Drainage Report

Tract 3157
468 Westmont Avenue

Prepared for
Alice Jo Meinhold Survivors Trust

Prepared by
Cannon
1050 Southwood Drive
San Luis Obispo, CA 93401

March 11, 2020

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1. Introduction and Background

1.1. Introduction

Alice Jo Meinhold Survivors Trust is proposing a new residential development in the City of San Luis Obispo. A drainage study was conducted to be submitted with the Tentative Tract Map application for the proposed project. The intent of that study was to establish the major drainage components that will be included with the proposed project, and to determine their effects on the horizontal and vertical layout of lots, roads, grading, and utilities. This report presents the methods and results generated from that study.

1.2. Project Location and Site Description

The proposed project is located in the City of San Luis Obispo in San Luis Obispo County California. The project site is along the north end of Stanford Drive and Cuesta Drive, between both sections of Westmont Ave. The site consists of approximately 4.94 acres of mostly agricultural land, along with some residential area and the wooded area along Twin Ridge Creek. Twin Ridge Creek runs through the western portion of the property and collects drainage from the large agricultural area north of the site as well as runoff from the project site.

1.3. Project Description

The project consists of the construction of 23 additional lots expanding the existing residential neighborhood. Most will be along Stanford Drive, while three are on the west side of the creek. In general, the lots are 6,000 sf to 7,000 sf with a few as large as 9,000 sf to 11,000 sf. The project includes extending Stanford Drive and looping it to existing Cuesta Drive.

2. Stormwater Regulations and Design Criteria

There are several governing bodies that have regulations and design criteria pertaining to stormwater management for new development. The project is currently located within the City of San Luis Obispo. This project is within the jurisdictions of the following agencies:

- City of San Luis Obispo
- Central Coast Regional Water Quality Control Board (RWQCB)
- California Department of Fish and Wildlife (CDFW)
- Federal Emergency Management Agency (FEMA)
- US Army Corps of Engineers (USACE)

2.1. City of San Luis Obispo

The City of San Luis Obispo has several regulations and standards that pertain to stormwater management, including:

- Municipal Code

- Waterway Management Plan (which includes the Drainage Design Manual)
- Standard Specifications and Engineering Standards

2.2. Municipal Code

There following sections of the Municipal Code pertain to stormwater management.

Creek Setbacks (Municipal Code 17.70.030)

The City's Creek Setback requirement applies to all creeks that are shown on Figure 9 of the Conservation and Open Space Element in the General Plan. Twin Ridge Creek is shown on that figure as a "perennial creek with degraded corridor but able to be restored or repaired." Per the code, a 20-foot setback is required for Twin Ridge Creek "from the existing top of bank (or the future top of bank resulting from a creek alteration reflected in a plan approved by the city), or from the edge of the predominant pattern of riparian vegetation, whichever is farther from the creek flow line".

Floodplain Management Regulations (Municipal Code 17.84)

The City's Floodplain Management Regulations apply to areas of special flood hazard as identified by FEMA, which are areas that FEMA has identified as subject to inundation by the 1% annual chance flood (100-year flood). The FEMA Flood Insurance Rate Map Number 06079C1066G, Panel 1066 (Appendix A) shows the project site to be outside of FEMA floodplain, so the requirements specific to those areas are not applicable to this project.

2.3. Waterway Management Plan (which includes the Drainage Design Manual)

The Waterway Management Plan (WMP) is a watershed-based management plan for San Luis Obispo Creek and its tributaries. The Drainage Design Manual (DDM) is Volume 3 of the WMP and provides design guidance and criteria intended to meet surface water management objectives. The following are some of the sections that pertain to the proposed project:

Off-Site Facility Analysis, Design, and Mitigation (DDM 3.3)

Runoff shall be managed to prevent any significant increase in downstream peak flows, including 2-year, 10-year, 50-year, and 100-year events. Significant generally means an increase of over 5 percent at and immediately downstream of the project site.

Channel and Conduit Capacity (DDM 7.2.1) and Hydraulic Gradient (7.2.10)

This section requires that conveyance systems shall be designed to convey the peak runoff for the 10-year design storm with the hydraulic gradient a minimum of 6 inches below the elevation of the inlet grates and manhole covers. In addition, an overland conveyance shall be provided for the 100-year event such that the water surface elevation is at least 1 foot below the finish floor of adjacent structures.

Inlets and Catch Basins (DDM 7.2.7)
Inlets shall be spaced so that gutter flow does not exceed a depth of 6 inches at the face of the curb for a 10-year storm and so that a 100-year storm will not cause any damage and can be contained within the right of way.

Outfalls/Open Channel & Pipe Systems (DDM 7.4.5)
Outfalls shall be above the mean low water (2-year flow) level unless the City approves an exception. A design exception has been submitted to the City for this project to allow outfalls below the mean low water.

2.4. Standard Specifications & Engineering Standards

Provide for Overland Escape (Uniform Design Criteria 5.1.1 B.)
All components of drainage systems in public improvements must be evaluated to consider the effect of failure of individual components and identify the route of overland escape. The evaluation must identify any necessary measures to prevent erosion or flooding along this route.

Alignment of Drainage Facilities (UDC 5.1.2)
Drainage facilities accepting runoff from public streets or other public areas must be in a public street or within a public drainage easement. Drainage easements must be used for drainage purposes exclusively and not combined with easements required for other public utility purposes. Easements for culverts and drainage facilities must be a minimum width of 15-feet. All such easements must provide access and future maintenance working areas. Easements must be along or adjacent to property lines and outside areas of proposed or existing structures.

Channel and Swales (UDC 5.1.6)
No diversion to roadside ditches will be allowed from natural drainage courses. Channels or swales may be required to be lined to an elevation of at least 1.0-foot above the design hydraulic gradient. The side slopes for channel or swale must not exceed 2:1 or 3:1 in sandy soils. Provide a minimum of 1-foot freeboard at design capacity. Provide typical sections and profile of the existing and proposed channels for a minimum of 500-feet each side of the development to establish an average profile grade through the development.

Storm Drains (UDC 5.1.7)
Minimum pipe diameter allowable on any storm drain or culverts that are maintained by the City is 18-inches. A lesser size may be approved for privately maintained facilities.

Outfalls (UDC 5.1.8)
Design energy dissipaters in complicate with the HDM Chapter 870, Channel and Shore Protection Erosion Control. The following items must be shown on the plans: stable rock size (weight), Rock Slope Protection class, dissipater trench dimensions, rock placement method, and RSP fabric type. Culvert energy dissipaters must be designed for the flow

from the Design Storm. Rock slope protection gradation must conform to Section 72 of the State Standard Specifications.

The applicant must provide a Stormwater Control Plan that clearly provides engineering analysis of all Water Quality Treatment, Runoff Retention, and Peak Flow Management controls for projects subject to those performance requirements.

2.5. Central Coast Regional Water Quality Control Board (RWQCB)

The RWQCB is responsible for administering and enforcing the National Pollutant Discharge Elimination System (NPDES) permit program, as authorized by the federal Clean Water Act. This program regulates the quality of stormwater that is discharged to surface water bodies. There are two separate permits that this project is required to obtain coverage under, one that applies to stormwater discharges during construction, and one that applies to stormwater discharges after construction is complete.

During Construction – Construction General Permit

Construction projects that disturb one or more acres of soil during construction are required to obtain coverage under the Construction General Permit. This permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). The SWPPP must list Best Management Practices (BMPs) the discharger will use to protect stormwater runoff and the placement of those BMPs. Additionally, the SWPPP must contain a visual monitoring program and a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs. Section A of the Construction General Permit describes the elements that must be contained in a SWPPP.

Post-Construction – Phase II Municipal General Permit

The Phase II Municipal General Permit applies to stormwater discharges from small Municipal Separate Storm Sewer Systems (MS4s). To comply with the requirements of the Phase II Municipal General Permit, the RWQCB approved Post-Construction Stormwater Management Requirements for Development Projects in the Central Coast Region (Post-Construction Requirements) through adoption of Resolution R3-2013-0032. A summary of the post-construction requirements is as follows:

- *Performance Requirement No. 1: Site Design and Runoff Reduction*
  This requirement is intended to limit the disturbance creeks and natural drainage features, minimize compaction of highly permeable soils, limit clearing and grading of native vegetation, minimize impervious surfaces, and minimizing stormwater runoff by collecting it for reuse and by infiltrating it onsite.
- *Performance Requirement No. 2: Water Quality Treatment*
  This requirement is intended to provide onsite retention or treatment (physical, biological, or chemical) of stormwater runoff from developed areas to reduce the discharge of pollutants from the site.
- *Performance Requirement No. 3: Runoff Retention*
  The requirement is intended to maintain the pre-developed hydrology with respect to volume, flow rate, and duration for the site by reducing overland flow

and promoting groundwater recharge. The project site is located in Watershed Management Zone 1 per the map included in Resolution R3-2013-0032, which are areas subject to Performance Requirement No. 3.

- *Performance Requirement No. 4: Peak Management*
  The requirement is intended to maintain the pre-developed hydrology with respect to peak discharge from the site. This requirement states that the post-development peak flows discharged from the site shall not exceed the pre-project peak flows for the 2-though 10-year storm events.

2.6. California Department of Fish and Wildlife (CDFW)

A biological study was conducted to define the limits of jurisdiction for the California Department of Fish and Wildlife (CDFW), which includes portions along Twin Ridge Creek. Proposed work that is within CDFW jurisdiction will be permitted through CDFW.

2.7. Federal Emergency Management Agency (FEMA)

The Federal Emergency Management Agency (FEMA) has established flood insurance zones throughout the City of San Luis Obispo. Development within these zones must be in compliance with both the City and FEMA regulations.

The current FEMA Flood Insurance Rate Map Number 06079C1066G (revised 11/16/12, Appendix A) for the area, shows the project site to be outside of FEMA floodplain, so the requirements specific to those areas are not applicable to this project.

2.8. US Army Corps of Engineers (USACE)

A biological study was conducted to define the limits of jurisdiction for the US Army Corps of Engineers (USACE), which includes Federal Wetlands and Other Waters of the United States as defined by Section 404 of the Clean Water Act. Both types of waterbodies were defined along Twin Ridge Creek. Proposed work that is within USACE jurisdiction will be permitted through USACE.

3. Existing Drainage Conditions

3.1. Description of Existing Offsite Flows that Discharge onto Project

Twin Ridge Creek runs along the western portion of the project site and flows south to north. The reach of Twin Ridge Creek that passes through the site begins to form in the agricultural area north of the site by discharge from a residential area and continues south to Highland Dr, where it joins the existing stormwater drainage system. The majority of offsite flow comes from the north and drains to Twin Ridge Creek. The other source of offsite flow is from Westmont Ave and the residential area east of the project site.

3.2. Description of Existing Onsite Drainage Conditions

The project site consists of approximately 4.94 acres of mostly agricultural land, along with some residential area and the wooded area along Twin Ridge Creek. The area considered for this study is shown on Figure 2. The study area for the existing conditions was divided into six sub-basins, two draining to Twin Ridge Creek, two to Stanford Dr, and two to Cuesta Drive.

Sub-basin Exist-TR1 includes the area that drains to the end of the Twin Ridge Creek Line of Investigation. This area is comprised of agricultural and oak woodland and also possibly includes residential runoff from an existing storm drain network.

Sub-basin Exist-TR2 is the largest sub-basin in the study and includes a large portion of the agricultural land north of the site, as well as two significant residential areas, the lot and buildings directly north of the site, a portion of Skyline Dr, and the houses to the east of Skyline Drive.

Sub-basin Exist-S1 includes the area that drains directly to the Line of Interest (LOI) where Stanford meets the project site. This area includes agricultural, impervious, and residential area.

Sub-basin Exist-S2 includes the area just south of the project site draining to a Point of Interest (POI) further along Stanford Drive. This area includes residential and impervious area.

Sub-basin Exist-C1 is a small area on the eastern boundary of the project site, draining directly to Cuesta Drive. This area includes residential and impervious area.

Sub-basin Exist-C2 includes the area east of the project site including a portion of Westmont and the residential properties north of Westmont. This area includes residential and impervious area.

3.3. Hydrologic Analyses of Existing Conditions

Hydrologic Analysis of Study Area

Hydrologic analyses were performed as part of this study to estimate the magnitudes of the stormwater runoff from the project study area considering the existing condition of the site. The project study area is shown on Figure 2. The computer program Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2015 was used to perform the hydrologic analyses and is based on the SCS Unit Hydrograph methodology and the following input parameters:

- Sub-basin Characteristics
  - Drainage Area
  - SCS Curve Number (CN)
  - Time of Concentration
- Precipitation Model: SCS Type 1 24-hour design storm (rainfall depths from Table C-3 SLO WMP, Vol. 1)

  - 2-year rainfall depth: 3.3 inches
  - 10-year rainfall depth: 4.6 inches
  - 25-year rainfall depth: 5.7 inches
  - 50-year rainfall depth: 6.5 inches
  - 100-year rainfall depth: 6.7 inches
- Time Interval: 1 minute

Composite curve numbers and times of concentration times were calculated for each sub-basin, and those calculations are included in Appendix B. According to the Web Soil Survey, the site was determined to be soil types C and D. These parameters, along with the sub-basin areas, were input into the hydrologic model for each sub-basin and runoff hydrographs for several design storms were generated. The peak flows for each sub-basin are shown in Table , and the associated hydrographs are included in Appendix B.

Table 1 – Summary of peak flows by sub-basin for discharge from study area for existing conditions

Sub-basin	Area		Peak Flow (cfs)				
	(Ac)	CN	2-yr	10-yr	25-yr	50-yr	100-yr
EXIST-TR1	0.37	69.1	0.15	0.37	0.58	0.74	0.78
EXIST-TR2	27.45	86.6	31.9	51.8	69.0	81.5	84.6
EXIST-C1	0.33	87.0	0.50	0.80	1.05	1.24	1.29
EXIST-C2	1.57	94.1	3.54	5.17	6.54	7.52	7.77
EXIST-S1	1.44	89.2	2.06	3.22	4.21	4.92	5.10
EXIST-S2	0.81	92.2	1.51	2.26	2.88	3.34	3.45

Combined peak flows are shown in Table The peak flows at Twin Ridge Creek were obtained by combining the hydrographs for sub-basins EXIST-TR1 and EXIST-TR2. The peak flows at Cuesta Drive were obtained by combining the hydrographs from EXIST-C1 and EXIST-C2. The total peak flows released from the site are shown and provide a limit for San Luis Obispo Drainage Design Manual Requirements. Hydrographs for POIs and sub-basins are included in Appendix B.

Table 2 – Summary of peak flows by POI for discharge from study area for existing conditions

Point of Interest	Peak Flow (cfs)				
	2-yr	10-yr	25-yr	50-yr	100-yr
Twin Ridge Creek	32.07	52.19	69.56	82.22	85.39
Cuesta Drive	3.98	5.88	7.47	8.63	8.92
EXIST-S1	2.06	3.22	4.21	4.92	5.10
EXIST-S2	1.51	2.26	2.88	3.34	3.45

4. Proposed Drainage Conditions

4.1. Description of Proposed Drainage Conditions

The project consists of the construction 23 additional lots expanding the existing residential neighborhood. Most will be along Stanford Drive, while three are on the west side of the creek. In general, the lots are 6,000 sf to 7,000 sf with a few as large as 9,000 sf to 11,000 sf. The project also includes widening the existing portion of Stanford Drive, as well as tying the east end into Cuesta Drive.

The major proposed drainage features are shown on Figure 4 and include two underground basins, one capturing the majority of runoff from the project site, and the other the offsite runoff from Westmont Ave.

Most of the proposed lots will drain to the streets, although lots 1-3 will drain to bioretention areas then directly to the creek. Runoff that collects in the lots will drain to the streets and is proposed to be conveyed by surface flow in the gutters and streets to curb inlets. The inlets will be connected to underground pipes that will convey the runoff to detention facilities. From the detention basins, the flow will be conveyed to either Cuesta or to the creek outfall. There are two emergency overland flow routes proposed, one to Stanford and one to Cuesta, and those are shown on Figure 4.

The area considered for this study is shown on Figure 3. The study area for the proposed conditions was divided into seven sub-basins.

Sub-basin PROP-TR1 includes the entire onsite area draining directly to Twin Ridge Creek. This area includes wooded land, and future residential and impervious areas.

Sub-basin PROP-TR2 includes the the offsite area that drains directly to Twin Ridge Creek. It is identical to EXIST-TR2, but with the subtraction of any onsite area included before. This area includes a large portion of the agricultural land north of the site, as well as two significant residential area, the lot and buildings directly north of the site, a portion of Skyline Dr, and the houses to the east of Skyline Drive.

Sub-basin PROP-TR3 includes a majority of the onsite residential and impervious area and drains to the larger detention basin on the site, before draining to Twin Ridge Creek through a proposed storm drain. This area includes residential and impervious area, as well as a small amount of park area.

Sub-basin PROP-S1 includes a small portion of the onsite area and drains directly to Stanford Drive. This area includes residential and impervious area.

Sub-basin PROP-S2 is identical to EXIST-S2 except that it cuts off at the site boundary. It includes existing residential and impervious area.

Sub-basin PROP-C1 is roughly the same as EXIST-C1, but now includes the proposed lots instead of existing residential and impervious area.

Sub-basin PROP-C2 is the offsite runoff from Westmont, but instead of draining directly to Cuesta Drive, it will be routed into an underground detention basin located between lots 15 and 16.

The proposed approach to peak flow management for this project at Twin Ridge Creek involves collecting a portion of the runoff from the proposed development detaining that flow in a detention facility, and then introducing it to Twin Ridge Creek resulting in an overall reduction in peak flow for the system. At Cuesta, the runoff is collected and detained in an underground detention facility and then released onto the proposed site at Cuesta Drive. The proposed drainage at Stanford was designed so that the runoff would match existing drainage conditions.

4.2. Hydrologic Analysis of Proposed Conditions

Hydrologic analyses were performed as part of this study to estimate the magnitudes of the stormwater runoff from the project study area considering the proposed condition of the site. The computer program Hydraflow Hydrographs Extension for AutoCAD Civil 3D 2017 was used to perform the hydrologic analyses and is based on the methodology described in Section 3.3.

The parameters for all of the detention facilities and outlet structures were input into the model and those parameters are included in Appendix C. Composite curve numbers and times of concentration were calculated for each sub-basin, and those calculations are included in Appendix C. These parameters, along with the sub-basin areas, were input into the hydrologic model for each sub-basin and runoff hydrographs for several design storms were generated. Table 5 shows the peak flows from each sub-basin before any detention. Sub-basin POST-TR3 routes through the detention facility, while sub-basin POST-TR1 and POST-TR2 flow directly to Twin Ridge Creek.

Table 1 – Summary of peak flows at each sub-basin for proposed conditions, before detention

Point of Interest	Peak Flow (cfs)				
	2-yr	10-yr	25-yr	50-yr	100-yr
PROP-TR1	2.31	3.74	4.98	5.89	6.12
PROP-TR2	30.25	48.47	64.09	75.44	78.28
PROP-TR3	5.09	7.62	9.74	11.27	11.65
PROP-C1	1.67	2.48	3.17	3.66	3.79
PROP-C2	3.09	4.46	5.61	6.44	6.65
PROP-S1	0.87	1.29	1.64	1.89	1.95
PROP-S2	1.24	1.86	2.38	2.75	2.85

Table 6 shows the peak flow at PROP-S1 and total peak flows at Twin Ridge Creek and Cuesta Dr, after detention. Twin Ridge Creek includes PROP-TR1, PROP-TR2, and

PROP-TR3 after being detained in the underground facility. Cuesta Dr includes PROP-C1 and PROP-C2 after being detained in the other underground facility.

Hydrographs for each sub-basin and POI are included in Appendix C.

Table 6 – Summary of peak flows at each sub-basin for proposed conditions, after detention

POI	Peak Flows (cfs)				
	2	10	25	50	100
PROP-S1	0.87	1.29	1.64	1.89	1.95
TWIN RIDGE CREEK	32.42	52.13	69.63	82.02	85.08
CUESTA DRIVE	3.97	5.52	6.66	7.43	7.62
PROP-S2	1.24	1.86	2.38	2.75	2.85

The discharge at Stanford Dr (PROP-S1 and PROP-S2) is less than the pre-developed condition.

4.3. Major Drainage Features

Detention Facilities

The proposed detention facilities are shown in Figure 4. The Stanford Basin will temporarily store water from PROP-TR3 before introducing it to Twin Ridge Creek. The Cuesta Basin will temporarily story water from the offsite area PROP-C2 before discharging it into Cuesta Dr along with the runoff from PROP-C1.

Both facilities are proposed as plastic arch chambers surrounded by gravel to accommodate proposed grading. As part of this study, the basin was sized using a trapezoidal open basin with a flow control structure as shown in Appendix C.

Outfalls to Twin Ridge Creek

The outfall is proposed in Twin Ridge Creek at the southwest corner of Lot 4 just before the end of the portion of creek being investigated. The proposed outfall consists of pipes that discharge through a headwall onto riprap aprons.

4.4. Post-construction Phase II Municipal General Permit Requirements

The post-construction requirements associated with the Phase II Municipal General Permit are summarized in Section 2.5. Compliance with these requirements is intended to be achieved by implementing strategies that include maintaining creek setbacks and constructing retention and detention facilities. A *Stormwater Control Plan for Post-construction Requirements* was prepared for the project by Cannon under separate cover.

4.5. Floodplain Analysis

Scope

The FEMA Flood Insurance Rate Map Number 06079C1066G shows the project site to be outside of FEMA floodplain, so the requirements specific to those areas are not applicable to this project. Figure DDM 3-2a (Appendix A) from the Drainage Design Manual shows the project site is not within the 100-year floodplain although it appears Twin Ridge Creek was not modeled as part of this figure. As part of this study, we have conducted a 100-yr flood plain analysis of Twin Ridge Creek along the project frontage. Finished floors are set at least 1ft above the 100-yr floodplain line as determined by this study.

Methodology

A HEC-RAS model was developed based on the flowline and topographic data captured by a field crew in February 2020. HEC-RAS cross sections were identified at locations of apparent channel geometry or slope change.

In order to set upstream boundary conditions, a steady state normal depth was assumed with a slope equal to the slope upstream of the model. At the downstream side of the property, the creek continues to flow in the channel which is highly overgrown. Due to the existing vegetation, the field crew was not able to obtain cross sections south of the property line. In order the correctly model this scenario, a Manning's coefficient for the most downstream section was increased to 0.1, from .045 which was used for the rest of the creek, and the downstream slope for the normal depth calculation was set to 0.5%.

The 100 year flow from existing TR-2 as shown in Table 1, Section 3.3 was input into a HEC-RAS model to determine water surface elevations.

A mixed flow regime was selected as most appropriate for the 100 year storm event as water elevations varied above and below critical depth.

Flood Plain Delineations

The boundary of the 100 year floodplain was created in HEC-RAS and exported into AutoCAD. Figure 5 shows the floodplain boundary as determined from the HEC-RAS analysis.

The analysis shows that the water does not overtop the banks of the existing stream, and the project decreased the amount of runoff to the creek, thus there is no need to conduct this analysis for a proposed condition.

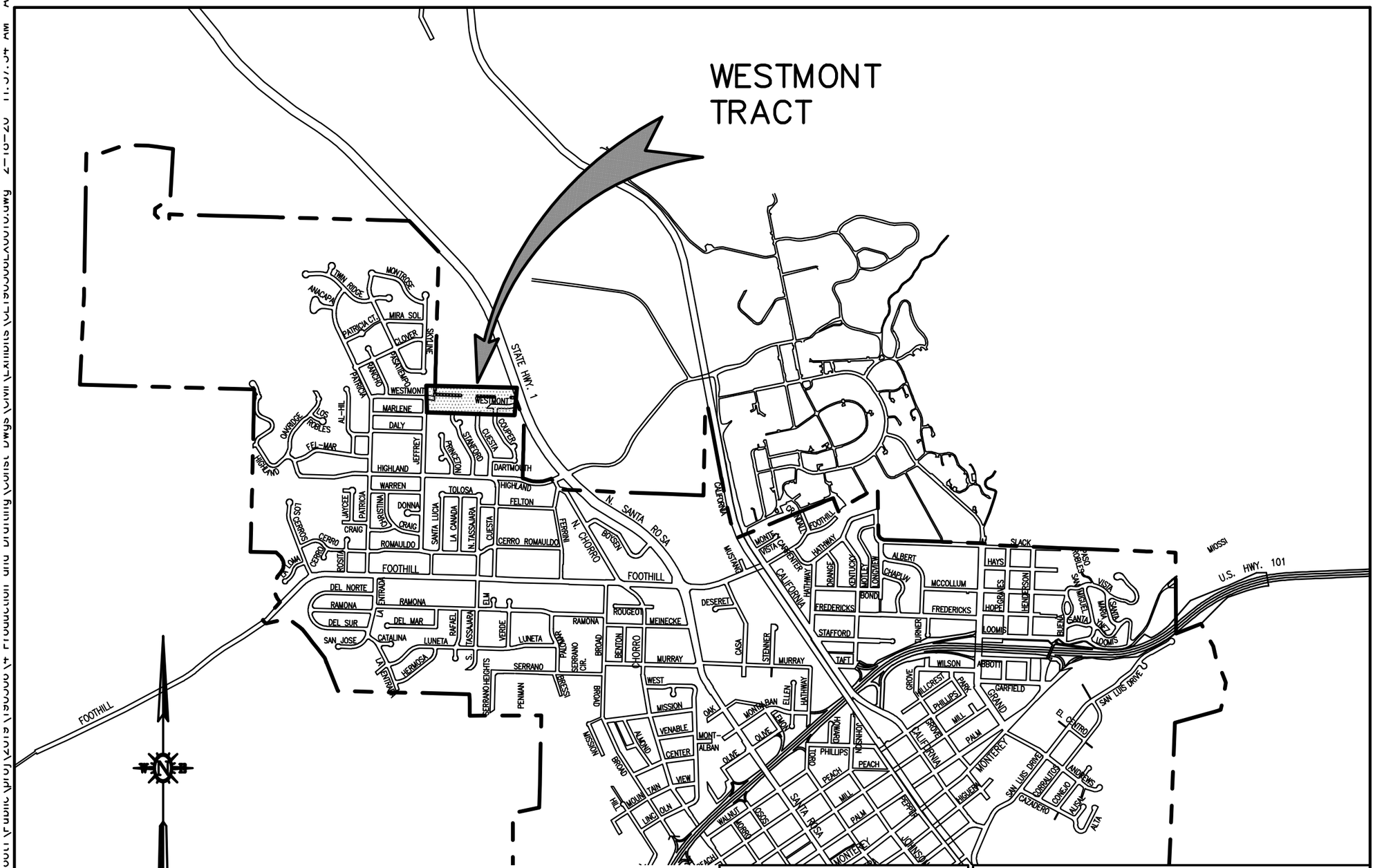
References

City of San Luis Obispo Department of Public Works and County of San Luis Obispo Flood Control District. 2003. *San Luis Obispo Creek Waterway Management Plan Volume I San Luis Obispo Creek Watershed*.

City of San Luis Obispo Department of Public Works and County of San Luis Obispo Flood Control District. 2003. *San Luis Obispo Creek Waterway Management Plan Volume III Drainage Design Manual*.

Federal Highway Administration (FHWA). July 2006. *Hydraulic Design of Energy Dissipators for Culverts and Channels, Hydraulic Engineering Circular No. 14, Third Edition.*

Federal Highway Administration (FHWA). August 2013. *Urban Drainage Design Manual, Hydraulic Engineering Circular No. 22, Third Edition.*



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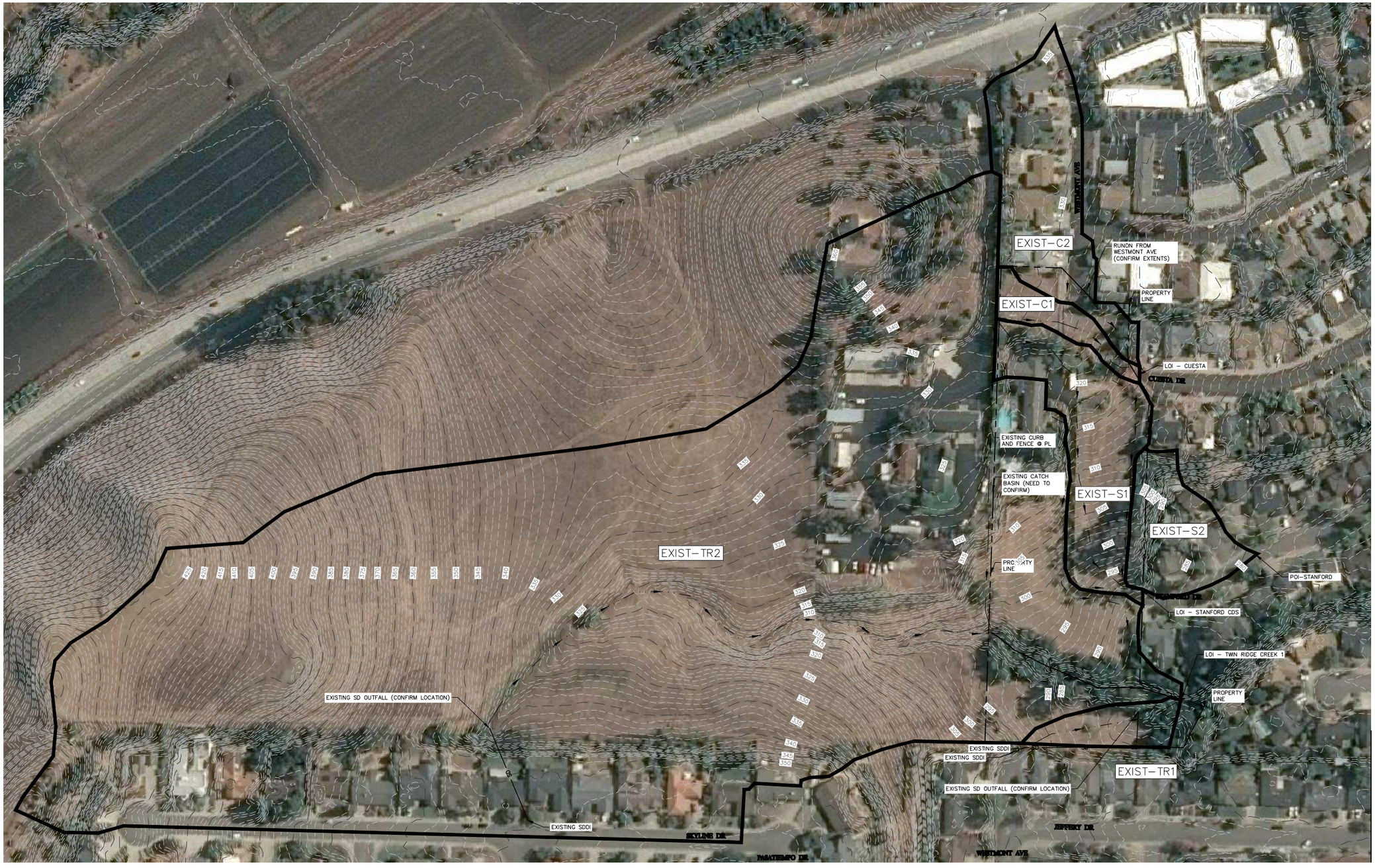
WESTMONT TRACT
VICINITY MAP

SAN LUIS OBISPO, CA

DRAWN BY AJB	DATE 01/28/2020	CA JOB NO. 190306
CHECKED BY	SCALE 1" = 2,000'	SHEET FIGURE 1



0 80 160

1 INCH = 80 FEET

REV. NO	DATE	REVISED — DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CKD. BY	APRD BY

Cannon
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San Luis Obispo, CA 93401
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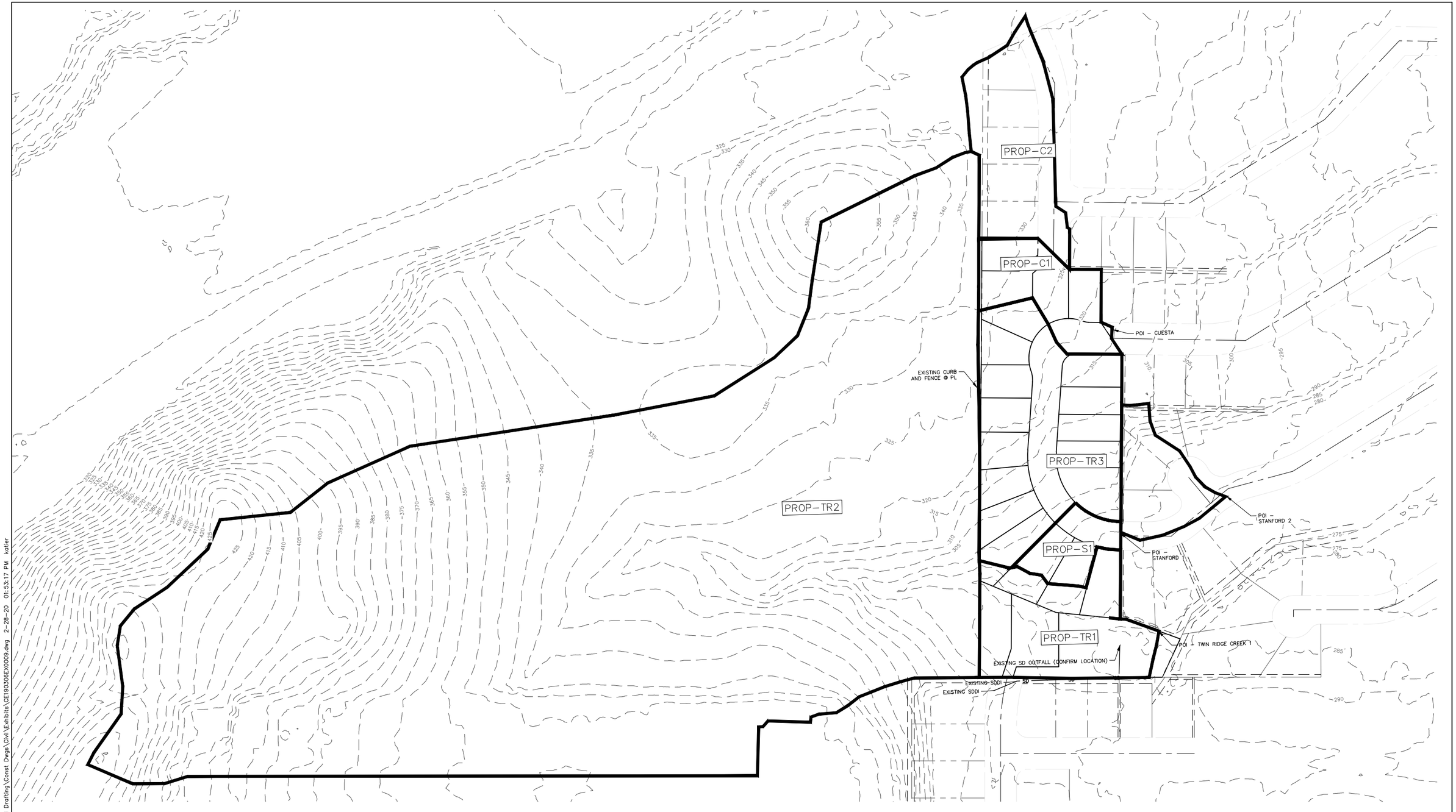
468 WESTMONT AVE

EXISTING DRAINAGE

SAN LUIS OBISPO, CA

DRAWN BY	DATE	CA JOB NO.
AJB	1/27/2019	190306
CHECKED BY	SCALE	SHEET
	1" = 40'	FIGURE 2



REV. NO	DATE	REVISED	DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CKD. BY	APRD BY

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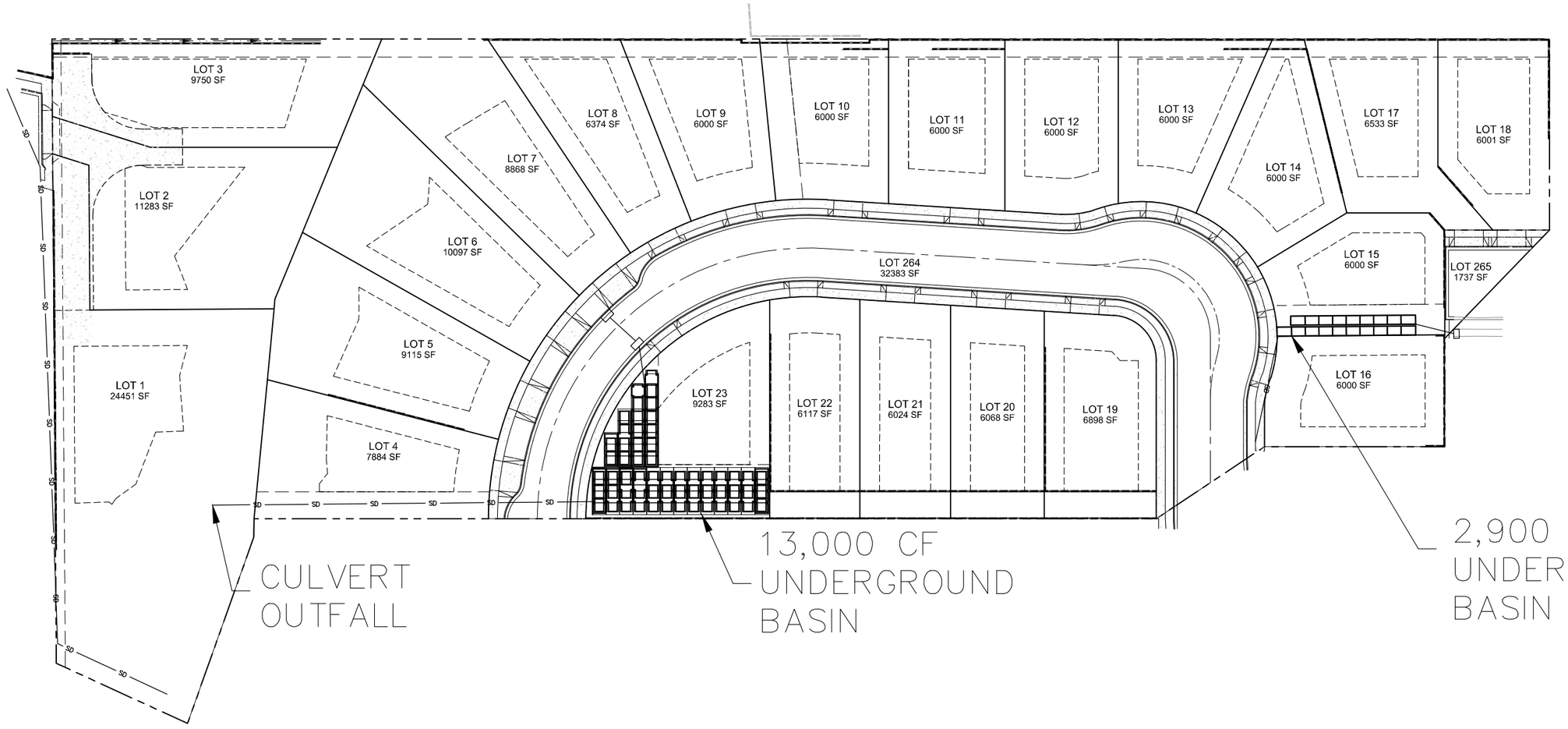
468 WESTMONT AVE

PROPOSED DRAINAGE CONDITIONS

SAN LUIS OBISPO, CA

DRAWN BY	DATE	CA JOB NO.
AJB	02/05/2020	190306
CHECKED BY	SCALE	SHEET
	1" = 80'	FIGURE 3



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0 30 60

1 INCH = 30 FEET

ORIGINAL SIZE: 24" X 36"

REV. NO	DATE	REVISED DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CKD. BY	APRD BY

Cannon

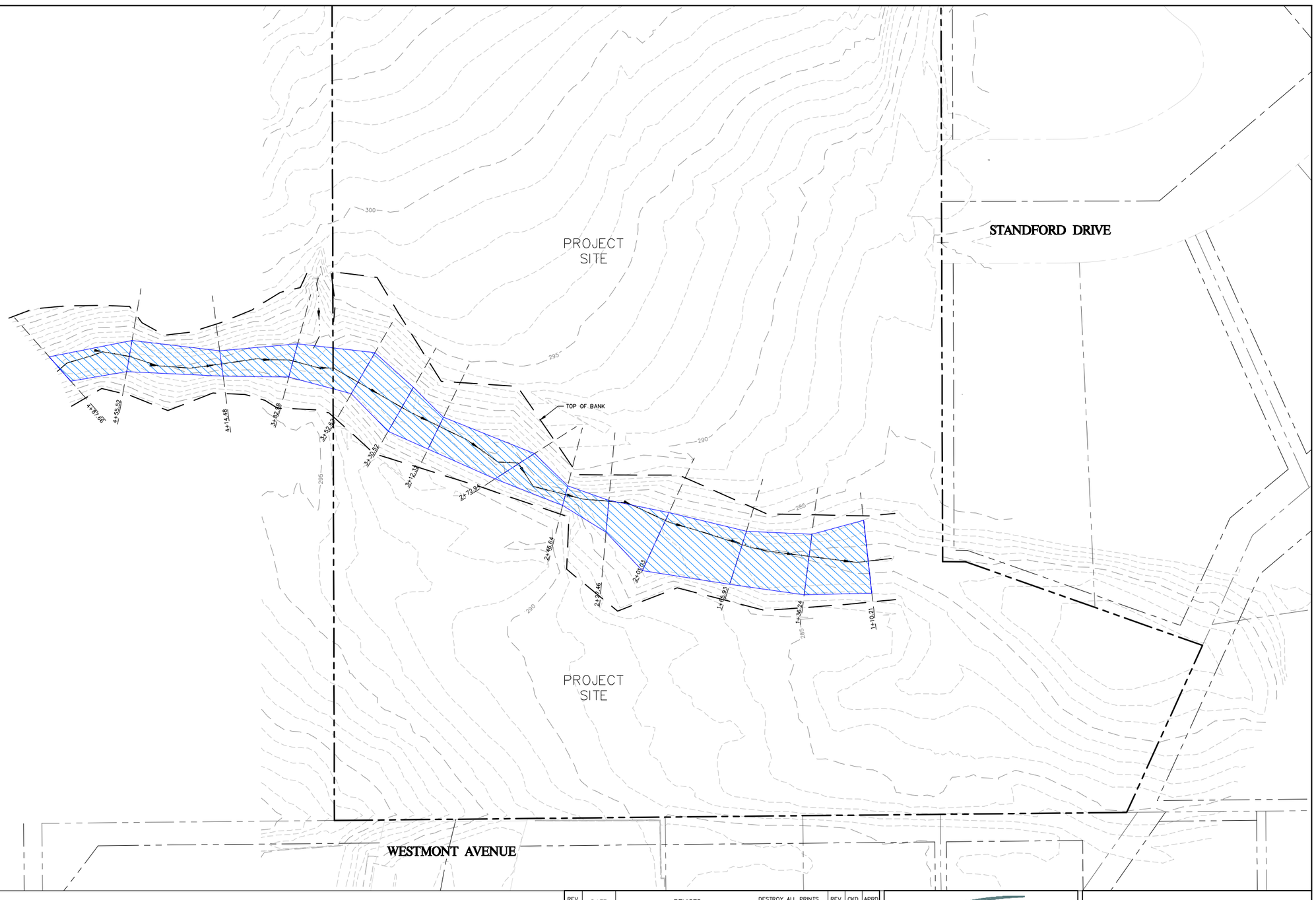
1050 Southwood Drive
San Luis Obispo, CA 93401
P 805.544.7407 F 805.544.3863

468 WESTMONT AVE

PROPOSED DRAINAGE FEATURES

SAN LUIS OBISPO, CA

DRAWN BY	DATE	CA JOB NO.
AJB	02/05/2020	190306
CHECKED BY	SCALE	SHEET
	1" = 40'	FIGURE 4



LEGEND

100 YEAR FLOODPLAIN LIMITS

REV. NO	DATE	REVISED	DESTROY ALL PRINTS BEARING EARLIER DATE	REV. BY	CKD. BY	APRD BY

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468 WESTMONT AVE
100 YEAR FLOODPLAIN MAP
SAN LUIS OBISPO, CA

DRAWN BY	DATE	CA JOB NO.
AJB	02/26/2020	190306
CHECKED BY	SCALE	SHEET
	1" = 20'	FIGURE 5

Appendix A

Site Data

1. FEMA FIRMette
2. NRCS Hydrologic Soil Group Map

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.

Coastal Base Flood Elevations (BFEs) shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

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 Universal Transverse Mercator (UTM) Zone 10. The **horizontal datum** was NAD83, GRS80 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/.

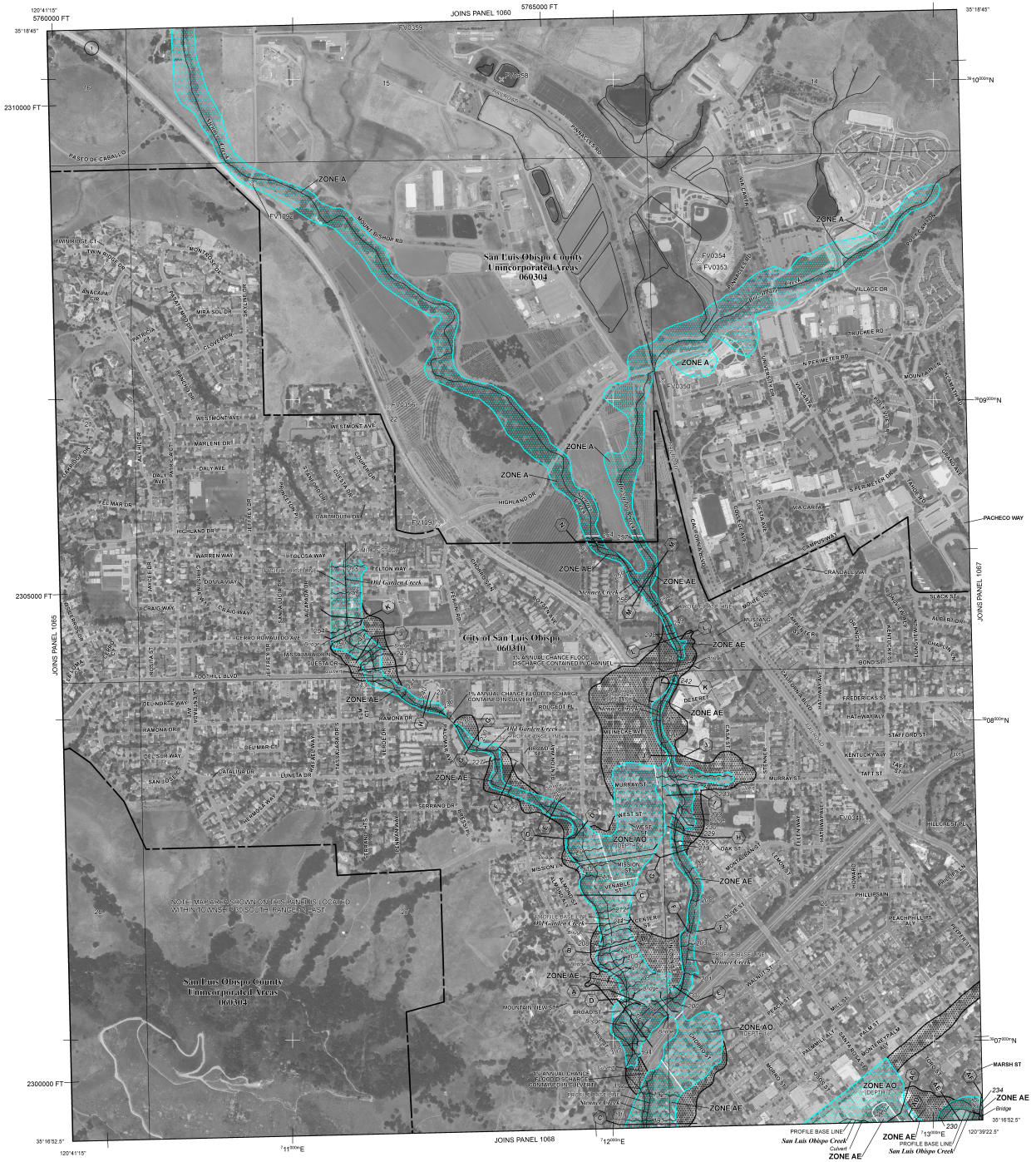
Base map information shown on this FIRM was derived from digital orthophotography collected by the U.S. Department of Agriculture Farm Service Agency under its National Agriculture Imagery Program (NAIP). This imagery was flown in 2010 and was produced with a 1-meter ground sample distance.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

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 and questions about this map, available products associated with this FIRM including historic versions of this FIRM, how to order products or the National Flood Insurance Program in general, please call the FEMA Map Information eXchange at 1-877-FEMA-MAP (1-877-336-2627) or visit the FEMA Map Service Center 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 website. Users may determine the current map date for each FIRM panel by visiting the FEMA Map Service Center website or by calling the FEMA Map Information eXchange.



LEGEND

SPECIAL FLOOD HAZARD AREAS 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 Area 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** Areas to be protected from 1% annual chance flood event 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 (EL 987) — 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

- (A) — (A) Cross section line
- (23) — (23) Transect line
- 97°07'30", 32°22'30" — Geographic coordinates referred to the North American Datum of 1983 (NAD 83), Western Hemisphere
- 4775000mE — 1000-meter Universal Transverse Mercator grid values, zone 10
- 6000000 FT — 5000-foot grid ticks: California State Plane coordinate system, Zone V (FIPSZONE = 405), Lambert 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
August 28, 2008

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL
November 16, 2012 - to update corporate limits, to incorporate previously issued Letters of Map Revision, and to reflect updated topographic information.

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" = 500'

250 0 250 500 750 1,000 FEET
150 0 150 300 METERS

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 1066G

FIRM

FLOOD INSURANCE RATE MAP

SAN LUIS OBISPO COUNTY, CALIFORNIA AND INCORPORATED AREAS

PANEL 1066 OF 2050

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
SAN LUIS OBISPO COUNTY	060304	1066	G
SAN LUIS OBISPO, CITY OF	060310	1066	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
06079C1066G

MAP REVISED
NOVEMBER 16, 2012

Federal Emergency Management Agency

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 San Luis Obispo County, California, Coastal Part

December 30, 2019

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

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: 1:3,190 if printed on A portrait (8.5" x 11") 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 10N 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: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 12, 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: Data not available.

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
128	Cropley clay, 2 to 9 percent slopes, MLRA 14	1.5	4.1%
163	Los Osos-Diablo complex, 9 to 15 percent slopes	33.6	89.1%
168	Los Osos variant clay loam, 15 to 50 percent slopes	2.5	6.8%
Totals for Area of Interest		**37.7**	**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.

San Luis Obispo County, California, Coastal Part

128—Cropley clay, 2 to 9 percent slopes, MLRA 14

Map Unit Setting

National map unit symbol: 2tb9j
Elevation: 0 to 2,340 feet
Mean annual precipitation: 12 to 28 inches
Mean annual air temperature: 56 to 60 degrees F
Frost-free period: 270 to 365 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Cropley

Setting

Landform: Alluvial fans, terraces
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Base slope, tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from calcareous shale

Typical profile

A1 - 0 to 11 inches: clay
Bss1 - 11 to 51 inches: clay
BCk1 - 51 to 79 inches: sandy clay loam

Properties and qualities

Slope: 2 to 9 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 15 percent
Gypsum, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (1.0 to 3.0 mmhos/cm)
Sodium adsorption ratio, maximum in profile: 5.0
Available water storage in profile: High (about 9.1 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: CLAYEY (R014XD001CA)
Hydric soil rating: No

Minor Components

Salinas

Percent of map unit: 3 percent
Landform: Terraces, alluvial fans
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Base slope, tread, talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

Los osos

Percent of map unit: 3 percent
Landform: Ridges, hillslopes
Landform position (two-dimensional): Summit, backslope, shoulder, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex, concave
Across-slope shape: Convex, concave
Hydric soil rating: No

Clear lake

Percent of map unit: 2 percent
Landform: Basin floors
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Hydric soil rating: Yes

Capay

Percent of map unit: 2 percent
Landform: Flood plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Base slope, dip
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

163—Los Osos-Diablo complex, 9 to 15 percent slopes

Map Unit Setting

National map unit symbol: hbp9
Elevation: 200 to 1,500 feet
Mean annual precipitation: 15 to 25 inches
Mean annual air temperature: 59 degrees F
Frost-free period: 275 to 350 days
Farmland classification: Not prime farmland

Map Unit Composition

Los osos and similar soils: 35 percent
Diablo and similar soils: 30 percent

Minor components: 35 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Los Osos

Setting

Landform: Hills, ridges
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Mountaintop, crest, side slope
Down-slope shape: Convex
Across-slope shape: Convex, linear
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 14 inches: loam
H2 - 14 to 32 inches: clay
H3 - 32 to 39 inches: sandy loam
H4 - 39 to 59 inches: weathered bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 20 to 40 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: LOAMY CLAYPAN (R015XD049CA)
Hydric soil rating: No

Description of Diablo

Setting

Landform: Hills, mountains
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Mountainflank, crest, side slope
Down-slope shape: Convex, linear
Across-slope shape: Convex
Parent material: Residuum weathered from mudstone, sandstone and/or shale

Typical profile

H1 - 0 to 38 inches: clay
H2 - 38 to 58 inches: clay
H3 - 58 to 62 inches: weathered bedrock

Properties and qualities

Slope: 9 to 15 percent
Depth to restrictive feature: 45 to 58 inches to paralithic bedrock
Natural drainage class: Well drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 2 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 9.8 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: CLAYEY (R015XD001CA)
Hydric soil rating: No

Minor Components

Cibo, clay

Percent of map unit: 9 percent
Hydric soil rating: No

Lodo, clay loam

Percent of map unit: 9 percent
Hydric soil rating: No

Millsap, loam

Percent of map unit: 9 percent
Hydric soil rating: No

Unnamed

Percent of map unit: 8 percent
Hydric soil rating: No

168—Los Osos variant clay loam, 15 to 50 percent slopes

Map Unit Setting

National map unit symbol: hbpg
Elevation: 300 to 1,500 feet
Mean annual precipitation: 14 to 22 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 240 to 300 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Los Osos Variant

Setting

Landform: Mountains, hills
Landform position (two-dimensional): Backslope, summit
Landform position (three-dimensional): Mountainflank, crest, side slope
Down-slope shape: Linear, convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 12 inches: clay loam
H2 - 12 to 27 inches: clay
H3 - 27 to 60 inches: clay loam

Properties and qualities

Slope: 15 to 50 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Well 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum in profile: 5 percent
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: High (about 10.3 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: C
Ecological site: FINE LOAMY (R015XD024CA)
Hydric soil rating: No

Minor Components

Calodo, loam

Percent of map unit: 3 percent
Hydric soil rating: No

Diablo, clay

Percent of map unit: 3 percent
Hydric soil rating: No

Los osos, clay loam

Percent of map unit: 3 percent
Hydric soil rating: No

Millsap, loam

Percent of map unit: 2 percent
Hydric soil rating: No

Nacimiento, silty clay loam

Percent of map unit: 2 percent
Hydric soil rating: No

Rock outcrop

Percent of map unit: 2 percent
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

The Soil Properties and Qualities section includes various soil properties and qualities displayed as thematic maps with a summary table for the soil map units in the selected area of interest. A single value or rating for each map unit is generated by aggregating the interpretive ratings of individual map unit components. This aggregation process is defined for each property or quality.

Soil Qualities and Features

Soil qualities are behavior and performance attributes that are not directly measured, but are inferred from observations of dynamic conditions and from soil properties. Example soil qualities include natural drainage, and frost action. Soil features are attributes that are not directly part of the soil. Example soil features include slope and depth to restrictive layer. These features can greatly impact the use and management of the soil.

Hydrologic Soil Group (190306)

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

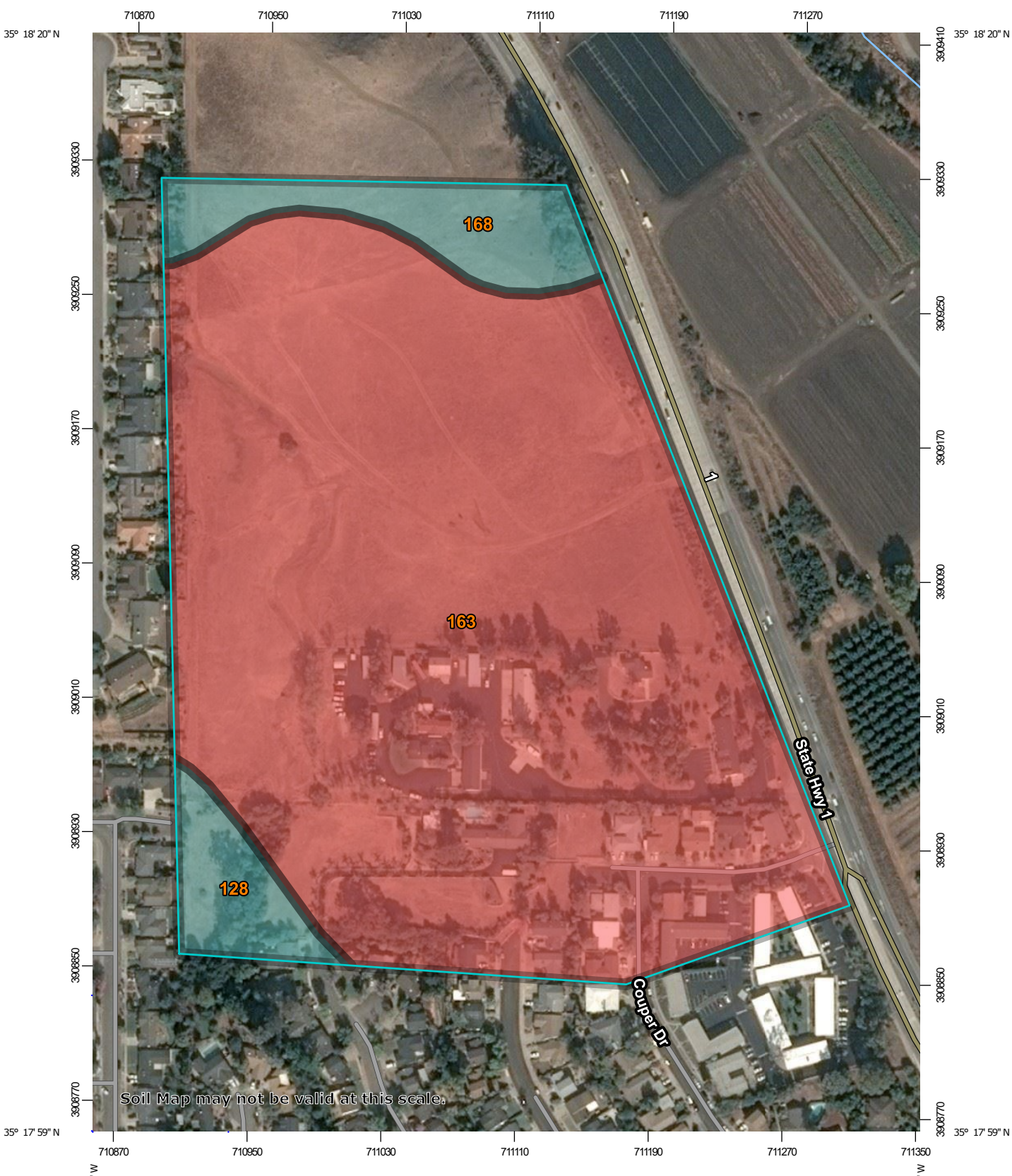
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Map—Hydrologic Soil Group (190306)



Map Scale: 1:3,190 if printed on A portrait (8.5" x 11") 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 10N WGS84

MAP LEGEND

Area of Interest (AOI)

Area of Interest (AOI)

Soils

Soil Rating Polygons

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Lines

A

A/D

B

B/D

C

C/D

D

Not rated or not available

Soil Rating Points

A

A/D

B

B/D

C

C/D

D

Not rated or not available

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: San Luis Obispo County, California, Coastal Part
Survey Area Data: Version 12, 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: Data not available.

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.

Table—Hydrologic Soil Group (190306)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
128	Cropley clay, 2 to 9 percent slopes, MLRA 14	C	1.5	4.1%
163	Los Osos-Diablo complex, 9 to 15 percent slopes	D	33.6	89.1%
168	Los Osos variant clay loam, 15 to 50 percent slopes	C	2.5	6.8%
Totals for Area of Interest			**37.7**	**100.0%**

Rating Options—Hydrologic Soil Group (190306)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Appendix B

Hydrologic Analyses of Existing Conditions

1. Composite Runoff Coefficient and Curve Number Calculations
2. Time of Concentration Calculations
3. Rational Method Peak Flow Calculations
4. SCS method hydrographs

Composite Runoff Coefficient and Curve Number Calculations - Existing Conditions

Project: 190306-Westmont
Updated: 2/18/2020
By: AJB

Runoff Coefficients (from Table 4-1 SLO DDM) and Curve Numbers (from Table 2-2a TR-55)

Type of Development	Hydrologic Soil Goup	Runoff Coefficient, *C*	Curve Number, *CN*	Description
Moderate Vegetation (s < 2%)	C	0.25	82	SLO DDM: Moderate Vegetation; TR-55: Woods-grass Combination (poor hydrologic condition)
Moderate Vegetation (s < 2%)	D	0.25	86	
Moderate Vegetation (s = 2-10%)	C	0.30	82	
Moderate Vegetation (s = 2-10%)	D	0.35	86	
Moderate Vegetation (s > 10%)	C	0.35	82	
Moderate Vegetation (s > 10%)	D	0.45	86	
Agricultural (s < 2%)	C	0.30	82	SLO DDM: Agriculture; TR-55: Row Crops, Straight Rows, Crop Residue Cover (good hydrologic condition)
Agricultural (s < 2%)	D	0.40	85	SLO Table 4-1 grassland/pasture
Agricultural (s = 2-10%)	C	0.35	82	
Agricultural (s = 2-10%)	D	0.45	85	
Agricultural (s > 10%)	C	0.40	82	
Agricultural (s > 10%)	D	0.50	85	
Impervious (s < 2%)	C	0.80	98	Impervious Surfaces
Impervious (s <2%)	D	0.85	98	
Impervious (s = 2-10%)	C	0.85	98	
Impervious (s = 2-10%)	D	0.87	98	
Impervious (s > 10%)	C	0.90	98	
Impervious (s > 10%)	D	0.90	98	
Parks (s < 2%)	C	0.10	74	SLO DDM: Unimproved Vacant Lots; TR-55: Moderate Vegetation (good hydrologic condition)
Parks (s < 2%)	D	0.15	80	
Parks (s = 2-10%)	C	0.15	74	
Parks (s = 2-10%)	D	0.20	80	
Parks (s > 10%)	C	0.20	74	
Parks (s > 10%)	D	0.30	80	
Residential District (1/4ac or less)	C	0.45	83	SLO DDM Table 4-1 SFR 6,000SF
Residential District (1/4ac or less)	D	0.45	87	SLO DDM Table 4-1 SFR 6,000SF
Residential District (1/4ac or less)	A	0.45	61	SLO DDM Table 4-1 SFR 6,000SF
Oak Woodland (>10%)	A	0.35	30	SLO DDM Table 4-1 Oak Woodland >10%
Oak Woodland (>10%)	C	0.35	41	
Oak Woodland (>10%)	D	0.45	48	

Calculation Description

Composite runoff coefficients and curve numbers are calculated by using the Area Weighted Average method as follows:

$$Composite\ C = \frac{\sum(C_1A_1 + C_2A_2 + \ldots + C_nA_n)}{\sum(A_1 + A_2 + \ldots + A_n)}$$

Composite Runoff Coefficient and Curve Number Calculation

Sub-basin	Total Area (sf)	Total Area, *A* (ac)	Hydrologic Soil Group	Moderate Vegetation Area (sf)			Agricultural Area (sf)			Impervious Area(sf)			Oak Woodland s>10%	Residential District (buildout condition)	Composite Runoff Coefficient, *C*	Composite Curve Number, *CN*
				s < 2%	s = 2-10%	s > 10%	s < 2%	s = 2-10%	s > 10%	s < 2%	s = 2-10%	s > 10%				
EXIST-C1	14,536	0.33	C	0	0	0	0	0	0	0	0	0			0.45	87.00
			D	0	0	0	0	0	0		0	0		14,536		
EXIST-C2	68,441	1.57	C	0	0	0	0	0	0	0	0	0		0	0.71	94.12
			D	0	0	0	0	0	0	44,318	0	0		24,123		
EXIST-S1	62,855	1.44	C	0	0	0	0	0	0	155	0	0			0.53	89.21
			D	0	0	0	0	0		12,491	0	0		50,209		
EXIST-S2	35,116	0.81	C	0	0					9,491				1,667	0.63	92.23
			D	0	0					7,808				16,150		
EXIST-TR1	16,015	0.37	C	0	0				10,980				5,035		0.38	69.11
			D	0	0											
EXIST-TR2	1,195,937	27.45	C	0	0				158,696	45,911			16,010	67,440	0.54	86.60
			D	0	0				491,871	189,828			7,401	218,780		
Total:	**1,392,900**	**31.98**		**0**	**0**	**0**	**0**	**0**	**661,547**	**310,002**	**0**	**0**		**392,905**		

Time of Concentration Calculation - Existing Conditions

Project: 190306-Westmont
Updated: 2/18/2020

Calculation Description

The following calculations are based on the procedures presented in the San Luis Obispo Drainage Design Manual and the NRCS publication TR-55: Urban Hydrology for Small Watersheds (June 1986 edition)

Sheet Flow (Flow Over Plane Surfaces)

$$T_{sf} = \frac{0.007(nL)^{0.8}}{(I_2)^{0.5} s^{0.4}} * (60\,min/hr)$$

T_{sf} = Travel Time for Sheet Flow (min)
n = Manning's Roughness Coefficient (from Table 3-1)
I_2 = 2-year, 24-hour rainfall (in)
L = Flow Length (ft) - 300 ft maximum
s = Land Slope (ft/ft)

Table 3-1 from TR-55

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods:[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information compiled by Engman (1996).
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Shallow Concentrated Flow

$$T_{sc} = \frac{L}{60V} \qquad V = K_u k S_p^{0.5}$$

T_{sc} = Travel Time for Shallow Concentrated Flow (min)
L = Flow Length (ft) - 1000 ft maximum
V = Velocity (ft/s) (per Equation Above)
K_u = 3.28
k = Interception Coefficient
= 0.457 (Grassed Waterway)
= 0.491 (Unpaved)
= 0.619 (Paved Areas; Small Upland Gullies)
S_p = Slope (%)

Channel Flow

$$T_{ch} = \frac{L}{60V} \qquad V = \frac{1.49 R^{2/3} s^{0.5}}{n}$$

T_{ch} = Travel Time for Channel Flow (min)
V = Velocity (ft/s) (per Manning Equation Above)
R = Hydraulic Radius (ft) = A/P_w
A = Cross-sectional Flow Area (sf)
P_w = Wetted Perimeter (ft)
s = Channel Slope (ft/ft)
n = Manning's Roughness Coefficient

Time of Concentration to Inlet

$T_c = T_{sf} + T_{sc} + T_{ch}$

Lag Time

$T_L = 0.6 * T_c$

Limitations

- Manning's kinematic solution should not be used for sheet flow longer than 300 feet. Equation 3-3 was developed for use with the four standard rainfall intensity-duration relationships.
- In watersheds with storm sewers, carefully identify the appropriate hydraulic flow path to estimate T_c. Storm sewers generally handle only a small portion of a large event. The rest of the peak flow travels by streets, lawns, and so on, to the outlet. Consult a standard hydraulics textbook to determine average velocity in pipes for either pressure or nonpressure flow.
- The minimum T_c used in TR-55 is 0.1 hour.

3–4 (210-VI-TR-55, Secc

if(

Time of Concentration Calculation

Sub-basin	Point of Discharge	Sheet Flow Time Calculation							Shallow Concentrated Flow Time Calculation							Channel Flow Time Calculation										Time of Conc.	Lag Time	
		n	Upper Elev (ft)	Lower Elev (ft)	L (ft)	I_2 (in)	s (ft/ft)	T_{SF} (min)	Upper Elev (ft)	Lower Elev (ft)	L (ft)	k	Sp (%)	V (ft/s)	T_{sc} (min)	Upper Elev (ft)	Lower Elev (ft)	L (ft)	A (sf)	P_w (ft)	R (ft)	s (ft/ft)	n	V (ft/s)	T_{ch} (min)	T_c (min)	T_L (min)	
EXIST-C1	CUESTA	0.150	332.50	315.00	300	3.29	0.150	10.4																		10.4	6.2	
EXIST-C2	CUESTA	0.050	334.50	330.00	137	3.29	0.033	4.2	330.0	314.5	424	0.619	3.7	3.88	1.8											6.1	3.6	*Channel Flow Calculations performed in FlowMaster
EXIST-S1	STANFORD CDS	0.150	331.00	312.00	300	3.29	0.063	14.7	312.0	287.0	293	0.457	8.5	4.38	1.1											15.8	9.5	*Channel Flow Calculations performed in FlowMaster
EXIST-S2	STANFORD	0.240	308.00	283.00	167	3.29	0.150	9.5	283.0	279.5	123	0.619	2.8	3.42	0.6											10.1	6.0	
EXIST-TR1	TWIN RIDGE CREEK	0.150	293.00	279.00	270	3.29	0.052	14.6																		14.6	8.8	
EXIST-TR2	TWIN RIDGE CREEK	0.150	425.00	396.00	300	3.29	0.097	12.4	396.0	326.0	441	0.457	15.9	5.97	1.2	326.0	289.0	1195	5.00	11.00	0.45	0.031	0.040	3.87	5.1	18.8	11.3	*assumed 6" flow depth

Peak Flow Calculations Using Rational Method - Existing Conditions

Project: 190306-Westmont
Updated: 2/18/2020

Calculation Description

The following calculations are based on the Rational Method as

$$Q = C*i*C_a*A$$

Q = Peak Rate of Runoff (cfs)
C = Runoff Coefficient
i = Rainfall Intensity (in/hr)
C_a = Antecedent Moistuer Factor
A = Drainage Area (acres)

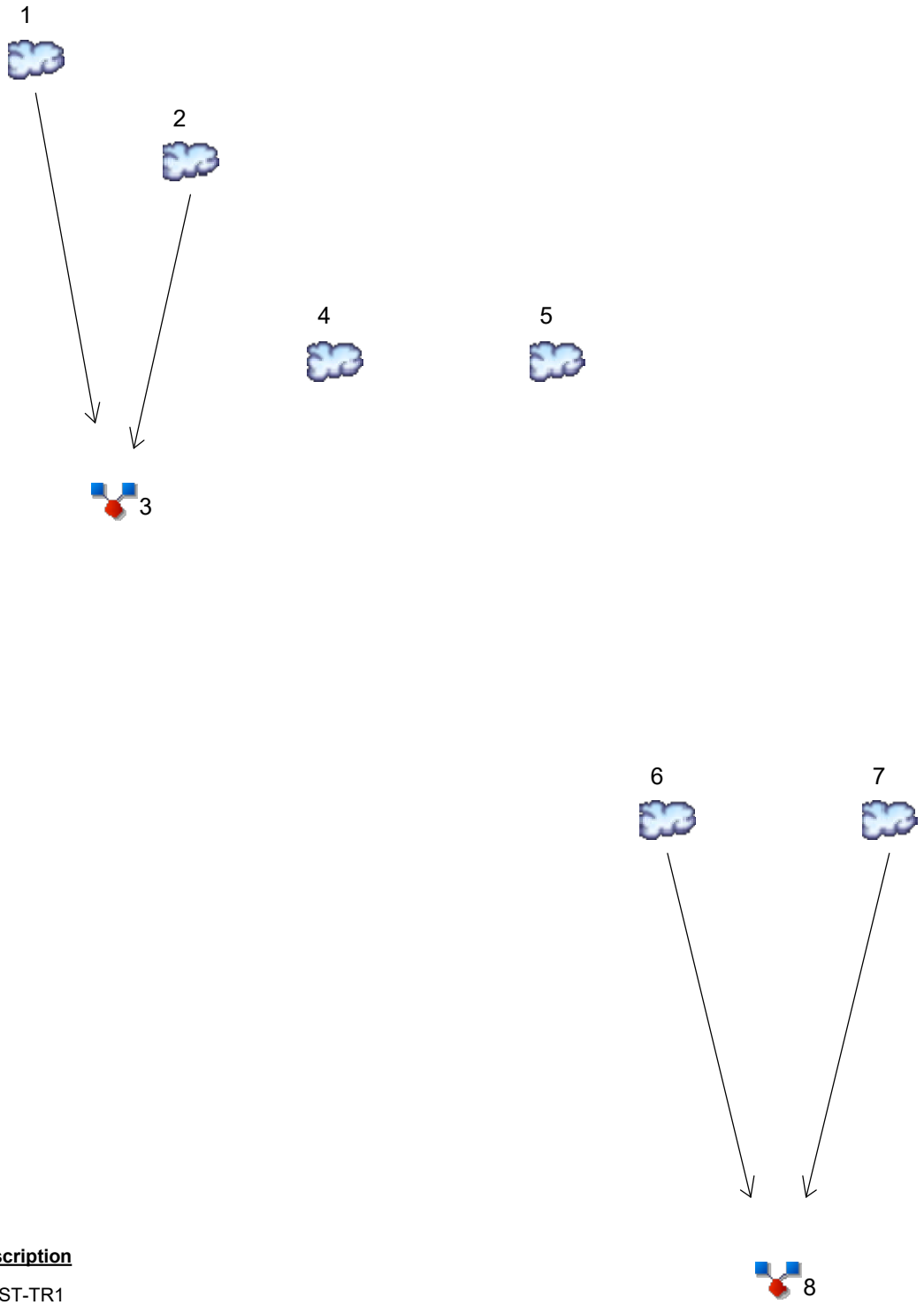
Parameters for Peak Flow Calculations for Areas with 550 mm to 700 mm Annual Rainfall (from Table 4-2 and Table 4-6 SLO DDM)

Recurrence Interval (years)	Antecedent Moisture Factor, C_a	Rainfall Intensity (in/hr) for Duration Given					
		10 min	15 min	30 min	60 min	120 min	180 min
2	1.00	2.09	1.81	1.18	0.75	0.55	0.47
10	1.00	3.58	2.99	2.09	1.30	0.91	0.83
25	1.10	4.02	3.50	2.40	1.50	1.10	0.98
50	1.20	4.61	3.90	2.60	1.69	1.30	1.14
100	1.25	5.00	4.29	2.91	1.85	1.38	1.22

Peak Flow Calculations

Sub-basin	Total Area, A (ac)	Composite Runoff Coefficient, C	Time of Conc. T_c (min)	Rainfall Intensity, i (in/hr)					Peak Flow (cfs) ($Q=C*i*C_a*A$)					Point of Discharge
				2-yr	10-yr	25-yr	50-yr	100-yr	2-yr	10-yr	25-yr	50-yr	100-yr	
EXIST-C1	0.33	0.45	10.4	2.06	3.54	3.98	4.55	4.94	0.31	0.53	0.66	0.82	0.93	CUESTA
EXIST-C2	1.57	0.71	6.1	2.09	3.58	4.02	4.61	5.00	2.32	3.99	4.92	6.16	6.96	CUESTA
EXIST-S1	1.44	0.53	15.8	1.78	2.94	3.45	3.83	4.22	1.36	2.25	2.90	3.52	4.04	STANFORD CDS
EXIST-S2	0.81	0.63	10.1	2.08	3.57	4.01	4.59	4.99	1.06	1.82	2.25	2.82	3.18	STANFORD
EXIST-TR1	0.37	0.38	14.6	1.83	3.04	3.54	3.95	4.35	0.26	0.43	0.55	0.67	0.77	TWIN RIDGE CREEK
EXIST-TR2	27.45	0.54	18.8	1.65	2.77	3.23	3.57	3.95	24.49	40.96	52.59	63.49	73.06	TWIN RIDGE CREEK
Total:	**152.38**								**29.80**	**49.99**	**63.87**	**77.47**	**88.94**	

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	EXIST-TR1
2	SCS Runoff	EXIST-TR2
3	Combine	Twin Ridge Creek
4	SCS Runoff	EXIST-S1
5	SCS Runoff	EXIST-S2
6	SCS Runoff	EXIST-C1
7	SCS Runoff	EXIST-C2
8	Combine	Cuesta Drive

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	SCS Runoff	------	-------	0.152	-------	-------	0.366	0.577	0.742	0.784	EXIST-TR1
2	SCS Runoff	------	-------	31.92	-------	-------	51.83	68.99	81.50	84.62	EXIST-TR2
3	Combine	1, 2	-------	32.07	-------	-------	52.19	69.56	82.22	85.39	Twin Ridge Creek
4	SCS Runoff	------	-------	2.061	-------	-------	3.221	4.205	4.918	5.096	EXIST-S1
5	SCS Runoff	------	-------	1.506	-------	-------	2.255	2.884	3.338	3.451	EXIST-S2
6	SCS Runoff	------	-------	0.495	-------	-------	0.795	1.054	1.242	1.289	EXIST-C1
7	SCS Runoff	------	-------	3.541	-------	-------	5.171	6.536	7.522	7.768	EXIST-C2
8	Combine	6, 7	-------	3.979	-------	-------	5.876	7.472	8.627	8.915	Cuesta Drive

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

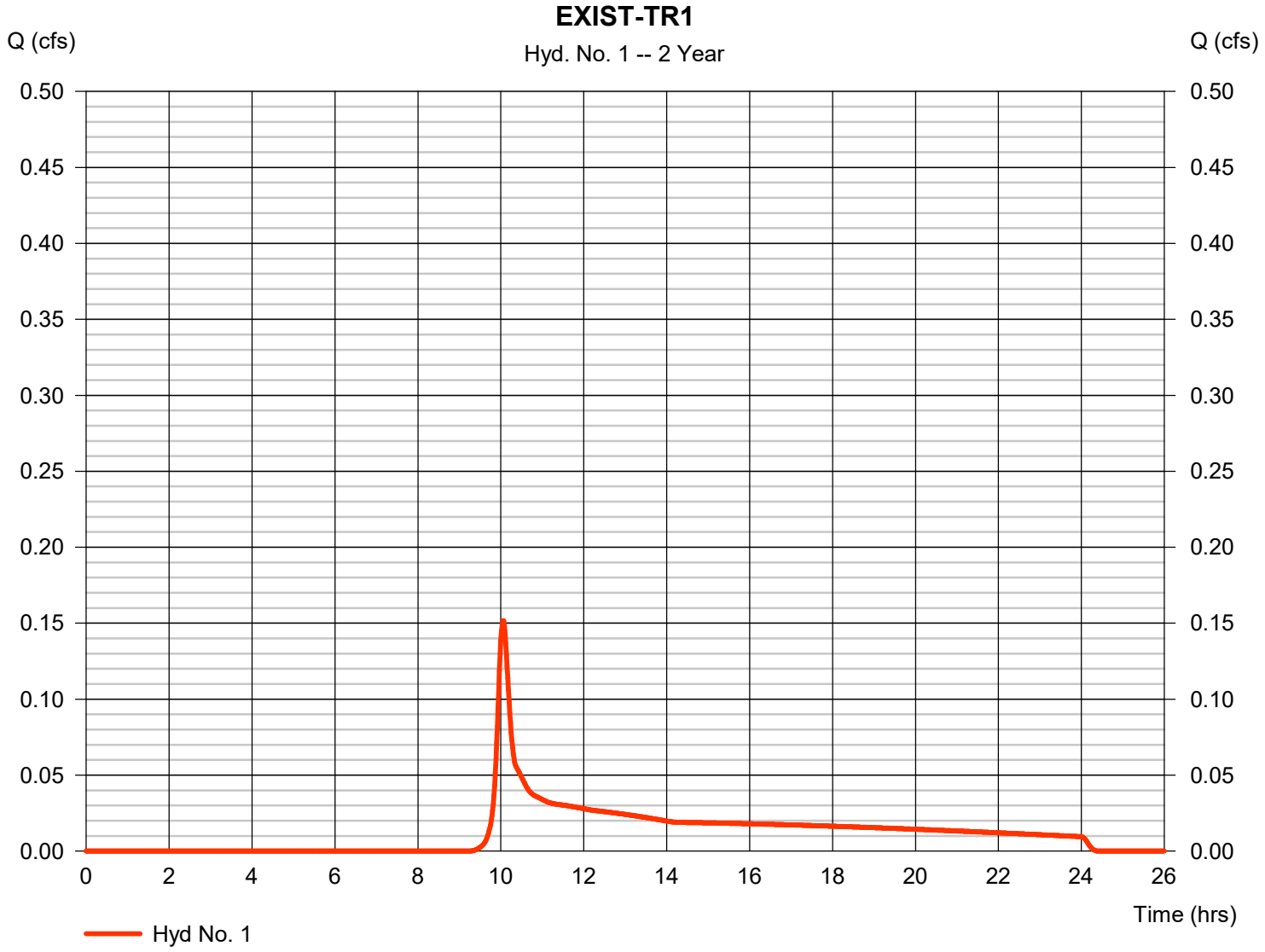
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.152	1	603	1,130	------	------	------	EXIST-TR1
2	SCS Runoff	31.92	1	605	196,378	------	------	------	EXIST-TR2
3	Combine	32.07	1	605	197,508	1, 2	------	------	Twin Ridge Creek
4	SCS Runoff	2.061	1	603	11,593	------	------	------	EXIST-S1
5	SCS Runoff	1.506	1	599	7,377	------	------	------	EXIST-S2
6	SCS Runoff	0.495	1	600	2,443	------	------	------	EXIST-C1
7	SCS Runoff	3.541	1	596	15,581	------	------	------	EXIST-C2
8	Combine	3.979	1	597	18,024	6, 7	------	------	Cuesta Drive

Hydrograph Report

Hyd. No. 1

EXIST-TR1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.152 cfs
Storm frequency	= 2 yrs	Time to peak	= 10.05 hrs
Time interval	= 1 min	Hyd. volume	= 1,130 cuft
Drainage area	= 0.370 ac	Curve number	= 69.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.60 min
Total precip.	= 3.30 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

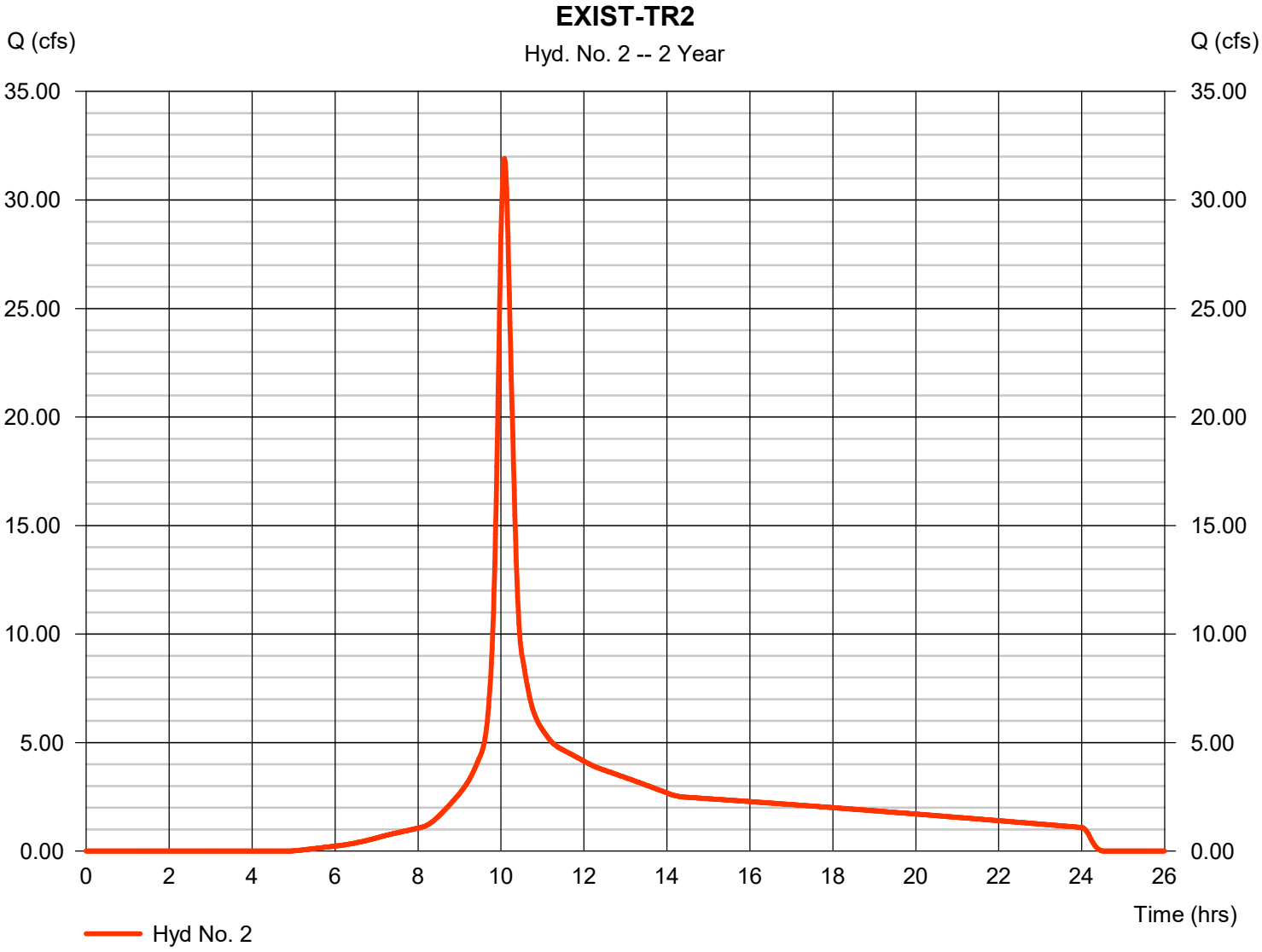


Hydrograph Report

Hyd. No. 2

EXIST-TR2

Hydrograph type	= SCS Runoff	Peak discharge	= 31.92 cfs
Storm frequency	= 2 yrs	Time to peak	= 10.08 hrs
Time interval	= 1 min	Hyd. volume	= 196,378 cuft
Drainage area	= 27.450 ac	Curve number	= 86.6
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 18.80 min
Total precip.	= 3.30 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

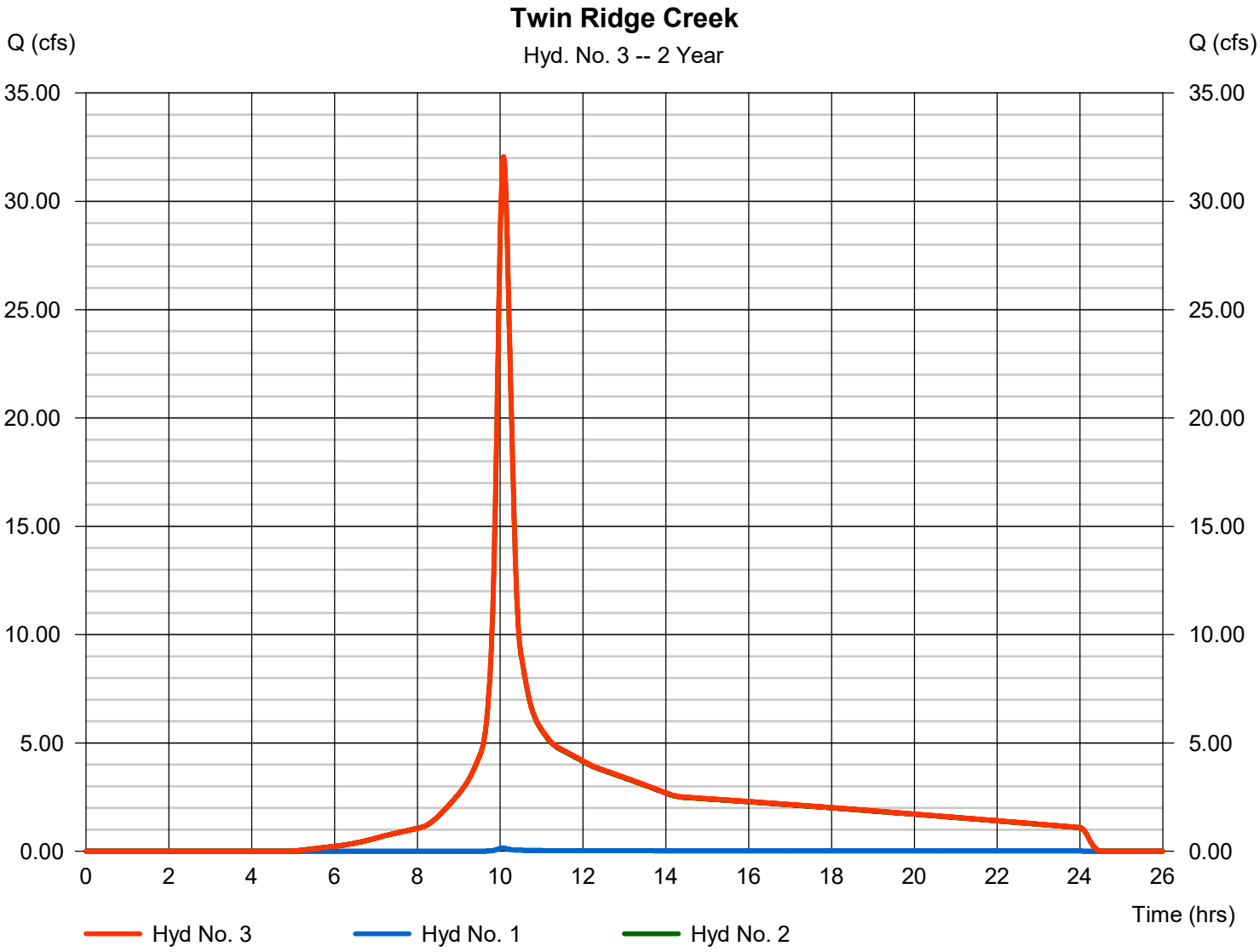


Hydrograph Report

Hyd. No. 3

Twin Ridge Creek

Hydrograph type	= Combine	Peak discharge	= 32.07 cfs
Storm frequency	= 2 yrs	Time to peak	= 10.08 hrs
Time interval	= 1 min	Hyd. volume	= 197,508 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 27.820 ac

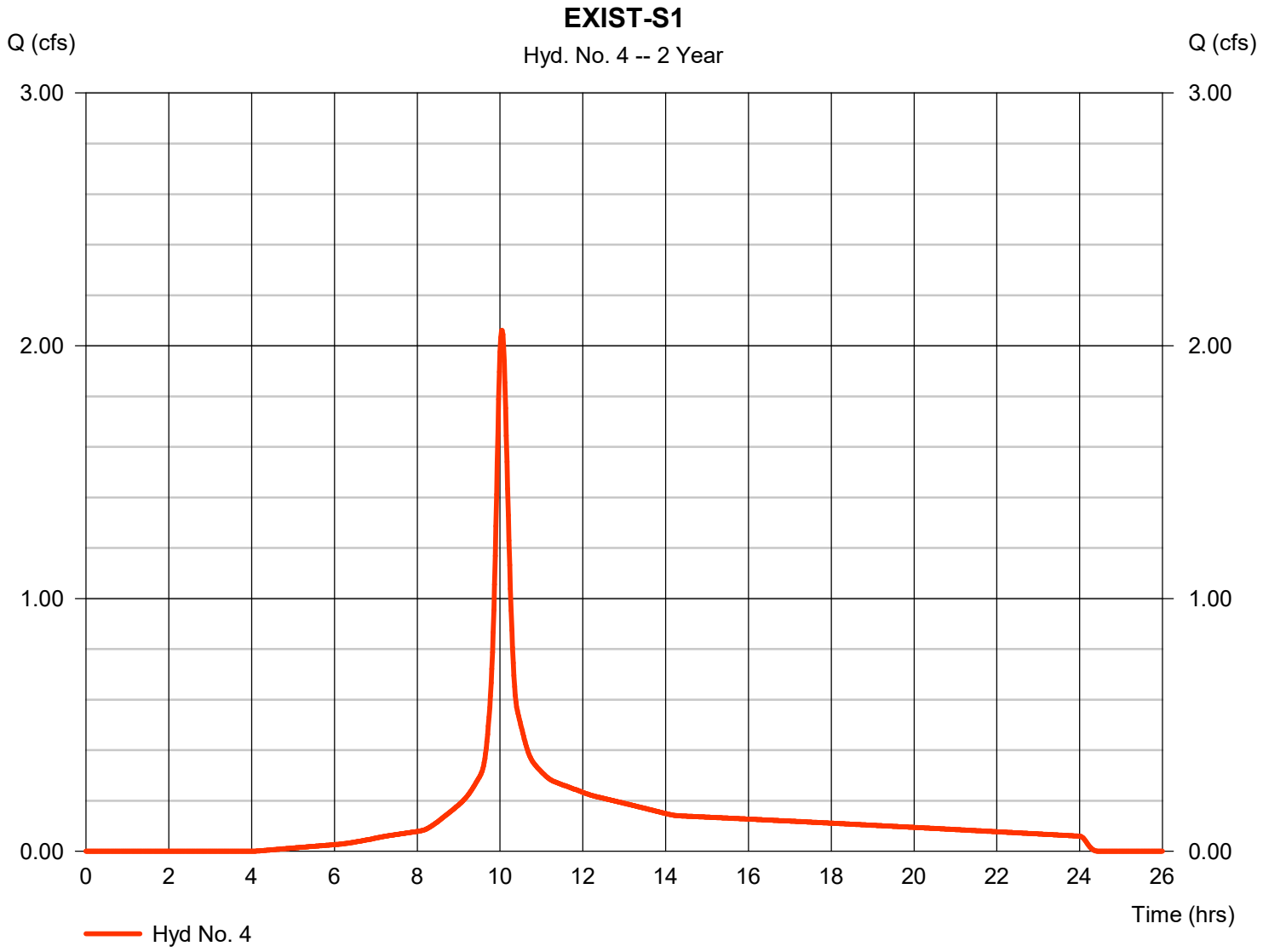


Hydrograph Report

Hyd. No. 4

EXIST-S1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.061 cfs
Storm frequency	=	2 yrs	Time to peak	=	10.05 hrs
Time interval	=	1 min	Hyd. volume	=	11,593 cuft
Drainage area	=	1.440 ac	Curve number	=	89.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.80 min
Total precip.	=	3.30 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

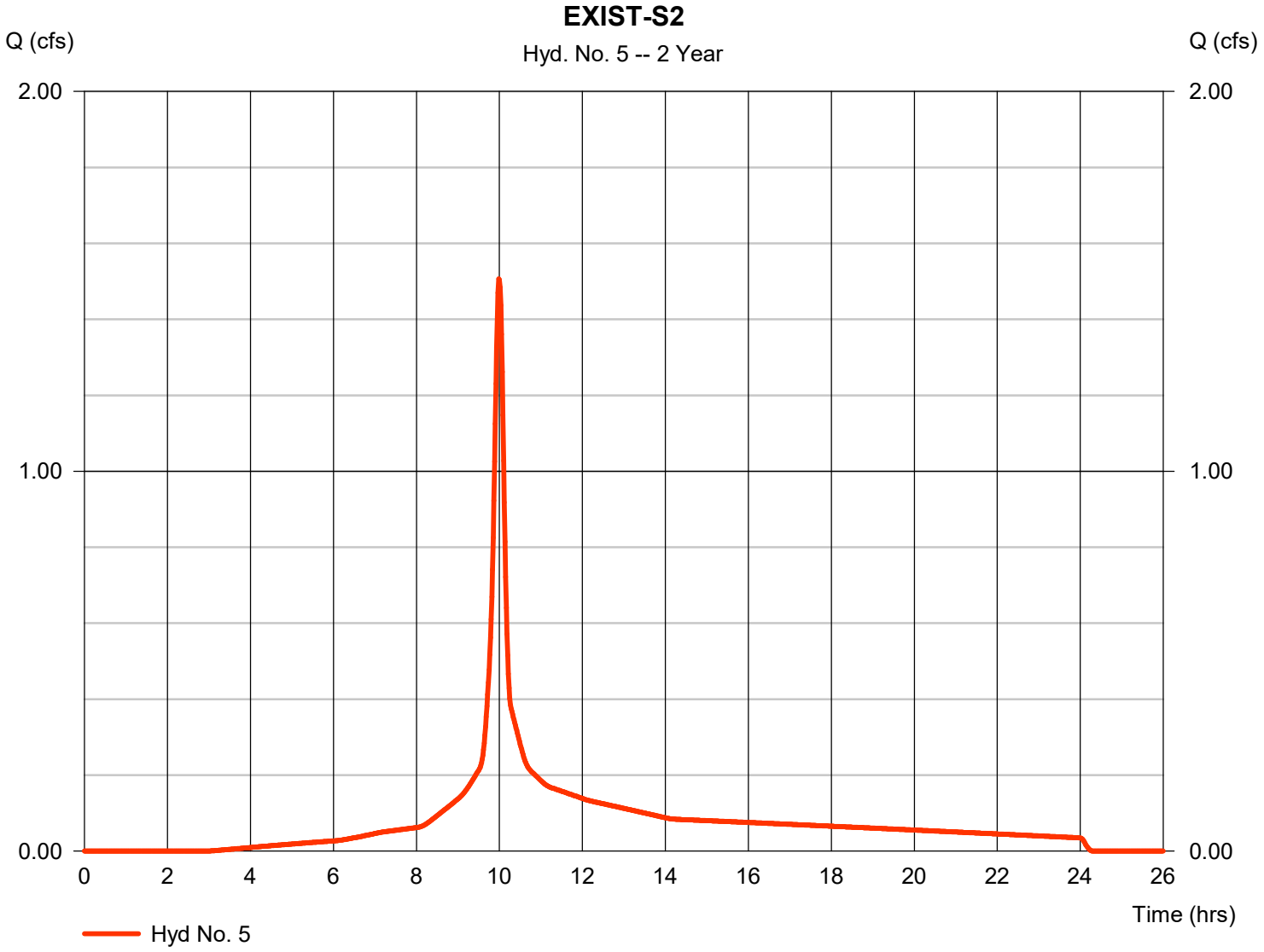


Hydrograph Report

Hyd. No. 5

EXIST-S2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.506 cfs
Storm frequency	=	2 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	7,377 cuft
Drainage area	=	0.810 ac	Curve number	=	92.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.10 min
Total precip.	=	3.30 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

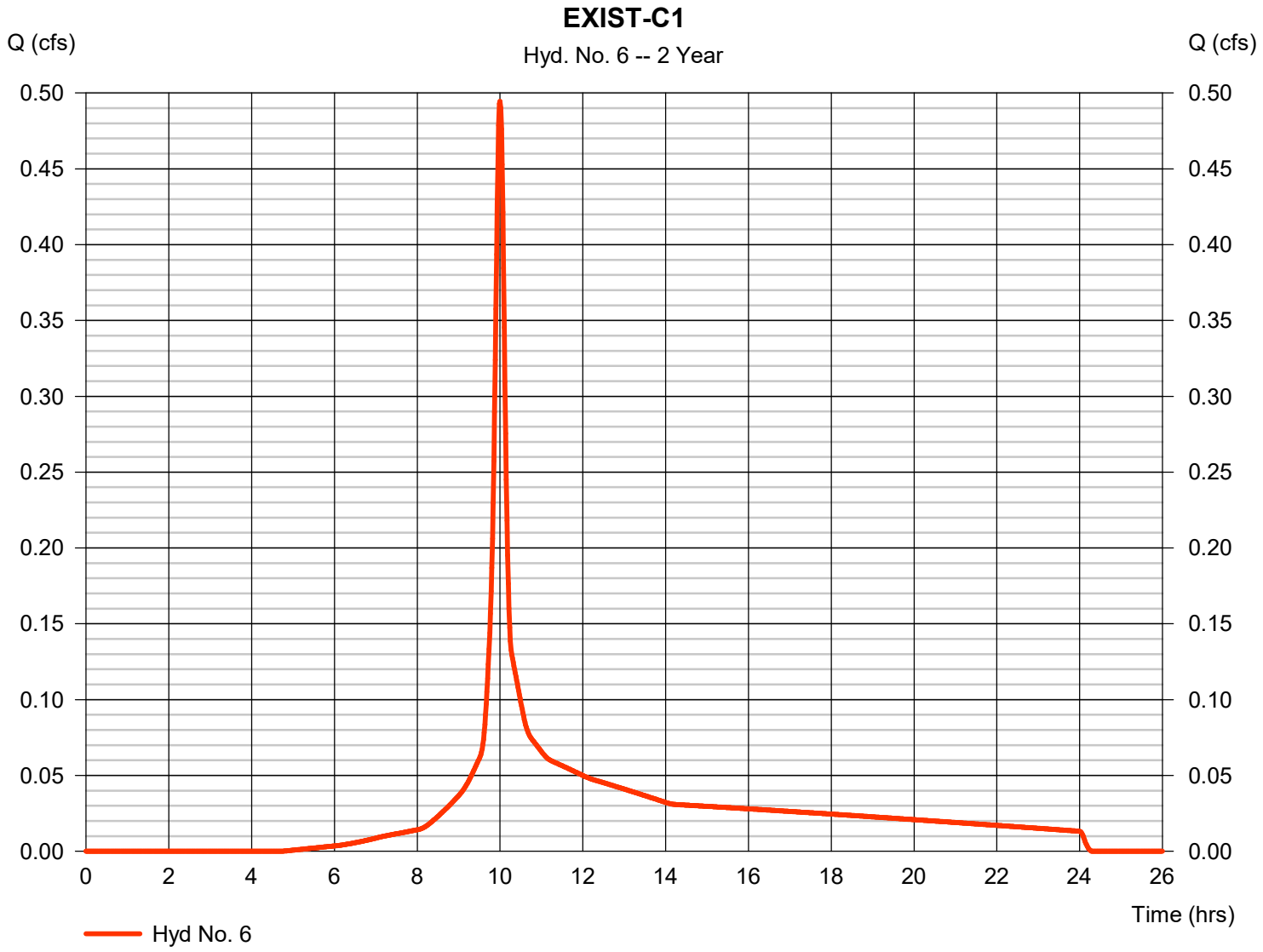


Hydrograph Report

Hyd. No. 6

EXIST-C1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.495 cfs
Storm frequency	= 2 yrs	Time to peak	= 10.00 hrs
Time interval	= 1 min	Hyd. volume	= 2,443 cuft
Drainage area	= 0.330 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.40 min
Total precip.	= 3.30 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

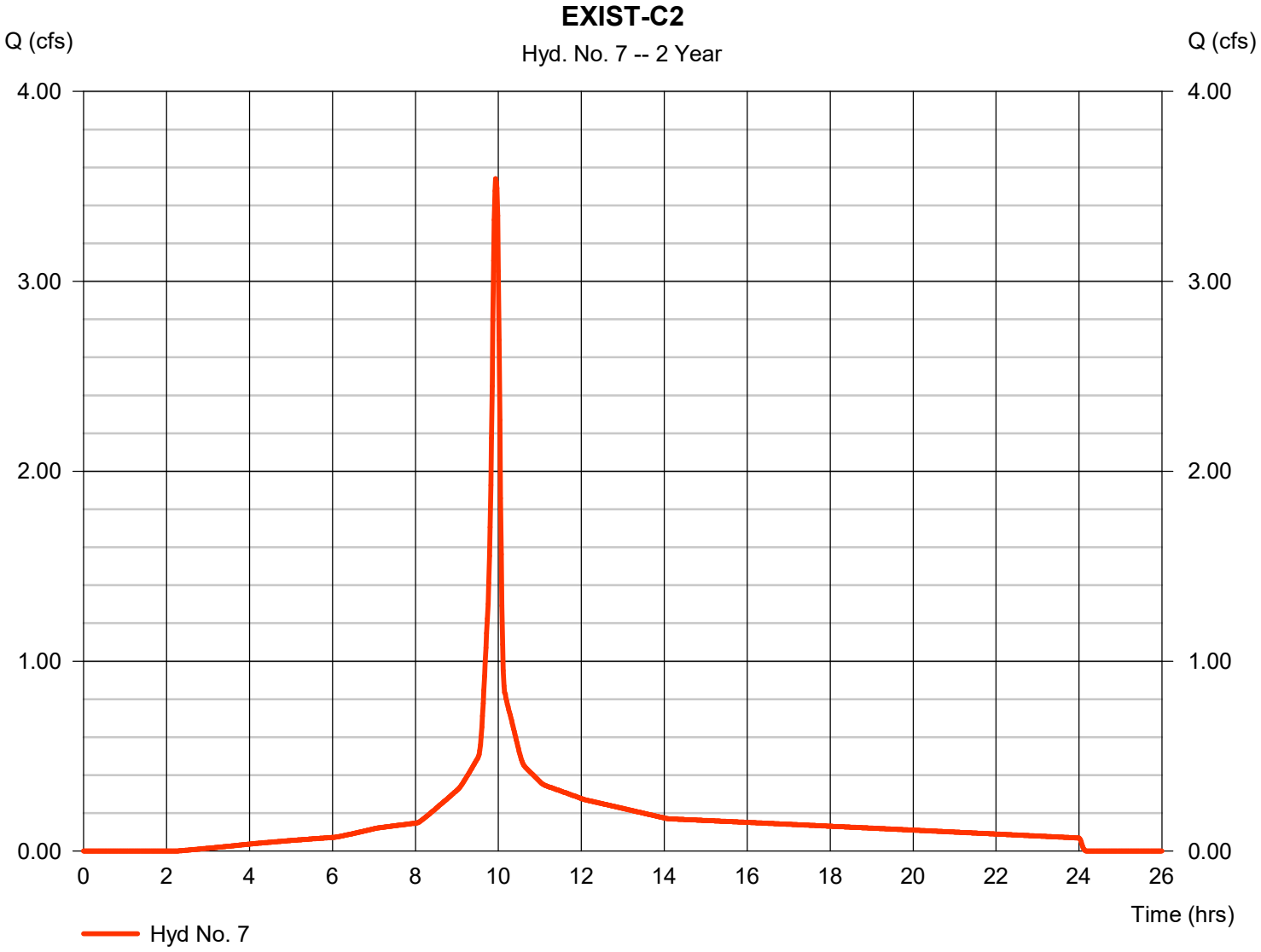


Hydrograph Report

Hyd. No. 7

EXIST-C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.541 cfs
Storm frequency	=	2 yrs	Time to peak	=	9.93 hrs
Time interval	=	1 min	Hyd. volume	=	15,581 cuft
Drainage area	=	1.570 ac	Curve number	=	94.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.10 min
Total precip.	=	3.30 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

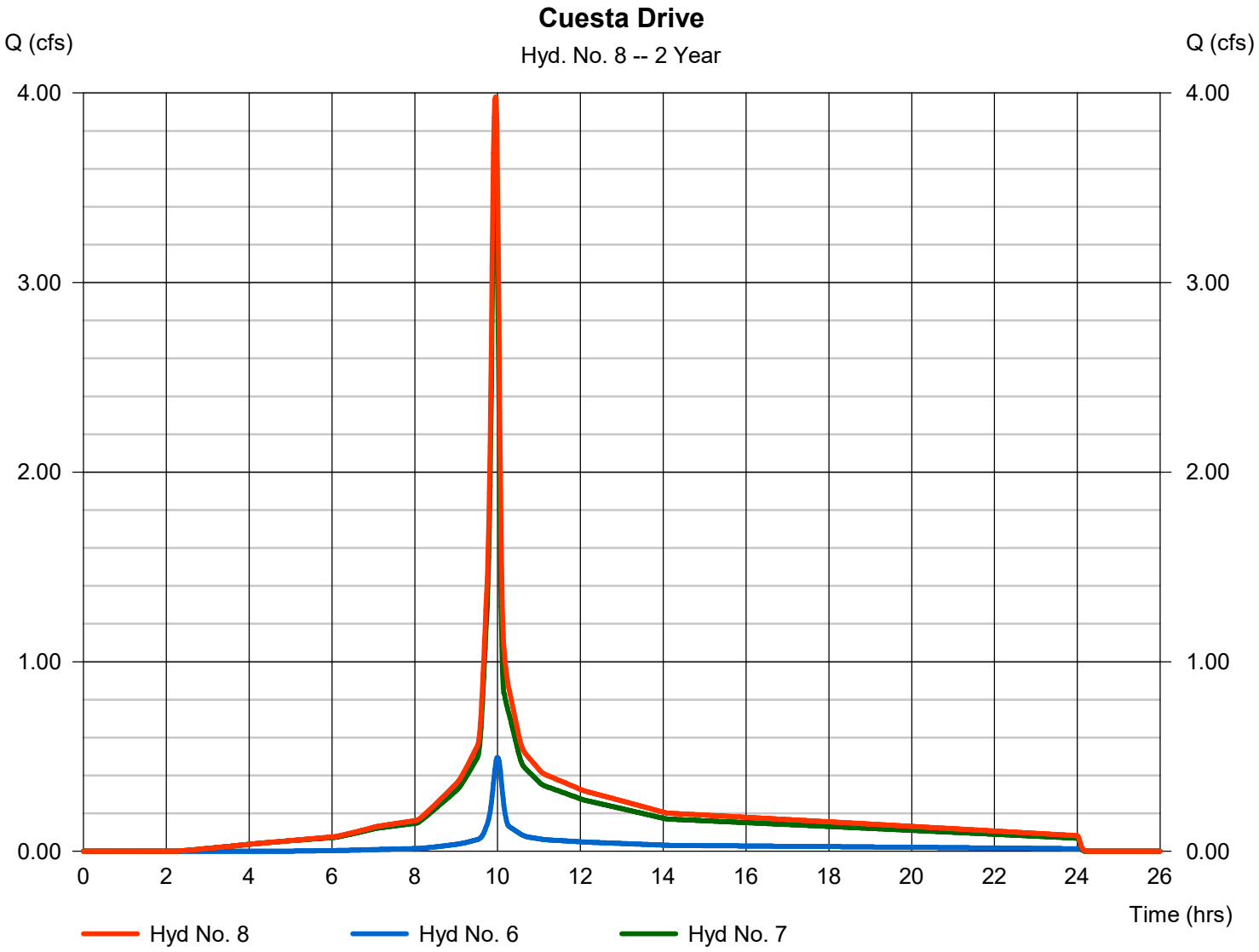


Hydrograph Report

Hyd. No. 8

Cuesta Drive

Hydrograph type	= Combine	Peak discharge	= 3.979 cfs
Storm frequency	= 2 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 18,024 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 1.900 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

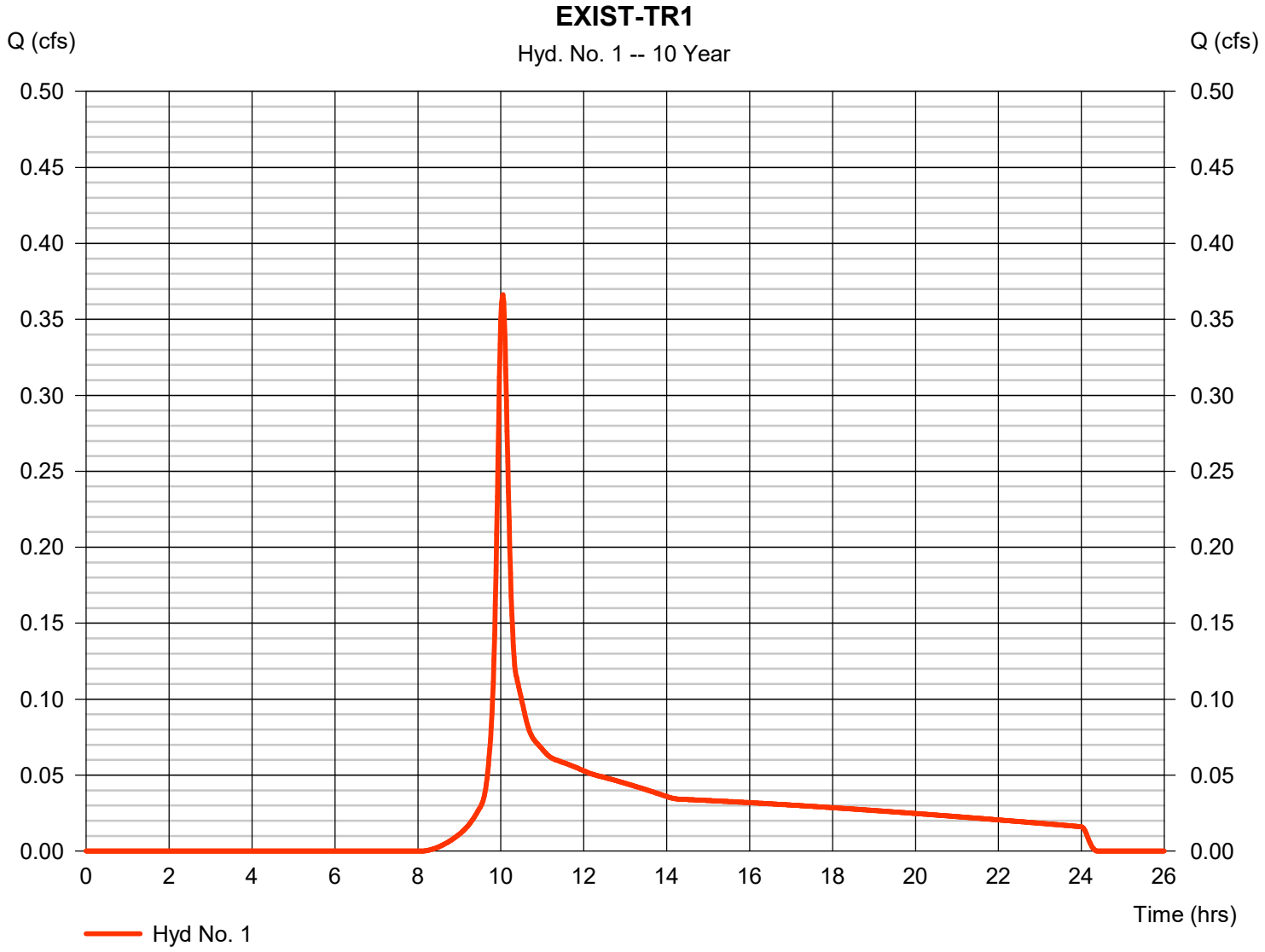
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.366	1	603	2,255	------	------	------	EXIST-TR1
2	SCS Runoff	51.83	1	604	314,207	------	------	------	EXIST-TR2
3	Combine	52.19	1	604	316,462	1, 2	------	------	Twin Ridge Creek
4	SCS Runoff	3.221	1	602	18,049	------	------	------	EXIST-S1
5	SCS Runoff	2.255	1	599	11,135	------	------	------	EXIST-S2
6	SCS Runoff	0.795	1	600	3,892	------	------	------	EXIST-C1
7	SCS Runoff	5.171	1	596	23,066	------	------	------	EXIST-C2
8	Combine	5.876	1	597	26,958	6, 7	------	------	Cuesta Drive

Hydrograph Report

Hyd. No. 1

EXIST-TR1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.366 cfs
Storm frequency	= 10 yrs	Time to peak	= 10.05 hrs
Time interval	= 1 min	Hyd. volume	= 2,255 cuft
Drainage area	= 0.370 ac	Curve number	= 69.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.60 min
Total precip.	= 4.60 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

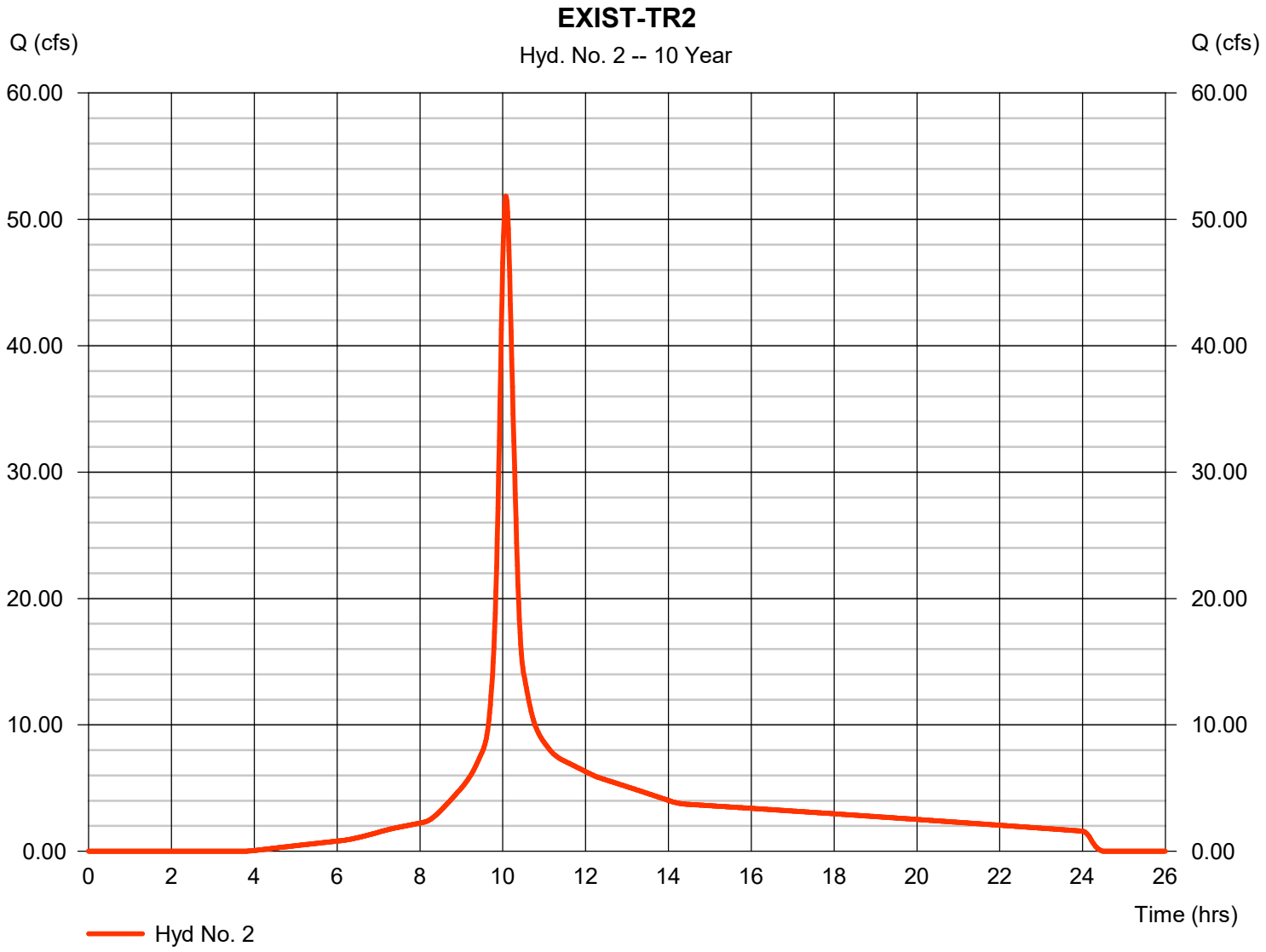


Hydrograph Report

Hyd. No. 2

EXIST-TR2

Hydrograph type	=	SCS Runoff	Peak discharge	=	51.83 cfs
Storm frequency	=	10 yrs	Time to peak	=	10.07 hrs
Time interval	=	1 min	Hyd. volume	=	314,207 cuft
Drainage area	=	27.450 ac	Curve number	=	86.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.80 min
Total precip.	=	4.60 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

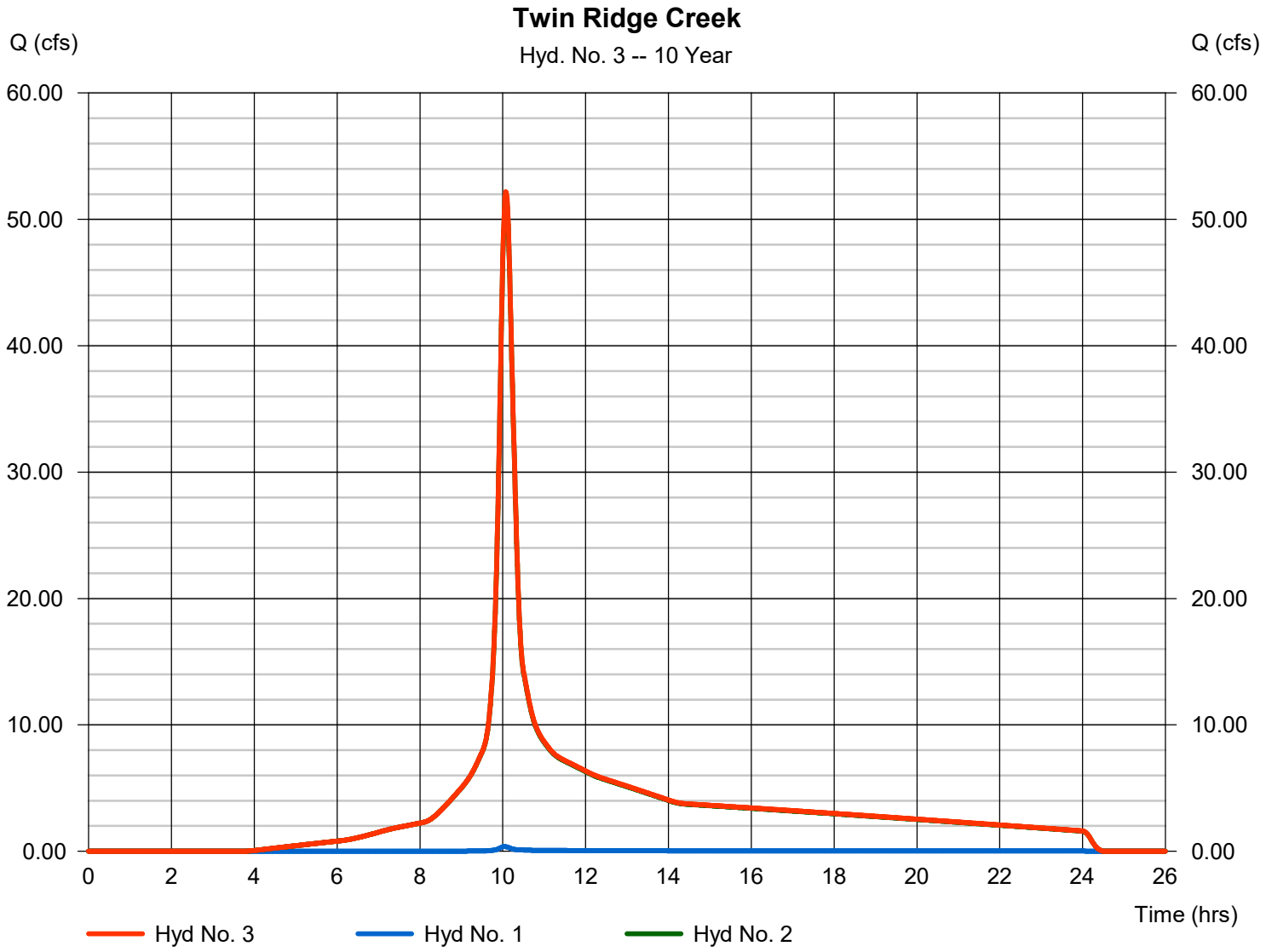


Hydrograph Report

Hyd. No. 3

Twin Ridge Creek

Hydrograph type	= Combine	Peak discharge	= 52.19 cfs
Storm frequency	= 10 yrs	Time to peak	= 10.07 hrs
Time interval	= 1 min	Hyd. volume	= 316,462 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 27.820 ac

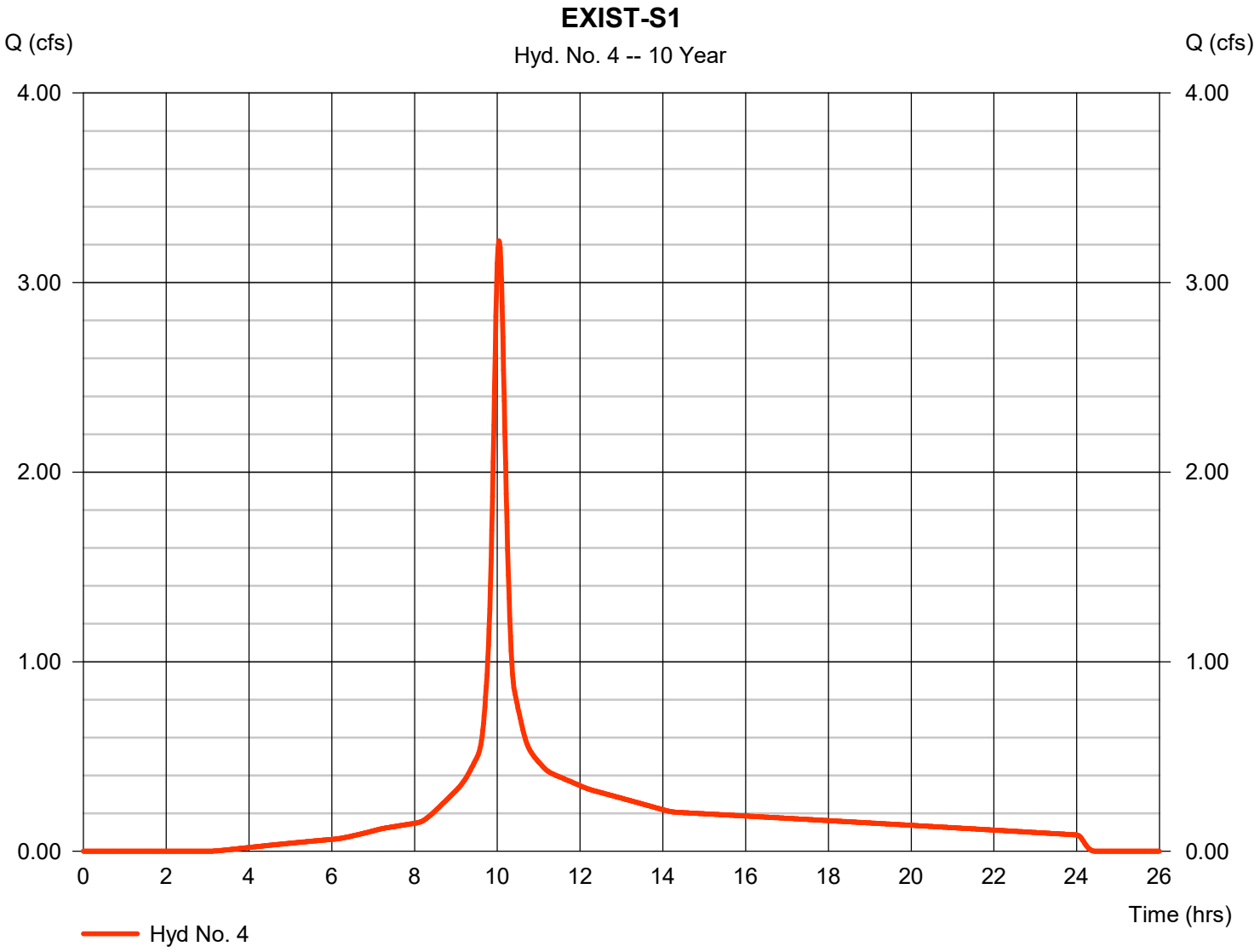


Hydrograph Report

Hyd. No. 4

EXIST-S1

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.221 cfs
Storm frequency	=	10 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	18,049 cuft
Drainage area	=	1.440 ac	Curve number	=	89.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.80 min
Total precip.	=	4.60 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

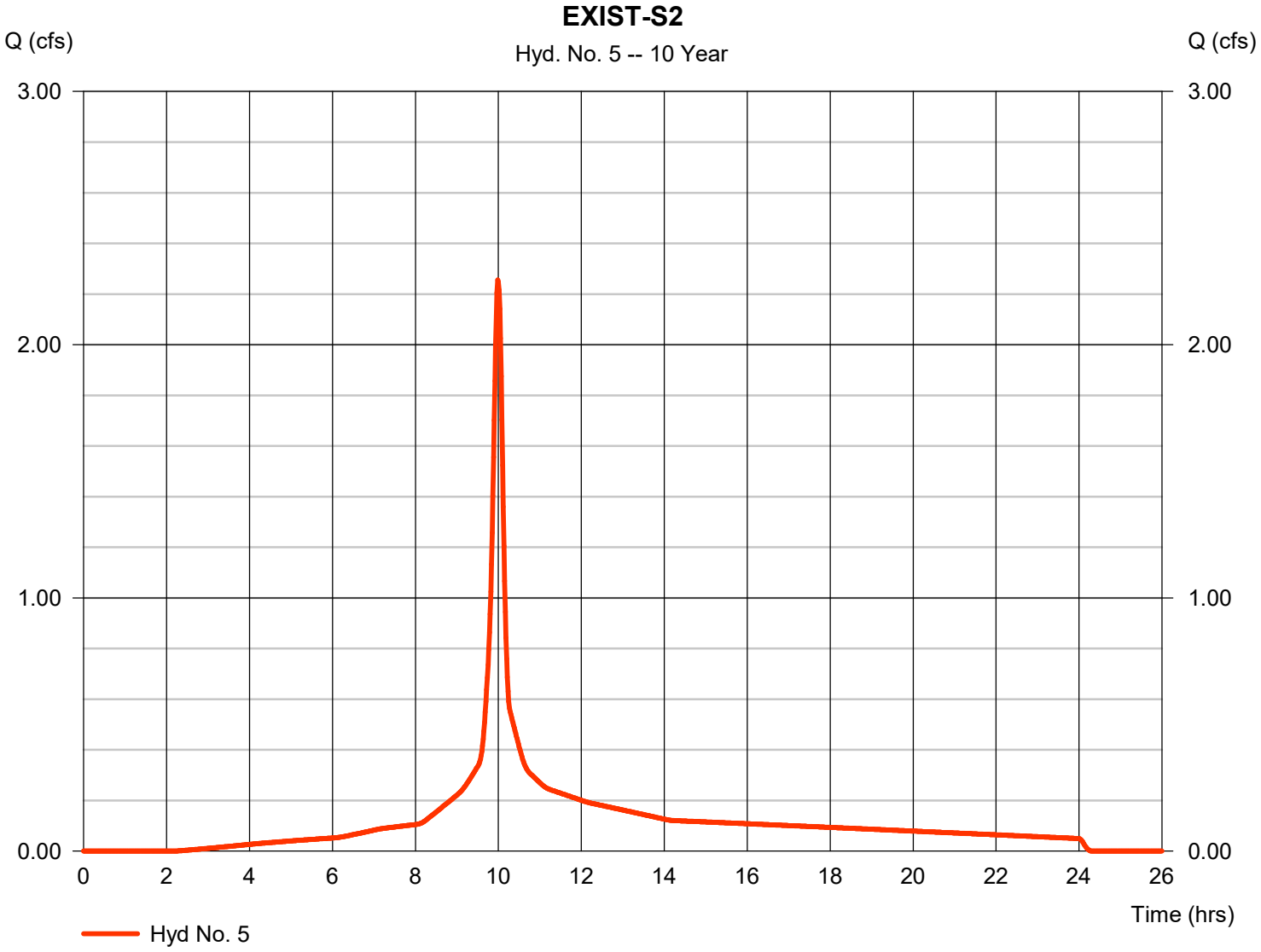


Hydrograph Report

Hyd. No. 5

EXIST-S2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.255 cfs
Storm frequency	=	10 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	11,135 cuft
Drainage area	=	0.810 ac	Curve number	=	92.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.10 min
Total precip.	=	4.60 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

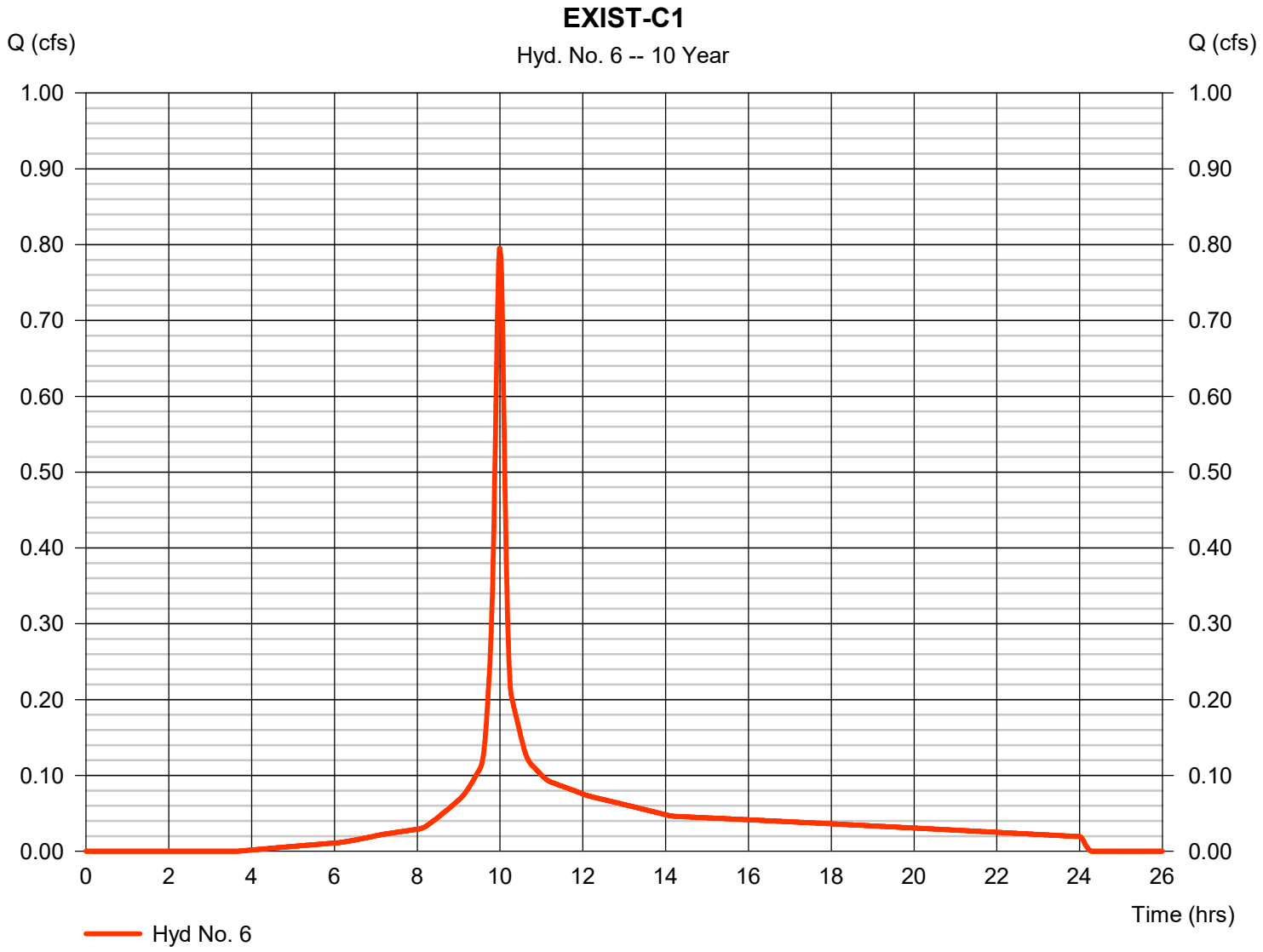


Hydrograph Report

Hyd. No. 6

EXIST-C1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.795 cfs
Storm frequency	= 10 yrs	Time to peak	= 10.00 hrs
Time interval	= 1 min	Hyd. volume	= 3,892 cuft
Drainage area	= 0.330 ac	Curve number	= 87
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 10.40 min
Total precip.	= 4.60 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

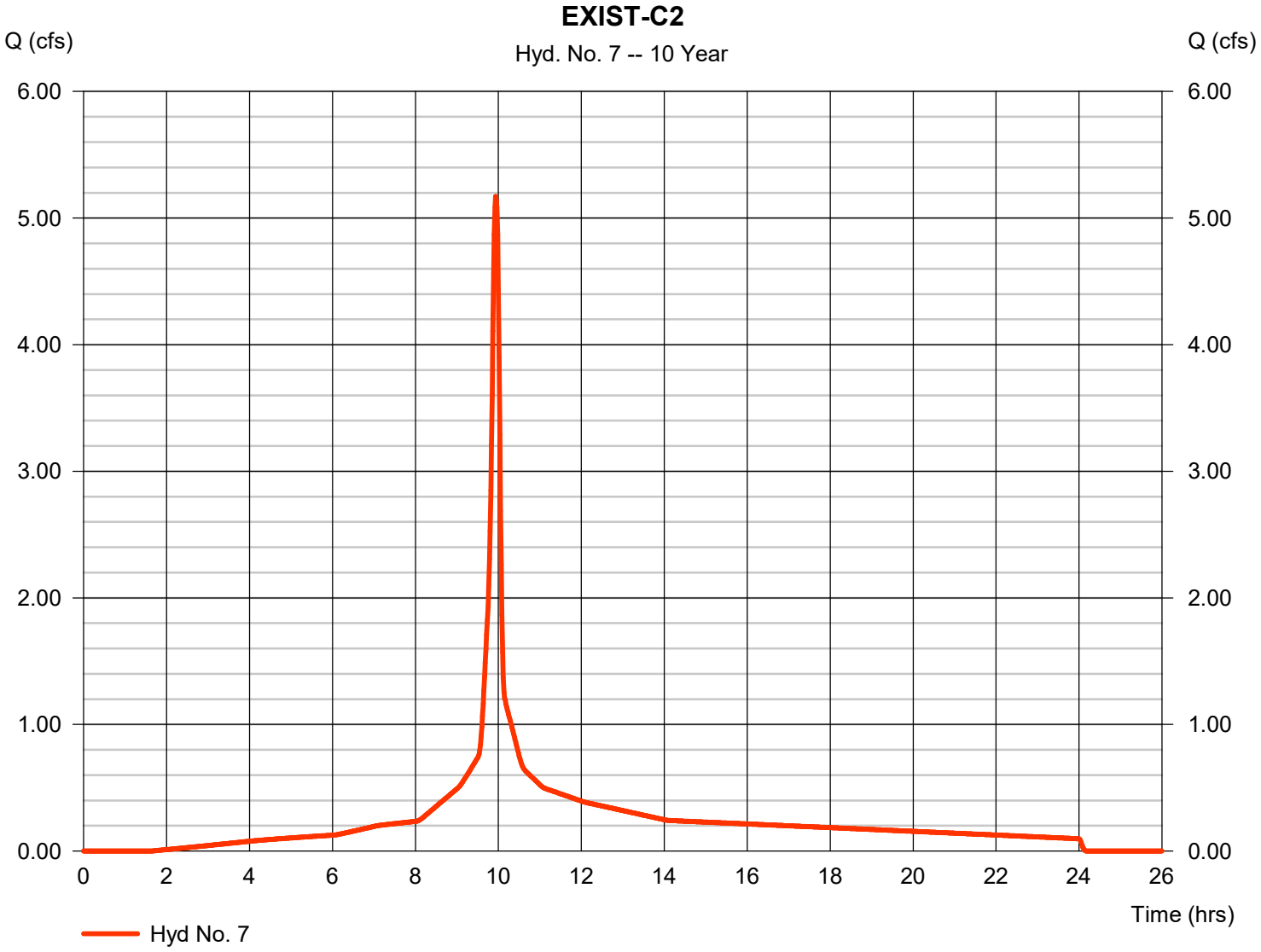


Hydrograph Report

Hyd. No. 7

EXIST-C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.171 cfs
Storm frequency	=	10 yrs	Time to peak	=	9.93 hrs
Time interval	=	1 min	Hyd. volume	=	23,066 cuft
Drainage area	=	1.570 ac	Curve number	=	94.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.10 min
Total precip.	=	4.60 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

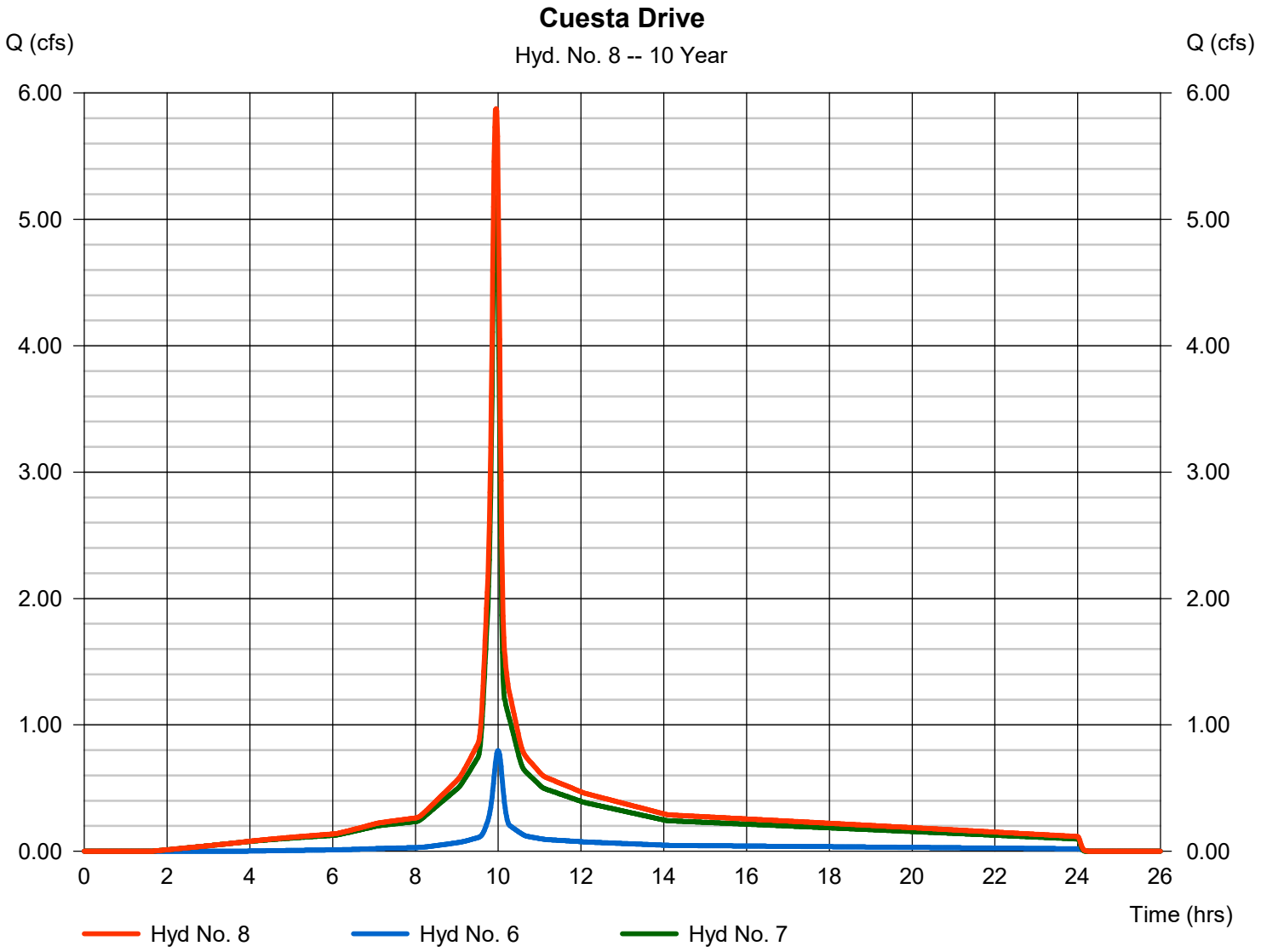


Hydrograph Report

Hyd. No. 8

Cuesta Drive

Hydrograph type	= Combine	Peak discharge	= 5.876 cfs
Storm frequency	= 10 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 26,958 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 1.900 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

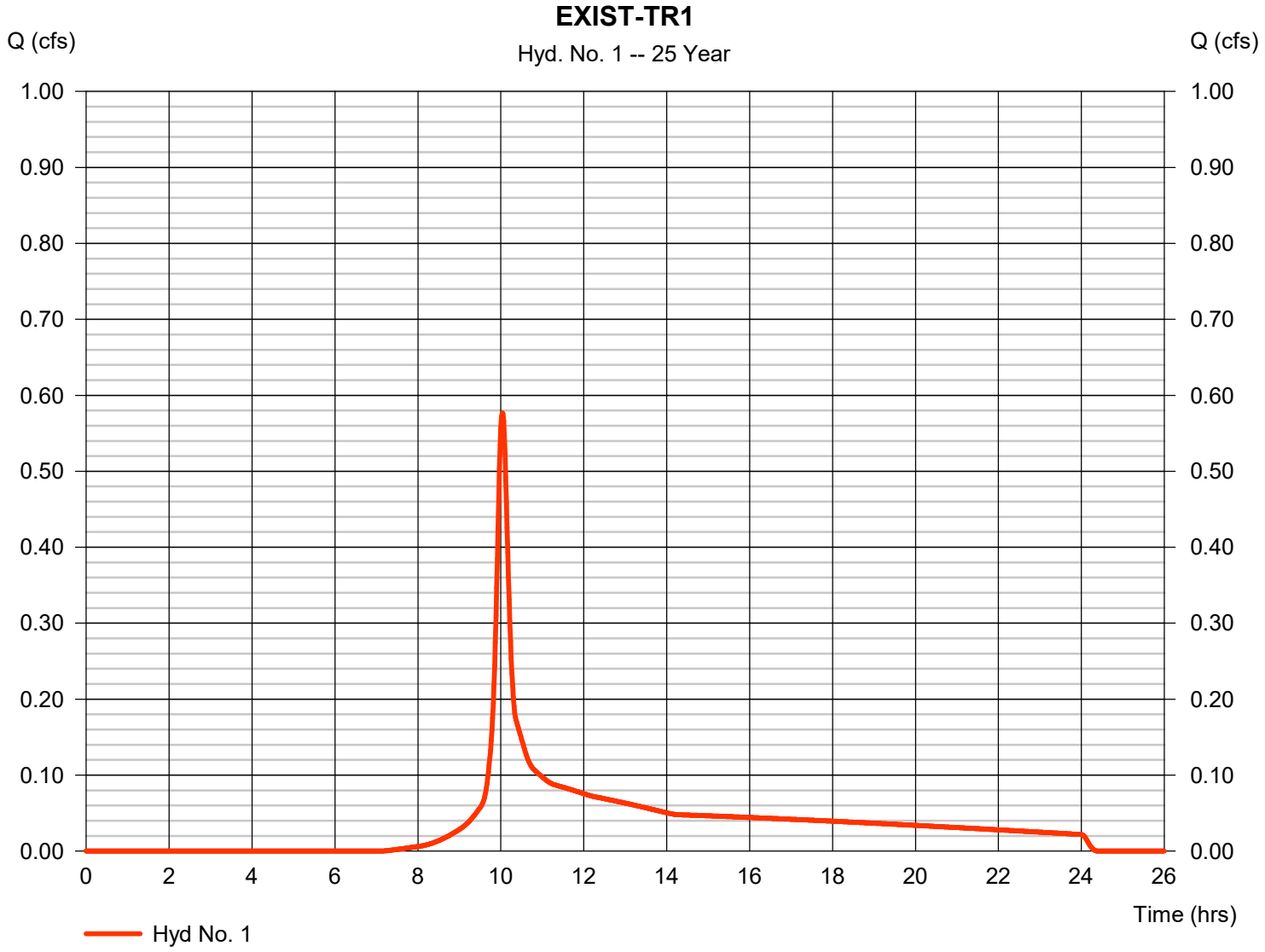
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.577	1	602	3,343	------	------	------	EXIST-TR1
2	SCS Runoff	68.99	1	604	417,336	------	------	------	EXIST-TR2
3	Combine	69.56	1	604	420,679	1, 2	------	------	Twin Ridge Creek
4	SCS Runoff	4.205	1	602	23,641	------	------	------	EXIST-S1
5	SCS Runoff	2.884	1	599	14,357	------	------	------	EXIST-S2
6	SCS Runoff	1.054	1	599	5,158	------	------	------	EXIST-C1
7	SCS Runoff	6.536	1	596	29,451	------	------	------	EXIST-C2
8	Combine	7.472	1	597	34,609	6, 7	------	------	Cuesta Drive

Hydrograph Report

Hyd. No. 1

EXIST-TR1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.577 cfs
Storm frequency	= 25 yrs	Time to peak	= 10.03 hrs
Time interval	= 1 min	Hyd. volume	= 3,343 cuft
Drainage area	= 0.370 ac	Curve number	= 69.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.60 min
Total precip.	= 5.70 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

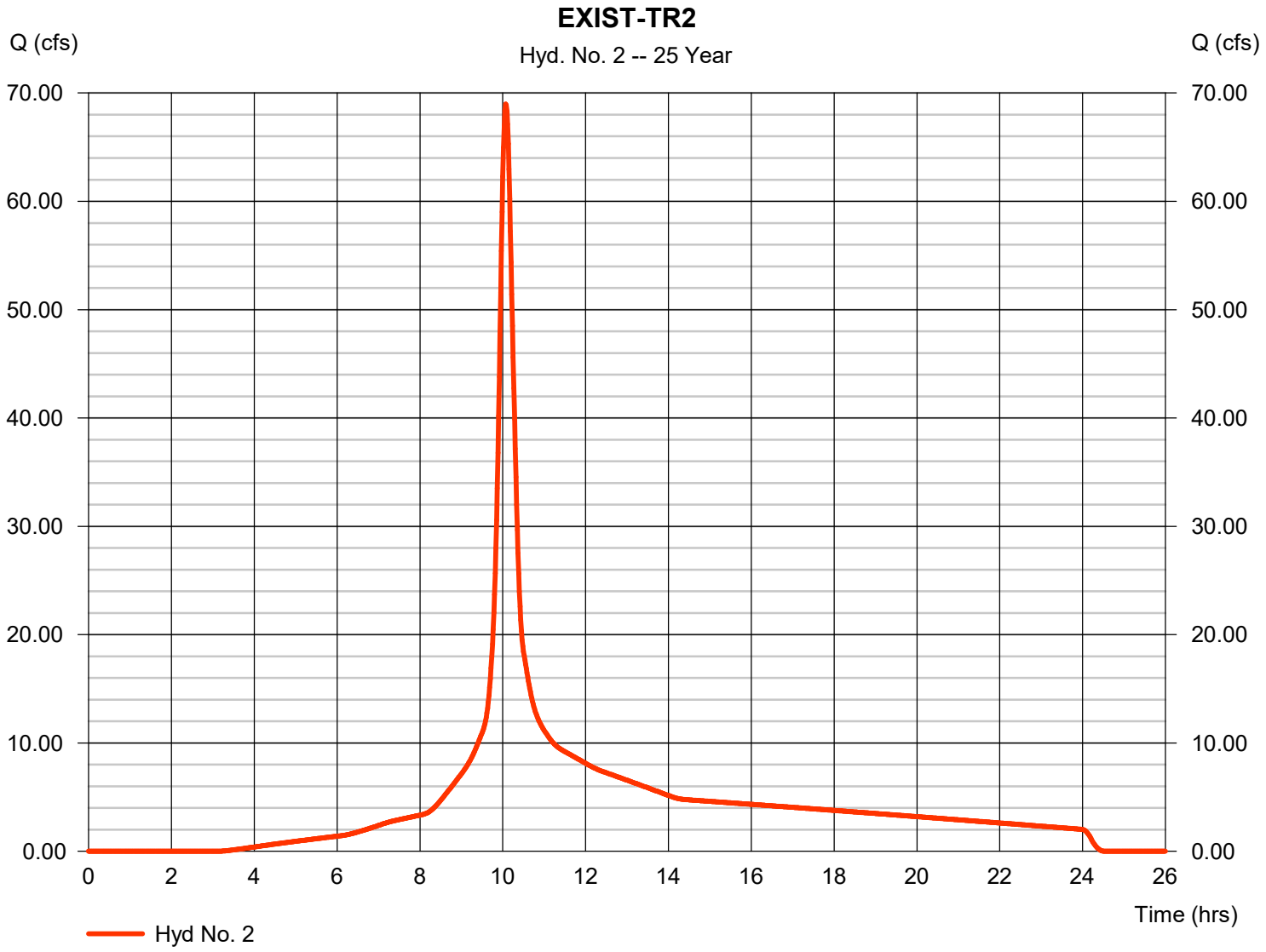


Hydrograph Report

Hyd. No. 2

EXIST-TR2

Hydrograph type	=	SCS Runoff	Peak discharge	=	68.99 cfs
Storm frequency	=	25 yrs	Time to peak	=	10.07 hrs
Time interval	=	1 min	Hyd. volume	=	417,336 cuft
Drainage area	=	27.450 ac	Curve number	=	86.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.80 min
Total precip.	=	5.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

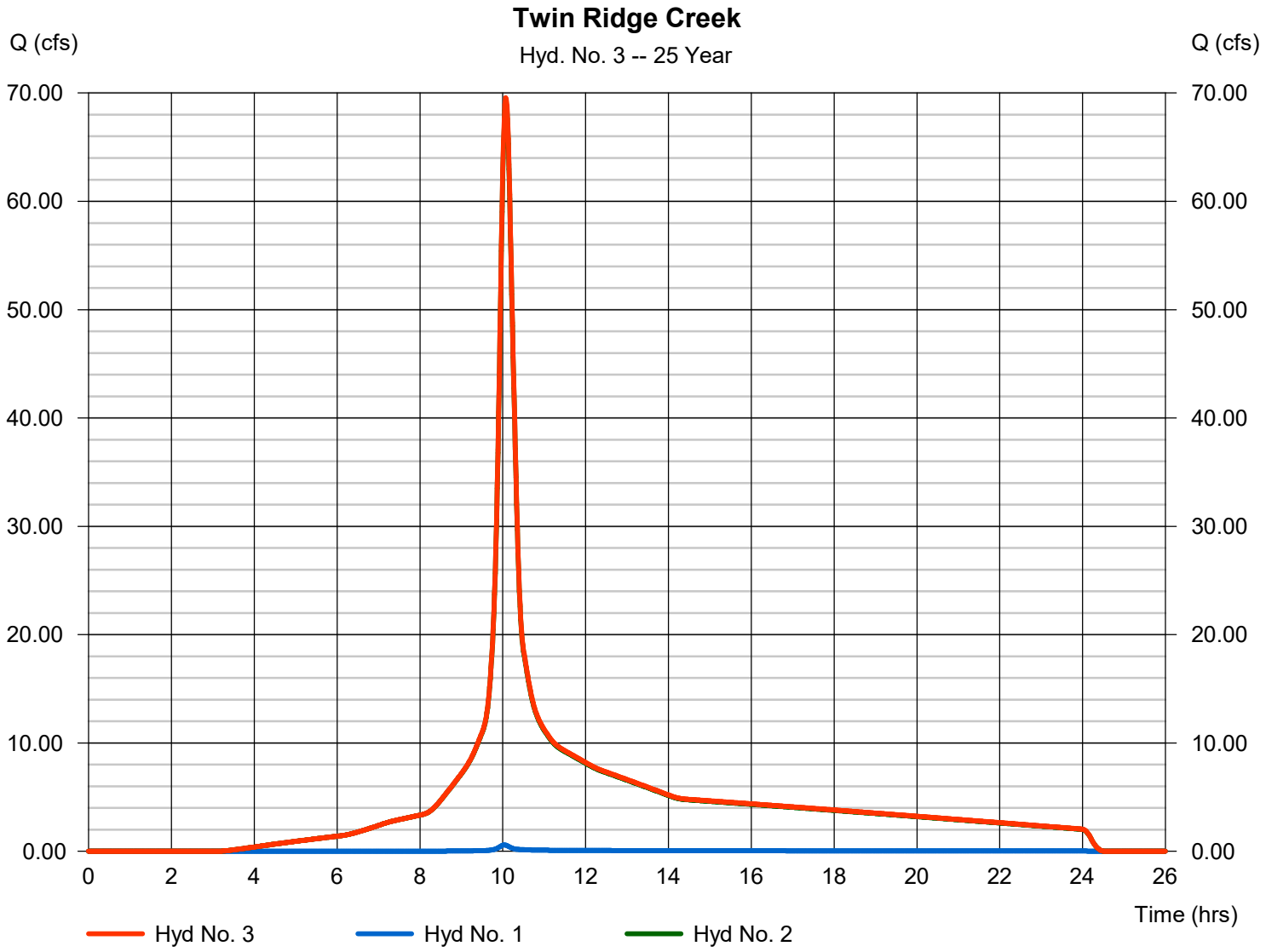


Hydrograph Report

Hyd. No. 3

Twin Ridge Creek

Hydrograph type	= Combine	Peak discharge	= 69.56 cfs
Storm frequency	= 25 yrs	Time to peak	= 10.07 hrs
Time interval	= 1 min	Hyd. volume	= 420,679 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 27.820 ac

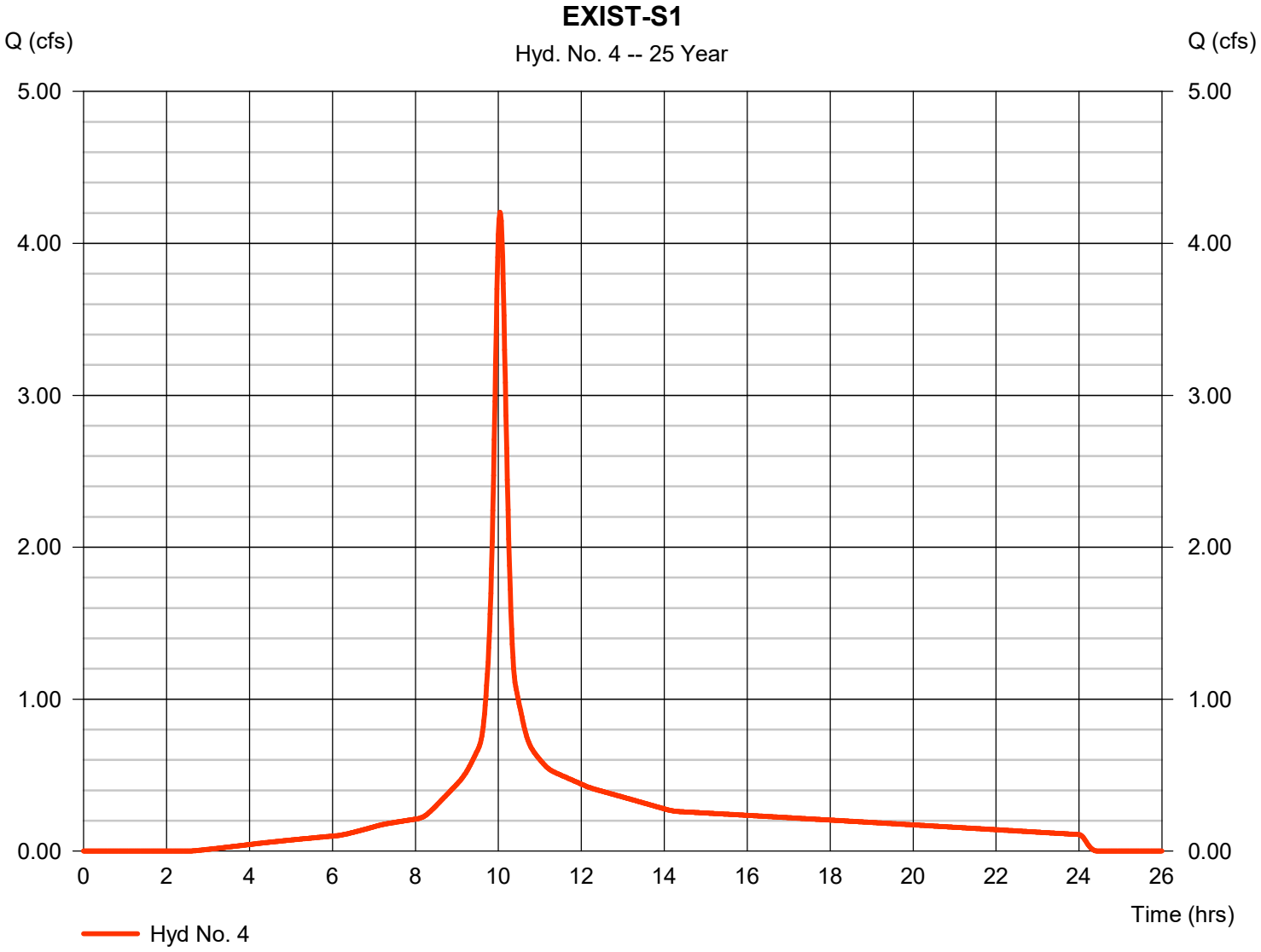


Hydrograph Report

Hyd. No. 4

EXIST-S1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.205 cfs
Storm frequency	=	25 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	23,641 cuft
Drainage area	=	1.440 ac	Curve number	=	89.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.80 min
Total precip.	=	5.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

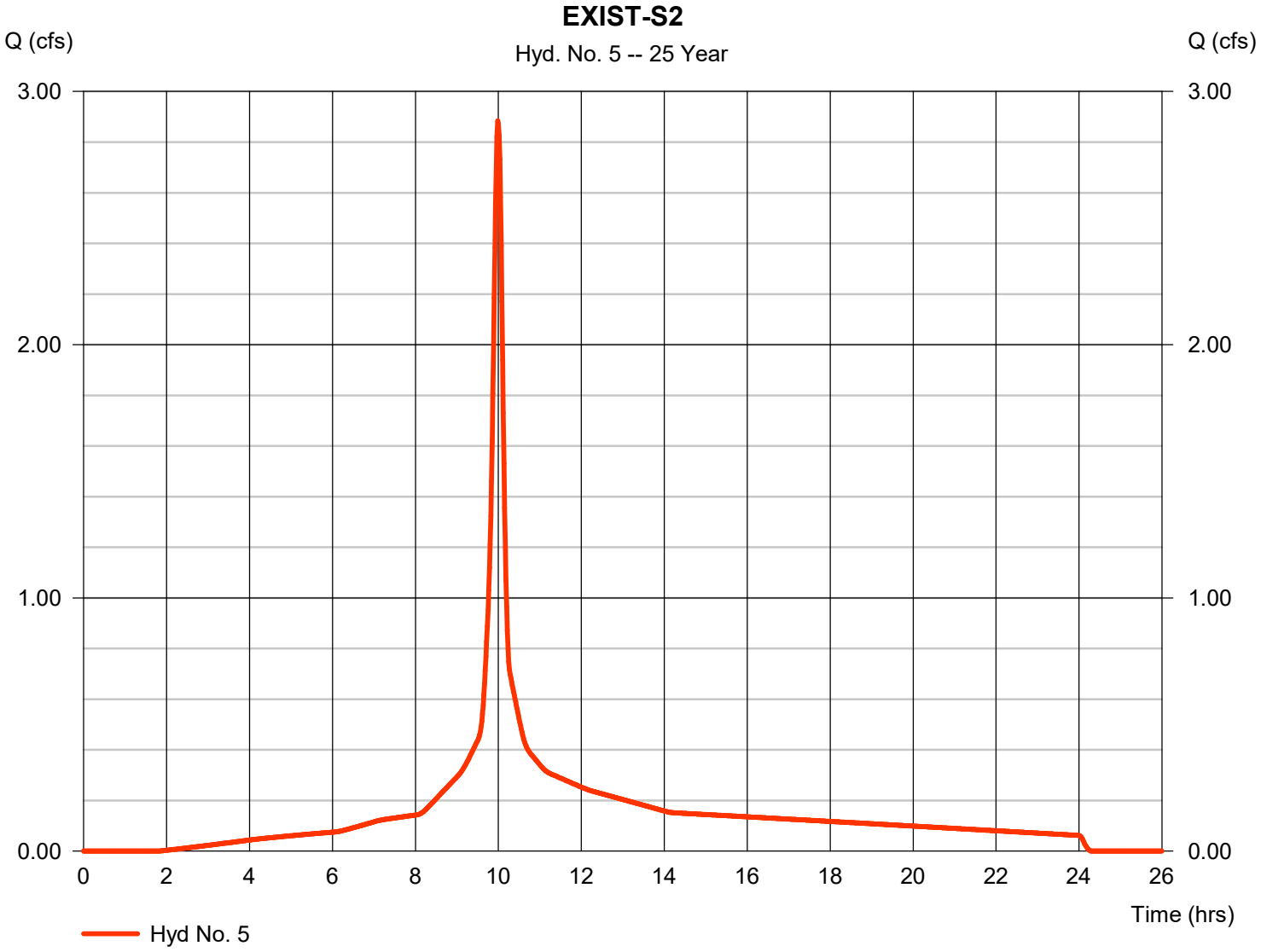


Hydrograph Report

Hyd. No. 5

EXIST-S2

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.884 cfs
Storm frequency	=	25 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	14,357 cuft
Drainage area	=	0.810 ac	Curve number	=	92.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.10 min
Total precip.	=	5.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

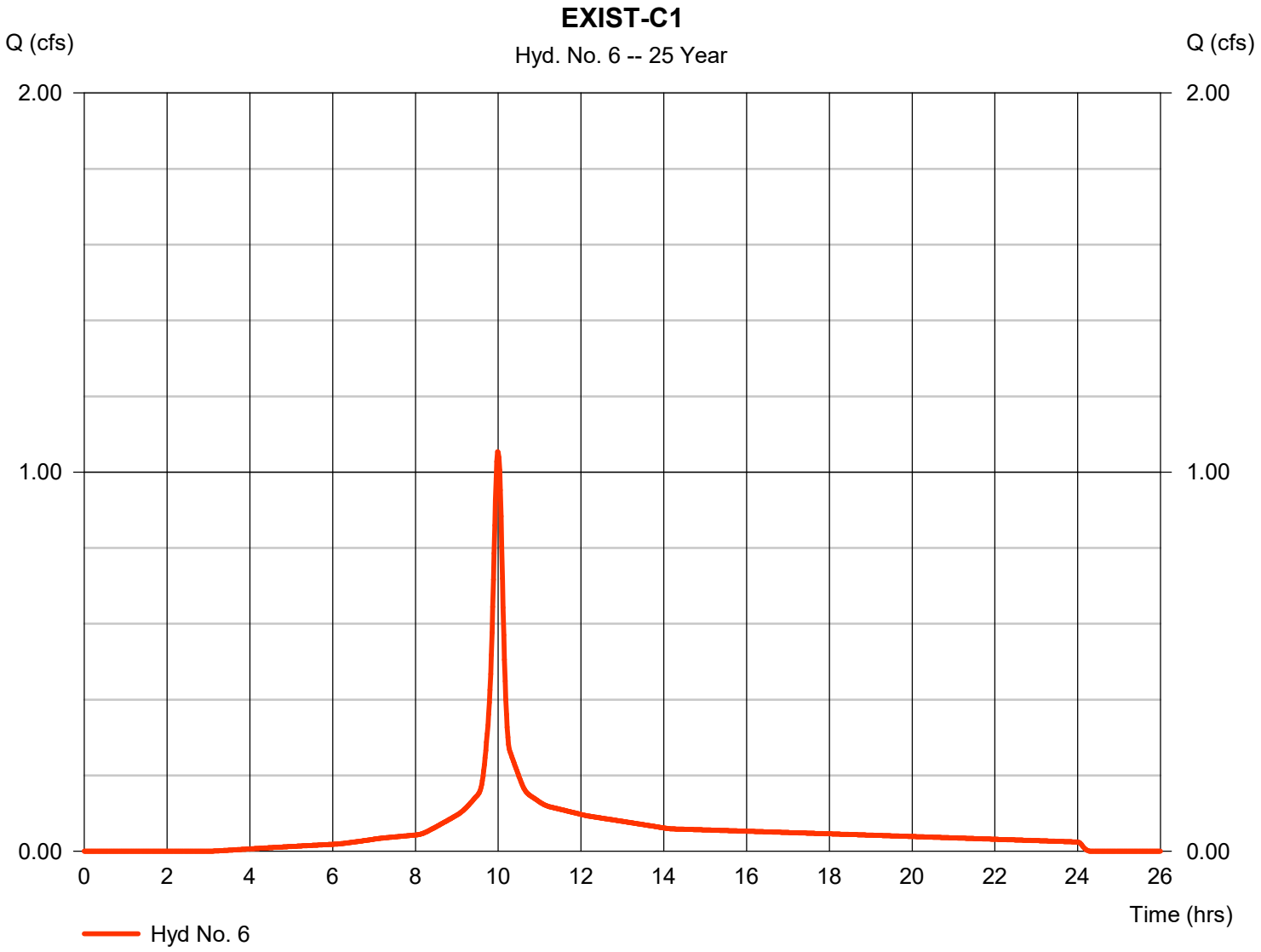


Hydrograph Report

Hyd. No. 6

EXIST-C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.054 cfs
Storm frequency	=	25 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	5,158 cuft
Drainage area	=	0.330 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.40 min
Total precip.	=	5.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

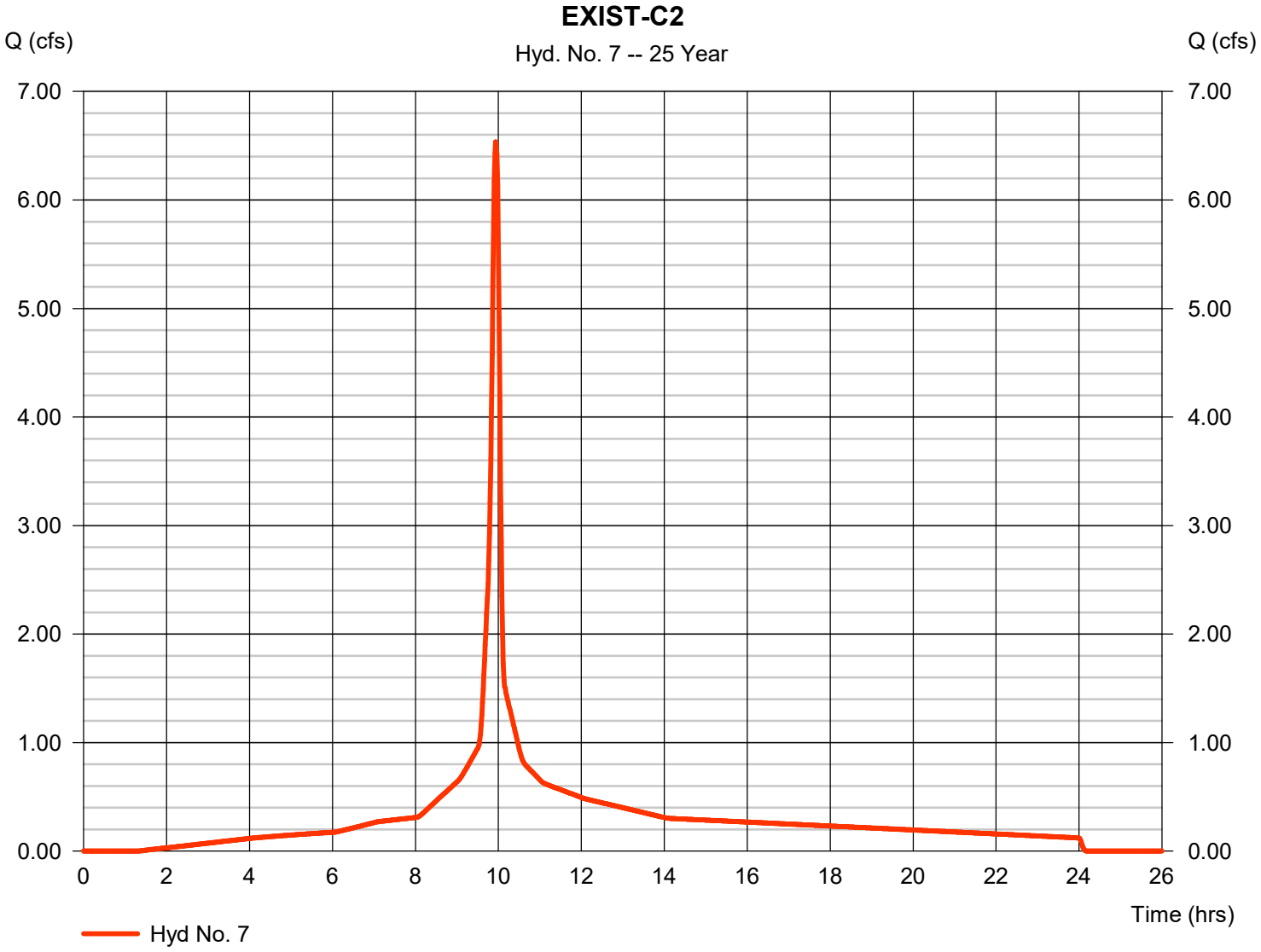


Hydrograph Report

Hyd. No. 7

EXIST-C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.536 cfs
Storm frequency	=	25 yrs	Time to peak	=	9.93 hrs
Time interval	=	1 min	Hyd. volume	=	29,451 cuft
Drainage area	=	1.570 ac	Curve number	=	94.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.10 min
Total precip.	=	5.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

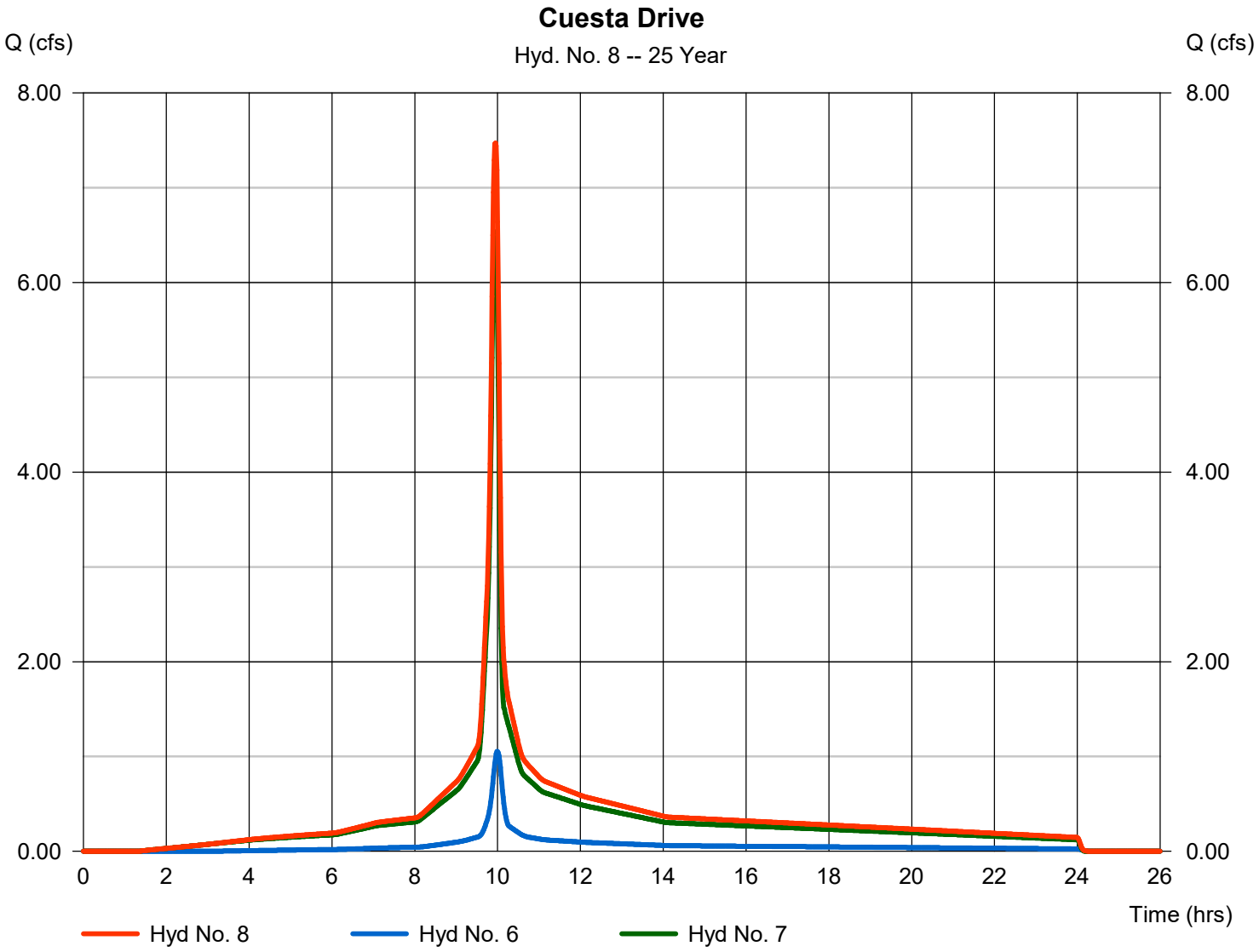


Hydrograph Report

Hyd. No. 8

Cuesta Drive

Hydrograph type	= Combine	Peak discharge	= 7.472 cfs
Storm frequency	= 25 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 34,609 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 1.900 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

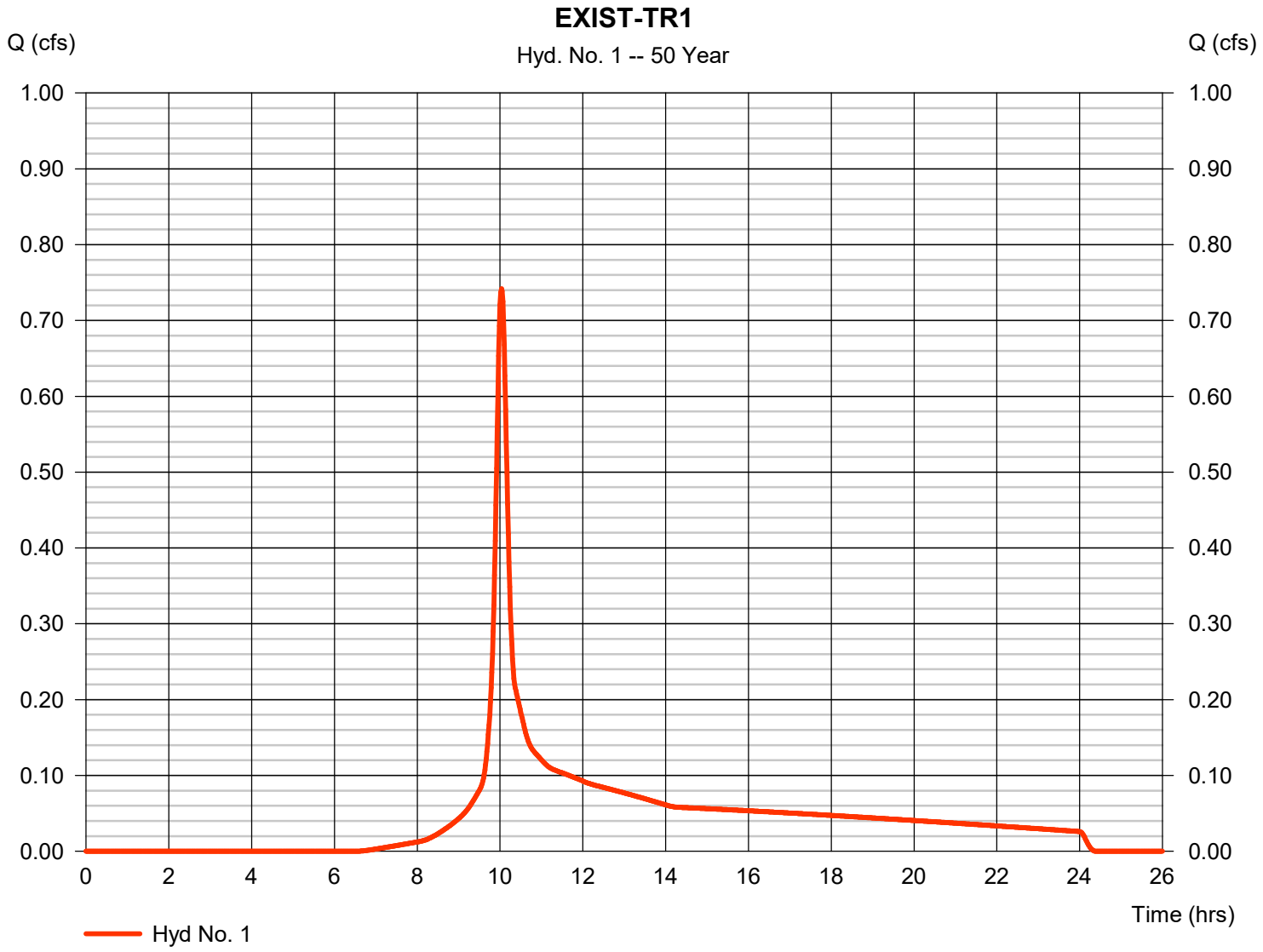
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.742	1	602	4,188	------	------	------	EXIST-TR1
2	SCS Runoff	81.50	1	604	493,495	------	------	------	EXIST-TR2
3	Combine	82.22	1	604	497,684	1, 2	------	------	Twin Ridge Creek
4	SCS Runoff	4.918	1	602	27,751	------	------	------	EXIST-S1
5	SCS Runoff	3.338	1	599	16,713	------	------	------	EXIST-S2
6	SCS Runoff	1.242	1	599	6,093	------	------	------	EXIST-C1
7	SCS Runoff	7.522	1	596	34,110	------	------	------	EXIST-C2
8	Combine	8.627	1	597	40,203	6, 7	------	------	Cuesta Drive

Hydrograph Report

Hyd. No. 1

EXIST-TR1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.742 cfs
Storm frequency	= 50 yrs	Time to peak	= 10.03 hrs
Time interval	= 1 min	Hyd. volume	= 4,188 cuft
Drainage area	= 0.370 ac	Curve number	= 69.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.60 min
Total precip.	= 6.50 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

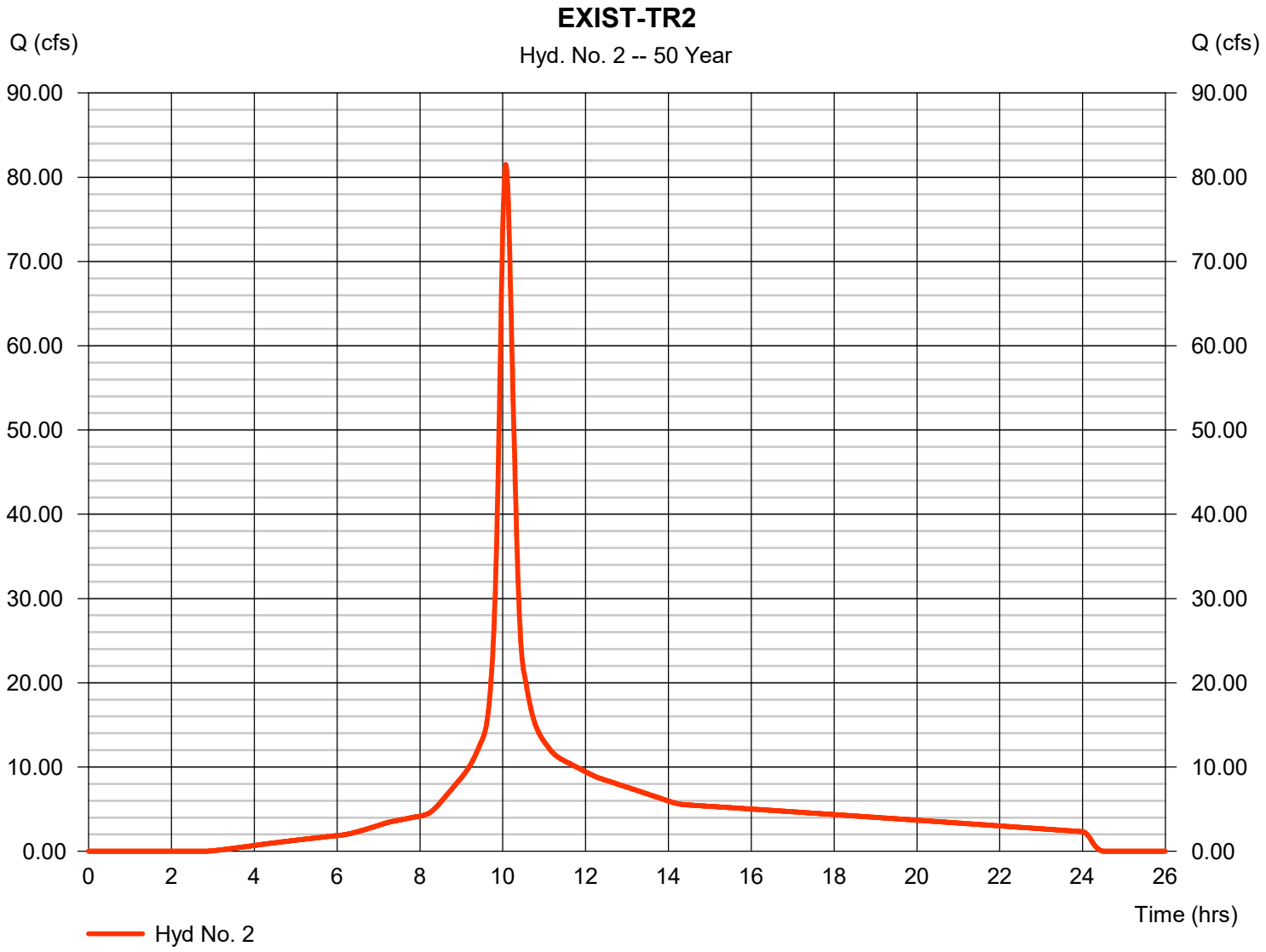


Hydrograph Report

Hyd. No. 2

EXIST-TR2

Hydrograph type	=	SCS Runoff	Peak discharge	=	81.50 cfs
Storm frequency	=	50 yrs	Time to peak	=	10.07 hrs
Time interval	=	1 min	Hyd. volume	=	493,495 cuft
Drainage area	=	27.450 ac	Curve number	=	86.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.80 min
Total precip.	=	6.50 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

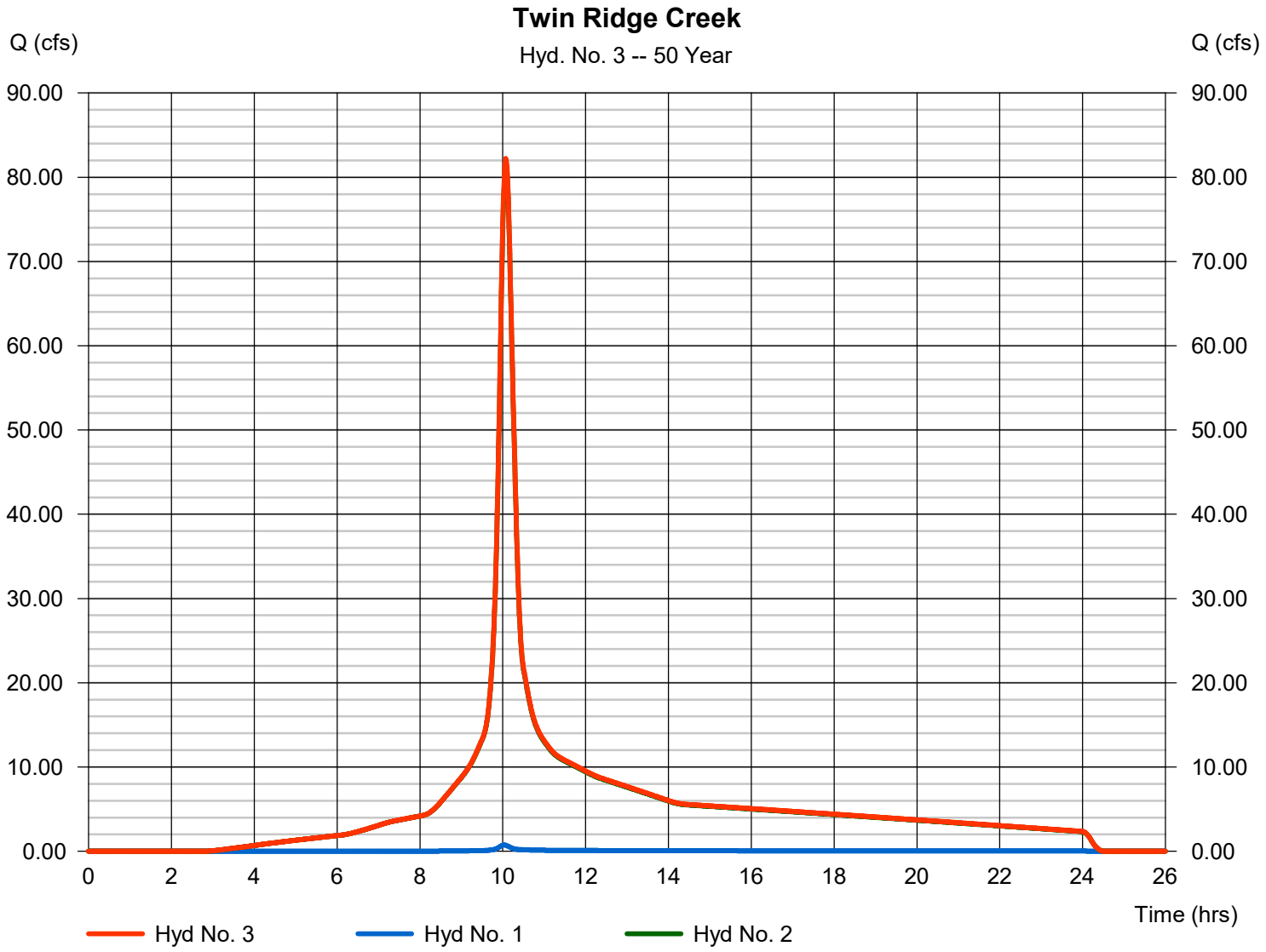


Hydrograph Report

Hyd. No. 3

Twin Ridge Creek

Hydrograph type	= Combine	Peak discharge	= 82.22 cfs
Storm frequency	= 50 yrs	Time to peak	= 10.07 hrs
Time interval	= 1 min	Hyd. volume	= 497,684 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 27.820 ac

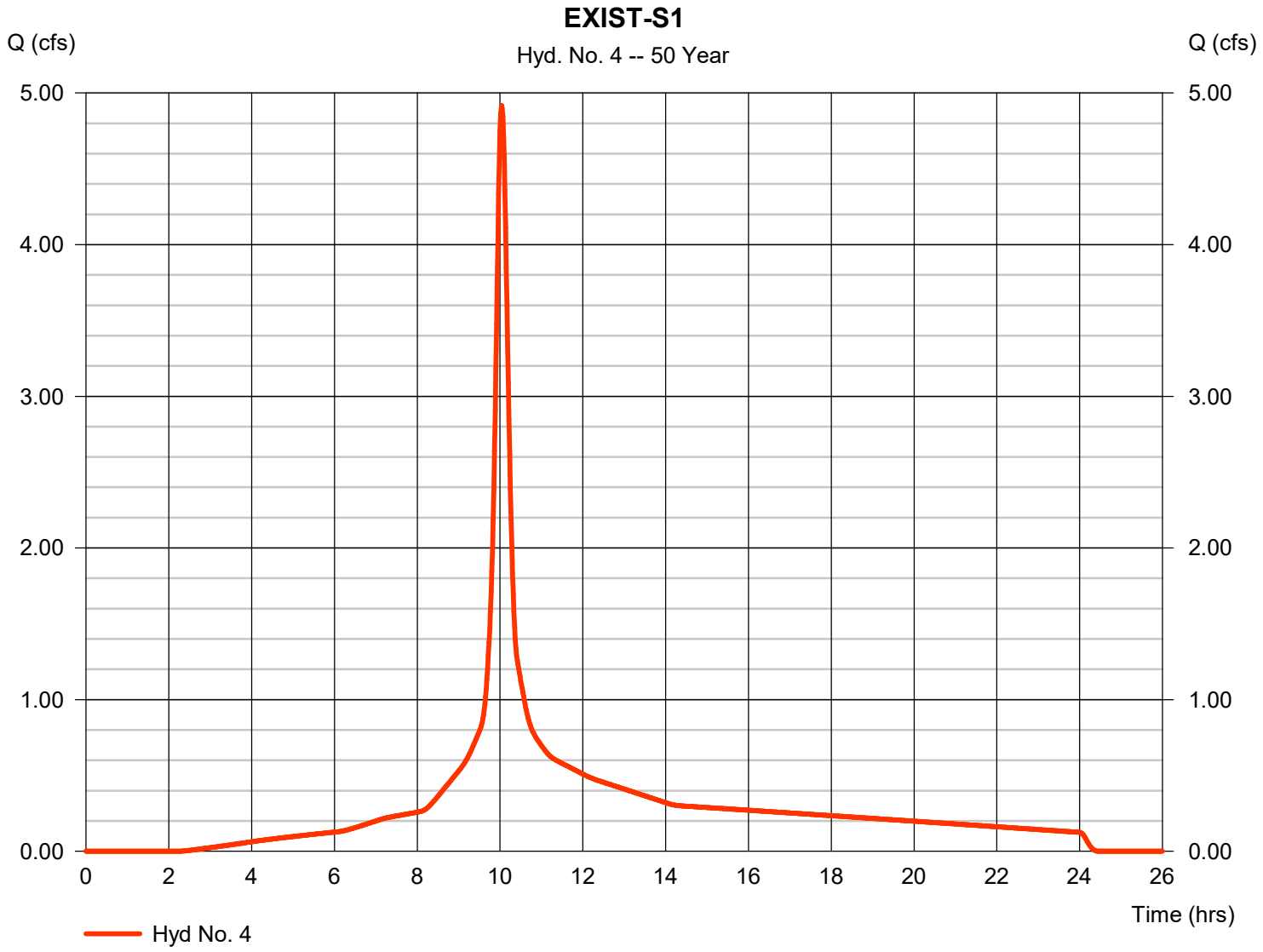


Hydrograph Report

Hyd. No. 4

EXIST-S1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.918 cfs
Storm frequency	=	50 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	27,751 cuft
Drainage area	=	1.440 ac	Curve number	=	89.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.80 min
Total precip.	=	6.50 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

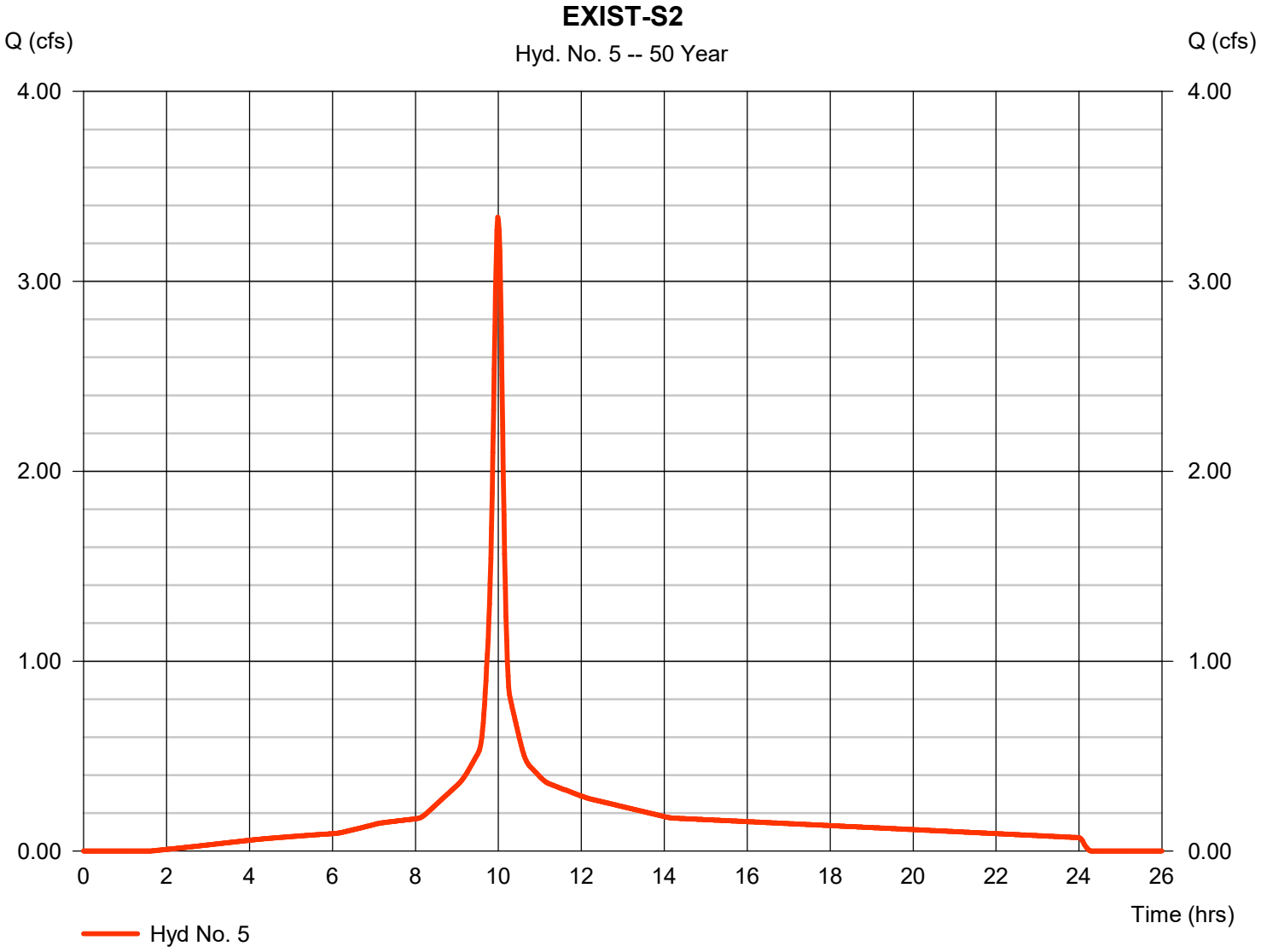


Hydrograph Report

Hyd. No. 5

EXIST-S2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.338 cfs
Storm frequency	=	50 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	16,713 cuft
Drainage area	=	0.810 ac	Curve number	=	92.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.10 min
Total precip.	=	6.50 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

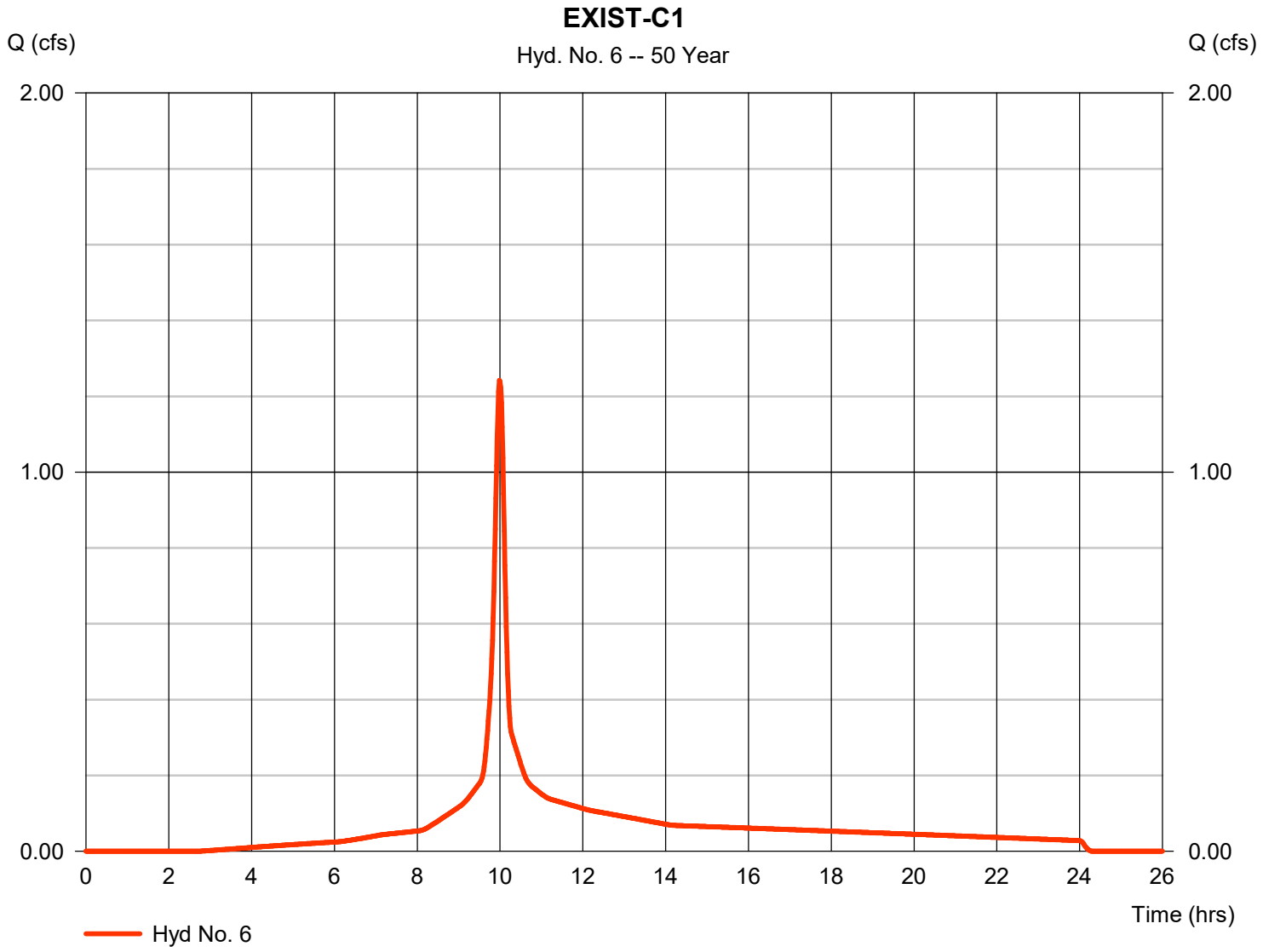


Hydrograph Report

Hyd. No. 6

EXIST-C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.242 cfs
Storm frequency	=	50 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	6,093 cuft
Drainage area	=	0.330 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.40 min
Total precip.	=	6.50 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

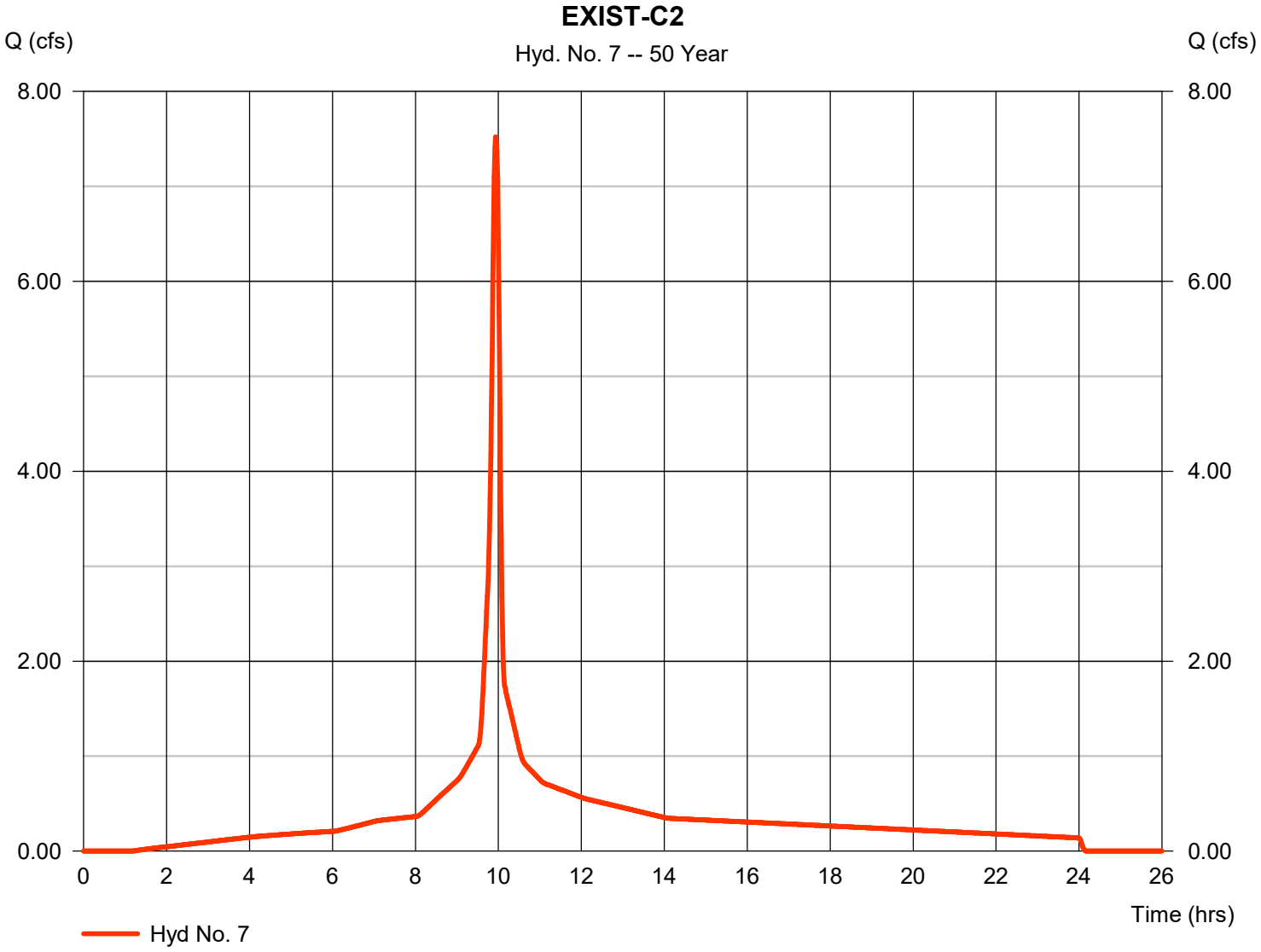


Hydrograph Report

Hyd. No. 7

EXIST-C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.522 cfs
Storm frequency	=	50 yrs	Time to peak	=	9.93 hrs
Time interval	=	1 min	Hyd. volume	=	34,110 cuft
Drainage area	=	1.570 ac	Curve number	=	94.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.10 min
Total precip.	=	6.50 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

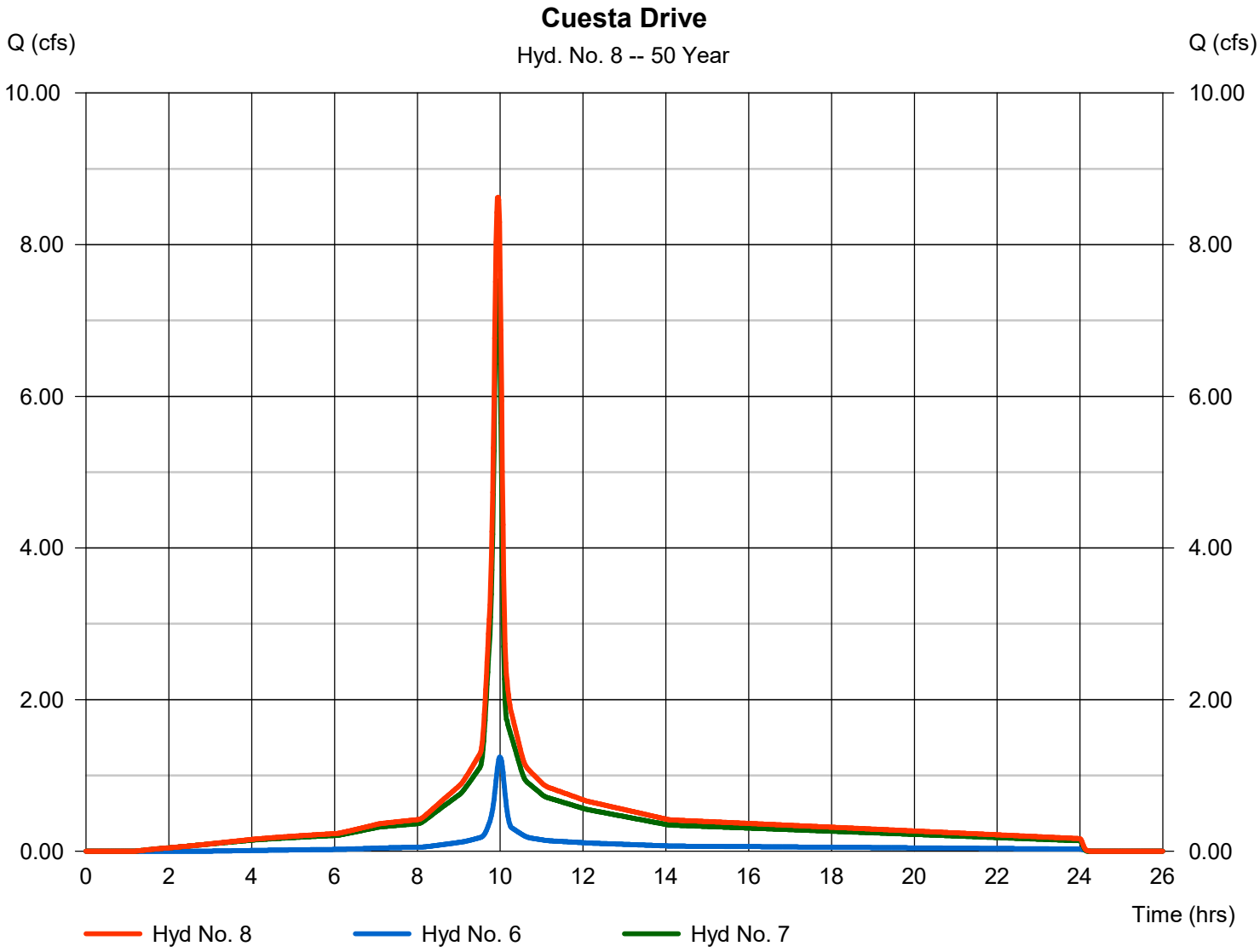


Hydrograph Report

Hyd. No. 8

Cuesta Drive

Hydrograph type	= Combine	Peak discharge	= 8.627 cfs
Storm frequency	= 50 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 40,203 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 1.900 ac



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

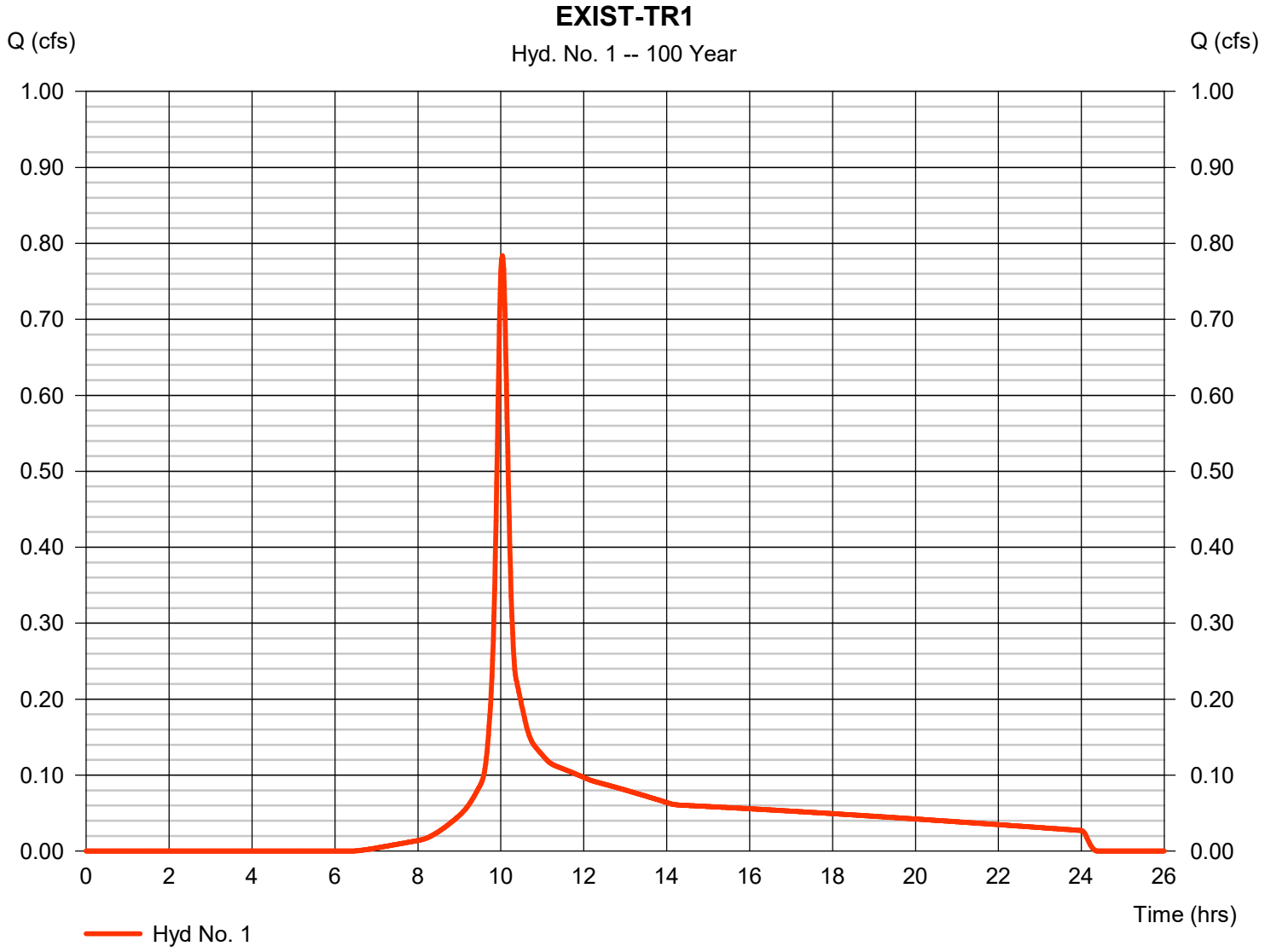
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.784	1	602	4,405	------	------	------	EXIST-TR1
2	SCS Runoff	84.62	1	604	512,647	------	------	------	EXIST-TR2
3	Combine	85.39	1	604	517,052	1, 2	------	------	Twin Ridge Creek
4	SCS Runoff	5.096	1	602	28,782	------	------	------	EXIST-S1
5	SCS Runoff	3.451	1	599	17,304	------	------	------	EXIST-S2
6	SCS Runoff	1.289	1	599	6,328	------	------	------	EXIST-C1
7	SCS Runoff	7.768	1	596	35,276	------	------	------	EXIST-C2
8	Combine	8.915	1	597	41,604	6, 7	------	------	Cuesta Drive

Hydrograph Report

Hyd. No. 1

EXIST-TR1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.784 cfs
Storm frequency	= 100 yrs	Time to peak	= 10.03 hrs
Time interval	= 1 min	Hyd. volume	= 4,405 cuft
Drainage area	= 0.370 ac	Curve number	= 69.1
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= User	Time of conc. (Tc)	= 14.60 min
Total precip.	= 6.70 in	Distribution	= Type I
Storm duration	= 24 hrs	Shape factor	= 484

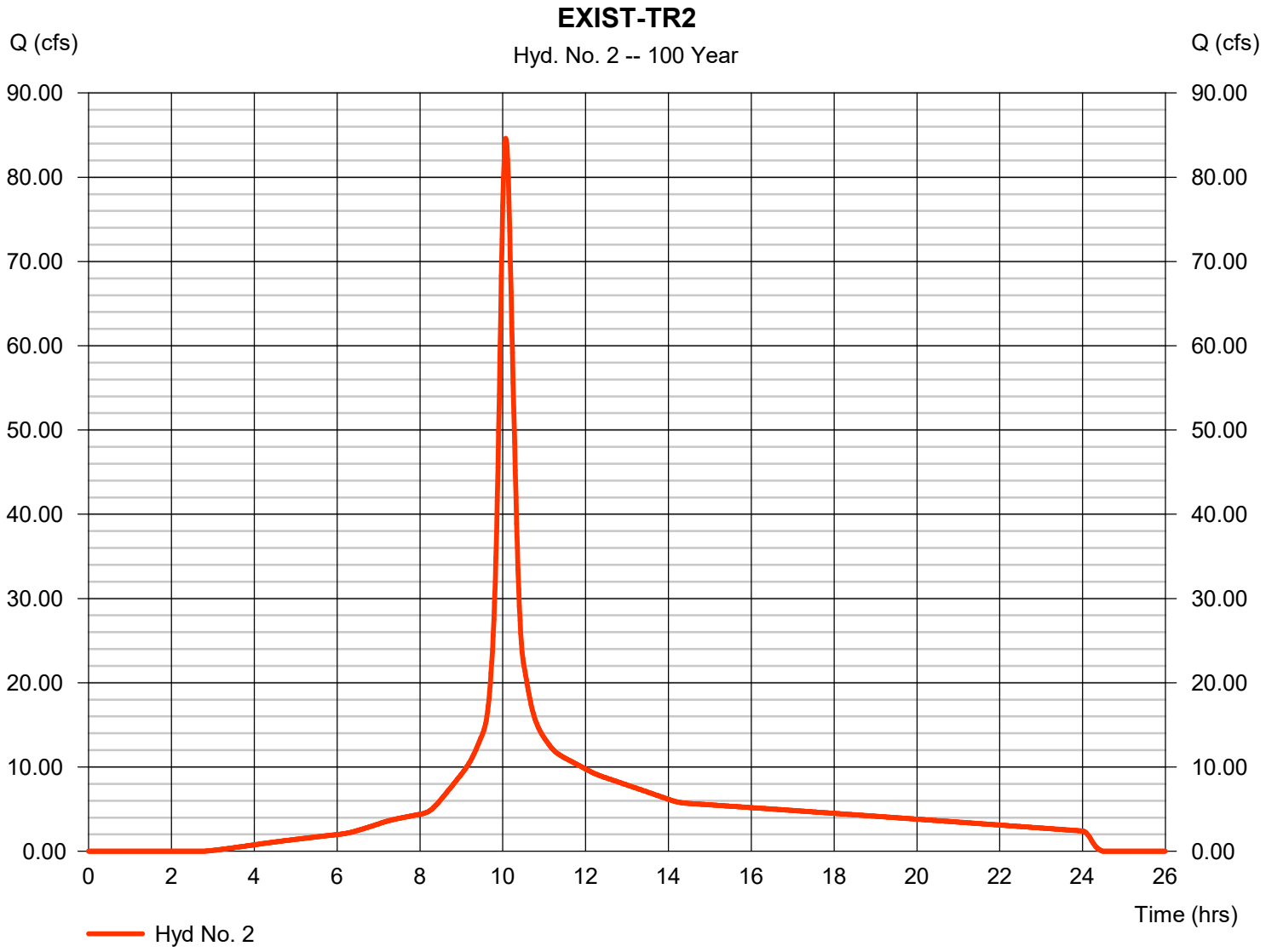


Hydrograph Report

Hyd. No. 2

EXIST-TR2

Hydrograph type	=	SCS Runoff	Peak discharge	=	84.62 cfs
Storm frequency	=	100 yrs	Time to peak	=	10.07 hrs
Time interval	=	1 min	Hyd. volume	=	512,647 cuft
Drainage area	=	27.450 ac	Curve number	=	86.6
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	18.80 min
Total precip.	=	6.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

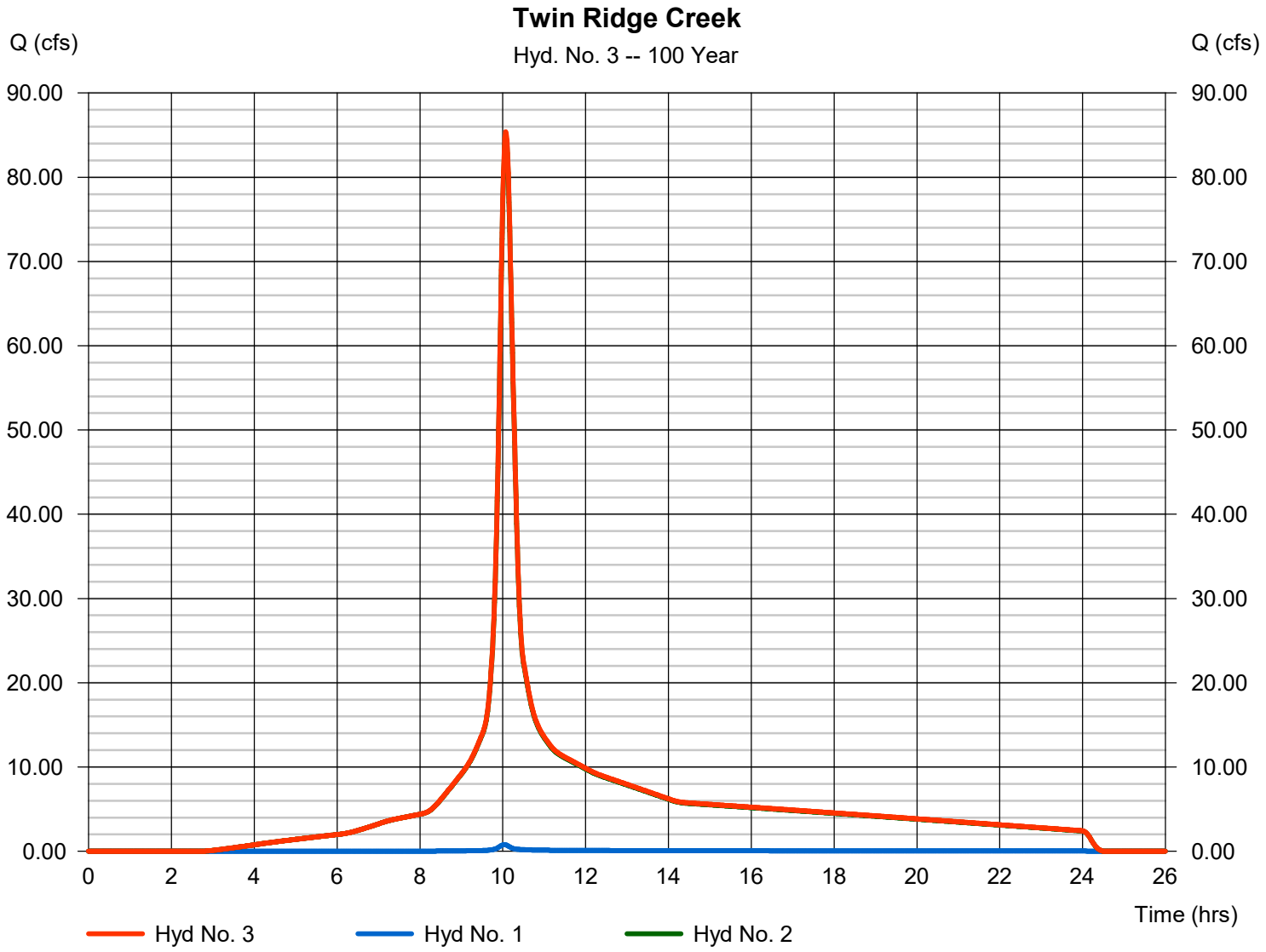


Hydrograph Report

Hyd. No. 3

Twin Ridge Creek

Hydrograph type	= Combine	Peak discharge	= 85.39 cfs
Storm frequency	= 100 yrs	Time to peak	= 10.07 hrs
Time interval	= 1 min	Hyd. volume	= 517,052 cuft
Inflow hyds.	= 1, 2	Contrib. drain. area	= 27.820 ac

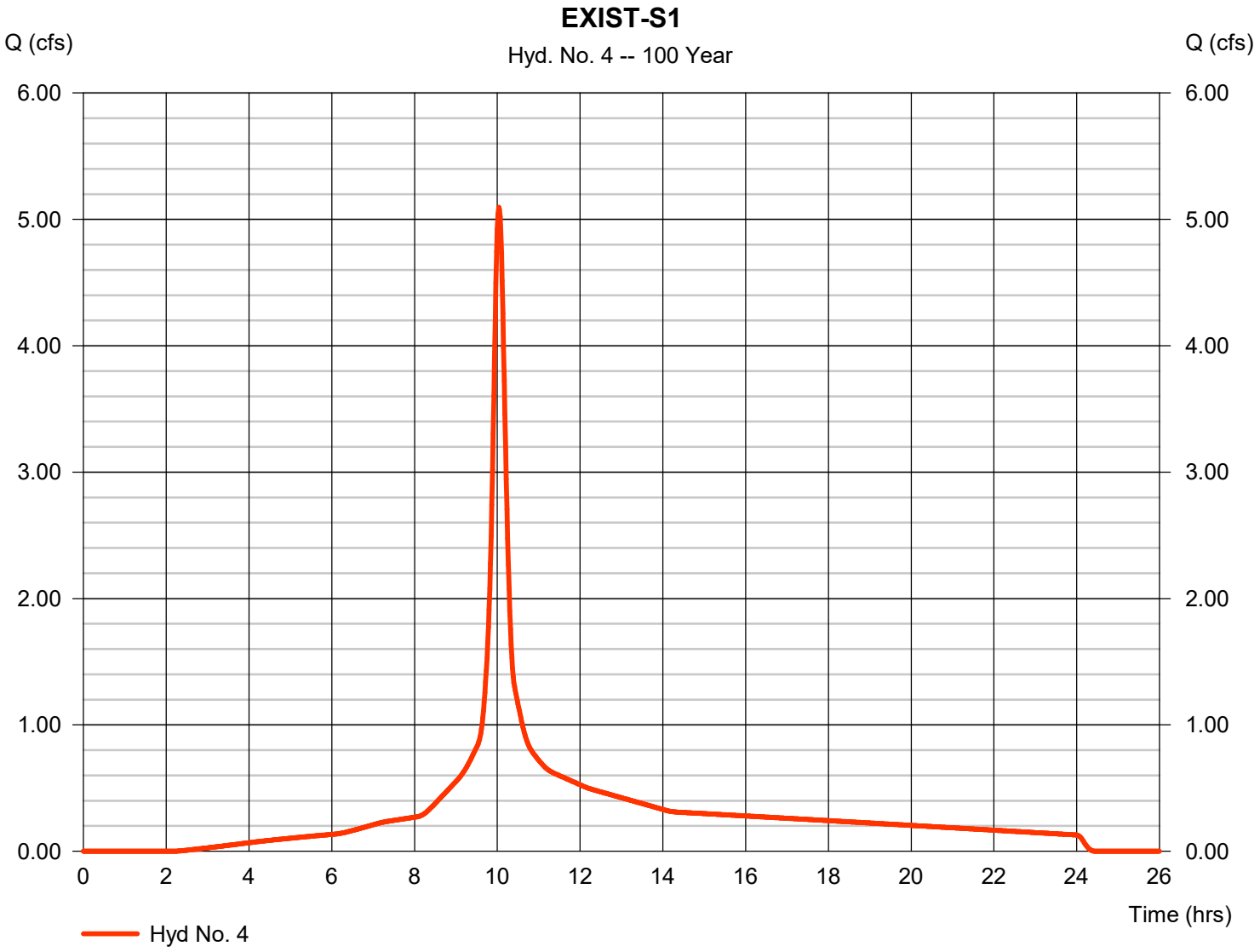


Hydrograph Report

Hyd. No. 4

EXIST-S1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.096 cfs
Storm frequency	=	100 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	28,782 cuft
Drainage area	=	1.440 ac	Curve number	=	89.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	15.80 min
Total precip.	=	6.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

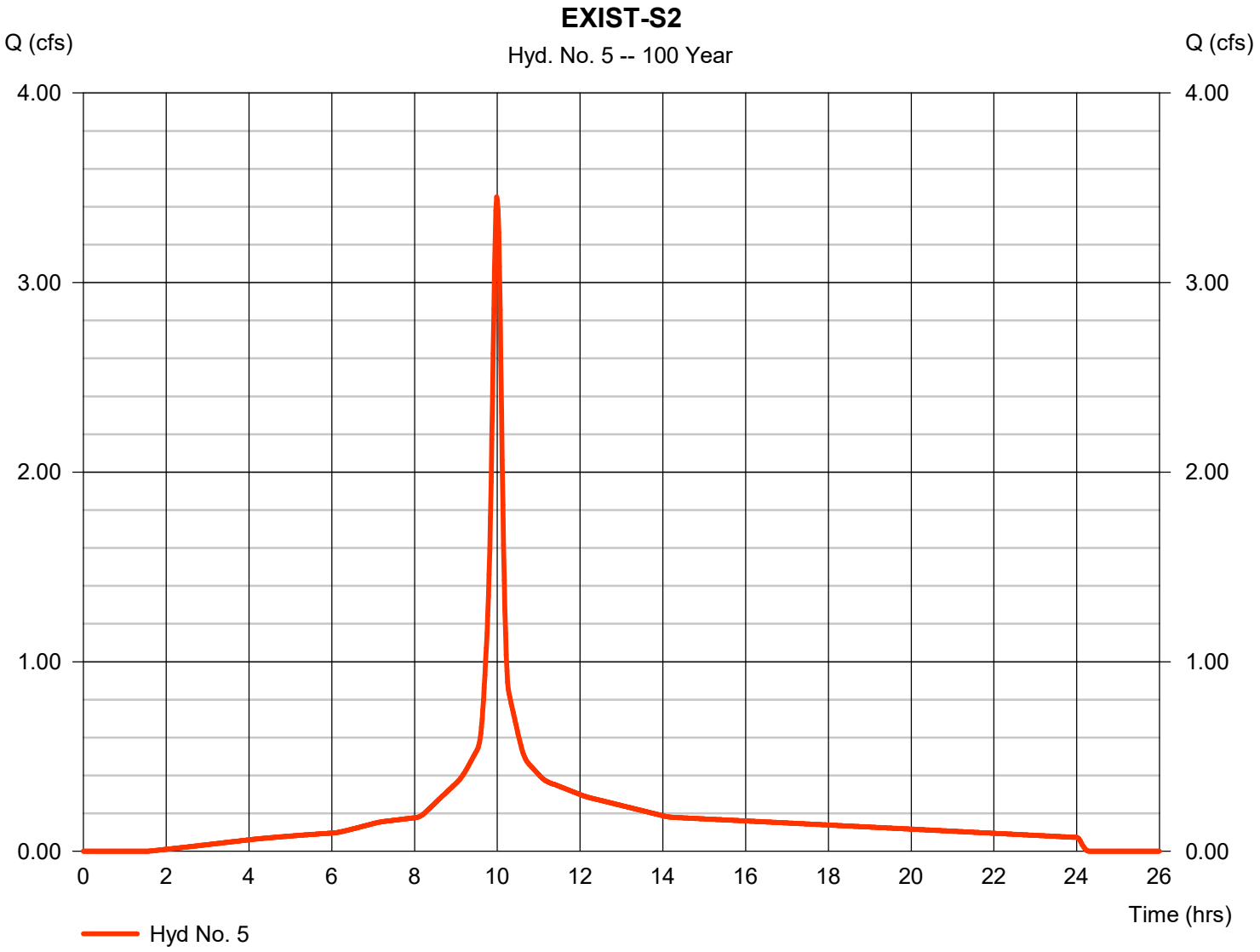


Hydrograph Report

Hyd. No. 5

EXIST-S2

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.451 cfs
Storm frequency	=	100 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	17,304 cuft
Drainage area	=	0.810 ac	Curve number	=	92.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.10 min
Total precip.	=	6.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

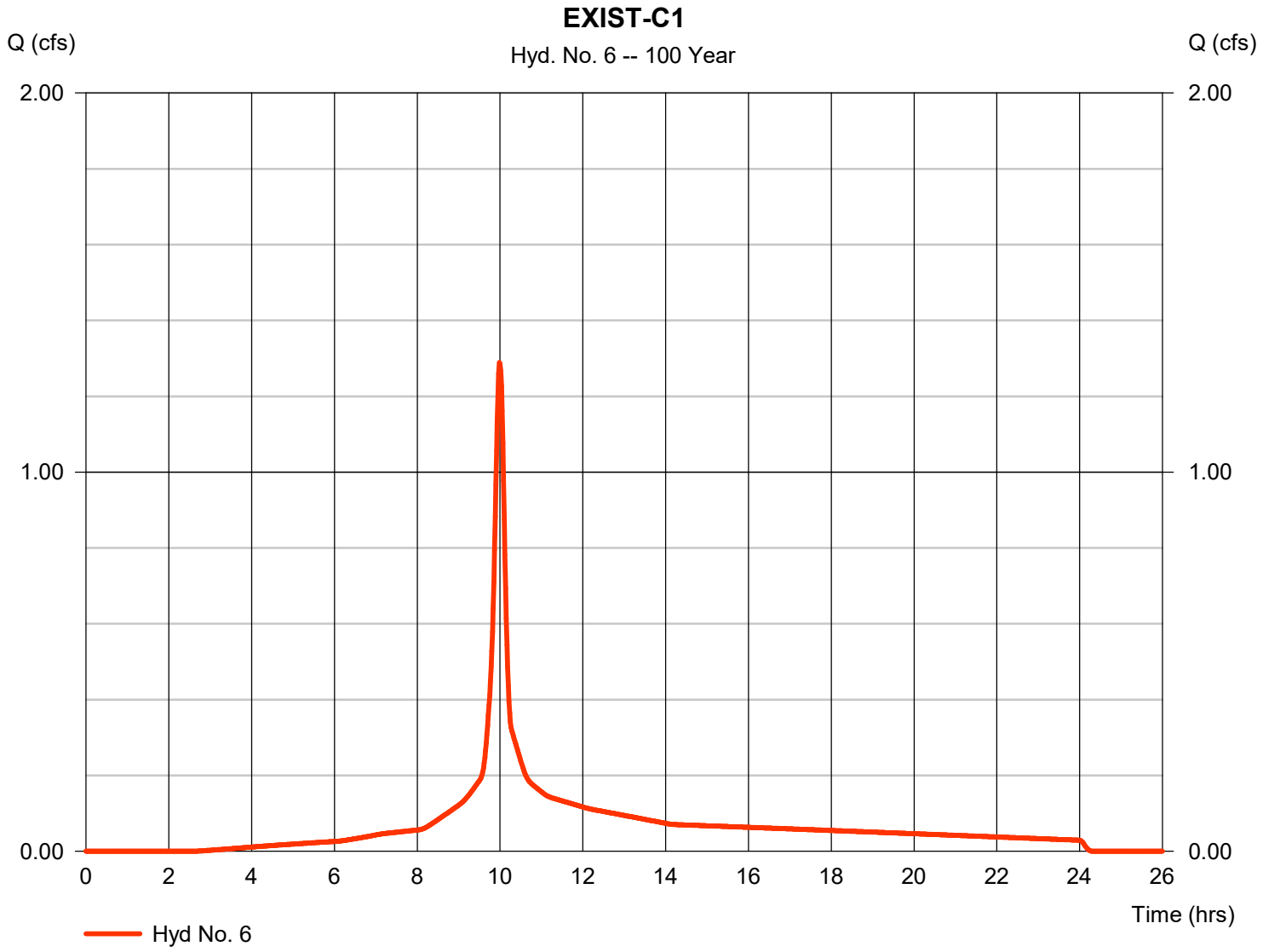


Hydrograph Report

Hyd. No. 6

EXIST-C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.289 cfs
Storm frequency	=	100 yrs	Time to peak	=	9.98 hrs
Time interval	=	1 min	Hyd. volume	=	6,328 cuft
Drainage area	=	0.330 ac	Curve number	=	87
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	10.40 min
Total precip.	=	6.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

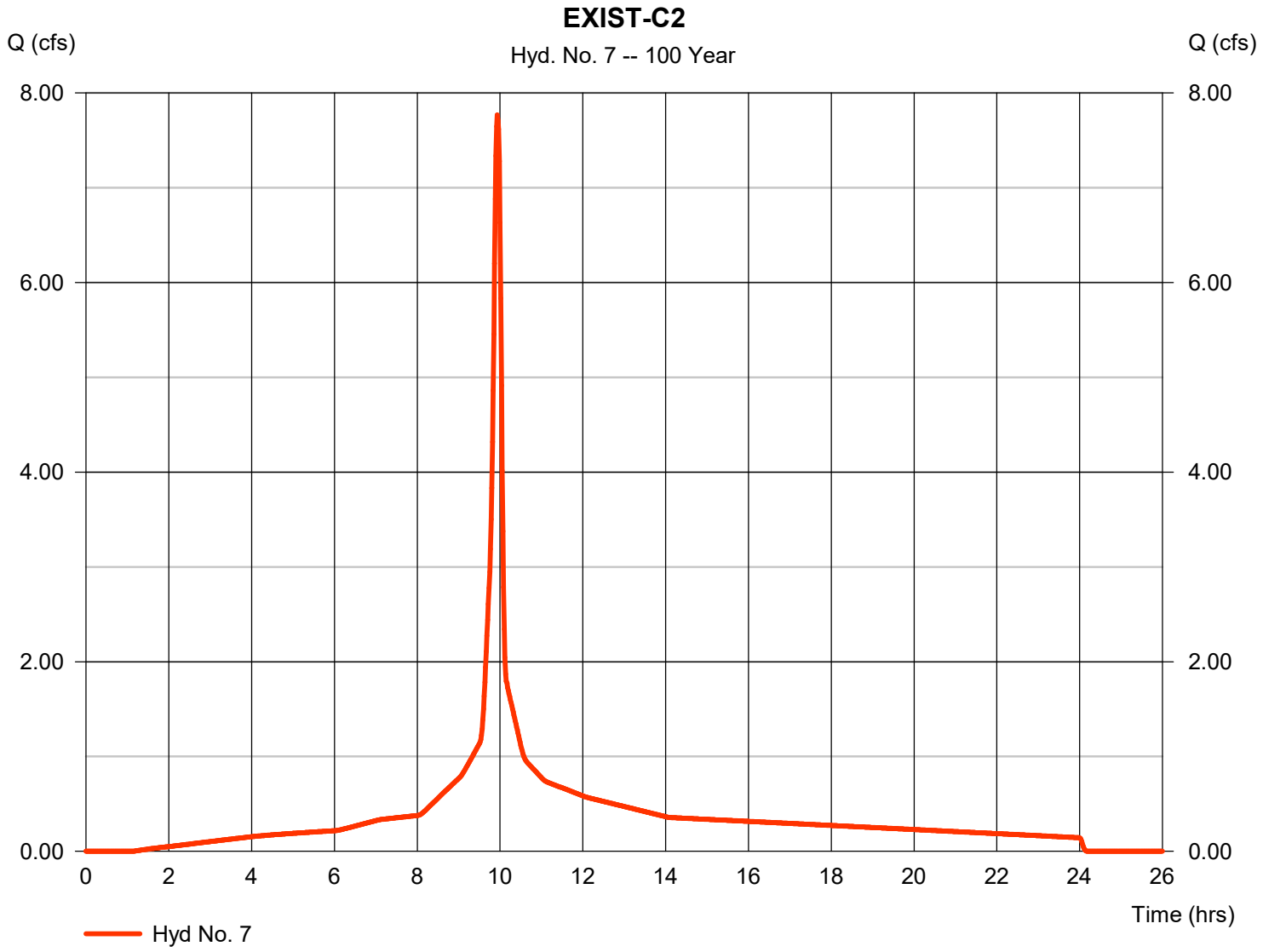


Hydrograph Report

Hyd. No. 7

EXIST-C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	7.768 cfs
Storm frequency	=	100 yrs	Time to peak	=	9.93 hrs
Time interval	=	1 min	Hyd. volume	=	35,276 cuft
Drainage area	=	1.570 ac	Curve number	=	94.1
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.10 min
Total precip.	=	6.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484

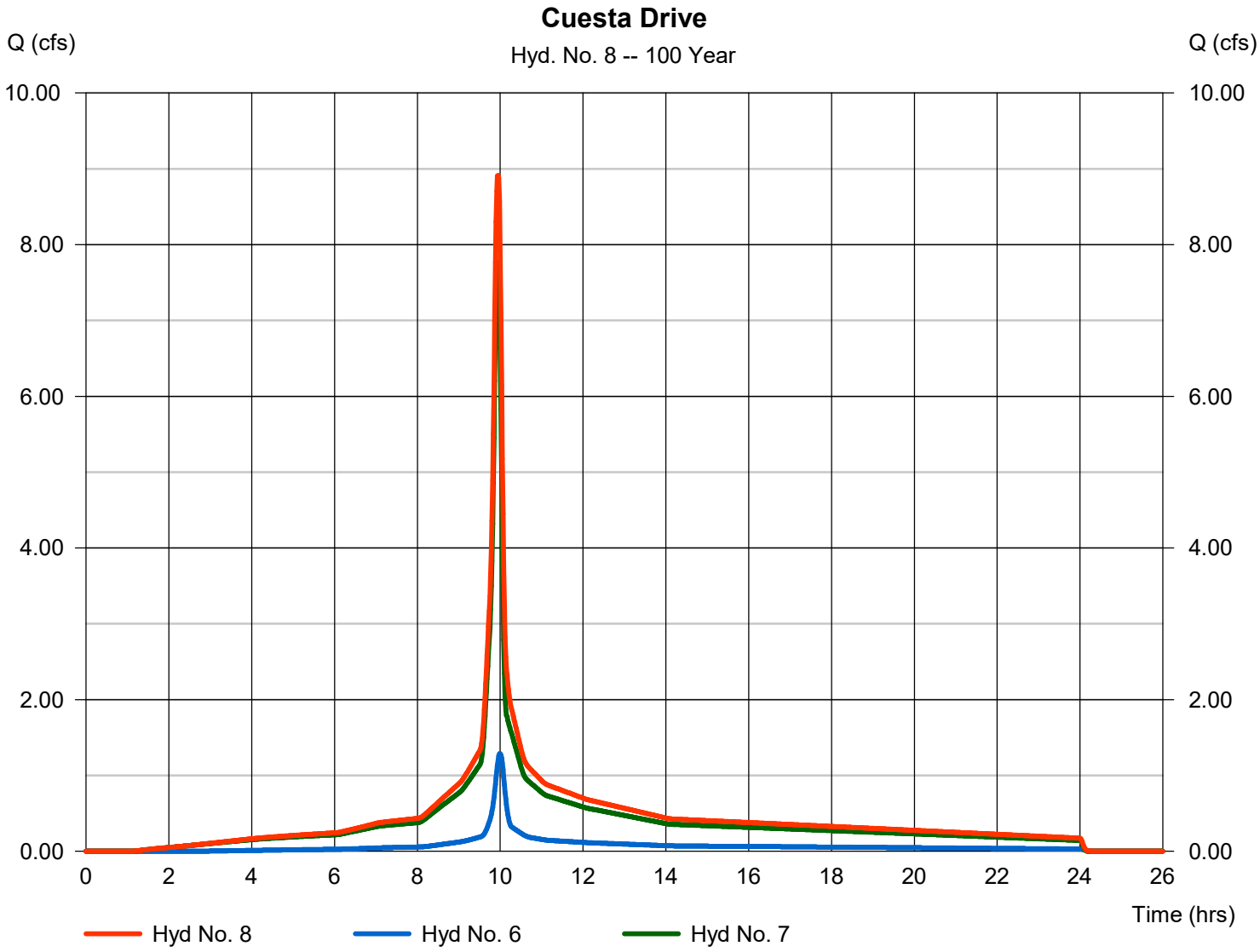


Hydrograph Report

Hyd. No. 8

Cuesta Drive

Hydrograph type	= Combine	Peak discharge	= 8.915 cfs
Storm frequency	= 100 yrs	Time to peak	= 9.95 hrs
Time interval	= 1 min	Hyd. volume	= 41,604 cuft
Inflow hyds.	= 6, 7	Contrib. drain. area	= 1.900 ac



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	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.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	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
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	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: F:\proj\2019\190306\3 Project Design\Civil\Design Calcs\HydraflowHydrographs\Rainall.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	0.00	3.30	0.00	0.00	4.60	5.70	6.50	6.70
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydraflow Table of Contents

190306Existing.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Appendix C

Hydrologic Analyses of Proposed Conditions

1. Composite Runoff Coefficient and Curve Number Calculations
2. Time of Concentration Calculations
3. Rational Method Peak Flow Calculations
4. SCS method hydrographs
5. Stanford Basin Model
6. Cuesta Basin Model

Composite Runoff Coefficient and Curve Number Calculations - Proposed Conditions

Project: 190306-Westmont
Updated: 2/4/2020

Runoff Coefficients (from Table 4-1 SLO DDM) and Curve Numbers (from Table 2-2a TR-55)

Type of Development	Hydrologic Soil Goup	Runoff Coefficient, *C*	Curve Number, *CN*	Description
Moderate Vegetation (s < 2%)	C	0.25	82	SLO DDM: Moderate Vegetation; TR-55: Woods-grass Combination (poor hydrologic condition)
Moderate Vegetation (s < 2%)	D	0.25	86	
Moderate Vegetation (s = 2-10%)	C	0.30	82	
Moderate Vegetation (s = 2-10%)	D	0.35	86	
Moderate Vegetation (s > 10%)	C	0.35	82	
Moderate Vegetation (s > 10%)	D	0.45	86	
Agricultural (s < 2%)	C	0.15	82	SLO DDM: Agriculture; TR-55: Row Crops, Straight Rows, Crop Residue Cover (good hydrologic condition)
Agricultural (s < 2%)	D	0.20	85	
Agricultural (s = 2-10%)	C	0.15	82	
Agricultural (s = 2-10%)	D	0.20	85	
Agricultural (s > 10%)	C	0.20	82	
Agricultural (s > 10%)	D	0.25	85	
Impervious (s < 2%)	C	0.80	98	Impervious Surfaces
Impervious (s <2%)	D	0.85	98	
Impervious (s = 2-10%)	C	0.85	98	
Impervious (s = 2-10%)	D	0.87	98	
Impervious (s > 10%)	C	0.90	98	
Impervious (s > 10%)	D	0.90	98	
Parks (s < 2%)	C	0.10	74	SLO DDM: Unimproved Vacant Lots; TR-55: Moderate Vegetation (good hydrologic condition)
Parks (s < 2%)	D	0.15	80	
Parks (s = 2-10%)	C	0.15	74	
Parks (s = 2-10%)	D	0.20	80	
Parks (s > 10%)	C	0.20	74	
Parks (s > 10%)	D	0.30	80	
Residential District (1/4ac or less)	C	0.45	83	SLO DDM Table 4-1 SFR 6,000SF
Residential District (1/4ac or less)	D	0.45	87	SLO DDM Table 4-1 SFR 6,000SF
Residential District (1/4ac or less)	A	0.45	61	SLO DDM Table 4-1 SFR 6,000SF
Oak Woodland (>10%)	A	0.35	30	SLO DDM Table 4-1 Oak Woodland >10%
Oak Woodland (>10%)	C	0.35	41	
Oak Woodland (>10%)	D	0.45	48	

Calculation Description

Composite runoff coefficients and curve numbers are calculated by using the Area Weighted Average method as follows:

$$Composite\ C = \frac{\sum(C_1A_1 + C_2A_2 + \ldots + C_nA_n)}{\sum(A_1 + A_2 + \ldots + A_n)}$$

Composite Runoff Coefficient and Curve Number Calculation

Sub-basin	Total Area (sf)	Total Area, *A* (ac)	Hydrologic Soil Group	Moderate Vegetation Area (sf)			Agricultural Area (sf)			Impervious Area(sf)			Oak Woodland s>10%	Residential District (buildout condition)	Park	Composite Runoff Coefficient, *C*	Composite Curve Number, *CN*
				s < 2%	s = 2-10%	s > 10%	s < 2%	s = 2-10%	s > 10%	s < 2%	s = 2-10%	s > 10%					
PROP-C1	33,855	0.78	C													0.65	92.52
			D							18,036				14,155	1,664		
PROP-C2	57,731	1.33	C													0.74	95.09
			D							42,442				15,289			
PROP-S1	17,232	0.40	C							1,090				885	43	0.67	92.90
			D							8,853				5,842	519		
PROP-S2	29,068	0.67	C							9,488				1,665		0.67	93.29
			D							7,752				10,163			
PROP-TR1	60,811	1.40	C							9,909				39,210		0.51	86.23
			D							110				11,582			
PROP-TR2	1,086,268	24.94	C						146,407	45,660				59,012		0.41	87.50
			D						489,619	180,907				164,663			
PROP-TR3	104,966	2.41	C													0.64	92.20
			D							51,168				51,344	2,454		
Total:	**1,284,965**	**31.91**		**0**	**0**	**0**	**0**	**0**	**636,026**	**324,247**	**0**	**0**		**322,466**			

Time of Concentration Calculation - Proposed Conditions

Project: 190306-Westmont
Updated: 2/4/2020

Calculation Description

The following calculations are based on the procedures presented in the San Luis Obispo Drainage Design Manual and the NRCS publication TR-55: Urban Hydrology for Small Watersheds (June 1986 edition)

Sheet Flow (Flow Over Plane Surfaces)

$$T_{sf} = \frac{0.007(nL)^{0.8}}{(I_2)^{0.5} s^{0.4}} * (60 min/hr)$$

T_{sf} = Travel Time for Sheet Flow (min)
n = Manning's Roughness Coefficient (from Table 3-1)
I_2 = 2-year, 24-hour rainfall (in)
L = Flow Length (ft) - 300 ft maximum
s = Land Slope (ft/ft)

Table 3-1 from TR-55

Table 3-1 Roughness coefficients (Manning's n) for sheet flow

Surface description	n [1]
Smooth surfaces (concrete, asphalt, gravel, or bare soil)	0.011
Fallow (no residue)	0.05
Cultivated soils:	
Residue cover ≤20%	0.06
Residue cover >20%	0.17
Grass:	
Short grass prairie	0.15
Dense grasses [2]	0.24
Bermudagrass	0.41
Range (natural)	0.13
Woods[3]	
Light underbrush	0.40
Dense underbrush	0.80

[1] The n values are a composite of information compiled by Engman (1986).
[2] Includes species such as weeping lovegrass, bluegrass, buffalo grass, blue grama grass, and native grass mixtures.
[3] When selecting n, consider cover to a height of about 0.1 ft. This is the only part of the plant cover that will obstruct sheet flow.

Shallow Concentrated Flow

$$T_{sc} = \frac{L}{60V} \qquad V = K_u k S_p^{0.5}$$

T_{sc} = Travel Time for Shallow Concentrated Flow (min)
L = Flow Length (ft) - 1000 ft maximum
V = Velocity (ft/s) (per Equation Above)
K_u = 3.28
k = Interception Coefficient
= 0.457 (Grassed Waterway)
= 0.491 (Unpaved)
= 0.619 (Paved Areas; Small Upland Gullies)
S_p = Slope (%)

Channel Flow

$$T_{ch} = \frac{L}{60V} \qquad V = \frac{1.49 R^{2/3} s^{0.5}}{n}$$

T_{ch} = Travel Time for Channel Flow (min)
V = Velocity (ft/s) (per Manning Equation Above)
R = Hydraulic Radius (ft) = A/P_w
A = Cross-sectional Flow Area (sf)
P_w = Wetted Perimeter (ft)
s = Channel Slope (ft/ft)
n = Manning's Roughness Coefficient

Time of Concentration to Inlet

$T_c = T_{sf} + T_{sc} + T_{ch}$

Lag Time

$T_L = 0.6 * T_c$

Time of Concentration Calculation

Sub-basin	Point of Discharge	Sheet Flow Time Calculation							Shallow Concentrated Flow Time Calculation							Channel Flow Time Calculation											Time of Conc.	Lag Time
		n	Upper Elev (ft)	Lower Elev (ft)	L (ft)	I_2 (in)	s (ft/ft)	T_{SF} (min)	Upper Elev (ft)	Lower Elev (ft)	L (ft)	k	Sp (%)	V (ft/s)	T_{sc} (min)	Upper Elev (ft)	Lower Elev (ft)	L (ft)	A (sf)	P_w (ft)	R (ft)	s (ft/ft)	n	V (ft/s)	T_{ch} (min)	T_c (min)	T_L (min)
PROP-C1	CUESTA	0.060	328.00	318.00	212	3.29	0.150	3.8																		6.0	3.6
PROP-C2	CUESTA BASIN	0.050	334.50	330.00	137	3.29	0.033	4.2	330.0	314.5	209	0.619	7.4	5.53	0.6											6.0	3.6
PROP-S1	STANFORD							5.0																		6.0	3.6
PROP-S2	STANFORD	0.240	308.00	283.00	167	3.29	0.150	9.5	283.0	279.5	123	0.619	2.8	3.42	0.6											10.1	6.0
PROP-TR1	TWIN RIDGE CREEK	0.060	297.00	287.00	154	3.29	0.065	4.1								287.0	279.0	276	5.00	11.00	0.45	0.029	0.040	3.75	1.2	6.0	3.6
PROP-TR2	TWIN RIDGE CREEK	0.150	425.00	396.00	300	3.29	0.097	12.4	396.0	326.0	441	0.457	15.9	5.97	1.2	326.0	289.0	1195	5.00	11.00	0.45	0.031	0.040	3.87	5.1	18.8	11.3
PROP-TR3	TWIN RIDGE CREEK	0.06	328.50	326.5	103	3	0.02	4.8	326.5	303	307	1	7.7	5.62	0.9	*assumed 6" flow depth										6.0	3.6

*Channel Flow Calculations performed in FlowMaster
*Channel Flow Calculations performed in FlowMaster

Peak Flow Calculations Using Rational Method - Proposed Conditions

Project: 190306-Westmont
Updated: 2/4/2020

Calculation Description

The following calculations are based on the Rational Method as

$$Q = C*i*C_a*A$$

Q = Peak Rate of Runoff (cfs)
C = Runoff Coefficient
i = Rainfall Intensity (in/hr)
C_a = Antecedent Moistuer Factor
A = Drainage Area (acres)

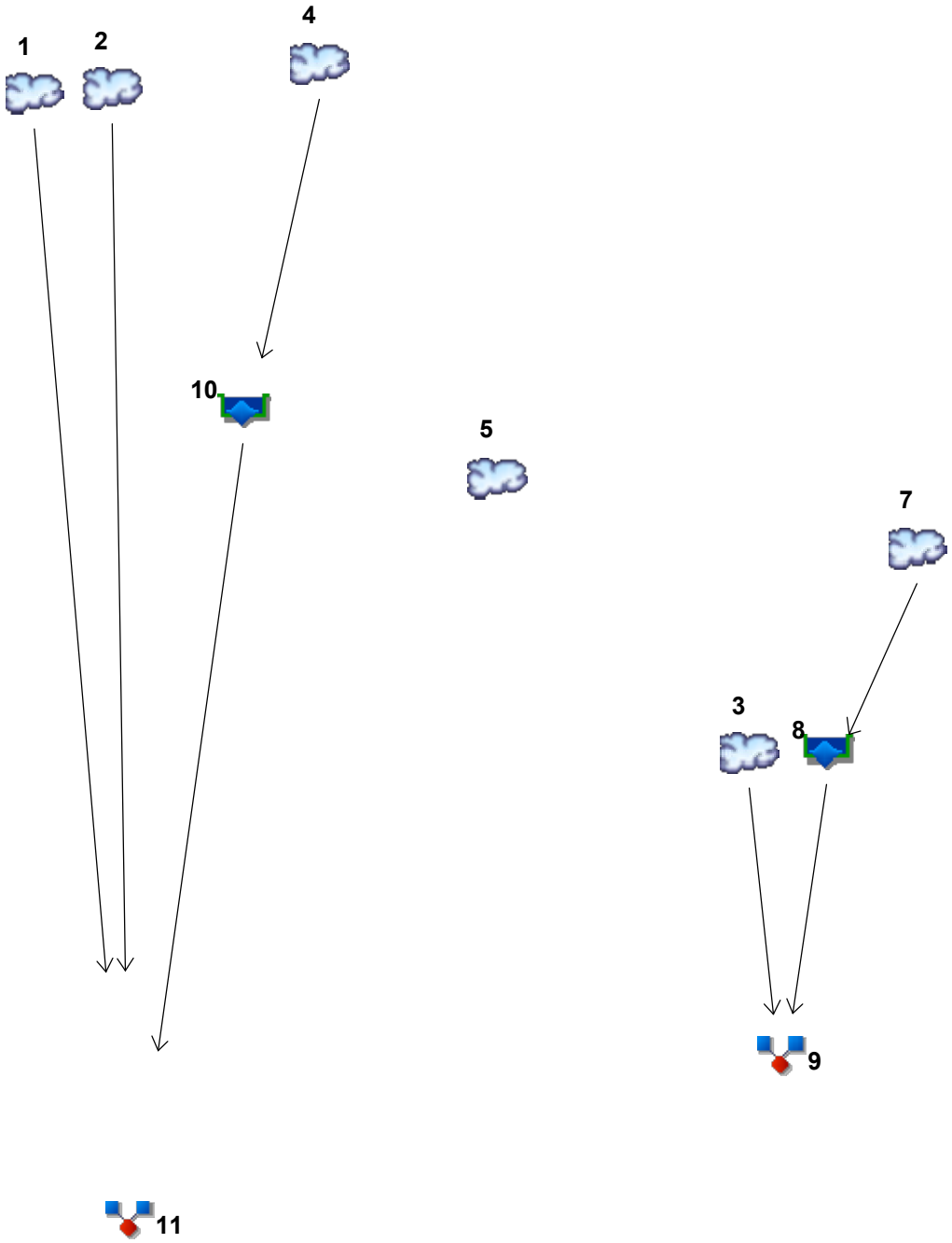
Parameters for Peak Flow Calculations for Areas with 550 mm to 700 mm Annual Rainfall (from Table 4-2 and Table 4-6 SLO DDM)

Recurrence Interval (years)	Antecedent Moisture Factor, C_a	Rainfall Intensity (in/hr) for Duration Given					
		10 min	15 min	30 min	60 min	120 min	180 min
2	1.00	2.09	1.81	1.18	0.75	0.55	0.47
10	1.00	3.58	2.99	2.09	1.30	0.91	0.83
25	1.10	4.02	3.50	2.40	1.50	1.10	0.98
50	1.20	4.61	3.90	2.60	1.69	1.30	1.14
100	1.25	5.00	4.29	2.91	1.85	1.38	1.22

Peak Flow Calculations

Sub-basin	Total Area, A (ac)	Composite Runoff Coefficient, C	Time of Conc. T_c (min)	Rainfall Intensity, i (in/hr)					Peak Flow (cfs) ($Q=C*i*C_a*A$)					Point of Discharge
				2-yr	10-yr	25-yr	50-yr	100-yr	2-yr	10-yr	25-yr	50-yr	100-yr	
PROP-C1	0.78	0.65	6.0	2.09	3.58	4.02	4.61	5.00	1.05	1.81	2.23	2.79	3.15	CUESTA
PROP-C2	1.33	0.74	6.0	2.09	3.58	4.02	4.61	5.00	2.06	3.53	4.36	5.45	6.16	CUESTA BASIN
PROP-S1	0.40	0.67	6.0	2.09	3.58	4.02	4.61	5.00	0.55	0.95	1.17	1.46	1.65	STANFORD
PROP-S2	0.67	0.67	10.1	2.08	3.57	4.01	4.59	4.99	0.93	1.60	1.97	2.47	2.79	STANFORD
PROP-TR1	1.40	0.51	6.0	2.09	3.58	4.02	4.61	5.00	1.48	2.54	3.13	3.92	4.43	TWIN RIDGE CREEK
PROP-TR2	24.94	0.41	18.8	1.65	2.77	3.23	3.57	3.95	16.80	28.10	36.08	43.55	50.12	TWIN RIDGE CREEK
PROP-TR3	2.41	0.64	6.0	2.09	3.58	4.02	4.61	5.00	3.21	5.51	6.79	8.50	9.61	TWIN RIDGE CREEK
Total:	**31.91**								**26.08**	**44.03**	**55.72**	**68.14**	**77.91**	

Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	PROP-TR1
2	SCS Runoff	PROP-TR2
3	SCS Runoff	PROP-C1
4	SCS Runoff	PROP-TR3
5	SCS Runoff	PROP-S1
6	SCS Runoff	PROP-S2
7	SCS Runoff	PROP-C2
8	Reservoir	CUESTA BASIN
9	Combine	POI - CUESTA
10	Reservoir	STANFORD DETENTION
11	Combine	TWIN RIDGE

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	SCS Runoff	------	-------	2.305	-------	-------	3.740	4.983	5.888	6.115	PROP-TR1
2	SCS Runoff	------	-------	30.25	-------	-------	48.47	64.09	75.44	78.28	PROP-TR2
3	SCS Runoff	------	-------	1.667	-------	-------	2.483	3.168	3.663	3.786	PROP-C1
4	SCS Runoff	------	-------	5.094	-------	-------	7.619	9.738	11.27	11.65	PROP-TR3
5	SCS Runoff	------	-------	0.867	-------	-------	1.285	1.635	1.888	1.952	PROP-S1
6	SCS Runoff	------	-------	1.237	-------	-------	1.856	2.377	2.753	2.847	PROP-S2
7	SCS Runoff	------	-------	3.091	-------	-------	4.462	5.610	6.441	6.648	PROP-C2
8	Reservoir	7	-------	2.437	-------	-------	3.250	3.741	4.083	4.165	CUESTA BASIN
9	Combine	3, 8	-------	3.973	-------	-------	5.515	6.656	7.427	7.620	POI - CUESTA
10	Reservoir	4	-------	1.147	-------	-------	2.033	3.328	3.960	4.096	STANFORD DETENTION
11	Combine	1, 2, 10	-------	32.42	-------	-------	52.13	69.63	82.02	85.08	TWIN RIDGE

Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

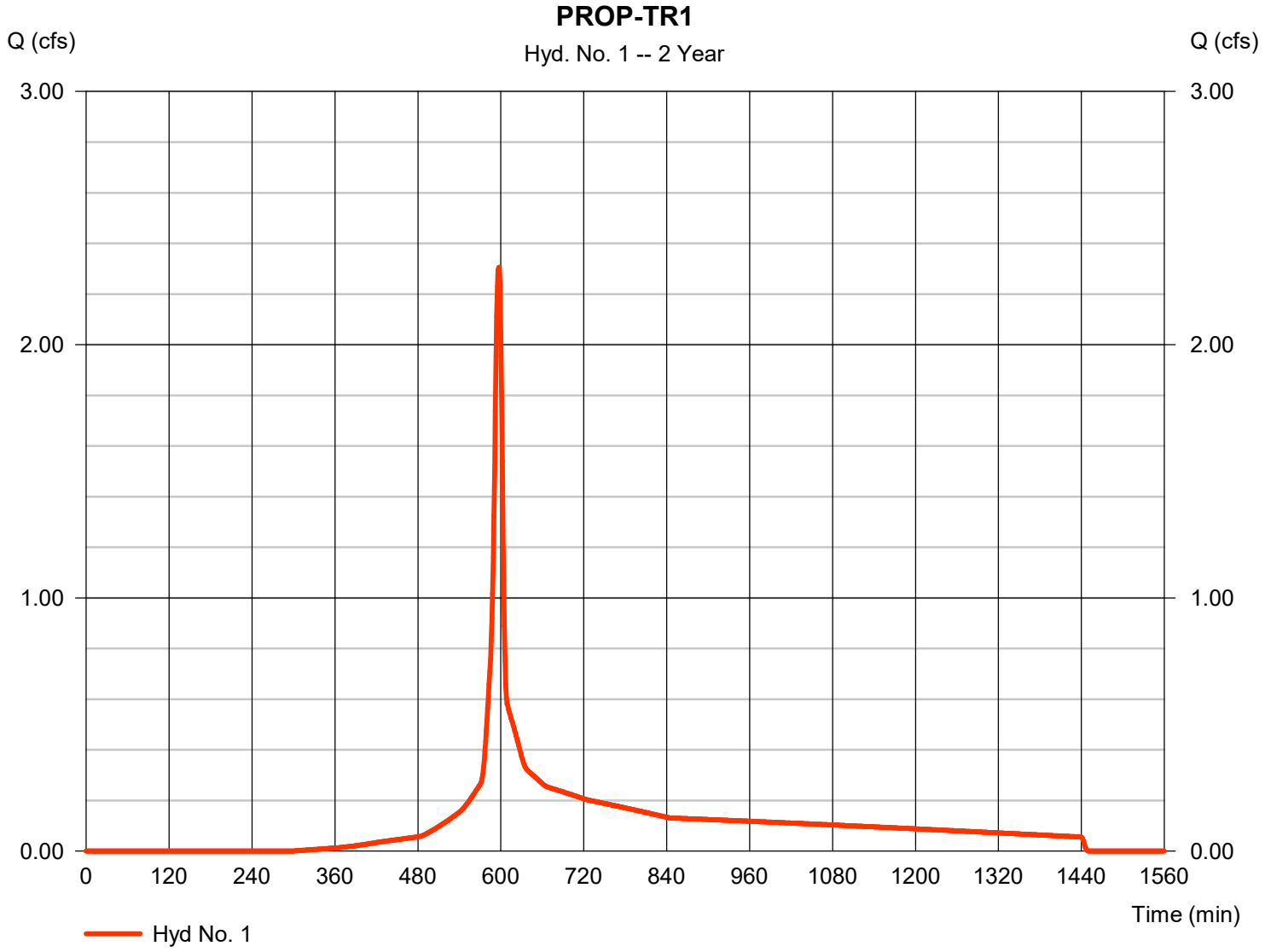
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.305	1	597	10,159	------	------	------	PROP-TR1
2	SCS Runoff	30.25	1	605	185,144	------	------	------	PROP-TR2
3	SCS Runoff	1.667	1	596	7,281	------	------	------	PROP-C1
4	SCS Runoff	5.094	1	596	22,236	------	------	------	PROP-TR3
5	SCS Runoff	0.867	1	596	3,792	------	------	------	PROP-S1
6	SCS Runoff	1.237	1	599	6,055	------	------	------	PROP-S2
7	SCS Runoff	3.091	1	596	13,708	------	------	------	PROP-C2
8	Reservoir	2.437	1	601	13,707	7	102.16	1,160	CUESTA BASIN
9	Combine	3.973	1	599	20,987	3, 8	------	------	POI - CUESTA
10	Reservoir	1.147	1	612	21,122	4	283.22	6,152	STANFORD DETENTION
11	Combine	32.42	1	604	216,424	1, 2, 10	------	------	TWIN RIDGE

Hydrograph Report

Hyd. No. 1

PROP-TR1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.305 cfs
Storm frequency	=	2 yrs	Time to peak	=	597 min
Time interval	=	1 min	Hyd. volume	=	10,159 cuft
Drainage area	=	1.400 ac	Curve number	=	86.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	3.30 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

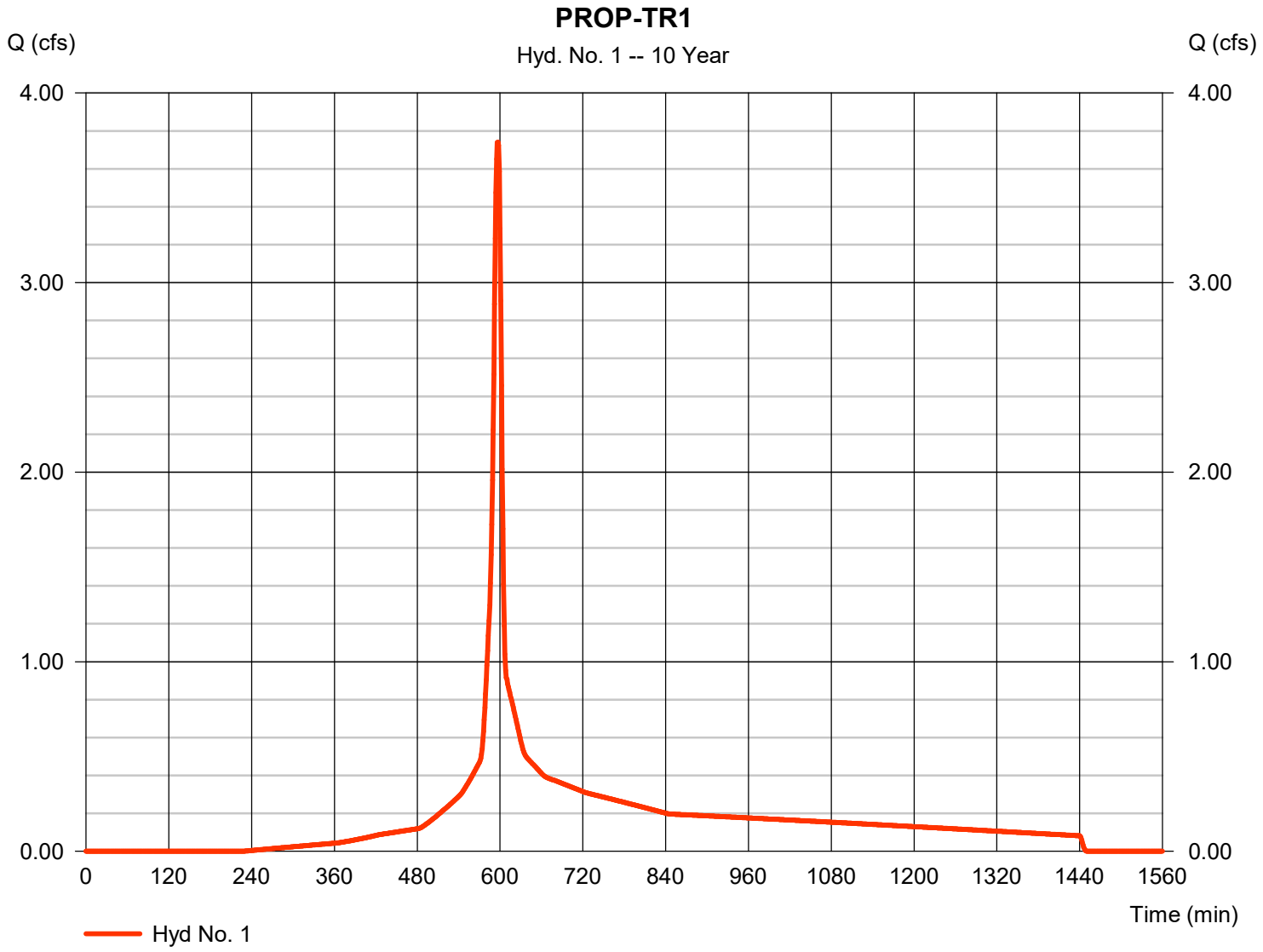
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	3.740	1	597	16,324	------	------	------	PROP-TR1
2	SCS Runoff	48.47	1	604	293,422	------	------	------	PROP-TR2
3	SCS Runoff	2.483	1	596	10,956	------	------	------	PROP-C1
4	SCS Runoff	7.619	1	596	33,565	------	------	------	PROP-TR3
5	SCS Runoff	1.285	1	596	5,682	------	------	------	PROP-S1
6	SCS Runoff	1.856	1	599	9,158	------	------	------	PROP-S2
7	SCS Runoff	4.462	1	596	20,088	------	------	------	PROP-C2
8	Reservoir	3.250	1	601	20,087	7	102.94	1,715	CUESTA BASIN
9	Combine	5.515	1	598	31,043	3, 8	------	------	POI - CUESTA
10	Reservoir	2.033	1	607	32,450	4	283.93	8,877	STANFORD DETENTION
11	Combine	52.13	1	604	342,194	1, 2, 10	------	------	TWIN RIDGE

Hydrograph Report

Hyd. No. 1

PROP-TR1

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.740 cfs
Storm frequency	=	10 yrs	Time to peak	=	597 min
Time interval	=	1 min	Hyd. volume	=	16,324 cuft
Drainage area	=	1.400 ac	Curve number	=	86.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	4.60 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

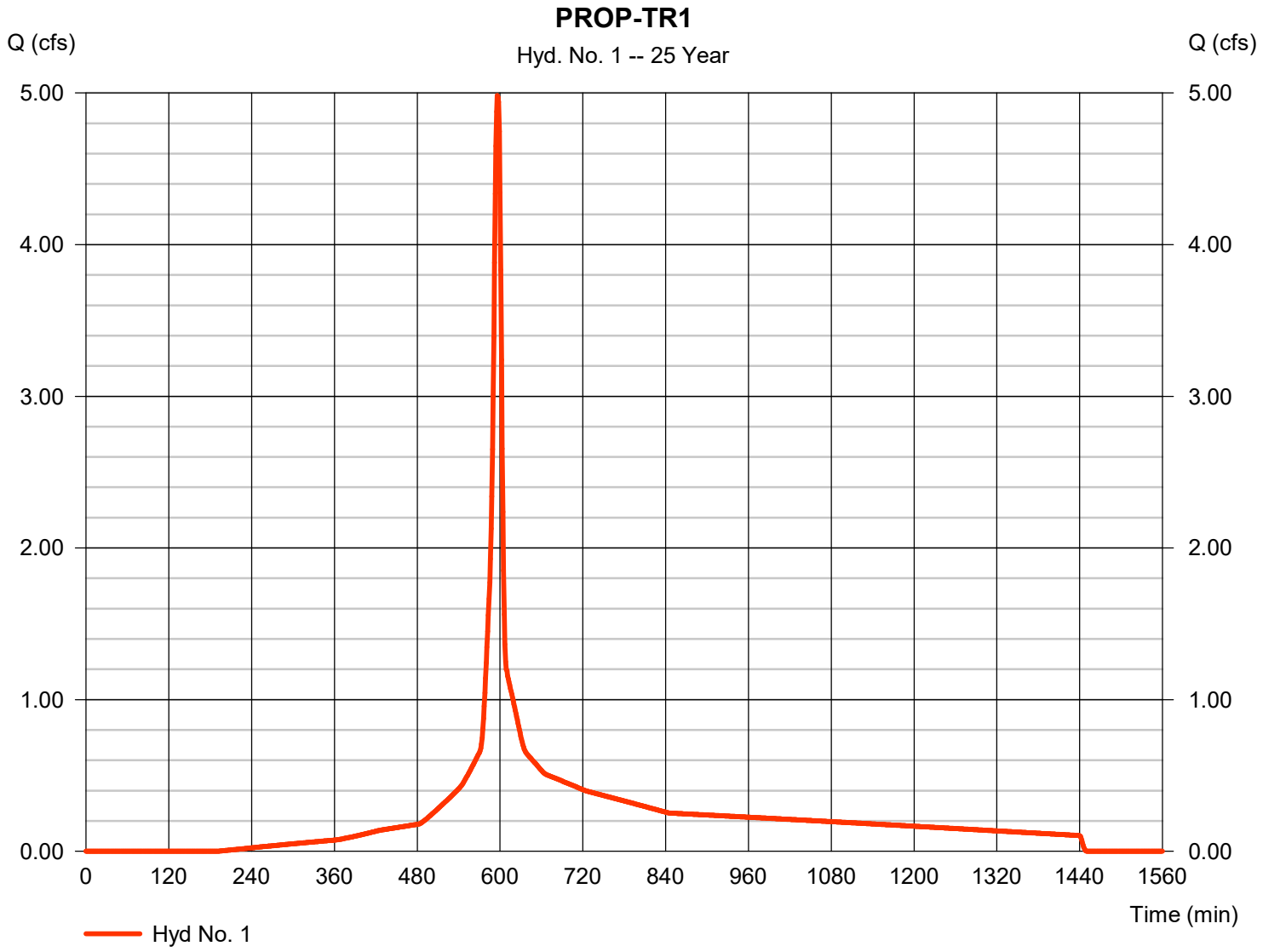
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	4.983	1	596	21,729	------	------	------	PROP-TR1
2	SCS Runoff	64.09	1	604	387,836	------	------	------	PROP-TR2
3	SCS Runoff	3.168	1	596	14,105	------	------	------	PROP-C1
4	SCS Runoff	9.738	1	596	43,277	------	------	------	PROP-TR3
5	SCS Runoff	1.635	1	596	7,300	------	------	------	PROP-S1
6	SCS Runoff	2.377	1	599	11,820	------	------	------	PROP-S2
7	SCS Runoff	5.610	1	596	25,517	------	------	------	PROP-C2
8	Reservoir	3.741	1	602	25,516	7	103.53	2,271	CUESTA BASIN
9	Combine	6.656	1	598	39,621	3, 8	------	------	POI - CUESTA
10	Reservoir	3.328	1	605	42,163	4	284.38	10,856	STANFORD DETENTION
11	Combine	69.63	1	604	451,725	1, 2, 10	------	------	TWIN RIDGE

Hydrograph Report

Hyd. No. 1

PROP-TR1

Hydrograph type	=	SCS Runoff	Peak discharge	=	4.983 cfs
Storm frequency	=	25 yrs	Time to peak	=	596 min
Time interval	=	1 min	Hyd. volume	=	21,729 cuft
Drainage area	=	1.400 ac	Curve number	=	86.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	5.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

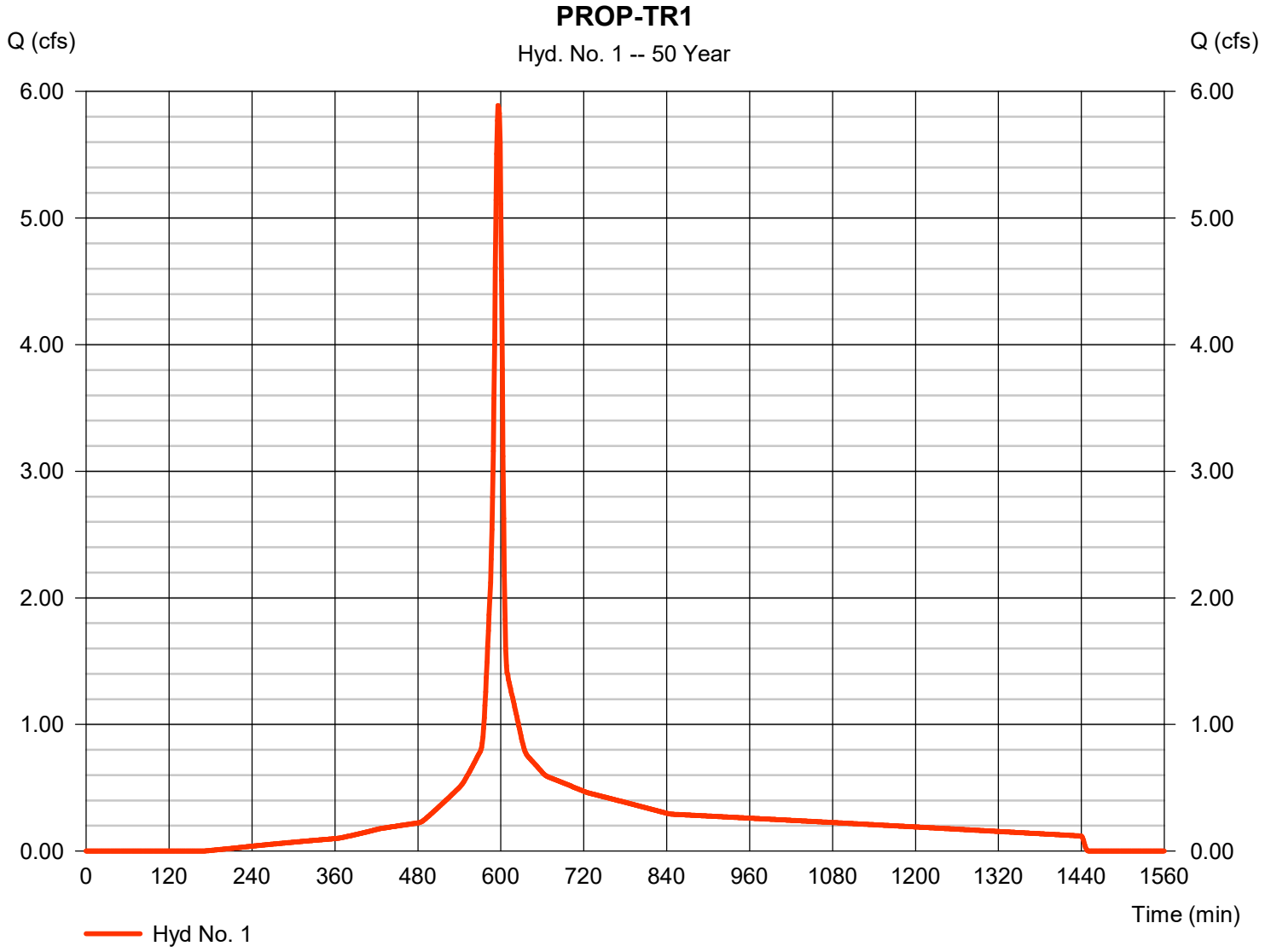
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	5.888	1	596	25,723	------	------	------	PROP-TR1
2	SCS Runoff	75.44	1	604	457,436	------	------	------	PROP-TR2
3	SCS Runoff	3.663	1	596	16,407	------	------	------	PROP-C1
4	SCS Runoff	11.27	1	596	50,382	------	------	------	PROP-TR3
5	SCS Runoff	1.888	1	596	8,483	------	------	------	PROP-S1
6	SCS Runoff	2.753	1	599	13,768	------	------	------	PROP-S2
7	SCS Runoff	6.441	1	596	29,475	------	------	------	PROP-C2
8	Reservoir	4.083	1	602	29,474	7	103.99	2,717	CUESTA BASIN
9	Combine	7.427	1	598	45,881	3, 8	------	------	POI - CUESTA
10	Reservoir	3.960	1	605	49,267	4	284.71	12,369	STANFORD DETENTION
11	Combine	82.02	1	604	532,424	1, 2, 10	------	------	TWIN RIDGE

Hydrograph Report

Hyd. No. 1

PROP-TR1

Hydrograph type	=	SCS Runoff	Peak discharge	=	5.888 cfs
Storm frequency	=	50 yrs	Time to peak	=	596 min
Time interval	=	1 min	Hyd. volume	=	25,723 cuft
Drainage area	=	1.400 ac	Curve number	=	86.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.50 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484



Hydrograph Summary Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11

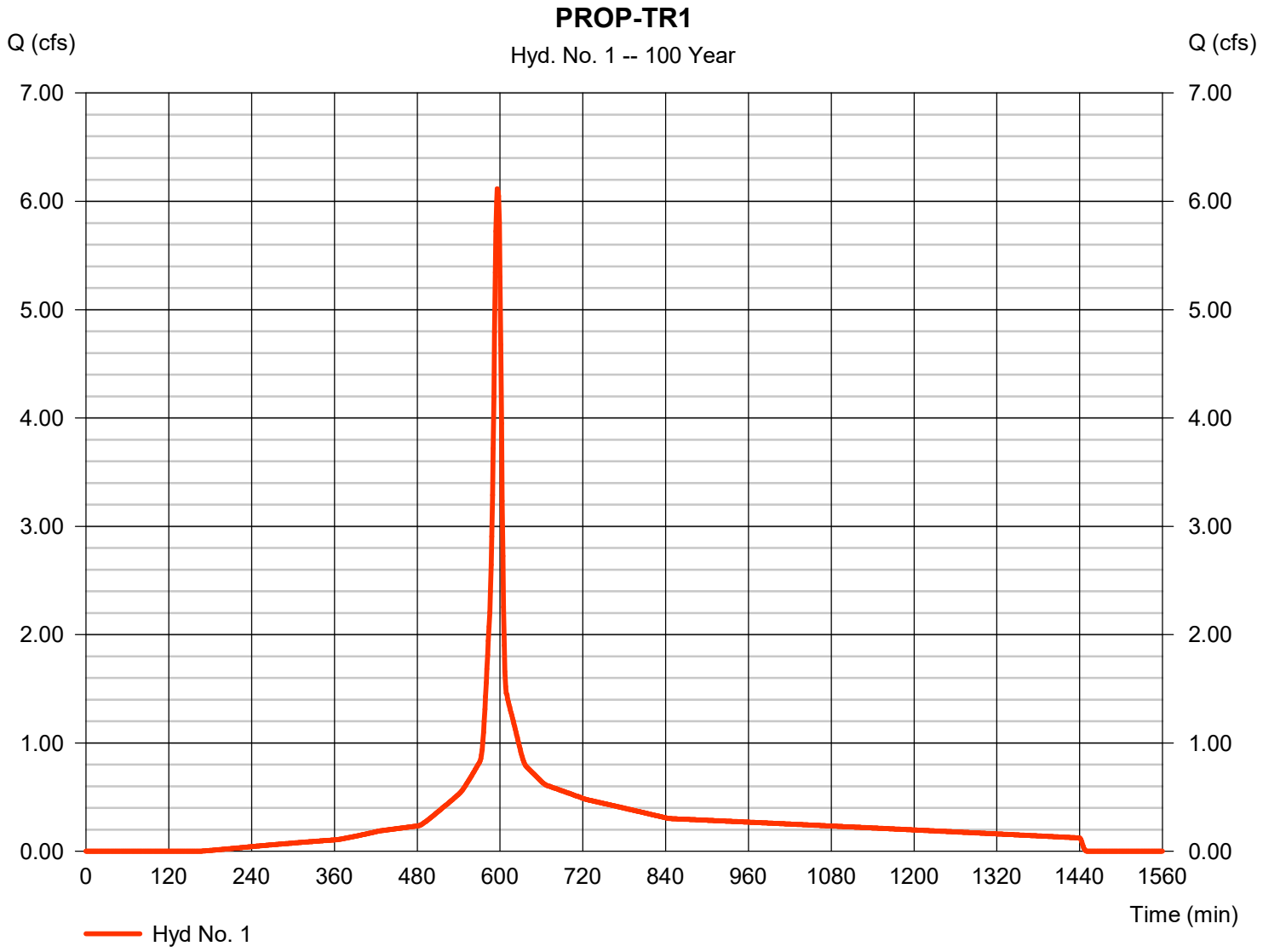
Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	6.115	1	596	26,728	------	------	------	PROP-TR1
2	SCS Runoff	78.28	1	604	474,925	------	------	------	PROP-TR2
3	SCS Runoff	3.786	1	596	16,983	------	------	------	PROP-C1
4	SCS Runoff	11.65	1	596	52,162	------	------	------	PROP-TR3
5	SCS Runoff	1.952	1	596	8,779	------	------	------	PROP-S1
6	SCS Runoff	2.847	1	599	14,256	------	------	------	PROP-S2
7	SCS Runoff	6.648	1	596	30,465	------	------	------	PROP-C2
8	Reservoir	4.165	1	602	30,464	7	104.11	2,832	CUESTA BASIN
9	Combine	7.620	1	598	47,448	3, 8	------	------	POI - CUESTA
10	Reservoir	4.096	1	605	51,047	4	284.79	12,757	STANFORD DETENTION
11	Combine	85.08	1	604	552,699	1, 2, 10	------	------	TWIN RIDGE

Hydrograph Report

Hyd. No. 1

PROP-TR1

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.115 cfs
Storm frequency	=	100 yrs	Time to peak	=	596 min
Time interval	=	1 min	Hyd. volume	=	26,728 cuft
Drainage area	=	1.400 ac	Curve number	=	86.2
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	User	Time of conc. (Tc)	=	6.00 min
Total precip.	=	6.70 in	Distribution	=	Type I
Storm duration	=	24 hrs	Shape factor	=	484



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	69.8703	13.1000	0.8658	--------
3	0.0000	0.0000	0.0000	--------
5	79.2597	14.6000	0.8369	--------
10	88.2351	15.5000	0.8279	--------
25	102.6072	16.5000	0.8217	--------
50	114.8193	17.2000	0.8199	--------
100	127.1596	17.8000	0.8186	--------

File name: SampleFHA.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	5.69	4.61	3.89	3.38	2.99	2.69	2.44	2.24	2.07	1.93	1.81	1.70
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	6.57	5.43	4.65	4.08	3.65	3.30	3.02	2.79	2.59	2.42	2.27	2.15
10	7.24	6.04	5.21	4.59	4.12	3.74	3.43	3.17	2.95	2.77	2.60	2.46
25	8.25	6.95	6.03	5.34	4.80	4.38	4.02	3.73	3.48	3.26	3.07	2.91
50	9.04	7.65	6.66	5.92	5.34	4.87	4.49	4.16	3.88	3.65	3.44	3.25
100	9.83	8.36	7.30	6.50	5.87	5.36	4.94	4.59	4.29	4.03	3.80	3.60

Tc = time in minutes. Values may exceed 60.

Precip. file name: F:\proj\2019\190306\3 Project Design\Civil\Design Calcs\HydraflowHydrographs\Rainall.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	0.00	3.30	0.00	0.00	4.60	5.70	6.50	6.70
SCS 6-Hr	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Huff-1st	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
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	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hydraflow Table of Contents

190306Proposed.gpw

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hydrograph Report

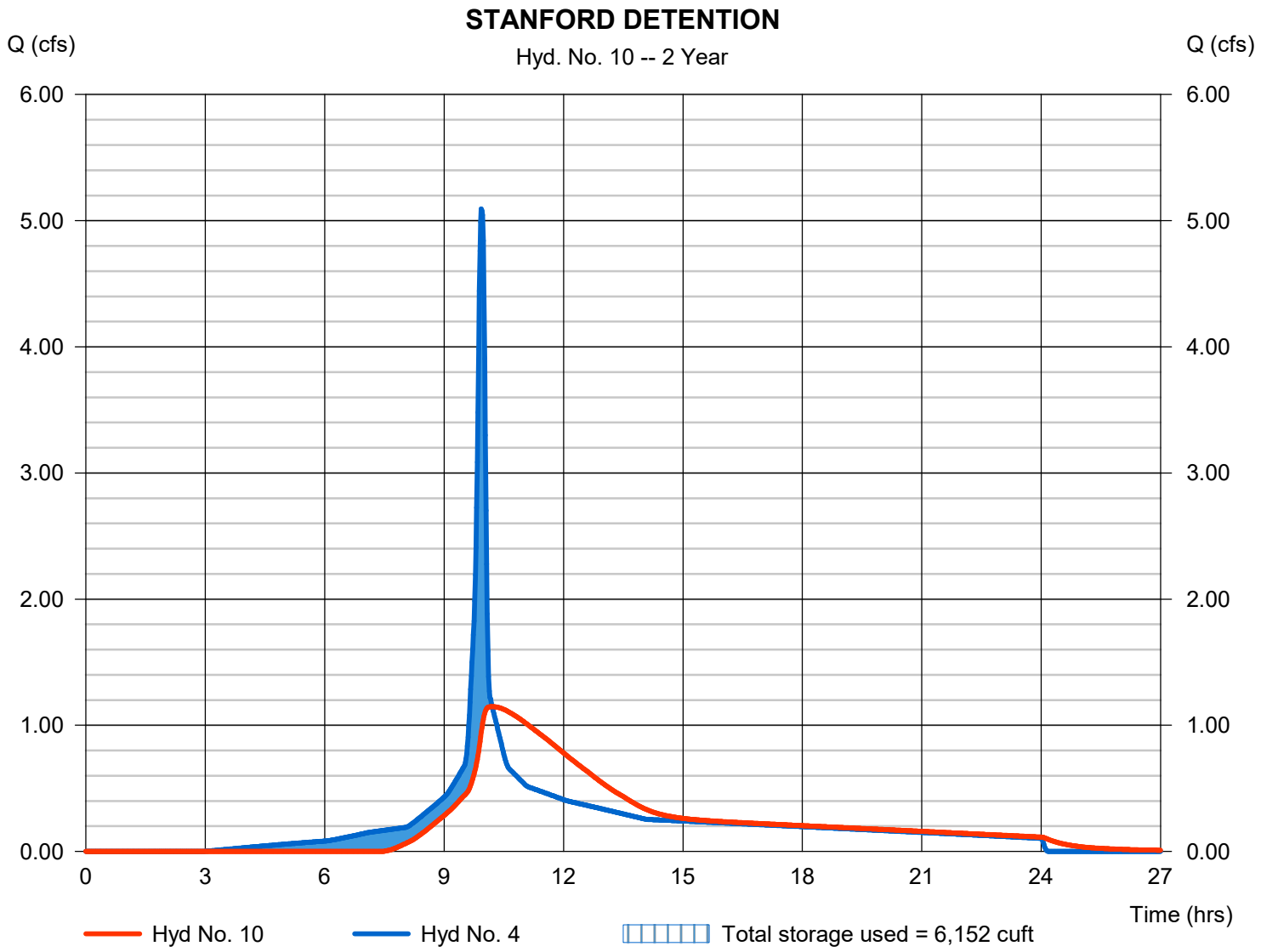
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 10

STANFORD DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	1.147 cfs
Storm frequency	=	2 yrs	Time to peak	=	10.20 hrs
Time interval	=	1 min	Hyd. volume	=	21,122 cuft
Inflow hyd. No.	=	4 - PROP-TR3	Max. Elevation	=	283.22 ft
Reservoir name	=	Stanford Basin	Max. Storage	=	6,152 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Pond No. 1 - Stanford Basin

Pond Data

Trapezoid -Bottom L x W = 80.0 x 25.0 ft, Side slope = 3.00:1, Bottom elev. = 281.00 ft, Depth = 4.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	281.00	2,000	0	0
0.40	281.40	2,258	851	851
0.80	281.80	2,527	957	1,808
1.20	282.20	2,808	1,067	2,874
1.60	282.60	3,100	1,181	4,056
2.00	283.00	3,404	1,300	5,356
2.40	283.40	3,719	1,424	6,780
2.80	283.80	4,046	1,553	8,333
3.20	284.20	4,385	1,686	10,019
3.60	284.60	4,735	1,823	11,842
4.00	285.00	5,096	1,966	13,808

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 18.00	6.00	10.00	Inactive
Span (in)	= 18.00	6.00	10.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 278.50	281.50	283.50	0.00
Length (ft)	= 10.00	0.00	0.00	0.00
Slope (%)	= 1.10	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	Yes	Yes	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 3.00	Inactive	Inactive	Inactive
Crest El. (ft)	= 285.00	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= 1	---	---	---
Multi-Stage	= Yes	No	No	No
Exfil.(in/hr)	= 0.000 (by 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	281.00	0.00	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.40	851	281.40	11.25 ic	0.00	0.00	---	0.00	---	---	---	---	---	0.000
0.80	1,808	281.80	11.25 ic	0.23 ic	0.00	---	0.00	---	---	---	---	---	0.230
1.20	2,874	282.20	11.25 ic	0.63 ic	0.00	---	0.00	---	---	---	---	---	0.634
1.60	4,056	282.60	11.25 ic	0.87 ic	0.00	---	0.00	---	---	---	---	---	0.872
2.00	5,356	283.00	11.25 ic	1.06 ic	0.00	---	0.00	---	---	---	---	---	1.057
2.40	6,780	283.40	11.25 ic	1.21 ic	0.00	---	0.00	---	---	---	---	---	1.214
2.80	8,333	283.80	11.25 ic	1.35 ic	0.33 ic	---	0.00	---	---	---	---	---	1.684
3.20	10,019	284.20	11.25 ic	1.48 ic	1.40 ic	---	0.00	---	---	---	---	---	2.876
3.60	11,842	284.60	11.25 ic	1.60 ic	2.17 ic	---	0.00	---	---	---	---	---	3.766
4.00	13,808	285.00	11.25 ic	1.70 ic	2.73 ic	---	0.00	---	---	---	---	---	4.437

Hydrograph Report

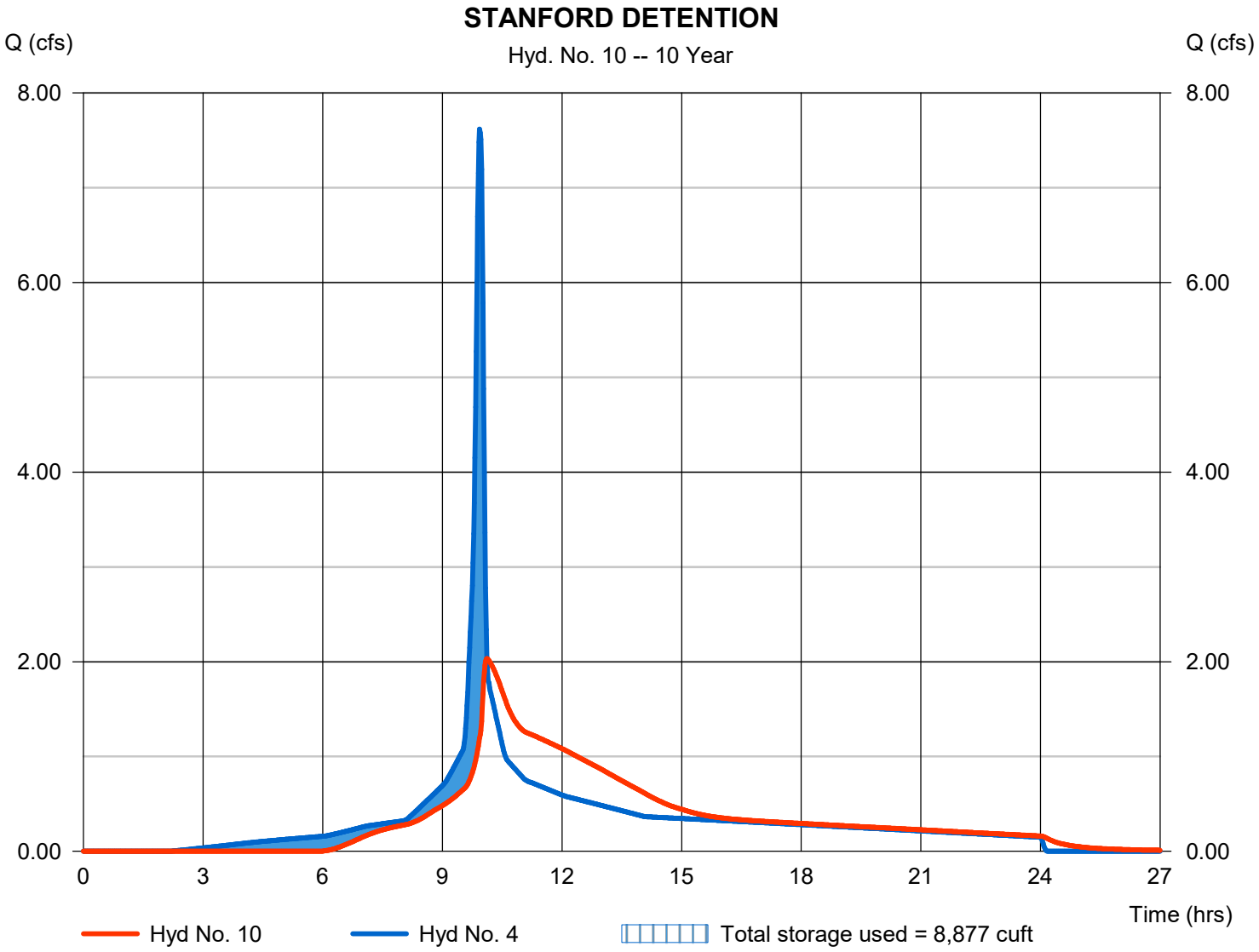
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 10

STANFORD DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 2.033 cfs
Storm frequency	= 10 yrs	Time to peak	= 10.12 hrs
Time interval	= 1 min	Hyd. volume	= 32,450 cuft
Inflow hyd. No.	= 4 - PROP-TR3	Max. Elevation	= 283.93 ft
Reservoir name	= Stanford Basin	Max. Storage	= 8,877 cuft

Storage Indication method used.



Hydrograph Report

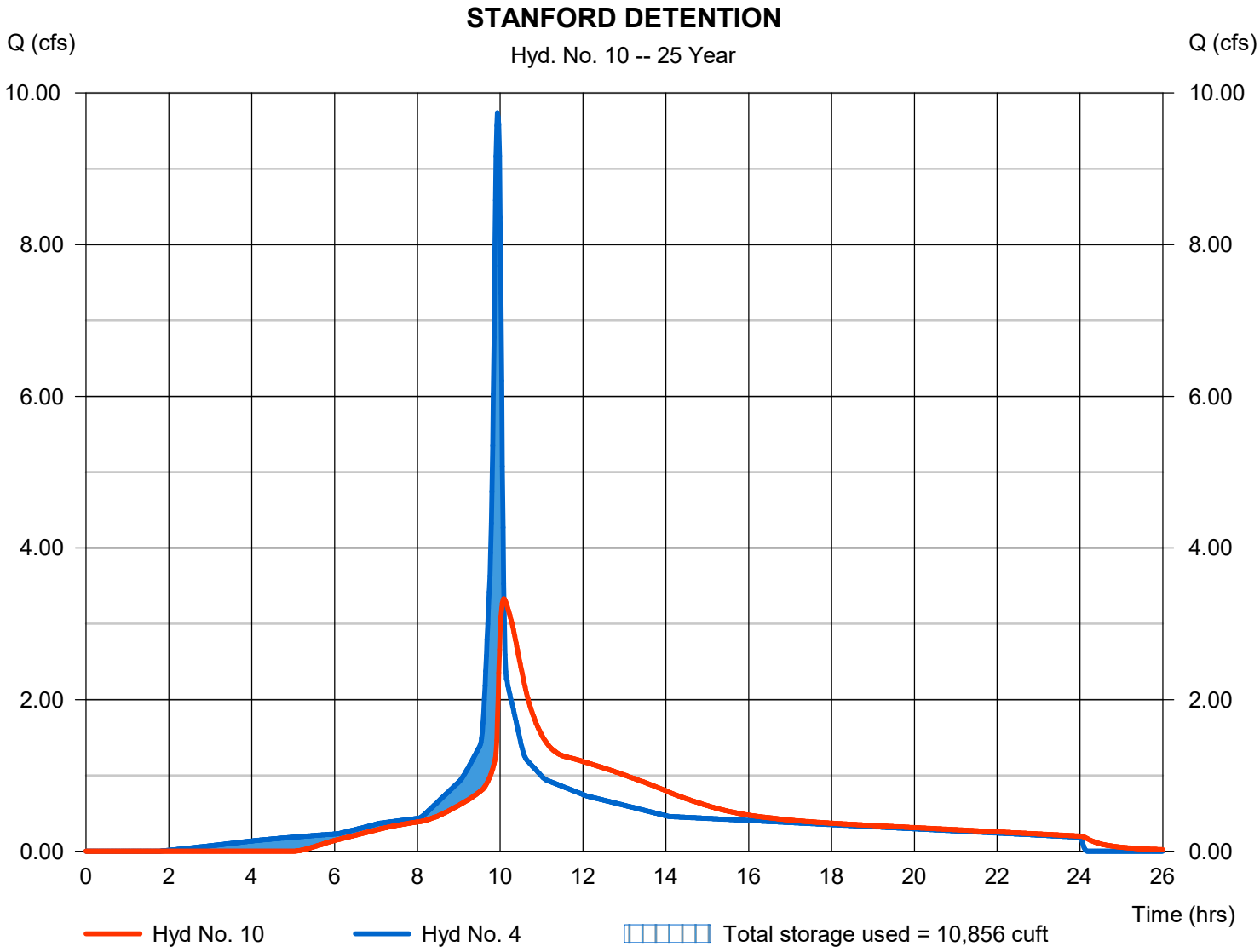
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 10

STANFORD DETENTION

Hydrograph type	=	Reservoir	Peak discharge	=	3.328 cfs
Storm frequency	=	25 yrs	Time to peak	=	10.08 hrs
Time interval	=	1 min	Hyd. volume	=	42,163 cuft
Inflow hyd. No.	=	4 - PROP-TR3	Max. Elevation	=	284.38 ft
Reservoir name	=	Stanford Basin	Max. Storage	=	10,856 cuft

Storage Indication method used.



Hydrograph Report

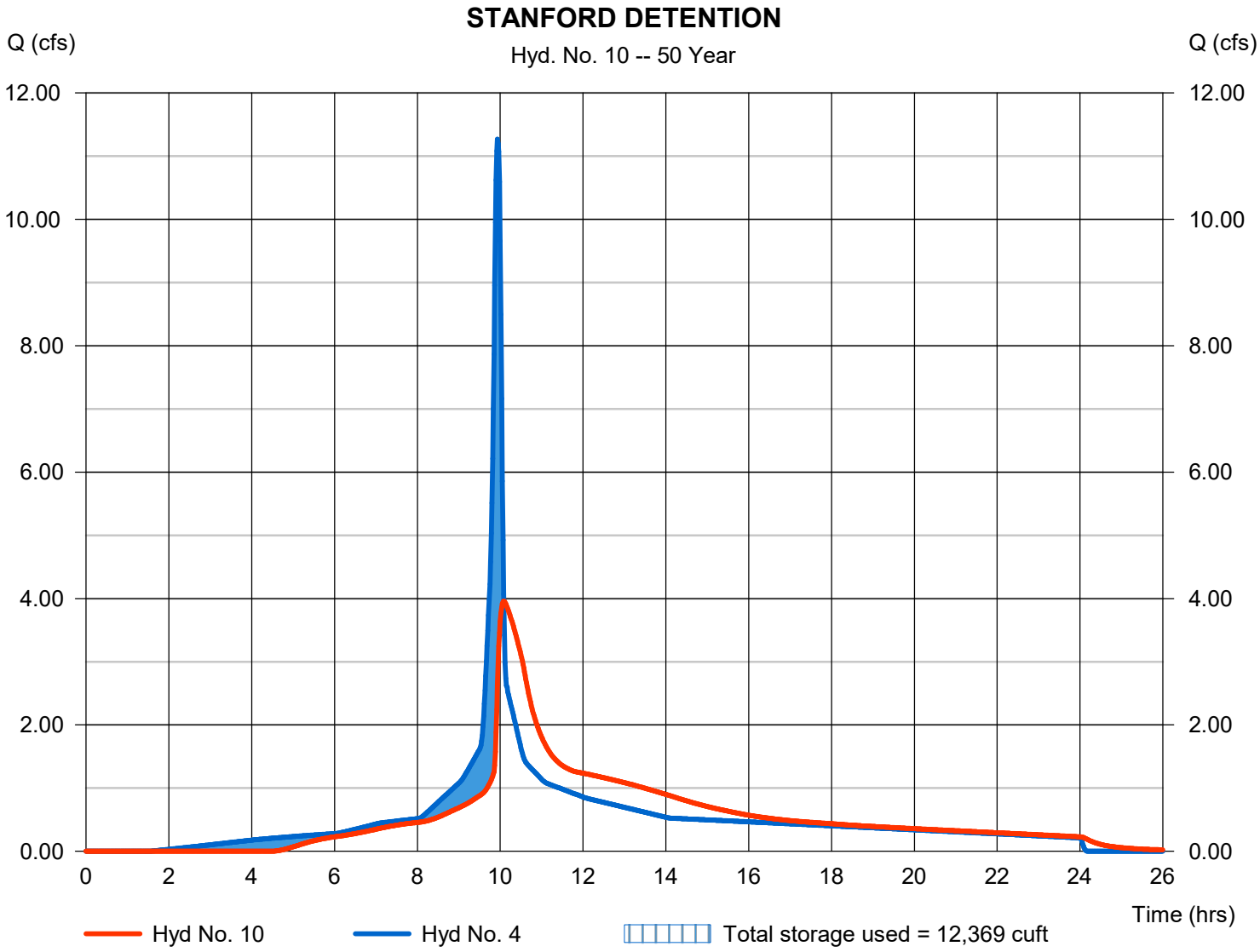
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 10

STANFORD DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 3.960 cfs
Storm frequency	= 50 yrs	Time to peak	= 10.08 hrs
Time interval	= 1 min	Hyd. volume	= 49,267 cuft
Inflow hyd. No.	= 4 - PROP-TR3	Max. Elevation	= 284.71 ft
Reservoir name	= Stanford Basin	Max. Storage	= 12,369 cuft

Storage Indication method used.



Hydrograph Report

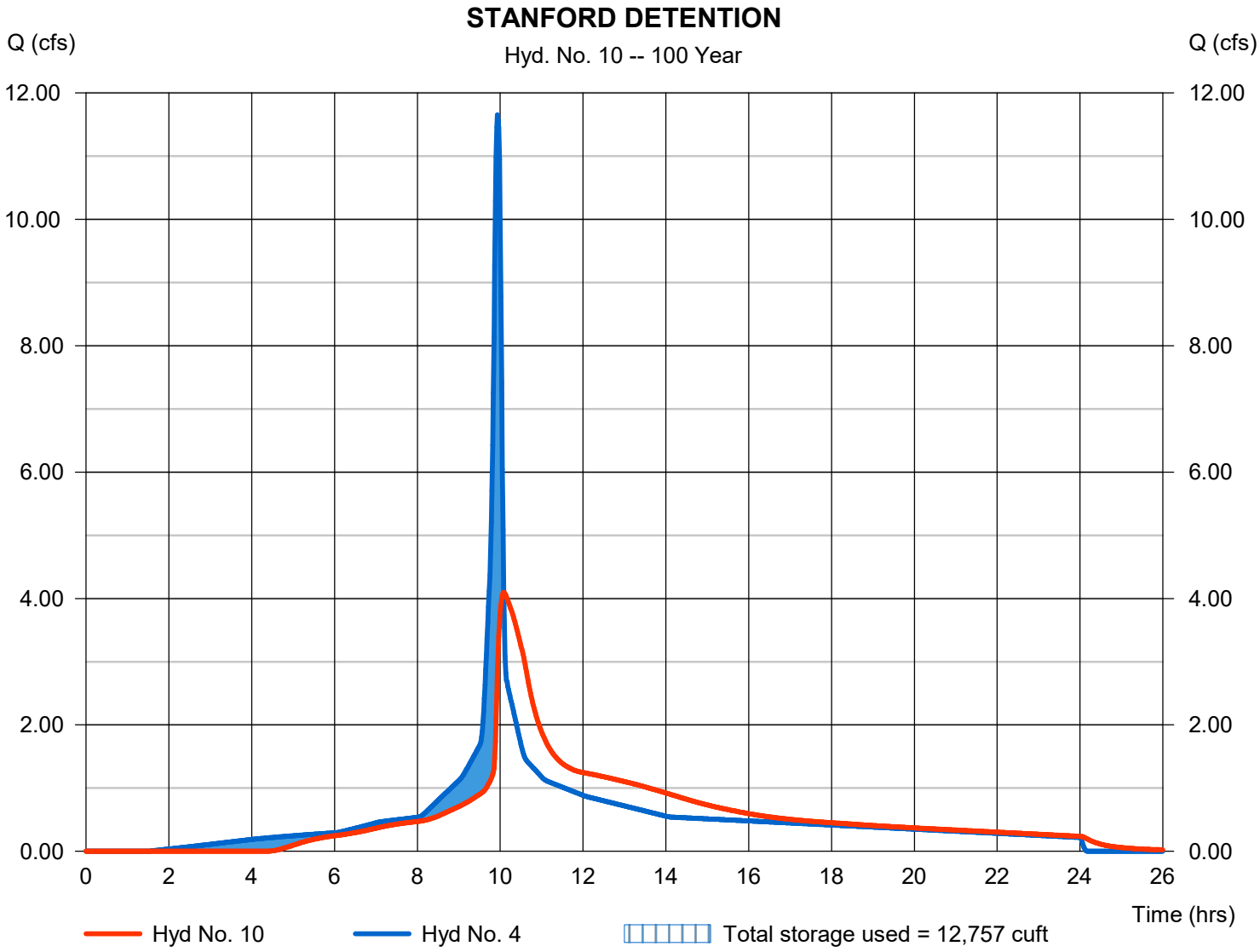
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 10

STANFORD DETENTION

Hydrograph type	= Reservoir	Peak discharge	= 4.096 cfs
Storm frequency	= 100 yrs	Time to peak	= 10.08 hrs
Time interval	= 1 min	Hyd. volume	= 51,047 cuft
Inflow hyd. No.	= 4 - PROP-TR3	Max. Elevation	= 284.79 ft
Reservoir name	= Stanford Basin	Max. Storage	= 12,757 cuft

Storage Indication method used.



Hydrograph Report

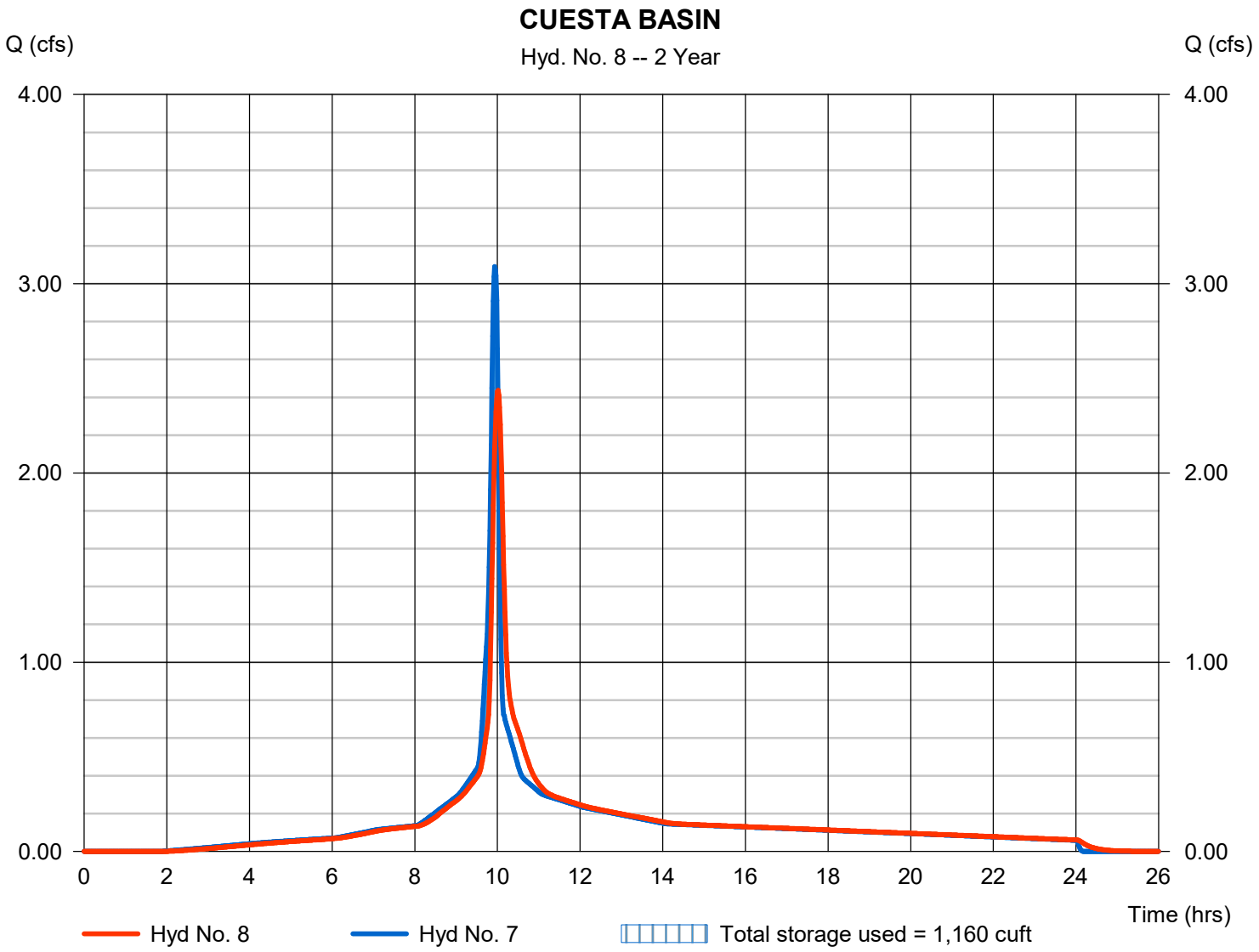
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 8

CUESTA BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	2.437 cfs
Storm frequency	=	2 yrs	Time to peak	=	10.02 hrs
Time interval	=	1 min	Hyd. volume	=	13,707 cuft
Inflow hyd. No.	=	7 - PROP-C2	Max. Elevation	=	102.16 ft
Reservoir name	=	Cuesta Basin	Max. Storage	=	1,160 cuft

Storage Indication method used.



Pond Report

Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Pond No. 2 - Cuesta Basin

Pond Data

Trapezoid -Bottom L x W = 70.0 x 5.0 ft, Side slope = 1.00:1, Bottom elev. = 100.00 ft, Depth = 15.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	100.00	350	0	0
1.50	101.50	584	698	698
3.00	103.00	836	1,063	1,761
4.50	104.50	1,106	1,454	3,215
6.00	106.00	1,394	1,873	5,088
7.50	107.50	1,700	2,318	7,406
9.00	109.00	2,024	2,791	10,197
10.50	110.50	2,366	3,290	13,487
12.00	112.00	2,726	3,817	17,304
13.50	113.50	3,104	4,370	21,674
15.00	115.00	3,500	4,951	26,625

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 48.00	6.00	8.00	0.00
Span (in)	= 48.00	4.00	6.00	0.00
No. Barrels	= 1	1	1	0
Invert El. (ft)	= 100.00	100.00	101.10	0.00
Length (ft)	= 0.00	0.00	0.00	0.00
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	Yes	No	No

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	100.00	0.00	0.00	0.00	---	---	---	---	---	---	---	0.000
1.50	698	101.50	0.93 ic	0.87 ic	0.43 ic	---	---	---	---	---	---	---	1.306
3.00	1,761	103.00	1.38 ic	1.30 ic	2.01 ic	---	---	---	---	---	---	---	3.307
4.50	3,215	104.50	1.65 ic	1.62 ic	2.81 ic	---	---	---	---	---	---	---	4.432
6.00	5,088	106.00	1.97 ic	1.89 ic	3.43 ic	---	---	---	---	---	---	---	5.319
7.50	7,406	107.50	2.14 ic	2.13 ic	3.95 ic	---	---	---	---	---	---	---	6.080
9.00	10,197	109.00	2.34 ic	2.34 ic	4.41 ic	---	---	---	---	---	---	---	6.753
10.50	13,487	110.50	2.53 ic	2.53 ic	4.83 ic	---	---	---	---	---	---	---	7.366
12.00	17,304	112.00	2.72 ic	2.72 ic	5.22 ic	---	---	---	---	---	---	---	7.933
13.50	21,674	113.50	2.92 ic	2.89 ic	5.58 ic	---	---	---	---	---	---	---	8.462
15.00	26,625	115.00	3.14 ic	3.05 ic	5.91 ic	---	---	---	---	---	---	---	8.958

Hydrograph Report

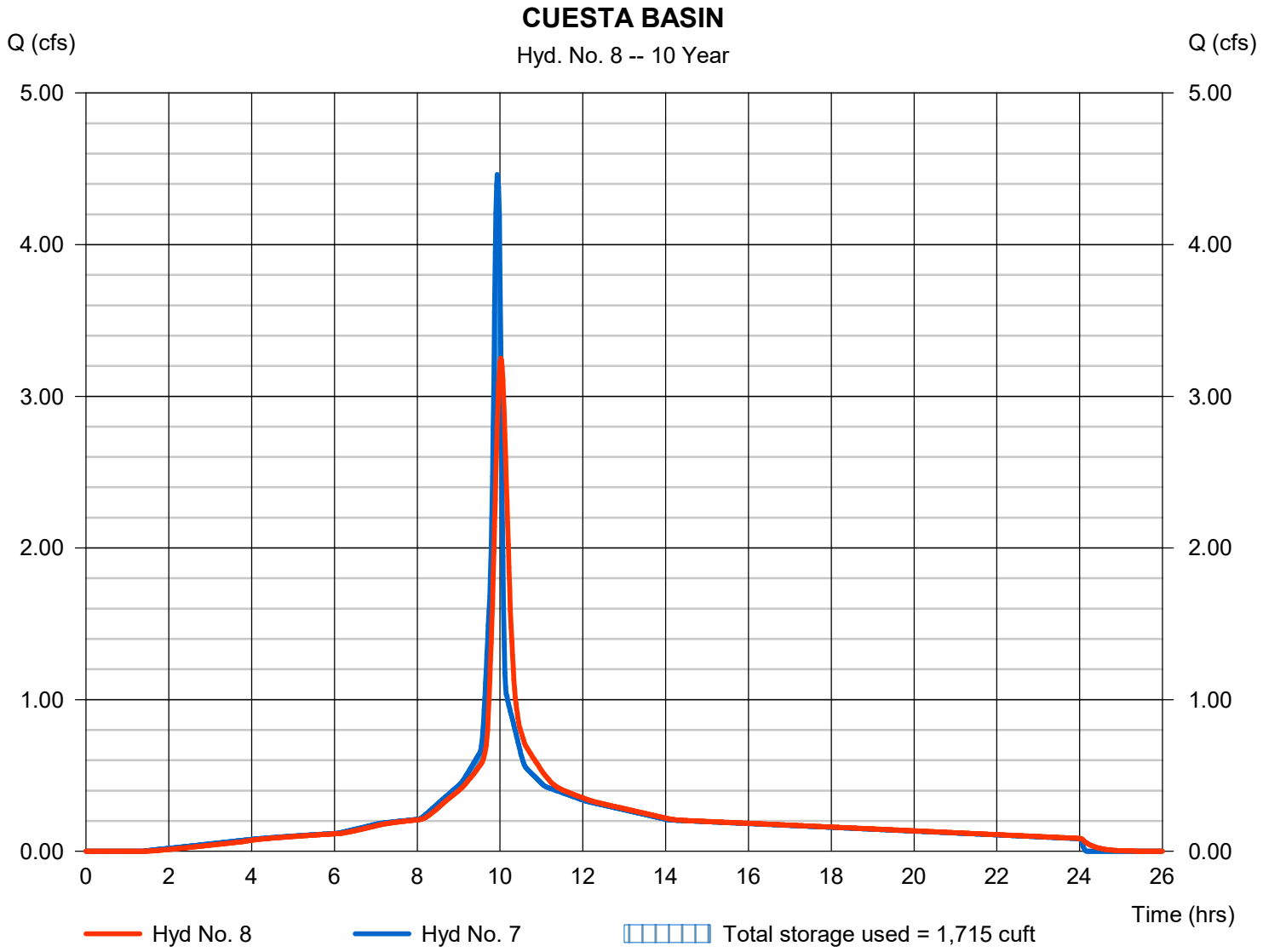
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 8

CUESTA BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	3.250 cfs
Storm frequency	=	10 yrs	Time to peak	=	10.02 hrs
Time interval	=	1 min	Hyd. volume	=	20,087 cuft
Inflow hyd. No.	=	7 - PROP-C2	Max. Elevation	=	102.94 ft
Reservoir name	=	Cuesta Basin	Max. Storage	=	1,715 cuft

Storage Indication method used.



Hydrograph Report

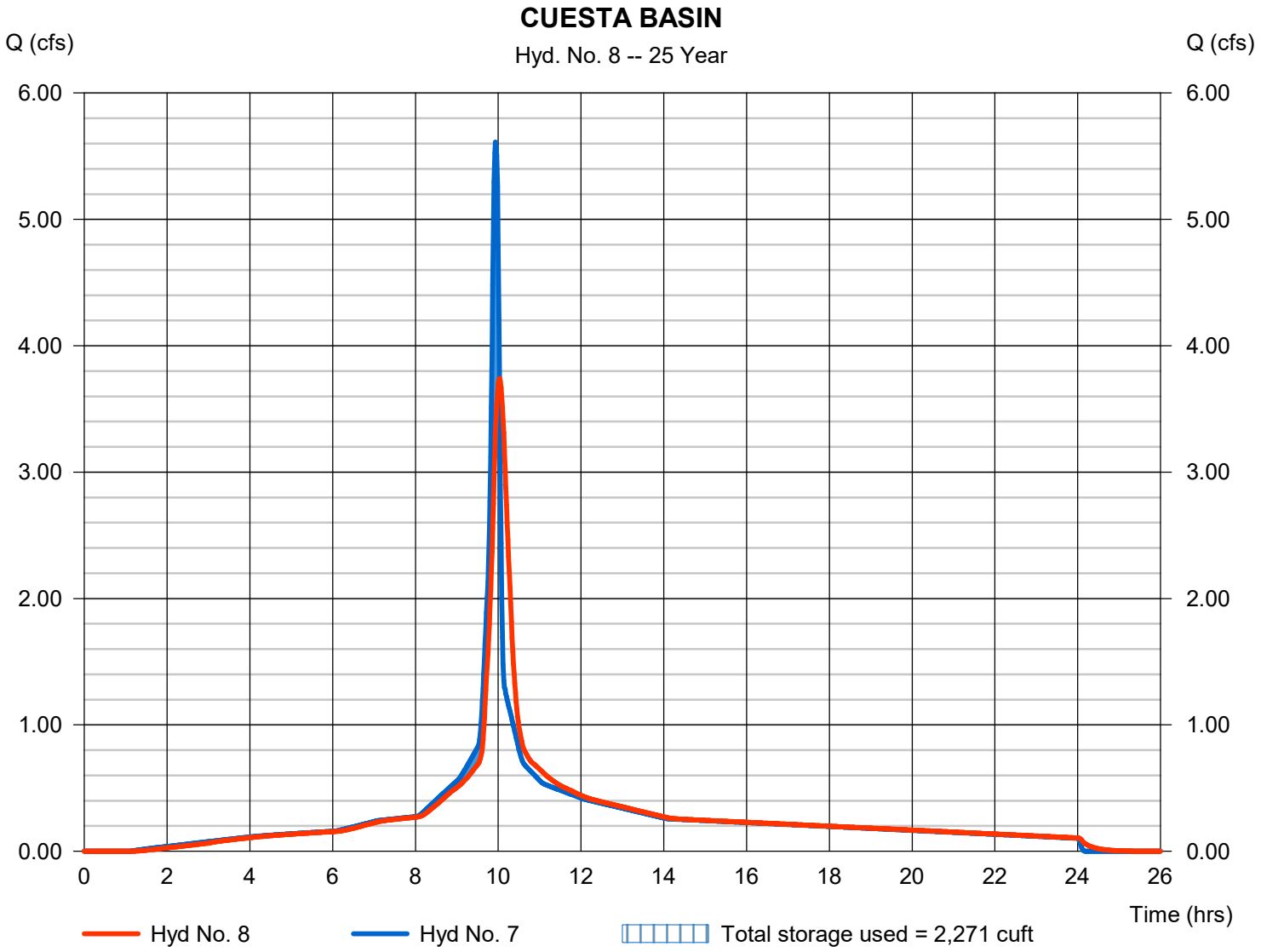
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 8

CUESTA BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	3.741 cfs
Storm frequency	=	25 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	25,516 cuft
Inflow hyd. No.	=	7 - PROP-C2	Max. Elevation	=	103.53 ft
Reservoir name	=	Cuesta Basin	Max. Storage	=	2,271 cuft

Storage Indication method used.



Hydrograph Report

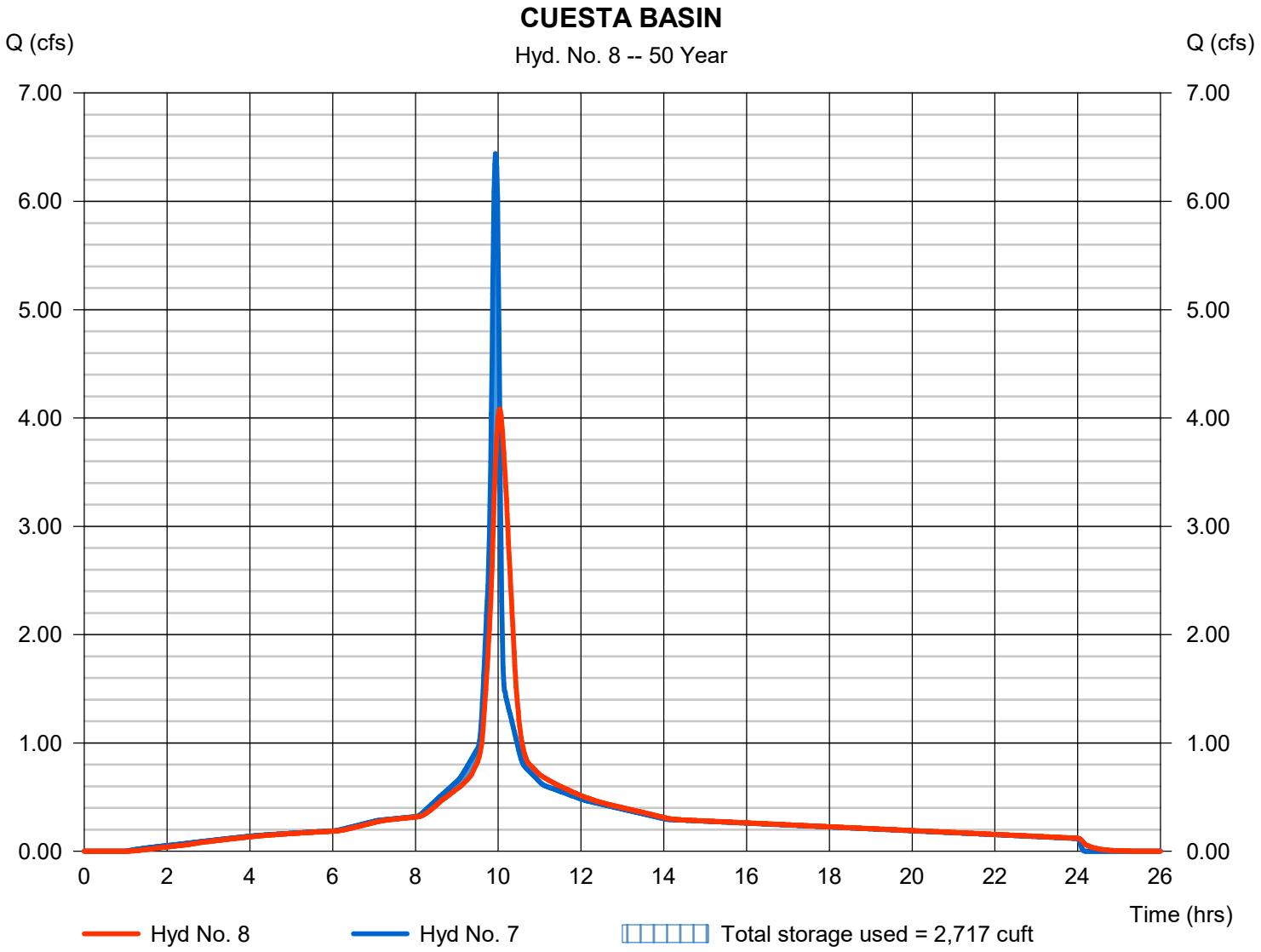
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 8

CUESTA BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	4.083 cfs
Storm frequency	=	50 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	29,474 cuft
Inflow hyd. No.	=	7 - PROP-C2	Max. Elevation	=	103.99 ft
Reservoir name	=	Cuesta Basin	Max. Storage	=	2,717 cuft

Storage Indication method used.



Hydrograph Report

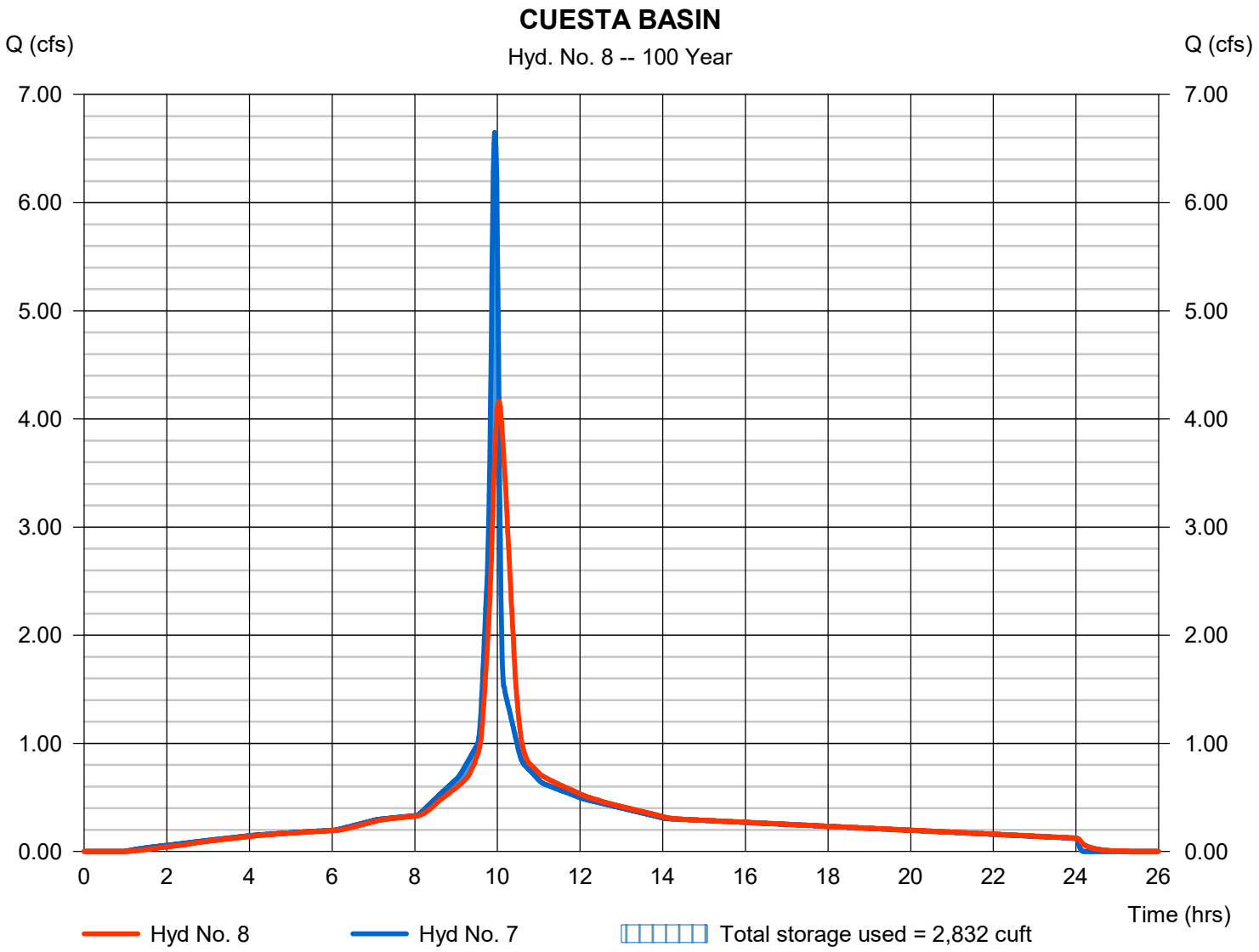
Hydraflow Hydrographs Extension for AutoCAD® Civil 3D® 2016 by Autodesk, Inc. v11 Wednesday, 03 / 11 / 2020

Hyd. No. 8

CUESTA BASIN

Hydrograph type	=	Reservoir	Peak discharge	=	4.165 cfs
Storm frequency	=	100 yrs	Time to peak	=	10.03 hrs
Time interval	=	1 min	Hyd. volume	=	30,464 cuft
Inflow hyd. No.	=	7 - PROP-C2	Max. Elevation	=	104.11 ft
Reservoir name	=	Cuesta Basin	Max. Storage	=	2,832 cuft

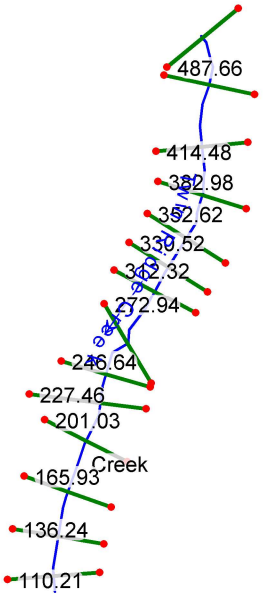
Storage Indication method used.

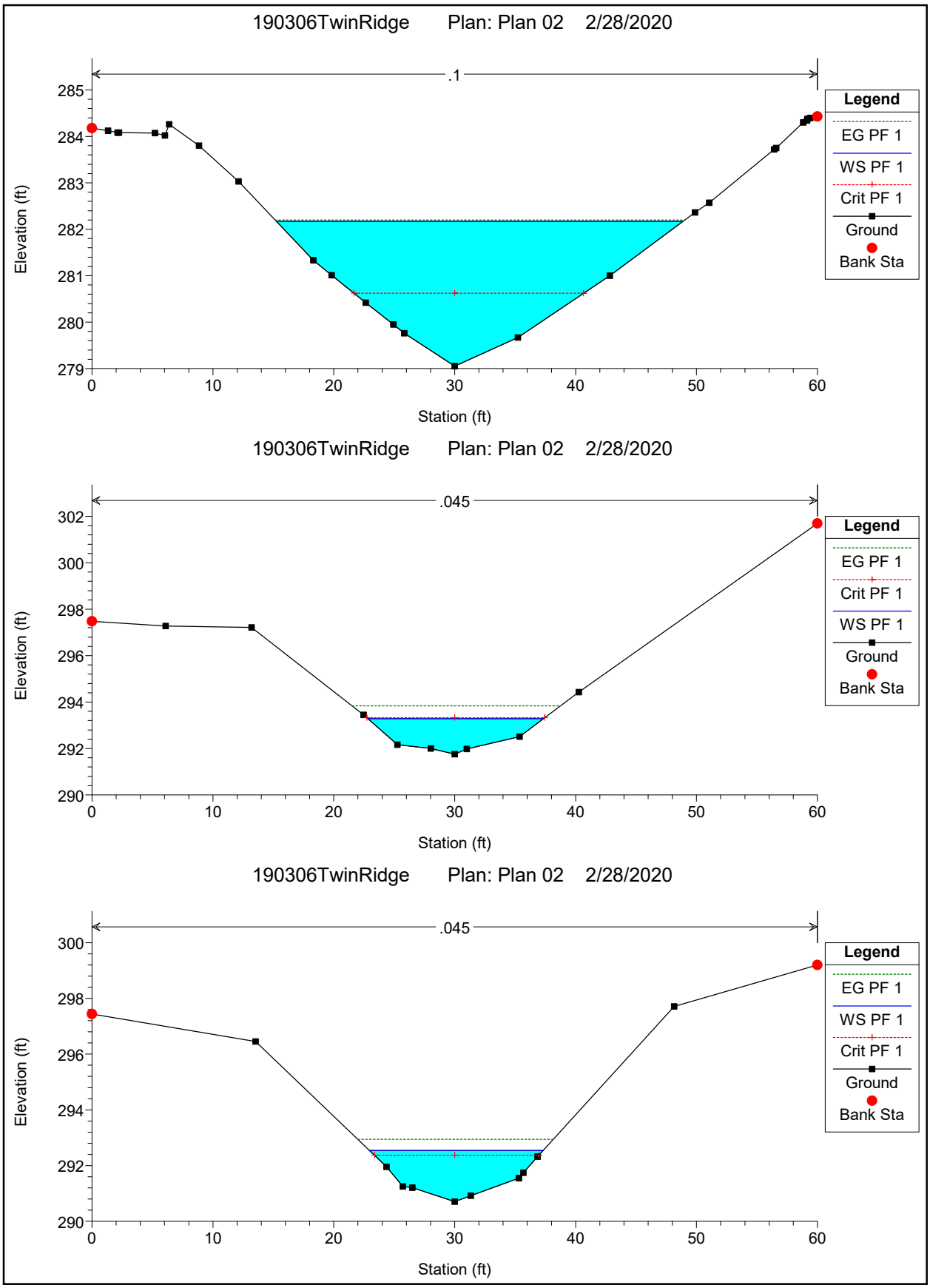


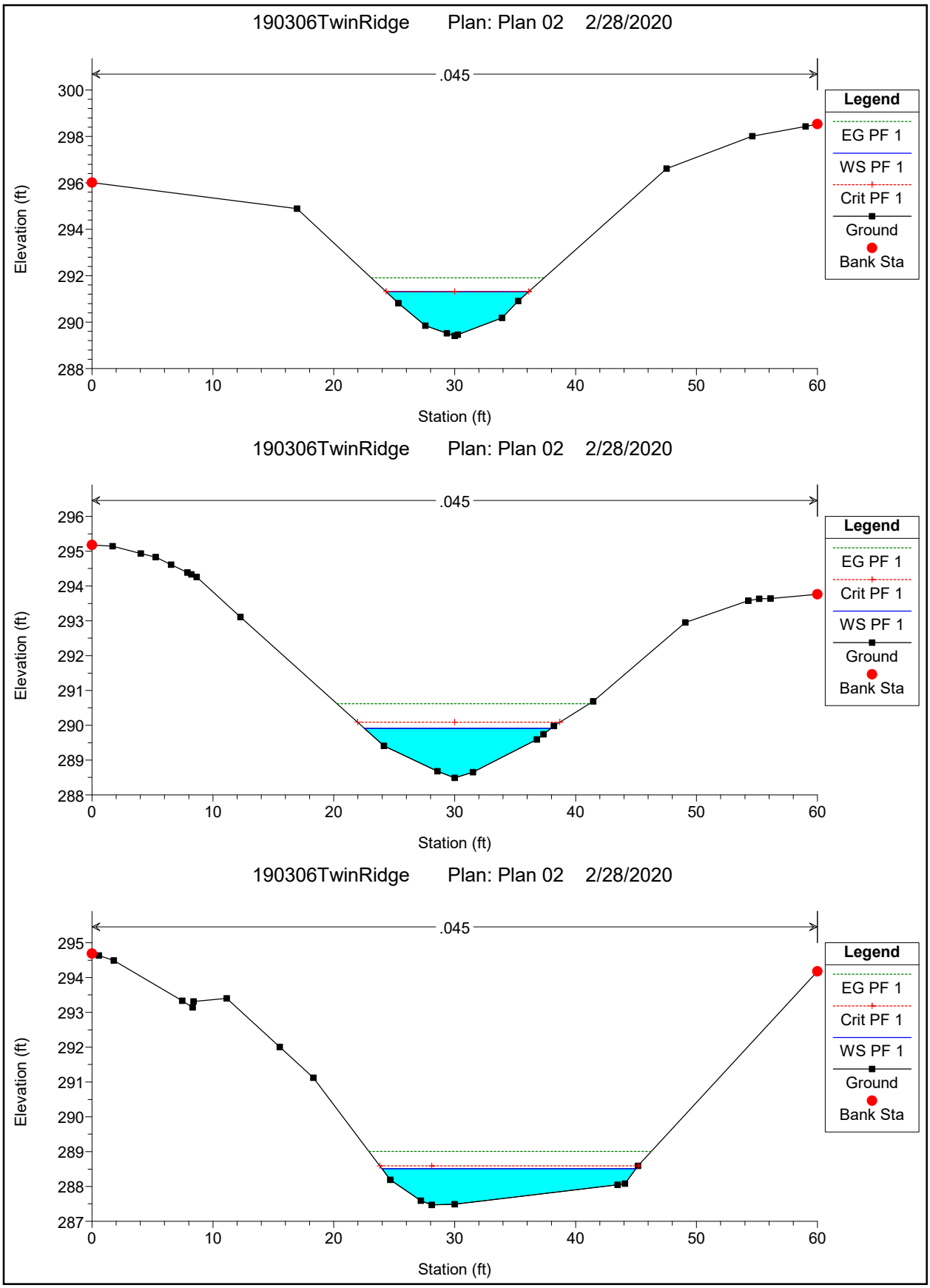
Appendix D

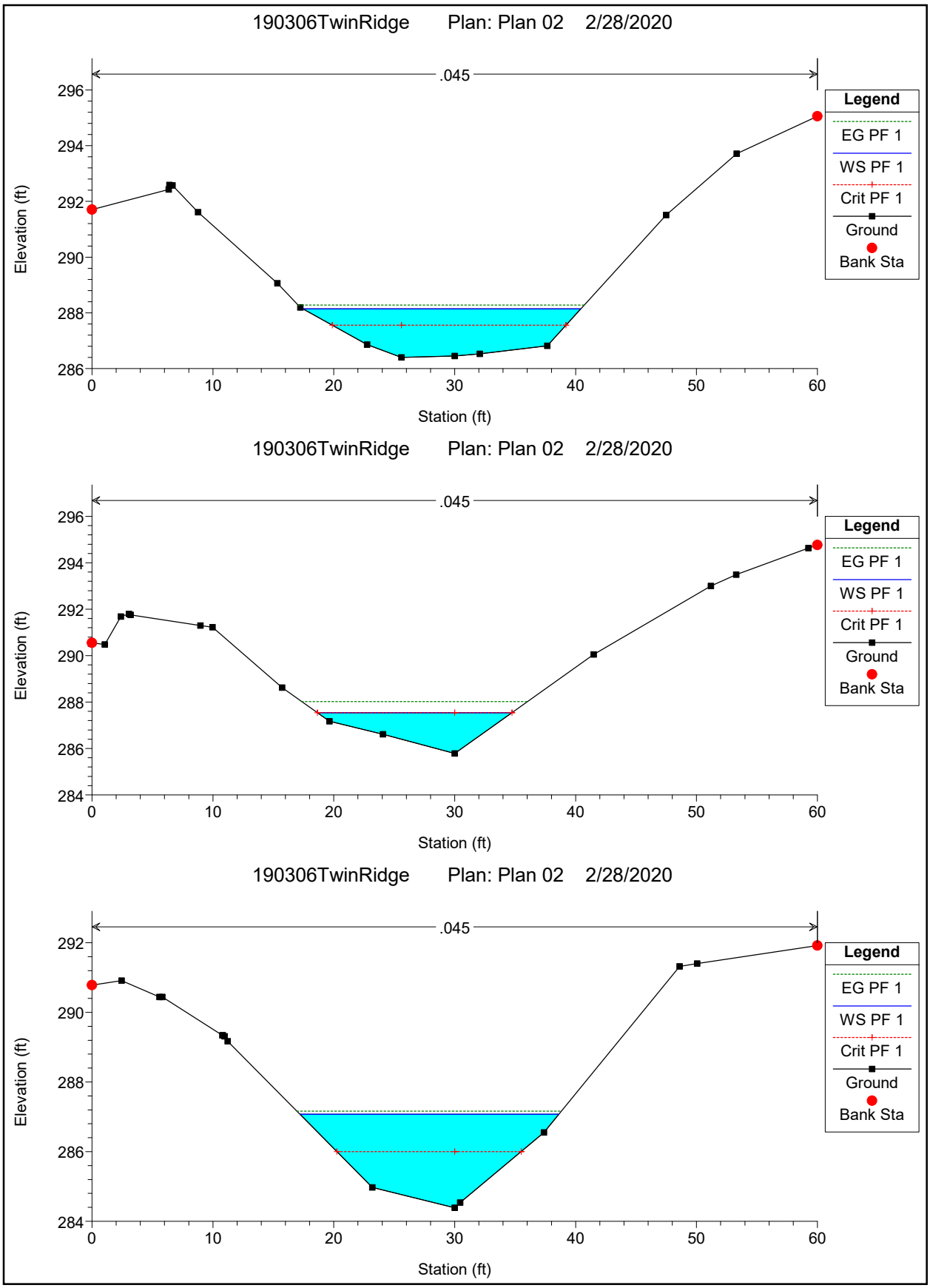
Floodplain Analysis

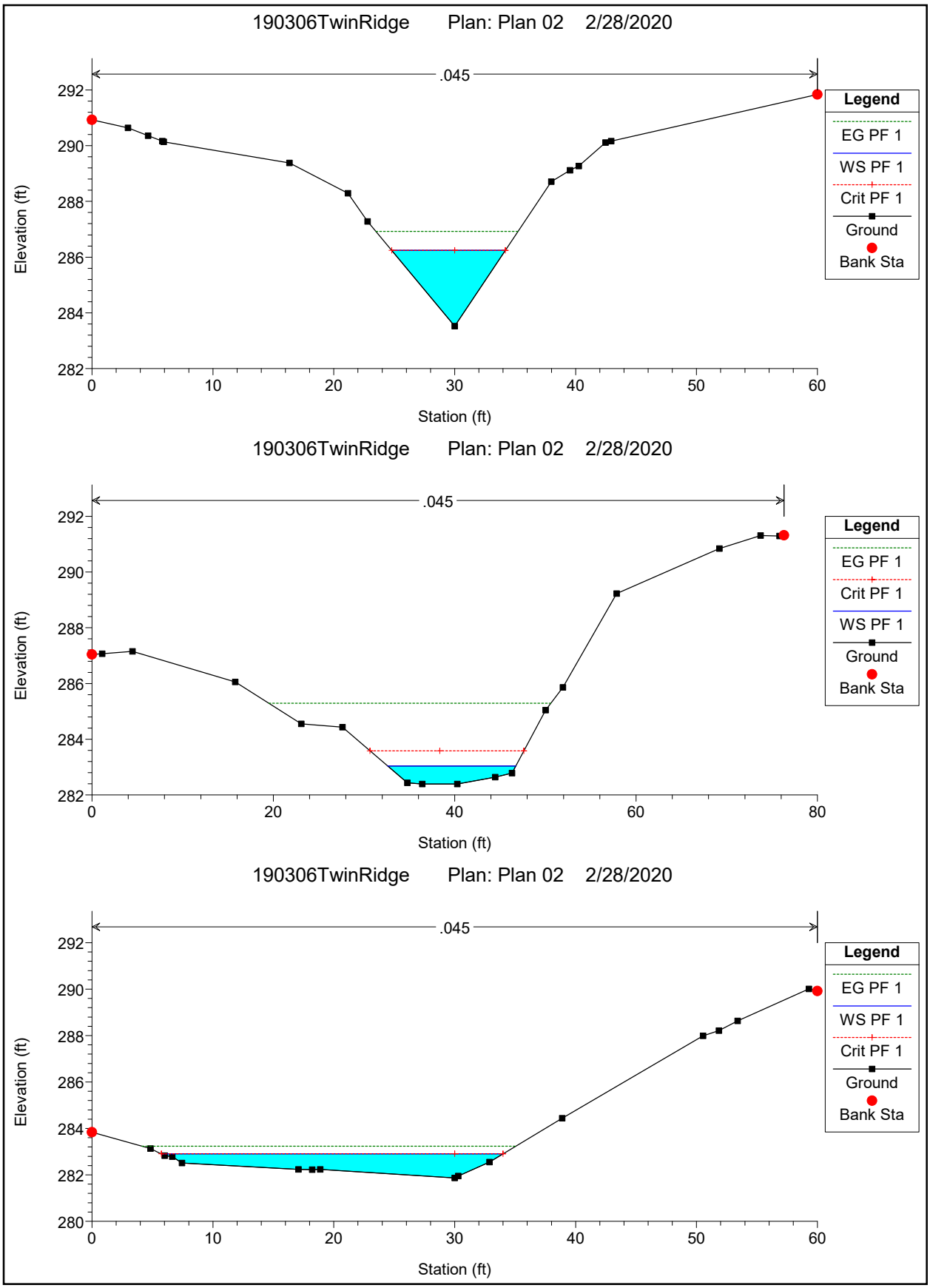
1. HEC-RAS Output

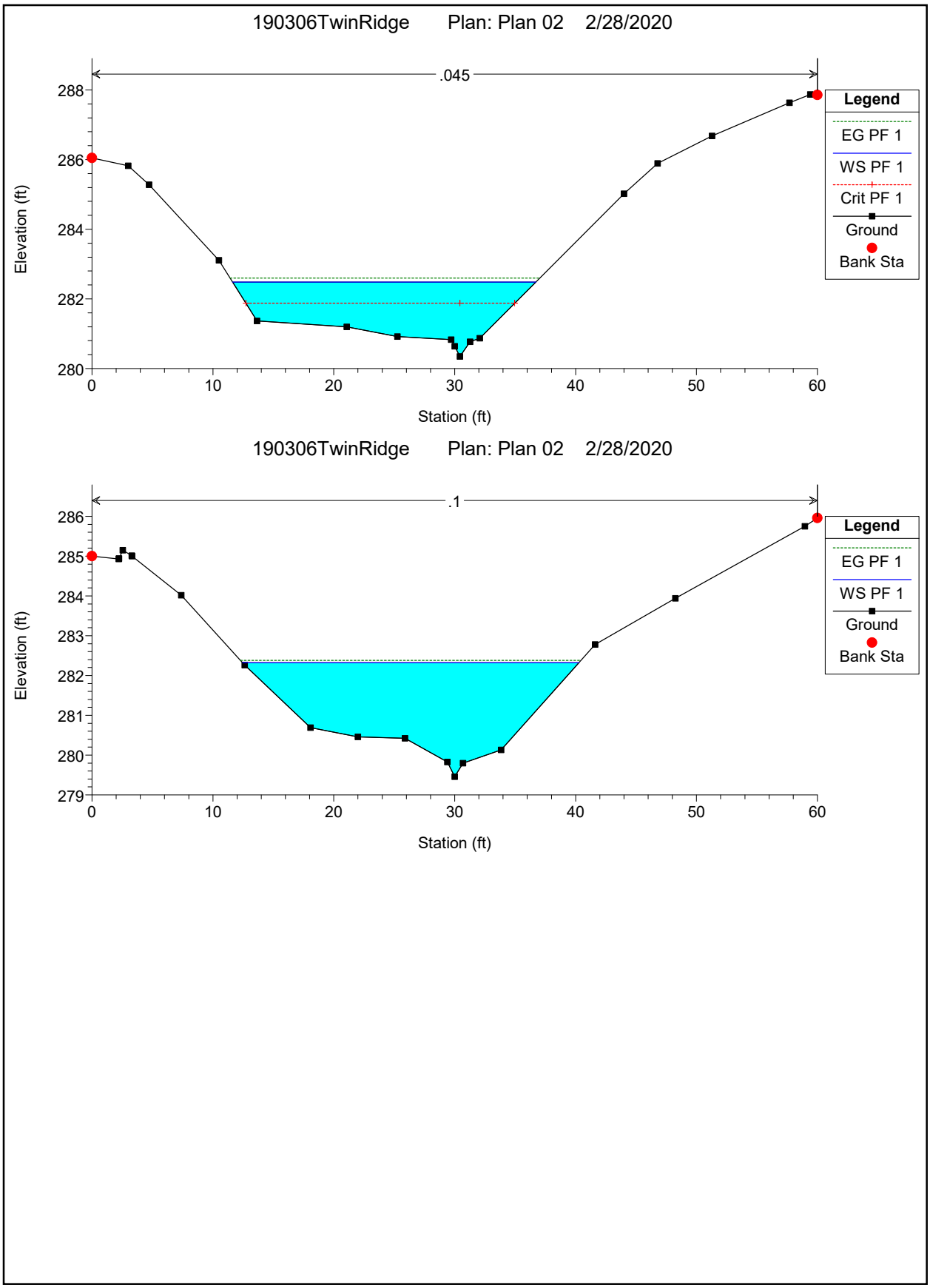

487.66
414.48
382.98
352.62
330.52
302.32
272.94
246.64
227.46
201.03
Creek
165.93
136.24
110.21

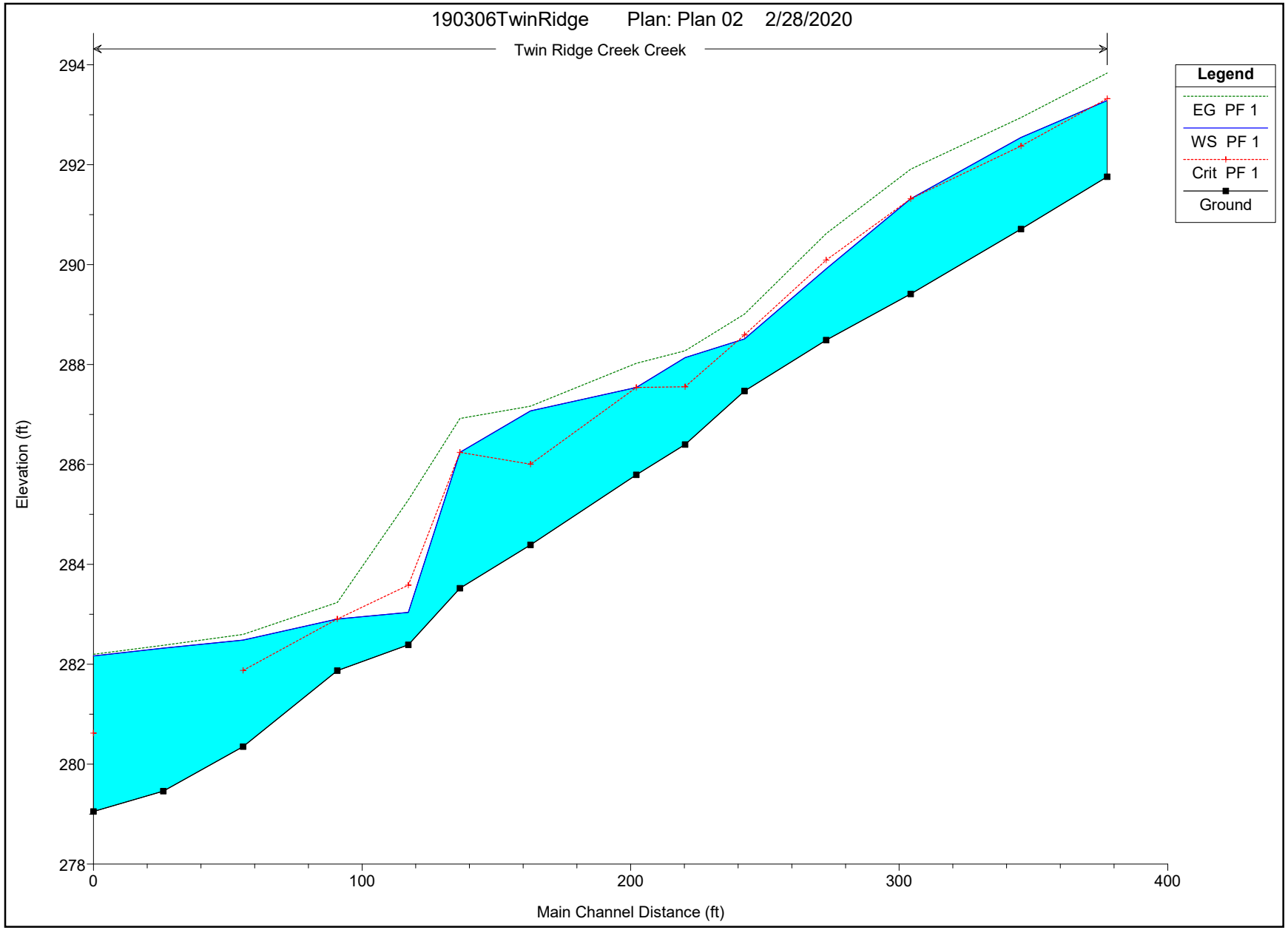

190306TwinRidge Plan: Plan 02 2/28/2020
.1
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta


190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
Crit PF 1
WS PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta


190306TwinRidge Plan: Plan 02 2/28/2020
.045
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
190306TwinRidge Plan: Plan 02 2/28/2020
.1
Elevation (ft)
Station (ft)
Legend
EG PF 1
WS PF 1
Ground
Bank Sta


190306TwinRidge Plan: Plan 02 2/28/2020
Twin Ridge Creek Creek
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
294
292
290
288
286
284
282
280
278
0
100
200
300
400
Main Channel Distance (ft)

HEC-RAS Plan: Plan 02 River: Twin Ridge Creek Reach: Creek Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Creek	487.66	PF 1	84.60	291.76	293.28	293.32	293.84	0.035008	5.96	14.20	14.53	1.06
Creek	455.52	PF 1	84.60	290.71	292.55	292.37	292.94	0.020119	5.04	16.77	14.37	0.82
Creek	414.48	PF 1	84.60	289.41	291.32	291.32	291.91	0.030950	6.17	13.71	11.81	1.01
Creek	382.98	PF 1	84.60	288.49	289.91	290.09	290.62	0.056044	6.73	12.57	15.44	1.32
Creek	352.62	PF 1	84.60	287.47	288.51	288.59	289.01	0.046733	5.65	14.98	21.01	1.18
Creek	330.52	PF 1	84.60	286.40	288.14	287.55	288.28	0.006127	2.95	28.66	22.98	0.47
Creek	312.32	PF 1	84.60	285.79	287.54	287.54	288.02	0.031972	5.57	15.19	16.10	1.01
Creek	272.94	PF 1	84.60	284.39	287.07	286.00	287.16	0.003011	2.44	34.69	21.41	0.34
Creek	246.64	PF 1	84.60	283.52	286.24	286.24	286.92	0.032390	6.62	12.78	9.40	1.00
Creek	227.46	PF 1	84.60	282.39	283.04	283.58	285.29	0.343616	12.05	7.02	14.14	3.01
Creek	201.03	PF 1	84.60	281.87	282.90	282.90	283.24	0.035323	4.62	18.30	28.27	1.01
Creek	165.93	PF 1	84.60	280.35	282.48	281.88	282.60	0.005250	2.71	31.22	25.08	0.43
Creek	136.24	PF 1	84.60	279.46	282.32		282.38	0.009115	1.90	44.50	27.83	0.27
Creek	110.21	PF 1	84.60	279.05	282.17	280.62	282.20	0.005008	1.48	57.15	33.62	0.20

HEC-RAS HEC-RAS 5.0.7 March 2019
U.S. Army Corps of Engineers
Hydrologic Engineering Center
609 Second Street
Davis, California

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

PROJECT DATA
Project Title: 190306TwinRidge
Project File : 190306TwinRidge.prj
Run Date and Time: 2/28/2020 2:01:08 PM

Project in English units

PLAN DATA

Plan Title: Plan 02
Plan File : f:\proj\2019\190306\3 Project Design\Civil\Design Calcs\HECRAS\190306TwinRidge.p02

Geometry Title: Geom 01
Geometry File : f:\proj\2019\190306\3 Project Design\Civil\Design Calcs\HECRAS\190306TwinRidge.g01

Flow Title : Flow 01
Flow File : f:\proj\2019\190306\3 Project Design\Civil\Design Calcs\HECRAS\190306TwinRidge.f01

Plan Summary Information:

Number of:	Cross Sections	= 14	Multiple Openings	=	0
	Culverts	= 0	Inline Structures	=	0
	Bridges	= 0	Lateral Structures	=	0

Computational Information
Water surface calculation tolerance = 0.01
Critical depth calculation tolerance = 0.01

```
    Maximum number of iterations         =  20
    Maximum difference tolerance         =  0.3
    Flow tolerance factor                =  0.001

Computation Options
    Critical depth computed only where necessary
    Conveyance Calculation Method: At breaks in n values only
    Friction Slope Method:         Average Conveyance
    Computational Flow Regime:     Mixed Flow



FLOW DATA

Flow Title: Flow 01
Flow File : f:\proj\2019\190306\3 Project Design\Civil\Design
Calcs\HECRAS\190306TwinRidge.f01

Flow Data (cfs)

  River           Reach           RS                  PF 1
  Twin Ridge CreekCreek           487.66              84.6


Boundary Conditions


  River           Reach           Profile                       Upstream
    Downstream


  Twin Ridge CreekCreek           PF 1                        Normal S = 0.035
 Normal S = 0.005




GEOMETRY DATA

Geometry Title: Geom 01
Geometry File : f:\proj\2019\190306\3 Project Design\Civil\Design
Calcs\HECRAS\190306TwinRidge.g01

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 487.66
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```
INPUT
Description:
Station Elevation Data    num=      11
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  297.48    6.09  297.28   13.19  297.21   22.46  293.45   25.26  292.16
   28.03     292      30  291.76   30.99  291.98   35.37  292.51   40.27  294.43
      60  301.69

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            32.14   32.14   32.14             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 455.52

INPUT
Description:
Station Elevation Data    num=      12
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  297.44   13.54  296.45   24.37  291.96   25.72  291.25    26.5  291.21
      30  290.71   31.33  290.92   35.31  291.55   35.68  291.74   36.86  292.32
   48.16  297.71      60   299.2

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            41.04   41.04   41.04             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 414.48

INPUT
Description:
Station Elevation Data    num=      13
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  296.01   16.96  294.89   25.34  290.82   27.58  289.85   29.36  289.52
      30  289.41   30.25  289.46   33.91  290.18   35.25  290.91   47.52  296.61
   54.61  298.01   59.03  298.43      60  298.53
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Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60             31.5    31.5    31.5             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 382.98

INPUT
Description:
Station Elevation Data    num=      22
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  295.18     1.7  295.14    4.03  294.93    5.27  294.83    6.55  294.61
    7.89  294.39    8.23  294.33    8.66  294.26   12.28  293.11   24.14  289.41
   28.58  288.68      30  288.49    31.5  288.65   36.79  289.59   37.35  289.74
    38.2  289.98   41.45  290.69   49.07  292.95   54.28  293.58   55.18  293.63
   56.12  293.64      60  293.76

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            30.36   30.36   30.36             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 352.62

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  294.69     .57  294.63     1.8  294.49    7.47  293.33    8.32  293.14
    8.41  293.31   11.14   293.4   15.52  292.01   18.31  291.12   24.68  288.19
    27.2  287.59   28.11  287.47      30  287.49   43.47  288.05   44.08  288.08
   45.16  288.59      60  294.18

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045
```

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Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60             22.1    22.1    22.1             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 330.52

INPUT
Description:
Station Elevation Data    num=      15
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  291.71    6.34  292.43    6.41  292.59    6.65  292.57    8.78  291.61
   15.33  289.06   17.23  288.19   22.76  286.86    25.6   286.4      30  286.45
   32.07  286.53   37.66  286.82   47.48  291.51   53.32  293.71      60  295.06

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60             18.2    18.2    18.2             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 312.32

INPUT
Description:
Station Elevation Data    num=      16
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  290.55    1.06  290.48    2.38  291.68    3.05   291.8    3.19  291.76
    8.96   291.3    9.96  291.22   15.72  288.62   19.64  287.17   24.07  286.61
      30  285.79    41.5  290.05   51.19     293   53.29  293.49   59.25  294.63
      60  294.77

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            39.38   39.38   39.38             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
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REACH: Creek RS: 272.94

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	290.78	2.44	290.91	5.59	290.44	5.82	290.44	10.79	289.34
10.81	289.34	10.96	289.31	11.23	289.17	23.19	284.97	30	284.39
30.46	284.54	37.39	286.55	48.61	291.32	50.06	291.4	60	291.92

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	0	.045	60	.045

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	60	26.3	26.3	.1	.3

CROSS SECTION

RIVER: Twin Ridge Creek
REACH: Creek RS: 246.64

INPUT
Description:
Station Elevation Data num= 15

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	290.93	2.97	290.64	4.65	290.36	5.82	290.16	5.94	290.14
16.34	289.38	21.17	288.29	22.79	287.28	30	283.52	37.98	288.71
39.54	289.12	40.26	289.27	42.47	290.11	42.95	290.16	60	291.84

Manning's n Values num= 3

Sta	n Val	Sta	n Val	Sta	n Val
0	.045	0	.045	60	.045

Bank Sta: Left	Right	Lengths: Left Channel	Right	Coeff Contr.	Expan.
0	60	19.18	19.18	.1	.3

CROSS SECTION

RIVER: Twin Ridge Creek
REACH: Creek RS: 227.46

INPUT
Description:
Station Elevation Data num= 18

Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev	Sta	Elev
0	287.04	1.13	287.07	4.47	287.15	15.8	286.06	23.08	284.55
27.62	284.43	34.77	282.43	36.43	282.39	40.28	282.39	44.47	282.64

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   46.32  282.78   50.02  285.04   51.94  285.86   57.87  289.23   69.19  290.84
   73.73  291.31   75.81  291.29   76.32  291.32

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045   76.32    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0   76.32            26.43   26.43   26.43             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 201.03

INPUT
Description:
Station Elevation Data    num=      17
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  283.84    4.84  283.13    6.02  282.83    6.63  282.79    7.44  282.51
   17.08  282.23   18.21  282.22   18.88  282.23      30  281.87    30.3  281.95
   32.88  282.55   38.89  284.44   50.54  287.99   51.85  288.21    53.4  288.63
    59.3  290.01      60  289.92

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            35.1    35.1    35.1             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 165.93

INPUT
Description:
Station Elevation Data    num=      18
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  286.05    2.99  285.82    4.71  285.28    10.5  283.11   13.65  281.37
   21.07   281.2   25.26  280.92   29.71  280.83      30  280.64   30.44  280.35
   31.28  280.77   32.07  280.87      44  285.02   46.79  285.89   51.29  286.68
   57.68  287.63   59.41  287.87      60  287.86

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0    .045       0    .045      60    .045
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Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            29.69   29.69   29.69             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 136.24

INPUT
Description:
Station Elevation Data    num=      19
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0     285    2.22  284.93    2.23  284.94    2.55  285.15    3.29  285.01
    3.31     285    7.39  284.02   12.64  282.26   18.07  280.69   21.99  280.46
   25.88  280.42   29.39  279.83      30  279.46   30.68   279.8   33.84  280.13
   41.62  282.78   48.25  283.94   58.96  285.75      60  285.96

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1       0      .1      60      .1

Bank Sta: Left   Right    Lengths: Left Channel   Right     Coeff Contr.   Expan.
             0      60            26.03   26.03   26.03             .1       .3

CROSS SECTION


RIVER: Twin Ridge Creek
REACH: Creek              RS: 110.21

INPUT
Description:
Station Elevation Data    num=      26
     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev     Sta    Elev
       0  284.18    1.34  284.12    2.11  284.08    2.23  284.08    5.21  284.07
    6.03  284.02    6.38  284.26    8.85   283.8   12.13  283.03    18.3  281.33
   19.82  281.01   22.64  280.42   24.93  279.95   25.82  279.76      30  279.05
   35.23  279.67   42.82     281   49.88  282.36   51.05  282.57   56.41  283.72
   56.59  283.75   58.83   284.3   59.13  284.34   59.17  284.38   59.42   284.4
      60  284.43

Manning's n Values        num=       3
     Sta   n Val     Sta   n Val     Sta   n Val
       0      .1       0      .1      60      .1

Bank Sta: Left   Right    Coeff Contr.   Expan.
             0      60             .1       .3
```

SUMMARY OF MANNING'S N VALUES

River:Twin Ridge Creek

Reach	River Sta.	n1	n2	n3
Creek	487.66	.045	.045	.045
Creek	455.52	.045	.045	.045
Creek	414.48	.045	.045	.045
Creek	382.98	.045	.045	.045
Creek	352.62	.045	.045	.045
Creek	330.52	.045	.045	.045
Creek	312.32	.045	.045	.045
Creek	272.94	.045	.045	.045
Creek	246.64	.045	.045	.045
Creek	227.46	.045	.045	.045
Creek	201.03	.045	.045	.045
Creek	165.93	.045	.045	.045
Creek	136.24	.1	.1	.1
Creek	110.21	.1	.1	.1

SUMMARY OF REACH LENGTHS

River: Twin Ridge Creek

Reach	River Sta.	Left	Channel	Right
Creek	487.66	32.14	32.14	32.14
Creek	455.52	41.04	41.04	41.04
Creek	414.48	31.5	31.5	31.5
Creek	382.98	30.36	30.36	30.36
Creek	352.62	22.1	22.1	22.1
Creek	330.52	18.2	18.2	18.2
Creek	312.32	39.38	39.38	39.38
Creek	272.94	26.3	26.3	26.3
Creek	246.64	19.18	19.18	19.18
Creek	227.46	26.43	26.43	26.43
Creek	201.03	35.1	35.1	35.1
Creek	165.93	29.69	29.69	29.69
Creek	136.24	26.03	26.03	26.03
Creek	110.21			

SUMMARY OF CONTRACTION AND EXPANSION COEFFICIENTS
River: Twin Ridge Creek

Reach	River Sta.	Contr.	Expan.
Creek	487.66	.1	.3
Creek	455.52	.1	.3
Creek	414.48	.1	.3
Creek	382.98	.1	.3
Creek	352.62	.1	.3
Creek	330.52	.1	.3
Creek	312.32	.1	.3
Creek	272.94	.1	.3
Creek	246.64	.1	.3
Creek	227.46	.1	.3
Creek	201.03	.1	.3
Creek	165.93	.1	.3
Creek	136.24	.1	.3
Creek	110.21	.1	.3