
## RAMSEY, MN

# STORMWATER NARRATIVE

## December 3, 2010

LANDFORM
From Site to Finish

## TABLE OF CONTENTS



## APPENDICES

## PROPOSED DEVELOPMENT

The proposed development consists of a new multistory apartment building and associated parking, landscaping, plaza areas and site utilities. The site lies between Sunwood Drive and Civic Center Drive and is adjacent to the existing Ramsey Municipal Parking Ramp located in the "COR" development (F.K.A. Ramsey Town Center) in Ramsey Minnesota.

## EXISTING SITE CONDTIONS

The project consists of vacant land and is comprised of approximately 3.03 acres. The site has been mass graded and prepped for development as part of the Ramsey Town Center development. Site drainage eventually is routed through the City's storm water system to a series of regional ponds.

## JURISDICTIONAL BODIES AND REQUIREMENTS

The City of Ramsey and Lower Rum River Watershed Management Organization (LRRWMO) have jurisdiction over stormwater runoff from proposed development at this site. The LRRWMO is the review agency for both the City and the Watershed Management Organization. The City requires the removal of at least 80% of total suspended solids. To meet this requirement, BMP's must be designed to treat the 1" rain event per the City of Ramsey as a method of pretreatment prior to entering the City's stormwater conveyance system. Onsite stormwater conveyance is to be deigned to handle the 10-year rainfall event by utilizing the rational method.

## EXISTING SITE DRAINAGE PATTERNS

The site is currently undeveloped and the site is generally flat with minimal elevation differential. The site is gently sloping from west to east. Storm sewer catch basins in the surrounding roadways serve as potential connections for stormwater conveyance.

## PROPOSED ON-SITE STORMWATER MANAGEMENT

The design goal of the proposed drainage plan is to follow existing drainage patterns, provide water quality treatment to at least mandated levels. Since rate control is currently handled by regional ponding provided by the City, no onsite rate control is necessary.

The proposed stormwater management plan will provide the required water quality pretreatment through the utilization of hydrodynamic separators designed to handle the peak runoff rates from the 1" event. Onsite storm sewer has been designed to convey the 10-year rainfall event. Details pertaining to these systems have been included both with this report and as shown on the submitted drawings. This project will share the treatment facilities with the westerly adjacent site due to the shared access location and points of connection for storm water. Since the storm drainage systems are utilizing a shared system for the majority of each project, the rates summary and pretreatment summary are inclusive of both projects. A separate narrative and plans for the Senior Living project adjacent to this site can be referred to for additional information.

*Table 1: Runoff Rates Summary*

| Event | Existing Runoff Rate (cfs) | Proposed Runoff Rate (cfs) to Regoinal Ponds |
|---|---|---|
| 2-yr (2.75") event | 1.56 | 16.27 |
| 10-yr (4.1") event | 6.98 | 26.16 |
| 100-yr (5.9") event | 16.85 | 39.27 |

*Table 2: Pretreatment Summary*

| Drainage Area | Pretreatment Device | 1" Event Peak Runoff Rate (cfs) | Design Treatment Capacity (cfs) |
|---|---|---|---|
| Drainage Area 1 | ecoStorm Model #1 | 0.42 | 1.9 |
| Drainage Area 2 | Aqua-Swirl #1 AS-3 Model | 0.88 | 1.8 |
| Drainage Area 3 | Aqua Swirl #2 AS-3 Model | 1.39 | 1.8 |
| Drainage Area 4 | ecoStorm Model #1.5 | 1.07 | 2.6 |

The ecoStorm and Aqua-Swirl structures have been sized adequately enough to treat the 1" event and convey the 10-year rainfall events. A diversion weir was used for each system to contain and treat the 1" event, but also to allow stormwater to by-pass during larger events.

**ALLEYWAY PONDING ANALYSIS**

It is our understanding the lower level of the existing parking structure adjacent to the proposed alleyway experiences fairly frequent freezing. It is not our intent to provide a solution to this problem. However, special attention to drainage and ponding in the proposed alleyway between the existing parking structure has been given and analyzed. The maximum ponding depth for each catch basin in the proposed alleyway was modeled assuming the outlet pipe to be 50% clogged during a 100-yr event. Overland overflow elevations have been designed at one foot below the proposed garage floor and the existing parking structure elevation as shown on the proposed grading plan. Since the ponding depth of each subcatchment will exceed the overland overflow elevation during the 100-yr event, a theoretical "glass wall" was necessary to model in order to conservatively compute how high each ponding area would bounce during the design event. The results of this analysis indicate the highest subcatchment surface ponding elevation to be 869.63 which is below the proposed garage floor and lower level parking structure elevation of 870.00. This theoretical "glass wall" is a very conservative approach to modeling due to this is not a land-locked basin and the ultimate overland overflow path would travel towards Sunwood Drive.

## CONCLUSION

The proposed design will provide pretreatment of storm water runoff prior to entering the City's stormwater system. The proposed design meets the intent of the LRRWMO and City of Ramsey regulations which dictate at least 80% of total suspended solids based on a 1" rain event.

## CONTACT INFORMATION

This document was prepared by:

Landform
105 South 5th Avenue, Suite 513
Minneapolis, MN 55401

Please direct any questions regarding this narrative to Steve Sabraski, PE at ssabraski@landform.net or 612.638.0243.

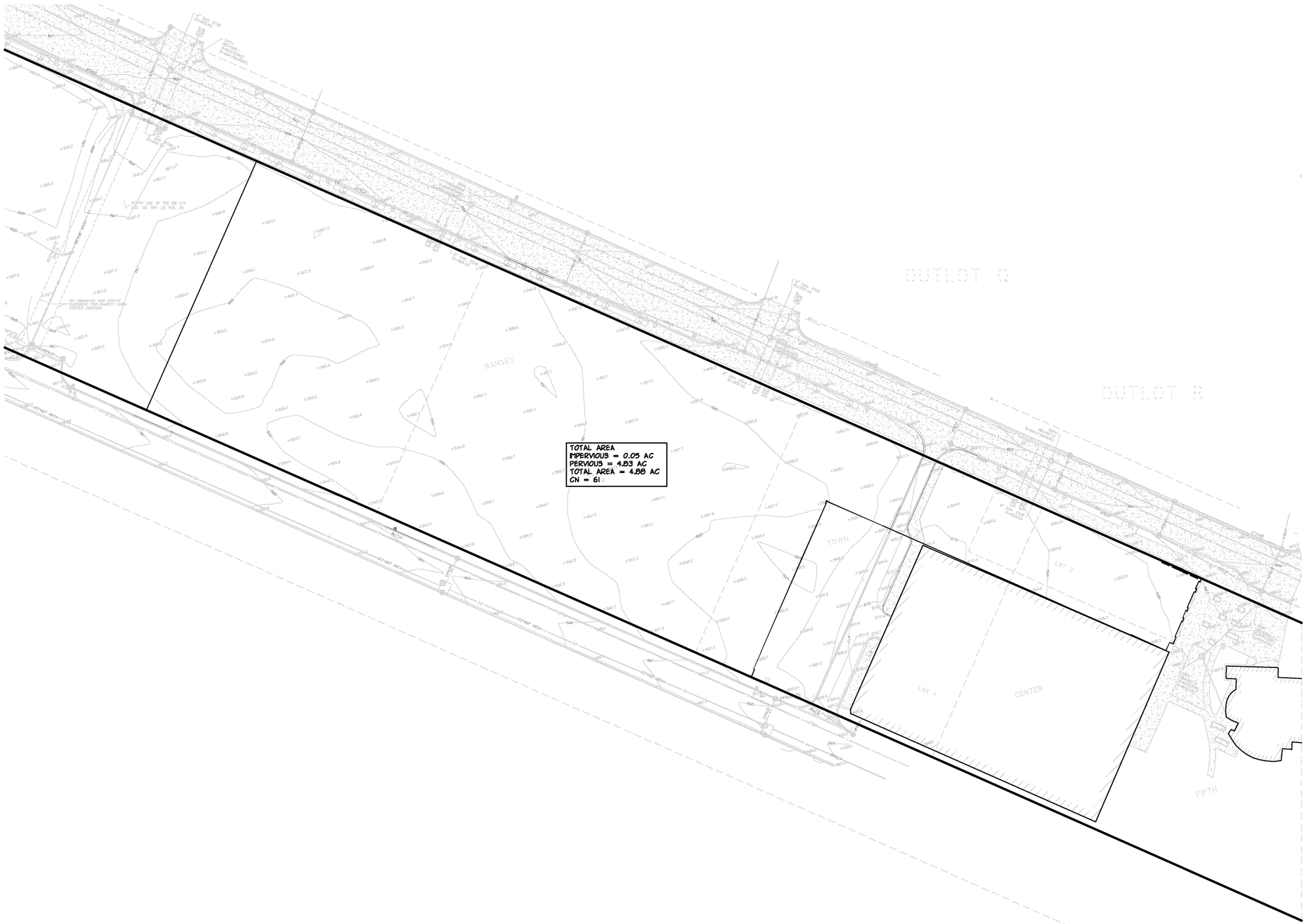
# APPENDIX A

# EXISTING DRAINAGE MAP

LANDFORM
From Site to Finish

# SENIOR LIVING / APTS

RAMSEY, MN




NORTH

0 100

LANDFORM

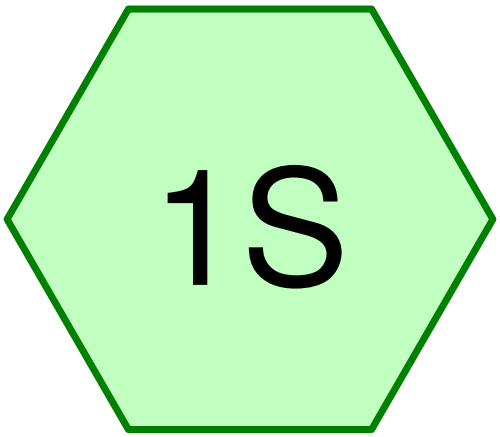
From Site to Finish

## EXISTING DRAINAGE MAP

12.03.2010

# APPENDIX B

# EXISTING HYDROCAD MODEL




# Existing

Subcat Reach Pond Link

**Drainage Diagram for UWA10002 - Existing**
Prepared by {enter your company name here}, Printed 12/1/2010

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 4.830 | 61 | >75% Grass cover, Good, HSG B (1S) |
| 0.050 | 98 | Paved parking, HSG B (1S) |
| **4.880** | | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| **4.880** | HSG B | 1S |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 0.000 | Other | |
| 4.880 | | **TOTAL AREA** |

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Existing** Runoff Area=4.880 ac 1.02% Impervious Runoff Depth>0.23"
Tc=5.0 min CN=61 Runoff=1.56 cfs 0.094 af

**Total Runoff Area = 4.880 ac Runoff Volume = 0.094 af Average Runoff Depth = 0.23"**
**98.98% Pervious = 4.830 ac 1.02% Impervious = 0.050 ac**

## Summary for Subcatchment 1S: Existing

[49] Hint: Tc<2dt may require smaller dt

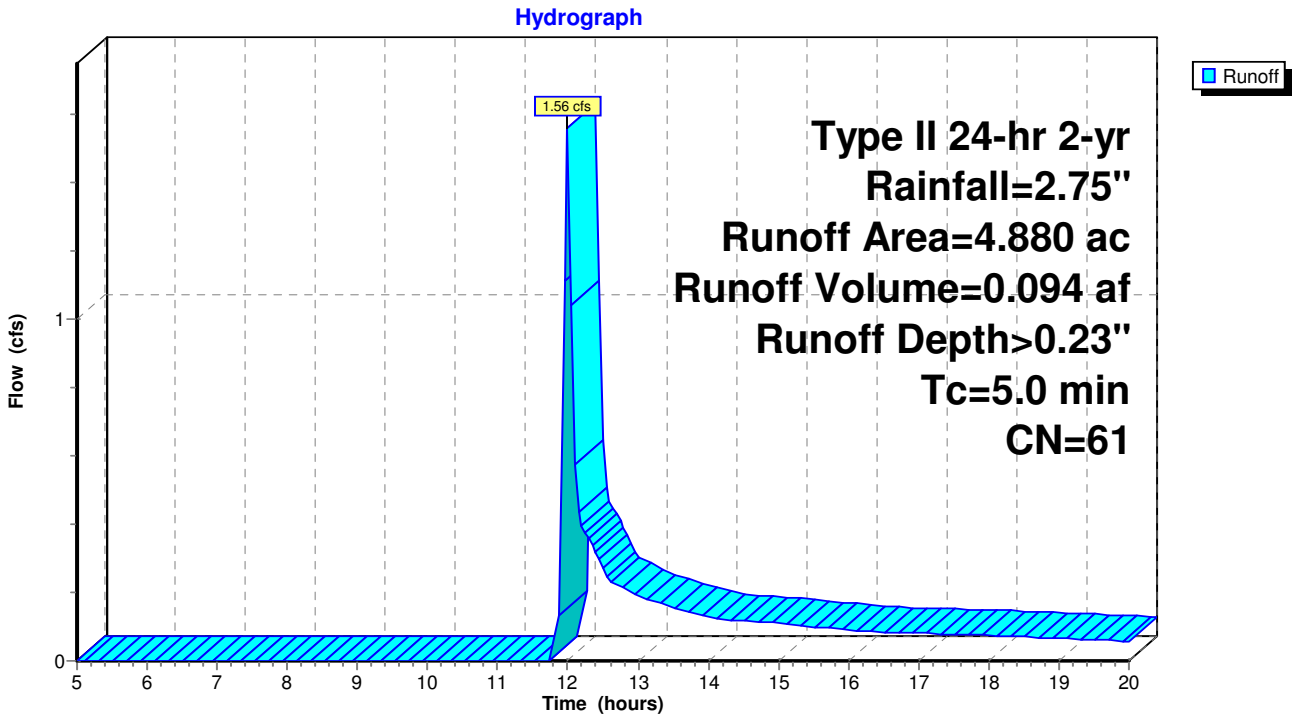
Runoff = 1.56 cfs @ 12.00 hrs, Volume= 0.094 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (ac) | CN | Description |
|---|---|---|
| 0.050 | 98 | Paved parking, HSG B |
| 4.830 | 61 | >75% Grass cover, Good, HSG B |
| 4.880 | 61 | Weighted Average |
| 4.830 | | 98.98% Pervious Area |
| 0.050 | | 1.02% Impervious Area |

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

### Subcatchment 1S: Existing



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Existing** Runoff Area=4.880 ac 1.02% Impervious Runoff Depth>0.76"
Tc=5.0 min CN=61 Runoff=6.98 cfs 0.310 af

**Total Runoff Area = 4.880 ac Runoff Volume = 0.310 af Average Runoff Depth = 0.76"**
**98.98% Pervious = 4.830 ac 1.02% Impervious = 0.050 ac**

## Summary for Subcatchment 1S: Existing

[49] Hint: Tc<2dt may require smaller dt

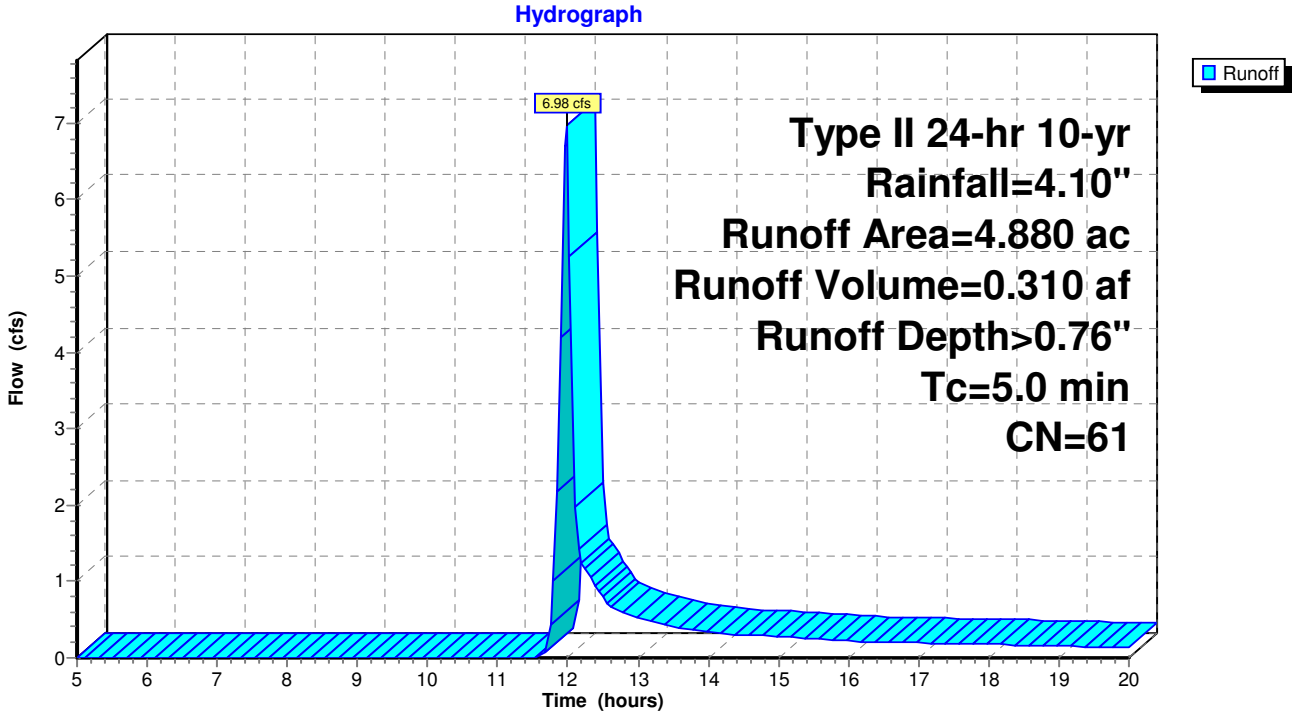
Runoff = 6.98 cfs @ 11.97 hrs, Volume= 0.310 af, Depth> 0.76"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (ac) | CN | Description |
|---|---|---|
| 0.050 | 98 | Paved parking, HSG B |
| 4.830 | 61 | >75% Grass cover, Good, HSG B |
| 4.880 | 61 | Weighted Average |
| 4.830 | | 98.98% Pervious Area |
| 0.050 | | 1.02% Impervious Area |

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

### Subcatchment 1S: Existing



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Existing** Runoff Area=4.880 ac 1.02% Impervious Runoff Depth>1.75"
Tc=5.0 min CN=61 Runoff=16.85 cfs 0.712 af

**Total Runoff Area = 4.880 ac Runoff Volume = 0.712 af Average Runoff Depth = 1.75"**
**98.98% Pervious = 4.830 ac 1.02% Impervious = 0.050 ac**

## Summary for Subcatchment 1S: Existing

[49] Hint: Tc<2dt may require smaller dt

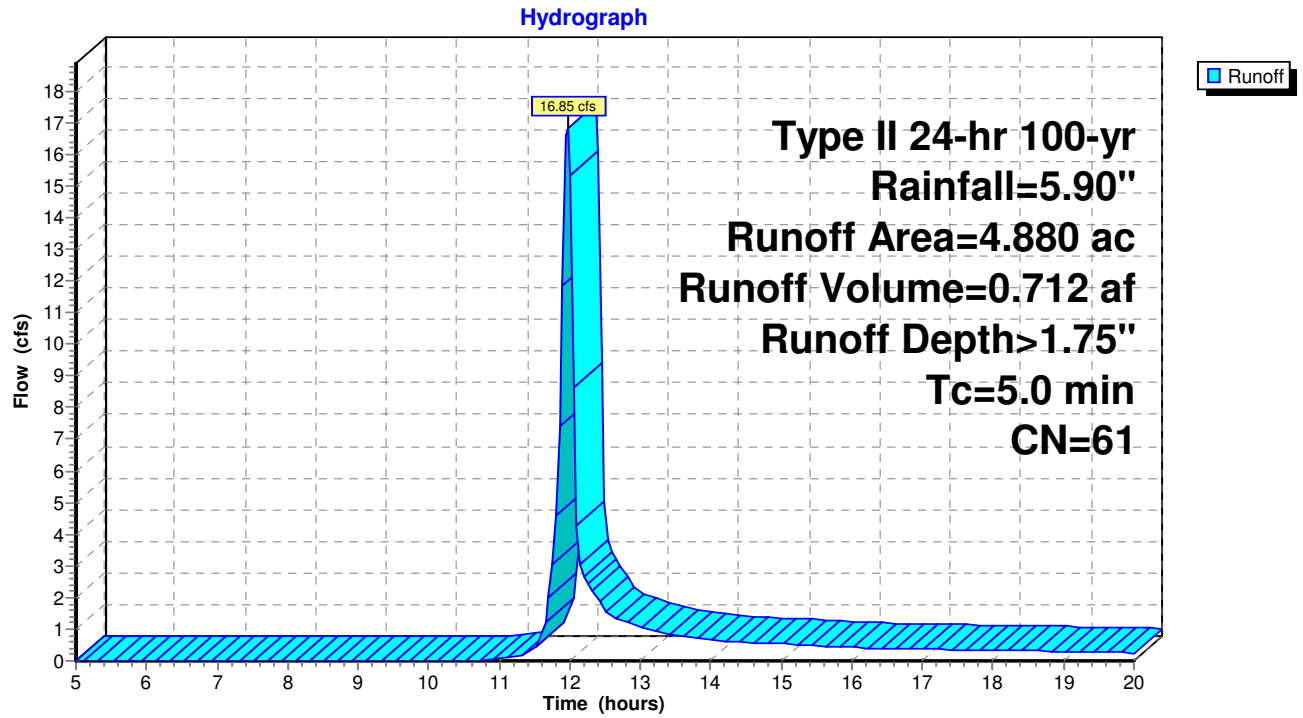
Runoff = 16.85 cfs @ 11.96 hrs, Volume= 0.712 af, Depth> 1.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (ac) | CN | Description |
|---|---|---|
| 0.050 | 98 | Paved parking, HSG B |
| 4.830 | 61 | >75% Grass cover, Good, HSG B |
| 4.880 | 61 | Weighted Average |
| 4.830 | | 98.98% Pervious Area |
| 0.050 | | 1.02% Impervious Area |

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

### Subcatchment 1S: Existing



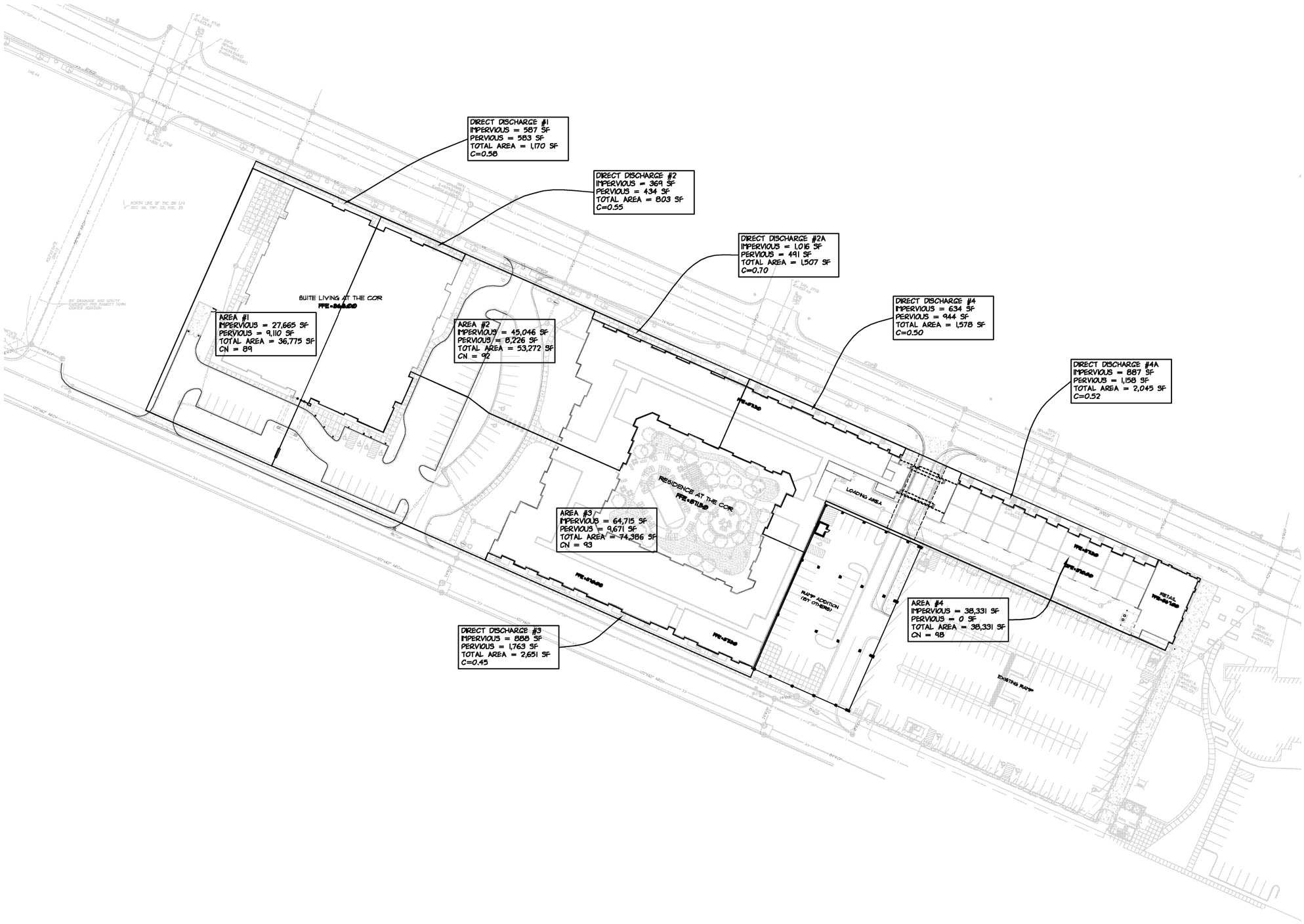
# APPENDIX C

# PROPOSED DRAINAGE MAP

LANDFORM
From Site to Finish

# SENIOR LIVING / APTS

RAMSEY, MN




NORTH

0 100

LANDFORM

From Site to Finish

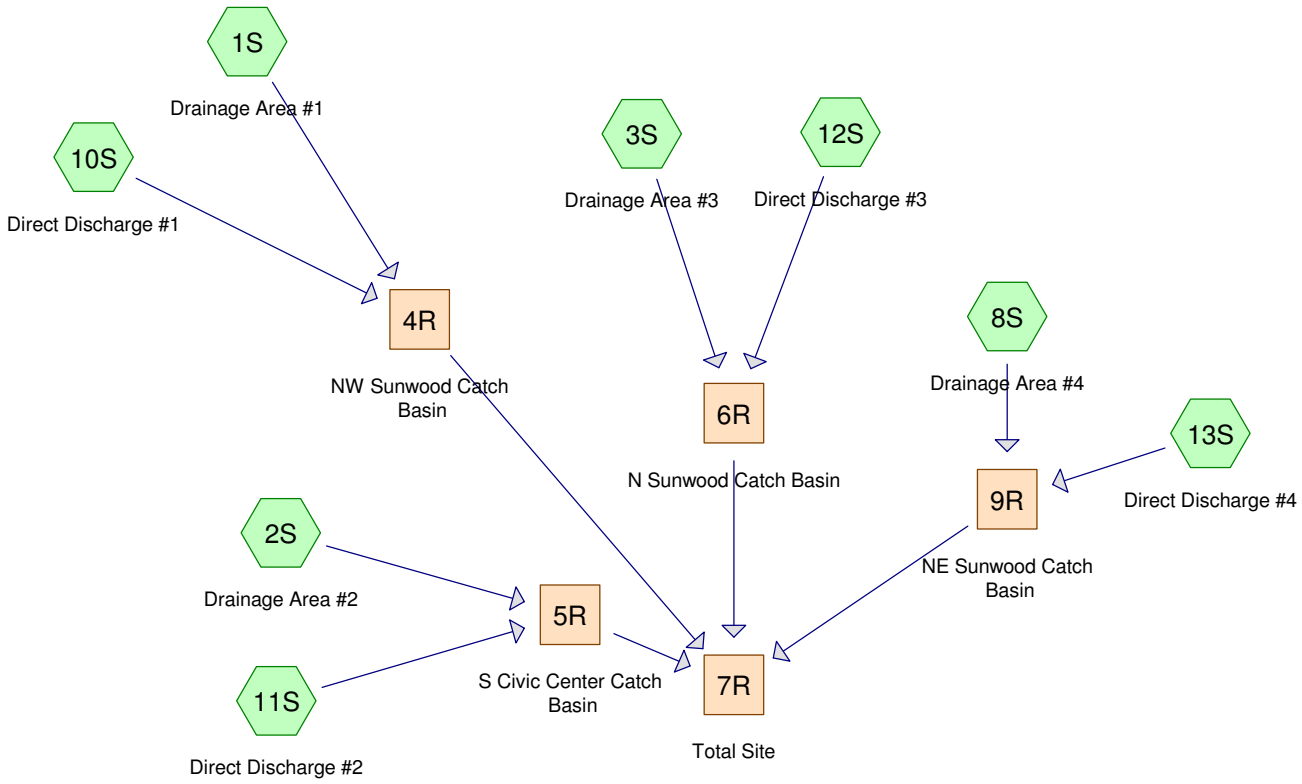
**PROPOSED DRAINAGE MAP**

**12.03.2010**

# APPENDIX D

# PROPOSED HYDROCAD MODEL

LANDFORM
From Site to Finish




Subcat Reach Pond Link

**Drainage Diagram for UWA10002 - Proposed**
Prepared by {enter your company name here}, Printed 12/1/2010

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| 0.743 | 61 | >75% Grass cover, Good, HSG B (1S, 2S, 3S, 10S, 11S, 12S, 13S) |
| 4.135 | 98 | Paved parking, HSG B (1S, 2S, 3S, 8S, 10S, 11S, 12S, 13S) |
| **4.879** | | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| **4.879** | HSG B | 1S, 2S, 3S, 8S, 10S, 11S, 12S, 13S |
| 0.000 | HSG C | |
| 0.000 | HSG D | |
| 0.000 | Other | |
| 4.879 | | **TOTAL AREA** |

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Drainage Area #1** Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>0.26"
Tc=5.0 min CN=89 Runoff=0.42 cfs 0.018 af

**Subcatchment 2S: Drainage Area #2** Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>0.37"
Tc=5.0 min CN=92 Runoff=0.89 cfs 0.037 af

**Subcatchment 3S: Drainage Area #3** Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>0.41"
Tc=5.0 min CN=93 Runoff=1.39 cfs 0.059 af

**Subcatchment 8S: Drainage Area #4** Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>0.74"
Tc=5.0 min CN=98 Runoff=1.16 cfs 0.054 af

**Subcatchment 10S: Direct Discharge #1** Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>0.07"
Tc=5.0 min CN=80 Runoff=0.00 cfs 0.000 af

**Subcatchment 11S: Direct Discharge #2** Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>0.11"
Tc=5.0 min CN=83 Runoff=0.01 cfs 0.001 af

**Subcatchment 12S: Direct Discharge #3** Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>0.01"
Tc=5.0 min CN=73 Runoff=0.00 cfs 0.000 af

**Subcatchment 13S: Direct Discharge #4** Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>0.04"
Tc=5.0 min CN=77 Runoff=0.00 cfs 0.000 af

**Reach 4R: NW Sunwood Catch Basin** Inflow=0.42 cfs 0.018 af
Outflow=0.42 cfs 0.018 af

**Reach 5R: S Civic Center Catch Basin** Inflow=0.90 cfs 0.038 af
Outflow=0.90 cfs 0.038 af

**Reach 6R: N Sunwood Catch Basin** Inflow=1.39 cfs 0.059 af
Outflow=1.39 cfs 0.059 af

**Reach 7R: Total Site** Inflow=3.86 cfs 0.169 af
Outflow=3.86 cfs 0.169 af

**Reach 9R: NE Sunwood Catch Basin** Inflow=1.16 cfs 0.055 af
Outflow=1.16 cfs 0.055 af

**Total Runoff Area = 4.879 ac Runoff Volume = 0.169 af Average Runoff Depth = 0.42"**
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

## Summary for Subcatchment 1S: Drainage Area #1

[49] Hint: Tc<2dt may require smaller dt

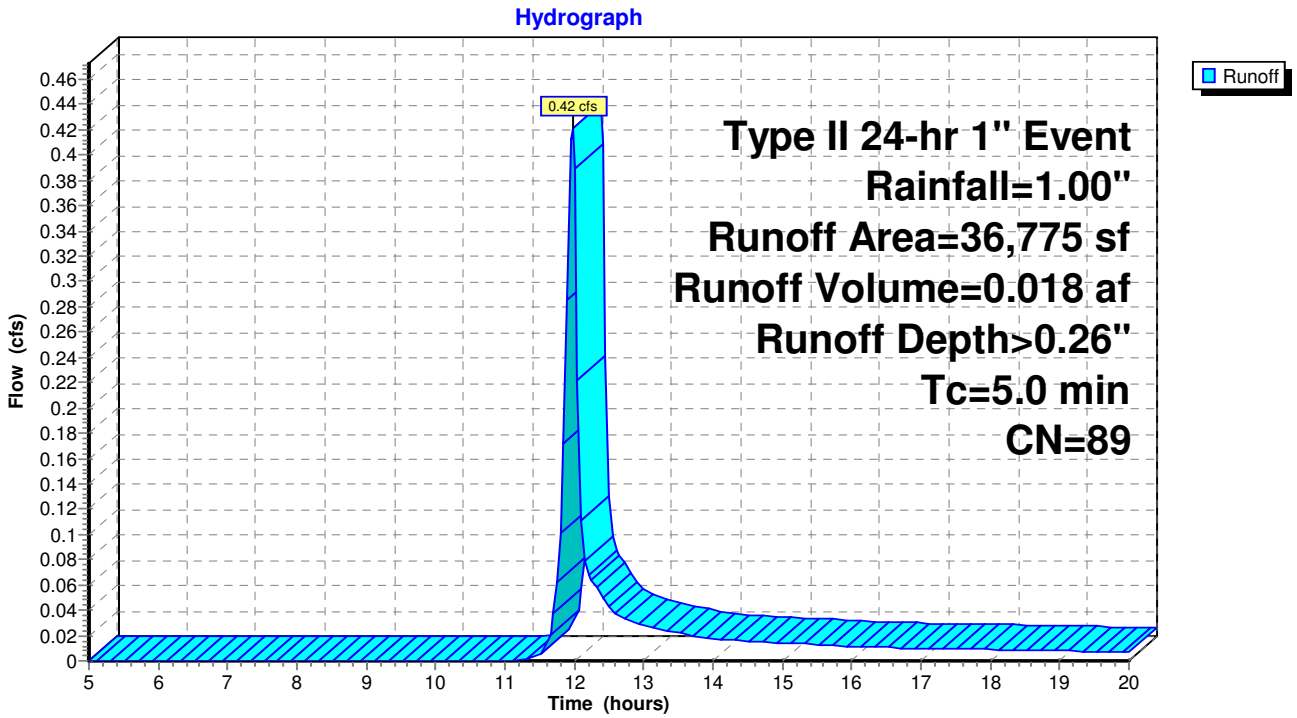
Runoff = 0.42 cfs @ 11.97 hrs, Volume= 0.018 af, Depth> 0.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 27,665 | 98 | Paved parking, HSG B |
| 9,110 | 61 | >75% Grass cover, Good, HSG B |
| 36,775 | 89 | Weighted Average |
| 9,110 | | 24.77% Pervious Area |
| 27,665 | | 75.23% Impervious Area |

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

### Subcatchment 1S: Drainage Area #1



## Summary for Subcatchment 2S: Drainage Area #2

[49] Hint: Tc<2dt may require smaller dt

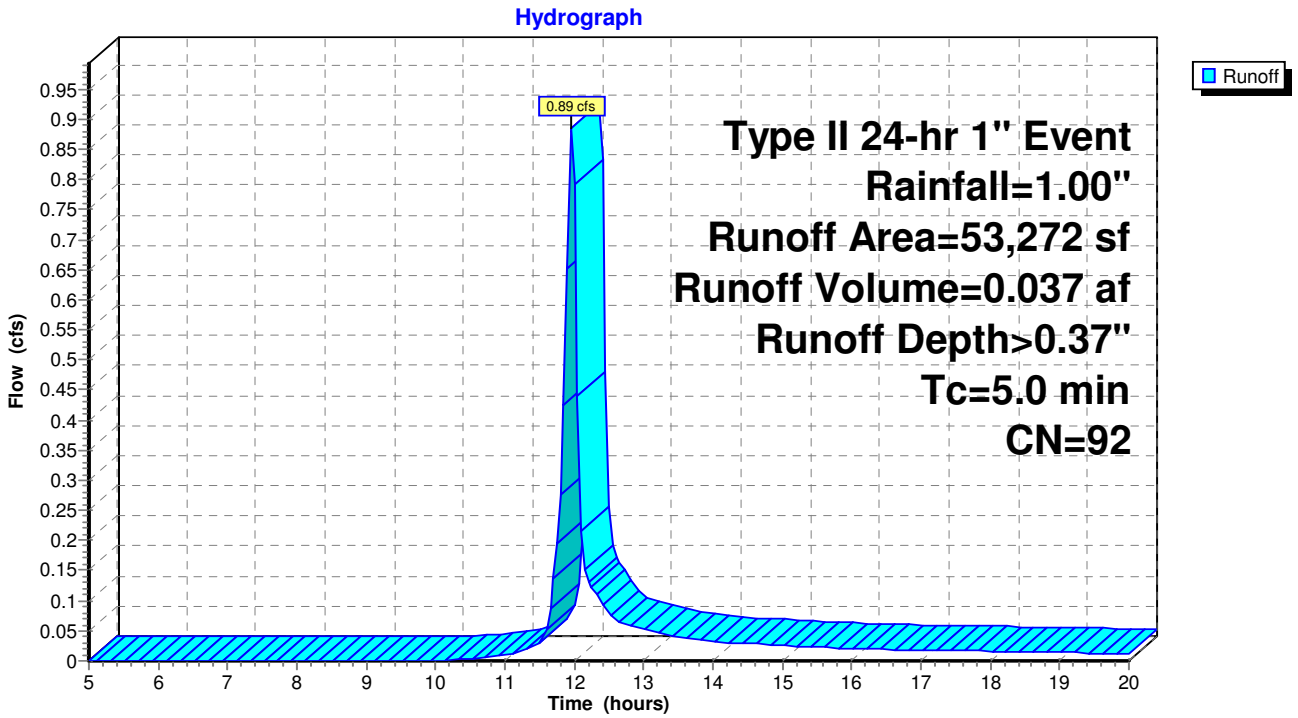
Runoff = 0.89 cfs @ 11.96 hrs, Volume= 0.037 af, Depth> 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 45,046 | 98 | Paved parking, HSG B |
| 8,226 | 61 | >75% Grass cover, Good, HSG B |
| 53,272 | 92 | Weighted Average |
| 8,226 | | 15.44% Pervious Area |
| 45,046 | | 84.56% Impervious Area |

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

### Subcatchment 2S: Drainage Area #2



## Summary for Subcatchment 3S: Drainage Area #3

[49] Hint: Tc<2dt may require smaller dt

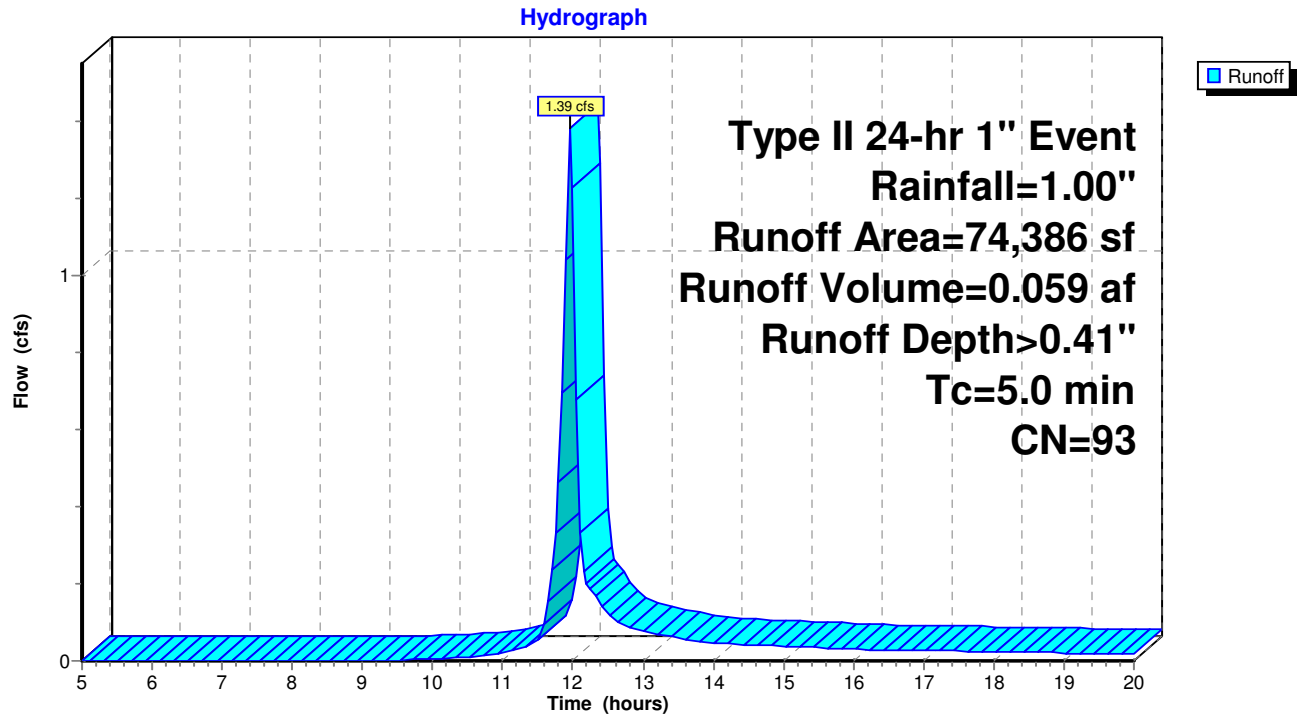
Runoff = 1.39 cfs @ 11.96 hrs, Volume= 0.059 af, Depth> 0.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 64,715 | 98 | Paved parking, HSG B |
| 9,671 | 61 | >75% Grass cover, Good, HSG B |
| 74,386 | 93 | Weighted Average |
| 9,671 | | 13.00% Pervious Area |
| 64,715 | | 87.00% Impervious Area |

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

### Subcatchment 3S: Drainage Area #3



## Summary for Subcatchment 8S: Drainage Area #4

[49] Hint: Tc<2dt may require smaller dt

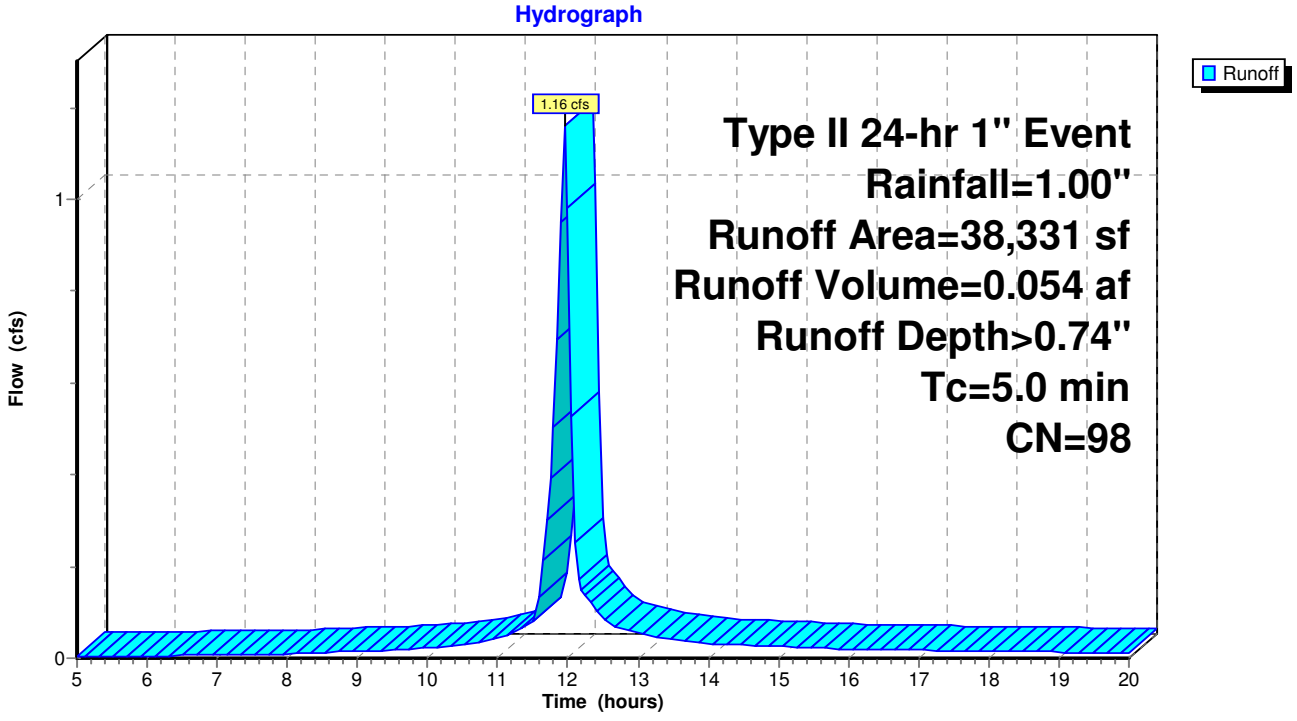
Runoff = 1.16 cfs @ 11.95 hrs, Volume= 0.054 af, Depth> 0.74"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 38,331 | 98 | Paved parking, HSG B |
| 0 | 61 | >75% Grass cover, Good, HSG B |
| 38,331 | 98 | Weighted Average |
| 38,331 | | 100.00% Impervious Area |

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

### Subcatchment 8S: Drainage Area #4



## Summary for Subcatchment 10S: Direct Discharge #1

[49] Hint: Tc<2dt may require smaller dt

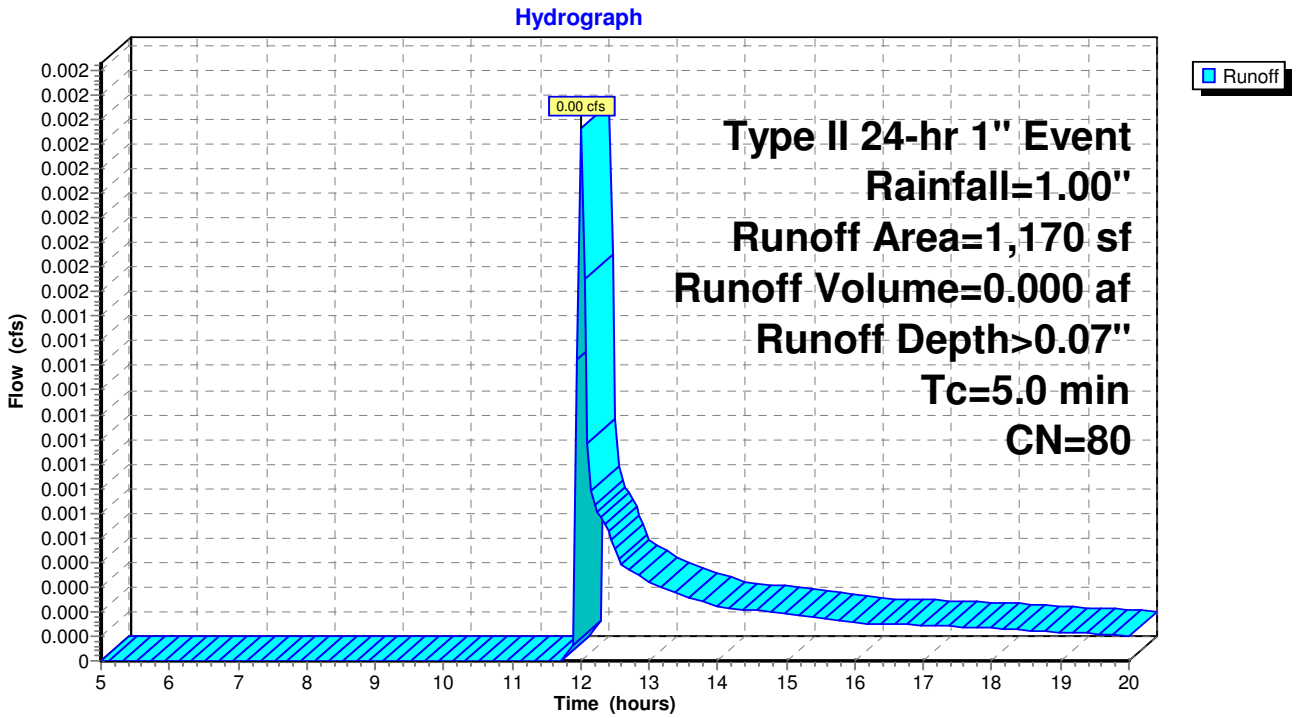
Runoff = 0.00 cfs @ 12.01 hrs, Volume= 0.000 af, Depth> 0.07"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 587 | 98 | Paved parking, HSG B |
| 583 | 61 | >75% Grass cover, Good, HSG B |
| 1,170 | 80 | Weighted Average |
| 583 | | 49.83% Pervious Area |
| 587 | | 50.17% Impervious Area |

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

### Subcatchment 10S: Direct Discharge #1



## Summary for Subcatchment 11S: Direct Discharge #2

[49] Hint: Tc<2dt may require smaller dt

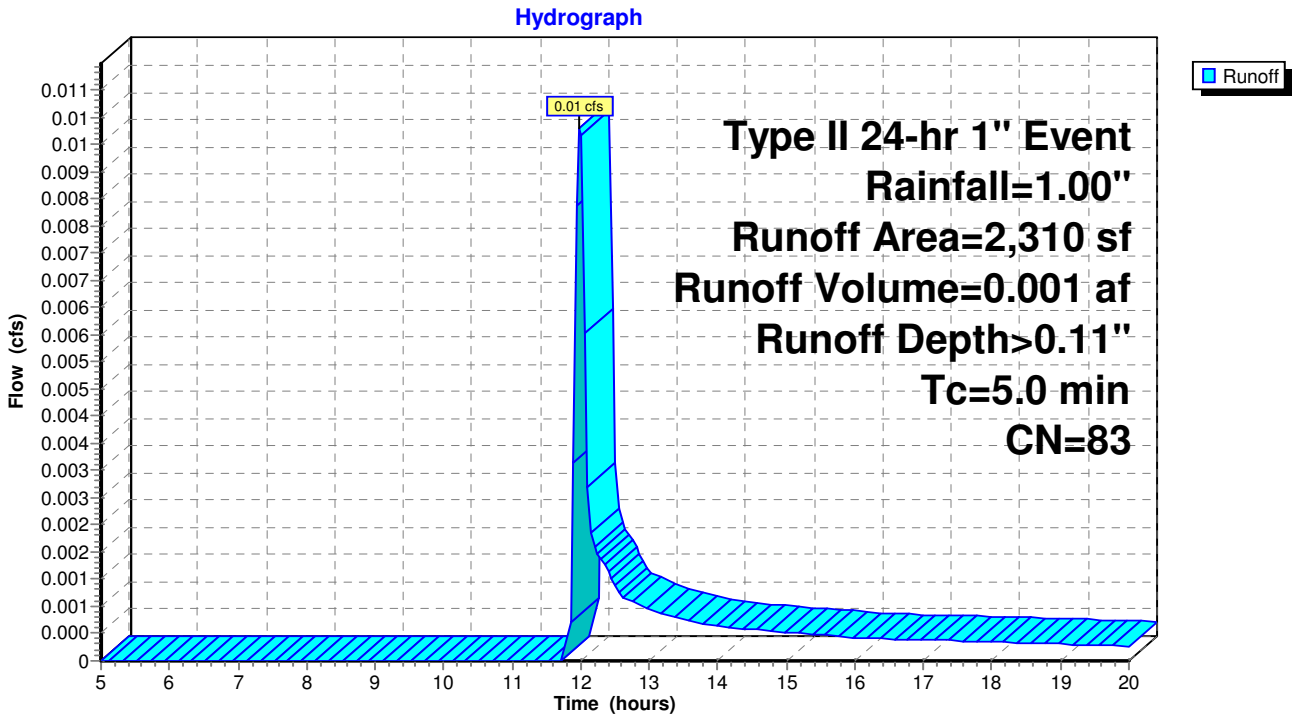
Runoff = 0.01 cfs @ 11.99 hrs, Volume= 0.001 af, Depth> 0.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 1,385 | 98 | Paved parking, HSG B |
| 925 | 61 | >75% Grass cover, Good, HSG B |
| 2,310 | 83 | Weighted Average |
| 925 | | 40.04% Pervious Area |
| 1,385 | | 59.96% Impervious Area |

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

## Subcatchment 11S: Direct Discharge #2



## Summary for Subcatchment 12S: Direct Discharge #3

[49] Hint: Tc<2dt may require smaller dt

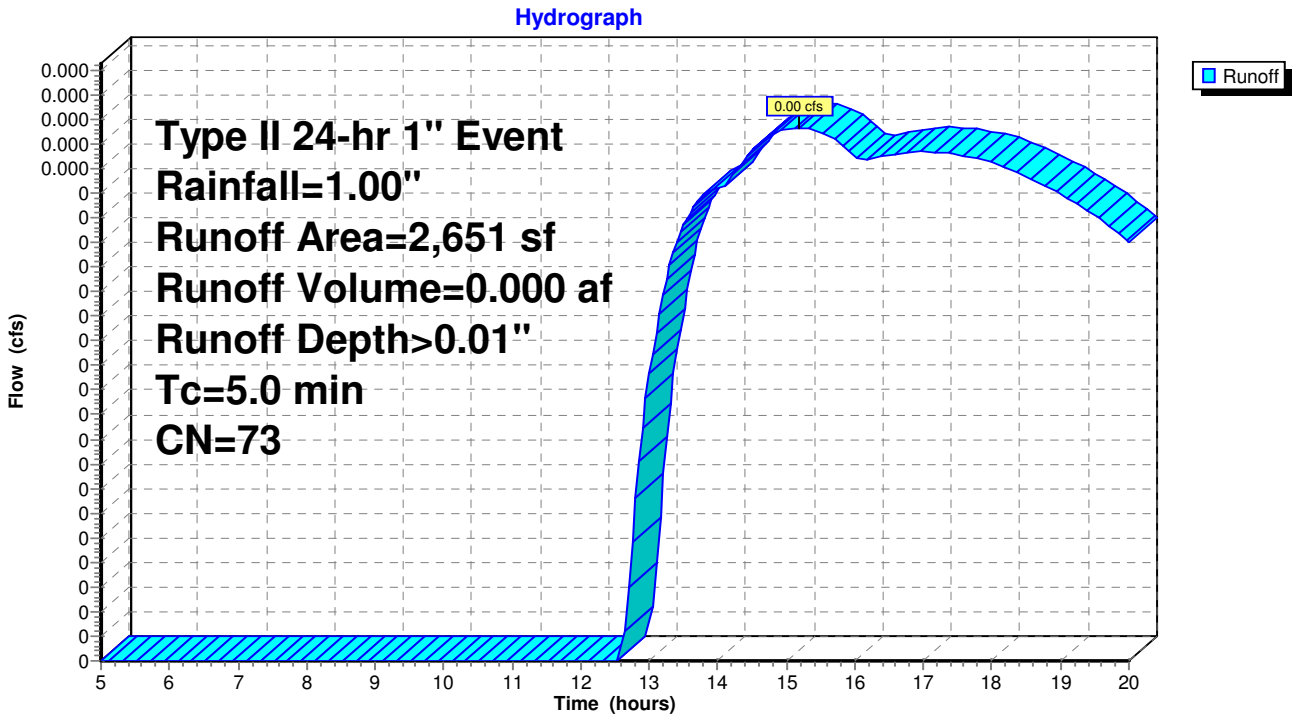
Runoff = 0.00 cfs @ 15.17 hrs, Volume= 0.000 af, Depth> 0.01"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 888 | 98 | Paved parking, HSG B |
| 1,763 | 61 | >75% Grass cover, Good, HSG B |
| 2,651 | 73 | Weighted Average |
| 1,763 | | 66.50% Pervious Area |
| 888 | | 33.50% Impervious Area |

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

### Subcatchment 12S: Direct Discharge #3



## Summary for Subcatchment 13S: Direct Discharge #4

[49] Hint: Tc<2dt may require smaller dt

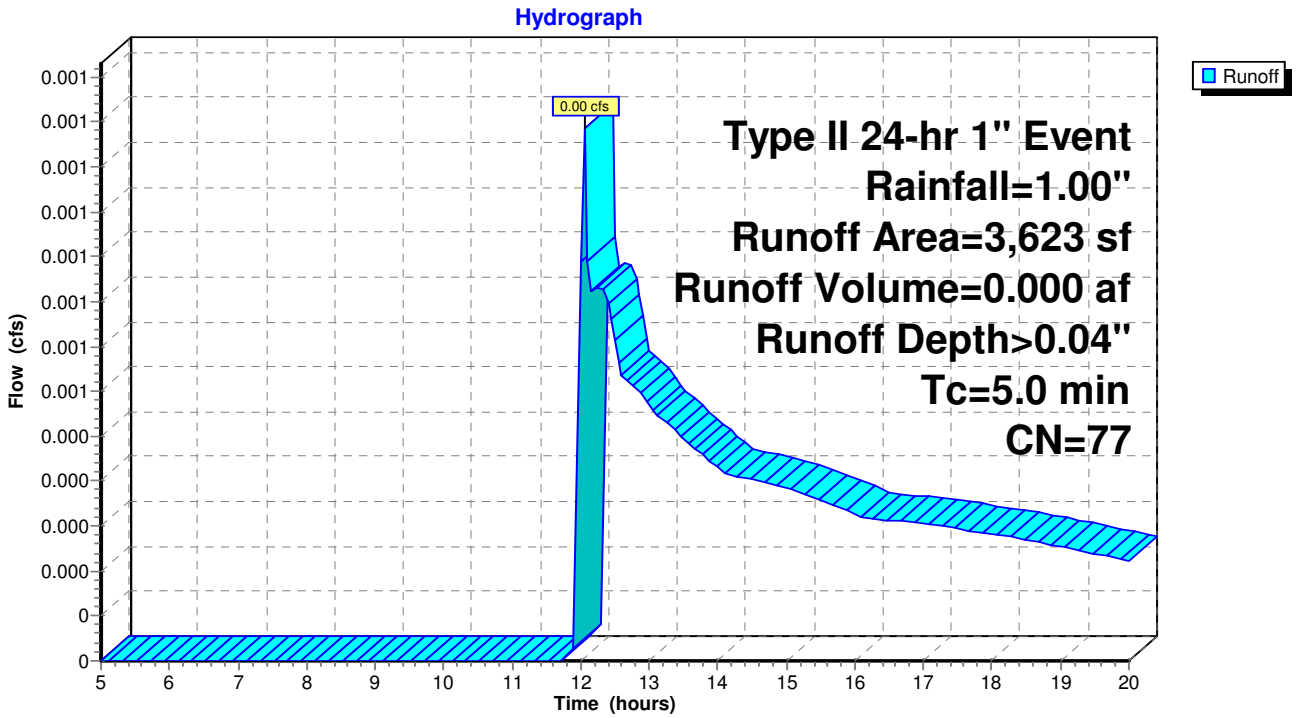
Runoff = 0.00 cfs @ 12.05 hrs, Volume= 0.000 af, Depth> 0.04"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 1" Event Rainfall=1.00"

| Area (sf) | CN | Description |
|---|---|---|
| 1,521 | 98 | Paved parking, HSG B |
| 2,102 | 61 | >75% Grass cover, Good, HSG B |
| 3,623 | 77 | Weighted Average |
| 2,102 | | 58.02% Pervious Area |
| 1,521 | | 41.98% Impervious Area |

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

### Subcatchment 13S: Direct Discharge #4



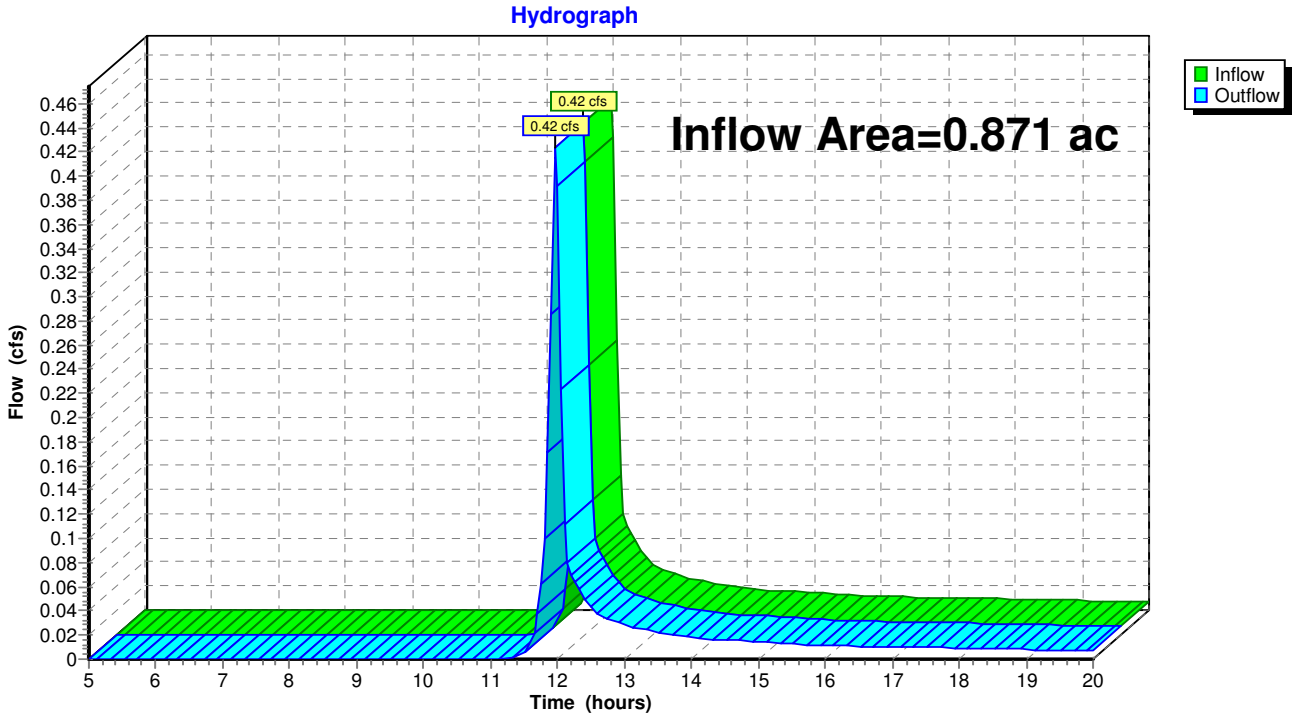
## Summary for Reach 4R: NW Sunwood Catch Basin

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

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 0.25" for 1" Event event
Inflow = 0.42 cfs @ 11.97 hrs, Volume= 0.018 af
Outflow = 0.42 cfs @ 11.97 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin



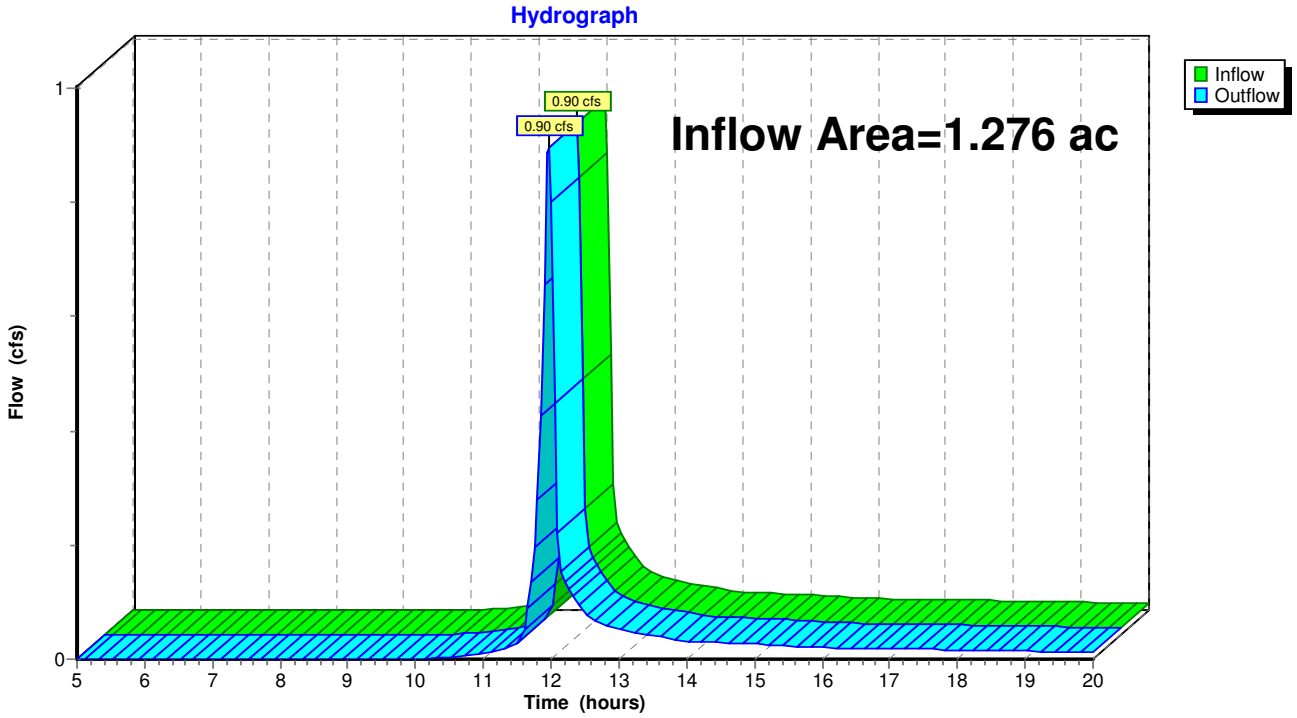
## Summary for Reach 5R: S Civic Center Catch Basin

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

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 0.36" for 1" Event event
Inflow = 0.90 cfs @ 11.96 hrs, Volume= 0.038 af
Outflow = 0.90 cfs @ 11.96 hrs, Volume= 0.038 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin



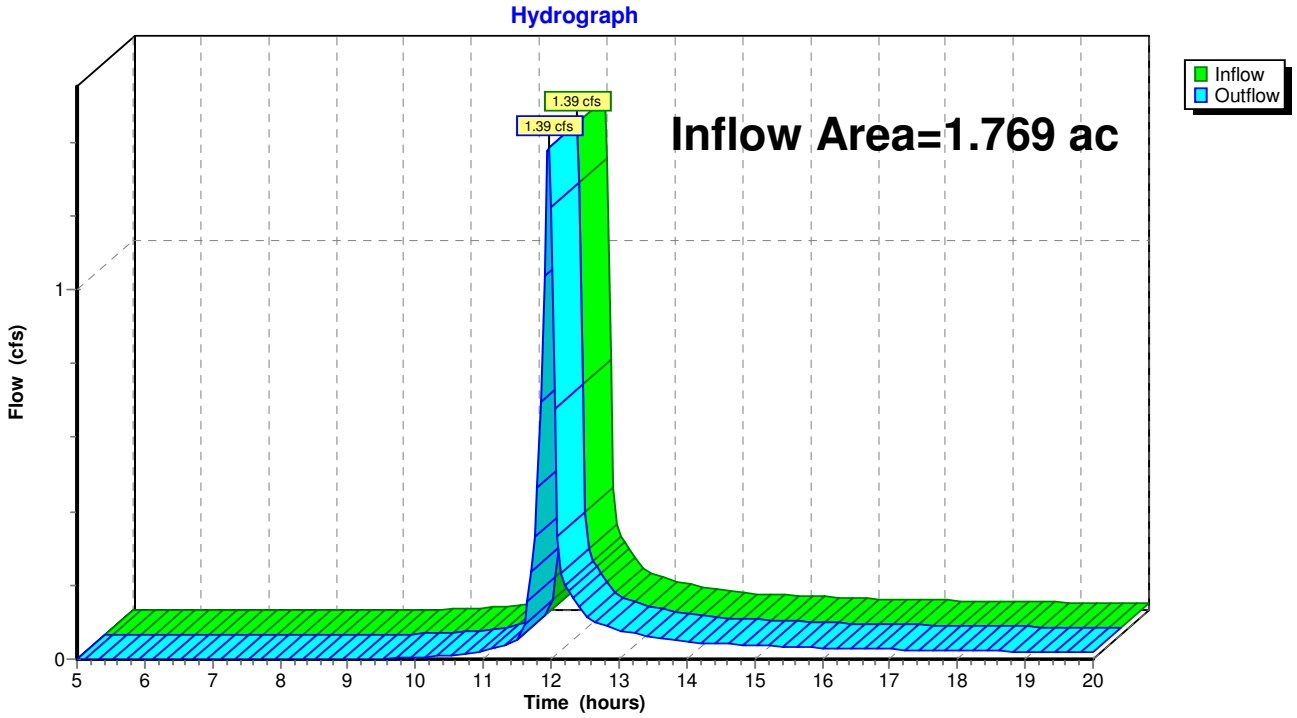
## Summary for Reach 6R: N Sunwood Catch Basin

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

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 0.40" for 1" Event event
Inflow = 1.39 cfs @ 11.96 hrs, Volume= 0.059 af
Outflow = 1.39 cfs @ 11.96 hrs, Volume= 0.059 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin



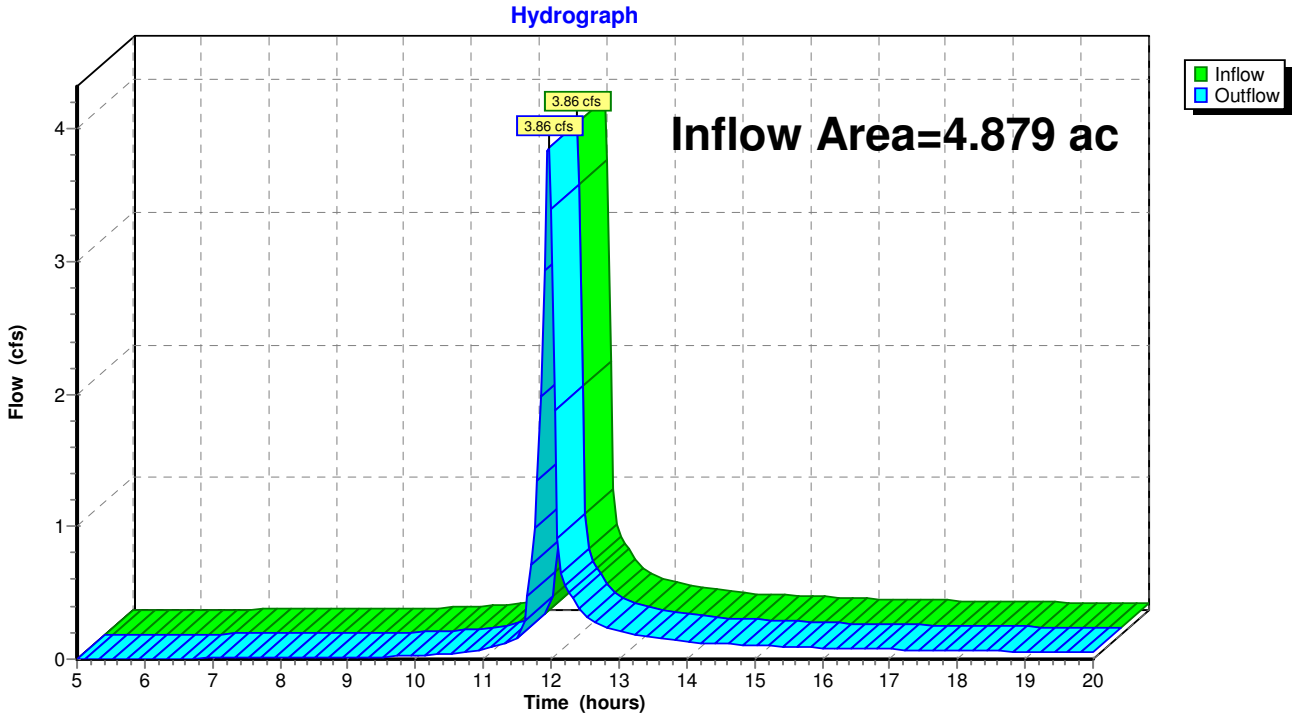
## Summary for Reach 7R: Total Site

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

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 0.42" for 1" Event event
Inflow = 3.86 cfs @ 11.96 hrs, Volume= 0.169 af
Outflow = 3.86 cfs @ 11.96 hrs, Volume= 0.169 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site



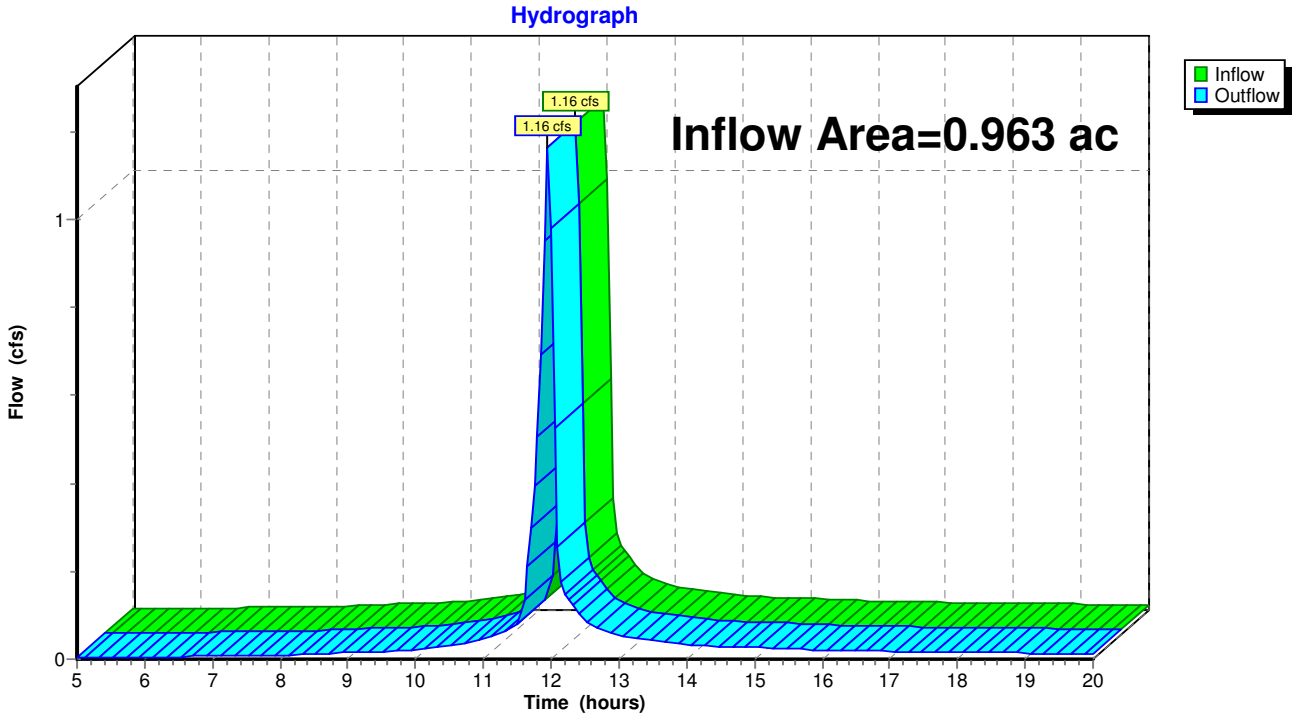
## Summary for Reach 9R: NE Sunwood Catch Basin

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

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 0.68" for 1" Event event
Inflow = 1.16 cfs @ 11.95 hrs, Volume= 0.055 af
Outflow = 1.16 cfs @ 11.95 hrs, Volume= 0.055 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Drainage Area #1** Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>1.56"
Tc=5.0 min CN=89 Runoff=2.50 cfs 0.110 af

**Subcatchment 2S: Drainage Area #2** Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>1.80"
Tc=5.0 min CN=92 Runoff=4.07 cfs 0.184 af

**Subcatchment 3S: Drainage Area #3** Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>1.89"
Tc=5.0 min CN=93 Runoff=5.88 cfs 0.269 af

**Subcatchment 8S: Drainage Area #4** Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>2.34"
Tc=5.0 min CN=98 Runoff=3.44 cfs 0.171 af

**Subcatchment 10S: Direct Discharge #1** Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>0.97"
Tc=5.0 min CN=80 Runoff=0.05 cfs 0.002 af

**Subcatchment 11S: Direct Discharge #2** Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>1.14"
Tc=5.0 min CN=83 Runoff=0.12 cfs 0.005 af

**Subcatchment 12S: Direct Discharge #3** Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>0.63"
Tc=5.0 min CN=73 Runoff=0.07 cfs 0.003 af

**Subcatchment 13S: Direct Discharge #4** Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>0.81"
Tc=5.0 min CN=77 Runoff=0.13 cfs 0.006 af

**Reach 4R: NW Sunwood Catch Basin** Inflow=2.55 cfs 0.112 af
Outflow=2.55 cfs 0.112 af

**Reach 5R: S Civic Center Catch Basin** Inflow=4.19 cfs 0.189 af
Outflow=4.19 cfs 0.189 af

**Reach 6R: N Sunwood Catch Basin** Inflow=5.96 cfs 0.272 af
Outflow=5.96 cfs 0.272 af

**Reach 7R: Total Site** Inflow=16.27 cfs 0.749 af
Outflow=16.27 cfs 0.749 af

**Reach 9R: NE Sunwood Catch Basin** Inflow=3.58 cfs 0.177 af
Outflow=3.58 cfs 0.177 af

**Total Runoff Area = 4.879 ac Runoff Volume = 0.749 af Average Runoff Depth = 1.84"**
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

## Summary for Subcatchment 1S: Drainage Area #1

[49] Hint: Tc<2dt may require smaller dt

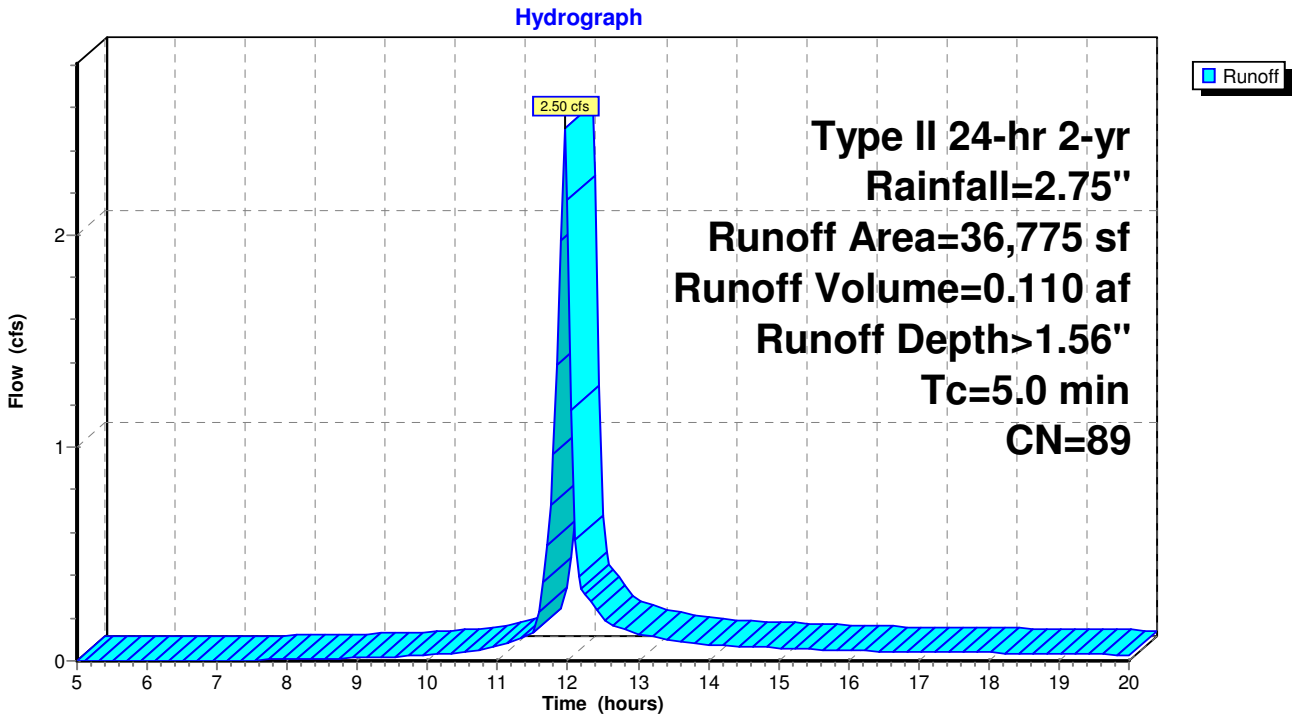
Runoff = 2.50 cfs @ 11.96 hrs, Volume= 0.110 af, Depth> 1.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 27,665 | 98 | Paved parking, HSG B |
| 9,110 | 61 | >75% Grass cover, Good, HSG B |
| 36,775 | 89 | Weighted Average |
| 9,110 | | 24.77% Pervious Area |
| 27,665 | | 75.23% Impervious Area |

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

### Subcatchment 1S: Drainage Area #1



## Summary for Subcatchment 2S: Drainage Area #2

[49] Hint: Tc<2dt may require smaller dt

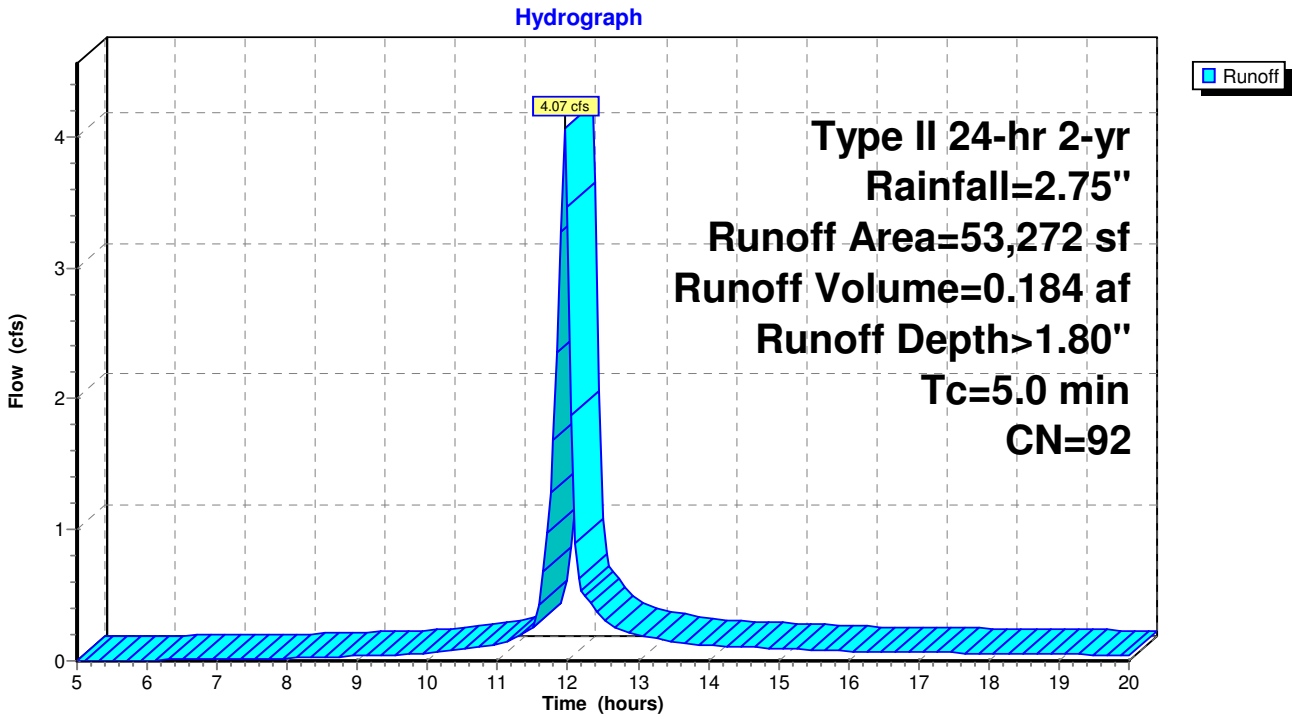
Runoff = 4.07 cfs @ 11.95 hrs, Volume= 0.184 af, Depth> 1.80"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 45,046 | 98 | Paved parking, HSG B |
| 8,226 | 61 | >75% Grass cover, Good, HSG B |
| 53,272 | 92 | Weighted Average |
| 8,226 | | 15.44% Pervious Area |
| 45,046 | | 84.56% Impervious Area |

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

### Subcatchment 2S: Drainage Area #2



## Summary for Subcatchment 3S: Drainage Area #3

[49] Hint: Tc<2dt may require smaller dt

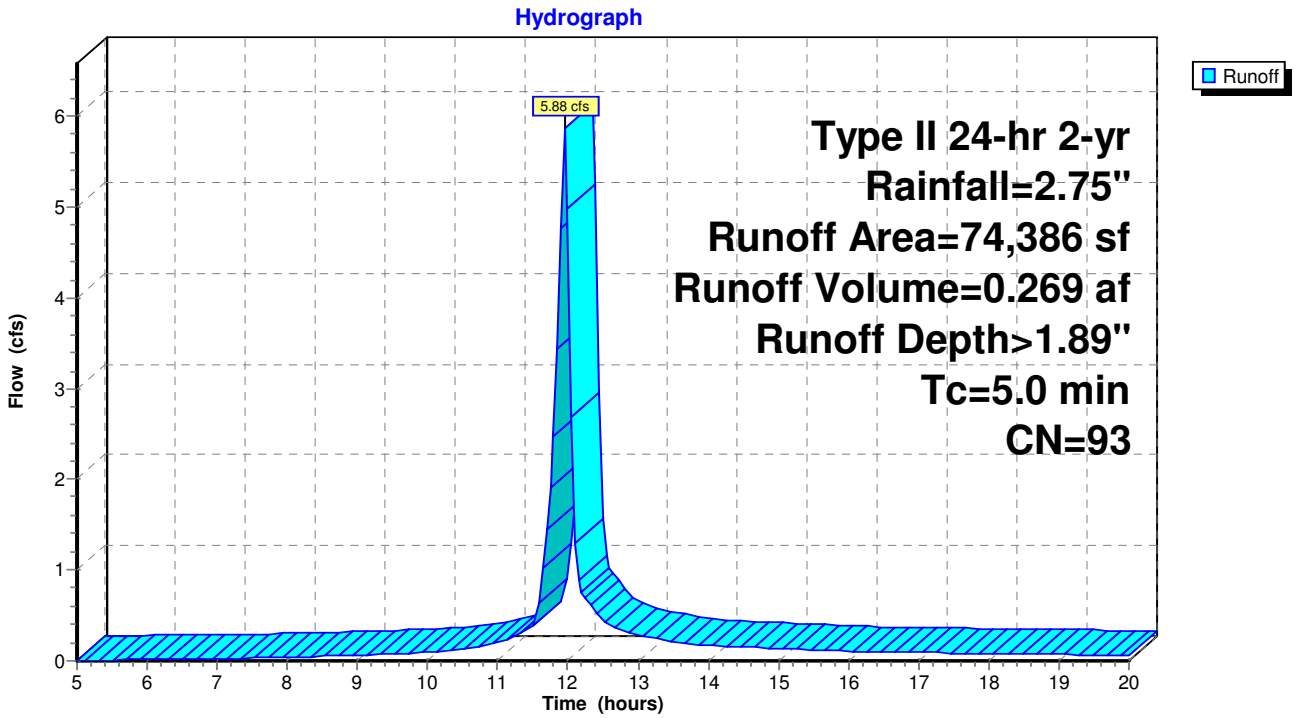
Runoff = 5.88 cfs @ 11.95 hrs, Volume= 0.269 af, Depth> 1.89"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 64,715 | 98 | Paved parking, HSG B |
| 9,671 | 61 | >75% Grass cover, Good, HSG B |
| 74,386 | 93 | Weighted Average |
| 9,671 | | 13.00% Pervious Area |
| 64,715 | | 87.00% Impervious Area |

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

### Subcatchment 3S: Drainage Area #3



## Summary for Subcatchment 8S: Drainage Area #4

[49] Hint: Tc<2dt may require smaller dt

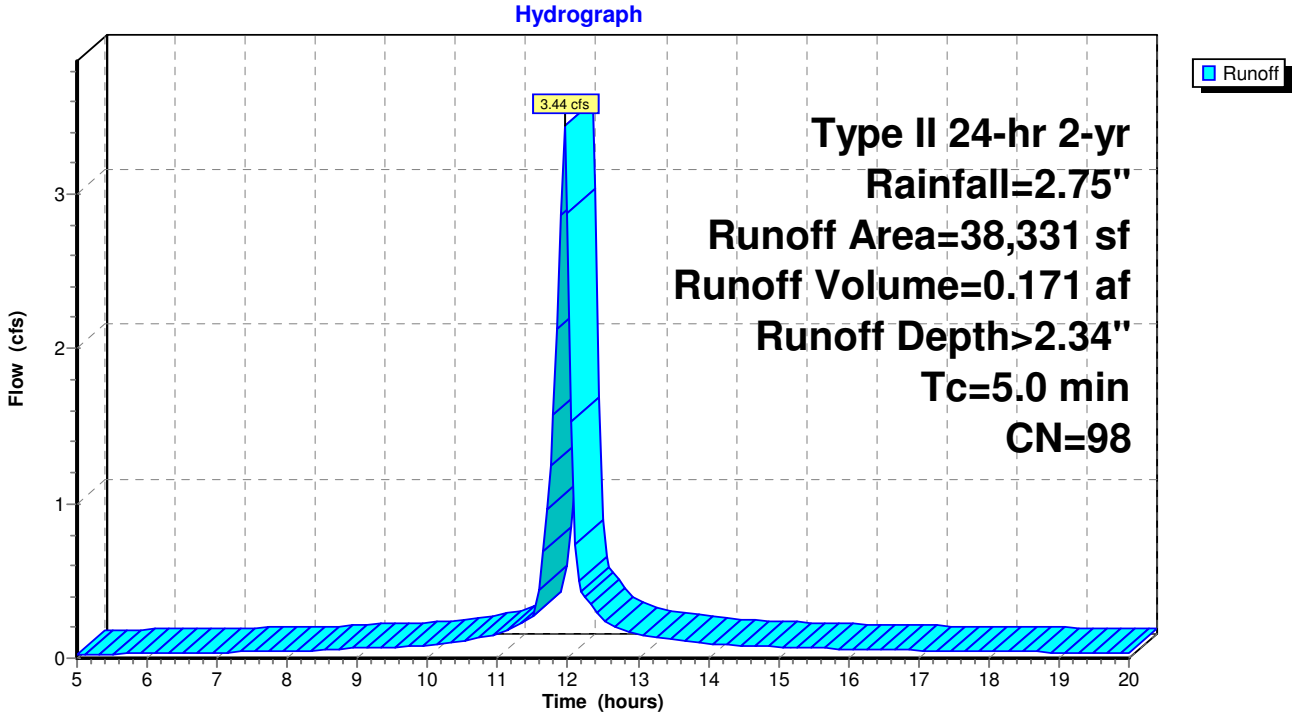
Runoff = 3.44 cfs @ 11.95 hrs, Volume= 0.171 af, Depth> 2.34"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 38,331 | 98 | Paved parking, HSG B |
| 0 | 61 | >75% Grass cover, Good, HSG B |
| 38,331 | 98 | Weighted Average |
| 38,331 | | 100.00% Impervious Area |

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

### Subcatchment 8S: Drainage Area #4



## Summary for Subcatchment 10S: Direct Discharge #1

[49] Hint: Tc<2dt may require smaller dt

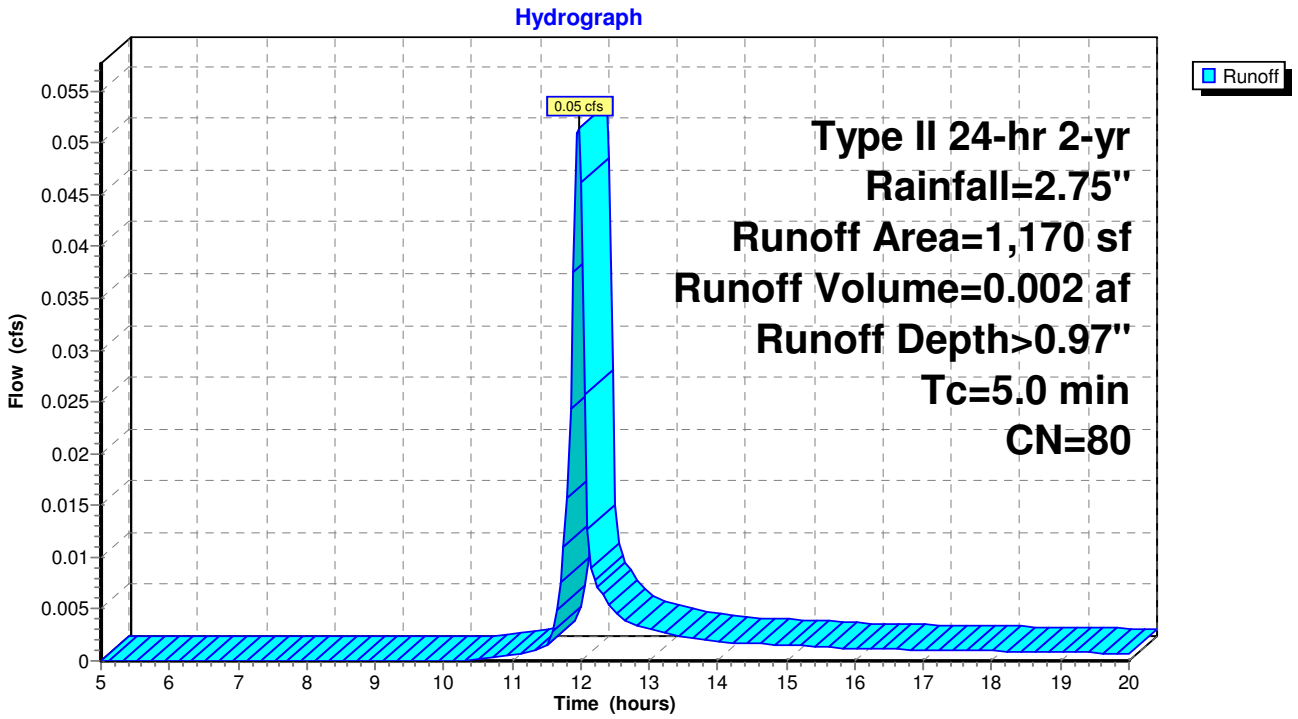
Runoff = 0.05 cfs @ 11.96 hrs, Volume= 0.002 af, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 587 | 98 | Paved parking, HSG B |
| 583 | 61 | >75% Grass cover, Good, HSG B |
| 1,170 | 80 | Weighted Average |
| 583 | | 49.83% Pervious Area |
| 587 | | 50.17% Impervious Area |

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

### Subcatchment 10S: Direct Discharge #1



## Summary for Subcatchment 11S: Direct Discharge #2

[49] Hint: Tc<2dt may require smaller dt

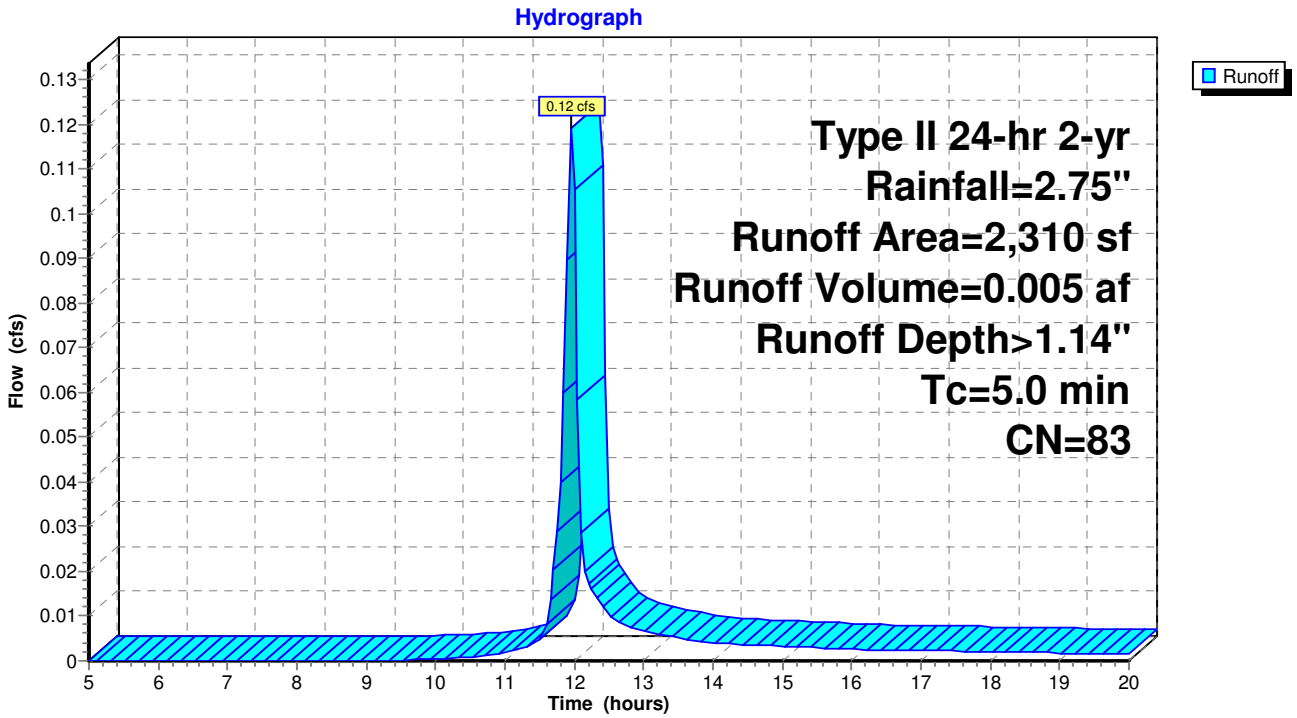
Runoff = 0.12 cfs @ 11.96 hrs, Volume= 0.005 af, Depth> 1.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 1,385 | 98 | Paved parking, HSG B |
| 925 | 61 | >75% Grass cover, Good, HSG B |
| 2,310 | 83 | Weighted Average |
| 925 | | 40.04% Pervious Area |
| 1,385 | | 59.96% Impervious Area |

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

### Subcatchment 11S: Direct Discharge #2



## Summary for Subcatchment 12S: Direct Discharge #3

[49] Hint: Tc<2dt may require smaller dt

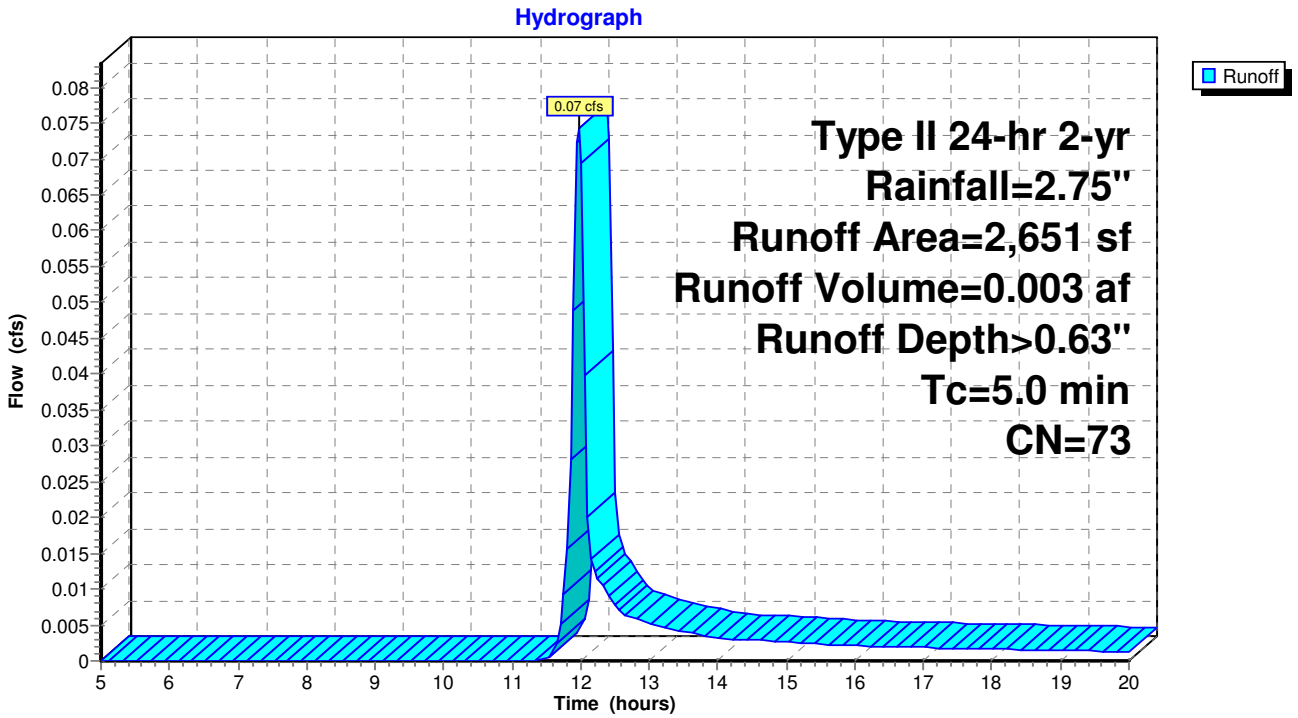
Runoff = 0.07 cfs @ 11.97 hrs, Volume= 0.003 af, Depth> 0.63"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 888 | 98 | Paved parking, HSG B |
| 1,763 | 61 | >75% Grass cover, Good, HSG B |
| 2,651 | 73 | Weighted Average |
| 1,763 | | 66.50% Pervious Area |
| 888 | | 33.50% Impervious Area |

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

## Subcatchment 12S: Direct Discharge #3



## Summary for Subcatchment 13S: Direct Discharge #4

[49] Hint: Tc<2dt may require smaller dt

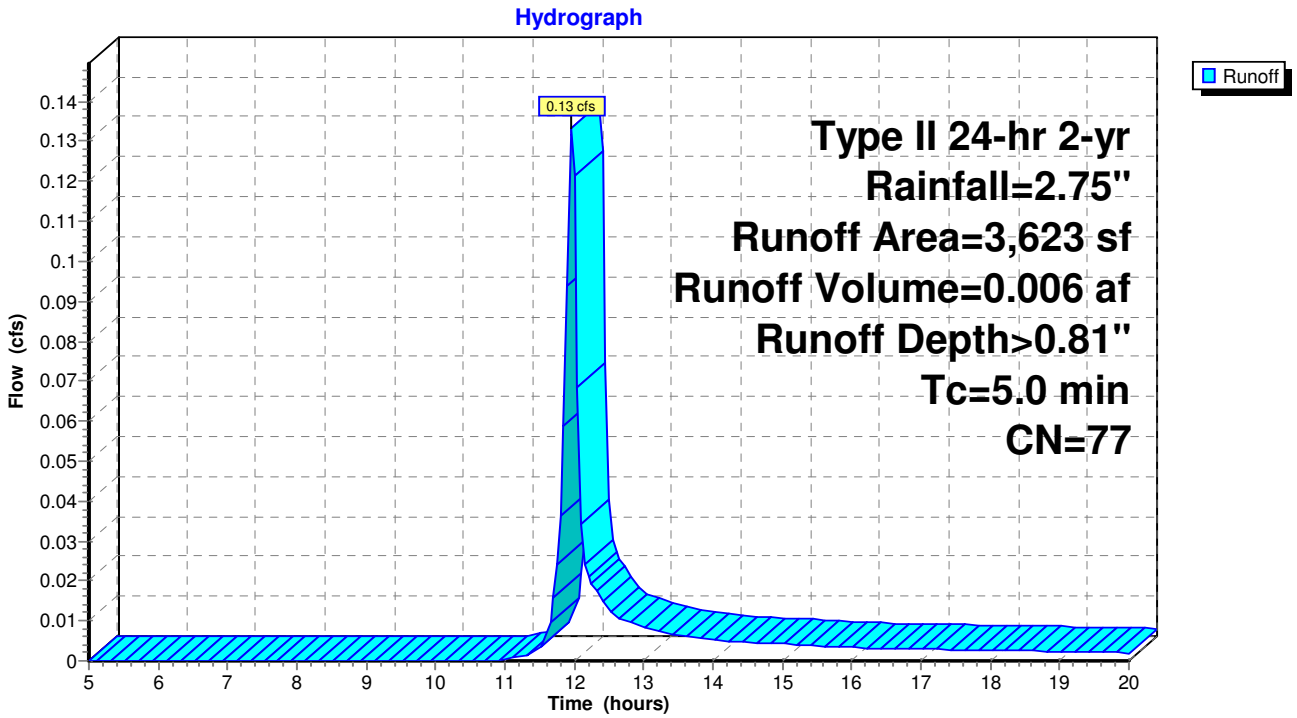
Runoff = 0.13 cfs @ 11.96 hrs, Volume= 0.006 af, Depth> 0.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-yr Rainfall=2.75"

| Area (sf) | CN | Description |
|---|---|---|
| 1,521 | 98 | Paved parking, HSG B |
| 2,102 | 61 | >75% Grass cover, Good, HSG B |
| 3,623 | 77 | Weighted Average |
| 2,102 | | 58.02% Pervious Area |
| 1,521 | | 41.98% Impervious Area |

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

### Subcatchment 13S: Direct Discharge #4



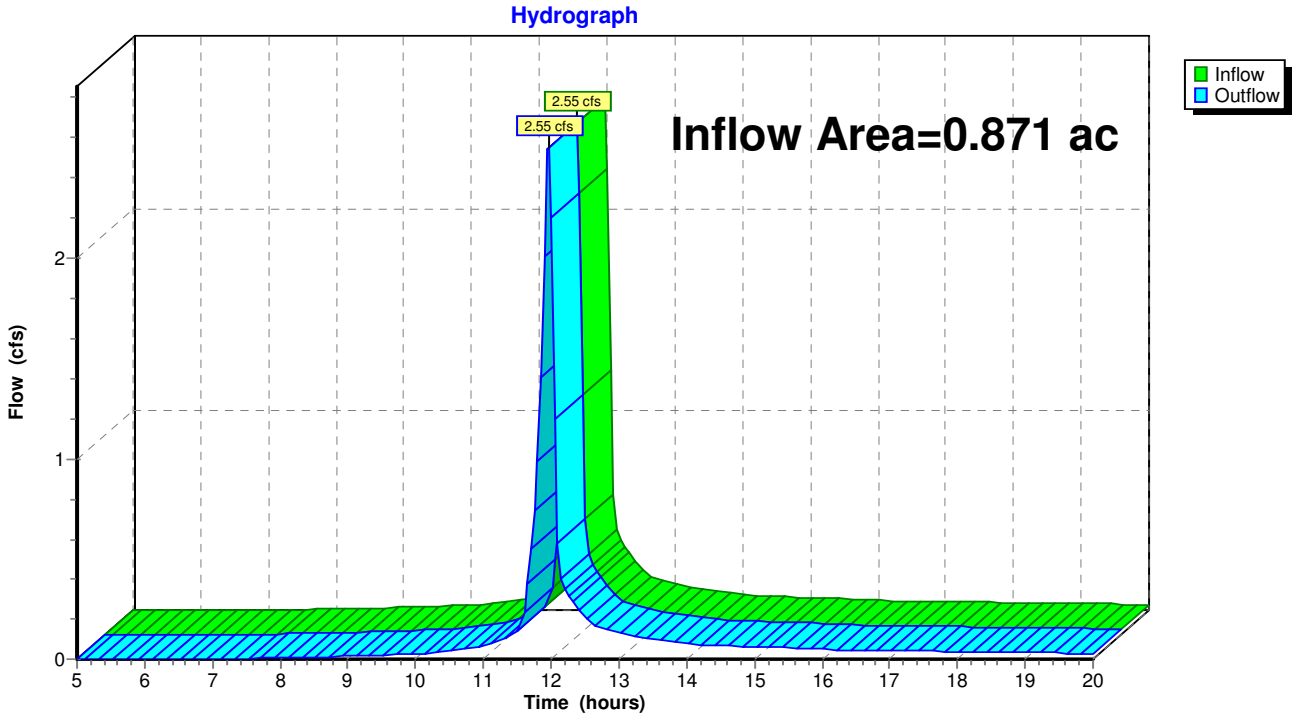
## Summary for Reach 4R: NW Sunwood Catch Basin

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

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 1.54" for 2-yr event
Inflow = 2.55 cfs @ 11.96 hrs, Volume= 0.112 af
Outflow = 2.55 cfs @ 11.96 hrs, Volume= 0.112 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin



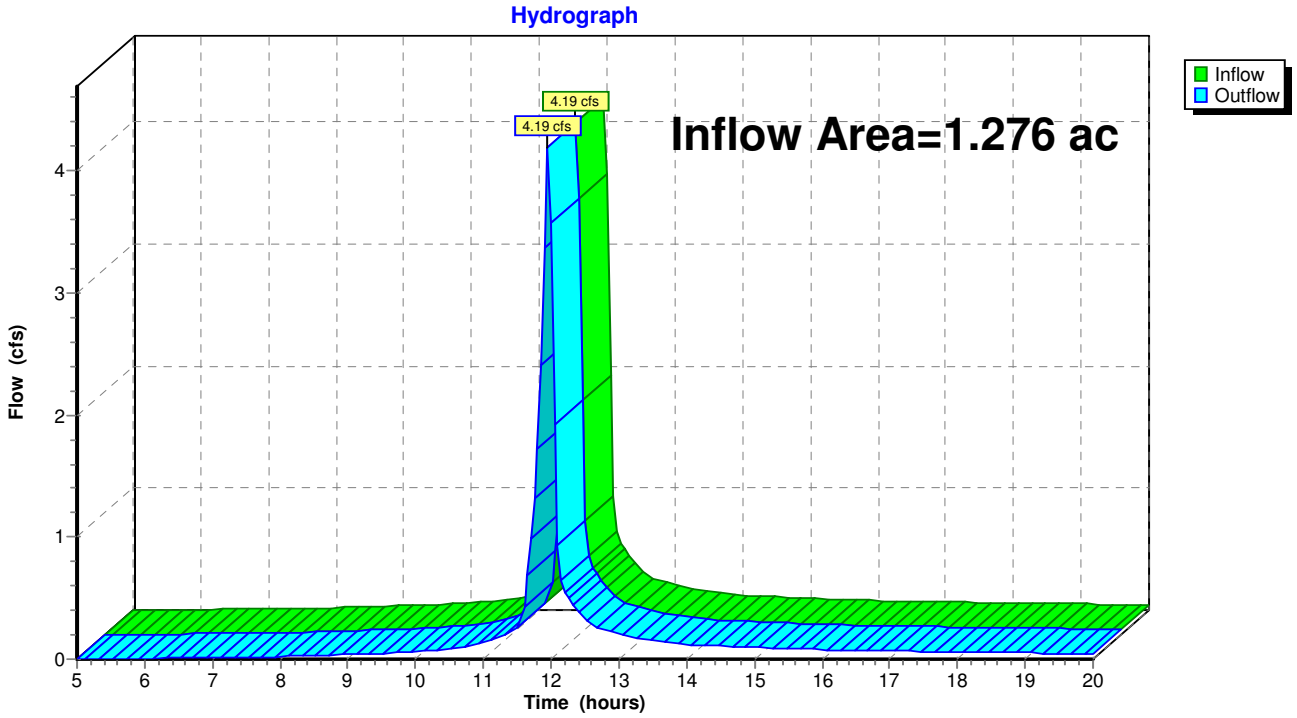
## Summary for Reach 5R: S Civic Center Catch Basin

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

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 1.77" for 2-yr event
Inflow = 4.19 cfs @ 11.95 hrs, Volume= 0.189 af
Outflow = 4.19 cfs @ 11.95 hrs, Volume= 0.189 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin



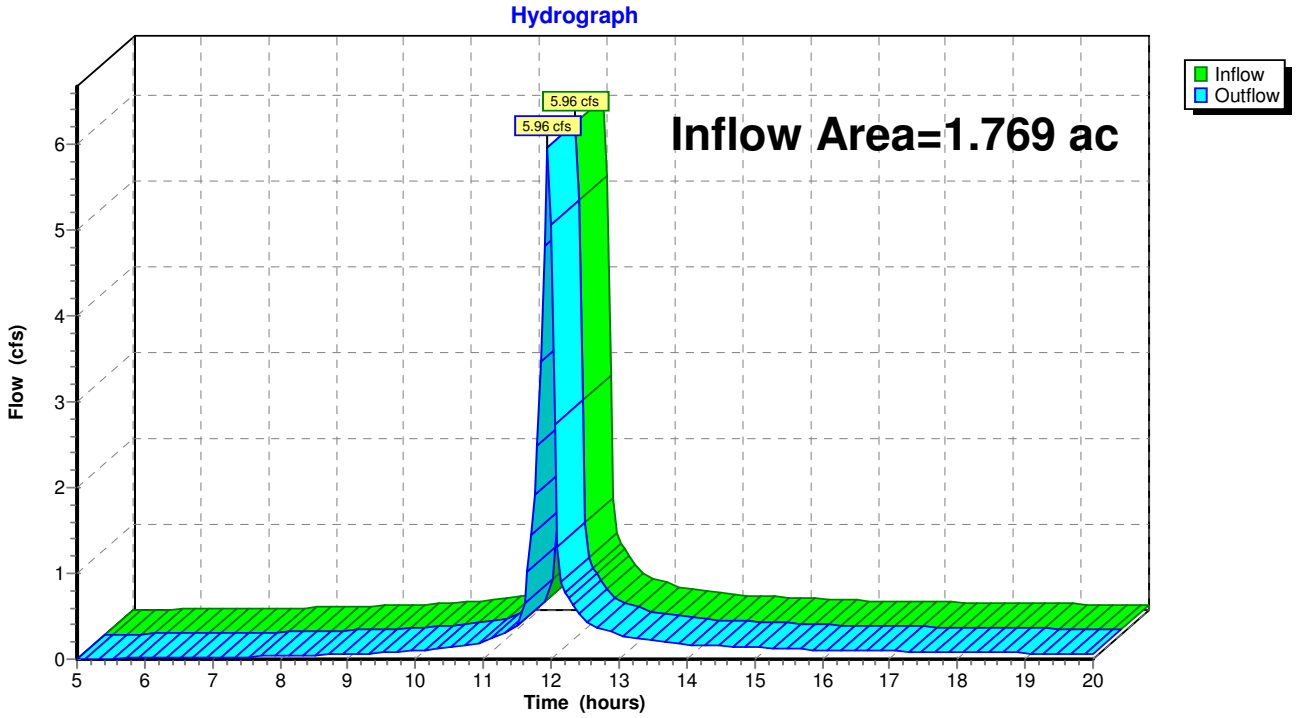
## Summary for Reach 6R: N Sunwood Catch Basin

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

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 1.85" for 2-yr event
Inflow = 5.96 cfs @ 11.95 hrs, Volume= 0.272 af
Outflow = 5.96 cfs @ 11.95 hrs, Volume= 0.272 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin



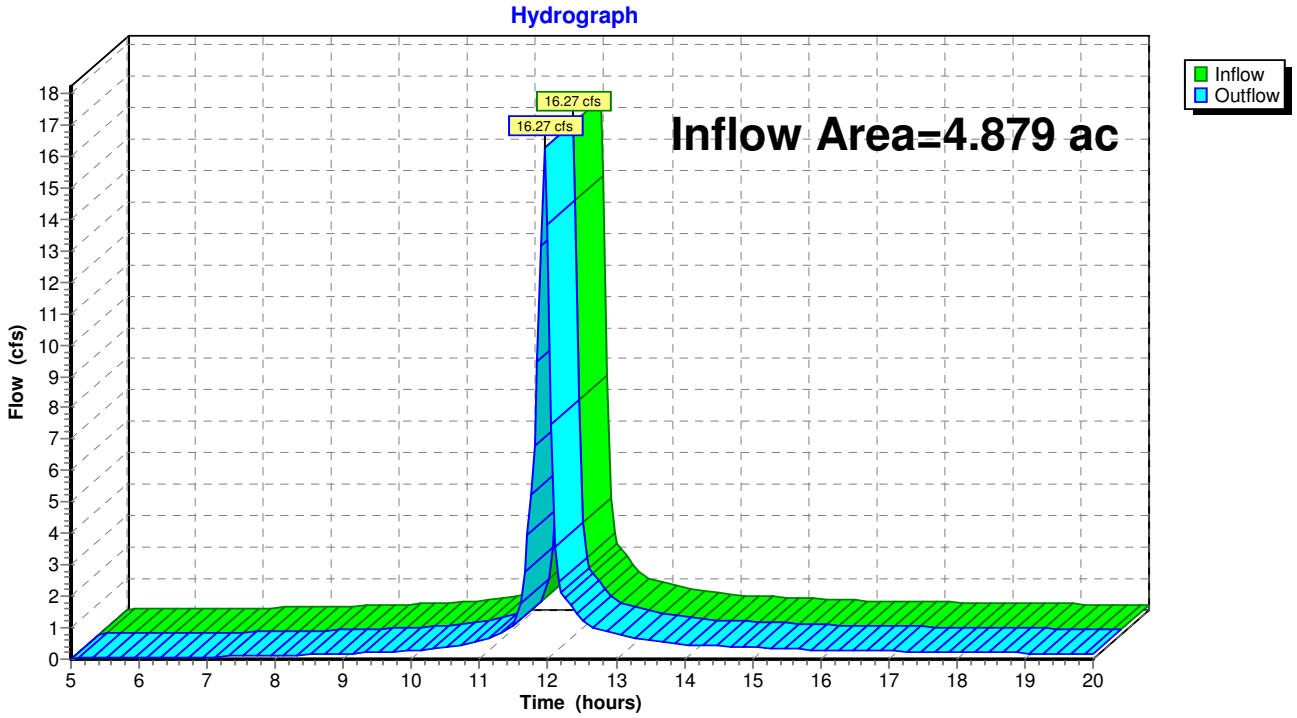
## Summary for Reach 7R: Total Site

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

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 1.84" for 2-yr event
Inflow = 16.27 cfs @ 11.95 hrs, Volume= 0.749 af
Outflow = 16.27 cfs @ 11.95 hrs, Volume= 0.749 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site



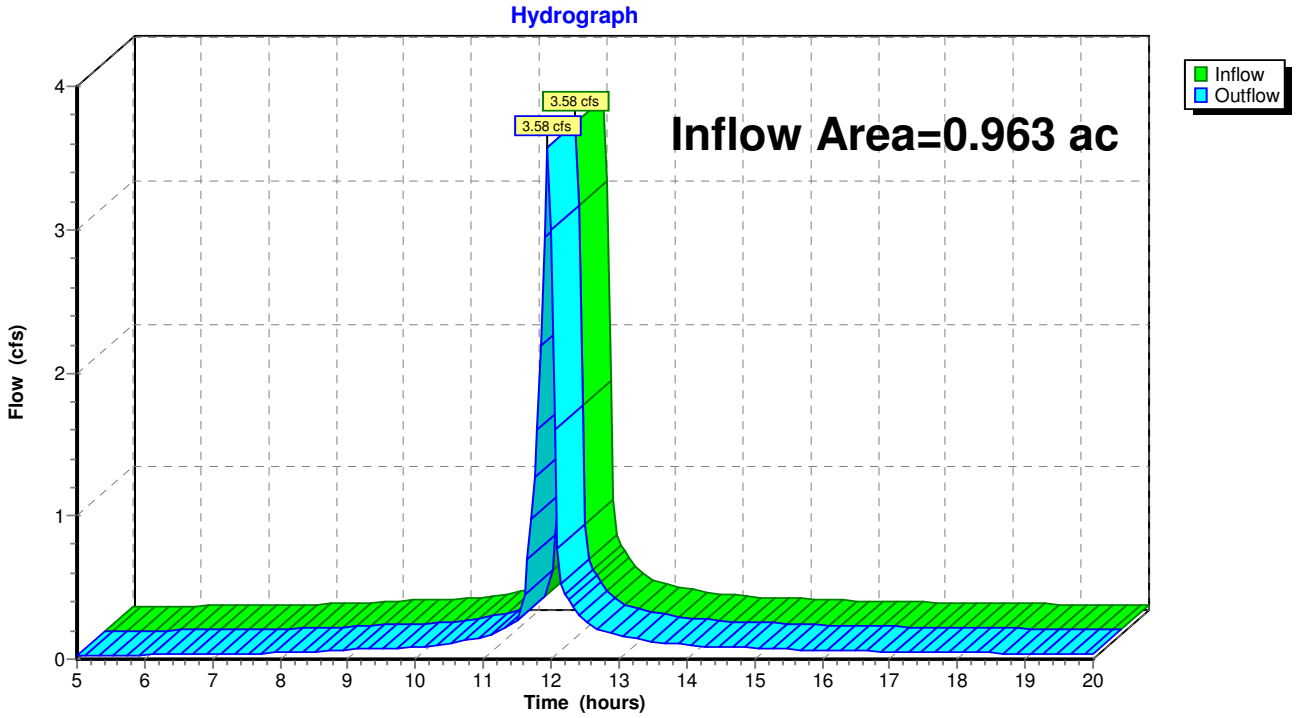
## Summary for Reach 9R: NE Sunwood Catch Basin

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

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 2.21" for 2-yr event
Inflow = 3.58 cfs @ 11.95 hrs, Volume= 0.177 af
Outflow = 3.58 cfs @ 11.95 hrs, Volume= 0.177 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Drainage Area #1** Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>2.73"
Tc=5.0 min CN=89 Runoff=4.24 cfs 0.192 af

**Subcatchment 2S: Drainage Area #2** Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>3.02"
Tc=5.0 min CN=92 Runoff=6.58 cfs 0.307 af

**Subcatchment 3S: Drainage Area #3** Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>3.11"
Tc=5.0 min CN=93 Runoff=9.38 cfs 0.443 af

**Subcatchment 8S: Drainage Area #4** Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>3.56"
Tc=5.0 min CN=98 Runoff=5.18 cfs 0.261 af

**Subcatchment 10S: Direct Discharge #1** Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>1.96"
Tc=5.0 min CN=80 Runoff=0.10 cfs 0.004 af

**Subcatchment 11S: Direct Discharge #2** Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>2.20"
Tc=5.0 min CN=83 Runoff=0.22 cfs 0.010 af

**Subcatchment 12S: Direct Discharge #3** Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>1.46"
Tc=5.0 min CN=73 Runoff=0.18 cfs 0.007 af

**Subcatchment 13S: Direct Discharge #4** Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>1.73"
Tc=5.0 min CN=77 Runoff=0.28 cfs 0.012 af

**Reach 4R: NW Sunwood Catch Basin** Inflow=4.34 cfs 0.196 af
Outflow=4.34 cfs 0.196 af

**Reach 5R: S Civic Center Catch Basin** Inflow=6.81 cfs 0.317 af
Outflow=6.81 cfs 0.317 af

**Reach 6R: N Sunwood Catch Basin** Inflow=9.55 cfs 0.450 af
Outflow=9.55 cfs 0.450 af

**Reach 7R: Total Site** Inflow=26.16 cfs 1.236 af
Outflow=26.16 cfs 1.236 af

**Reach 9R: NE Sunwood Catch Basin** Inflow=5.46 cfs 0.273 af
Outflow=5.46 cfs 0.273 af

**Total Runoff Area = 4.879 ac Runoff Volume = 1.236 af Average Runoff Depth = 3.04"**
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

## Summary for Subcatchment 1S: Drainage Area #1

[49] Hint: Tc<2dt may require smaller dt

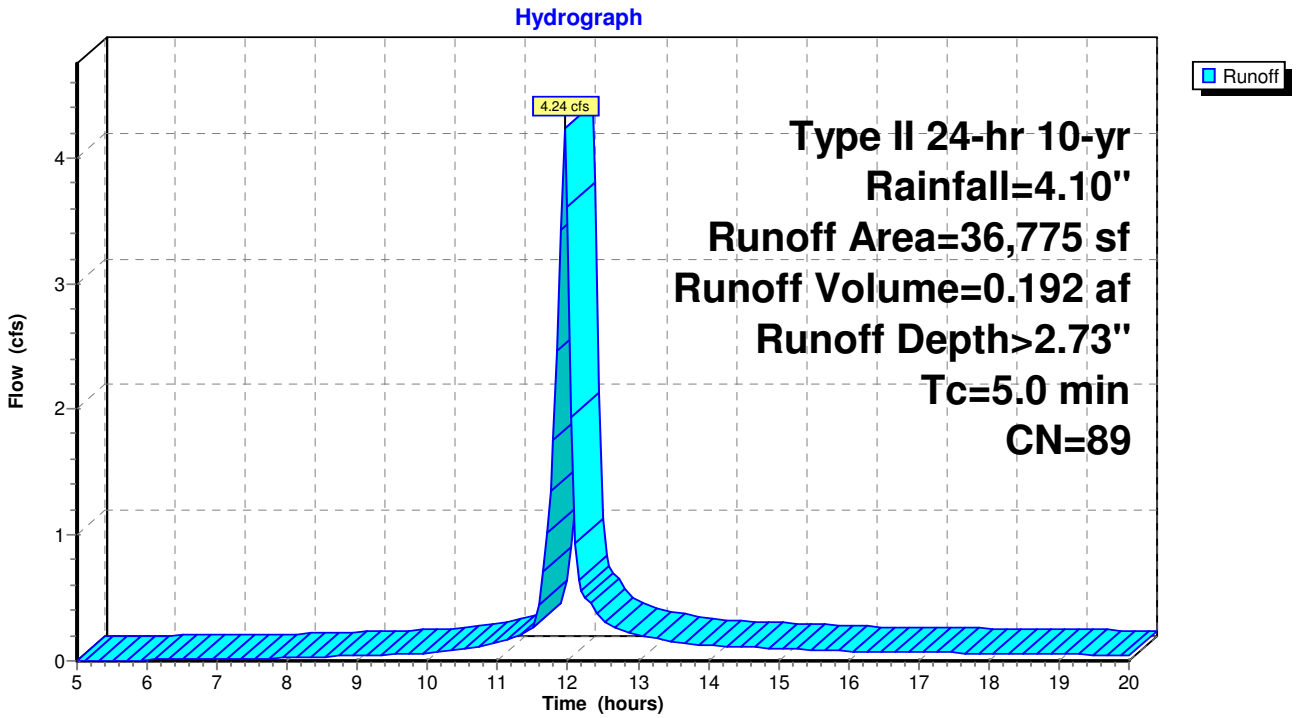
Runoff = 4.24 cfs @ 11.95 hrs, Volume= 0.192 af, Depth> 2.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 27,665 | 98 | Paved parking, HSG B |
| 9,110 | 61 | >75% Grass cover, Good, HSG B |
| 36,775 | 89 | Weighted Average |
| 9,110 | | 24.77% Pervious Area |
| 27,665 | | 75.23% Impervious Area |

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

### Subcatchment 1S: Drainage Area #1



## Summary for Subcatchment 2S: Drainage Area #2

[49] Hint: Tc<2dt may require smaller dt

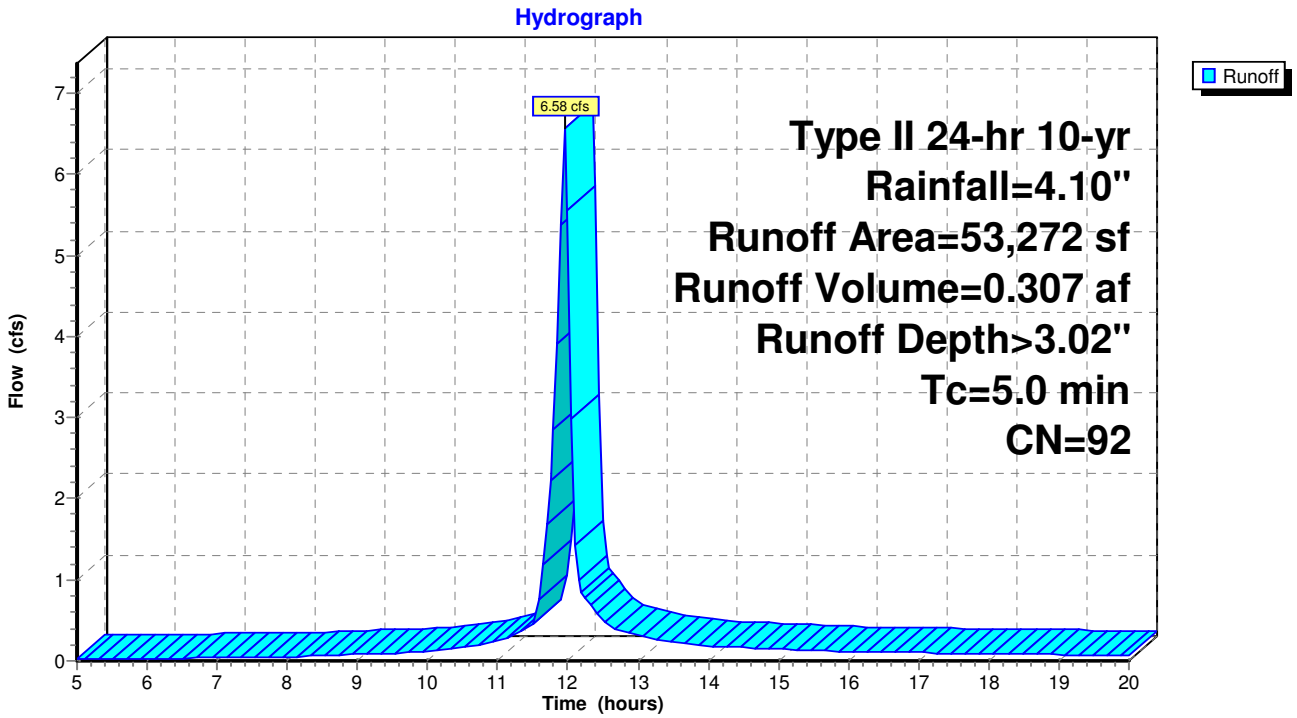
Runoff = 6.58 cfs @ 11.95 hrs, Volume= 0.307 af, Depth> 3.02"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 45,046 | 98 | Paved parking, HSG B |
| 8,226 | 61 | >75% Grass cover, Good, HSG B |
| 53,272 | 92 | Weighted Average |
| 8,226 | | 15.44% Pervious Area |
| 45,046 | | 84.56% Impervious Area |

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

### Subcatchment 2S: Drainage Area #2



## Summary for Subcatchment 3S: Drainage Area #3

[49] Hint: Tc<2dt may require smaller dt

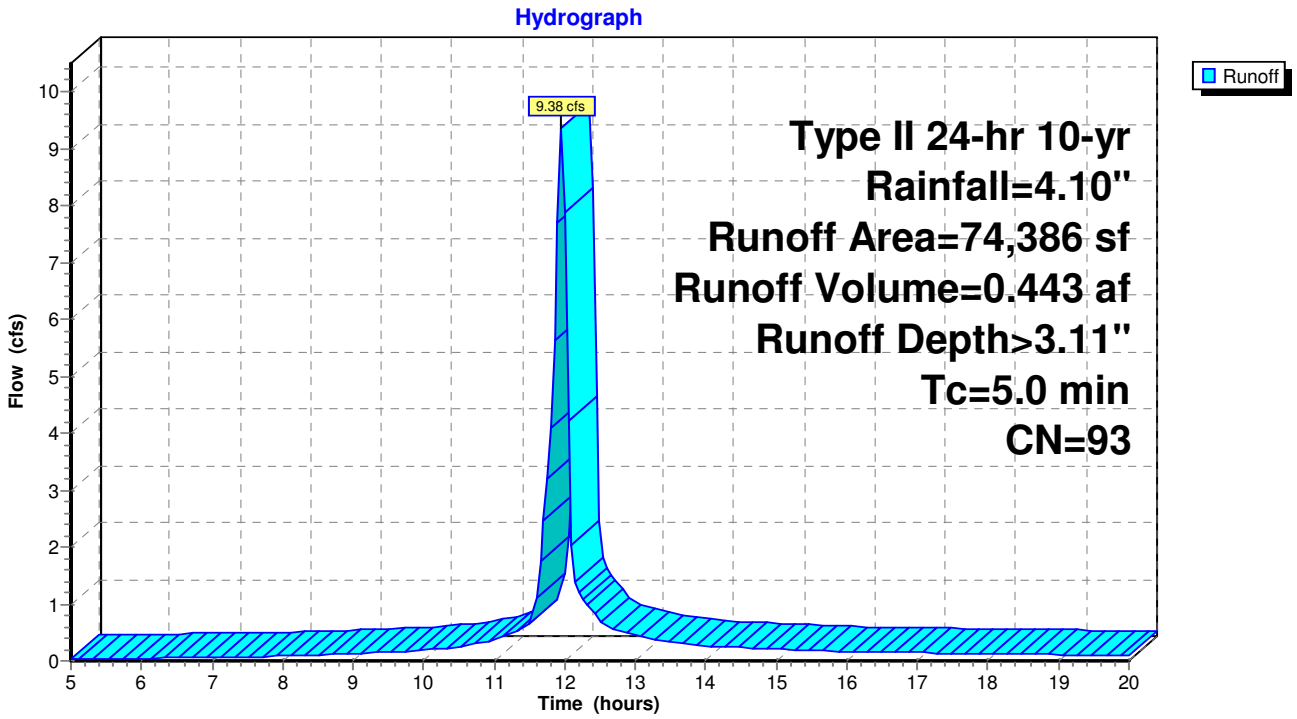
Runoff = 9.38 cfs @ 11.95 hrs, Volume= 0.443 af, Depth> 3.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 64,715 | 98 | Paved parking, HSG B |
| 9,671 | 61 | >75% Grass cover, Good, HSG B |
| 74,386 | 93 | Weighted Average |
| 9,671 | | 13.00% Pervious Area |
| 64,715 | | 87.00% Impervious Area |

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

### Subcatchment 3S: Drainage Area #3



## Summary for Subcatchment 8S: Drainage Area #4

[49] Hint: Tc<2dt may require smaller dt

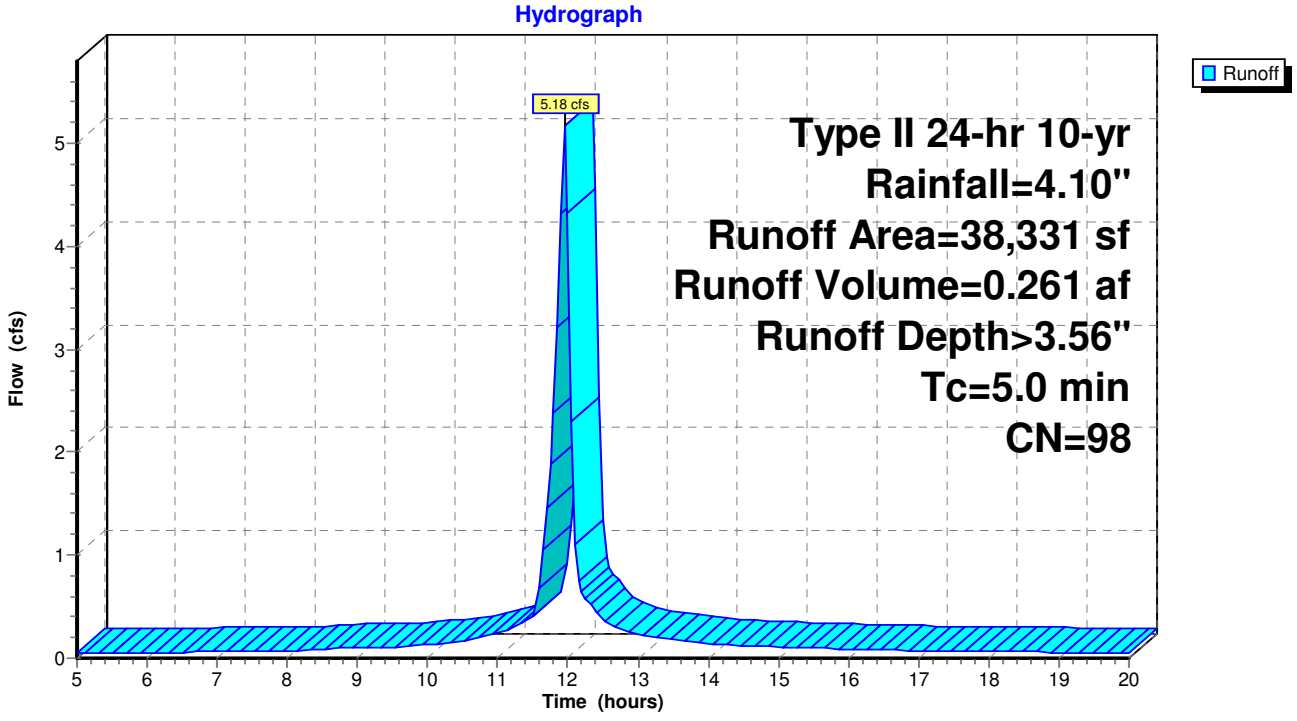
Runoff = 5.18 cfs @ 11.95 hrs, Volume= 0.261 af, Depth> 3.56"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 38,331 | 98 | Paved parking, HSG B |
| 0 | 61 | >75% Grass cover, Good, HSG B |
| 38,331 | 98 | Weighted Average |
| 38,331 | | 100.00% Impervious Area |

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

### Subcatchment 8S: Drainage Area #4



## Summary for Subcatchment 10S: Direct Discharge #1

[49] Hint: Tc<2dt may require smaller dt

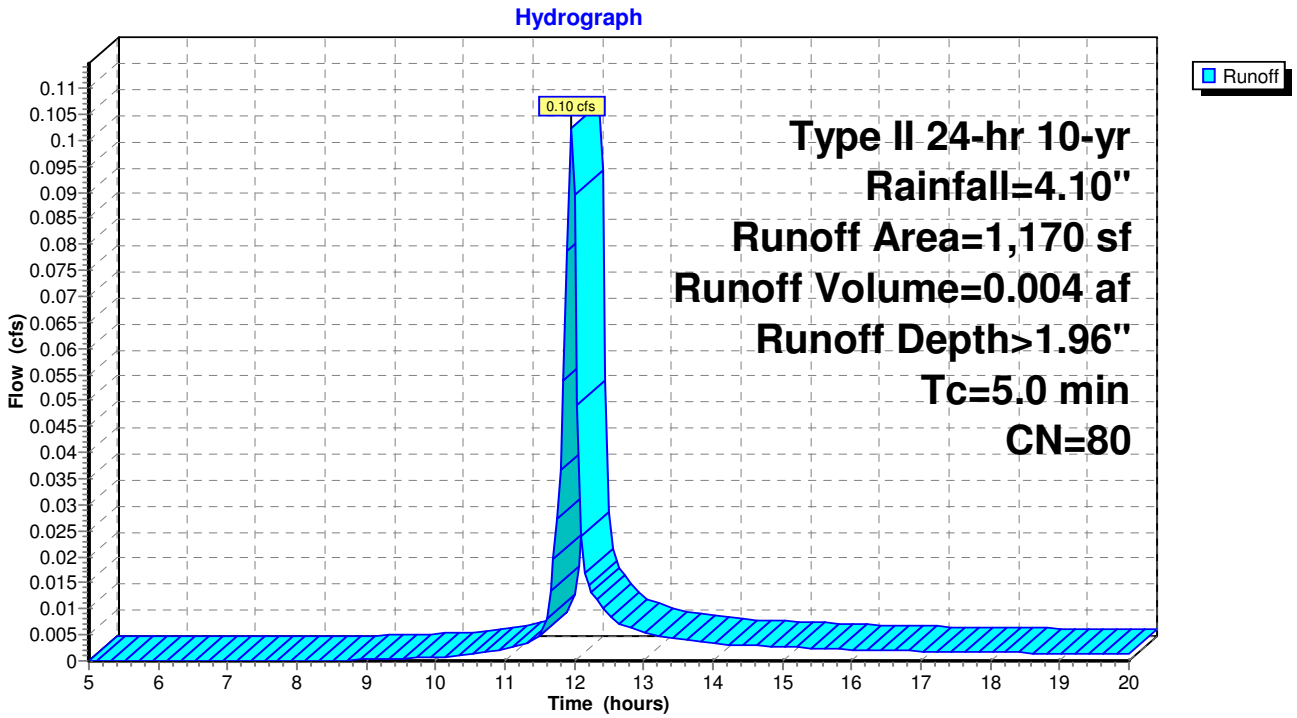
Runoff = 0.10 cfs @ 11.96 hrs, Volume= 0.004 af, Depth> 1.96"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 587 | 98 | Paved parking, HSG B |
| 583 | 61 | >75% Grass cover, Good, HSG B |
| 1,170 | 80 | Weighted Average |
| 583 | | 49.83% Pervious Area |
| 587 | | 50.17% Impervious Area |

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

### Subcatchment 10S: Direct Discharge #1



## Summary for Subcatchment 11S: Direct Discharge #2

[49] Hint: Tc<2dt may require smaller dt

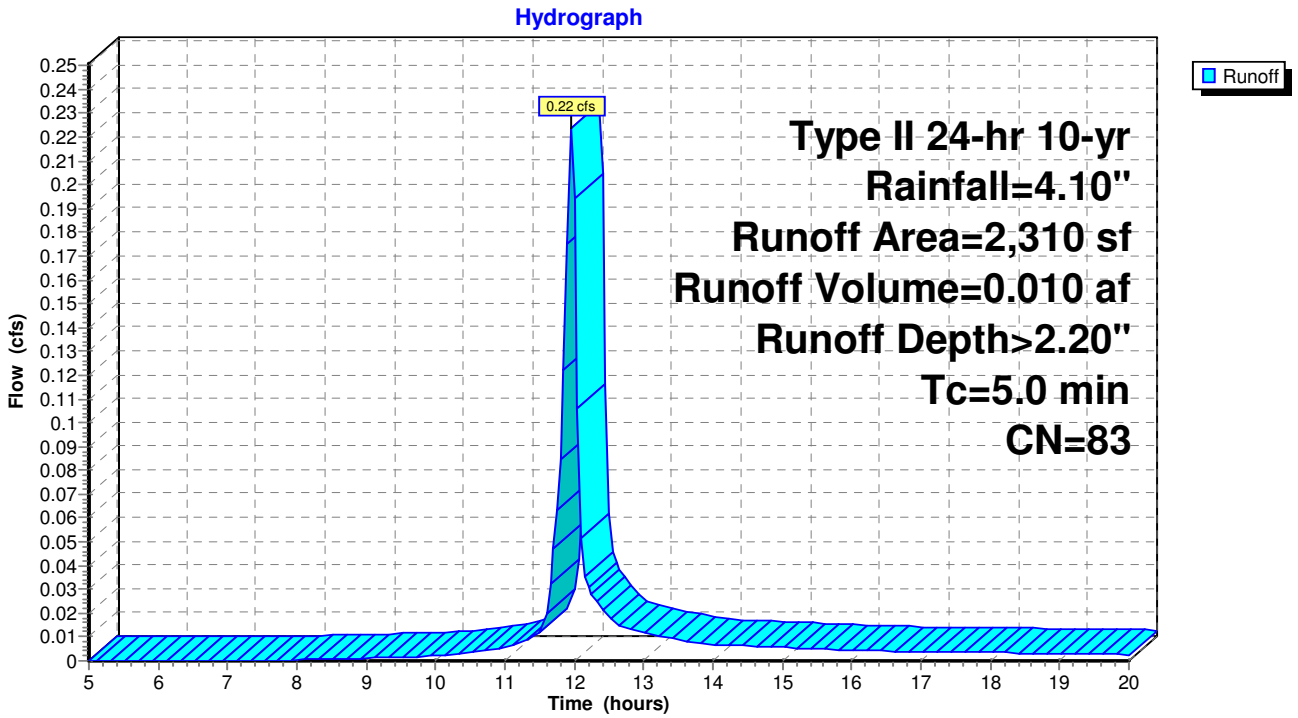
Runoff = 0.22 cfs @ 11.96 hrs, Volume= 0.010 af, Depth> 2.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 1,385 | 98 | Paved parking, HSG B |
| 925 | 61 | >75% Grass cover, Good, HSG B |
| 2,310 | 83 | Weighted Average |
| 925 | | 40.04% Pervious Area |
| 1,385 | | 59.96% Impervious Area |

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

## Subcatchment 11S: Direct Discharge #2



## Summary for Subcatchment 12S: Direct Discharge #3

[49] Hint: Tc<2dt may require smaller dt

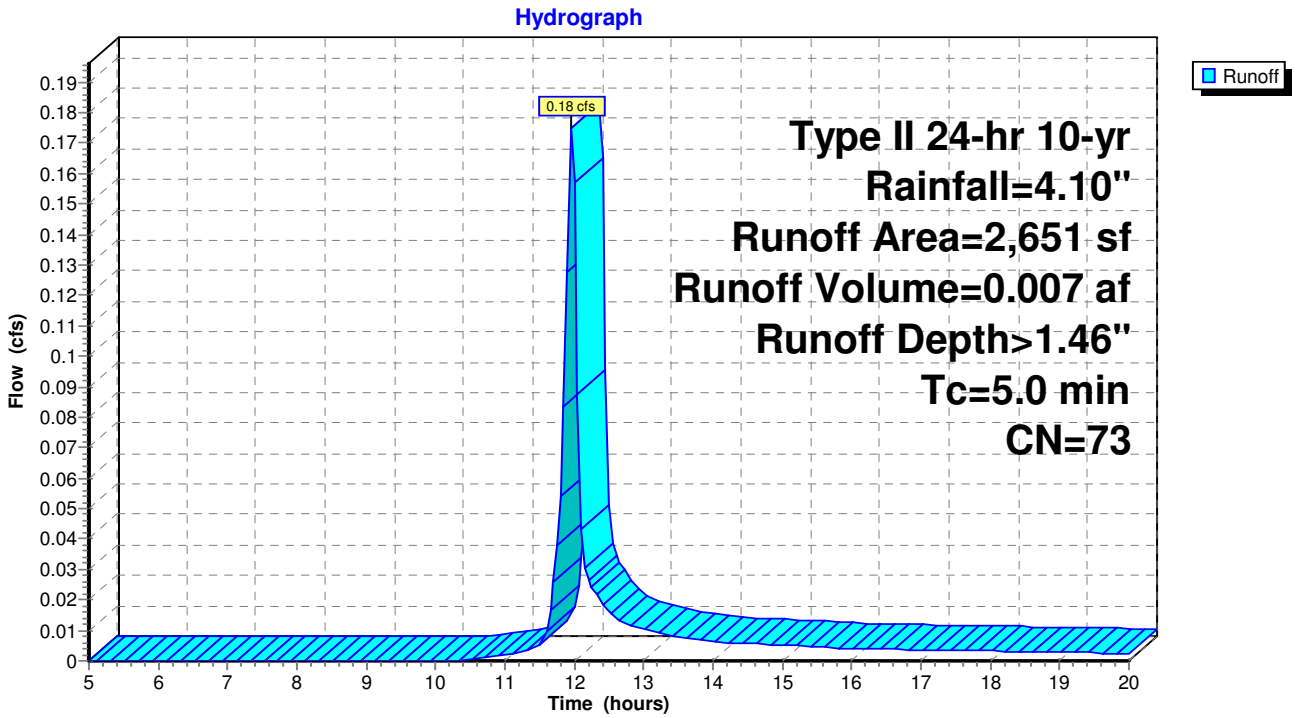
Runoff = 0.18 cfs @ 11.96 hrs, Volume= 0.007 af, Depth> 1.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 888 | 98 | Paved parking, HSG B |
| 1,763 | 61 | >75% Grass cover, Good, HSG B |
| 2,651 | 73 | Weighted Average |
| 1,763 | | 66.50% Pervious Area |
| 888 | | 33.50% Impervious Area |

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

## Subcatchment 12S: Direct Discharge #3



## Summary for Subcatchment 13S: Direct Discharge #4

[49] Hint: Tc<2dt may require smaller dt

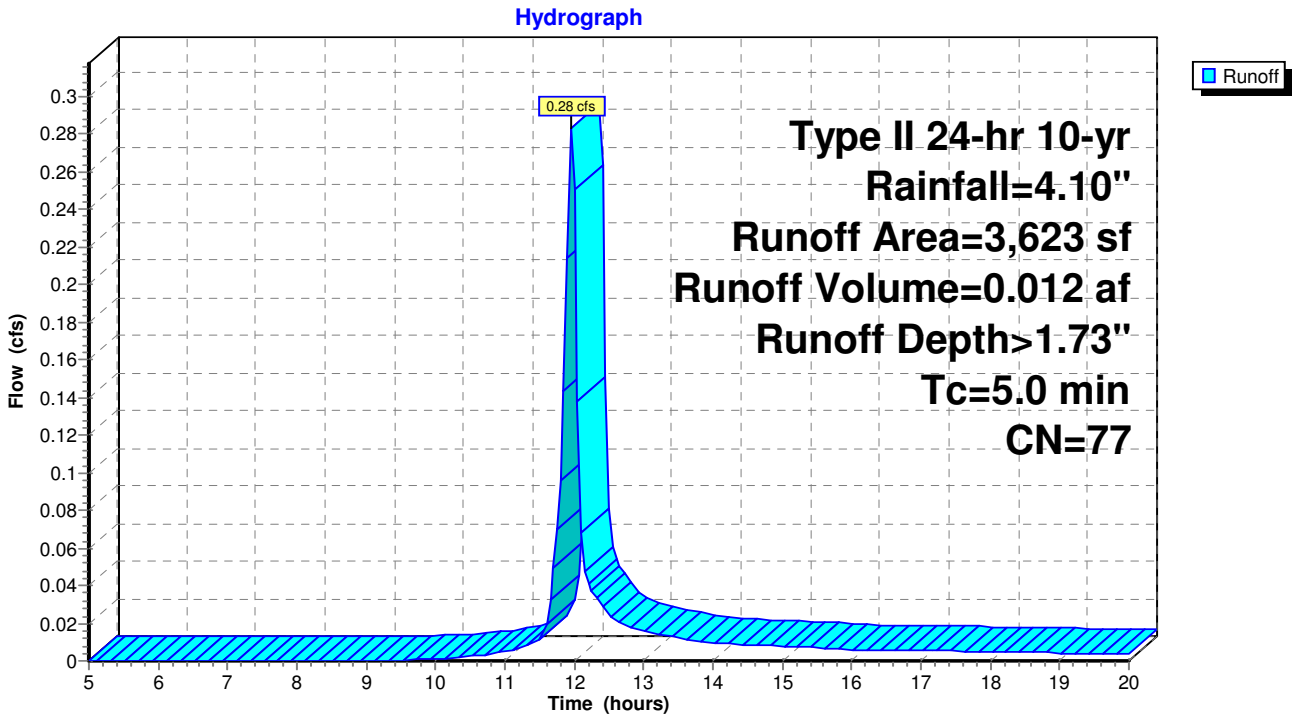
Runoff = 0.28 cfs @ 11.96 hrs, Volume= 0.012 af, Depth> 1.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-yr Rainfall=4.10"

| Area (sf) | CN | Description |
|---|---|---|
| 1,521 | 98 | Paved parking, HSG B |
| 2,102 | 61 | >75% Grass cover, Good, HSG B |
| 3,623 | 77 | Weighted Average |
| 2,102 | | 58.02% Pervious Area |
| 1,521 | | 41.98% Impervious Area |

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

### Subcatchment 13S: Direct Discharge #4



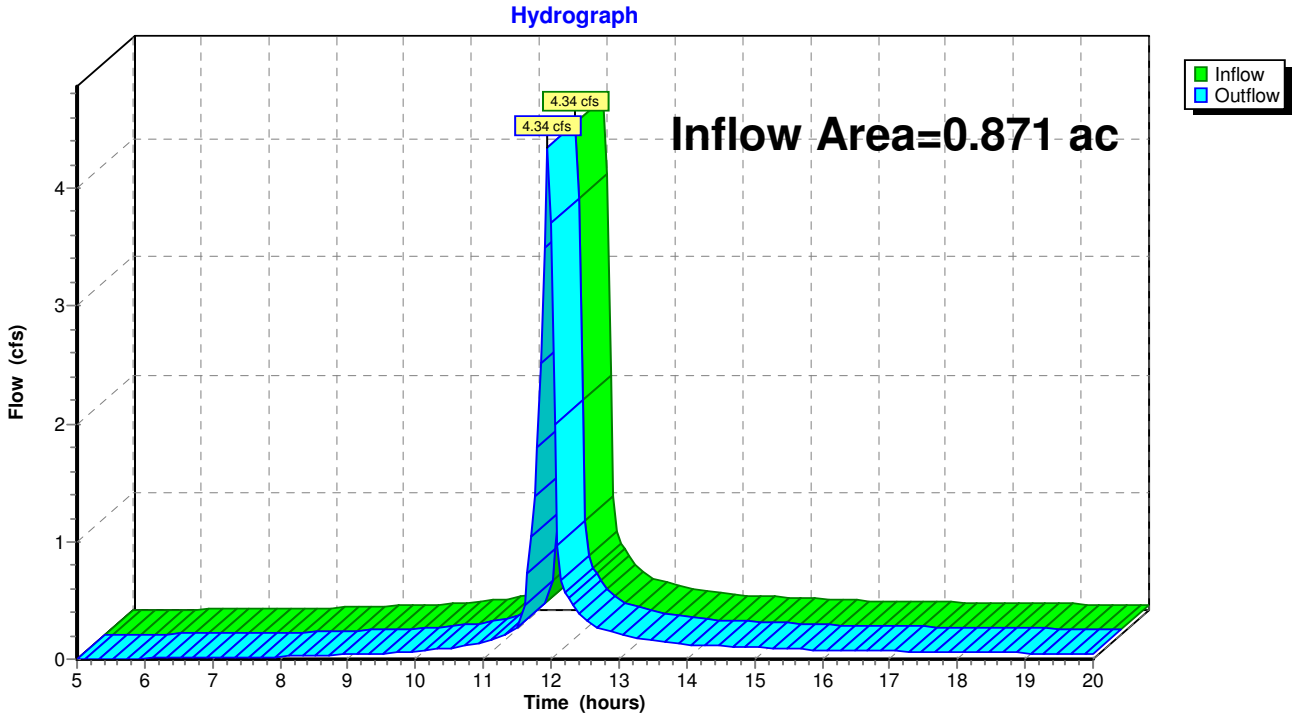
## Summary for Reach 4R: NW Sunwood Catch Basin

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

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 2.71" for 10-yr event
Inflow = 4.34 cfs @ 11.95 hrs, Volume= 0.196 af
Outflow = 4.34 cfs @ 11.95 hrs, Volume= 0.196 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin



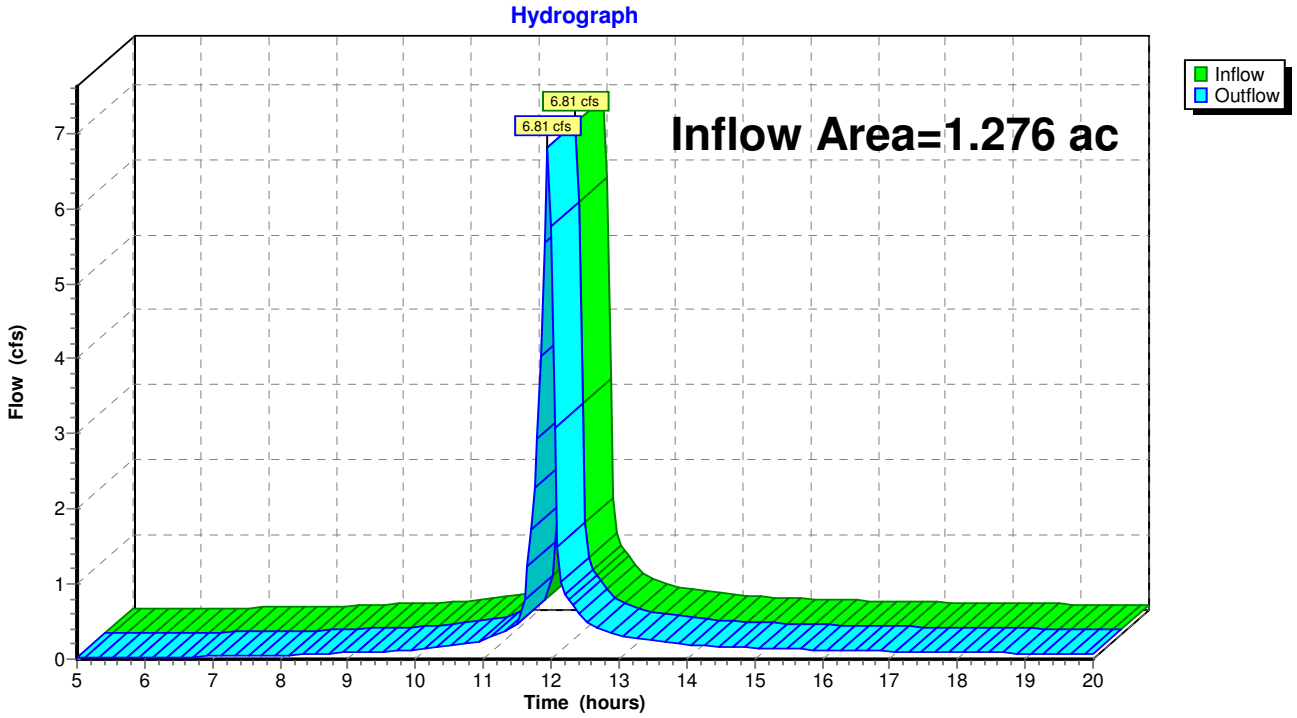
## Summary for Reach 5R: S Civic Center Catch Basin

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

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 2.98" for 10-yr event
Inflow = 6.81 cfs @ 11.95 hrs, Volume= 0.317 af
Outflow = 6.81 cfs @ 11.95 hrs, Volume= 0.317 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin



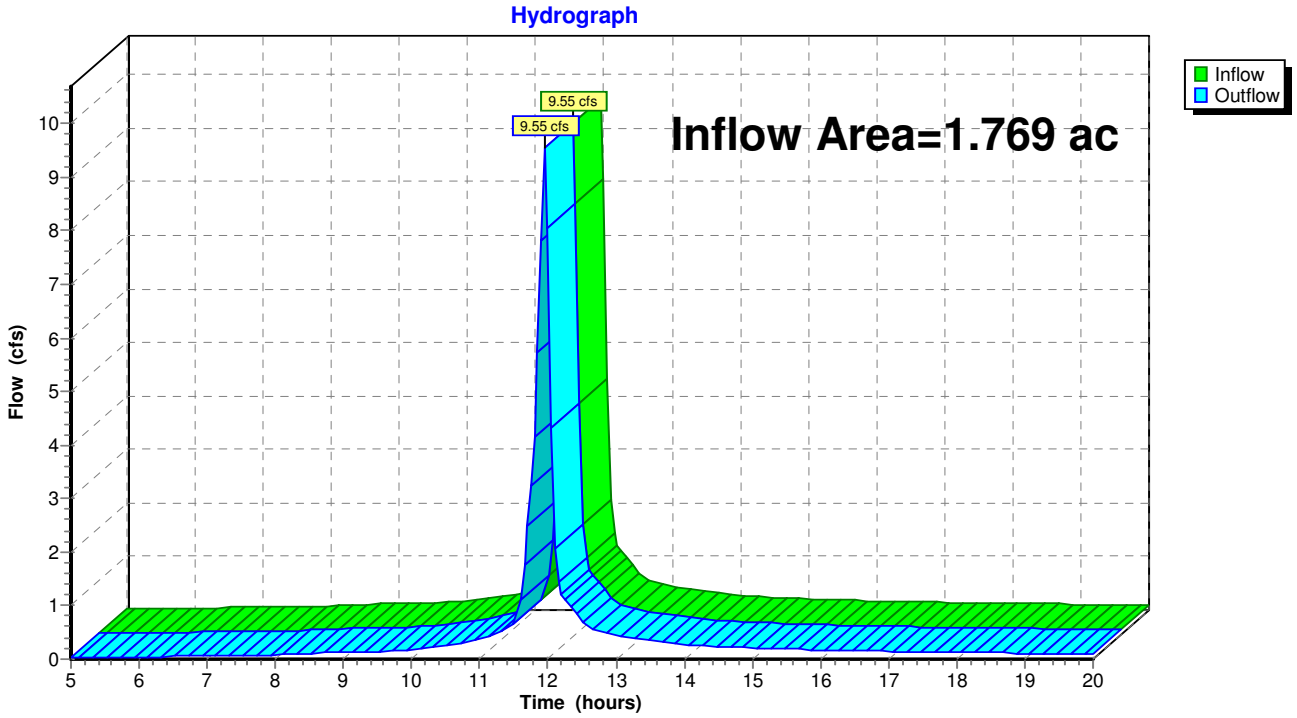
## Summary for Reach 6R: N Sunwood Catch Basin

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

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 3.05" for 10-yr event
Inflow = 9.55 cfs @ 11.95 hrs, Volume= 0.450 af
Outflow = 9.55 cfs @ 11.95 hrs, Volume= 0.450 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin



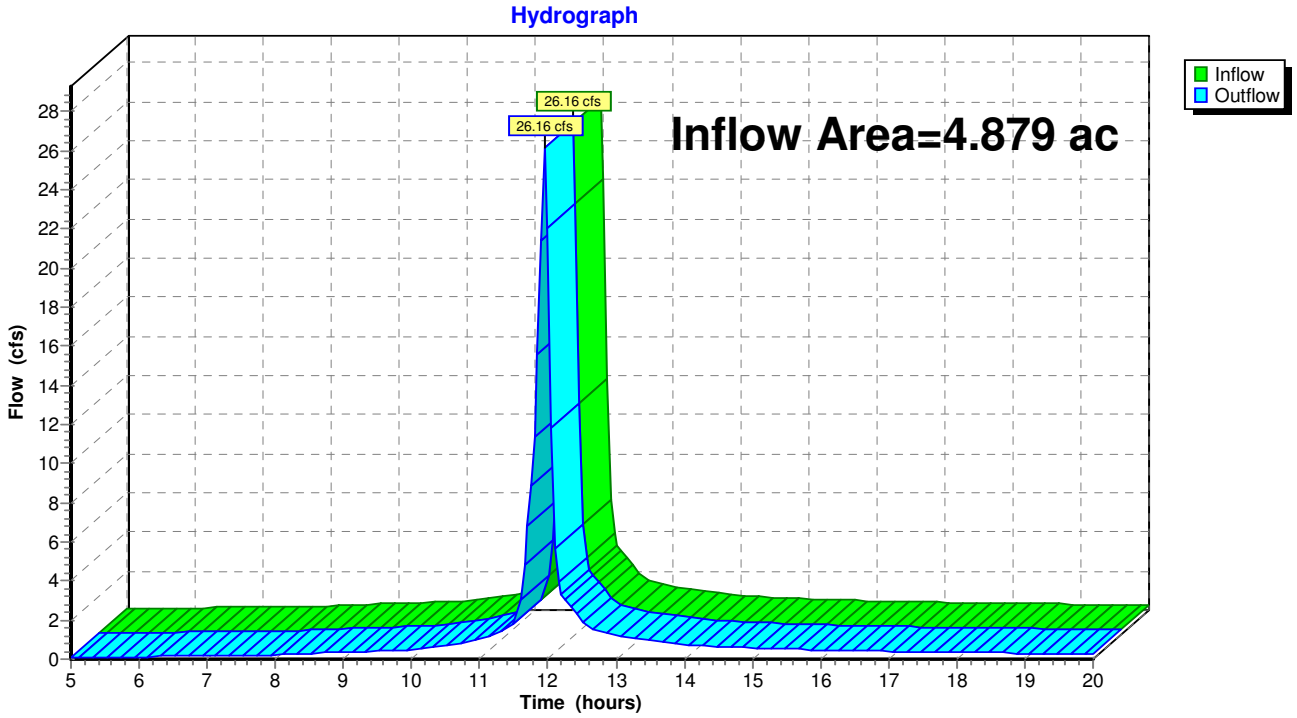
## Summary for Reach 7R: Total Site

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

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 3.04" for 10-yr event
Inflow = 26.16 cfs @ 11.95 hrs, Volume= 1.236 af
Outflow = 26.16 cfs @ 11.95 hrs, Volume= 1.236 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site



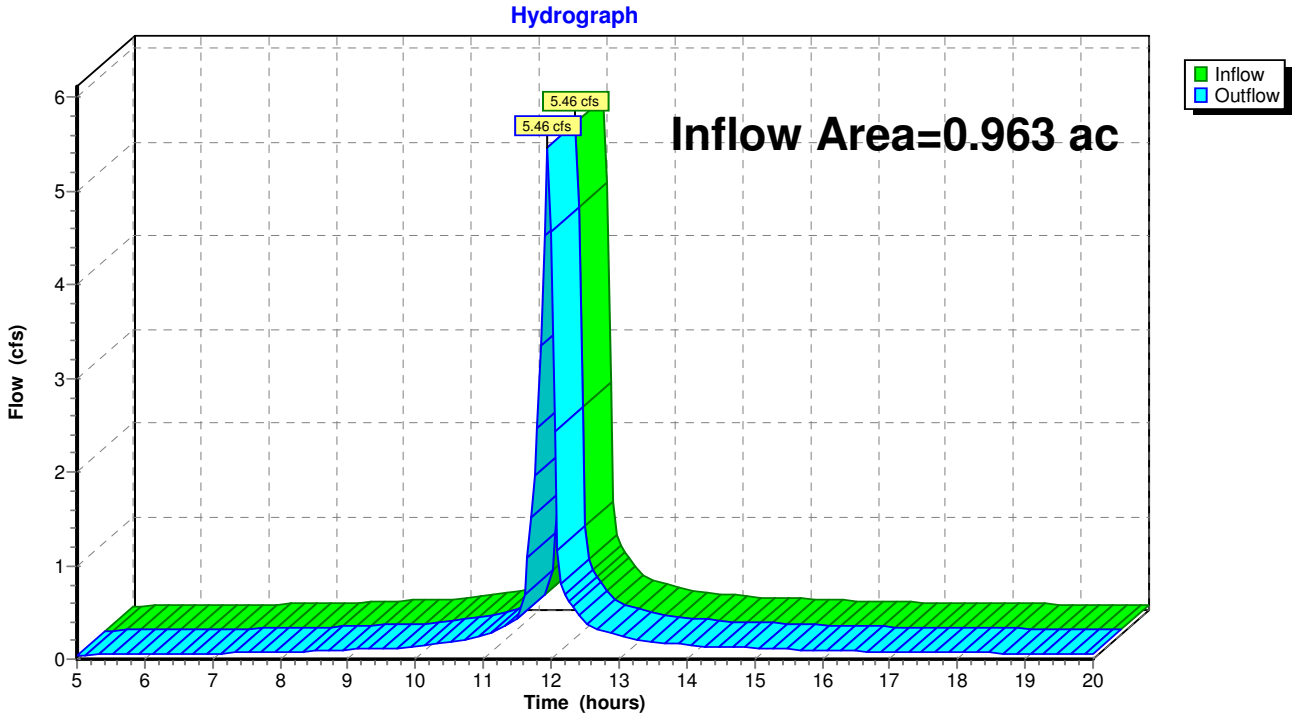
## Summary for Reach 9R: NE Sunwood Catch Basin

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

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 3.40" for 10-yr event
Inflow = 5.46 cfs @ 11.95 hrs, Volume= 0.273 af
Outflow = 5.46 cfs @ 11.95 hrs, Volume= 0.273 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 9R: NE Sunwood Catch Basin



Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

**Subcatchment 1S: Drainage Area #1** Runoff Area=36,775 sf 75.23% Impervious Runoff Depth>4.35"
Tc=5.0 min CN=89 Runoff=6.55 cfs 0.306 af

**Subcatchment 2S: Drainage Area #2** Runoff Area=53,272 sf 84.56% Impervious Runoff Depth>4.66"
Tc=5.0 min CN=92 Runoff=9.89 cfs 0.474 af

**Subcatchment 3S: Drainage Area #3** Runoff Area=74,386 sf 87.00% Impervious Runoff Depth>4.75"
Tc=5.0 min CN=93 Runoff=13.97 cfs 0.677 af

**Subcatchment 8S: Drainage Area #4** Runoff Area=38,331 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=7.48 cfs 0.380 af

**Subcatchment 10S: Direct Discharge #1** Runoff Area=1,170 sf 50.17% Impervious Runoff Depth>3.43"
Tc=5.0 min CN=80 Runoff=0.17 cfs 0.008 af

**Subcatchment 11S: Direct Discharge #2** Runoff Area=2,310 sf 59.96% Impervious Runoff Depth>3.73"
Tc=5.0 min CN=83 Runoff=0.37 cfs 0.016 af

**Subcatchment 12S: Direct Discharge #3** Runoff Area=2,651 sf 33.50% Impervious Runoff Depth>2.77"
Tc=5.0 min CN=73 Runoff=0.33 cfs 0.014 af

**Subcatchment 13S: Direct Discharge #4** Runoff Area=3,623 sf 41.98% Impervious Runoff Depth>3.14"
Tc=5.0 min CN=77 Runoff=0.50 cfs 0.022 af

**Reach 4R: NW Sunwood Catch Basin** Inflow=6.73 cfs 0.314 af
Outflow=6.73 cfs 0.314 af

**Reach 5R: S Civic Center Catch Basin** Inflow=10.26 cfs 0.491 af
Outflow=10.26 cfs 0.491 af

**Reach 6R: N Sunwood Catch Basin** Inflow=14.30 cfs 0.691 af
Outflow=14.30 cfs 0.691 af

**Reach 7R: Total Site** Inflow=39.27 cfs 1.897 af
Outflow=39.27 cfs 1.897 af

**Reach 9R: NE Sunwood Catch Basin** Inflow=7.98 cfs 0.402 af
Outflow=7.98 cfs 0.402 af

**Total Runoff Area = 4.879 ac Runoff Volume = 1.897 af Average Runoff Depth = 4.67"**
**15.24% Pervious = 0.743 ac 84.76% Impervious = 4.135 ac**

## Summary for Subcatchment 1S: Drainage Area #1

[49] Hint: Tc<2dt may require smaller dt

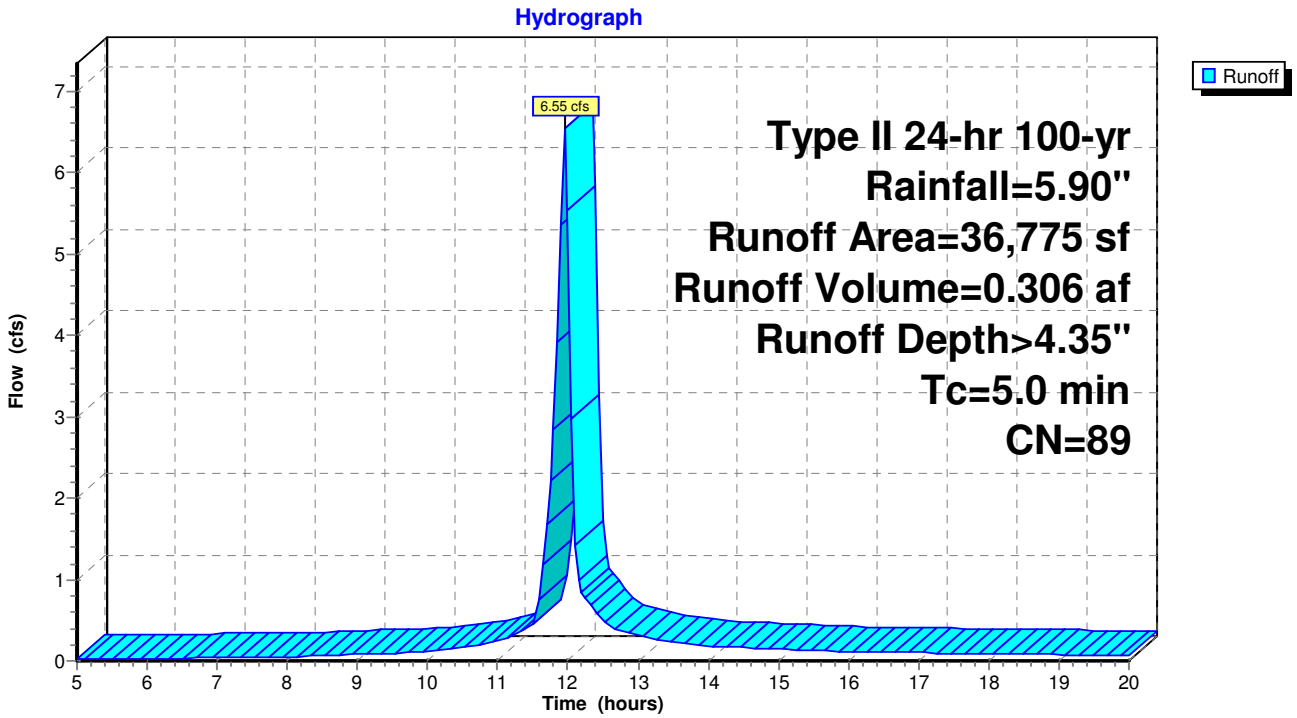
Runoff = 6.55 cfs @ 11.95 hrs, Volume= 0.306 af, Depth> 4.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 27,665 | 98 | Paved parking, HSG B |
| 9,110 | 61 | >75% Grass cover, Good, HSG B |
| 36,775 | 89 | Weighted Average |
| 9,110 | | 24.77% Pervious Area |
| 27,665 | | 75.23% Impervious Area |

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

### Subcatchment 1S: Drainage Area #1



## Summary for Subcatchment 2S: Drainage Area #2

[49] Hint: Tc<2dt may require smaller dt

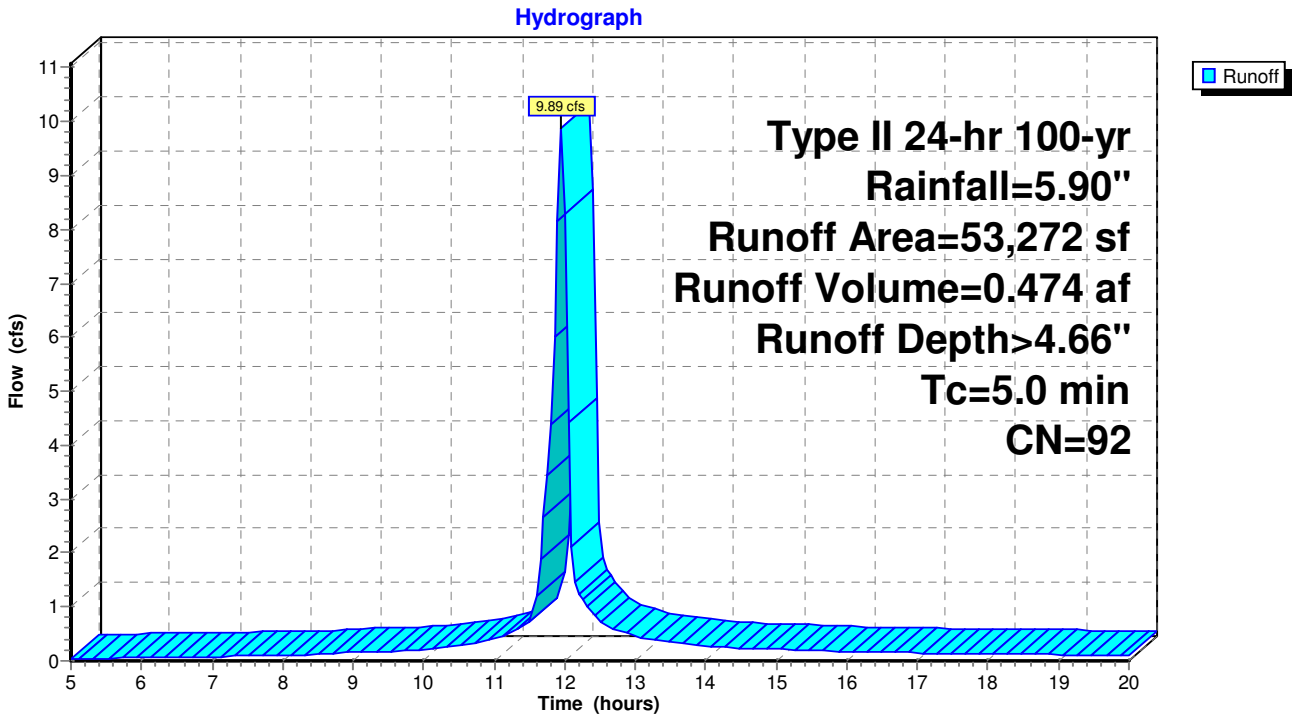
Runoff = 9.89 cfs @ 11.95 hrs, Volume= 0.474 af, Depth> 4.66"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 45,046 | 98 | Paved parking, HSG B |
| 8,226 | 61 | >75% Grass cover, Good, HSG B |
| 53,272 | 92 | Weighted Average |
| 8,226 | | 15.44% Pervious Area |
| 45,046 | | 84.56% Impervious Area |

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

### Subcatchment 2S: Drainage Area #2



## Summary for Subcatchment 3S: Drainage Area #3

[49] Hint: Tc<2dt may require smaller dt

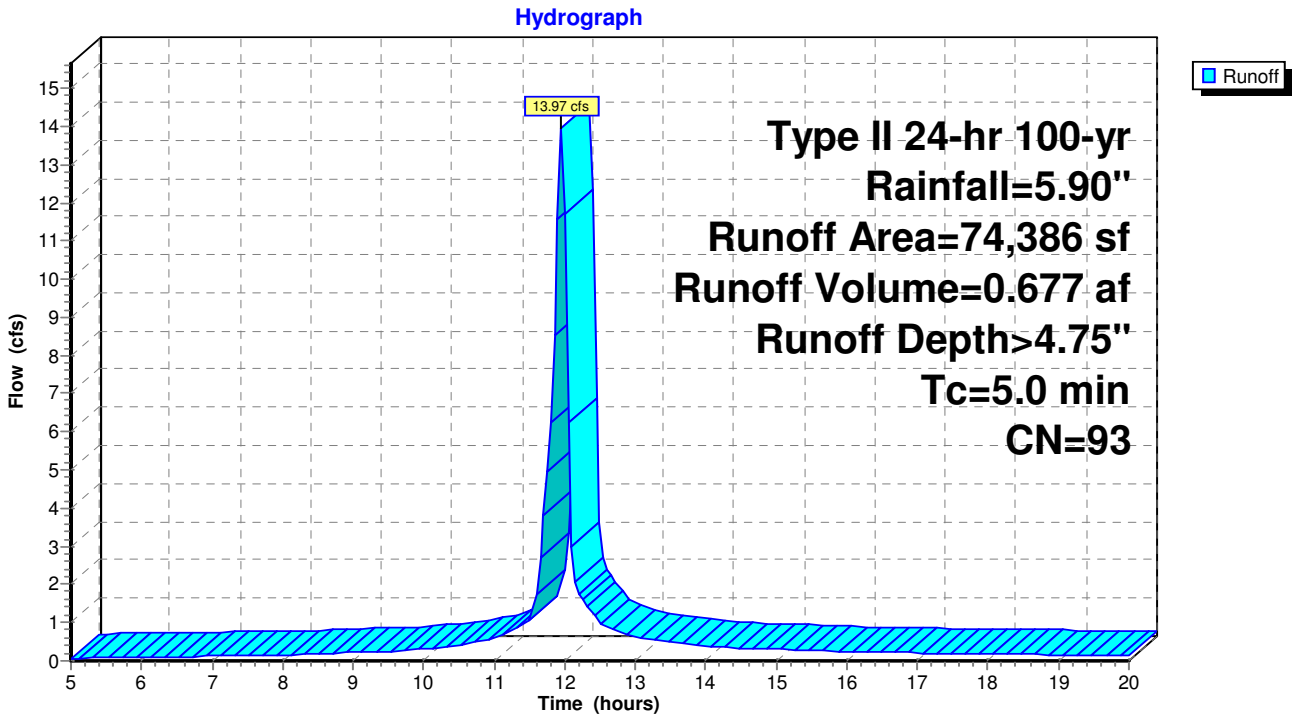
Runoff = 13.97 cfs @ 11.95 hrs, Volume= 0.677 af, Depth> 4.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 64,715 | 98 | Paved parking, HSG B |
| 9,671 | 61 | >75% Grass cover, Good, HSG B |
| 74,386 | 93 | Weighted Average |
| 9,671 | | 13.00% Pervious Area |
| 64,715 | | 87.00% Impervious Area |

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

### Subcatchment 3S: Drainage Area #3



## Summary for Subcatchment 8S: Drainage Area #4

[49] Hint: Tc<2dt may require smaller dt

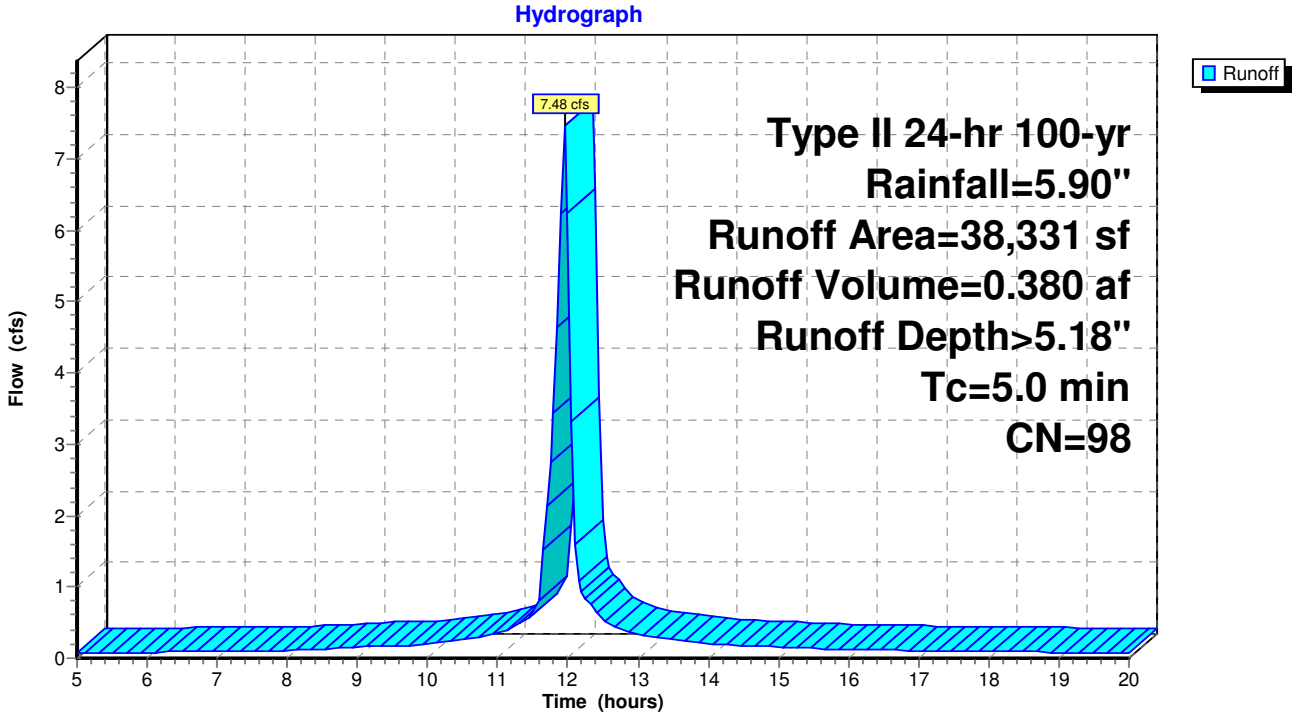
Runoff = 7.48 cfs @ 11.95 hrs, Volume= 0.380 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 38,331 | 98 | Paved parking, HSG B |
| 0 | 61 | >75% Grass cover, Good, HSG B |
| 38,331 | 98 | Weighted Average |
| 38,331 | | 100.00% Impervious Area |

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

### Subcatchment 8S: Drainage Area #4



## Summary for Subcatchment 10S: Direct Discharge #1

[49] Hint: Tc<2dt may require smaller dt

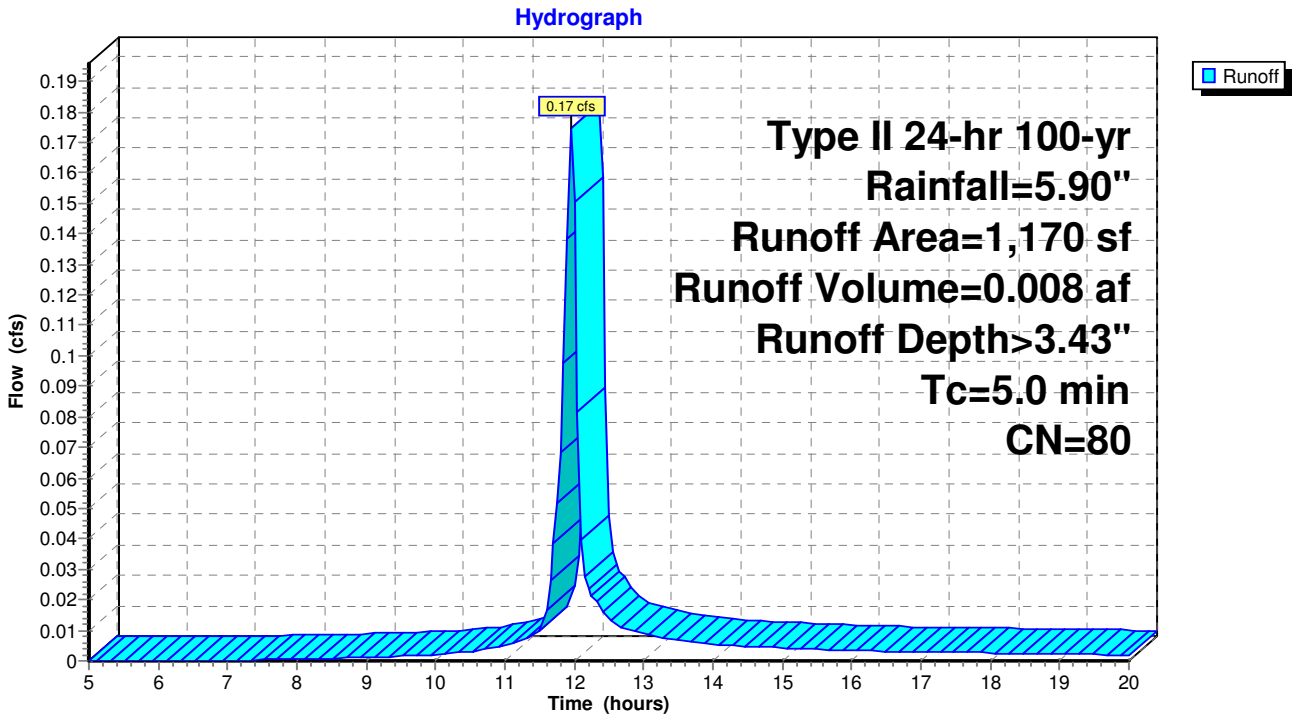
Runoff = 0.17 cfs @ 11.95 hrs, Volume= 0.008 af, Depth> 3.43"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 587 | 98 | Paved parking, HSG B |
| 583 | 61 | >75% Grass cover, Good, HSG B |
| 1,170 | 80 | Weighted Average |
| 583 | | 49.83% Pervious Area |
| 587 | | 50.17% Impervious Area |

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

### Subcatchment 10S: Direct Discharge #1



## Summary for Subcatchment 11S: Direct Discharge #2

[49] Hint: Tc<2dt may require smaller dt

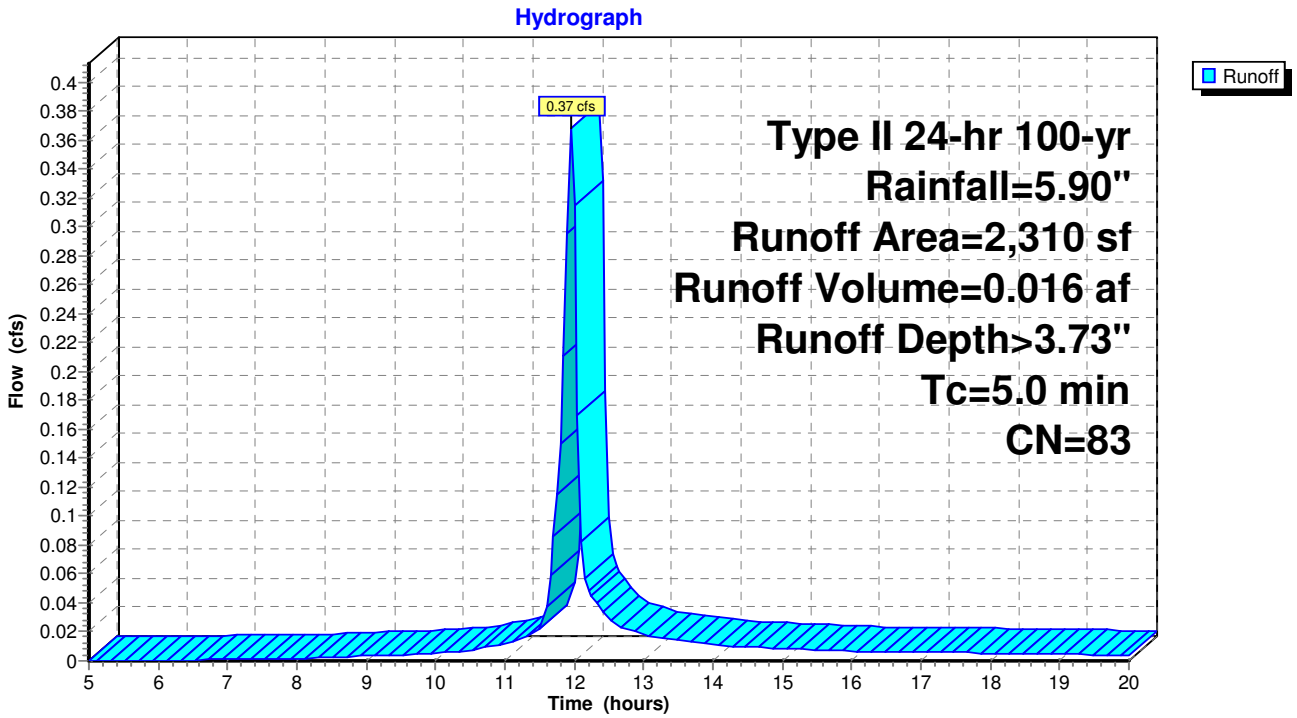
Runoff = 0.37 cfs @ 11.95 hrs, Volume= 0.016 af, Depth> 3.73"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 1,385 | 98 | Paved parking, HSG B |
| 925 | 61 | >75% Grass cover, Good, HSG B |
| 2,310 | 83 | Weighted Average |
| 925 | | 40.04% Pervious Area |
| 1,385 | | 59.96% Impervious Area |

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

## Subcatchment 11S: Direct Discharge #2



## Summary for Subcatchment 12S: Direct Discharge #3

[49] Hint: Tc<2dt may require smaller dt

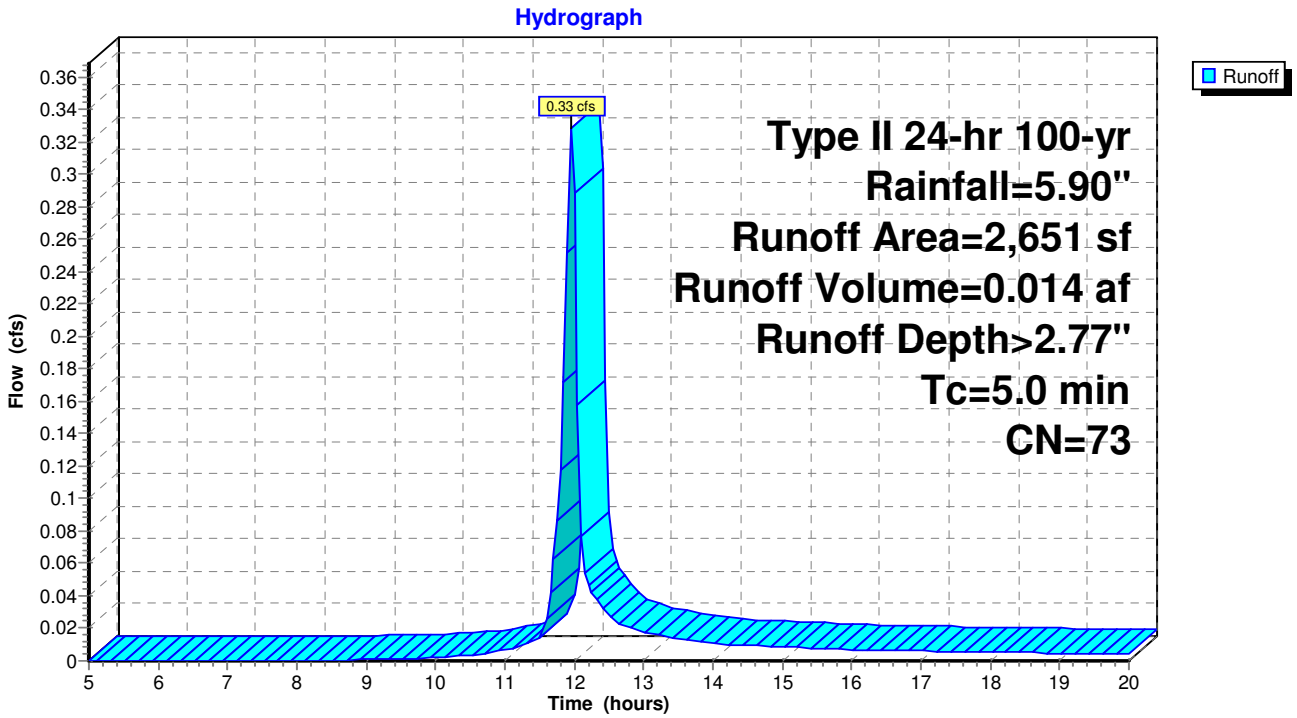
Runoff = 0.33 cfs @ 11.96 hrs, Volume= 0.014 af, Depth> 2.77"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 888 | 98 | Paved parking, HSG B |
| 1,763 | 61 | >75% Grass cover, Good, HSG B |
| 2,651 | 73 | Weighted Average |
| 1,763 | | 66.50% Pervious Area |
| 888 | | 33.50% Impervious Area |

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

### Subcatchment 12S: Direct Discharge #3



## Summary for Subcatchment 13S: Direct Discharge #4

[49] Hint: Tc<2dt may require smaller dt

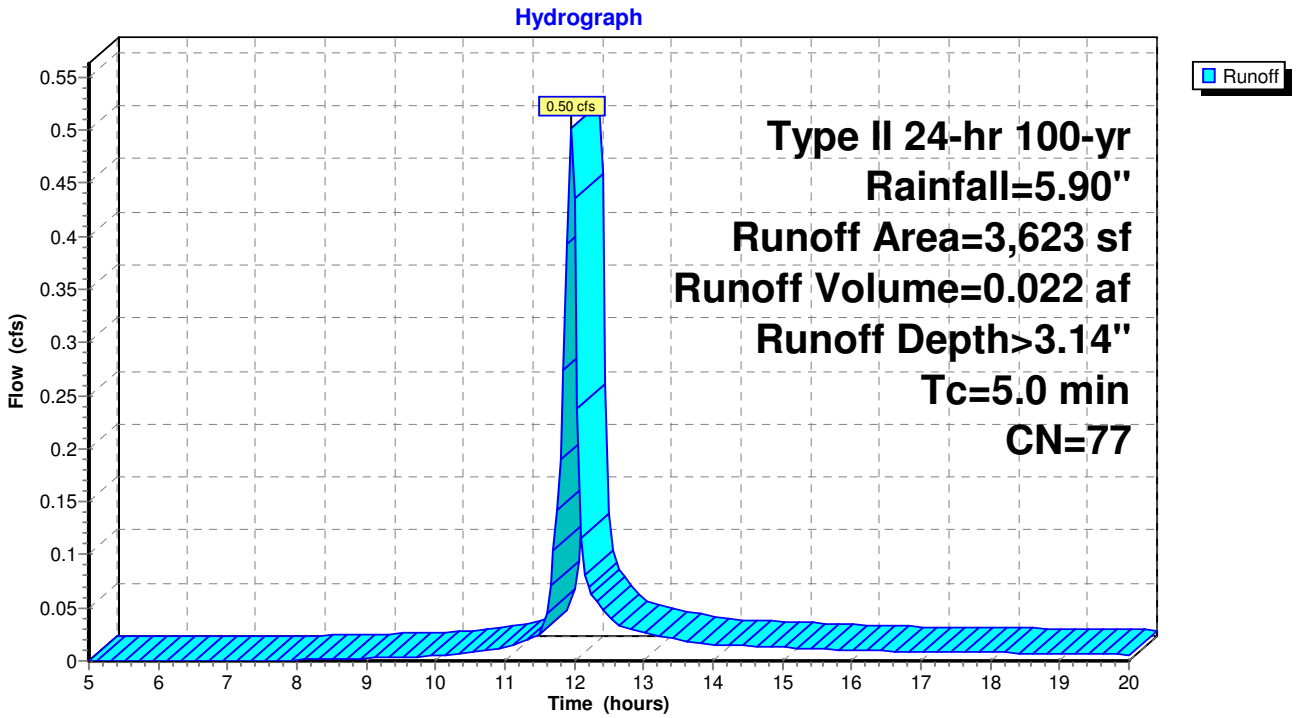
Runoff = 0.50 cfs @ 11.96 hrs, Volume= 0.022 af, Depth> 3.14"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 1,521 | 98 | Paved parking, HSG B |
| 2,102 | 61 | >75% Grass cover, Good, HSG B |
| 3,623 | 77 | Weighted Average |
| 2,102 | | 58.02% Pervious Area |
| 1,521 | | 41.98% Impervious Area |

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

### Subcatchment 13S: Direct Discharge #4



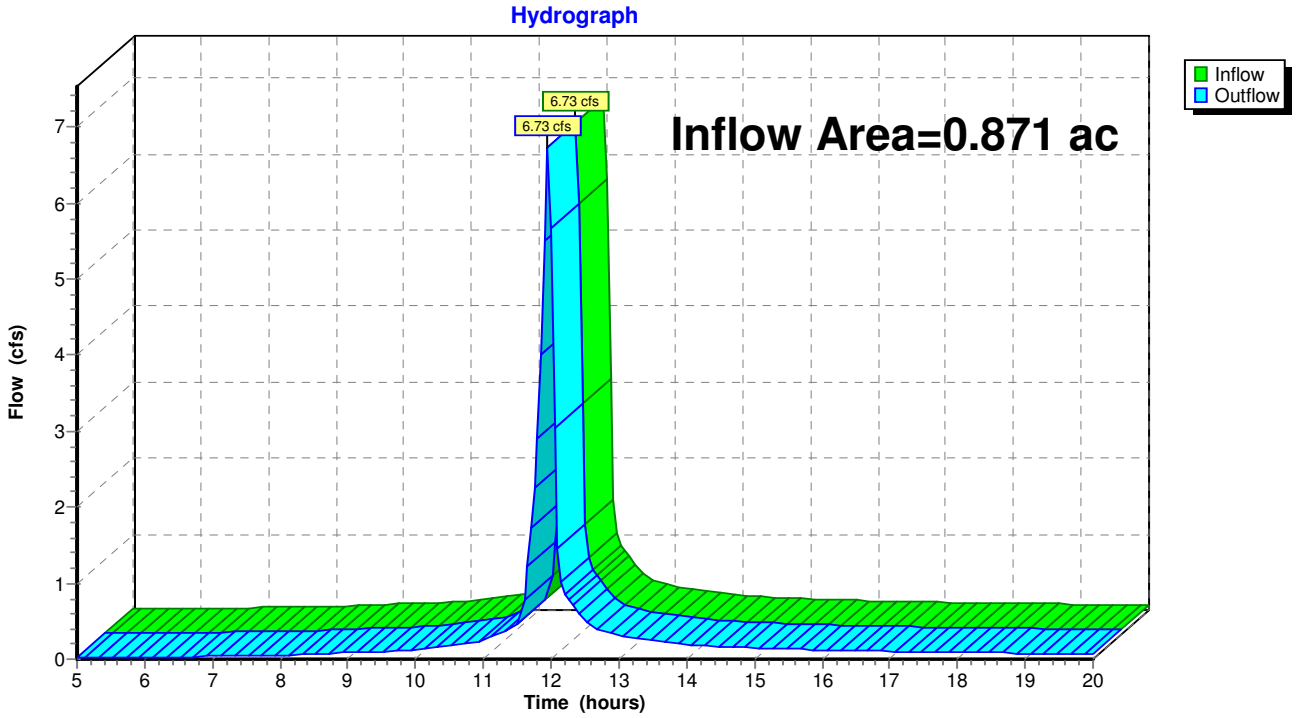
## Summary for Reach 4R: NW Sunwood Catch Basin

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

Inflow Area = 0.871 ac, 74.46% Impervious, Inflow Depth > 4.32" for 100-yr event
Inflow = 6.73 cfs @ 11.95 hrs, Volume= 0.314 af
Outflow = 6.73 cfs @ 11.95 hrs, Volume= 0.314 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 4R: NW Sunwood Catch Basin



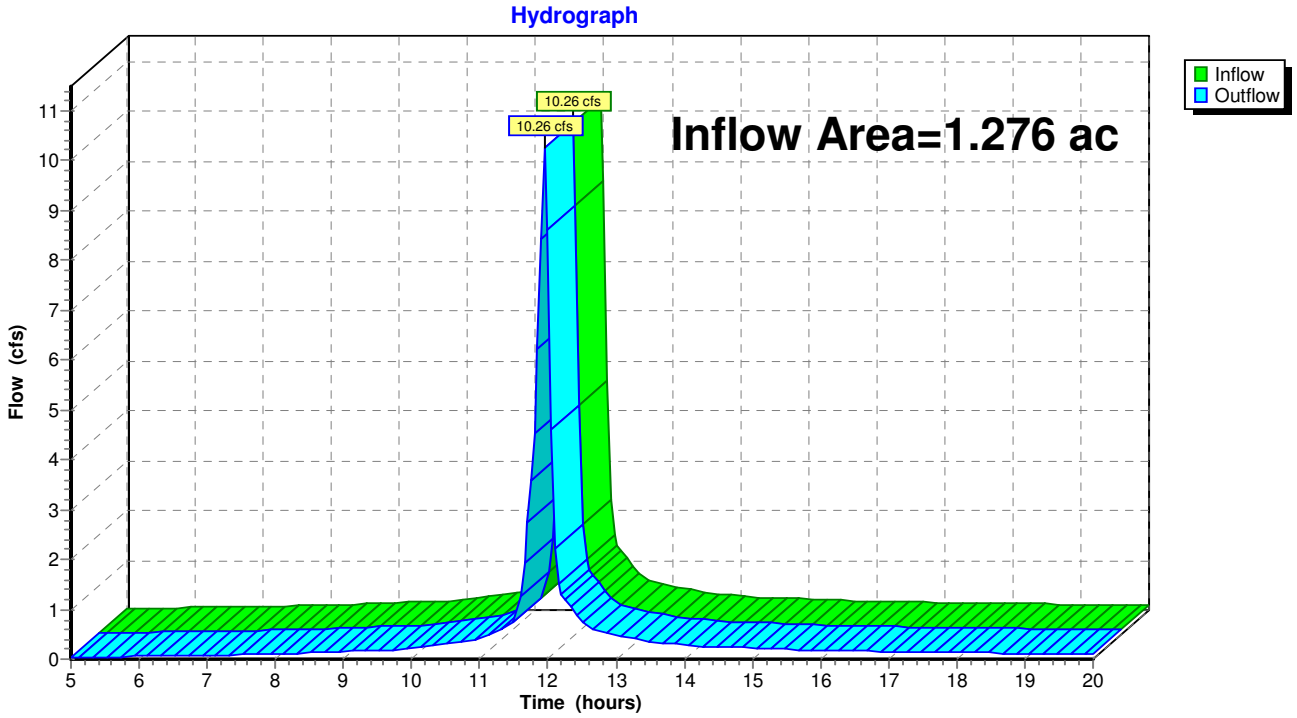
## Summary for Reach 5R: S Civic Center Catch Basin

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

Inflow Area = 1.276 ac, 83.54% Impervious, Inflow Depth > 4.62" for 100-yr event
Inflow = 10.26 cfs @ 11.95 hrs, Volume= 0.491 af
Outflow = 10.26 cfs @ 11.95 hrs, Volume= 0.491 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 5R: S Civic Center Catch Basin



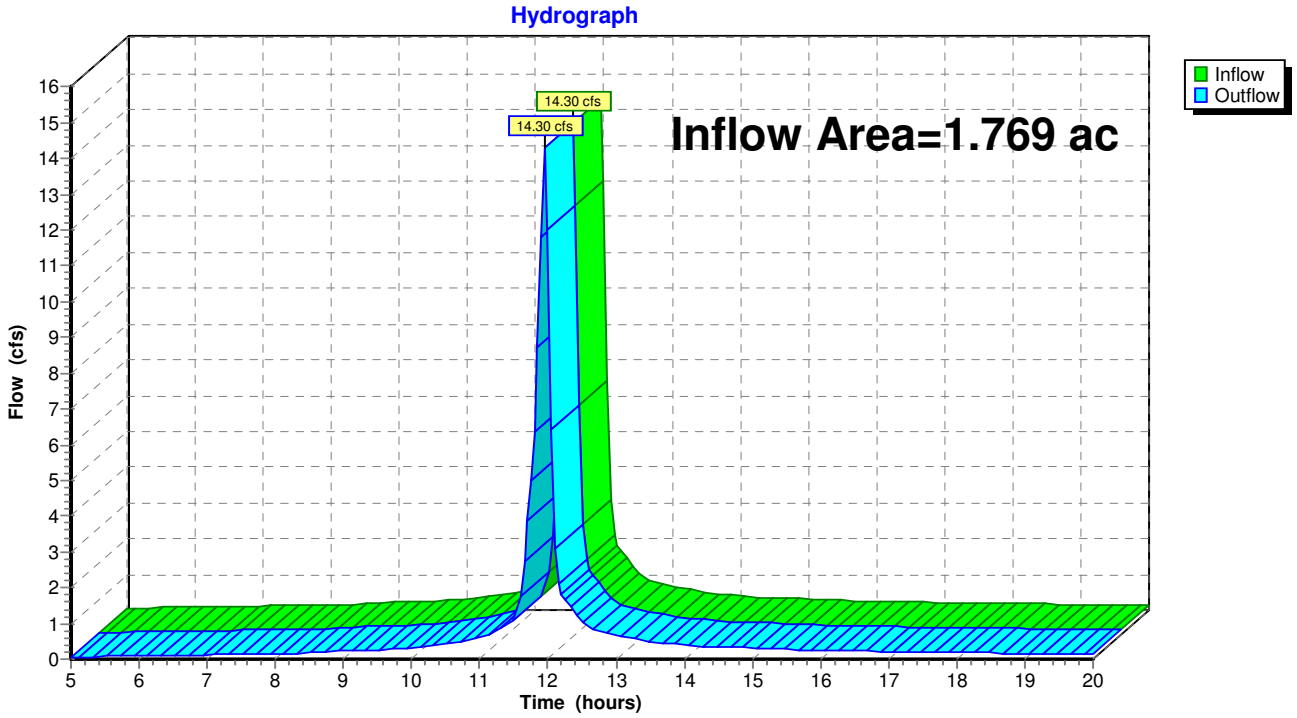
## Summary for Reach 6R: N Sunwood Catch Basin

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

Inflow Area = 1.769 ac, 85.16% Impervious, Inflow Depth > 4.69" for 100-yr event
Inflow = 14.30 cfs @ 11.95 hrs, Volume= 0.691 af
Outflow = 14.30 cfs @ 11.95 hrs, Volume= 0.691 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 6R: N Sunwood Catch Basin



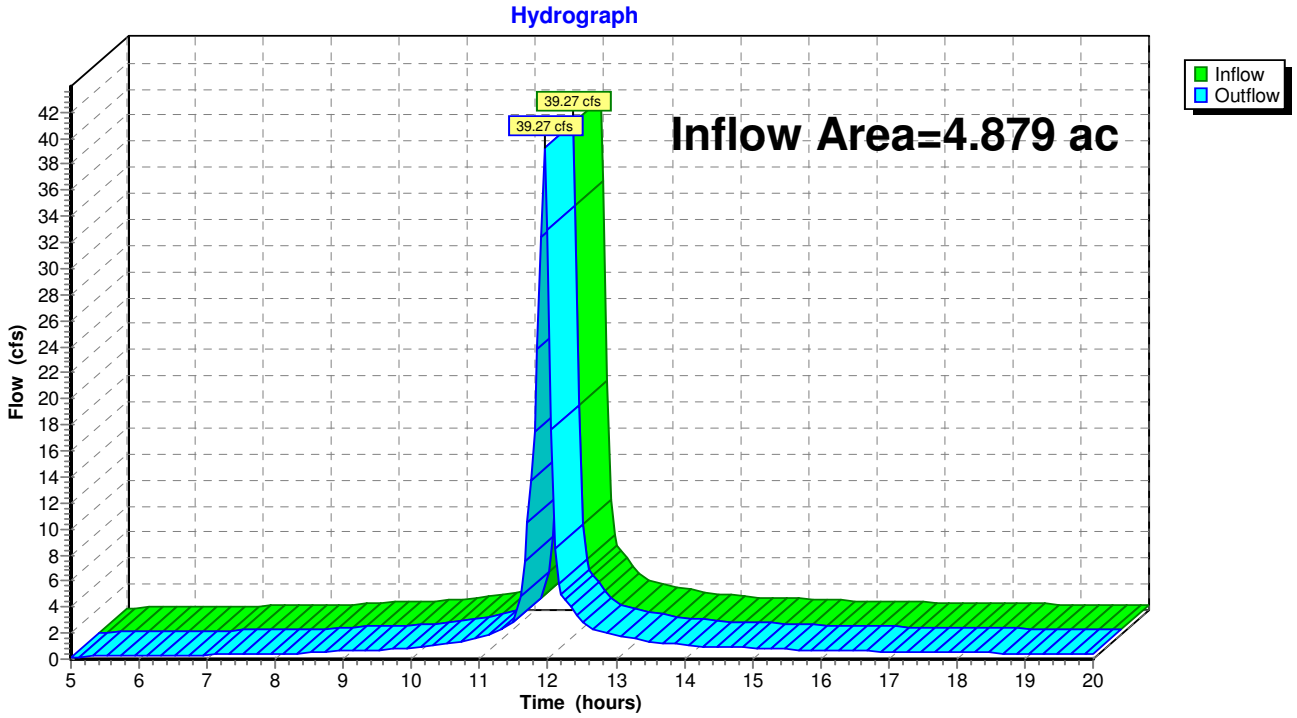
## Summary for Reach 7R: Total Site

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

Inflow Area = 4.879 ac, 84.76% Impervious, Inflow Depth > 4.67" for 100-yr event
Inflow = 39.27 cfs @ 11.95 hrs, Volume= 1.897 af
Outflow = 39.27 cfs @ 11.95 hrs, Volume= 1.897 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

### Reach 7R: Total Site



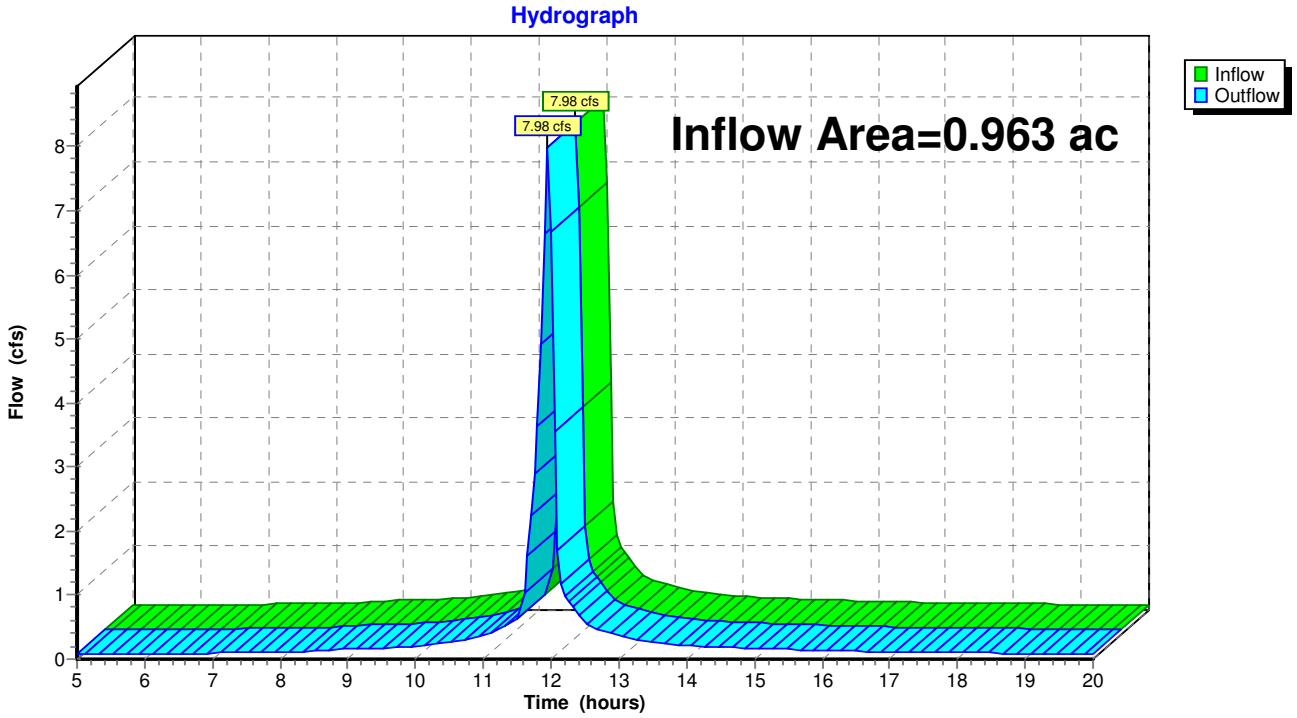
## Summary for Reach 9R: NE Sunwood Catch Basin

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

Inflow Area = 0.963 ac, 94.99% Impervious, Inflow Depth > 5.00" for 100-yr event
Inflow = 7.98 cfs @ 11.95 hrs, Volume= 0.402 af
Outflow = 7.98 cfs @ 11.95 hrs, Volume= 0.402 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs

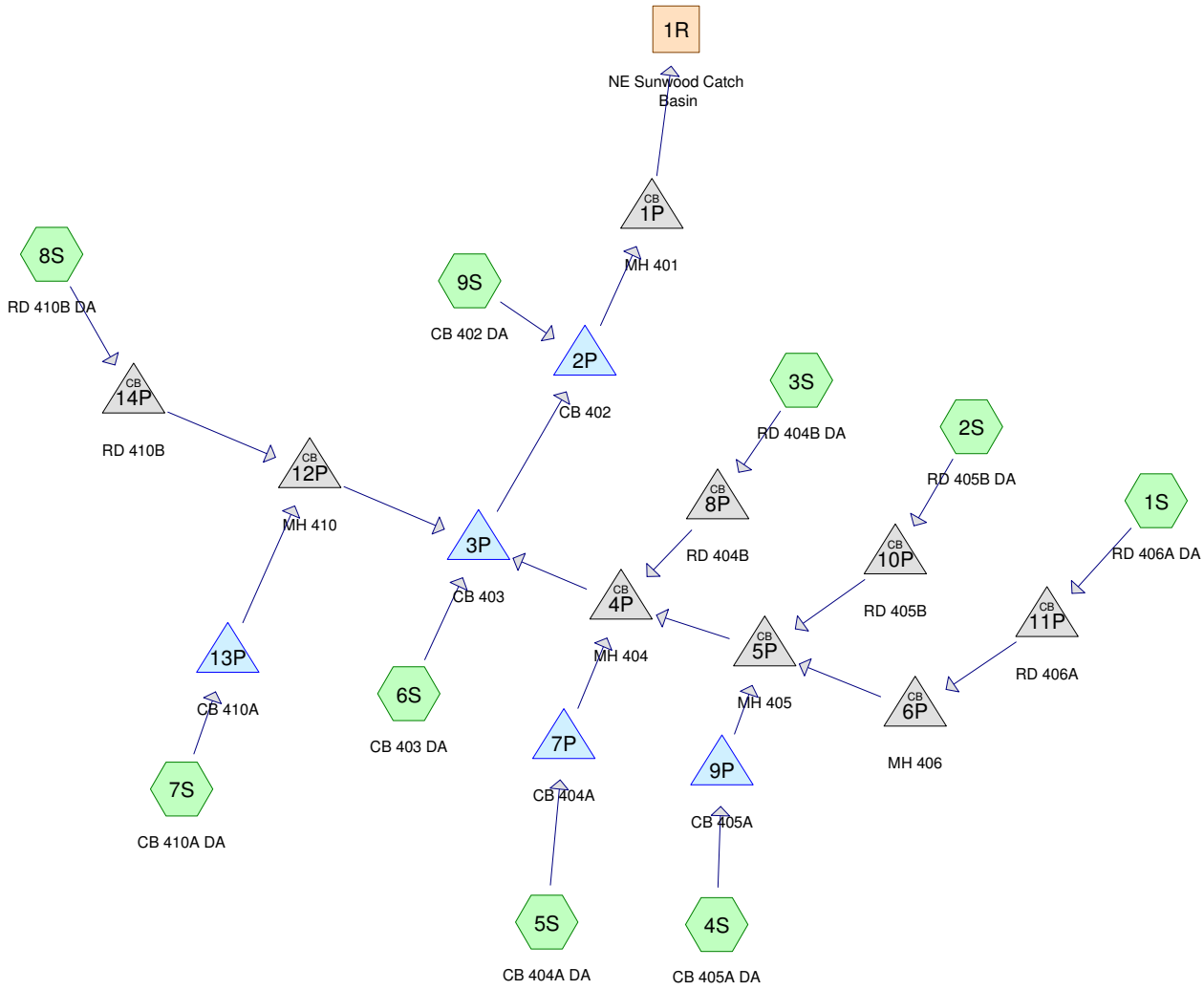
### Reach 9R: NE Sunwood Catch Basin



# APPENDIX E

# ALLEYWAY HYDROCAD MODEL

LANDFORM
From Site to Finish




**Drainage Diagram for UWA10002 - Alley Ponding**

Prepared by {enter your company name here}, Printed 12/1/2010

## Area Listing (all nodes)

| Area (acres) | CN | Description (subcatchment-numbers) |
|---|---|---|
| **0.880** | 98 | Paved parking, HSG C (1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S) |
| 0.880 | | **TOTAL AREA** |

## Soil Listing (all nodes)

| Area (acres) | Soil Group | Subcatchment Numbers |
|---|---|---|
| 0.000 | HSG A | |
| 0.000 | HSG B | |
| **0.880** | HSG C | 1S, 2S, 3S, 4S, 5S, 6S, 7S, 8S, 9S |
| 0.000 | HSG D | |
| 0.000 | Other | |
| 0.880 | | **TOTAL AREA** |

## Pipe Listing (all nodes)

| Line# | Node Number | In-Invert (feet) | Out-Invert (feet) | Length (feet) | Slope (ft/ft) | n | Diam/Width (inches) | Height (inches) | Fill (inches) |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 1P | 864.31 | 864.10 | 26.0 | 0.0081 | 0.013 | 15.0 | 0.0 | 7.5 |
| 2 | 2P | 864.50 | 864.31 | 24.0 | 0.0079 | 0.013 | 15.0 | 0.0 | 0.0 |
| 3 | 3P | 864.81 | 864.50 | 39.0 | 0.0079 | 0.013 | 15.0 | 0.0 | 0.0 |
| 4 | 4P | 865.31 | 865.01 | 37.0 | 0.0081 | 0.013 | 12.0 | 0.0 | 0.0 |
| 5 | 5P | 865.68 | 865.31 | 75.0 | 0.0049 | 0.013 | 12.0 | 0.0 | 0.0 |
| 6 | 6P | 866.16 | 865.68 | 96.0 | 0.0050 | 0.013 | 12.0 | 0.0 | 0.0 |
| 7 | 7P | 865.42 | 865.31 | 11.0 | 0.0100 | 0.013 | 12.0 | 0.0 | 0.0 |
| 8 | 8P | 866.50 | 866.31 | 19.0 | 0.0100 | 0.010 | 8.0 | 0.0 | 0.0 |
| 9 | 9P | 865.79 | 865.68 | 11.0 | 0.0100 | 0.013 | 12.0 | 0.0 | 0.0 |
| 10 | 10P | 866.84 | 866.68 | 16.0 | 0.0100 | 0.010 | 8.0 | 0.0 | 0.0 |
| 11 | 11P | 866.24 | 866.16 | 16.0 | 0.0050 | 0.010 | 12.0 | 0.0 | 0.0 |
| 12 | 12P | 865.33 | 865.01 | 32.0 | 0.0100 | 0.013 | 12.0 | 0.0 | 0.0 |
| 13 | 13P | 865.48 | 865.33 | 15.0 | 0.0100 | 0.013 | 12.0 | 0.0 | 0.0 |
| 14 | 14P | 865.89 | 865.33 | 56.0 | 0.0100 | 0.010 | 12.0 | 0.0 | 0.0 |

Time span=5.00-20.00 hrs, dt=0.01 hrs, 1501 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

**Subcatchment 1S: RD 406A DA** Runoff Area=6,695 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=1.33 cfs 0.066 af

**Subcatchment 2S: RD 405B DA** Runoff Area=3,189 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.64 cfs 0.032 af

**Subcatchment 3S: RD 404B DA** Runoff Area=3,250 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.65 cfs 0.032 af

**Subcatchment 4S: CB 405A DA** Runoff Area=4,701 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.94 cfs 0.047 af

**Subcatchment 5S: CB 404A DA** Runoff Area=1,295 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.26 cfs 0.013 af

**Subcatchment 6S: CB 403 DA** Runoff Area=1,569 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.31 cfs 0.016 af

**Subcatchment 7S: CB 410A DA** Runoff Area=2,119 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.42 cfs 0.021 af

**Subcatchment 8S: RD 410B DA** Runoff Area=12,918 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=2.57 cfs 0.128 af

**Subcatchment 9S: CB 402 DA** Runoff Area=2,595 sf 100.00% Impervious Runoff Depth>5.18"
Tc=5.0 min CN=98 Runoff=0.52 cfs 0.026 af

**Reach 1R: NE Sunwood Catch Basin** Inflow=8.74 cfs 0.376 af
Outflow=8.74 cfs 0.376 af

**Pond 1P: MH 401** Peak Elev=873.94' Inflow=8.74 cfs 0.376 af
15.0" Round Culvert w/ 7.5" fill n=0.013 L=26.0' S=0.0081 '/' Outflow=8.74 cfs 0.376 af

**Pond 2P: CB 402** Peak Elev=868.91' Storage=170 cf Inflow=5.08 cfs 0.378 af
Outflow=8.74 cfs 0.376 af

**Pond 3P: CB 403** Peak Elev=869.34' Storage=604 cf Inflow=5.50 cfs 0.353 af
Outflow=4.59 cfs 0.352 af

**Pond 4P: MH 404** Peak Elev=869.73' Inflow=2.84 cfs 0.189 af
12.0" Round Culvert n=0.013 L=37.0' S=0.0081 '/' Outflow=2.84 cfs 0.189 af

**Pond 5P: MH 405** Peak Elev=870.08' Inflow=2.76 cfs 0.144 af
12.0" Round Culvert n=0.013 L=75.0' S=0.0049 '/' Outflow=2.76 cfs 0.144 af

**Pond 6P: MH 406** Peak Elev=870.25' Inflow=1.34 cfs 0.066 af
12.0" Round Culvert n=0.013 L=96.0' S=0.0050 '/' Outflow=1.34 cfs 0.066 af

**Pond 7P: CB 404A** Peak Elev=869.44' Storage=178 cf Inflow=0.26 cfs 0.013 af
Outflow=1.20 cfs 0.013 af

**Pond 8P: RD 404B** Peak Elev=869.87' Inflow=0.65 cfs 0.032 af
8.0" Round Culvert n=0.010 L=19.0' S=0.0100 '/' Outflow=0.65 cfs 0.032 af

**Pond 9P: CB 405A** Peak Elev=869.63' Storage=616 cf Inflow=0.94 cfs 0.047 af
Outflow=2.55 cfs 0.046 af

**Pond 10P: RD 405B** Peak Elev=870.20' Inflow=0.64 cfs 0.032 af
8.0" Round Culvert n=0.010 L=16.0' S=0.0100 '/' Outflow=0.64 cfs 0.032 af

**Pond 11P: RD 406A** Peak Elev=870.36' Inflow=1.33 cfs 0.066 af
12.0" Round Culvert n=0.010 L=16.0' S=0.0050 '/' Outflow=1.34 cfs 0.066 af

**Pond 12P: MH 410** Peak Elev=869.72' Inflow=2.57 cfs 0.149 af
12.0" Round Culvert n=0.013 L=32.0' S=0.0100 '/' Outflow=2.57 cfs 0.149 af

**Pond 13P: CB 410A** Peak Elev=869.38' Storage=272 cf Inflow=0.42 cfs 0.021 af
Outflow=1.35 cfs 0.021 af

**Pond 14P: RD 410B** Peak Elev=870.14' Inflow=2.57 cfs 0.128 af
12.0" Round Culvert n=0.010 L=56.0' S=0.0100 '/' Outflow=2.57 cfs 0.128 af

**Total Runoff Area = 0.880 ac Runoff Volume = 0.380 af Average Runoff Depth = 5.18"**
**0.00% Pervious = 0.000 ac 100.00% Impervious = 0.880 ac**

## Summary for Subcatchment 1S: RD 406A DA

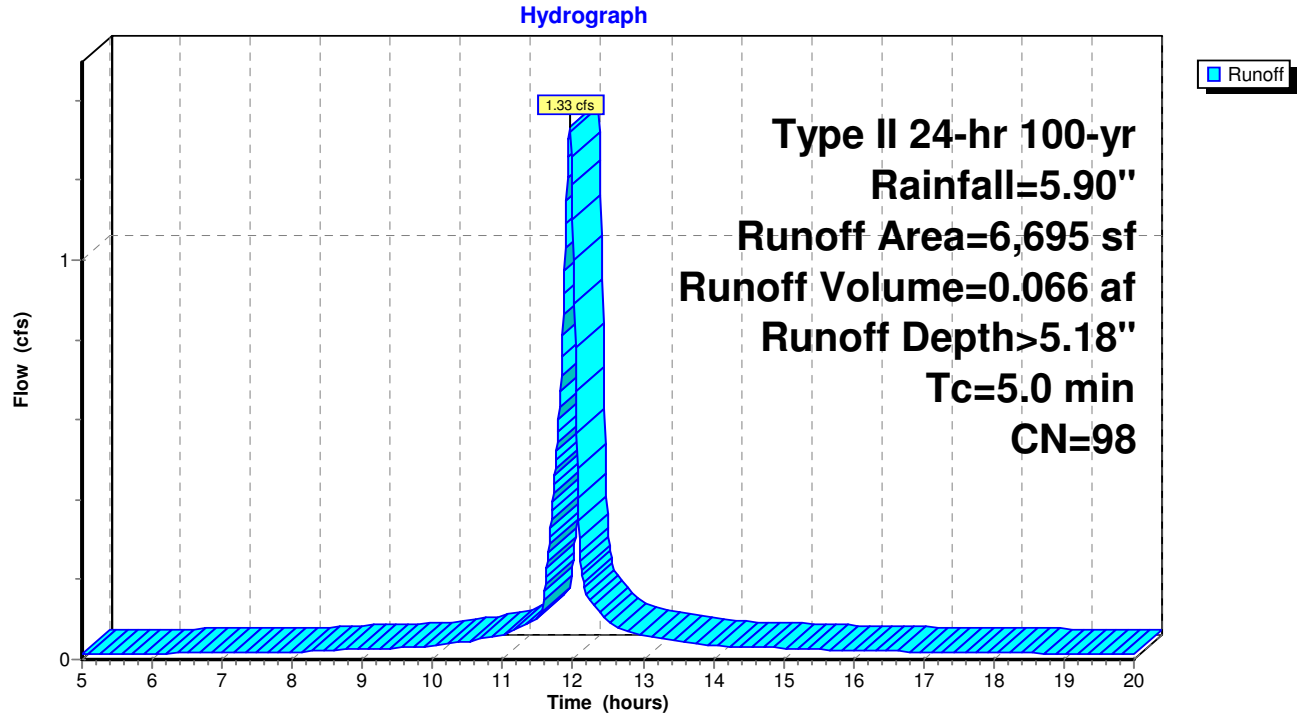
Runoff = 1.33 cfs @ 11.96 hrs, Volume= 0.066 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 6,695 | 98 | Paved parking, HSG C |
| 6,695 | | 100.00% Impervious Area |

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

## Subcatchment 1S: RD 406A DA



## Summary for Subcatchment 2S: RD 405B DA

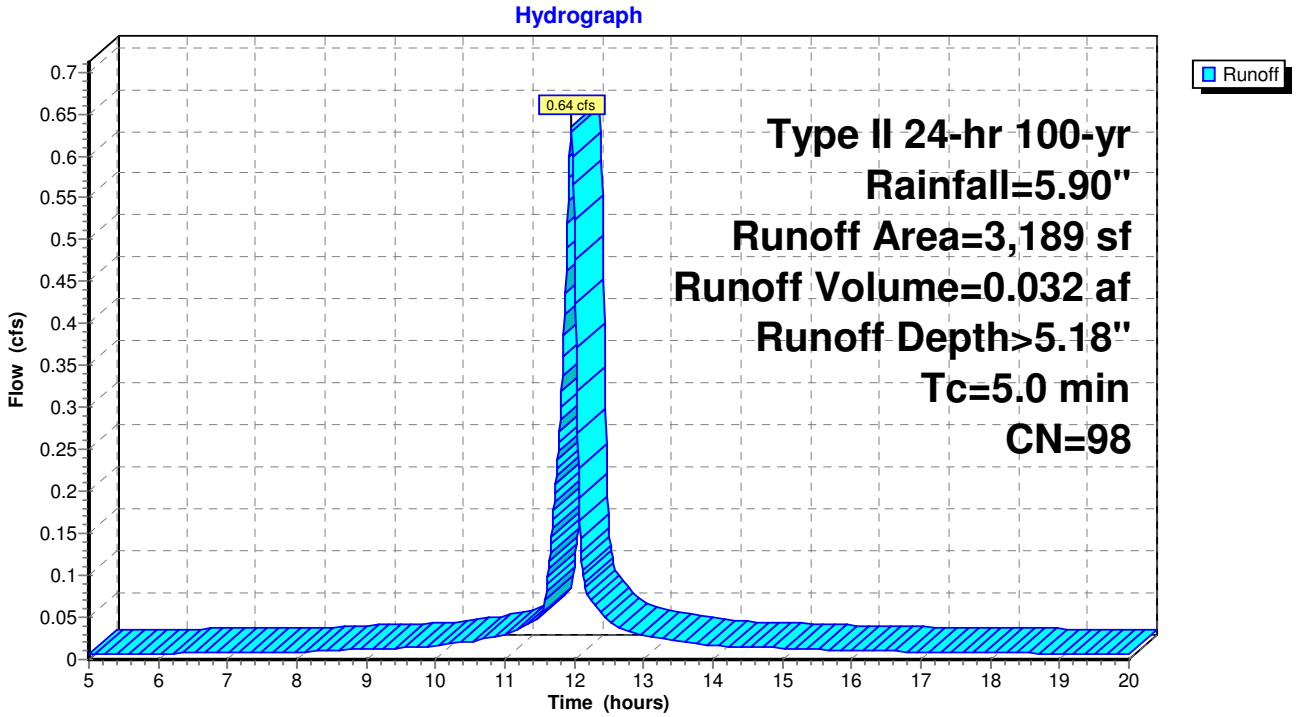
Runoff = 0.64 cfs @ 11.96 hrs, Volume= 0.032 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 3,189 | 98 | Paved parking, HSG C |
| 3,189 | | 100.00% Impervious Area |

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

## Subcatchment 2S: RD 405B DA



## Summary for Subcatchment 3S: RD 404B DA

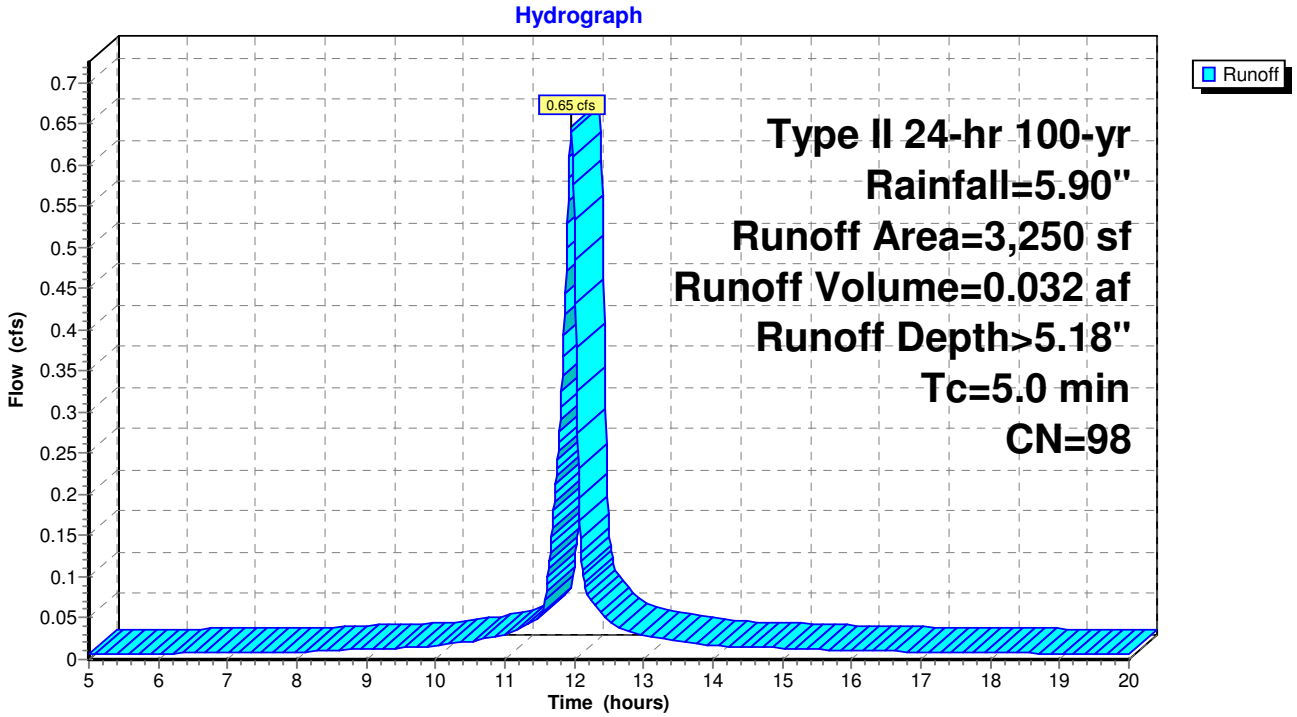
Runoff = 0.65 cfs @ 11.96 hrs, Volume= 0.032 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 3,250 | 98 | Paved parking, HSG C |
| 3,250 | | 100.00% Impervious Area |

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

## Subcatchment 3S: RD 404B DA



## Summary for Subcatchment 4S: CB 405A DA

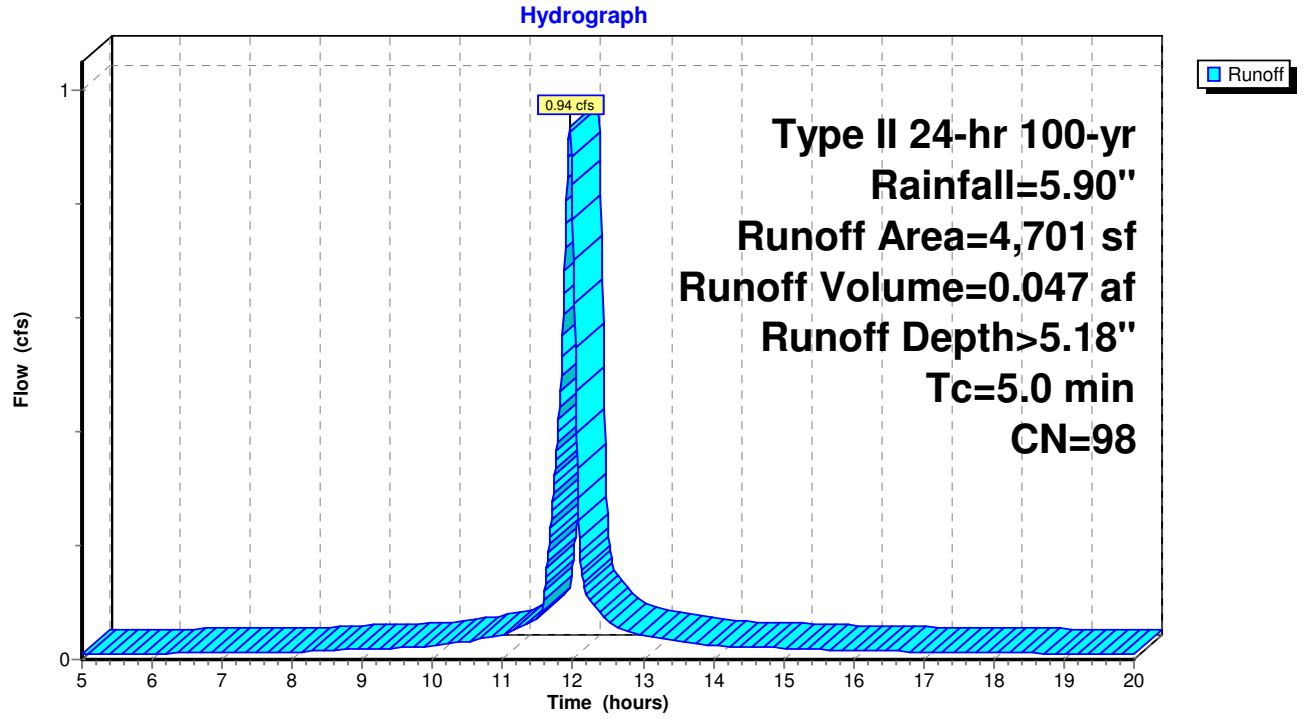
Runoff = 0.94 cfs @ 11.96 hrs, Volume= 0.047 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 4,701 | 98 | Paved parking, HSG C |
| 4,701 | | 100.00% Impervious Area |

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

## Subcatchment 4S: CB 405A DA



## Summary for Subcatchment 5S: CB 404A DA

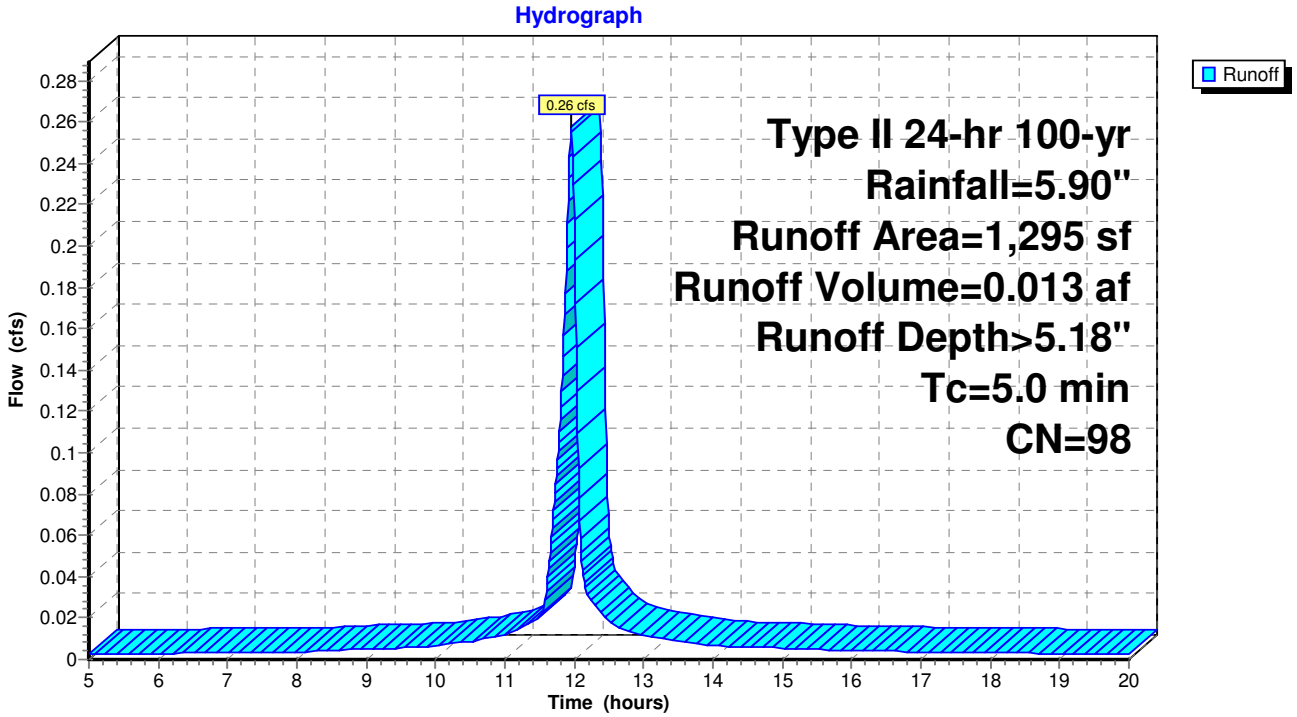
Runoff = 0.26 cfs @ 11.96 hrs, Volume= 0.013 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 1,295 | 98 | Paved parking, HSG C |
| 1,295 | | 100.00% Impervious Area |

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

## Subcatchment 5S: CB 404A DA



## Summary for Subcatchment 6S: CB 403 DA

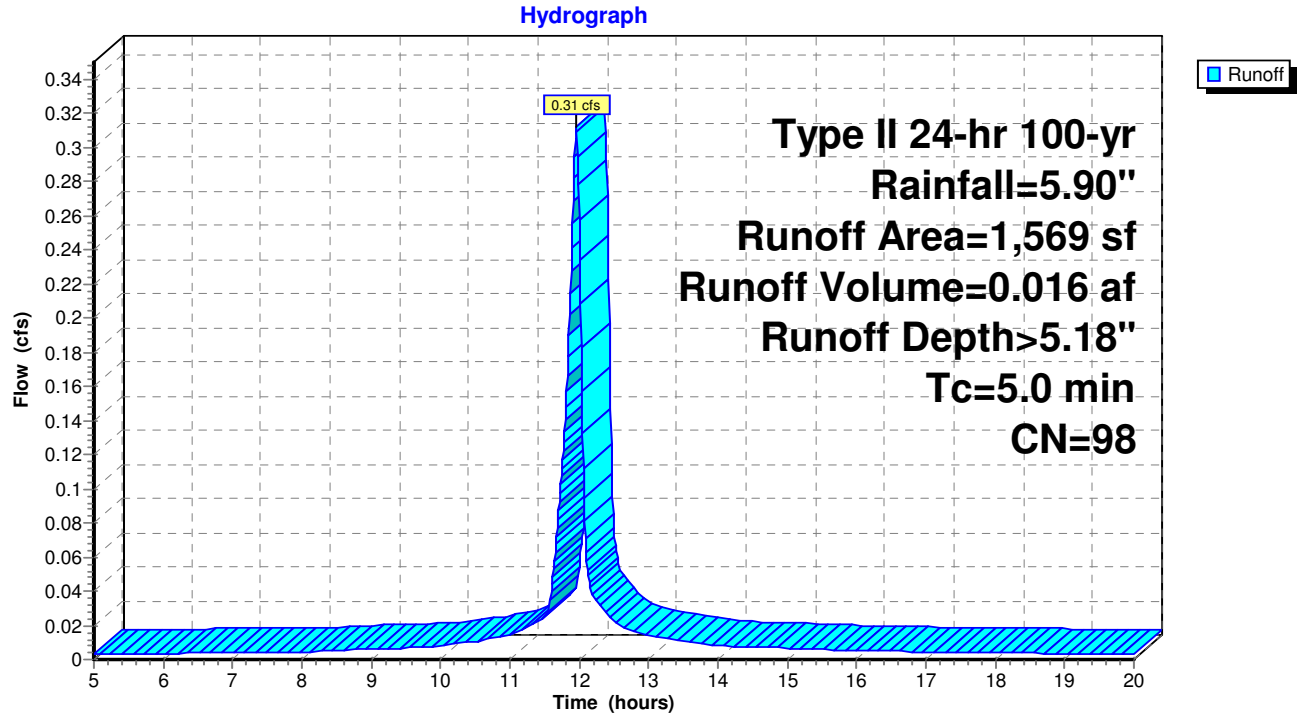
Runoff = 0.31 cfs @ 11.96 hrs, Volume= 0.016 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 1,569 | 98 | Paved parking, HSG C |
| 1,569 | | 100.00% Impervious Area |

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

## Subcatchment 6S: CB 403 DA



## Summary for Subcatchment 7S: CB 410A DA

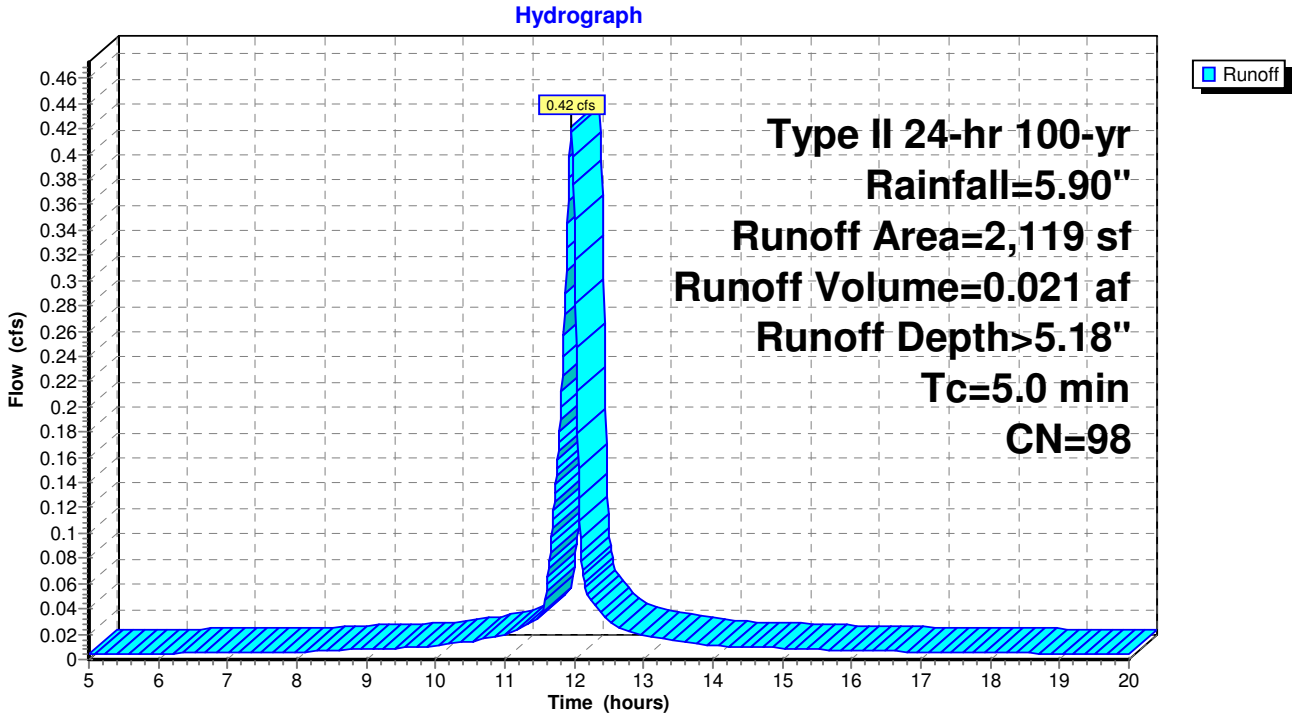
Runoff = 0.42 cfs @ 11.96 hrs, Volume= 0.021 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 2,119 | 98 | Paved parking, HSG C |
| 2,119 | | 100.00% Impervious Area |

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

## Subcatchment 7S: CB 410A DA



## Summary for Subcatchment 8S: RD 410B DA

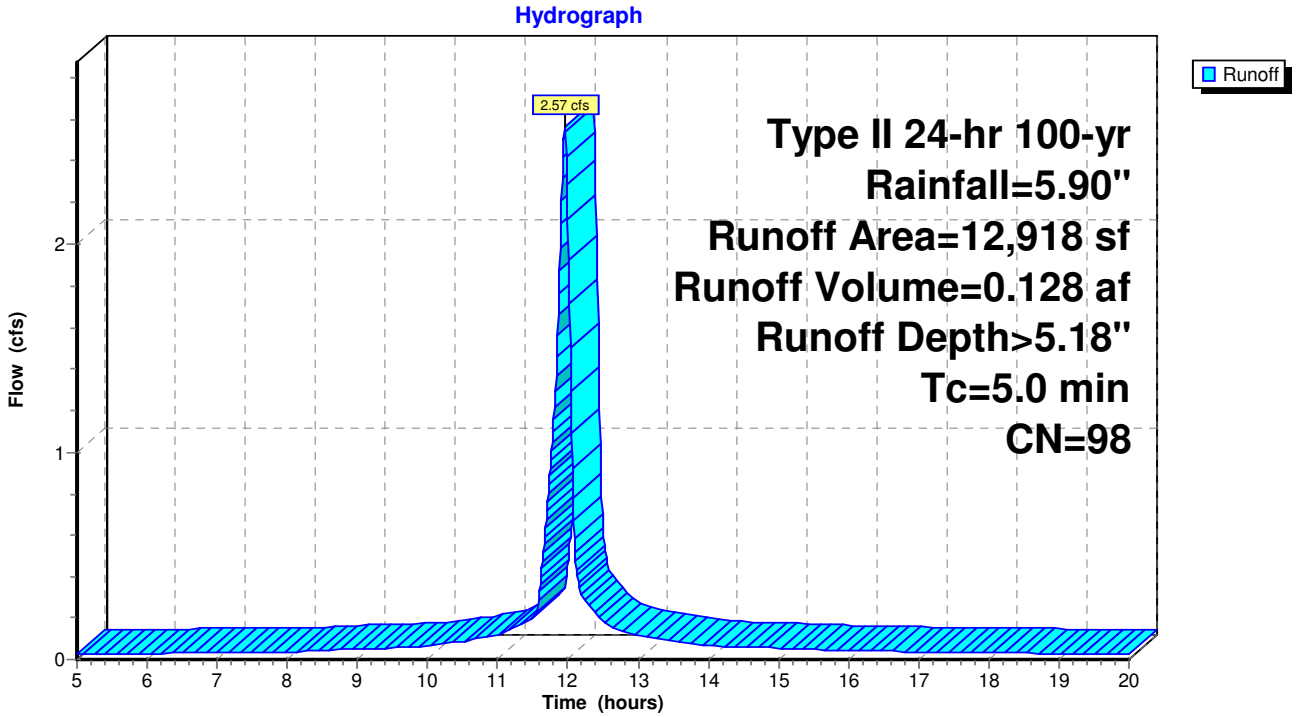
Runoff = 2.57 cfs @ 11.96 hrs, Volume= 0.128 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 12,918 | 98 | Paved parking, HSG C |
| 12,918 | | 100.00% Impervious Area |

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

## Subcatchment 8S: RD 410B DA



## Summary for Subcatchment 9S: CB 402 DA

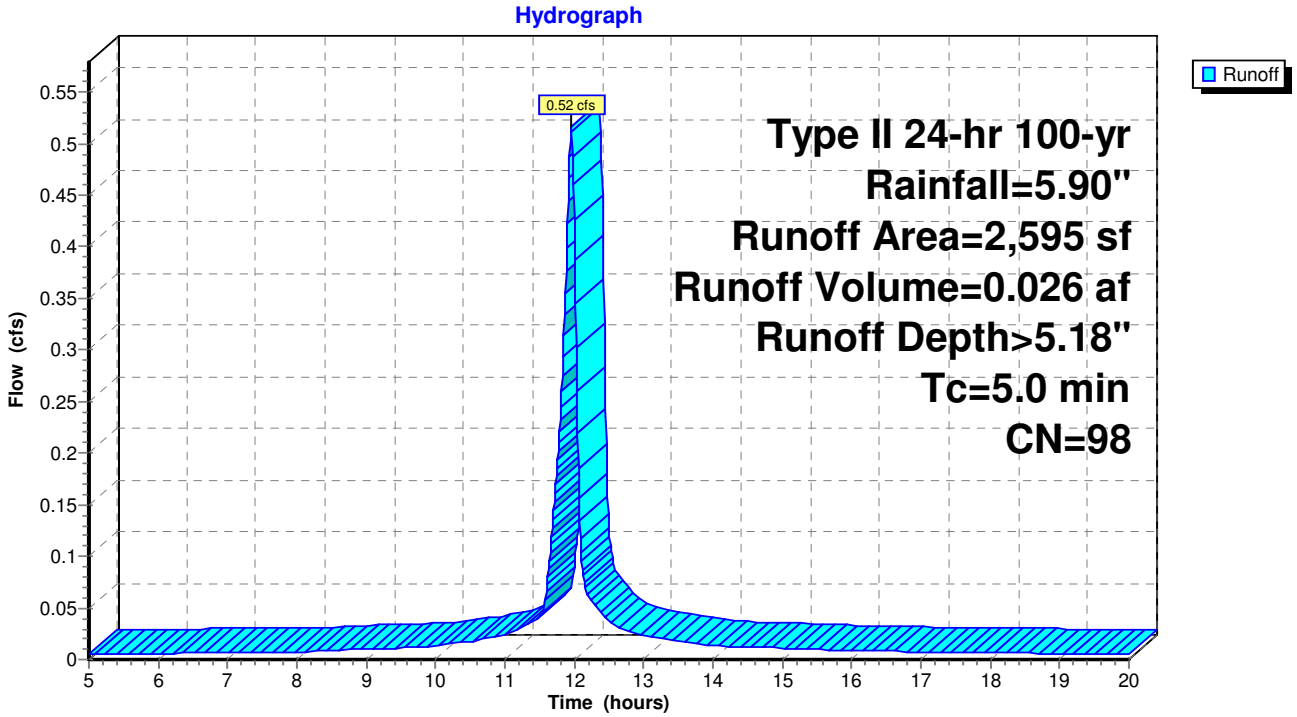
Runoff = 0.52 cfs @ 11.96 hrs, Volume= 0.026 af, Depth> 5.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Type II 24-hr 100-yr Rainfall=5.90"

| Area (sf) | CN | Description |
|---|---|---|
| 2,595 | 98 | Paved parking, HSG C |
| 2,595 | | 100.00% Impervious Area |

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

## Subcatchment 9S: CB 402 DA



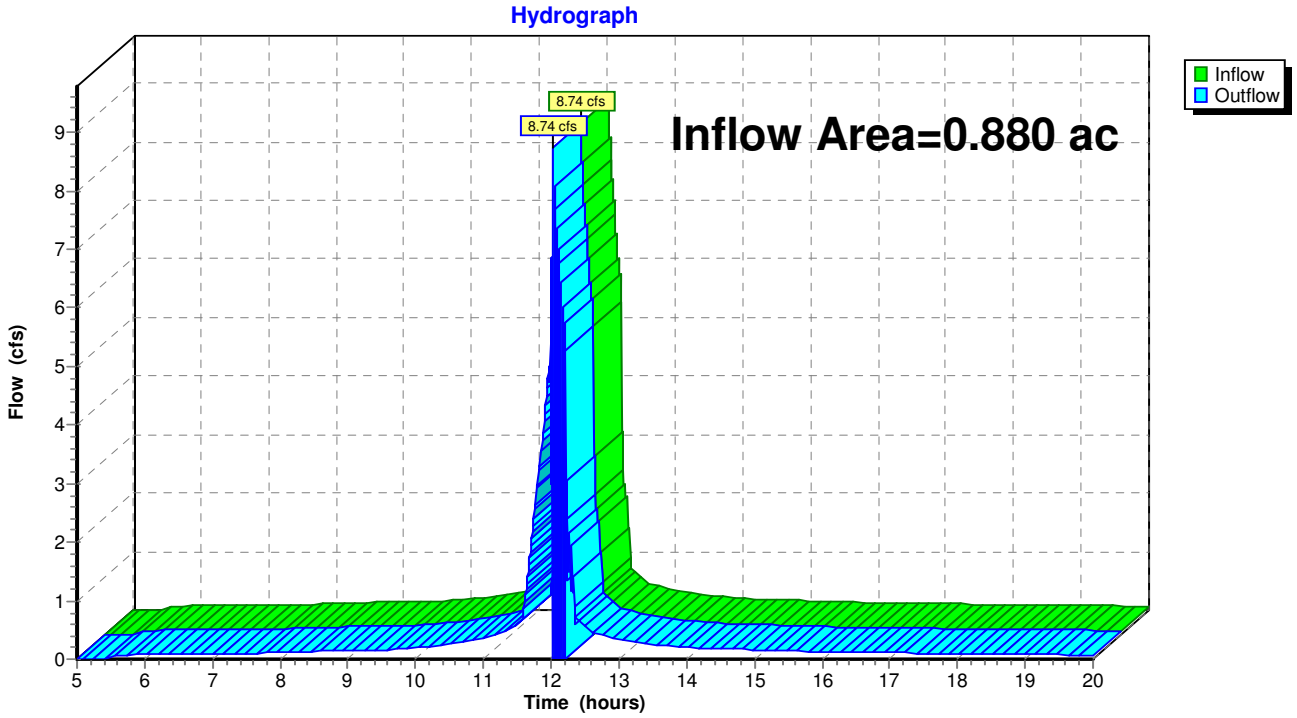
## Summary for Reach 1R: NE Sunwood Catch Basin

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

Inflow Area = 0.880 ac,100.00% Impervious, Inflow Depth > 5.13" for 100-yr event
Inflow = 8.74 cfs @ 12.03 hrs, Volume= 0.376 af
Outflow = 8.74 cfs @ 12.03 hrs, Volume= 0.376 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs

### Reach 1R: NE Sunwood Catch Basin



## Summary for Pond 1P: MH 401

[57] Hint: Peaked at 873.94' (Flood elevation advised)
[80] Warning: Exceeded Pond 2P by 5.05' @ 12.03 hrs (13.27 cfs 0.068 af)

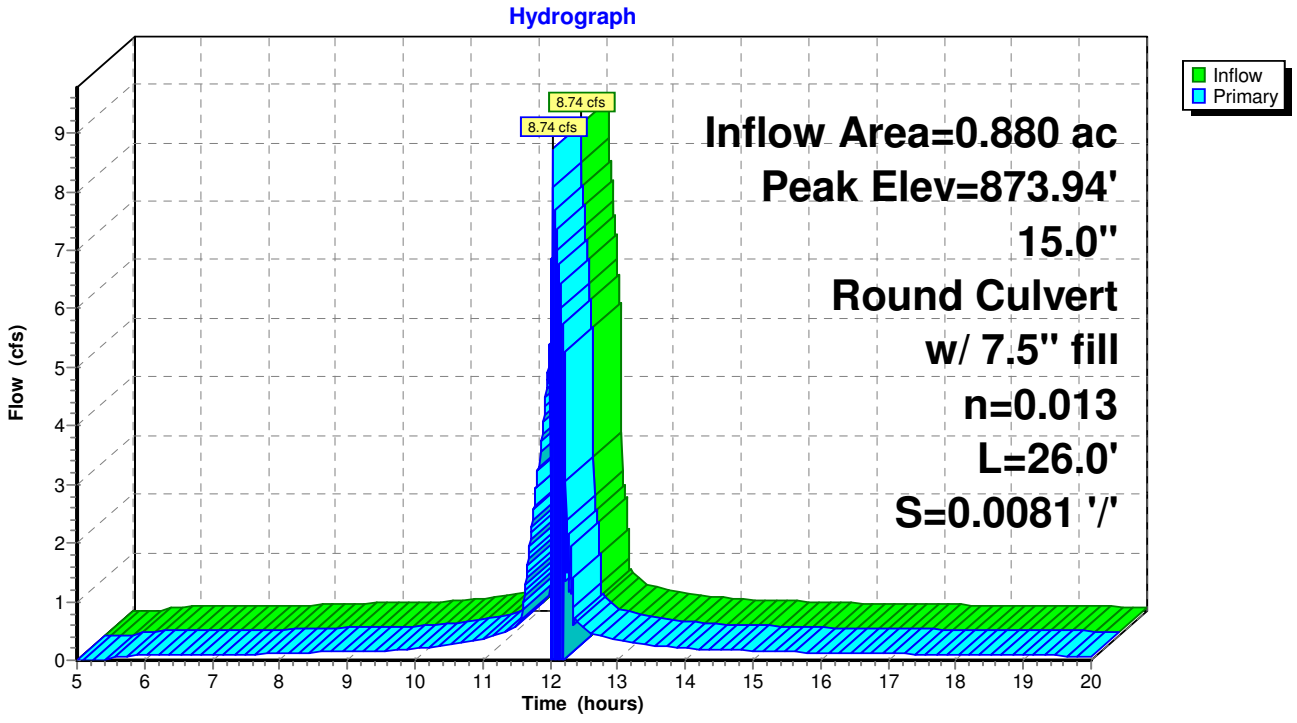
| | | | | |
|---|---|---|---|---|
| Inflow Area = | 0.880 ac,100.00% Impervious, | Inflow Depth > | 5.13" | for 100-yr event |
| Inflow = | 8.74 cfs @ 12.03 hrs, | Volume= | 0.376 af | |
| Outflow = | 8.74 cfs @ 12.03 hrs, | Volume= | 0.376 af, | Atten= 0%, Lag= 0.0 min |
| Primary = | 8.74 cfs @ 12.03 hrs, | Volume= | 0.376 af | |

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 873.94' @ 12.03 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 864.94' | **15.0" Round Culvert w/ 7.5" fill**<br>L= 26.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 864.31' / 864.10' S= 0.0081 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |

**Primary OutFlow** Max=8.74 cfs @ 12.03 hrs HW=873.94' TW=0.00' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 8.74 cfs @ 14.24 fps)

## Pond 1P: MH 401



## Summary for Pond 2P: CB 402

[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.880 ac,100.00% Impervious, Inflow Depth > 5.15" for 100-yr event
Inflow = 5.08 cfs @ 11.98 hrs, Volume= 0.378 af
Outflow = 8.74 cfs @ 12.03 hrs, Volume= 0.376 af, Atten= 0%, Lag= 3.0 min
Primary = 8.74 cfs @ 12.03 hrs, Volume= 0.376 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 868.91' @ 12.02 hrs Surf.Area= 598 sf Storage= 170 cf

Plug-Flow detention time= 2.8 min calculated for 0.376 af (100% of inflow)
Center-of-Mass det. time= 1.4 min ( 733.6 - 732.2 )

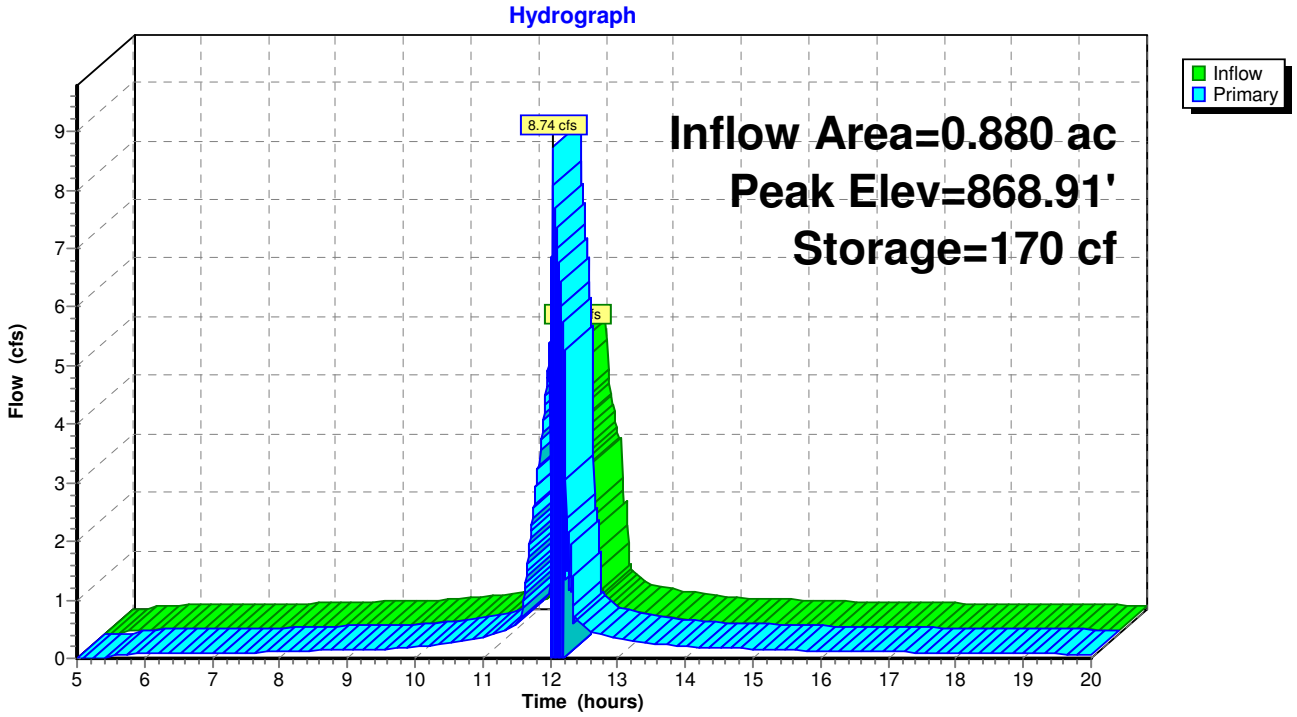
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 864.50' | 233 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 864.50 | 13 | 0 | 0 |
| 868.33 | 13 | 50 | 50 |
| 868.64 | 133 | 23 | 72 |
| 869.00 | 760 | 161 | 233 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 864.50' | **15.0" Round Culvert**<br>L= 24.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 864.50' / 864.31' S= 0.0079 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |
| #2 | Device 1 | 868.33' | **24.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 12.03 hrs HW=868.90' TW=873.94' (Dynamic Tailwater)
↑—**1=Culvert** ( Controls 0.00 cfs)
↑—**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 2P: CB 402



## Summary for Pond 3P: CB 403

[82] Warning: Early inflow requires earlier time span
[80] Warning: Exceeded Pond 4P by 0.15' @ 5.25 hrs (1.45 cfs 0.023 af)
[80] Warning: Exceeded Pond 12P by 0.15' @ 5.25 hrs (1.45 cfs 0.025 af)

Inflow Area = 0.820 ac,100.00% Impervious, Inflow Depth > 5.16" for 100-yr event
Inflow = 5.50 cfs @ 11.96 hrs, Volume= 0.353 af
Outflow = 4.59 cfs @ 11.98 hrs, Volume= 0.352 af, Atten= 17%, Lag= 1.5 min
Primary = 4.59 cfs @ 11.98 hrs, Volume= 0.352 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.34' @ 12.00 hrs Surf.Area= 1,238 sf Storage= 604 cf

Plug-Flow detention time= 3.5 min calculated for 0.352 af (100% of inflow)
Center-of-Mass det. time= 2.0 min ( 732.5 - 730.5 )

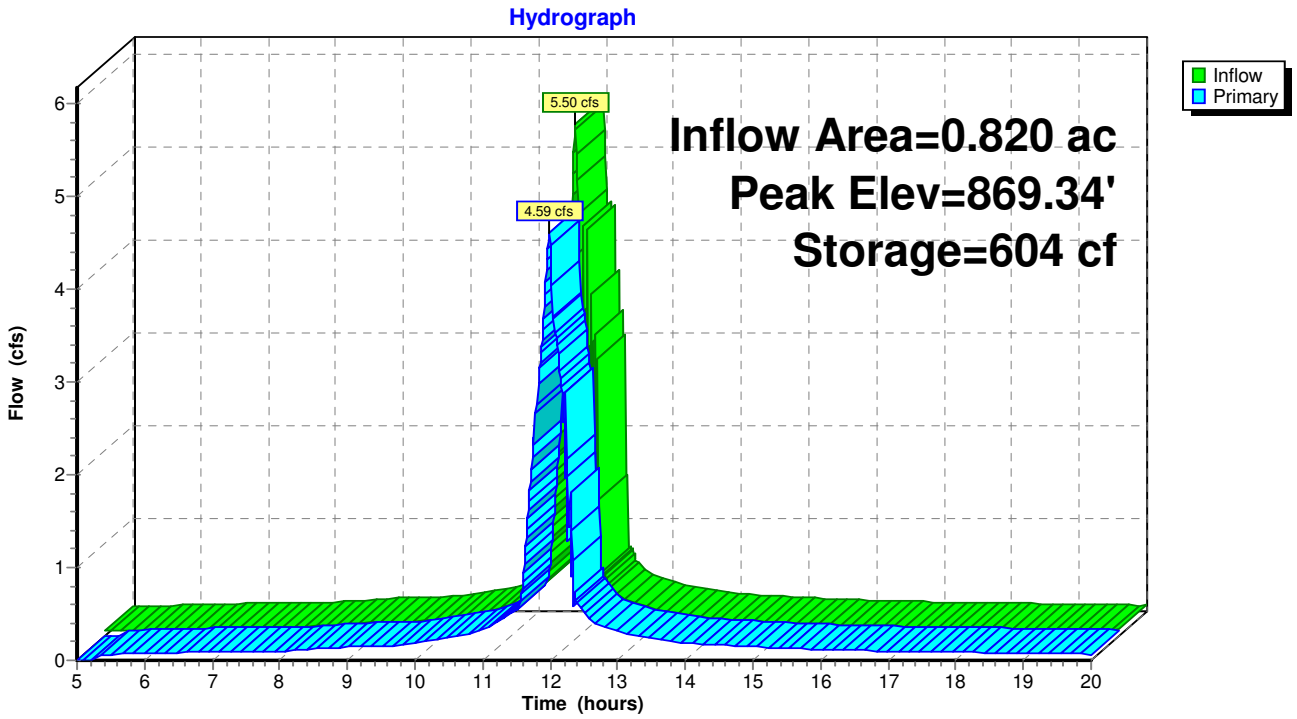
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 864.81' | 1,488 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 864.81 | 13 | 0 | 0 |
| 868.55 | 13 | 49 | 49 |
| 869.00 | 861 | 197 | 245 |
| 869.40 | 1,303 | 433 | 678 |
| 870.00 | 1,397 | 810 | 1,488 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 864.81' | **15.0" Round Culvert**<br>L= 39.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 864.81' / 864.50' S= 0.0079 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |
| #2 | Device 1 | 868.55' | **24.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=4.50 cfs @ 11.98 hrs HW=869.32' TW=868.74' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 4.50 cfs @ 3.67 fps)
└**2=Orifice/Grate** (Passes 4.50 cfs of 11.52 cfs potential flow)

## Pond 3P: CB 403



## Summary for Pond 4P: MH 404

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 869.73' (Flood elevation advised)
[80] Warning: Exceeded Pond 5P by 0.15' @ 5.26 hrs (1.23 cfs 0.022 af)
[80] Warning: Exceeded Pond 7P by 0.72' @ 12.26 hrs (3.21 cfs 0.065 af)
[80] Warning: Exceeded Pond 8P by 0.45' @ 12.26 hrs (1.13 cfs 0.036 af)

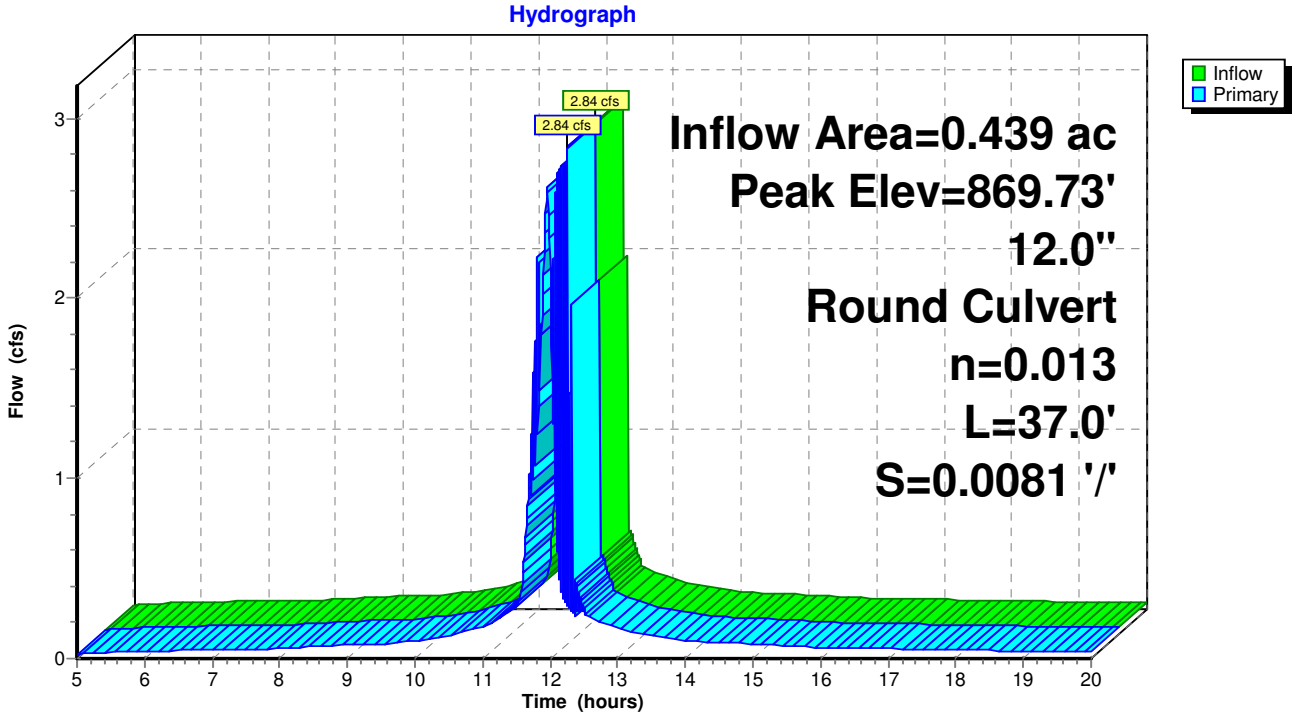
Inflow Area = 0.439 ac,100.00% Impervious, Inflow Depth > 5.16" for 100-yr event
Inflow = 2.84 cfs @ 12.26 hrs, Volume= 0.189 af
Outflow = 2.84 cfs @ 12.26 hrs, Volume= 0.189 af, Atten= 0%, Lag= 0.0 min
Primary = 2.84 cfs @ 12.26 hrs, Volume= 0.189 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.73' @ 11.97 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.31' | **12.0" Round Culvert**<br>L= 37.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.31' / 865.01' S= 0.0081 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |

**Primary OutFlow** Max=2.65 cfs @ 12.26 hrs HW=869.25' TW=868.76' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 2.65 cfs @ 3.38 fps)

## Pond 4P: MH 404



## Summary for Pond 5P: MH 405

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 870.08' (Flood elevation advised)
[80] Warning: Exceeded Pond 6P by 0.78' @ 12.11 hrs (2.63 cfs 0.042 af)
[80] Warning: Exceeded Pond 9P by 1.88' @ 12.33 hrs (3.70 cfs 0.073 af)
[80] Warning: Exceeded Pond 10P by 0.79' @ 12.11 hrs (1.49 cfs 0.027 af)

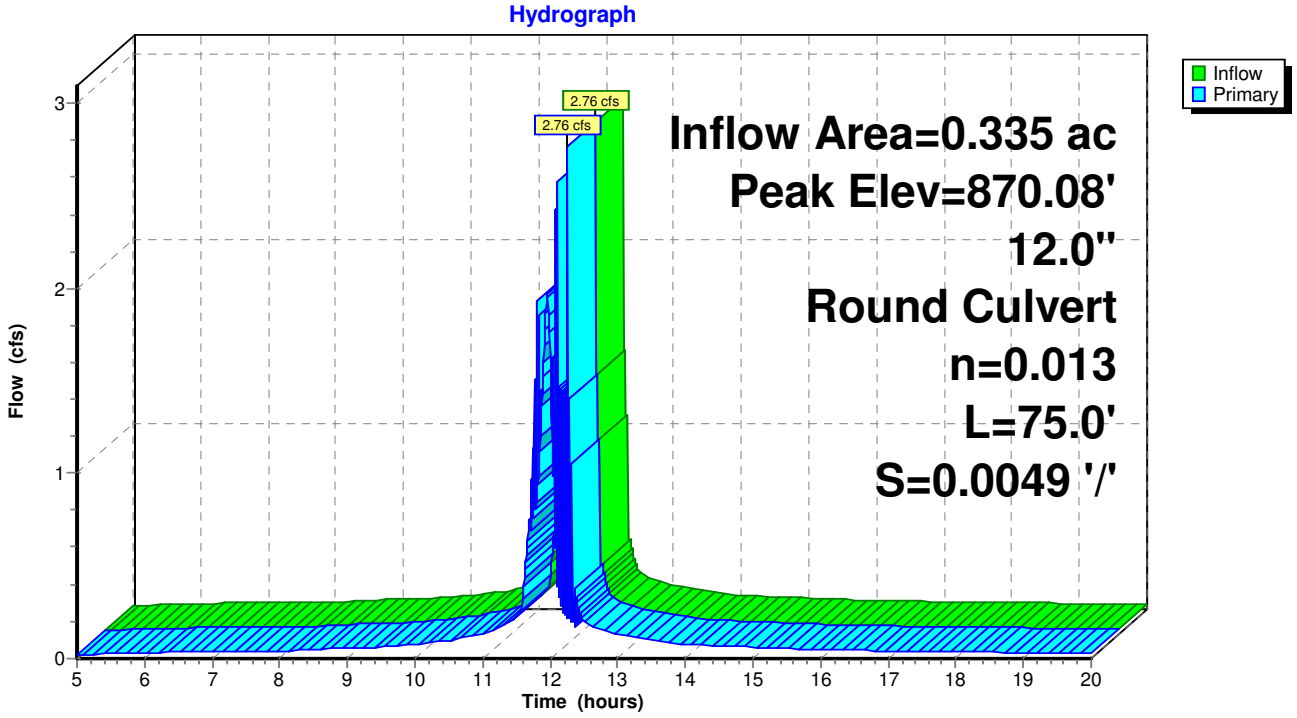
Inflow Area = 0.335 ac,100.00% Impervious, Inflow Depth > 5.17" for 100-yr event
Inflow = 2.76 cfs @ 12.26 hrs, Volume= 0.144 af
Outflow = 2.76 cfs @ 12.26 hrs, Volume= 0.144 af, Atten= 0%, Lag= 0.0 min
Primary = 2.76 cfs @ 12.26 hrs, Volume= 0.144 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 870.08' @ 11.97 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.68' | **12.0" Round Culvert**<br>L= 75.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.68' / 865.31' S= 0.0049 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |

**Primary OutFlow** Max=1.73 cfs @ 12.26 hrs HW=869.56' TW=869.27' (Dynamic Tailwater)
↳**1=Culvert** (Outlet Controls 1.73 cfs @ 2.20 fps)

### Pond 5P: MH 405



## Summary for Pond 6P: MH 406

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 870.25' (Flood elevation advised)
[80] Warning: Exceeded Pond 11P by 0.79' @ 12.12 hrs (3.35 cfs 0.063 af)

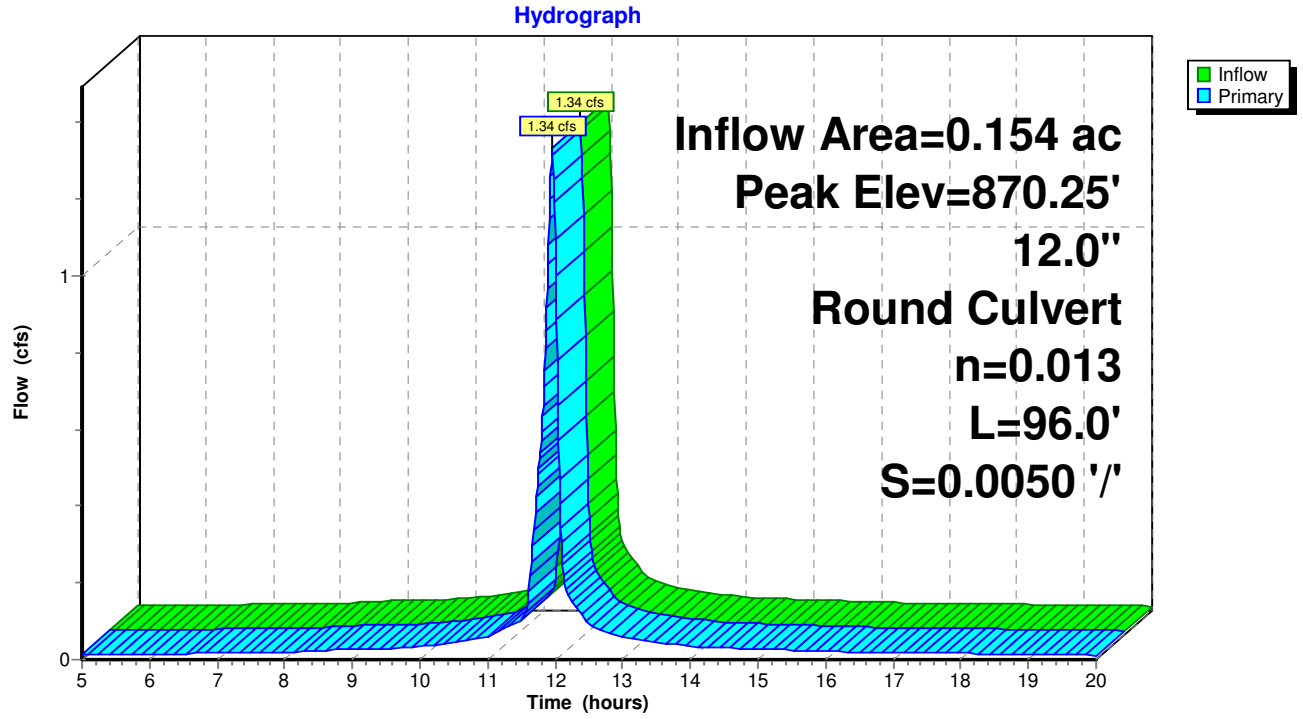
| | | | | | |
|---|---|---|---|---|---|
| Inflow Area = | 0.154 ac,100.00% Impervious, | Inflow Depth > | 5.18" | for | 100-yr event |
| Inflow = | 1.34 cfs @ | 11.95 hrs, Volume= | 0.066 af | | |
| Outflow = | 1.34 cfs @ | 11.95 hrs, Volume= | 0.066 af, | Atten= 0%, | Lag= 0.0 min |
| Primary = | 1.34 cfs @ | 11.95 hrs, Volume= | 0.066 af | | |

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 870.25' @ 11.98 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 866.16' | **12.0" Round Culvert**<br>L= 96.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 866.16' / 865.68' S= 0.0050 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |

**Primary OutFlow** Max=1.06 cfs @ 11.95 hrs HW=870.14' TW=870.01' (Dynamic Tailwater)
↳**1=Culvert** (Outlet Controls 1.06 cfs @ 1.34 fps)

### Pond 6P: MH 406



## Summary for Pond 7P: CB 404A

[82] Warning: Early inflow requires earlier time span
[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.030 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 0.26 cfs @ 11.96 hrs, Volume= 0.013 af
Outflow = 1.20 cfs @ 12.10 hrs, Volume= 0.013 af, Atten= 0%, Lag= 8.6 min
Primary = 1.20 cfs @ 12.10 hrs, Volume= 0.013 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.44' @ 12.04 hrs Surf.Area= 563 sf Storage= 178 cf

Plug-Flow detention time= 23.2 min calculated for 0.013 af (98% of inflow)
Center-of-Mass det. time= 13.0 min ( 741.5 - 728.5 )

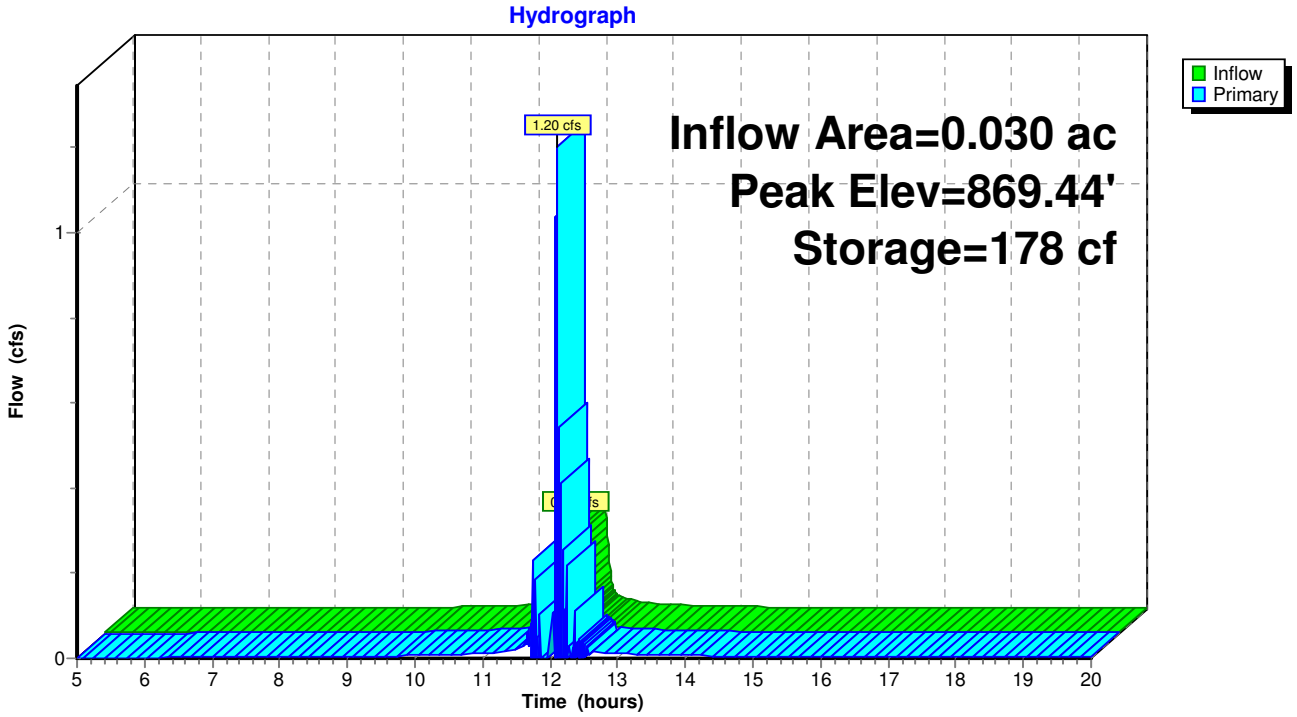
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 865.42' | 660 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 865.42 | 4 | 0 | 0 |
| 868.63 | 4 | 13 | 13 |
| 869.00 | 100 | 19 | 32 |
| 869.50 | 625 | 181 | 213 |
| 870.00 | 1,162 | 447 | 660 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.42' | **12.0" Round Culvert**<br>L= 11.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.42' / 865.31' S= 0.0100 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |
| #2 | Device 1 | 868.63' | **24.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 12.10 hrs HW=869.34' TW=869.40' (Dynamic Tailwater)
└**1=Culvert** ( Controls 0.00 cfs)
└**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 7P: CB 404A



## Summary for Pond 8P: RD 404B

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 869.87' (Flood elevation advised)
[87] Warning: Oscillations may require Finer Routing or smaller dt

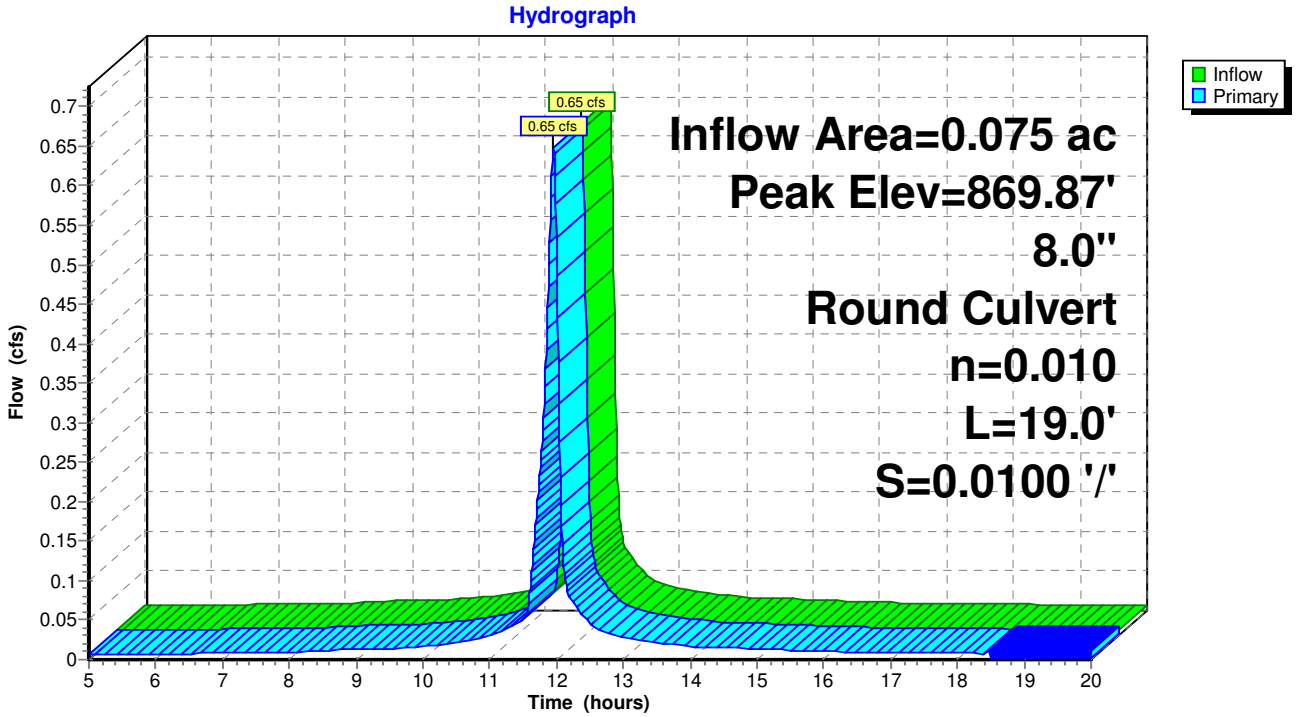
Inflow Area = 0.075 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 0.65 cfs @ 11.96 hrs, Volume= 0.032 af
Outflow = 0.65 cfs @ 11.96 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min
Primary = 0.65 cfs @ 11.96 hrs, Volume= 0.032 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.87' @ 11.98 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 866.50' | **8.0" Round Culvert**<br>L= 19.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 866.50' / 866.31' S= 0.0100 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.53 cfs @ 11.96 hrs HW=869.80' TW=869.70' (Dynamic Tailwater)
**1=Culvert** (Inlet Controls 0.53 cfs @ 1.53 fps)

### Pond 8P: RD 404B



## Summary for Pond 9P: CB 405A

[82] Warning: Early inflow requires earlier time span
[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.108 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 0.94 cfs @ 11.96 hrs, Volume= 0.047 af
Outflow = 2.55 cfs @ 12.26 hrs, Volume= 0.046 af, Atten= 0%, Lag= 18.2 min
Primary = 2.55 cfs @ 12.26 hrs, Volume= 0.046 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.63' @ 12.07 hrs Surf.Area= 2,077 sf Storage= 616 cf

Plug-Flow detention time= 10.0 min calculated for 0.046 af (99% of inflow)
Center-of-Mass det. time= 7.3 min ( 735.9 - 728.5 )

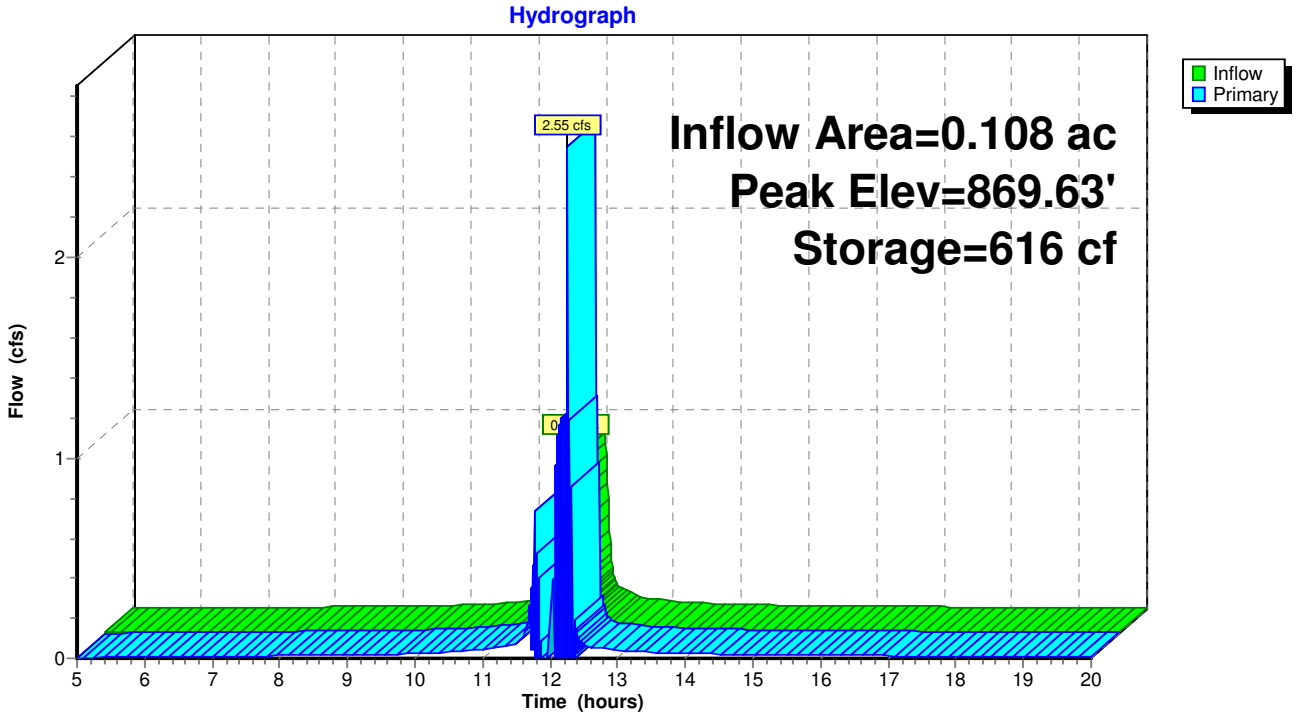
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 865.79' | 1,784 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 865.79 | 4 | 0 | 0 |
| 868.63 | 4 | 11 | 11 |
| 869.00 | 150 | 28 | 40 |
| 869.50 | 1,261 | 353 | 393 |
| 870.00 | 4,305 | 1,392 | 1,784 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.79' | **12.0" Round Culvert**<br>L= 11.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.79' / 865.68' S= 0.0100 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |
| #2 | Device 1 | 868.63' | **24.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 12.26 hrs HW=869.29' TW=869.56' (Dynamic Tailwater)
└**1=Culvert** ( Controls 0.00 cfs)
└**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 9P: CB 405A



## Summary for Pond 10P: RD 405B

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 870.20' (Flood elevation advised)
[87] Warning: Oscillations may require Finer Routing or smaller dt

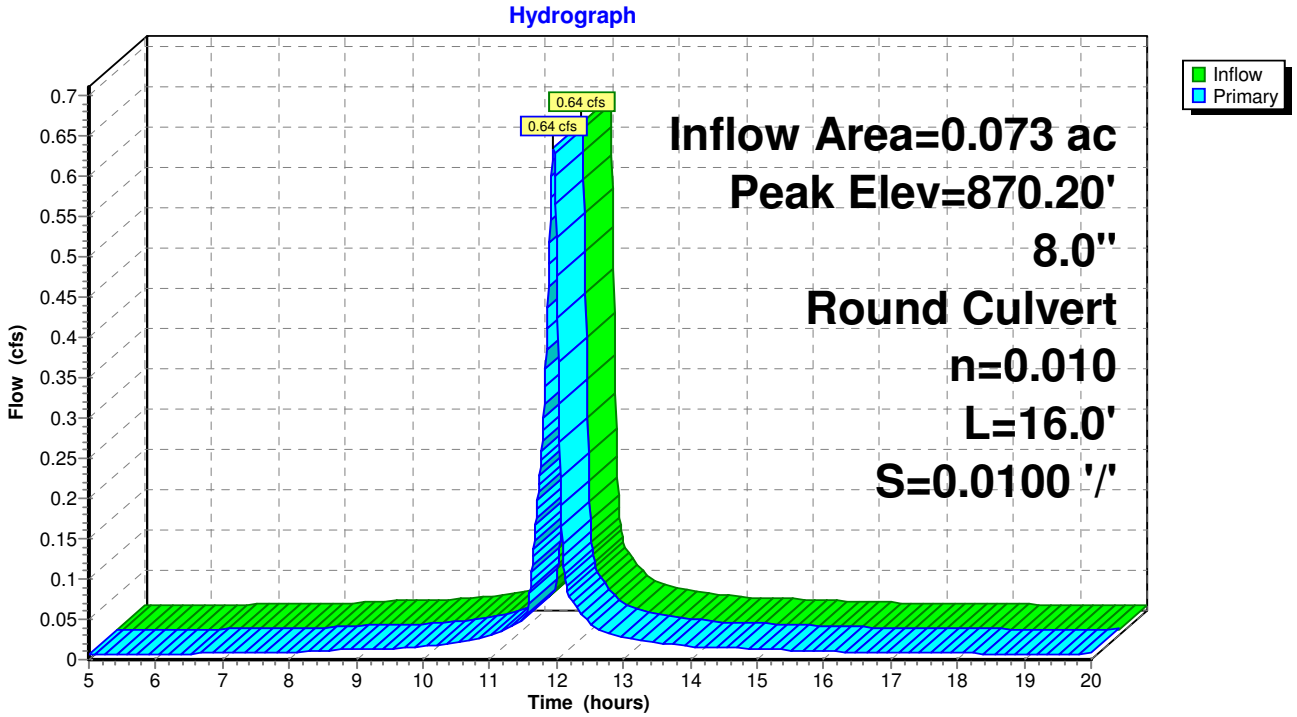
Inflow Area = 0.073 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 0.64 cfs @ 11.96 hrs, Volume= 0.032 af
Outflow = 0.64 cfs @ 11.96 hrs, Volume= 0.032 af, Atten= 0%, Lag= 0.0 min
Primary = 0.64 cfs @ 11.96 hrs, Volume= 0.032 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 870.20' @ 11.98 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 866.84' | **8.0" Round Culvert**<br>L= 16.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 866.84' / 866.68' S= 0.0100 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.45 cfs @ 11.96 hrs HW=870.10' TW=870.02' (Dynamic Tailwater)
**1=Culvert** (Inlet Controls 0.45 cfs @ 1.30 fps)

### Pond 10P: RD 405B



## Summary for Pond 11P: RD 406A

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 870.36' (Flood elevation advised)
[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[87] Warning: Oscillations may require Finer Routing or smaller dt

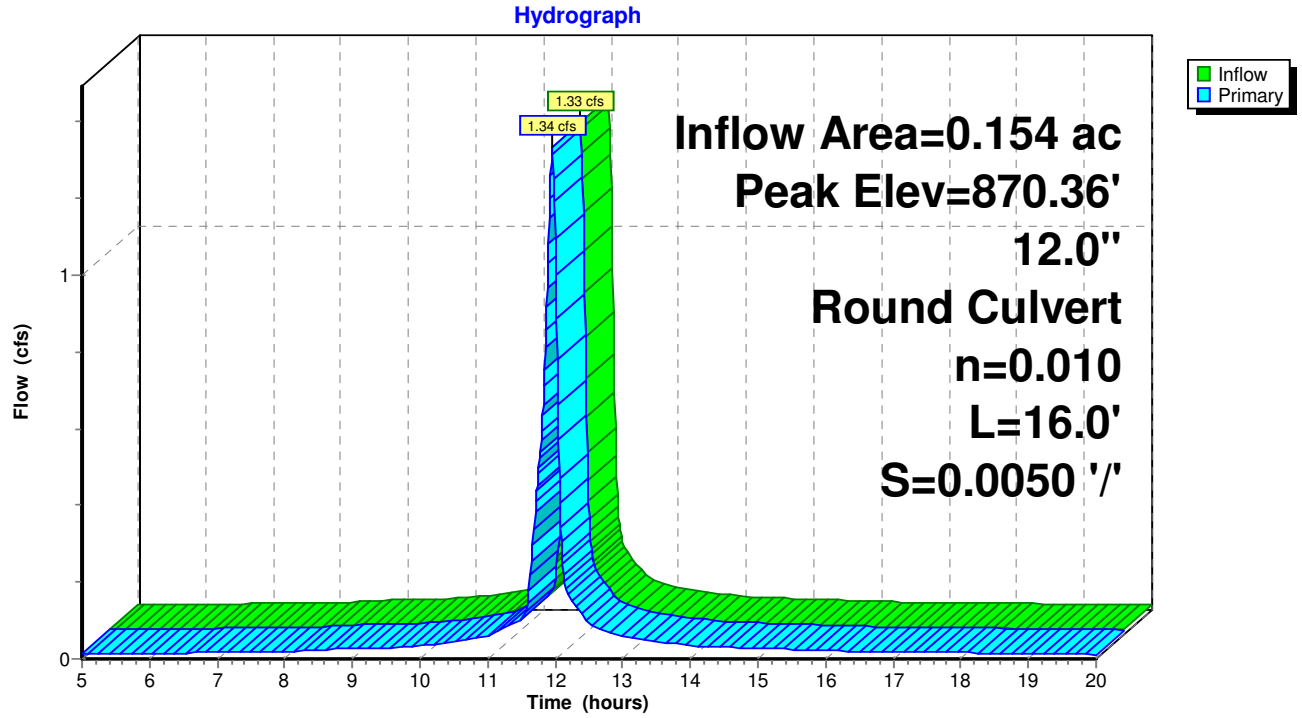
Inflow Area = 0.154 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 1.33 cfs @ 11.96 hrs, Volume= 0.066 af
Outflow = 1.34 cfs @ 11.95 hrs, Volume= 0.066 af, Atten= 0%, Lag= 0.0 min
Primary = 1.34 cfs @ 11.95 hrs, Volume= 0.066 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 870.36' @ 11.98 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 866.24' | **12.0" Round Culvert**<br>L= 16.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 866.24' / 866.16' S= 0.0050 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=0.62 cfs @ 11.95 hrs HW=870.16' TW=870.14' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 0.62 cfs @ 0.78 fps)

### Pond 11P: RD 406A



## Summary for Pond 12P: MH 410

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 869.72' (Flood elevation advised)
[80] Warning: Exceeded Pond 13P by 0.42' @ 11.97 hrs (2.44 cfs 0.046 af)
[80] Warning: Exceeded Pond 14P by 0.19' @ 12.12 hrs (1.67 cfs 0.029 af)

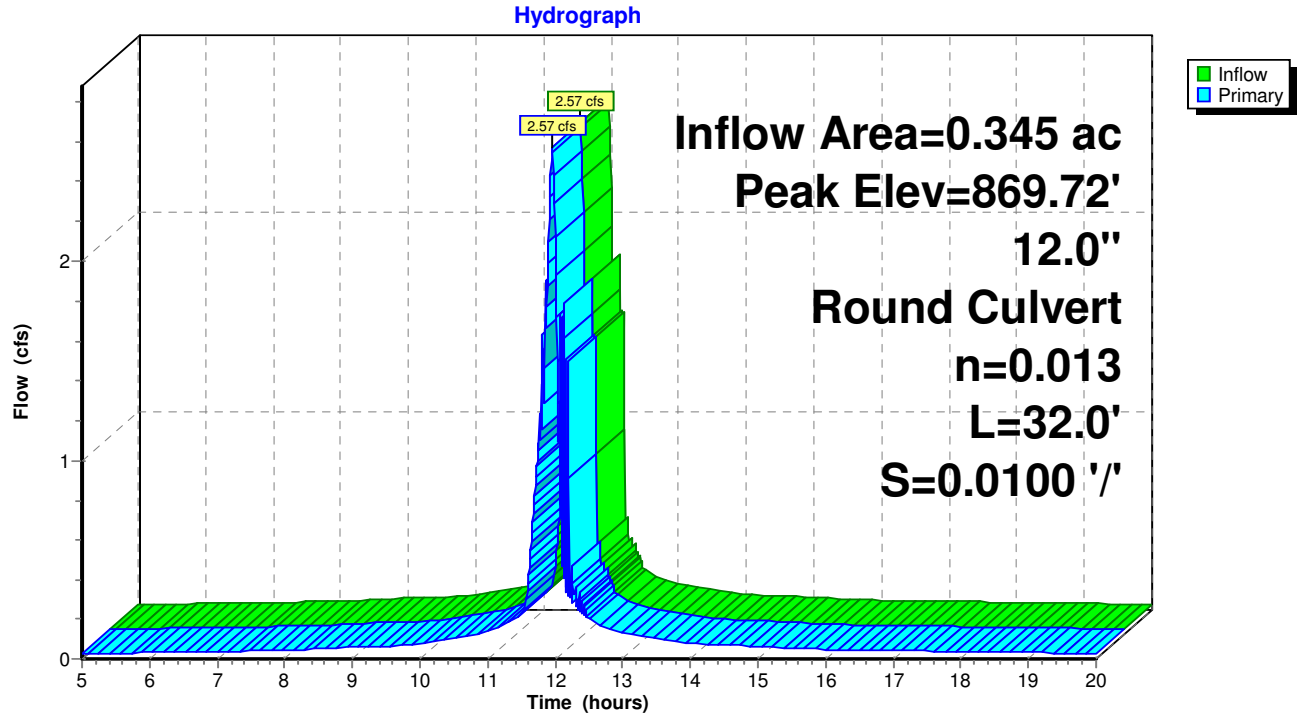
Inflow Area = 0.345 ac,100.00% Impervious, Inflow Depth > 5.17" for 100-yr event
Inflow = 2.57 cfs @ 11.96 hrs, Volume= 0.149 af
Outflow = 2.57 cfs @ 11.96 hrs, Volume= 0.149 af, Atten= 0%, Lag= 0.0 min
Primary = 2.57 cfs @ 11.96 hrs, Volume= 0.149 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.72' @ 11.97 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.33' | **12.0" Round Culvert**<br>L= 32.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.33' / 865.01' S= 0.0100 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |

**Primary OutFlow** Max=2.46 cfs @ 11.96 hrs HW=869.68' TW=869.26' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 2.46 cfs @ 3.14 fps)

### Pond 12P: MH 410



## Summary for Pond 13P: CB 410A

[82] Warning: Early inflow requires earlier time span
[90] Warning: Qout>Qin may require Finer Routing or smaller dt
[87] Warning: Oscillations may require Finer Routing or smaller dt

Inflow Area = 0.049 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 0.42 cfs @ 11.96 hrs, Volume= 0.021 af
Outflow = 1.35 cfs @ 12.12 hrs, Volume= 0.021 af, Atten= 0%, Lag= 9.8 min
Primary = 1.35 cfs @ 12.12 hrs, Volume= 0.021 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 869.38' @ 12.05 hrs Surf.Area= 1,200 sf Storage= 272 cf

Plug-Flow detention time= 15.4 min calculated for 0.021 af (99% of inflow)
Center-of-Mass det. time= 9.2 min ( 737.7 - 728.5 )

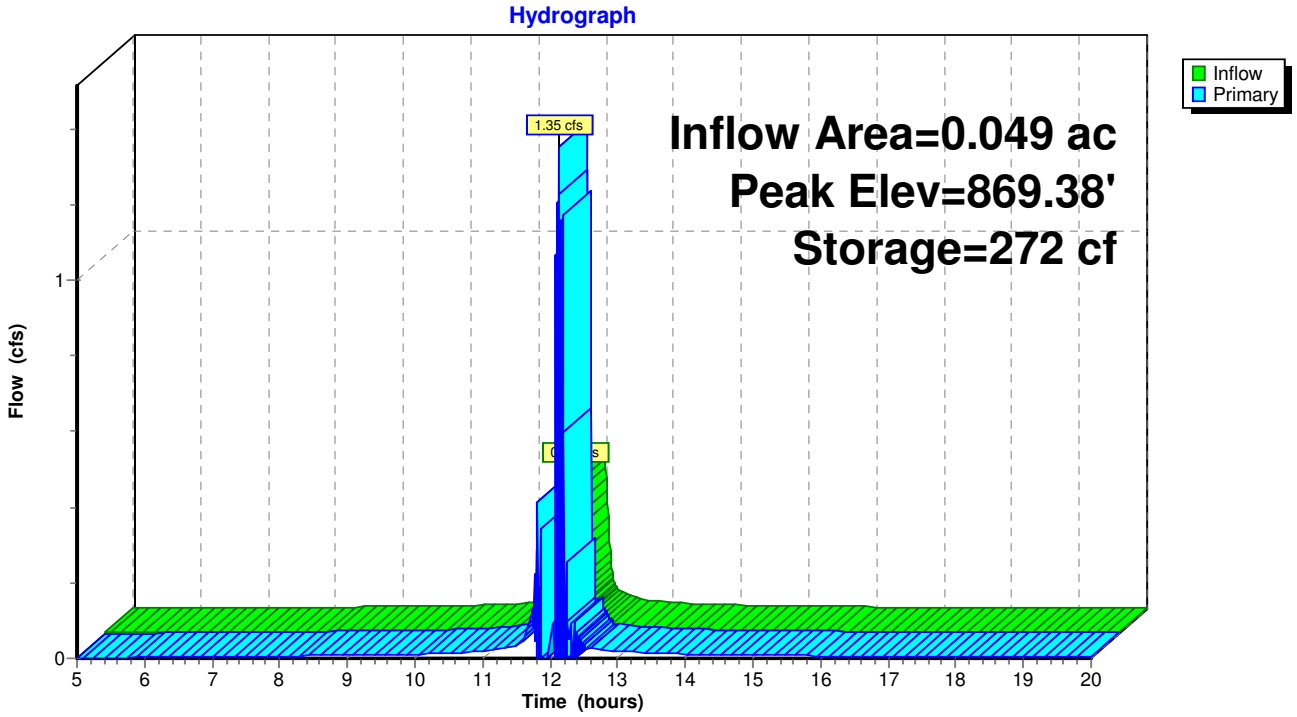
| Volume | Invert | Avail.Storage | Storage Description |
|---|---|---|---|
| #1 | 865.48' | 1,302 cf | **Custom Stage Data (Prismatic)** Listed below (Recalc) |

| Elevation (feet) | Surf.Area (sq-ft) | Inc.Store (cubic-feet) | Cum.Store (cubic-feet) |
|---|---|---|---|
| 865.48 | 4 | 0 | 0 |
| 868.63 | 4 | 13 | 13 |
| 869.00 | 78 | 15 | 28 |
| 869.40 | 1,253 | 266 | 294 |
| 870.00 | 2,107 | 1,008 | 1,302 |

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.48' | **12.0" Round Culvert**<br>L= 15.0' RCP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.48' / 865.33' S= 0.0100 '/' Cc= 0.900<br>n= 0.013 Concrete pipe, straight & clean |
| #2 | Device 1 | 868.63' | **24.0" Horiz. Orifice/Grate** C= 0.600<br>Limited to weir flow at low heads |

**Primary OutFlow** Max=0.00 cfs @ 12.12 hrs HW=869.30' TW=869.38' (Dynamic Tailwater)
└─**1=Culvert** ( Controls 0.00 cfs)
└─**2=Orifice/Grate** ( Controls 0.00 cfs)

## Pond 13P: CB 410A



## Summary for Pond 14P: RD 410B

[82] Warning: Early inflow requires earlier time span
[57] Hint: Peaked at 870.14' (Flood elevation advised)

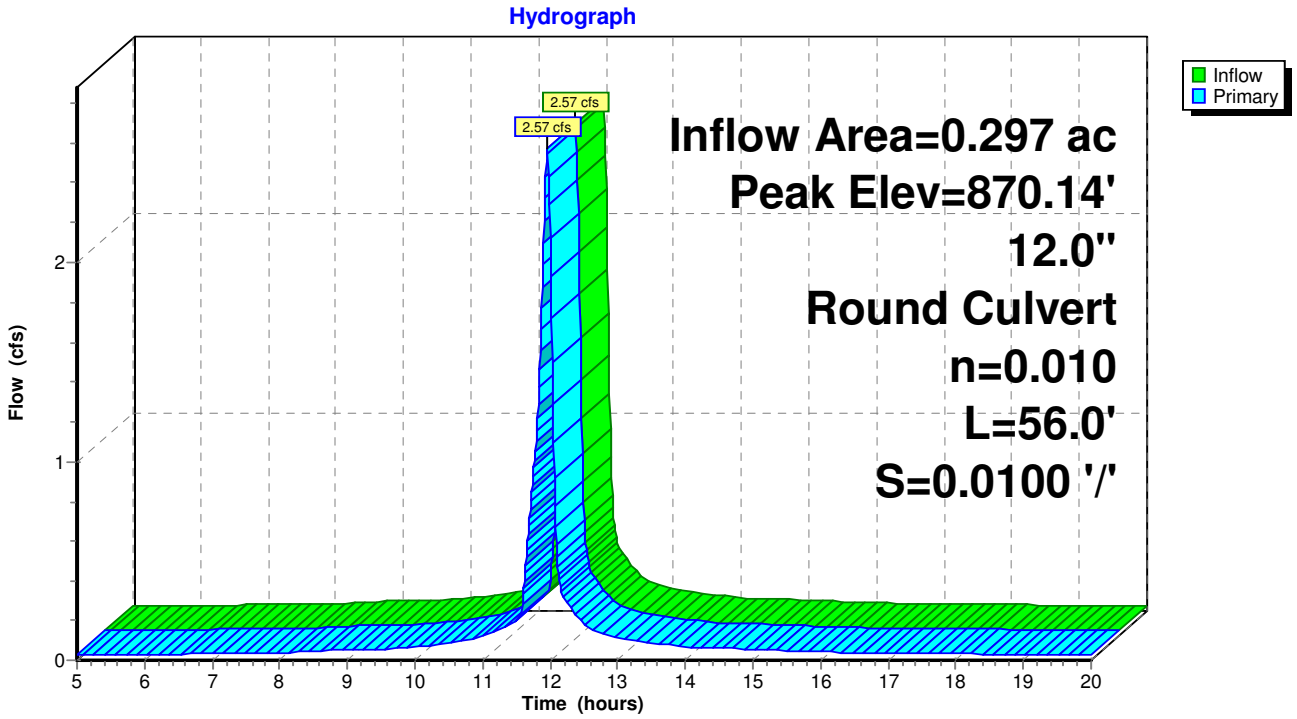
Inflow Area = 0.297 ac,100.00% Impervious, Inflow Depth > 5.18" for 100-yr event
Inflow = 2.57 cfs @ 11.96 hrs, Volume= 0.128 af
Outflow = 2.57 cfs @ 11.96 hrs, Volume= 0.128 af, Atten= 0%, Lag= 0.0 min
Primary = 2.57 cfs @ 11.96 hrs, Volume= 0.128 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.01 hrs
Peak Elev= 870.14' @ 11.97 hrs

| Device | Routing | Invert | Outlet Devices |
|---|---|---|---|
| #1 | Primary | 865.89' | **12.0" Round Culvert**<br>L= 56.0' CPP, square edge headwall, Ke= 0.500<br>Inlet / Outlet Invert= 865.89' / 865.33' S= 0.0100 '/' Cc= 0.900<br>n= 0.010 PVC, smooth interior |

**Primary OutFlow** Max=2.43 cfs @ 11.96 hrs HW=870.10' TW=869.68' (Dynamic Tailwater)
↳**1=Culvert** (Inlet Controls 2.43 cfs @ 3.10 fps)

### Pond 14P: RD 410B

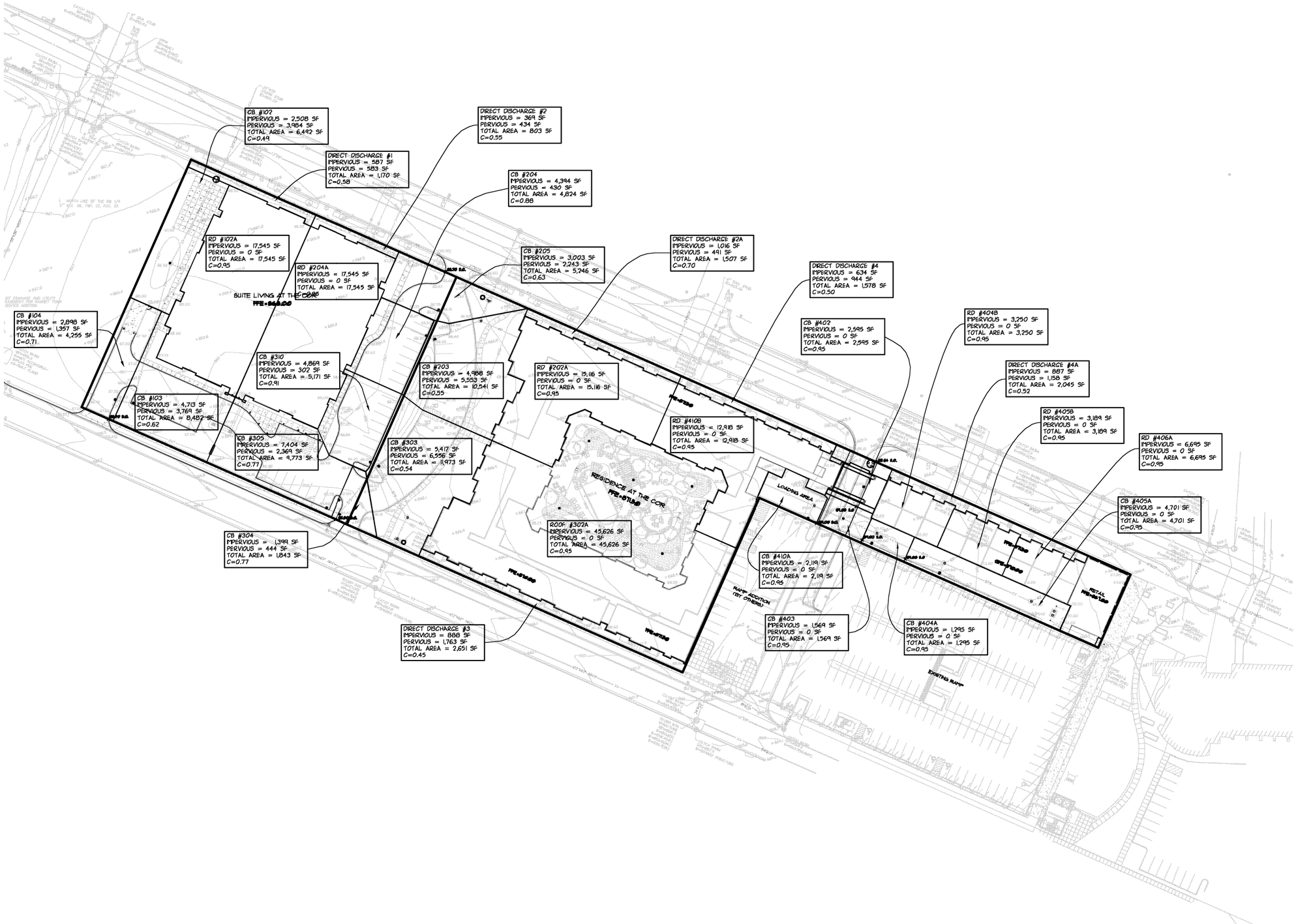


# APPENDIX F

# PROPOSED STORM SEWER DRAINAGE MAP

# SENIOR LIVING / APTS

RAMSEY, MN




NORTH

0 100

LANDFORM

From Site to Finish

## PROPOSED STORM SEWER DRAINAGE MAP

12.03.2010

# APPENDIX G

# STORM SEWER DESIGN CALCULATIONS

LANDFORM
From Site to Finish

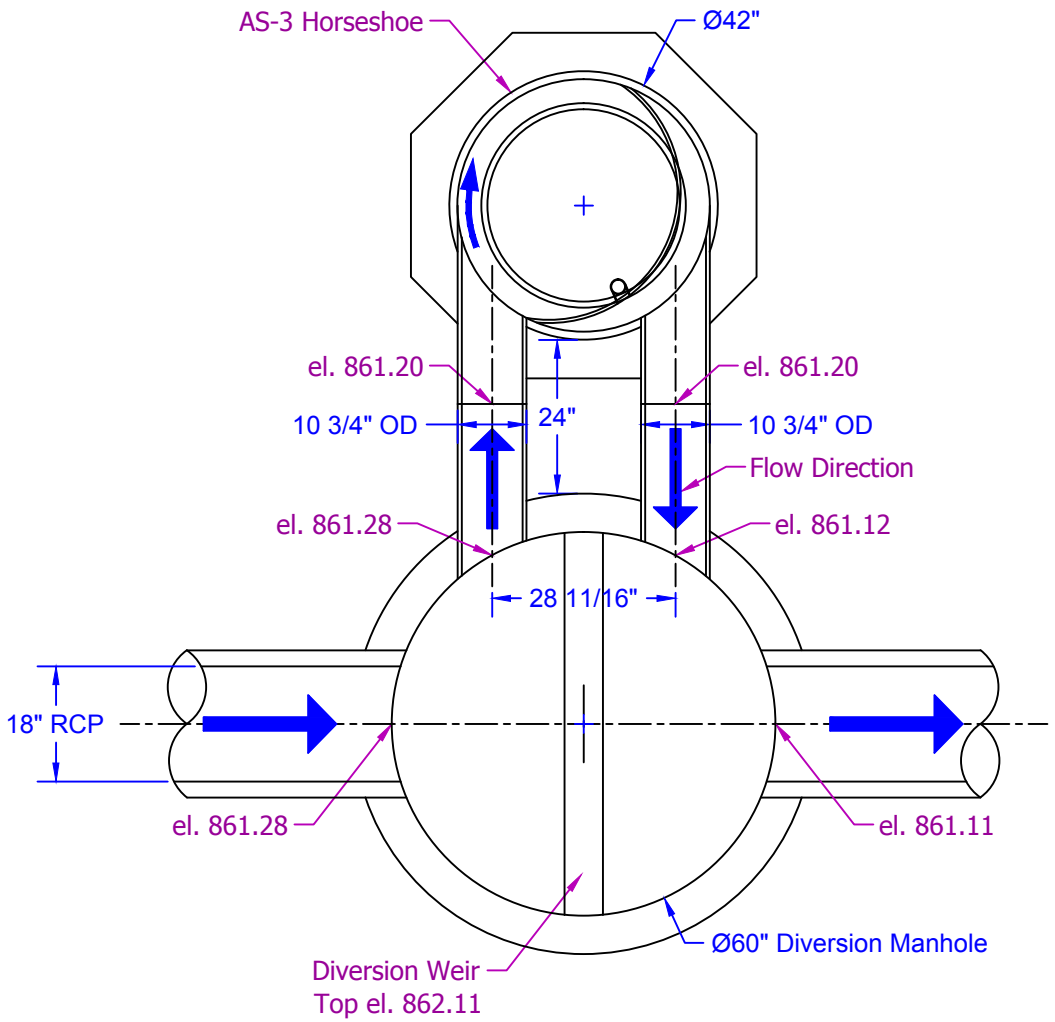
# STORM SEWER DESIGN CALCULATIONS

| | | | |
|---|---|---|---|
| **DATE** | 12/03/10 | **FILE** | UWA10002 Storm Sewer Design Calcuations.xls |
| **PROJECT NAME** | The Residence at the COR / COR Senior Living | **STORM FREQUENCY** | 10 years |
| **PROJECT NUMBER** | UWA10002 / TOT10005 | **CALCULATIONS BY** | SES |
| **PROJECT LOCATION** | Ramsey, MN | **MN STATE ZONE** | 1 *(Use "1" for areas within Twin Cities and southward)* |
| **PROJECT ENGINEER** | DWH | | |

| Segment | | A - Trib. Areas | | C - Coef. | | Tc - Time of Conc. | | | I - Intensity | | Q - Rate | | Pipe | | | | | | | | Upstream Structure | | | | | | | Downstream Structure | | | | | | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| From | To | CB Ac. | Pipe Ac. | CB Indiv. | Pipe Avg. | CB Min. | Pipe Min. | Total Min. | CB In/Hr | Total In/Hr | CB CFS | Pipe CFS | Len. Ft. | Dia. In. | Grade % | Mat'l. | Man's. n | Vel. Ft/S | Cap. CFS | Excess Cap. | Structure | Top Rim | Invert | Build | Size | Casting | Structure | Top Rim | Inlet | Match | Drop (FT) | Build | |
| **100 SERIES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 104 | CB 103 | 0.10 | 0.10 | 0.71 | 0.71 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 0.5 | 0.5 | 18 | 12 | 0.90 | RCP | 0.013 | 4.3 | 3.4 | 2.9 | CB 104 | 866.23 | 863.26 | 2.97 | 27" | R-3250-A | CB 103 | 866.23 | 863.09 | 8/10ths | | 3.14 | |
| CB 103 | CB 102 | 0.19 | 0.29 | 0.62 | 0.65 | 5.0 | 0.6 | 5.6 | 7.10 | 6.95 | 0.9 | 1.3 | 147 | 12 | 0.90 | RCP | 0.013 | 4.3 | 3.4 | 2.1 | CB 103 | 866.23 | 863.09 | 3.14 | 48" | R-3250-A | CB 102 | 866.50 | 861.77 | 8/10ths | | 4.73 | |
| CB 102 | Eco St #1 | 0.15 | 0.84 | 0.49 | 0.76 | 5.0 | 0.2 | 5.9 | 7.10 | 6.95 | 0.5 | 4.5 | 97 | 15 | 0.90 | PVC | 0.010 | 6.5 | 8.0 | 3.5 | CB 102 | 866.50 | 861.57 | 4.93 | 48" | R-1792-FG | Eco St #1 | 866.00 | 860.70 | 8/10ths | | 5.30 | |
| Eco St #1 | EX 100 | 0.00 | 0.84 | 0.00 | 0.76 | 5.0 | 0.1 | 6.0 | 7.10 | 6.95 | 0.0 | 4.5 | 22 | 15 | 0.90 | RCP | 0.013 | 5.0 | 6.1 | 1.6 | Eco St #1 | 866.00 | 860.70 | 5.30 | 72" | na | EX 100 | 864.40 | 860.50 | 8/10ths | | 3.90 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 102A | CB 102 | 0.40 | 0.40 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 2.7 | 2.7 | 22 | 12 | 1.00 | PVC | 0.010 | 5.9 | 4.6 | 1.9 | RD 102A | 868.00 | 861.99 | 6.01 | na | na | CB 102 | 866.50 | 861.77 | 8/10ths | | 4.73 | |
| **200 SERIES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 204A | CB 204 | 0.40 | 0.40 | 0.95 | 0.95 | 5.0 | 0.2 | 5.2 | 7.10 | 7.10 | 2.7 | 2.7 | 58 | 12 | 0.50 | PVC | 0.010 | 4.2 | 3.3 | 0.6 | RD 204A | 868.00 | 862.38 | 5.63 | na | na | CB 204 | 866.13 | 862.09 | 8/10ths | | 4.04 | |
| CB 204 | STUB 203A | 0.11 | 0.63 | 0.88 | 0.88 | 5.0 | 0.0 | 5.2 | 7.10 | 7.10 | 0.7 | 3.9 | 3 | 15 | 0.50 | RCP | 0.013 | 3.7 | 4.6 | 0.6 | CB 204 | 866.13 | 861.89 | 4.25 | 48" | R-3250-A | STUB 203A | 866.25 | 861.87 | 8/10ths | | 4.38 | |
| STUB 203A | CB 203 | 0.00 | 0.63 | 0.00 | 0.88 | 5.0 | 0.0 | 5.3 | 7.10 | 7.10 | 0.0 | 3.9 | 5 | 15 | 0.50 | RCP | 0.013 | 3.7 | 4.6 | 0.6 | STUB 203A | 866.25 | 861.87 | 4.38 | na | na | CB 203 | 866.13 | 861.85 | 8/10ths | | 4.28 | |
| CB 203 | MH 202 | 0.24 | 0.88 | 0.55 | 0.79 | 5.0 | 0.2 | 5.5 | 7.10 | 7.10 | 1.0 | 4.9 | 50 | 18 | 0.50 | RCP | 0.013 | 4.2 | 7.4 | 2.5 | CB 203 | 866.13 | 861.65 | 4.49 | 48" | R-3250-A | MH 202 | 867.25 | 861.40 | 8/10ths | | 5.86 | |
| MH 202 | MH 201 | 0.00 | 1.22 | 0.00 | 0.83 | 5.0 | 0.1 | 5.6 | 7.10 | 6.95 | 0.0 | 7.1 | 23 | 18 | 0.50 | RCP | 0.013 | 4.2 | 7.4 | 0.3 | MH 202 | 867.25 | 861.40 | 5.86 | 48" | R-1642 | MH 201 | 867.00 | 861.28 | Drop | 0.17 | 5.72 | |
| MH 201 | EX 200 | 0.00 | 1.22 | 0.00 | 0.83 | 5.0 | 0.1 | 5.6 | 7.10 | 6.95 | 0.0 | 7.1 | 22 | 18 | 0.50 | RCP | 0.013 | 4.2 | 7.4 | 0.3 | MH 201 | 867.00 | 861.11 | 5.89 | 60" | na | EX 200 | 866.20 | 861.00 | 8/10ths | | 5.20 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 205 | CB 204 | 0.12 | 0.12 | 0.63 | 0.63 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 0.5 | 0.5 | 28 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 3.0 | CB 205 | 865.93 | 862.37 | 3.56 | 48" | R-3250-A | CB 204 | 866.13 | 862.09 | 8/10ths | | 4.04 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 202A | MH 202 | 0.35 | 0.35 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 2.3 | 2.3 | 20 | 12 | 1.00 | PVC | 0.010 | 5.9 | 4.6 | 2.3 | RD 202A | 871.50 | 862.00 | 9.51 | na | na | MH 202 | 867.25 | 861.80 | 8/10ths | | 5.46 | |
| **300 SERIES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 305 | CB 304 | 0.22 | 0.22 | 0.77 | 0.77 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 1.2 | 1.2 | 14 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 2.3 | CB 305 | 865.33 | 861.85 | 3.48 | 27" | R-3250-A | CB 304 | 865.23 | 861.71 | 8/10ths | | 3.52 | |
| CB 304 | STUB 303A | 0.04 | 0.27 | 0.77 | 0.77 | 5.0 | 0.2 | 5.2 | 7.10 | 7.10 | 0.2 | 1.5 | 44 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 2.1 | CB 304 | 865.23 | 861.71 | 3.52 | 48" | R-3250-A | STUB 303A | 866.30 | 861.27 | 8/10ths | | 5.03 | |
| STUB 303A | CB 303 | 0.00 | 0.27 | 0.00 | 0.77 | 5.0 | 0.1 | 5.3 | 7.10 | 7.10 | 0.0 | 1.5 | 19 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 2.1 | STUB 303A | 866.30 | 861.27 | 5.03 | na | na | CB 303 | 865.83 | 861.08 | 8/10ths | | 4.75 | |
| CB 303 | MH 302 | 0.27 | 0.66 | 0.54 | 0.70 | 5.0 | 0.2 | 5.5 | 7.10 | 6.95 | 1.1 | 3.2 | 60 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 0.4 | CB 303 | 865.83 | 861.08 | 4.75 | 48" | R-3250-A | MH 302 | 866.50 | 860.48 | 8/10ths | | 6.02 | |
| MH 302 | MH 301 | 0.00 | 1.71 | 0.00 | 0.85 | 5.0 | 0.1 | 5.6 | 7.10 | 6.95 | 0.0 | 10.1 | 25 | 18 | 1.00 | RCP | 0.013 | 5.9 | 10.5 | 0.4 | MH 302 | 866.50 | 860.08 | 6.42 | 48" | R-1642 | MH 301 | 865.25 | 859.83 | Drop | 0.17 | 5.42 | |
| MH 301 | EX 300 | 0.00 | 1.71 | 0.00 | 0.85 | 5.0 | 0.0 | 5.6 | 7.10 | 6.95 | 0.0 | 10.1 | 16 | 18 | 1.00 | RCP | 0.013 | 5.9 | 10.5 | 0.4 | MH 301 | 865.25 | 859.66 | 5.59 | 60" | na | EX 300 | 864.50 | 859.50 | 8/10ths | | 5.00 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 302A | MH 302 | 1.05 | 1.05 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 7.1 | 7.1 | 30 | 15 | 1.00 | PVC | 0.010 | 6.8 | 8.4 | 1.3 | RD 302A | 870.00 | 860.58 | 9.42 | na | na | MH 302 | 866.50 | 860.28 | 8/10ths | | 6.22 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 310 | STUB 303B | 0.12 | 0.12 | 0.91 | 0.91 | 5.0 | 0.0 | 5.0 | 7.10 | 7.10 | 0.8 | 0.8 | 4 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 2.8 | CB 310 | 865.83 | 861.17 | 4.66 | na | na | STUB 303B | 866.25 | 861.13 | 8/10ths | | 5.12 | |
| STUB 303B | CB 303 | 0.00 | 0.12 | 0.00 | 0.91 | 5.0 | 0.0 | 5.0 | 7.10 | 7.10 | 0.0 | 0.8 | 5 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 2.8 | STUB 303B | 866.25 | 861.13 | 5.12 | na | na | CB 303 | 865.83 | 861.08 | 8/10ths | | 4.75 | |
| **400 SERIES** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 406A | MH 406 | 0.15 | 0.15 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 1.0 | 1.0 | 16 | 12 | 0.50 | PVC | 0.010 | 4.2 | 3.3 | 2.2 | RD 406A | 870.00 | 866.24 | 3.76 | na | na | MH 406 | 869.70 | 866.16 | 8/10ths | | 3.54 | |
| MH 406 | MH 405 | 0.00 | 0.15 | 0.00 | 0.95 | 5.0 | 0.5 | 5.6 | 7.10 | 6.95 | 0.0 | 1.0 | 96 | 12 | 0.50 | RCP | 0.013 | 3.2 | 2.5 | 1.5 | MH 406 | 869.70 | 866.16 | 3.54 | 48" | R-1642 | MH 405 | 869.40 | 865.68 | 8/10ths | | 3.72 | |
| MH 405 | MH 404 | 0.00 | 0.33 | 0.00 | 0.95 | 5.0 | 0.4 | 6.0 | 7.10 | 6.95 | 0.0 | 2.2 | 75 | 12 | 0.50 | RCP | 0.013 | 3.2 | 2.5 | 0.3 | MH 405 | 869.40 | 865.68 | 3.72 | 48" | R-1642 | MH 404 | 869.40 | 865.31 | 8/10ths | | 4.09 | |
| MH 404 | CB 403 | 0.00 | 0.44 | 0.00 | 0.95 | 5.0 | 0.2 | 6.1 | 7.10 | 6.80 | 0.0 | 2.8 | 37 | 12 | 0.80 | RCP | 0.013 | 4.1 | 3.2 | 0.3 | MH 404 | 869.40 | 865.31 | 4.09 | 48" | R-1642 | CB 403 | 868.55 | 865.01 | 8/10ths | | 3.54 | |
| CB 403 | CB 402 | 0.04 | 0.82 | 0.95 | 0.95 | 5.0 | 0.1 | 6.2 | 7.10 | 6.80 | 0.2 | 5.3 | 39 | 15 | 0.80 | RCP | 0.013 | 4.7 | 5.8 | 0.5 | CB 403 | 868.55 | 864.81 | 3.74 | 48" | R-1792-FG | CB 402 | 868.33 | 864.50 | 8/10ths | | 3.83 | |
| CB 402 | Eco St #2 | 0.06 | 0.88 | 0.95 | 0.95 | 5.0 | 0.1 | 6.3 | 7.10 | 6.80 | 0.4 | 5.7 | 24 | 15 | 0.80 | RCP | 0.013 | 4.7 | 5.8 | 0.1 | CB 402 | 868.33 | 864.50 | 3.83 | 48" | R-3250-A | Eco St #2 | 868.61 | 864.31 | 8/10ths | | 4.30 | |
| Eco St #2 | EX 400 | 0.00 | 0.88 | 0.00 | 0.95 | 5.0 | 0.1 | 6.4 | 7.10 | 6.80 | 0.0 | 5.7 | 26 | 15 | 0.80 | RCP | 0.013 | 4.7 | 5.8 | 0.1 | Eco St #2 | 868.61 | 864.31 | 4.30 | 84" | na | EX 400 | 867.90 | 864.10 | 8/10ths | | 3.80 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 405A | MH 405 | 0.11 | 0.11 | 0.95 | 0.95 | 5.0 | 0.0 | 5.0 | 7.10 | 7.10 | 0.7 | 0.7 | 11 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 2.8 | CB 405A | 868.63 | 865.79 | 2.84 | 27" | R-3250-A | MH 405 | 869.40 | 865.68 | 8/10ths | | 3.72 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 405B | MH 405 | 0.07 | 0.07 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 0.5 | 0.5 | 16 | 8 | 1.00 | PVC | 0.010 | 4.5 | 1.6 | 1.1 | RD 405B | 870.00 | 866.84 | 3.16 | na | na | MH 405 | 869.40 | 866.68 | Drop | 1.00 | 2.72 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 404A | MH 404 | 0.03 | 0.03 | 0.95 | 0.95 | 5.0 | 0.0 | 5.0 | 7.10 | 7.10 | 0.2 | 0.2 | 11 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 3.4 | CB 404A | 868.63 | 865.42 | 3.21 | 27" | R-3250-A | MH 404 | 869.40 | 865.31 | 8/10ths | | 4.09 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 404B | MH 404 | 0.07 | 0.07 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 0.5 | 0.5 | 19 | 8 | 1.00 | PVC | 0.010 | 4.5 | 1.6 | 1.1 | RD 404B | 870.00 | 866.50 | 3.50 | na | na | MH 404 | 869.40 | 866.31 | Drop | 1.00 | 3.09 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CB 410A | MH 410 | 0.05 | 0.05 | 0.95 | 0.95 | 5.0 | 0.1 | 5.1 | 7.10 | 7.10 | 0.3 | 0.3 | 15 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 3.2 | CB 410A | 868.63 | 865.48 | 3.15 | 27" | R-3250-A | MH 410 | 869.10 | 865.33 | 8/10ths | | 3.77 | |
| MH 410 | CB 403 | 0.00 | 0.35 | 0.00 | 0.95 | 5.0 | 0.1 | 5.3 | 7.10 | 7.10 | 0.0 | 2.3 | 32 | 12 | 1.00 | RCP | 0.013 | 4.5 | 3.6 | 1.2 | MH 410 | 869.10 | 865.33 | 3.77 | 48" | R-1642 | CB 403 | 868.55 | 865.01 | 8/10ths | | 3.54 | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| RD 410B | MH 410 | 0.30 | 0.30 | 0.95 | 0.95 | 5.0 | 0.2 | 5.2 | 7.10 | 7.10 | 2.0 | 2.0 | 56 | 12 | 1.00 | PVC | 0.010 | 5.9 | 4.6 | 2.6 | RD 410B | 870.00 | 865.89 | 4.11 | na | na | MH 410 | 869.10 | 865.33 | 8/10ths | | 3.77 | |

# APPENDIX H

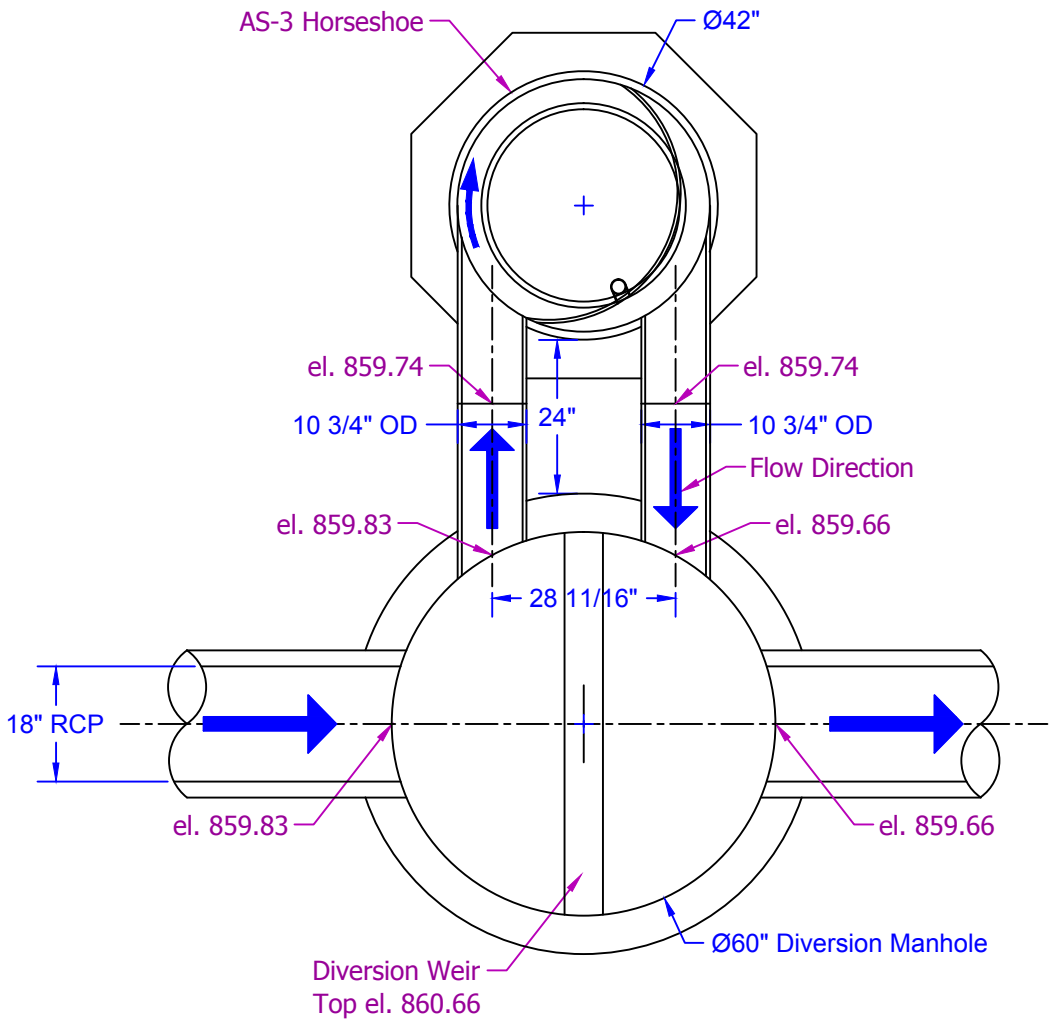
# PROPRIETARY TREATMENT DEVICES




AquaShield
STORMWATER TREATMENT SOLUTIONS
2705 Kanasita Drive, Chattanooga, TN 37343
Phone (888) 344-9044 Fax (423) 826-2112
www.aquashieldinc.com

Aqua-Swirl Concentrator
Model AS-3 Horseshoe Layout STR #1 (North)
The Residence at the COR
Ramsey, MN - Project: #UWA10002

| | |
|---|---|
| Document: | AS-3 Off-Line Layout |
| Drawn By: | JCW |
| Scale: | 1:30 |
| Date: | 12/01/10 |




AquaShield
STORMWATER TREATMENT SOLUTIONS
2705 Kanasita Drive, Chattanooga, TN 37343
Phone (888) 344-9044 Fax (423) 826-2112
www.aquashieldinc.com

Aqua-Swirl Concentrator
Model AS-3 Horseshoe Layout STR #2 (South)
The Residence at the COR
Ramsey, MN - Project: #UWA10002

| | |
|---|---|
| Document: | AS-3 Off-Line Layout |
| Drawn By: | JCW |
| Scale: | 1:30 |
| Date: | 12/01/10 |

www.royalenterprises.net

Royal ENVIRONMENTAL SYSTEMS, Inc.
A Division of Royal Enterprises America

| | | | |
|---|---|---|---|
| PROJECT: | SUITE LIVING AT THE COR | LOCATION: | RAMSEY, MN |
| OWNER: | <ENTER OWNER> | SCALE: | NONE |
| ENGINEER: | LANDFORM | DRAWN BY: | LRH |
| CONTRACTOR: | TBD | DATE: | 11–30–10 |
| MANUFACTURER: | Royal Concrete Pipe | DWG. NO.: | RCP_SuiteCOR–Ramsey_STS1.dwg |
| PRODUCT DESIGNATION: | ecoStorm - gross particulate separation technology | | |
| DESIGNED BY: LRH | CHECK 1: RO | CHECK 2: SEG | |

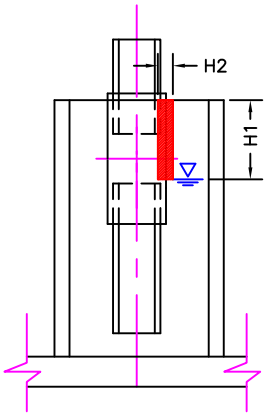
REVISIONS
.

ecoStorm

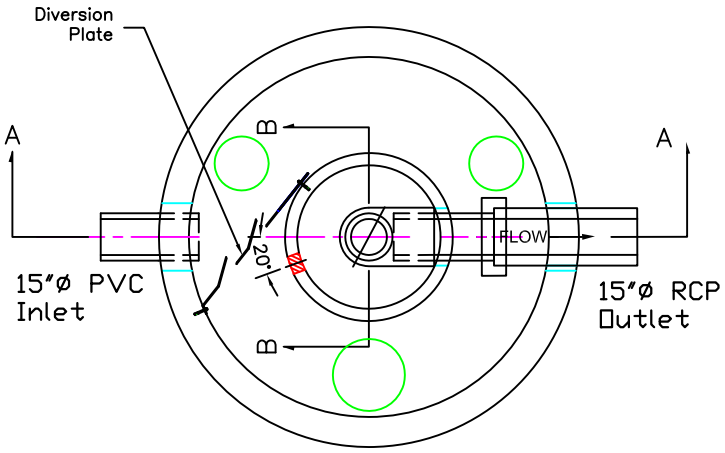
| ecoStorm model no. | D1 dia. (ft.) | D2 dia. (ft.) | D3 dia. (in.) | vertical weir H1 (in.) | vertical weir H2 (in.) | "tee" Fibergl. (in.) | Flow Diffuser |
|---|---|---|---|---|---|---|---|
| 1 | 6.00 | 2.50 | 15.00 | 18.00 | 6.00 | 15.00 | Stainless Steel Diversion Plate: ~~45°~~ ~~pvc~~ ~~(in.)~~ . |

# ecoStorm #1

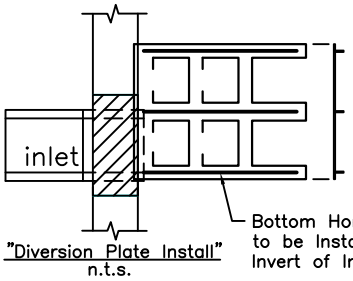
*Online*




SECTION B–B
n.t.s.

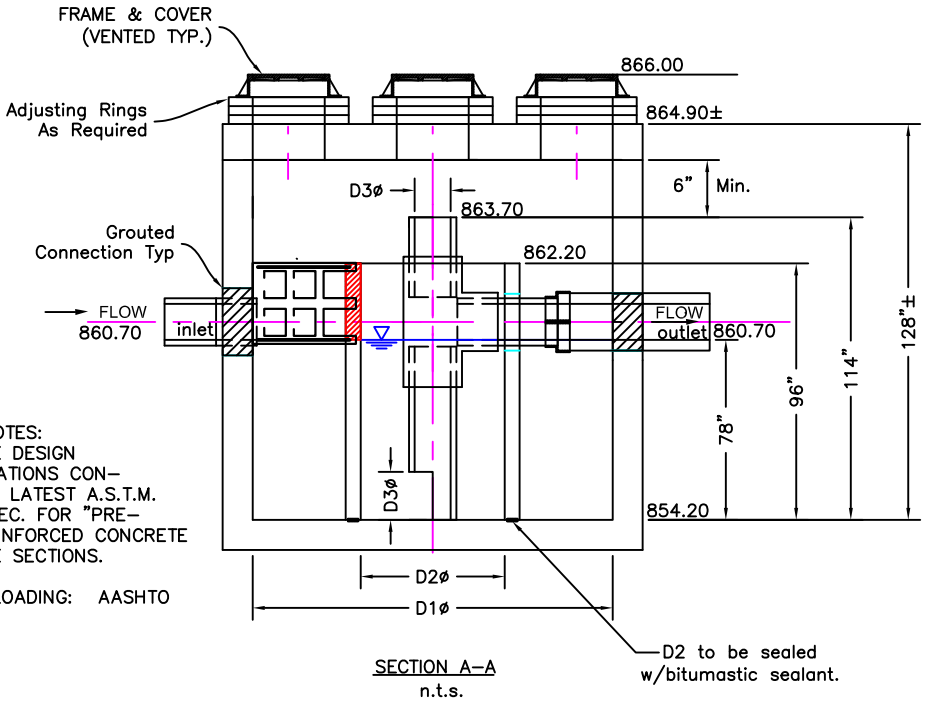



PLAN
n.t.s.

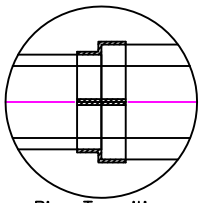



"Diversion Plate Install"
n.t.s.

Bottom Horizontal to be Installed at Invert of Inlet Pipe




SECTION A–A
n.t.s.



Pipe Transition
To be installed with flanged horizontal.

GENERAL NOTES:
MANHOLE DESIGN SPECIFICATIONS CONFORM TO LATEST A.S.T.M. C478 SPEC. FOR "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.

DESIGN LOADING: AASHTO HS25

www.royalenterprises.net

Royal ENVIRONMENTAL SYSTEMS, Inc.
A Division of Royal Enterprises America

| | | | |
|---|---|---|---|
| PROJECT: | RESIDENCE AT THE COR | LOCATION: | RAMSEY, MN |
| OWNER: | <ENTER OWNER> | SCALE: | NONE |
| ENGINEER: | LANDFORM | DRAWN BY: | LRH |
| CONTRACTOR: | TBD | DATE: | 11-30-10 |
| MANUFACTURER: | Royal Concrete Pipe | DWG. NO.: | RCP_ResidenceCOR-Ramsey_STS2.dwg |
| PRODUCT DESIGNATION: | ecoStorm - gross particulate separation technology | | |
| DESIGNED BY: LRH | CHECK 1: RO | | CHECK 2: SEG |

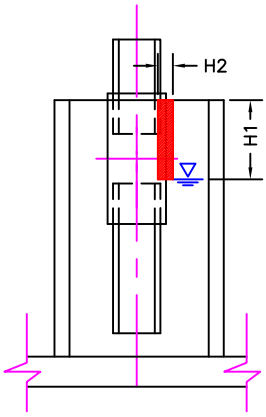
REVISIONS
.

ecoStorm

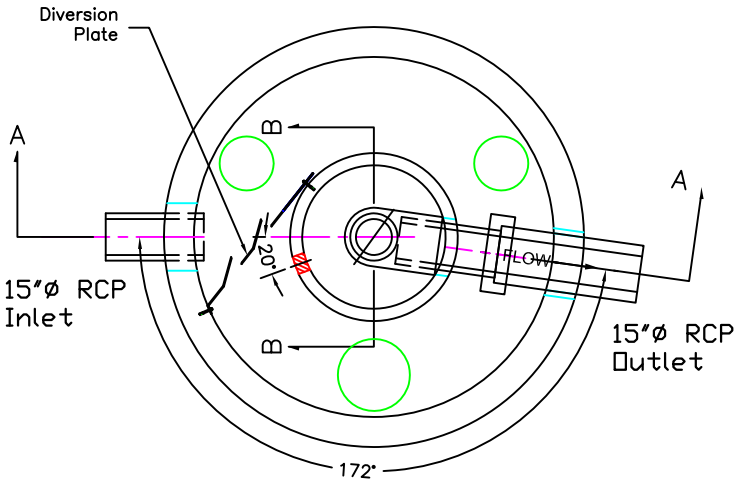
| ecoStorm model no. | D1 dia. (ft.) | D2 dia. (ft.) | D3 dia. (in.) | vertical weir H1 (in.) | vertical weir H2 (in.) | "tee" Fibergl. (in.) | Flow Diffuser |
|---|---|---|---|---|---|---|---|
| 1.5 | 7.00 | 2.50 | 15.00 | 18.00 | 6.00 | 15.00 | Stainless Steel Diversion Plate: ~~45°~~ ~~pvc~~ ~~(in.)~~ ~~.~~ |

# ecoStorm #2

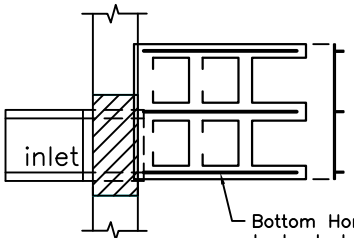
*Online*




SECTION B–B
n.t.s.

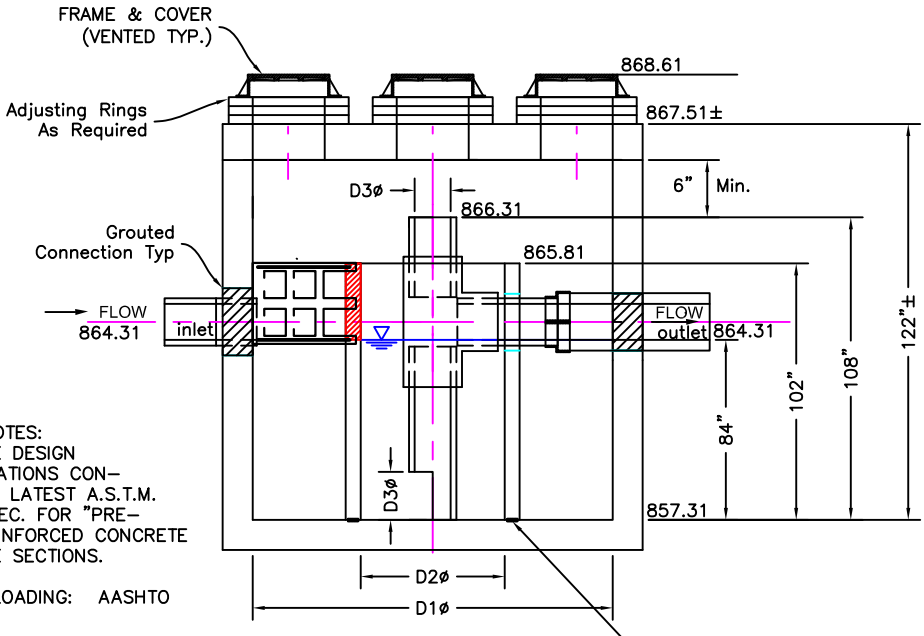



PLAN
n.t.s.

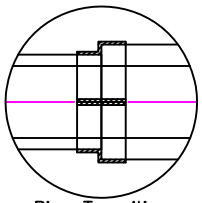



"Diversion Plate Install"
n.t.s.

Bottom Horizontal to be Installed at Invert of Inlet Pipe




SECTION A–A
n.t.s.



Pipe Transition
To be installed with flanged horizontal.

GENERAL NOTES:
MANHOLE DESIGN SPECIFICATIONS CONFORM TO LATEST A.S.T.M. C478 SPEC. FOR "PRECAST REINFORCED CONCRETE MANHOLE SECTIONS.

DESIGN LOADING: AASHTO HS25



# ecoStorm® Stormwater Treatment Specifications

## Structural, hydrodynamic, gross particulate separation technology

## Part 1.00 – General

### 1.01 Description

A. Work included:
The contractor, and/or manufacturer selected by the contractor and approved by the engineer, shall furnish all labor, commodity materials, equipment, and incidentals required and shall install the structural stormwater treatment system and appurtenances in accordance with the drawings and these specifications.

### 1.02 Quality Control Inspection

A. The structural stormwater treatment system shall be dry-fitted in the manufacturer's yard prior to shipment to the project site. The unit, when dry-fitted, shall have all component connections pre-drilled and anchored. Section joints shall be clearly marked for the contractor to properly install and align the unit in the field.

B. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection by the engineer. Such inspection may be made at the place of manufacture, on the work site after delivery, or at both locations. Sections rejected after delivery to the site shall be marked for identification and shall be removed from the site at once. Any section that has been damaged after delivery may be rejected and, if already installed, shall be acceptably repaired (if permitted) or removed and replaced, entirely at the contractor's expense.

C. All sections shall be inspected for general appearance, dimensions, soundness, etc. The surface shall be dense, close-textured, and free of excess bug holes, cracks, roughness, and exposure of reinforcement.

D. Imperfections may be repaired, subject to the acceptance of the engineer. Repairs shall be carefully inspected before final acceptance.

### 1.03 Submittals

A. Shop drawings:
The contractor shall submit to the engineer six sets of shop drawings and the corresponding hydraulic sizing and calibration for the specific site for which the stormwater treatment system has been designed prior to release of bid documents.

## Part 2.00 – Products

### 2.01 Materials and Design

The structural stormwater treatment system shall be made of pre-cast concrete. The manufacturer shall be a member of the American Concrete Pipe Association or the National Pre-cast Concrete Association and meet the following manufacturing requirements:

A. Structures shall be designed to comply with ASTM Designation C-478.

B. Sections shall have watertight joints consisting of either gasketed joints per ASTM C-443, or a butyl mastic sealant conforming to ASTM C-990.

C. Pipe openings shall be provided with a flexible rubber sleeve per ASTM C-923, or shall be made watertight by the contractor with cement mortar, and shall be sized to accept pipes of the specified size(s) and material(s).

D. Internal components shall be made of stainless steel, fiberglass, and/or high density polyethylene (HDPE).

E. Casting for manhole frames and covers shall be vented and per the governing city's requirements.

F. All sections shall be cured by an approved method. Sections shall not be shipped until the concrete has attained a compressive strength of 4,000 psi.

### 2.02 Hydraulic Design

The specified stormwater treatment system shall be hydraulically designed for the specific site in which it will be installed. The calibration of the specified system shall account for peak flow rates (supplied to specified stormwater treatment system company by owner/engineer) that correspond with predetermined regional rainfall data to maintain peak removal efficiencies and to not cause upstream flooding or pooling of stormwater.

The structural stormwater treatment system shall consist of one round pre-cast concrete structure (D1) with another smaller diameter structure (D2) housed within the main structure D1. The D2 structure should be integrally cast or sealed with a bitumastic sealant to the base of the D1 structure.

The D1 structure shall have an on-center, mechanically fastened inlet deflector plate that induces a swirling flow pattern between the D1 and the D2 walls. This area will accumulate, store and retain captured/settled solids deposited by numerous storm events and prevent washout of separated solid pollutants under peak design flow until which time the maximum storage volume of solid contaminants is reached.

The D3 internal piping shall be fiberglass or PVC and designed to discharge clean water downstream, while retaining floatable debris within the structure to a defined peak flow rate.

## 2.03 Device Testing and Analysis

The following minimum testing standards are critical to ensure proper design and function of the stormwater treatment system:

- Testing was performed using a full scale unit to minimize scaling error.
- Testing, data analysis, and development of the performance function was performed by an independent 3rd party.
- Removal efficiencies were determined by using a sediment mass balance approach to ensure accurate measurement. No automated samplers or grab samples were utilized to determine device removal efficiency.
- Water temperature was recorded during testing and water viscosity is accounted for in the device performance function.
- Testing was performed with several wholly independent particle sizes or particle size distributions (able to be separated by sieving) to promote repeatability of tests and development of an accurate performance function applicable to a wide range of particle sizes.
- Each test must be repeated a minimum of three times with all input values ~constant (e.g. flow rate, temp., influent sediment concentration, etc.). Test repeatability must be sufficiently accurate as to result in a greater than 95% confidence of the final performance function when including all testing data points.
- A performance function must be created using the testing data and provide for scaling of the treatment unit; allowing for design variability of the unit dimensions, flow rate, and sediment gradation at a minimum.
- Testing must be performed to determine not only the device removal efficiency, but also the devices ability to retain previously captured material.

## 2.04 Performance

The device(s) shall meet and utilize the testing and analysis requirements listed in Section 2.03 above to meet the following treatment targets (default treatment targets are based on the ecoStorm design guidelines):

- 80% TSS removal
- Particle size of 110 microns
- Flow rate generated during a 1” storm event

The device must also be capable of conveying the peak flow, as defined by the engineer, with negligible hydraulic impacts to the upstream storm sewer system and minimal washout of previously captured material.

## 2.05 Manufacturer

The structural stormwater treatment system shall be the ecoStorm® Stormwater Treatment System as manufactured by Royal Environmental Systems of Stacy, Minnesota, or an authorized manufacturer approved by Royal Environmental Systems to produce the ecoStorm Stormwater Treatment System.

## Part 3.00 – Execution

### 3.01 Installation

A. The structural stormwater treatment system shall be constructed according to the sizes shown on the drawings and as specified herein. Install at elevations and locations shown on the drawings or as otherwise directed by the engineer.
B. Place the pre-cast base units on a granular sub-base in accordance with the governing city's requirements. The granular sub-base shall be checked for level prior to setting and the pre-cast base sections of the stormwater treatment system shall be checked with a horizontal level at four quadrants after setting. If the slope exceeds 0.25%, the base section shall be removed and the granular excavation floor material re-leveled.
C. The ecoStorm Stormwater Treatment System is designed to be watertight. The final installation must guarantee a watertight structure either through infiltration or exfiltration testing. Failure to achieve a watertight structure is grounds for rejection.

**END OF SECTION**