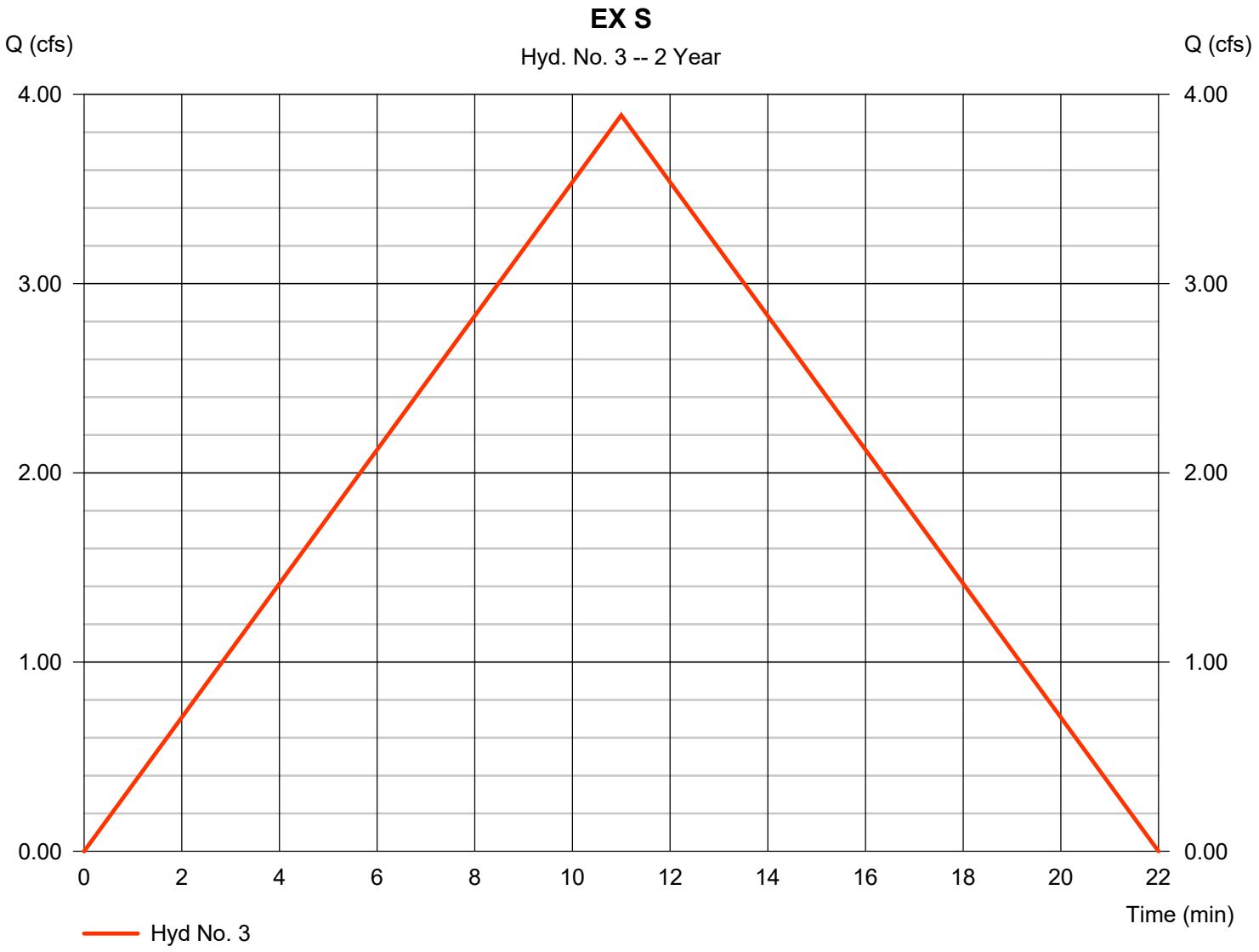


Hydrograph Report

Hyd. No. 3

EX S

Hydrograph type	=	Rational	Peak discharge	=	3.890 cfs
Storm frequency	=	2 yrs	Time to peak	=	11 min
Time interval	=	1 min	Hyd. volume	=	2,567 cuft
Drainage area	=	2.760 ac	Runoff coeff.	=	0.33
Intensity	=	4.271 in/hr	Tc by User	=	11.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 4

EX NE

Hydrograph type	=	Rational	Peak discharge	=	9.921 cfs
Storm frequency	=	2 yrs	Time to peak	=	24 min
Time interval	=	1 min	Hyd. volume	=	14,286 cuft
Drainage area	=	10.130 ac	Runoff coeff.	=	0.33
Intensity	=	2.968 in/hr	Tc by User	=	24.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 5

EX SE

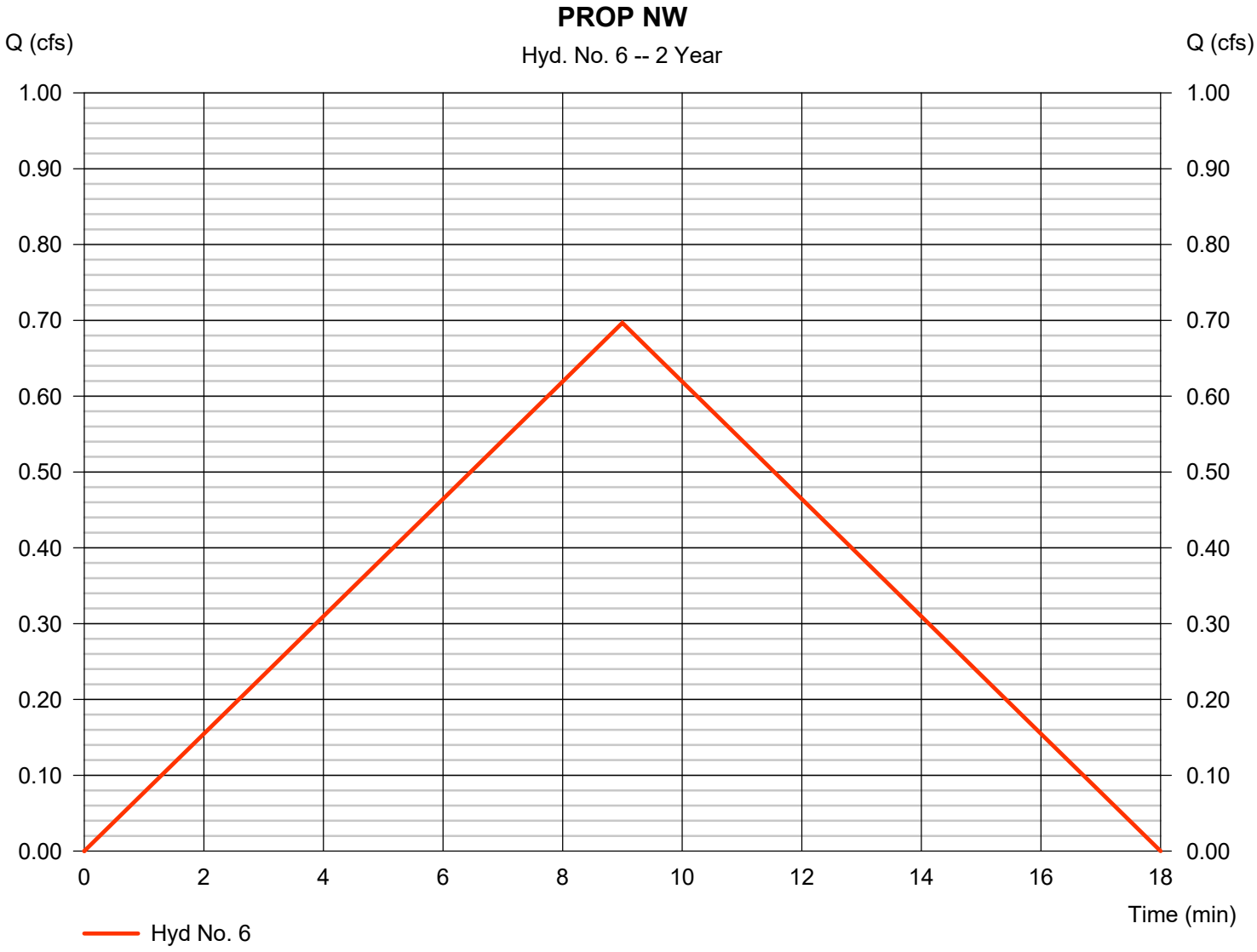
Hydrograph type	=	Rational	Peak discharge	=	7.316 cfs
Storm frequency	=	2 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	5,268 cuft
Drainage area	=	5.370 ac	Runoff coeff.	=	0.33
Intensity	=	4.129 in/hr	Tc by User	=	12.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 6

PROP NW

Hydrograph type	=	Rational	Peak discharge	=	0.697 cfs
Storm frequency	=	2 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	376 cuft
Drainage area	=	0.460 ac	Runoff coeff.	=	0.33
Intensity	=	4.589 in/hr	Tc by User	=	9.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

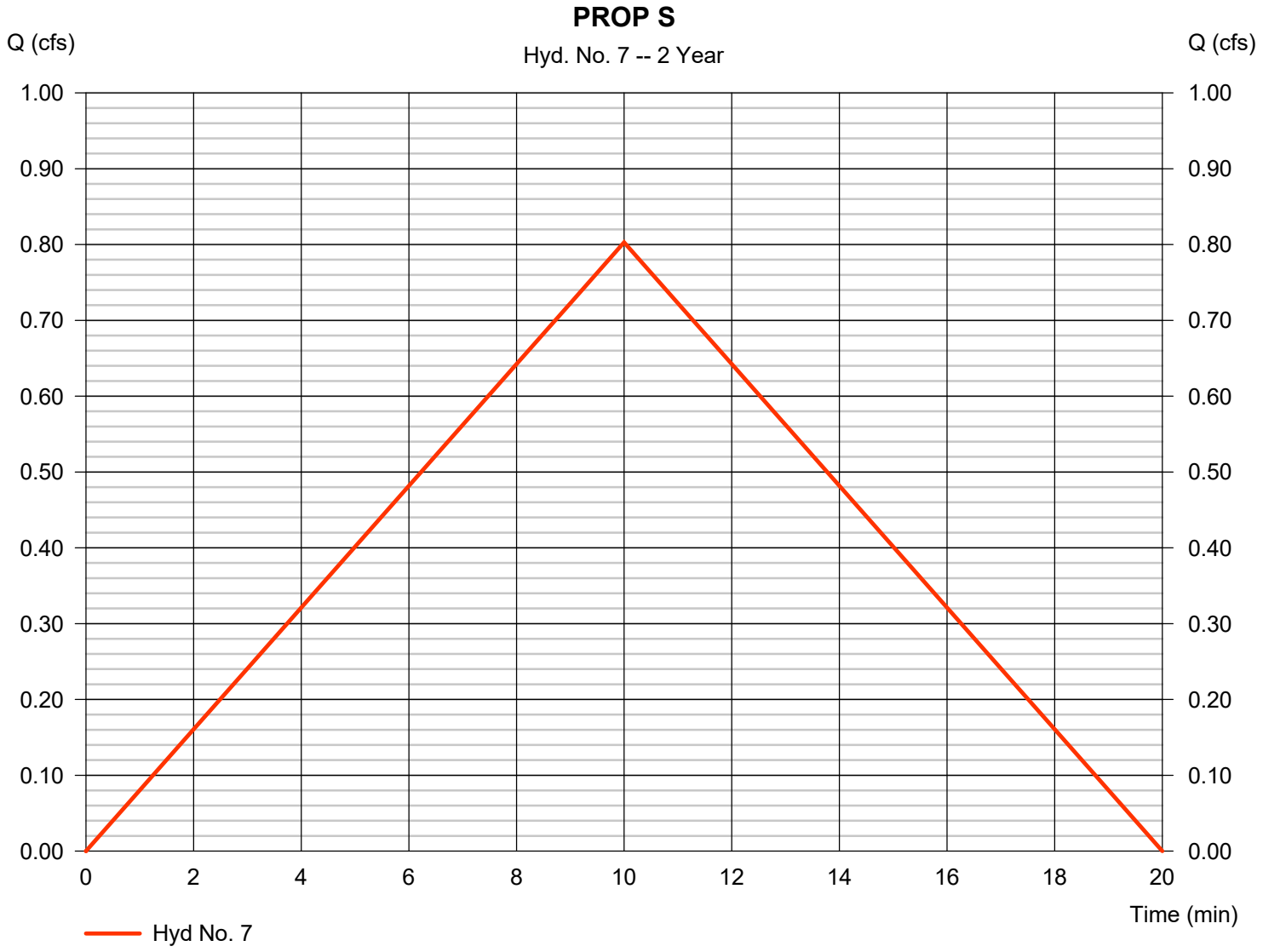


Hydrograph Report

Hyd. No. 7

PROP S

Hydrograph type	=	Rational	Peak discharge	=	0.803 cfs
Storm frequency	=	2 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	482 cuft
Drainage area	=	0.550 ac	Runoff coeff.	=	0.33
Intensity	=	4.424 in/hr	Tc by User	=	10.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

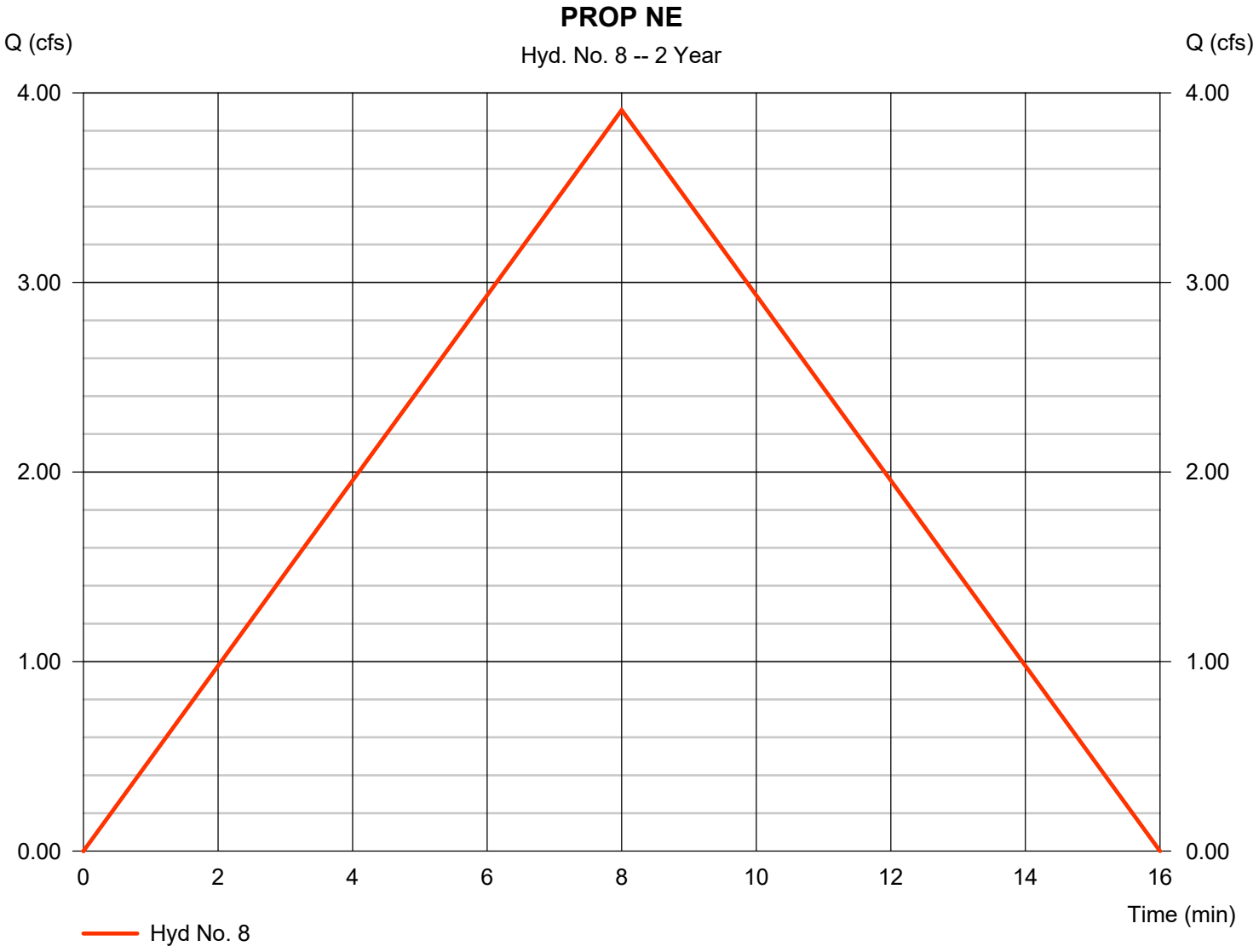


Hydrograph Report

Hyd. No. 8

PROP NE

Hydrograph type	=	Rational	Peak discharge	=	3.910 cfs
Storm frequency	=	2 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	1,877 cuft
Drainage area	=	1.000 ac	Runoff coeff.	=	0.82
Intensity	=	4.768 in/hr	Tc by User	=	8.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

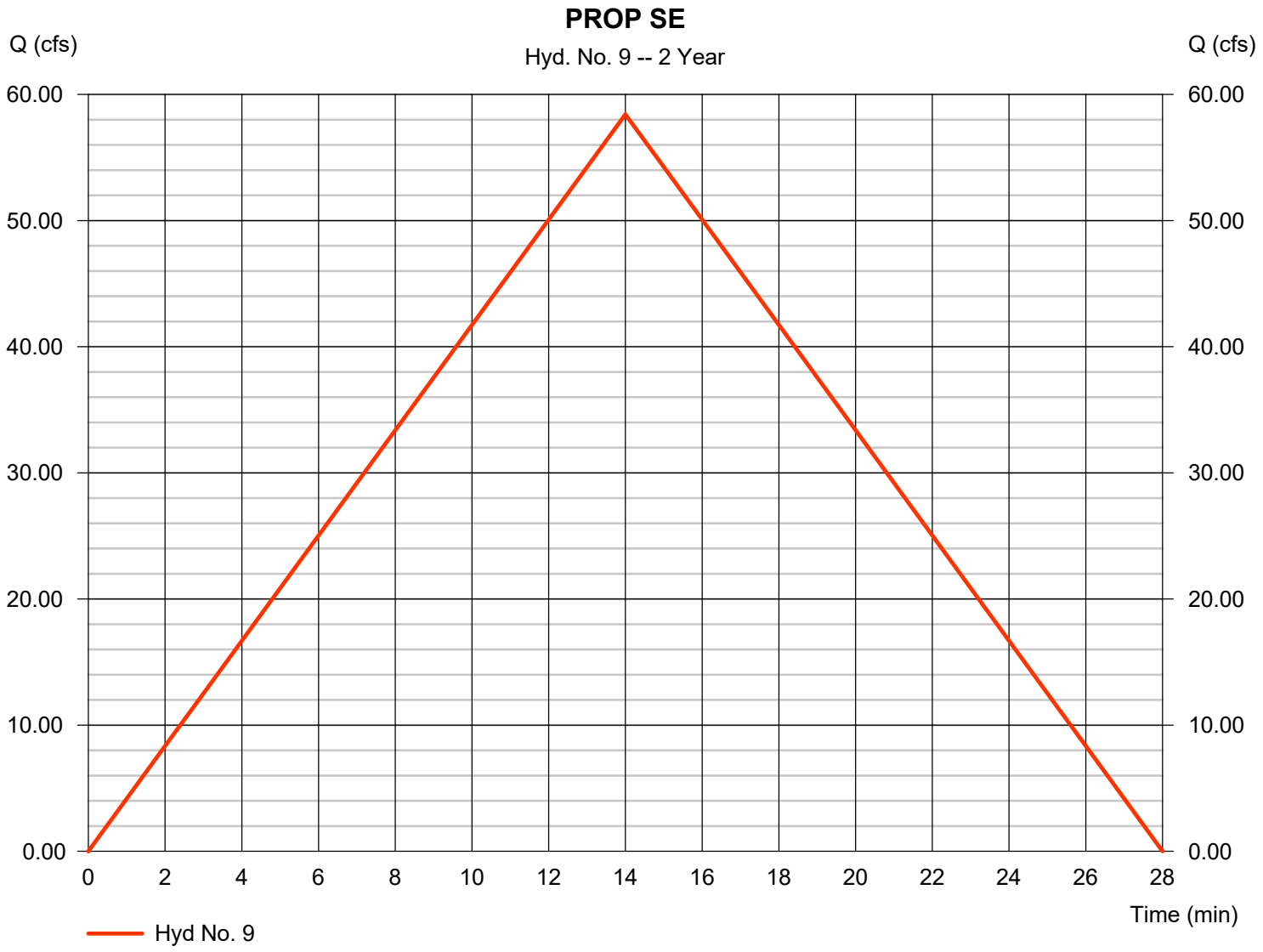


Hydrograph Report

Hyd. No. 9

PROP SE

Hydrograph type	=	Rational	Peak discharge	=	58.42 cfs
Storm frequency	=	2 yrs	Time to peak	=	14 min
Time interval	=	1 min	Hyd. volume	=	49,074 cuft
Drainage area	=	18.400 ac	Runoff coeff.	=	0.82
Intensity	=	3.872 in/hr	Tc by User	=	14.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

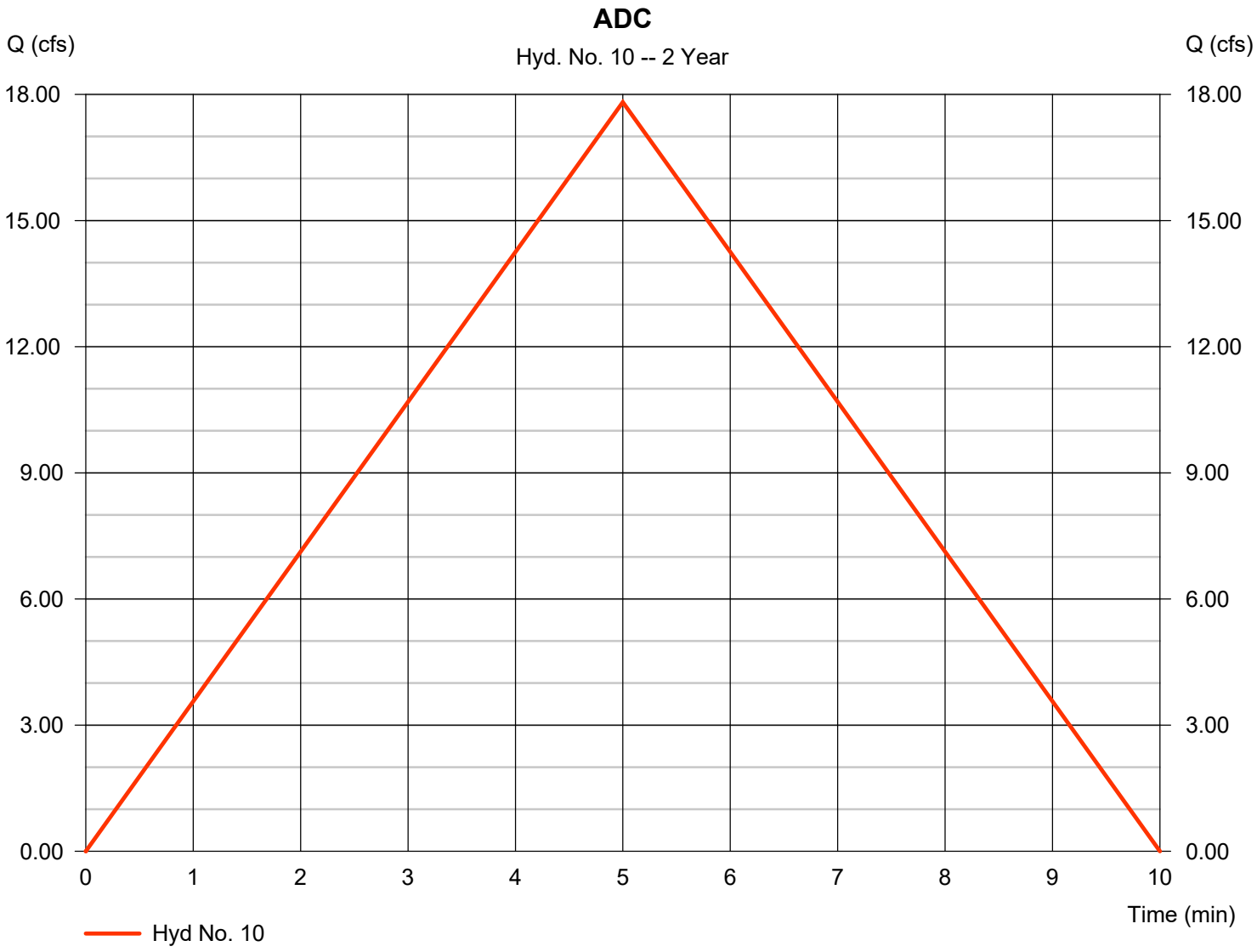


Hydrograph Report

Hyd. No. 10

ADC

Hydrograph type	=	Rational	Peak discharge	=	17.82 cfs
Storm frequency	=	2 yrs	Time to peak	=	5 min
Time interval	=	1 min	Hyd. volume	=	5,345 cuft
Drainage area	=	4.020 ac	Runoff coeff.	=	0.82
Intensity	=	5.405 in/hr	Tc by User	=	5.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 11

LOT 1 FREE RELEASE

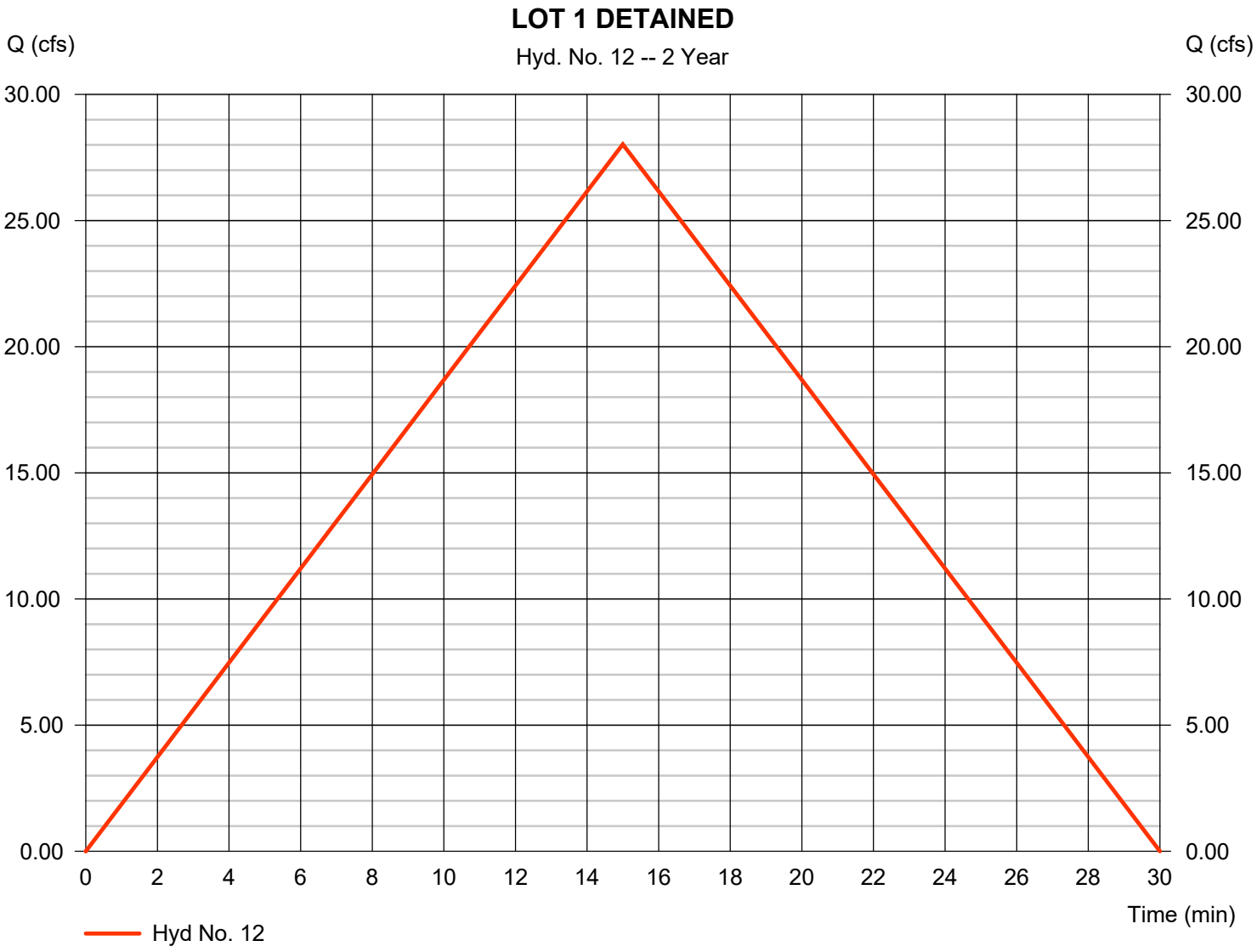
Hydrograph type	=	Rational	Peak discharge	=	2.485 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	2,236 cuft
Drainage area	=	1.890 ac	Runoff coeff.	=	0.35
Intensity	=	3.756 in/hr	Tc by User	=	15.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 12

LOT 1 DETAINED

Hydrograph type	=	Rational	Peak discharge	=	28.02 cfs
Storm frequency	=	2 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	25,222 cuft
Drainage area	=	13.090 ac	Runoff coeff.	=	0.57
Intensity	=	3.756 in/hr	Tc by User	=	15.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1



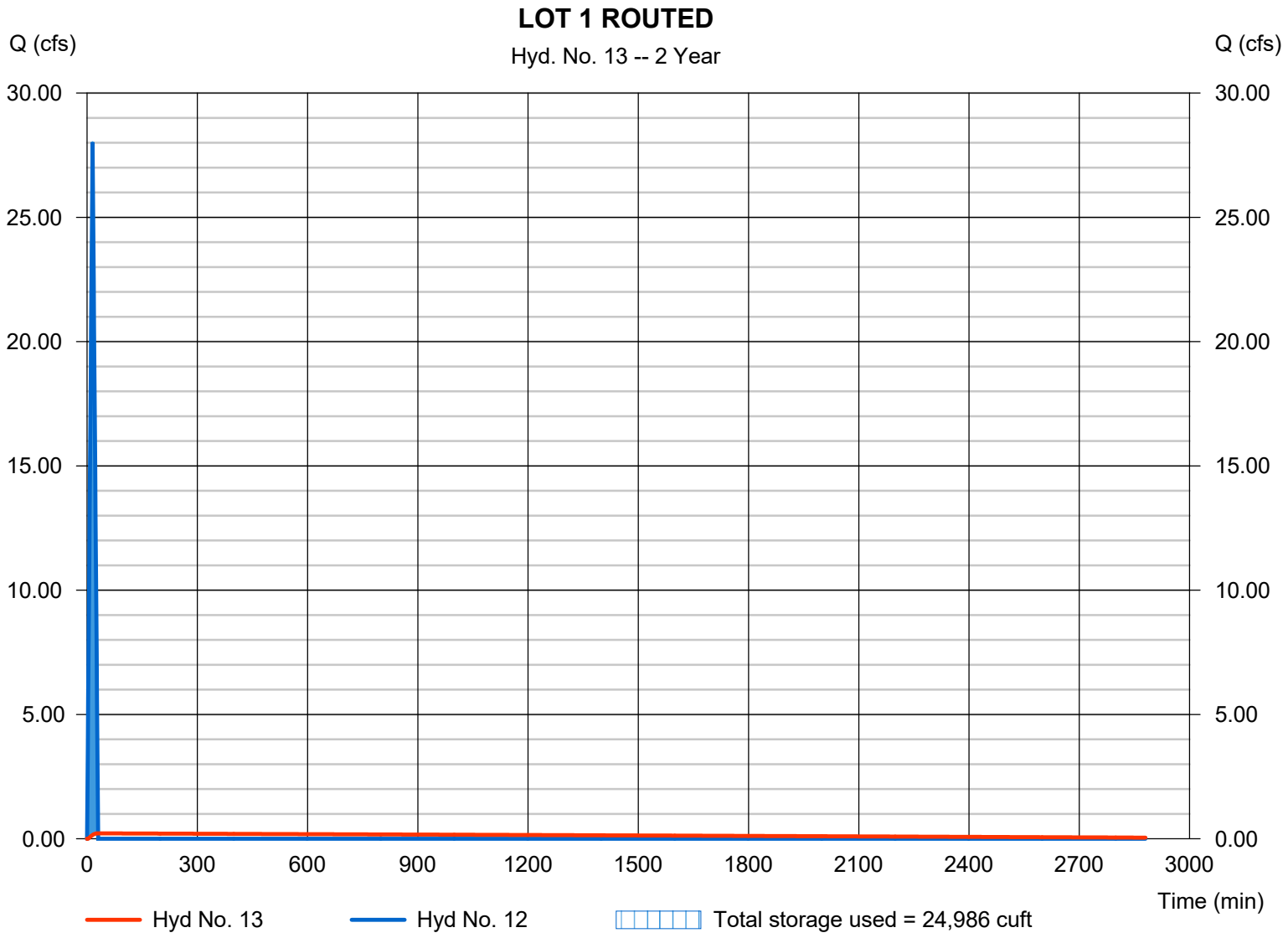
Hydrograph Report

Hyd. No. 13

LOT 1 ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	0.217 cfs
Storm frequency	=	2 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	23,007 cuft
Inflow hyd. No.	=	12 - LOT 1 DETAINED	Max. Elevation	=	1001.90 ft
Reservoir name	=	LOT 1 POND	Max. Storage	=	24,986 cuft

Storage Indication method used.



Pond Report

Pond No. 3 - LOT 1 POND

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 1000.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	1000.00	11,836	0	0
1.00	1001.00	13,183	12,502	12,502
2.00	1002.00	14,586	13,877	26,379
3.00	1003.00	16,045	15,308	41,688
4.00	1004.00	17,561	16,796	58,483

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 30.00	2.50	0.00	0.00
Span (in)	= 30.00	2.50	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 999.98	1000.00	0.00	0.00
Length (ft)	= 58.75	0.10	0.00	0.00
Slope (%)	= 0.40	0.01	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	Yes	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 6.00	0.00	0.00	0.00
Crest El. (ft)	= 1003.10	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Rect	---	---	---
Multi-Stage	= Yes	No	No	No

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

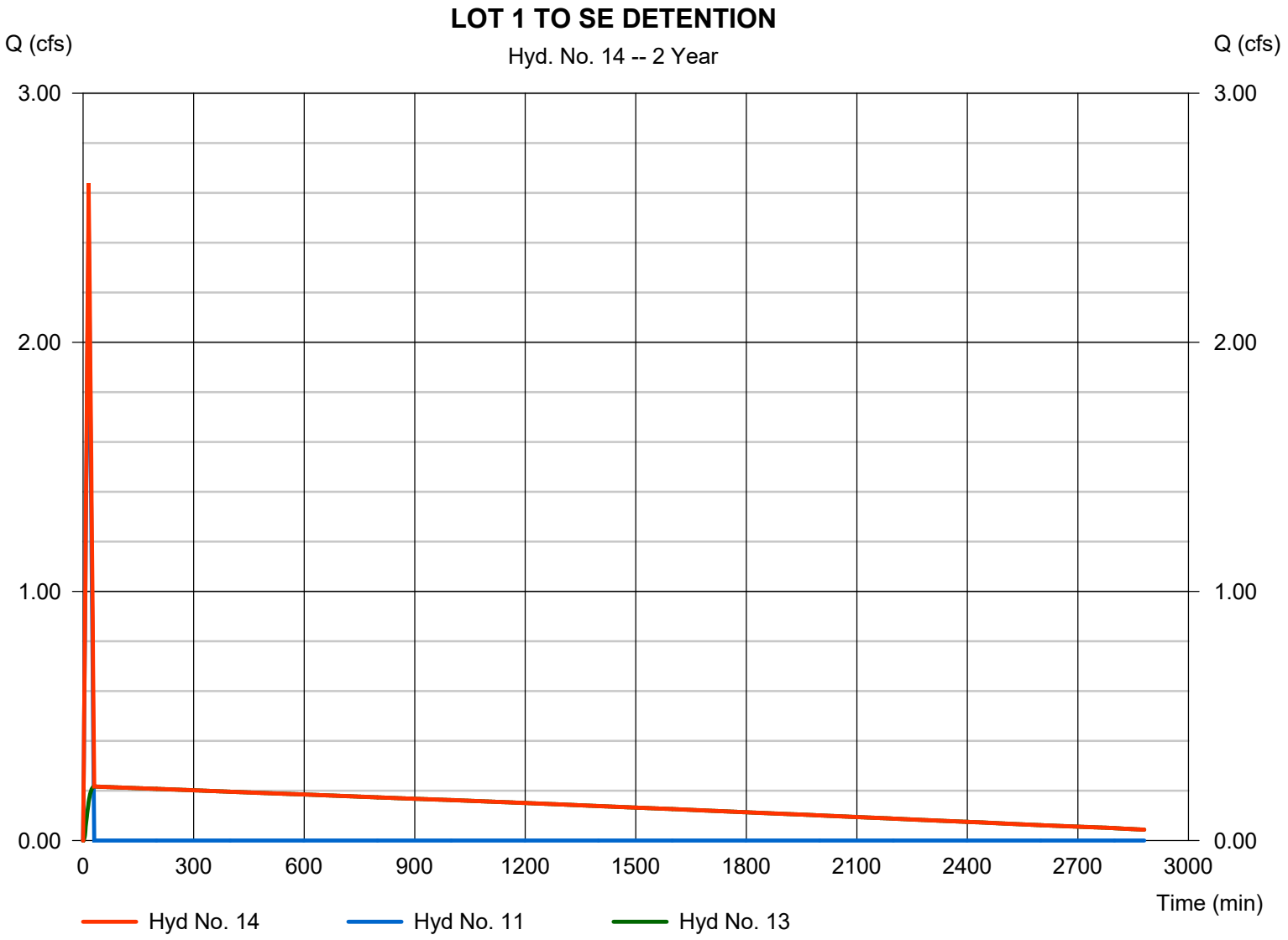
Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	1000.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	12,502	1001.00	0.16 ic	0.15 ic	---	---	0.00	---	---	---	---	---	0.153
2.00	26,379	1002.00	0.23 ic	0.22 ic	---	---	0.00	---	---	---	---	---	0.223
3.00	41,688	1003.00	0.29 ic	0.28 ic	---	---	0.00	---	---	---	---	---	0.276
4.00	58,483	1004.00	17.25 oc	0.19 ic	---	---	17.06	---	---	---	---	---	17.25

Hydrograph Report

Hyd. No. 14

LOT 1 TO SE DETENTION

Hydrograph type	= Combine	Peak discharge	= 2.638 cfs
Storm frequency	= 2 yrs	Time to peak	= 15 min
Time interval	= 1 min	Hyd. volume	= 25,243 cuft
Inflow hyds.	= 11, 13	Contrib. drain. area	= 1.890 ac

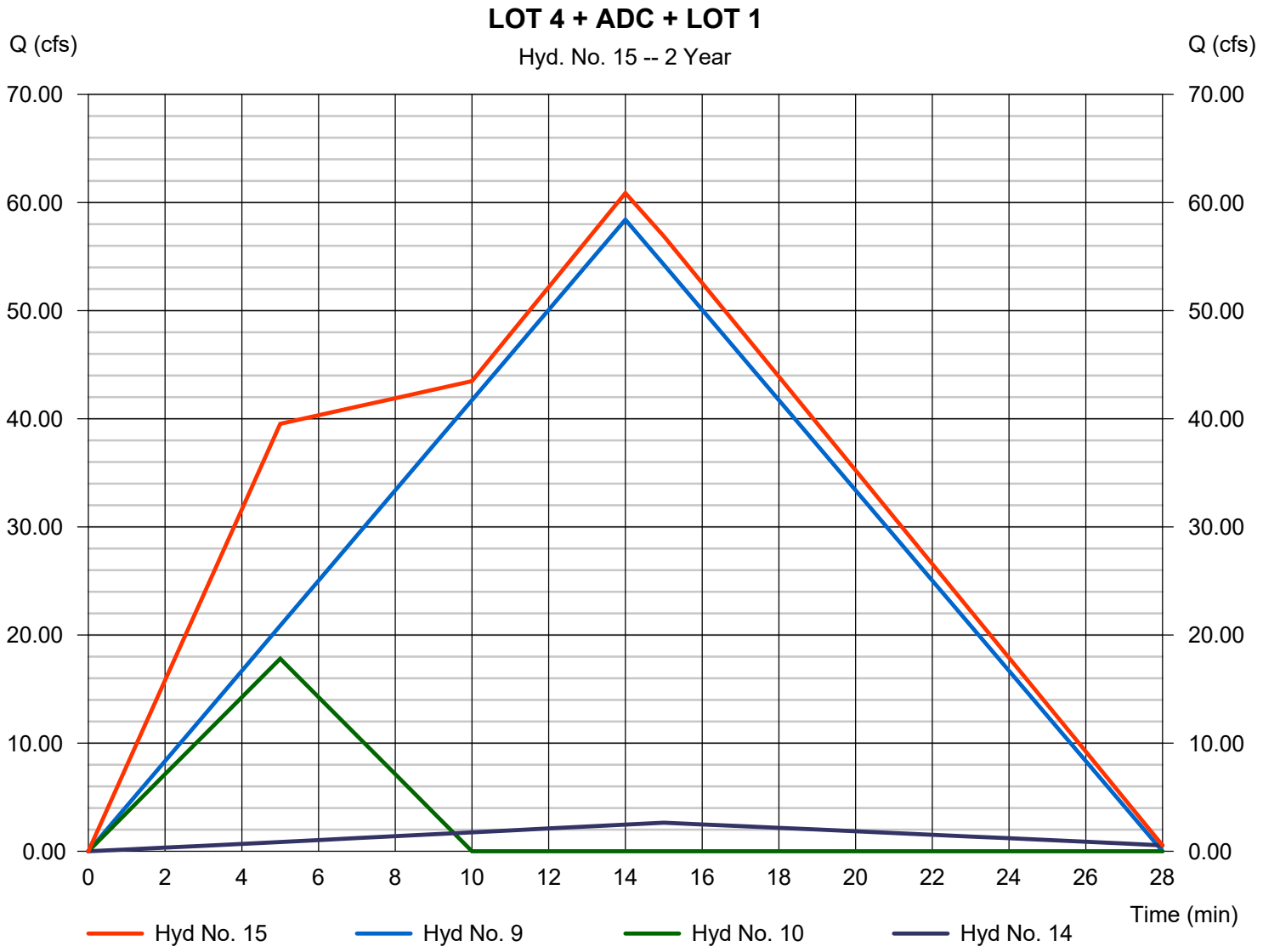


Hydrograph Report

Hyd. No. 15

LOT 4 + ADC + LOT 1

Hydrograph type	= Combine	Peak discharge	= 60.88 cfs
Storm frequency	= 2 yrs	Time to peak	= 14 min
Time interval	= 1 min	Hyd. volume	= 79,662 cuft
Inflow hyds.	= 9, 10, 14	Contrib. drain. area	= 22.420 ac



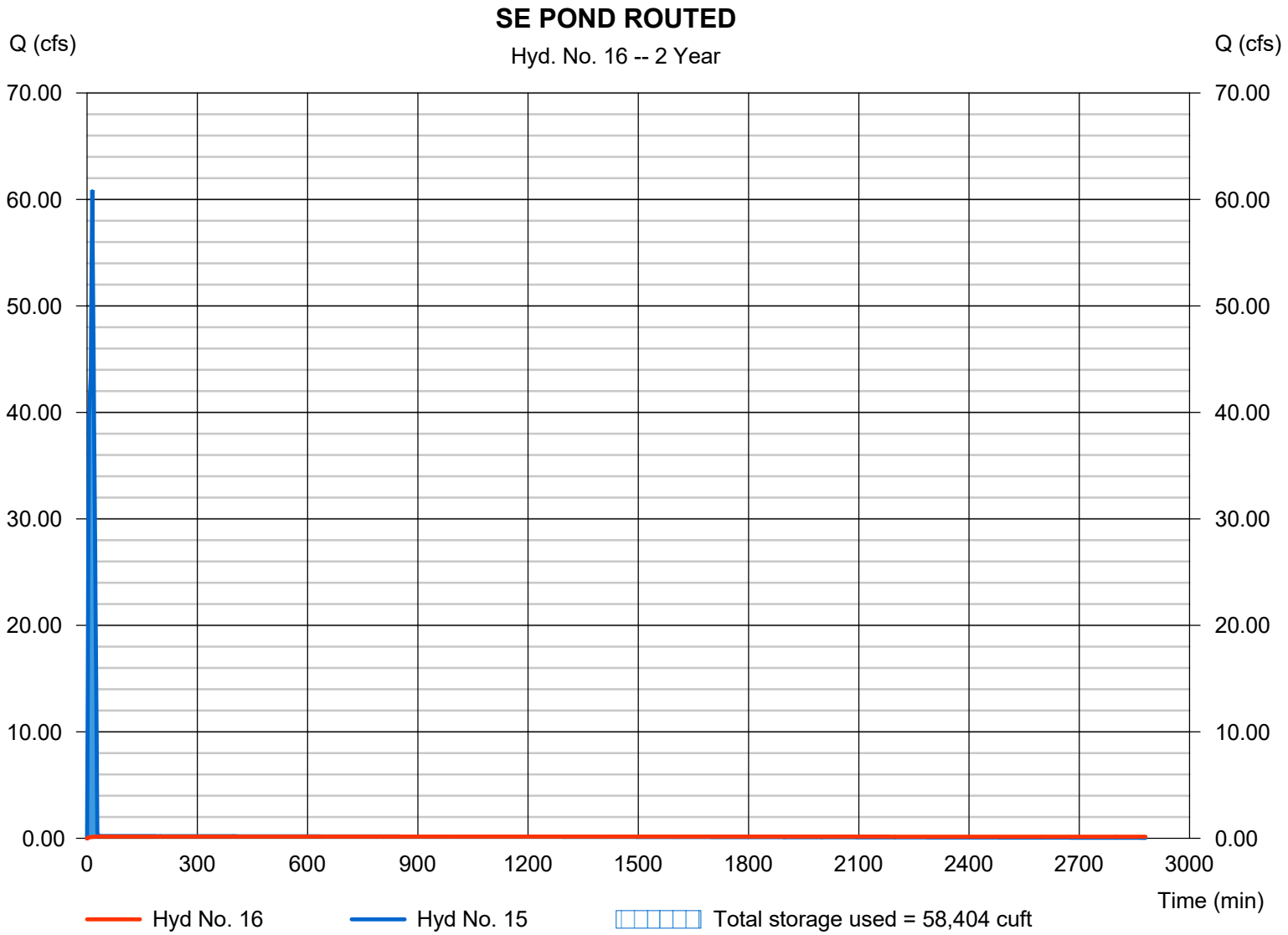
Hydrograph Report

Hyd. No. 16

SE POND ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	0.160 cfs
Storm frequency	=	2 yrs	Time to peak	=	1033 min
Time interval	=	1 min	Hyd. volume	=	27,357 cuft
Inflow hyd. No.	=	15 - LOT 4 + ADC + LOT 1	Max. Elevation	=	979.52 ft
Reservoir name	=	SE POND	Max. Storage	=	58,404 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - SE POND

Pond Data

Contours -User-defined contour areas. Average end area method used for volume calculation. Begining Elevation = 977.50 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	977.50	00	0	0
0.50	978.00	2,104	526	526
1.50	979.00	8,661	5,383	5,909
2.50	980.00	195,050	101,856	107,764
3.50	981.00	34,620	114,835	222,599
4.50	982.00	49,338	41,979	264,578
5.50	983.00	62,913	56,126	320,704
6.50	984.00	75,079	68,996	389,700
7.50	985.00	83,515	79,297	468,997
8.50	986.00	87,022	85,269	554,265
9.50	987.00	90,587	88,805	643,070
10.50	988.00	94,208	92,398	735,467

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 42.00	24.00	0.00	1.00
Span (in)	= 42.00	24.00	0.00	1.00
No. Barrels	= 1	1	0	14
Invert El. (ft)	= 977.00	982.50	0.00	977.10
Length (ft)	= 15.00	0.00	0.00	4.37
Slope (%)	= 1.33	0.00	0.00	n/a
N-Value	= .010	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	Yes	No	Yes

Weir Structures

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

Exfil.(in/hr) = 0.000 (by Contour)

TW Elev. (ft) = 0.00

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

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
0.00	0	977.50	0.00	0.00	---	0.00	---	---	---	---	---	---	0.000
0.50	526	978.00	2.10 ic	0.00	---	0.02	---	---	---	---	---	---	0.020
1.50	5,909	979.00	2.10 ic	0.00	---	0.10	---	---	---	---	---	---	0.103
2.50	107,764	980.00	2.10 ic	0.00	---	0.22	---	---	---	---	---	---	0.222
3.50	222,599	981.00	2.10 ic	0.00	---	0.37	---	---	---	---	---	---	0.367
4.50	264,578	982.00	2.10 ic	0.00	---	0.54	---	---	---	---	---	---	0.535
5.50	320,704	983.00	2.25 ic	1.50 ic	---	0.72	---	---	---	---	---	---	2.219
6.50	389,700	984.00	11.34 oc	10.60 ic	---	0.73	---	---	---	---	---	---	11.33
7.50	468,997	985.00	19.51 oc	18.52 ic	---	0.77	---	---	---	---	---	---	19.29
8.50	554,265	986.00	24.83 oc	23.91 ic	---	0.84	---	---	---	---	---	---	24.76
9.50	643,070	987.00	29.22 oc	28.30 ic	---	0.92	---	---	---	---	---	---	29.22
10.50	735,467	988.00	33.22 oc	32.08 ic	---	1.13	---	---	---	---	---	---	33.22

Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

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	3.696	1	12	2,661	------	------	------	EX SW
2	Rational	4.488	1	9	2,424	------	------	------	EX NW
3	Rational	5.395	1	11	3,561	------	------	------	EX S
4	Rational	14.18	1	24	20,424	------	------	------	EX NE
5	Rational	10.18	1	12	7,328	------	------	------	EX SE
6	Rational	0.960	1	9	519	------	------	------	PROP NW
7	Rational	1.110	1	10	666	------	------	------	PROP S
8	Rational	5.371	1	8	2,578	------	------	------	PROP NE
9	Rational	81.71	1	14	68,636	------	------	------	PROP SE
10	Rational	24.21	1	5	7,263	------	------	------	ADC
11	Rational	3.484	1	15	3,135	------	------	------	LOT 1 FREE RELEASE
12	Rational	39.30	1	15	35,366	------	------	------	LOT 1 DETAINED
13	Reservoir	0.254	1	30	30,287	12	1002.57	35,084	LOT 1 ROUTED
14	Combine	3.666	1	15	33,422	11, 13	------	------	LOT 1 TO SE DETENTION
15	Combine	85.13	1	14	109,321	9, 10, 14	------	------	LOT 4 + ADC + LOT 1
16	Reservoir	0.188	1	1244	32,215	15	979.74	81,606	SE POND ROUTED

Hydrograph Report

Hyd. No. 1

EX SW

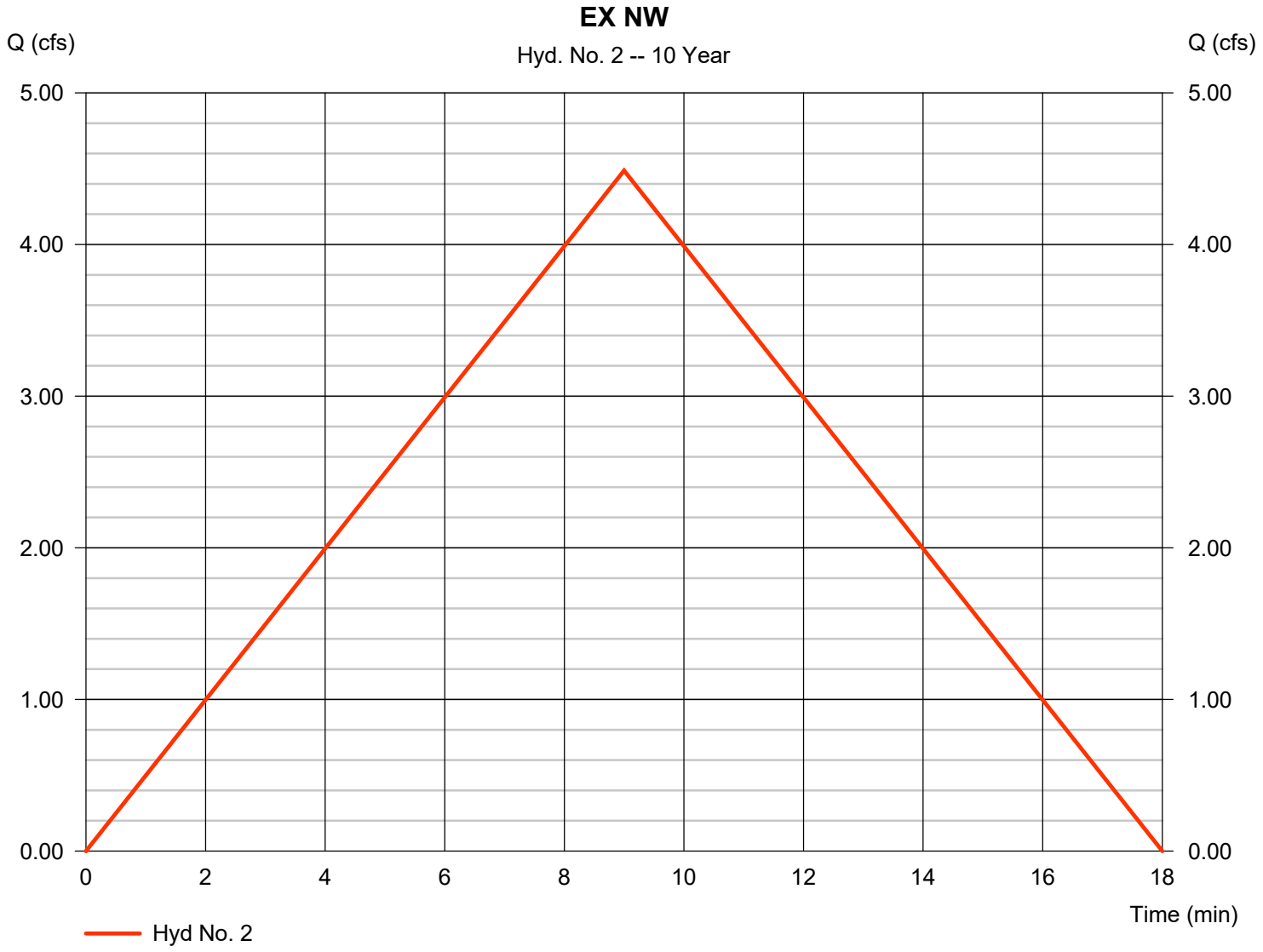
Hydrograph type	=	Rational	Peak discharge	=	3.696 cfs
Storm frequency	=	10 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	2,661 cuft
Drainage area	=	1.950 ac	Runoff coeff.	=	0.33
Intensity	=	5.743 in/hr	Tc by User	=	12.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 2

EX NW

Hydrograph type	=	Rational	Peak discharge	=	4.488 cfs
Storm frequency	=	10 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	2,424 cuft
Drainage area	=	2.150 ac	Runoff coeff.	=	0.33
Intensity	=	6.326 in/hr	Tc by User	=	9.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

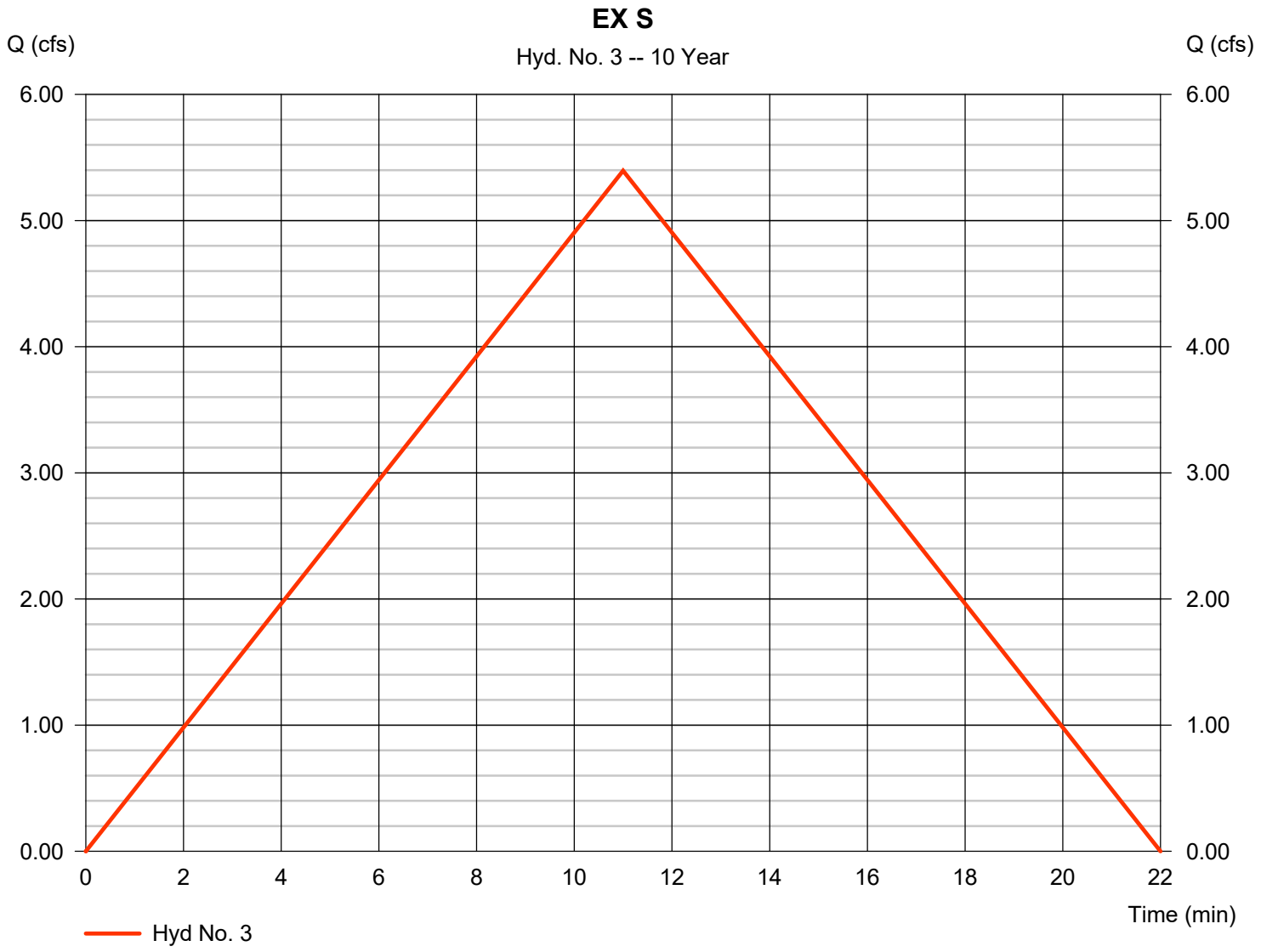


Hydrograph Report

Hyd. No. 3

EX S

Hydrograph type	=	Rational	Peak discharge	=	5.395 cfs
Storm frequency	=	10 yrs	Time to peak	=	11 min
Time interval	=	1 min	Hyd. volume	=	3,561 cuft
Drainage area	=	2.760 ac	Runoff coeff.	=	0.33
Intensity	=	5.924 in/hr	Tc by User	=	11.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1



Hydrograph Report

Hyd. No. 4

EX NE

Hydrograph type	=	Rational	Peak discharge	=	14.18 cfs
Storm frequency	=	10 yrs	Time to peak	=	24 min
Time interval	=	1 min	Hyd. volume	=	20,424 cuft
Drainage area	=	10.130 ac	Runoff coeff.	=	0.33
Intensity	=	4.243 in/hr	Tc by User	=	24.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 5

EX SE

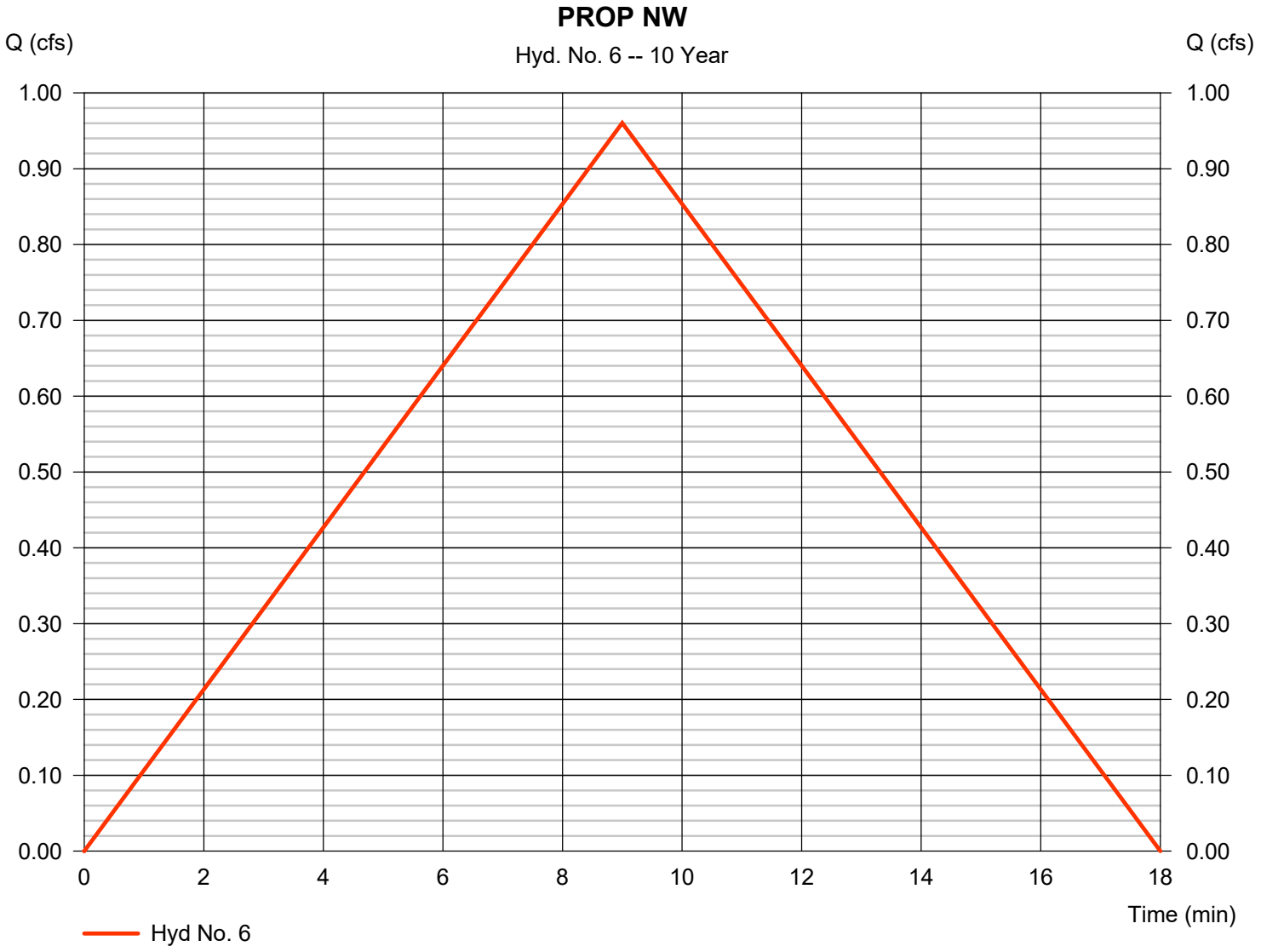
Hydrograph type	=	Rational	Peak discharge	=	10.18 cfs
Storm frequency	=	10 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	7,328 cuft
Drainage area	=	5.370 ac	Runoff coeff.	=	0.33
Intensity	=	5.743 in/hr	Tc by User	=	12.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

Hydrograph Report

Hyd. No. 6

PROP NW

Hydrograph type	=	Rational	Peak discharge	=	0.960 cfs
Storm frequency	=	10 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	519 cuft
Drainage area	=	0.460 ac	Runoff coeff.	=	0.33
Intensity	=	6.326 in/hr	Tc by User	=	9.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

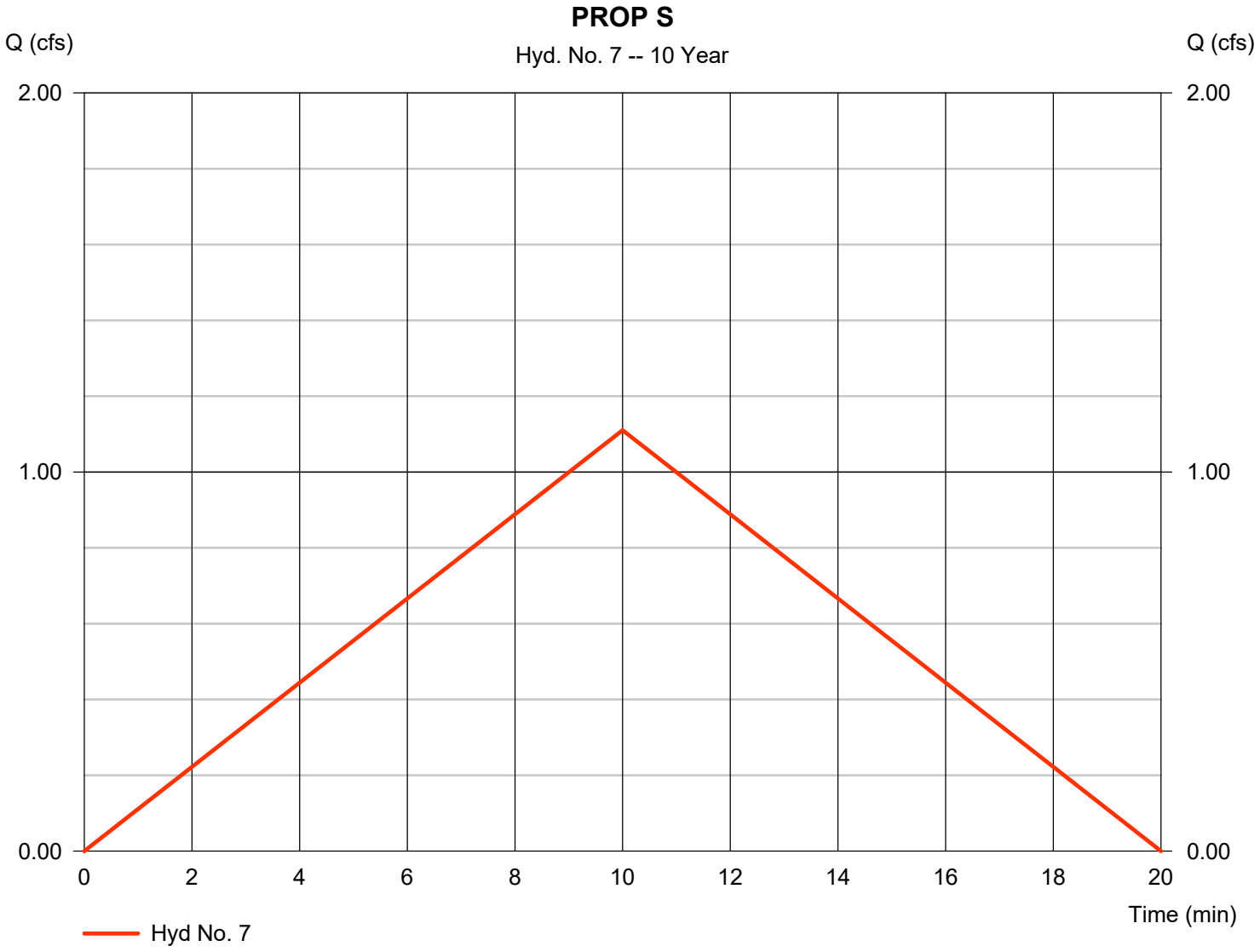


Hydrograph Report

Hyd. No. 7

PROP S

Hydrograph type	=	Rational	Peak discharge	=	1.110 cfs
Storm frequency	=	10 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	666 cuft
Drainage area	=	0.550 ac	Runoff coeff.	=	0.33
Intensity	=	6.118 in/hr	Tc by User	=	10.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

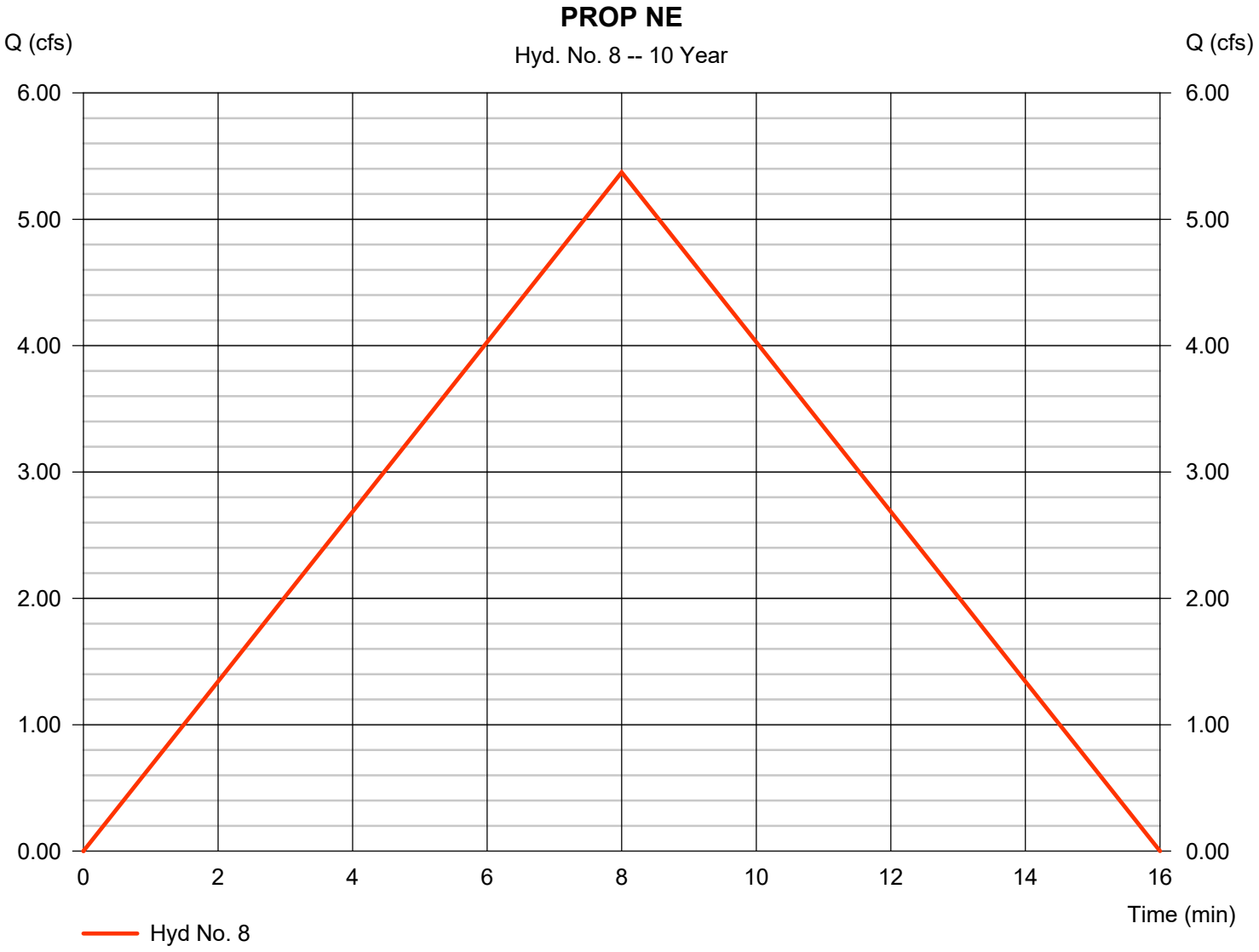


Hydrograph Report

Hyd. No. 8

PROP NE

Hydrograph type	=	Rational	Peak discharge	=	5.371 cfs
Storm frequency	=	10 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	2,578 cuft
Drainage area	=	1.000 ac	Runoff coeff.	=	0.82
Intensity	=	6.550 in/hr	Tc by User	=	8.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

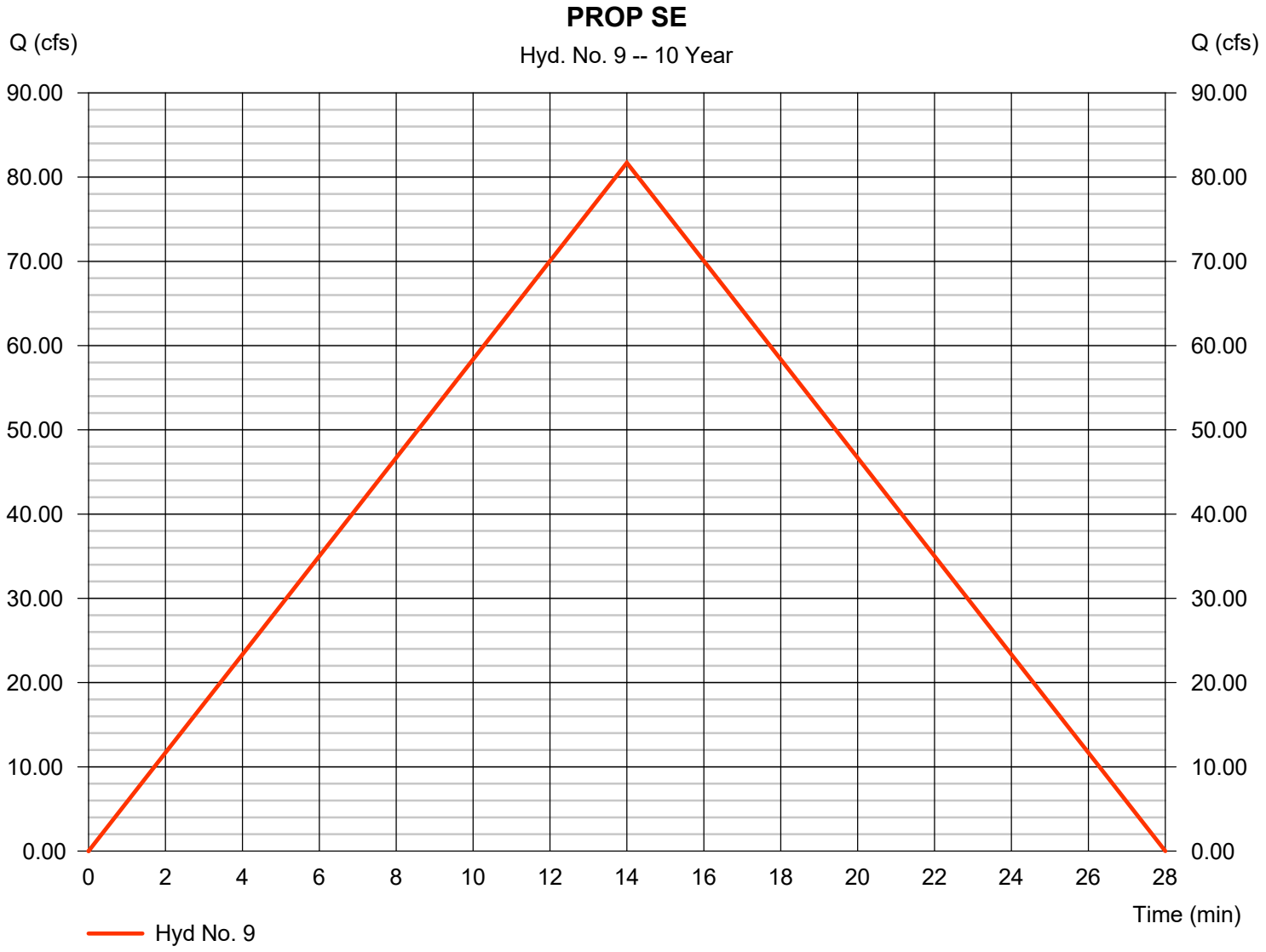


Hydrograph Report

Hyd. No. 9

PROP SE

Hydrograph type	=	Rational	Peak discharge	=	81.71 cfs
Storm frequency	=	10 yrs	Time to peak	=	14 min
Time interval	=	1 min	Hyd. volume	=	68,636 cuft
Drainage area	=	18.400 ac	Runoff coeff.	=	0.82
Intensity	=	5.416 in/hr	Tc by User	=	14.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

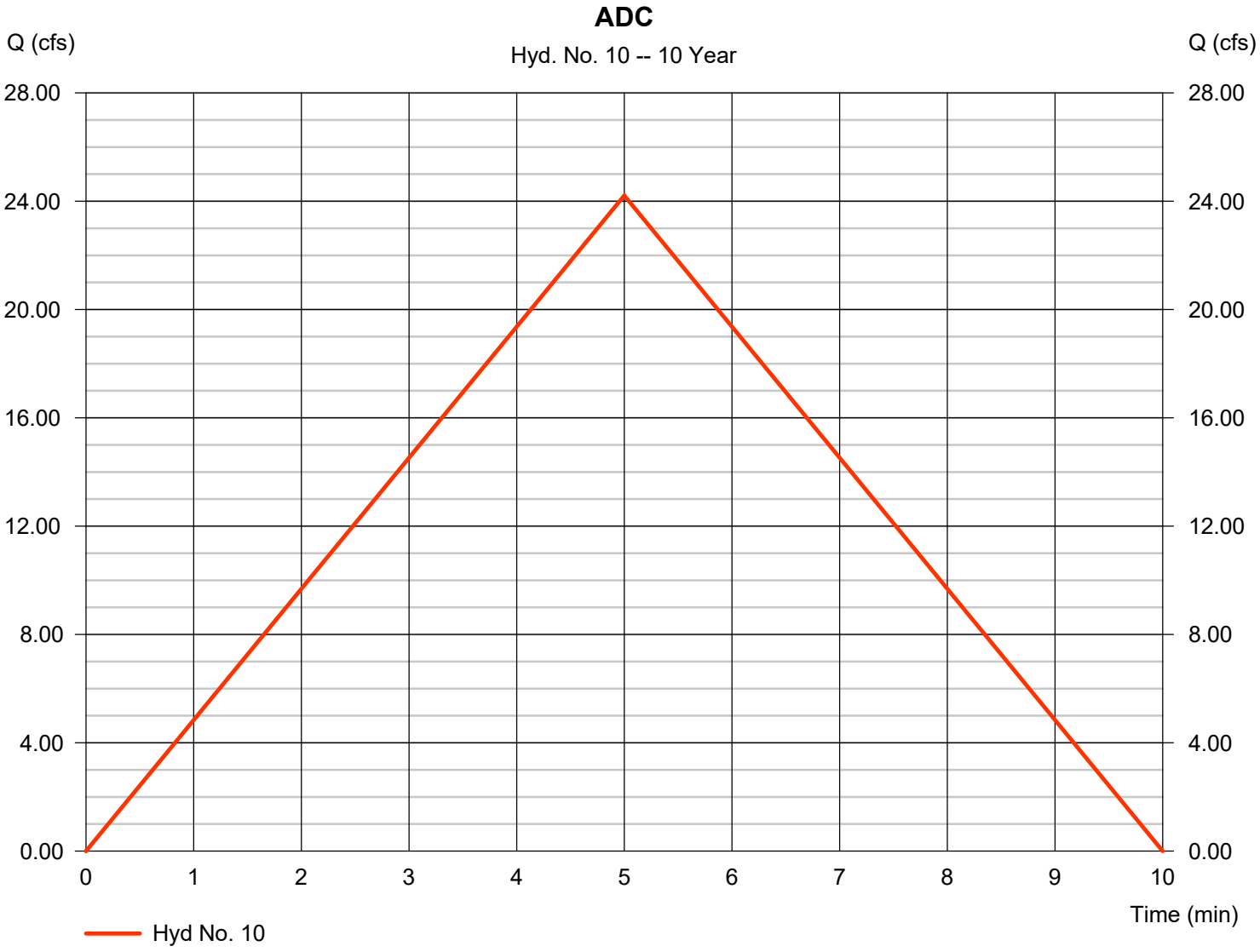


Hydrograph Report

Hyd. No. 10

ADC

Hydrograph type	=	Rational	Peak discharge	=	24.21 cfs
Storm frequency	=	10 yrs	Time to peak	=	5 min
Time interval	=	1 min	Hyd. volume	=	7,263 cuft
Drainage area	=	4.020 ac	Runoff coeff.	=	0.82
Intensity	=	7.344 in/hr	Tc by User	=	5.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

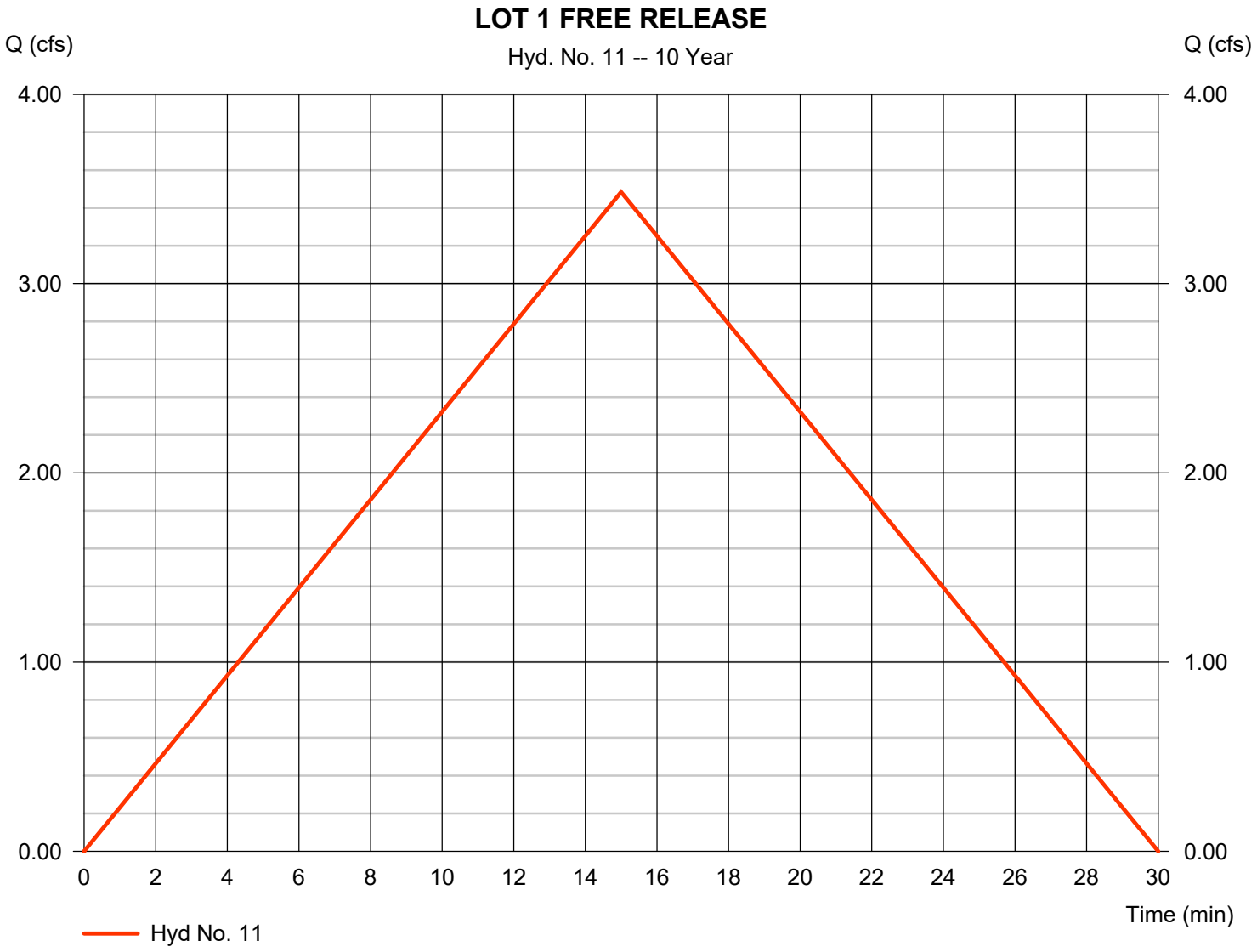


Hydrograph Report

Hyd. No. 11

LOT 1 FREE RELEASE

Hydrograph type	=	Rational	Peak discharge	=	3.484 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	3,135 cuft
Drainage area	=	1.890 ac	Runoff coeff.	=	0.35
Intensity	=	5.267 in/hr	Tc by User	=	15.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

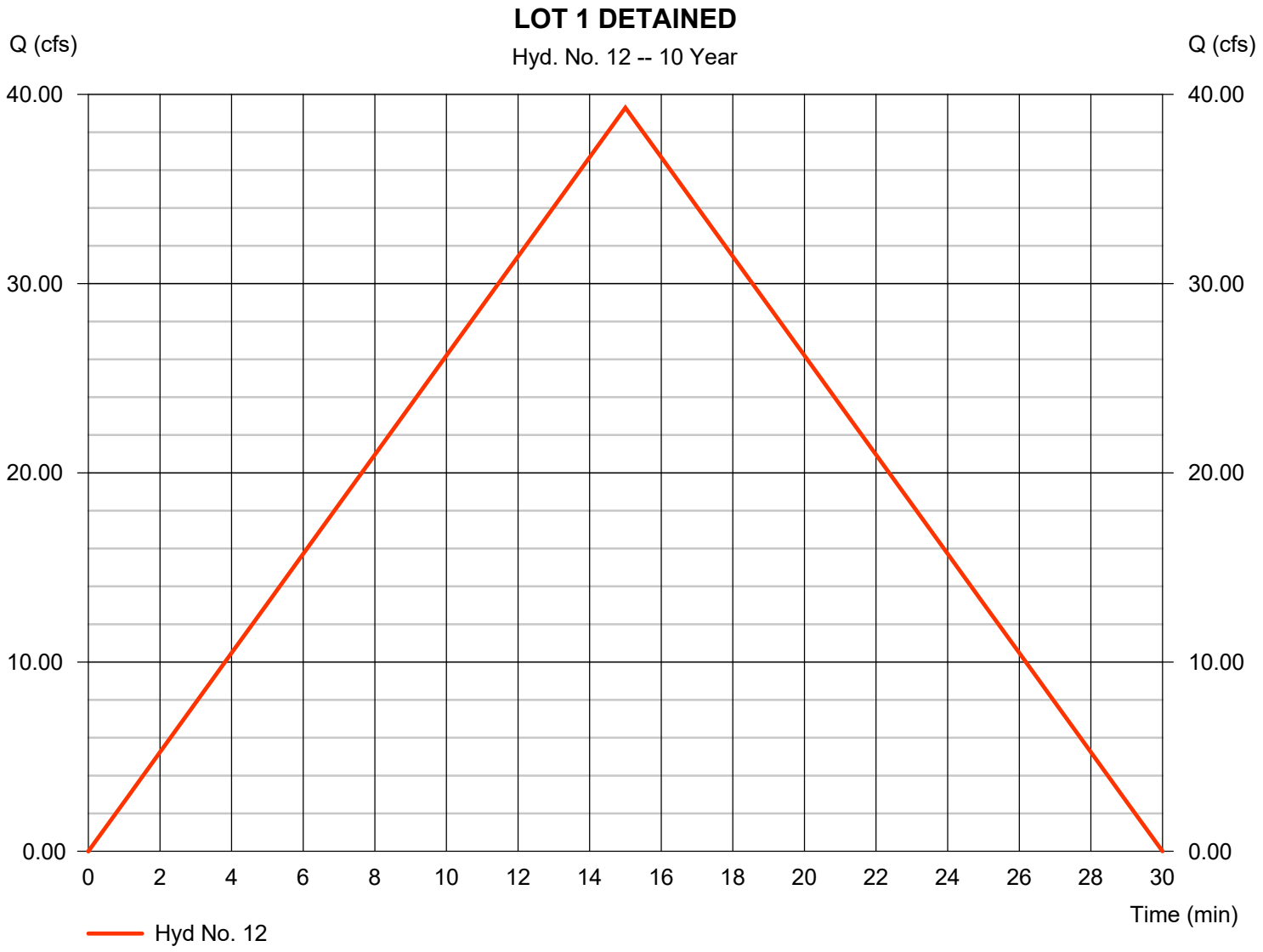


Hydrograph Report

Hyd. No. 12

LOT 1 DETAINED

Hydrograph type	=	Rational	Peak discharge	=	39.30 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	35,366 cuft
Drainage area	=	13.090 ac	Runoff coeff.	=	0.57
Intensity	=	5.267 in/hr	Tc by User	=	15.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1



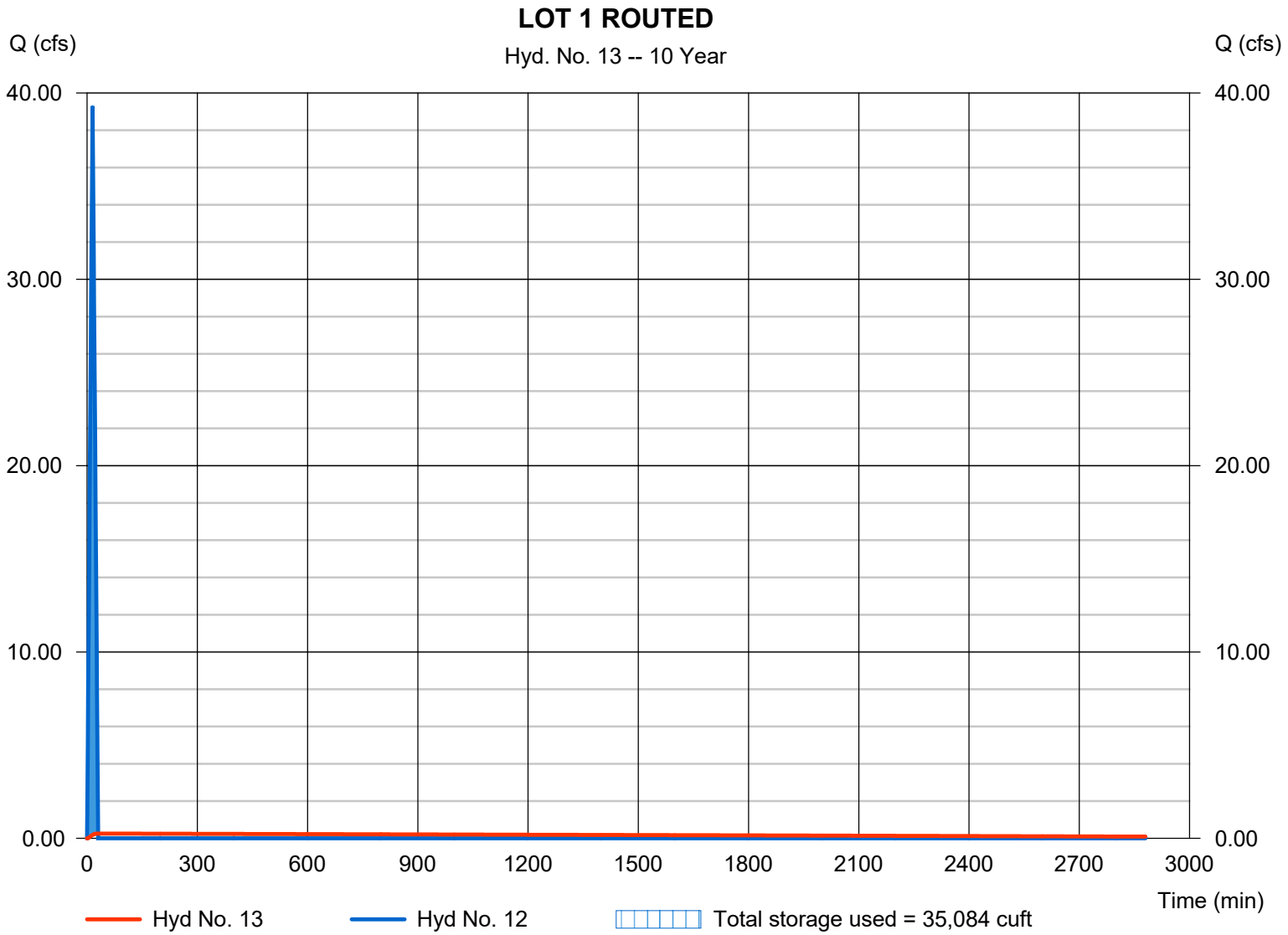
Hydrograph Report

Hyd. No. 13

LOT 1 ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	0.254 cfs
Storm frequency	=	10 yrs	Time to peak	=	30 min
Time interval	=	1 min	Hyd. volume	=	30,287 cuft
Inflow hyd. No.	=	12 - LOT 1 DETAINED	Max. Elevation	=	1002.57 ft
Reservoir name	=	LOT 1 POND	Max. Storage	=	35,084 cuft

Storage Indication method used.

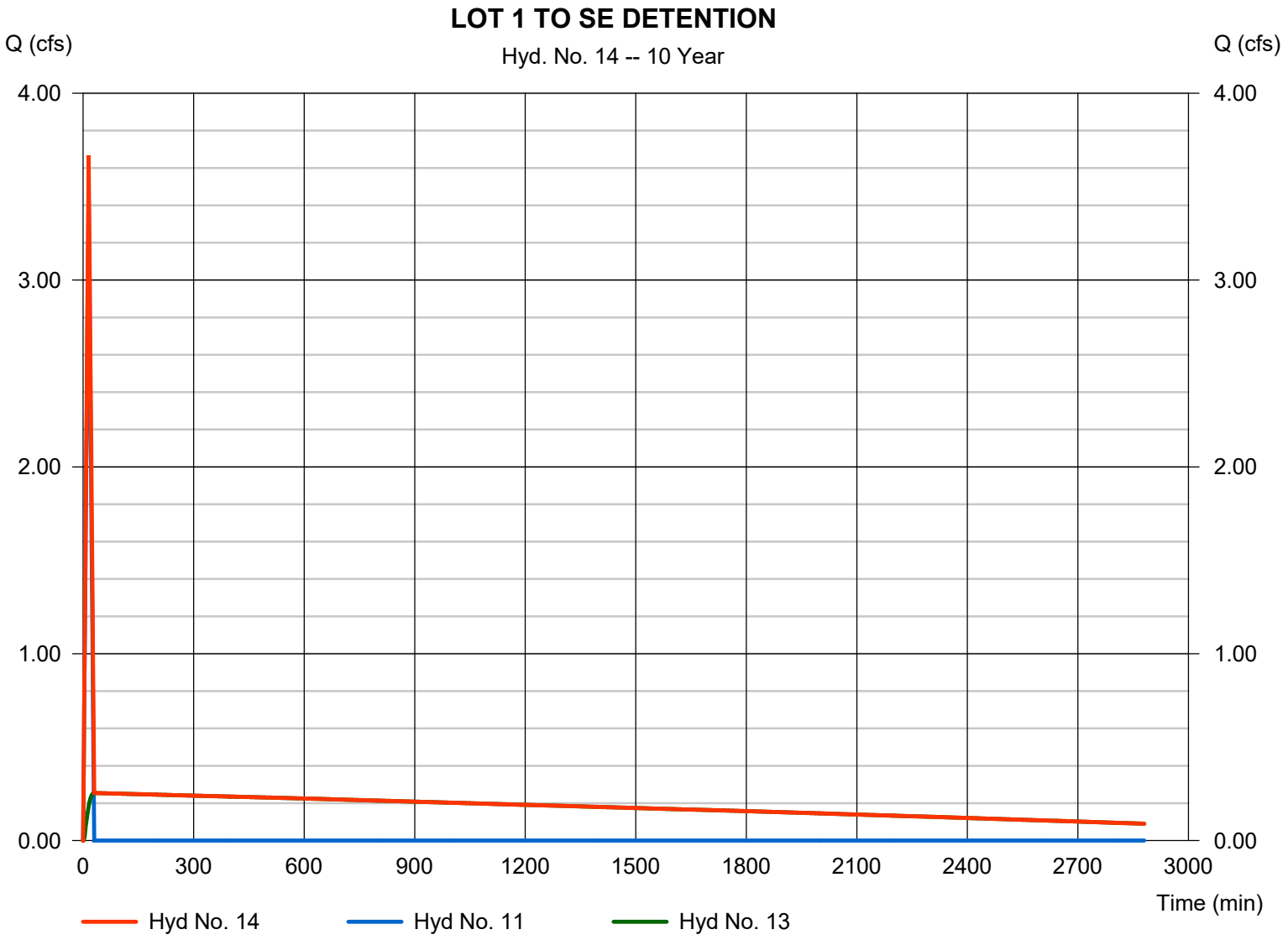


Hydrograph Report

Hyd. No. 14

LOT 1 TO SE DETENTION

Hydrograph type	=	Combine	Peak discharge	=	3.666 cfs
Storm frequency	=	10 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	33,422 cuft
Inflow hyds.	=	11, 13	Contrib. drain. area	=	1.890 ac

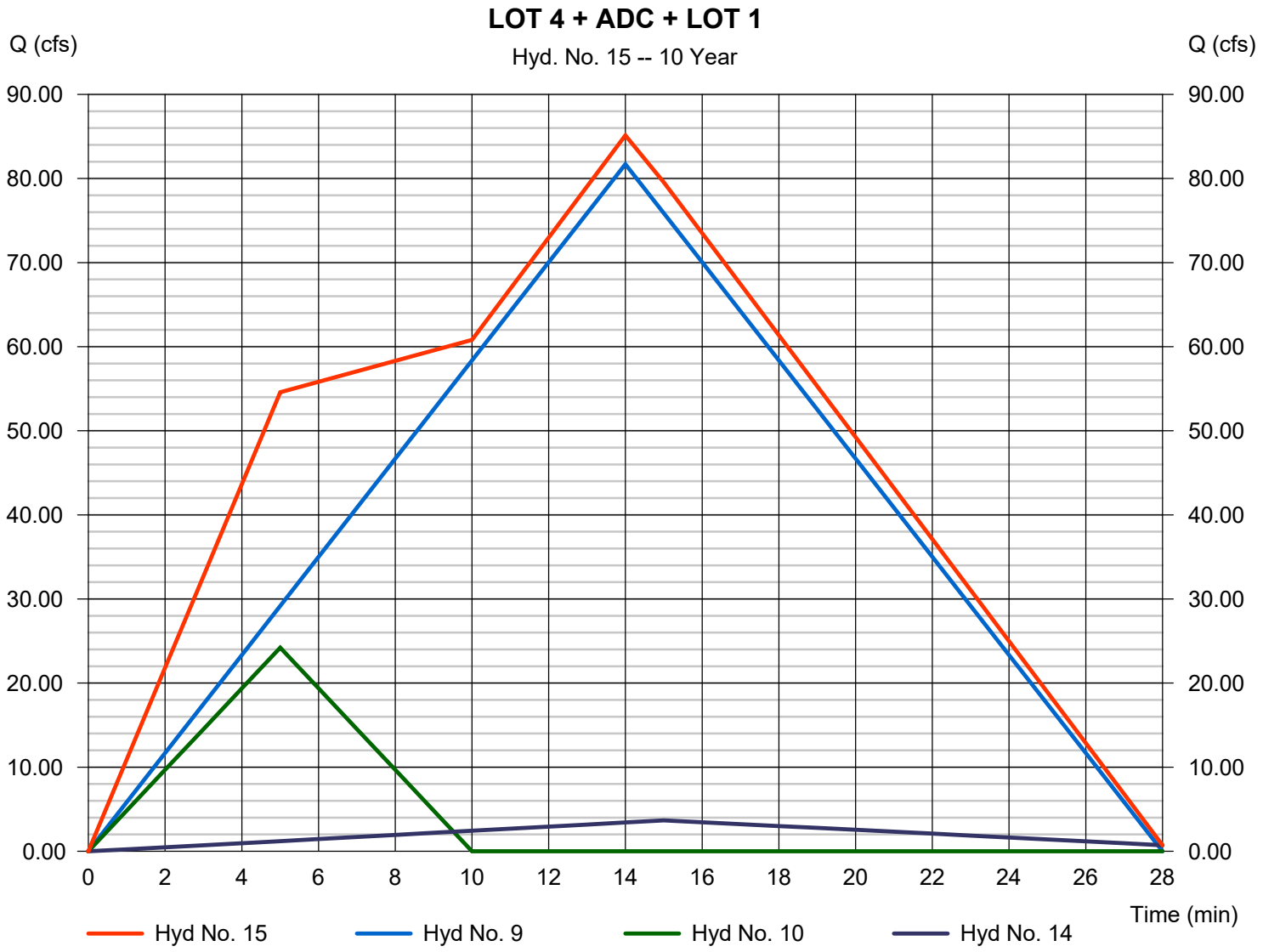


Hydrograph Report

Hyd. No. 15

LOT 4 + ADC + LOT 1

Hydrograph type	=	Combine	Peak discharge	=	85.13 cfs
Storm frequency	=	10 yrs	Time to peak	=	14 min
Time interval	=	1 min	Hyd. volume	=	109,321 cuft
Inflow hyds.	=	9, 10, 14	Contrib. drain. area	=	22.420 ac



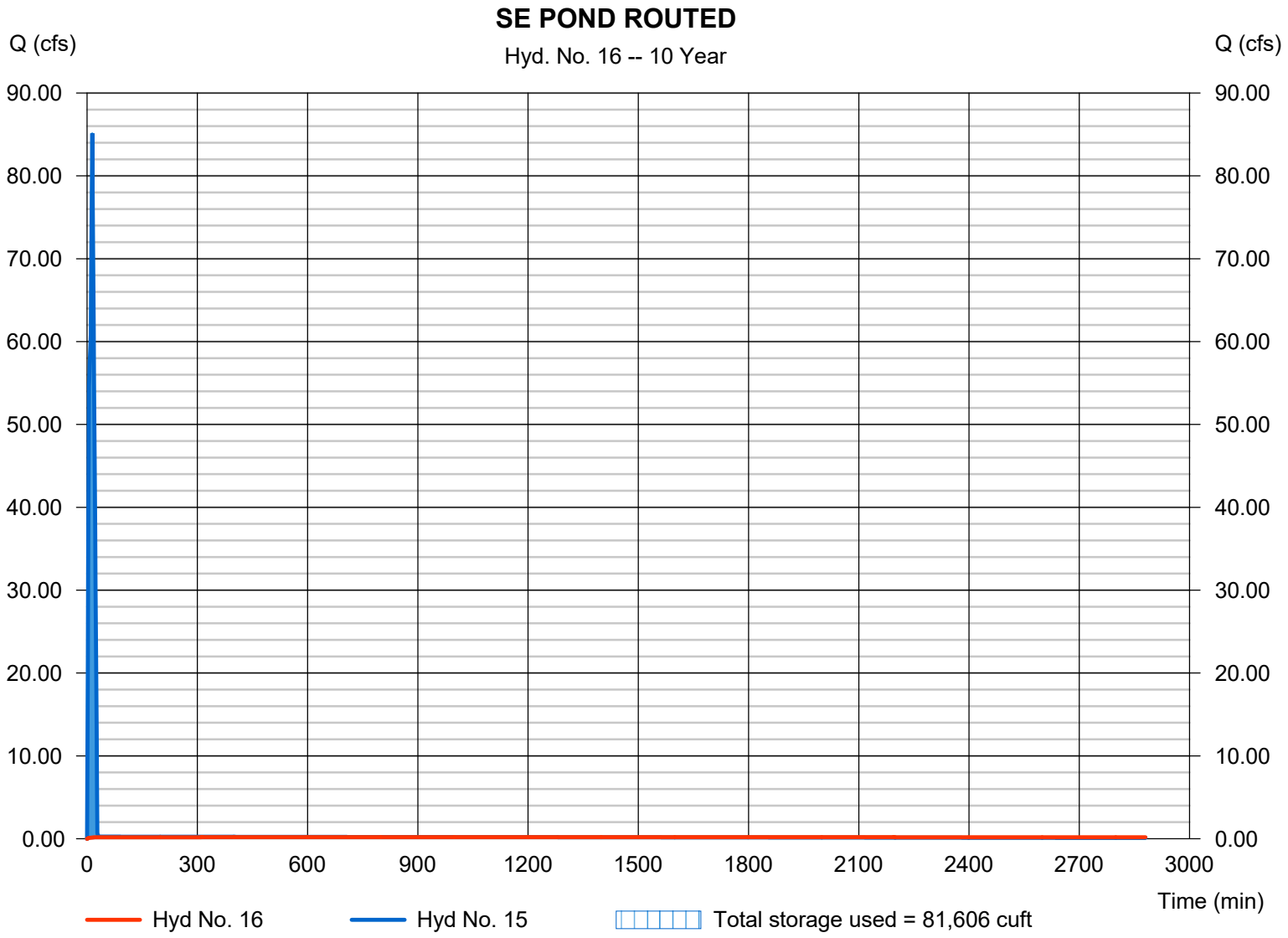
Hydrograph Report

Hyd. No. 16

SE POND ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	0.188 cfs
Storm frequency	=	10 yrs	Time to peak	=	1244 min
Time interval	=	1 min	Hyd. volume	=	32,215 cuft
Inflow hyd. No.	=	15 - LOT 4 + ADC + LOT 1	Max. Elevation	=	979.74 ft
Reservoir name	=	SE POND	Max. Storage	=	81,606 cuft

Storage Indication method used.



Hydrograph Summary Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

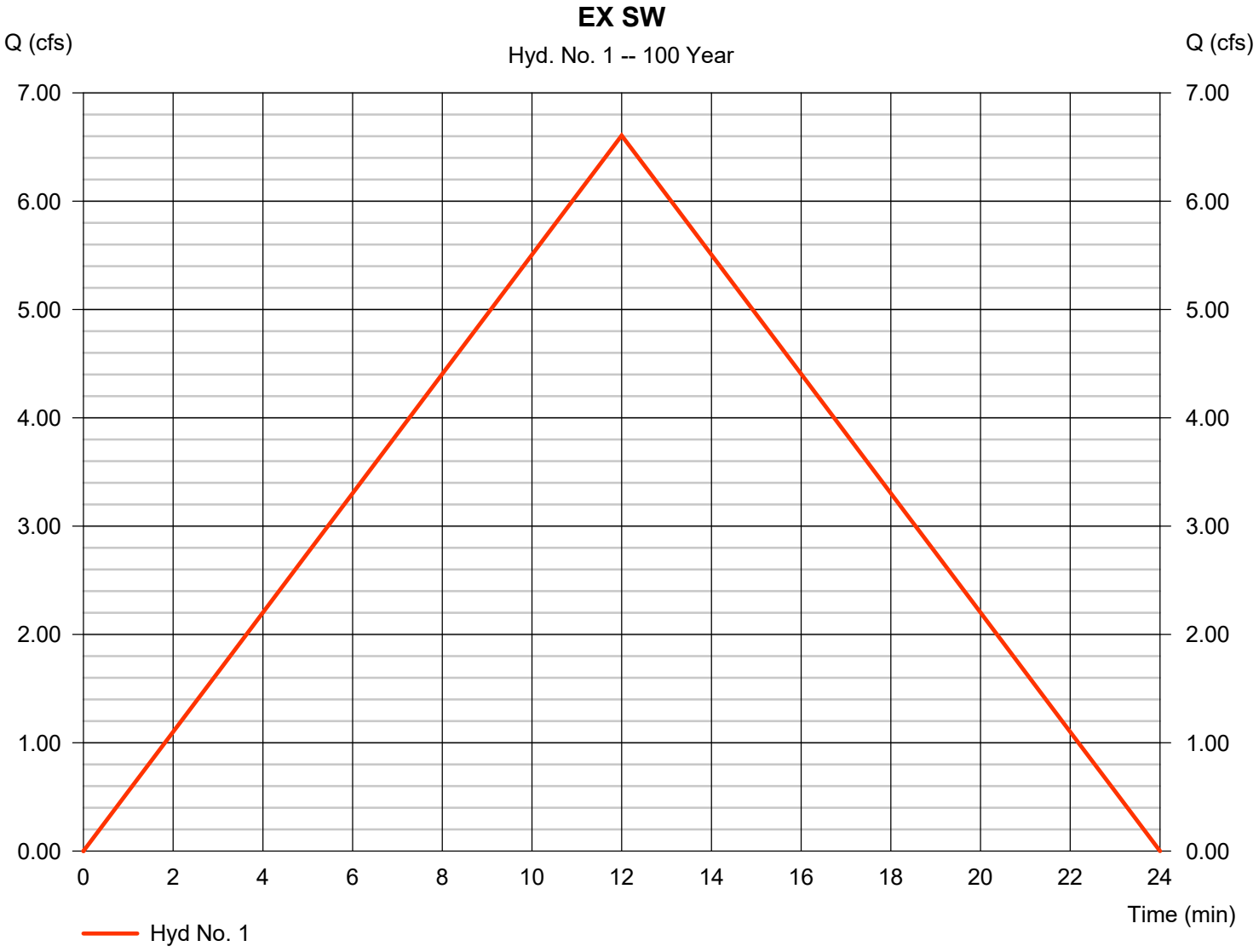
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	Rational	6.607	1	12	4,757	------	------	------	EX SW
2	Rational	7.971	1	9	4,304	------	------	------	EX NW
3	Rational	9.626	1	11	6,353	------	------	------	EX S
4	Rational	25.81	1	24	37,163	------	------	------	EX NE
5	Rational	18.19	1	12	13,100	------	------	------	EX SE
6	Rational	1.705	1	9	921	------	------	------	PROP NW
7	Rational	1.977	1	10	1,186	------	------	------	PROP S
8	Rational	9.515	1	8	4,567	------	------	------	PROP NE
9	Rational	146.63	1	14	123,167	------	------	------	PROP SE
10	Rational	42.51	1	5	12,753	------	------	------	ADC
11	Rational	6.263	1	15	5,636	------	------	------	LOT 1 FREE RELEASE
12	Rational	70.64	1	15	63,574	------	------	------	LOT 1 DETAINED
13	Reservoir	15.03	1	27	54,439	12	1003.92	57,136	LOT 1 ROUTED
14	Combine	16.55	1	26	60,075	11, 13	------	------	LOT 1 TO SE DETENTION
15	Combine	152.70	1	14	195,995	9, 10, 14	------	------	LOT 4 + ADC + LOT 1
16	Reservoir	0.285	1	130	48,139	15	980.45	159,737	SE POND ROUTED

Hydrograph Report

Hyd. No. 1

EX SW

Hydrograph type	=	Rational	Peak discharge	=	6.607 cfs
Storm frequency	=	100 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	4,757 cuft
Drainage area	=	1.950 ac	Runoff coeff.	=	0.33
Intensity	=	10.267 in/hr	Tc by User	=	12.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

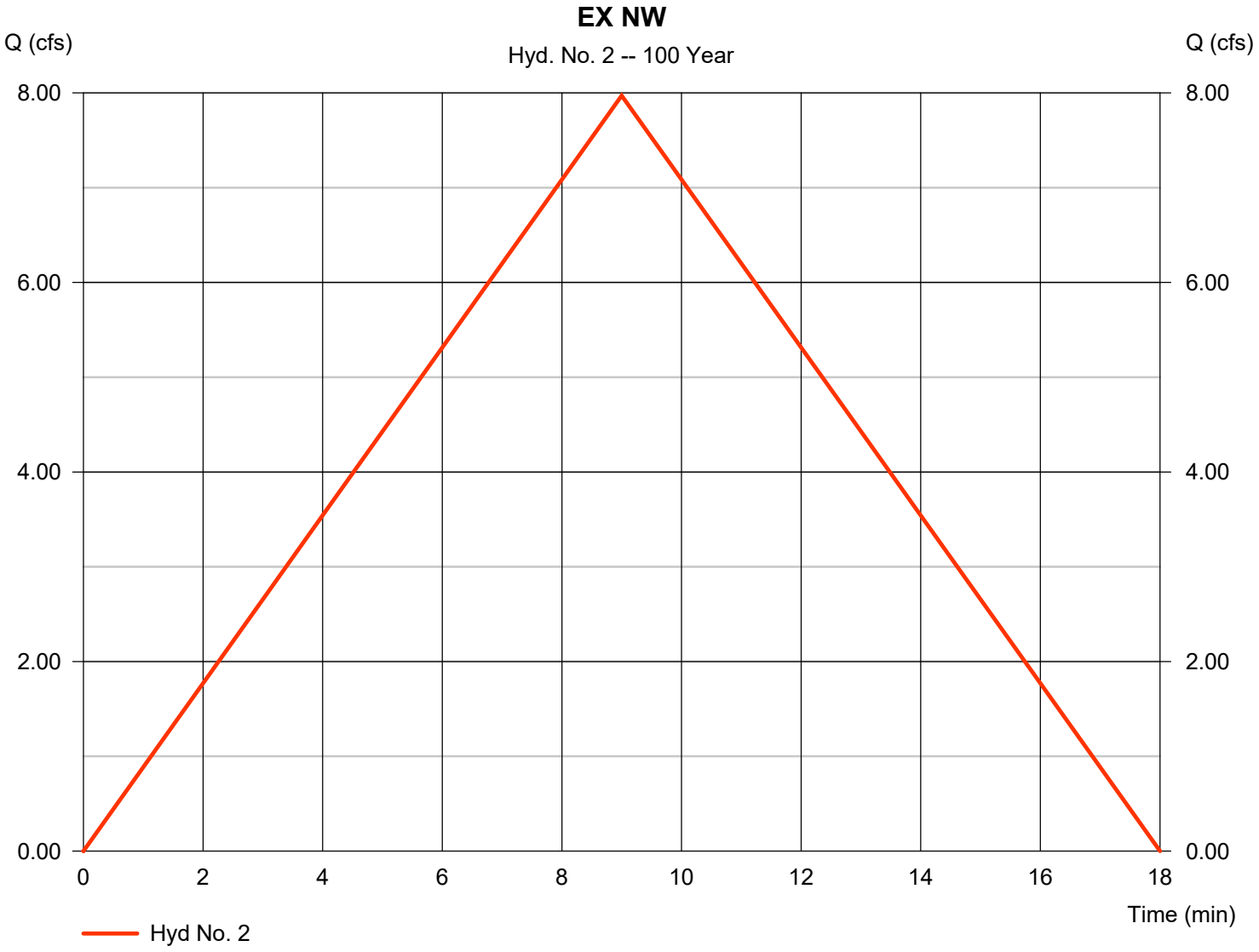


Hydrograph Report

Hyd. No. 2

EX NW

Hydrograph type	=	Rational	Peak discharge	=	7.971 cfs
Storm frequency	=	100 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	4,304 cuft
Drainage area	=	2.150 ac	Runoff coeff.	=	0.33
Intensity	=	11.235 in/hr	Tc by User	=	9.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

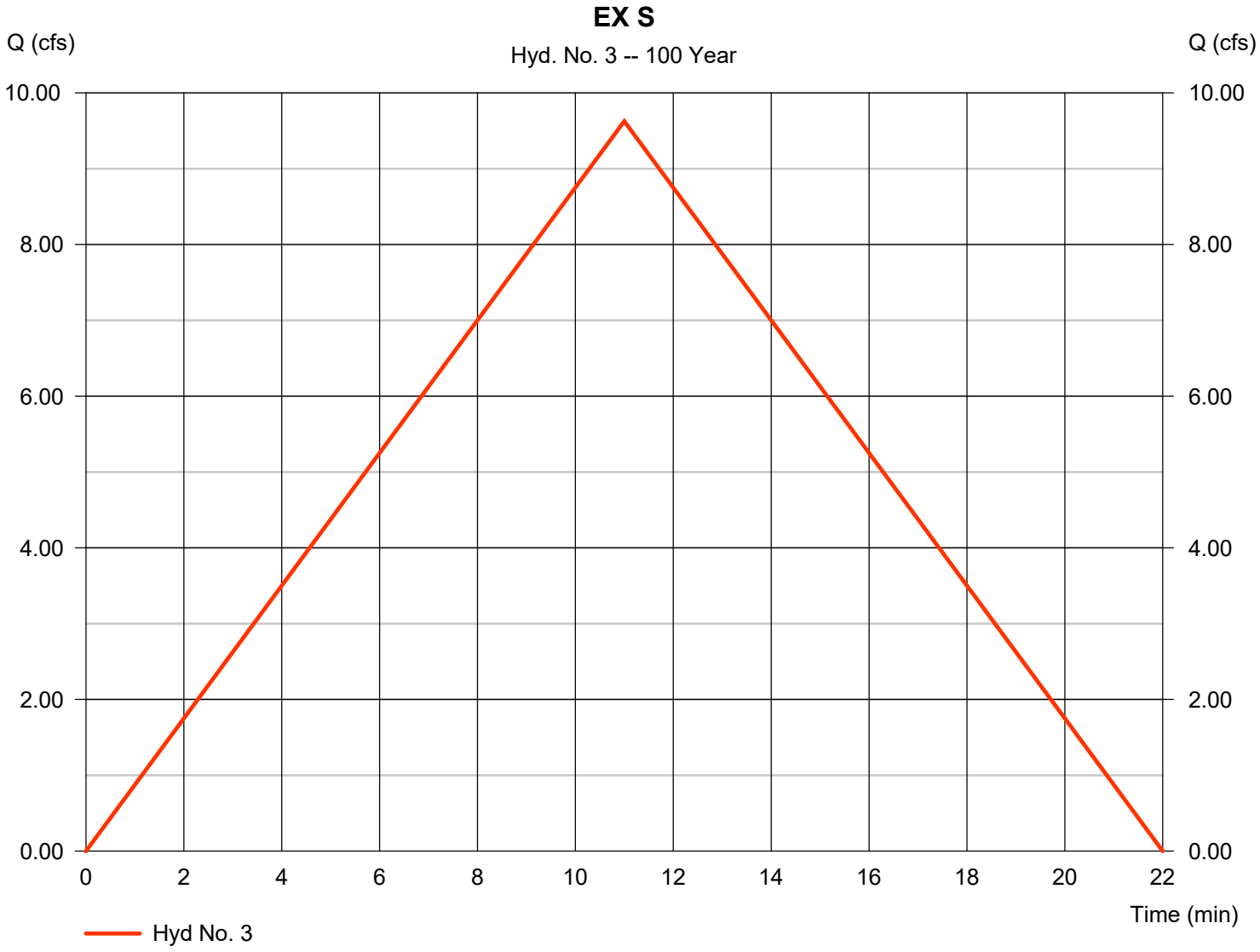


Hydrograph Report

Hyd. No. 3

EX S

Hydrograph type	=	Rational	Peak discharge	=	9.626 cfs
Storm frequency	=	100 yrs	Time to peak	=	11 min
Time interval	=	1 min	Hyd. volume	=	6,353 cuft
Drainage area	=	2.760 ac	Runoff coeff.	=	0.33
Intensity	=	10.569 in/hr	Tc by User	=	11.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

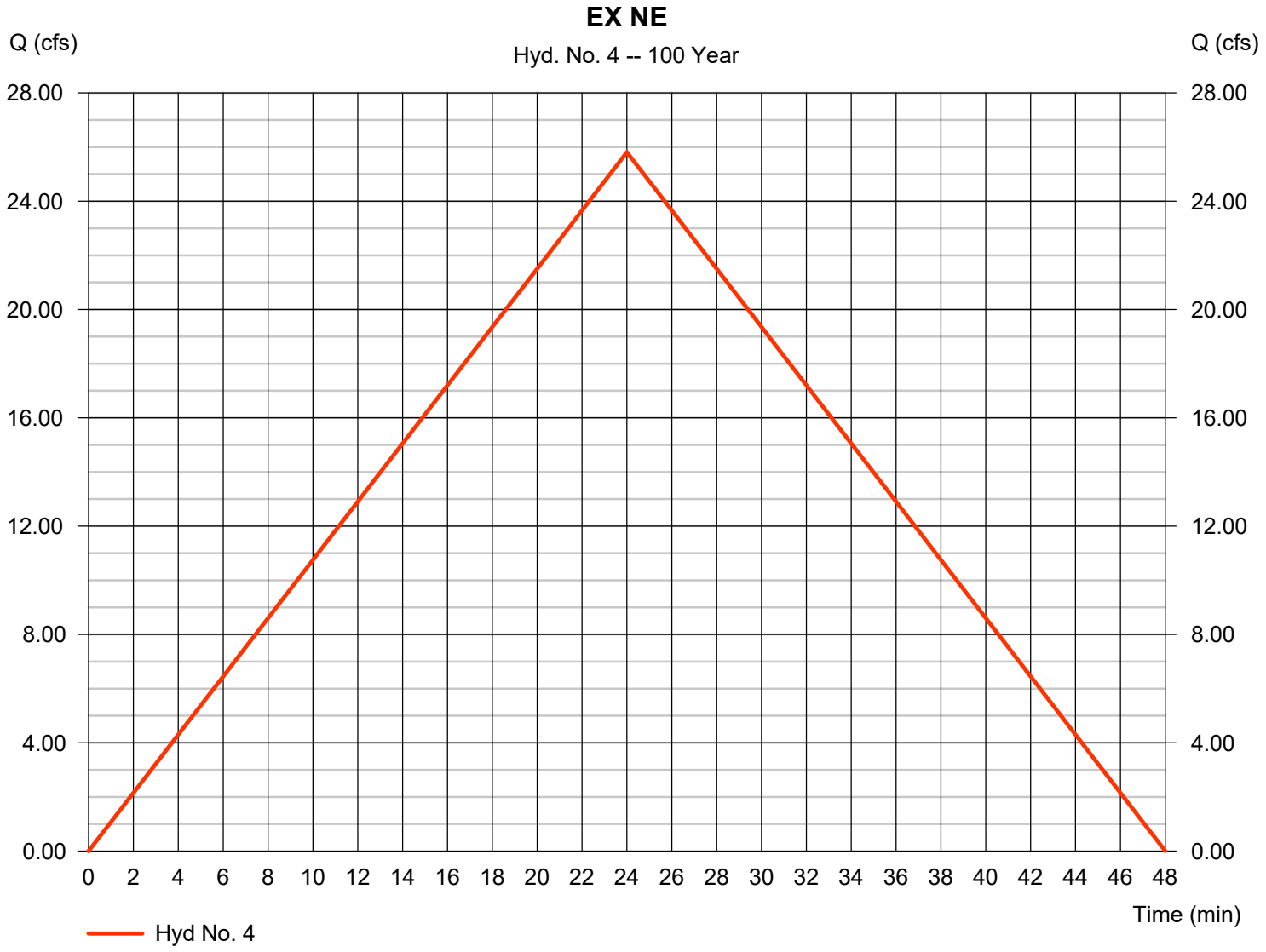


Hydrograph Report

Hyd. No. 4

EX NE

Hydrograph type	=	Rational	Peak discharge	=	25.81 cfs
Storm frequency	=	100 yrs	Time to peak	=	24 min
Time interval	=	1 min	Hyd. volume	=	37,163 cuft
Drainage area	=	10.130 ac	Runoff coeff.	=	0.33
Intensity	=	7.720 in/hr	Tc by User	=	24.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

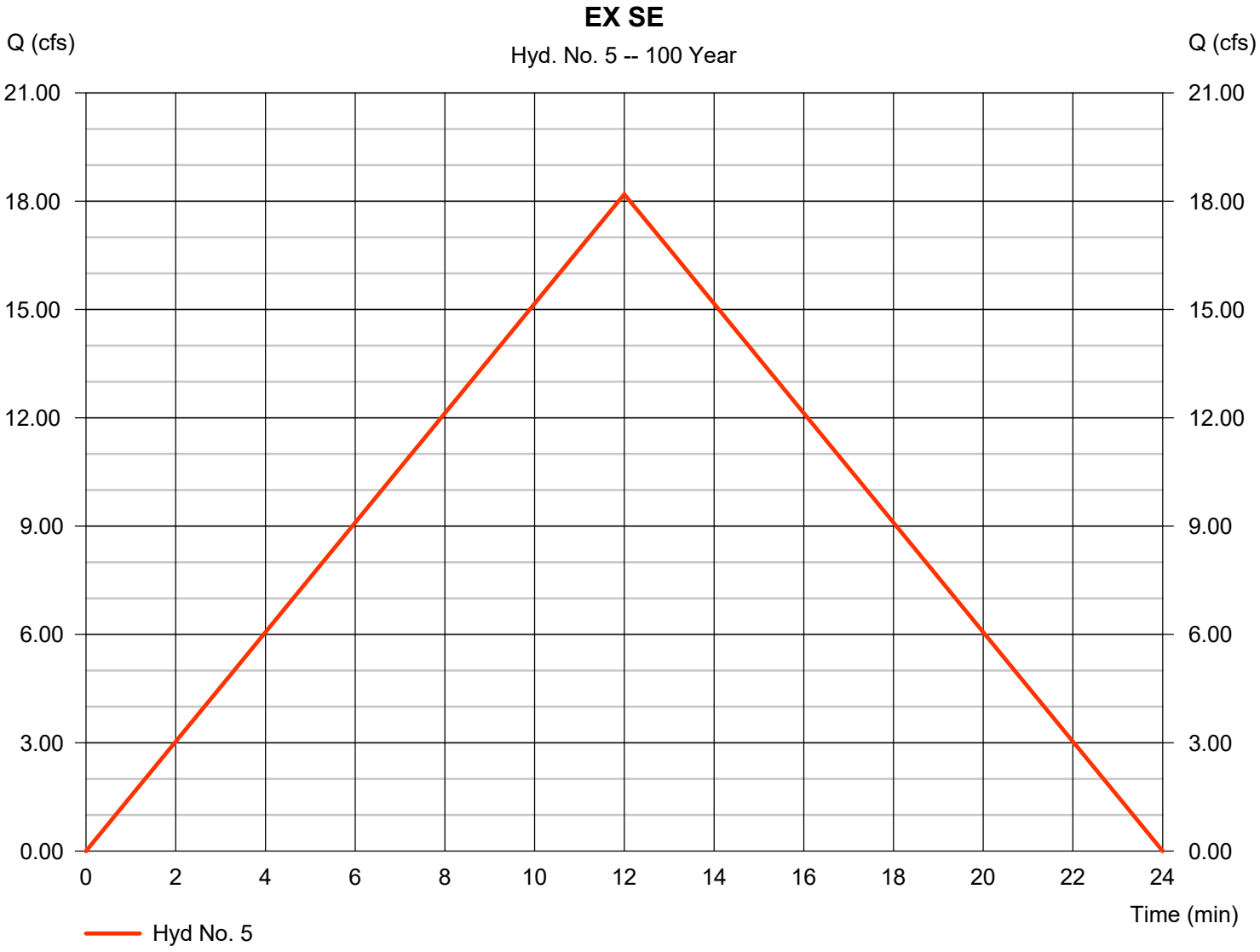


Hydrograph Report

Hyd. No. 5

EX SE

Hydrograph type	=	Rational	Peak discharge	=	18.19 cfs
Storm frequency	=	100 yrs	Time to peak	=	12 min
Time interval	=	1 min	Hyd. volume	=	13,100 cuft
Drainage area	=	5.370 ac	Runoff coeff.	=	0.33
Intensity	=	10.267 in/hr	Tc by User	=	12.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

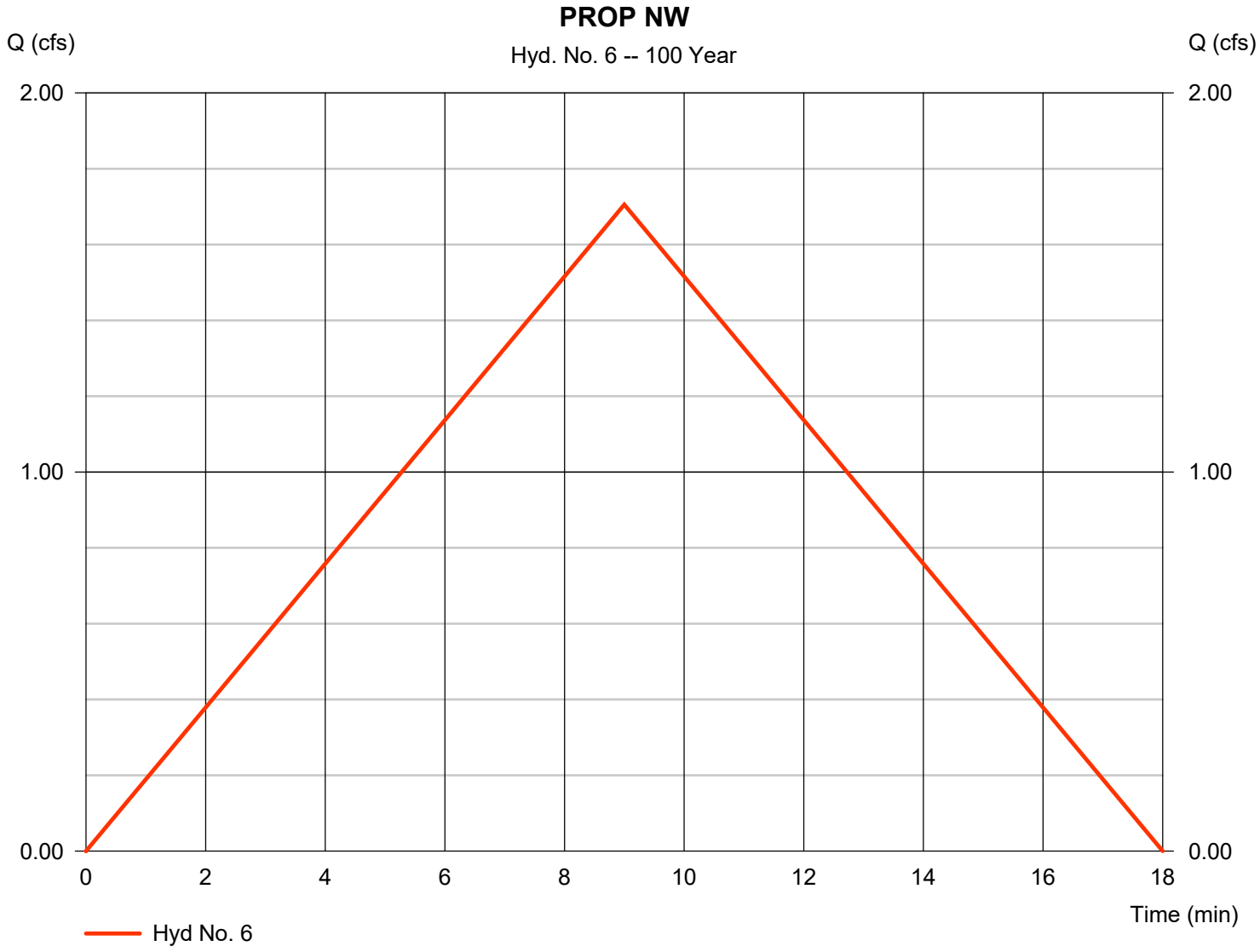


Hydrograph Report

Hyd. No. 6

PROP NW

Hydrograph type	=	Rational	Peak discharge	=	1.705 cfs
Storm frequency	=	100 yrs	Time to peak	=	9 min
Time interval	=	1 min	Hyd. volume	=	921 cuft
Drainage area	=	0.460 ac	Runoff coeff.	=	0.33
Intensity	=	11.235 in/hr	Tc by User	=	9.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

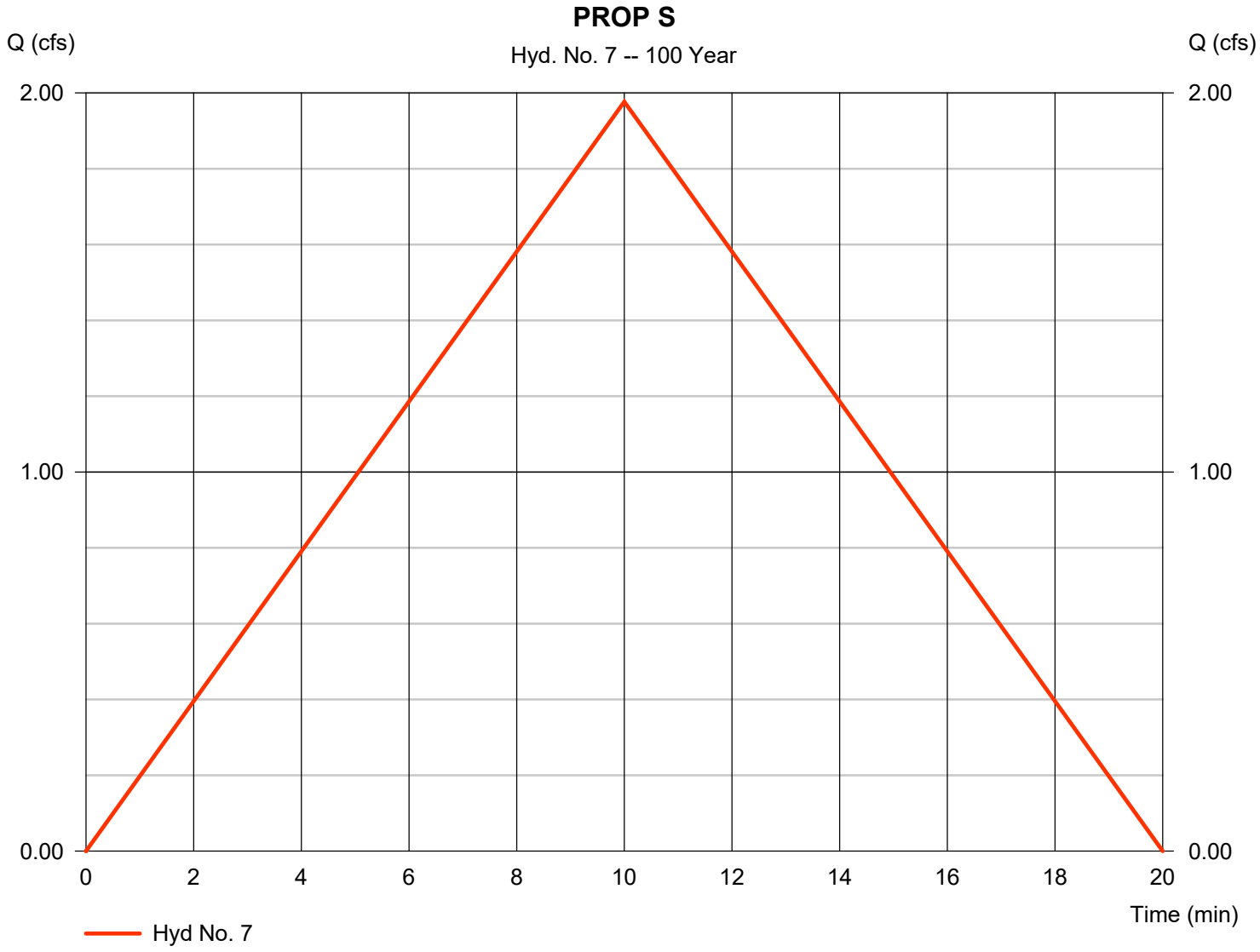


Hydrograph Report

Hyd. No. 7

PROP S

Hydrograph type	=	Rational	Peak discharge	=	1.977 cfs
Storm frequency	=	100 yrs	Time to peak	=	10 min
Time interval	=	1 min	Hyd. volume	=	1,186 cuft
Drainage area	=	0.550 ac	Runoff coeff.	=	0.33
Intensity	=	10.890 in/hr	Tc by User	=	10.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

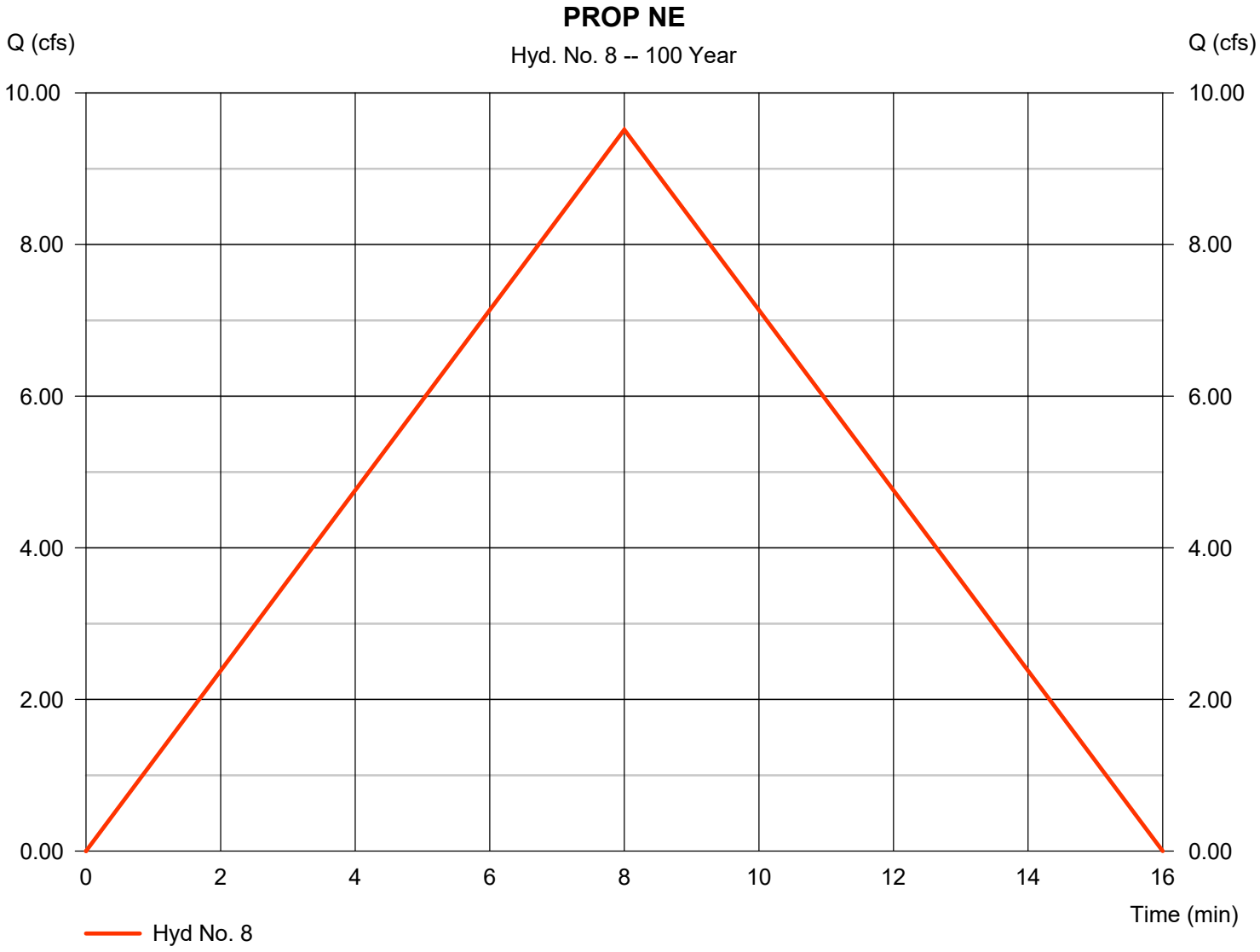


Hydrograph Report

Hyd. No. 8

PROP NE

Hydrograph type	=	Rational	Peak discharge	=	9.515 cfs
Storm frequency	=	100 yrs	Time to peak	=	8 min
Time interval	=	1 min	Hyd. volume	=	4,567 cuft
Drainage area	=	1.000 ac	Runoff coeff.	=	0.82
Intensity	=	11.604 in/hr	Tc by User	=	8.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

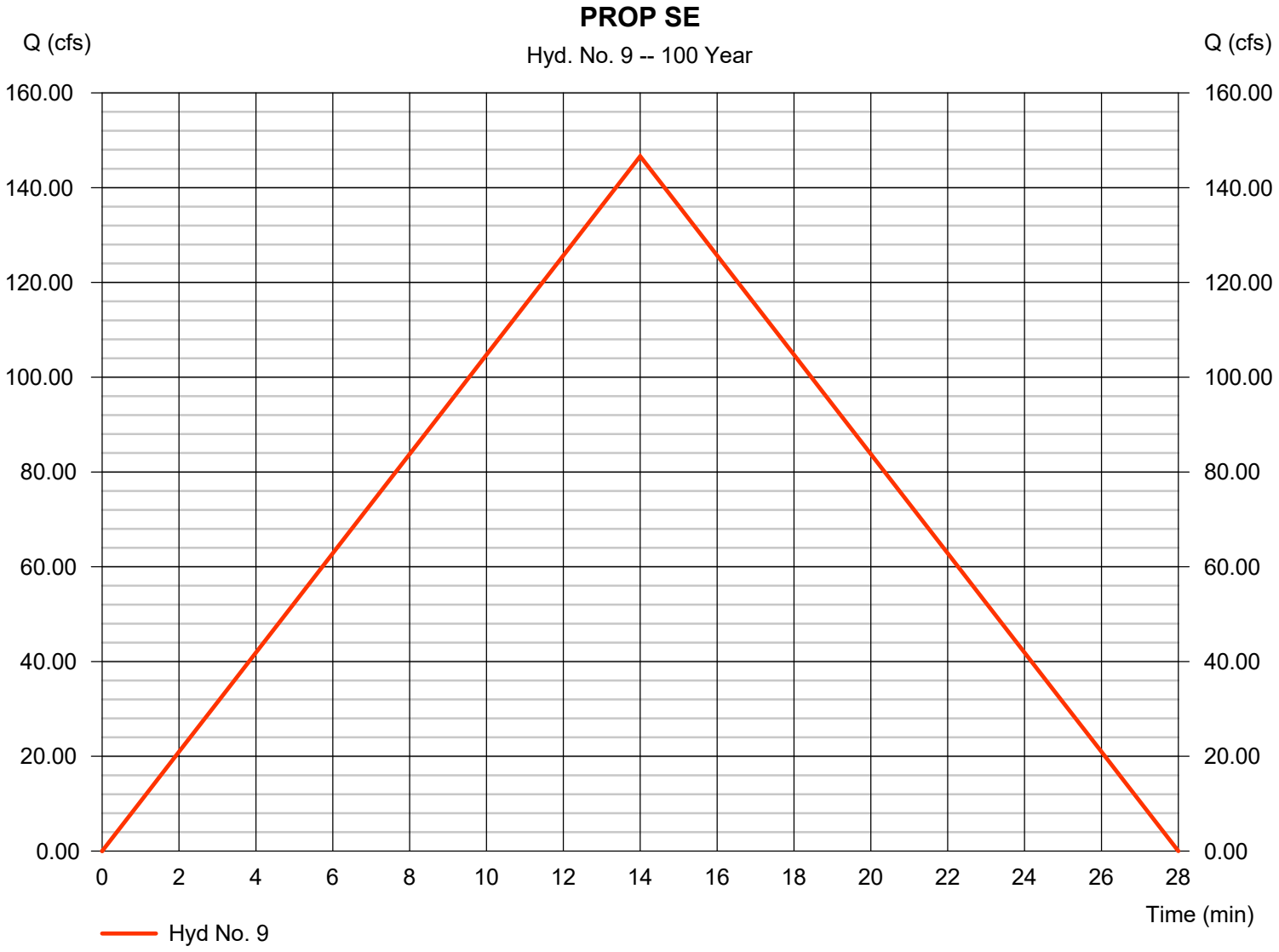


Hydrograph Report

Hyd. No. 9

PROP SE

Hydrograph type	=	Rational	Peak discharge	=	146.63 cfs
Storm frequency	=	100 yrs	Time to peak	=	14 min
Time interval	=	1 min	Hyd. volume	=	123,167 cuft
Drainage area	=	18.400 ac	Runoff coeff.	=	0.82
Intensity	=	9.718 in/hr	Tc by User	=	14.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

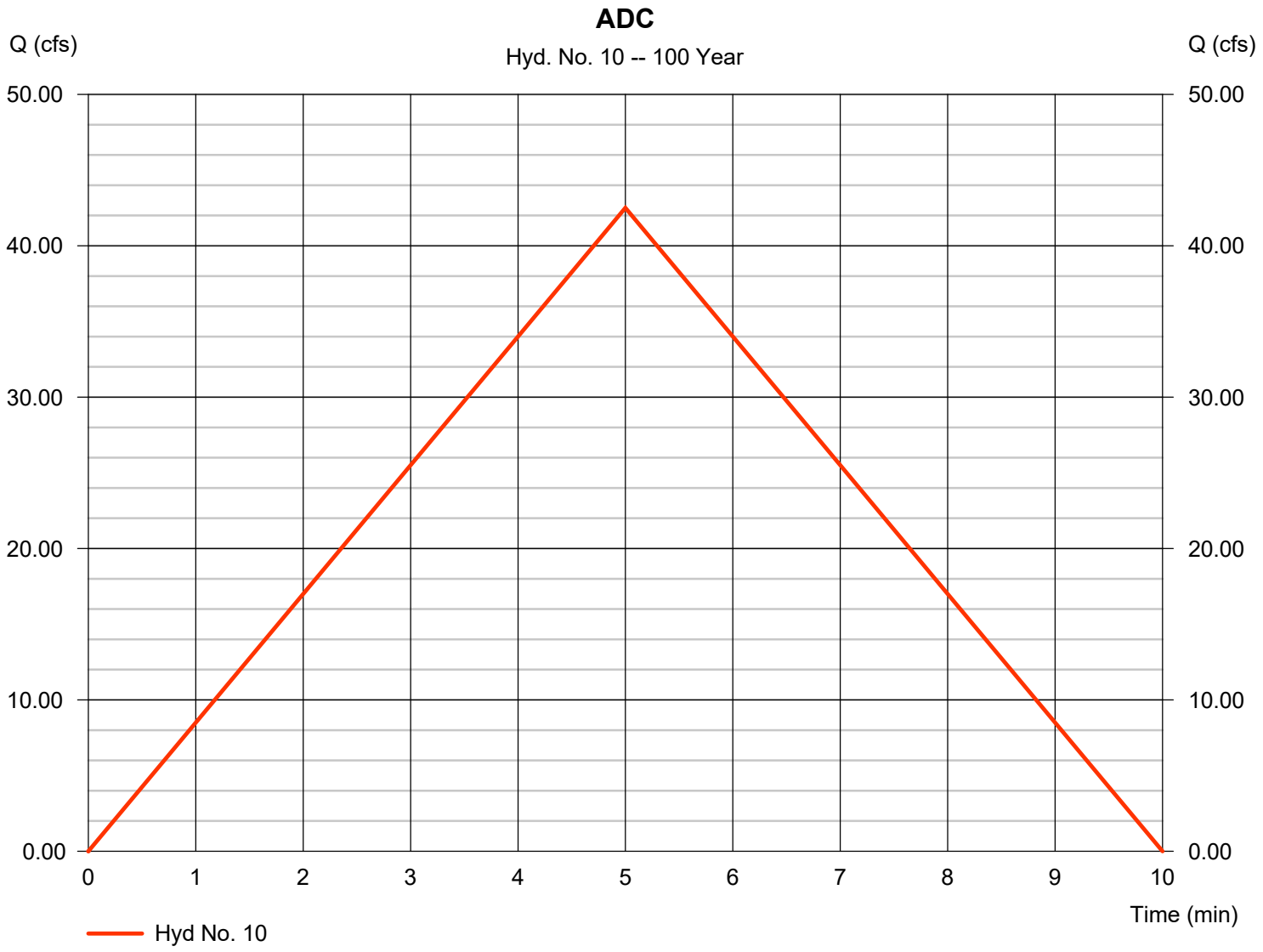


Hydrograph Report

Hyd. No. 10

ADC

Hydrograph type	=	Rational	Peak discharge	=	42.51 cfs
Storm frequency	=	100 yrs	Time to peak	=	5 min
Time interval	=	1 min	Hyd. volume	=	12,753 cuft
Drainage area	=	4.020 ac	Runoff coeff.	=	0.82
Intensity	=	12.896 in/hr	Tc by User	=	5.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

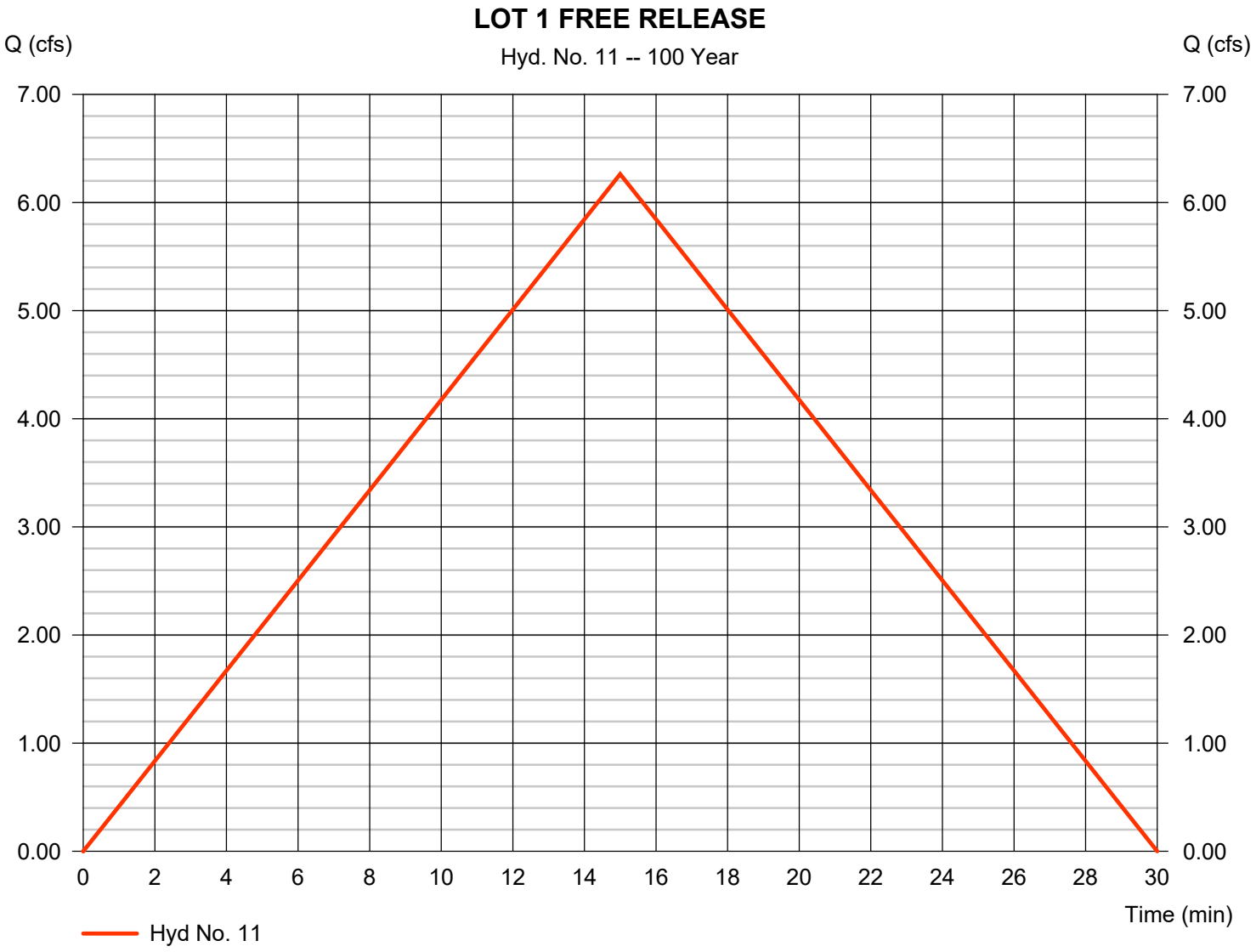


Hydrograph Report

Hyd. No. 11

LOT 1 FREE RELEASE

Hydrograph type	=	Rational	Peak discharge	=	6.263 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	5,636 cuft
Drainage area	=	1.890 ac	Runoff coeff.	=	0.35
Intensity	=	9.467 in/hr	Tc by User	=	15.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1

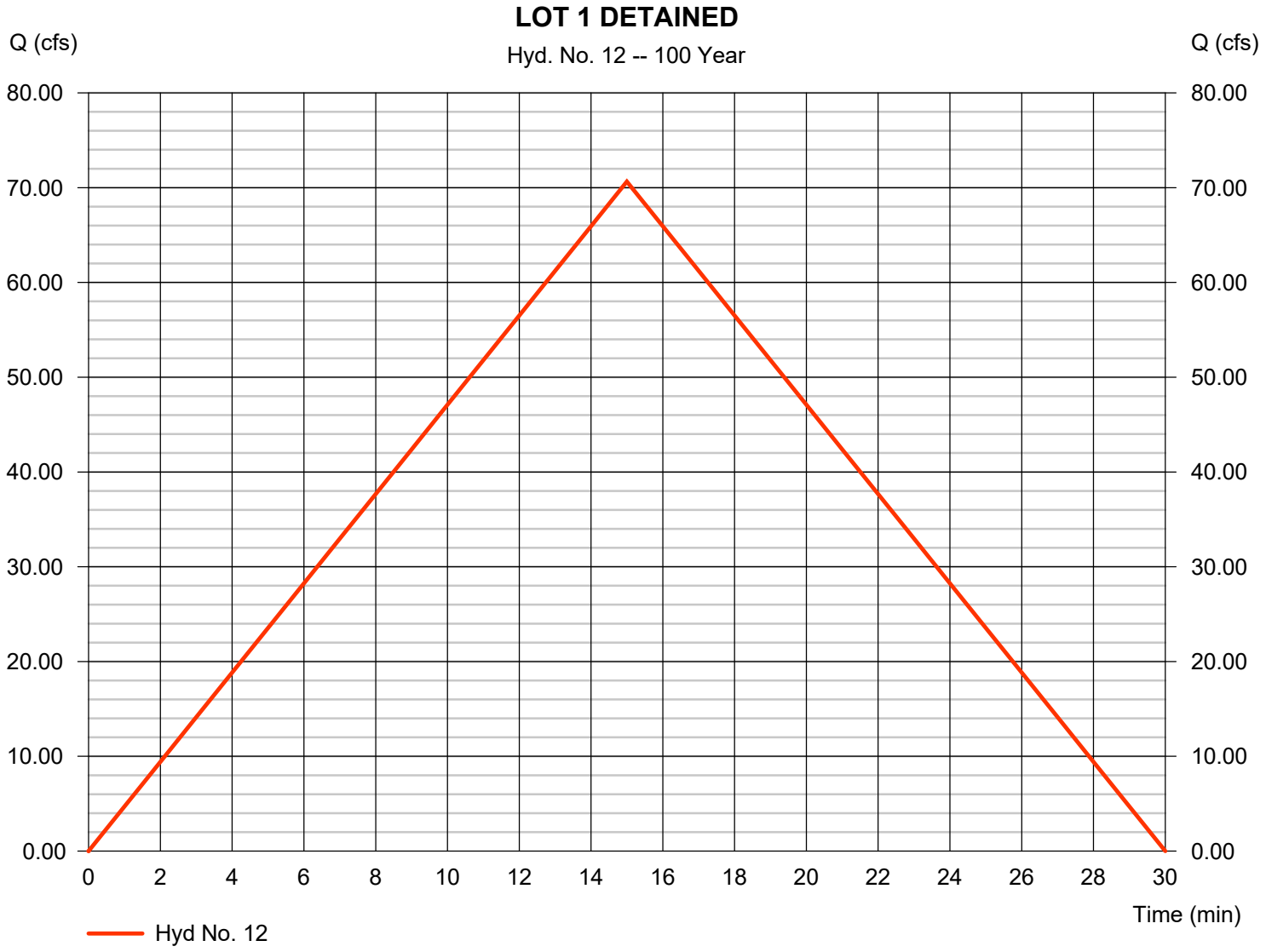


Hydrograph Report

Hyd. No. 12

LOT 1 DETAINED

Hydrograph type	=	Rational	Peak discharge	=	70.64 cfs
Storm frequency	=	100 yrs	Time to peak	=	15 min
Time interval	=	1 min	Hyd. volume	=	63,574 cuft
Drainage area	=	13.090 ac	Runoff coeff.	=	0.57
Intensity	=	9.467 in/hr	Tc by User	=	15.00 min
IDF Curve	=	APWA 2011 K.IDF	Asc/Rec limb fact	=	1/1



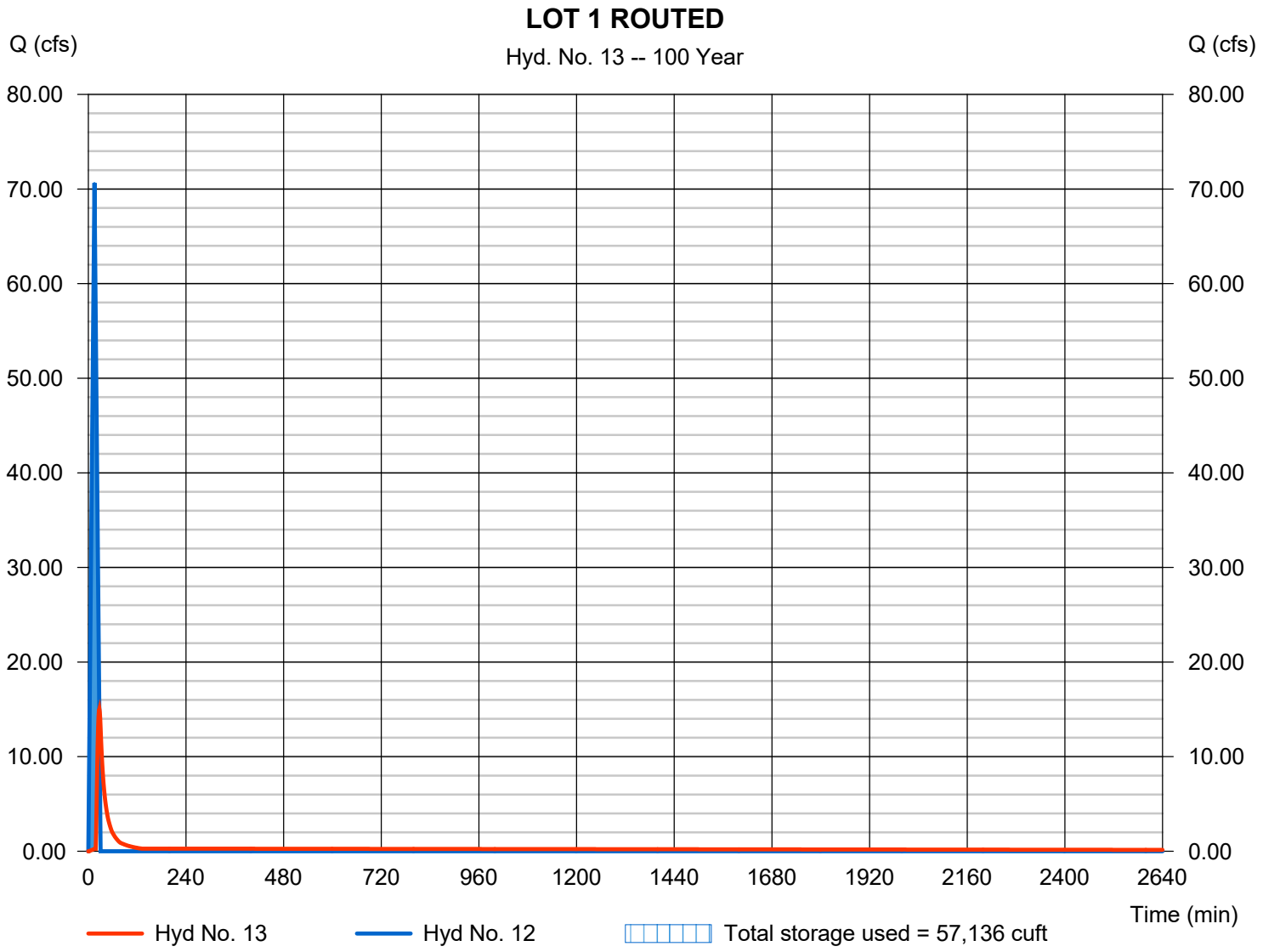
Hydrograph Report

Hyd. No. 13

LOT 1 ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	15.03 cfs
Storm frequency	=	100 yrs	Time to peak	=	27 min
Time interval	=	1 min	Hyd. volume	=	54,439 cuft
Inflow hyd. No.	=	12 - LOT 1 DETAINED	Max. Elevation	=	1003.92 ft
Reservoir name	=	LOT 1 POND	Max. Storage	=	57,136 cuft

Storage Indication method used.

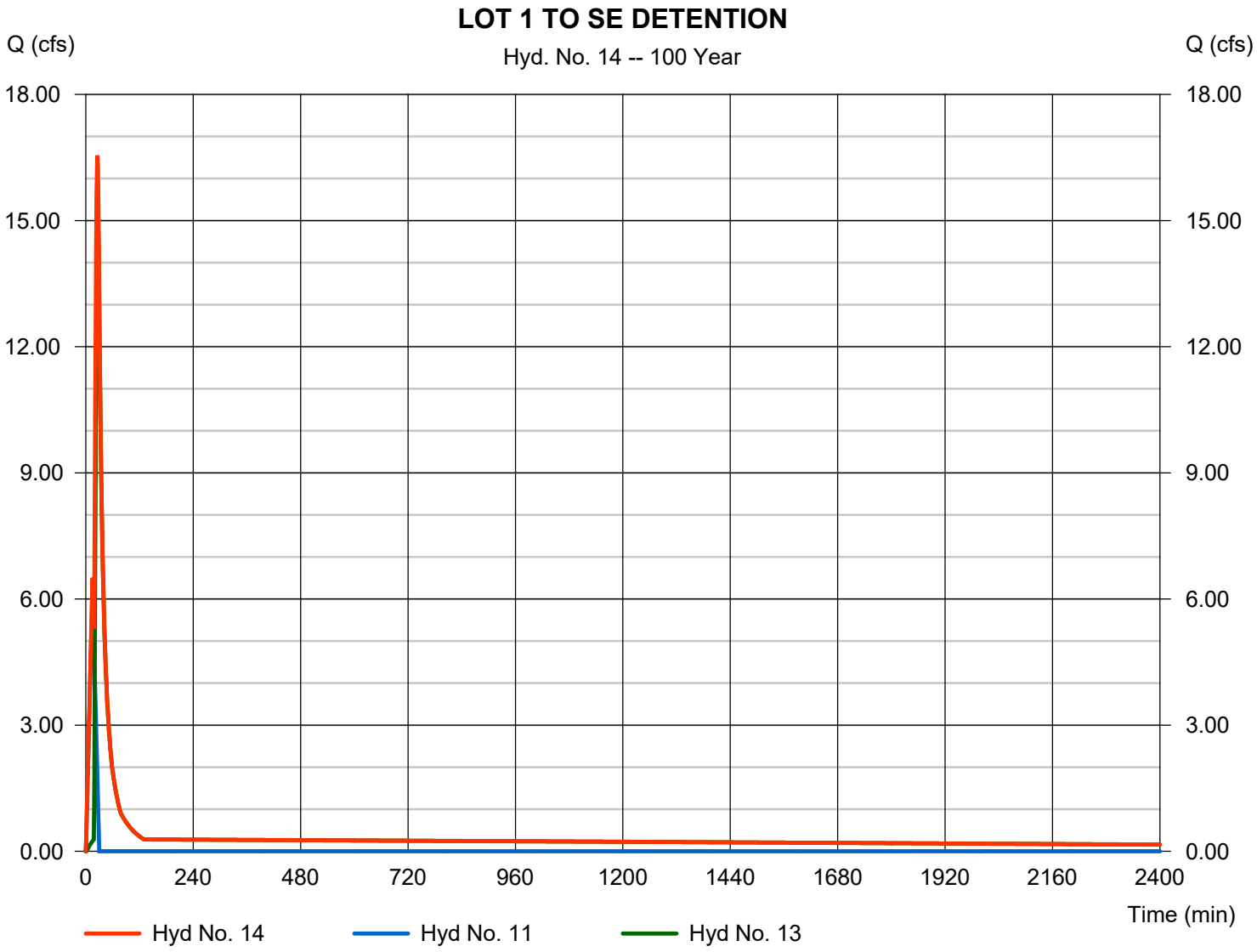


Hydrograph Report

Hyd. No. 14

LOT 1 TO SE DETENTION

Hydrograph type	=	Combine	Peak discharge	=	16.55 cfs
Storm frequency	=	100 yrs	Time to peak	=	26 min
Time interval	=	1 min	Hyd. volume	=	60,075 cuft
Inflow hyds.	=	11, 13	Contrib. drain. area	=	1.890 ac

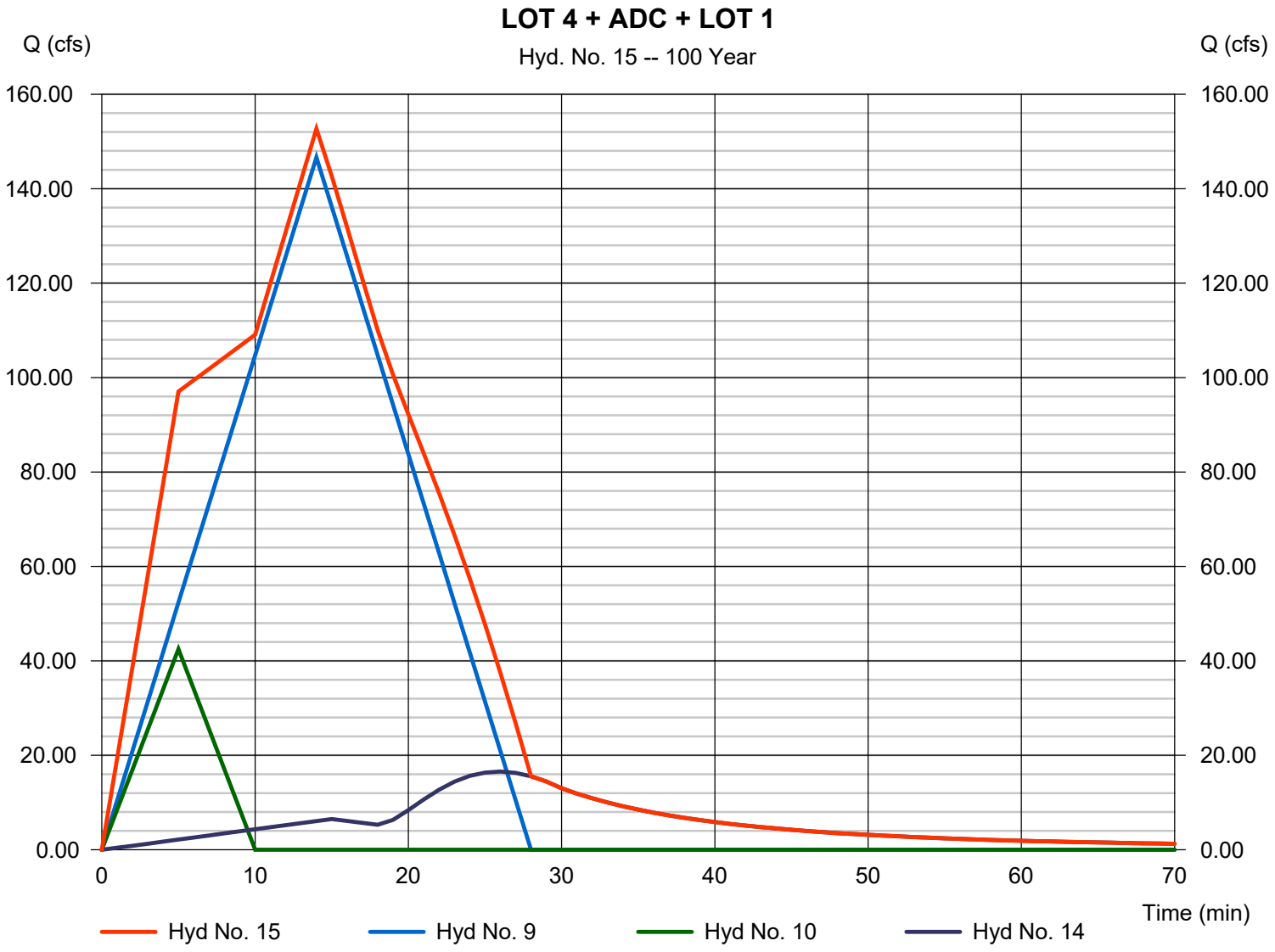


Hydrograph Report

Hyd. No. 15

LOT 4 + ADC + LOT 1

Hydrograph type	=	Combine	Peak discharge	=	152.70 cfs
Storm frequency	=	100 yrs	Time to peak	=	14 min
Time interval	=	1 min	Hyd. volume	=	195,995 cuft
Inflow hyds.	=	9, 10, 14	Contrib. drain. area	=	22.420 ac



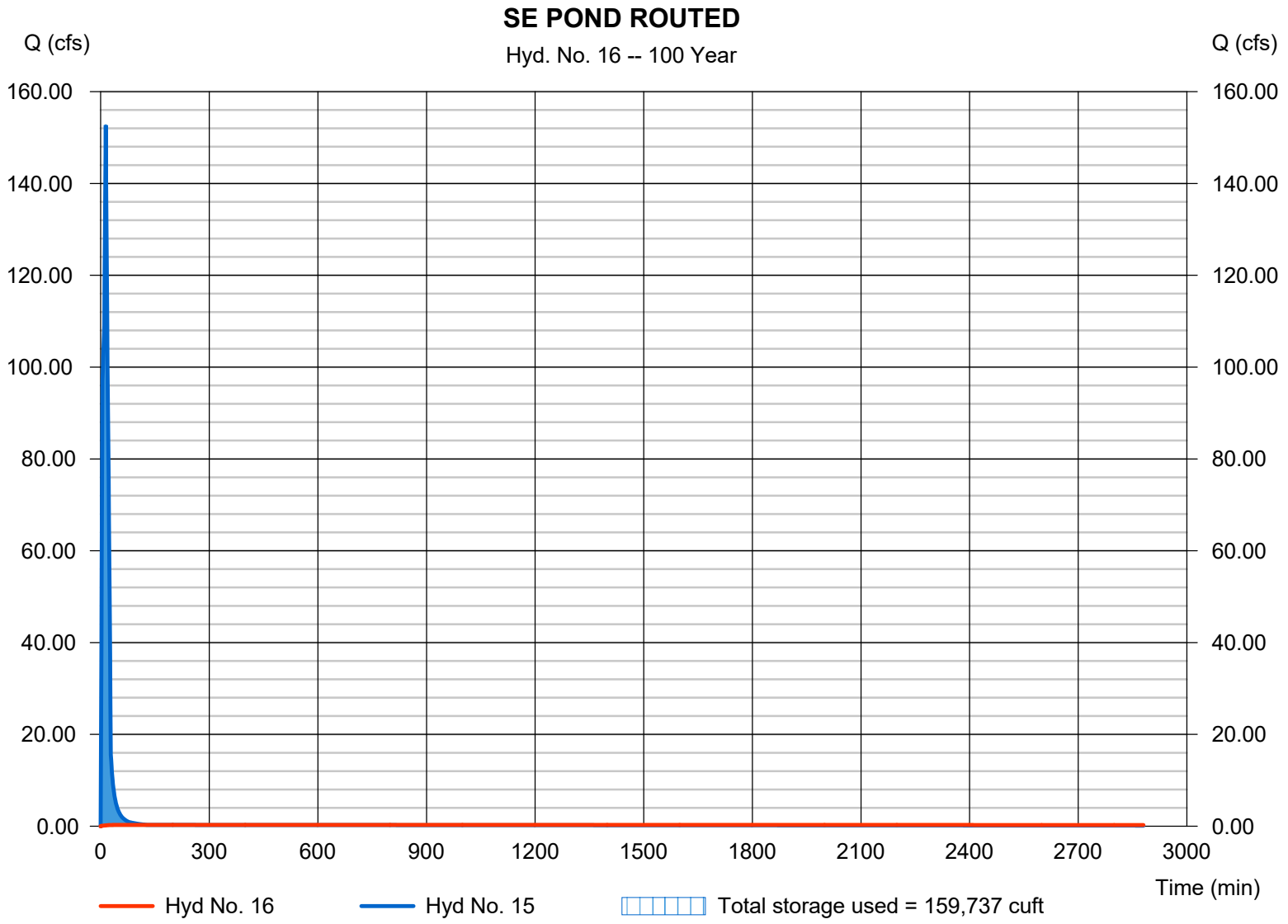
Hydrograph Report

Hyd. No. 16

SE POND ROUTED

Hydrograph type	=	Reservoir	Peak discharge	=	0.285 cfs
Storm frequency	=	100 yrs	Time to peak	=	130 min
Time interval	=	1 min	Hyd. volume	=	48,139 cuft
Inflow hyd. No.	=	15 - LOT 4 + ADC + LOT 1	Max. Elevation	=	980.45 ft
Reservoir name	=	SE POND	Max. Storage	=	159,737 cuft

Storage Indication method used.



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	0.0000	0.0000	0.0000	--------
2	79.5706	15.0000	0.8977	--------
3	0.0000	0.0000	0.0000	--------
5	100.0945	17.1000	0.8850	--------
10	90.6951	15.4000	0.8336	--------
25	112.5419	15.8000	0.8190	--------
50	135.5891	16.1000	0.8156	--------
100	160.7297	16.8000	0.8186	--------

File name: APWA 2011 K.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	5.41	4.42	3.76	3.27	2.90	2.61	2.37	2.18	2.02	1.88	1.76	1.65
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	6.47	5.40	4.65	4.09	3.66	3.31	3.03	2.79	2.59	2.42	2.27	2.14
10	7.34	6.12	5.27	4.64	4.16	3.77	3.46	3.19	2.97	2.78	2.62	2.47
25	9.37	7.86	6.80	6.01	5.40	4.91	4.51	4.18	3.89	3.65	3.44	3.25
50	11.27	9.48	8.22	7.28	6.55	5.96	5.48	5.08	4.74	4.44	4.19	3.96
100	12.90	10.89	9.47	8.40	7.57	6.90	6.35	5.89	5.50	5.16	4.86	4.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: C:\AP\Hydraflow\Town Centre LSMO.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	1.37	3.71	0.00	3.30	5.20	6.00	6.80	7.80
SCS 6-Hr	0.00	1.80	0.00	0.00	2.60	0.00	0.00	4.00
Huff-1st	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Huff-2nd	2.49	3.10	0.00	4.01	4.64	5.52	6.21	6.90
Huff-3rd	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-4th	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-Indy	0.00	1.55	0.00	2.75	4.00	5.38	6.50	8.00
Custom	0.00	1.75	0.00	2.80	3.90	5.25	6.00	7.10

Weir Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Jun 9 2022

Emergency Spillway

Rectangular Weir

Crest	= Broad
Bottom Length (ft)	= 175.00
Total Depth (ft)	= 1.50

Calculations

Weir Coeff. Cw	= 2.60
Compute by:	Known Q
Known Q (cfs)	= 152.70

Highlighted

Depth (ft)	= 0.48
Q (cfs)	= 152.70
Area (sqft)	= 84.48
Velocity (ft/s)	= 1.81
Top Width (ft)	= 175.00

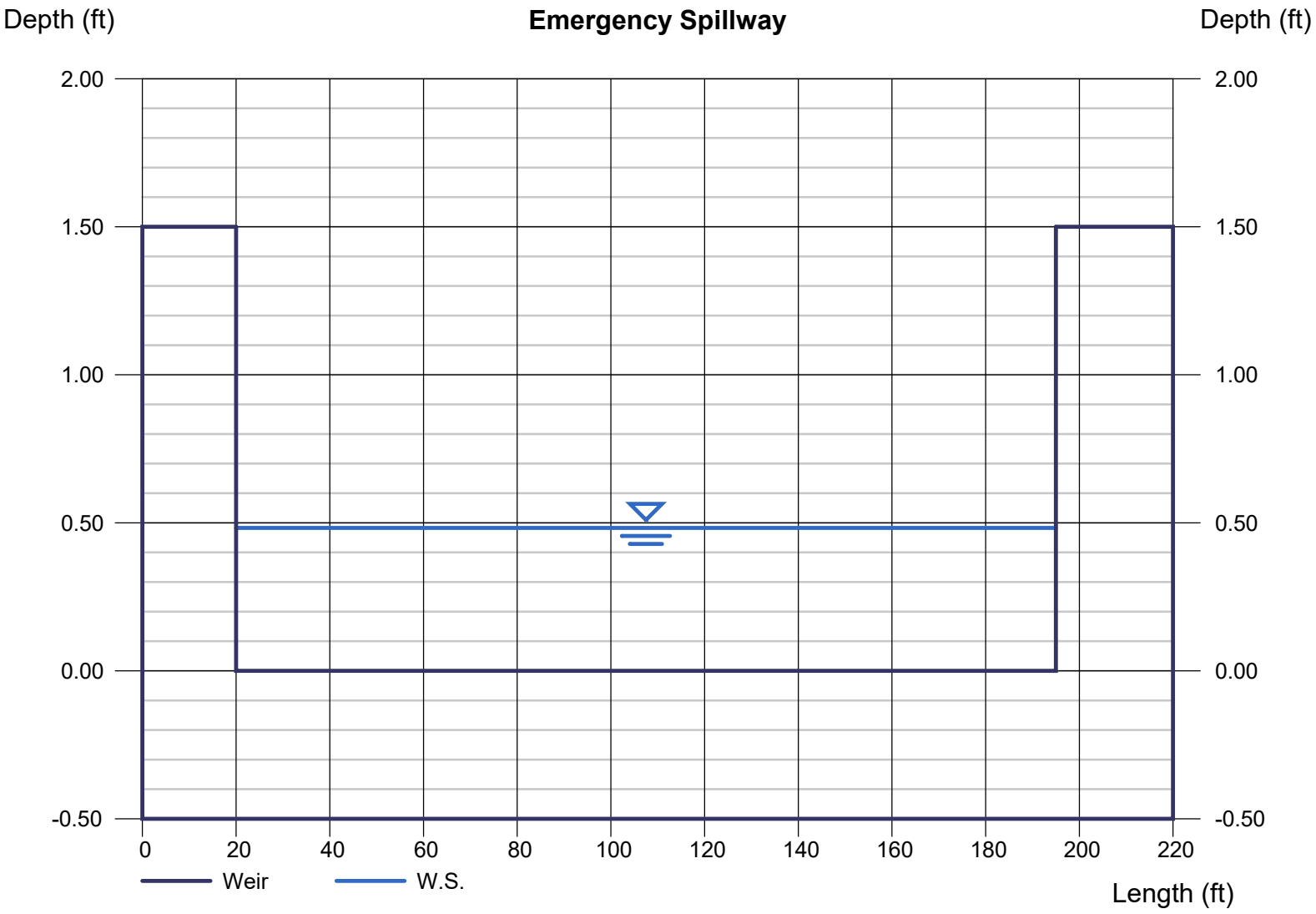


Exhibit H

Proposed Drainage Area Map

North

0 40' 80' 160'

PROPOSED DRAINAGE MAP

SCALE: 1" = 80'

NE TOWN CENTRE BLVD

POI NW

NW

SE

NE

S

POI S

NE TOWN CENTRE BLVD

NE INDEPENDENCE AVENUE

LOT 1 - LEE'S SUMMIT TOWN CENTRE

SW

POI SE

POI NE

AUTOMOTIVE DETAIL CENTER

POI SW

NE TOWN CENTRE DRIVE

ENGINEERING SOLUTIONS
ENGINEERING & SURVEYING
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005032186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

TOWN CENTRE VACANT GROUND
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Project: TOWN CENTER, LSMO

Issue Date: June 6, 2022

Proposed Drainage Map
Preliminary Plans for:
Town Centre Future Lot 4
Lee's Summit, Jackson County, Missouri

STATE OF MISSOURI
MATTHEW J. SCHLICHT
NUMBER PE-2006019708
PROFESSIONAL ENGINEER

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

Exhibit I

Detention Basin Plan

DETENTION BASIN PLAN

SCALE: 1" = 40'

NOTES:

1. THE BASIN SHALL BE CONSTRUCTED WITH THE EROSION AND SEDIMENT CONTROL MEASURES.
2. AN AS-BUILT DETENTION BASIN PLAN SHALL BE SUBMITTED AND ACCEPTED PRIOR TO ISSUANCE OF A CERTIFICATE OF SUBSTANTIAL COMPLETION, WITH AS-BUILT VERSUS PROPOSED STORAGE.

Galvanized
Trash Guard
For Influent Flared End

CONTROL STRUCTURE – BASIN SE

$\frac{1}{4}$" = 1'-0"

SECTION VIEW – BASIN SE

N.T.S.

ENGINEERING
ENGINEERING & SURVEYING
SOLUTIONS
50 SE 30TH STREET
LEE'S SUMMIT, MO 64082
P:(816) 623-9888 F:(816)623-9849

Professional Registration
Missouri
Engineering 2005002186-D
Surveying 2005008319-D
Kansas
Engineering E-1695
Surveying LS-218
Oklahoma
Engineering 6254
Nebraska
Engineering CA2821

TOWN CENTRE VACANT GROUND
LEE'S SUMMIT, JACKSON COUNTY, MISSOURI

Project:
TOWN CENTER,
LSMO

Issue Date:
June 6, 2022

Detention Basin Plan
Preliminary Plans for:
Town Centre Future Lot 4
Lee's Summit, Jackson County, Missouri

MATTHEW J. SCHLICHT
NUMBER
PE-2006019708

Matthew J. Schlicht
MO PE 2006019708
KS PE 19071
OK PE 25226

REVISIONS

EXHIBIT

Exhibit J

40 Hour Extended Detention Calculations

Calculate Water Quality for Storm Study

Project: FUTURE LOT 4 - TOWN CENTRE Date: 6-10-22

To Calculate: WQv = P * Rv * A

P (in) =	1.37
P (ft) =	0.11
Impervious Area (sq. ft.) =	846,432.39
Total Area (sq. ft.) =	976,615.20
Impervious Area (ac) =	19.43
Total Area (acre) =	22.42
Rv = (0.05 * 0.009(I)) =	0.83
Percent Impervious (I) =	86.67
WQ_v (cu. ft.) =	92,546
WQ_v (ac. ft.) =	2.125

Enter data in these Fields

Unit Conversions
1 Acre = 43,560 Sq. Ft.

18.4

4.02

C = 0.82

Pond Volume

Elevation	Area (Sq. Ft.)	Volume (Cu. Ft.)
977.50	-	-
978.00	2,104.00	526.00
979.00	8,661.00	5,908.50
980.00	19,505.00	19,991.50
981.00	34,620.00	47,054.00
982.00	49,338.00	89,033.00
983.00	62,913.00	145,158.50
984.00	75,079.00	214,154.50
985.00	83,515.00	293,451.50
986.00	87,022.00	378,720.00
987.00	90,587.00	467,524.50
988.00	94,208.00	559,922.00

40 HOUR DETENTION CALC.

To Calculate: 40 Hour Detention (EDDB)

I. Basin Water Quality Storage Volume

Step 1) Tributary area To EDDB, A_t (ac) =	A_T (ac) =	22.42
Step 2) Calculate WQ_v using Sec. 6 (ac-ft) =	WQ_v (ac. ft.)=	2.125
Step 3) Add 20 Percent to Step 2.	V_{design} (ac-ft) =	2.549

II.a. Water Quality Outlet Type

Step 1) Set water quality outlet type
Type 1 = single orifice
Type 2 = perforated riser or plate
Type 3 = v-notch weir

Outlet Type = 2

Step 2) Proceed to Step IIb, IIc, or IId based on selection

To Calculate Z_{WQ} (ft) interpolate from Storm Study (Sheet 13)

Elevation 1 =	982.00	Storage 1 =	89,033.00
Elevation X =		Storage X =	92,545.77
Elevation 2 =	983.00	Storage 2 =	145,158.00
		Elevation X =	982.06
Lowest Elevation of Pond =	977.50		
Elevation X =	982.06		
Z_{WQ} (ft) =	4.56		

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation:	Z_{WQ} (ft) =	4.56
Step 2) Recommended maximum outlet area per row:	A_0 (in^2) =	1.809
Step 3) Circular perforation diameter per row assuming a single column:	D_1 (in) =	0.410
1	n_c (unitless) =	1
Step 5) Design circular perforation diameter (should be between 1 and 2 inches):	D_{perf} (in) =	1.000
Step 6) Horizontal perforation column spacing when n_c > 1, center to center:	S_c (in) =	4
Step 7) Number of rows (4" vertical spacing between perforations, center to center):	n_r (unitless) =	14

Calculates the diameter of each hole given the depth of water and the area per row. Assuming 4" spacing. If less than 1" use 1" as D_{perf}.

Note: If $D_{perf} \geq 1.0$ inch, $S_c = 4$

Recommended Method: Perforated Riser