

Macro Storm Water Study

for:

Lot 1 – Lee’s Summit Town Centre

Lee’s Summit, MO 64064

Prepared for:

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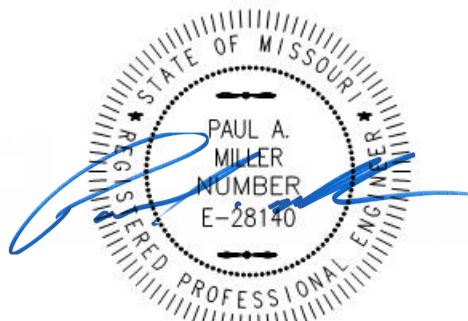
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General Information

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.

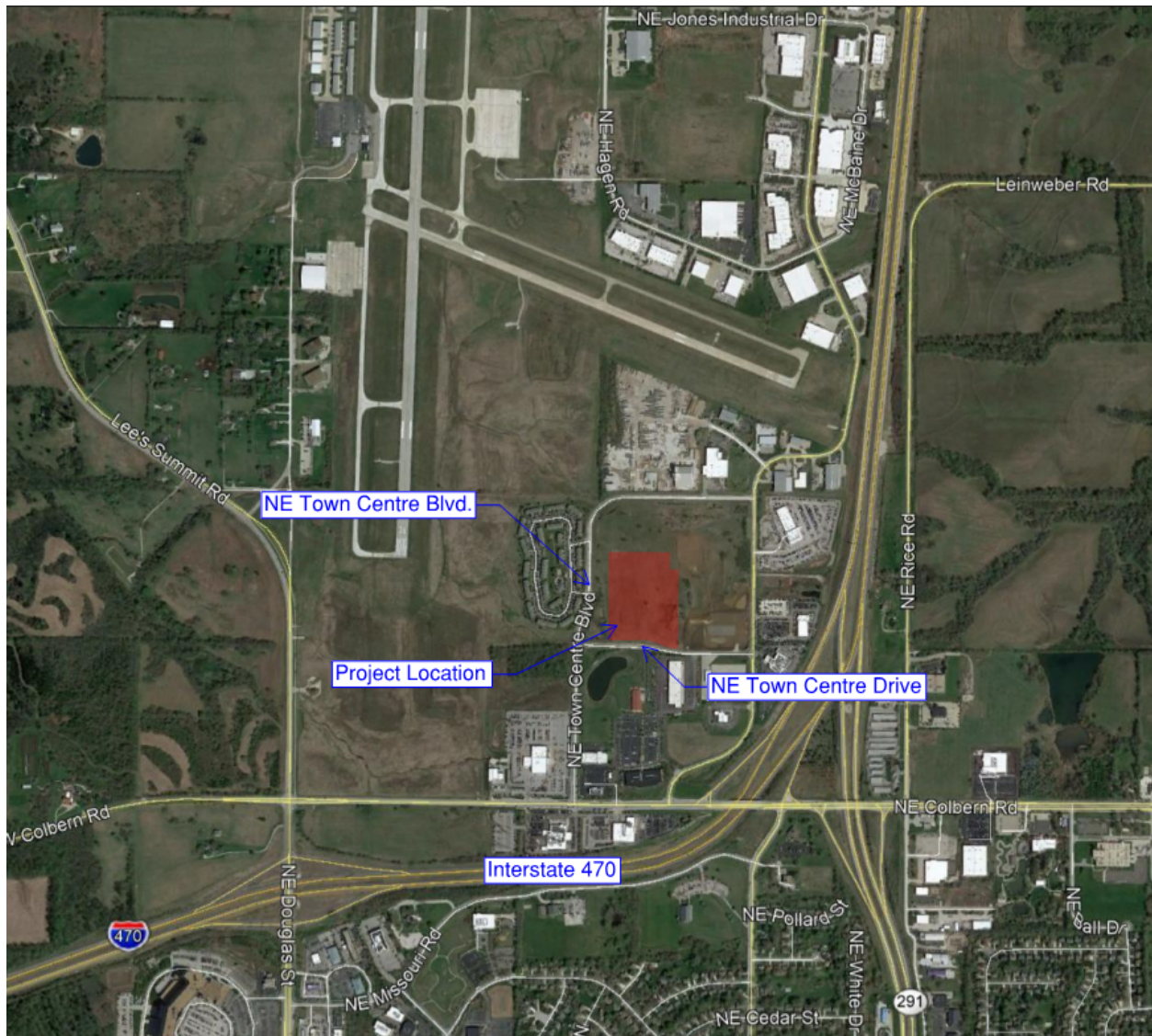


Figure 1. - Location Map (no scale)

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

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

Utility Legend

existing
proposed

Linetypes

sanm	sanitary main
sans	sanitary service
stm	storm sewer (existing)
stm	storm sewer (solid wall, proposed)
stm	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
datu	underground cable/phone/data service
fence-chainlink	fence-chainlink
fence-wood	fence-wood
fence-barbed wire	fence-barbed wire
treeline	treeline

Symbols

S	sanitary manhole
co	service cleanout
fmv	force main release valve
□	rectangular structure
○	circular structure
Y	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

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:

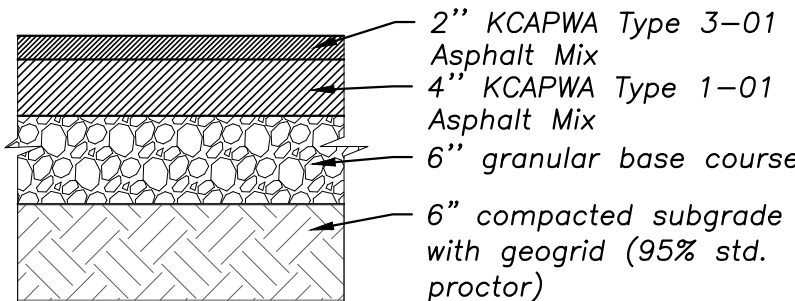
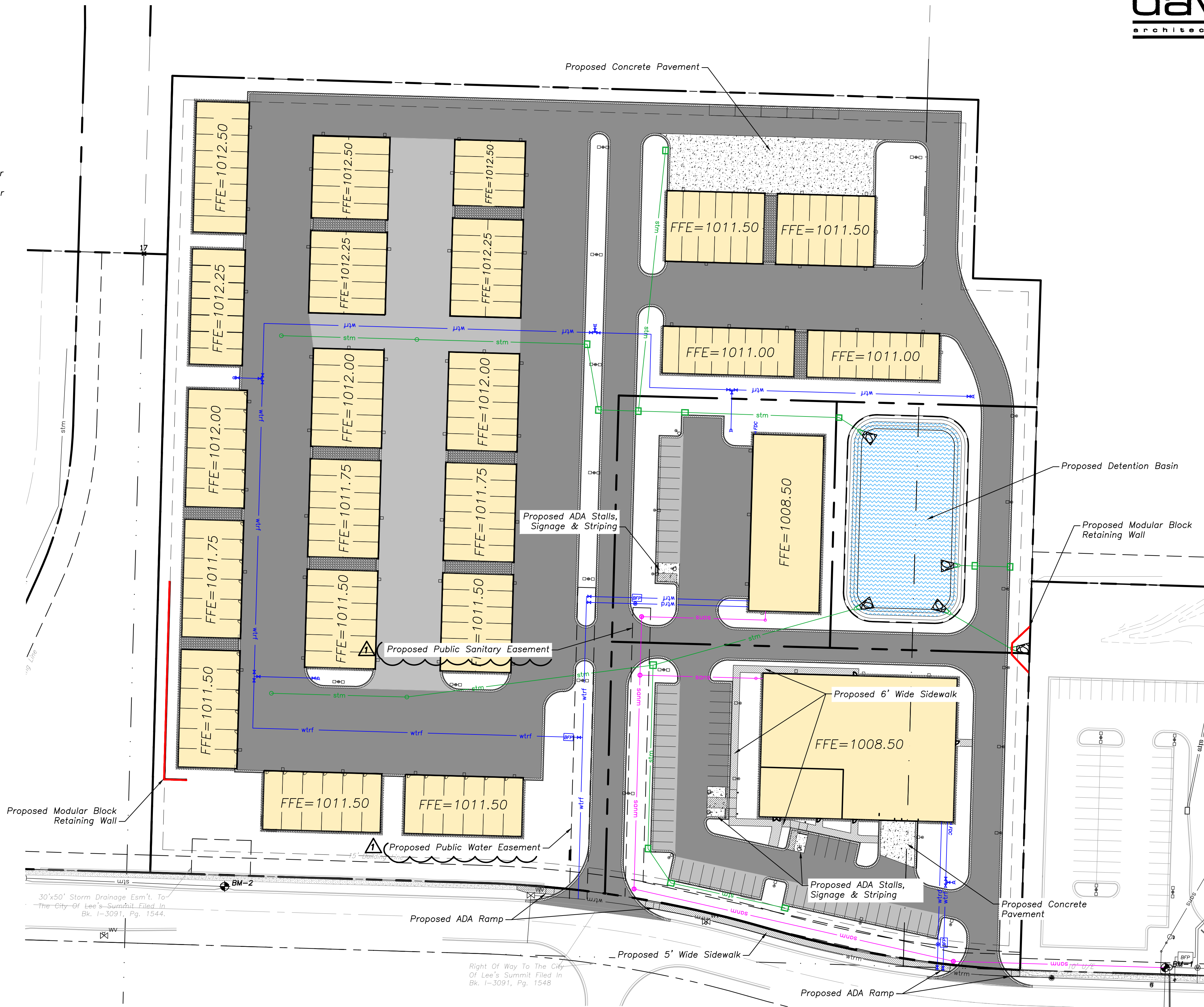
- The running and cross slopes for all sidewalks, accessible paths, ramps, designated parking stalls, etc., shall be in compliance with latest Federal ADA guidelines, in addition to any accessibility standards adopted by the governing municipality. Prior to installation/construction, if any discrepancies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

Property Legend

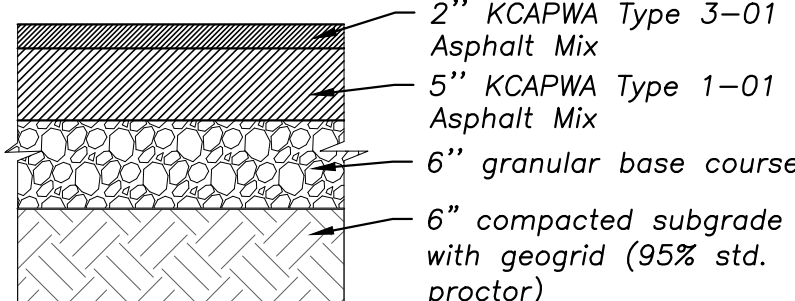
—	right of way
—	property lines
—	easements
—	setbacks

Grading Legend

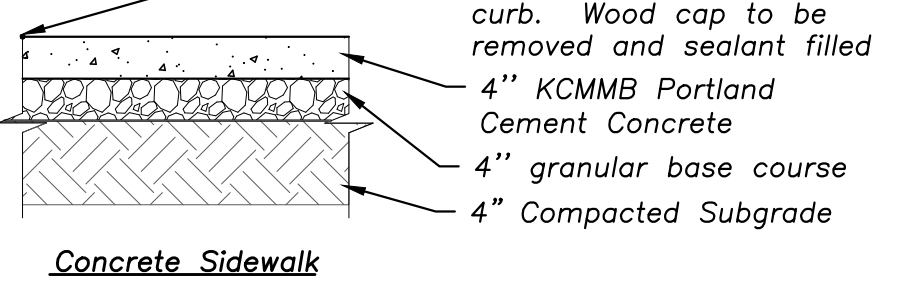
—	existing minor contour
—	existing major contour
—	proposed minor contour
—	proposed major contour



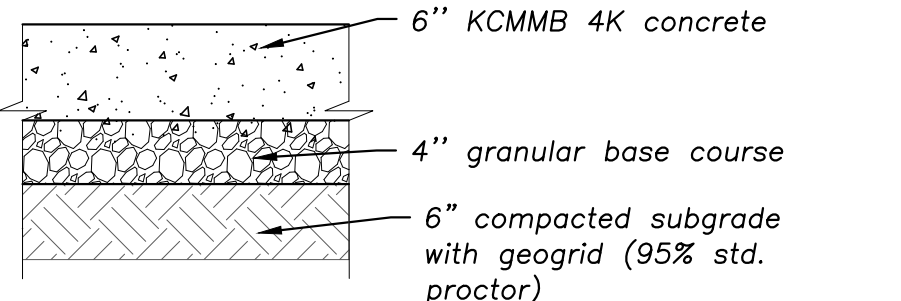
Standard Asphalt Pavement Section



Heavy Duty Asphalt Pavement Section



Concrete Sidewalk



Concrete Pavement Section



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

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

C1.2

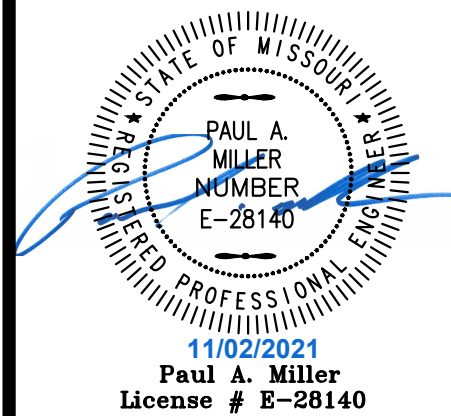
drawing type
PDP & Rezoning

project number
20231

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Soil Map—Jackson County, Missouri



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, NGS12
National Geodetic Survey
SSM-C-3, #2022
1315 East-West Highway
Silver Spring, Maryland 20910-3262
(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 Imagery Program (NAIP) dated 2014. Produced at scale of 1:24,000.

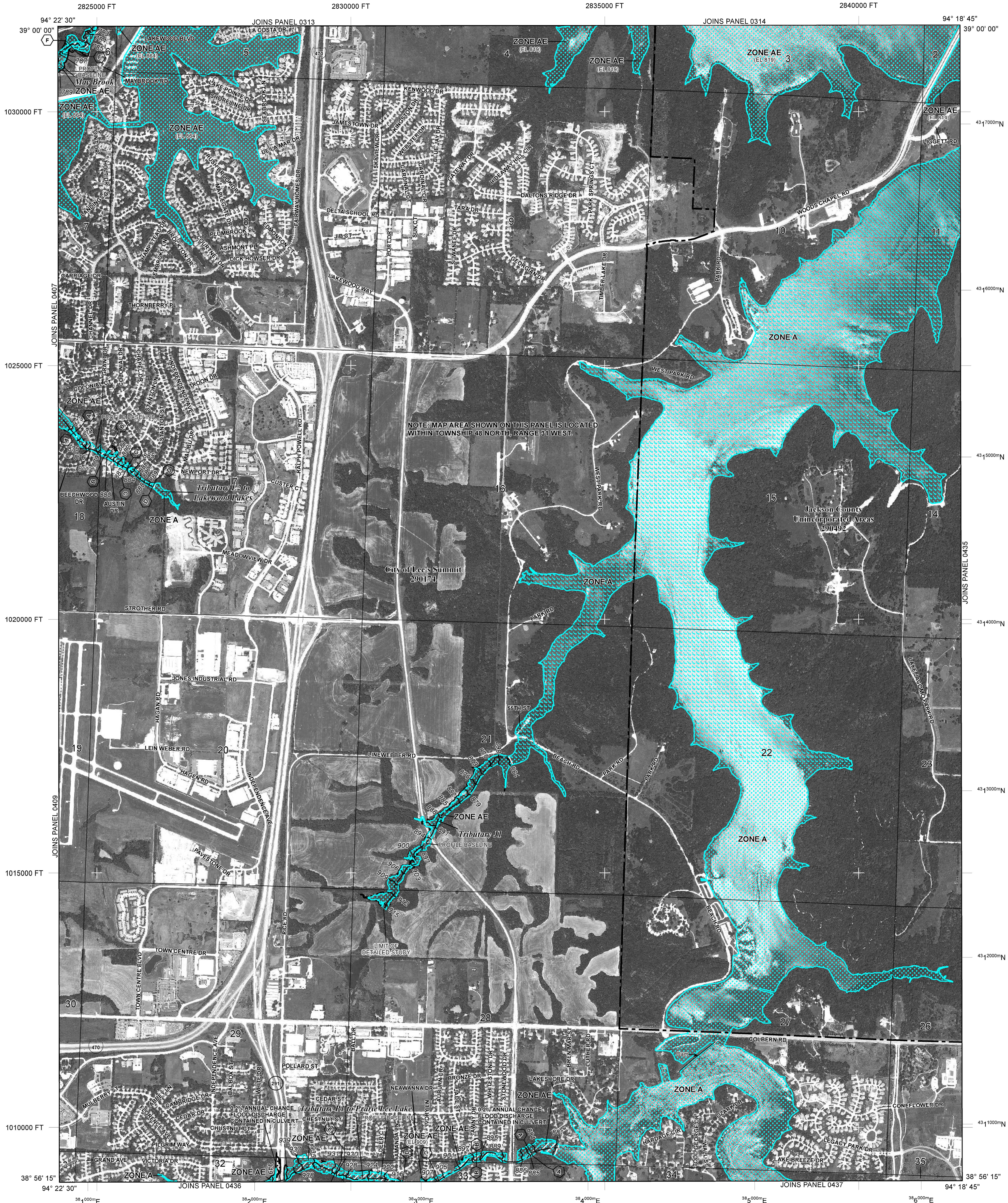
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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 desiccated. 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; areas of flood depths of 1 foot or more, but less than 1 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.

Base Flood Elevation line and value; elevation in feet*

Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

Cross section line

Transect line

Culvert

Bridge

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

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, 2008

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'

800 0 1000 2000 FEET

300 0 300 600 METERS

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
goss natural gas service schematic
elpu underground primary electric
elsu underground secondary electric
elpo overhead electric
datu underground cable/phone/data
datasu 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



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	

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



Local Benchmarks:

BM-1: (Sanitary Sewer Manhole, Center of Lid)
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existing minor contour
existing major contour
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Utility Legend

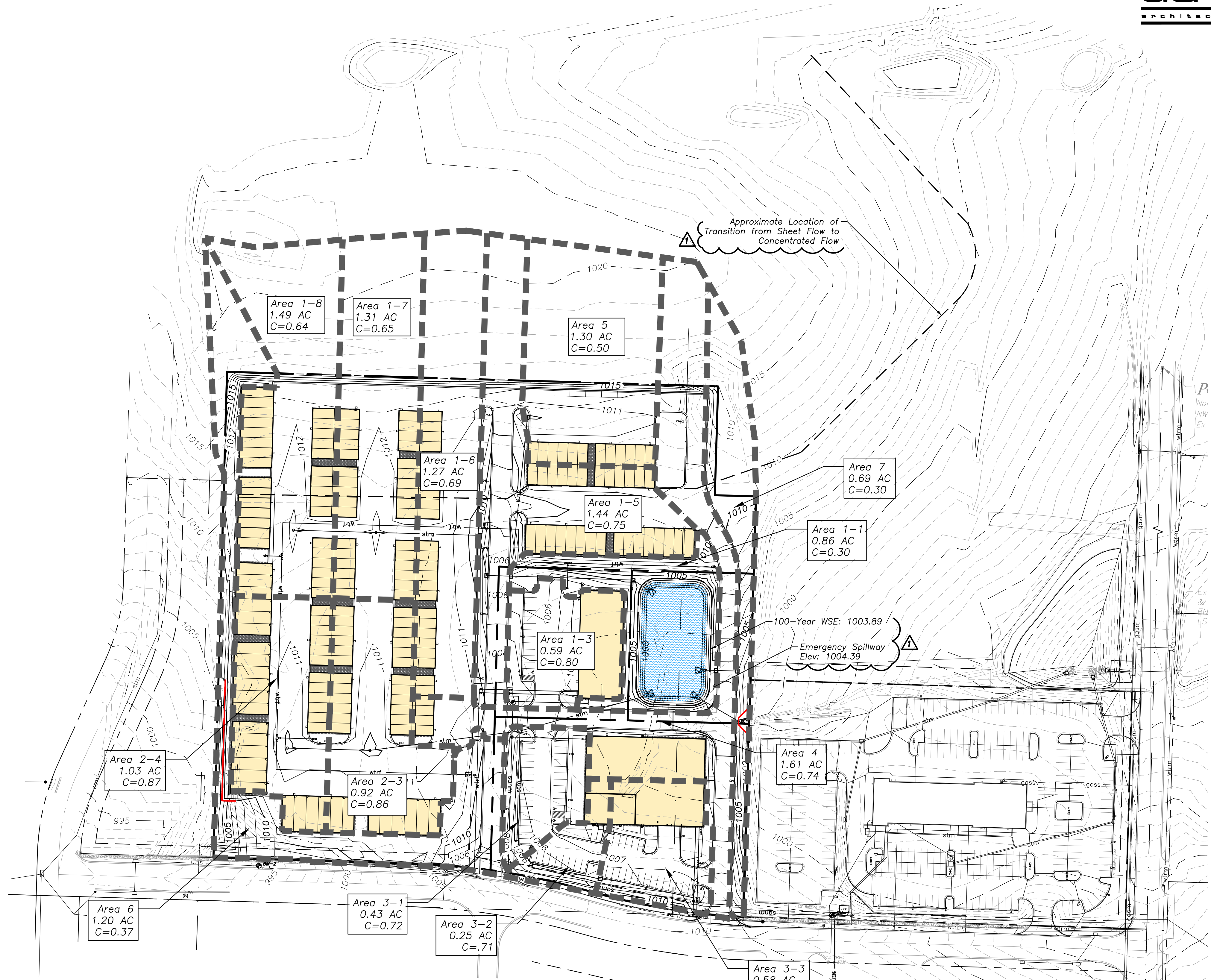
existing
proposed

Linetypes

sanm sanitary main
sans sanitary service
ssm storm sewer (existing)
ssmw storm sewer (solid wall, proposed)
ssm storm sewer (solid wall, proposed)
ssm 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
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datu underground cable/phone/data
datasu underground cable/phone/data service
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service cleanout
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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

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



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

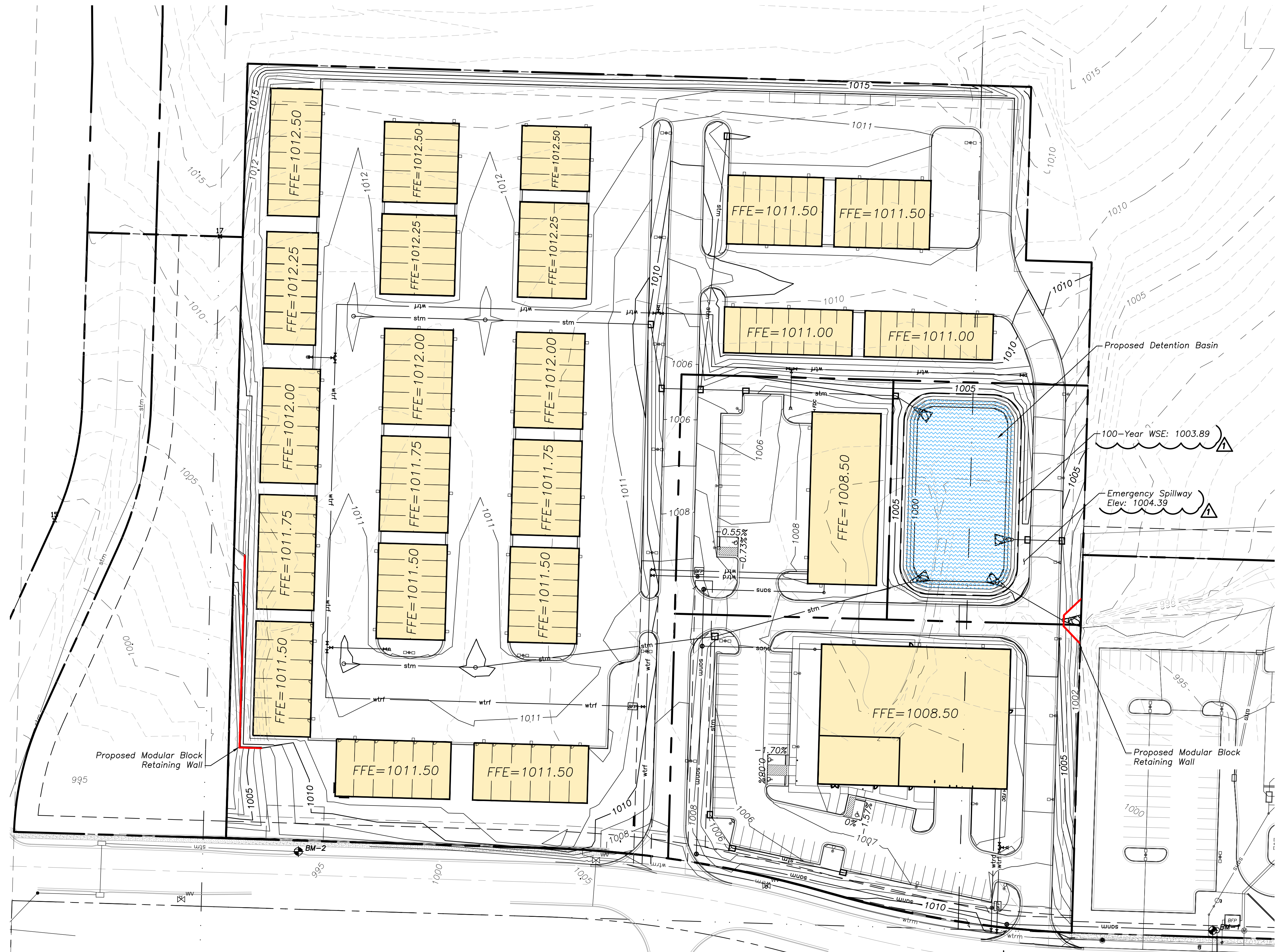
sanm sanitary main
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gass natural gas service schematic
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right of way
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rectangular structure
circular structure
fire hydrant
water valve
water meter
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



1 Grading Plan
scale: 1"=50'



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

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
 Location: Lee's Summit, Missouri

By: JMP
 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

		Change in CN	LS
		17+	8
Predevelopment CN:	80.00	7 to 16	7
		4 to 6	6
Postdevelopment CN:	93.04	1 to 3	5
		0	4
Difference:	13.04	-7 to -1	3
		-8 to -17	2
LS Required (see new scale adopted by KCAPWA BMP Manual Addendum #1 Accepted November 10, 2016)	6.7	-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
Location: Lee's Summit, Missouri

By: JMP
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 Vegetation)	0.73	0	0
Native Vegetation Preserved or Established	1.13	9.25	10.4525
			0
			0
			0
TOTAL²:	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
TOTAL²:	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

\\023\Lee's Summit Town Centre Lot 1 - clh\Civil\Storm\20231 - Hydraflow - 11.2.2021.gpw

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

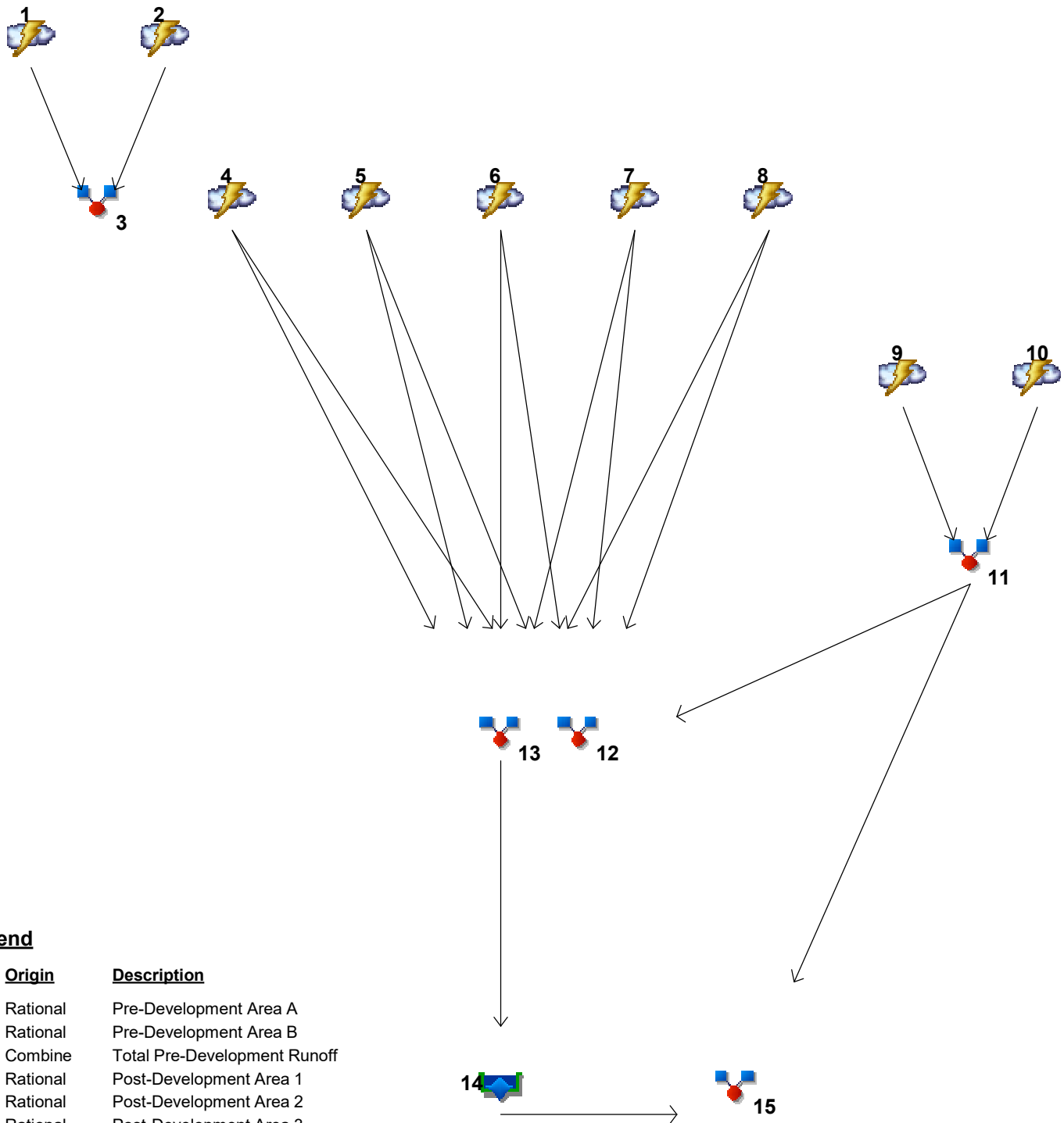
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Watershed Model Schematic

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



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 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, 13	-----	-----	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
P:\20231 Lee's Summit Town Centre Lot 1 - c					Civil 3D Period 2021 Year Hydraflow - 11			2021, gdw 2 / 2021	

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

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

Tuesday, 11 / 2 / 2021

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

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

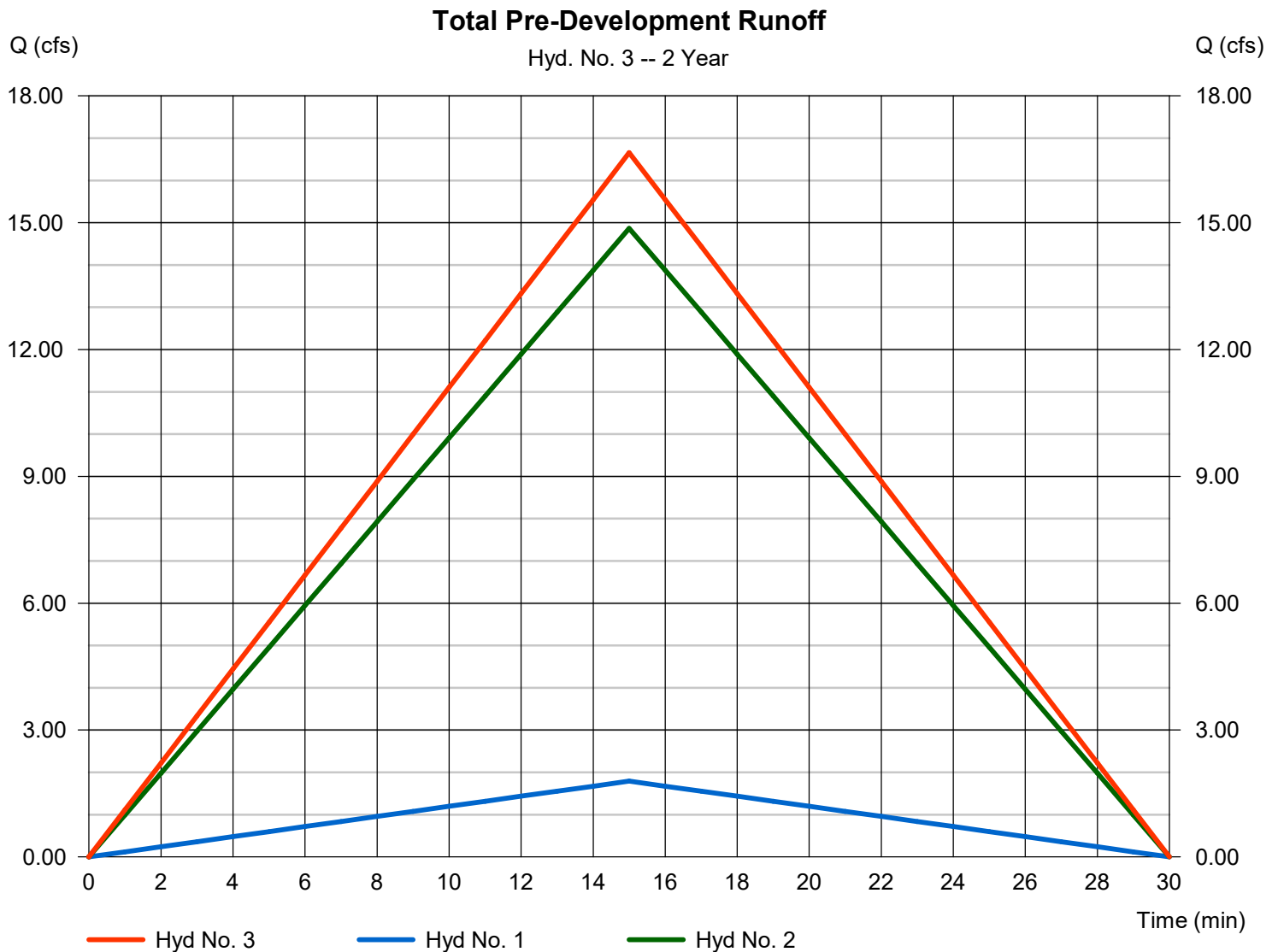
Tuesday, 11 / 2 / 2021

Hyd. No. 3

Total Pre-Development Runoff

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

Peak discharge = 16.66 cfs
 Time to peak = 15 min
 Hyd. volume = 14,993 cuft
 Contrib. drain. area = 14.960 ac



Hydrograph Report

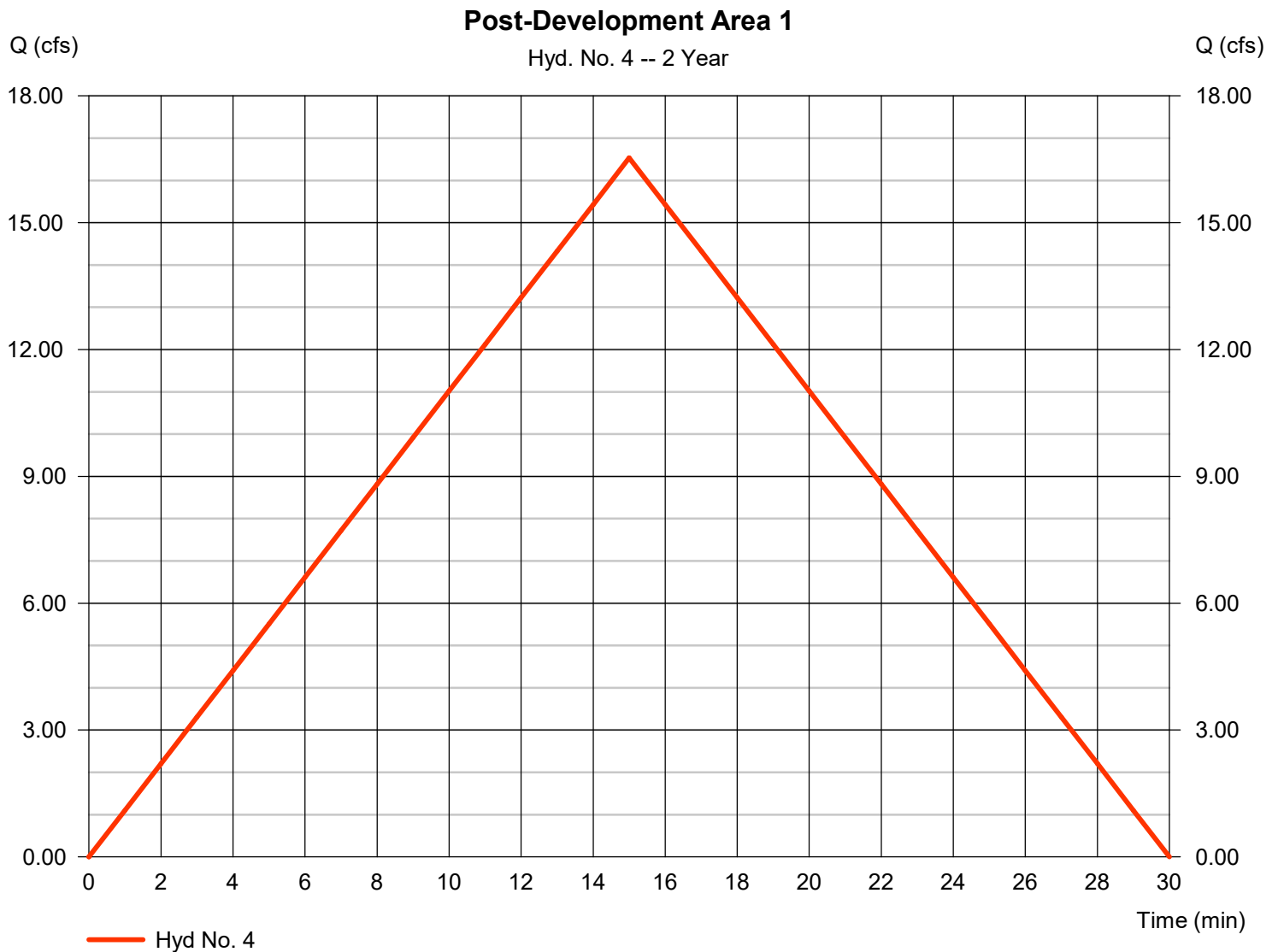
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

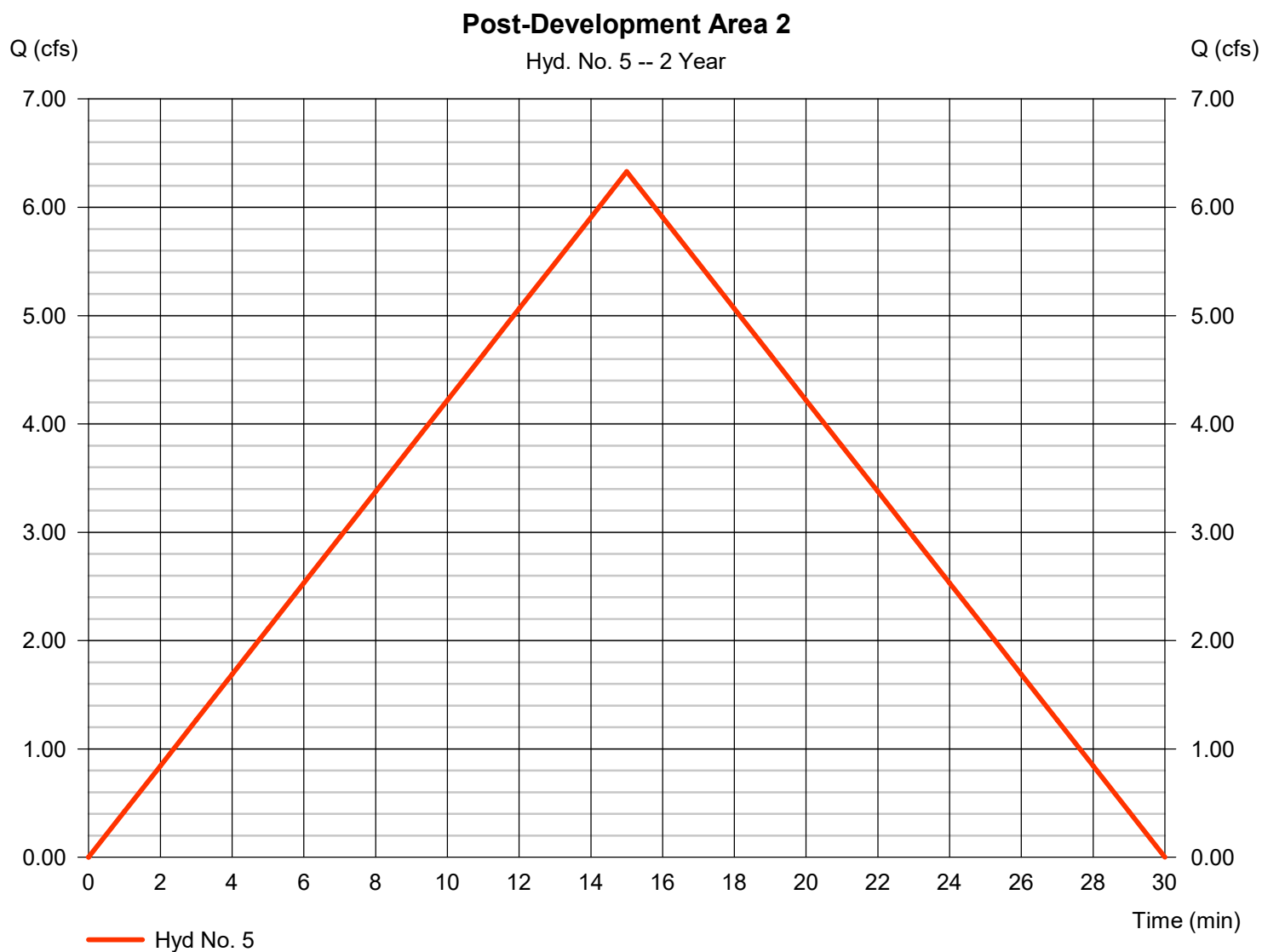
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

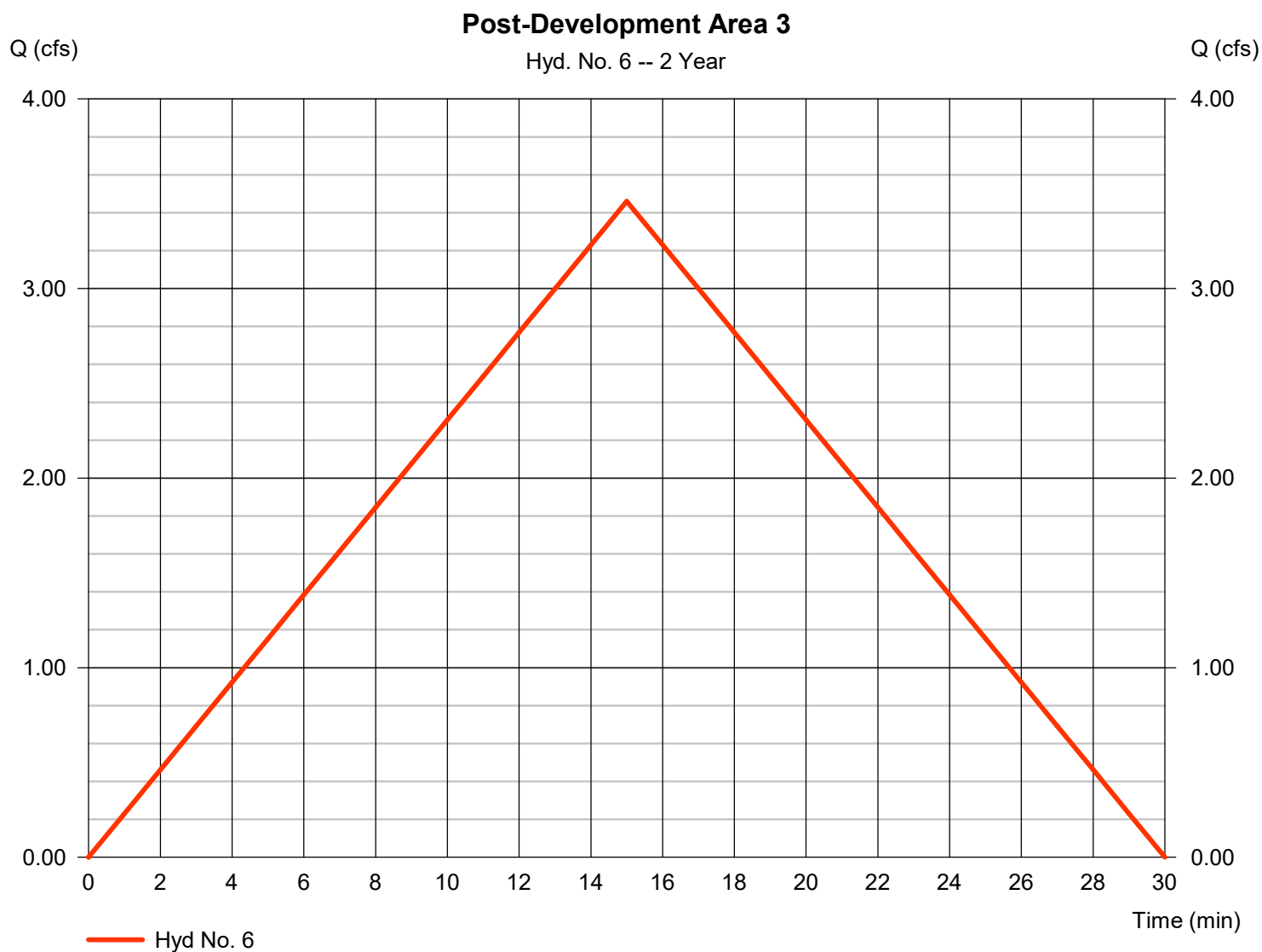
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

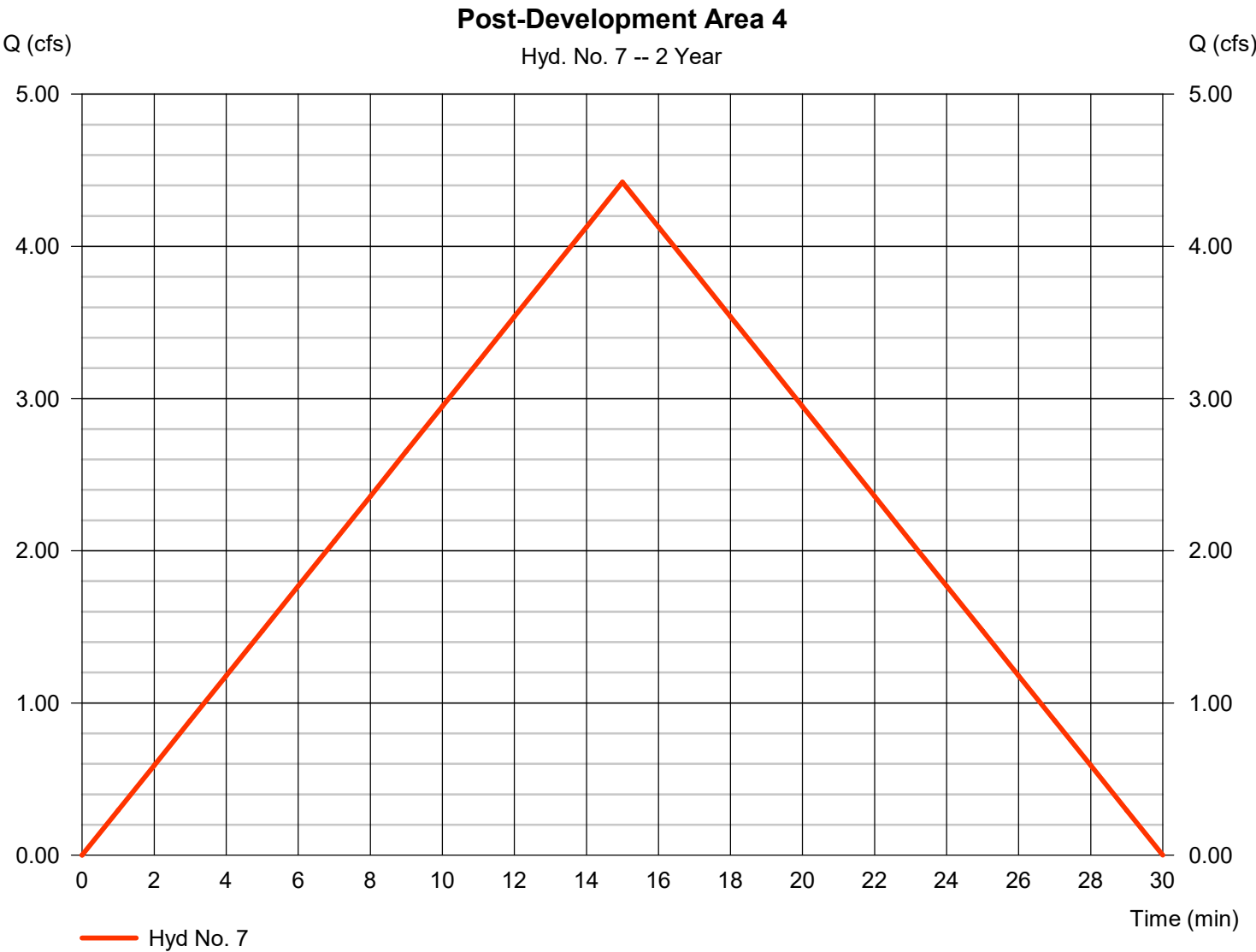
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

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

Tuesday, 11 / 2 / 2021

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

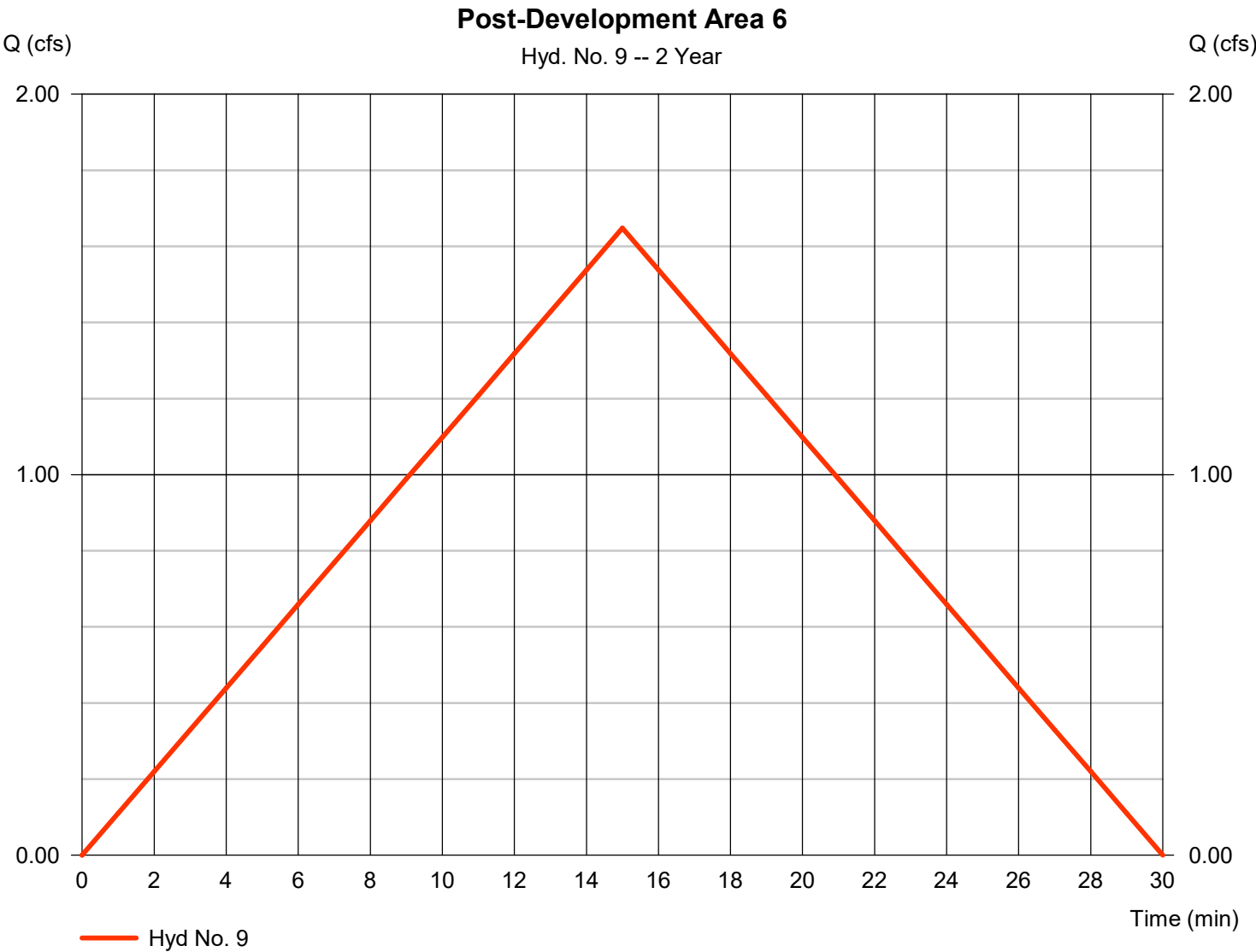


Hydrograph Report

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

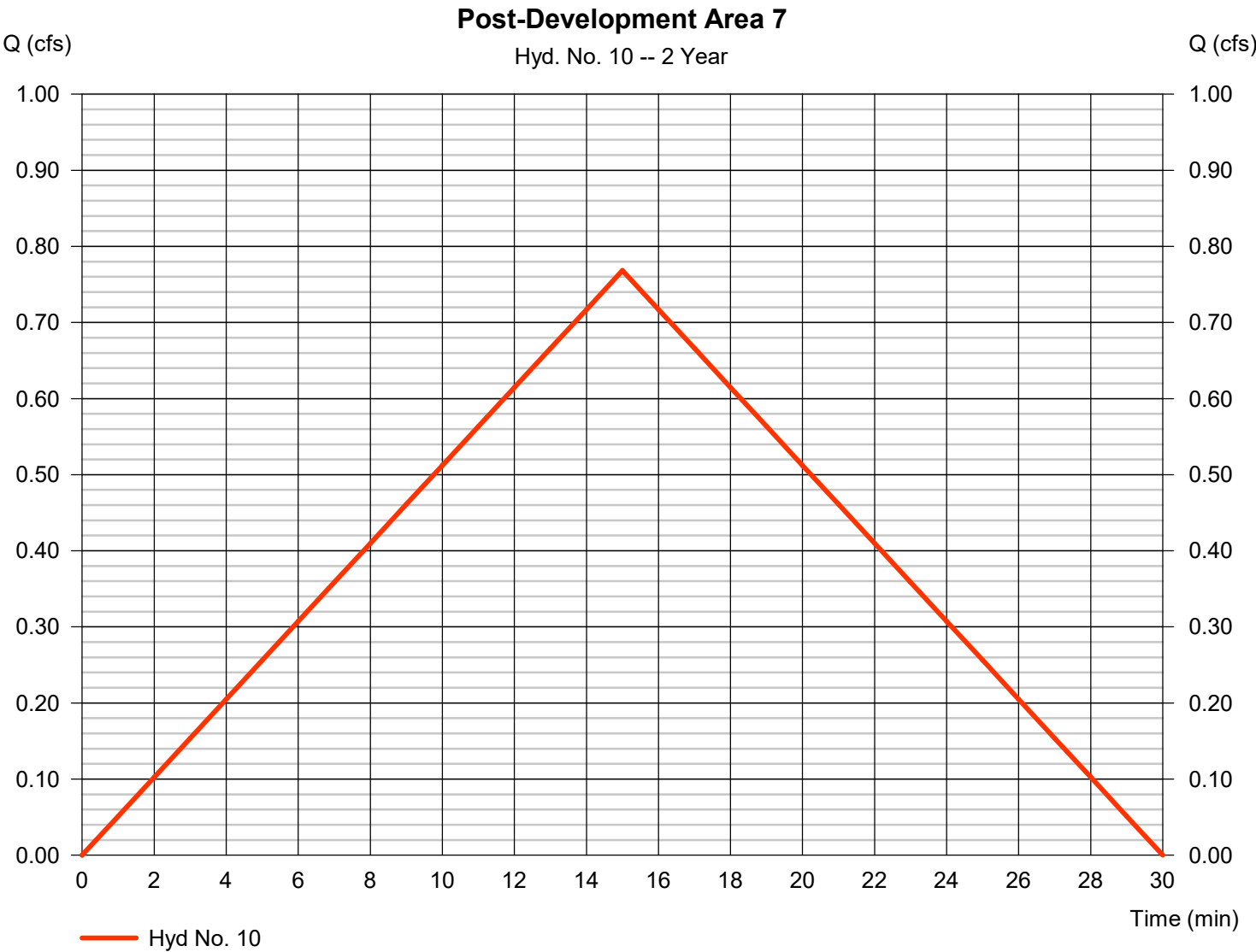


Hydrograph Report

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

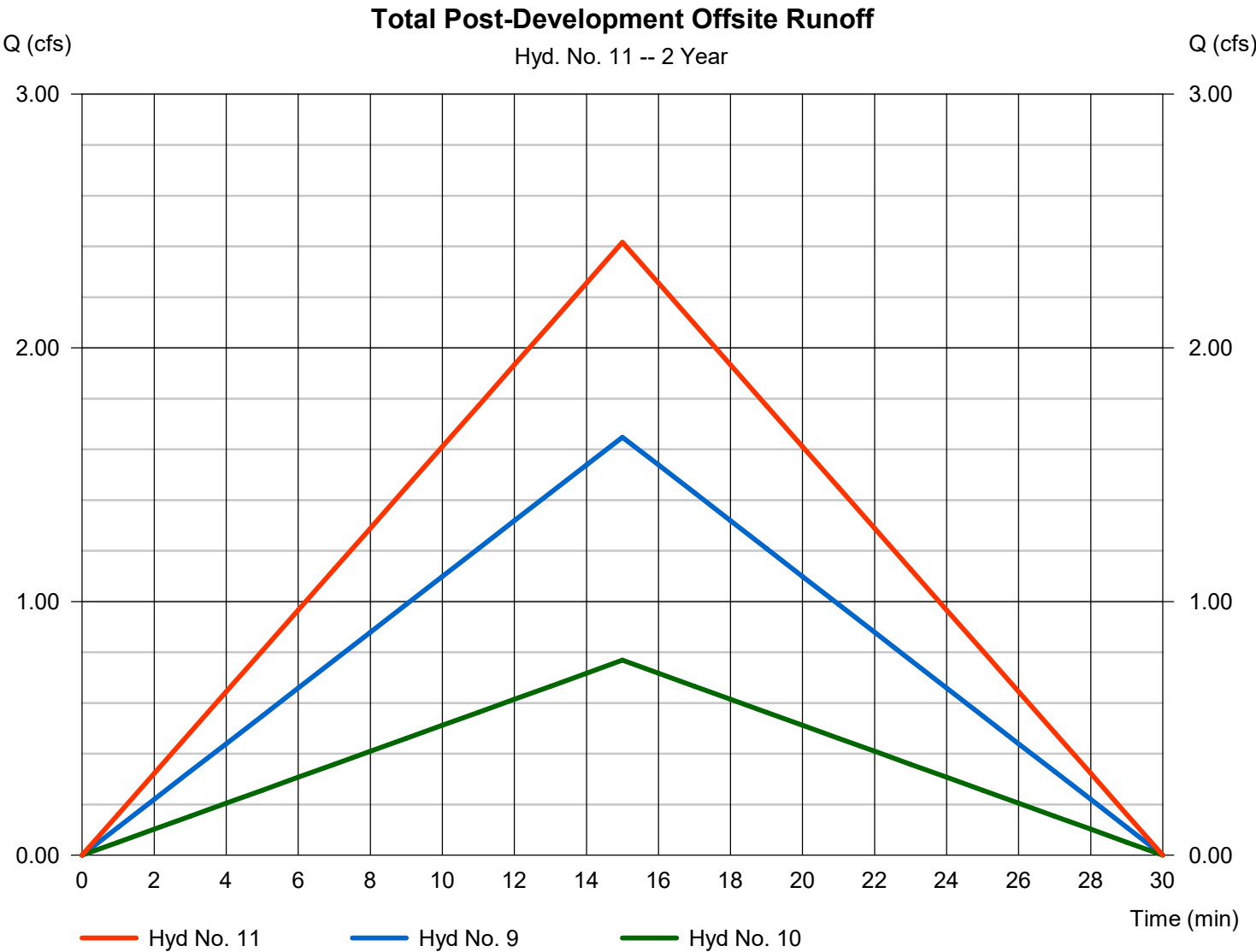
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

Hyd. No. 11

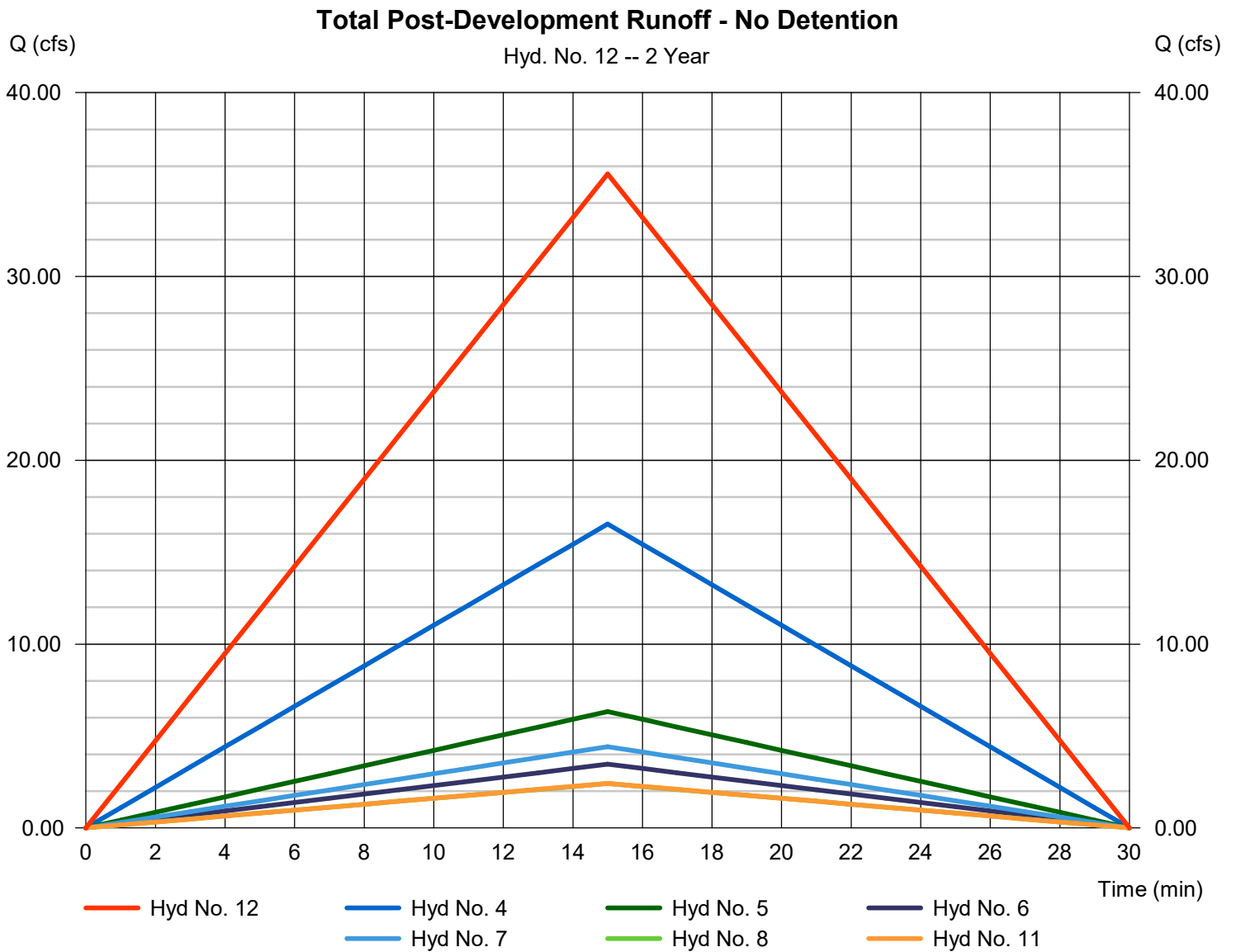
Total Post-Development Offsite Runoff

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



Total Post-Development Runoff - No Detention

Peak discharge = 35.58 cfs
Time to peak = 15 min
Hyd. volume = 32,018 cuft
Contrib. drain. area = 13.090 ac



Hydrograph Report

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

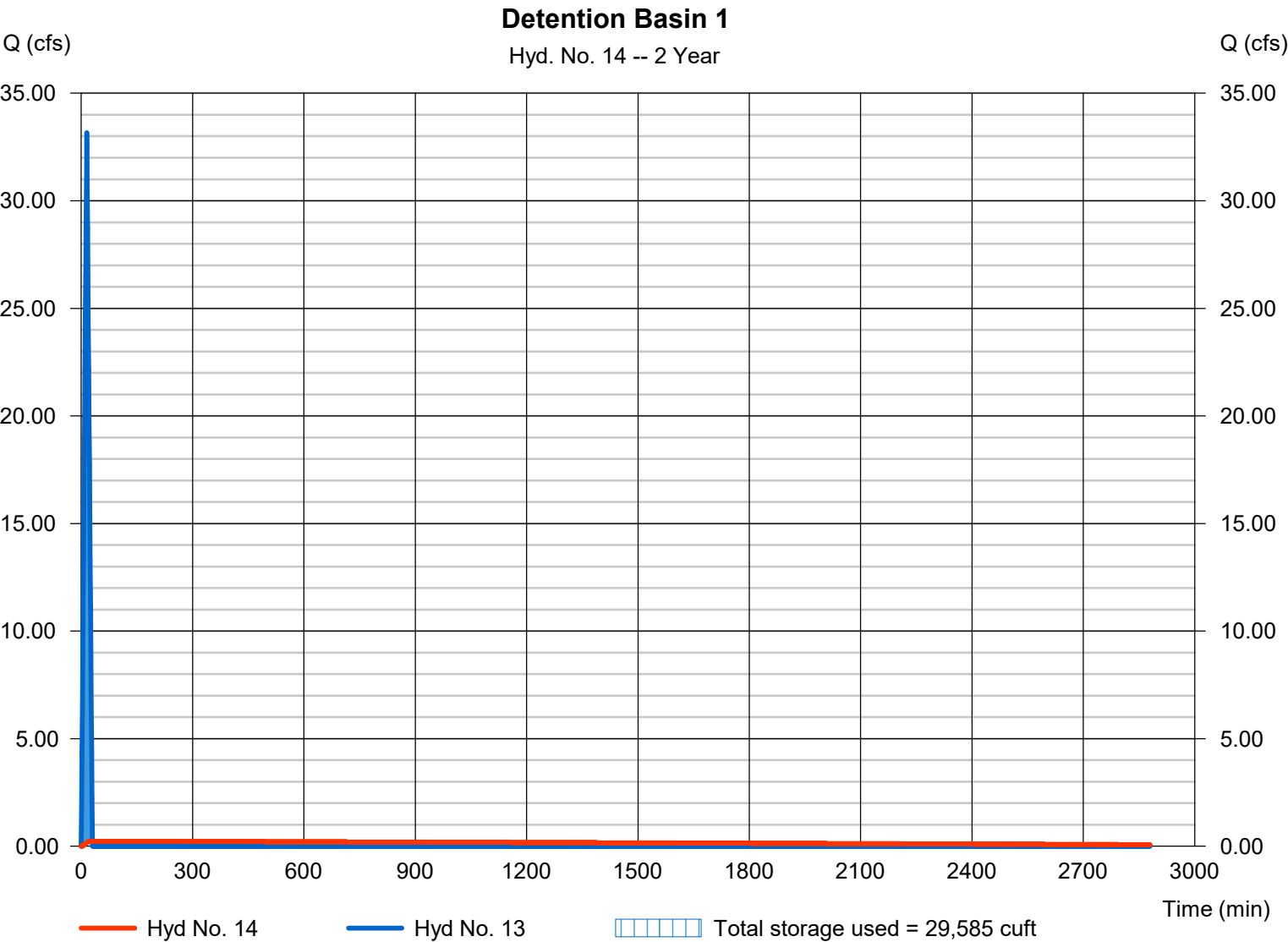
Tuesday, 11 / 2 / 2021

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	Max. Elevation	= 1002.21 ft
Reservoir name	= Detention Basin	Max. Storage	= 29,585 cuft

Storage Indication method used.



Pond Report

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

Tuesday, 11 / 2 / 2021

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

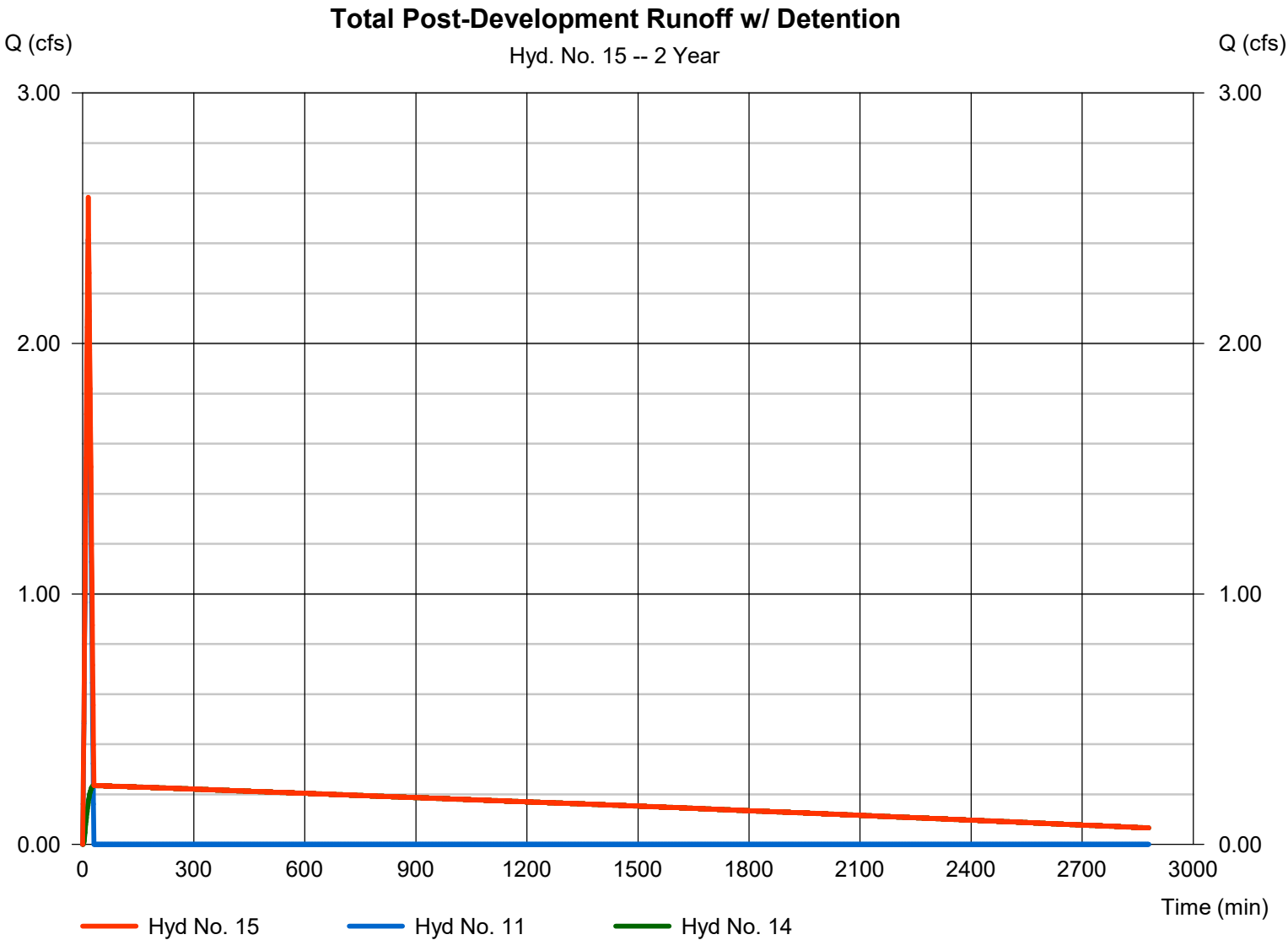
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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, 13	-----	-----	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
P:\20231 Lee's Summit Town Centre Lot 1 - c					Civil 3D 2021 Year 1 Hydraflow - 11			2021, gdw 2 / 2021	

Hydrograph Report

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

Tuesday, 11 / 2 / 2021

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

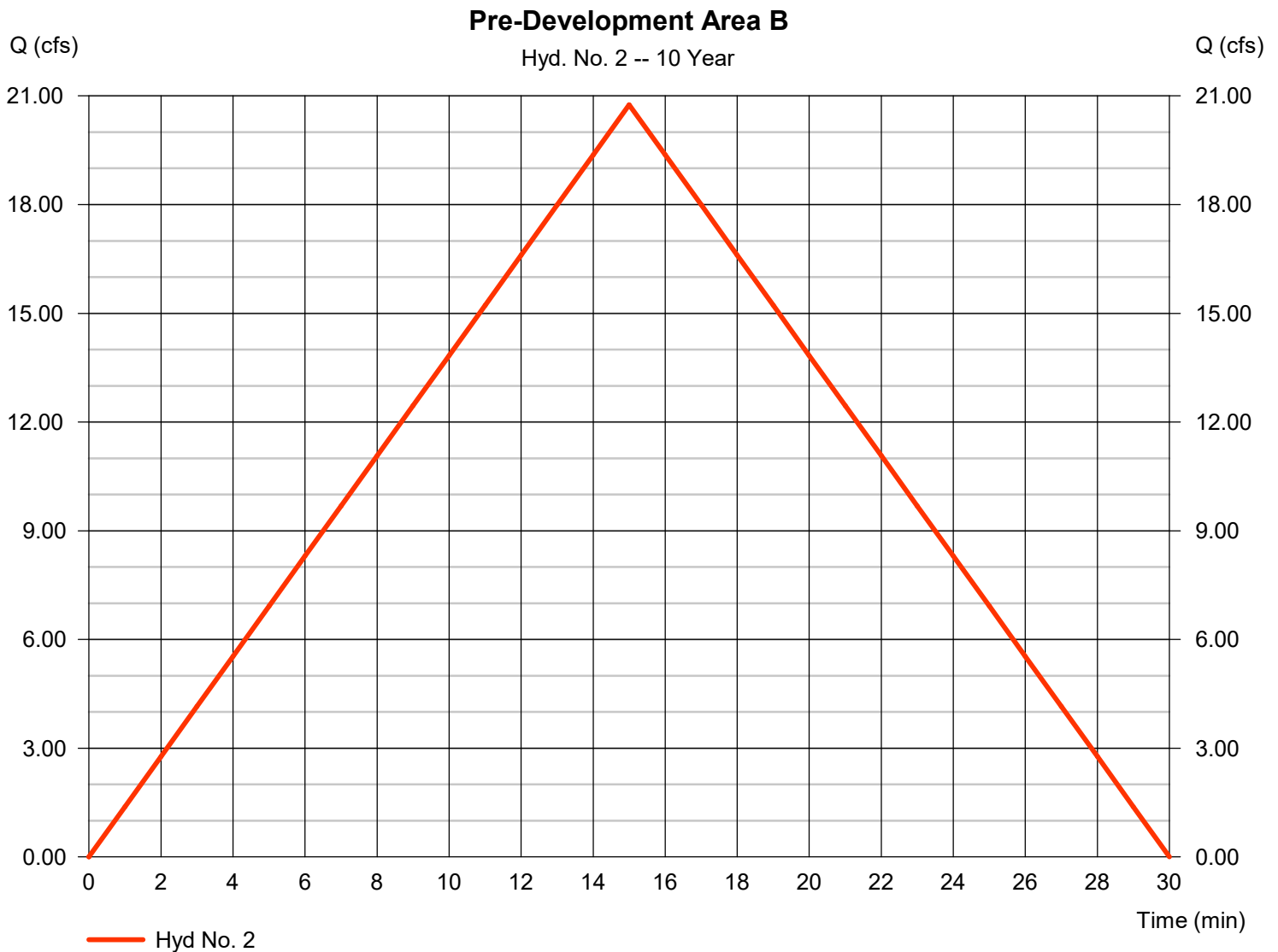
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

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

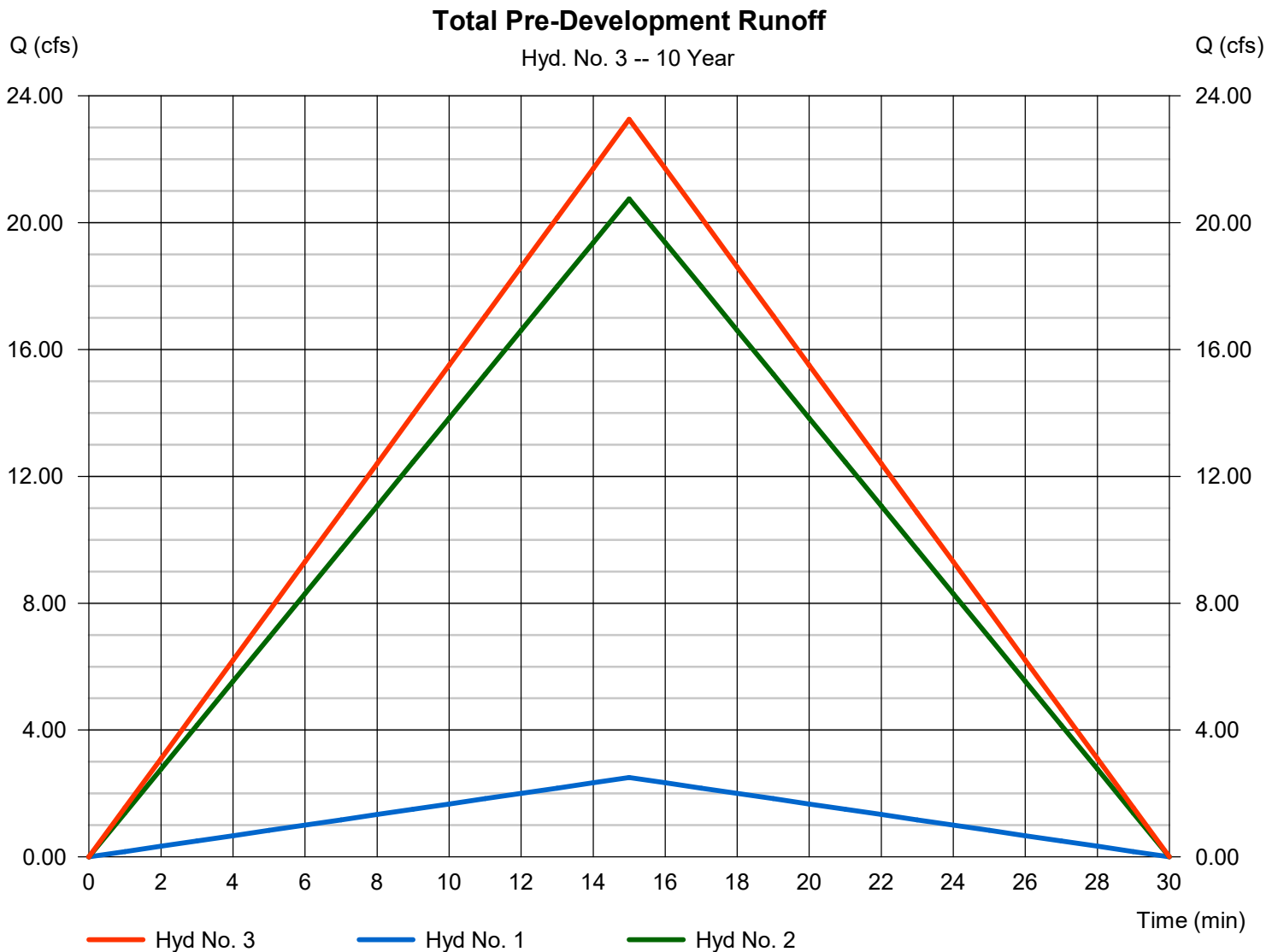
Tuesday, 11 / 2 / 2021

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type = Combine
 Storm frequency = 10 yrs
 Time interval = 1 min
 Inflow hyds. = 1, 2

Peak discharge = 23.26 cfs
 Time to peak = 15 min
 Hyd. volume = 20,934 cuft
 Contrib. drain. area = 14.960 ac



Hydrograph Report

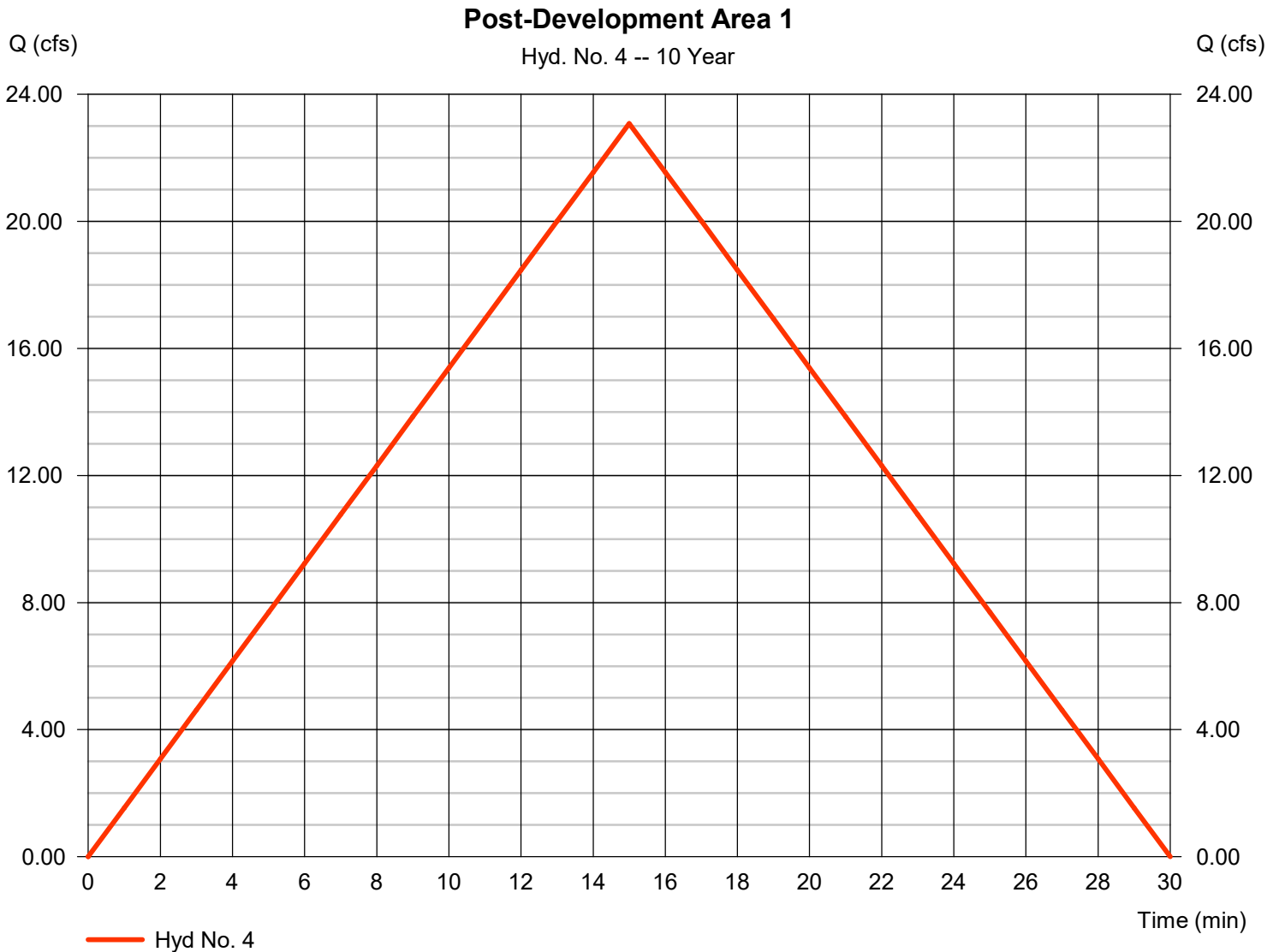
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

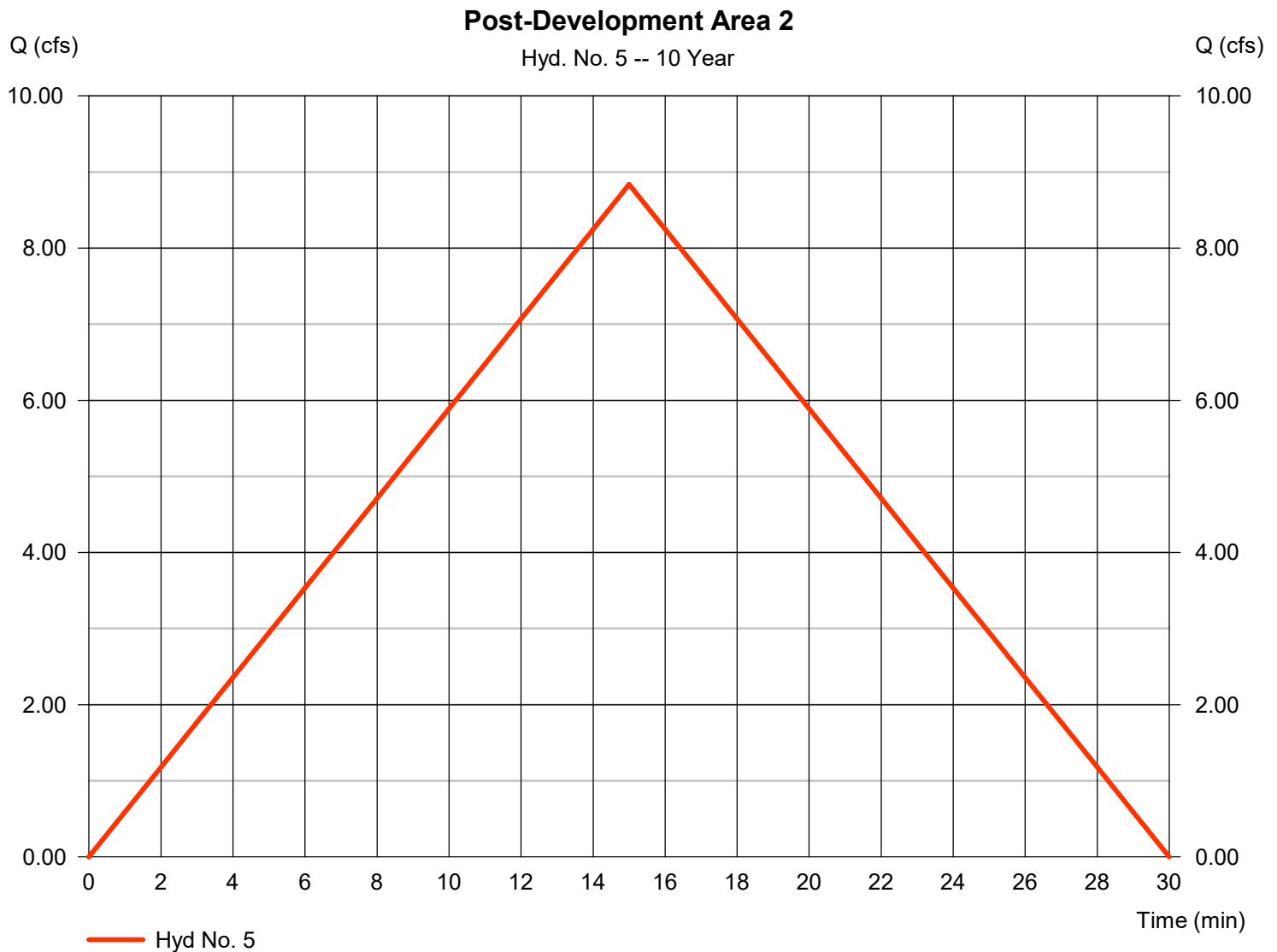
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

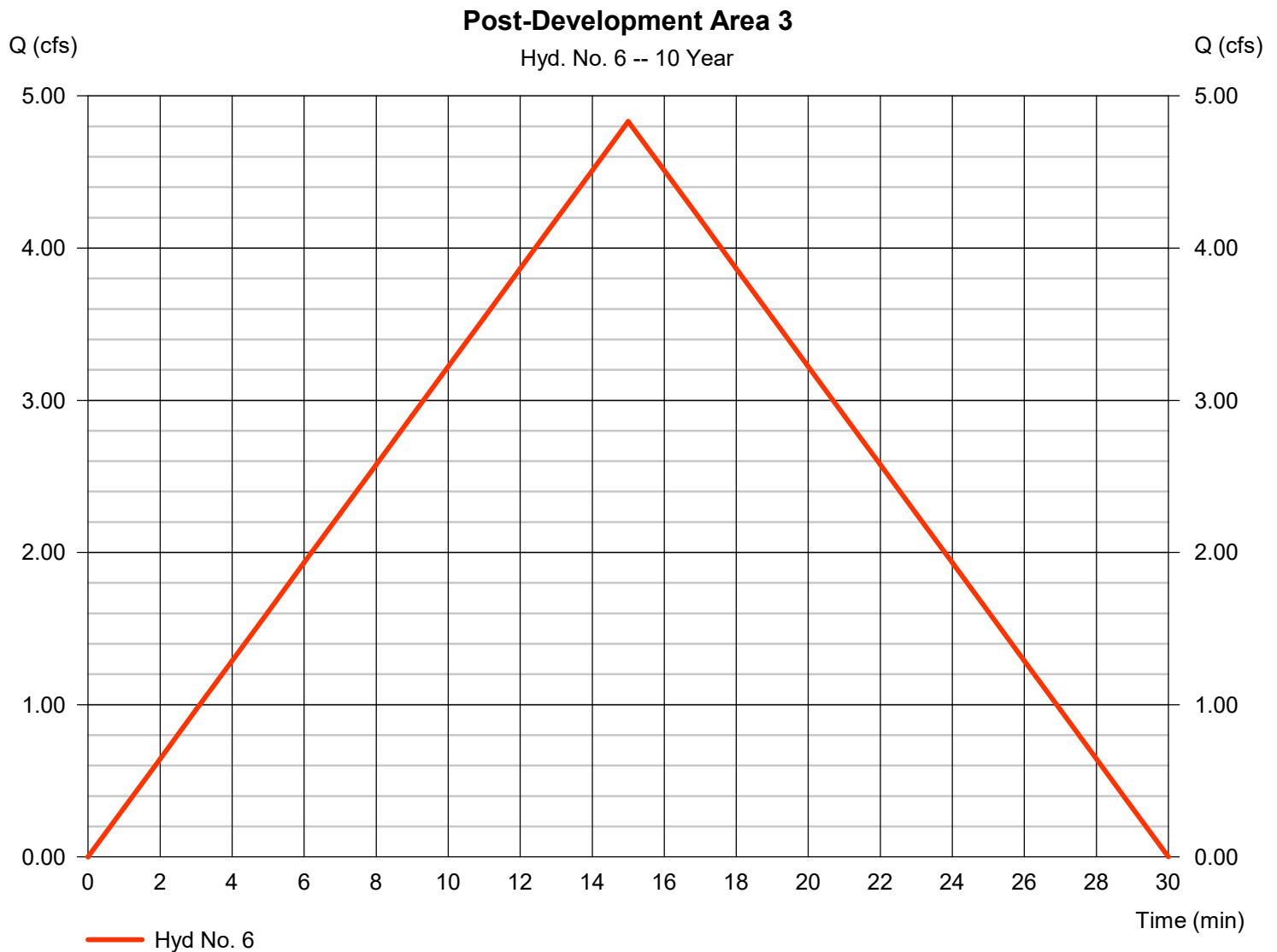
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

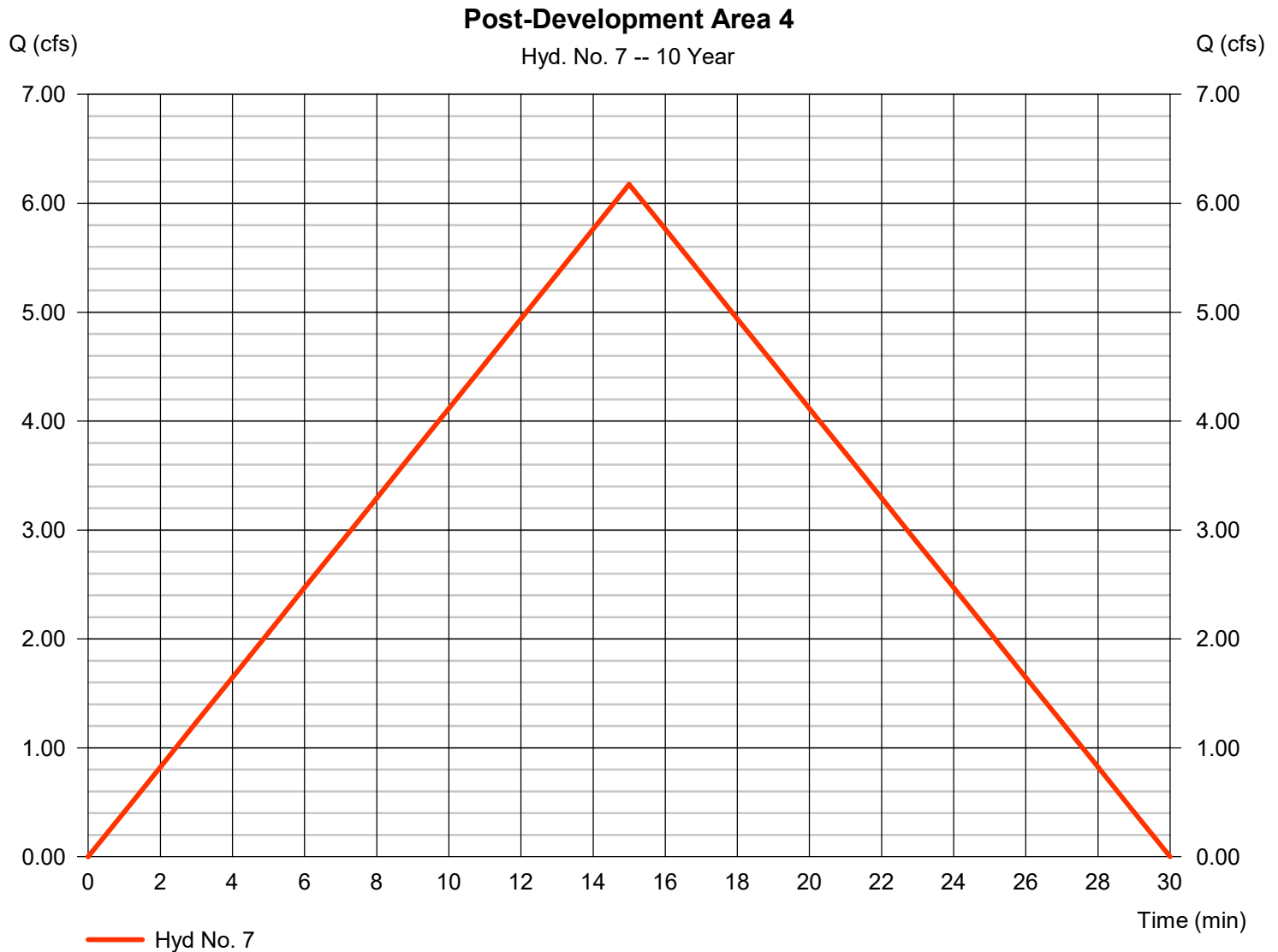
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

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

Tuesday, 11 / 2 / 2021

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

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

Tuesday, 11 / 2 / 2021

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



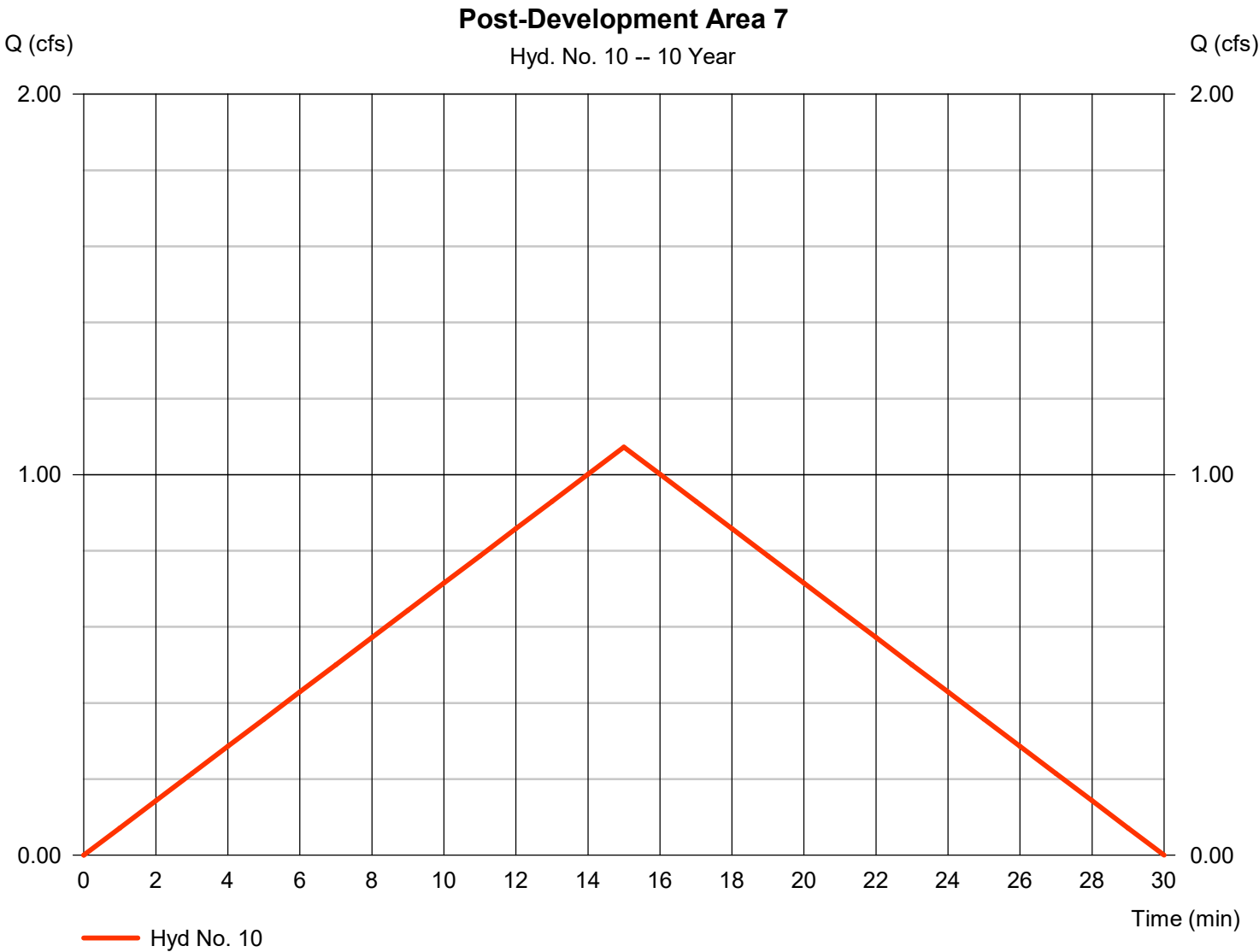
Hydrograph Report

Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021
Tuesday, 11 / 2 / 2021

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

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

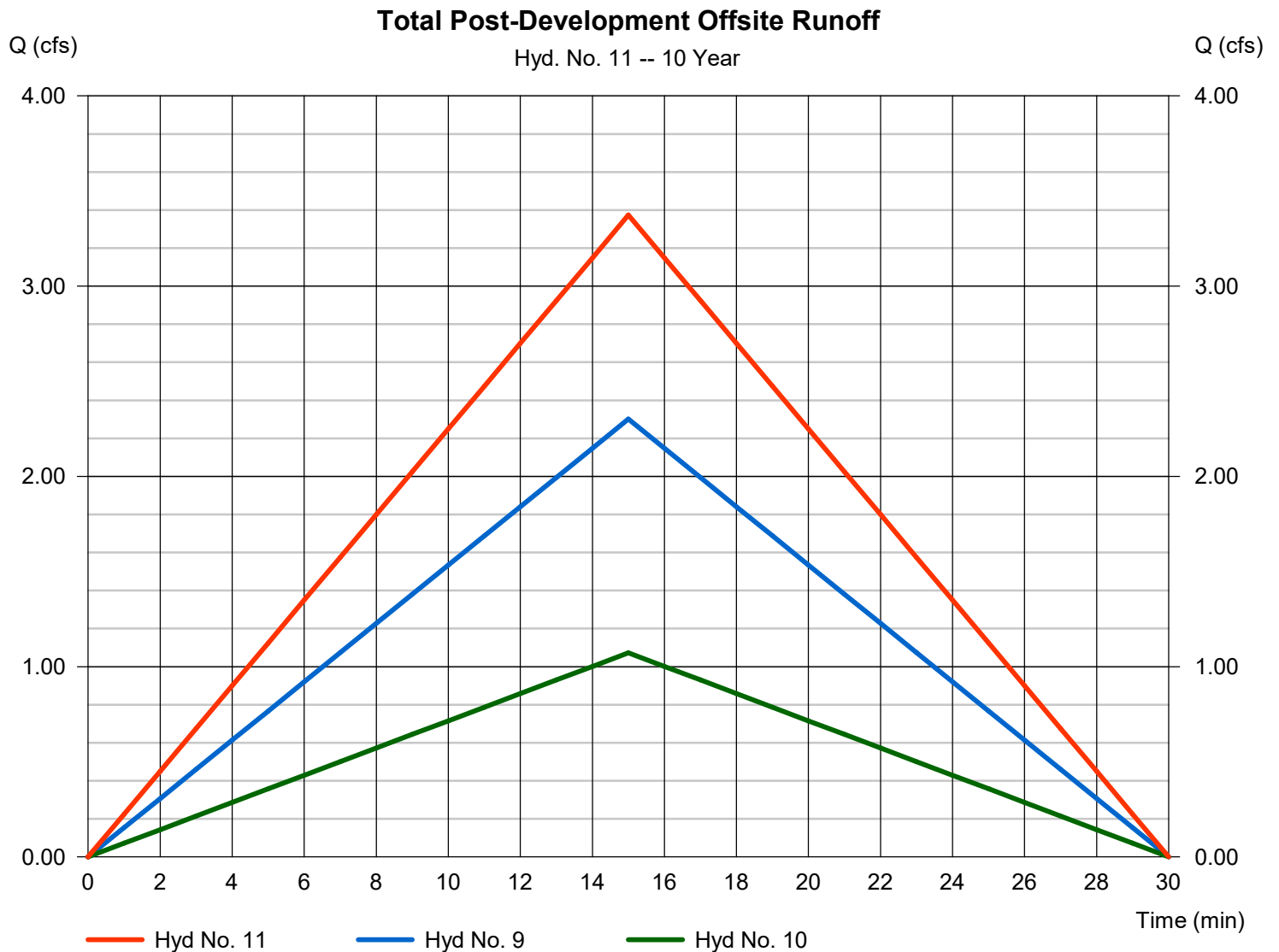
Tuesday, 11 / 2 / 2021

Hyd. No. 11

Total Post-Development Offsite Runoff

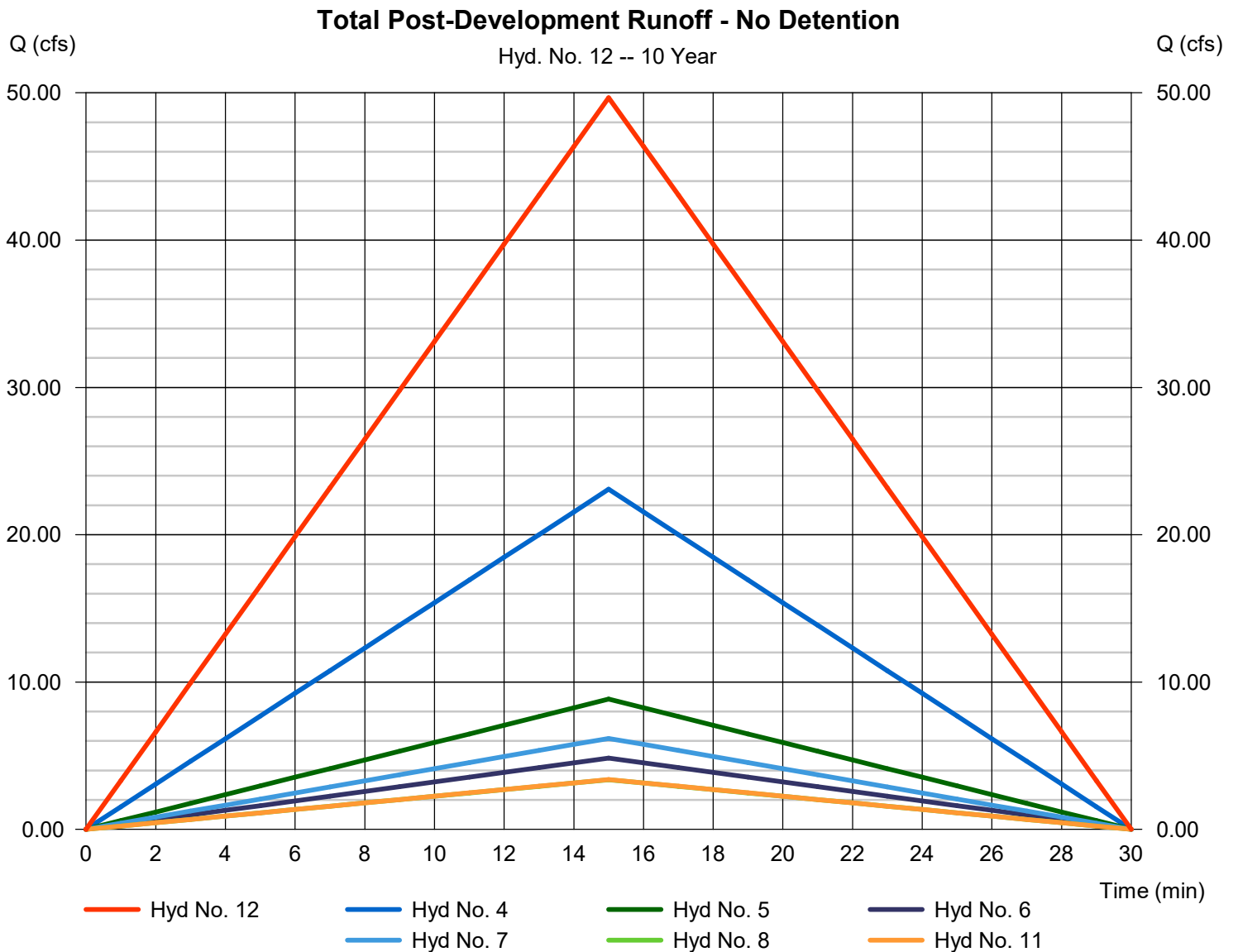
Hydrograph type = Combine
 Storm frequency = 10 yrs
 Time interval = 1 min
 Inflow hyds. = 9, 10

Peak discharge = 3.374 cfs
 Time to peak = 15 min
 Hyd. volume = 3,036 cuft
 Contrib. drain. area = 1.890 ac



Total Post-Development Runoff - No Detention

Peak discharge = 49.67 cfs
Time to peak = 15 min
Hyd. volume = 44,705 cuft
Contrib. drain. area = 13.090 ac



Hydrograph Report

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

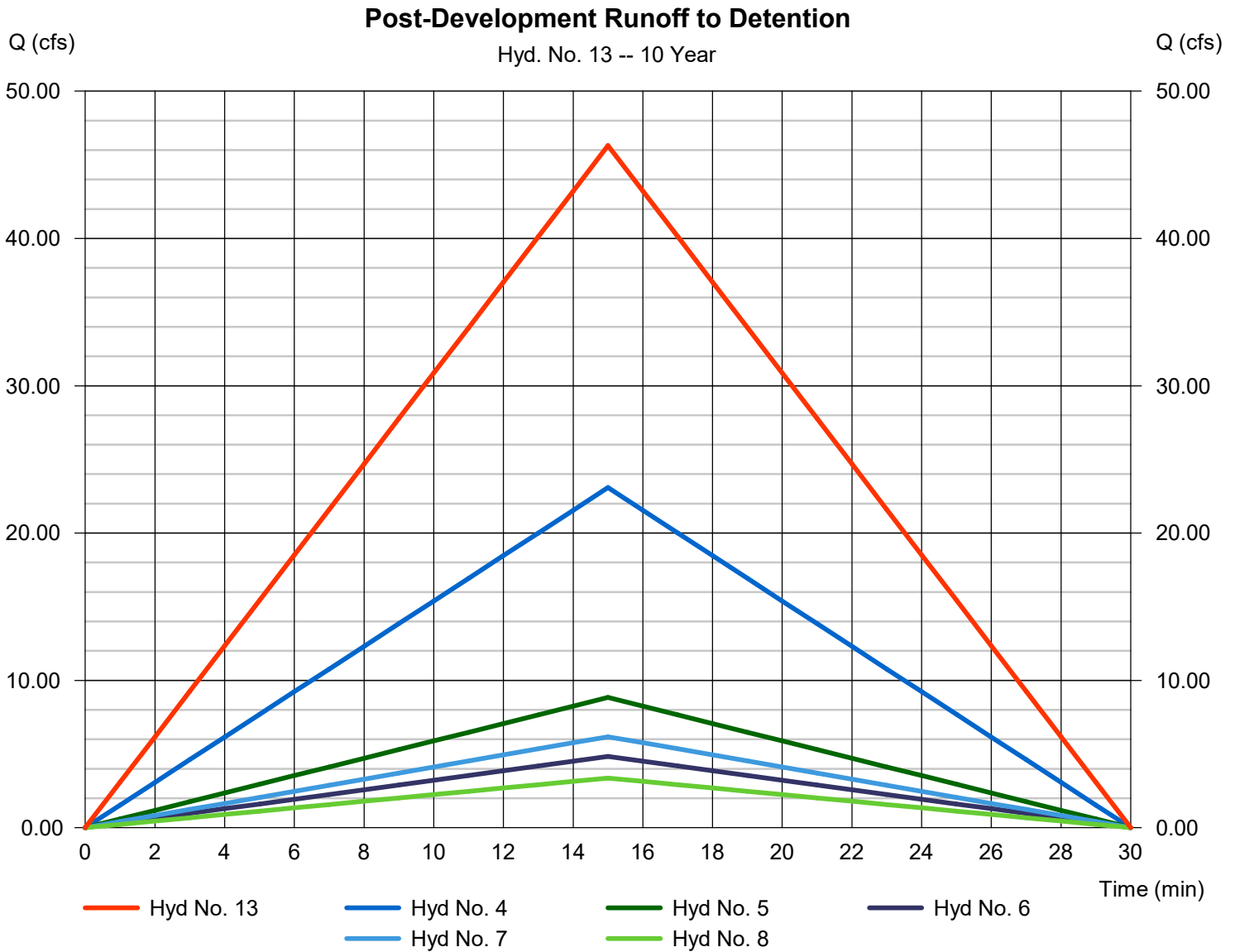
Tuesday, 11 / 2 / 2021

Hyd. No. 13

Post-Development Runoff to Detention

Hydrograph type = Combine
 Storm frequency = 10 yrs
 Time interval = 1 min
 Inflow hyds. = 4, 5, 6, 7, 8

Peak discharge = 46.30 cfs
 Time to peak = 15 min
 Hyd. volume = 41,668 cuft
 Contrib. drain. area = 13.090 ac



Hydrograph Report

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

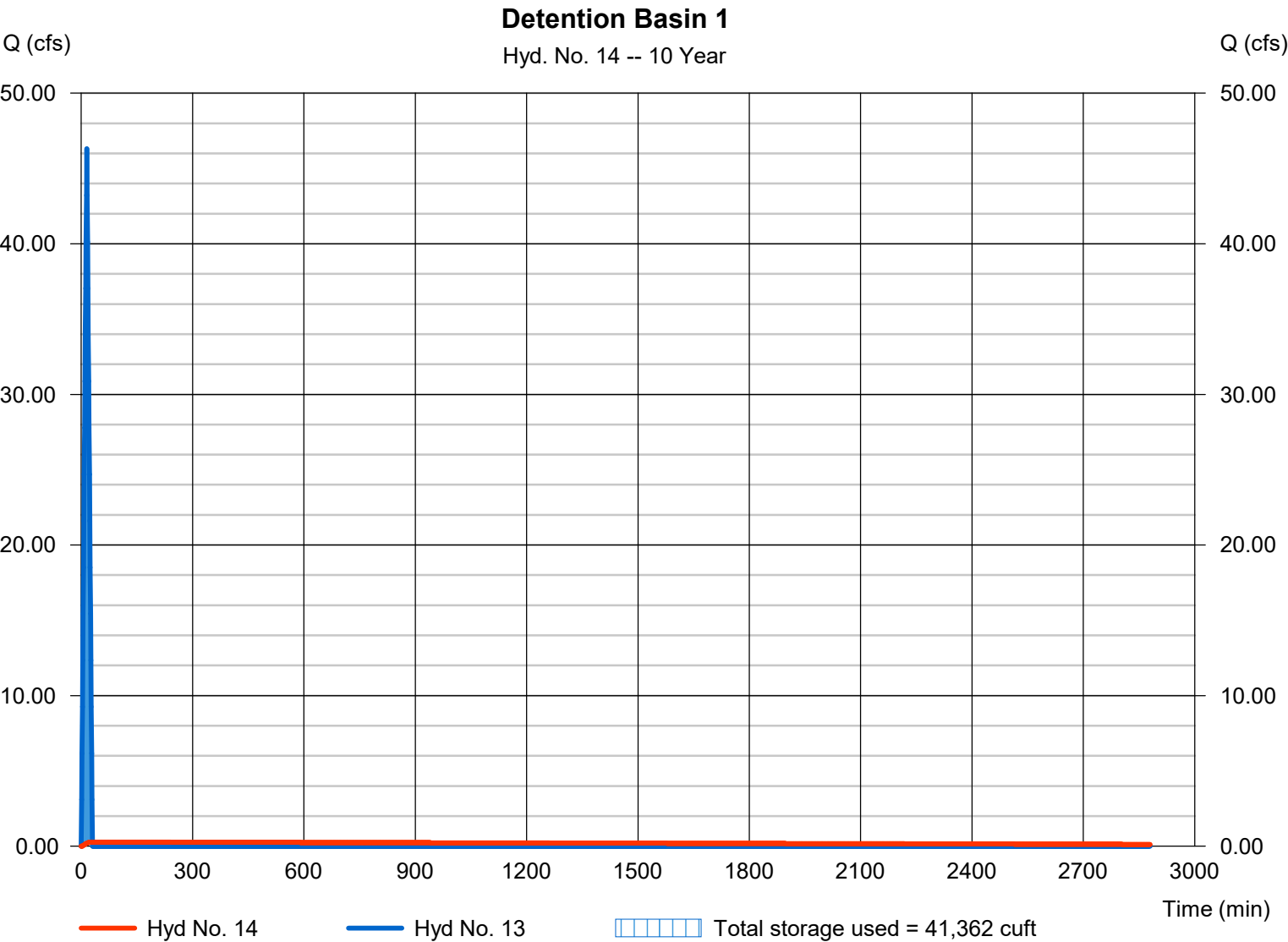
Tuesday, 11 / 2 / 2021

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	Max. Elevation	= 1002.98 ft
Reservoir name	= Detention Basin	Max. Storage	= 41,362 cuft

Storage Indication method used.



Hydrograph Report

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

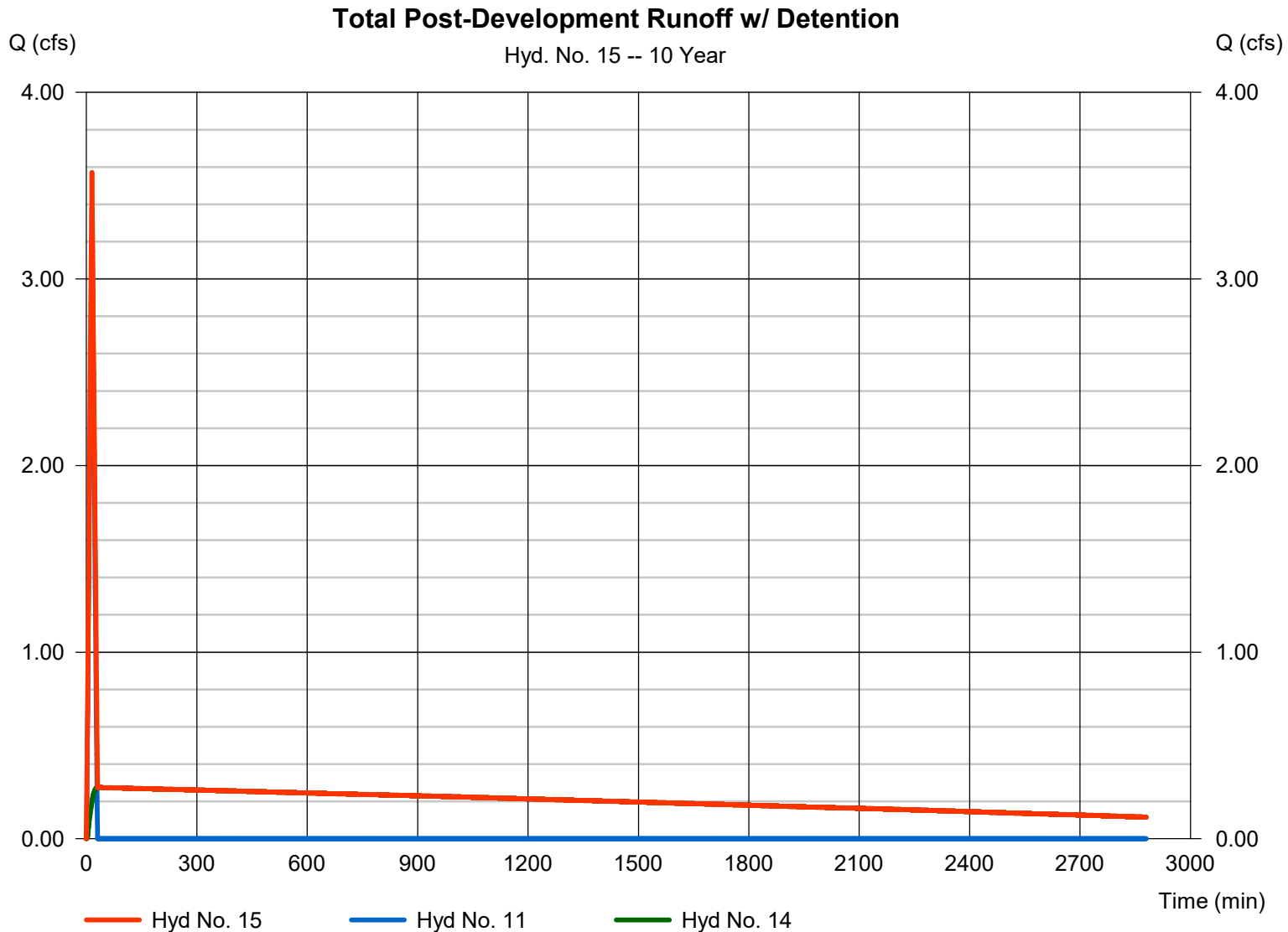
Tuesday, 11 / 2 / 2021

Hyd. No. 15

Total Post-Development Runoff w/ Detention

Hydrograph type = Combine
 Storm frequency = 10 yrs
 Time interval = 1 min
 Inflow hyds. = 11, 14

Peak discharge = 3.572 cfs
 Time to peak = 15 min
 Hyd. volume = 37,189 cuft
 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, 13	-----	-----	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
P:\20231 Lee's Summit Town Centre Lot 1 - c					Civil 3D Period 2020 Year			Hydraflow - 11-2-2021.gpw 2 / 2021	

Hydrograph Report

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

Tuesday, 11 / 2 / 2021

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

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

Tuesday, 11 / 2 / 2021

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

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

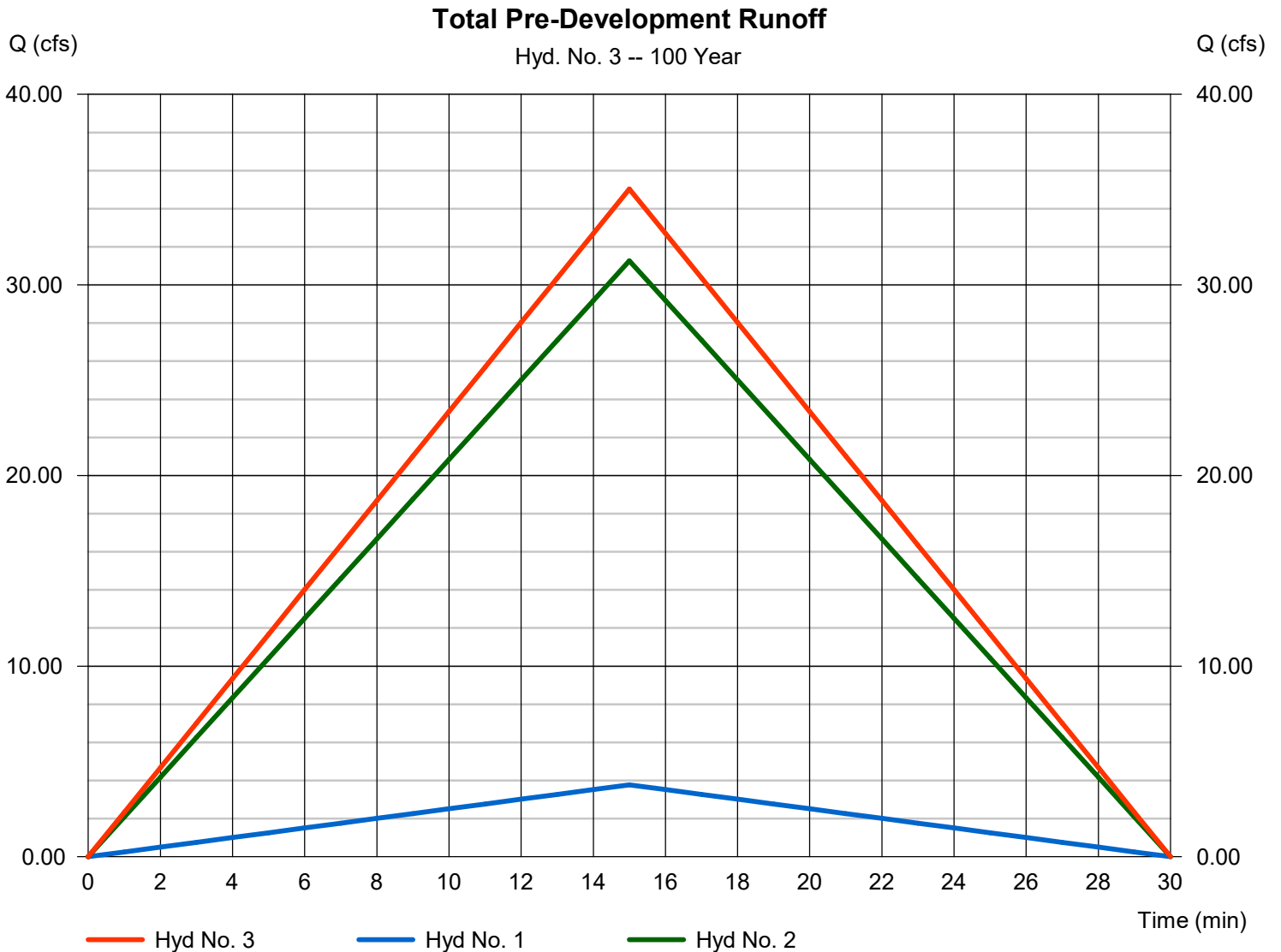
Tuesday, 11 / 2 / 2021

Hyd. No. 3

Total Pre-Development Runoff

Hydrograph type = Combine
 Storm frequency = 100 yrs
 Time interval = 1 min
 Inflow hyds. = 1, 2

Peak discharge = 35.04 cfs
 Time to peak = 15 min
 Hyd. volume = 31,534 cuft
 Contrib. drain. area = 14.960 ac



Hydrograph Report

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

Tuesday, 11 / 2 / 2021

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

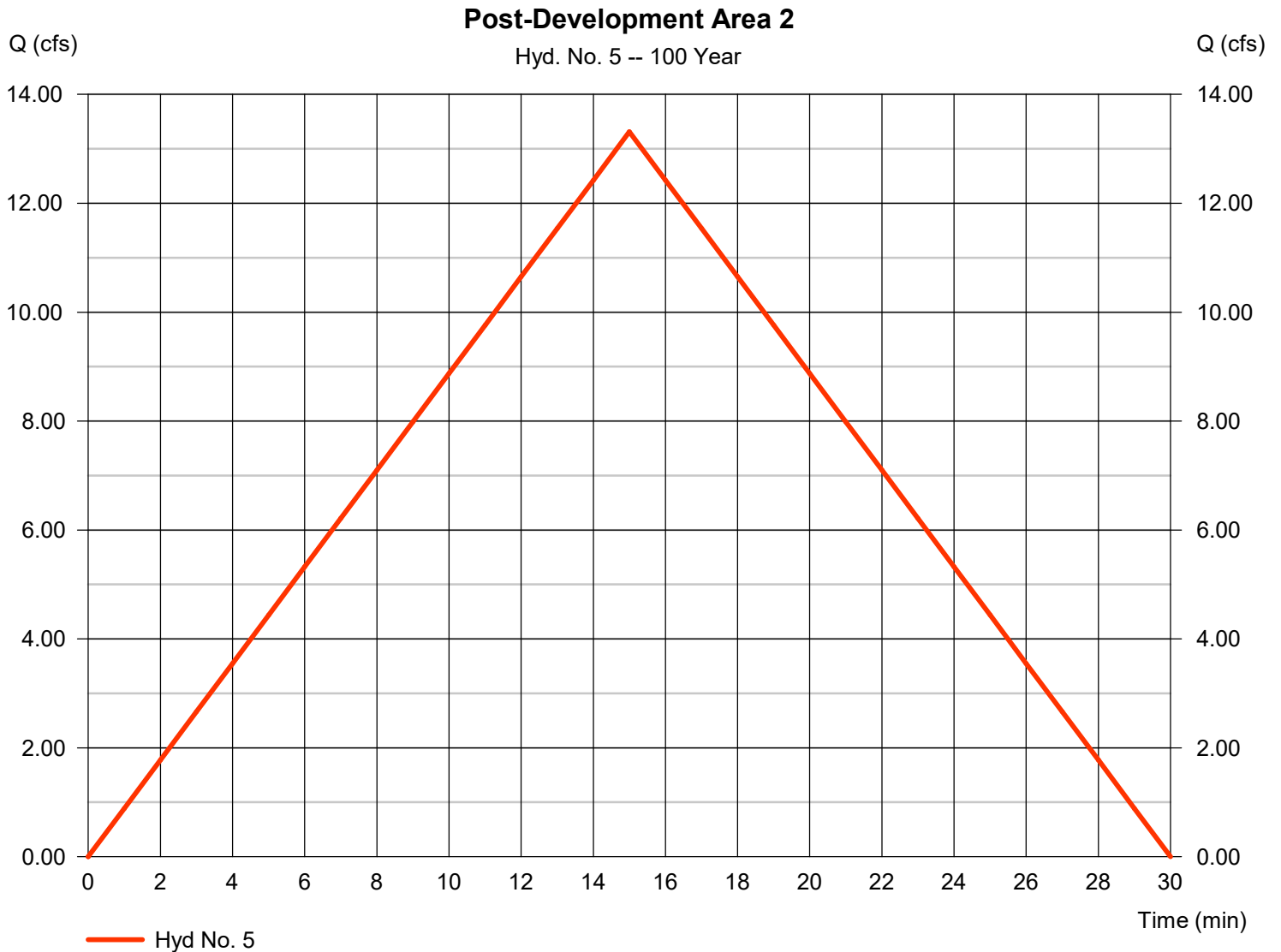
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

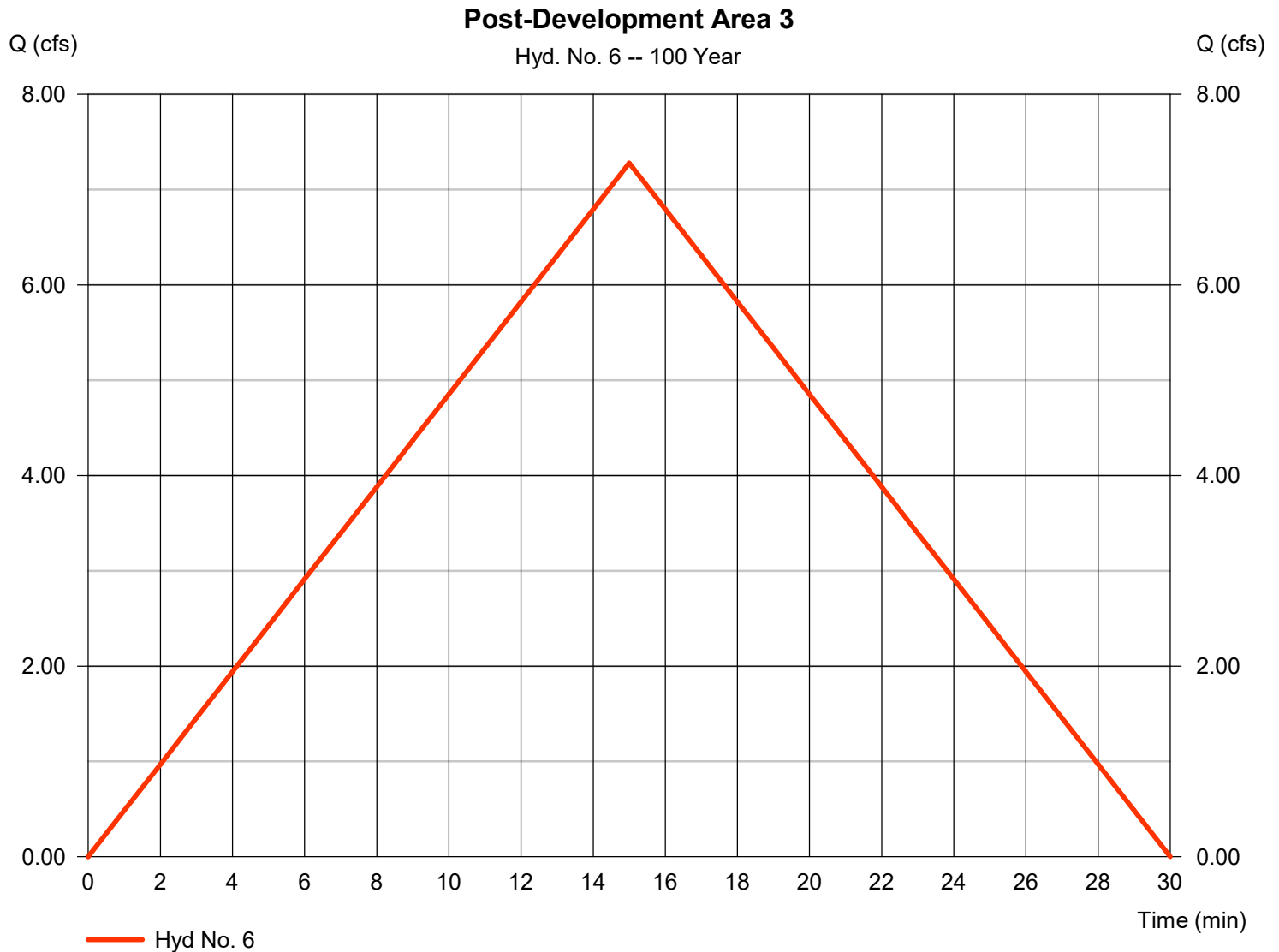
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

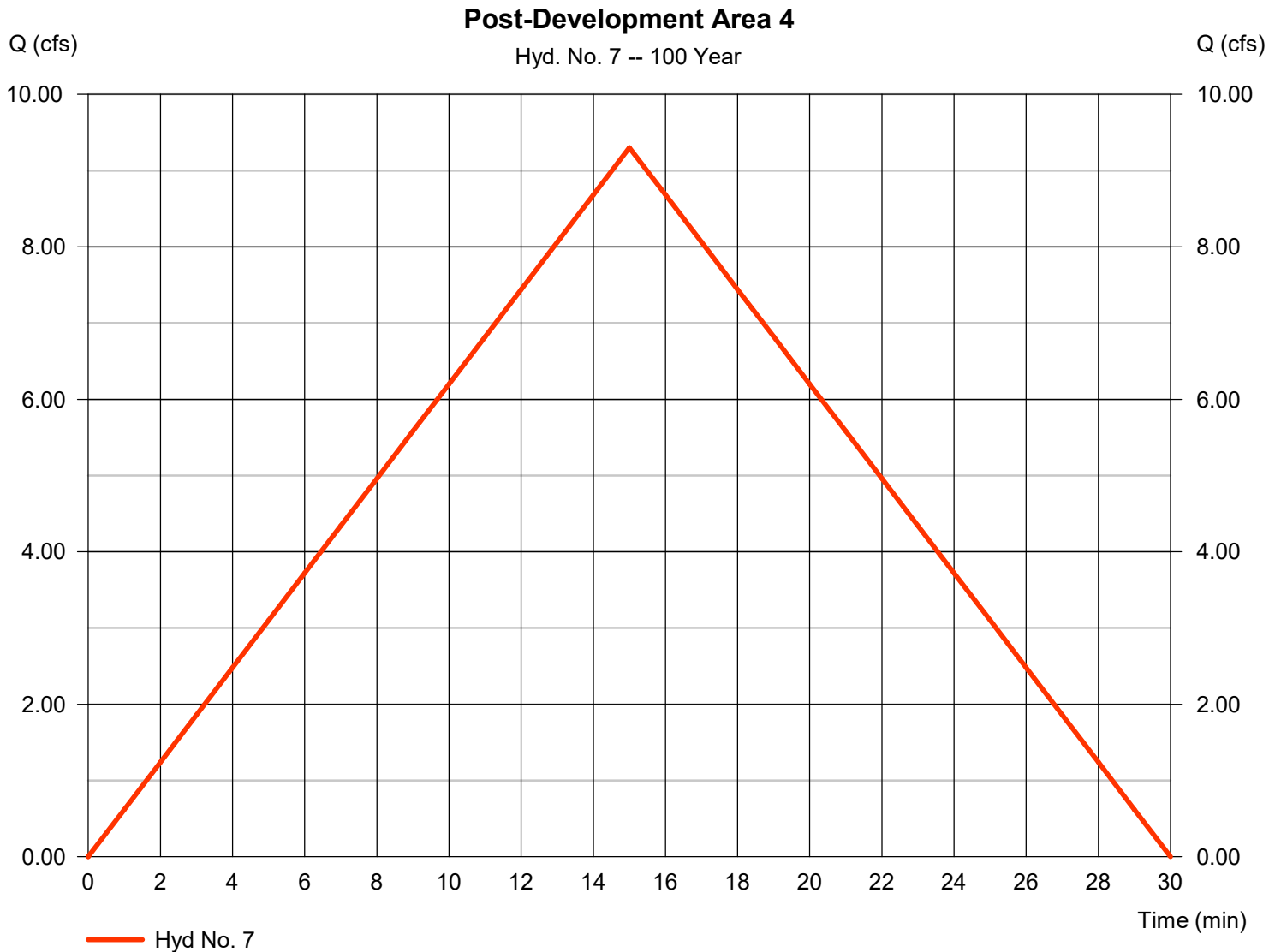
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

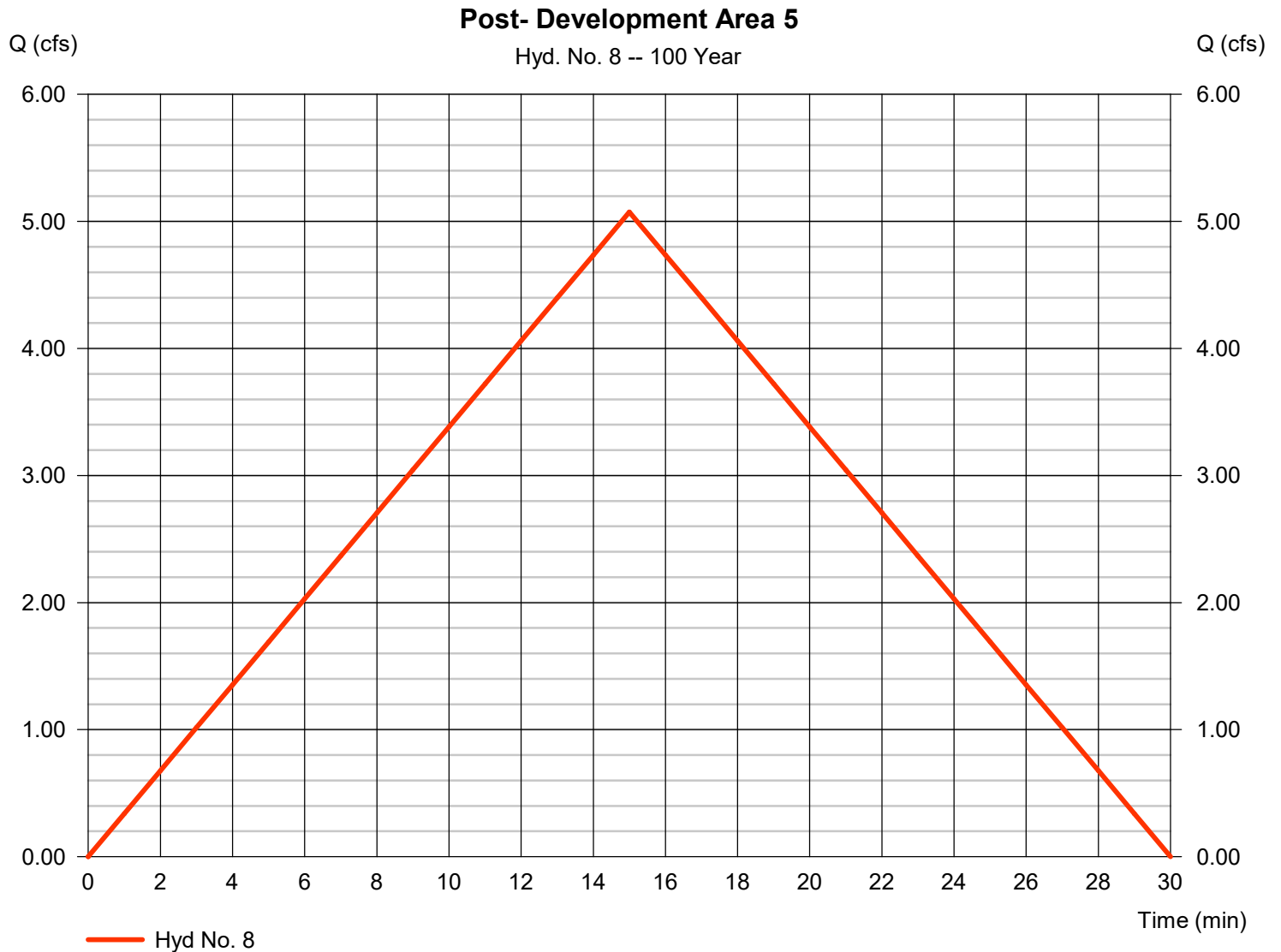
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

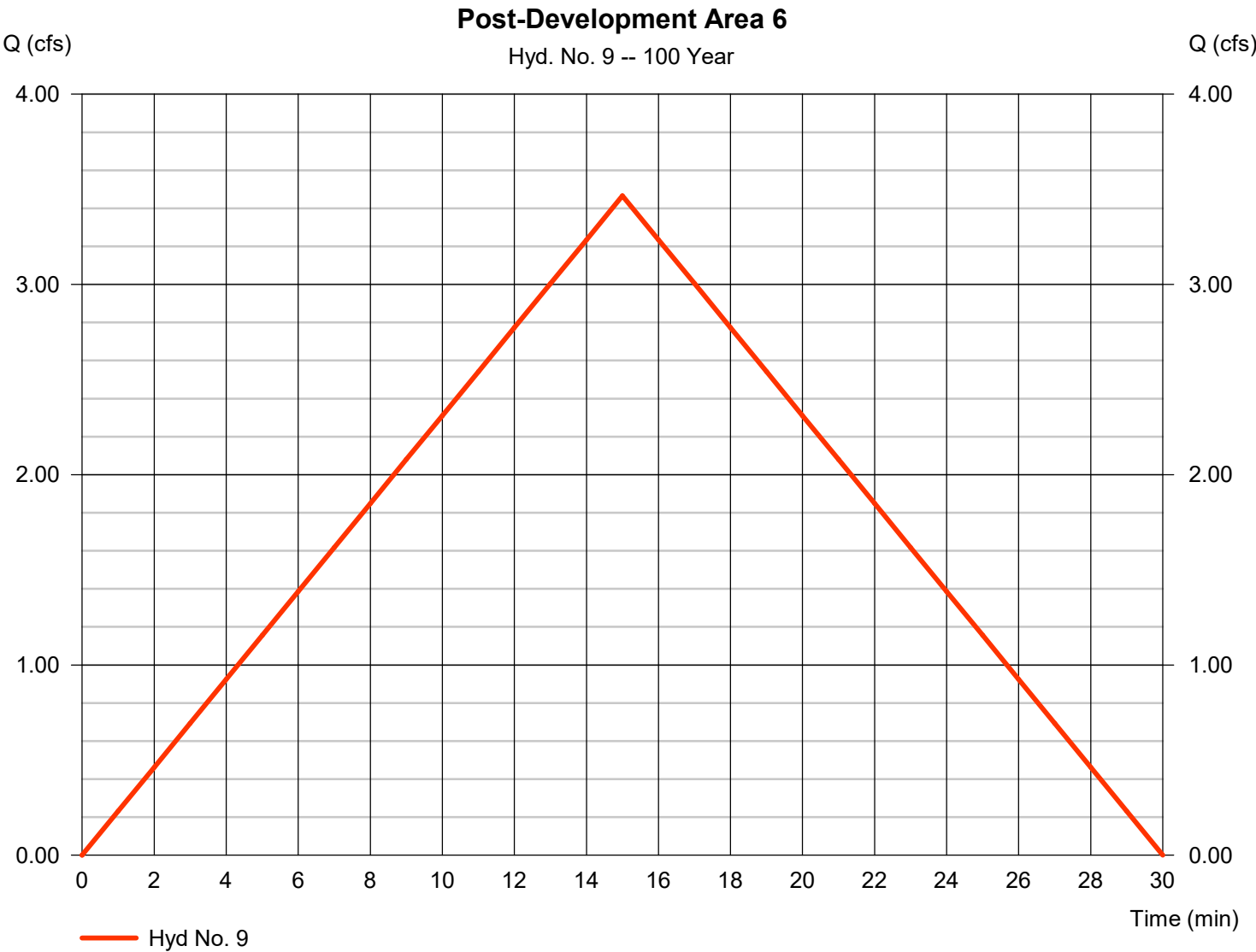


Hydrograph Report

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

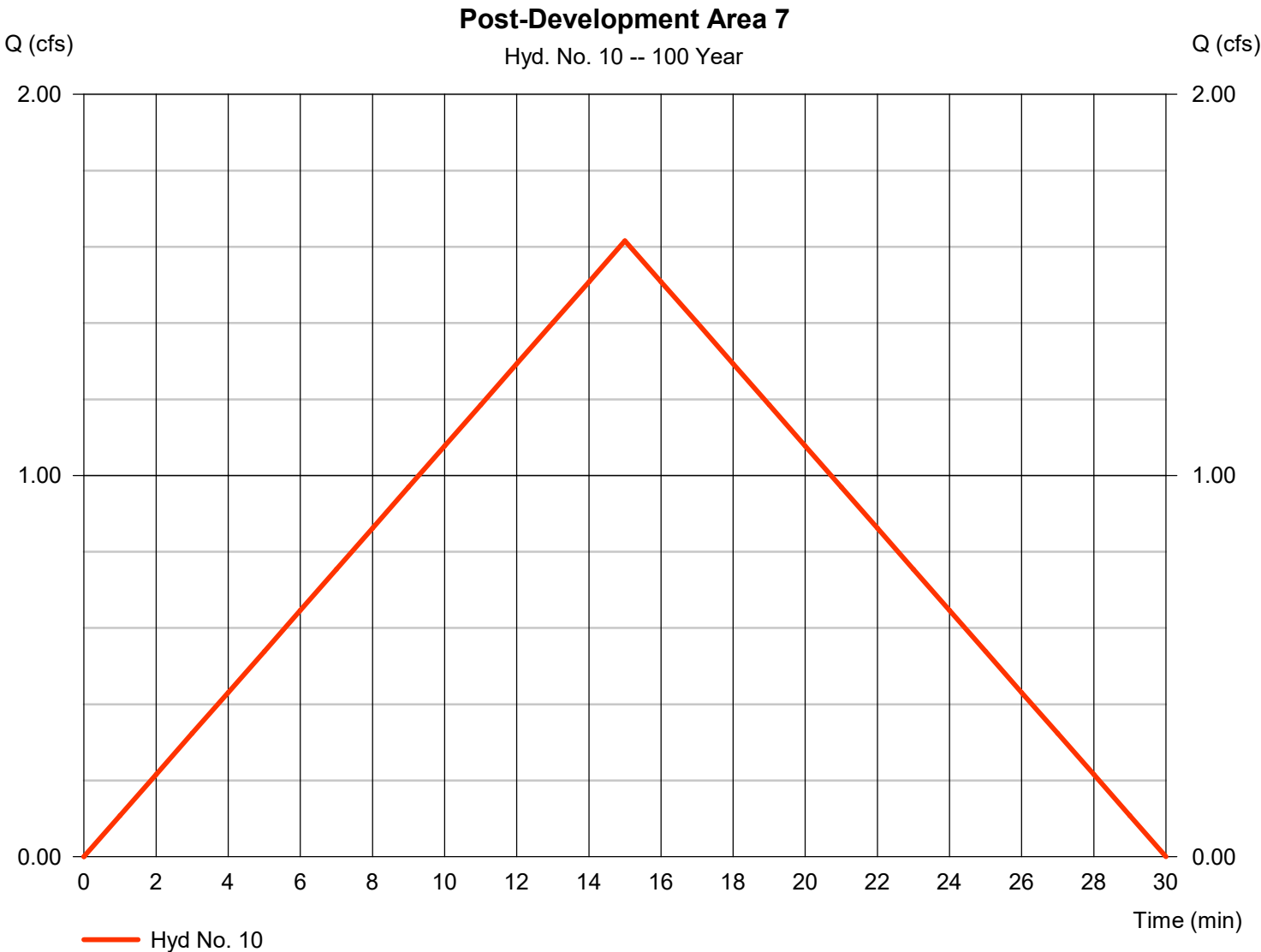
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

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

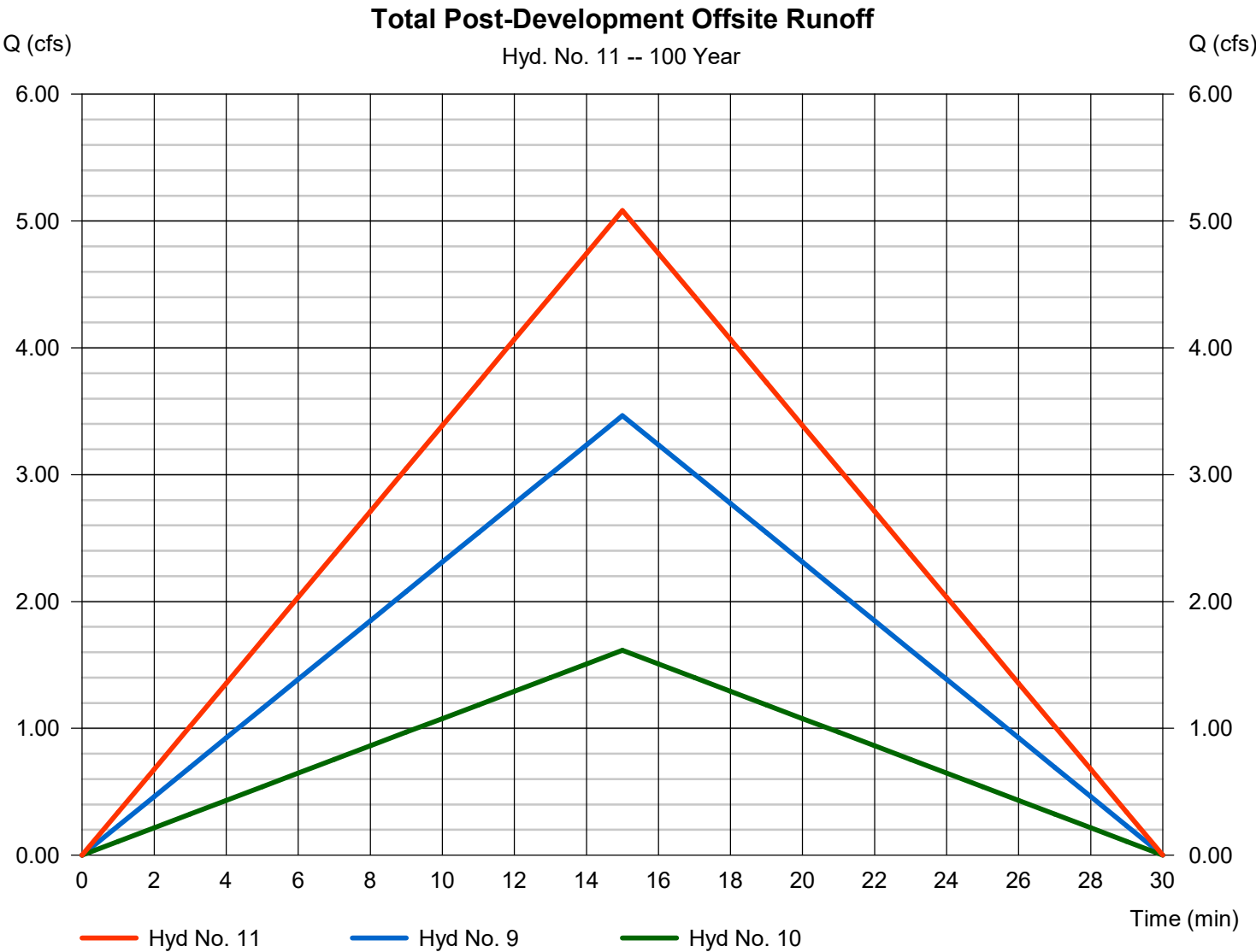
Hydraflow Hydrographs Extension for Autodesk® Civil 3D® by Autodesk, Inc. v2021

Tuesday, 11 / 2 / 2021

Hyd. No. 11

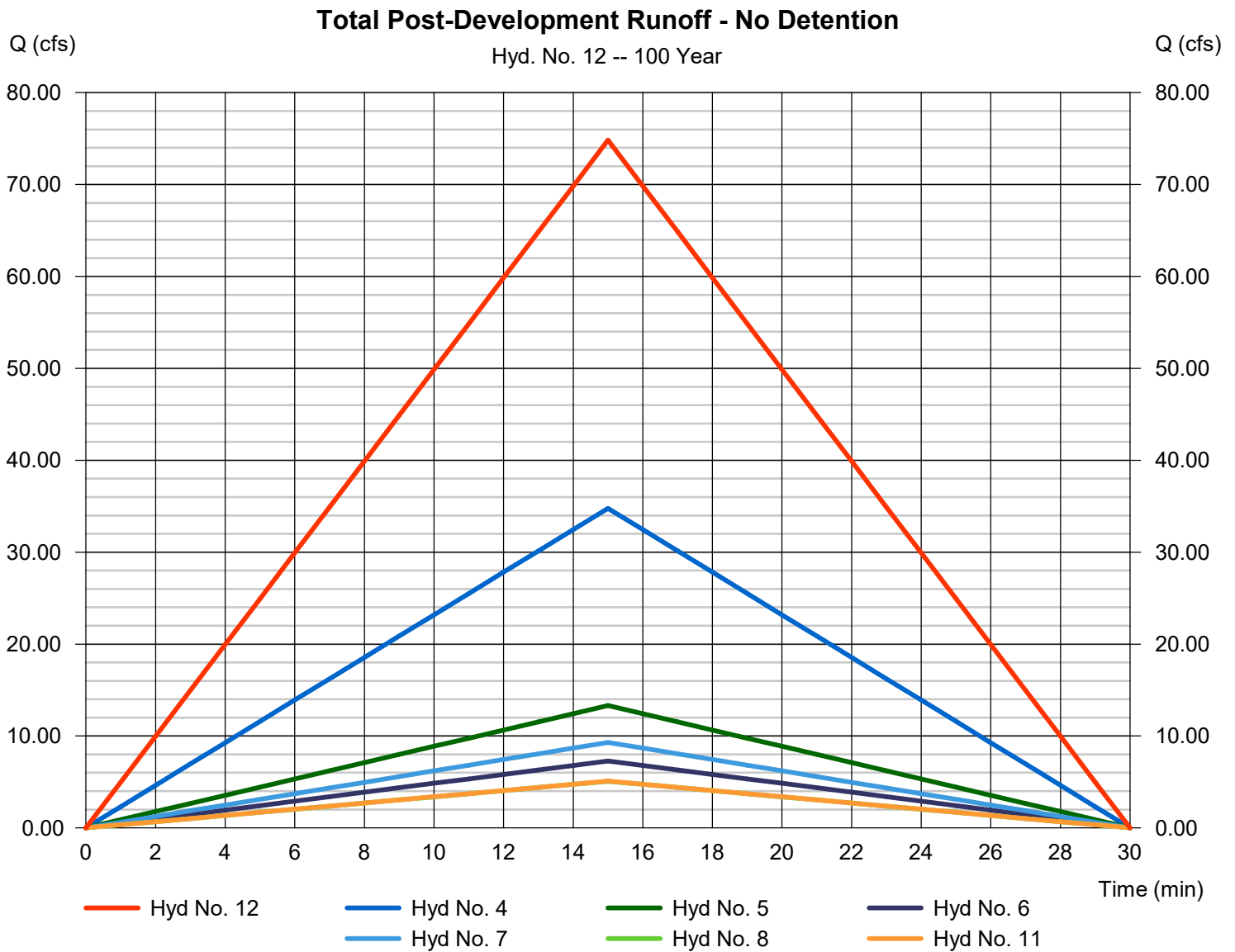
Total Post-Development Offsite Runoff

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



Total Post-Development Runoff - No Detention

Peak discharge = 74.83 cfs
Time to peak = 15 min
Hyd. volume = 67,343 cuft
Contrib. drain. area = 13.090 ac



Hydrograph Report

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

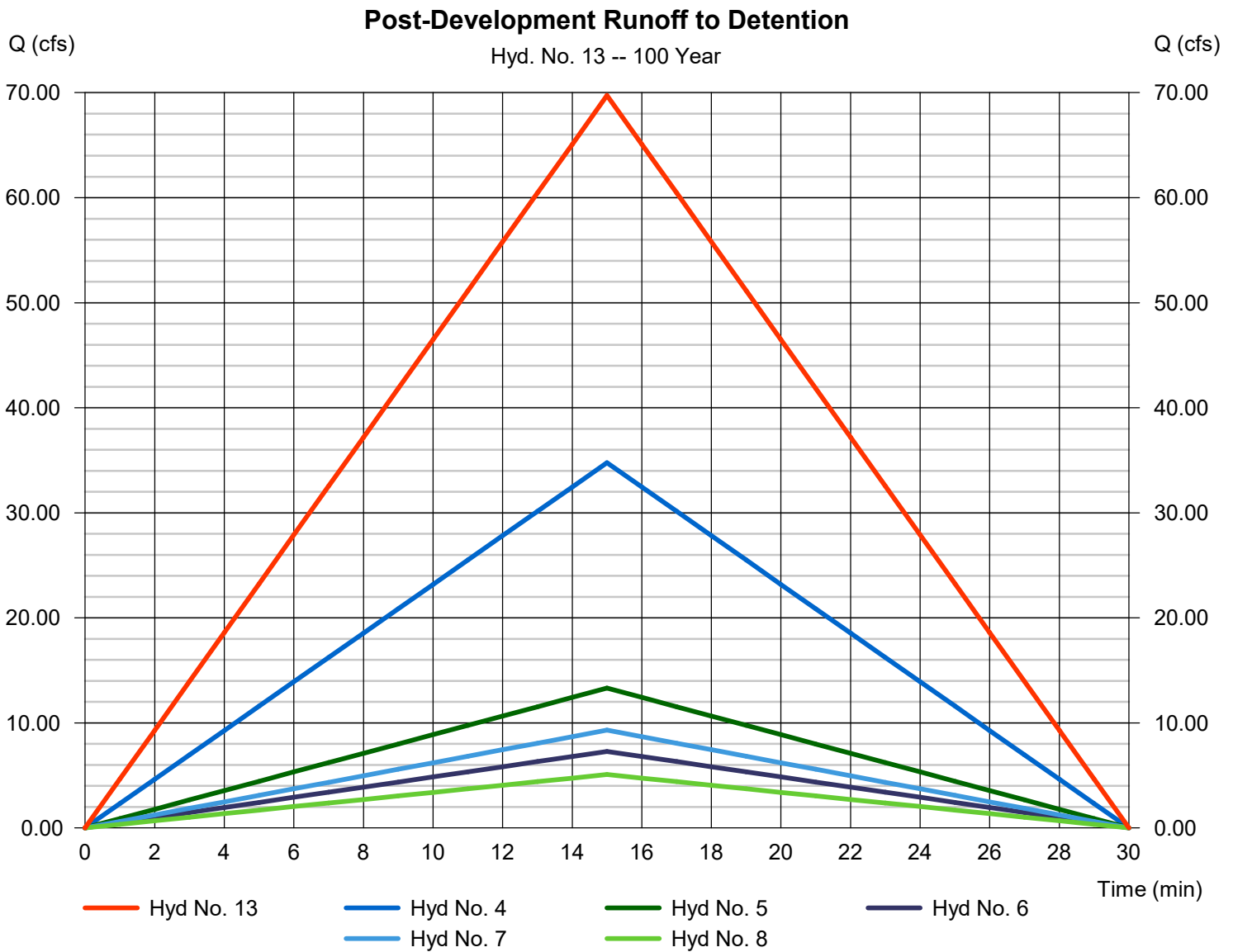
Tuesday, 11 / 2 / 2021

Hyd. No. 13

Post-Development Runoff to Detention

Hydrograph type = Combine
 Storm frequency = 100 yrs
 Time interval = 1 min
 Inflow hyds. = 4, 5, 6, 7, 8

Peak discharge = 69.74 cfs
 Time to peak = 15 min
 Hyd. volume = 62,769 cuft
 Contrib. drain. area = 13.090 ac



Hydrograph Report

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

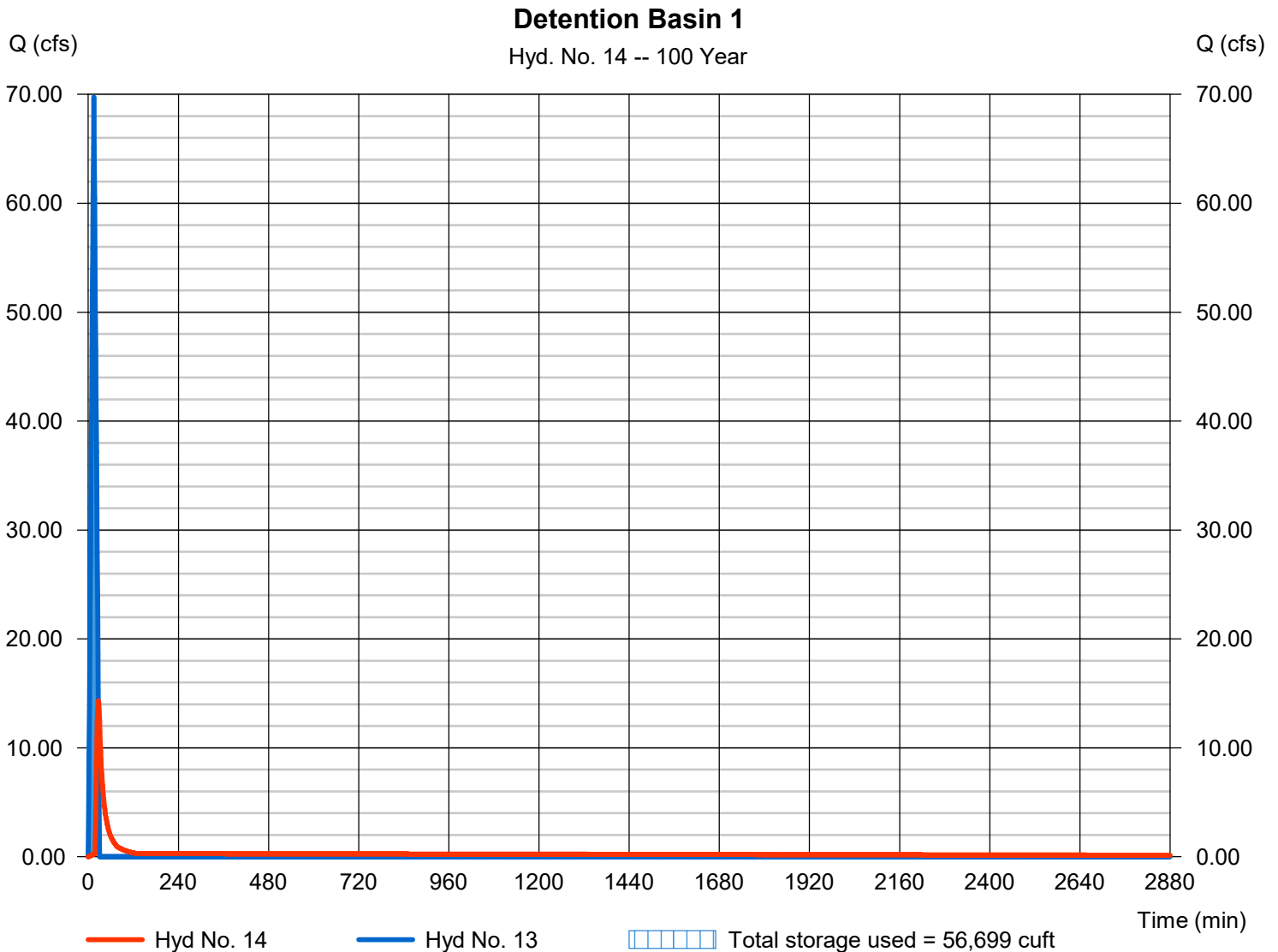
Tuesday, 11 / 2 / 2021

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

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

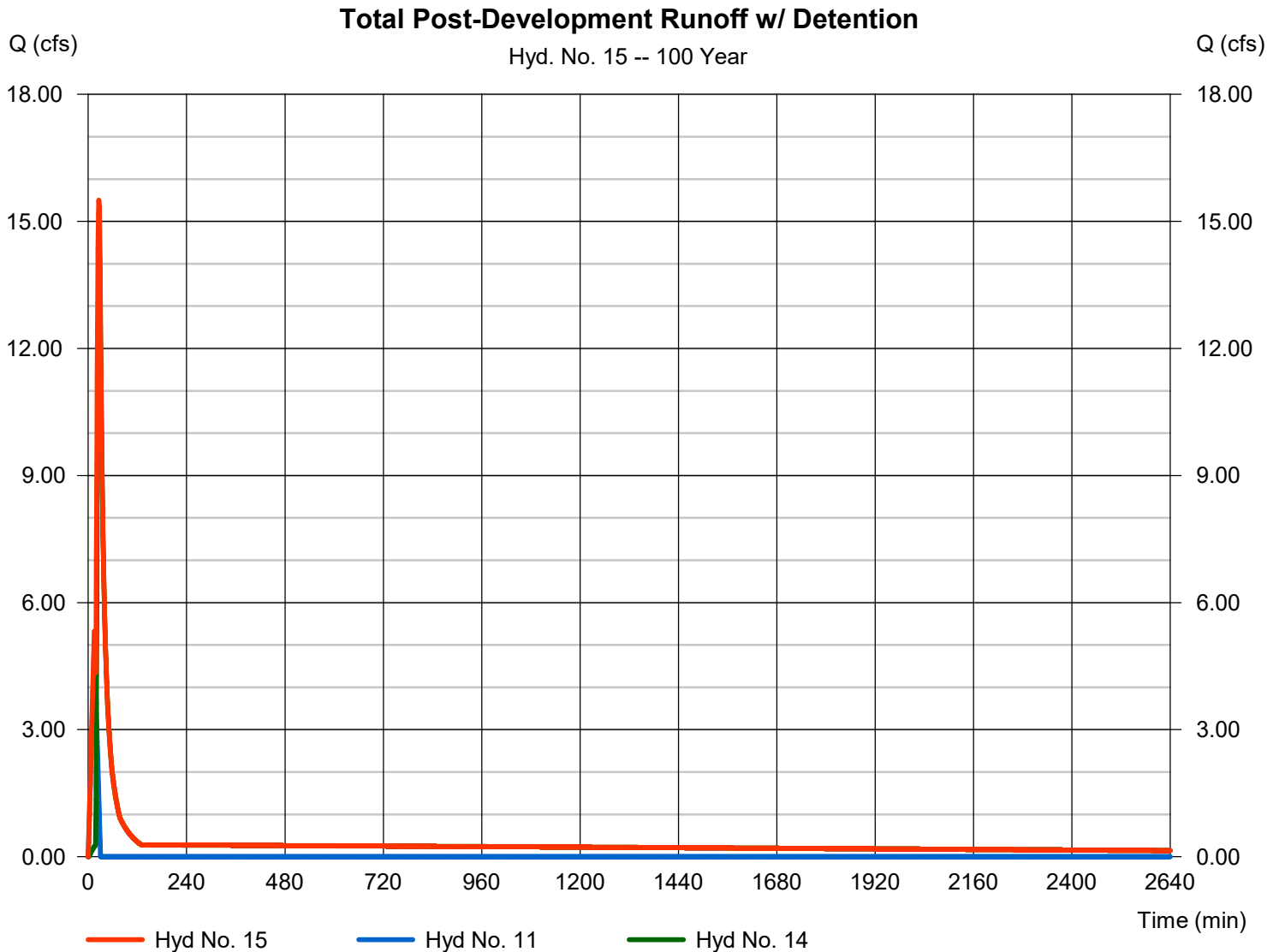
Tuesday, 11 / 2 / 2021

Hyd. No. 15

Total Post-Development Runoff w/ Detention

Hydrograph type = Combine
 Storm frequency = 100 yrs
 Time interval = 1 min
 Inflow hyds. = 11, 14

Peak discharge = 15.50 cfs
 Time to peak = 26 min
 Hyd. volume = 58,212 cuft
 Contrib. drain. area = 0.000 ac



Hydraflow Rainfall Report

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

Tuesday, 11 / 2 / 2021

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

$$\text{Intensity} = B / (T_c + D)^E$$

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