DECEMBER 18, 2020

Detention Calculations for

BRIDGEWATER CHURCH DEVELOPMENT

BUTLER COUNTY, FAIRFIELD TOWNSHIP, OHIO

prepared by:

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Table of Contents

INTRODUCTION

The proposed project includes the construction of a detention basin for the proposed Casey's gas station, future improvements to the existing Bridgewater church and developments on the two remaining lots. Drainage swales are proposed to be constructed on the west and north ends of the site to convey storm water to the proposed basin.

STRATEGY

Butler County Stormwater Rules and Regulations follow a modified critical year storm method. The critical year storm event is determined by calculating the percent increase in runoff from a 24-hour storm frequency for a 1-year storm event under post-developed conditions compared with the runoff for a 1-year under pre-developed conditions. The post-developed runoff must be controlled for storms of a frequency between one year and the critical storm so that the rate of runoff does not exceed the peak rate of runoff for a pre-developed, 24-hour, 1-year frequency storm. All storm events greater than the critical year must be controlled such the post-developed runoff rate is reduced by one pre-developed storm event (i.e. Post-100 to Pre-50, Post-50 to Pre-25 etc...) The current site is close to 20 acres therefore the SCS (Urban Hydrology for Small Watersheds) TR55 method was used for the hydrologic analysis.

DRAINAGE OVERVIEW

Pre-developed Conditions

The existing site is currently undeveloped open space in good condition. The watershed generally sheet flows with some shallow concentrated flow north west across the site to an unnamed tributary to the Great Miami River.

A summary of the current conditions on the school site are as follows:

TABLE 1 – Pre-Developed Conditions Summary

PRE-DEVELOPED										
Tributary Area	**Area (ac)**	**CN**	**Tc (min)**	**Q_1 (cfs)**	**Q_2 (cfs)**	**Q_5 (cfs)**	**Q_{10} (cfs)**	**Q_{25} (cfs)**	**Q_{50} (cfs)**	**Q_{100} (cfs)**
Onsite	19.74	80	23	16.68	22.72	34.11	42.69	53.29	62.30	69.59

Refer to Appendix A for the Pre-Developed drainage map for the site.

Post-developed Conditions

The existing drainage pattern is maintained under the post-developed conditions. Drainage Swales are proposed on the West and North end of the site to convey storm water to the proposed basin. The critical year storm event was calculated, and those values were determined as follows:

- Pre-developed, 1-year, stormwater runoff volume = 1.42 Ac-ft
- Post-developed, 1-year, stormwater runoff volume = 2.20 Ac-ft
- Percent increase = 55%
- Critical Year storm event = **10-year**

Therefore, the peak flows for the 1-, 2-, 5- and 10-year storm events under post-developed conditions must not exceed the peak flow from this watershed under pre-developed conditions for the 1-year storm event.

Post-developed conditions are as follows.

TABLE 2 – Post-Developed Conditions Summary

POST-DEVELOPED										
Tributary Area	**Area (ac)**	**CN**	**Tc (min)**	**Q_1 (cfs)**	**Q_2 (cfs)**	**Q_5 (cfs)**	**Q_{10} (cfs)**	**Q_{25} (cfs)**	**Q_{50} (cfs)**	**Q_{100} (cfs)**
Onsite Total to Pond	19.74	87	10	41.48	52.06	70.91	84.51	100.9	114.5	125.4
Pond Outflow				2.25	4.20	8.91	16.51	29.67	38.90	44.10

Refer to Appendix A for the Post-Developed drainage map for the site.

Water Quality

The proposed site will disturb more than 1 acre and therefore is subject to the post-construction stormwater management requirements set forth in the Construction Site Storm Water General Permit from the Ohio EPA. The permit requires projects to capture and treat stormwater for a storm event of 0.90 inches. The orifice size listed below are designed per EPA Permit No. OH000005 to release the water quality volume over 48 hours as required for dry basins. Appendix C shows the calculations for the water quality volume.

Tributary Area (Ac)	**i**	**WQv (Required) (cu-ft)**	**Orifice size (in)**	**Elevation @ Volume Provided (ft)**
19.74	0.53	34,098	2.5	727.46

Refer to Appendix B for water quality calculations for the site.

Post-Developed Release

Proposed Outlet structure is as follows:

- 6" perforated riser with a 2.5" water quality orifice @ 724.97
- (1)-13" W s 42"H weir @ 727.56 on south side of structure
- (2)-30" W x 12"H windows @ 729.50 on west / east side of structure
- (4)-30" W x 6"H windows (N, S, W, E)
- 30" (class IV RCP) culvert @ 724.95
- Spillway @ 731.50
- Top of berm at 732.50

The post-developed flows for the basin are summarized as follows:

	Pre-Developed Allowable Peak Flow (cfs)	Post-Developed Peak Flow from Proposed Basin (cfs)	Peak Basin Water Surface Elevation (ft) (Post Developed Condition)
1-yr	16.68	2.25	728.24
2-yr	16.68	4.20	728.63
5-yr	16.68	8.91	729.37
10-yr	16.68	16.51	729.87
25-yr	42.69	29.67	730.37
50-yr	53.29	38.90	730.76
100-yr	62.30	44.10	731.07

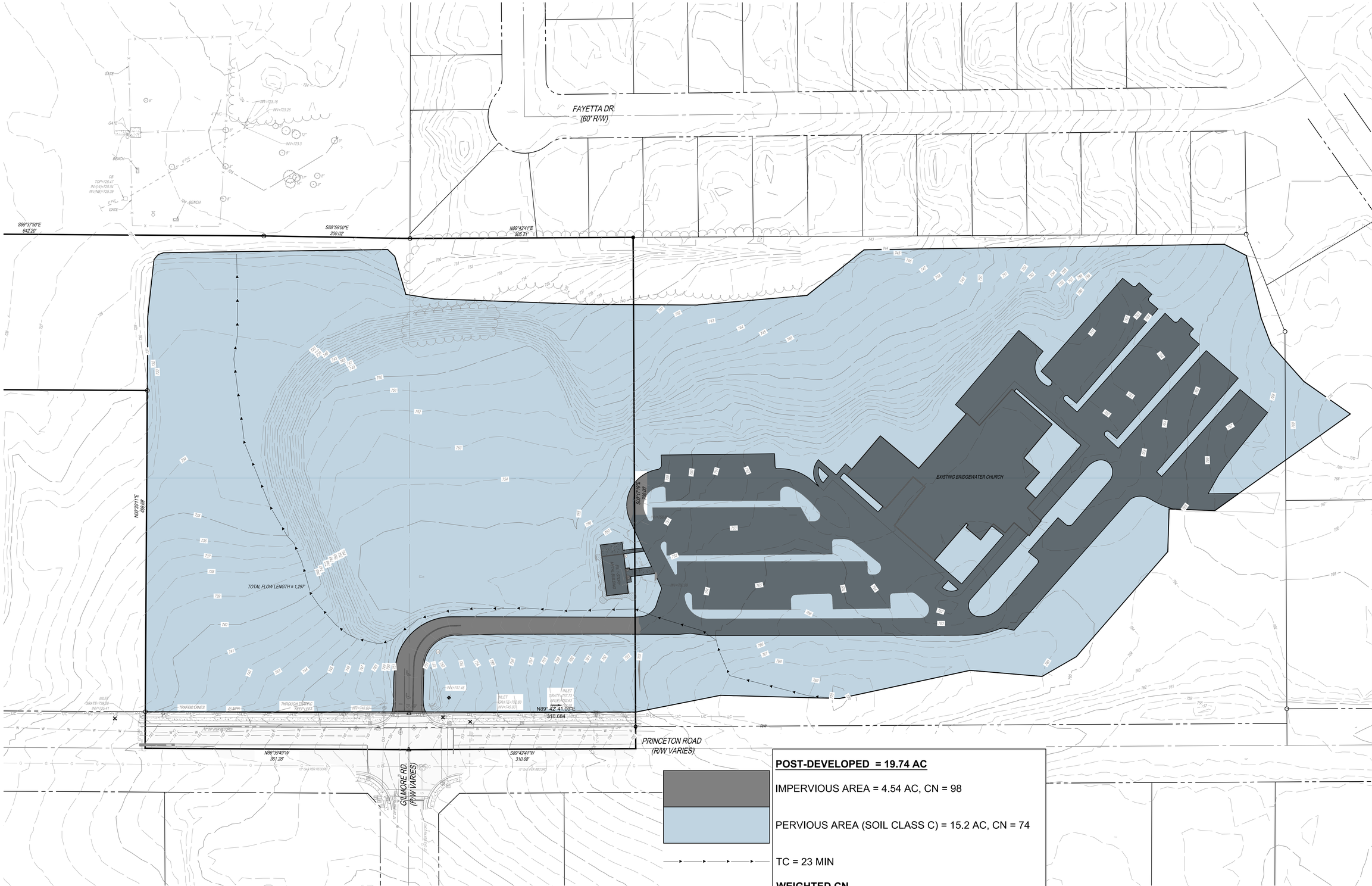
CONCLUSION

In conclusion, the stormwater management system on site has been designed to meet the requirements set forth by the Butler County Stormwater Regulations. Post developed flows up to the critical 10-year event have been held back to the 1-year predeveloped condition and the following storm events have been held back to roughly 70% of the Predeveloped Storm events for the year prior. Therefore, we conclude that the proposed system is conservative and has capacity to meet the needs of future developments to come.

Appendix A

Pre-Post Drainage Maps

INSPIRED PEOPLE ▲ CREATIVE DESIGN ▲ TRANSFORMING COMMUNITIES



POST-DEVELOPED = 19.74 AC

IMPERVIOUS AREA = 4.54 AC, CN = 98

PERVIOUS AREA (SOIL CLASS C) = 15.2 AC, CN = 74

TC = 23 MIN

WEIGHTED CN

(4.54*98+15.2*74) = 80
19.74

NOTE:
UNDERGROUND UTILITIES ARE PLOTTED FROM A COMPILATION OF AVAILABLE RECORD INFORMATION, GIS AND SURFACE INDICATIONS OF UNDERGROUND STRUCTURES AND MAY NOT BE INCLUSIVE. PRECISE LOCATIONS AND THE EXISTENCE OR NON EXISTENCE OF UNDERGROUND UTILITIES CANNOT BE VERIFIED. PLEASE NOTIFY THE OHIO UTILITY PROTECTION SERVICE AT 1-800-362-2764 BEFORE ANY PERIOD OF EXCAVATION OR CONSTRUCTION ACTIVITY.

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www.kleingers.com
6305 Centre Park Dr.
West Chester, OH 45069
513.779.7851

SEAL:

NO.	DATE	DESCRIPTION
1	12/18/2020	STORM WATER REPORT

BRIDGEWATER CHURCH MASTER PLAN

FAIRFIELD TOWNSHIP
BUTLER COUNTY, OHIO

PROJECT NO: 180075.000
DATE: 12/18/2020
SCALE: 0 20 40 80
SHEET NAME: PRE-DEVELOPED
SHEET NO. 1 OF 2

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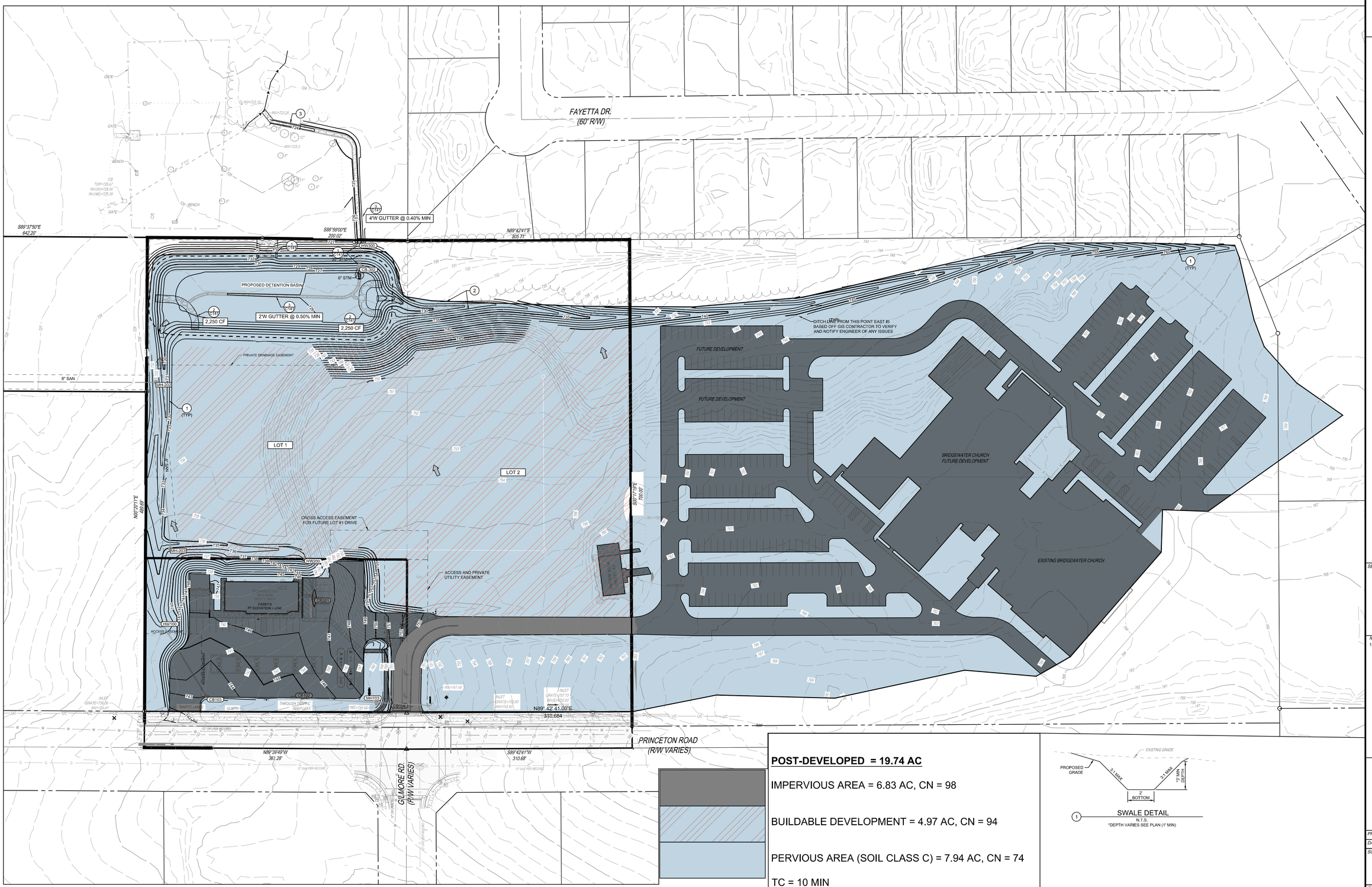
INSPIRED PEOPLE ▲ CREATIVE DESIGN ▲ TRANSFORMING COMMUNITIES



POST-DEVELOPED = 19.74 AC

IMPERVIOUS AREA = 6.83 AC, CN = 98

BUILDABLE DEVELOPMENT = 4.97 AC, CN = 94

PERVIOUS AREA (SOIL CLASS C) = 7.94 AC, CN = 74

TC = 10 MIN

WEIGHTED CN

$$\frac{(6.83*98+4.97*94+7.94*74)}{19.74} = 87$$

1 SWALE DETAIL
N.T.S.
*DEPTH VARIES SEE PLAN (1' MIN)

NOTE:
UNDERGROUND UTILITIES ARE PLOTTED FROM A COMPILATION OF AVAILABLE RECORD INFORMATION, GIS AND SURFACE INDICATIONS OF UNDERGROUND STRUCTURES AND MAY NOT BE INCLUSIVE. PRECISE LOCATIONS AND THE EXISTENCE OR NON EXISTENCE OF UNDERGROUND UTILITIES CANNOT BE VERIFIED. PLEASE NOTIFY THE OHIO UTILITY PROTECTION SERVICE AT 1-800-362-2764 BEFORE ANY PERIOD OF EXCAVATION OR CONSTRUCTION ACTIVITY.

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NO.	DATE	DESCRIPTION
1	12/18/2020	STORM WATER REPORT

BRIDGEWATER CHURCH MASTER PLAN

FAIRFIELD TOWNSHIP
BUTLER COUNTY, OHIO

PROJECT NO: 180075.000
DATE: 12/18/2020
SCALE: 0 20 40 80
SHEET NAME: POST-DEVELOPED
SHEET NO. 2 OF 2

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Appendix B

Water Quality Volume Calculations

Dry Extended Detention Basin WQv Compliance Tool

version 3.1 2018-10-25

Project Summary

Project Name:	**Bridge Water Church Development**				
Subwatershed ID/Label:	**TRIBUTARY ONSITE**				
Submitted by:	**MEK**				
Date:	**12/18/2020**				
Subwatershed Drainage Area, A_{total} =	**19.74**	**acres**	**=**	**859,874**	**ft2**
Subwatershed Impervious Area, A_{imp} =	**10.50**	**acres**	**=**	**457,380**	**ft2**
Imperviousness fraction, i =	**0.53**			**53**	**%**
Water Quality Volume, WQv =	**34,098**	**ft^3**	**=**	**0.78**	**ac-ft**

Step 1 - Soil Suitability

Soil Series | **HSG**

Step 2 - Dry ED Basin Volume Requirements

Extended Detention Volume, EDv =	**34098**	**ft^3**
Minimum Sediment Storage Volume, $V_{sediment}$ =	**6820**	**ft^3**
Minimum Forebay Volume, $V_{forebay}$ =	**3410**	**ft^3**
Minimum Permanent Micropool Volume, $V_{micropool}$ =	**3410**	**ft^3**

Step 3 - Basin Stage-Storage Relationship

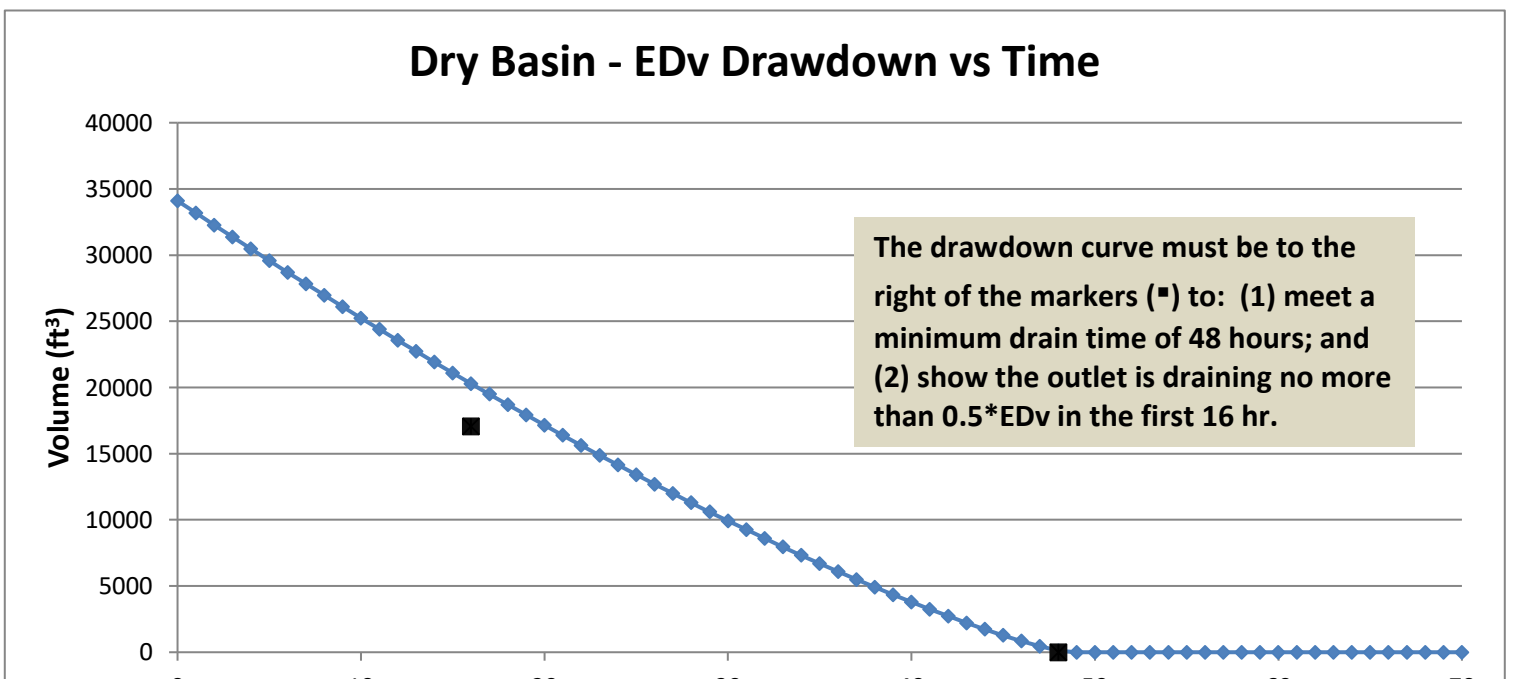
	Elevation ft	Area ft^2		Incremental Volume ft^3	Cumulative Volume ft^3
Bottom of Permanent Micropool =	725.00	45			
(include forebay area if below EDv)	726.00	12,115		**4,299**	**4,299**
	727.00	22,311		**16,956**	**21,255**
	728.00	24,847		**23,568**	**44,823**
	729.00	27,408		**26,117**	**70,940**
	730.00	30,487		**28,934**	**99,874**
	731.00	34,288		**32,369**	**132,242**
	732.00	39,227		**36,730**	**168,972**

Step 4 - Outlet Elevations and Storage Volumes

WQ Orifice Invert Elevation =	725.00				
Elevation of Top of EDv =	727.56				
Secondary Outlet Invert Elevation =	727.56				OKAY
WQ Treatment Volume Provided, $V_{treatment}$ =	34,140	ft^3			
Treatment Vol Provided Relative to EDv, $V_{treatment}/EDv$ =	1.00		=	100%	OKAY
Permanent Pool Volume Provided, PPv =	0	ft^3			
Forebay Volume Provided, $V_{forebay}$ =	3,410	ft^3	=	1.00	
Is forebay volume below WQ outlet? (Yes or No)	No		=	100%	OKAY
Permanent Micropool Volume Provided, $V_{micropool}$ =	0	ft^3			
Ratio $V_{micropool}$ Provided to $V_{micropool}$ Required =	0.00		=	0%	NOT MET
Sediment Storage Volume Provided, $V_{sediment}$ =	3,410	ft^3			
Ratio $V_{sediment}$ Provided to $V_{sediment}$ Required =	0.50		=	50%	NOT MET

Step 5 - Outlet (Orifice) Sizing

Maximum Hydraulic Head, Hmax =	2.56	ft			
Orifice Coefficient, C =	0.6				
Target (Minimum) Draw-down Time, T_d =	48	hr			
Target Average Discharge, Q_{avg} =	0.20	cfs			
Average Hydraulic Head, H_{avg} =	1.28	ft			
Estimated Orifice Area, $A_{orifice}$ =	5.22	in^2	=	0.036	ft^2
Estimated Orifice Diameter, $D_{orifice}$ =	2.58	in	=	0.21	ft
Design Orifice Diameter, $D_{orifice}$ =	2.50	in	=	0.21	ft
Design Orifice Area, $A_{orifice}$ =	4.88	in^2	=	0.034	ft^2
Time to Completely Drain EDv, T_d =	49	hr	must be ≥ 48 hr		OKAY
Volume Drained in First 16 hr =	13,803	ft^3			
% of EDv =	40.5	%	must be ≤ 50%		OKAY




0
10
20
30
40
50
60
70
Time (hr)

Appendix C

Soils Maps

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 Butler County, Ohio

BridgeWater Church

September 29, 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.

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Custom Soil Resource Report
Soil Map

Map Scale: 1:3,440 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 50 100 200 300

Feet: 0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 16N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:15,800.

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

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

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

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

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

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

Soil Survey Area: Butler County, Ohio
Survey Area Data: Version 20, Jun 10, 2020

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

Date(s) aerial images were photographed: Oct 28, 2019—Dec 5, 2019

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
DaB	Dana silt loam, 2 to 6 percent slopes	9.3	39.3%
RdA	Raub silt loam, 0 to 2 percent slopes	1.7	7.1%
WyB2	Wynn silt loam, 2 to 6 percent slopes, eroded	7.3	30.8%
WyC2	Wynn silt loam, 6 to 12 percent slopes, eroded	4.4	18.6%
XeB	Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes	1.0	4.3%
XfB	Xenia silt loam, bedrock substratum, 2 to 6 percent slopes	0.0	0.0%
Totals for Area of Interest		**23.6**	**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.

Butler County, Ohio

DaB—Dana silt loam, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2w0v8
Elevation: 590 to 1,180 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Dana

Setting

Landform: Till plains, ground moraines
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve, crest
Down-slope shape: Convex, linear
Across-slope shape: Linear, convex
Parent material: Loess over loamy till derived from sedimentary rock

Typical profile

Ap - 0 to 14 inches: silt loam
Bt - 14 to 37 inches: silty clay loam
2BC - 37 to 48 inches: clay loam
2Cd - 48 to 79 inches: loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 37 to 55 inches to densic material
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.60 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.3 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: R111DY012IN - Till Ridge Prairie
Hydric soil rating: No

Minor Components

Raub

Percent of map unit: 5 percent
Landform: Hillslopes, till plains
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Interfluve
Down-slope shape: Linear
Across-slope shape: Convex
Ecological site: R111DY012IN - Till Ridge Prairie
Hydric soil rating: No

Brookston

Percent of map unit: 5 percent
Landform: — error in exists on —
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear, concave
Across-slope shape: Concave
Ecological site: F111DY008IN - Till Depression Flatwood
Hydric soil rating: Yes

RdA—Raub silt loam, 0 to 2 percent slopes

Map Unit Setting

National map unit symbol: 5pp0
Elevation: 360 to 1,000 feet
Mean annual precipitation: 30 to 45 inches
Mean annual air temperature: 48 to 57 degrees F
Frost-free period: 150 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

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

Description of Raub

Setting

Landform: Rises on till plains
Landform position (three-dimensional): Rise
Parent material: Silty loess over loamy till

Typical profile

H1 - 0 to 15 inches: silt loam
H2 - 15 to 37 inches: silty clay loam
H3 - 37 to 43 inches: clay loam
H4 - 43 to 60 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 35 percent
Available water capacity: High (about 10.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: D
Ecological site: R111DY012IN - Till Ridge Prairie
Hydric soil rating: No

Minor Components

Ragsdale

Percent of map unit: 5 percent
Landform: Depressions
Ecological site: F111DY015IN - Wet Loess Upland
Hydric soil rating: Yes

Dana

Percent of map unit: 5 percent
Landform: Till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: R111DY012IN - Till Ridge Prairie
Hydric soil rating: No

WyB2—Wynn silt loam, 2 to 6 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2xqyg
Elevation: 880 to 1,040 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Wynn, eroded, and similar soils: 90 percent

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

Description of Wynn, Eroded

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Linear
Parent material: Loess over loamy till over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 5 inches: silt loam
Bt - 5 to 15 inches: silty clay loam
2Bt2 - 15 to 25 inches: clay loam
2BC - 25 to 29 inches: clay
3Cr - 29 to 39 inches: bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 28 to 33 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 25 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 4.6 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F111DY010IN - Till Ridge
Hydric soil rating: No

Minor Components

Millsdale

Percent of map unit: 7 percent
Landform: Stream terraces, drainageways
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Base slope, tread
Down-slope shape: Concave
Across-slope shape: Linear
Ecological site: F111DY008IN - Till Depression Flatwood
Hydric soil rating: Yes

Miamian, eroded

Percent of map unit: 3 percent
Landform: Recessionial moraines, till plains

Landform position (two-dimensional): Shoulder, backslope, summit
Landform position (three-dimensional): Nose slope, interfluve
Down-slope shape: Linear, convex
Across-slope shape: Convex, linear
Ecological site: F111DY010IN - Till Ridge
Hydric soil rating: No

WyC2—Wynn silt loam, 6 to 12 percent slopes, eroded

Map Unit Setting

National map unit symbol: 2xqyh
Elevation: 880 to 1,040 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: Farmland of local importance

Map Unit Composition

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

Description of Wynn, Eroded

Setting

Landform: Till plains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Convex
Parent material: Loess over loamy till over residuum weathered from limestone and shale

Typical profile

Ap - 0 to 8 inches: silt loam
Bt1 - 8 to 12 inches: silty clay loam
2Bt2 - 12 to 16 inches: silty clay loam
2Bt3 - 16 to 26 inches: clay
2BC - 26 to 33 inches: clay
3Cr - 33 to 43 inches: bedrock

Properties and qualities

Slope: 6 to 12 percent
Depth to restrictive feature: 32 to 34 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately low (0.00 to 0.03 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Calcium carbonate, maximum content: 45 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: Low (about 5.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F111DY010IN - Till Ridge
Hydric soil rating: No

Minor Components

Miamian

Percent of map unit: 5 percent
Landform: Till plains
Landform position (two-dimensional): Shoulder, summit
Landform position (three-dimensional): Interfluve
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111DY010IN - Till Ridge
Hydric soil rating: No

Eden, eroded

Percent of map unit: 5 percent
Landform: Till plains
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Nose slope
Down-slope shape: Convex
Across-slope shape: Linear
Ecological site: F111DY023IN - Moderately Deep Restricted
Hydric soil rating: No

XeB—Xenia silt loam, Southern Ohio Till Plain, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 2t98y
Elevation: 400 to 1,020 feet
Mean annual precipitation: 37 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 145 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Xenia

Setting

Landform: Till plains
Landform position (two-dimensional): Shoulder, backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loess over loamy till

Typical profile

Ap - 0 to 9 inches: silt loam
Bt1 - 9 to 29 inches: silty clay loam
2Bt2 - 29 to 40 inches: clay loam
2BCt - 40 to 58 inches: loam
2Cd - 58 to 79 inches: loam

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 40 to 60 inches to densic material
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Low to moderately high (0.01 to 0.20 in/hr)
Depth to water table: About 18 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 40 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water capacity: High (about 9.9 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F111DY010IN - Till Ridge
Hydric soil rating: No

Minor Components

Fincastle

Percent of map unit: 5 percent
Landform: Till plains
Landform position (two-dimensional): Summit, footslope
Landform position (three-dimensional): Side slope
Down-slope shape: Linear
Across-slope shape: Linear
Ecological site: F111DY009IN - Wet Till Ridge
Hydric soil rating: No

Russell

Percent of map unit: 5 percent
Landform: Till plains
Landform position (two-dimensional): Backslope, shoulder
Landform position (three-dimensional): Side slope
Down-slope shape: Convex

Across-slope shape: Linear
Ecological site: F111DY010IN - Till Ridge
Hydric soil rating: No

Cyclone

Percent of map unit: 5 percent
Landform: Flats, depressions, till plains
Landform position (two-dimensional): Summit, toeslope
Landform position (three-dimensional): Dip
Down-slope shape: Concave
Across-slope shape: Linear, concave
Ecological site: F111DY008IN - Till Depression Flatwood
Hydric soil rating: Yes

XfB—Xenia silt loam, bedrock substratum, 2 to 6 percent slopes

Map Unit Setting

National map unit symbol: 5pq5
Elevation: 680 to 1,020 feet
Mean annual precipitation: 35 to 45 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 150 to 180 days
Farmland classification: All areas are prime farmland

Map Unit Composition

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

Description of Xenia

Setting

Landform: Rises on till plains
Landform position (two-dimensional): Summit
Landform position (three-dimensional): Interfluve
Parent material: Silty loess over till over

Typical profile

H1 - 0 to 7 inches: silt loam
H2 - 7 to 33 inches: silty clay loam
H3 - 33 to 40 inches: clay loam
H4 - 40 to 55 inches: flaggy clay loam
H5 - 55 to 65 inches: weathered bedrock

Properties and qualities

Slope: 2 to 6 percent
Depth to restrictive feature: 48 to 72 inches to paralithic bedrock
Drainage class: Moderately well drained
Runoff class: Medium
Capacity of the most limiting layer to transmit water (Ksat): Very low to moderately high (0.00 to 0.20 in/hr)

Depth to water table: About 24 to 42 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 50 percent
Available water capacity: Moderate (about 8.7 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: F111DY010IN - Till Ridge
Forage suitability group: Unnamed (G111DYA-6OH)
Other vegetative classification: Unnamed (G111DYA-6OH)
Hydric soil rating: No

Minor Components

Soils greater than 60 inches to rock

Percent of map unit: 5 percent

Fincastle, bedrock substratum, bedrock substratum

Percent of map unit: 5 percent
Landform: Till plains
Hydric soil rating: No

Russell, bedrock substratum, bedrock substratum

Percent of map unit: 3 percent
Landform: Till plains

Ragsdale

Percent of map unit: 1 percent
Landform: Drainageways
Ecological site: F111DY015IN - Wet Loess Upland
Hydric soil rating: Yes

Miamian, bedrock substratum, bedrock substratum

Percent of map unit: 1 percent
Landform: Till plains

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Appendix D

Hydrology Studio Data

Table of Contents

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

Contents continued...

Basin Model

Hydrology Studio v 3.0.0.16

Project Name:

12-14-2020

Hydrograph by Return Period

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Outflow (cfs)							
			1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr
1	NRCS Runoff	Pre DEVELOPED	16.68	22.72		34.11	42.69	53.29	62.30	69.59
2	NRCS Runoff	Post DEVELOPED	41.48	52.06		70.91	84.51	100.9	114.5	125.4
3	Pond Route	Post DETENTION BASIN	2.250	4.202		8.911	16.51	29.67	38.90	44.10

Hydrograph 1-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	16.68	12.13	59,531	----		
2	NRCS Runoff	Post DEVELOPED	41.48	11.98	93,949	----		
3	Pond Route	Post DETENTION BASIN	2.250	13.20	74,409	2	728.24	53,145

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

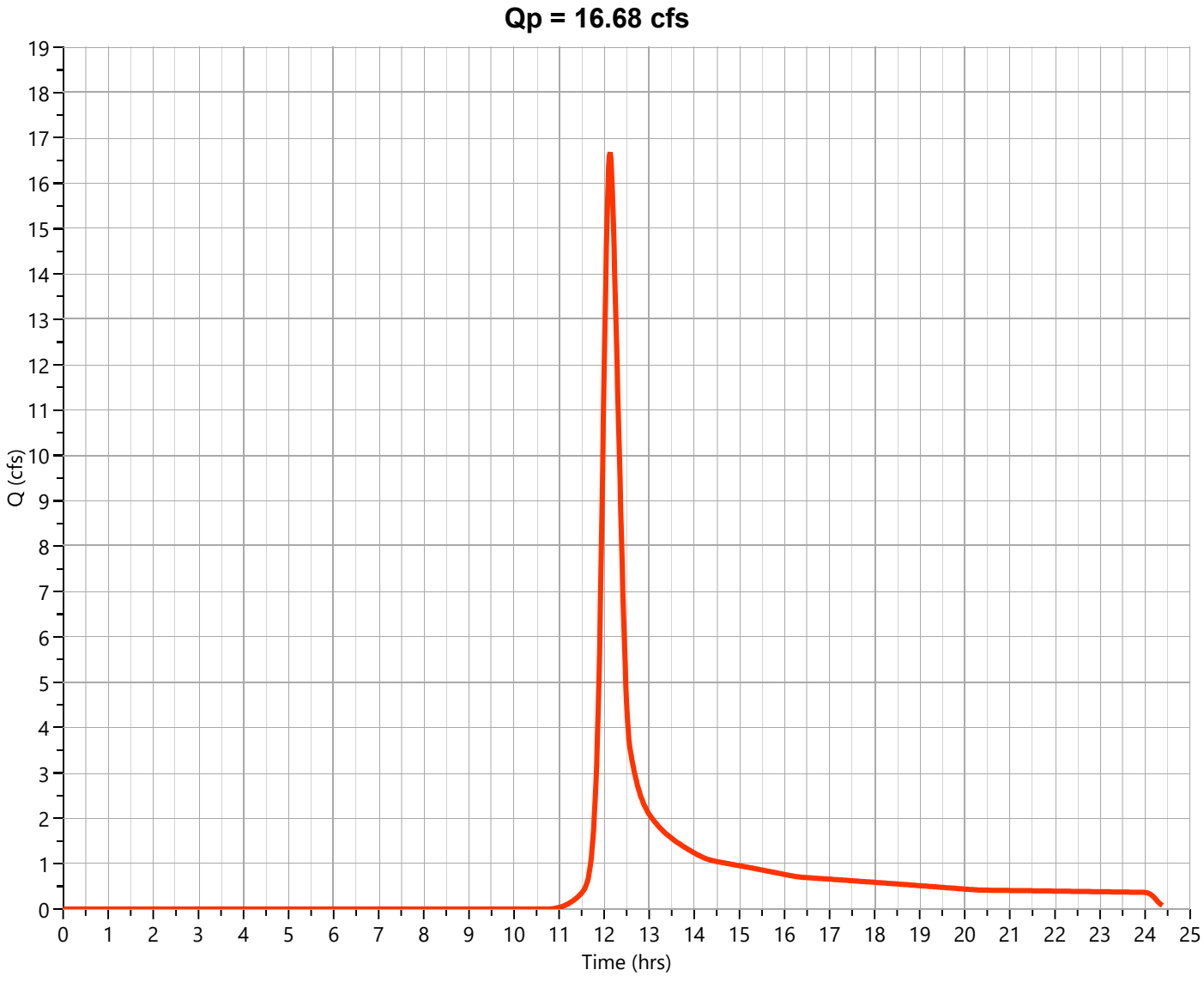
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 16.68 cfs
Storm Frequency	= 1-yr	Time to Peak	= 12.13 hrs
Time Interval	= 1 min	Runoff Volume	= 59,531 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 2.50 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Tc by TR55 Worksheet

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

DEVELOPED
NRCS Runoff

Hyd. No. 1

Description	Segments			
	A	B	C	Tc (min)
Sheet Flow				
Description				
Manning's n	0.150	0.013	0.013	
Flow Length (ft)	100			
2-yr, 24-hr Precip. (in)	2.900000	2.900000	2.900000	
Land Slope (%)	4			
Travel Time (min)	**7.80**	**0.00**	**0.00**	**7.80**
Shallow Concentrated Flow				
Flow Length (ft)	300			
Watercourse Slope (%)	3			
Surface Description	Unpaved	Paved	Paved	
Average Velocity (ft/s)	2.79			
Travel Time (min)	**1.79**	**0.00**	**0.00**	**1.79**
Channel Flow				
X-sectional Flow Area (sqft)	2			
Wetted Perimiter (ft)	4			
Channel Slope (%)	3			
Manning's n	0.150	0.013	0.013	
Velocity (ft/s)	1.08			
Flow Length (ft)	896			
Travel Time (min)	**13.81**	**0.00**	**0.00**	**13.81**
Total Travel Time				**23.44 min**

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

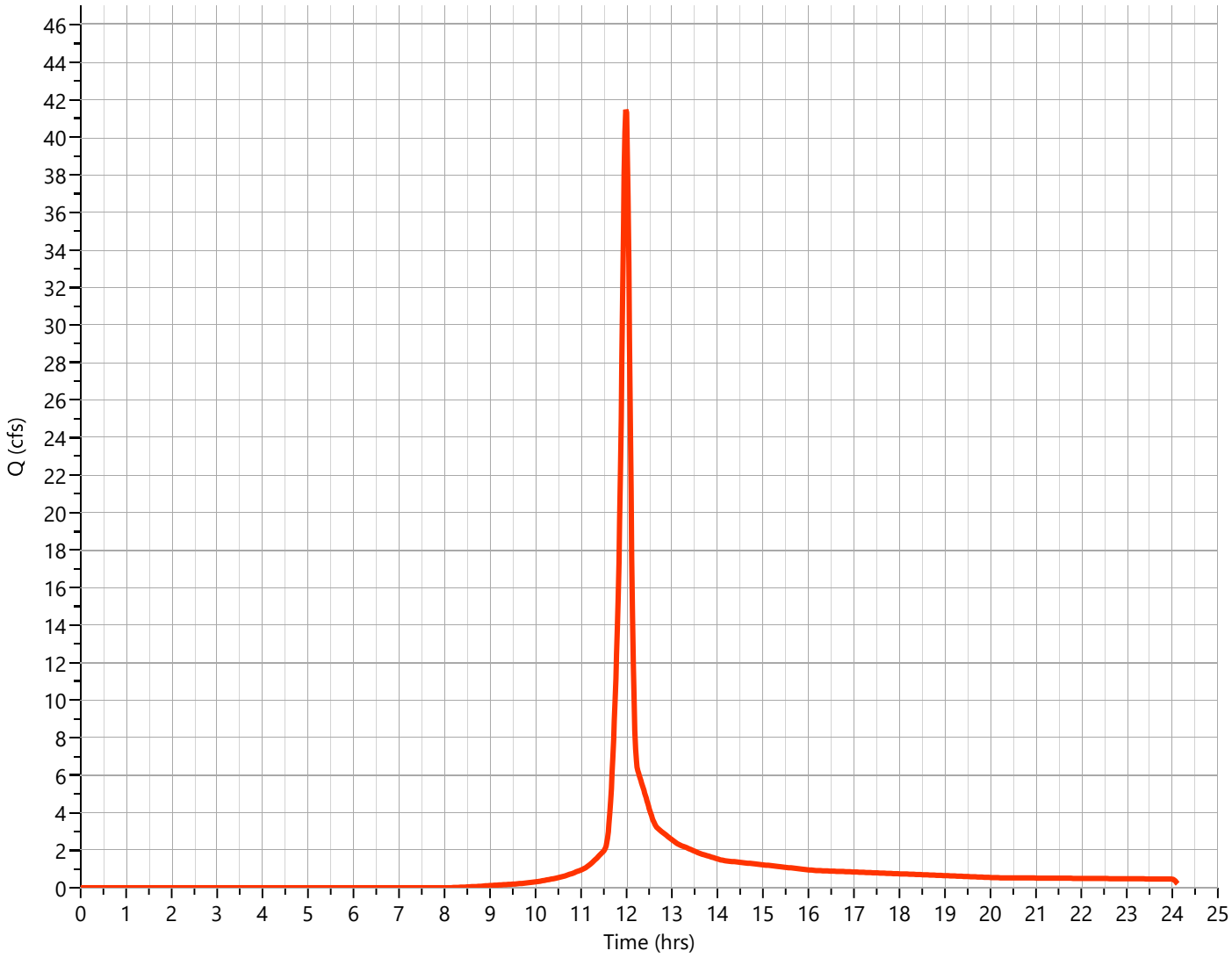
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 41.48 cfs
Storm Frequency	= 1-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 93,949 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 2.50 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

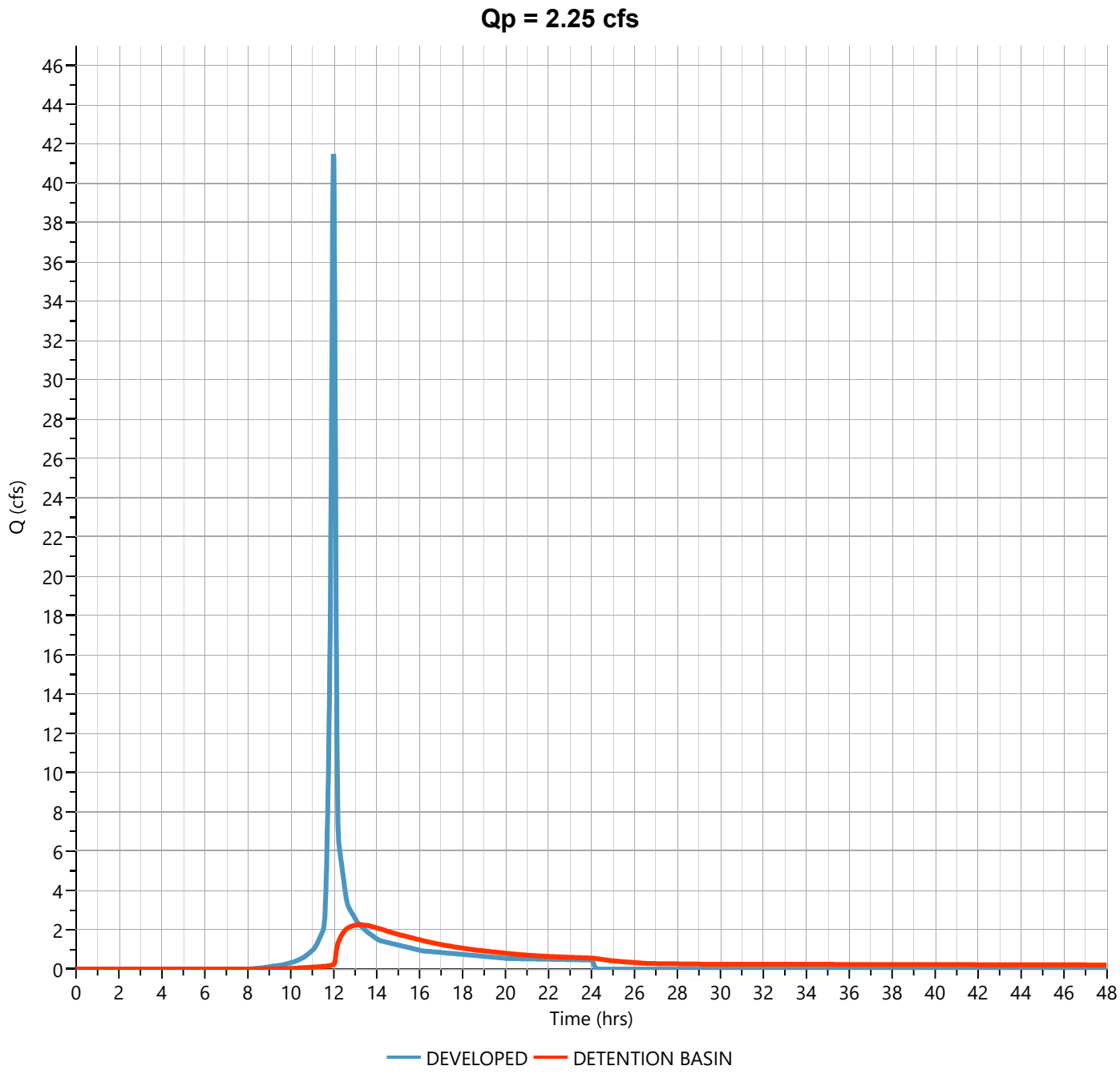
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 2.250 cfs
Storm Frequency	= 1-yr	Time to Peak	= 13.20 hrs
Time Interval	= 1 min	Hydrograph Volume	= 74,409 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 728.24 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 53,145 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 8.05 hrs



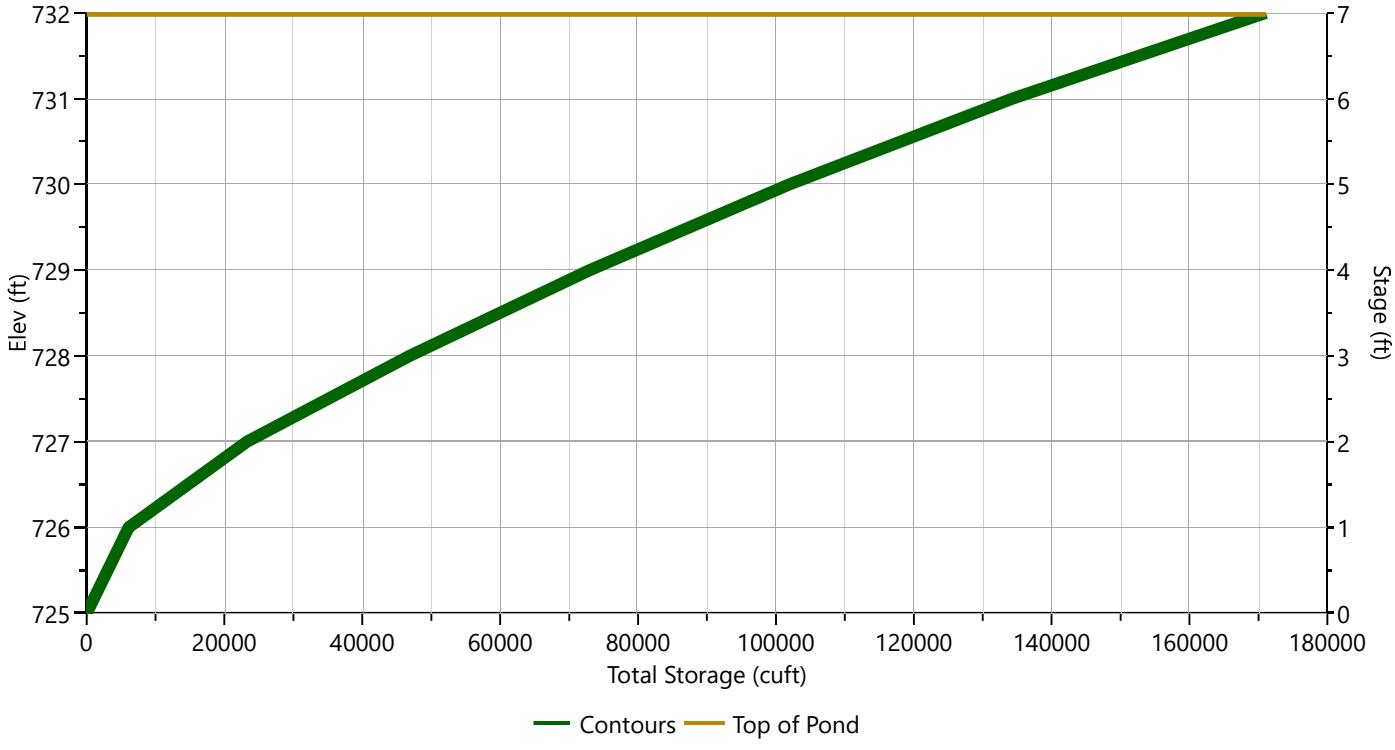
DETENTION BASIN

Stage-Storage

User Defined Contours	
Description	**Input**
Bottom Elevation, ft	725.00
Voids (%)	100.00
Volume Calc	None

Stage / Storage Table

Stage (ft)	Elevation (ft)	Contour Area (sqft)	Incr. Storage (cuft)	Total Storage (cuft)
0.00	725.00	45	0.000	0.000
1.00	726.00	12,115	6,080	6,080
2.00	727.00	22,311	17,213	23,293
3.00	728.00	24,847	23,579	46,872
4.00	729.00	27,408	26,128	73,000
5.00	730.00	30,487	28,948	101,947
6.00	731.00	34,288	32,388	134,335
7.00	732.00	39,227	36,758	171,092



Pond Report

Project Name:

Hydrology Studio v 3.0.0.16

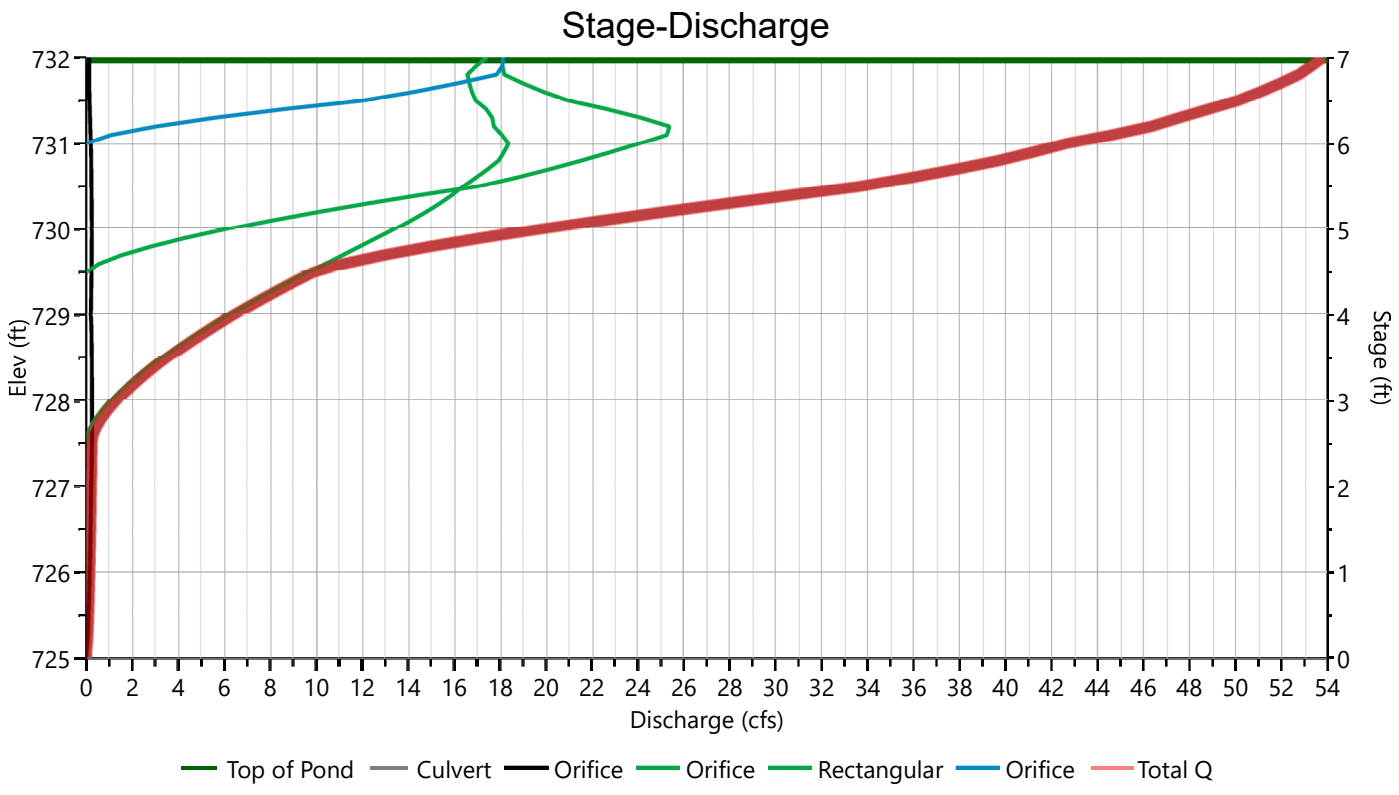
12-14-2020

DETENTION BASIN

Stage-Discharge

Culvert / Orifices	Culvert	Orifices			Orifice Plate	
		1*	2*	3*		
Rise, in	30	2.5	12	6	Orifice Dia, in	
Span, in	30	2.5	30	30	No. Orifices	
No. Barrels	1	1	2	4	Invert Elevation, ft	
Invert Elevation, ft	725.00	725.00	729.50	731.00	Height, ft	
Orifice Coefficient, Co	0.60	0.60	0.60	0.60	Orifice Coefficient, Co	
Length, ft	8					
Barrel Slope, %	.5					
N-Value, n	0.013					
Weirs	**Riser***	**Weirs**			**Ancillary**	
		1	2*	3		
Shape / Type	Box	Rectangular	Rectangular		Exfiltration, in/hr	
Crest Elevation, ft	732	731.5	727.56			
Crest Length, ft	12	10	1.08			
Angle, deg						
Weir Coefficient, Cw	3.3		3.3			

*Routes through Culvert.



DETENTION BASIN

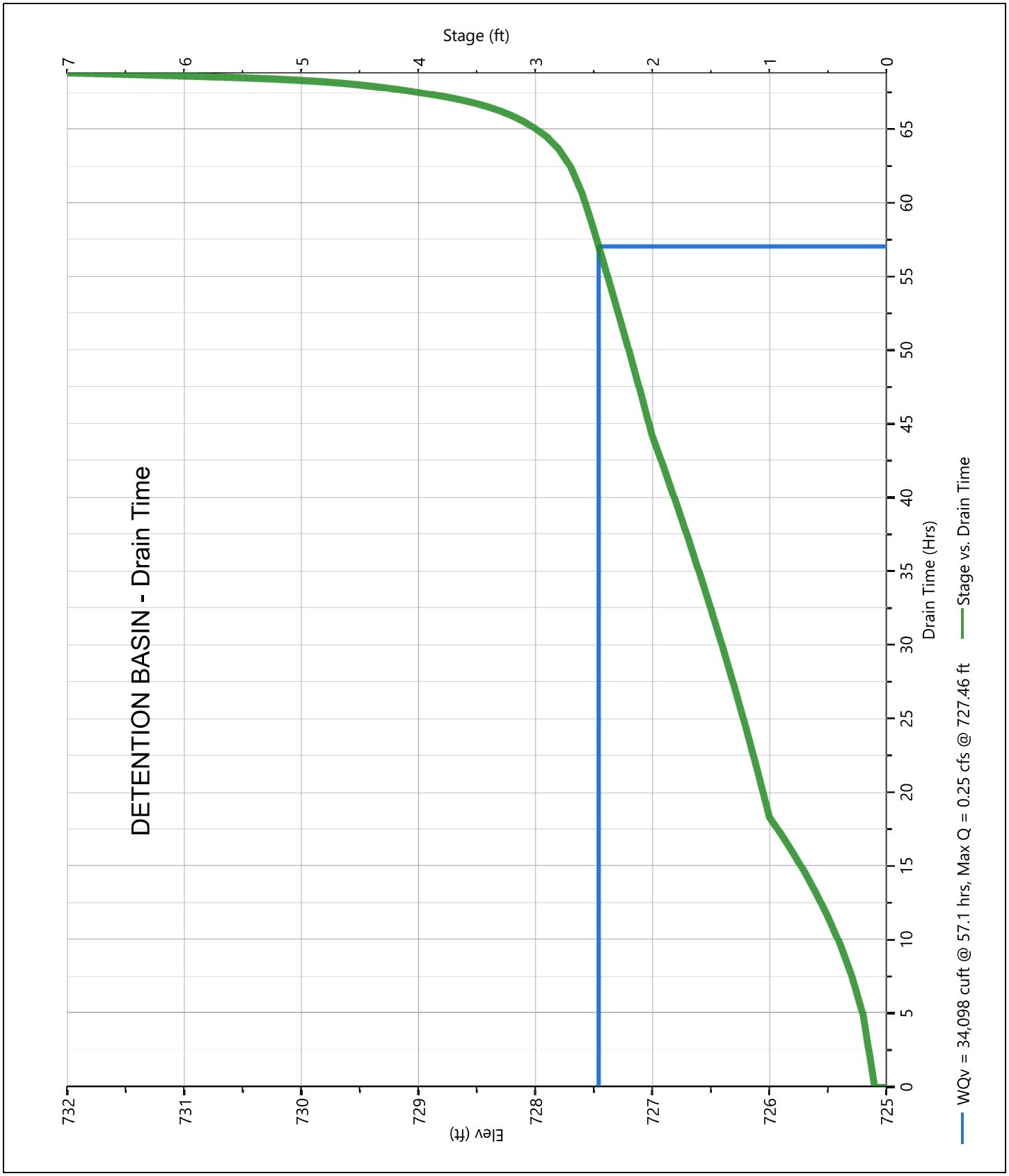
Stage-Storage-Discharge Summary

Stage (ft)	Elev. (ft)	Storage (cuft)	Culvert (cfs)	Orifices, cfs			Riser (cfs)	Weirs, cfs			Pf Riser (cfs)	Exfil (cfs)	User (cfs)	Total (cfs)
				1	2	3		1	2	3				
0.00	725.00	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					0.000
1.00	726.00	6,080	0.150 oc	0.150	0.000	0.000	0.000	0.000	0.000					0.150
2.00	727.00	23,293	0.220 oc	0.220	0.000	0.000	0.000	0.000	0.000					0.220
3.00	728.00	46,872	1.292 oc	0.252	0.000	0.000	0.000	0.000	1.040					1.292
4.00	729.00	73,000	6.360 oc	0.201	0.000	0.000	0.000	0.000	6.159					6.360
5.00	730.00	101,947	19.63 oc	0.241	6.019	0.000	0.000	0.000	13.37 s					19.63
6.00	731.00	134,335	42.64 ic	0.201	24.07	0.000	0.000	0.000	18.37 s					42.64
7.00	732.00	171,092	53.80 ic	0.124	18.13	18.13	0.000	0.000	17.42 s					53.80

Suffix key: ic = inlet control, oc = outlet control, s = submerged weir

DETENTION BASIN

Extended Detention



Design Storm Report

Custom Storm filename:

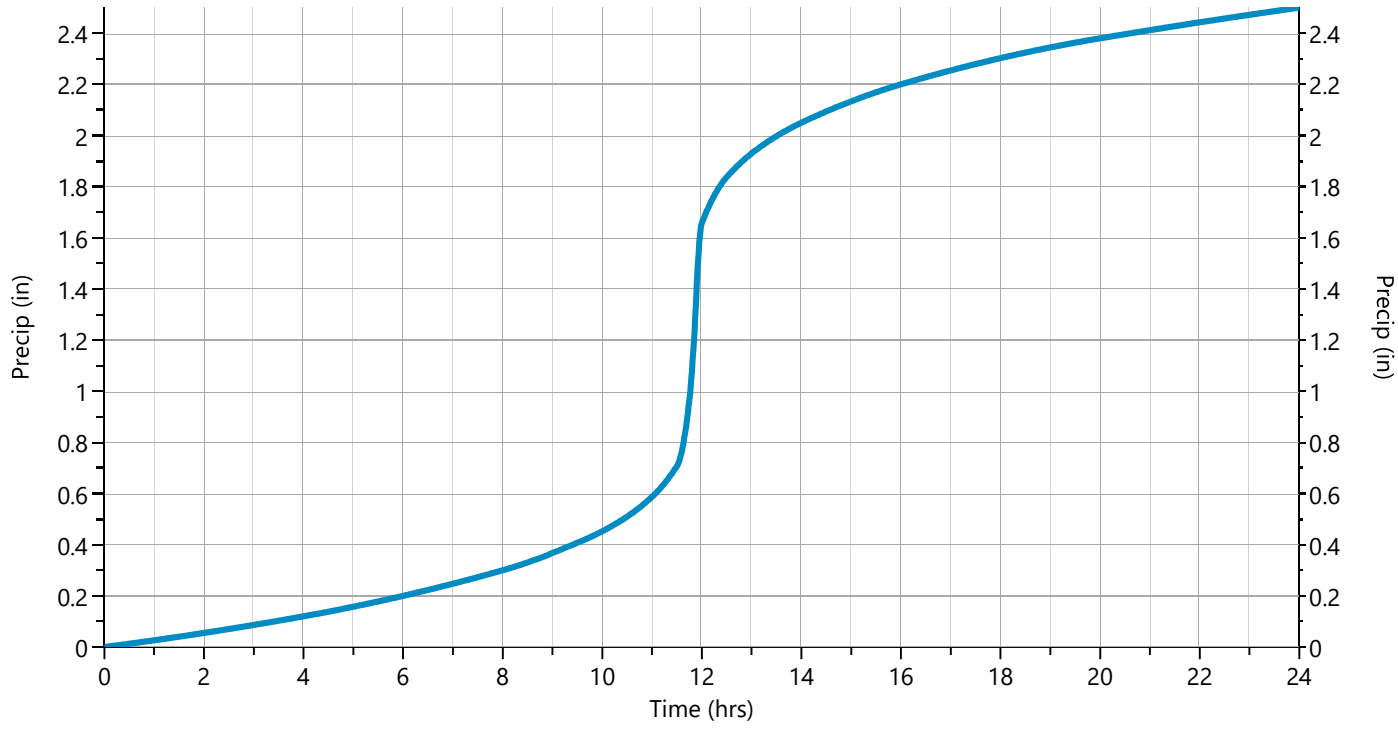
Hydrology Studio v 3.0.0.16

12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	✔ 1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

Incremental Rainfall Distribution, 1-yr									
Time (hrs)	**Precip (in)**	**Time (hrs)**	**Precip (in)**	**Time (hrs)**	**Precip (in)**	**Time (hrs)**	**Precip (in)**	**Time (hrs)**	**Precip (in)**
11.42	0.004633	11.60	0.014045	11.78	0.036526	11.97	0.034399	12.15	0.007029
11.43	0.004700	11.62	0.015689	11.80	0.041100	11.98	0.023989	12.17	0.006871
11.45	0.004767	11.63	0.017333	11.82	0.045674	12.00	0.013580	12.18	0.006712
11.47	0.004833	11.65	0.018978	11.83	0.050248	12.02	0.008576	12.20	0.006554
11.48	0.004900	11.67	0.020622	11.85	0.054822	12.03	0.008137	12.22	0.006396
11.50	0.004967	11.68	0.022267	11.87	0.059396	12.05	0.007979	12.23	0.006238
11.52	0.005841	11.70	0.023911	11.88	0.063970	12.07	0.007821	12.25	0.006079
11.53	0.007467	11.72	0.025556	11.90	0.068544	12.08	0.007663	12.27	0.005921
11.55	0.009111	11.73	0.027200	**11.92**	**0.073119**	12.10	0.007504	12.28	0.005762
11.57	0.010756	11.75	0.028844	11.93	0.047813	12.12	0.007346	12.30	0.005604
11.58	0.012400	11.77	0.031710	11.95	0.044809	12.13	0.007187	12.32	0.005446



Hydrograph 2-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	22.72	12.13	79,327	----		
2	NRCS Runoff	Post DEVELOPED	52.06	11.98	118,383	----		
3	Pond Route	Post DETENTION BASIN	4.202	12.62	98,502	2	728.63	63,424

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

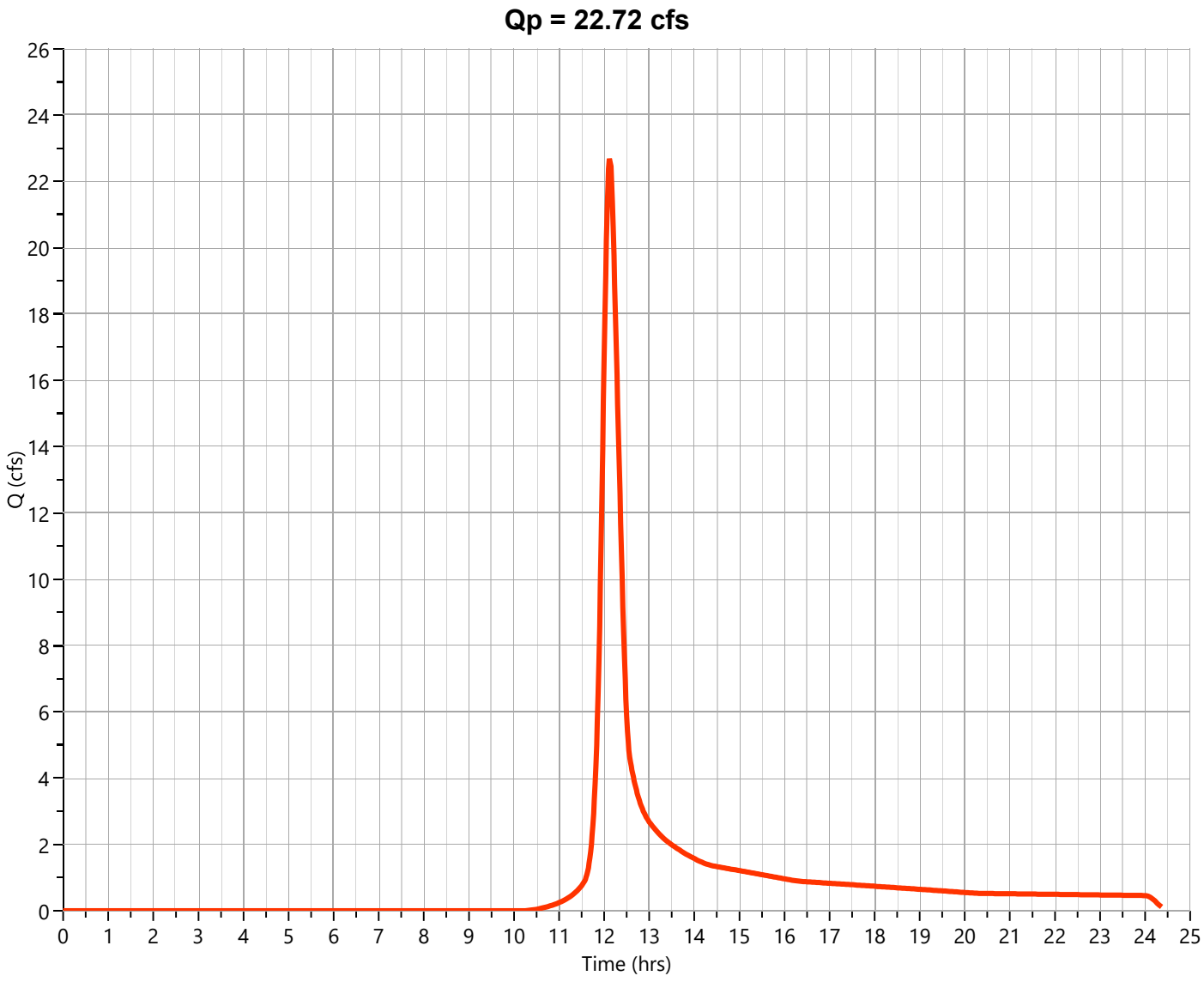
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 22.72 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.13 hrs
Time Interval	= 1 min	Runoff Volume	= 79,327 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 2.90 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

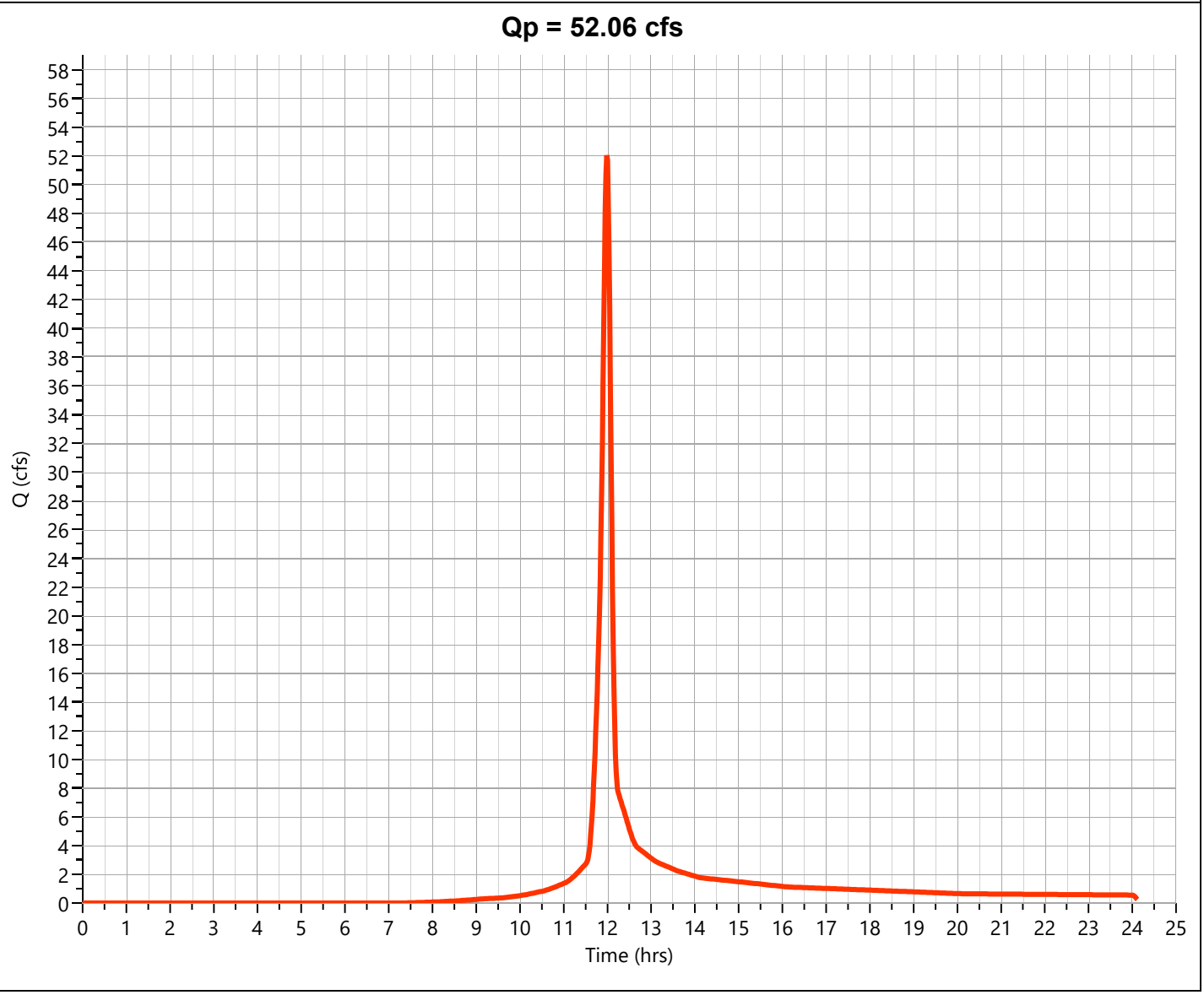
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 52.06 cfs
Storm Frequency	= 2-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 118,383 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 2.90 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

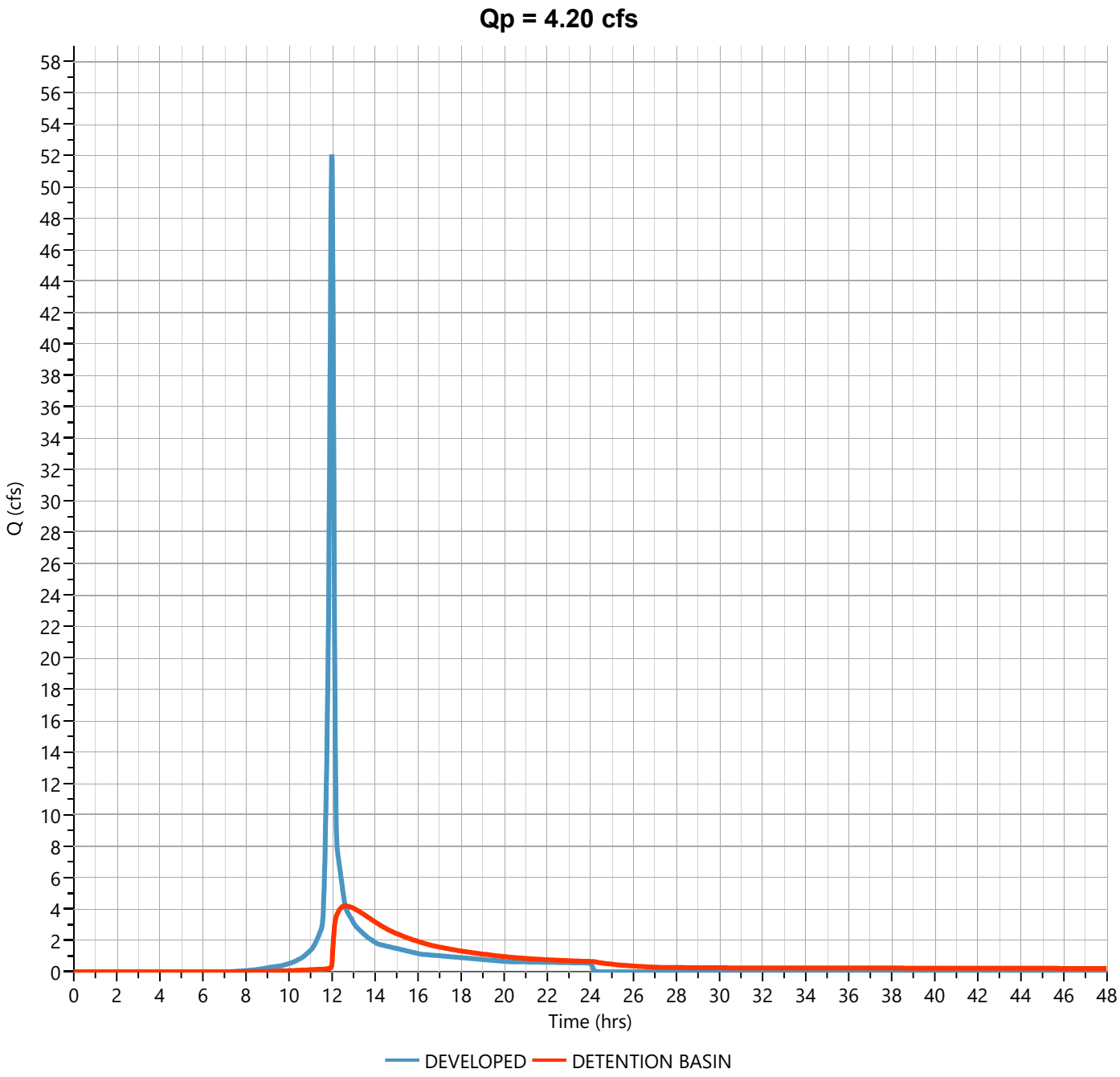
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 4.202 cfs
Storm Frequency	= 2-yr	Time to Peak	= 12.62 hrs
Time Interval	= 1 min	Hydrograph Volume	= 98,502 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 728.63 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 63,424 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 6.51 hrs



Design Storm Report

Custom Storm filename:

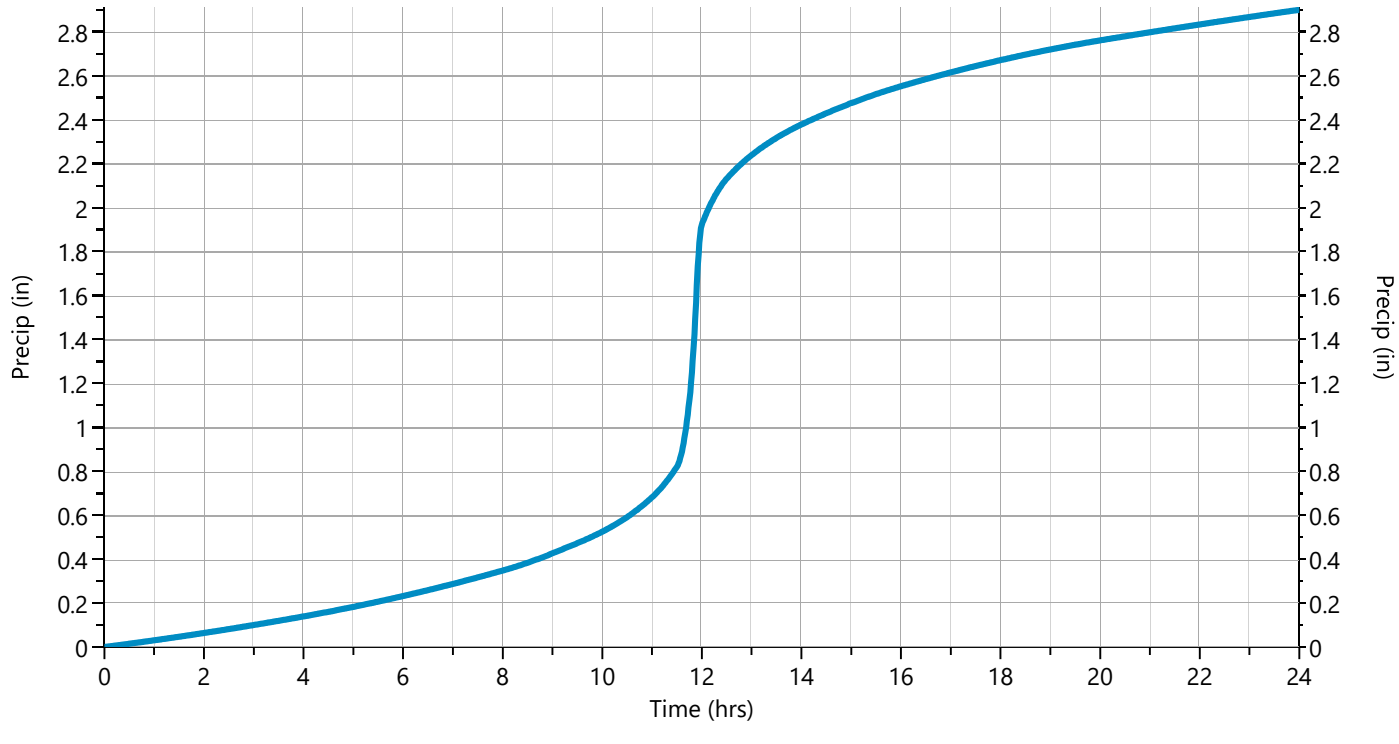
Hydrology Studio v 3.0.0.16

12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	1-yr	✔ 2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

Incremental Rainfall Distribution, 2-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.42	0.005375	11.60	0.016292	11.78	0.042370	11.97	0.039903	12.15	0.008154
11.43	0.005452	11.62	0.018199	11.80	0.047676	11.98	0.027828	12.17	0.007970
11.45	0.005529	11.63	0.020107	11.82	0.052982	12.00	0.015752	12.18	0.007787
11.47	0.005607	11.65	0.022014	11.83	0.058288	12.02	0.009948	12.20	0.007603
11.48	0.005684	11.67	0.023922	11.85	0.063594	12.03	0.009440	12.22	0.007419
11.50	0.005761	11.68	0.025829	11.87	0.068900	12.05	0.009256	12.23	0.007236
11.52	0.006775	11.70	0.027737	11.88	0.074206	12.07	0.009072	12.25	0.007052
11.53	0.008661	11.72	0.029644	11.90	0.079512	12.08	0.008888	12.27	0.006868
11.55	0.010569	11.73	0.031552	**11.92**	**0.084818**	12.10	0.008705	12.28	0.006685
11.57	0.012477	11.75	0.033460	11.93	0.055463	12.12	0.008521	12.30	0.006501
11.58	0.014384	11.77	0.036784	11.95	0.051978	12.13	0.008337	12.32	0.006317



Hydrograph 5-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	34.11	12.12	116,873	----		
2	NRCS Runoff	Post DEVELOPED	70.91	11.98	162,839	----		
3	Pond Route	Post DETENTION BASIN	8.911	12.35	142,537	2	729.37	83,744

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

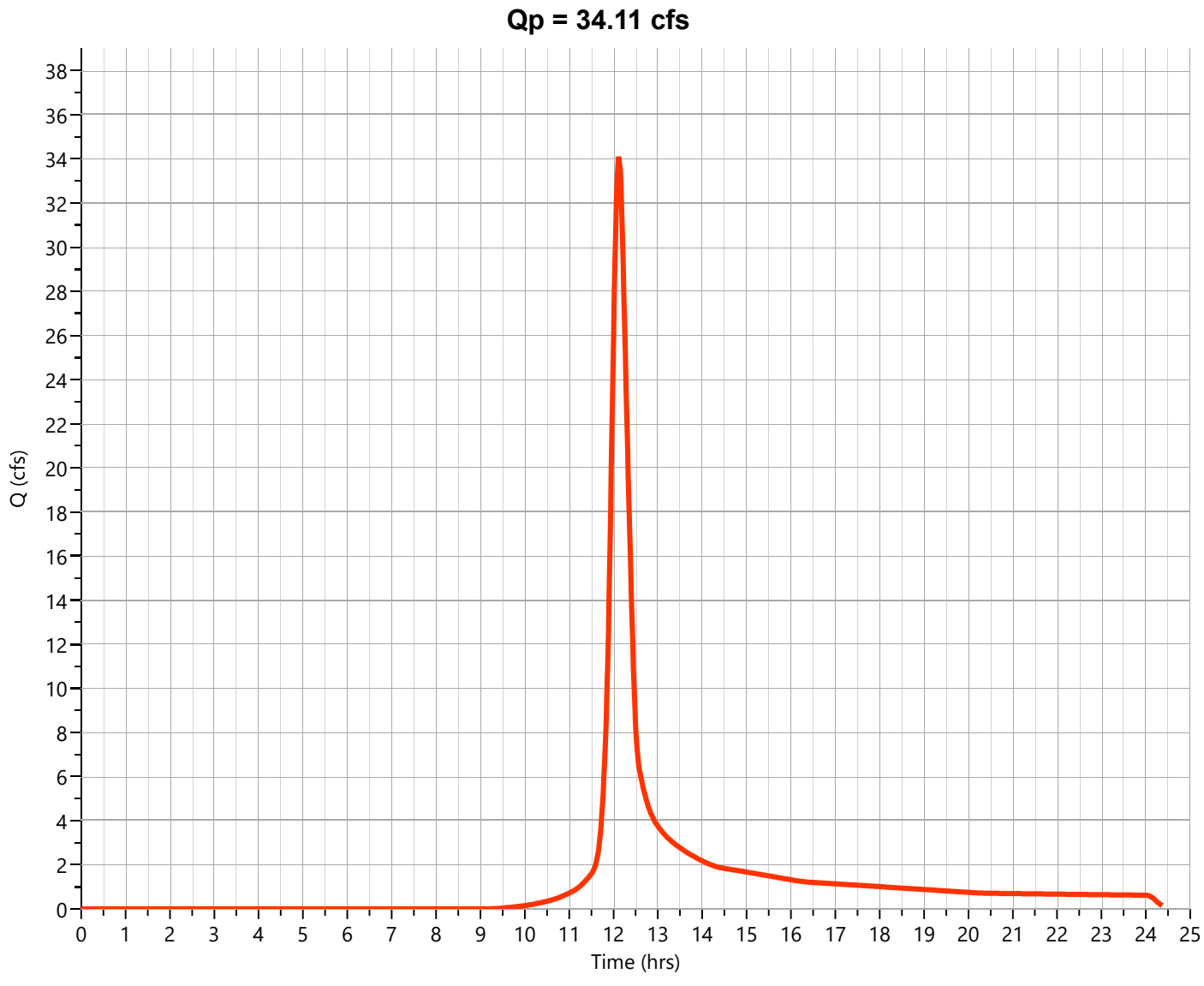
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 34.11 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.12 hrs
Time Interval	= 1 min	Runoff Volume	= 116,873 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 3.60 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

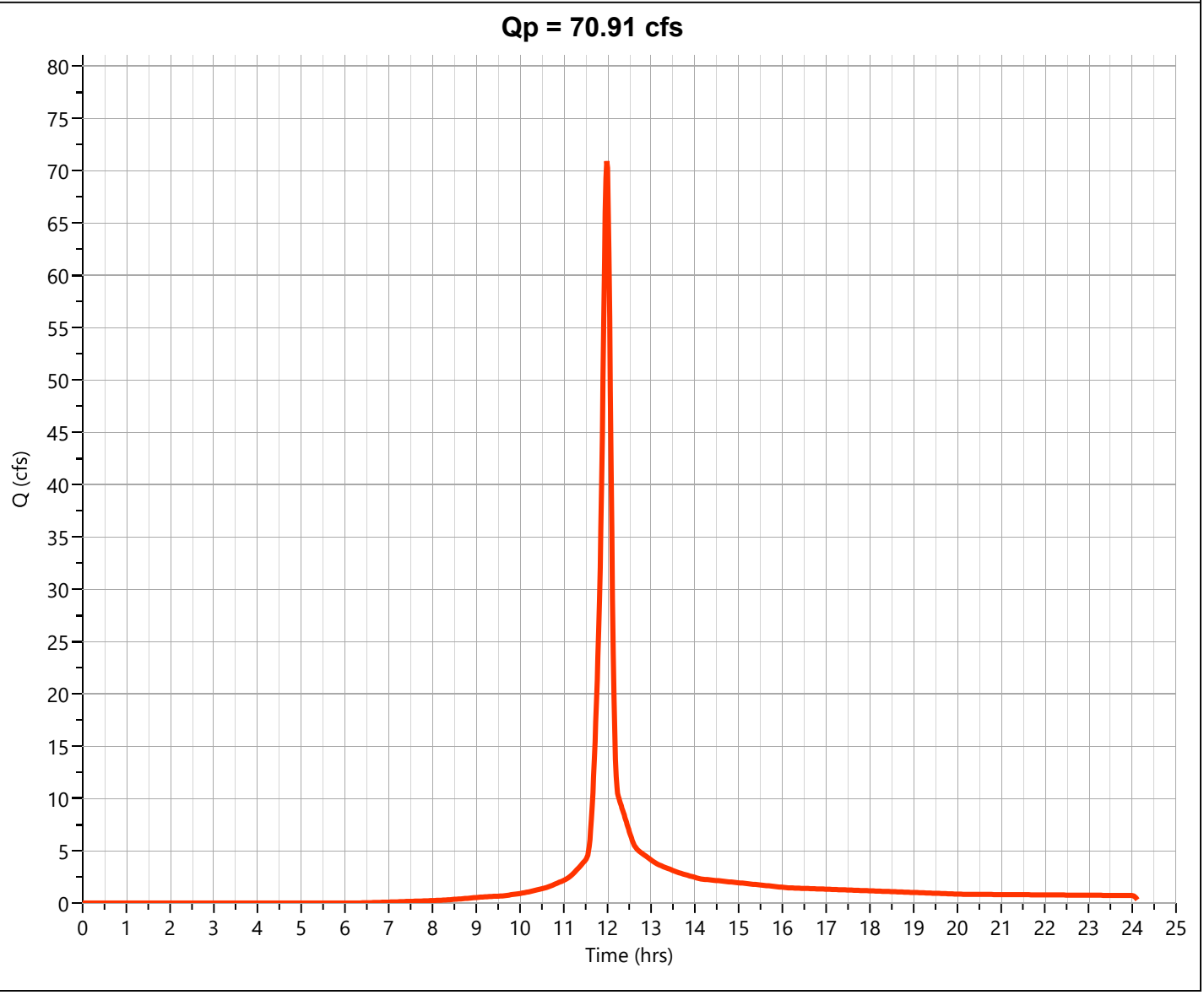
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 70.91 cfs
Storm Frequency	= 5-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 162,839 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 3.60 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Hydrology Studio v 3.0.0.16

12-14-2020

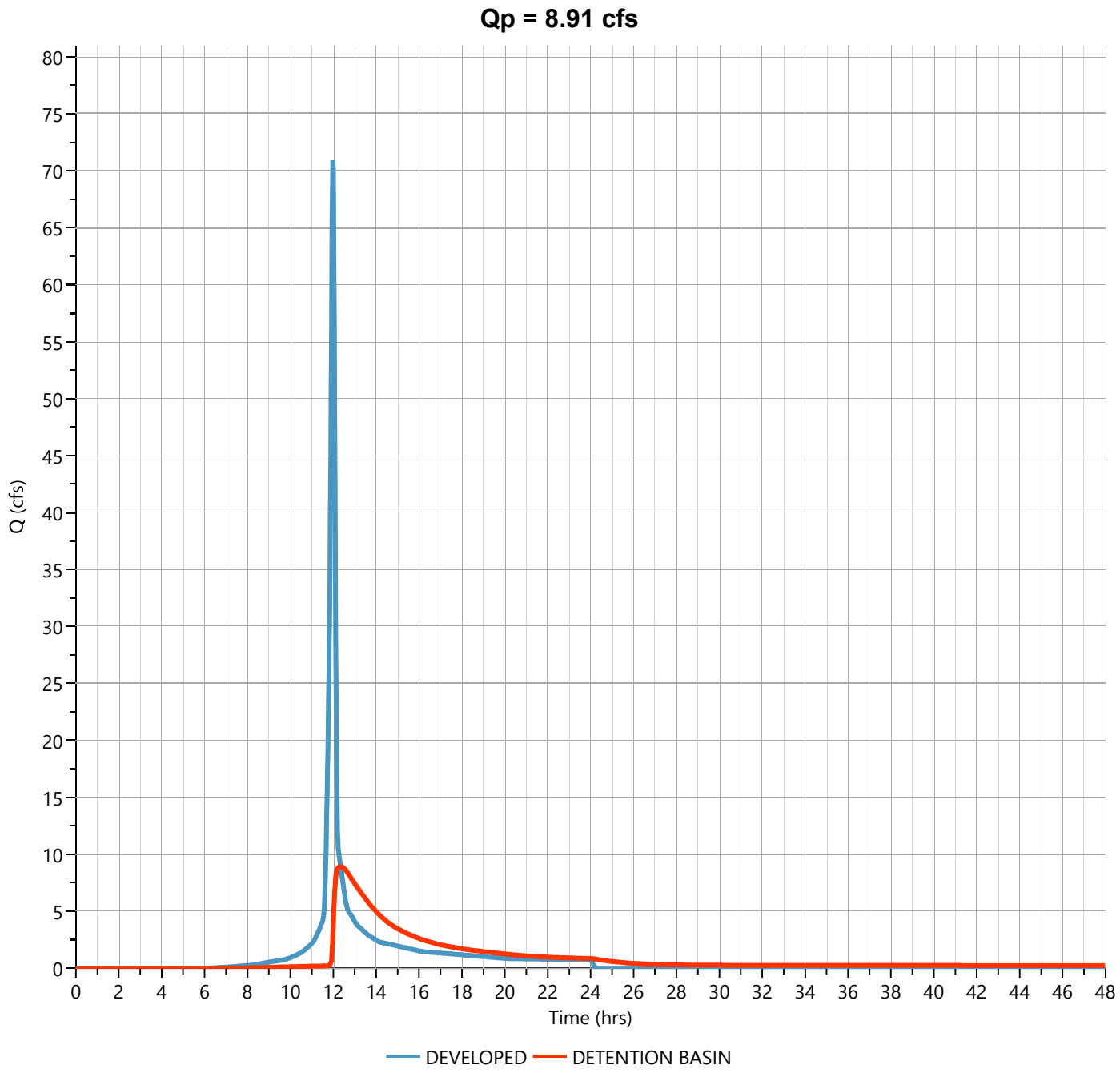
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 8.911 cfs
Storm Frequency	= 5-yr	Time to Peak	= 12.35 hrs
Time Interval	= 1 min	Hydrograph Volume	= 142,537 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 729.37 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 83,744 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 4.99 hrs



Design Storm Report

Custom Storm filename:

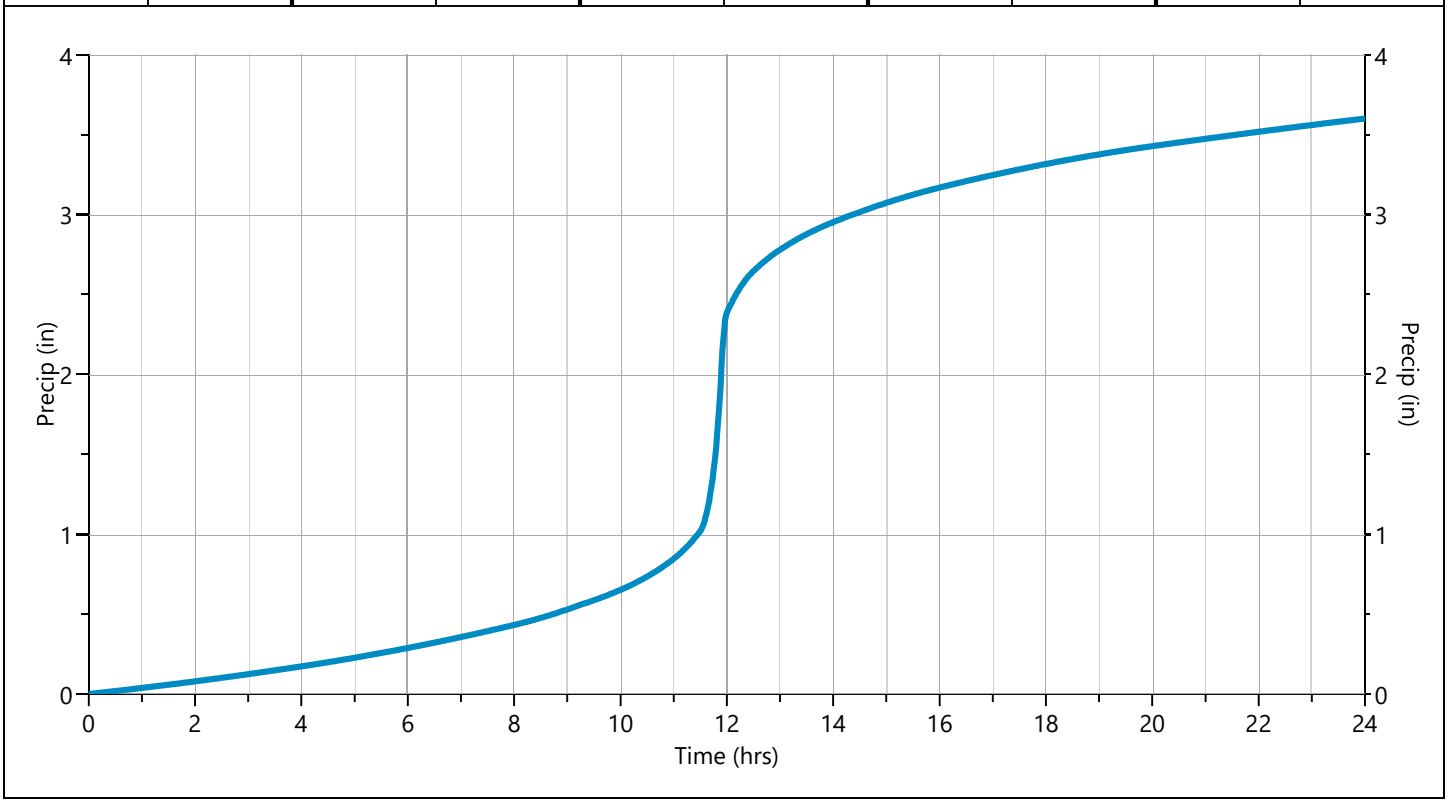
Hydrology Studio v 3.0.0.16

12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	✔ 5-yr	10-yr	25-yr	50-yr	100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

Incremental Rainfall Distribution, 5-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.42	0.006672	11.60	0.020224	11.78	0.052597	11.97	0.049535	12.15	0.010122
11.43	0.006768	11.62	0.022592	11.80	0.059184	11.98	0.034545	12.17	0.009894
11.45	0.006864	11.63	0.024960	11.82	0.065771	12.00	0.019555	12.18	0.009666
11.47	0.006960	11.65	0.027328	11.83	0.072357	12.02	0.012349	12.20	0.009438
11.48	0.007056	11.67	0.029696	11.85	0.078944	12.03	0.011718	12.22	0.009210
11.50	0.007152	11.68	0.032064	11.87	0.085531	12.05	0.011490	12.23	0.008982
11.52	0.008411	11.70	0.034432	11.88	0.092117	12.07	0.011262	12.25	0.008754
11.53	0.010752	11.72	0.036800	11.90	0.098704	12.08	0.011034	12.27	0.008526
11.55	0.013120	11.73	0.039168	**11.92**	**0.105291**	12.10	0.010806	12.28	0.008298
11.57	0.015488	11.75	0.041536	11.93	0.068851	12.12	0.010578	12.30	0.008070
11.58	0.017856	11.77	0.045663	11.95	0.064525	12.13	0.010350	12.32	0.007842



Hydrograph 10-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	42.69	12.12	145,373	----		
2	NRCS Runoff	Post DEVELOPED	84.51	11.98	195,517	----		
3	Pond Route	Post DETENTION BASIN	16.51	12.18	174,984	2	729.87	98,201

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

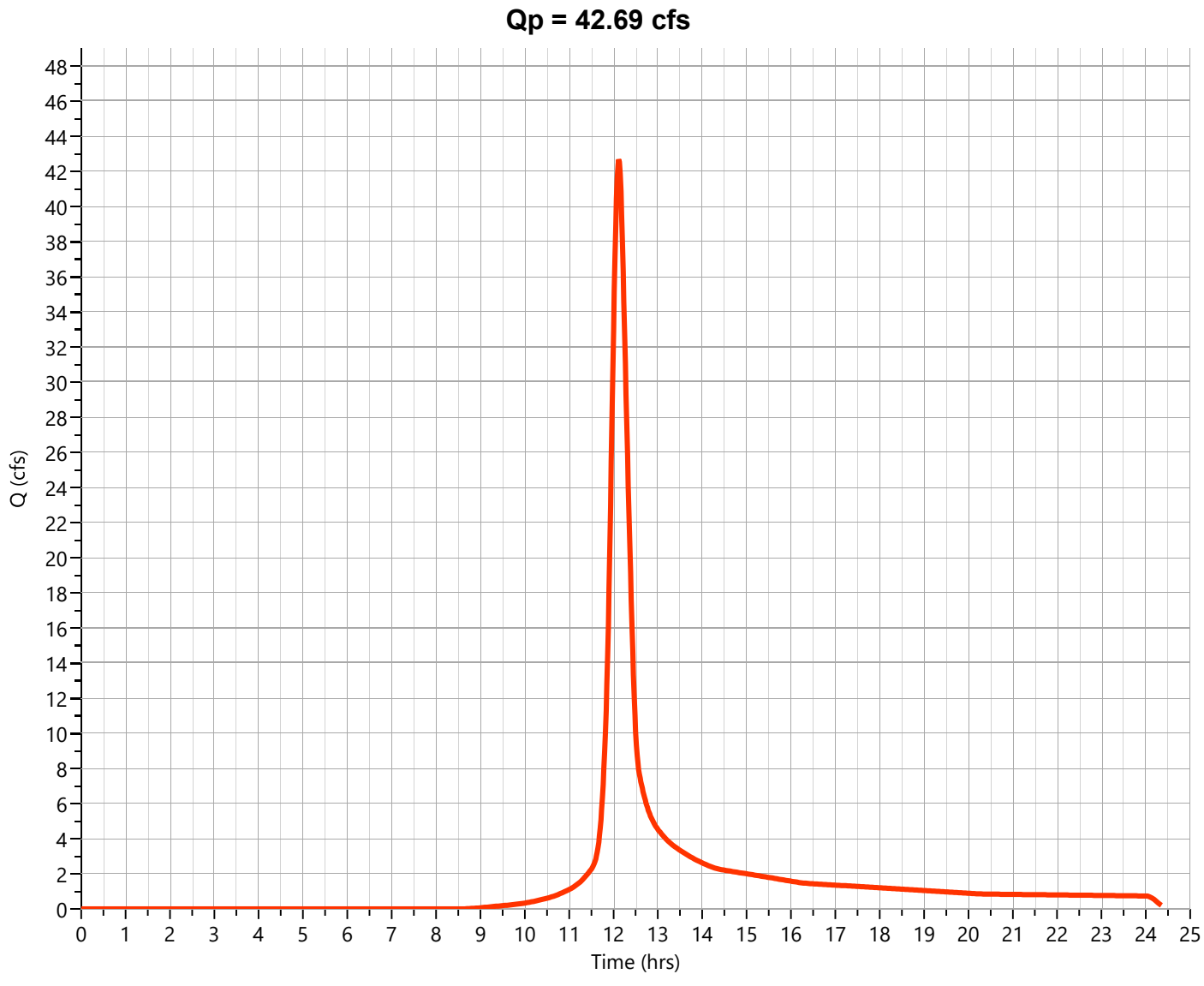
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 42.69 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.12 hrs
Time Interval	= 1 min	Runoff Volume	= 145,373 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 4.10 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

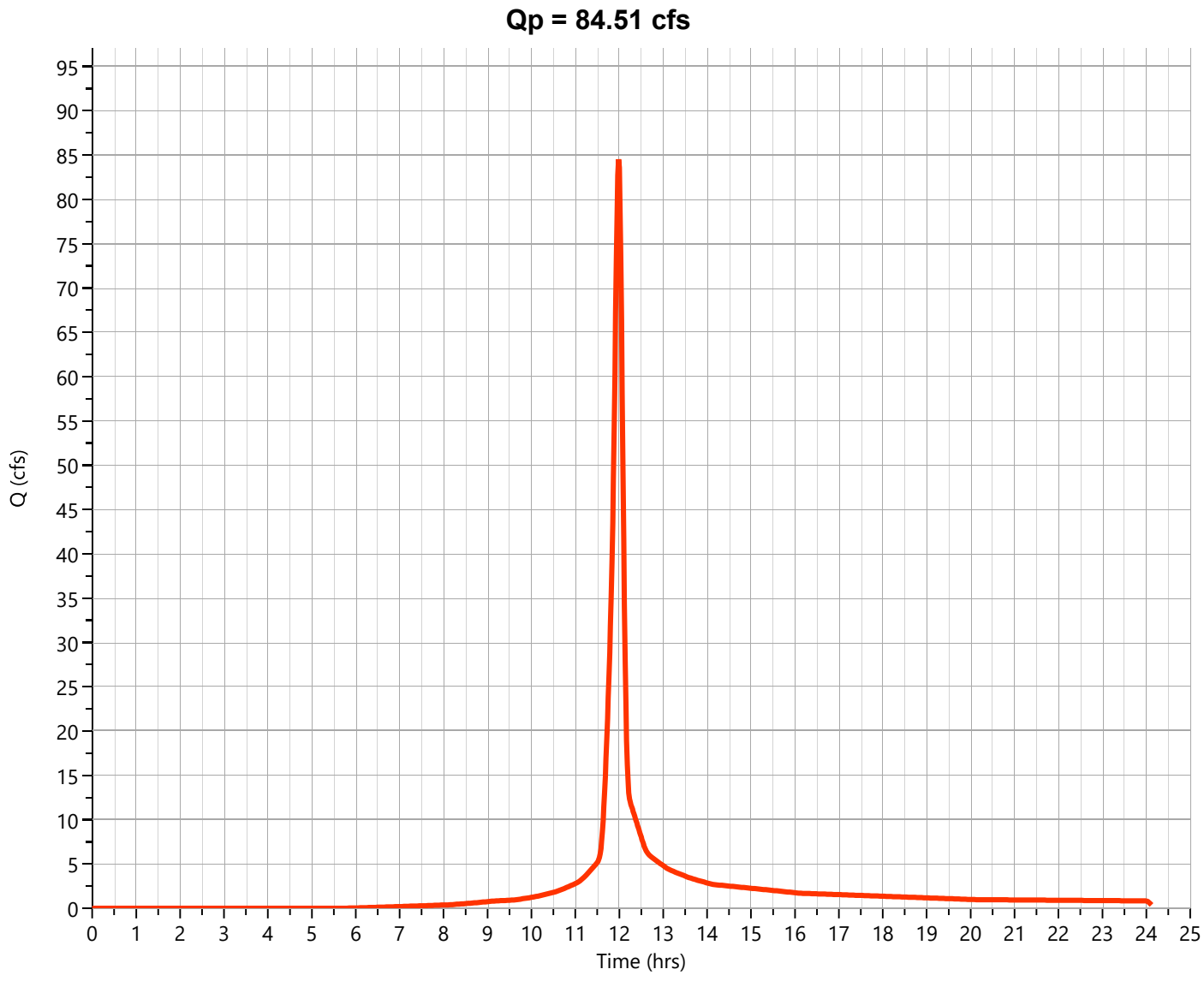
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 84.51 cfs
Storm Frequency	= 10-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 195,517 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 4.10 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Hydrology Studio v 3.0.0.16

12-14-2020

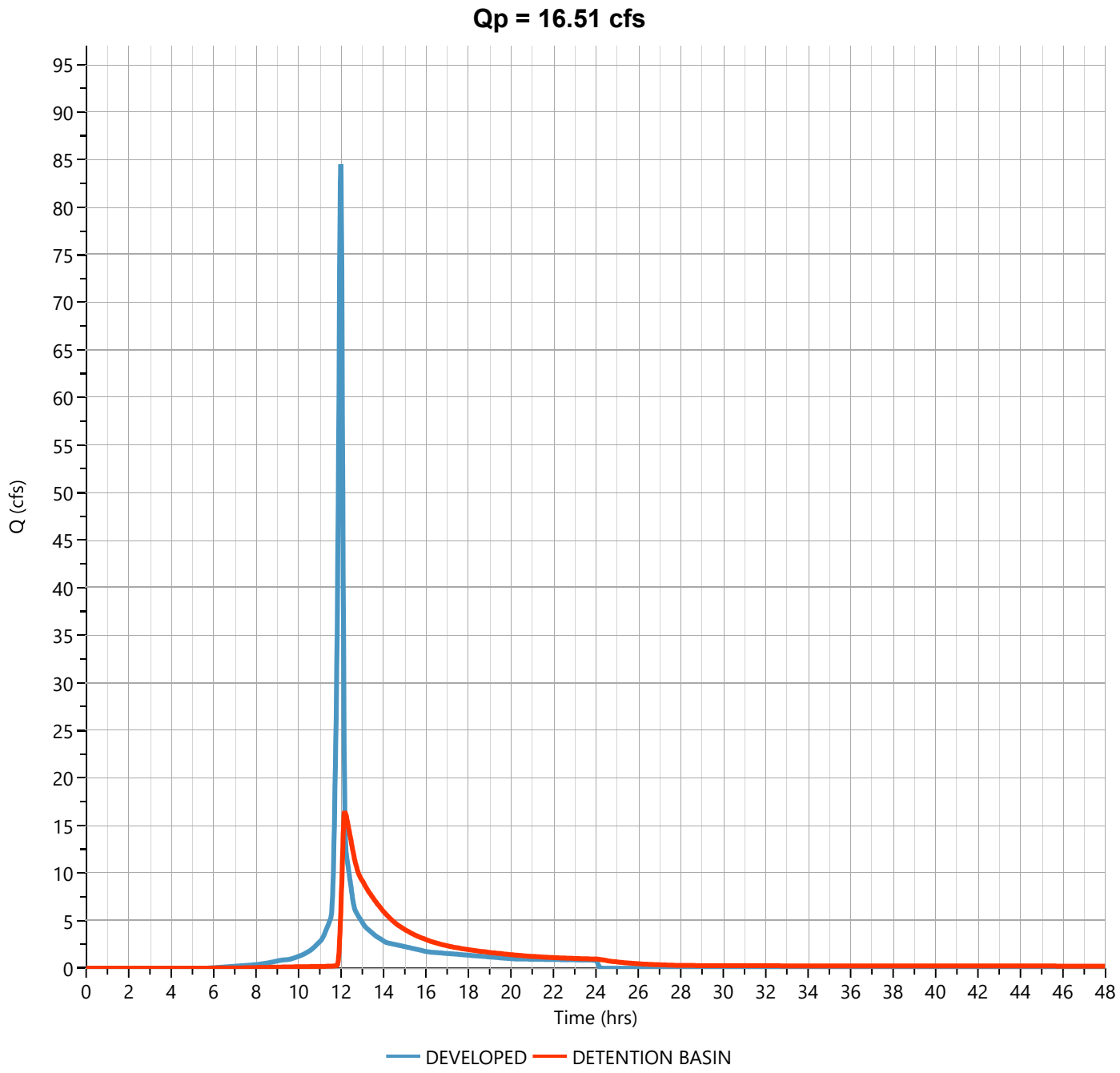
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 16.51 cfs
Storm Frequency	= 10-yr	Time to Peak	= 12.18 hrs
Time Interval	= 1 min	Hydrograph Volume	= 174,984 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 729.87 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 98,201 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 4.38 hrs



Design Storm Report

Custom Storm filename:

Hydrology Studio v 3.0.0.16

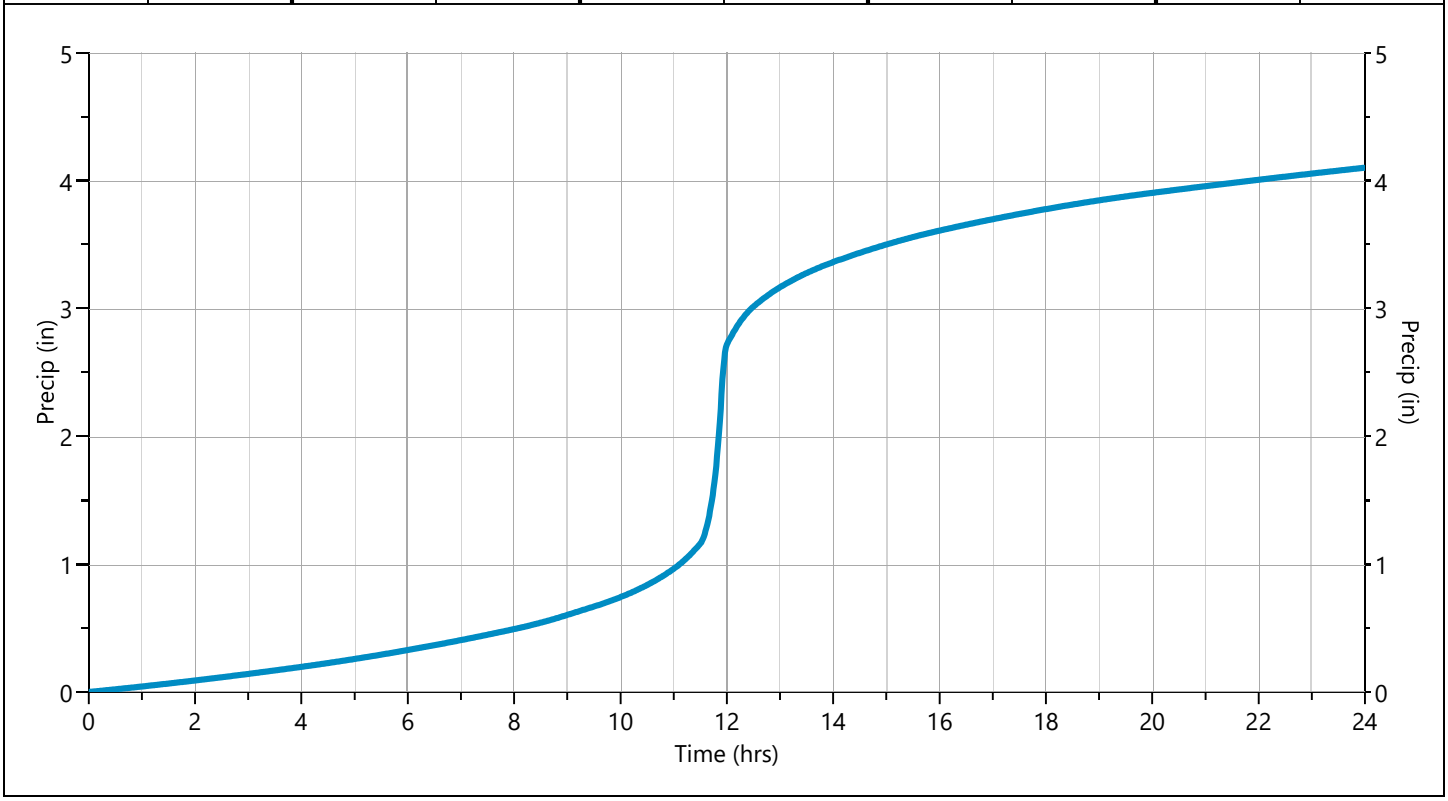
12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	✔ 10-yr	25-yr	50-yr	100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

Incremental Rainfall Distribution, 10-yr

Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.42	0.007599	11.60	0.023033	11.78	0.059903	11.97	0.056415	12.15	0.011528
11.43	0.007708	11.62	0.025730	11.80	0.067404	11.98	0.039343	12.17	0.011268
11.45	0.007817	11.63	0.028427	11.82	0.074906	12.00	0.022271	12.18	0.011009
11.47	0.007927	11.65	0.031124	11.83	0.082407	12.02	0.014064	12.20	0.010749
11.48	0.008036	11.67	0.033821	11.85	0.089909	12.03	0.013345	12.22	0.010489
11.50	0.008145	11.68	0.036517	11.87	0.097410	12.05	0.013086	12.23	0.010230
11.52	0.009579	11.70	0.039214	11.88	0.104912	12.07	0.012826	12.25	0.009970
11.53	0.012245	11.72	0.041911	11.90	0.112413	12.08	0.012567	12.27	0.009710
11.55	0.014942	11.73	0.044608	**11.92**	**0.119914**	12.10	0.012307	12.28	0.009450
11.57	0.017639	11.75	0.047305	11.93	0.078414	12.12	0.012047	12.30	0.009191
11.58	0.020336	11.77	0.052004	11.95	0.073487	12.13	0.011787	12.32	0.008931



Hydrograph 25-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	53.29	12.12	180,936	----		
2	NRCS Runoff	Post DEVELOPED	100.9	11.98	235,436	----		
3	Pond Route	Post DETENTION BASIN	29.67	12.15	214,681	2	730.37	113,784

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

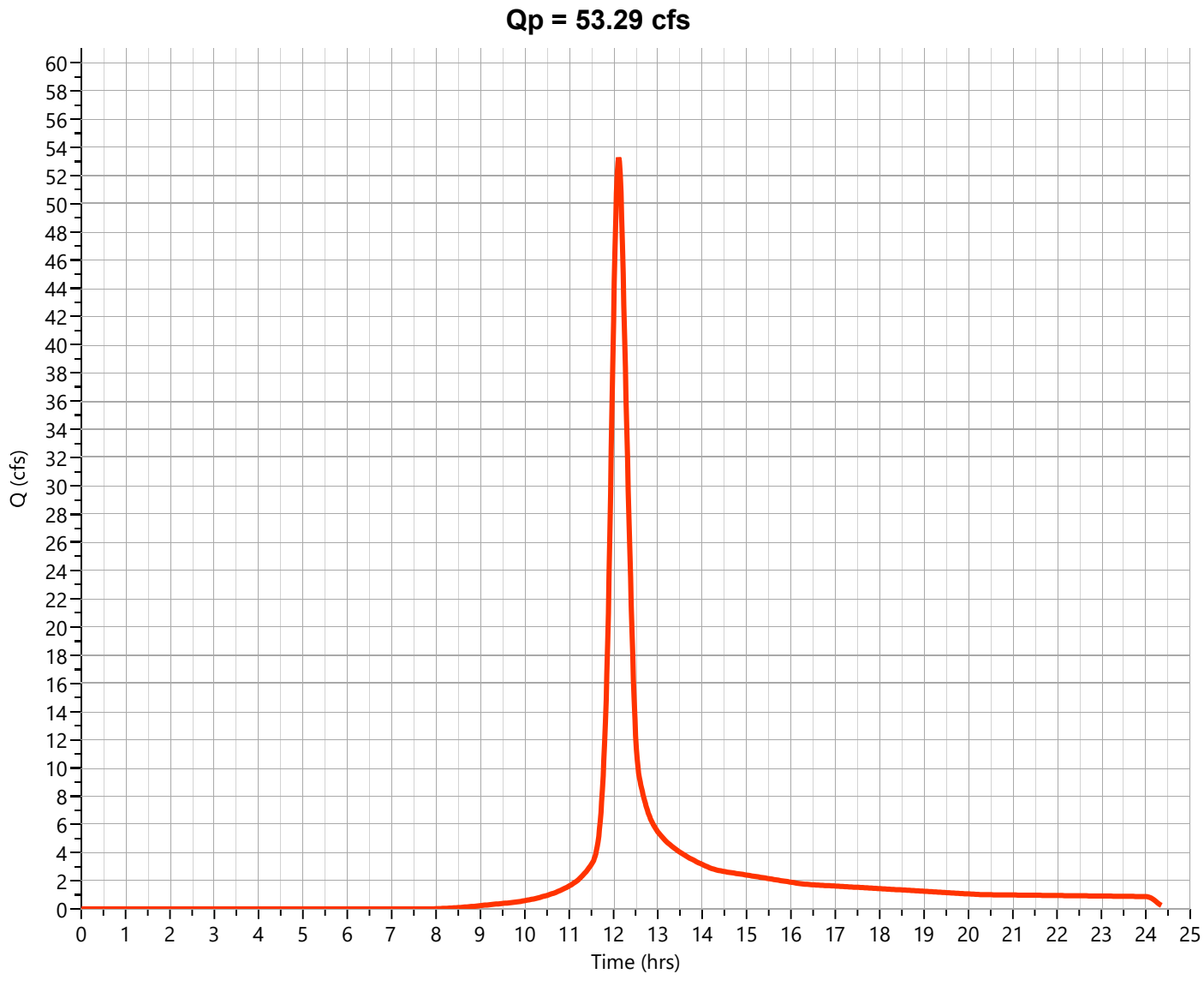
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 53.29 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.12 hrs
Time Interval	= 1 min	Runoff Volume	= 180,936 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 4.70 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

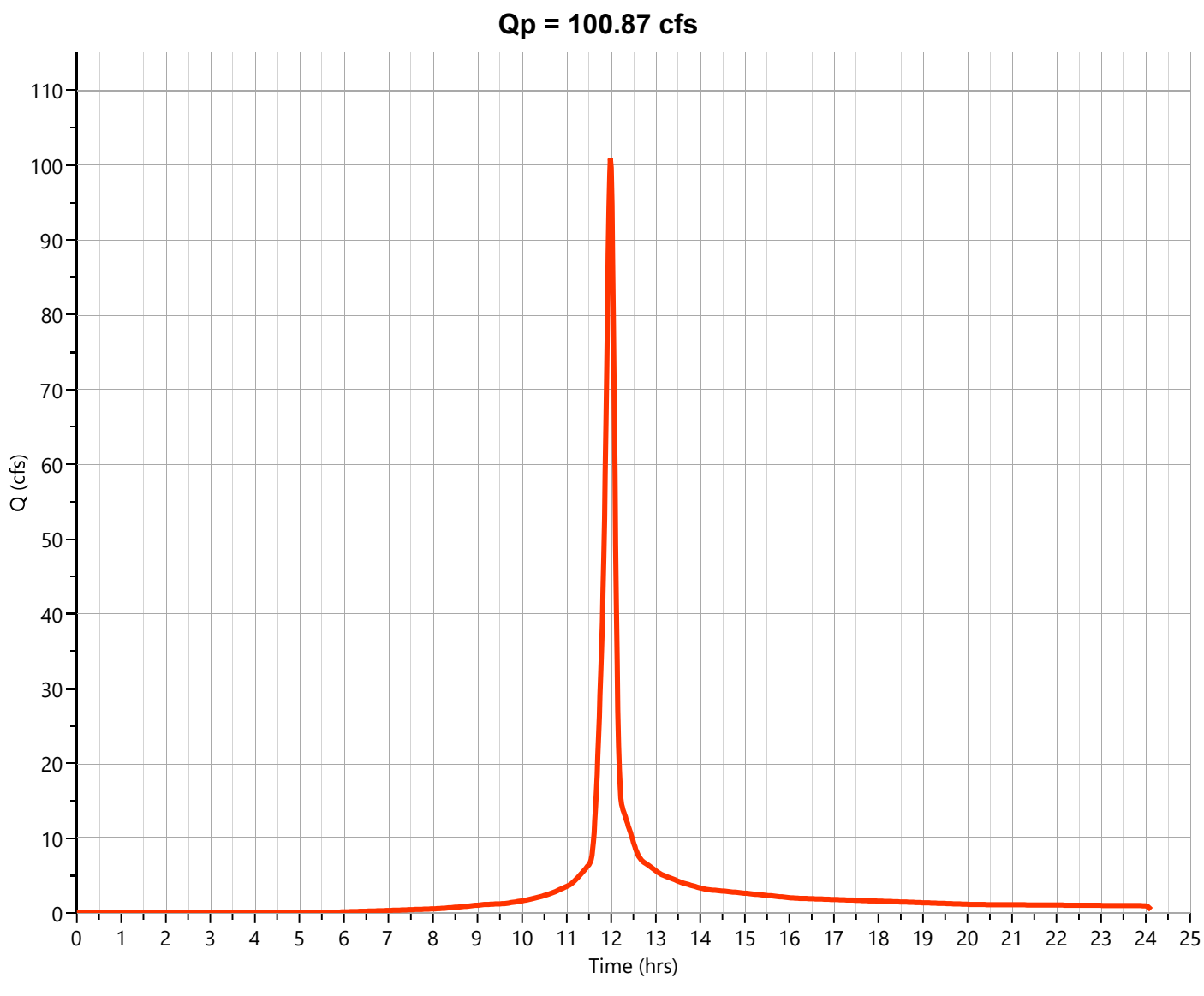
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 100.9 cfs
Storm Frequency	= 25-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 235,436 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 4.70 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Hydrology Studio v 3.0.0.16

12-14-2020

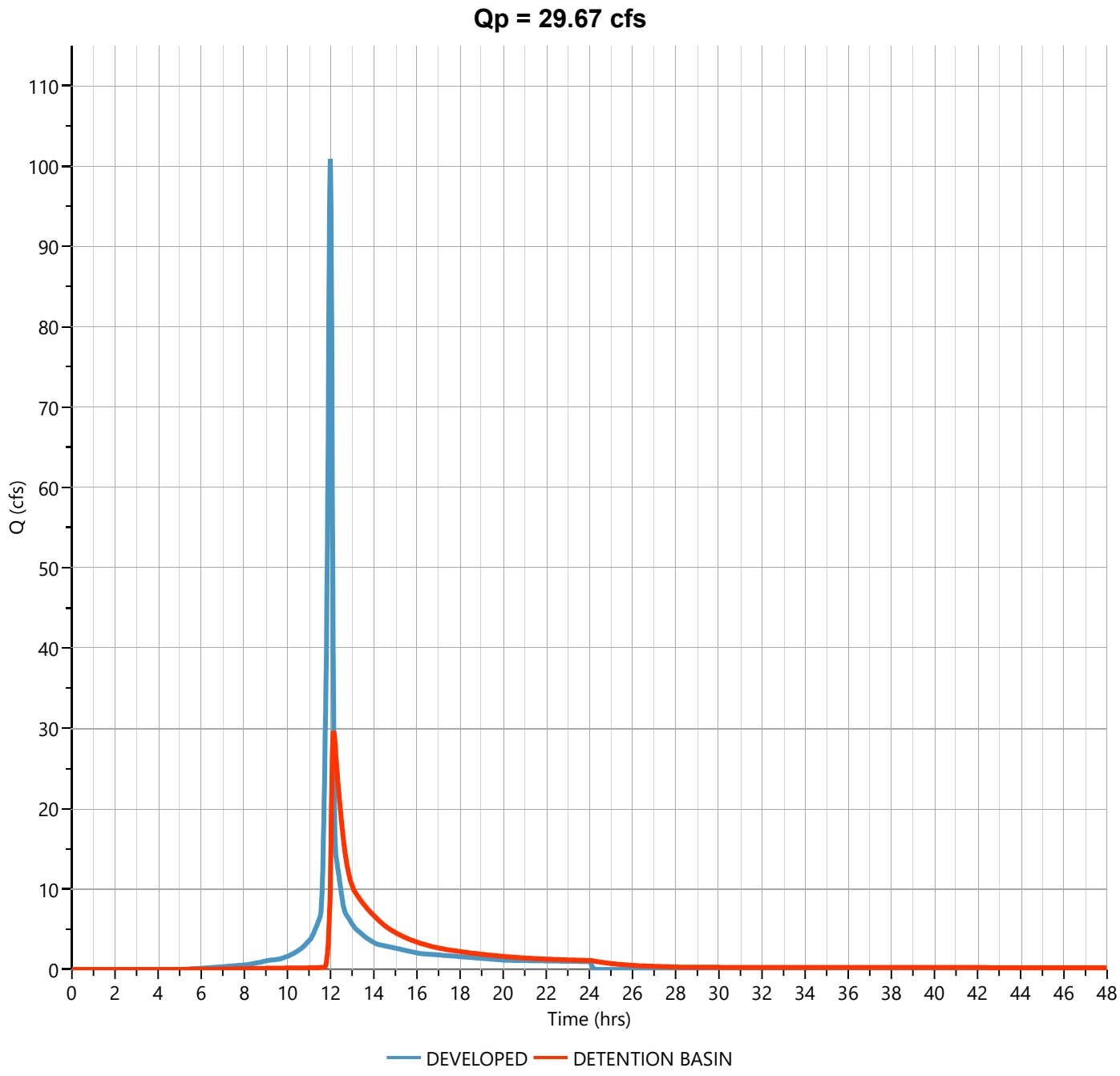
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 29.67 cfs
Storm Frequency	= 25-yr	Time to Peak	= 12.15 hrs
Time Interval	= 1 min	Hydrograph Volume	= 214,681 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 730.37 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 113,784 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 2.11 hrs



Design Storm Report

Custom Storm filename:

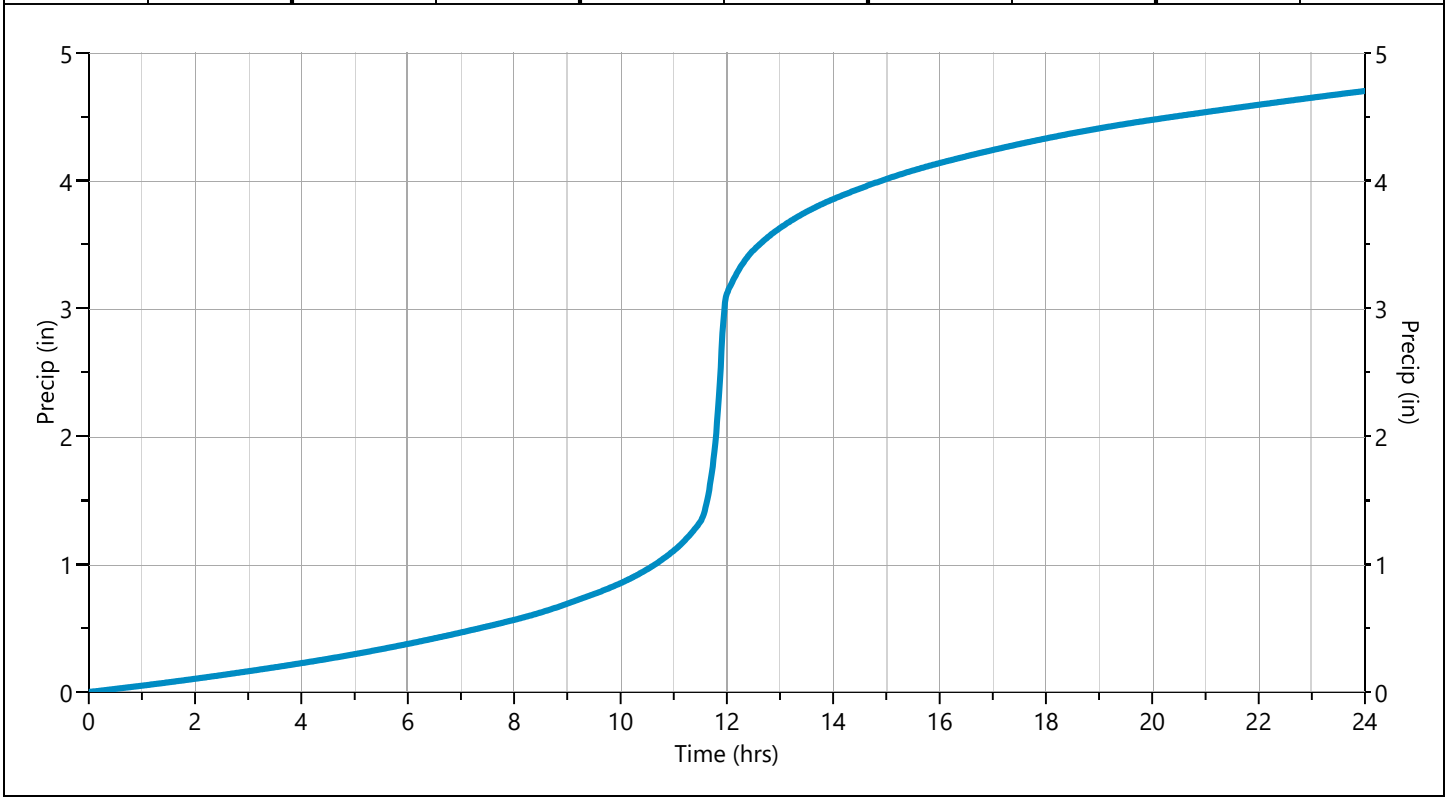
Hydrology Studio v 3.0.0.16

12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	✔ 25-yr	50-yr	100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

Incremental Rainfall Distribution, 25-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.42	0.008711	11.60	0.026404	11.78	0.068669	11.97	0.064670	12.15	0.013215
11.43	0.008836	11.62	0.029495	11.80	0.077268	11.98	0.045100	12.17	0.012917
11.45	0.008961	11.63	0.032587	11.82	0.085867	12.00	0.025530	12.18	0.012620
11.47	0.009087	11.65	0.035678	11.83	0.094467	12.02	0.016122	12.20	0.012322
11.48	0.009212	11.67	0.038770	11.85	0.103066	12.03	0.015298	12.22	0.012024
11.50	0.009337	11.68	0.041861	11.87	0.111665	12.05	0.015001	12.23	0.011727
11.52	0.010981	11.70	0.044953	11.88	0.120264	12.07	0.014703	12.25	0.011429
11.53	0.014037	11.72	0.048045	11.90	0.128864	12.08	0.014405	12.27	0.011131
11.55	0.017129	11.73	0.051136	**11.92**	**0.137463**	12.10	0.014108	12.28	0.010834
11.57	0.020221	11.75	0.054228	11.93	0.089889	12.12	0.013810	12.30	0.010536
11.58	0.023312	11.77	0.059615	11.95	0.084241	12.13	0.013513	12.32	0.010238



Hydrograph 50-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	62.30	12.12	211,458	----		
2	NRCS Runoff	Post DEVELOPED	114.5	11.98	269,142	----		
3	Pond Route	Post DETENTION BASIN	38.90	12.13	248,226	2	730.76	126,496

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

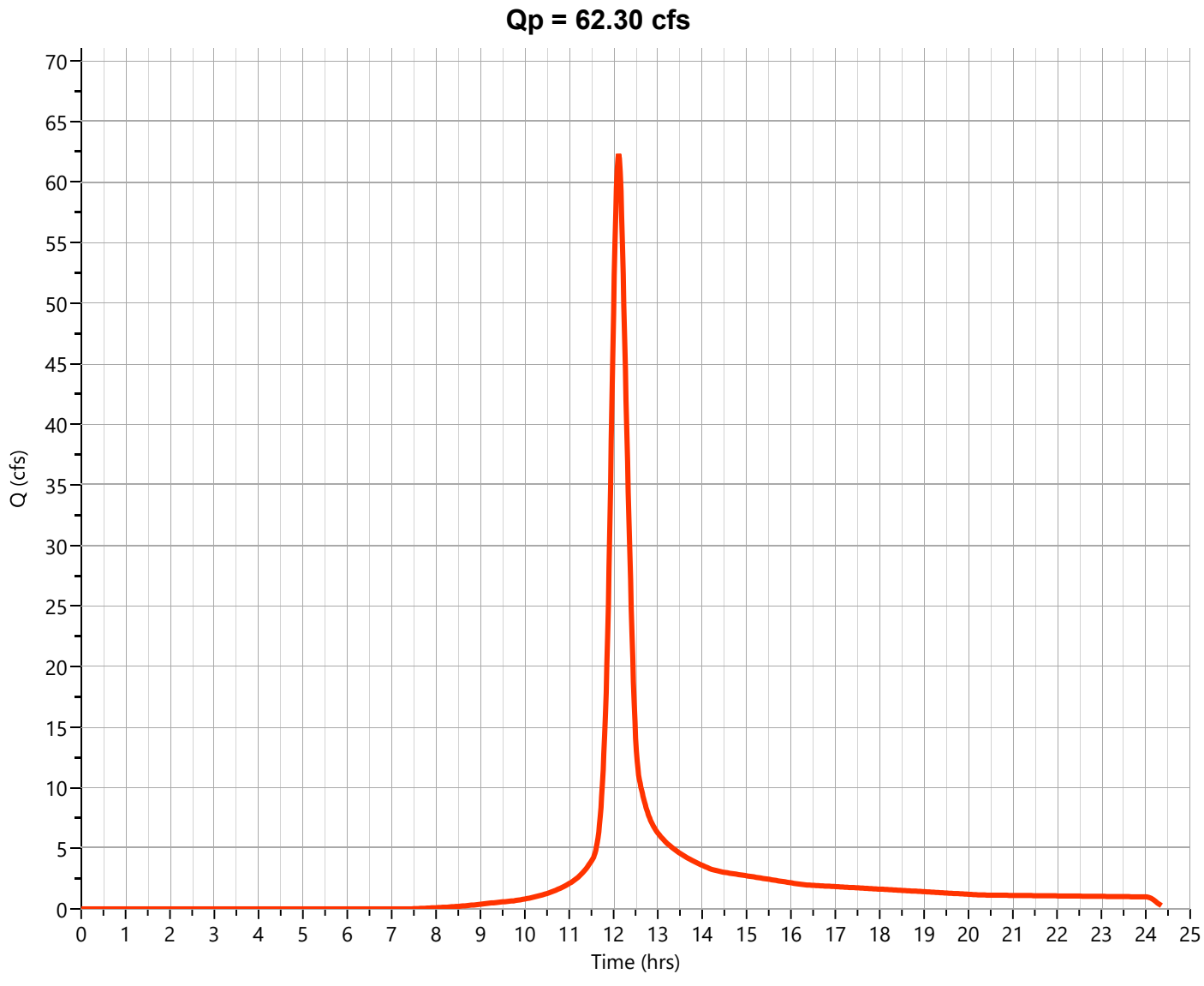
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 62.30 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.12 hrs
Time Interval	= 1 min	Runoff Volume	= 211,458 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 5.20 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

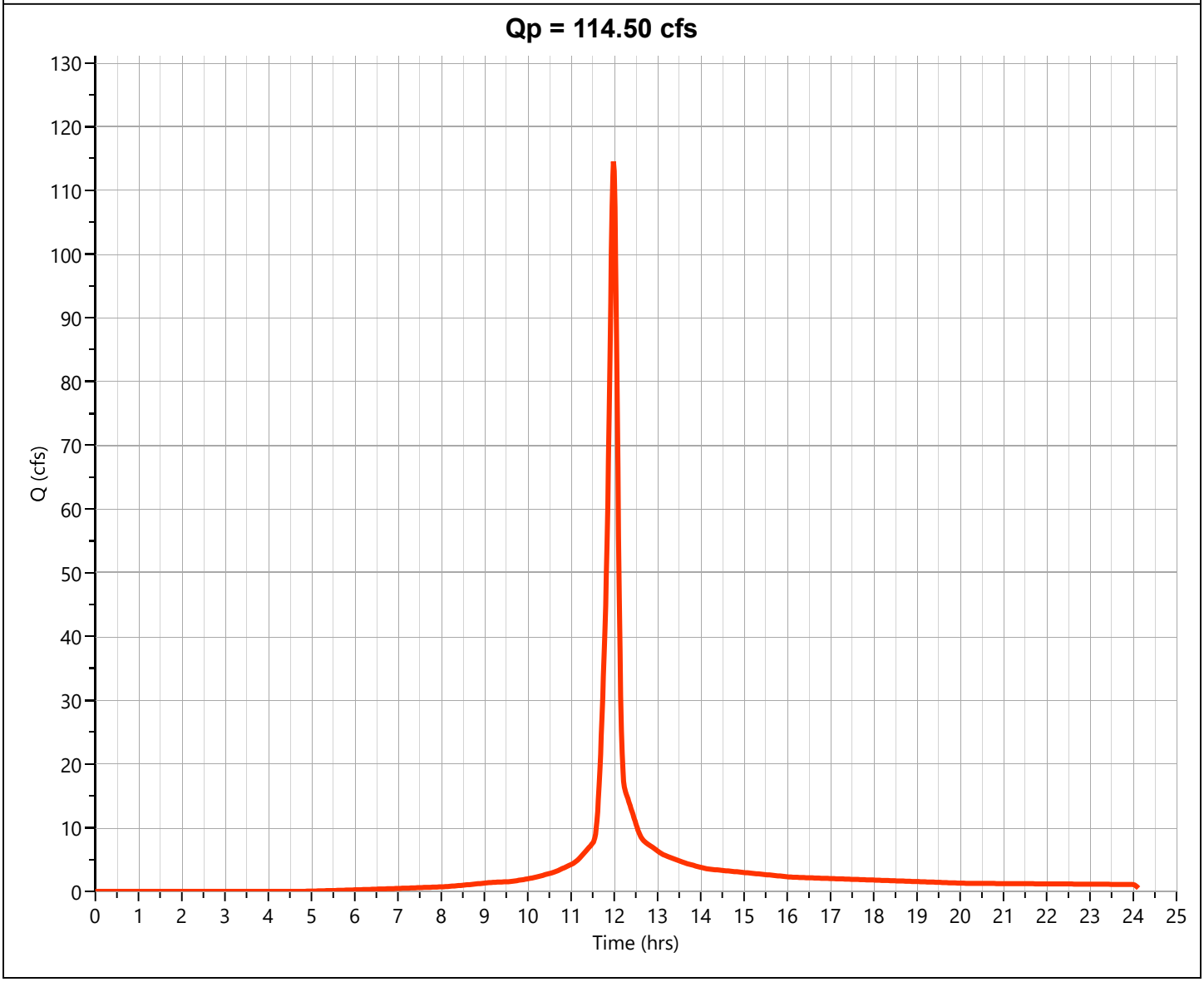
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 114.5 cfs
Storm Frequency	= 50-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 269,142 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 5.20 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

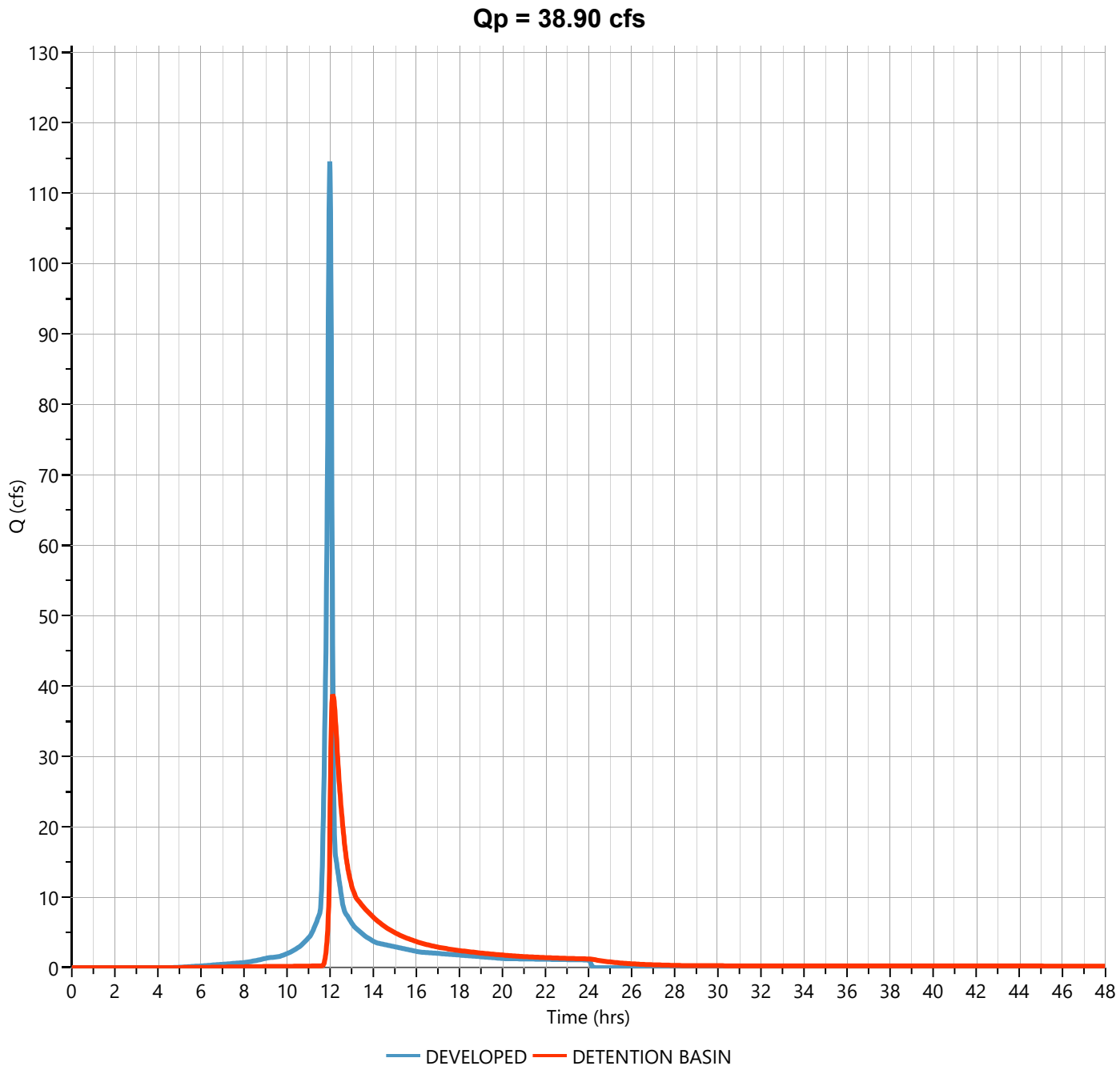
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 38.90 cfs
Storm Frequency	= 50-yr	Time to Peak	= 12.13 hrs
Time Interval	= 1 min	Hydrograph Volume	= 248,226 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 730.76 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 126,496 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.96 hrs



Design Storm Report

Custom Storm filename:

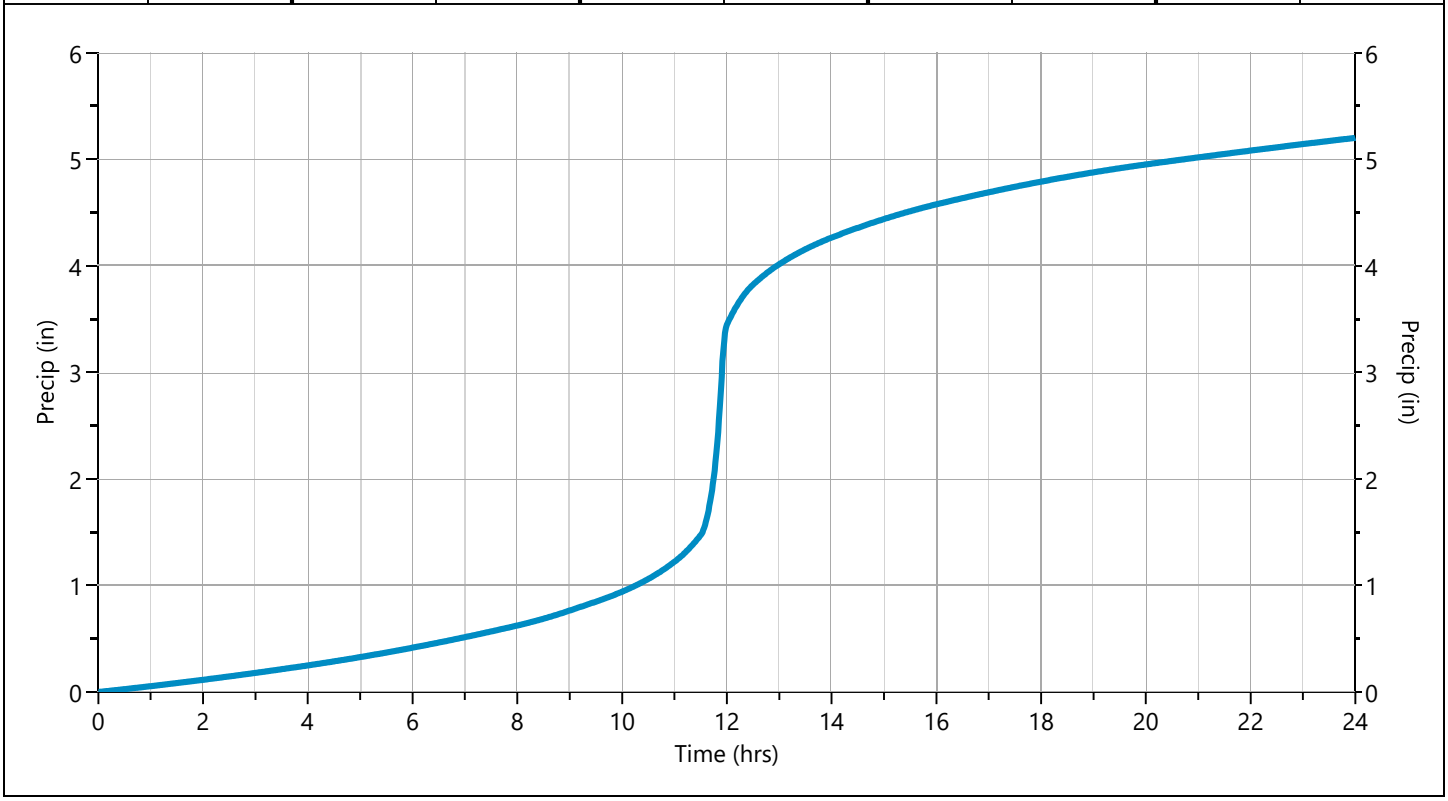
Hydrology Studio v 3.0.0.16

12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	✔ 50-yr	100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

Incremental Rainfall Distribution, 50-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.42	0.009637	11.60	0.029212	11.78	0.075974	11.97	0.071550	12.15	0.014621
11.43	0.009776	11.62	0.032633	11.80	0.085488	11.98	0.049898	12.17	0.014291
11.45	0.009915	11.63	0.036053	11.82	0.095002	12.00	0.028246	12.18	0.013962
11.47	0.010053	11.65	0.039474	11.83	0.104516	12.02	0.017837	12.20	0.013633
11.48	0.010192	11.67	0.042894	11.85	0.114030	12.03	0.016926	12.22	0.013304
11.50	0.010331	11.68	0.046315	11.87	0.123545	12.05	0.016597	12.23	0.012974
11.52	0.012149	11.70	0.049735	11.88	0.133058	12.07	0.016267	12.25	0.012645
11.53	0.015531	11.72	0.053156	11.90	0.142572	12.08	0.015938	12.27	0.012315
11.55	0.018951	11.73	0.056576	**11.92**	**0.152087**	12.10	0.015609	12.28	0.011986
11.57	0.022372	11.75	0.059996	11.93	0.099452	12.12	0.015279	12.30	0.011657
11.58	0.025792	11.77	0.065957	11.95	0.093202	12.13	0.014950	12.32	0.011327



Hydrograph 100-yr Summary

Project Name:

12-14-2020

Hydrology Studio v 3.0.0.16

Hyd. No.	Hydrograph Type	Hydrograph Name	Peak Flow (cfs)	Time to Peak (hrs)	Hydrograph Volume (cuft)	Inflow Hyd(s)	Maximum Elevation (ft)	Maximum Storage (cuft)
1	NRCS Runoff	Pre DEVELOPED	69.59	12.12	236,344	----		
2	NRCS Runoff	Post DEVELOPED	125.4	11.98	296,332	----		
3	Pond Route	Post DETENTION BASIN	44.10	12.13	275,301	2	731.08	137,074

Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

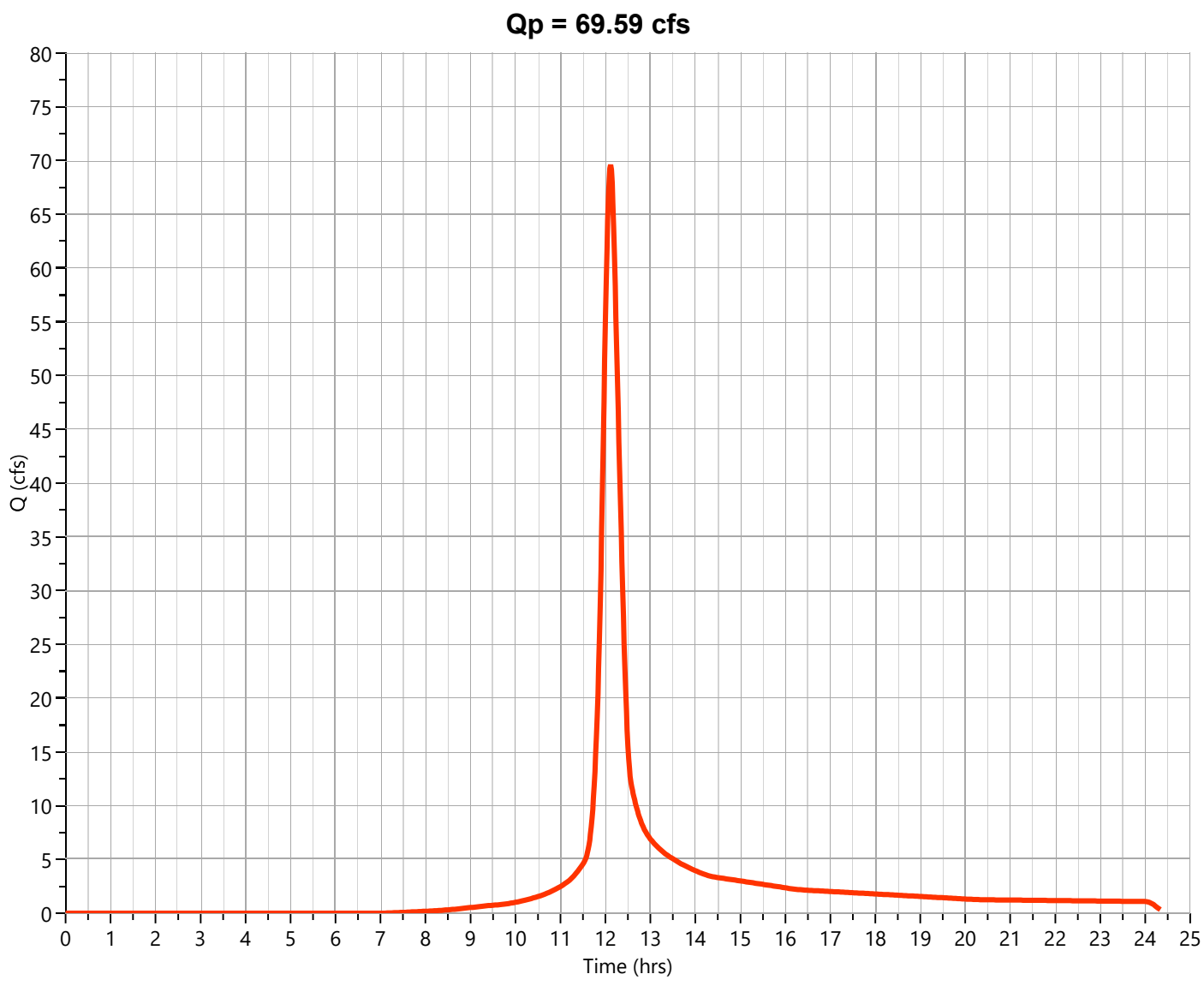
Pre DEVELOPED

Hyd. No. 1

Hydrograph Type	= NRCS Runoff	Peak Flow	= 69.59 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.12 hrs
Time Interval	= 1 min	Runoff Volume	= 236,344 cuft
Drainage Area	= 19.76 ac	Curve Number	= 79*
Tc Method	= TR55 (See Worksheet)	Time of Conc. (Tc)	= 23.44 min
Total Rainfall	= 5.60 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
4.54	98	IMPERVIOUS
15.2	74	PERVIOUS, CLASS C
19.76	**79**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

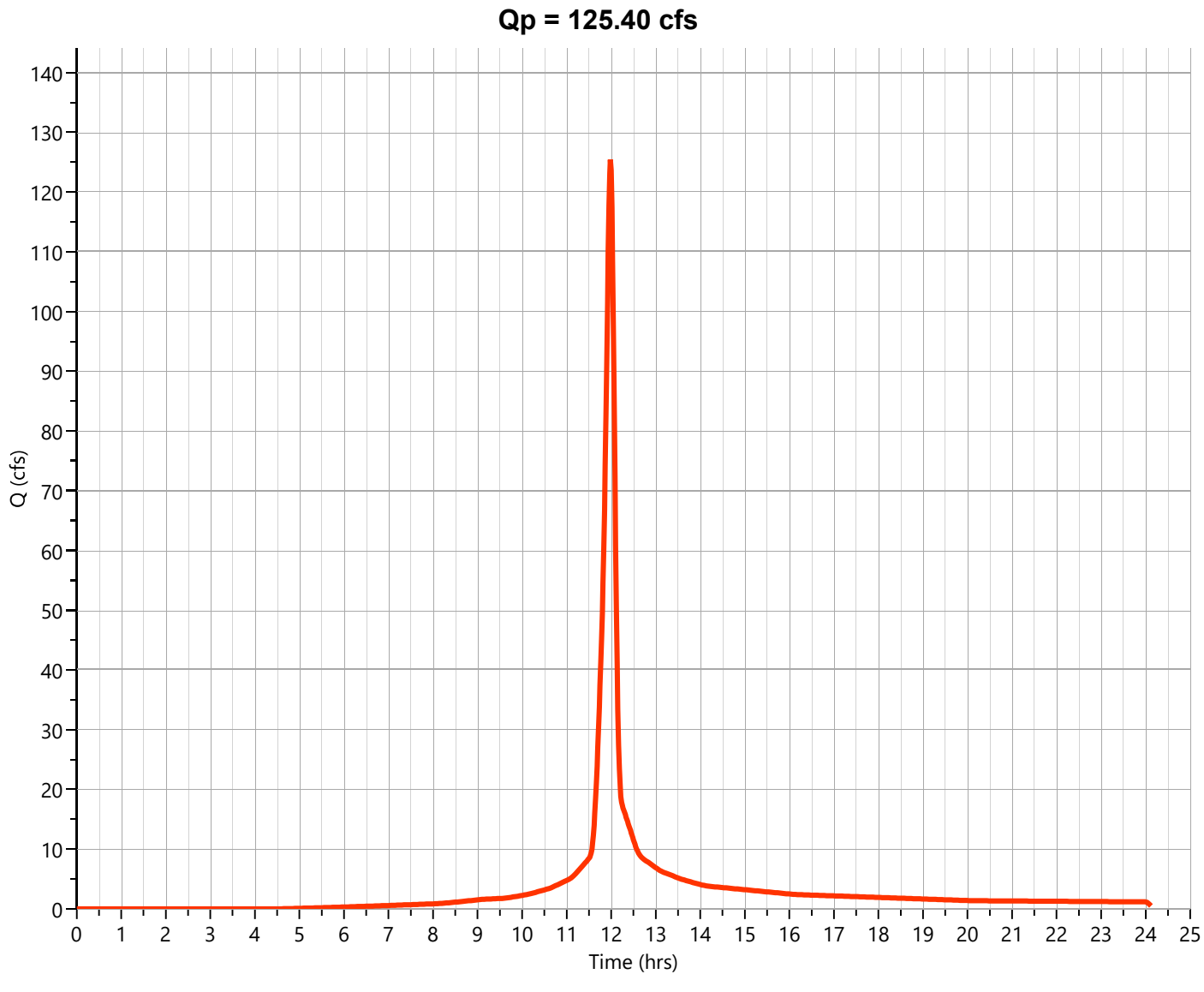
Post DEVELOPED

Hyd. No. 2

Hydrograph Type	= NRCS Runoff	Peak Flow	= 125.4 cfs
Storm Frequency	= 100-yr	Time to Peak	= 11.98 hrs
Time Interval	= 1 min	Runoff Volume	= 296,332 cuft
Drainage Area	= 19.74 ac	Curve Number	= 87*
Tc Method	= User	Time of Conc. (Tc)	= 10.0 min
Total Rainfall	= 5.60 in	Design Storm	= Type II
Storm Duration	= 24 hrs	Shape Factor	= 484

*** Composite CN Worksheet**

AREA (ac)	CN	DESCRIPTION
6.83	98	IMPERVIOUS
4.97	94	BUILDABLE DEVELOPMENT
7.94	74	PERVIOUS, CLASS C
19.74	**87**	Weighted CN Method Employed



Hydrograph Report

Project Name:

Hydrology Studio v 3.0.0.16

12-14-2020

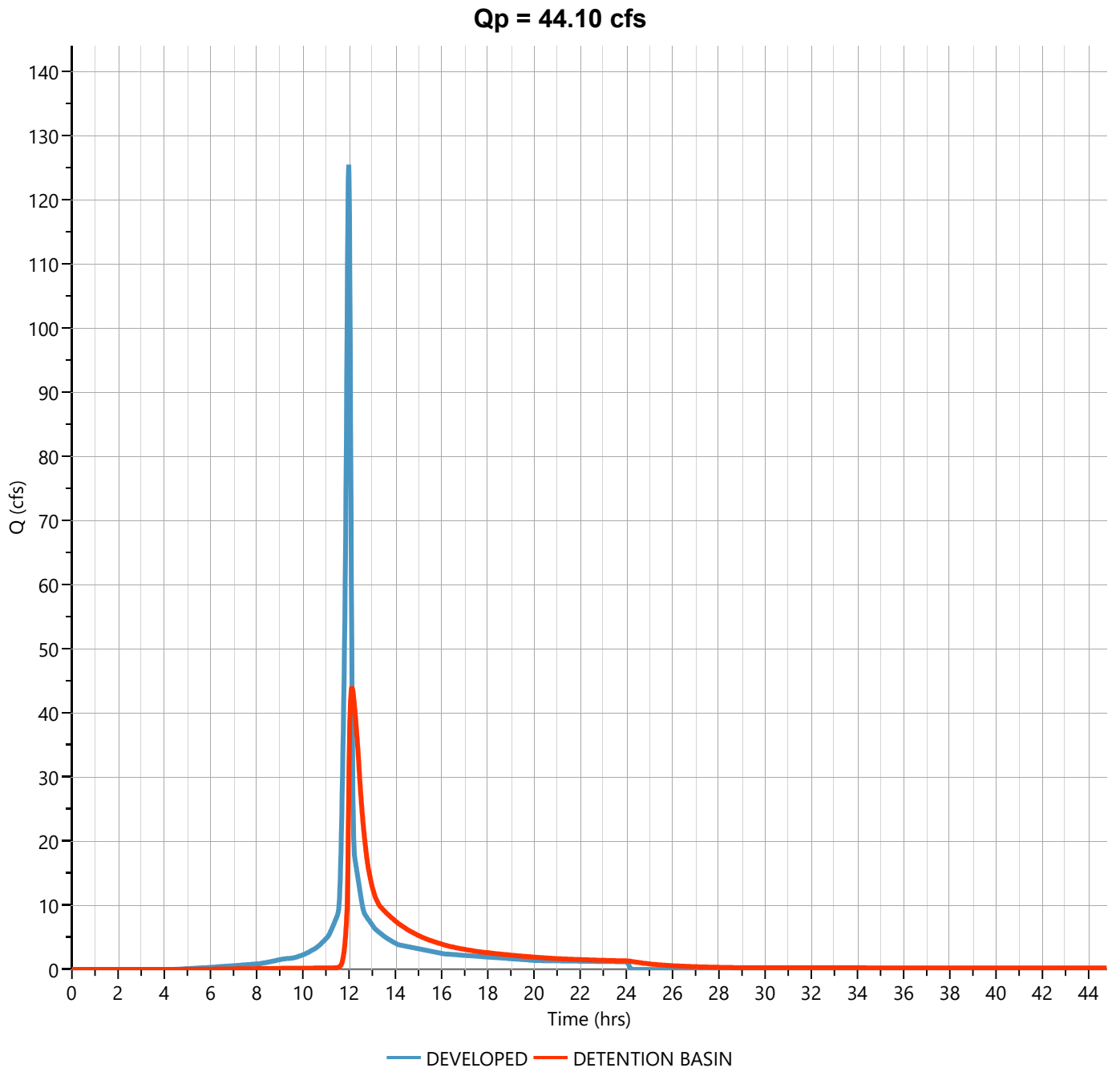
Post DETENTION BASIN

Hyd. No. 3

Hydrograph Type	= Pond Route	Peak Flow	= 44.10 cfs
Storm Frequency	= 100-yr	Time to Peak	= 12.13 hrs
Time Interval	= 1 min	Hydrograph Volume	= 275,301 cuft
Inflow Hydrograph	= 2 - DEVELOPED	Max. Elevation	= 731.08 ft
Pond Name	= DETENTION BASIN	Max. Storage	= 137,074 cuft

Pond Routing by Storage Indication Method

Center of mass detention time = 1.89 hrs



Design Storm Report

Custom Storm filename:

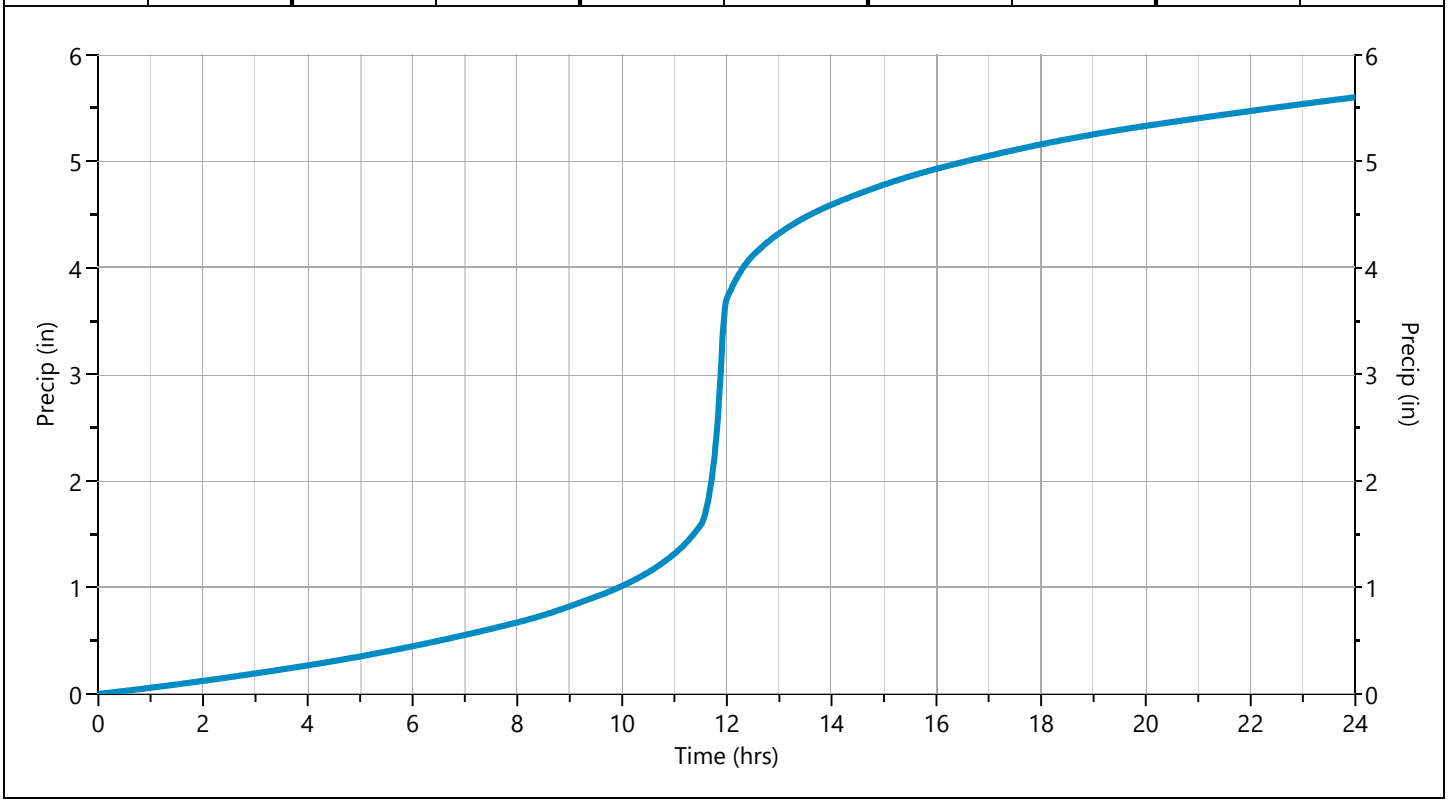
Hydrology Studio v 3.0.0.16

12-14-2020

Storm Distribution: NRCS/SCS - Type II

Storm Duration	Total Rainfall Volume (in)								
	1-yr	2-yr	3-yr	5-yr	10-yr	25-yr	50-yr	✔ 100-yr	
24 hrs	2.50	2.90	0.00	3.60	4.10	4.70	5.20	5.60	

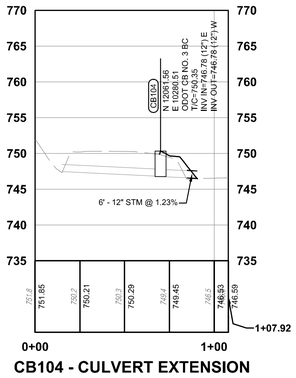
Incremental Rainfall Distribution, 100-yr									
Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)	Time (hrs)	Precip (in)
11.42	0.010379	11.60	0.031460	11.78	0.081818	11.97	0.077054	12.15	0.015745
11.43	0.010528	11.62	0.035143	11.80	0.092064	11.98	0.053736	12.17	0.015391
11.45	0.010677	11.63	0.038827	11.82	0.102310	12.00	0.030419	12.18	0.015036
11.47	0.010827	11.65	0.042510	11.83	0.112556	12.02	0.019210	12.20	0.014681
11.48	0.010976	11.67	0.046194	11.85	0.122802	12.03	0.018228	12.22	0.014327
11.50	0.011125	11.68	0.049877	11.87	0.133048	12.05	0.017873	12.23	0.013972
11.52	0.013084	11.70	0.053561	11.88	0.143294	12.07	0.017519	12.25	0.013618
11.53	0.016725	11.72	0.057245	11.90	0.153540	12.08	0.017164	12.27	0.013263
11.55	0.020409	11.73	0.060928	**11.92**	**0.163786**	12.10	0.016809	12.28	0.012908
11.57	0.024093	11.75	0.064612	11.93	0.107101	12.12	0.016455	12.30	0.012553
11.58	0.027776	11.77	0.071030	11.95	0.100372	12.13	0.016100	12.32	0.012199



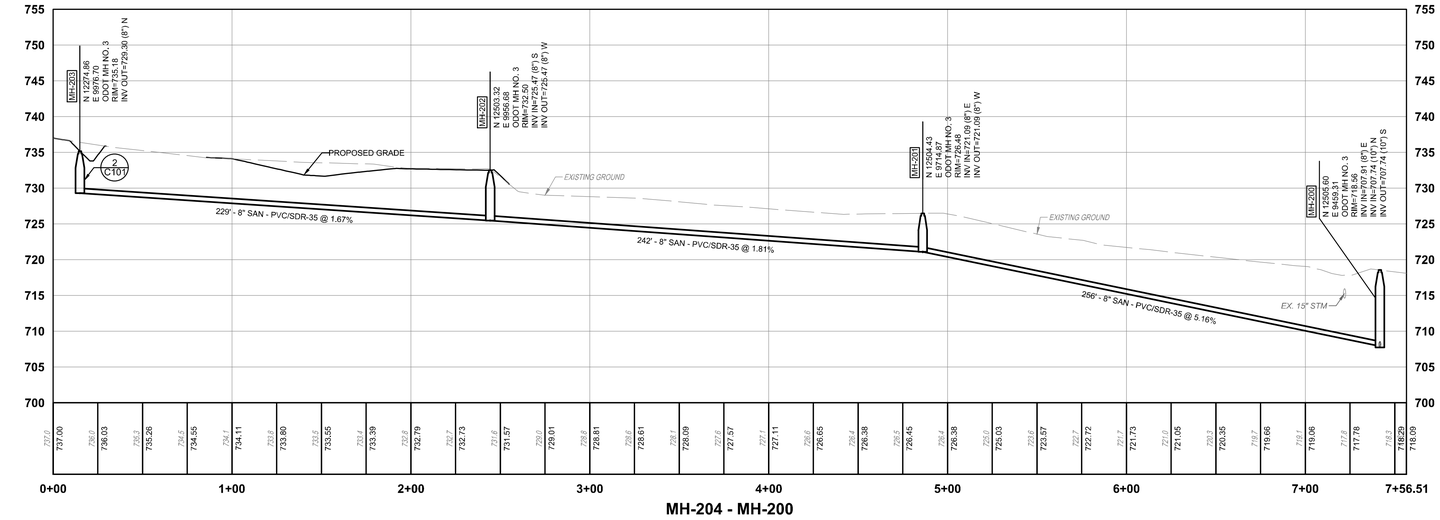
Appendix E

Outlet Structures

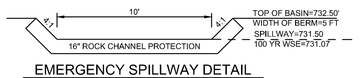
INSPIRED PEOPLE ▲ CREATIVE DESIGN ▲ TRANSFORMING COMMUNITIES



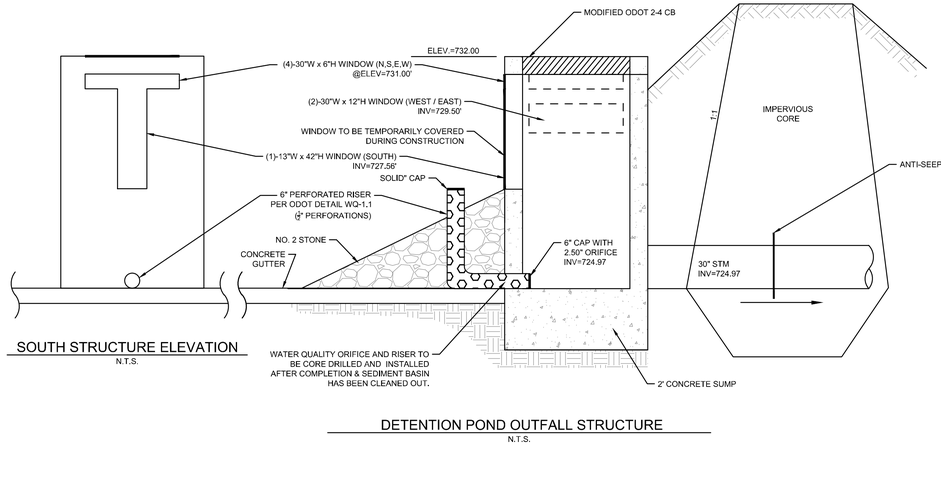
CB104 - CULVERT EXTENSION



MH-204 - MH-200

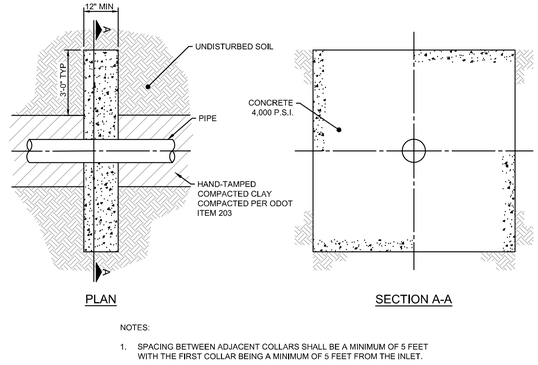


EMERGENCY SPILLWAY DETAIL
N.T.S.



SOUTH STRUCTURE ELEVATION
N.T.S.

DETENTION POND OUTFALL STRUCTURE
N.T.S.



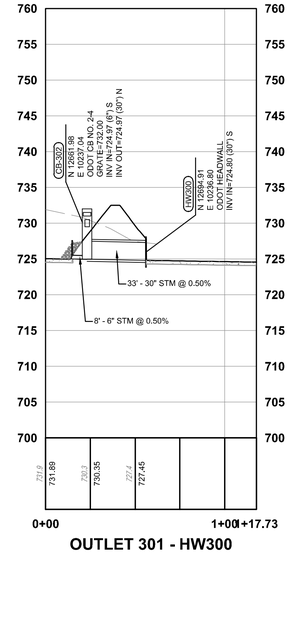
PLAN

SECTION A-A

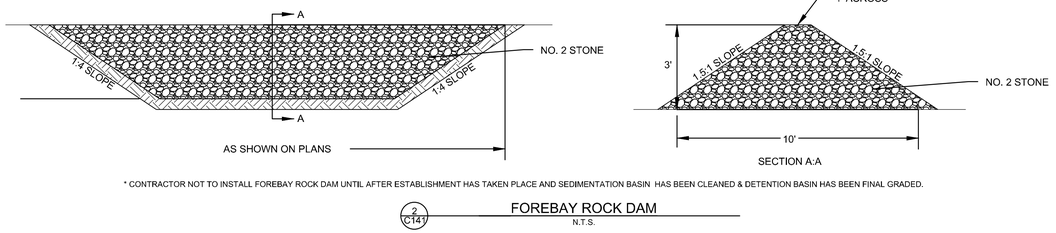
NOTES:

1. SPACING BETWEEN ADJACENT COLLARS SHALL BE A MINIMUM OF 5 FEET WITH THE FIRST COLLAR BEING A MINIMUM OF 5 FEET FROM THE INLET.
2. FURNISH A MINIMUM OF 2 COLLARS PER OUTLET CONDUIT.
3. ALL ANTI-SEEP COLLARS AND THEIR CONNECTIONS SHALL BE WATERTIGHT.

ANTI-SEEP COLLAR DETAIL
N.T.S.



OUTLET 301 - HW300



* CONTRACTOR NOT TO INSTALL FOREBAY ROCK DAM UNTIL AFTER ESTABLISHMENT HAS TAKEN PLACE AND SEDIMENTATION BASIN HAS BEEN CLEANED & DETENTION BASIN HAS BEEN FINAL GRADED.

FOREBAY ROCK DAM
N.T.S.

NORTH DETENTION POND OUTLET STRUCTURE AND EMERGENCY SPILLWAY
1 C141

NOTES:

1. CONCRETE GUTTER. SEE GRADING PLAN FOR MORE DETAIL

CONCRETE GUTTER SECTION DETAIL
3 C141
N.T.S.

NOTE:
UNDERGROUND UTILITIES ARE PLOTTED FROM A COMPILATION OF AVAILABLE RECORD INFORMATION, GIS AND SURFACE INDICATIONS OF UNDERGROUND STRUCTURES AND MAY NOT BE INCLUSIVE. PRECISE LOCATIONS AND THE EXISTENCE OR NON EXISTENCE OF UNDERGROUND UTILITIES CANNOT BE VERIFIED. PLEASE NOTIFY THE KENTUCKY UTILITY PROTECTION SERVICE AT 1-800-752-6007 BEFORE ANY PERIOD OF EXCAVATION OR CONSTRUCTION ACTIVITY.

811 Know what's below. Call before you dig.

THE KLEINGERS GROUP
CIVIL ENGINEERING
SURVEYING
LANDSCAPE ARCHITECTURE
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SEAL:

STATE OF OHIO
STEVEN R. KORTE
E-61033
REGISTERED PROFESSIONAL ENGINEER

NO.	DATE	DESCRIPTION
1	12/21/20	CONSTRUCTION DOCUMENTS

BRIDGEWATER CHURCH
SUBDIVISION
FAIRFIELD TOWNSHIP
BUTLER COUNTY, OHIO

PROJECT NO: **180075.000**
DATE: **12/18/2020**
SCALE: V 0 5 10 20 / H 0 20 40 80

SHEET NAME:
UTILITY PROFILES & DETAILS

SHEET NO.
C141

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