Stormwater Management Report

Drainage Calculations
for

Block 1501
Lots 2 & 3
Borough of Westwood, Bergen County, New Jersey

Project Location: 220 Kinderkamack Road, Westwood, N.J.
And
49 Fairview Avenue

Submitted on behalf of:

Westwood Investments, LLC
c/o Kyodo USA
17-01 Pollitt Drive
Fair Lawn, NJ 07410
(201) 213-1956

Prepared by:

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Job No. 17327
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Table of Contents

1. Introduction

This application for commercial and residential development includes these computations regarding the proposed drainage system as shown on the plans entitled, "***Site Plan Block 1501 Lots 2 and 3, Borough of Westwood, Bergen County, New Jersey***", prepared by Canger Engineering Associates, Tranquility, New Jersey dated November 4, 2019, Sheets 1 thru 8.

The overall area of the site is 0.51 acres, consisting of a three-story office building and associated parking area exiting onto Fairview Avenue to the south and a detached dwelling, garage and driveway exiting onto Kinderkamack Road to the north.

The site is limited by size to include a design for any non-structural best management practices, such as constructed wetlands, wet ponds, or water quality swales, which require large areas reserved for stormwater design purposes. It currently utilizes underground seepage pits to handle runoff generated from the site as part of a previous site plan application to the Borough of Westwood. The site is located entirely within urban lands and all surrounding properties are fully developed. This development application does not require any environmental permits from the New Jersey Department of Environmental Protection regarding state open waters, wetlands and wetland buffers, or flood hazard areas.

The subject property is located in the CO Central Office District Zone. The existing residential dwelling and driveway area currently located on the site will be removed. The existing parking area for the office building will be relocated to access Kinderkamack Road. The site will be improved with a proposed townhouse building, associated walkways and driveways, which will access Fairview Avenue.

A stormwater collection system has been provided to collect the excess stormwater runoff from the parking area and detain it within a series of seepage pits. The proposed storm drain system includes concrete curb, inlet, a trench grate, plastic pipe, and reinforced concrete seepage rings and pits. Access manholes have also been provided for periodic maintenance of the system, as required.

The drainage system has been designed to work using gravity and other natural forces. There are no mechanical systems associated with the design. The maintenance for this system includes periodic inspections and removal of sediment material accumulations via access manholes are provided atop the seepage rings. The existing seepage pits on site will also be utilized.

The proposed stormwater collection system has been designed to safely convey the receiving runoff. The proposed system collects runoff, provides detention, and recharges the stormwater back into the existing ground water aquifer.

2. Methodology

In order to compare the pre and post development discharge rates for the property, drainages calculation were prepared utilizing the Modified Rational Method.

The individual ***drainage areas*** are defined and analyzed under both pre-development and post development scenarios. The general design standards have been implemented in accordance with local Municipal Stormwater Management Ordinances.

The ***runoff coefficients*** represent the characteristics of the surface of the ground and its ability to allow or prevent stormwater runoff from advancing. Once the appropriate runoff curve numbers are designated for the vegetated and improved conditions, a ***weighted runoff coefficient*** is then computed to represent the runoff characteristics of the overall contributory areas.

The ***time of concentration*** is the elapsed duration for the stormwater runoff to travel from the most remote point within the watershed to the point of discharge being considered. An averaged time of concentration is utilized with the coinciding ***rainfall amounts*** obtained from the appropriate ***New Jersey 24 Hour Rainfall Frequency Data***.

The individual ***drainage areas*** are factored with the corresponding ***type of rainfall***, the ***rainfall amounts*** and ***weighted runoff coefficients*** to determine the pre and post-development peak stormwater runoff rates.

3. Drainage Calculations

Hydrologic Computations – TR55 Methodology

Modified Rational Peak Discharge Method - Existing and Proposed Conditions

- Runoff Coefficients
- Time of Concentration Tc and travel time Tt
- Peak Discharge

Computed Peak Stormwater Discharge Rates for the following: Two (2) Year, Ten (10) Year, Twenty-Five (25) Year, and One Hundred (100) Year Storms

Project Description

File Name	Drainage Report November 7, 2019 Pre Development 2YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	2
Nodes	2
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	2 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	X-SubArea1	0.11	0.6700	2.31	1.55	0.17	0.17	0 00:16:01
2	X-SubArea2	0.41	0.6700	2.31	1.55	0.63	0.63	0 00:16:01

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PointDischarge1	Outfall	68.00					0.00	0.00					
2	PointDischarge2	Outfall	68.00					0.00	0.00					

Subbasin Hydrology

Subbasin : X-SubArea1

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	D	0.95
-	0.05	D	0.35
Composite Area & Weighted Runoff Coeff.	0.11		0.67

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

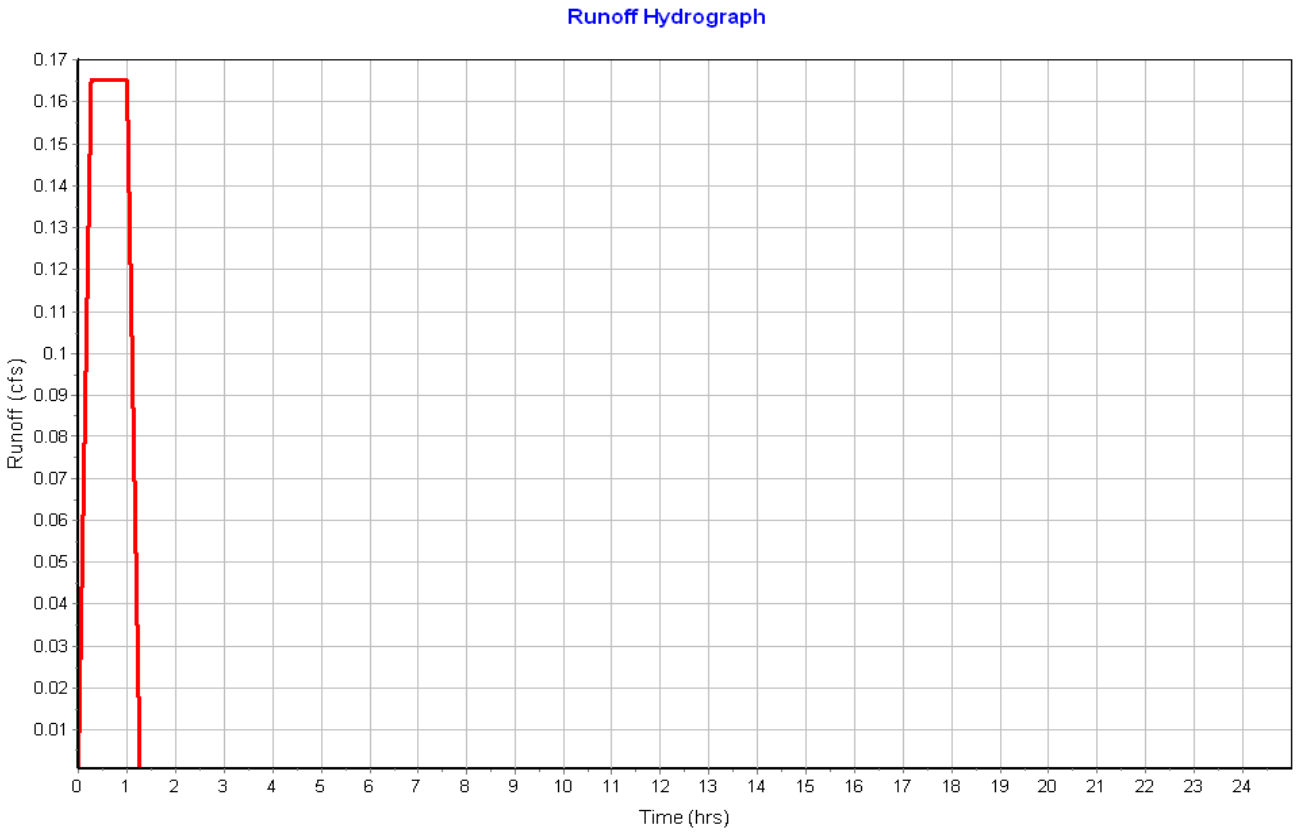
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 2.31
Total Runoff (in) 1.55
Peak Runoff (cfs) 0.17
Rainfall Intensity 2.310
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea1



Subbasin : X-SubArea2

Input Data

Area (ac) 0.41
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.19	D	0.35
-	0.22	D	0.95
Composite Area & Weighted Runoff Coeff.	0.41		0.67

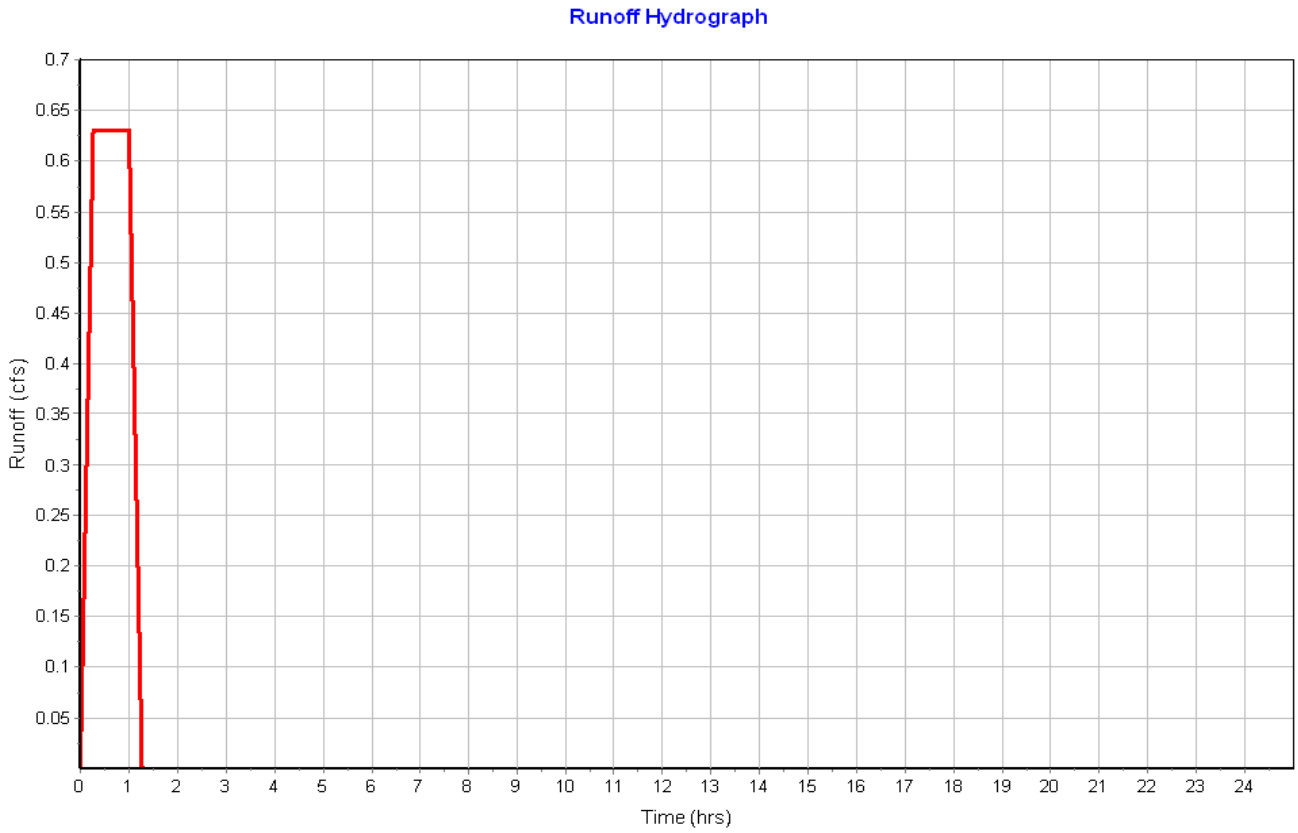
Time of Concentration

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 2.31
Total Runoff (in) 1.55
Peak Runoff (cfs) 0.63
Rainfall Intensity 2.310
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea2



Project Description

File Name	Drainage Report November 7, 2019 Pre Development 10YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	2
Nodes	2
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	10 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	X-SubArea1	0.11	0.6700	3.22	2.16	0.23	0.23	0 00:16:01
2	X-SubArea2	0.41	0.6700	3.22	2.16	0.88	0.88	0 00:16:01

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PointDischarge1	Outfall	68.00					0.00	0.00					
2	PointDischarge2	Outfall	68.00					0.00	0.00					

Subbasin Hydrology

Subbasin : X-SubArea1

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	D	0.95
-	0.05	D	0.35
Composite Area & Weighted Runoff Coeff.	0.11		0.67

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

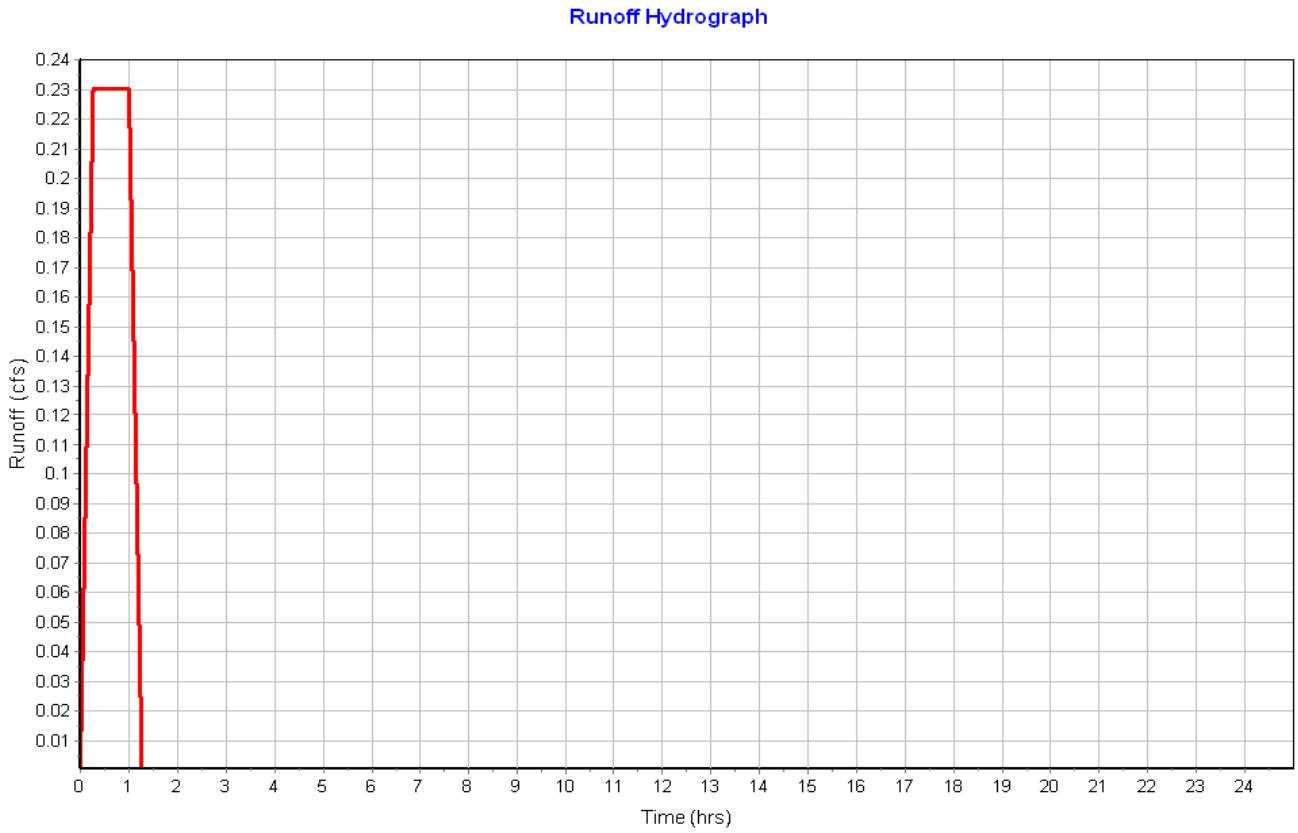
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 3.22
Total Runoff (in) 2.16
Peak Runoff (cfs) 0.23
Rainfall Intensity 3.220
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea1



Subbasin : X-SubArea2

Input Data

Area (ac) 0.41
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.19	D	0.35
-	0.22	D	0.95
Composite Area & Weighted Runoff Coeff.	0.41		0.67

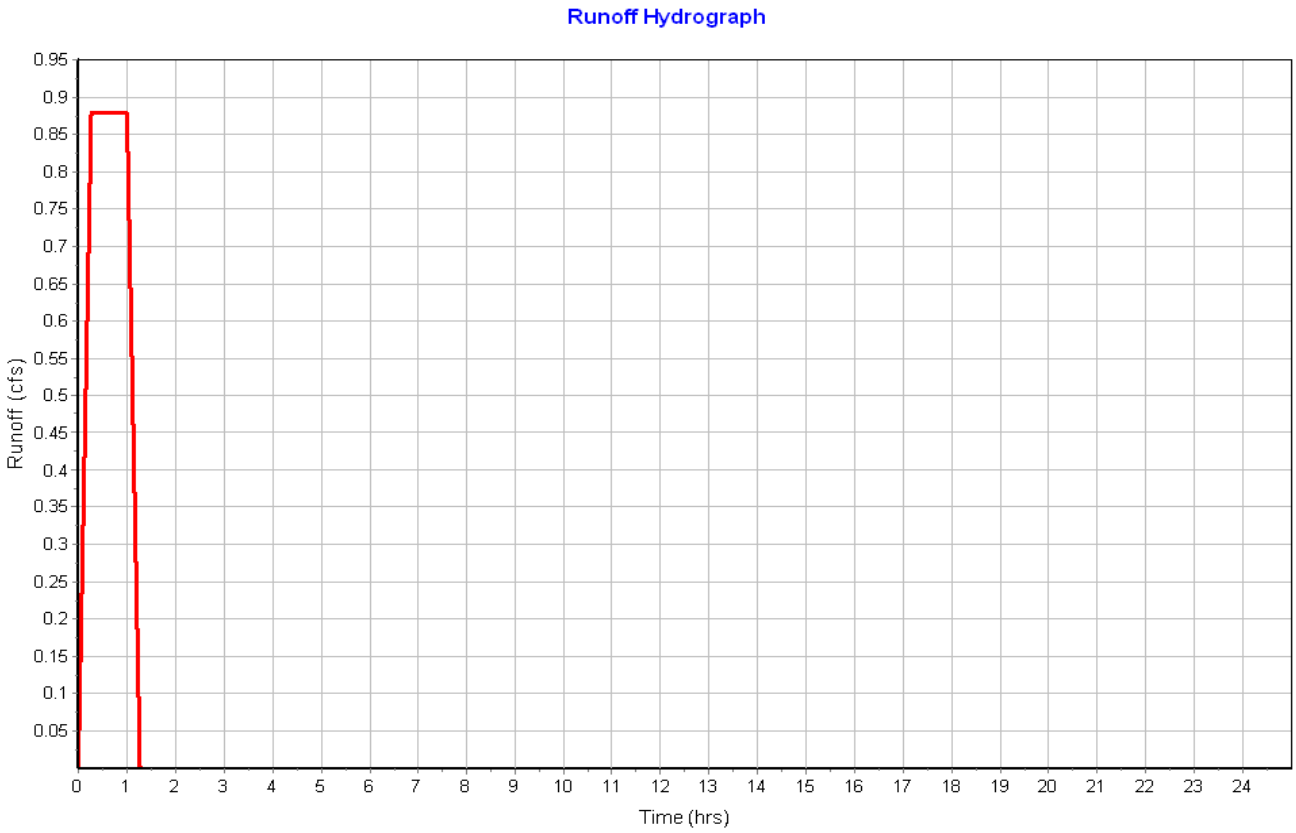
Time of Concentration

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 3.22
Total Runoff (in) 2.16
Peak Runoff (cfs) 0.88
Rainfall Intensity 3.220
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea2



Project Description

File Name	Drainage Report November 7, 2019 Pre Development 25YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	2
Nodes	2
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	25 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	X-SubArea1	0.11	0.6700	3.74	2.51	0.27	0.27	0 00:16:01
2	X-SubArea2	0.41	0.6700	3.74	2.51	1.02	1.02	0 00:16:01

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PointDischarge1	Outfall	68.00					0.00	0.00					
2	PointDischarge2	Outfall	68.00					0.00	0.00					

Subbasin Hydrology

Subbasin : X-SubArea1

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	D	0.95
-	0.05	D	0.35
Composite Area & Weighted Runoff Coeff.	0.11		0.67

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

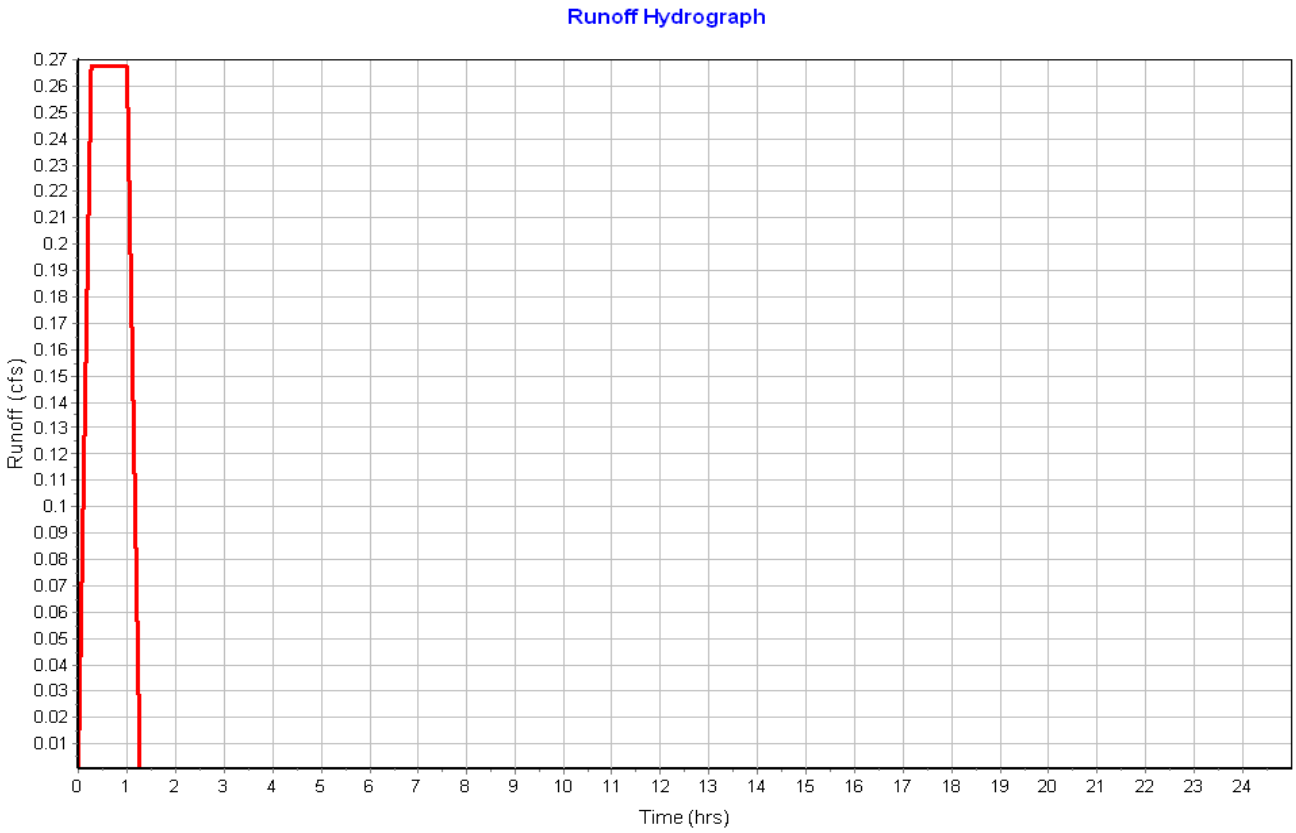
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 3.74
Total Runoff (in) 2.51
Peak Runoff (cfs) 0.27
Rainfall Intensity 3.740
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea1



Subbasin : X-SubArea2

Input Data

Area (ac) 0.41
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.19	D	0.35
-	0.22	D	0.95
Composite Area & Weighted Runoff Coeff.	0.41		0.67

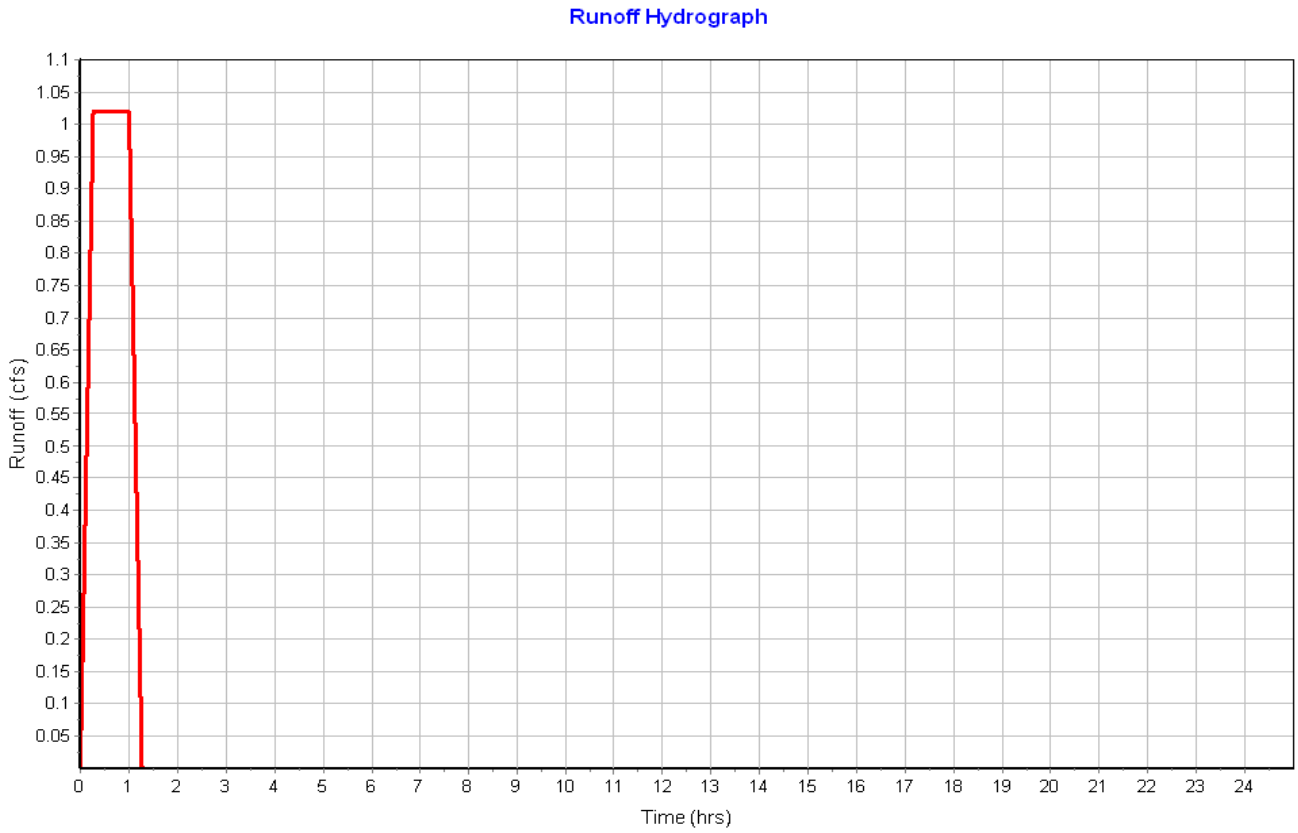
Time of Concentration

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 3.74
Total Runoff (in) 2.51
Peak Runoff (cfs) 1.02
Rainfall Intensity 3.740
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea2



Project Description

File Name	Drainage Report November 7, 2019 Pre Development 100YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	NO

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	2
Nodes	2
Junctions	0
Outfalls	2
Flow Diversions	0
Inlets	0
Storage Nodes	0
Links	0
Channels	0
Pipes	0
Pumps	0
Orifices	0
Weirs	0
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	X-SubArea1	0.11	0.6700	4.80	3.22	0.34	0.34	0 00:16:01
2	X-SubArea2	0.41	0.6700	4.80	3.22	1.31	1.31	0 00:16:01

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	PointDischarge1	Outfall	68.00					0.00	0.00					
2	PointDischarge2	Outfall	68.00					0.00	0.00					

Subbasin Hydrology

Subbasin : X-SubArea1

Input Data

Area (ac) 0.11
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	D	0.95
-	0.05	D	0.35
Composite Area & Weighted Runoff Coeff.	0.11		0.67

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

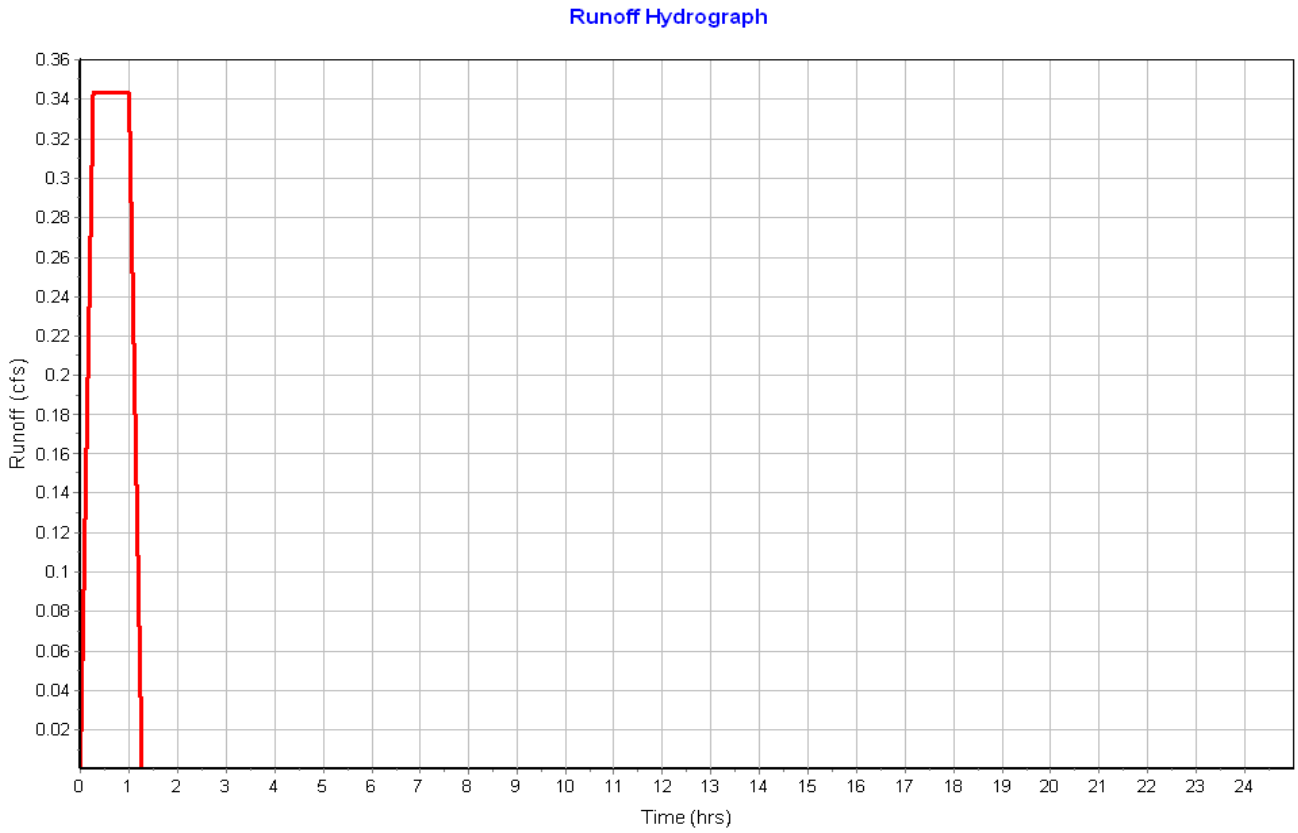
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 4.80
Total Runoff (in) 3.22
Peak Runoff (cfs) 0.34
Rainfall Intensity 4.800
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea1



Subbasin : X-SubArea2

Input Data

Area (ac) 0.41
Weighted Runoff Coefficient 0.6700

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.19	D	0.35
-	0.22	D	0.95
Composite Area & Weighted Runoff Coeff.	0.41		0.67

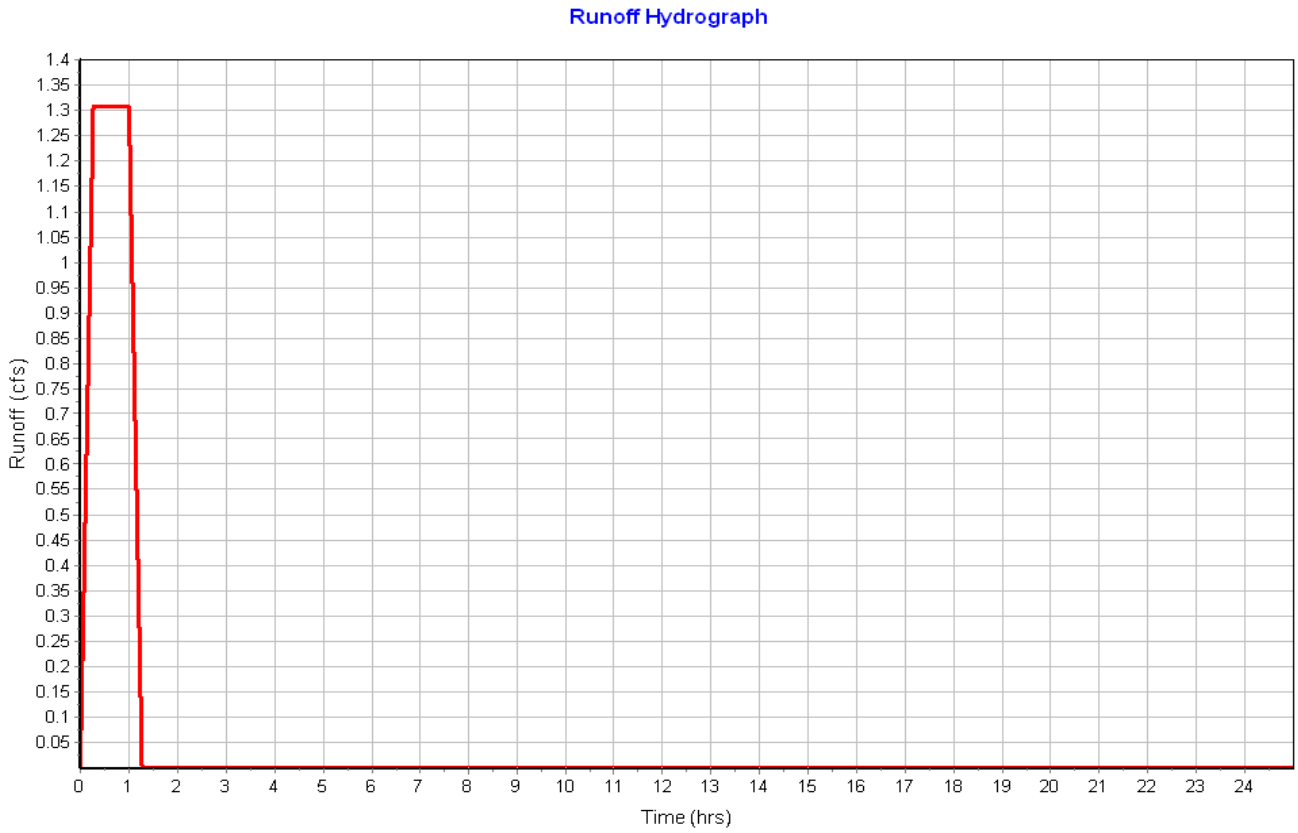
Time of Concentration

User-Defined TOC override (minutes): 16.02

Subbasin Runoff Results

Total Rainfall (in) 4.80
Total Runoff (in) 3.22
Peak Runoff (cfs) 1.31
Rainfall Intensity 4.800
Weighted Runoff Coefficient 0.6700
Time of Concentration (days hh:mm:ss) 0 00:16:01

Subbasin : X-SubArea2



Project Description

File Name	Drainage Report November 7, 2019 Post Development 2YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	4
Nodes	5
Junctions	1
Outfalls	3
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	1
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	2 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	ProposedDrainageAreaNo.1	0.08	0.7200	2.31	1.66	0.13	0.13	0 00:17:02
2	ProposedDrainageAreaNo.2	0.28	0.7200	2.31	1.66	0.47	0.47	0 00:17:02
3	ProposedDrainageAreaNo.2A	0.06	0.7200	2.31	1.66	0.10	0.10	0 00:17:02
4	ProposedDrainageAreaNo.3	0.09	0.7200	2.31	1.66	0.15	0.15	0 00:17:02

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	65.00	69.00	65.00	70.00	0.00	0.24	65.21	0.00	3.79	0 00:00	0.00	0.00
2	Out-1	Outfall	68.00					0.13	68.00					
3	Out-2	Outfall	64.50					0.24	64.71					
4	Out-3	Outfall	68.00					0.15	68.00					
5	Stor-01	Storage Node	65.00	69.00	65.00		0.00	0.57	66.07				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-2	78.00	65.00	64.50	0.6400	12.000	0.0150	0.24	2.47	0.10	1.99	0.21	0.21	0.00	Calculated
2	Orifice-1	Orifice	Stor-01	Jun-01		65.00	65.00		3.000		0.24							
3	Weir-01	Weir	Stor-01	Jun-01		65.00	65.00				0.00							

Subbasin Hydrology

Subbasin : ProposedDrainageAreaNo.1

Input Data

Area (ac) 0.08
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.08	-	0.72
Composite Area & Weighted Runoff Coeff.	0.08		0.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

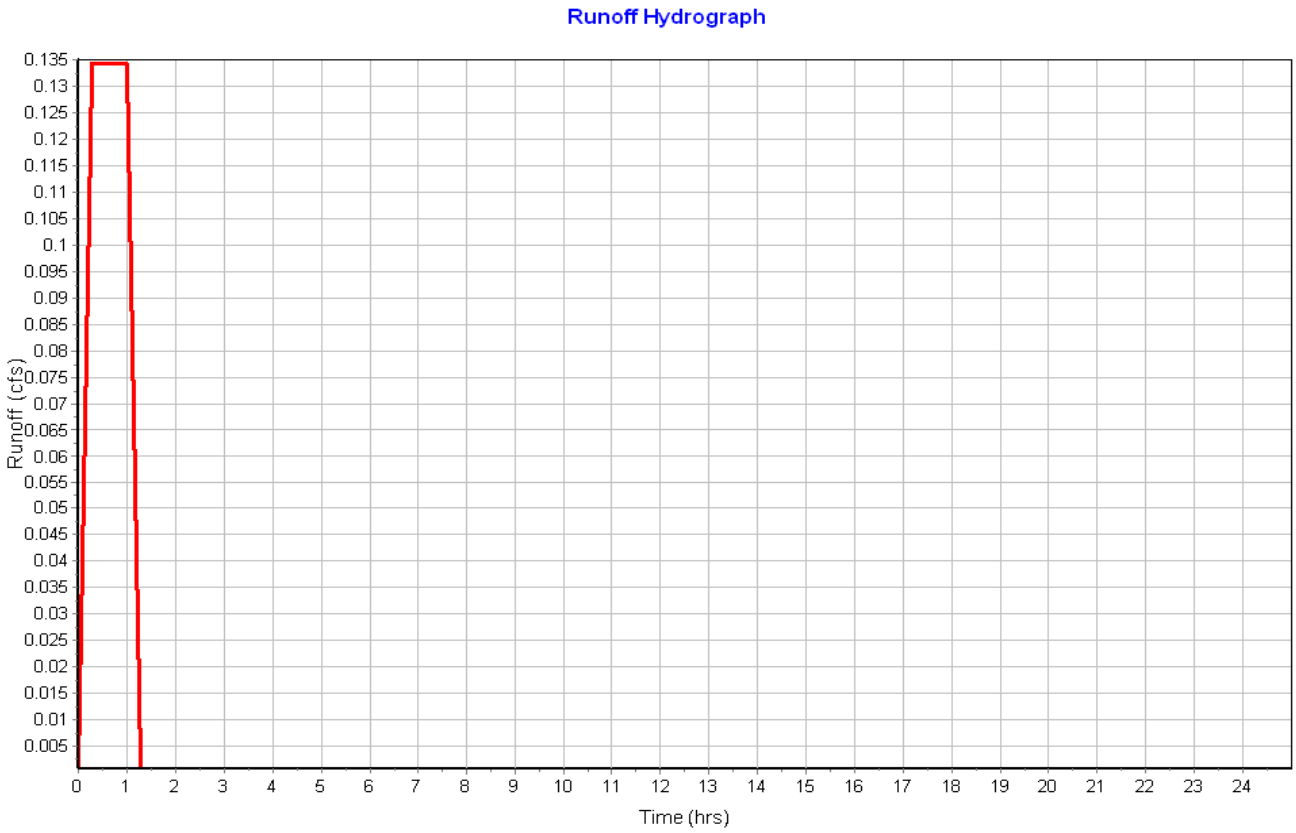
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 2.31
Total Runoff (in) 1.66
Peak Runoff (cfs) 0.13
Rainfall Intensity 2.310
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.1



Subbasin : ProposedDrainageAreaNo.2

Input Data

Area (ac) 0.28
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.20	-	0.72
Composite Area & Weighted Runoff Coeff.	0.20		0.72

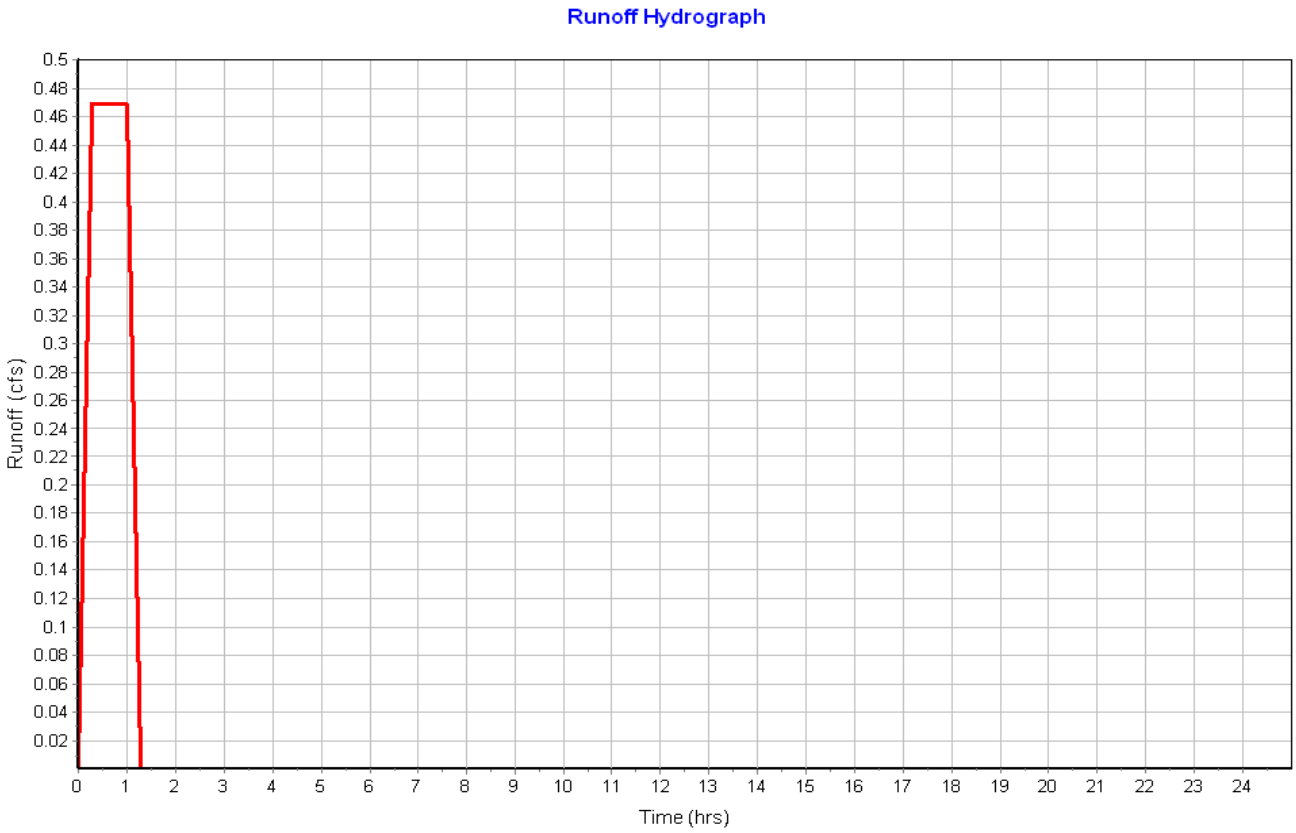
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 2.31
Total Runoff (in) 1.66
Peak Runoff (cfs) 0.47
Rainfall Intensity 2.310
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2



Subbasin : ProposedDrainageAreaNo.2A

Input Data

Area (ac) 0.06
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	-	0.72
Composite Area & Weighted Runoff Coeff.	0.06		0.72

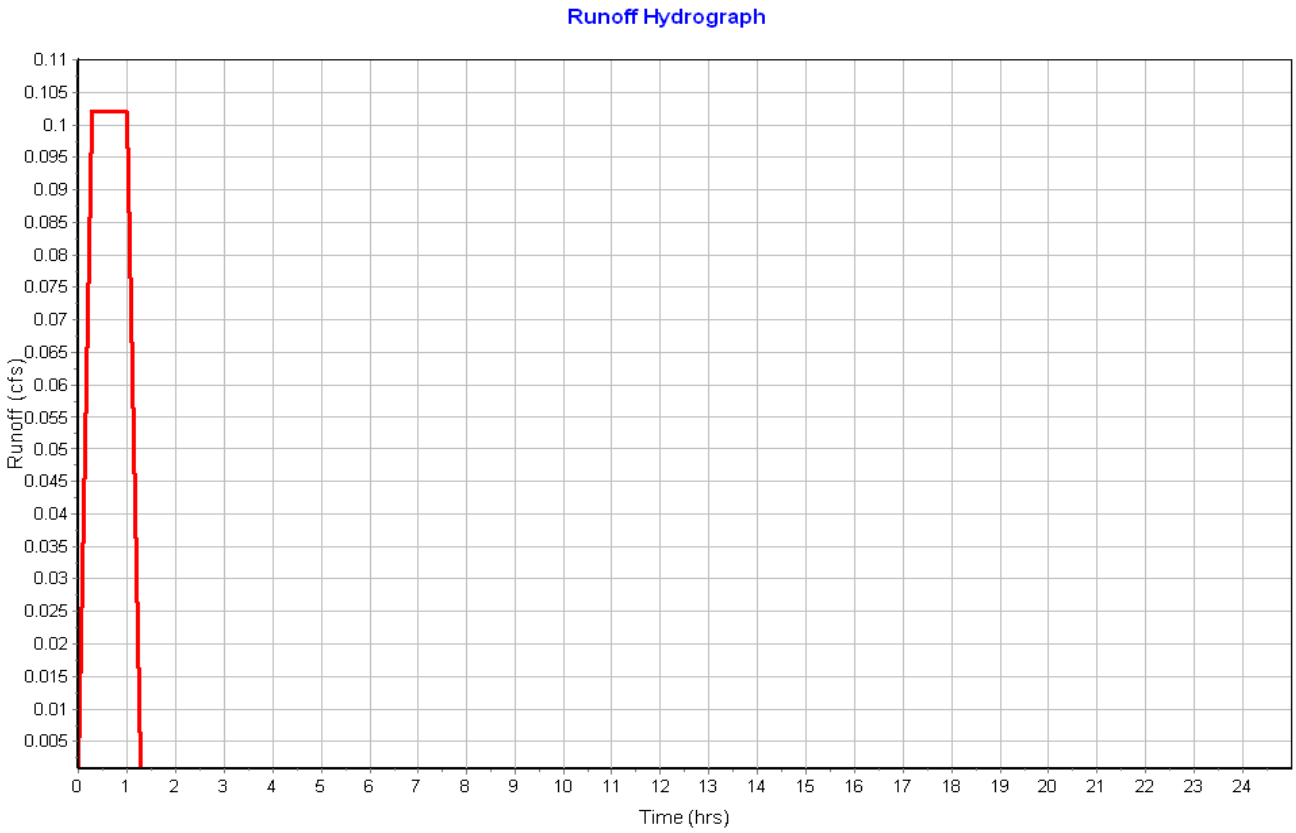
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 2.31
Total Runoff (in) 1.66
Peak Runoff (cfs) 0.10
Rainfall Intensity 2.310
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2A



Subbasin : ProposedDrainageAreaNo.3

Input Data

Area (ac) 0.09
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.09	-	0.72
Composite Area & Weighted Runoff Coeff.	0.09		0.72

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.0	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.34	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	15.93	0.00	0.00

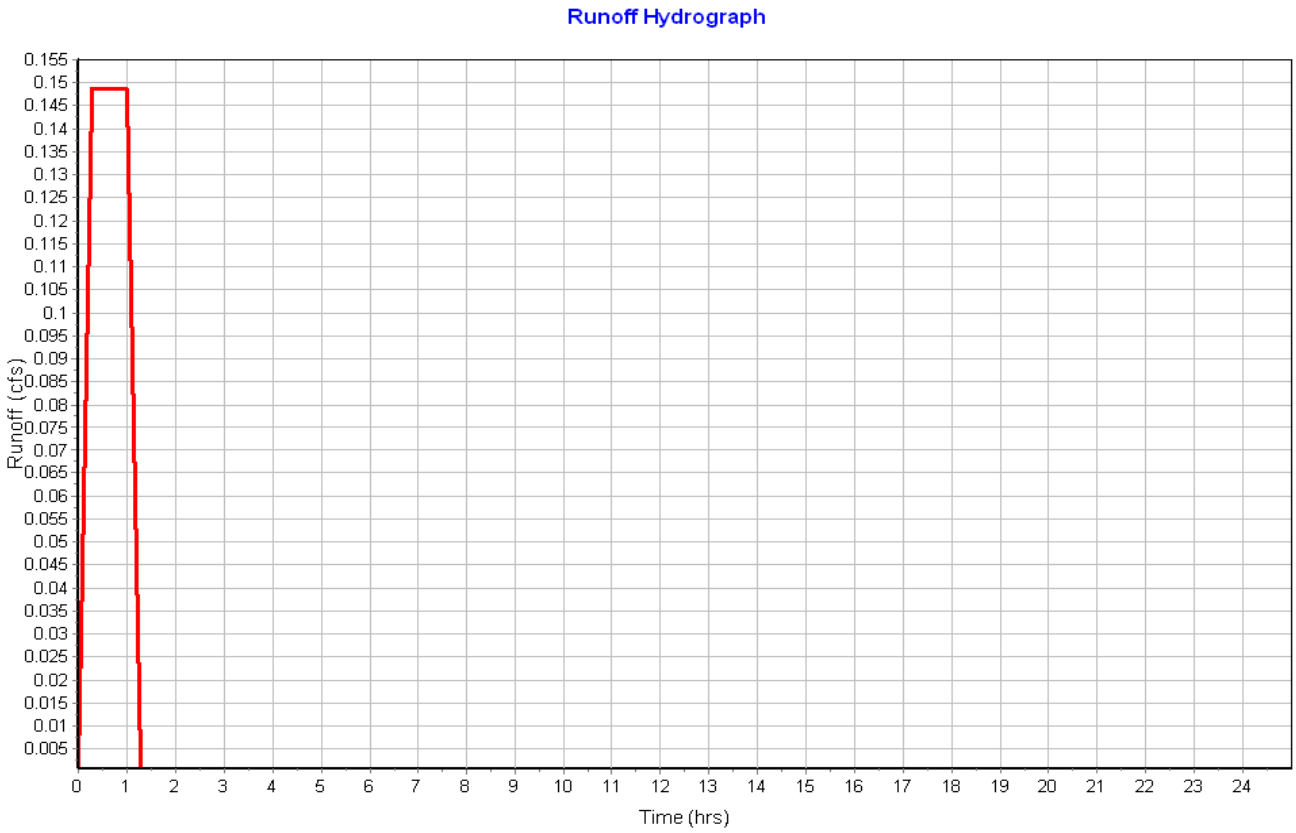
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	1.25	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.80	0.00	0.00
Computed Flow Time (min) :	1.11	0.00	0.00

Total TOC (min) 17.04

Subbasin Runoff Results

Total Rainfall (in) 2.31
Total Runoff (in) 1.66
Peak Runoff (cfs) 0.15
Rainfall Intensity 2.310
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.3



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	Jun-01	65.00	69.00	4.00	65.00	0.00	70.00	1.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	0.24	0.00	65.21	0.21	0.00	3.79	65.01	0.01	0 01:07	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	78.00	65.00	0.00	64.50	0.00	0.50	0.6400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	0.24	0 01:07	2.47	0.10	1.99	0.65	0.21	0.21	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft)	65.00
Max (Rim) Elevation (ft)	69.00
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	65.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

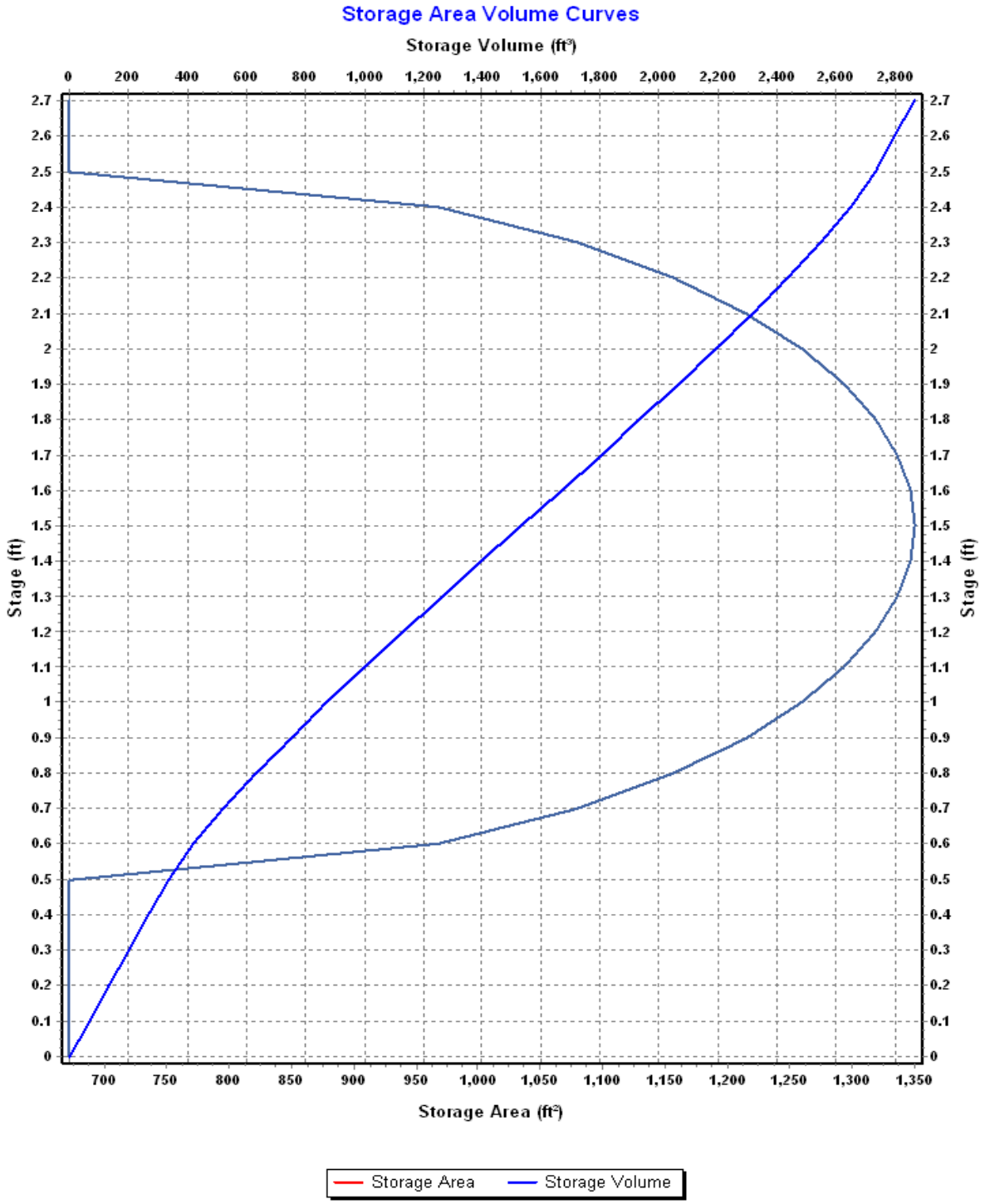
Infiltration/Exfiltration

Constant Flow Rate (cfs)	0.1000

Storage Area Volume Curves

Storage Curve : Storage-01

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	672.0000	0.000
0.1	672.0000	67.20
0.2	672.0000	134.40
0.3	672.0000	201.60
0.4	672.0000	268.80
0.5	672.0000	336.00
0.6	967.5333	417.98
0.7	1078.8000	520.30
0.8	1156.1888	632.05
0.9	1214.4000	750.58
1	1259.1652	874.26
1.1	1293.3973	1001.89
1.2	1318.7708	1132.50
1.3	1336.3016	1265.25
1.4	1346.6015	1399.40
1.5	1350.0000	1534.23
1.6	1346.6015	1669.06
1.7	1336.3016	1803.21
1.8	1318.7708	1935.96
1.9	1293.3973	2066.57
2	1259.1652	2194.20
2.1	1214.4000	2317.88
2.2	1156.1888	2436.41
2.3	1078.8000	2548.16
2.4	967.5333	2650.48
2.5	672.0000	2732.46
2.6	672.0000	2799.66
2.7	672.0000	2866.86


Storage Area Volume Curves
Storage Volume (ft³)
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800
Stage (ft)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4 2.5 2.6 2.7
700 750 800 850 900 950 1,000 1,050 1,100 1,150 1,200 1,250 1,300 1,350
Storage Area (ft²)
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-01	Rectangular	No	67.50	2.50	4.00	0.67	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-1	Side	CIRCULAR	No	3.00			65.00	0.61

Output Summary Results

Peak Inflow (cfs)	0.57
Peak Lateral Inflow (cfs)	0.57
Peak Outflow (cfs)	0.24
Peak Exfiltration Flow Rate (cfm)	6.00
Max HGL Elevation Attained (ft)	66.07
Max HGL Depth Attained (ft)	1.07
Average HGL Elevation Attained (ft)	65.05
Average HGL Depth Attained (ft)	0.05
Time of Max HGL Occurrence (days hh:mm)	0 01:07
Total Exfiltration Volume (1000-ft³)	0.834
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Drainage Report November 7, 2019 Post Development 10YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	4
Nodes	5
Junctions	1
Outfalls	3
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	1
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	10 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	ProposedDrainageAreaNo.1	0.08	0.7200	3.22	2.32	0.19	0.19	0 00:17:02
2	ProposedDrainageAreaNo.2	0.28	0.7200	3.22	2.32	0.65	0.65	0 00:17:02
3	ProposedDrainageAreaNo.2A	0.06	0.7200	3.22	2.32	0.14	0.14	0 00:17:02
4	ProposedDrainageAreaNo.3	0.09	0.7200	3.22	2.32	0.21	0.21	0 00:17:02

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	65.00	69.00	65.00	70.00	0.00	0.29	65.23	0.00	3.77	0 00:00	0.00	0.00
2	Out-1	Outfall	68.00					0.19	68.00					
3	Out-2	Outfall	64.50					0.29	64.73					
4	Out-3	Outfall	68.00					0.21	68.00					
5	Stor-01	Storage Node	65.00	69.00	65.00		0.00	0.80	66.55				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-2	78.00	65.00	64.50	0.6400	12.000	0.0150	0.29	2.47	0.12	2.10	0.23	0.23	0.00	Calculated
2	Orifice-1	Orifice	Stor-01	Jun-01		65.00	65.00		3.000		0.29							
3	Weir-01	Weir	Stor-01	Jun-01		65.00	65.00				0.00							

Subbasin Hydrology

Subbasin : ProposedDrainageAreaNo.1

Input Data

Area (ac) 0.08
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.08	-	0.72
Composite Area & Weighted Runoff Coeff.	0.08		0.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

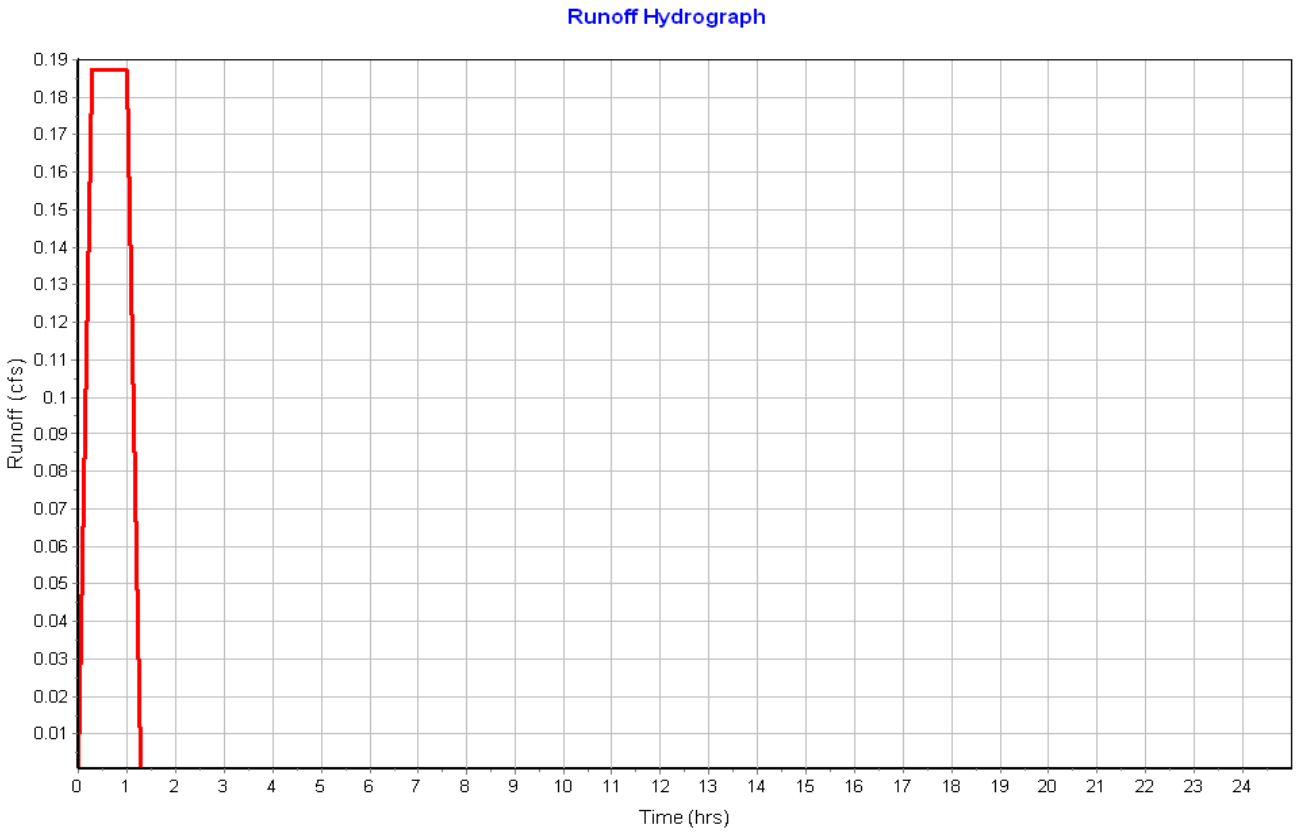
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.22
Total Runoff (in) 2.32
Peak Runoff (cfs) 0.19
Rainfall Intensity 3.220
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.1



Subbasin : ProposedDrainageAreaNo.2

Input Data

Area (ac) 0.28
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.20	-	0.72
Composite Area & Weighted Runoff Coeff.	0.20		0.72

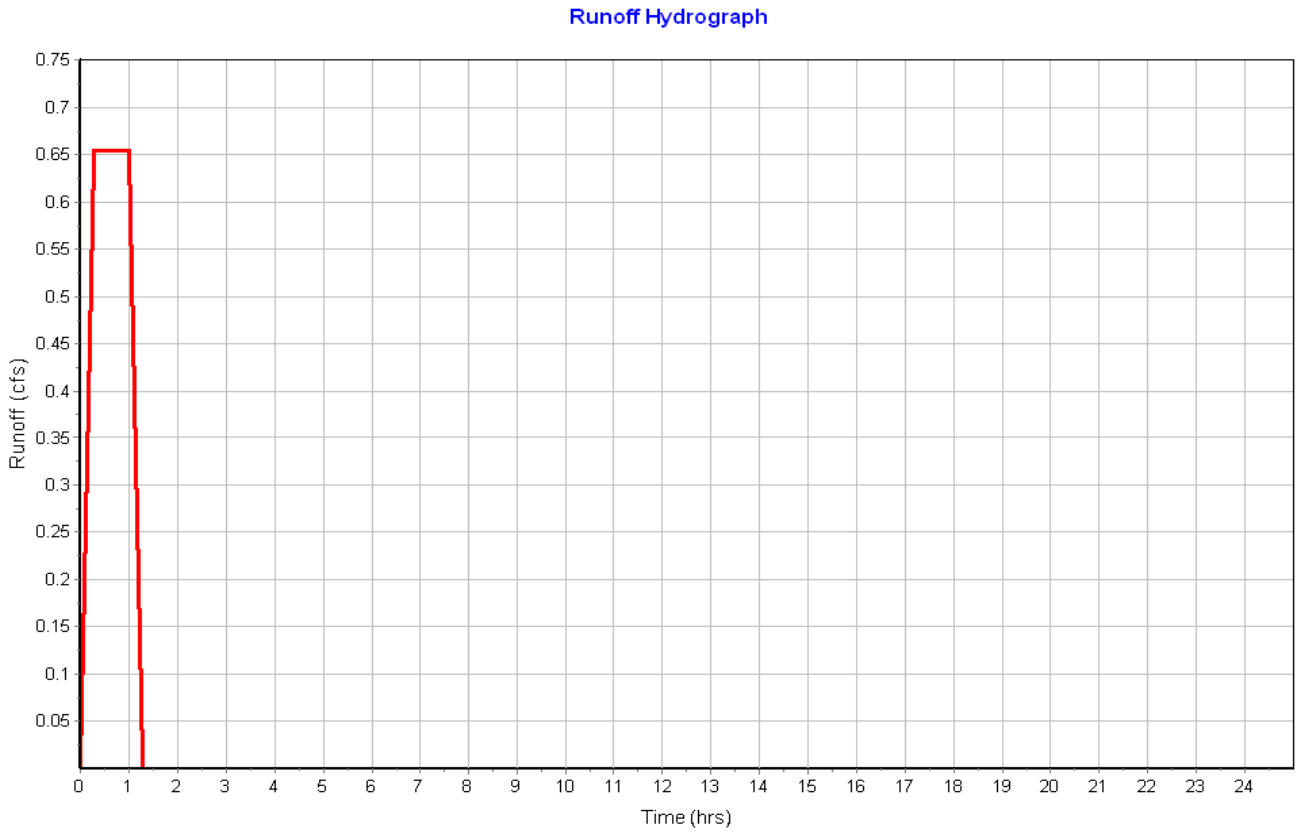
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.22
Total Runoff (in) 2.32
Peak Runoff (cfs) 0.65
Rainfall Intensity 3.220
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2



Subbasin : ProposedDrainageAreaNo.2A

Input Data

Area (ac) 0.06
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	-	0.72
Composite Area & Weighted Runoff Coeff.	0.06		0.72

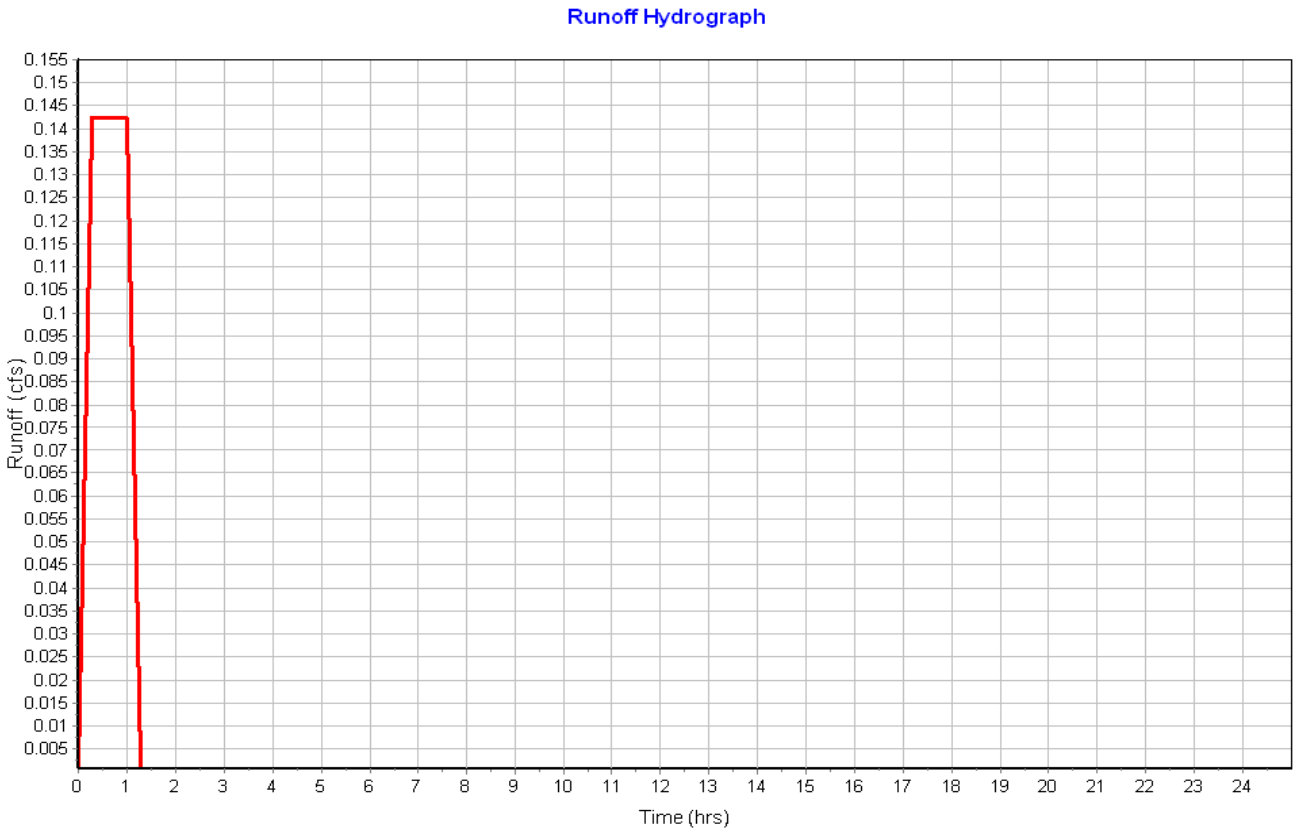
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.22
Total Runoff (in) 2.32
Peak Runoff (cfs) 0.14
Rainfall Intensity 3.220
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2A



Subbasin : ProposedDrainageAreaNo.3

Input Data

Area (ac) 0.09
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.09	-	0.72
Composite Area & Weighted Runoff Coeff.	0.09		0.72

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.0	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.34	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	15.93	0.00	0.00

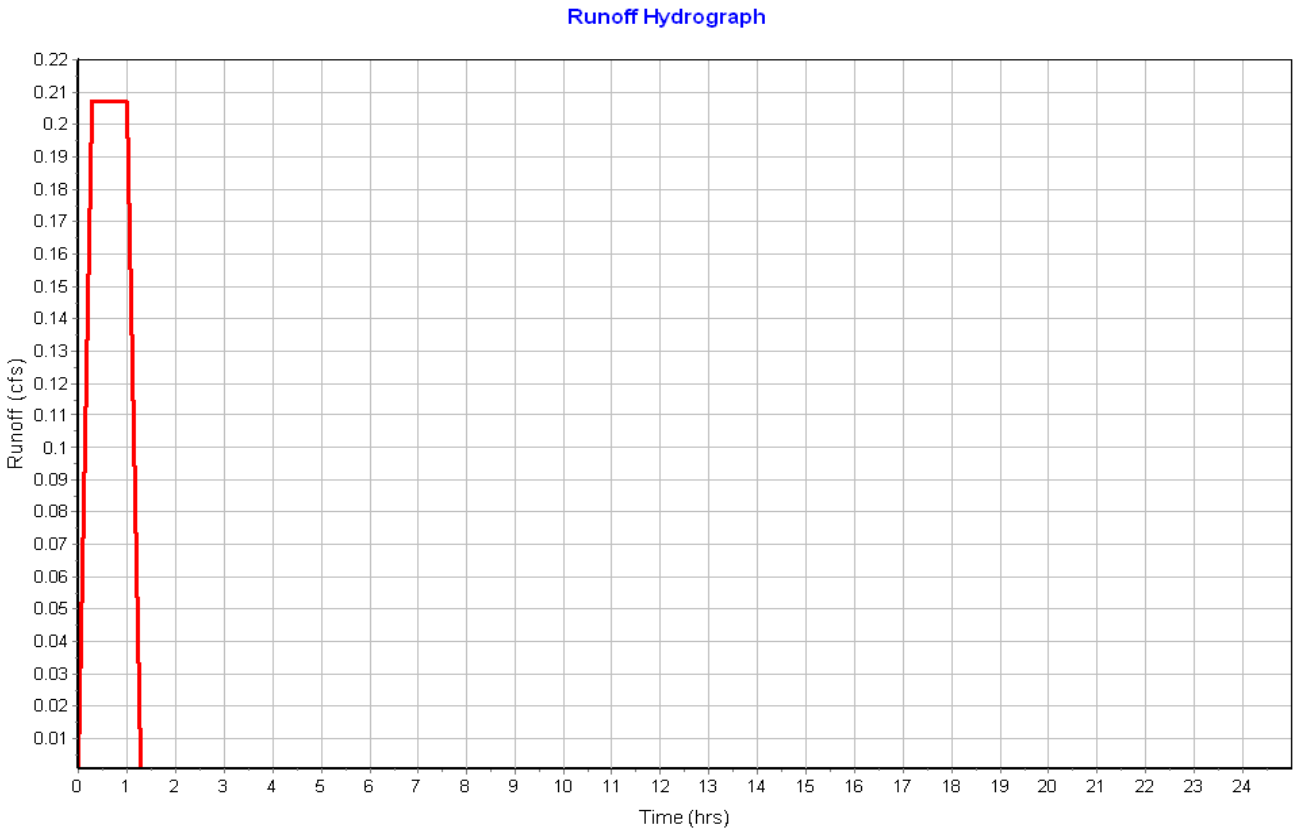
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	1.25	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.80	0.00	0.00
Computed Flow Time (min) :	1.11	0.00	0.00

Total TOC (min) 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.22
Total Runoff (in) 2.32
Peak Runoff (cfs) 0.21
Rainfall Intensity 3.220
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.3



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-01	65.00	69.00	4.00	65.00	0.00	70.00	1.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	0.29	0.00	65.23	0.23	0.00	3.77	65.02	0.02	0 01:08	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	78.00	65.00	0.00	64.50	0.00	0.50	0.6400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	0.29	0 01:09	2.47	0.12	2.10	0.62	0.23	0.23	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft)	65.00
Max (Rim) Elevation (ft)	69.00
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	65.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

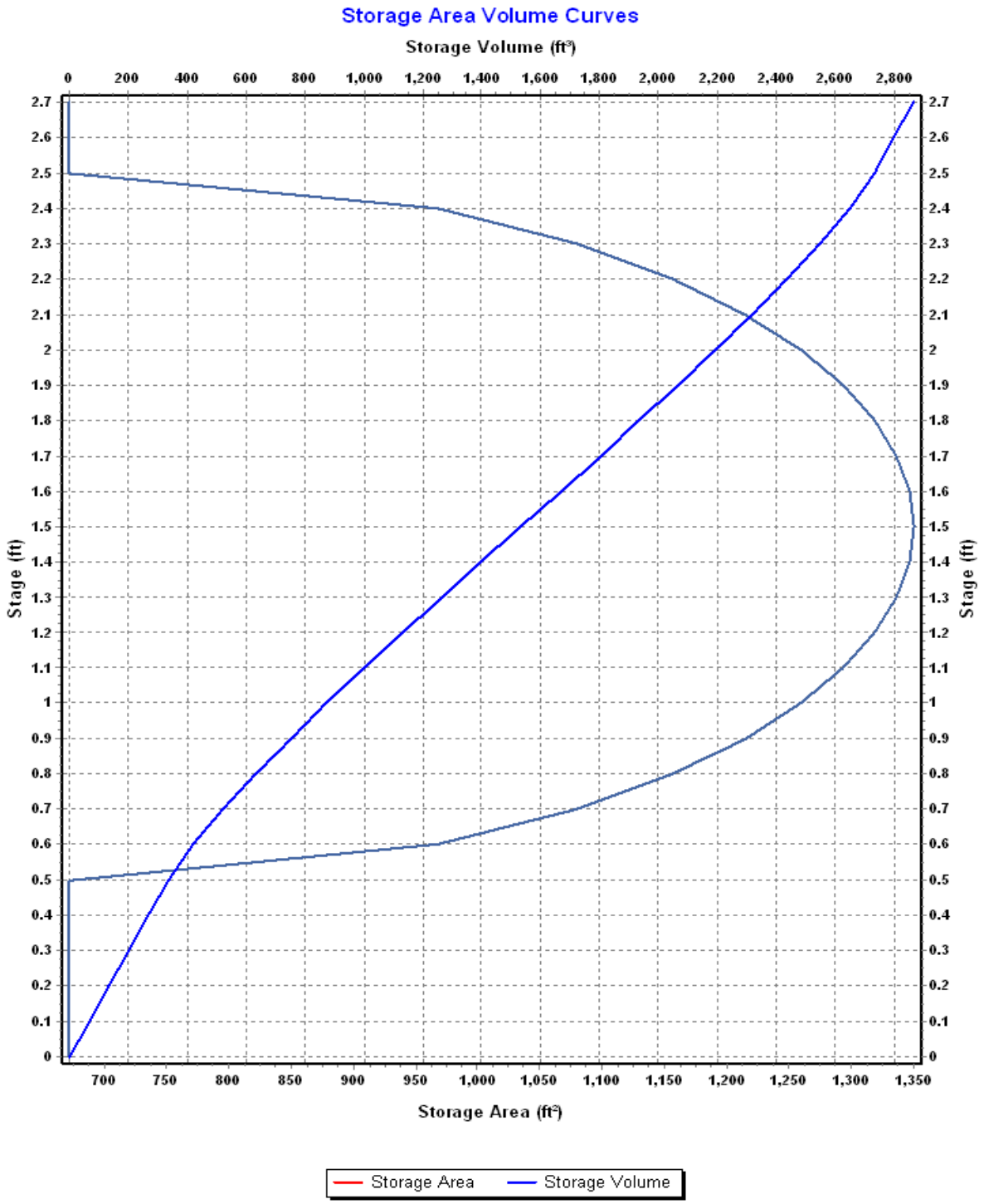
Infiltration/Exfiltration

Constant Flow Rate (cfs)	0.1000

Storage Area Volume Curves

Storage Curve : Storage-01

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	672.0000	0.000
0.1	672.0000	67.20
0.2	672.0000	134.40
0.3	672.0000	201.60
0.4	672.0000	268.80
0.5	672.0000	336.00
0.6	967.5333	417.98
0.7	1078.8000	520.30
0.8	1156.1888	632.05
0.9	1214.4000	750.58
1	1259.1652	874.26
1.1	1293.3973	1001.89
1.2	1318.7708	1132.50
1.3	1336.3016	1265.25
1.4	1346.6015	1399.40
1.5	1350.0000	1534.23
1.6	1346.6015	1669.06
1.7	1336.3016	1803.21
1.8	1318.7708	1935.96
1.9	1293.3973	2066.57
2	1259.1652	2194.20
2.1	1214.4000	2317.88
2.2	1156.1888	2436.41
2.3	1078.8000	2548.16
2.4	967.5333	2650.48
2.5	672.0000	2732.46
2.6	672.0000	2799.66
2.7	672.0000	2866.86


Storage Area Volume Curves
Storage Volume (ft³)
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800
Stage (ft)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4 2.5 2.6 2.7
Stage (ft)
Storage Area (ft²)
700 750 800 850 900 950 1,000 1,050 1,100 1,150 1,200 1,250 1,300 1,350
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-01	Rectangular	No	67.50	2.50	4.00	0.67	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-1	Side	CIRCULAR	No	3.00			65.00	0.61

Output Summary Results

Peak Inflow (cfs)	0.80
Peak Lateral Inflow (cfs)	0.80
Peak Outflow (cfs)	0.29
Peak Exfiltration Flow Rate (cfm)	6.00
Max HGL Elevation Attained (ft)	66.55
Max HGL Depth Attained (ft)	1.55
Average HGL Elevation Attained (ft)	65.09
Average HGL Depth Attained (ft)	0.09
Time of Max HGL Occurrence (days hh:mm)	0 01:08
Total Exfiltration Volume (1000-ft³)	1.018
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Drainage Report November 7, 2019 Post Development 25YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	4
Nodes	5
Junctions	1
Outfalls	3
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	1
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	25 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	ProposedDrainageAreaNo.1	0.08	0.7200	3.74	2.69	0.22	0.22	0 00:17:02
2	ProposedDrainageAreaNo.2	0.28	0.7200	3.74	2.69	0.76	0.76	0 00:17:02
3	ProposedDrainageAreaNo.2A	0.06	0.7200	3.74	2.69	0.17	0.17	0 00:17:02
4	ProposedDrainageAreaNo.3	0.09	0.7200	3.74	2.69	0.24	0.24	0 00:17:02

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	65.00	69.00	65.00	70.00	0.00	0.32	65.24	0.00	3.76	0 00:00	0.00	0.00
2	Out-1	Outfall	68.00					0.22	68.00					
3	Out-2	Outfall	64.50					0.32	64.74					
4	Out-3	Outfall	68.00					0.24	68.00					
5	Stor-01	Storage Node	65.00	69.00	65.00		0.00	0.92	66.83				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-2	78.00	65.00	64.50	0.6400	12.000	0.0150	0.32	2.47	0.13	2.16	0.24	0.24	0.00	Calculated
2	Orifice-1	Orifice	Stor-01	Jun-01		65.00	65.00		3.000		0.32							
3	Weir-01	Weir	Stor-01	Jun-01		65.00	65.00				0.00							

Subbasin Hydrology

Subbasin : ProposedDrainageAreaNo.1

Input Data

Area (ac) 0.08
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.08	-	0.72
Composite Area & Weighted Runoff Coeff.	0.08		0.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

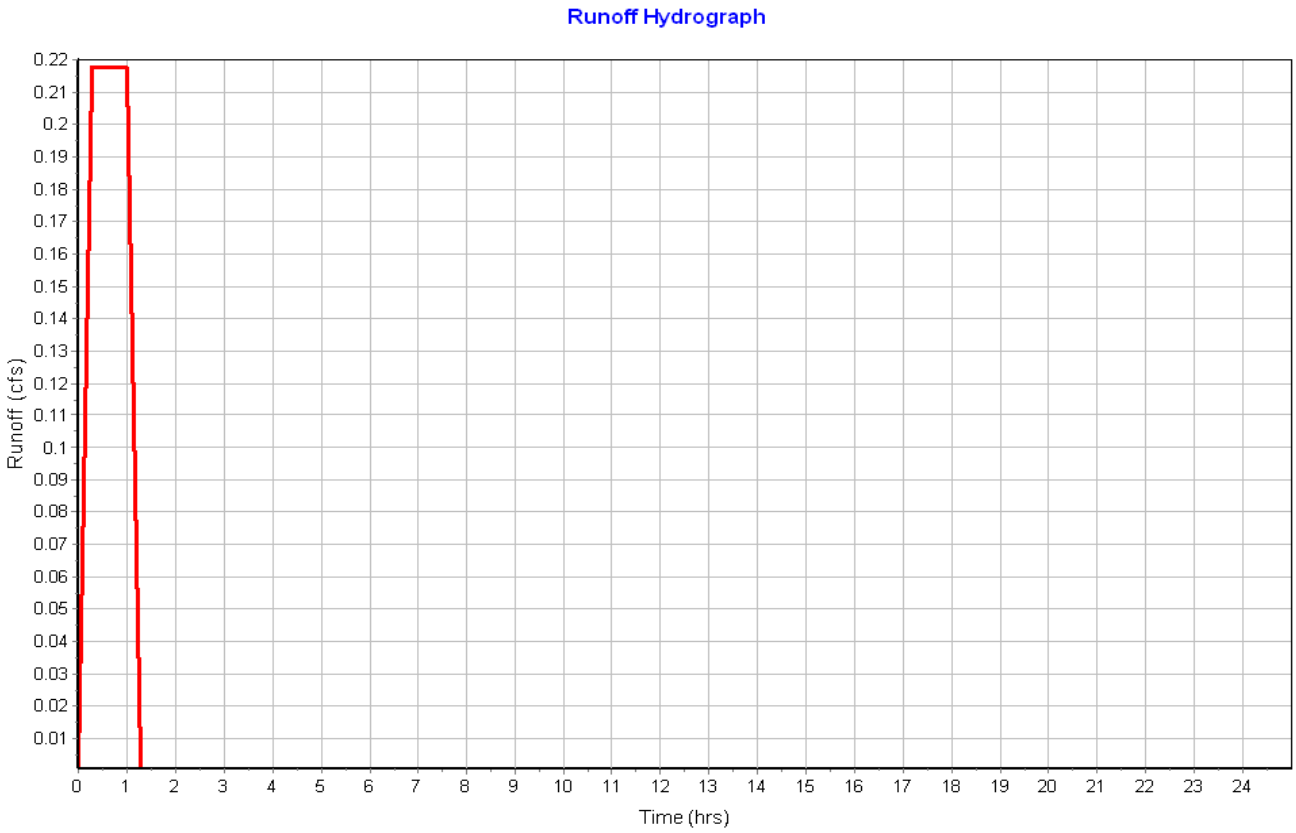
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.74
Total Runoff (in) 2.69
Peak Runoff (cfs) 0.22
Rainfall Intensity 3.740
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.1



Subbasin : ProposedDrainageAreaNo.2

Input Data

Area (ac) 0.28
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.20	-	0.72
Composite Area & Weighted Runoff Coeff.	0.20		0.72

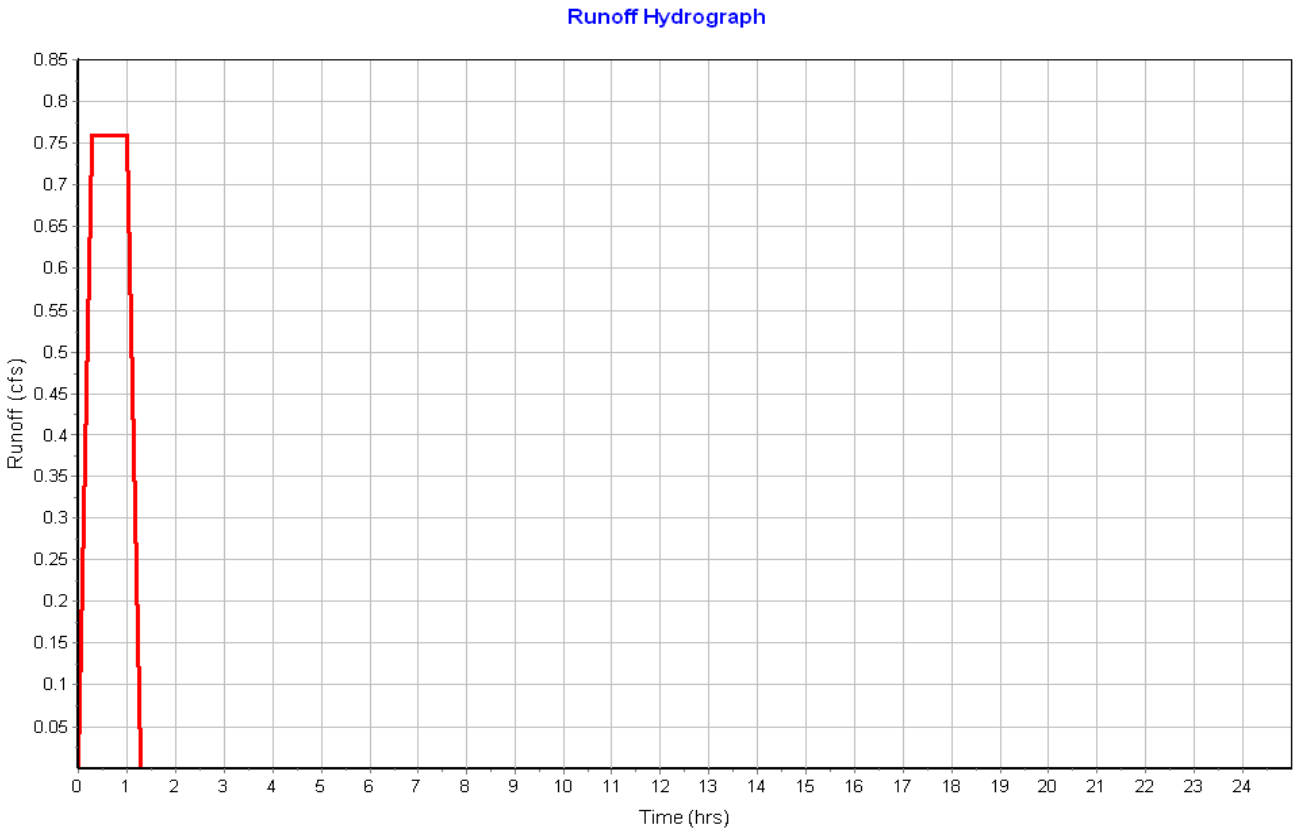
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.74
Total Runoff (in) 2.69
Peak Runoff (cfs) 0.76
Rainfall Intensity 3.740
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2



Subbasin : ProposedDrainageAreaNo.2A

Input Data

Area (ac) 0.06
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	-	0.72
Composite Area & Weighted Runoff Coeff.	0.06		0.72

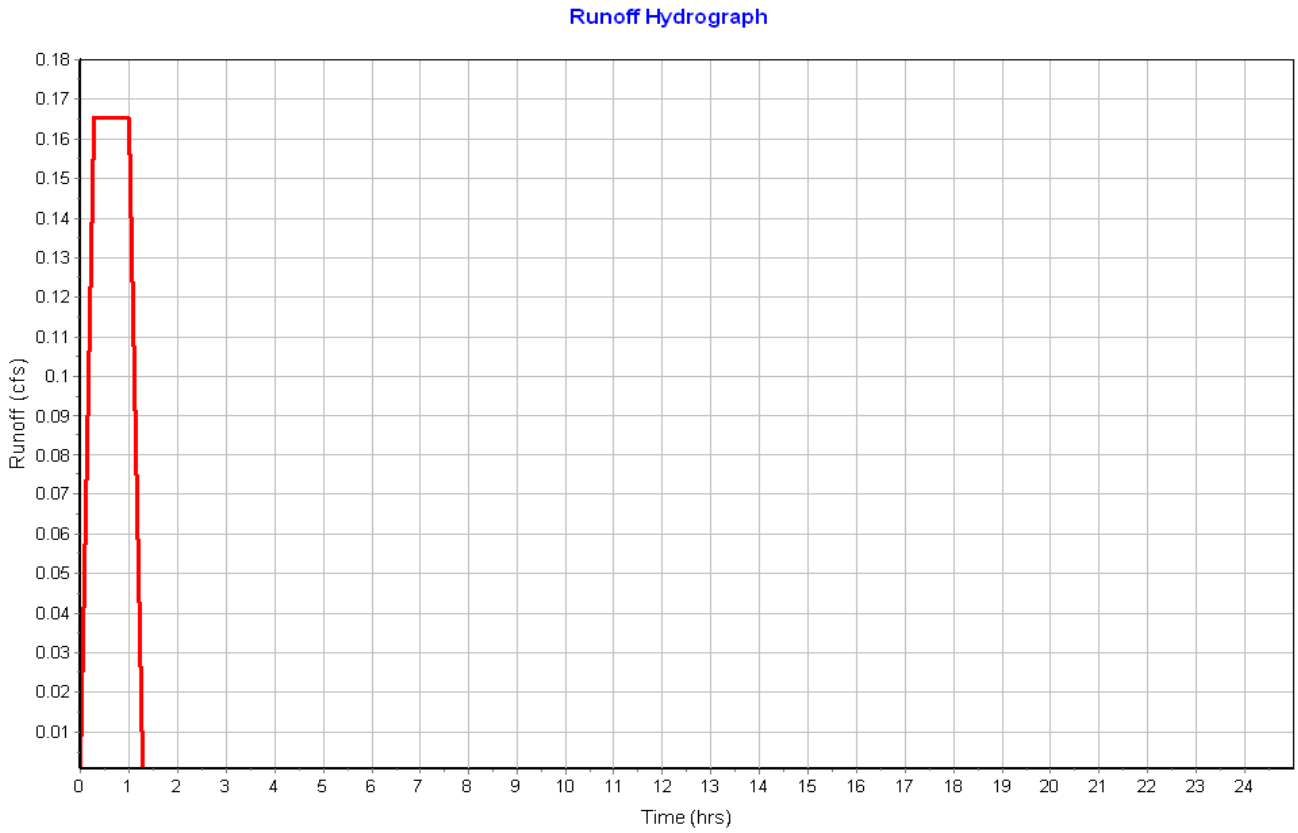
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.74
Total Runoff (in) 2.69
Peak Runoff (cfs) 0.17
Rainfall Intensity 3.740
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2A



Subbasin : ProposedDrainageAreaNo.3

Input Data

Area (ac) 0.09
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.09	-	0.72
Composite Area & Weighted Runoff Coeff.	0.09		0.72

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.0	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.34	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	15.93	0.00	0.00

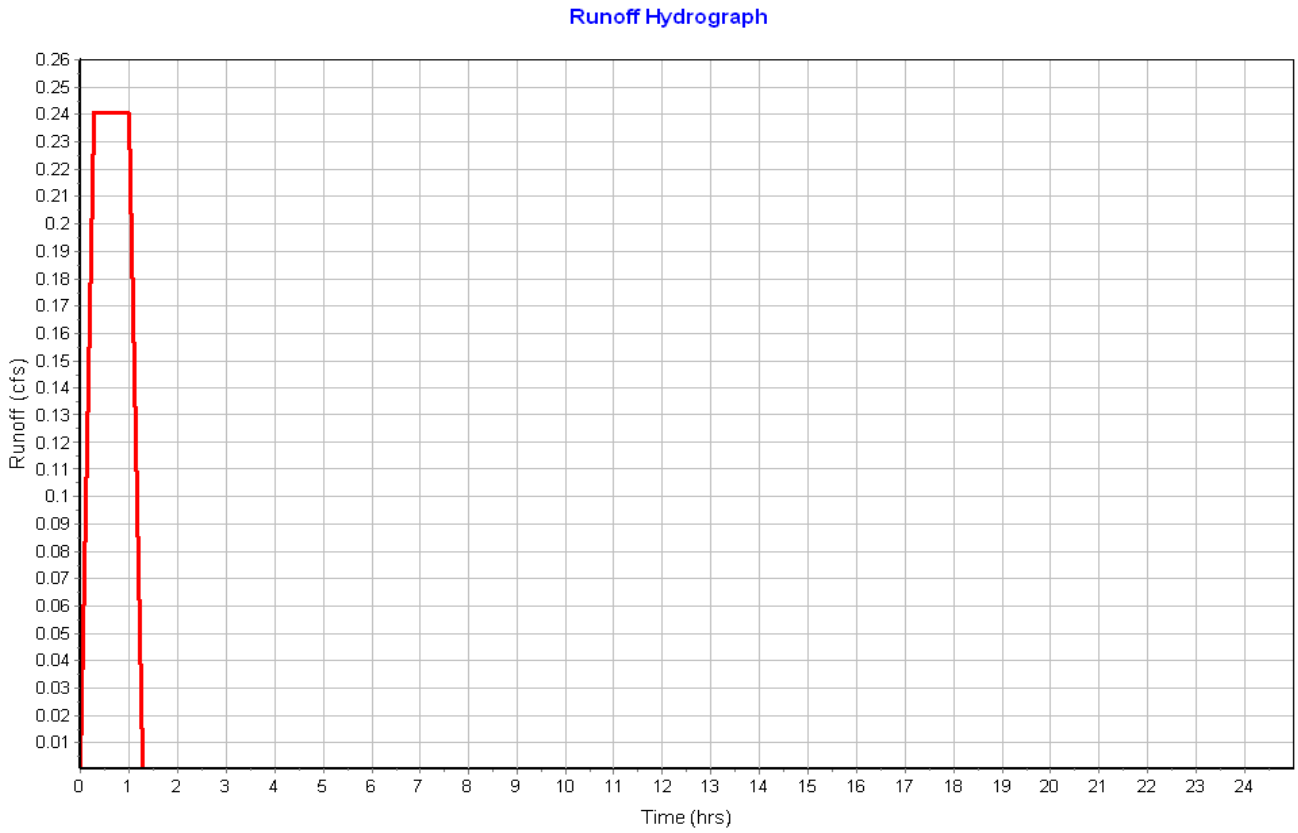
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	1.25	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.80	0.00	0.00
Computed Flow Time (min) :	1.11	0.00	0.00

Total TOC (min) 17.04

Subbasin Runoff Results

Total Rainfall (in) 3.74
Total Runoff (in) 2.69
Peak Runoff (cfs) 0.24
Rainfall Intensity 3.740
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.3



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft^2)	Minimum Pipe Cover (in)
1	Jun-01	65.00	69.00	4.00	65.00	0.00	70.00	1.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	0.32	0.00	65.24	0.24	0.00	3.76	65.02	0.02	0 01:09	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	78.00	65.00	0.00	64.50	0.00	0.50	0.6400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	0.32	0 01:09	2.47	0.13	2.16	0.60	0.24	0.24	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft)	65.00
Max (Rim) Elevation (ft)	69.00
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	65.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

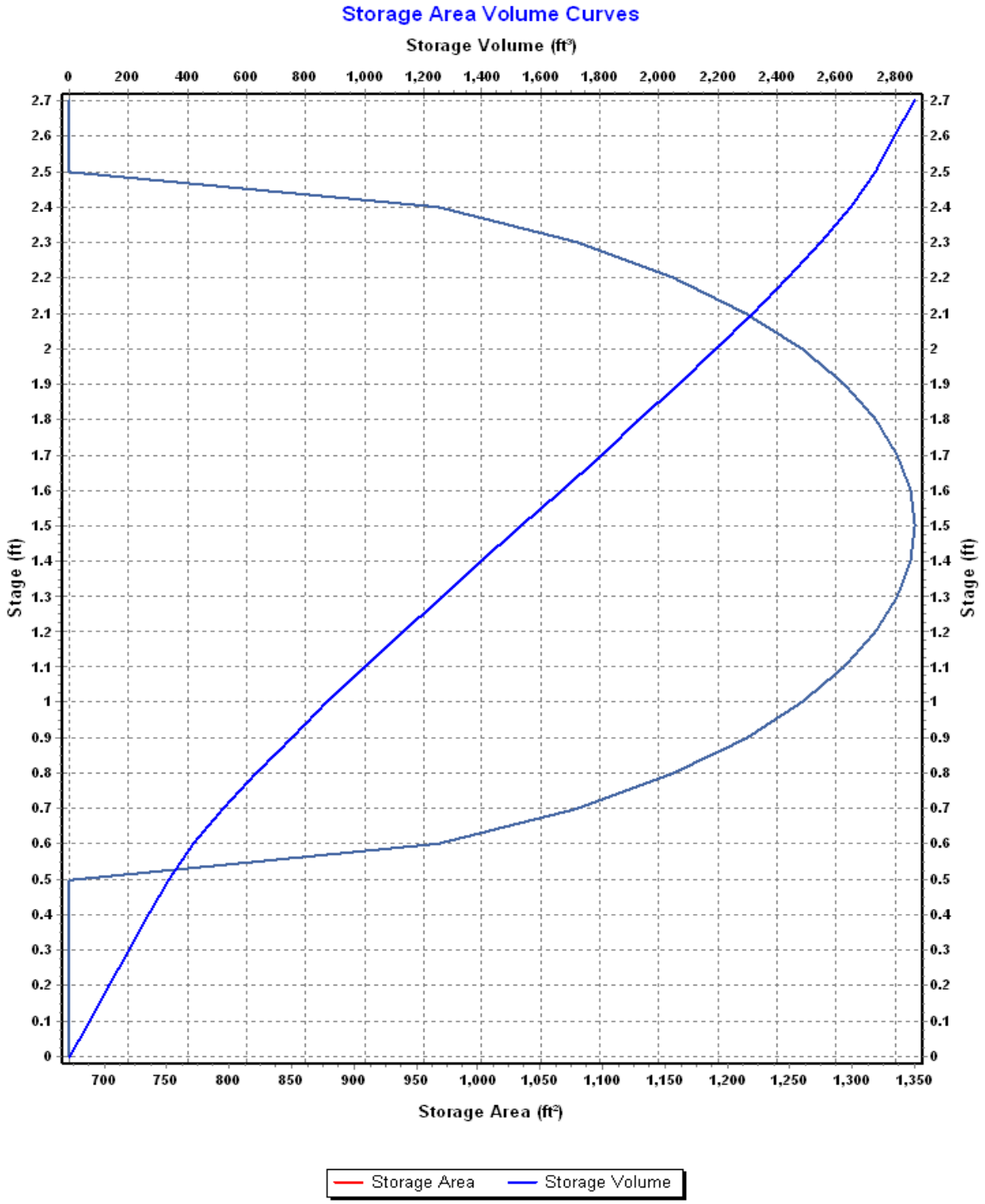
Infiltration/Exfiltration

Constant Flow Rate (cfs)	0.1000

Storage Area Volume Curves

Storage Curve : Storage-01

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	672.0000	0.000
0.1	672.0000	67.20
0.2	672.0000	134.40
0.3	672.0000	201.60
0.4	672.0000	268.80
0.5	672.0000	336.00
0.6	967.5333	417.98
0.7	1078.8000	520.30
0.8	1156.1888	632.05
0.9	1214.4000	750.58
1	1259.1652	874.26
1.1	1293.3973	1001.89
1.2	1318.7708	1132.50
1.3	1336.3016	1265.25
1.4	1346.6015	1399.40
1.5	1350.0000	1534.23
1.6	1346.6015	1669.06
1.7	1336.3016	1803.21
1.8	1318.7708	1935.96
1.9	1293.3973	2066.57
2	1259.1652	2194.20
2.1	1214.4000	2317.88
2.2	1156.1888	2436.41
2.3	1078.8000	2548.16
2.4	967.5333	2650.48
2.5	672.0000	2732.46
2.6	672.0000	2799.66
2.7	672.0000	2866.86


Storage Area Volume Curves
Storage Volume (ft³)
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800
Stage (ft)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4 2.5 2.6 2.7
Stage (ft)
Storage Area (ft²)
700 750 800 850 900 950 1,000 1,050 1,100 1,150 1,200 1,250 1,300 1,350
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-01	Rectangular	No	67.50	2.50	4.00	0.67	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-1	Side	CIRCULAR	No	3.00			65.00	0.61

Output Summary Results

Peak Inflow (cfs)	0.92
Peak Lateral Inflow (cfs)	0.92
Peak Outflow (cfs)	0.32
Peak Exfiltration Flow Rate (cfm)	6.00
Max HGL Elevation Attained (ft)	66.83
Max HGL Depth Attained (ft)	1.83
Average HGL Elevation Attained (ft)	65.12
Average HGL Depth Attained (ft)	0.12
Time of Max HGL Occurrence (days hh:mm)	0 01:09
Total Exfiltration Volume (1000-ft³)	1.114
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

Project Description

File Name	Drainage Report November 7, 2019 Post Development 100YR.SPF

Project Options

Flow Units	CFS
Elevation Type	Elevation
Hydrology Method	Modified Rational
Time of Concentration (TOC) Method	SCS TR-55
Link Routing Method	Kinematic Wave
Enable Overflow Ponding at Nodes	YES
Skip Steady State Analysis Time Periods	YES

Analysis Options

Start Analysis On	Nov 08, 2019	11:00:00
End Analysis On	Nov 09, 2019	12:00:00
Start Reporting On	Nov 08, 2019	11:00:00
Antecedent Dry Days	0	days
Runoff (Dry Weather) Time Step	0 01:00:00	days hh:mm:ss
Runoff (Wet Weather) Time Step	0 00:05:00	days hh:mm:ss
Reporting Time Step	0 00:05:00	days hh:mm:ss
Routing Time Step	30	seconds

Number of Elements

	Qty
Rain Gages	4
Subbasins	4
Nodes	5
Junctions	1
Outfalls	3
Flow Diversions	0
Inlets	0
Storage Nodes	1
Links	3
Channels	0
Pipes	1
Pumps	0
Orifices	1
Weirs	1
Outlets	0
Pollutants	0
Land Uses	0

Rainfall Details

Return Period	100 year(s)

Subbasin Summary

SN	Subbasin ID	Area (ac)	Weighted Runoff Coefficient	Total Rainfall (in)	Total Runoff (in)	Total Runoff Volume (ac-in)	Peak Runoff (cfs)	Time of Concentration (days hh:mm:ss)
1	ProposedDrainageAreaNo.1	0.08	0.7200	4.80	3.46	0.28	0.28	0 00:17:02
2	ProposedDrainageAreaNo.2	0.28	0.7200	4.80	3.46	0.97	0.97	0 00:17:02
3	ProposedDrainageAreaNo.2A	0.06	0.7200	4.80	3.46	0.21	0.21	0 00:17:02
4	ProposedDrainageAreaNo.3	0.09	0.7200	4.80	3.46	0.31	0.31	0 00:17:02

Node Summary

SN	Element ID	Element Type	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Initial Water Elevation (ft)	Surcharge Elevation (ft)	Ponded Area (ft²)	Peak Inflow (cfs)	Max HGL Elevation Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	Junction	65.00	69.00	65.00	70.00	0.00	0.42	65.28	0.00	3.72	0 00:00	0.00	0.00
2	Out-1	Outfall	68.00					0.28	68.00					
3	Out-2	Outfall	64.50					0.42	64.78					
4	Out-3	Outfall	68.00					0.31	68.00					
5	Stor-01	Storage Node	65.00	69.00	65.00		0.00	1.19	67.52				0.00	0.00

Link Summary

SN	Element ID	Element Type	From (Inlet) Node	To (Outlet) Node	Length	Inlet Invert Elevation	Outlet Invert Elevation	Average Slope	Diameter or Height	Manning's Roughness	Peak Flow	Design Flow Capacity	Peak Flow/ Design Flow Ratio	Peak Flow Velocity	Peak Flow Depth	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged	Reported Condition
					(ft)	(ft)	(ft)	(%)	(in)		(cfs)	(cfs)		(ft/sec)	(ft)		(min)	
1	Link-01	Pipe	Jun-01	Out-2	78.00	65.00	64.50	0.6400	12.000	0.0150	0.42	2.47	0.17	2.35	0.28	0.28	0.00	Calculated
2	Orifice-1	Orifice	Stor-01	Jun-01		65.00	65.00		3.000		0.37							
3	Weir-01	Weir	Stor-01	Jun-01		65.00	65.00				0.05							

Subbasin Hydrology

Subbasin : ProposedDrainageAreaNo.1

Input Data

Area (ac) 0.08
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.08	-	0.72
Composite Area & Weighted Runoff Coeff.	0.08		0.72

Time of Concentration

TOC Method : SCS TR-55

Sheet Flow Equation :

Tc = (0.007 * ((n * Lf)^0.8)) / ((P^0.5) * (Sf^0.4))

Where :

Tc = Time of Concentration (hr)
n = Manning's roughness
Lf = Flow Length (ft)
P = 2 yr, 24 hr Rainfall (inches)
Sf = Slope (ft/ft)

Shallow Concentrated Flow Equation :

V = 16.1345 * (Sf^0.5) (unpaved surface)
V = 20.3282 * (Sf^0.5) (paved surface)
V = 15.0 * (Sf^0.5) (grassed waterway surface)
V = 10.0 * (Sf^0.5) (nearly bare & untilled surface)
V = 9.0 * (Sf^0.5) (cultivated straight rows surface)
V = 7.0 * (Sf^0.5) (short grass pasture surface)
V = 5.0 * (Sf^0.5) (woodland surface)
V = 2.5 * (Sf^0.5) (forest w/heavy litter surface)
Tc = (Lf / V) / (3600 sec/hr)

Where:

Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)

Channel Flow Equation :

V = (1.49 * (R^(2/3)) * (Sf^0.5)) / n
R = Aq / Wp
Tc = (Lf / V) / (3600 sec/hr)

Where :

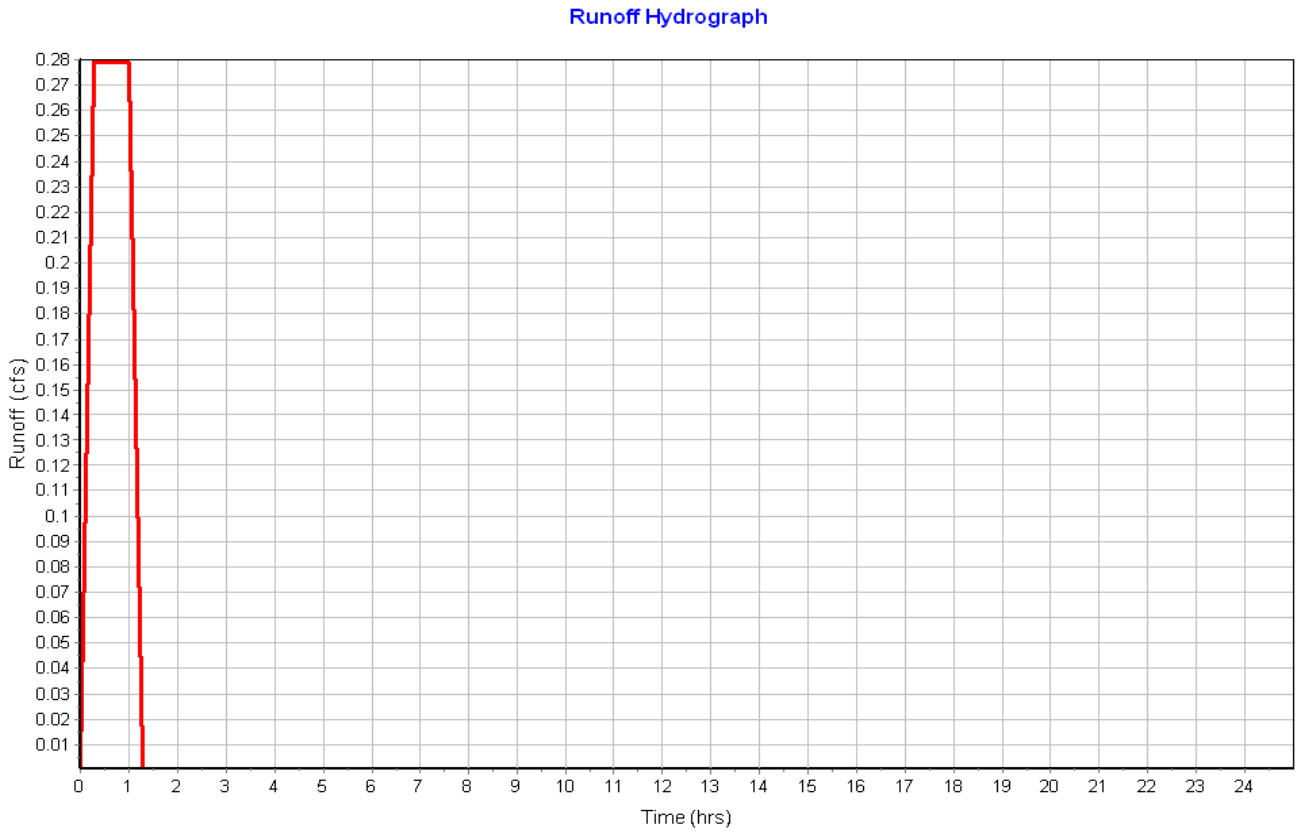
Tc = Time of Concentration (hr)
Lf = Flow Length (ft)
R = Hydraulic Radius (ft)
Aq = Flow Area (ft²)
Wp = Wetted Perimeter (ft)
V = Velocity (ft/sec)
Sf = Slope (ft/ft)
n = Manning's roughness

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 4.80
Total Runoff (in) 3.46
Peak Runoff (cfs) 0.28
Rainfall Intensity 4.800
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.1



Subbasin : ProposedDrainageAreaNo.2

Input Data

Area (ac) 0.28
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.20	-	0.72
Composite Area & Weighted Runoff Coeff.	0.20		0.72

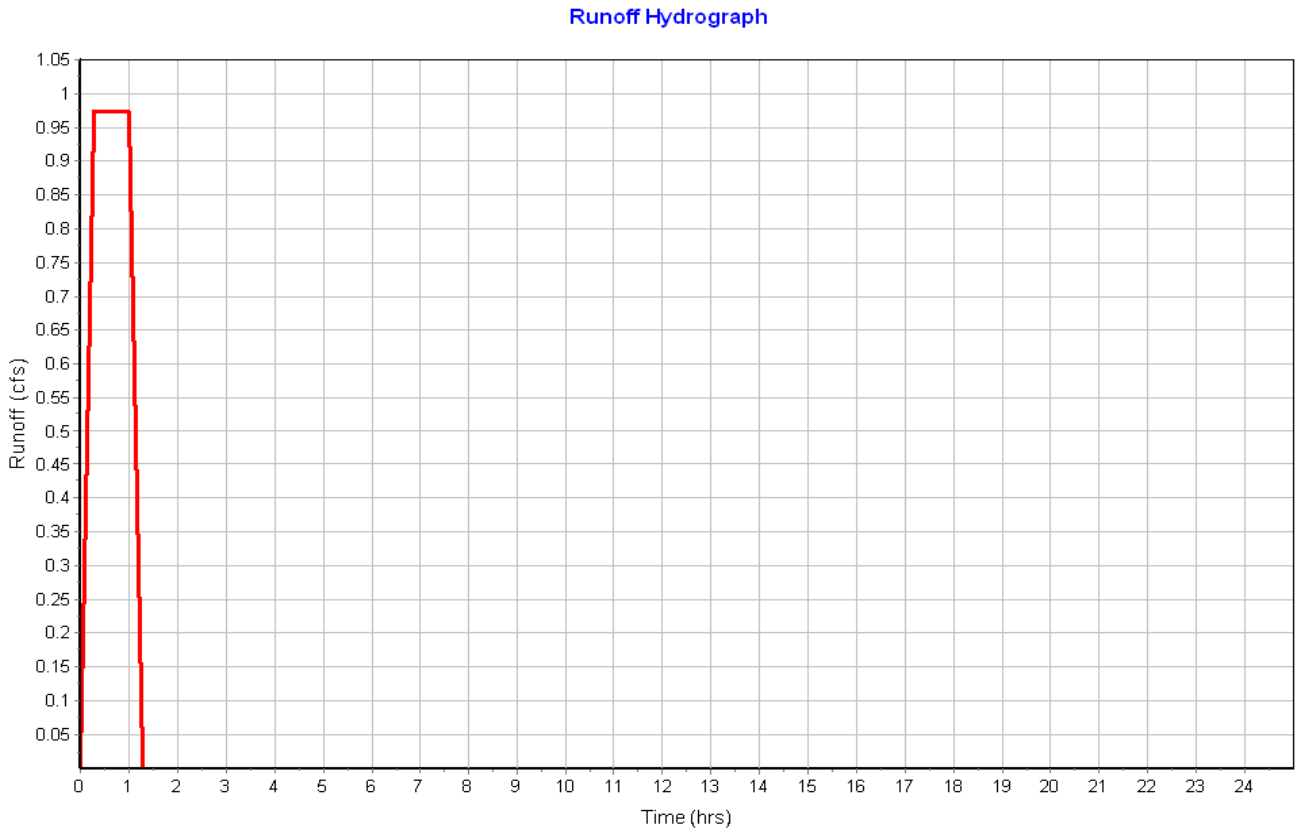
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 4.80
Total Runoff (in) 3.46
Peak Runoff (cfs) 0.97
Rainfall Intensity 4.800
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2



Subbasin : ProposedDrainageAreaNo.2A

Input Data

Area (ac) 0.06
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.06	-	0.72
Composite Area & Weighted Runoff Coeff.	0.06		0.72

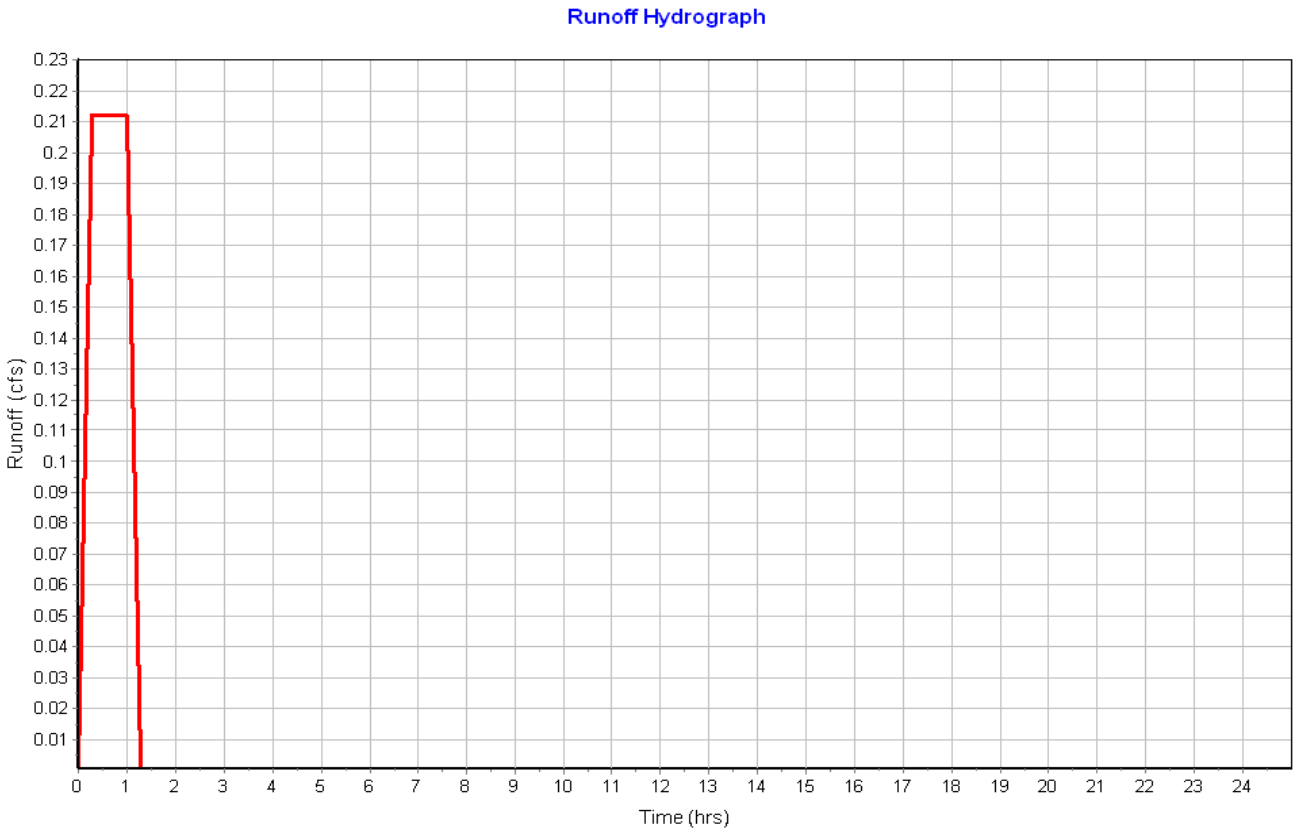
Time of Concentration

User-Defined TOC override (minutes): 17.04

Subbasin Runoff Results

Total Rainfall (in) 4.80
Total Runoff (in) 3.46
Peak Runoff (cfs) 0.21
Rainfall Intensity 4.800
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.2A



Subbasin : ProposedDrainageAreaNo.3

Input Data

Area (ac) 0.09
Weighted Runoff Coefficient 0.7200

Runoff Coefficient

Soil/Surface Description	Area (acres)	Soil Group	Runoff Coeff.
-	0.09	-	0.72
Composite Area & Weighted Runoff Coeff.	0.09		0.72

Time of Concentration

Sheet Flow Computations	Subarea A	Subarea B	Subarea C
Manning's Roughness :	.2	0.00	0.00
Flow Length (ft) :	100	0.00	0.00
Slope (%) :	1.0	0.00	0.00
2 yr, 24 hr Rainfall (in) :	3.34	0.00	0.00
Velocity (ft/sec) :	0.10	0.00	0.00
Computed Flow Time (min) :	15.93	0.00	0.00

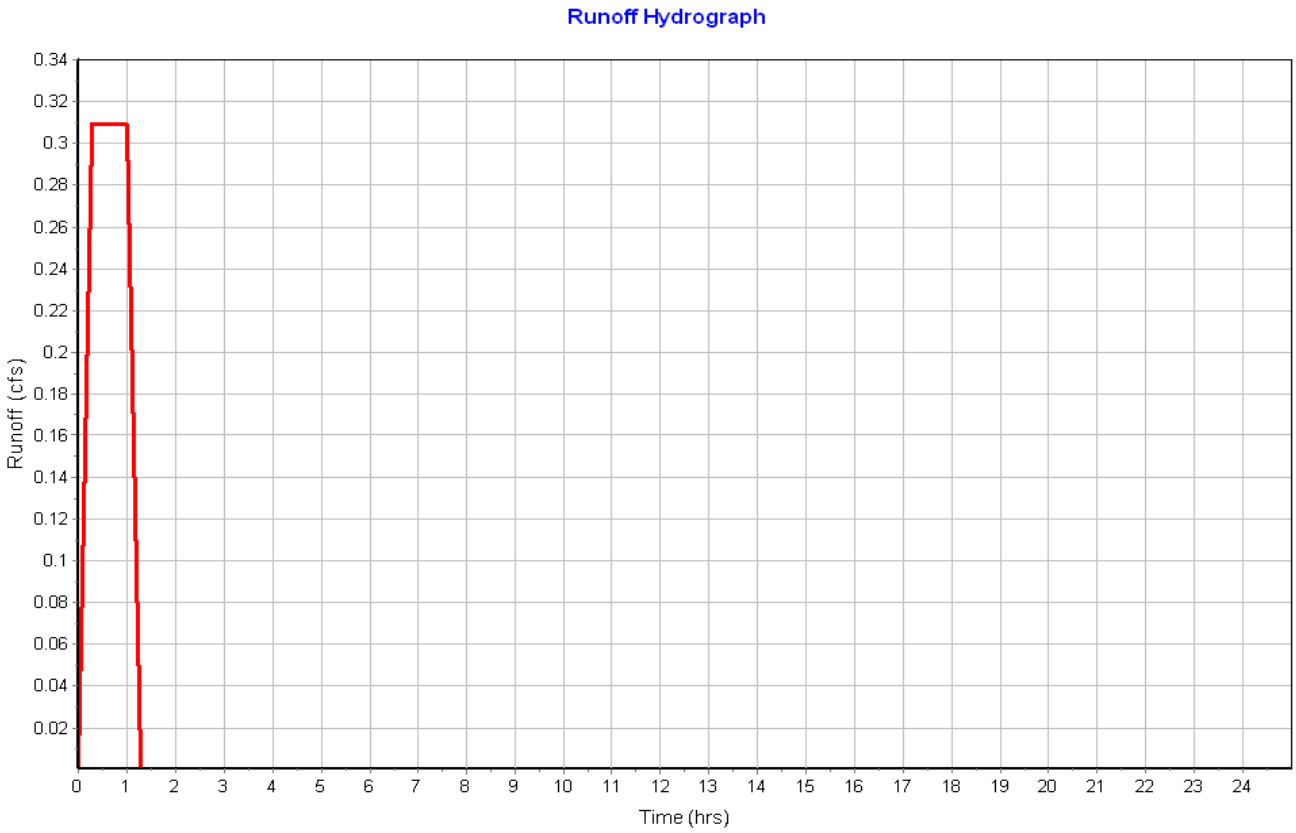
Shallow Concentrated Flow Computations	Subarea A	Subarea B	Subarea C
Flow Length (ft) :	120	0.00	0.00
Slope (%) :	1.25	0.00	0.00
Surface Type :	Unpaved	Unpaved	Unpaved
Velocity (ft/sec) :	1.80	0.00	0.00
Computed Flow Time (min) :	1.11	0.00	0.00

Total TOC (min) 17.04

Subbasin Runoff Results

Total Rainfall (in) 4.80
Total Runoff (in) 3.46
Peak Runoff (cfs) 0.31
Rainfall Intensity 4.800
Weighted Runoff Coefficient 0.7200
Time of Concentration (days hh:mm:ss) 0 00:17:02

Subbasin : ProposedDrainageAreaNo.3



Junction Input

SN	Element ID	Invert Elevation (ft)	Ground/Rim (Max) Elevation (ft)	Ground/Rim (Max) Offset (ft)	Initial Water Elevation (ft)	Initial Water Depth (ft)	Surcharge Elevation (ft)	Surcharge Depth (ft)	Ponded Area (ft²)	Minimum Pipe Cover (in)
1	Jun-01	65.00	69.00	4.00	65.00	0.00	70.00	1.00	0.00	0.00

Junction Results

SN	Element ID	Peak Inflow (cfs)	Peak Lateral Inflow (cfs)	Max HGL Elevation Attained (ft)	Max HGL Depth Attained (ft)	Max Surcharge Depth Attained (ft)	Min Freeboard Attained (ft)	Average HGL Elevation Attained (ft)	Average HGL Depth Attained (ft)	Time of Max HGL Occurrence (days hh:mm)	Time of Peak Flooding Occurrence (days hh:mm)	Total Flooded Volume (ac-in)	Total Time Flooded (min)
1	Jun-01	0.42	0.00	65.28	0.28	0.00	3.72	65.03	0.03	0 01:09	0 00:00	0.00	0.00

Pipe Input

SN	Element ID	Length (ft)	Inlet Invert Elevation (ft)	Inlet Invert Offset (ft)	Outlet Invert Elevation (ft)	Outlet Invert Offset (ft)	Total Drop (ft)	Average Slope (%)	Pipe Shape	Pipe Diameter or Height (in)	Pipe Width (in)	Manning's Roughness	Entrance Losses	Exit/Bend Losses	Additional Losses	Initial Flow (cfs)	Flap Gate	No. of Barrels
1	Link-01	78.00	65.00	0.00	64.50	0.00	0.50	0.6400	CIRCULAR	12.000	12.000	0.0150	0.5000	0.5000	0.0000	0.00	No	1

Pipe Results

SN	Element ID	Peak Flow (cfs)	Time of Peak Flow Occurrence (days hh:mm)	Design Flow Capacity (cfs)	Peak Flow/ Design Flow Ratio	Peak Flow Velocity (ft/sec)	Travel Time (min)	Peak Flow Depth (ft)	Peak Flow Depth/ Total Depth Ratio	Total Time Surcharged (min)	Froude Number	Reported Condition
1	Link-01	0.42	0 01:10	2.47	0.17	2.35	0.55	0.28	0.28	0.00		Calculated

Storage Nodes

Storage Node : Stor-01

Input Data

Invert Elevation (ft)	65.00
Max (Rim) Elevation (ft)	69.00
Max (Rim) Offset (ft)	4.00
Initial Water Elevation (ft)	65.00
Initial Water Depth (ft)	0.00
Ponded Area (ft²)	0.00
Evaporation Loss	0.00

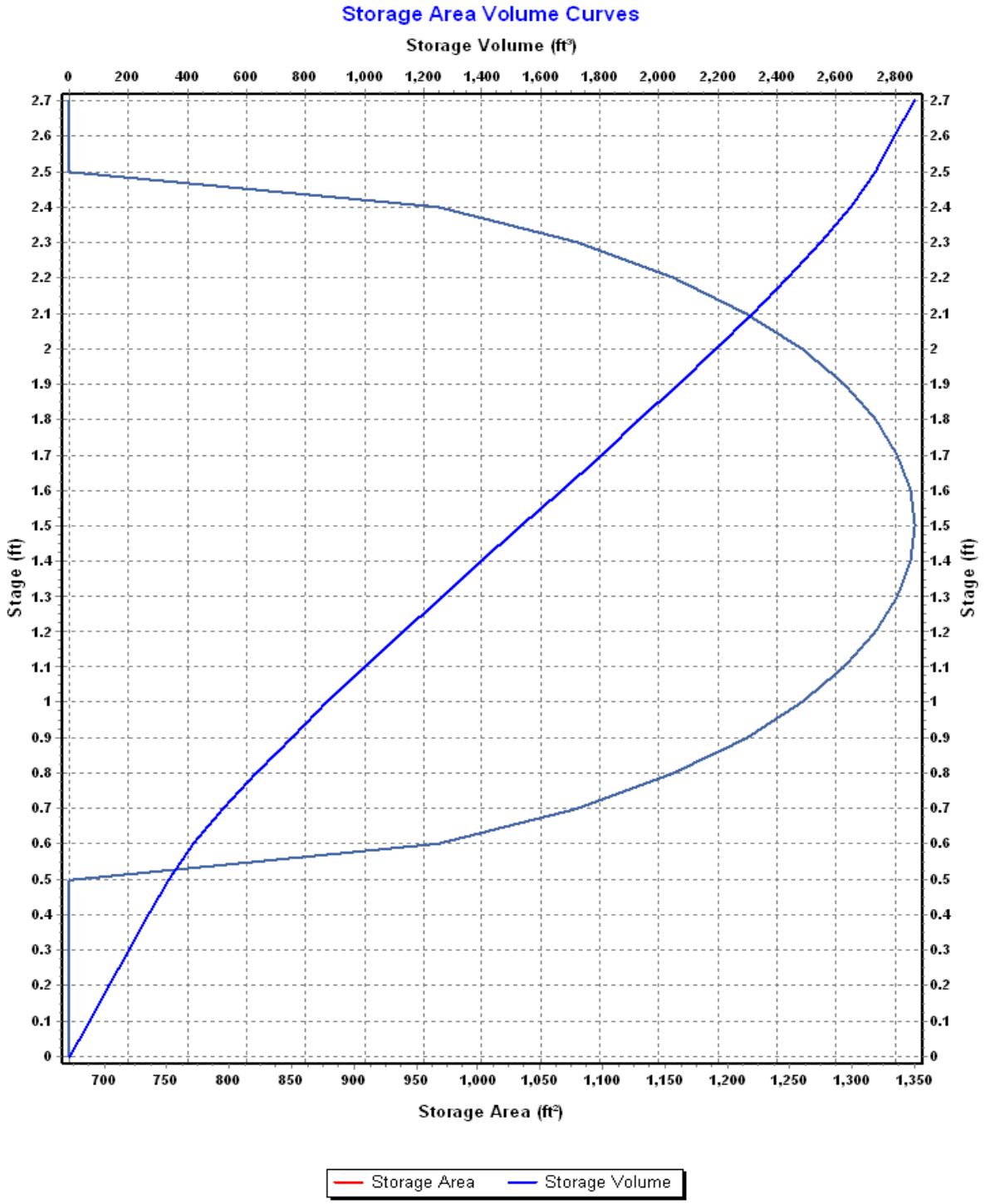
Infiltration/Exfiltration

Constant Flow Rate (cfs)	0.1000

Storage Area Volume Curves

Storage Curve : Storage-01

Stage (ft)	Storage Area (ft²)	Storage Volume (ft³)
0	672.0000	0.000
0.1	672.0000	67.20
0.2	672.0000	134.40
0.3	672.0000	201.60
0.4	672.0000	268.80
0.5	672.0000	336.00
0.6	967.5333	417.98
0.7	1078.8000	520.30
0.8	1156.1888	632.05
0.9	1214.4000	750.58
1	1259.1652	874.26
1.1	1293.3973	1001.89
1.2	1318.7708	1132.50
1.3	1336.3016	1265.25
1.4	1346.6015	1399.40
1.5	1350.0000	1534.23
1.6	1346.6015	1669.06
1.7	1336.3016	1803.21
1.8	1318.7708	1935.96
1.9	1293.3973	2066.57
2	1259.1652	2194.20
2.1	1214.4000	2317.88
2.2	1156.1888	2436.41
2.3	1078.8000	2548.16
2.4	967.5333	2650.48
2.5	672.0000	2732.46
2.6	672.0000	2799.66
2.7	672.0000	2866.86


Storage Area Volume Curves
Storage Volume (ft³)
0 200 400 600 800 1,000 1,200 1,400 1,600 1,800 2,000 2,200 2,400 2,600 2,800
Stage (ft)
0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1 1.1 1.2 1.3 1.4 1.5 1.6 1.7 1.8 1.9 2 2.1 2.2 2.3 2.4 2.5 2.6 2.7
Storage Area (ft²)
700 750 800 850 900 950 1,000 1,050 1,100 1,150 1,200 1,250 1,300 1,350
Storage Area
Storage Volume

Storage Node : Stor-01 (continued)

Outflow Weirs

SN	Element ID	Weir Type	Flap Gate	Crest Elevation (ft)	Crest Offset (ft)	Length (ft)	Weir Total Height (ft)	Discharge Coefficient
1	Weir-01	Rectangular	No	67.50	2.50	4.00	0.67	3.33

Outflow Orifices

SN	Element ID	Orifice Type	Orifice Shape	Flap Gate	Circular Orifice Diameter (in)	Rectangular Orifice Height (in)	Rectangular Orifice Width (in)	Orifice Invert Elevation (ft)	Orifice Coefficient
1	Orifice-1	Side	CIRCULAR	No	3.00			65.00	0.61

Output Summary Results

Peak Inflow (cfs)	1.19
Peak Lateral Inflow (cfs)	1.19
Peak Outflow (cfs)	0.42
Peak Exfiltration Flow Rate (cfm)	6.00
Max HGL Elevation Attained (ft)	67.52
Max HGL Depth Attained (ft)	2.52
Average HGL Elevation Attained (ft)	65.17
Average HGL Depth Attained (ft)	0.17
Time of Max HGL Occurrence (days hh:mm)	0 01:09
Total Exfiltration Volume (1000-ft³)	1.294
Total Flooded Volume (ac-in)	0
Total Time Flooded (min)	0
Total Retention Time (sec)	0.00

4. Summary Table

0.5135 Acre Basin

Storm Event	Pre-Development Stormwater Runoff Peak Flow	Post-Development Stormwater Runoff Peak Flow	Post-Development Stormwater Runoff Peak Flows with Routed Discharges	Required Stormwater Peak Runoff Reduction ***Rates***	Provided Stormwater Peak Runoff Reduction Rates	Stormwater Peak Runoff Reduction ***Rates Met***
Two (2) Year	0.80 cfs	0.85 cfs	0.52 cfs	50 %	35.0 %	NO **
Ten (10) Year	1.11 cfs	1.19 cfs	0.69 cfs	25 %	37.8 %	YES
Twenty-Five (25) Year	1.29 cfs	1.39 cfs	0.78 cfs	N.A.	39.5 %	Zero Increase in Runoff Requirement Met
One-Hundred (100) Year	1.65 cfs	1.77 cfs	1.01 cfs	25 %	38.8 %	YES

***** Note: The stormwater detention system utilizes a minimum three (3) inch orifice, and in part due to the small size of the existing drainage area, does meet or exceed the required peak runoff reduction rate for the 2-year storm. A smaller orifice would achieve compliance at the expense of potential maintenance issues with the stormwater detention system.***

5. Conclusions

This study demonstrates that the stormwater management plan prepared for this proposed site development application provides adequate storage of the stormwater runoff generated to reduce the post development flows to less than predevelopment levels.

The outlet structure has been equipped with a three (3) inch orifice and a four (4) foot weir to reduce the outflows from the detention system. These reductions of the post-development flows to prescribed less than pre-development levels satisfy those requirements for stormwater management regulated by the State of New Jersey, the County of Bergen, and the Borough of Westwood, except for the two (2) year storm.

A vegetative grass strip has been provided to provide disconnected impervious areas which will slightly increase the time of concentration for the proposed conditions, and it will also provide additional water quality measures to the site which will reduce the amount of sediment introduced into the system. A minimum orifice diameter of three (3) inches was utilized in order to avoid clogging with trash and leaf litter. Inlet filters and trash racks will also be provided to further mitigate this potential condition.

The pre-existing runoff rates were calculated for various storms over the 0.5135-acre site that drains from the easterly side end of the property westerly to Kinderkamack Road. The two (2), ten (10), and one-hundred (100) year peak discharge rates were calculated for the present conditions to be 0.80 cfs., 1.11 cfs., and 1.65 cfs. respectively. The twenty-five (25) year peak discharge rate was also calculated under pre-development conditions to be 1.29 cfs.

The post development runoff was also calculated for the same the 0.5135-acre site. The two (2), ten (10), and one-hundred (100) year peak discharge rates were calculated for the post development conditions to be 0.85 cfs., 1.19 cfs., and 1.77 cfs. respectively. The twenty-five (25) year peak discharge rate was also calculated to be 1.39 cfs.

The contributing stormwater collected by the stormwater collection system was routed through the proposed control structure resulting with the two (2), ten (10), and one-hundred (100) year peak discharge flow rates out of the detention facility, in addition with some off-site flows were calculated to be 0.52 cfs, 0.69 cfs, and 1.01 cfs. The twenty-five (25) year routed peak discharge flow rates out of the detention facility was calculated to be 0.78 cfs.

The twenty-five (25) year peak discharge rate was computed to determine compliance with Bergen County Planning Department requirements for Zero Increase in Runoff and to demonstrate the adequacy of the design for the stormwater collection system that safely conveys runoff from the site to the detention system to a one and into Kinderkamack Road.

The maximum storage within the detention system was calculated to be 963.6 cubic feet for the two (2) year storm with the high-water level equal to 66.07 feet. The maximum storage was also calculated for the ten (10) year storm to be 1,599.6 cubic feet while the high-water level is 66.55 feet, and for the one hundred (100) year storm to be 2,749.5 cubic feet and the high-water level is 67.52 feet.

6. Supplemental Information

- *USDA Web Soil Survey Report*

- *United State Geological Survey*
  The National Map Advanced Viewer
  National FWS Wetlands
  FEMA Flood Zones

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 Bergen County, New Jersey

Westwood, N.J.

December 10, 2019

Preface

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

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

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

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

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

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

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Contents

How Soil Surveys Are Made

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

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

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

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

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

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

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

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

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

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

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

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

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

Soil Map

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

Map Scale: 1:468 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 5 10 20 30

Feet
0 20 40 80 120

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Bergen County, New Jersey
Survey Area Data: Version 16, Sep 16, 2019

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

Date(s) aerial images were photographed: Oct 7, 2013—Feb 26, 2017

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

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
UR	Urban land	0.5	100.0%
Totals for Area of Interest		**0.5**	**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.

Bergen County, New Jersey

UR—Urban land

Map Unit Setting

National map unit symbol: b0ss
Elevation: 0 to 170 feet
Mean annual precipitation: 30 to 64 inches
Mean annual air temperature: 46 to 79 degrees F
Frost-free period: 131 to 178 days
Farmland classification: Not prime farmland

Map Unit Composition

Urban land: 95 percent
Minor components: 5 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Urban Land

Setting

Parent material: Surface covered by pavement, concrete, buildings, and other structures underlain by disturbed and natural soil material

Interpretive groups

Land capability classification (irrigated): None specified
Land capability classification (nonirrigated): 8s
Hydric soil rating: Unranked

Minor Components

Udorthents

Percent of map unit: 5 percent
Landform: Low hills
Down-slope shape: Linear
Across-slope shape: Linear
Hydric soil rating: No

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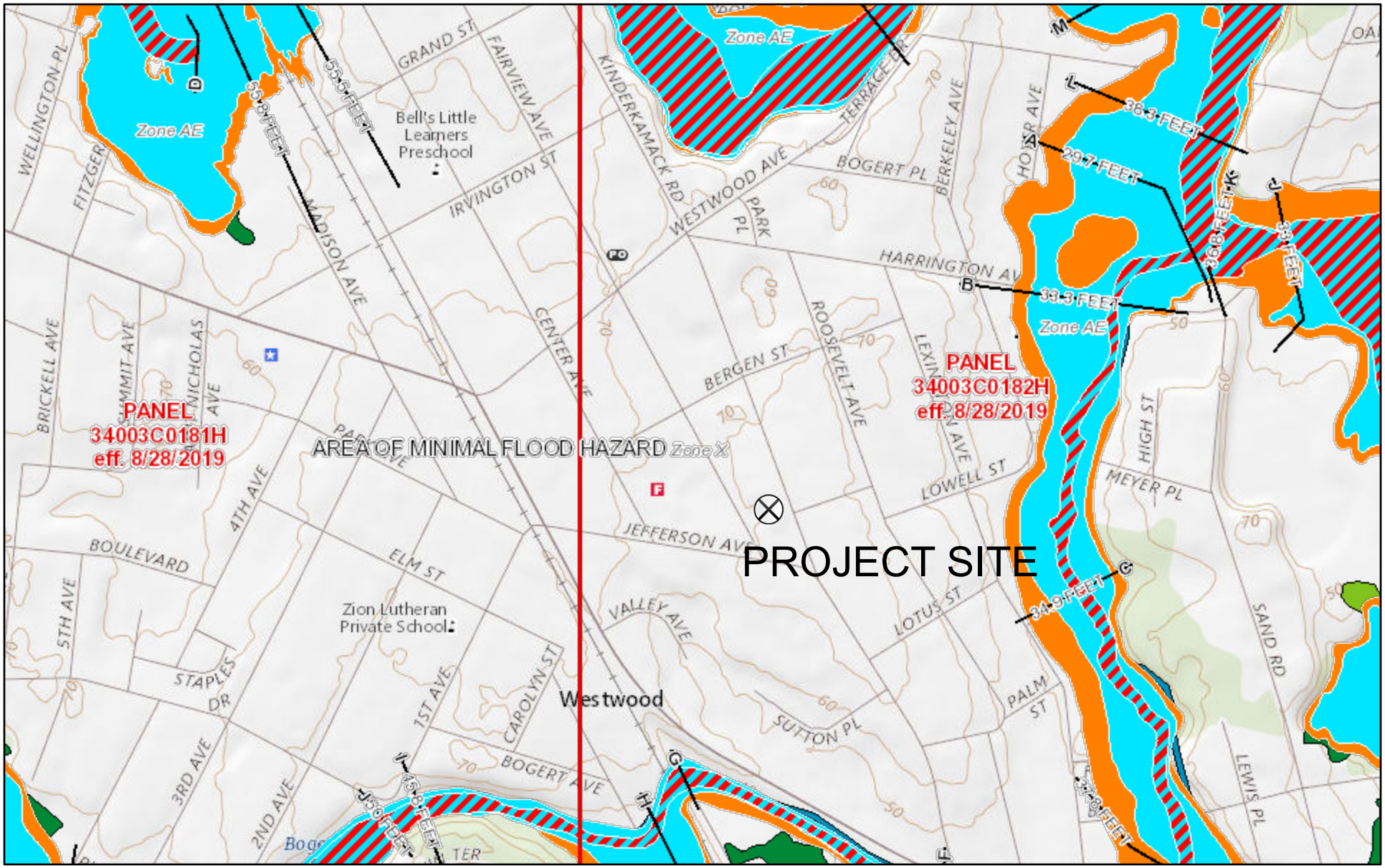
The National Map Advanced Viewer



12/10/2019, 1:56:34 PM

1:9,028

0 0.05 0.1 0.2 mi

0 0.07 0.15 0.3 km

Override 1

Flood Hazard Zones

1% Annual Chance Flood Hazard

Regulatory Floodway

Special Floodway

Area of Undetermined Flood Hazard

0.2% Annual Chance Flood Hazard

U.S. Fish and Wildlife Service, National Standards and Support Team, USGS

USGS The National Map: National Boundaries Dataset, 3DEP Elevation Program, Geographic Names Information System, National Hydrography Dataset, National Land Cover Database, National Structures Dataset, and National Transportation Dataset; USGS Global