Final Stormwater Management Report
for

Woodland Glen - 2nd Plat

Lee's Summit, Missouri

February 17, 2020
Rev. April 28, 2020

prepared for

Duggan Homes

prepared by

Schlagel & Associates, PA
Lenexa, Kansas

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05.05.2020

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1.0 FOREWARD

Woodland Glen – 2nd Plat is a proposed 17.26-acre development located in Lee's Summit, Missouri. The site is generally located east of SW Ward Road and north of SW Scherer Road. The site location is shown in the vicinity map in Figure 1. The property is currently zoned P-1 and PMIX. The proposed site plan is provided in Figure 2.

1.1 OBJECTIVE

The intent of this report is to provide information pertaining to the existing and proposed watersheds, identify and address any downstream drainage issues, determine and address any detention requirements, provide 40-hour extended detention of runoff from the local 90% mean annual even, and address permitting requirements. This study provides the final design calculations for the development of the facility and associated infrastructure. Detailed design will be required with permit documents.

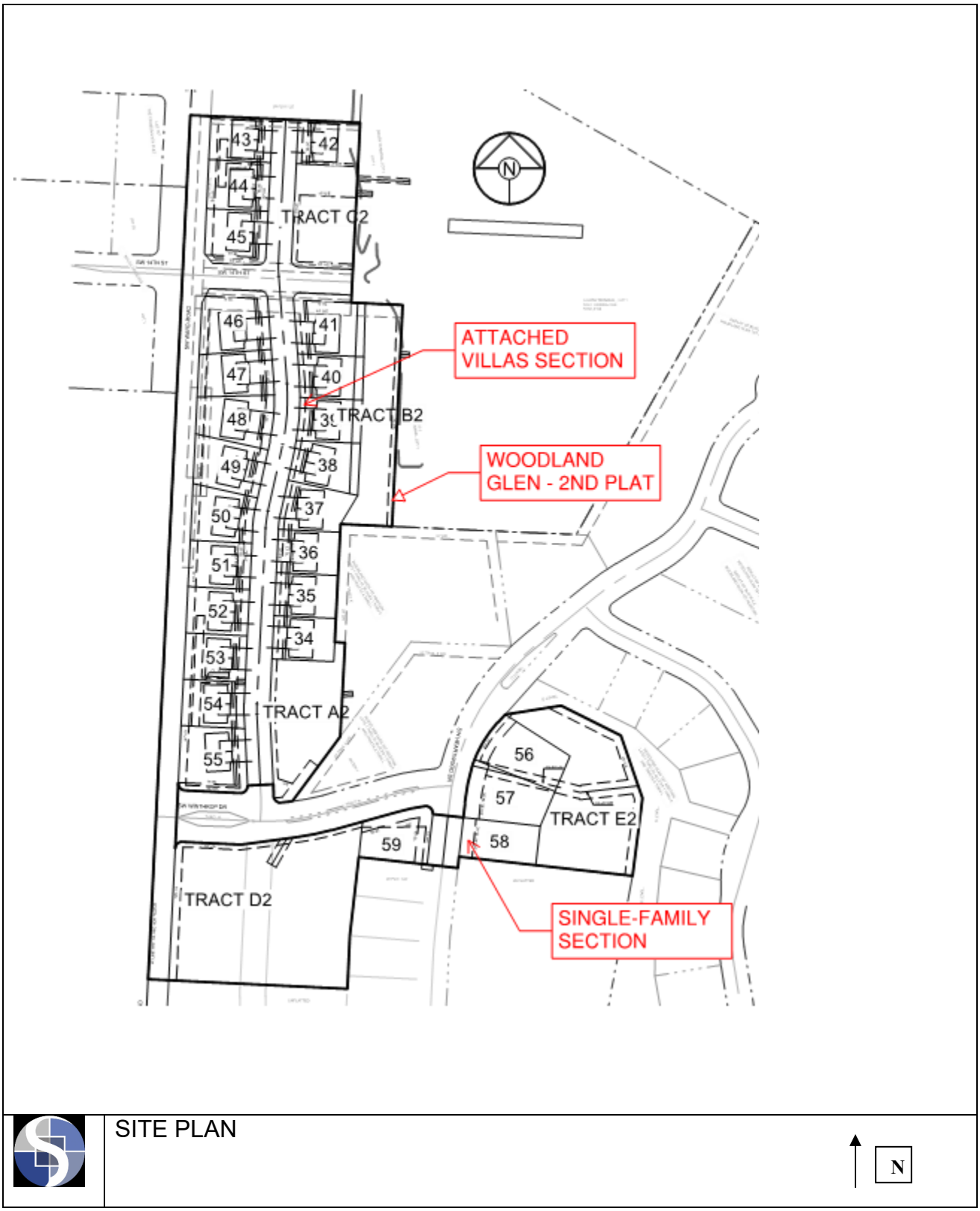
The Attached Villas Section of this proposed plan will drain into new detention basins. It is proposed that this portion of the site will provide detention that meets the requirements of the APWA Comprehensive Control Strategy. This entails limiting post-development peak discharge rates from the site for the 2-year, 10-year, and 100-year design storm events, as well as providing 40-hour extended detention of runoff from the local 90% mean annual event.

1.2 METHODOLOGY

Watersheds for the site were defined according to their soil cover and soil type, tributary area, and runoff times of concentration. Soil cover was determined from inspection of the site and aerial photography. The *N.R.C.S. Soil Survey of Jackson County, Missouri* was obtained from the NRCS website and was utilized in determining soil type. Watershed size was defined by both aerial topography and topographical survey, and by the proposed grading plan. Time of concentrations were compiled according to *NRCS TR-55 Urban Hydrology for Small Watersheds (1986)* methodology for sheet flow, shallow concentrated flow, and channel flow. *HydroCAD Version 10.0* was used to model the runoff and detention outlet structures. All storm events were modeled as 24-hour durations with S.C.S. Type II distribution. Detention analysis was completed for the 2-year, 10-year, and 100-year storm events.

Figure 1: Location Map

Figure 2: Site Plan



2.0 STORMWATER COLLECTION AND DETENTION SYSTEM

The site area being analyzed with this report are lots 34 through 55 and Tracts A2, B2, and C2, this area will be referred to as the Attached Villas Section. The remaining platted area including lots 56 through 59 and Tracts D2 and E2, and will be referred to as the Single-Family Section and will not part of this report. The drainage and detention for the Single-Family Section of this site is to be gathered and conveyed by existing storm infrastructure and then carried to the existing detention located just to the east of lots 34, 35, and 36, reference Sheet 1 of 3 of the Drainage Area Maps provided in Appendix A. The Attached Villas Section of the site general will drain from the west to east, either to the existing detention basin or towards property owned by the City of Lee's Summit. There is existing storm sewer along SW Ward Road that drains onto this section of the property, and with this development will be piped through the site directly downstream along its current drainage path. Stormwater detention will be required to limit the proposed 2-year, 10-year, and 100-year stormwater peak discharge rates per the requirements of the APWA Comprehensive Control Strategy.

2.1 EXISTING CONDITIONS

The existing drainage area (EX-1) drains from the west to east and is shown on the Existing Conditions Drainage Area Map, Sheet 2 of 3, provided in Appendix A.

2.1.1 Curve Number

The existing ground cover conditions were generally classified as woods/grass combination, in fair condition. The Curve Number (CN) was assigned based on the existing cover conditions and Hydrologic Soil Group (HSG), as tabulated in TR-55. The site is predominately classified as HSG D soils. This results in a CN for the woods/grass combination of 82. The existing condition runoff calculations are provided for informational and comparison purposes only, as the proposed post-development peak discharge rates will need to comply with the reduced allowed runoff rates as outlined in the APWA Comprehensive Control Strategy.

The CN and sub-basin existing drainage area is provided in Table 1.

2.1.2 Time of Concentration

As mentioned in Section 1.2, time of concentrations were compiled according to *NRCS TR-55 Urban Hydrology for Small Watersheds (1986)* methodology for sheet flow, shallow concentrated flow, and channel flow. Sheet flow lengths were limited to 100 feet. The flow was then considered shallow concentrated until a channel was visible from either the USGS topographic map or the aerial photograph, and then from that point was considered channel flow. All channel flow velocities were assumed to be six feet per second. The existing sub-basin time of concentration is provided in Table 1. Detailed calculations of the existing times of concentration are provided in Appendix B.

Table 1: Existing Drainage Sub-Basin Characteristics

Sub-Basin	Area (ac.)	CN	Tc (min)	2-year (cfs)	10-year (cfs)	100-year (cfs)
EX-1	9.73	82	6.8	29.47	54.23	87.90
Totals	**9.73**			**29.47**	**54.23**	**87.90**

2.2 PROPOSED CONDITIONS

In the proposed conditions, drainage area (PR-1), containing 2.59 acres, will be routed to an extended dry detention basin (EDDB-1) located in the southeast corner of the site. An outlet from this basin will drain east and be located just upstream of the existing detention basin.

Drainage area (PR-2), containing 4.99 acres, will be routed to an extended dry detention basin (EDDB-2) located near the north end of the site just east of Lot 13. An outlet from this basin will drain east to land owned by the City of Lee's Summit.

Drainage area (PR-3), containing 1.26 acres, consists of rear yard drainage and will be routed to another extended dry detention basin (EDDB-3) located east of Lots 4 through 8 and will similarly drain to land owned by the City of Lee's Summit.

The three extended dry detention basins (EDDB-1, EDDB-2, and EDDB-3) will provide post-development peak discharge rate control as well as 40-hour extended detention of runoff from the local 90% mean annual event (1.37 inch, 24-hour event).

At the north end of the site, drainage area (PR-4), containing 0.22 of an acre, consists of rear yard drainage and will drain directly offsite.

In the southeast corner of the site, a small drainage area (PR-5), containing 0.67 of an acre, consists of rear yard drainage and will drain towards the existing detention basin. In the peak discharge rates comparison later on in this report, this area has been excluded from the Comprehensive Control Strategy comparison as this will drain to the existing basin.

The Proposed Drainage Area Map, Sheet 3 of 3, is provided in Appendix A.

2.2.1 Curve Number

For all on-site developed areas, the HSG was increased a minimum of one level. Curve Numbers were assigned according to impervious areas at CN=98 and grass/open areas at CN=80 (>75% grass cover in good condition). The composite CN calculations are provided in Appendix B. The composite CN and sub-basin drainage areas for the proposed sub-basins are provided in Table 2.

2.2.2 Time of Concentration

The proposed watersheds were divided into sub-basins for analysis. Time of concentration for the proposed conditions have been conservatively estimated at 5.0 minutes due to the small nature of each sub-watershed and with the amount of paved surfaces that is proposed in each sub-watershed. Detailed calculations of the proposed times of concentration are provided in Appendix B. The proposed sub-basin times of concentration are provided in Table 2.

Table 2: Proposed Drainage Sub-Basin Characteristics

Sub-Basin	Area (ac.)	CN	Tc (min)	2-year (cfs)	10-year (cfs)	100-year (cfs)
PR-1	2.59	90	5.0	10.96	18.05	27.39
PR-2	4.99	90	5.0	21.12	34.78	52.77
PR-3	1.26	83	5.0	4.20	7.61	12.23
PR-4	0.22	85	5.0	0.79	1.39	2.20
PR-5*	0.67	83	5.0	2.23	4.05	6.50
Totals	**9.73**			**39.30**	**65.88**	**101.09**

* Indicates this area drains to an existing detention basin and will be exempt from proposed calculations.

2.2.3 Detention Analysis

The site will need to provide detention that meets the requirements of the APWA Comprehensive Control Strategy. This entails limiting post-development peak discharge rates from the site for the 2-year, 10-year, and 100-year design storm events, as well as providing 40-hour extended detention of runoff from the local 90% mean annual event. The post-development peak discharge rates from the site shall not exceed the following:

- 2-year storm peak rate less than or equal to 0.5 cfs per site acre
- 10-year storm peak rate less than or equal to 2.0 cfs per site acre
- 100-year storm peak rate less than or equal to 3.0 cfs per site acre

Based on the proposed drainage area of 9.06 acres (note that PR-5 has been excluded from this calculation as this area drains directly to the existing detention basin), the allowable maximum post-development peak discharge rates are shown below:

Area (acres)	2-year (cfs) (max. 0.5 cfs/acre)	10-year (cfs) (max. 2.0 cfs/acre)	100-year (cfs) (max. 3.0 cfs/acre)
9.06	**4.53**	**18.12**	**27.18**

The proposed site release peak runoff rate results are shown below:

	Area (ac.)	WQv (cfs)	2-year (cfs)	10-year (cfs)	100-year (cfs)
EDDB-1	2.59	0.22	0.44	0.54	2.42
EDDB-2	4.99	0.28	1.08	7.68	15.58
EDDB-3	1.26	0.10	0.45	0.59	0.71
PR-4	0.22	N/A	0.79	1.39	2.20
Totals	**9.06**		**2.76**	**10.20**	**20.91**
Allowed			**4.53**	**18.12**	**27.18**

The proposed extended dry detention basins (EDDB-1, EDDB-2, and EDDB-3) have been modeled with Single Orifice openings to control the water quality event, which provides 40-hour extended detention of runoff from the local 90% mean annual event. The volume required for the Water Quality Volume (WQv) is not being used for the for the volume to detain the 100-year storm event. All EDDB outlet structures are designed to handle the 100-year storm event and the 100-year "Clogged" event should the orifices become impaired during a storm event. If such an event should occur the basins are designed to receive the flow and will not over top the extents of the basins (reference the following table). There are also Emergency Spillways located on the east side of the basins, should the outlet structures become compromised in any way.

	Area (ac.)	100-year (Clogged) (cfs)	Water Surface Elevation (ft.)	Top of Basin (ft.)
EDDB-1	2.59	7.17	990.76	992.00
EDDB-2	4.99	19.33	976.35	979.00
EDDB-3	1.26	0.65	973.55	974.00

The detailed detention calculations, as well as outlet structure design assumptions are provided in Appendix B.

2.3 PERMIT REQUIREMENTS

The following sections provide a discussion of the federal and state stormwater permitting that may be required for the proposed development. Supporting maps are located in Appendix "A"

2.3.1 Corp of Engineers (COE)

The National Wetland Inventory Map was reviewed for the site which shows a freshwater pond (0.17 acres in size) and a freshwater emergent wetland (0.23 acres in size). The proposed project does not intend to impact the pond or wetland; therefore, no permitting requirements are anticipated with the COE. A copy of the NWI map is included in Appendix A.

2.3.2 Federal Emergency Management Agency (FEMA)

The site is contained in Zone X on FIRM map number 29095C0419G, panel 419. Therefore, no FEMA requirements are associated with this project. A copy of the FIRM map is included in Appendix A.

2.3.3 Missouri Department of Natural Resources

A Notice of Intent (NOI) and Stormwater Pollution Prevention Plan (SWPPP) will be required by MDNR for the permitting of construction stormwater discharge for the site. This permit will be applied for before development and will be held open until the completion of the project.

3.0 CONCLUSION

Woodland Glen – 2nd Plat is a proposed 17.26-acre development located in Lee's Summit, Missouri. The proposed development provides detention that meets the requirements of the APWA Comprehensive Control Strategy. This entails limiting post-development peak discharge rates from the site for the 2-year, 10-year, and 100-year design storm events, as well as providing 40-hour extended detention of runoff from the local 90% mean annual event.

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APPENDIX A – Supplementary Information

INDICATES AREAS OF THE WOODLAND GLEN PRELIMINARY PLAT DRAINING TO THE EXISTING DETENTION BASIN. THIS STORMWATER MGMT. REPORT ASSUMES THE EXISTING BASIN HANDLES THE PROPOSED DEVELOPMENT OF THESE AREAS.

WARD ROAD

SW WARD ROAD

SCHERER ROAD

SW WINTHROP DR

SW 141ST ST

SW HEARTWOOD DR

TRACT D2

TRACT E2

TRACT C2

PR-1
2.59 AC.

PR-2
4.99 AC.

PR-3
1.26 AC.

OFFSITE PR-5
0.67 AC.

OFFSITE PR-4
0.22 AC.

EDDB #1

EDDB #2

EDDB #3

EXISTING DETENTION BASIN

1329.73'
S87°24'20"E

0 200' 400'

SCALE: 1" = 200'

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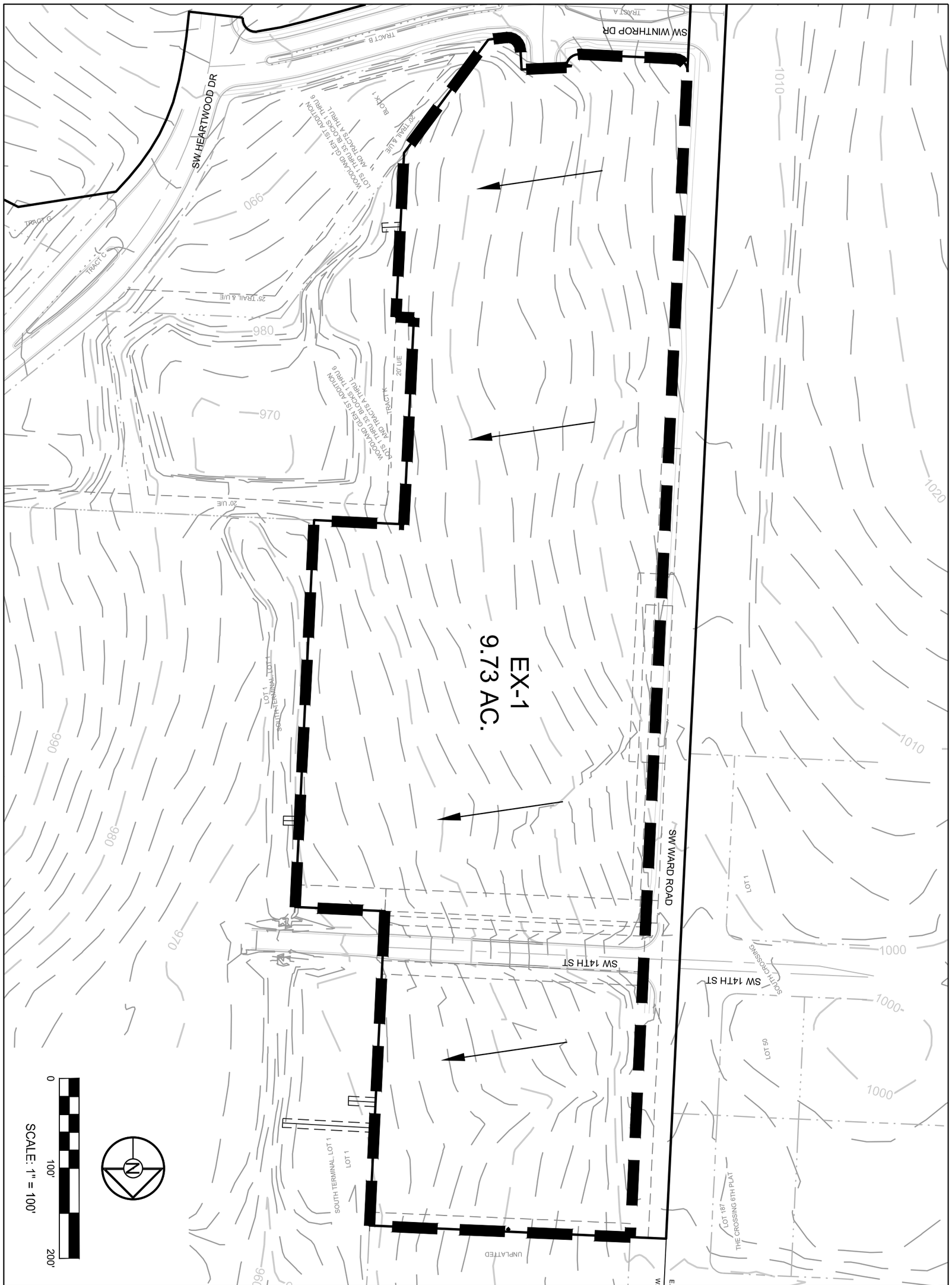
WOODLAND GLEN

SW WARD RD & SW WINTHROP DR
LEE'S SUMMIT, MO

DRAWN BY:	DATE PREPARED:	PROJ. NUMBER:
RPM	4/15/2020	18-017

OVERALL MAP

SHEET 1 OF 3



SHEET 2 OF 3

EXISTING DRAINAGE AREA MAP

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WOODLAND GLEN

SW WARD RD & SW WINTHROP DR
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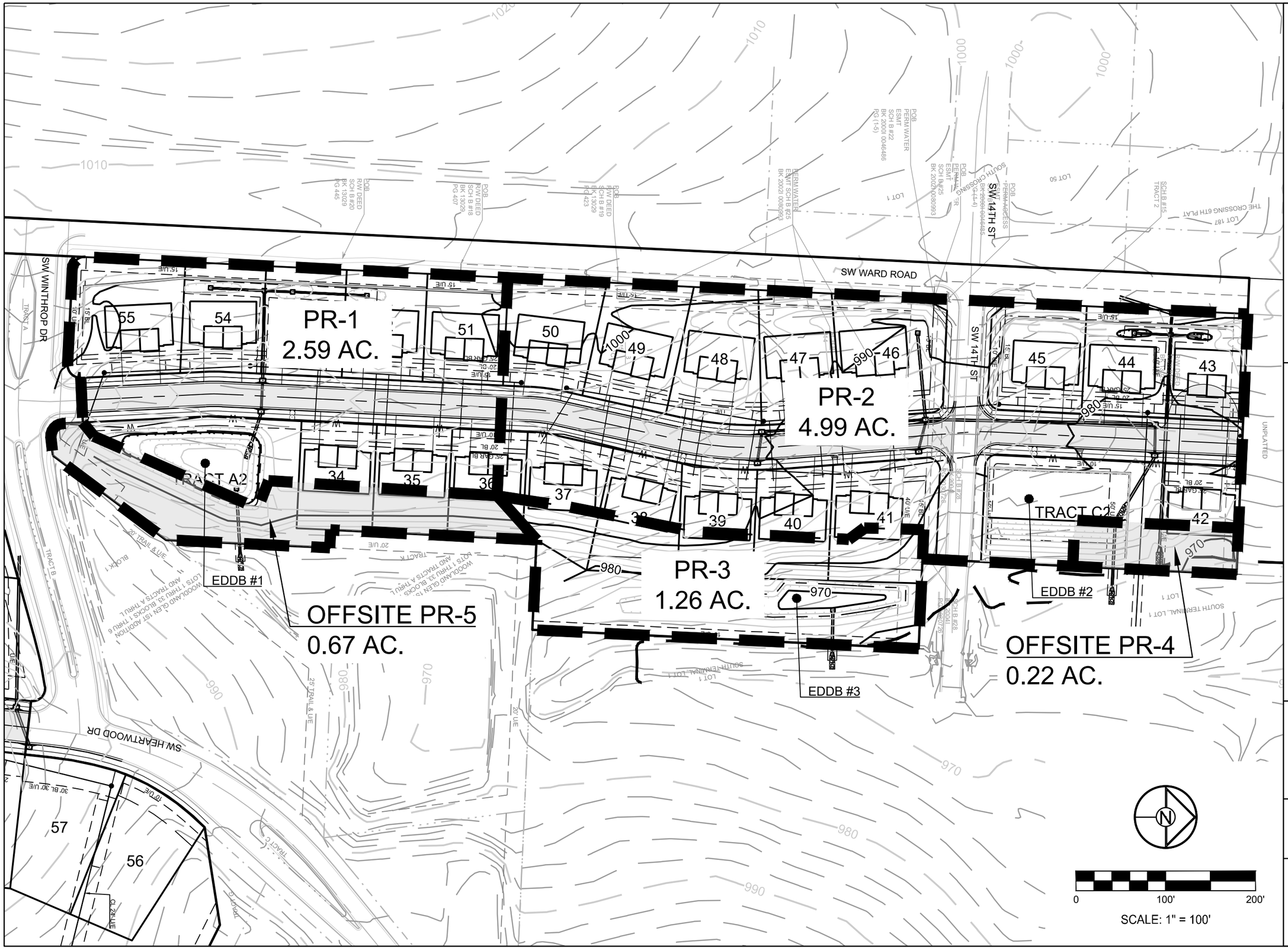

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WOODLAND GLEN

SW WARD RD & SW WINTHROP DR
LEE'S SUMMIT, MO

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RPM	4/15/2020	18-017

PROPOSED DRAINAGE AREA MAP

SHEET 3 OF 3

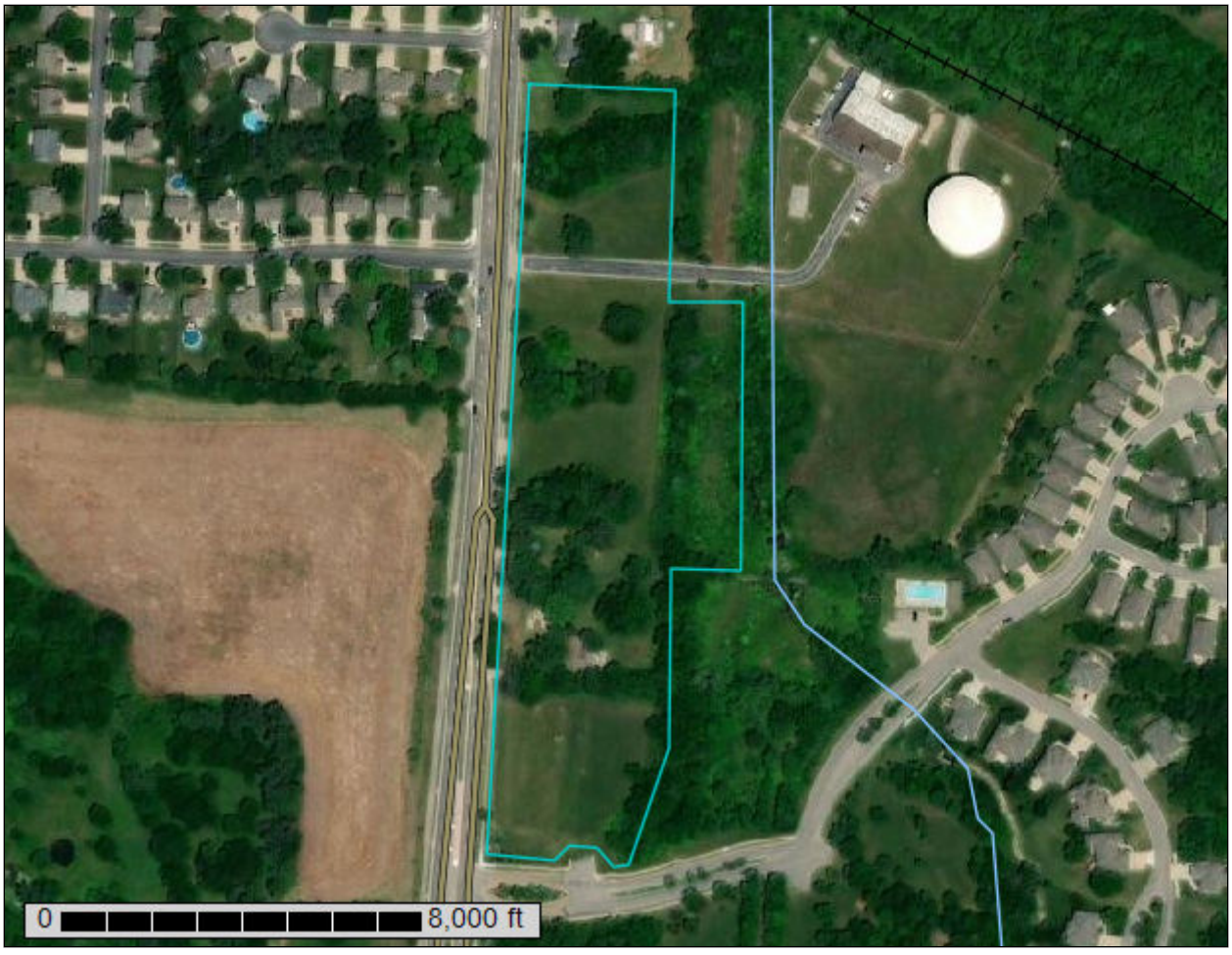
United States Department of Agriculture

NRCS

Natural Resources Conservation Service

A product of the National Cooperative Soil Survey, a joint effort of the United States Department of Agriculture and other Federal agencies, State agencies including the Agricultural Experiment Stations, and local participants

Custom Soil Resource Report for Jackson County, Missouri



June 20, 2018

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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Contents

Soil Map

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

Map Scale: 1:2,340 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 30 60 120 180

Feet
0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 18, Sep 16, 2017

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

Date(s) aerial images were photographed: Jun 11, 2017—Sep 22, 2017

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 (Woodland Glen)

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	9.0	97.1%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	0.3	2.9%
Totals for Area of Interest		**9.2**	**100.0%**

Map Unit Descriptions (Woodland Glen)

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit.

A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils.

Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit descriptions along with some characteristics of each. A few areas of minor components may not have been observed, and consequently they are not mentioned in the descriptions, especially where the pattern was so complex that it was impractical to make enough observations to identify all the soils and miscellaneous areas on the landscape.

The presence of minor components in a map unit in no way diminishes the usefulness or accuracy of the data. The objective of mapping is not to delineate pure taxonomic classes but rather to separate the landscape into landforms or landform segments that have similar use and management requirements. The delineation of such segments on the map provides sufficient information for the development of resource plans. If intensive use of small areas is planned, however,

onsite investigation is needed to define and locate the soils and miscellaneous areas.

An identifying symbol precedes the map unit name in the map unit descriptions. Each description includes general facts about the unit and gives important soil properties and qualities.

Soils that have profiles that are almost alike make up a *soil series*. Except for differences in texture of the surface layer, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer, slope, stoniness, salinity, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into *soil phases*. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Alpha silt loam, 0 to 2 percent slopes, is a phase of the Alpha series.

Some map units are made up of two or more major soils or miscellaneous areas. These map units are complexes, associations, or undifferentiated groups.

A *complex* consists of two or more soils or miscellaneous areas in such an intricate pattern or in such small areas that they cannot be shown separately on the maps. The pattern and proportion of the soils or miscellaneous areas are somewhat similar in all areas. Alpha-Beta complex, 0 to 6 percent slopes, is an example.

An *association* is made up of two or more geographically associated soils or miscellaneous areas that are shown as one unit on the maps. Because of present or anticipated uses of the map units in the survey area, it was not considered practical or necessary to map the soils or miscellaneous areas separately. The pattern and relative proportion of the soils or miscellaneous areas are somewhat similar. Alpha-Beta association, 0 to 2 percent slopes, is an example.

An *undifferentiated group* is made up of two or more soils or miscellaneous areas that could be mapped individually but are mapped as one unit because similar interpretations can be made for use and management. The pattern and proportion of the soils or miscellaneous areas in a mapped area are not uniform. An area can be made up of only one of the major soils or miscellaneous areas, or it can be made up of all of them. Alpha and Beta soils, 0 to 2 percent slopes, is an example.

Some surveys include *miscellaneous areas*. Such areas have little or no soil material and support little or no vegetation. Rock outcrop is an example.

Jackson County, Missouri

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

Map Unit Setting

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

Map Unit Composition

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

Description of Greenton

Setting

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

Typical profile

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

Properties and qualities

Slope: 5 to 9 percent
Depth to restrictive feature: About 16 inches to abrupt textural change
Natural drainage class: Somewhat poorly drained
Runoff class: Very high
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: About 12 to 30 inches
Frequency of flooding: None
Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Low (about 3.6 inches)

Interpretive groups

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

Description of Urban Land

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Across-slope shape: Convex, concave

Interpretive groups

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

10120—Sharpsburg silt loam, 2 to 5 percent slopes

Map Unit Setting

National map unit symbol: 2ql02
Elevation: 1,000 to 1,300 feet
Mean annual precipitation: 33 to 41 inches
Mean annual air temperature: 50 to 55 degrees F
Frost-free period: 177 to 220 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Sharpsburg and similar soils: 95 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Sharpsburg

Setting

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

Typical profile

A - 0 to 17 inches: silt loam
Bt - 17 to 55 inches: silty clay loam
C - 55 to 60 inches: silty clay loam

Properties and qualities

Slope: 2 to 5 percent
Depth to restrictive feature: More than 80 inches
Natural drainage class: Moderately well 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: More than 80 inches
Frequency of flooding: None

Frequency of ponding: None
Salinity, maximum in profile: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water storage in profile: Very high (about 12.0 inches)

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 2e
Hydrologic Soil Group: C
Ecological site: Loess Upland Prairie (R109XY002MO)
Other vegetative classification: Grass/Prairie (Herbaceous Vegetation)
Hydric soil rating: No

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group (Woodland Glen)

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

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

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

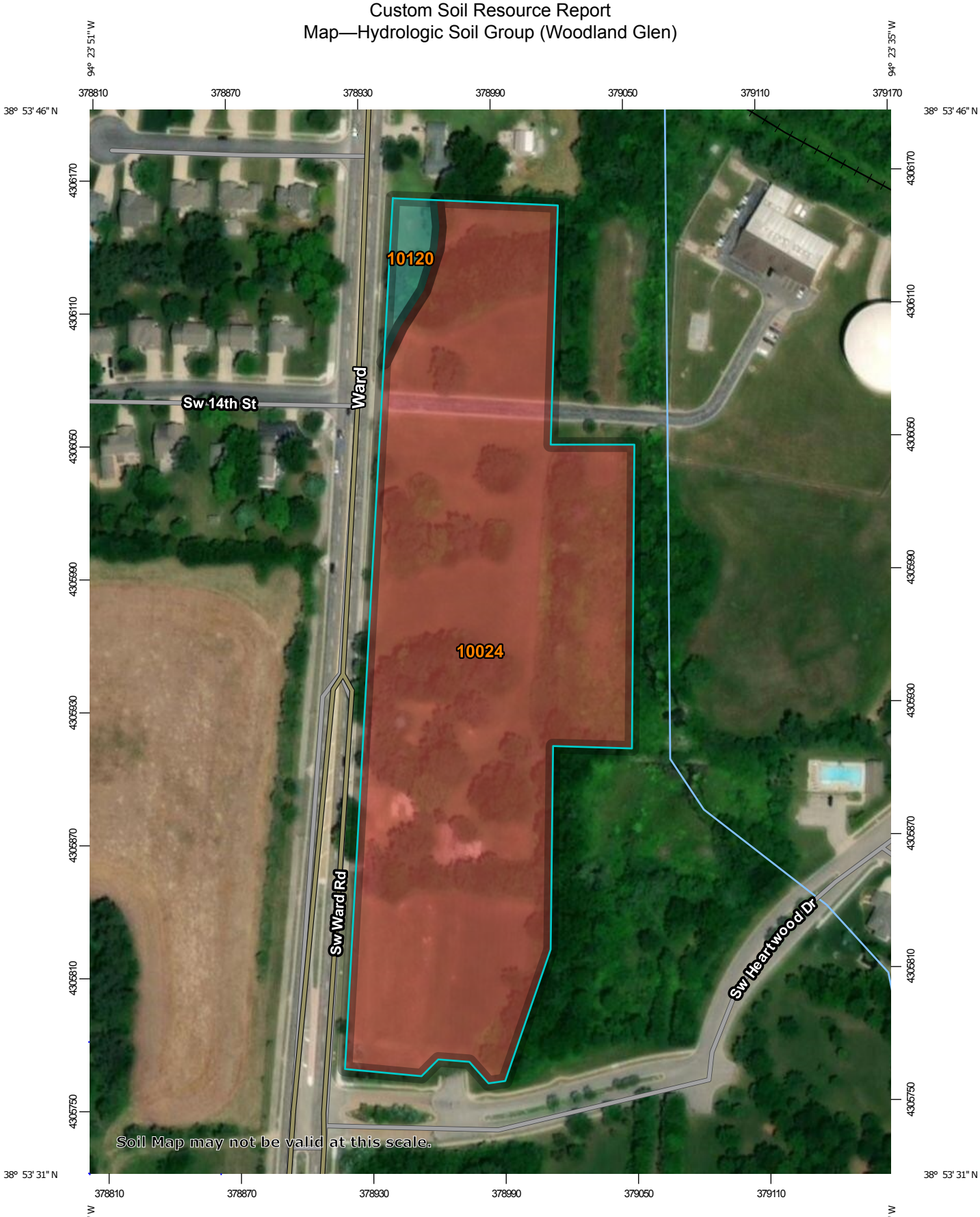
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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

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

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

Custom Soil Resource Report
Map—Hydrologic Soil Group (Woodland Glen)



Map Scale: 1:2,340 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 30 60 120 180

Feet: 0 100 200 400 600

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 15N WGS84

MAP LEGEND

Area of Interest (AOI)

- Area of Interest (AOI)

Soils

Soil Rating Polygons

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points

- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features

- Streams and Canals

Transportation

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

Background

- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:24,000.

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

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

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

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

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

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

Soil Survey Area: Jackson County, Missouri
Survey Area Data: Version 18, Sep 16, 2017

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

Date(s) aerial images were photographed: Jun 11, 2017—Sep 22, 2017

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

Table—Hydrologic Soil Group (Woodland Glen)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
10024	Greenton-Urban land complex, 5 to 9 percent slopes	D	9.0	97.1%
10120	Sharpsburg silt loam, 2 to 5 percent slopes	C	0.3	2.9%
Totals for Area of Interest			**9.2**	**100.0%**

Rating Options—Hydrologic Soil Group (Woodland Glen)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Water Quality Volume Calculation- EDDB-1

WQV = P * Weighted RV

WQV - Water Quality Volume (watershed-inches)
P - Rainfall Event (1.37 inches in Kansas City)
RV - Volumetric Runoff Coefficient

RV = 0.05 + 0.009(I)

I - Percent Site Imperviousness (%)

I. Determine Weighted RV & Weighted Rational C Coefficient

Cover Type	% Impervious	Area (Ac.)	Total Impervious Area (Ac.)	Rational Runoff Coefficient	RV	C * Area	RV * Area
Impervious	100	1.45	1.45	0.90	0.95	1.31	1.38
Grass/Open Space	0	1.14	0.00	0.30	0.05	0.34	0.06
Total	**56**	**2.59**	**1.45**			**1.65**	**1.43**

Rv = Sum(Rv*A)/Total Area = 1.435 / 2.59 = 0.554

C = Sum(C*A)/Total Area = 1.647 / 2.59 = 0.636

II. Determine Water Quality Volume

WQV = P * Rv = 1.37 * 0.5539 = **0.759 in**

III. Determine Total Water Quality Volume

Total Watershed Area (AT) = 2.59 acres
WQV = 0.759 in

WQV = (2.59 * 0.758)/12 = **0.16 ac-ft** 7133.912 c.f.

IV. Peak rate of runoff for WQv

Q = K*C*i*A
K = 1 for WQv
C = 0.3 + 0.6 I
I = Percent impervious
i = Rainfall Intensity from Table 9 in BMP manual

C = 0.3+0.6*I = 0.64
K = 1.00
i = 1.90
Q (cfs) = **3.13**

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer:	JPB
Checked by:	
Company:	Schlagel
Date:	6/20/2018
Project:	18-017
Location:	

EDDB-1

I. Basin Water Quality Storage Volume:

Step 1) Tributary Area to EDDB, A_T (ac.)	A_T (ac.) =	2.59
Step 2) Calculate WQv using method in Section 6.1	WQv (ac-ft) =	0.16
Step 3) Add 20 percent to account for silt and sand sediment deposition in the basin	V_{design} (ac-ft) =	0.20

IIa. Water Quality Outlet Type

Step 1) Set Water Quality Outlet Type — Outlet Type = 1.00

Type 1 = Single Orifice
Type 2 = Perforated riser or plate
Type 3 = v-notch weir

Step 2) Proceed to step 2b, 2c, or 2d based on water quality outlet type

IIb. Water Quality Outlet, Single Orifice

Step 1) Depth of water quality volume at outlet, Z_{WQ} (ft.) — Z_{WQ} (ft.) = 2.70

Step 2) Average head of Water Quality volume over invert of orifice, H_{WQ} (ft) — H_{WQ} (ft.) = 1.35

$H_{WQ} = 0.5 * Z_{WQ}$

Step 3) Average water quality outflow rate, Q_{WQ} (cfs) — Q_{WQ} (cfs) = 0.54

$Q_{WQ} =$ ~~$(WQv * 43{,}560)/(40 * 3600)$~~ VA

Step 4) Set value of orifice discharge coefficient, C_O — C_O = 0.66

$C_O = 0.66$ when thickness of riser/weir plate is = or < orifice diameter
$C_O = 0.80$ when thickness of riser/weir plate is > orifice diameter

Step 5) Water quality outlet orifice diameter (4.0-in, min.), D_O (in) — D_O (in) = 4.00

$D_O = 12 * 2 * (Q_{WQ}/C_O * \pi * (2 * g * H)^{0.5}))^{0.5}$

Step 6) To size outlet orifice for EDDB with an irregular stage-volume relationship, use Single Outlet Worksheet

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	2.70
Step 2) Recommended maximum outlet area per row, A_O (in^2) $A_O = (WQv)/(0.013 * Z_{WQ}^2 + 0.22 * Z_{WQ} - 0.10)$	A_O (in^2) =	0.28
Step 3) Circular perforation diameter per row assuming a single column, D_1 (in)	D_1 (in) =	0.60
Step 4) Number of Columns, n_c	n_c =	1.00
Step 5) Design circular perforation diameter (should be between 1 and 2 inches), D_{perf} (in)	D_{perf} (in) =	1.00
Step 6) Horizontal perforation column spacing when $n_c > 1$, center to center, S_c If D_{perf} >/= 1.0 in, S_c =4	S_c (in)=	N/A
Step 7) Number of rows (4" vertical spacing between perforations, center to center), n_r	n_r =	8.00

IIb. Water Quality Outlet, V-notch Weir

Step 1) Depth of water quality volume above permanent pool, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	2.70
Step 2) Average head of Water Quality volume over invert of V-notch, H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft.) =	1.35
Step 3) Average water quality outflow rate, Q_{WQ} (cfs) $Q_{WQ} = (WQv * 43{,}560)/(40 * 3600)$	Q_{WQ} (cfs) =	0.06
Step 4) V-notch weir coefficient, C_V	C_V =	2.50
Step 5) V-notch weir angle, θ (deg) $\theta = 2 * \arctan(Q_{WQ} / C_V * H_{WQ}^{5/2}))$ V-notch angle should be at least 20 degeres. Set to 20 degrees if calculated angle is smaller.	θ (deg) =	1.60
Step 6) Top width of V-notch weir $W_V = 2 * Z_{WQ} * TAN(\theta/2)$	W_V =	0.08

Step 7) To calculate v-notch angle for EDDB with and irregular stage-volume relationship, use the V-notch Weir Worksheet

Water Quality Volume Calculation- EDDB-2

WQV = P * Weighted RV

WQV - Water Quality Volume (watershed-inches)
P - Rainfall Event (1.37 inches in Kansas City)
RV - Volumetric Runoff Coefficient

RV = 0.05 + 0.009(I)

I - Percent Site Imperviousness (%)

I. Determine Weighted RV & Weighted Rational C Coefficient

Cover Type	% Impervious	Area (Ac.)	Total Impervious Area (Ac.)	Rational Runoff Coefficient	RV	C * Area	RV * Area
Impervious	100	2.90	2.90	0.90	0.95	2.61	2.76
Grass/Open Space	0	2.09	0.00	0.30	0.05	0.63	0.10
Total	**58**	**4.99**	**2.90**			**3.24**	**2.86**

Rv = Sum(Rv*A)/Total Area = 2.86 / 4.99 = 0.573

C = Sum(C*A)/Total Area = 3.237 / 4.99 = 0.649

II. Determine Water Quality Volume

WQV = P * Rv = 1.37 * 0.573 = **0.785 in**

III. Determine Total Water Quality Volume

Total Watershed Area (AT) = 4.99 acres
WQV = 0.785 in

WQV = (4.99 * 0.785)/12 = **0.33 ac-ft** 14220.58 c.f.

IV. Peak rate of runoff for WQv

Q = K*C*i*A
K = 1 for WQv
C = 0.3 + 0.6 I
I = Percent impervious
i = Rainfall Intensity from Table 9 in BMP manual

C = 0.3+0.6*I = 0.65
K = 1.00
i = 1.90
Q (cfs) = **6.15**

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer:	JPB
Checked by:	
Company:	Schlagel
Date:	6/20/2018
Project:	18-017
Location:	

EDDB-2

I. Basin Water Quality Storage Volume:

Step 1) Tributary Area to EDDB, A_T (ac.)	A_T (ac.) =	4.99
Step 2) Calculate WQv using method in Section 6.1	WQv (ac-ft) =	0.33
Step 3) Add 20 percent to account for silt and sand sediment deposition in the basin	V_{design} (ac-ft) =	0.39

IIa. Water Quality Outlet Type

Step 1) Set Water Quality Outlet Type — Outlet Type = 1.00

Type 1 = Single Orifice
Type 2 = Perforated riser or plate
Type 3 = v-notch weir

Step 2) Proceed to step 2b, 2c, or 2d based on water quality outlet type

IIb. Water Quality Outlet, Single Orifice

Step 1) Depth of water quality volume at outlet, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	2.60
Step 2) Average head of Water Quality volume over invert of orifice, H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft.) =	1.30
Step 3) Average water quality outflow rate, Q_{WQ} (cfs) Q_{WQ} = ~~(WQv * 43,560)/(40 * 3600)~~ VA	Q_{WQ} (cfs) =	0.53
Step 4) Set value of orifice discharge coefficient, C_O C_O = 0.66 when thickness of riser/weir plate is = or < orifice diameter C_O = 0.80 when thickness of riser/weir plate is > orifice diameter	C_O =	0.66
Step 5) Water quality outlet orifice diameter (4.0-in, min.), D_O (in) $D_O = 12 * 2 *(Q_{WQ}/C_O * \pi * (2 *g *H)^{0.5}))^{0.5}$	D_O (in) =	4.00

Step 6) To size outlet orifice for EDDB with an irregular stage-volume relationship, use Single Outlet Worksheet

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	2.60
Step 2) Recommended maximum outlet area per row, A_O (in^2) $A_O = (WQv)/(0.013 * Z_{WQ}^2 + 0.22 * Z_{WQ} -0.10)$	A_O (in^2) =	0.58
Step 3) Circular perforation diameter per row assuming a single column, D_1 (in)	D_1 (in) =	0.86
Step 4) Number of Columns, n_c	n_c =	1.00
Step 5) Design circular perforation diameter (should be between 1 and 2 inches), D_{perf} (in)	D_{perf} (in) =	1.00

Step 6) Horizontal perforation column spacing when n_c > 1, center to center, S_c If D_{perf} >/= 1.0 in, S_c =4	S_c (in)=	N/A
Step 7) Number of rows (4" vertical spacing between perforations, center to center), n_r	n_r =	7.00

IIb. Water Quality Outlet, V-notch Weir

Step 1) Depth of water quality volume above permanent pool, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	2.60
Step 2) Average head of Water Quality volume over invert of V-notch, H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft.) =	1.30
Step 3) Average water quality outflow rate, Q_{WQ} (cfs) $Q_{WQ} = (WQv * 43{,}560)/(40 * 3600)$	Q_{WQ} (cfs) =	0.12
Step 4) V-notch weir coefficient, C_V	C_V =	2.50
Step 5) V-notch weir angle, θ (deg) $\theta = 2 * \arctan(Q_{WQ} / C_V * H_{WQ}^{5/2}))$ V-notch angle should be at least 20 degeres. Set to 20 degrees if calculated angle is smaller.	θ (deg) =	2.00
Step 6) Top width of V-notch weir $W_V = 2 * Z_{WQ} * TAN(\theta/2)$	W_V =	0.09

Step 7) To calculate v-notch angle for EDDB with and irregular stage-volume relationship, use the V-notch Weir Worksheet

III. Flood Control

Refer to APWA Specifications Section 5608

IV. Trash Racks

Step 1) Total outlet area, A_{ot} (in^2)	A_{ot} (in^2) =	251.00
Step 2) Required trash rack open area, A_t (in^2) $A_t = A_{ot} * 77 * e^{(-0.124 * D)}$ for single orifice outlet $A_t = (A_{ot}/2) * 77 * e^{(-0.124 * D)}$ for orifice plate outlet $At = 4 * A_{ot}$ for v-notch weir outlet	A_t (in^2) =	1004.00

Water Quality Volume Calculation- EDDB-3

WQV = P * Weighted RV

WQV - Water Quality Volume (watershed-inches)
P - Rainfall Event (1.37 inches in Kansas City)
RV - Volumetric Runoff Coefficient

RV = 0.05 + 0.009(I)

I - Percent Site Imperviousness (%)

I. Determine Weighted RV & Weighted Rational C Coefficient

Cover Type	% Impervious	Area (Ac.)	Total Impervious Area (Ac.)	Rational Runoff Coefficient	RV	C * Area	RV * Area
Impervious	100	0.18	0.18	0.90	0.95	0.16	0.17
Grass/Open Space	0	1.08	0.00	0.30	0.05	0.32	0.05
Total	**14**	**1.26**	**0.18**			**0.49**	**0.23**

Rv = Sum(Rv*A)/Total Area = 0.225 / 1.26 = 0.179

C = Sum(C*A)/Total Area = 0.486 / 1.26 = 0.386

II. Determine Water Quality Volume

WQV = P * Rv = 1.37 * 0.1786 = **0.245 in**

III. Determine Total Water Quality Volume

Total Watershed Area (AT) = 1.26 acres
WQV = 0.245 in

WQV = (1.26 * 0.244)/12 = **0.03 ac-ft** 1118.948 c.f.

IV. Peak rate of runoff for WQv

Q = K*C*i*A
K = 1 for WQv
C = 0.3 + 0.6 I
I = Percent impervious
i = Rainfall Intensity from Table 9 in BMP manual

C = 0.3+0.6*I = 0.39
K = 1.00
i = 1.90
Q (cfs) = **0.92**

Design Procedure Form: Extended Dry Detention Basin (EDDB)
Main Worksheet

Designer:	JPB
Checked by:	
Company:	Schlagel
Date:	6/20/2018
Project:	18-017
Location:	

EDDB-3

I. Basin Water Quality Storage Volume:

Step 1) Tributary Area to EDDB, A_T (ac.)	A_T (ac.) =	1.26
Step 2) Calculate WQv using method in Section 6.1	WQv (ac-ft) =	0.03
Step 3) Add 20 percent to account for silt and sand sediment deposition in the basin	V_{design} (ac-ft) =	0.03

IIa. Water Quality Outlet Type

Step 1) Set Water Quality Outlet Type — Outlet Type = 1.00

Type 1 = Single Orifice
Type 2 = Perforated riser or plate
Type 3 = v-notch weir

Step 2) Proceed to step 2b, 2c, or 2d based on water quality outlet type

IIb. Water Quality Outlet, Single Orifice

Step 1) Depth of water quality volume at outlet, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	0.70
Step 2) Average head of Water Quality volume over invert of orifice, H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft.) =	0.35
Step 3) Average water quality outflow rate, Q_{WQ} (cfs) Q_{WQ} = ~~(WQv * 43,560)/(40 * 3600)~~ VA	Q_{WQ} (cfs) =	0.28
Step 4) Set value of orifice discharge coefficient, C_O C_O = 0.66 when thickness of riser/weir plate is = or < orifice diameter C_O = 0.80 when thickness of riser/weir plate is > orifice diameter	C_O =	0.66
Step 5) Water quality outlet orifice diameter (4.0-in, min.), D_O (in) $D_O = 12 * 2 *(Q_{WQ}/C_O * \pi * (2 *g *H)^{0.5}))^{0.5}$	D_O (in) =	4.00

Step 6) To size outlet orifice for EDDB with an irregular stage-volume relationship, use Single Outlet Worksheet

IIc. Water Quality Outlet, Perforated Riser

Step 1) Depth at outlet above lowest perforation, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	0.70
Step 2) Recommended maximum outlet area per row, A_O (in^2) $A_O = (WQv)/(0.013 * Z_{WQ}^2 + 0.22 * Z_{WQ} -0.10)$	A_O (in^2) =	0.43
Step 3) Circular perforation diameter per row assuming a single column, D_1 (in)	D_1 (in) =	0.74
Step 4) Number of Columns, n_c	n_c =	1.00
Step 5) Design circular perforation diameter (should be between 1 and 2 inches), D_{perf} (in)	D_{perf} (in) =	1.00

Step 6) Horizontal perforation column spacing when n_c > 1, center to center, S_c If D_{perf} >/= 1.0 in, S_c =4	S_c (in)=	N/A
Step 7) Number of rows (4" vertical spacing between perforations, center to center), n_r	n_r =	2.00

IIb. Water Quality Outlet, V-notch Weir

Step 1) Depth of water quality volume above permanent pool, Z_{WQ} (ft.)	Z_{WQ} (ft.) =	0.70
Step 2) Average head of Water Quality volume over invert of V-notch, H_{WQ} (ft) $H_{WQ} = 0.5 * Z_{WQ}$	H_{WQ} (ft.) =	0.35
Step 3) Average water quality outflow rate, Q_{WQ} (cfs) $Q_{WQ} = (WQv * 43{,}560)/(40 * 3600)$	Q_{WQ} (cfs) =	0.01
Step 4) V-notch weir coefficient, C_V	C_V =	2.50
Step 5) V-notch weir angle, θ (deg) $\theta = 2 * \arctan(Q_{WQ} / C_V * H_{WQ}^{5/2}))$ V-notch angle should be at least 20 degeres. Set to 20 degrees if calculated angle is smaller.	θ (deg) =	9.00
Step 6) Top width of V-notch weir $W_V = 2 * Z_{WQ} * TAN(\theta/2)$	W_V =	0.11
Step 7) To calculate v-notch angle for EDDB with and irregular stage-volume relationship, use the V-notch Weir Worksheet		

III. Flood Control

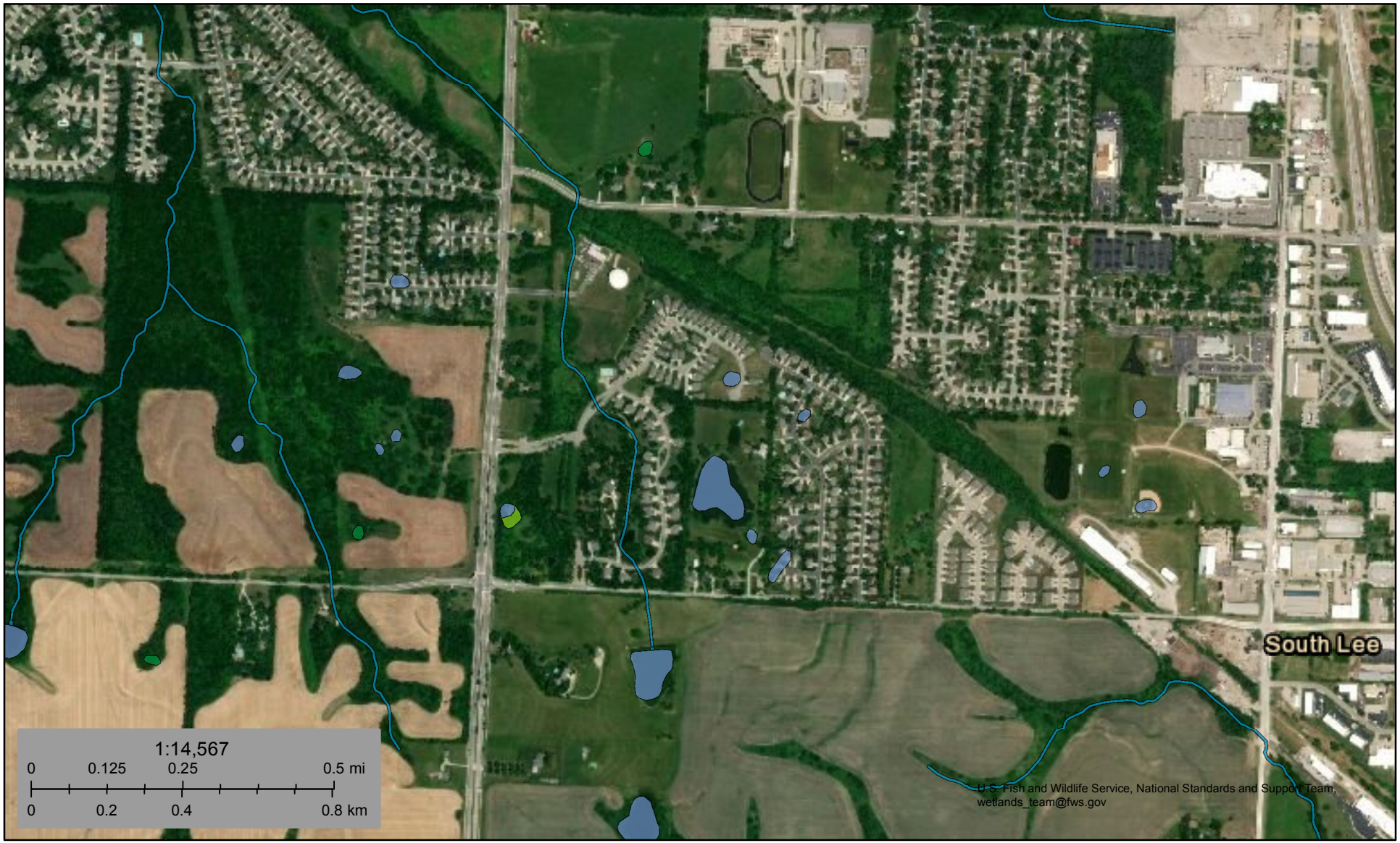
Refer to APWA Specifications Section 5608

IV. Trash Racks

Step 1) Total outlet area, A_{ot} (in^2)	A_{ot} (in^2) =	251.00
Step 2) Required trash rack open area, A_t (in^2) $A_t = A_{ot} * 77 * e^{(-0.124 * D)}$ for single orifice outlet $A_t = (A_{ot}/2) * 77 * e^{(-0.124 * D)}$ for orifice plate outlet $At = 4 * A_{ot}$ for v-notch weir outlet	A_t (in^2) =	1004.00

U.S. Fish and Wildlife Service
National Wetlands Inventory

Woodland Glen



June 21, 2018

Wetlands

- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Other
- Riverine

not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

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

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

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

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

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

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

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

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

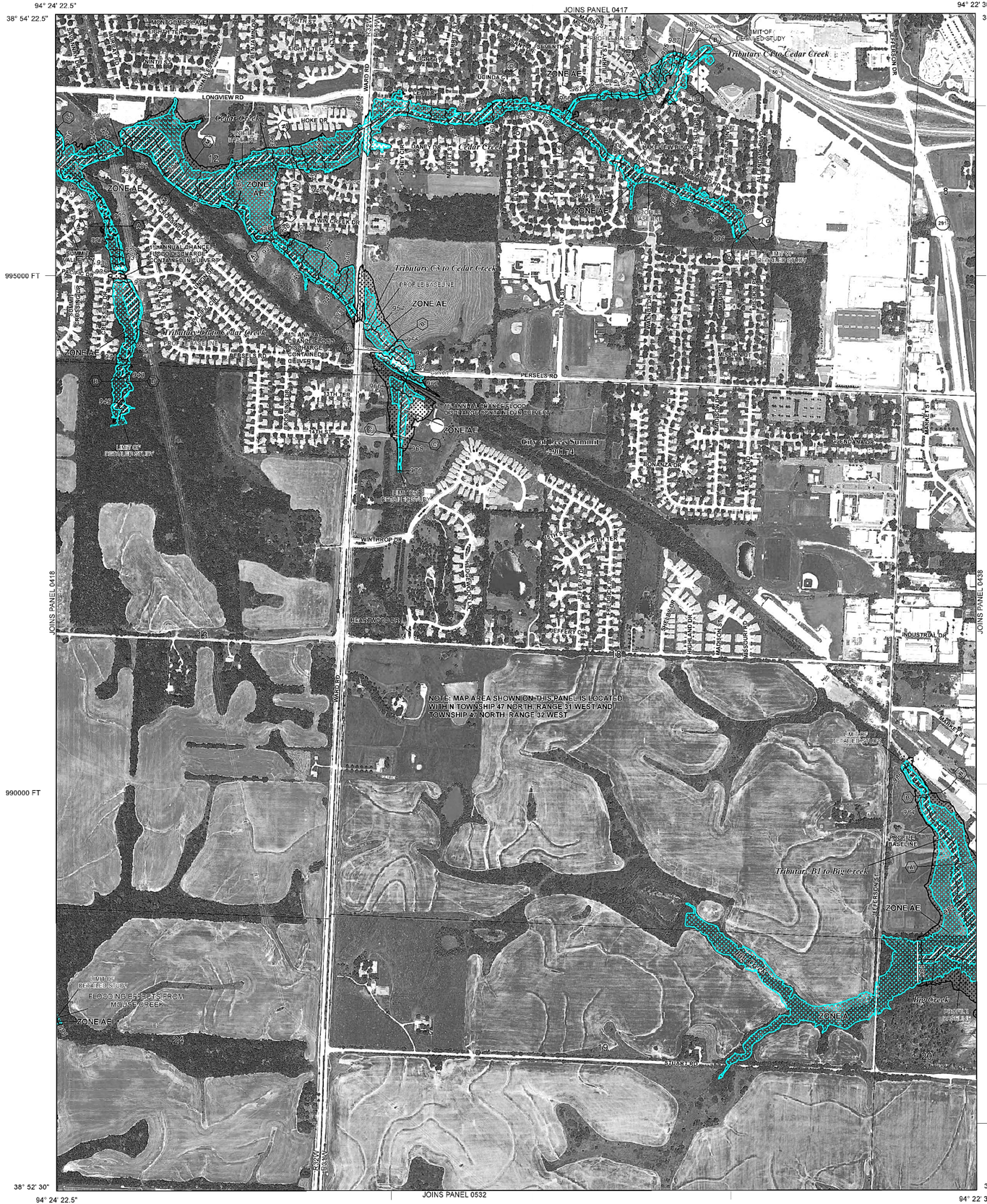
The **profile baselines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile baseline**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

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

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

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

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



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

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

FLOODWAY AREAS IN ZONE AE

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

OTHER FLOOD AREAS

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

OTHER AREAS

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

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

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

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

*Referenced to the North American Vertical Datum of 1988

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

MAP REPOSITORIES
Refer to Map Repositories list on Map Index

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

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

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

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

MAP SCALE 1" = 500'
250 0 500 1000 FEET
150 0 150 300 METERS

NFIP
NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0419G

FIRM

FLOOD INSURANCE RATE MAP

JACKSON COUNTY, MISSOURI AND INCORPORATED AREAS

PANEL 419 OF 625
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

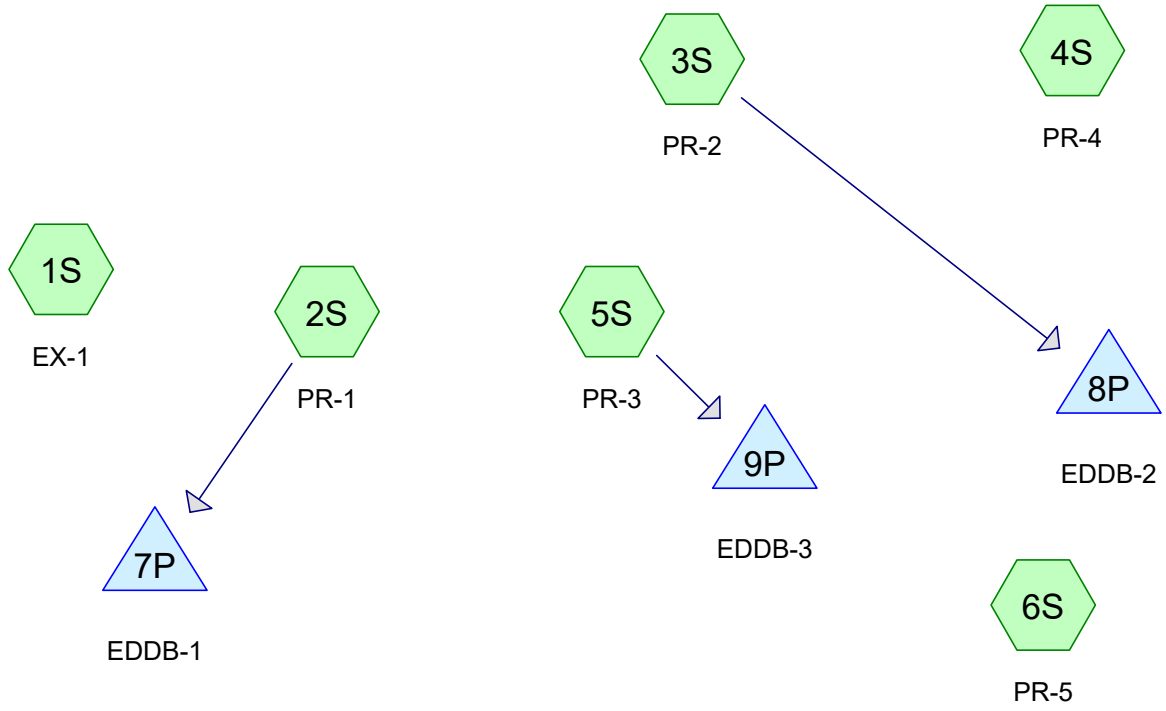
CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
LEE'S SUMMIT, CITY OF	290174	0419	G

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

MAP NUMBER
29095C0419G

APPENDIX B- HydroCAD Output



Subcat Reach Pond Link

Routing Diagram for 18-017 Hydro Single Orifice
Prepared by Schlagel & Associates, P.A., Printed 4/28/2020

Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX-1 Runoff Area=9.730 ac 0.00% Impervious Runoff Depth>1.64"
Flow Length=410' Tc=6.8 min CN=82 Runoff=29.47 cfs 1.331 af

Subcatchment2S: PR-1 Runoff Area=2.590 ac 55.98% Impervious Runoff Depth>2.29"
Tc=5.0 min CN=90 Runoff=10.96 cfs 0.494 af

Subcatchment3S: PR-2 Runoff Area=4.990 ac 58.12% Impervious Runoff Depth>2.29"
Tc=5.0 min CN=90 Runoff=21.12 cfs 0.952 af

Subcatchment4S: PR-4 Runoff Area=0.220 ac 27.27% Impervious Runoff Depth>1.87"
Tc=5.0 min CN=85 Runoff=0.79 cfs 0.034 af

Subcatchment5S: PR-3 Runoff Area=1.260 ac 14.29% Impervious Runoff Depth>1.72"
Tc=5.0 min CN=83 Runoff=4.20 cfs 0.180 af

Subcatchment6S: PR-5 Runoff Area=0.670 ac 16.42% Impervious Runoff Depth>1.72"
Tc=5.0 min CN=83 Runoff=2.23 cfs 0.096 af

Pond 7P: EDDB-1 Peak Elev=987.57' Storage=12,878 cf Inflow=10.96 cfs 0.494 af
Outflow=0.44 cfs 0.311 af

Pond 8P: EDDB-2 Peak Elev=972.80' Storage=25,739 cf Inflow=21.12 cfs 0.952 af
Outflow=1.08 cfs 0.523 af

Pond 9P: EDDB-3 Peak Elev=971.32' Storage=3,671 cf Inflow=4.20 cfs 0.180 af
Outflow=0.45 cfs 0.173 af

Total Runoff Area = 19.460 ac Runoff Volume = 3.087 af Average Runoff Depth = 1.90"
75.85% Pervious = 14.760 ac 24.15% Impervious = 4.700 ac

Summary for Subcatchment 1S: EX-1

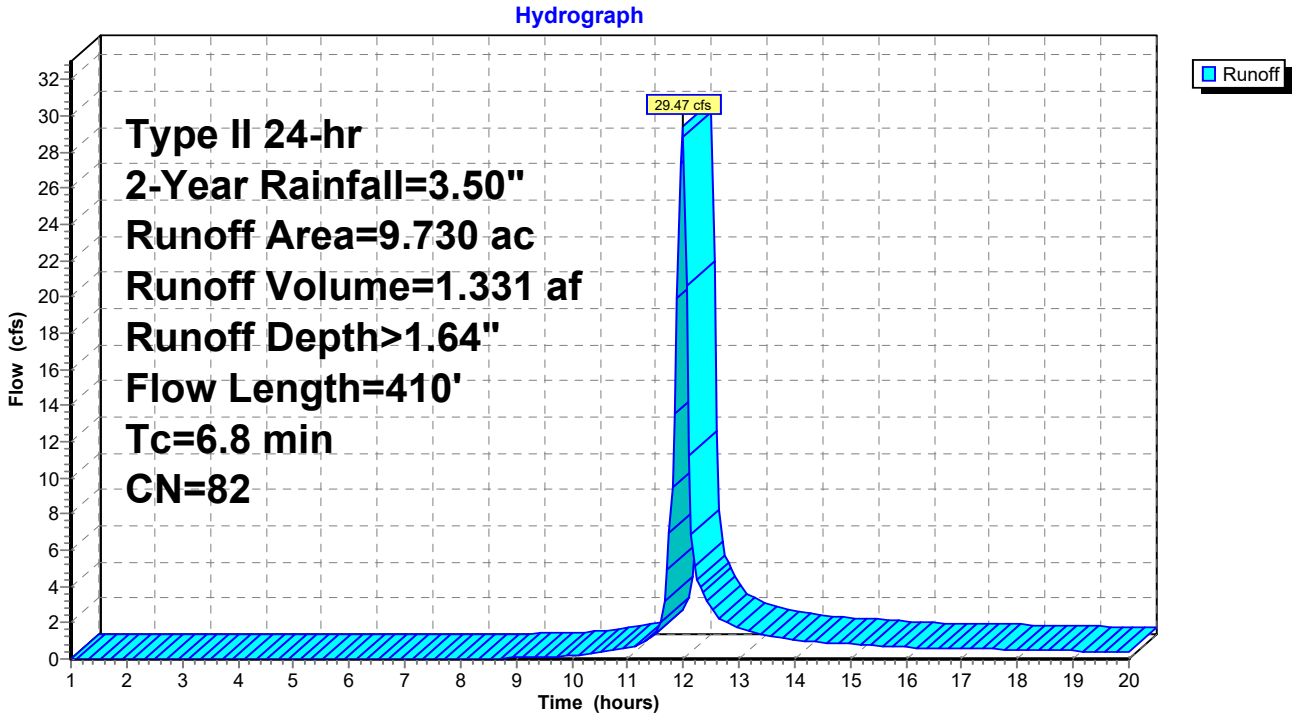
Runoff = 29.47 cfs @ 11.98 hrs, Volume= 1.331 af, Depth> 1.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
9.730	82	Woods/grass comb., Fair, HSG D
9.730		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	100	0.0700	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
1.1	310	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.8	410	Total			

Subcatchment 1S: EX-1



Summary for Subcatchment 2S: PR-1

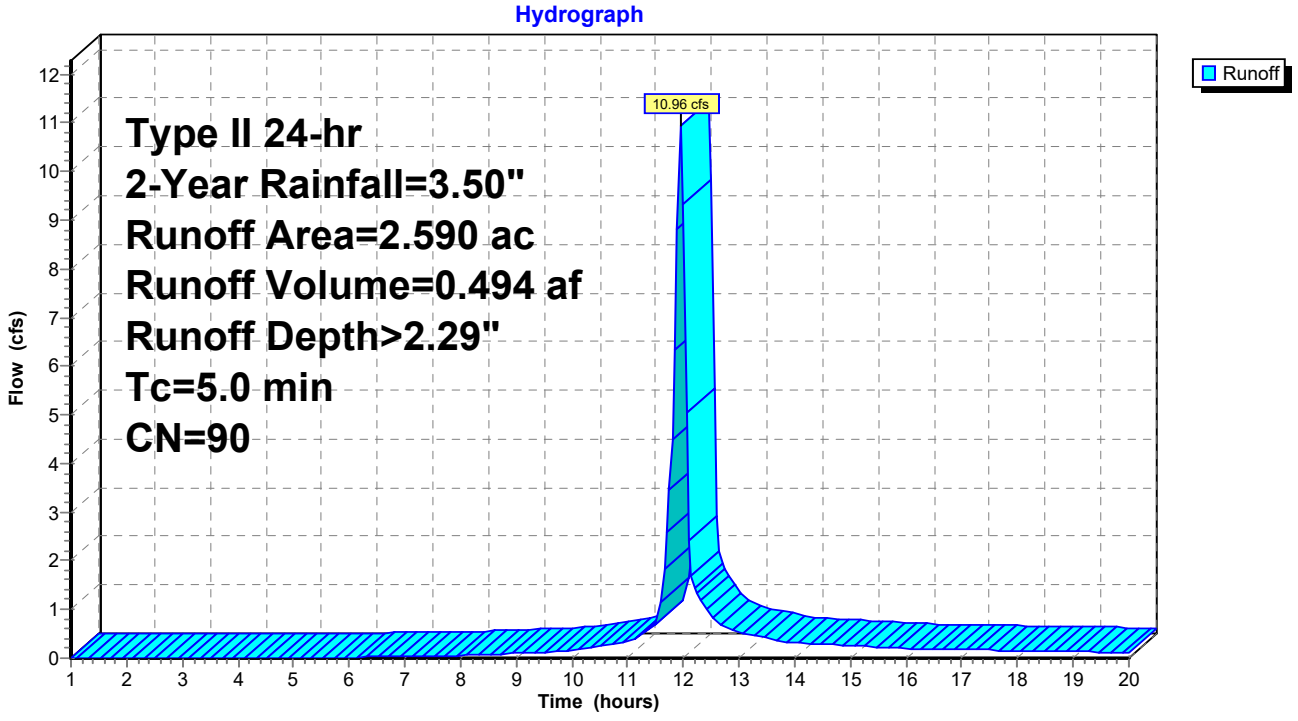
Runoff = 10.96 cfs @ 11.95 hrs, Volume= 0.494 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
1.450	98	Paved parking, HSG D
1.140	80	>75% Grass cover, Good, HSG D
2.590	90	Weighted Average
1.140		44.02% Pervious Area
1.450		55.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: PR-1



Summary for Subcatchment 3S: PR-2

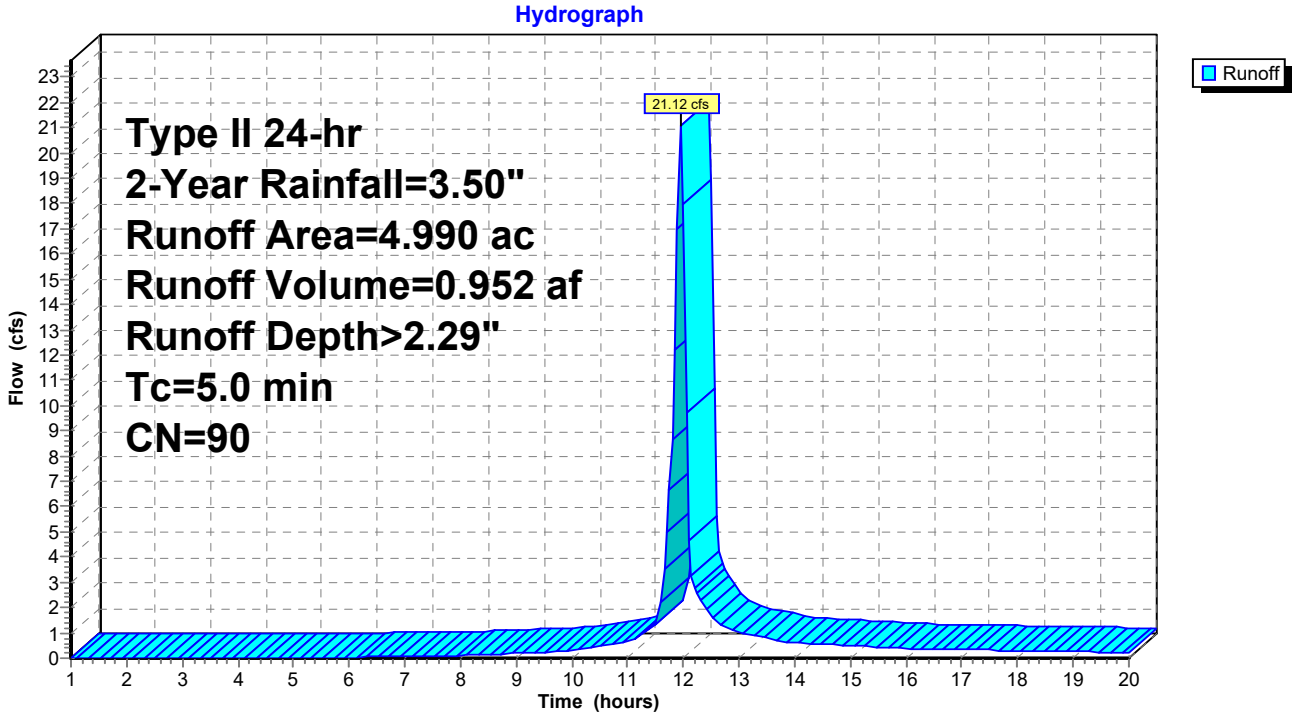
Runoff = 21.12 cfs @ 11.95 hrs, Volume= 0.952 af, Depth> 2.29"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
2.900	98	Paved parking, HSG D
2.090	80	>75% Grass cover, Good, HSG D
4.990	90	Weighted Average
2.090		41.88% Pervious Area
2.900		58.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: PR-2



Summary for Subcatchment 4S: PR-4

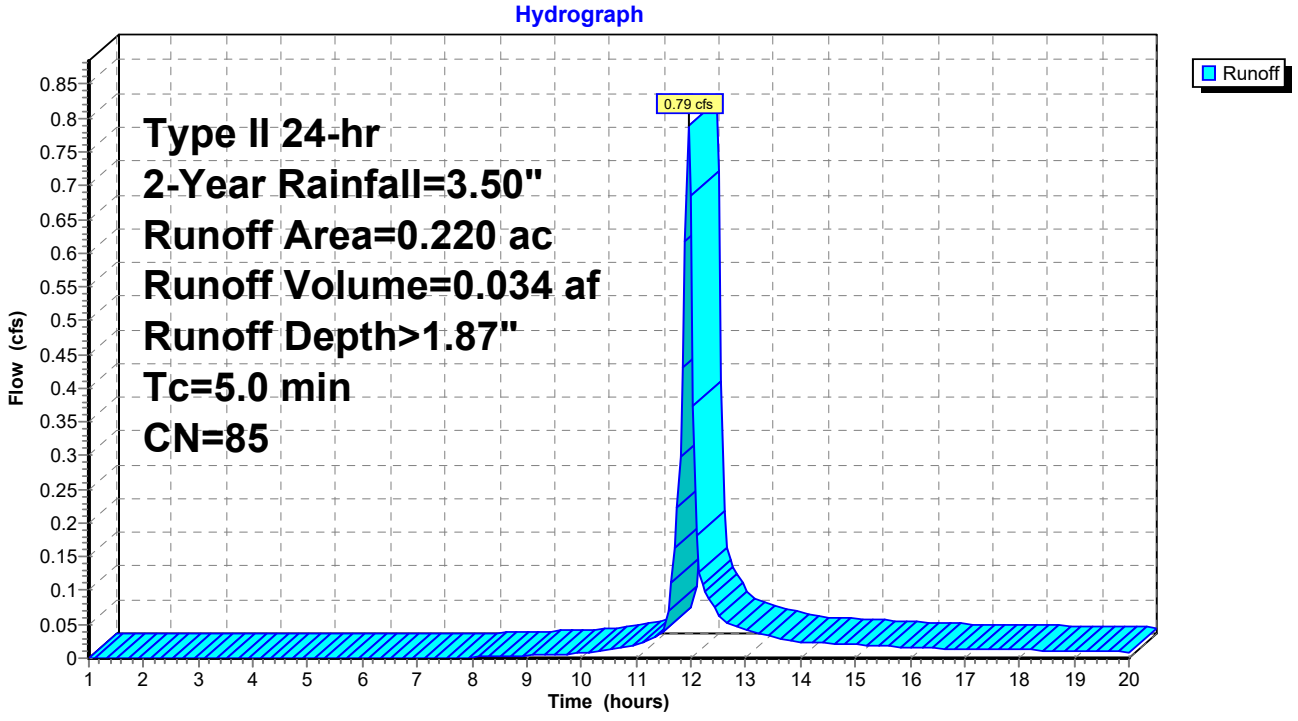
Runoff = 0.79 cfs @ 11.96 hrs, Volume= 0.034 af, Depth> 1.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.060	98	Paved parking, HSG D
0.160	80	>75% Grass cover, Good, HSG D
0.220	85	Weighted Average
0.160		72.73% Pervious Area
0.060		27.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: PR-4



Summary for Subcatchment 5S: PR-3

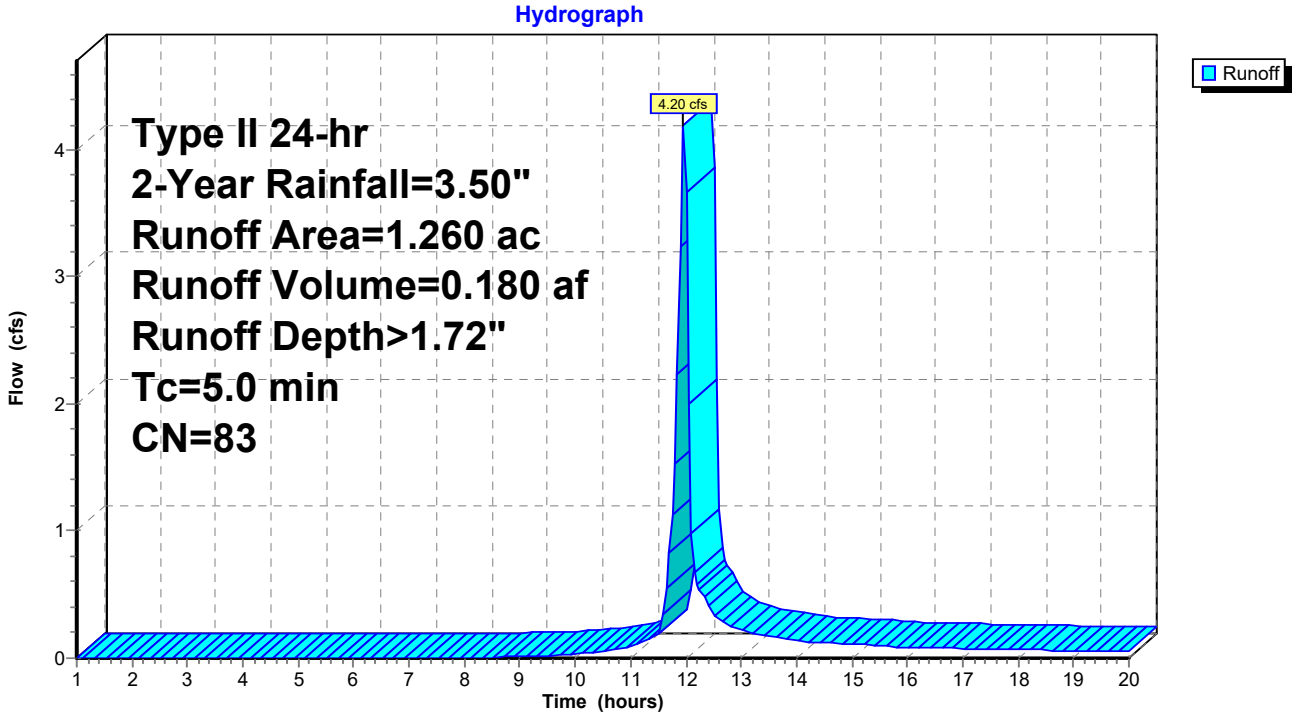
Runoff = 4.20 cfs @ 11.96 hrs, Volume= 0.180 af, Depth> 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG D
1.080	80	>75% Grass cover, Good, HSG D
1.260	83	Weighted Average
1.080		85.71% Pervious Area
0.180		14.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: PR-3



Summary for Subcatchment 6S: PR-5

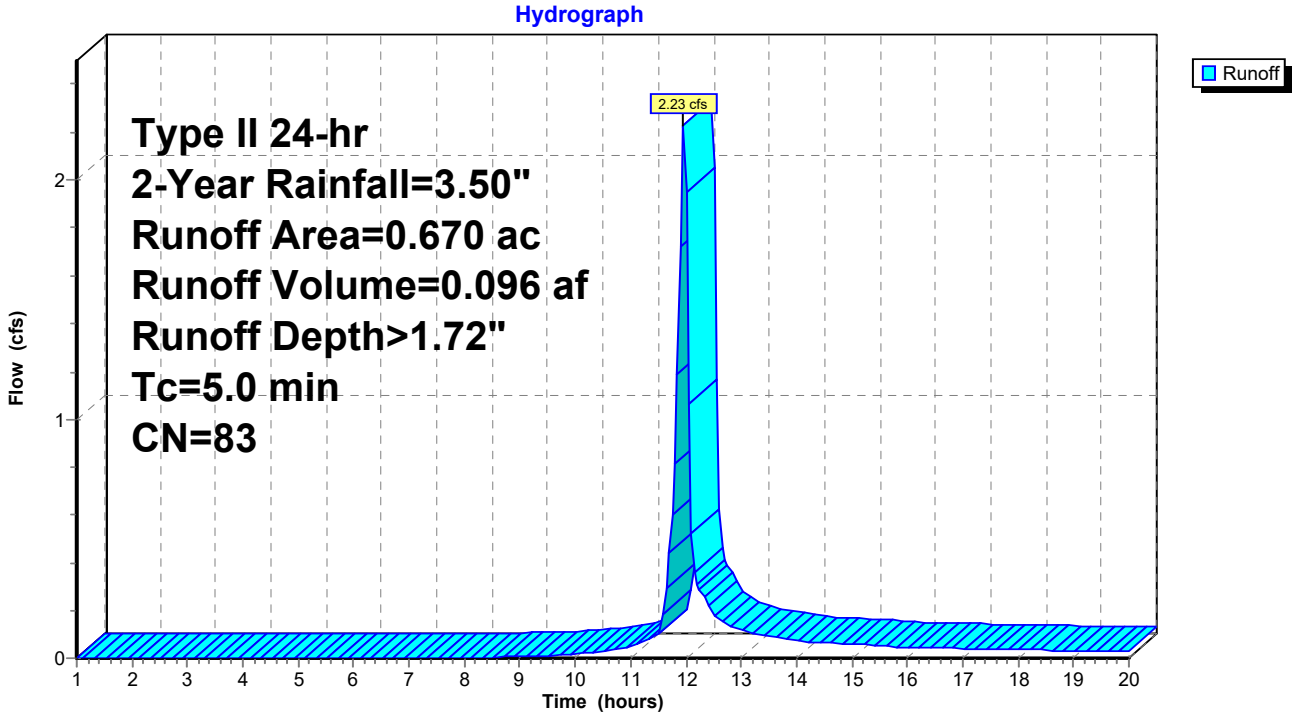
Runoff = 2.23 cfs @ 11.96 hrs, Volume= 0.096 af, Depth> 1.72"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=3.50"

Area (ac)	CN	Description
0.110	98	Paved parking, HSG D
0.560	80	>75% Grass cover, Good, HSG D
0.670	83	Weighted Average
0.560		83.58% Pervious Area
0.110		16.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: PR-5



Summary for Pond 7P: EDDB-1

Inflow Area = 2.590 ac, 55.98% Impervious, Inflow Depth > 2.29" for 2-Year event
Inflow = 10.96 cfs @ 11.95 hrs, Volume= 0.494 af
Outflow = 0.44 cfs @ 13.37 hrs, Volume= 0.311 af, Atten= 96%, Lag= 84.8 min
Primary = 0.44 cfs @ 13.37 hrs, Volume= 0.311 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 987.57' @ 13.37 hrs Surf.Area= 5,320 sf Storage= 12,878 cf

Plug-Flow detention time= 224.8 min calculated for 0.311 af (63% of inflow)
Center-of-Mass det. time= 153.6 min (916.9 - 763.3)

Volume	Invert	Avail.Storage	Storage Description
#1	984.00'	48,565 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

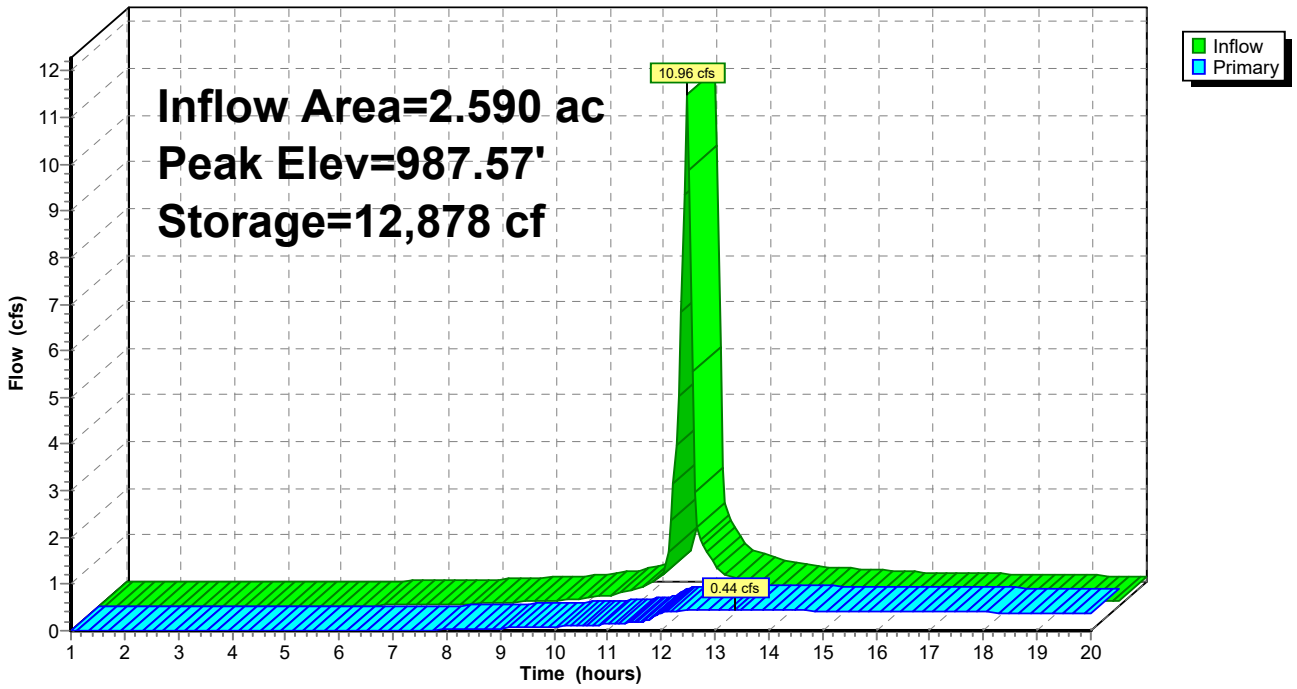
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
984.00	2,004	0	0
986.00	3,749	5,753	5,753
988.00	5,748	9,497	15,250
990.00	8,206	13,954	29,204
992.00	11,155	19,361	48,565

Device	Routing	Invert	Outlet Devices
#1	Primary	984.00'	**15.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 984.00' / 983.50' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	984.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	990.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.44 cfs @ 13.37 hrs HW=987.57' (Free Discharge)
└**1=Culvert** (Passes 0.44 cfs of 10.13 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.44 cfs @ 8.94 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

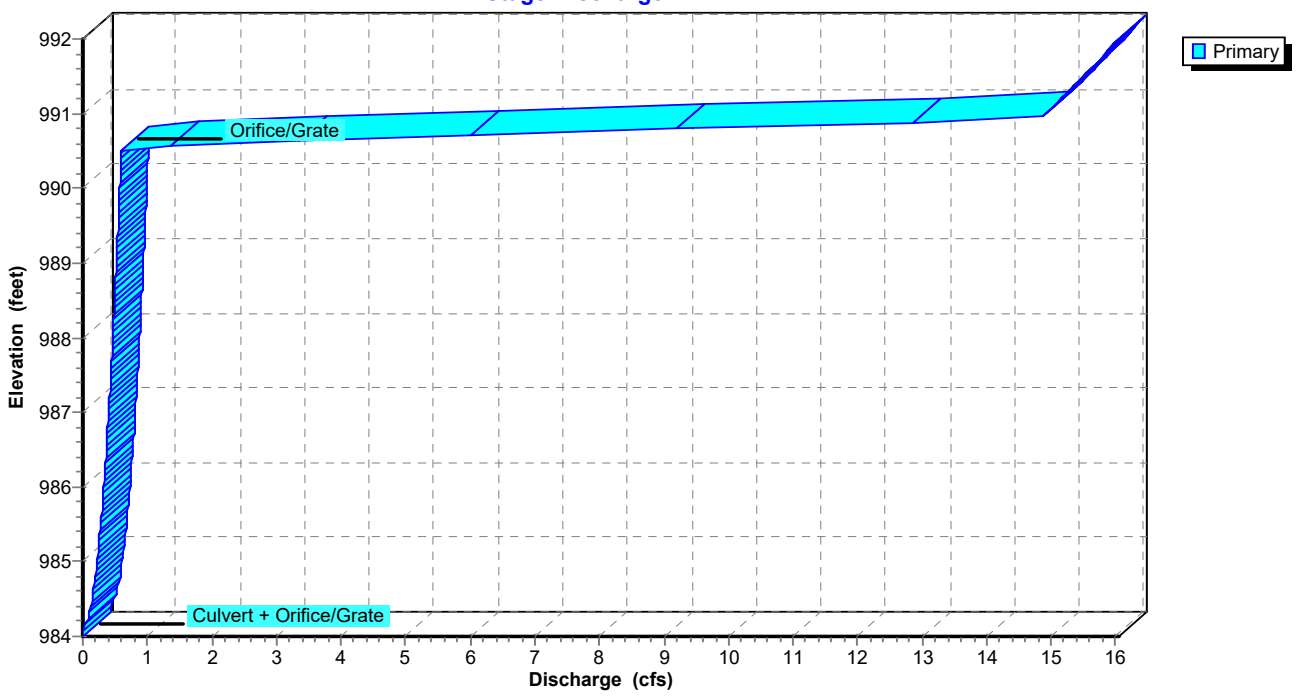
Pond 7P: EDDB-1

Hydrograph

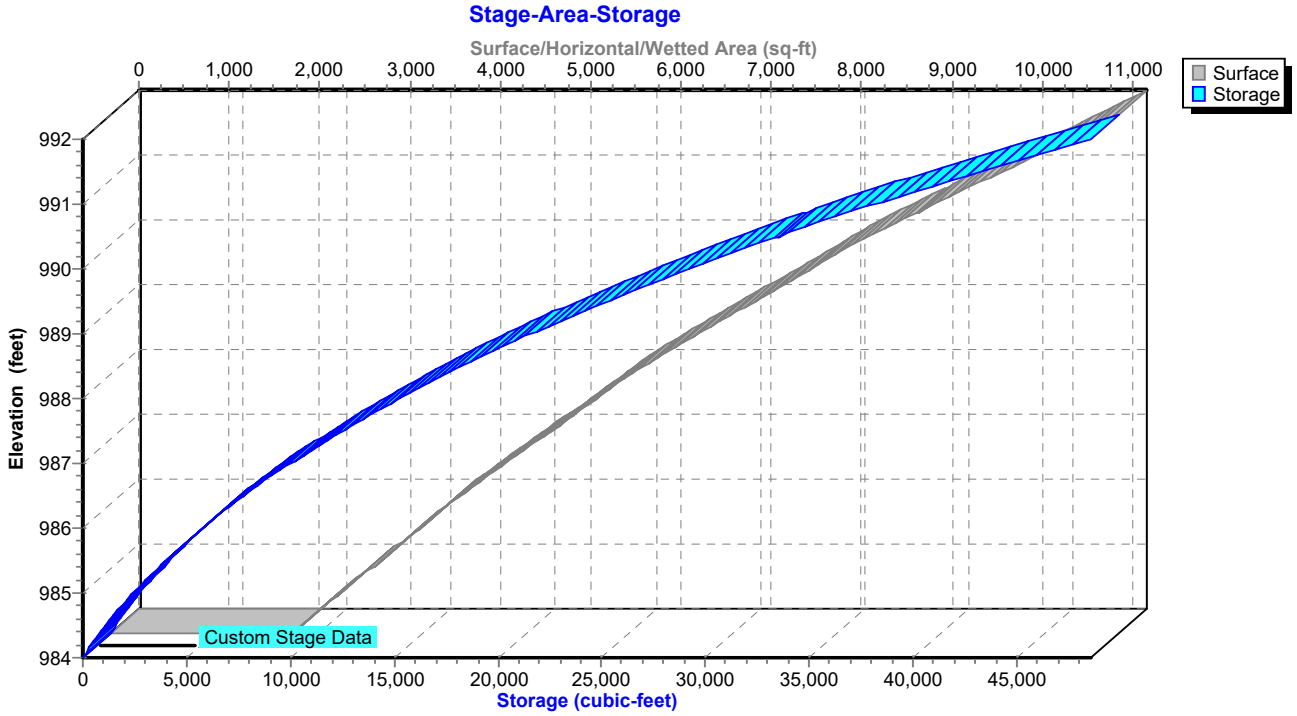


Pond 7P: EDDB-1

Stage-Discharge



Pond 7P: EDDB-1



Summary for Pond 8P: EDDB-2

Inflow Area = 4.990 ac, 58.12% Impervious, Inflow Depth > 2.29" for 2-Year event
Inflow = 21.12 cfs @ 11.95 hrs, Volume= 0.952 af
Outflow = 1.08 cfs @ 12.94 hrs, Volume= 0.523 af, Atten= 95%, Lag= 59.3 min
Primary = 1.08 cfs @ 12.94 hrs, Volume= 0.523 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 972.80' @ 12.94 hrs Surf.Area= 9,885 sf Storage= 25,739 cf

Plug-Flow detention time= 227.9 min calculated for 0.523 af (55% of inflow)
Center-of-Mass det. time= 151.9 min (915.2 - 763.3)

Volume	Invert	Avail.Storage	Storage Description
#1	970.00'	96,669 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

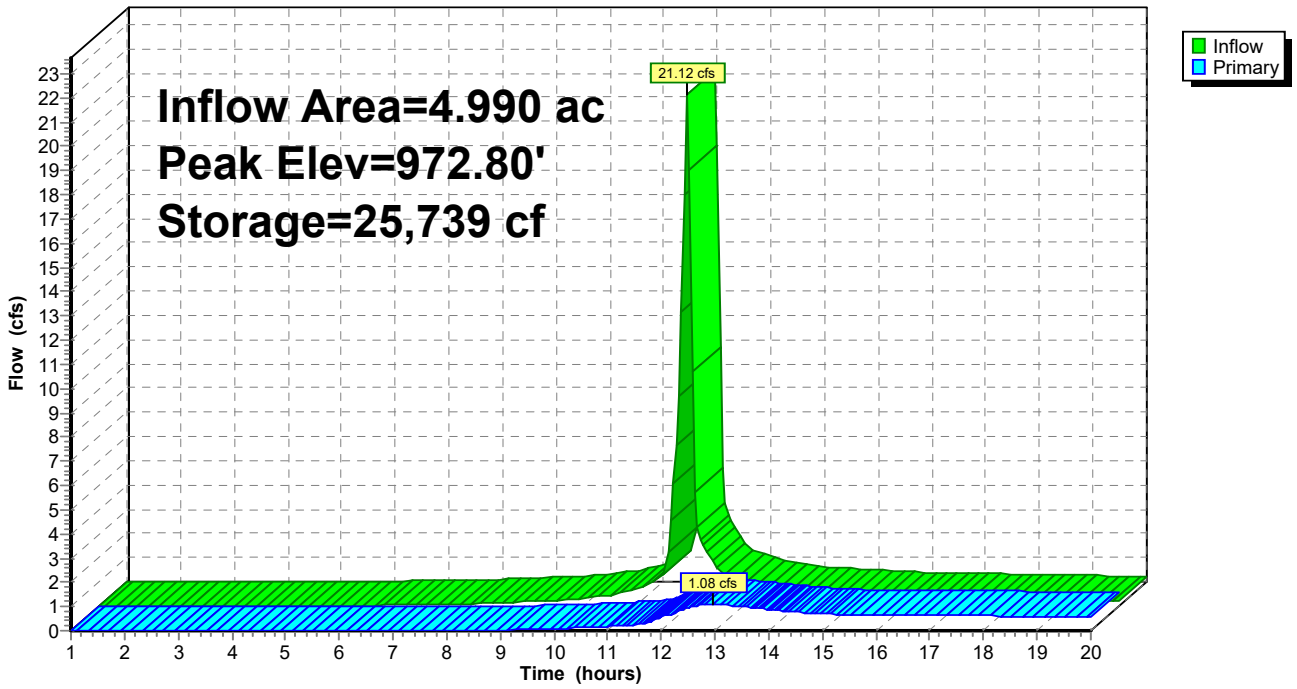
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
970.00	8,478	0	0
972.00	9,473	17,951	17,951
974.00	10,497	19,970	37,921
976.00	11,504	22,001	59,922
978.00	12,504	24,008	83,930
979.00	12,974	12,739	96,669

Device	Routing	Invert	Outlet Devices
#1	Primary	970.00'	**18.0" Round Culvert** L= 73.1' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 970.00' / 969.56' S= 0.0060 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	970.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	972.60'	**16.0" W x 16.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	975.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.08 cfs @ 12.94 hrs HW=972.80' (Free Discharge)
- **1=Culvert** (Passes 0.68 cfs of 11.12 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.68 cfs @ 7.82 fps)
  - **4=Orifice/Grate** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Orifice Controls 0.40 cfs @ 1.45 fps)

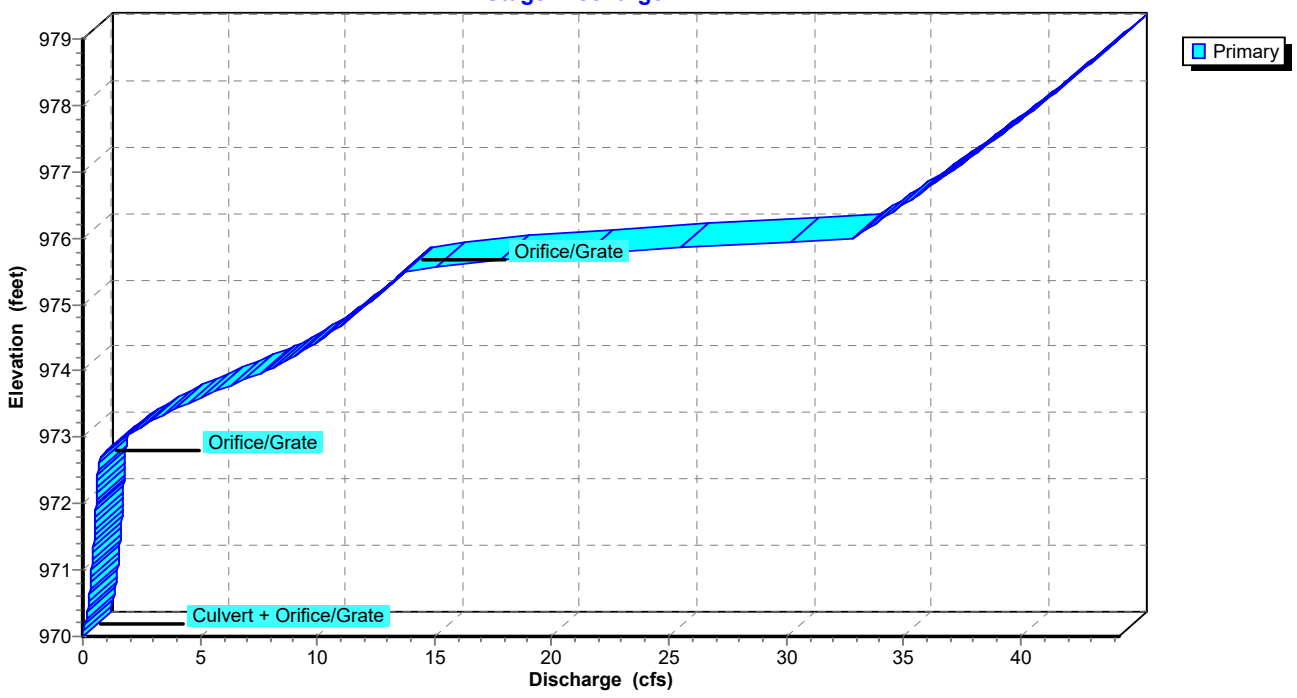
Pond 8P: EDDB-2

Hydrograph

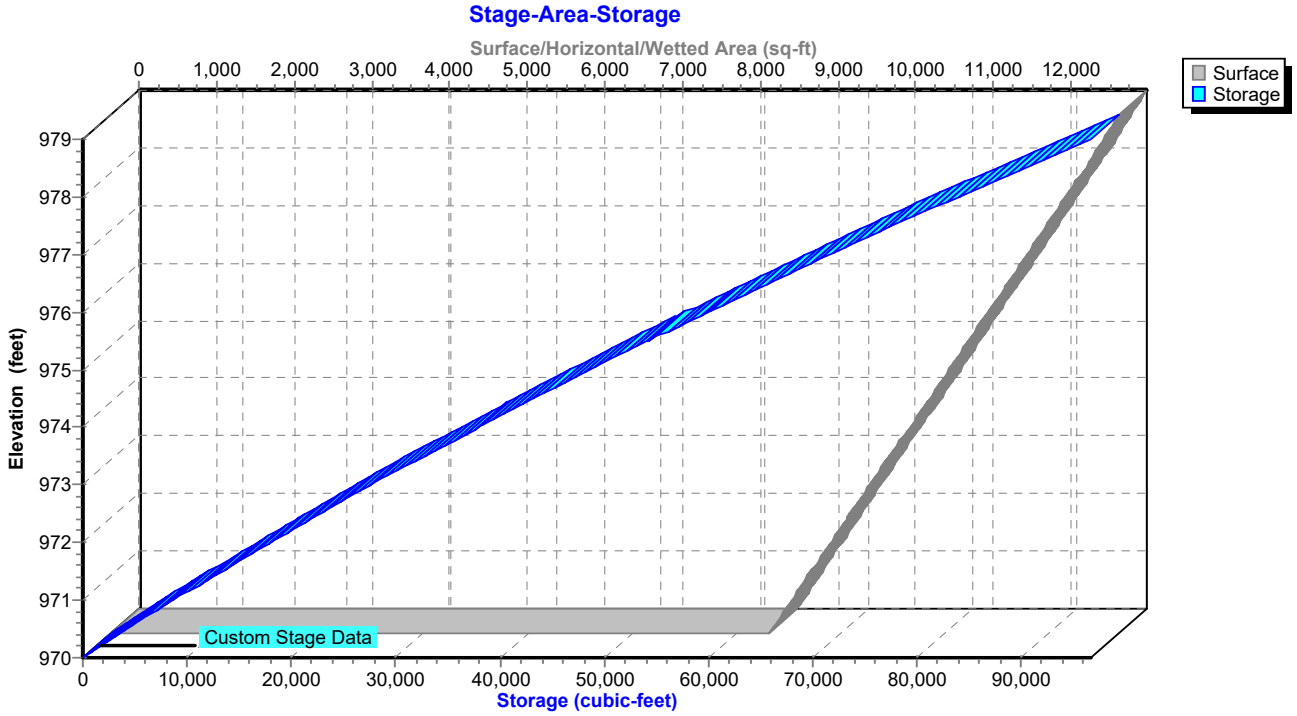


Pond 8P: EDDB-2

Stage-Discharge



Pond 8P: EDDB-2



Summary for Pond 9P: EDDB-3

Inflow Area = 1.260 ac, 14.29% Impervious, Inflow Depth > 1.72" for 2-Year event
Inflow = 4.20 cfs @ 11.96 hrs, Volume= 0.180 af
Outflow = 0.45 cfs @ 12.37 hrs, Volume= 0.173 af, Atten= 89%, Lag= 24.6 min
Primary = 0.45 cfs @ 12.37 hrs, Volume= 0.173 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 971.32' @ 12.37 hrs Surf.Area= 3,823 sf Storage= 3,671 cf

Plug-Flow detention time= 99.1 min calculated for 0.173 af (96% of inflow)
Center-of-Mass det. time= 84.3 min (868.0 - 783.6)

Volume	Invert	Avail.Storage	Storage Description
#1	970.00'	21,597 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

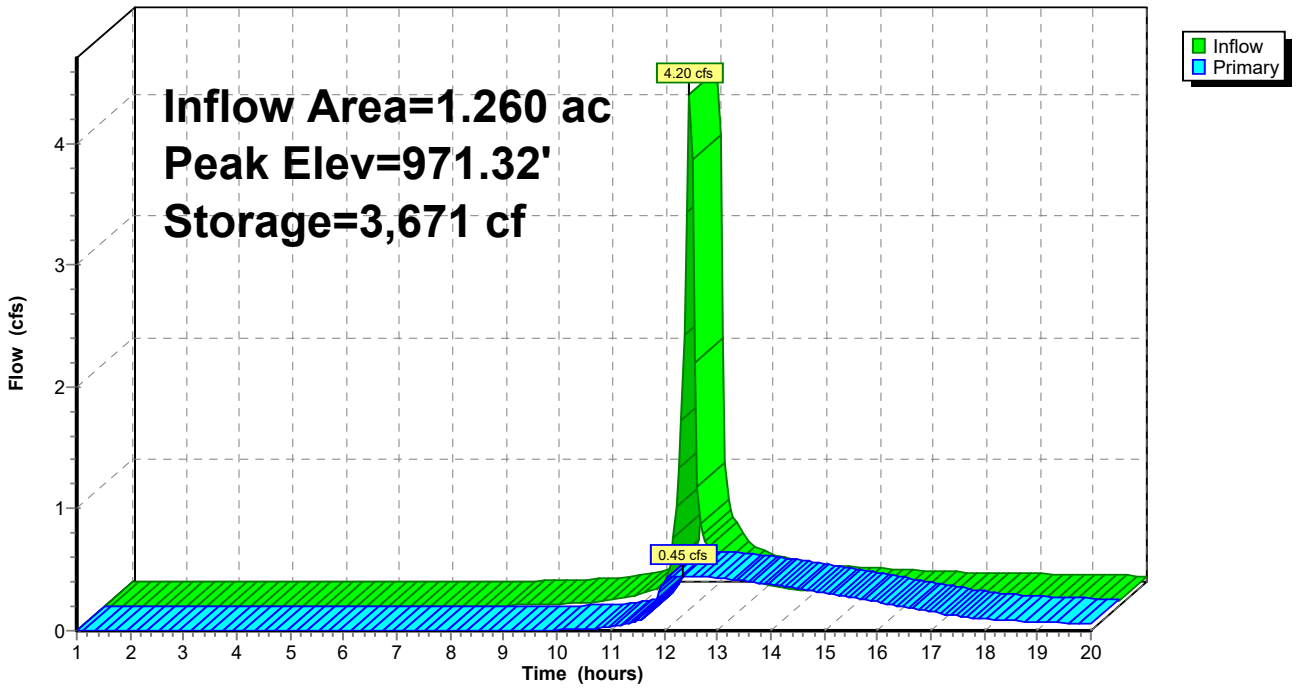
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
970.00	1,727	0	0
972.00	4,895	6,622	6,622
974.00	10,080	14,975	21,597

Device	Routing	Invert	Outlet Devices
#1	Primary	968.53'	**15.0" Round Culvert** L= 45.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 968.53' / 968.12' S= 0.0091 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	970.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	973.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.45 cfs @ 12.37 hrs HW=971.32' (Free Discharge)
└**1=Culvert** (Passes 0.45 cfs of 8.62 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.45 cfs @ 5.18 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

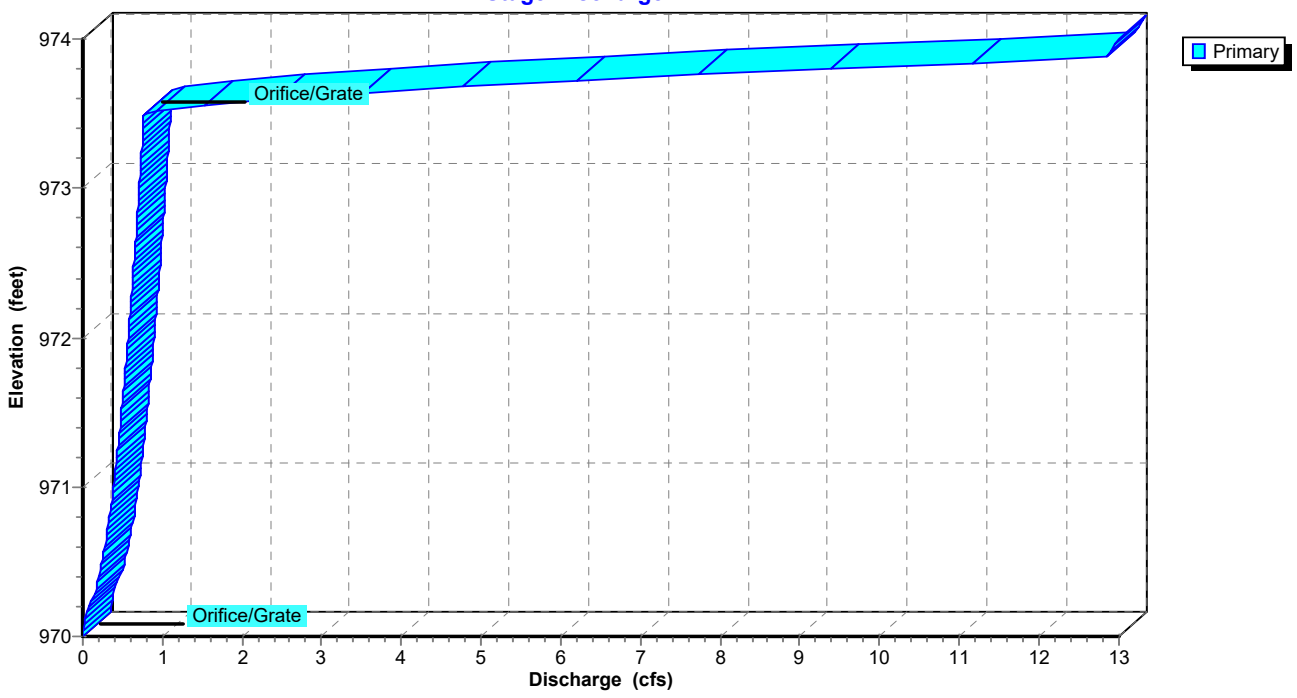
Pond 9P: EDDB-3

Hydrograph

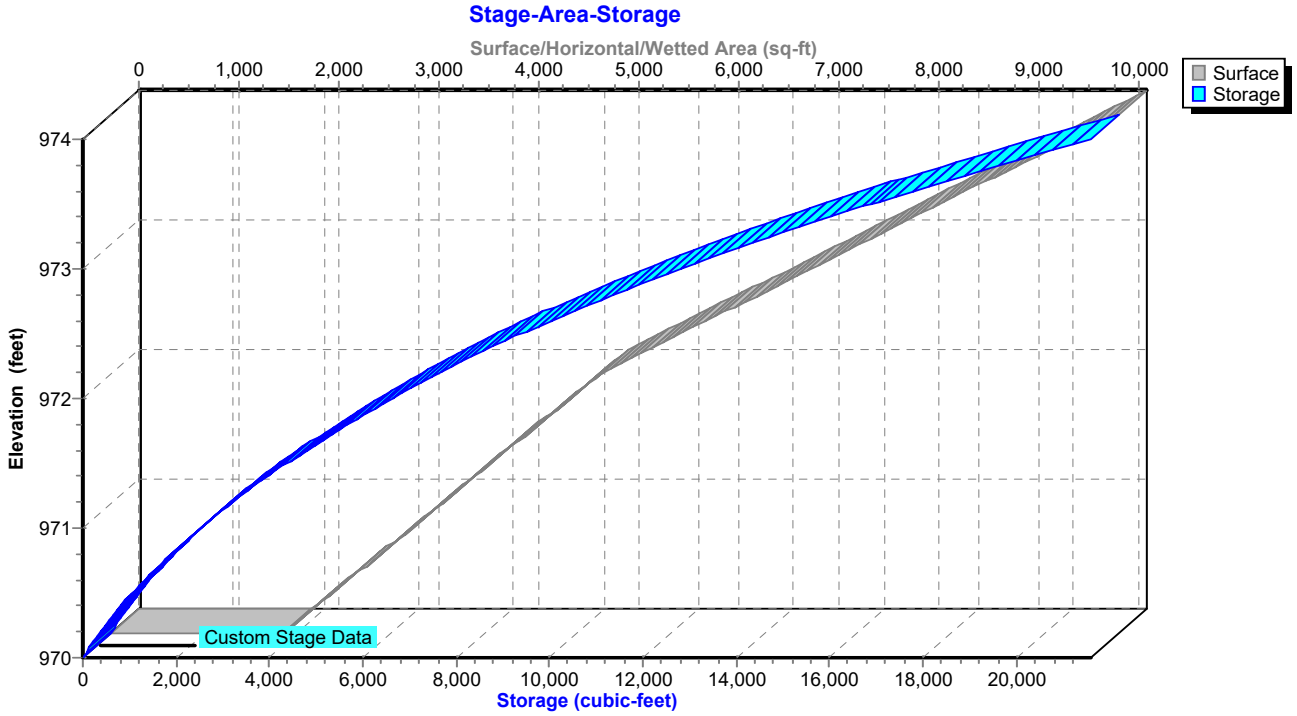


Pond 9P: EDDB-3

Stage-Discharge



Pond 9P: EDDB-3



Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX-1 Runoff Area=9.730 ac 0.00% Impervious Runoff Depth>3.11"
Flow Length=410' Tc=6.8 min CN=82 Runoff=54.23 cfs 2.526 af

Subcatchment2S: PR-1 Runoff Area=2.590 ac 55.98% Impervious Runoff Depth>3.92"
Tc=5.0 min CN=90 Runoff=18.05 cfs 0.845 af

Subcatchment3S: PR-2 Runoff Area=4.990 ac 58.12% Impervious Runoff Depth>3.92"
Tc=5.0 min CN=90 Runoff=34.78 cfs 1.629 af

Subcatchment4S: PR-4 Runoff Area=0.220 ac 27.27% Impervious Runoff Depth>3.41"
Tc=5.0 min CN=85 Runoff=1.39 cfs 0.062 af

Subcatchment5S: PR-3 Runoff Area=1.260 ac 14.29% Impervious Runoff Depth>3.21"
Tc=5.0 min CN=83 Runoff=7.61 cfs 0.337 af

Subcatchment6S: PR-5 Runoff Area=0.670 ac 16.42% Impervious Runoff Depth>3.21"
Tc=5.0 min CN=83 Runoff=4.05 cfs 0.179 af

Pond 7P: EDDB-1 Peak Elev=989.27' Storage=23,529 cf Inflow=18.05 cfs 0.845 af
Outflow=0.54 cfs 0.417 af

Pond 8P: EDDB-2 Peak Elev=973.97' Storage=37,644 cf Inflow=34.78 cfs 1.629 af
Outflow=7.68 cfs 1.130 af

Pond 9P: EDDB-3 Peak Elev=972.16' Storage=7,424 cf Inflow=7.61 cfs 0.337 af
Outflow=0.59 cfs 0.321 af

Total Runoff Area = 19.460 ac Runoff Volume = 5.579 af Average Runoff Depth = 3.44"
75.85% Pervious = 14.760 ac 24.15% Impervious = 4.700 ac

Summary for Subcatchment 1S: EX-1

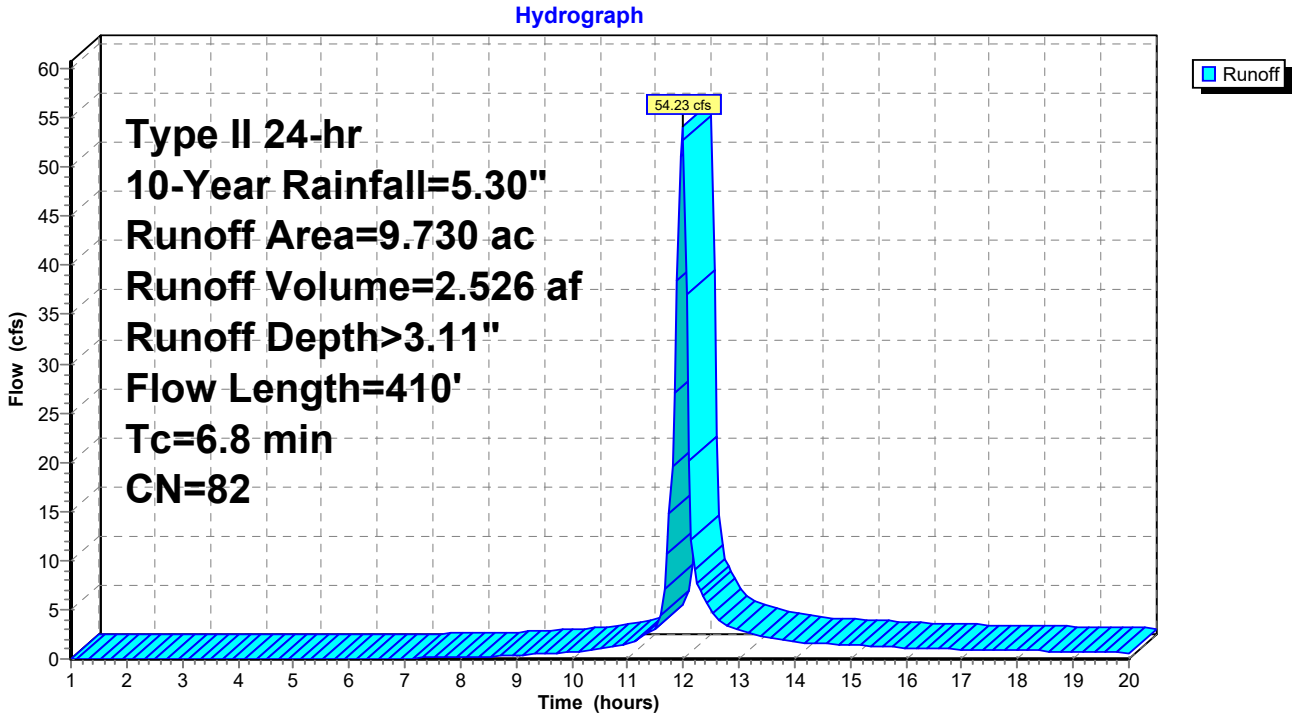
Runoff = 54.23 cfs @ 11.98 hrs, Volume= 2.526 af, Depth> 3.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
9.730	82	Woods/grass comb., Fair, HSG D
9.730		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	100	0.0700	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
1.1	310	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.8	410	Total			

Subcatchment 1S: EX-1



Summary for Subcatchment 2S: PR-1

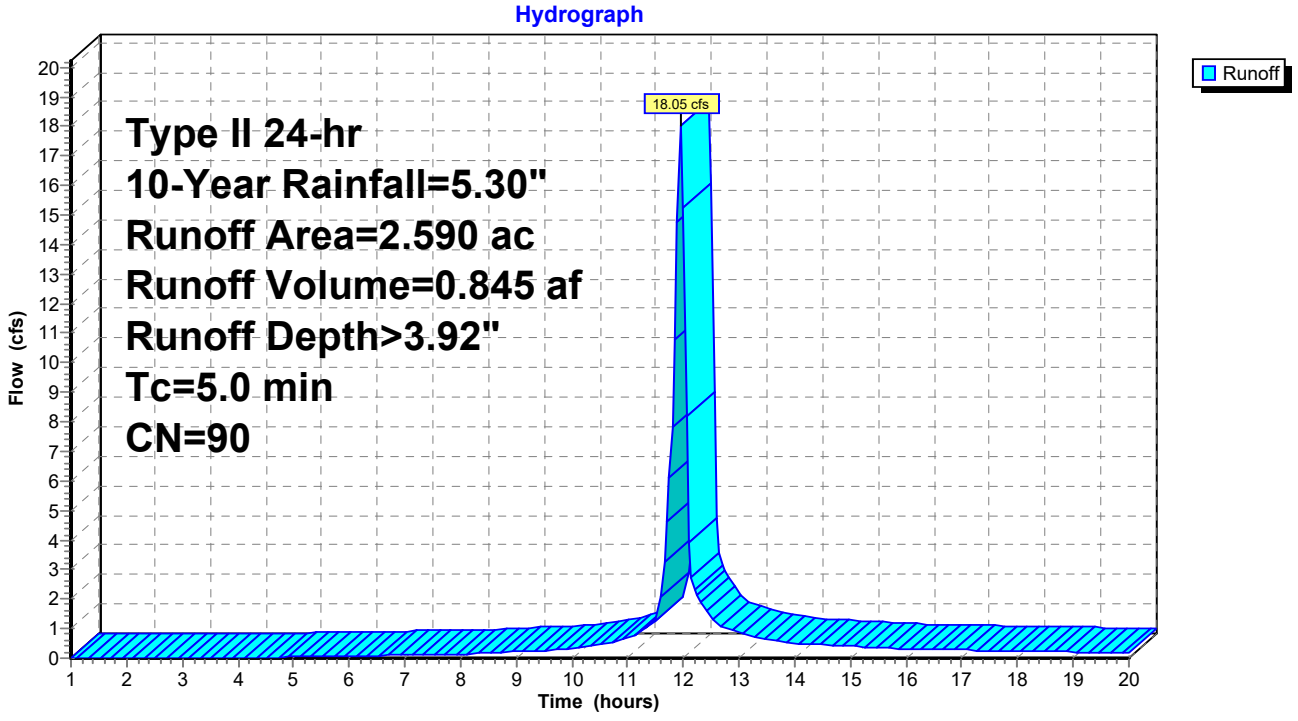
Runoff = 18.05 cfs @ 11.95 hrs, Volume= 0.845 af, Depth> 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
1.450	98	Paved parking, HSG D
1.140	80	>75% Grass cover, Good, HSG D
2.590	90	Weighted Average
1.140		44.02% Pervious Area
1.450		55.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: PR-1



Summary for Subcatchment 3S: PR-2

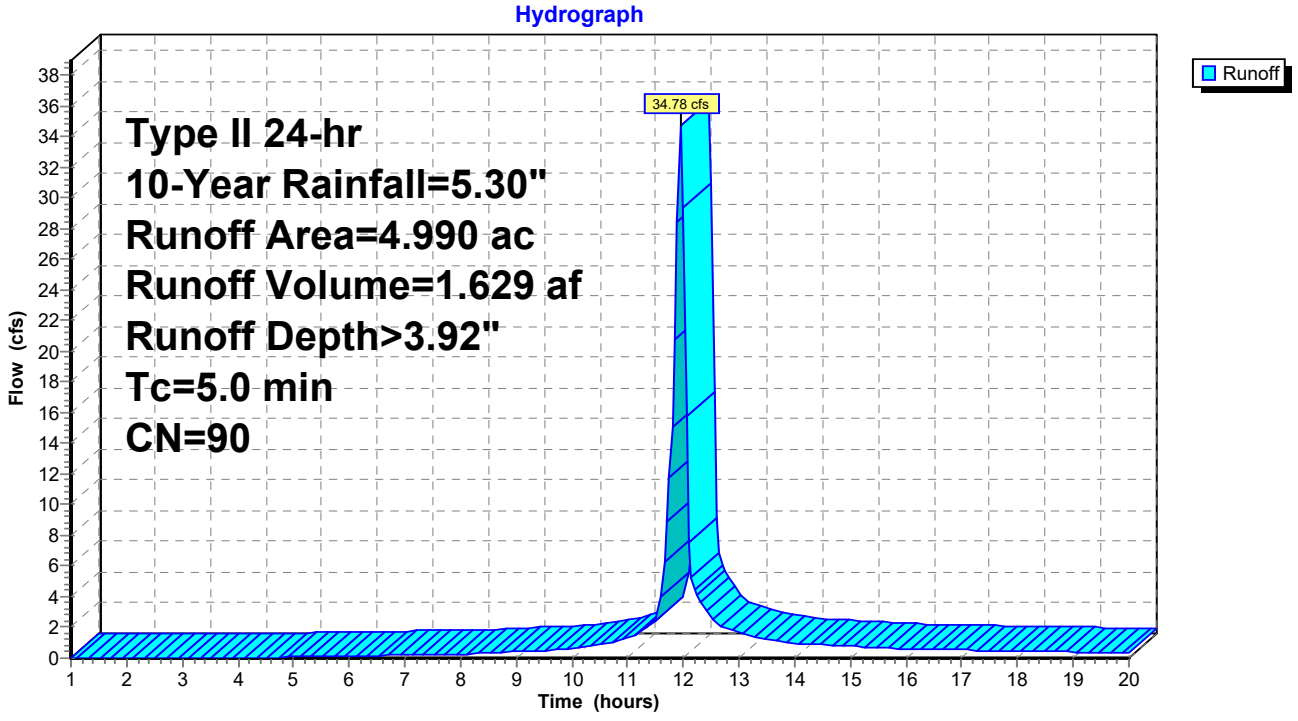
Runoff = 34.78 cfs @ 11.95 hrs, Volume= 1.629 af, Depth> 3.92"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
2.900	98	Paved parking, HSG D
2.090	80	>75% Grass cover, Good, HSG D
4.990	90	Weighted Average
2.090		41.88% Pervious Area
2.900		58.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: PR-2



Summary for Subcatchment 4S: PR-4

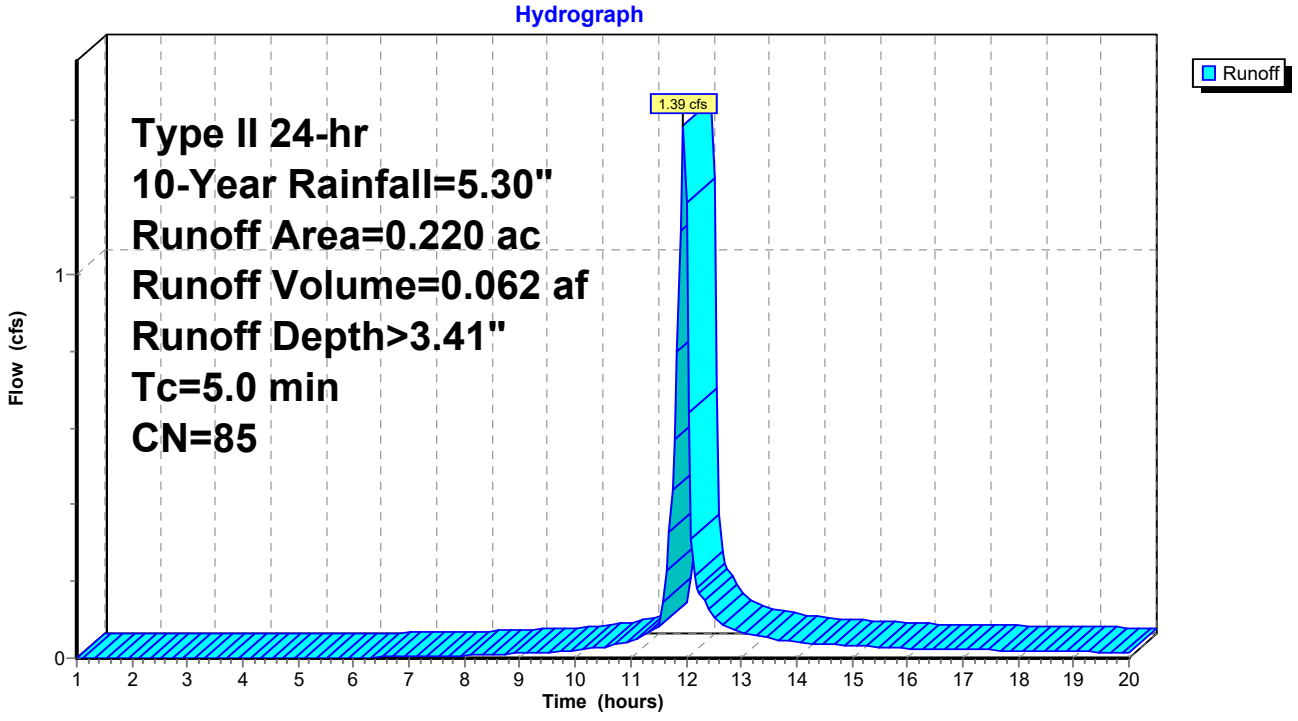
Runoff = 1.39 cfs @ 11.95 hrs, Volume= 0.062 af, Depth> 3.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.060	98	Paved parking, HSG D
0.160	80	>75% Grass cover, Good, HSG D
0.220	85	Weighted Average
0.160		72.73% Pervious Area
0.060		27.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: PR-4



Summary for Subcatchment 5S: PR-3

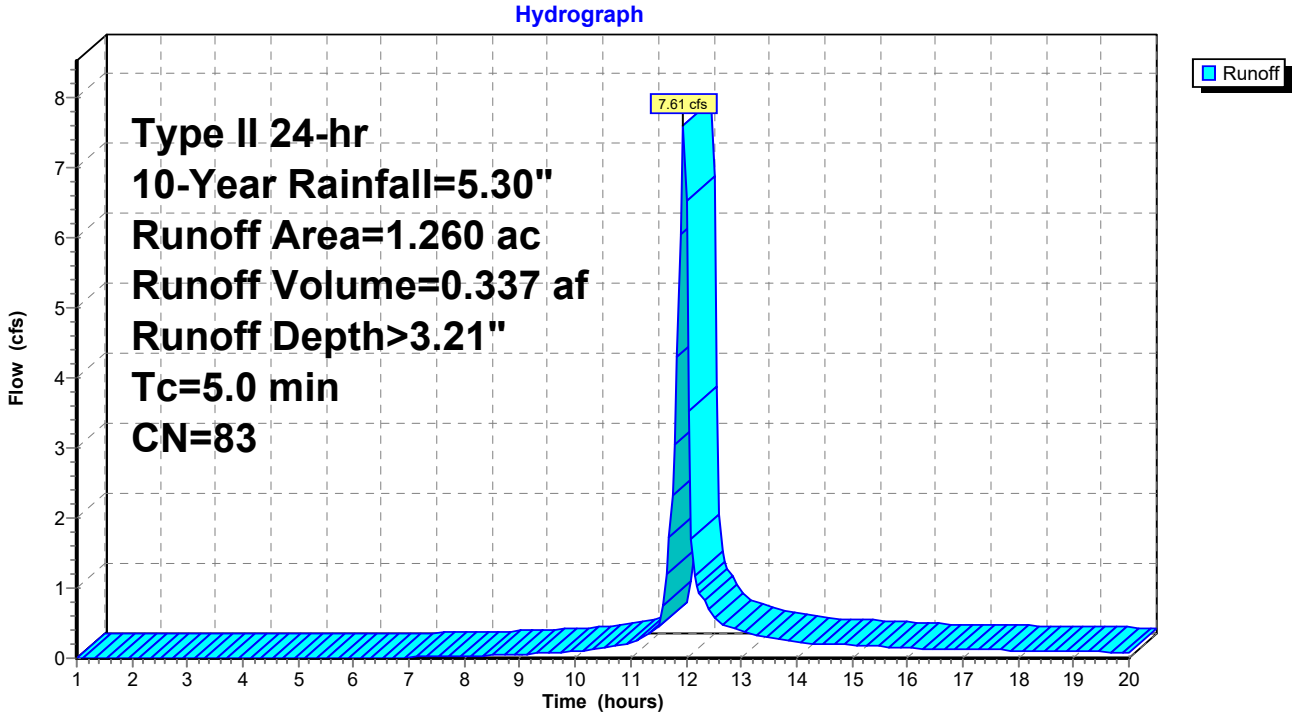
Runoff = 7.61 cfs @ 11.95 hrs, Volume= 0.337 af, Depth> 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG D
1.080	80	>75% Grass cover, Good, HSG D
1.260	83	Weighted Average
1.080		85.71% Pervious Area
0.180		14.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: PR-3



Summary for Subcatchment 6S: PR-5

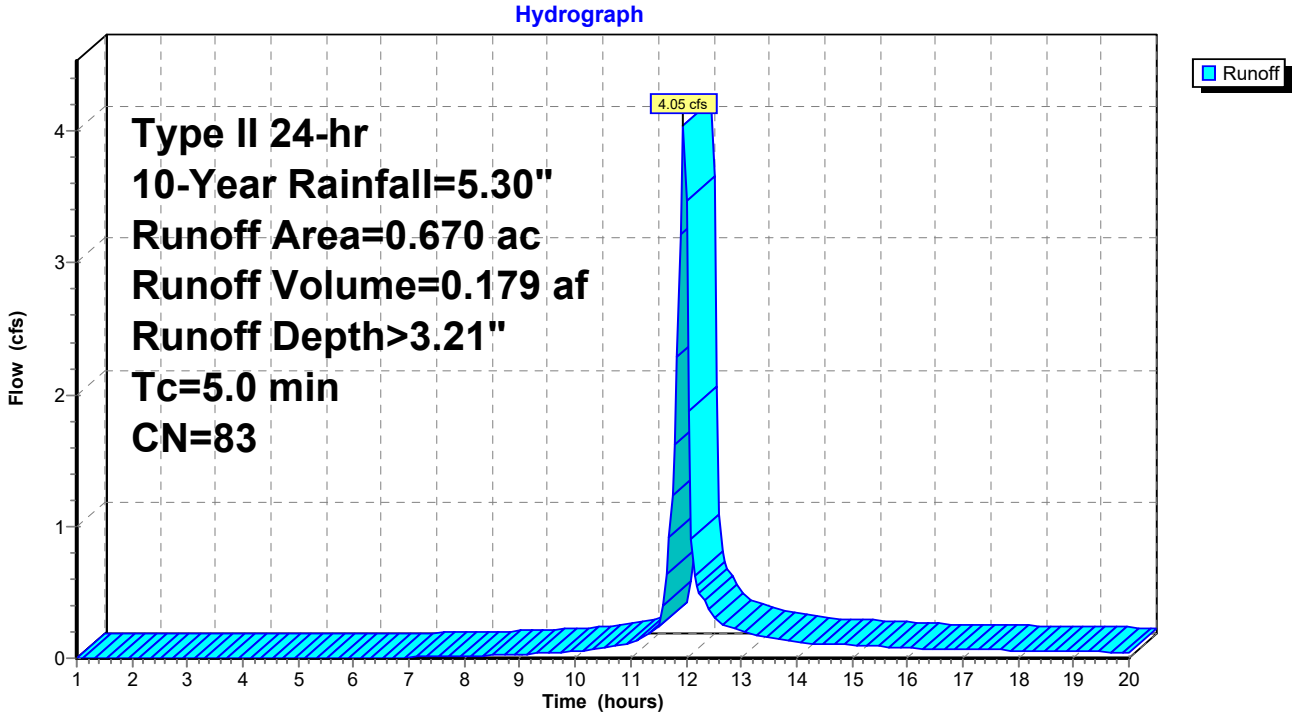
Runoff = 4.05 cfs @ 11.95 hrs, Volume= 0.179 af, Depth> 3.21"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=5.30"

Area (ac)	CN	Description
0.110	98	Paved parking, HSG D
0.560	80	>75% Grass cover, Good, HSG D
0.670	83	Weighted Average
0.560		83.58% Pervious Area
0.110		16.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: PR-5



Summary for Pond 7P: EDDB-1

Inflow Area = 2.590 ac, 55.98% Impervious, Inflow Depth > 3.92" for 10-Year event
Inflow = 18.05 cfs @ 11.95 hrs, Volume= 0.845 af
Outflow = 0.54 cfs @ 13.90 hrs, Volume= 0.417 af, Atten= 97%, Lag= 116.8 min
Primary = 0.54 cfs @ 13.90 hrs, Volume= 0.417 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 989.27' @ 13.90 hrs Surf.Area= 7,307 sf Storage= 23,529 cf

Plug-Flow detention time= 230.1 min calculated for 0.417 af (49% of inflow)
Center-of-Mass det. time= 146.9 min (897.4 - 750.5)

Volume	Invert	Avail.Storage	Storage Description
#1	984.00'	48,565 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

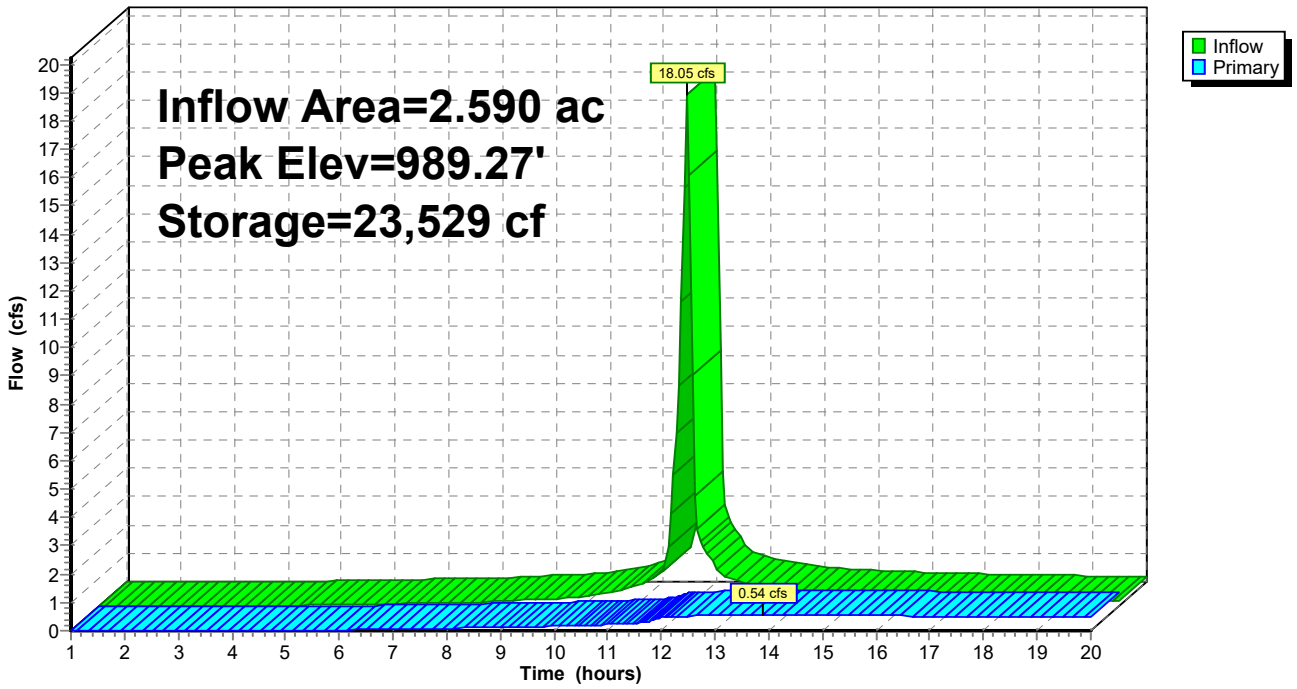
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
984.00	2,004	0	0
986.00	3,749	5,753	5,753
988.00	5,748	9,497	15,250
990.00	8,206	13,954	29,204
992.00	11,155	19,361	48,565

Device	Routing	Invert	Outlet Devices
#1	Primary	984.00'	**15.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 984.00' / 983.50' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	984.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	990.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.54 cfs @ 13.90 hrs HW=989.27' (Free Discharge)
└**1=Culvert** (Passes 0.54 cfs of 12.73 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.54 cfs @ 10.92 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

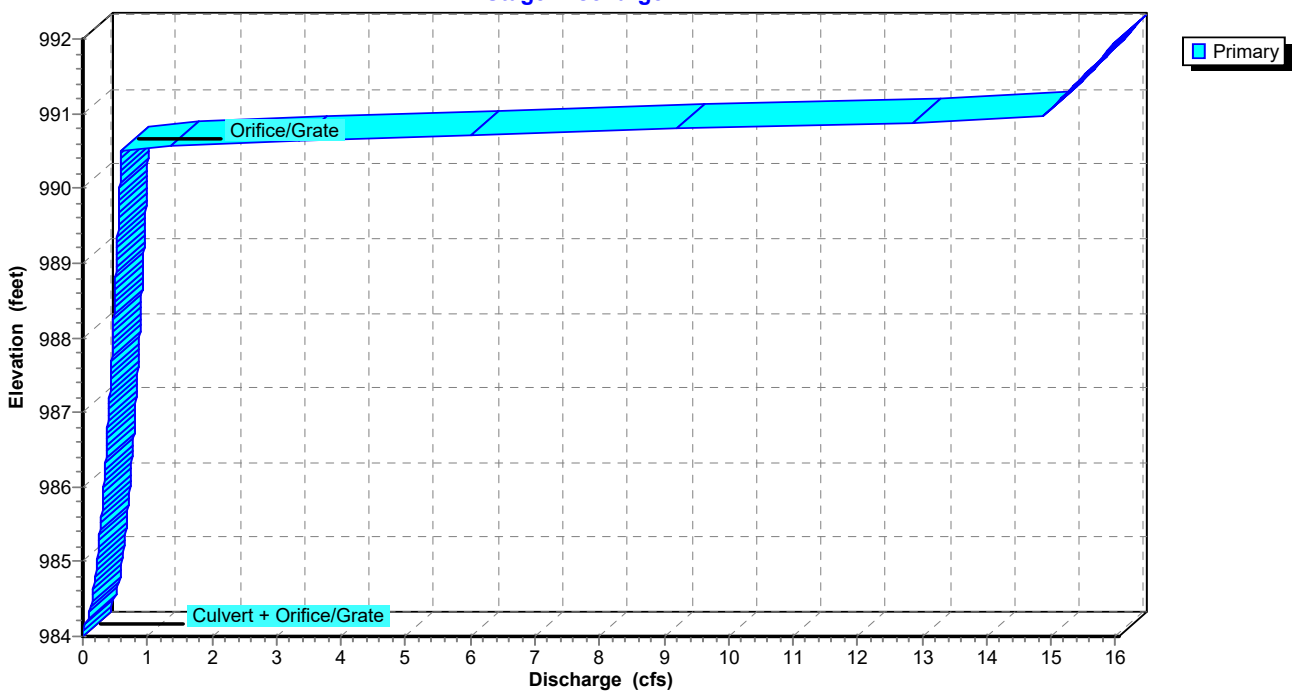
Pond 7P: EDDB-1

Hydrograph

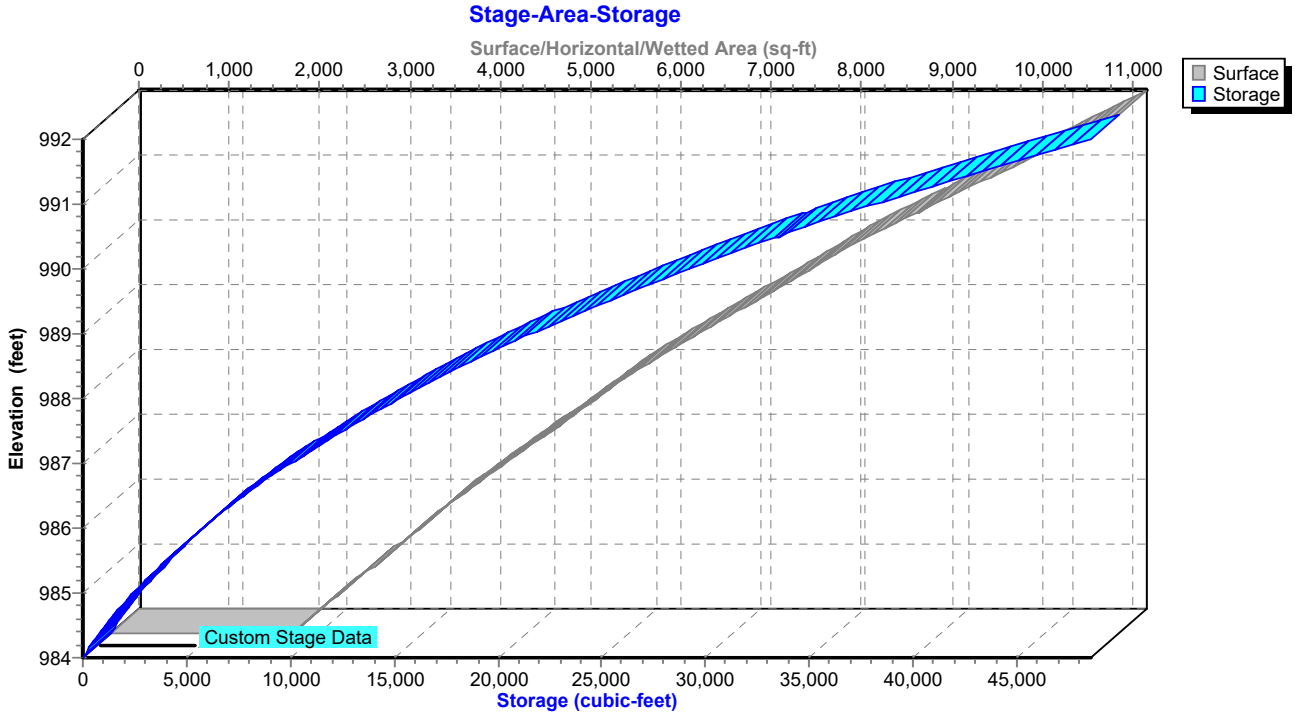


Pond 7P: EDDB-1

Stage-Discharge



Pond 7P: EDDB-1



Summary for Pond 8P: EDDB-2

Inflow Area = 4.990 ac, 58.12% Impervious, Inflow Depth > 3.92" for 10-Year event
Inflow = 34.78 cfs @ 11.95 hrs, Volume= 1.629 af
Outflow = 7.68 cfs @ 12.11 hrs, Volume= 1.130 af, Atten= 78%, Lag= 9.7 min
Primary = 7.68 cfs @ 12.11 hrs, Volume= 1.130 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 973.97' @ 12.11 hrs Surf.Area= 10,483 sf Storage= 37,644 cf

Plug-Flow detention time= 150.6 min calculated for 1.130 af (69% of inflow)
Center-of-Mass det. time= 84.1 min (834.6 - 750.5)

Volume	Invert	Avail.Storage	Storage Description
#1	970.00'	96,669 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

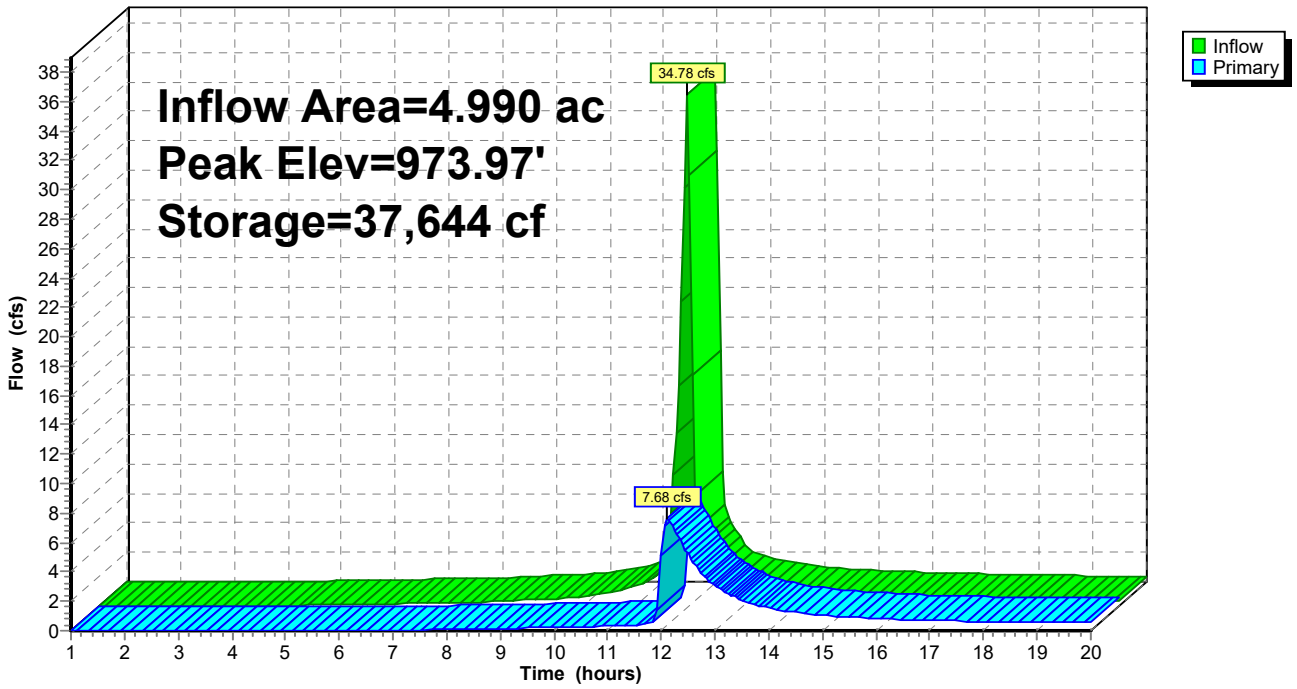
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
970.00	8,478	0	0
972.00	9,473	17,951	17,951
974.00	10,497	19,970	37,921
976.00	11,504	22,001	59,922
978.00	12,504	24,008	83,930
979.00	12,974	12,739	96,669

Device	Routing	Invert	Outlet Devices
#1	Primary	970.00'	**18.0" Round Culvert** L= 73.1' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 970.00' / 969.56' S= 0.0060 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	970.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	972.60'	**16.0" W x 16.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	975.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=7.61 cfs @ 12.11 hrs HW=973.96' (Free Discharge)
- **1=Culvert** (Passes 0.82 cfs of 14.35 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.82 cfs @ 9.38 fps)
  - **4=Orifice/Grate** (Controls 0.00 cfs)
- **3=Orifice/Grate** (Orifice Controls 6.80 cfs @ 3.82 fps)

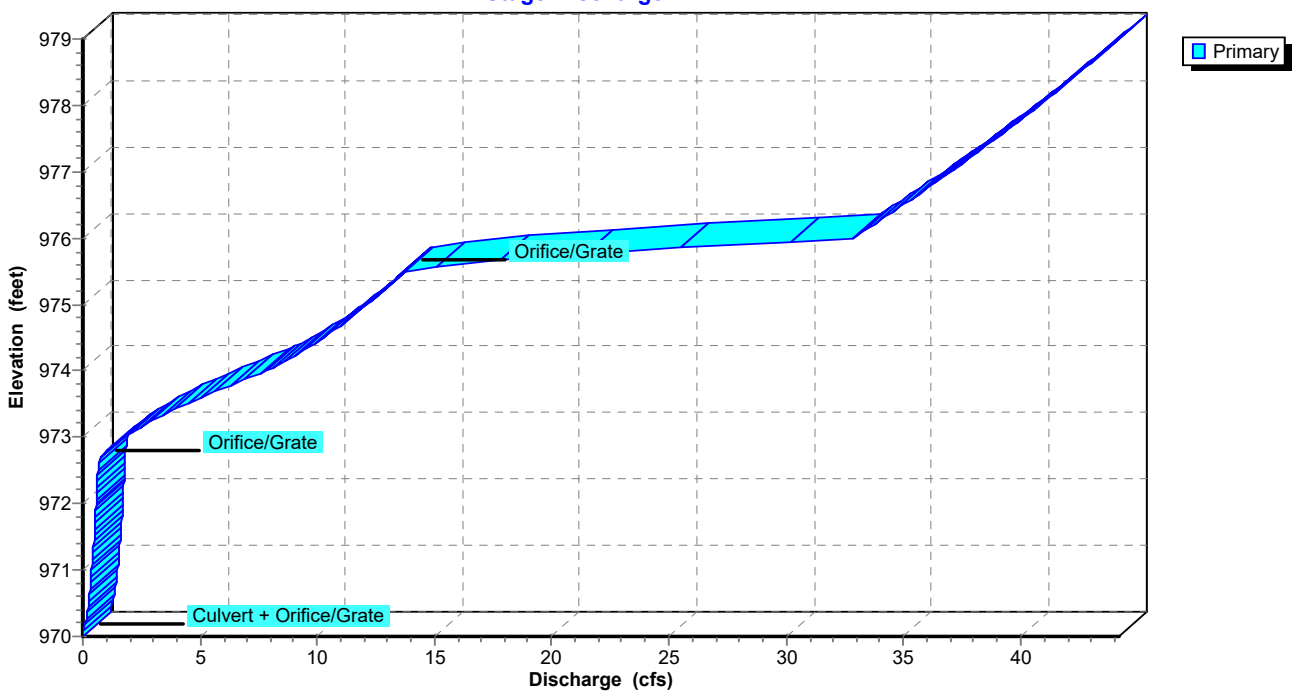
Pond 8P: EDDB-2

Hydrograph

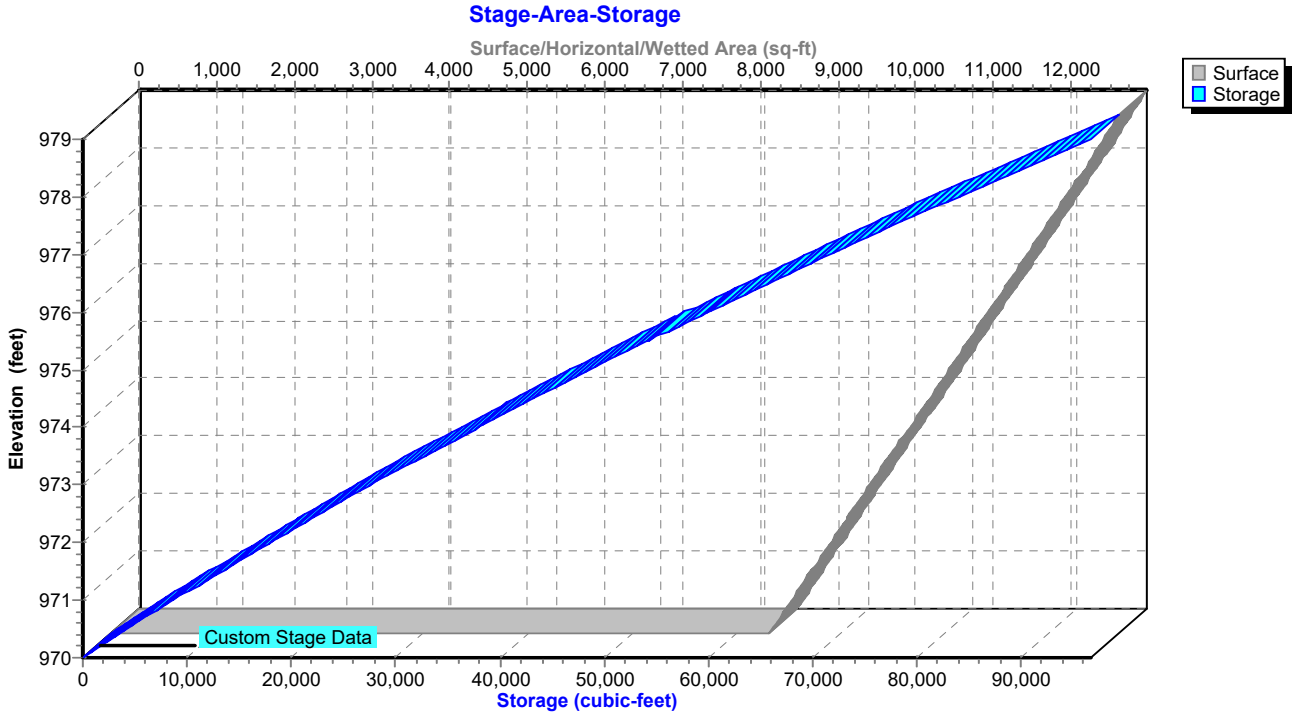


Pond 8P: EDDB-2

Stage-Discharge



Pond 8P: EDDB-2



Summary for Pond 9P: EDDB-3

Inflow Area = 1.260 ac, 14.29% Impervious, Inflow Depth > 3.21" for 10-Year event
Inflow = 7.61 cfs @ 11.95 hrs, Volume= 0.337 af
Outflow = 0.59 cfs @ 12.51 hrs, Volume= 0.321 af, Atten= 92%, Lag= 33.4 min
Primary = 0.59 cfs @ 12.51 hrs, Volume= 0.321 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 972.16' @ 12.51 hrs Surf.Area= 5,303 sf Storage= 7,424 cf

Plug-Flow detention time= 143.4 min calculated for 0.321 af (95% of inflow)
Center-of-Mass det. time= 125.3 min (894.9 - 769.6)

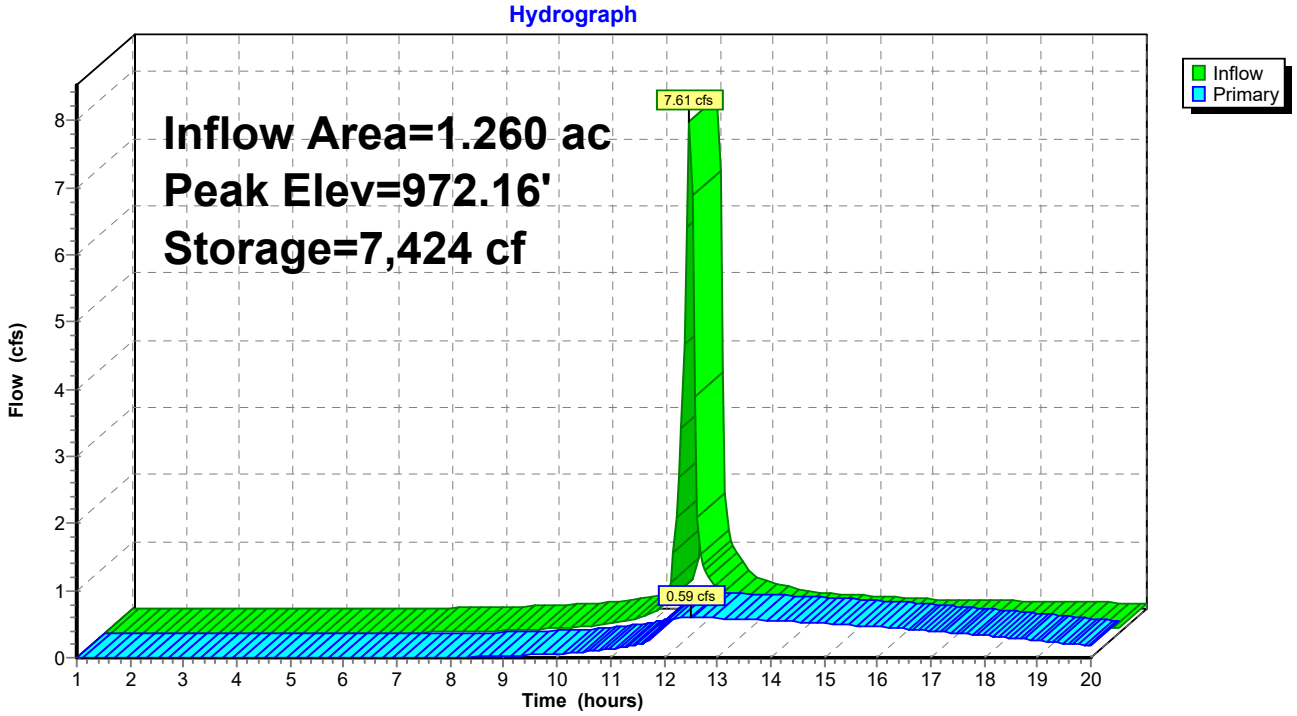
Volume	Invert	Avail.Storage	Storage Description
#1	970.00'	21,597 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
970.00	1,727	0	0
972.00	4,895	6,622	6,622
974.00	10,080	14,975	21,597

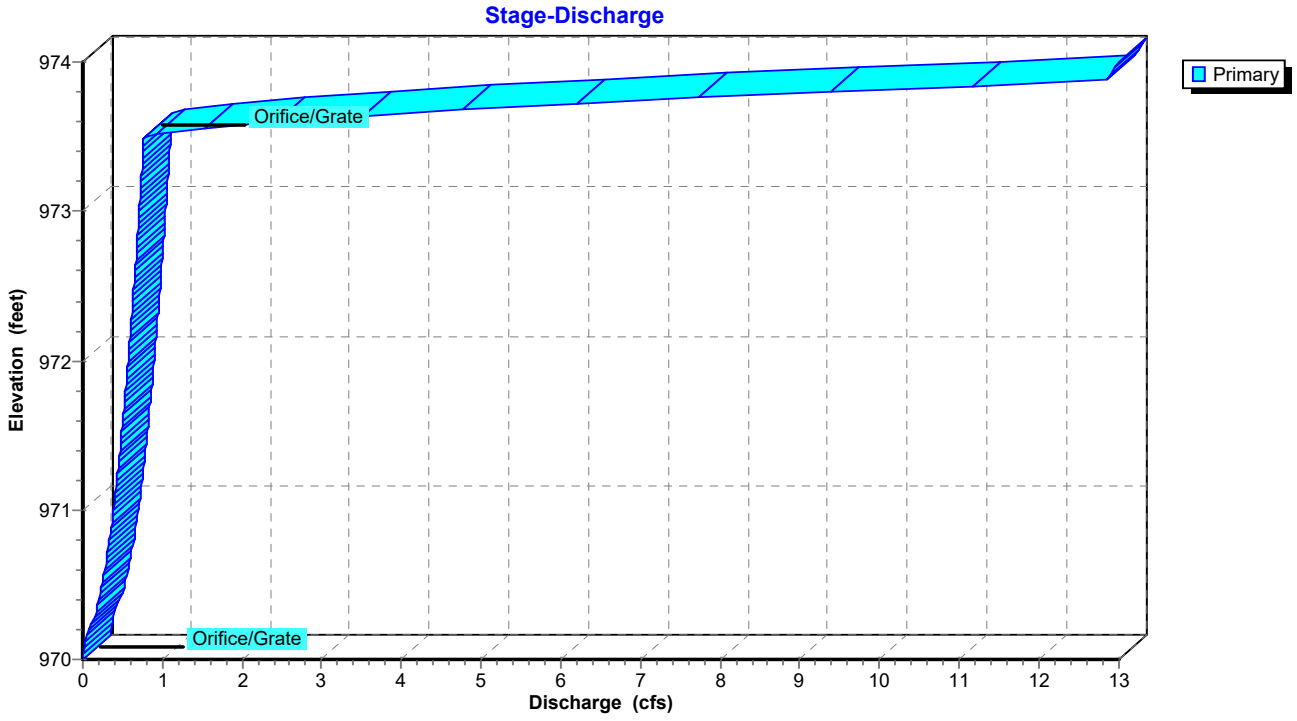
Device	Routing	Invert	Outlet Devices
#1	Primary	968.53'	**15.0" Round Culvert** L= 45.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 968.53' / 968.12' S= 0.0091 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	970.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	973.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.59 cfs @ 12.51 hrs HW=972.16' (Free Discharge)
└**1=Culvert** (Passes 0.59 cfs of 10.24 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.59 cfs @ 6.79 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

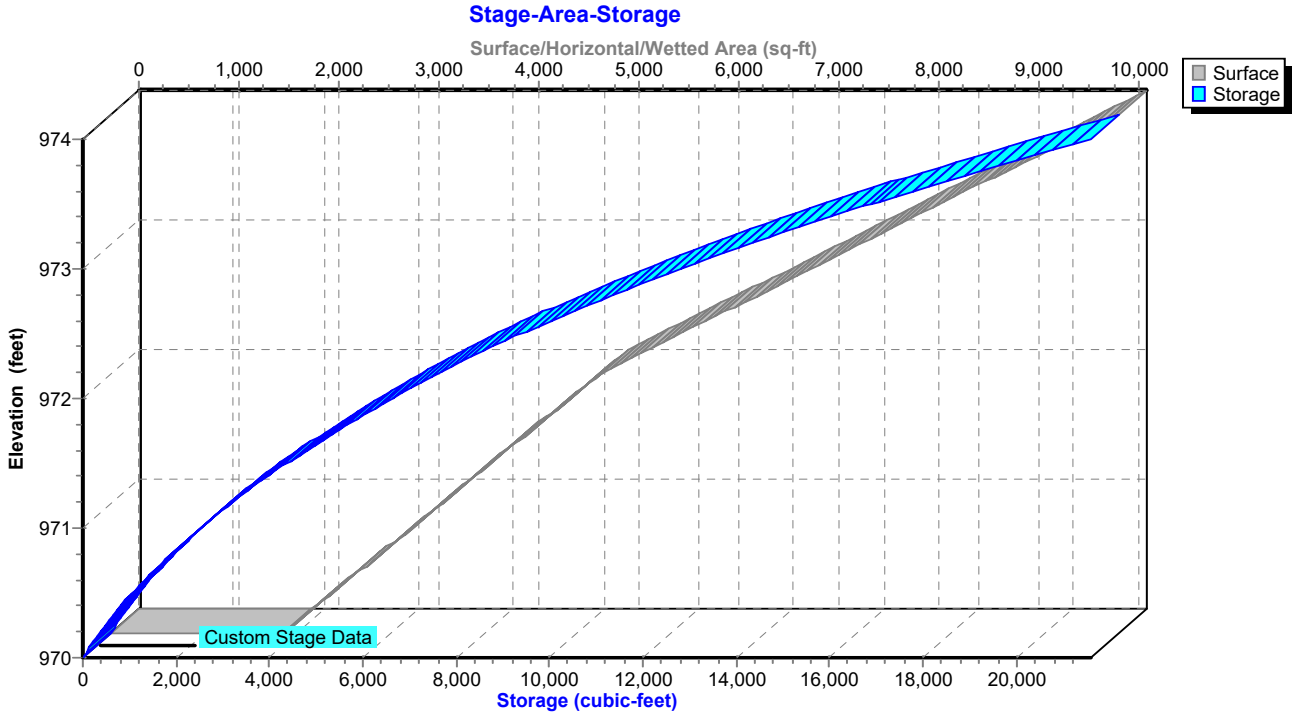
Pond 9P: EDDB-3



Pond 9P: EDDB-3



Pond 9P: EDDB-3



Time span=1.00-20.00 hrs, dt=0.05 hrs, 381 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment1S: EX-1 Runoff Area=9.730 ac 0.00% Impervious Runoff Depth>5.22"
Flow Length=410' Tc=6.8 min CN=82 Runoff=87.90 cfs 4.232 af

Subcatchment2S: PR-1 Runoff Area=2.590 ac 55.98% Impervious Runoff Depth>6.14"
Tc=5.0 min CN=90 Runoff=27.39 cfs 1.326 af

Subcatchment3S: PR-2 Runoff Area=4.990 ac 58.12% Impervious Runoff Depth>6.14"
Tc=5.0 min CN=90 Runoff=52.77 cfs 2.554 af

Subcatchment4S: PR-4 Runoff Area=0.220 ac 27.27% Impervious Runoff Depth>5.56"
Tc=5.0 min CN=85 Runoff=2.20 cfs 0.102 af

Subcatchment5S: PR-3 Runoff Area=1.260 ac 14.29% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=83 Runoff=12.23 cfs 0.560 af

Subcatchment6S: PR-5 Runoff Area=0.670 ac 16.42% Impervious Runoff Depth>5.34"
Tc=5.0 min CN=83 Runoff=6.50 cfs 0.298 af

Pond 7P: EDDB-1 Peak Elev=990.60' Storage=34,418 cf Inflow=27.39 cfs 1.326 af
Outflow=2.42 cfs 0.638 af

Pond 8P: EDDB-2 Peak Elev=975.60' Storage=55,311 cf Inflow=52.77 cfs 2.554 af
Outflow=15.58 cfs 2.009 af

Pond 9P: EDDB-3 Peak Elev=973.03' Storage=13,071 cf Inflow=12.23 cfs 0.560 af
Outflow=0.71 cfs 0.475 af

Total Runoff Area = 19.460 ac Runoff Volume = 9.072 af Average Runoff Depth = 5.59"
75.85% Pervious = 14.760 ac 24.15% Impervious = 4.700 ac

Summary for Subcatchment 1S: EX-1

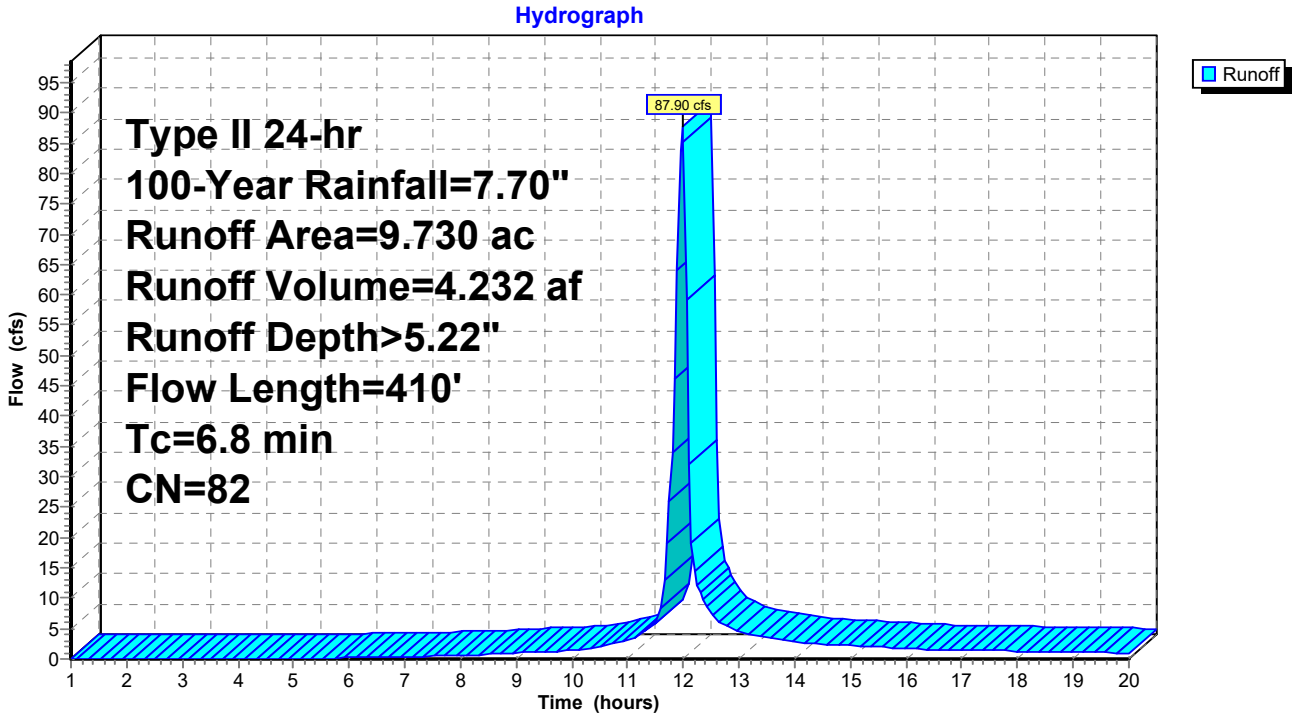
Runoff = 87.90 cfs @ 11.98 hrs, Volume= 4.232 af, Depth> 5.22"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
9.730	82	Woods/grass comb., Fair, HSG D
9.730		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	100	0.0700	0.29		**Sheet Flow,** Grass: Short n= 0.150 P2= 3.50"
1.1	310	0.0800	4.55		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.8	410	Total			

Subcatchment 1S: EX-1



Summary for Subcatchment 2S: PR-1

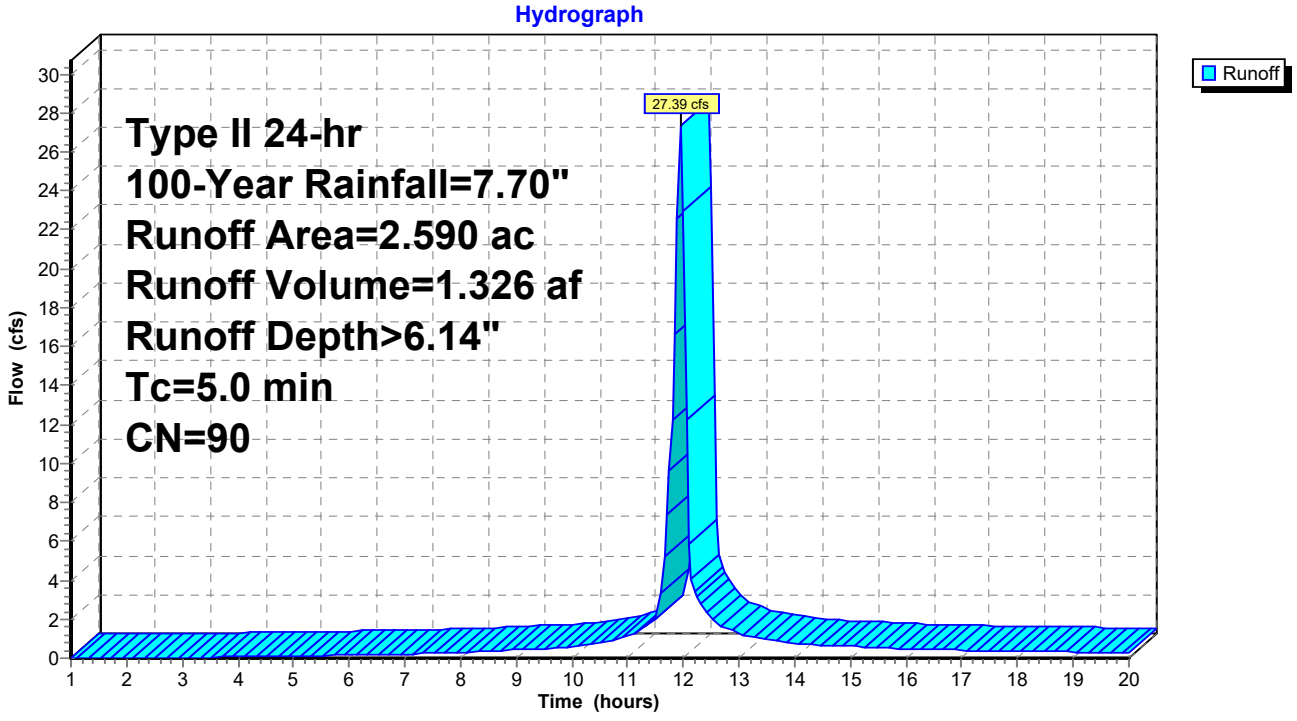
Runoff = 27.39 cfs @ 11.95 hrs, Volume= 1.326 af, Depth> 6.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
1.450	98	Paved parking, HSG D
1.140	80	>75% Grass cover, Good, HSG D
2.590	90	Weighted Average
1.140		44.02% Pervious Area
1.450		55.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 2S: PR-1



Summary for Subcatchment 3S: PR-2

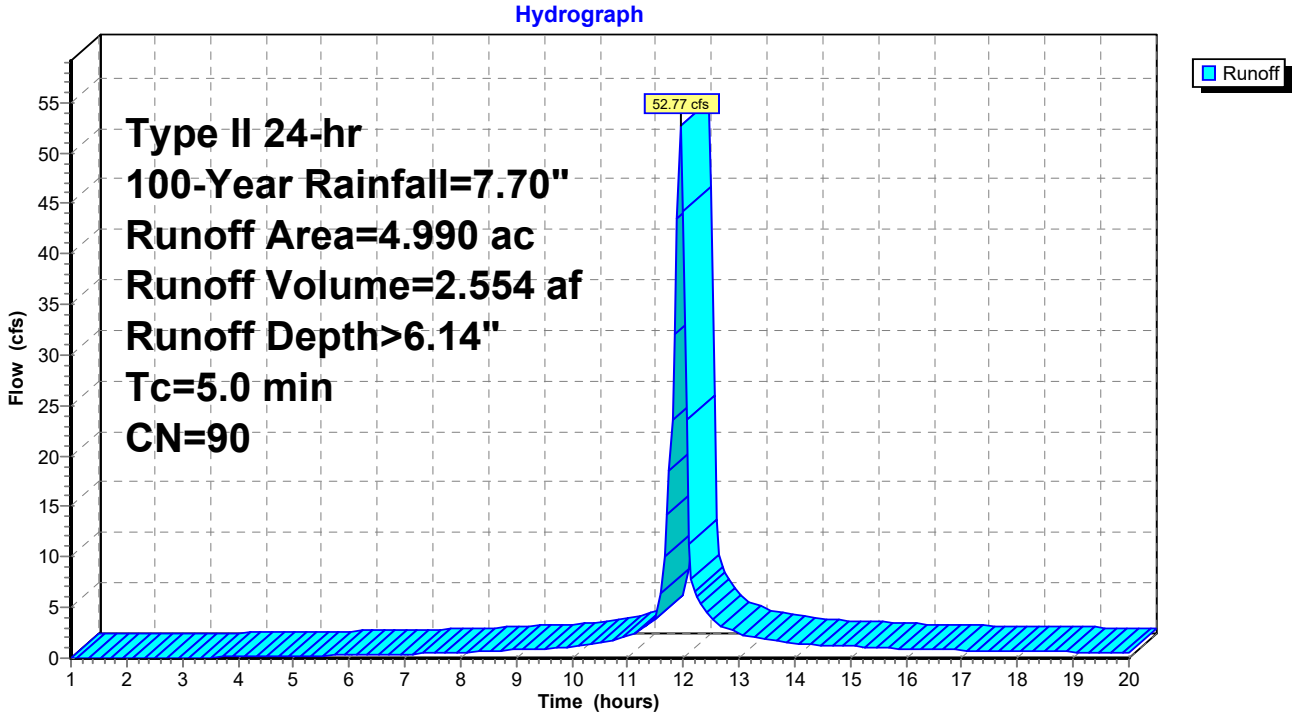
Runoff = 52.77 cfs @ 11.95 hrs, Volume= 2.554 af, Depth> 6.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
2.900	98	Paved parking, HSG D
2.090	80	>75% Grass cover, Good, HSG D
4.990	90	Weighted Average
2.090		41.88% Pervious Area
2.900		58.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 3S: PR-2



Summary for Subcatchment 4S: PR-4

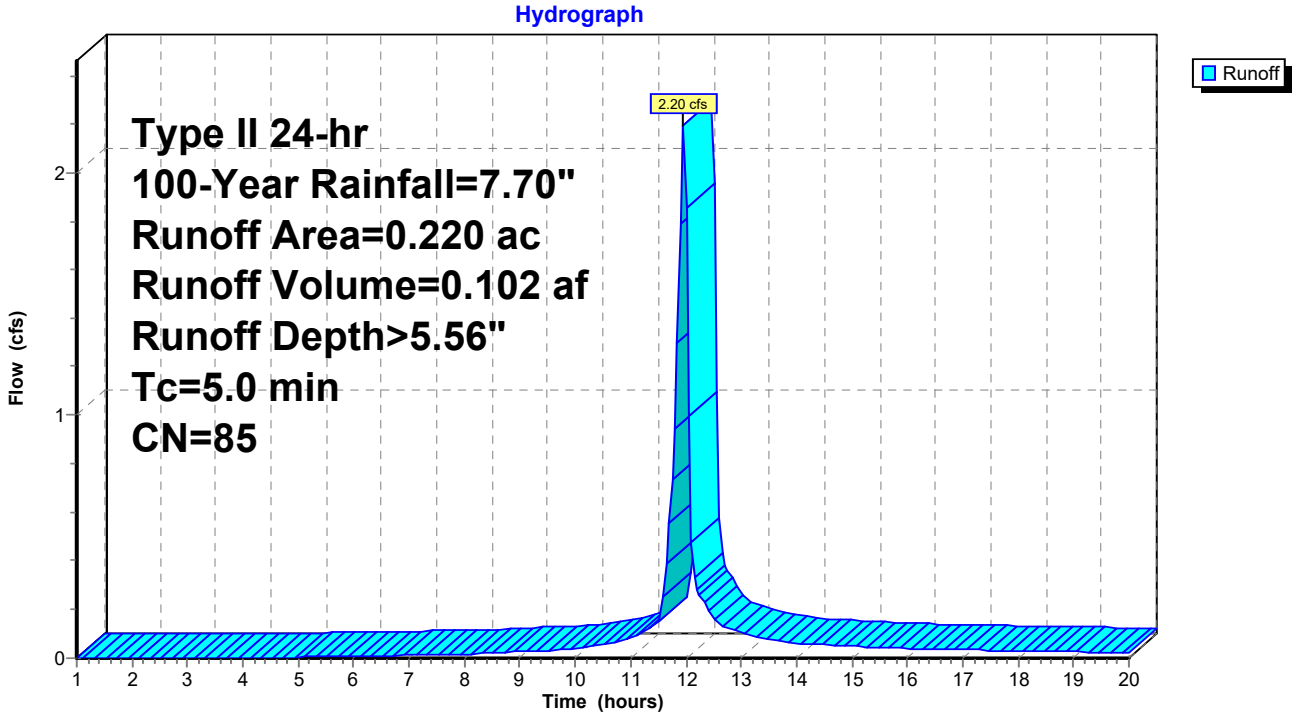
Runoff = 2.20 cfs @ 11.95 hrs, Volume= 0.102 af, Depth> 5.56"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.060	98	Paved parking, HSG D
0.160	80	>75% Grass cover, Good, HSG D
0.220	85	Weighted Average
0.160		72.73% Pervious Area
0.060		27.27% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 4S: PR-4



Summary for Subcatchment 5S: PR-3

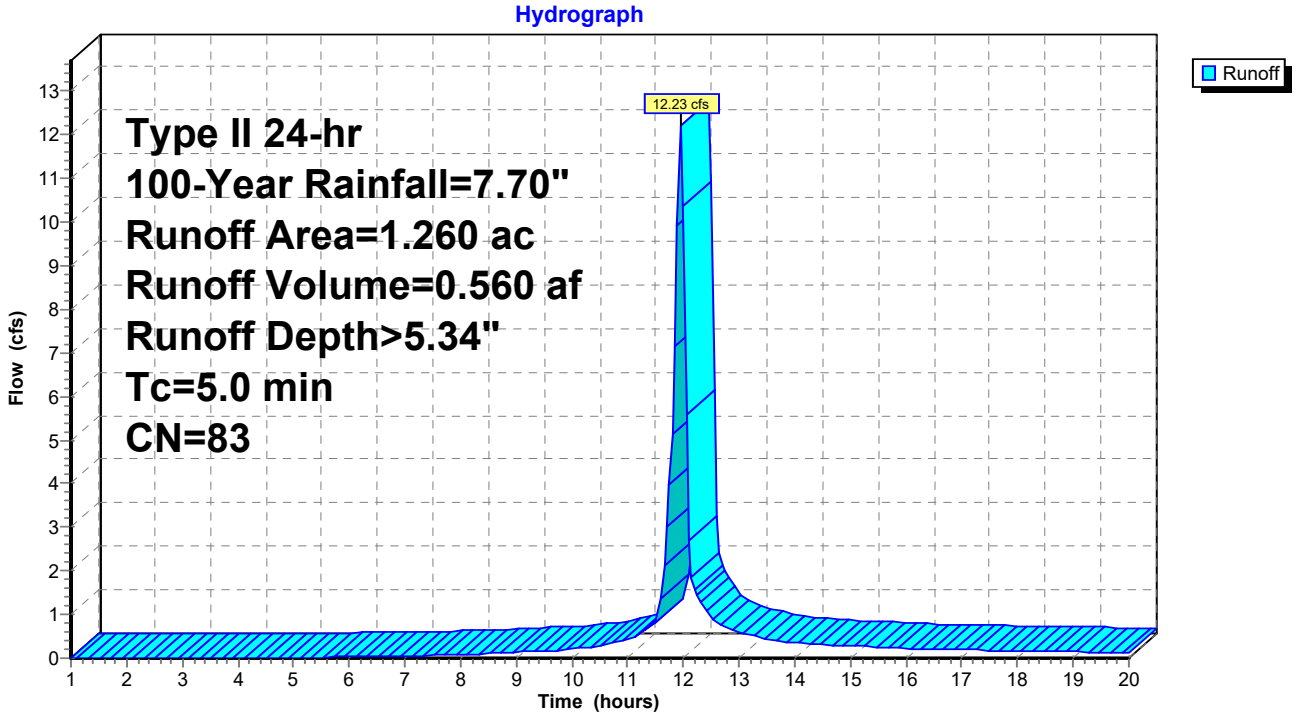
Runoff = 12.23 cfs @ 11.95 hrs, Volume= 0.560 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.180	98	Paved parking, HSG D
1.080	80	>75% Grass cover, Good, HSG D
1.260	83	Weighted Average
1.080		85.71% Pervious Area
0.180		14.29% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 5S: PR-3



Summary for Subcatchment 6S: PR-5

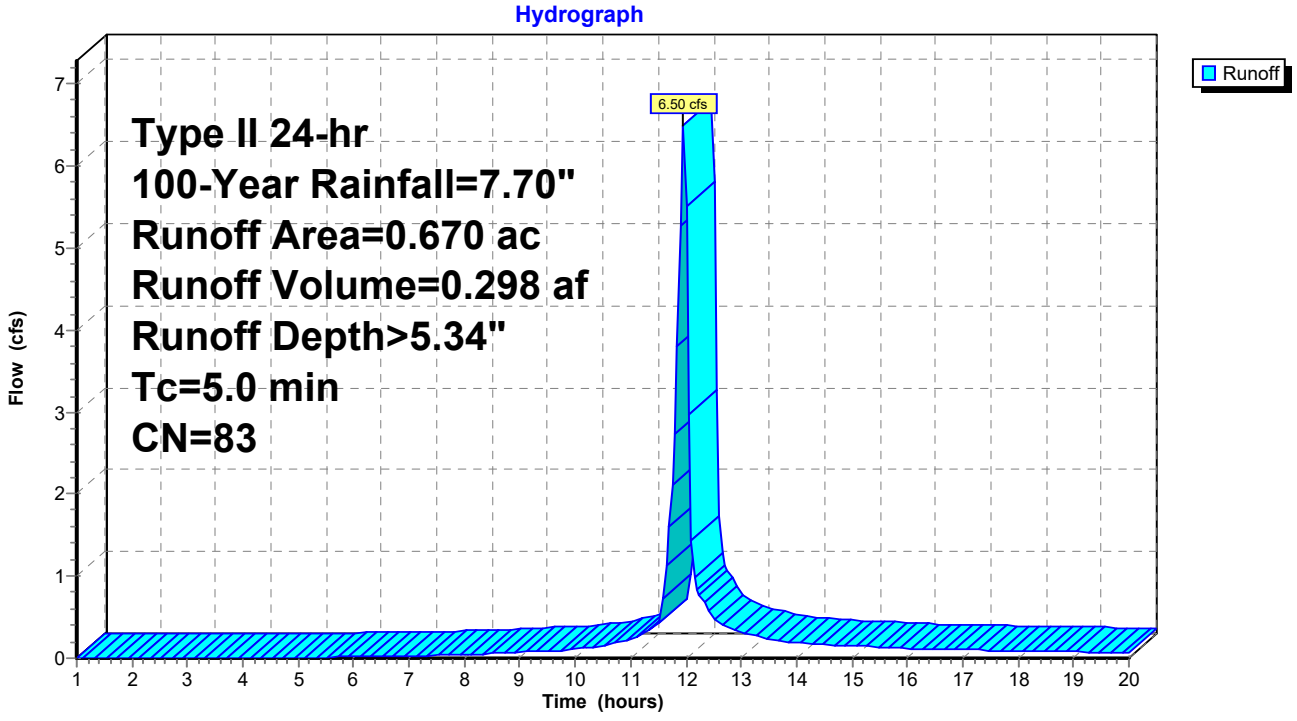
Runoff = 6.50 cfs @ 11.95 hrs, Volume= 0.298 af, Depth> 5.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.70"

Area (ac)	CN	Description
0.110	98	Paved parking, HSG D
0.560	80	>75% Grass cover, Good, HSG D
0.670	83	Weighted Average
0.560		83.58% Pervious Area
0.110		16.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.0					**Direct Entry,**

Subcatchment 6S: PR-5



Summary for Pond 7P: EDDB-1

Inflow Area = 2.590 ac, 55.98% Impervious, Inflow Depth > 6.14" for 100-Year event
Inflow = 27.39 cfs @ 11.95 hrs, Volume= 1.326 af
Outflow = 2.42 cfs @ 12.42 hrs, Volume= 0.638 af, Atten= 91%, Lag= 28.1 min
Primary = 2.42 cfs @ 12.42 hrs, Volume= 0.638 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 990.60' @ 12.42 hrs Surf.Area= 9,095 sf Storage= 34,418 cf

Plug-Flow detention time= 200.3 min calculated for 0.637 af (48% of inflow)
Center-of-Mass det. time= 111.7 min (851.5 - 739.8)

Volume	Invert	Avail.Storage	Storage Description
#1	984.00'	48,565 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

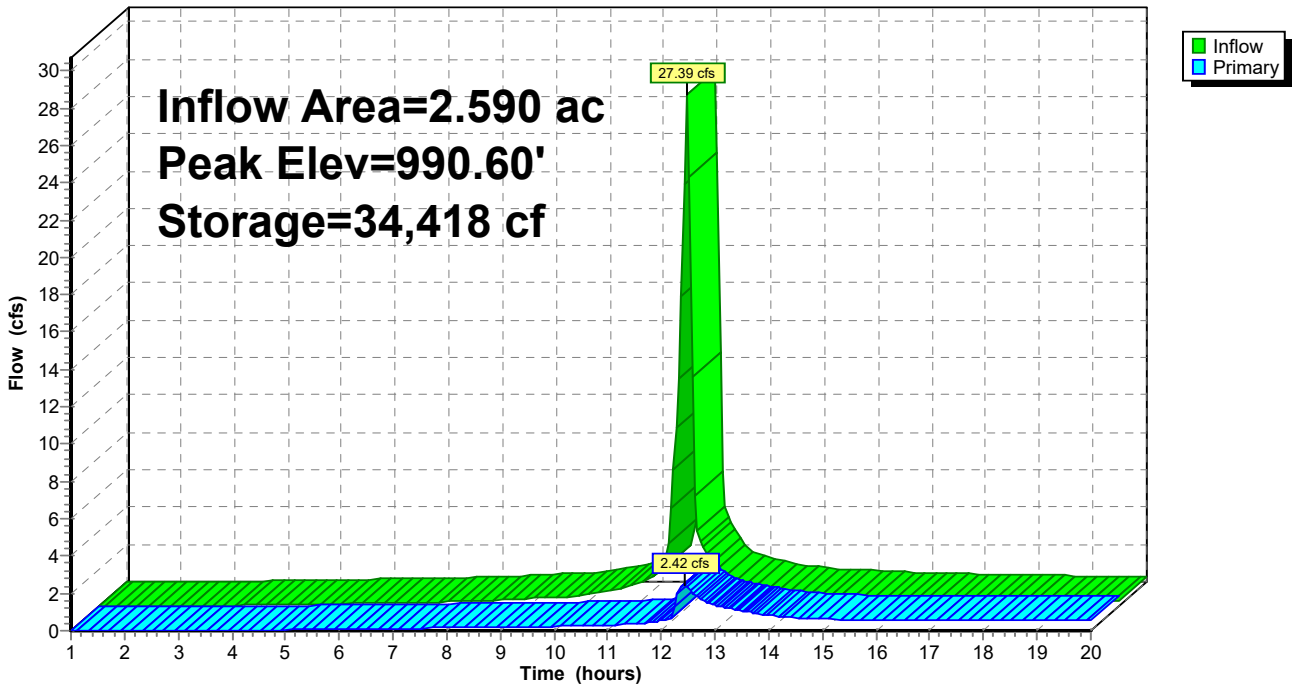
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
984.00	2,004	0	0
986.00	3,749	5,753	5,753
988.00	5,748	9,497	15,250
990.00	8,206	13,954	29,204
992.00	11,155	19,361	48,565

Device	Routing	Invert	Outlet Devices
#1	Primary	984.00'	**15.0" Round Culvert** L= 50.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 984.00' / 983.50' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	984.00'	**3.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	990.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=2.31 cfs @ 12.42 hrs HW=990.60' (Free Discharge)
└**1=Culvert** (Passes 2.31 cfs of 14.45 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.60 cfs @ 12.25 fps)
  └**3=Orifice/Grate** (Weir Controls 1.71 cfs @ 1.05 fps)

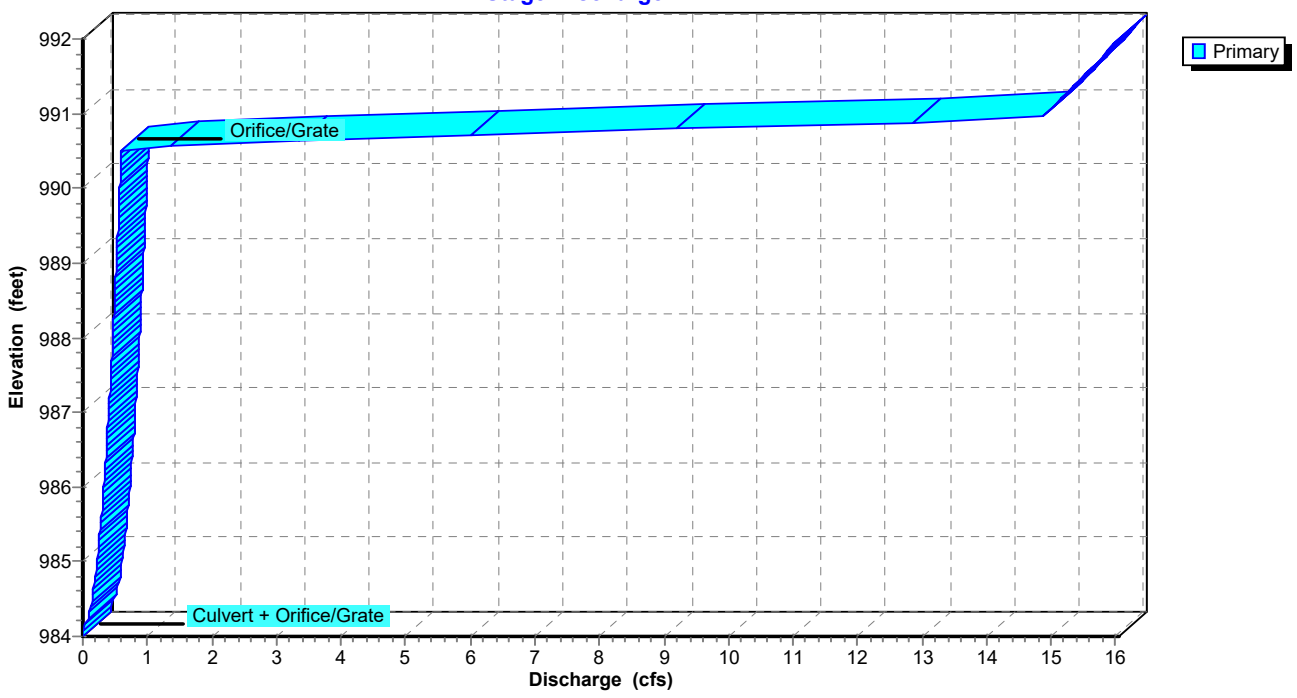
Pond 7P: EDDB-1

Hydrograph

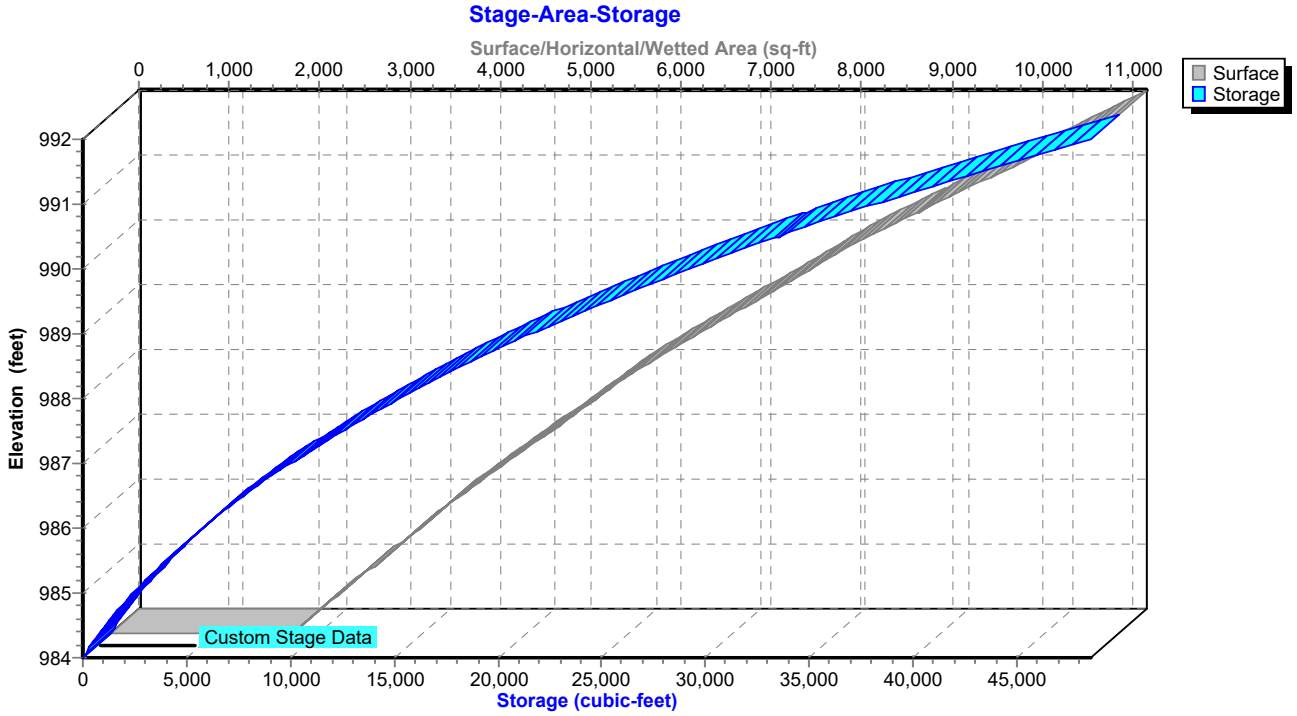


Pond 7P: EDDB-1

Stage-Discharge



Pond 7P: EDDB-1



Summary for Pond 8P: EDDB-2

Inflow Area = 4.990 ac, 58.12% Impervious, Inflow Depth > 6.14" for 100-Year event
Inflow = 52.77 cfs @ 11.95 hrs, Volume= 2.554 af
Outflow = 15.58 cfs @ 12.09 hrs, Volume= 2.009 af, Atten= 70%, Lag= 8.5 min
Primary = 15.58 cfs @ 12.09 hrs, Volume= 2.009 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 975.60' @ 12.09 hrs Surf.Area= 11,300 sf Storage= 55,311 cf

Plug-Flow detention time= 122.0 min calculated for 2.009 af (79% of inflow)
Center-of-Mass det. time= 65.1 min (804.9 - 739.8)

Volume	Invert	Avail.Storage	Storage Description
#1	970.00'	96,669 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

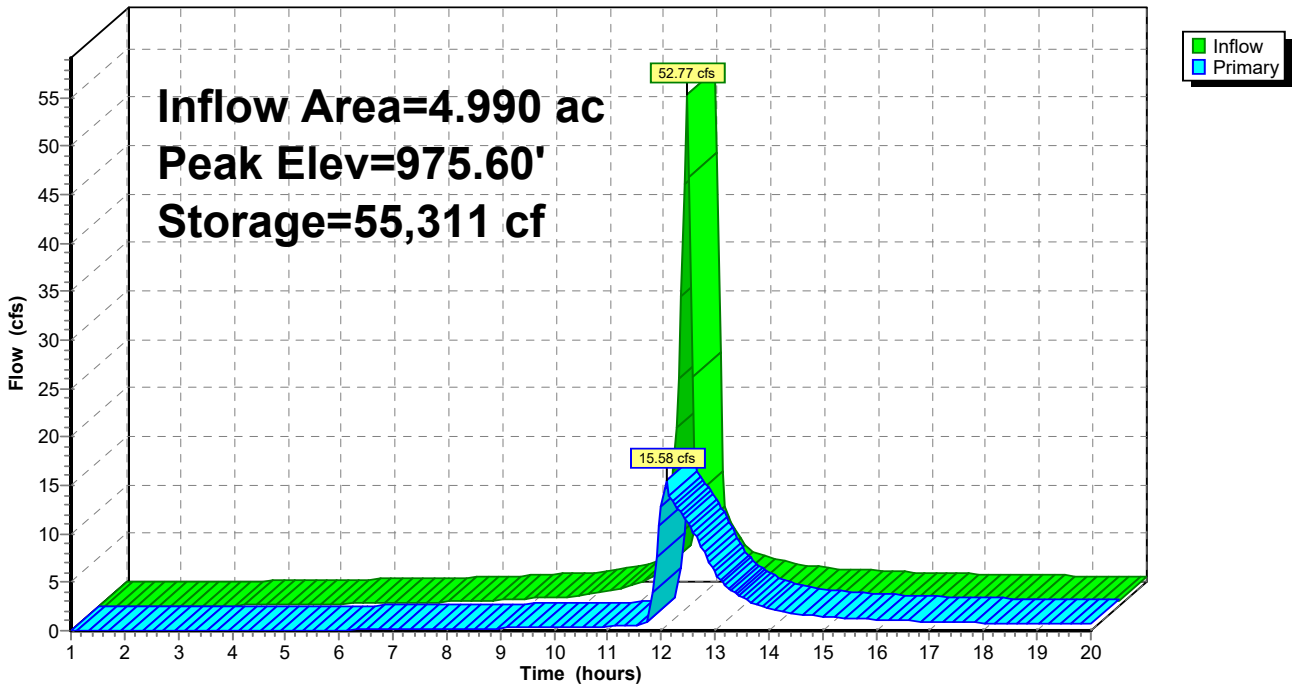
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
970.00	8,478	0	0
972.00	9,473	17,951	17,951
974.00	10,497	19,970	37,921
976.00	11,504	22,001	59,922
978.00	12,504	24,008	83,930
979.00	12,974	12,739	96,669

Device	Routing	Invert	Outlet Devices
#1	Primary	970.00'	**18.0" Round Culvert** L= 73.1' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 970.00' / 969.56' S= 0.0060 '/' Cc= 0.900 n= 0.013, Flow Area= 1.77 sf
#2	Device 1	970.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Primary	972.60'	**16.0" W x 16.0" H Vert. Orifice/Grate** C= 0.600
#4	Device 1	975.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=15.33 cfs @ 12.09 hrs HW=975.59' (Free Discharge)
- **1=Culvert** (Passes 2.33 cfs of 17.92 cfs potential flow)
  - **2=Orifice/Grate** (Orifice Controls 0.98 cfs @ 11.21 fps)
  - **4=Orifice/Grate** (Weir Controls 1.35 cfs @ 0.97 fps)
- **3=Orifice/Grate** (Orifice Controls 12.99 cfs @ 7.31 fps)

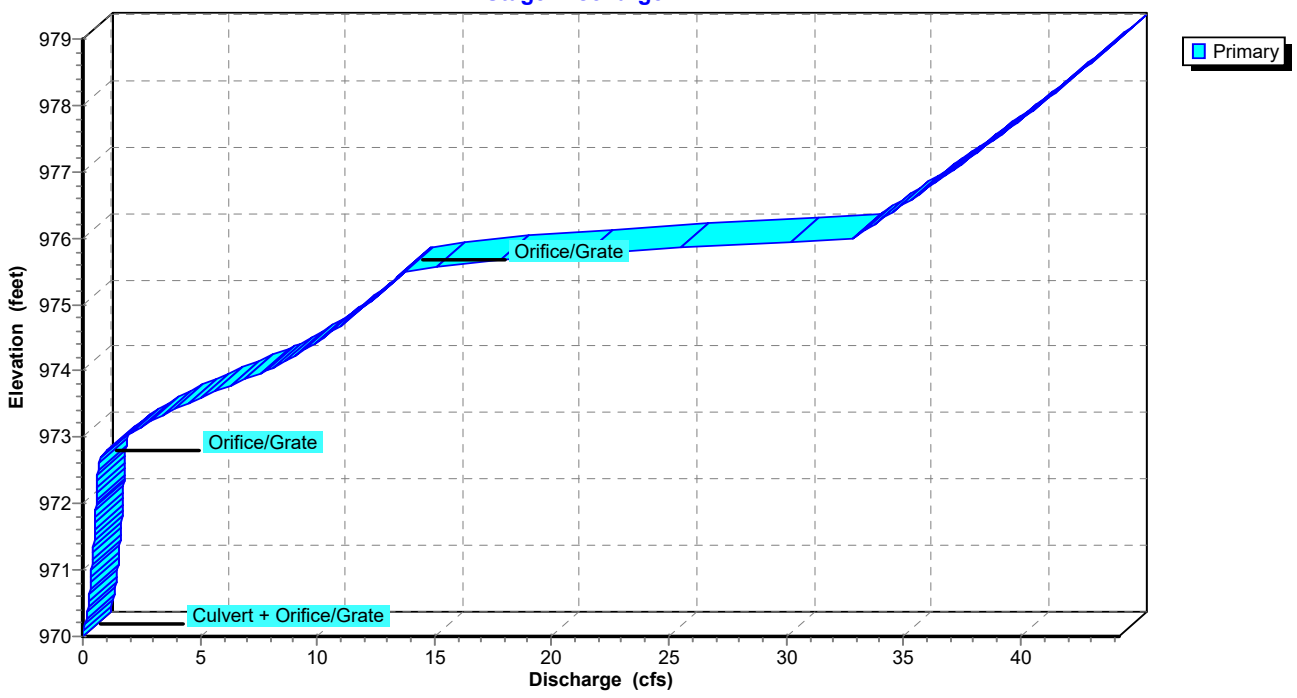
Pond 8P: EDDB-2

Hydrograph

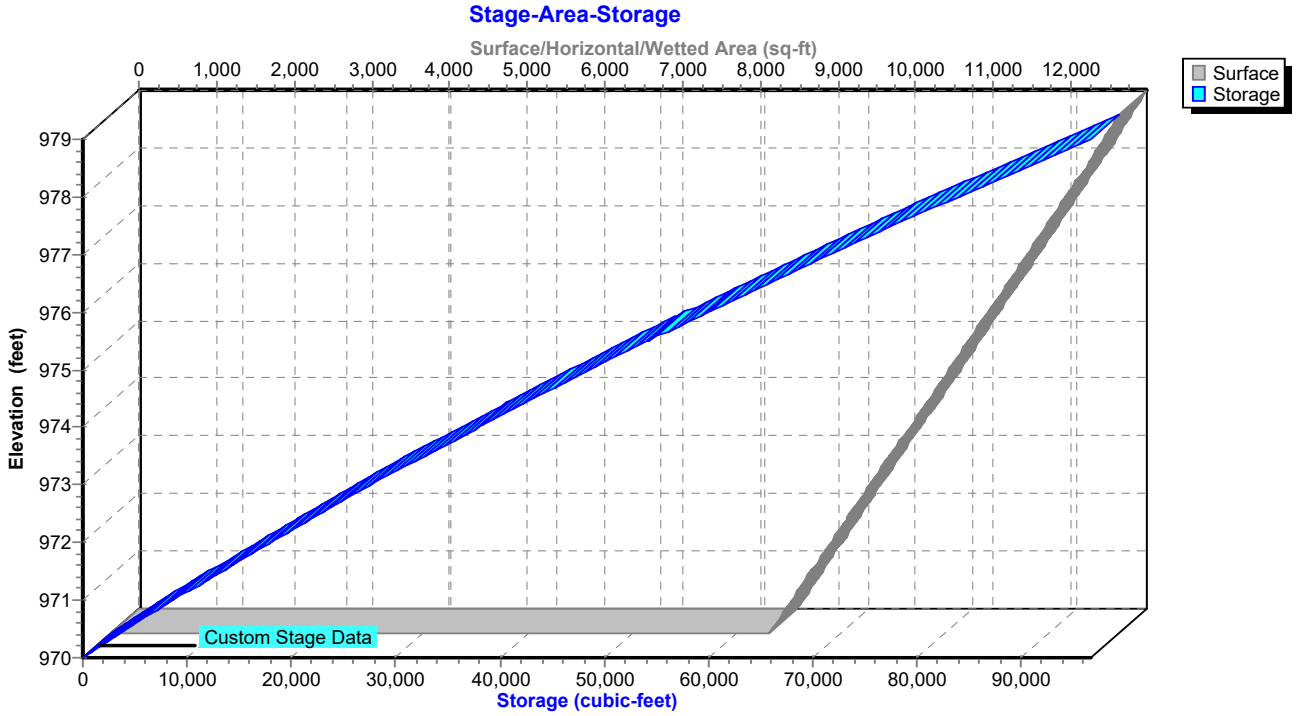


Pond 8P: EDDB-2

Stage-Discharge



Pond 8P: EDDB-2



Summary for Pond 9P: EDDB-3

Inflow Area = 1.260 ac, 14.29% Impervious, Inflow Depth > 5.34" for 100-Year event
Inflow = 12.23 cfs @ 11.95 hrs, Volume= 0.560 af
Outflow = 0.71 cfs @ 12.74 hrs, Volume= 0.475 af, Atten= 94%, Lag= 47.0 min
Primary = 0.71 cfs @ 12.74 hrs, Volume= 0.475 af

Routing by Stor-Ind method, Time Span= 1.00-20.00 hrs, dt= 0.05 hrs
Peak Elev= 973.03' @ 12.74 hrs Surf.Area= 7,576 sf Storage= 13,071 cf

Plug-Flow detention time= 190.0 min calculated for 0.474 af (85% of inflow)
Center-of-Mass det. time= 144.1 min (901.8 - 757.7)

Volume	Invert	Avail.Storage	Storage Description
#1	970.00'	21,597 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

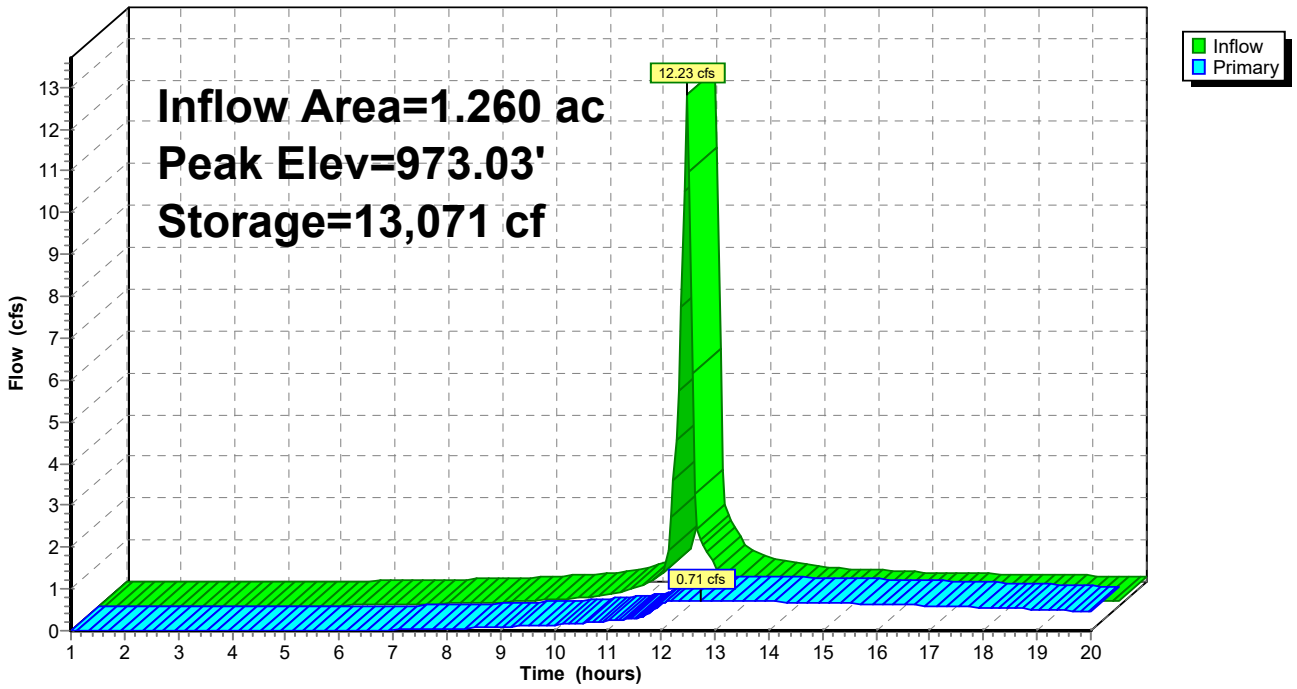
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
970.00	1,727	0	0
972.00	4,895	6,622	6,622
974.00	10,080	14,975	21,597

Device	Routing	Invert	Outlet Devices
#1	Primary	968.53'	**15.0" Round Culvert** L= 45.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 968.53' / 968.12' S= 0.0091 '/' Cc= 0.900 n= 0.013, Flow Area= 1.23 sf
#2	Device 1	970.00'	**4.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	973.50'	**48.0" x 48.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.71 cfs @ 12.74 hrs HW=973.03' (Free Discharge)
└**1=Culvert** (Passes 0.71 cfs of 11.64 cfs potential flow)
  └**2=Orifice/Grate** (Orifice Controls 0.71 cfs @ 8.15 fps)
  └**3=Orifice/Grate** (Controls 0.00 cfs)

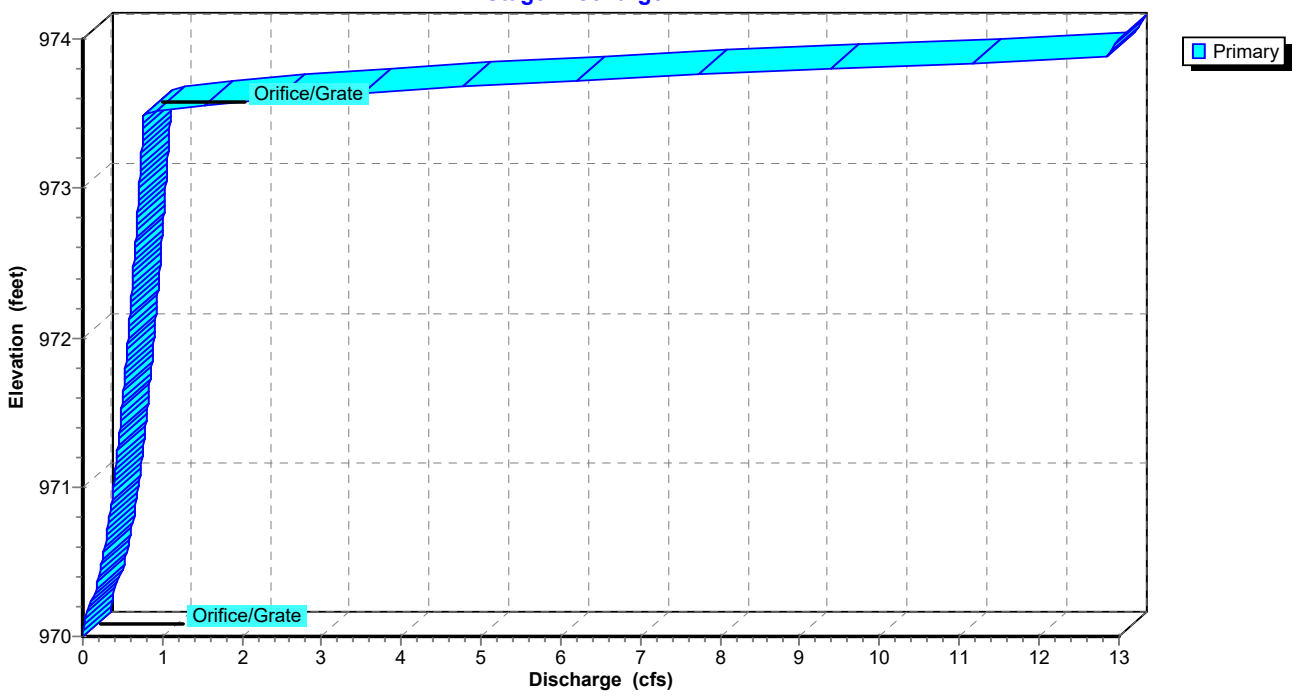
Pond 9P: EDDB-3

Hydrograph



Pond 9P: EDDB-3

Stage-Discharge



Pond 9P: EDDB-3