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# Preliminary Stormwater Management Report

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## Clover Shopping Center Redevelopment

City of Bloomington, MN  
Nine Mile Creek Watershed District

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Prepared for:  
Kraus Anderson  
501 South Eighth Street  
Minneapolis, MN 55404  
Contact: Tim Marco

Prepared by:  
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Contact: Jason Scrimshaw, P.E.

Prepared On: September 8, 2021

**Preliminary Stormwater Management Report  
for  
Southtown Shopping Center Redevelopment**

**Prepared for:**

**Kraus Anderson**

**September 8, 2021**

**Prepared By:**

**Kimley-Horn and Associates, Inc.  
767 Eustis Street, Suite 100  
St. Paul, MN 55114**

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Registered Professional Engineer under the laws of the State of Minnesota.

---

Adam Tjaden, P.E.

Date: September 8, 2021 Registration No. 59337

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## 1.0 Introduction

Kraus-Anderson proposes to complete redevelopment of a portion of the Clover Shopping Center located on the northeast corner of the intersection of Interstate Highway 35 and W 98<sup>th</sup> Street in Bloomington, MN. The Site is subject to the requirements of the Nine Mile Creek Watershed District (furthermore to be referred as NMCWD) and is subject to the requirements of the City of Bloomington Stormwater standards. The proposed site encompasses approximately 4 acres of which 2.8 acres are proposed for redevelopment activity. This report provides information on the primary stormwater regulator design criteria and the preliminary approach to stormwater management towards meeting those criteria.

## 2.0 Regulatory Criteria

The primary regulatory criteria evaluated at this preliminary stage of design is the NMCWD Stormwater Management Standards relating to retention volume and rate control. To meet the retention volume requirements, the project must provide 1.1 inches of retention volume for the regulated surfaces, and infiltration features must draw down within 48 hours. The preliminary evaluation assumes that the work will disturb more than 50 percent of the existing impervious surface in the project area such that the regulatory impervious standards apply to the entire redevelopment area (2.8 acres). That is, all impervious for this project (disturbed or not) is assumed to be regulated surface. Disturbed areas are those where underlying soils are exposed during redevelopment. Also required by the NMCWD, rate control was evaluated to ensure that the underground system reduces discharge rates from existing to proposed conditions in the 2, 10, and 100-year events. Pollutant removal efficiencies were not evaluated at this preliminary stage, in general, providing the required 1.1 inches of retention volume for the regulated surface will allow the site to meet the pollutant load reduction targets for TSS and TP for the regulated surfaces.

## 3.0 Existing Conditions

The existing site is comprised of buildings and associated parking lot areas. The western portion of the existing building on site will be demolished as part of this project. The land use within the project area is assumed to be all impervious in existing conditions. In general, existing drainage patterns will be maintained as part of this project.

## 4.0 Proposed Conditions

The proposed redevelopment consists of new building and parking areas, watermain improvements, landscaping, and a planned underground stormwater management system. In general, site improvements will maintain the overall existing drainage patterns. The land use within the project area is assumed to be all impervious in proposed conditions.

Appendix A shows the location of the proposed underground stormwater management system along with the contributing drainage area to the system, proposed storm sewer routing, other onsite drainage areas, and site grades. The planned underground stormwater management system consists of a series of 42-inch diameter perforated CMP pipes surrounded by coarse rock. No site-specific geotechnical information is available currently beyond the USGS Web Soil Survey. At this preliminary

phase we have assumed that soils at the planned depth of the infiltration systems are uniform sands classified as SP under the Unified Soil Classification System. Based on these soils, we are using a design infiltration rate of 0.8 inches hour, consistent with the recommendations in the Minnesota Stormwater Manual. To meet the required 48-hour drawdown criteria, the outlet for the system is set at an elevation that corresponds to the required treatment volume that can pass through the bottom of the system within 48 hours.

## 5.0 Preliminary Design Summary

Based on the project regulated surface area of 2.8 acres, the project will require a retention volume of 11,408 cubic feet of storage volume. Volume can be obtained within the surface parking lot area in a series of underground infiltration chambers. The available retention volume of the proposed stormwater management system is 23,988 cubic feet with a total volume of 31,774 cubic feet. The underground system also manages proposed discharge rates from the site, reducing the proposed rates from existing conditions. Table 1 summarizes the existing and proposed site discharge rates. See Appendix A for existing and proposed conditions HydroCAD model summaries.

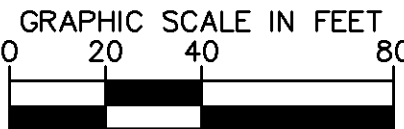
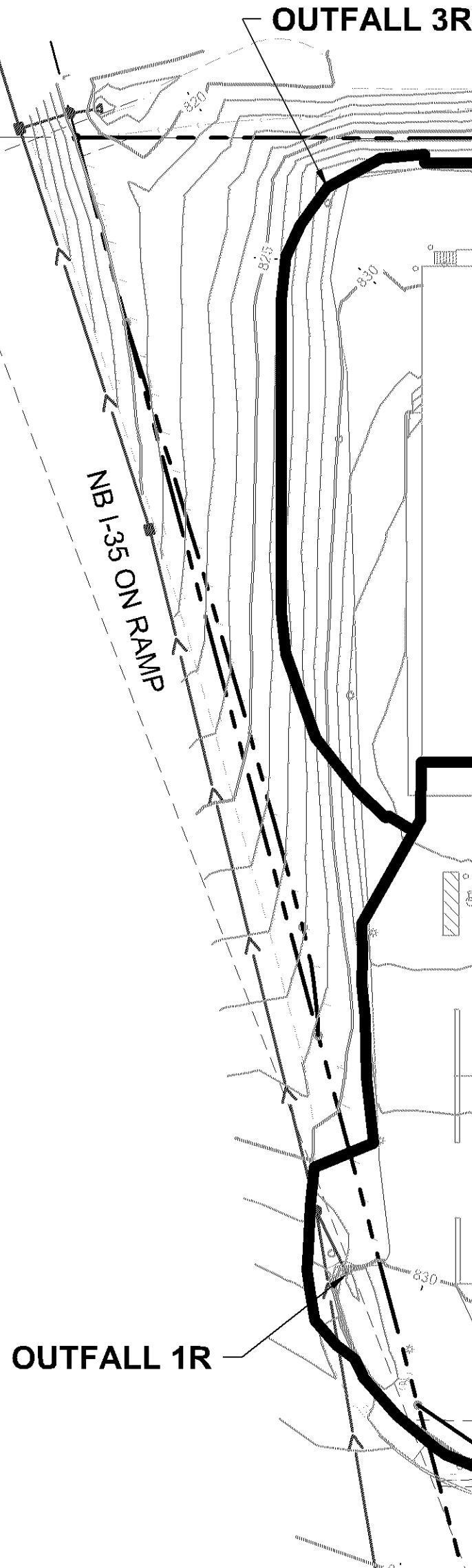
**Table 1. Site Discharge Summary**

Storm Event	2-year	10-year	100-year
<b>Outfall 3R</b>			
Existing Conditions	3.91	5.91	10.51
Proposed Conditions	3.88	5.86	10.42
<b>Outfall 2R</b>			
Existing Conditions	1.46	2.21	3.93
Proposed Conditions	0.96	1.45	2.58
<b>Outfall 1R</b>			
Existing Conditions	8.00	12.08	21.47
Proposed Conditions	0.00	0.00	4.39

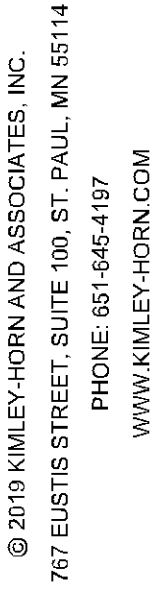
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## Appendix A

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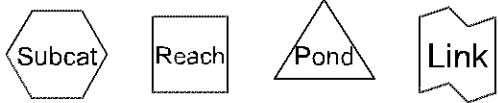
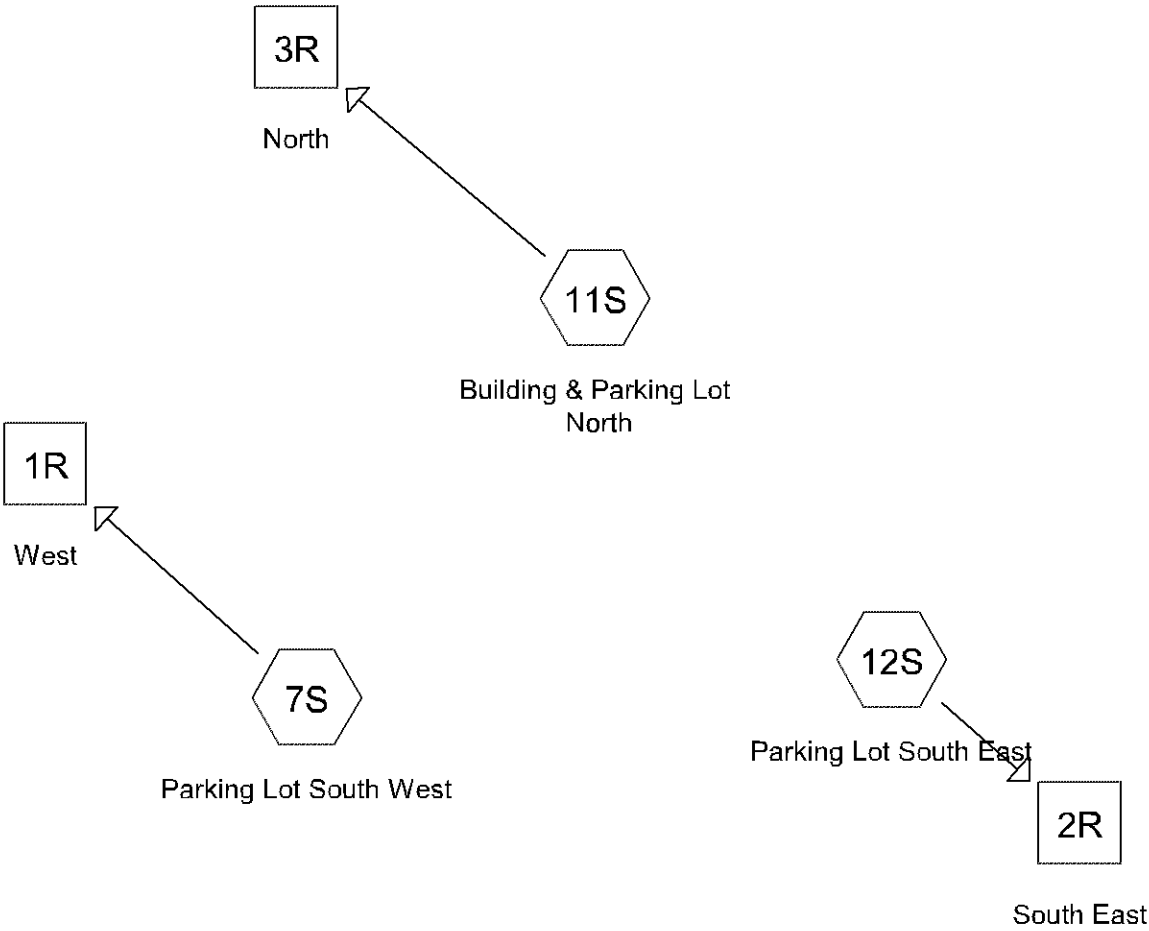


CLOVER SHOPPING  
 CENTER  
 PREPARED FOR  
**KRAUS**  
 ANDERSON  
 DEVELOPMENT  
 BLOOMINGTON, MN

[illegible]







**2021-0827 - Clover Shopping Center Existing Conditions**

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**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
3.408	98	Paved parking, HSG A (7S, 11S, 12S)
<b>3.408</b>	<b>98</b>	<b>TOTAL AREA</b>

**2021-0827 - Clover Shopping Center Existing Condition MSE 24-hr 3 2-Year Rainfall=2.83"**

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Page 3

**Summary for Subcatchment 7S: Parking Lot South West**

Runoff = 8.00 cfs @ 12.14 hrs, Volume= 0.441 af, Depth= 2.60"

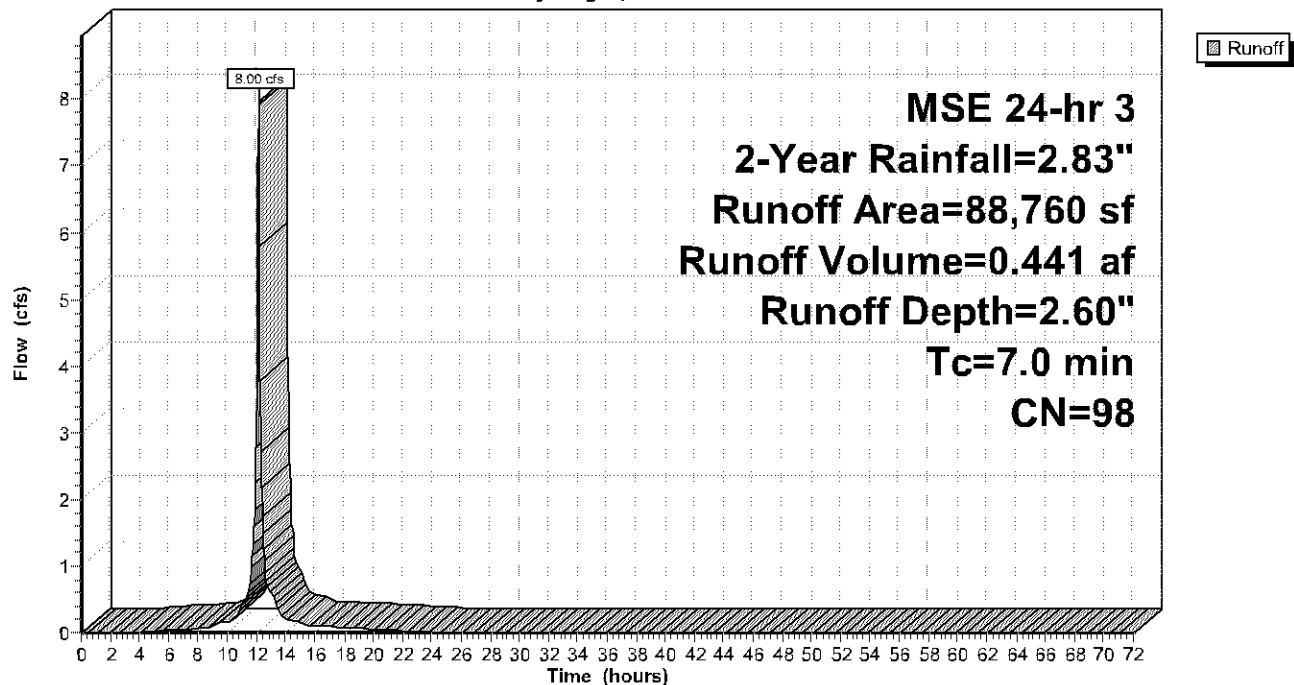
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
88,760	98	Paved parking, HSG A
88,760		100.00% Impervious Area

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

**Subcatchment 7S: Parking Lot South West**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condition MSE 24-hr 3 2-Year Rainfall=2.83"**

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**Summary for Subcatchment 11S: Building & Parking Lot North**

Runoff = 3.91 cfs @ 12.14 hrs, Volume= 0.216 af, Depth= 2.60"

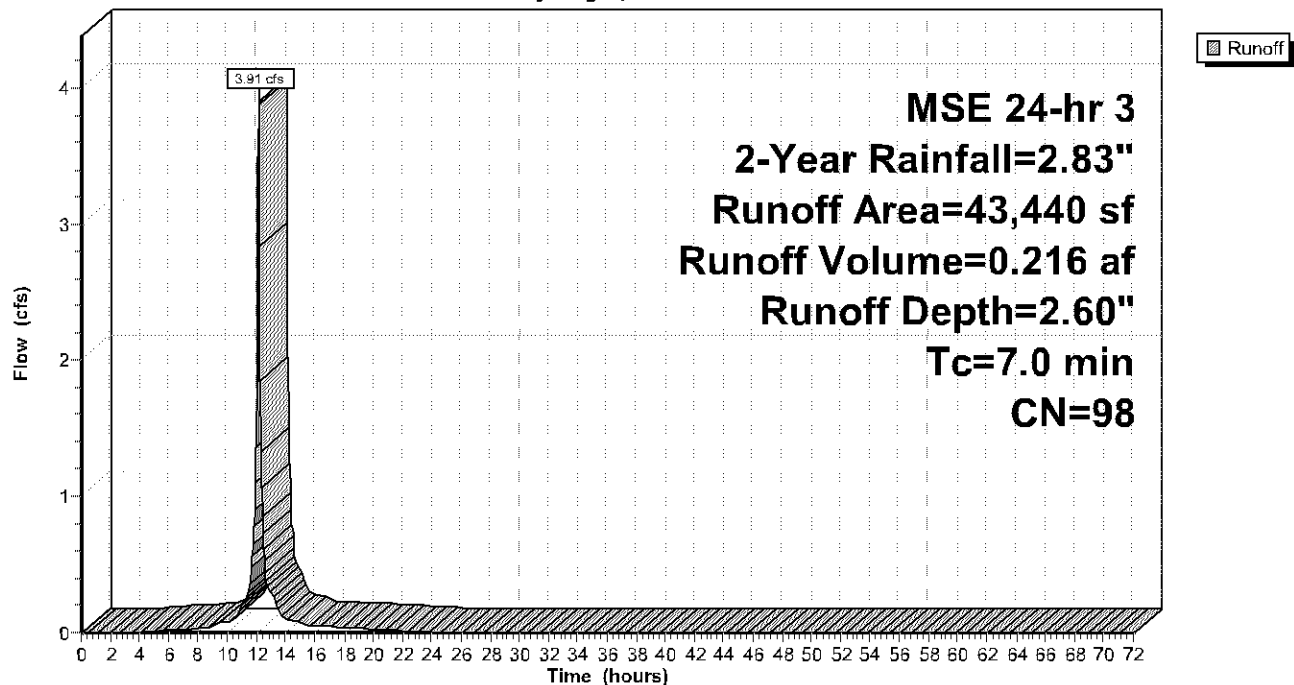
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
43,440	98	Paved parking, HSG A
43,440		100.00% Impervious Area

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

**Subcatchment 11S: Building & Parking Lot North**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condition MSE 24-hr 3 2-Year Rainfall=2.83"**

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**Summary for Subcatchment 12S: Parking Lot South East**

Runoff = 1.46 cfs @ 12.14 hrs, Volume= 0.081 af, Depth= 2.60"

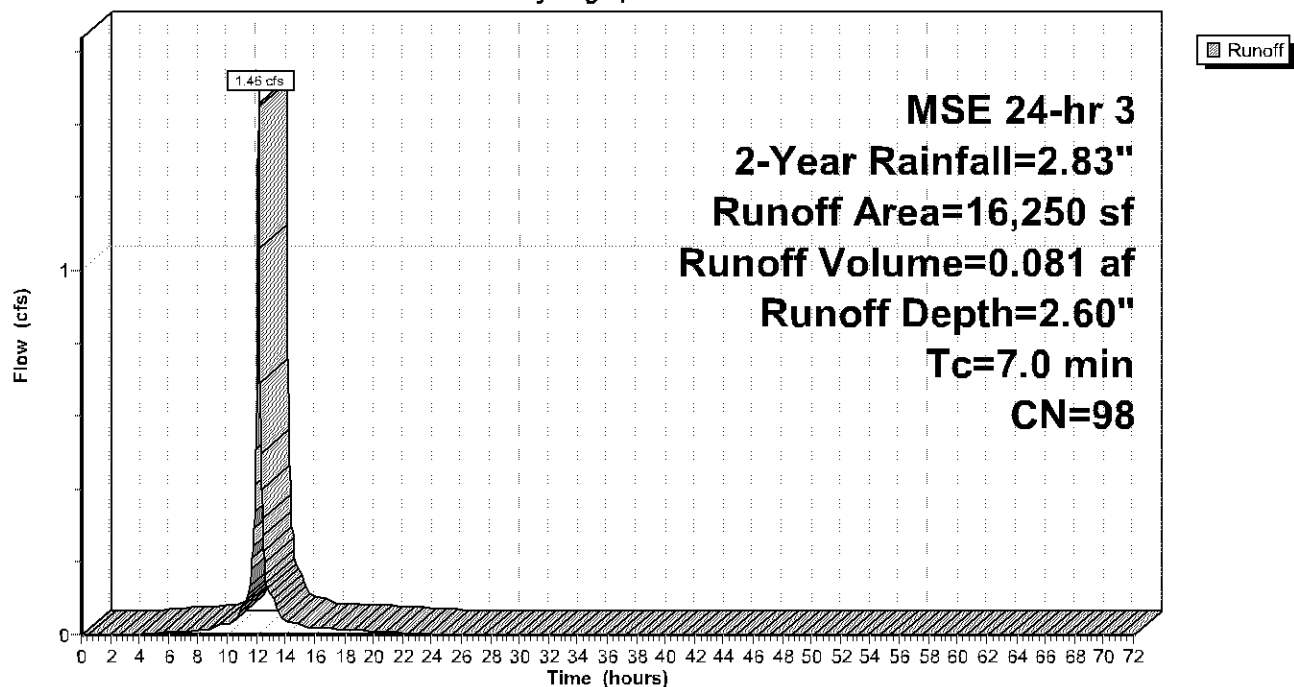
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
16,250	98	Paved parking, HSG A
16,250		100.00% Impervious Area

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

**Subcatchment 12S: Parking Lot South East**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condition MSE 24-hr 3 2-Year Rainfall=2.83"**

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**Summary for Reach 1R: West**

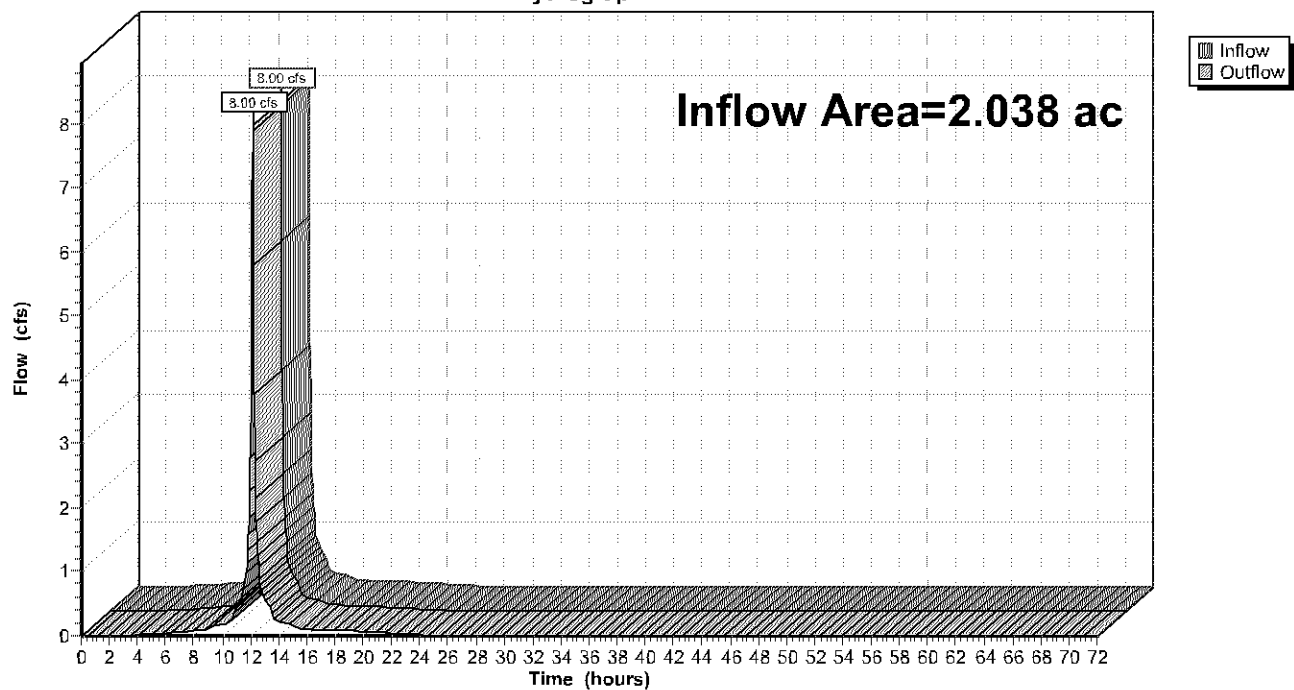
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.038 ac, 100.00% Impervious, Inflow Depth = 2.60" for 2-Year event  
 Inflow = 8.00 cfs @ 12.14 hrs, Volume= 0.441 af  
 Outflow = 8.00 cfs @ 12.14 hrs, Volume= 0.441 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 1R: West**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condition MSE 24-hr 3 2-Year Rainfall=2.83"**

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**Summary for Reach 2R: South East**

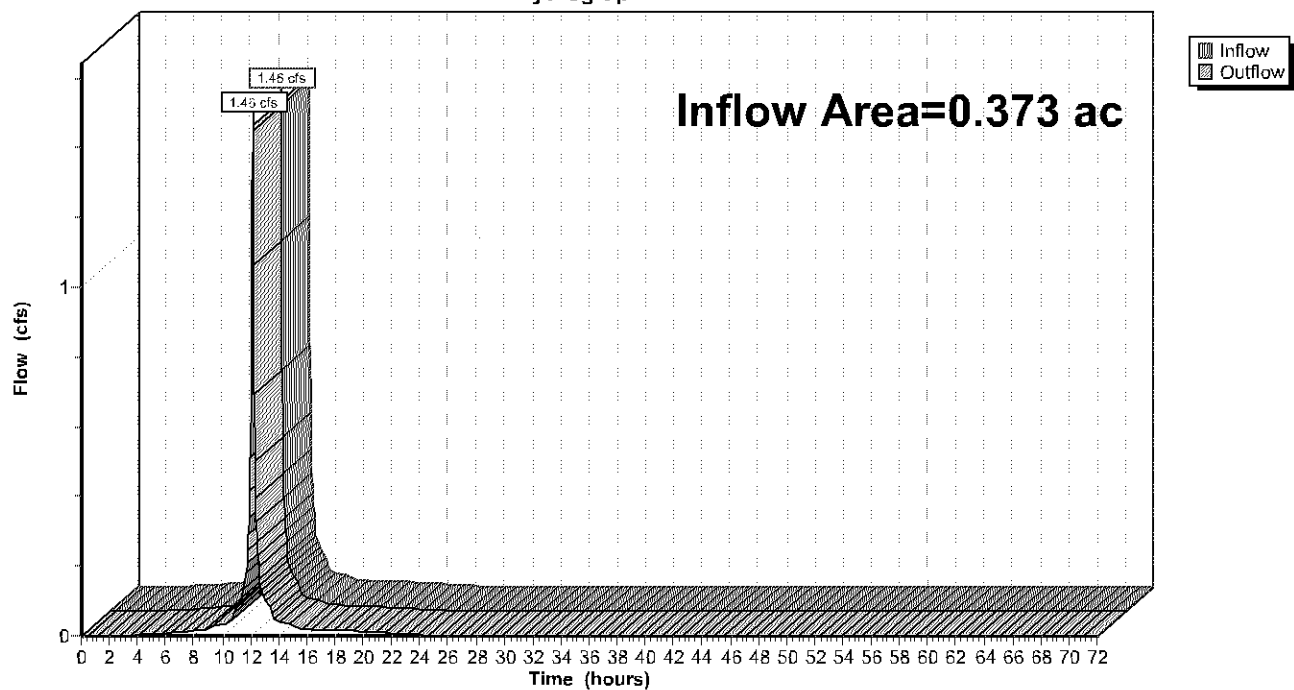
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.373 ac, 100.00% Impervious, Inflow Depth = 2.60" for 2-Year event  
 Inflow = 1.46 cfs @ 12.14 hrs, Volume= 0.081 af  
 Outflow = 1.46 cfs @ 12.14 hrs, Volume= 0.081 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 2R: South East**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condition MSE 24-hr 3 2-Year Rainfall=2.83"**

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**Summary for Reach 3R: North**

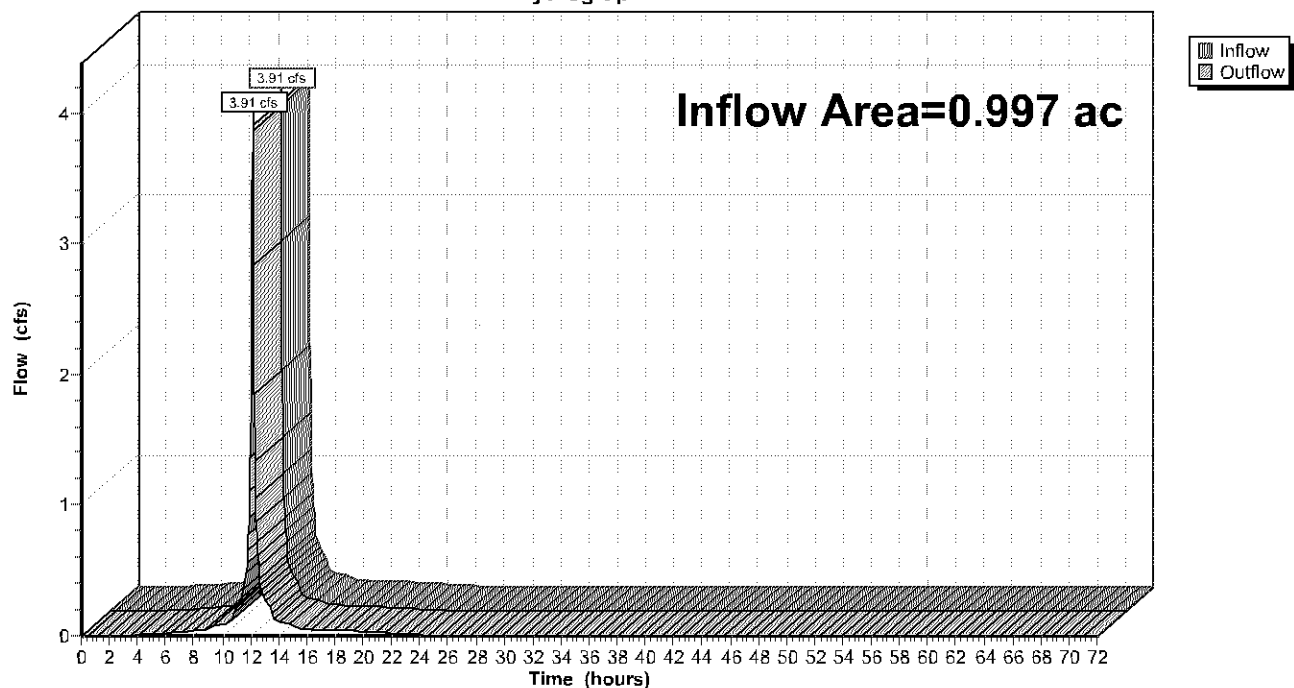
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.997 ac, 100.00% Impervious, Inflow Depth = 2.60" for 2-Year event  
 Inflow = 3.91 cfs @ 12.14 hrs, Volume= 0.216 af  
 Outflow = 3.91 cfs @ 12.14 hrs, Volume= 0.216 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 3R: North**

Hydrograph





**2021-0827 - Clover Shopping Center Existing Conditio** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Subcatchment 7S: Parking Lot South West

Runoff = 12.08 cfs @ 12.14 hrs, Volume= 0.680 af, Depth= 4.00"

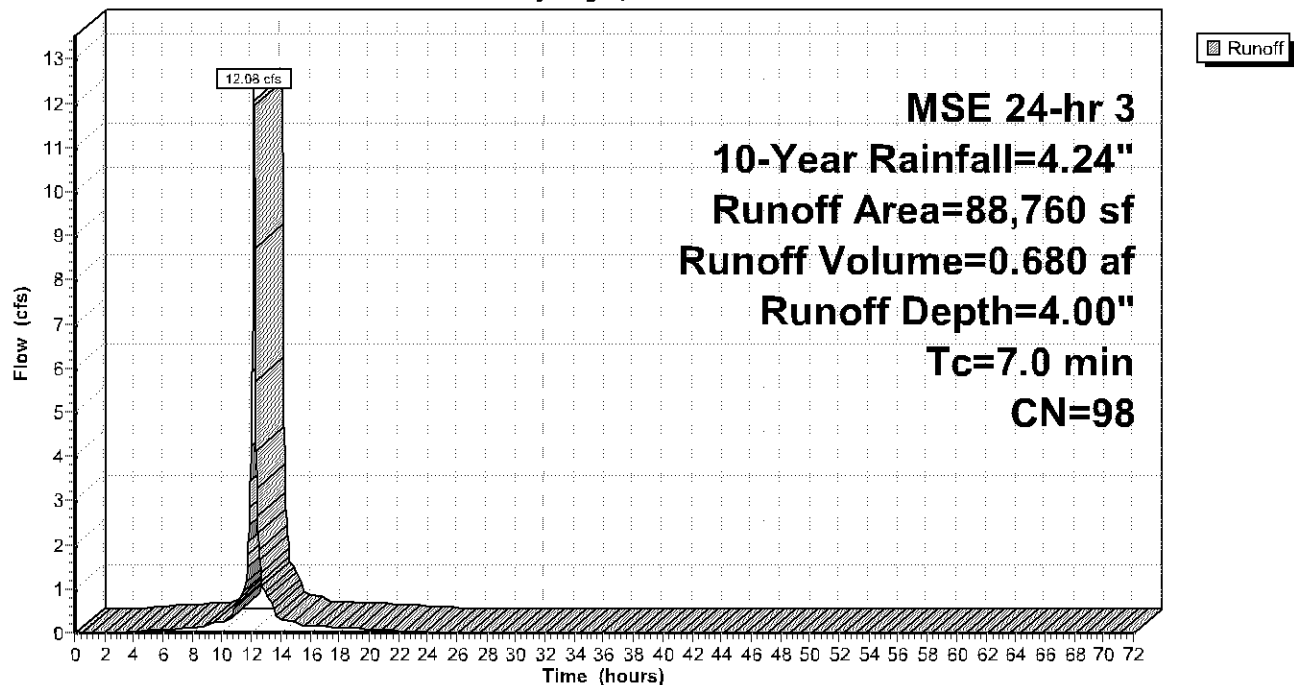
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
88,760	98	Paved parking, HSG A
88,760		100.00% Impervious Area

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

### Subcatchment 7S: Parking Lot South West

Hydrograph



**2021-0827 - Clover Shopping Center Existing Conditio** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Subcatchment 11S: Building & Parking Lot North

Runoff = 5.91 cfs @ 12.14 hrs, Volume= 0.333 af, Depth= 4.00"

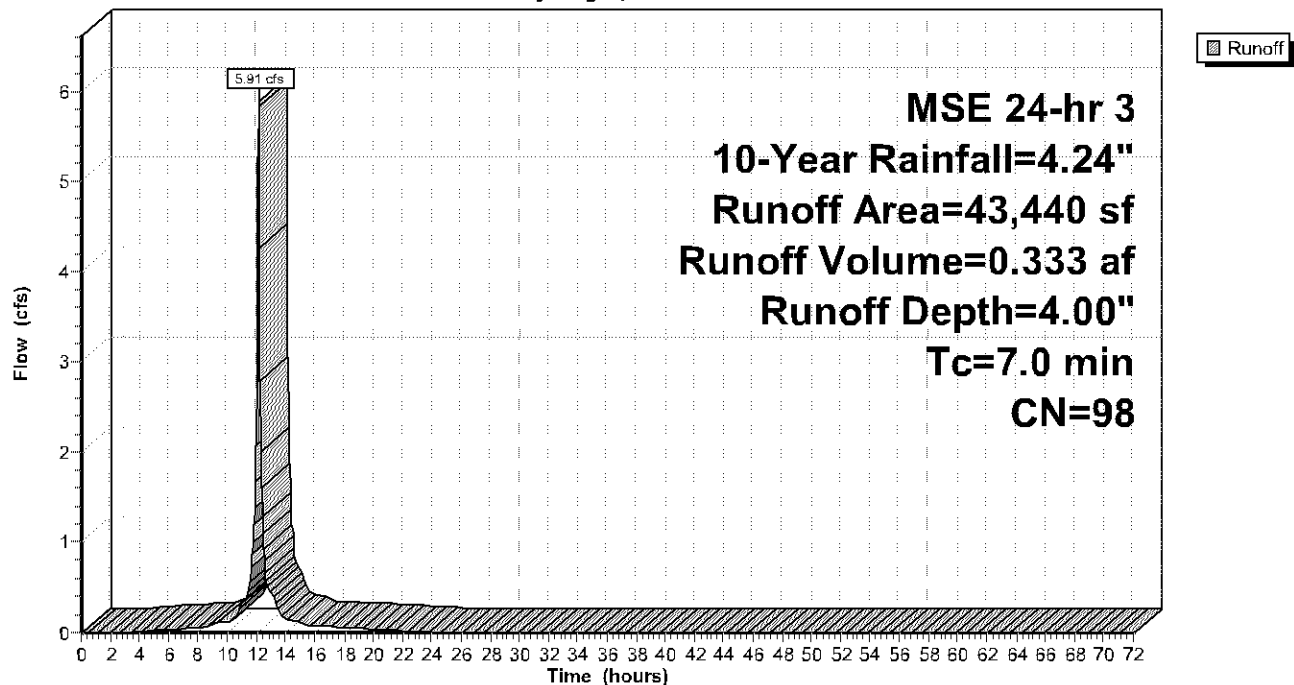
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
43,440	98	Paved parking, HSG A
43,440		100.00% Impervious Area

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

### Subcatchment 11S: Building & Parking Lot North

Hydrograph



**2021-0827 - Clover Shopping Center Existing Conditio** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Subcatchment 12S: Parking Lot South East

Runoff = 2.21 cfs @ 12.14 hrs, Volume= 0.124 af, Depth= 4.00"

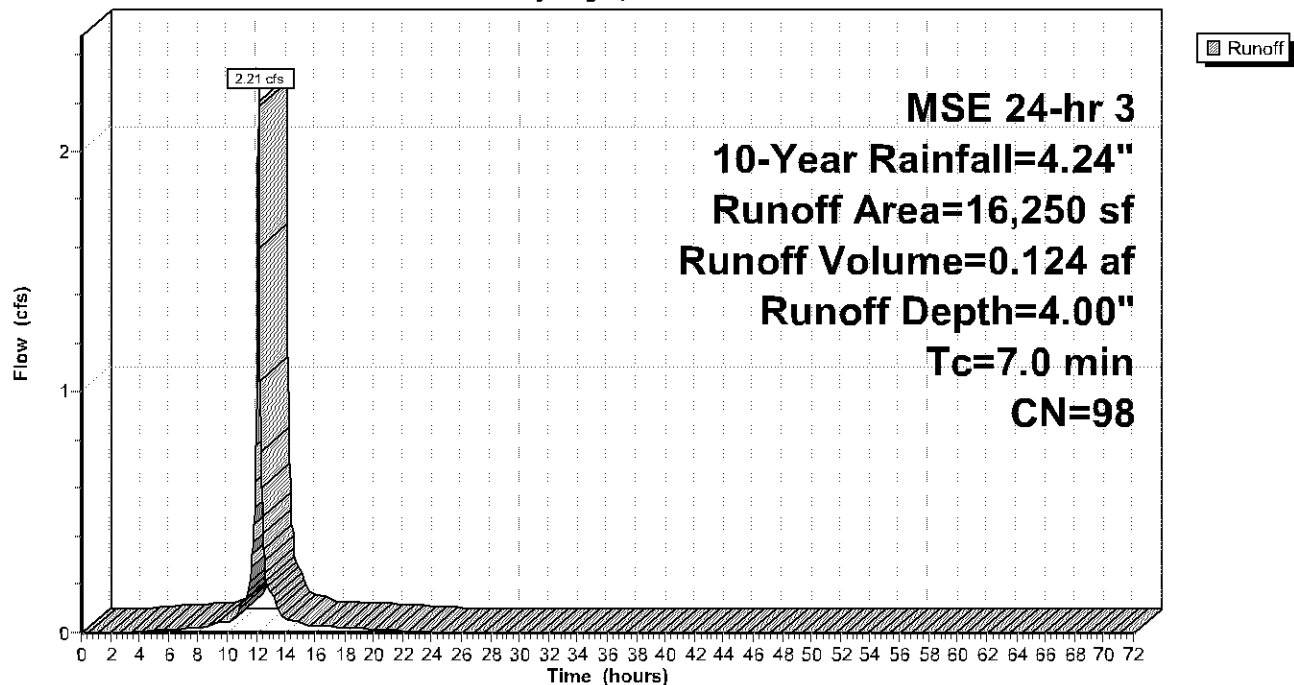
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
16,250	98	Paved parking, HSG A
16,250		100.00% Impervious Area

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

### Subcatchment 12S: Parking Lot South East

Hydrograph



**2021-0827 - Clover Shopping Center Existing Conditio** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Reach 1R: West

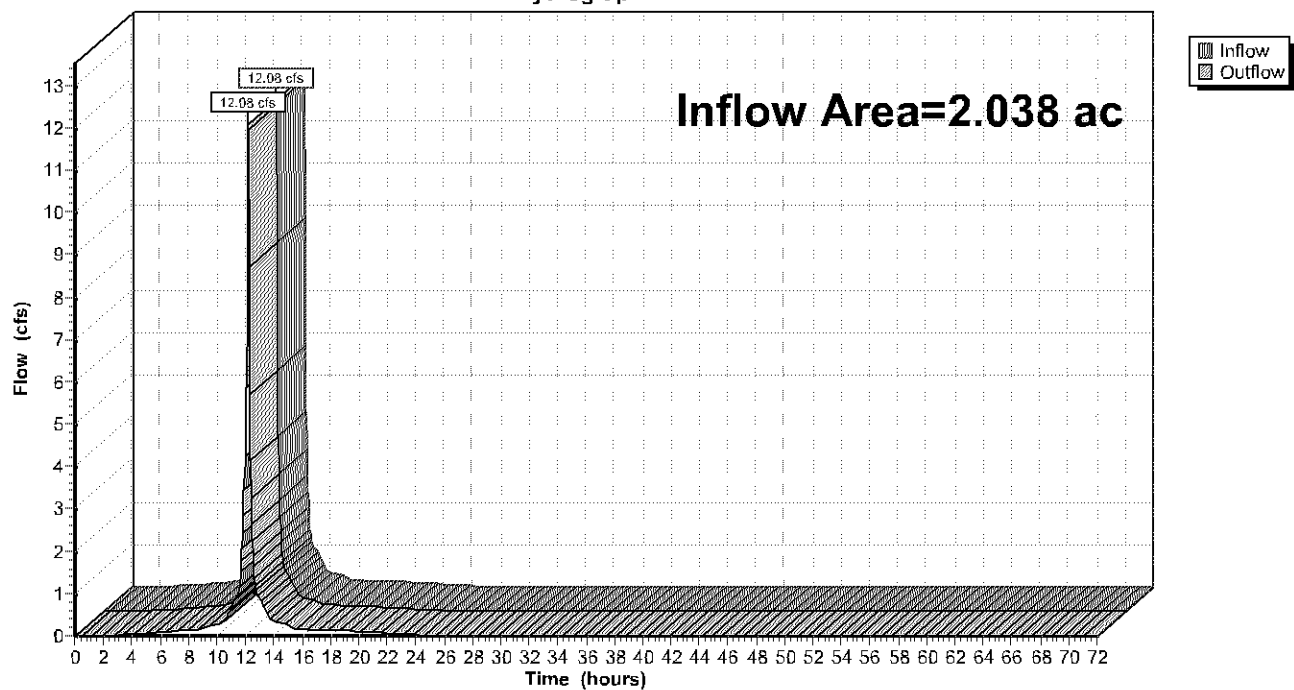
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.038 ac, 100.00% Impervious, Inflow Depth = 4.00" for 10-Year event  
 Inflow = 12.08 cfs @ 12.14 hrs, Volume= 0.680 af  
 Outflow = 12.08 cfs @ 12.14 hrs, Volume= 0.680 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 1R: West

Hydrograph



**2021-0827 - Clover Shopping Center Existing Conditio** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Reach 2R: South East

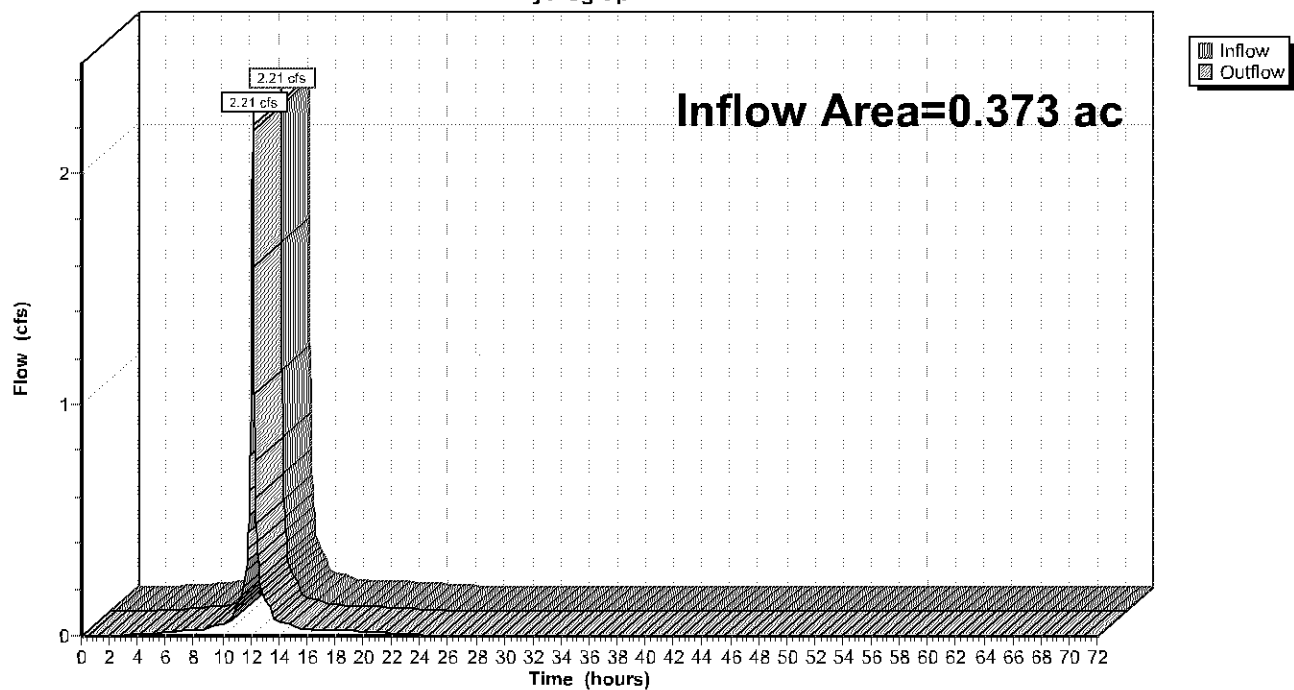
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.373 ac, 100.00% Impervious, Inflow Depth = 4.00" for 10-Year event  
 Inflow = 2.21 cfs @ 12.14 hrs, Volume= 0.124 af  
 Outflow = 2.21 cfs @ 12.14 hrs, Volume= 0.124 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 2R: South East

Hydrograph



**2021-0827 - Clover Shopping Center Existing Conditio** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Reach 3R: North

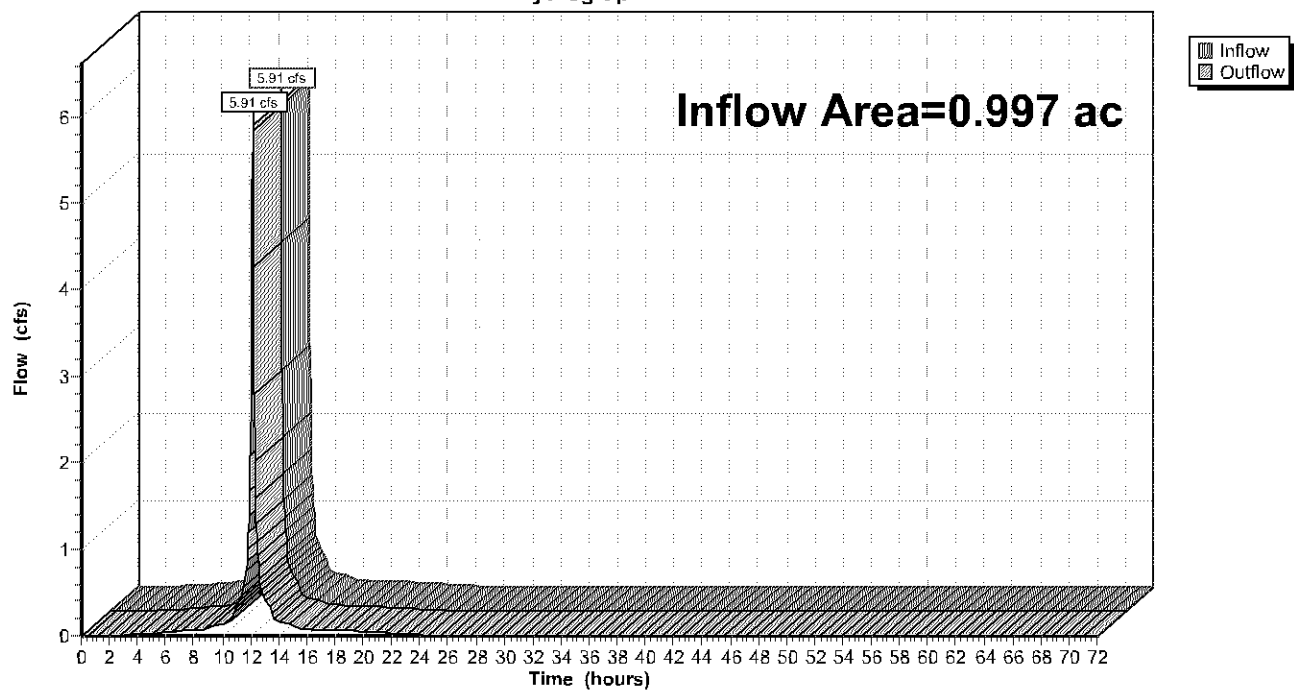
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.997 ac, 100.00% Impervious, Inflow Depth = 4.00" for 10-Year event  
 Inflow = 5.91 cfs @ 12.14 hrs, Volume= 0.333 af  
 Outflow = 5.91 cfs @ 12.14 hrs, Volume= 0.333 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 3R: North

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condi** MSE 24-hr 3 100-Year Rainfall=7.50"

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**Summary for Subcatchment 7S: Parking Lot South West**

Runoff = 21.47 cfs @ 12.14 hrs, Volume= 1.233 af, Depth= 7.26"

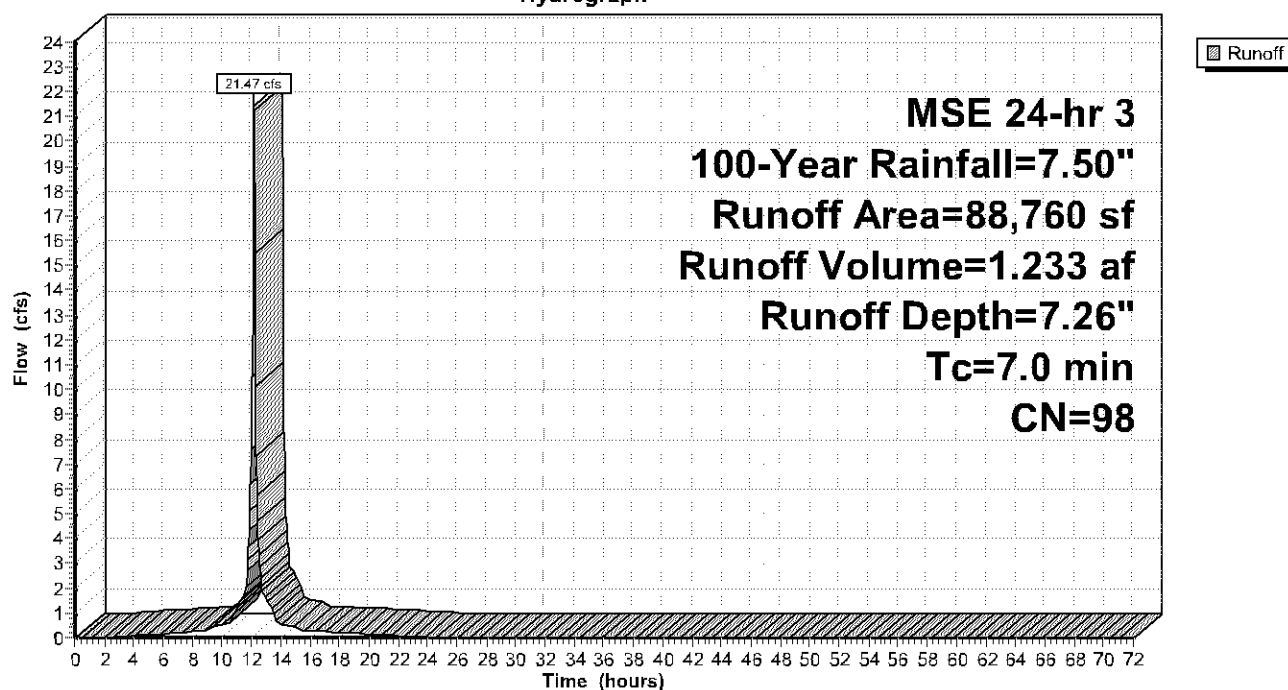
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
88,760	98	Paved parking, HSG A
88,760		100.00% Impervious Area

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

**Subcatchment 7S: Parking Lot South West**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condi** MSE 24-hr 3 100-Year Rainfall=7.50"

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### Summary for Subcatchment 11S: Building & Parking Lot North

Runoff = 10.51 cfs @ 12.14 hrs, Volume= 0.603 af, Depth= 7.26"

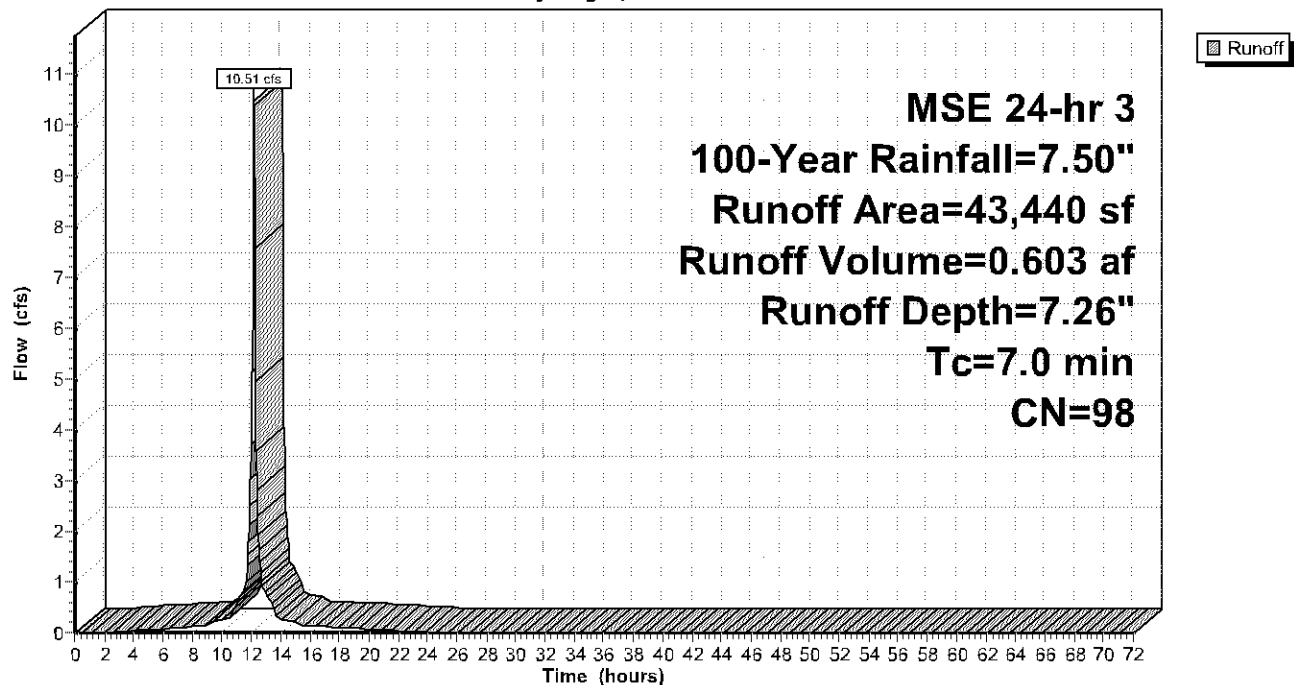
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
43,440	98	Paved parking, HSG A
43,440		100.00% Impervious Area

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

### Subcatchment 11S: Building & Parking Lot North

Hydrograph





**2021-0827 - Clover Shopping Center Existing Condi** MSE 24-hr 3 100-Year Rainfall=7.50"

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### Summary for Subcatchment 12S: Parking Lot South East

Runoff = 3.93 cfs @ 12.14 hrs, Volume= 0.226 af, Depth= 7.26"

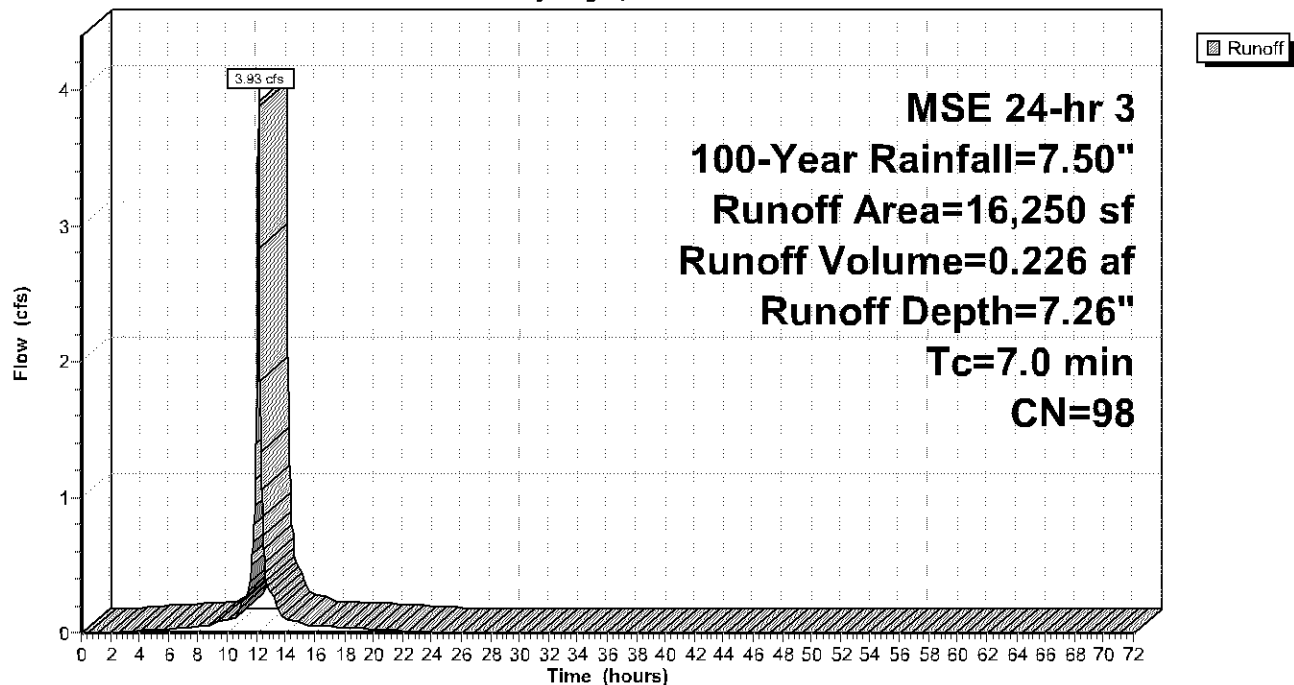
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
16,250	98	Paved parking, HSG A
16,250		100.00% Impervious Area

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

### Subcatchment 12S: Parking Lot South East

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condi** MSE 24-hr 3 100-Year Rainfall=7.50"

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### Summary for Reach 1R: West

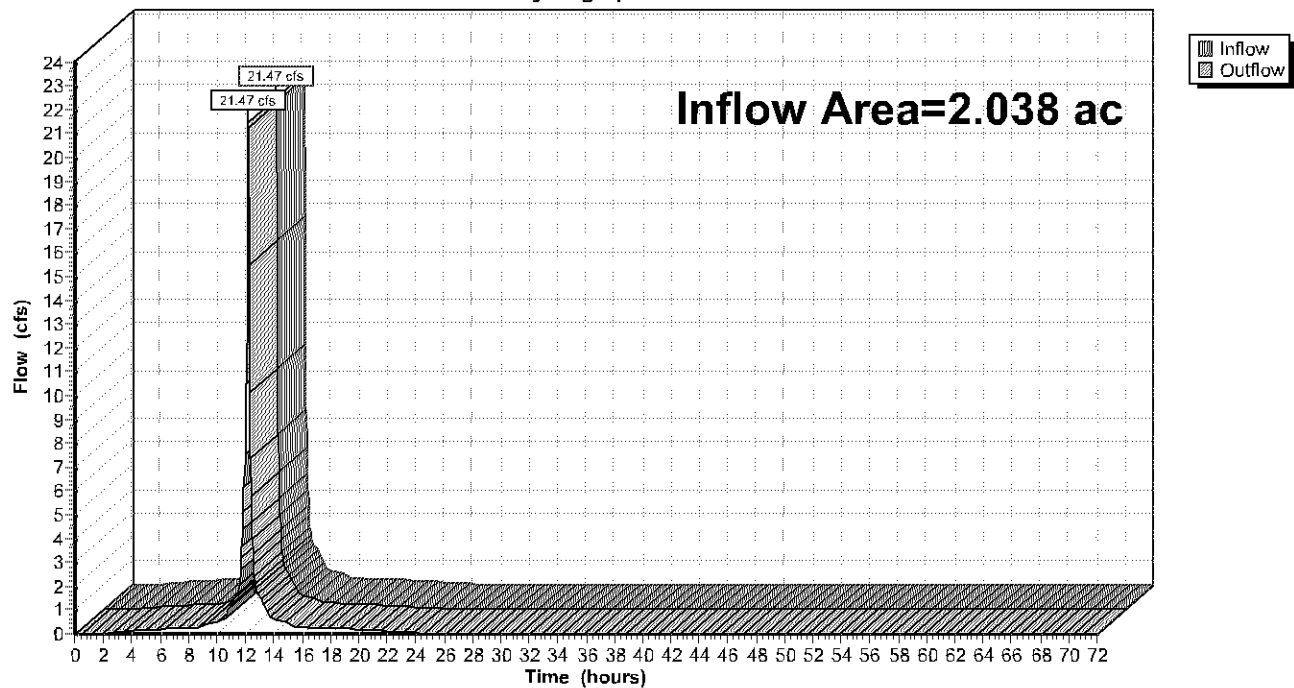
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.038 ac, 100.00% Impervious, Inflow Depth = 7.26" for 100-Year event  
 Inflow = 21.47 cfs @ 12.14 hrs, Volume= 1.233 af  
 Outflow = 21.47 cfs @ 12.14 hrs, Volume= 1.233 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 1R: West

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condi** MSE 24-hr 3 100-Year Rainfall=7.50"

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**Summary for Reach 2R: South East**

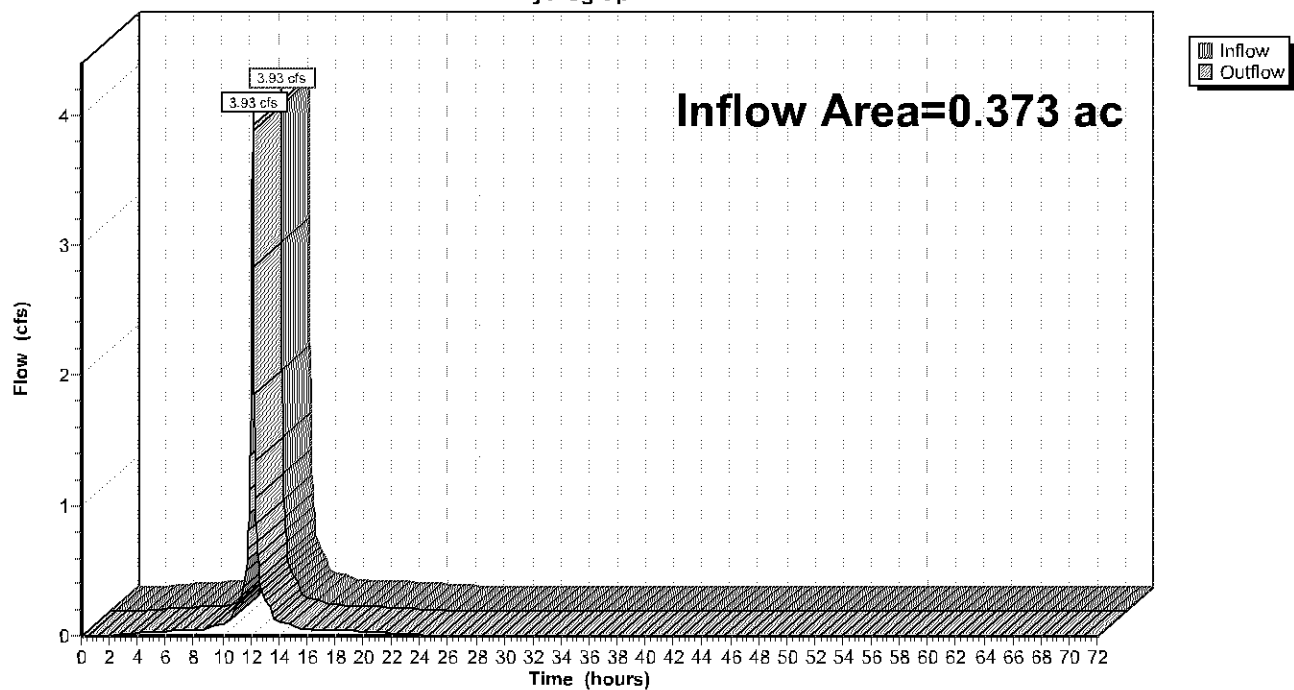
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.373 ac, 100.00% Impervious, Inflow Depth = 7.26" for 100-Year event  
Inflow = 3.93 cfs @ 12.14 hrs, Volume= 0.226 af  
Outflow = 3.93 cfs @ 12.14 hrs, Volume= 0.226 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 2R: South East**

Hydrograph



**2021-0827 - Clover Shopping Center Existing Condi** MSE 24-hr 3 100-Year Rainfall=7.50"

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### Summary for Reach 3R: North

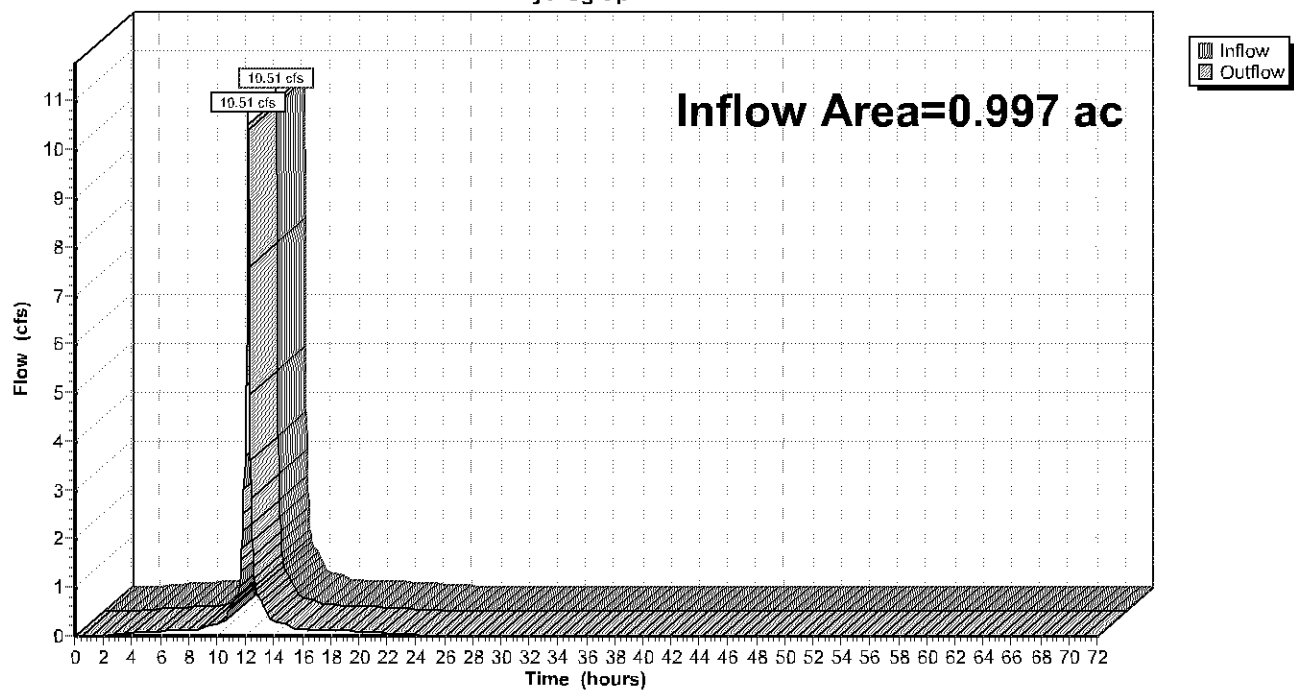
[40] Hint: Not Described (Outflow=Inflow)

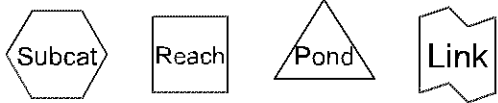
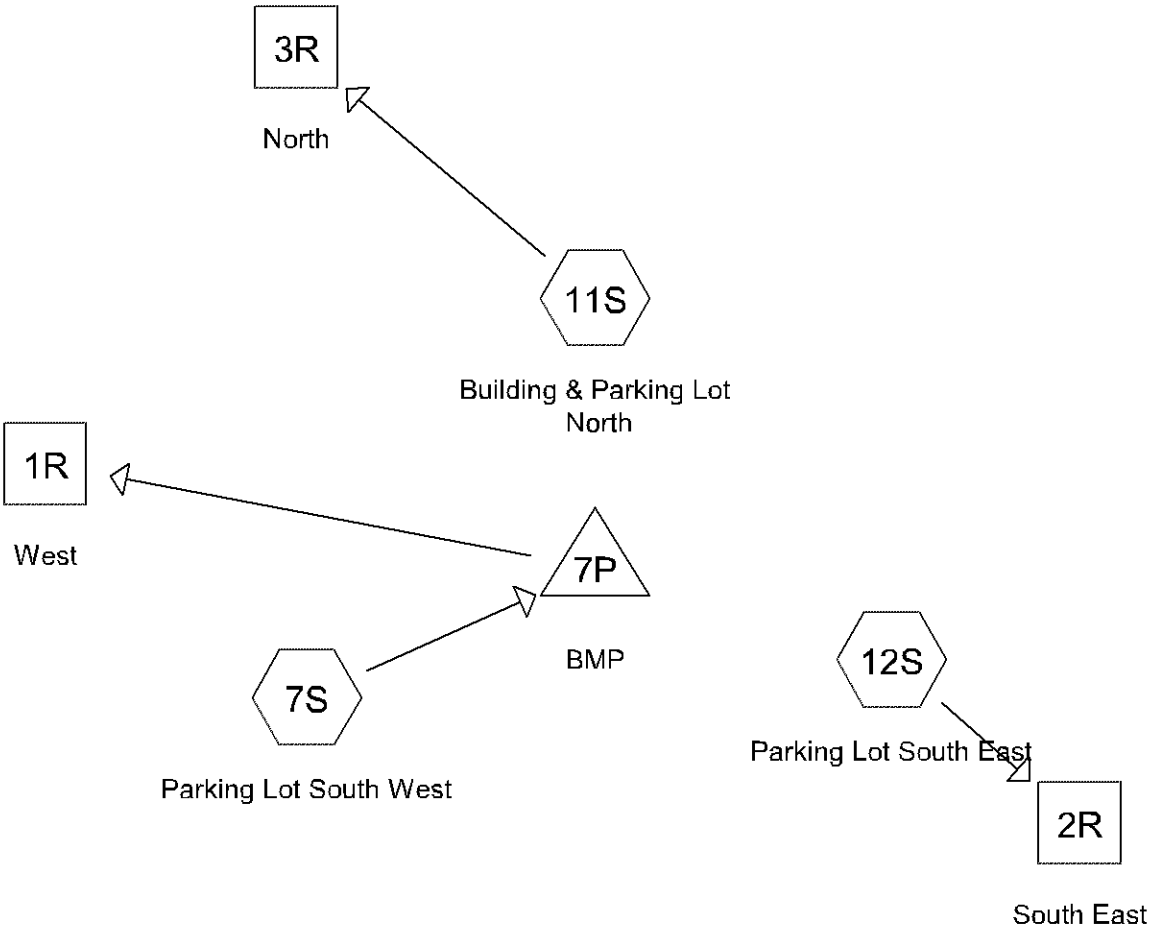
Inflow Area = 0.997 ac, 100.00% Impervious, Inflow Depth = 7.26" for 100-Year event  
 Inflow = 10.51 cfs @ 12.14 hrs, Volume= 0.603 af  
 Outflow = 10.51 cfs @ 12.14 hrs, Volume= 0.603 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 3R: North

Hydrograph





**2021-0831 - Clover Shopping Center Proposed Conditions**

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**Area Listing (all nodes)**

Area (acres)	CN	Description (subcatchment-numbers)
3.408	98	Paved parking, HSG A (7S, 11S, 12S)
<b>3.408</b>	<b>98</b>	<b>TOTAL AREA</b>

**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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**Summary for Subcatchment 7S: Parking Lot South West**

Runoff = 8.53 cfs @ 12.14 hrs, Volume= 0.471 af, Depth= 2.60"

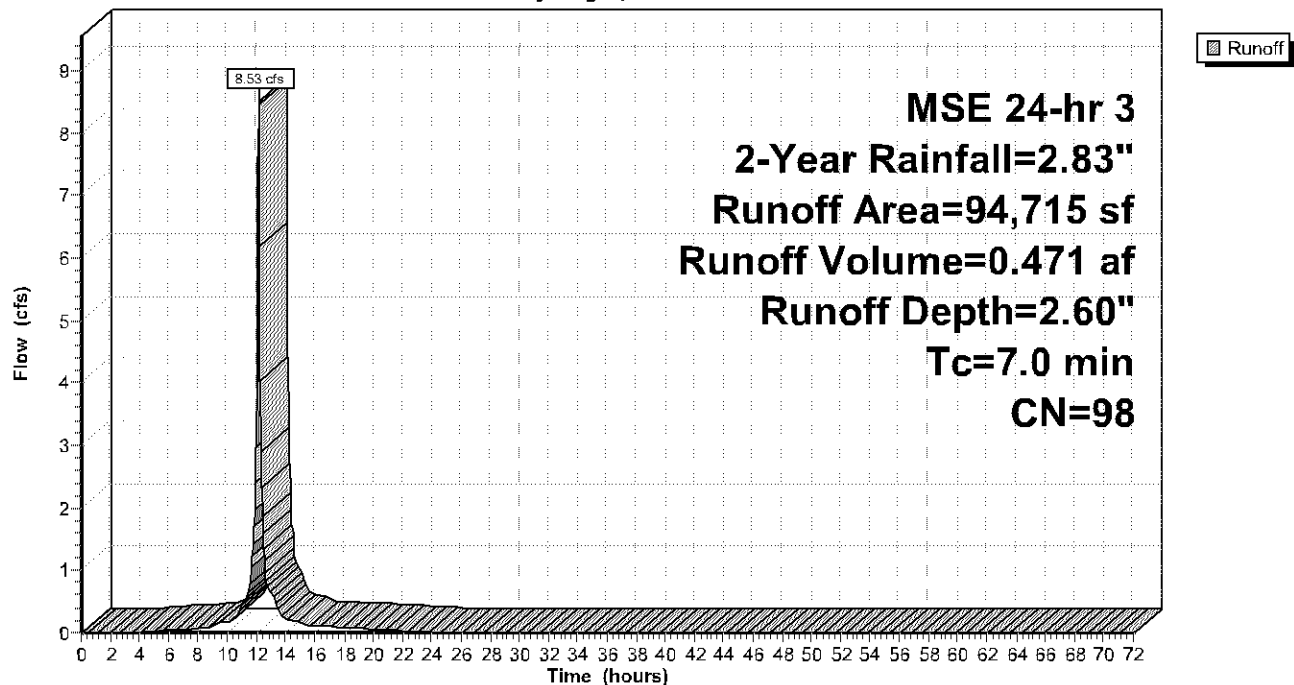
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
94,715	98	Paved parking, HSG A
94,715		100.00% Impervious Area

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

**Subcatchment 7S: Parking Lot South West**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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Page 4

**Summary for Subcatchment 11S: Building & Parking Lot North**

Runoff = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af, Depth= 2.60"

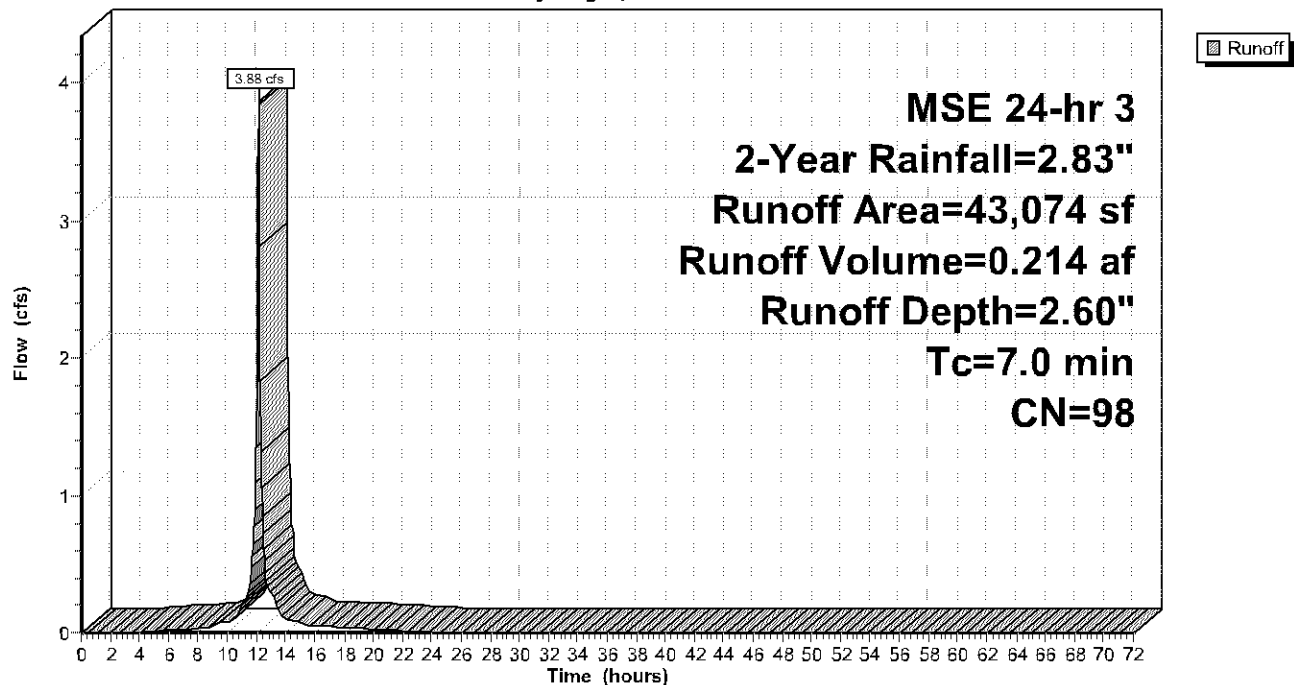
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
43,074	98	Paved parking, HSG A
43,074		100.00% Impervious Area

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

**Subcatchment 11S: Building & Parking Lot North**

Hydrograph





**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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**Summary for Subcatchment 12S: Parking Lot South East**

Runoff = 0.96 cfs @ 12.14 hrs, Volume= 0.053 af, Depth= 2.60"

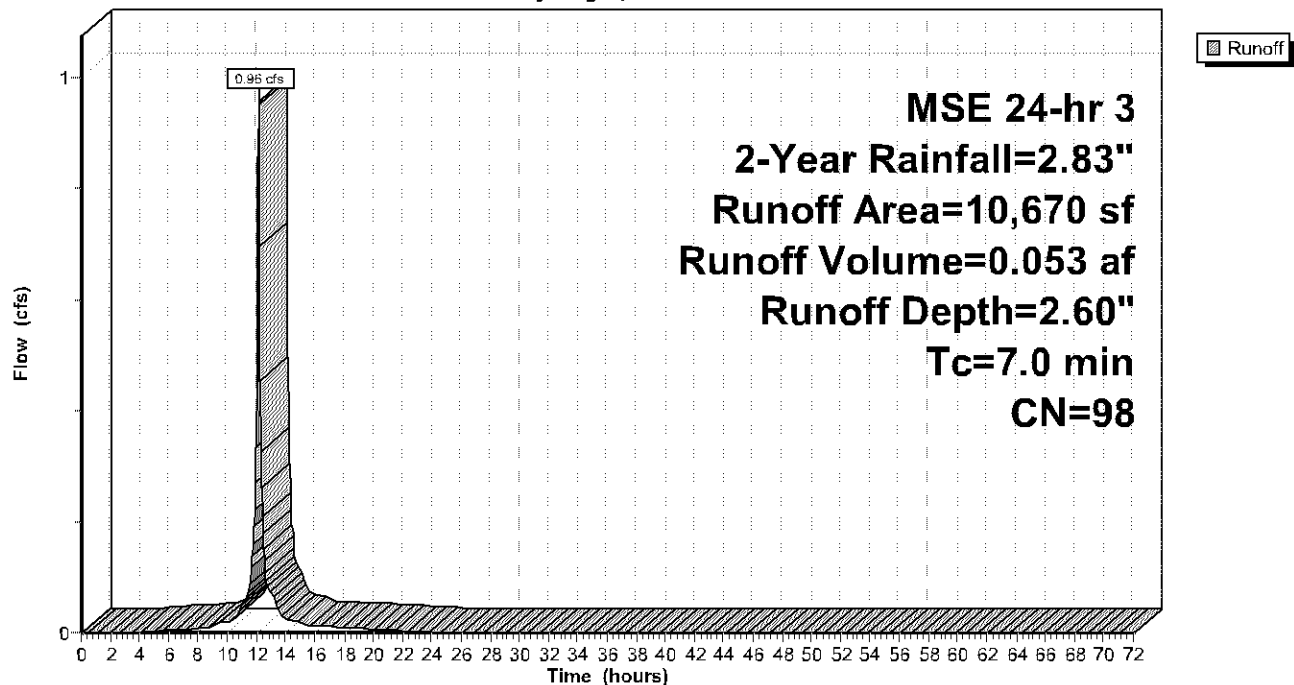
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 2-Year Rainfall=2.83"

Area (sf)	CN	Description
10,670	98	Paved parking, HSG A
10,670		100.00% Impervious Area

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

**Subcatchment 12S: Parking Lot South East**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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**Summary for Reach 1R: West**

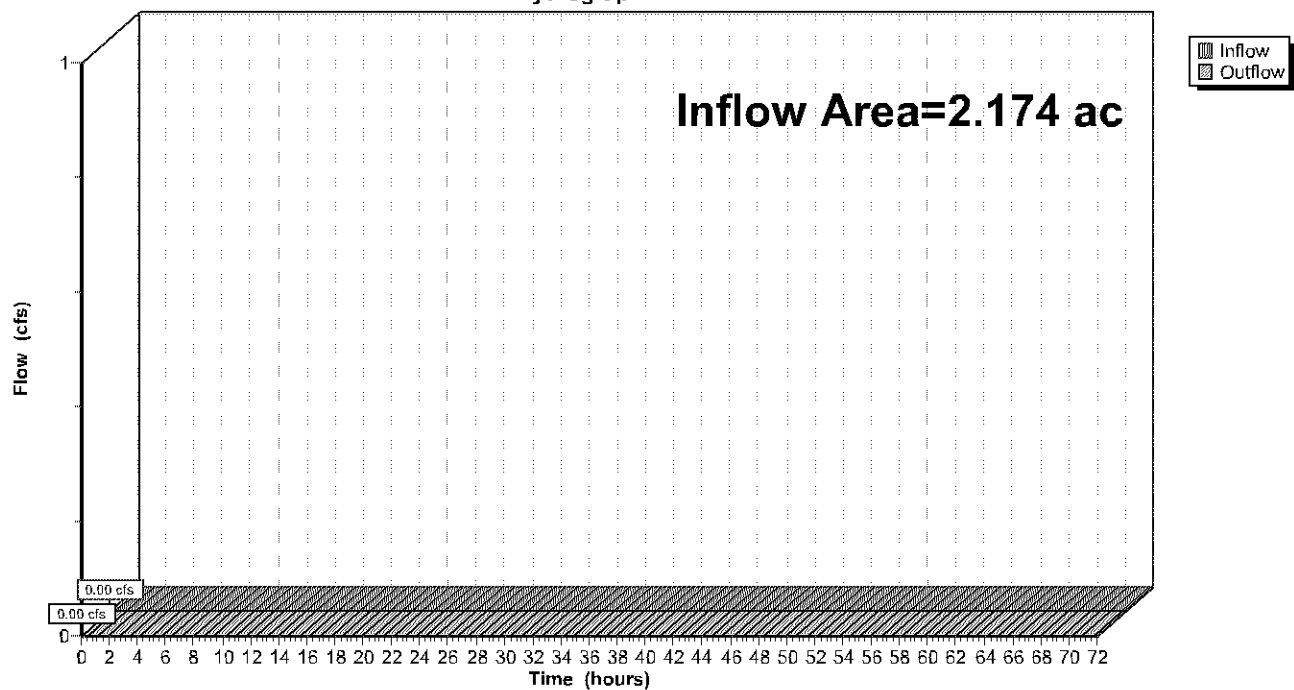
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.174 ac, 100.00% Impervious, Inflow Depth = 0.00" for 2-Year event  
Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 1R: West**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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### Summary for Reach 2R: South East

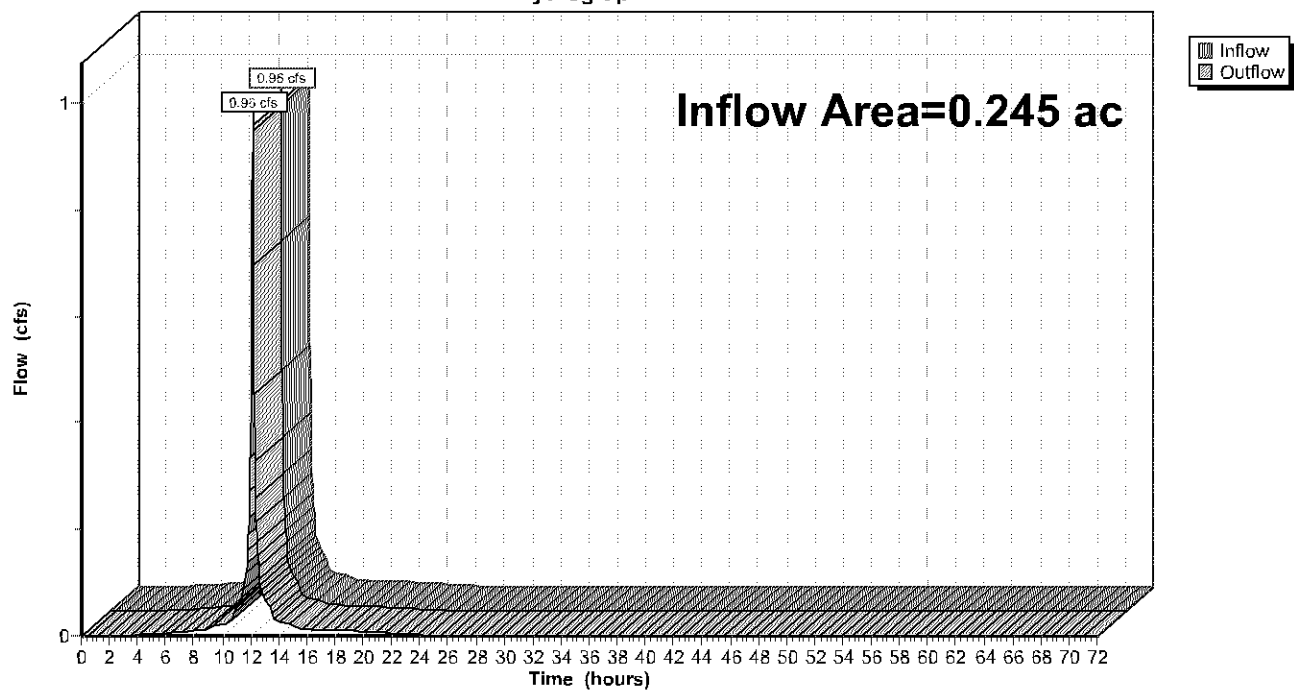
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.245 ac, 100.00% Impervious, Inflow Depth = 2.60" for 2-Year event  
 Inflow = 0.96 cfs @ 12.14 hrs, Volume= 0.053 af  
 Outflow = 0.96 cfs @ 12.14 hrs, Volume= 0.053 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 2R: South East

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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### Summary for Reach 3R: North

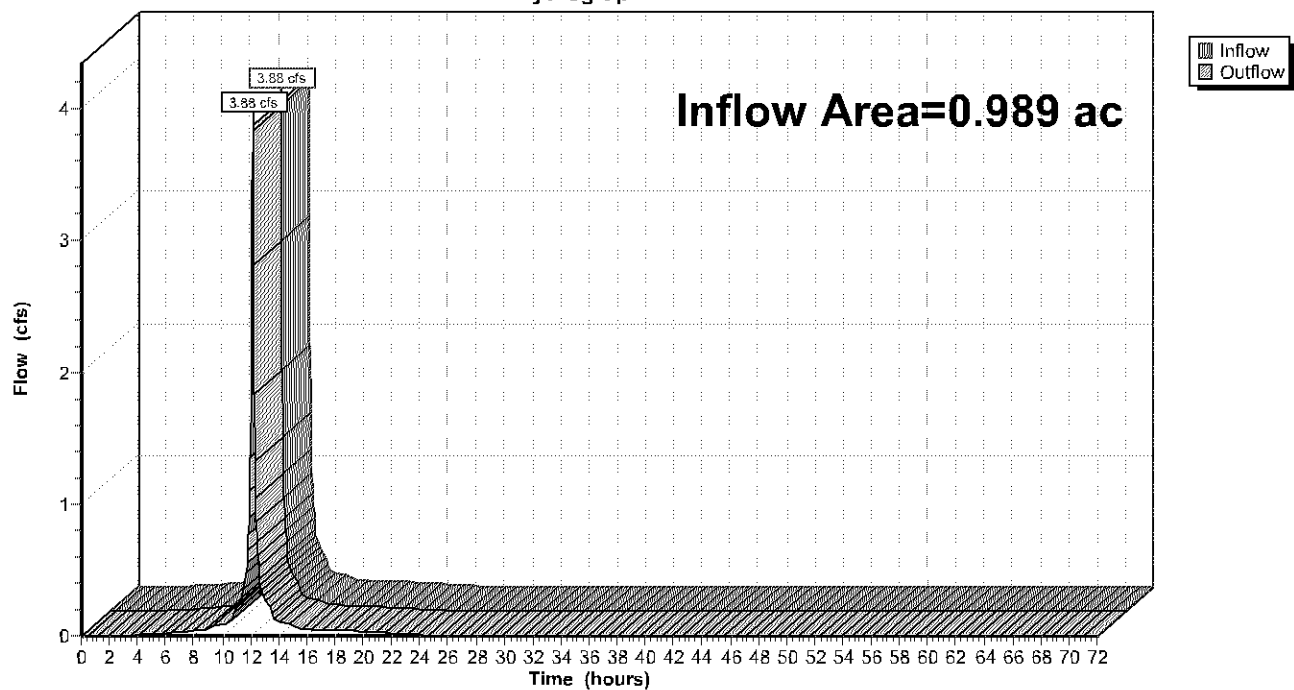
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.989 ac, 100.00% Impervious, Inflow Depth = 2.60" for 2-Year event  
 Inflow = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af  
 Outflow = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 3R: North

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Conditio** MSE 24-hr 3 2-Year Rainfall=2.83"

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**Summary for Pond 7P: BMP**

Inflow Area = 2.174 ac, 100.00% Impervious, Inflow Depth = 2.60" for 2-Year event  
 Inflow = 8.53 cfs @ 12.14 hrs, Volume= 0.471 af  
 Outflow = 0.20 cfs @ 10.95 hrs, Volume= 0.471 af, Atten= 98%, Lag= 0.0 min  
 Discarded = 0.20 cfs @ 10.95 hrs, Volume= 0.471 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
 Peak Elev= 826.90' @ 14.90 hrs Surf.Area= 11,020 sf Storage= 12,825 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 543.7 min ( 1,298.6 - 754.8 )

Volume	Invert	Avail.Storage	Storage Description
#1A	825.00'	11,877 cf	<b>58.00'W x 190.00'L x 4.50'H Field A</b> 49,590 cf Overall - 19,896 cf Embedded = 29,694 cf x 40.0% Voids
#2A	825.50'	19,896 cf	<b>CMP Round 42 x 99 Inside #1</b> Effective Size= 42.0"W x 42.0"H => 9.62 sf x 20.00'L = 192.4 cf Overall Size= 42.0"W x 42.0"H x 20.00'L Row Length Adjustment= +8.00' x 9.62 sf x 11 rows
		31,774 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	825.00'	<b>0.800 in/hr Exfiltration over Surface area</b>
#2	Primary	828.20'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.20 cfs @ 10.95 hrs HW=825.05' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.20 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=825.00' TW=0.00' (Dynamic Tailwater)  
 ↑2=Orifice/Grate ( Controls 0.00 cfs)

**2021-0831 - Clover Shopping Center Proposed Condition** MSE 24-hr 3 2-Year Rainfall=2.83"

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### Pond 7P: BMP - Chamber Wizard Field A

**Chamber Model = CMP Round 42 (Round Corrugated Metal Pipe)**

Effective Size= 42.0"W x 42.0"H => 9.62 sf x 20.00'L = 192.4 cf

Overall Size= 42.0"W x 42.0"H x 20.00'L

Row Length Adjustment= +8.00' x 9.62 sf x 11 rows

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long +8.00' Row Adjustment = 188.00' Row Length +12.0" End Stone x 2 = 190.00' Base Length

11 Rows x 42.0" Wide + 21.0" Spacing x 10 + 12.0" Side Stone x 2 = 58.00' Base Width

6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

99 Chambers x 192.4 cf +8.00' Row Adjustment x 9.62 sf x 11 Rows = 19,896.5 cf Chamber Storage

49,590.0 cf Field - 19,896.5 cf Chambers = 29,693.5 cf Stone x 40.0% Voids = 11,877.4 cf Stone Storage

Chamber Storage + Stone Storage = 31,773.9 cf = 0.729 af

Overall Storage Efficiency = 64.1%

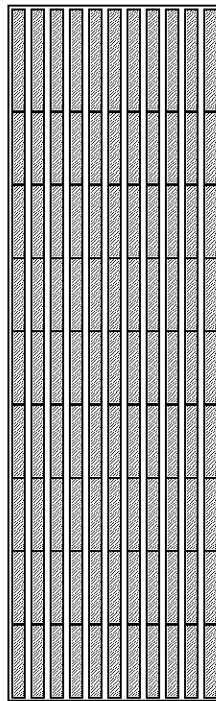
Overall System Size = 190.00' x 58.00' x 4.50'

99 Chambers

1,836.7 cy Field

1,099.8 cy Stone

PROVIDE  
STAGE/STORAGE REPORT  
IN FUTURE  
SUBMITTALS.



2021-0831 - Clover Shopping Center Proposed Conditio MSE 24-hr 3 2-Year Rainfall=2.83"

Prepared by Kimley-Horn

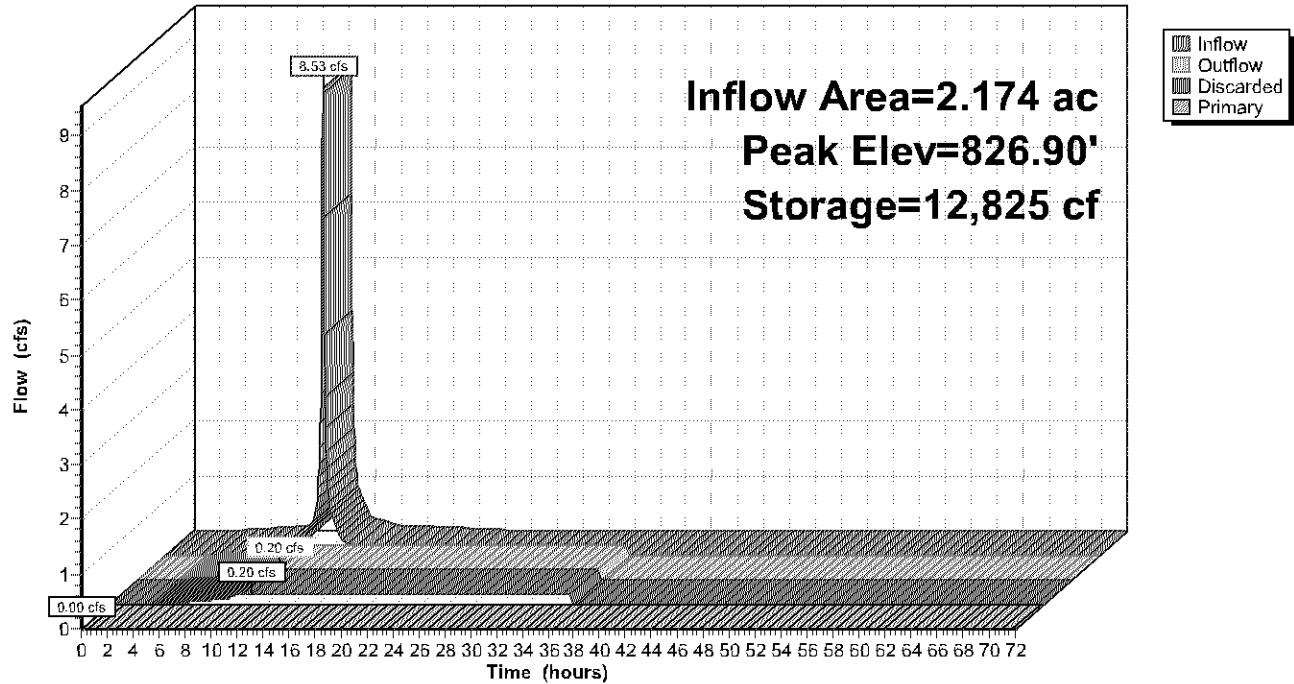
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**Pond 7P: BMP**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Subcatchment 7S: Parking Lot South West

Runoff = 12.89 cfs @ 12.14 hrs, Volume= 0.726 af, Depth= 4.00"

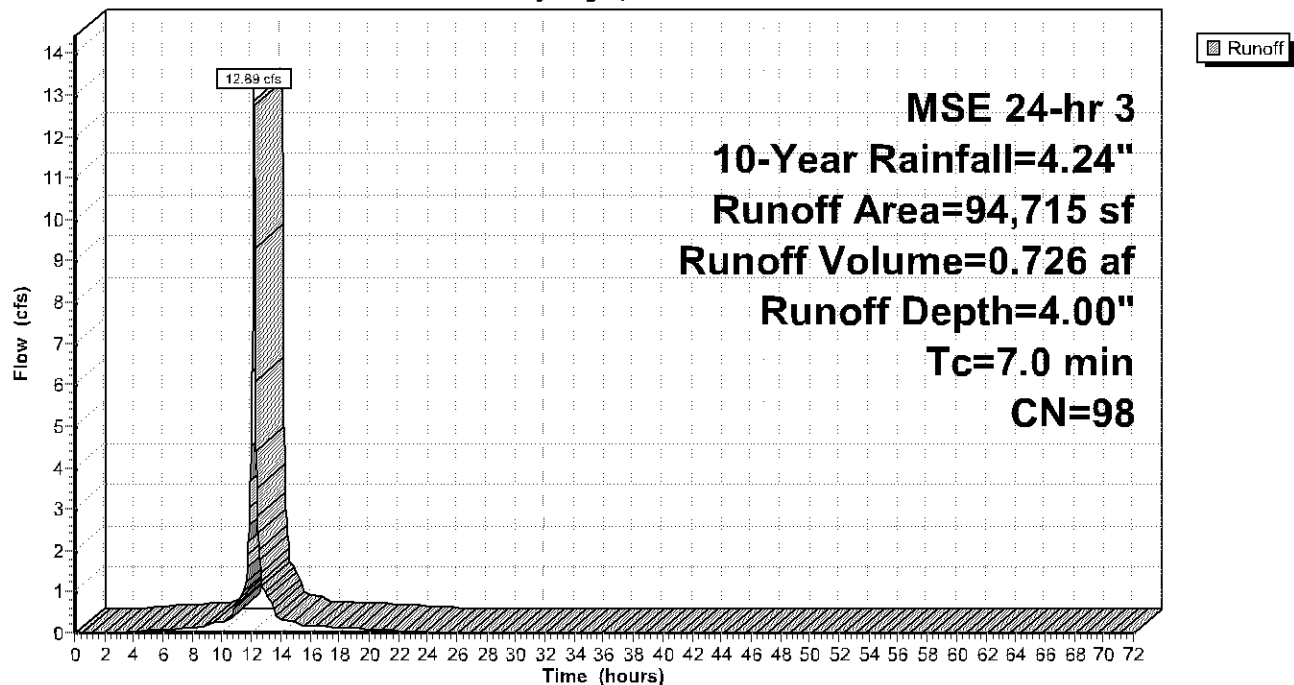
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
94,715	98	Paved parking, HSG A
94,715		100.00% Impervious Area

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

### Subcatchment 7S: Parking Lot South West

Hydrograph





**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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**Summary for Subcatchment 11S: Building & Parking Lot North**

Runoff = 5.86 cfs @ 12.14 hrs, Volume= 0.330 af, Depth= 4.00"

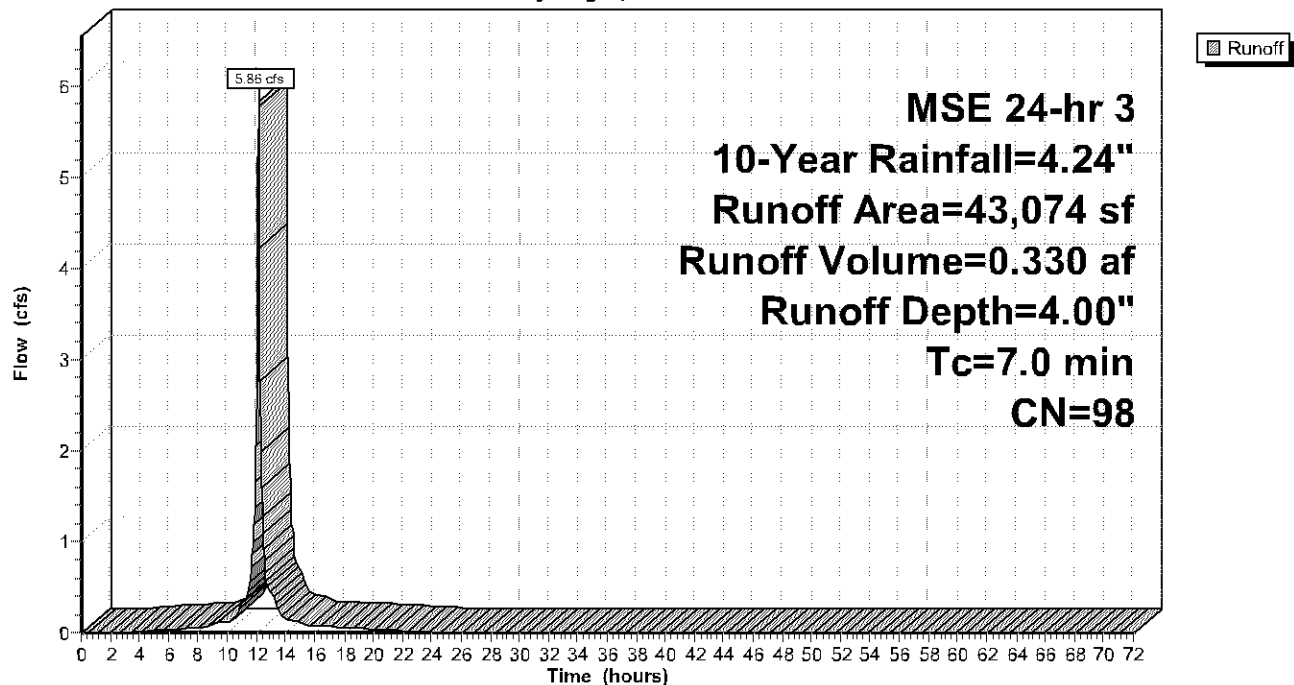
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
43,074	98	Paved parking, HSG A
43,074		100.00% Impervious Area

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

**Subcatchment 11S: Building & Parking Lot North**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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**Summary for Subcatchment 12S: Parking Lot South East**

Runoff = 1.45 cfs @ 12.14 hrs, Volume= 0.082 af, Depth= 4.00"

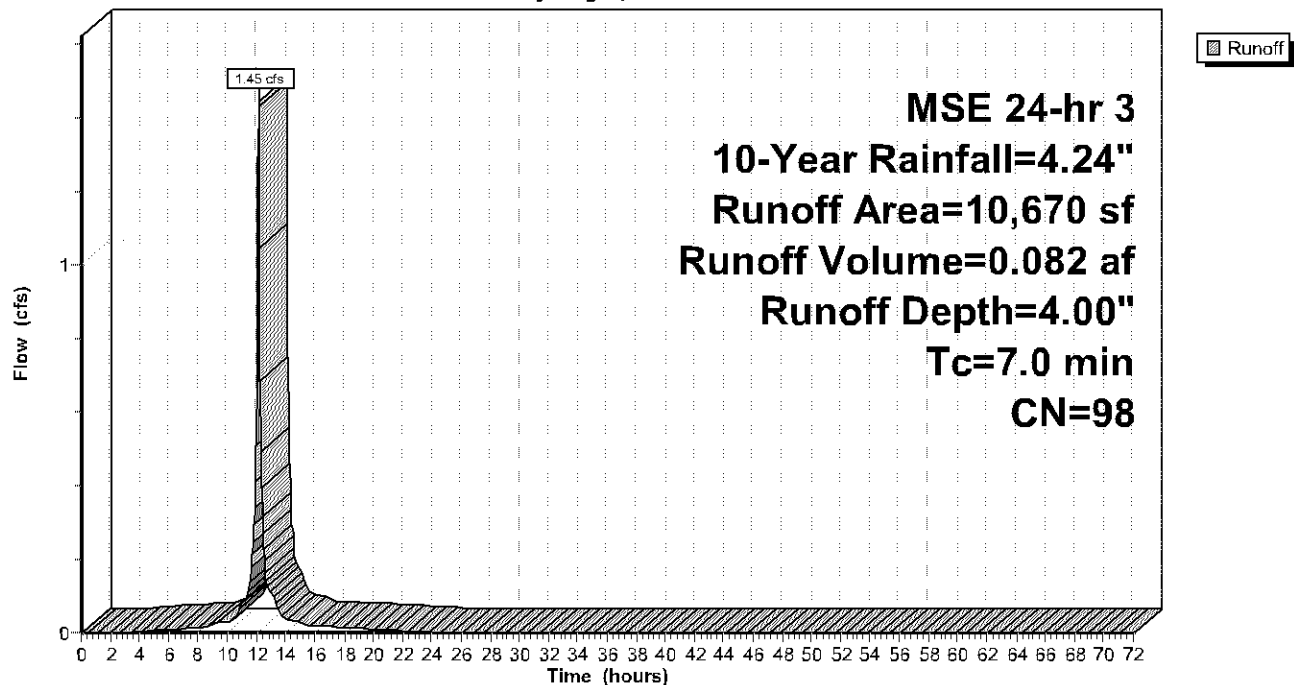
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 10-Year Rainfall=4.24"

Area (sf)	CN	Description
10,670	98	Paved parking, HSG A
10,670		100.00% Impervious Area

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

**Subcatchment 12S: Parking Lot South East**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Reach 1R: West

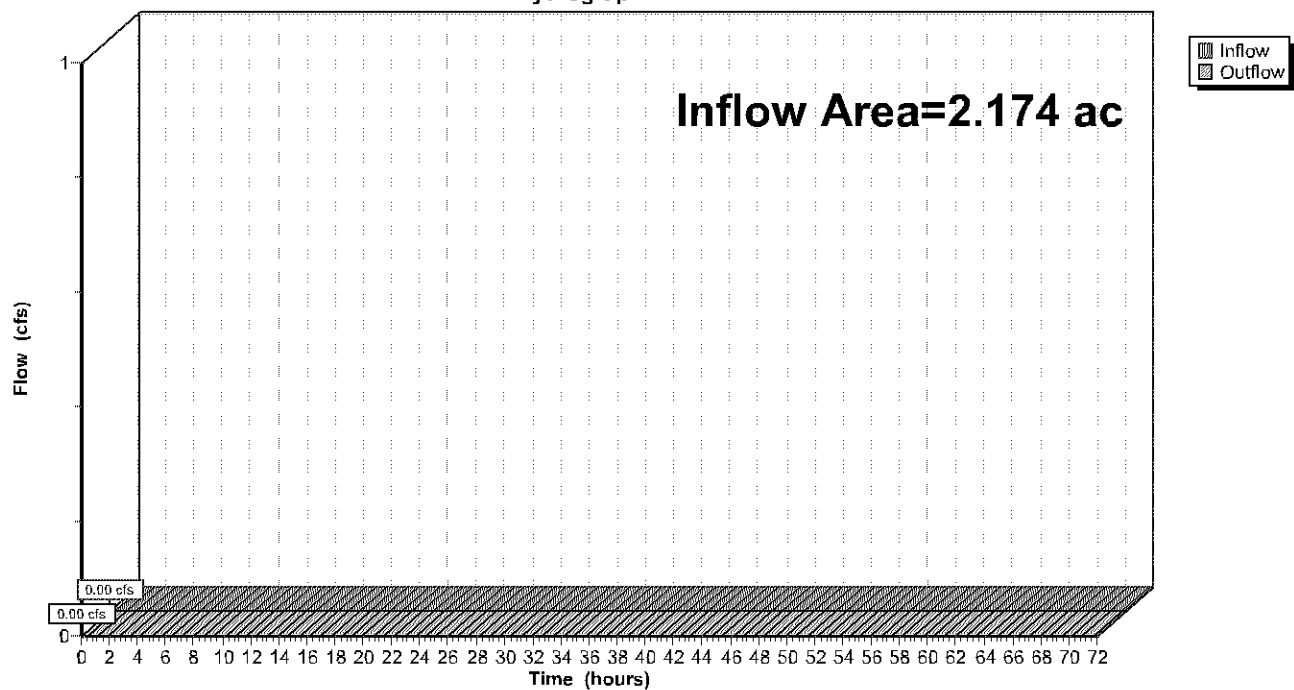
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.174 ac, 100.00% Impervious, Inflow Depth = 0.00" for 10-Year event  
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af  
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 1R: West

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Reach 2R: South East

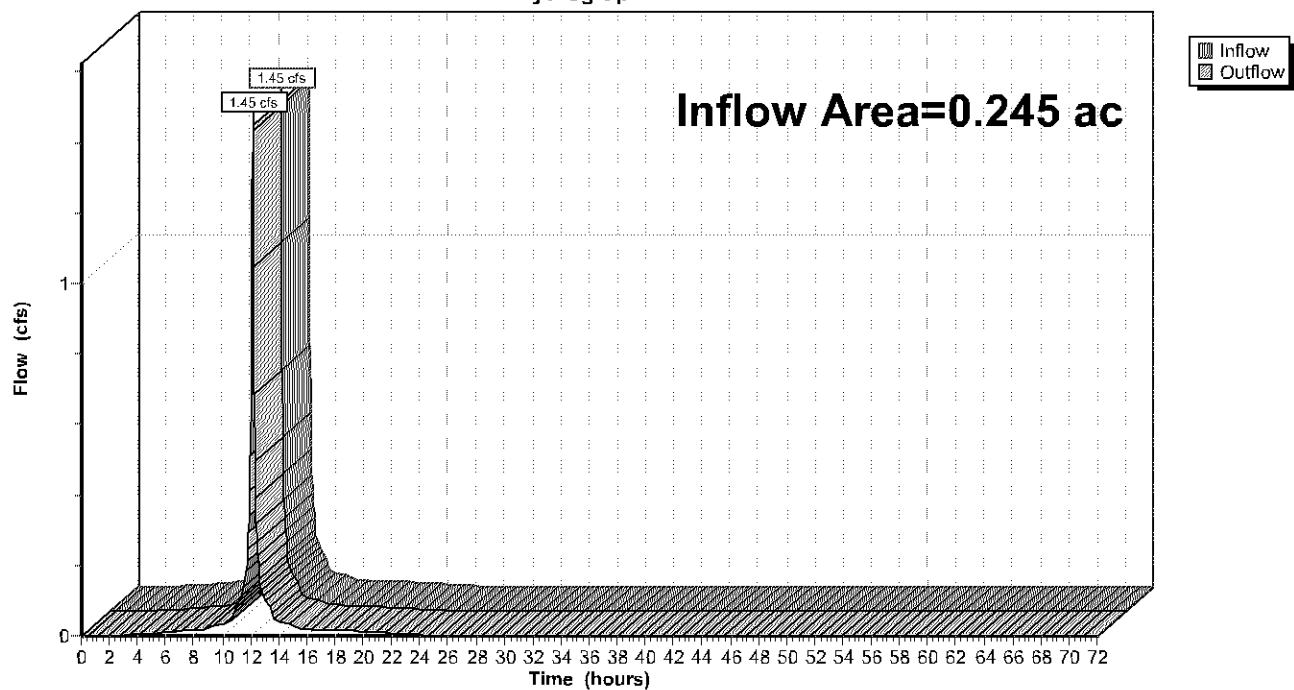
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.245 ac, 100.00% Impervious, Inflow Depth = 4.00" for 10-Year event  
 Inflow = 1.45 cfs @ 12.14 hrs, Volume= 0.082 af  
 Outflow = 1.45 cfs @ 12.14 hrs, Volume= 0.082 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 2R: South East

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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### Summary for Reach 3R: North

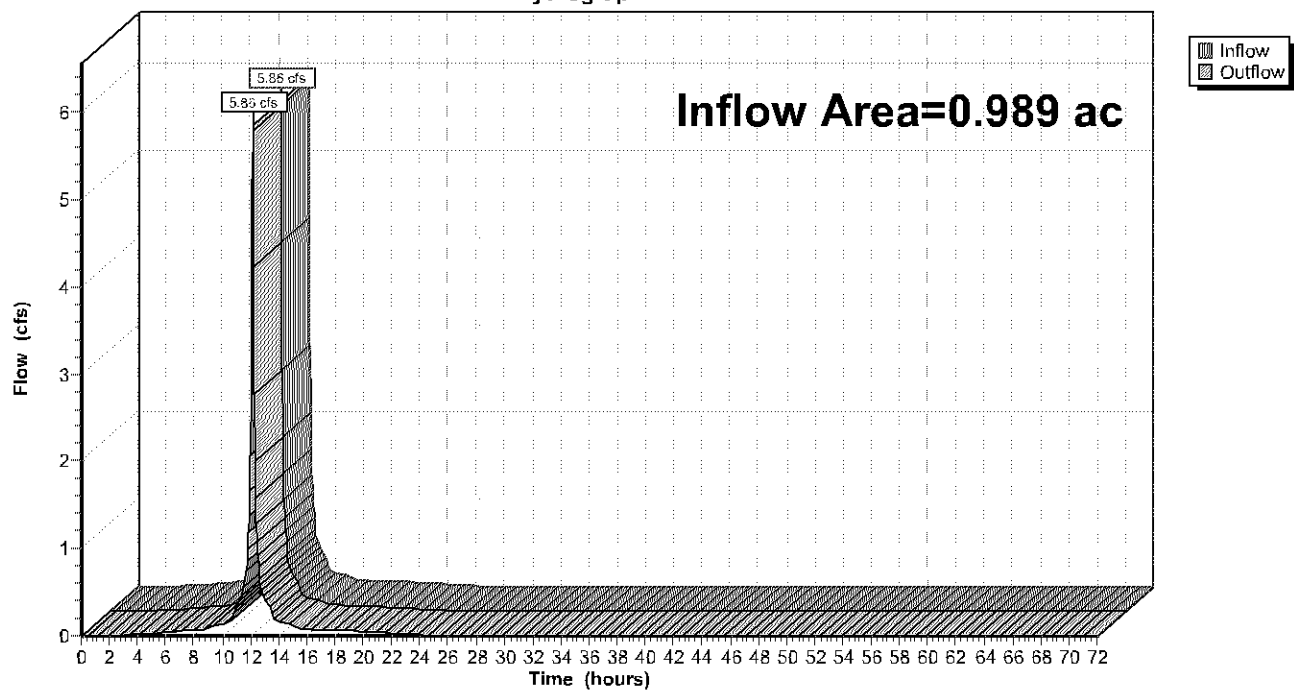
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.989 ac, 100.00% Impervious, Inflow Depth = 4.00" for 10-Year event  
 Inflow = 5.86 cfs @ 12.14 hrs, Volume= 0.330 af  
 Outflow = 5.86 cfs @ 12.14 hrs, Volume= 0.330 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

### Reach 3R: North

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condi** MSE 24-hr 3 10-Year Rainfall=4.24"

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**Summary for Pond 7P: BMP**

Inflow Area = 2.174 ac, 100.00% Impervious, Inflow Depth = 4.00" for 10-Year event  
 Inflow = 12.89 cfs @ 12.14 hrs, Volume= 0.726 af  
 Outflow = 0.20 cfs @ 9.85 hrs, Volume= 0.726 af, Atten= 98%, Lag= 0.0 min  
 Discarded = 0.20 cfs @ 9.85 hrs, Volume= 0.726 af  
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
 Peak Elev= 827.92' @ 15.17 hrs Surf.Area= 11,020 sf Storage= 21,684 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 916.8 min ( 1,665.2 - 748.4 )

Volume	Invert	Avail.Storage	Storage Description
#1A	825.00'	11,877 cf	<b>58.00'W x 190.00'L x 4.50'H Field A</b> 49,590 cf Overall - 19,896 cf Embedded = 29,694 cf x 40.0% Voids
#2A	825.50'	19,896 cf	<b>CMP Round 42 x 99 Inside #1</b> Effective Size= 42.0"W x 42.0"H => 9.62 sf x 20.00'L = 192.4 cf Overall Size= 42.0"W x 42.0"H x 20.00'L Row Length Adjustment= +8.00' x 9.62 sf x 11 rows
		31,774 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	825.00'	<b>0.800 in/hr Exfiltration over Surface area</b>
#2	Primary	828.20'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.20 cfs @ 9.85 hrs HW=825.05' (Free Discharge)  
 ↑1=Exfiltration (Exfiltration Controls 0.20 cfs)

**Primary OutFlow** Max=0.00 cfs @ 0.00 hrs HW=825.00' TW=0.00' (Dynamic Tailwater)  
 ↑2=Orifice/Grate ( Controls 0.00 cfs)

### Pond 7P: BMP - Chamber Wizard Field A

#### Chamber Model = CMP Round 42 (Round Corrugated Metal Pipe)

Effective Size= 42.0"W x 42.0"H => 9.62 sf x 20.00'L = 192.4 cf

Overall Size= 42.0"W x 42.0"H x 20.00'L

Row Length Adjustment= +8.00' x 9.62 sf x 11 rows

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long +8.00' Row Adjustment = 188.00' Row Length +12.0" End Stone x 2 = 190.00' Base Length

11 Rows x 42.0" Wide + 21.0" Spacing x 10 + 12.0" Side Stone x 2 = 58.00' Base Width

6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

99 Chambers x 192.4 cf +8.00' Row Adjustment x 9.62 sf x 11 Rows = 19,896.5 cf Chamber Storage

49,590.0 cf Field - 19,896.5 cf Chambers = 29,693.5 cf Stone x 40.0% Voids = 11,877.4 cf Stone Storage

Chamber Storage + Stone Storage = 31,773.9 cf = 0.729 af

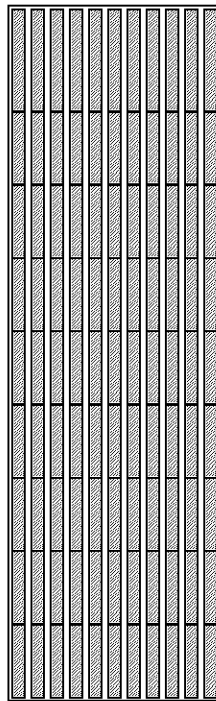
Overall Storage Efficiency = 64.1%

Overall System Size = 190.00' x 58.00' x 4.50'

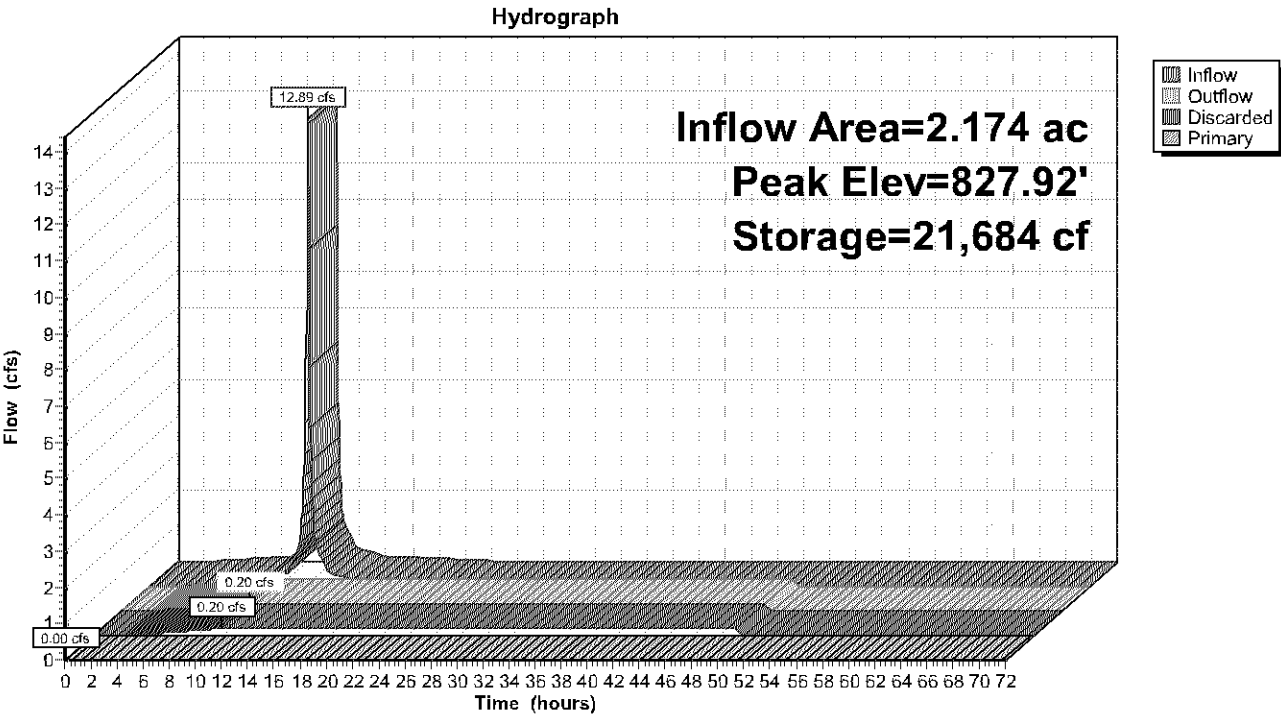
99 Chambers

1,836.7 cy Field

1,099.8 cy Stone



Pond 7P: BMP





**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Summary for Subcatchment 7S: Parking Lot South West**

Runoff = 22.91 cfs @ 12.14 hrs, Volume= 1.316 af, Depth= 7.26"

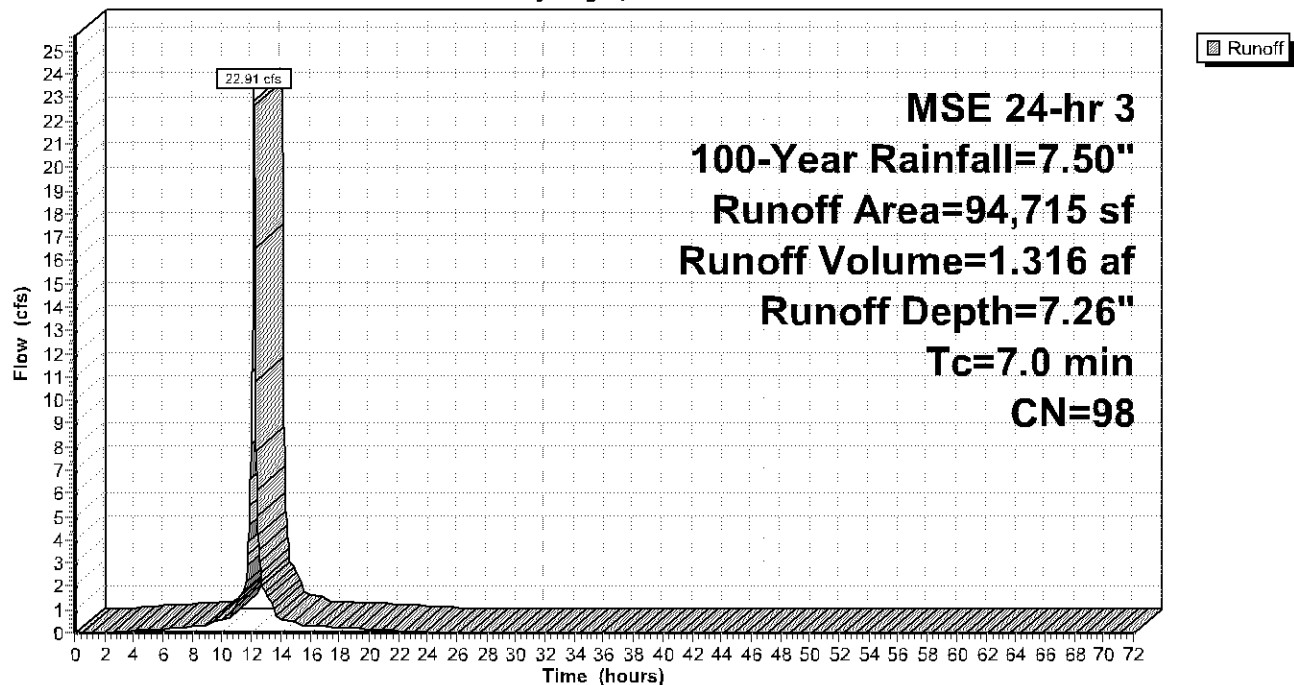
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
94,715	98	Paved parking, HSG A
94,715		100.00% Impervious Area

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

**Subcatchment 7S: Parking Lot South West**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Summary for Subcatchment 11S: Building & Parking Lot North**

Runoff = 10.42 cfs @ 12.14 hrs, Volume= 0.598 af, Depth= 7.26"

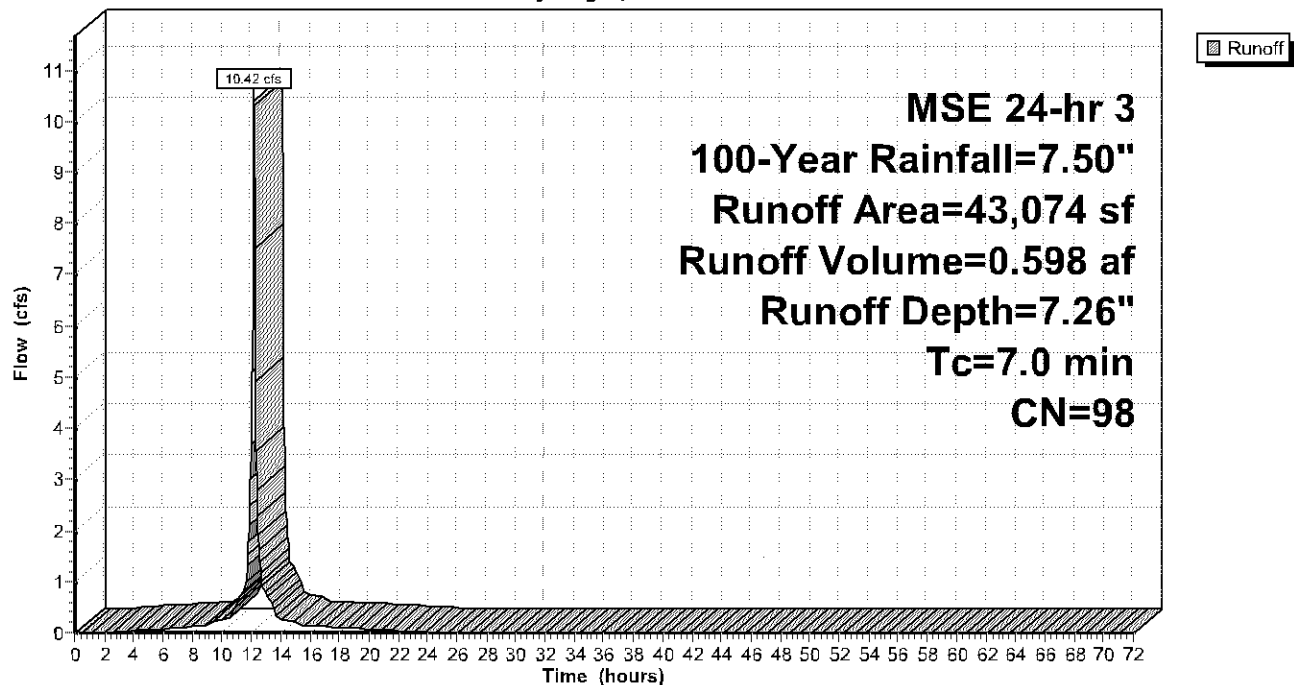
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
43,074	98	Paved parking, HSG A
43,074		100.00% Impervious Area

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

**Subcatchment 11S: Building & Parking Lot North**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

Prepared by Kimley-Horn

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**Summary for Subcatchment 12S: Parking Lot South East**

Runoff = 2.58 cfs @ 12.14 hrs, Volume= 0.148 af, Depth= 7.26"

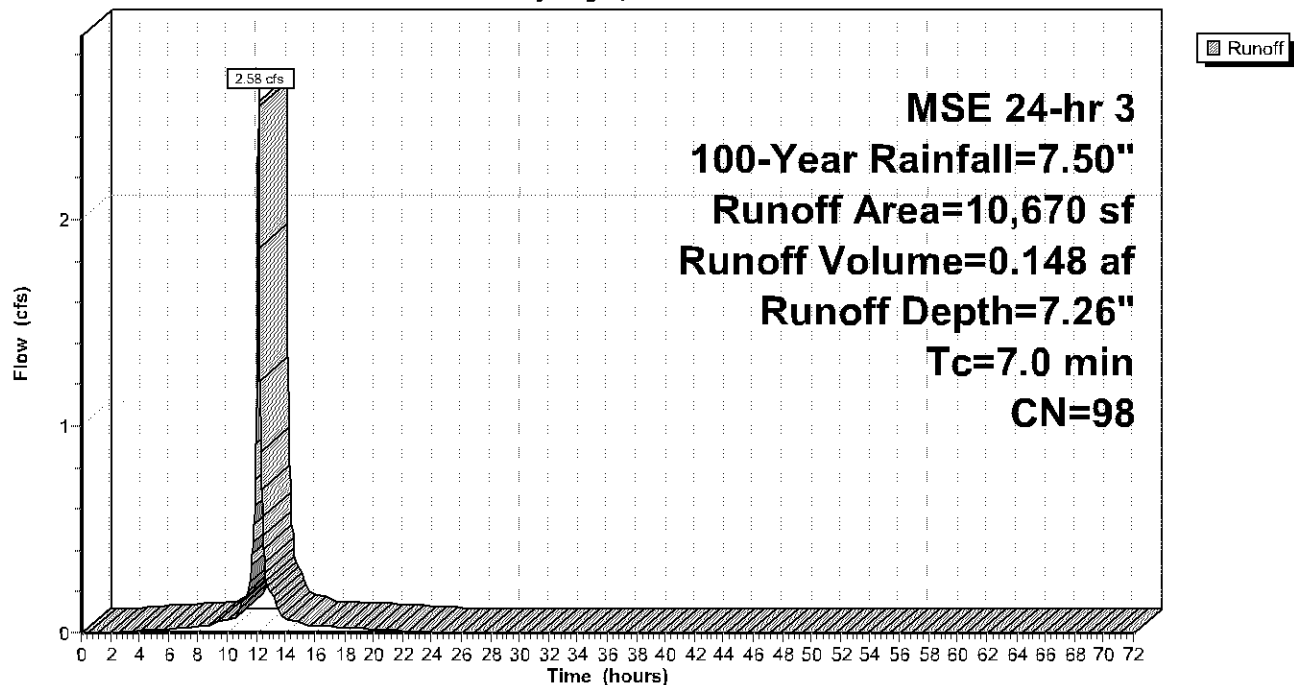
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
MSE 24-hr 3 100-Year Rainfall=7.50"

Area (sf)	CN	Description
10,670	98	Paved parking, HSG A
10,670		100.00% Impervious Area

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

**Subcatchment 12S: Parking Lot South East**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Summary for Reach 1R: West**

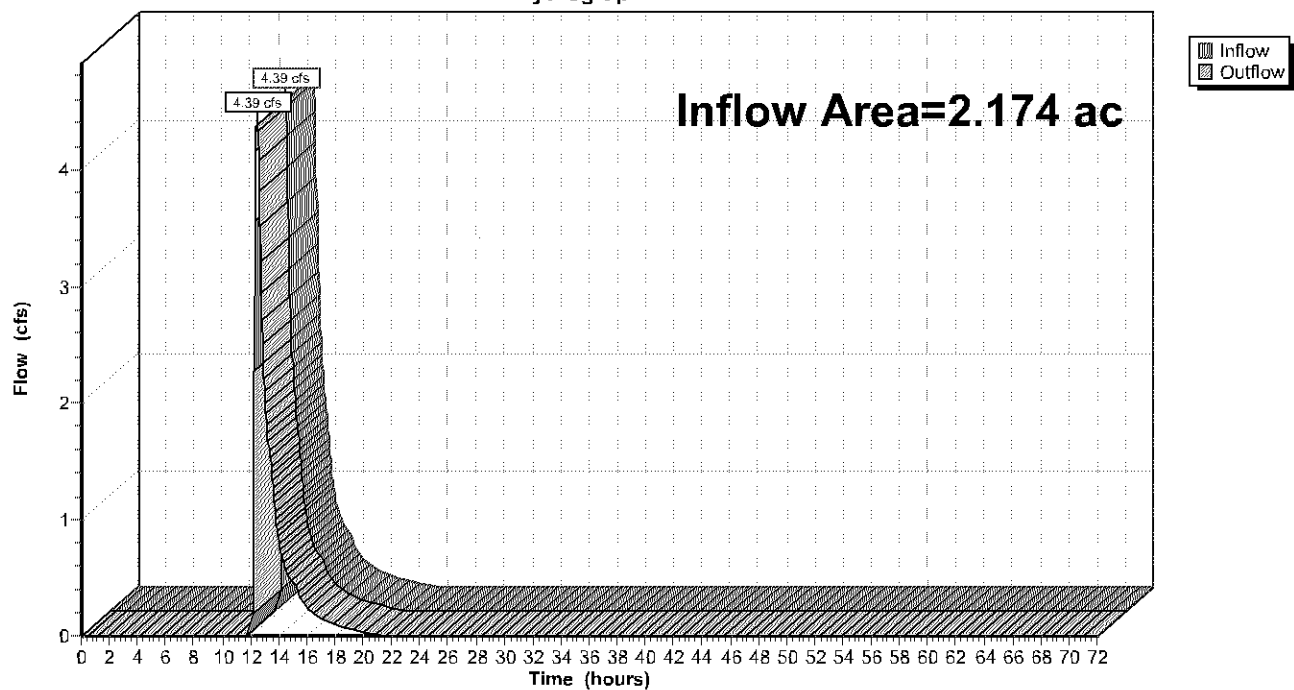
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 2.174 ac, 100.00% Impervious, Inflow Depth = 2.44" for 100-Year event  
 Inflow = 4.39 cfs @ 12.43 hrs, Volume= 0.442 af  
 Outflow = 4.39 cfs @ 12.43 hrs, Volume= 0.442 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 1R: West**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Summary for Reach 2R: South East**

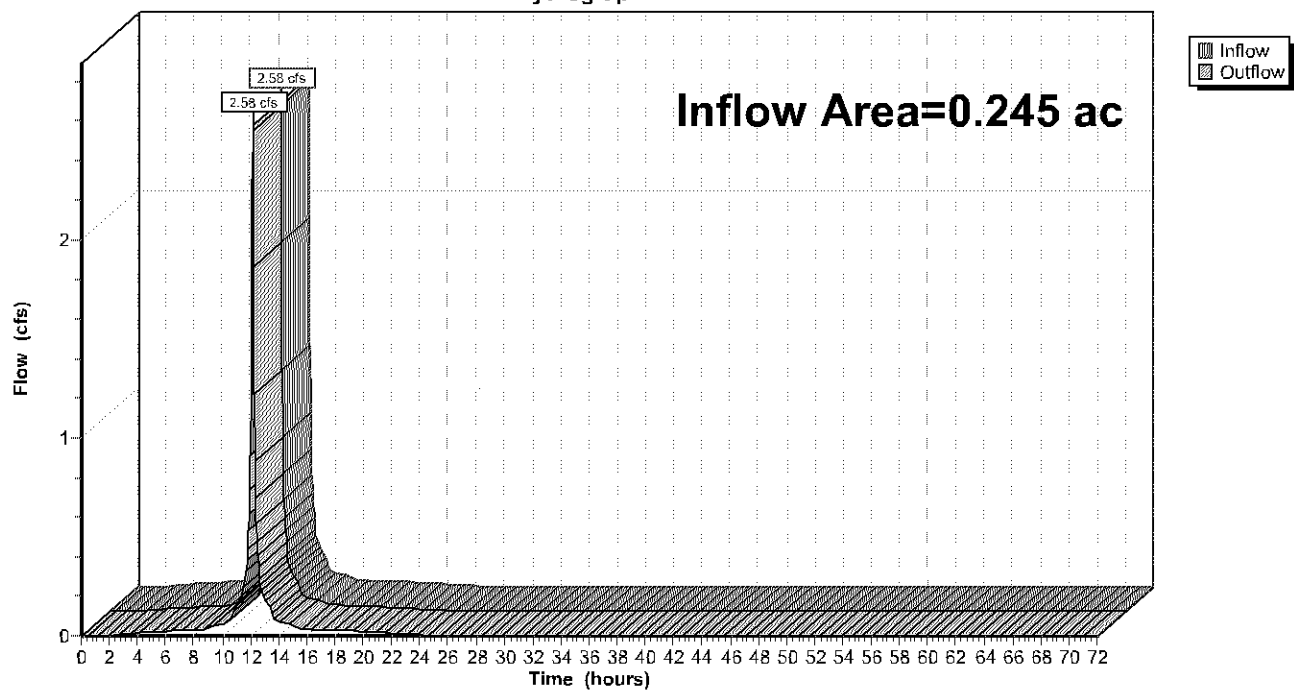
[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.245 ac, 100.00% Impervious, Inflow Depth = 7.26" for 100-Year event  
 Inflow = 2.58 cfs @ 12.14 hrs, Volume= 0.148 af  
 Outflow = 2.58 cfs @ 12.14 hrs, Volume= 0.148 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 2R: South East**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Summary for Reach 3R: North**

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area = 0.989 ac, 100.00% Impervious, Inflow Depth = 7.26" for 100-Year event

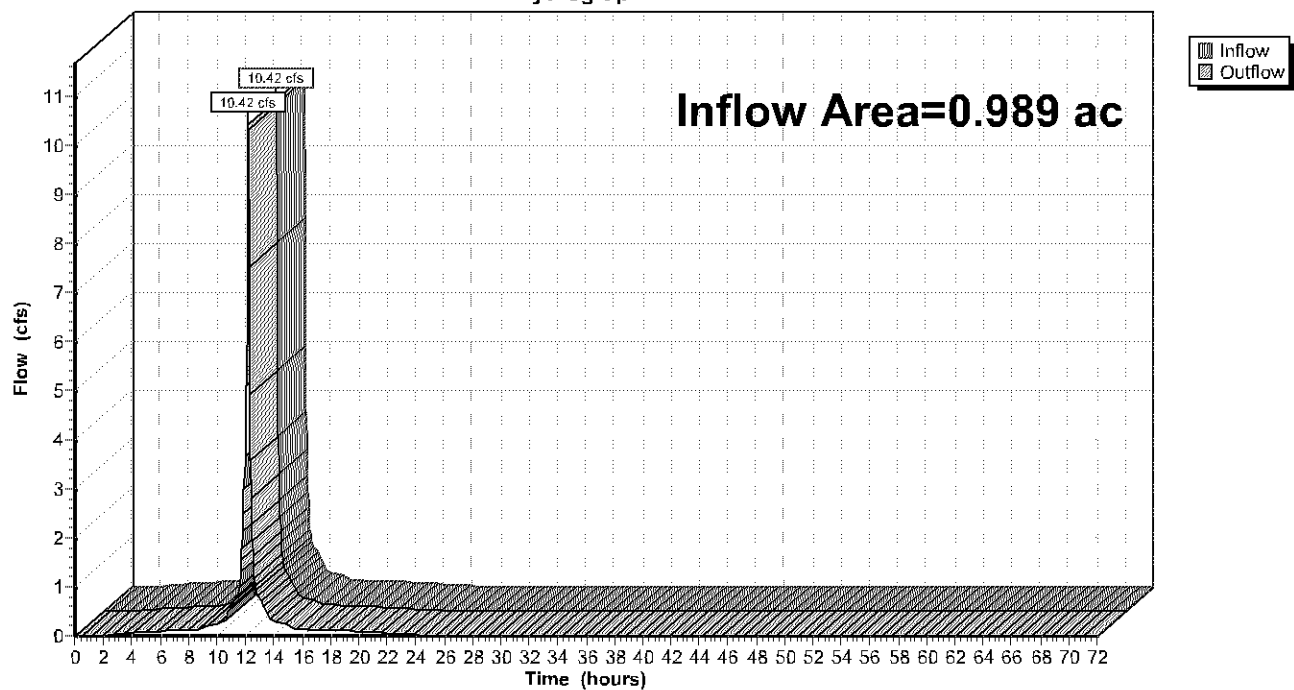
Inflow = 10.42 cfs @ 12.14 hrs, Volume= 0.598 af

Outflow = 10.42 cfs @ 12.14 hrs, Volume= 0.598 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs

**Reach 3R: North**

Hydrograph



**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Summary for Pond 7P: BMP**

Inflow Area = 2.174 ac, 100.00% Impervious, Inflow Depth = 7.26" for 100-Year event  
 Inflow = 22.91 cfs @ 12.14 hrs, Volume= 1.316 af  
 Outflow = 4.60 cfs @ 12.43 hrs, Volume= 1.316 af, Atten= 80%, Lag= 17.5 min  
 Discarded = 0.20 cfs @ 7.80 hrs, Volume= 0.874 af  
 Primary = 4.39 cfs @ 12.43 hrs, Volume= 0.442 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.05 hrs  
 Peak Elev= 829.37' @ 12.43 hrs Surf.Area= 11,020 sf Storage= 31,194 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 716.8 min ( 1,458.0 - 741.2 )

Volume	Invert	Avail.Storage	Storage Description
#1A	825.00'	11,877 cf	<b>58.00'W x 190.00'L x 4.50'H Field A</b> 49,590 cf Overall - 19,896 cf Embedded = 29,694 cf x 40.0% Voids
#2A	825.50'	19,896 cf	<b>CMP Round 42 x 99 Inside #1</b> Effective Size= 42.0"W x 42.0"H => 9.62 sf x 20.00'L = 192.4 cf Overall Size= 42.0"W x 42.0"H x 20.00'L Row Length Adjustment= +8.00' x 9.62 sf x 11 rows
		31,774 cf	Total Available Storage

Storage Group A created with Chamber Wizard

Device	Routing	Invert	Outlet Devices
#1	Discarded	825.00'	<b>0.800 in/hr Exfiltration over Surface area</b>
#2	Primary	828.20'	<b>15.0" Vert. Orifice/Grate</b> C= 0.600 Limited to weir flow at low heads

**Discarded OutFlow** Max=0.20 cfs @ 7.80 hrs HW=825.05' (Free Discharge)  
 ↑ **1=Exfiltration** (Exfiltration Controls 0.20 cfs)

**Primary OutFlow** Max=4.38 cfs @ 12.43 hrs HW=829.37' TW=0.00' (Dynamic Tailwater)  
 ↑ **2=Orifice/Grate** (Orifice Controls 4.38 cfs @ 3.67 fps)

**2021-0831 - Clover Shopping Center Proposed Condit MSE 24-hr 3 100-Year Rainfall=7.50"**

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**Pond 7P: BMP - Chamber Wizard Field A****Chamber Model = CMP Round 42 (Round Corrugated Metal Pipe)**

Effective Size= 42.0"W x 42.0"H =&gt; 9.62 sf x 20.00'L = 192.4 cf

Overall Size= 42.0"W x 42.0"H x 20.00'L

Row Length Adjustment= +8.00' x 9.62 sf x 11 rows

42.0" Wide + 21.0" Spacing = 63.0" C-C Row Spacing

9 Chambers/Row x 20.00' Long +8.00' Row Adjustment = 188.00' Row Length +12.0" End Stone x 2 =  
190.00' Base Length

11 Rows x 42.0" Wide + 21.0" Spacing x 10 + 12.0" Side Stone x 2 = 58.00' Base Width

6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

99 Chambers x 192.4 cf +8.00' Row Adjustment x 9.62 sf x 11 Rows = 19,896.5 cf Chamber Storage

49,590.0 cf Field - 19,896.5 cf Chambers = 29,693.5 cf Stone x 40.0% Voids = 11,877.4 cf Stone Storage

Chamber Storage + Stone Storage = 31,773.9 cf = 0.729 af

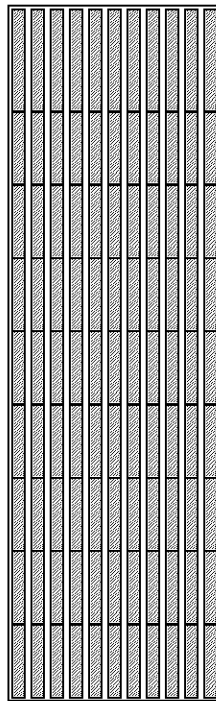
Overall Storage Efficiency = 64.1%

Overall System Size = 190.00' x 58.00' x 4.50'

99 Chambers

1,836.7 cy Field

1,099.8 cy Stone





Pond 7P: BMP

Hydrograph

