March 5, 2021

Craig Dossey
El Paso County
Planning and Community Development
2880 International Circle, Suite 110
Colorado Springs, CO 80910

Re: ***Final Drainage Report Revision 3, Cherokee WRF Total Dissolved Solids Reduction Facility***

Dear Mr. Dossey:

On behalf of the Cherokee Metropolitan District, Burns & McDonnell Engineering Company Inc. (Burns & McDonnell) is submitting Revision 3 of this Final Drainage Report for the Cherokee Water Reclamation Facility (WRF) Total Dissolved Solids (TDS) Reduction Project. It has been prepared as a submittal in accordance with the list of required documents provided by the El Paso County Planning and Community Development Department during the Pre-Application meeting for this project.

This Final Drainage Report has been prepared to present proposed stormwater management improvements associated with the development of the TDS Reduction Facility, as it alters the current drainage patterns and imperviousness of the stie. Standards presented in the El Paso County Drainage Criteria Manual, Volumes 1 and 2 were adhered to in this Report and its analysis.

Closing
Please feel free to contact either of the undersigned should you have any questions. Nick can be reached at 720-551-9941 or ntessitore@burnsmcd.com. Sarah can be reached at 720-866-7543 or sjforeman@burnsmcd.com.

Sincerely,

Sarah Foreman, EIT
Staff Environmental Engineer

Nick Tessitore, PE
Associate Civil Engineer

Attachments:
Attachment 1 – TDS Reduction Project Final Drainage Report, Revision 3

Cherokee Metropolitan District
TDS Reduction Project

Final Drainage Report

Cherokee Metropolitan District

Cherokee TDS Reduction
Project No. 119416
Document No. LP-PLAT-RT-0002

Revision 3
3/5/2021

PCD Filing No.: PPR-20-044

Cherokee Metropolitan District
TDS Reduction Project

Final Drainage Report

prepared for

Cherokee Metropolitan District
Cherokee TDS Reduction
El Paso, Colorado

Project No. 119416

Revision 3
3/5/2021

prepared by

Burns & McDonnell Engineering Company, Inc.
Denver, CO

INDEX AND CERTIFICATION

Cherokee Metropolitan District
TDS Reduction Project

Final Drainage Report

Project No. 119416

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Certification

I hereby certify, as a Professional Engineer in the state of Colorado, that the information in this document was assembled under my direct personal charge. This report is not intended or represented to be suitable for reuse by the Cherokee Metropolitan District or others without specific verification or adaptation by the Engineer.

Nick Tessitore, P.E. Colorado

Date: December 11, 2020

El Paso County Drainage Statements

Engineer's Statement

The attached drainage plan and report were prepared under my direction and supervision and are correct to the best of my knowledge and belief. Said drainage report has been prepared according to the criteria established by the County for drainage reports and said report is in conformity with the master plan of the drainage basin. I accept responsibility for any liability caused by any negligent acts, errors or omissions on my part in preparing this report.

Name

Seal

Developer's Statement

I, the developer have read and will comply with all of the requirements specified in this drainage report and plan.

Garney Construction

Business Name

By: David Staats

Title: Project Manager

Address: 7911 Shaffer Parkway

Littleton, CO 80127

El Paso County Statement

Filed in accordance with Section 51.1 of the El Paso Land Development Code, as amended.

APPROVED
Engineering Department
04/14/2021 2:21:48 PM
dsdnijkamp
EPC Planning & Community Development Department

ECM Administrator

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LIST OF ABBREVIATIONS

Abbreviation	Term/Phrase/Name
BMcD	Burns & McDonnell
CDPHE	Colorado Department of Public Health and Environment
Cherokee	Cherokee Metropolitan District
CMP	Corrugated Metal Pipe
cfs	Cubic feet per second
EURV	Excess Urban Runoff Volume
FDR	Final Drainage Report
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Association
fps	feet per second
ft	feet
HEC	Hydraulic Engineering Circular
MHFD	Mile High Flood District
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
PDR	Process Design Report
SCS	Soil Conservation Service
TDS	Total Dissolved Solids
WQCD	Water Quality Control Division
WQCV	Water Quality Capture Volume
WRF	Water Reclamation Facility

1.0 GENERAL LOCATION AND DESCRIPTION

This Final Drainage Report (FDR) is being prepared as part of the required submittal documents to El Paso County for the Total Dissolved Solids (TDS) Reduction Facility construction at the Cherokee Metropolitan District (Cherokee) Water Reclamation Facility (WRF). A Preliminary Drainage Report was not developed for this project because of the reduced timeline.

1.1 Site Location

The Cherokee WRF is located at the northeast corner of Milne Road and Drennan Road in El Paso County, Colorado. More accurately, it is located within the southwest ¼ of Section 8, Township 35 South, Range 63 West.

The Cherokee WRF is surrounded by residential properties along the northern and eastern boundaries and agricultural grazing land along the southern and western boundaries. All surrounding residential properties are vacant except for one single family residence at the northwest corner of the site. There are no major drainageways or storm drainage facilities adjacent to the site.

1.2 Description of Property

1.2.1 Existing Site

The Cherokee WRF property encompasses an entire quarter section and is approximately 160 acres in area. Vegetative cover consists of native grasses. The site includes the existing WRF, which consists of various water treatment buildings, basins, digestors, and related infrastructure. Several existing utility lines are present at the site, including sanitary sewer, electrical, and telephone. All existing infrastructure at the site is presented on the Existing Drainage Basin Map in Appendix F.

1.2.2 Existing Site Drainage

The existing site slopes generally from the north to the south, with approximately 46 feet of overall elevation change from the high to low elevation points. The mean percent grade within the property boundary is 3%. Generally, precipitation that falls on the western undeveloped half of the property flows into an existing ephemeral swale that discharges at the southern boundary via a 12-inch corrugated metal pipe (CMP) culvert under Drennan Road. Precipitation that falls on the eastern undeveloped half of the property flows to the southeast and ultimately discharges offsite at the southeast corner of the property. Finally, precipitation that falls within the existing WRF, which is located at the center of the property, flows to the south and into an existing detention pond. The detention pond is outfitted with a 24-inch CMP discharge pipe that releases flow just upstream of the culvert under Drennan Road. The existing

detention pond is only lined with native vegetation, so a minor volume of stormwater is lost to infiltration and is not discharged from the pond. Existing site conditions are presented on the Existing Drainage Basin Map, which is located in Appendix F.

1.2.3 Natural Resources Conservations Service (NRCS) Soil Survey

Soil data was obtained from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) website – Web Soil Survey Tool. According to the NRCS report, the soils vary within the property and the offsite drainage basins. These soil types are summarized in Table 1-1 and broken down by onsite and offsite soil type. The full NRCS Soil Report can be found in Appendix A. The onsite soils are classified as Hydrologic Soil Groups A and B thus, it exhibits moderate runoff rates and infiltration rates when thoroughly wet.

Table 1-1: NRCS Soil Report Summary

Soil Type	Map Unit Symbol	Hydrologic Soil Group
Onsite Soil Types		
Ascalon sandy loam, 3 to 9 percent slopes	3	B
Bijou loamy sand, 1 to 8 percent slopes	5	A
Olnest sandy loam, 0 to 3 percent slopes	124	B
Offsite Soil Types		
Ascalon sandy loam, 1 to 3 percent slopes	2	B
Ascalon sandy loam, 3 to 9 percent slopes	3	B
Bijou loamy sand, 1 to 8 percent slopes	5	A
Bijou sandy loam, 3 to 8 percent slopes	7	A
Truckton Blakeland complex, 9 to 20 percent slopes	100	B
Olnest sandy loam, 0 to 3 percent slopes	124	B

Source: U.S. Department of Agriculture, Natural Resources Conservation Service, *Web Soil Survey*. Accessed August 10, 2020, from *http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx*.

1.2.4 Project Description

The purpose of this project is to construct a TDS Reduction Facility at the existing WRF. Construction of the TDS Reduction Facility will include installation of new basins, tanks, buildings, bioreactors, and associated infrastructure. Additionally, the TDS Reduction Facility will include seven (7) new evaporation ponds and access roads that will encompass approximately 50 acres in area.

2.0 DRAINAGE BASINS AND SUB-BASINS

2.1 Major Basin Descriptions

The WRF property is divided from the northwest corner to the southeast corner by two El Paso County drainage basins. The southwestern half of the property is located within the Upper Dry Squirrel Basin and the northeastern half of the property is located within the Drennan Basin. Both drainage basins are located within the Chico Creek major basin.

The Drennan Basin (CHDS0400) and the Upper Dry Squirrel Basin (CHDS0200) flow generally to the southeast towards Dry Squirrel Creek. These major basins are characterized by minor slopes and minimal vegetation. Runoff is collected into intermittent streams until it reaches Dry Squirrel Creek, which ultimately discharges into Chico Creek and the Arkansas River.

The Federal Emergency Management Agency (FEMA) flood map panel number 08041C0815G data classifies the WRF property as Zone X, Area of Minimal Flood Hazard. The FEMA flood map is provided in Appendix B.

The WRF property is not located within the boundary of any drainage basin planning studies, flood hazard delineation reports, or flood insurance studies. There are no adjacent irrigation facilities or other obstructions that may influence or be influenced by this project.

2.2 Sub-Basin Descriptions

Included in Appendix F is an Off Site Drainage Map (Figure 1), which shows the extents of the offsite drainage basins, and an Existing Drainage Basin Map (Figure 2), which shows the extents of the pre-development onsite drainage basins along with locations of existing drainage features within the project site. Pre-development onsite drainage basins and offsite drainage basins were determined for the WRF property in the Final Drainage Report (GMS, 2008) that was developed for the construction of the original facility. Pre-development site flows from the 2008 Report were recalculated to account for more accurate soil types on and offsite. The property contains eight (8) onsite drainage basins and is impacted by two offsite drainage basins. All onsite and offsite drainage basins are discussed in the sections below. A summary of weighted curve numbers, acreage, and runoff flow rates for each drainage basin is included in Table 4-1.

All offsite and onsite drainage basins consist of both Hydrologic Soil Groups A and B. A weighted curve number was calculated for each basin based on percentage of soil group, gravel roads, asphalt pavement, and buildings.

2.2.1 Offsite Basin OS-1

Offsite Basin OS-1 enters the WRF property at the northwest corner and flows onto onsite Basin G. This basin consists primarily of native vegetation. Drainage is generally conveyed as sheet flow within the basin and does not concentrate until it flows onto onsite Basin G.

2.2.2 Offsite Basin OS-2

Offsite Basin OS-2 enters the WRF property as sheet flow at the northern boundary into onsite Basin H and is located directly to the east of Basin OS-1. This basin primarily consists of native vegetation and gravel roads.

2.2.3 Onsite Basin A

Onsite Basin A is located southeast corner of the WRF property. This basin primarily consists of native vegetation and gravel roads. Runoff in Basin A generally flows to the southwest and discharges into a culvert located under the site entrance. The culvert carries stormwater into the southeast corner of onsite Basin B where it flows west to the existing culvert under Drennan Road and discharges offsite.

2.2.4 Onsite Basin B

Onsite Basin B is located along the southern site boundary west of the entrance road and downstream of the existing detention basin. This basin consists of gravel roads, asphalt pavement, and native vegetation. Runoff generally flows to the southwest and discharges at the southwest corner of the basin into the 12-inch CMP culvert that carries stormwater offsite. Onsite Basin B also accepts discharge from onsite Basin A and the existing detention pond located in onsite Basin D via culvert.

2.2.5 Onsite Basin C

Onsite Basin C is located in the west-central portion of the WRF property. This basin consists of infiltration basins, gravel roads, asphalt pavement, buildings, and native vegetation. The western boundary of Basin C terminates at the centerline of an ephemeral swale that runs north-south in the west-central portion of the property. Runoff in onsite Basin C generally flows to the south and west and discharges into the ephemeral swale. The basin ultimately discharges at the southernmost point into onsite Basin G.

2.2.6 Onsite Basin D

Onsite Basin D is located in the southern-central portion of the WRF property and consists of buildings, asphalt pavement, and native vegetation. Additionally, Basin D contains the existing detention pond. Runoff from onsite Basins E and F flow onto Basin D along the northeastern basin boundary and

discharges into the detention pond. The existing 24-inch CMP culvert located in the detention pond releases runoff from the pond onto onsite Basin B.

2.2.7 Onsite Basin E

Onsite Basin E is located in the center of the WRF property and consists of infiltration basins, asphalt pavement, buildings, and native vegetation. Runoff from Basin E flows generally to the south and discharges at the southernmost corner of the basin onto both onsite Basins D and F. Stormwater flows from onsite Basin E ultimately discharge into the existing detention pond.

2.2.8 Onsite Basin F

Onsite Basin F is located in the east-central portion of the WRF property and consists of buildings, asphalt pavement, and native vegetation. Runoff from onsite Basin F flows generally to the south and to the west and discharges at the southernmost corner of the basin onto onsite Basin D. Stormwater flows from onsite Basin F ultimately discharge into the existing detention pond.

2.2.9 Onsite Basin G

Onsite Basin G incorporates the western half of the WRF property and consists of gravel roads and native vegetation. Runoff from Basin G flows generally to the south and east towards the ephemeral swale located in the west-central portion of the property. The eastern boundary of Basin G extends to the centerline of the swale. The ephemeral swale terminates at the southeast corner of the Basin G boundary. Discharge from the ephemeral swale is dissipated and carried into onsite Basin B at the southeast corner of the basin boundary. Basin B contains the 12-inch culvert that carries stormwater offsite. Offsite Basin OS-1 and onsite basins A, B, and C ultimately discharge onto Basin G.

2.2.10 Onsite Basin H

Onsite Basin H incorporates the eastern half of the WRF property and consists of gravel roads and native vegetation. Runoff from Basin H flows to the south and east and ultimately discharges in the southeast corner of the property. Offsite Basin OS-2 also flows onto Basin H. Stormwater flows from Basin H do not enter the WRF facilities and discharge offsite. Runoff from Basins H and OS-1 were not utilized in any hydraulic computations.

3.0 DRAINAGE DESIGN CRITERIA

3.1 Development Criteria Reference

The design criteria for the proposed drainage system for the WRF TDS Reduction Facility are in accordance with El Paso County's *Drainage Criteria Manual, Volumes 1 and 2* (El Paso County 1994, 2002). Criteria from the Mile High Flood District (MHFD) Urban Storm Drainage Criteria Manual (USDCM), Volume 2 was also utilized in the design of the proposed drainage system. The USDCM, Volume 2 and related software (see Section 3.3) was used to modify the existing detention pond.

3.2 Hydrologic Criteria

The Soil Conservation Service (SCS) Hydrograph Procedure, as described in Section 5.3 of the El Paso County Drainage Criteria Manual, Volume 1, was used to calculate runoff for all parts of the project area. This method was utilized because the overall drainage area is greater than 100 acres. The Hydraflow Hydrographs Extension for Autodesk Civil 3D was utilized for runoff calculations. All detailed results of the hydrologic computation are presented in Appendix D.

As required by the first paragraph Section 2.1 of the El Paso County Drainage Criteria Manual, Volume 1, design storm and recurrence interval data was collected from the National Oceanic and Atmospheric Administration (NOAA) Atlas 14, Volume 8, Version 2 and is summarized in Table 3-1. Precipitation data can also be referenced in Appendix C. 1-hour rainfall depths for the 2, 5, 10, 25, 50, 100, and 500-year storms were utilized for detention basin design (see Section 3.3). 6-hour and 24-hour rainfall depths for the 2-year and 100-year storms were inputted into the Hydraflow Hydrographs Extension for Autodesk Civil 3D for analysis with the SCS Hydrograph Procedure. The 10-year, 6-hour and 24-hour storm was also inputted to calculate peak flows during the 10-year storm for sizing of hydraulic structures.

Table 3-1: NOAA Precipitation Estimates

Duration	Average Recurrence Interval (Years)						
	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
1-Hour	0.99	1.29	1.91	1.99	2.35	2.74	3.75
6-Hour	1.46	-	2.30	-	-	4.13	-
24-Hour	1.77	-	2.69	-	-	4.61	-

3.3 Hydraulic Criteria

Hydraulic analyses were performed to size and evaluate the performance of the detention pond outlet structure, drainage swale, and culverts. The site was designed with the assumption of being classified as nonurbanizing. As described in Section 13.2.1 of the El Paso Drainage Criteria Manual, Volume 1, the detention pond was redesigned to meet the full spectrum detention requirements developed by the MHFD. The allowable release rates for the detention pond were calculated from Table 13-2 of the El Paso County Drainage Criteria Manual, Volume 1. The calculated release rates are included in Appendix D and summarized in Table 3-2. The MHFD "UD-Detention_v4.03" software was used to determine if the existing detention pond was appropriately sized and design the outlet structure and the software was adjusted to achieve the allowable release rates. The results of the UD-Detention software were inputted into the Hydraflow Hydrographs Extension for Autodesk Civil 3D to complete the analysis of the site.

Table 3-2: Calculated Release Rates

Design Return	Allowable Release Rate (cfs)
2-Year	0.21
5-Year	0.82
100-Year	7.07

The swale was designed to convey the runoff from the 100-year, 24-hour storm event (see Section 2.2.1 of the Drainage Criteria Manual, Volume 1). In accordance with Section 6.5.3 of Drainage Criteria Manual, the following formula was used to calculate the required freeboard in the swale:

$$H = 1.0 + 0.025\ V\ D^{0.33} = 1.1\ ft$$

Where:
V = average channel velocity, 3.39 fps
D = maximum depth of flow, 2.26 ft

Both culverts were designed to carry the 10-year storm while maintaining a headwater-to-depth ratio that is less than the culvert diameter and control the 100-year storm without exceeding the overtop requirements of 12-inches, as required by Section 6.4.1 of the Drainage Criteria Manual. The culvert and drainage swale sizing were done using the Hydraflow Express software. The detailed results of all the hydraulic culvert computations are presented in Appendix E.

The Federal Highway Administration (FHWA) Culvert Hydraulic Analysis Program Software, HY-8, was also utilized to analyze the existing 12-inch CMP culvert outfall and Drennan Road crossing to determine the depth overtopping on Drennan Road and potential impacts to the roadway. The results of the analysis are included in Appendix E.

One riprap apron was sized using calculations from the FHWA Hydraulic Engineering Circular (HEC) No. 14, Third Edition: Hydraulic Design of Energy Dissipators for Culverts and Channels (FHWA, 2006). The results of the riprap apron sizing calculations are included in Appendix E.

3.4 Water Quality Management

To verify compliance with the County's criteria and promote enhanced water quality in stormwater leaving the site, Best Management Practices (BMP's) were utilized. A Four-Step Process for water quality control BMP selection is provided in Appendix I of the El Paso County Engineering Criteria Manual (El Paso County, 2016). The Four-Step Process was adhered to in the drainage design and is discussed below. In accordance with Section 13.4.2 of the Drainage Criteria Manual, the detention pond must be designed to capture, detain, and release the water quality capture volume (WQCV) within a time period of 40 hours and the excess urban runoff volume (EURV) within 72 hours.

3.4.1 Water Quality Control BMP Selection

3.4.1.1 Employ Runoff Reduction Practices

The first step of the BMP selection process is to reduce runoff from the proposed facility by reducing impervious areas to the extent practicable and routing runoff from impervious spaces over grass-lined areas. The proposed design of the TDS Reduction Facility significantly reduces the tributary area, thus reducing the runoff, to the west-central swale through the construction of the evaporation ponds. The evaporation ponds encompass approximately 50 acres in area and will intercept all precipitation that falls in them. Additionally, the grass swale will be vegetated after grading activities are completed to promote further infiltration.

The tributary areas contributing to the detention pond will be slightly reduced, thus reducing runoff, due to construction of the evaporation ponds. However, the imperviousness of the tributary areas will increase slightly as new infrastructure is installed. However, runoff will flow over several grass-lined stretches before it discharges into the detention pond.

3.4.1.2 Stabilize Drainageways

The second step of the BMP selection process is to choose appropriate stabilization methods for existing and new drainageways to prevent erosion. The only drainageway present on site is the ephemeral swale, which will be re-constructed as part of the improvements to the site. Due to the low channel slopes and flow velocities, grass was selected as the stabilization method for the channel. Erosion control blanket will also be utilized. Channel hydraulics are discussed in Section 4.2.1.

3.4.1.3 Provide Water Quality Capture Volume (WQCV)

In accordance with Section I.7.1B of Appendix I of the El Paso County Engineering Criteria Manual, the drainage basins that contain the existing WRF infrastructure require stormwater quality detention. An existing extended detention basin is already present on site and receives runoff from the appropriate tributary area. The extended detention basin is considered an appropriate BMP because the site is large and subject to controlled release rates. As part of the improvements to the site, the extended detention basin will be regraded and outfitted with an outlet structure that provides for full spectrum detention. Hydraulic calculations for the detention basin are discussed in Section 4.2.2.

3.4.1.4 Consider Need for Industrial and Commercial BMPs

The construction of the TDS Reduction Facility at the Cherokee WRF will involve significant redevelopment activity. In accordance with Appendix I of the El Paso County Engineering Criteria Manual, the need for specialized BMPs must be considered if redevelopment activity will be significant. However, due to the nature of construction, no specialized BMPs will be required for the construction of this facility. Management of temporary construction materials and spill prevention and response procedures during construction are discussed in the construction Stormwater Management Plan (SWMP).

4.0 DRAINAGE FACILITY DESIGN

4.1 General Concept

To accommodate the TDS Reduction Facility at the WRF, proposed additions to the site include installation of new basins, tanks, buildings, bioreactors, and associated infrastructure. Additionally, the TDS Reduction Facility will include seven (7) new evaporation ponds and access roads that will encompass approximately 50 acres in area. Drainage improvements will include the construction of a grass swale to divert stormwater around the evaporation ponds, the installation of two new culverts, and the modification of the existing detention pond to allow for full-spectrum detention and increased capacity. The pond will allow for full-spectrum detention with the installation of an outlet structure in combination with the existing outlet pipe. An outlet structure was not previously installed in the pond. A spillway will also be installed in the pond that will discharge runoff to the southwest toward the site outfall. A forebay, trickle channel, and detention pond access road will be incorporated in accordance with El Paso County requirements.

The engineered grass swale will include a riprap apron at the outlet of the channel to dissipate flow. All runoff and tributary flows from the site will be conveyed overland. Construction of the TDS Reduction Facility and drainage improvements will result in the modification of the existing onsite drainage basins as discussed below. Post-development drainage basins are also presented on the Proposed Drainage Basin Map in Appendix F.

The proposed improvements to the WRF property will replace the existing ephemeral swale with an engineered grass swale. The construction of the evaporation ponds will also greatly reduce the contributing drainage area to this swale. These changes will result in the elimination of onsite Basin G and the modification of Basins B and C. Basin C is broken into three sub-basins, C1, C2, and C3. The discharge points for basins C1 and C2 were utilized to size the two proposed culverts. Basin A will not be modified as part of the construction of the TDS Reduction Facility. Onsite Basins A, B, C and offsite Basin OS-1 will discharge into the engineered grass swale. At the outlet of the grass swale, a riprap protection apron will be installed to dissipate flow before it discharges into the existing 12-inch CMP and is carried offsite. The 12-inch CMP will not be moved and will still be utilized as the site outfall.

New infrastructure for the TDS Reduction Facility will result in increased imperviousness in Basin E and the slight modification of the contributing drainage areas for Basins E and F. Minor regrading of the detention pond will result in a slight modification of Basin D. However, the pond grading will not change the basin imperviousness or time of concentration. Basins D, E, and F will continue to discharge into the

existing detention pond, which will be outfitted with an outlet structure, trickle channel and emergency spillway. The detention pond will discharge onto the southern portion of Basin B and will be carried to the 12-inch CMP and offsite. The capacity of the 12-inch CMP was analyzed and is discussed in Section 4.2.1. It was determined that the CMP is adequate for site flows.

Additionally, Basin H will not be modified a part of the construction of the TDS Reduction Facility. Basin OS-2 will still discharge into Basin H and all runoff will flow to the southeast and exit the property at the southeast corner.

The proposed drainage improvements associated with the Cherokee WRF TDS Reduction Facility will not adversely impact downstream properties.

4.2 Specific Details

Pre-development and post-development hydrologic calculations, including time of concentration and flows for the following design storms are summarized in Tables 4-1 and 4-2. The peak flows for the design storms were used to size the drainage swale, culverts, and riprap apron.

- 10-year, 24-hour, and
- 100-year, 24-hour.

Peak flow calculations were used to size and design all hydraulic structures, including the engineered swale, culverts, detention pond outlet structure, and detention pond emergency spillway. Hydraulic structure design is discussed in Sections 4.2.1 and 4.2.2.

Calculated peak flows from offsite basin OS-1 and post-development basin C2 was used to size culvert C2. Peak flows from post-development basin C1 were used to size culvert C1. The grass-lined engineered swale and riprap apron were sized with peak flows from offsite basin OS-1 and post-development basins A, B, C1, C2, and C3. The detention pond outlet structure and emergency spillway were sized with peak flows from post-development basins D, E, and F. The basin combinations used to size each hydraulic structure are summarized on the schematics included with the Hydraflow results in Appendix D.

Table 4-1: Pre-Development Hydrologic Conditions

Minor Drainage Basin	Curve Number	Area (Acres)	Time of Concentration, T_c	10-Year, 24-Hour Flow (cfs)	100-Year, 24-Hour Flow (cfs)
OS-1	56	429.0	114.4	8.6	94.6
OS-2	51	4.54	34.3	0.0	1.3

Minor Drainage Basin	Curve Number	Area (Acres)	Time of Concentration, T_c	10-Year, 24-Hour Flow (cfs)	100-Year, 24-Hour Flow (cfs)
A	57	7.64	37.5	0.3	4.0
B	61	3.51	32.4	0.4	2.9
C	62	10.05	34.3	1.1	8.4
D	61	4.49	37.0	0.4	3.5
E	66	11.35	55.5	1.8	8.9
F	58	12.47	43.0	0.6	6.7
G	55	67.09	50.3	1.3	24.3
H	59	39.62	57.9	1.9	18.2

Table 4-2: Post-Development Hydrologic Conditions

Minor Drainage Basin	Curve Number	Area (Acres)	Time of Concentration, T_c	10-Year, 24-Hour Flow (cfs)	100-Year, 24-Hour Flow (cfs)
OS-1	56	429.0	114.40	8.6	94.6
OS-2	51	4.54	34.30	0.0	1.3
A	57	7.64	37.50	0.3	4.0
B	64	2.77	32.40	0.5	2.8
C1	57	2.31	34.06	0.1	1.3
C2	60	19.72	20.30	2.0	19.6
C3	55	9.99	16.90	0.2	7.0
D	61	4.49	37.00	0.4	3.5
E	66	10.09	34.10	2.1	10.9
F	58	12.13	43.00	0.6	6.5
H	59	39.62	57.90	1.9	18.2

4.2.1 Hydraulic Structures

The grass swale is a 4-foot flat bottom ditch with side slopes at four horizontal to one vertical (4H:1V). Channel slopes are low, which results in low flow velocities. The swale was analyzed for capacity, velocity, and flow depth at the minimum and maximum slopes that will be constructed. Results of the channel analysis are provided in Appendix E.

The riprap apron at the outlet of the grass swale is 30 feet by 30 feet in dimension and will be constructed with Type M riprap at a 28-inch depth. The apron was sized based on the outlet flow velocity from the grass swale. Results of the riprap apron sizing calculation are provided in Appendix E.

One stormwater culvert will be installed to convey stormwater from the overhead electrical easement area to the grass swale. This culvert was sized based on the discharge flow from Sub-Basin C1. Another culvert will be installed along the alignment of the grass swale to allow for a haul road to cross the swale and allow access to the evaporation ponds. This culvert was sized based on the discharge from Sub-Basin C2 and offsite basin OS-1. The runoff calculations for each culvert sub-basin are included in Appendix D and summarized in Table 4-2. Culvert profiles with the hydraulic grade lines for the 10-year and 100-year storms are included in Appendix E. The design information for the engineered swale and two stormwater culverts is summarized in Table 4-3. Design flow rates for each structure are summed, not routed, so that flow rates are conservative because time of concentration differs across the drainage basins.

Table 4-3: Hydraulic Structure Summary

Hydraulic Structure	Tributary Basins	Combined 10-Year, 24-Hour Flow (cfs)	Combined 100-Year, 24-Hour Flow (cfs)	Maximum Flow Depth (ft)	Maximum Velocity (fps)
Engineered Grass Swale	Offsite Basin 1 Onsite Basins A, B, C1, C2, C3	9.5	99.9	2.26	8.46[1]
Culvert C1	Onsite Basin C1	0.1	2.6	1.19	2.94
Culvert C2	Offsite Basin 1 Onsite Basins C1 and C2	2.0	19.6	2.76	8.06

[1] Section 6.5.2 of the Drainage Criteria Manual, Volume 1 states that concrete, soil, or riprap must be utilized if channel velocities exceed 6.0 fps. However, only a short section of the swale is at a 3% slope and is near the start of the swale. At this portion of the swale, the maximum flow rate will not likely be reached, so no degradation of the swale is expected.

The existing 12-inch CMP outfall was analyzed with the FHWA HY-8 software to determine overtopping on Drennan Road during the 100-year, 24-hour storm. The results of the analysis indicated a maximum overtop of approximately 0.7 feet (8.4 inches) on Drennan Road during the design storm. The results of the HY-8 analysis are included in Appendix E. The 12-inch CMP was also analyzed in the 2008 Final Drainage Report (GMS, 2008). The analysis completed for the 2008 Report indicated that the road would be overtopped 0.65 feet and overtopping would not cause damage to the WRF facility or downstream structures. The results of the HY-8 analysis for the TDS Reduction Facility indicate that the proposed improvements to the site will not significantly change how the design storm will impact the 12-inch CMP and Drennan Road.

4.2.2 Detention Pond

The post-development flows from Basins D, E, and F will be conveyed overland to the existing detention pond, which will be regraded for additional capacity. The regraded pond has a footprint of roughly 1.3 acres measured at the top of the pond, which is at elevation 5898. The volume of the pond will be increased from 2.91 acre-feet to 3.14 acre-feet. The pond is sufficiently sized to hold the 100-year, 1-hour storm event and will be installed with an outlet structure that controls the WQCV and EURV and releases stormwater at a rate equal to or less than the calculated release rates in Appendix D. The existing detention pond will only be lined with native vegetation, so a minor volume of stormwater will be lost to infiltration and will not be discharged from the pond. The drainage area for the detention pond includes post-development Basins D, E, and F (26.71 total acres). The 100-year storage volume is based on a peak inflow, calculated by the UD-Detention software, of 25.8 cfs. The pond will also be installed with an emergency spillway. A concrete forebay will be installed at the detention pond inlet. The forebay will be fitted with a 7.5-inch notch that will discharge water into the concrete trickle channel. Additionally, the forebay is designed to hold 5% of the WQCV and drain within five minutes (see forebay calculations in Appendix E).

The pond will be installed with an outlet structure consisting of a reinforced concrete box with a well screen, WQCV/EURV orifice plate, circular vertical orifice, and outlet pipe with an orifice plate. The existing 24-inch CMP culvert will be maintained as the outlet pipe for the detention pond. The total capacity of the pond is 3.14 acre-feet at the top of pond elevation of 5898. A 22-foot wide emergency spillway at elevation 3897.0 accounts for overflow capacity at a depth of 0.50 feet for the peak 100-year outflow. Appendix E contains the detention pond calculations.

4.2.3 Cost Estimate of Proposed Facilities

The cost estimate for all proposed facilities associated with the Cherokee WRF TDS Reduction Facility and all required fees are submitted under separate cover.

4.3 Other Government Agency Requirements

Construction of the Cherokee WRF TDS Reduction Facility is also governed by the Colorado Department of Public Health and Environment (CDPHE) Water Quality Control Division (WQCD). A Site Location Application Package was submitted to the WQCD and approved on May 19, 2020. A Process Design Report (PDR) was developed for the project and submitted to the WQCD in August 2020.

5.0 CONCLUSIONS

5.1 Compliance with Standards

The design of the proposed drainage system for the Cherokee WRF TDS Reduction Facility project complies with the adopted drainage criteria of El Paso County. The design criteria for the proposed drainage system are in accordance with the *El Paso County Drainage Criteria Manual, Volume 1*.

6.0 REFERENCES

El Paso County, 1994. *Drainage Criteria Manual Volume 1*. October.

El Paso County, 2002. *Drainage Criteria Manual Volume 2.* November 1.

El Paso County, 2016. *Engineering Criteria Manual*. December 13.

FWHA, 2006. *HEC No. 14, 3rd Edition: Hydraulic Design of Energy Dissipators for Culverts and Channels*. July.

GMS, 2008. *Final Drainage Report for Black Squirrel Creek Wastewater Treatment Plant*. March.

MHFD, 2010. *Urban Storm Drainage Criteria Manual, Volume 3.* November

APPENDIX A – HYDROLOGIC SOIL INFORMATION

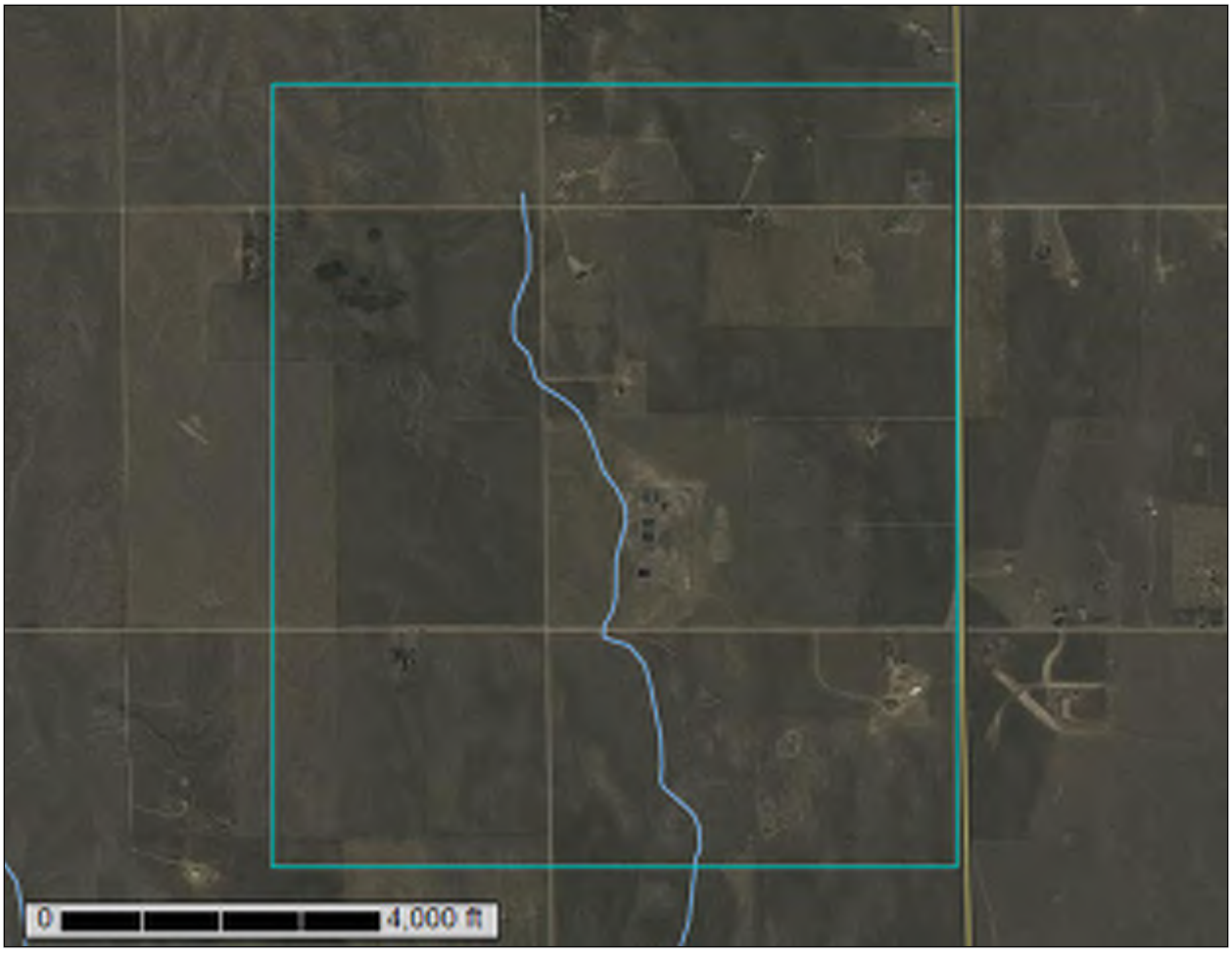
United States Department of Agriculture

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 El Paso County Area, Colorado



August 10, 2020

Preface

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

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

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

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

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

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

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How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

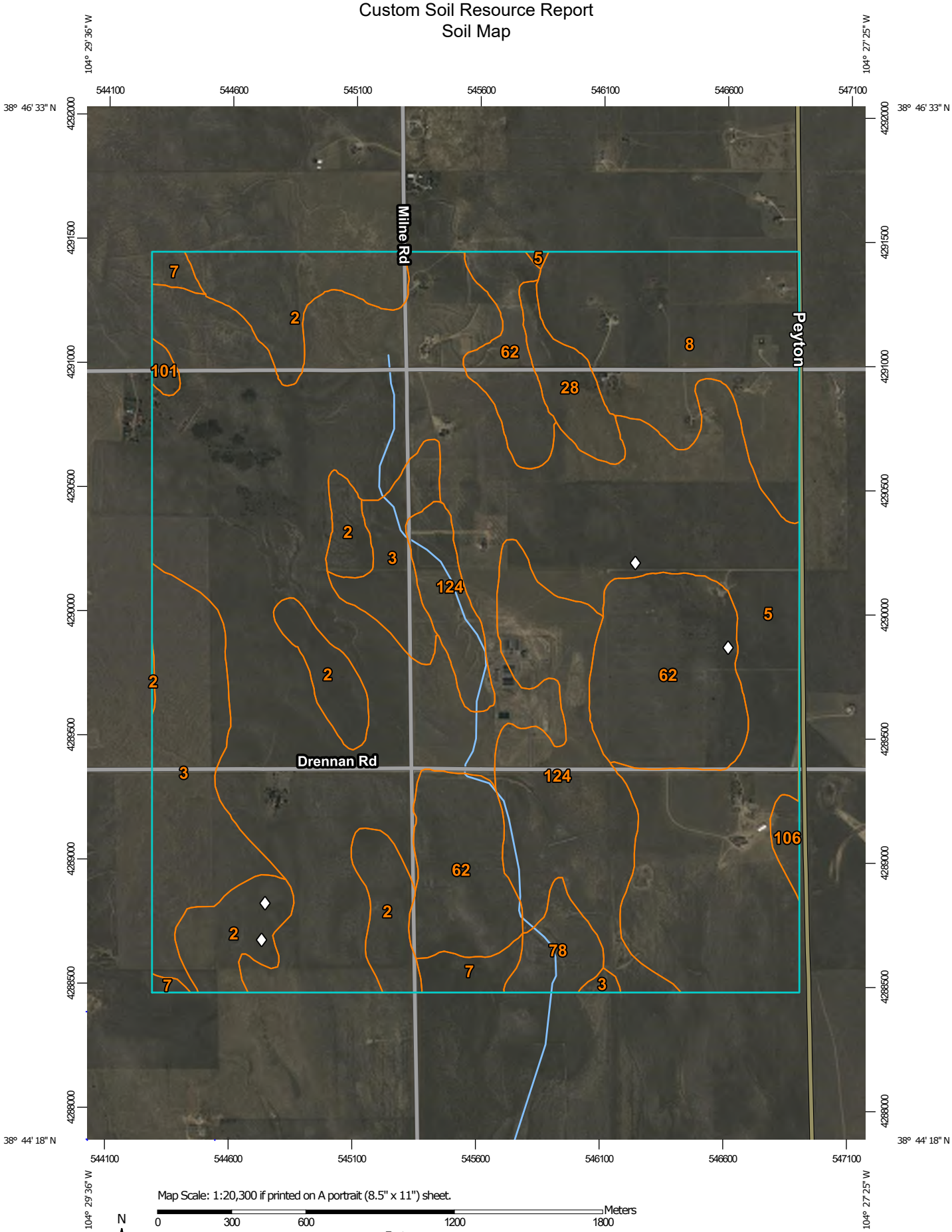
After soil scientists located and identified the significant natural bodies of soil in the survey area, they drew the boundaries of these bodies on aerial photographs and

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

Soil Map

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

Custom Soil Resource Report
Soil Map



MAP 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.

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.

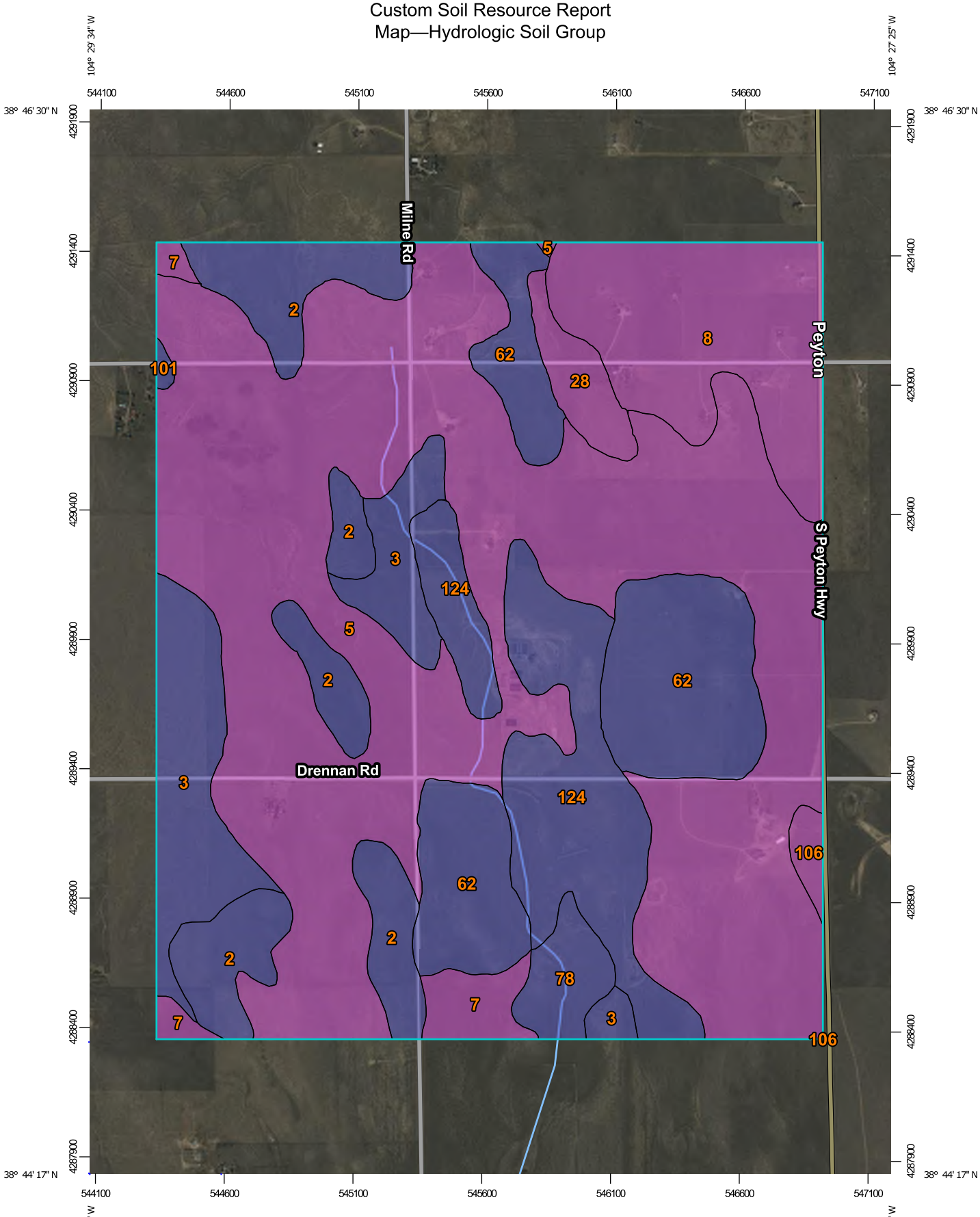
Soil Survey Area: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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.

Custom Soil Resource Report
Map—Hydrologic Soil Group



Map Scale: 1:20,000 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 250 500 1000 1500

Feet
0 500 1000 2000 3000

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N 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.

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: El Paso County Area, Colorado
Survey Area Data: Version 18, Jun 5, 2020

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

Date(s) aerial images were photographed: Sep 11, 2018—Oct 20, 2018

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
2	Ascalon sandy loam, 1 to 3 percent slopes	160.7	8.3%
3	Ascalon sandy loam, 3 to 9 percent slopes	155.4	8.0%
5	Bijou loamy sand, 1 to 8 percent slopes	955.0	49.3%
7	Bijou sandy loam, 3 to 8 percent slopes	22.8	1.2%
8	Blakeland loamy sand, 1 to 9 percent slopes	174.3	9.0%
28	Ellicott loamy coarse sand, 0 to 5 percent slopes	30.5	1.6%
62	Olnest-Vona complex, cool, 1 to 6 percent slopes, eroded	219.8	11.3%
78	Sampson loam, 0 to 3 percent slopes	26.5	1.4%
101	Ustic Torrifluvents, loamy	4.5	0.2%
106	Wigton loamy sand, 1 to 8 percent slopes	8.4	0.4%
124	Olnest sandy loam, 0 to 3 percent slopes	178.8	9.2%
Totals for Area of Interest		**1,936.7**	**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.

El Paso County Area, Colorado

2—Ascalon sandy loam, 1 to 3 percent slopes

Map Unit Setting

National map unit symbol: 367q
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 130 to 150 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

Ascalon and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ascalon

Setting

Landform: Flats
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Mixed alluvium and/or eolian deposits

Typical profile

A - 0 to 8 inches: sandy loam
Bt - 8 to 21 inches: sandy clay loam
BC - 21 to 27 inches: sandy loam
Ck1 - 27 to 48 inches: sandy loam
Ck2 - 48 to 60 inches: loamy sand

Properties and qualities

Slope: 1 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B
Ecological site: R069XY026CO - Sandy Plains LRU's A & B
Other vegetative classification: SANDY PLAINS (069BY026CO)
Hydric soil rating: No

Minor Components

Pleasant
Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Other soils
Percent of map unit: 1 percent
Hydric soil rating: No

3—Ascalon sandy loam, 3 to 9 percent slopes

Map Unit Setting
National map unit symbol: 2tlny
Elevation: 3,870 to 5,960 feet
Mean annual precipitation: 13 to 18 inches
Mean annual air temperature: 46 to 54 degrees F
Frost-free period: 95 to 155 days
Farmland classification: Not prime farmland

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

Description of Ascalon

Setting
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Wind-reworked alluvium and/or calcareous sandy eolian deposits

Typical profile
Ap - 0 to 6 inches: sandy loam
Bt1 - 6 to 12 inches: sandy clay loam
Bt2 - 12 to 19 inches: sandy clay loam
Bk1 - 19 to 35 inches: fine sandy loam
Bk2 - 35 to 80 inches: fine sandy loam

Properties and qualities
Slope: 3 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 5.98 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline (0.1 to 1.9 mmhos/cm)
Sodium adsorption ratio, maximum: 1.0
Available water capacity: Moderate (about 7.1 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Olnest

Percent of map unit: 10 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Interfluves
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

5—Bijou loamy sand, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tqxq
Elevation: 4,000 to 5,300 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

Bijou and similar soils: 85 percent
Minor components: 15 percent

Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Bijou

Setting

Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands

Typical profile

A - 0 to 4 inches: loamy sand
AB - 4 to 9 inches: loamy sand
Bt - 9 to 36 inches: sandy loam
BC - 36 to 50 inches: loamy sand
C - 50 to 79 inches: loamy sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.1 to 0.2 mmhos/cm)
Available water capacity: Low (about 5.6 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: A
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Valent

Percent of map unit: 10 percent
Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Olnest

Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear

Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

7—Bijou sandy loam, 3 to 8 percent slopes

Map Unit Setting

National map unit symbol: 2tqxs
Elevation: 5,700 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Bijou

Setting

Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands

Typical profile

A - 0 to 4 inches: sandy loam
Bt1 - 4 to 8 inches: sandy loam
Bt2 - 8 to 21 inches: sandy loam
Bw - 21 to 28 inches: sandy loam
C - 28 to 79 inches: loamy coarse sand

Properties and qualities

Slope: 3 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline (0.1 to 0.2 mmhos/cm)
Available water capacity: Low (about 5.0 inches)

Interpretive groups

Land capability classification (irrigated): 6e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A

Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Valent
Percent of map unit: 10 percent
Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY015CO - Deep Sand
Hydric soil rating: No

Olnest
Percent of map unit: 5 percent
Landform: Hillslopes
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

8—Blakeland loamy sand, 1 to 9 percent slopes

Map Unit Setting
National map unit symbol: 369v
Elevation: 4,600 to 5,800 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 46 to 48 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition
Blakeland and similar soils: 98 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Blakeland

Setting
Landform: Hills, flats
Landform position (three-dimensional): Side slope, talf
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium derived from sedimentary rock and/or eolian deposits derived from sedimentary rock

Typical profile

A - 0 to 11 inches: loamy sand
AC - 11 to 27 inches: loamy sand
C - 27 to 60 inches: sand

Properties and qualities

Slope: 1 to 9 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 5 percent
Available water capacity: Low (about 4.5 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R049XB210CO - Sandy Foothill
Hydric soil rating: No

Minor Components

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

28—Ellicott loamy coarse sand, 0 to 5 percent slopes

Map Unit Setting

National map unit symbol: 3680
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 125 to 145 days
Farmland classification: Not prime farmland

Map Unit Composition

Ellicott and similar soils: 97 percent
Minor components: 3 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Ellicott

Setting

Landform: Flood plains, stream terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy alluvium

Typical profile

A - 0 to 4 inches: loamy coarse sand
C - 4 to 60 inches: stratified coarse sand to sandy loam

Properties and qualities

Slope: 0 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Runoff class: Very low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: FrequentNone
Frequency of ponding: None
Available water capacity: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 7w
Hydrologic Soil Group: A
Ecological site: R069XY031CO - Sandy Bottomland LRU's A & B
Other vegetative classification: SANDY BOTTOMLAND (069AY031CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 1 percent
Hydric soil rating: No

Fluvaquentic haplaquoll

Percent of map unit: 1 percent
Landform: Swales
Hydric soil rating: Yes

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

62—Olnest-Vona complex, cool, 1 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2t51g
Elevation: 5,900 to 6,200 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 48 to 54 degrees F
Frost-free period: 130 to 170 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Olnest, Eroded

Setting

Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian deposits and/or old alluvium

Typical profile

A - 0 to 2 inches: sandy loam
Bt - 2 to 21 inches: sandy clay loam
Bk - 21 to 26 inches: sandy clay loam
BCk - 26 to 79 inches: sandy loam

Properties and qualities

Slope: 1 to 5 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.5 to 2.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Moderate (about 6.7 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: B

Ecological site: R067BY024CO - Sandy Plains
Forage suitability group: Loamy, Dry (G067BW019CO)
Other vegetative classification: Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Description of Vona, Eroded

Setting

Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Eolian sands

Typical profile

A - 0 to 2 inches: sandy loam
Bt1 - 2 to 12 inches: sandy loam
Bt2 - 12 to 17 inches: sandy loam
Bk - 17 to 41 inches: sandy loam
BCk - 41 to 79 inches: loamy sand

Properties and qualities

Slope: 3 to 6 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat excessively drained
Capacity of the most limiting layer to transmit water (Ksat): High (2.00 to 6.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Gypsum, maximum content: 2 percent
Maximum salinity: Nonsaline to slightly saline (0.5 to 4.0 mmhos/cm)
Sodium adsorption ratio, maximum: 2.0
Available water capacity: Moderate (about 7.2 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R067BY024CO - Sandy Plains
Forage suitability group: Loamy, Dry (G067BW019CO)
Other vegetative classification: Sandy Plains #24 (067XY024CO_2), Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Minor Components

Olnest, cool

Percent of map unit: 8 percent
Landform: Hillslopes
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains

Other vegetative classification: Loamy, Dry (G067BW019CO)
Hydric soil rating: No

Vona, cool

Percent of map unit: 7 percent
Landform: Sand sheets
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Other vegetative classification: Sandy Plains #24 (067XY024CO_2), Loamy, Dry (G067BW019CO)
Hydric soil rating: No

78—Sampson loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 369s
Elevation: 5,500 to 6,500 feet
Mean annual precipitation: 13 to 15 inches
Mean annual air temperature: 47 to 50 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Sampson

Setting

Landform: Alluvial fans, terraces, depressions
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Alluvium

Typical profile

A - 0 to 15 inches: loam
Bt - 15 to 34 inches: clay loam
Bk - 34 to 60 inches: sandy clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.60 to 2.00 in/hr)

Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.2 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3c
Hydrologic Soil Group: B
Ecological site: R049XY202CO - Loamy Foothill
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

101—Ustic Torrifluvents, loamy

Map Unit Setting

National map unit symbol: 3673
Elevation: 5,500 to 7,000 feet
Mean annual precipitation: 13 to 16 inches
Mean annual air temperature: 47 to 52 degrees F
Frost-free period: 125 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Ustic Torrifluvents

Setting

Landform: Flood plains, stream terraces
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Sandy, clayey, stratified loamy

Typical profile

A - 0 to 6 inches: variable
C - 6 to 60 inches: stratified loamy sand to clay loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 10 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Moderate (about 8.6 inches)

Interpretive groups

Land capability classification (irrigated): 2e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: B
Ecological site: R069XY037CO - Saline Overflow LRU's A & B
Other vegetative classification: OVERFLOW (069BY036CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

106—Wigton loamy sand, 1 to 8 percent slopes

Map Unit Setting

National map unit symbol: 3678
Elevation: 5,300 to 6,000 feet
Mean annual precipitation: 12 to 14 inches
Mean annual air temperature: 48 to 52 degrees F
Frost-free period: 135 to 155 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of Wigton

Setting

Landform: Dunes
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Noncalcareous, dune-like sandy eolian deposits

Typical profile

A - 0 to 8 inches: loamy sand
AC - 8 to 19 inches: loamy sand
C - 19 to 60 inches: sand

Properties and qualities

Slope: 1 to 8 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Excessively drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): High to very high (5.95 to 19.98 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water capacity: Low (about 3.8 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 6e
Hydrologic Soil Group: A
Ecological site: R067BY015CO - Deep Sand
Other vegetative classification: DEEP SANDS (069BY019CO)
Hydric soil rating: No

Minor Components

Other soils

Percent of map unit: 4 percent
Hydric soil rating: No

Pleasant

Percent of map unit: 1 percent
Landform: Depressions
Hydric soil rating: Yes

124—Olnest sandy loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 2t51j
Elevation: 4,500 to 6,100 feet
Mean annual precipitation: 14 to 16 inches
Mean annual air temperature: 50 to 54 degrees F

Frost-free period: 130 to 170 days
Farmland classification: Prime farmland if irrigated

Map Unit Composition

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

Description of Olnest

Setting

Landform: Sand sheets
Parent material: Eolian sands

Typical profile

A - 0 to 4 inches: sandy loam
Bt - 4 to 20 inches: sandy clay loam
Bk1 - 20 to 48 inches: sandy loam
Bk2 - 48 to 79 inches: very fine sandy loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately high to high (0.20 to 2.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 14 percent
Maximum salinity: Very slightly saline (2.0 to 3.9 mmhos/cm)
Available water capacity: Moderate (about 7.4 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4c
Hydrologic Soil Group: B
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Minor Components

Udic haplusterts, ponded

Percent of map unit: 5 percent
Landform: Closed depressions
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Concave
Ecological site: R067BY010CO - Closed Upland Depression
Hydric soil rating: No

Otero

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

Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

Vona

Percent of map unit: 5 percent
Landform: Sand sheets
Ecological site: R067BY024CO - Sandy Plains
Hydric soil rating: No

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APPENDIX B – FEMA FLOOD ZONES

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FEMA

/HJHQG

Feet

APPENDIX C – NOAA RAINFALL DATA

NOAA Atlas 14, Volume 8, Version 2
Location name: Colorado Springs, Colorado, USA*
Latitude: 38.7547°, Longitude: -104.4735°
Elevation: 5912.49 ft**
* source: ESRI Maps
** source: USGS

POINT PRECIPITATION FREQUENCY ESTIMATES

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

NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

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

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.246** (0.199-0.309)	**0.299** (0.242-0.376)	**0.393** (0.316-0.494)	**0.476** (0.381-0.602)	**0.601** (0.468-0.795)	**0.704** (0.533-0.941)	**0.814** (0.595-1.11)	**0.932** (0.652-1.31)	**1.10** (0.737-1.58)	**1.23** (0.801-1.78)
10-min	**0.360** (0.291-0.452)	**0.438** (0.354-0.550)	**0.575** (0.463-0.724)	**0.697** (0.558-0.882)	**0.880** (0.685-1.16)	**1.03** (0.781-1.38)	**1.19** (0.871-1.63)	**1.36** (0.954-1.91)	**1.61** (1.08-2.31)	**1.80** (1.17-2.61)
15-min	**0.439** (0.355-0.551)	**0.534** (0.431-0.671)	**0.701** (0.564-0.883)	**0.851** (0.680-1.08)	**1.07** (0.835-1.42)	**1.26** (0.953-1.68)	**1.45** (1.06-1.99)	**1.66** (1.16-2.33)	**1.96** (1.32-2.81)	**2.20** (1.43-3.18)
30-min	**0.638** (0.515-0.800)	**0.774** (0.625-0.972)	**1.01** (0.816-1.28)	**1.23** (0.984-1.56)	**1.55** (1.21-2.05)	**1.82** (1.38-2.43)	**2.10** (1.54-2.87)	**2.40** (1.68-3.37)	**2.83** (1.90-4.07)	**3.18** (2.07-4.60)
60-min	**0.820** (0.663-1.03)	**0.988** (0.798-1.24)	**1.29** (1.04-1.63)	**1.57** (1.26-1.99)	**1.99** (1.56-2.65)	**2.35** (1.78-3.15)	**2.74** (2.00-3.75)	**3.15** (2.21-4.43)	**3.75** (2.52-5.40)	**4.23** (2.76-6.13)
2-hr	**1.00** (0.816-1.25)	**1.20** (0.977-1.50)	**1.57** (1.27-1.96)	**1.91** (1.54-2.40)	**2.43** (1.92-3.22)	**2.88** (2.21-3.85)	**3.37** (2.49-4.59)	**3.90** (2.76-5.45)	**4.66** (3.16-6.68)	**5.29** (3.47-7.60)
3-hr	**1.09** (0.891-1.36)	**1.30** (1.06-1.62)	**1.69** (1.38-2.11)	**2.07** (1.67-2.58)	**2.64** (2.09-3.50)	**3.14** (2.42-4.18)	**3.69** (2.74-5.02)	**4.29** (3.05-5.98)	**5.16** (3.52-7.37)	**5.88** (3.88-8.42)
6-hr	**1.23** (1.01-1.52)	**1.46** (1.20-1.80)	**1.89** (1.54-2.34)	**2.30** (1.87-2.86)	**2.95** (2.35-3.88)	**3.51** (2.72-4.65)	**4.13** (3.08-5.58)	**4.81** (3.44-6.66)	**5.79** (3.98-8.23)	**6.61** (4.39-9.41)
12-hr	**1.35** (1.11-1.65)	**1.61** (1.32-1.97)	**2.08** (1.71-2.56)	**2.52** (2.06-3.11)	**3.19** (2.55-4.14)	**3.76** (2.93-4.93)	**4.38** (3.29-5.87)	**5.06** (3.64-6.94)	**6.02** (4.17-8.48)	**6.81** (4.57-9.64)
24-hr	**1.52** (1.26-1.85)	**1.77** (1.47-2.16)	**2.24** (1.85-2.74)	**2.69** (2.21-3.30)	**3.38** (2.72-4.36)	**3.97** (3.11-5.17)	**4.61** (3.49-6.14)	**5.32** (3.86-7.26)	**6.34** (4.42-8.86)	**7.17** (4.85-10.1)
2-day	**1.72** (1.43-2.08)	**1.99** (1.66-2.41)	**2.49** (2.07-3.02)	**2.95** (2.44-3.60)	**3.67** (2.98-4.70)	**4.29** (3.38-5.54)	**4.95** (3.77-6.54)	**5.68** (4.15-7.70)	**6.73** (4.73-9.34)	**7.58** (5.17-10.6)
3-day	**1.85** (1.55-2.23)	**2.16** (1.81-2.61)	**2.72** (2.27-3.29)	**3.23** (2.68-3.92)	**4.00** (3.25-5.09)	**4.65** (3.67-5.97)	**5.35** (4.08-7.02)	**6.10** (4.48-8.22)	**7.18** (5.07-9.91)	**8.05** (5.51-11.2)
4-day	**1.98** (1.67-2.38)	**2.32** (1.95-2.79)	**2.92** (2.44-3.52)	**3.46** (2.88-4.19)	**4.27** (3.47-5.41)	**4.95** (3.92-6.33)	**5.67** (4.34-7.42)	**6.45** (4.74-8.65)	**7.55** (5.35-10.4)	**8.44** (5.80-11.7)
7-day	**2.36** (1.99-2.82)	**2.73** (2.30-3.27)	**3.38** (2.84-4.06)	**3.97** (3.32-4.78)	**4.84** (3.95-6.09)	**5.57** (4.43-7.07)	**6.35** (4.89-8.25)	**7.18** (5.31-9.57)	**8.36** (5.95-11.4)	**9.30** (6.44-12.8)
10-day	**2.68** (2.27-3.19)	**3.09** (2.61-3.68)	**3.80** (3.20-4.54)	**4.43** (3.71-5.31)	**5.36** (4.39-6.70)	**6.14** (4.90-7.76)	**6.96** (5.37-9.00)	**7.83** (5.81-10.4)	**9.06** (6.48-12.3)	**10.0** (6.98-13.8)
20-day	**3.50** (2.98-4.13)	**4.07** (3.46-4.82)	**5.03** (4.27-5.97)	**5.85** (4.94-6.97)	**7.01** (5.74-8.63)	**7.92** (6.34-9.88)	**8.86** (6.87-11.3)	**9.82** (7.33-12.9)	**11.1** (8.01-15.0)	**12.2** (8.52-16.6)
30-day	**4.18** (3.58-4.93)	**4.89** (4.18-5.77)	**6.05** (5.15-7.15)	**7.00** (5.93-8.31)	**8.31** (6.81-10.1)	**9.32** (7.48-11.5)	**10.3** (8.02-13.1)	**11.3** (8.48-14.8)	**12.7** (9.15-17.0)	**13.7** (9.65-18.6)
45-day	**5.11** (4.38-6.00)	**5.94** (5.09-6.98)	**7.28** (6.22-8.57)	**8.36** (7.11-9.89)	**9.82** (8.05-11.9)	**10.9** (8.77-13.4)	**12.0** (9.33-15.1)	**13.0** (9.76-16.8)	**14.4** (10.4-19.1)	**15.4** (10.9-20.8)
60-day	**5.95** (5.11-6.96)	**6.85** (5.89-8.03)	**8.30** (7.10-9.74)	**9.45** (8.05-11.1)	**11.0** (9.03-13.2)	**12.1** (9.76-14.8)	**13.2** (10.3-16.5)	**14.3** (10.7-18.4)	**15.6** (11.3-20.6)	**16.6** (11.8-22.4)

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

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

Please refer to NOAA Atlas 14 document for more information.

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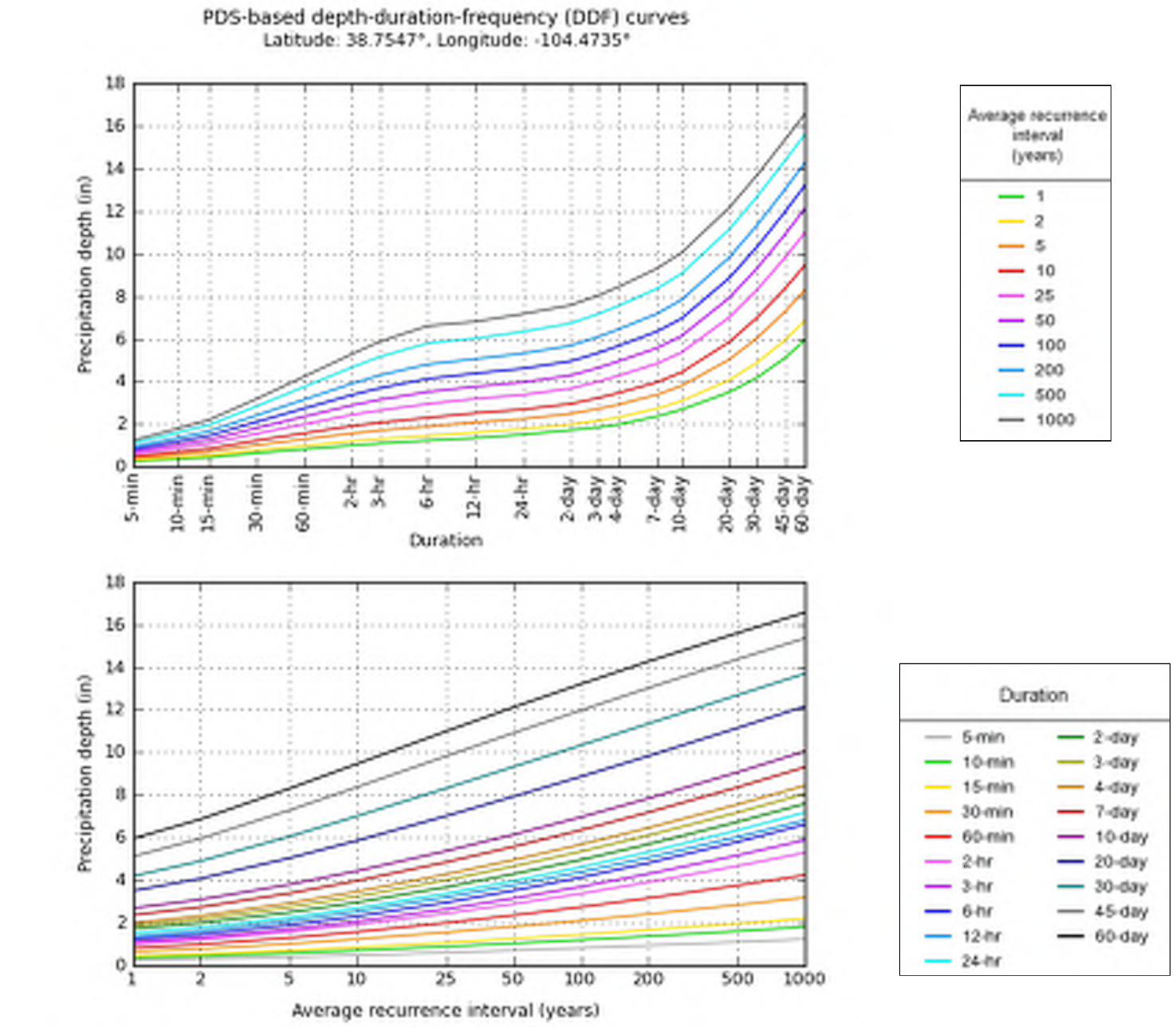
PF graphical



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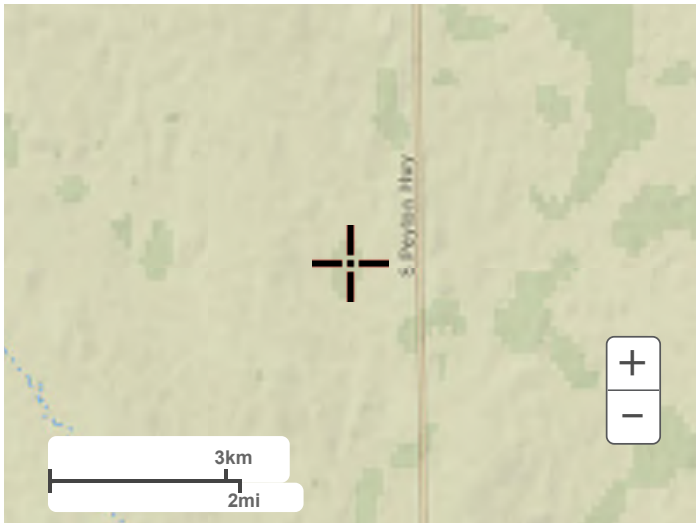
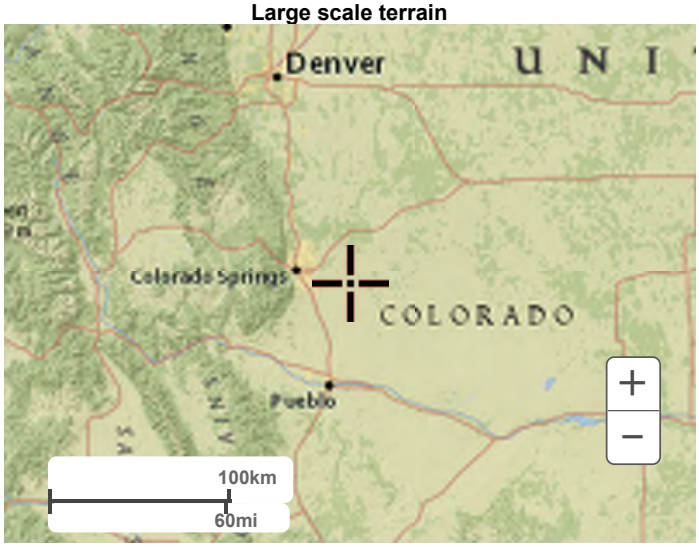
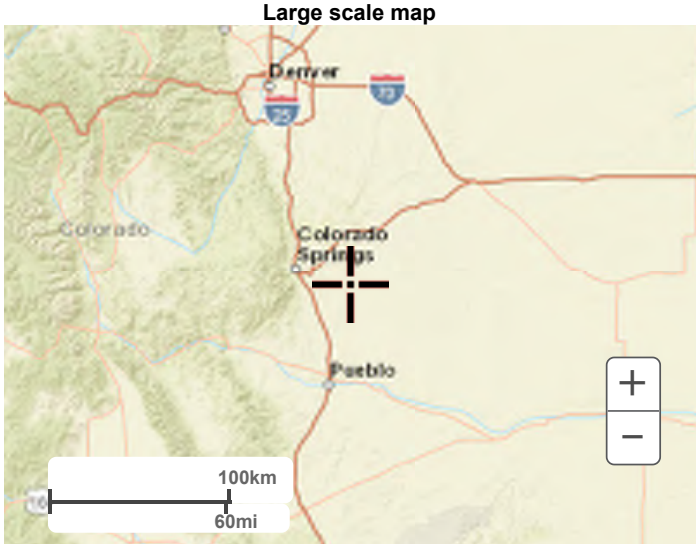
Small scale terrain



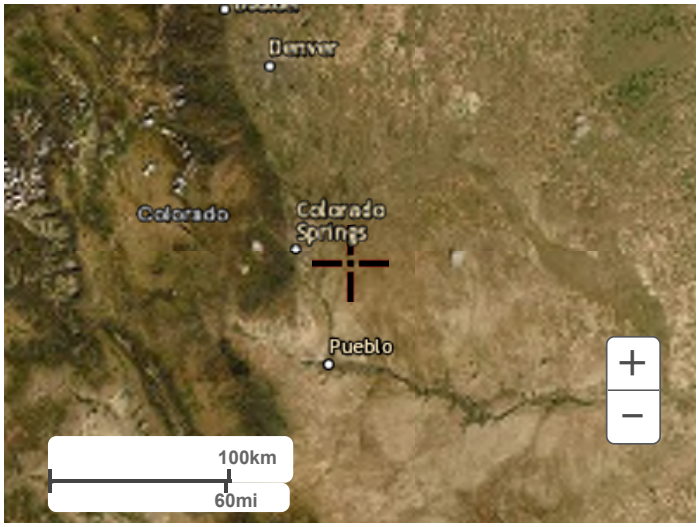
Large scale terrain



Large scale map



Large scale aerial



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APPENDIX D – HYDROLOGIC CALCULATIONS

WEIGHTED CURVE NUMBER AND RELEASE RATE CALCULATIONS

Pre and Post Development Basin Weighted Curve Number Calculation

Cherokee WRF TDS Reduction Facility
El Paso County, Colorado

Pre-Development

			Buildings		Infiltration Area*		Gravel (Soil Type A)		Gravel (Soil Type B)		Pavement		Vegetated Area (Soil Type A)		Vegetated Area (Soil Type B)		Weighted Curve Number
			CN = 98		No Runoff		CN = 76 (A)		CN = 85 (B)		CN = 98		CN = 49		CN = 61		
Basin	Area (SF)	Area (AC)	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	
OS-1	18,685,933	428.97	0	0	0	0	0	0	0	0	0	0	8,210,189	188.48	10,475,744	240.49	56
OS-2	197,762	4.54	0	0	0	0	0	0	0	0	0	0	157,252	3.61	40,511	0.93	51
A	332,744	7.64	0	0.00	0	0.00	7,290	0.17	0	0.00	0	0.00	117,312	2.69	208,137	4.78	57
B	152,976	3.51	0	0.00	0	0.00	732	0.02	6,545	0.15	8,924	0.20	42,479	0.98	94,295	2.16	61
C	437,705	10.05	6,036	0.14	39,591	0.91	2,470	0.06	0	0.00	59,352	1.36	210,100	4.82	159,747	3.67	62
D	195,572	4.49	675	0.02	18,047	0.41	0	0.00	0	0.00	18,648	0.43	54,632	1.25	121,617	2.79	61
E	494,609	11.35	7,197	0.17	38,430	0.88	0	0.00	0	0.00	94,397	2.17	112,764	2.59	280,250	6.43	66
F	543,184	12.47	487	0.01	0	0.00	0	0.00	0	0.00	4,681	0.11	136,437	3.13	401,579	9.22	58
G	2,922,266	67.09	0	0.00	0	0.00	0	0.00	47,910	1.10	0	0.00	1,499,245	34.42	1,375,111	31.57	55
H	1,725,874	39.62	0	0.00	0	0.00	0	0.00	5,770	0.13	0	0.00	364,897	8.38	1,355,208	31.11	59

* Infiltration Areas not included in calculations

Post-Development

			Buildings		Infiltration Area*		Gravel (Soil Type A)		Gravel (Soil Type B)		Pavement		Vegetated Area (Soil Type A)		Vegetated Area (Soil Type B)		Weighted Curve Number
			CN = 98		No Runoff		CN = 76 (A)		CN = 85 (B)		CN = 98		CN = 49		CN = 61		
Basin	Area (SF)	Area (AC)	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	SF	AC	
OS-1	18,685,933	428.97	0	0	0	0	0	0	0	0	0	0	8,210,189	188.48	10,475,744	240.49	56
OS-2	197,762	4.54	0	0	0	0	0	0	0	0	0	0	157,252	3.61	40,511	0.93	51
A	332,744	7.64	0	0.00	0	0.00	7,290	0.17	0	0.00	0	0.00	117,312	2.69	208,137	4.78	57
B	120,463	2.77	0	0.00	0	0.00	0	0.00	6,262	0.14	8,924	0.20	12,338	0.28	92,939	2.13	64
C1	104,240	2.39	0	0.00	0	0.00	3,690	0.08	6,310	0.14	0	0.00	49,254	1.13	44,986	1.03	57
C2	859,034	19.72	6,040	0.14	1,103,022	25.32	0	0.00	10,294	0.24	44,962	1.03	247,540	5.68	550,198	12.63	60
C3	435,300	9.99	12,948	0.30	1,026,955	23.58	31,197	0.72	1,551	0.04	14,690	0.34	336,269	7.72	38,645	0.89	55
D	195,572	4.49	675	0.02	18,047	0.41	0	0.00	0	0.00	18,648	0.43	54,632	1.25	121,617	2.79	61
E	439,674	10.09	7,197	0.17	38,430	0.88	0	0.00	0	0.00	94,397	2.17	112,506	2.58	225,574	5.18	66
F	528,303	12.13	487	0.01	0	0.00	0	0.00	0	0.00	4,681	0.11	54,632	1.25	106,817	2.45	58
H	1,725,874	39.62	0	0.00	0	0.00	0	0.00	5,770	0.13	0	0.00	364,897	8.38	1,355,208	31.11	59

* Infiltration Areas not included in calculations

Allowable Release Rate Calculation
Cherokee WRF TDS Reduction Facility
El Paso County, Colorado

Table 13-2 - Allowable Unit Release Rates (cfs/ac)
El Paso County Drainage Criteria Manual, Volume 1

Design Return	NRCS Hydrologic Soil Group (CFS/AC)		
	A	B	C/D
2	0	0.01	0.04
5	0	0.04	0.3
100	0.1	0.3	0.5

Pre-Development NCRS Soil Type Summary

Basin	Soil 3	Acres	Soil 5	Acres	Soil 62	Acres	Soil 124	Acres	Total SF	Total Acre
A	0	0.00	117,312	2.69	0	0.00	215,427	4.95	332,739	7.64
B	0	0.00	42,565	0.98	0	0.00	110,200	2.53	152,766	3.51
C	0	0.00	279,388	6.41	0	0.00	197,922	4.54	477,310	10.96
D	0	0.00	62,794	1.44	0	0.00	150,439	3.45	213,233	4.90
E	0	0.00	193,240	4.44	0	0.00	340,085	7.81	533,325	12.24
F	0	0.00	138,946	3.19	0	0.00	404,303	9.28	543,249	12.47
G	288,561	6.62	1,526,008	35.03	0	0.00	1,108,078	25.44	2,922,647	67.09
H	0	0.00	365,009	8.38	318,291	7.31	1,139,936	26.17	1,823,236	41.86

Allowable Release Rate Calculations

Basin	Soil A	Soil B	Soil A Runoff 2 year	Soil A Runoff 5 Year	Soil A Runoff 100 year	Soil B Runoff 2 year	Soil B Runoff 5 Year	Soil B Runoff 100 year	Total Runoff 2 year	Total Runoff 5 year	Total Runoff 100 year
A	2.69	4.95	0	0	0.27	0.05	0.20	1.48	0.05	0.20	1.75
B	0.98	2.53	0	0	0.10	0.03	0.10	0.76	0.03	0.10	0.86
C	6.41	4.54	0	0	0.64	0.05	0.18	1.36	0.05	0.18	2.00
D	1.44	3.45	0	0	0.14	0.03	0.14	1.04	0.03	0.14	1.18
E	4.44	7.81	0	0	0.44	0.08	0.31	2.34	0.08	0.31	2.79
F	3.19	9.28	0	0	0.32	0.09	0.37	2.78	0.09	0.37	3.10
G	35.03	32.06	0	0	3.50	0.32	1.28	9.62	0.32	1.28	13.12
H	8.38	33.48	0	0	0.84	0.33	1.34	10.04	0.33	1.34	10.88
								All Basins =	**0.98**	**3.92**	**35.69**
								Basins D, E, F =	**0.21**	**0.82**	**7.07**

SCS HYDROGRAPH CALCULATIONS – EXISTING CONDITIONS

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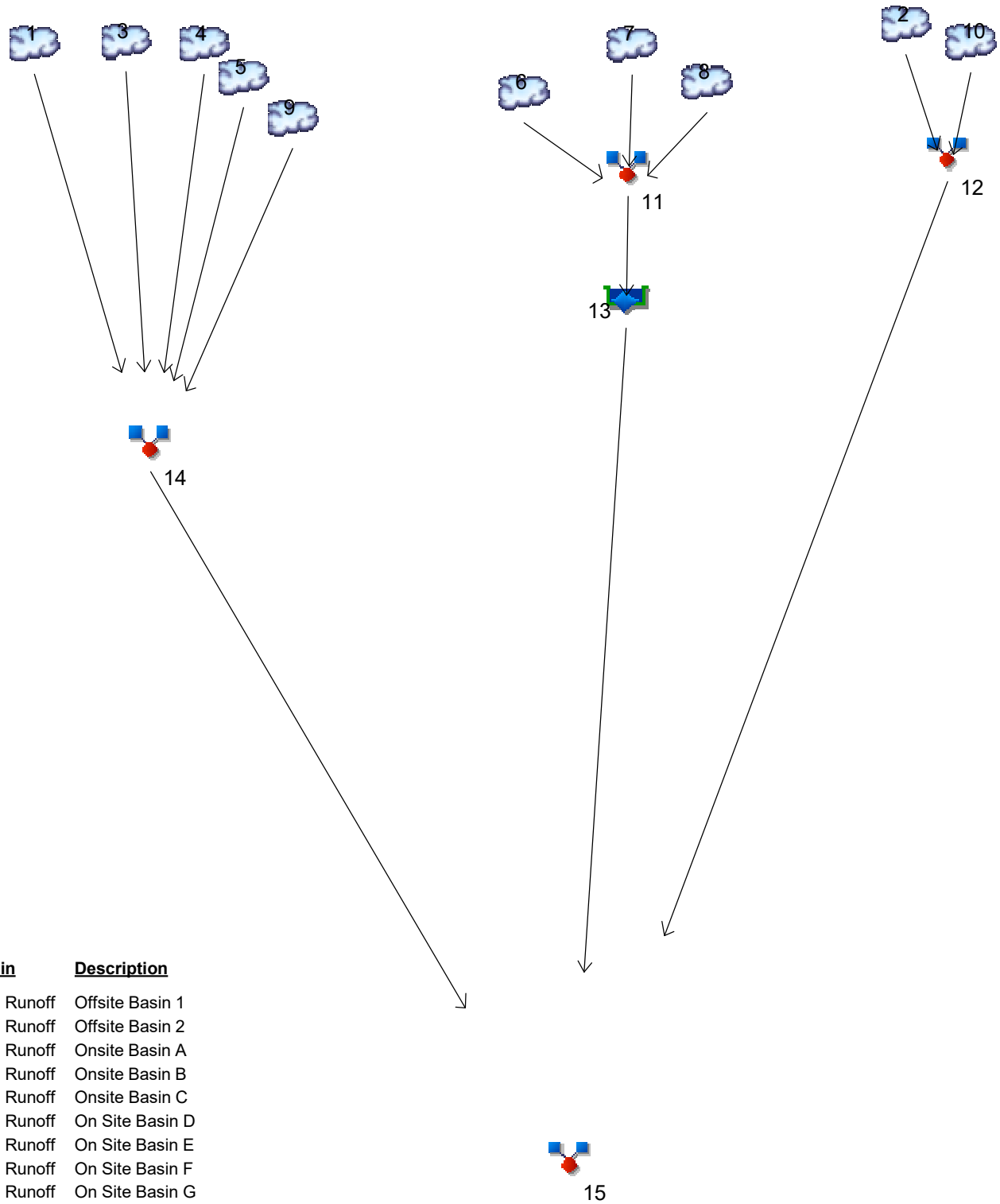
Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Offsite Basin 1
2	SCS Runoff	Offsite Basin 2
3	SCS Runoff	Onsite Basin A
4	SCS Runoff	Onsite Basin B
5	SCS Runoff	Onsite Basin C
6	SCS Runoff	On Site Basin D
7	SCS Runoff	On Site Basin E
8	SCS Runoff	On Site Basin F
9	SCS Runoff	On Site Basin G
10	SCS Runoff	On Site Basin H
11	Combine	Detention Pond Flow
12	Combine	Offsite Flow
13	Reservoir	Pond 1
14	Combine	Ephemeral Stream
15	Combine	Total Discharge

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	------	-------	0.379	-------	-------	8.620	-------	-------	94.58	Offsite Basin 1
2	SCS Runoff	------	-------	0.000	-------	-------	0.027	-------	-------	1.252	Offsite Basin 2
3	SCS Runoff	------	-------	0.010	-------	-------	0.282	-------	-------	3.969	Onsite Basin A
4	SCS Runoff	------	-------	0.013	-------	-------	0.352	-------	-------	2.922	Onsite Basin B
5	SCS Runoff	------	-------	0.049	-------	-------	1.141	-------	-------	8.370	Onsite Basin C
6	SCS Runoff	------	-------	0.016	-------	-------	0.423	-------	-------	3.473	On Site Basin D
7	SCS Runoff	------	-------	0.191	-------	-------	1.773	-------	-------	8.918	On Site Basin E
8	SCS Runoff	------	-------	0.020	-------	-------	0.568	-------	-------	6.703	On Site Basin F
9	SCS Runoff	------	-------	0.039	-------	-------	1.336	-------	-------	24.25	On Site Basin G
10	SCS Runoff	------	-------	0.084	-------	-------	1.936	-------	-------	18.20	On Site Basin H
11	Combine	6, 7, 8,	-------	0.199	-------	-------	2.727	-------	-------	18.37	Detention Pond Flow
12	Combine	2, 10,	-------	0.083	-------	-------	1.933	-------	-------	19.18	Offsite Flow
13	Reservoir	11	-------	0.085	-------	-------	1.387	-------	-------	10.41	Pond 1
14	Combine	1, 3, 4,	-------	0.467	-------	-------	10.24	-------	-------	113.27	Ephemeral Stream
15	Combine	5, 9, 12, 13, 14	-------	0.656	-------	-------	12.72	-------	-------	140.17	Total Discharge

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.379	2	1446	7,650	------	------	------	Offsite Basin 1
2	SCS Runoff	0.000	2	n/a	0	------	------	------	Offsite Basin 2
3	SCS Runoff	0.010	2	1440	242	------	------	------	Onsite Basin A
4	SCS Runoff	0.013	2	918	452	------	------	------	Onsite Basin B
5	SCS Runoff	0.049	2	824	1,601	------	------	------	Onsite Basin C
6	SCS Runoff	0.016	2	920	565	------	------	------	On Site Basin D
7	SCS Runoff	0.191	2	782	3,793	------	------	------	On Site Basin E
8	SCS Runoff	0.020	2	1440	625	------	------	------	On Site Basin F
9	SCS Runoff	0.039	2	1442	523	------	------	------	On Site Basin G
10	SCS Runoff	0.084	2	1110	2,836	------	------	------	On Site Basin H
11	Combine	0.199	2	786	4,984	6, 7, 8,	------	------	Detention Pond Flow
12	Combine	0.083	2	1110	2,817	2, 10,	------	------	Offsite Flow
13	Reservoir	0.085	2	1442	2,031	11	5892.86	3,590	Pond 1
14	Combine	0.467	2	1442	10,440	1, 3, 4,	------	------	Ephemeral Stream
15	Combine	0.656	2	1440	16,607	5, 9, 12, 13, 14	------	------	Total Discharge

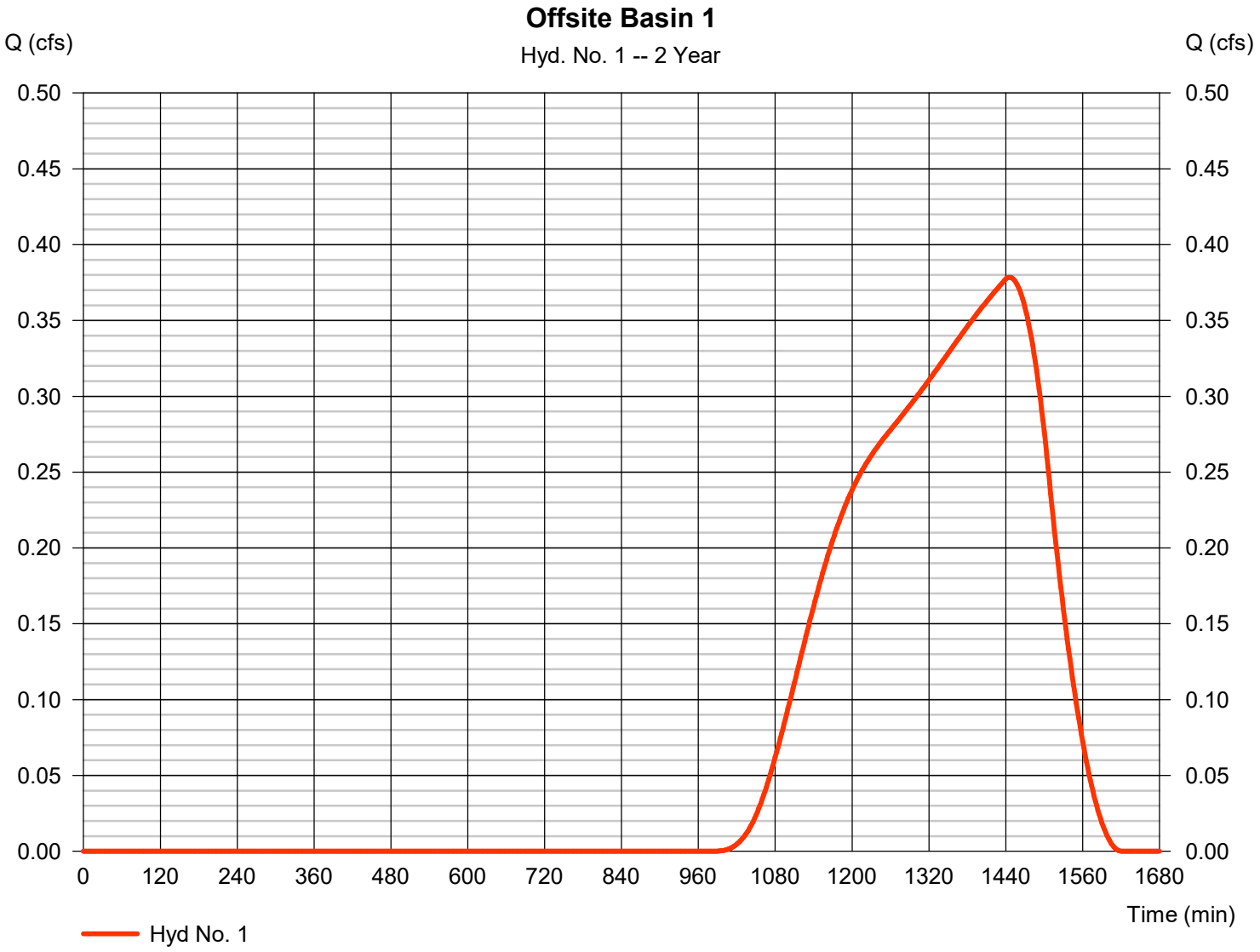
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.379 cfs
Storm frequency	= 2 yrs	Time to peak	= 1446 min
Time interval	= 2 min	Hyd. volume	= 7,650 cuft
Drainage area	= 428.970 ac	Curve number	= 56*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 114.40 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



TR55 Tc Worksheet

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

Hyd. No. 1

Offsite Basin 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 1.74		0.00		0.00		
Travel Time (min)	**= 33.54**	**+**	**0.00**	**+**	**0.00**	**=**	**33.54**
Shallow Concentrated Flow							
Flow length (ft)	= 10323.00		0.00		0.00		
Watercourse slope (%)	= 1.74		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.13		0.00		0.00		
Travel Time (min)	**= 80.84**	**+**	**0.00**	**+**	**0.00**	**=**	**80.84**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 114.40 min

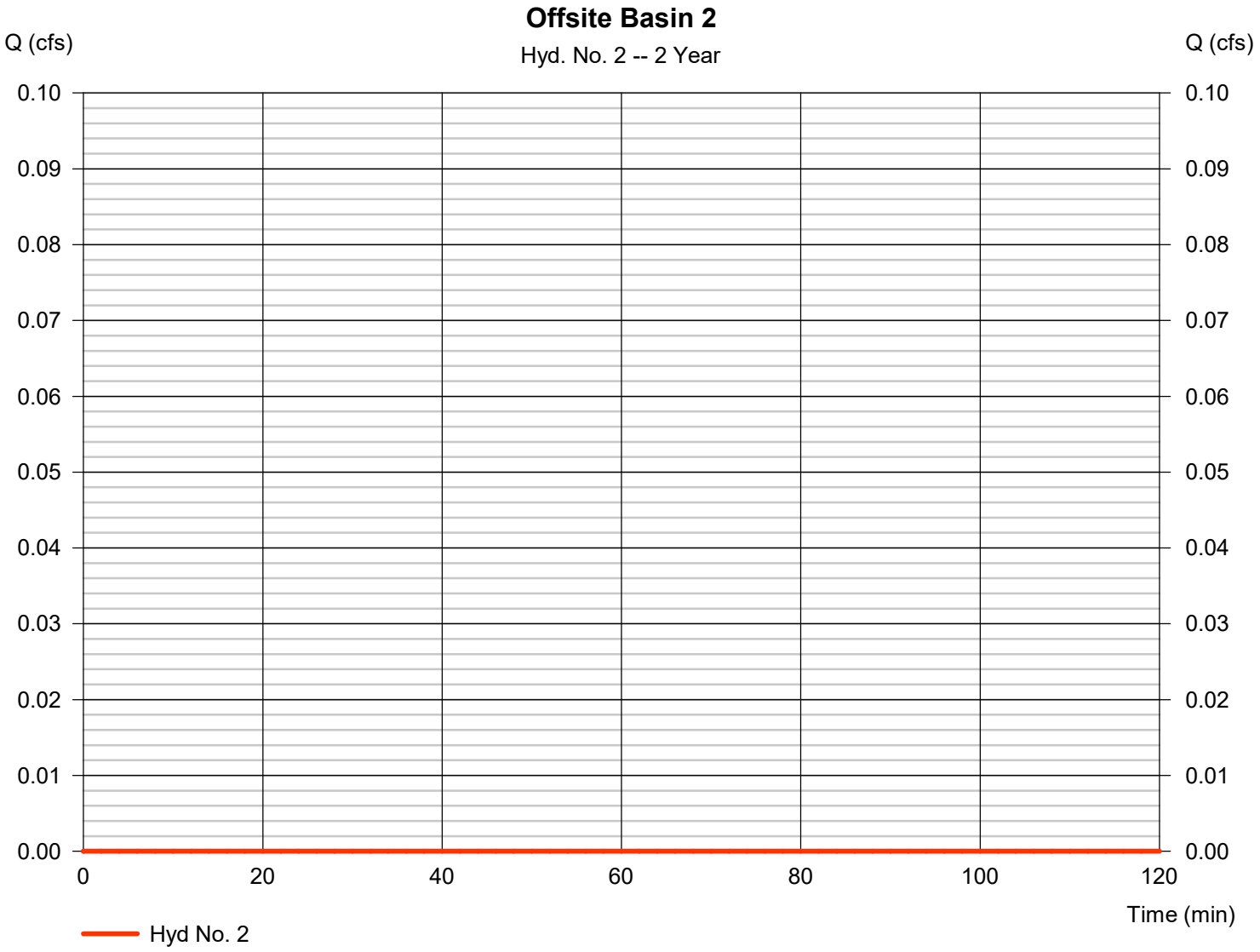
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Drainage area	= 4.540 ac	Curve number	= 51*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



TR55 Tc Worksheet

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

Hyd. No. 2

Offsite Basin 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.42		0.00		0.00		
Travel Time (min)	**= 29.40**	**+**	**0.00**	**+**	**0.00**	**=**	**29.40**
Shallow Concentrated Flow							
Flow length (ft)	= 731.00		0.00		0.00		
Watercourse slope (%)	= 2.42		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.51		0.00		0.00		
Travel Time (min)	**= 4.85**	**+**	**0.00**	**+**	**0.00**	**=**	**4.85**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 34.30 min

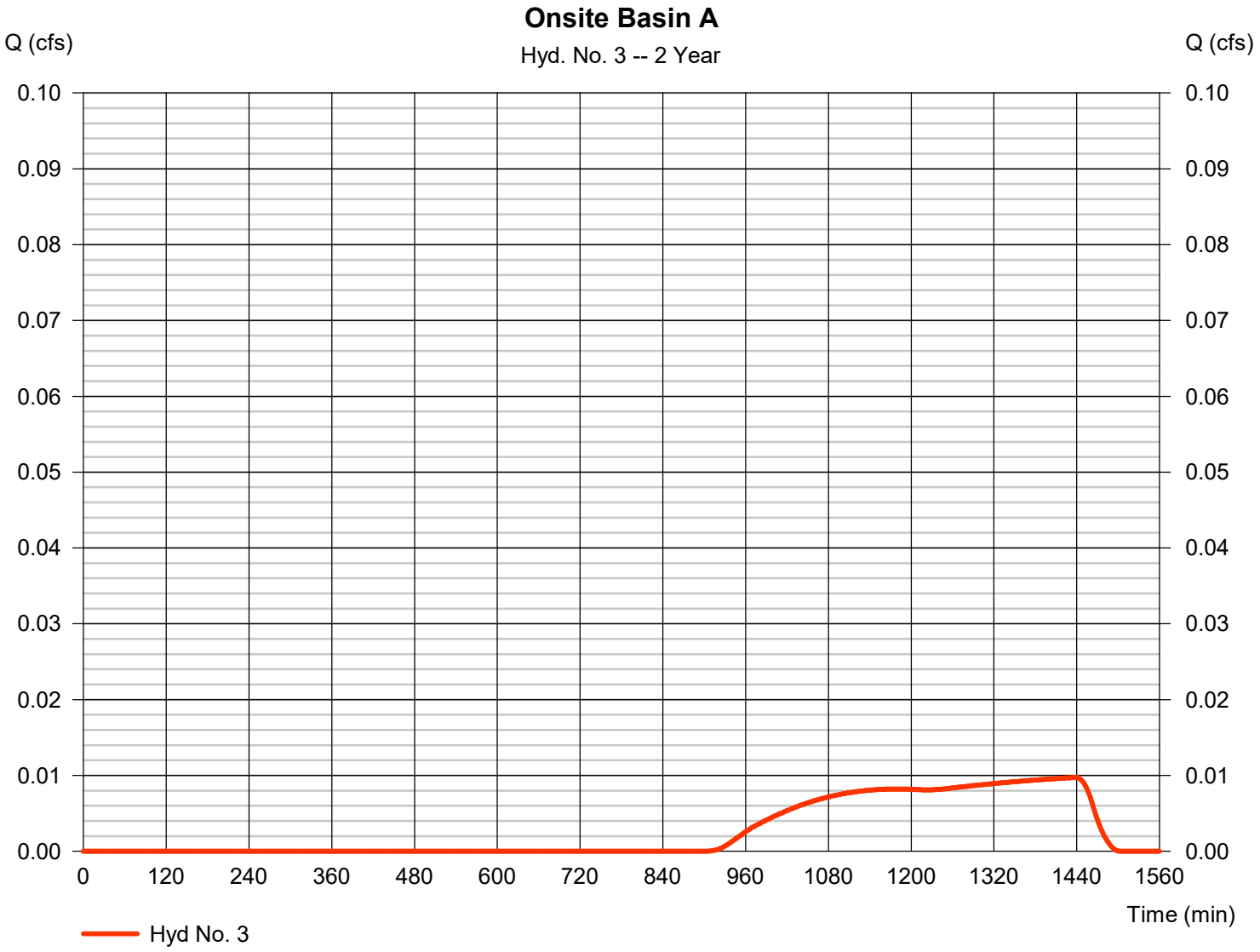
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.010 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 242 cuft
Drainage area	= 7.640 ac	Curve number	= 57*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.50 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 76)] / 7.640



TR55 Tc Worksheet

Hyd. No. 3

Onsite Basin A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 786.82		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 5.75**	**+**	**0.00**	**+**	**0.00**	**=**	**5.75**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 37.50 min

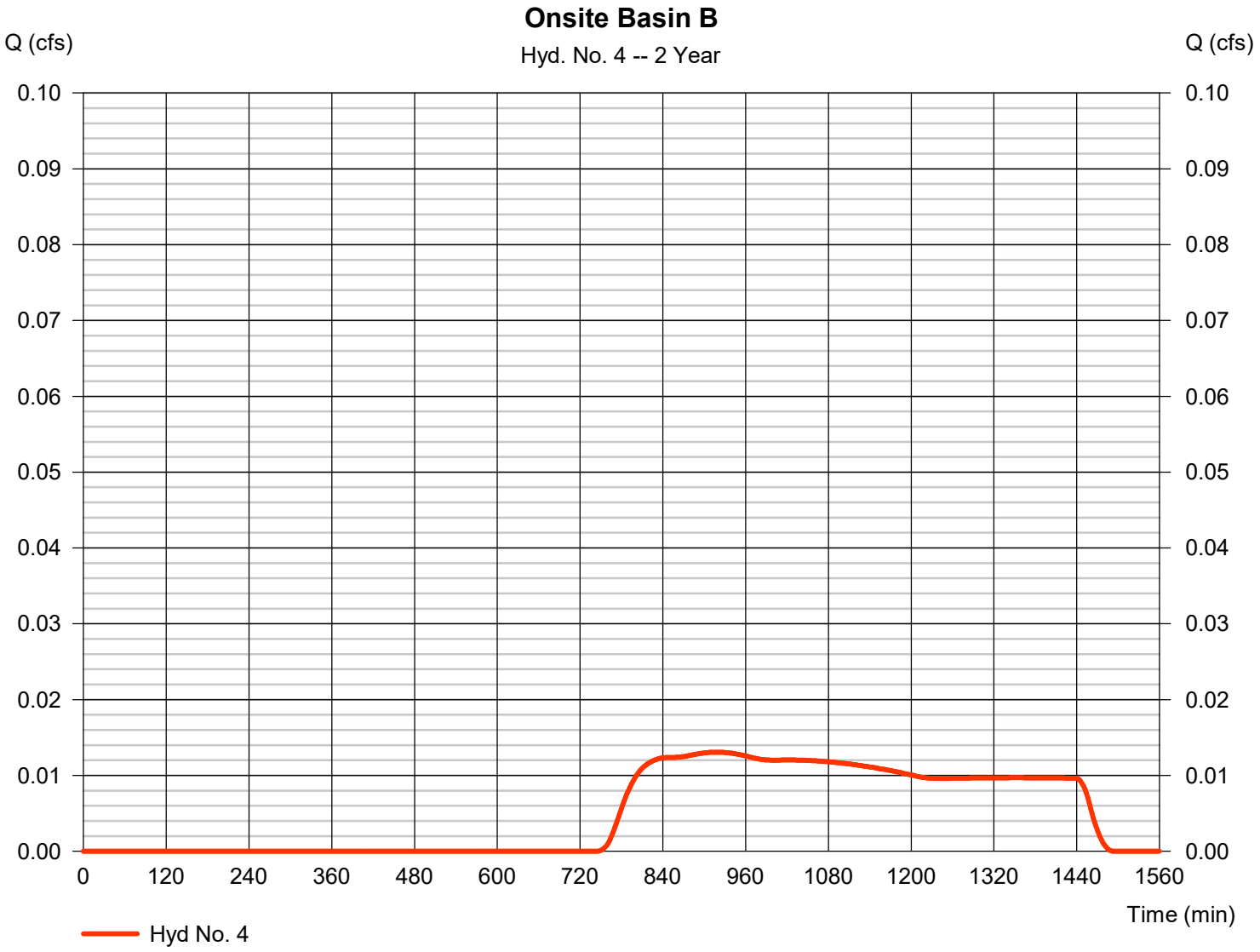
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.013 cfs
Storm frequency	=	2 yrs	Time to peak	=	918 min
Time interval	=	2 min	Hyd. volume	=	452 cuft
Drainage area	=	3.510 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 85) + (0.020 x 76) + (2.160 x 61) + (0.980 x 49) + (0.200 x 98)] / 3.510



TR55 Tc Worksheet

Hyd. No. 4

Onsite Basin B

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 73.94		0.00		0.00		
Watercourse slope (%)	= 1.35		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.87		0.00		0.00		
Travel Time (min)	**= 0.66**	**+**	**0.00**	**+**	**0.00**	**=**	**0.66**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 32.40 min

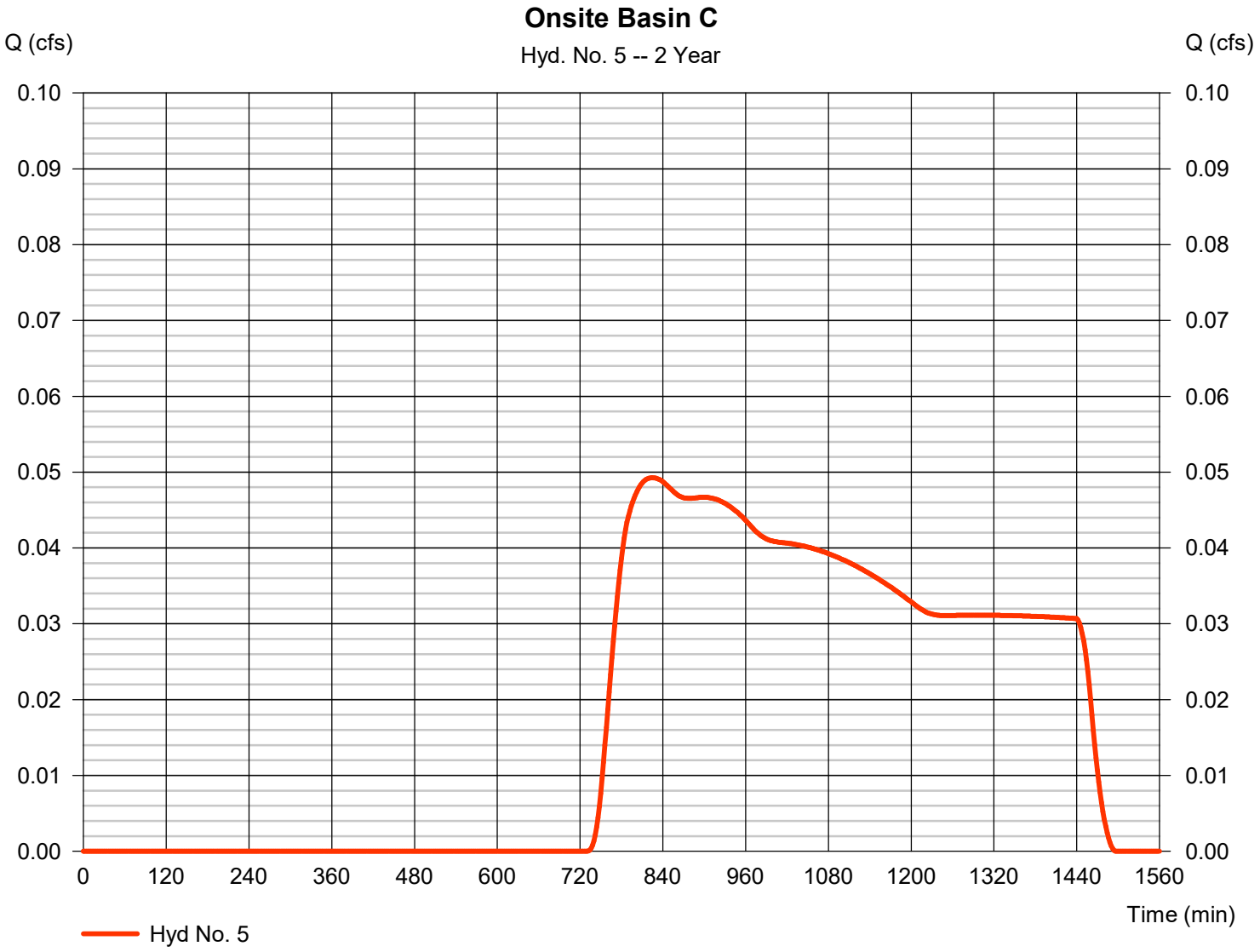
Hydrograph Report

Hyd. No. 5

Onsite Basin C

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.049 cfs
Storm frequency	=	2 yrs	Time to peak	=	824 min
Time interval	=	2 min	Hyd. volume	=	1,601 cuft
Drainage area	=	10.050 ac	Curve number	=	62*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.30 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.060 x 76) + (0.140 x 98) + (1.360 x 98) + (4.820 x 61) + (3.670 x 49)] / 10.050



TR55 Tc Worksheet

Hyd. No. 5

Onsite Basin C

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		1.77		0.00		
Land slope (%)	= 3.00		0.00		0.00		
Travel Time (min)	**= 26.98**	**+**	**0.00**	**+**	**0.00**	**=**	**26.98**
Shallow Concentrated Flow							
Flow length (ft)	= 869.87		0.00		0.00		
Watercourse slope (%)	= 1.50		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.98		0.00		0.00		
Travel Time (min)	**= 7.34**	**+**	**0.00**	**+**	**0.00**	**=**	**7.34**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 34.30 min

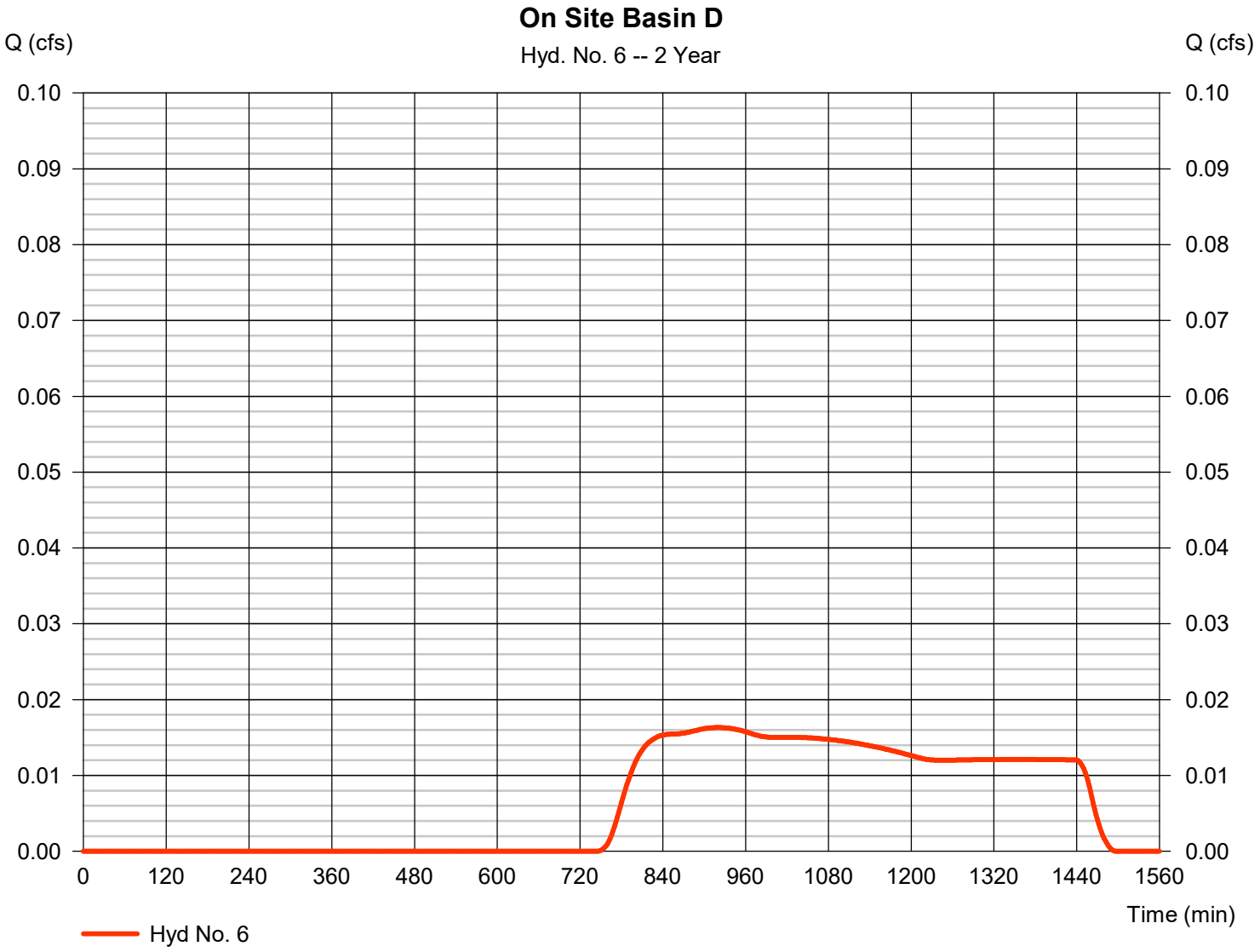
Hydrograph Report

Hyd. No. 6

On Site Basin D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.016 cfs
Storm frequency	= 2 yrs	Time to peak	= 920 min
Time interval	= 2 min	Hyd. volume	= 565 cuft
Drainage area	= 4.490 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.00 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.430 x 98) + (0.020 x 98) + (2.790 x 61) + (1.250 x 49)] / 4.490



TR55 Tc Worksheet

Hyd. No. 6

On Site Basin D

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 245.0		55.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		1.77		0.00		
Land slope (%)	= 1.50		1.50		0.00		
Travel Time (min)	**= 30.27**	**+**	**1.13**	**+**	**0.00**	**=**	**31.40**
Shallow Concentrated Flow							
Flow length (ft)	= 109.14		477.45		0.00		
Watercourse slope (%)	= 2.00		1.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		1.61		0.00		
Travel Time (min)	**= 0.63**	**+**	**4.93**	**+**	**0.00**	**=**	**5.56**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 37.00 min

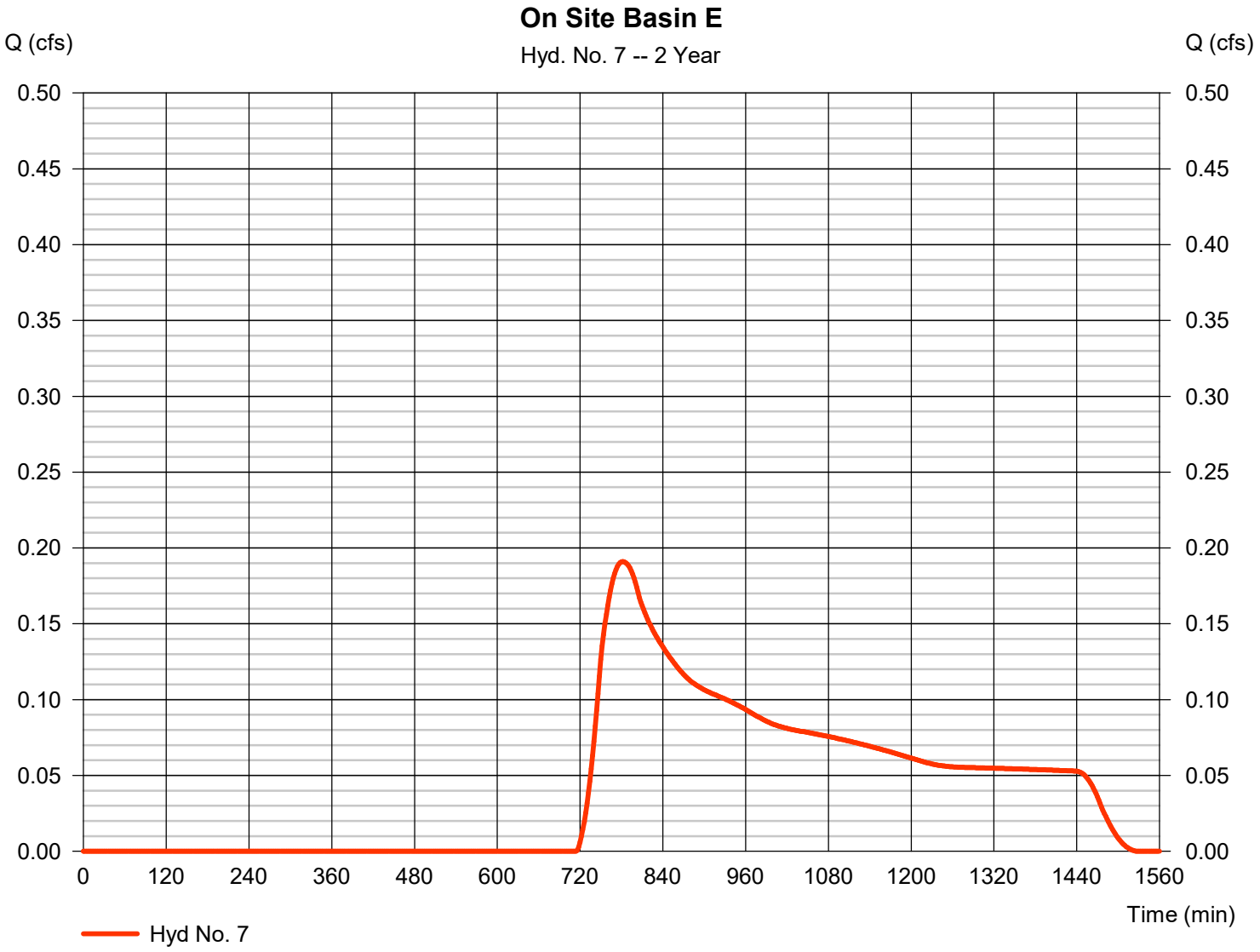
Hydrograph Report

Hyd. No. 7

On Site Basin E

Hydrograph type	= SCS Runoff	Peak discharge	= 0.191 cfs
Storm frequency	= 2 yrs	Time to peak	= 782 min
Time interval	= 2 min	Hyd. volume	= 3,793 cuft
Drainage area	= 11.350 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 55.50 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (2.170 x 98) + (6.420 x 61) + (2.590 x 49)] / 11.350



TR55 Tc Worksheet

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Hyd. No. 7

On Site Basin E

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.150		0.150		
Flow length (ft)	= 161.2		92.5		164.9		
Two-year 24-hr precip. (in)	= 1.77		1.77		1.77		
Land slope (%)	= 2.00		10.83		1.50		
Travel Time (min)	**= 19.30**	**+**	**6.30**	**+**	**22.05**	**=**	**47.65**
Shallow Concentrated Flow							
Flow length (ft)	= 101.77		994.48		0.00		
Watercourse slope (%)	= 2.00		2.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		2.28		0.00		
Travel Time (min)	**= 0.59**	**+**	**7.26**	**+**	**0.00**	**=**	**7.85**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 55.50 min

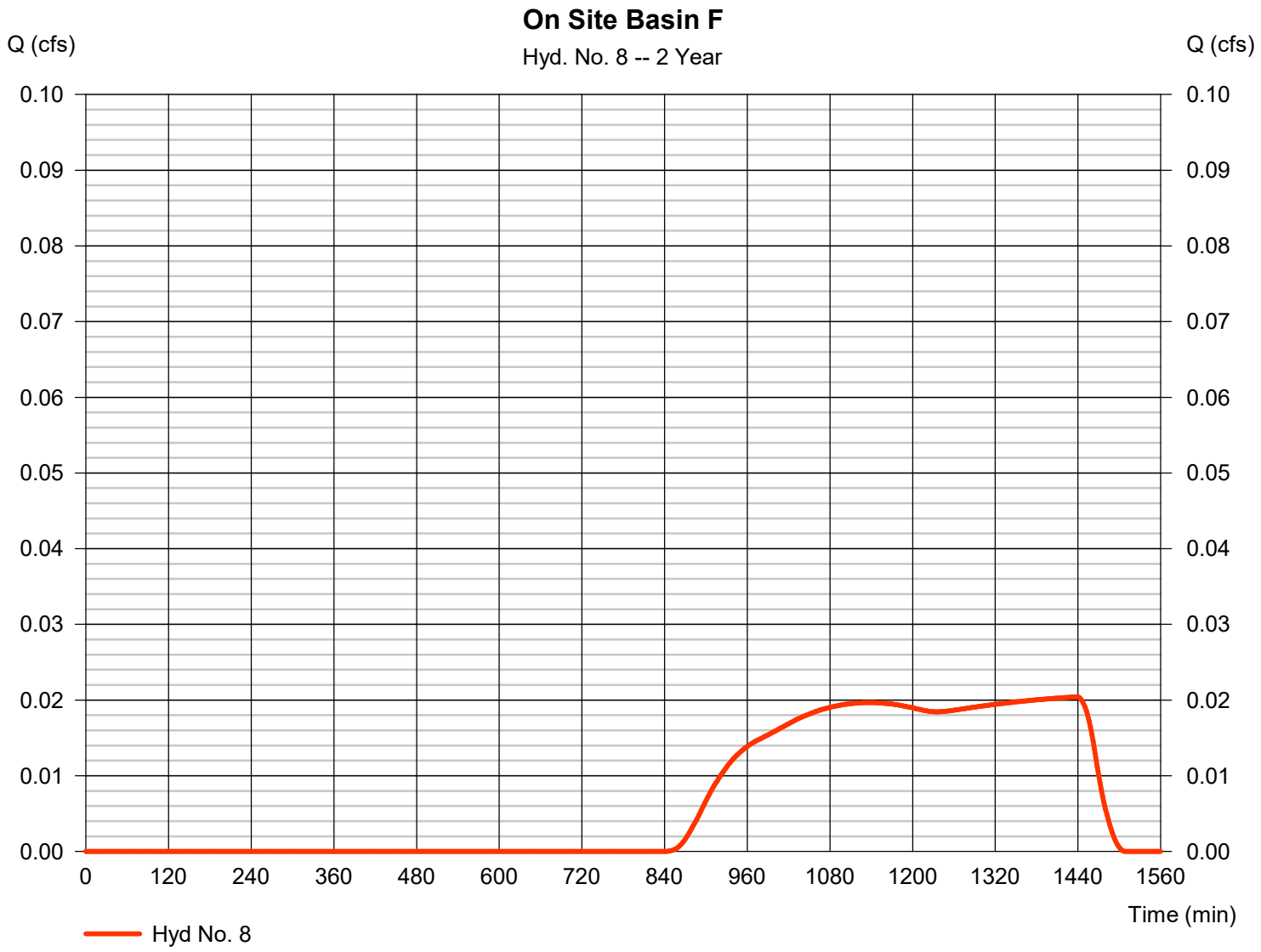
Hydrograph Report

Hyd. No. 8

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.020 cfs
Storm frequency	=	2 yrs	Time to peak	=	1440 min
Time interval	=	2 min	Hyd. volume	=	625 cuft
Drainage area	=	12.470 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 98) + (0.110 x 98) + (9.220 x 61) + (3.130 x 49)] / 12.470



TR55 Tc Worksheet

Hyd. No. 8

On Site Basin F

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		1.77		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 100.00		1367.56		200.00		
Watercourse slope (%)	= 6.53		2.00		5.55		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=4.12		2.28		3.80		
Travel Time (min)	**= 0.40**	**+**	**9.99**	**+**	**0.88**	**=**	**11.27**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 43.00 min

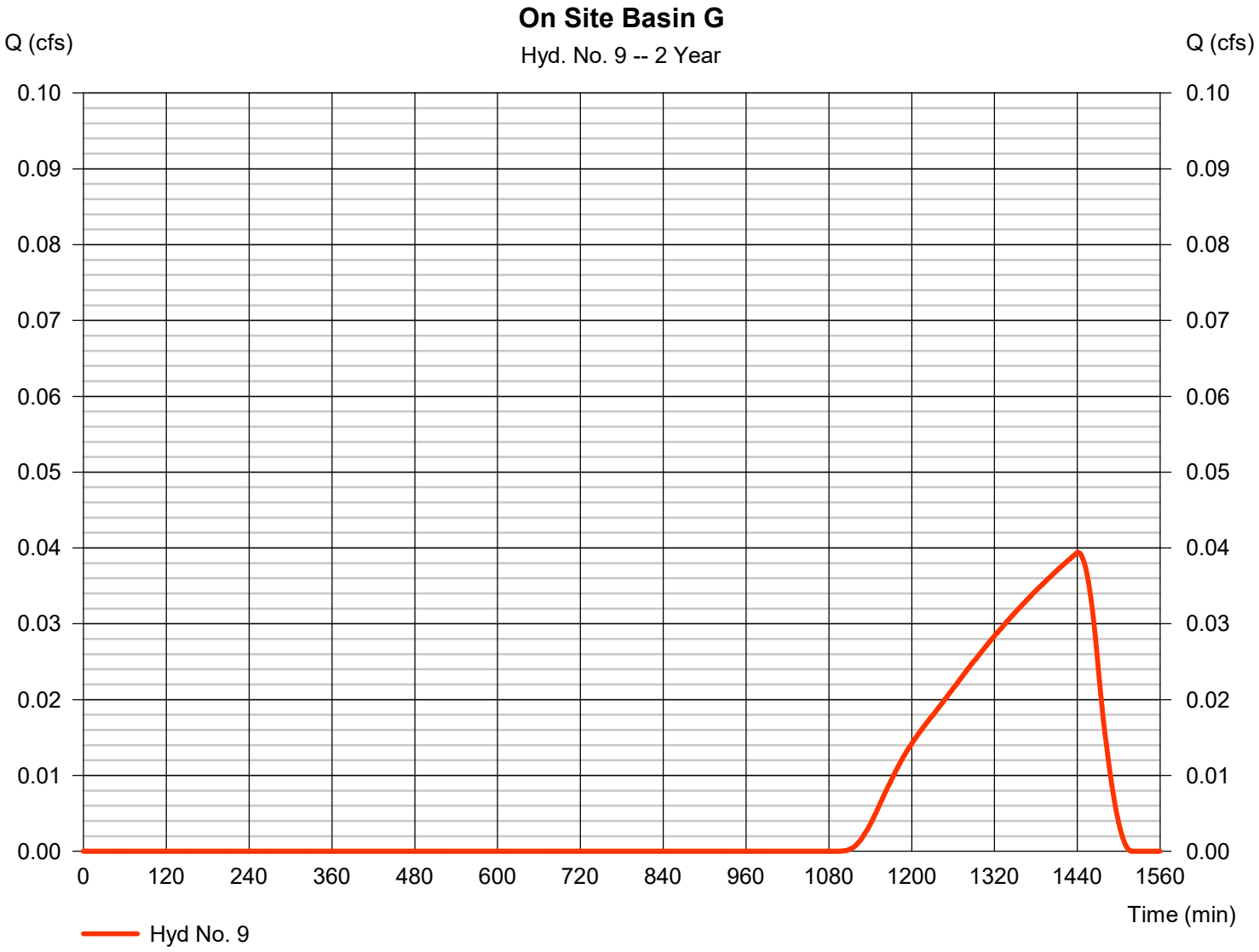
Hydrograph Report

Hyd. No. 9

On Site Basin G

Hydrograph type	= SCS Runoff	Peak discharge	= 0.039 cfs
Storm frequency	= 2 yrs	Time to peak	= 1442 min
Time interval	= 2 min	Hyd. volume	= 523 cuft
Drainage area	= 67.090 ac	Curve number	= 55*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 50.30 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(34.420 x 49) + (31.570 x 61) + (1.100 x 85)] / 67.090



TR55 Tc Worksheet

Hyd. No. 9

On Site Basin G

Description	A	B	C	Totals
Sheet Flow				
Manning's n-value	= 0.150	0.150	0.150	
Flow length (ft)	= 100.0	100.0	100.0	
Two-year 24-hr precip. (in)	= 1.77	1.77	1.77	
Land slope (%)	= 2.15	3.80	4.11	
Travel Time (min)	**= 12.80**	**+ 10.19**	**+ 9.88**	**= 32.87**
Shallow Concentrated Flow				
Flow length (ft)	= 530.22	603.73	1399.26	
Watercourse slope (%)	= 1.50	5.00	2.00	
Surface description	= Unpaved	Unpaved	Unpaved	
Average velocity (ft/s)	=1.98	3.61	2.28	
Travel Time (min)	**= 4.47**	**+ 2.79**	**+ 10.22**	**= 17.48**
Channel Flow				
X sectional flow area (sqft)	= 0.00	0.00	0.00	
Wetted perimeter (ft)	= 0.00	0.00	0.00	
Channel slope (%)	= 0.00	0.00	0.00	
Manning's n-value	= 0.015	0.015	0.015	
Velocity (ft/s)	=0.00			
		0.00		
			0.00	
Flow length (ft)	({0})0.0	0.0	0.0	
Travel Time (min)	**= 0.00**	**+ 0.00**	**+ 0.00**	**= 0.00**

Total Travel Time, Tc ..... 50.30 min

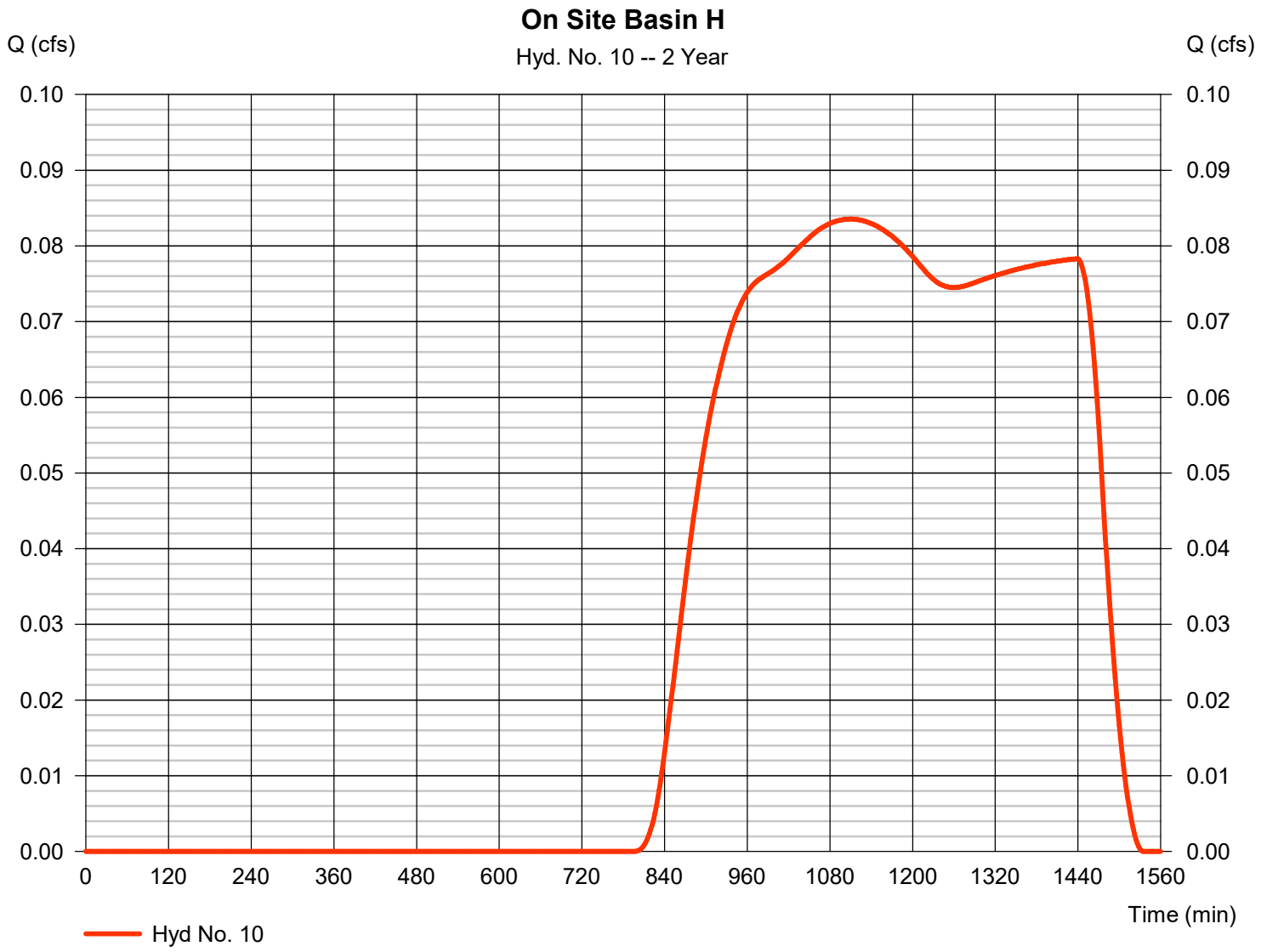
Hydrograph Report

Hyd. No. 10

On Site Basin H

Hydrograph type	= SCS Runoff	Peak discharge	= 0.084 cfs
Storm frequency	= 2 yrs	Time to peak	= 1110 min
Time interval	= 2 min	Hyd. volume	= 2,836 cuft
Drainage area	= 39.620 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 57.90 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(31.110 x 61) + (8.380 x 49) + (0.130 x 85)] / 39.620



TR55 Tc Worksheet

Hyd. No. 10

On Site Basin H

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 1933.72		600.56		556.40		
Watercourse slope (%)	= 1.25		3.00		1.50		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=1.80		2.79		1.98		
Travel Time (min)	**= 17.87**	**+**	**3.58**	**+**	**4.69**	**=**	**26.14**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

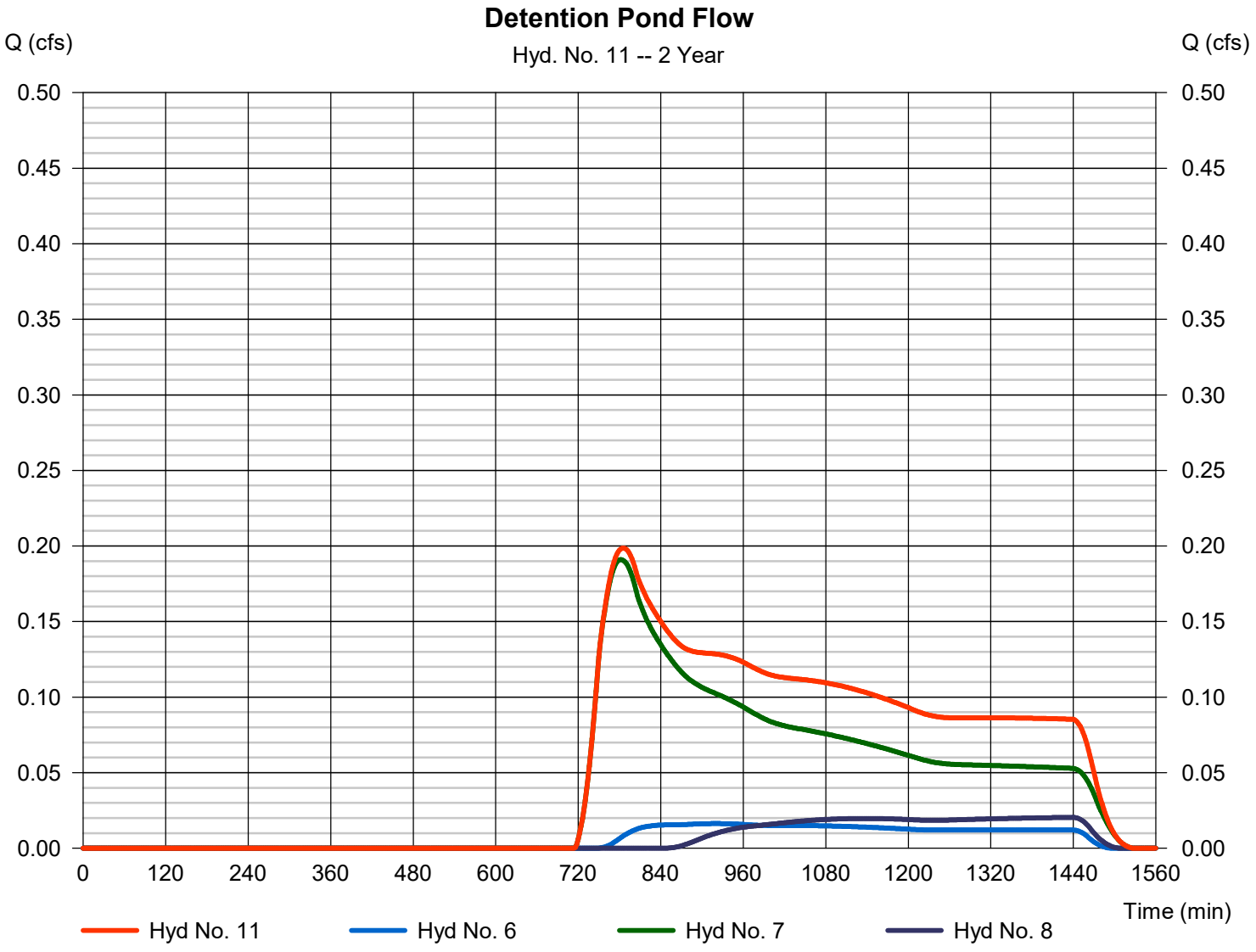
Total Travel Time, Tc ..... 57.90 min

Hydrograph Report

Hyd. No. 11

Detention Pond Flow

Hydrograph type	= Combine	Peak discharge	= 0.199 cfs
Storm frequency	= 2 yrs	Time to peak	= 786 min
Time interval	= 2 min	Hyd. volume	= 4,984 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 28.310 ac

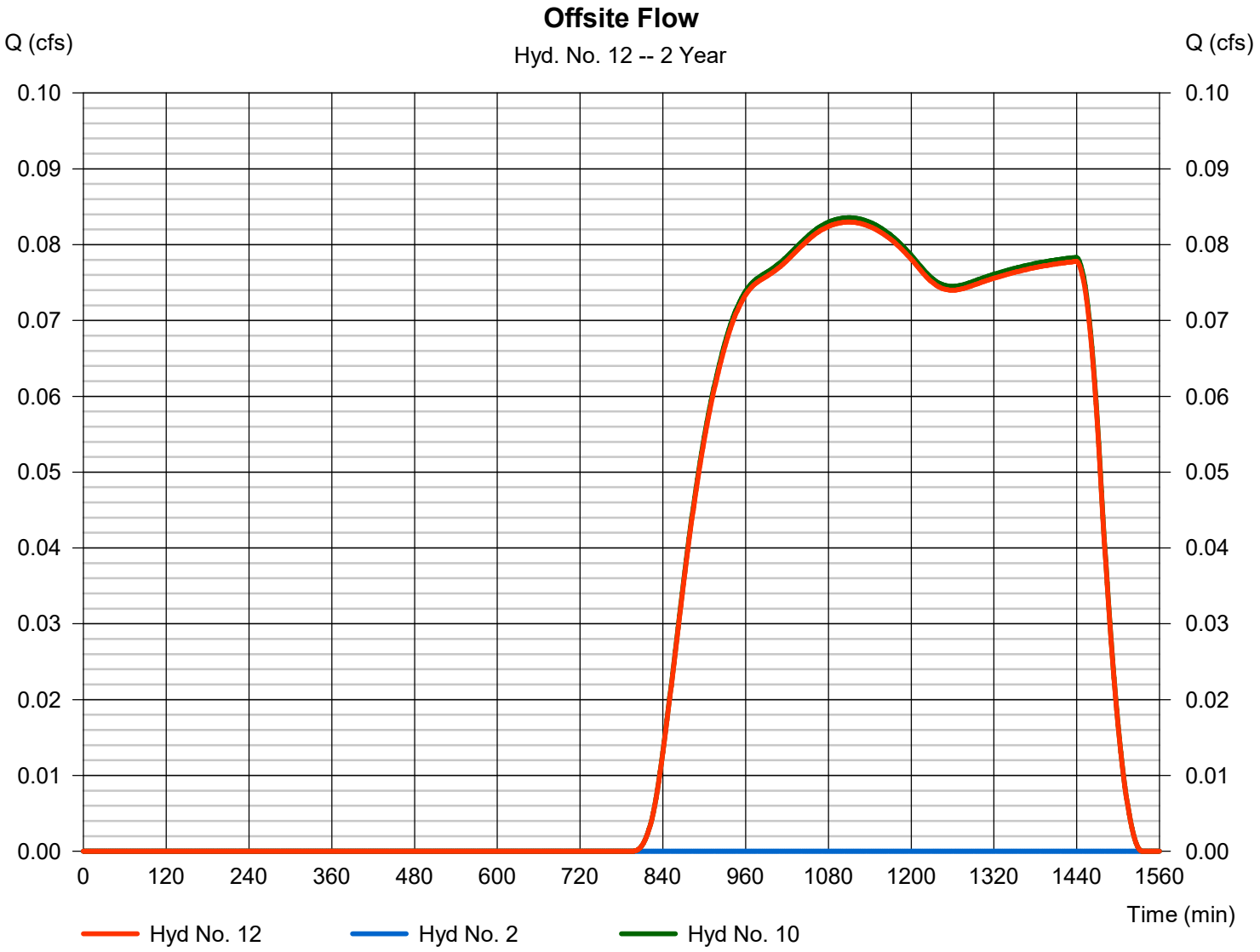


Hydrograph Report

Hyd. No. 12

Offsite Flow

Hydrograph type	= Combine	Peak discharge	= 0.083 cfs
Storm frequency	= 2 yrs	Time to peak	= 1110 min
Time interval	= 2 min	Hyd. volume	= 2,817 cuft
Inflow hyds.	= 2, 10	Contrib. drain. area	= 44.160 ac



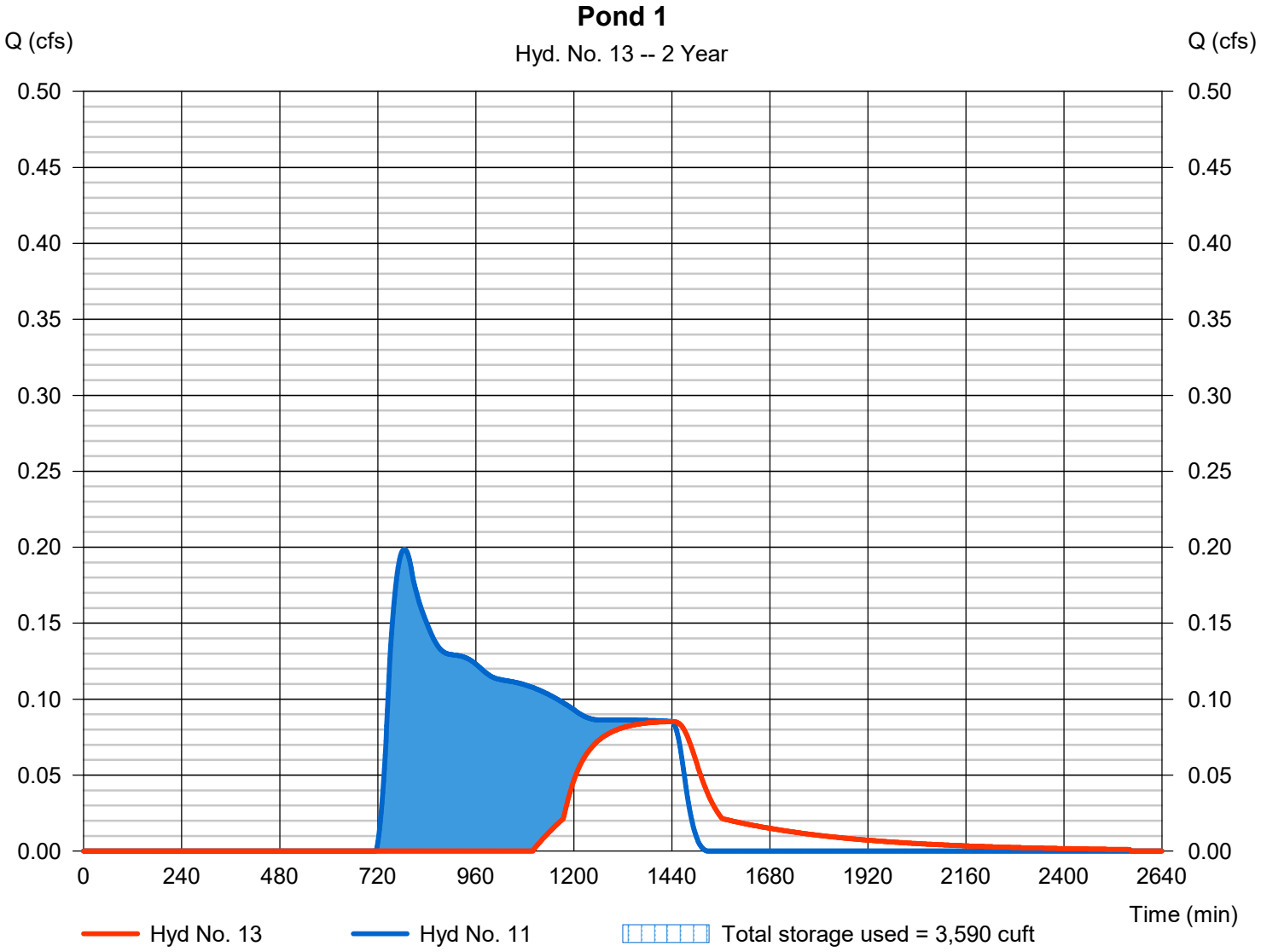
Hydrograph Report

Hyd. No. 13

Pond 1

Hydrograph type	=	Reservoir	Peak discharge	=	0.085 cfs
Storm frequency	=	2 yrs	Time to peak	=	1442 min
Time interval	=	2 min	Hyd. volume	=	2,031 cuft
Inflow hyd. No.	=	11 - Detention Pond Flow	Max. Elevation	=	5892.86 ft
Reservoir name	=	Pond 1	Max. Storage	=	3,590 cuft

Storage Indication method used.



Pond Report

Pond No. 1 - Pond 1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 5892.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	5892.00	1,770	0	0
1.00	5893.00	7,238	4,196	4,196
2.00	5894.00	12,045	9,539	13,735
3.00	5895.00	18,047	14,944	28,679
4.00	5896.00	25,583	21,704	50,382
5.00	5897.00	36,234	30,752	81,134
5.50	5897.50	44,882	20,238	101,372
6.00	5898.00	57,768	25,592	126,965

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	0.00	0.00	0.00
Span (in)	= 24.00	0.00	0.00	0.00
No. Barrels	= 1	0	0	0
Invert El. (ft)	= 5892.73	0.00	0.00	0.00
Length (ft)	= 56.03	0.00	0.00	0.00
Slope (%)	= 0.54	0.00	0.00	n/a
N-Value	= .023	.013	.013	n/a
Orifice Coeff.	= 0.60	0.60	0.60	0.60
Multi-Stage	= n/a	No	No	No

Weir Structures

	[A]	[B]	[C]	[D]
Crest Len (ft)	= 87.50	0.00	0.00	0.00
Crest El. (ft)	= 5897.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Ciplti	---	---	---
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	5892.00	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.10	420	5892.10	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.20	839	5892.20	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.30	1,259	5892.30	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.40	1,678	5892.40	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.50	2,098	5892.50	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.60	2,517	5892.60	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.70	2,937	5892.70	0.00	---	---	---	0.00	---	---	---	---	---	0.000
0.80	3,356	5892.80	0.02 oc	---	---	---	0.00	---	---	---	---	---	0.021
0.90	3,776	5892.90	0.14 oc	---	---	---	0.00	---	---	---	---	---	0.136
1.00	4,196	5893.00	0.35 oc	---	---	---	0.00	---	---	---	---	---	0.345
1.10	5,149	5893.10	0.64 oc	---	---	---	0.00	---	---	---	---	---	0.638
1.20	6,103	5893.20	1.00 oc	---	---	---	0.00	---	---	---	---	---	1.000
1.30	7,057	5893.30	1.42 oc	---	---	---	0.00	---	---	---	---	---	1.423
1.40	8,011	5893.40	1.89 oc	---	---	---	0.00	---	---	---	---	---	1.891
1.50	8,965	5893.50	2.39 oc	---	---	---	0.00	---	---	---	---	---	2.392
1.60	9,919	5893.60	2.92 oc	---	---	---	0.00	---	---	---	---	---	2.923
1.70	10,873	5893.70	3.47 oc	---	---	---	0.00	---	---	---	---	---	3.469
1.80	11,827	5893.80	4.02 oc	---	---	---	0.00	---	---	---	---	---	4.024
1.90	12,781	5893.90	4.57 oc	---	---	---	0.00	---	---	---	---	---	4.574
2.00	13,735	5894.00	5.11 oc	---	---	---	0.00	---	---	---	---	---	5.112
2.10	15,229	5894.10	5.63 oc	---	---	---	0.00	---	---	---	---	---	5.630
2.20	16,723	5894.20	6.12 oc	---	---	---	0.00	---	---	---	---	---	6.119
2.30	18,218	5894.30	6.57 oc	---	---	---	0.00	---	---	---	---	---	6.568
2.40	19,712	5894.40	6.96 oc	---	---	---	0.00	---	---	---	---	---	6.956
2.50	21,207	5894.50	7.27 oc	---	---	---	0.00	---	---	---	---	---	7.267
2.60	22,701	5894.60	7.46 oc	---	---	---	0.00	---	---	---	---	---	7.464
2.70	24,195	5894.70	7.45 oc	---	---	---	0.00	---	---	---	---	---	7.446
2.80	25,690	5894.80	8.05 oc	---	---	---	0.00	---	---	---	---	---	8.052
2.90	27,184	5894.90	9.07 oc	---	---	---	0.00	---	---	---	---	---	9.067
3.00	28,679	5895.00	9.97 oc	---	---	---	0.00	---	---	---	---	---	9.970
3.10	30,849	5895.10	10.81 oc	---	---	---	0.00	---	---	---	---	---	10.81
3.20	33,019	5895.20	11.58 oc	---	---	---	0.00	---	---	---	---	---	11.58
3.30	35,190	5895.30	12.31 oc	---	---	---	0.00	---	---	---	---	---	12.31
3.40	37,360	5895.40	13.00 oc	---	---	---	0.00	---	---	---	---	---	13.00

Continues on next page...

Pond 1

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.50	39,531	5895.50	13.65 oc	---	---	---	0.00	---	---	---	---	---	13.65
3.60	41,701	5895.60	14.27 oc	---	---	---	0.00	---	---	---	---	---	14.27
3.70	43,871	5895.70	14.87 oc	---	---	---	0.00	---	---	---	---	---	14.87
3.80	46,042	5895.80	15.44 oc	---	---	---	0.00	---	---	---	---	---	15.44
3.90	48,212	5895.90	15.99 oc	---	---	---	0.00	---	---	---	---	---	15.99
4.00	50,382	5896.00	16.52 oc	---	---	---	0.00	---	---	---	---	---	16.52
4.10	53,458	5896.10	17.04 oc	---	---	---	0.00	---	---	---	---	---	17.04
4.20	56,533	5896.20	17.54 oc	---	---	---	0.00	---	---	---	---	---	17.54
4.30	59,608	5896.30	18.03 oc	---	---	---	0.00	---	---	---	---	---	18.03
4.40	62,683	5896.40	18.51 oc	---	---	---	0.00	---	---	---	---	---	18.51
4.50	65,758	5896.50	18.97 oc	---	---	---	0.00	---	---	---	---	---	18.97
4.60	68,833	5896.60	19.42 oc	---	---	---	0.00	---	---	---	---	---	19.42
4.70	71,909	5896.70	19.86 oc	---	---	---	0.00	---	---	---	---	---	19.86
4.80	74,984	5896.80	20.30 oc	---	---	---	0.00	---	---	---	---	---	20.30
4.90	78,059	5896.90	20.72 oc	---	---	---	0.00	---	---	---	---	---	20.72
5.00	81,134	5897.00	21.13 oc	---	---	---	0.00	---	---	---	---	---	21.13
5.05	83,158	5897.05	21.33 oc	---	---	---	0.00	---	---	---	---	---	21.33
5.10	85,182	5897.10	21.54 oc	---	---	---	0.00	---	---	---	---	---	21.54
5.15	87,206	5897.15	21.74 oc	---	---	---	0.00	---	---	---	---	---	21.74
5.20	89,229	5897.20	21.93 oc	---	---	---	0.00	---	---	---	---	---	21.93
5.25	91,253	5897.25	22.13 oc	---	---	---	0.00	---	---	---	---	---	22.13
5.30	93,277	5897.30	22.32 oc	---	---	---	0.00	---	---	---	---	---	22.32
5.35	95,301	5897.35	22.52 oc	---	---	---	0.00	---	---	---	---	---	22.52
5.40	97,325	5897.40	22.71 oc	---	---	---	0.00	---	---	---	---	---	22.71
5.45	99,349	5897.45	22.90 oc	---	---	---	0.00	---	---	---	---	---	22.90
5.50	101,372	5897.50	23.09 oc	---	---	---	0.00	---	---	---	---	---	23.09
5.55	103,932	5897.55	23.28 oc	---	---	---	3.24	---	---	---	---	---	26.52
5.60	106,491	5897.60	23.46 oc	---	---	---	9.16	---	---	---	---	---	32.62
5.65	109,050	5897.65	23.65 oc	---	---	---	16.83	---	---	---	---	---	40.48
5.70	111,609	5897.70	23.83 oc	---	---	---	25.91	---	---	---	---	---	49.74
5.75	114,169	5897.75	24.01 oc	---	---	---	36.21	---	---	---	---	---	60.22
5.80	116,728	5897.80	24.19 oc	---	---	---	47.60	---	---	---	---	---	71.79
5.85	119,287	5897.85	24.37 oc	---	---	---	59.98	---	---	---	---	---	84.35
5.90	121,846	5897.90	24.54 oc	---	---	---	73.28	---	---	---	---	---	97.83
5.95	124,405	5897.95	24.72 oc	---	---	---	87.44	---	---	---	---	---	112.16
6.00	126,965	5898.00	24.90 oc	---	---	---	103.02	---	---	---	---	---	127.92

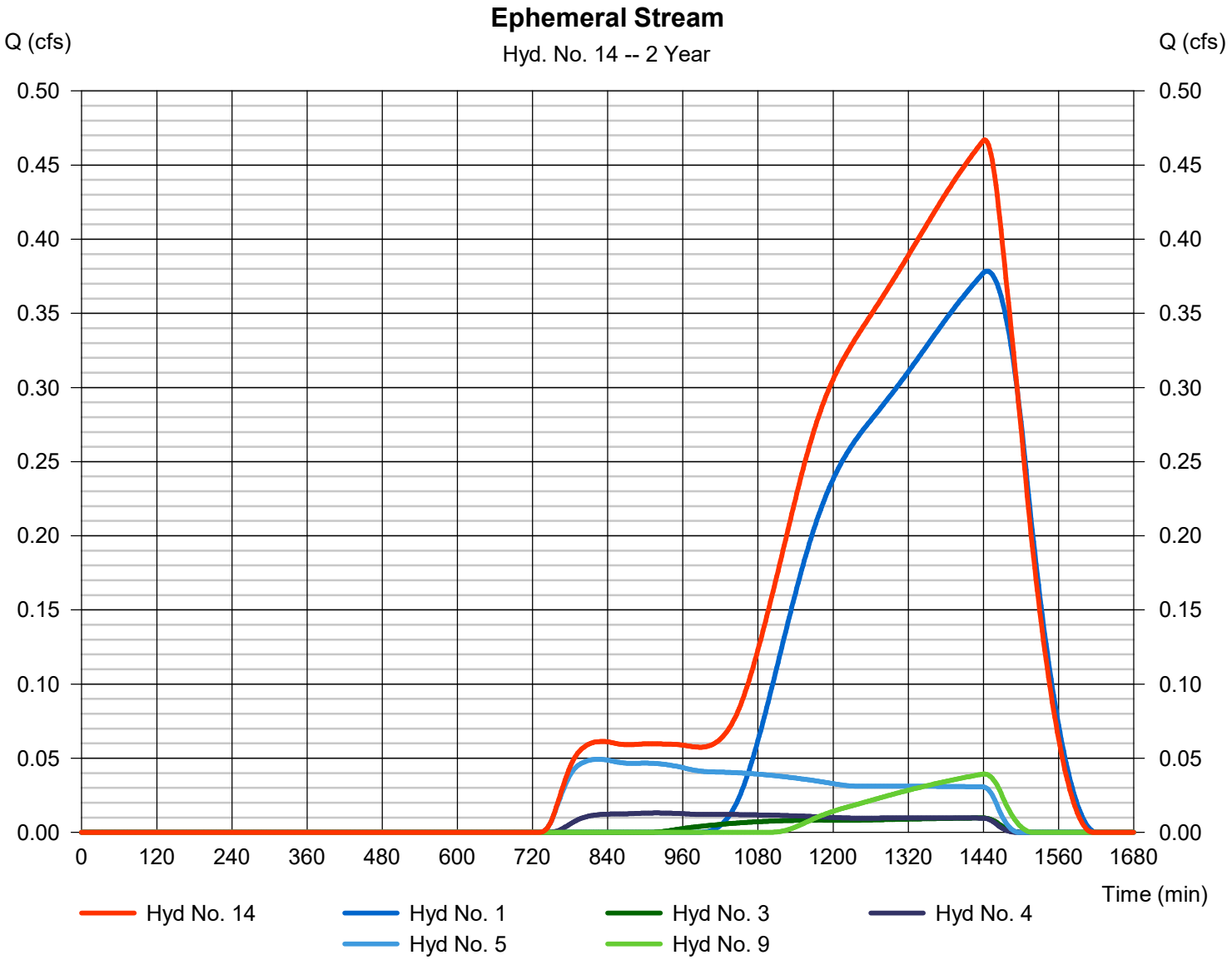
...End

Hydrograph Report

Hyd. No. 14

Ephemeral Stream

Hydrograph type	= Combine	Peak discharge	= 0.467 cfs
Storm frequency	= 2 yrs	Time to peak	= 1442 min
Time interval	= 2 min	Hyd. volume	= 10,440 cuft
Inflow hyds.	= 1, 3, 4, 5, 9	Contrib. drain. area	= 517.260 ac

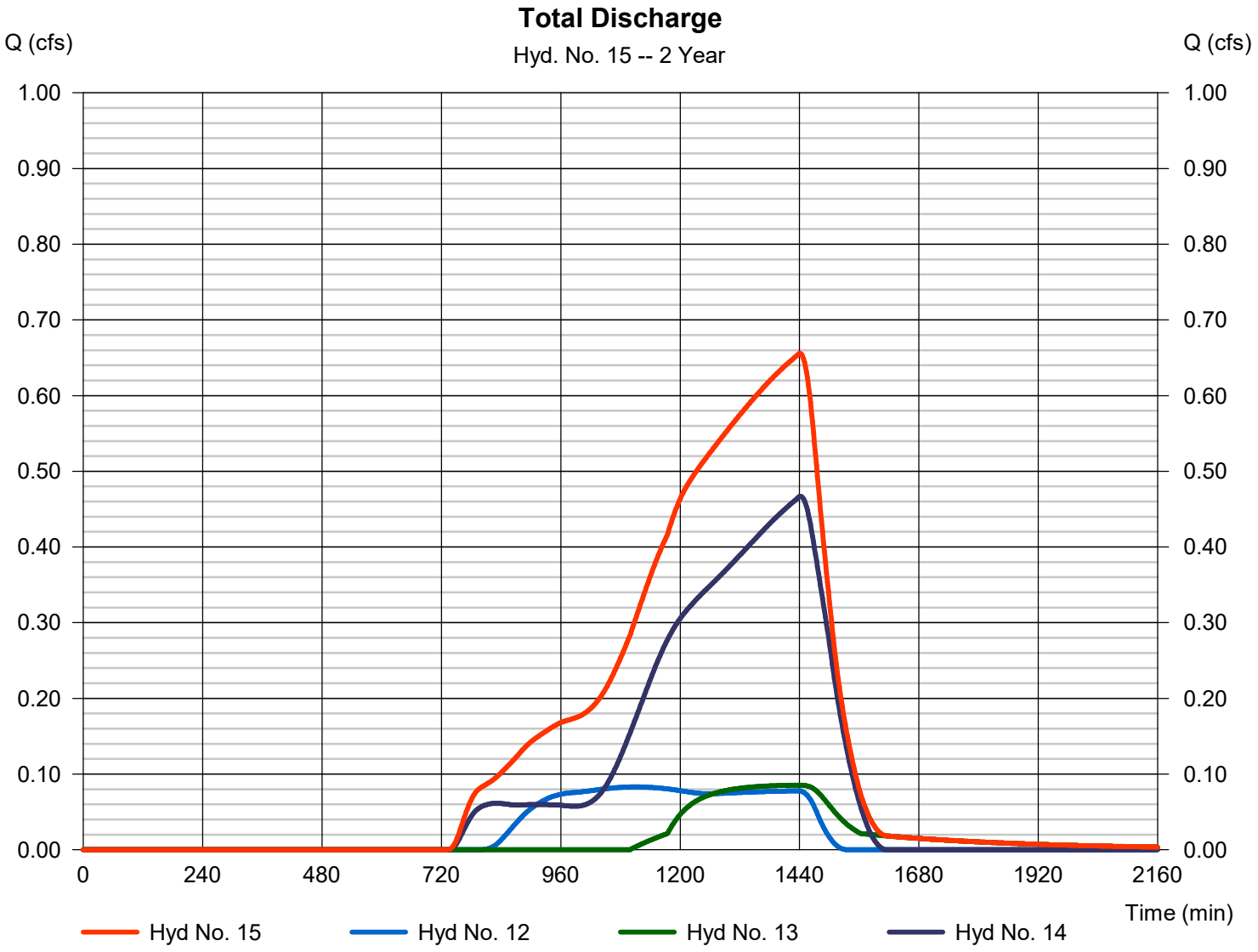


Hydrograph Report

Hyd. No. 15

Total Discharge

Hydrograph type	= Combine	Peak discharge	= 0.656 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 16,607 cuft
Inflow hyds.	= 12, 13, 14	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.620	2	850	217,477	------	------	------	Offsite Basin 1
2	SCS Runoff	0.027	2	914	927	------	------	------	Offsite Basin 2
3	SCS Runoff	0.282	2	758	4,434	------	------	------	Onsite Basin A
4	SCS Runoff	0.352	2	740	3,292	------	------	------	Onsite Basin B
5	SCS Runoff	1.141	2	740	10,175	------	------	------	Onsite Basin C
6	SCS Runoff	0.423	2	744	4,112	------	------	------	On Site Basin D
7	SCS Runoff	1.773	2	752	16,537	------	------	------	On Site Basin E
8	SCS Runoff	0.568	2	760	8,281	------	------	------	On Site Basin F
9	SCS Runoff	1.336	2	782	29,261	------	------	------	On Site Basin G
10	SCS Runoff	1.936	2	772	29,471	------	------	------	On Site Basin H
11	Combine	2.727	2	752	28,929	6, 7, 8,	------	------	Detention Pond Flow
12	Combine	1.933	2	772	30,197	2, 10,	------	------	Offsite Flow
13	Reservoir	1.387	2	800	25,987	11	5893.29	6,975	Pond 1
14	Combine	10.24	2	840	263,843	1, 3, 4,	------	------	Ephemeral Stream
15	Combine	12.72	2	820	325,615	5, 9, 12, 13, 14	------	------	Total Discharge

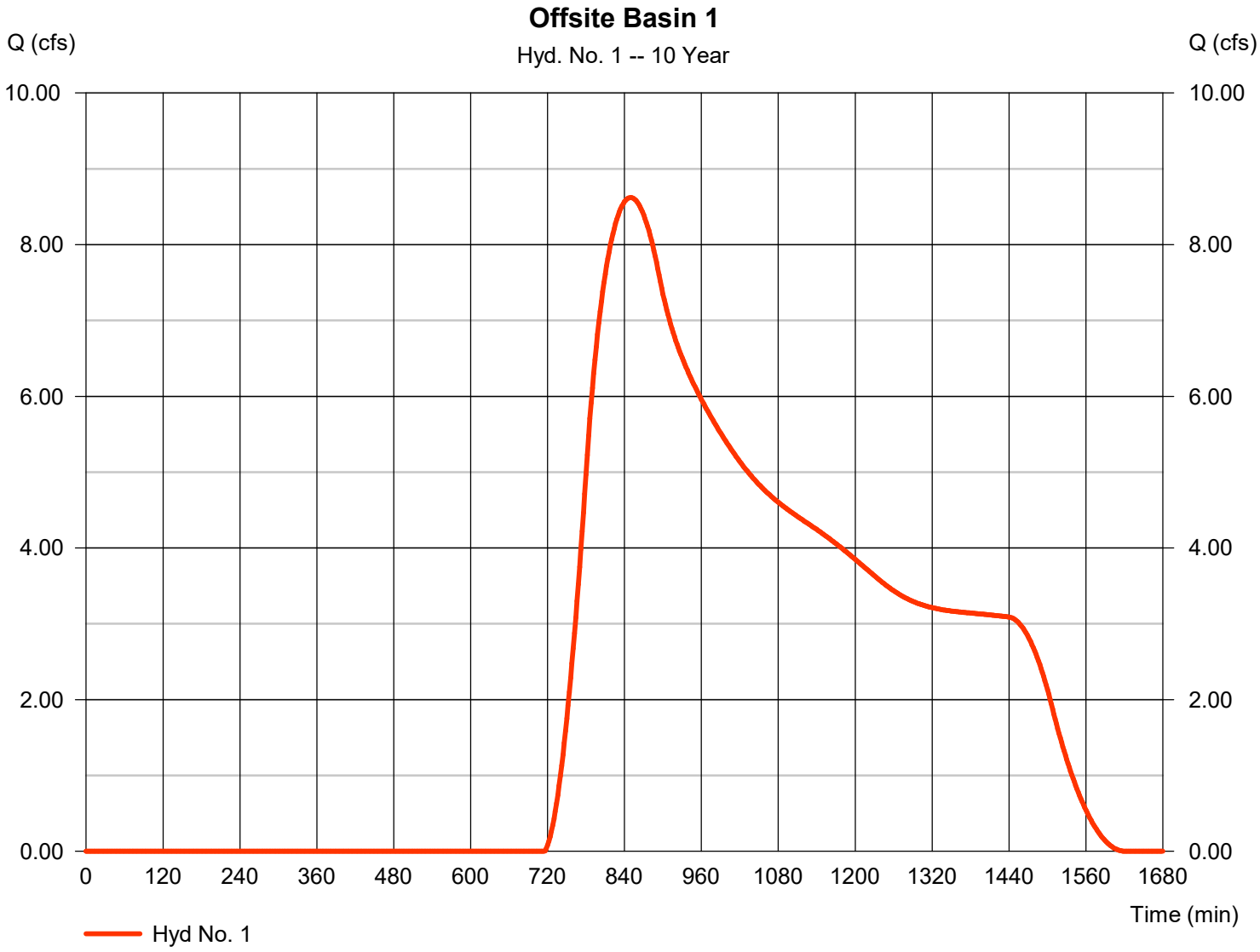
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	= SCS Runoff	Peak discharge	= 8.620 cfs
Storm frequency	= 10 yrs	Time to peak	= 850 min
Time interval	= 2 min	Hyd. volume	= 217,477 cuft
Drainage area	= 428.970 ac	Curve number	= 56*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 114.40 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



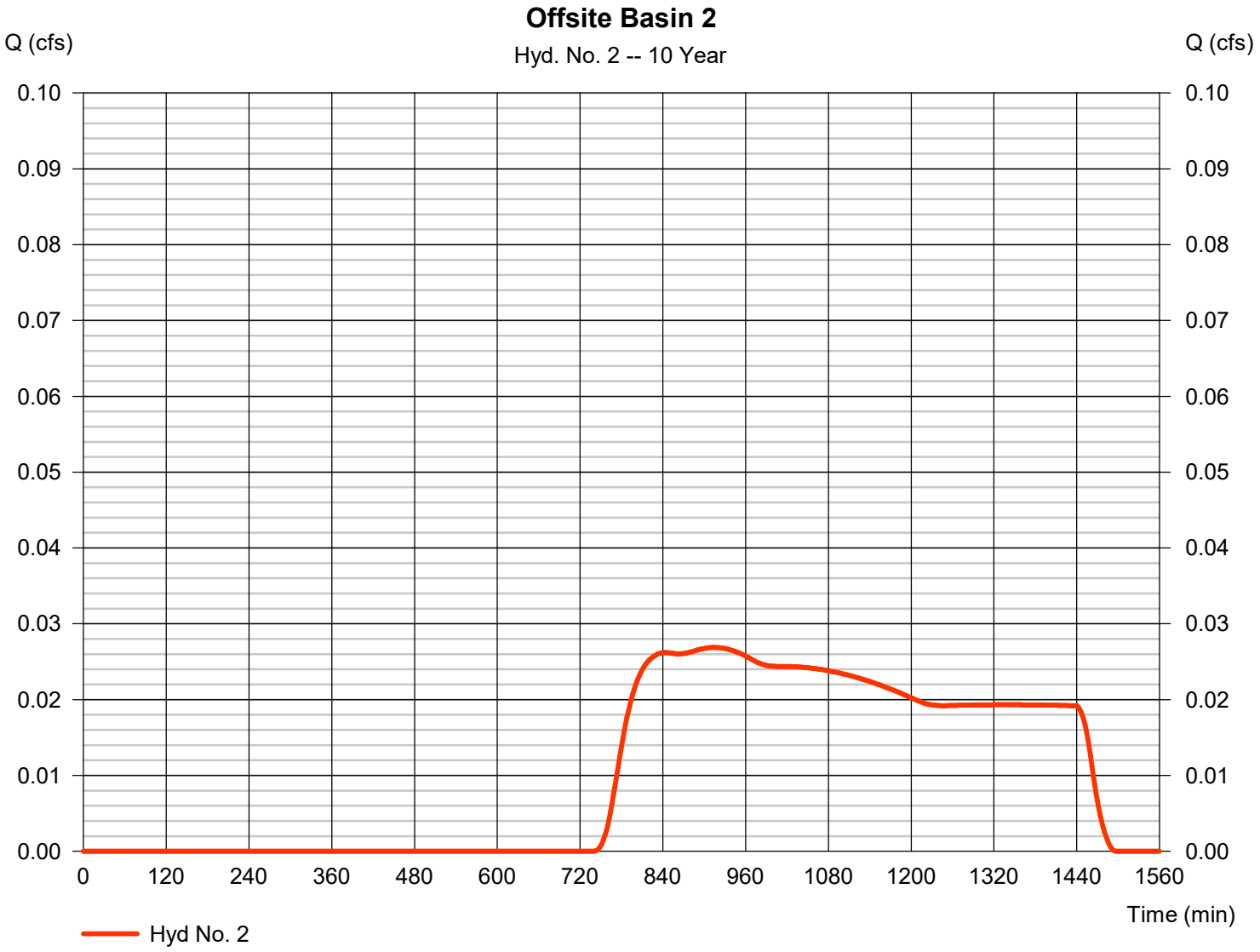
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.027 cfs
Storm frequency	= 10 yrs	Time to peak	= 914 min
Time interval	= 2 min	Hyd. volume	= 927 cuft
Drainage area	= 4.540 ac	Curve number	= 51*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



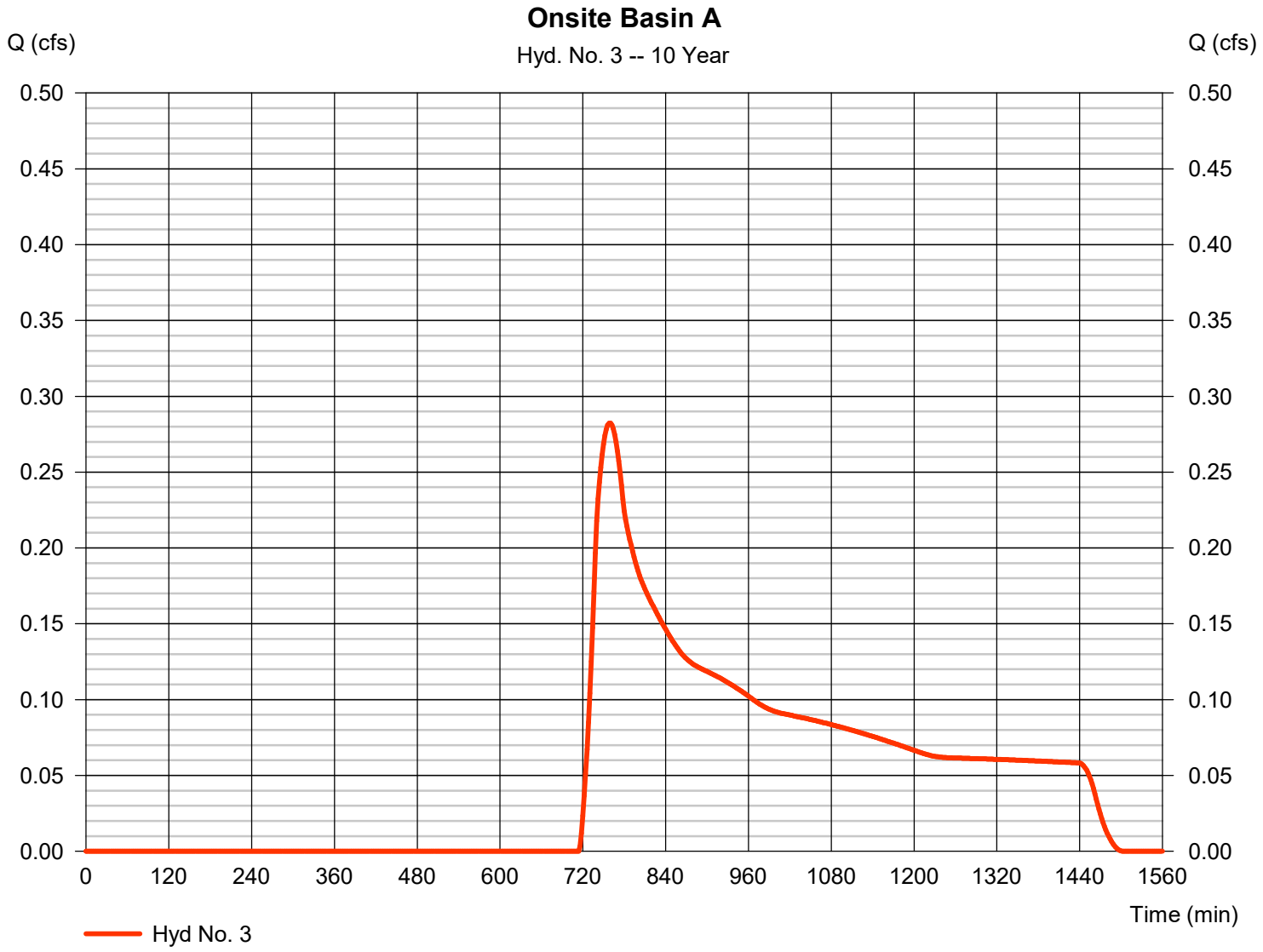
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.282 cfs
Storm frequency	=	10 yrs	Time to peak	=	758 min
Time interval	=	2 min	Hyd. volume	=	4,434 cuft
Drainage area	=	7.640 ac	Curve number	=	57*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	37.50 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 76)] / 7.640



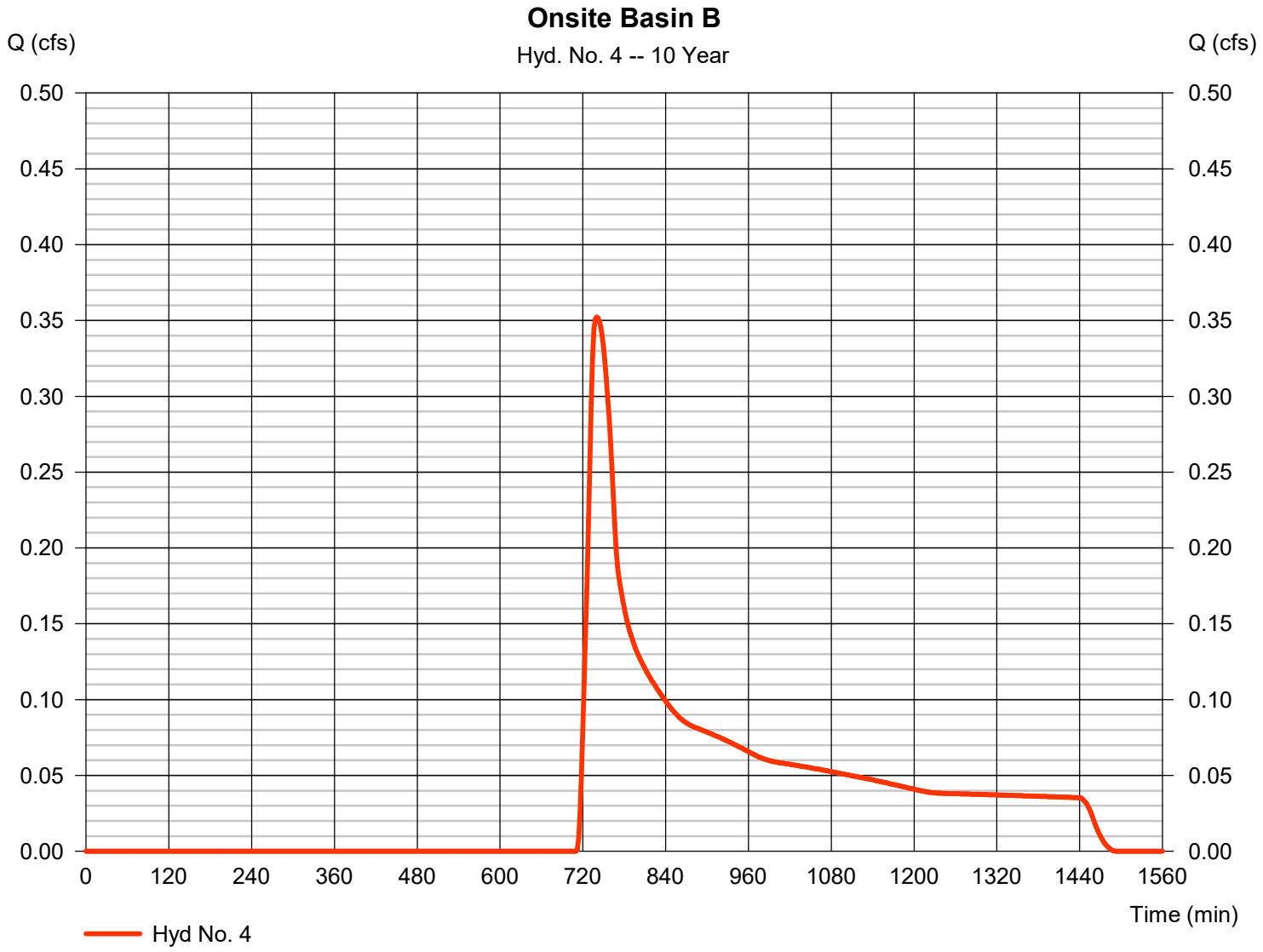
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.352 cfs
Storm frequency	=	10 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	3,292 cuft
Drainage area	=	3.510 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 85) + (0.020 x 76) + (2.160 x 61) + (0.980 x 49) + (0.200 x 98)] / 3.510



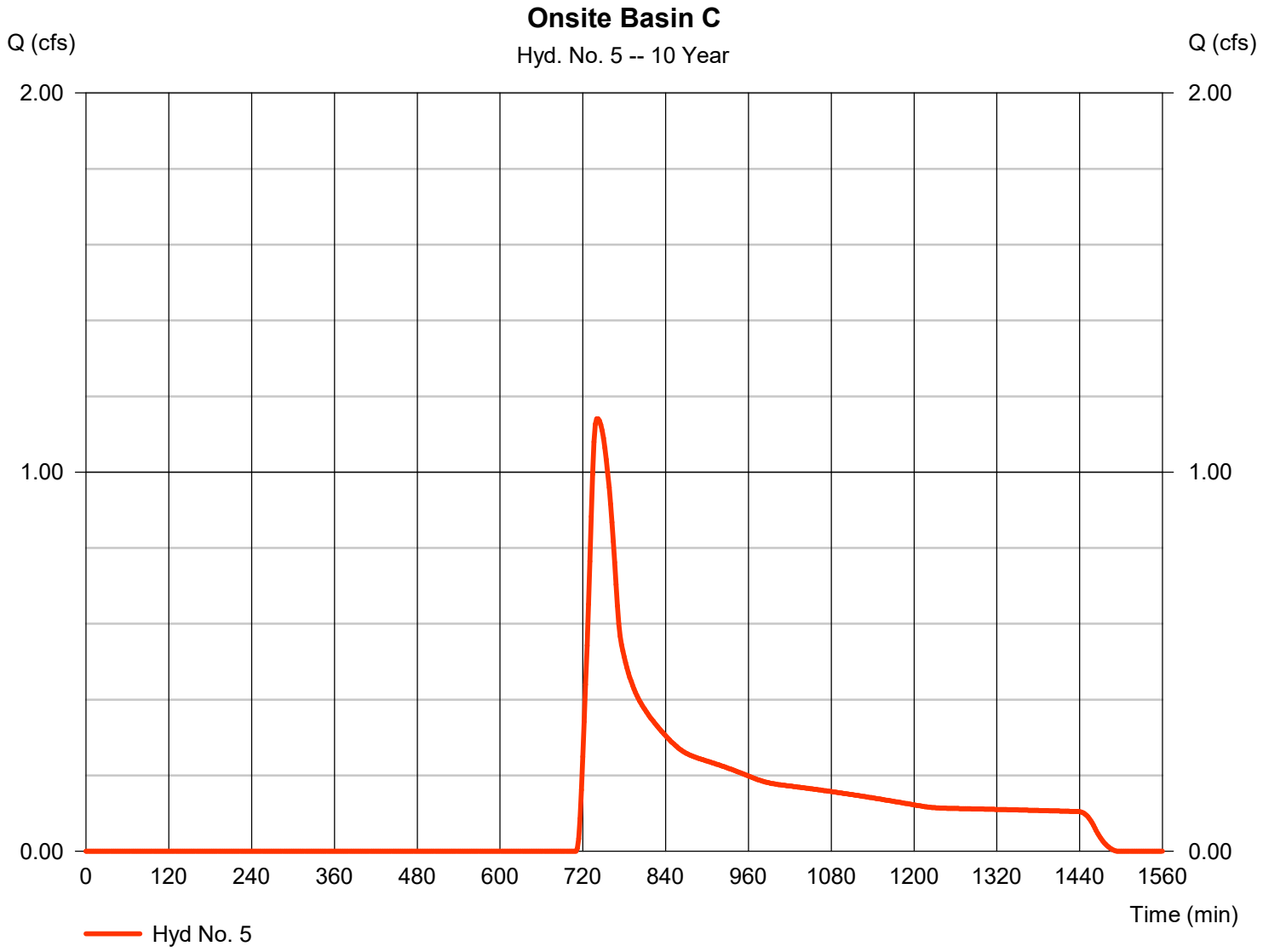
Hydrograph Report

Hyd. No. 5

Onsite Basin C

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.141 cfs
Storm frequency	=	10 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	10,175 cuft
Drainage area	=	10.050 ac	Curve number	=	62*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.30 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.060 x 76) + (0.140 x 98) + (1.360 x 98) + (4.820 x 61) + (3.670 x 49)] / 10.050



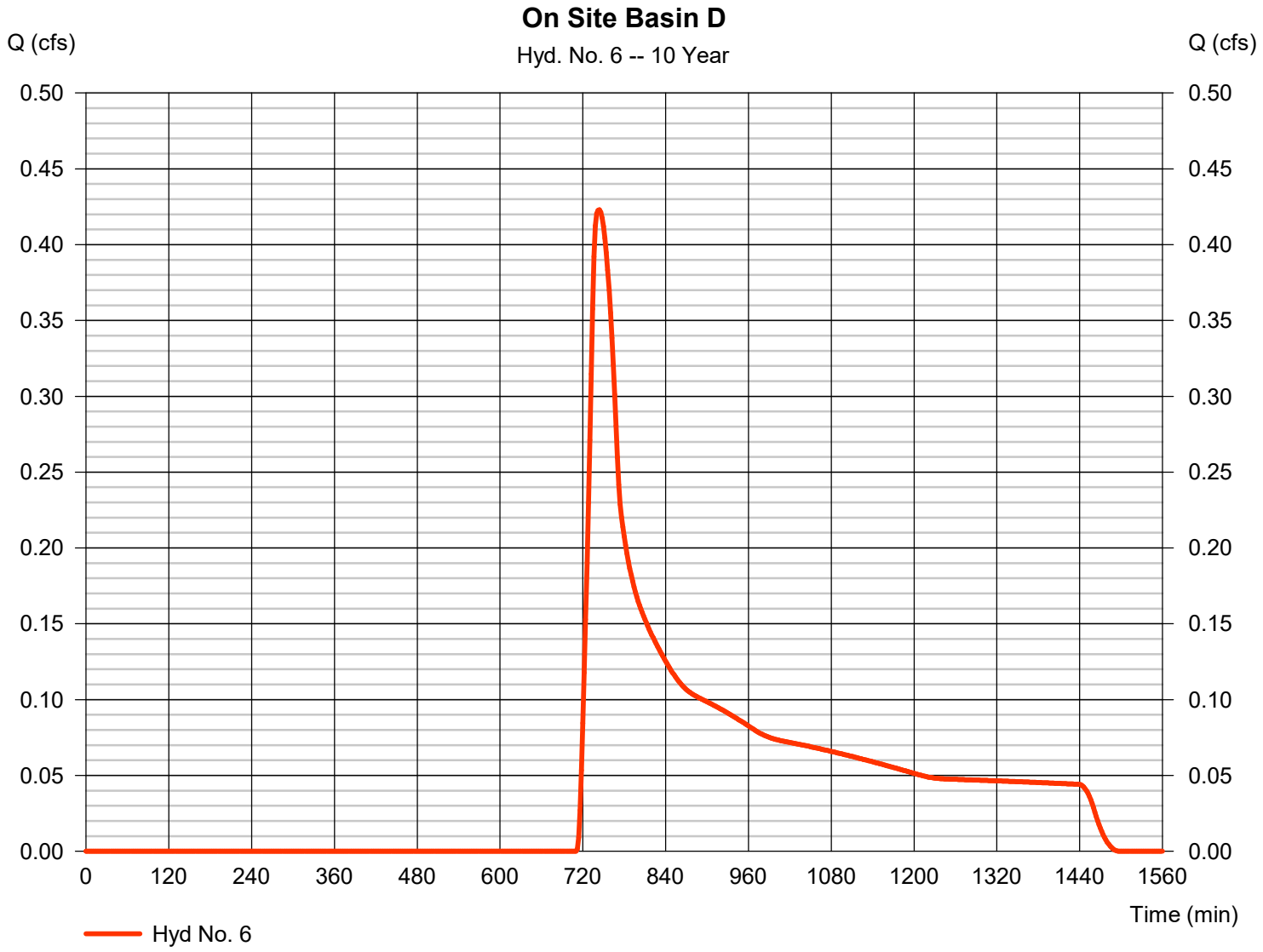
Hydrograph Report

Hyd. No. 6

On Site Basin D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.423 cfs
Storm frequency	= 10 yrs	Time to peak	= 744 min
Time interval	= 2 min	Hyd. volume	= 4,112 cuft
Drainage area	= 4.490 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.00 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.430 x 98) + (0.020 x 98) + (2.790 x 61) + (1.250 x 49)] / 4.490



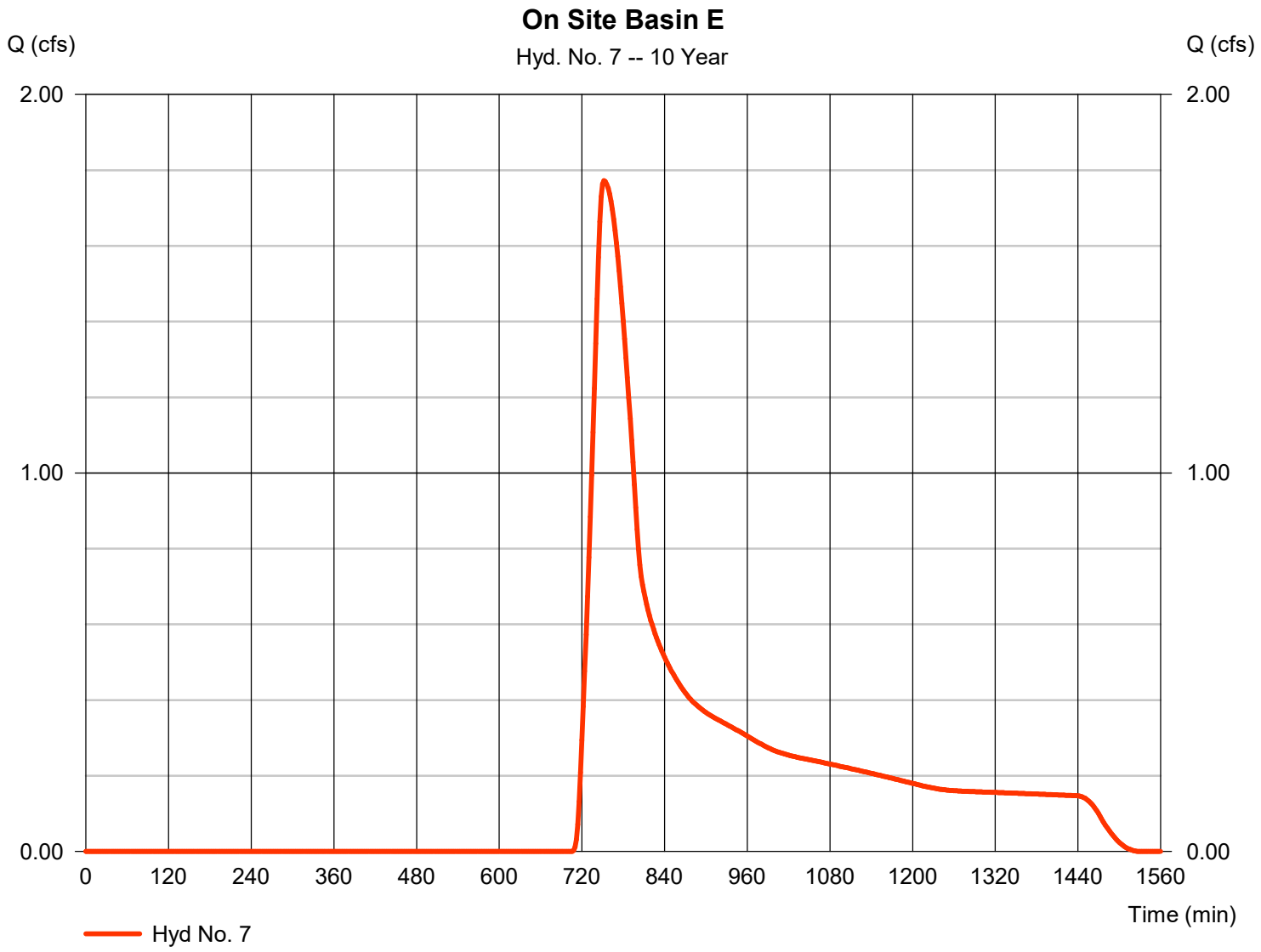
Hydrograph Report

Hyd. No. 7

On Site Basin E

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.773 cfs
Storm frequency	=	10 yrs	Time to peak	=	752 min
Time interval	=	2 min	Hyd. volume	=	16,537 cuft
Drainage area	=	11.350 ac	Curve number	=	66*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	55.50 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.170 x 98) + (2.170 x 98) + (6.420 x 61) + (2.590 x 49)] / 11.350



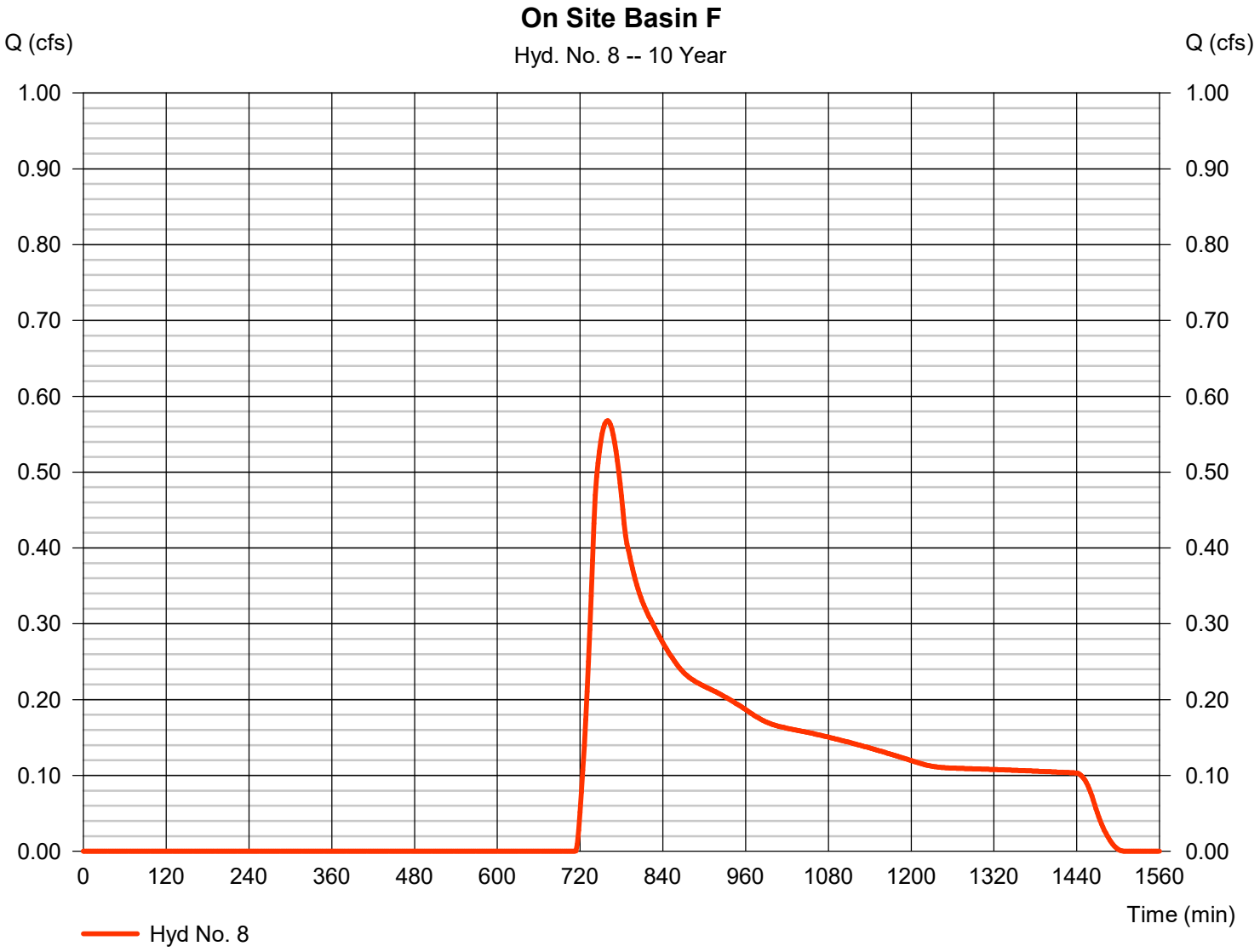
Hydrograph Report

Hyd. No. 8

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.568 cfs
Storm frequency	=	10 yrs	Time to peak	=	760 min
Time interval	=	2 min	Hyd. volume	=	8,281 cuft
Drainage area	=	12.470 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 98) + (0.110 x 98) + (9.220 x 61) + (3.130 x 49)] / 12.470



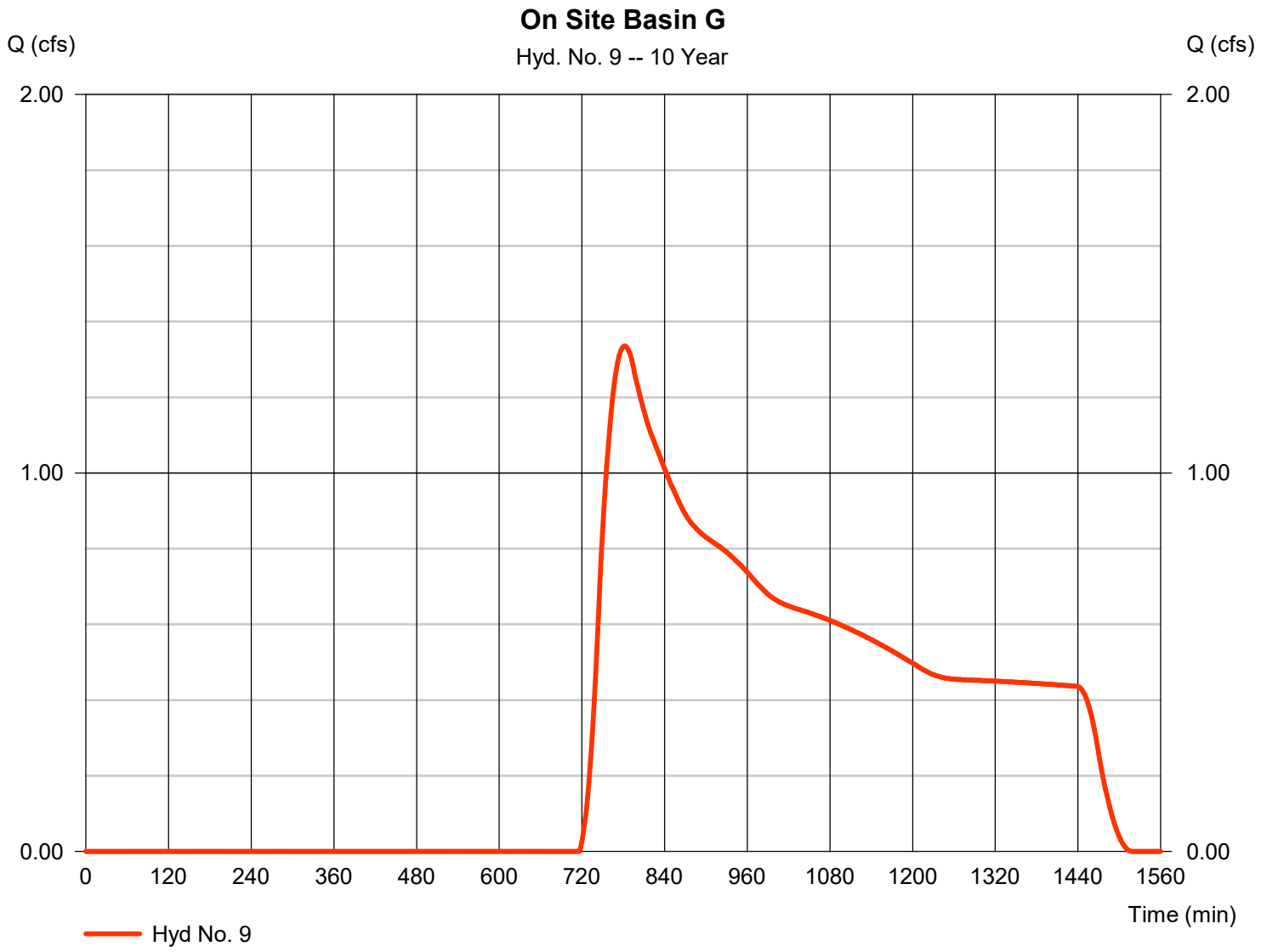
Hydrograph Report

Hyd. No. 9

On Site Basin G

Hydrograph type	= SCS Runoff	Peak discharge	= 1.336 cfs
Storm frequency	= 10 yrs	Time to peak	= 782 min
Time interval	= 2 min	Hyd. volume	= 29,261 cuft
Drainage area	= 67.090 ac	Curve number	= 55*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 50.30 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(34.420 x 49) + (31.570 x 61) + (1.100 x 85)] / 67.090



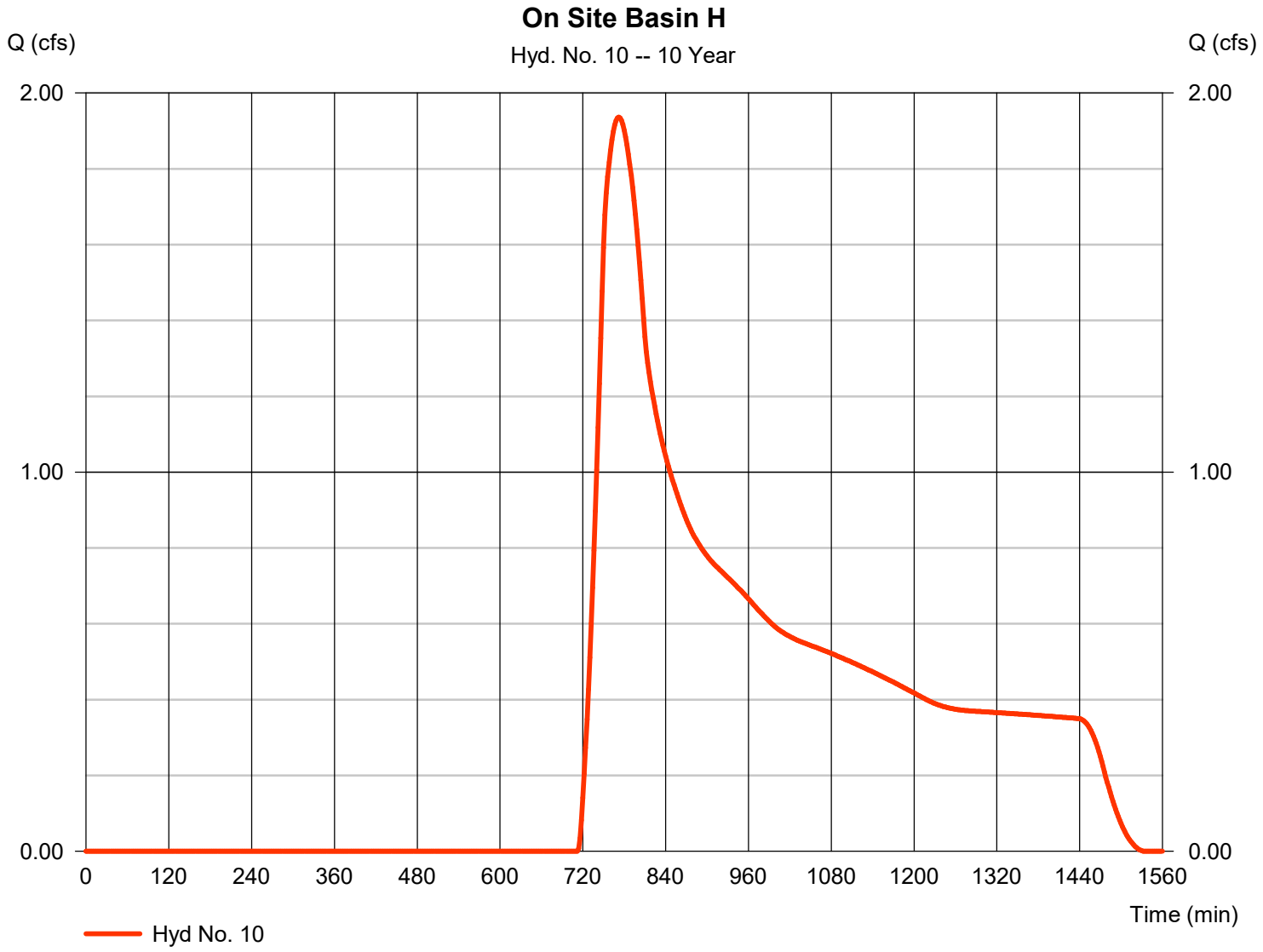
Hydrograph Report

Hyd. No. 10

On Site Basin H

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.936 cfs
Storm frequency	=	10 yrs	Time to peak	=	772 min
Time interval	=	2 min	Hyd. volume	=	29,471 cuft
Drainage area	=	39.620 ac	Curve number	=	59*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	57.90 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(31.110 x 61) + (8.380 x 49) + (0.130 x 85)] / 39.620

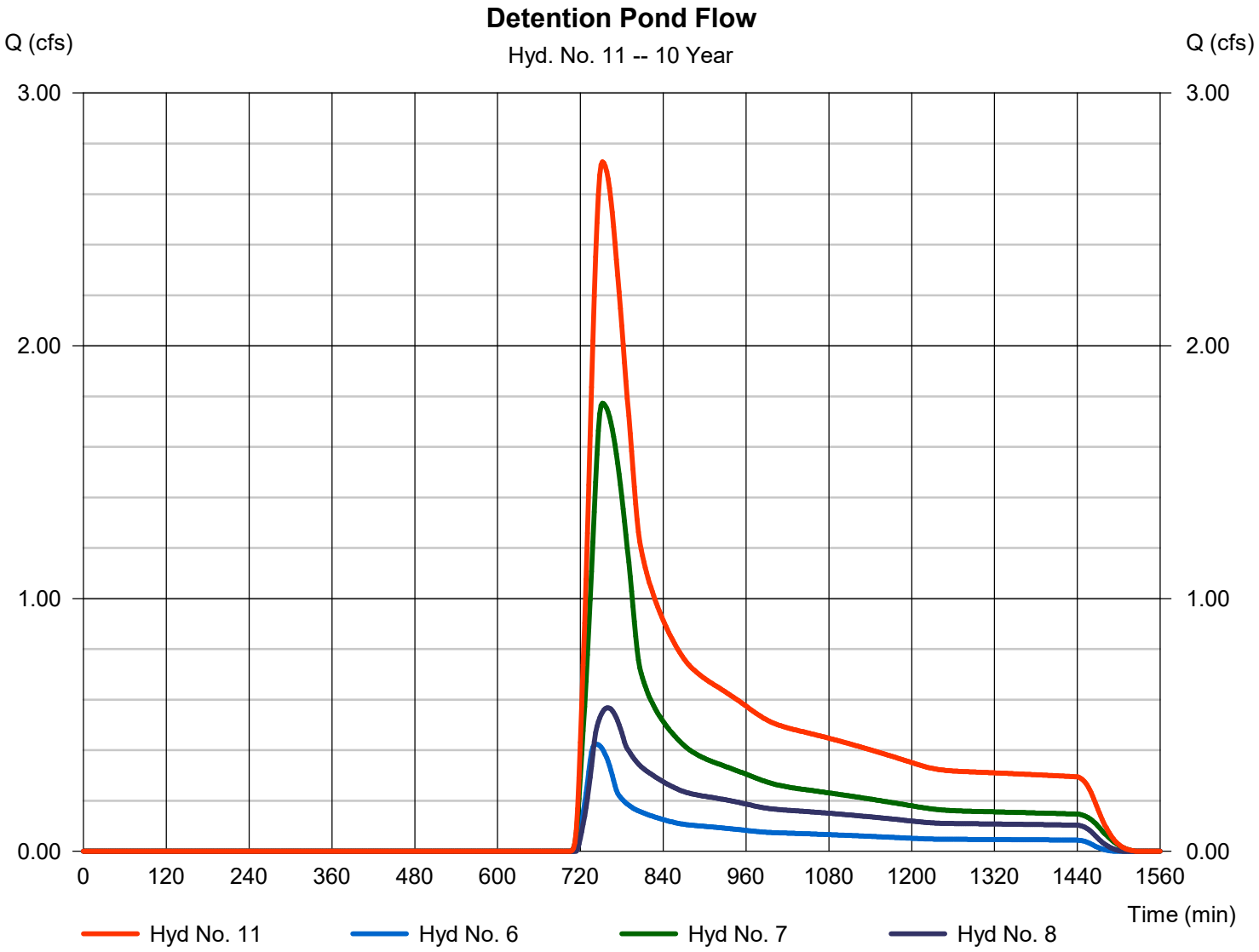


Hydrograph Report

Hyd. No. 11

Detention Pond Flow

Hydrograph type	= Combine	Peak discharge	= 2.727 cfs
Storm frequency	= 10 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 28,929 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 28.310 ac

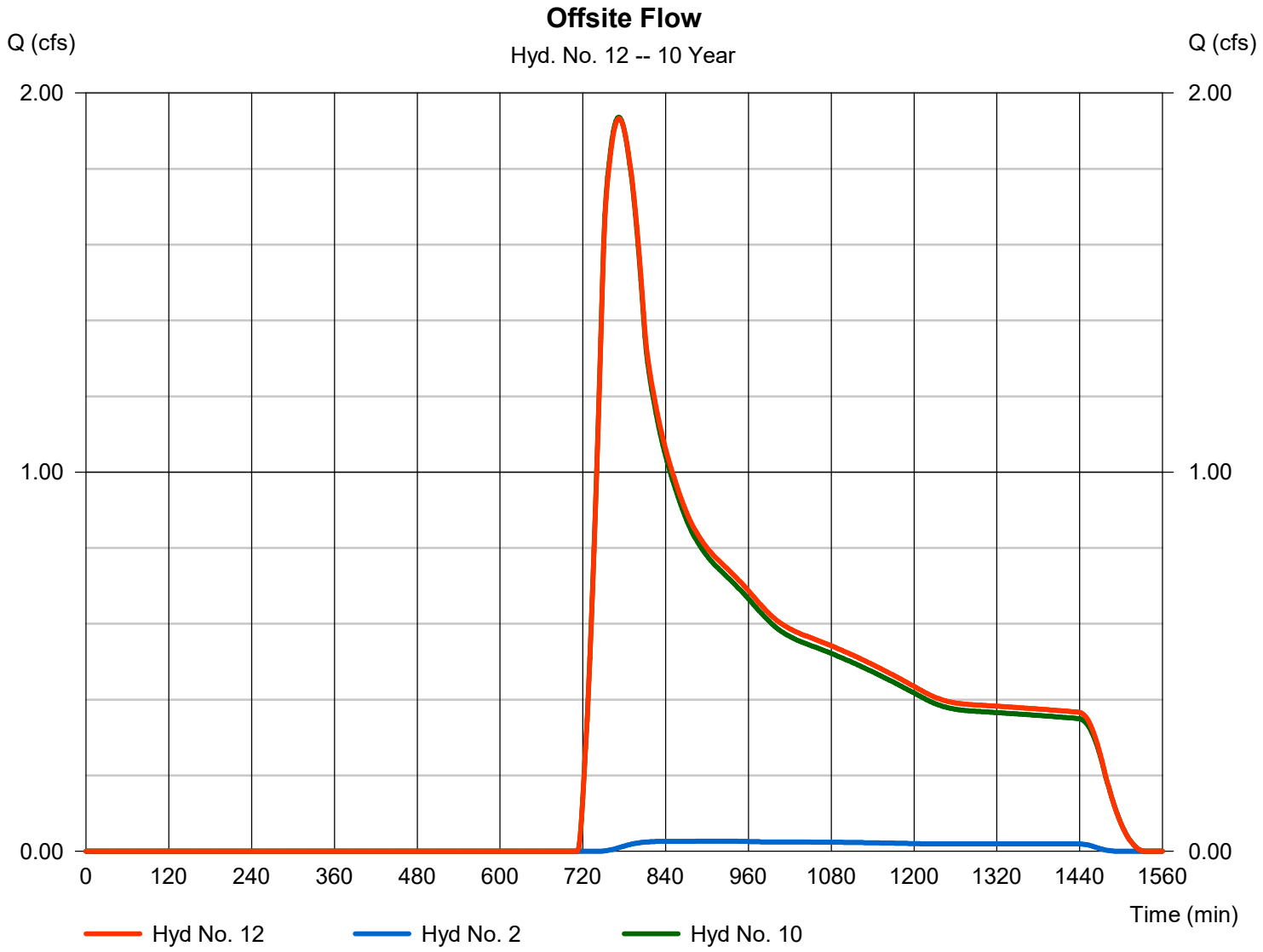


Hydrograph Report

Hyd. No. 12

Offsite Flow

Hydrograph type	= Combine	Peak discharge	= 1.933 cfs
Storm frequency	= 10 yrs	Time to peak	= 772 min
Time interval	= 2 min	Hyd. volume	= 30,197 cuft
Inflow hyds.	= 2, 10	Contrib. drain. area	= 44.160 ac



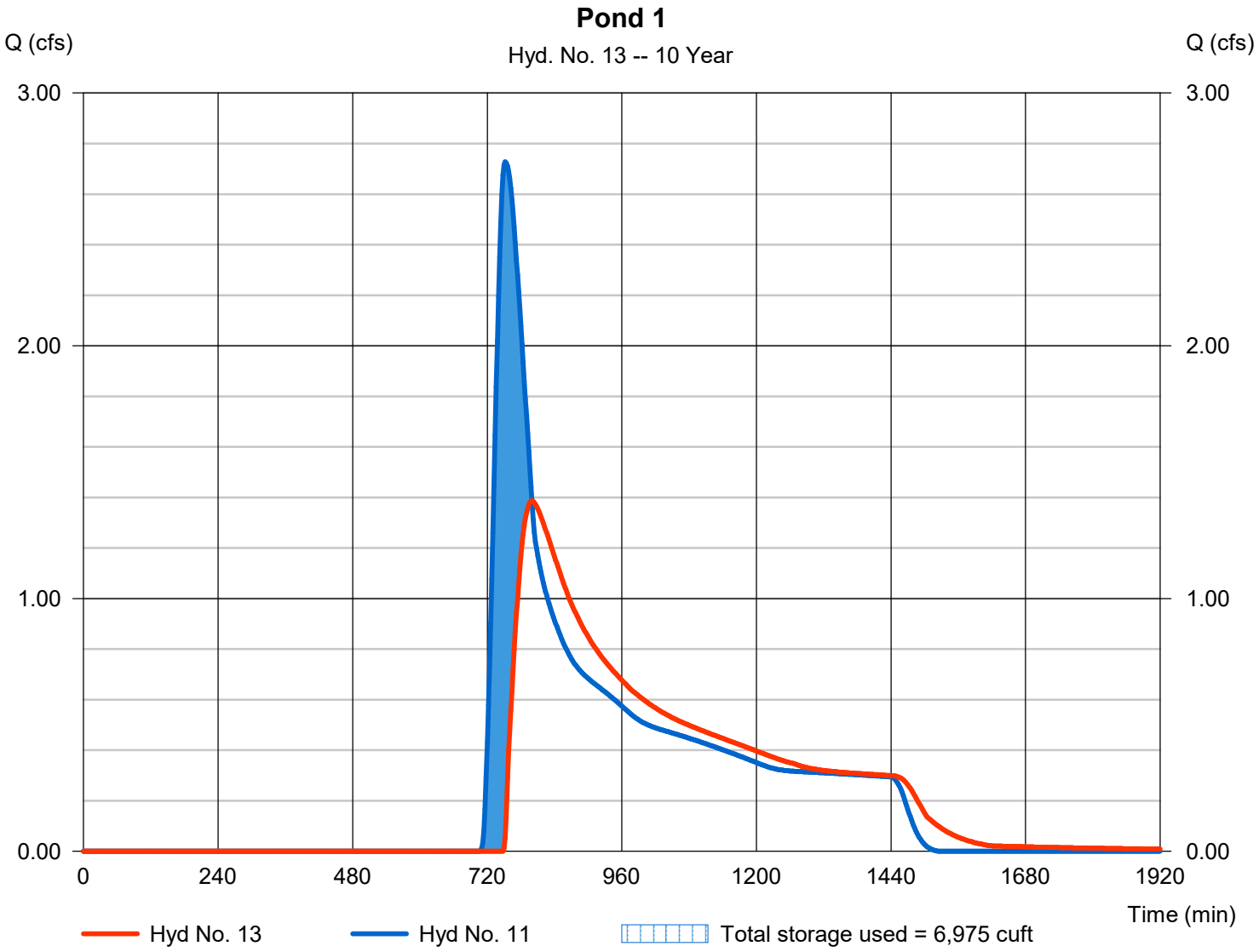
Hydrograph Report

Hyd. No. 13

Pond 1

Hydrograph type	=	Reservoir	Peak discharge	=	1.387 cfs
Storm frequency	=	10 yrs	Time to peak	=	800 min
Time interval	=	2 min	Hyd. volume	=	25,987 cuft
Inflow hyd. No.	=	11 - Detention Pond Flow	Max. Elevation	=	5893.29 ft
Reservoir name	=	Pond 1	Max. Storage	=	6,975 cuft

Storage Indication method used.

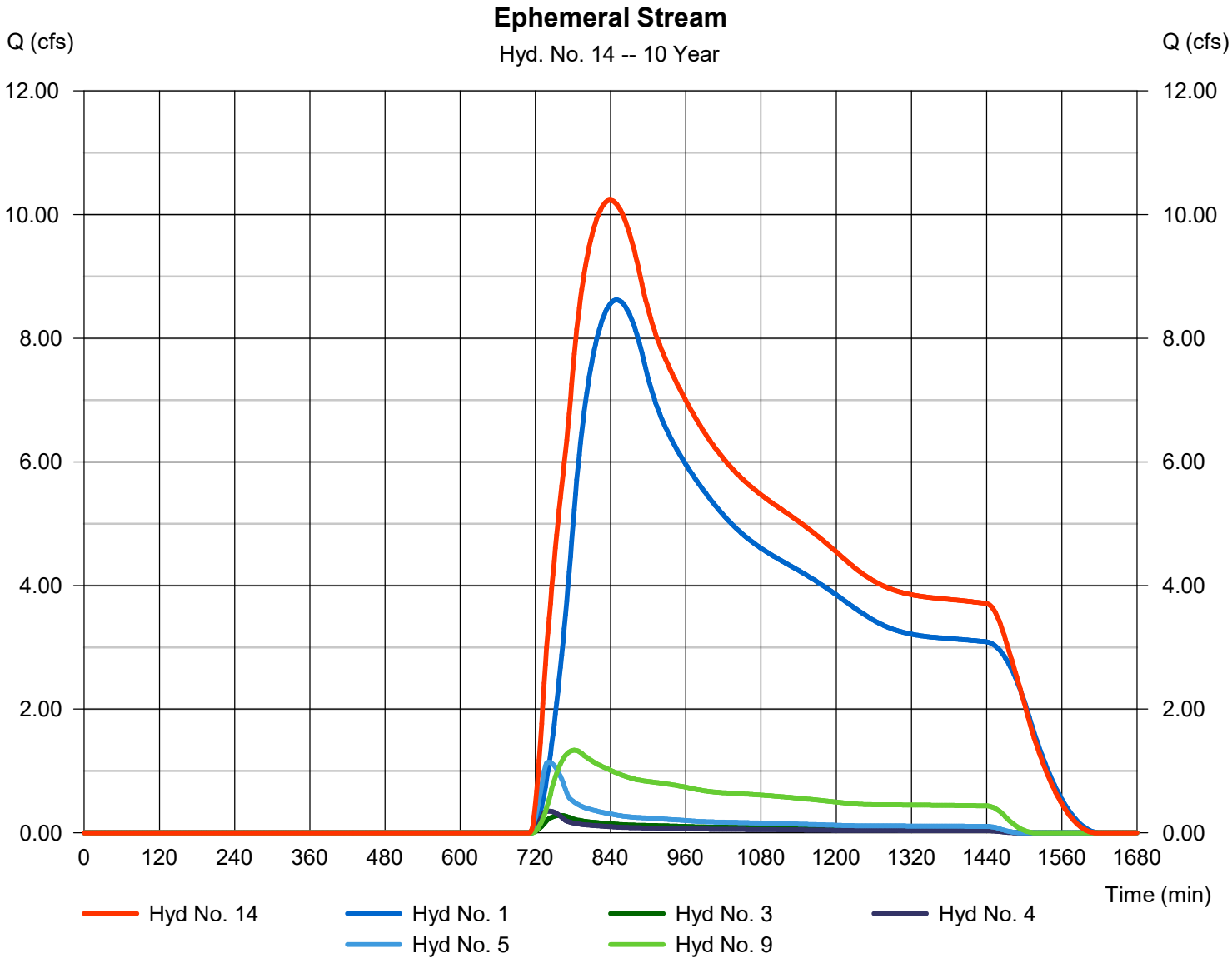


Hydrograph Report

Hyd. No. 14

Ephemeral Stream

Hydrograph type	=	Combine	Peak discharge	=	10.24 cfs
Storm frequency	=	10 yrs	Time to peak	=	840 min
Time interval	=	2 min	Hyd. volume	=	263,843 cuft
Inflow hyds.	=	1, 3, 4, 5, 9	Contrib. drain. area	=	517.260 ac

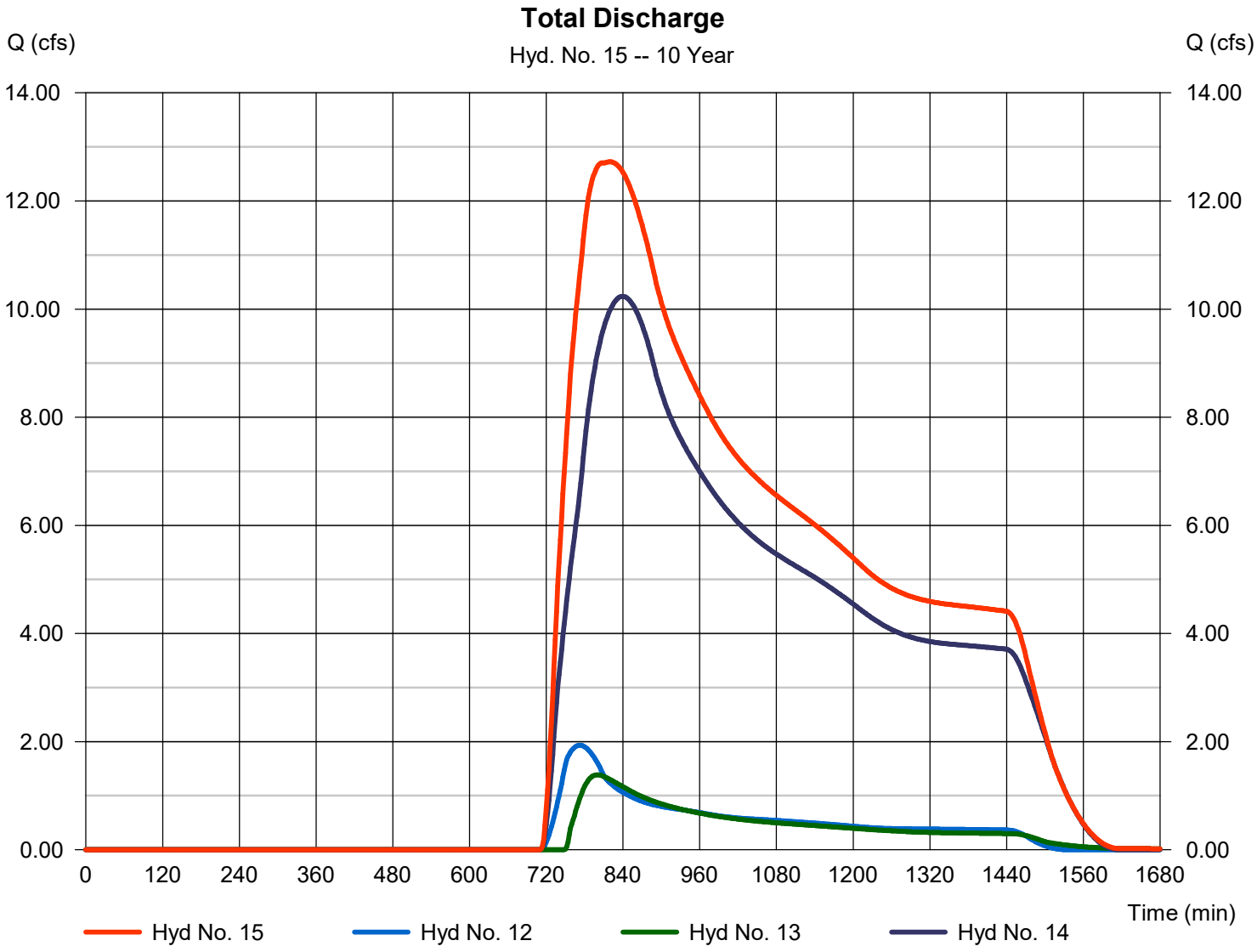


Hydrograph Report

Hyd. No. 15

Total Discharge

Hydrograph type	=	Combine	Peak discharge	=	12.72 cfs
Storm frequency	=	10 yrs	Time to peak	=	820 min
Time interval	=	2 min	Hyd. volume	=	325,615 cuft
Inflow hyds.	=	12, 13, 14	Contrib. drain. area	=	0.000 ac



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	94.58	2	794	1,324,269	------	------	------	Offsite Basin 1
2	SCS Runoff	1.252	2	740	9,570	------	------	------	Offsite Basin 2
3	SCS Runoff	3.969	2	740	25,052	------	------	------	Onsite Basin A
4	SCS Runoff	2.922	2	734	14,722	------	------	------	Onsite Basin B
5	SCS Runoff	8.370	2	736	43,420	------	------	------	Onsite Basin C
6	SCS Runoff	3.473	2	736	18,388	------	------	------	On Site Basin D
7	SCS Runoff	8.918	2	748	60,023	------	------	------	On Site Basin E
8	SCS Runoff	6.703	2	742	43,910	------	------	------	On Site Basin F
9	SCS Runoff	24.25	2	746	193,042	------	------	------	On Site Basin G
10	SCS Runoff	18.20	2	752	146,640	------	------	------	On Site Basin H
11	Combine	18.37	2	746	122,321	6, 7, 8,	------	------	Detention Pond Flow
12	Combine	19.18	2	752	155,210	2, 10,	------	------	Offsite Flow
13	Reservoir	10.41	2	776	119,418	11	5895.05	29,813	Pond 1
14	Combine	113.27	2	782	1,595,655	1, 3, 4,	------	------	Ephemeral Stream
15	Combine	140.17	2	778	1,884,725	5, 9, 12, 13, 14	------	------	Total Discharge

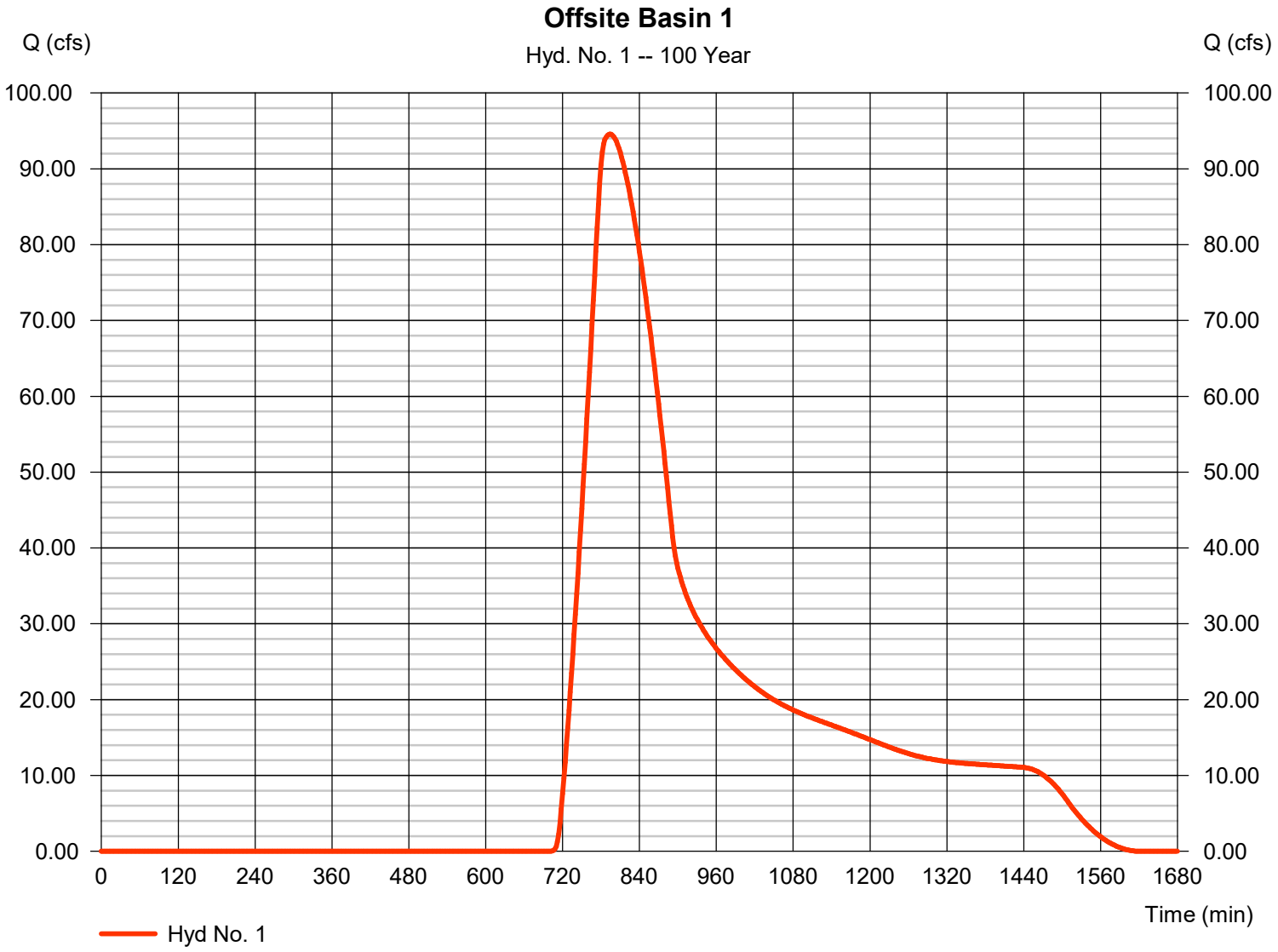
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	= SCS Runoff	Peak discharge	= 94.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 794 min
Time interval	= 2 min	Hyd. volume	= 1,324,269 cuft
Drainage area	= 428.970 ac	Curve number	= 56*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 114.40 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



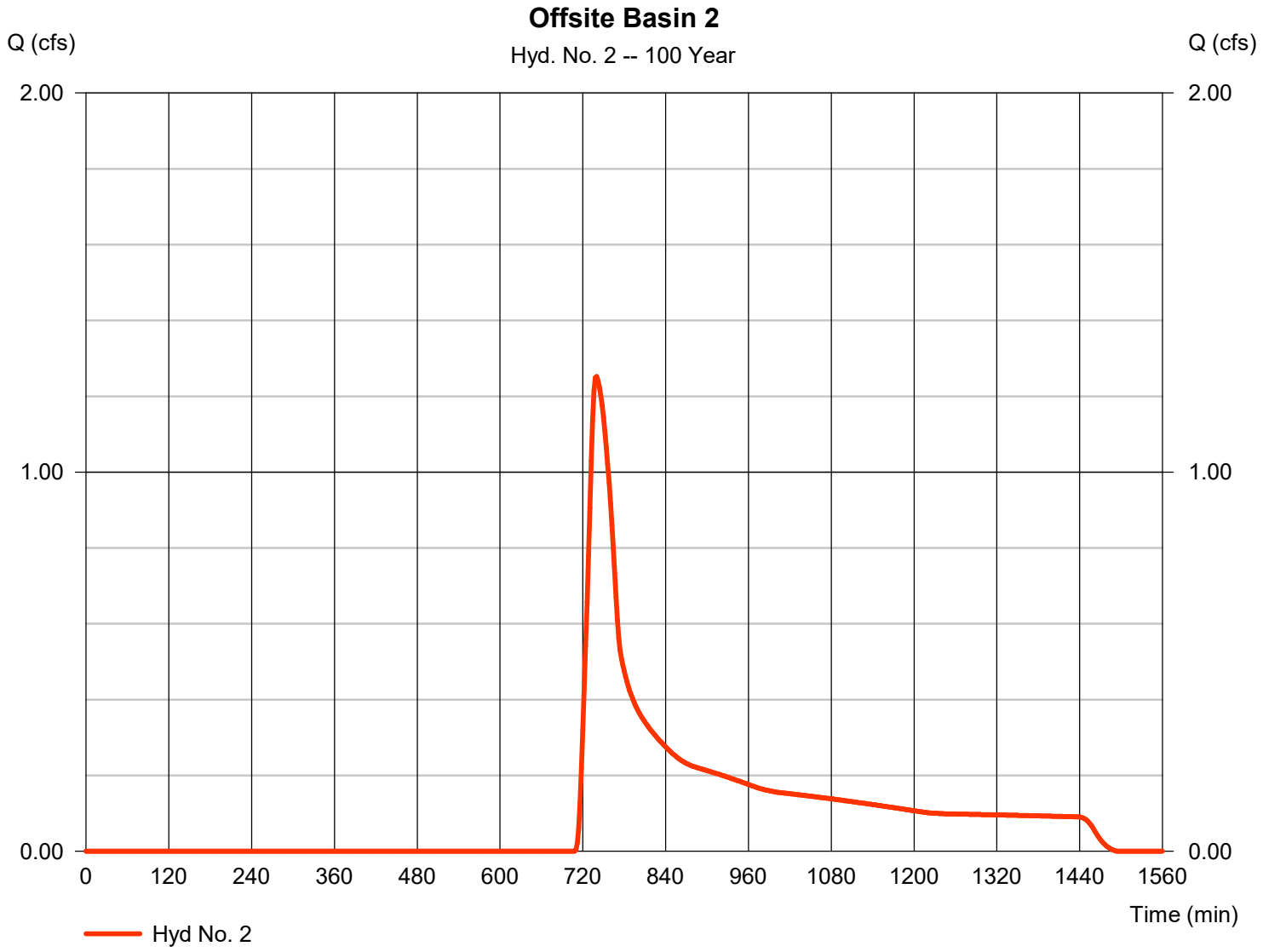
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.252 cfs
Storm frequency	=	100 yrs	Time to peak	=	740 min
Time interval	=	2 min	Hyd. volume	=	9,570 cuft
Drainage area	=	4.540 ac	Curve number	=	51*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.30 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



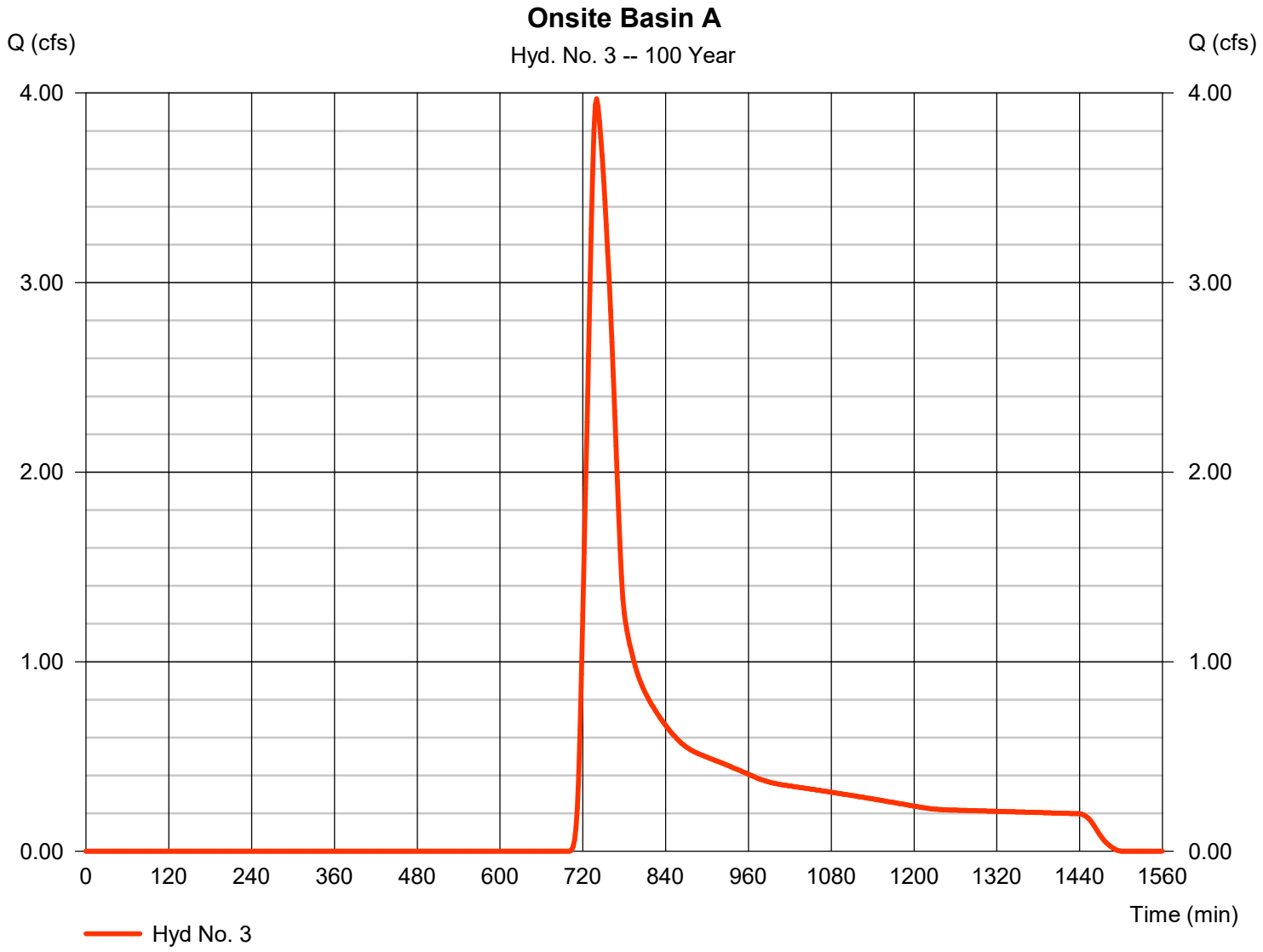
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	= SCS Runoff	Peak discharge	= 3.969 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 25,052 cuft
Drainage area	= 7.640 ac	Curve number	= 57*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.50 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 76)] / 7.640



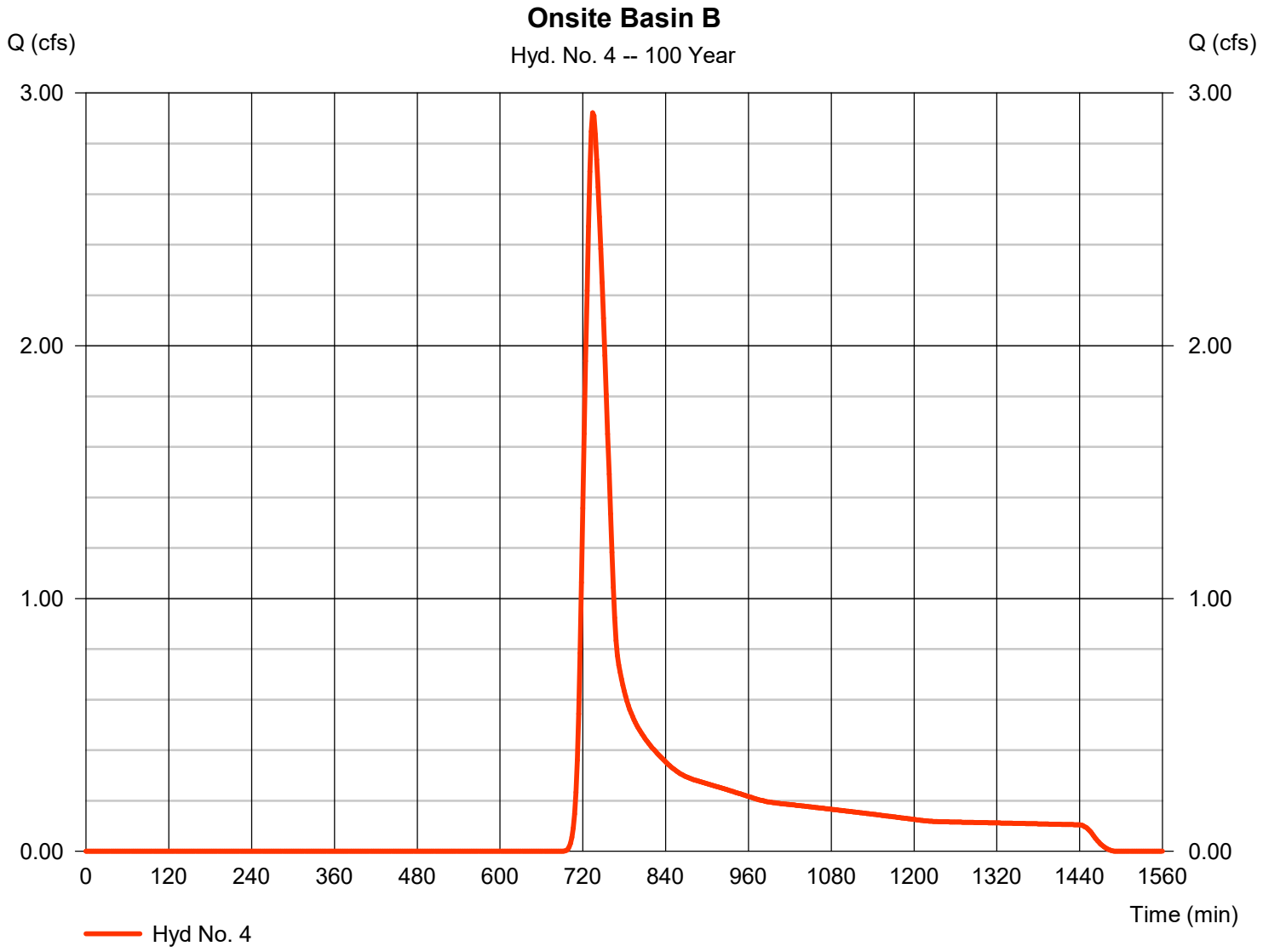
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.922 cfs
Storm frequency	=	100 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	14,722 cuft
Drainage area	=	3.510 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.150 x 85) + (0.020 x 76) + (2.160 x 61) + (0.980 x 49) + (0.200 x 98)] / 3.510



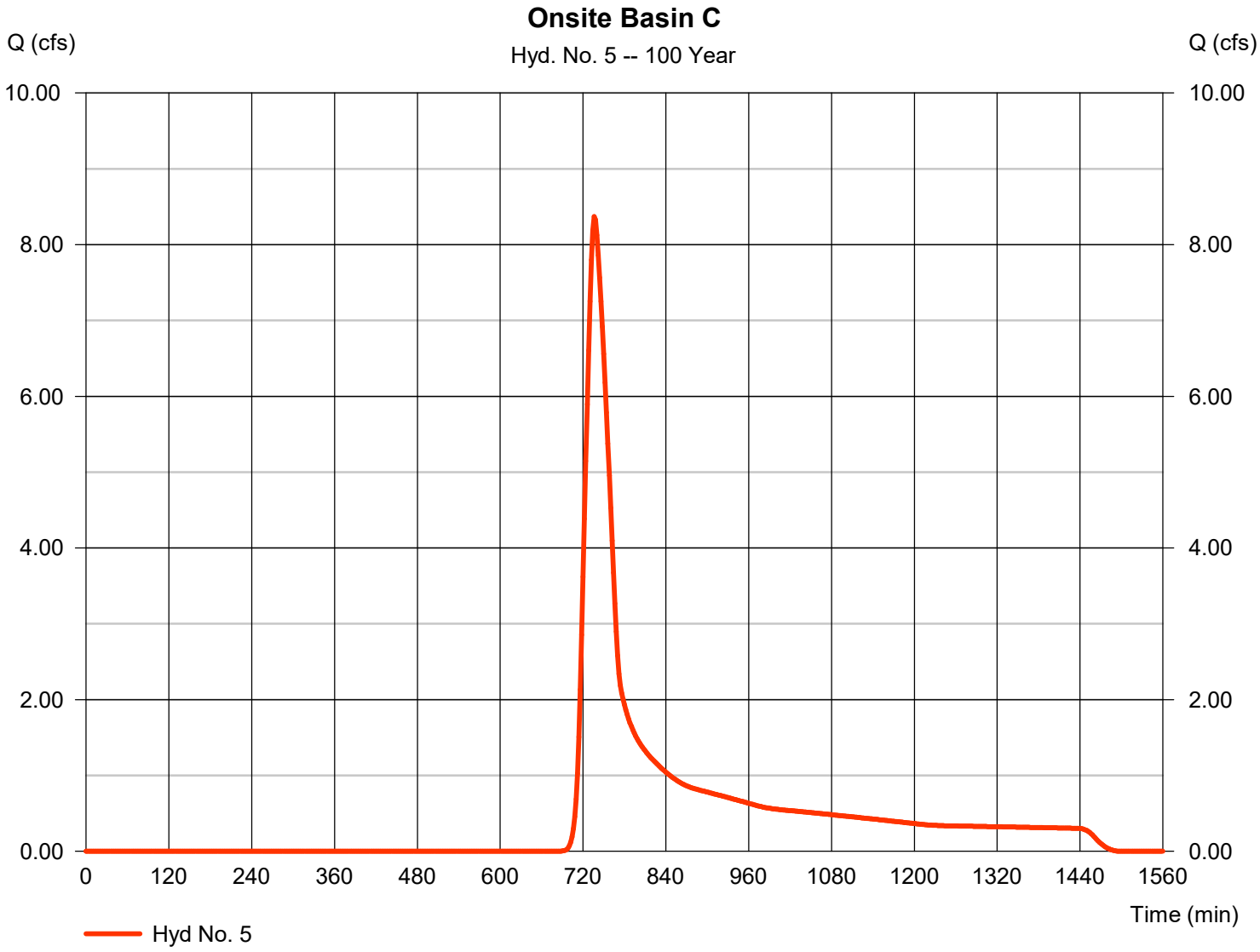
Hydrograph Report

Hyd. No. 5

Onsite Basin C

Hydrograph type	= SCS Runoff	Peak discharge	= 8.370 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 43,420 cuft
Drainage area	= 10.050 ac	Curve number	= 62*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.060 x 76) + (0.140 x 98) + (1.360 x 98) + (4.820 x 61) + (3.670 x 49)] / 10.050



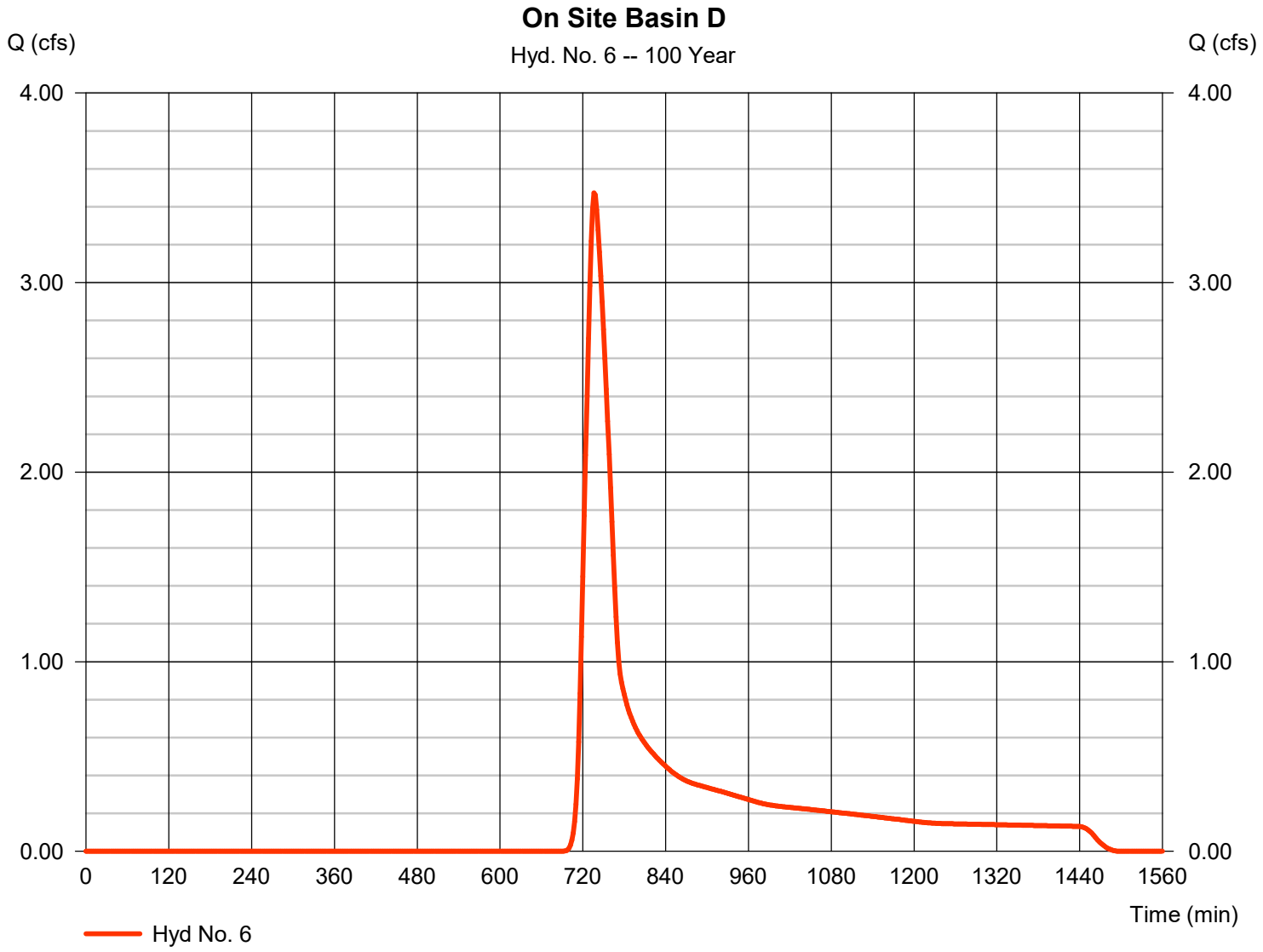
Hydrograph Report

Hyd. No. 6

On Site Basin D

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.473 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	18,388 cuft
Drainage area	=	4.490 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	37.00 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.430 x 98) + (0.020 x 98) + (2.790 x 61) + (1.250 x 49)] / 4.490



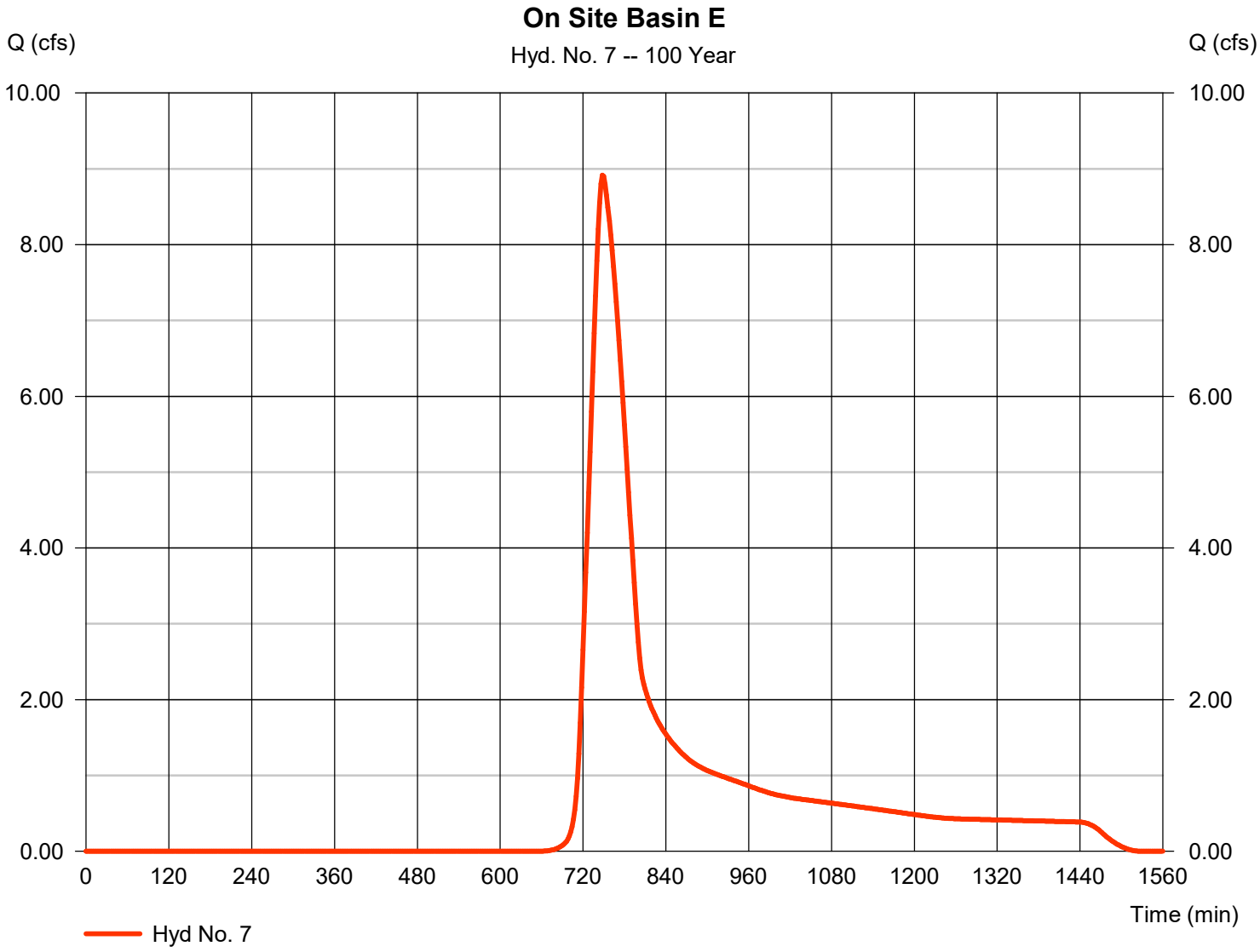
Hydrograph Report

Hyd. No. 7

On Site Basin E

Hydrograph type	= SCS Runoff	Peak discharge	= 8.918 cfs
Storm frequency	= 100 yrs	Time to peak	= 748 min
Time interval	= 2 min	Hyd. volume	= 60,023 cuft
Drainage area	= 11.350 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 55.50 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.170 x 98) + (2.170 x 98) + (6.420 x 61) + (2.590 x 49)] / 11.350



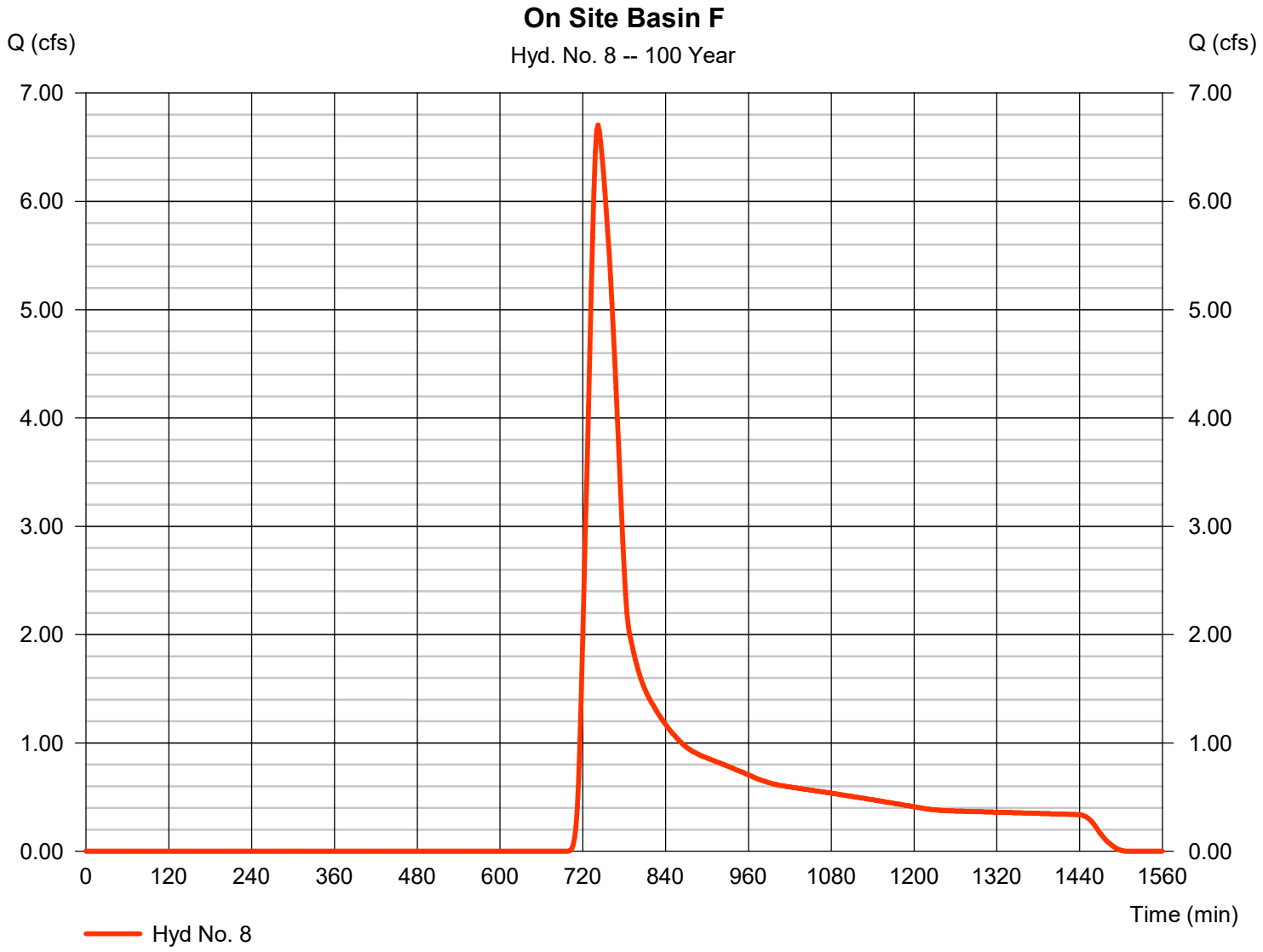
Hydrograph Report

Hyd. No. 8

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.703 cfs
Storm frequency	=	100 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	43,910 cuft
Drainage area	=	12.470 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.010 x 98) + (0.110 x 98) + (9.220 x 61) + (3.130 x 49)] / 12.470



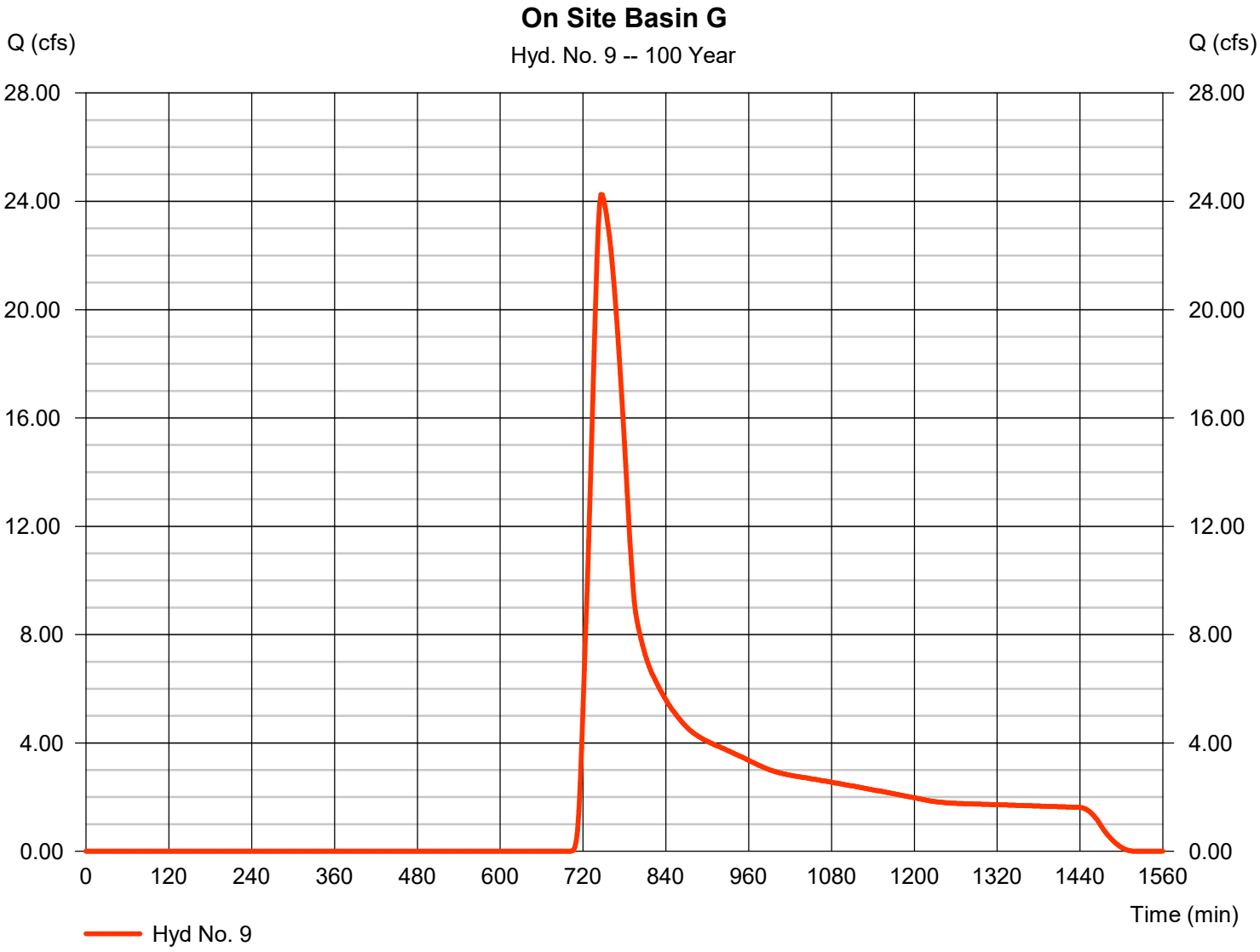
Hydrograph Report

Hyd. No. 9

On Site Basin G

Hydrograph type	= SCS Runoff	Peak discharge	= 24.25 cfs
Storm frequency	= 100 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 193,042 cuft
Drainage area	= 67.090 ac	Curve number	= 55*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 50.30 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(34.420 x 49) + (31.570 x 61) + (1.100 x 85)] / 67.090



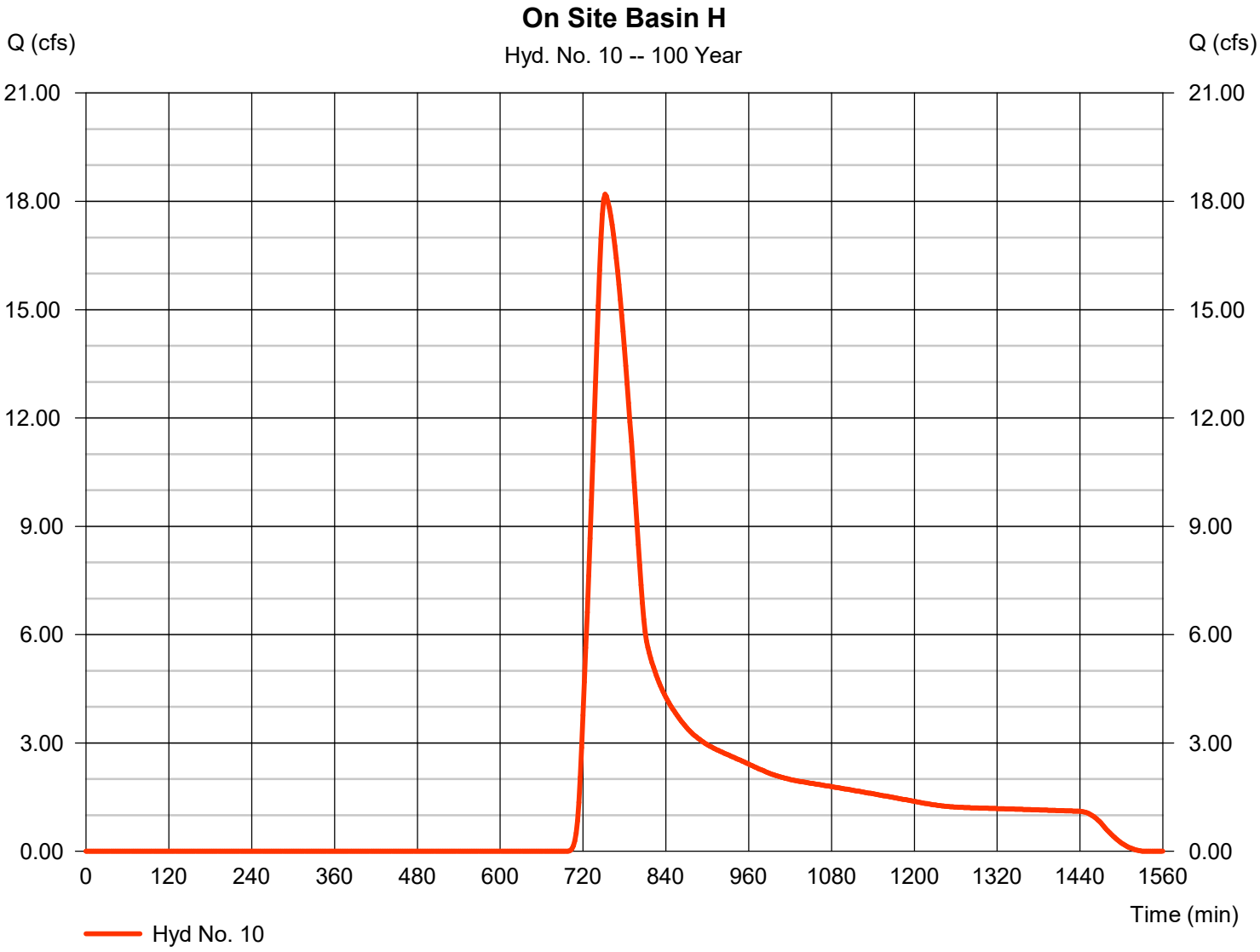
Hydrograph Report

Hyd. No. 10

On Site Basin H

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.20 cfs
Storm frequency	=	100 yrs	Time to peak	=	752 min
Time interval	=	2 min	Hyd. volume	=	146,640 cuft
Drainage area	=	39.620 ac	Curve number	=	59*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	57.90 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(31.110 x 61) + (8.380 x 49) + (0.130 x 85)] / 39.620

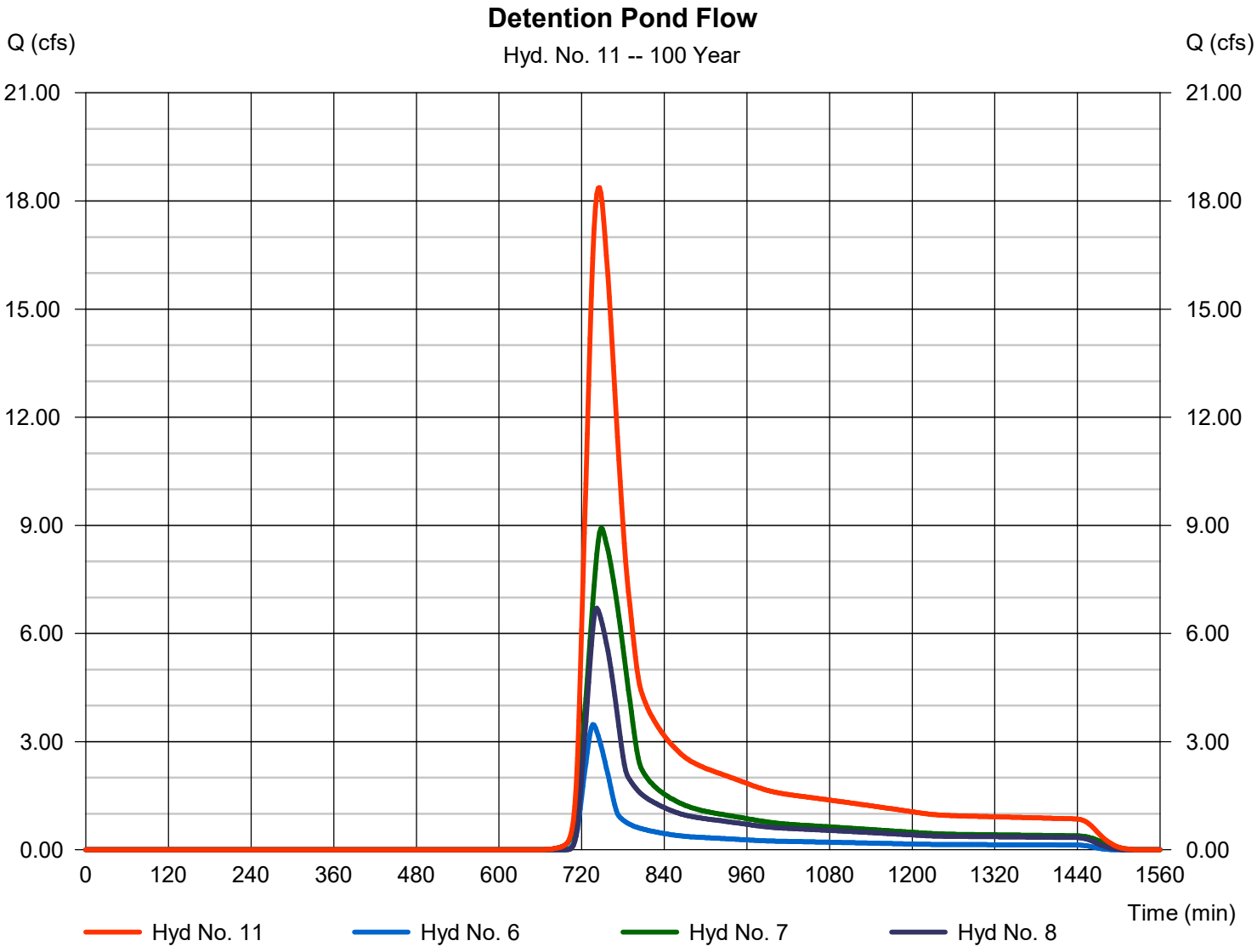


Hydrograph Report

Hyd. No. 11

Detention Pond Flow

Hydrograph type	= Combine	Peak discharge	= 18.37 cfs
Storm frequency	= 100 yrs	Time to peak	= 746 min
Time interval	= 2 min	Hyd. volume	= 122,321 cuft
Inflow hyds.	= 6, 7, 8	Contrib. drain. area	= 28.310 ac

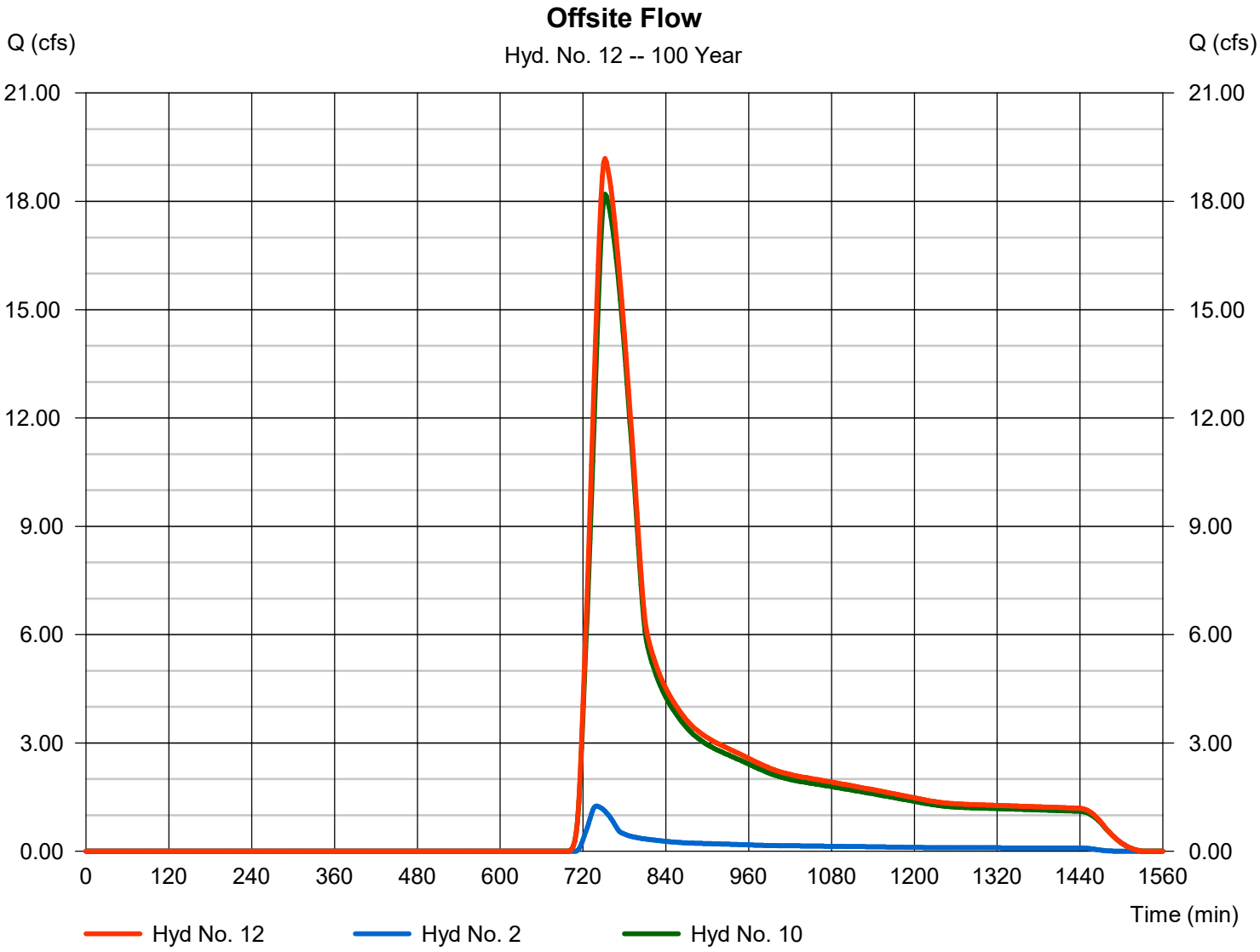


Hydrograph Report

Hyd. No. 12

Offsite Flow

Hydrograph type	= Combine	Peak discharge	= 19.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 155,210 cuft
Inflow hyds.	= 2, 10	Contrib. drain. area	= 44.160 ac



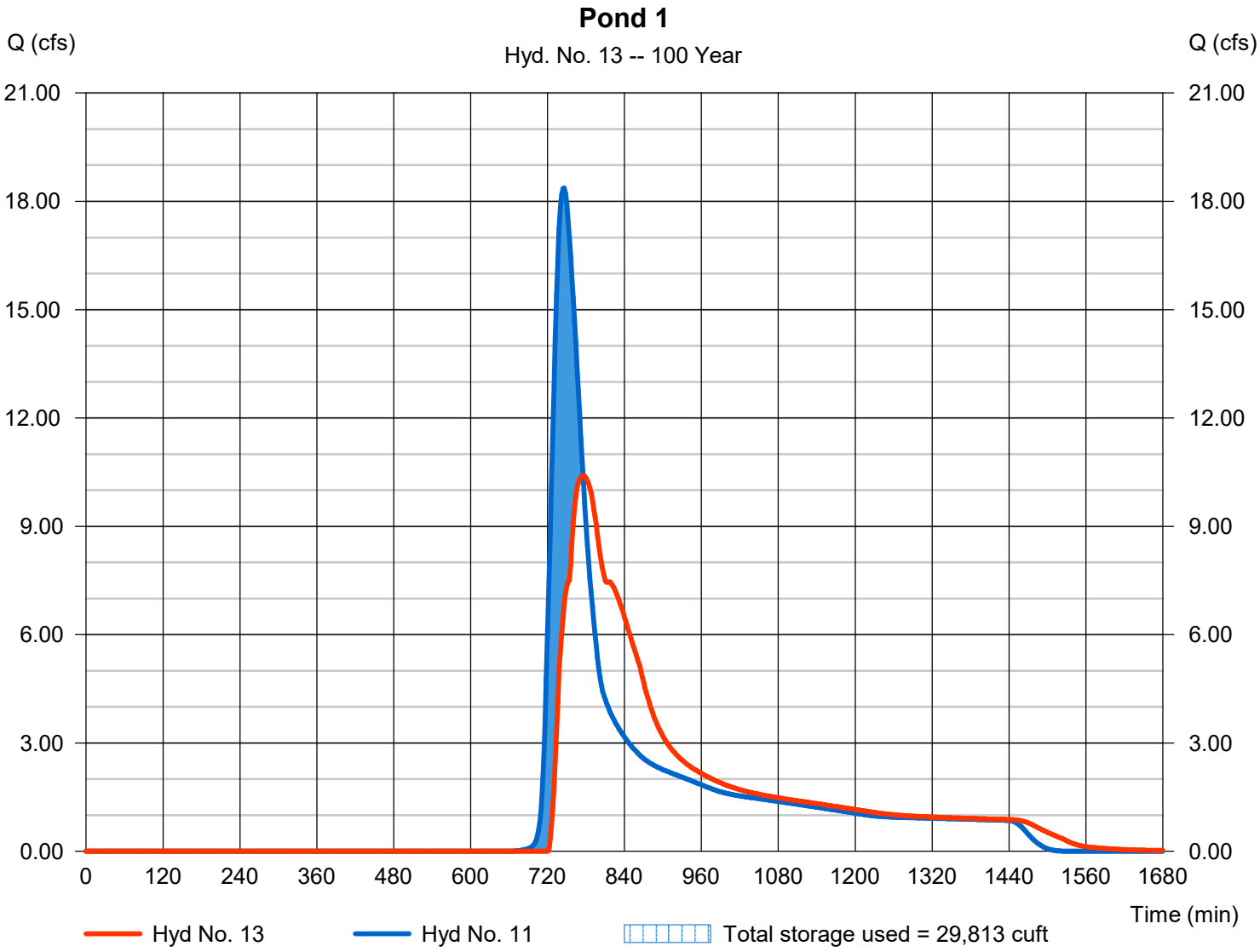
Hydrograph Report

Hyd. No. 13

Pond 1

Hydrograph type	= Reservoir	Peak discharge	= 10.41 cfs
Storm frequency	= 100 yrs	Time to peak	= 776 min
Time interval	= 2 min	Hyd. volume	= 119,418 cuft
Inflow hyd. No.	= 11 - Detention Pond Flow	Max. Elevation	= 5895.05 ft
Reservoir name	= Pond 1	Max. Storage	= 29,813 cuft

Storage Indication method used.

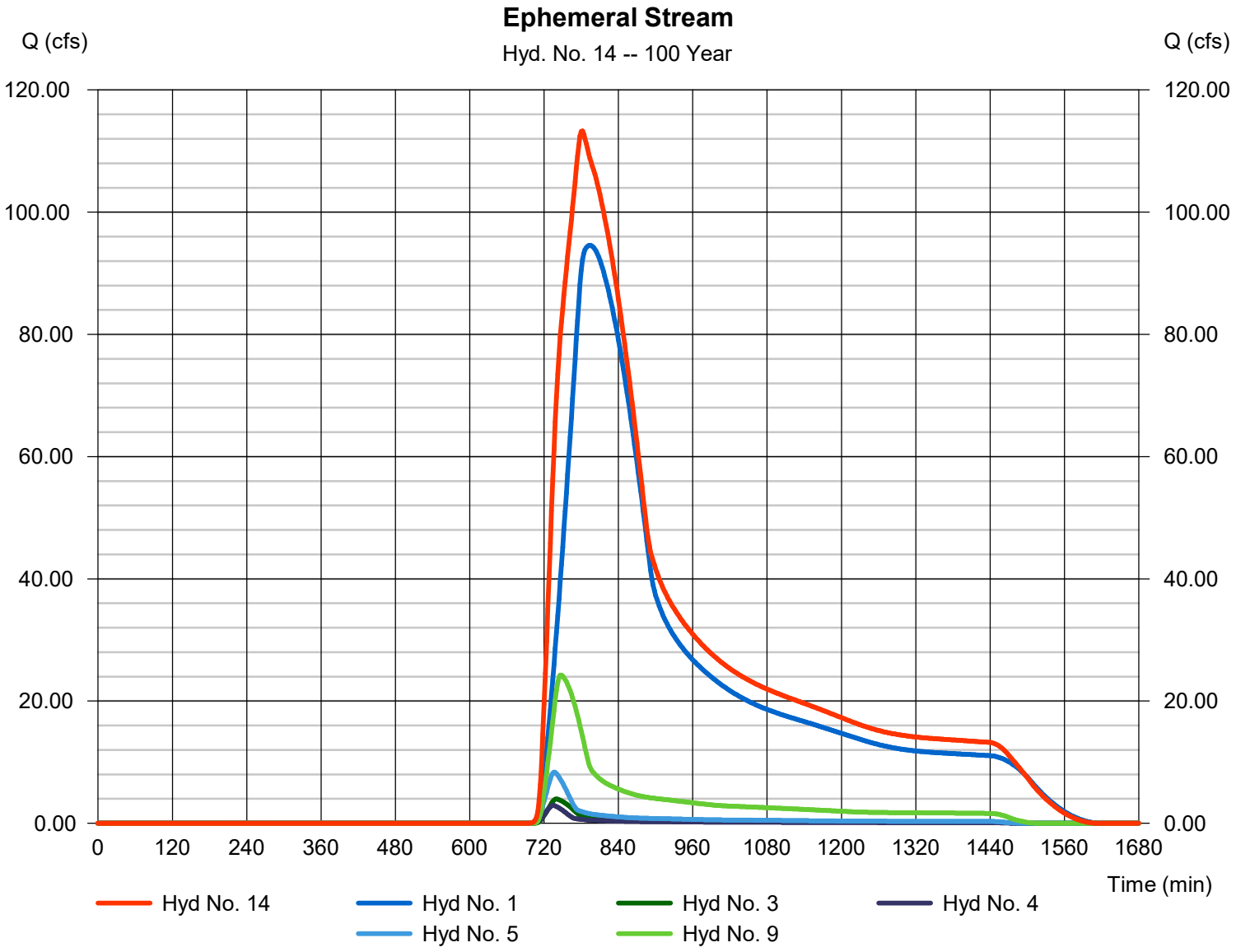


Hydrograph Report

Hyd. No. 14

Ephemeral Stream

Hydrograph type	=	Combine	Peak discharge	=	113.27 cfs
Storm frequency	=	100 yrs	Time to peak	=	782 min
Time interval	=	2 min	Hyd. volume	=	1,595,655 cuft
Inflow hyds.	=	1, 3, 4, 5, 9	Contrib. drain. area	=	517.260 ac

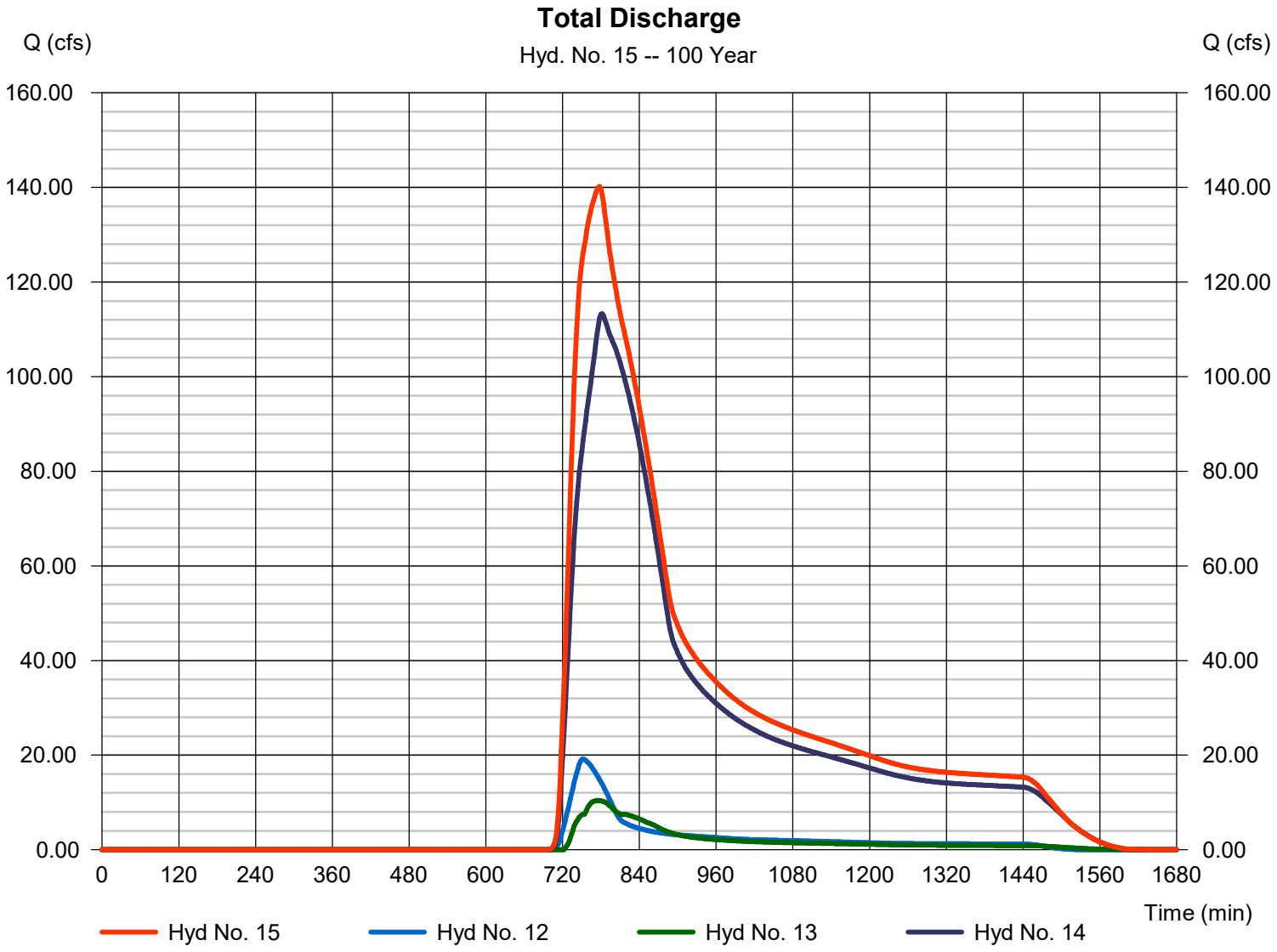


Hydrograph Report

Hyd. No. 15

Total Discharge

Hydrograph type	= Combine	Peak discharge	= 140.17 cfs
Storm frequency	= 100 yrs	Time to peak	= 778 min
Time interval	= 2 min	Hyd. volume	= 1,884,725 cuft
Inflow hyds.	= 12, 13, 14	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	19.7890	7.4000	0.7561	--------
2	25.0946	7.6000	0.7677	--------
3	0.0000	0.0000	0.0000	--------
5	33.7537	7.7000	0.7745	--------
10	38.9252	7.4000	0.7625	--------
25	45.5828	6.9000	0.7450	--------
50	50.5681	6.6000	0.7309	--------
100	51.3489	5.7000	0.7003	--------

File name: Cherokee Rainfall.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.95	2.28	1.89	1.62	1.43	1.28	1.16	1.07	0.99	0.93	0.87	0.82
2	3.59	2.78	2.29	1.97	1.73	1.55	1.41	1.29	1.20	1.12	1.05	0.99
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	4.71	3.65	3.01	2.58	2.27	2.03	1.84	1.69	1.57	1.46	1.37	1.29
10	5.71	4.41	3.64	3.12	2.74	2.46	2.24	2.05	1.90	1.77	1.67	1.57
25	7.20	5.55	4.57	3.92	3.46	3.10	2.82	2.59	2.40	2.25	2.11	1.99
50	8.43	6.49	5.35	4.60	4.05	3.64	3.31	3.05	2.83	2.65	2.49	2.35
100	9.77	7.47	6.15	5.29	4.67	4.20	3.83	3.53	3.29	3.08	2.90	2.74

Tc = time in minutes. Values may exceed 60.

Precip. file name: Z:\Clients\WTR\CherokeeMetr\119461_TDSReduce\Design\Civil\Stormwater\Cherokee Rainfall.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	1.77	0.00	0.00	2.69	0.00	0.00	4.61
SCS 6-Hr	0.00	1.46	0.00	0.00	2.30	0.00	0.00	4.13
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	1.20	0.00	0.00	1.91	0.00	0.00	3.37

SCS HYDROGRAPH CALCULATIONS – PROPOSED CONDITIONS

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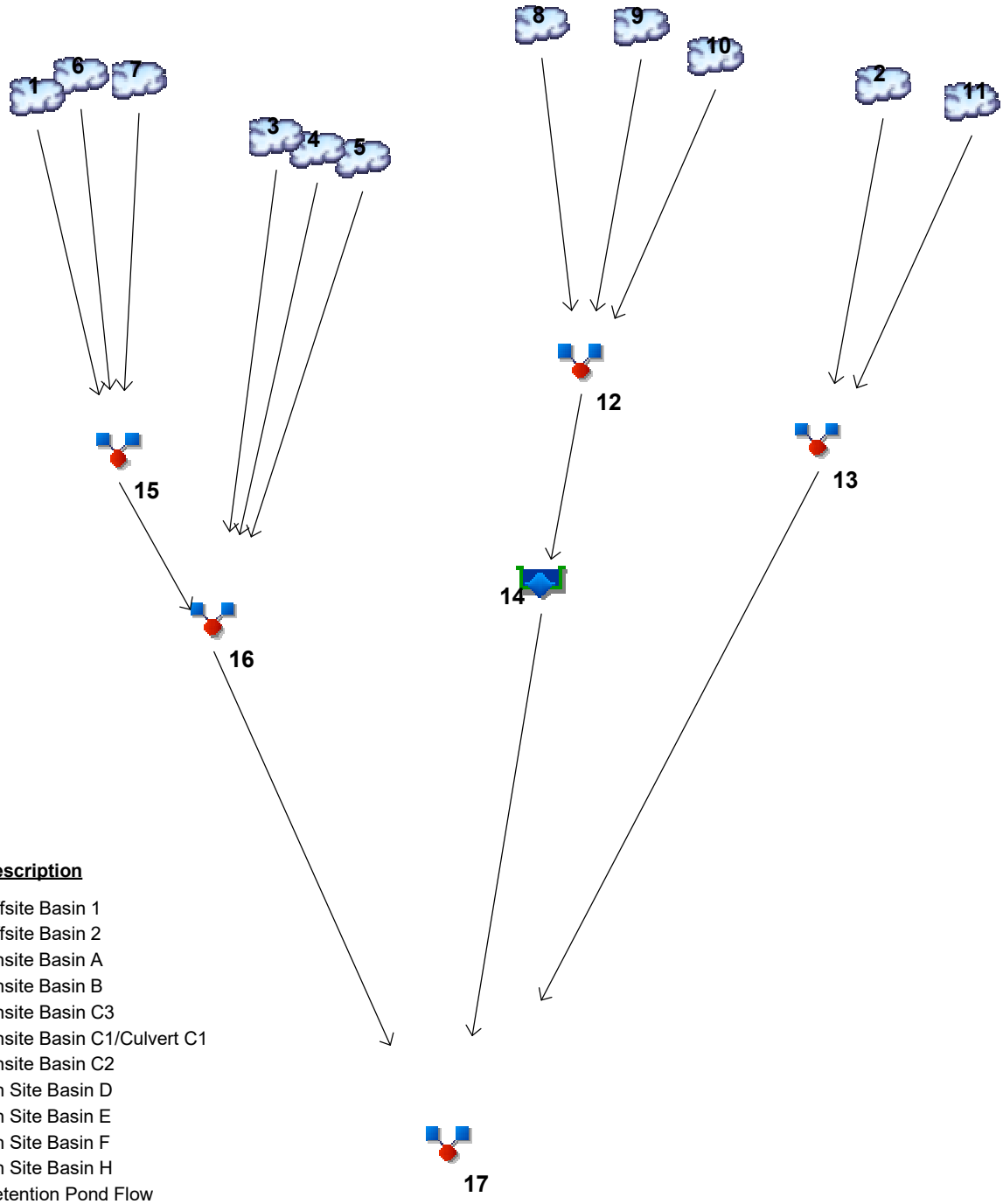
Watershed Model Schematic



Legend

Hyd.	Origin	Description
1	SCS Runoff	Offsite Basin 1
2	SCS Runoff	Offsite Basin 2
3	SCS Runoff	Onsite Basin A
4	SCS Runoff	Onsite Basin B
5	SCS Runoff	Onsite Basin C3
6	SCS Runoff	Onsite Basin C1/Culvert C1
7	SCS Runoff	Onsite Basin C2
8	SCS Runoff	On Site Basin D
9	SCS Runoff	On Site Basin E
10	SCS Runoff	On Site Basin F
11	SCS Runoff	On Site Basin H
12	Combine	Detention Pond Flow
13	Combine	Flow to Offsite
14	Reservoir	Pond Routing
15	Combine	Culvert C2
16	Combine	Engineered Grass Swale Flow
17	Combine	Total Site

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	------	-------	0.379	-------	2.377	8.620	-------	-------	94.58	Offsite Basin 1
2	SCS Runoff	------	-------	0.000	-------	0.007	0.027	-------	-------	1.252	Offsite Basin 2
3	SCS Runoff	------	-------	0.010	-------	0.059	0.282	-------	-------	3.969	Onsite Basin A
4	SCS Runoff	------	-------	0.028	-------	0.176	0.472	-------	-------	2.843	Onsite Basin B
5	SCS Runoff	------	-------	0.006	-------	0.043	0.237	-------	-------	6.953	Onsite Basin C3
6	SCS Runoff	------	-------	0.003	-------	0.019	0.132	-------	-------	2.579	Onsite Basin C1/Culvert C1
7	SCS Runoff	------	-------	0.055	-------	0.463	1.981	-------	-------	19.60	Onsite Basin C2
8	SCS Runoff	------	-------	0.016	-------	0.126	0.423	-------	-------	3.473	On Site Basin D
9	SCS Runoff	------	-------	0.195	-------	0.917	2.148	-------	-------	10.88	On Site Basin E
10	SCS Runoff	------	-------	0.020	-------	0.131	0.552	-------	-------	6.520	On Site Basin F
11	SCS Runoff	------	-------	0.084	-------	0.552	1.936	-------	-------	18.20	On Site Basin H
12	Combine	8, 9, 10,	-------	1.432	-------	3.479	6.425	-------	-------	27.52	Detention Pond Flow
13	Combine	2, 11,	-------	0.083	-------	0.548	1.933	-------	-------	19.18	Flow to Offsite
14	Reservoir	12	-------	0.278	-------	1.157	3.029	-------	-------	13.52	Pond Routing
15	Combine	1, 6, 7,	-------	0.427	-------	2.584	9.090	-------	-------	97.16	Culvert C2
16	Combine	3, 4, 5, 15	-------	0.467	-------	2.769	9.544	-------	-------	99.92	Engineered Grass Swale Flow
17	Combine	13, 14, 16	-------	0.668	-------	3.734	12.18	-------	-------	124.15	Total Site

Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	0.379	2	1446	7,650	------	------	------	Offsite Basin 1
2	SCS Runoff	0.000	2	n/a	0	------	------	------	Offsite Basin 2
3	SCS Runoff	0.010	2	1440	242	------	------	------	Onsite Basin A
4	SCS Runoff	0.028	2	770	675	------	------	------	Onsite Basin B
5	SCS Runoff	0.006	2	1440	78	------	------	------	Onsite Basin C3
6	SCS Runoff	0.003	2	1440	76	------	------	------	Onsite Basin C1/Culvert C1
7	SCS Runoff	0.055	2	932	1,956	------	------	------	Onsite Basin C2
8	SCS Runoff	0.016	2	920	565	------	------	------	On Site Basin D
9	SCS Runoff	0.195	2	758	3,359	------	------	------	On Site Basin E
10	SCS Runoff	0.020	2	1440	608	------	------	------	On Site Basin F
11	SCS Runoff	0.084	2	1110	2,836	------	------	------	On Site Basin H
12	Combine	1.432	2	736	10,924	8, 9, 10,	------	------	Detention Pond Flow
13	Combine	0.083	2	1110	2,817	2, 11,	------	------	Flow to Offsite
14	Reservoir	0.278	2	844	7,967	12	5892.97	4,062	Pond Routing
15	Combine	0.427	2	1440	9,647	1, 6, 7,	------	------	Culvert C2
16	Combine	0.467	2	1440	11,630	3, 4, 5, 15	------	------	Engineered Grass Swale Flow
17	Combine	0.668	2	1440	22,414	13, 14, 16	------	------	Total Site

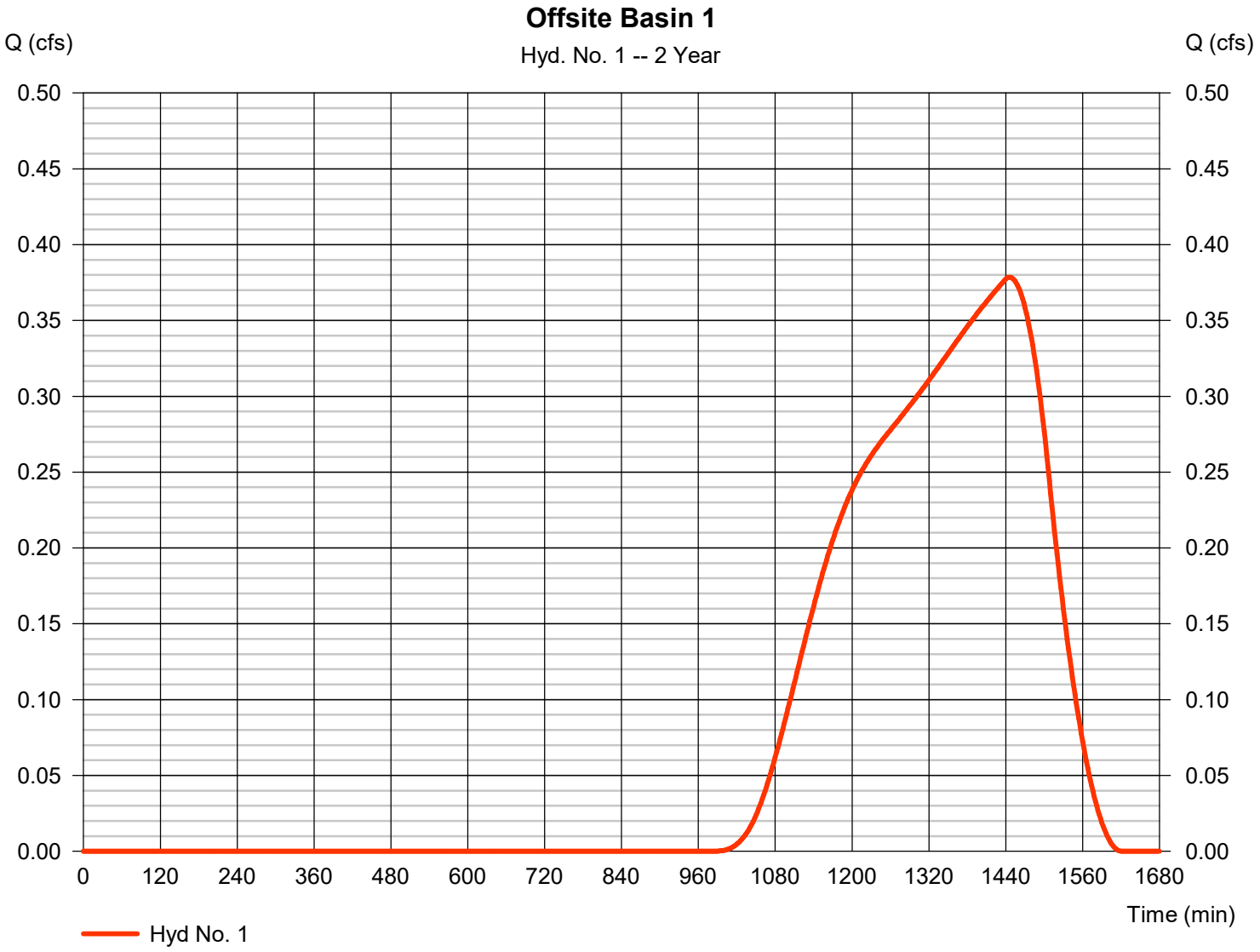
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	= SCS Runoff	Peak discharge	= 0.379 cfs
Storm frequency	= 2 yrs	Time to peak	= 1446 min
Time interval	= 2 min	Hyd. volume	= 7,650 cuft
Drainage area	= 428.970 ac	Curve number	= 56*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 114.40 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



TR55 Tc Worksheet

Hyd. No. 1

Offsite Basin 1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		1.77		1.77		
Land slope (%)	= 1.74		0.00		0.00		
Travel Time (min)	**= 33.54**	**+**	**0.00**	**+**	**0.00**	**=**	**33.54**
Shallow Concentrated Flow							
Flow length (ft)	= 10323.00		0.00		0.00		
Watercourse slope (%)	= 1.74		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.13		0.00		0.00		
Travel Time (min)	**= 80.84**	**+**	**0.00**	**+**	**0.00**	**=**	**80.84**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 114.40 min

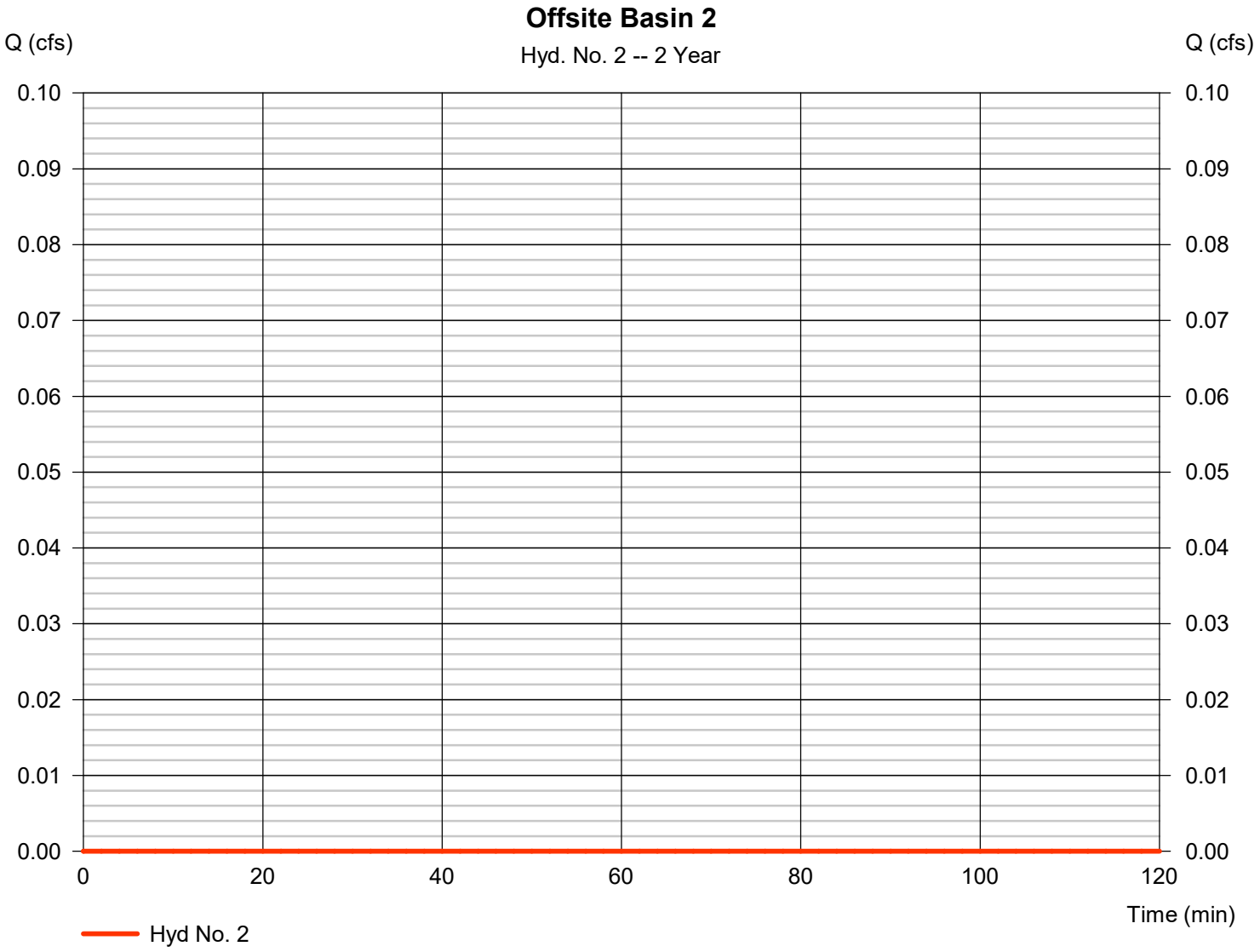
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.000 cfs
Storm frequency	= 2 yrs	Time to peak	= n/a
Time interval	= 2 min	Hyd. volume	= 0 cuft
Drainage area	= 4.540 ac	Curve number	= 51*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



TR55 Tc Worksheet

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

Hyd. No. 2

Offsite Basin 2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.42		0.00		0.00		
Travel Time (min)	**= 29.40**	**+**	**0.00**	**+**	**0.00**	**=**	**29.40**
Shallow Concentrated Flow							
Flow length (ft)	= 731.00		0.00		0.00		
Watercourse slope (%)	= 2.42		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.51		0.00		0.00		
Travel Time (min)	**= 4.85**	**+**	**0.00**	**+**	**0.00**	**=**	**4.85**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 34.30 min

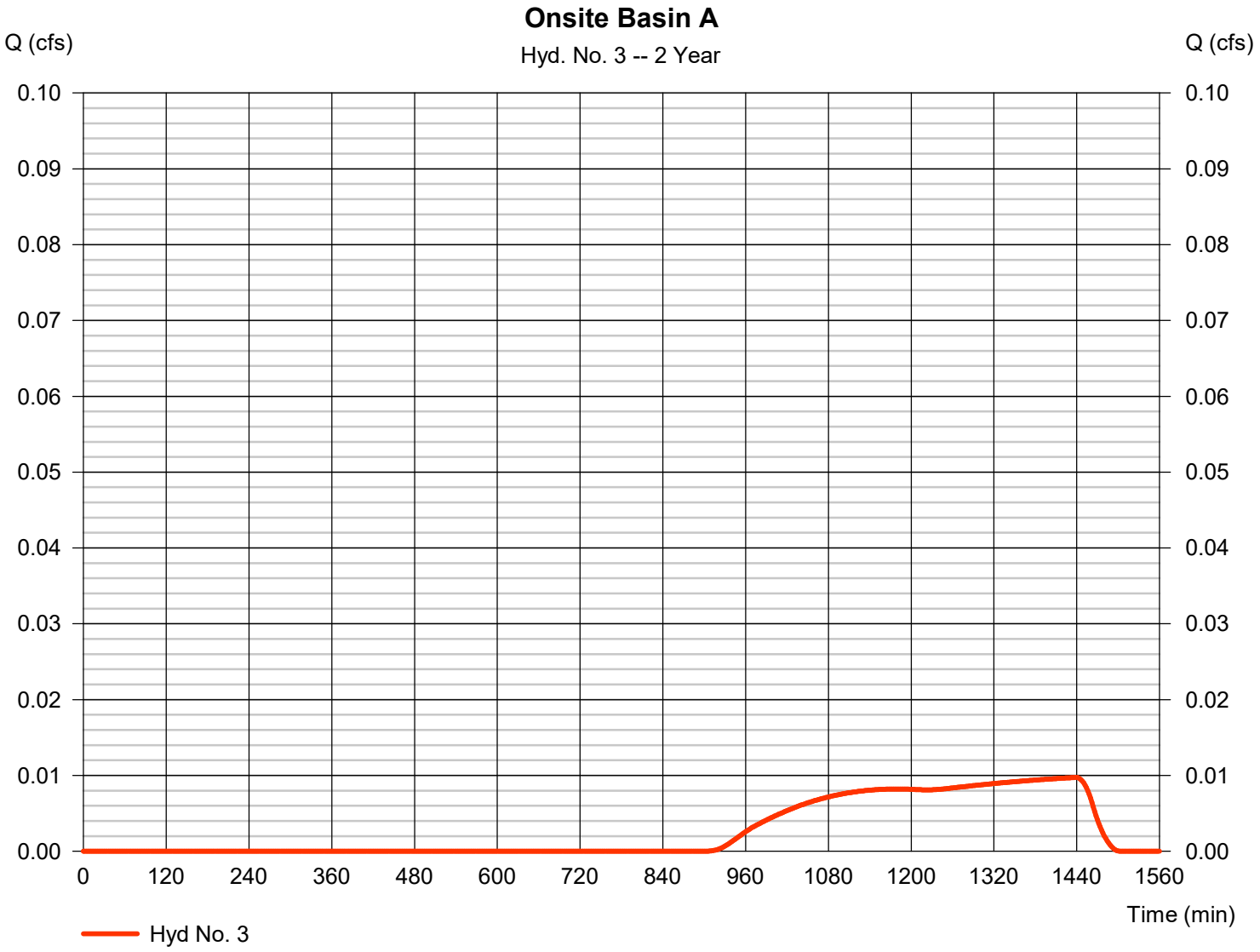
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.010 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 242 cuft
Drainage area	= 7.640 ac	Curve number	= 57*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.50 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 85)] / 7.640



TR55 Tc Worksheet

Hyd. No. 3

Onsite Basin A

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 786.82		0.00		0.00		
Watercourse slope (%)	= 2.00		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.28		0.00		0.00		
Travel Time (min)	**= 5.75**	**+**	**0.00**	**+**	**0.00**	**=**	**5.75**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 37.50 min

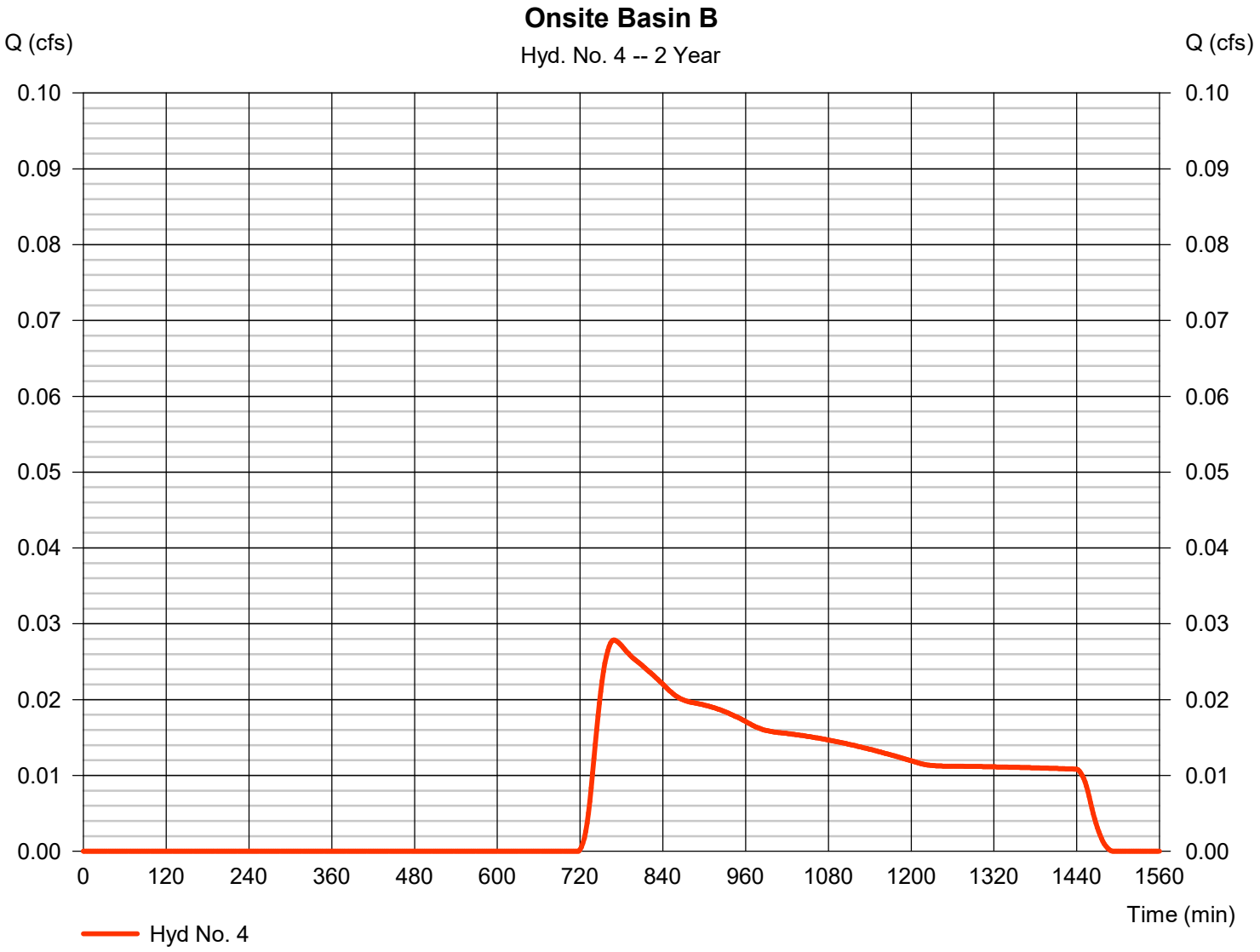
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.028 cfs
Storm frequency	=	2 yrs	Time to peak	=	770 min
Time interval	=	2 min	Hyd. volume	=	675 cuft
Drainage area	=	2.770 ac	Curve number	=	64*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.144 x 85) + (0.205 x 98) + (0.283 x 49) + (2.134 x 61)] / 2.770



TR55 Tc Worksheet

Hyd. No. 4

Onsite Basin B

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 73.94		0.00		0.00		
Watercourse slope (%)	= 1.35		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.87		0.00		0.00		
Travel Time (min)	**= 0.66**	**+**	**0.00**	**+**	**0.00**	**=**	**0.66**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 32.40 min

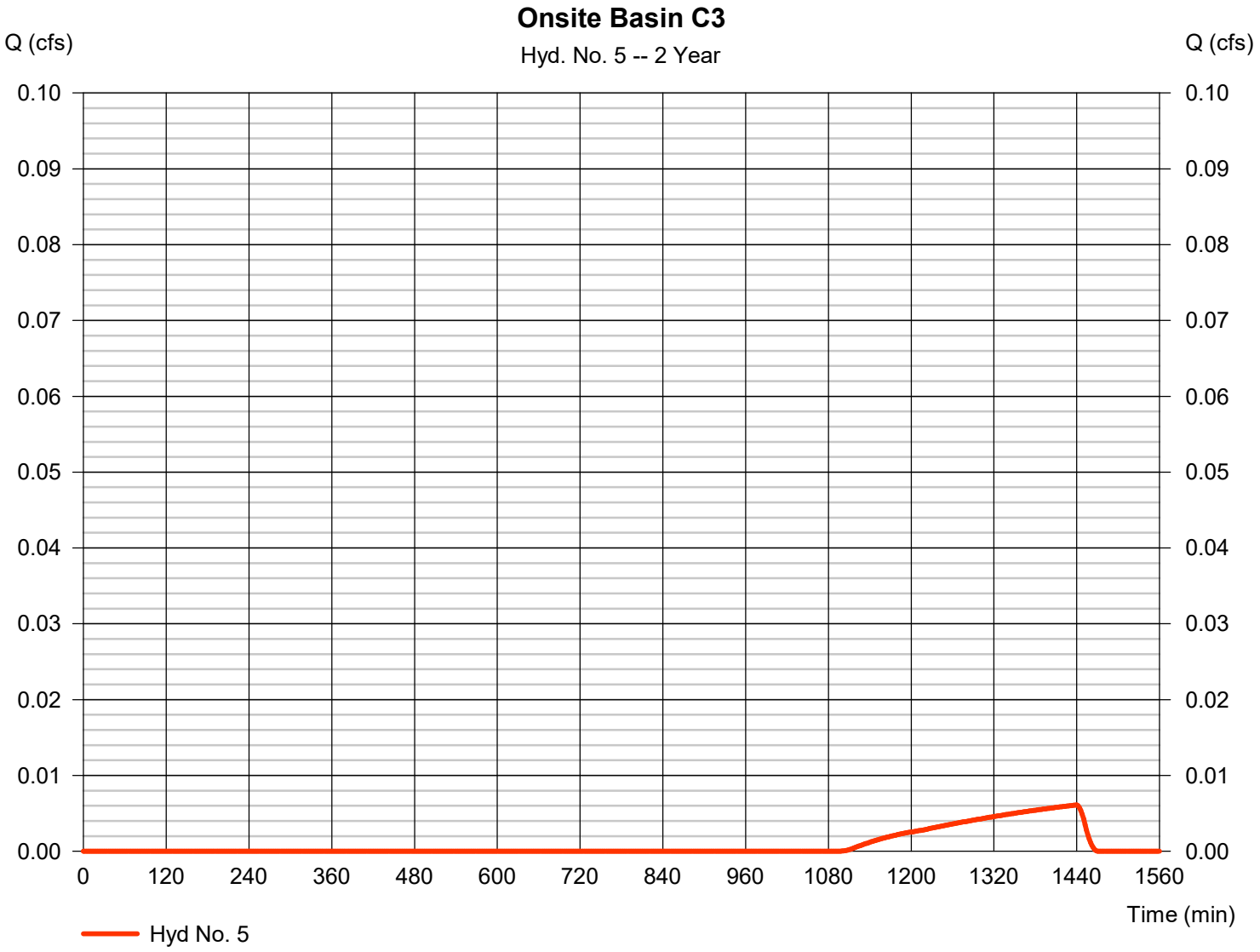
Hydrograph Report

Hyd. No. 5

Onsite Basin C3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.006 cfs
Storm frequency	=	2 yrs	Time to peak	=	1440 min
Time interval	=	2 min	Hyd. volume	=	78 cuft
Drainage area	=	9.990 ac	Curve number	=	55*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.90 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.297 x 98) + (0.716 x 76) + (0.036 x 85) + (0.337 x 98) + (7.720 x 49) + (0.887 x 61)] / 9.990



TR55 Tc Worksheet

Hyd. No. 5

Onsite Basin C3

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 168.2		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 4.30		0.00		0.00		
Travel Time (min)	**= 14.70**	**+**	**0.00**	**+**	**0.00**	**=**	**14.70**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Unpaved		Unpaved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 31.95		0.00		0.00		
Wetted perimeter (ft)	= 23.54		0.00		0.00		
Channel slope (%)	= 0.82		0.00		0.00		
Manning's n-value	= 0.026		0.013		0.026		
Velocity (ft/s)	=6.38						
			0.00				
					0.00		
Flow length (ft)	({0})829.5		0.0		0.0		
Travel Time (min)	**= 2.17**	**+**	**0.00**	**+**	**0.00**	**=**	**2.17**
Total Travel Time, Tc							**16.90 min**

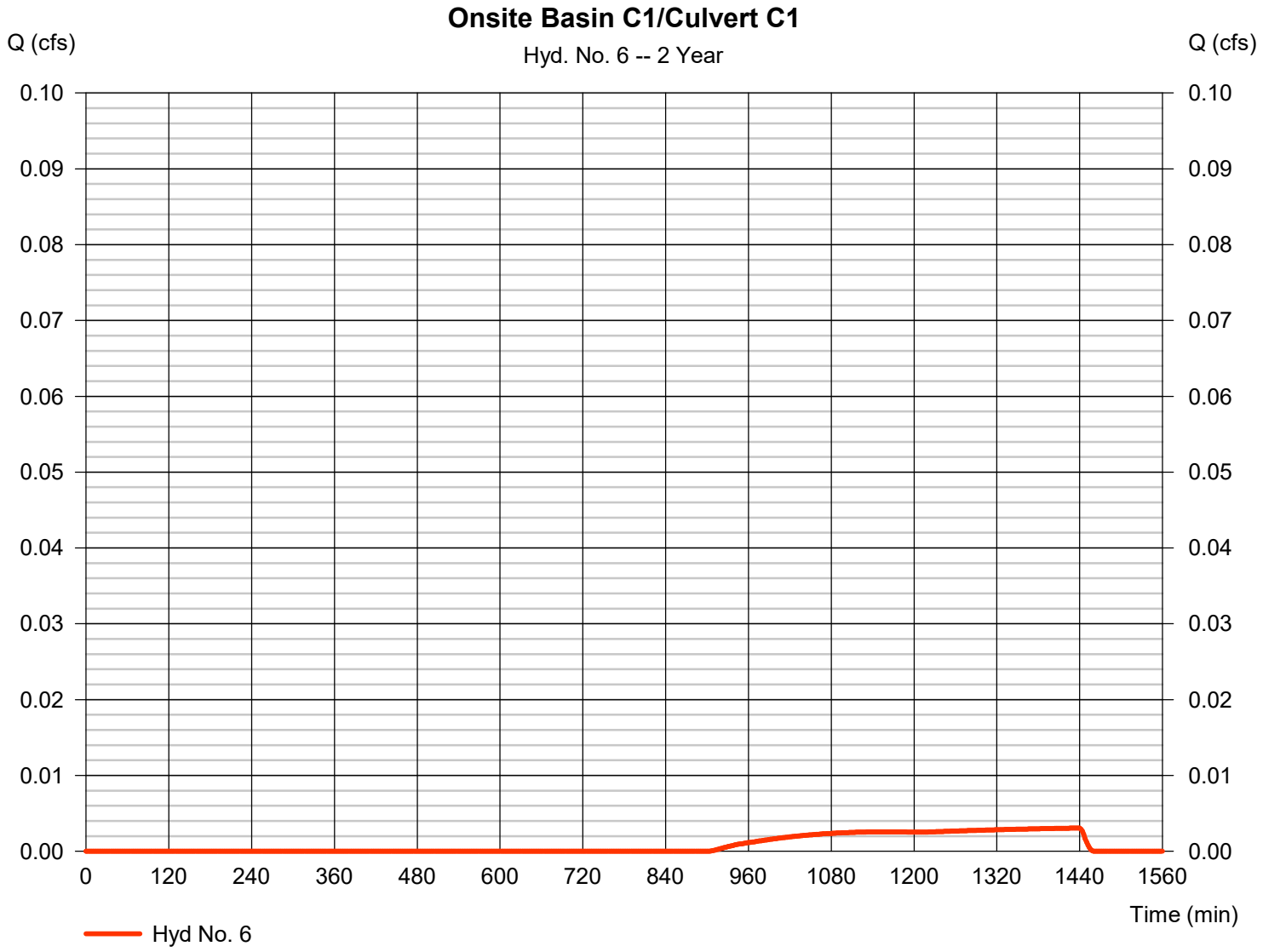
Hydrograph Report

Hyd. No. 6

Onsite Basin C1/Culvert C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.003 cfs
Storm frequency	=	2 yrs	Time to peak	=	1440 min
Time interval	=	2 min	Hyd. volume	=	76 cuft
Drainage area	=	2.310 ac	Curve number	=	57*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.06 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.145 x 85) + (1.131 x 49) + (1.033 x 61)] / 2.310



TR55 Tc Worksheet

Hyd. No. 6

Onsite Basin C1/Culvert C1

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 97.5		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 0.43		0.00		0.00		
Travel Time (min)	**= 23.85**	**+**	**0.00**	**+**	**0.00**	**=**	**23.85**
Shallow Concentrated Flow							
Flow length (ft)	= 1391.72		0.00		0.00		
Watercourse slope (%)	= 1.98		0.00		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=2.27		0.00		0.00		
Travel Time (min)	**= 10.22**	**+**	**0.00**	**+**	**0.00**	**=**	**10.22**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 34.06 min

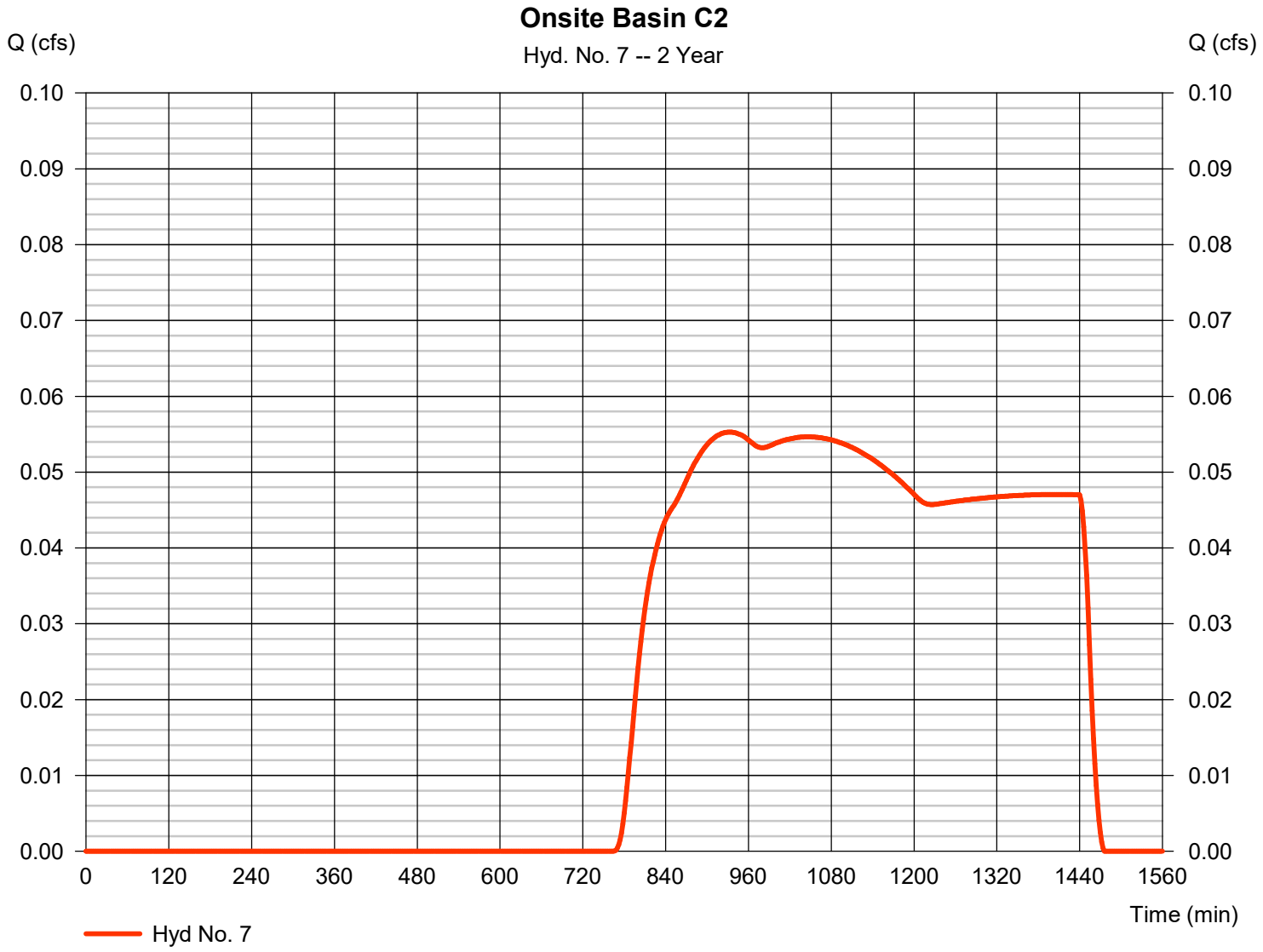
Hydrograph Report

Hyd. No. 7

Onsite Basin C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.055 cfs
Storm frequency	=	2 yrs	Time to peak	=	932 min
Time interval	=	2 min	Hyd. volume	=	1,956 cuft
Drainage area	=	19.720 ac	Curve number	=	60*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.30 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.139 x 98) + (0.236 x 85) + (1.032 x 98) + (5.683 x 49) + (12.631 x 61)] / 19.720



TR55 Tc Worksheet

Hyd. No. 7

Onsite Basin C2

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 119.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.85		0.00		0.00		
Travel Time (min)	**= 13.14**	**+**	**0.00**	**+**	**0.00**	**=**	**13.14**
Shallow Concentrated Flow							
Flow length (ft)	= 0.00		0.00		0.00		
Watercourse slope (%)	= 0.00		0.00		0.00		
Surface description	= Paved		Paved		Paved		
Average velocity (ft/s)	=0.00		0.00		0.00		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**
Channel Flow							
X sectional flow area (sqft)	= 31.95		0.00		0.00		
Wetted perimeter (ft)	= 23.54		0.00		0.00		
Channel slope (%)	= 0.77		0.00		0.00		
Manning's n-value	= 0.026		0.015		0.015		
Velocity (ft/s)	=6.18						
			0.00				
					0.00		
Flow length (ft)	({0})2662.5		0.0		0.0		
Travel Time (min)	**= 7.18**	**+**	**0.00**	**+**	**0.00**	**=**	**7.18**

Total Travel Time, Tc ..... 20.30 min

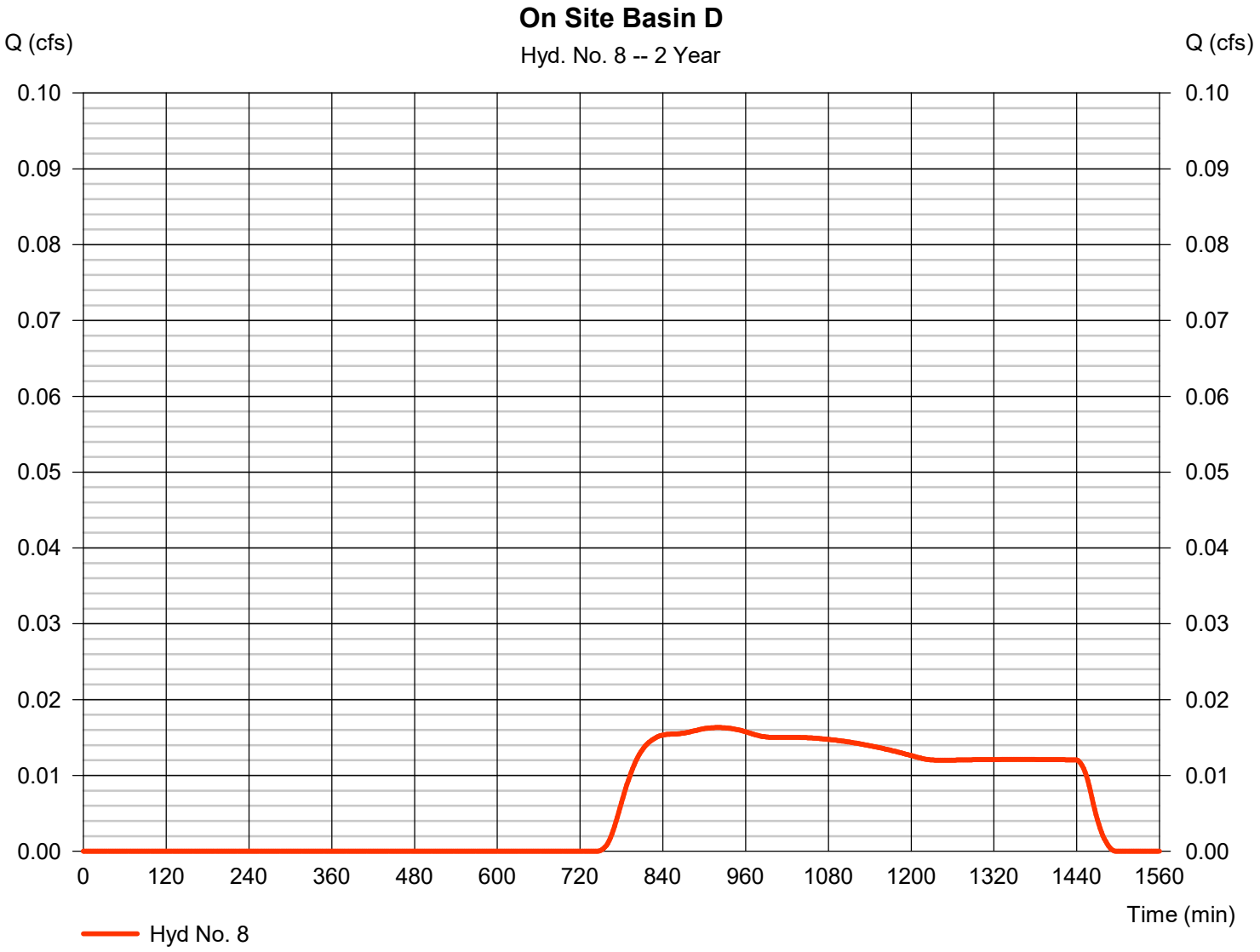
Hydrograph Report

Hyd. No. 8

On Site Basin D

Hydrograph type	= SCS Runoff	Peak discharge	= 0.016 cfs
Storm frequency	= 2 yrs	Time to peak	= 920 min
Time interval	= 2 min	Hyd. volume	= 565 cuft
Drainage area	= 4.490 ac	Curve number	= 61*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.00 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.015 x 98) + (0.428 x 98) + (1.254 x 49) + (2.792 x 61)] / 4.490



TR55 Tc Worksheet

Hyd. No. 8

On Site Basin D

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 245.0		55.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		1.77		0.00		
Land slope (%)	= 1.50		1.50		0.00		
Travel Time (min)	**= 30.27**	**+**	**1.13**	**+**	**0.00**	**=**	**31.40**
Shallow Concentrated Flow							
Flow length (ft)	= 109.14		477.45		0.00		
Watercourse slope (%)	= 2.00		1.00		0.00		
Surface description	= Paved		Unpaved		Paved		
Average velocity (ft/s)	=2.87		1.61		0.00		
Travel Time (min)	**= 0.63**	**+**	**4.93**	**+**	**0.00**	**=**	**5.56**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 37.00 min

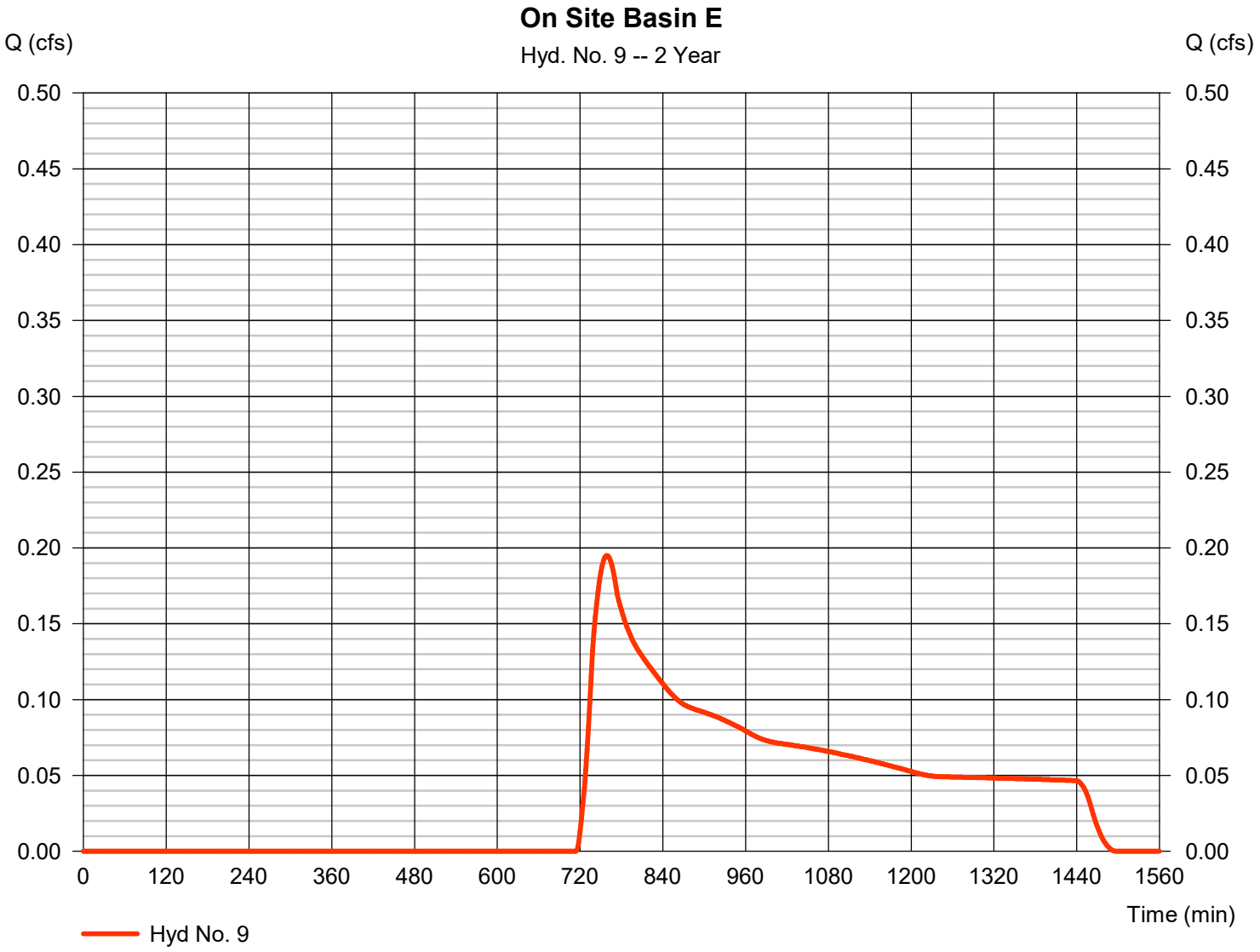
Hydrograph Report

Hyd. No. 9

On Site Basin E

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.195 cfs
Storm frequency	=	2 yrs	Time to peak	=	758 min
Time interval	=	2 min	Hyd. volume	=	3,359 cuft
Drainage area	=	10.090 ac	Curve number	=	66*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.10 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.165 x 98) + (2.167 x 98) + (2.583 x 49) + (5.178 x 61)] / 10.090



TR55 Tc Worksheet

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

Hyd. No. 9

On Site Basin E

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.150		0.150		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 3.94		0.00		0.00		
Travel Time (min)	**= 24.19**	**+**	**0.00**	**+**	**0.00**	**=**	**24.19**
Shallow Concentrated Flow							
Flow length (ft)	= 924.04		210.58		0.00		
Watercourse slope (%)	= 1.43		0.78		0.00		
Surface description	= Unpaved		Paved		Paved		
Average velocity (ft/s)	=1.93		1.80		0.00		
Travel Time (min)	**= 7.98**	**+**	**1.95**	**+**	**0.00**	**=**	**9.94**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 34.10 min

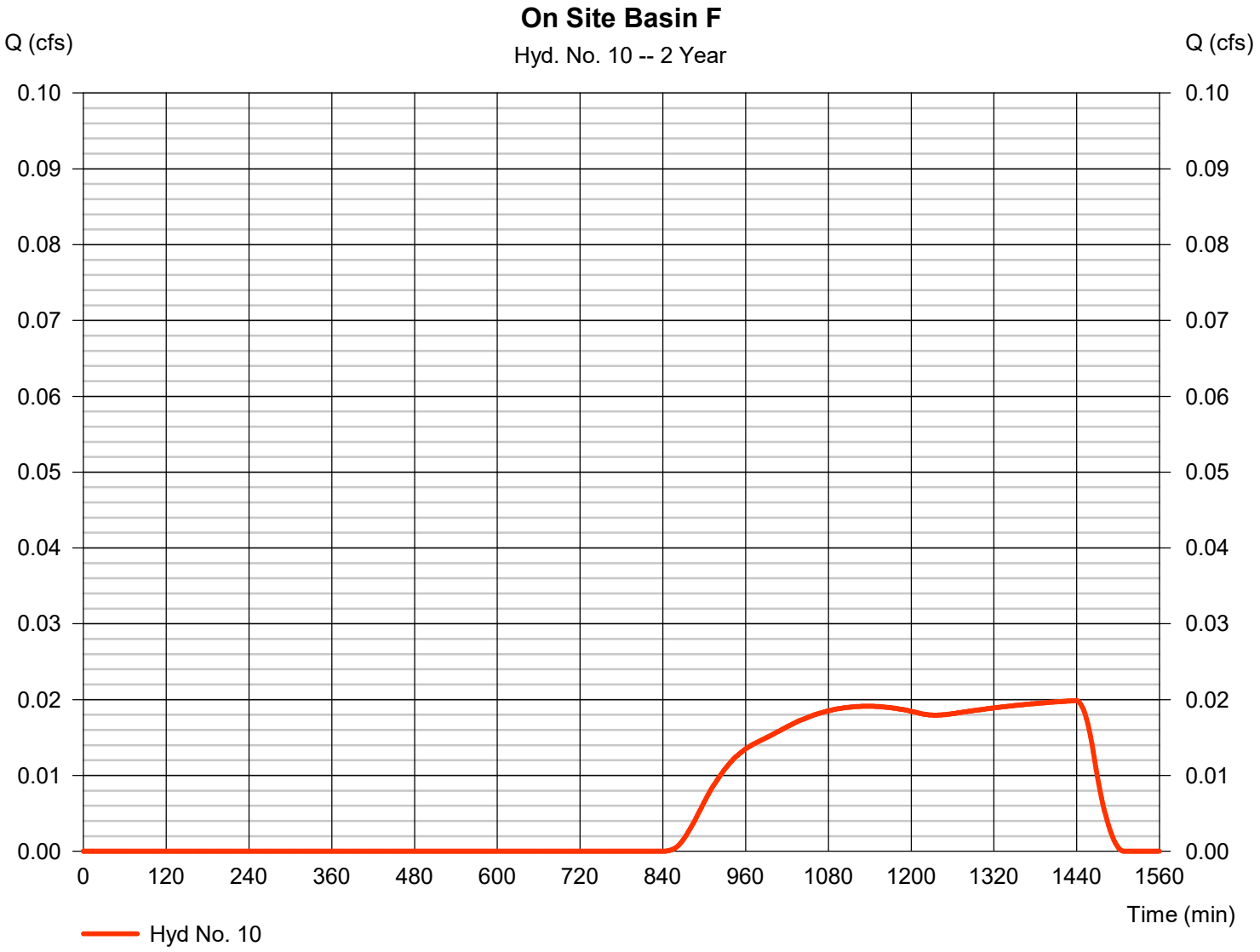
Hydrograph Report

Hyd. No. 10

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.020 cfs
Storm frequency	=	2 yrs	Time to peak	=	1440 min
Time interval	=	2 min	Hyd. volume	=	608 cuft
Drainage area	=	12.130 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	1.77 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.011 x 98) + (0.107 x 98) + (3.132 x 49) + (8.879 x 61)] / 12.130



TR55 Tc Worksheet

Hyd. No. 10

On Site Basin F

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 100.00		1367.56		200.00		
Watercourse slope (%)	= 6.53		2.00		5.55		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=4.12		2.28		3.80		
Travel Time (min)	**= 0.40**	**+**	**9.99**	**+**	**0.88**	**=**	**11.27**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

Total Travel Time, Tc ..... 43.00 min

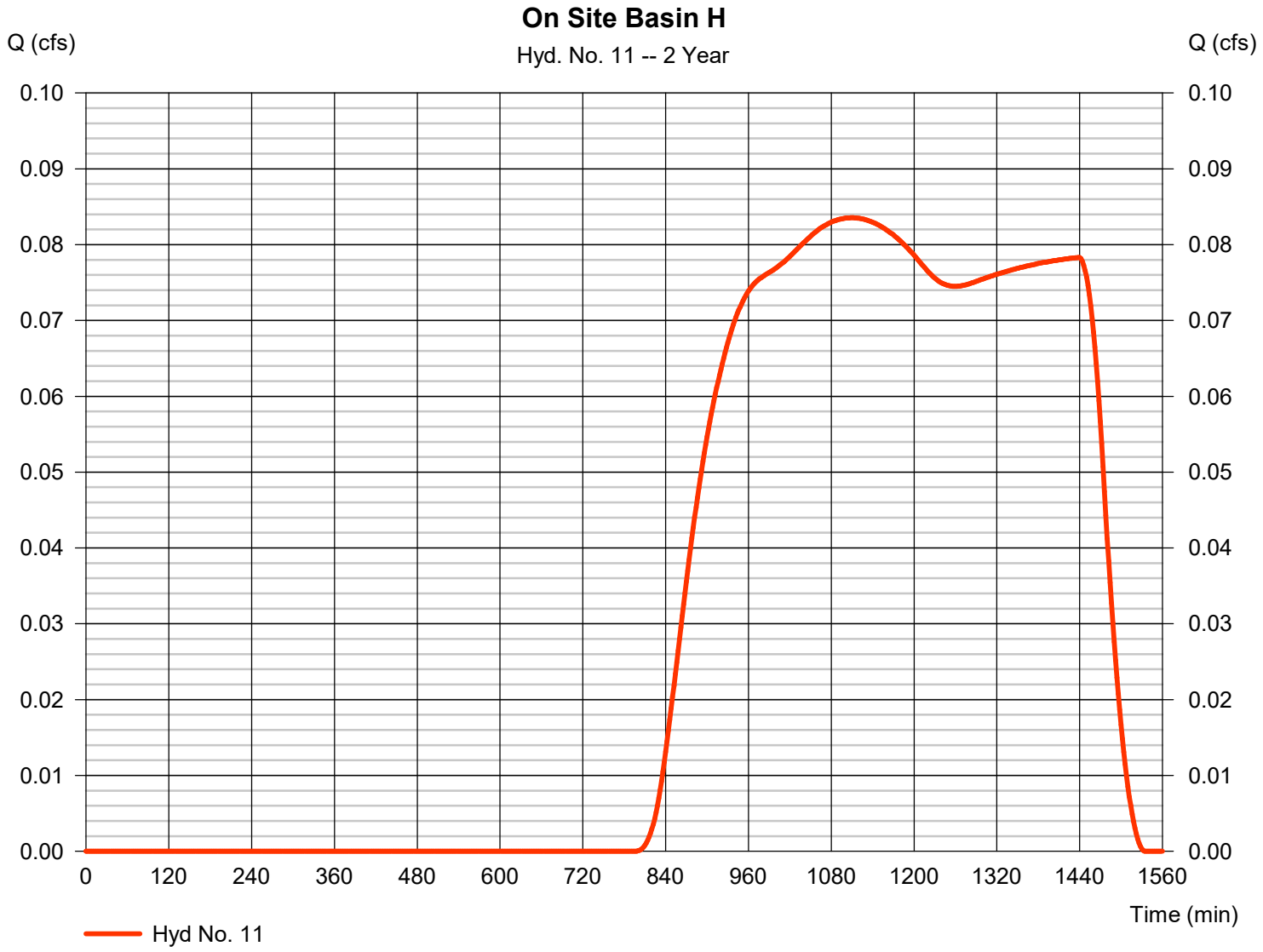
Hydrograph Report

Hyd. No. 11

On Site Basin H

Hydrograph type	= SCS Runoff	Peak discharge	= 0.084 cfs
Storm frequency	= 2 yrs	Time to peak	= 1110 min
Time interval	= 2 min	Hyd. volume	= 2,836 cuft
Drainage area	= 39.620 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 57.90 min
Total precip.	= 1.77 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.132 x 85) + (8.377 x 49) + (31.111 x 61)] / 39.620



TR55 Tc Worksheet

Hyd. No. 11

On Site Basin H

Description	A		B		C		Totals
Sheet Flow							
Manning's n-value	= 0.150		0.011		0.011		
Flow length (ft)	= 300.0		0.0		0.0		
Two-year 24-hr precip. (in)	= 1.77		0.00		0.00		
Land slope (%)	= 2.00		0.00		0.00		
Travel Time (min)	**= 31.73**	**+**	**0.00**	**+**	**0.00**	**=**	**31.73**
Shallow Concentrated Flow							
Flow length (ft)	= 1933.72		600.56		556.40		
Watercourse slope (%)	= 1.25		3.00		1.50		
Surface description	= Unpaved		Unpaved		Unpaved		
Average velocity (ft/s)	=1.80		2.79		1.98		
Travel Time (min)	**= 17.87**	**+**	**3.58**	**+**	**4.69**	**=**	**26.14**
Channel Flow							
X sectional flow area (sqft)	= 0.00		0.00		0.00		
Wetted perimeter (ft)	= 0.00		0.00		0.00		
Channel slope (%)	= 0.00		0.00		0.00		
Manning's n-value	= 0.015		0.015		0.015		
Velocity (ft/s)	=0.00						
			0.00				
					0.00		
Flow length (ft)	({0})0.0		0.0		0.0		
Travel Time (min)	**= 0.00**	**+**	**0.00**	**+**	**0.00**	**=**	**0.00**

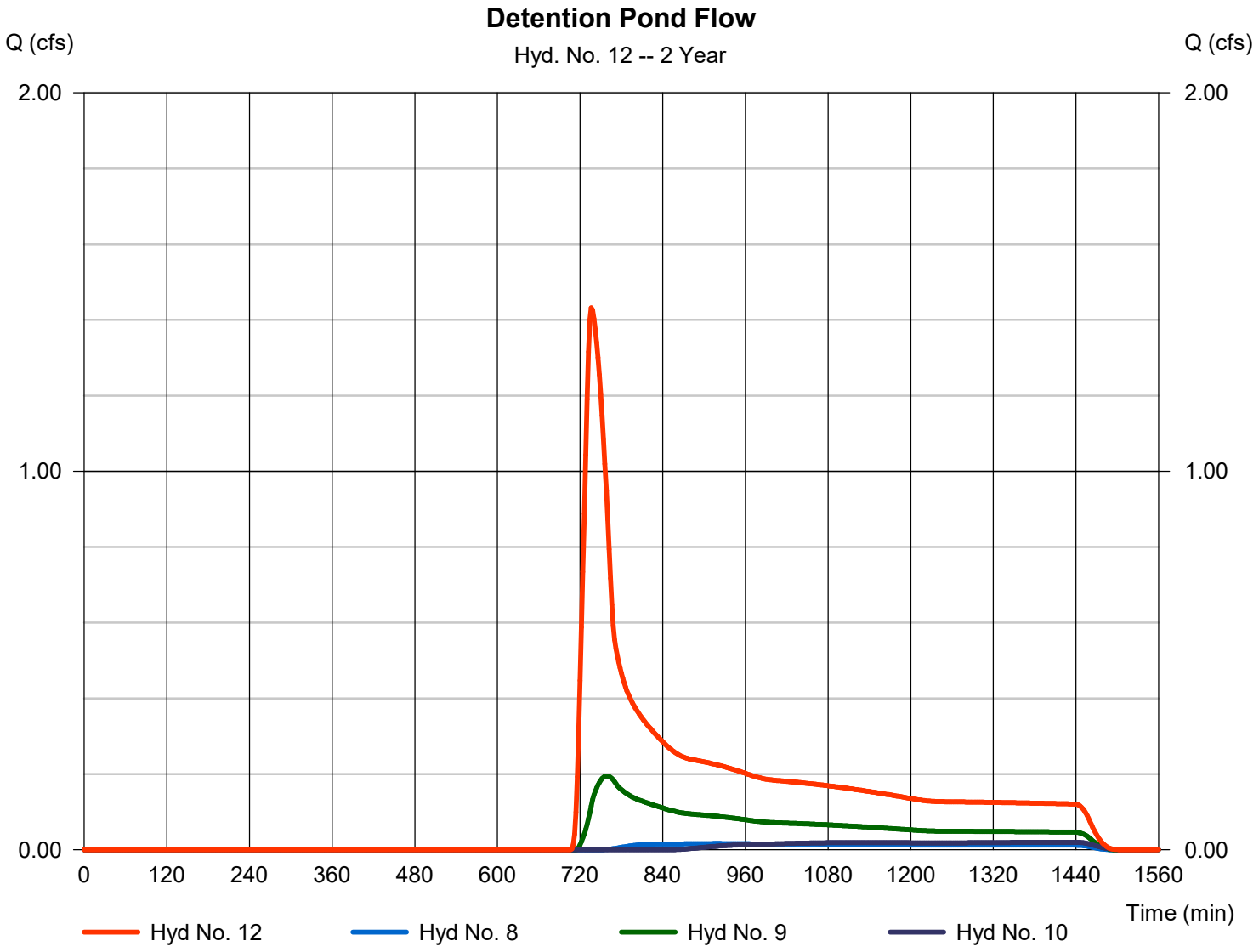
Total Travel Time, Tc ..... 57.90 min

Hydrograph Report

Hyd. No. 12

Detention Pond Flow

Hydrograph type	= Combine	Peak discharge	= 1.432 cfs
Storm frequency	= 2 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 10,924 cuft
Inflow hyds.	= 8, 9, 10	Contrib. drain. area	= 26.710 ac

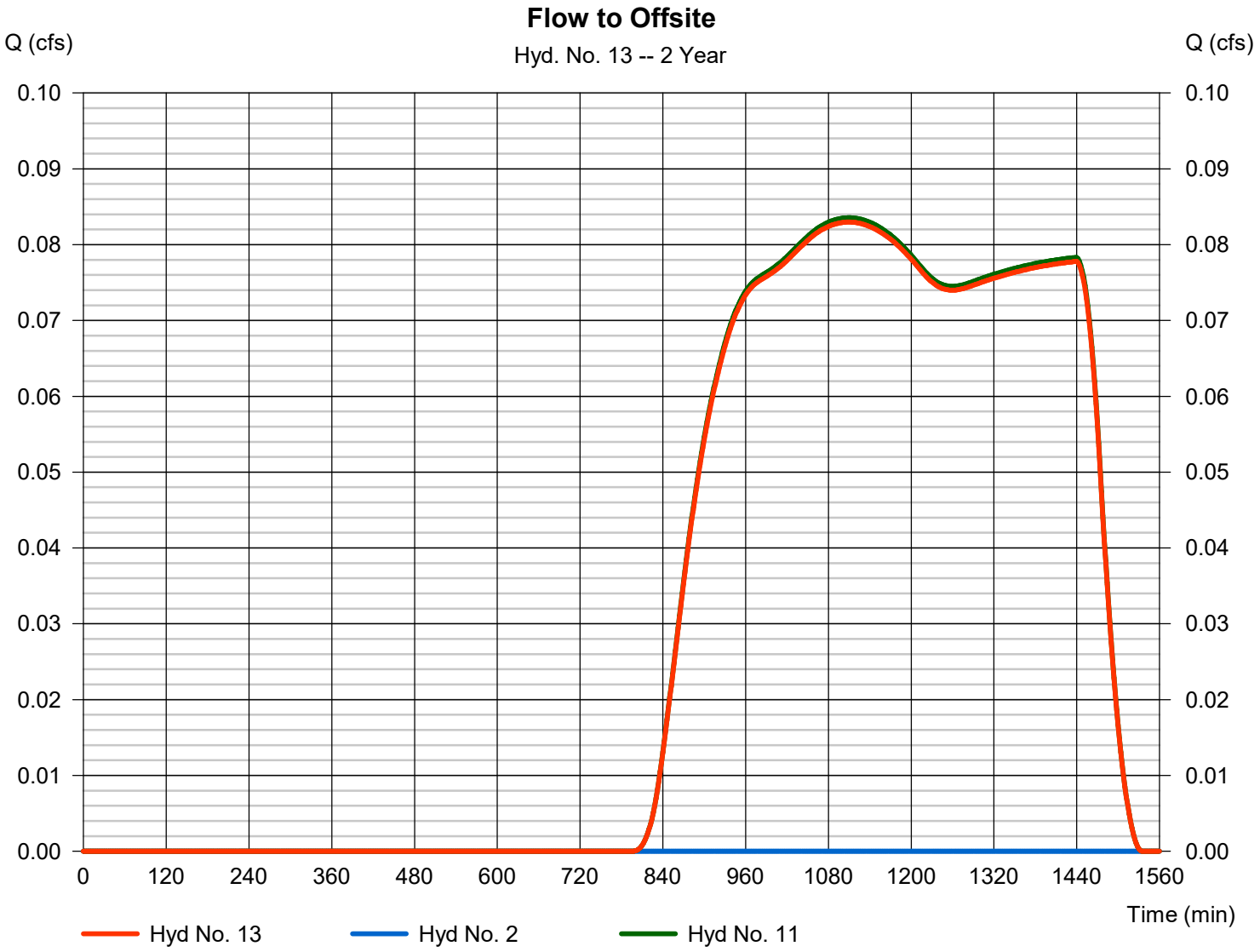


Hydrograph Report

Hyd. No. 13

Flow to Offsite

Hydrograph type	= Combine	Peak discharge	= 0.083 cfs
Storm frequency	= 2 yrs	Time to peak	= 1110 min
Time interval	= 2 min	Hyd. volume	= 2,817 cuft
Inflow hyds.	= 2, 11	Contrib. drain. area	= 44.160 ac



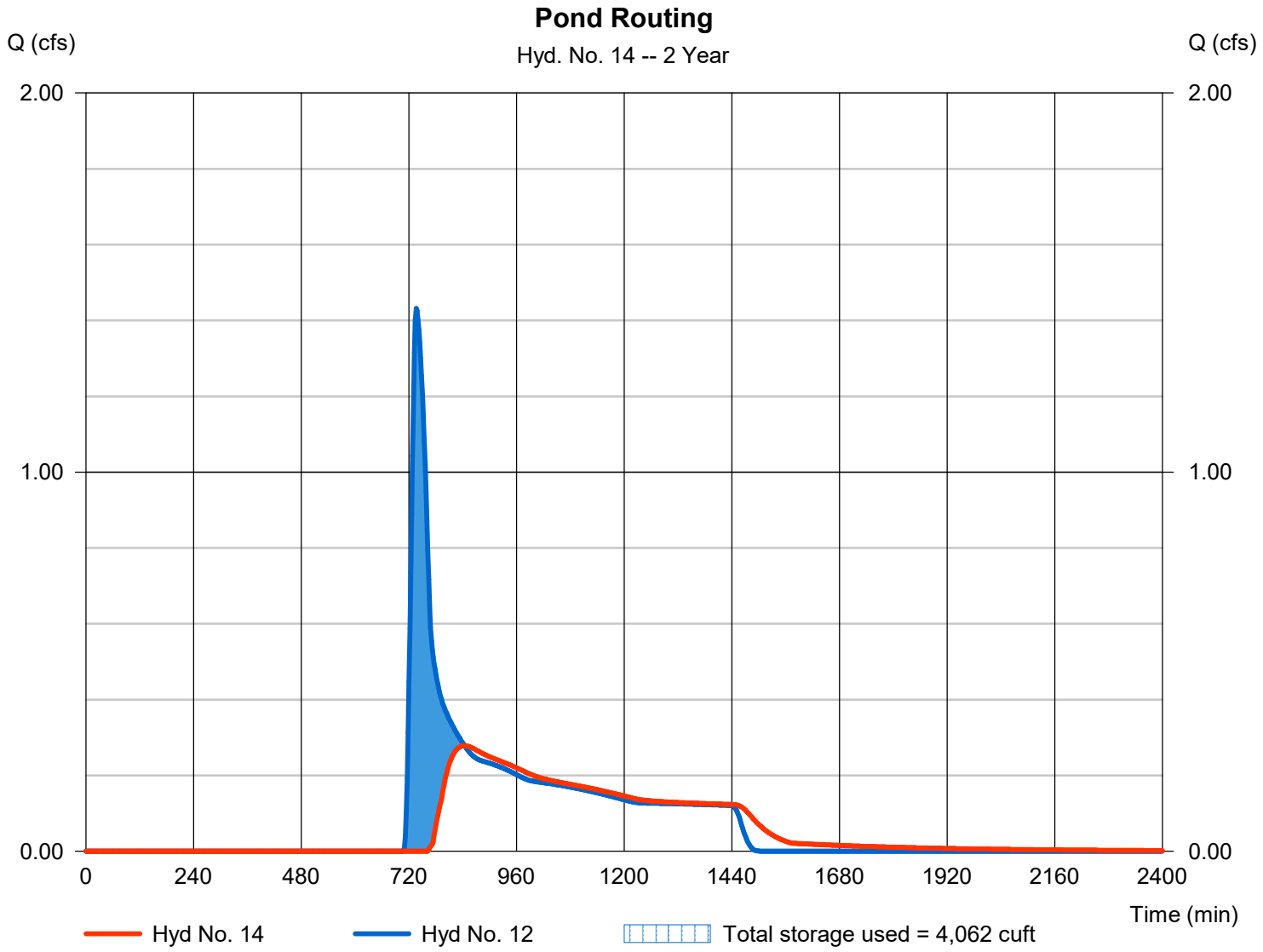
Hydrograph Report

Hyd. No. 14

Pond Routing

Hydrograph type	=	Reservoir	Peak discharge	=	0.278 cfs
Storm frequency	=	2 yrs	Time to peak	=	844 min
Time interval	=	2 min	Hyd. volume	=	7,967 cuft
Inflow hyd. No.	=	12 - Detention Pond Flow	Max. Elevation	=	5892.97 ft
Reservoir name	=	Pond 1	Max. Storage	=	4,062 cuft

Storage Indication method used.



Pond No. 1 - Pond 1

Pond Data

Contours -User-defined contour areas. Conic method used for volume calculation. Begining Elevation = 5892.00 ft

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour area (sqft)	Incr. Storage (cuft)	Total storage (cuft)
0.00	5892.00	1,770	0	0
1.00	5893.00	7,238	4,196	4,196
2.00	5894.00	12,045	9,539	13,735
3.00	5895.00	18,047	14,944	28,679
4.00	5896.00	25,583	21,704	50,382
5.00	5897.00	36,234	30,752	81,134
5.50	5897.50	44,882	20,238	101,372
6.00	5898.00	57,768	25,592	126,965

Culvert / Orifice Structures

	[A]	[B]	[C]	[PrfRsr]
Rise (in)	= 24.00	12.00	0.00	0.00
Span (in)	= 24.00	12.00	0.00	0.00
No. Barrels	= 1	1	0	0
Invert El. (ft)	= 5892.73	5893.23	0.00	0.00
Length (ft)	= 56.03	0.00	0.00	0.00
Slope (%)	= 0.54	0.00	0.00	n/a
N-Value	= .023	.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)	= 87.50	Inactive	0.00	0.00
Crest El. (ft)	= 5897.50	0.00	0.00	0.00
Weir Coeff.	= 3.33	3.33	3.33	3.33
Weir Type	= Ciplti	Rect	---	---
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	5892.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.10	420	5892.10	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.20	839	5892.20	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.30	1,259	5892.30	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.40	1,678	5892.40	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.50	2,098	5892.50	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.60	2,517	5892.60	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.70	2,937	5892.70	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.80	3,356	5892.80	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
0.90	3,776	5892.90	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.00	4,196	5893.00	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.10	5,149	5893.10	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.20	6,103	5893.20	0.00	0.00	---	---	0.00	---	---	---	---	---	0.000
1.30	7,057	5893.30	0.02 oc	0.02 ic	---	---	0.00	---	---	---	---	---	0.023
1.40	8,011	5893.40	0.14 oc	0.13 ic	---	---	0.00	---	---	---	---	---	0.130
1.50	8,965	5893.50	0.32 oc	0.31 ic	---	---	0.00	---	---	---	---	---	0.307
1.60	9,919	5893.60	0.57 oc	0.56 ic	---	---	0.00	---	---	---	---	---	0.559
1.70	10,873	5893.70	0.87 oc	0.86 ic	---	---	0.00	---	---	---	---	---	0.863
1.80	11,827	5893.80	1.25 oc	1.21 ic	---	---	0.00	---	---	---	---	---	1.211
1.90	12,781	5893.90	1.63 oc	1.58 ic	---	---	0.00	---	---	---	---	---	1.578
2.00	13,735	5894.00	1.99 oc	1.95 ic	---	---	0.00	---	---	---	---	---	1.950
2.10	15,229	5894.10	2.37 oc	2.31 ic	---	---	0.00	---	---	---	---	---	2.315
2.20	16,723	5894.20	2.69 oc	2.61 ic	---	---	0.00	---	---	---	---	---	2.611
2.30	18,218	5894.30	2.86 oc	2.85 ic	---	---	0.00	---	---	---	---	---	2.854
2.40	19,712	5894.40	3.11 oc	3.09 ic	---	---	0.00	---	---	---	---	---	3.095
2.50	21,207	5894.50	3.36 oc	3.32 ic	---	---	0.00	---	---	---	---	---	3.318
2.60	22,701	5894.60	3.54 oc	3.53 ic	---	---	0.00	---	---	---	---	---	3.529
2.70	24,195	5894.70	3.71 oc	3.71 ic	---	---	0.00	---	---	---	---	---	3.711
2.80	25,690	5894.80	3.88 oc	3.85 ic	---	---	0.00	---	---	---	---	---	3.855
2.90	27,184	5894.90	4.06 oc	3.98 ic	---	---	0.00	---	---	---	---	---	3.980
3.00	28,679	5895.00	4.14 oc	4.13 ic	---	---	0.00	---	---	---	---	---	4.127
3.10	30,849	5895.10	4.32 oc	4.24 ic	---	---	0.00	---	---	---	---	---	4.245
3.20	33,019	5895.20	4.40 oc	4.38 ic	---	---	0.00	---	---	---	---	---	4.385
3.30	35,190	5895.30	4.57 oc	4.50 ic	---	---	0.00	---	---	---	---	---	4.495
3.40	37,360	5895.40	4.66 oc	4.63 ic	---	---	0.00	---	---	---	---	---	4.628

Continues on next page...

Pond 1

Stage / Storage / Discharge Table

Stage ft	Storage cuft	Elevation ft	Clv A cfs	Clv B cfs	Clv C cfs	PrfRsr cfs	Wr A cfs	Wr B cfs	Wr C cfs	Wr D cfs	Exfil cfs	User cfs	Total cfs
3.50	39,531	5895.50	4.74 oc	4.74 ic	---	---	0.00	---	---	---	---	---	4.741
3.60	41,701	5895.60	4.91 oc	4.86 ic	---	---	0.00	---	---	---	---	---	4.861
3.70	43,871	5895.70	4.99 oc	4.98 ic	---	---	0.00	---	---	---	---	---	4.984
3.80	46,042	5895.80	5.15 oc	5.08 ic	---	---	0.00	---	---	---	---	---	5.083
3.90	48,212	5895.90	5.23 oc	5.20 ic	---	---	0.00	---	---	---	---	---	5.201
4.00	50,382	5896.00	5.31 oc	5.31 ic	---	---	0.00	---	---	---	---	---	5.309
4.10	53,458	5896.10	5.46 oc	5.41 ic	---	---	0.00	---	---	---	---	---	5.409
4.20	56,533	5896.20	5.54 oc	5.52 ic	---	---	0.00	---	---	---	---	---	5.520
4.30	59,608	5896.30	5.61 oc	5.61 ic	---	---	0.00	---	---	---	---	---	5.614
4.40	62,683	5896.40	5.76 oc	5.72 ic	---	---	0.00	---	---	---	---	---	5.718
4.50	65,758	5896.50	5.83 oc	5.82 ic	---	---	0.00	---	---	---	---	---	5.825
4.60	68,833	5896.60	5.97 oc	5.91 ic	---	---	0.00	---	---	---	---	---	5.913
4.70	71,909	5896.70	6.04 oc	6.02 ic	---	---	0.00	---	---	---	---	---	6.016
4.80	74,984	5896.80	6.10 oc	6.10 ic	---	---	0.00	---	---	---	---	---	6.104
4.90	78,059	5896.90	6.23 oc	6.20 ic	---	---	0.00	---	---	---	---	---	6.201
5.00	81,134	5897.00	6.29 oc	6.29 ic	---	---	0.00	---	---	---	---	---	6.294
5.05	83,158	5897.05	6.36 oc	6.34 ic	---	---	0.00	---	---	---	---	---	6.339
5.10	85,182	5897.10	6.41 oc	6.38 ic	---	---	0.00	---	---	---	---	---	6.381
5.15	87,206	5897.15	6.47 oc	6.42 ic	---	---	0.00	---	---	---	---	---	6.420
5.20	89,229	5897.20	6.47 oc	6.47 ic	---	---	0.00	---	---	---	---	---	6.472
5.25	91,253	5897.25	6.53 oc	6.52 ic	---	---	0.00	---	---	---	---	---	6.516
5.30	93,277	5897.30	6.58 oc	6.56 ic	---	---	0.00	---	---	---	---	---	6.557
5.35	95,301	5897.35	6.64 oc	6.60 ic	---	---	0.00	---	---	---	---	---	6.597
5.40	97,325	5897.40	6.69 oc	6.64 ic	---	---	0.00	---	---	---	---	---	6.636
5.45	99,349	5897.45	6.69 oc	6.69 ic	---	---	0.00	---	---	---	---	---	6.687
5.50	101,372	5897.50	6.74 oc	6.73 ic	---	---	0.00	---	---	---	---	---	6.732
5.55	103,932	5897.55	6.79 oc	6.77 ic	---	---	3.24	---	---	---	---	---	10.01
5.60	106,491	5897.60	6.83 oc	6.81 ic	---	---	9.23	---	---	---	---	---	16.04
5.65	109,050	5897.65	6.88 oc	6.85 ic	---	---	16.75	---	---	---	---	---	23.60
5.70	111,609	5897.70	6.92 oc	6.89 ic	---	---	25.91	---	---	---	---	---	32.80
5.75	114,169	5897.75	6.96 oc	6.93 ic	---	---	36.21	---	---	---	---	---	43.14
5.80	116,728	5897.80	7.00 oc	6.97 ic	---	---	47.60	---	---	---	---	---	54.57
5.85	119,287	5897.85	7.04 oc	7.01 ic	---	---	60.11	---	---	---	---	---	67.11
5.90	121,846	5897.90	7.08 oc	7.05 ic	---	---	73.15	---	---	---	---	---	80.19
5.95	124,405	5897.95	7.11 oc	7.09 ic	---	---	87.44	---	---	---	---	---	94.53
6.00	126,965	5898.00	7.15 oc	7.13 ic	---	---	103.02	---	---	---	---	---	110.14

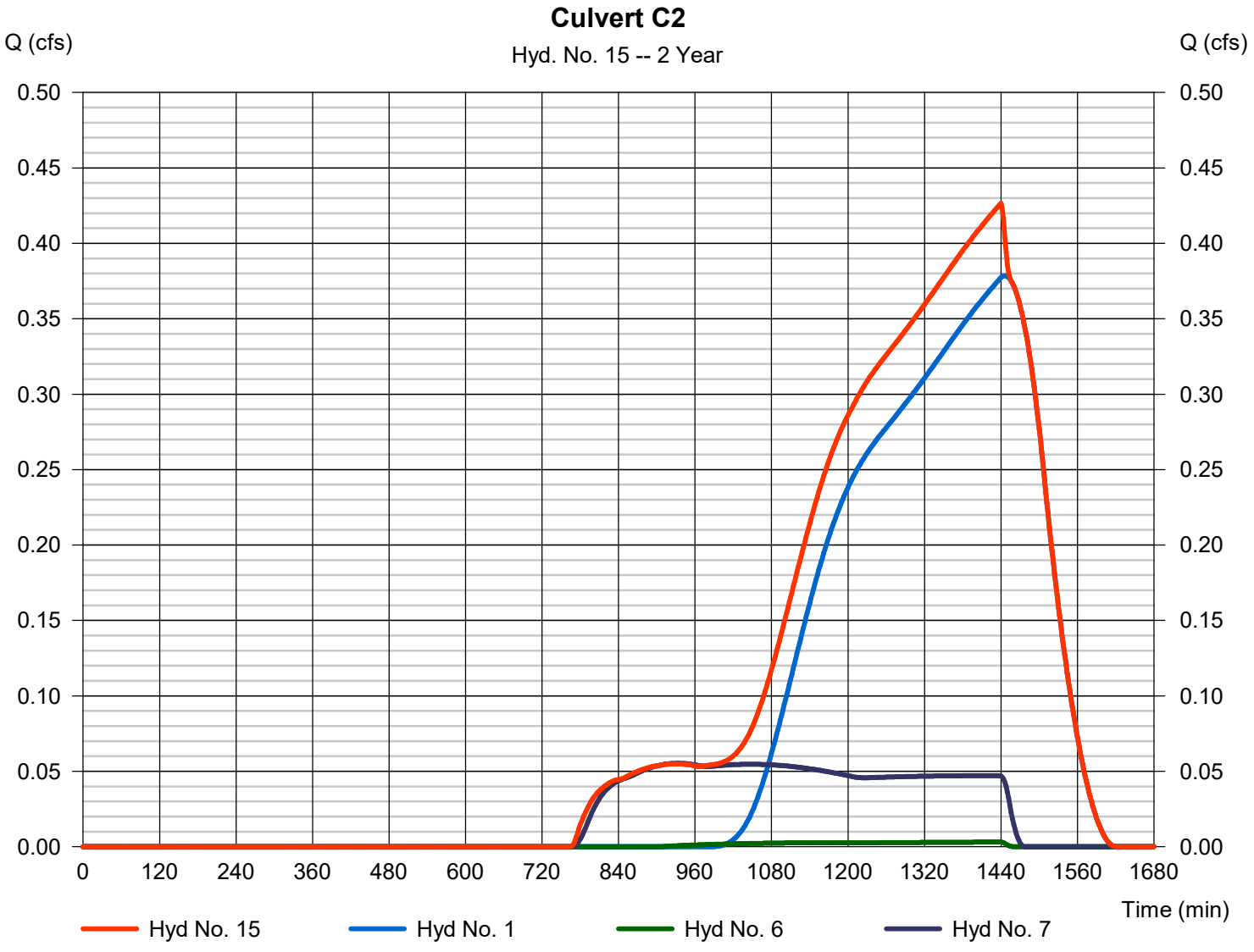
...End

Hydrograph Report

Hyd. No. 15

Culvert C2

Hydrograph type	= Combine	Peak discharge	= 0.427 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 9,647 cuft
Inflow hyds.	= 1, 6, 7	Contrib. drain. area	= 451.000 ac

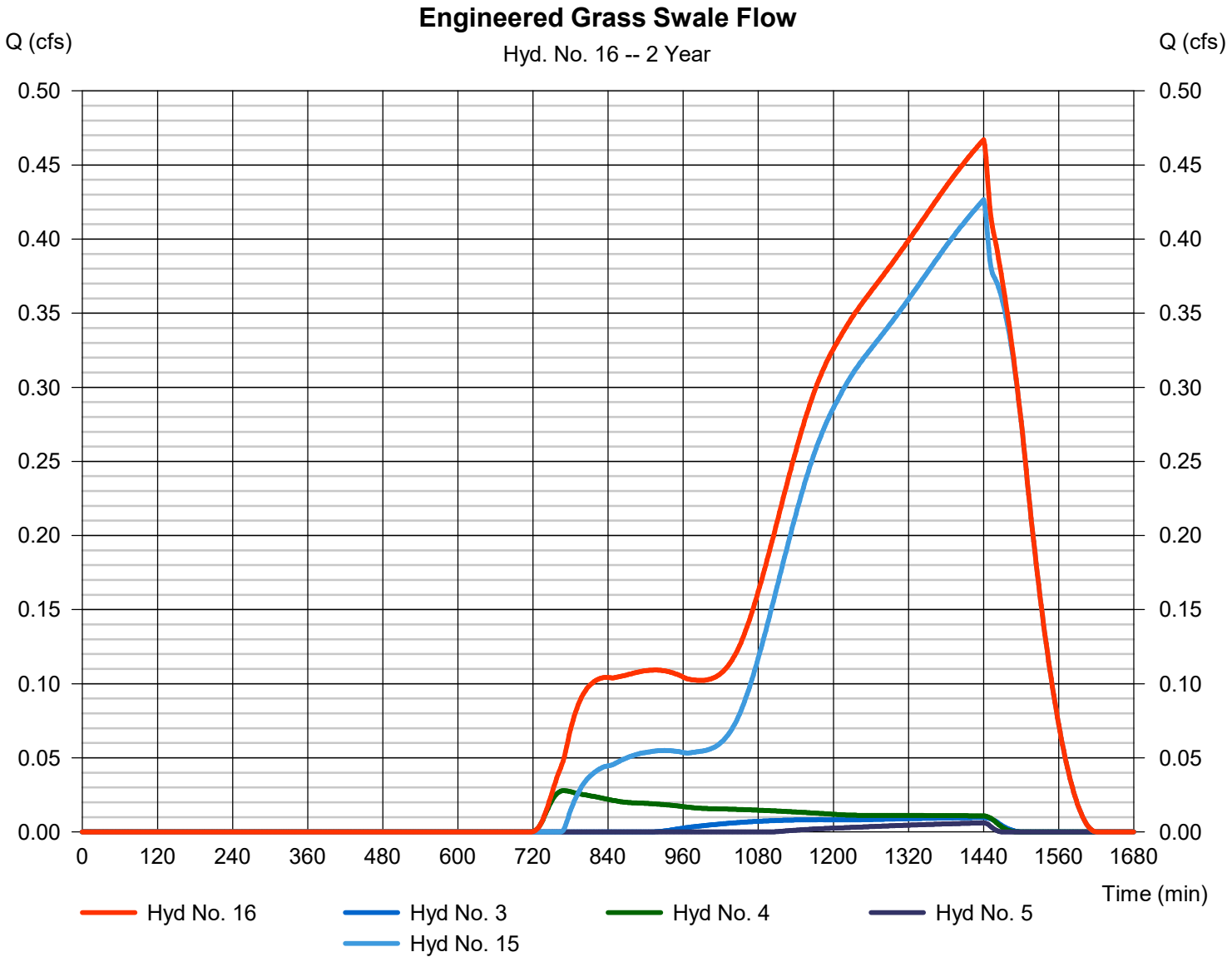


Hydrograph Report

Hyd. No. 16

Engineered Grass Swale Flow

Hydrograph type	= Combine	Peak discharge	= 0.467 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 11,630 cuft
Inflow hyds.	= 3, 4, 5, 15	Contrib. drain. area	= 20.400 ac

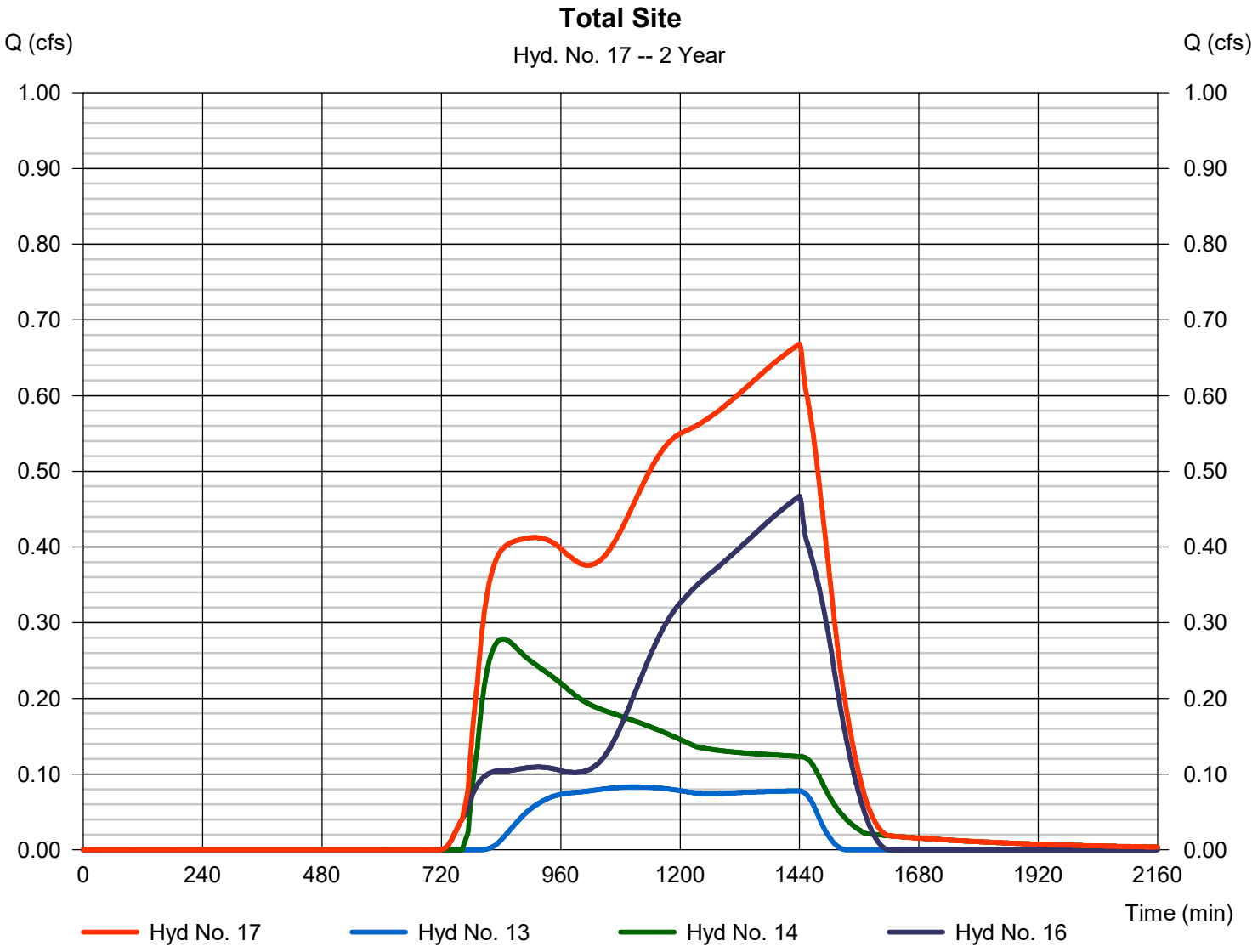


Hydrograph Report

Hyd. No. 17

Total Site

Hydrograph type	= Combine	Peak discharge	= 0.668 cfs
Storm frequency	= 2 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 22,414 cuft
Inflow hyds.	= 13, 14, 16	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	2.377	2	936	81,935	------	------	------	Offsite Basin 1
2	SCS Runoff	0.007	2	1440	166	------	------	------	Offsite Basin 2
3	SCS Runoff	0.059	2	812	1,792	------	------	------	Onsite Basin A
4	SCS Runoff	0.176	2	744	1,876	------	------	------	Onsite Basin B
5	SCS Runoff	0.043	2	914	1,504	------	------	------	Onsite Basin C3
6	SCS Runoff	0.019	2	780	559	------	------	------	Onsite Basin C1/Culvert C1
7	SCS Runoff	0.463	2	748	7,885	------	------	------	Onsite Basin C2
8	SCS Runoff	0.126	2	756	2,025	------	------	------	On Site Basin D
9	SCS Runoff	0.917	2	742	8,327	------	------	------	On Site Basin E
10	SCS Runoff	0.131	2	788	3,469	------	------	------	On Site Basin F
11	SCS Runoff	0.552	2	800	13,326	------	------	------	On Site Basin H
12	Combine	3.479	2	736	23,903	8, 9, 10,	------	------	Detention Pond Flow
13	Combine	0.548	2	800	13,402	2, 11,	------	------	Flow to Offsite
14	Reservoir	1.157	2	772	20,947	12	5893.24	6,459	Pond Routing
15	Combine	2.584	2	930	90,240	1, 6, 7,	------	------	Culvert C2
16	Combine	2.769	2	926	97,604	3, 4, 5, 15	------	------	Engineered Grass Swale Flow
17	Combine	3.734	2	910	131,953	13, 14, 16	------	------	Total Site

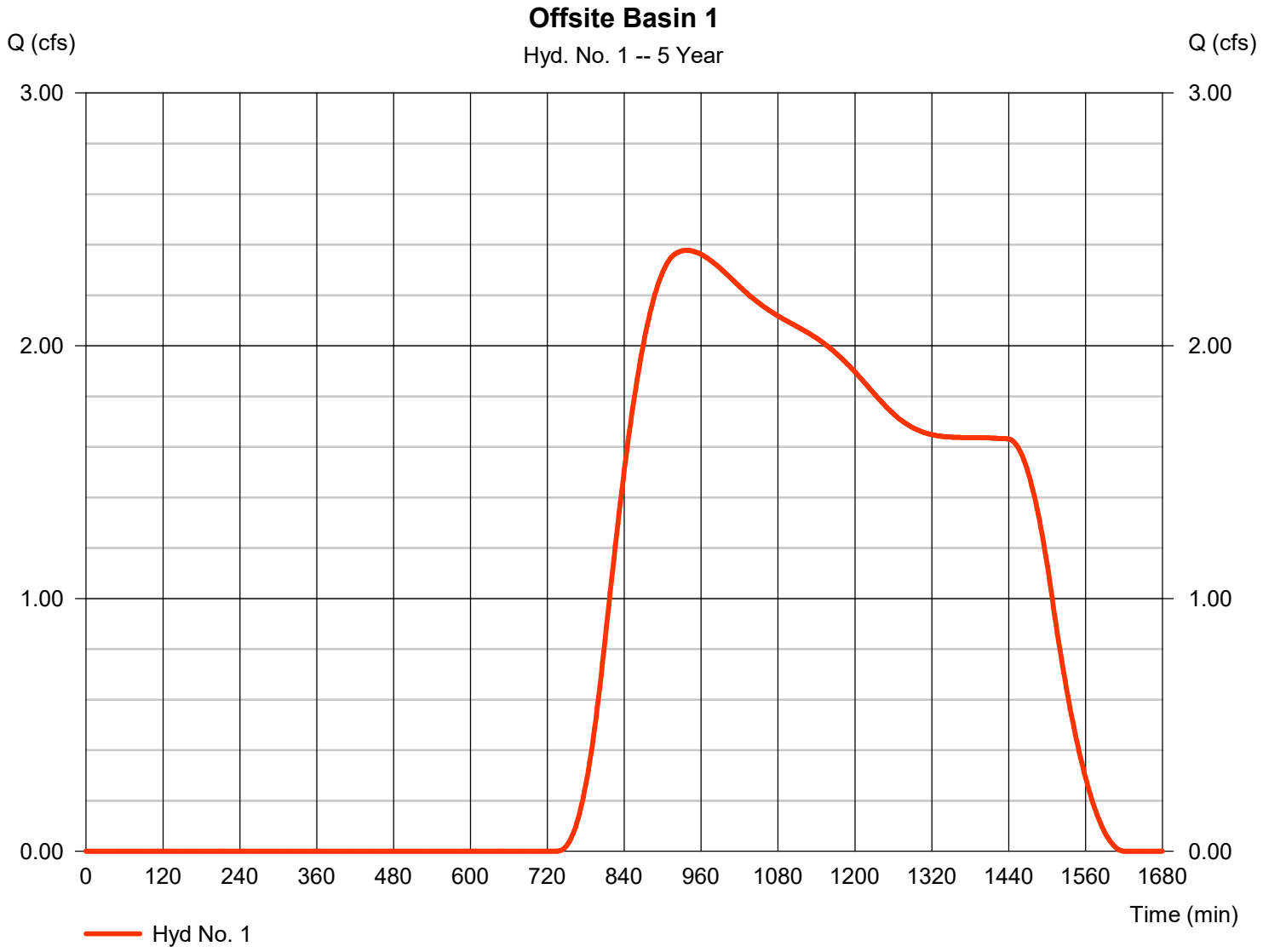
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	= SCS Runoff	Peak discharge	= 2.377 cfs
Storm frequency	= 5 yrs	Time to peak	= 936 min
Time interval	= 2 min	Hyd. volume	= 81,935 cuft
Drainage area	= 428.970 ac	Curve number	= 56*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 114.40 min
Total precip.	= 2.24 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



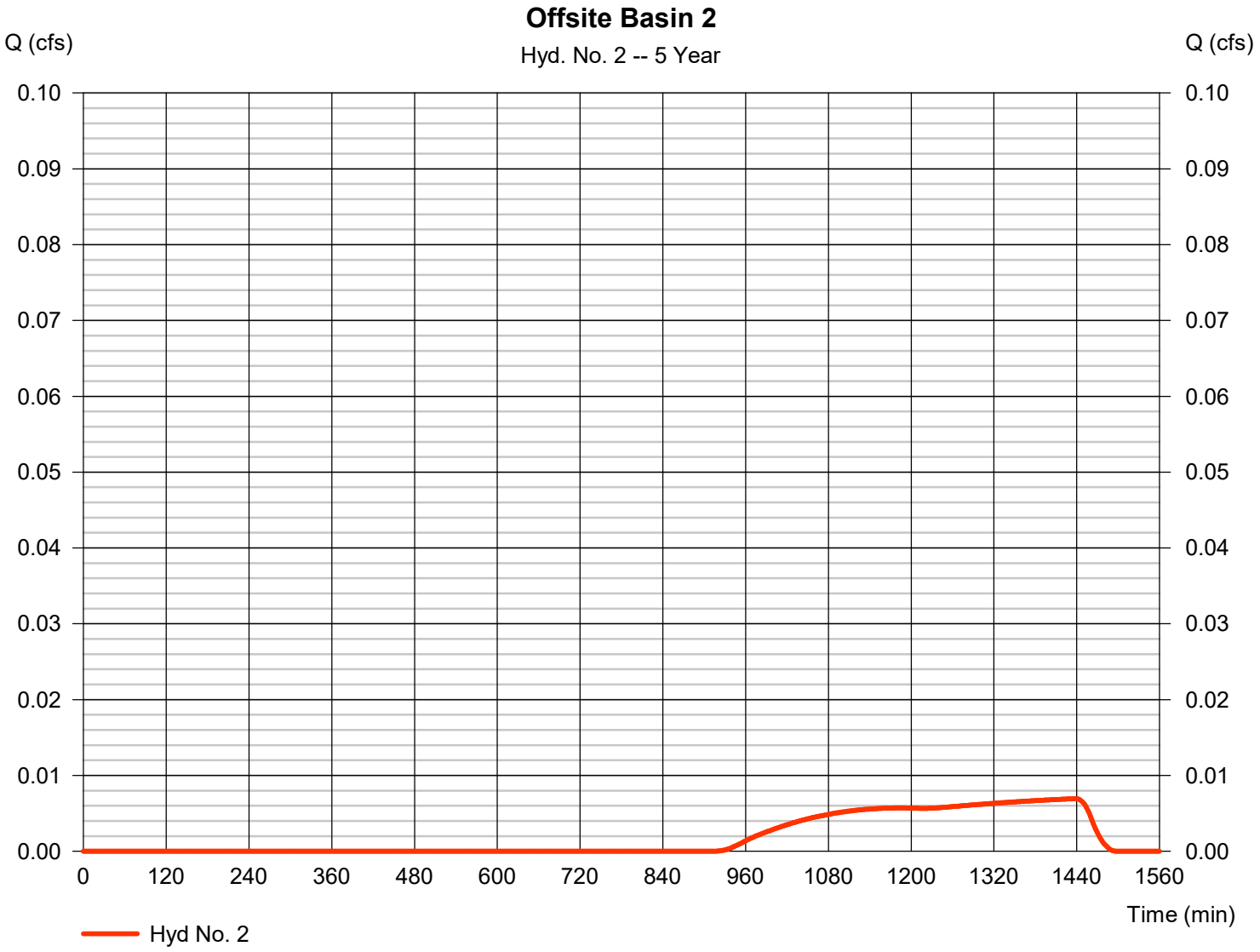
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.007 cfs
Storm frequency	= 5 yrs	Time to peak	= 1440 min
Time interval	= 2 min	Hyd. volume	= 166 cuft
Drainage area	= 4.540 ac	Curve number	= 51*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 2.24 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



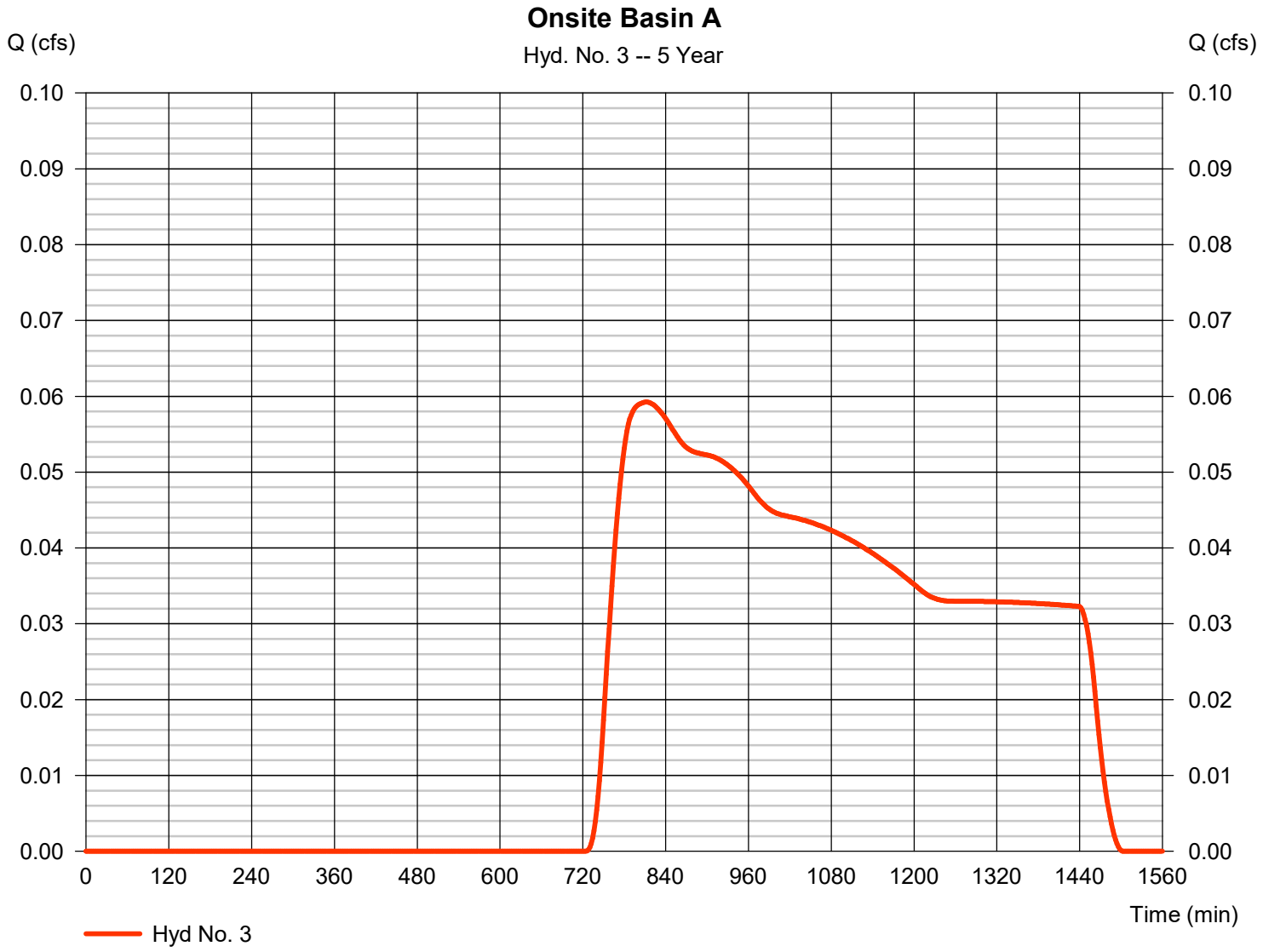
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	= SCS Runoff	Peak discharge	= 0.059 cfs
Storm frequency	= 5 yrs	Time to peak	= 812 min
Time interval	= 2 min	Hyd. volume	= 1,792 cuft
Drainage area	= 7.640 ac	Curve number	= 57*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.50 min
Total precip.	= 2.24 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 85)] / 7.640



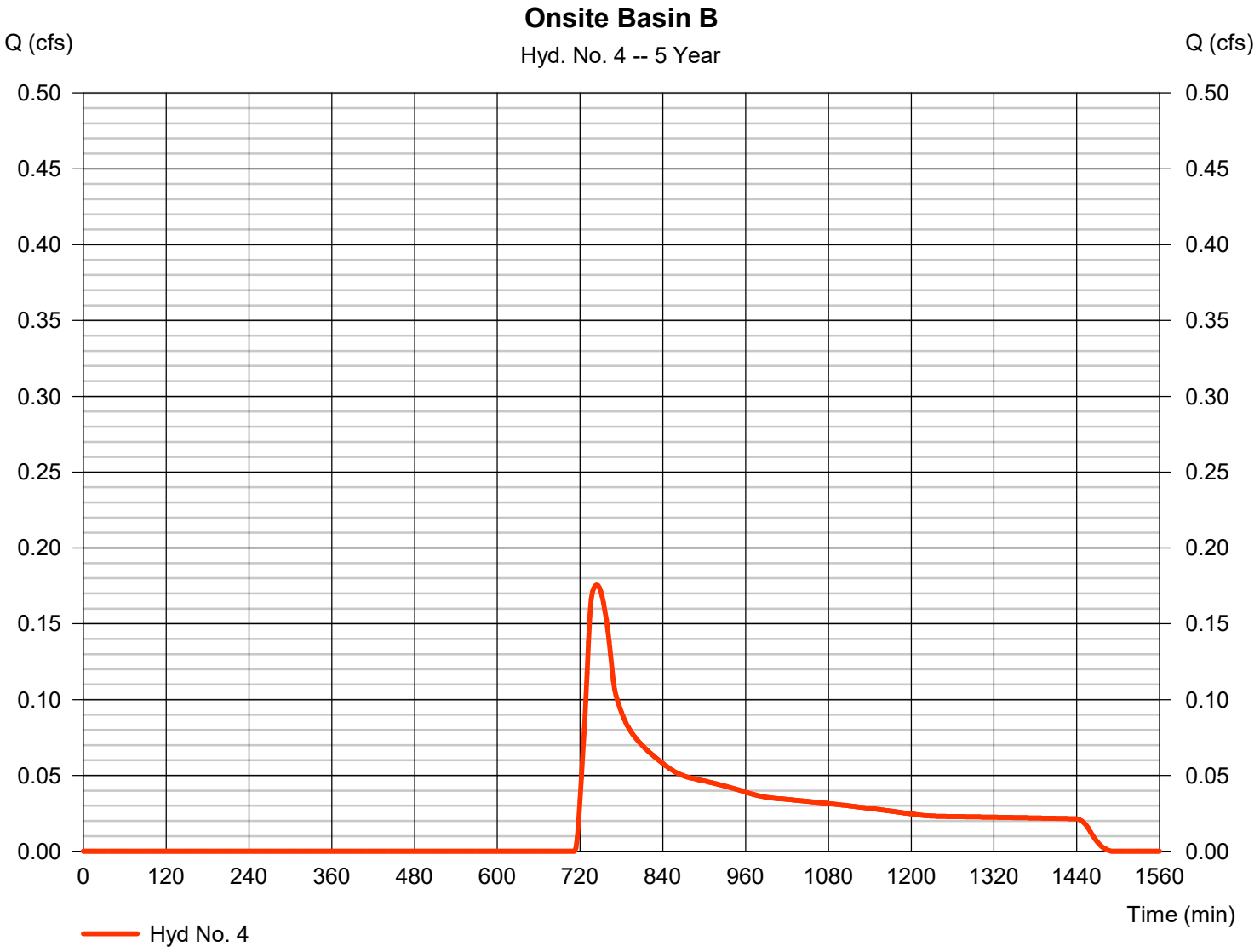
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.176 cfs
Storm frequency	=	5 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	1,876 cuft
Drainage area	=	2.770 ac	Curve number	=	64*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	2.24 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.144 x 85) + (0.205 x 98) + (0.283 x 49) + (2.134 x 61)] / 2.770



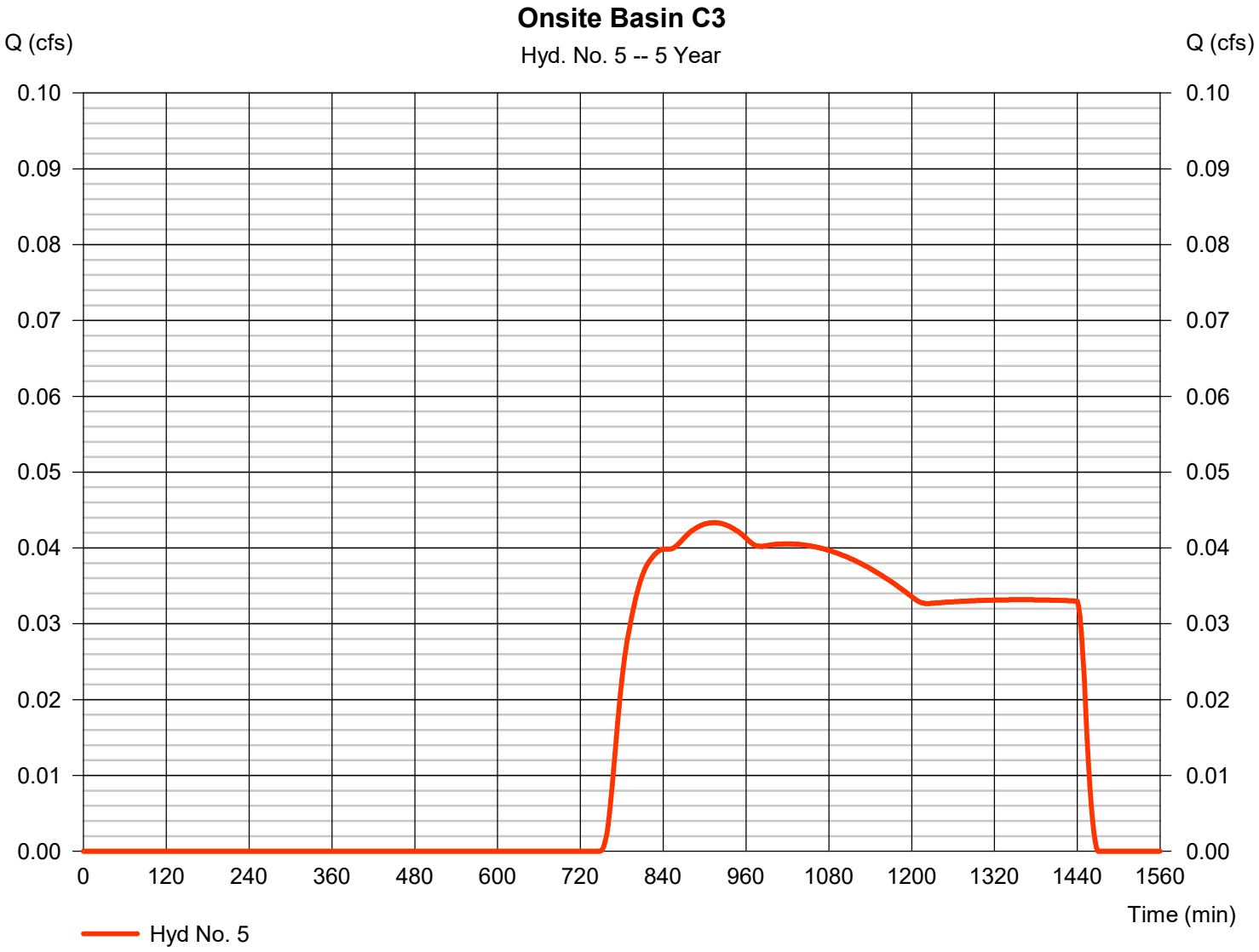
Hydrograph Report

Hyd. No. 5

Onsite Basin C3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.043 cfs
Storm frequency	=	5 yrs	Time to peak	=	914 min
Time interval	=	2 min	Hyd. volume	=	1,504 cuft
Drainage area	=	9.990 ac	Curve number	=	55*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.90 min
Total precip.	=	2.24 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.297 x 98) + (0.716 x 76) + (0.036 x 85) + (0.337 x 98) + (7.720 x 49) + (0.887 x 61)] / 9.990



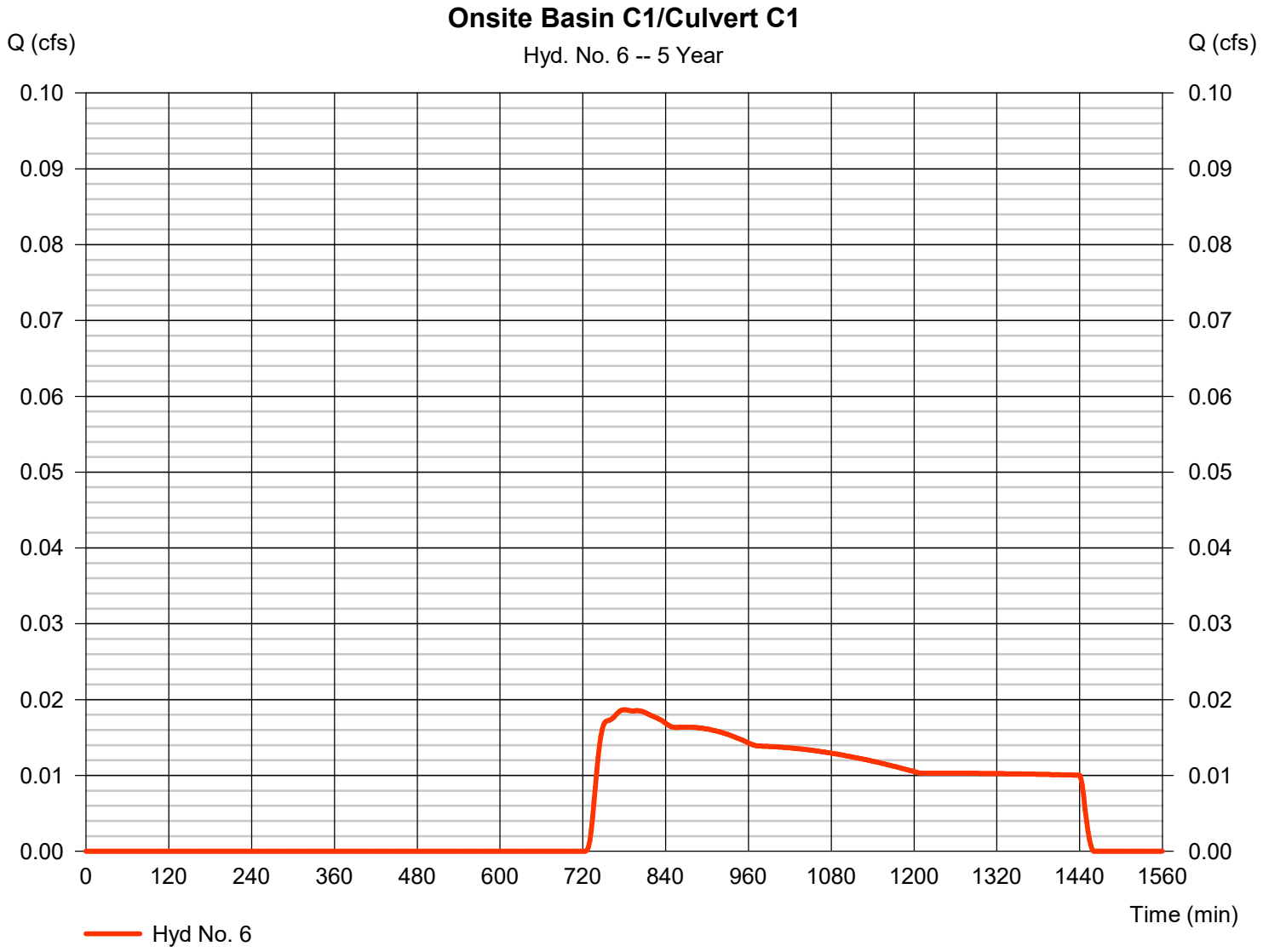
Hydrograph Report

Hyd. No. 6

Onsite Basin C1/Culvert C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.019 cfs
Storm frequency	=	5 yrs	Time to peak	=	780 min
Time interval	=	2 min	Hyd. volume	=	559 cuft
Drainage area	=	2.310 ac	Curve number	=	57*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.06 min
Total precip.	=	2.24 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.145 x 85) + (1.131 x 49) + (1.033 x 61)] / 2.310



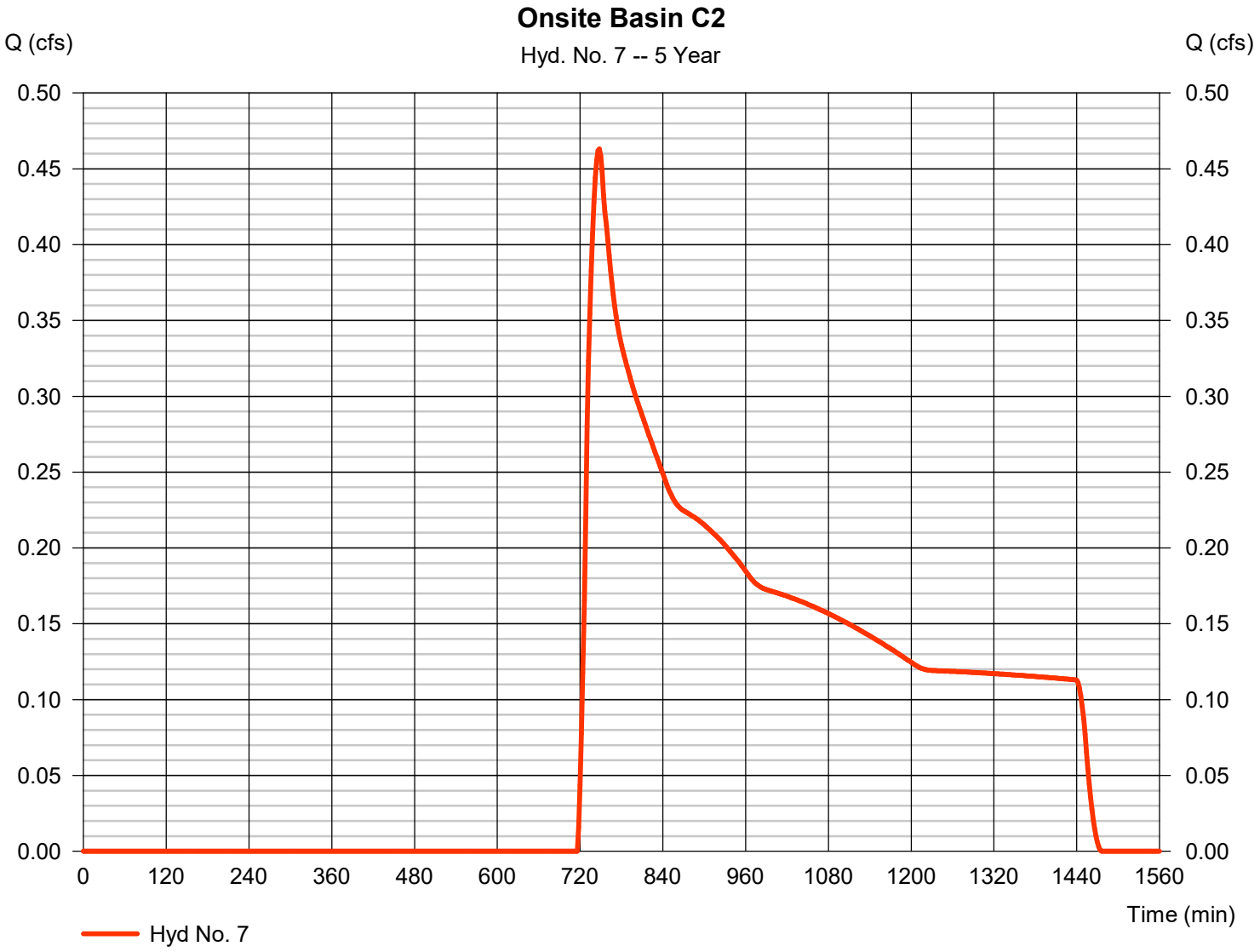
Hydrograph Report

Hyd. No. 7

Onsite Basin C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.463 cfs
Storm frequency	=	5 yrs	Time to peak	=	748 min
Time interval	=	2 min	Hyd. volume	=	7,885 cuft
Drainage area	=	19.720 ac	Curve number	=	60*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.30 min
Total precip.	=	2.24 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.139 x 98) + (0.236 x 85) + (1.032 x 98) + (5.683 x 49) + (12.631 x 61)] / 19.720



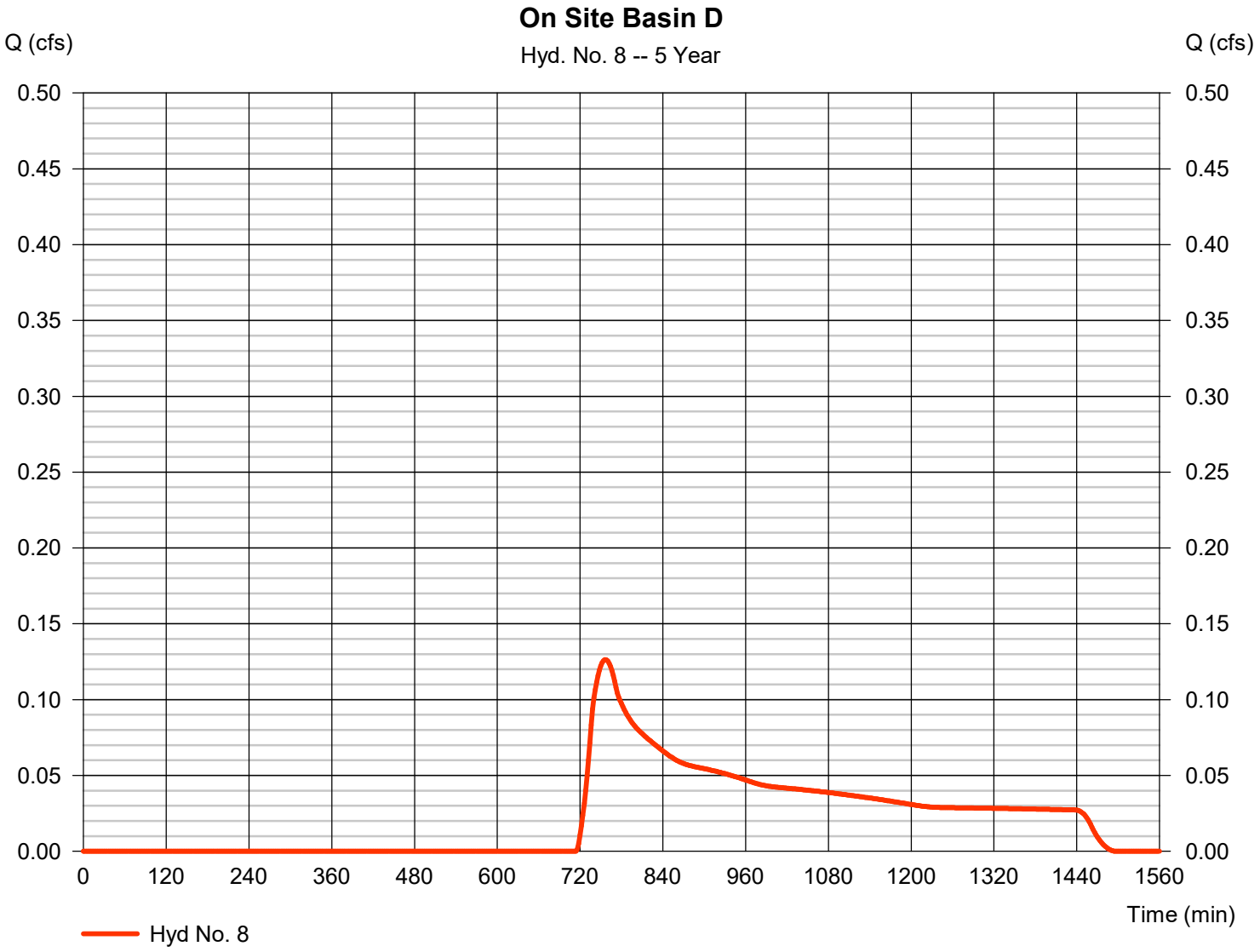
Hydrograph Report

Hyd. No. 8

On Site Basin D

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.126 cfs
Storm frequency	=	5 yrs	Time to peak	=	756 min
Time interval	=	2 min	Hyd. volume	=	2,025 cuft
Drainage area	=	4.490 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	37.00 min
Total precip.	=	2.24 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.015 x 98) + (0.428 x 98) + (1.254 x 49) + (2.792 x 61)] / 4.490



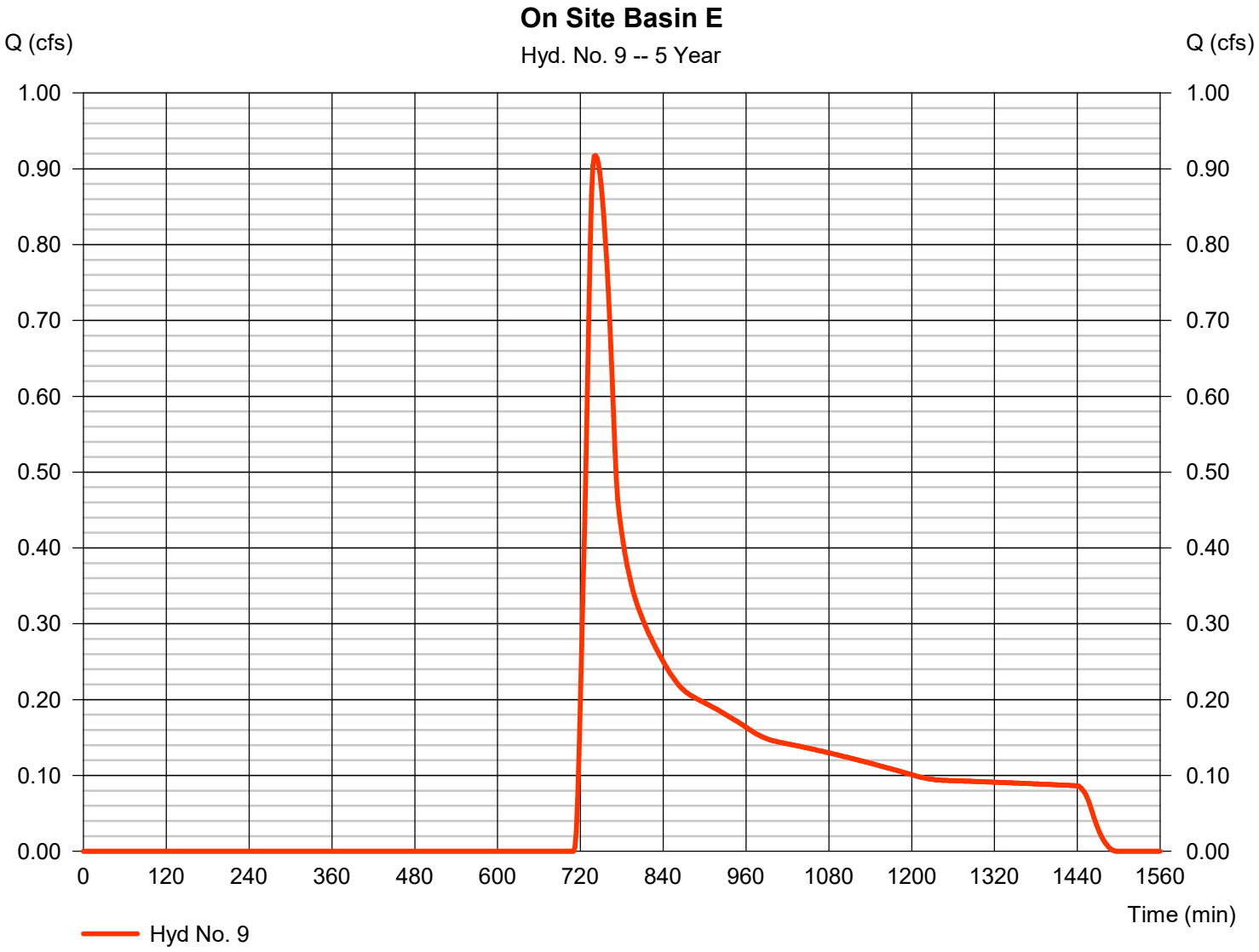
Hydrograph Report

Hyd. No. 9

On Site Basin E

Hydrograph type	= SCS Runoff	Peak discharge	= 0.917 cfs
Storm frequency	= 5 yrs	Time to peak	= 742 min
Time interval	= 2 min	Hyd. volume	= 8,327 cuft
Drainage area	= 10.090 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.10 min
Total precip.	= 2.24 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.165 x 98) + (2.167 x 98) + (2.583 x 49) + (5.178 x 61)] / 10.090



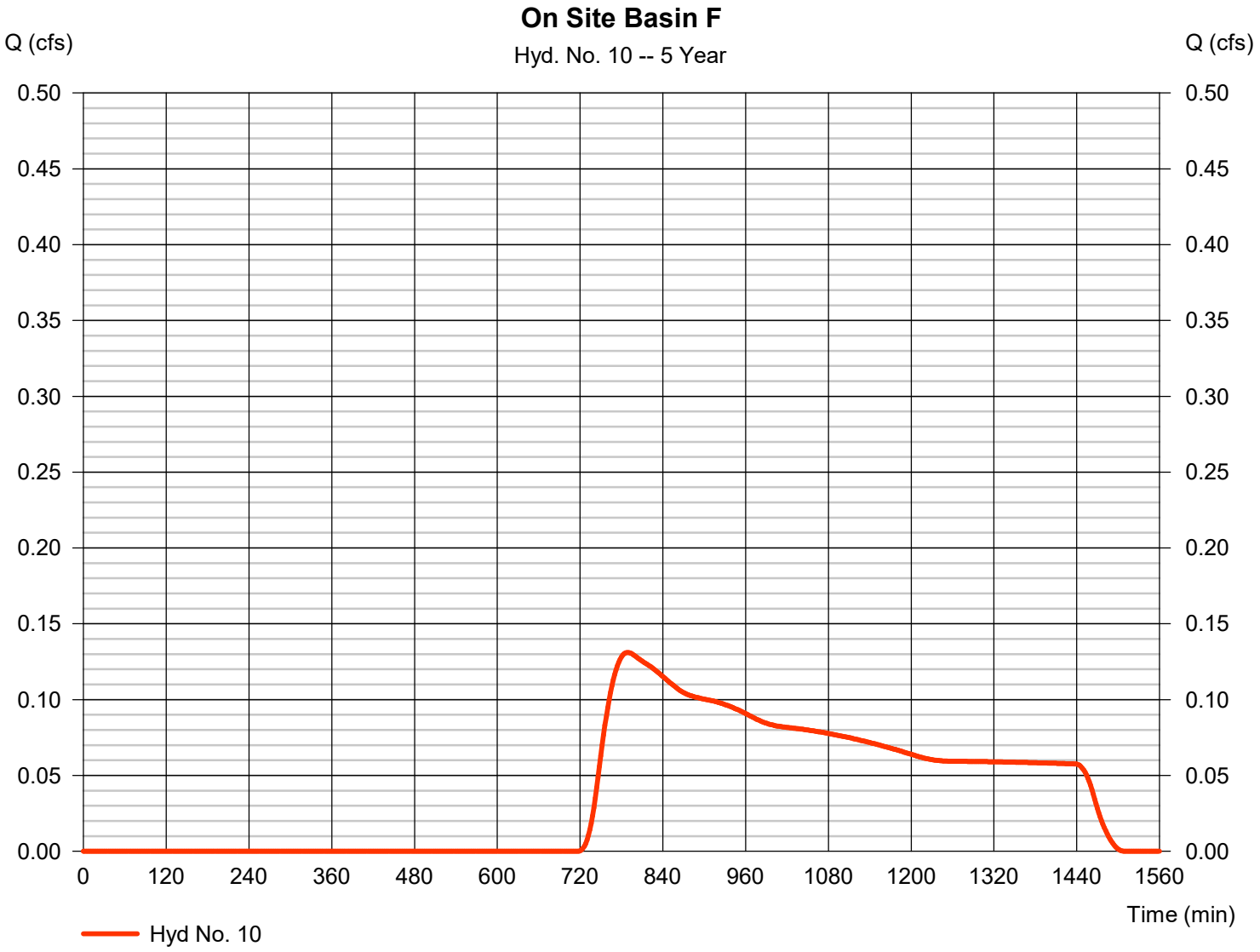
Hydrograph Report

Hyd. No. 10

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.131 cfs
Storm frequency	=	5 yrs	Time to peak	=	788 min
Time interval	=	2 min	Hyd. volume	=	3,469 cuft
Drainage area	=	12.130 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	2.24 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.011 x 98) + (0.107 x 98) + (3.132 x 49) + (8.879 x 61)] / 12.130



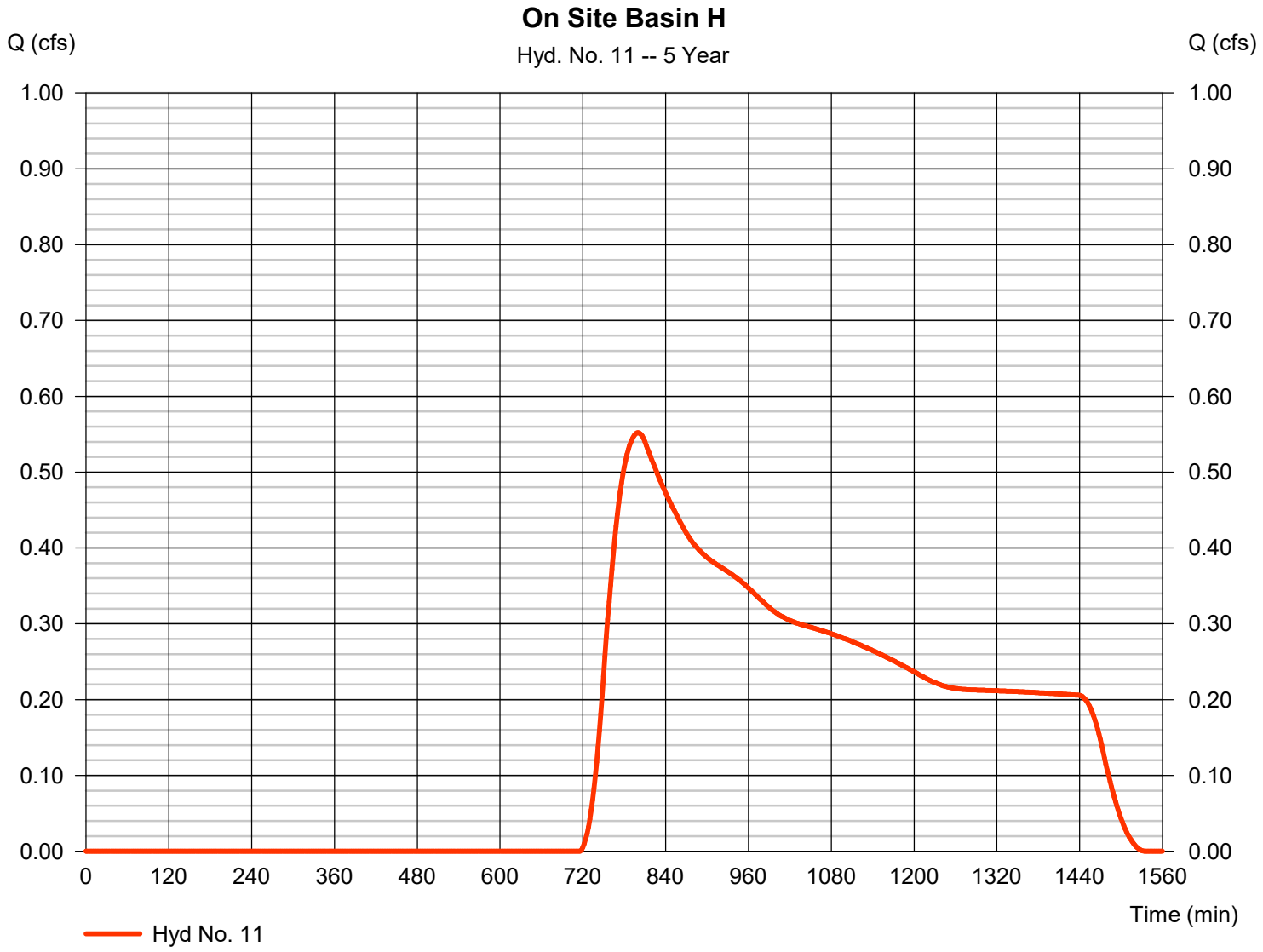
Hydrograph Report

Hyd. No. 11

On Site Basin H

Hydrograph type	= SCS Runoff	Peak discharge	= 0.552 cfs
Storm frequency	= 5 yrs	Time to peak	= 800 min
Time interval	= 2 min	Hyd. volume	= 13,326 cuft
Drainage area	= 39.620 ac	Curve number	= 59*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 57.90 min
Total precip.	= 2.24 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.132 x 85) + (8.377 x 49) + (31.111 x 61)] / 39.620

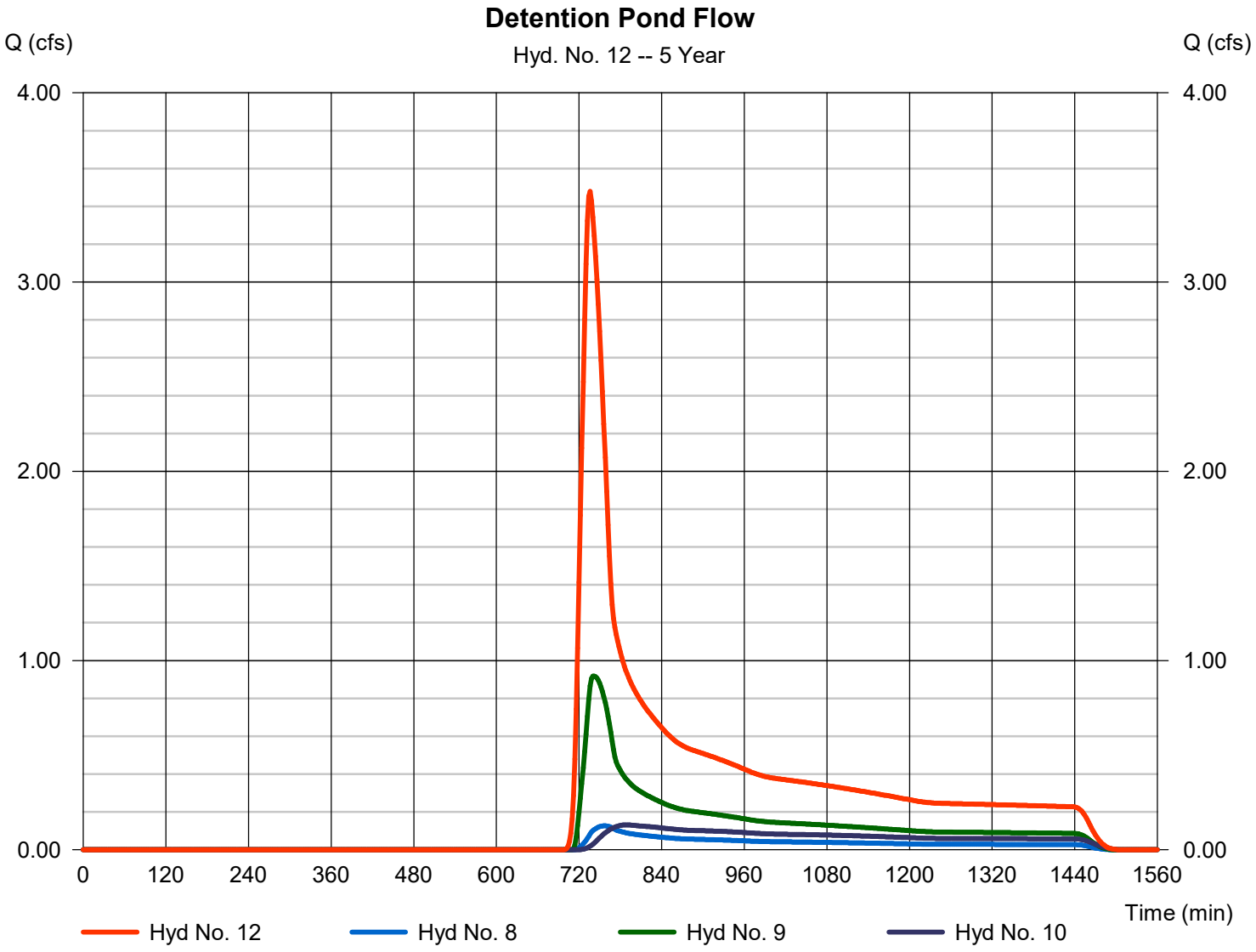


Hydrograph Report

Hyd. No. 12

Detention Pond Flow

Hydrograph type	= Combine	Peak discharge	= 3.479 cfs
Storm frequency	= 5 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 23,903 cuft
Inflow hyds.	= 8, 9, 10	Contrib. drain. area	= 26.710 ac

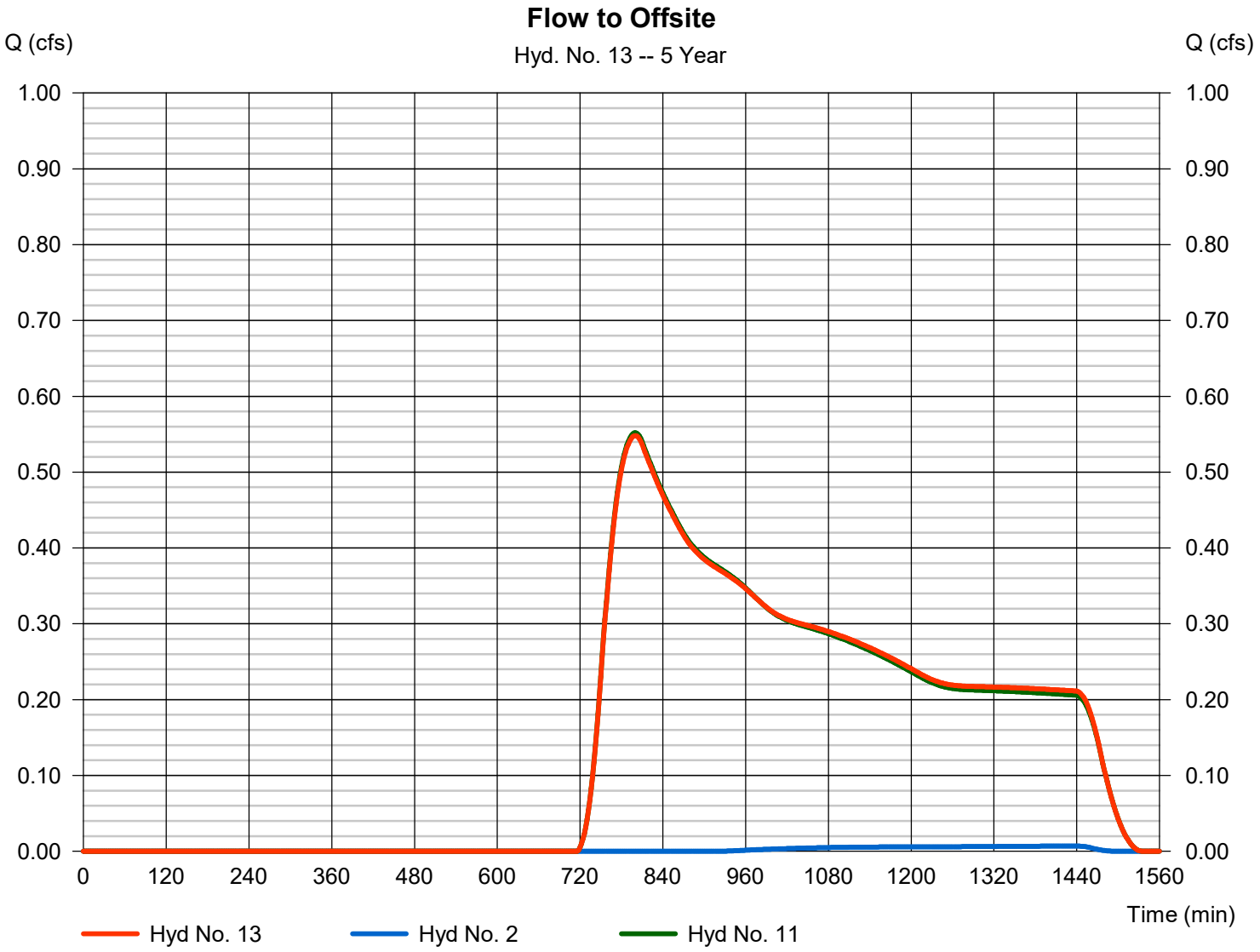


Hydrograph Report

Hyd. No. 13

Flow to Offsite

Hydrograph type	= Combine	Peak discharge	= 0.548 cfs
Storm frequency	= 5 yrs	Time to peak	= 800 min
Time interval	= 2 min	Hyd. volume	= 13,402 cuft
Inflow hyds.	= 2, 11	Contrib. drain. area	= 44.160 ac



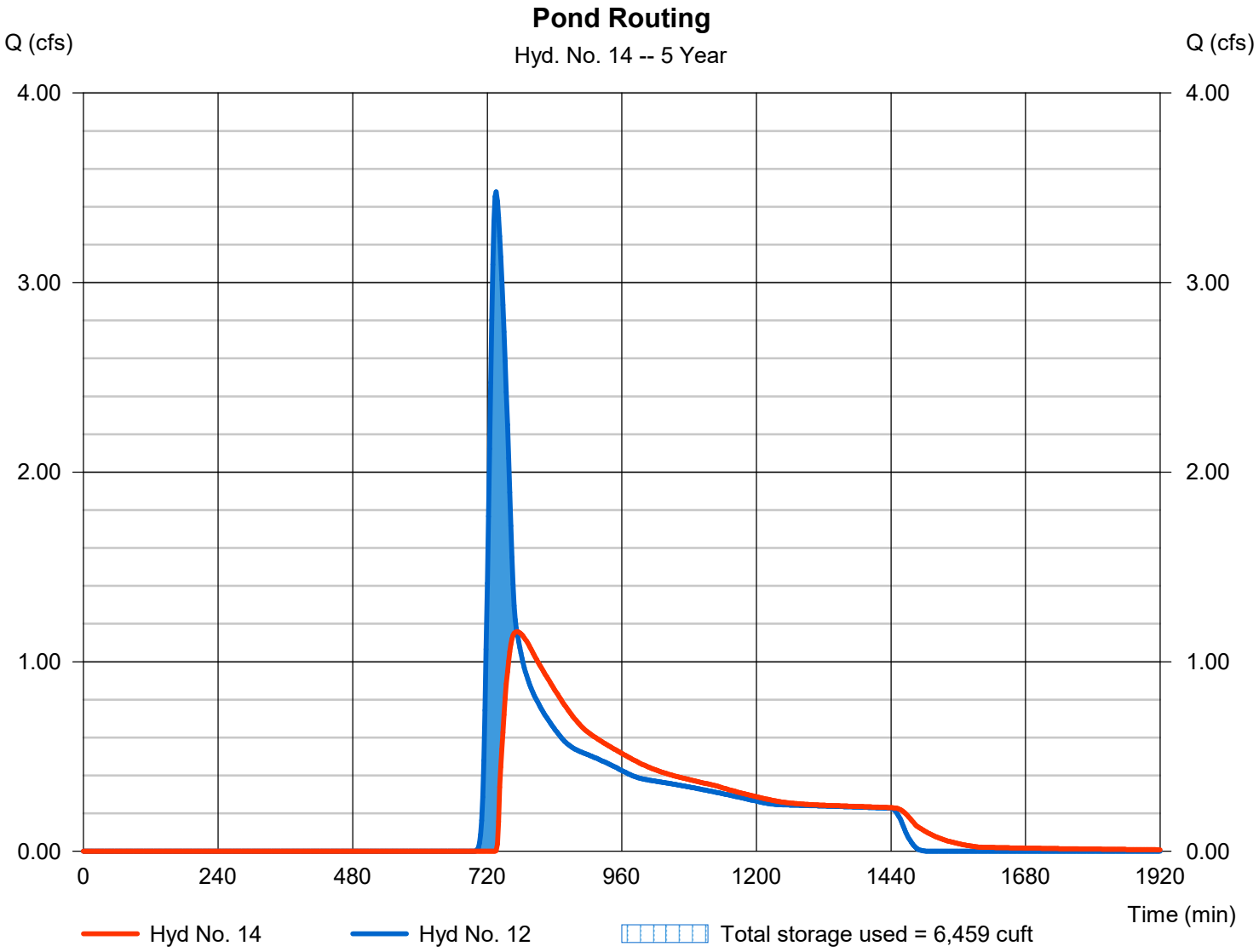
Hydrograph Report

Hyd. No. 14

Pond Routing

Hydrograph type	=	Reservoir	Peak discharge	=	1.157 cfs
Storm frequency	=	5 yrs	Time to peak	=	772 min
Time interval	=	2 min	Hyd. volume	=	20,947 cuft
Inflow hyd. No.	=	12 - Detention Pond Flow	Max. Elevation	=	5893.24 ft
Reservoir name	=	Pond 1	Max. Storage	=	6,459 cuft

Storage Indication method used.

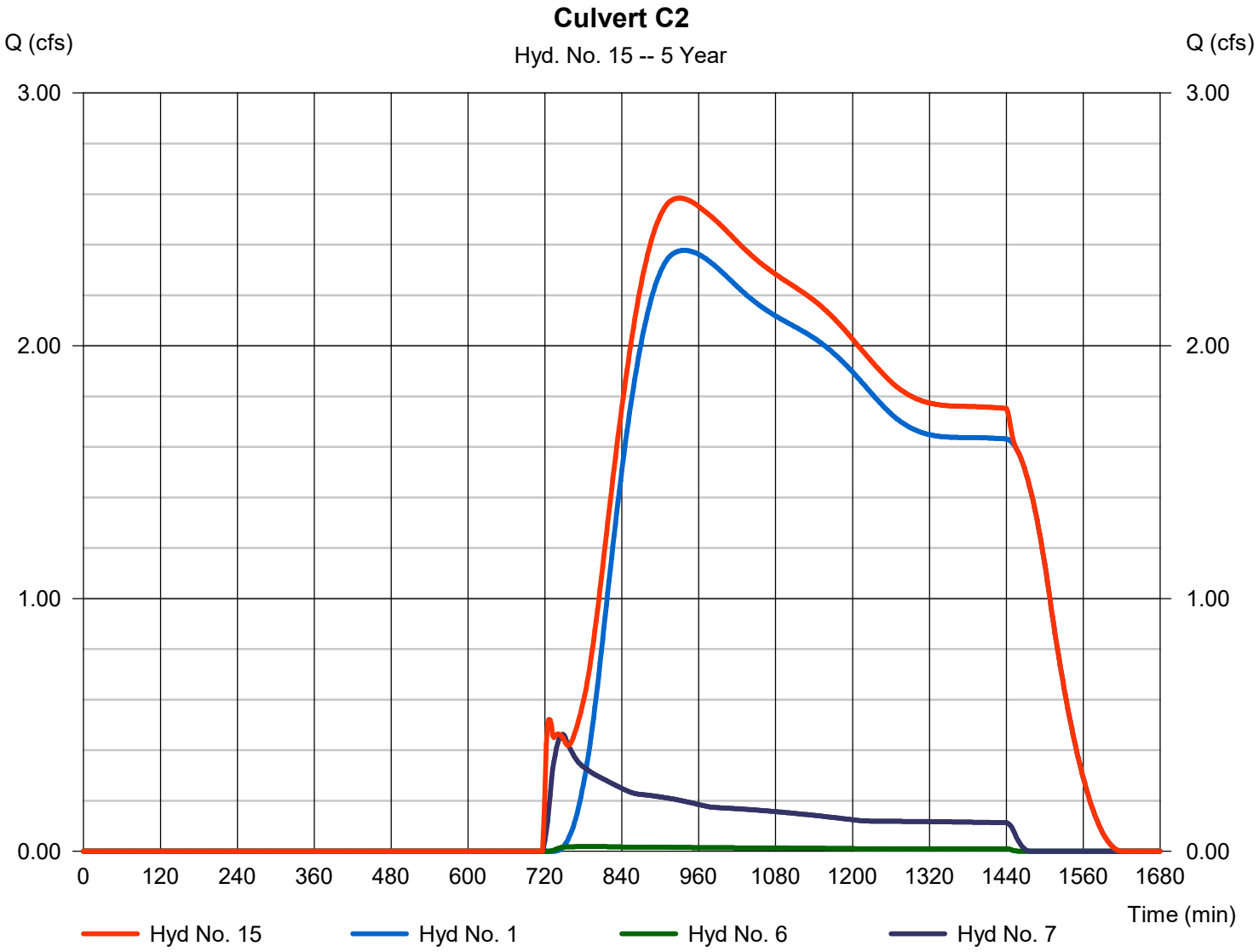


Hydrograph Report

Hyd. No. 15

Culvert C2

Hydrograph type	= Combine	Peak discharge	= 2.584 cfs
Storm frequency	= 5 yrs	Time to peak	= 930 min
Time interval	= 2 min	Hyd. volume	= 90,240 cuft
Inflow hyds.	= 1, 6, 7	Contrib. drain. area	= 451.000 ac

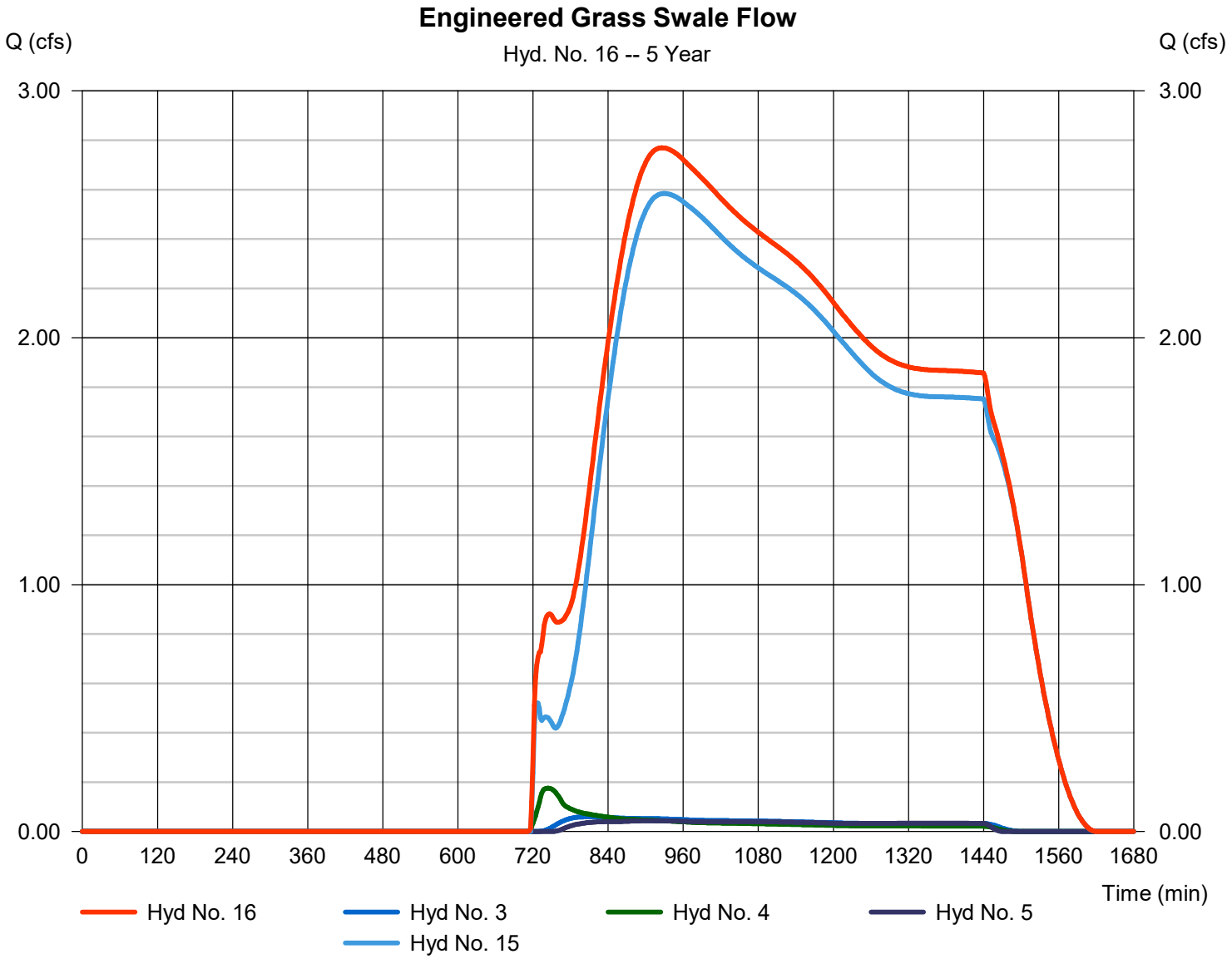


Hydrograph Report

Hyd. No. 16

Engineered Grass Swale Flow

Hydrograph type	= Combine	Peak discharge	= 2.769 cfs
Storm frequency	= 5 yrs	Time to peak	= 926 min
Time interval	= 2 min	Hyd. volume	= 97,604 cuft
Inflow hyds.	= 3, 4, 5, 15	Contrib. drain. area	= 20.400 ac

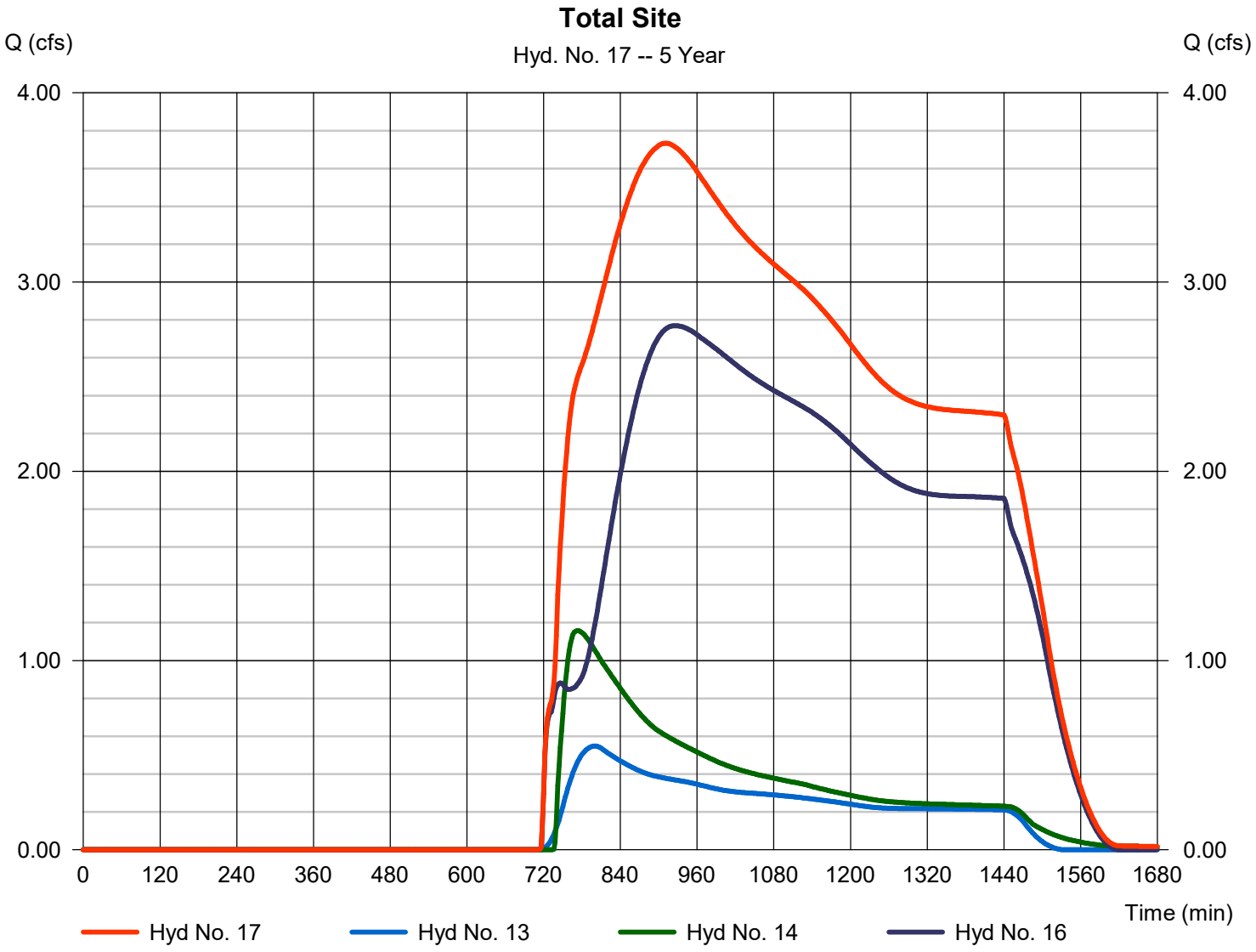


Hydrograph Report

Hyd. No. 17

Total Site

Hydrograph type	= Combine	Peak discharge	= 3.734 cfs
Storm frequency	= 5 yrs	Time to peak	= 910 min
Time interval	= 2 min	Hyd. volume	= 131,953 cuft
Inflow hyds.	= 13, 14, 16	Contrib. drain. area	= 0.000 ac



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	8.620	2	850	217,477	------	------	------	Offsite Basin 1
2	SCS Runoff	0.027	2	914	927	------	------	------	Offsite Basin 2
3	SCS Runoff	0.282	2	758	4,434	------	------	------	Onsite Basin A
4	SCS Runoff	0.472	2	738	3,466	------	------	------	Onsite Basin B
5	SCS Runoff	0.237	2	744	4,357	------	------	------	Onsite Basin C3
6	SCS Runoff	0.132	2	726	1,382	------	------	------	Onsite Basin C1/Culvert C1
7	SCS Runoff	1.981	2	732	16,686	------	------	------	Onsite Basin C2
8	SCS Runoff	0.423	2	744	4,112	------	------	------	On Site Basin D
9	SCS Runoff	2.148	2	738	14,641	------	------	------	On Site Basin E
10	SCS Runoff	0.552	2	760	8,055	------	------	------	On Site Basin F
11	SCS Runoff	1.936	2	772	29,471	------	------	------	On Site Basin H
12	Combine	6.425	2	736	40,495	8, 9, 10,	------	------	Detention Pond Flow
13	Combine	1.933	2	772	30,197	2, 11,	------	------	Flow to Offsite
14	Reservoir	3.029	2	762	37,539	12	5893.62	10,105	Pond Routing
15	Combine	9.090	2	848	235,253	1, 6, 7,	------	------	Culvert C2
16	Combine	9.544	2	846	250,900	3, 4, 5, 15	------	------	Engineered Grass Swale Flow
17	Combine	12.18	2	826	318,636	13, 14, 16	------	------	Total Site

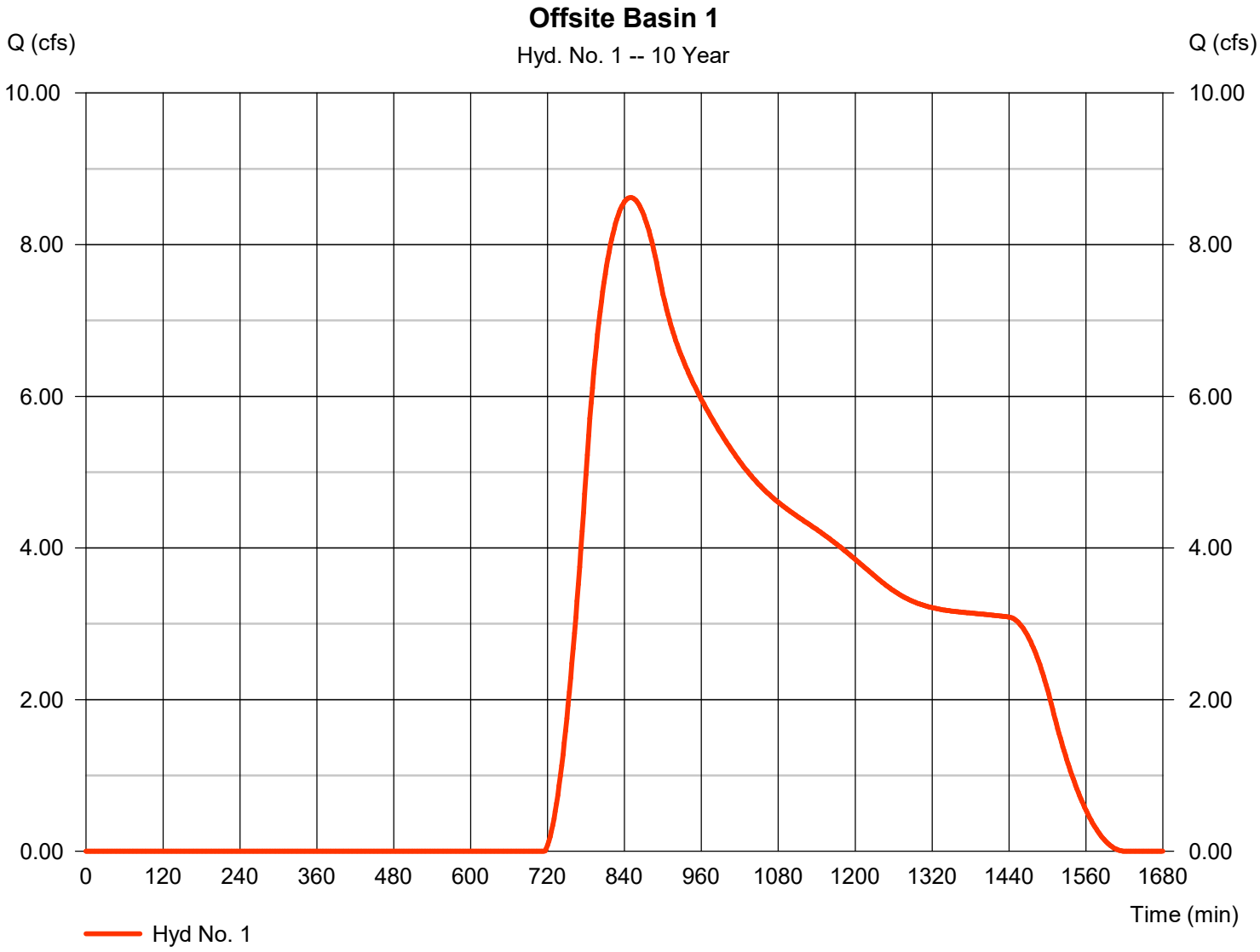
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	=	SCS Runoff	Peak discharge	=	8.620 cfs
Storm frequency	=	10 yrs	Time to peak	=	850 min
Time interval	=	2 min	Hyd. volume	=	217,477 cuft
Drainage area	=	428.970 ac	Curve number	=	56*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	114.40 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



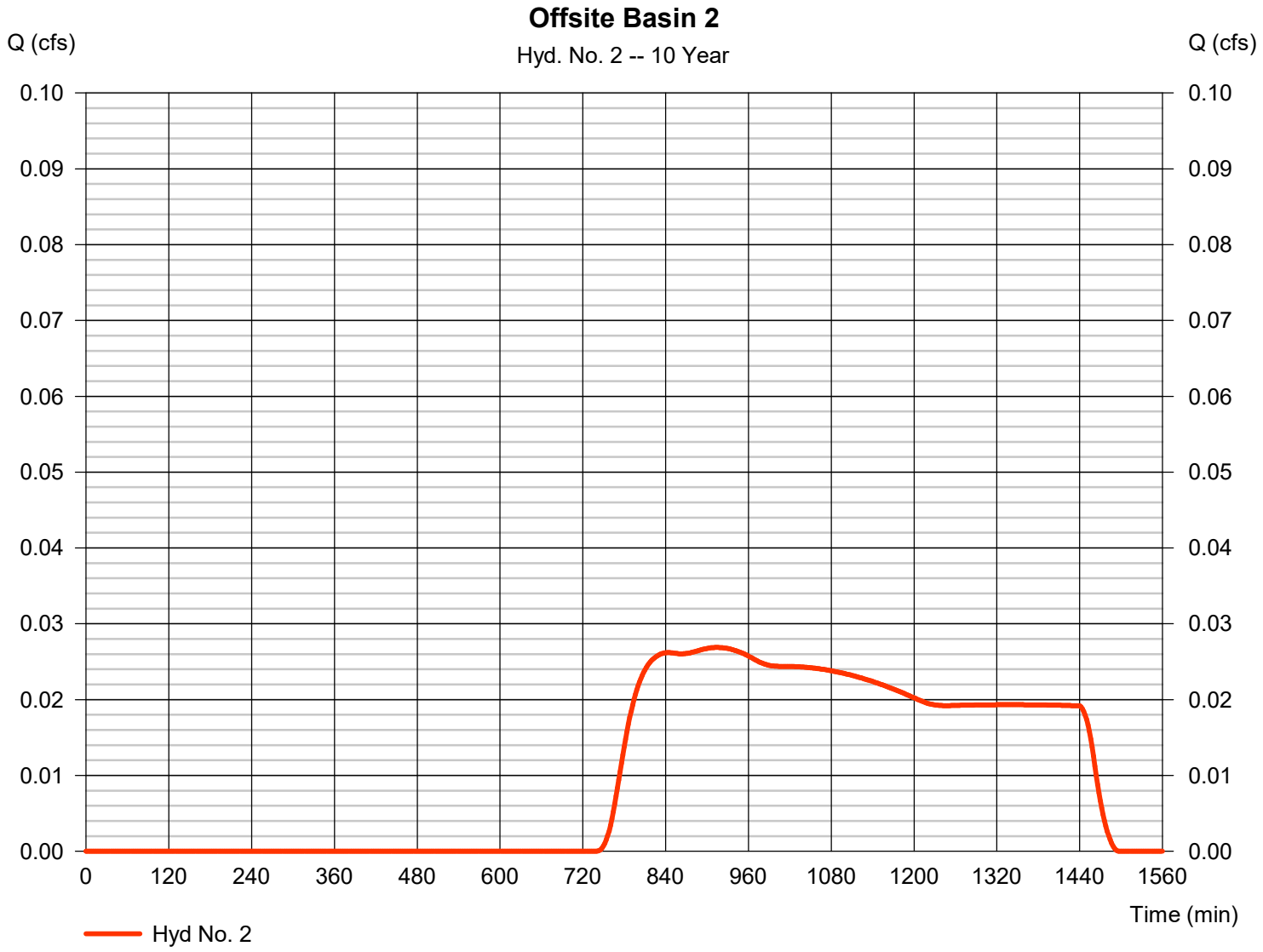
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	= SCS Runoff	Peak discharge	= 0.027 cfs
Storm frequency	= 10 yrs	Time to peak	= 914 min
Time interval	= 2 min	Hyd. volume	= 927 cuft
Drainage area	= 4.540 ac	Curve number	= 51*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 2.69 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



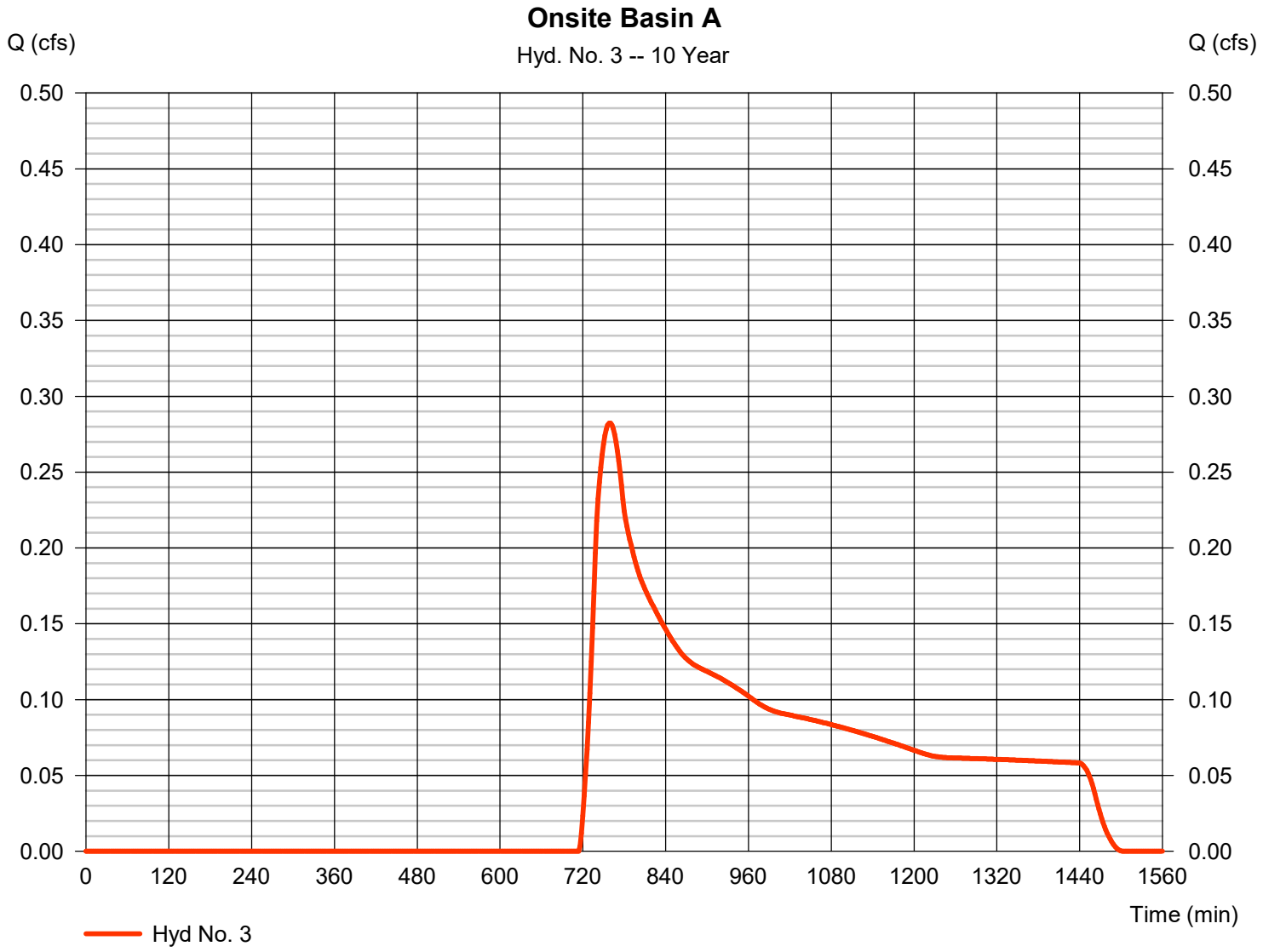
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.282 cfs
Storm frequency	=	10 yrs	Time to peak	=	758 min
Time interval	=	2 min	Hyd. volume	=	4,434 cuft
Drainage area	=	7.640 ac	Curve number	=	57*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	37.50 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 85)] / 7.640



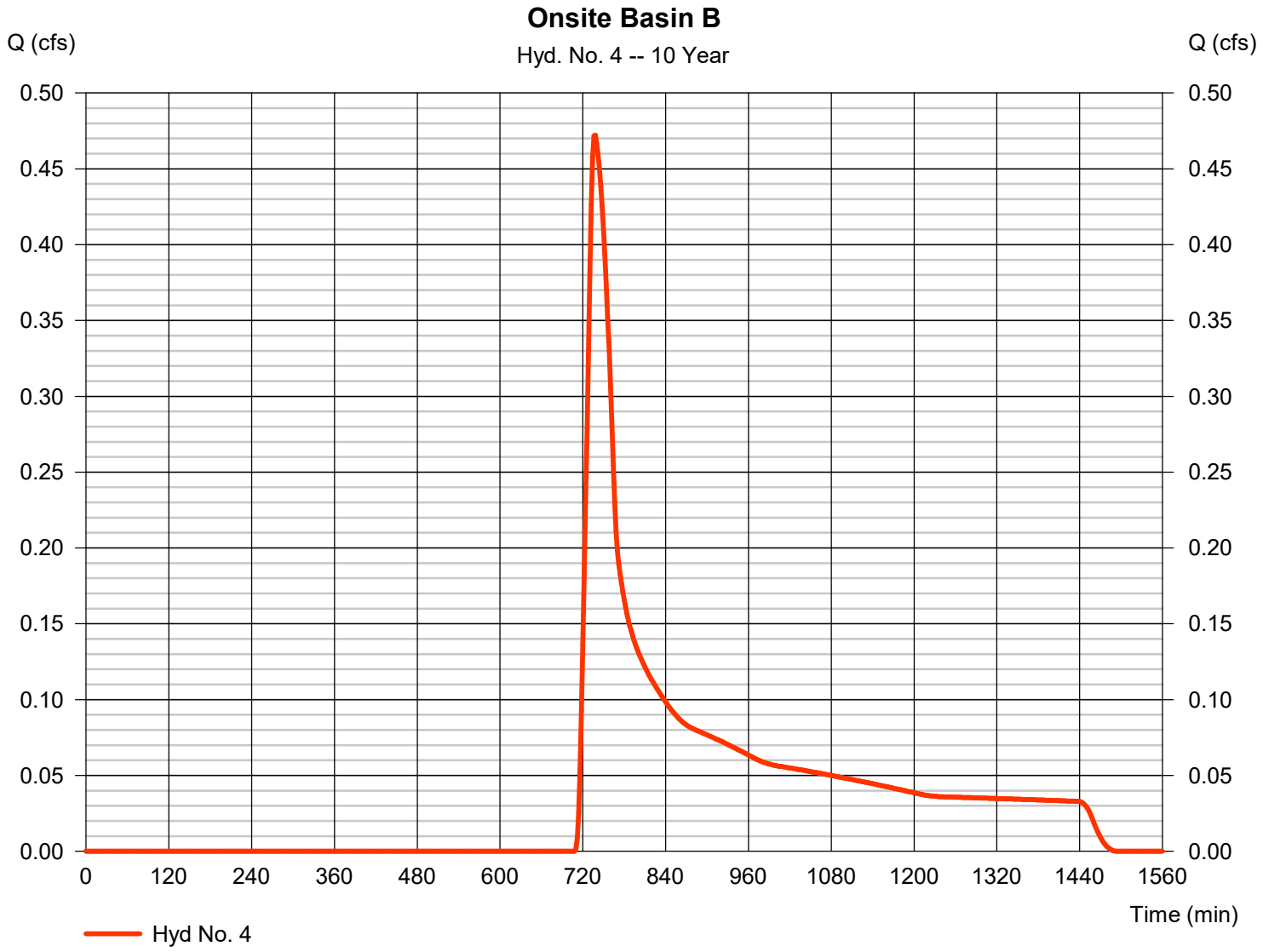
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.472 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	3,466 cuft
Drainage area	=	2.770 ac	Curve number	=	64*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.144 x 85) + (0.205 x 98) + (0.283 x 49) + (2.134 x 61)] / 2.770



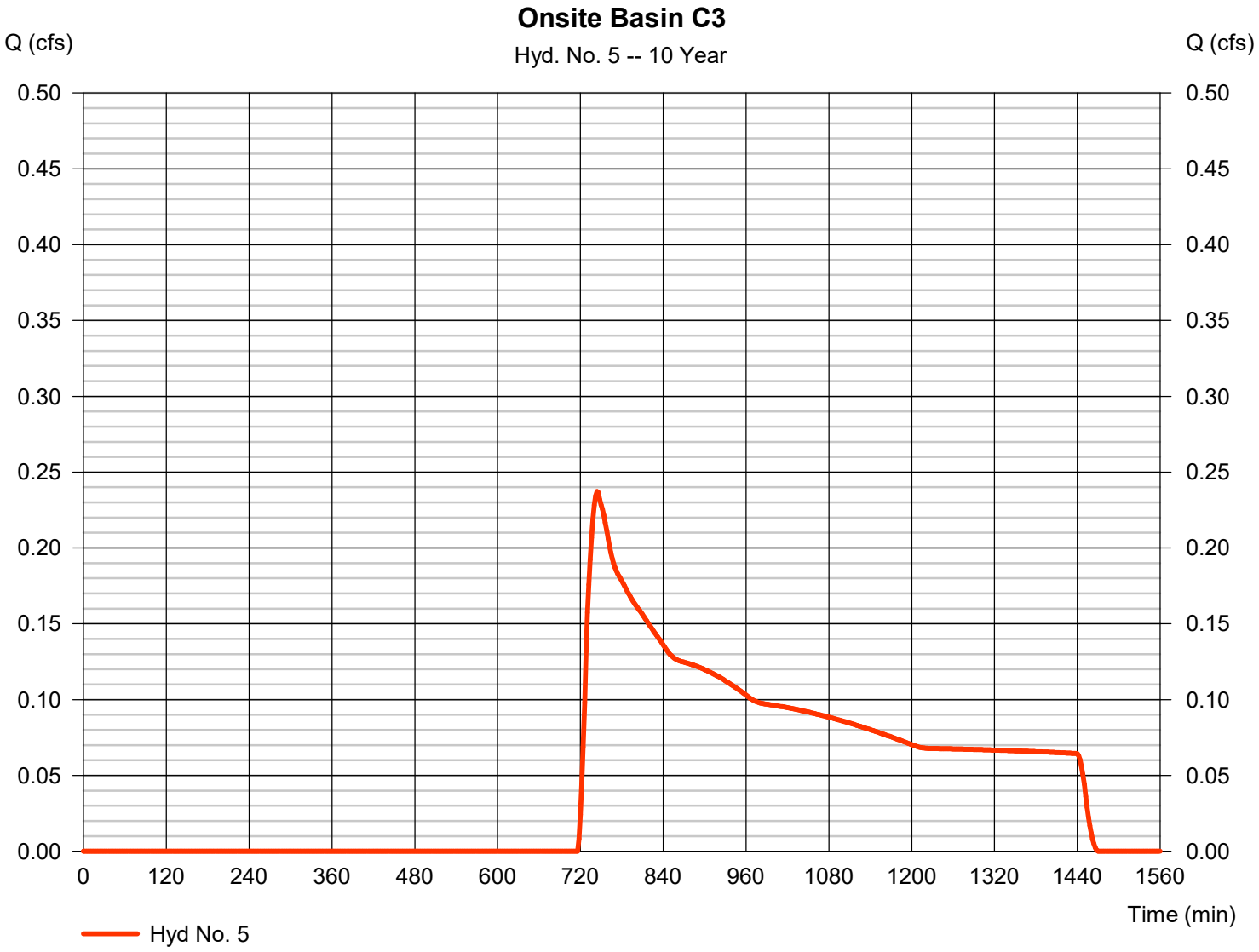
Hydrograph Report

Hyd. No. 5

Onsite Basin C3

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.237 cfs
Storm frequency	=	10 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	4,357 cuft
Drainage area	=	9.990 ac	Curve number	=	55*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.90 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.297 x 98) + (0.716 x 76) + (0.036 x 85) + (0.337 x 98) + (7.720 x 49) + (0.887 x 61)] / 9.990



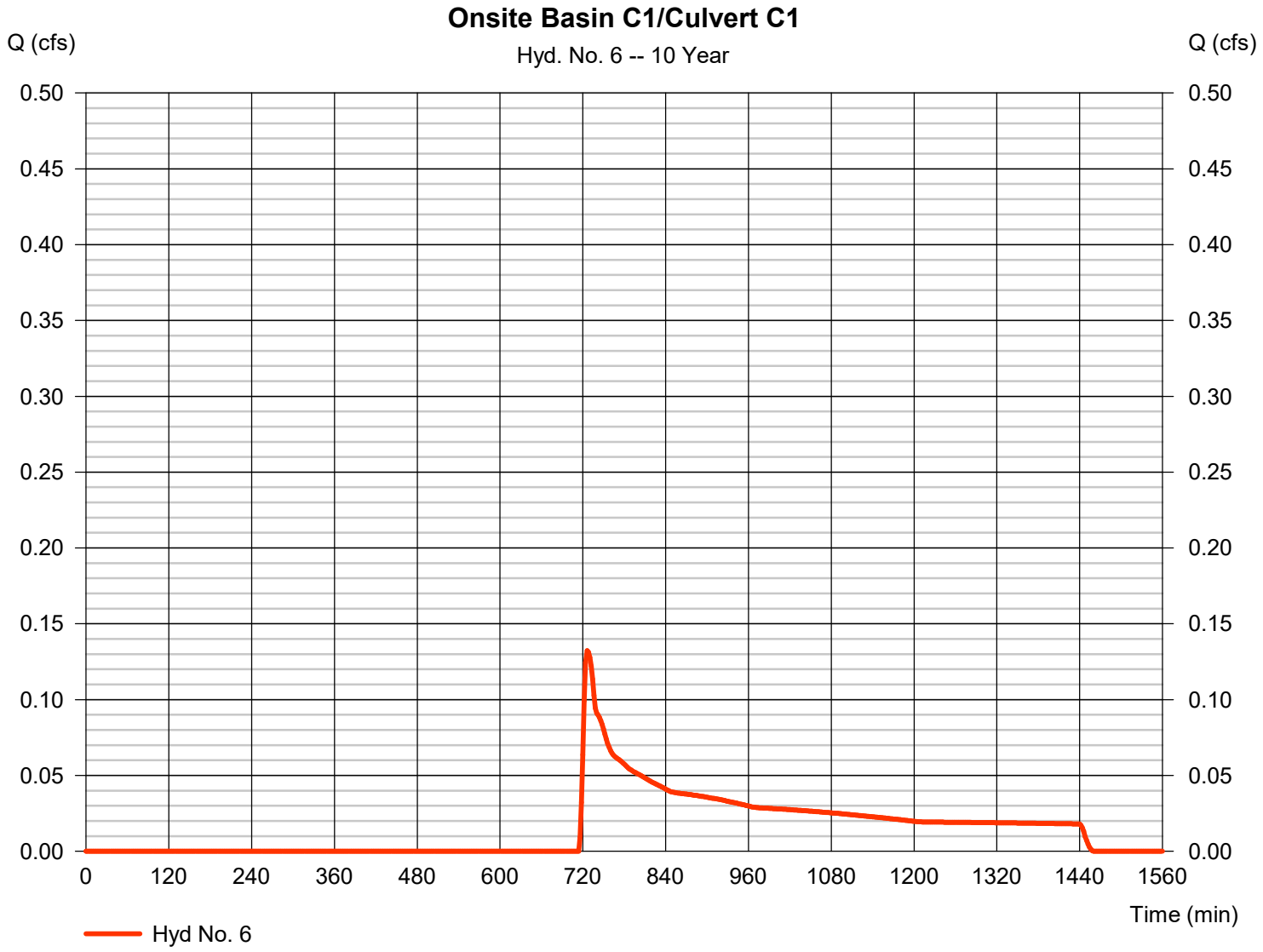
Hydrograph Report

Hyd. No. 6

Onsite Basin C1/Culvert C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.132 cfs
Storm frequency	=	10 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	1,382 cuft
Drainage area	=	2.310 ac	Curve number	=	57*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.06 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.145 x 85) + (1.131 x 49) + (1.033 x 61)] / 2.310



Hydrograph Report

Hyd. No. 7

Onsite Basin C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.981 cfs
Storm frequency	=	10 yrs	Time to peak	=	732 min
Time interval	=	2 min	Hyd. volume	=	16,686 cuft
Drainage area	=	19.720 ac	Curve number	=	60*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.30 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.139 x 98) + (0.236 x 85) + (1.032 x 98) + (5.683 x 49) + (12.631 x 61)] / 19.720

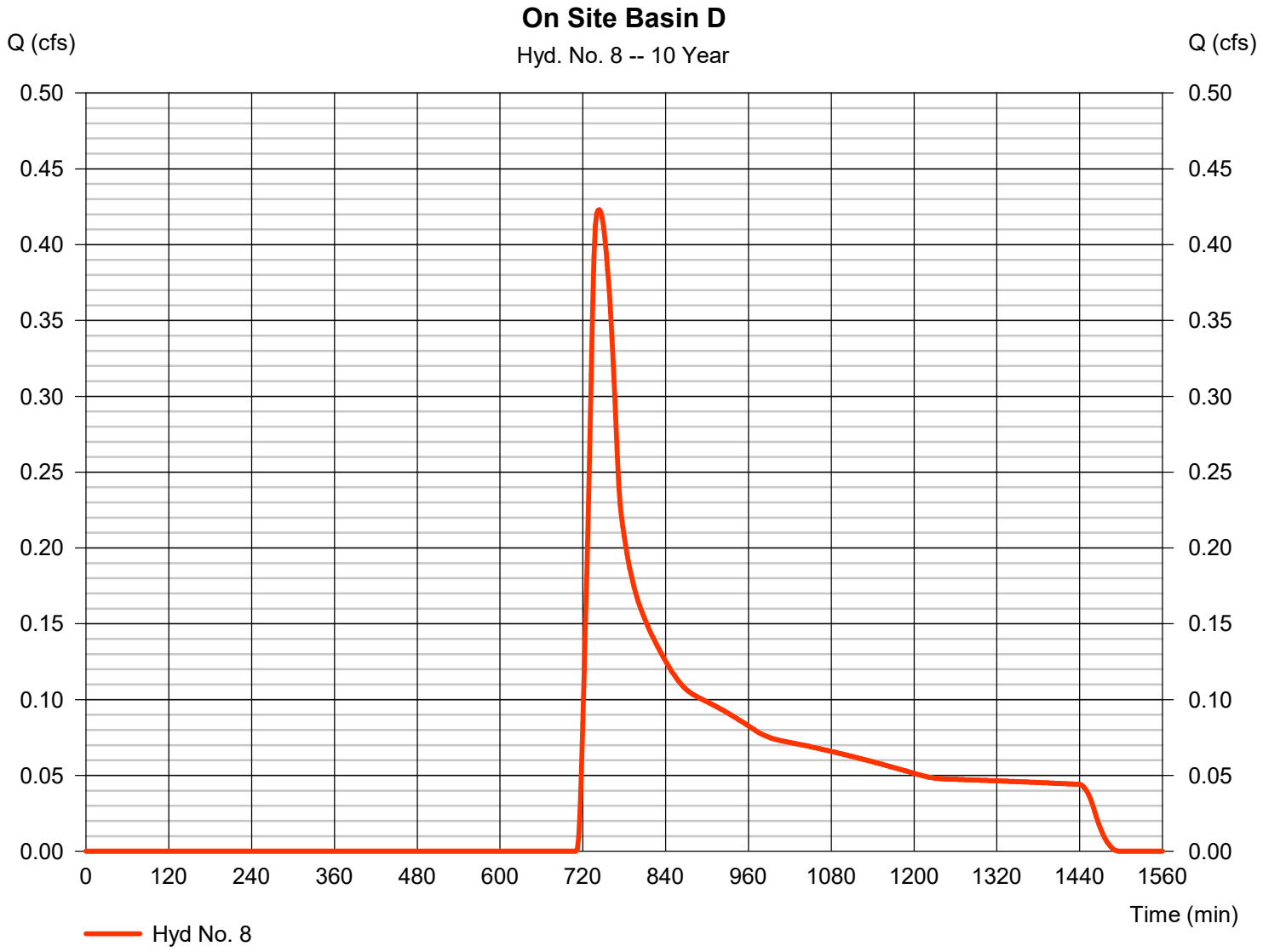
Hydrograph Report

Hyd. No. 8

On Site Basin D

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.423 cfs
Storm frequency	=	10 yrs	Time to peak	=	744 min
Time interval	=	2 min	Hyd. volume	=	4,112 cuft
Drainage area	=	4.490 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	37.00 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.015 x 98) + (0.428 x 98) + (1.254 x 49) + (2.792 x 61)] / 4.490



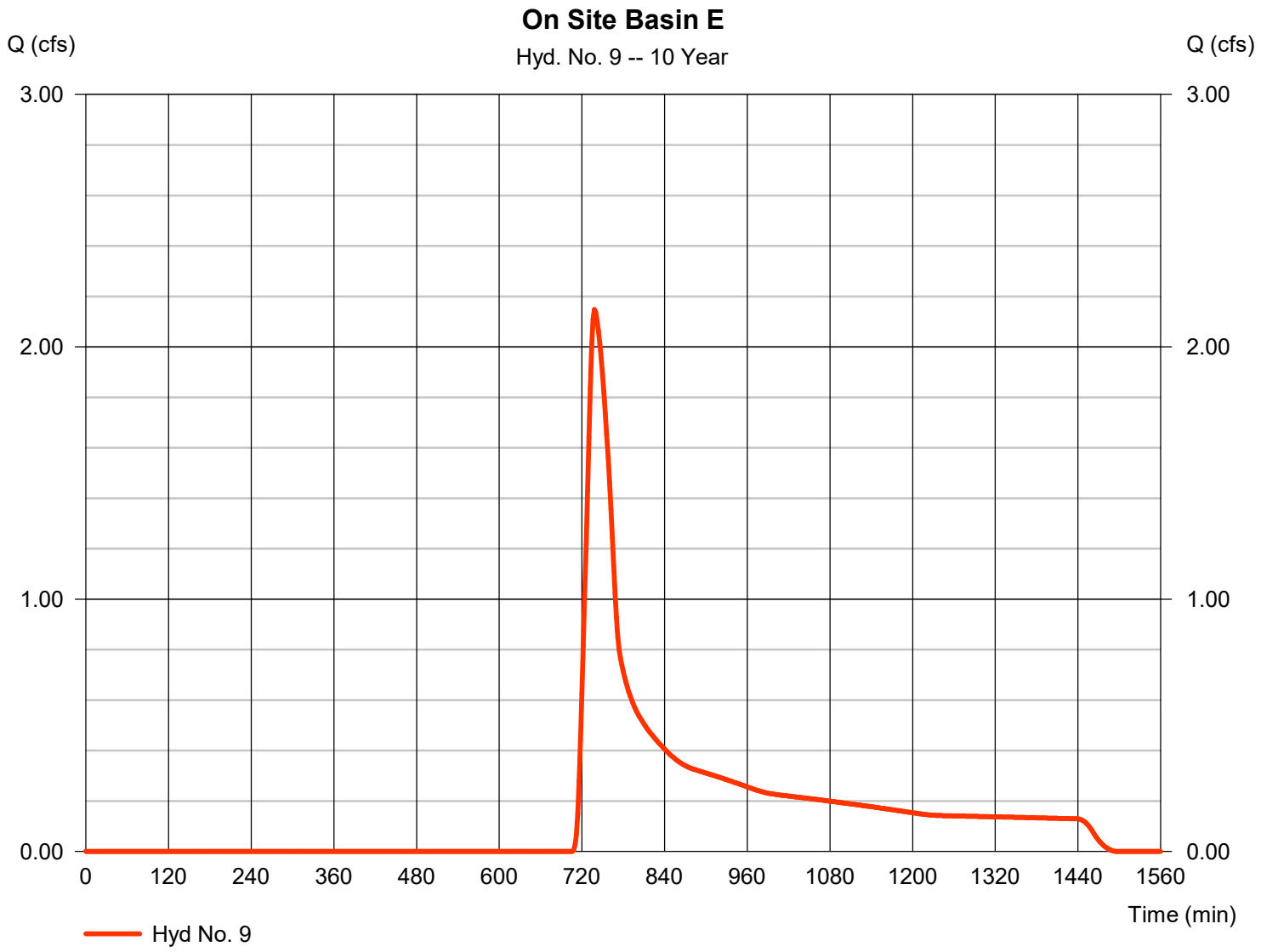
Hydrograph Report

Hyd. No. 9

On Site Basin E

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.148 cfs
Storm frequency	=	10 yrs	Time to peak	=	738 min
Time interval	=	2 min	Hyd. volume	=	14,641 cuft
Drainage area	=	10.090 ac	Curve number	=	66*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.10 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.165 x 98) + (2.167 x 98) + (2.583 x 49) + (5.178 x 61)] / 10.090



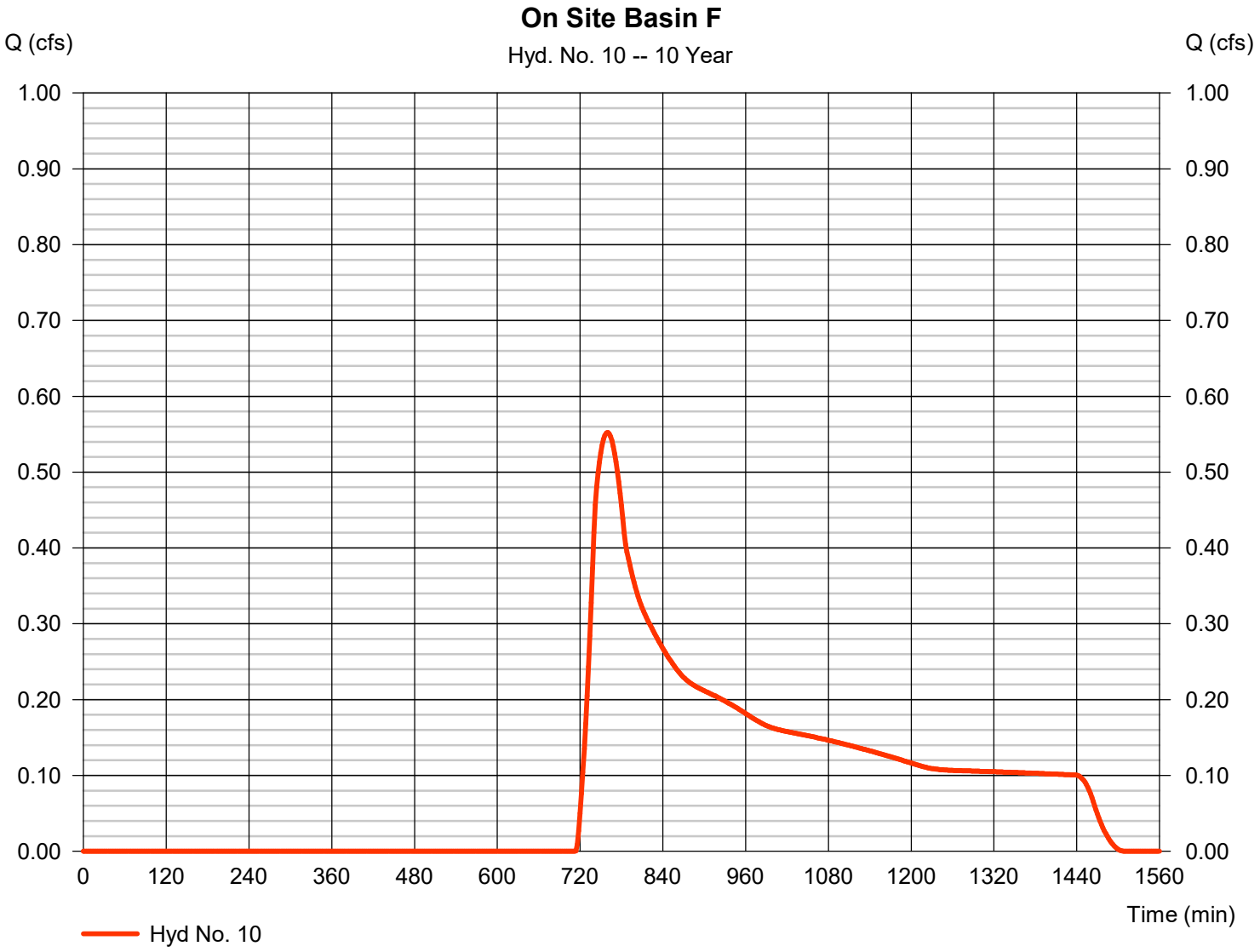
Hydrograph Report

Hyd. No. 10

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	0.552 cfs
Storm frequency	=	10 yrs	Time to peak	=	760 min
Time interval	=	2 min	Hyd. volume	=	8,055 cuft
Drainage area	=	12.130 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.011 x 98) + (0.107 x 98) + (3.132 x 49) + (8.879 x 61)] / 12.130



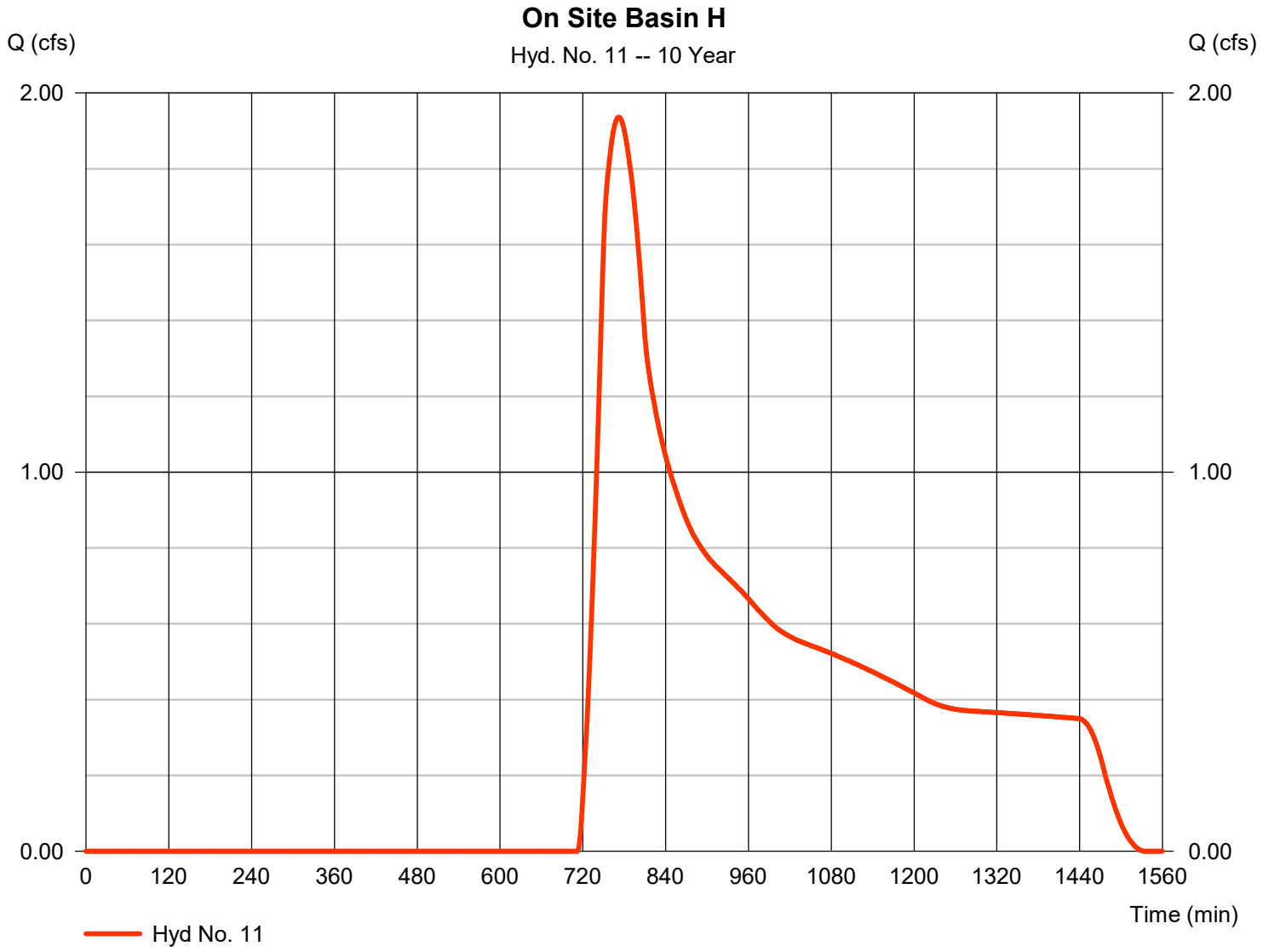
Hydrograph Report

Hyd. No. 11

On Site Basin H

Hydrograph type	=	SCS Runoff	Peak discharge	=	1.936 cfs
Storm frequency	=	10 yrs	Time to peak	=	772 min
Time interval	=	2 min	Hyd. volume	=	29,471 cuft
Drainage area	=	39.620 ac	Curve number	=	59*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	57.90 min
Total precip.	=	2.69 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.132 x 85) + (8.377 x 49) + (31.111 x 61)] / 39.620

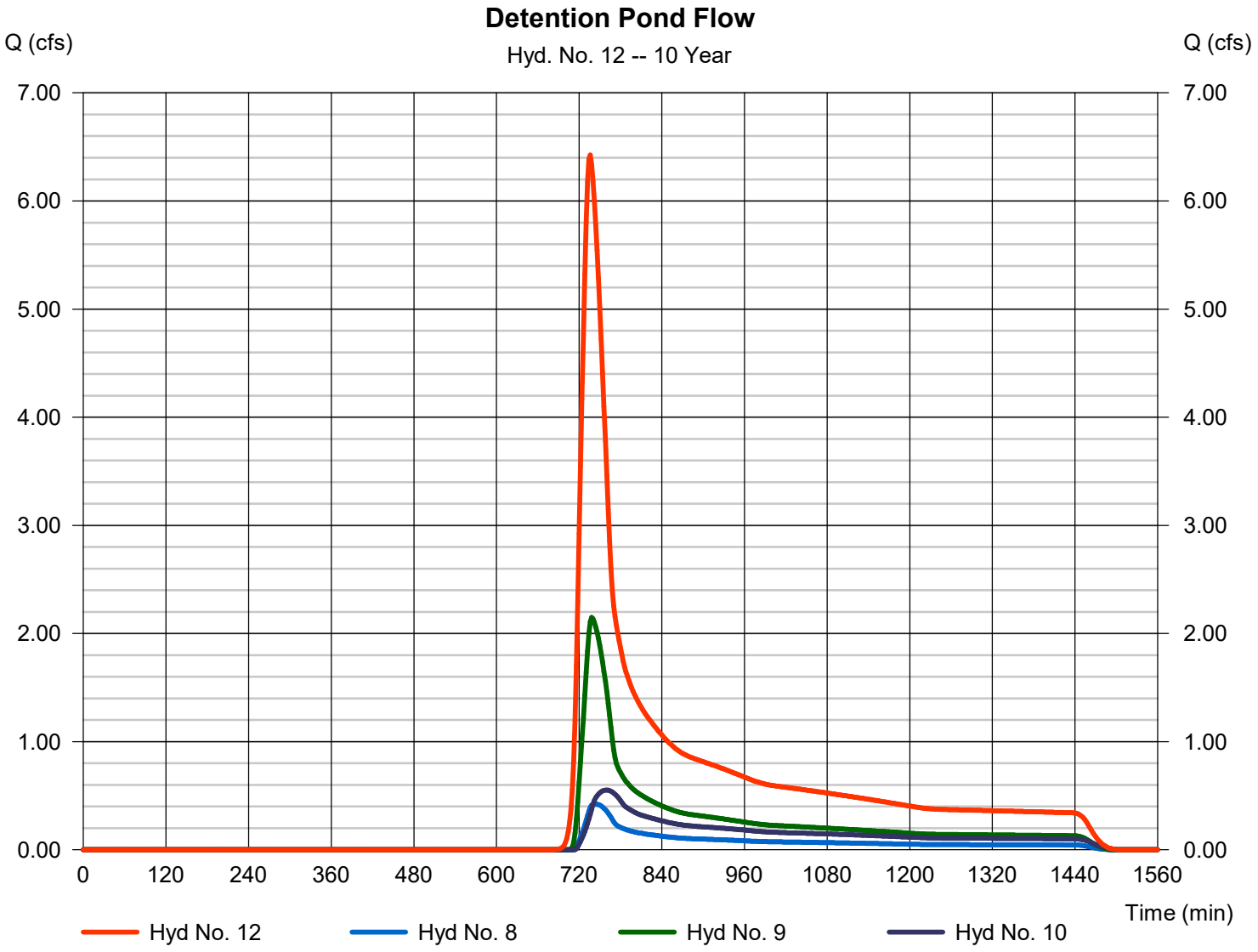


Hydrograph Report

Hyd. No. 12

Detention Pond Flow

Hydrograph type	= Combine	Peak discharge	= 6.425 cfs
Storm frequency	= 10 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 40,495 cuft
Inflow hyds.	= 8, 9, 10	Contrib. drain. area	= 26.710 ac

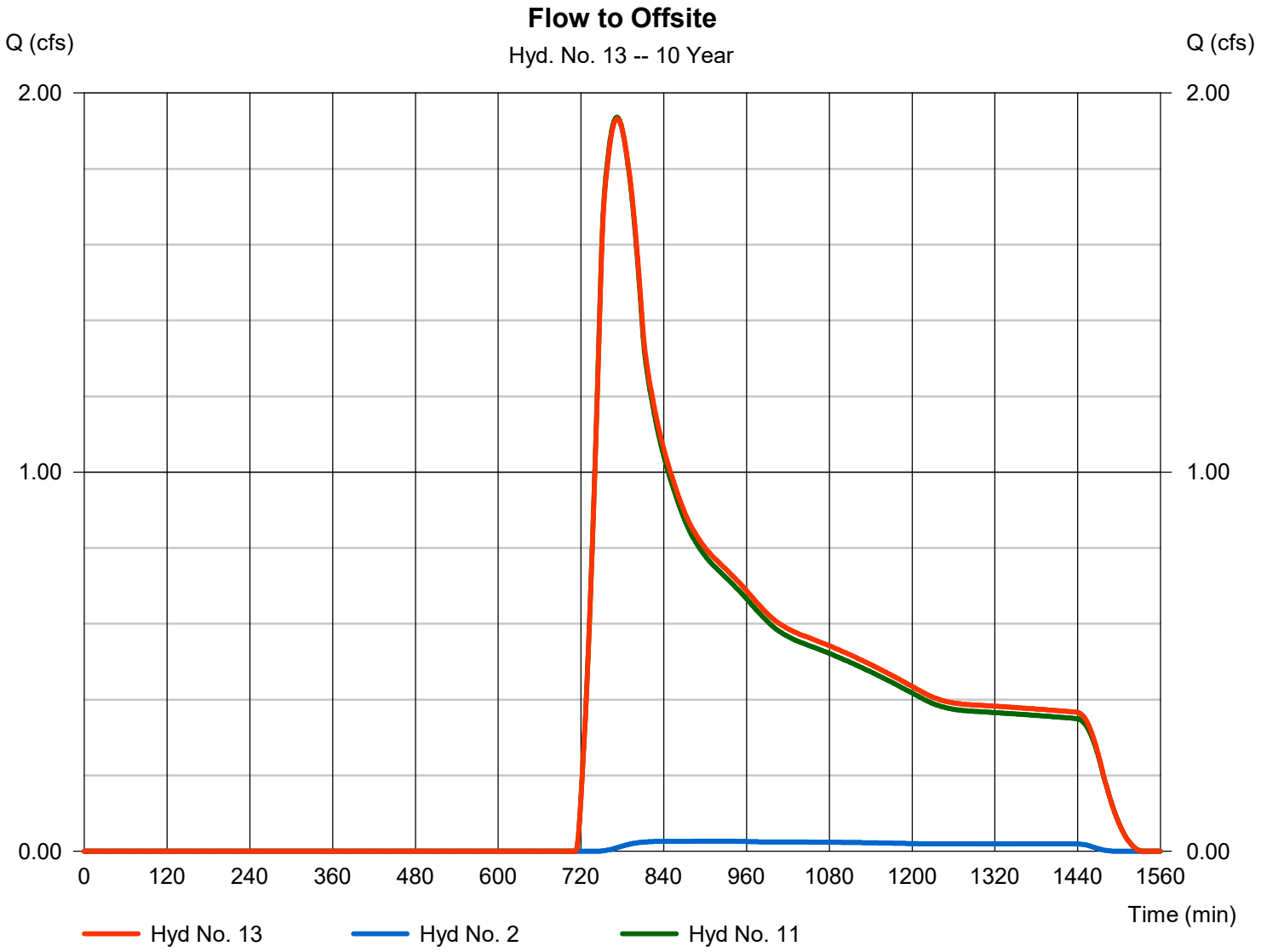


Hydrograph Report

Hyd. No. 13

Flow to Offsite

Hydrograph type	= Combine	Peak discharge	= 1.933 cfs
Storm frequency	= 10 yrs	Time to peak	= 772 min
Time interval	= 2 min	Hyd. volume	= 30,197 cuft
Inflow hyds.	= 2, 11	Contrib. drain. area	= 44.160 ac



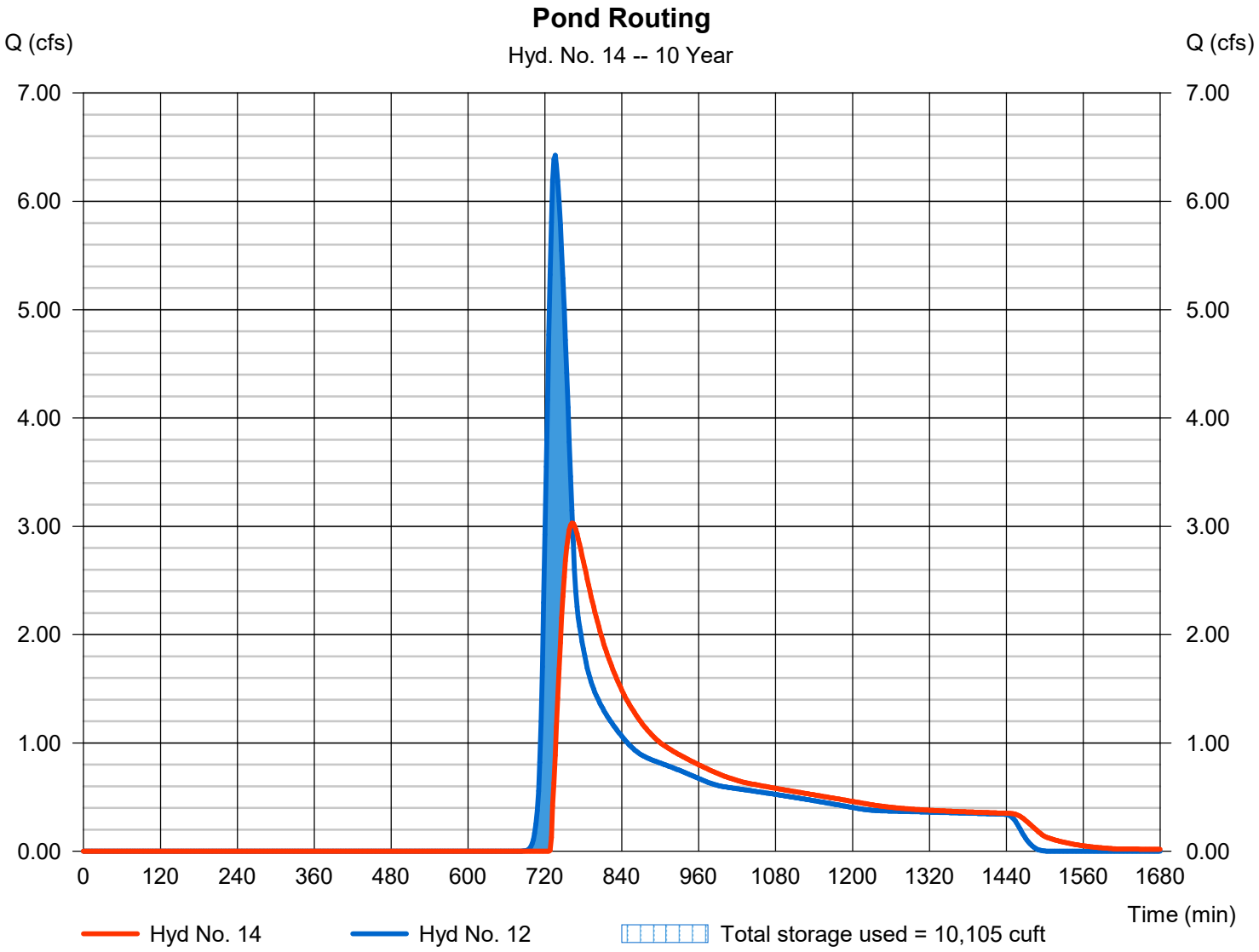
Hydrograph Report

Hyd. No. 14

Pond Routing

Hydrograph type	=	Reservoir	Peak discharge	=	3.029 cfs
Storm frequency	=	10 yrs	Time to peak	=	762 min
Time interval	=	2 min	Hyd. volume	=	37,539 cuft
Inflow hyd. No.	=	12 - Detention Pond Flow	Max. Elevation	=	5893.62 ft
Reservoir name	=	Pond 1	Max. Storage	=	10,105 cuft

Storage Indication method used.

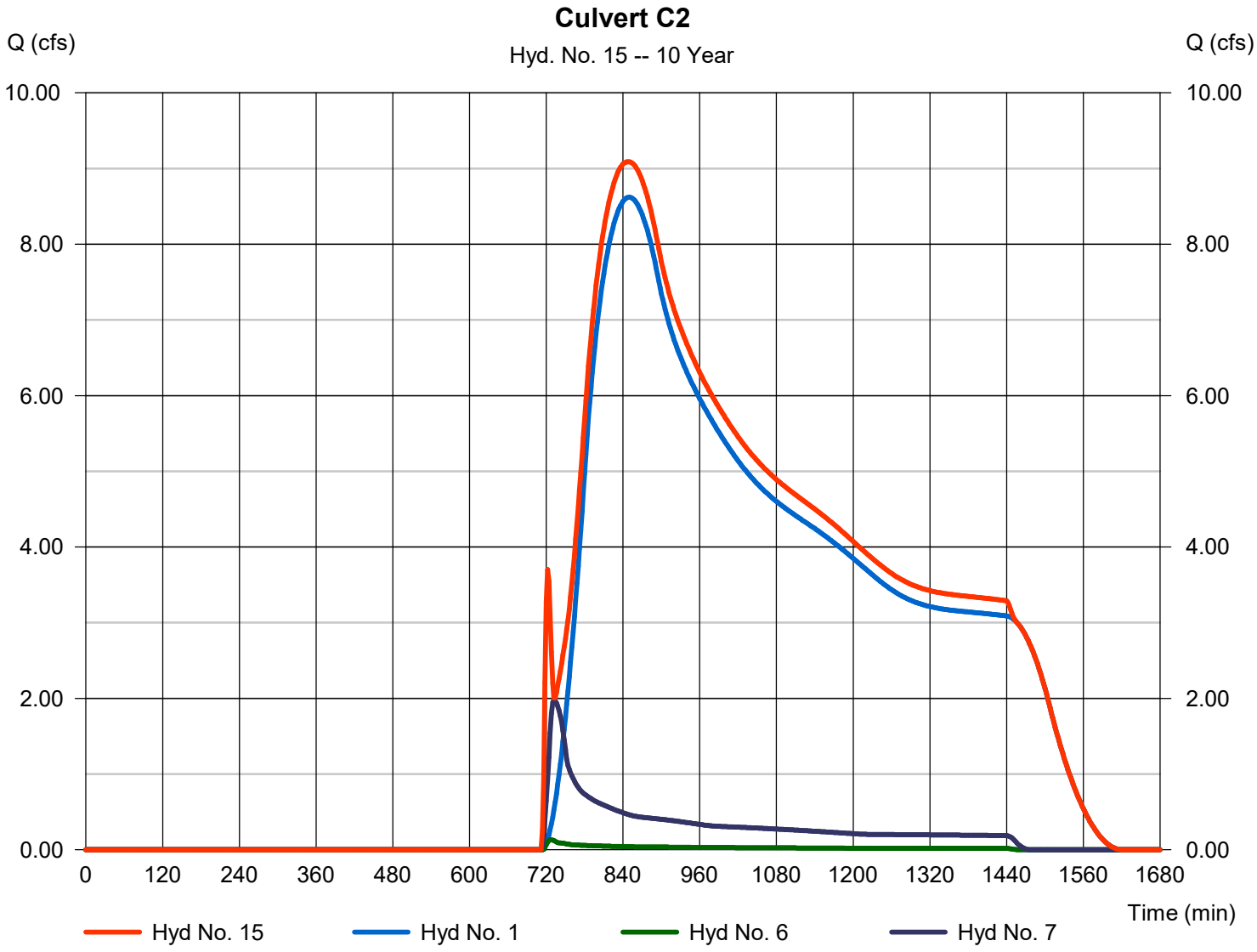


Hydrograph Report

Hyd. No. 15

Culvert C2

Hydrograph type	= Combine	Peak discharge	= 9.090 cfs
Storm frequency	= 10 yrs	Time to peak	= 848 min
Time interval	= 2 min	Hyd. volume	= 235,253 cuft
Inflow hyds.	= 1, 6, 7	Contrib. drain. area	= 451.000 ac

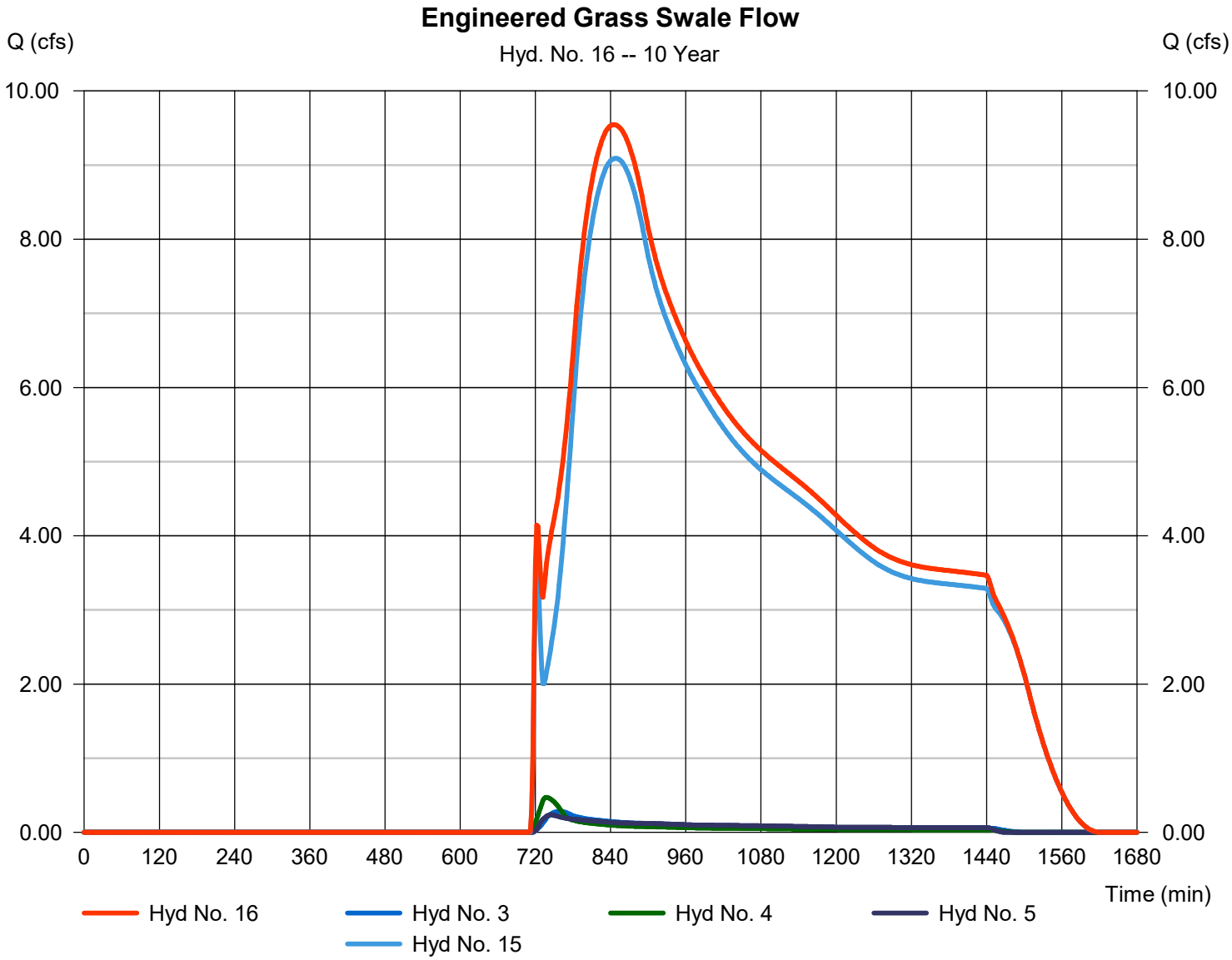


Hydrograph Report

Hyd. No. 16

Engineered Grass Swale Flow

Hydrograph type	= Combine	Peak discharge	= 9.544 cfs
Storm frequency	= 10 yrs	Time to peak	= 846 min
Time interval	= 2 min	Hyd. volume	= 250,900 cuft
Inflow hyds.	= 3, 4, 5, 15	Contrib. drain. area	= 20.400 ac

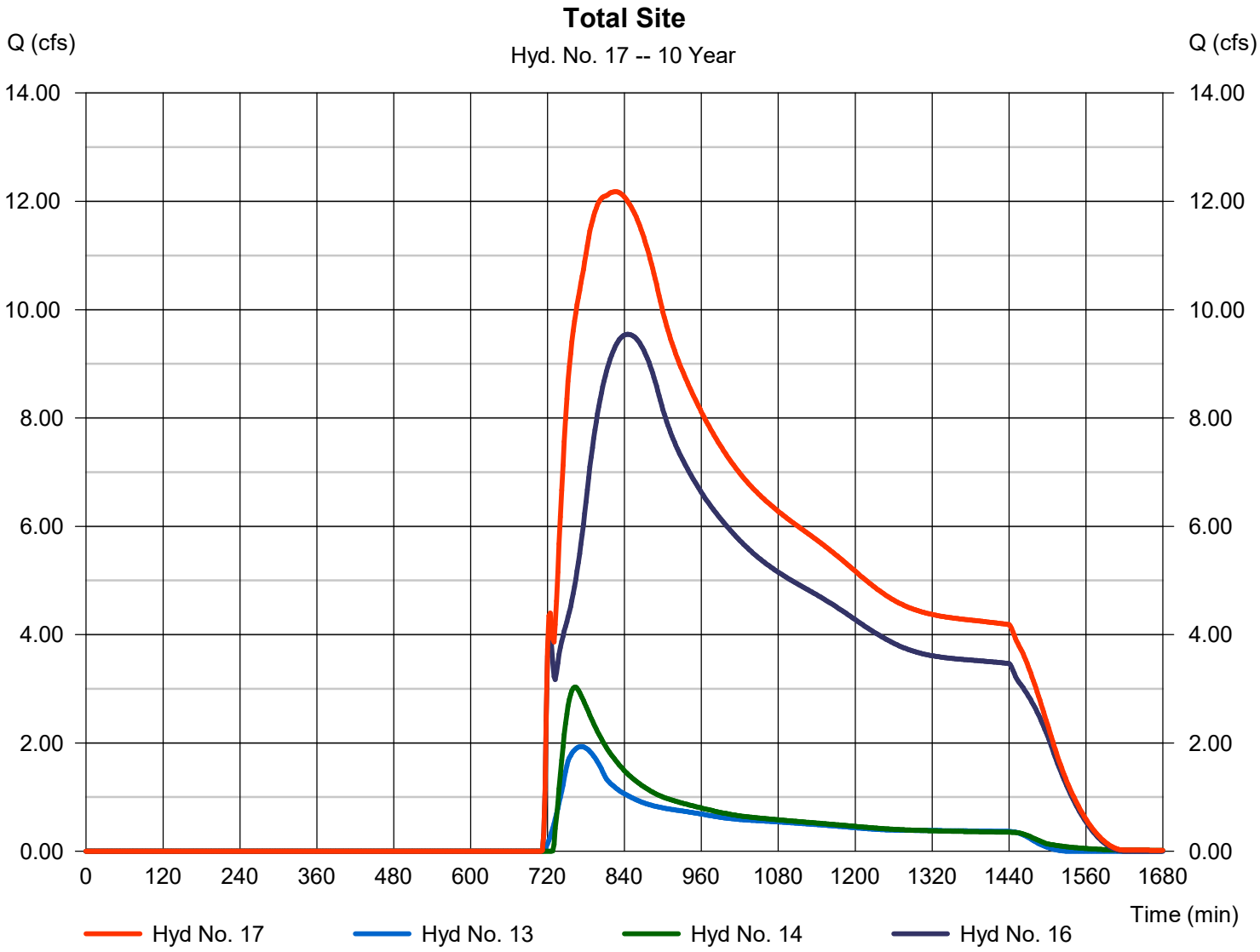


Hydrograph Report

Hyd. No. 17

Total Site

Hydrograph type	=	Combine	Peak discharge	=	12.18 cfs
Storm frequency	=	10 yrs	Time to peak	=	826 min
Time interval	=	2 min	Hyd. volume	=	318,636 cuft
Inflow hyds.	=	13, 14, 16	Contrib. drain. area	=	0.000 ac



Hydrograph Summary Report

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

Hyd. No.	Hydrograph type (origin)	Peak flow (cfs)	Time interval (min)	Time to Peak (min)	Hyd. volume (cuft)	Inflow hyd(s)	Maximum elevation (ft)	Total strge used (cuft)	Hydrograph Description
1	SCS Runoff	94.58	2	794	1,324,269	------	------	------	Offsite Basin 1
2	SCS Runoff	1.252	2	740	9,570	------	------	------	Offsite Basin 2
3	SCS Runoff	3.969	2	740	25,052	------	------	------	Onsite Basin A
4	SCS Runoff	2.843	2	734	13,573	------	------	------	Onsite Basin B
5	SCS Runoff	6.953	2	726	28,745	------	------	------	Onsite Basin C3
6	SCS Runoff	2.579	2	722	7,811	------	------	------	Onsite Basin C1/Culvert C1
7	SCS Runoff	19.60	2	728	78,674	------	------	------	Onsite Basin C2
8	SCS Runoff	3.473	2	736	18,388	------	------	------	On Site Basin D
9	SCS Runoff	10.88	2	736	53,144	------	------	------	On Site Basin E
10	SCS Runoff	6.520	2	742	42,713	------	------	------	On Site Basin F
11	SCS Runoff	18.20	2	752	146,640	------	------	------	On Site Basin H
12	Combine	27.52	2	736	142,828	8, 9, 10,	------	------	Detention Pond Flow
13	Combine	19.18	2	752	155,210	2, 11,	------	------	Flow to Offsite
14	Reservoir	13.52	2	760	139,871	12	5895.48	39,093	Pond Routing
15	Combine	97.16	2	794	1,409,374	1, 6, 7,	------	------	Culvert C2
16	Combine	99.92	2	792	1,485,079	3, 4, 5, 15	------	------	Engineered Grass Swale Flow
17	Combine	124.15	2	784	1,780,159	13, 14, 16	------	------	Total Site

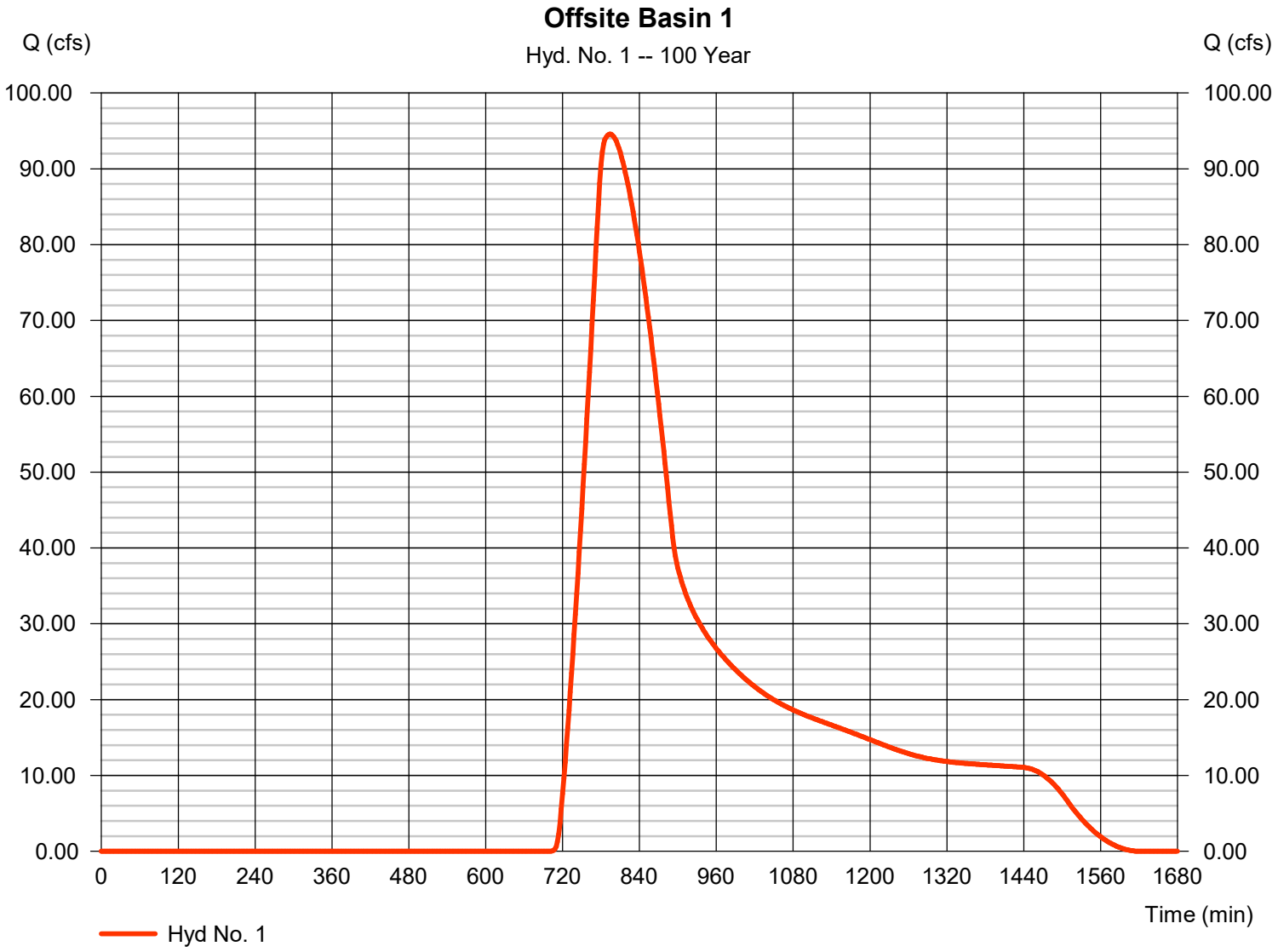
Hydrograph Report

Hyd. No. 1

Offsite Basin 1

Hydrograph type	= SCS Runoff	Peak discharge	= 94.58 cfs
Storm frequency	= 100 yrs	Time to peak	= 794 min
Time interval	= 2 min	Hyd. volume	= 1,324,269 cuft
Drainage area	= 428.970 ac	Curve number	= 56*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 114.40 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(240.490 x 61) + (188.480 x 49)] / 428.970



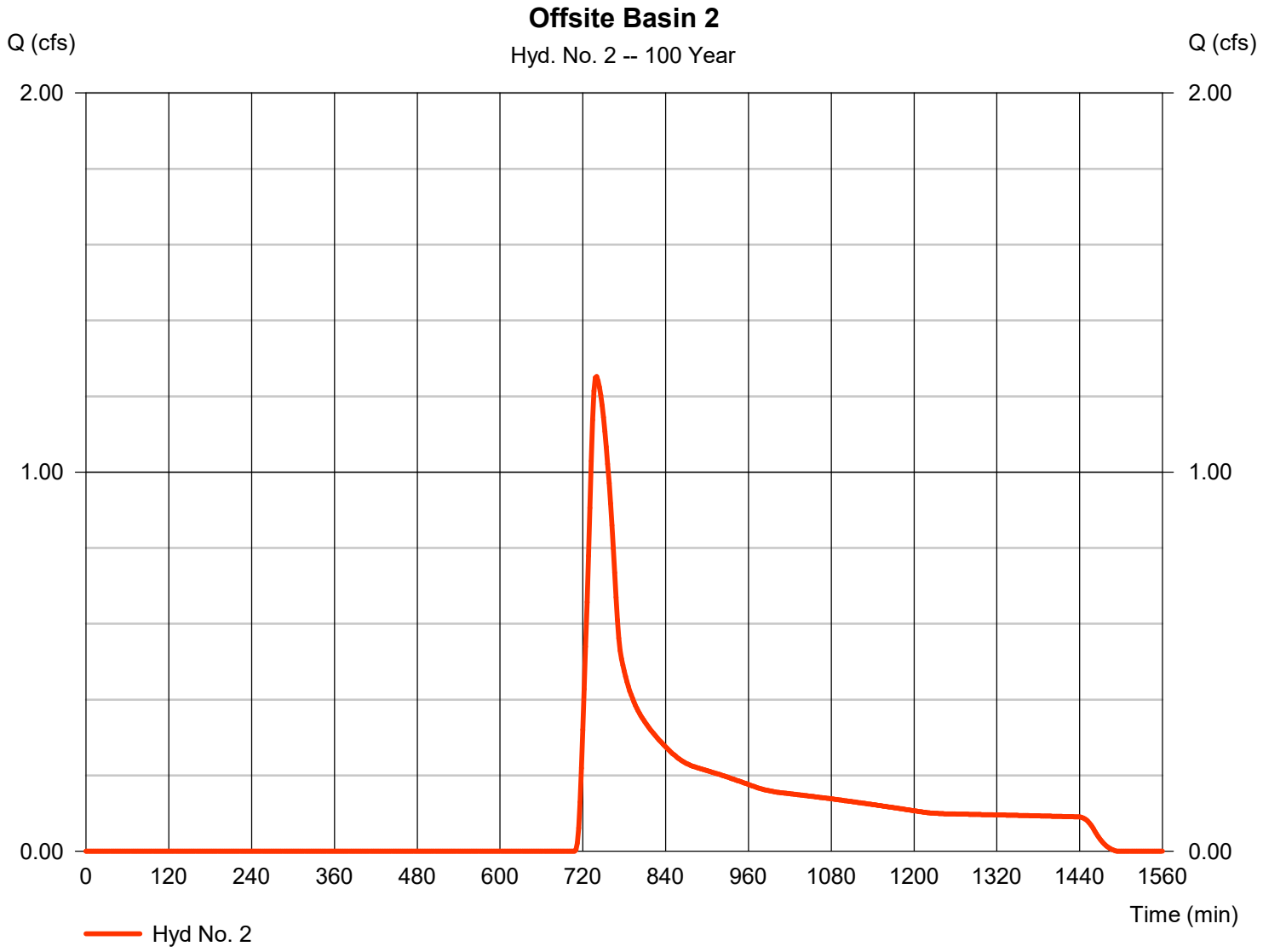
Hydrograph Report

Hyd. No. 2

Offsite Basin 2

Hydrograph type	= SCS Runoff	Peak discharge	= 1.252 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 9,570 cuft
Drainage area	= 4.540 ac	Curve number	= 51*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.30 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(3.610 x 49) + (0.930 x 61)] / 4.540



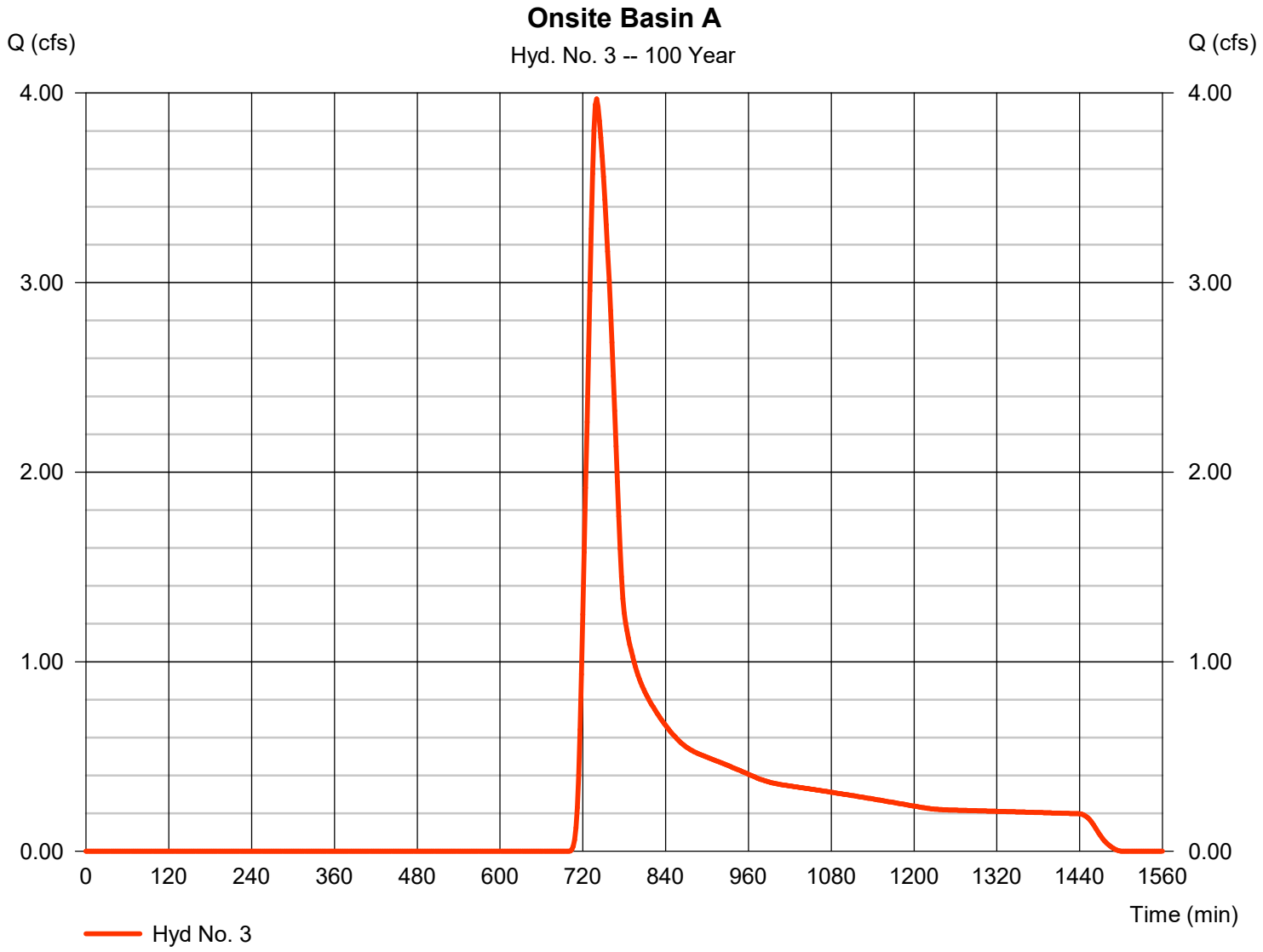
Hydrograph Report

Hyd. No. 3

Onsite Basin A

Hydrograph type	= SCS Runoff	Peak discharge	= 3.969 cfs
Storm frequency	= 100 yrs	Time to peak	= 740 min
Time interval	= 2 min	Hyd. volume	= 25,052 cuft
Drainage area	= 7.640 ac	Curve number	= 57*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 37.50 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(2.690 x 49) + (4.780 x 61) + (0.170 x 85)] / 7.640



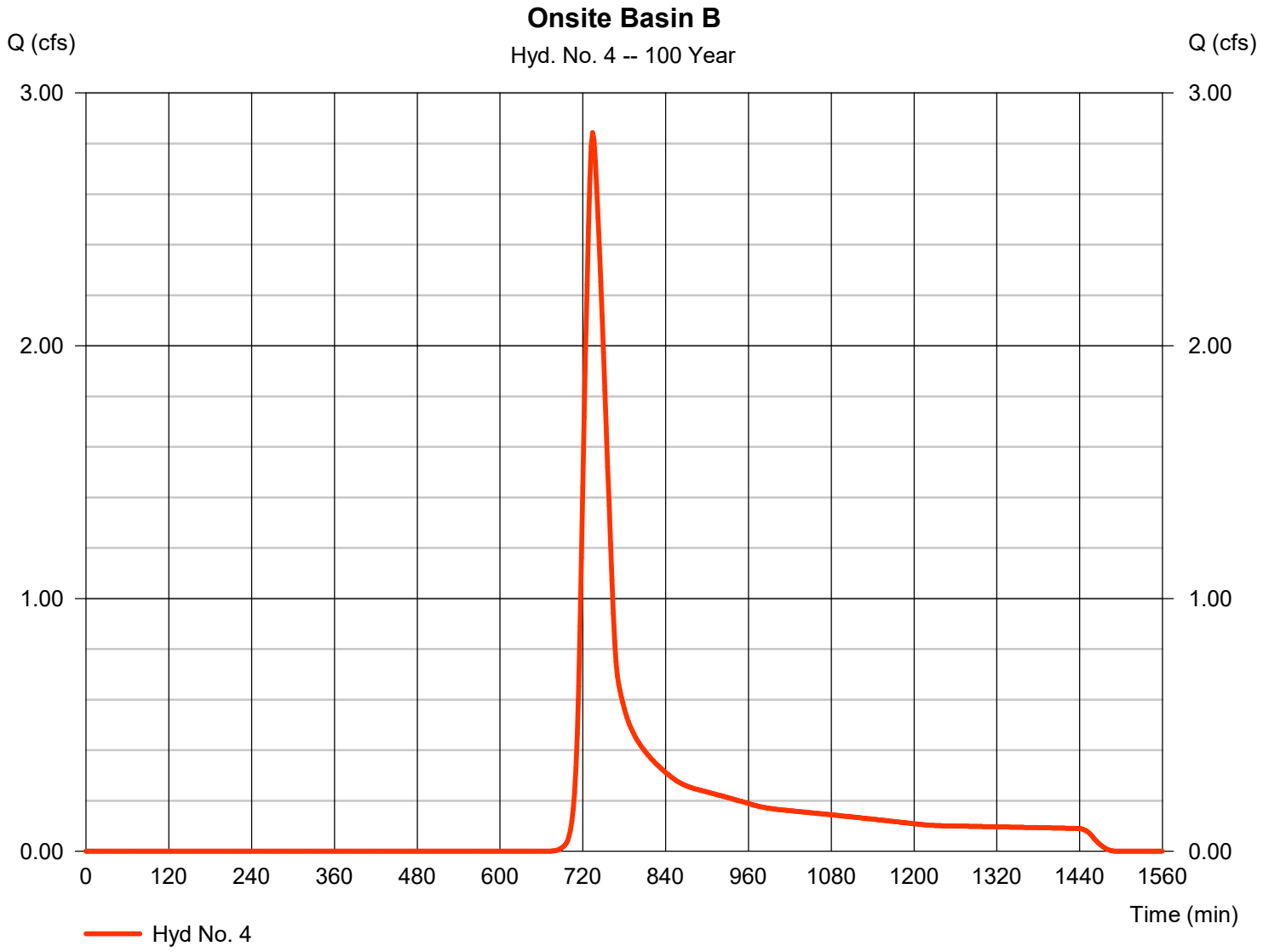
Hydrograph Report

Hyd. No. 4

Onsite Basin B

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.843 cfs
Storm frequency	=	100 yrs	Time to peak	=	734 min
Time interval	=	2 min	Hyd. volume	=	13,573 cuft
Drainage area	=	2.770 ac	Curve number	=	64*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	32.40 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.144 x 85) + (0.205 x 98) + (0.283 x 49) + (2.134 x 61)] / 2.770



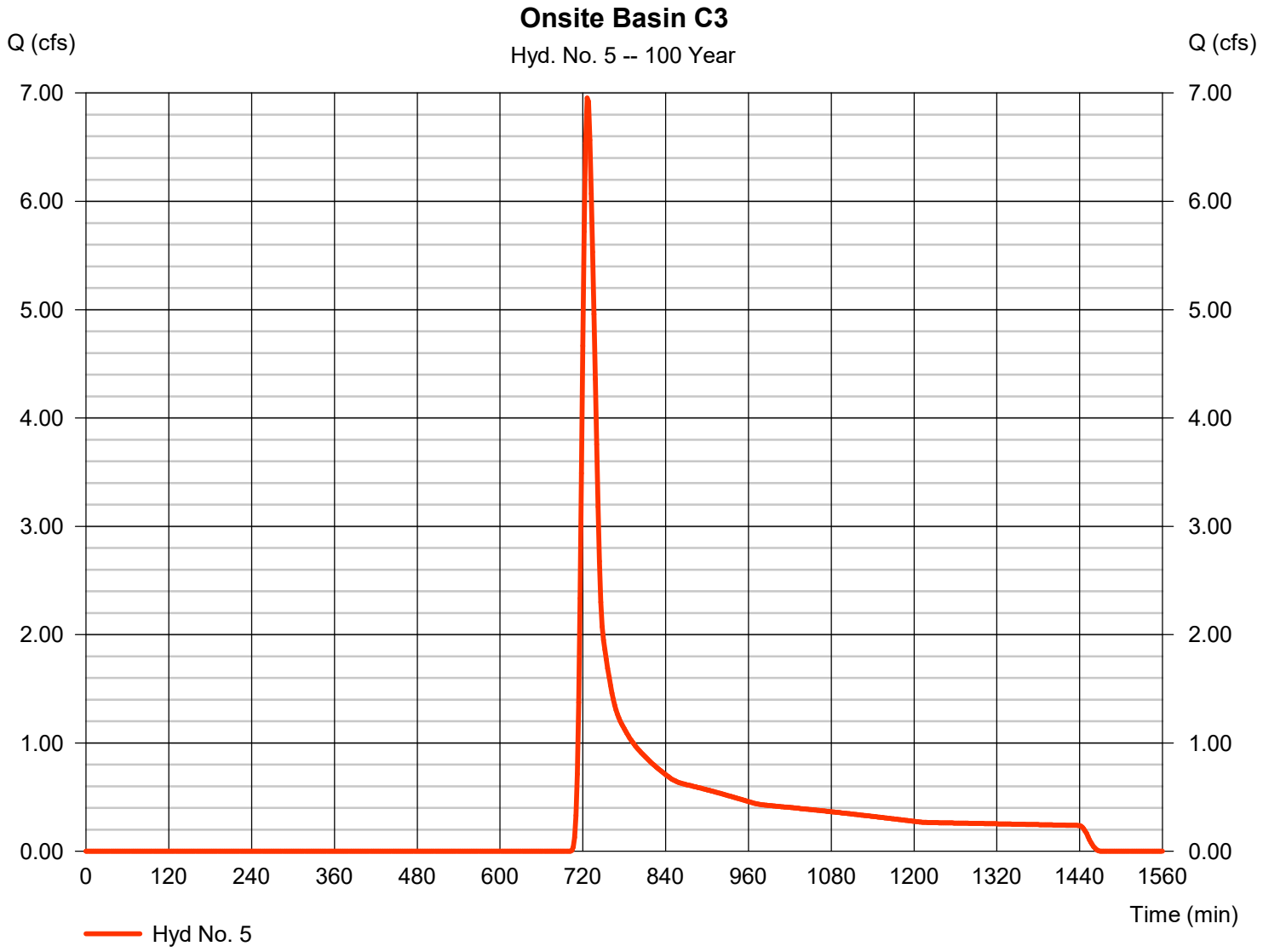
Hydrograph Report

Hyd. No. 5

Onsite Basin C3

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.953 cfs
Storm frequency	=	100 yrs	Time to peak	=	726 min
Time interval	=	2 min	Hyd. volume	=	28,745 cuft
Drainage area	=	9.990 ac	Curve number	=	55*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	16.90 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.297 x 98) + (0.716 x 76) + (0.036 x 85) + (0.337 x 98) + (7.720 x 49) + (0.887 x 61)] / 9.990



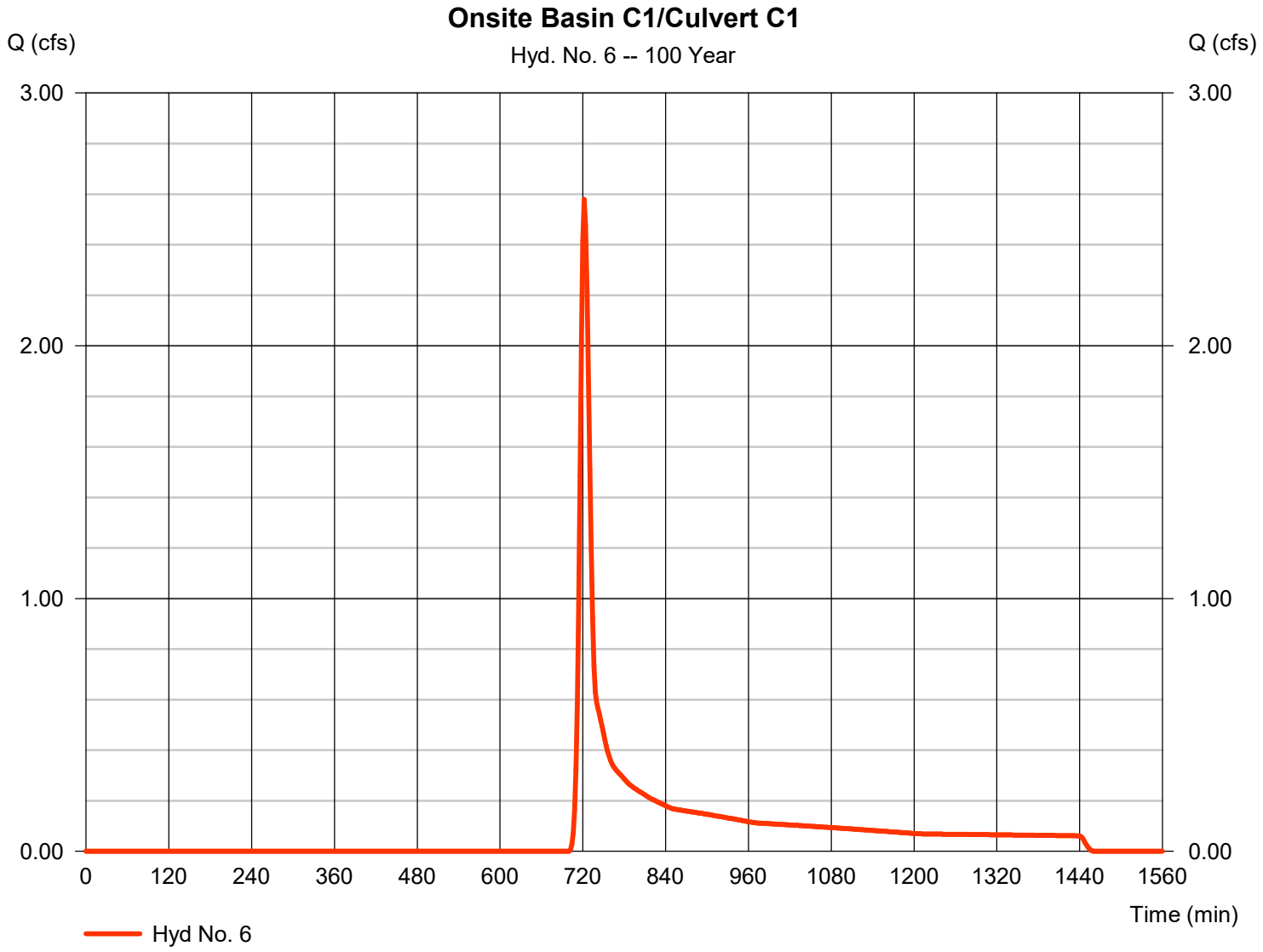
Hydrograph Report

Hyd. No. 6

Onsite Basin C1/Culvert C1

Hydrograph type	=	SCS Runoff	Peak discharge	=	2.579 cfs
Storm frequency	=	100 yrs	Time to peak	=	722 min
Time interval	=	2 min	Hyd. volume	=	7,811 cuft
Drainage area	=	2.310 ac	Curve number	=	57*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	34.06 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.145 x 85) + (1.131 x 49) + (1.033 x 61)] / 2.310



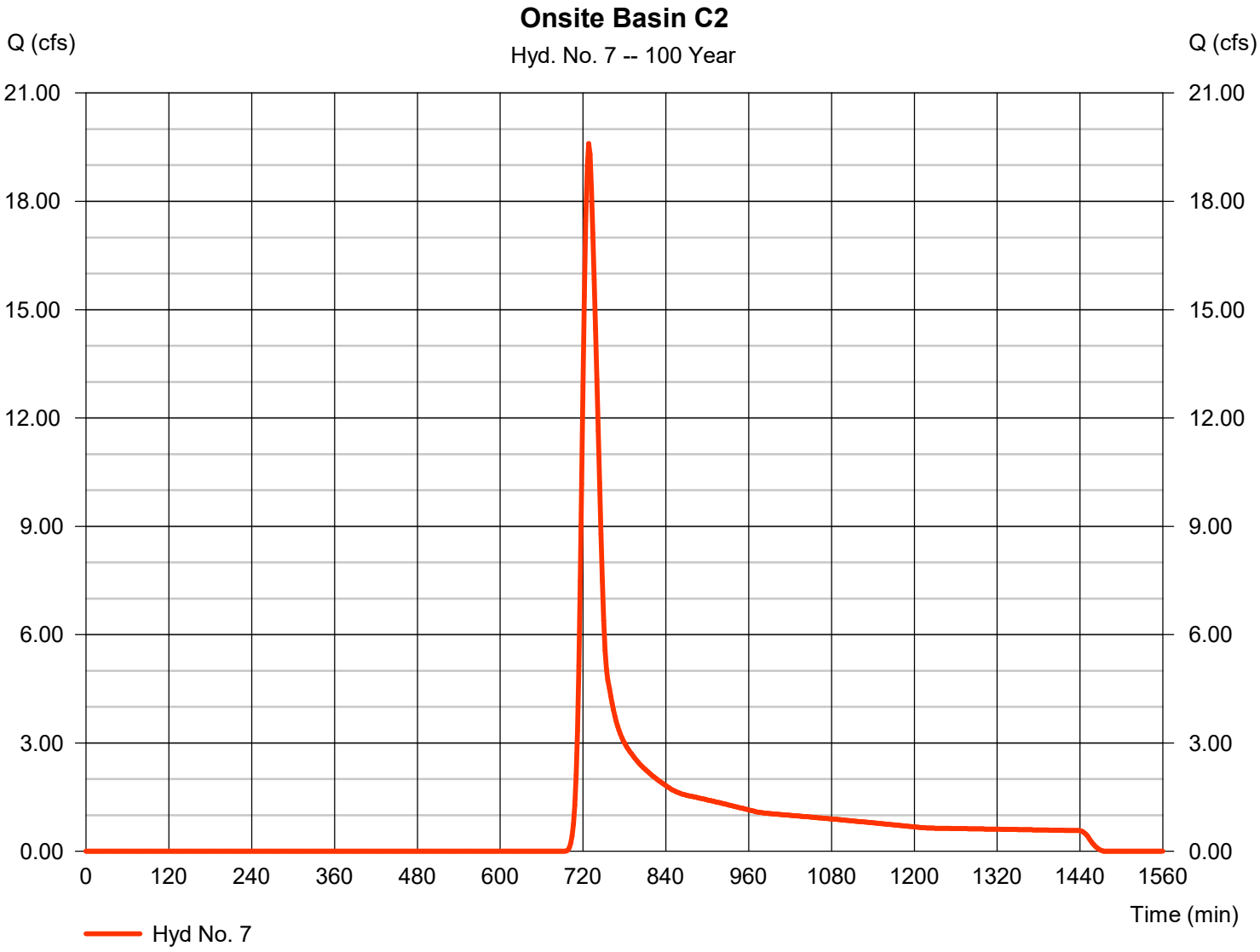
Hydrograph Report

Hyd. No. 7

Onsite Basin C2

Hydrograph type	=	SCS Runoff	Peak discharge	=	19.60 cfs
Storm frequency	=	100 yrs	Time to peak	=	728 min
Time interval	=	2 min	Hyd. volume	=	78,674 cuft
Drainage area	=	19.720 ac	Curve number	=	60*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	20.30 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.139 x 98) + (0.236 x 85) + (1.032 x 98) + (5.683 x 49) + (12.631 x 61)] / 19.720



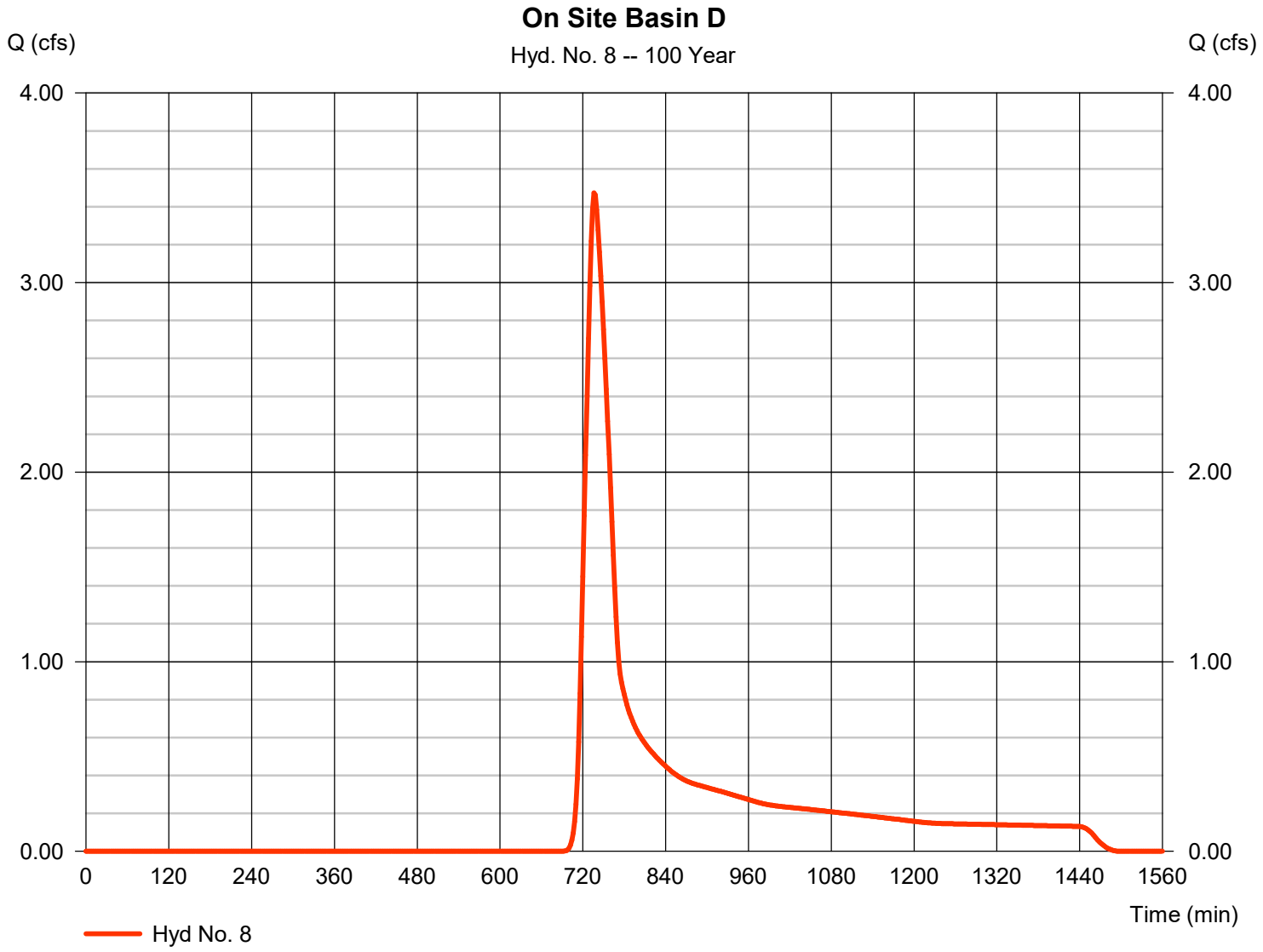
Hydrograph Report

Hyd. No. 8

On Site Basin D

Hydrograph type	=	SCS Runoff	Peak discharge	=	3.473 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	18,388 cuft
Drainage area	=	4.490 ac	Curve number	=	61*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	37.00 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.015 x 98) + (0.428 x 98) + (1.254 x 49) + (2.792 x 61)] / 4.490



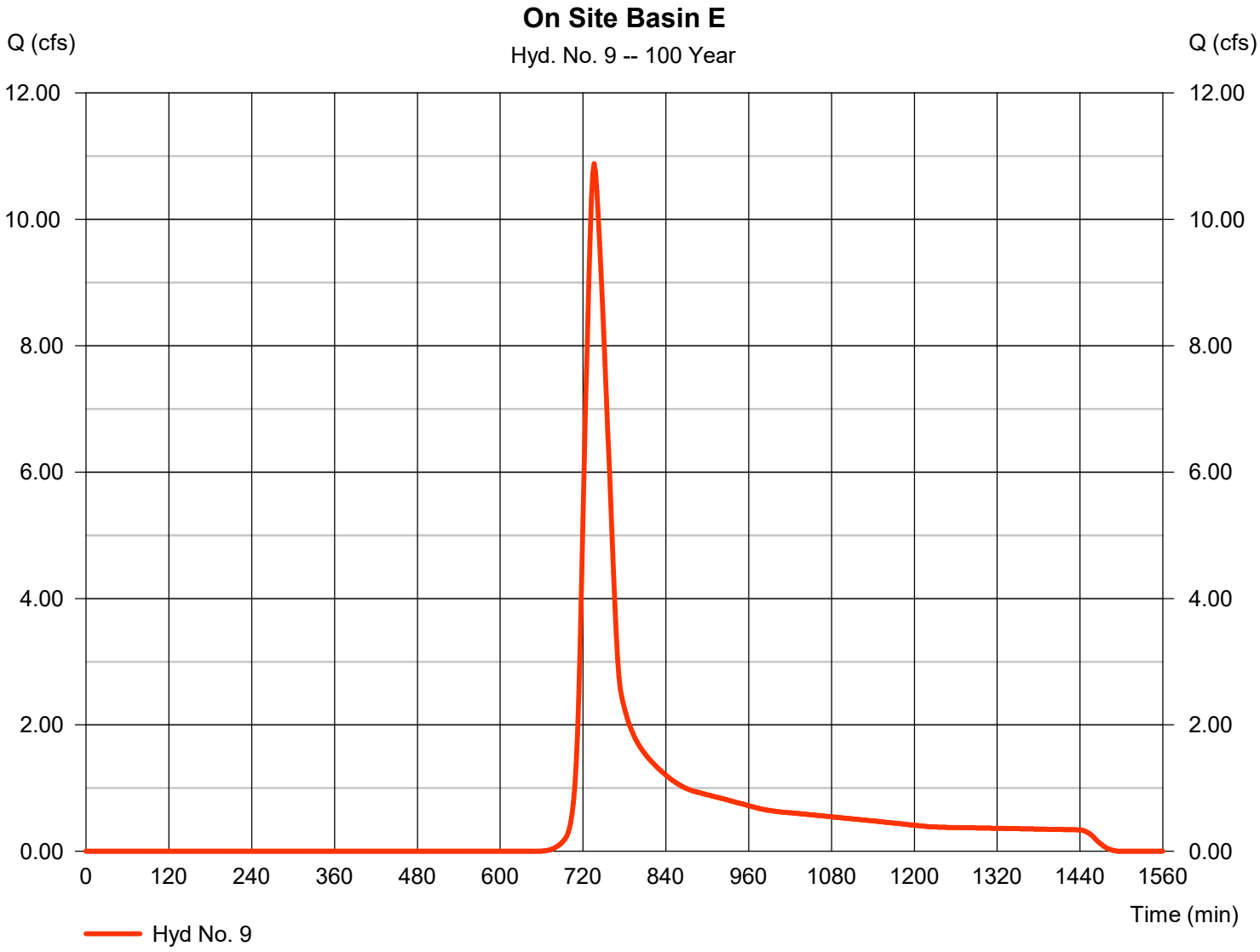
Hydrograph Report

Hyd. No. 9

On Site Basin E

Hydrograph type	= SCS Runoff	Peak discharge	= 10.88 cfs
Storm frequency	= 100 yrs	Time to peak	= 736 min
Time interval	= 2 min	Hyd. volume	= 53,144 cuft
Drainage area	= 10.090 ac	Curve number	= 66*
Basin Slope	= 0.0 %	Hydraulic length	= 0 ft
Tc method	= TR55	Time of conc. (Tc)	= 34.10 min
Total precip.	= 4.61 in	Distribution	= Type II
Storm duration	= 24 hrs	Shape factor	= 484

* Composite (Area/CN) = [(0.165 x 98) + (2.167 x 98) + (2.583 x 49) + (5.178 x 61)] / 10.090



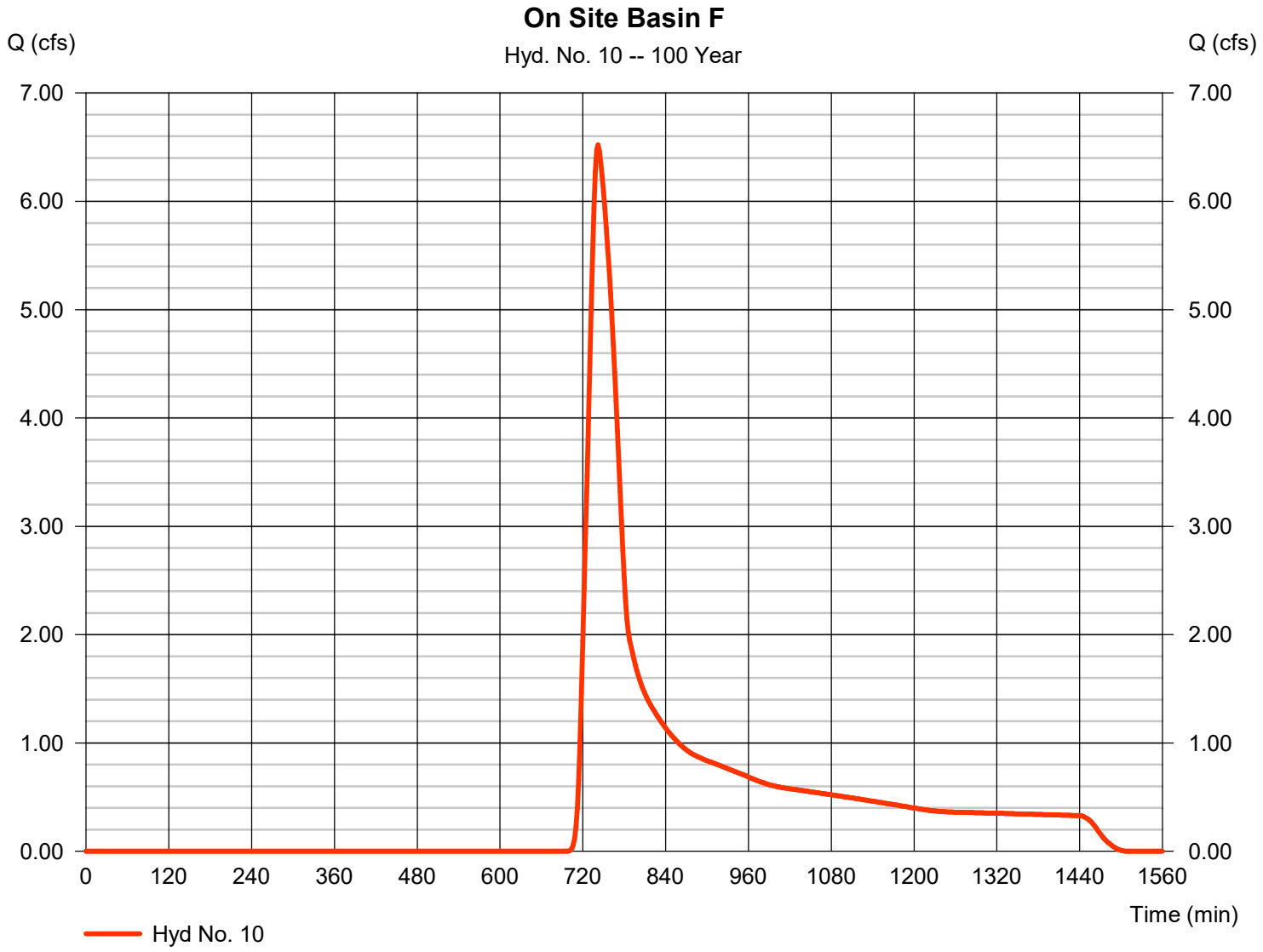
Hydrograph Report

Hyd. No. 10

On Site Basin F

Hydrograph type	=	SCS Runoff	Peak discharge	=	6.520 cfs
Storm frequency	=	100 yrs	Time to peak	=	742 min
Time interval	=	2 min	Hyd. volume	=	42,713 cuft
Drainage area	=	12.130 ac	Curve number	=	58*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	43.00 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.011 x 98) + (0.107 x 98) + (3.132 x 49) + (8.879 x 61)] / 12.130



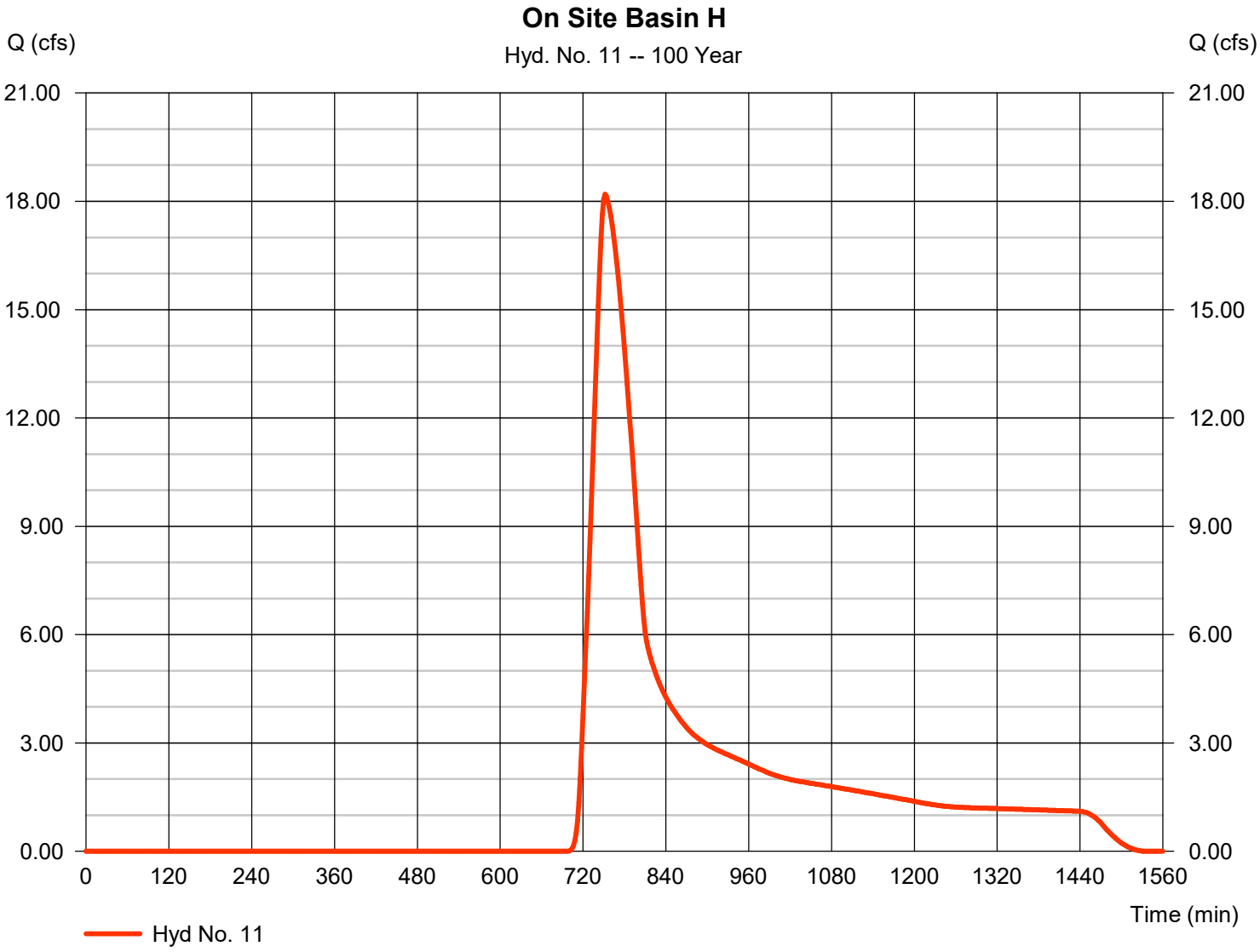
Hydrograph Report

Hyd. No. 11

On Site Basin H

Hydrograph type	=	SCS Runoff	Peak discharge	=	18.20 cfs
Storm frequency	=	100 yrs	Time to peak	=	752 min
Time interval	=	2 min	Hyd. volume	=	146,640 cuft
Drainage area	=	39.620 ac	Curve number	=	59*
Basin Slope	=	0.0 %	Hydraulic length	=	0 ft
Tc method	=	TR55	Time of conc. (Tc)	=	57.90 min
Total precip.	=	4.61 in	Distribution	=	Type II
Storm duration	=	24 hrs	Shape factor	=	484

* Composite (Area/CN) = [(0.132 x 85) + (8.377 x 49) + (31.111 x 61)] / 39.620

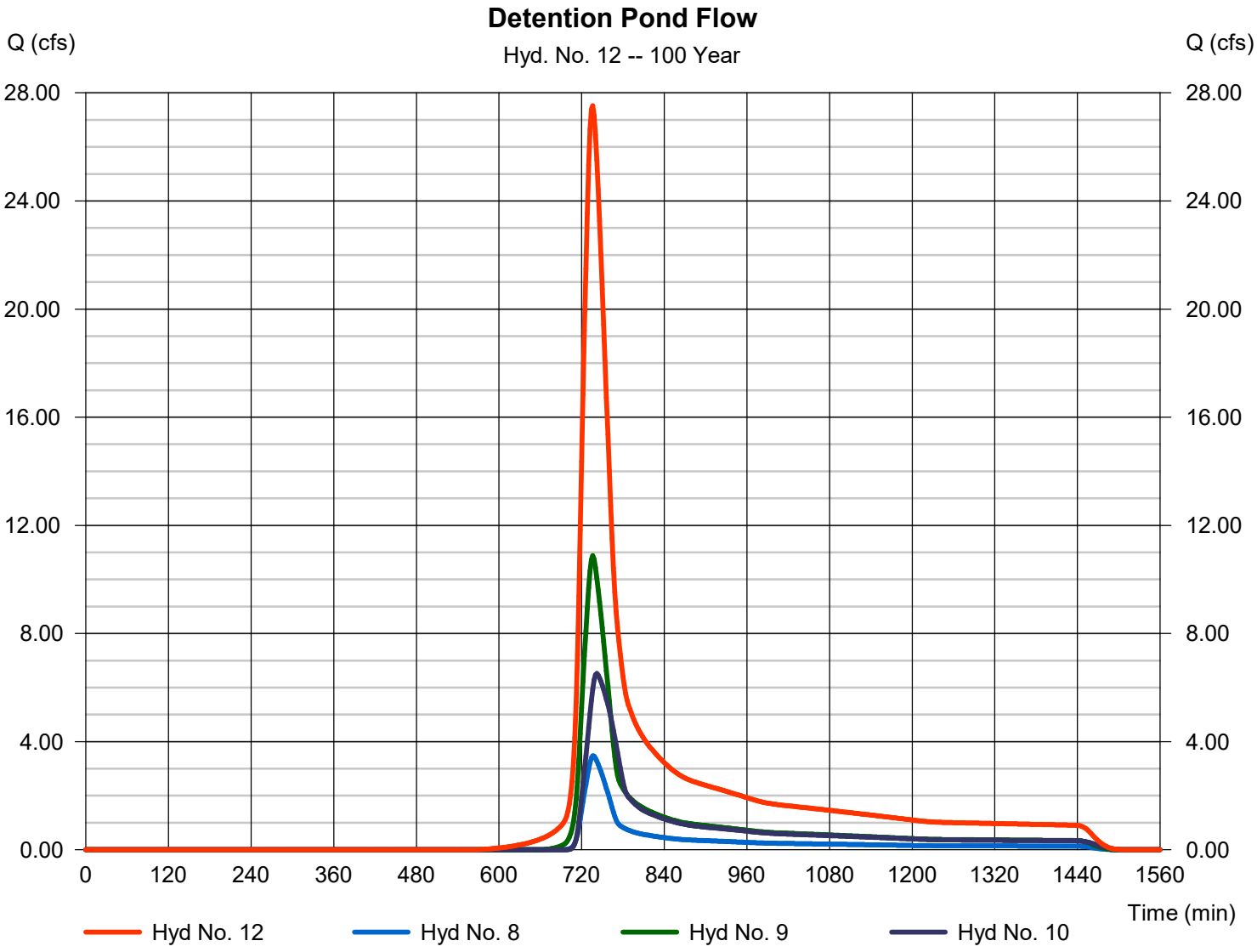


Hydrograph Report

Hyd. No. 12

Detention Pond Flow

Hydrograph type	=	Combine	Peak discharge	=	27.52 cfs
Storm frequency	=	100 yrs	Time to peak	=	736 min
Time interval	=	2 min	Hyd. volume	=	142,828 cuft
Inflow hyds.	=	8, 9, 10	Contrib. drain. area	=	26.710 ac

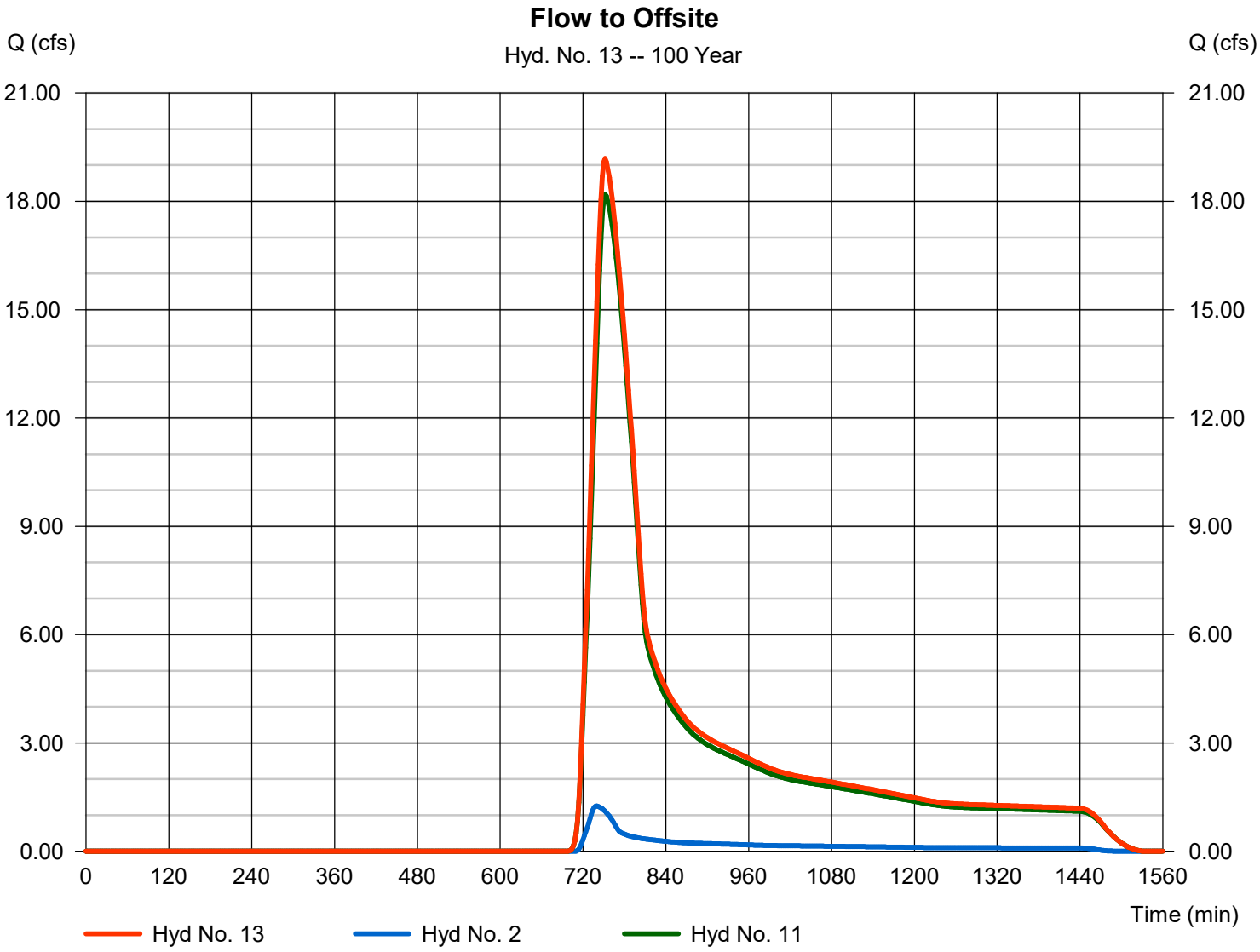


Hydrograph Report

Hyd. No. 13

Flow to Offsite

Hydrograph type	= Combine	Peak discharge	= 19.18 cfs
Storm frequency	= 100 yrs	Time to peak	= 752 min
Time interval	= 2 min	Hyd. volume	= 155,210 cuft
Inflow hyds.	= 2, 11	Contrib. drain. area	= 44.160 ac



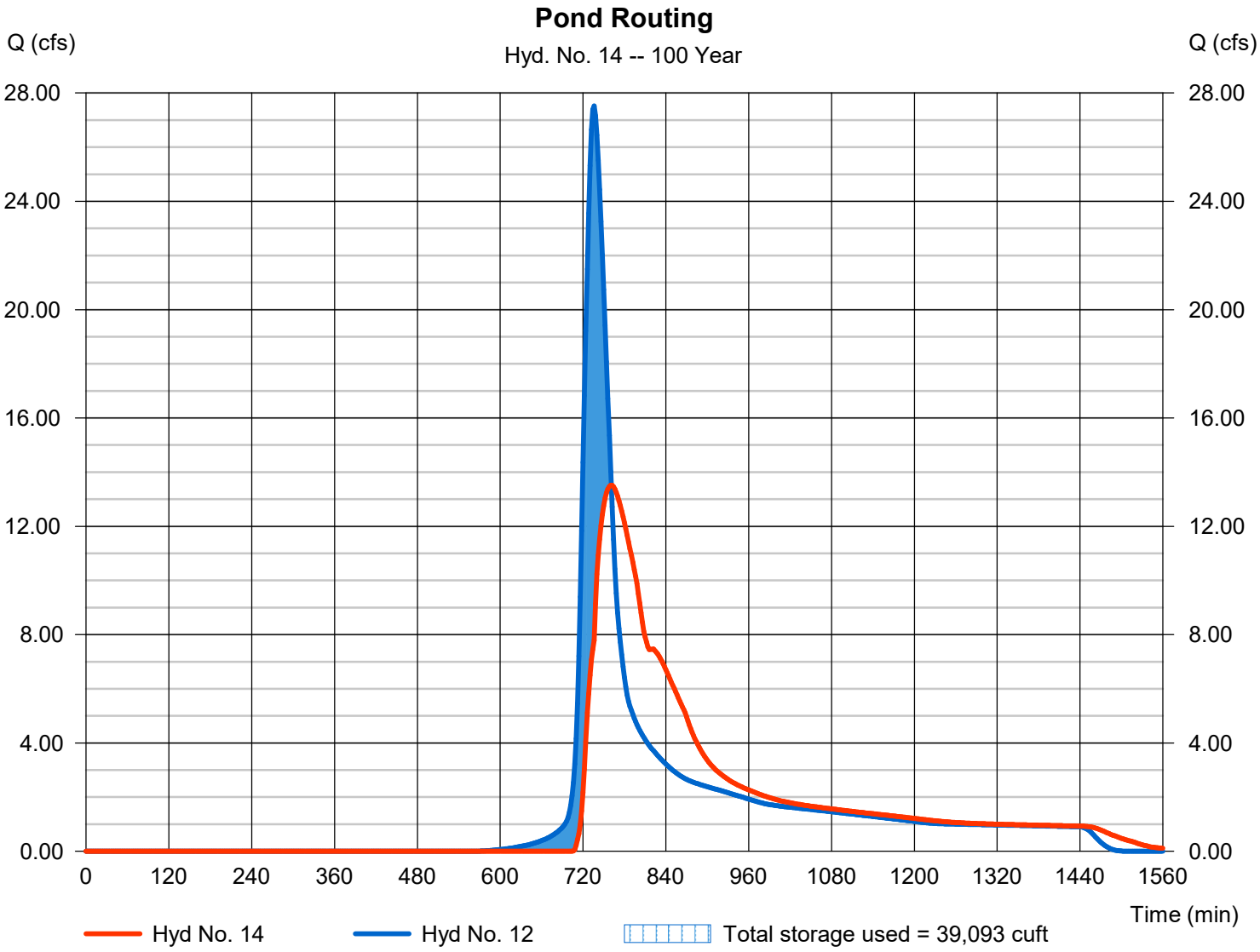
Hydrograph Report

Hyd. No. 14

Pond Routing

Hydrograph type	=	Reservoir	Peak discharge	=	13.52 cfs
Storm frequency	=	100 yrs	Time to peak	=	760 min
Time interval	=	2 min	Hyd. volume	=	139,871 cuft
Inflow hyd. No.	=	12 - Detention Pond Flow	Max. Elevation	=	5895.48 ft
Reservoir name	=	Pond 1	Max. Storage	=	39,093 cuft

Storage Indication method used.

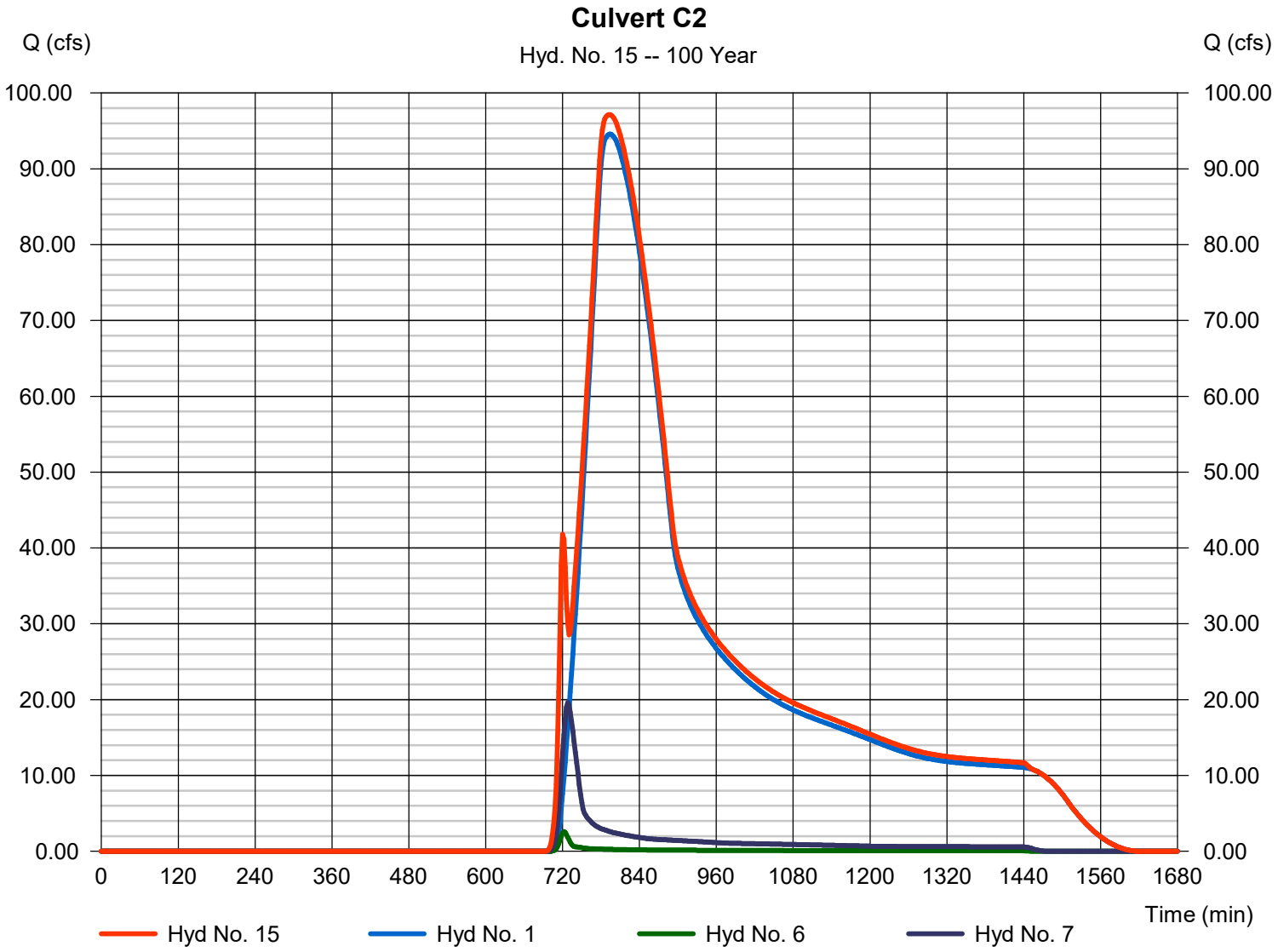


Hydrograph Report

Hyd. No. 15

Culvert C2

Hydrograph type	= Combine	Peak discharge	= 97.16 cfs
Storm frequency	= 100 yrs	Time to peak	= 794 min
Time interval	= 2 min	Hyd. volume	= 1,409,374 cuft
Inflow hyds.	= 1, 6, 7	Contrib. drain. area	= 451.000 ac

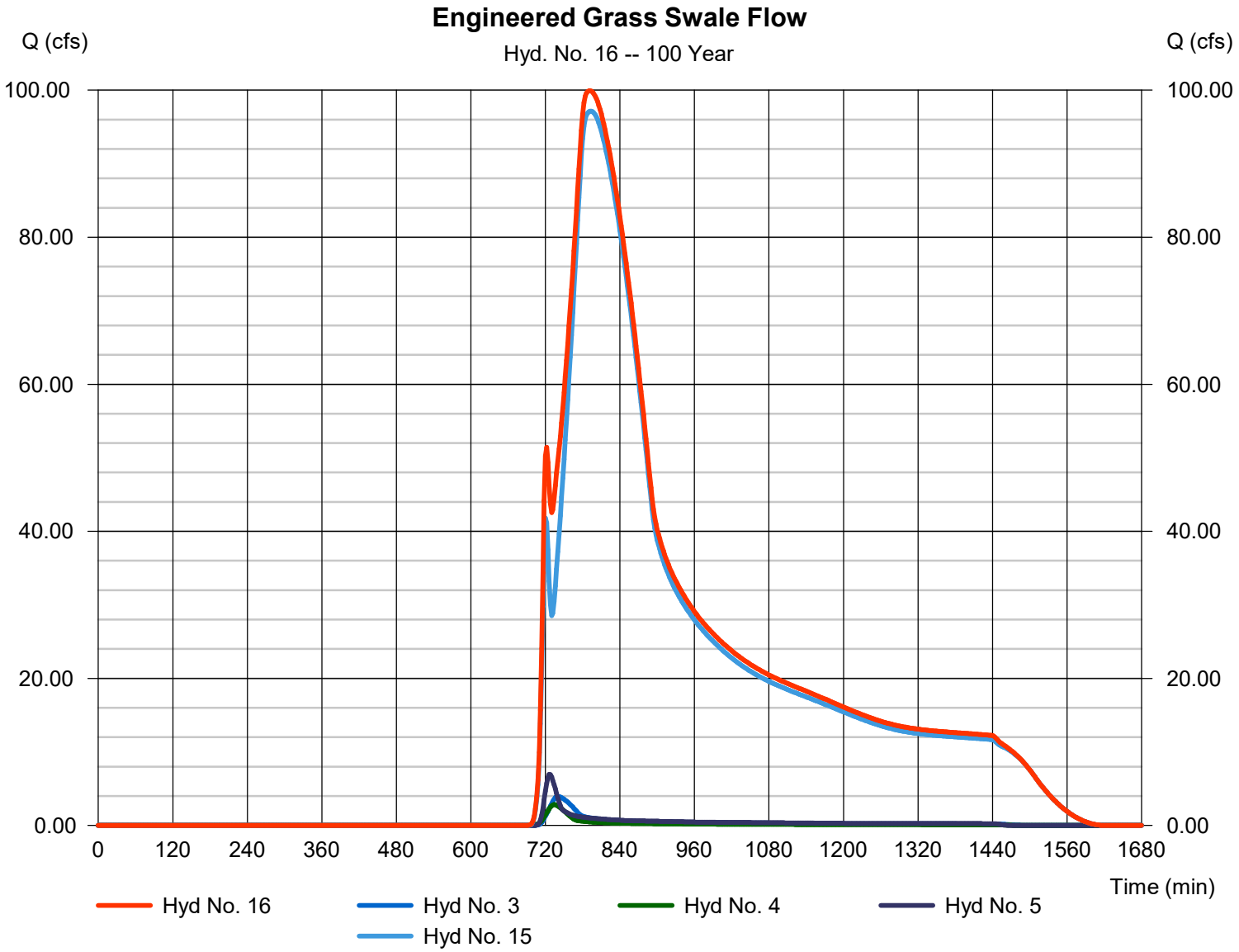


Hydrograph Report

Hyd. No. 16

Engineered Grass Swale Flow

Hydrograph type	= Combine	Peak discharge	= 99.92 cfs
Storm frequency	= 100 yrs	Time to peak	= 792 min
Time interval	= 2 min	Hyd. volume	= 1,485,079 cuft
Inflow hyds.	= 3, 4, 5, 15	Contrib. drain. area	= 20.400 ac

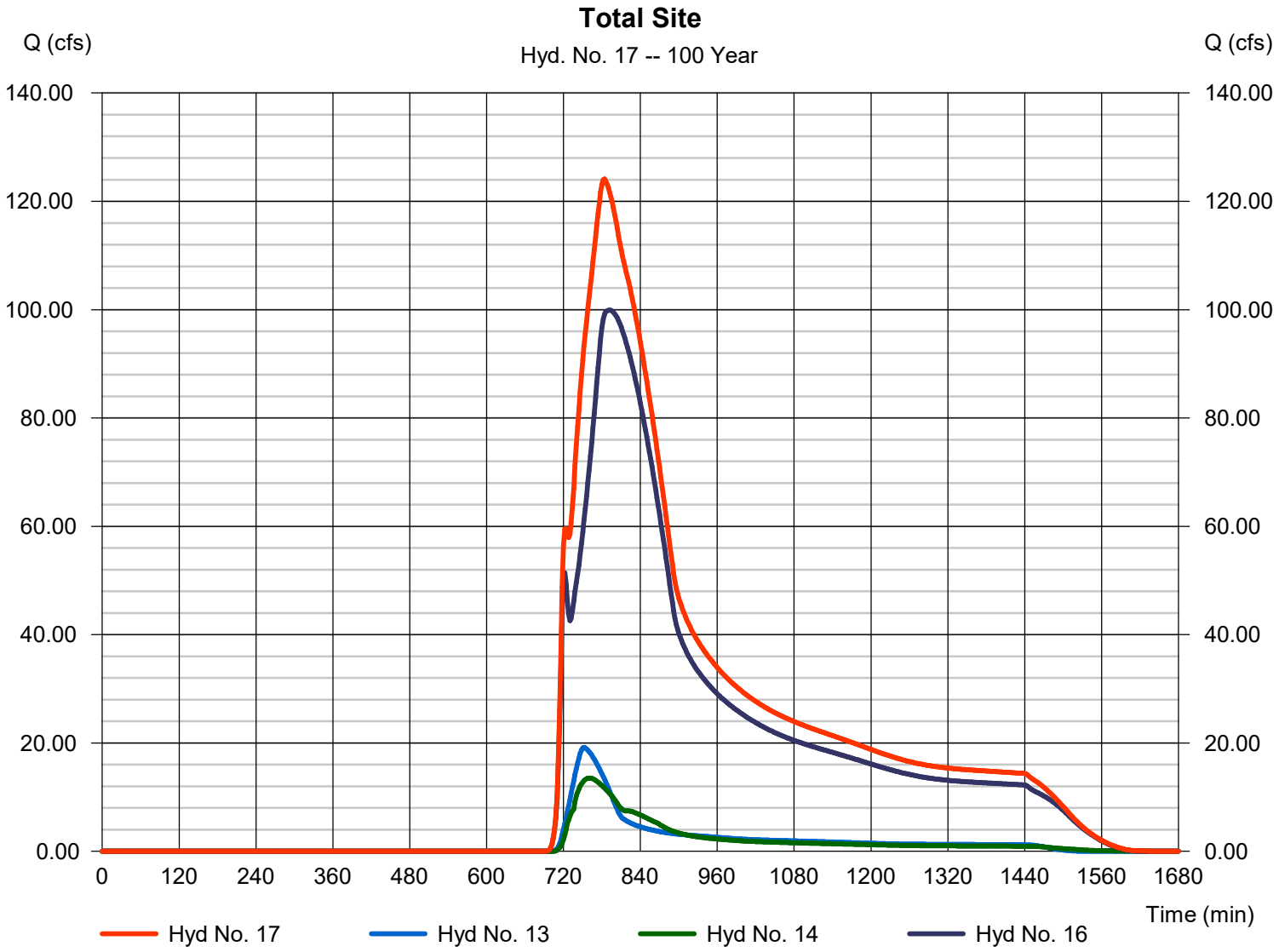


Hydrograph Report

Hyd. No. 17

Total Site

Hydrograph type	= Combine	Peak discharge	= 124.15 cfs
Storm frequency	= 100 yrs	Time to peak	= 784 min
Time interval	= 2 min	Hyd. volume	= 1,780,159 cuft
Inflow hyds.	= 13, 14, 16	Contrib. drain. area	= 0.000 ac



Hydraflow Rainfall Report

Return Period (Yrs)	Intensity-Duration-Frequency Equation Coefficients (FHA)			
	B	D	E	(N/A)
1	19.7890	7.4000	0.7561	--------
2	25.0946	7.6000	0.7677	--------
3	0.0000	0.0000	0.0000	--------
5	33.7537	7.7000	0.7745	--------
10	38.9252	7.4000	0.7625	--------
25	45.5828	6.9000	0.7450	--------
50	50.5681	6.6000	0.7309	--------
100	51.3489	5.7000	0.7003	--------

File name: Cherokee Rainfall.IDF

Intensity = B / (Tc + D)^E

Return Period (Yrs)	Intensity Values (in/hr)											
	5 min	10	15	20	25	30	35	40	45	50	55	60
1	2.95	2.28	1.89	1.62	1.43	1.28	1.16	1.07	0.99	0.93	0.87	0.82
2	3.59	2.78	2.29	1.97	1.73	1.55	1.41	1.29	1.20	1.12	1.05	0.99
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	4.71	3.65	3.01	2.58	2.27	2.03	1.84	1.69	1.57	1.46	1.37	1.29
10	5.71	4.41	3.64	3.12	2.74	2.46	2.24	2.05	1.90	1.77	1.67	1.57
25	7.20	5.55	4.57	3.92	3.46	3.10	2.82	2.59	2.40	2.25	2.11	1.99
50	8.43	6.49	5.35	4.60	4.05	3.64	3.31	3.05	2.83	2.65	2.49	2.35
100	9.77	7.47	6.15	5.29	4.67	4.20	3.83	3.53	3.29	3.08	2.90	2.74

Tc = time in minutes. Values may exceed 60.

Precip. file name: Z:\Clients\WTR\CherokeeMetr\119461_TDSReduce\Design\Civil\Stormwater\Cherokee Rainfall.pcp

Storm Distribution	Rainfall Precipitation Table (in)							
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
SCS 24-hour	0.00	1.77	0.00	2.24	2.69	0.00	0.00	4.61
SCS 6-Hr	0.00	1.46	0.00	1.89	2.30	0.00	0.00	4.13
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	1.20	0.00	1.57	1.91	0.00	0.00	3.37

APPENDIX E – HYDRAULIC CALCULATIONS

HYDRAULIC STRUCTURE CALCULATIONS

Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 5 2020

Engineered Grass Swale - Minimum Slope

Trapezoidal

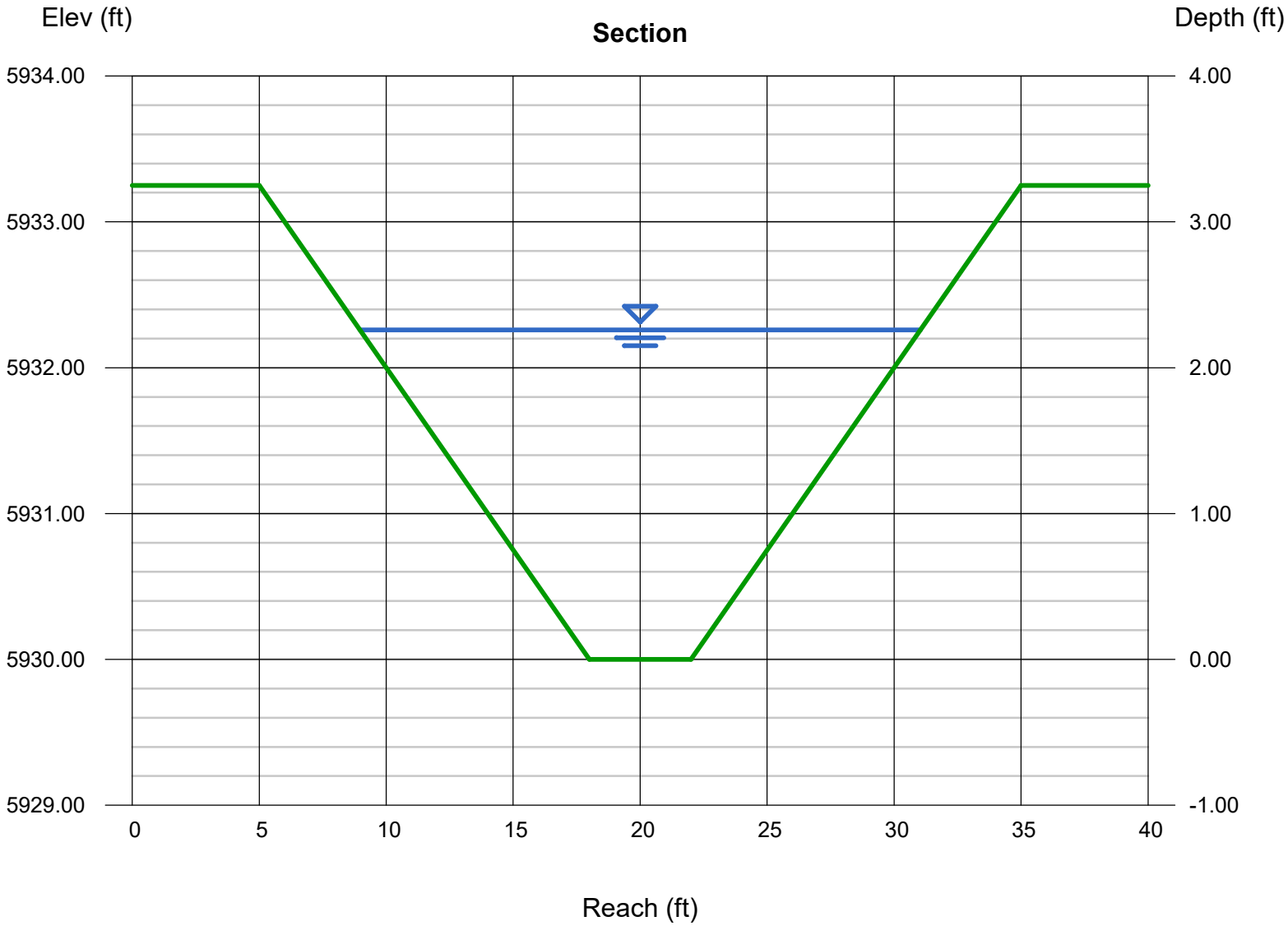
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.25
Invert Elev (ft)	= 5930.00
Slope (%)	= 0.25
N-Value	= 0.026

Calculations

Compute by:	Known Q
Known Q (cfs)	= 99.98

Highlighted

Depth (ft)	= 2.26
Q (cfs)	= 99.98
Area (sqft)	= 29.47
Velocity (ft/s)	= 3.39
Wetted Perim (ft)	= 22.64
Crit Depth, Yc (ft)	= 1.65
Top Width (ft)	= 22.08
EGL (ft)	= 2.44



Channel Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 5 2020

Engineered Grass Swale - Maximum Slope

Trapezoidal

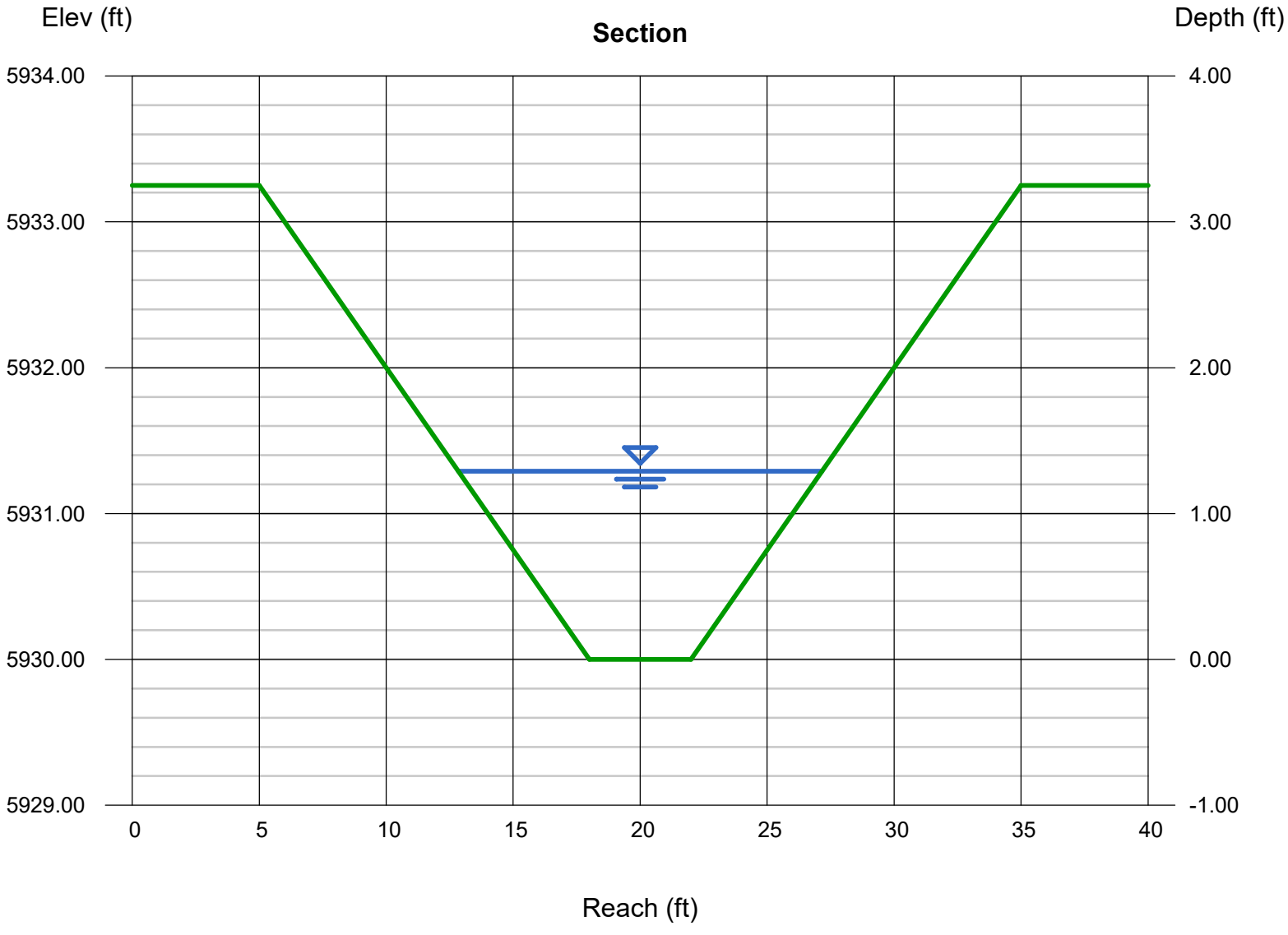
Bottom Width (ft)	= 4.00
Side Slopes (z:1)	= 4.00, 4.00
Total Depth (ft)	= 3.25
Invert Elev (ft)	= 5930.00
Slope (%)	= 3.00
N-Value	= 0.026

Calculations

Compute by:	Known Q
Known Q (cfs)	= 99.98

Highlighted

Depth (ft)	= 1.29
Q (cfs)	= 99.98
Area (sqft)	= 11.82
Velocity (ft/s)	= 8.46
Wetted Perim (ft)	= 14.64
Crit Depth, Yc (ft)	= 1.65
Top Width (ft)	= 14.32
EGL (ft)	= 2.40



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 5 2020

Culvert C1 - 10-Year Flow

Invert Elev Dn (ft)	=	5905.00
Pipe Length (ft)	=	69.00
Slope (%)	=	1.45
Invert Elev Up (ft)	=	5906.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

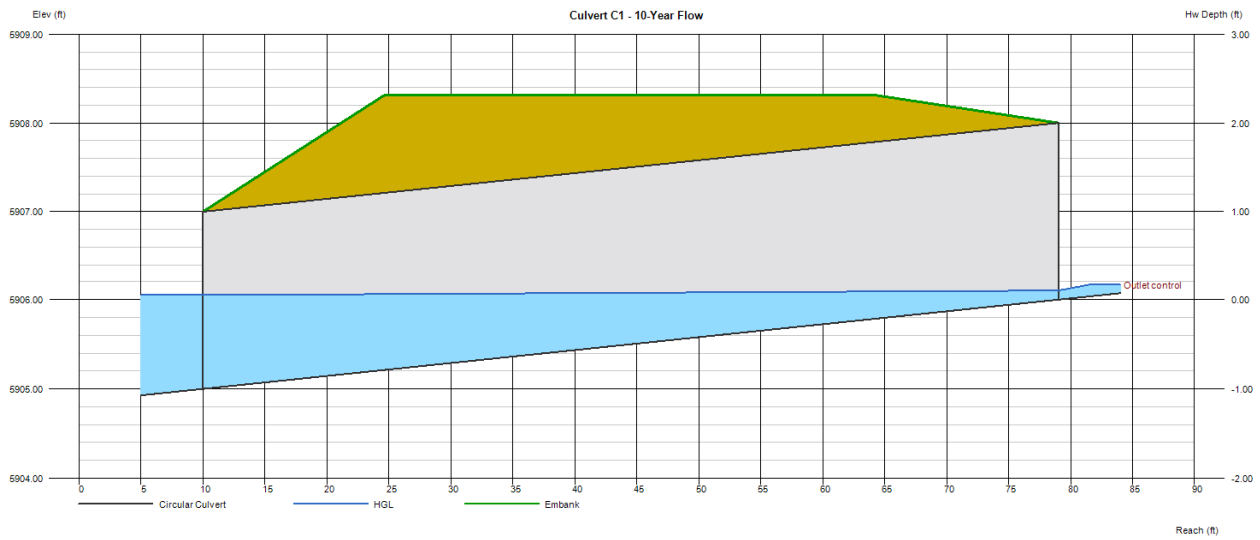
Top Elevation (ft)	=	5908.31
Top Width (ft)	=	39.77
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	0.09
Qmax (cfs)	=	1.28
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	0.09
Qpipe (cfs)	=	0.09
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	0.05
Veloc Up (ft/s)	=	1.49
HGL Dn (ft)	=	5906.05
HGL Up (ft)	=	5906.10
Hw Elev (ft)	=	5906.17
Hw/D (ft)	=	0.08
Flow Regime	=	Outlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 5 2020

Culvert C1 - 100-Year Flow

Invert Elev Dn (ft)	=	5905.00
Pipe Length (ft)	=	69.00
Slope (%)	=	1.45
Invert Elev Up (ft)	=	5906.00
Rise (in)	=	24.0
Shape	=	Circular
Span (in)	=	24.0
No. Barrels	=	1
n-Value	=	0.024
Culvert Type	=	Circular Corrugate Metal Pipe
Culvert Entrance	=	Projecting
Coeff. K,M,c,Y,k	=	0.034, 1.5, 0.0553, 0.54, 0.9

Embankment

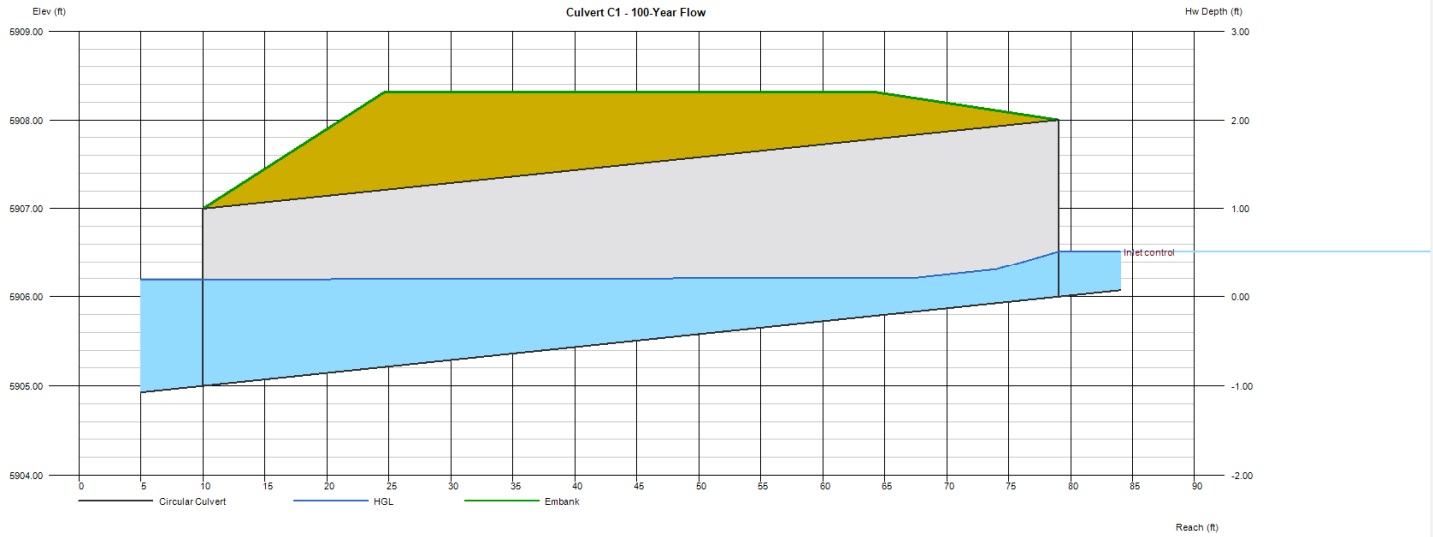
Top Elevation (ft)	=	5908.31
Top Width (ft)	=	39.77
Crest Width (ft)	=	0.00

Calculations

Qmin (cfs)	=	0.09
Qmax (cfs)	=	1.28
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	1.24
Qpipe (cfs)	=	1.24
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	0.64
Veloc Up (ft/s)	=	2.94
HGL Dn (ft)	=	5906.19
HGL Up (ft)	=	5906.38
Hw Elev (ft)	=	5906.51
Hw/D (ft)	=	0.26
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 5 2020

Culvert C2 - 10-Year Flow

Invert Elev Dn (ft)	=	5901.75
Pipe Length (ft)	=	50.00
Slope (%)	=	5.84
Invert Elev Up (ft)	=	5904.67
Rise (in)	=	42.0
Shape	=	Box
Span (in)	=	72.0
No. Barrels	=	1
n-Value	=	0.015
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

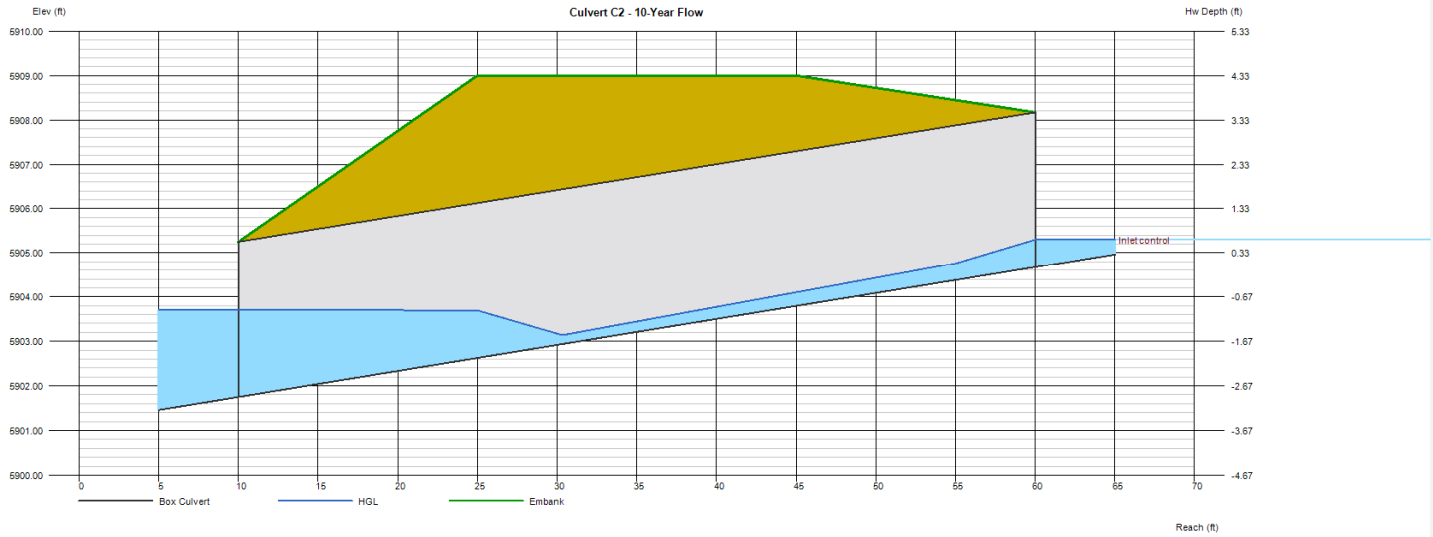
Top Elevation (ft)	=	5909.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	22.00

Calculations

Qmin (cfs)	=	9.13
Qmax (cfs)	=	97.48
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	9.13
Qpipe (cfs)	=	9.13
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	0.78
Veloc Up (ft/s)	=	3.65
HGL Dn (ft)	=	5903.71
HGL Up (ft)	=	5905.09
Hw Elev (ft)	=	5905.30
Hw/D (ft)	=	0.18
Flow Regime	=	Inlet Control



Culvert Report

Hydraflow Express Extension for Autodesk® Civil 3D® by Autodesk, Inc. Thursday, Nov 5 2020

Culvert C2 - 100-Year Flow

Invert Elev Dn (ft)	=	5901.75
Pipe Length (ft)	=	50.00
Slope (%)	=	5.84
Invert Elev Up (ft)	=	5904.67
Rise (in)	=	42.0
Shape	=	Box
Span (in)	=	72.0
No. Barrels	=	1
n-Value	=	0.015
Culvert Type	=	Rectagular Concrete
Culvert Entrance	=	Tapered inlet throat
Coeff. K,M,c,Y,k	=	0.475, 0.667, 0.0179, 0.97, 0.2

Embankment

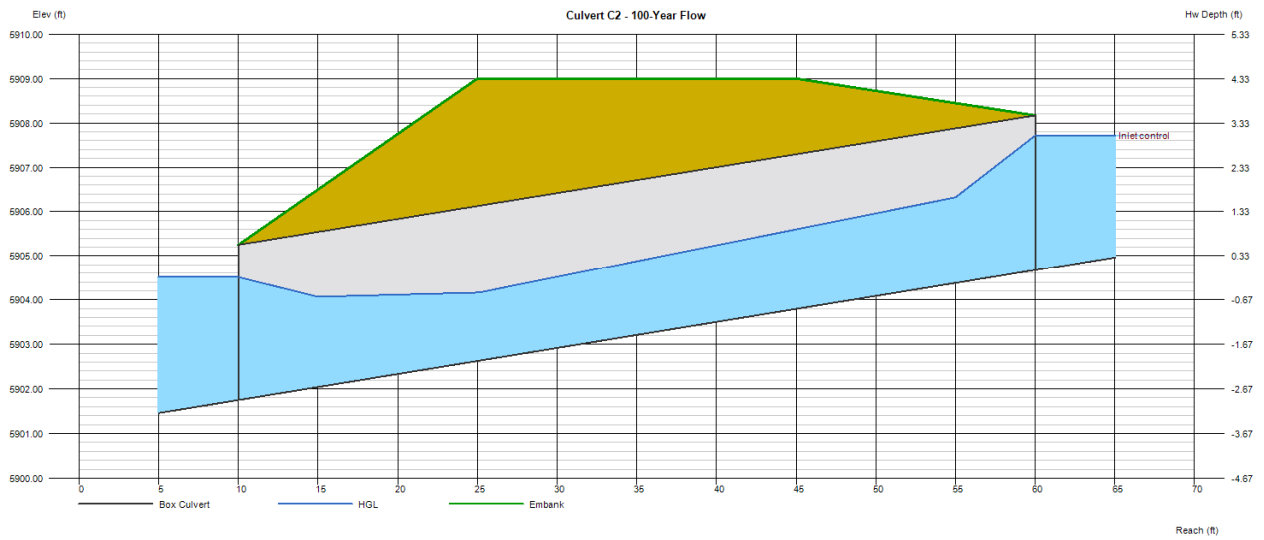
Top Elevation (ft)	=	5909.00
Top Width (ft)	=	20.00
Crest Width (ft)	=	22.00

Calculations

Qmin (cfs)	=	9.13
Qmax (cfs)	=	97.48
Tailwater Elev (ft)	=	(dc+D)/2

Highlighted

Qtotal (cfs)	=	97.33
Qpipe (cfs)	=	97.33
Qovertop (cfs)	=	0.00
Veloc Dn (ft/s)	=	5.88
Veloc Up (ft/s)	=	8.06
HGL Dn (ft)	=	5904.51
HGL Up (ft)	=	5906.68
Hw Elev (ft)	=	5907.72
Hw/D (ft)	=	0.87
Flow Regime	=	Inlet Control



Cheroke WRF TDS Reduction Facility
RIPRAP APRON CALCULATION

Calculation by: SJF date: 11/3/2020
Checked by: JLL date:

Riprap Size Calculation

				Reference
Peak Runoff for the 100-year, 24-hour event, Q	**Q =**	99.98	ft^3/s	
Channel Outlet Velocity, V	**V =**	3.39	ft/s	
Acceleration of Gravity, g	**g =**	32.2	ft/s^2	Federal Highway Administration HEC No. 14, Hydraulic Design of Energy Dissipators for Culverts and Channels, Appendix D
Riprap Specific Gravity, S	**S =**	2.5		
Minimum Riprap Size, D_{50}min	**D_{50min} =**	0.08	ft	

$$D_{50} = \frac{0.692}{S-1}\left(\frac{V^2}{2g}\right)$$

Design Riprap Size, D_{50}	**d_m =**	1	ft	
		12	in	
Check, $D_{50} > D_{50min}$		OK		

Apron Size Calculation

				Reference
Channel Depth, D	**D =**	3.25	ft	Federal Highway Administration HEC No. 14, Hydraulic Design of Energy Dissipators for Culverts and Channels, Table 10.1
Minimum Apron Length, $L_{min} = 5.5D$[1]	**L_{min} =**	17.88	ft	
Minimum Apron Depth, $D_{Amin} = 2.3D_{50}$	**D_{Amin} =**	27.60	in	
Design Apron Length, L	**L =**	30.00	ft	
Design Apron Depth, D_A	**D_A =**	28.00	in	
Check, $L > L_{min}$		OK		
Check, $D_A > D_{Amin}$		OK		

Notes:
1. Culvert rise replaced with channel depth

Table 10.1. Example Riprap Classes and Apron Dimensions

Class	D_{50} (mm)	D_{50} (in)	Apron Length[1]	Apron Depth
1	125	5	4D	$3.5D_{50}$
2	150	6	4D	$3.3D_{50}$
3	250	10	5D	$2.4D_{50}$
4	350	14	6D	$2.2D_{50}$
5	500	20	7D	$2.0D_{50}$
6	550	22	8D	$2.0D_{50}$

[1]D is the culvert rise.

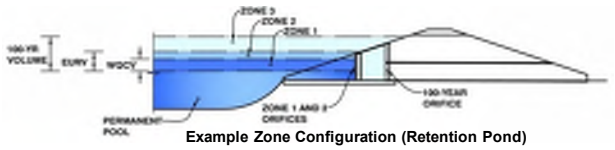
DETENTION POND CALCULATIONS

DETENTION BASIN STAGE-STORAGE TABLE BUILDER

MHFD-Detention, Version 4.03 (May 2020)

Project: **Cherokee TDS Reduction Facility**

Basin ID: **Stormwater Detention Pond**



Example Zone Configuration (Retention Pond)

Watershed Information

Selected BMP Type =	**EDB**	
Watershed Area =	26.71	acres
Watershed Length =	2,482	ft
Watershed Length to Centroid =	1,241	ft
Watershed Slope =	0.015	ft/ft
Watershed Imperviousness =	12.40%	percent
Percentage Hydrologic Soil Group A =	31.9%	percent
Percentage Hydrologic Soil Group B =	68.1%	percent
Percentage Hydrologic Soil Groups C/D =	0.0%	percent
Target WQCV Drain Time =	40.0	hours
Location for 1-hr Rainfall Depths =	User Input	

After providing required inputs above including 1-hour rainfall depths, click 'Run CUHP' to generate runoff hydrographs using the embedded Colorado Urban Hydrograph Procedure.

			Optional User Overrides	
Water Quality Capture Volume (WQCV) =	0.178	acre-feet		acre-feet
Excess Urban Runoff Volume (EURV) =	0.298	acre-feet		acre-feet
2-yr Runoff Volume (P1 = 0.99 in.) =	0.160	acre-feet	0.99	inches
5-yr Runoff Volume (P1 = 1.29 in.) =	0.280	acre-feet	1.29	inches
10-yr Runoff Volume (P1 = 1.57 in.) =	0.646	acre-feet	1.57	inches
25-yr Runoff Volume (P1 = 1.99 in.) =	1.641	acre-feet	1.99	inches
50-yr Runoff Volume (P1 = 2.35 in.) =	2.370	acre-feet	2.35	inches
100-yr Runoff Volume (P1 = 2.74 in.) =	3.397	acre-feet	2.74	inches
500-yr Runoff Volume (P1 = 3.75 in.) =	5.599	acre-feet	3.75	inches
Approximate 2-yr Detention Volume =	0.159	acre-feet		
Approximate 5-yr Detention Volume =	0.245	acre-feet		
Approximate 10-yr Detention Volume =	0.449	acre-feet		
Approximate 25-yr Detention Volume =	0.670	acre-feet		
Approximate 50-yr Detention Volume =	0.769	acre-feet		
Approximate 100-yr Detention Volume =	1.062	acre-feet		

Define Zones and Basin Geometry

Zone 1 Volume (WQCV) =	0.178	acre-feet
Zone 2 Volume (EURV - Zone 1) =	0.120	acre-feet
Zone 3 Volume (100-year - Zones 1 & 2) =	0.764	acre-feet
Total Detention Basin Volume =	1.062	acre-feet
Initial Surcharge Volume (ISV) =	user	ft^3
Initial Surcharge Depth (ISD) =	user	ft
Total Available Detention Depth (H_{total}) =	user	ft
Depth of Trickle Channel (H_{TC}) =	user	ft
Slope of Trickle Channel (S_{TC}) =	user	ft/ft
Slopes of Main Basin Sides (S_{main}) =	user	H:V
Basin Length-to-Width Ratio ($R_{L/W}$) =	user	
Initial Surcharge Area (A_{ISV}) =	user	ft^2
Surcharge Volume Length (L_{ISV}) =	user	ft
Surcharge Volume Width (W_{ISV}) =	user	ft
Depth of Basin Floor (H_{FLOOR}) =	user	ft
Length of Basin Floor (L_{FLOOR}) =	user	ft
Width of Basin Floor (W_{FLOOR}) =	user	ft
Area of Basin Floor (A_{FLOOR}) =	user	ft^2
Volume of Basin Floor (V_{FLOOR}) =	user	ft^3
Depth of Main Basin (H_{MAIN}) =	user	ft
Length of Main Basin (L_{MAIN}) =	user	ft
Width of Main Basin (W_{MAIN}) =	user	ft
Area of Main Basin (A_{MAIN}) =	user	ft^2
Volume of Main Basin (V_{MAIN}) =	user	ft^3
Calculated Total Basin Volume (V_{total}) =	**user**	acre-feet

Depth Increment = ft

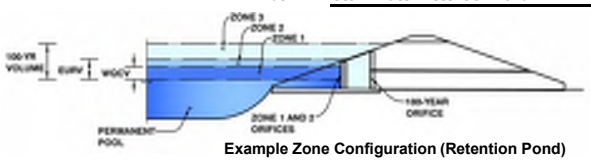
Stage - Storage Description	Stage (ft)	Optional Override Stage (ft)	Length (ft)	Width (ft)	Area (ft^2)	Optional Override Area (ft^2)	Area (acre)	Volume (ft^3)	Volume (ac-ft)
Top of Micropool	--	0.00	--	--	--	100	0.002		
5893	--	0.30	--	--	--	2,455	0.056	383	0.009
5894	--	1.30	--	--	--	13,792	0.317	8,507	0.195
5895	--	2.30	--	--	--	22,019	0.505	26,412	0.606
5896	--	3.30	--	--	--	30,994	0.712	52,919	1.215
5897	--	4.30	--	--	--	39,974	0.918	88,403	2.029
5898	--	5.30	--	--	--	57,088	1.311	136,934	3.144

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.03 (May 2020)

Project: **Cherokee TDS Reduction Facility**

Basin ID: **Stormwater Detention Pond**



Example Zone Configuration (Retention Pond)

	Estimated Stage (ft)	Estimated Volume (ac-ft)	Outlet Type
Zone 1 (WQCV)	1.25	0.178	Orifice Plate
Zone 2 (EURV)	1.60	0.120	Circular Orifice
Zone 3 (100-year)	3.08	0.764	Weir&Pipe (Circular)
Total (all zones)		1.062	

User Input: Orifice at Underdrain Outlet (typically used to drain WQCV in a Filtration BMP)

Underdrain Orifice Invert Depth = [ ] ft (distance below the filtration media surface)

Underdrain Orifice Diameter = [ ] inches

Calculated Parameters for Underdrain

Underdrain Orifice Area = [ ] ft^2

Underdrain Orifice Centroid = [ ] feet

User Input: Orifice Plate with one or more orifices or Elliptical Slot Weir (typically used to drain WQCV and/or EURV in a sedimentation BMP)

Invert of Lowest Orifice = 0.00 ft (relative to basin bottom at Stage = 0 ft)

Depth at top of Zone using Orifice Plate = 1.30 ft (relative to basin bottom at Stage = 0 ft)

Orifice Plate: Orifice Vertical Spacing = N/A inches

Orifice Plate: Orifice Area per Row = 1.40 sq. inches (diameter = 1-5/16 inches)

Calculated Parameters for Plate

WQ Orifice Area per Row = 9.722E-03 ft^2

Elliptical Half-Width = N/A feet

Elliptical Slot Centroid = N/A feet

Elliptical Slot Area = N/A ft^2

User Input: Stage and Total Area of Each Orifice Row (numbered from lowest to highest)

	Row 1 (required)	Row 2 (optional)	Row 3 (optional)	Row 4 (optional)	Row 5 (optional)	Row 6 (optional)	Row 7 (optional)	Row 8 (optional)
Stage of Orifice Centroid (ft)	0.00	0.75						
Orifice Area (sq. inches)	1.40	1.40						

	Row 9 (optional)	Row 10 (optional)	Row 11 (optional)	Row 12 (optional)	Row 13 (optional)	Row 14 (optional)	Row 15 (optional)	Row 16 (optional)
Stage of Orifice Centroid (ft)								
Orifice Area (sq. inches)								

User Input: Vertical Orifice (Circular or Rectangular)

	Zone 2 Circular	Not Selected	
Invert of Vertical Orifice =	1.30	N/A	ft (relative to basin bottom at Stage = 0 ft)
Depth at top of Zone using Vertical Orifice =	2.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Vertical Orifice Diameter =	4.50	N/A	inches

Calculated Parameters for Vertical Orifice

	Zone 2 Circular	Not Selected	
Vertical Orifice Area =	0.11	N/A	ft^2
Vertical Orifice Centroid =	0.19	N/A	feet

User Input: Overflow Weir (Dropbox with Flat or Sloped Grate and Outlet Pipe OR Rectangular/Trapezoidal Weir (and No Outlet Pipe)

	Zone 3 Weir	Not Selected	
Overflow Weir Front Edge Height, Ho =	2.20	N/A	ft (relative to basin bottom at Stage = 0 ft)
Overflow Weir Front Edge Length =	5.00	N/A	feet
Overflow Weir Grate Slope =	4.00	N/A	H:V
Horiz. Length of Weir Sides =	5.00	N/A	feet
Overflow Grate Open Area % =	70%	N/A	%, grate open area/total area
Debris Clogging % =	50%	N/A	%

Calculated Parameters for Overflow Weir

	Zone 3 Weir	Not Selected	
Height of Grate Upper Edge, H_t =	3.45	N/A	feet
Overflow Weir Slope Length =	5.15	N/A	feet
Grate Open Area / 100-yr Orifice Area =	23.75	N/A	
Overflow Grate Open Area w/o Debris =	18.04	N/A	ft^2
Overflow Grate Open Area w/ Debris =	9.02	N/A	ft^2

User Input: Outlet Pipe w/ Flow Restriction Plate (Circular Orifice, Restrictor Plate, or Rectangular Orifice)

	Zone 3 Circular	Not Selected	
Depth to Invert of Outlet Pipe =	0.00	N/A	ft (distance below basin bottom at Stage = 0 ft)
Circular Orifice Diameter =	11.80	N/A	inches

Calculated Parameters for Outlet Pipe w/ Flow Restriction Plate

	Zone 3 Circular	Not Selected	
Outlet Orifice Area =	0.76	N/A	ft^2
Outlet Orifice Centroid =	0.49	N/A	feet
Half-Central Angle of Restrictor Plate on Pipe =	N/A	N/A	radians

User Input: Emergency Spillway (Rectangular or Trapezoidal)

Spillway Invert Stage= 4.30 ft (relative to basin bottom at Stage = 0 ft)

Spillway Crest Length = 22.00 feet

Spillway End Slopes = 4.00 H:V

Freeboard above Max Water Surface = 0.50 feet

Calculated Parameters for Spillway

Spillway Design Flow Depth= 0.50 feet

Stage at Top of Freeboard = 5.30 feet

Basin Area at Top of Freeboard = 1.31 acres

Basin Volume at Top of Freeboard = 3.14 acre-ft

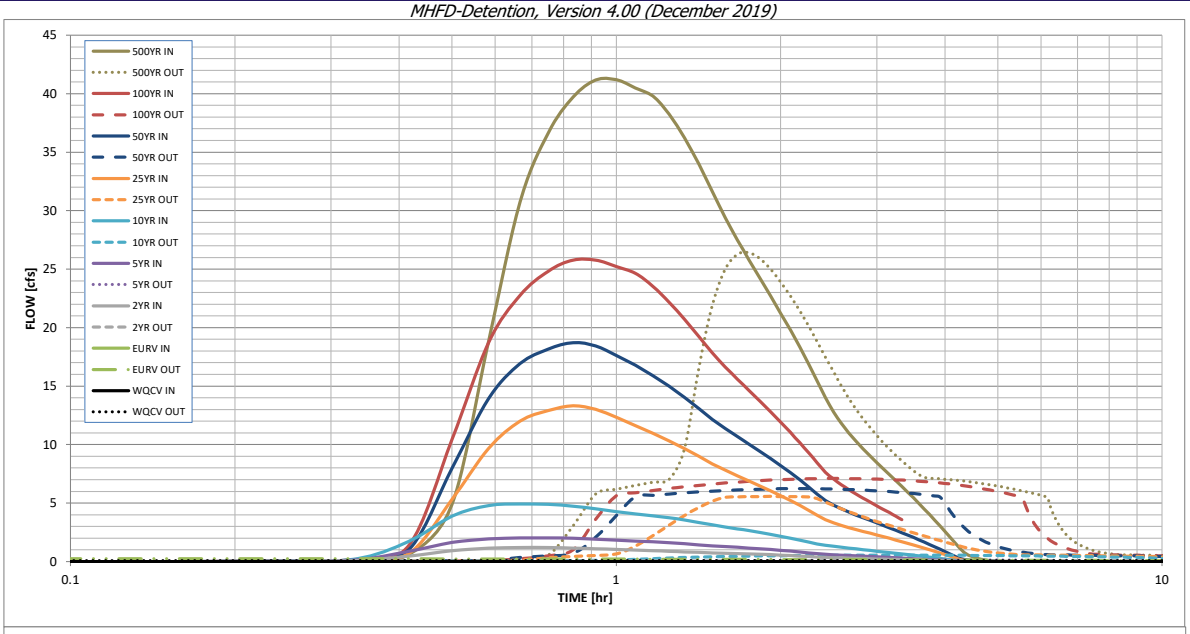
Routed Hydrograph Results

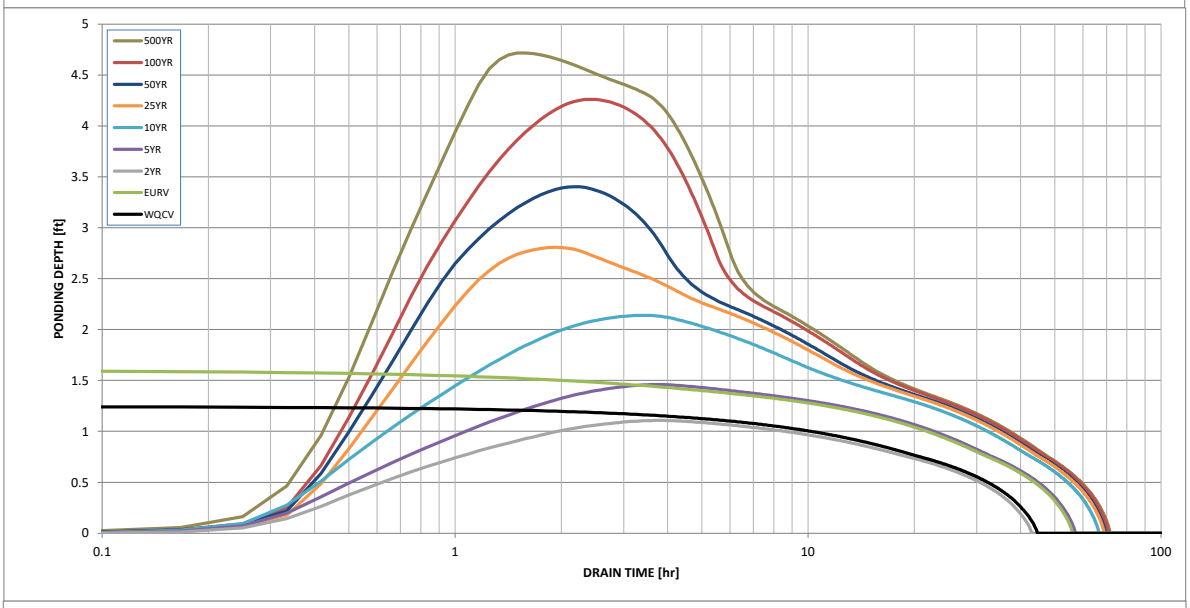
The user can override the default CUHP hydrographs and runoff volumes by entering new values in the Inflow Hydrographs table (Columns W through AF).

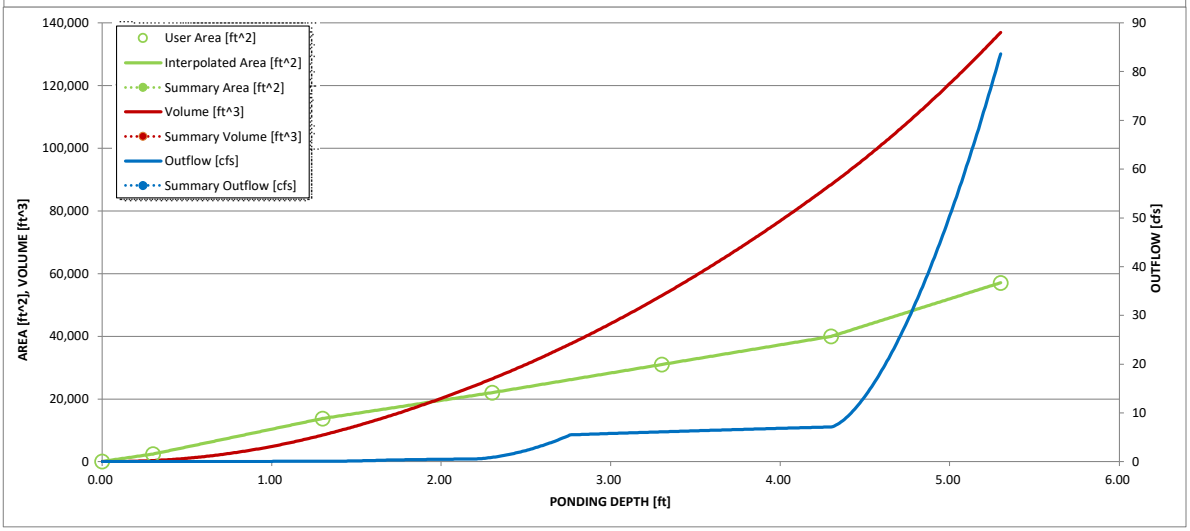
Design Storm Return Period =	WQCV	EURV	2 Year	5 Year	10 Year	25 Year	50 Year	100 Year	500 Year
One-Hour Rainfall Depth (in) =	N/A	N/A	0.99	1.29	1.57	1.99	2.35	2.74	3.75
CUHP Runoff Volume (acre-ft) =	0.178	0.298	0.160	0.280	0.646	1.641	2.370	3.397	5.599
Inflow Hydrograph Volume (acre-ft) =	N/A	N/A	0.160	0.280	0.646	1.641	2.370	3.397	5.599
CUHP Predevelopment Peak Q (cfs) =	N/A	N/A	0.2	0.4	3.1	11.3	16.5	23.6	38.7
OPTIONAL Override Predevelopment Peak Q (cfs) =	N/A	N/A							
Predevelopment Unit Peak Flow, q (cfs/acre) =	N/A	N/A	0.01	0.01	0.12	0.42	0.62	0.88	1.45
Peak Inflow Q (cfs) =	N/A	N/A	1.2	2.0	4.9	13.3	18.7	25.8	41.2
Peak Outflow Q (cfs) =	0.09	0.3	0.08	0.1	0.6	5.6	6.2	7.1	26.4
Ratio Peak Outflow to Predevelopment Q =	N/A	N/A	N/A	0.4	0.2	0.5	0.4	0.3	0.7
Structure Controlling Flow =	Plate	Vertical Orifice 1	Plate	Vertical Orifice 1	Vertical Orifice 1	Outlet Plate 1	Outlet Plate 1	Outlet Plate 1	Spillway
Max Velocity through Grate 1 (fps) =	N/A	N/A	N/A	N/A	N/A	0.3	0.3	0.3	0.4
Max Velocity through Grate 2 (fps) =	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Time to Drain 97% of Inflow Volume (hours) =	41	50	39	52	57	49	43	39	29
Time to Drain 99% of Inflow Volume (hours) =	**43**	54	41	55	62	60	58	56	49
Maximum Ponding Depth (ft) =	1.25	1.60	1.11	1.46	2.14	2.81	3.40	4.26	4.72
Area at Maximum Ponding Depth (acres) =	0.30	0.37	0.26	0.34	0.47	0.61	0.73	0.91	1.08
Maximum Volume Stored (acre-ft) =	0.180	0.299	0.137	0.245	0.523	0.885	1.287	1.993	2.439

DETENTION BASIN OUTLET STRUCTURE DESIGN

MHFD-Detention, Version 4.00 (December 2019)







Cherokee TDS Reduction Facility
FOREBAY CALCULATIONS

Calculation by: SJF Date: 2/26/2021
Checked by: MJL Date: 2/26/2021

Forebay Design

Percent of WQC Volume	**% =**	5%		See Attachment 1-1
WQCV	**WQCV =**	0.180	ac-ft	See UD Detention Sheet
Required Volume of Forebay, V_R = %WQCV	**V_R =**	0.01	ac-ft	
		392	cf	
Forebay Maximum Depth, d	**d =**	30	in	Attachment 2-1
Forebay Design Depth, d_f	**d_f =**	12	in	
Forebay Length, L	**L =**	35	ft	
Forebay Width, W	**W =**	12	ft	
Forebay Design Volume, V_F = L x W x (d_f/12)	**V_F =**	420	cf	
$d > d_f$		OK		
$V_F > V_R$		OK		

Forebay Rectangular Outlet Notch Design

Required Forebay Drain Time, t	**t =**	5	min	See Attachment 1-1
		300	sec	
Required Outlet Flow Rate, $Q_R = V_F / t$	**Q_R =**	1.40	cfs	
Notch Width, $W_N = Q_R/(3.33*(d_f/12)^{1.5})*12+0.2*d_f$	**W_N =**	7.45	in	

Extended Detention Basin (EDB)—Sedimentation Facility

Description

An extended detention basin (EDB) is a sedimentation basin designed to totally drain dry sometime after stormwater runoff ends. It is an adaptation of a detention basin used for flood control. The primary difference is in the outlet design. The EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. The EDB's drain time for the brim-full water quality capture volume (i.e., time to fully evacuate the design capture volume) of 40 hours is recommended to remove a significant portion of fine particulate pollutants found in urban stormwater runoff. Soluble pollutant removal can be somewhat enhanced by providing a small wetland marsh or ponding area in the basin's bottom to promote biological uptake. The basins are considered to be "dry" because they are designed not to have a significant permanent pool of water remaining between storm runoff events. However, EDB may develop wetland vegetation and sometimes shallow pools in the bottom portions of the facilities.

General Application

An EDB can be used to enhance stormwater runoff quality and reduce peak stormwater runoff rates. If these basins are constructed early in the development cycle, they can also be used to trap sediment from construction activities within the tributary drainage area. The accumulated sediment, however, will need to be removed after upstream land disturbances cease and before the basin is placed into final long-term use. Also, an EDB can sometimes be retrofitted into existing flood control detention basins.

EDBs can be used to improve the quality of urban runoff from roads, parking lots, residential neighborhoods, commercial areas, and industrial sites and are generally used for regional or

8. Dam Embankment	The embankment should be designed not to fail during a 100-year and larger storms. Embankment slopes should be no steeper than 3:1, preferably 4:1 or flatter, and planted with turf forming grasses. Poorly compacted native soils should be excavated and replaced. Embankment soils should be compacted to at least 95 percent of their maximum density according to ASTM D 698-70 (Modified Proctor). Spillway structures and overflows should be designed in accordance with the City of Colorado Springs and El Paso County Drainage Criteria Manual and should consider UDFCD drop-structure design guidelines.
9. Vegetation	Bottom vegetation provides erosion control and sediment entrapment. Pond bottom, berms, and side sloping areas may be planted with native grasses or with irrigated turf, depending on the local setting.
10. Access	All weather stable access to the bottom, forebay, and outlet works area shall be provided for maintenance vehicles. Maximum grades should be 10 percent with a solid driving surface of gravel, rock, or concrete.
11. Inlet	Dissipate flow energy at pond's inflow point(s) to limit erosion and promote particle sedimentation. Inlets should be designed in accordance with the City of Colorado Springs and El Paso County Drainage Criteria Manual's drop structure criteria or another type of energy dissipating structure.
12. Forebay Design	Provide the opportunity for larger particles to settle out in the inlet in an area that has a solid surface bottom to facilitate mechanical sediment removal. A rock berm should be constructed between the forebay and the main EDB. The forebay volume of the permanent pool should be 5 to 10 percent of the design water quality capture volume. A pipe throughout the berm to convey water the EDB should be offset from the inflow streamline to prevent short circuiting and should be sized to drain the forebay volume in 5 minutes.
13. Flood Storage	Combining the water quality facility with a flood control facility is recommended. The 10-year, 100-year, or other floods may be detained above the WQCV. See the *New Development Planning* section of this chapter for further guidance.
14. Multiple Uses	Whenever desirable and feasible, incorporate the EDB within a larger flood control basin. Also, whenever possible try to provide for other urban uses such as active or passive recreation, and wildlife habitat. If multiple uses are being contemplated, use the multiple-stage detention basin to limit inundation of passive recreational areas to one or two occurrences a year. Generally, the

Extended Detention Basin (EDB) T-5

Description

An extended detention basin (EDB) is a sedimentation basin designed to detain stormwater for many hours after storm runoff ends. This BMP is similar to a detention basin used for flood control, however; the EDB uses a much smaller outlet that extends the emptying time of the more frequently occurring runoff events to facilitate pollutant removal. The EDB's 40-hour drain time for the water quality capture volume (WQCV) is recommended to remove a significant portion of total suspended solids (TSS). Soluble pollutant removal is enhanced by providing a small wetland marsh or "micropool" at the outlet to promote biological uptake. The basins are sometimes called "dry ponds" because they are designed not to have a significant permanent pool of water remaining between storm runoff events.

Photograph EDB-1: This EDB includes a concrete trickle channel and a micropool with a concrete bottom and grouted boulder sideslopes. The vegetation growing in the sediment of the micropool adds to the natural look of this facility and ties into the surrounding landscape.

An extended detention basin can also be designed to provide Full Spectrum Detention. In this case, the EDB is sized for 100-year peak reduction and the excess urban runoff volume (EURV) is used instead of the WQCV. The EURV is designed with a drain time of approximately 72 hours. Widespread use of Full Spectrum Detention is anticipated to reduce impacts on major drainageways by reducing post-development peak discharges to better resemble pre-development peaks. Refer to the *Storage* chapter of Volume 2 for additional information on Full Spectrum Detention.

Site Selection

EDBs are well suited for watersheds with at least five impervious acres up to approximately one square mile of watershed. Smaller watersheds can result in an orifice size prone to clogging. Larger watersheds and watersheds with baseflows can complicate the design and reduce the level of treatment provided. EBDs are also well suited where flood detention is incorporated into the same basin.

Use the WQCV (or the EURV) when designing an EDB only for water quality. Use the EURV when incorporating water quality into a flood control facility.

Extended Detention Basin	
Functions	
LID/Volume Red.	Somewhat
WQCV Capture	Yes
WQCV+Flood Control	Yes
Fact Sheet Includes EURV Guidance	Yes
Typical Effectiveness for Targeted Pollutants[3]	
Sediment/Solids	Good
Nutrients	Moderate
Total Metals	Moderate
Bacteria	Poor
Other Considerations	
Life-cycle Costs[4]	Moderate

[3] Based primarily on data from the International Stormwater BMP Database (www.bmpdatabase.org).

[4] Based primarily on BMP-REALCOST available at www.udfcd.org. Analysis based on a single installation (not based on the maximum recommended watershed tributary to each BMP).

Table EDB-4. EDB Component Criteria

	On-Site EDBs for Watersheds up to 1 Impervious Acre[1]	EDBs with Watersheds up to 2 Impervious Acres[1]	EDBs with Watersheds up to 5 Impervious Acres	EDBs with Watersheds over 5 Impervious Acres	EDBs with Watersheds over 20 Impervious Acres
Forebay Release and Configuration	A forebay and trickle channel may not be necessary for this size site. Specific site operations should be considered to determine if a forebay will serve to reduce the maintenance requirements.	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch configuration	Release 2% of the undetained 100-year peak discharge by way of a wall/notch or berm/pipe[2] configuration
Minimum Forebay Volume		1% of the WQCV	2% of the WQCV	3% of the WQCV	3% of the WQCV
Maximum Forebay Depth		12 inches	18 inches	18 inches	30 inches
Trickle Channel Capacity		≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity	≥ the maximum possible forebay outlet capacity
Micropool	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2	Area ≥ 10 ft^2
Initial Surcharge Volume	Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 inches	Depth ≥ 4 in. Volume ≥ 0.3% WQCV	Depth ≥ 4 in. Volume ≥ 0.3% WQCV

[1] EDBs are not recommended for sites with less than 2 impervious acres. Consider a sand filter or rain garden.

[2] Round up to the first standard pipe size (minimum 8 inches).

Design Example

The *UD-BMP* workbook, designed as a tool for both designer and reviewing agency is available at www.udfcd.org. This section provides a completed design form from this workbook as an example.

HY-8 ANALYSIS

HY-8 Culvert Analysis Report

Crossing Discharge Data

Discharge Selection Method: Specify Minimum, Design, and Maximum Flow

Minimum Flow: 0 cfs

Design Flow: 100 cfs

Maximum Flow: 150 cfs

Site Data - EX. 12-inch CMP

Site Data Option: Culvert Invert Data

Inlet Station: -40.00 ft

Inlet Elevation: 5890.30 ft

Outlet Station: 40.00 ft

Outlet Elevation: 5889.50 ft

Number of Barrels: 1

Culvert Data Summary - EX. 12-inch CMP

Barrel Shape: Circular

Barrel Diameter: 1.00 ft

Barrel Material: Corrugated Steel

Embedment: 0.00 in

Barrel Manning's n: 0.0240

Culvert Type: Straight

Inlet Configuration: Thin Edge Projecting

Inlet Depression: None

Roadway Data for Crossing: Drennan Road Crossing

Roadway Profile Shape: Irregular Roadway Shape (coordinates)

Irregular Roadway Cross-Section:

Coord No.	Station (ft)	Elevation (ft)
0	0.00	5895.00
1	75.00	5894.00
2	188.00	5893.00
3	311.00	5892.35
4	552.00	5892.10
5	858.00	5892.20
6	988.00	5892.00
7	1074.00	5891.30
8	1155.00	5892.00
9	1227.00	5893.00
10	1322.00	5894.00
11	1394.00	5895.00

Roadway Surface: Gravel

Roadway Top Width: 30.00 ft

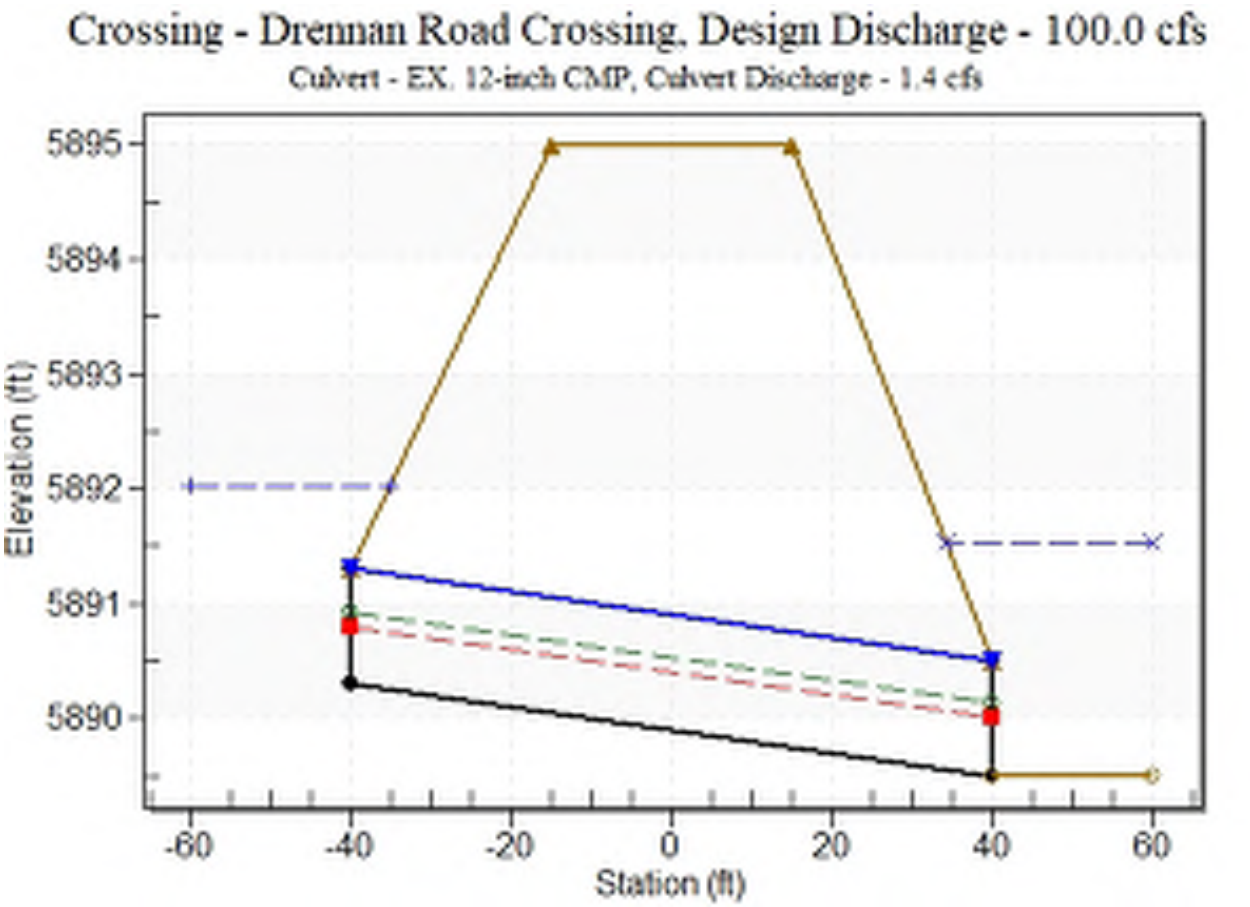
Table 1 - Downstream Channel Rating Curve (Crossing: Drennan Road Crossing)

Flow (cfs)	Water Surface Elev (ft)	Depth (ft)	Velocity (ft/s)	Shear (psf)	Froude Number
0.00	5889.50	0.00	0.00	0.00	0.00
15.00	5890.32	0.82	3.32	0.51	0.78
30.00	5890.66	1.16	4.00	0.72	0.81
45.00	5890.90	1.40	4.45	0.88	0.83
60.00	5891.10	1.60	4.80	1.00	0.85
75.00	5891.27	1.77	5.08	1.11	0.86
90.00	5891.43	1.93	5.32	1.20	0.87
100.00	5891.52	2.02	5.47	1.26	0.88
120.00	5891.69	2.19	5.73	1.37	0.89
135.00	5891.81	2.31	5.90	1.44	0.89
150.00	5891.92	2.42	6.06	1.51	0.90

Tailwater Channel Data - Drennan Road Crossing

Tailwater Channel Option: Trapezoidal Channel
Bottom Width: 3.00 ft
Side Slope (H:V): 3.00 (_:1)
Channel Slope: 0.0100
Channel Manning's n: 0.0300
Channel Invert Elevation: 5889.50 ft

Water Surface Profile Plot for Culvert: EX. 12-inch CMP



Crossing Front View (Roadway Profile): Drennan Road Crossing

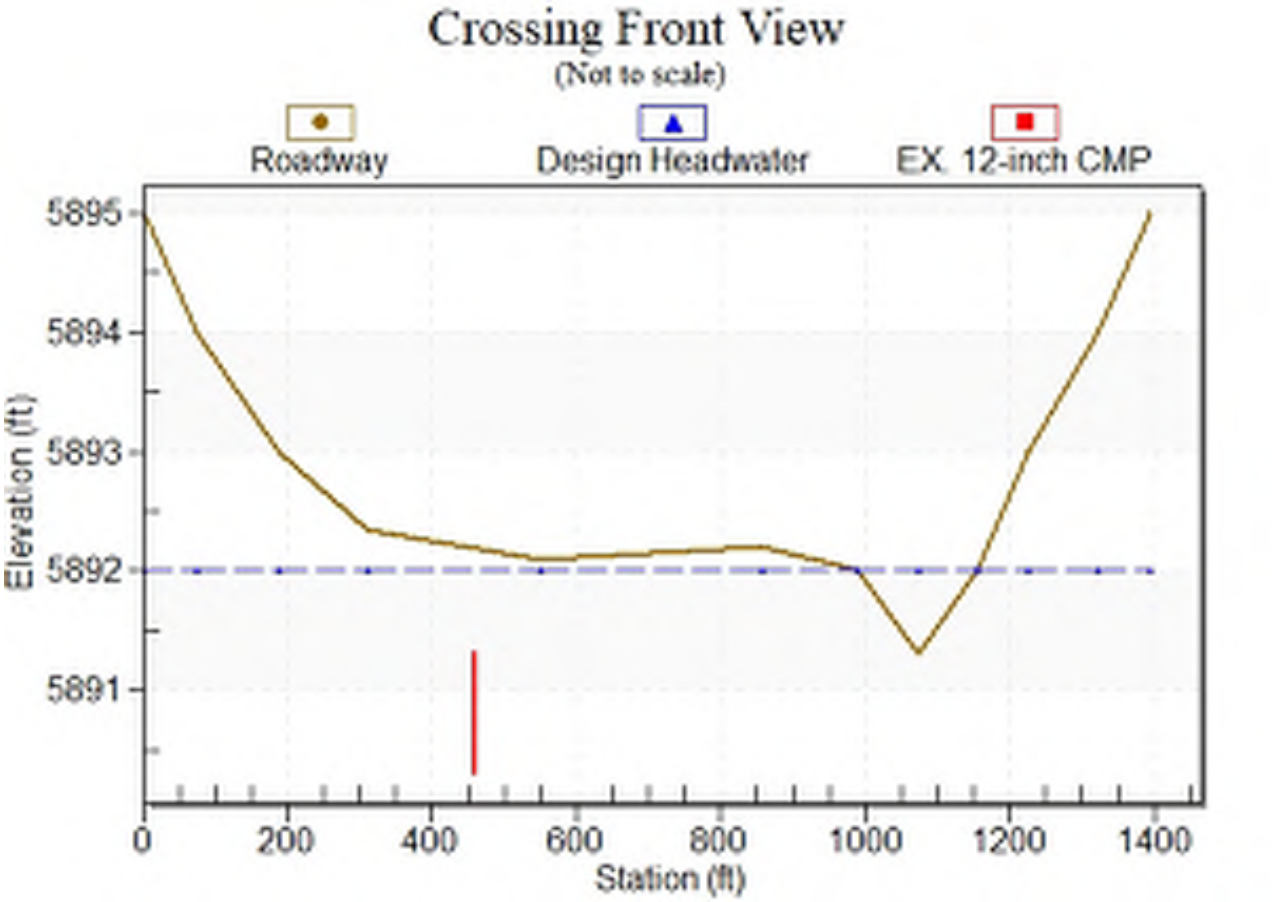


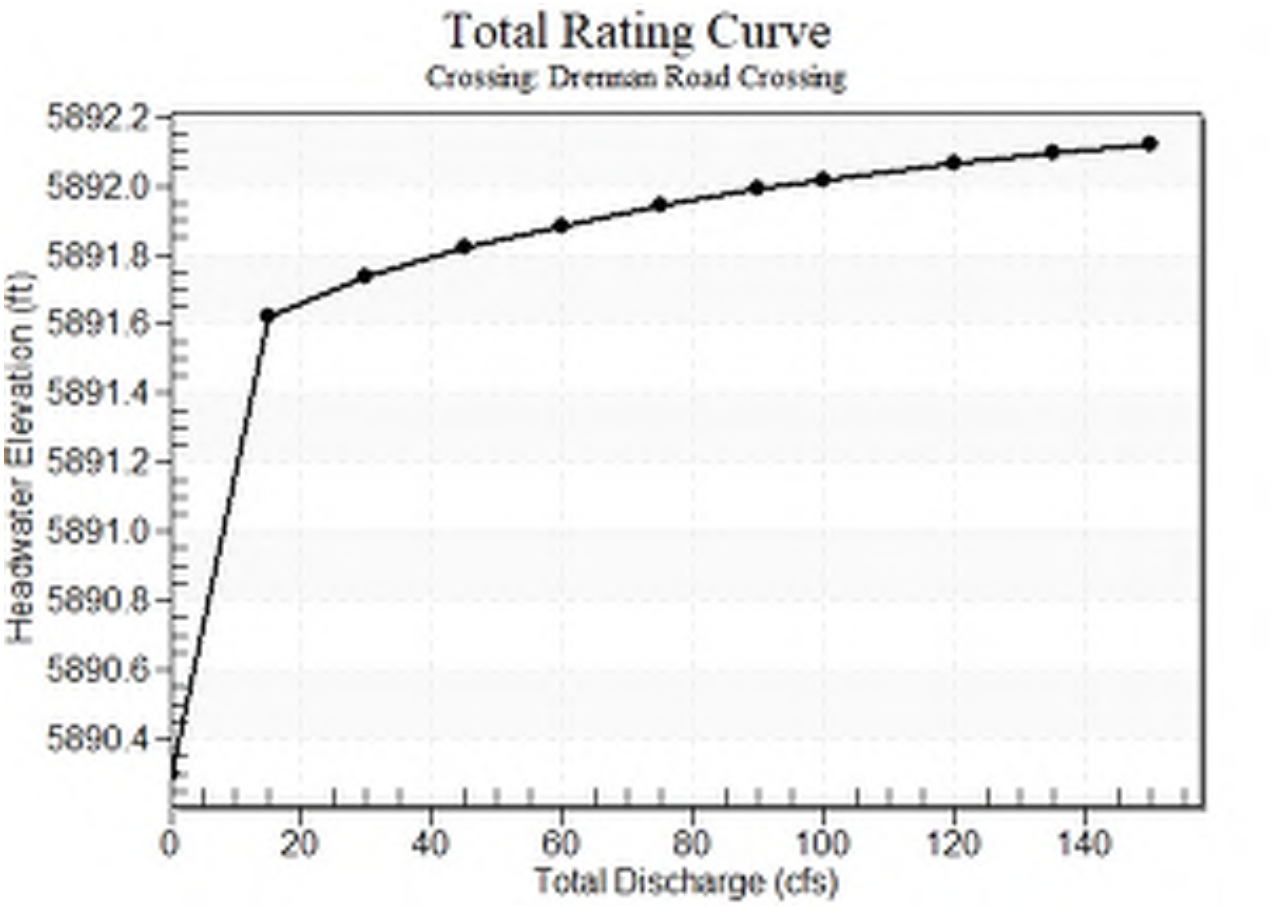
Table 2 - Culvert Summary Table: EX. 12-inch CMP

Total Discharge (cfs)	Culvert Discharge (cfs)	Headwater Elevation (ft)	Inlet Control Depth (ft)	Outlet Control Depth (ft)	Flow Type	Normal Depth (ft)	Critical Depth (ft)	Outlet Depth (ft)	Tailwater Depth (ft)	Outlet Velocity (ft/s)	Tailwater Velocity (ft/s)
0.00	0.00	5890.30	0.000	0.000	0-NF	0.000	0.000	0.000	0.000	0.000	0.000
15.00	2.27	5891.62	1.099	1.320	7-M2t	1.000	0.644	0.825	0.825	3.270	3.323
30.00	2.03	5891.74	1.009	1.437	4-FFf	0.875	0.608	1.000	1.158	2.587	4.002
45.00	1.87	5891.82	0.950	1.519	4-FFf	0.792	0.583	1.000	1.403	2.383	4.451
60.00	1.73	5891.88	0.898	1.585	4-FFf	0.738	0.559	1.000	1.603	2.202	4.795
75.00	1.60	5891.94	0.850	1.641	4-FFf	0.693	0.536	1.000	1.774	2.033	5.079
90.00	1.47	5891.99	0.804	1.689	4-FFf	0.652	0.513	1.000	1.926	1.869	5.322
100.00	1.38	5892.02	0.773	1.716	4-FFf	0.624	0.497	1.000	2.019	1.755	5.468
120.00	1.19	5892.06	0.706	1.762	4-FFf	0.568	0.461	1.000	2.190	1.520	5.728
135.00	1.05	5892.09	0.653	1.793	4-FFf	0.524	0.430	1.000	2.306	1.334	5.902
150.00	0.89	5892.12	0.592	1.821	4-FFf	0.476	0.395	1.000	2.415	1.131	6.063

Table 3 - Summary of Culvert Flows at Crossing: Drennan Road Crossing

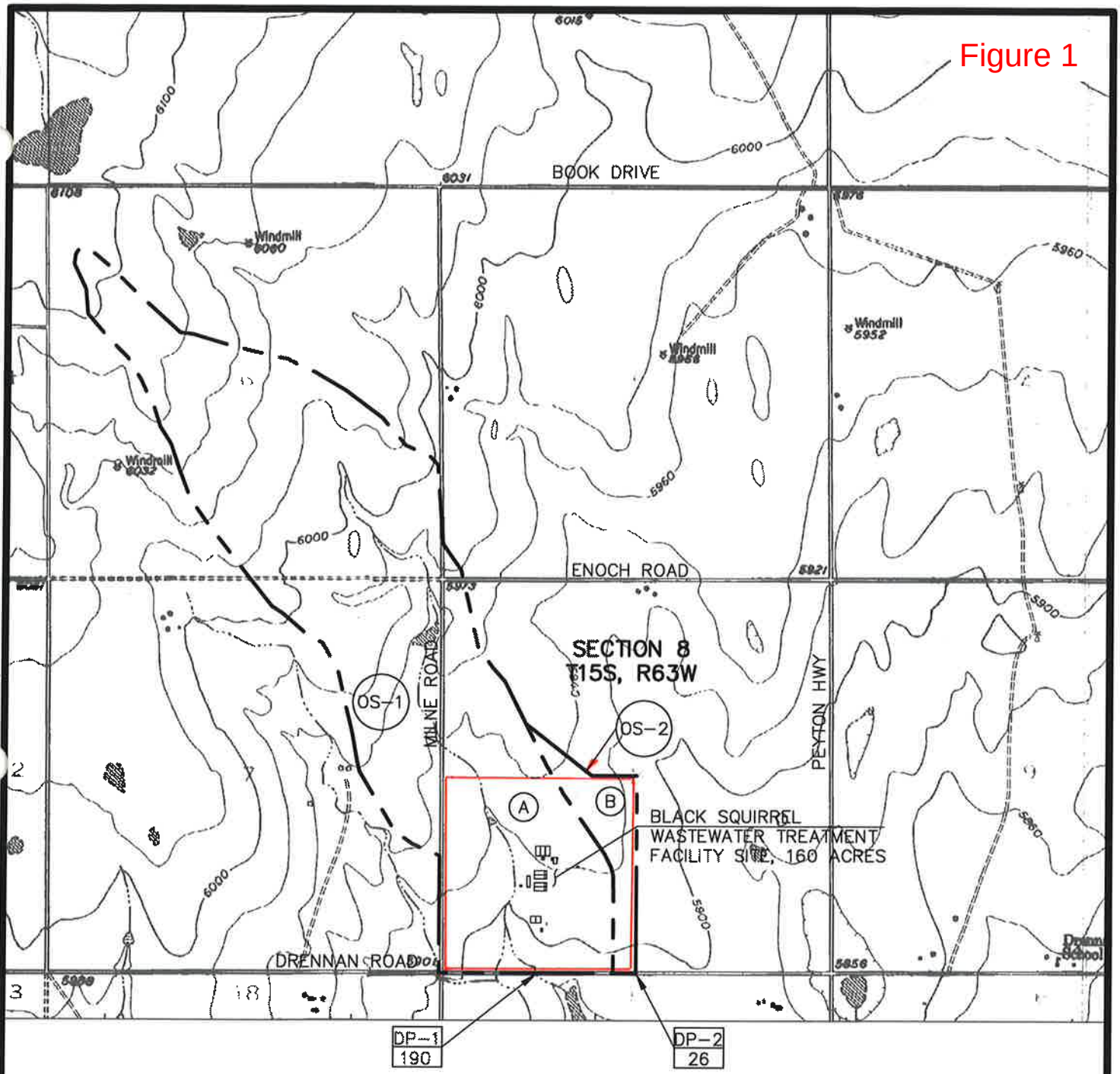
Headwater Elevation (ft)	Total Discharge (cfs)	EX. 12-inch CMP Discharge (cfs)	Roadway Discharge (cfs)	Iterations
5890.30	0.00	0.00	0.00	1
5891.62	15.00	2.27	12.63	16
5891.74	30.00	2.03	27.82	8
5891.82	45.00	1.87	42.93	6
5891.88	60.00	1.73	58.03	5
5891.94	75.00	1.60	73.26	5
5891.99	90.00	1.47	88.16	4
5892.02	100.00	1.38	98.31	3
5892.06	120.00	1.19	118.63	3
5892.09	135.00	1.05	133.90	3
5892.12	150.00	0.89	149.10	2
5891.30	1.81	1.81	0.00	Overtopping

Rating Curve Plot for Crossing: Drennan Road Crossing



APPENDIX F – DRAINAGE DELINEATIONS

Figure 1



0' 2000' 4000'

SCALE: HORIZ. 1" = 2000'

LEGEND

BASIN DESIGNATION

DESIGN POINT
Q100 CFS

99073003.DWG

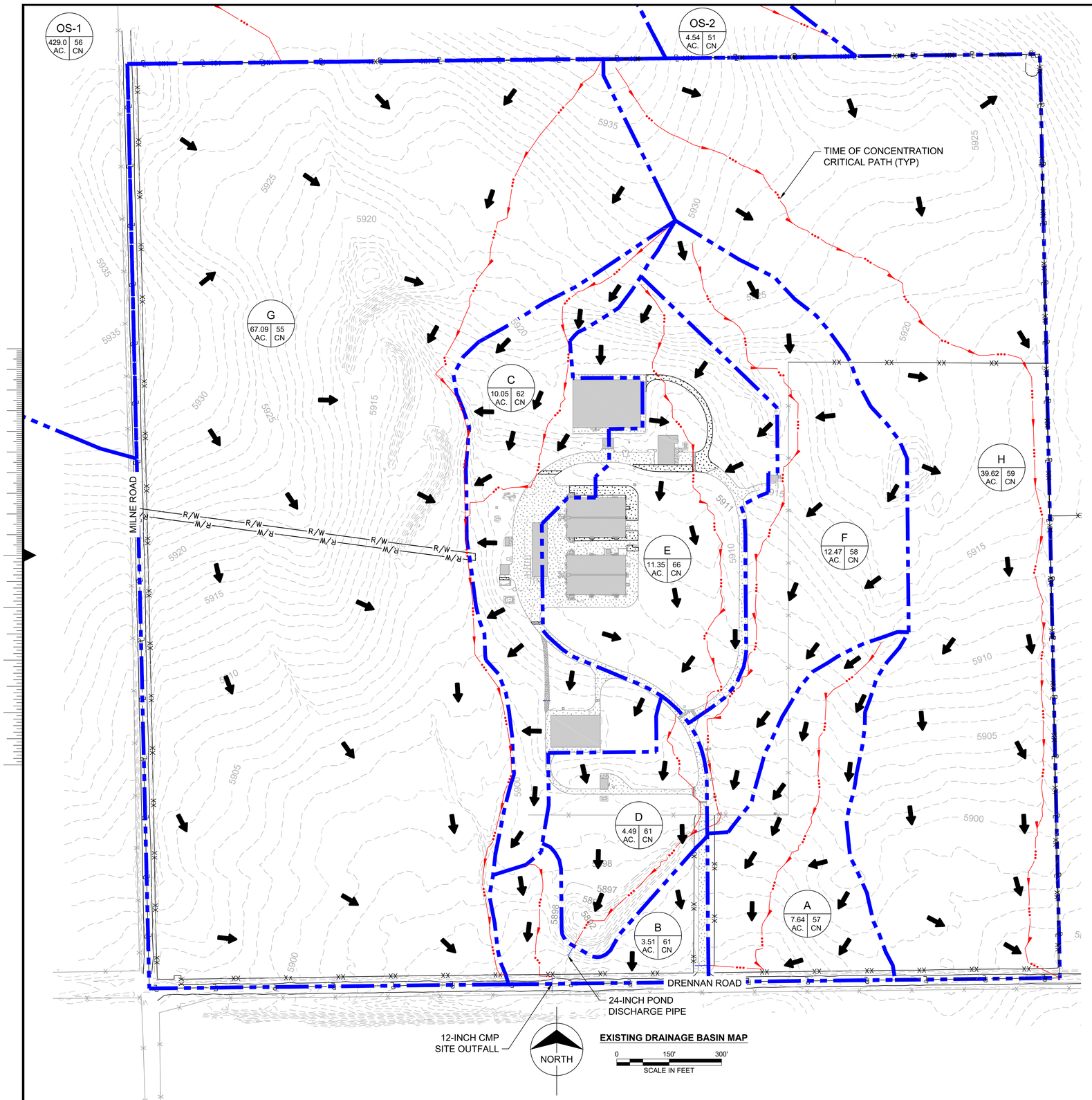
OFF SITE DRAINAGE MAP
WASTEWATER TREATMENT FACILITY
CHEROKEE METROPOLITAN DISTRICT

GMS, INC.

CONSULTING ENGINEERS
611 N. WEBER, SUITE 300
COLORADO SPRINGS, COLORADO 80903

MARCH 18, 2008

G:\CHEROKEE\315651003\99073003.dwg, 3/18/2008 2:16:42 PM, klw, \\GMSSV01\Xerox WorkC 7345 PS, 1:1



LEGEND

- EXISTING MAJOR CONTOUR (5530)
- EXISTING MINOR CONTOUR
- EXISTING BASIN BOUNDARY
- EXISTING BASIN TIME OF CONCENTRATION FLOW PATH
- FLOW DIRECTION
- BASIN DESIGNATION: BASIN (BASIN ID); xx.xx AC. (AREA (ACRES)); xx CN (CURVE NUMBER)

BASIN	10-YEAR 24-HR FLOW (CFS)	100-YEAR 24-HR FLOW (CFS)
OFF-1	8.6	94.6
OFF-2	0.0	1.3
A	0.3	4.0
B	0.4	2.9
C	1.1	8.4
D	0.4	3.5
E	1.8	8.9
F	0.6	6.7
G	1.3	24.3
H	1.9	18.2

NOTES:

1. ONSITE AND OFFSITE DRAINAGE BASINS WERE TAKEN FROM THE FINAL DRAINAGE REPORT FOR BLACK SQUIRREL CREEK WASTEWATER TREATMENT PLAN, COMPLETED BY GMS, INC. CONSULTING ENGINEERS IN MARCH 2008 FOR THE CHEROKEE WATER RECLAMATION FACILITY.
2. BASINS B, C, AND G ARE SEPARATED BY THE CENTERLINE OF THE EPHEMERAL SWALE. SEE REPORT TEXT FOR MORE DETAILED EXISTING BASIN DESCRIPTIONS.
3. PEAK FLOW RATES FOR EXISTING CONDITIONS FROM THE 2008 FINAL DRAINAGE REPORT (SEE NOTE 1) WERE RECALCULATED IN THIS FINAL DRAINAGE REPORT TO ACCOUNT FOR ACCURATE SOIL CONDITIONS ON AND OFF SITE.

no.	date	by	ckd	description

BURNS McDONNELL
9785 Maroon Cir., Suite 400
Centennial, CO 80112
303-721-9292

date	detailed
NOVEMBER 2020	S. FOREMAN
designed	checked
S. FOREMAN	J. LEE

CHEROKEE METROPOLITAN DISTRICT
TDS REDUCTION FACILITY
EXISTING DRAINAGE BASIN MAP

project	contract
119461	

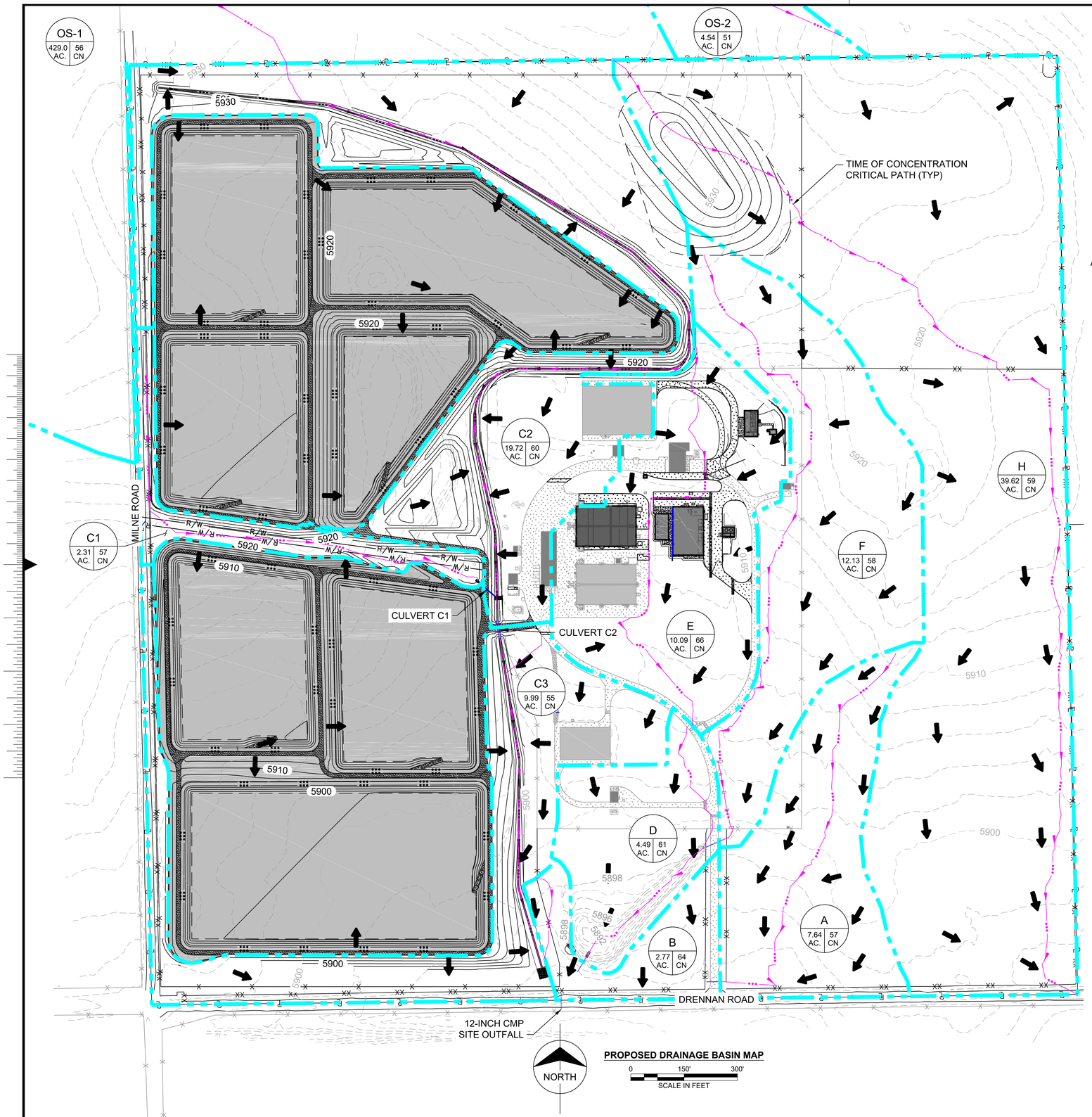
drawing FIGURE 2 – rev. 0

sheet 9 of sheets

file 119461_DRAINAGE BASIN_EXISTING.DWG

Scale For Microfilming: Millimeters / Inches

Z:\CLIENTS\WTR\CHEROKEEMETR\119461_TDSREDUCE\DESIGN\CIVIL\STORMWATER\119461_DRAINAGE BASIN_EXISTING.DWG 11/5/2020 10:44 AM SJFOREMAN



PROPOSED DRAINAGE BASIN MAP

LEGEND

5530	EXISTING MAJOR CONTOUR
	EXISTING MINOR CONTOUR
5530	DESIGN MAJOR CONTOUR
	DESIGN MINOR CONTOUR
	PROPOSED BOUNDARY BASIN
	EXISTING BASIN TIME OF CONCENTRATION FLOW PATH
	AREA NOT IN DRAINAGE BOUNDARY
	FLOW DIRECTION
BASIN (xx.xx AC. / xx CN) — AREA (ACRES), BASIN ID, CURVE NUMBER	BASIN DESIGNATION

BASIN	10-YEAR 24-HR FLOW (CFS)	100-YEAR 24-HR FLOW (CFS)
OS-1	8.6	94.6
OS-2	0.0	1.3
A	0.3	4.0
B	0.5	2.8
C1	0.1	1.3
C2	2.0	19.6
C3	0.2	7.0
D	0.4	3.5
E	2.1	10.9
F	0.6	6.5
H	1.9	18.2

NOTES:

1. EXISTING DRAINAGE BASIN G WAS ELIMINATED DUE TO CONSTRUCTION OF THE EVAPORATION PONDS. SEE REPORT TEXT FOR DESCRIPTION OF OTHER BASIN MODIFICATIONS.

no.	date	by	ckd	description

PRELIMINARY - NOT FOR CONSTRUCTION

BURNS McDONNELL
9785 Maroon Cir., Suite 400
Centennial, CO 80112
303-721-9292

date	detailed
NOVEMBER 2020	S. FOREMAN
designed	**checked**
S. FOREMAN	J. LEE

CHEROKEE METROPOLITAN DISTRICT

CHEROKEE METROPOLITAN DISTRICT TDS REDUCTION FACILITY

PROPOSED DRAINAGE BASIN MAP

project	contract
119461	

drawing **FIGURE 3 –** **rev.** **0**

sheet # **of** sheets

file 119461_DRAINAGE BASIN_PROPOSED.DWG

Scale For Microfilming: Millimeters / Inches

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BURNS McDONNELL

CREATE AMAZING.

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