JBMac Ventures
Sherwood, Oregon

Preliminary Stormwater Report

Date: March 2022

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AKS Job Number: 8627-03 & 8627-04

AKS ENGINEERING & FORESTRY

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Contents

Tables

Exhibits

Appendices

PRELIMINARY STORMWATER REPORT

JBMAC VENTURES
SHERWOOD, OREGON

1.0 Purpose of Report

The purpose of this report is to analyze the effects the proposed development will have on the existing stormwater conveyance system; document the criteria, methodology, and informational sources used to design the proposed stormwater system; and present the results of the preliminary hydraulic analysis.

2.0 Project Location/Description

The JBMac Ventures project is located at Tax Lot 500, 600, and 700, Washington County Tax Map 2S 1 29DC, Sherwood, Oregon. Improvements are split into two parts. Part 1 encompasses Tax Lot 500 and includes the construction of an industrial building, paved parking, private underground utilities, and stormwater management facility. Part 2 encompasses Tax Lot 600 and 700 and includes the construction of a shared driveway and frontage improvements to SW Oregon Street. Per discussion with City of Sherwood staff, stormwater runoff from Part 1 of the development will be managed by a private facility while runoff from Part 2 of the development will be routed to the public system for treatment at a regional facility.

3.0 Regulatory Design Criteria

3.1 Stormwater Quantity

Per *CWS Design and Construction Standards Manual for Sanitary Sewer and Surface Water Management* (R&O 19-5, as amended by R&O 19-22), Section 4.02.1, Mitigation Requirement, the District or City shall determine which of the following techniques may be used:

a. *Construction of permanent on-site stormwater quantity detention facilities designed in accordance with this Chapter; or*

b. *Enlargement or improvement of the downstream conveyance system in accordance with this Chapter and Chapter 5; or*

c. *Payment of a Storm and Surface Water Management System Development Charge (SWM SDC), as provided in CWS Ordinance 28, which includes a water quantity component to meet these requirements. If district or City requires that an on-site detention facility be constructed, the development shall be eligible for a credit against SWM SDC fees, as provided in District Ordinance and Rules.*

Per R&O 19-5, as amended by R&O 19-22, Section 4.02.2, Criteria for Requiring On-Site Detention for Conveyance Capacity, on-site detention is required when any of the following conditions exist:

1. *There is an identified downstream deficiency and the District or City determines that detention rather than conveyance system enlargement is the more effective solution.*

2. *There is an identified regional detention site within the boundary of the development.*

3. *Water quantity facilities are required by District-adopted watershed management plans or subbasin master plans or District- approved subbasin strategy.*

3.2 Hydromodification

Per R&O 19-5, as amended by R&O 19-22, Section 4.03, Hydromodification Approach Requirements, implementing or funding techniques to reduce impacts to the downstream receiving water body is

required when a new development or other activities create or modify 1,000 square feet or more of impervious surfaces or increase the amount or rate of surface water leaving the site. The funding can be directed, or the following techniques can be implemented to reduce impacts to the downstream receiving water body:

a. *Construction of permanent LIDA designed in accordance with this Chapter; or*

b. *Construction of a permanent stormwater detention facility designed in accordance with this Chapter; or*

c. *Construction or funding of a hydromodification approach that is consistent with a District-approved subbasin strategy; or*

d. *Payment of a Hydromodification Fee-In-Lieu.*

Per R&O 19-5, as amended by R&O 19-22, Section 4.03.3, the receiving reach for this project is Rock Creek. The Risk Level for the receiving reach identified for this project is Low. The Development Class was determined using the Hydromodification Map provided by CWS. The project site is classified as a Developed Area. Per Section 4.08.1, Impervious Area Used in Design, the project site is classified as a Large Project as it is greater than 80,000 square feet. Using these input parameters, per Table 4-2, Hydromodification Approach Project Category Table (shown below), the project falls within Category 2. See details in the appendices of this report for further information.

TABLE 4-2
HYDROMODIFICATION APPROACH PROJECT CATEGORY TABLE

<table>
<tr><th>Development Class/
Risk Level</th><th>Small Project
1,000 – 12,000 SF</th><th>Medium Project
>12,000 – 80,000 SF</th><th>Large Project
> 80,000 SF</th></tr>
<tr><td>Expansion/High</td><td rowspan="6">Category 1</td><td rowspan="2">Category 3</td><td rowspan="4">Category 3</td></tr>
<tr><td>Expansion/ Moderate</td></tr>
<tr><td>Expansion/ Low</td><td>Category 2</td></tr>
<tr><td>Developed/ High</td><td>Category 3</td></tr>
<tr><td>Developed/ Moderate</td><td rowspan="2">Category 2</td><td rowspan="2">Category 2</td></tr>
<tr><td>Developed/ Low</td></tr>
</table>

Table 4-2 from R&O 19-5, as amended by R&O 19-22

Per R&O 19-5, as amended by R&O 19-22, Section 4.03.5b, Hydromodification Approach Selection – Category 2, any of the following options may be used to address hydromodification:

1. *Infiltration facility, using the Standard LIDA Sizing, described in Section 4.08.5; or*
2. *Peak-Flow Matching Detention, using design criteria described in Section 4.08.6; or*
3. *Combination of Infiltration facility and Peak-Flow Matching Detention, using criteria described in Section 4.08.5 and 4.08.6; or*
4. *Any option listed in Category 3.*

3.3 Stormwater Quality

Per R&O 19-5, as amended by R&O 19-22, Section 4.04, Water Quality Treatment Requirements, implementing or funding a permanent water quality approach is required when a new development or other activities create or modify 1,000 square feet or more of impervious surfaces, or increase the amount

of stormwater runoff or pollution leaving the site. Unless there is a more efficient and effective regional approach within the subbasin that was designed to incorporate the development, or there is an approach in the subbasin which is demonstrated to have the capacity to treat the site.

This project will create approximately 157,359 square feet of new impervious area, therefore requiring water quality mitigation. Stormwater quality management for Part 1 of this project will be met by the combination of a stormwater quality manhole and new stormwater facility. Stormwater quality management for Part 2 of this project will be met by a public regional stormwater facility.

Per discussion with City of Sherwood Staff, all stormwater runoff resulting from improvements to Tax Lot 600 and 700 as well as the frontage improvements to SW Oregon Street is to be routed to the public system. This runoff will be treated at a public regional facility. A stormwater report being completed by Kittelson & Associates on behalf of the city of Sherwood includes the subject site within their area of analysis. An exhibit included as Appendix B of this report highlights the area to be routed to the regional facility.

4.0 Design Methodology

The Santa Barbara Urban Hydrograph (SBUH) Method was used to analyze stormwater runoff from the site. This method uses the Soil Conservation Service (SCS) Type 1A 24-hour design storm. HydroCAD 10.00-22 computer software aided in the analysis. Representative runoff curve numbers (CN) were obtained from the Natural Resources Conservation Service (NRCS) *Technical Release 55* and are included in the appendices.

5.0 Design Parameters

5.1 Design Storms

Stormwater mains, inlets, and laterals for the site are placed at locations that adequately collect and convey the stormwater for the proposed improvements. Per R&O 19-5, as amended by R&O 19-22, Section 5.05.2, the stormwater analysis used the 24-hour design storm for the evaluation and design of the existing and proposed stormwater facilities. The following 24-hour rainfall intensities from CWS Standard Drawing No. 1280 were used as the design storms for the recurrence interval:

Table 5-1: Rainfall Intensities

Recurrence Interval (Years)	Total Precipitation Depth (Inches)
2	2.50
5	3.10
10	3.45
25	3.90

5.2 Predeveloped Site Conditions

5.2.1 Site Topography

Existing on-site grades generally vary from ±2 to 5 percent, with most of the site draining to the northeast towards land owned by the Southern Pacific Railroad. The site has a high point of ±187 feet along the western property line and a low point of ±162 feet in the northeast corner.

5.2.2 Land Use

The property is zoned Light Industrial (LI). The property is open grassland and is currently undeveloped.

5.3 Soil Type

The soil beneath the project area is classified as Aloha Silt Loam and Quatama Loam, according to the NRCS Web Soil Survey for Washington County. The following table outlines the Hydrologic Soil Group rating for the soil type:

Table 5-2: Hydrologic Soil Group Ratings

NRCS Map Unit Identification	NRCS Soil Classification	Hydrologic Soil Group Rating
1	Aloha Silt Loam	C
37A	Quatama Loam	C

Further information on this soil type is included in the Geotech Report and NRCS Soil Resource Report located in the appendices of this report.

5.4 Post-Developed Site Conditions

5.4.1 Site Topography

The on-site slopes will be modified to create a flat pad for the new building and gently sloped impervious surfaces for proper drainage. All stormwater from the new impervious areas will be collected by new or existing stormwater infrastructure and will not impact surrounding properties. Post-Development flow paths will generally mimic Pre-Development flow paths.

5.4.2 Land Use

The property's zoning will remain LI.

5.4.3 Description of Off-Site Contributing Basins

The surrounding properties do not direct any stormwater runoff towards the development area.

6.0 Stormwater Analyses

6.1 Proposed Stormwater Conduit Sizing and Inlet Spacing

The proposed storm system pipes will be sized using Manning's equation to convey the peak flows from the 25-year storm event.

6.2 Proposed Stormwater Quality Control Facility

Stormwater quality management for Part 1 of this project will be met by the combination of a stormwater quality manhole and new private stormwater facility. The new stormwater facility has been designed per CWS Design and Construction Standards for Sanitary Sewer and Surface Water Management (R&O 19-05). The facility has been sized to treat runoff from all impervious surfaces on Tax Lot 500. Detailed calculations are included as Appendix E.

Stormwater quality management for Part 2 of this project will be met by a public regional stormwater facility. Per discussion with City of Sherwood Staff, all stormwater runoff resulting from improvements to Tax Lot 600 and 700 as well as the frontage improvements to SW Oregon Street is to be routed to the public system. This runoff will be treated for water quality at a public regional facility. A stormwater report being completed by Kittelson & Associates on behalf of the City of Sherwood includes the subject site within their area of analysis. An exhibit included as Appendix B of this report highlights the area to be routed to the regional facility.

6.3 Hydromodification

Part 1 of this project will create approximately 133,720 SF of new impervious surface. The proposed site improvements will reduce impacts to the downstream receiving water body by implementing a private detention pond facility designed per CWS standards. Per R&O 19-5, as amended by R&O 19-22, Section 4.03.5b, Hydromodification Approach Selection – Category 2, hydromodification will be met to the fullest potential of the site by peak-flow matching. Post-developed runoff rates from the site will not exceed the predeveloped runoff rates for 50% of the 2-year, 5-year and 10-year design storms, when on-site stormwater infrastructure is accounted for.

Part 2 of this project will create approximately 8,327 SF of new impervious surface. Per discussion with City of Sherwood Staff, all stormwater runoff resulting from improvements to Tax Lot 600 and 700 as well as the frontage improvements to SW Oregon Street is to be routed to the public system. This runoff will be managed by a public regional facility. A stormwater report being completed by Kittelson & Associates on behalf of the city of Sherwood includes the subject site within their area of analysis. An exhibit included as Appendix B of this report highlights the area to be routed to the regional facility.

6.4 Proposed Stormwater Quantity Control Facility

Stormwater quantity management for the newly created impervious areas in part 1 will be addressed by the construction of a stormwater quality facility in the northeast corner of the site. The following table summarizes the pre and post developed flows from the stormwater facility. Post developed flows are limited to less than the allowable pre-development peak flows, as outlined within CWS stormwater quantity and hydromodification management requirements.

See Equations 1 for additional information regarding the allowable release rate from the Private Facility for the 2-yr storm event.

Equation 1: 50 percent of the 2-Year Storm

$$Pre\ Developed\ 2\ Year = 0.42\ cfs$$

$$Required\ Private\ Facility\ Flow\ Reduction\ (50\%\ of\ 2\ Year) = \frac{(0.42\ cfs)}{2} = 0.21\ cfs$$

Table 6-1: Pre and Post Development On-Site Flows (Part 1)

Recurrence Interval (Years)	Peak Pre-Development Flows (cfs)	Peak Post-Development Flows (cfs)*	Peak Flow Increase or (Decrease) – (cfs)
2	0.42 (50% of 2-yr=0.21)	0.21	0.00
5	0.73	0.48	-0.25
10	0.93	0.67	-0.26
25	1.21	1.08	-0.13

Based on the peak flow comparison in the table above, the total peak flow rates for the Part 1 project area do not exceed 50% of the 2-year, 5-year, and 10-year design storms.

Stormwater quantity management for the newly created impervious areas in Part 2 will be addressed by a public regional facility operated by the City of Sherwood. The following table summarizes the pre and post developed flows from the Part 2 project area.

Table 6-2: Pre and Post Development On-Site Flows (Part 2)

Recurrence Interval (Years)	Peak Pre-Development Flows (cfs)	Peak Post-Development Flows (cfs)*	Peak Flow Increase or (Decrease) – (cfs)
2	0.29 (50% of 2-yr=0.15)	0.52	+0.23
5	0.49	0.74	+0.25
10	0.62	0.88	+0.26
25	0.80	1.06	+0.26

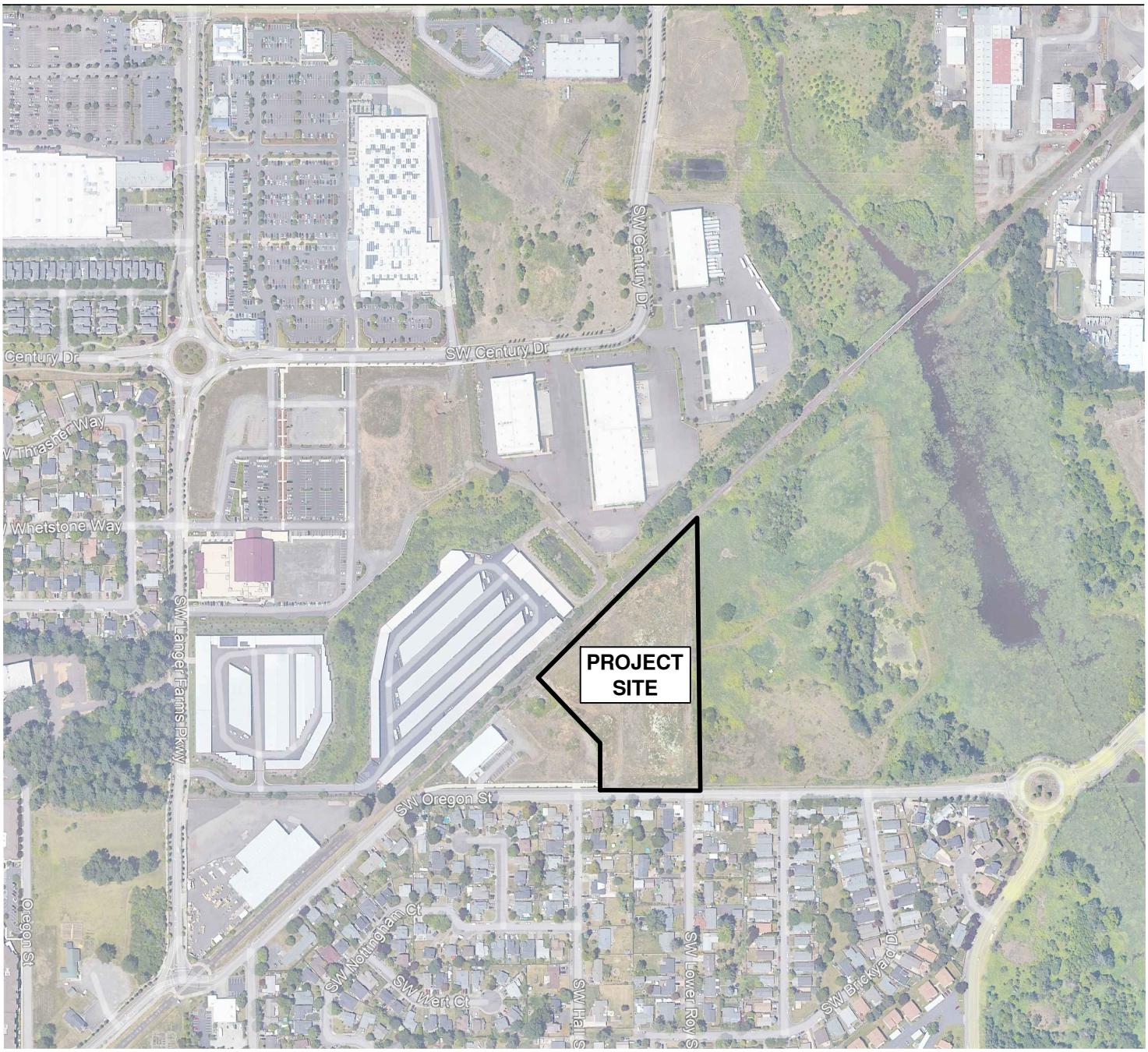
Based on the peak flow comparison in the table above, the total peak flow rates from the Part 2 project area exceed the 50% of the 2-year, 5-year, and 10-year design storm. Due to the increase in peak flows resulting from Part 2 of the development additional stormwater quantity management will be required. Per discussions with City of Sherwood staff, the City is prepared to accept all stormwater runoff from the development of Tax Lot 600 and 700 as well as the frontage improvements to SW Oregon Street for management in their regional facility. A stormwater report being completed by Kittelson & Associates on behalf of the city of Sherwood provides additional information on how the city will treat and manage this stormwater.

6.5 Downstream Analysis

Stormwater from Part 1 of this project discharges to an existing drainage ditch within the Southern Pacific Railroad ROW. Stormwater then flows approximately 1,000 feet east into Rock Creek. As shown in table 6-1 the private stormwater facility will result in a decrease in peak flow during the 25-year storm event when compared to the pre-developed condition. Therefore, the existing drainage ditch downstream of the project site is expected be adequate.

Stormwater from Part 2 of this project discharges to the public stormwater system. As part of the analysis being completed by Kittelson & Associates the downstream capacity of the public system is being assessed. Any deficiencies in the existing network will be identified by Kittelson & Associates and addressed by the City of Sherwood.

Exhibit A: Vicinity Map



N

SCALE: 1"= 500 FEET

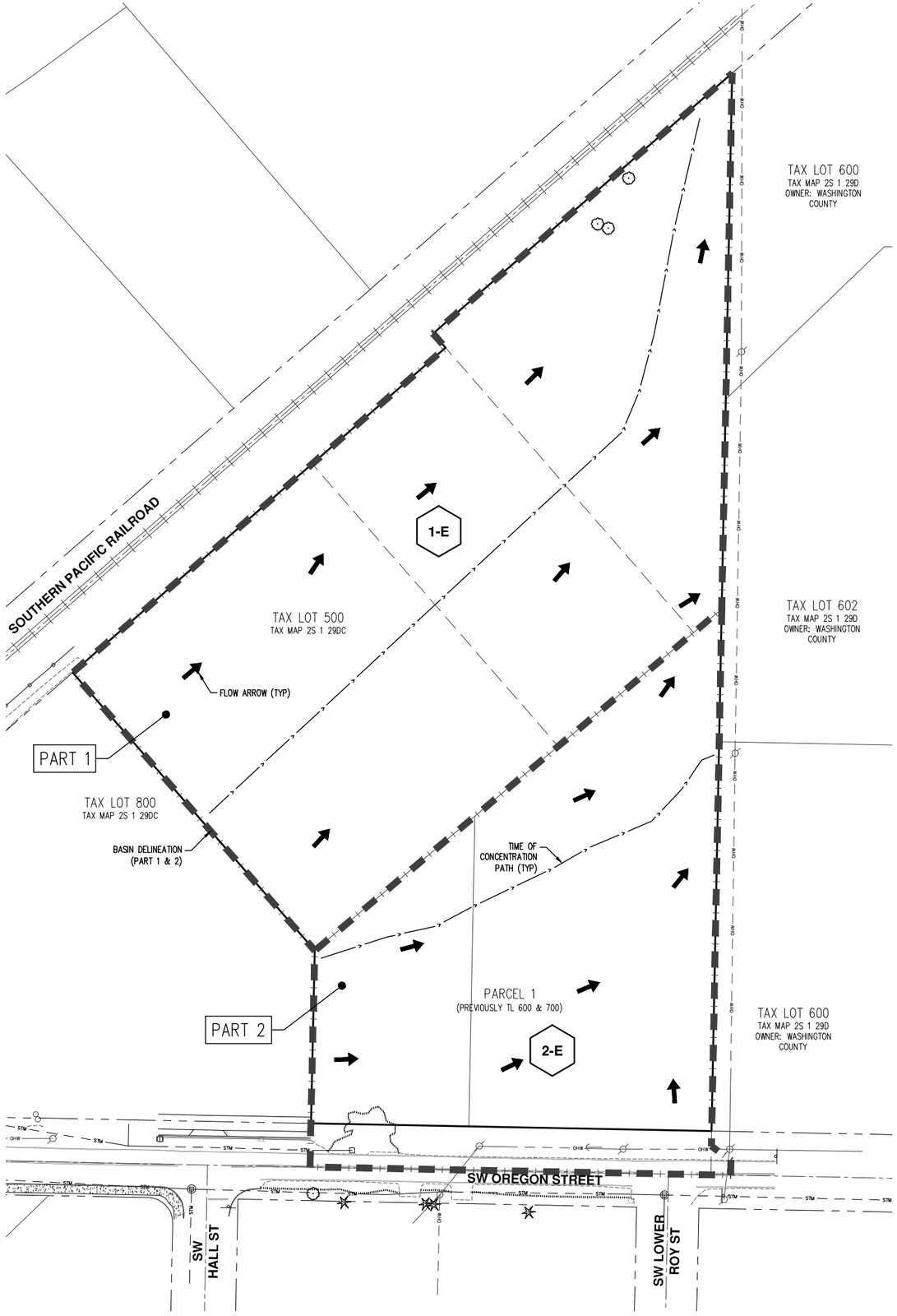
500 0 200 300 400 500

DATE: 06/16/2022

VICINITY MAP	EXHIBIT A
AKS ENGINEERING & FORESTRY, LLC 12965 SW HERMAN RD, STE 100 TUALATIN, OR 97062 P: 503.563.6151 F: 503.563.6152 aks-eng.com	DRWN: APC CHKD: BGC AKS JOB: 8627-03

DWG: 8627-03 VICINITY MAP | EXH A

Appendix A: Pre-Developed Catchment Basins Map and Peak Flow Calculations - HydroCAD



LEGEND

- BASIN DELINEATION (PART 1 & 2)
- SUBBASIN DELINEATION
- TIME OF CONCENTRATION PATH
- SUBBASIN (XX)
- FLOW ARROW

NOTES:

1. CATCHMENT AREAS SHOWN ON THIS MAP ARE:
   - SHOWN TO ILLUSTRATE THE SUBCATCHMENT DELINEATION BASED ON EXISTING CONDITIONS PRIOR TO THE JBMAC VENTURES DEVELOPMENT.

N

SCALE: 1" = 50 FEET

50 0 10 25 50

ORIGINAL PAGE SIZE: 22" x 34"

PRE-DEVELOPED CATCHMENT BASINS MAP
OREGON STREET JBMAC
SHERWOOD, OREGON

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REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 8, 2003
GREG G. CARLSON

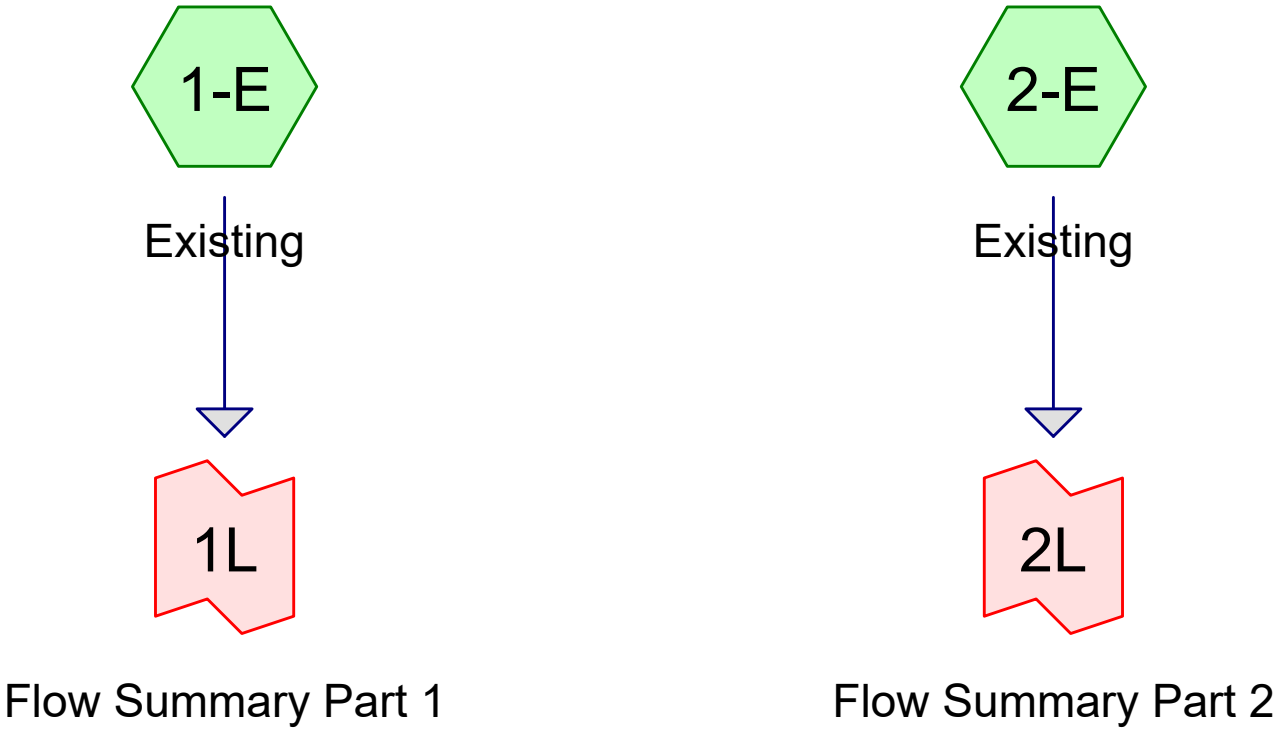
PRELIMINARY NOT FOR CONSTRUCTION

RENEWS:

JOB NUMBER:	8627-03
DATE:	06/16/2022
DESIGNED BY:	APC & TJ
DRAWN BY:	APC
CHECKED BY:	BGC

PRE

AKS DRAWING FILE: 8627-03 BASIN AREA PRE.DWG | LAYOUT: PRE



Flow Summary Part 1

Flow Summary Part 2

Subcat Reach Pond Link

Routing Diagram for 8627-03 Pre-DEV
Prepared by AKS Engineering, Printed 6/16/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
6.244	79	50-75% Grass cover, Fair, HSG C (1-E, 2-E)
0.077	98	Impervious Paving, HSG C (2-E)
6.322	**79**	**TOTAL AREA**

Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-E: Existing Runoff Area=174,233 sf 0.00% Impervious Runoff Depth=0.84"
Flow Length=707' Slope=0.0300 '/' Tc=28.3 min CN=79/0 Runoff=0.42 cfs 0.279 af

Subcatchment2-E: Existing Runoff Area=101,133 sf 3.34% Impervious Runoff Depth=0.89"
Flow Length=363' Tc=22.8 min CN=79/98 Runoff=0.29 cfs 0.171 af

Link 1L: Flow Summary Part 1 Inflow=0.42 cfs 0.279 af
Primary=0.42 cfs 0.279 af

Link 2L: Flow Summary Part 2 Inflow=0.29 cfs 0.171 af
Primary=0.29 cfs 0.171 af

Total Runoff Area = 6.322 ac Runoff Volume = 0.450 af Average Runoff Depth = 0.85"
98.77% Pervious = 6.244 ac 1.23% Impervious = 0.077 ac

Summary for Subcatchment 1-E: Existing

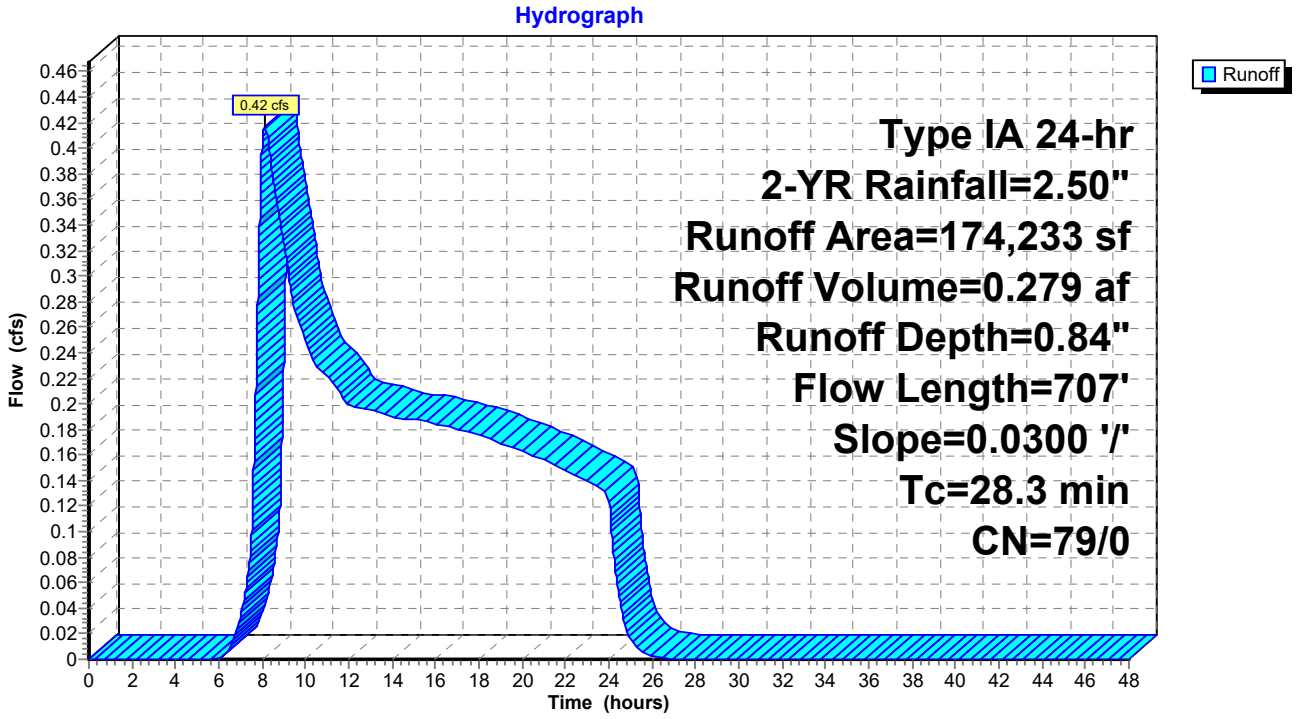
Runoff = 0.42 cfs @ 8.13 hrs, Volume= 0.279 af, Depth= 0.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

Area (sf)	CN	Description
174,233	79	50-75% Grass cover, Fair, HSG C
174,233		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	300	0.0300	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
5.6	407	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
28.3	707	Total			

Subcatchment 1-E: Existing



Summary for Subcatchment 2-E: Existing

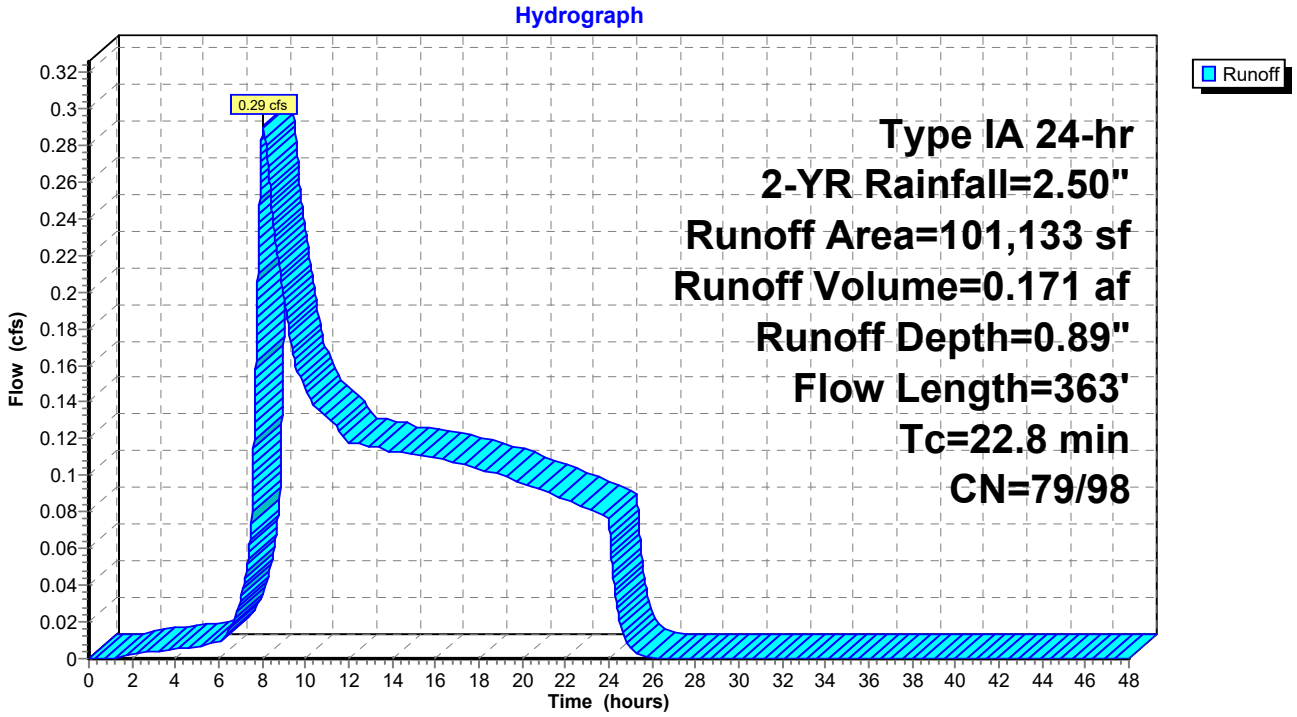
Runoff = 0.29 cfs @ 8.02 hrs, Volume= 0.171 af, Depth= 0.89"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

	Area (sf)	CN	Description
	97,758	79	50-75% Grass cover, Fair, HSG C
*	3,375	98	Impervious Paving, HSG C
	101,133	80	Weighted Average
	97,758		96.66% Pervious Area
	3,375		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	300	0.0316	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
0.6	63	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.8	363	Total			

Subcatchment 2-E: Existing

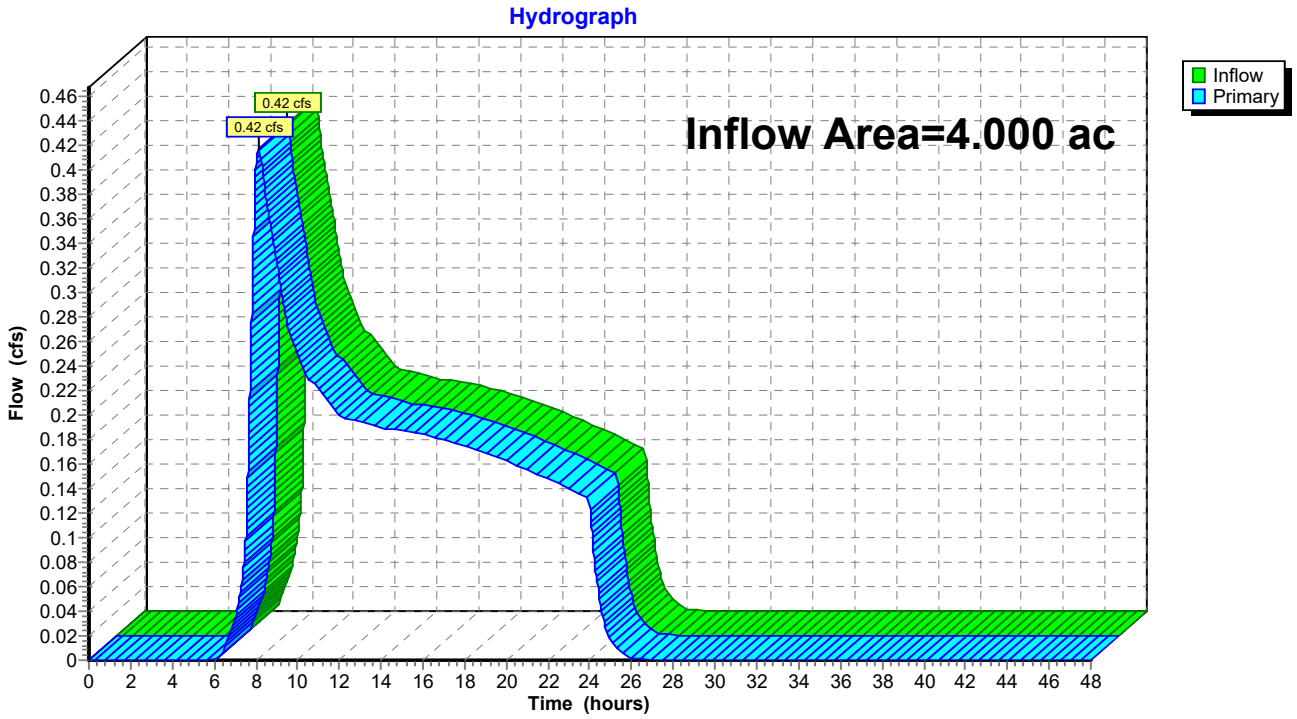


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 0.00% Impervious, Inflow Depth = 0.84" for 2-YR event
Inflow = 0.42 cfs @ 8.13 hrs, Volume= 0.279 af
Primary = 0.42 cfs @ 8.13 hrs, Volume= 0.279 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

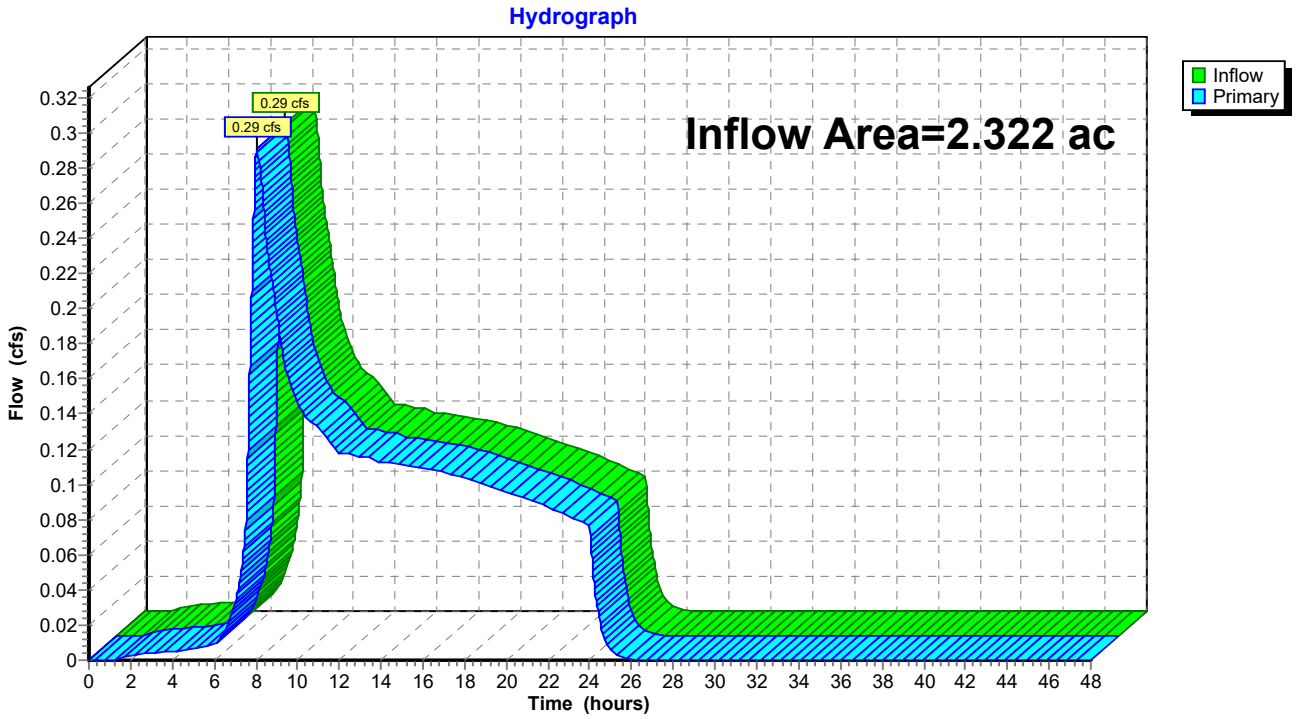


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 3.34% Impervious, Inflow Depth = 0.89" for 2-YR event
Inflow = 0.29 cfs @ 8.02 hrs, Volume= 0.171 af
Primary = 0.29 cfs @ 8.02 hrs, Volume= 0.171 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-E: Existing Runoff Area=174,233 sf 0.00% Impervious Runoff Depth=1.26"
Flow Length=707' Slope=0.0300 '/' Tc=28.3 min CN=79/0 Runoff=0.73 cfs 0.421 af

Subcatchment2-E: Existing Runoff Area=101,133 sf 3.34% Impervious Runoff Depth=1.32"
Flow Length=363' Tc=22.8 min CN=79/98 Runoff=0.49 cfs 0.255 af

Link 1L: Flow Summary Part 1 Inflow=0.73 cfs 0.421 af
Primary=0.73 cfs 0.421 af

Link 2L: Flow Summary Part 2 Inflow=0.49 cfs 0.255 af
Primary=0.49 cfs 0.255 af

Total Runoff Area = 6.322 ac Runoff Volume = 0.675 af Average Runoff Depth = 1.28"
98.77% Pervious = 6.244 ac 1.23% Impervious = 0.077 ac

Summary for Subcatchment 1-E: Existing

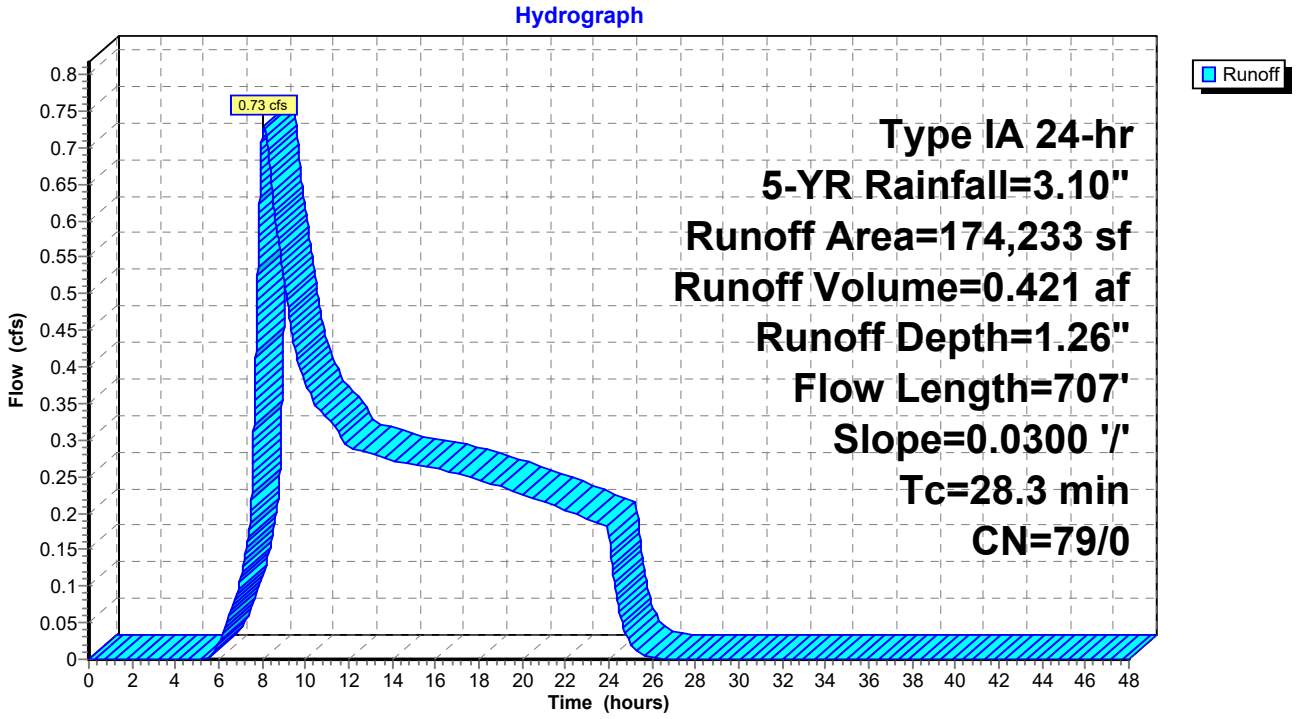
Runoff = 0.73 cfs @ 8.07 hrs, Volume= 0.421 af, Depth= 1.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

Area (sf)	CN	Description
174,233	79	50-75% Grass cover, Fair, HSG C
174,233		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	300	0.0300	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
5.6	407	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
28.3	707	Total			

Subcatchment 1-E: Existing



Summary for Subcatchment 2-E: Existing

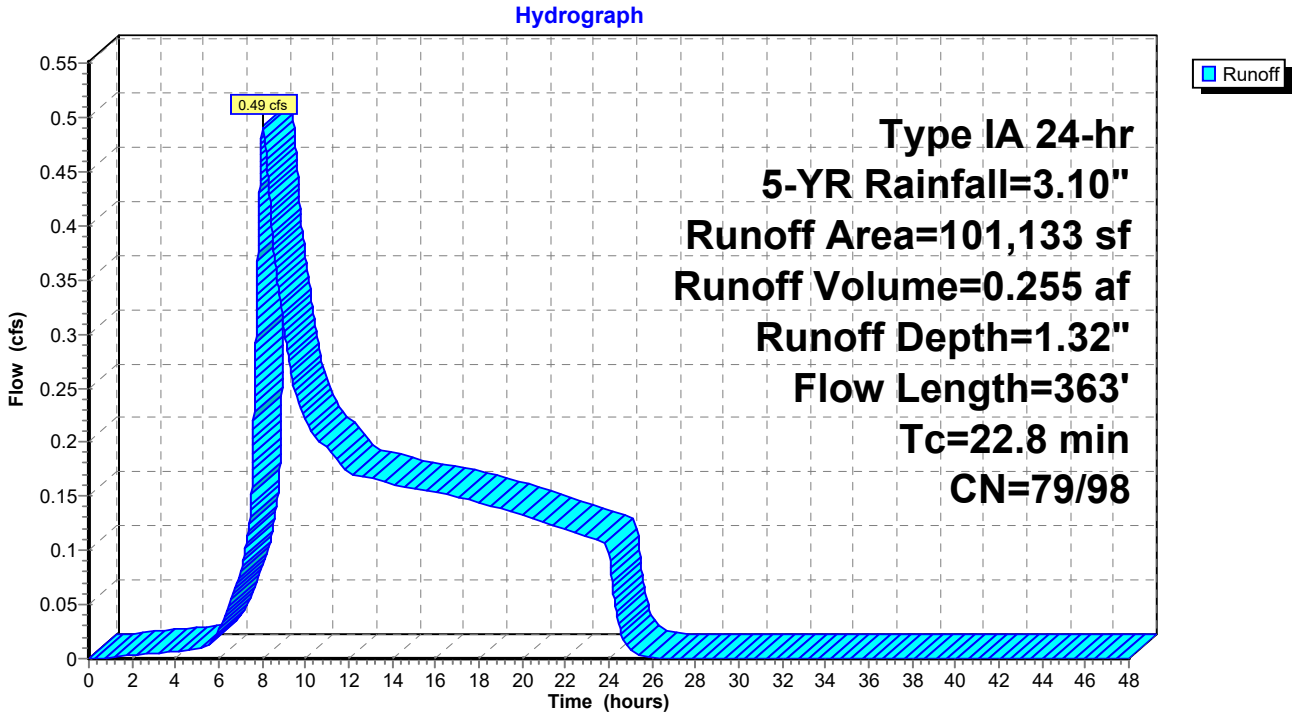
Runoff = 0.49 cfs @ 8.01 hrs, Volume= 0.255 af, Depth= 1.32"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

	Area (sf)	CN	Description
	97,758	79	50-75% Grass cover, Fair, HSG C
*	3,375	98	Impervious Paving, HSG C
	101,133	80	Weighted Average
	97,758		96.66% Pervious Area
	3,375		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	300	0.0316	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
0.6	63	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.8	363	Total			

Subcatchment 2-E: Existing

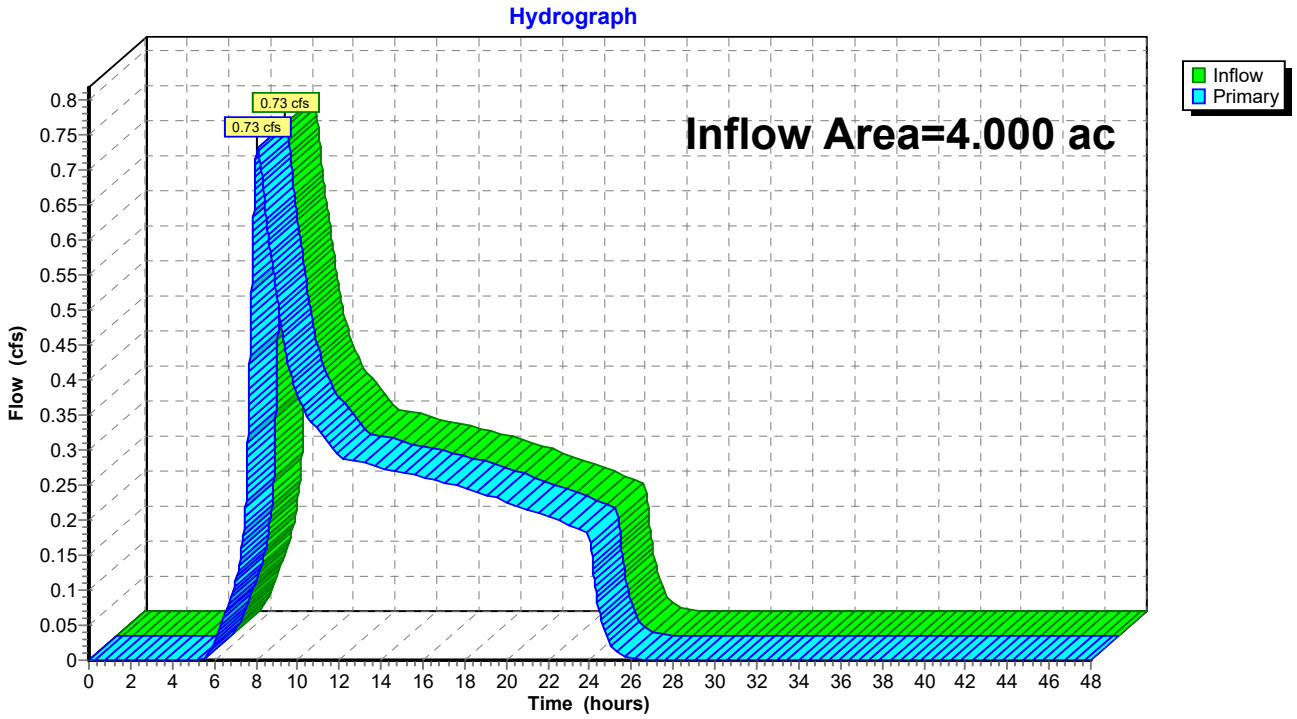


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 0.00% Impervious, Inflow Depth = 1.26" for 5-YR event
Inflow = 0.73 cfs @ 8.07 hrs, Volume= 0.421 af
Primary = 0.73 cfs @ 8.07 hrs, Volume= 0.421 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

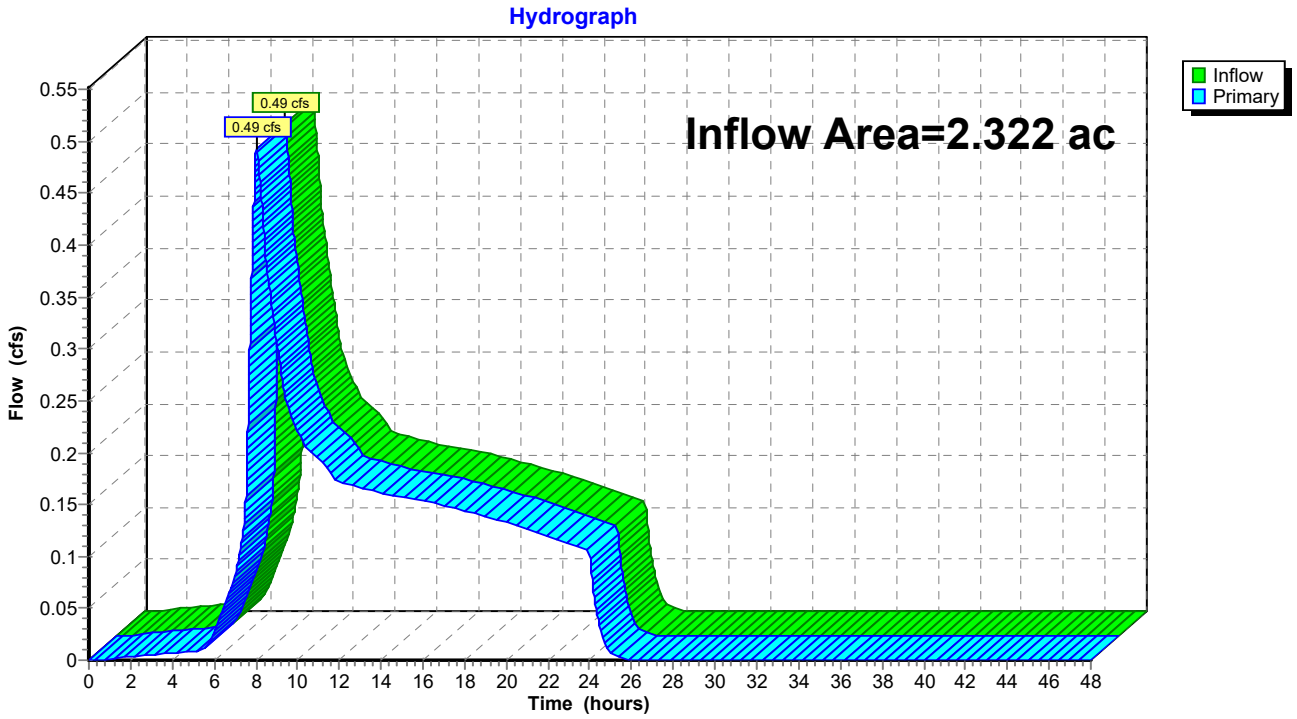


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 3.34% Impervious, Inflow Depth = 1.32" for 5-YR event
Inflow = 0.49 cfs @ 8.01 hrs, Volume= 0.255 af
Primary = 0.49 cfs @ 8.01 hrs, Volume= 0.255 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-E: Existing Runoff Area=174,233 sf 0.00% Impervious Runoff Depth=1.53"
Flow Length=707' Slope=0.0300 '/' Tc=28.3 min CN=79/0 Runoff=0.93 cfs 0.509 af

Subcatchment2-E: Existing Runoff Area=101,133 sf 3.34% Impervious Runoff Depth=1.58"
Flow Length=363' Tc=22.8 min CN=79/98 Runoff=0.62 cfs 0.306 af

Link 1L: Flow Summary Part 1 Inflow=0.93 cfs 0.509 af
Primary=0.93 cfs 0.509 af

Link 2L: Flow Summary Part 2 Inflow=0.62 cfs 0.306 af
Primary=0.62 cfs 0.306 af

Total Runoff Area = 6.322 ac Runoff Volume = 0.815 af Average Runoff Depth = 1.55"
98.77% Pervious = 6.244 ac 1.23% Impervious = 0.077 ac

Summary for Subcatchment 1-E: Existing

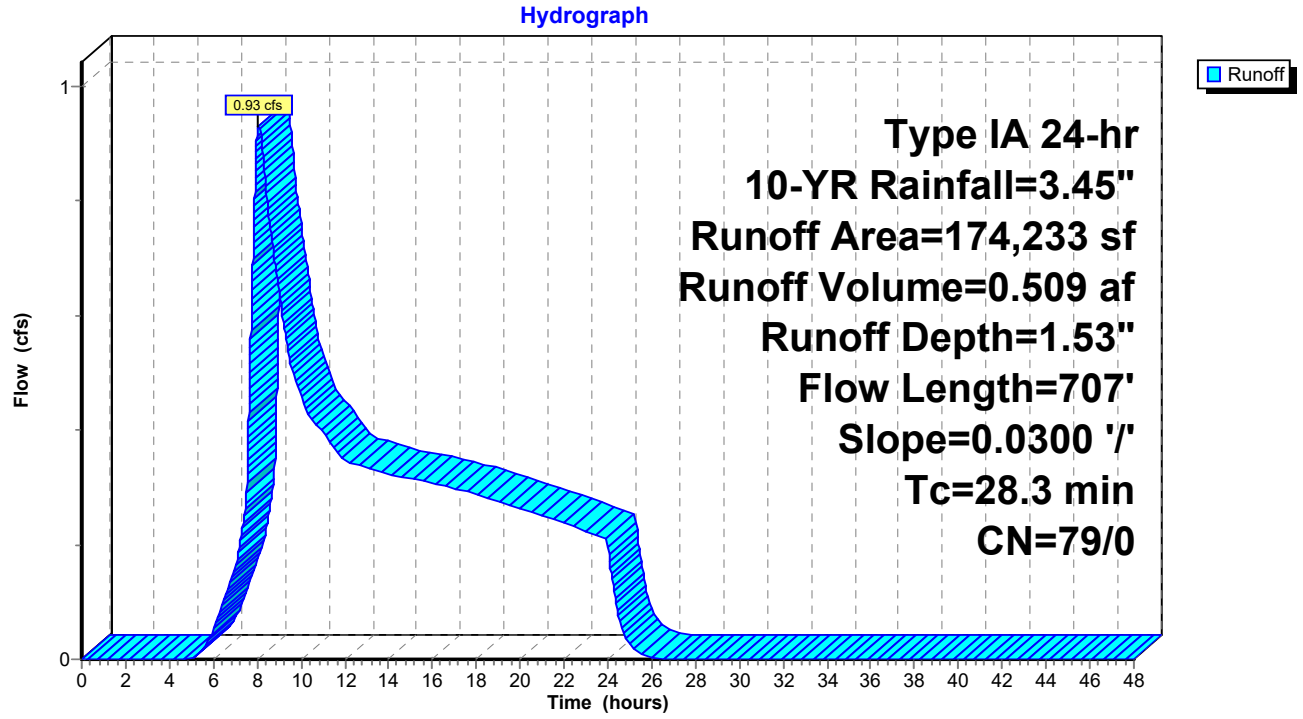
Runoff = 0.93 cfs @ 8.04 hrs, Volume= 0.509 af, Depth= 1.53"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

Area (sf)	CN	Description
174,233	79	50-75% Grass cover, Fair, HSG C
174,233		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	300	0.0300	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
5.6	407	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
28.3	707	Total			

Subcatchment 1-E: Existing



Summary for Subcatchment 2-E: Existing

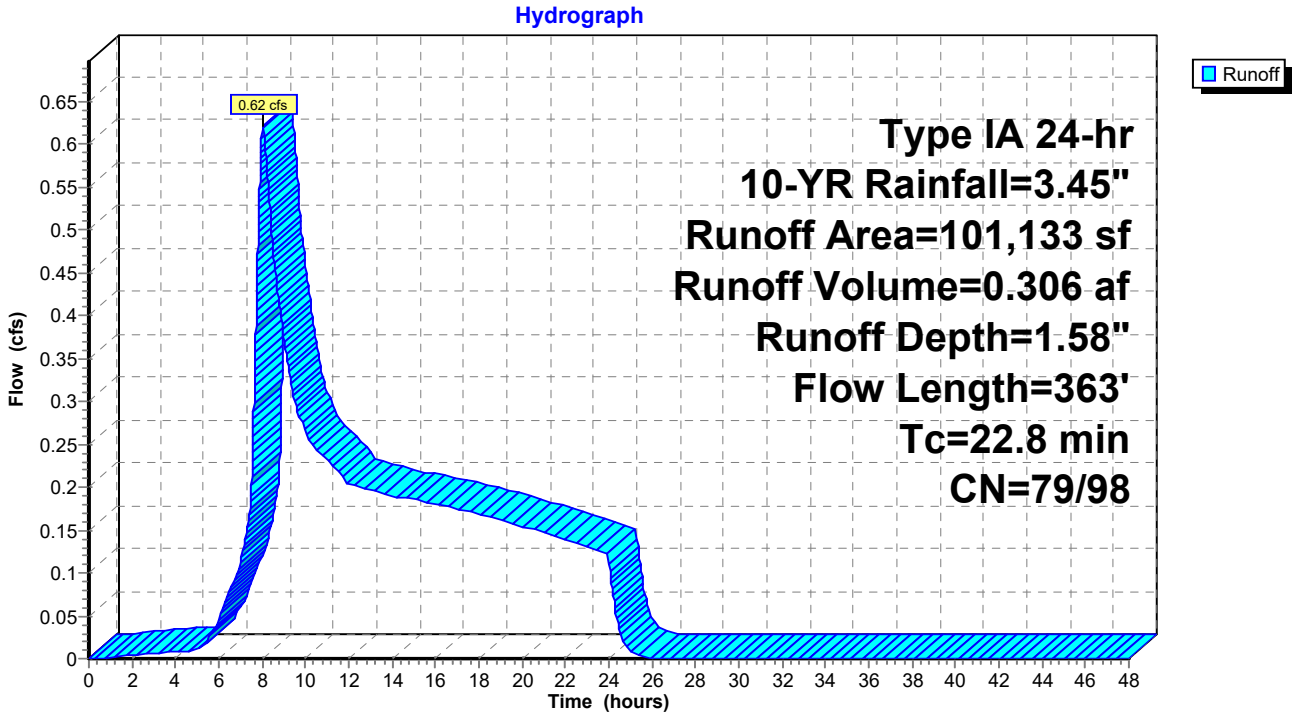
Runoff = 0.62 cfs @ 8.01 hrs, Volume= 0.306 af, Depth= 1.58"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

	Area (sf)	CN	Description
	97,758	79	50-75% Grass cover, Fair, HSG C
*	3,375	98	Impervious Paving, HSG C
	101,133	80	Weighted Average
	97,758		96.66% Pervious Area
	3,375		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	300	0.0316	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
0.6	63	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.8	363	Total			

Subcatchment 2-E: Existing

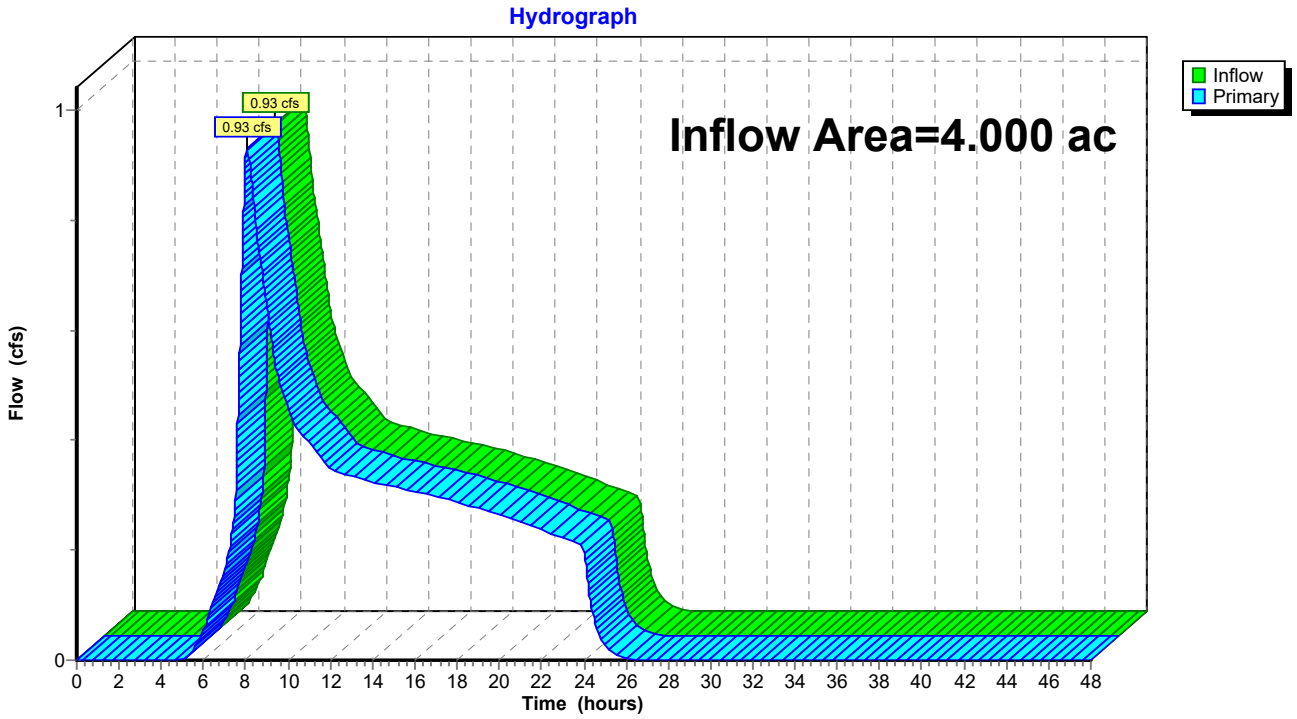


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 0.00% Impervious, Inflow Depth = 1.53" for 10-YR event
Inflow = 0.93 cfs @ 8.04 hrs, Volume= 0.509 af
Primary = 0.93 cfs @ 8.04 hrs, Volume= 0.509 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

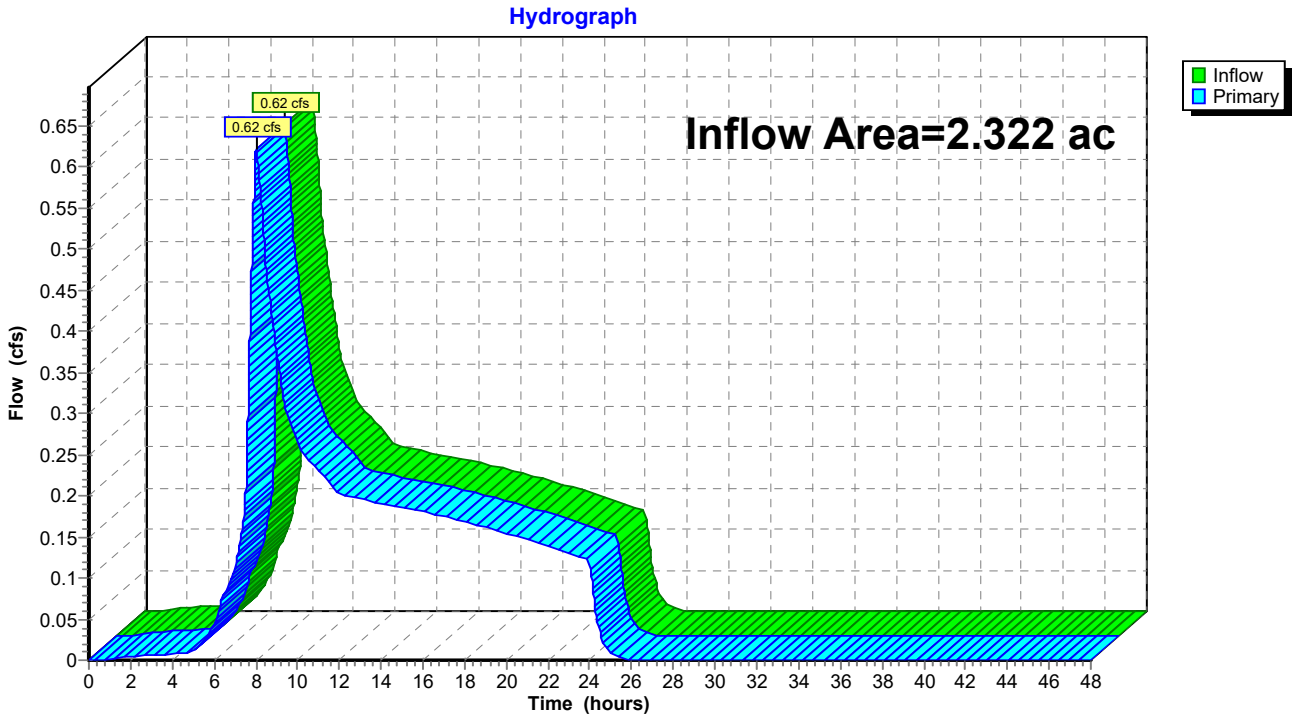


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 3.34% Impervious, Inflow Depth = 1.58" for 10-YR event
Inflow = 0.62 cfs @ 8.01 hrs, Volume= 0.306 af
Primary = 0.62 cfs @ 8.01 hrs, Volume= 0.306 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Time span=0.00-48.00 hrs, dt=0.01 hrs, 4801 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-E: Existing Runoff Area=174,233 sf 0.00% Impervious Runoff Depth=1.88"
Flow Length=707' Slope=0.0300 '/' Tc=28.3 min CN=79/0 Runoff=1.21 cfs 0.628 af

Subcatchment2-E: Existing Runoff Area=101,133 sf 3.34% Impervious Runoff Depth=1.94"
Flow Length=363' Tc=22.8 min CN=79/98 Runoff=0.80 cfs 0.376 af

Link 1L: Flow Summary Part 1 Inflow=1.21 cfs 0.628 af
Primary=1.21 cfs 0.628 af

Link 2L: Flow Summary Part 2 Inflow=0.80 cfs 0.376 af
Primary=0.80 cfs 0.376 af

Total Runoff Area = 6.322 ac Runoff Volume = 1.003 af Average Runoff Depth = 1.90"
98.77% Pervious = 6.244 ac 1.23% Impervious = 0.077 ac

Summary for Subcatchment 1-E: Existing

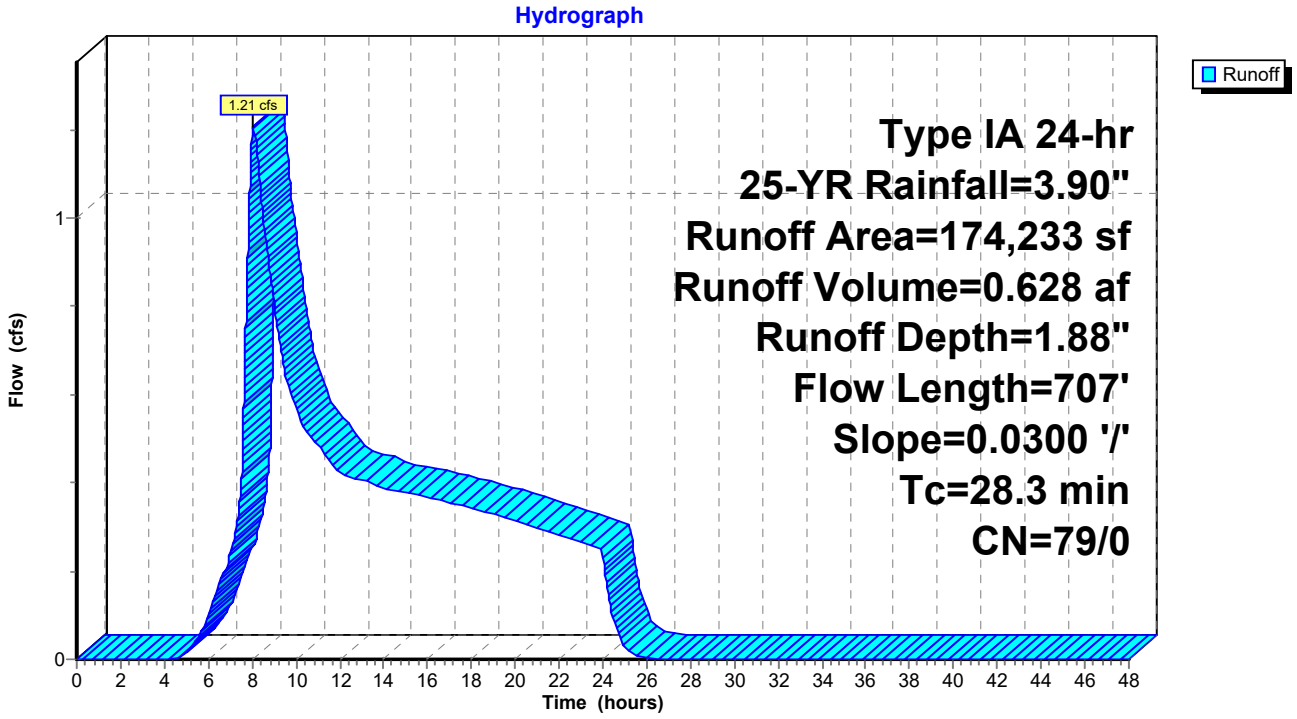
Runoff = 1.21 cfs @ 8.02 hrs, Volume= 0.628 af, Depth= 1.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
174,233	79	50-75% Grass cover, Fair, HSG C
174,233		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	300	0.0300	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
5.6	407	0.0300	1.21		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
28.3	707	Total			

Subcatchment 1-E: Existing



Summary for Subcatchment 2-E: Existing

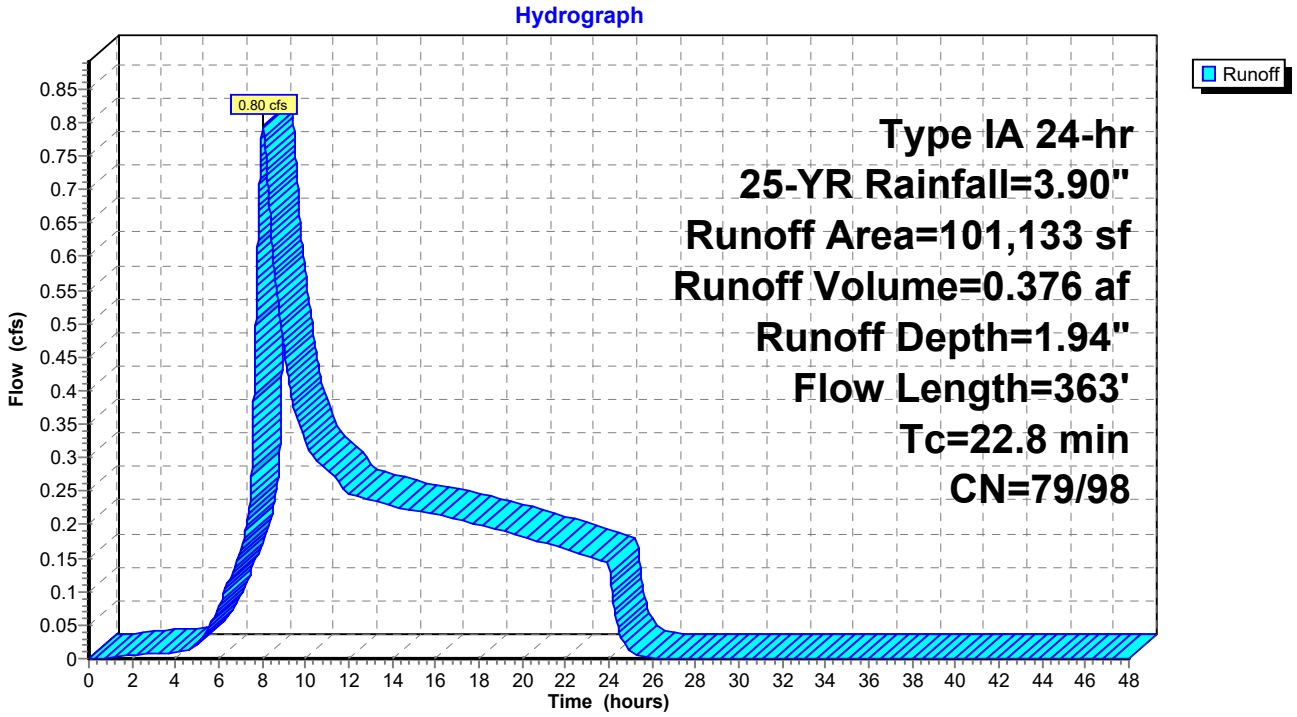
Runoff = 0.80 cfs @ 8.01 hrs, Volume= 0.376 af, Depth= 1.94"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-48.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
	97,758	79	50-75% Grass cover, Fair, HSG C
*	3,375	98	Impervious Paving, HSG C
	101,133	80	Weighted Average
	97,758		96.66% Pervious Area
	3,375		3.34% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	300	0.0316	0.22		**Sheet Flow,** Grass: Short n= 0.150 P2= 2.50"
0.6	63	0.0600	1.71		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
22.8	363	Total			

Subcatchment 2-E: Existing

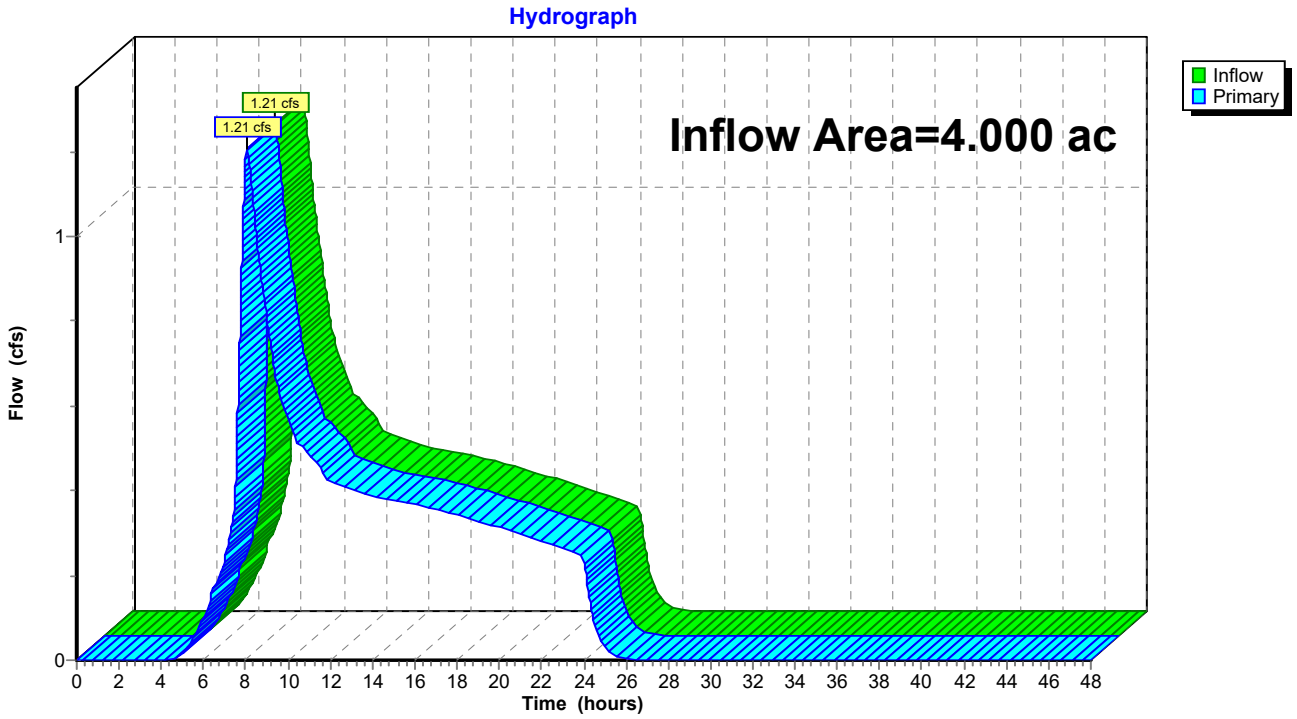


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 0.00% Impervious, Inflow Depth = 1.88" for 25-YR event
Inflow = 1.21 cfs @ 8.02 hrs, Volume= 0.628 af
Primary = 1.21 cfs @ 8.02 hrs, Volume= 0.628 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

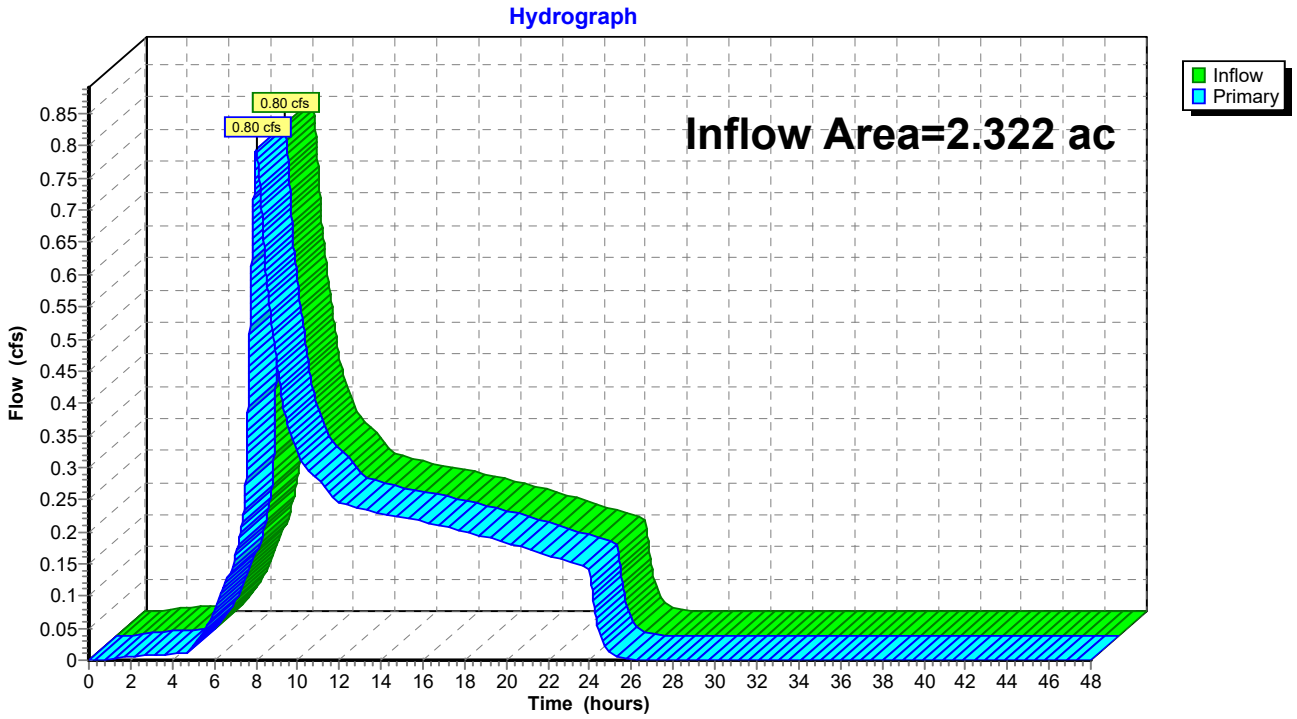


Summary for Link 2L: Flow Summary Part 2

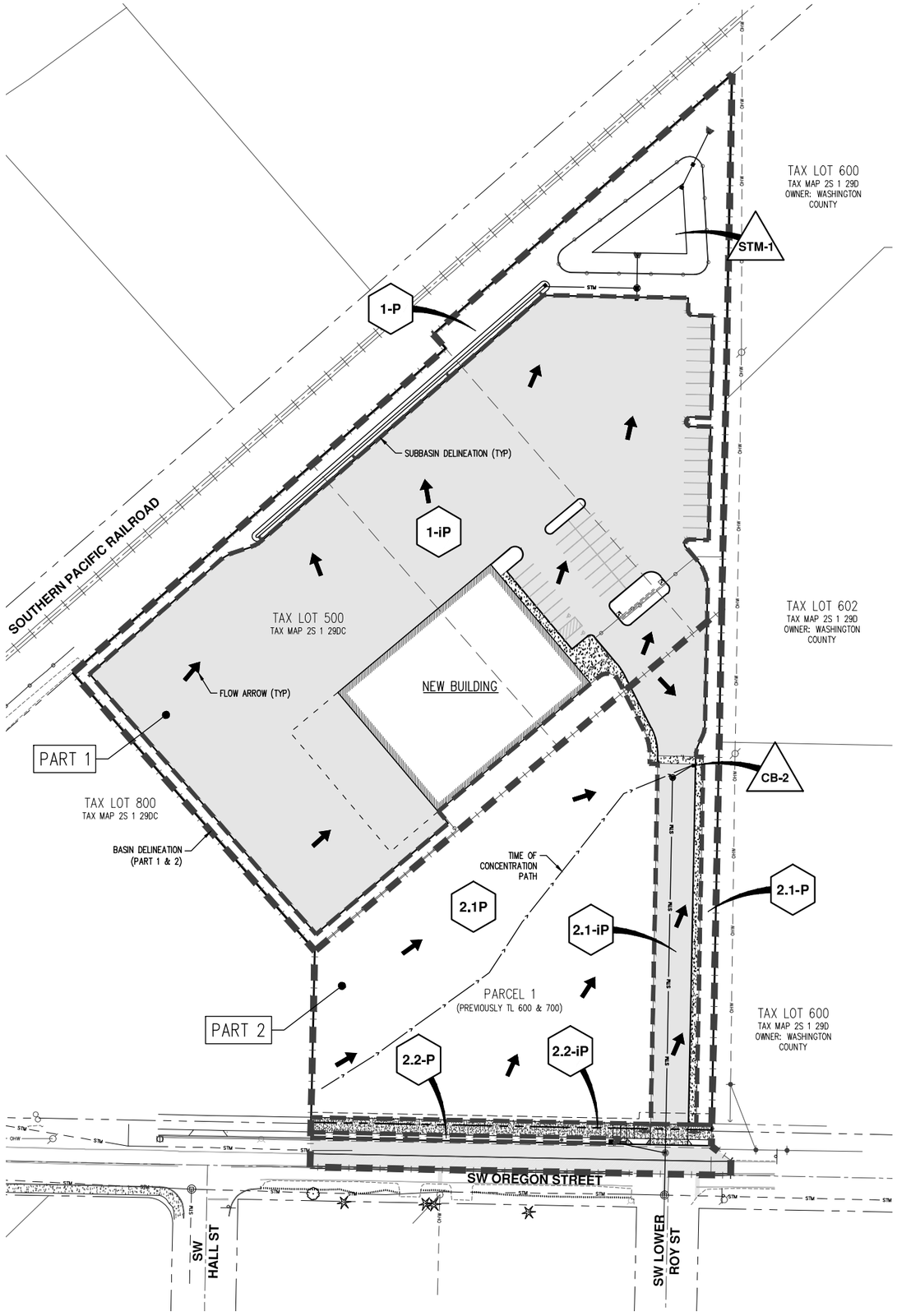
Inflow Area = 2.322 ac, 3.34% Impervious, Inflow Depth = 1.94" for 25-YR event
Inflow = 0.80 cfs @ 8.01 hrs, Volume= 0.376 af
Primary = 0.80 cfs @ 8.01 hrs, Volume= 0.376 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-48.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Appendix B: Post-Developed Catchment Basins Map and Peak Flow Calculations - HydroCAD



LEGEND

- BASIN DELINEATION (PART 1 & 2)
- SUBBASIN DELINEATION
- TIME OF CONCENTRATION PATH
- SUBBASIN (XX)
- STORMWATER POND/CB (X)
- FLOW ARROW

NOTES:

1. CATCHMENT AREAS SHOWN ON THIS MAP ARE:
   - SHOWN TO ILLUSTRATE THE SUBCATCHMENT DELINEATION AS A RESULT OF THE JBMAC VENTURES DEVELOPMENT.
   - USED FOR PURPOSES OF CONVEYANCE SIZING FOR THE JBMAC DEVELOPMENT ONLY. A REVIEW OF THE STORM DRAIN SYSTEM DOWNSTREAM OF THE SUBJECT SITE IS ADDRESSED IN THE "JBMAC VENTURES FINAL STORMWARER REPORT".
   - NOT INTENDED FOR WATER QUALITY CALCULATIONS. STORMWATER QUALITY CRITERIA FOR THIS SITE WERE FORMERLY ADDRESSED IN THE "JBMAC VENTURES FINAL STORMWATER REPORT."

N

SCALE: 1" = 50 FEET

50 0 10 25 50

ORIGINAL PAGE SIZE: 22" x 34"

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POST-DEVELOPED CATCHMENT BASINS MAP
OREGON STREET JBMAC
SHERWOOD, OREGON

REGISTERED PROFESSIONAL ENGINEER
OREGON
JULY 8, 2003
BRIAN G. CARLSON

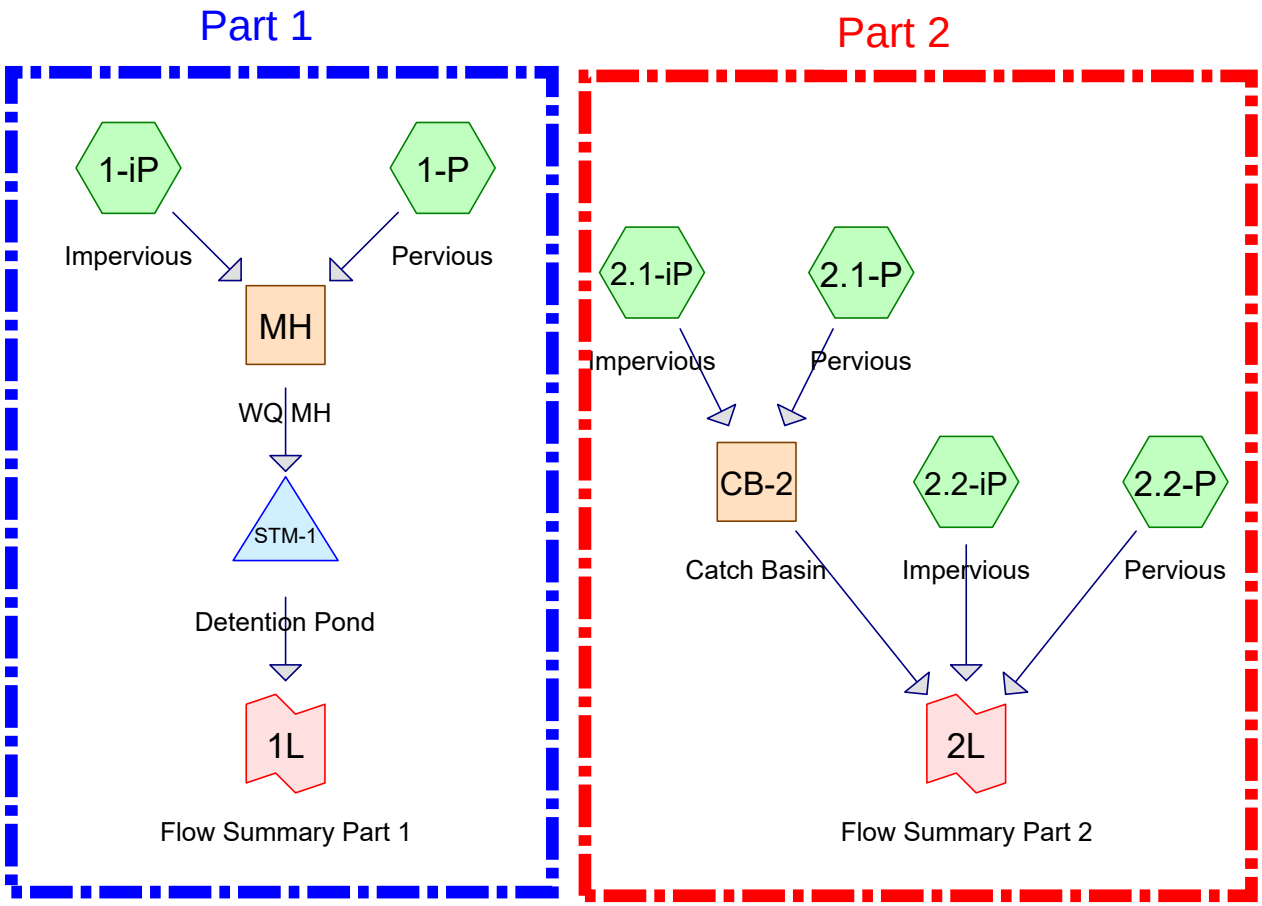
PRELIMINARY NOT FOR CONSTRUCTION

RENEWS:

JOB NUMBER:	8627-03
DATE:	06/16/2022
DESIGNED BY:	APC & TJ
DRAWN BY:	APC
CHECKED BY:	BGC

POST

AKS DRAWING FILE: 8627-03 BASIN AREALDWG | LAYOUT: POST



Subcat Reach Pond Link

Routing Diagram for 8627-03 POST-DEV
Prepared by AKS Engineering, Printed 6/16/2022

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
2.631	79	50-75% Grass cover, Fair, HSG C (1-P, 2.1-P, 2.2-P)
3.690	98	Roof/Drive Aisle (1-iP, 2.1-iP, 2.2-iP)
6.321	**90**	**TOTAL AREA**

Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-iP: Impervious Runoff Area=133,720 sf 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=1.77 cfs 0.581 af

Subcatchment1-P: Pervious Runoff Area=40,503 sf 0.00% Impervious Runoff Depth=0.84"
Tc=5.0 min CN=79/0 Runoff=0.15 cfs 0.065 af

Subcatchment2.1-iP: Impervious Runoff Area=15,312 sf 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=0.20 cfs 0.067 af

Subcatchment2.1-P: Pervious Runoff Area=72,679 sf 0.00% Impervious Runoff Depth=0.84"
Flow Length=409' Tc=27.4 min CN=79/0 Runoff=0.18 cfs 0.116 af

Subcatchment2.2-iP: Impervious Runoff Area=11,702 sf 100.00% Impervious Runoff Depth=2.27"
Tc=5.0 min CN=0/98 Runoff=0.15 cfs 0.051 af

Subcatchment2.2-P: Pervious Runoff Area=1,440 sf 0.00% Impervious Runoff Depth=0.84"
Tc=5.0 min CN=79/0 Runoff=0.01 cfs 0.002 af

Reach CB-2: Catch Basin Avg. Flow Depth=0.24' Max Vel=2.80 fps Inflow=0.37 cfs 0.183 af
10.0" Round Pipe n=0.010 L=302.0' S=0.0050 '/' Capacity=2.01 cfs Outflow=0.37 cfs 0.183 af

Reach MH: WQ MH Avg. Flow Depth=0.28' Max Vel=11.66 fps Inflow=1.91 cfs 0.646 af
10.0" Round Pipe n=0.010 L=26.3' S=0.0722 '/' Capacity=7.66 cfs Outflow=1.91 cfs 0.646 af

Pond STM-1: Detention Pond Peak Elev=170.92' Storage=15,914 cf Inflow=1.91 cfs 0.646 af
Outflow=0.21 cfs 0.595 af

Link 1L: Flow Summary Part 1 Inflow=0.21 cfs 0.595 af
Primary=0.21 cfs 0.595 af

Link 2L: Flow Summary Part 2 Inflow=0.52 cfs 0.236 af
Primary=0.52 cfs 0.236 af

Total Runoff Area = 6.321 ac Runoff Volume = 0.882 af Average Runoff Depth = 1.67"
41.63% Pervious = 2.631 ac 58.37% Impervious = 3.690 ac

Summary for Subcatchment 1-iP: Impervious

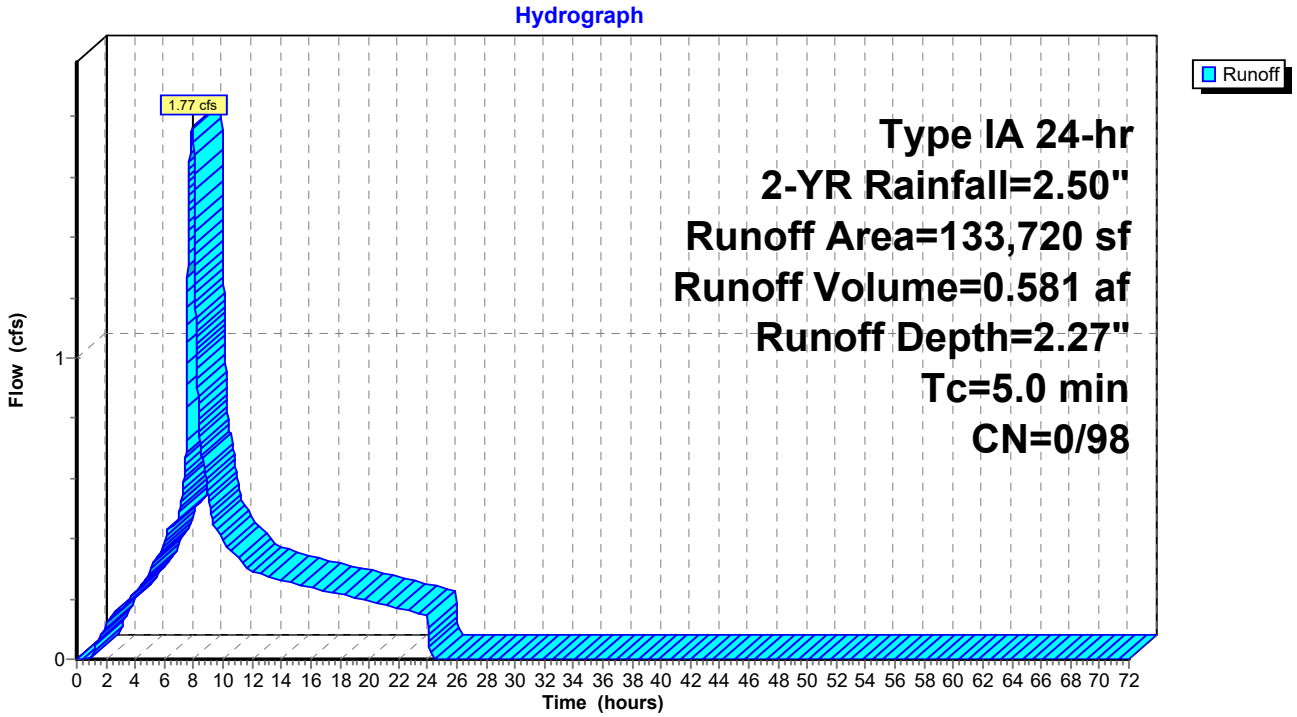
Runoff = 1.77 cfs @ 7.88 hrs, Volume= 0.581 af, Depth= 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

	Area (sf)	CN	Description
*	133,720	98	Roof/Drive Aisle
	133,720		100.00% Impervious Area

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

Subcatchment 1-iP: Impervious



Summary for Subcatchment 1-P: Pervious

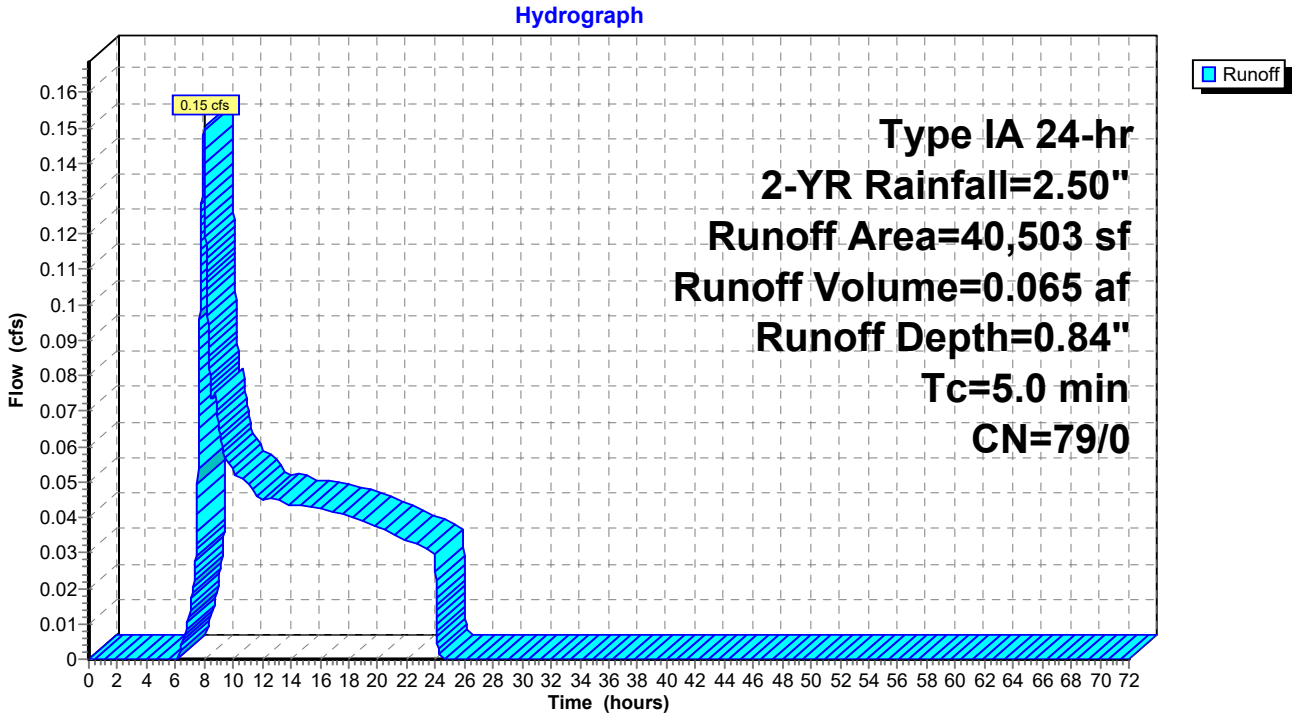
Runoff = 0.15 cfs @ 8.00 hrs, Volume= 0.065 af, Depth= 0.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

Area (sf)	CN	Description
40,503	79	50-75% Grass cover, Fair, HSG C
40,503		100.00% Pervious Area

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

Subcatchment 1-P: Pervious



Summary for Subcatchment 2.1-iP: Impervious

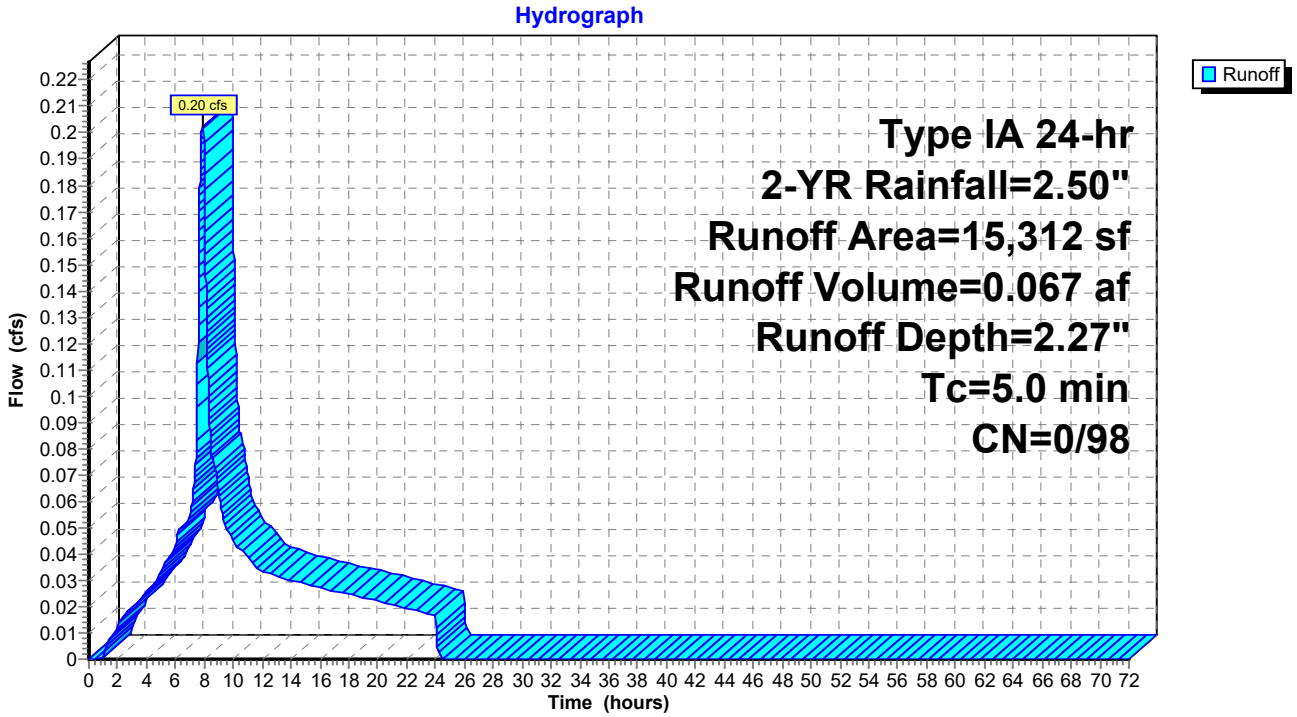
Runoff = 0.20 cfs @ 7.88 hrs, Volume= 0.067 af, Depth= 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

	Area (sf)	CN	Description
*	15,312	98	Roof/Drive Aisle
	15,312		100.00% Impervious Area

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

Subcatchment 2.1-iP: Impervious



Summary for Subcatchment 2.1-P: Pervious

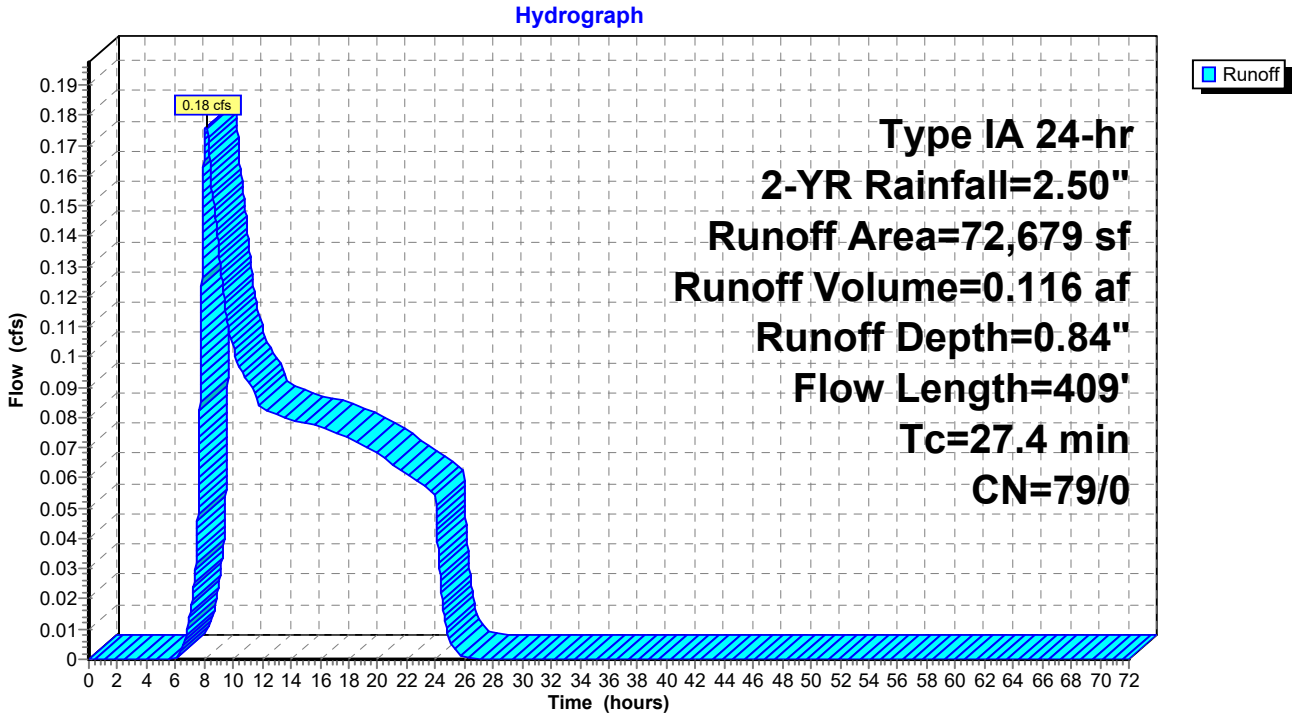
Runoff = 0.18 cfs @ 8.12 hrs, Volume= 0.116 af, Depth= 0.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

Area (sf)	CN	Description
72,679	79	50-75% Grass cover, Fair, HSG C
72,679		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	300	0.0220	0.19		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
1.7	109	0.0227	1.05		**Shallow Concentrated Flow, Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
27.4	409	Total			

Subcatchment 2.1-P: Pervious



Summary for Subcatchment 2.2-iP: Impervious

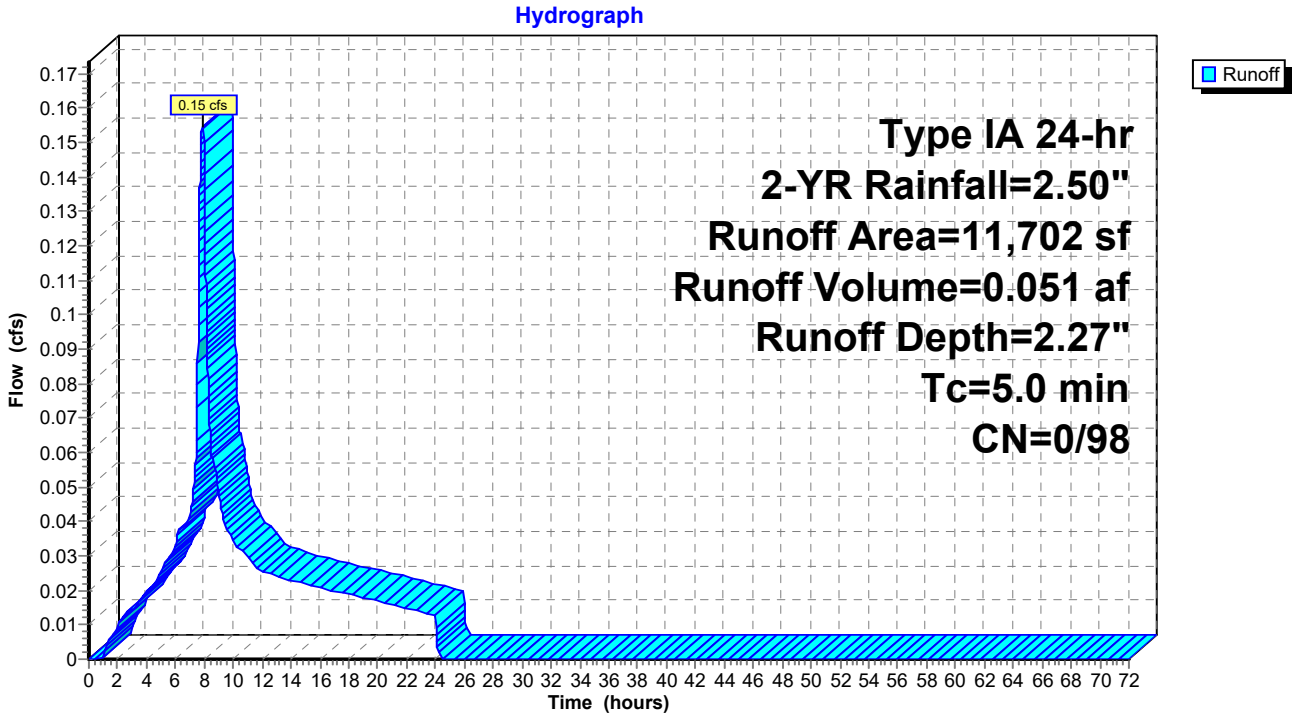
Runoff = 0.15 cfs @ 7.88 hrs, Volume= 0.051 af, Depth= 2.27"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

	Area (sf)	CN	Description
*	11,702	98	Roof/Drive Aisle
	11,702		100.00% Impervious Area

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

Subcatchment 2.2-iP: Impervious



Summary for Subcatchment 2.2-P: Pervious

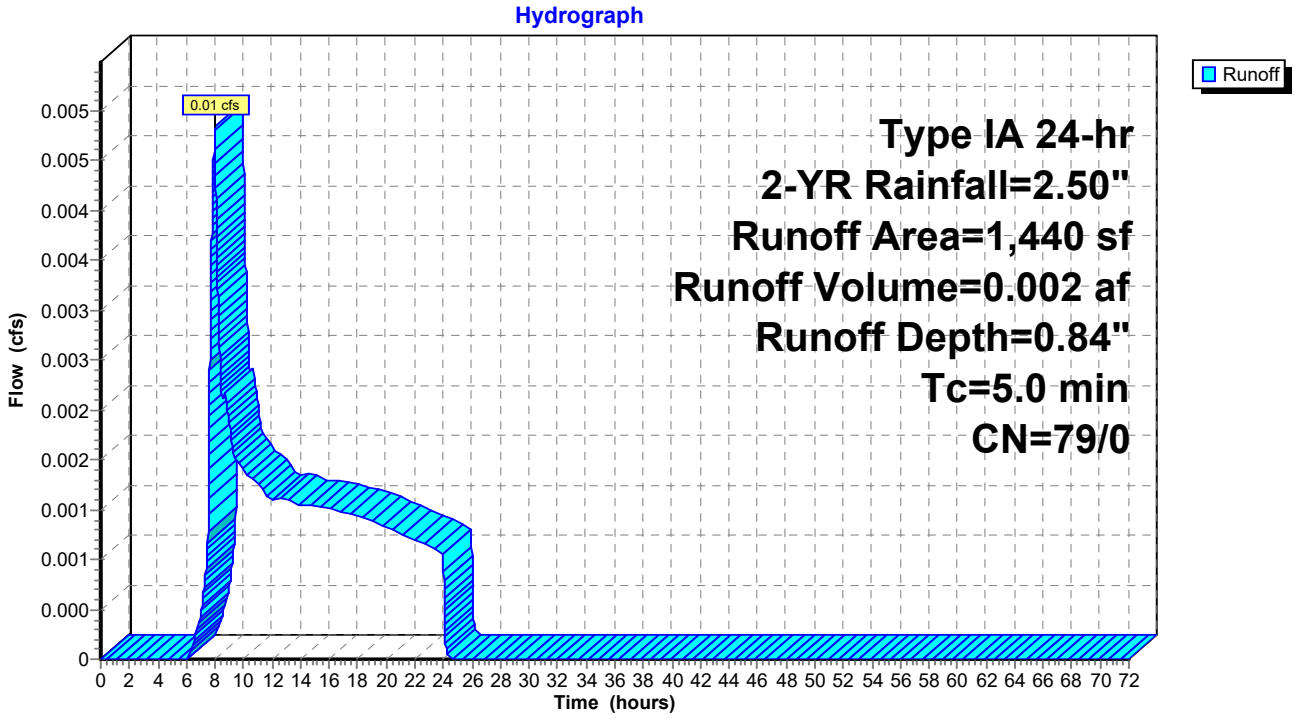
Runoff = 0.01 cfs @ 8.00 hrs, Volume= 0.002 af, Depth= 0.84"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 2-YR Rainfall=2.50"

Area (sf)	CN	Description
1,440	79	50-75% Grass cover, Fair, HSG C
1,440		100.00% Pervious Area

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

Subcatchment 2.2-P: Pervious



Summary for Reach CB-2: Catch Basin

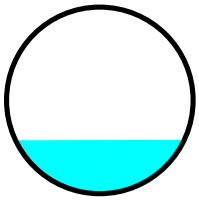
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.020 ac, 17.40% Impervious, Inflow Depth = 1.09" for 2-YR event
Inflow = 0.37 cfs @ 8.00 hrs, Volume= 0.183 af
Outflow = 0.37 cfs @ 8.01 hrs, Volume= 0.183 af, Atten= 1%, Lag= 0.6 min

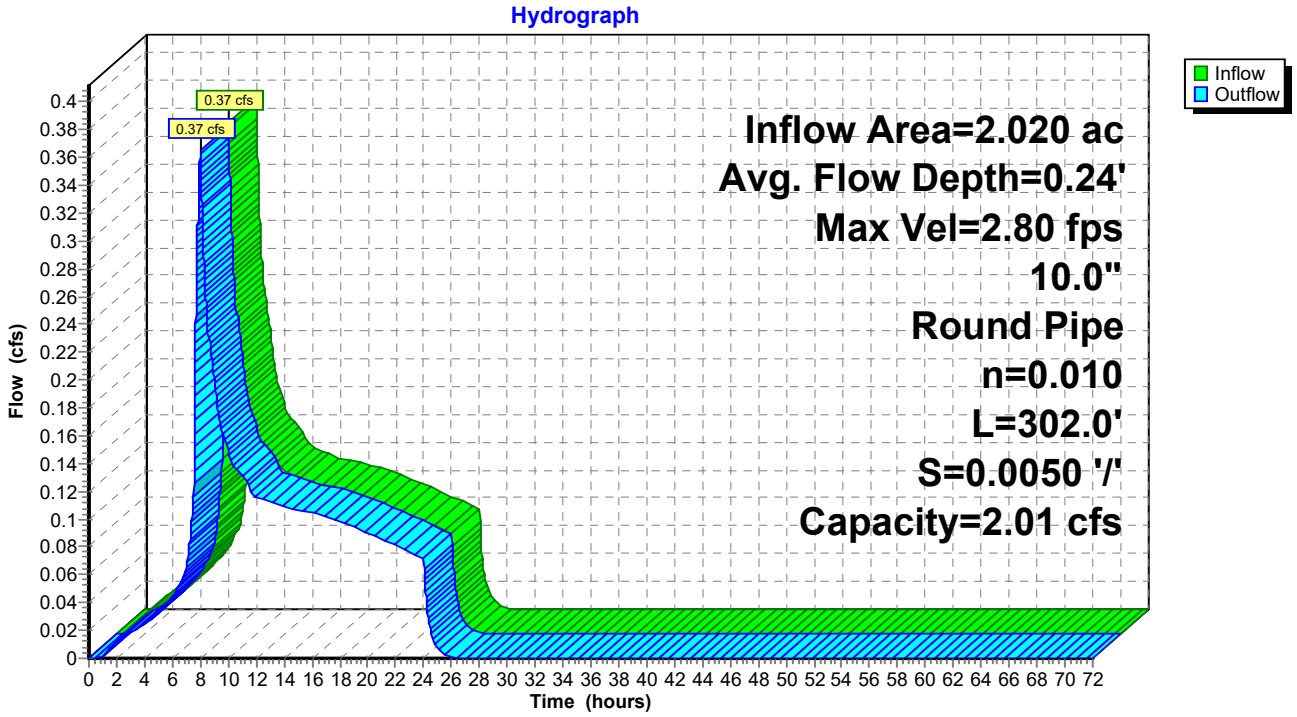
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 2.80 fps, Min. Travel Time= 1.8 min
Avg. Velocity = 1.64 fps, Avg. Travel Time= 3.1 min

Peak Storage= 39 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.24'
Defined Flood Depth= 177.89' Flow Area= 20.2 sf, Capacity= -1,793.61 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.01 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 302.0' Slope= 0.0050 '/'
Inlet Invert= 176.89', Outlet Invert= 175.38'



Reach CB-2: Catch Basin



Summary for Reach MH: WQ MH

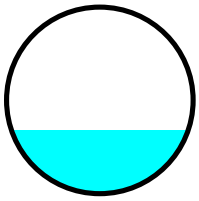
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 1.94" for 2-YR event
Inflow = 1.91 cfs @ 7.90 hrs, Volume= 0.646 af
Outflow = 1.91 cfs @ 7.90 hrs, Volume= 0.646 af, Atten= 0%, Lag= 0.0 min

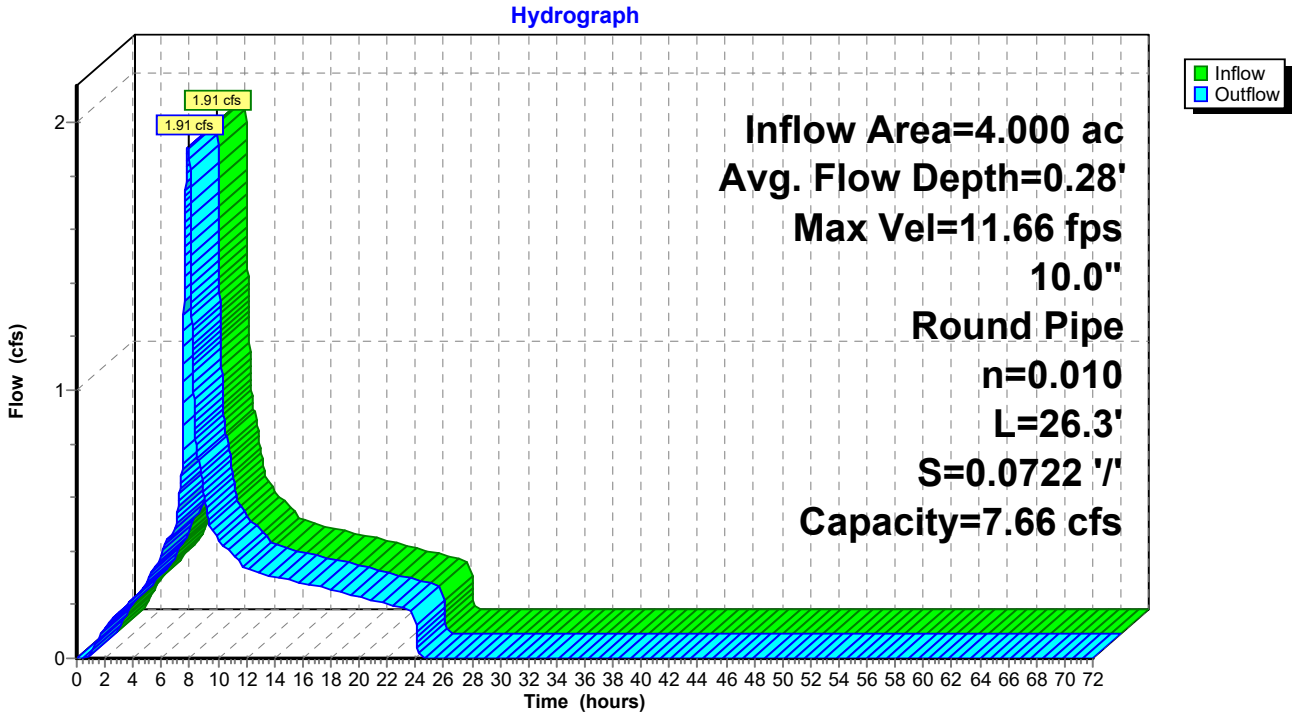
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 11.66 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 6.64 fps, Avg. Travel Time= 0.1 min

Peak Storage= 4 cf @ 7.90 hrs
Average Depth at Peak Storage= 0.28'
Defined Flood Depth= 171.30' Flow Area= 19.4 sf, Capacity= -6,563.73 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 7.66 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 26.3' Slope= 0.0722 '/'
Inlet Invert= 169.30', Outlet Invert= 167.40'



Reach MH: WQ MH



Summary for Pond STM-1: Detention Pond

[63] Warning: Exceeded Reach MH INLET depth by 1.54' @ 24.25 hrs

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 1.94" for 2-YR event
Inflow = 1.91 cfs @ 7.90 hrs, Volume= 0.646 af
Outflow = 0.21 cfs @ 21.30 hrs, Volume= 0.595 af, Atten= 89%, Lag= 804.2 min
Primary = 0.21 cfs @ 21.30 hrs, Volume= 0.595 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 170.92' @ 21.30 hrs Surf.Area= 5,726 sf Storage= 15,914 cf

Plug-Flow detention time= 982.7 min calculated for 0.595 af (92% of inflow)
Center-of-Mass det. time= 927.0 min (1,618.4 - 691.4)

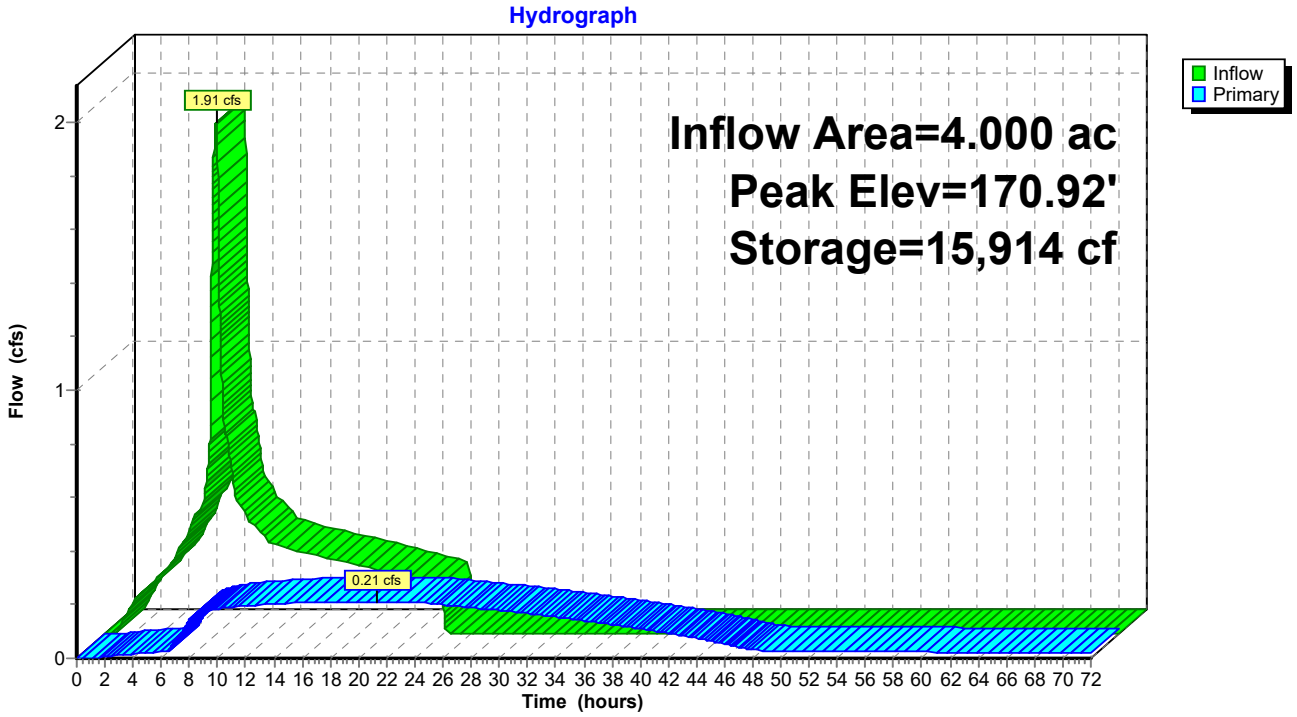
Volume	Invert	Avail.Storage	Storage Description
#1	166.75'	24,092 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.75	2,138	224.0	0	0	2,138
167.00	2,309	232.0	556	556	2,434
168.00	3,059	267.0	2,675	3,231	3,846
169.00	3,912	297.0	3,477	6,708	5,222
170.00	4,832	316.0	4,364	11,072	6,198
171.00	5,809	335.0	5,313	16,385	7,234
172.20	7,056	357.6	7,707	24,092	8,548

Device	Routing	Invert	Outlet Devices
#1	Primary	166.00'	**10.0" Round Outlet Pipe** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 166.00' / 163.00' S= 0.0600 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	166.75'	**0.9" Vert. WQ Outlet** C= 0.600
#3	Device 1	168.25'	**2.0" Vert. 2-YR Storm** C= 0.600
#4	Device 1	170.92'	**2.2' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.21 cfs @ 21.30 hrs HW=170.92' TW=0.00' (Dynamic Tailwater)
↑**1=Outlet Pipe** (Passes 0.21 cfs of 5.57 cfs potential flow)
↑**2=WQ Outlet** (Orifice Controls 0.04 cfs @ 9.79 fps)
3=2-YR Storm (Orifice Controls 0.17 cfs @ 7.74 fps)
4=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Pond STM-1: Detention Pond

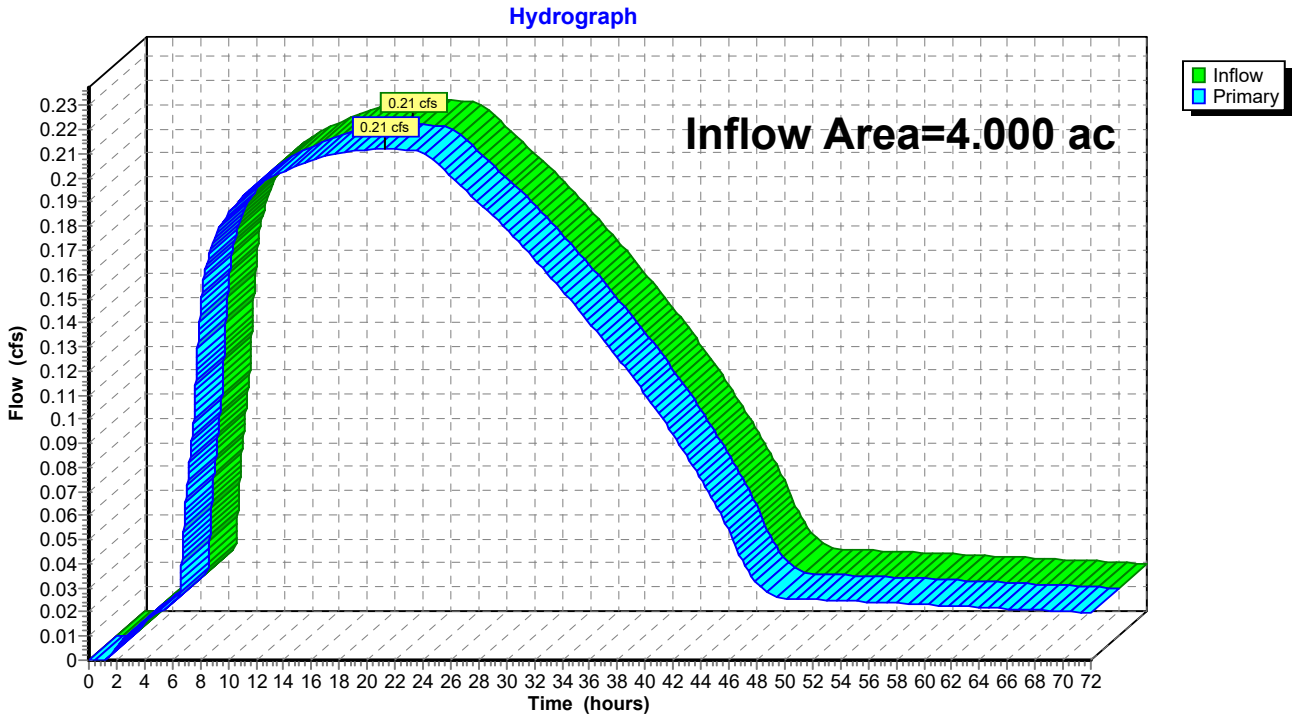


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth > 1.79" for 2-YR event
Inflow = 0.21 cfs @ 21.30 hrs, Volume= 0.595 af
Primary = 0.21 cfs @ 21.30 hrs, Volume= 0.595 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

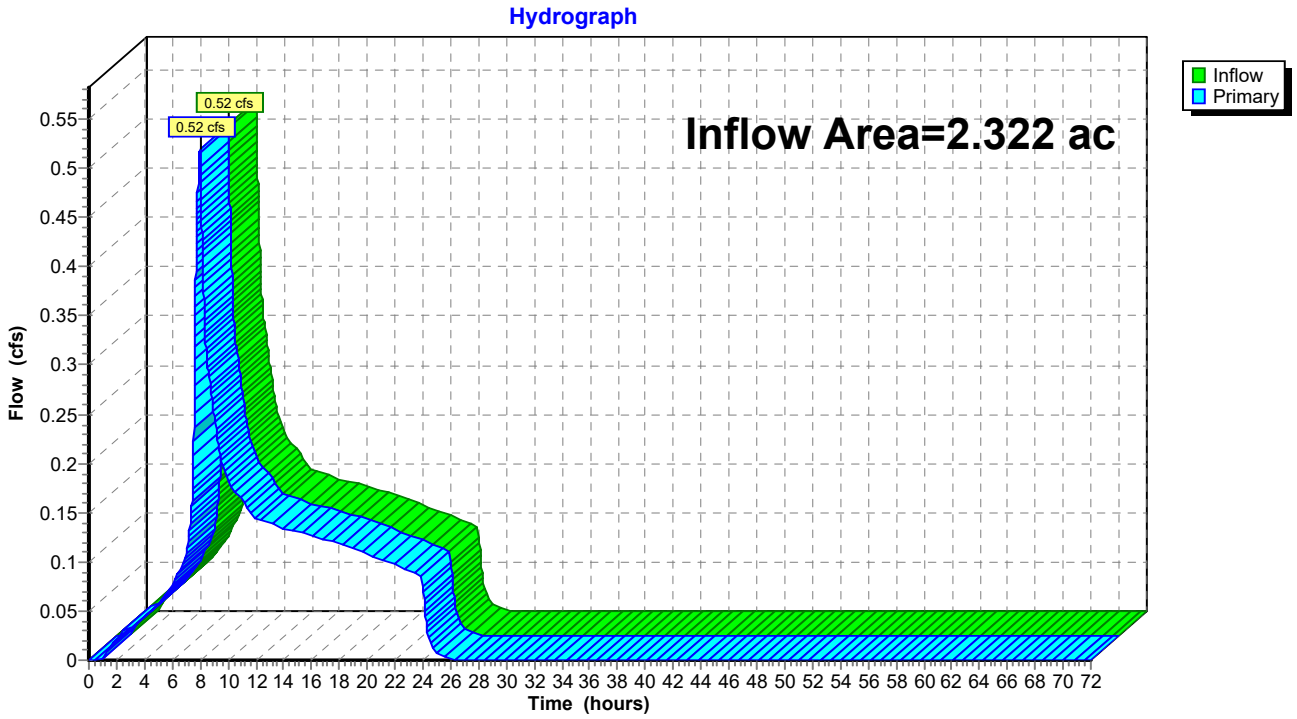


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 26.71% Impervious, Inflow Depth = 1.22" for 2-YR event
Inflow = 0.52 cfs @ 8.00 hrs, Volume= 0.236 af
Primary = 0.52 cfs @ 8.00 hrs, Volume= 0.236 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-iP: Impervious Runoff Area=133,720 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=0/98 Runoff=2.22 cfs 0.734 af

Subcatchment1-P: Pervious Runoff Area=40,503 sf 0.00% Impervious Runoff Depth=1.26"
Tc=5.0 min CN=79/0 Runoff=0.25 cfs 0.098 af

Subcatchment2.1-iP: Impervious Runoff Area=15,312 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=0/98 Runoff=0.25 cfs 0.084 af

Subcatchment2.1-P: Pervious Runoff Area=72,679 sf 0.00% Impervious Runoff Depth=1.26"
Flow Length=409' Tc=27.4 min CN=79/0 Runoff=0.31 cfs 0.175 af

Subcatchment2.2-iP: Impervious Runoff Area=11,702 sf 100.00% Impervious Runoff Depth=2.87"
Tc=5.0 min CN=0/98 Runoff=0.19 cfs 0.064 af

Subcatchment2.2-P: Pervious Runoff Area=1,440 sf 0.00% Impervious Runoff Depth=1.26"
Tc=5.0 min CN=79/0 Runoff=0.01 cfs 0.003 af

Reach CB-2: Catch Basin Avg. Flow Depth=0.30' Max Vel=3.14 fps Inflow=0.55 cfs 0.259 af
10.0" Round Pipe n=0.010 L=302.0' S=0.0050 '/' Capacity=2.01 cfs Outflow=0.55 cfs 0.259 af

Reach MH: WQ MH Avg. Flow Depth=0.32' Max Vel=12.50 fps Inflow=2.46 cfs 0.831 af
10.0" Round Pipe n=0.010 L=26.3' S=0.0722 '/' Capacity=7.66 cfs Outflow=2.46 cfs 0.831 af

Pond STM-1: Detention Pond Peak Elev=171.03' Storage=16,570 cf Inflow=2.46 cfs 0.831 af
Outflow=0.48 cfs 0.780 af

Link 1L: Flow Summary Part 1 Inflow=0.48 cfs 0.780 af
Primary=0.48 cfs 0.780 af

Link 2L: Flow Summary Part 2 Inflow=0.74 cfs 0.327 af
Primary=0.74 cfs 0.327 af

Total Runoff Area = 6.321 ac Runoff Volume = 1.159 af Average Runoff Depth = 2.20"
41.63% Pervious = 2.631 ac 58.37% Impervious = 3.690 ac

Summary for Subcatchment 1-iP: Impervious

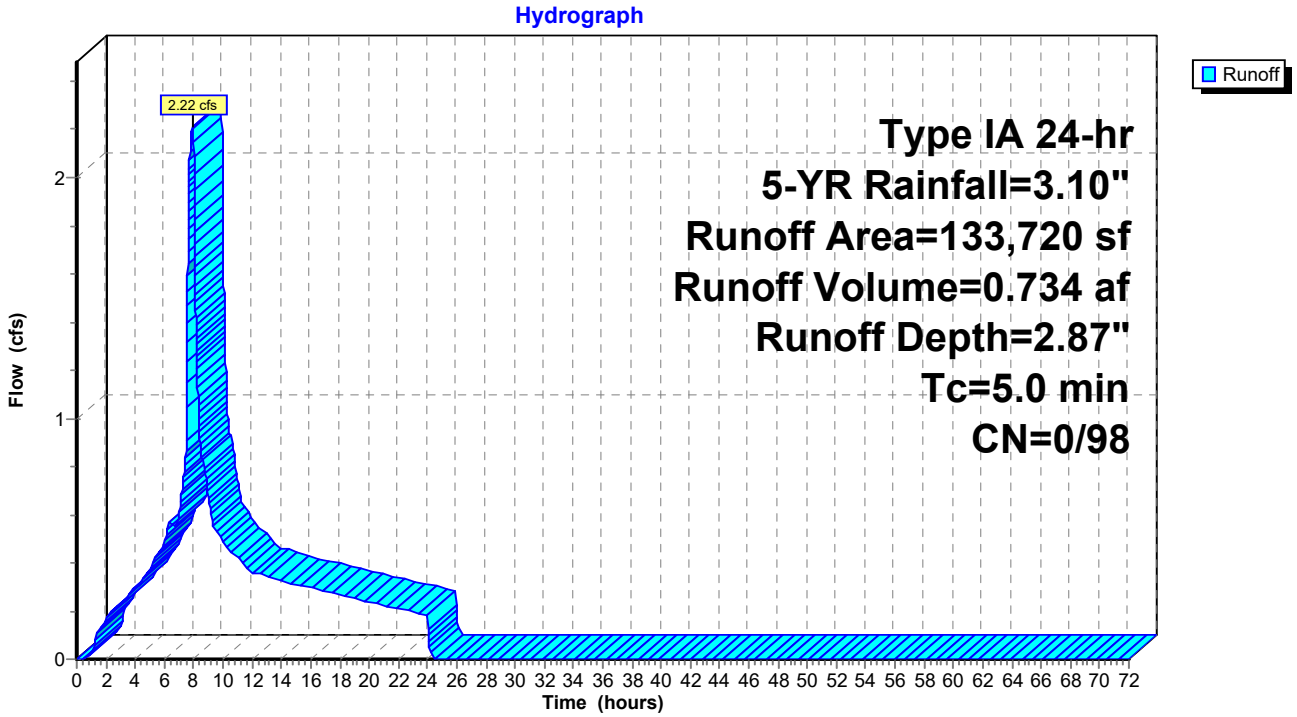
Runoff = 2.22 cfs @ 7.88 hrs, Volume= 0.734 af, Depth= 2.87"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

	Area (sf)	CN	Description
*	133,720	98	Roof/Drive Aisle
	133,720		100.00% Impervious Area

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

Subcatchment 1-iP: Impervious



Summary for Subcatchment 1-P: Pervious

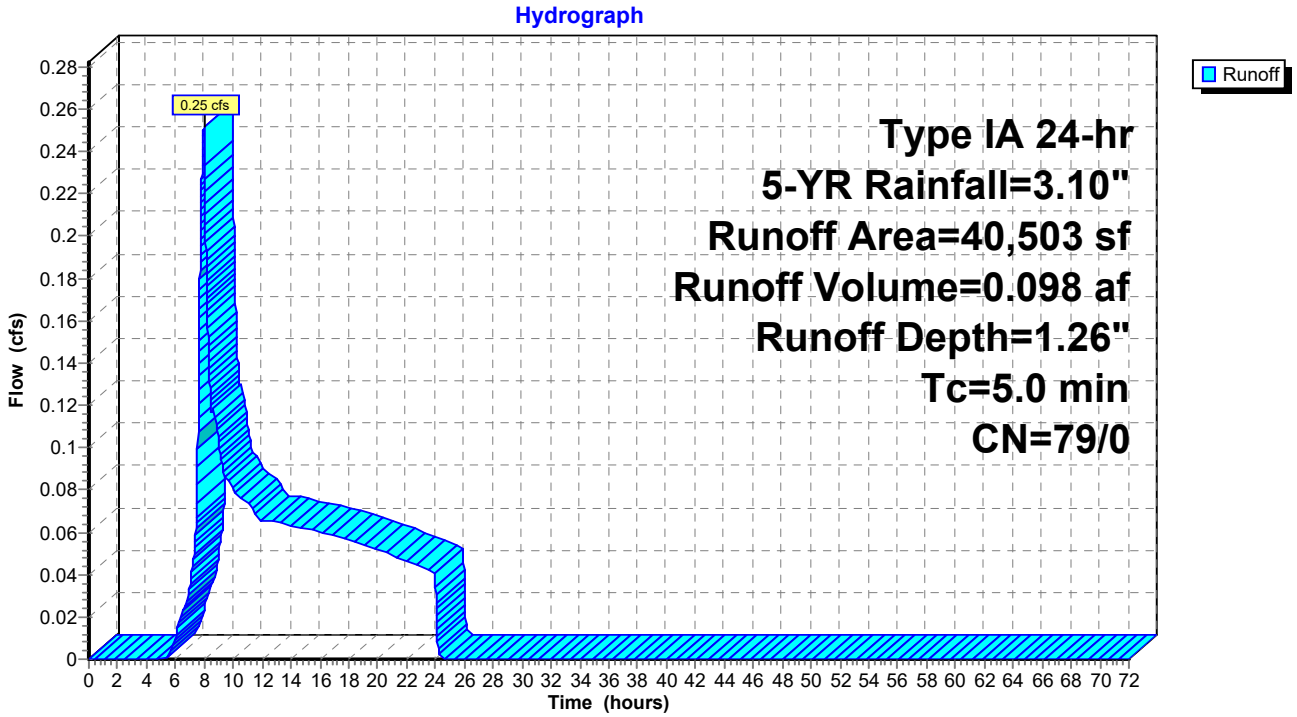
Runoff = 0.25 cfs @ 8.00 hrs, Volume= 0.098 af, Depth= 1.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

Area (sf)	CN	Description
40,503	79	50-75% Grass cover, Fair, HSG C
40,503		100.00% Pervious Area

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

Subcatchment 1-P: Pervious



Summary for Subcatchment 2.1-iP: Impervious

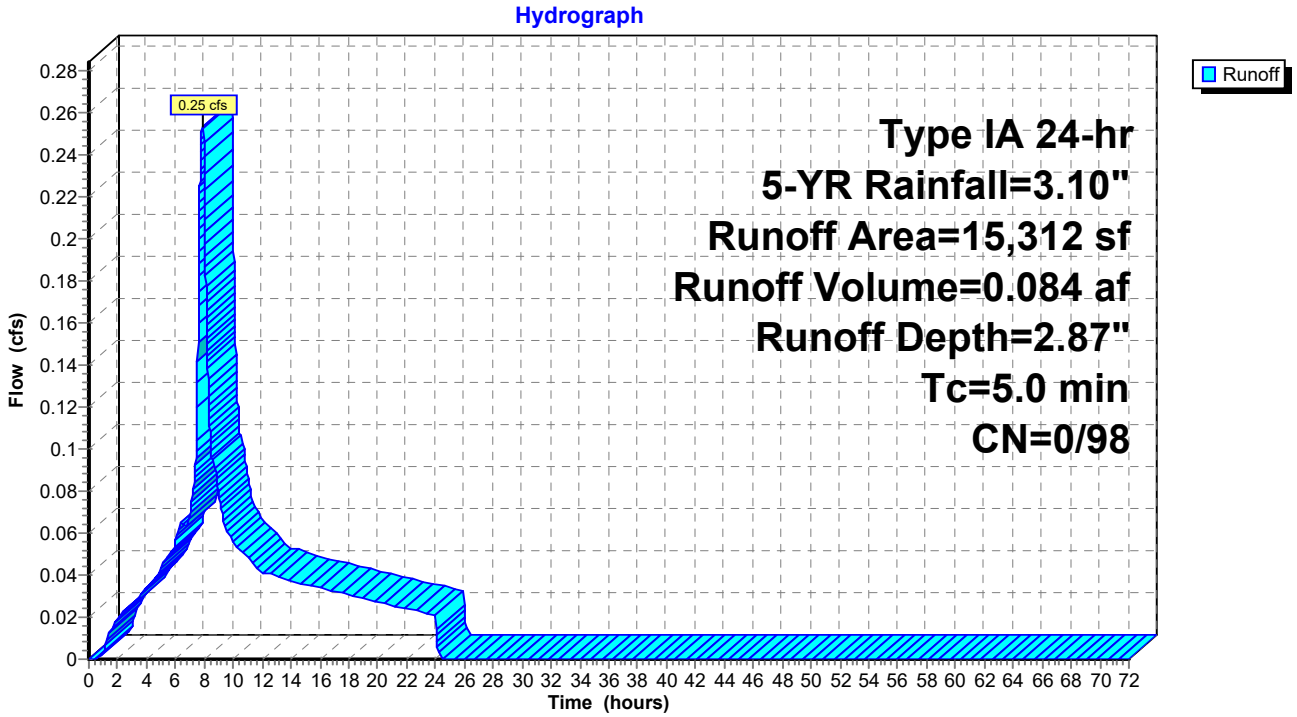
Runoff = 0.25 cfs @ 7.88 hrs, Volume= 0.084 af, Depth= 2.87"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

	Area (sf)	CN	Description
*	15,312	98	Roof/Drive Aisle
	15,312		100.00% Impervious Area

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

Subcatchment 2.1-iP: Impervious



Summary for Subcatchment 2.1-P: Pervious

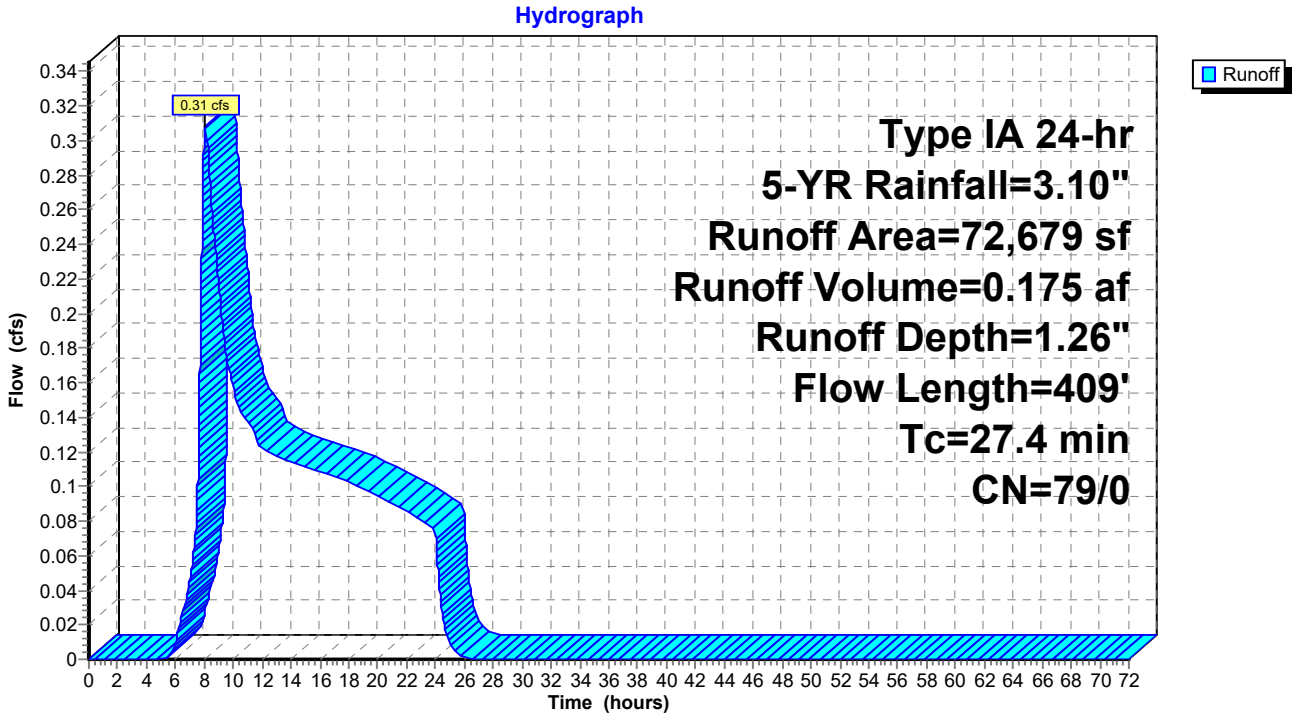
Runoff = 0.31 cfs @ 8.05 hrs, Volume= 0.175 af, Depth= 1.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

Area (sf)	CN	Description
72,679	79	50-75% Grass cover, Fair, HSG C
72,679		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	300	0.0220	0.19		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
1.7	109	0.0227	1.05		**Shallow Concentrated Flow, Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
27.4	409	Total			

Subcatchment 2.1-P: Pervious



Summary for Subcatchment 2.2-iP: Impervious

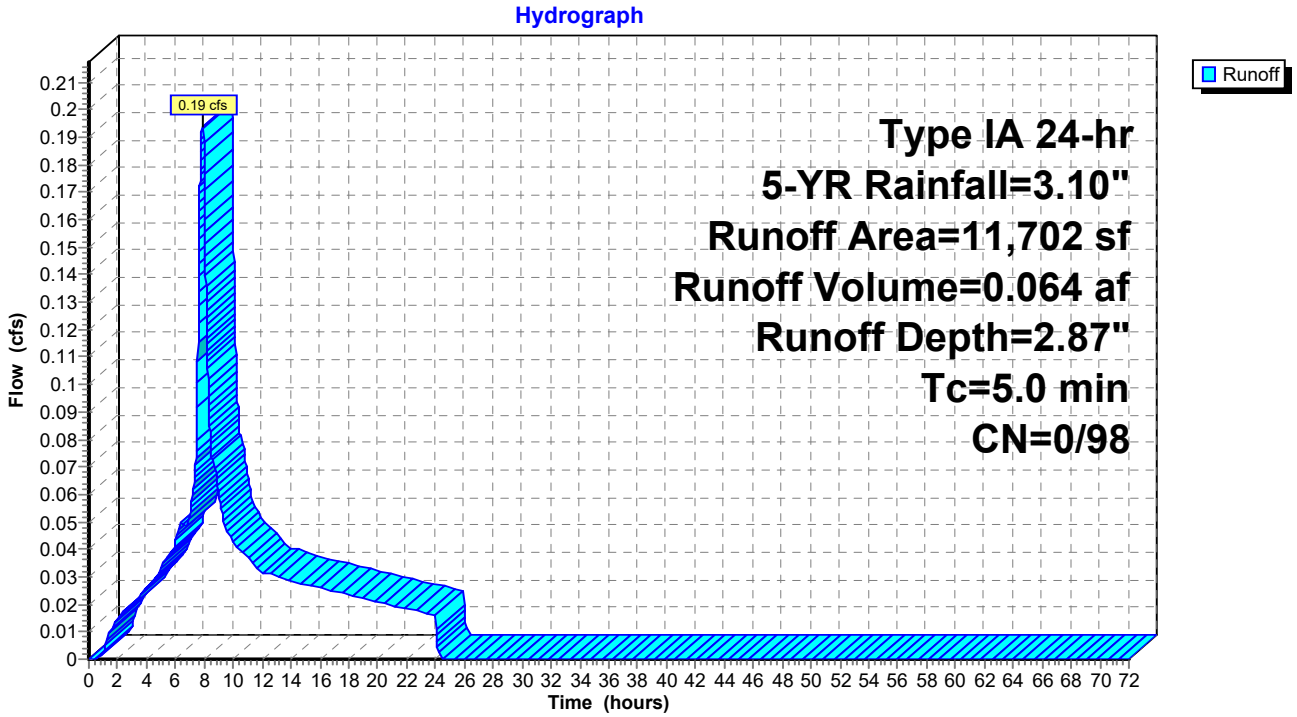
Runoff = 0.19 cfs @ 7.88 hrs, Volume= 0.064 af, Depth= 2.87"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

	Area (sf)	CN	Description
*	11,702	98	Roof/Drive Aisle
	11,702		100.00% Impervious Area

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

Subcatchment 2.2-iP: Impervious



Summary for Subcatchment 2.2-P: Pervious

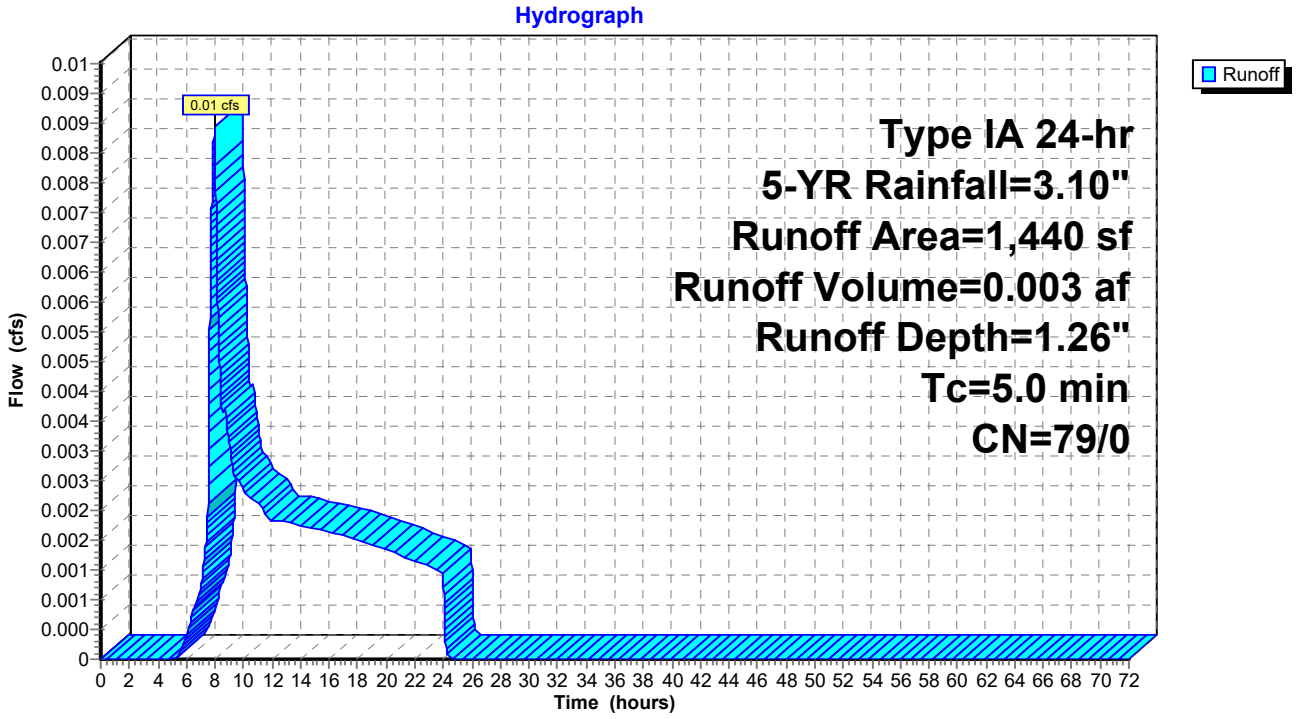
Runoff = 0.01 cfs @ 8.00 hrs, Volume= 0.003 af, Depth= 1.26"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 5-YR Rainfall=3.10"

Area (sf)	CN	Description
1,440	79	50-75% Grass cover, Fair, HSG C
1,440		100.00% Pervious Area

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

Subcatchment 2.2-P: Pervious



Summary for Reach CB-2: Catch Basin

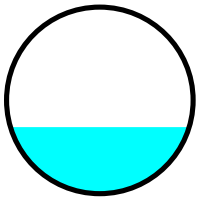
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.020 ac, 17.40% Impervious, Inflow Depth = 1.54" for 5-YR event
Inflow = 0.55 cfs @ 8.00 hrs, Volume= 0.259 af
Outflow = 0.55 cfs @ 8.01 hrs, Volume= 0.259 af, Atten= 1%, Lag= 0.6 min

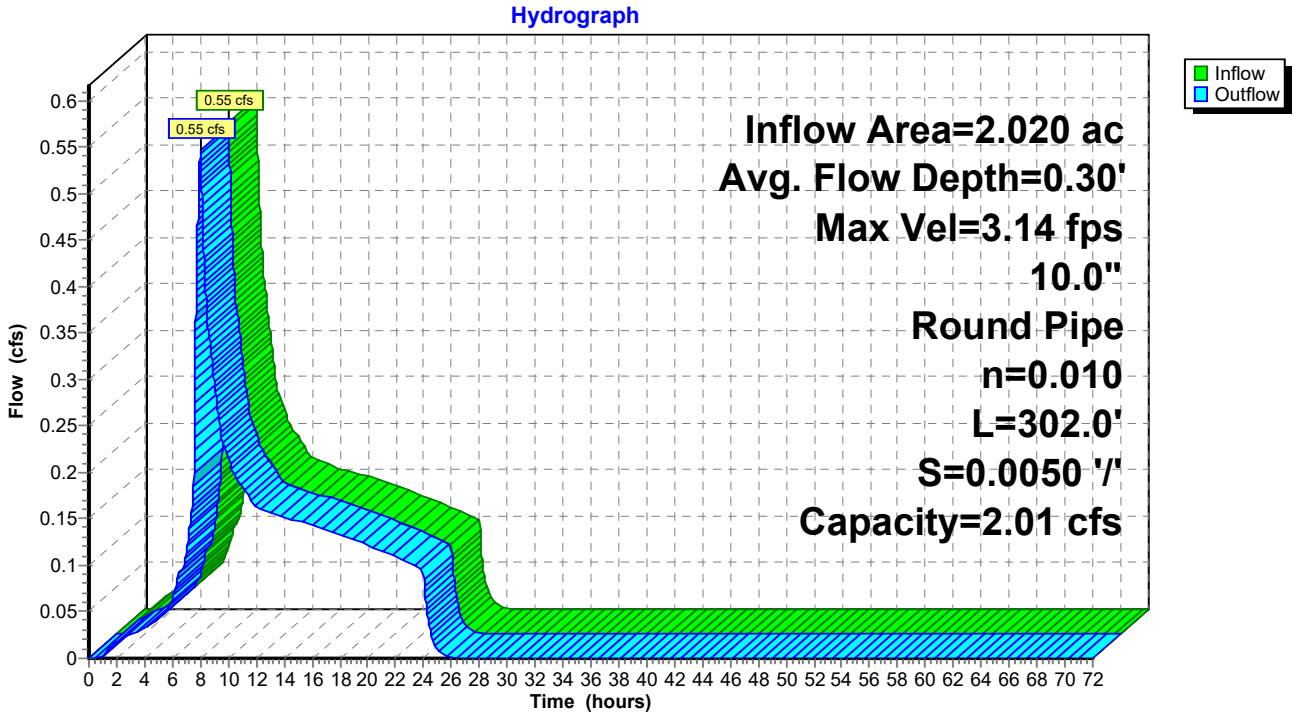
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.14 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.79 fps, Avg. Travel Time= 2.8 min

Peak Storage= 53 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.30'
Defined Flood Depth= 177.89' Flow Area= 20.2 sf, Capacity= -1,793.61 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.01 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 302.0' Slope= 0.0050 '/'
Inlet Invert= 176.89', Outlet Invert= 175.38'



Reach CB-2: Catch Basin



Summary for Reach MH: WQ MH

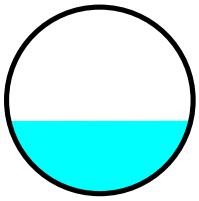
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 2.49" for 5-YR event
Inflow = 2.46 cfs @ 7.89 hrs, Volume= 0.831 af
Outflow = 2.46 cfs @ 7.89 hrs, Volume= 0.831 af, Atten= 0%, Lag= 0.0 min

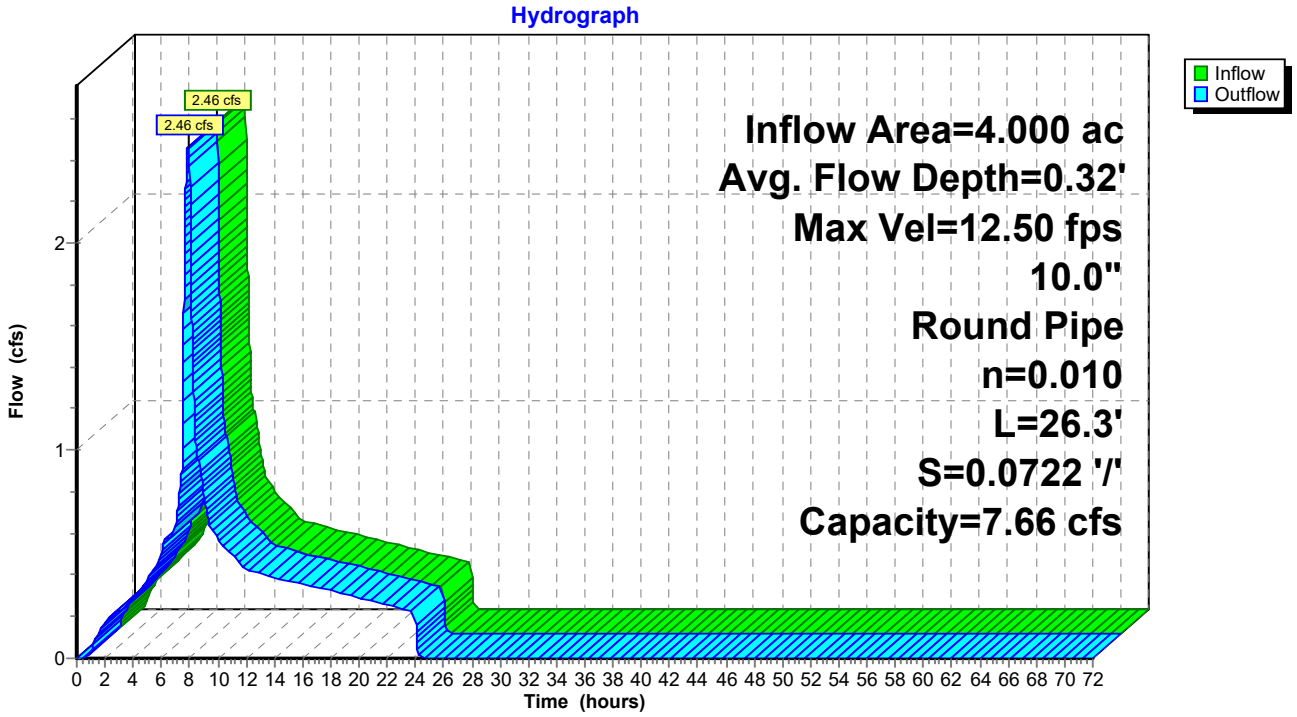
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 12.50 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 7.13 fps, Avg. Travel Time= 0.1 min

Peak Storage= 5 cf @ 7.89 hrs
Average Depth at Peak Storage= 0.32'
Defined Flood Depth= 171.30' Flow Area= 19.4 sf, Capacity= -6,563.73 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 7.66 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 26.3' Slope= 0.0722 '/'
Inlet Invert= 169.30', Outlet Invert= 167.40'



Reach MH: WQ MH



Summary for Pond STM-1: Detention Pond

[63] Warning: Exceeded Reach MH INLET depth by 1.59' @ 24.27 hrs

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 2.49" for 5-YR event
Inflow = 2.46 cfs @ 7.89 hrs, Volume= 0.831 af
Outflow = 0.48 cfs @ 11.19 hrs, Volume= 0.780 af, Atten= 80%, Lag= 197.8 min
Primary = 0.48 cfs @ 11.19 hrs, Volume= 0.780 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 171.03' @ 11.19 hrs Surf.Area= 5,841 sf Storage= 16,570 cf

Plug-Flow detention time= 812.4 min calculated for 0.780 af (94% of inflow)
Center-of-Mass det. time= 767.6 min (1,453.2 - 685.6)

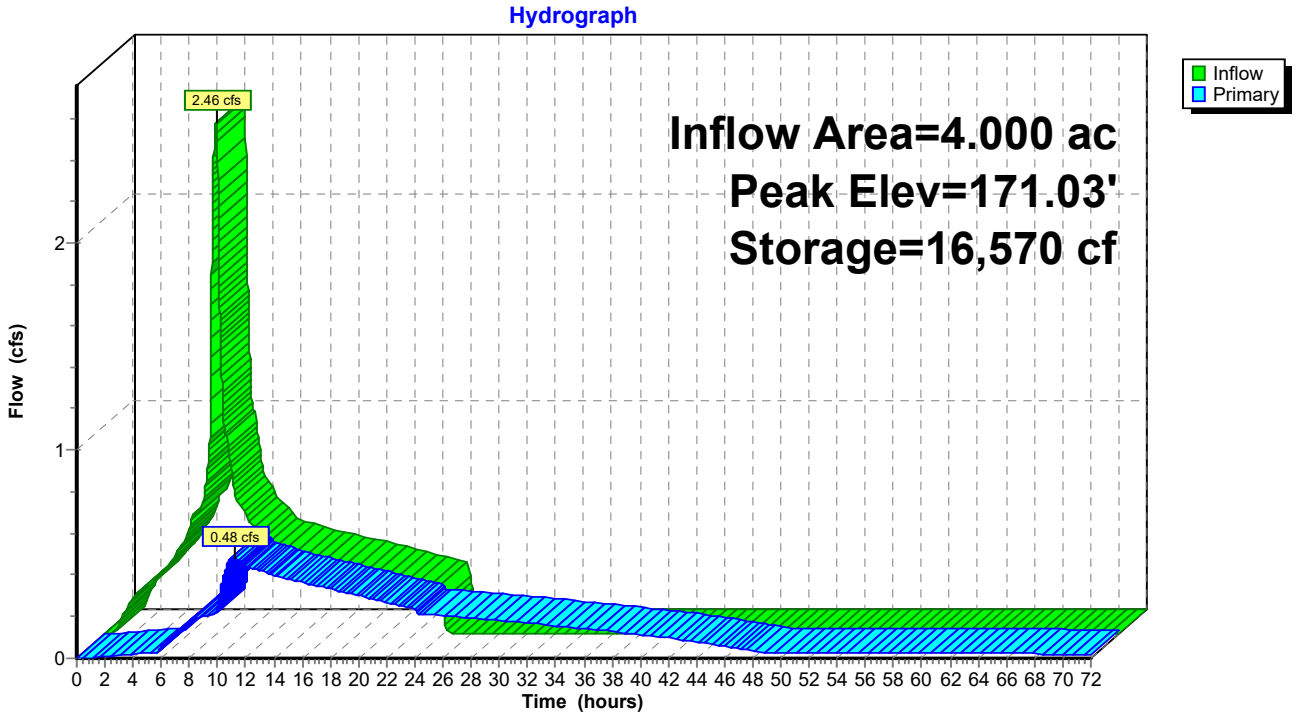
Volume	Invert	Avail.Storage	Storage Description
#1	166.75'	24,092 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.75	2,138	224.0	0	0	2,138
167.00	2,309	232.0	556	556	2,434
168.00	3,059	267.0	2,675	3,231	3,846
169.00	3,912	297.0	3,477	6,708	5,222
170.00	4,832	316.0	4,364	11,072	6,198
171.00	5,809	335.0	5,313	16,385	7,234
172.20	7,056	357.6	7,707	24,092	8,548

Device	Routing	Invert	Outlet Devices
#1	Primary	166.00'	**10.0" Round Outlet Pipe** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 166.00' / 163.00' S= 0.0600 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	166.75'	**0.9" Vert. WQ Outlet** C= 0.600
#3	Device 1	168.25'	**2.0" Vert. 2-YR Storm** C= 0.600
#4	Device 1	170.92'	**2.2' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.48 cfs @ 11.19 hrs HW=171.03' TW=0.00' (Dynamic Tailwater)
↑**1=Outlet Pipe** (Passes 0.48 cfs of 5.64 cfs potential flow)
↑**2=WQ Outlet** (Orifice Controls 0.04 cfs @ 9.92 fps)
3=2-YR Storm (Orifice Controls 0.17 cfs @ 7.91 fps)
4=Sharp-Crested Rectangular Weir (Weir Controls 0.27 cfs @ 1.09 fps)

Pond STM-1: Detention Pond

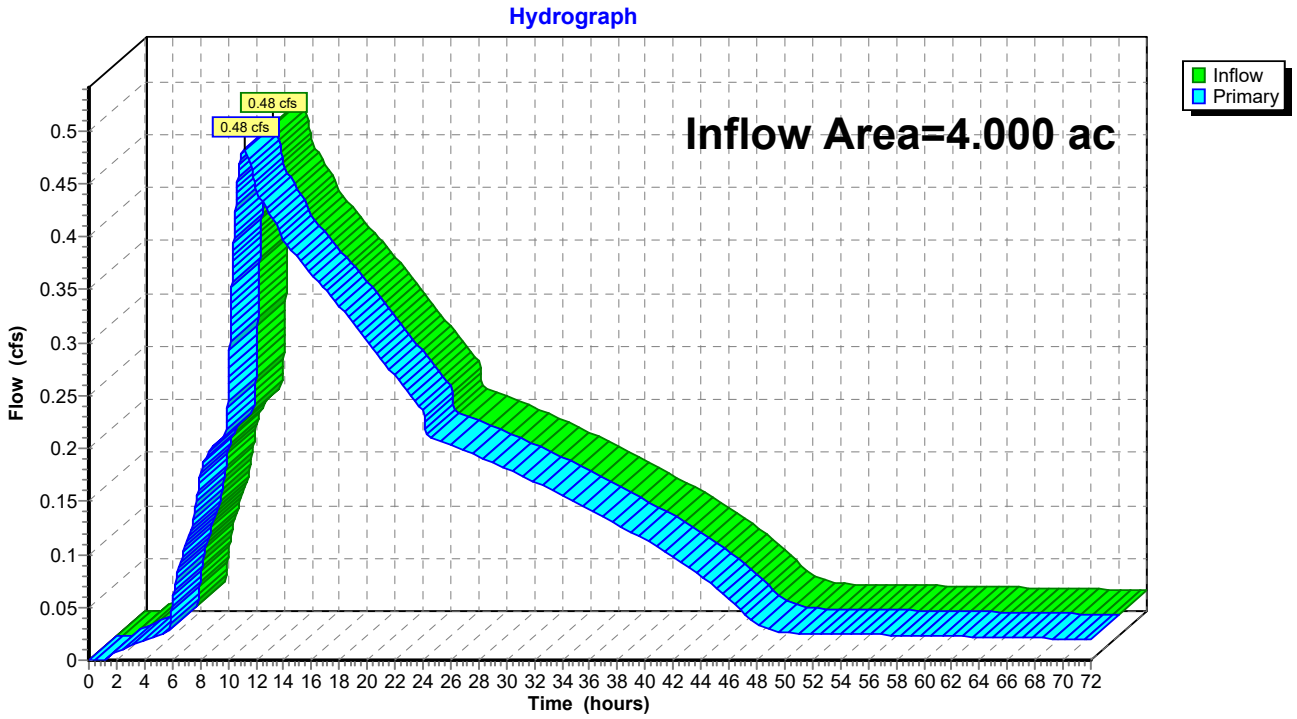


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth > 2.34" for 5-YR event
Inflow = 0.48 cfs @ 11.19 hrs, Volume= 0.780 af
Primary = 0.48 cfs @ 11.19 hrs, Volume= 0.780 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

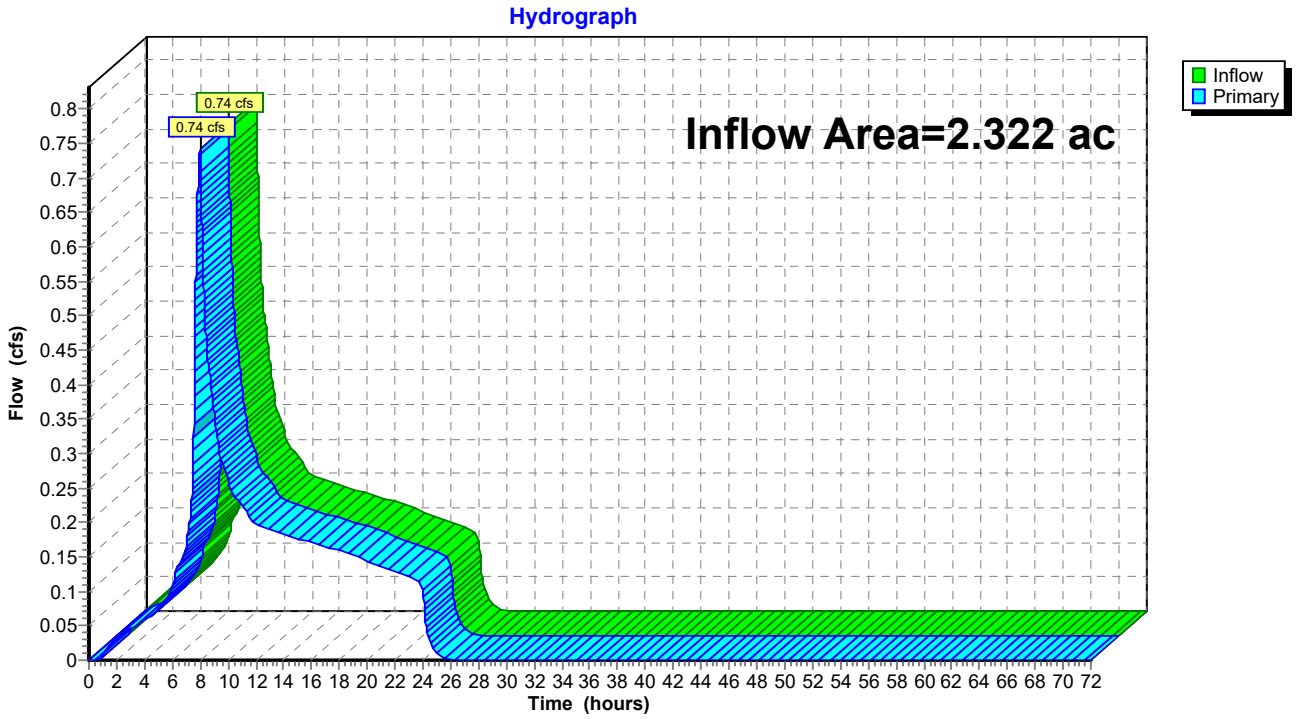


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 26.71% Impervious, Inflow Depth = 1.69" for 5-YR event
Inflow = 0.74 cfs @ 8.00 hrs, Volume= 0.327 af
Primary = 0.74 cfs @ 8.00 hrs, Volume= 0.327 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-iP: Impervious Runoff Area=133,720 sf 100.00% Impervious Runoff Depth=3.22"
Tc=5.0 min CN=0/98 Runoff=2.48 cfs 0.823 af

Subcatchment1-P: Pervious Runoff Area=40,503 sf 0.00% Impervious Runoff Depth=1.53"
Tc=5.0 min CN=79/0 Runoff=0.32 cfs 0.118 af

Subcatchment2.1-iP: Impervious Runoff Area=15,312 sf 100.00% Impervious Runoff Depth=3.22"
Tc=5.0 min CN=0/98 Runoff=0.28 cfs 0.094 af

Subcatchment2.1-P: Pervious Runoff Area=72,679 sf 0.00% Impervious Runoff Depth=1.53"
Flow Length=409' Tc=27.4 min CN=79/0 Runoff=0.39 cfs 0.212 af

Subcatchment2.2-iP: Impervious Runoff Area=11,702 sf 100.00% Impervious Runoff Depth=3.22"
Tc=5.0 min CN=0/98 Runoff=0.22 cfs 0.072 af

Subcatchment2.2-P: Pervious Runoff Area=1,440 sf 0.00% Impervious Runoff Depth=1.53"
Tc=5.0 min CN=79/0 Runoff=0.01 cfs 0.004 af

Reach CB-2: Catch Basin Avg. Flow Depth=0.33' Max Vel=3.31 fps Inflow=0.66 cfs 0.307 af
10.0" Round Pipe n=0.010 L=302.0' S=0.0050 '/' Capacity=2.01 cfs Outflow=0.66 cfs 0.307 af

Reach MH: WQ MH Avg. Flow Depth=0.35' Max Vel=12.93 fps Inflow=2.78 cfs 0.941 af
10.0" Round Pipe n=0.010 L=26.3' S=0.0722 '/' Capacity=7.66 cfs Outflow=2.78 cfs 0.941 af

Pond STM-1: Detention Pond Peak Elev=171.08' Storage=16,855 cf Inflow=2.78 cfs 0.941 af
Outflow=0.67 cfs 0.890 af

Link 1L: Flow Summary Part 1 Inflow=0.67 cfs 0.890 af
Primary=0.67 cfs 0.890 af

Link 2L: Flow Summary Part 2 Inflow=0.88 cfs 0.383 af
Primary=0.88 cfs 0.383 af

Total Runoff Area = 6.321 ac Runoff Volume = 1.324 af Average Runoff Depth = 2.51"
41.63% Pervious = 2.631 ac 58.37% Impervious = 3.690 ac

Summary for Subcatchment 1-iP: Impervious

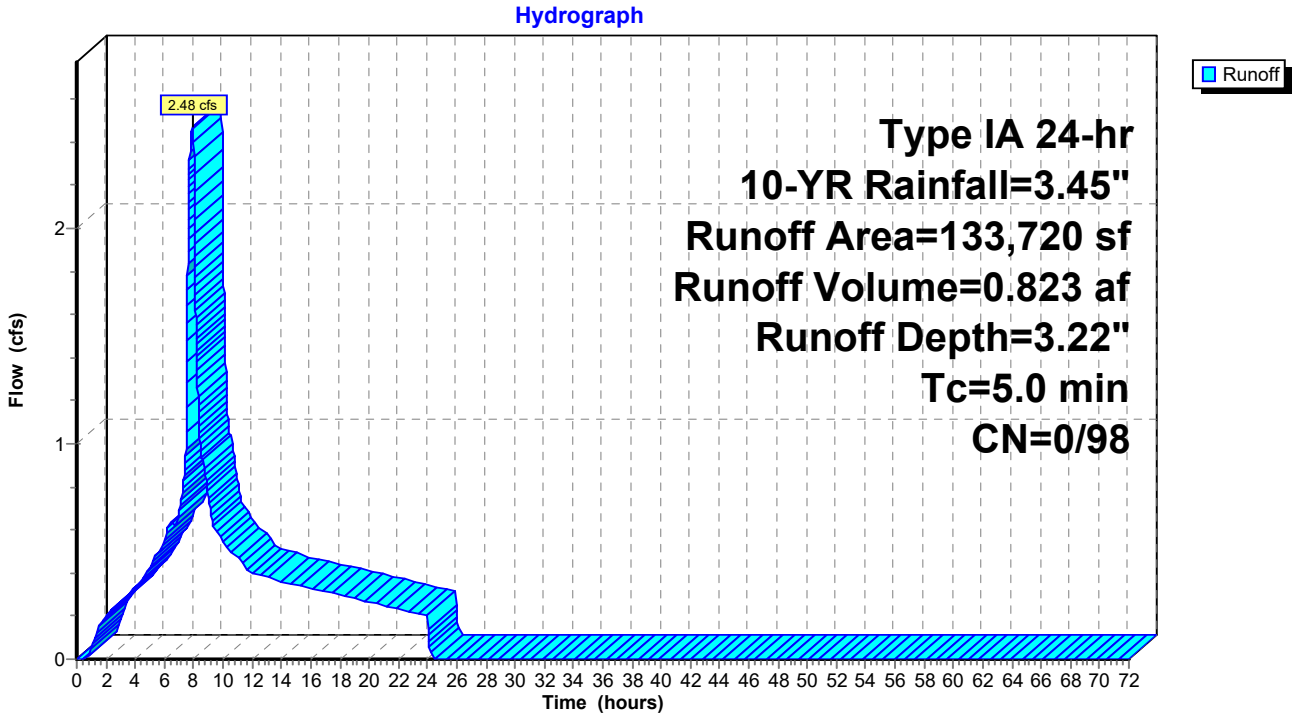
Runoff = 2.48 cfs @ 7.88 hrs, Volume= 0.823 af, Depth= 3.22"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

	Area (sf)	CN	Description
*	133,720	98	Roof/Drive Aisle
	133,720		100.00% Impervious Area

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

Subcatchment 1-iP: Impervious



Summary for Subcatchment 1-P: Pervious

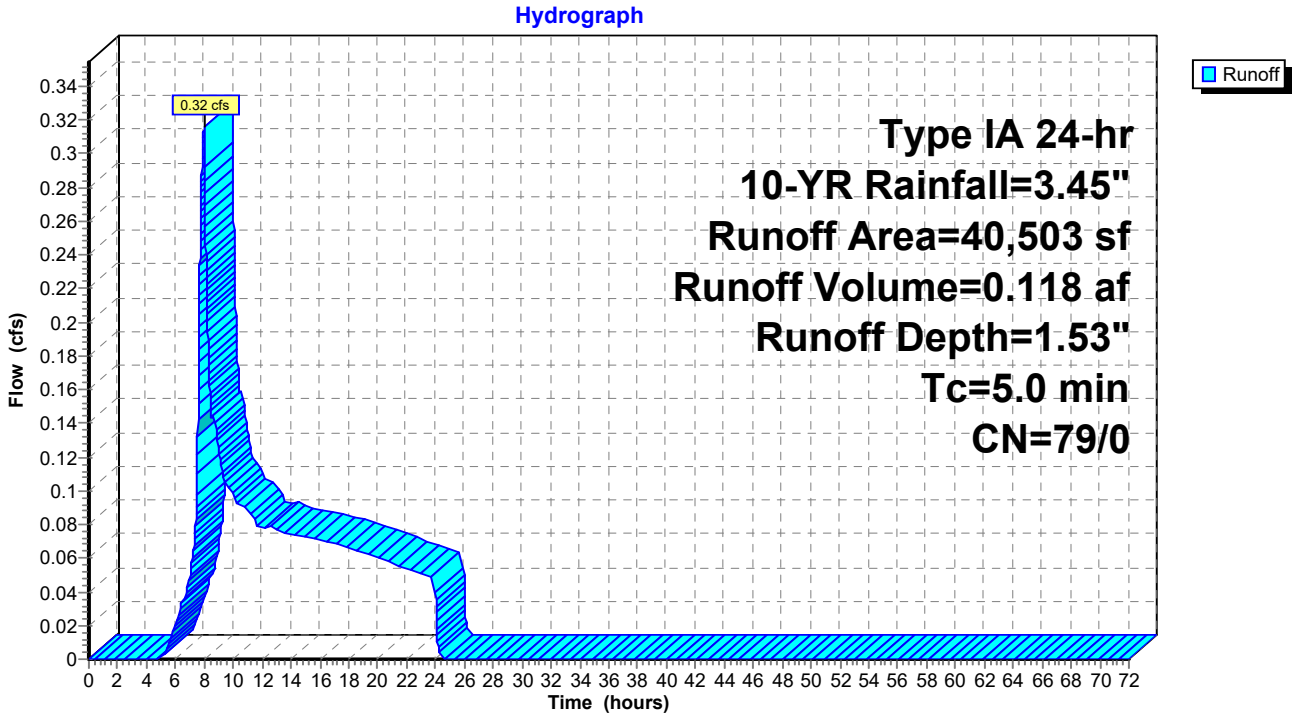
Runoff = 0.32 cfs @ 7.99 hrs, Volume= 0.118 af, Depth= 1.53"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

Area (sf)	CN	Description
40,503	79	50-75% Grass cover, Fair, HSG C
40,503		100.00% Pervious Area

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

Subcatchment 1-P: Pervious



Summary for Subcatchment 2.1-iP: Impervious

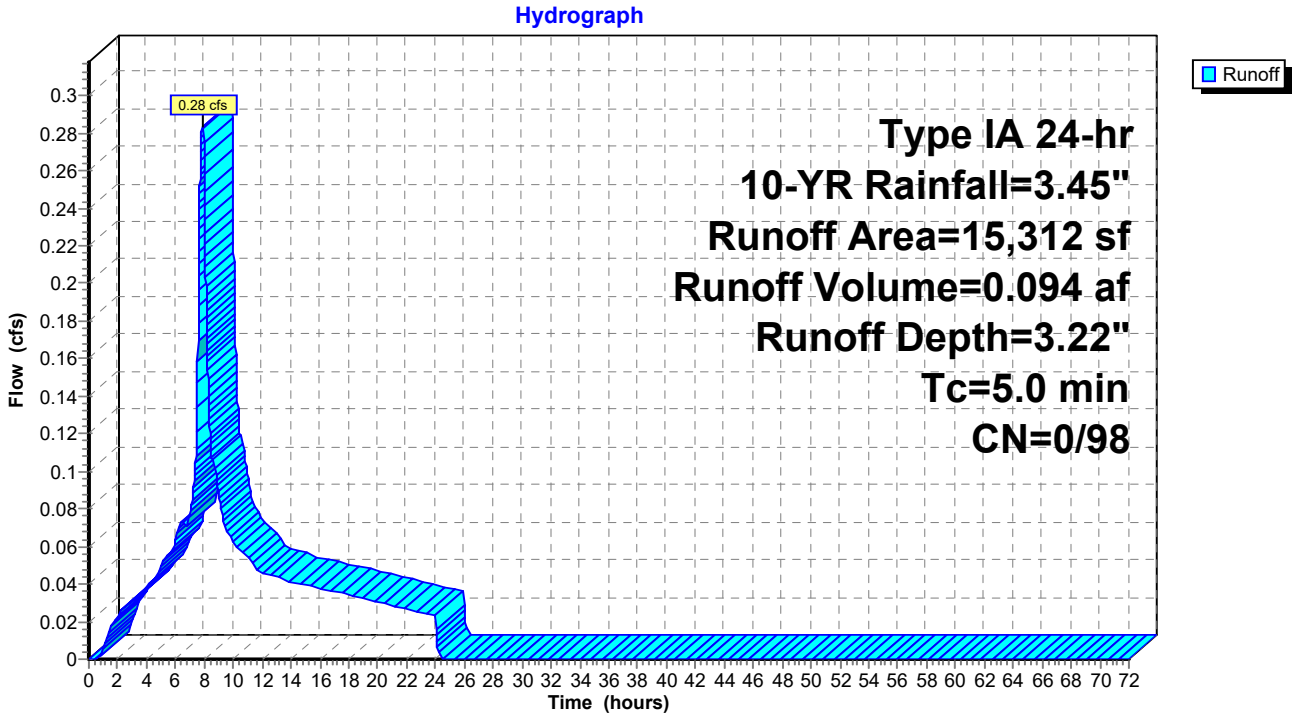
Runoff = 0.28 cfs @ 7.88 hrs, Volume= 0.094 af, Depth= 3.22"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

	Area (sf)	CN	Description
*	15,312	98	Roof/Drive Aisle
	15,312		100.00% Impervious Area

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

Subcatchment 2.1-iP: Impervious



Summary for Subcatchment 2.1-P: Pervious

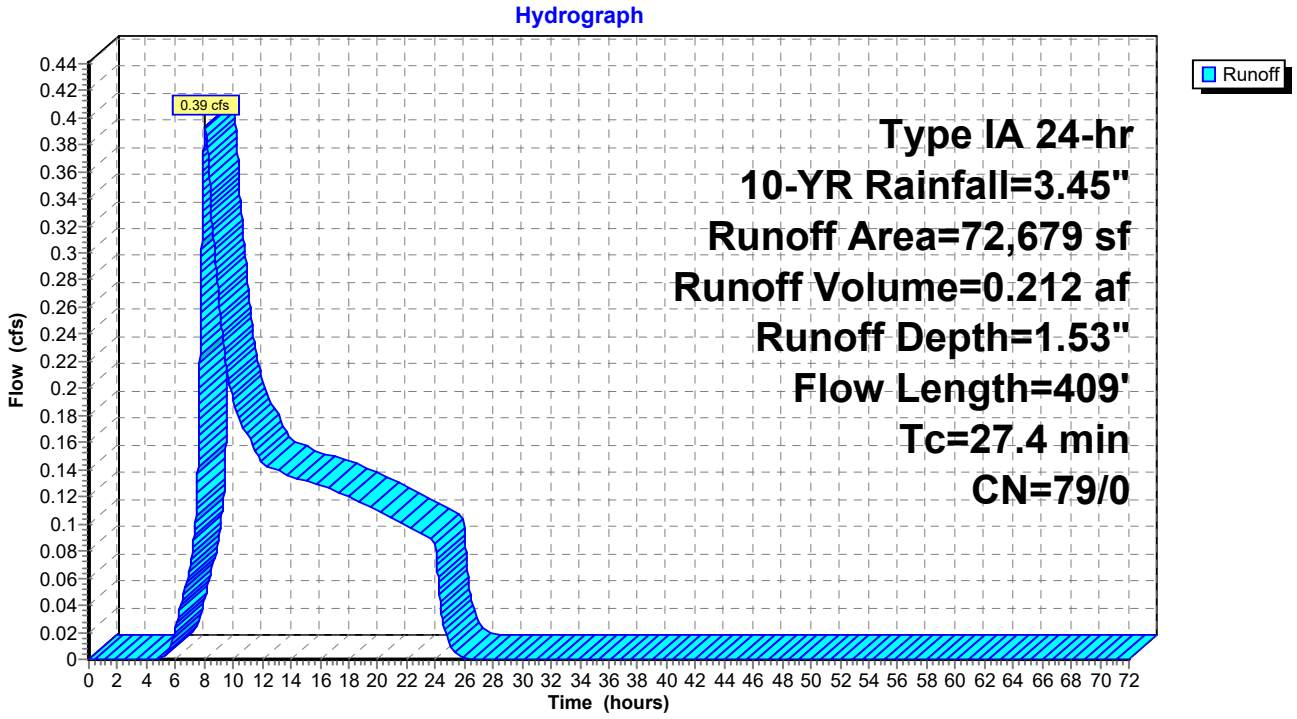
Runoff = 0.39 cfs @ 8.03 hrs, Volume= 0.212 af, Depth= 1.53"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

Area (sf)	CN	Description
72,679	79	50-75% Grass cover, Fair, HSG C
72,679		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	300	0.0220	0.19		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
1.7	109	0.0227	1.05		**Shallow Concentrated Flow, Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
27.4	409	Total			

Subcatchment 2.1-P: Pervious



Summary for Subcatchment 2.2-iP: Impervious

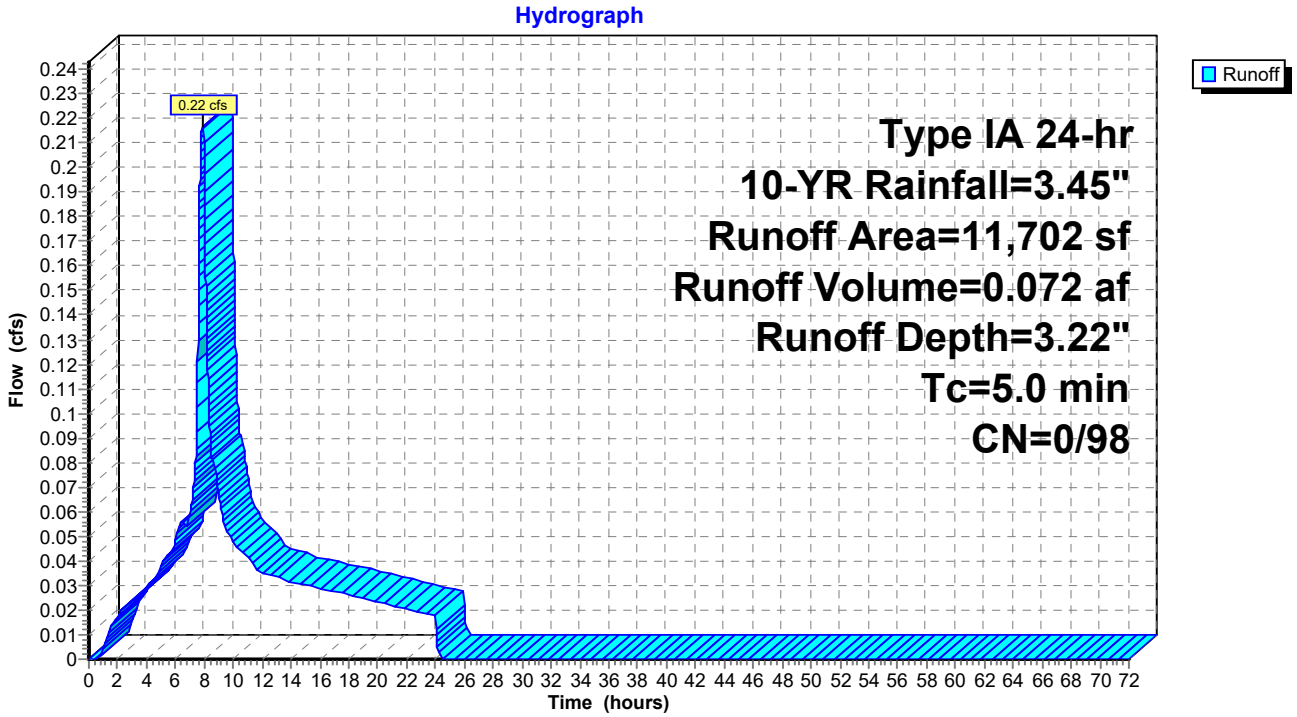
Runoff = 0.22 cfs @ 7.88 hrs, Volume= 0.072 af, Depth= 3.22"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

	Area (sf)	CN	Description
*	11,702	98	Roof/Drive Aisle
	11,702		100.00% Impervious Area

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

Subcatchment 2.2-iP: Impervious



Summary for Subcatchment 2.2-P: Pervious

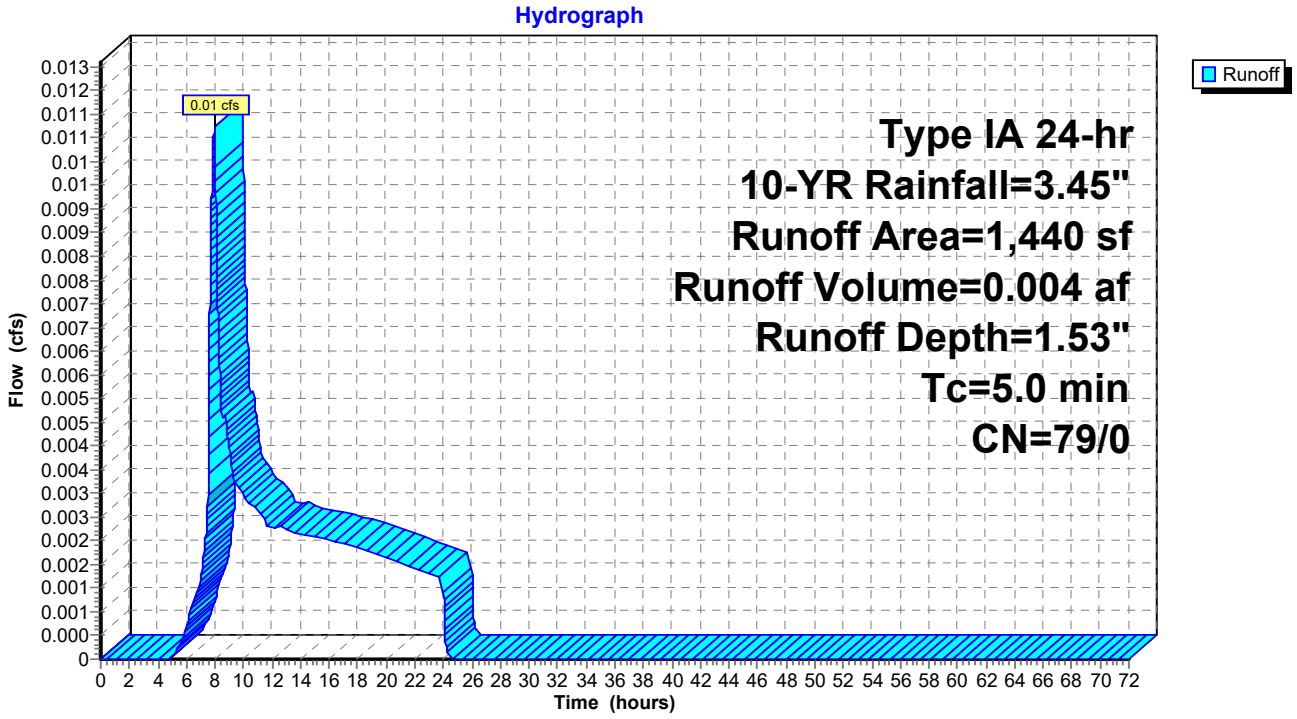
Runoff = 0.01 cfs @ 7.99 hrs, Volume= 0.004 af, Depth= 1.53"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 10-YR Rainfall=3.45"

Area (sf)	CN	Description
1,440	79	50-75% Grass cover, Fair, HSG C
1,440		100.00% Pervious Area

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

Subcatchment 2.2-P: Pervious



Summary for Reach CB-2: Catch Basin

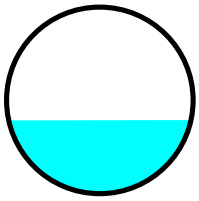
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.020 ac, 17.40% Impervious, Inflow Depth = 1.82" for 10-YR event
Inflow = 0.66 cfs @ 8.00 hrs, Volume= 0.307 af
Outflow = 0.66 cfs @ 8.01 hrs, Volume= 0.307 af, Atten= 1%, Lag= 0.6 min

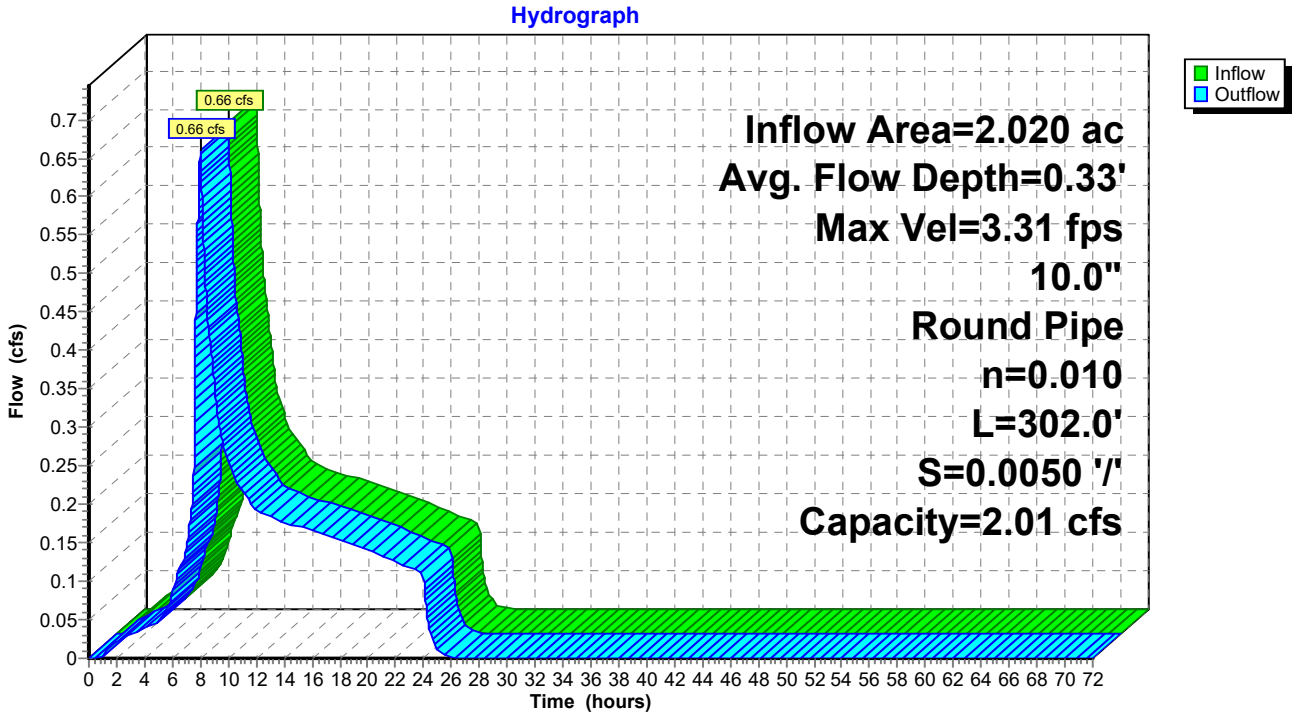
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.31 fps, Min. Travel Time= 1.5 min
Avg. Velocity = 1.87 fps, Avg. Travel Time= 2.7 min

Peak Storage= 60 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.33'
Defined Flood Depth= 177.89' Flow Area= 20.2 sf, Capacity= -1,793.61 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.01 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 302.0' Slope= 0.0050 '/'
Inlet Invert= 176.89', Outlet Invert= 175.38'



Reach CB-2: Catch Basin



Summary for Reach MH: WQ MH

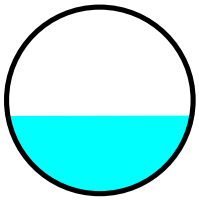
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 2.82" for 10-YR event
Inflow = 2.78 cfs @ 7.89 hrs, Volume= 0.941 af
Outflow = 2.78 cfs @ 7.89 hrs, Volume= 0.941 af, Atten= 0%, Lag= 0.0 min

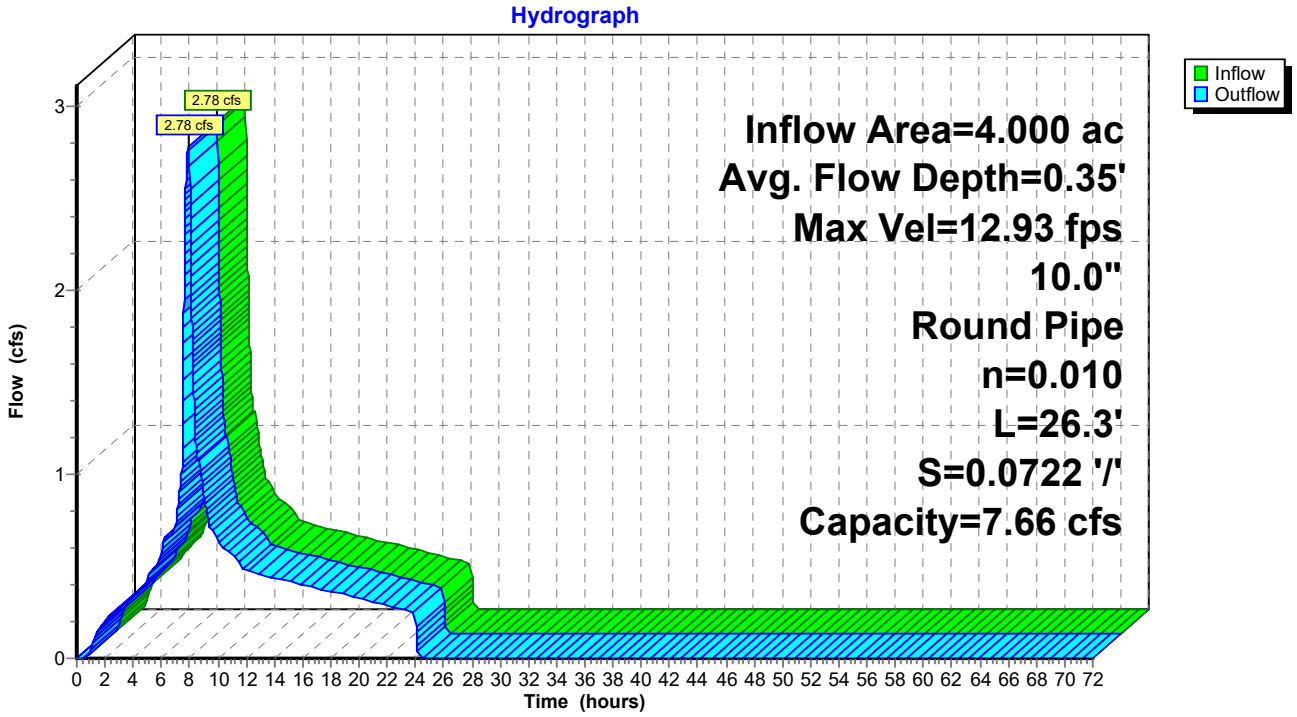
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 12.93 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 7.39 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 7.89 hrs
Average Depth at Peak Storage= 0.35'
Defined Flood Depth= 171.30' Flow Area= 19.4 sf, Capacity= -6,563.73 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 7.66 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 26.3' Slope= 0.0722 '/'
Inlet Invert= 169.30', Outlet Invert= 167.40'



Reach MH: WQ MH



Summary for Pond STM-1: Detention Pond

[63] Warning: Exceeded Reach MH INLET depth by 1.62' @ 10.11 hrs

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 2.82" for 10-YR event
Inflow = 2.78 cfs @ 7.89 hrs, Volume= 0.941 af
Outflow = 0.67 cfs @ 9.82 hrs, Volume= 0.890 af, Atten= 76%, Lag= 115.6 min
Primary = 0.67 cfs @ 9.82 hrs, Volume= 0.890 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 171.08' @ 9.82 hrs Surf.Area= 5,889 sf Storage= 16,855 cf

Plug-Flow detention time= 726.9 min calculated for 0.890 af (95% of inflow)
Center-of-Mass det. time= 686.9 min (1,369.8 - 682.9)

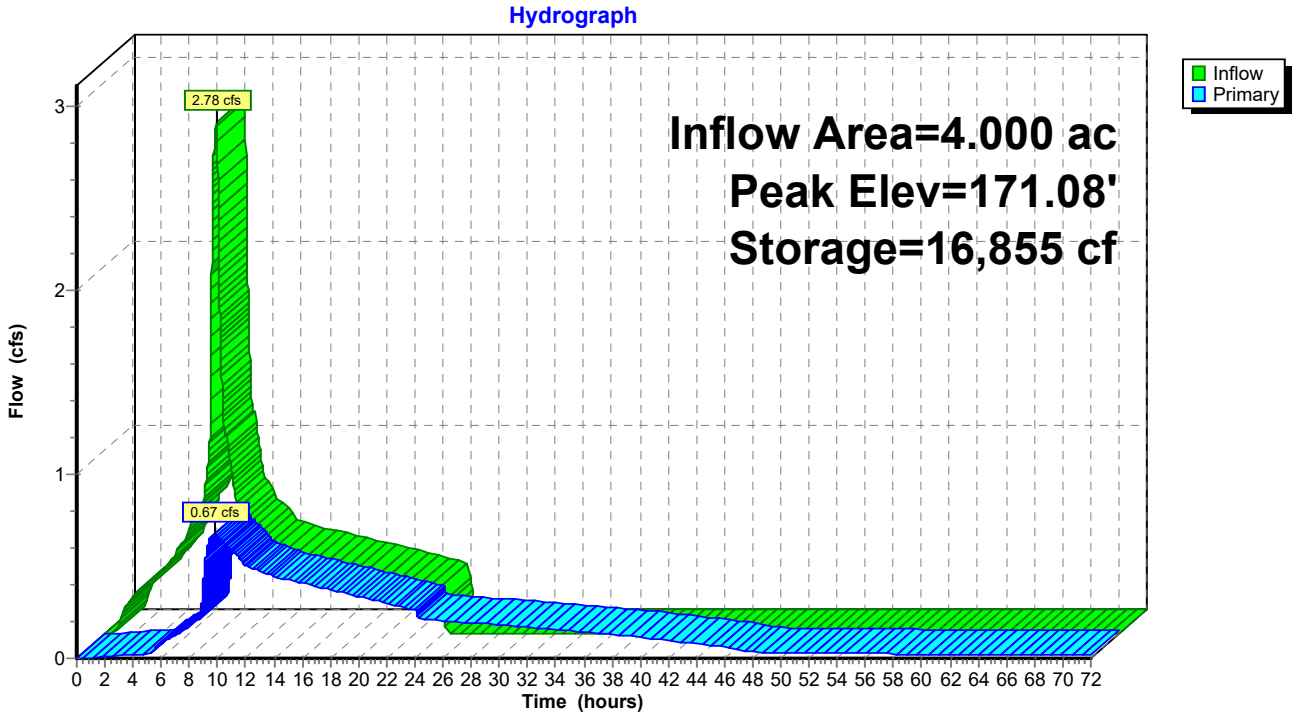
Volume	Invert	Avail.Storage	Storage Description
#1	166.75'	24,092 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.75	2,138	224.0	0	0	2,138
167.00	2,309	232.0	556	556	2,434
168.00	3,059	267.0	2,675	3,231	3,846
169.00	3,912	297.0	3,477	6,708	5,222
170.00	4,832	316.0	4,364	11,072	6,198
171.00	5,809	335.0	5,313	16,385	7,234
172.20	7,056	357.6	7,707	24,092	8,548

Device	Routing	Invert	Outlet Devices
#1	Primary	166.00'	**10.0" Round Outlet Pipe** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 166.00' / 163.00' S= 0.0600 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	166.75'	**0.9" Vert. WQ Outlet** C= 0.600
#3	Device 1	168.25'	**2.0" Vert. 2-YR Storm** C= 0.600
#4	Device 1	170.92'	**2.2' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=0.67 cfs @ 9.82 hrs HW=171.08' TW=0.00' (Dynamic Tailwater)
↑**1=Outlet Pipe** (Passes 0.67 cfs of 5.67 cfs potential flow)
- **2=WQ Outlet** (Orifice Controls 0.04 cfs @ 9.98 fps)
- **3=2-YR Storm** (Orifice Controls 0.17 cfs @ 7.98 fps)
- **4=Sharp-Crested Rectangular Weir** (Weir Controls 0.46 cfs @ 1.31 fps)

Pond STM-1: Detention Pond

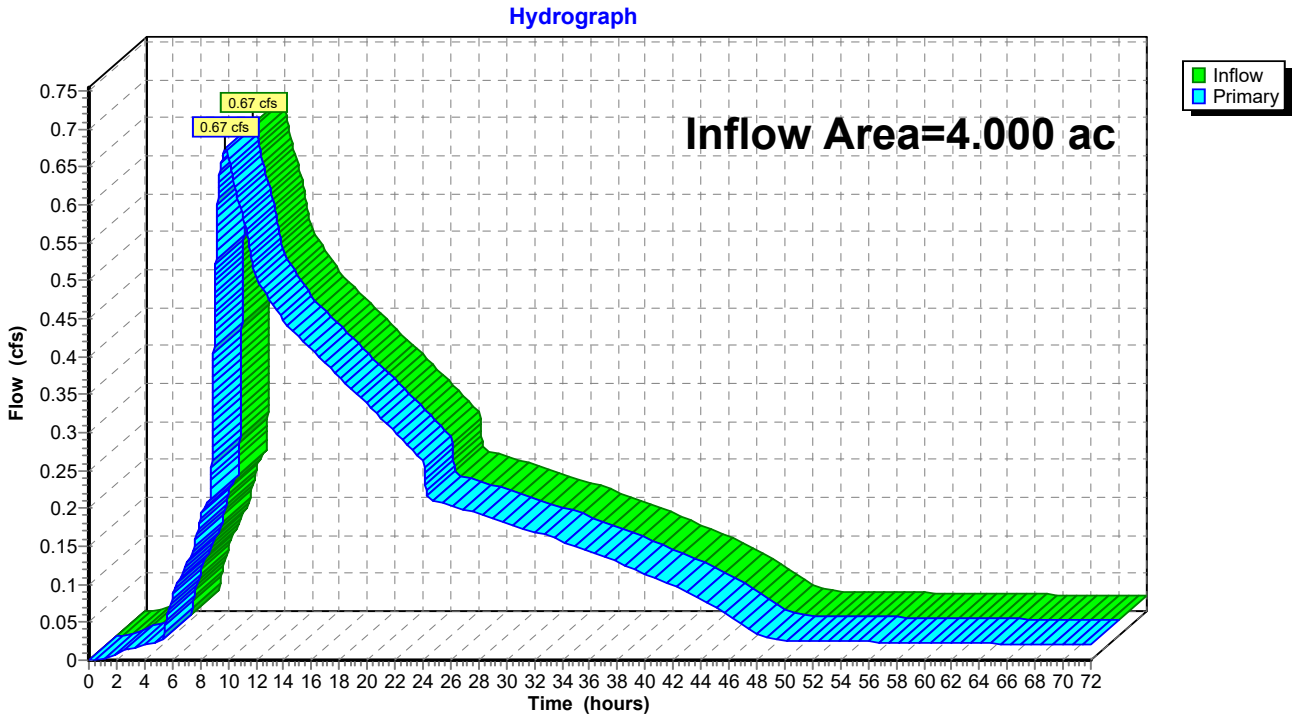


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth > 2.67" for 10-YR event
Inflow = 0.67 cfs @ 9.82 hrs, Volume= 0.890 af
Primary = 0.67 cfs @ 9.82 hrs, Volume= 0.890 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

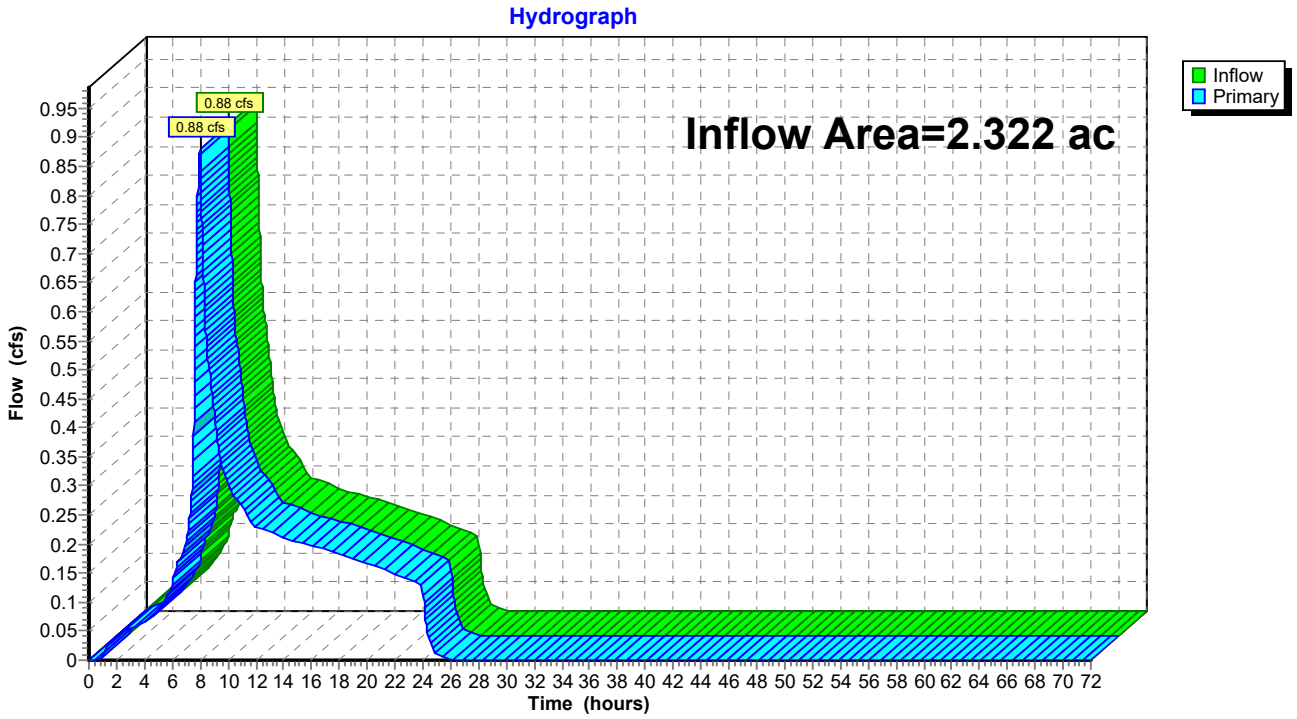


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 26.71% Impervious, Inflow Depth = 1.98" for 10-YR event
Inflow = 0.88 cfs @ 8.00 hrs, Volume= 0.383 af
Primary = 0.88 cfs @ 8.00 hrs, Volume= 0.383 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Time span=0.00-72.00 hrs, dt=0.01 hrs, 7201 points x 2
Runoff by SBUH method, Split Pervious/Imperv.
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment1-iP: Impervious Runoff Area=133,720 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=0/98 Runoff=2.81 cfs 0.938 af

Subcatchment1-P: Pervious Runoff Area=40,503 sf 0.00% Impervious Runoff Depth=1.88"
Tc=5.0 min CN=79/0 Runoff=0.40 cfs 0.146 af

Subcatchment2.1-iP: Impervious Runoff Area=15,312 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=0/98 Runoff=0.32 cfs 0.107 af

Subcatchment2.1-P: Pervious Runoff Area=72,679 sf 0.00% Impervious Runoff Depth=1.88"
Flow Length=409' Tc=27.4 min CN=79/0 Runoff=0.51 cfs 0.262 af

Subcatchment2.2-iP: Impervious Runoff Area=11,702 sf 100.00% Impervious Runoff Depth=3.67"
Tc=5.0 min CN=0/98 Runoff=0.25 cfs 0.082 af

Subcatchment2.2-P: Pervious Runoff Area=1,440 sf 0.00% Impervious Runoff Depth=1.88"
Tc=5.0 min CN=79/0 Runoff=0.01 cfs 0.005 af

Reach CB-2: Catch Basin Avg. Flow Depth=0.37' Max Vel=3.50 fps Inflow=0.82 cfs 0.369 af
10.0" Round Pipe n=0.010 L=302.0' S=0.0050 '/' Capacity=2.01 cfs Outflow=0.81 cfs 0.369 af

Reach MH: WQ MH Avg. Flow Depth=0.38' Max Vel=13.42 fps Inflow=3.21 cfs 1.084 af
10.0" Round Pipe n=0.010 L=26.3' S=0.0722 '/' Capacity=7.66 cfs Outflow=3.21 cfs 1.084 af

Pond STM-1: Detention Pond Peak Elev=171.17' Storage=17,366 cf Inflow=3.21 cfs 1.084 af
Outflow=1.08 cfs 1.032 af

Link 1L: Flow Summary Part 1 Inflow=1.08 cfs 1.032 af
Primary=1.08 cfs 1.032 af

Link 2L: Flow Summary Part 2 Inflow=1.06 cfs 0.456 af
Primary=1.06 cfs 0.456 af

Total Runoff Area = 6.321 ac Runoff Volume = 1.540 af Average Runoff Depth = 2.92"
41.63% Pervious = 2.631 ac 58.37% Impervious = 3.690 ac

Summary for Subcatchment 1-iP: Impervious

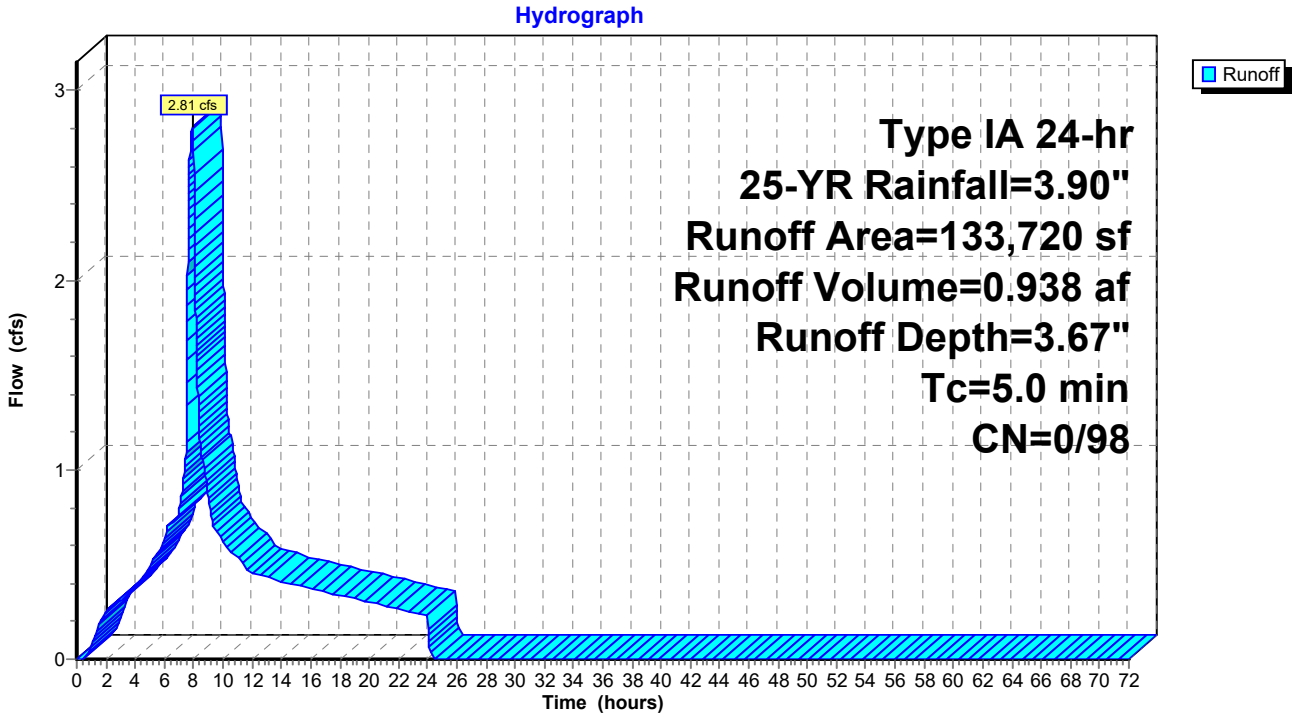
Runoff = 2.81 cfs @ 7.88 hrs, Volume= 0.938 af, Depth= 3.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
*	133,720	98	Roof/Drive Aisle
	133,720		100.00% Impervious Area

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

Subcatchment 1-iP: Impervious



Summary for Subcatchment 1-P: Pervious

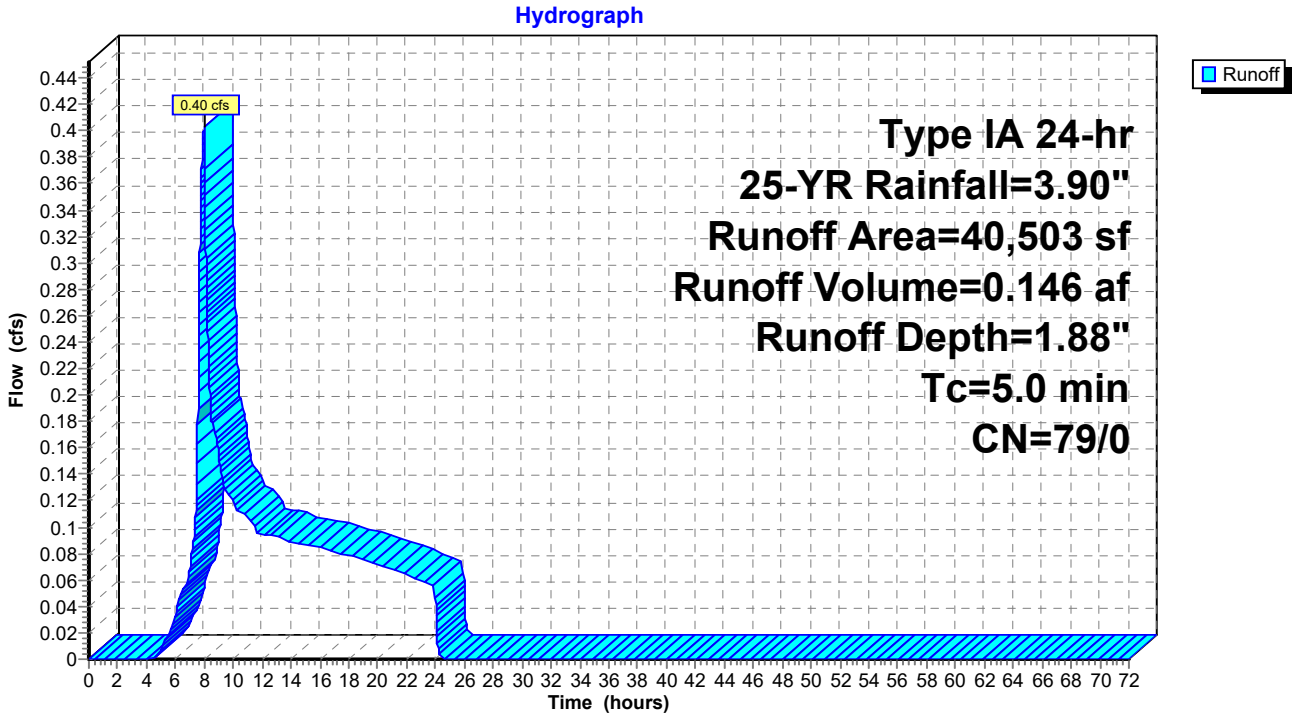
Runoff = 0.40 cfs @ 7.98 hrs, Volume= 0.146 af, Depth= 1.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
40,503	79	50-75% Grass cover, Fair, HSG C
40,503		100.00% Pervious Area

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

Subcatchment 1-P: Pervious



Summary for Subcatchment 2.1-iP: Impervious

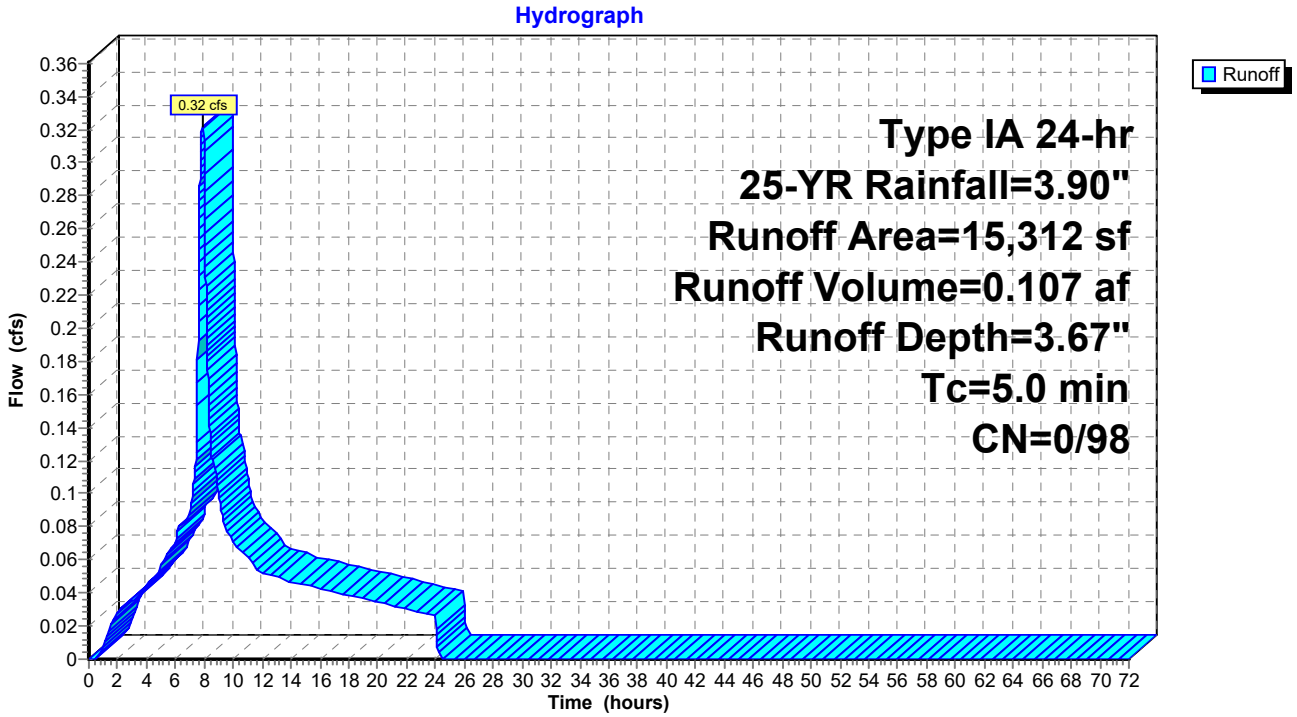
Runoff = 0.32 cfs @ 7.88 hrs, Volume= 0.107 af, Depth= 3.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
*	15,312	98	Roof/Drive Aisle
	15,312		100.00% Impervious Area

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

Subcatchment 2.1-iP: Impervious



Summary for Subcatchment 2.1-P: Pervious

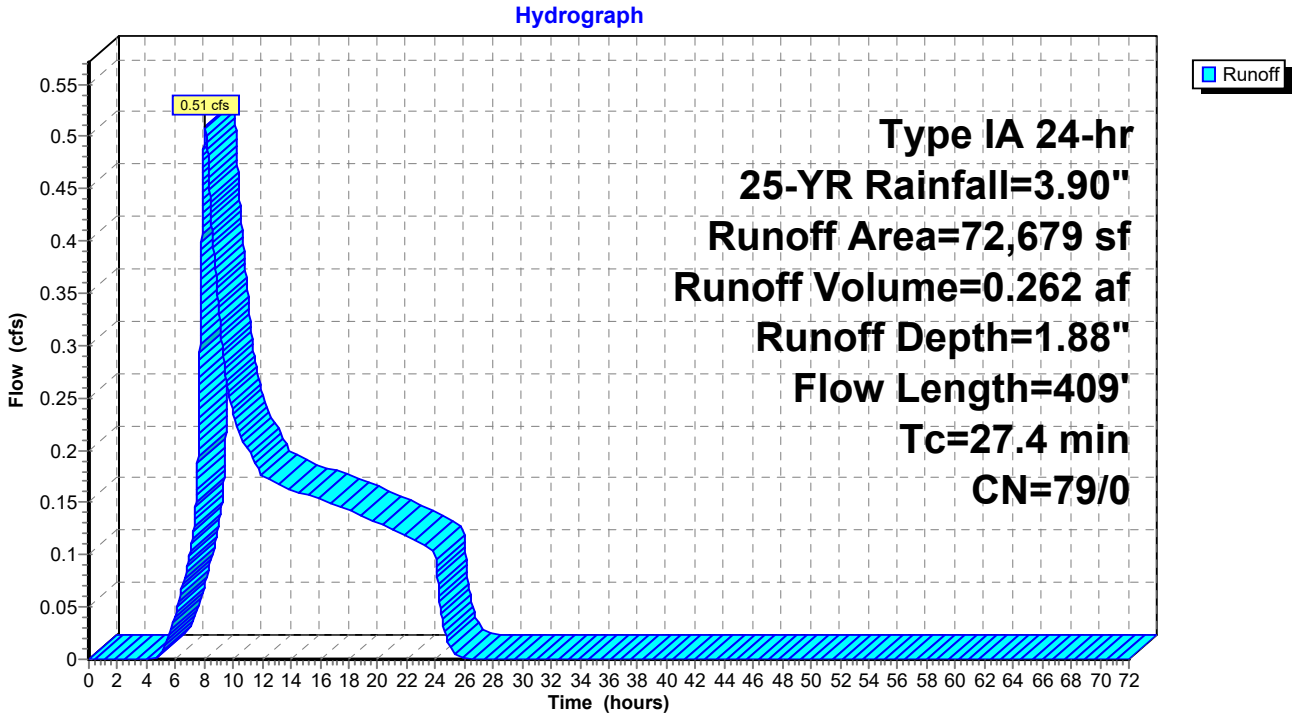
Runoff = 0.51 cfs @ 8.01 hrs, Volume= 0.262 af, Depth= 1.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
72,679	79	50-75% Grass cover, Fair, HSG C
72,679		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.7	300	0.0220	0.19		**Sheet Flow, Sheet Flow** Grass: Short n= 0.150 P2= 2.50"
1.7	109	0.0227	1.05		**Shallow Concentrated Flow, Concentrated Flow** Short Grass Pasture Kv= 7.0 fps
27.4	409	Total			

Subcatchment 2.1-P: Pervious



Summary for Subcatchment 2.2-iP: Impervious

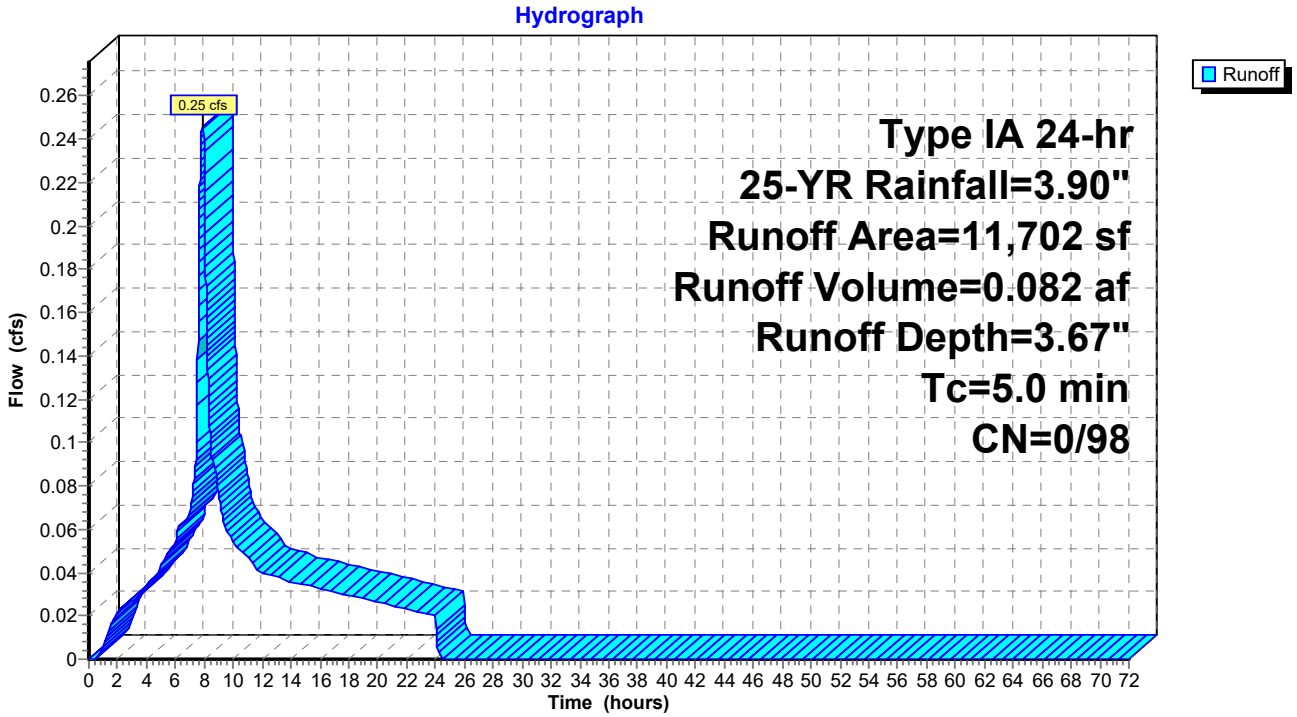
Runoff = 0.25 cfs @ 7.88 hrs, Volume= 0.082 af, Depth= 3.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

	Area (sf)	CN	Description
*	11,702	98	Roof/Drive Aisle
	11,702		100.00% Impervious Area

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

Subcatchment 2.2-iP: Impervious



Summary for Subcatchment 2.2-P: Pervious

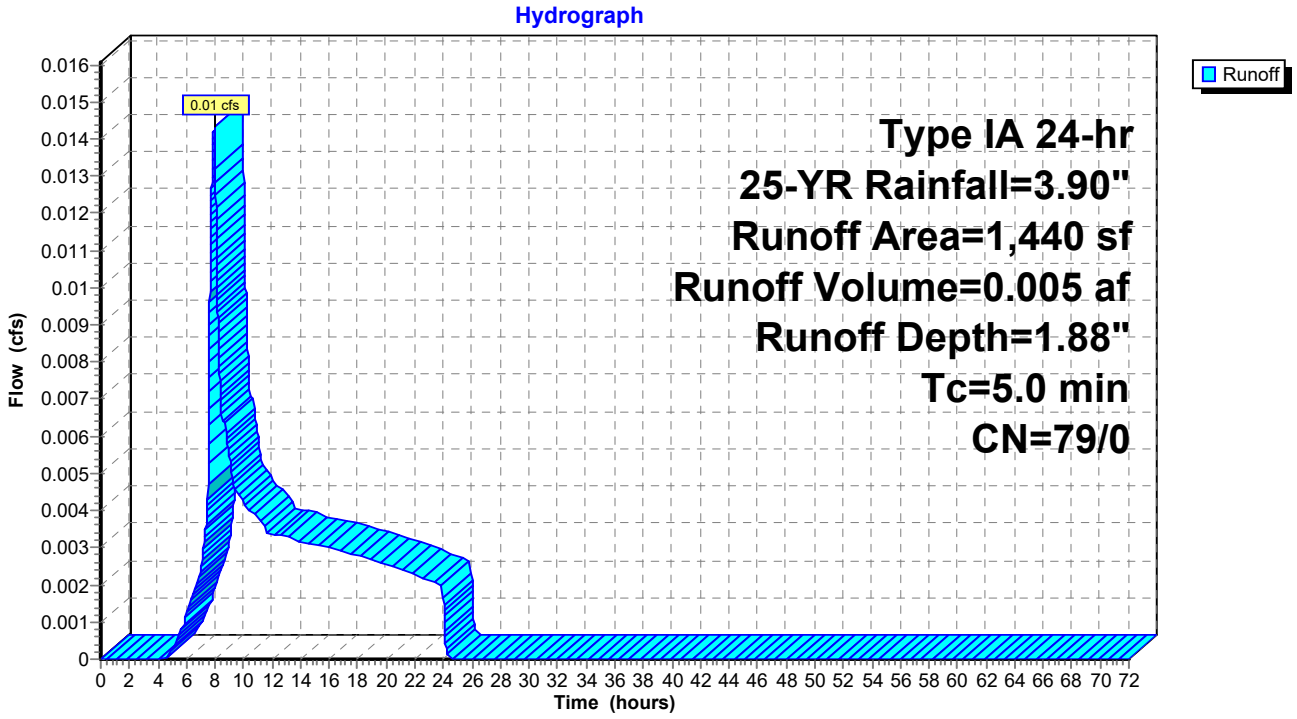
Runoff = 0.01 cfs @ 7.98 hrs, Volume= 0.005 af, Depth= 1.88"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-72.00 hrs, dt= 0.01 hrs
Type IA 24-hr 25-YR Rainfall=3.90"

Area (sf)	CN	Description
1,440	79	50-75% Grass cover, Fair, HSG C
1,440		100.00% Pervious Area

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

Subcatchment 2.2-P: Pervious



Summary for Reach CB-2: Catch Basin

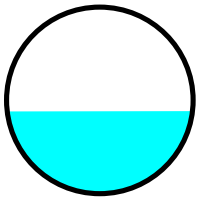
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 2.020 ac, 17.40% Impervious, Inflow Depth = 2.19" for 25-YR event
Inflow = 0.82 cfs @ 8.00 hrs, Volume= 0.369 af
Outflow = 0.81 cfs @ 8.01 hrs, Volume= 0.369 af, Atten= 1%, Lag= 0.6 min

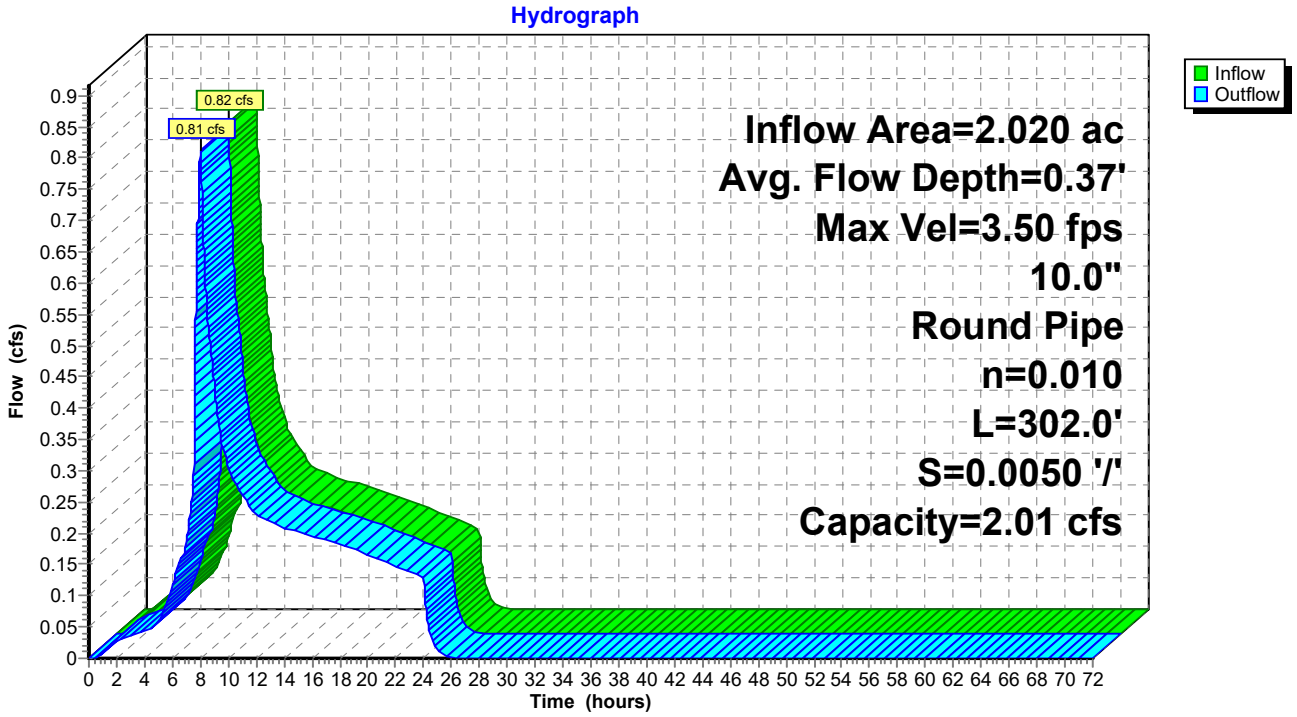
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 3.50 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 1.97 fps, Avg. Travel Time= 2.6 min

Peak Storage= 70 cf @ 8.01 hrs
Average Depth at Peak Storage= 0.37'
Defined Flood Depth= 177.89' Flow Area= 20.2 sf, Capacity= -1,793.61 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 2.01 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 302.0' Slope= 0.0050 '/'
Inlet Invert= 176.89', Outlet Invert= 175.38'



Reach CB-2: Catch Basin



Summary for Reach MH: WQ MH

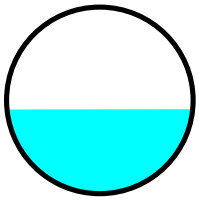
[52] Hint: Inlet/Outlet conditions not evaluated

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 3.25" for 25-YR event
Inflow = 3.21 cfs @ 7.89 hrs, Volume= 1.084 af
Outflow = 3.21 cfs @ 7.89 hrs, Volume= 1.084 af, Atten= 0%, Lag= 0.0 min

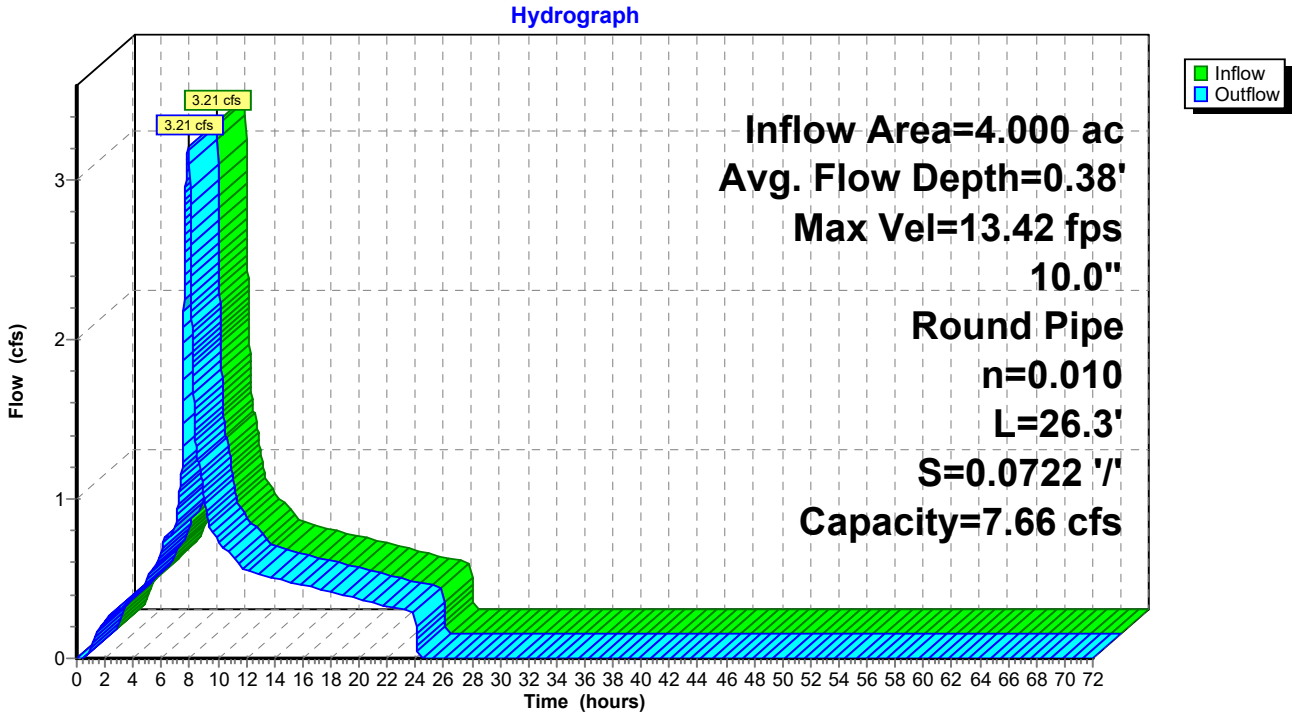
Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Max. Velocity= 13.42 fps, Min. Travel Time= 0.0 min
Avg. Velocity = 7.69 fps, Avg. Travel Time= 0.1 min

Peak Storage= 6 cf @ 7.89 hrs
Average Depth at Peak Storage= 0.38'
Defined Flood Depth= 171.30' Flow Area= 19.4 sf, Capacity= -6,563.73 cfs
Bank-Full Depth= 0.83' Flow Area= 0.5 sf, Capacity= 7.66 cfs

10.0" Round Pipe
n= 0.010 PVC, smooth interior
Length= 26.3' Slope= 0.0722 '/'
Inlet Invert= 169.30', Outlet Invert= 167.40'



Reach MH: WQ MH



Summary for Pond STM-1: Detention Pond

[63] Warning: Exceeded Reach MH INLET depth by 1.66' @ 9.11 hrs

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth = 3.25" for 25-YR event
Inflow = 3.21 cfs @ 7.89 hrs, Volume= 1.084 af
Outflow = 1.08 cfs @ 8.90 hrs, Volume= 1.032 af, Atten= 66%, Lag= 60.3 min
Primary = 1.08 cfs @ 8.90 hrs, Volume= 1.032 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 171.17' @ 8.90 hrs Surf.Area= 5,975 sf Storage= 17,366 cf

Plug-Flow detention time= 639.3 min calculated for 1.032 af (95% of inflow)
Center-of-Mass det. time= 604.1 min (1,283.9 - 679.9)

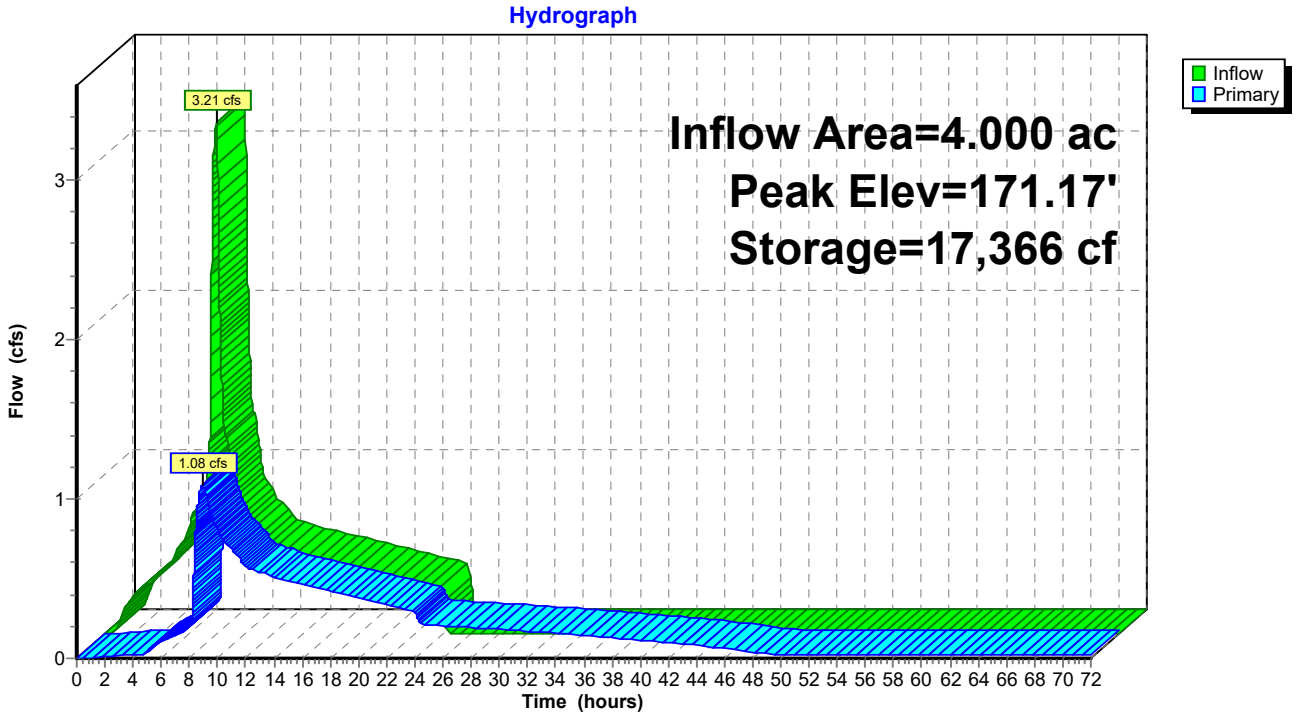
Volume	Invert	Avail.Storage	Storage Description
#1	166.75'	24,092 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
166.75	2,138	224.0	0	0	2,138
167.00	2,309	232.0	556	556	2,434
168.00	3,059	267.0	2,675	3,231	3,846
169.00	3,912	297.0	3,477	6,708	5,222
170.00	4,832	316.0	4,364	11,072	6,198
171.00	5,809	335.0	5,313	16,385	7,234
172.20	7,056	357.6	7,707	24,092	8,548

Device	Routing	Invert	Outlet Devices
#1	Primary	166.00'	**10.0" Round Outlet Pipe** L= 50.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 166.00' / 163.00' S= 0.0600 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.55 sf
#2	Device 1	166.75'	**0.9" Vert. WQ Outlet** C= 0.600
#3	Device 1	168.25'	**2.0" Vert. 2-YR Storm** C= 0.600
#4	Device 1	170.92'	**2.2' long Sharp-Crested Rectangular Weir** 2 End Contraction(s)

Primary OutFlow Max=1.08 cfs @ 8.90 hrs HW=171.17' TW=0.00' (Dynamic Tailwater)
↑**1=Outlet Pipe** (Passes 1.08 cfs of 5.72 cfs potential flow)
↑**2=WQ Outlet** (Orifice Controls 0.04 cfs @ 10.08 fps)
3=2-YR Storm (Orifice Controls 0.18 cfs @ 8.10 fps)
4=Sharp-Crested Rectangular Weir (Weir Controls 0.86 cfs @ 1.62 fps)

Pond STM-1: Detention Pond

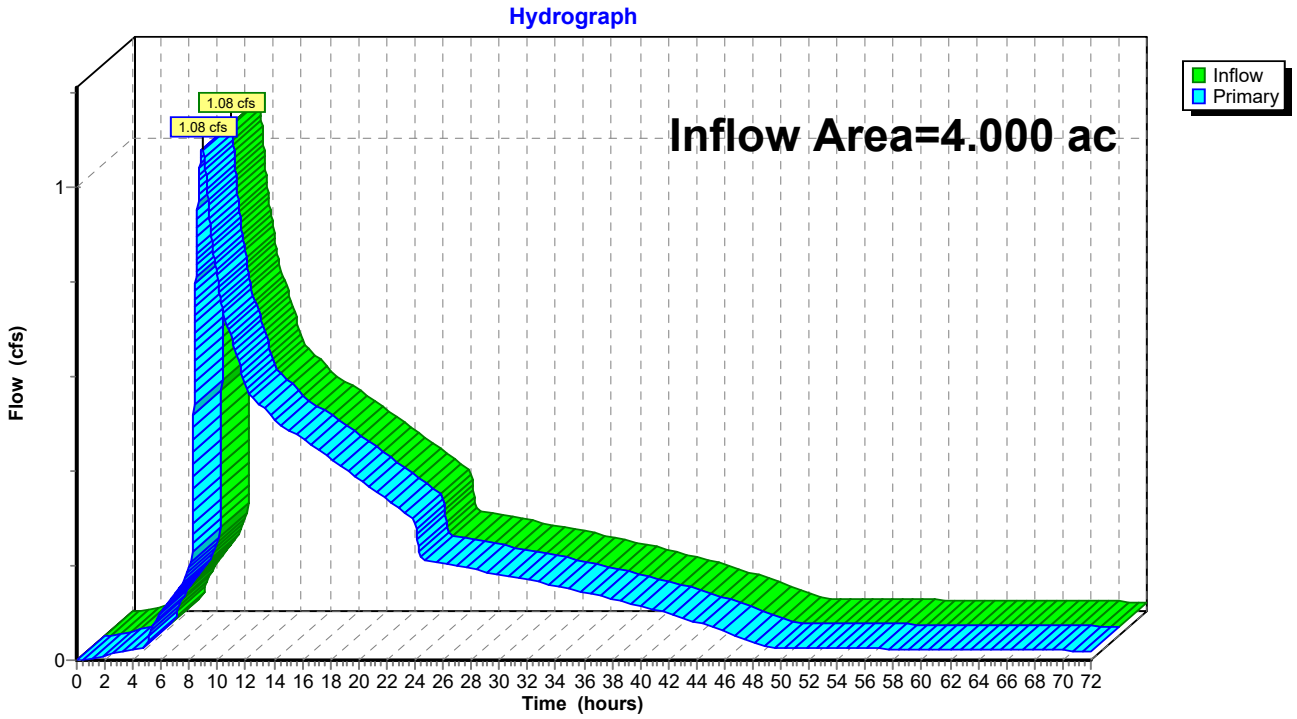


Summary for Link 1L: Flow Summary Part 1

Inflow Area = 4.000 ac, 76.75% Impervious, Inflow Depth > 3.10" for 25-YR event
Inflow = 1.08 cfs @ 8.90 hrs, Volume= 1.032 af
Primary = 1.08 cfs @ 8.90 hrs, Volume= 1.032 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 1L: Flow Summary Part 1

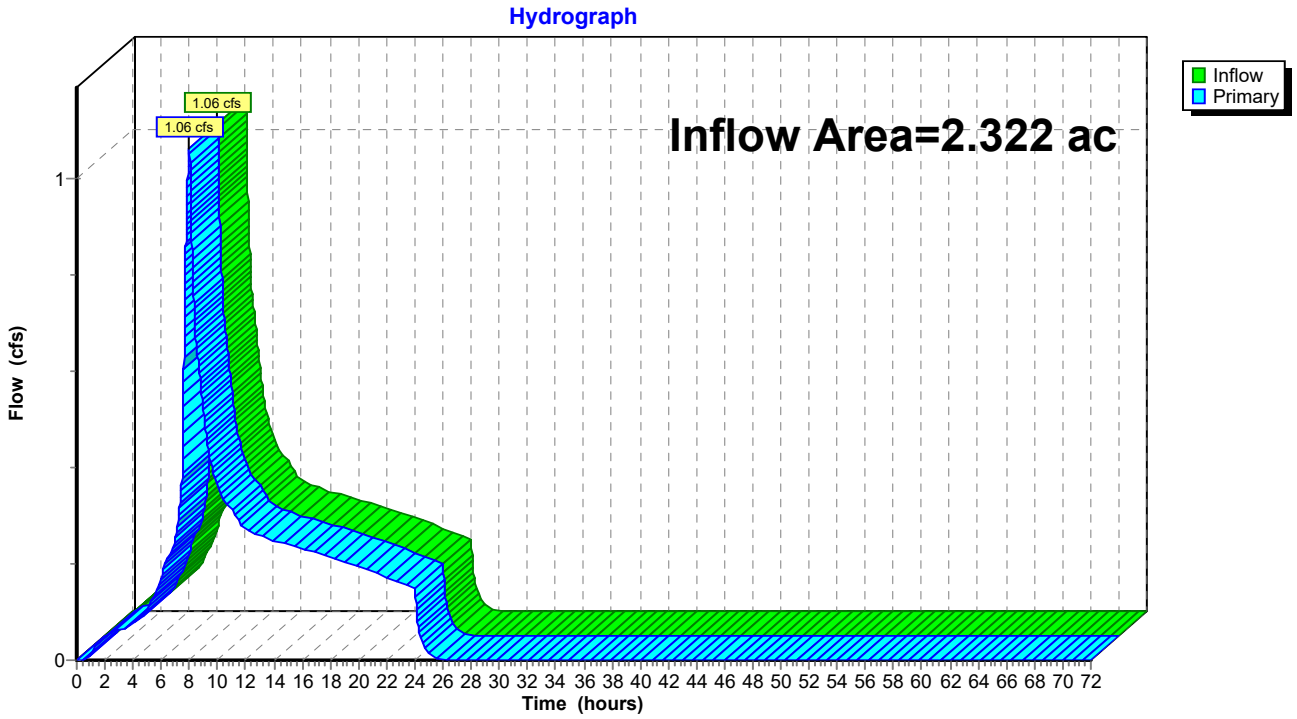


Summary for Link 2L: Flow Summary Part 2

Inflow Area = 2.322 ac, 26.71% Impervious, Inflow Depth = 2.36" for 25-YR event
Inflow = 1.06 cfs @ 8.00 hrs, Volume= 0.456 af
Primary = 1.06 cfs @ 8.00 hrs, Volume= 0.456 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs

Link 2L: Flow Summary Part 2



Appendix C: TR-55 Runoff Curve Numbers

Table 2-2a Runoff curve numbers for urban areas [1/]

Cover description: Cover type and hydrologic condition	Average percent impervious area [2/]	Curve numbers for hydrologic soil group: A	B	C	D
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc.) [3/]:					
Poor condition (grass cover < 50%)		68	79	86	89
Fair condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover > 75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of-way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only) [4/]		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1- to 2-inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation) [5/]		77	86	91	94
Idle lands (CN's are determined using cover types similar to those in table 2-2c).					

[1] Average runoff condition, and $I_a = 0.2S$.

[2] The average percent impervious area shown was used to develop the composite CN's. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition. CN's for other combinations of conditions may be computed using figure 2-3 or 2-4.

[3] CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.

[4] Composite CN's for natural desert landscaping should be computed using figures 2-3 or 2-4 based on the impervious area percentage (CN = 98) and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.

[5] Composite CN's to use for the design of temporary measures during grading and construction should be computed using figure 2-3 or 2-4 based on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

Appendix D: USDA-NRCS Soil Resource Report

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 Washington County, Oregon

JBMac Ventures

June 14, 2022

Preface

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

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

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

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

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

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

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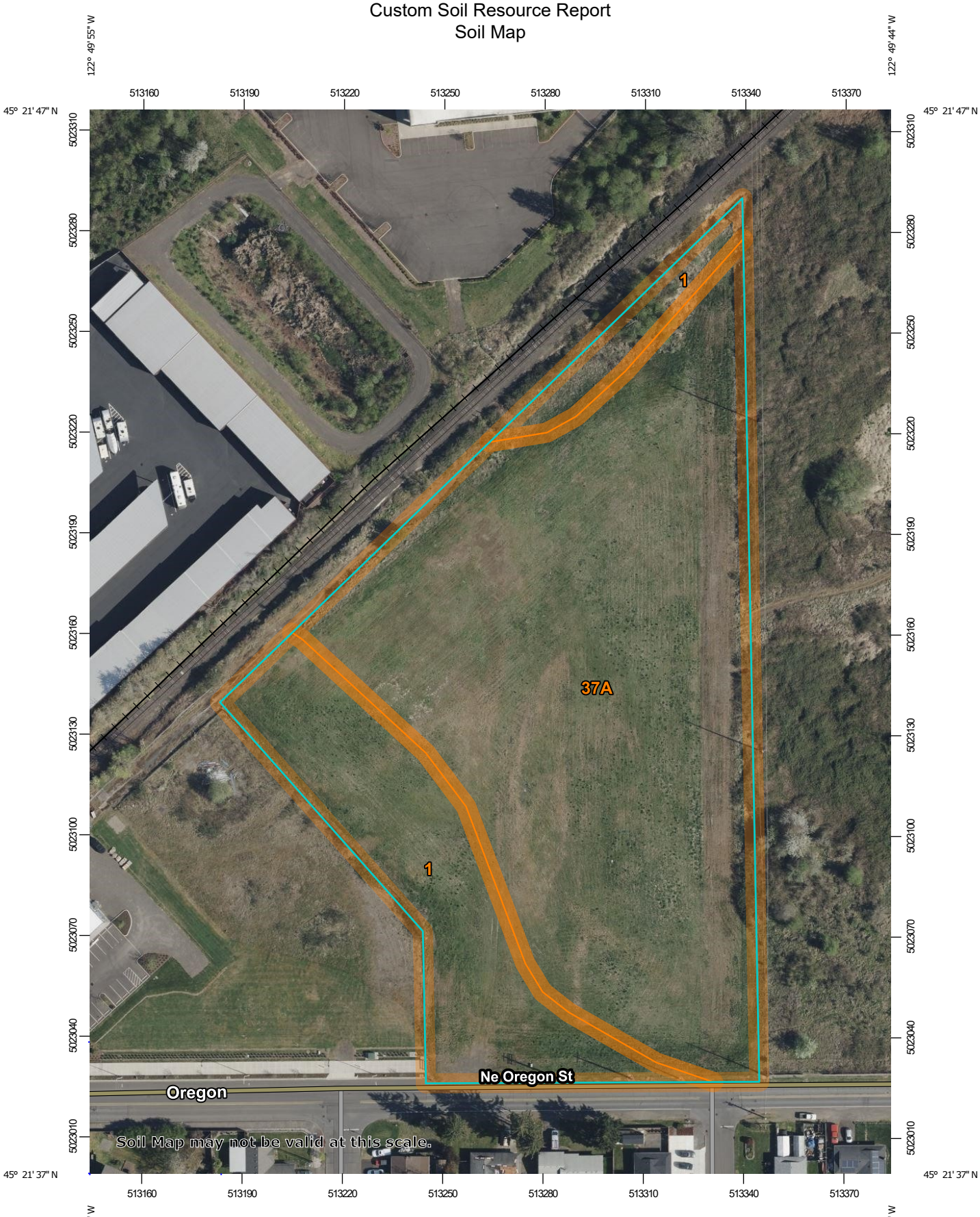
Contents

Soil Map

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

Custom Soil Resource Report
Soil Map



Map Scale: 1:1,540 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 20 40 80 120

Feet
0 50 100 200 300

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

MAP LEGEND

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

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

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

Water Features
- Streams and Canals

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

Background
- Aerial Photography

MAP INFORMATION

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

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

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

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

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

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

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

Soil Survey Area: Washington County, Oregon
Survey Area Data: Version 21, Oct 27, 2021

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

Date(s) aerial images were photographed: Apr 16, 2021—Apr 18, 2021

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
1	Aloha silt loam	1.6	25.4%
37A	Quatama loam, 0 to 3 percent slopes	4.7	74.6%
Totals for Area of Interest		**6.3**	**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.

Washington County, Oregon

1—Aloha silt loam

Map Unit Setting

National map unit symbol: 21x8
Elevation: 150 to 250 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 160 to 210 days
Farmland classification: Prime farmland if drained

Map Unit Composition

Aloha and similar soils: 90 percent
Minor components: 1 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Aloha

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Old loamy alluvium

Typical profile

H1 - 0 to 8 inches: silt loam
H2 - 8 to 46 inches: silt loam
H3 - 46 to 65 inches: silt loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Somewhat poorly drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 18 to 24 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: High (about 11.8 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C/D
Ecological site: R002XC007OR - Valley Swale Group
Forage suitability group: Somewhat Poorly Drained (G002XY005OR)
Other vegetative classification: Somewhat Poorly Drained (G002XY005OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 1 percent
Landform: Terraces

Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

37A—Quatama loam, 0 to 3 percent slopes

Map Unit Setting

National map unit symbol: 21zl
Elevation: 140 to 250 feet
Mean annual precipitation: 40 to 50 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 165 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Quatama and similar soils: 85 percent
Minor components: 4 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Quatama

Setting

Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Loamy alluvium

Typical profile

H1 - 0 to 15 inches: loam
H2 - 15 to 30 inches: clay loam
H3 - 30 to 62 inches: loam

Properties and qualities

Slope: 0 to 3 percent
Depth to restrictive feature: More than 80 inches
Drainage class: Moderately well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: About 24 to 36 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Moderate (about 8.8 inches)

Interpretive groups

Land capability classification (irrigated): 2w
Land capability classification (nonirrigated): 2w
Hydrologic Soil Group: C
Ecological site: R002XC008OR - Valley Terrace Group

Forage suitability group: Moderately Well Drained < 15% Slopes (G002XY004OR)
Other vegetative classification: Moderately Well Drained < 15% Slopes (G002XY004OR)
Hydric soil rating: No

Minor Components

Huberly

Percent of map unit: 4 percent
Landform: Terraces
Landform position (three-dimensional): Tread
Down-slope shape: Linear
Across-slope shape: Linear
Other vegetative classification: Poorly Drained (G002XY006OR)
Hydric soil rating: Yes

References

American Association of State Highway and Transportation Officials (AASHTO). 2004. Standard specifications for transportation materials and methods of sampling and testing. 24th edition.

American Society for Testing and Materials (ASTM). 2005. Standard classification of soils for engineering purposes. ASTM Standard D2487-00.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deep-water habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS-79/31.

Federal Register. July 13, 1994. Changes in hydric soils of the United States.

Federal Register. September 18, 2002. Hydric soils of the United States.

Hurt, G.W., and L.M. Vasilas, editors. Version 6.0, 2006. Field indicators of hydric soils in the United States.

National Research Council. 1995. Wetlands: Characteristics and boundaries.

Soil Survey Division Staff. 1993. Soil survey manual. Soil Conservation Service. U.S. Department of Agriculture Handbook 18. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_054262

Soil Survey Staff. 1999. Soil taxonomy: A basic system of soil classification for making and interpreting soil surveys. 2nd edition. Natural Resources Conservation Service, U.S. Department of Agriculture Handbook 436. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053577

Soil Survey Staff. 2010. Keys to soil taxonomy. 11th edition. U.S. Department of Agriculture, Natural Resources Conservation Service. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053580

Tiner, R.W., Jr. 1985. Wetlands of Delaware. U.S. Fish and Wildlife Service and Delaware Department of Natural Resources and Environmental Control, Wetlands Section.

United States Army Corps of Engineers, Environmental Laboratory. 1987. Corps of Engineers wetlands delineation manual. Waterways Experiment Station Technical Report Y-87-1.

United States Department of Agriculture, Natural Resources Conservation Service. National forestry manual. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/home/?cid=nrcs142p2_053374

United States Department of Agriculture, Natural Resources Conservation Service. National range and pasture handbook. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/landuse/rangepasture/?cid=stelprdb1043084

United States Department of Agriculture, Natural Resources Conservation Service. National soil survey handbook, title 430-VI. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/scientists/?cid=nrcs142p2_054242

United States Department of Agriculture, Natural Resources Conservation Service. 2006. Land resource regions and major land resource areas of the United States, the Caribbean, and the Pacific Basin. U.S. Department of Agriculture Handbook 296. http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/soils/?cid=nrcs142p2_053624

United States Department of Agriculture, Soil Conservation Service. 1961. Land capability classification. U.S. Department of Agriculture Handbook 210. http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_052290.pdf

Appendix E: Stormwater Quality Calculations

STORMWATER QUALITY CALCULATIONS

AKS ENGINEERING & FORESTRY, LLC | 12965 SW Herman Rd, Suite 100 | Tualatin, OR 97062
p: 503.563.6151 | f: 503.563.6152 | www.aks-eng.com

PROJECT
JBMac Ventures

AKS JOB NO.
8627-03 and 8627-04

DATE
6/14/2022

PREPARED FOR:
JBMac Ventures, LLC

ADDRESS
19435 SW 129th Ave

CITY/STATE/ZIP
Tualatin, OR 97062

PROJECT MANAGER:
BGC

PREPARED BY:
APC

REVIEWED BY:
BGC

IMPERVIOUS AREA TABLE		
SUBCATCHMENT		NET CHANGE (sq ft)
Existing 1-E (sf)	PROPOSED 1-iP (sf)	
0.00	**133,720**	133,720.00
***TOTAL**	133,720.00	

Note:
*Runoff generated on impervious area to be treated by new pond.

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SUBCATCHMENT 1-Ip

IMPERVIOUS AREA USED IN DESIGN
Per CWS 4.05.5 - R&O 07-20

133,720 square feet

WATER QUALITY VOLUME (WQV)
Per CWS 4.05.6b - R&O 07-20

WQV = 0.36 in. X Area (sq ft.) / 12 in. per ft. =

4012 cubic feet

WATER QUALITY FLOW (WQF)
Per CWS 4.05.6b - R&O 07-20

WQF = WQV (sf) / 14,400 seconds =

0.28 cubic feet per second

WATER QUALITY MANHOLE SUMP VOLUME CALCULATIONS
Per CWS 4.06.1b - R&O 07-20

CWS Criteria: Sump Volume = 20 cubic feet per 1.0 cfs of flow

Calculated 25-year Flow through WQ Manhole = **3.2** cubic feet per second

Calculated Manhole Sump Volume = **64.0** cubic feet

Calculated Manhole Sump Depth (60" dia. MH) = **3.3** feet **therefore sump = 3.3 ft.**

3 ft. minimum < Sump Depth < 5 ft. maximum

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EXTENDED DRY BASIN WATER QUALITY FLOW DESIGN AND CALCULATIONS

Hydraulic Design Criteria (Per CWS 4.06.3 - R&O 07-20)

Design Flow: Water Quality Flow

Water Quality Drawdown Time: 48 hours

Maximum Water Design Depth: 4.0 feet

Minimum Freeboard: 1.0 foot (for facilities not protected from high flows)

48-HOUR WATER QUALITY DRAW DOWN RATE (Q):

Water Quality Volume Pond Depth = **1.50** feet

$Q = \frac{\text{WQV (sf)}}{172{,}800 \text{ seconds}} =$ **0.023** cubic feet per second

ORIFICE SIZING

Diameter of Orifice

$$D = 24 \times \left[\frac{Q/(C[2gH]^{0.5})}{\pi}\right]^{0.5} =$$ **0.92** inches

ORIFICE SIZING ASSUMPTIONS:

Q	C	g	H*
(cfs)		(ft/s^2)	(ft)
0.023	0.62	32.2	1.0

Note:
* H is 2/3 of the temporary detention height to centerline of orifice

POND ELEVATIONS:

Top of Pond =	172.20	feet
Top of WQV Storage =	168.25	feet
Top of Dead Storage =	166.75	feet
Centerline of Orifice Elevation =	166.75	feet

25-YEAR STORM EVENT:

Peak Flow Elevation =	171.20	feet
Freeboard depth =	**1.00**	foot
Ponding depth =	4.45	feet
Total Pond Depth =	**5.45**	feet

STORMWATER QUALITY CALCULATIONS

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EXTENDED DRY BASIN VOLUME

Contour Elevation (Feet)	Contour Area (SF)	Average Area (SF)	Contour Interval (Feet)	Incremental Volume (CF)	Cumulative Volume (CF)	
166.75	2,138			0	0	
		2,224	0.25			
167.00	2,309			556	556	
		2,684	1.00			
168.00	3,059			2,684	3,240	
		3,161	0.25			
168.25	3,263			790	4,030	Top of WQV
		3,588	0.75			
169.00	3,912			2,691	6,721	
		4,372	1.00			
170.00	4,832			4,372	11,093	
		5,321	1.00			
171.00	5,809			5,321	16,414	
		6,433	1.20			
172.20	7,056			7,720	24,134	

171.2

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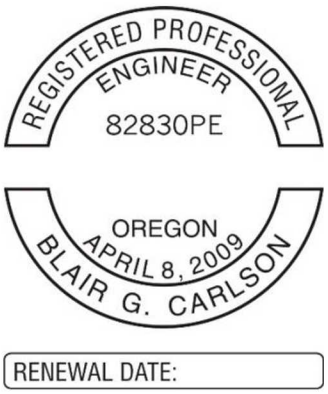

Date: 7/28/2022
To: Eric Rutledge, City of Sherwood
From: Blair Carlson
Project Name: JBMac Ventures – Oregon Street
AKS Job No.: **8627-03/04**
Subject: **Stormwater Routing and Standards**

Eric –

Per our correspondence to date and following up on the discussion from our coordination meeting on July 12th, 2022, we wanted to provide some additional clarification into our plan for stormwater routing, our understanding of Clean Water Services rules and design requirements, and the results of our additional field investigations.

There will be no change to the existing flow pattern, path, level of concentration, or volumes of discharge during the design storm events, and the route of stormwater downslope from the outfall of our private system at no point enters the Rail right-of-way. The proposed flow path is through the existing drainage path from the subject property and along the northern edge of the adjacent parcel to eventually enter Rock Creek as it does under existing conditions. This was verified through field survey to tie to the rail right-of-way using the available survey records of said rail right-of-way.

Further guidance regarding maintaining historic flow patterns is provided through the Clean Water Services Design and Construction Manual (DCM), Oregon Department of Transportation Hydraulics Manual, and Washington County Grading ordinance as referenced below:

- The project is required to maintain the existing flow path in the basin per CWS DCM 4.04.4(c.) and CWS DCM 5.05.5(a.)
    - 5.05.5(a.): *Developments shall not materially increase or concentrate runoff onto adjacent properties, except when the runoff is contained in an existing drainage way.*
    - 4.04.4(c.): *Discharges to sensitive areas shall maintain the hydro period and flows of pre-development site conditions to the extent necessary to protect the characteristic functions of the sensitive area. Conversely, discharge of flows that may be critical to downstream water quality sensitive areas into other catchments will not be permitted unless addressed in the applicant's Service Provider Letter.*

- The project is required to install and maintain a Private Stormwater Facility, not a Public Stormwater Facility as the stormwater facility only serves a single property, Taxlot 500 (CWS DCM 4.07.7(d.))
    - A Public Stormwater Facility would technically require approval of a variance from the City/CWS.

- The projects proposed outfall plan is technically defined as sheet flow by CWS at the outlet structure (CWS ESC Detail 825, as required by CWS DCM 5.05.6)

- As the outfall is entirely located on the JBMac property and provides sheet flow from the outfall to the existing drainage path, all conditions will be met as required.

- The DCM references the ODOT Hydraulics Manual as the guidance to follow regarding stormwater outfall design, so the Oregon Drainage Law reference becomes a direct citation through CWS rules (CWS DCM 5.07.7).
  - This is the excerpt from the ODOT Hydraulics Manual that provides an overview and explanation of Oregon Drainage Law as it pertains to this item. (https://www.oregon.gov/odot/GeoEnvironmental/Docs_Hydraulics_Manual/Hydraulics-02.pdf).

2.2 Oregon Drainage Law

Oregon drainage law, which originates from common law or case law, has developed without legislative action, and it is embodied in the decisions of the courts. Therefore, there are no Oregon Revised Statues to cite pertaining to Oregon drainage law.

Oregon has adopted the civil law doctrine of drainage. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water that naturally comes to his land from above, but he is entitled to not have the normal drainage changed or substantially increased. The lower landowner may not obstruct the runoff from the upper land if the upper landowner is properly discharging the water.

For a landowner to drain water onto lands of another in the State of Oregon, one of two conditions must be satisfied initially: (1) the lands must contain a natural drainage course; or, (2) the landowner must have acquired the right of drainage supported by valuable consideration (i.e. a purchased drainage easement). In addition, because Oregon has adopted the civil law doctrine of drainage, the following three basic elements must be followed.

1. A landowner may not divert water onto adjoining land that would not otherwise have flowed there. “Divert water” includes but is not necessarily limited to:
   a. water diverted from one drainage area to another, and,
   b. water collected and discharged which normally would infiltrate into the ground, pond, and/or evaporate.
2. The upper landowner may not change the place where the water flows onto the lower owner’s land. (Most of the diversions not in compliance with this element result from grading and paving work and/or improvements to water collection systems.)
3. The upper landowner may not accumulate a large quantity of water, then release it, greatly accelerating the flow onto the lower owner’s land. This does not mean that the upper landowner cannot accelerate the water at all; experience has found the drainage to be improper only when the acceleration and concentration were substantially increased.

- Washington County does have a drainage component to their Grading Ordinance (689) that governs how drainage should be handled between properties in these situations in unincorporated areas of Washington County. (https://www.co.washington.or.us/LUT/Divisions/Building/Forms/Grading/upload/Grading-Ordinance-No-689-adopted-May-2008x.pdf). While that does not technically apply inside the City of Sherwood, it provides additional context for our approach since it conforms to County requirements as well.

> **14.12.310 Drainage facilities and terraces**
>
> A. Drainage Analysis Report: Site specific drainage analysis report shall be submitted to substantiate that:
>
> 1. The proposed grading work shall preserve the existing site natural drainage channel characteristics (via sheet flow or concentrated flow) and its surrounding adjacent properties in quantity, quality, and flow rate. When changes are made, the design shall preserve the quantity, quality, the flow rate and the pattern of flow that leaves the proposed work site to the adjacent surrounding properties at predevelopment level.

Based on the standards referenced above, the proposed stormwater design accounts for the following:

- Not concentrating flow beyond the level that it concentrates under existing conditions.
- Providing water quality treatment per CWS standards.
- The proposed stormwater outfall is located on our property and leaves the property through the existing flow path, perpetuating the current condition and not entering onto rail property downstream of our site.
- The project is matching the rate of existing discharge (predevelopment per CWS standards) in our proposed stormwater design.
- Washington County defines “natural drainage” as both sheet flow and concentrated flow under the existing conditions, so the fact that the drainage path downslope of our outfall is a combination of ditches and overland sheet flow downslope of our outfall does not change the rules under which it is evaluated.

Based on this information and additional field verification, an easement is not required under Clean Water Services rules, Oregon Drainage Law, or Washington County Rules as there is no change to predevelopment/existing conditions. As the drainage path **does not enter** the rail right-of-way, the rail company cannot give an easement or permission for something that is not on their property, so no further action is needed on this subject and it should be considered closed.