DOCKETED	
Docket Number:	25-OPT-01
Project Title:	Viracocha Hill Battery Energy Storage System Project
TN #:	261770
Document Title:	Volume 2 Viracocha Hill BESS Appendix 5-15A Hydrology & Hydraulics Report
Description:	Volume 2 Viracocha Hill BESS Appendix 5-15A Hydrology & Hydraulics Report
Filer:	Sam Shantry
Organization:	Jacobs
Submitter Role:	Applicant Consultant
Submission Date:	2/14/2025 1:54:38 PM
Docketed Date:	2/14/2025

Appendix 5.15A
Hydrology & Hydraulics Report

Preliminary Hydrology & Hydraulics Report

Viracocha Wind LLC

Viracocha Hill BESS
Project No. 177321

Revision 0
02/07/2025

Preliminary Hydrology & Hydraulics Report

prepared for

Viracocha Wind LLC
Viracocha Hill BESS
Alameda County, California

Project No. 177321

Revision 0
02/07/2025

prepared by

Burns & McDonnell Western Enterprises, Inc.
Brea, CA

INDEX AND CERTIFICATION

Viracocha Wind LLC
Preliminary Hydrology & Hydraulics Report
Project No. 177321

Report Index

Certifications

I hereby certify, as a Professional Engineer in the state of California, that the information in this document was assembled under my direct supervisory control. This report is not intended or represented to be suitable for reuse by Viracocha Wind, LLC or others without specific verification or adaptation by the Engineer.

This document is being released for the purpose of permitting under the authority of J. Tanner Dowell P.E. C66555. It is not to be used for construction purposes.

02/07/2025

TABLE OF CONTENTS

Page No.

APPENDICES

* * * * *

LIST OF TABLES

* * * * *

LIST OF FIGURES

1.0 SITE CONDITIONS

1.1 Site Description

Viracocha Wind LLC (Viracocha Wind) proposes to install the new Viracocha Hill Battery Energy Storage System. The site is located along Altamont Pass Road near the city of Tracy, Alameda County, California. See Figure 1-1 for project general vicinity map. The buildable area encompasses 16.8 acres. The area of the property Viracocha Wind is proposing to disturb during construction is approximately 11.5 acres. Viracocha Wind will add a new point of access off Altamont Pass Road as a part of this project.

The property is mostly grassland/pasture. The existing site drainage generally flows from the south and north toward the middle of the site and exits the project to the east.

1.2 Project Description

The project is planned to be a 90 MW battery storage facility with a capacity of 360 MWh. In addition to batteries, the development will include inverters, transformers, access roads, and a project substation. The new 230kV substation will tie into the existing PG&E Ralph Substation.

1.3 Project Stormwater Management Requirements

The Alameda County Hydrology & Hydraulics Manual and C.3 Stormwater Technical Guidance Manual were used in conjunction with the standards and requirements of the State of California to determine the design of the following stormwater management practices and treatment controls.

The pre-developed watershed associated with the current topography has been delineated as indicated on the exhibit found in Appendix A. The post-developed watershed associated with the proposed topography has been delineated as indicated on the exhibit in Appendix B.

1.4 Soils

Existing site soil information was taken from NRCS. The NRCS Web Soil Survey (8) classifies the types of soils found within the watershed according to hydrologic soils group: A, B, C, or D. The soil type on the project site and adjacent areas was determined to be mostly clay. Hydrologic soil group D was specified for the watersheds encompassing the Project site, indicating that soils have high runoff potential when saturated. The NRCS Web Soil Survey is included in Appendix E.

Figure 1-1: General Vicinity Map

2.0 HYDROLOGY AND HYDRAULICS

2.1 Rainfall Data

Rainfall depths for Alameda County, CA were obtained from the National Oceanic and Atmospheric Administration. The SCS rainfall distribution for this project is Type I. See Table 2.1 for rainfall data.

Table 2.1 Design Storm Frequency-Depth

Return Frequency (yr)	24 Hour Depth (in)
2	1.59
10	2.45
25	3.01
100	3.93

2.2 Runoff Data

HydroCAD 10.20-2 software was utilized to model the stormwater runoff at the site. The SCS TR-55 methodology was used for this model to calculate the pre and post developed runoff rates for storage design. Tables 2.2, 2.3 & 2.4 provide detailed information regarding curve numbers, land coverages, and times of concentration for the project.

Table 2.2 Standard Runoff Curve Numbers

Land Type	Curve Number
Gravel	96
Grass	80
Impervious	98
Pasture/Grassland/Range	80
Water Surface	98

Table 2.3 Land Coverages

Land Coverage	Pre-Developed Area (ac)	Pre-Developed Curve Number (CN)	Post-Developed Area (ac)	Post-Developed Curve Number (CN)
Gravel		96	6.24	96
Grass		80	1.92	80
Impervious		98		98
Pasture	37.6	80	29.4	80
Water		98		98
Total Area	37.6		37.6	
Weighted CN		80		83

Table 2.4 Times of Concentrations

Drainage Area	Pre-Developed Time of Concentration (hrs)	Post-Developed Time of Concentration (hrs)
1	0.432	0.103
2	N/A	0.215
3	N/A	0.235
4	N/A	0.190
5	N/A	0.157

*

2.3 Stormwater Management Facilities

Drainage ditches will be used along the perimeter of the site to intercept onsite and offsite flows. The flat bottom ditches will be 4-foot wide and approximately 1 foot deep. Riprap will be at the outlets of each ditch and culvert to dissipate energy and prevent erosion. Culverts will be placed under the entrance roads to carry those flows offsite.

A detention basin is proposed to be used at the site to mitigate the effects of higher runoff rates from the development of the site. The rectangular basin will be excavated earth and vegetated with a grass bottom and side slopes.

The southern basin will have a bottom elevation of 410’ and a top elevation of 415’. Although the area draining to the pond and drainage channel after construction has greater imperviousness than before construction, the proposed detention basin control structure was designed to not exceed the pre-construction drainage flows into the surrounding areas. Details for the control structure are given in Table 2.5.

The detention basin is designed with a control structure that will control storm events up to and including the 100-year event. Tables 2.6 summarize the detention basin.

Table 2.5 Extended Detention Basin Control Devices

Structure Name	Control Device
Control Structure #1	24” CMP principal outlet, top elevation 414.00’
Orifice of Control Structure #1	(1) – 6” circular orifice at 411.50’ (1) – 4” circular orifice at 413.00’
Outlet pipe for Control Structure #1	12” diameter CHDPE, upstream invert elevation 410.00’

Tables 2.6 Extended Detention Basin Stage-Discharge-Storage

Return Frequency (yr)	Stage Elevation (ft)	Discharge (cfs)	Storage (ac-ft)
2	411.78	0.21	0.452
10	412.19	0.63	0.572
100	413.45	1.46	0.980

2.4 Results

As summarized in Section 2.3, a dry detention basin is proposed to mitigate the impacts of stormwater runoff from changes in drainage patterns that would result from the construction of the new energy storage development. The SCS Type I storm distribution was used to calculate stormwater flow rates. Flow rate calculations and level pool routing calculations were completed using HydroCAD. See Appendix B for HydroCAD calculations.

Tables 2.7 below summarizes the stormwater flow conditions for the area.

Table 2.7a Site Flow Results

	Return Frequency					
Drainage Area*	85th Percentile			1-Year		
	Pre-Developed Flow (cfs)	Post-Developed Flow without SWM (cfs)	Post-Developed Flow with SWM (cfs)	Pre-Developed Flow (cfs)	Post-Developed Flow without SWM (cfs)	Post-Developed Flow with SWM (cfs)
1	0.00	0.17	0.00	1.02	3.62	0.01
2	N/A	0.00	0.00	N/A	0.69	0.40
3	N/A	0.00	0.00	N/A	0.22	0.21
4	N/A	0.00		N/A	0.17	
5	N/A	0.00	N/A	N/A	0.14	N/A
TOTAL	0.00	0.00		1.02	0.76	

*Drainage Areas do not match between pre- and post-construction.

Table 2.7b Site Flow Results

	Return Frequency					
Drainage Area*	2-Year			10-Year		
	Pre-Developed Flow (cfs)	Post-Developed Flow without SWM (cfs)	Post-Developed Flow with SWM (cfs)	Pre-Developed Flow (cfs)	Post-Developed Flow without SWM (cfs)	Post-Developed Flow with SWM (cfs)
1	3.56	5.49	0.21	13.49	10.53	0.63
2	N/A	2.43	1.67	N/A	8.96	7.43
3	N/A	0.81	0.79	N/A	2.98	3.38
4	N/A	0.53		N/A	1.75	
5	N/A	0.43	N/A	N/A	1.40	N/A
TOTAL	3.56	3.10		13.49	12.84	

*Drainage Areas do not match between pre- and post-construction.

Table 2.7c Site Flow Results

	Return Frequency					
Drainage Area*	25-Year			100-Year		
	Pre-Developed Flow (cfs)	Post-Developed Flow without SWM (cfs)	Post-Developed Flow with SWM (cfs)	Pre-Developed Flow (cfs)	Post-Developed Flow without SWM (cfs)	Post-Developed Flow with SWM (cfs)
1	21.37	13.88	0.90	35.72	19.40	1.46
2	N/A	14.10	12.18	N/A	23.40	20.78
3	N/A	4.70	5.54	N/A	7.81	9.60
4	N/A	2.69		N/A	4.38	
5	N/A	2.16	N/A	N/A	3.51	N/A
TOTAL	21.37	20.78		35.72	35.35	

*Drainage Areas do not match between pre- and post-construction.

3.0 BEST MANAGEMENT PRACTICES

3.1 Stormwater Pollution Prevention Plan

A plan for erosion and sediment control during construction was developed as part of the Stormwater Management Plan (SWMP) necessary for a general construction permit in the State of California. The following stormwater management techniques were incorporated into the final site design to mitigate erosion for post-construction conditions.

3.2 Stormwater Quality Control Plan

A plan for stormwater quality control during and after construction was developed in accordance with the C.3 Stormwater Technical Guidance (C.3). As a Regulated Project (Parcel-Based Development ≥ 5000 sq. ft. Impervious), the C.3 requires that the site have the following four categories of stormwater control measures: site design, source control, stormwater treatment, and hydromodification management. The following stormwater quality control measures as well as those incorporated into the stormwater management techniques below will protect water resources near the site.

3.2.1 Site Design Controls

In Stormwater Management Section.

3.2.2 Source Controls

This section describes control measures for activities that have been identified as potentially significant sources of pollutants in stormwater. Outdoor material storage, trash storage, and waste handling areas will be graded to prevent run-on and direct any runoff to treatment controls to not pollute receiving waters. These areas will have a base with a material impervious to leaks and spills and a cover or enclosure to prevent rainfall from directly contacting the storage area.

3.2.3 Treatment Controls

Treatment Controls are engineered systems designed to remove pollutants from stormwater runoff.

To meet the trash control requirement, the proposed detention basin outlet control structure will have a screen or other device to trap particles 5 millimeters or greater and prevent them from being discharged offsite.

3.2.4 Hydromodification Management

Hydromodification management (HM) measures include site design and stormwater treatment measures that promote infiltration or otherwise minimize the change in the rate and flow of runoff, when compared to the pre-development condition. These measures include constructed facilities that manage the flow rates of stormwater leaving a site. The detention basin will be designed such that post-construction runoff rates match pre-construction rates from 10 percent of the pre-construction 2-year peak flow up to the pre-construction 10-year peak flow.

3.3 Stormwater Management

Stormwater management focused on the inclusion of temporary and permanent BMPs to manage runoff through the project site. Methods of controlling stormwater runoff and mitigating erosion were an integral part of the site layout and grading plan and were developed by the project engineer. Permanent methods include site-wide vegetation, detention basins, and preservation of existing drainage patterns. Temporary methods include use of silt fence, and stabilized construction entrances.

3.3.1 Establishment of Vegetation

The most effective strategy for mitigating erosion is the re-establishment and maintenance of vegetation. Vegetation will be reestablished in disturbed areas promptly after construction activities have temporarily or permanently ceased.

3.3.2 Minimization of Impervious Area

While the addition of impervious surfaces is inevitable during this development, strategies have been put in place to minimize them. Minimum allowable roadway cross sections and pervious pavements (gravel) are used.

3.3.3 Site Grading

The site grading was designed to maintain areas of mild slopes and to remove areas of concentrated stormwater runoff by removing undulations. The proposed grading maximizes sheet flow of runoff to both limit flow velocity and depth across the site.

3.3.3.1 Minimization of Soil Compaction

Clearing, grading, and equipment can remove and compact existing soils. Construction vehicles and equipment will be restricted to access roads and areas designated for storage.

3.3.4 Silt Fence

In areas of sheet flow, silt fence was proposed to control sediment removal from on-site runoff that will not be directed into the detention basin.

4.0 CONCLUSIONS

The Viracocha Hill Energy Storage Stormwater Management Plan was developed to comply with the C.3 and Caltrans Standard Specifications. The plan aims to reduce peak flow, to improve pollutant removal, to encourage infiltration and evapotranspiration, and to provide ongoing protection of stormwater quality. BMPs and stormwater control measures will be installed and inspected to ensure the goals are reached.

APPENDIX A – PRE-CONSTRUCTION DRAINAGE EXHIBIT

Scale For Microfilming
Millimeters
Inches

NORTH

0 80' 160'
SCALE IN FEET

REFERENCE DRAWING

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BURNS McDONNELL
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BREA, CA 92821
Burns & McDonnell Western Enterprises, Inc.

designed D. ROSENBLUM | detailed D. ROSENBLUM

Viracocha Hill Project

ALAMEDA COUNTY, CALIFORNIA

VIRACOCHA HILL BESS
PRE-CONSTRUCTION
DRAINAGE EXHIBIT

project 177321 | contract -

drawing SK-C100 – | rev. 0

sheet of sheets

file Pre-Construction Watershed Delineation.dwg

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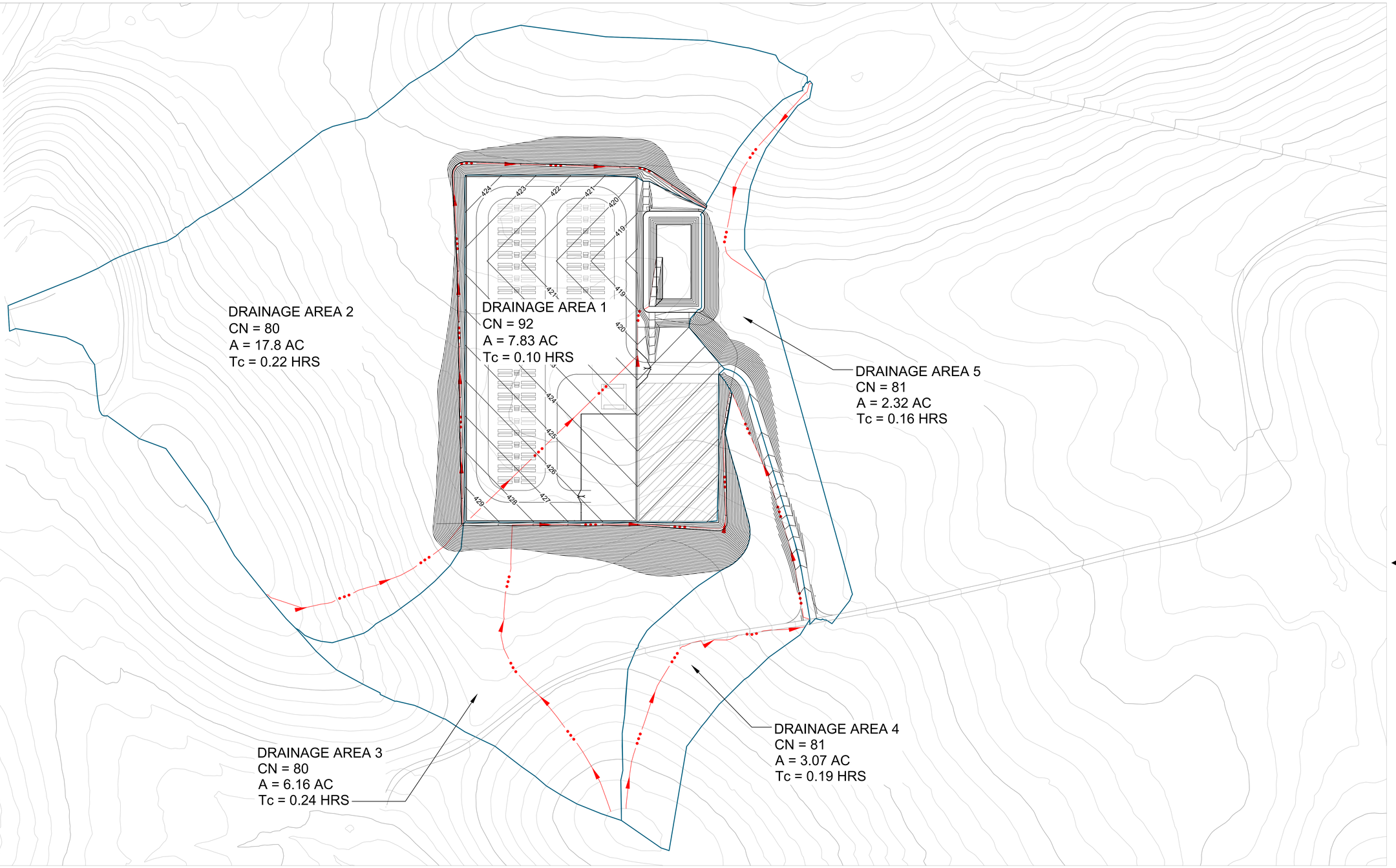
APPENDIX B – POST-CONSTRUCTION DRAINAGE EXHIBIT



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Viracocha Hill Project

ALAMEDA COUNTY, CALIFORNIA

VIRACOCHA HILL BESS
POST-CONSTRUCTION
DRAINAGE EXHIBIT

project 177321 | contract -

drawing **SK-C200** | rev. **0**

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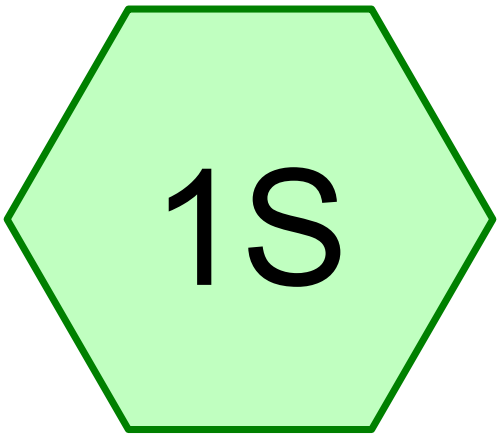
APPENDIX C – PRE-CONSTRUCTION HYDROCAD REPORT



DRAINAGE AREA 1

Subcat Reach Pond Link

Routing Diagram for Pre-Construction
Prepared by Burns & McDonnell, Printed 1/8/2025

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-yr, 24-hr	Type I 24-hr		Default	24.00	1	1.25	2
2	2-yr, 24-hr	Type I 24-hr		Default	24.00	1	1.59	2
3	10-yr, 24-hr	Type I 24-hr		Default	24.00	1	2.45	2
4	25-yr, 24-hr	Type I 24-hr		Default	24.00	1	3.01	2
5	85th Percentile	Type I 24-hr		Default	24.00	1	0.45	2
6	100-yr, 24-hr	Type I 24-hr		Default	24.00	1	3.93	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
37.596	80	Pasture/grassland/range, Good, HSG D (1S)
37.596	**80**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
37.596	HSG D	1S
0.000	Other	
37.596		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	37.596	0.000	37.596	Pasture/grassland/range, Good	1S
0.000	**0.000**	**0.000**	**37.596**	**0.000**	**37.596**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=1,637,671 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=1,699' Tc=25.9 min CN=80 Runoff=1.02 cfs 0.542 af

Total Runoff Area = 37.596 ac Runoff Volume = 0.542 af Average Runoff Depth = 0.17"
100.00% Pervious = 37.596 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

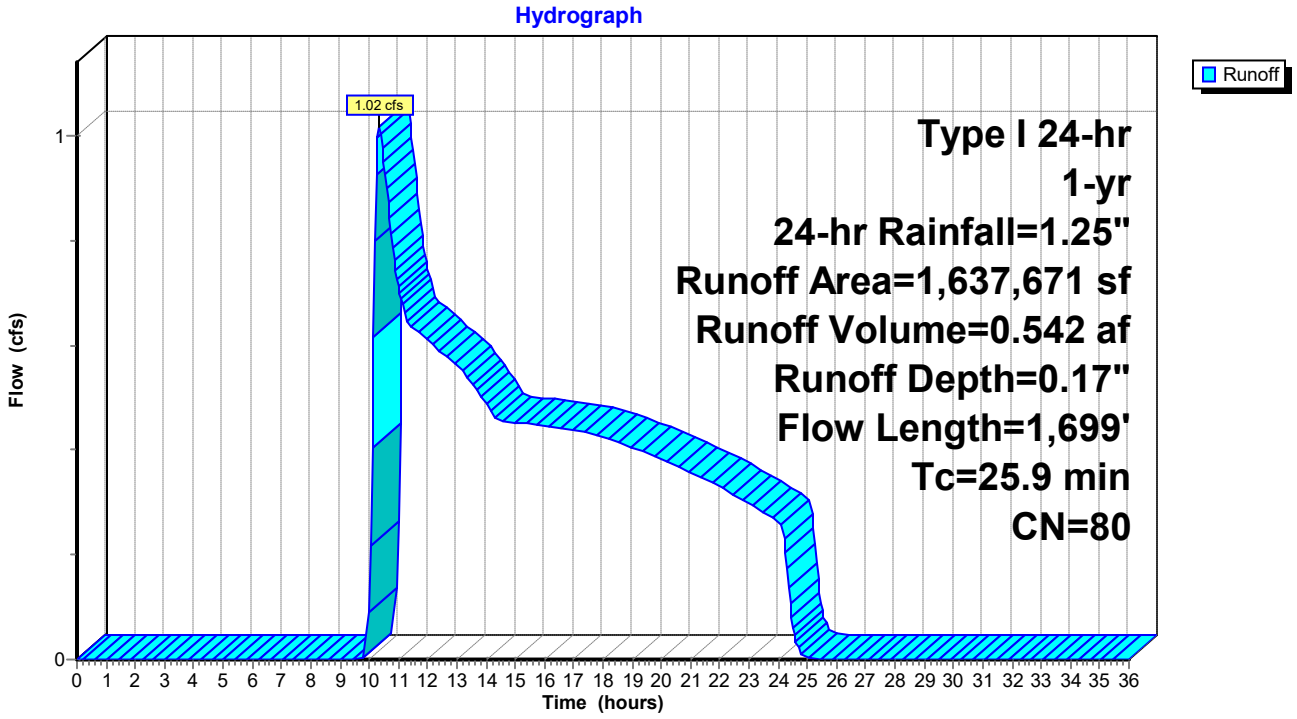
Runoff = 1.02 cfs @ 10.36 hrs, Volume= 0.542 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type I 24-hr 1-yr, 24-hr Rainfall=1.25"

Area (sf)	CN	Description
1,637,671	80	Pasture/grassland/range, Good, HSG D
1,637,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	100	0.0250	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
13.2	1,599	0.0826	2.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.9	1,699	Total			

Subcatchment 1S: DRAINAGE AREA 1



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=1,637,671 sf 0.00% Impervious Runoff Depth=0.33"
Flow Length=1,699' Tc=25.9 min CN=80 Runoff=3.56 cfs 1.037 af

Total Runoff Area = 37.596 ac Runoff Volume = 1.037 af Average Runoff Depth = 0.33"
100.00% Pervious = 37.596 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

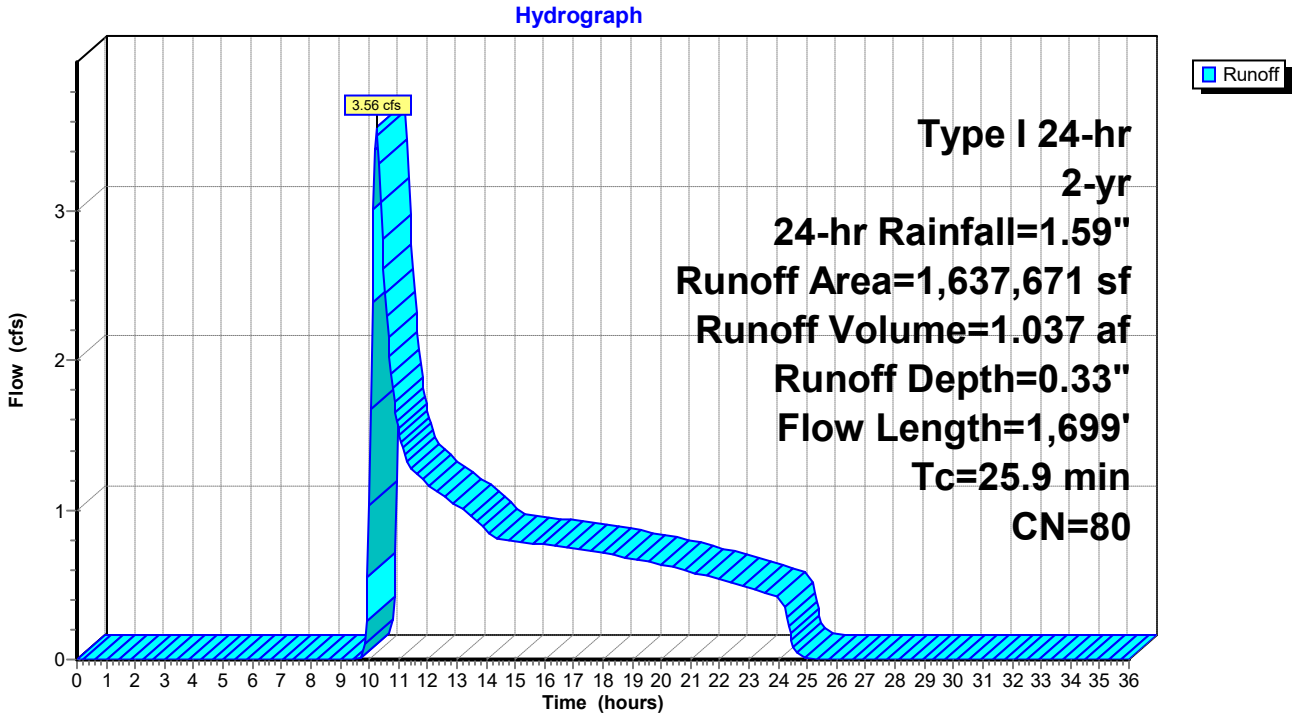
Runoff = 3.56 cfs @ 10.26 hrs, Volume= 1.037 af, Depth= 0.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr, 24-hr Rainfall=1.59"

Area (sf)	CN	Description
1,637,671	80	Pasture/grassland/range, Good, HSG D
1,637,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	100	0.0250	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
13.2	1,599	0.0826	2.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.9	1,699	Total			

Subcatchment 1S: DRAINAGE AREA 1



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=1,637,671 sf 0.00% Impervious Runoff Depth=0.85"
Flow Length=1,699' Tc=25.9 min CN=80 Runoff=13.49 cfs 2.677 af

Total Runoff Area = 37.596 ac Runoff Volume = 2.677 af Average Runoff Depth = 0.85"
100.00% Pervious = 37.596 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

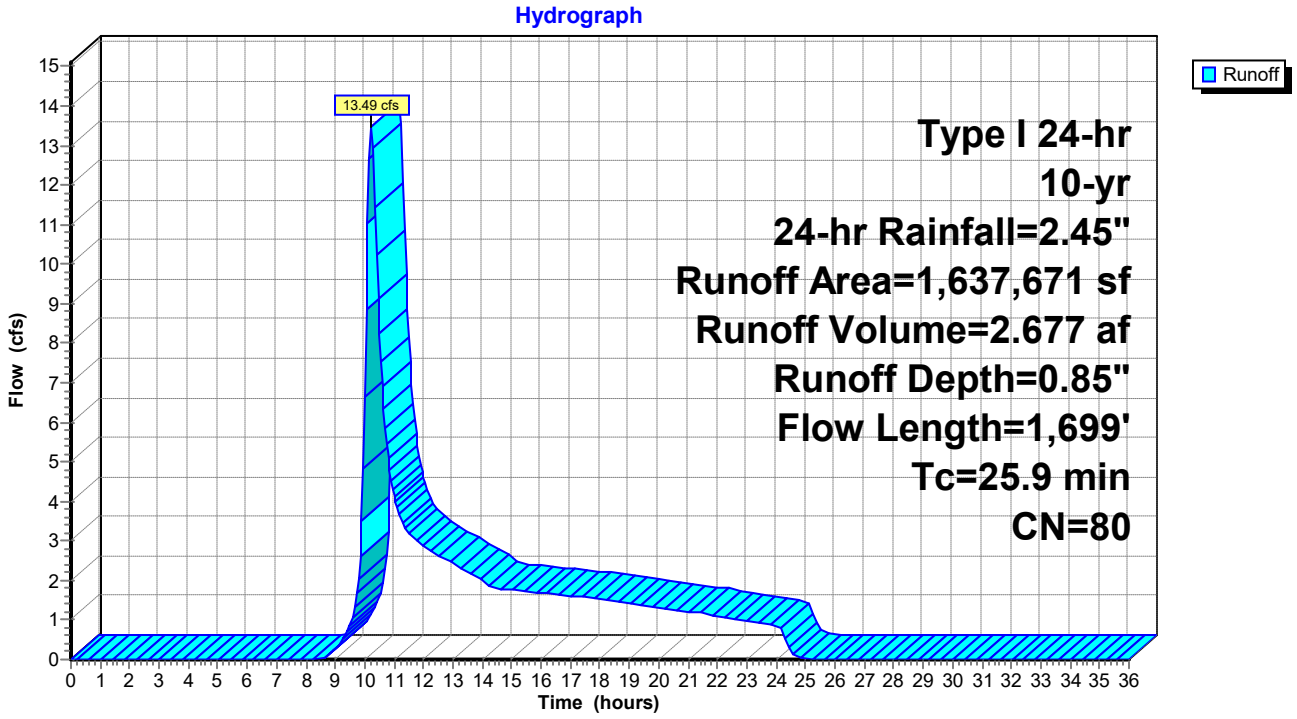
Runoff = 13.49 cfs @ 10.22 hrs, Volume= 2.677 af, Depth= 0.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type I 24-hr 10-yr, 24-hr Rainfall=2.45"

Area (sf)	CN	Description
1,637,671	80	Pasture/grassland/range, Good, HSG D
1,637,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	100	0.0250	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
13.2	1,599	0.0826	2.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.9	1,699	Total			

Subcatchment 1S: DRAINAGE AREA 1



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=1,637,671 sf 0.00% Impervious Runoff Depth=1.26"
Flow Length=1,699' Tc=25.9 min CN=80 Runoff=21.37 cfs 3.940 af

Total Runoff Area = 37.596 ac Runoff Volume = 3.940 af Average Runoff Depth = 1.26"
100.00% Pervious = 37.596 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

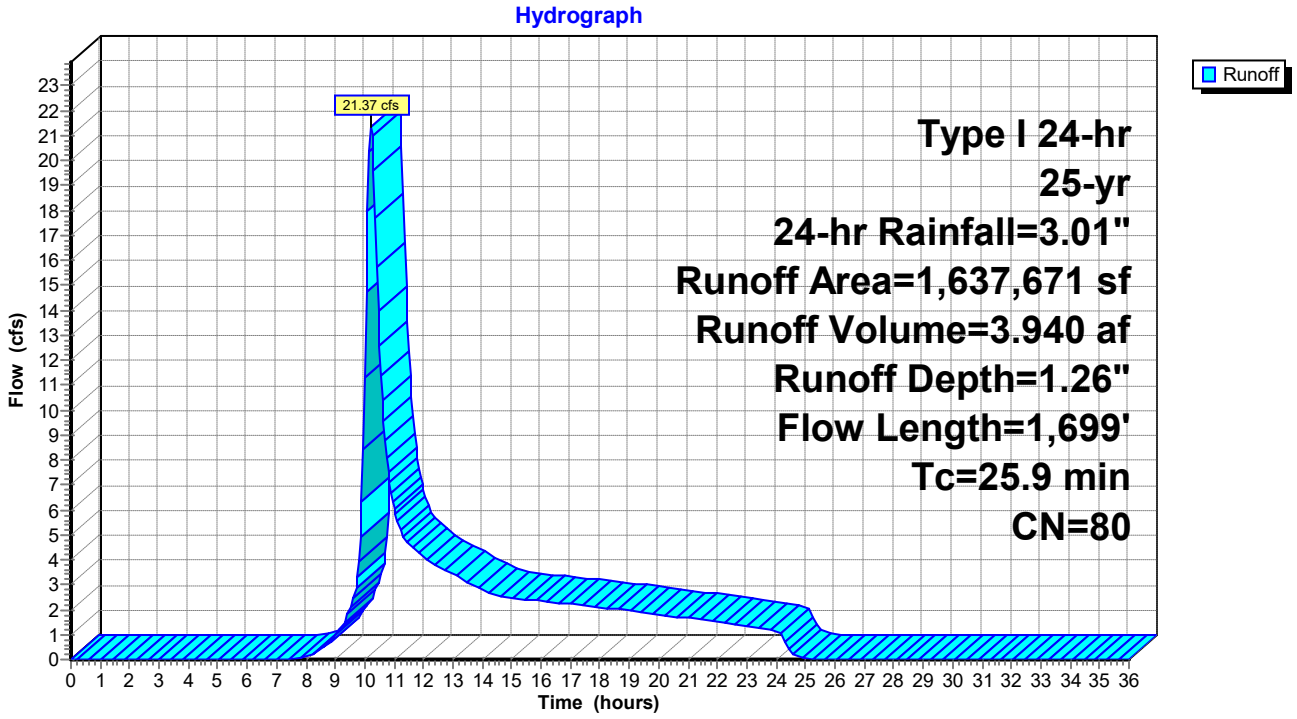
Runoff = 21.37 cfs @ 10.21 hrs, Volume= 3.940 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type I 24-hr 25-yr, 24-hr Rainfall=3.01"

Area (sf)	CN	Description
1,637,671	80	Pasture/grassland/range, Good, HSG D
1,637,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	100	0.0250	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
13.2	1,599	0.0826	2.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.9	1,699	Total			

Subcatchment 1S: DRAINAGE AREA 1



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=1,637,671 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,699' Tc=25.9 min CN=80 Runoff=0.00 cfs 0.000 af

Total Runoff Area = 37.596 ac Runoff Volume = 0.000 af Average Runoff Depth = 0.00"
100.00% Pervious = 37.596 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

[45] Hint: Runoff=Zero

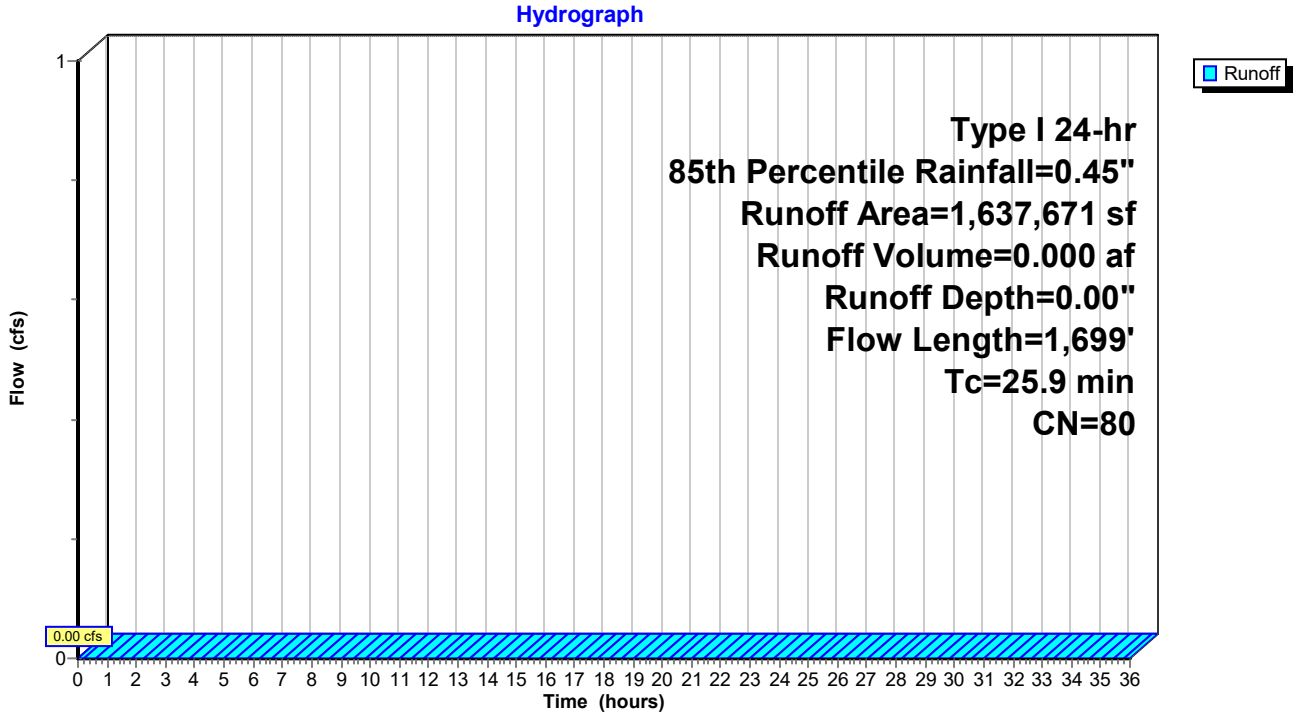
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type I 24-hr 85th Percentile Rainfall=0.45"

Area (sf)	CN	Description
1,637,671	80	Pasture/grassland/range, Good, HSG D
1,637,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	100	0.0250	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
13.2	1,599	0.0826	2.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.9	1,699	Total			

Subcatchment 1S: DRAINAGE AREA 1



Time span=0.00-36.00 hrs, dt=0.05 hrs, 721 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=1,637,671 sf 0.00% Impervious Runoff Depth=1.98"
Flow Length=1,699' Tc=25.9 min CN=80 Runoff=35.72 cfs 6.216 af

Total Runoff Area = 37.596 ac Runoff Volume = 6.216 af Average Runoff Depth = 1.98"
100.00% Pervious = 37.596 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

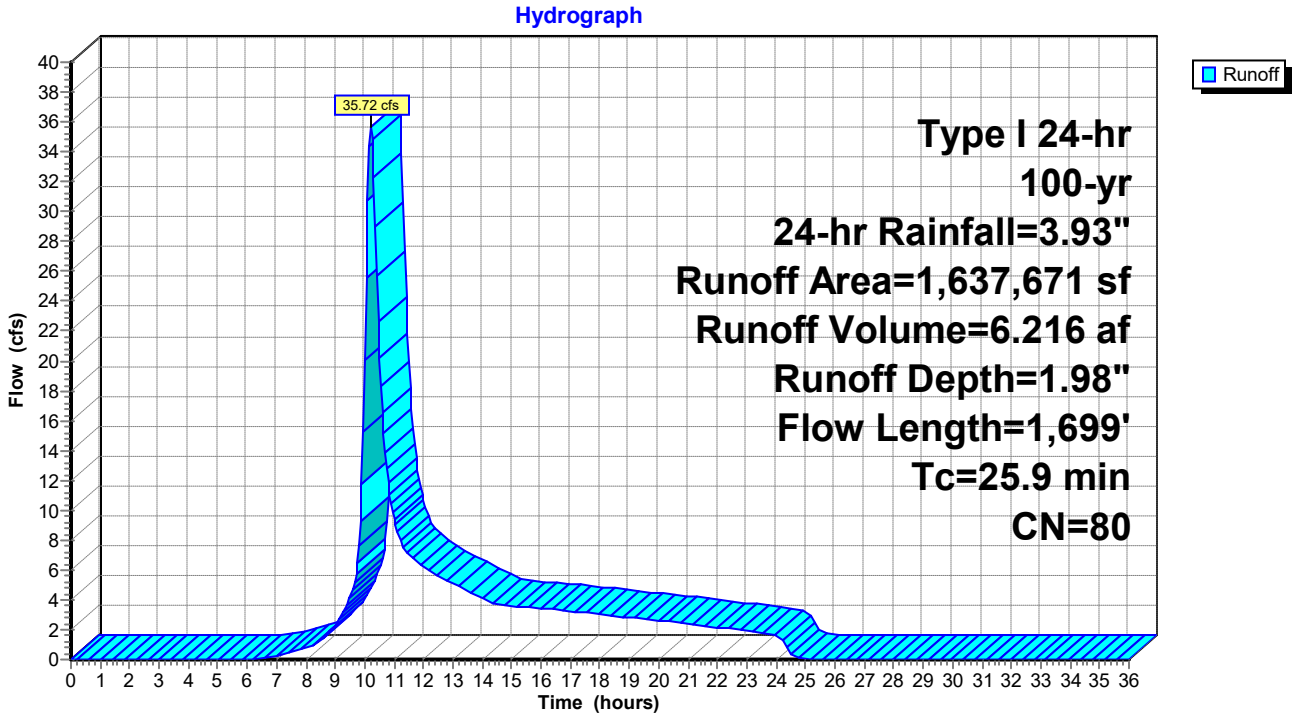
Runoff = 35.72 cfs @ 10.20 hrs, Volume= 6.216 af, Depth= 1.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-yr, 24-hr Rainfall=3.93"

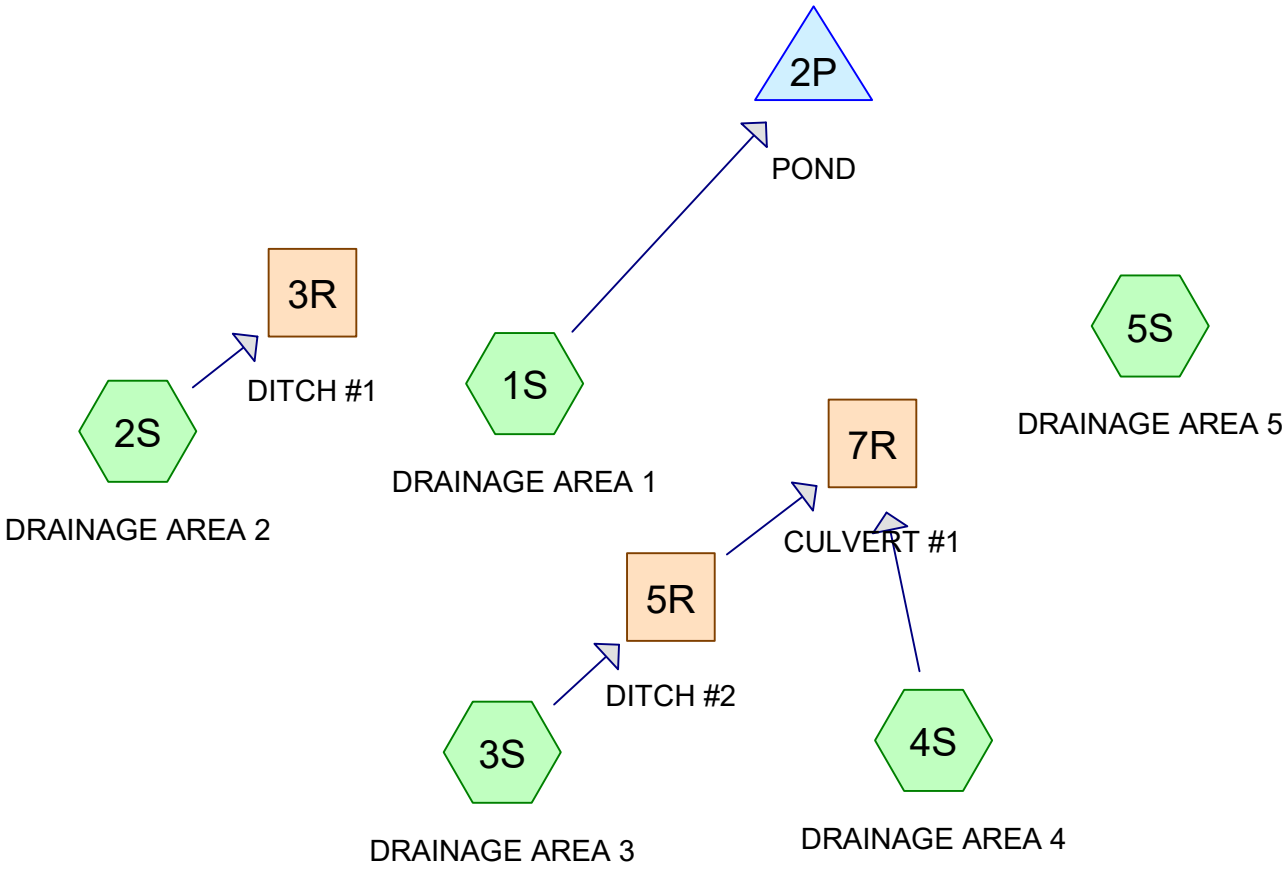
Area (sf)	CN	Description
1,637,671	80	Pasture/grassland/range, Good, HSG D
1,637,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.7	100	0.0250	0.13		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
13.2	1,599	0.0826	2.01		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
25.9	1,699	Total			

Subcatchment 1S: DRAINAGE AREA 1



APPENDIX D – POST-CONSTRUCTION HYDROCAD REPORT



Subcat Reach Pond Link

Routing Diagram for Post-Construction
Prepared by Burns & McDonnell, Printed 1/15/2025

Rainfall Events Listing

Event#	Event Name	Storm Type	Curve	Mode	Duration (hours)	B/B	Depth (inches)	AMC
1	1-yr, 24-hr	Type I 24-hr		Default	24.00	1	1.25	2
2	2-yr, 24-hr	Type I 24-hr		Default	24.00	1	1.59	2
3	10-yr, 24-hr	Type I 24-hr		Default	24.00	1	2.45	2
4	25-yr, 24-hr	Type I 24-hr		Default	24.00	1	3.01	2
5	85th Percentile	Type I 24-hr		Default	24.00	1	0.45	2
6	100-yr, 24-hr	Type I 24-hr		Default	24.00	1	3.93	2

Area Listing (selected nodes)

Area (acres)	CN	Description (subcatchment-numbers)
1.916	80	>75% Grass cover, Good, HSG D (1S)
6.243	96	Gravel surface, HSG D (1S, 4S, 5S)
29.064	80	Pasture/grassland/range, Good, HSG D (2S, 3S, 4S, 5S)
37.223	**83**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
37.223	HSG D	1S, 2S, 3S, 4S, 5S
0.000	Other	
37.223		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	1.916	0.000	1.916	>75% Grass cover, Good	1S
0.000	0.000	0.000	6.243	0.000	6.243	Gravel surface	1S, 4S, 5S
0.000	0.000	0.000	29.064	0.000	29.064	Pasture/grassland/range, Good	2S, 3S, 4S, 5S
0.000	**0.000**	**0.000**	**37.223**	**0.000**	**37.223**	**TOTAL AREA**	

Pipe Listing (selected nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Width (inches)	Diam/Height (inches)	Inside-Fill (inches)	Node Name
1	7R	415.95	414.88	72.0	0.0149	0.013	0.0	18.0	0.0	
2	2P	410.00	409.00	44.0	0.0227	0.013	0.0	12.0	0.0	

Time span=0.00-54.00 hrs, dt=0.05 hrs, 1081 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=340,869 sf 0.00% Impervious Runoff Depth=0.60"
Flow Length=683' Tc=6.2 min CN=92 Runoff=3.62 cfs 0.388 af

Subcatchment 2S: DRAINAGE AREA 2 Runoff Area=777,719 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=1,706' Tc=12.9 min CN=80 Runoff=0.67 cfs 0.258 af

Subcatchment 3S: DRAINAGE AREA 3 Runoff Area=268,223 sf 0.00% Impervious Runoff Depth=0.17"
Flow Length=1,354' Tc=14.1 min CN=80 Runoff=0.22 cfs 0.089 af

Subcatchment 4S: DRAINAGE AREA 4 Runoff Area=133,567 sf 0.00% Impervious Runoff Depth=0.20"
Flow Length=993' Tc=11.4 min CN=81 Runoff=0.17 cfs 0.050 af

Subcatchment 5S: DRAINAGE AREA 5 Runoff Area=101,061 sf 0.00% Impervious Runoff Depth=0.20"
Flow Length=495' Tc=9.4 min CN=81 Runoff=0.14 cfs 0.038 af

Reach 3R: DITCH #1 Avg. Flow Depth=0.09' Max Vel=1.05 fps Inflow=0.67 cfs 0.258 af
n=0.030 L=1,250.6' S=0.0120 '/' Capacity=29.31 cfs Outflow=0.40 cfs 0.258 af

Reach 5R: DITCH #2 Avg. Flow Depth=0.05' Max Vel=0.66 fps Inflow=0.22 cfs 0.089 af
n=0.030 L=715.3' S=0.0097 '/' Capacity=26.38 cfs Outflow=0.14 cfs 0.089 af

Reach 7R: CULVERT #1 Avg. Flow Depth=0.13' Max Vel=2.70 fps Inflow=0.21 cfs 0.139 af
18.0" Round Pipe n=0.013 L=72.0' S=0.0149 '/' Capacity=12.81 cfs Outflow=0.21 cfs 0.139 af

Pond 2P: POND Peak Elev=411.55' Storage=16,875 cf Inflow=3.62 cfs 0.388 af
Primary=0.01 cfs 0.012 af Secondary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.012 af

Total Runoff Area = 37.223 ac Runoff Volume = 0.822 af Average Runoff Depth = 0.26"
100.00% Pervious = 37.223 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

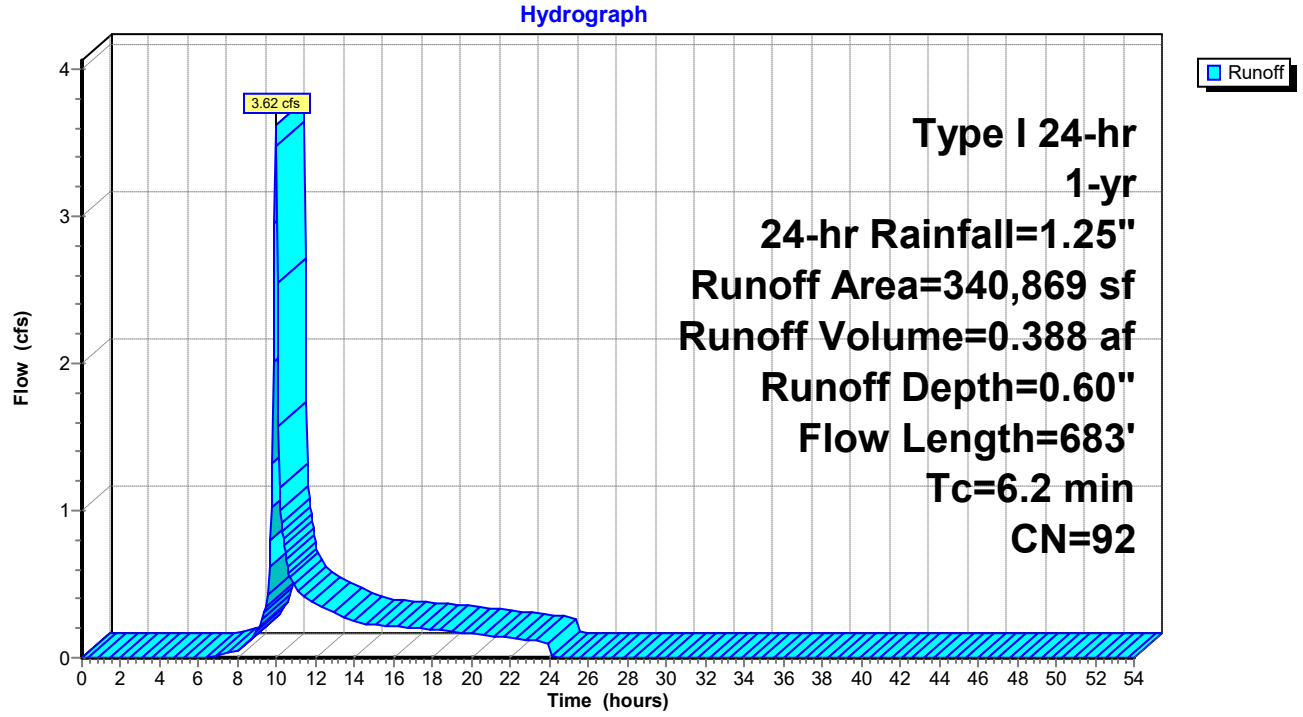
Runoff = 3.62 cfs @ 9.97 hrs, Volume= 0.388 af, Depth= 0.60"
Routed to Pond 2P : POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 1-yr, 24-hr Rainfall=1.25"

Area (sf)	CN	Description
257,425	96	Gravel surface, HSG D
83,444	80	>75% Grass cover, Good, HSG D
340,869	92	Weighted Average
340,869		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0200	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.59"
2.7	370	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	113	0.0444	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	100	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	683	Total			

Subcatchment 1S: DRAINAGE AREA 1



Summary for Subcatchment 2S: DRAINAGE AREA 2

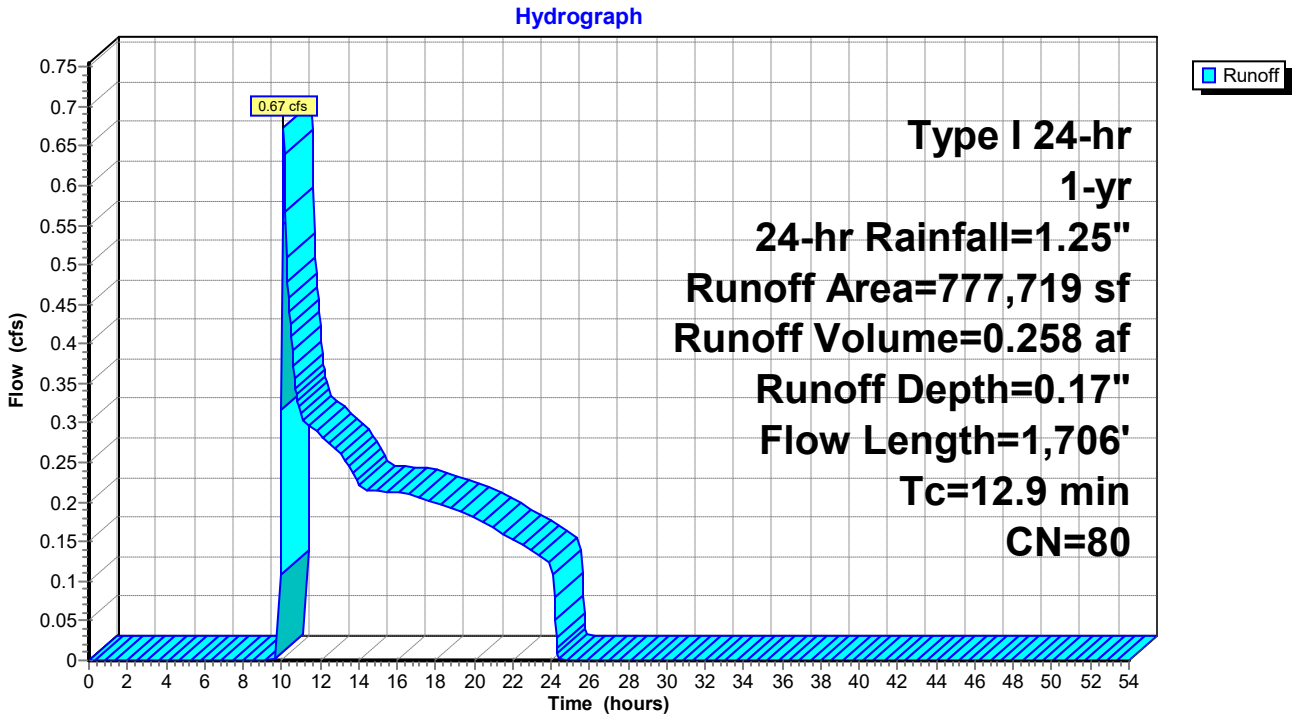
Runoff = 0.67 cfs @ 10.12 hrs, Volume= 0.258 af, Depth= 0.17"
Routed to Reach 3R : DITCH #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 1-yr, 24-hr Rainfall=1.25"

Area (sf)	CN	Description
777,719	80	Pasture/grassland/range, Good, HSG D
777,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
1.9	355	0.1905	3.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.7	1,251	0.0120	5.71	39.97	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=1.00' Z= 3.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
12.9	1,706	Total			

Subcatchment 2S: DRAINAGE AREA 2



Summary for Subcatchment 3S: DRAINAGE AREA 3

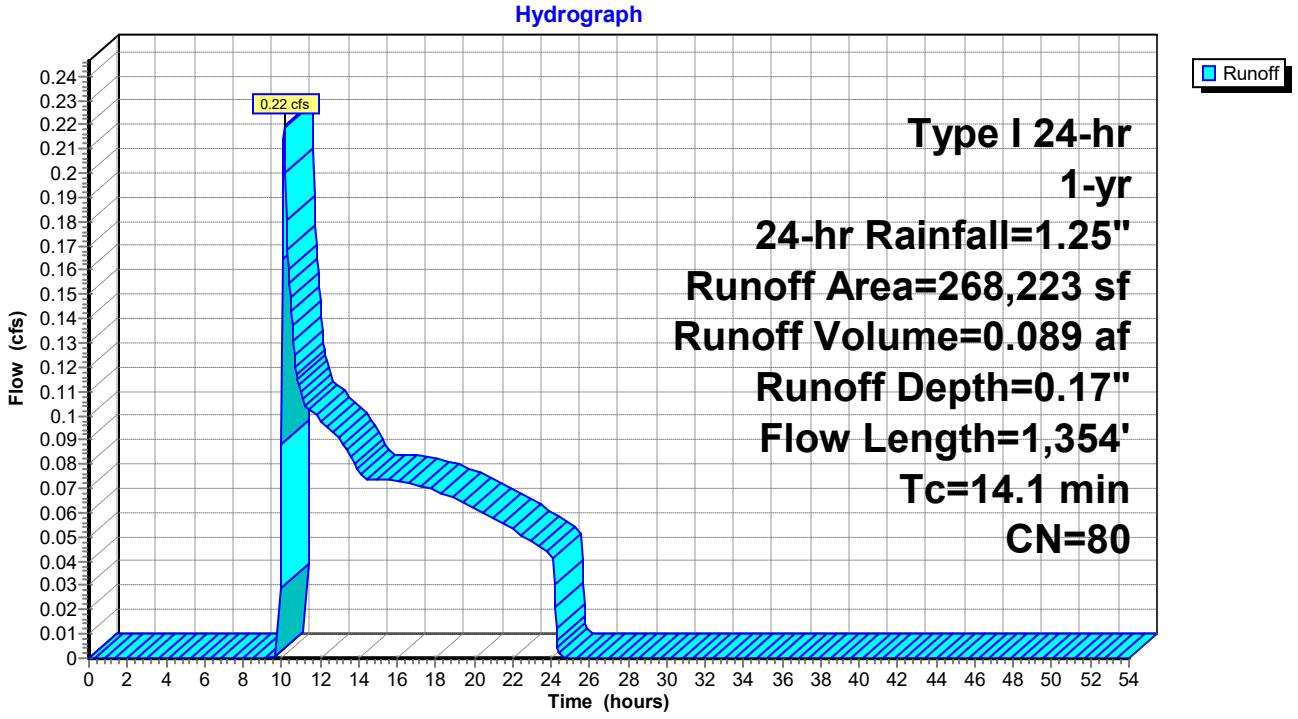
Runoff = 0.22 cfs @ 10.14 hrs, Volume= 0.089 af, Depth= 0.17"
Routed to Reach 5R : DITCH #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 1-yr, 24-hr Rainfall=1.25"

Area (sf)	CN	Description
268,223	80	Pasture/grassland/range, Good, HSG D
268,223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
3.6	550	0.1317	2.54		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	617	0.0090	4.23	19.82	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=0.75' Z= 3.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
0.8	87	0.0688	1.84		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.1	1,354	Total			

Subcatchment 3S: DRAINAGE AREA 3



Summary for Subcatchment 4S: DRAINAGE AREA 4

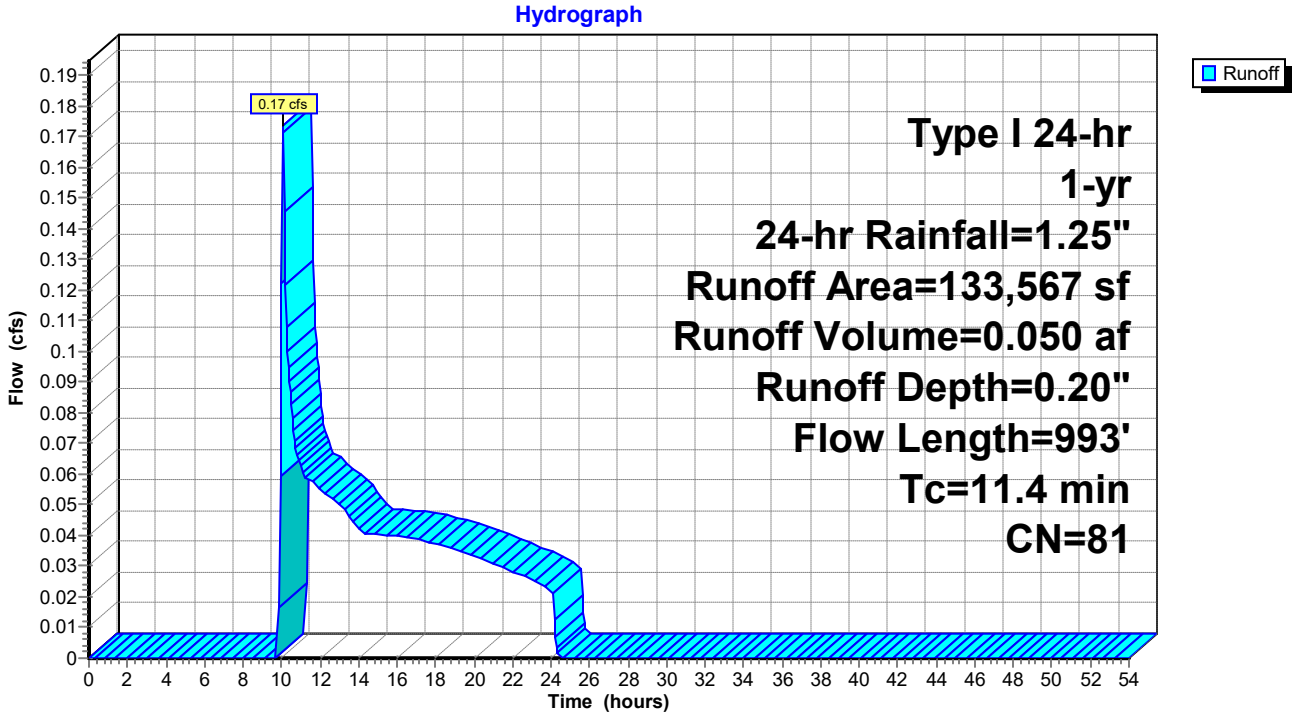
Runoff = 0.17 cfs @ 10.08 hrs, Volume= 0.050 af, Depth= 0.20"
Routed to Reach 7R : CULVERT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 1-yr, 24-hr Rainfall=1.25"

	Area (sf)	CN	Description
*	6,582	96	Gravel surface, HSG D
	126,985	80	Pasture/grassland/range, Good, HSG D
	133,567	81	Weighted Average
	133,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.1057	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.9	457	0.1389	2.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	436	0.0460	5.01	9.40	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 & 12.0 '/' Top.W=7.50' n= 0.025 Earth, clean & winding
11.4	993	Total			

Subcatchment 4S: DRAINAGE AREA 4



Summary for Subcatchment 5S: DRAINAGE AREA 5

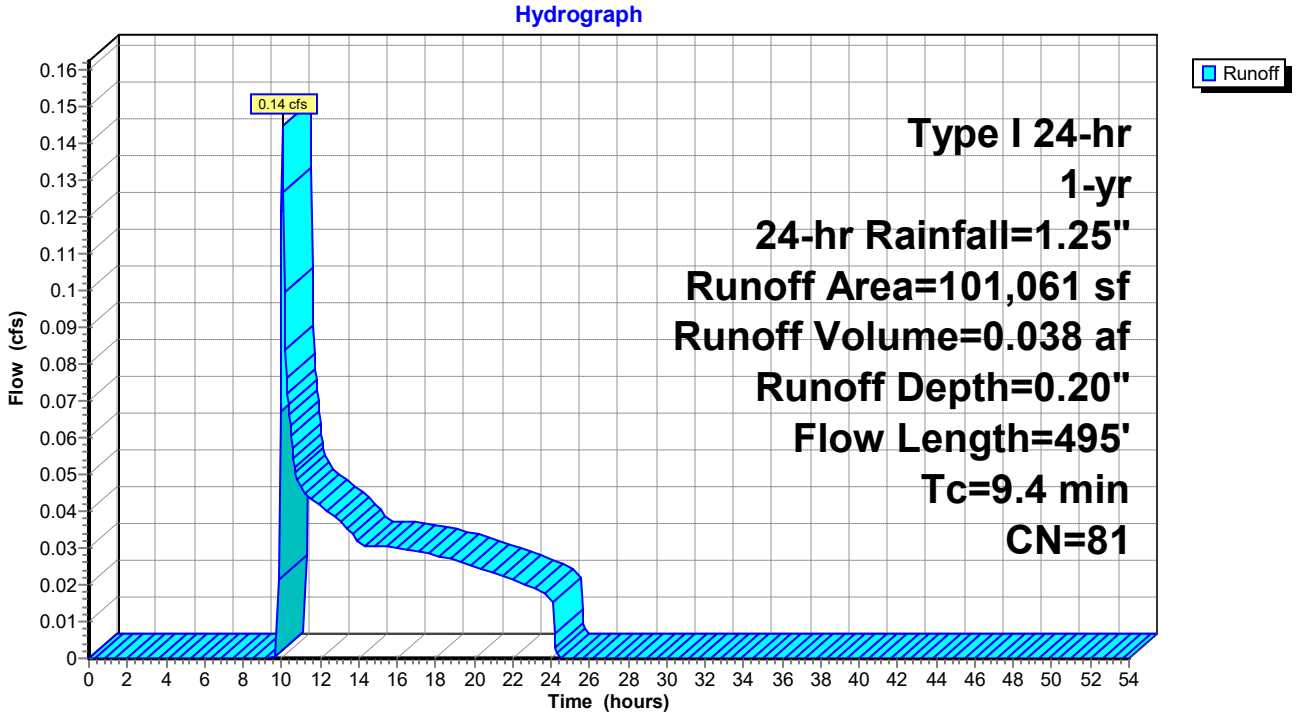
Runoff = 0.14 cfs @ 10.05 hrs, Volume= 0.038 af, Depth= 0.20"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 1-yr, 24-hr Rainfall=1.25"

	Area (sf)	CN	Description
*	7,957	96	Gravel surface, HSG D
	93,104	80	Pasture/grassland/range, Good, HSG D
	101,061	81	Weighted Average
	101,061		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	100	0.1177	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.6	395	0.1348	2.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	495	Total			

Subcatchment 5S: DRAINAGE AREA 5



Summary for Reach 3R: DITCH #1

Inflow Area = 17.854 ac, 0.00% Impervious, Inflow Depth = 0.17" for 1-yr, 24-hr event
Inflow = 0.67 cfs @ 10.12 hrs, Volume= 0.258 af
Outflow = 0.40 cfs @ 10.85 hrs, Volume= 0.258 af, Atten= 40%, Lag= 43.8 min

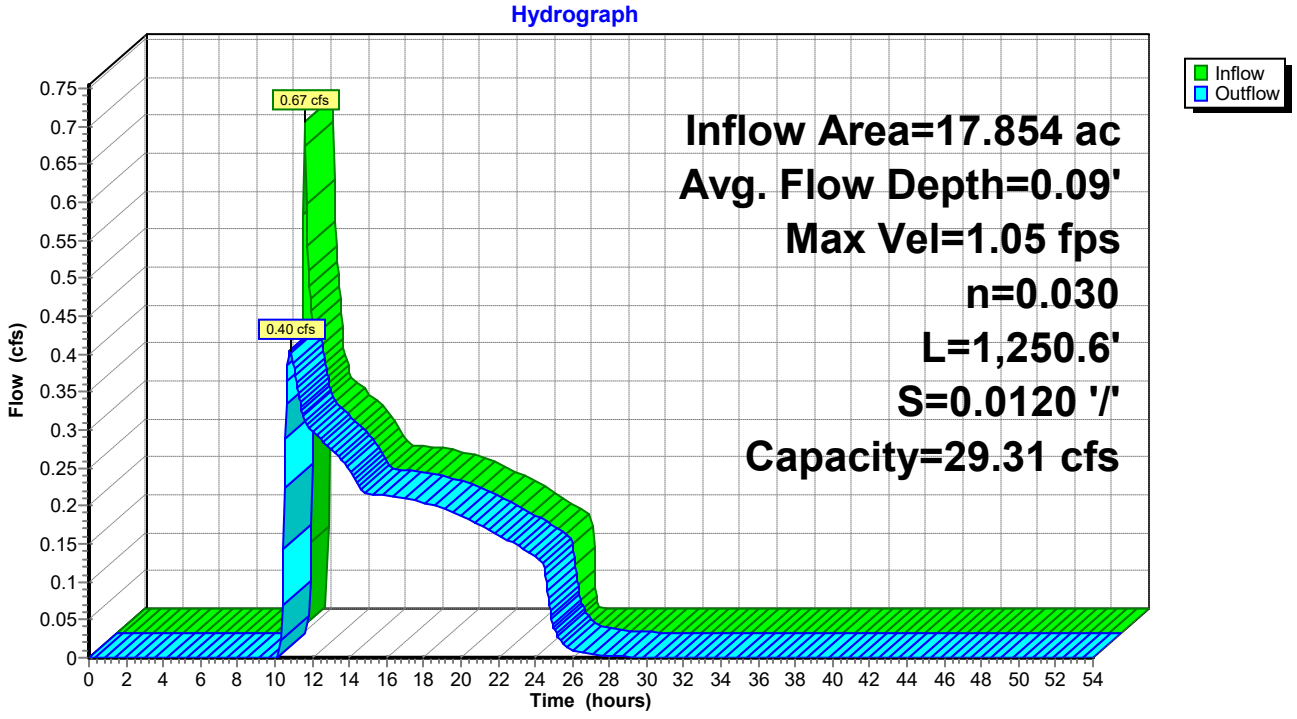
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.05 fps, Min. Travel Time= 19.9 min
Avg. Velocity = 0.60 fps, Avg. Travel Time= 35.0 min

Peak Storage= 484 cf @ 10.51 hrs
Average Depth at Peak Storage= 0.09' , Surface Width= 4.54'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 29.31 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 1,250.6' Slope= 0.0120 '/'
Inlet Invert= 429.00', Outlet Invert= 414.00'

‡

Reach 3R: DITCH #1



Summary for Reach 5R: DITCH #2

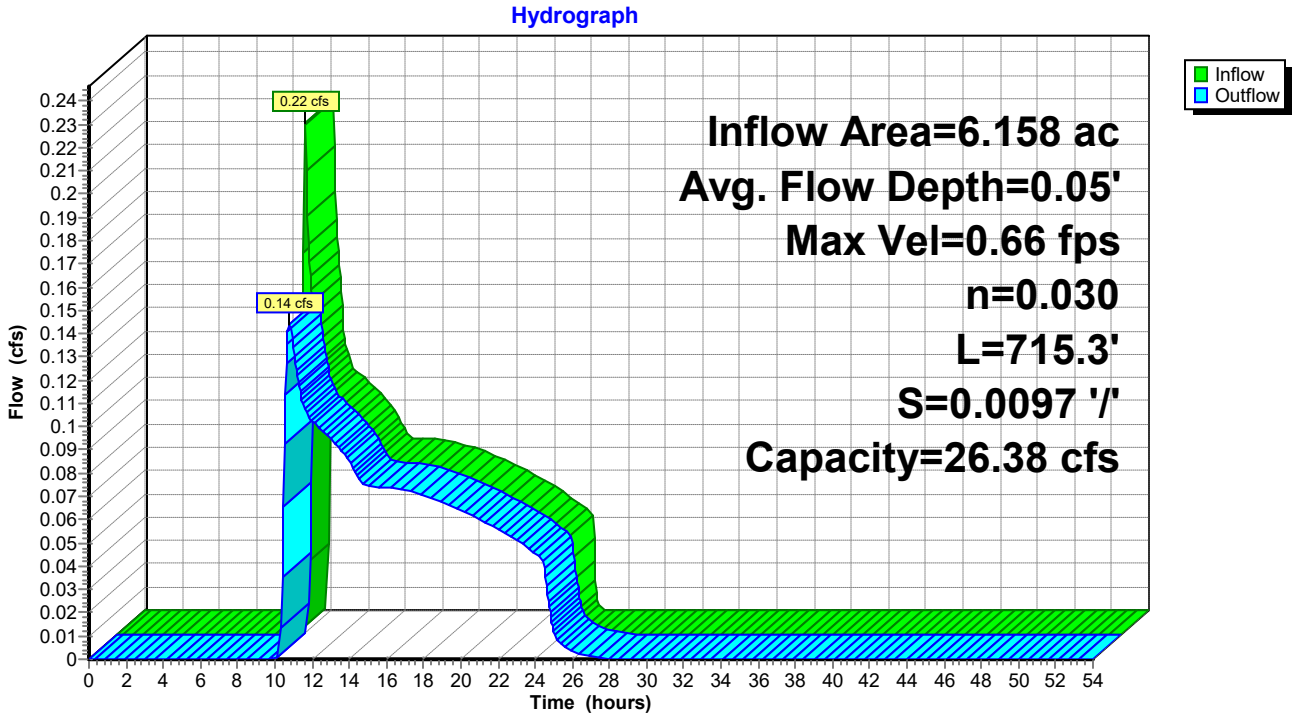
Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth = 0.17" for 1-yr, 24-hr event
Inflow = 0.22 cfs @ 10.14 hrs, Volume= 0.089 af
Outflow = 0.14 cfs @ 10.79 hrs, Volume= 0.089 af, Atten= 35%, Lag= 39.5 min
Routed to Reach 7R : CULVERT #1

Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.66 fps, Min. Travel Time= 17.9 min
Avg. Velocity = 0.43 fps, Avg. Travel Time= 27.8 min

Peak Storage= 155 cf @ 10.50 hrs
Average Depth at Peak Storage= 0.05' , Surface Width= 4.31'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 26.38 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 715.3' Slope= 0.0097 '/'
Inlet Invert= 429.00', Outlet Invert= 422.05'

‡



Summary for Reach 7R: CULVERT #1

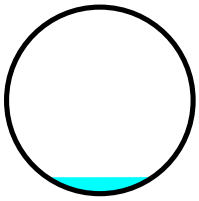
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 9.224 ac, 0.00% Impervious, Inflow Depth = 0.18" for 1-yr, 24-hr event
Inflow = 0.21 cfs @ 10.76 hrs, Volume= 0.139 af
Outflow = 0.21 cfs @ 10.77 hrs, Volume= 0.139 af, Atten= 0%, Lag= 0.7 min

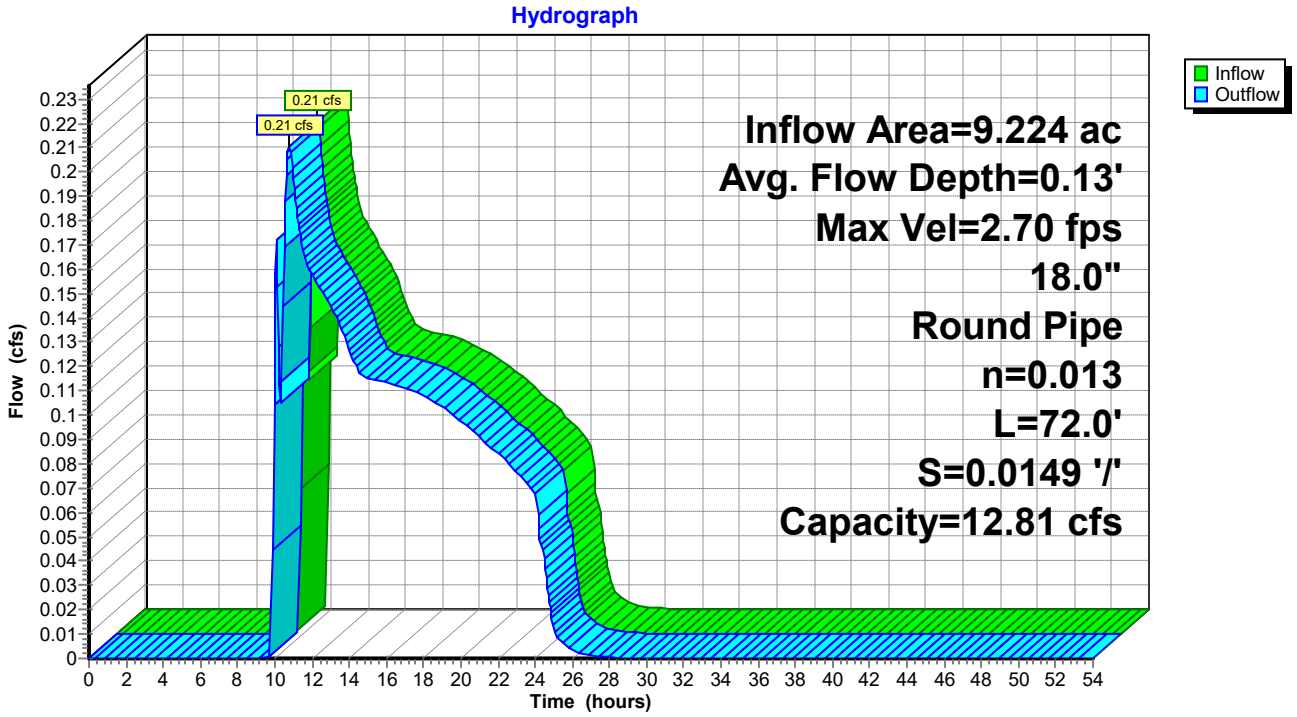
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.70 fps, Min. Travel Time= 0.4 min
Avg. Velocity = 1.85 fps, Avg. Travel Time= 0.6 min

Peak Storage= 6 cf @ 10.76 hrs
Average Depth at Peak Storage= 0.13' , Surface Width= 0.85'
Defined Flood Depth= 423.67' Flow Area= 85.9 sf, Capacity= -15,110.35 cfs
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 12.81 cfs

18.0" Round Pipe
n= 0.013
Length= 72.0' Slope= 0.0149 '/'
Inlet Invert= 415.95', Outlet Invert= 414.88'



Reach 7R: CULVERT #1



Summary for Pond 2P: POND

Inflow Area = 7.825 ac, 0.00% Impervious, Inflow Depth = 0.60" for 1-yr, 24-hr event
Inflow = 3.62 cfs @ 9.97 hrs, Volume= 0.388 af
Outflow = 0.01 cfs @ 24.17 hrs, Volume= 0.012 af, Atten= 100%, Lag= 852.2 min
Primary = 0.01 cfs @ 24.17 hrs, Volume= 0.012 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Peak Elev= 411.55' @ 24.17 hrs Surf.Area= 12,073 sf Storage= 16,875 cf
Flood Elev= 415.00' Surf.Area= 18,000 sf Storage= 68,443 cf

Plug-Flow detention time= 1,595.4 min calculated for 0.012 af (3% of inflow)
Center-of-Mass det. time= 1,280.9 min (2,098.6 - 817.7)

Volume	Invert	Avail.Storage	Storage Description
#1	410.00'	68,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

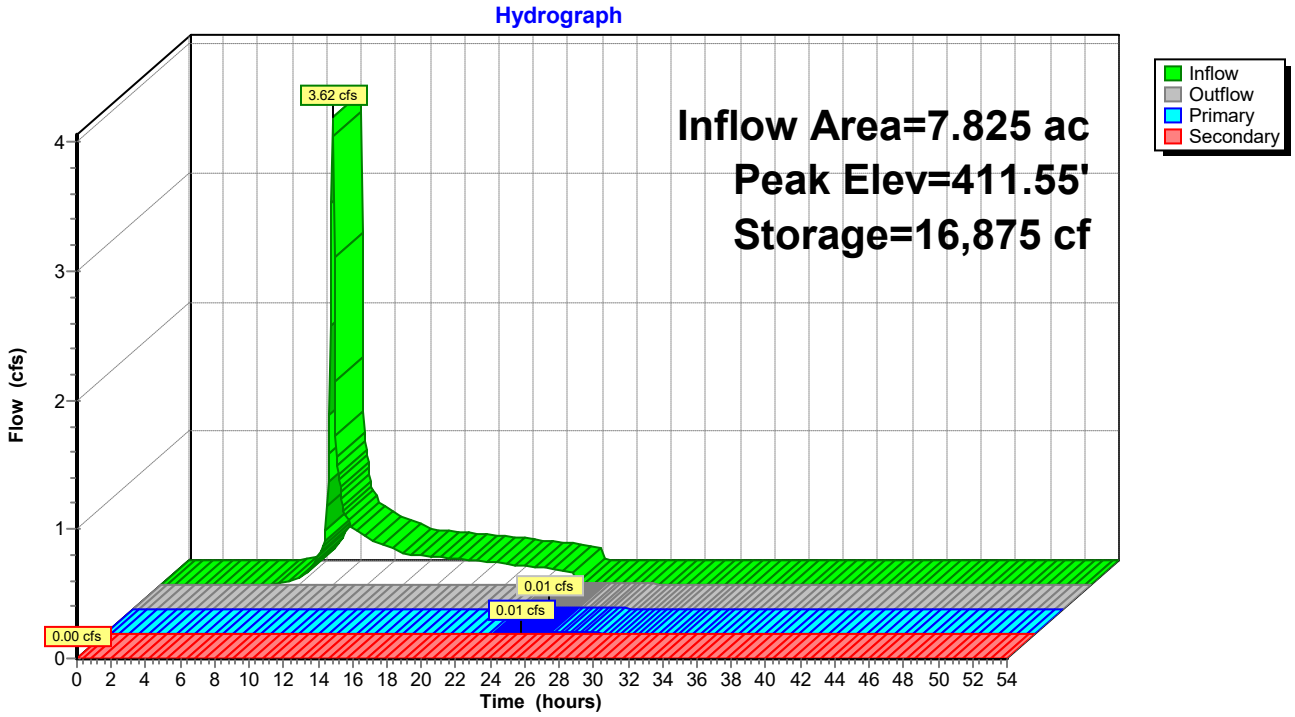
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
410.00	9,667	0	0
411.00	11,189	10,428	10,428
412.00	12,783	11,986	22,414
413.00	14,449	13,616	36,030
414.00	16,188	15,319	51,349
415.00	18,000	17,094	68,443

Device	Routing	Invert	Outlet Devices
#1	Primary	410.00'	**12.0" Round Culvert** L= 44.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 410.00' / 409.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	411.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	413.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	414.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 12.00 18.00

Primary OutFlow Max=0.01 cfs @ 24.17 hrs HW=411.55' (Free Discharge)
└**1=Culvert** (Passes 0.01 cfs of 3.07 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.01 cfs @ 0.79 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└**5=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 2P: POND


Hydrograph
Inflow Area=7.825 ac
Peak Elev=411.55'
Storage=16,875 cf
3.62 cfs
0.01 cfs
0.01 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0 1 2 3 4
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54

Time span=0.00-54.00 hrs, dt=0.05 hrs, 1081 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=340,869 sf 0.00% Impervious Runoff Depth=0.88"
Flow Length=683' Tc=6.2 min CN=92 Runoff=5.49 cfs 0.572 af

Subcatchment 2S: DRAINAGE AREA 2 Runoff Area=777,719 sf 0.00% Impervious Runoff Depth=0.33"
Flow Length=1,706' Tc=12.9 min CN=80 Runoff=2.43 cfs 0.492 af

Subcatchment 3S: DRAINAGE AREA 3 Runoff Area=268,223 sf 0.00% Impervious Runoff Depth=0.33"
Flow Length=1,354' Tc=14.1 min CN=80 Runoff=0.81 cfs 0.170 af

Subcatchment 4S: DRAINAGE AREA 4 Runoff Area=133,567 sf 0.00% Impervious Runoff Depth=0.36"
Flow Length=993' Tc=11.4 min CN=81 Runoff=0.53 cfs 0.093 af

Subcatchment 5S: DRAINAGE AREA 5 Runoff Area=101,061 sf 0.00% Impervious Runoff Depth=0.36"
Flow Length=495' Tc=9.4 min CN=81 Runoff=0.43 cfs 0.070 af

Reach 3R: DITCH #1 Avg. Flow Depth=0.21' Max Vel=1.74 fps Inflow=2.43 cfs 0.492 af
n=0.030 L=1,250.6' S=0.0120 '/' Capacity=29.31 cfs Outflow=1.67 cfs 0.492 af

Reach 5R: DITCH #2 Avg. Flow Depth=0.12' Max Vel=1.13 fps Inflow=0.81 cfs 0.170 af
n=0.030 L=715.3' S=0.0097 '/' Capacity=26.38 cfs Outflow=0.59 cfs 0.170 af

Reach 7R: CULVERT #1 Avg. Flow Depth=0.25' Max Vel=4.01 fps Inflow=0.79 cfs 0.262 af
18.0" Round Pipe n=0.013 L=72.0' S=0.0149 '/' Capacity=12.81 cfs Outflow=0.79 cfs 0.262 af

Pond 2P: POND Peak Elev=411.78' Storage=19,688 cf Inflow=5.49 cfs 0.572 af
Primary=0.21 cfs 0.192 af Secondary=0.00 cfs 0.000 af Outflow=0.21 cfs 0.192 af

Total Runoff Area = 37.223 ac Runoff Volume = 1.397 af Average Runoff Depth = 0.45"
100.00% Pervious = 37.223 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

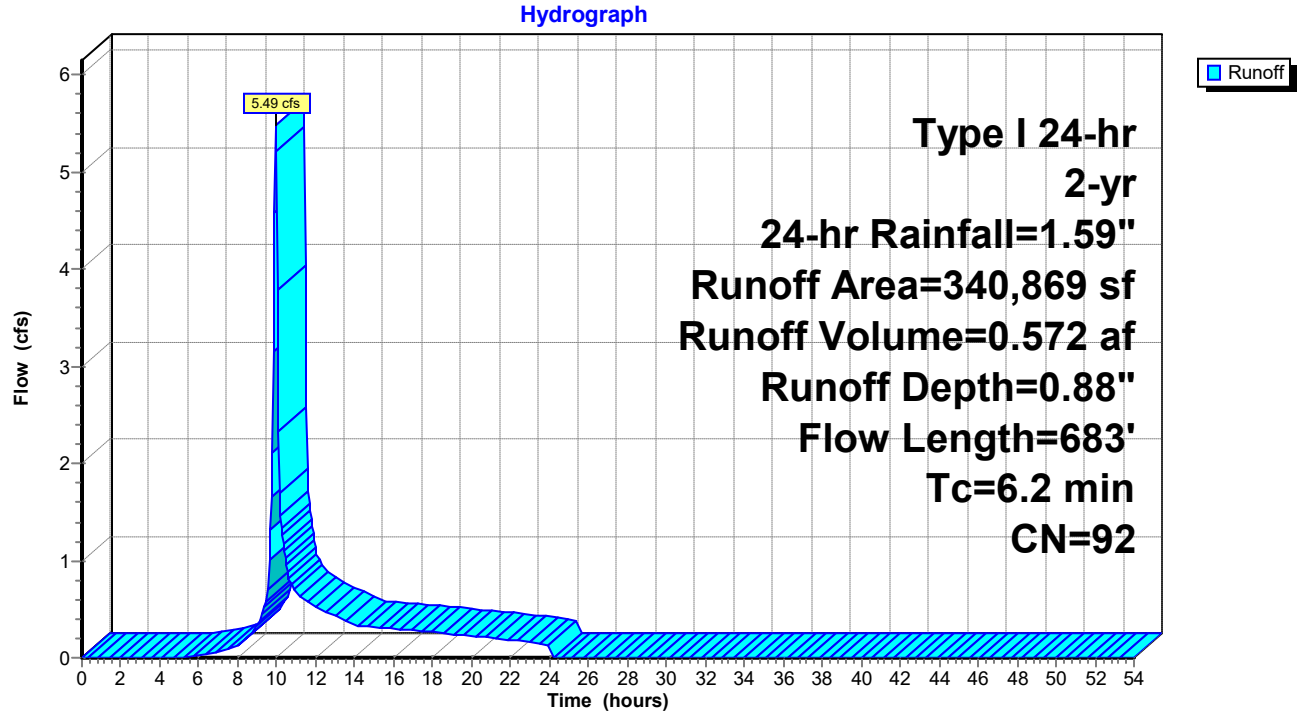
Runoff = 5.49 cfs @ 9.96 hrs, Volume= 0.572 af, Depth= 0.88"
Routed to Pond 2P : POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr, 24-hr Rainfall=1.59"

Area (sf)	CN	Description
257,425	96	Gravel surface, HSG D
83,444	80	>75% Grass cover, Good, HSG D
340,869	92	Weighted Average
340,869		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0200	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.59"
2.7	370	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	113	0.0444	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	100	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	683	Total			

Subcatchment 1S: DRAINAGE AREA 1



Summary for Subcatchment 2S: DRAINAGE AREA 2

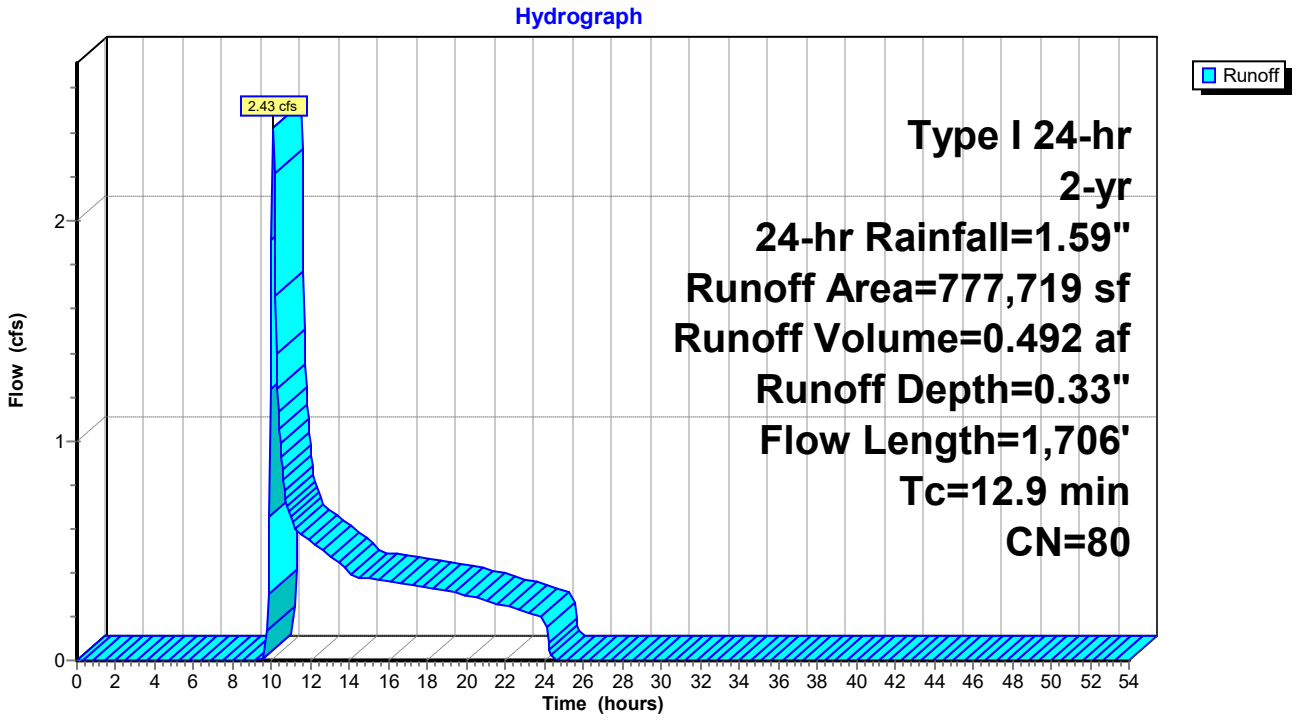
Runoff = 2.43 cfs @ 10.08 hrs, Volume= 0.492 af, Depth= 0.33"
Routed to Reach 3R : DITCH #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr, 24-hr Rainfall=1.59"

Area (sf)	CN	Description
777,719	80	Pasture/grassland/range, Good, HSG D
777,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
1.9	355	0.1905	3.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.7	1,251	0.0120	5.71	39.97	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=1.00' Z= 3.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
12.9	1,706	Total			

Subcatchment 2S: DRAINAGE AREA 2



Summary for Subcatchment 3S: DRAINAGE AREA 3

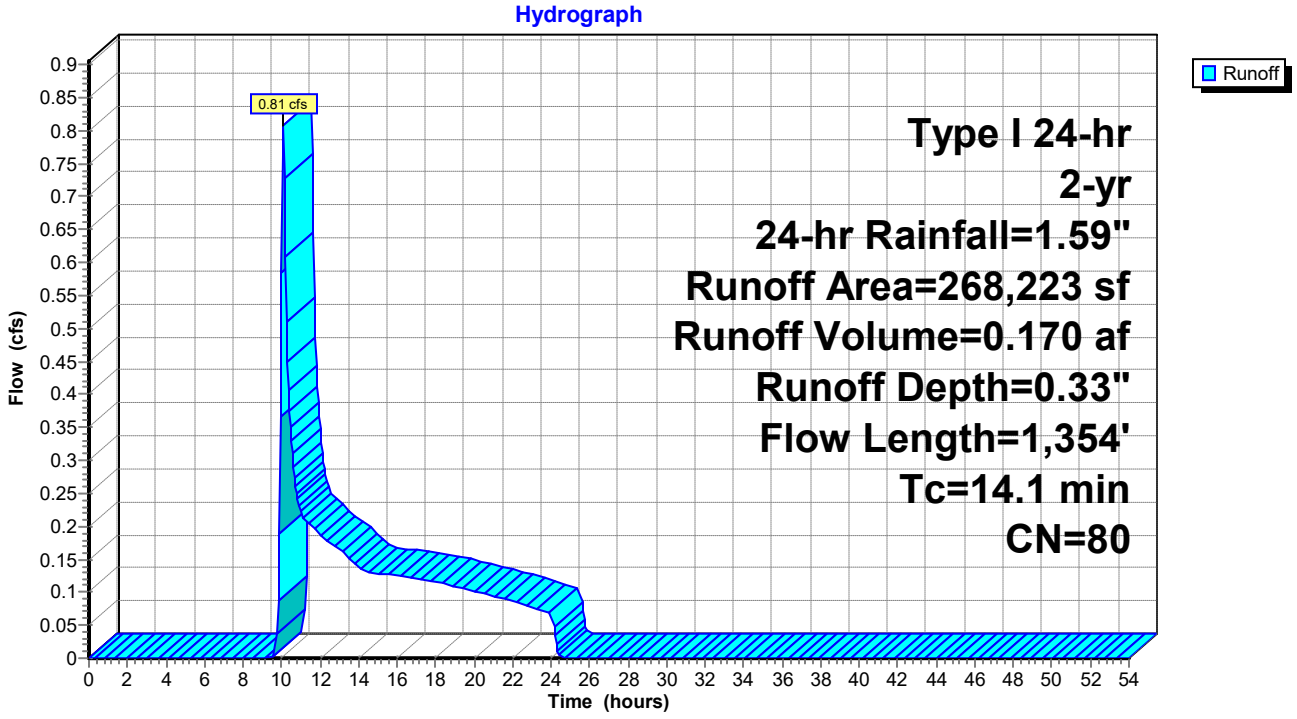
Runoff = 0.81 cfs @ 10.09 hrs, Volume= 0.170 af, Depth= 0.33"
Routed to Reach 5R : DITCH #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr, 24-hr Rainfall=1.59"

Area (sf)	CN	Description
268,223	80	Pasture/grassland/range, Good, HSG D
268,223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
3.6	550	0.1317	2.54		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	617	0.0090	4.23	19.82	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=0.75' Z= 3.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
0.8	87	0.0688	1.84		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.1	1,354	Total			

Subcatchment 3S: DRAINAGE AREA 3



Summary for Subcatchment 4S: DRAINAGE AREA 4

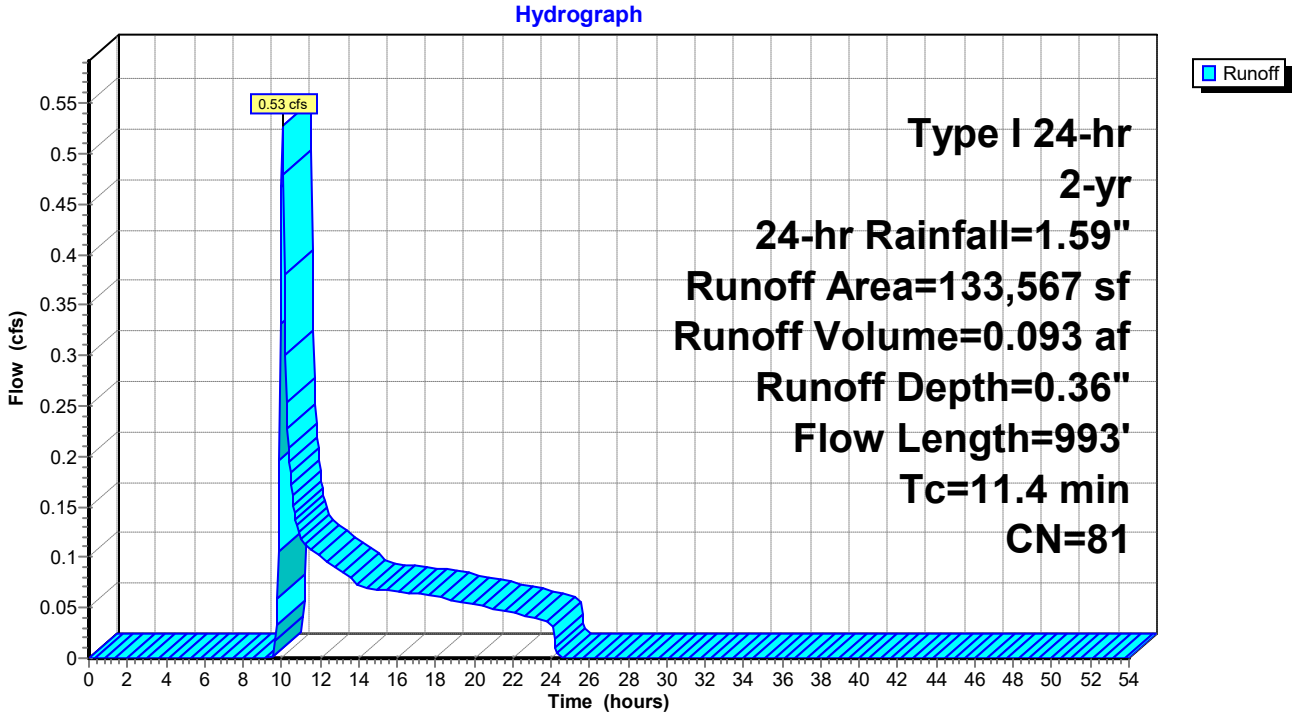
Runoff = 0.53 cfs @ 10.05 hrs, Volume= 0.093 af, Depth= 0.36"
Routed to Reach 7R : CULVERT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr, 24-hr Rainfall=1.59"

	Area (sf)	CN	Description
*	6,582	96	Gravel surface, HSG D
	126,985	80	Pasture/grassland/range, Good, HSG D
	133,567	81	Weighted Average
	133,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.1057	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.9	457	0.1389	2.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	436	0.0460	5.01	9.40	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 & 12.0 '/' Top.W=7.50' n= 0.025 Earth, clean & winding
11.4	993	Total			

Subcatchment 4S: DRAINAGE AREA 4



Summary for Subcatchment 5S: DRAINAGE AREA 5

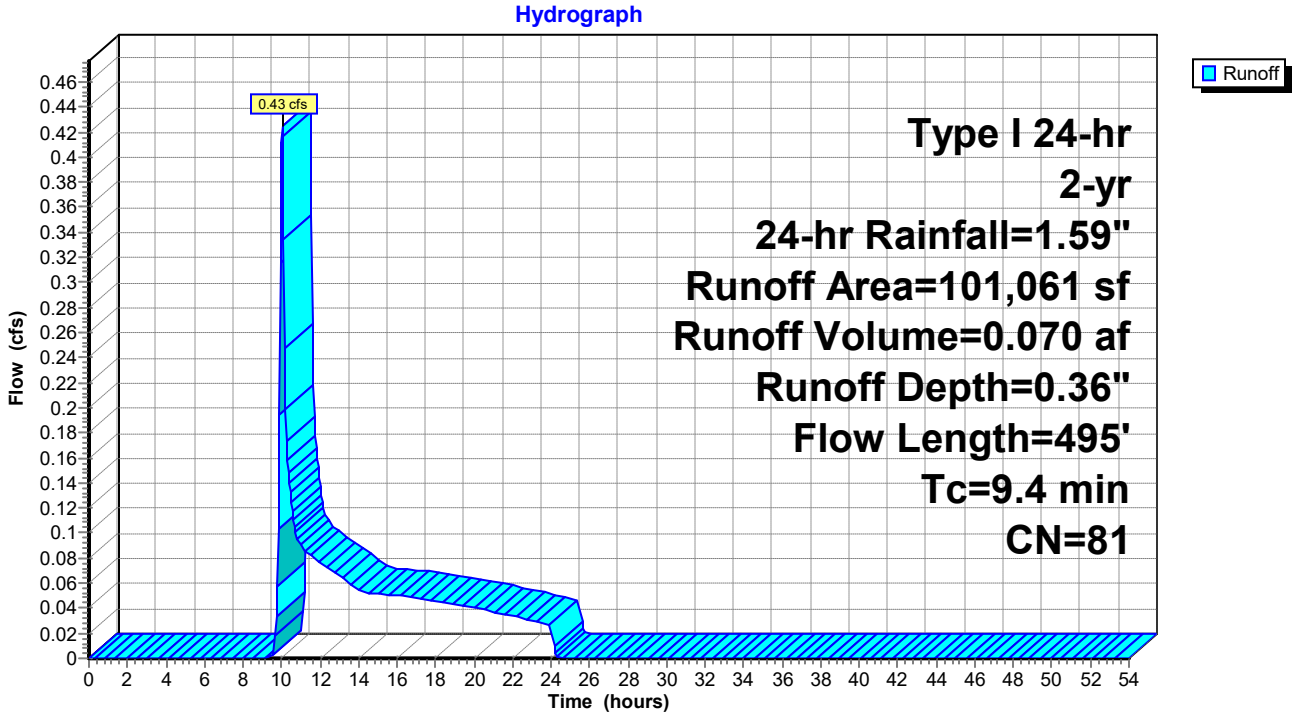
Runoff = 0.43 cfs @ 10.03 hrs, Volume= 0.070 af, Depth= 0.36"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 2-yr, 24-hr Rainfall=1.59"

	Area (sf)	CN	Description
*	7,957	96	Gravel surface, HSG D
	93,104	80	Pasture/grassland/range, Good, HSG D
	101,061	81	Weighted Average
	101,061		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	100	0.1177	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.6	395	0.1348	2.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	495	Total			

Subcatchment 5S: DRAINAGE AREA 5



Summary for Reach 3R: DITCH #1

Inflow Area = 17.854 ac, 0.00% Impervious, Inflow Depth = 0.33" for 2-yr, 24-hr event
Inflow = 2.43 cfs @ 10.08 hrs, Volume= 0.492 af
Outflow = 1.67 cfs @ 10.41 hrs, Volume= 0.492 af, Atten= 31%, Lag= 20.0 min

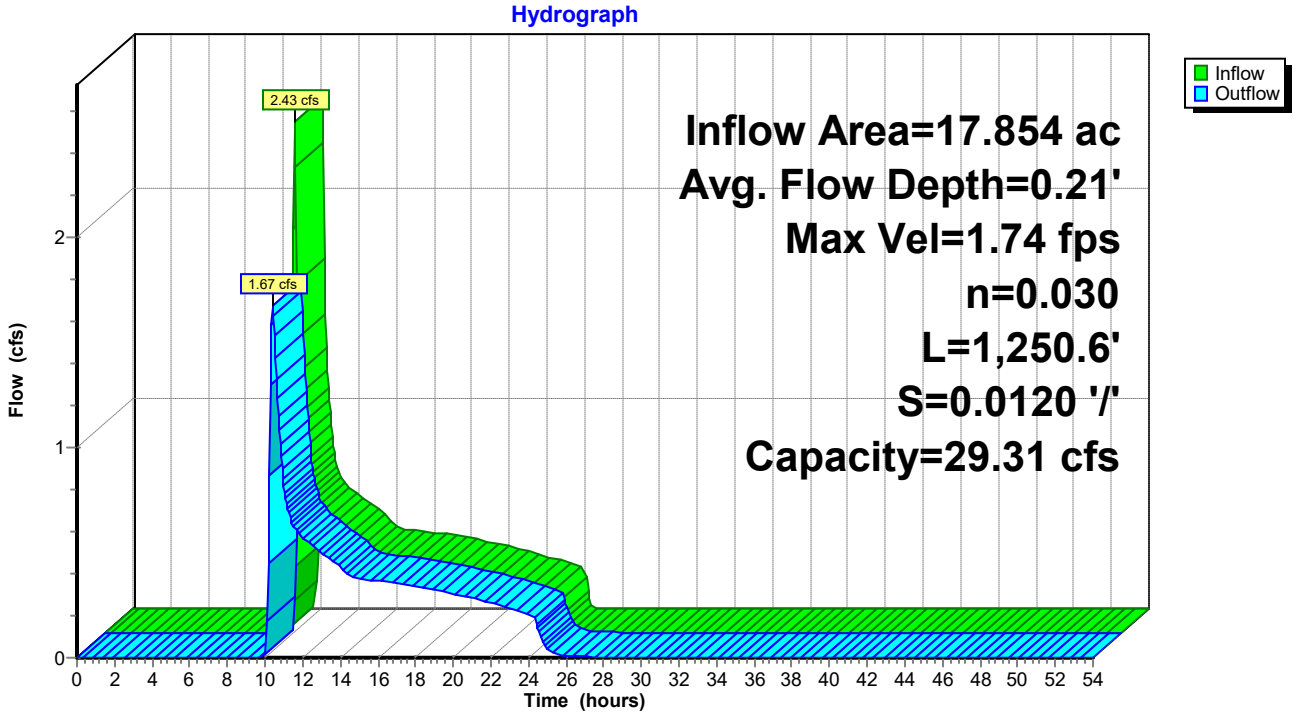
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.74 fps, Min. Travel Time= 12.0 min
Avg. Velocity = 0.72 fps, Avg. Travel Time= 29.1 min

Peak Storage= 1,203 cf @ 10.21 hrs
Average Depth at Peak Storage= 0.21' , Surface Width= 5.25'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 29.31 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 1,250.6' Slope= 0.0120 '/'
Inlet Invert= 429.00', Outlet Invert= 414.00'

‡

Reach 3R: DITCH #1



Summary for Reach 5R: DITCH #2

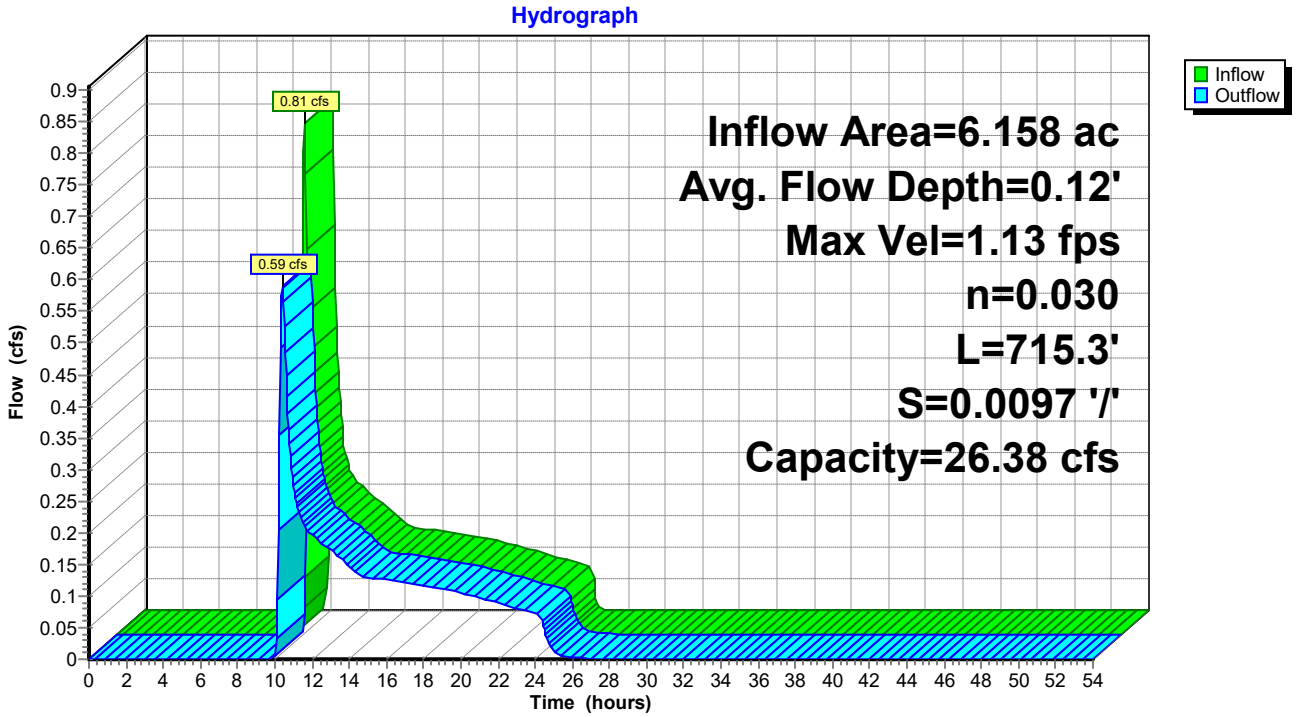
Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth = 0.33" for 2-yr, 24-hr event
Inflow = 0.81 cfs @ 10.09 hrs, Volume= 0.170 af
Outflow = 0.59 cfs @ 10.39 hrs, Volume= 0.170 af, Atten= 27%, Lag= 18.1 min
Routed to Reach 7R : CULVERT #1

Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.13 fps, Min. Travel Time= 10.6 min
Avg. Velocity = 0.52 fps, Avg. Travel Time= 22.9 min

Peak Storage= 378 cf @ 10.21 hrs
Average Depth at Peak Storage= 0.12' , Surface Width= 4.73'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 26.38 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 715.3' Slope= 0.0097 '/'
Inlet Invert= 429.00', Outlet Invert= 422.05'

‡



Summary for Reach 7R: CULVERT #1

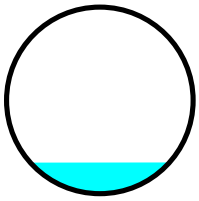
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 9.224 ac, 0.00% Impervious, Inflow Depth = 0.34" for 2-yr, 24-hr event
Inflow = 0.79 cfs @ 10.38 hrs, Volume= 0.262 af
Outflow = 0.79 cfs @ 10.39 hrs, Volume= 0.262 af, Atten= 0%, Lag= 0.7 min

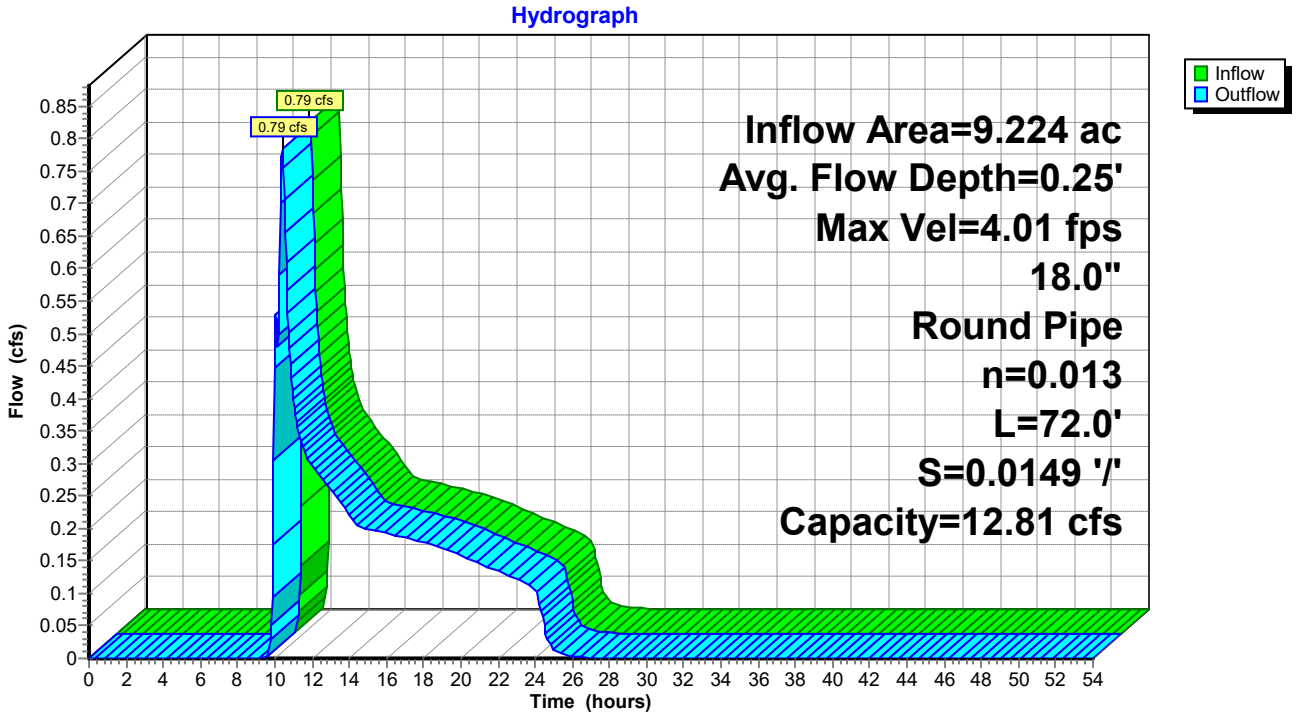
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 4.01 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 2.17 fps, Avg. Travel Time= 0.6 min

Peak Storage= 14 cf @ 10.38 hrs
Average Depth at Peak Storage= 0.25' , Surface Width= 1.12'
Defined Flood Depth= 423.67' Flow Area= 85.9 sf, Capacity= -15,110.35 cfs
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 12.81 cfs

18.0" Round Pipe
n= 0.013
Length= 72.0' Slope= 0.0149 '/'
Inlet Invert= 415.95', Outlet Invert= 414.88'



Reach 7R: CULVERT #1



Summary for Pond 2P: POND

Inflow Area = 7.825 ac, 0.00% Impervious, Inflow Depth = 0.88" for 2-yr, 24-hr event
Inflow = 5.49 cfs @ 9.96 hrs, Volume= 0.572 af
Outflow = 0.21 cfs @ 20.71 hrs, Volume= 0.192 af, Atten= 96%, Lag= 644.5 min
Primary = 0.21 cfs @ 20.71 hrs, Volume= 0.192 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Peak Elev= 411.78' @ 20.71 hrs Surf.Area= 12,438 sf Storage= 19,688 cf
Flood Elev= 415.00' Surf.Area= 18,000 sf Storage= 68,443 cf

Plug-Flow detention time= 840.4 min calculated for 0.192 af (34% of inflow)
Center-of-Mass det. time= 617.3 min (1,417.4 - 800.1)

Volume	Invert	Avail.Storage	Storage Description
#1	410.00'	68,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

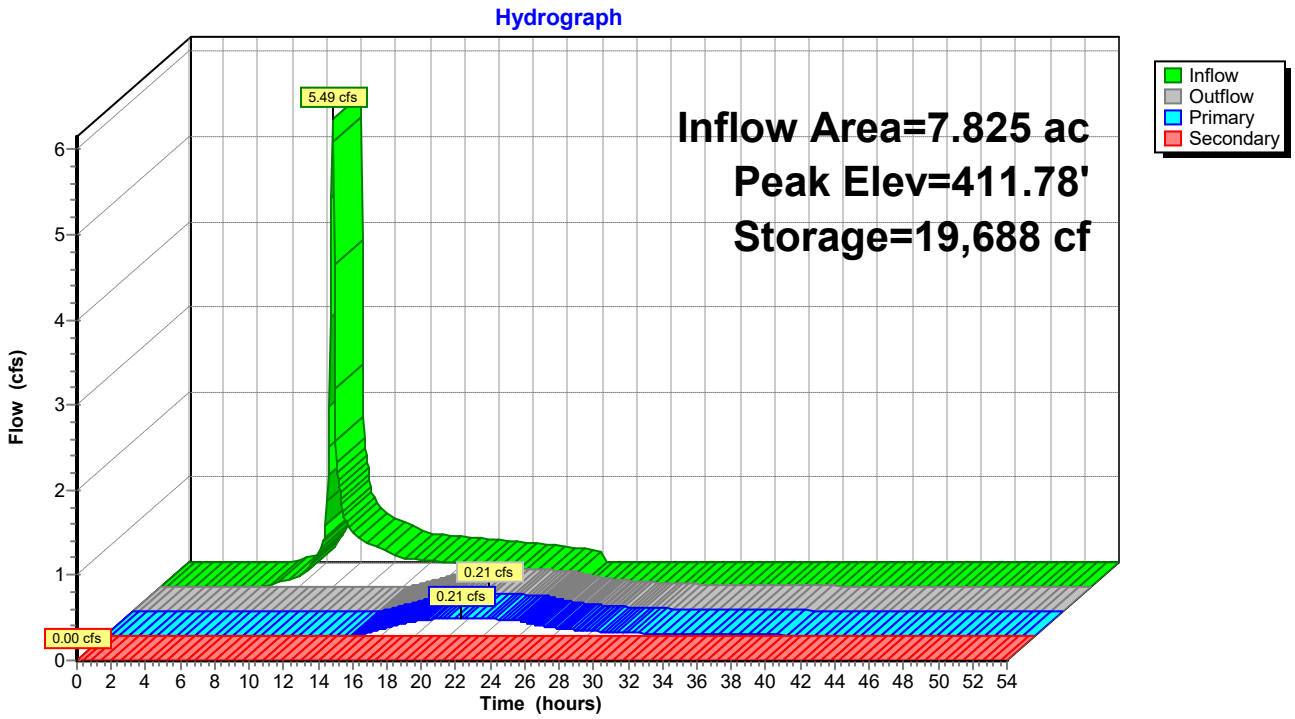
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
410.00	9,667	0	0
411.00	11,189	10,428	10,428
412.00	12,783	11,986	22,414
413.00	14,449	13,616	36,030
414.00	16,188	15,319	51,349
415.00	18,000	17,094	68,443

Device	Routing	Invert	Outlet Devices
#1	Primary	410.00'	**12.0" Round Culvert** L= 44.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 410.00' / 409.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	411.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	413.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	414.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 12.00 18.00

Primary OutFlow Max=0.21 cfs @ 20.71 hrs HW=411.78' (Free Discharge)
└**1=Culvert** (Passes 0.21 cfs of 3.38 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.21 cfs @ 1.81 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└**5=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 2P: POND


Hydrograph
Inflow Area=7.825 ac
Peak Elev=411.78'
Storage=19,688 cf
5.49 cfs
0.21 cfs
0.21 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54
0 1 2 3 4 5 6

Time span=0.00-54.00 hrs, dt=0.05 hrs, 1081 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=340,869 sf 0.00% Impervious Runoff Depth=1.65"
Flow Length=683' Tc=6.2 min CN=92 Runoff=10.53 cfs 1.074 af

Subcatchment 2S: DRAINAGE AREA 2 Runoff Area=777,719 sf 0.00% Impervious Runoff Depth=0.85"
Flow Length=1,706' Tc=12.9 min CN=80 Runoff=8.96 cfs 1.271 af

Subcatchment 3S: DRAINAGE AREA 3 Runoff Area=268,223 sf 0.00% Impervious Runoff Depth=0.85"
Flow Length=1,354' Tc=14.1 min CN=80 Runoff=2.98 cfs 0.438 af

Subcatchment 4S: DRAINAGE AREA 4 Runoff Area=133,567 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=993' Tc=11.4 min CN=81 Runoff=1.75 cfs 0.232 af

Subcatchment 5S: DRAINAGE AREA 5 Runoff Area=101,061 sf 0.00% Impervious Runoff Depth=0.91"
Flow Length=495' Tc=9.4 min CN=81 Runoff=1.40 cfs 0.175 af

Reach 3R: DITCH #1 Avg. Flow Depth=0.49' Max Vel=2.82 fps Inflow=8.96 cfs 1.271 af
n=0.030 L=1,250.6' S=0.0120 '/' Capacity=29.31 cfs Outflow=7.43 cfs 1.271 af

Reach 5R: DITCH #2 Avg. Flow Depth=0.29' Max Vel=1.88 fps Inflow=2.98 cfs 0.438 af
n=0.030 L=715.3' S=0.0097 '/' Capacity=26.38 cfs Outflow=2.61 cfs 0.438 af

Reach 7R: CULVERT #1 Avg. Flow Depth=0.53' Max Vel=6.11 fps Inflow=3.38 cfs 0.670 af
18.0" Round Pipe n=0.013 L=72.0' S=0.0149 '/' Capacity=12.81 cfs Outflow=3.38 cfs 0.670 af

Pond 2P: POND Peak Elev=412.19' Storage=24,912 cf Inflow=10.53 cfs 1.074 af
Primary=0.63 cfs 0.693 af Secondary=0.00 cfs 0.000 af Outflow=0.63 cfs 0.693 af

Total Runoff Area = 37.223 ac Runoff Volume = 3.191 af Average Runoff Depth = 1.03"
100.00% Pervious = 37.223 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

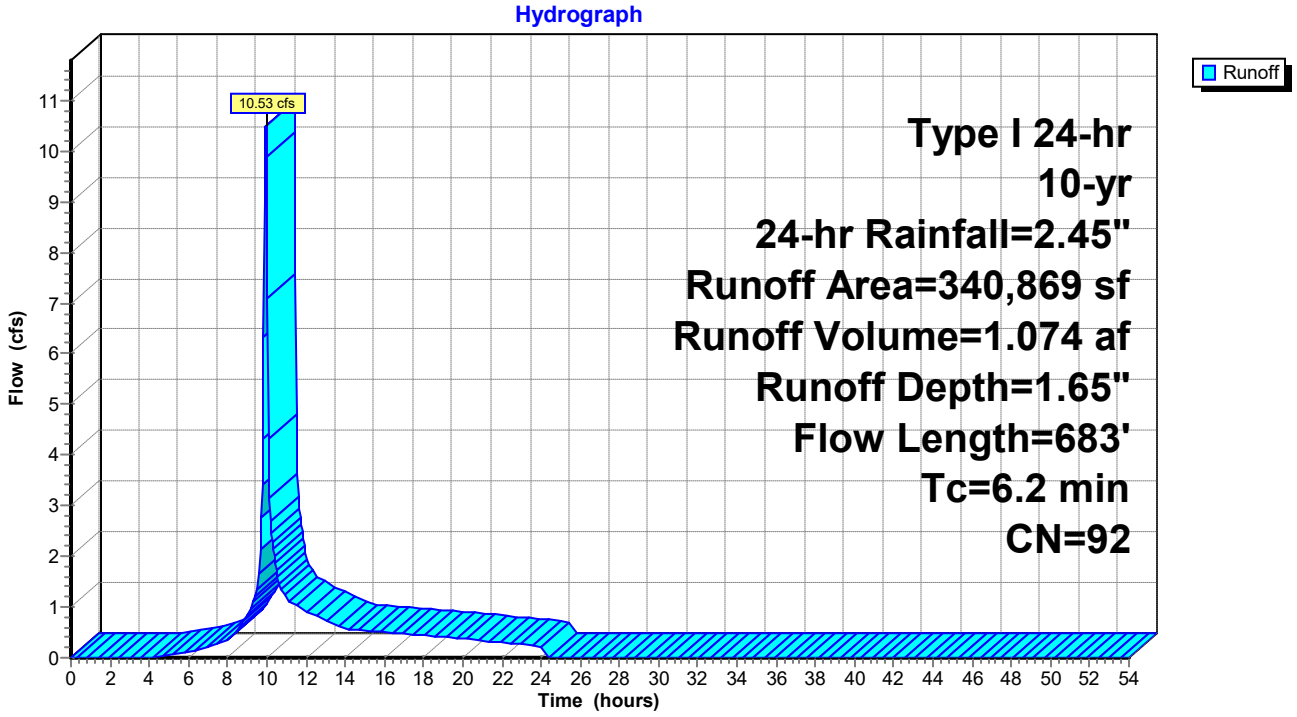
Runoff = 10.53 cfs @ 9.96 hrs, Volume= 1.074 af, Depth= 1.65"
Routed to Pond 2P : POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 10-yr, 24-hr Rainfall=2.45"

Area (sf)	CN	Description
257,425	96	Gravel surface, HSG D
83,444	80	>75% Grass cover, Good, HSG D
340,869	92	Weighted Average
340,869		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0200	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.59"
2.7	370	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	113	0.0444	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	100	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	683	Total			

Subcatchment 1S: DRAINAGE AREA 1



Summary for Subcatchment 2S: DRAINAGE AREA 2

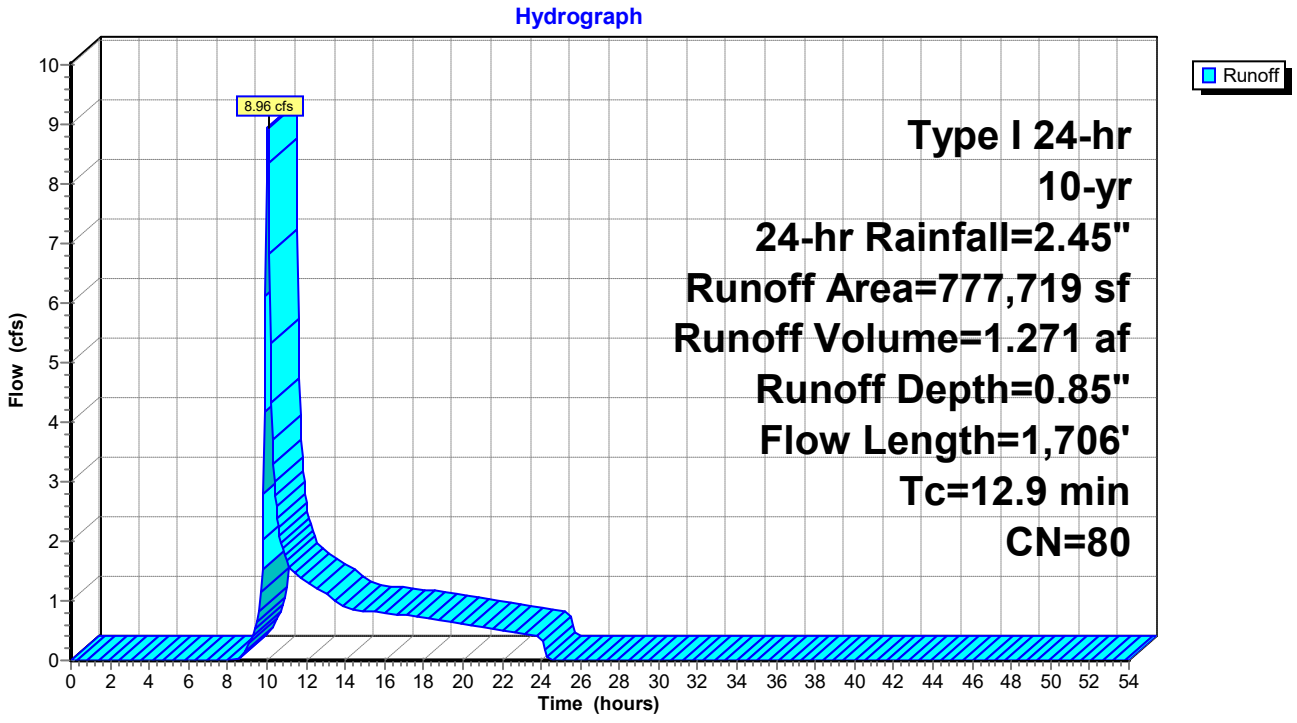
Runoff = 8.96 cfs @ 10.06 hrs, Volume= 1.271 af, Depth= 0.85"
Routed to Reach 3R : DITCH #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 10-yr, 24-hr Rainfall=2.45"

Area (sf)	CN	Description
777,719	80	Pasture/grassland/range, Good, HSG D
777,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
1.9	355	0.1905	3.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.7	1,251	0.0120	5.71	39.97	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=1.00' Z= 3.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
12.9	1,706	Total			

Subcatchment 2S: DRAINAGE AREA 2



Summary for Subcatchment 3S: DRAINAGE AREA 3

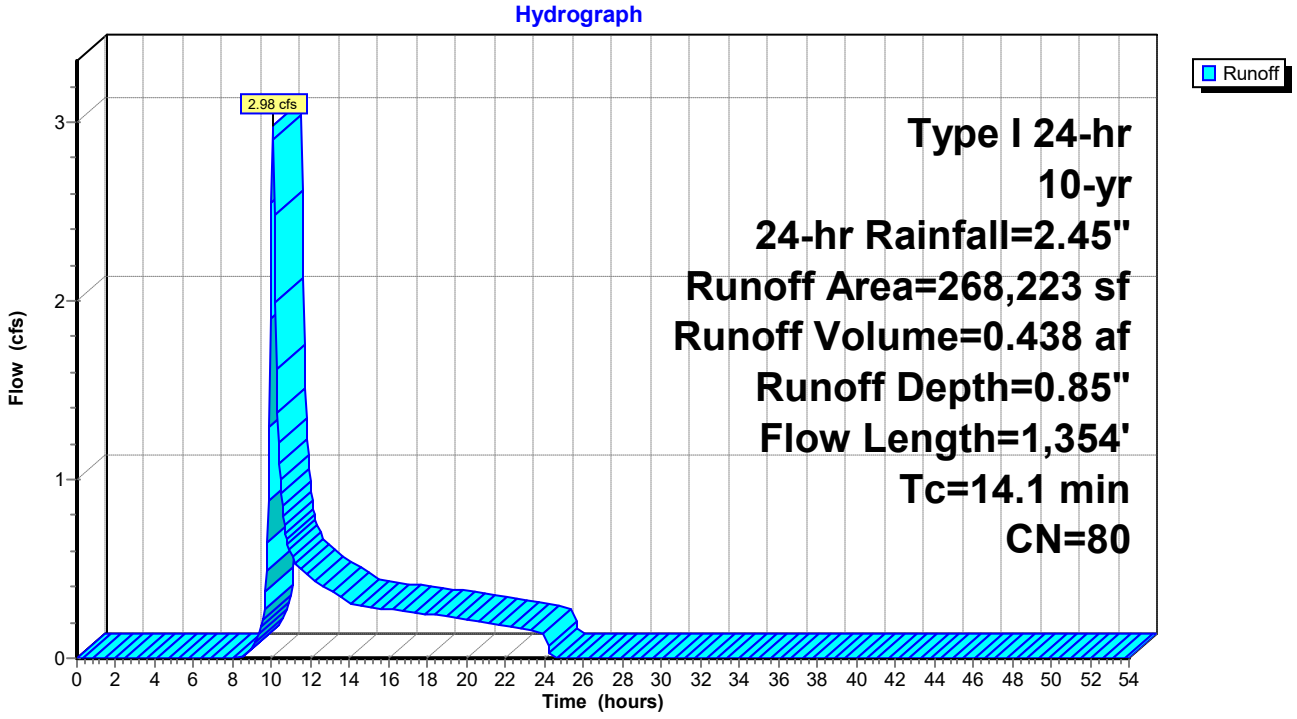
Runoff = 2.98 cfs @ 10.07 hrs, Volume= 0.438 af, Depth= 0.85"
Routed to Reach 5R : DITCH #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 10-yr, 24-hr Rainfall=2.45"

Area (sf)	CN	Description
268,223	80	Pasture/grassland/range, Good, HSG D
268,223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
3.6	550	0.1317	2.54		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	617	0.0090	4.23	19.82	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=0.75' Z= 3.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
0.8	87	0.0688	1.84		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.1	1,354	Total			

Subcatchment 3S: DRAINAGE AREA 3



Summary for Subcatchment 4S: DRAINAGE AREA 4

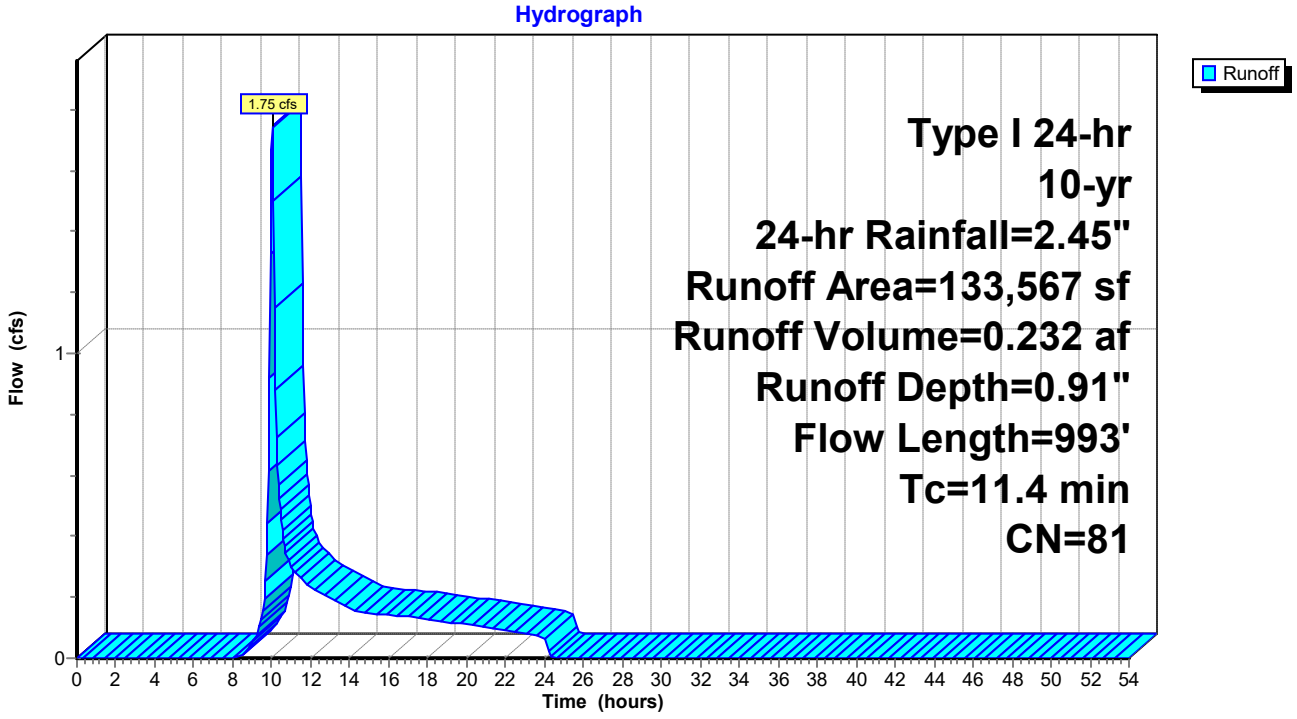
Runoff = 1.75 cfs @ 10.04 hrs, Volume= 0.232 af, Depth= 0.91"
Routed to Reach 7R : CULVERT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 10-yr, 24-hr Rainfall=2.45"

	Area (sf)	CN	Description
*	6,582	96	Gravel surface, HSG D
	126,985	80	Pasture/grassland/range, Good, HSG D
	133,567	81	Weighted Average
	133,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.1057	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.9	457	0.1389	2.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	436	0.0460	5.01	9.40	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 & 12.0 '/' Top.W=7.50' n= 0.025 Earth, clean & winding
11.4	993	Total			

Subcatchment 4S: DRAINAGE AREA 4



Summary for Subcatchment 5S: DRAINAGE AREA 5

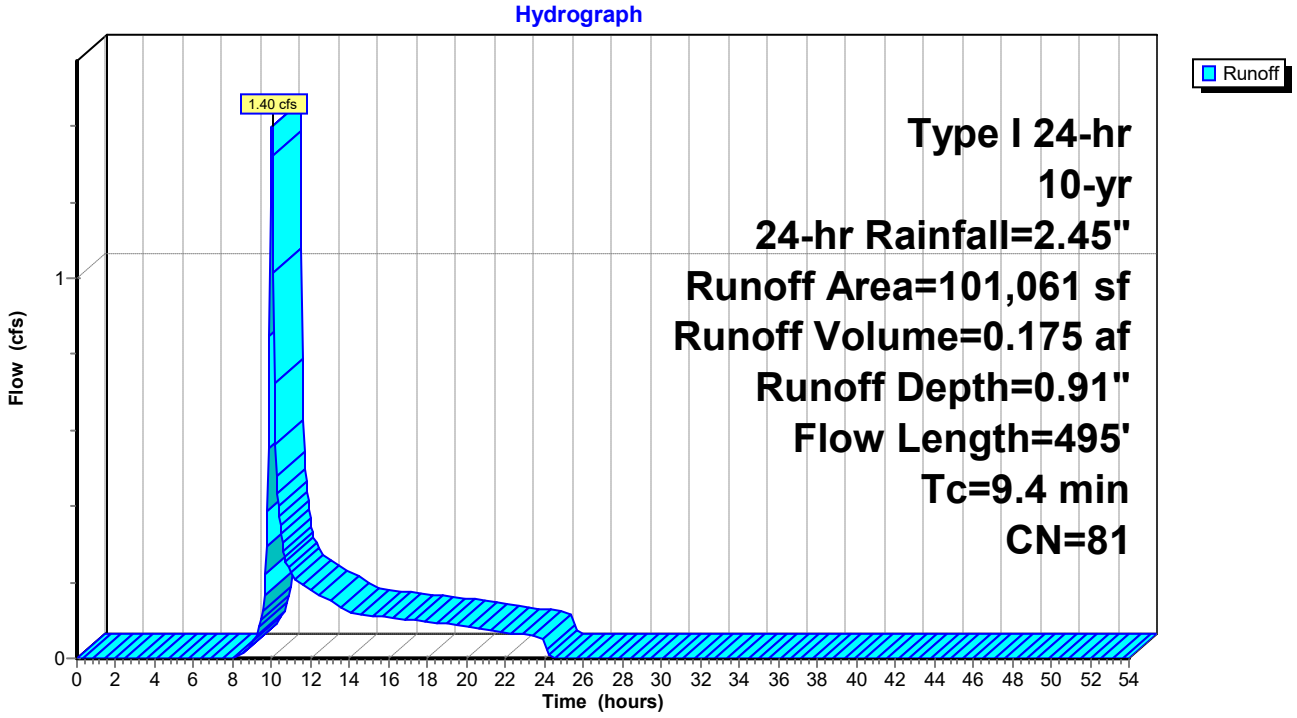
Runoff = 1.40 cfs @ 10.01 hrs, Volume= 0.175 af, Depth= 0.91"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 10-yr, 24-hr Rainfall=2.45"

	Area (sf)	CN	Description
*	7,957	96	Gravel surface, HSG D
	93,104	80	Pasture/grassland/range, Good, HSG D
	101,061	81	Weighted Average
	101,061		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	100	0.1177	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.6	395	0.1348	2.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	495	Total			

Subcatchment 5S: DRAINAGE AREA 5



Summary for Reach 3R: DITCH #1

Inflow Area = 17.854 ac, 0.00% Impervious, Inflow Depth = 0.85" for 10-yr, 24-hr event
Inflow = 8.96 cfs @ 10.06 hrs, Volume= 1.271 af
Outflow = 7.43 cfs @ 10.26 hrs, Volume= 1.271 af, Atten= 17%, Lag= 12.1 min

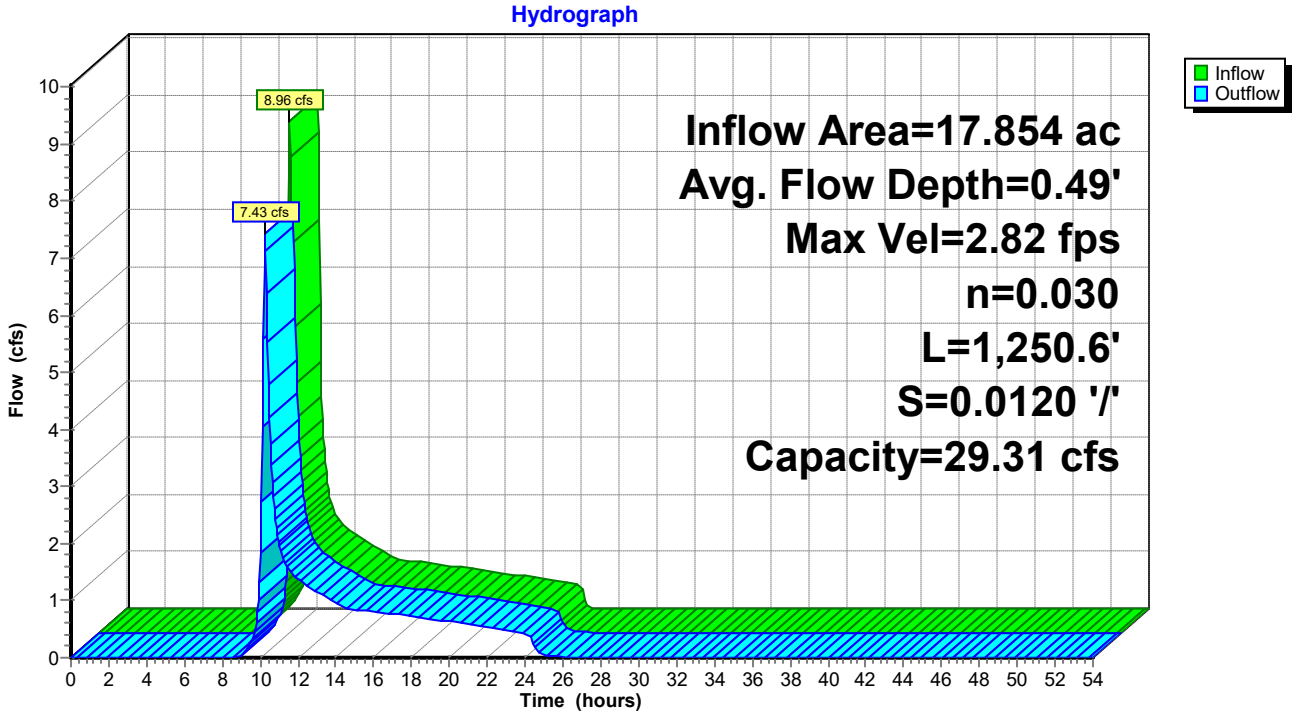
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.82 fps, Min. Travel Time= 7.4 min
Avg. Velocity = 0.92 fps, Avg. Travel Time= 22.5 min

Peak Storage= 3,327 cf @ 10.13 hrs
Average Depth at Peak Storage= 0.49' , Surface Width= 6.92'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 29.31 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 1,250.6' Slope= 0.0120 '/'
Inlet Invert= 429.00', Outlet Invert= 414.00'

‡

Reach 3R: DITCH #1



Summary for Reach 5R: DITCH #2

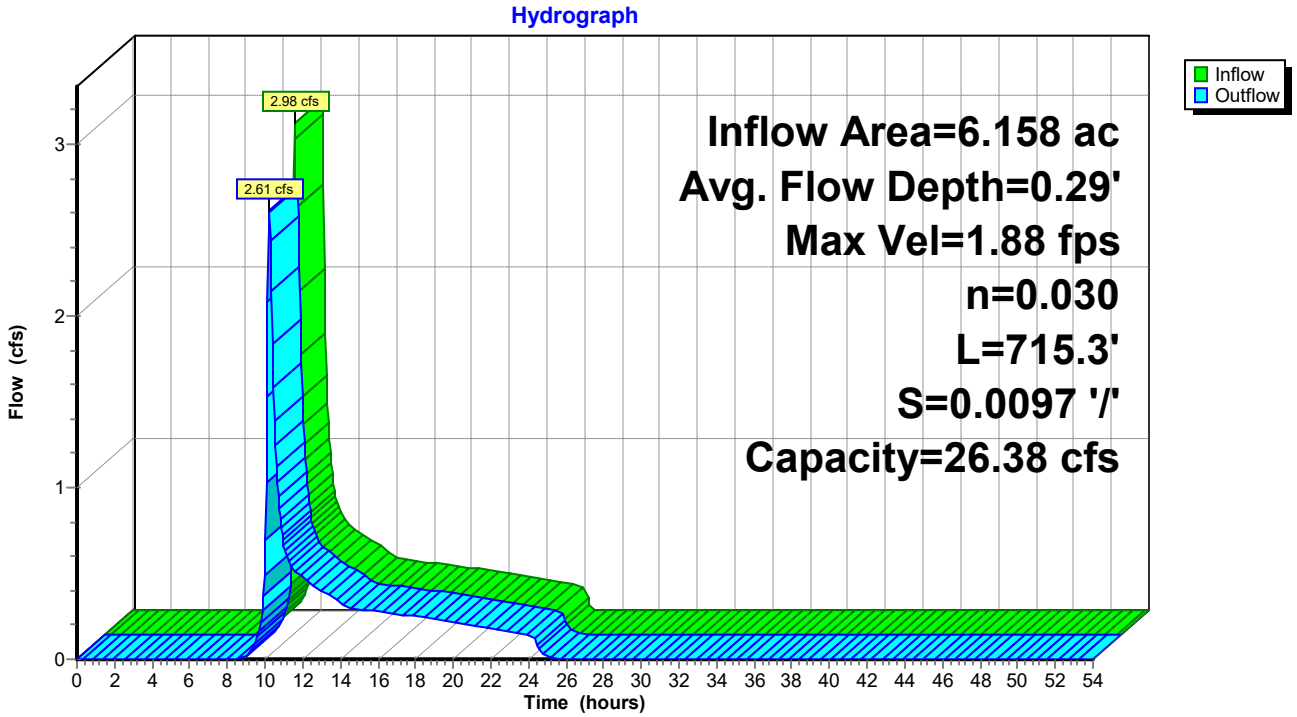
Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth = 0.85" for 10-yr, 24-hr event
Inflow = 2.98 cfs @ 10.07 hrs, Volume= 0.438 af
Outflow = 2.61 cfs @ 10.25 hrs, Volume= 0.438 af, Atten= 12%, Lag= 10.6 min
Routed to Reach 7R : CULVERT #1

Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.88 fps, Min. Travel Time= 6.3 min
Avg. Velocity = 0.68 fps, Avg. Travel Time= 17.6 min

Peak Storage= 997 cf @ 10.14 hrs
Average Depth at Peak Storage= 0.29' , Surface Width= 5.72'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 26.38 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 715.3' Slope= 0.0097 '/'
Inlet Invert= 429.00', Outlet Invert= 422.05'

‡



Summary for Reach 7R: CULVERT #1

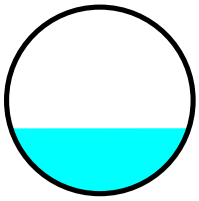
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 9.224 ac, 0.00% Impervious, Inflow Depth = 0.87" for 10-yr, 24-hr event
Inflow = 3.38 cfs @ 10.21 hrs, Volume= 0.670 af
Outflow = 3.38 cfs @ 10.22 hrs, Volume= 0.670 af, Atten= 0%, Lag= 0.3 min

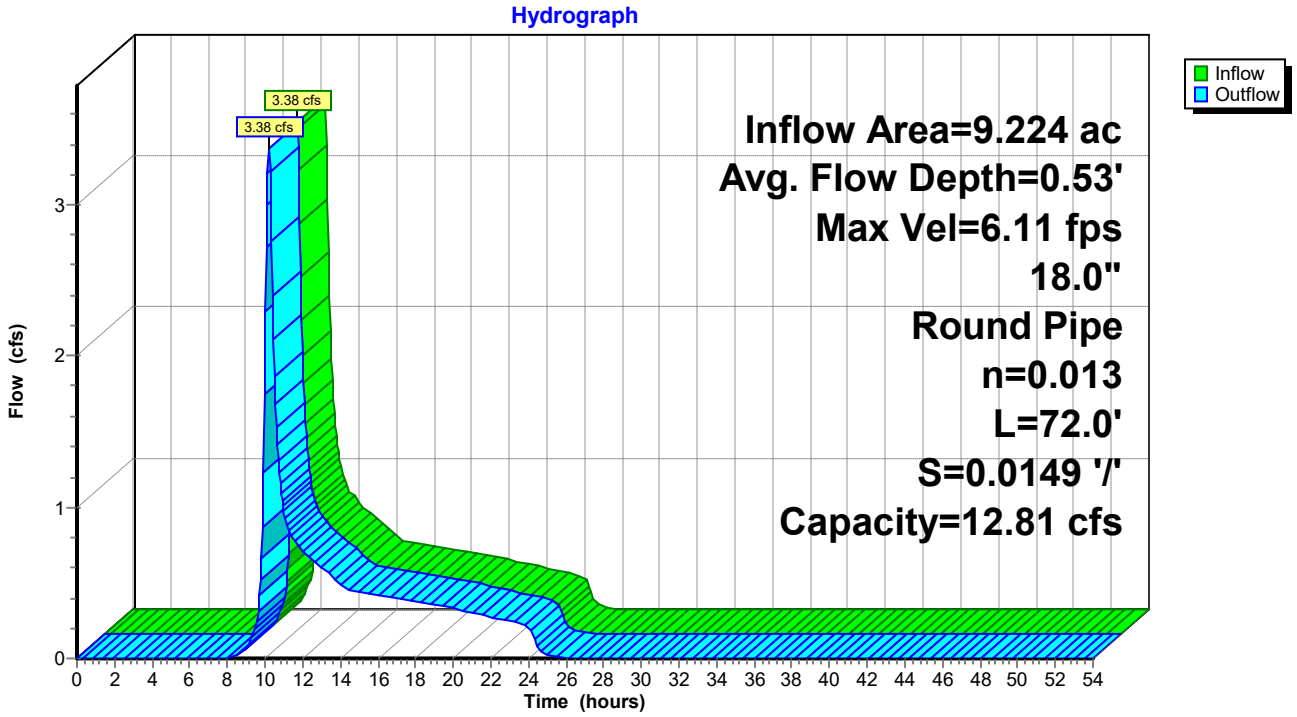
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.11 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.67 fps, Avg. Travel Time= 0.5 min

Peak Storage= 40 cf @ 10.22 hrs
Average Depth at Peak Storage= 0.53' , Surface Width= 1.43'
Defined Flood Depth= 423.67' Flow Area= 85.9 sf, Capacity= -15,110.35 cfs
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 12.81 cfs

18.0" Round Pipe
n= 0.013
Length= 72.0' Slope= 0.0149 '/'
Inlet Invert= 415.95', Outlet Invert= 414.88'



Reach 7R: CULVERT #1



Summary for Pond 2P: POND

Inflow Area = 7.825 ac, 0.00% Impervious, Inflow Depth = 1.65" for 10-yr, 24-hr event
Inflow = 10.53 cfs @ 9.96 hrs, Volume= 1.074 af
Outflow = 0.63 cfs @ 13.71 hrs, Volume= 0.693 af, Atten= 94%, Lag= 225.1 min
Primary = 0.63 cfs @ 13.71 hrs, Volume= 0.693 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Peak Elev= 412.19' @ 13.71 hrs Surf.Area= 13,105 sf Storage= 24,912 cf
Flood Elev= 415.00' Surf.Area= 18,000 sf Storage= 68,443 cf

Plug-Flow detention time= 509.4 min calculated for 0.693 af (65% of inflow)
Center-of-Mass det. time= 347.1 min (1,119.9 - 772.7)

Volume	Invert	Avail.Storage	Storage Description
#1	410.00'	68,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

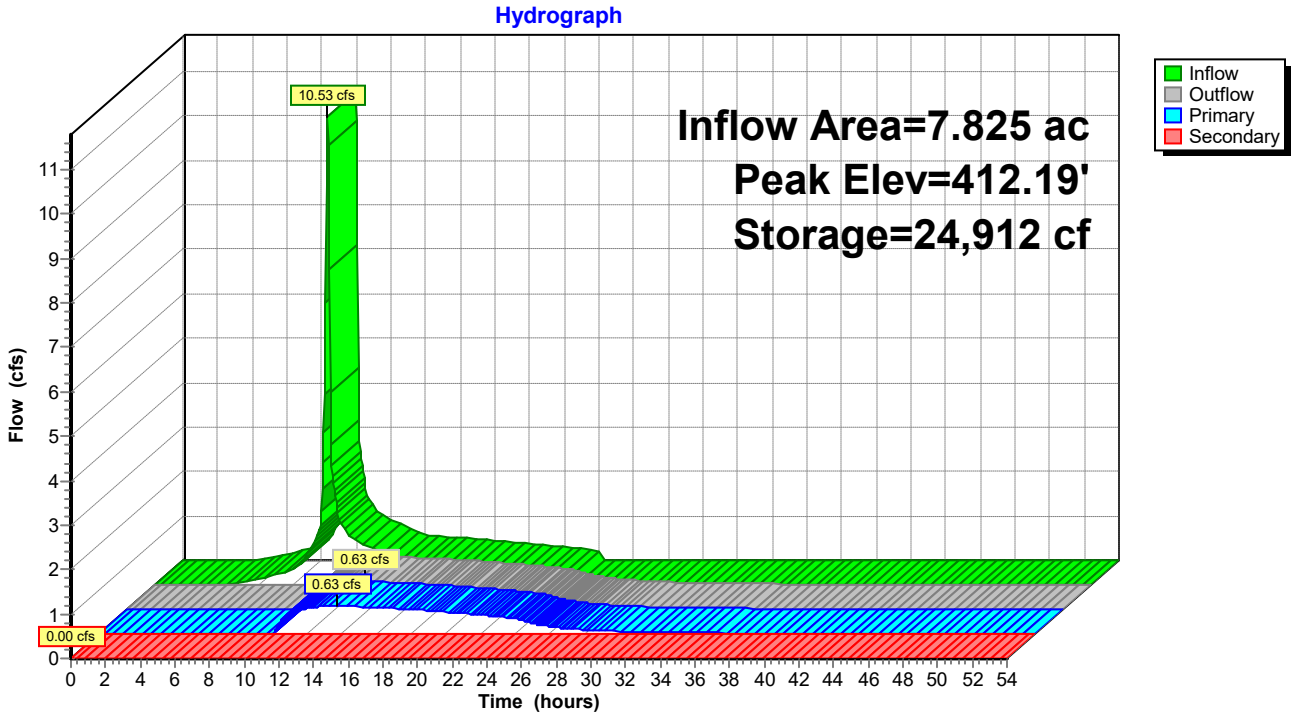
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
410.00	9,667	0	0
411.00	11,189	10,428	10,428
412.00	12,783	11,986	22,414
413.00	14,449	13,616	36,030
414.00	16,188	15,319	51,349
415.00	18,000	17,094	68,443

Device	Routing	Invert	Outlet Devices
#1	Primary	410.00'	**12.0" Round Culvert** L= 44.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 410.00' / 409.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	411.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	413.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	414.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 12.00 18.00

Primary OutFlow Max=0.63 cfs @ 13.71 hrs HW=412.19' (Free Discharge)
└**1=Culvert** (Passes 0.63 cfs of 3.88 cfs potential flow)
  ├**2=Orifice/Grate** (Orifice Controls 0.63 cfs @ 3.20 fps)
  ├**3=Orifice/Grate** (Controls 0.00 cfs)
  └**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└**5=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 2P: POND


Hydrograph
Inflow Area=7.825 ac
Peak Elev=412.19'
Storage=24,912 cf
10.53 cfs
0.63 cfs
0.63 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54
0 1 2 3 4 5 6 7 8 9 10 11

Time span=0.00-54.00 hrs, dt=0.05 hrs, 1081 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=340,869 sf 0.00% Impervious Runoff Depth=2.17"
Flow Length=683' Tc=6.2 min CN=92 Runoff=13.88 cfs 1.415 af

Subcatchment 2S: DRAINAGE AREA 2 Runoff Area=777,719 sf 0.00% Impervious Runoff Depth=1.26"
Flow Length=1,706' Tc=12.9 min CN=80 Runoff=14.10 cfs 1.871 af

Subcatchment 3S: DRAINAGE AREA 3 Runoff Area=268,223 sf 0.00% Impervious Runoff Depth=1.26"
Flow Length=1,354' Tc=14.1 min CN=80 Runoff=4.70 cfs 0.645 af

Subcatchment 4S: DRAINAGE AREA 4 Runoff Area=133,567 sf 0.00% Impervious Runoff Depth=1.32"
Flow Length=993' Tc=11.4 min CN=81 Runoff=2.69 cfs 0.338 af

Subcatchment 5S: DRAINAGE AREA 5 Runoff Area=101,061 sf 0.00% Impervious Runoff Depth=1.32"
Flow Length=495' Tc=9.4 min CN=81 Runoff=2.16 cfs 0.255 af

Reach 3R: DITCH #1 Avg. Flow Depth=0.64' Max Vel=3.26 fps Inflow=14.10 cfs 1.871 af
n=0.030 L=1,250.6' S=0.0120 '/' Capacity=29.31 cfs Outflow=12.18 cfs 1.871 af

Reach 5R: DITCH #2 Avg. Flow Depth=0.38' Max Vel=2.19 fps Inflow=4.70 cfs 0.645 af
n=0.030 L=715.3' S=0.0097 '/' Capacity=26.38 cfs Outflow=4.22 cfs 0.645 af

Reach 7R: CULVERT #1 Avg. Flow Depth=0.69' Max Vel=6.98 fps Inflow=5.55 cfs 0.983 af
18.0" Round Pipe n=0.013 L=72.0' S=0.0149 '/' Capacity=12.81 cfs Outflow=5.54 cfs 0.983 af

Pond 2P: POND Peak Elev=412.66' Storage=31,214 cf Inflow=13.88 cfs 1.415 af
Primary=0.90 cfs 1.034 af Secondary=0.00 cfs 0.000 af Outflow=0.90 cfs 1.034 af

Total Runoff Area = 37.223 ac Runoff Volume = 4.525 af Average Runoff Depth = 1.46"
100.00% Pervious = 37.223 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

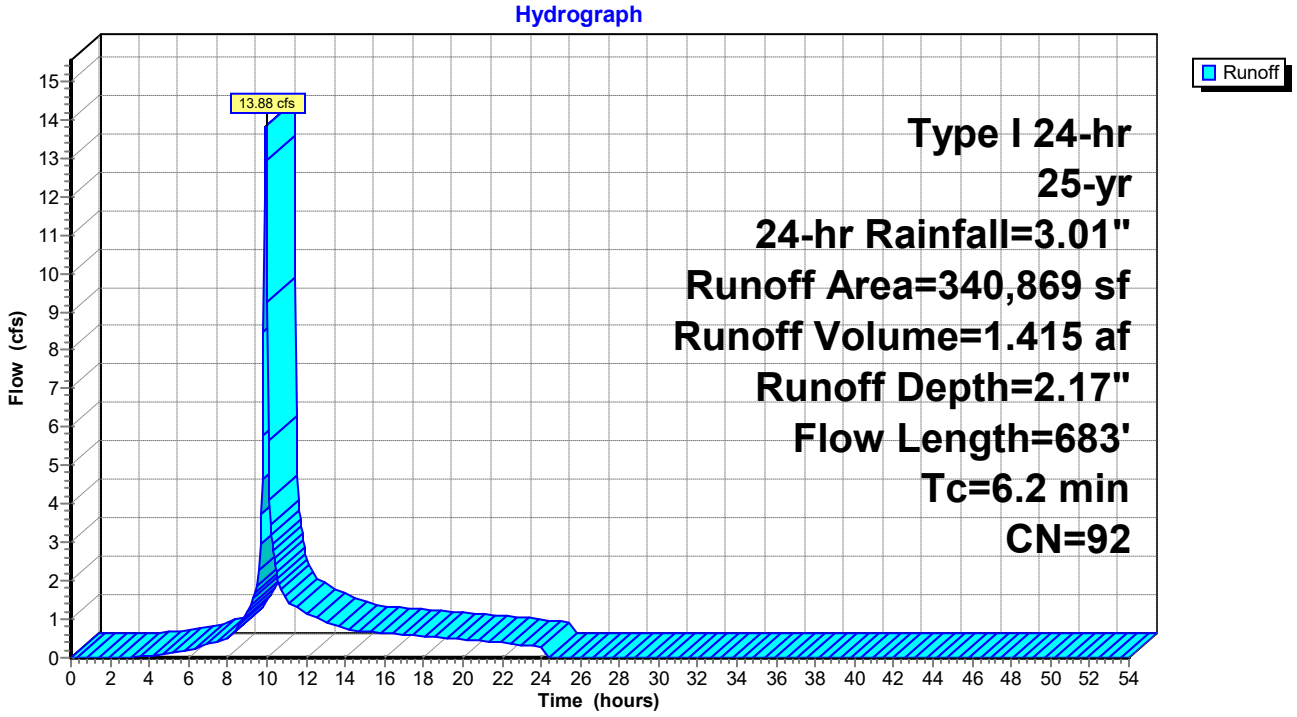
Runoff = 13.88 cfs @ 9.96 hrs, Volume= 1.415 af, Depth= 2.17"
Routed to Pond 2P : POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 25-yr, 24-hr Rainfall=3.01"

Area (sf)	CN	Description
257,425	96	Gravel surface, HSG D
83,444	80	>75% Grass cover, Good, HSG D
340,869	92	Weighted Average
340,869		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0200	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.59"
2.7	370	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	113	0.0444	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	100	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	683	Total			

Subcatchment 1S: DRAINAGE AREA 1



Summary for Subcatchment 2S: DRAINAGE AREA 2

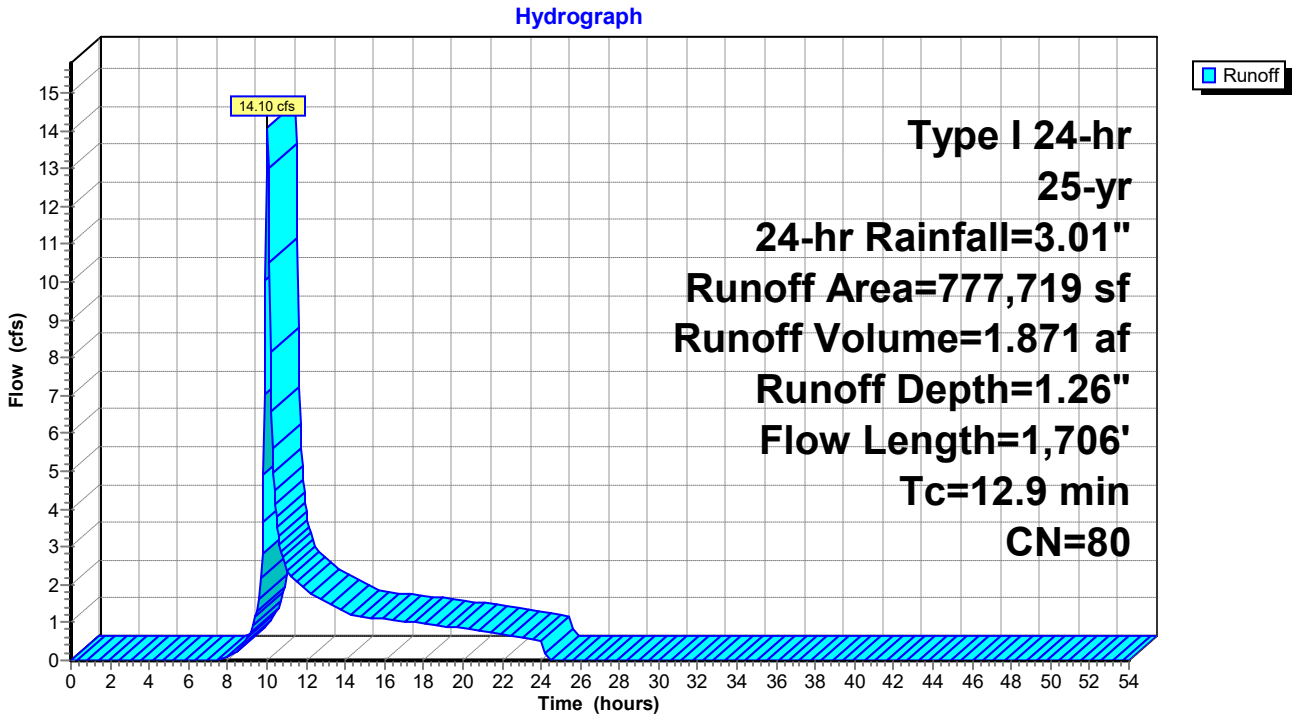
Runoff = 14.10 cfs @ 10.05 hrs, Volume= 1.871 af, Depth= 1.26"
Routed to Reach 3R : DITCH #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 25-yr, 24-hr Rainfall=3.01"

Area (sf)	CN	Description
777,719	80	Pasture/grassland/range, Good, HSG D
777,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
1.9	355	0.1905	3.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.7	1,251	0.0120	5.71	39.97	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=1.00' Z= 3.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
12.9	1,706	Total			

Subcatchment 2S: DRAINAGE AREA 2



Summary for Subcatchment 3S: DRAINAGE AREA 3

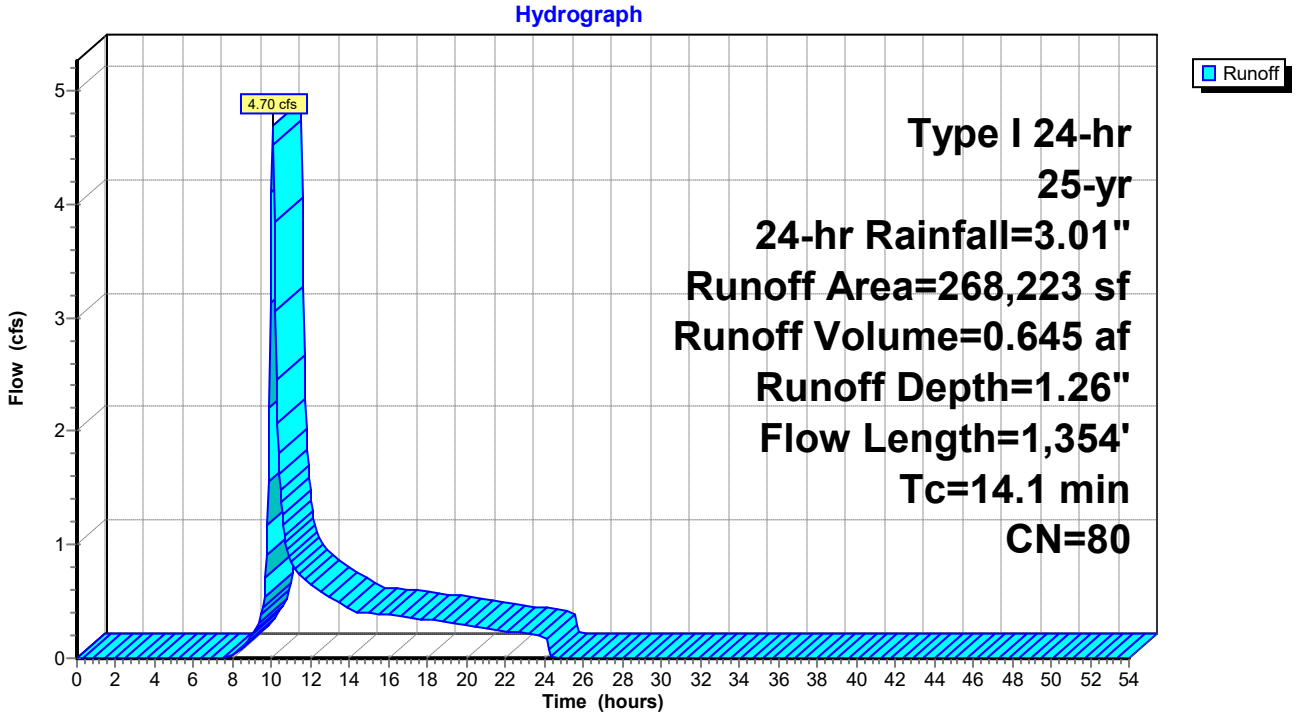
Runoff = 4.70 cfs @ 10.06 hrs, Volume= 0.645 af, Depth= 1.26"
Routed to Reach 5R : DITCH #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 25-yr, 24-hr Rainfall=3.01"

Area (sf)	CN	Description
268,223	80	Pasture/grassland/range, Good, HSG D
268,223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
3.6	550	0.1317	2.54		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	617	0.0090	4.23	19.82	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=0.75' Z= 3.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
0.8	87	0.0688	1.84		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.1	1,354	Total			

Subcatchment 3S: DRAINAGE AREA 3



Summary for Subcatchment 4S: DRAINAGE AREA 4

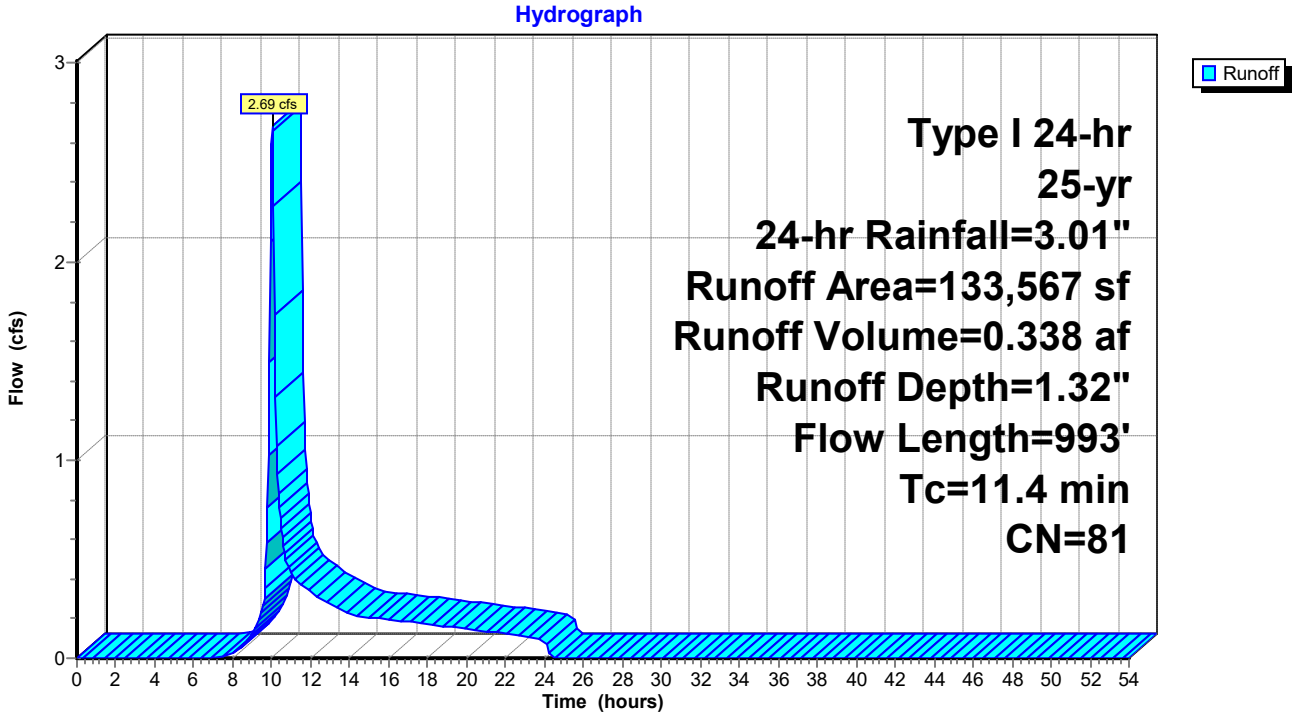
Runoff = 2.69 cfs @ 10.03 hrs, Volume= 0.338 af, Depth= 1.32"
Routed to Reach 7R : CULVERT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 25-yr, 24-hr Rainfall=3.01"

	Area (sf)	CN	Description
*	6,582	96	Gravel surface, HSG D
	126,985	80	Pasture/grassland/range, Good, HSG D
	133,567	81	Weighted Average
	133,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.1057	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.9	457	0.1389	2.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	436	0.0460	5.01	9.40	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 & 12.0 '/' Top.W=7.50' n= 0.025 Earth, clean & winding
11.4	993	Total			

Subcatchment 4S: DRAINAGE AREA 4



Summary for Subcatchment 5S: DRAINAGE AREA 5

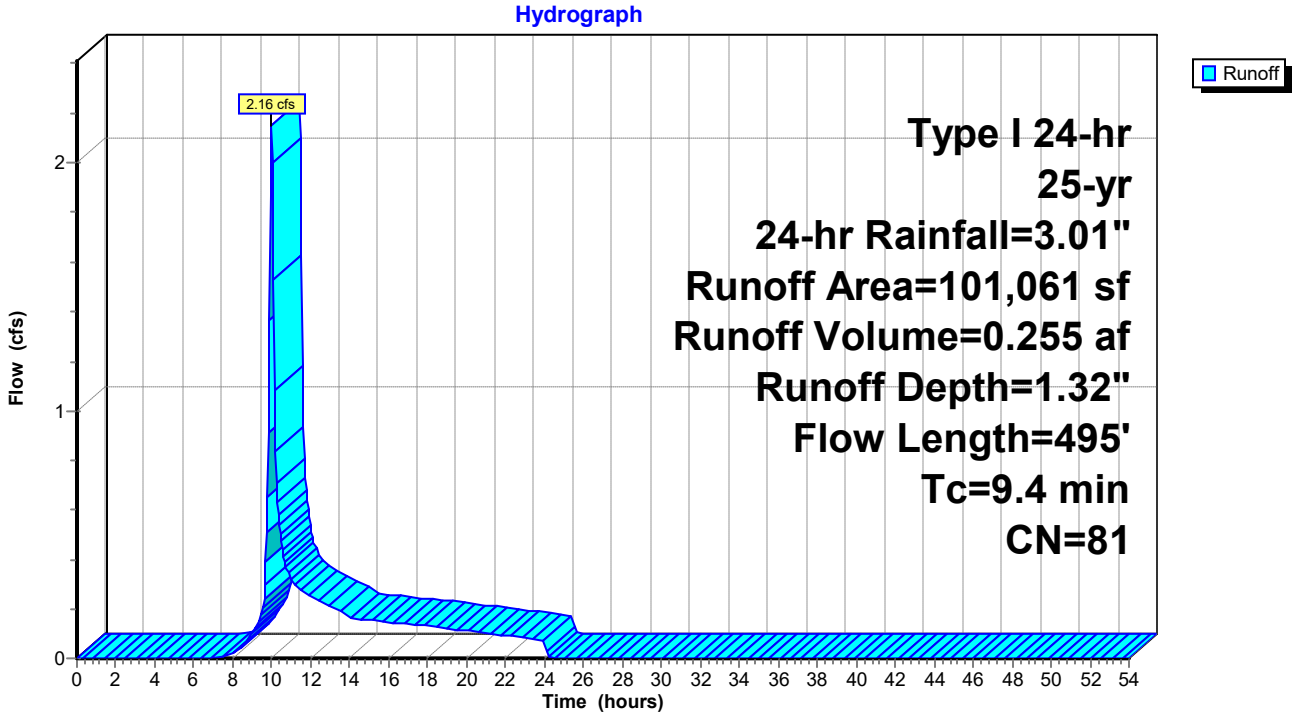
Runoff = 2.16 cfs @ 10.01 hrs, Volume= 0.255 af, Depth= 1.32"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 25-yr, 24-hr Rainfall=3.01"

	Area (sf)	CN	Description
*	7,957	96	Gravel surface, HSG D
	93,104	80	Pasture/grassland/range, Good, HSG D
	101,061	81	Weighted Average
	101,061		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	100	0.1177	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.6	395	0.1348	2.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	495	Total			

Subcatchment 5S: DRAINAGE AREA 5



Summary for Reach 3R: DITCH #1

Inflow Area = 17.854 ac, 0.00% Impervious, Inflow Depth = 1.26" for 25-yr, 24-hr event
Inflow = 14.10 cfs @ 10.05 hrs, Volume= 1.871 af
Outflow = 12.18 cfs @ 10.22 hrs, Volume= 1.871 af, Atten= 14%, Lag= 10.4 min

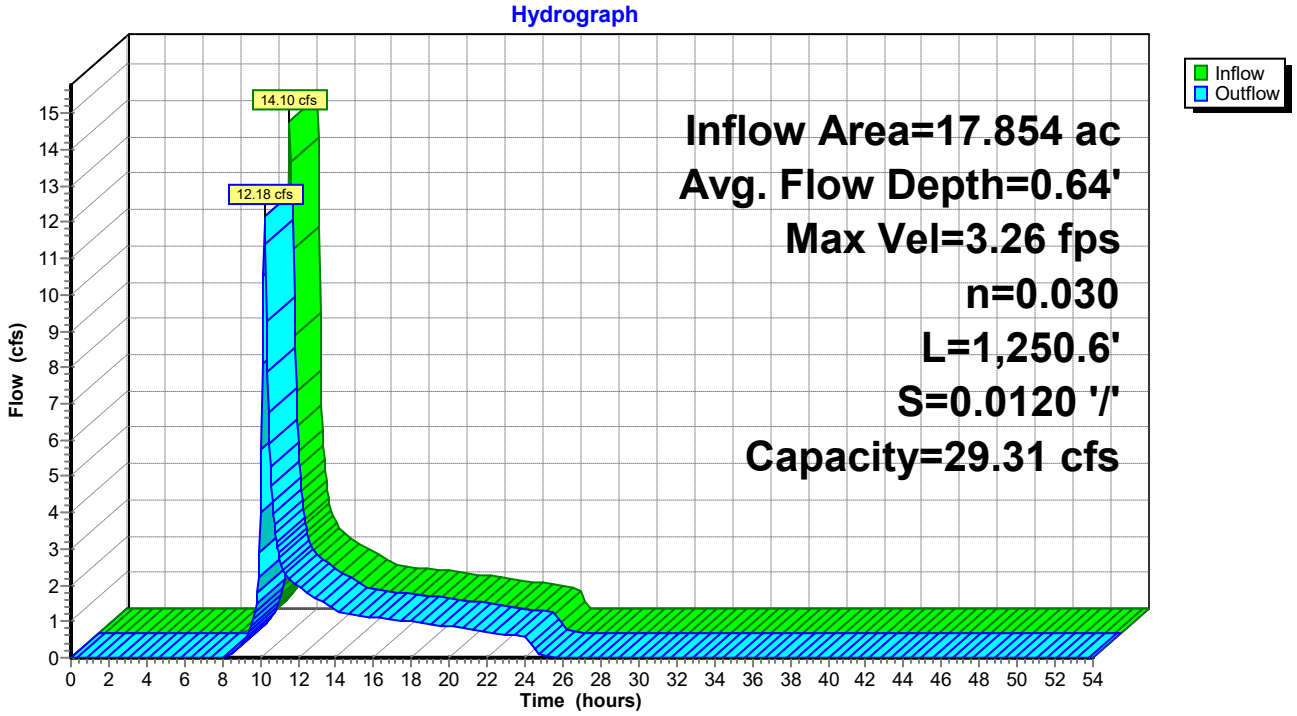
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.26 fps, Min. Travel Time= 6.4 min
Avg. Velocity = 1.02 fps, Avg. Travel Time= 20.4 min

Peak Storage= 4,694 cf @ 10.12 hrs
Average Depth at Peak Storage= 0.64' , Surface Width= 7.81'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 29.31 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 1,250.6' Slope= 0.0120 '/'
Inlet Invert= 429.00', Outlet Invert= 414.00'

‡

Reach 3R: DITCH #1



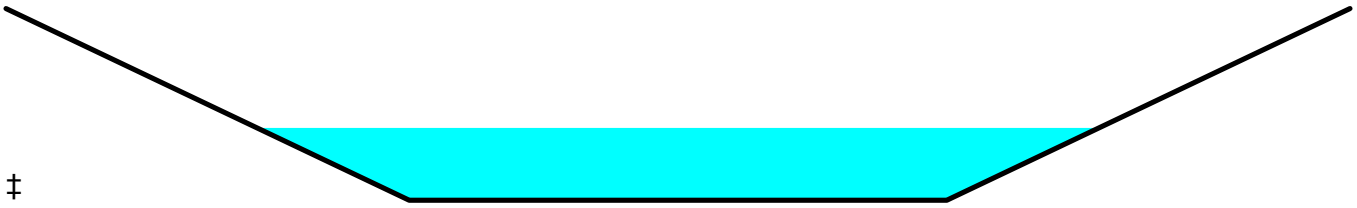
Summary for Reach 5R: DITCH #2

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth = 1.26" for 25-yr, 24-hr event
Inflow = 4.70 cfs @ 10.06 hrs, Volume= 0.645 af
Outflow = 4.22 cfs @ 10.22 hrs, Volume= 0.645 af, Atten= 10%, Lag= 9.1 min
Routed to Reach 7R : CULVERT #1

Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.19 fps, Min. Travel Time= 5.4 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 15.9 min

Peak Storage= 1,383 cf @ 10.12 hrs
Average Depth at Peak Storage= 0.38' , Surface Width= 6.26'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 26.38 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 715.3' Slope= 0.0097 '/'
Inlet Invert= 429.00', Outlet Invert= 422.05'



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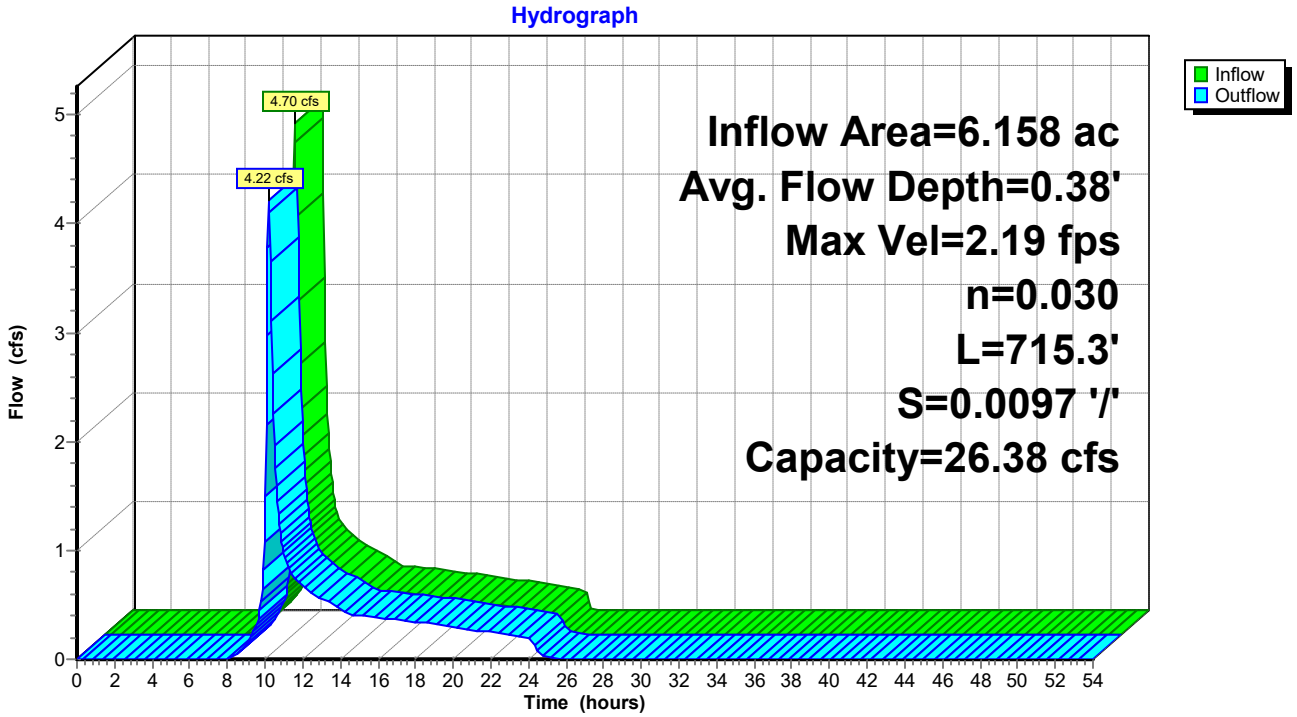
Reach 5R: DITCH #2



Summary for Reach 7R: CULVERT #1

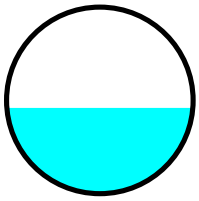
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 9.224 ac, 0.00% Impervious, Inflow Depth = 1.28" for 25-yr, 24-hr event
Inflow = 5.55 cfs @ 10.18 hrs, Volume= 0.983 af
Outflow = 5.54 cfs @ 10.18 hrs, Volume= 0.983 af, Atten= 0%, Lag= 0.2 min

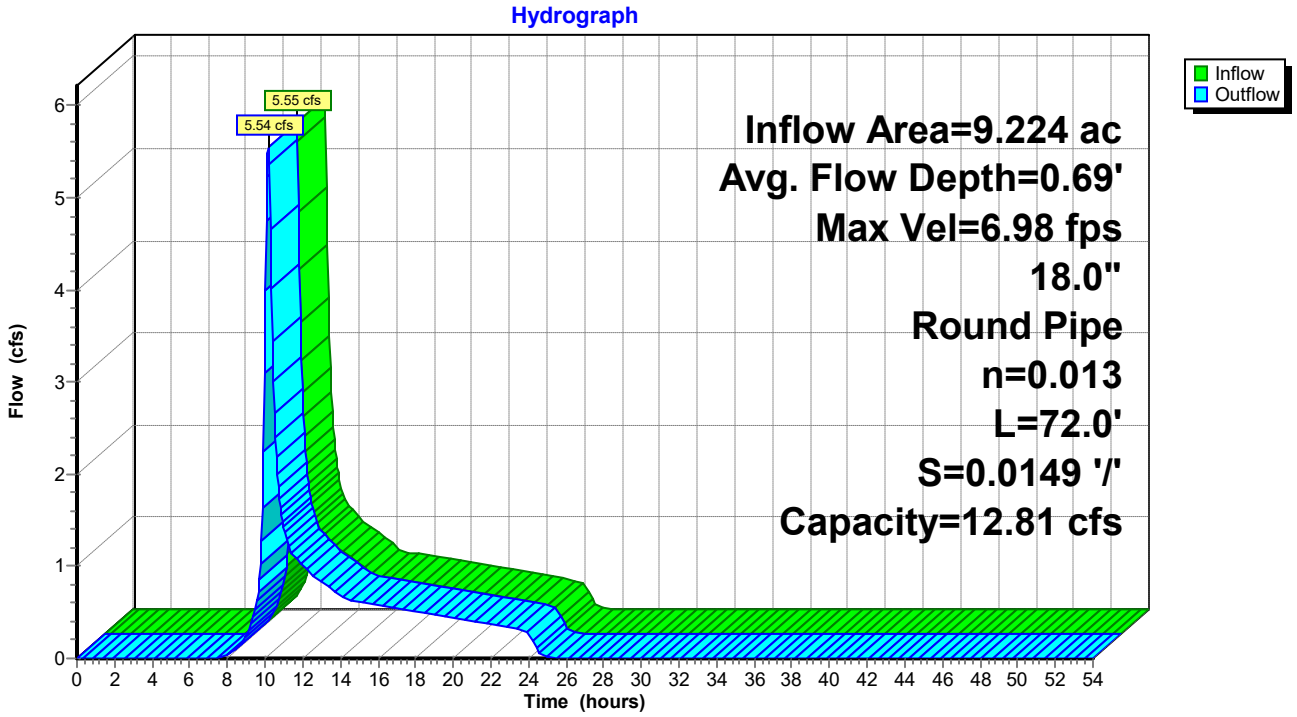
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 6.98 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 2.90 fps, Avg. Travel Time= 0.4 min

Peak Storage= 57 cf @ 10.18 hrs
Average Depth at Peak Storage= 0.69' , Surface Width= 1.50'
Defined Flood Depth= 423.67' Flow Area= 85.9 sf, Capacity= -15,110.35 cfs
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 12.81 cfs

18.0" Round Pipe
n= 0.013
Length= 72.0' Slope= 0.0149 '/'
Inlet Invert= 415.95', Outlet Invert= 414.88'



Reach 7R: CULVERT #1



Summary for Pond 2P: POND

Inflow Area = 7.825 ac, 0.00% Impervious, Inflow Depth = 2.17" for 25-yr, 24-hr event
Inflow = 13.88 cfs @ 9.96 hrs, Volume= 1.415 af
Outflow = 0.90 cfs @ 13.23 hrs, Volume= 1.034 af, Atten= 94%, Lag= 196.1 min
Primary = 0.90 cfs @ 13.23 hrs, Volume= 1.034 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Peak Elev= 412.66' @ 13.23 hrs Surf.Area= 13,883 sf Storage= 31,214 cf
Flood Elev= 415.00' Surf.Area= 18,000 sf Storage= 68,443 cf

Plug-Flow detention time= 470.3 min calculated for 1.033 af (73% of inflow)
Center-of-Mass det. time= 336.8 min (1,098.1 - 761.3)

Volume	Invert	Avail.Storage	Storage Description
#1	410.00'	68,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

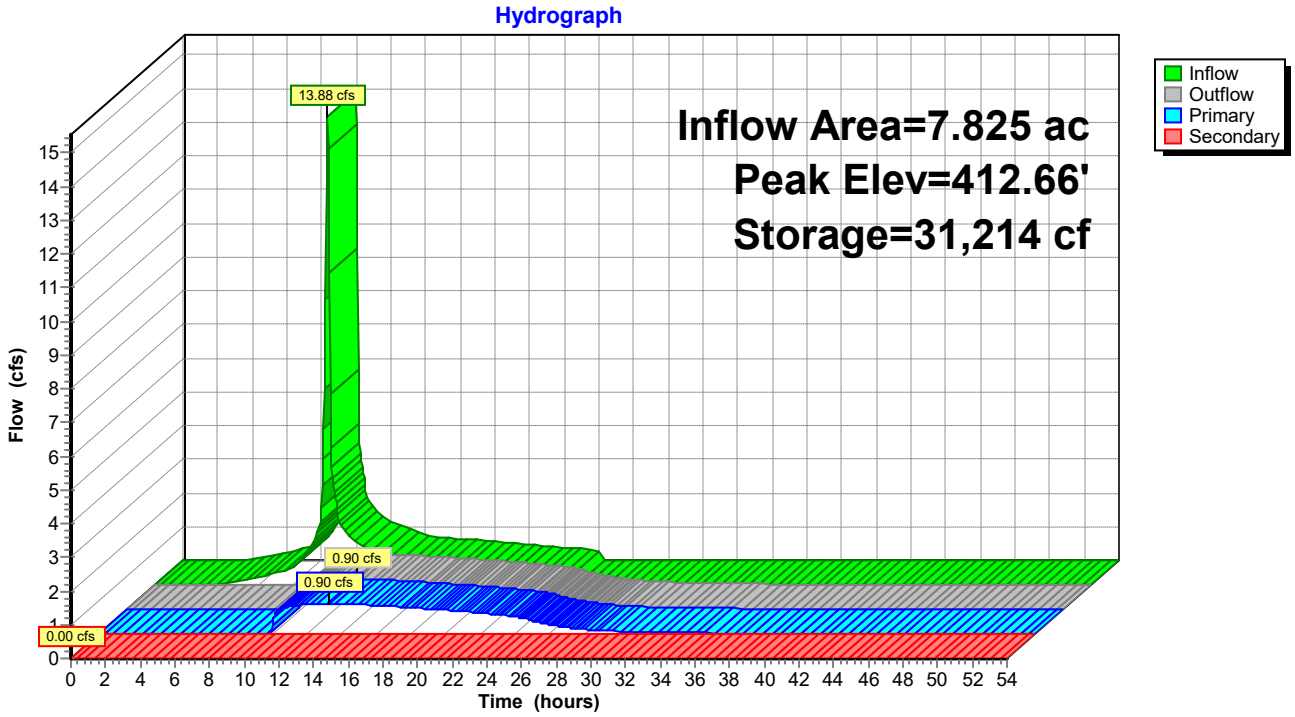
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
410.00	9,667	0	0
411.00	11,189	10,428	10,428
412.00	12,783	11,986	22,414
413.00	14,449	13,616	36,030
414.00	16,188	15,319	51,349
415.00	18,000	17,094	68,443

Device	Routing	Invert	Outlet Devices
#1	Primary	410.00'	**12.0" Round Culvert** L= 44.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 410.00' / 409.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	411.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	413.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	414.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 12.00 18.00

Primary OutFlow Max=0.90 cfs @ 13.23 hrs HW=412.66' (Free Discharge)
└─**1=Culvert** (Passes 0.90 cfs of 4.39 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 0.90 cfs @ 4.59 fps)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└─**5=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 2P: POND


Hydrograph
Inflow Area=7.825 ac
Peak Elev=412.66'
Storage=31,214 cf
13.88 cfs
0.90 cfs
0.90 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)

Time span=0.00-54.00 hrs, dt=0.05 hrs, 1081 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=340,869 sf 0.00% Impervious Runoff Depth=0.07"
Flow Length=683' Tc=6.2 min CN=92 Runoff=0.17 cfs 0.043 af

Subcatchment 2S: DRAINAGE AREA 2 Runoff Area=777,719 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,706' Tc=12.9 min CN=80 Runoff=0.00 cfs 0.000 af

Subcatchment 3S: DRAINAGE AREA 3 Runoff Area=268,223 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=1,354' Tc=14.1 min CN=80 Runoff=0.00 cfs 0.000 af

Subcatchment 4S: DRAINAGE AREA 4 Runoff Area=133,567 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=993' Tc=11.4 min CN=81 Runoff=0.00 cfs 0.000 af

Subcatchment 5S: DRAINAGE AREA 5 Runoff Area=101,061 sf 0.00% Impervious Runoff Depth=0.00"
Flow Length=495' Tc=9.4 min CN=81 Runoff=0.00 cfs 0.000 af

Reach 3R: DITCH #1 Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.030 L=1,250.6' S=0.0120 '/' Capacity=29.31 cfs Outflow=0.00 cfs 0.000 af

Reach 5R: DITCH #2 Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
n=0.030 L=715.3' S=0.0097 '/' Capacity=26.38 cfs Outflow=0.00 cfs 0.000 af

Reach 7R: CULVERT #1 Avg. Flow Depth=0.00' Max Vel=0.00 fps Inflow=0.00 cfs 0.000 af
18.0" Round Pipe n=0.013 L=72.0' S=0.0149 '/' Capacity=12.81 cfs Outflow=0.00 cfs 0.000 af

Pond 2P: POND Peak Elev=410.19' Storage=1,890 cf Inflow=0.17 cfs 0.043 af
Primary=0.00 cfs 0.000 af Secondary=0.00 cfs 0.000 af Outflow=0.00 cfs 0.000 af

Total Runoff Area = 37.223 ac Runoff Volume = 0.043 af Average Runoff Depth = 0.01"
100.00% Pervious = 37.223 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

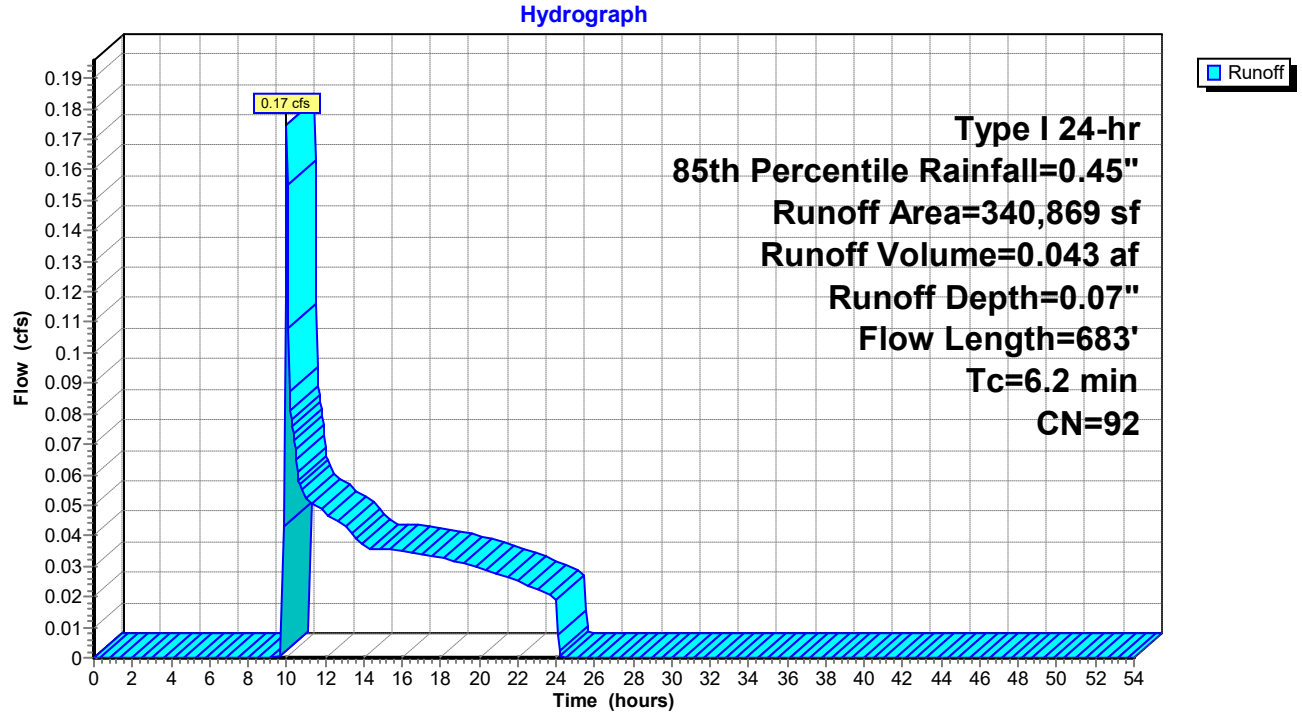
Runoff = 0.17 cfs @ 10.01 hrs, Volume= 0.043 af, Depth= 0.07"
Routed to Pond 2P : POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 85th Percentile Rainfall=0.45"

Area (sf)	CN	Description
257,425	96	Gravel surface, HSG D
83,444	80	>75% Grass cover, Good, HSG D
340,869	92	Weighted Average
340,869		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0200	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.59"
2.7	370	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	113	0.0444	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	100	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	683	Total			

Subcatchment 1S: DRAINAGE AREA 1



Summary for Subcatchment 2S: DRAINAGE AREA 2

[45] Hint: Runoff=Zero

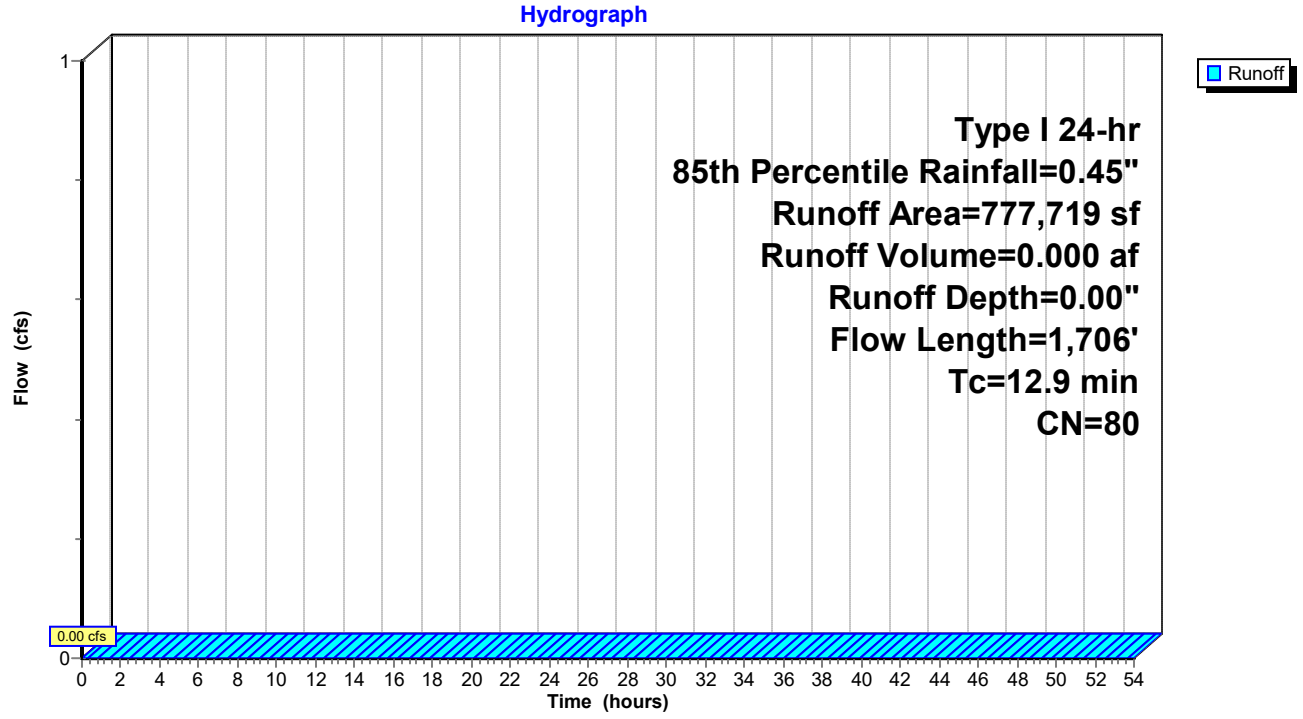
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Reach 3R : DITCH #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 85th Percentile Rainfall=0.45"

Area (sf)	CN	Description
777,719	80	Pasture/grassland/range, Good, HSG D
777,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
1.9	355	0.1905	3.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.7	1,251	0.0120	5.71	39.97	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=1.00' Z= 3.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
12.9	1,706	Total			

Subcatchment 2S: DRAINAGE AREA 2



Summary for Subcatchment 3S: DRAINAGE AREA 3

[45] Hint: Runoff=Zero

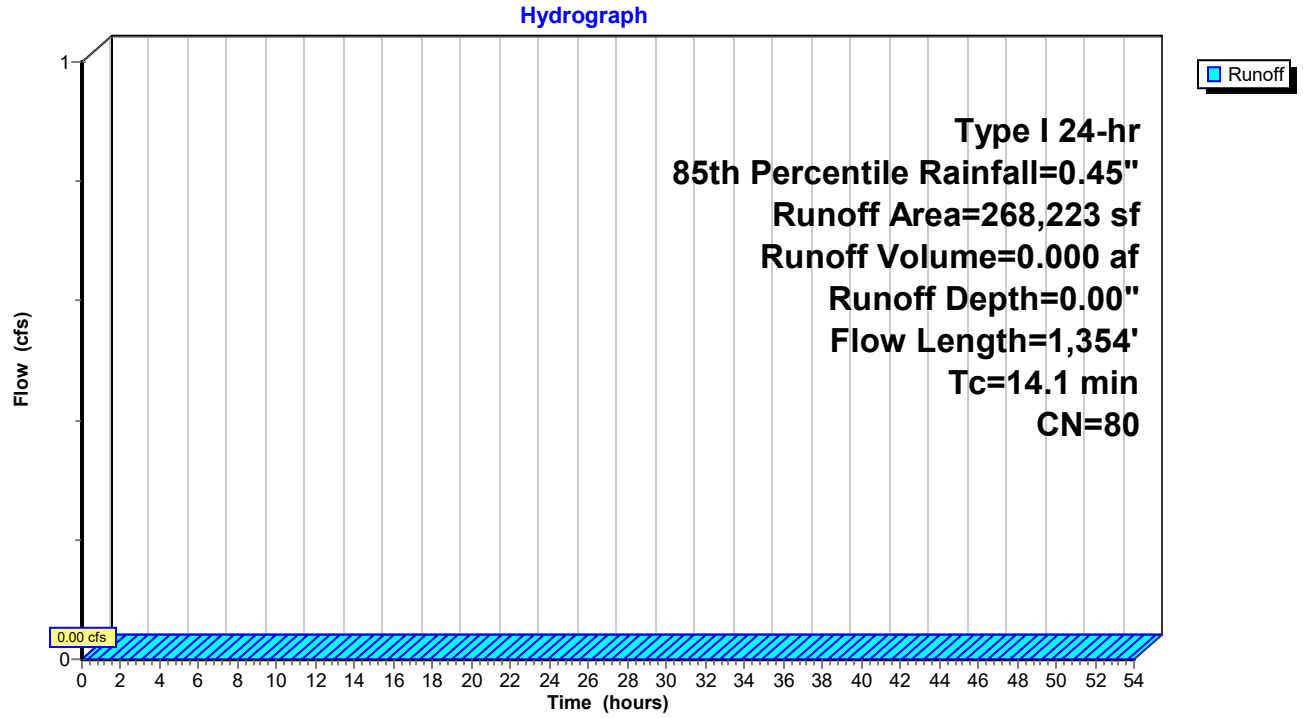
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Reach 5R : DITCH #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 85th Percentile Rainfall=0.45"

Area (sf)	CN	Description
268,223	80	Pasture/grassland/range, Good, HSG D
268,223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
3.6	550	0.1317	2.54		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	617	0.0090	4.23	19.82	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=0.75' Z= 3.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
0.8	87	0.0688	1.84		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.1	1,354	Total			

Subcatchment 3S: DRAINAGE AREA 3



Summary for Subcatchment 4S: DRAINAGE AREA 4

[45] Hint: Runoff=Zero

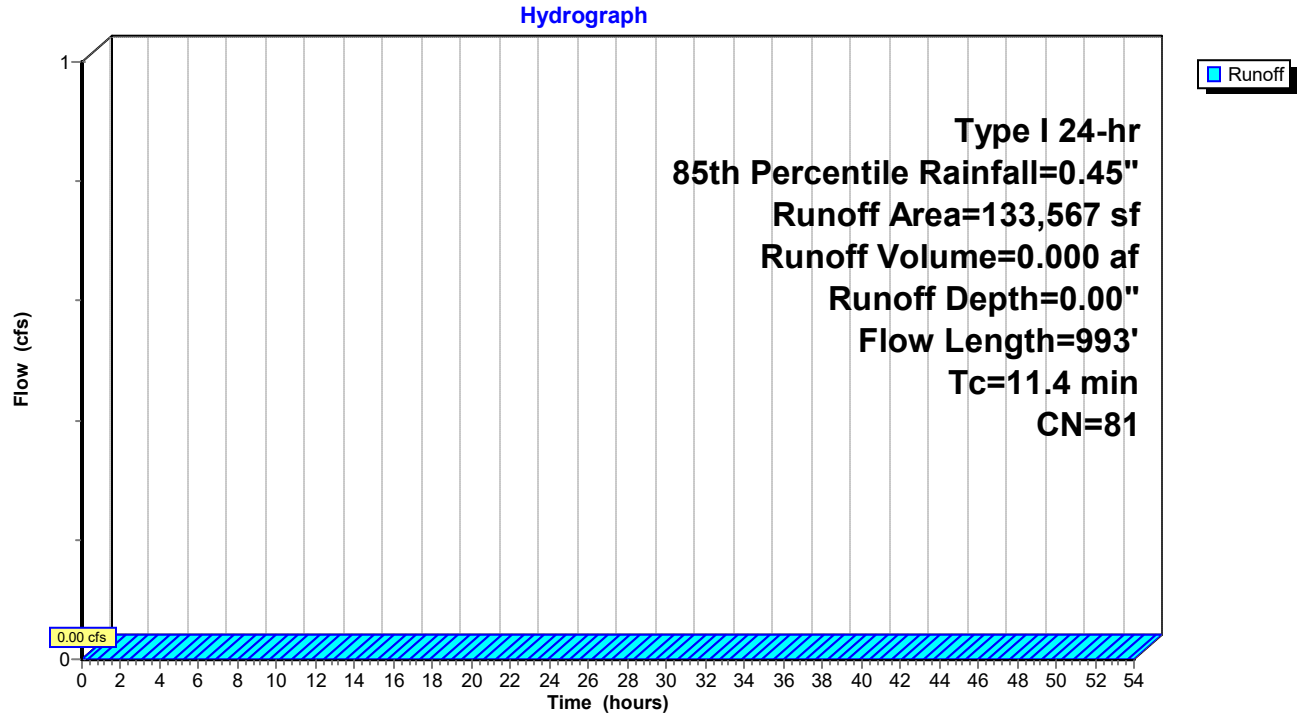
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"
Routed to Reach 7R : CULVERT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 85th Percentile Rainfall=0.45"

	Area (sf)	CN	Description
*	6,582	96	Gravel surface, HSG D
	126,985	80	Pasture/grassland/range, Good, HSG D
	133,567	81	Weighted Average
	133,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.1057	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.9	457	0.1389	2.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	436	0.0460	5.01	9.40	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 & 12.0 '/' Top.W=7.50' n= 0.025 Earth, clean & winding
11.4	993	Total			

Subcatchment 4S: DRAINAGE AREA 4



Summary for Subcatchment 5S: DRAINAGE AREA 5

[45] Hint: Runoff=Zero

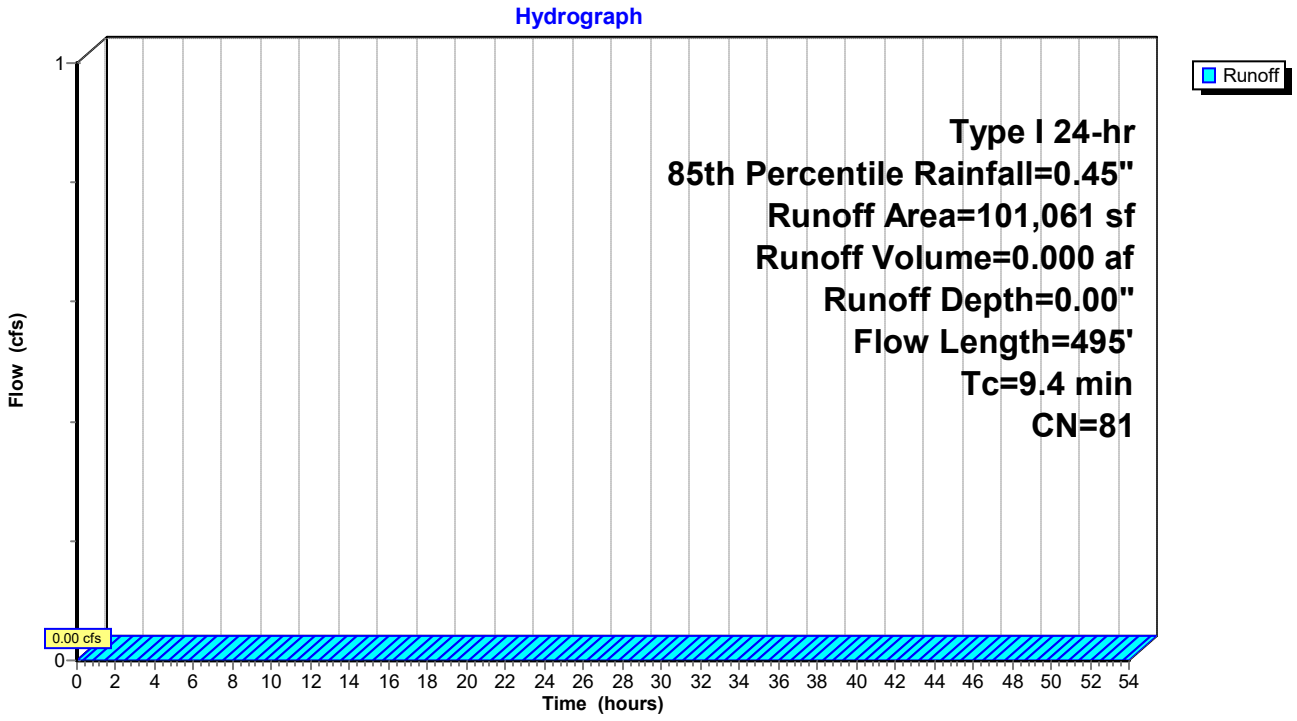
Runoff = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 85th Percentile Rainfall=0.45"

	Area (sf)	CN	Description
*	7,957	96	Gravel surface, HSG D
	93,104	80	Pasture/grassland/range, Good, HSG D
	101,061	81	Weighted Average
	101,061		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	100	0.1177	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.6	395	0.1348	2.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	495	Total			

Subcatchment 5S: DRAINAGE AREA 5



Summary for Reach 3R: DITCH #1

Inflow Area = 17.854 ac, 0.00% Impervious, Inflow Depth = 0.00" for 85th Percentile event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

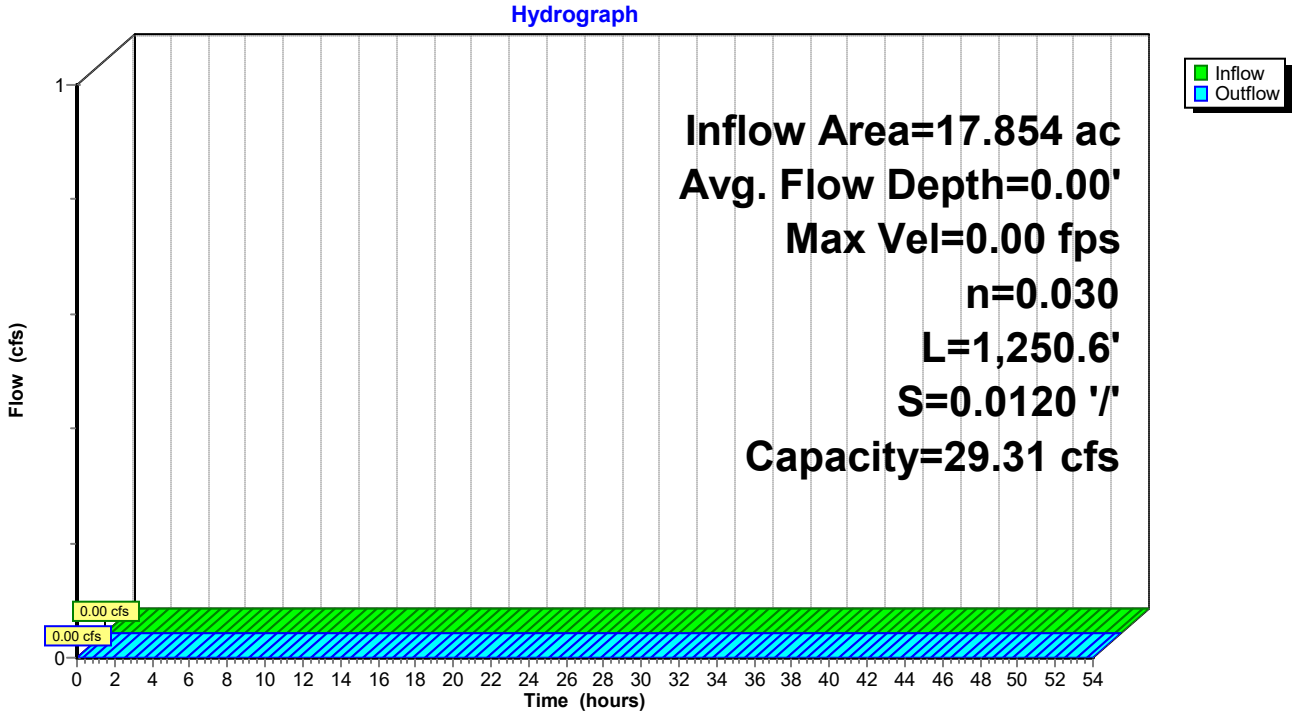
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 29.31 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 1,250.6' Slope= 0.0120 '/'
Inlet Invert= 429.00', Outlet Invert= 414.00'

‡

Reach 3R: DITCH #1



Summary for Reach 5R: DITCH #2

Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth = 0.00" for 85th Percentile event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Routed to Reach 7R : CULVERT #1

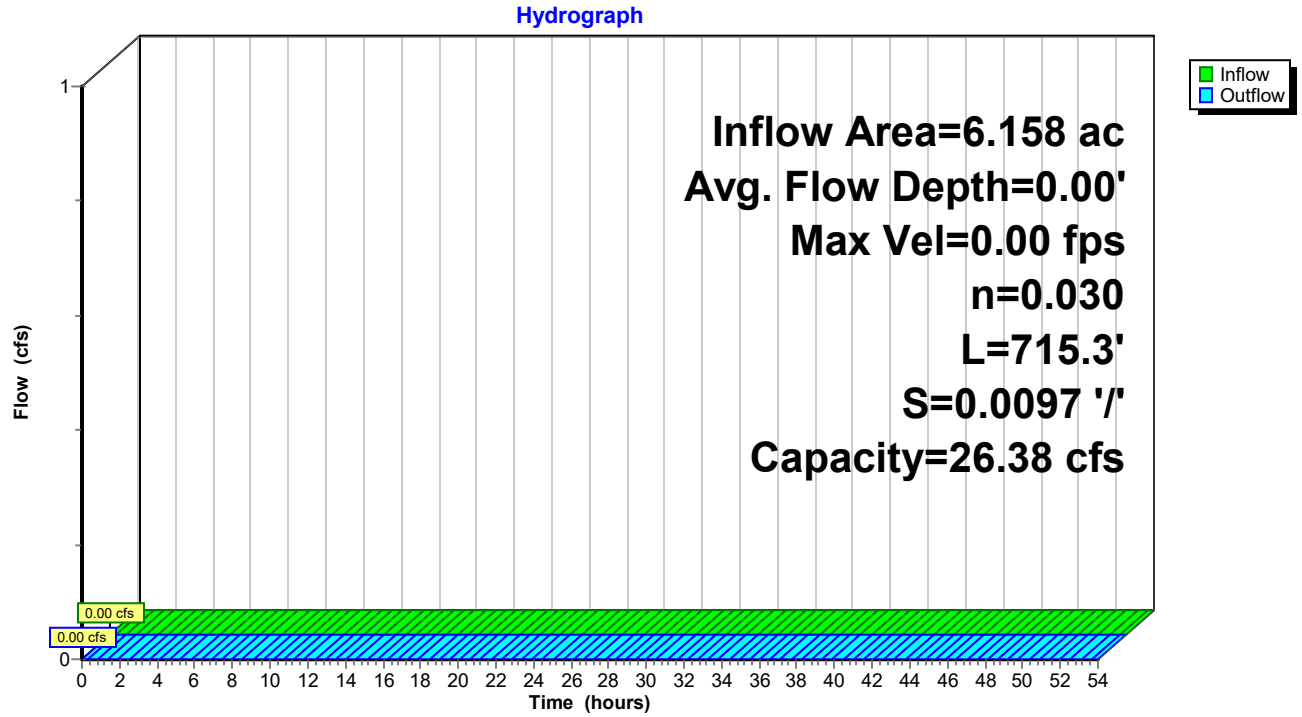
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 26.38 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 715.3' Slope= 0.0097 '/'
Inlet Invert= 429.00', Outlet Invert= 422.05'

‡

Reach 5R: DITCH #2



Summary for Reach 7R: CULVERT #1

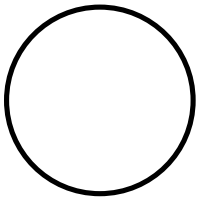
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 9.224 ac, 0.00% Impervious, Inflow Depth = 0.00" for 85th Percentile event
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

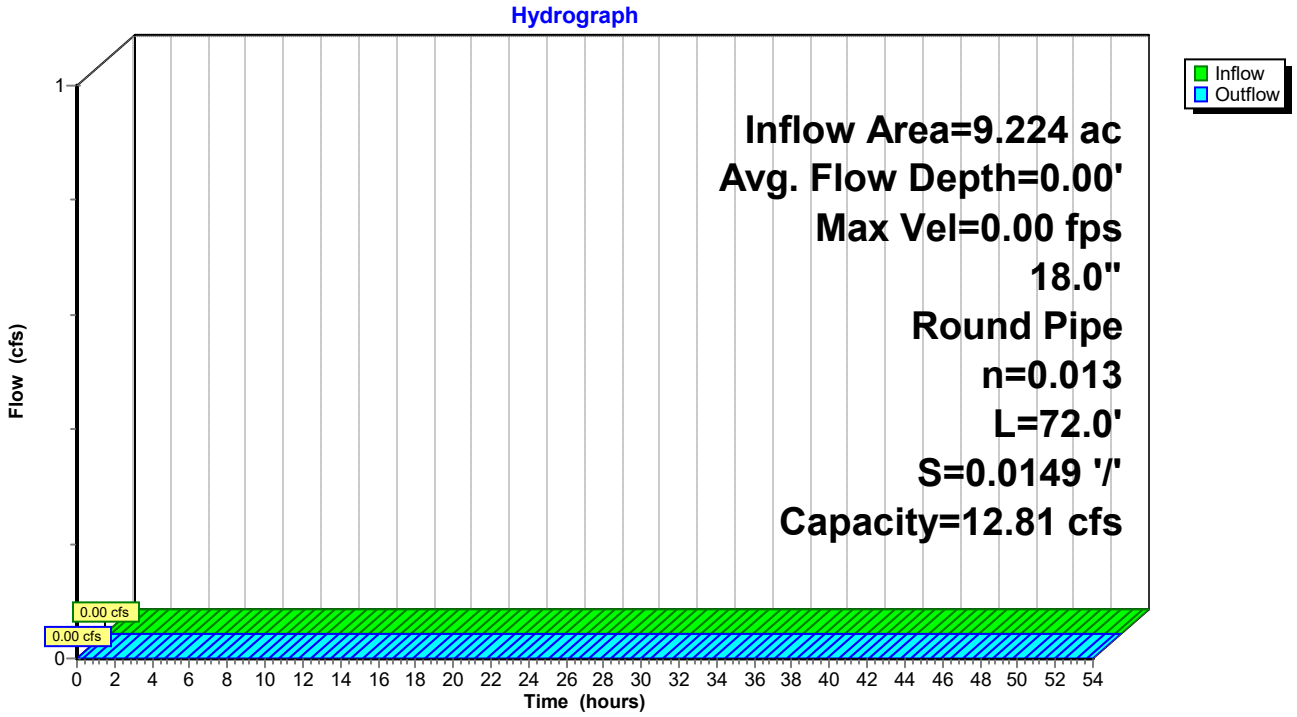
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.00 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 0.00 fps, Avg. Travel Time= 0.0 min

Peak Storage= 0 cf @ 0.00 hrs
Average Depth at Peak Storage= 0.00'
Defined Flood Depth= 423.67' Flow Area= 85.9 sf, Capacity= -15,110.35 cfs
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 12.81 cfs

18.0" Round Pipe
n= 0.013
Length= 72.0' Slope= 0.0149 '/'
Inlet Invert= 415.95', Outlet Invert= 414.88'



Reach 7R: CULVERT #1



Summary for Pond 2P: POND

Inflow Area = 7.825 ac, 0.00% Impervious, Inflow Depth = 0.07" for 85th Percentile event
Inflow = 0.17 cfs @ 10.01 hrs, Volume= 0.043 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Peak Elev= 410.19' @ 24.40 hrs Surf.Area= 9,960 sf Storage= 1,890 cf
Flood Elev= 415.00' Surf.Area= 18,000 sf Storage= 68,443 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no outflow)

Volume	Invert	Avail.Storage	Storage Description
#1	410.00'	68,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

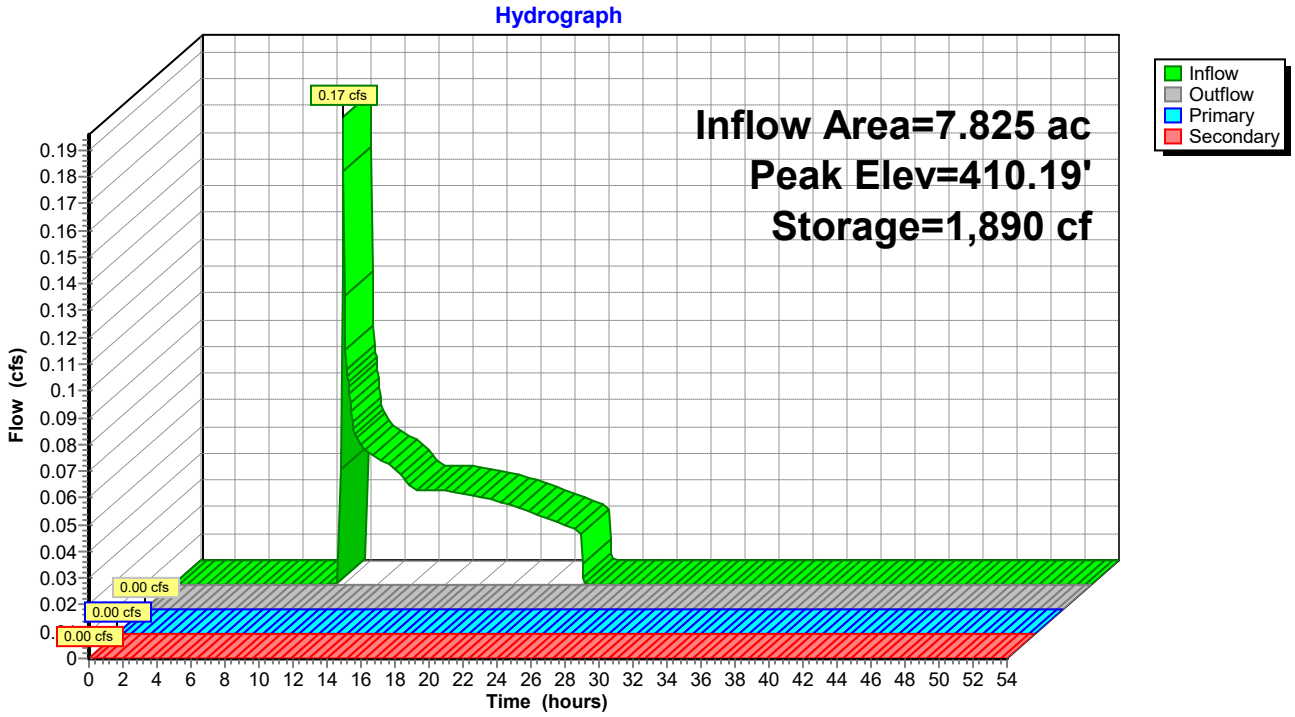
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
410.00	9,667	0	0
411.00	11,189	10,428	10,428
412.00	12,783	11,986	22,414
413.00	14,449	13,616	36,030
414.00	16,188	15,319	51,349
415.00	18,000	17,094	68,443

Device	Routing	Invert	Outlet Devices
#1	Primary	410.00'	**12.0" Round Culvert** L= 44.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 410.00' / 409.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	411.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	413.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	414.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 12.00 18.00

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└─**1=Culvert** (Controls 0.00 cfs)
  ├─**2=Orifice/Grate** (Controls 0.00 cfs)
  ├─**3=Orifice/Grate** (Controls 0.00 cfs)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└─**5=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 2P: POND


Hydrograph
Inflow Area=7.825 ac
Peak Elev=410.19'
Storage=1,890 cf
0.17 cfs
0.00 cfs
0.00 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)

Time span=0.00-54.00 hrs, dt=0.05 hrs, 1081 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: DRAINAGE AREA 1 Runoff Area=340,869 sf 0.00% Impervious Runoff Depth=3.05"
Flow Length=683' Tc=6.2 min CN=92 Runoff=19.40 cfs 1.989 af

Subcatchment 2S: DRAINAGE AREA 2 Runoff Area=777,719 sf 0.00% Impervious Runoff Depth=1.98"
Flow Length=1,706' Tc=12.9 min CN=80 Runoff=23.40 cfs 2.952 af

Subcatchment 3S: DRAINAGE AREA 3 Runoff Area=268,223 sf 0.00% Impervious Runoff Depth=1.98"
Flow Length=1,354' Tc=14.1 min CN=80 Runoff=7.81 cfs 1.018 af

Subcatchment 4S: DRAINAGE AREA 4 Runoff Area=133,567 sf 0.00% Impervious Runoff Depth=2.06"
Flow Length=993' Tc=11.4 min CN=81 Runoff=4.38 cfs 0.527 af

Subcatchment 5S: DRAINAGE AREA 5 Runoff Area=101,061 sf 0.00% Impervious Runoff Depth=2.06"
Flow Length=495' Tc=9.4 min CN=81 Runoff=3.51 cfs 0.399 af

Reach 3R: DITCH #1 Avg. Flow Depth=0.84' Max Vel=3.81 fps Inflow=23.40 cfs 2.952 af
n=0.030 L=1,250.6' S=0.0120 '/' Capacity=29.31 cfs Outflow=20.78 cfs 2.952 af

Reach 5R: DITCH #2 Avg. Flow Depth=0.51' Max Vel=2.59 fps Inflow=7.81 cfs 1.018 af
n=0.030 L=715.3' S=0.0097 '/' Capacity=26.38 cfs Outflow=7.12 cfs 1.018 af

Reach 7R: CULVERT #1 Avg. Flow Depth=0.97' Max Vel=7.95 fps Inflow=9.62 cfs 1.545 af
18.0" Round Pipe n=0.013 L=72.0' S=0.0149 '/' Capacity=12.81 cfs Outflow=9.60 cfs 1.545 af

Pond 2P: POND Peak Elev=413.45' Storage=42,690 cf Inflow=19.40 cfs 1.989 af
Primary=1.46 cfs 1.607 af Secondary=0.00 cfs 0.000 af Outflow=1.46 cfs 1.607 af

Total Runoff Area = 37.223 ac Runoff Volume = 6.885 af Average Runoff Depth = 2.22"
100.00% Pervious = 37.223 ac 0.00% Impervious = 0.000 ac

Summary for Subcatchment 1S: DRAINAGE AREA 1

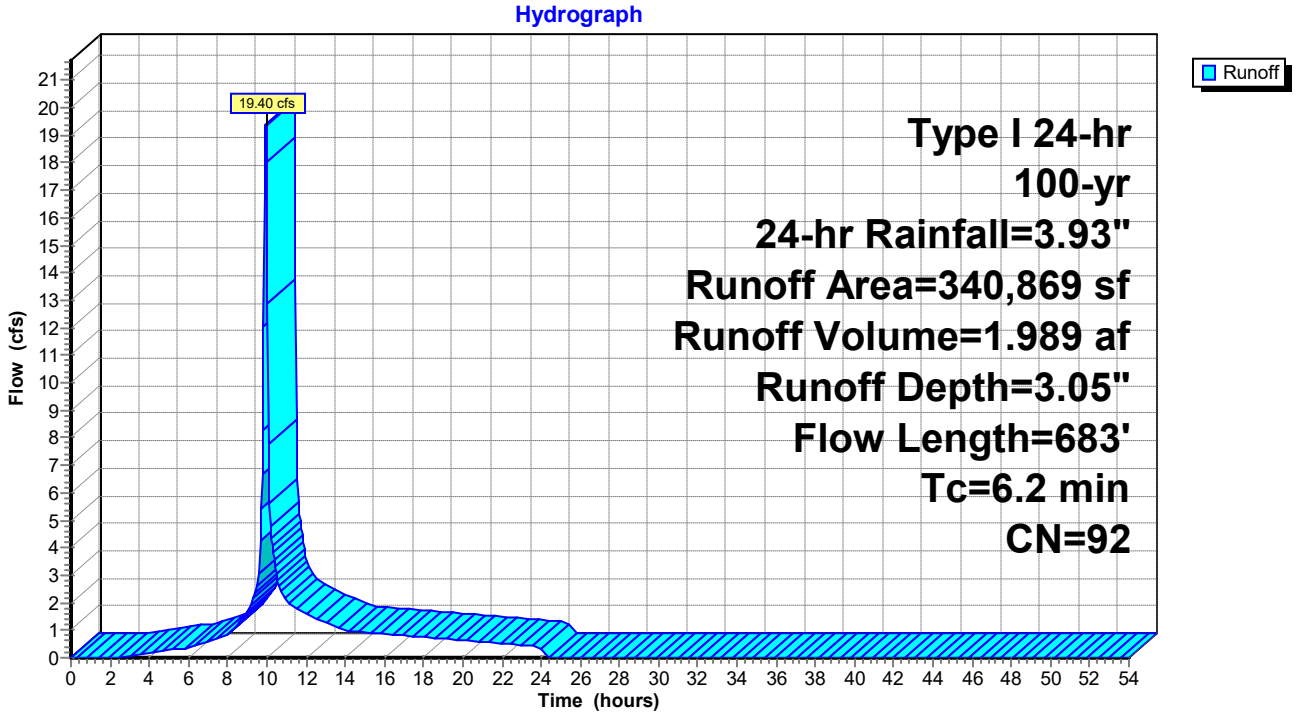
Runoff = 19.40 cfs @ 9.96 hrs, Volume= 1.989 af, Depth= 3.05"
Routed to Pond 2P : POND

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-yr, 24-hr Rainfall=3.93"

Area (sf)	CN	Description
257,425	96	Gravel surface, HSG D
83,444	80	>75% Grass cover, Good, HSG D
340,869	92	Weighted Average
340,869		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0200	0.97		**Sheet Flow,** Smooth surfaces n= 0.011 P2= 1.59"
2.7	370	0.0200	2.28		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
1.3	113	0.0444	1.47		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	100	0.0500	3.60		**Shallow Concentrated Flow,** Unpaved Kv= 16.1 fps
6.2	683	Total			

Subcatchment 1S: DRAINAGE AREA 1



Summary for Subcatchment 2S: DRAINAGE AREA 2

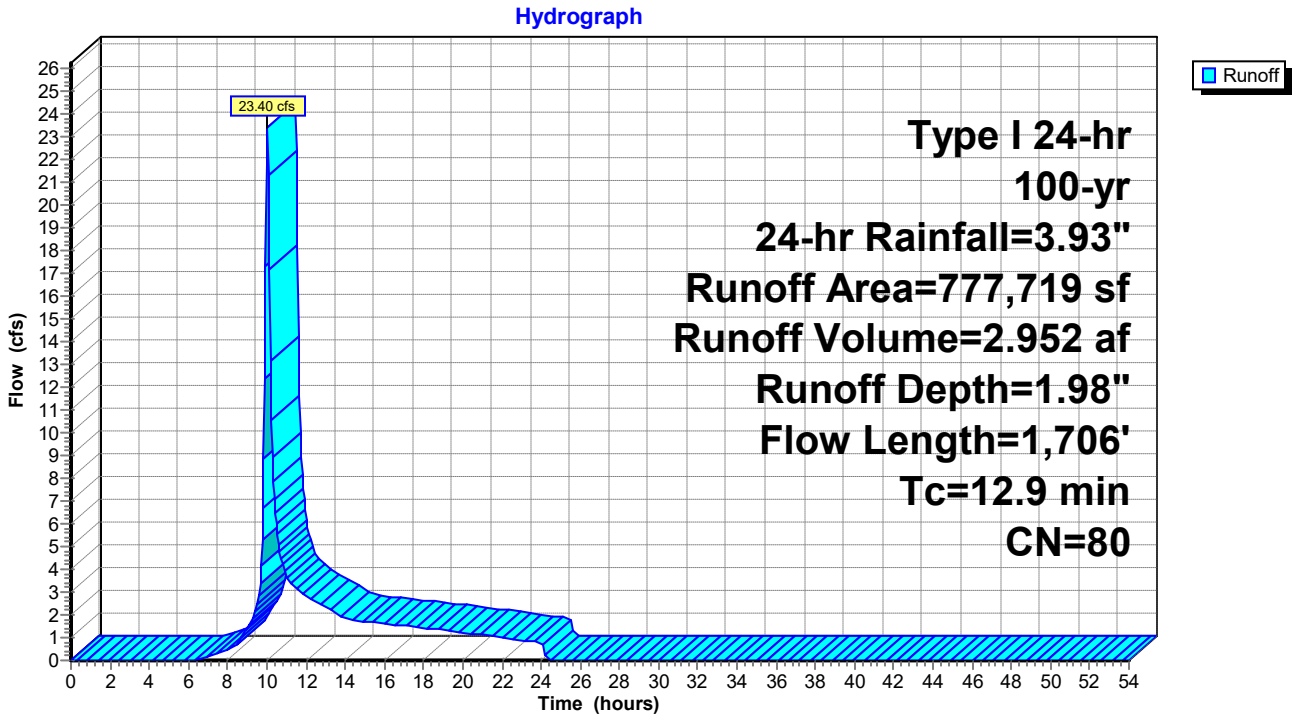
Runoff = 23.40 cfs @ 10.05 hrs, Volume= 2.952 af, Depth= 1.98"
Routed to Reach 3R : DITCH #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-yr, 24-hr Rainfall=3.93"

Area (sf)	CN	Description
777,719	80	Pasture/grassland/range, Good, HSG D
777,719		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
1.9	355	0.1905	3.06		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
3.7	1,251	0.0120	5.71	39.97	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=1.00' Z= 3.0 '/' Top.W=10.00' n= 0.022 Earth, clean & straight
12.9	1,706	Total			

Subcatchment 2S: DRAINAGE AREA 2



Summary for Subcatchment 3S: DRAINAGE AREA 3

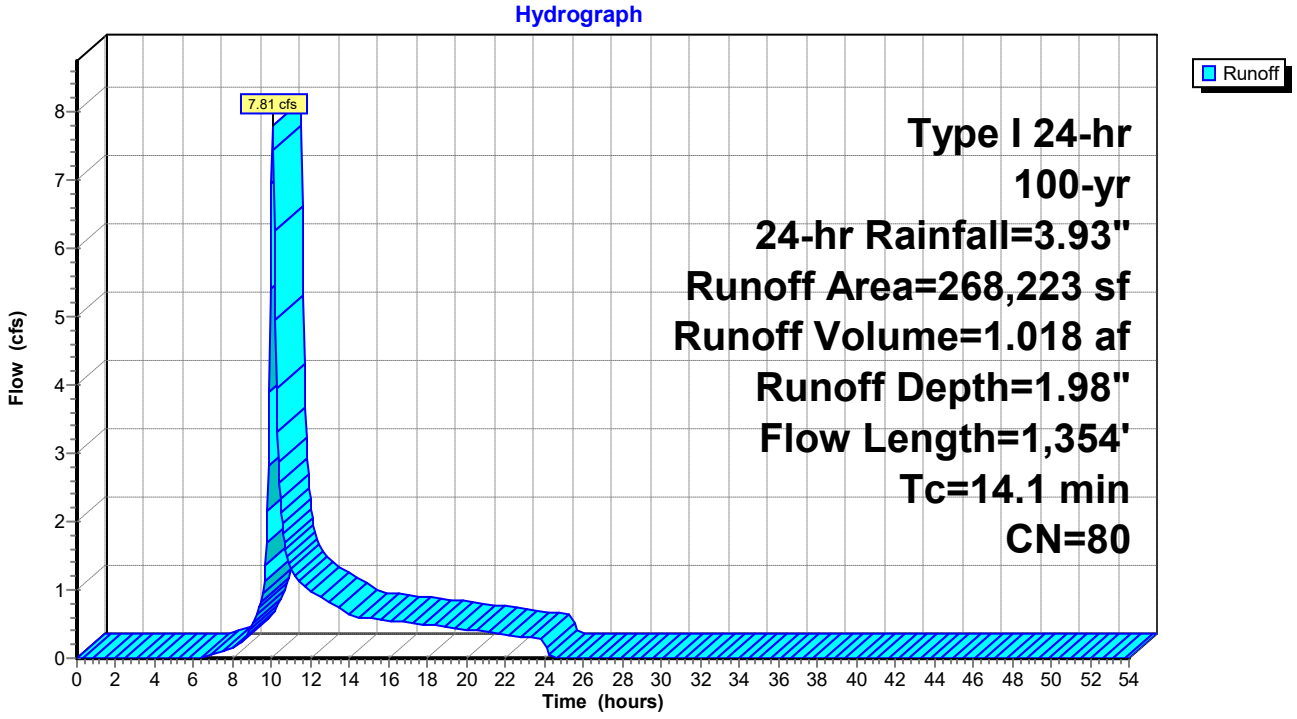
Runoff = 7.81 cfs @ 10.06 hrs, Volume= 1.018 af, Depth= 1.98"
Routed to Reach 5R : DITCH #2

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-yr, 24-hr Rainfall=3.93"

Area (sf)	CN	Description
268,223	80	Pasture/grassland/range, Good, HSG D
268,223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.3	100	0.1000	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
3.6	550	0.1317	2.54		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
2.4	617	0.0090	4.23	19.82	**Trap/Vee/Rect Channel Flow,** Bot.W=4.00' D=0.75' Z= 3.0 '/' Top.W=8.50' n= 0.022 Earth, clean & straight
0.8	87	0.0688	1.84		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
14.1	1,354	Total			

Subcatchment 3S: DRAINAGE AREA 3



Summary for Subcatchment 4S: DRAINAGE AREA 4

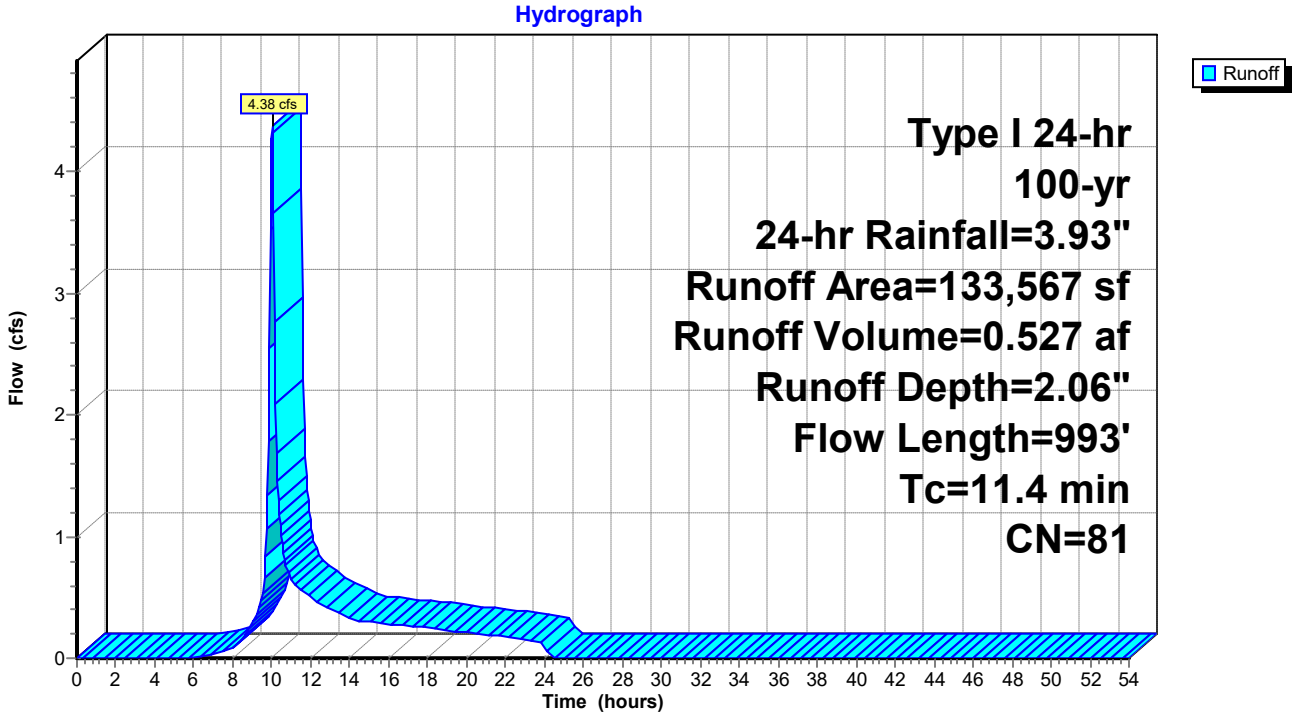
Runoff = 4.38 cfs @ 10.03 hrs, Volume= 0.527 af, Depth= 2.06"
Routed to Reach 7R : CULVERT #1

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-yr, 24-hr Rainfall=3.93"

	Area (sf)	CN	Description
*	6,582	96	Gravel surface, HSG D
	126,985	80	Pasture/grassland/range, Good, HSG D
	133,567	81	Weighted Average
	133,567		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.1	100	0.1057	0.23		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.9	457	0.1389	2.61		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
1.4	436	0.0460	5.01	9.40	**Trap/Vee/Rect Channel Flow,** Bot.W=0.00' D=0.50' Z= 3.0 & 12.0 '/' Top.W=7.50' n= 0.025 Earth, clean & winding
11.4	993	Total			

Subcatchment 4S: DRAINAGE AREA 4



Summary for Subcatchment 5S: DRAINAGE AREA 5

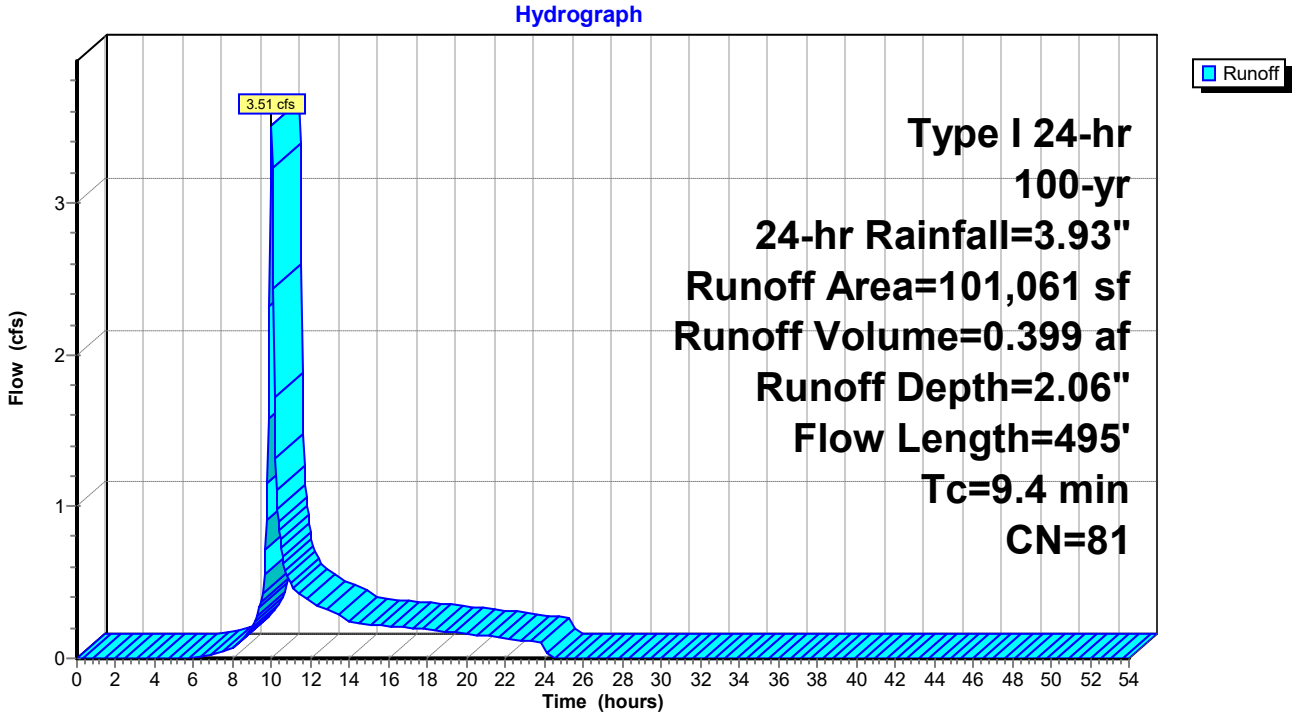
Runoff = 3.51 cfs @ 10.00 hrs, Volume= 0.399 af, Depth= 2.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Type I 24-hr 100-yr, 24-hr Rainfall=3.93"

	Area (sf)	CN	Description
*	7,957	96	Gravel surface, HSG D
	93,104	80	Pasture/grassland/range, Good, HSG D
	101,061	81	Weighted Average
	101,061		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.8	100	0.1177	0.24		**Sheet Flow,** Grass: Short n= 0.150 P2= 1.59"
2.6	395	0.1348	2.57		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
9.4	495	Total			

Subcatchment 5S: DRAINAGE AREA 5



Summary for Reach 3R: DITCH #1

Inflow Area = 17.854 ac, 0.00% Impervious, Inflow Depth = 1.98" for 100-yr, 24-hr event
Inflow = 23.40 cfs @ 10.05 hrs, Volume= 2.952 af
Outflow = 20.78 cfs @ 10.20 hrs, Volume= 2.952 af, Atten= 11%, Lag= 9.2 min

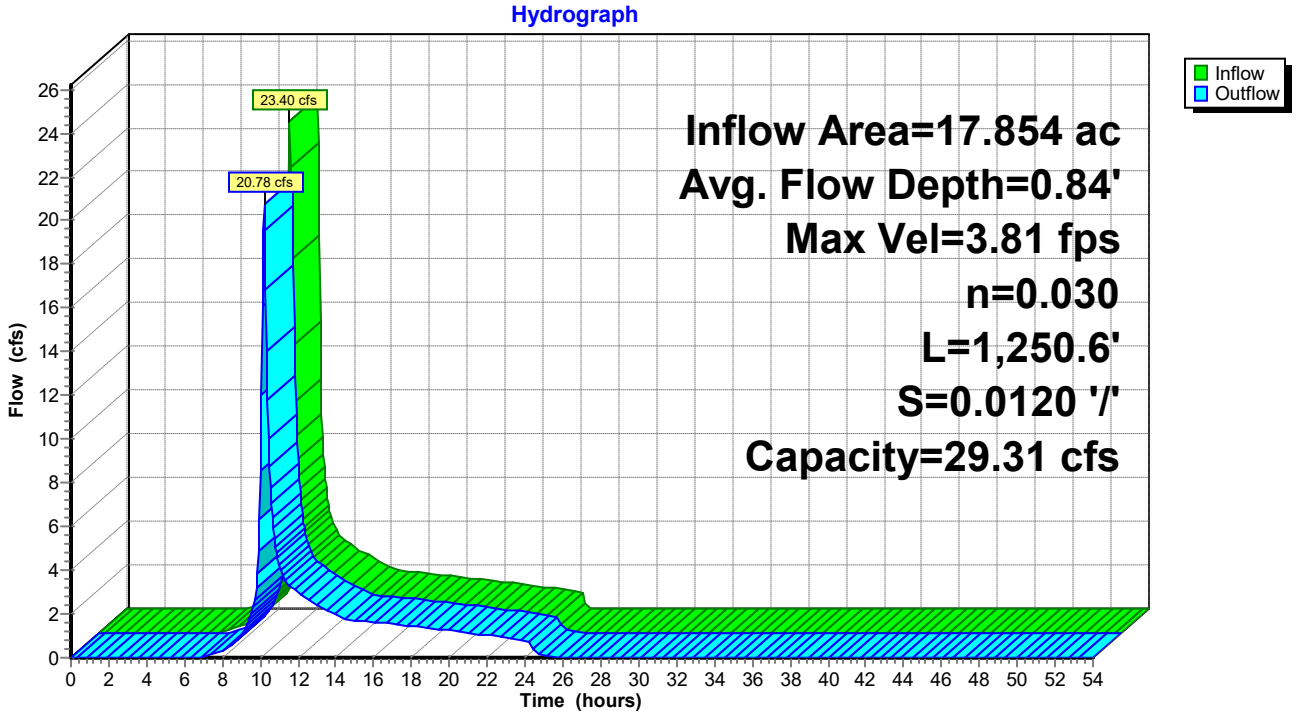
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.81 fps, Min. Travel Time= 5.5 min
Avg. Velocity = 1.16 fps, Avg. Travel Time= 17.9 min

Peak Storage= 6,877 cf @ 10.11 hrs
Average Depth at Peak Storage= 0.84' , Surface Width= 9.05'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 29.31 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 1,250.6' Slope= 0.0120 '/'
Inlet Invert= 429.00', Outlet Invert= 414.00'

‡

Reach 3R: DITCH #1



Summary for Reach 5R: DITCH #2

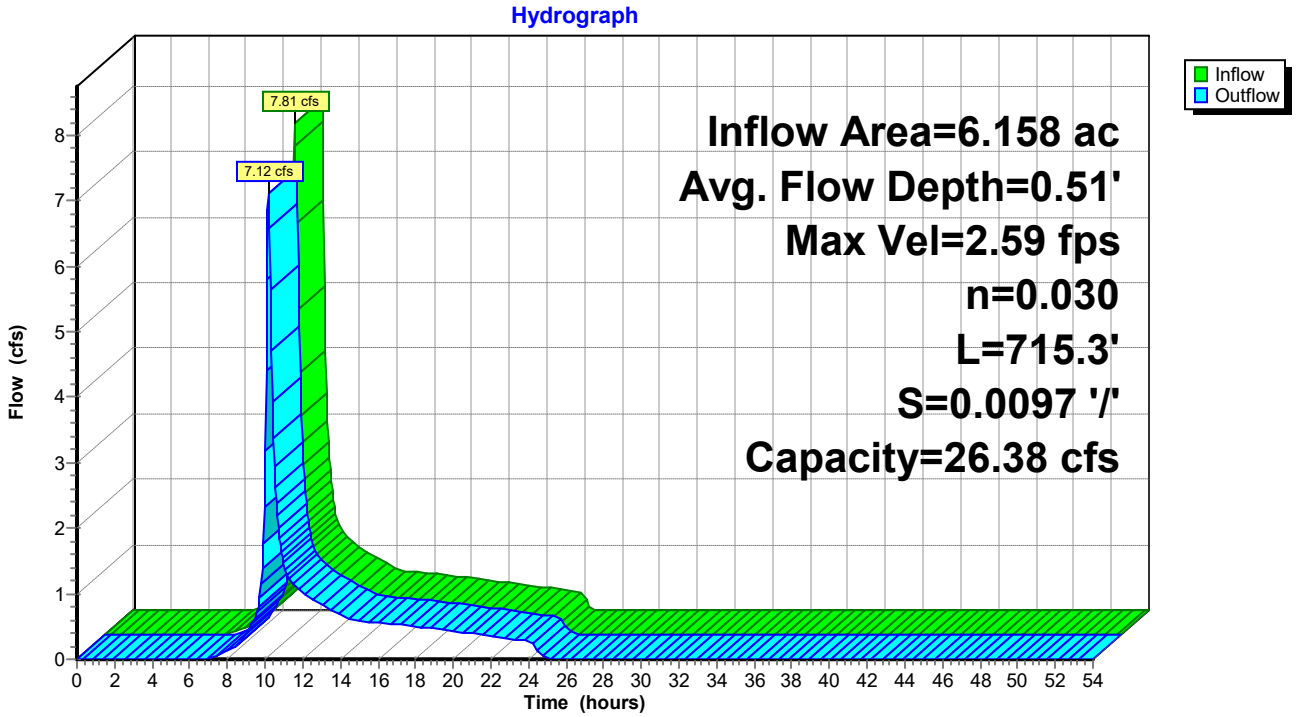
Inflow Area = 6.158 ac, 0.00% Impervious, Inflow Depth = 1.98" for 100-yr, 24-hr event
Inflow = 7.81 cfs @ 10.06 hrs, Volume= 1.018 af
Outflow = 7.12 cfs @ 10.19 hrs, Volume= 1.018 af, Atten= 9%, Lag= 7.9 min
Routed to Reach 7R : CULVERT #1

Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.59 fps, Min. Travel Time= 4.6 min
Avg. Velocity = 0.85 fps, Avg. Travel Time= 14.0 min

Peak Storage= 1,996 cf @ 10.11 hrs
Average Depth at Peak Storage= 0.51' , Surface Width= 7.03'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 26.38 cfs

4.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 715.3' Slope= 0.0097 '/'
Inlet Invert= 429.00', Outlet Invert= 422.05'

‡



Summary for Reach 7R: CULVERT #1

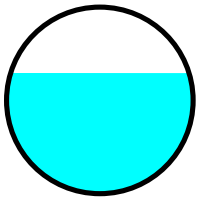
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 9.224 ac, 0.00% Impervious, Inflow Depth = 2.01" for 100-yr, 24-hr event
Inflow = 9.62 cfs @ 10.14 hrs, Volume= 1.545 af
Outflow = 9.60 cfs @ 10.14 hrs, Volume= 1.545 af, Atten= 0%, Lag= 0.3 min

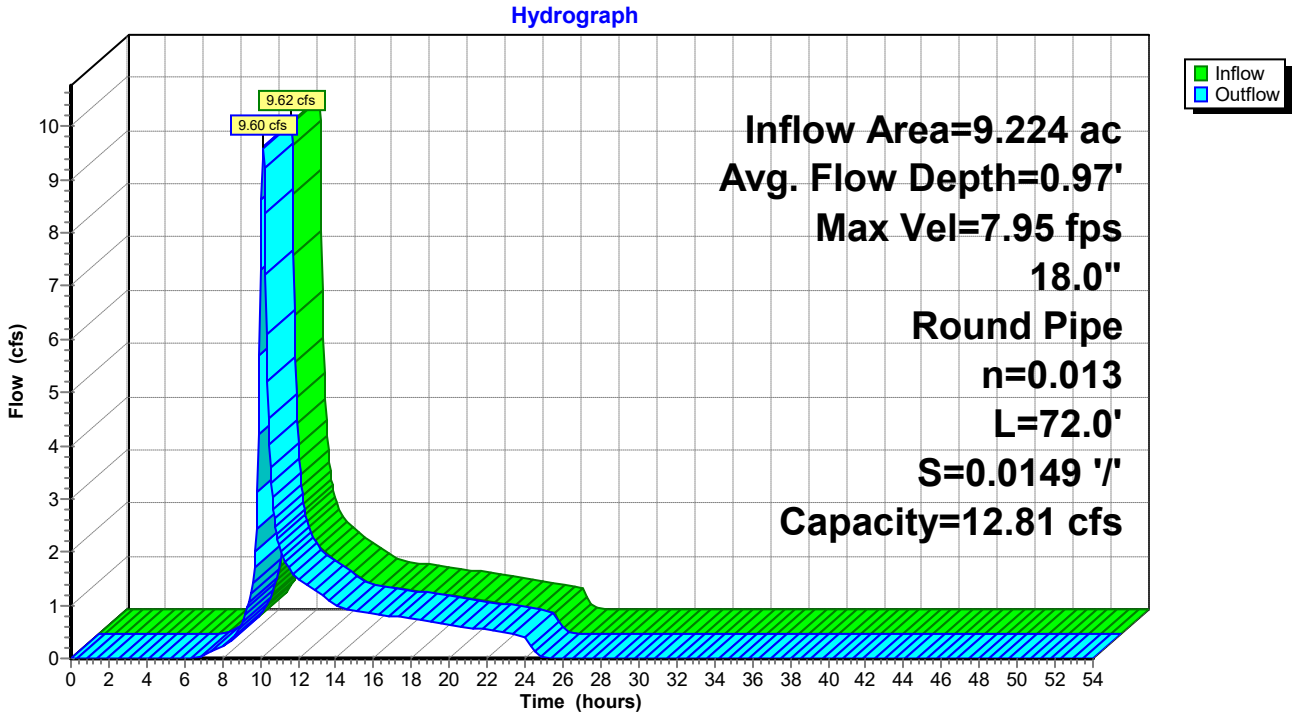
Routing by Stor-Ind+Trans method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Max. Velocity= 7.95 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 3.22 fps, Avg. Travel Time= 0.4 min

Peak Storage= 87 cf @ 10.14 hrs
Average Depth at Peak Storage= 0.97' , Surface Width= 1.43'
Defined Flood Depth= 423.67' Flow Area= 85.9 sf, Capacity= -15,110.35 cfs
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 12.81 cfs

18.0" Round Pipe
n= 0.013
Length= 72.0' Slope= 0.0149 '/'
Inlet Invert= 415.95', Outlet Invert= 414.88'



Reach 7R: CULVERT #1



Summary for Pond 2P: POND

Inflow Area = 7.825 ac, 0.00% Impervious, Inflow Depth = 3.05" for 100-yr, 24-hr event
Inflow = 19.40 cfs @ 9.96 hrs, Volume= 1.989 af
Outflow = 1.46 cfs @ 12.38 hrs, Volume= 1.607 af, Atten= 92%, Lag= 145.5 min
Primary = 1.46 cfs @ 12.38 hrs, Volume= 1.607 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-54.00 hrs, dt= 0.05 hrs
Peak Elev= 413.45' @ 12.38 hrs Surf.Area= 15,230 sf Storage= 42,690 cf
Flood Elev= 415.00' Surf.Area= 18,000 sf Storage= 68,443 cf

Plug-Flow detention time= 453.3 min calculated for 1.605 af (81% of inflow)
Center-of-Mass det. time= 349.5 min (1,097.5 - 748.0)

Volume	Invert	Avail.Storage	Storage Description
#1	410.00'	68,443 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

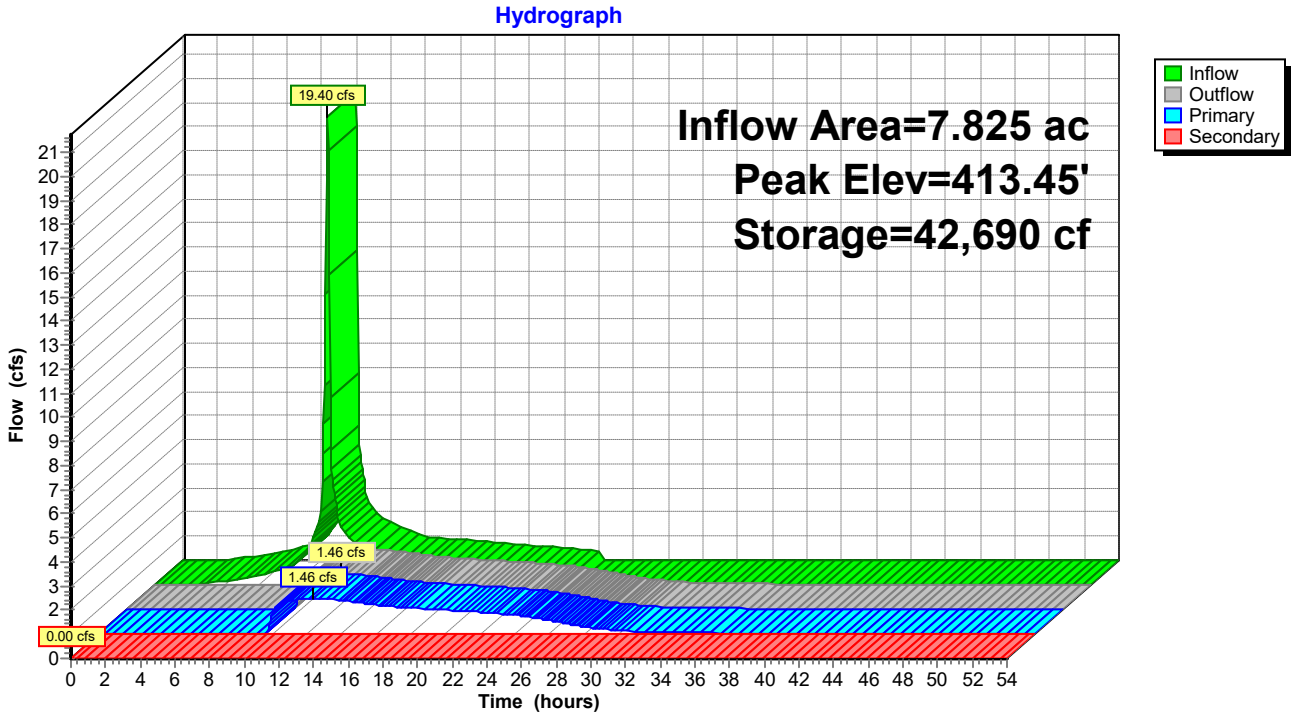
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
410.00	9,667	0	0
411.00	11,189	10,428	10,428
412.00	12,783	11,986	22,414
413.00	14,449	13,616	36,030
414.00	16,188	15,319	51,349
415.00	18,000	17,094	68,443

Device	Routing	Invert	Outlet Devices
#1	Primary	410.00'	**12.0" Round Culvert** L= 44.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 410.00' / 409.00' S= 0.0227 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	411.50'	**6.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Device 1	413.00'	**4.0" Vert. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#4	Device 1	414.00'	**24.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#5	Secondary	414.00'	**Custom Weir/Orifice, Cv= 2.62 (C= 3.28)** Head (feet) 0.00 1.00 Width (feet) 12.00 18.00

Primary OutFlow Max=1.46 cfs @ 12.38 hrs HW=413.45' (Free Discharge)
└─**1=Culvert** (Passes 1.46 cfs of 5.13 cfs potential flow)
  ├─**2=Orifice/Grate** (Orifice Controls 1.23 cfs @ 6.28 fps)
  ├─**3=Orifice/Grate** (Orifice Controls 0.22 cfs @ 2.56 fps)
  └─**4=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=410.00' (Free Discharge)
└─**5=Custom Weir/Orifice** (Controls 0.00 cfs)

Pond 2P: POND


Hydrograph
Inflow Area=7.825 ac
Peak Elev=413.45'
Storage=42,690 cf
19.40 cfs
1.46 cfs
1.46 cfs
0.00 cfs
Inflow
Outflow
Primary
Secondary
Flow (cfs)
Time (hours)

APPENDIX E – NRCS WEB SOIL SURVEY

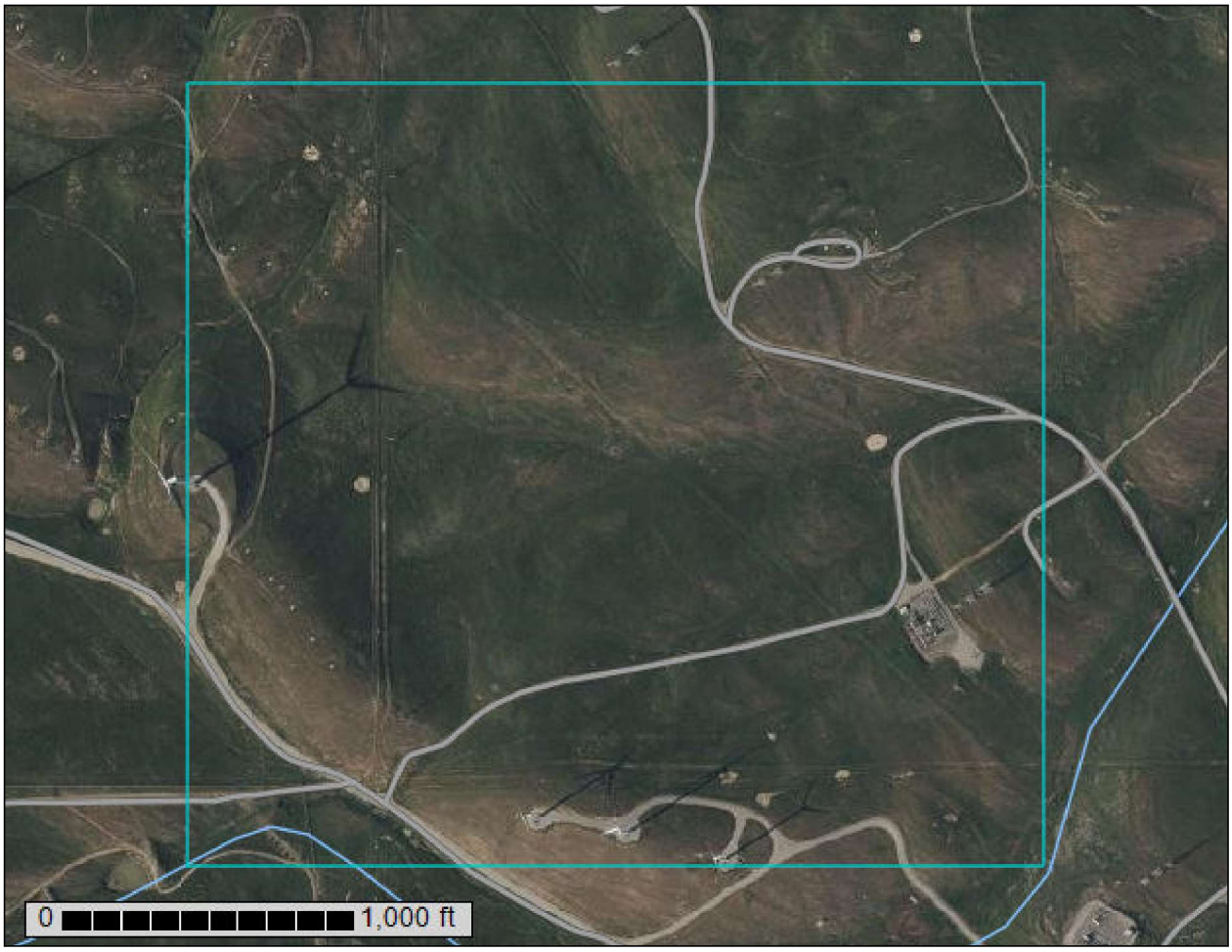
United States Department of Agriculture

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 Alameda Area, California



December 2, 2024

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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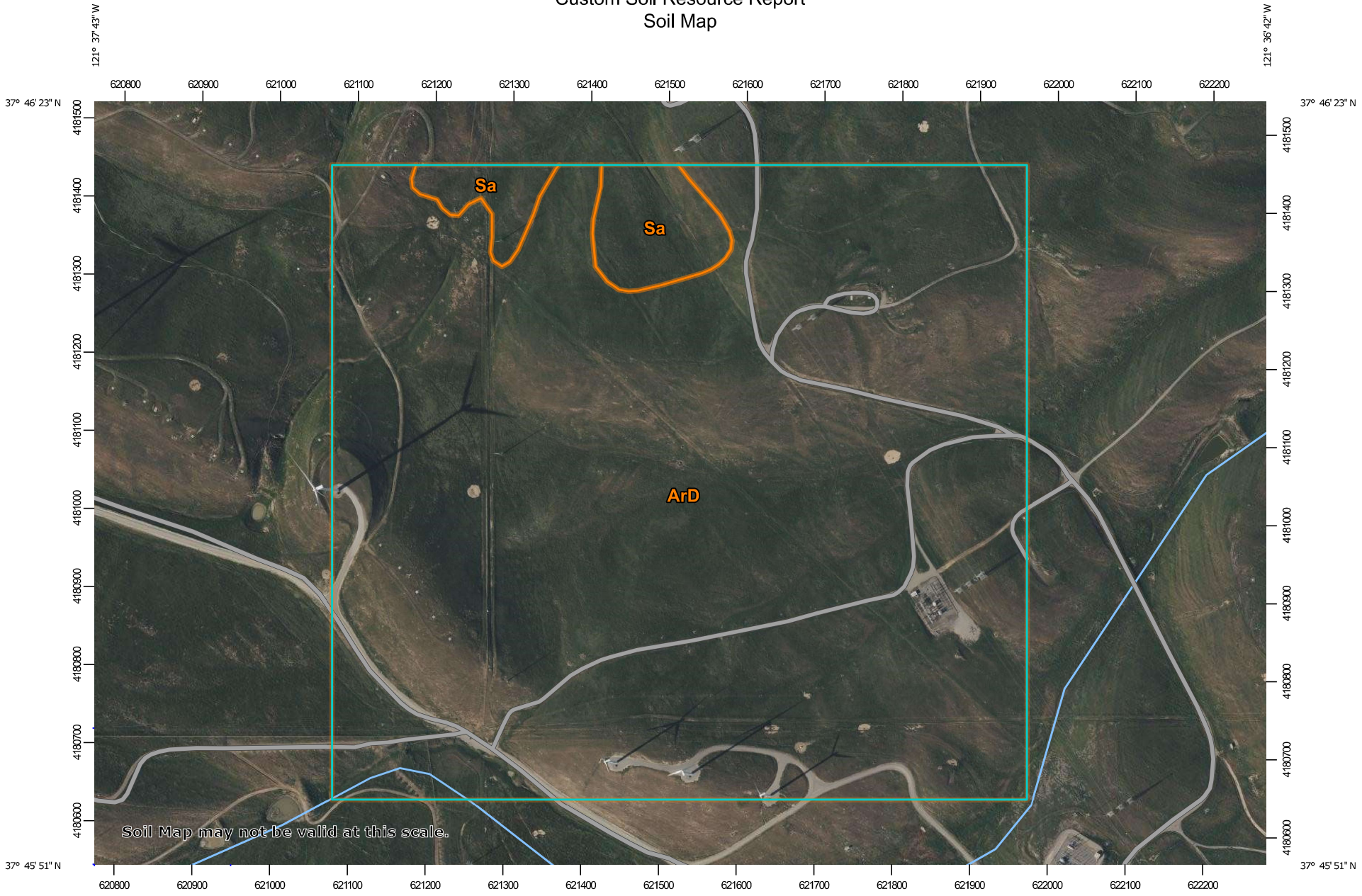
Contents

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.

Custom Soil Resource Report
Soil Map



Map Scale: 1:6,890 if printed on A landscape (11" x 8.5") sheet.

N

Meters: 0 100 200 400 600

Feet: 0 300 600 1200 1800

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 10N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

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: Alameda Area, California
Survey Area Data: Version 18, Sep 9, 2024

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

Date(s) aerial images were photographed: Mar 9, 2022—Mar 11, 2022

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
ArD	Altamont rocky clay, moderately deep, 7 to 30 percent slopes	171.6	95.3%
Sa	San Ysidro loam, 0 to 2 percent slopes, MLRA 14	8.5	4.7%
Totals for Area of Interest		**180.1**	**100.0%**

Map Unit Descriptions

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

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

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

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

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

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

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

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

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

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

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

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

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

Alameda Area, California

ArD—Altamont rocky clay, moderately deep, 7 to 30 percent slopes

Map Unit Setting

National map unit symbol: hb2s
Elevation: 700 to 1,700 feet
Mean annual precipitation: 10 to 15 inches
Mean annual air temperature: 57 degrees F
Frost-free period: 240 to 260 days
Farmland classification: Not prime farmland

Map Unit Composition

Altamont and similar soils: 70 percent
Minor components: 30 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Altamont

Setting

Landform: Hills
Landform position (two-dimensional): Backslope
Landform position (three-dimensional): Side slope
Down-slope shape: Convex
Across-slope shape: Convex
Parent material: Residuum weathered from sandstone and shale

Typical profile

H1 - 0 to 20 inches: clay
H2 - 20 to 28 inches: clay
H3 - 28 to 32 inches: weathered bedrock

Properties and qualities

Slope: 7 to 30 percent
Depth to restrictive feature: 18 to 36 inches to paralithic bedrock
Drainage class: Well drained
Runoff class: High
Capacity of the most limiting layer to transmit water (Ksat): Very low (0.00 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Calcium carbonate, maximum content: 15 percent
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.3 inches)

Interpretive groups

Land capability classification (irrigated): 4e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: D
Ecological site: R015XD137CA - CLAYEY HILLS
Hydric soil rating: No

Minor Components

Rock outcrop

Percent of map unit: 15 percent

Hydric soil rating: No

Diablo

Percent of map unit: 6 percent
Hydric soil rating: No

Linne

Percent of map unit: 5 percent
Hydric soil rating: No

Clear lake

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

Pescadero

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

Sa—San Ysidro loam, 0 to 2 percent slopes, MLRA 14

Map Unit Setting

National map unit symbol: 2tyys
Elevation: 70 to 1,990 feet
Mean annual precipitation: 13 to 22 inches
Mean annual air temperature: 59 to 61 degrees F
Frost-free period: 300 to 360 days
Farmland classification: Not prime farmland

Map Unit Composition

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

Description of San Ysidro

Setting

Landform: Terraces, alluvial fans, valley floors
Landform position (two-dimensional): Toeslope, footslope
Landform position (three-dimensional): Tread, talf
Down-slope shape: Linear
Across-slope shape: Linear

Parent material: Alluvium derived from sedimentary rock

Typical profile

A - 0 to 23 inches: loam
B1 - 23 to 38 inches: clay loam
Bt2 - 38 to 64 inches: loam

Properties and qualities

Slope: 0 to 2 percent
Depth to restrictive feature: 16 to 24 inches to abrupt textural change
Drainage class: Moderately well drained
Runoff class: Low
Capacity of the most limiting layer to transmit water (Ksat): Moderately low to moderately high (0.06 to 0.20 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Maximum salinity: Nonsaline to very slightly saline (0.0 to 2.0 mmhos/cm)
Available water supply, 0 to 60 inches: Low (about 4.1 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 4e
Hydrologic Soil Group: C
Ecological site: R014XE029CA - LOAMY CLAYPAN
Hydric soil rating: No

Minor Components

Arbuckle

Percent of map unit: 6 percent
Hydric soil rating: No

Pleasanton, loam

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

Rincon

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

Solano

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

Palexeralfs

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

Pescadero

Percent of map unit: 1 percent
Landform: Basin floors
Landform position (two-dimensional): Toeslope
Landform position (three-dimensional): Talf
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: Yes

Cropley, clay

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

Soil Information for All Uses

Soil Properties and Qualities

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

Soil Qualities and Features

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

Hydrologic Soil Group (Salka Viracocha Hill BESS)

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.

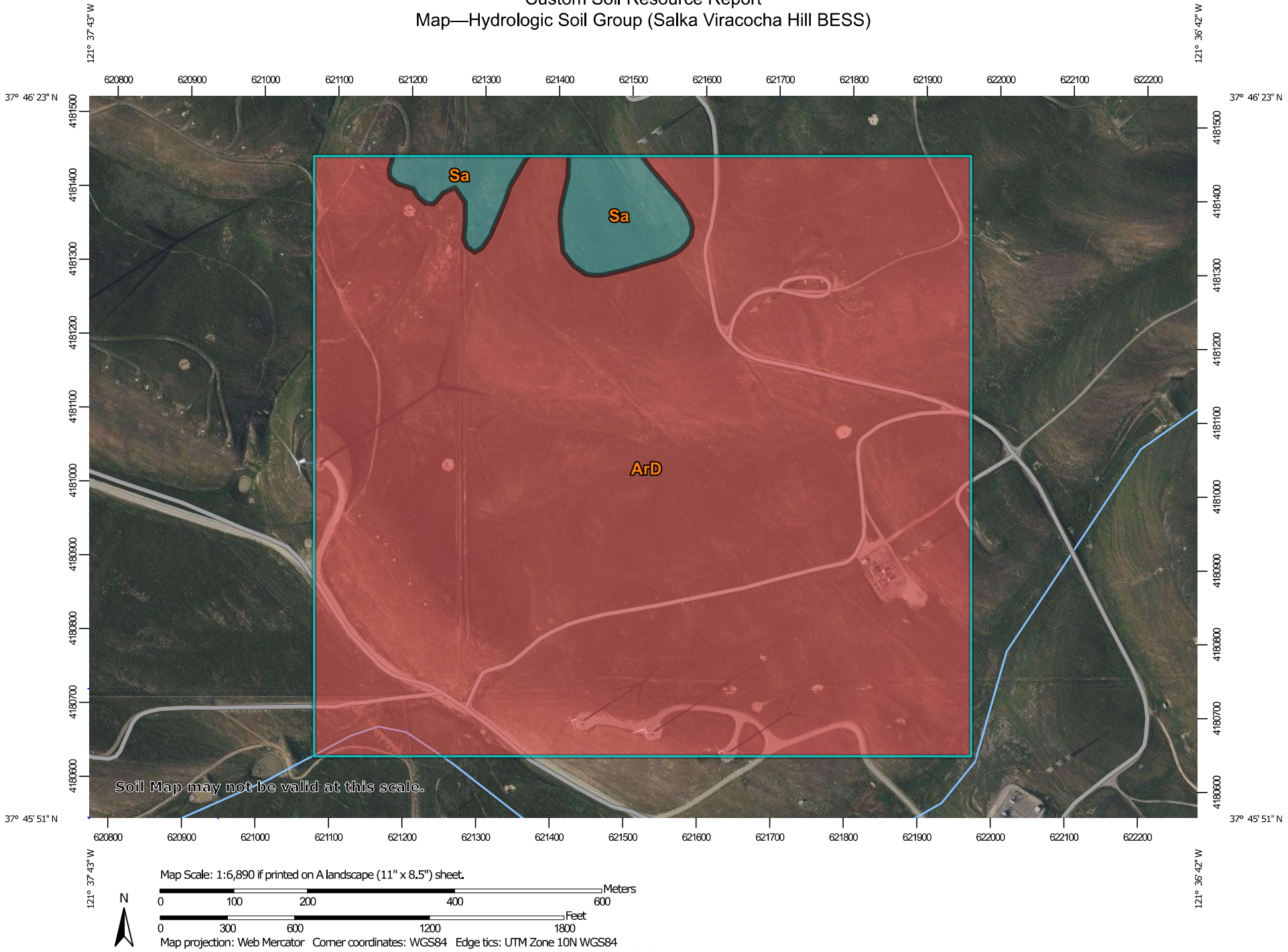
Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

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 (Salka Viracocha Hill BESS)



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 1:20,000.

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: Alameda Area, California
Survey Area Data: Version 18, Sep 9, 2024

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

Date(s) aerial images were photographed: Mar 9, 2022—Mar 11, 2022

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 (Salka Viracocha Hill BESS)

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
ArD	Altamont rocky clay, moderately deep, 7 to 30 percent slopes	D	171.6	95.3%
Sa	San Ysidro loam, 0 to 2 percent slopes, MLRA 14	C	8.5	4.7%
Totals for Area of Interest			**180.1**	**100.0%**

Rating Options—Hydrologic Soil Group (Salka Viracocha Hill BESS)

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

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