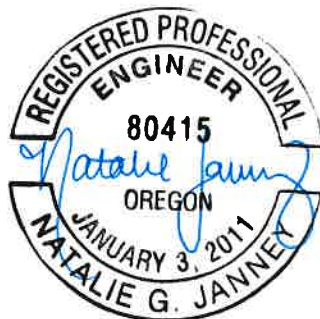


**PRELIMINARY DRAINAGE ANALYSIS
FOR**

**Baxter Apartments
Salem, Oregon**

*December 20, 2024
Revised February 3, 2025*



Renew date: 6.30.2025



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INTRODUCTION

The Baxter Apartments is a 135 unit multi-family development project located at 1709 Baxter Road. The parcel of land to be developed includes Tax Lot 200 and 100 of Marion County Assessor's Map 08 3W 14BD. The project site area is approximately 7.47 acres in size. The property is bound by Baxter Road to the south, with Abbie Ave, Mac Street, and Snowflake Ave all stubbing to the property boundaries on the west and east. An aerial image can be seen below, with the approximate project area outlined in **ORANGE**.



Figure 1: Project Site

Green Stormwater Infrastructure (GSI) to the Maximum Extent Feasible (MEF) will be used for the new developed areas per City of Salem Administrative Rules, Chapter 109, Division 004, Stormwater System, (Standards). All facilities will be constructed to meet the City of Salem standards.

EXISTING CONDITIONS

The portion of the property to be developed is roughly square in shape. The property is bound by Baxter Road to the south. Surface conditions consist of lawn, with the property having one residential home and three additional out-buildings. The topographical high point of the property is at the approximate location

of the residential home, with the property sloping away in all directions. The average slope across the property ranges from 3 to 6%. There are no offsite properties draining to or through the subject property.

Given the topography, this property drains to two different drainage basins. The majority of the property drains to the east, with a smaller portion draining to the west. The attached Existing Conditions map shows the area that drains to the west, measuring to be 84,918 square feet. This design considers the development of the multi-family project as well as the accompanying public improvements. For this reason, the area used for the total site in this analysis is 7.47 acres (325,321 square feet). The portion draining to the west is approximately 5.52 acres (240,403 square feet).

There are some existing trees on the property. The majority of the significant trees are in the location of proposed public improvements and will need to be removed.

Time of concentration was calculated separately for the property draining to the east and the west. The worksheets can be found in Appendix C.

Table 1: Pre-developed Drainage Basin Summary

Basin	Contributing Area (ft ²)			CN	Tc (min)
	Impervious CN = 98	Pervious CN = 74	Predeveloped CN = 72		
West			89,092	72	28.12
East			244,577	72	30.55

SOILS

The preliminary soils information was obtained from the National Resource Conservation Services Web Soil Survey. The soil map and accompanying information can be found in Appendix B. The soils on the site consists of Nekia Silty Clay which is classified as hydrologic soil group C. As required by the City of Salem Stormwater Standards, the existing conditions curve number of HSG C of 72 is used for the analysis.

A geotechnical investigation has not been formalized at this time. For the purposes of preliminary design, it will be assumed that the soil does not allow for infiltration. As such, the facility will not include an output for natural infiltration and the sizing of the facility will be conservative. An percolation test will be conducted and used for the final design.

DEVELOPED CONDITIONS

The multi-family project will consist of 135 living units, varying from 1 bedroom/1 bathroom units to 3 bedroom/2 bathroom units. Additional structures included in the project are a recreation building, pavilion, covered mail area, and a pump house. Motor vehicle and bicycle parking are proposed as well.

The development of the site also includes the construction of Snowline Street around the project as well as constructing cul-de-sac bulbs for Abbie Ave and Snowball Ave.

The table below summarizes the impervious and pervious surface totals. For this analysis, a curve number of 98 is used for the impervious surfaces and a curve number of 74 is used for the pervious surfaces, which consist of landscaping. A time of concentration of 5 was used for both basins.

Table 2: Developed Drainage Basin Summary

Basin	Contributing Area (ft ²)			CN	Tc (min)
	Impervious CN = 98	Pervious CN = 74	TOTAL		
West	34203	22795	56998	88	5
East	178796	91198	269994	90	5

The total area draining to the west does not equal the predeveloped area draining to the west. This will be discussed in the next section but is a function of grading the total site for accessibility.

EXPLANATION OF DESIGN

The propose site straddles two drainage basins, with a portion draining to the west while the majority drains to the east. The proposed design takes a portion of the proposed project to a facility located in the southwest corner of the property to be treated, detained and outlet to the west. Areas draining to the west include Buildings B, C, D, E, H, I, and M, the walkways in front of Building D, and the landscaped area surrounding Buildings C, D, and E. The remaining portion of the property will be routed to a stormwater facility located east of Snowline Street.

The culs-de-sac will be routed to the public system located east of Snowline Street (the east facility). This is done to keep all of the publicly generated stormwater together and routed to a public system. Routing the culs-de-sac to the west basin would require the west basin to also be a publicly maintained facility. By routing the runoff to the east facility, only one facility will need to be maintained by the public.

Because the proposed design is rerouting runoff that historically flows to the west to a different drainage basin, the east facility will be oversized to ensure the flowrate out does not exceed the predeveloped rate for the east basin. While more area will be draining to the east in the developed condition than in the predeveloped condition, the flowrate will not exceed the predeveloped flowrate.

The east facility will be designed for this project, including the construction of Snowline Street. Plans for the development of the remaining property are not known at this time. Because of this, the facility is design for this project only. However, the facility could be expanded with a new flow control structure in the future to be used for future development.

Both the east and west facilities will be designed as combination facilities, with the treatment of the stormwater being achieved through the filtration through the growing media. The facilities will use above ground detention and a flow control structure to restrict the flow to less than or equal to the predeveloped rate for each basin.

STORMWATER ANALYSIS

Stormwater analysis was conducted using HydroCAD 10.20 and the Santa Barbara Unit Hydrograph. This analysis considers the water quality event as well as controlling the ½ the 2, 10, 25, and 100 year storm events to their predeveloped rates. Based on the region, these storms are modeled with the NRCS Type 1A rainfall distribution. The precipitation depths listed in the table below come from the City of Salem Stormwater Design Standards.

Table 3: City of Salem 24-hour Rainfall Depths (in)

Storm Event	24-hour Rainfall Depth (in)
Water Quality	1.38
1/2 - 2 year	1.1
10 year	3.2
25 year	3.6
100 year	4.4

Analysis was done for the west and east basins independently. The flow from each facility is designed to not exceed the predeveloped rate. Because infiltration is not considered in the preliminary design and to provide the most conservative preliminary design, storage is only considered above the growing media.

The table below shows the predeveloped flowrates calculated for both the west and east basins. Please note that these values are based on only the area impacted by this project. This means that the area of property left undeveloped has not been included in any of the analysis and is not artificially inflating the allowable runoff rate.

Table 4: Allowable Predeveloped Flowrate (cfs)

Storm Event	Basin	
	West	East
1/2 - 2 year	0.006	0.018
10 year	0.207	0.551
25 year	0.299	0.794
100 year	0.509	1.350

WATER QUALITY ANALYSIS

For the analysis of the water quality storm, treatment is assumed to be achieved to the City of Salem standards once the water infiltrates through the growing media. The infiltration rate through the growing media is assumed to be 2 inches per hour.

The west facility is modeled in the preliminary phase as a rain garden with a bottom surface area of 1,300 square feet, with the growing media at an elevation of 502.00. The top of the facility is set at elevation 505.00 with a square footage of 4,300 square feet. The east facility is modeled in the preliminary phase as a combination facility with a bottom surface area of 10,061 square feet, with the growing media at an elevation of 482.00. The top of the facility is set at an elevation of 486.00 with a surface area of 19,148 square feet. These elevations are preliminary and subject to change during the final design phase. It is likely that the east facility will require retaining walls due to the topography sloping down in this area. The west facility will likely need some retaining walls as well for the same reason. The slope in both of these areas exceeds 5% for the west and 8% to the east. These are the low points in both directions.

Both the East and West facility are modeled ensuring that the top elevation fits on the sit with the required setbacks. Exact grading around the facility will be determined with the final design phase.

The table below gives a summary of the proposed facilities and the water depth modeled.

Table 5: Water Quality Summary

Basin	Facility Bottom Size (ft ²)	Growing Media Elevation	WQ Water Depth (feet)
West	1300	502.00	0.28
East	10061	482.00	0.28

Both facilities are able to treat the stormwater through the growing media.

WATER QUANTITY ANALYSIS

The west and east facilities are both design to detain the stormwater to the predeveloped rate for each basin. The east facility is designed for only the runoff generated from this project. The table below summarizes the facilities.

Table 6: Flow Control Summary

		Storm Event	Predeveloped Flowrate (cfs)	Orifice #	Orifice Diameter	Orifice Elevation	Developed Flowrate (cfs)	Water Depth (ft)
Basin	West	1/2 - 2 year	0.006	1	0.3	502.00	0.003	1.24
		10 year	0.207	2	4.5	504.00	0.122	2.23
		25 year	0.299	2	4.5	504.00	0.163	2.28
		100 year	0.509	2	4.5	504.00	0.259	2.42
	East	1/2 - 2 year	0.018	1	0.3	482.00	0.003	1.19
		10 year	0.551	2	8	485.00	0.340	3.33
		25 year	0.794	2	8	485.00	0.474	3.40
		100 year	1.350	2	8	485.00	0.722	3.52

The maximum water depth for both facilities is less than 4 feet. The flows are able to be controlled to at or below the predeveloped flowrates for each basin. The east basin overdetains to allow for some of the area that historically drains to the west to flow to the east, without increasing the overall flowrate into the east basin.

OPERATION AND MAINTENANCE

The East facility would include public stormwater and therefore would be the responsibility of the City of Salem to maintain. The facility will be placed in easements for the City to access for maintenance. In the future, the east facility could be placed on its own parcel, but that is not proposed at this time, since the facility may be used in the future for additional stormwater and may need to get larger.

The West facility will include stormwater generated from private property only. For this reason, the west facility will be privately owned and maintained. Operations and maintenance forms have been included in Appendix CC. It will be the responsibility of the property owner to maintain the stormwater facility.

CONCLUSIONS

This report demonstrates a preliminary feasibility for the Compass Point Apartments. Additional design work will need to be done during the final design phase in order to more fully comply with the City of Salem Design Standards. This will likely include acquiring design exceptions for the retaining walls that will likely be needed in the stormwater facilities and for redirecting some of the flow from the west basin to the east. If there are any questions, please contact Natalie Janney at NJanney@mtengineering.net.



APPENDIX A: MAPS

08 3W 14BD

08 3W 14BD
SALEM



MARION COUNTY, OREGON
SE1/4 NW1/4 SEC14 T8S R3W W.M.
SCALE 1" = 100'

LEGEND

- LINE TYPES
- | | |
|--------------------------|-----------------------|
| Taxlot Boundary | Historical Boundary |
| Road Right-of-Way | Easement |
| Railroad Right-of-Way | Railroad Centerline |
| Private Road ROW | Taxcode Line |
| Subdivision/Plat Bndry | Map Boundary |
| Waterline - Taxlot Bndry | Waterline - Non Bndry |

- CORNER TYPES
- | | |
|-----------------------|-----------------------------------|
| + 1/16TH Section Cor. | 1/4 Section Cor. |
| ⊙ DLC Corner | 16, 15
Section Corner
21 22 |

NUMBERS
Tax Code Number
00 00 0

Acreage 0.25 AC All acres listed are Net Acres, excluding any portions of the taxlot within public ROW's

NOTES
Tick Marks: A tick mark in the road indicates that the labeled dimension extends into the public ROW

175.00 200.00

CANCELLED NUMBERS			
300			
400			
500			
601			
801			

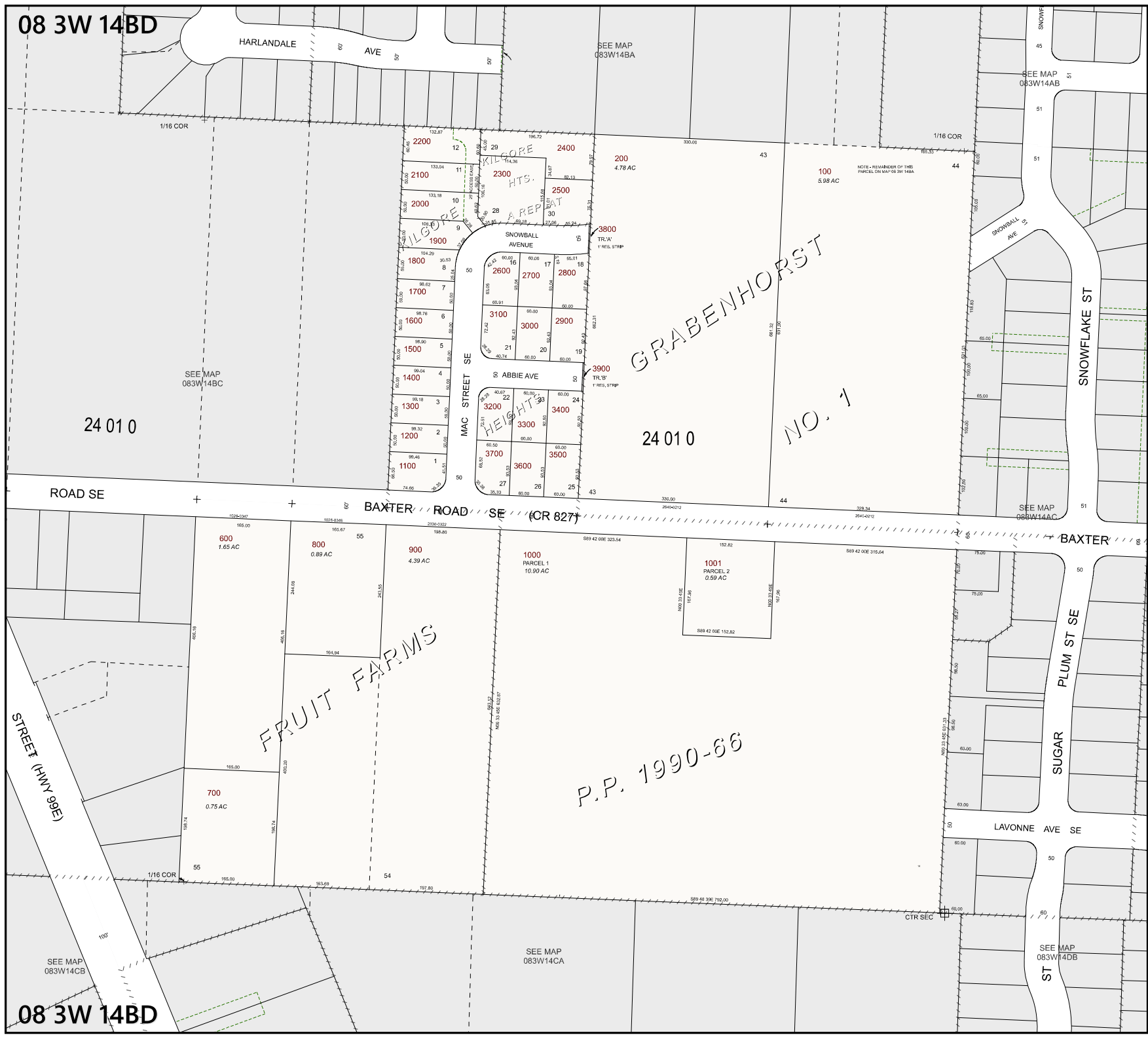
DISCLAIMER: THIS MAP WAS PREPARED FOR ASSESSMENT PURPOSES ONLY



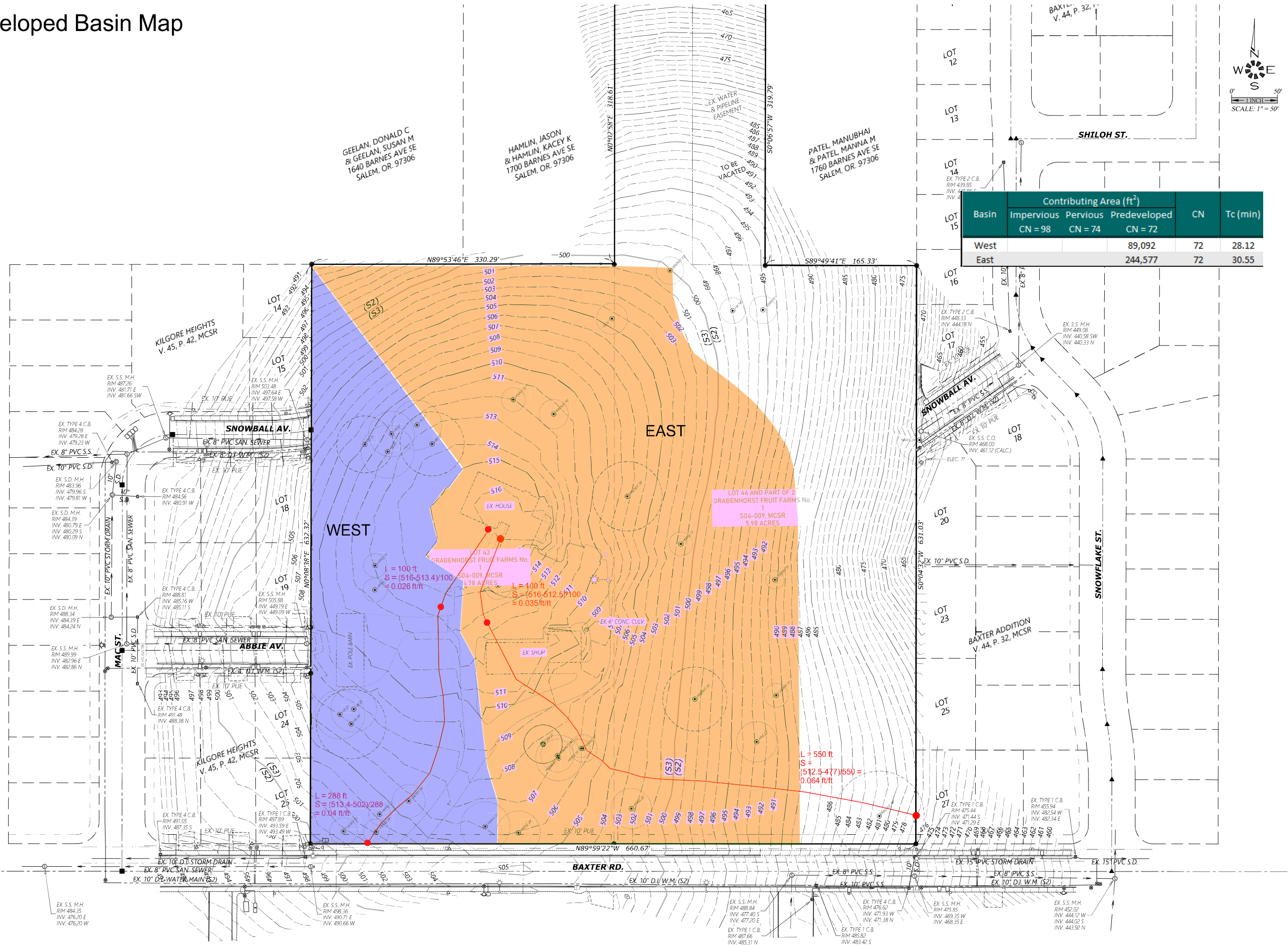
FOR ADDITIONAL MAPS VISIT OUR WEBSITE AT www.co.marion.or.us

PLOT DATE: 10/16/2020

SALEM
08 3W 14BD



Pre-developed Basin Map



Basin	Contributing Area (ft²)			CN	Tc (min)
	Impervious CN = 98	Pervious CN = 74	Predeveloped CN = 72		
West			89,092	72	28.12
East			244,577	72	30.55

MULTI/TECH

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EXISTING
CONDITIONS
PLAN

COMPASS POINTS
MULTI-FAMILY HOUSING

NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE WITHOUT WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.
DIMENSIONS & NOTES TAKE
PRECEDENCE OVER
GRAPHICAL REPRESENTATION.

Design:	M.D.G.
Drawn:	J.P.H.
Checked:	B.M.G.
Issue Date:	9/13/24
Scale:	AS SHOWN
As-Built:	----



EXPIRES: 06-30-2025

JOB # 7707

SDR2

IE HEIGHTS
P. 42, MCSR

EXISTING TREES AFFECTED BY APARTMENT DEVELOPMENT

⊙ = EXISTING TREE TO REMAIN

⊗ = EXISTING TREE TO BE REMOVED

⊛ = EXISTING OAK TREE 20" + DIA. TO REMAIN

⊘ = EXISTING OAK TREE 20" + DIA. TO BE REMOVED

		Storm Event	Predeveloped Flowrate (cfs)	Orifice #	Orifice Diameter	Orifice Elevation	Developed Flowrate (cfs)	Water Depth (ft)
Basin	West	1/2 - 2 year	0.006	1	0.3	502.00	0.003	1.24
		10 year	0.207	2	4.5	504.00	0.122	2.23
		25 year	0.299	2	4.5	504.00	0.163	2.28
		100 year	0.509	2	4.5	504.00	0.259	2.42
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		25 year	0.794	2	8	485.00	0.474	3.40
		100 year	1.350	2	8	485.00	0.722	3.52



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BAXTER DEVELOPMENT

NO CHANGES, MODIFICATIONS
OR REPRODUCTIONS TO BE
MADE TO THESE DRAWINGS
WITHOUT WRITTEN
AUTHORIZATION FROM THE
DESIGN ENGINEER.

DIMENSIONS & NOTES TAKE
PRECEDENCE OVER
GRAPHICAL REPRESENTATION.

Design: M.D.G.
 Drawn: J.P.H.
 Checked: B.M.G.
 Issue Date: 1/30/25
 Scale: AS SHOWN

EXPIRES: 06-30-2025

JOB # 7707

SDR11



APPENDIX B: SOIL INFORMATION



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

Water Features

Streams and Canals

Transportation

Rails

Interstate Highways

US Routes

Major Roads

Local Roads

Background

Aerial Photography

Soil Area

Stony Spot

Very Stony Spot

Wet Spot

Other

Special Line Features

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: [Web Soil Survey](#)
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: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

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

Date(s) aerial images were photographed: May 17, 2023—Jun 3, 2023

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.

USDA
Natural Resources
Conservation Service

Web Soil Survey
National Cooperative Soil Survey

6/28/2024
Page 2 of 3

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
NeB	Nekia silty clay loam, 2 to 7 percent slopes	3.9	41.0%
NeC	Nekia silty clay loam, 7 to 12 percent slopes	5.7	59.0%
Totals for Area of Interest		9.6	100.0%

Marion County Area, Oregon

NeB—Nekia silty clay loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 24qt
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Nekia and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R002XC012OR - Red Hill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)

Other vegetative classification: Well drained < 15% Slopes
(G002XY002OR)
Hydric soil rating: No

Minor Components

Aquults

Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023

Marion County Area, Oregon

NeC—Nekia silty clay loam, 7 to 12 percent slopes

Map Unit Setting

National map unit symbol: 24qv
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nekia and similar soils: 86 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 7 to 12 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Drainage class: 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: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water supply, 0 to 60 inches: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Ecological site: R002XC012OR - Red Hill Group
Forage suitability group: Well drained < 15% Slopes (G002XY002OR)

Other vegetative classification: Well drained < 15% Slopes
(G002XY002OR)
Hydric soil rating: No

Minor Components

Aquults

Percent of map unit: 2 percent
Landform: Hills
Hydric soil rating: Yes

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 21, Sep 8, 2023



APPENDIX C: TIME OF CONCENTRATION

Worksheet 3: Time of Concentration (T_C) or travel time (T_t)

Project Compass Points Apartments	By N. Janney	Date 2/3/2025
Location Baxter Road, Salem, Oregon	Checked	Date

Check one: ☒ Present ☐ Developed

Check one: ☒ T_C ☐ T_t through subarea

Notes: Space for as many as two segments per flow type can be used for each worksheet.
Include a map, schematic, or description of flow segments.

Sheet flow (Applicable to runoff)

Segment ID	East	West
1. Surface description (table 3-1)	Pre-developed	Pre-developed
2. Manning's roughness coefficient, n (table 3-1)	0.30	0.30
3. Flow length, L (total L $\geq$ 300 ft) ft	100	100
4. Two-year 24-hour rainfall, P_2 in	2.2	2.2
5. Land slope, s ft/ft	0.035	0.026
6. $T_t = \frac{0.007 (nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_t hr	0.274	0.309

=

Shallow concentrated flow

Segment ID	East	West
7. Surface description (paved or unpaved)	Pre-developed	Pre-developed
8. Flow length, L ft	550	288
9. Watercourse slope, s ft/ft	0.0645	0.0395
10. Average velocity, V (figure 3-1) ft/s	0.65	0.5
11. $T_t = \frac{L}{3600 V}$ Compute T_t hr	0.235	0.16

=

Channel flow

Segment ID		
12. Cross sectional flow area, a ft ²		
13. Wetted perimeter, p_w ft		
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute r ft		
15. Channel slope, s ft/ft		
16. Manning's roughness coefficient, n		
17. $V = \frac{1.49 r^{2/3} s^{1/2}}{n}$ Compute V ft/s		
18. Flow length, L ft		
19. $T_t = \frac{L}{3600 V}$ Compute T_t hr		
20. Watershed or subarea T_C or T_t (add T_t in steps 6, 11, and 19) Hr		

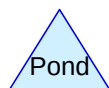
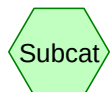
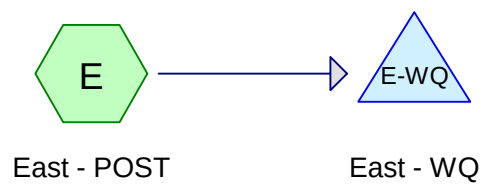
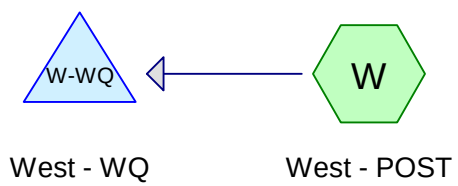
+

T(east) = 0.274 + 0.235 = 0.509 hours =
30.55 min

T(west) = 0.308 + 0.16 = 0.469 hours =
28.12 min



APPENDIX D: WATER QUALITY HYDROGRAPHS



Prelim Hydrographs 121424

Prepared by Multi/Tech Engineering Service

HydroCAD® 10.20-5c s/n 00948 © 2023 HydroCAD Software Solutions LLC

Type IA 24-hr Water Quality Rainfall=1.38"

Printed 2/3/2025

Page 2

Summary for Subcatchment E: East - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

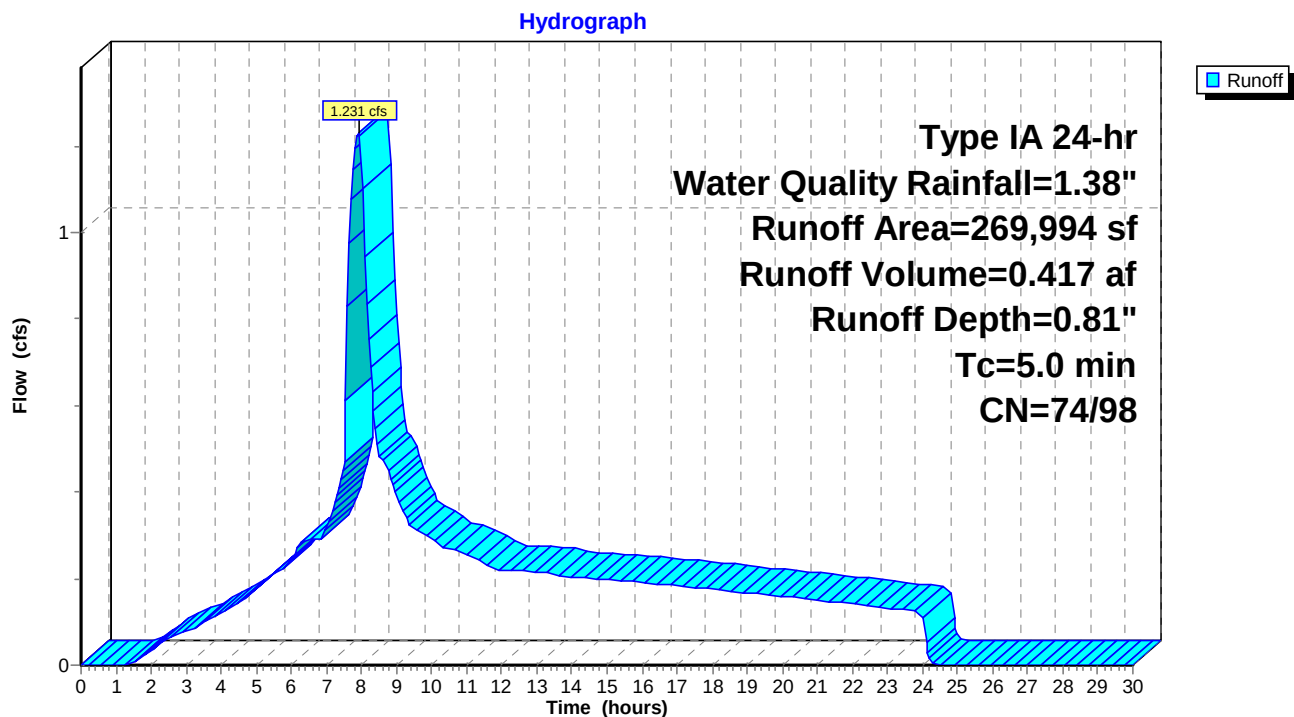
Runoff = 1.231 cfs @ 7.91 hrs, Volume= 0.417 af, Depth= 0.81"
Routed to Pond E-WQ : East - WQ

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr Water Quality Rainfall=1.38"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST



Prelim Hydrographs 121424

Type IA 24-hr Water Quality Rainfall=1.38"

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Summary for Pond E-WQ: East - WQ

[92] Warning: Device #2 is above defined storage

Inflow Area = 6.198 ac, 66.22% Impervious, Inflow Depth = 0.81" for Water Quality event
 Inflow = 1.231 cfs @ 7.91 hrs, Volume= 0.417 af
 Outflow = 0.495 cfs @ 8.48 hrs, Volume= 0.416 af, Atten= 60%, Lag= 34.1 min
 Discarded = 0.495 cfs @ 8.48 hrs, Volume= 0.416 af
 Primary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 482.28' @ 8.48 hrs Surf.Area= 10,687 sf Storage= 2,857 cf

Plug-Flow detention time= 76.6 min calculated for 0.416 af (100% of inflow)
 Center-of-Mass det. time= 76.7 min (790.1 - 713.4)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	58,418 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	10,061	0	0
486.00	19,148	58,418	58,418

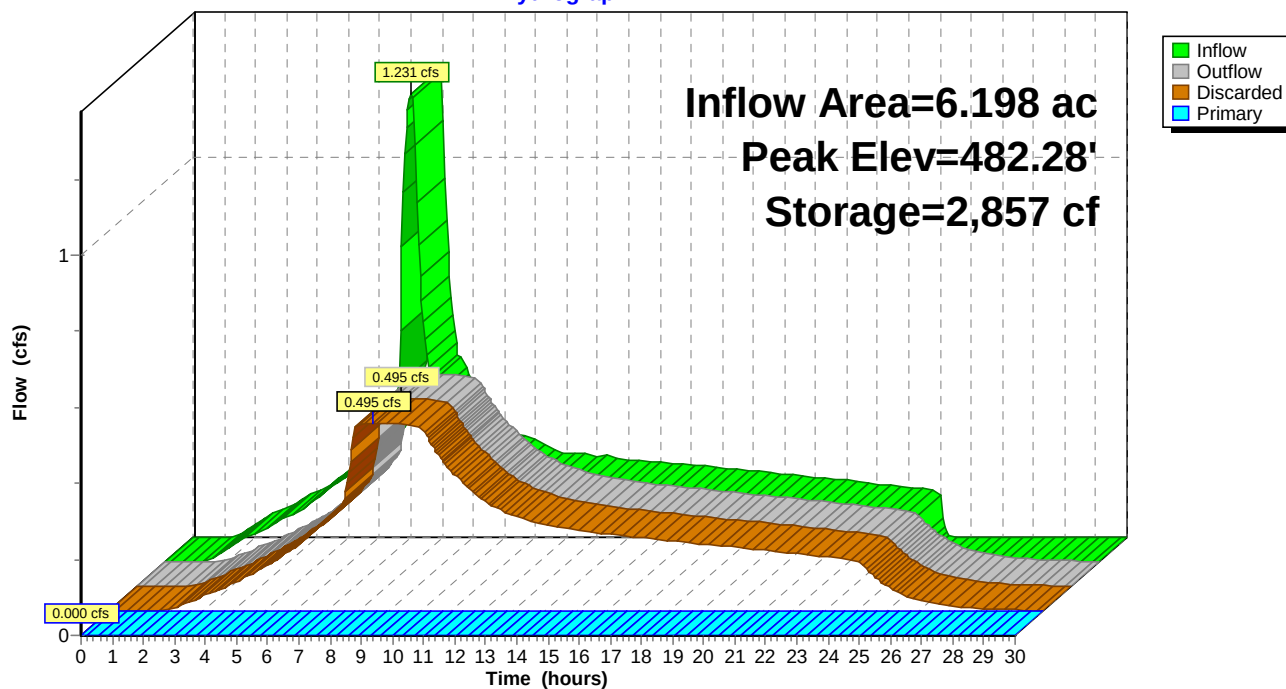
Device	Routing	Invert	Outlet Devices
#1	Discarded	482.00'	2.000 in/hr Exfiltration over Surface area
#2	Primary	503.00'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.495 cfs @ 8.48 hrs HW=482.28' (Free Discharge)
 ↑ **1=Exfiltration** (Exfiltration Controls 0.495 cfs)

Primary OutFlow Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)
 ↑ **2=Orifice/Grate** (Controls 0.000 cfs)

Pond E-WQ: East - WQ

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr Water Quality Rainfall=1.38"

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Page 3

Summary for Subcatchment W: West - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.224 cfs @ 7.91 hrs, Volume= 0.079 af, Depth= 0.72"
Routed to Pond W-WQ : West - WQ

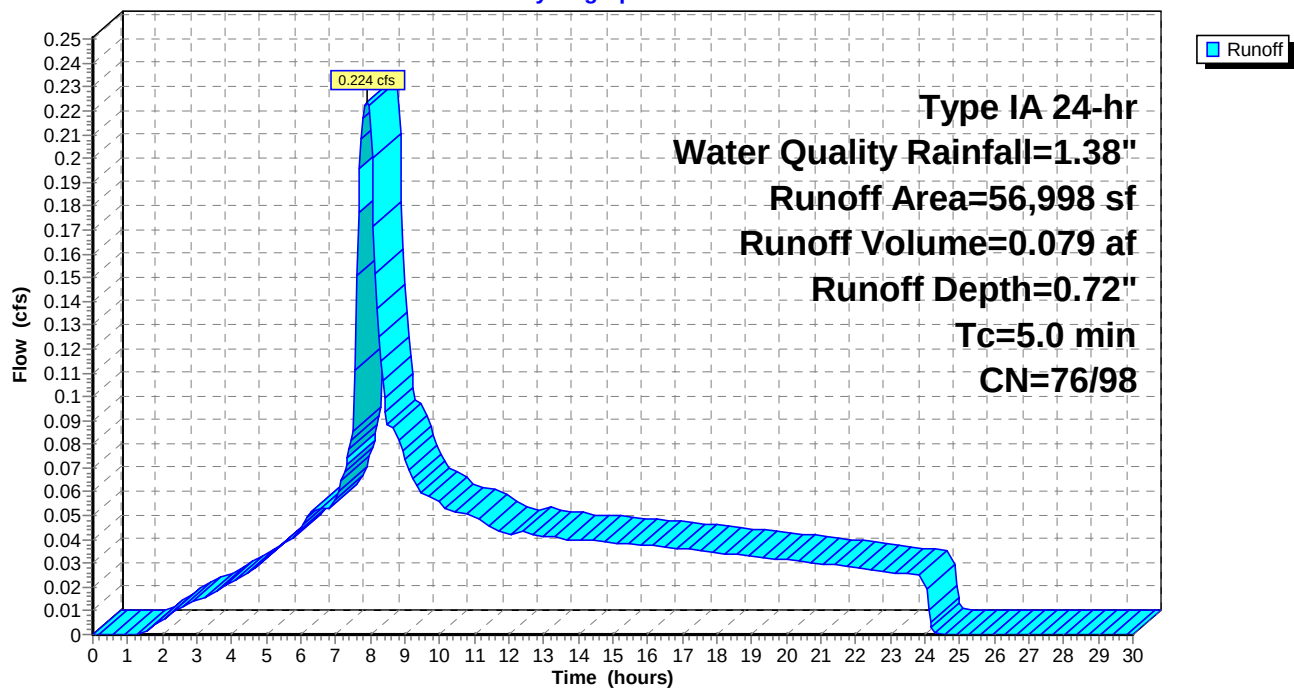
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr Water Quality Rainfall=1.38"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph



Prelim Hydrographs 121424

Type IA 24-hr Water Quality Rainfall=1.38"

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Summary for Pond W-WQ: West - WQ

Inflow Area = 1.308 ac, 57.08% Impervious, Inflow Depth = 0.72" for Water Quality event
 Inflow = 0.224 cfs @ 7.91 hrs, Volume= 0.079 af
 Outflow = 0.073 cfs @ 9.02 hrs, Volume= 0.079 af, Atten= 67%, Lag= 66.8 min
 Discarded = 0.073 cfs @ 9.02 hrs, Volume= 0.079 af
 Primary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 502.28' @ 9.02 hrs Surf.Area= 1,583 sf Storage= 408 cf

Plug-Flow detention time= 35.2 min calculated for 0.079 af (100% of inflow)
 Center-of-Mass det. time= 35.1 min (759.3 - 724.1)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	8,400 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

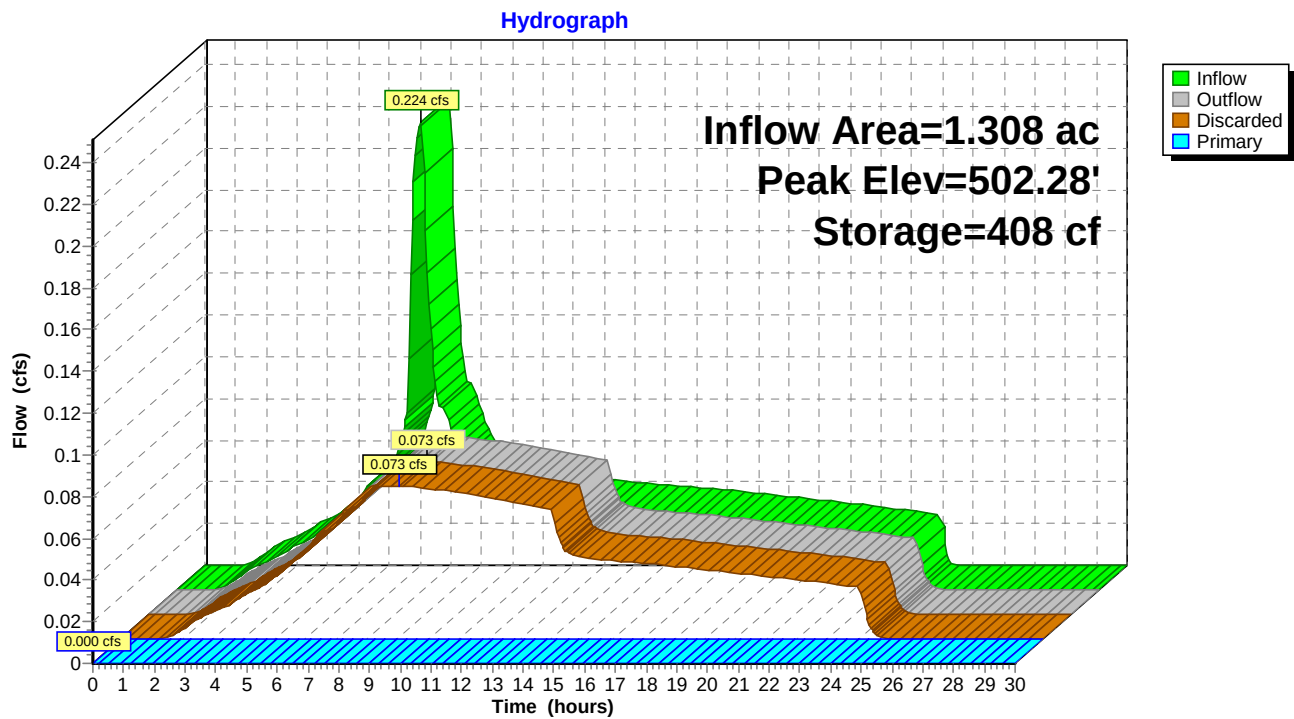
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,300	0	0
505.00	4,300	8,400	8,400

Device	Routing	Invert	Outlet Devices
#1	Discarded	502.00'	2.000 in/hr Exfiltration over Surface area
#2	Primary	503.00'	18.0" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.073 cfs @ 9.02 hrs HW=502.28' (Free Discharge)
 ↑ **1=Exfiltration** (Exfiltration Controls 0.073 cfs)

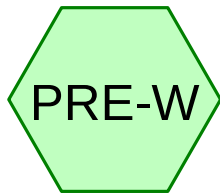
Primary OutFlow Max=0.000 cfs @ 0.00 hrs HW=502.00' (Free Discharge)
 ↑ **2=Orifice/Grate** (Controls 0.000 cfs)

Pond W-WQ: West - WQ

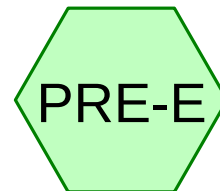




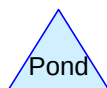
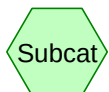
APPENDIX E: PREDEVELOPED HYDROGRAPHS



West - PRE



East - PRE



Prelim Hydrographs 121424

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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

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Summary for Subcatchment PRE-E: East - PRE

Runoff = 0.018 cfs @ 23.04 hrs, Volume= 0.012 af, Depth= 0.02"

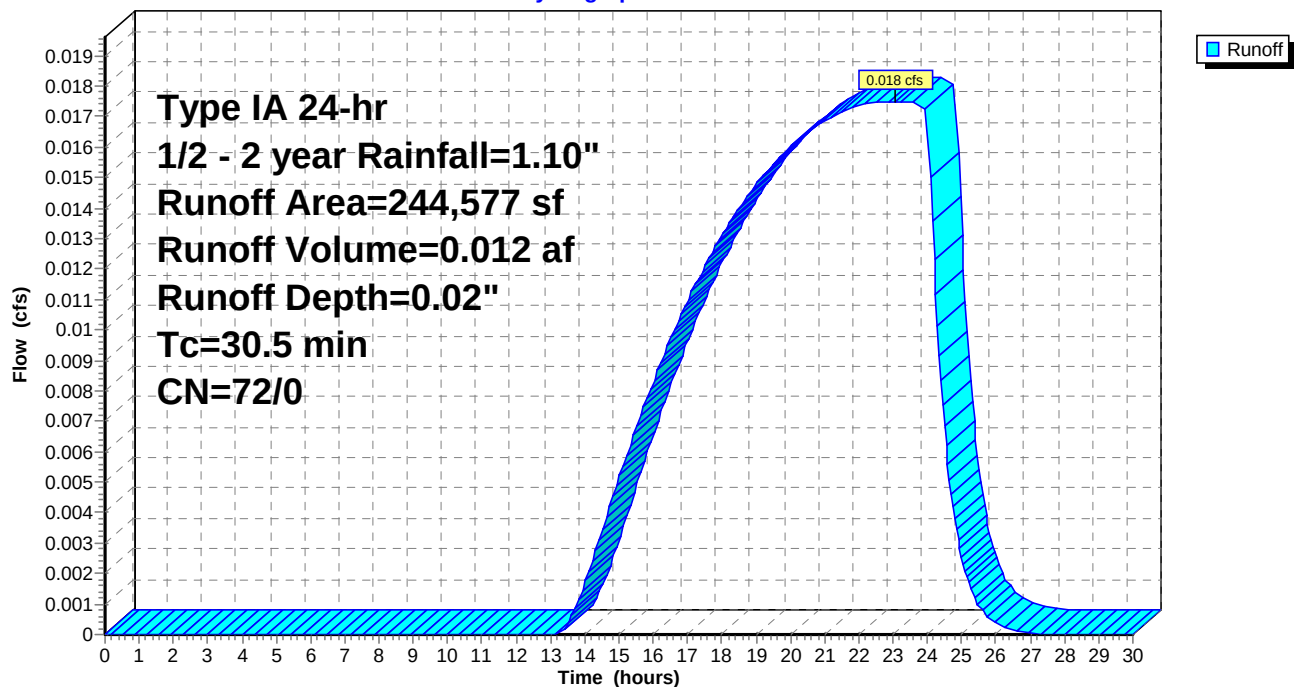
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

	Area (sf)	CN	Description
*	244,577	72	City of Salem, Predeveloped HSG C
	244,577	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph



Summary for Subcatchment PRE-W: West - PRE

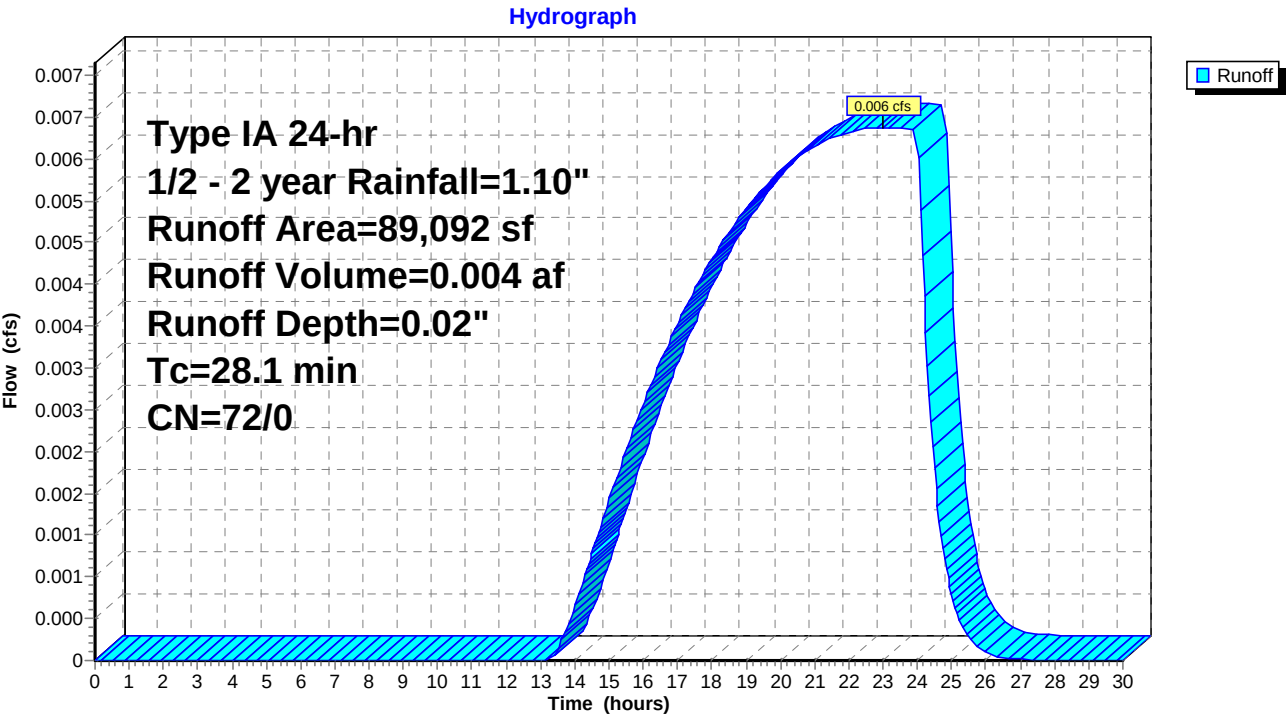
Runoff = 0.006 cfs @ 22.99 hrs, Volume= 0.004 af, Depth= 0.02"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

	Area (sf)	CN	Description
*	89,092	72	City of Salem, Predeveloped HSG C
	89,092	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE



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Type IA 24-hr 10 year Rainfall=3.20"

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Page 4

Summary for Subcatchment PRE-E: East - PRE

Runoff = 0.551 cfs @ 8.25 hrs, Volume= 0.435 af, Depth= 0.93"

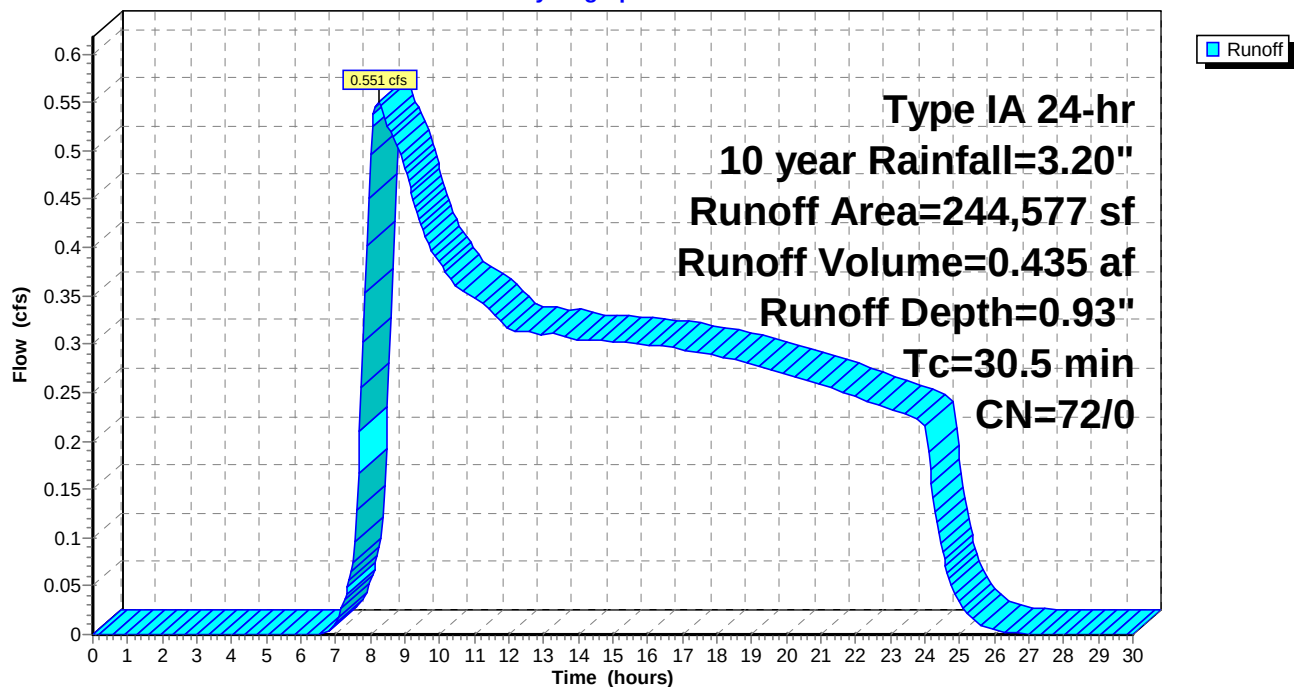
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.20"

	Area (sf)	CN	Description
*	244,577	72	City of Salem, Predeveloped HSG C
	244,577	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph



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Type IA 24-hr 10 year Rainfall=3.20"

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Summary for Subcatchment PRE-W: West - PRE

Runoff = 0.207 cfs @ 8.21 hrs, Volume= 0.158 af, Depth= 0.93"

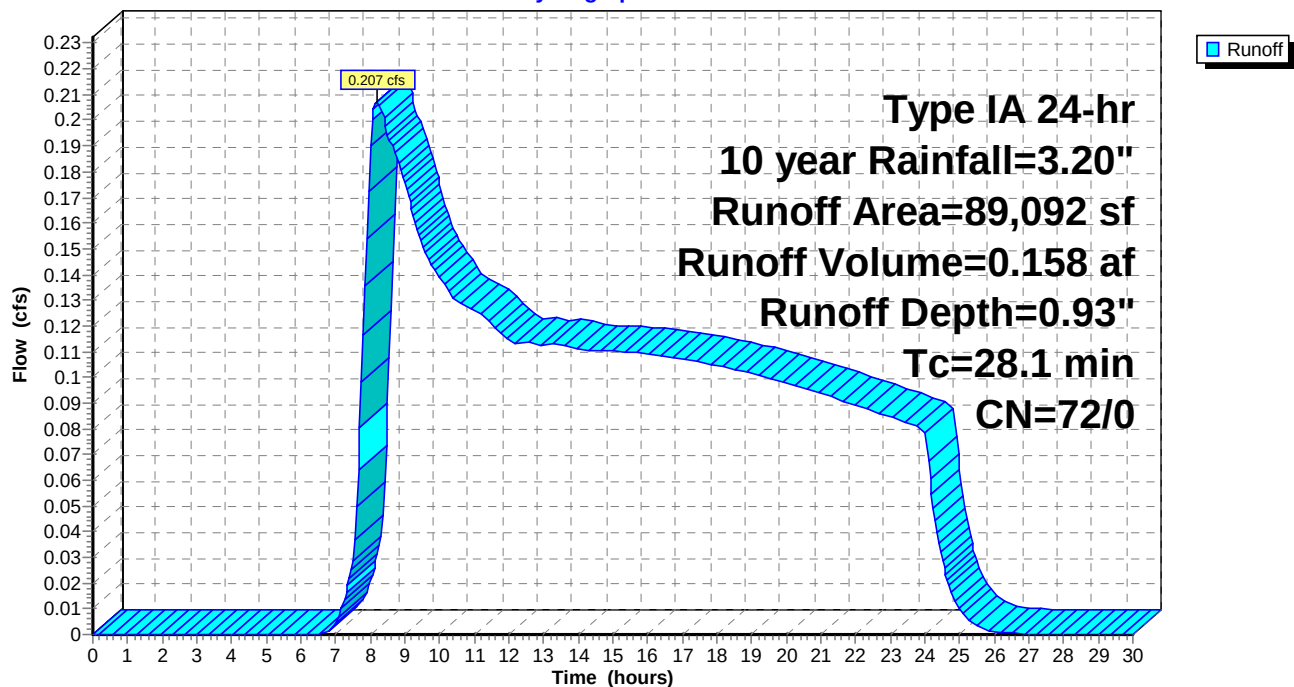
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10 year Rainfall=3.20"

	Area (sf)	CN	Description
*	89,092	72	City of Salem, Predeveloped HSG C
	89,092	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 25 year Rainfall=3.60"

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Summary for Subcatchment PRE-E: East - PRE

Runoff = 0.794 cfs @ 8.19 hrs, Volume= 0.555 af, Depth= 1.19"

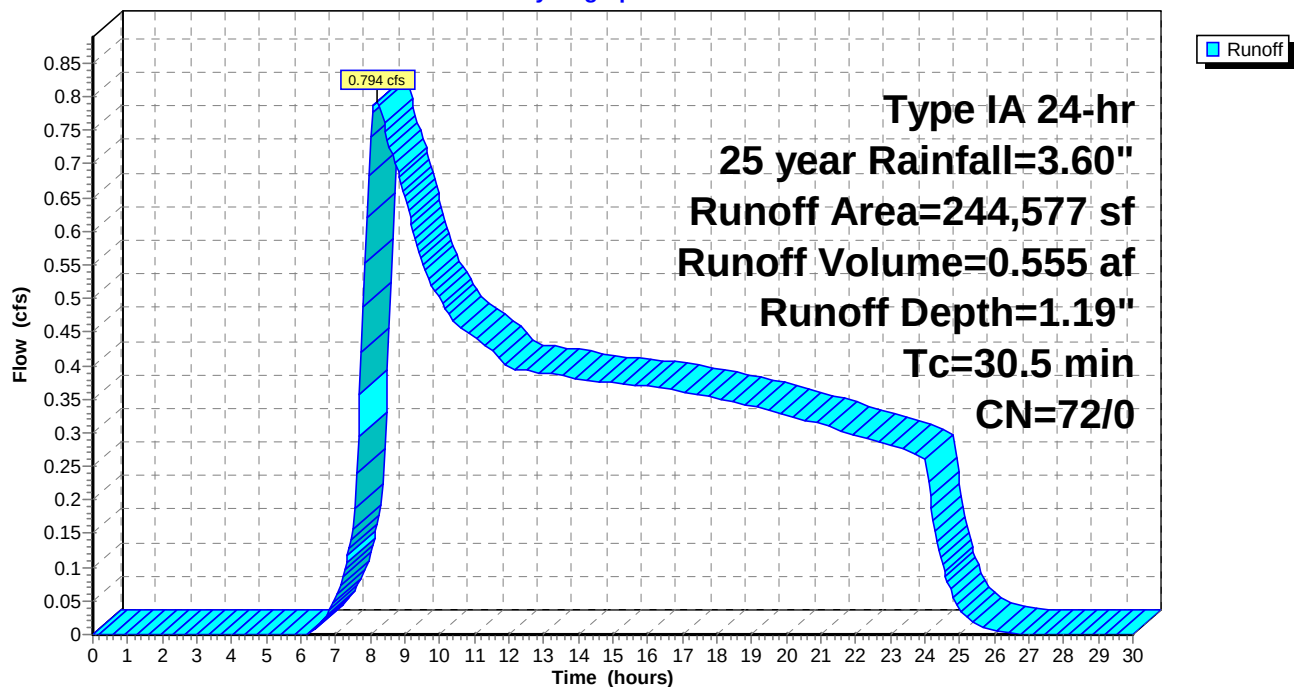
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.60"

	Area (sf)	CN	Description
*	244,577	72	City of Salem, Predeveloped HSG C
	244,577	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 25 year Rainfall=3.60"

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Page 7

Summary for Subcatchment PRE-W: West - PRE

Runoff = 0.299 cfs @ 8.16 hrs, Volume= 0.202 af, Depth= 1.19"

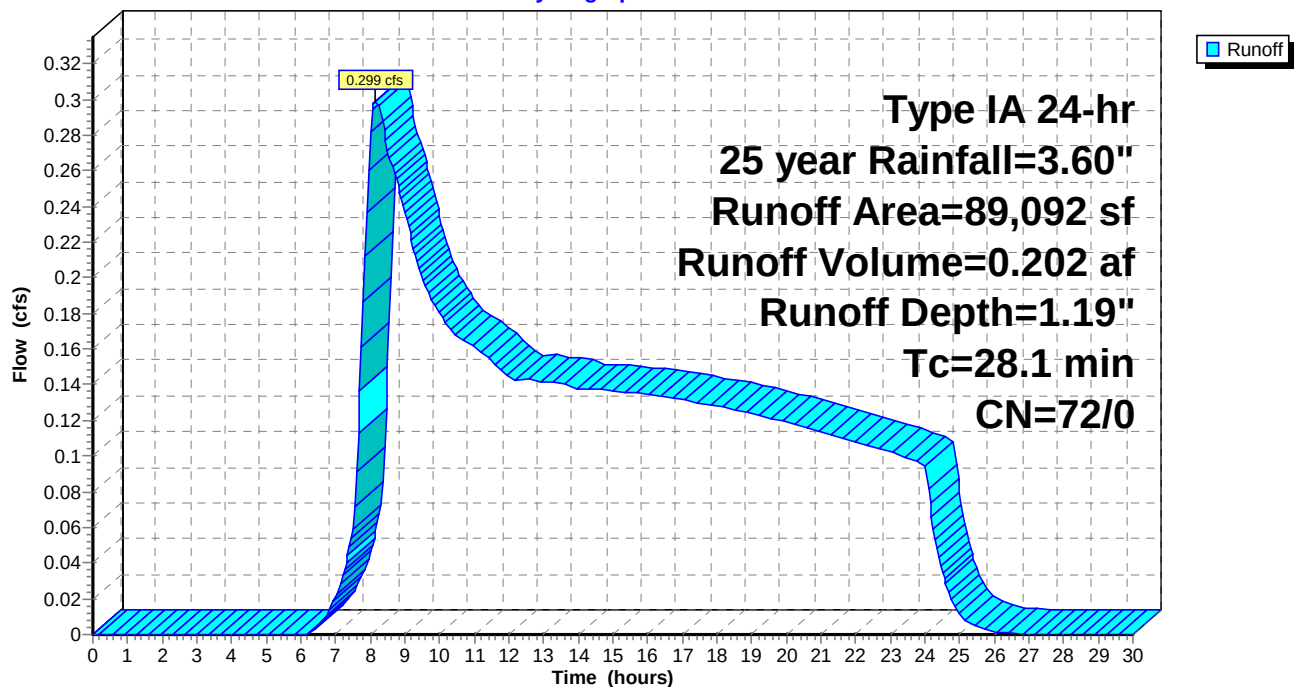
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25 year Rainfall=3.60"

	Area (sf)	CN	Description
*	89,092	72	City of Salem, Predeveloped HSG C
	89,092	72	100.00% Pervious Area

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

Subcatchment PRE-W: West - PRE

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 100 year Rainfall=4.40"

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Summary for Subcatchment PRE-E: East - PRE

Runoff = 1.350 cfs @ 8.12 hrs, Volume= 0.817 af, Depth= 1.75"

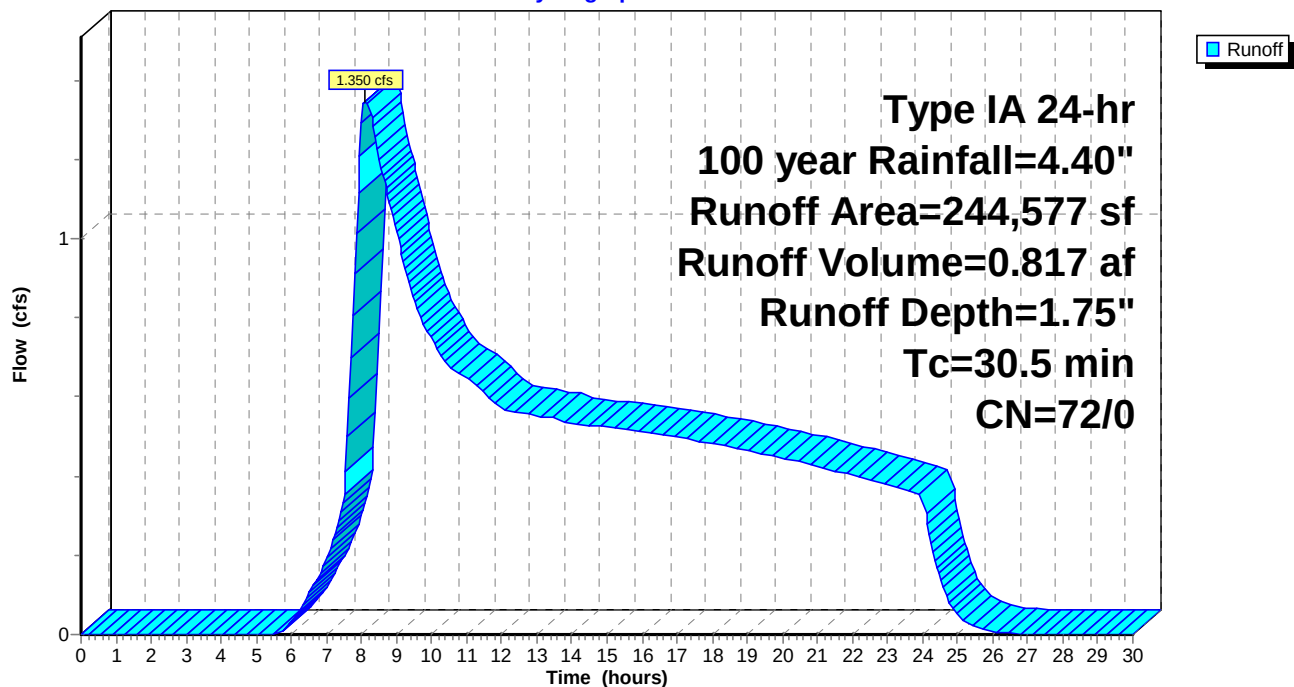
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

	Area (sf)	CN	Description
*	244,577	72	City of Salem, Predeveloped HSG C
	244,577	72	100.00% Pervious Area

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

Subcatchment PRE-E: East - PRE

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 100 year Rainfall=4.40"

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Summary for Subcatchment PRE-W: West - PRE

Runoff = 0.509 cfs @ 8.09 hrs, Volume= 0.298 af, Depth= 1.75"

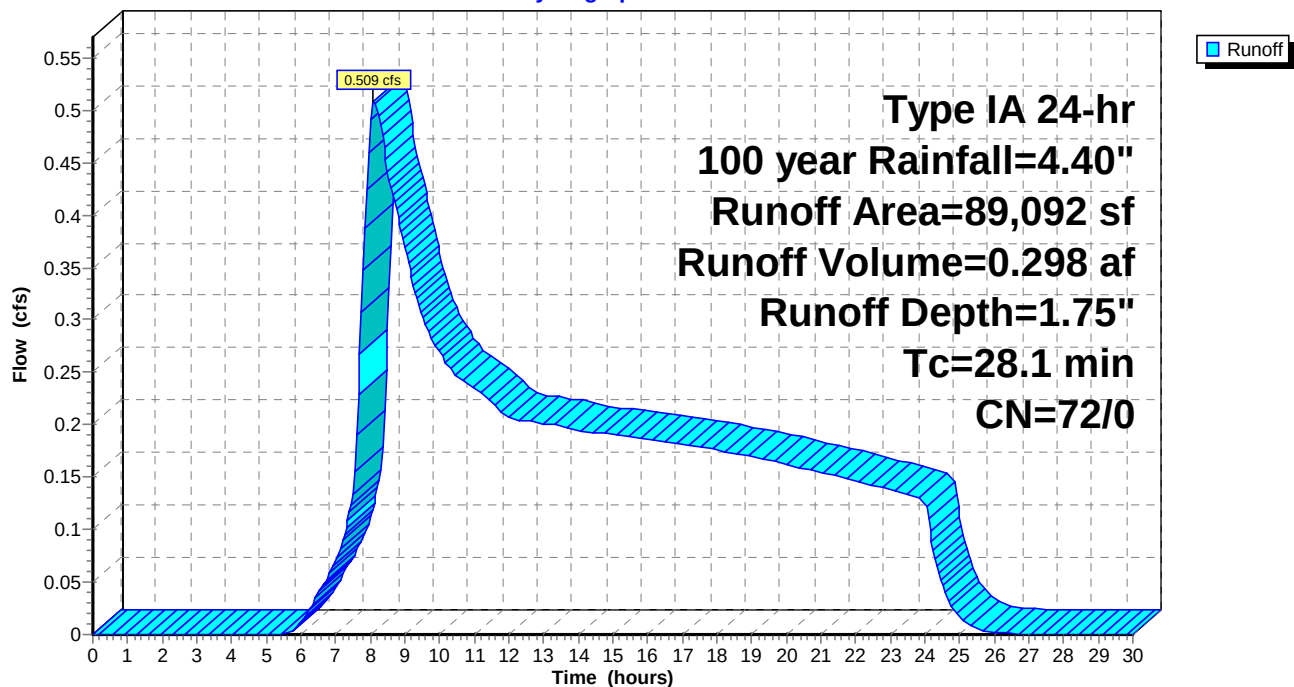
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100 year Rainfall=4.40"

	Area (sf)	CN	Description
*	89,092	72	City of Salem, Predeveloped HSG C
	89,092	72	100.00% Pervious Area

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

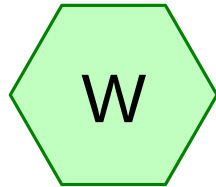
Subcatchment PRE-W: West - PRE

Hydrograph

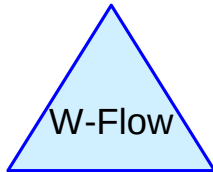




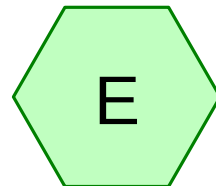
APPENDIX F: WATER QUANTITY HYDROGRAPHS



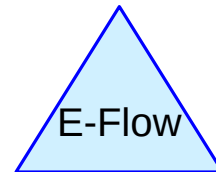
West - POST



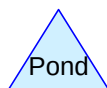
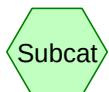
West



East - POST



East



Routing Diagram for Prelim Hydrographs 121424

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Prelim Hydrographs 121424

Prepared by Multi/Tech Engineering Service

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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

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Summary for Subcatchment E: East - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.944 cfs @ 7.92 hrs, Volume= 0.311 af, Depth= 0.60"
Routed to Pond E-Flow : East

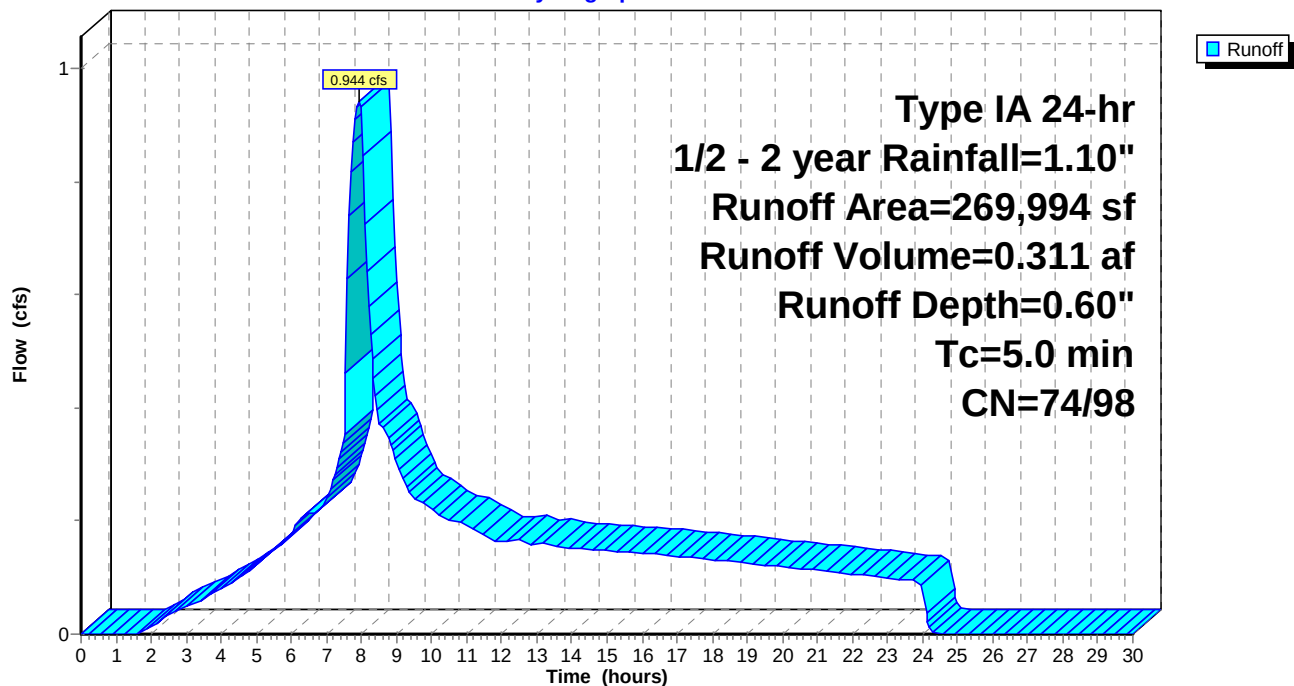
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph



Prelim Hydrographs 121424

Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

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Summary for Pond E-Flow: East

[92] Warning: Device #3 is above defined storage

Inflow Area = 6.198 ac, 66.22% Impervious, Inflow Depth = 0.60" for 1/2 - 2 year event
 Inflow = 0.944 cfs @ 7.92 hrs, Volume= 0.311 af
 Outflow = 0.003 cfs @ 24.32 hrs, Volume= 0.004 af, Atten= 100%, Lag= 984.4 min
 Primary = 0.003 cfs @ 24.32 hrs, Volume= 0.004 af
 Secondary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af
 Tertiary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 483.18' @ 24.32 hrs Surf.Area= 12,731 sf Storage= 13,395 cf

Plug-Flow detention time= 961.5 min calculated for 0.004 af (1% of inflow)
 Center-of-Mass det. time= 411.0 min (1,129.3 - 718.4)

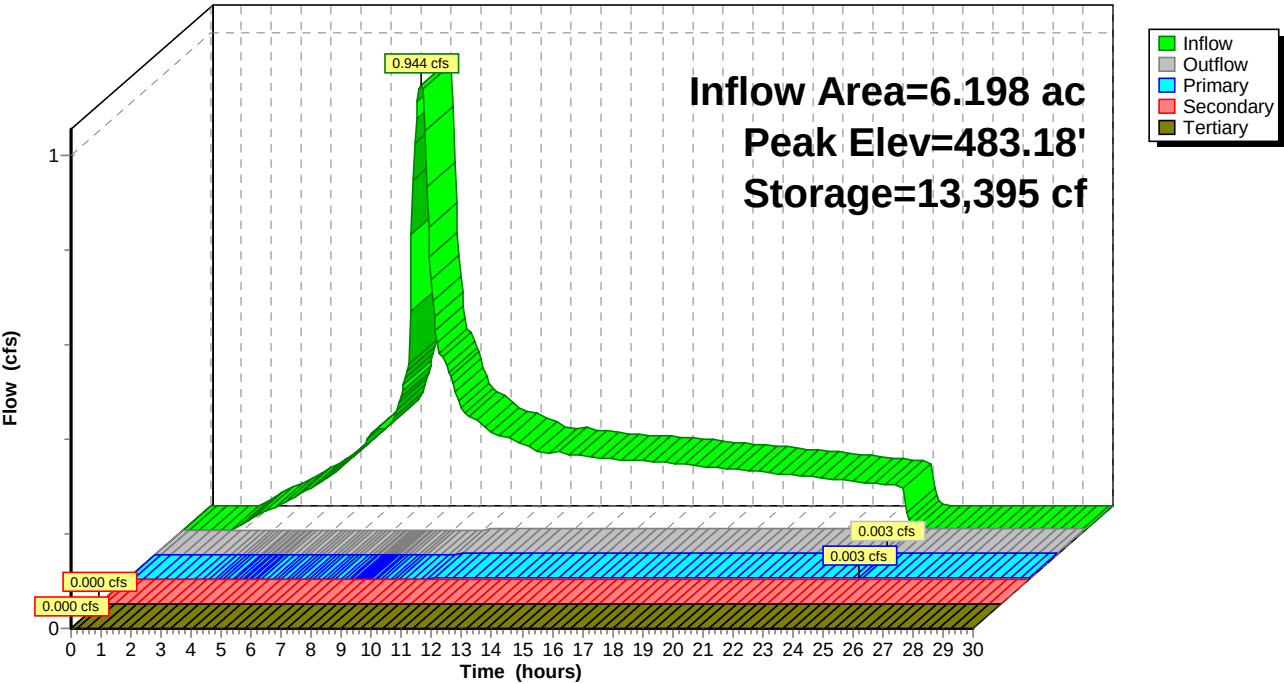
Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	58,418 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	10,061	0	0
486.00	19,148	58,418	58,418

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	8.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Tertiary	486.50'	6.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=0.003 cfs @ 24.32 hrs HW=483.18' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 0.003 cfs @ 5.22 fps)**Secondary OutFlow** Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)↑ **2=Orifice/Grate** (Controls 0.000 cfs)**Tertiary OutFlow** Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)↑ **3=Sharp-Crested Rectangular Weir** (Controls 0.000 cfs)

Pond E-Flow: East

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

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Summary for Subcatchment W: West - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.172 cfs @ 7.92 hrs, Volume= 0.058 af, Depth= 0.53"
Routed to Pond W-Flow : West

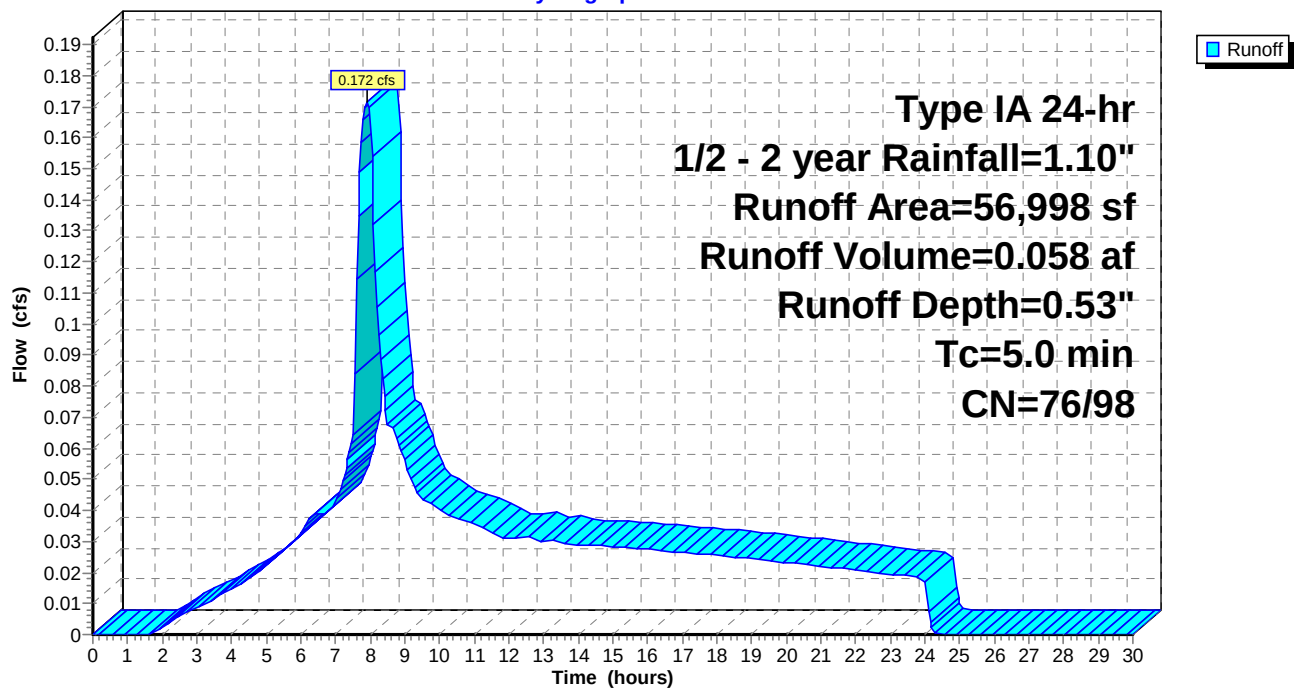
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph



Prelim Hydrographs 121424

Type IA 24-hr 1/2 - 2 year Rainfall=1.10"

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Summary for Pond W-Flow: West

Inflow Area = 1.308 ac, 57.08% Impervious, Inflow Depth = 0.53" for 1/2 - 2 year event
 Inflow = 0.172 cfs @ 7.92 hrs, Volume= 0.058 af
 Outflow = 0.003 cfs @ 24.19 hrs, Volume= 0.005 af, Atten= 98%, Lag= 976.5 min
 Primary = 0.003 cfs @ 24.19 hrs, Volume= 0.005 af
 Secondary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 503.24' @ 24.19 hrs Surf.Area= 2,540 sf Storage= 2,380 cf

Plug-Flow detention time= 848.6 min calculated for 0.005 af (8% of inflow)
 Center-of-Mass det. time= 388.6 min (1,116.0 - 727.4)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	8,400 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,300	0	0
505.00	4,300	8,400	8,400

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	4.5" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.003 cfs @ 24.19 hrs HW=503.24' (Free Discharge)

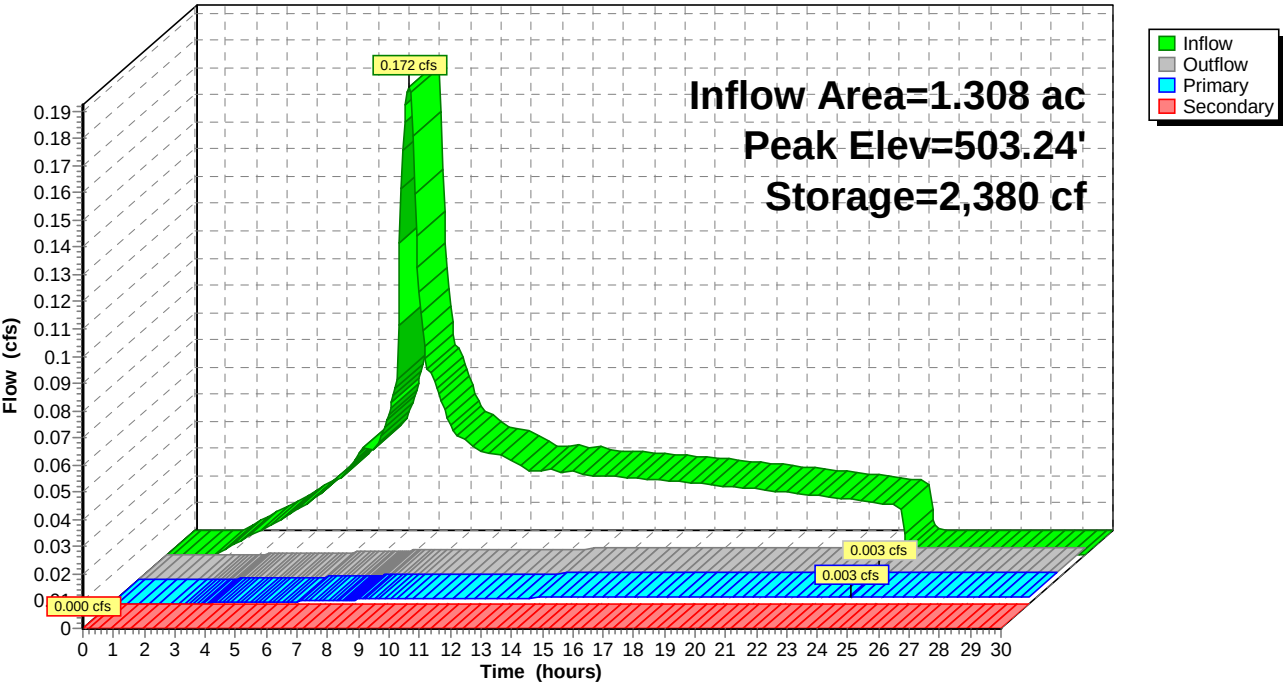
↑ **1=Orifice/Grate** (Orifice Controls 0.003 cfs @ 5.36 fps)

Secondary OutFlow Max=0.000 cfs @ 0.00 hrs HW=502.00' (Free Discharge)

↑ **2=Orifice/Grate** (Controls 0.000 cfs)

Pond W-Flow: West

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 10 year Rainfall=3.20"

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Summary for Subcatchment E: East - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 3.445 cfs @ 7.92 hrs, Volume= 1.196 af, Depth= 2.32"
Routed to Pond E-Flow : East

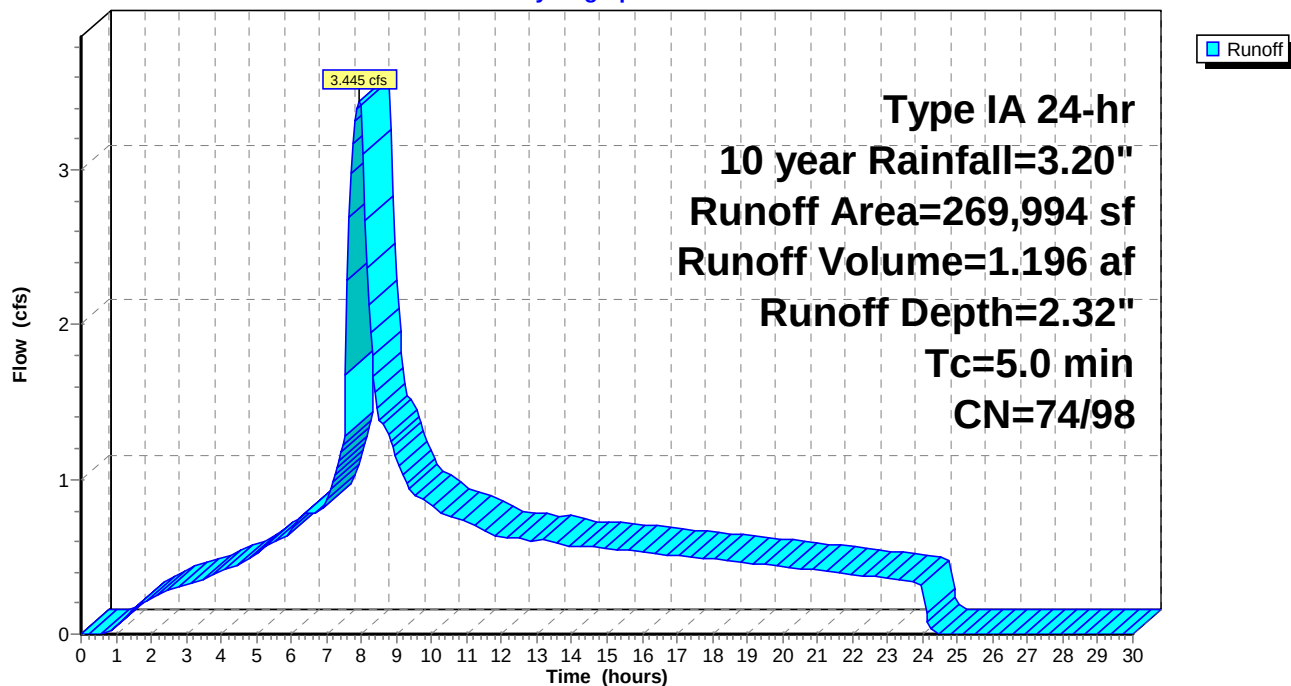
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 10 year Rainfall=3.20"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph



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Type IA 24-hr 10 year Rainfall=3.20"

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Summary for Pond E-Flow: East

[92] Warning: Device #3 is above defined storage

Inflow Area = 6.198 ac, 66.22% Impervious, Inflow Depth = 2.32" for 10 year event
 Inflow = 3.445 cfs @ 7.92 hrs, Volume= 1.196 af
 Outflow = 0.340 cfs @ 23.80 hrs, Volume= 0.215 af, Atten= 90%, Lag= 952.7 min
 Primary = 0.004 cfs @ 23.80 hrs, Volume= 0.008 af
 Secondary = 0.335 cfs @ 23.80 hrs, Volume= 0.207 af
 Tertiary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 485.33' @ 23.80 hrs Surf.Area= 17,624 sf Storage= 46,082 cf

Plug-Flow detention time= 1,094.4 min calculated for 0.215 af (18% of inflow)
 Center-of-Mass det. time= 685.2 min (1,381.6 - 696.4)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	58,418 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

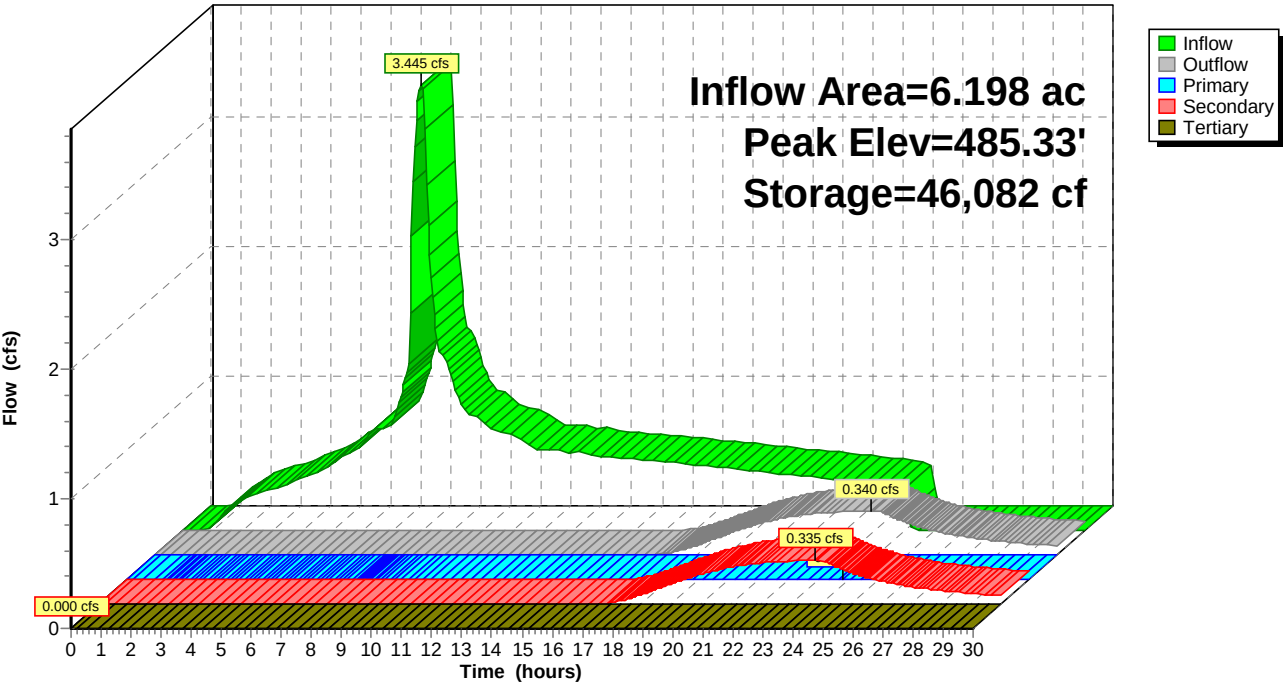
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	10,061	0	0
486.00	19,148	58,418	58,418

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	8.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Tertiary	486.50'	6.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=0.004 cfs @ 23.80 hrs HW=485.33' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 8.79 fps)**Secondary OutFlow** Max=0.335 cfs @ 23.80 hrs HW=485.33' (Free Discharge)↑ **2=Orifice/Grate** (Orifice Controls 0.335 cfs @ 1.95 fps)**Tertiary OutFlow** Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)↑ **3=Sharp-Crested Rectangular Weir** (Controls 0.000 cfs)

Pond E-Flow: East

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 10 year Rainfall=3.20"

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Summary for Subcatchment W: West - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.681 cfs @ 7.93 hrs, Volume= 0.239 af, Depth= 2.19"
Routed to Pond W-Flow : West

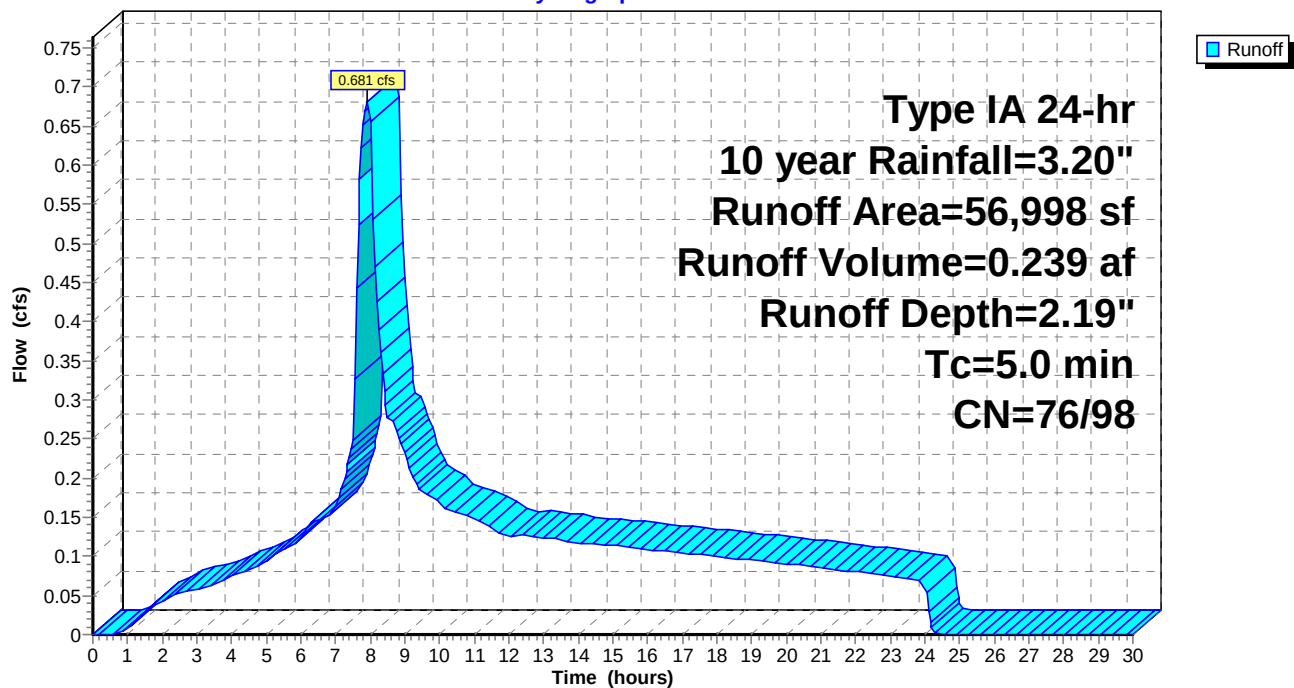
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 10 year Rainfall=3.20"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph



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Type IA 24-hr 10 year Rainfall=3.20"

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Summary for Pond W-Flow: West

Inflow Area = 1.308 ac, 57.08% Impervious, Inflow Depth = 2.19" for 10 year event
 Inflow = 0.681 cfs @ 7.93 hrs, Volume= 0.239 af
 Outflow = 0.122 cfs @ 13.38 hrs, Volume= 0.130 af, Atten= 82%, Lag= 327.0 min
 Primary = 0.004 cfs @ 13.38 hrs, Volume= 0.007 af
 Secondary = 0.119 cfs @ 13.38 hrs, Volume= 0.123 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 504.23' @ 13.38 hrs Surf.Area= 3,533 sf Storage= 5,397 cf

Plug-Flow detention time= 594.5 min calculated for 0.130 af (55% of inflow)
 Center-of-Mass det. time= 337.9 min (1,045.9 - 707.9)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	8,400 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,300	0	0
505.00	4,300	8,400	8,400

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	4.5" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 13.38 hrs HW=504.23' (Free Discharge)

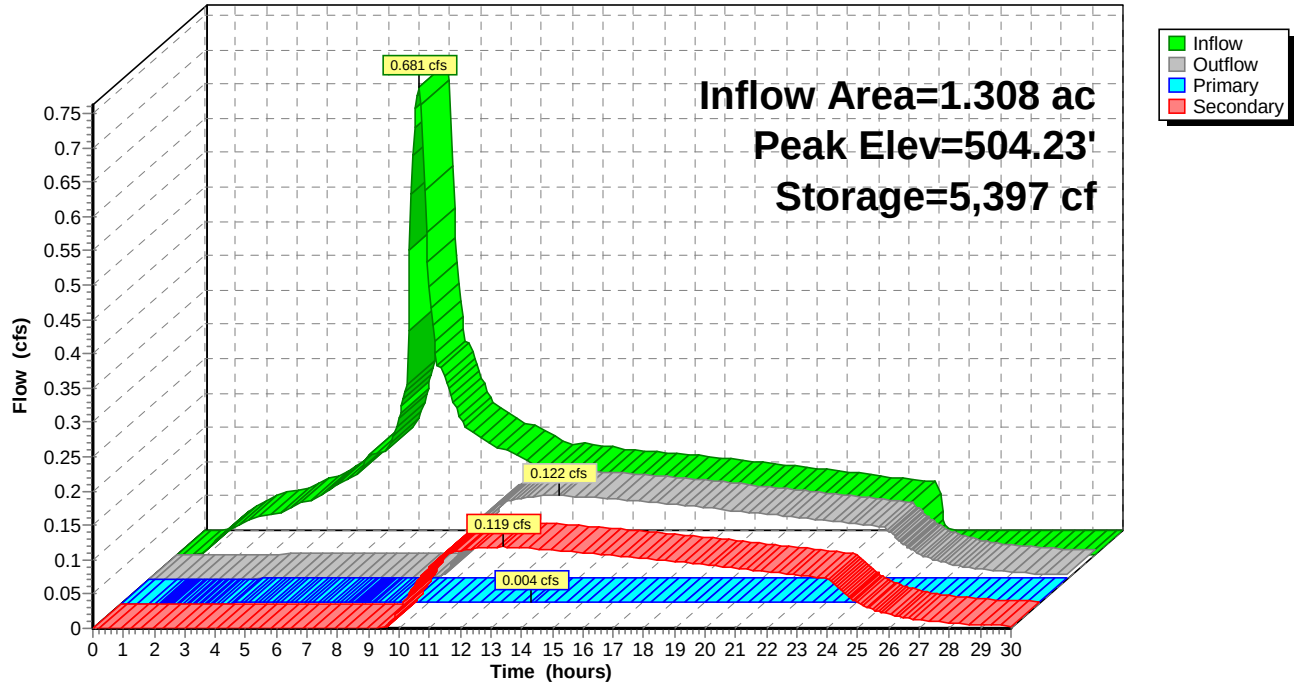
↑ **1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 7.20 fps)

Secondary OutFlow Max=0.119 cfs @ 13.38 hrs HW=504.23' (Free Discharge)

↑ **2=Orifice/Grate** (Orifice Controls 0.119 cfs @ 1.64 fps)

Pond W-Flow: West

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 25 year Rainfall=3.60"

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Summary for Subcatchment E: East - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 3.988 cfs @ 7.92 hrs, Volume= 1.380 af, Depth= 2.67"
Routed to Pond E-Flow : East

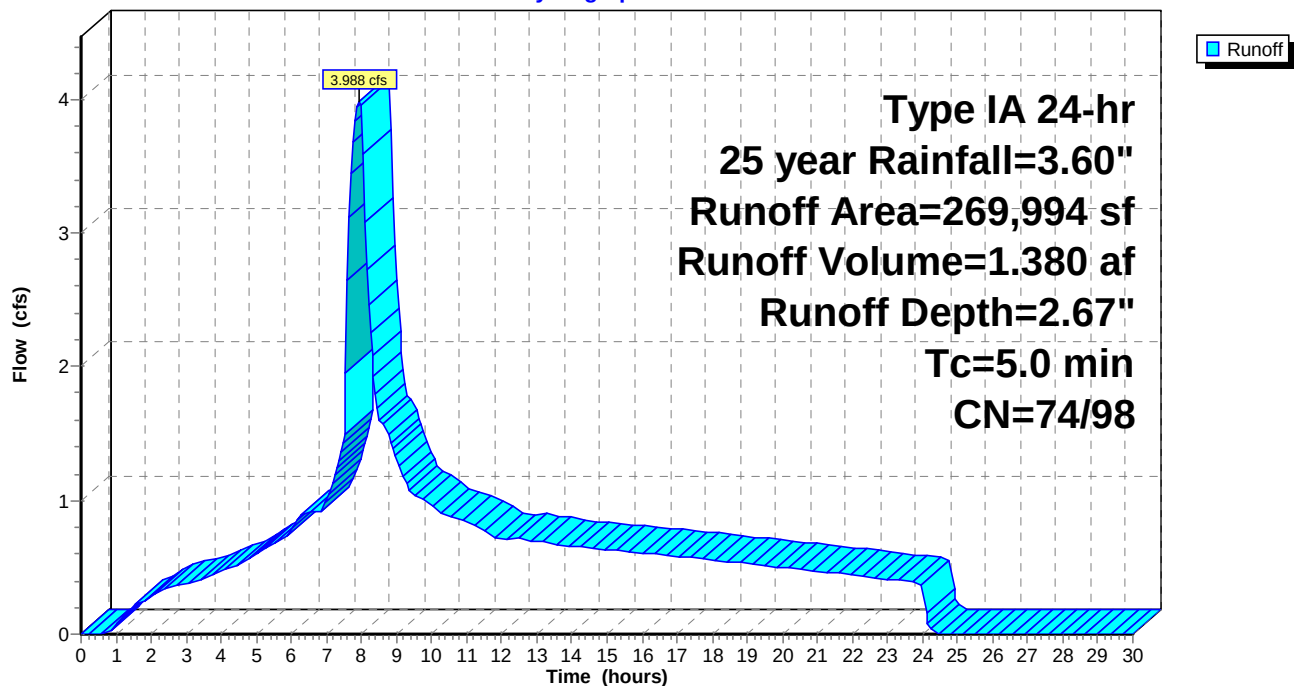
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 25 year Rainfall=3.60"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 25 year Rainfall=3.60"

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Summary for Pond E-Flow: East

[92] Warning: Device #3 is above defined storage

Inflow Area = 6.198 ac, 66.22% Impervious, Inflow Depth = 2.67" for 25 year event
 Inflow = 3.988 cfs @ 7.92 hrs, Volume= 1.380 af
 Outflow = 0.474 cfs @ 20.88 hrs, Volume= 0.395 af, Atten= 88%, Lag= 777.7 min
 Primary = 0.004 cfs @ 20.88 hrs, Volume= 0.008 af
 Secondary = 0.469 cfs @ 20.88 hrs, Volume= 0.386 af
 Tertiary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 485.40' @ 20.88 hrs Surf.Area= 17,783 sf Storage= 47,319 cf

Plug-Flow detention time= 939.8 min calculated for 0.395 af (29% of inflow)
 Center-of-Mass det. time= 592.2 min (1,286.1 - 694.0)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	58,418 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

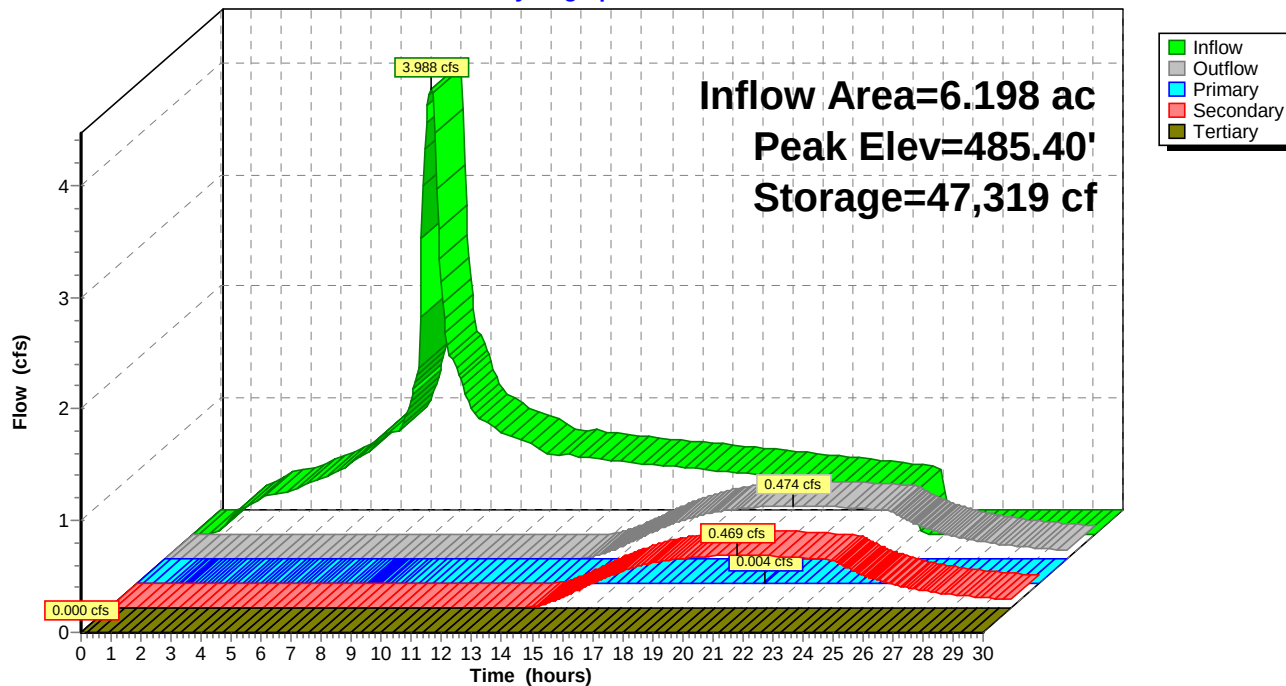
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	10,061	0	0
486.00	19,148	58,418	58,418

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	8.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Tertiary	486.50'	6.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=0.004 cfs @ 20.88 hrs HW=485.40' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 8.88 fps)**Secondary OutFlow** Max=0.469 cfs @ 20.88 hrs HW=485.40' (Free Discharge)↑ **2=Orifice/Grate** (Orifice Controls 0.469 cfs @ 2.15 fps)**Tertiary OutFlow** Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)↑ **3=Sharp-Crested Rectangular Weir** (Controls 0.000 cfs)

Pond E-Flow: East

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 25 year Rainfall=3.60"

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Summary for Subcatchment W: West - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.795 cfs @ 7.93 hrs, Volume= 0.277 af, Depth= 2.54"
Routed to Pond W-Flow : West

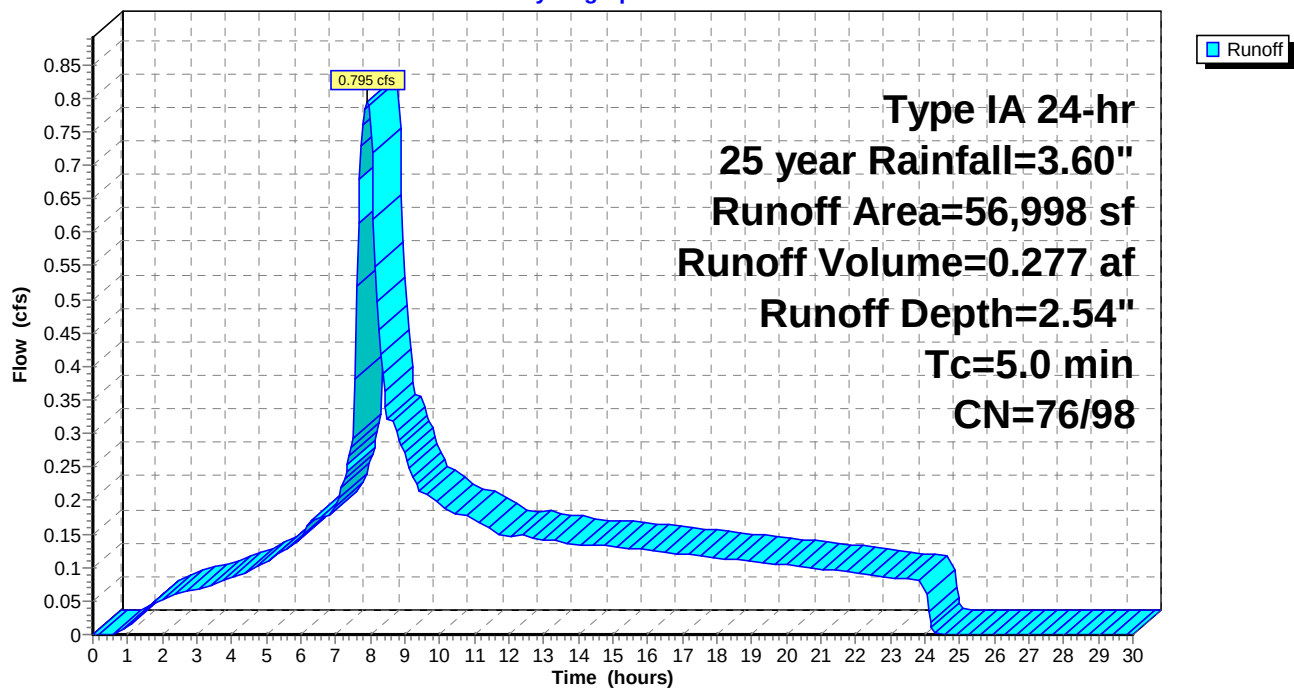
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 25 year Rainfall=3.60"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 25 year Rainfall=3.60"

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Summary for Pond W-Flow: West

Inflow Area = 1.308 ac, 57.08% Impervious, Inflow Depth = 2.54" for 25 year event
 Inflow = 0.795 cfs @ 7.93 hrs, Volume= 0.277 af
 Outflow = 0.163 cfs @ 11.32 hrs, Volume= 0.168 af, Atten= 79%, Lag= 203.2 min
 Primary = 0.004 cfs @ 11.32 hrs, Volume= 0.007 af
 Secondary = 0.159 cfs @ 11.32 hrs, Volume= 0.161 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 504.28' @ 11.32 hrs Surf.Area= 3,580 sf Storage= 5,564 cf

Plug-Flow detention time= 521.3 min calculated for 0.168 af (61% of inflow)
 Center-of-Mass det. time= 291.5 min (996.7 - 705.2)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	8,400 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,300	0	0
505.00	4,300	8,400	8,400

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	4.5" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 11.32 hrs HW=504.28' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 7.27 fps)**Secondary OutFlow** Max=0.159 cfs @ 11.32 hrs HW=504.28' (Free Discharge)↑ **2=Orifice/Grate** (Orifice Controls 0.159 cfs @ 1.80 fps)

Prelim Hydrographs 121424

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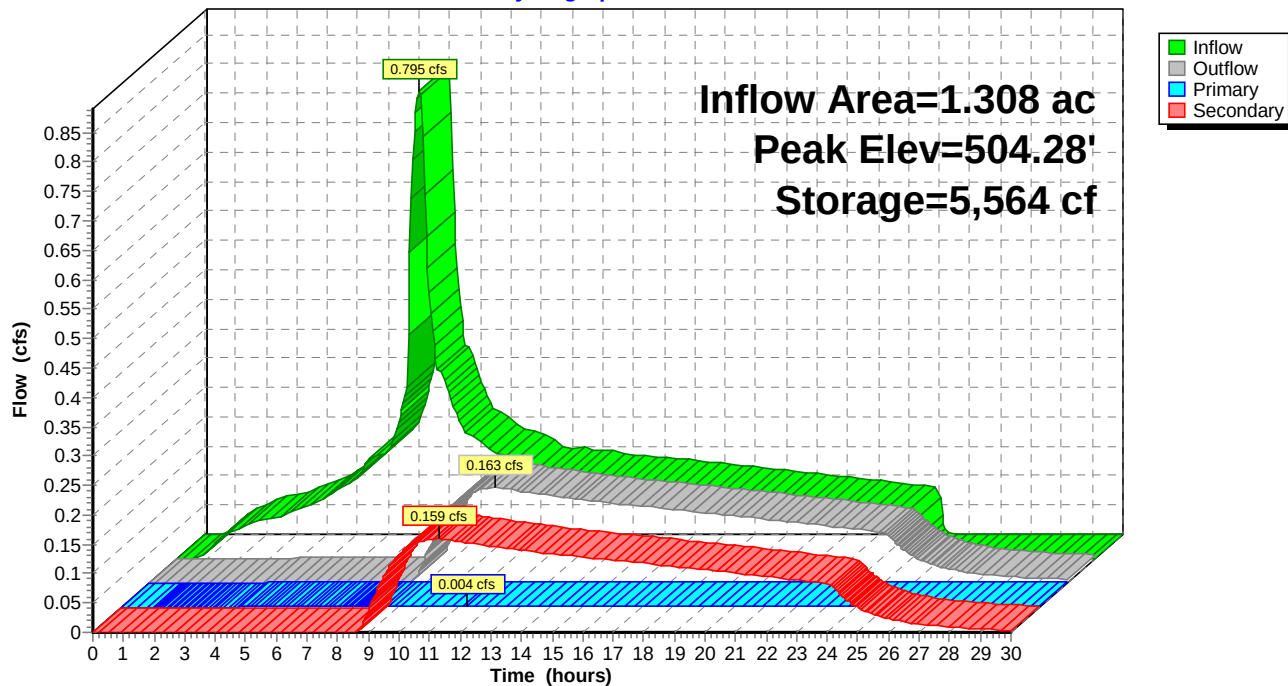
Type IA 24-hr 25 year Rainfall=3.60"

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Pond W-Flow: West

Hydrograph



Prelim Hydrographs 121424

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Type IA 24-hr 100 year Rainfall=4.40"

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Summary for Subcatchment E: East - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 5.100 cfs @ 7.92 hrs, Volume= 1.755 af, Depth= 3.40"
Routed to Pond E-Flow : East

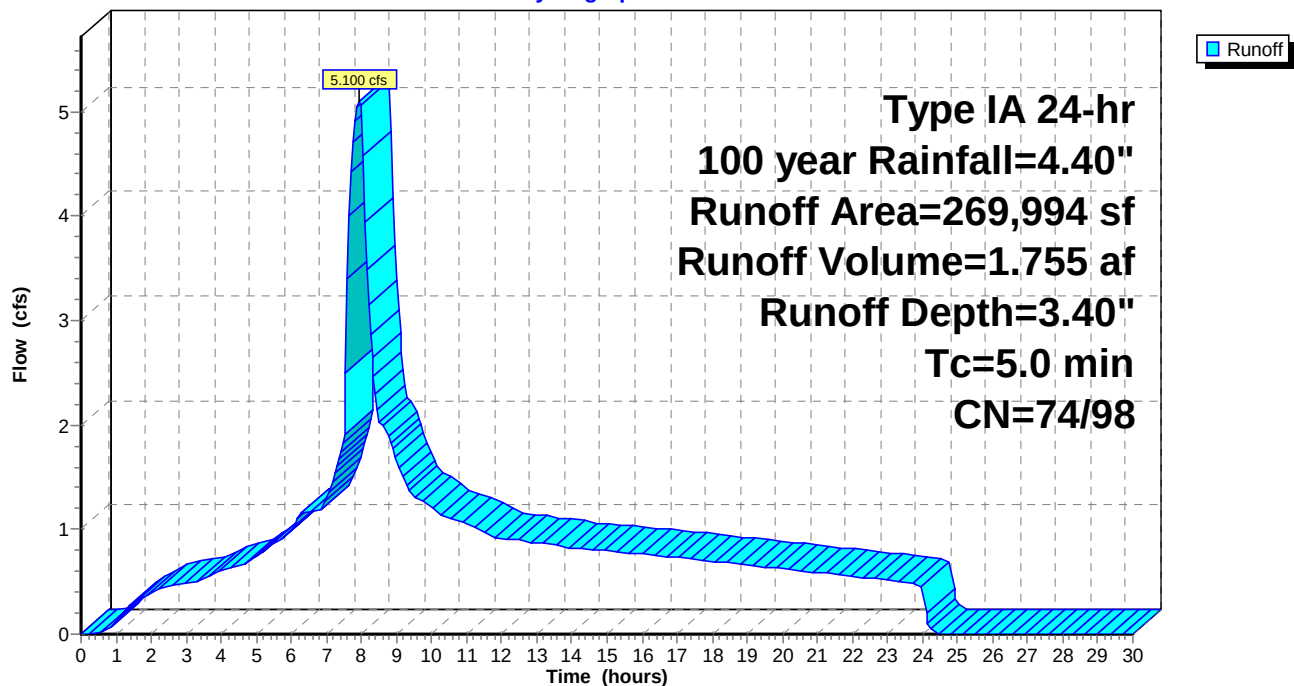
Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 100 year Rainfall=4.40"

Area (sf)	CN	Description
178,796	98	Roofs, HSG C
91,198	74	>75% Grass cover, Good, HSG C
269,994	90	Weighted Average
91,198	74	33.78% Pervious Area
178,796	98	66.22% Impervious Area

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

Subcatchment E: East - POST

Hydrograph



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Type IA 24-hr 100 year Rainfall=4.40"

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Summary for Pond E-Flow: East

[92] Warning: Device #3 is above defined storage

Inflow Area = 6.198 ac, 66.22% Impervious, Inflow Depth = 3.40" for 100 year event
 Inflow = 5.100 cfs @ 7.92 hrs, Volume= 1.755 af
 Outflow = 0.722 cfs @ 17.26 hrs, Volume= 0.766 af, Atten= 86%, Lag= 560.6 min
 Primary = 0.004 cfs @ 17.26 hrs, Volume= 0.009 af
 Secondary = 0.718 cfs @ 17.26 hrs, Volume= 0.757 af
 Tertiary = 0.000 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 485.52' @ 17.26 hrs Surf.Area= 18,058 sf Storage= 49,495 cf

Plug-Flow detention time= 758.8 min calculated for 0.764 af (44% of inflow)
 Center-of-Mass det. time= 464.9 min (1,154.7 - 689.8)

Volume	Invert	Avail.Storage	Storage Description
#1	482.00'	58,418 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

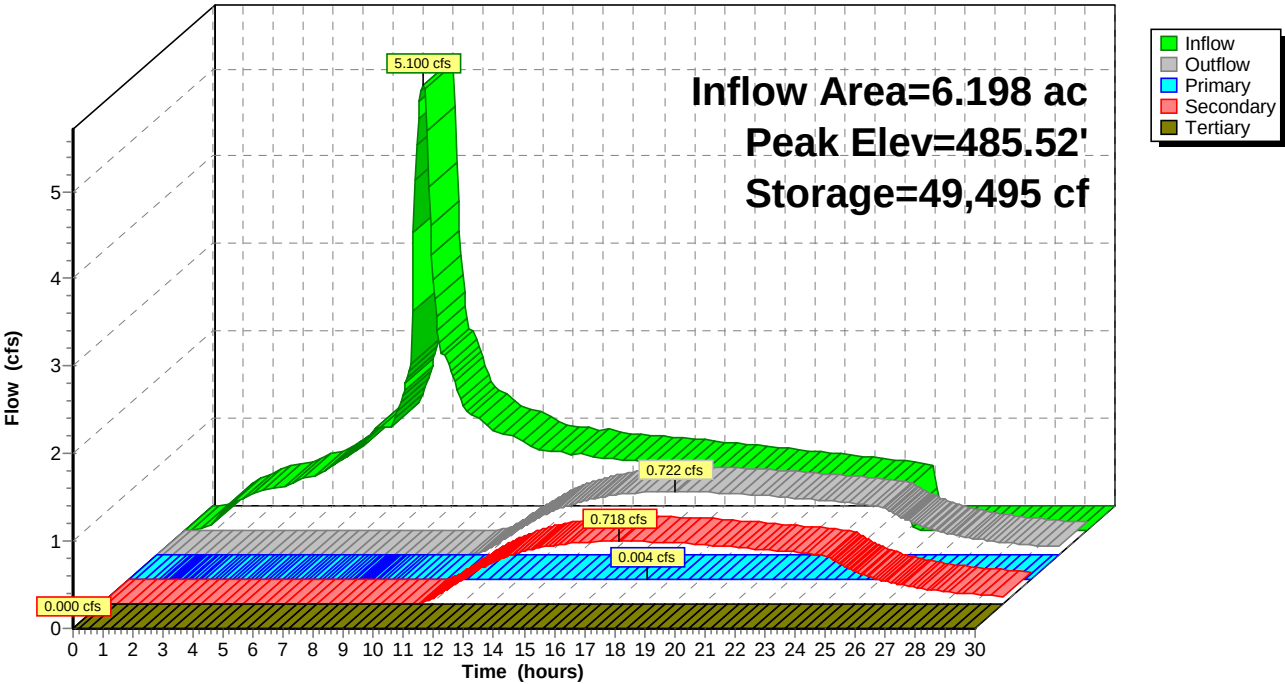
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
482.00	10,061	0	0
486.00	19,148	58,418	58,418

Device	Routing	Invert	Outlet Devices
#1	Primary	482.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	485.00'	8.0" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#3	Tertiary	486.50'	6.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s)

Primary OutFlow Max=0.004 cfs @ 17.26 hrs HW=485.52' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 9.03 fps)**Secondary OutFlow** Max=0.718 cfs @ 17.26 hrs HW=485.52' (Free Discharge)↑ **2=Orifice/Grate** (Orifice Controls 0.718 cfs @ 2.46 fps)**Tertiary OutFlow** Max=0.000 cfs @ 0.00 hrs HW=482.00' (Free Discharge)↑ **3=Sharp-Crested Rectangular Weir** (Controls 0.000 cfs)

Pond E-Flow: East

Hydrograph



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Type IA 24-hr 100 year Rainfall=4.40"

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Summary for Subcatchment W: West - POST

[49] Hint: $T_c < 2dt$ may require smaller dt

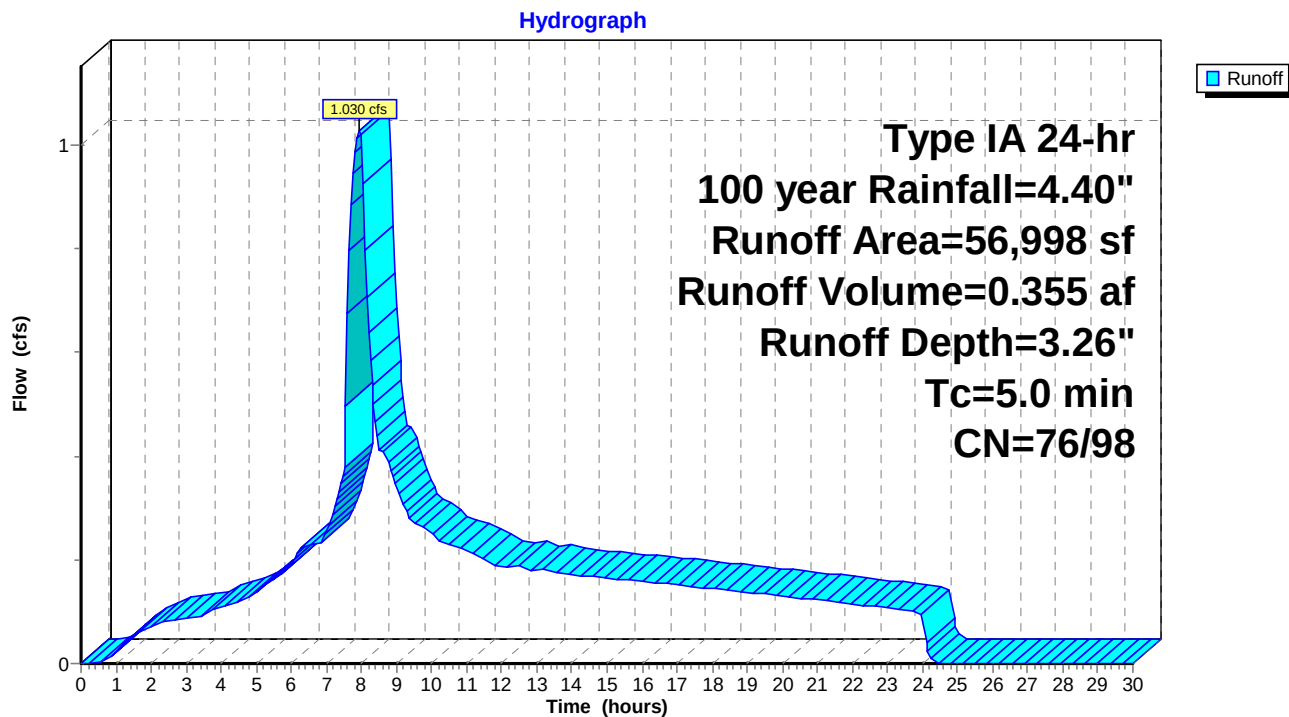
Runoff = 1.030 cfs @ 7.93 hrs, Volume= 0.355 af, Depth= 3.26"
Routed to Pond W-Flow : West

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type IA 24-hr 100 year Rainfall=4.40"

Area (sf)	CN	Description
32,533	98	Roofs, HSG C
22,795	74	>75% Grass cover, Good, HSG C
1,670	98	Water Surface, 0% imp, HSG C
56,998	88	Weighted Average
24,465	76	42.92% Pervious Area
32,533	98	57.08% Impervious Area

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

Subcatchment W: West - POST



Prelim Hydrographs 121424

Type IA 24-hr 100 year Rainfall=4.40"

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Summary for Pond W-Flow: West

Inflow Area = 1.308 ac, 57.08% Impervious, Inflow Depth = 3.26" for 100 year event
 Inflow = 1.030 cfs @ 7.93 hrs, Volume= 0.355 af
 Outflow = 0.259 cfs @ 9.86 hrs, Volume= 0.247 af, Atten= 75%, Lag= 116.1 min
 Primary = 0.004 cfs @ 9.86 hrs, Volume= 0.008 af
 Secondary = 0.255 cfs @ 9.86 hrs, Volume= 0.239 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Peak Elev= 504.42' @ 9.86 hrs Surf.Area= 3,718 sf Storage= 6,065 cf

Plug-Flow detention time= 424.7 min calculated for 0.247 af (69% of inflow)
 Center-of-Mass det. time= 235.4 min (935.7 - 700.2)

Volume	Invert	Avail.Storage	Storage Description
#1	502.00'	8,400 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
502.00	1,300	0	0
505.00	4,300	8,400	8,400

Device	Routing	Invert	Outlet Devices
#1	Primary	502.00'	0.3" Horiz. Orifice/Grate C= 0.600 Limited to weir flow at low heads
#2	Secondary	504.00'	4.5" Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.004 cfs @ 9.86 hrs HW=504.42' (Free Discharge)↑ **1=Orifice/Grate** (Orifice Controls 0.004 cfs @ 7.49 fps)**Secondary OutFlow** Max=0.255 cfs @ 9.86 hrs HW=504.42' (Free Discharge)↑ **2=Orifice/Grate** (Orifice Controls 0.255 cfs @ 2.31 fps)

Prelim Hydrographs 121424

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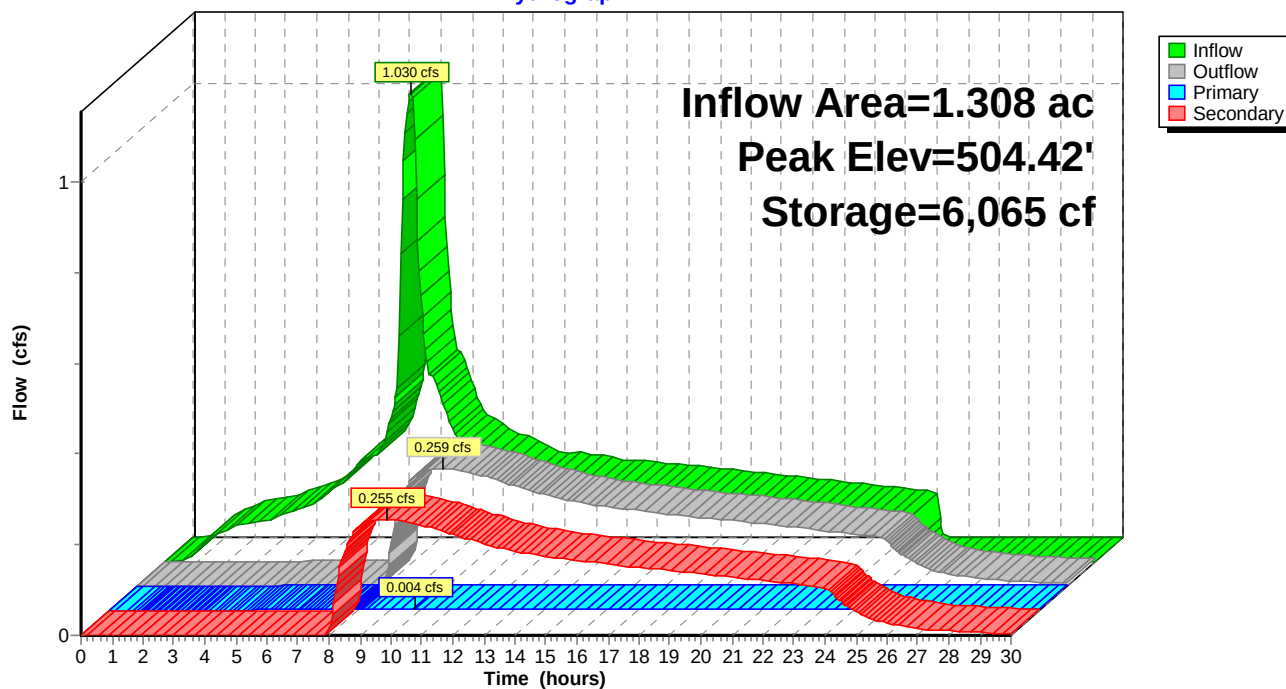
Type IA 24-hr 100 year Rainfall=4.40"

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Pond W-Flow: West

Hydrograph





APPENDIX G: OPERATIONS AND MAINTENANCE FORM

Chapter 109
Division 011 - Operations and Maintenance of Stormwater Facilities
Appendix B to 109-011 – Facility Maintenance Forms

1. Stormwater Planter

Stormwater Planters are designed to allow runoff to filter through layers of topsoil (thus capturing pollutants) and then either infiltrate into the native soils (infiltration planter) or be collected in a pipe to be discharged off-site (filtration planter). The planter is sized to accept runoff and temporarily store the water in a reservoir on top of the soil. The filtration planter is designed with an impervious bottom or is placed on an impervious surface. Water should drain through the planter within 24 hours after a storm event.

Inspections

All facility components and vegetation shall be inspected for proper operations and structural stability. *These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, and two times per year thereafter.* It is recommended that a visual inspection be made within 48 hours after each major storm event to ensure proper function. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Date: ____/____/____ Inspector's Name: _____

Downspout from rooftop or sheet flow from paving allows unimpeded stormwater flow to the planter.

- ☐ Debris shall be removed routinely and upon discovery.
- ☐ Damaged pipe shall be repaired upon discovery.

Inspection Comments: _____

Splash blocks prevent splashing against adjacent structures and convey water without disrupting media.

- ☐ Any deficiencies in structure such as cracking, rotting, and failure shall be repaired.

Inspection Comments: _____

Planter reservoir receives and detains stormwater prior to infiltration. Water should drain from planter within 24 hours of storm event.

- ☐ Sources of clogging shall be identified and corrected.
- ☐ Topsoil may need to be amended with sand or compost, or replaced.

Inspection Comments: _____

Amended soils consisting of sand, compost, drain rock, and topsoil shall allow stormwater to percolate uniformly through the planter.

- ☐ The planter shall be excavated and cleaned, and gravel or soil shall be replaced to correct low infiltration rates.
- ☐ Holes that are not consistent with the design and allow water to flow directly through the planter to the ground shall be plugged.
- ☐ Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures. Sediment shall be removed if it is more than 4 inches thick or so thick as to damage or kill vegetation.
- ☐ Litter and debris shall be removed.

Inspection Comments: _____

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1. Stormwater Planter (continued)

Planter shall contain filter media and vegetation.

- ☐ Structural deficiencies in the planter including rot, cracks, and failure shall be repaired.

Inspection Comments: _____

Overflow pipe safely conveys flow exceeding reservoir capacity to an approved stormwater receiving system.

- ☐ Overflow pipe shall be kept clear at all times.
- ☐ Damaged pipe shall be repaired or replaced upon discovery.

Inspection Comments: _____

Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. Proper horticultural practices shall be employed to ensure plants are vigorous and healthy.

- ☐ Mulch shall be replenished as needed, but not inhibiting water flow.
- ☐ Vegetation, large shrubs, or trees that limit access or interfere with planter operation shall be pruned or removed.
- ☐ Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
- ☐ Nuisance or prohibited vegetation from the City of Salem Non-Native Invasive Plant list shall be removed when discovered. Invasive vegetation shall be removed upon discovery.
- ☐ Dead vegetation shall be removed upon discovery.
- ☐ Vegetation shall be replaced as soon as possible to maintain cover density and control erosion where soils are exposed.

Inspection Comments: _____

Debris and litter shall be removed to ensure stormwater infiltration and to prevent clogging of overflow drains and interference with plant growth.

Inspection Comments: _____

Spill prevention measures shall be exercised when handling substances that contaminate stormwater.

- ☐ Releases of pollutants shall be corrected and reported to the City as soon as identified.

Inspection Comments: _____

Training and/or written guidance information for O&M of stormwater planters shall be provided to all property owners and tenants. This Facility Maintenance Form can be used to meet this requirement.

Inspection Comments: _____

Access to the stormwater planter shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.

- ☐ Obstacles preventing maintenance personnel and/or equipment access to the stormwater planter shall be removed.
- ☐ Gravel or ground cover shall be added if erosion has occurred.

Inspection Comments: _____

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1. Stormwater Planter (continued)

Nuisance insects and rodents shall not be harbored in the stormwater planter.

Pest control measures shall be taken when nuisance insects/rodents are found to be present.

- ☐ Holes in the ground located in and around the stormwater planter shall be filled and compacted.

Inspection Comments: _____

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2. Rain Garden

A rain garden is a **vegetated infiltration basin** or depression created by excavation, berms, or small dams to provide for short-term ponding of surface water until it percolates into the soil. The basin should infiltrate stormwater within 24 hours.

Inspections

All facility components and vegetation shall be inspected for proper operations and structural stability. *These inspections shall occur, at a minimum, quarterly for the first two years from the date of installation, and two times per year thereafter.* It is recommended that a visual inspection be made within 48 hours after each major storm event to ensure proper function. The facility owner must keep a log, recording all inspection dates, observations, and maintenance activities. The following items shall be inspected and maintained as stated:

Date: ____/____/____

Inspector's Name: _____

Basin inlet shall ensure unrestricted stormwater flow to the vegetated basin.

- ☐ Sources of erosion shall be identified and controlled when native soil is exposed or erosion channels are present.
- ☐ Inlet shall be kept clear at all times.
- ☐ Rock splash pads shall be replenished to prevent erosion.

Inspection Comments: _____

Embankment, dikes, berms, and side slopes retain water in the infiltration basin.

- ☐ Structural deficiencies shall be corrected upon discovery.
- ☐ Slopes shall be stabilized using appropriate erosion control measures when soil is exposed/flow channels are forming.
- ☐ Sources of erosion damage shall be identified and controlled.

Inspection Comments: _____

Overflow or emergency spillway conveys flow exceeding reservoir capacity to an approved stormwater receiving system.

- ☐ Overflow shall be kept clear at all times.
- ☐ Sources of erosion damage shall be identified and controlled when soil is exposed.
- ☐ Rocks or other armament shall be replaced when only one layer of rock exists.

Inspection Comments: _____

Amended soils shall allow stormwater to percolate uniformly through the infiltration basin. If water remains 36 hours after a storm, sources of possible clogging shall be identified and corrected.

- ☐ Basin shall be raked and, if necessary, soil shall be excavated and cleaned or replaced.

Inspection Comments: _____

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2. Rain Garden (continued)

Sediment/Basin debris management shall prevent loss of infiltration basin volume caused by sedimentation.

- ☐ Sediment exceeding 3 inches in depth, or so thick as to damage or kill vegetation, shall be removed.
- ☐ Sediment accumulation shall be hand-removed with minimum damage to vegetation using proper erosion control measures.

Inspection Comments: _____

Debris and litter shall be removed to ensure stormwater infiltration and to prevent clogging of overflow drains and interference with plant growth.

- ☐ Restricted sources of sediment and debris, such as discarded lawn clippings, shall be identified and prevented.

Inspection Comments: _____

Vegetation shall be healthy and dense enough to provide filtering while protecting underlying soils from erosion. Proper horticultural practices shall be employed to ensure that plants are vigorous and healthy.

- ☐ Mulch shall be replenished as needed, but not inhibiting water flow.
- ☐ Vegetation, large shrubs, or trees that interfere with rain garden operation shall be pruned.
- ☐ Fallen leaves and debris from deciduous plant foliage shall be raked and removed.
- ☐ Nuisance or prohibited vegetation from the City of Salem Non-Native Invasive Plant list shall be removed when discovered. Invasive vegetation shall be removed immediately upon discovery.
- ☐ Dead vegetation shall be removed upon discovery.
- ☐ Vegetation shall be replaced as soon as possible to maintain cover density and control erosion where soils are exposed.

Inspection Comments: _____

Spill prevention measures shall be exercised when handling substances that contaminate stormwater.

- ☐ Releases of pollutants shall be corrected as soon as identified.

Inspection Comments: _____

Training and/or written guidance information for operating and maintaining vegetated infiltration basins shall be provided to all property owners and tenants. This Facility Maintenance Form can be used to meet this requirement.

Inspection Comments: _____

Access to the infiltration basin shall be safe and efficient. Egress and ingress routes shall be maintained to design standards. Roadways shall be maintained to accommodate size and weight of vehicles, if applicable.

- ☐ Obstacles preventing maintenance personnel and/or equipment access to the infiltration basin shall be removed.
- ☐ Gravel or ground cover shall be added if erosion has occurred.

Inspection Comments: _____

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2. Rain Garden (continued)

Nuisance insects and rodents shall not be harbored in the infiltration basin. Pest control measures shall be taken when nuisance insects/rodents are found to be present.

- ☐ Holes in the ground located in and around the infiltration basin shall be filled.

Inspection Comments: _____

If used at this site, the following will be applicable:

Fences shall be maintained to preserve their functionality and appearance.

- ☐ Collapsed fences shall be restored to an upright position.
- ☐ Jagged edges and damaged fences shall be repaired or replaced.

Inspection Comments: _____
