PL202100191

Kimley»Horn

Preliminary Stormwater Management Report

Clover Shopping Center Redevelopment

City of Bloomington, MN
Nine Mile Creek Watershed District

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

Prepared by:
Kimley-Horn
767 Eustis Street, Suite 100
St. Paul, MN 55114
Contact: Jason Scrimshaw, P.E.

Prepared On: September 8, 2021

Kimley»Horn

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

Kimley»Horn

Table of Contents

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 98th 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

Kimley»Horn

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

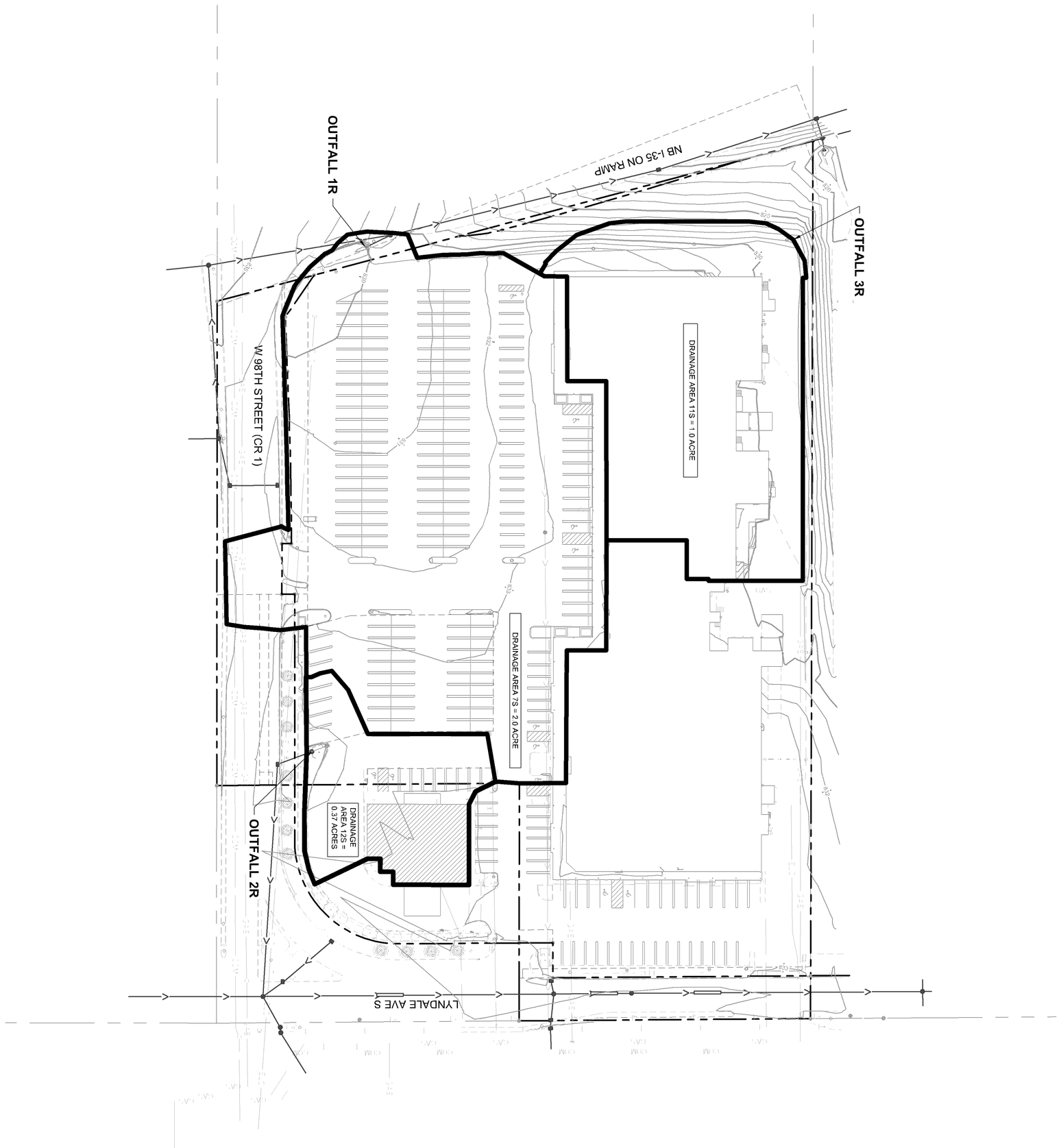
Based on the project regulated surface area of 2.8 acres, the project will require a retention volume of 11,408 cubic feet of storage volume. Volume can be obtained within the surface parking lot area in a series of underground infiltration chambers. The available retention volume of the proposed stormwater 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

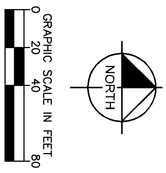
Storm Event	2-year	10-year	100-year
Outfall 3R			
Existing Conditions	3.91	5.91	10.51
Proposed Conditions	3.88	5.86	10.42
Outfall 2R			
Existing Conditions	1.46	2.21	3.93
Proposed Conditions	0.96	1.45	2.58
Outfall 1R			
Existing Conditions	8.00	12.08	21.47
Proposed Conditions	0.00	0.00	4.39

Kimley»Horn

Appendix A



PL2021001911



PRELIMINARY - NOT FOR CONSTRUCTION

SHEET NUMBER
EX - 1

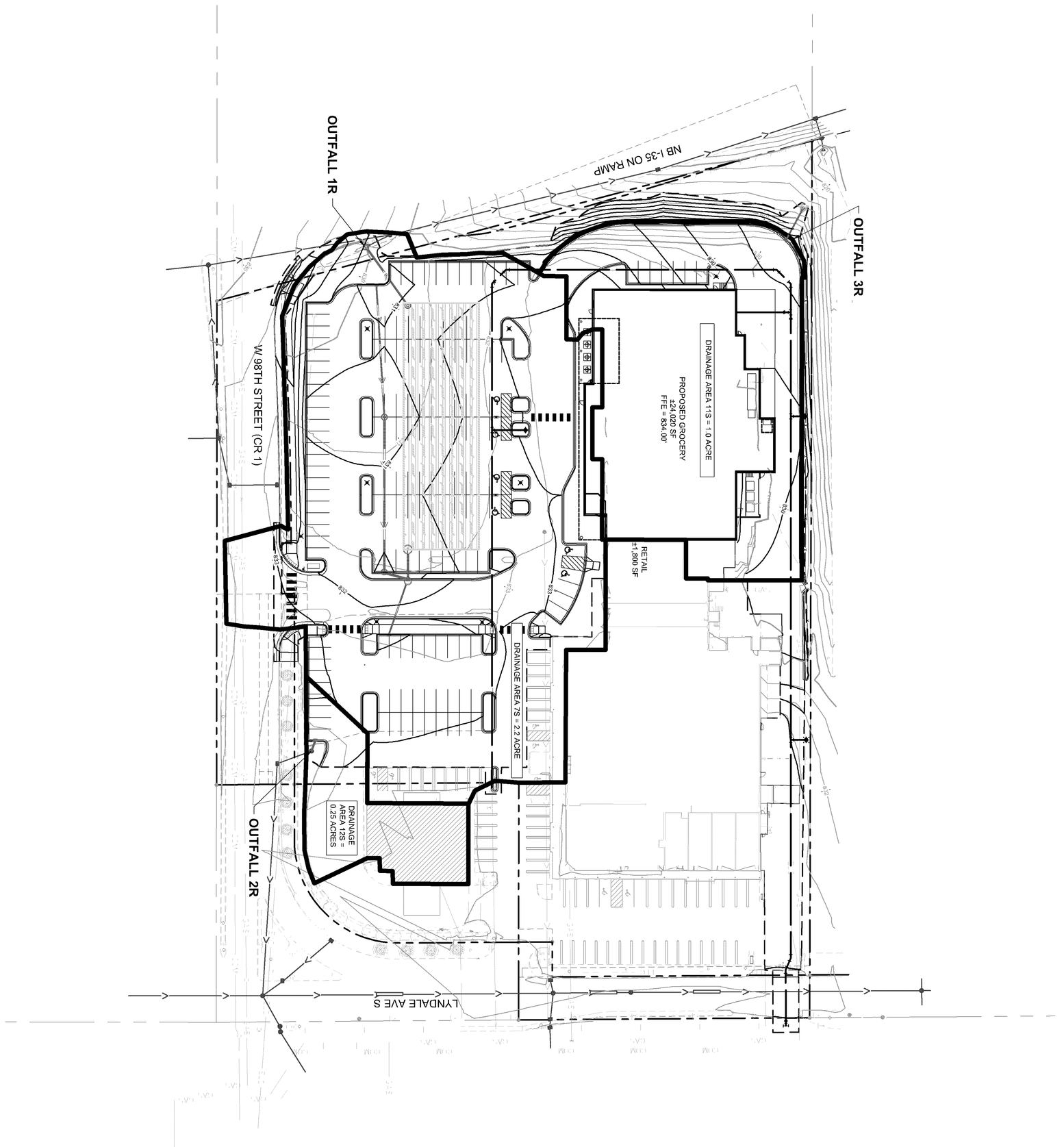
CLOVER SHOPPING CENTER
PREPARED FOR
KRAUS ANDERSON DEVELOPMENT
BLOOMINGTON MN

EXISTING DRAINAGE AREA MAP

Kimley»Horn

767 EUSTIS STREET, SUITE 100, ST. PAUL, MN 55114
PHONE: 651-645-4197
WWW.KIMLEY-HORN.COM

No.	REVISIONS	DATE	BY



PL20210019

0 20 40 60 GRAPHIC SCALE IN FEET

NORTH

PRELIMINARY - NOT FOR CONSTRUCTION

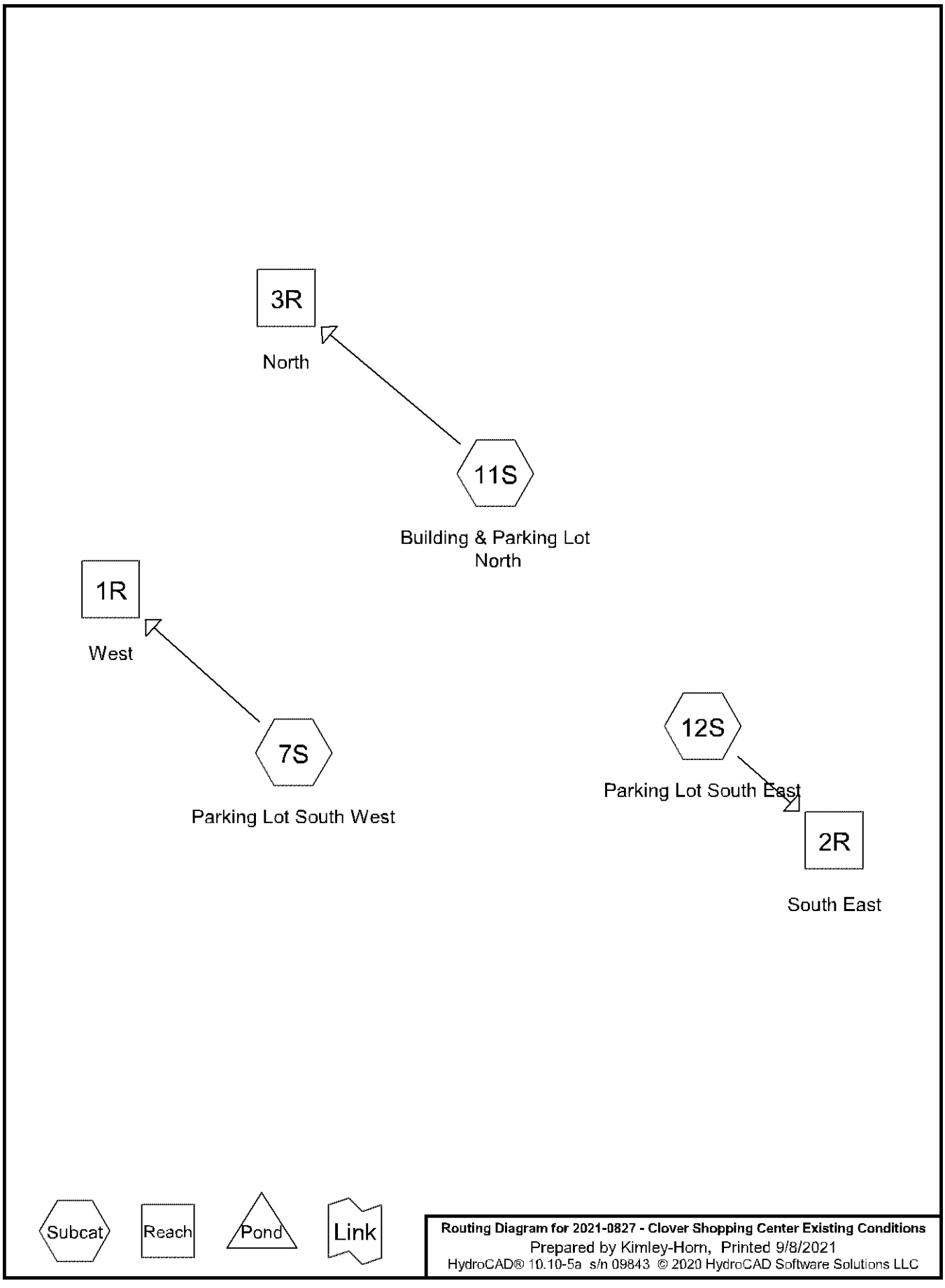
SHEET NUMBER
EX - 2

CLOVER SHOPPING CENTER
PREPARED FOR
KRAUS ANDERSON DEVELOPMENT
BLOOMINGTON MN

PROPOSED DRAINAGE AREA MAP

Kimley»Horn
© 2021 KIMLEY-HORN AND ASSOCIATES, INC.
767 EUSTIS STREET, SUITE 100, ST. PAUL, MN 55114
PHONE: 651-645-4197
WWW.KIMLEY-HORN.COM

No.	REVISIONS	DATE	BY


3R
North
11S
Building & Parking Lot North
1R
West
7S
Parking Lot South West
12S
Parking Lot South East
2R
South East
Subcat
Reach
Pond
Link
Routing Diagram for 2021-0827 - Clover Shopping Center Existing Conditions
Prepared by Kimley-Horn, Printed 9/8/2021
HydroCAD® 10.10-5a s/n 09843 © 2020 HydroCAD Software Solutions LLC

Area Listing (all nodes)

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

Summary for Subcatchment 7S: Parking Lot South West

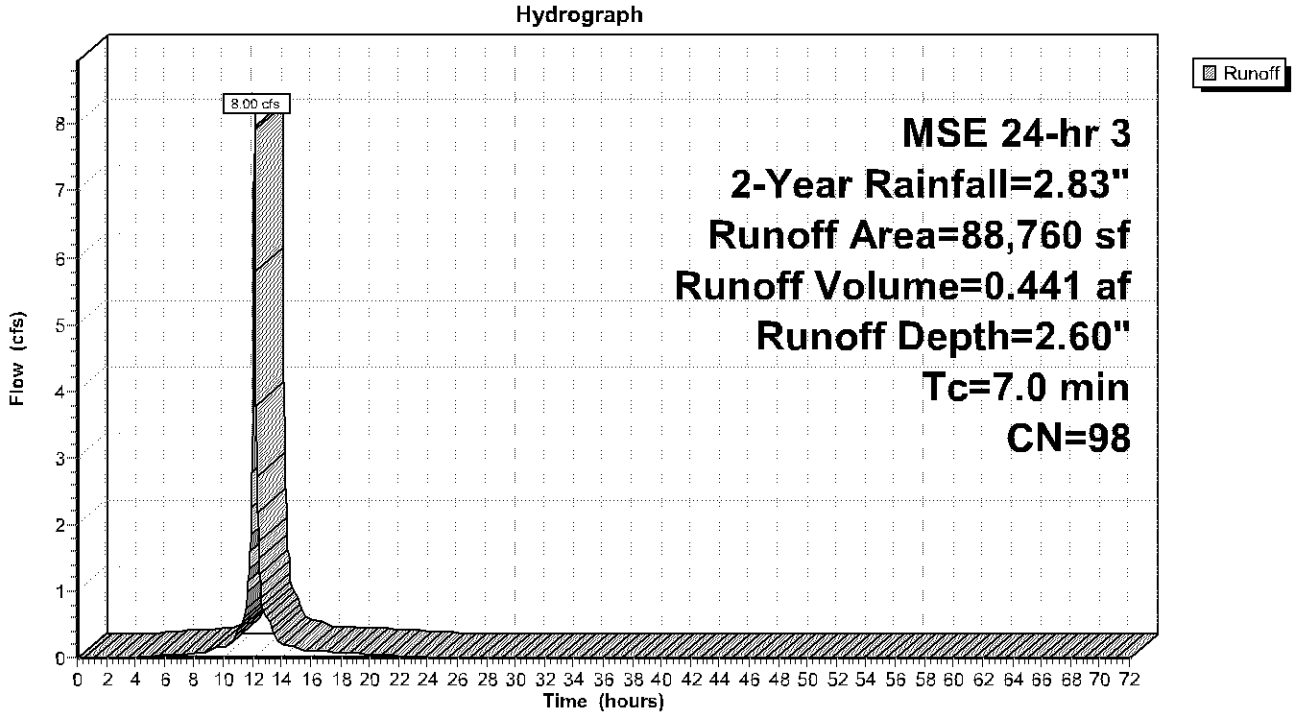
Runoff = 8.00 cfs @ 12.14 hrs, Volume= 0.441 af, Depth= 2.60"

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



Summary for Subcatchment 11S: Building & Parking Lot North

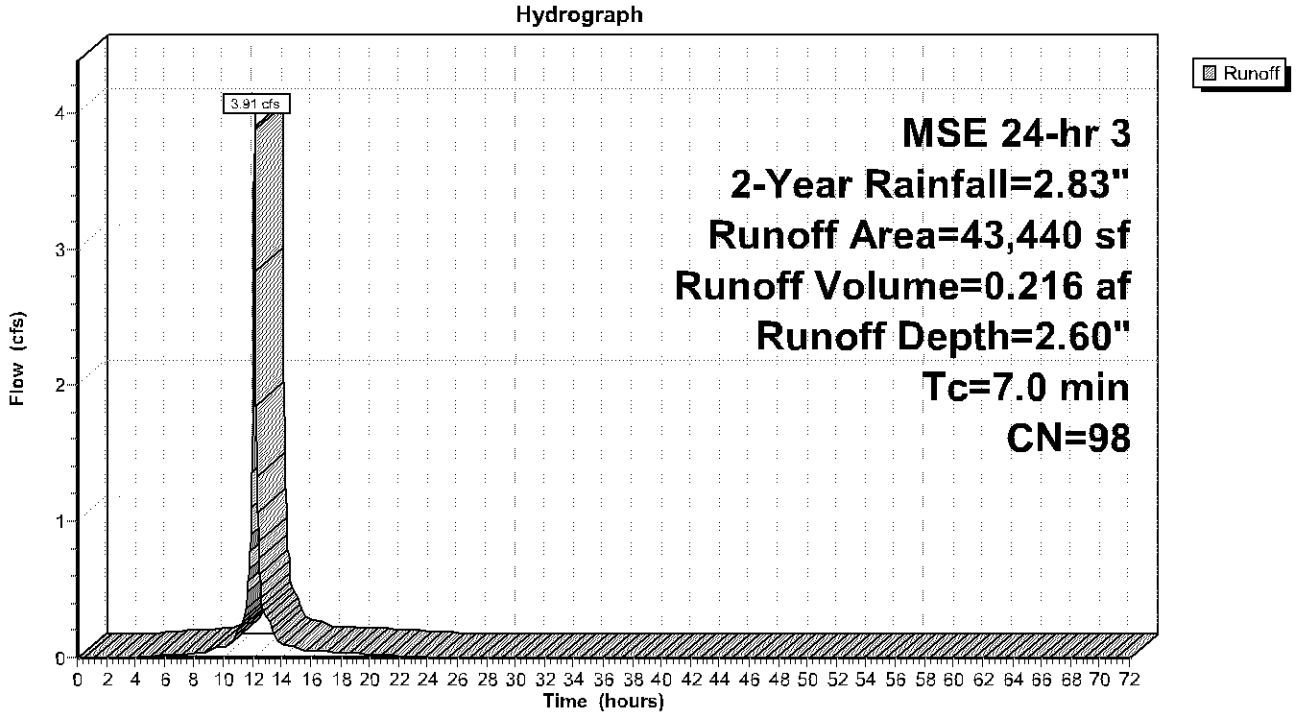
Runoff = 3.91 cfs @ 12.14 hrs, Volume= 0.216 af, Depth= 2.60"

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



Summary for Subcatchment 12S: Parking Lot South East

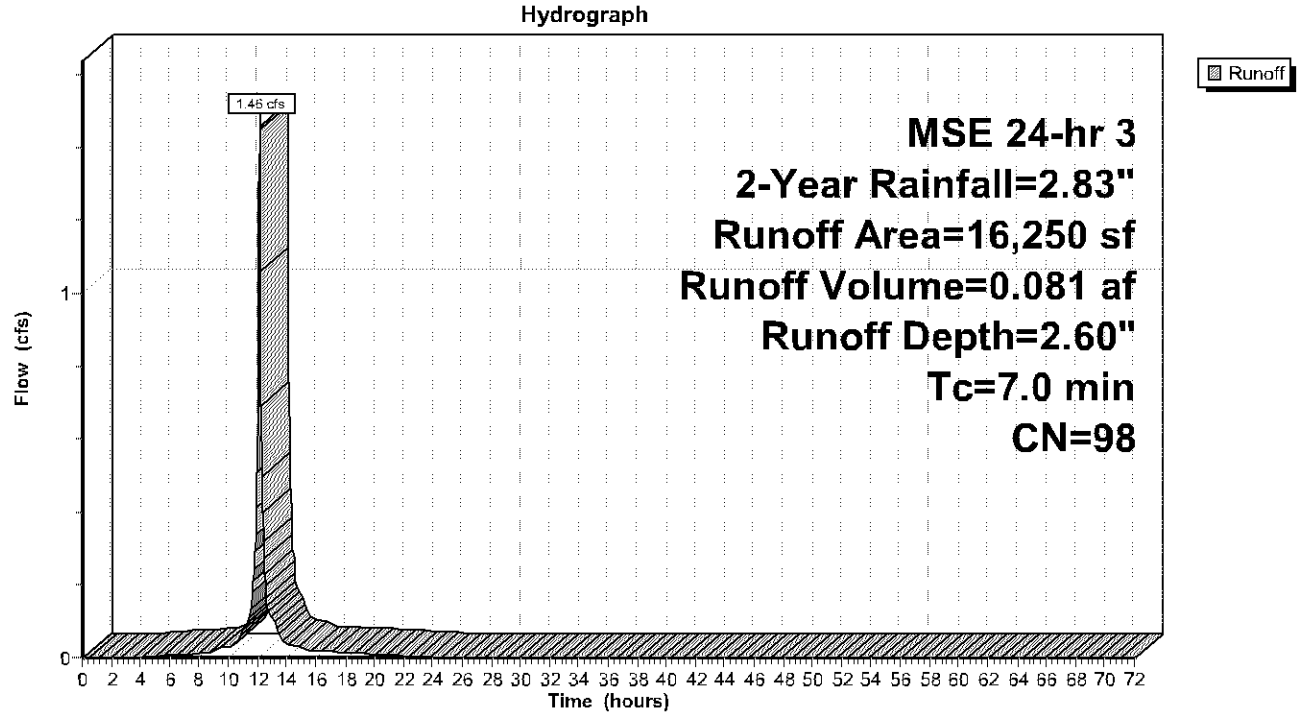
Runoff = 1.46 cfs @ 12.14 hrs, Volume= 0.081 af, Depth= 2.60"

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



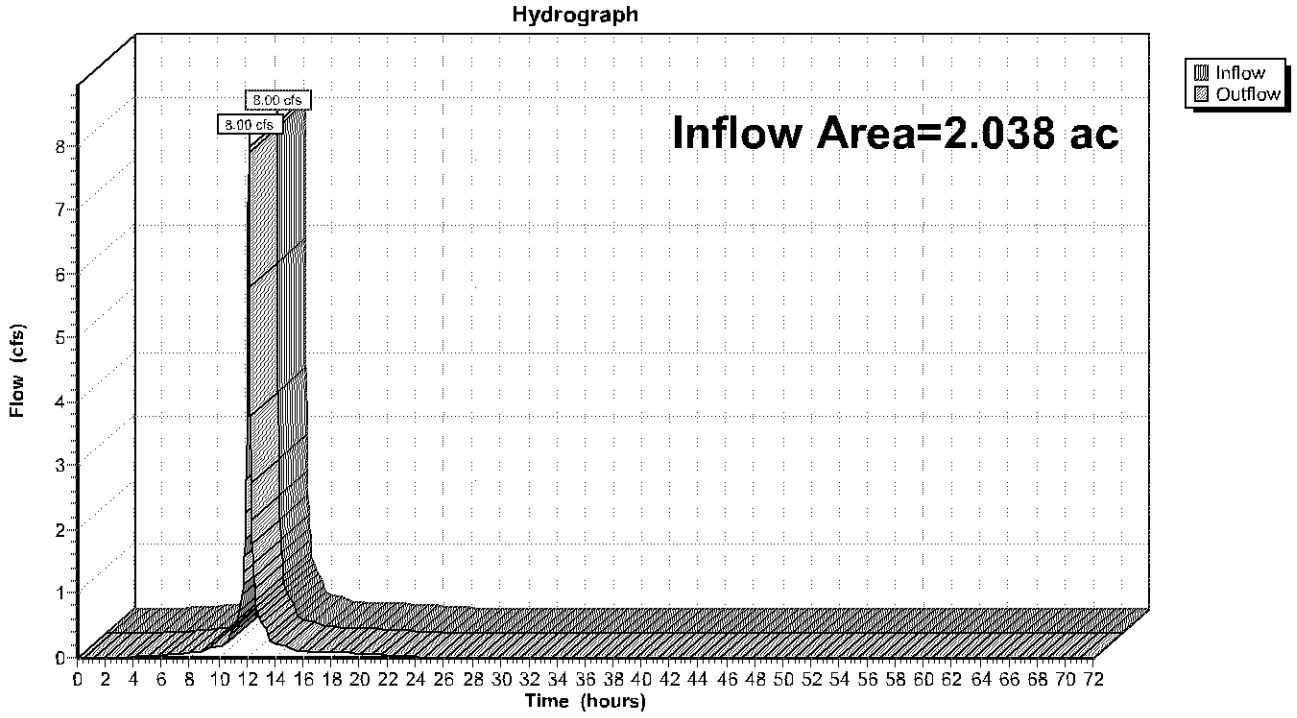
Summary for Reach 1R: West

[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



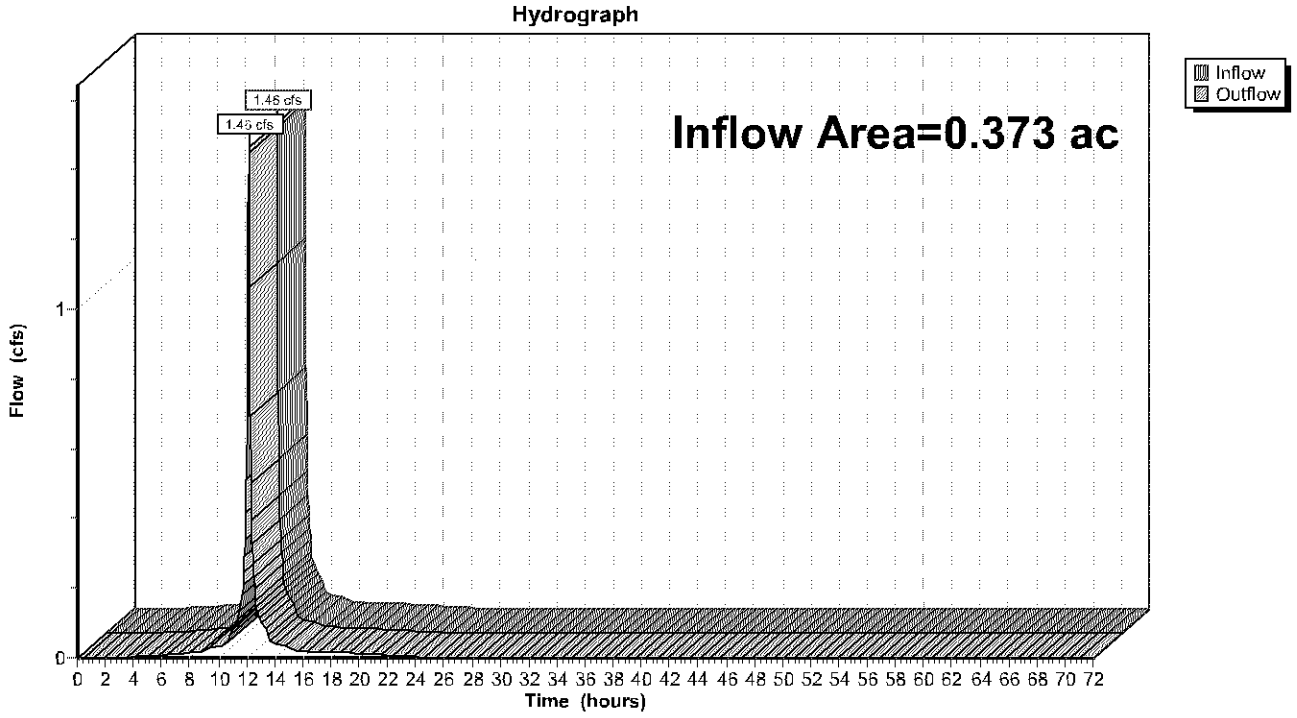
Summary for Reach 2R: South East

[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



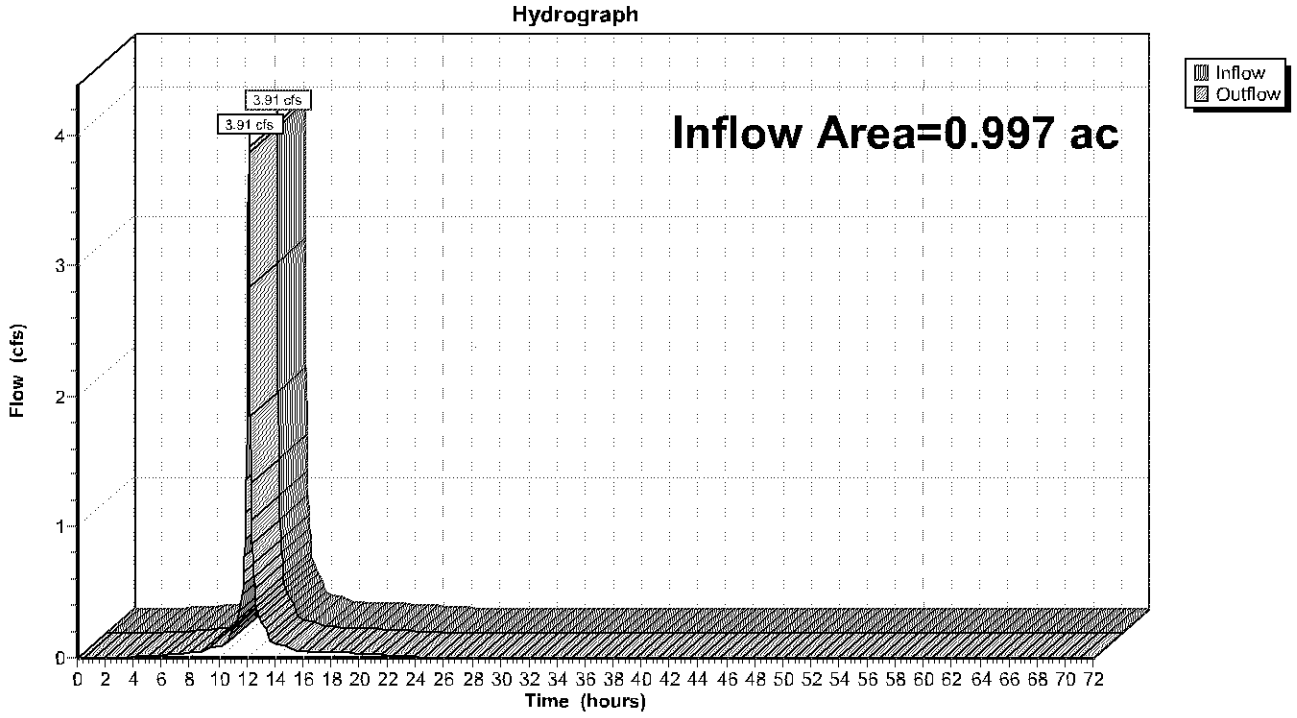
Summary for Reach 3R: North

[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



Summary for Subcatchment 7S: Parking Lot South West

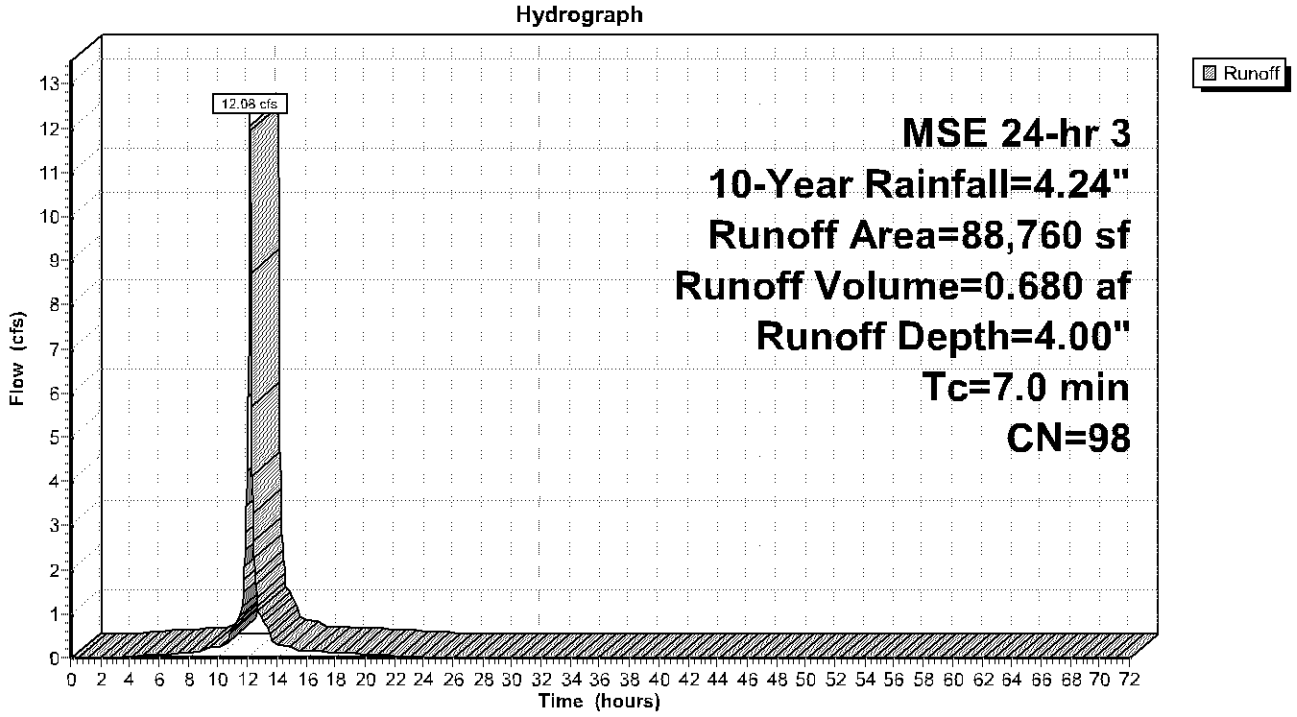
Runoff = 12.08 cfs @ 12.14 hrs, Volume= 0.680 af, Depth= 4.00"

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



Summary for Subcatchment 11S: Building & Parking Lot North

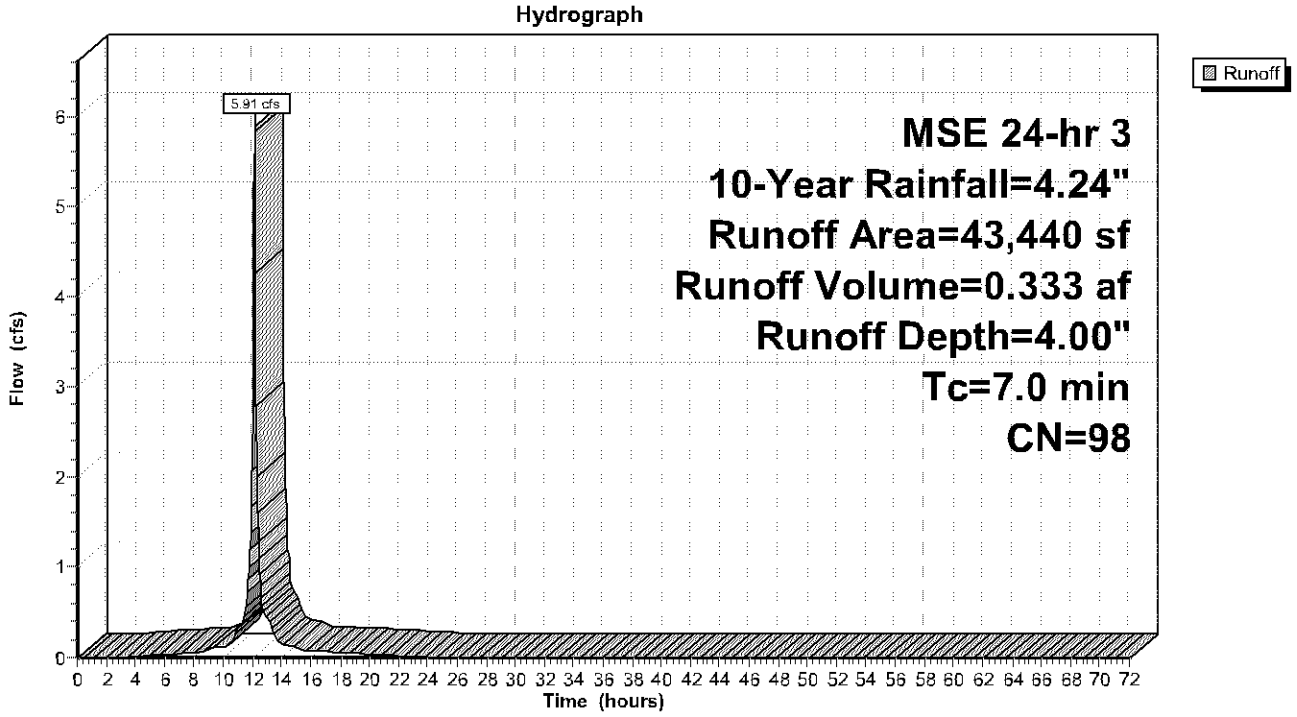
Runoff = 5.91 cfs @ 12.14 hrs, Volume= 0.333 af, Depth= 4.00"

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



Summary for Subcatchment 12S: Parking Lot South East

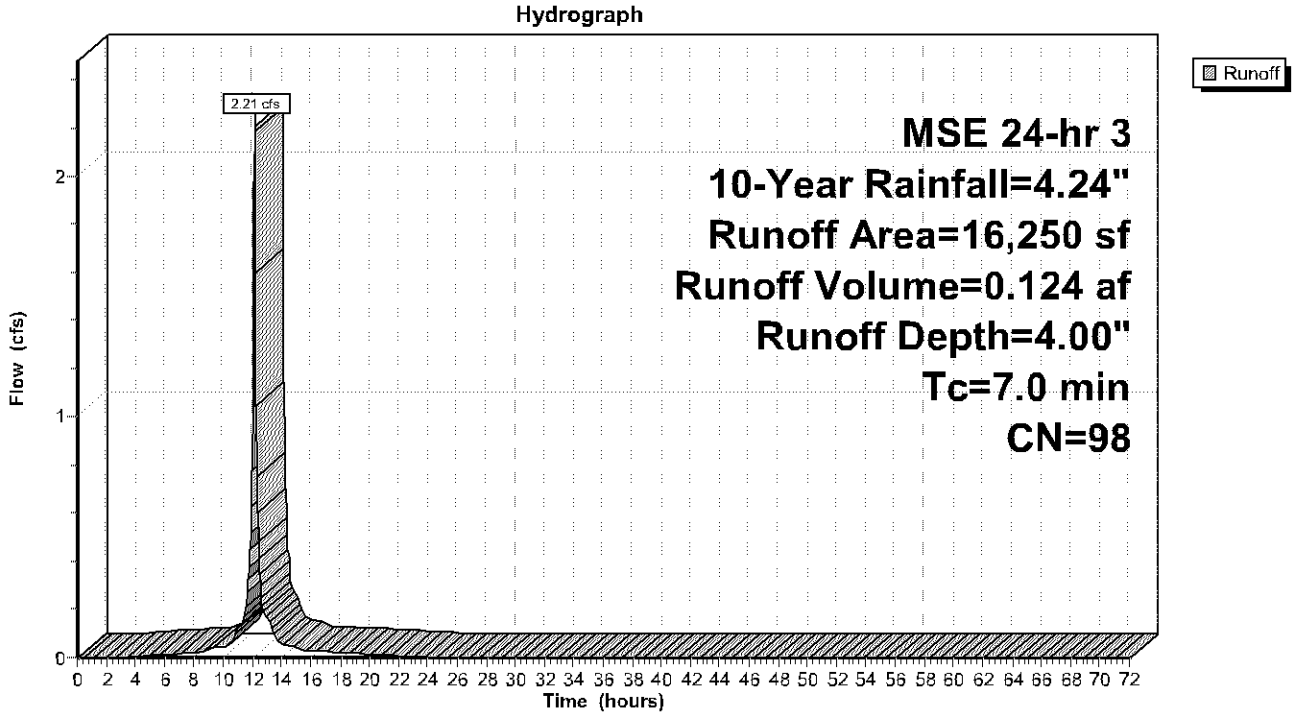
Runoff = 2.21 cfs @ 12.14 hrs, Volume= 0.124 af, Depth= 4.00"

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



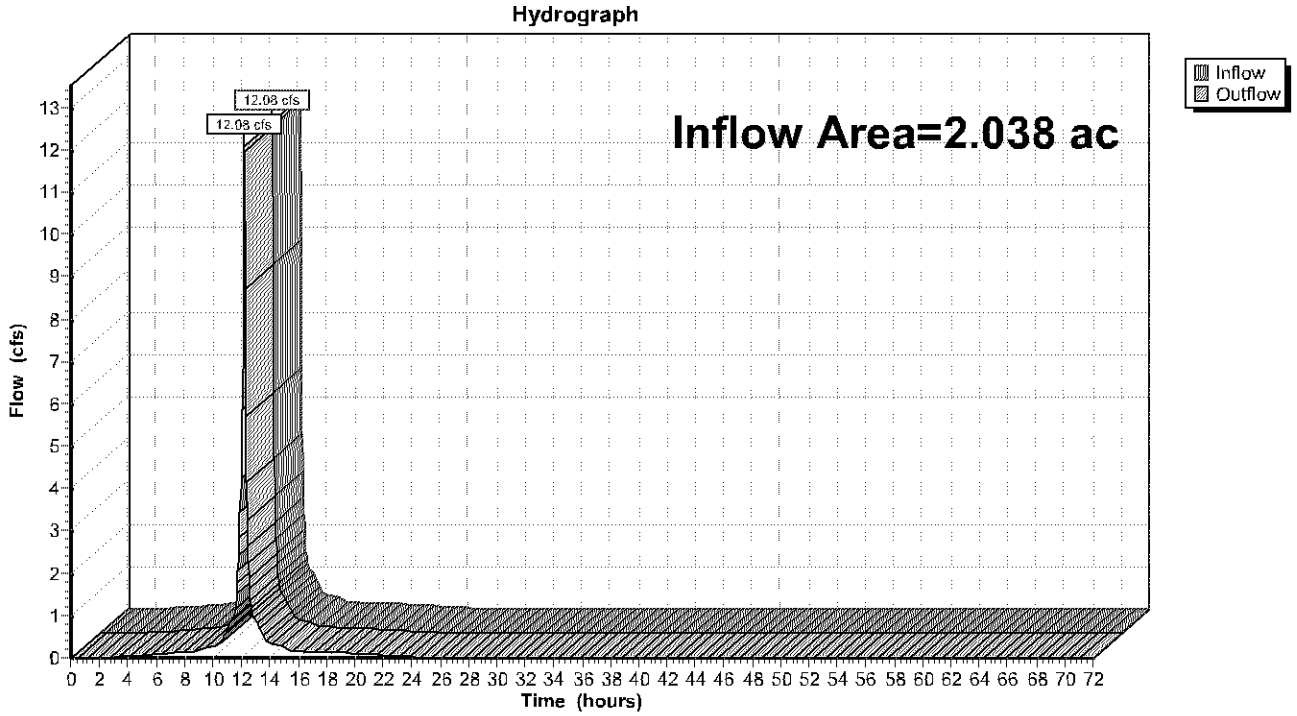
Summary for Reach 1R: West

[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



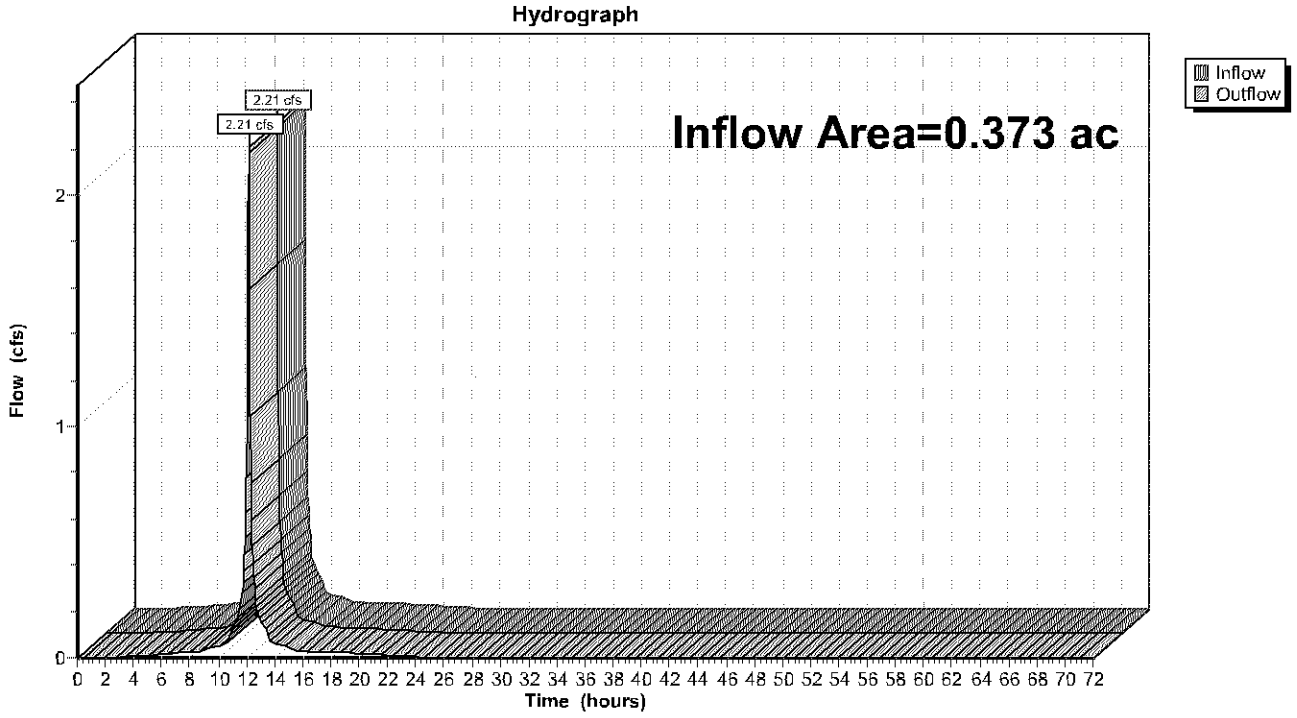
Summary for Reach 2R: South East

[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



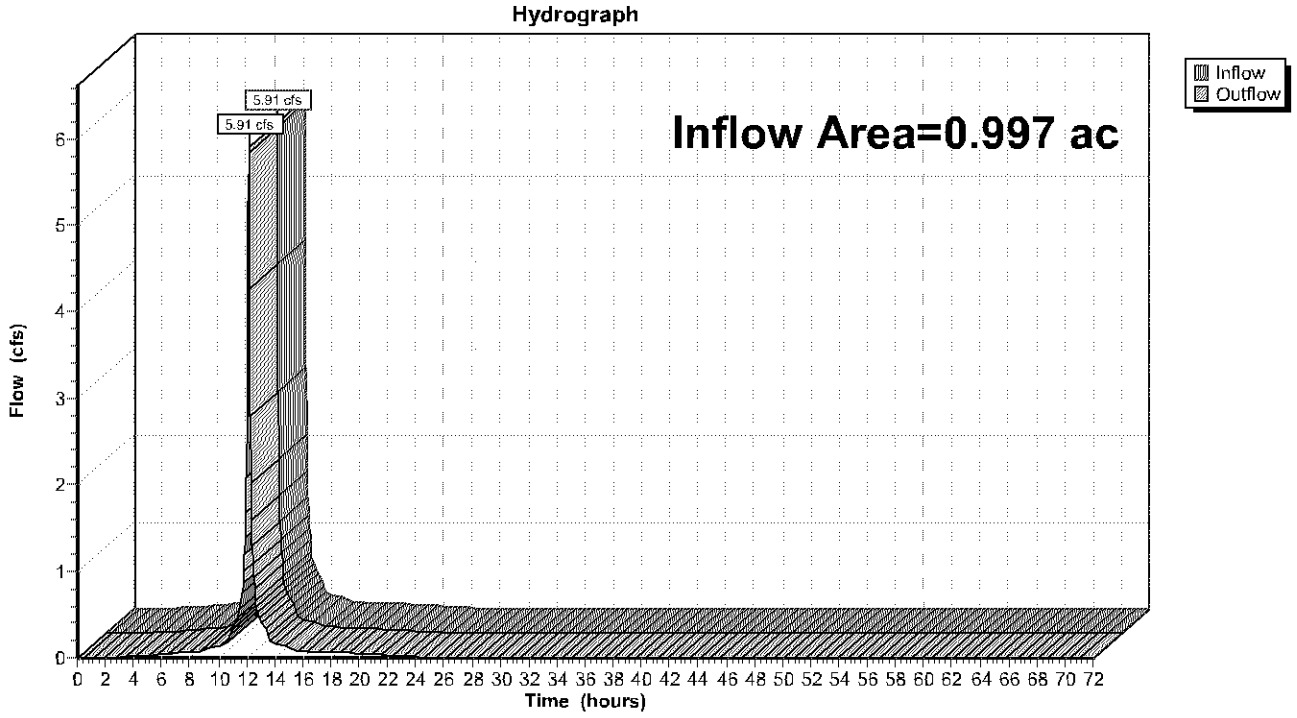
Summary for Reach 3R: North

[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



Summary for Subcatchment 7S: Parking Lot South West

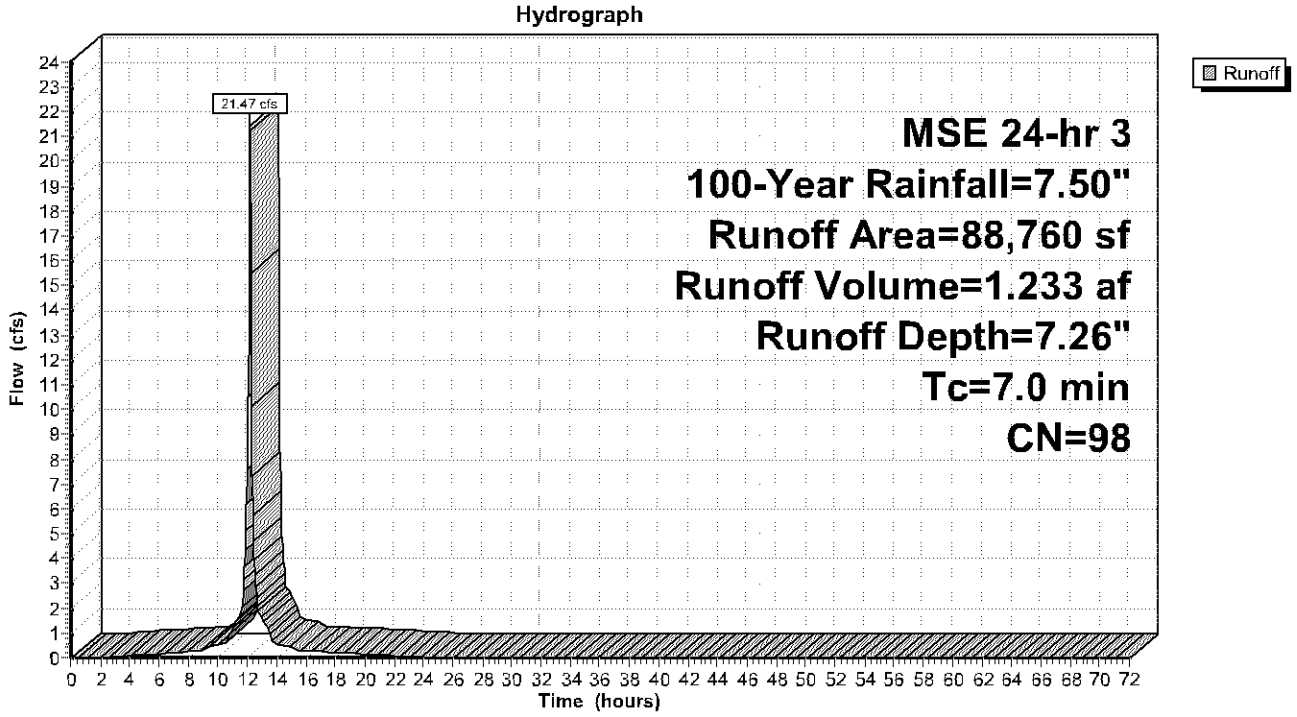
Runoff = 21.47 cfs @ 12.14 hrs, Volume= 1.233 af, Depth= 7.26"

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



Summary for Subcatchment 11S: Building & Parking Lot North

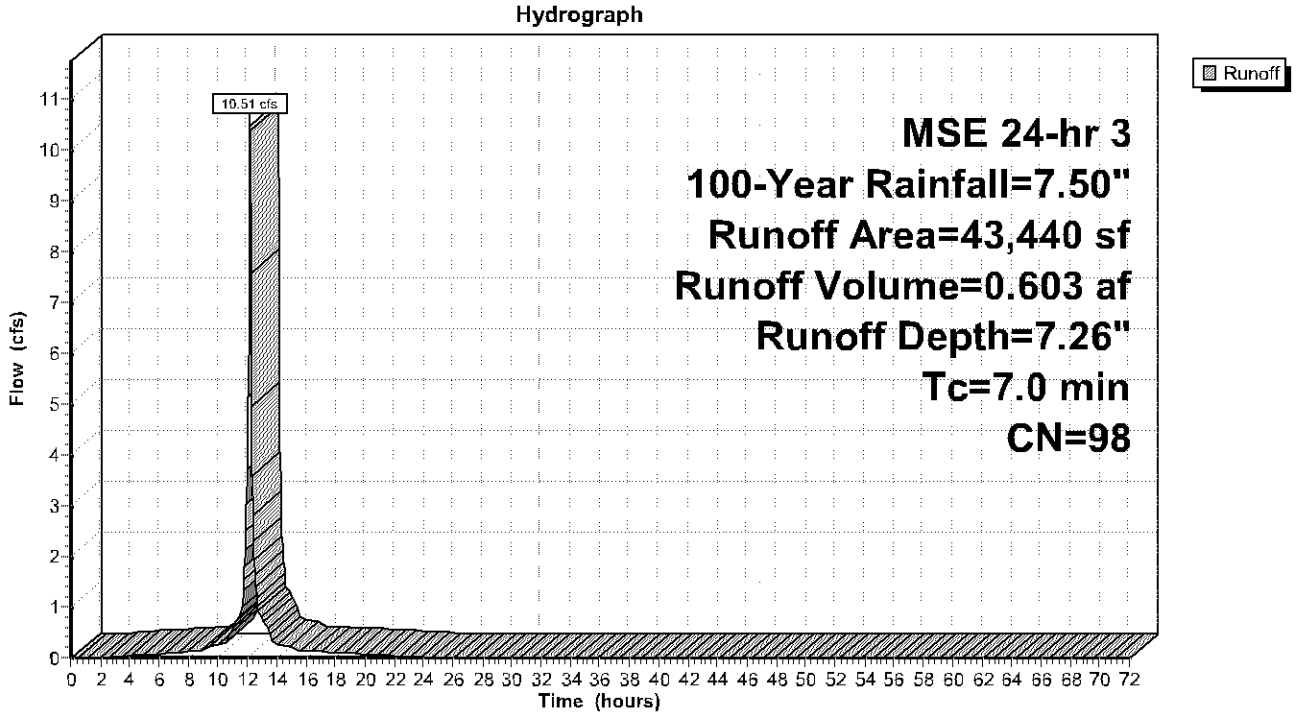
Runoff = 10.51 cfs @ 12.14 hrs, Volume= 0.603 af, Depth= 7.26"

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



Summary for Subcatchment 12S: Parking Lot South East

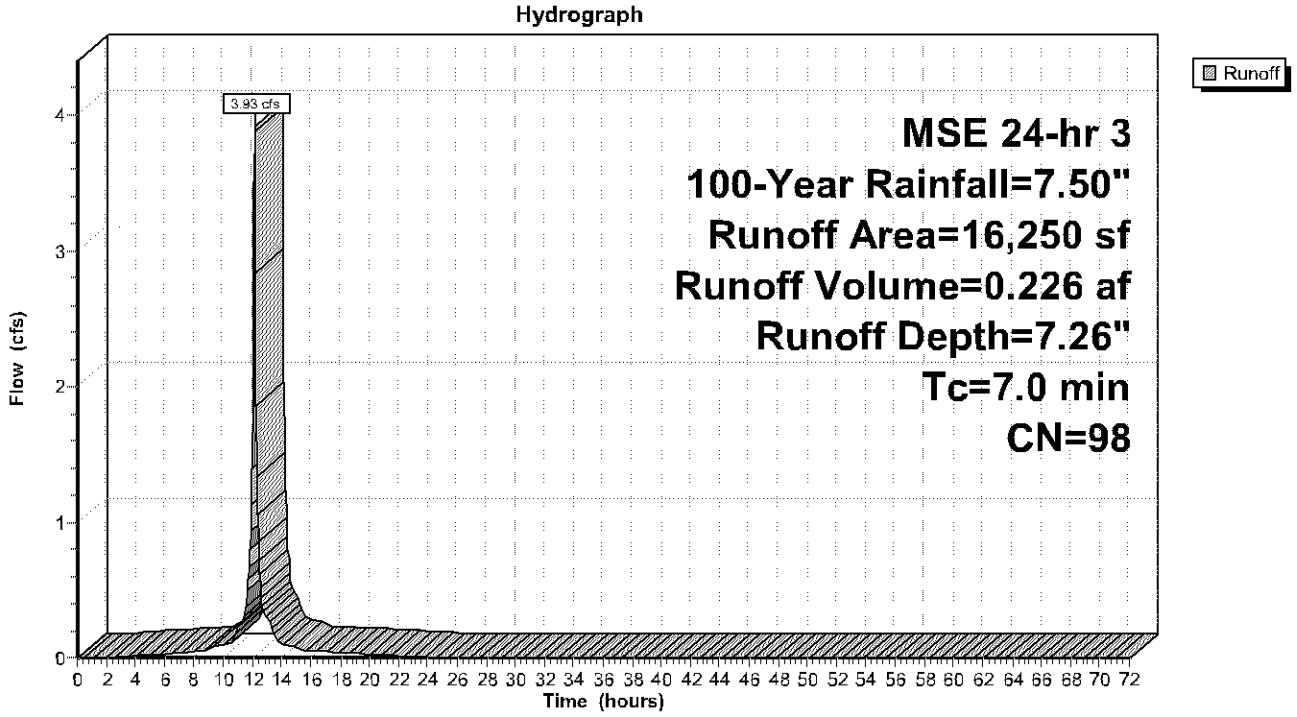
Runoff = 3.93 cfs @ 12.14 hrs, Volume= 0.226 af, Depth= 7.26"

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



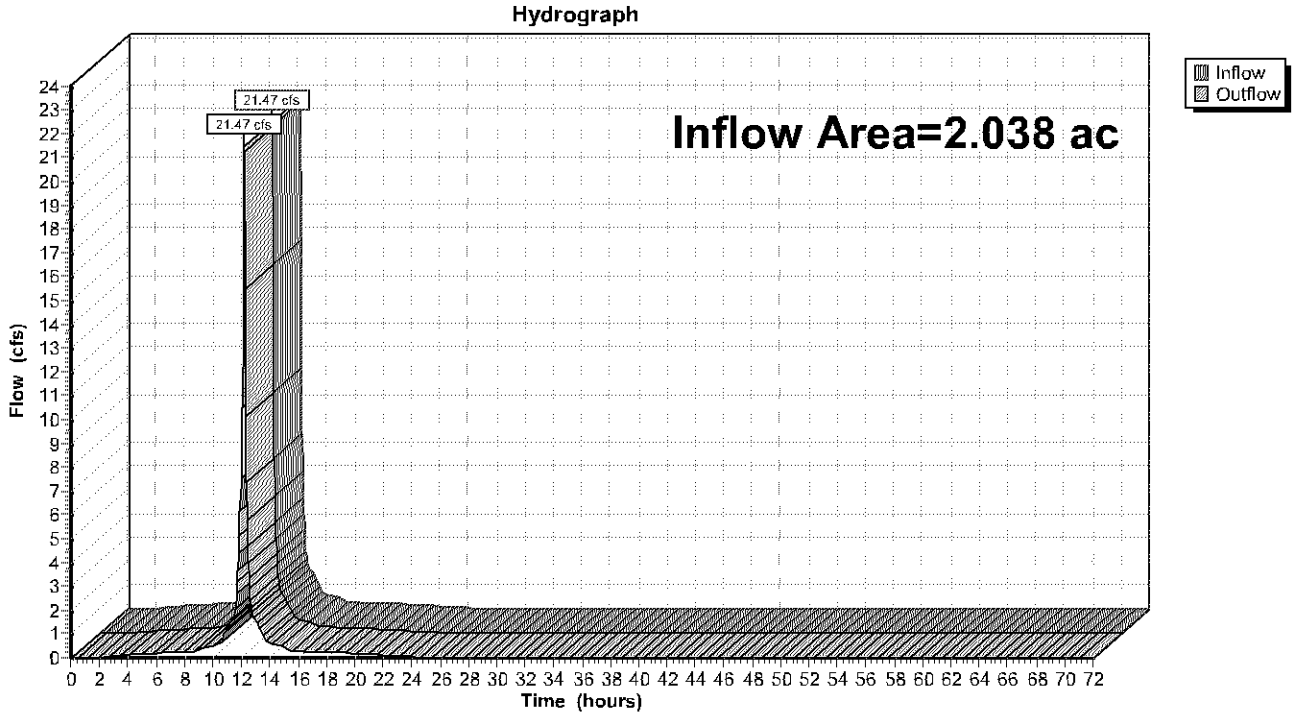
Summary for Reach 1R: West

[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



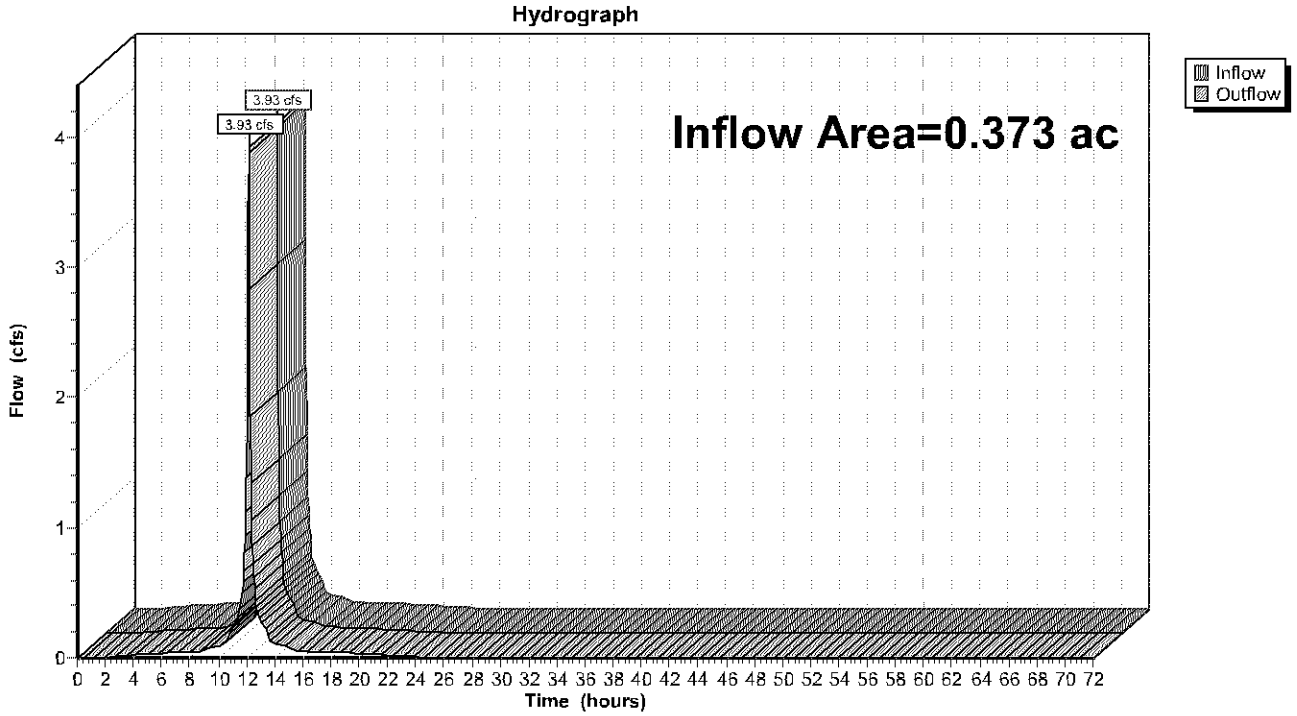
Summary for Reach 2R: South East

[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



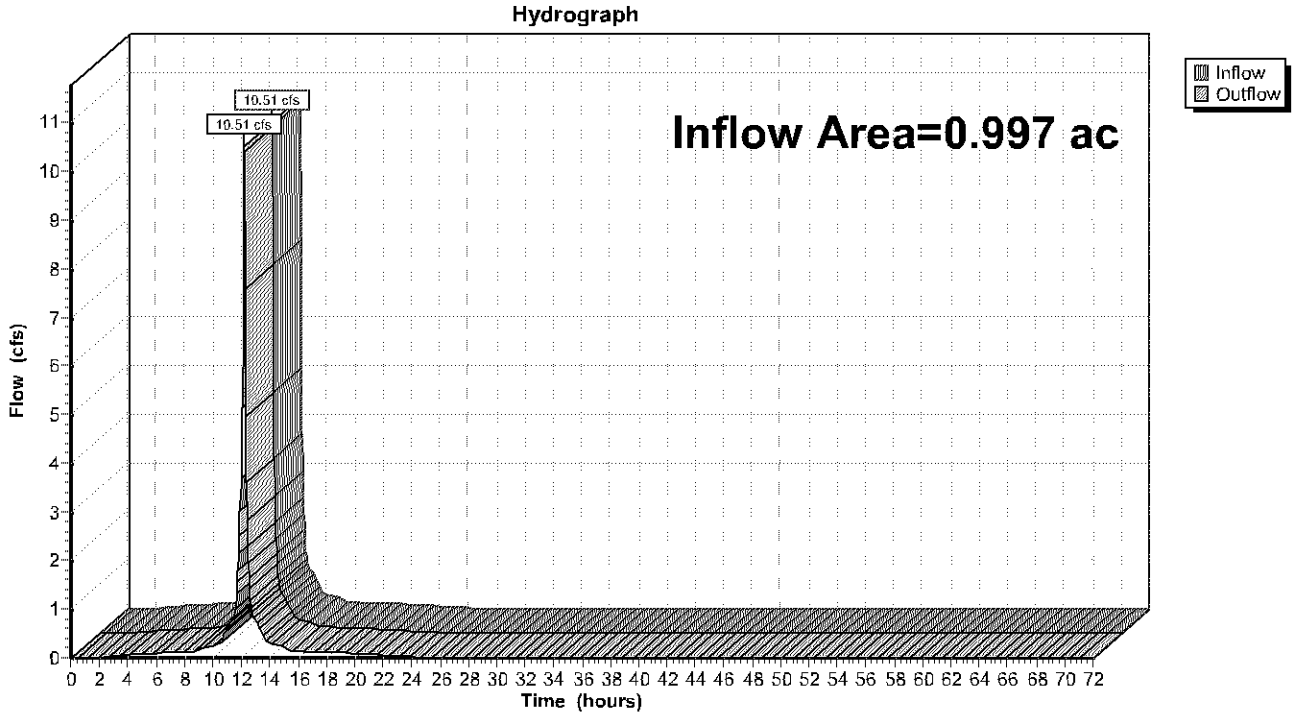
Summary for Reach 3R: North

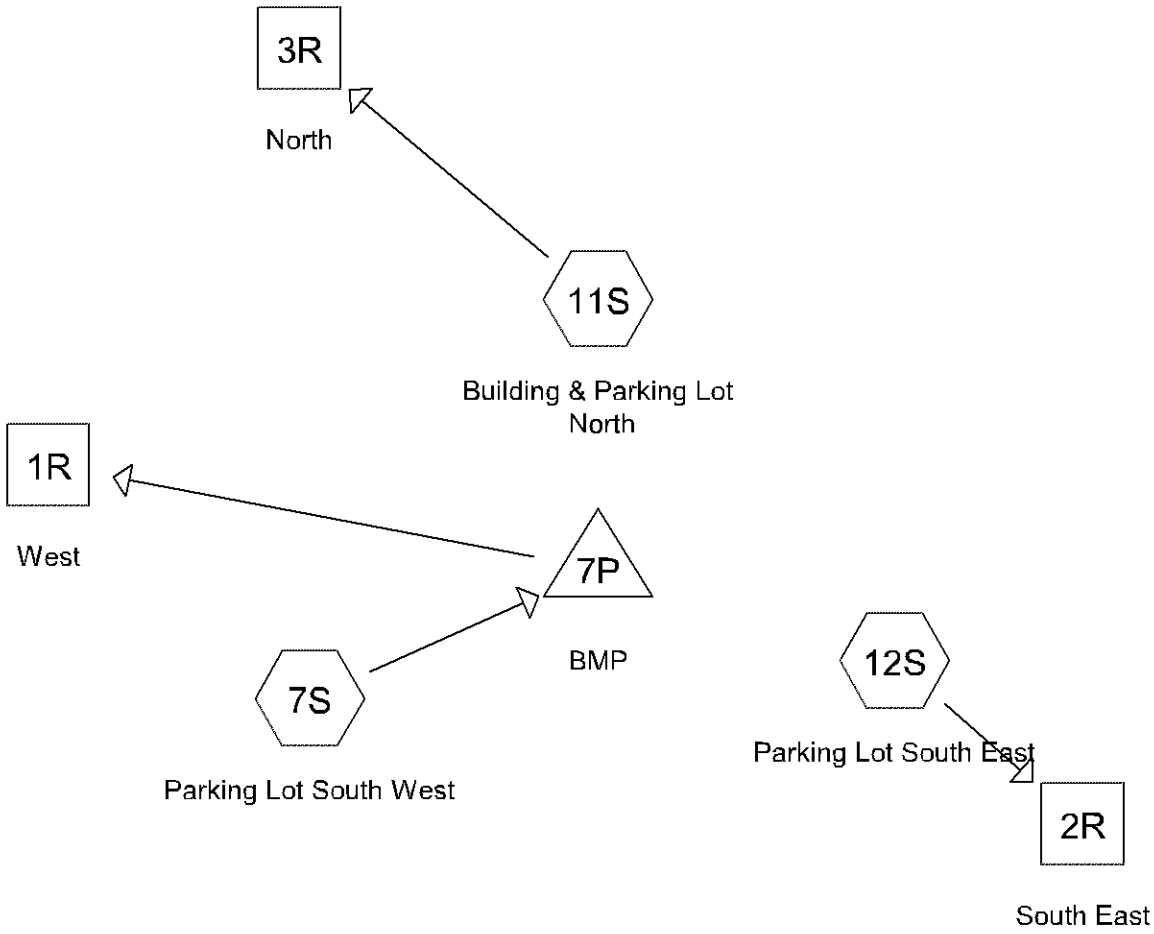
[40] Hint: Not Described (Outflow=Inflow)

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





Subcat Reach Pond Link

Routing Diagram for 2021-0831 - Clover Shopping Center Proposed Conditions
Prepared by Kimley-Horn, Printed 9/8/2021

Area Listing (all nodes)

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

Summary for Subcatchment 7S: Parking Lot South West

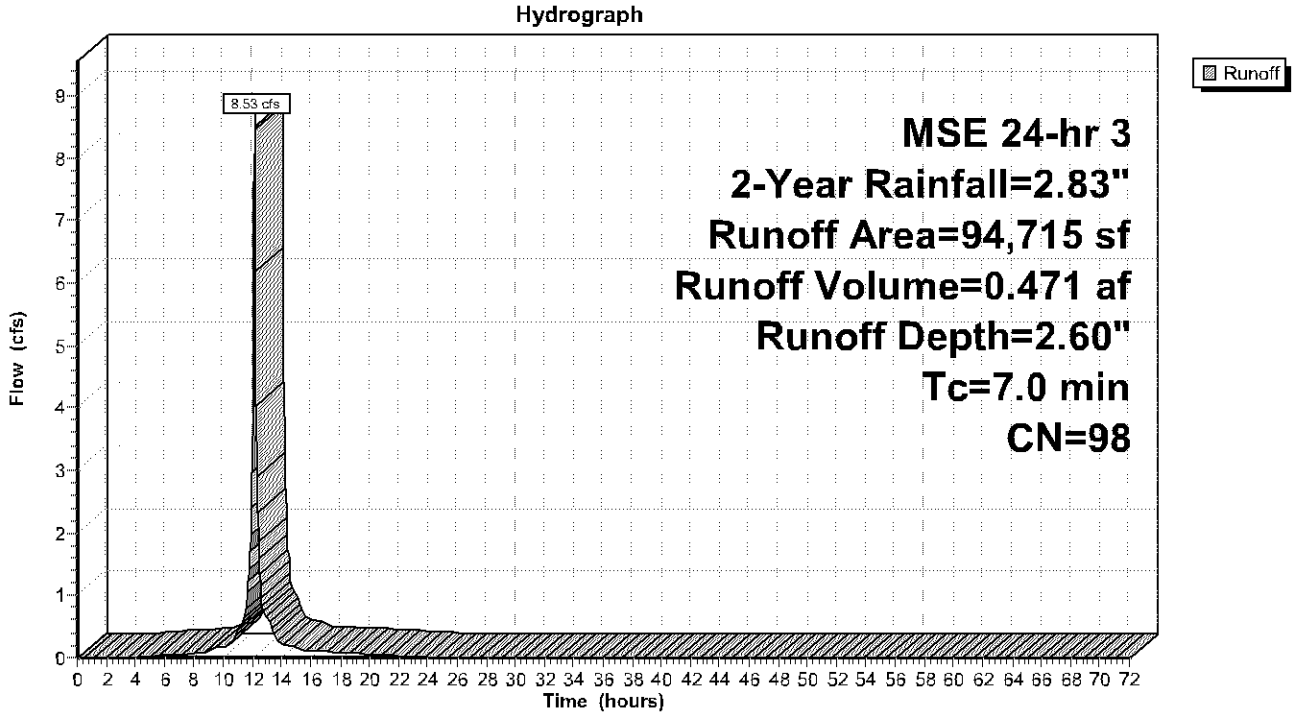
Runoff = 8.53 cfs @ 12.14 hrs, Volume= 0.471 af, Depth= 2.60"

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



Summary for Subcatchment 11S: Building & Parking Lot North

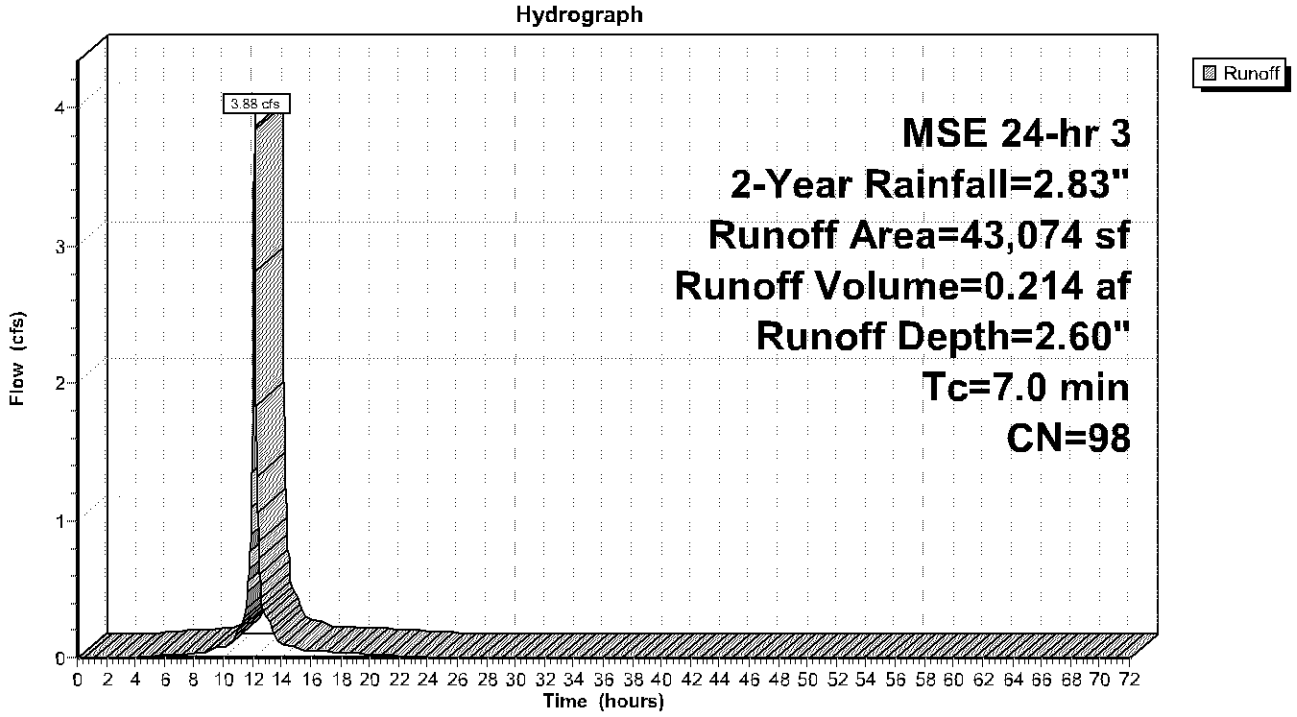
Runoff = 3.88 cfs @ 12.14 hrs, Volume= 0.214 af, Depth= 2.60"

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



Summary for Subcatchment 12S: Parking Lot South East

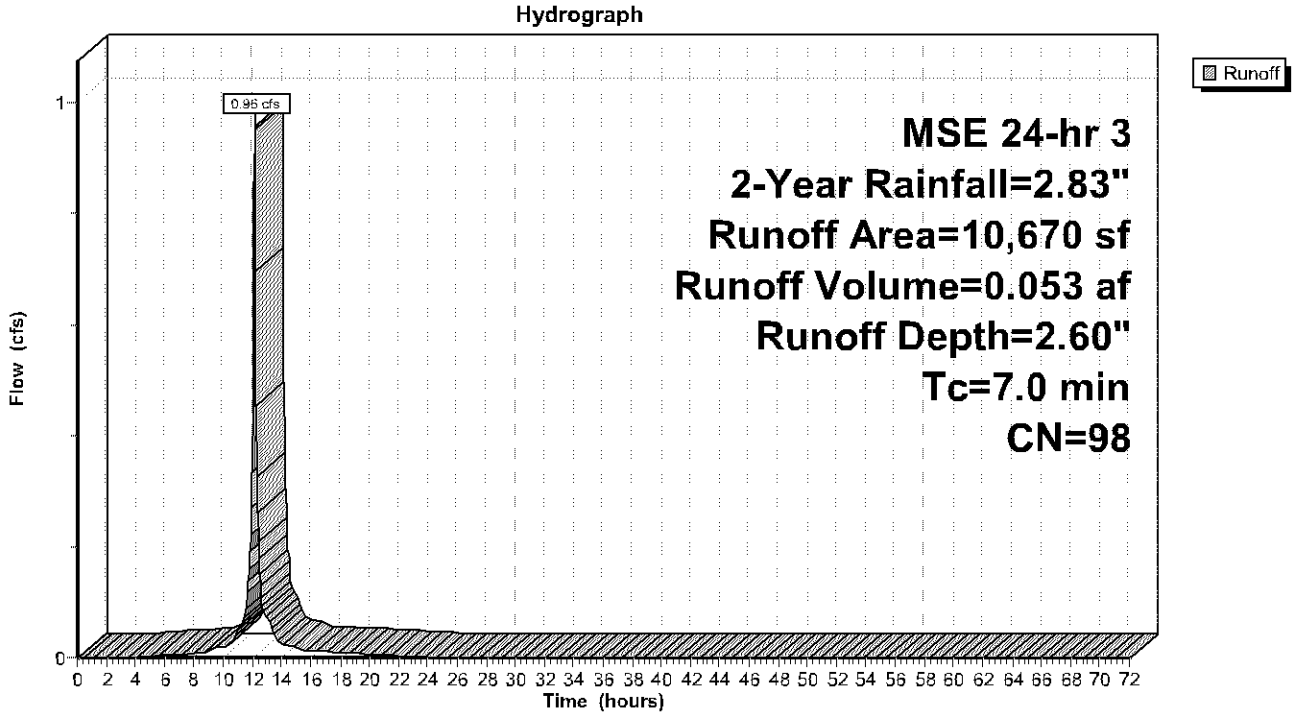
Runoff = 0.96 cfs @ 12.14 hrs, Volume= 0.053 af, Depth= 2.60"

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



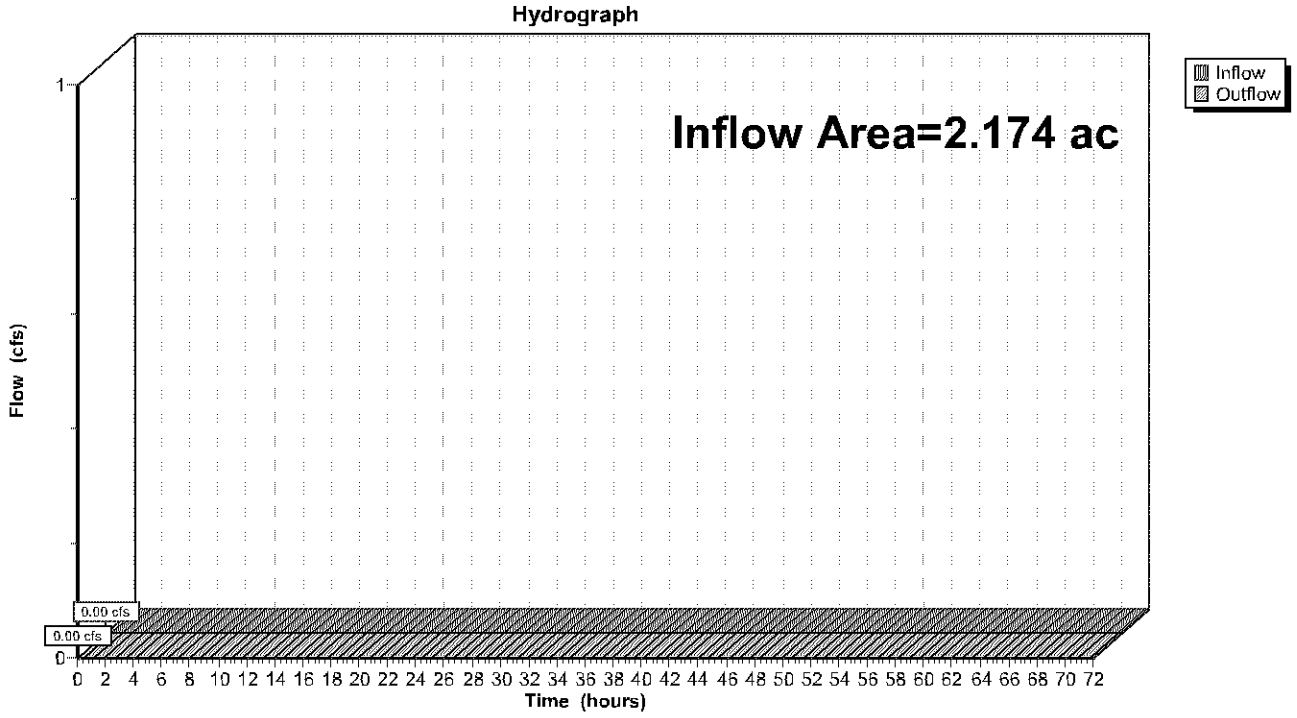
Summary for Reach 1R: West

[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



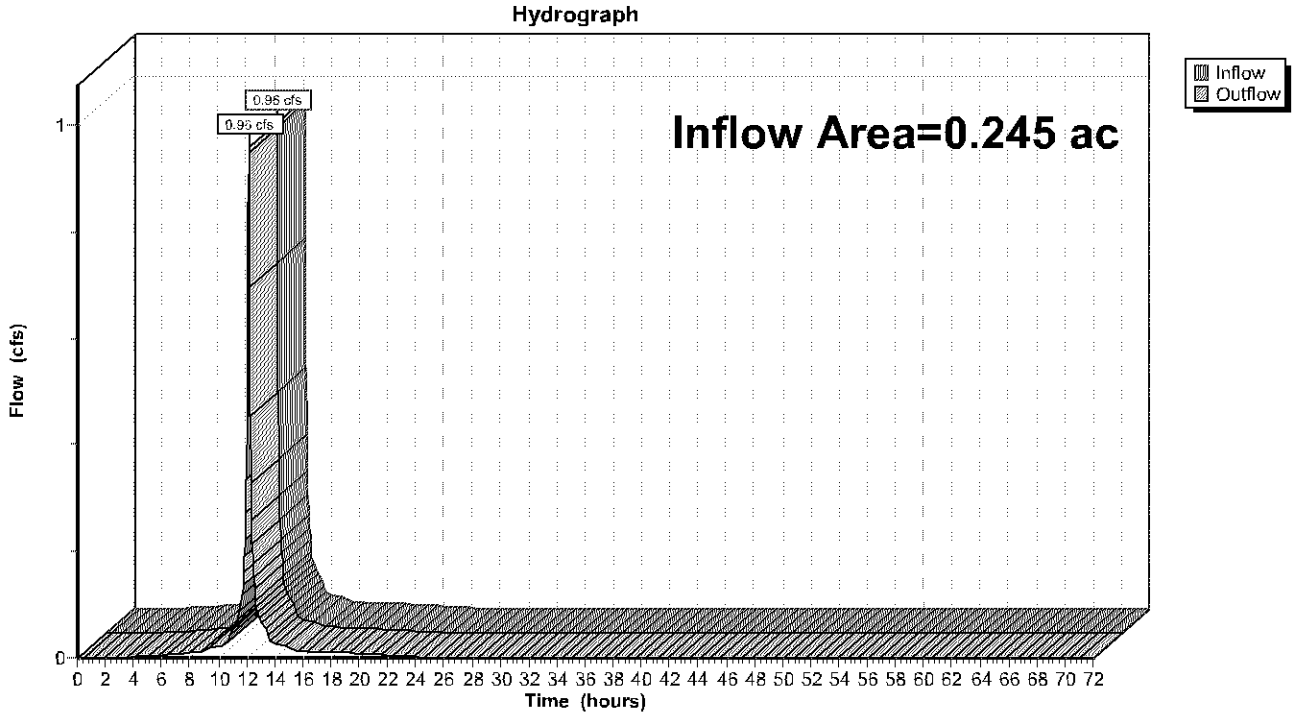
Summary for Reach 2R: South East

[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



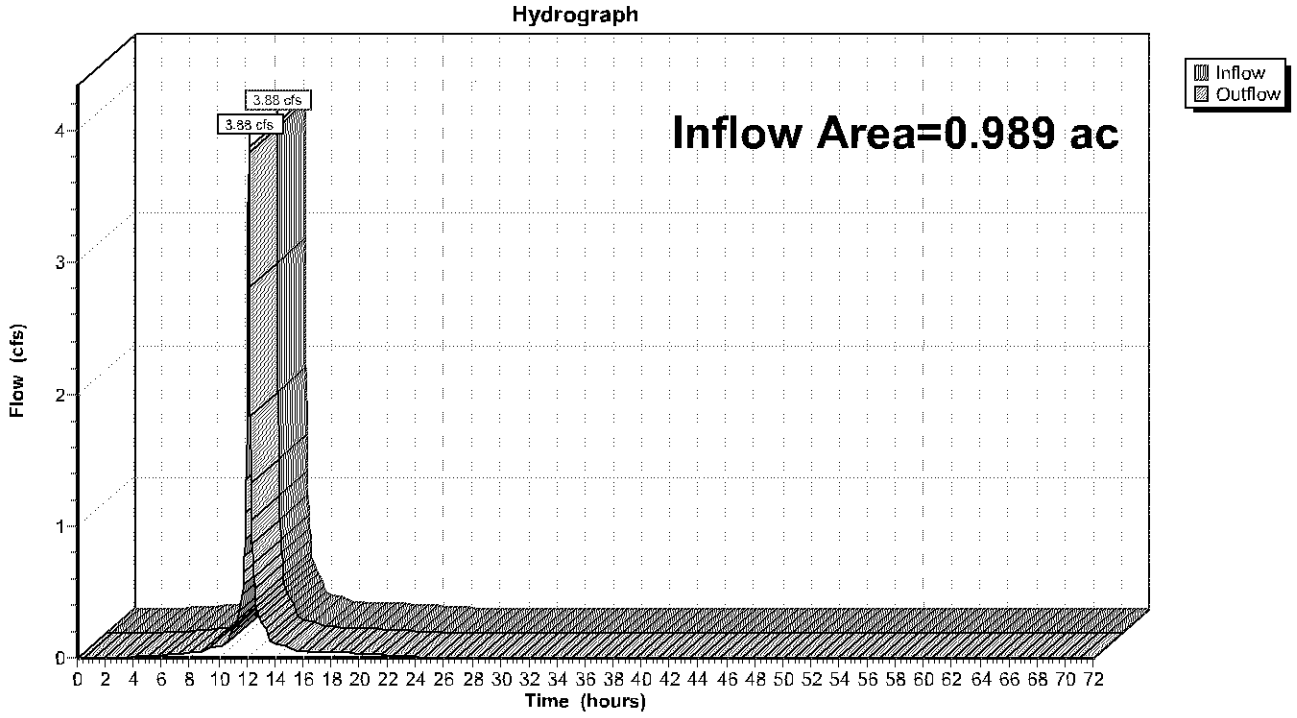
Summary for Reach 3R: North

[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



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	**58.00'W x 190.00'L x 4.50'H Field A** 49,590 cf Overall - 19,896 cf Embedded = 29,694 cf x 40.0% Voids
#2A	825.50'	19,896 cf	**CMP Round 42** x 99 Inside #1 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'	**0.800 in/hr Exfiltration over Surface area**
#2	Primary	828.20'	**15.0" Vert. Orifice/Grate** 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)

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

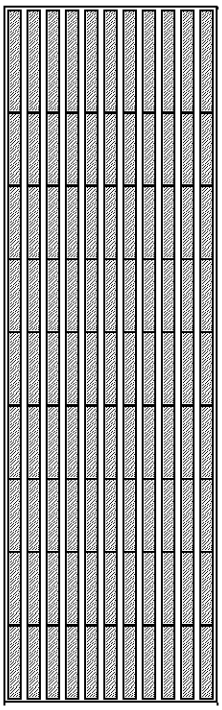
99 Chambers x 192.4 cf +8.00' Row Adjustment x 9.62 sf x 11 Rows = 19,896.5 cf Chamber Storage

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

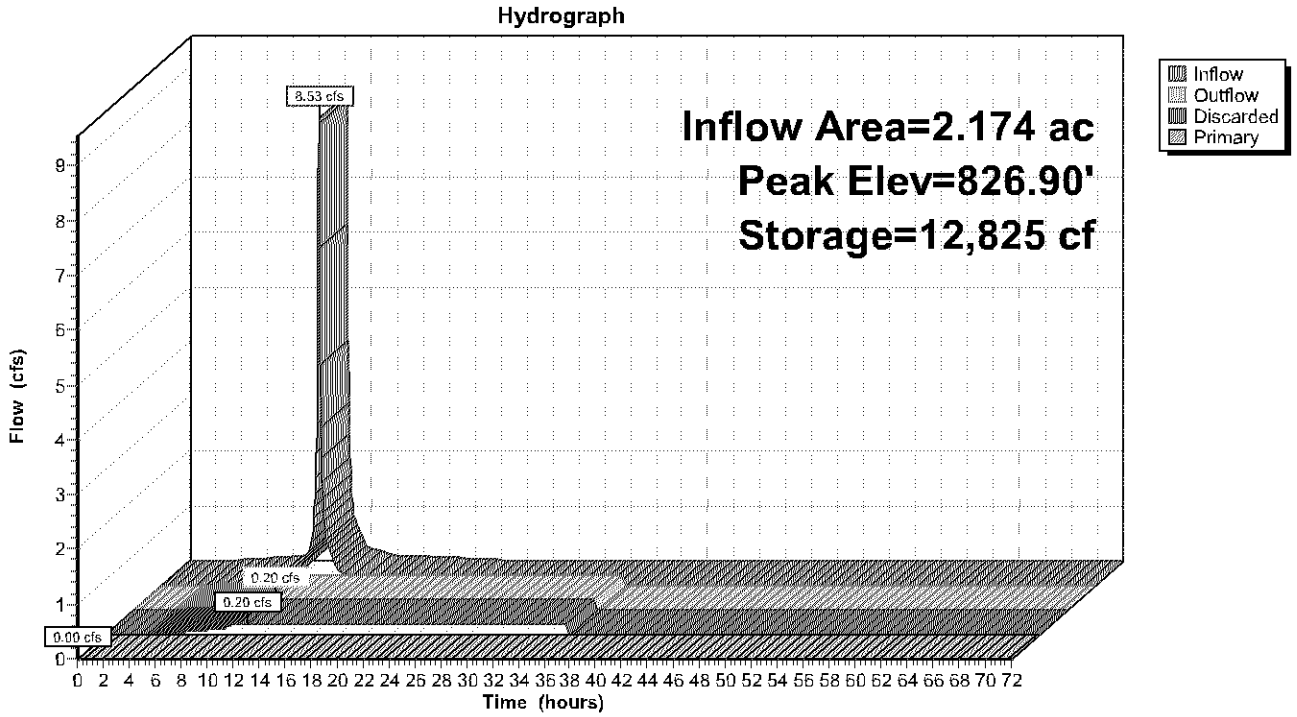
Chamber Storage + Stone Storage = 31,773.9 cf = 0.729 af
Overall Storage Efficiency = 64.1%
Overall System Size = 190.00' x 58.00' x 4.50'

99 Chambers
1,836.7 cy Field
1,099.8 cy Stone

PROVIDE STAGE/STORAGEREPORT IN FUTURE SUBITTALS.



Pond 7P: BMP


Hydrograph
Inflow
Outflow
Discarded
Primary
Inflow Area=2.174 ac
Peak Elev=826.90'
Storage=12,825 cf
8.53 cfs
0.20 cfs
0.20 cfs
0.00 cfs
Flow (cfs)
Time (hours)

Summary for Subcatchment 7S: Parking Lot South West

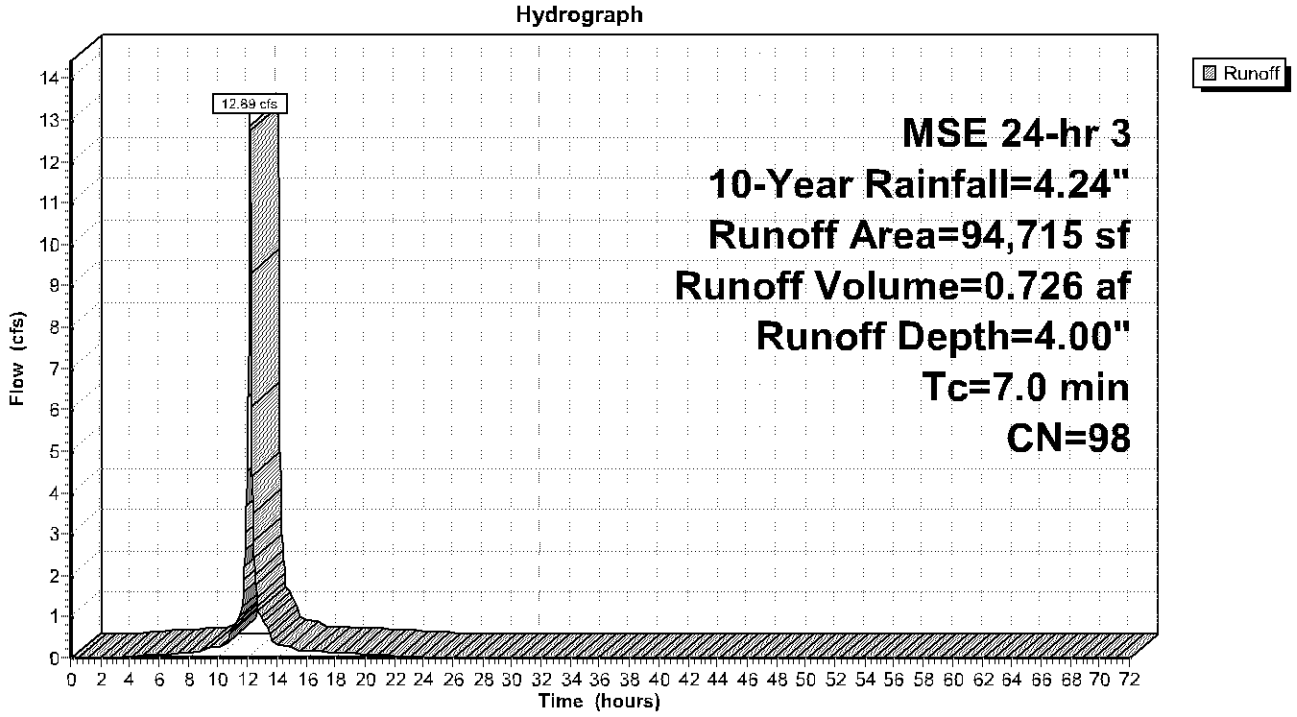
Runoff = 12.89 cfs @ 12.14 hrs, Volume= 0.726 af, Depth= 4.00"

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



Summary for Subcatchment 11S: Building & Parking Lot North

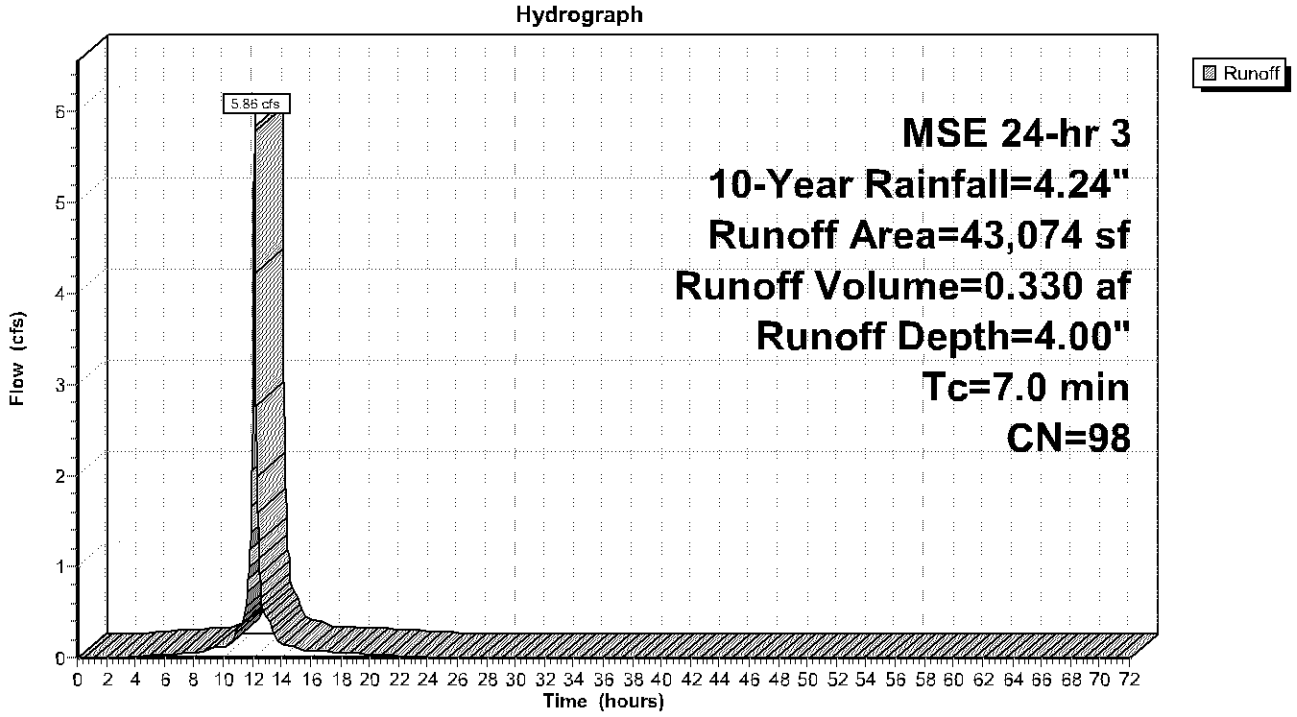
Runoff = 5.86 cfs @ 12.14 hrs, Volume= 0.330 af, Depth= 4.00"

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



Summary for Subcatchment 12S: Parking Lot South East

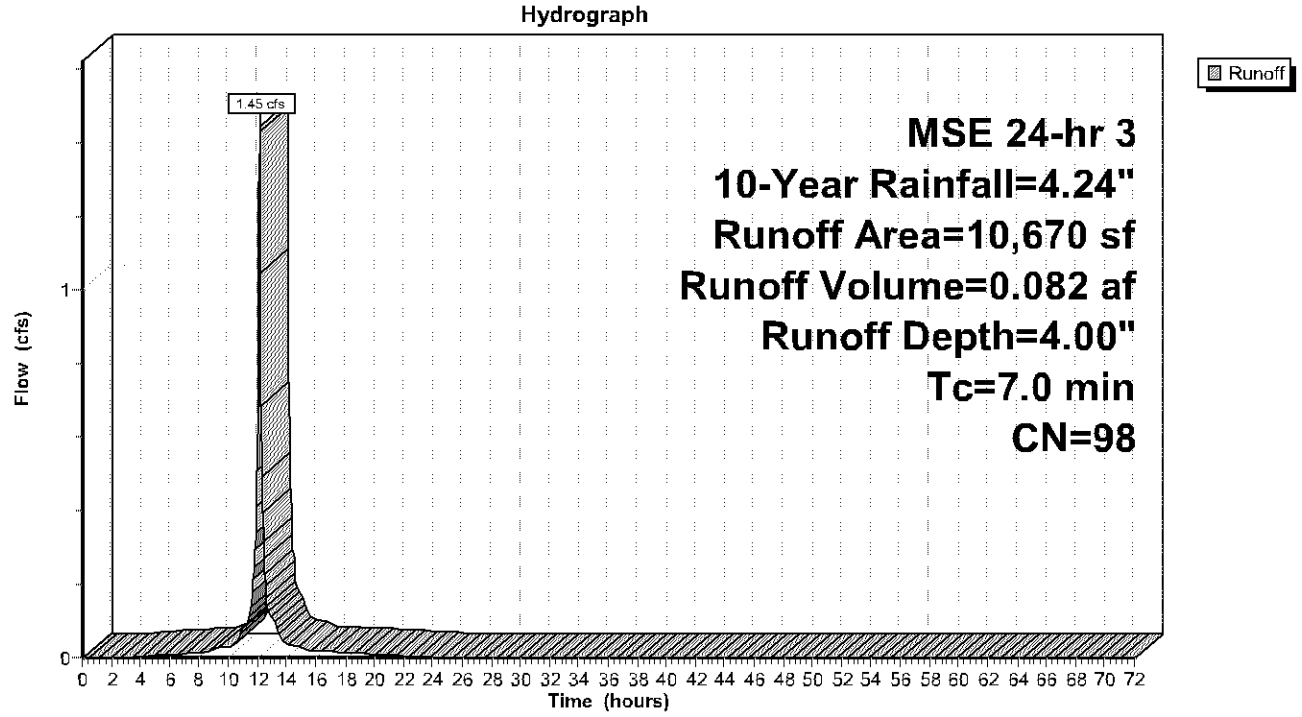
Runoff = 1.45 cfs @ 12.14 hrs, Volume= 0.082 af, Depth= 4.00"

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



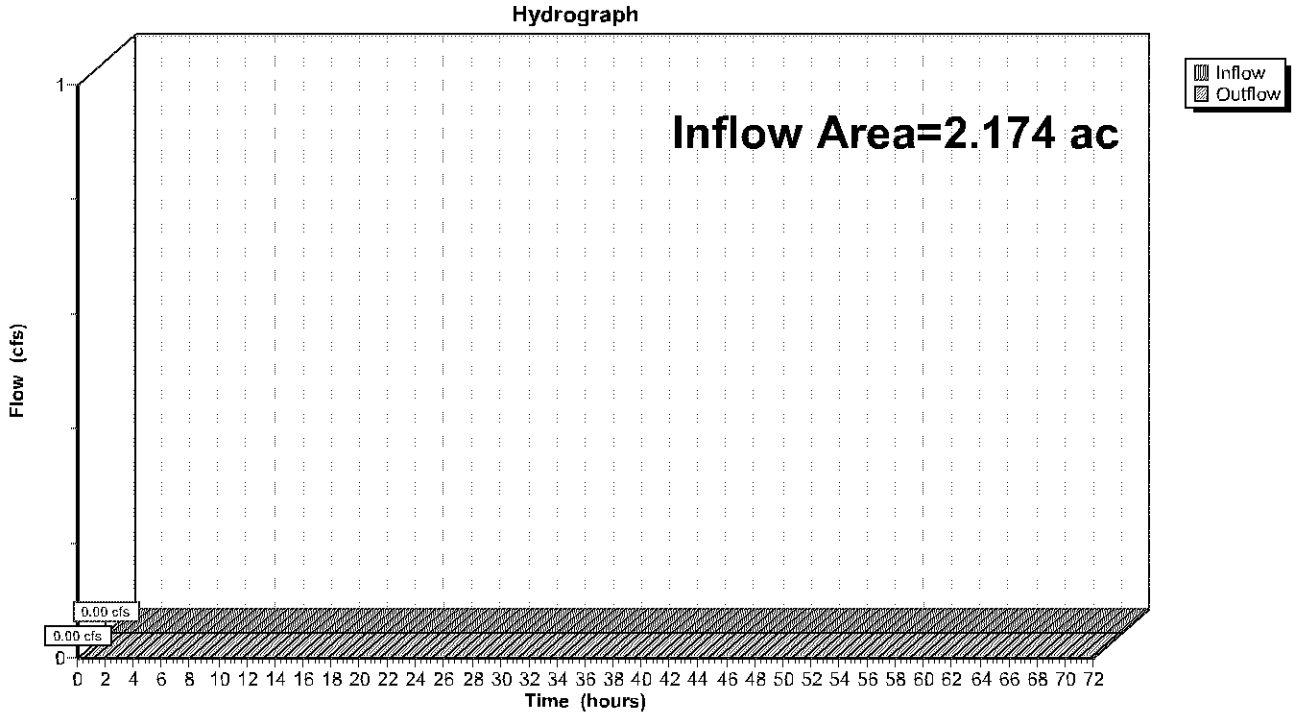
Summary for Reach 1R: West

[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



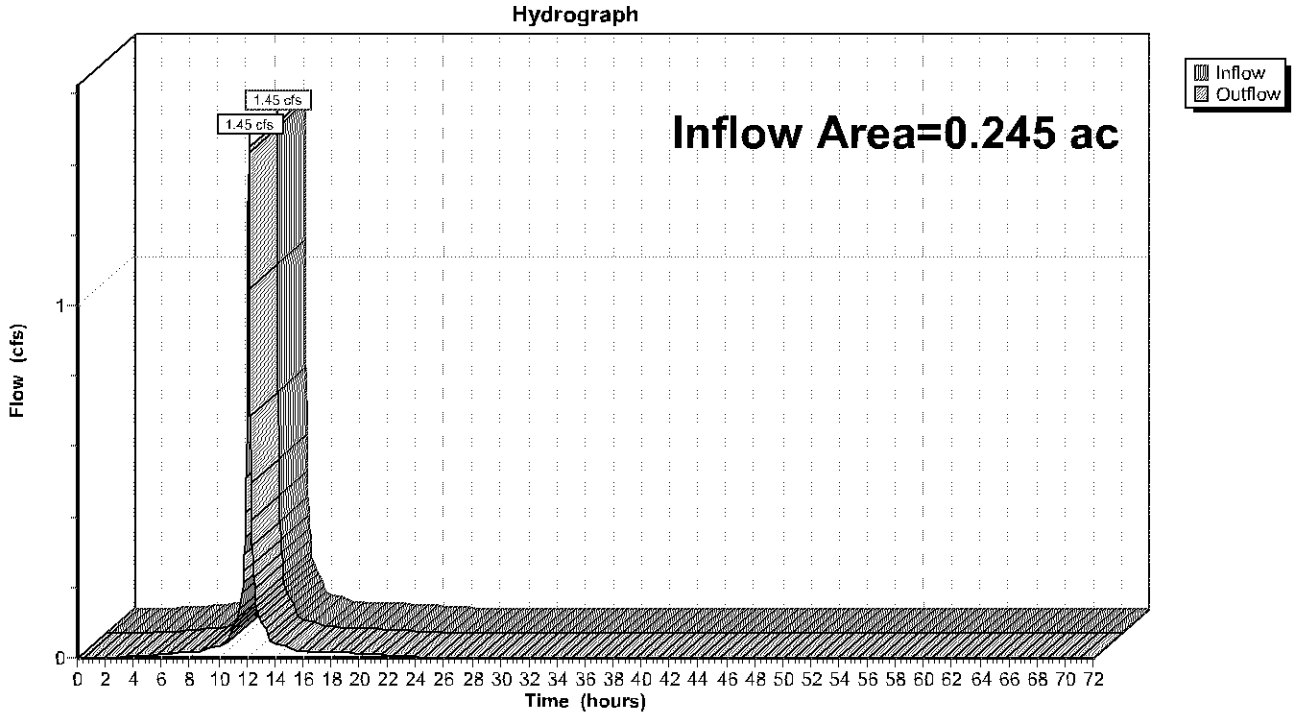
Summary for Reach 2R: South East

[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



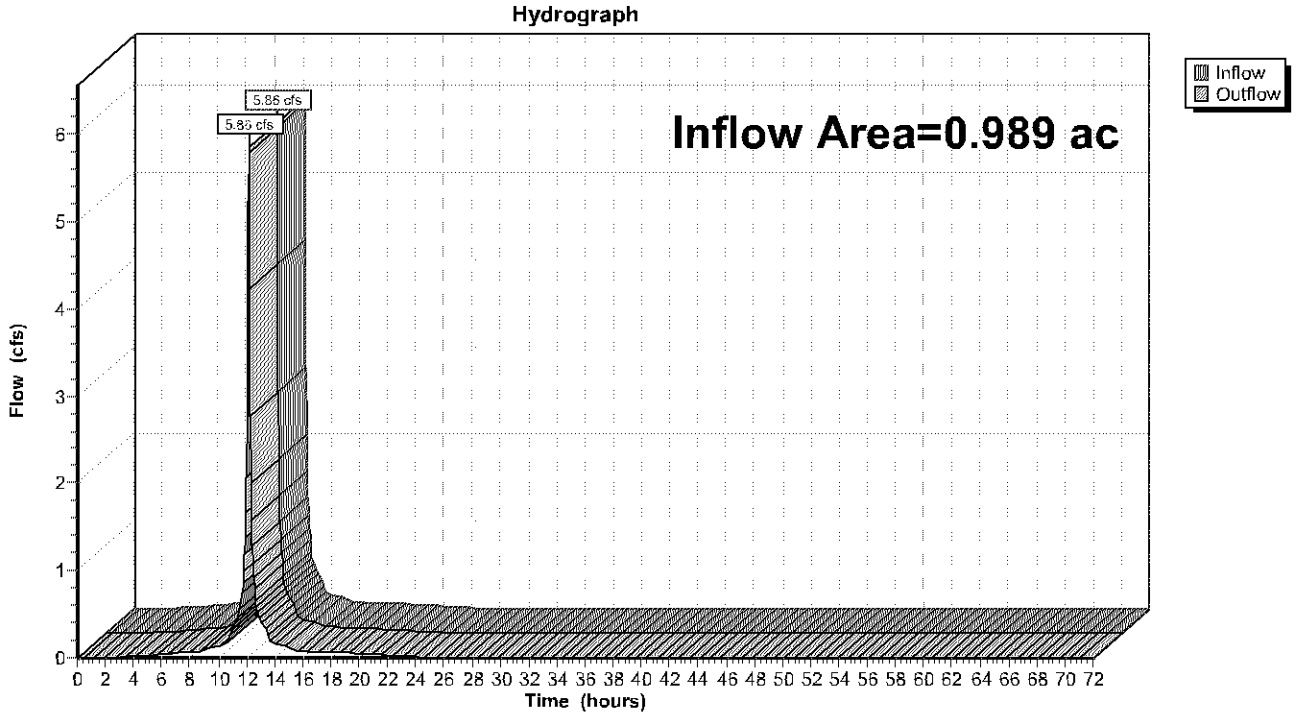
Summary for Reach 3R: North

[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



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	**58.00'W x 190.00'L x 4.50'H Field A** 49,590 cf Overall - 19,896 cf Embedded = 29,694 cf x 40.0% Voids
#2A	825.50'	19,896 cf	**CMP Round 42** x 99 Inside #1 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'	**0.800 in/hr Exfiltration over Surface area**
#2	Primary	828.20'	**15.0" Vert. Orifice/Grate** 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

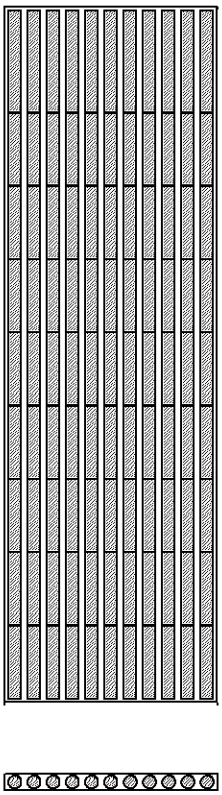
9 Chambers/Row x 20.00' Long +8.00' Row Adjustment = 188.00' Row Length +12.0" End Stone x 2 = 190.00' Base Length
11 Rows x 42.0" Wide + 21.0" Spacing x 10 + 12.0" Side Stone x 2 = 58.00' Base Width
6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

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

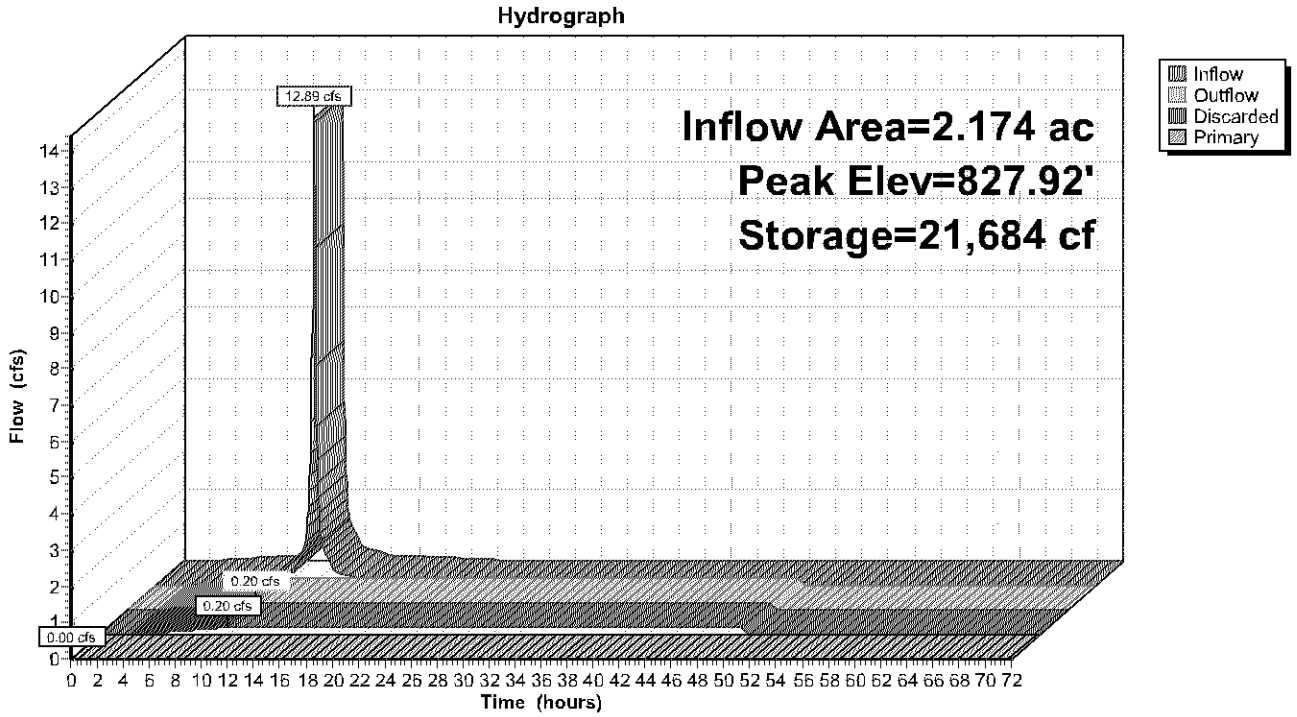
49,590.0 cf Field - 19,896.5 cf Chambers = 29,693.5 cf Stone x 40.0% Voids = 11,877.4 cf Stone Storage

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


Hydrograph
Inflow Area=2.174 ac
Peak Elev=827.92'
Storage=21,684 cf
12.89 cfs
0.20 cfs
0.20 cfs
0.00 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)

Summary for Subcatchment 7S: Parking Lot South West

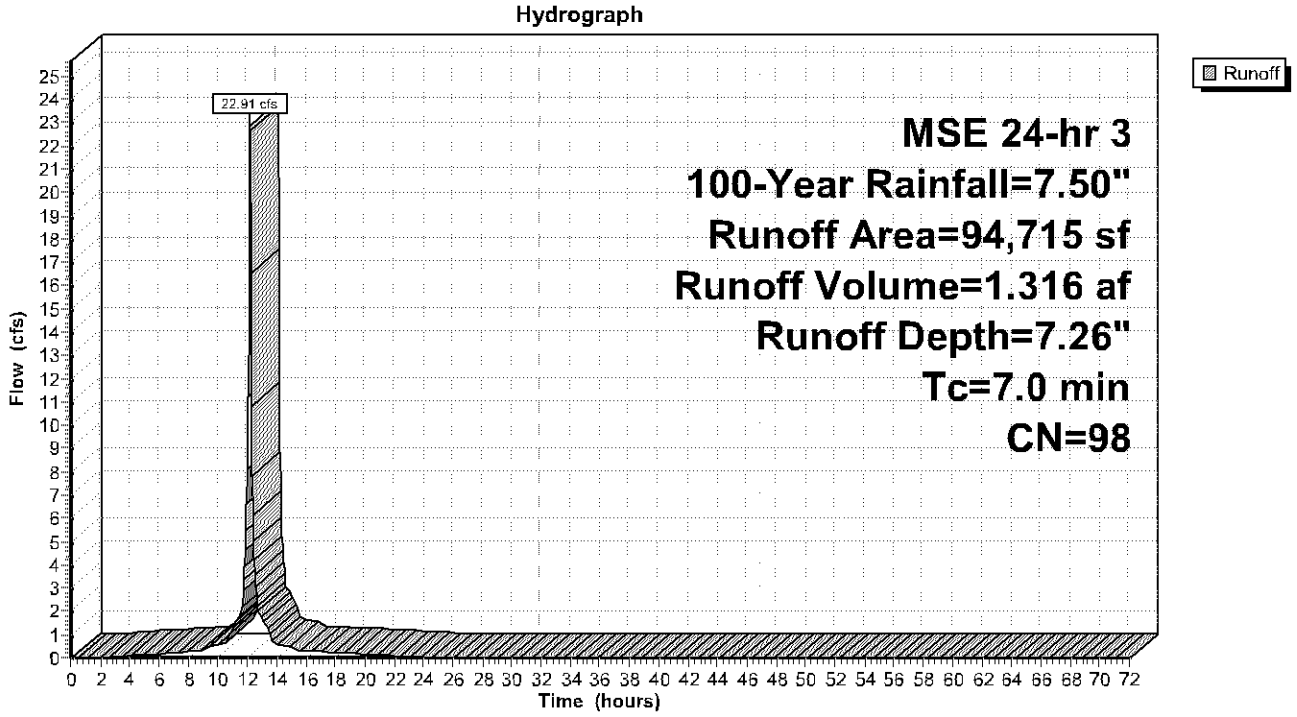
Runoff = 22.91 cfs @ 12.14 hrs, Volume= 1.316 af, Depth= 7.26"

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



Summary for Subcatchment 11S: Building & Parking Lot North

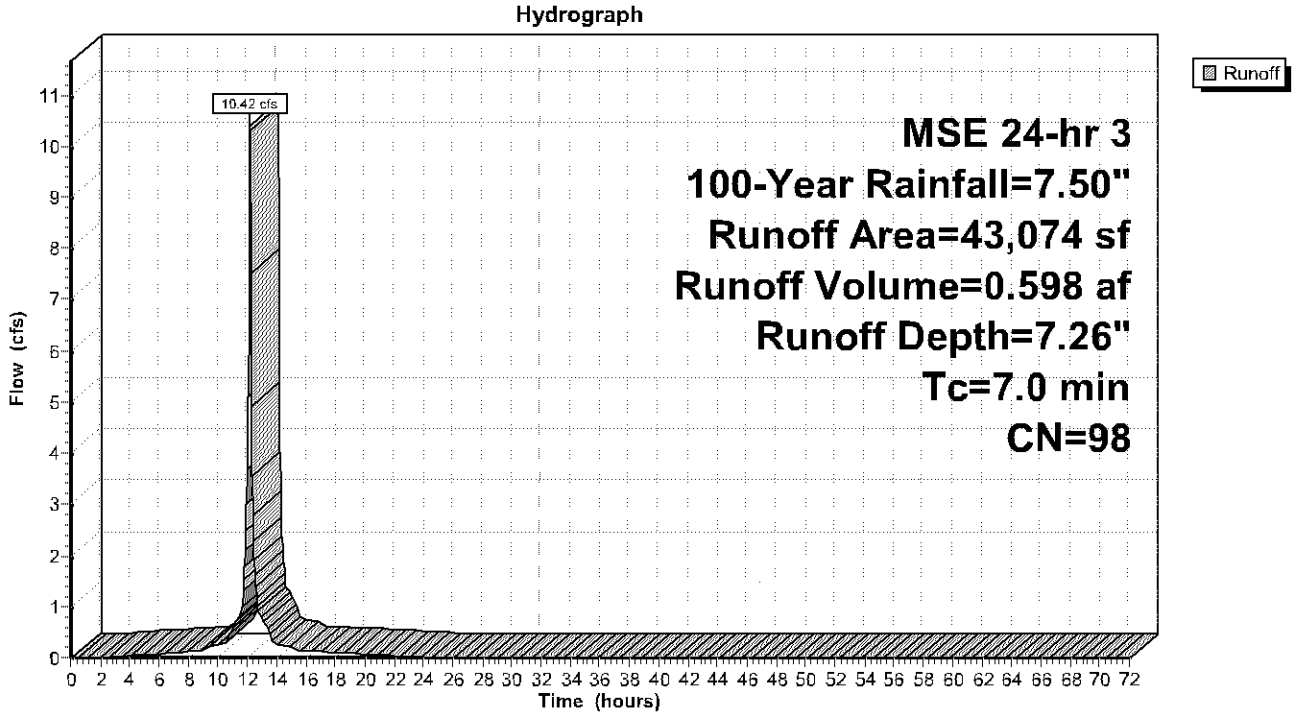
Runoff = 10.42 cfs @ 12.14 hrs, Volume= 0.598 af, Depth= 7.26"

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



Summary for Subcatchment 12S: Parking Lot South East

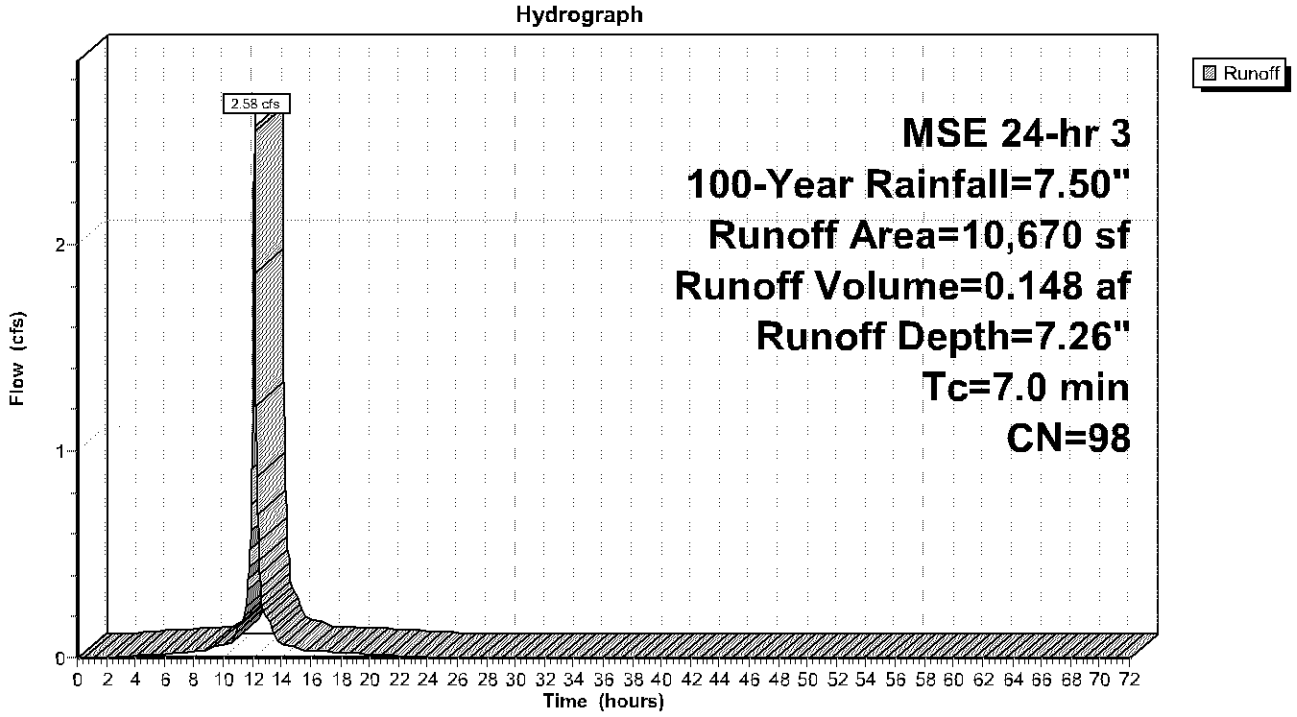
Runoff = 2.58 cfs @ 12.14 hrs, Volume= 0.148 af, Depth= 7.26"

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



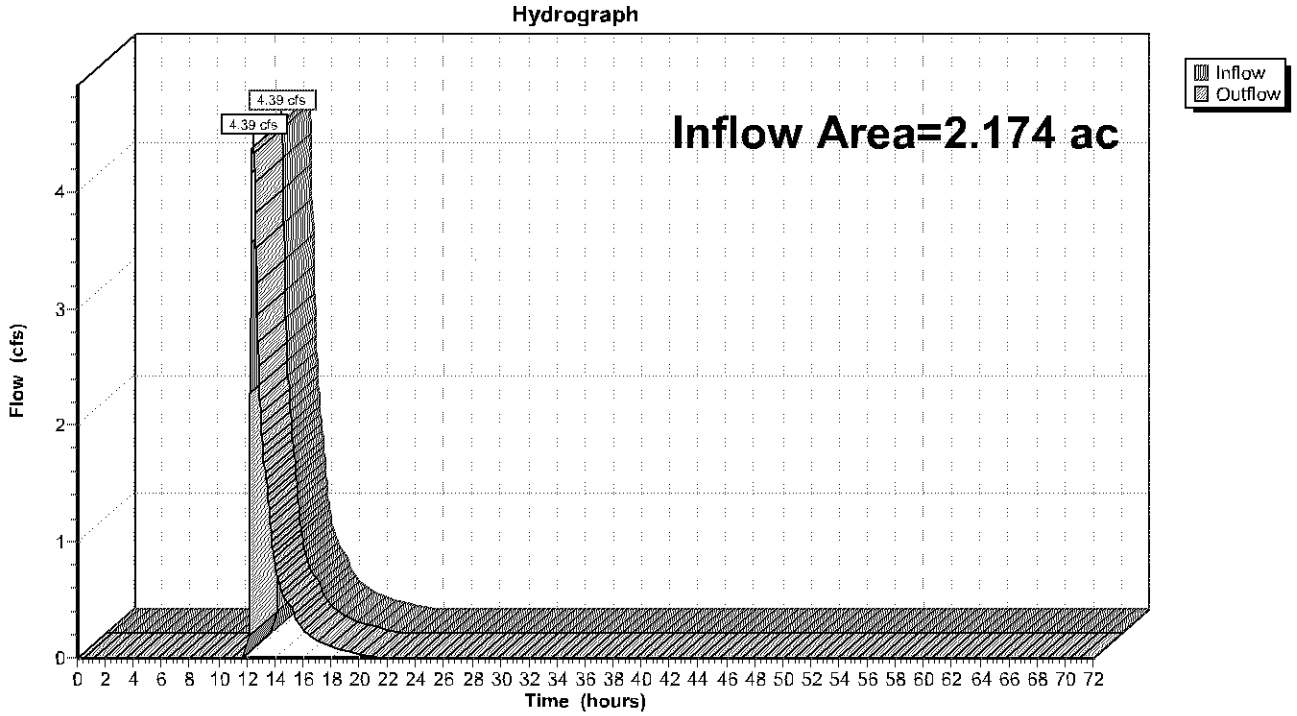
Summary for Reach 1R: West

[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



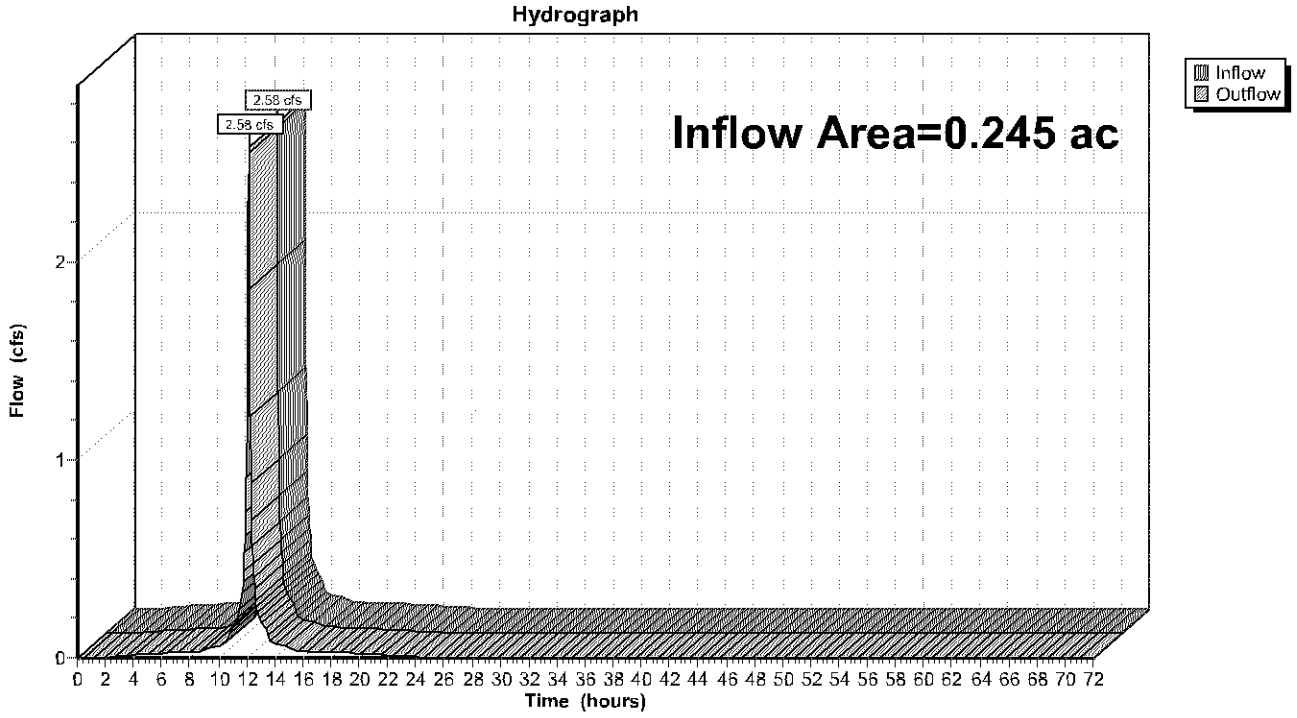
Summary for Reach 2R: South East

[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



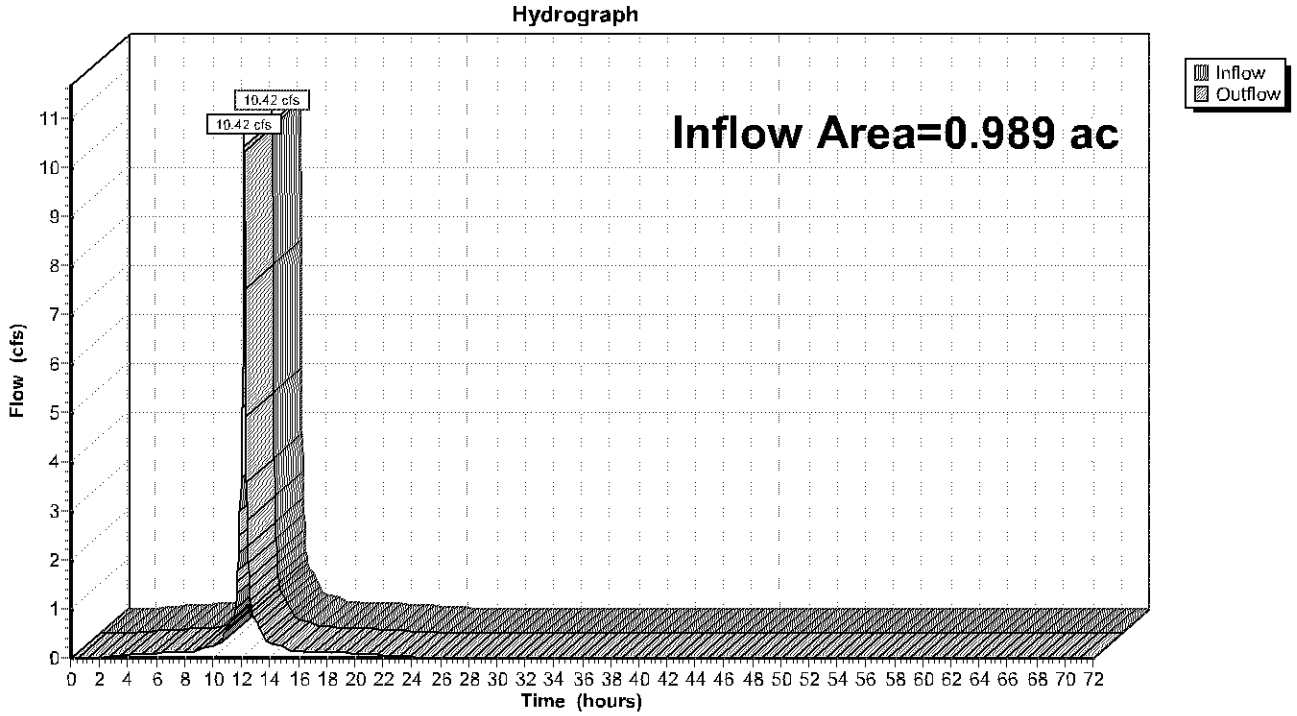
Summary for Reach 3R: North

[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



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	**58.00'W x 190.00'L x 4.50'H Field A** 49,590 cf Overall - 19,896 cf Embedded = 29,694 cf x 40.0% Voids
#2A	825.50'	19,896 cf	**CMP Round 42** x 99 Inside #1 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'	**0.800 in/hr Exfiltration over Surface area**
#2	Primary	828.20'	**15.0" Vert. Orifice/Grate** 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)

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

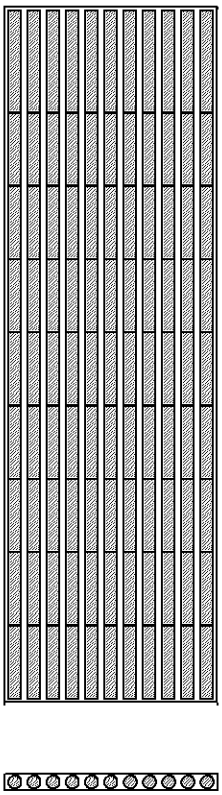
9 Chambers/Row x 20.00' Long +8.00' Row Adjustment = 188.00' Row Length +12.0" End Stone x 2 = 190.00' Base Length
11 Rows x 42.0" Wide + 21.0" Spacing x 10 + 12.0" Side Stone x 2 = 58.00' Base Width
6.0" Stone Base + 42.0" Chamber Height + 6.0" Stone Cover = 4.50' Field Height

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

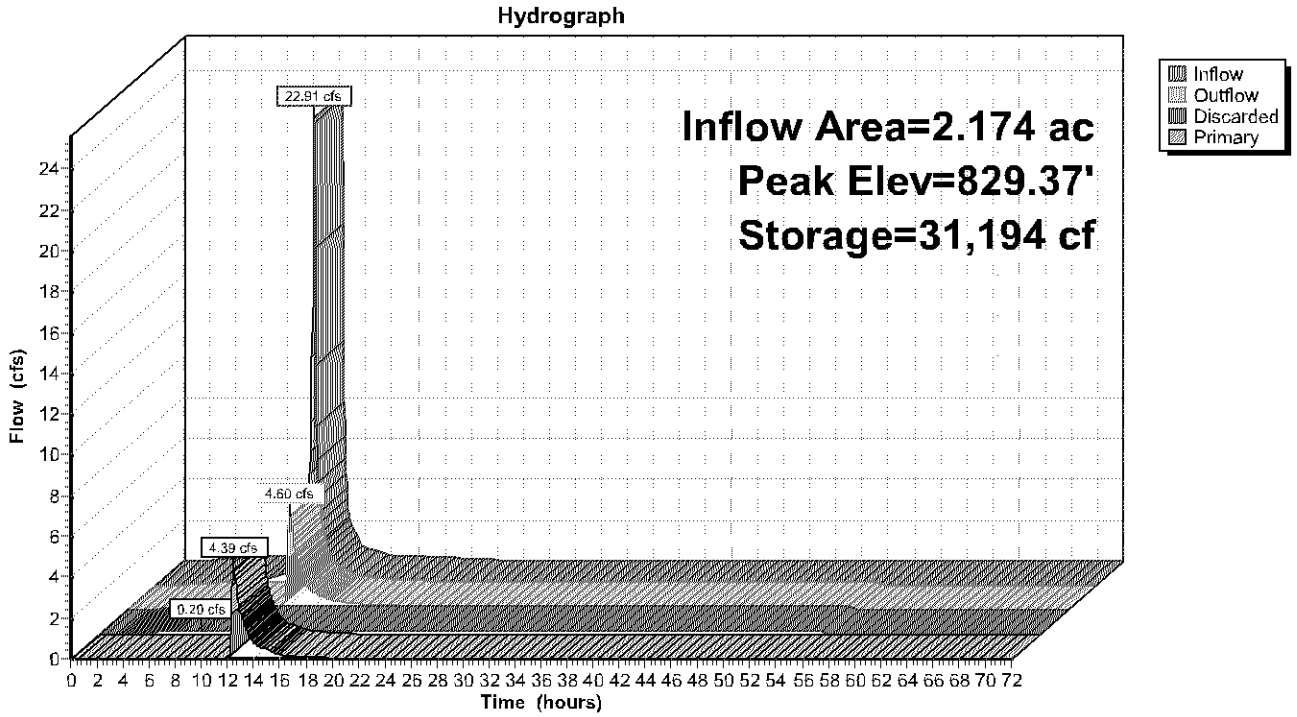
49,590.0 cf Field - 19,896.5 cf Chambers = 29,693.5 cf Stone x 40.0% Voids = 11,877.4 cf Stone Storage

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


Hydrograph
Inflow Area=2.174 ac
Peak Elev=829.37'
Storage=31,194 cf
22.91 cfs
4.60 cfs
4.39 cfs
0.20 cfs
Inflow
Outflow
Discarded
Primary
Flow (cfs)
Time (hours)