

# **Oak & Cobb**

## **Drainage Report**

**September 13, 2016**

**Prepared For:** City of Jonesboro  
**Prepared By:** Robert Helvey, EIT  
**Reviewed By:** Brahm Driver, PE



**Ecological Design Group, Inc.**



LANDSCAPE ARCHITECTURE  
CIVIL ENGINEERING  
ENVIRONMENTAL PLANNING

**ECOLOGICAL DESIGN GROUP, INC.**

120 South Izard Street      210 East Merriman Ave.  
Little Rock, AR 72201      Wynne, Arkansas 72396



## Technical Memo

**To:** City of Jonesboro  
**From:** Brahm Driver, PE  
**Date:** September 14, 2016  
**Re:** Oak & Cobb - Stormwater Calculations

---

Ecological Design Group, Inc. (EDG) is submitting this technical memo and drainage report with stormwater calculations for your review and approval.

EDG performed the hydrologic and hydraulic analysis of the existing and proposed conditions for the proposed Oak & Cobb project located on the SW corner of the E Oak Ave. and Cobb St. intersection (Approximate WGS84 Coordinates: 35.833676, -90.702121). The project will consist of a proposed multifamily building, four (4) single family houses, asphalt parking, a rain garden, and sidewalk improvements. Attached to this memo are the stormwater calculations, associated drainage maps and other documentation required by the City of Jonesboro's Stormwater Drainage Design Manual (2008, Revised February 2009).

**Project:** Oak & Cobb

**Location:** SW corner of the E Oak Ave. and Cobb St. intersection  
(Approximate WGS84 Coordinates: 35.833676, -90.702121)

**Engineer:** Brahm Driver  
314 South 3<sup>rd</sup> Street  
Rogers, Arkansas 72756  
(479) 935-4826

### **PROJECT DESCRIPTION**

The project will consist of a proposed multifamily building, four (4) single family houses, asphalt parking, a rain garden, and sidewalk improvements. The site is approximately 0.66 acres.

## **DESIGN POINT(S)**

There are two (2) drainage design points for this project. Design Point 1 (DPI) is at the NE corner of the site. Design Point 2 (DP2) is at the SE corner of the site.

## **PRE-DEVELOPMENT**

The site predominantly single family homes with grassed backyards and several trees, concrete/asphalt driveways, and public sidewalk.

## **POST-DEVELOPMENT**

The site will include a proposed multifamily building, four (4) single family houses, asphalt parking, a rain garden, and sidewalk improvements. Open areas will be lawn (sod) unless otherwise indicated on the landscape plans.

## **ANALYSIS**

Table 1 displays the pre-development peak rates:

Table 1: Pre-Development Runoff Values

	<b>PRE-DEVELOPMENT RUNOFF (CFS)</b>					
	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>
<b>DPI</b>	0.95	1.25	1.51	1.76	1.97	2.20
<b>DP2</b>	2.29	3.02	3.64	4.25	4.76	5.32

Table 2 displays the post-development peak rates:

Table 2: Post-Development Runoff Values

	<b>POST-DEVELOPMENT RUNOFF (CFS)</b>					
	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>
<b>DPI</b>	0.72	0.95	1.14	1.33	1.49	1.66
<b>DP2</b>	2.21	2.88	3.44	4.00	4.47	4.98

Table 3 displays the comparison between pre and post development peak rates (The negative numbers correspond to a reduction of peak rates from the pre to post condition):

Table 3: Post-Development Minus Pre-Development

	<b>POST MINUS PRE-DEVELOPMENT RUNOFF (CFS)</b>					
	<b>2</b>	<b>5</b>	<b>10</b>	<b>25</b>	<b>50</b>	<b>100</b>
<b>DPI</b>	-0.23	-0.30	-0.37	-0.43	-0.48	-0.54
<b>DP2</b>	-0.08	-0.14	-0.20	-0.25	-0.29	-0.34

As seen in the tables above, there is not an increase between peak pre-development and peak post-development rates for the 2, 10, 25, 50 and 100 year storms.

All pertinent drainage information and analysis can be found attached to this memo. The hydrologic calculations were performed using the SCS method and HydroCAD Version 10.00 stormwater modeling software. Please refer to the attached calculations for your review and reference as necessary.

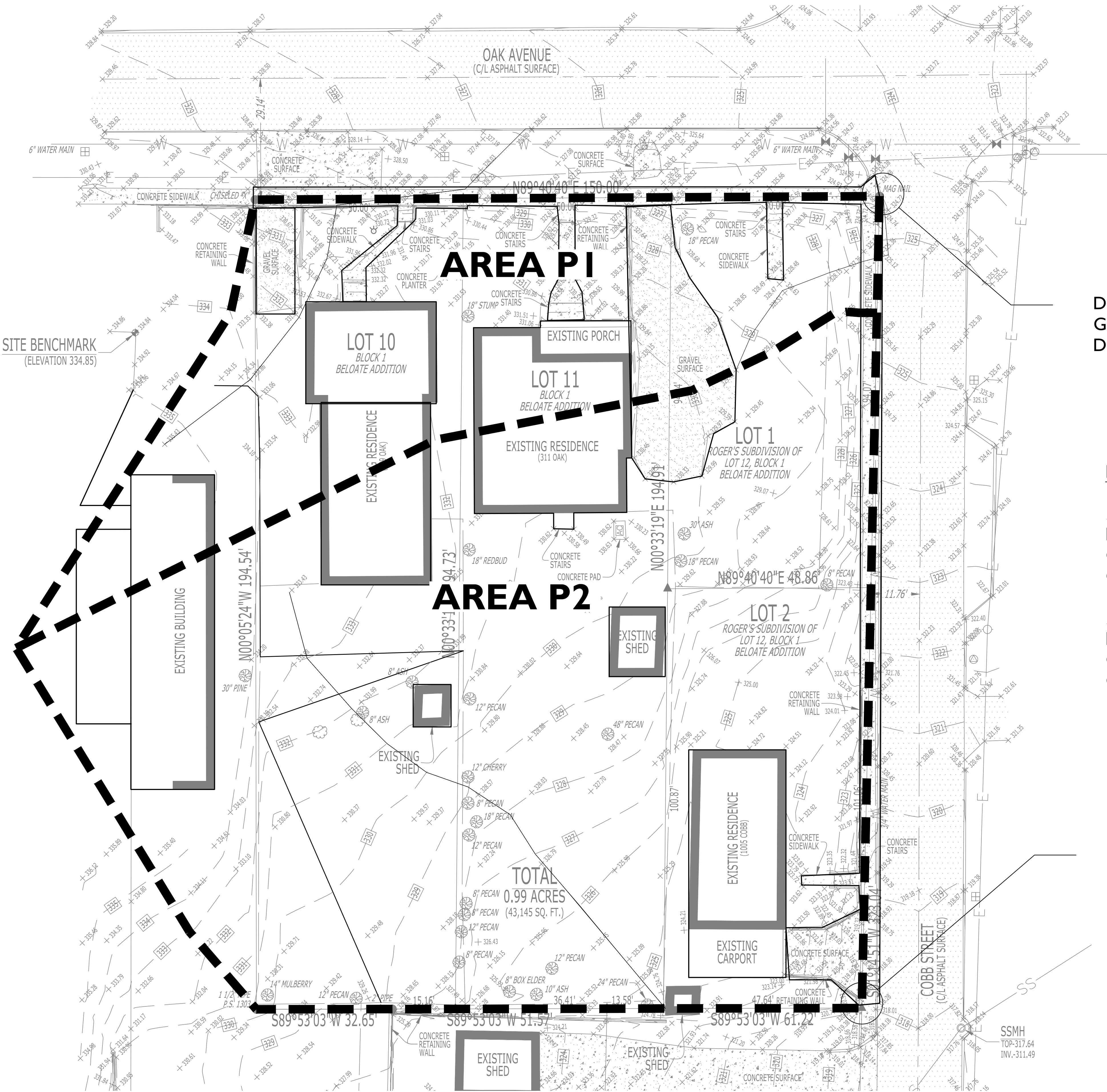
If you need any additional information or have any questions, please do not hesitate to contact me at (501) 944-3090.

Sincerely,

Ecological Design Group, Inc.



Brahm Driver, PE



DESIGN POINT 1  
GUTTER LINE AT SW CORNER OF OAK AND COBB  
DRAINAGE AREA 9,500 SF (APPROX)

PRE-DEVELOPMENT AREA SUMMARY

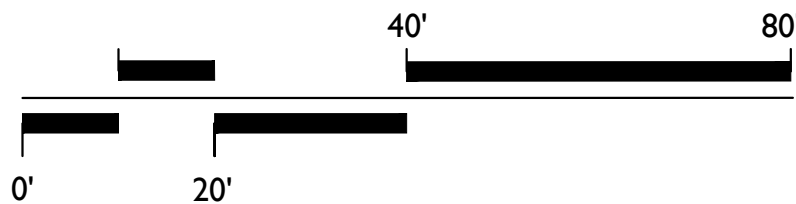
AREA E1 (TOTAL AREA = 9,585 SF)  
IMPERVIOUS = 3,587 SF  
GRAVEL = 788 SF  
GRASS (FAIR, HSG C) = 5,210 SF

AREA E2 (TOTAL AREA = 24,488 SF)  
IMPERVIOUS = 5,354 SF  
GRAVEL = 450 SF  
GRASS (FAIR, HSG C) = 18,684 SF

DESIGN POINT 2  
GUTTER LINE ON WEST SIDE OF COBB  
DRAINAGE AREA 24,500 SF (APPROX)

**PRE-DEVELOPMENT DRAINAGE MAP**

SCALE: NTS



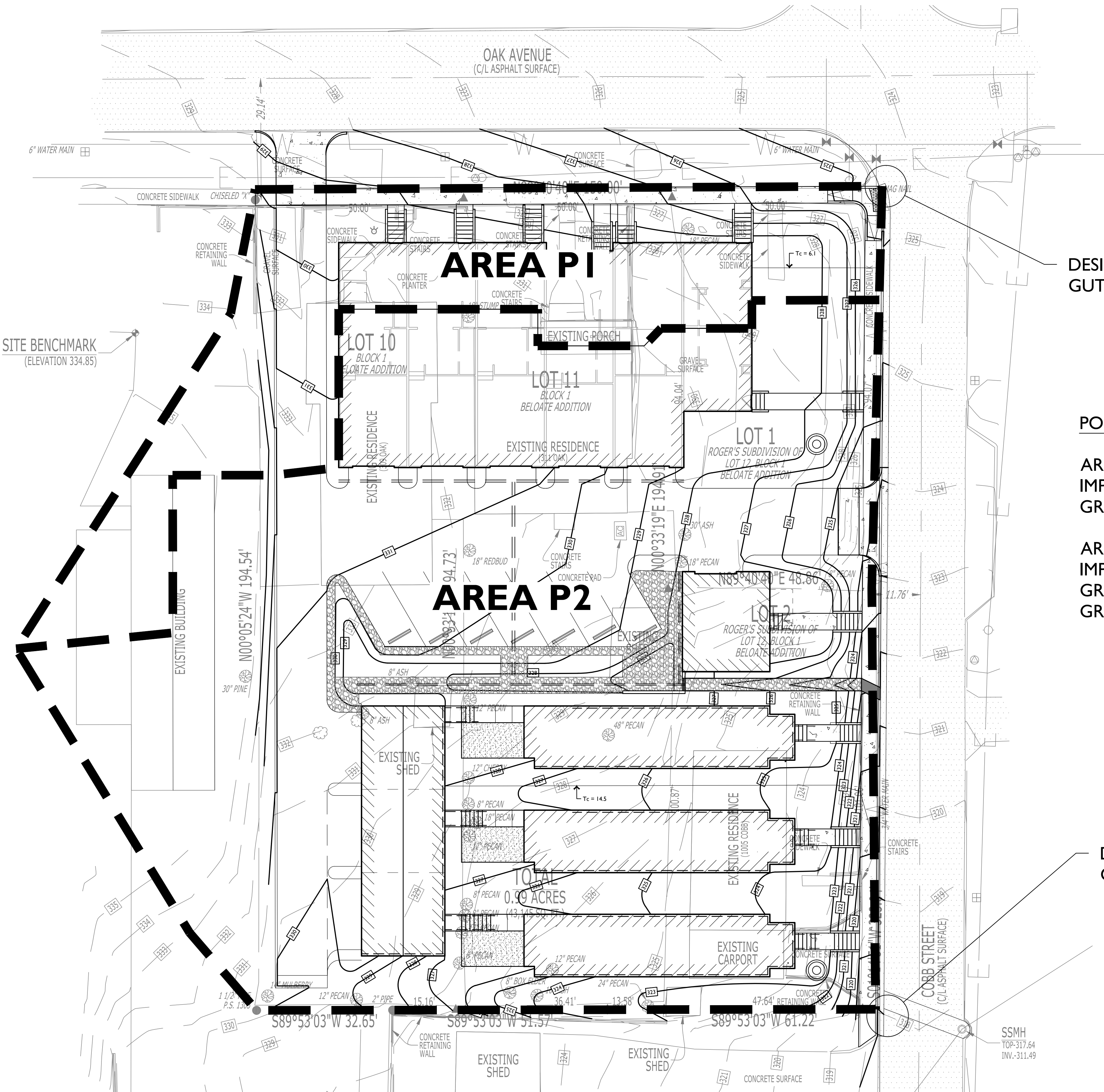
Know what's below.  
Call before you dig.

REVISIONS	

SHEET TITLE	
ISSUE DATE	

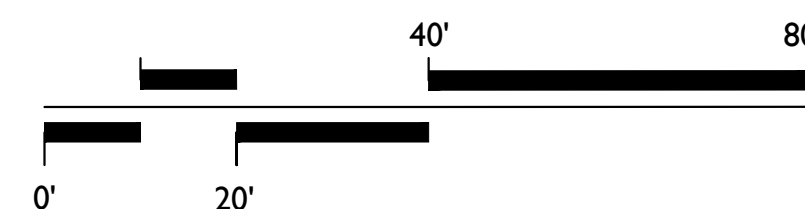
SHEET NO.





1 POST-DEVELOPMENT DRAINAGE MAP

SCALE: NTS



DESIGN POINT 1  
GUTTER LINE AT SW CORNER OF OAK AND COBB

POST-DEVELOPMENT AREA SUMMARY

AREA P1 (TOTAL AREA = 7,180 SF)  
IMPERVIOUS = 4,016 SF  
GRASS (GOOD, HSG C) = 3,164 SF

AREA P2 (TOTAL AREA = 27,450 SF)  
IMPERVIOUS = 15,979 SF  
GRAVEL = 1381 SF  
GRASS (GOOD, HSG C) = 10,090 SF

DESIGN POINT 2  
GUTTER LINE ON WEST SIDE OF COBB

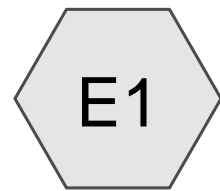
REVISIONS	

SHEET TITLE	
ISSUE DATE	

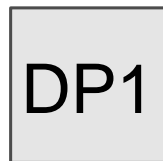
SHEET NO.



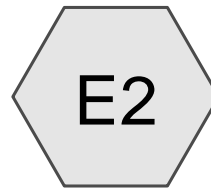
Know what's below.  
Call before you dig.



AREA/E1



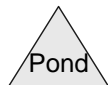
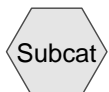
Design Point 1



AREA/E2



Design Point 2



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

Page 2

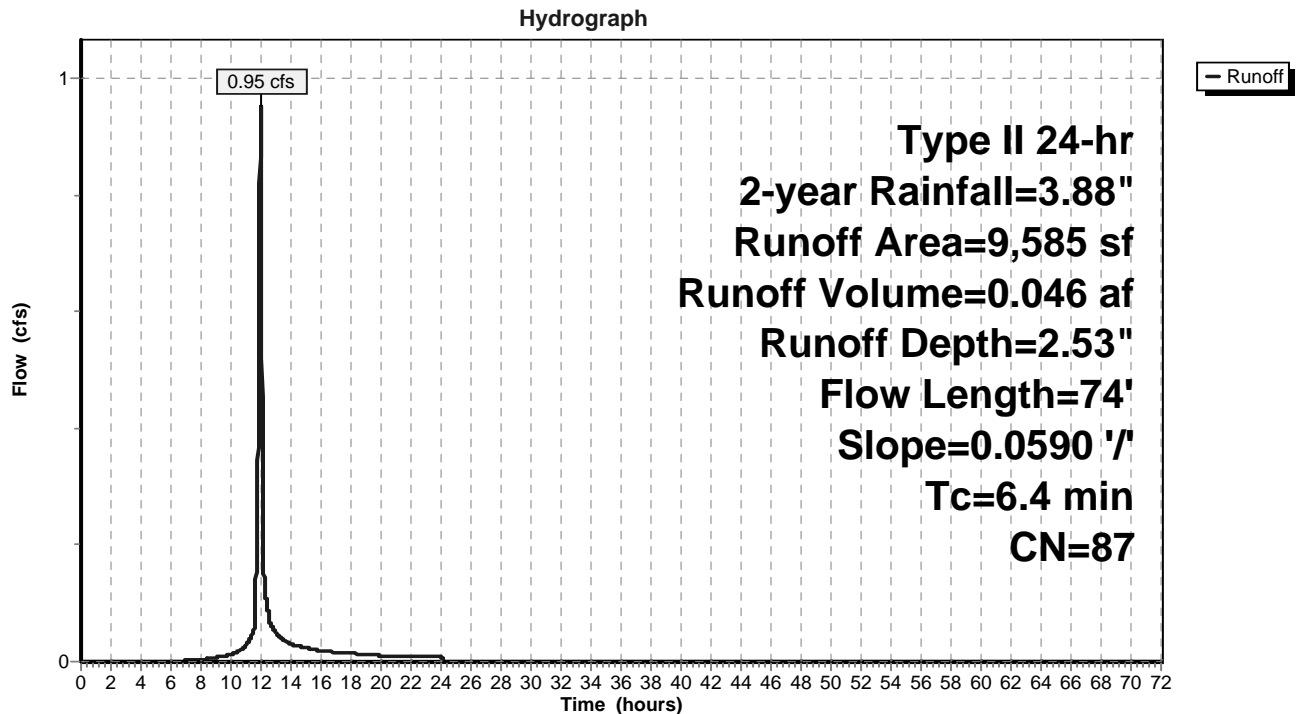
**Summary for Subcatchment E1: AREA E1**

Runoff = 0.95 cfs @ 11.98 hrs, Volume= 0.046 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 2-year Rainfall=3.88"

Area (sf)	CN	Description
3,587	98	Paved parking, HSG C
788	89	Gravel roads, HSG C
5,210	79	50-75% Grass cover, Fair, HSG C
9,585	87	Weighted Average
5,998		62.58% Pervious Area
3,587		37.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	74	0.0590	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 4.08"

**Subcatchment E1: AREA E1**



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

Page 3

**Summary for Subcatchment E2: AREA E2**

Runoff = 2.29 cfs @ 11.99 hrs, Volume= 0.118 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 2-year Rainfall=3.88"

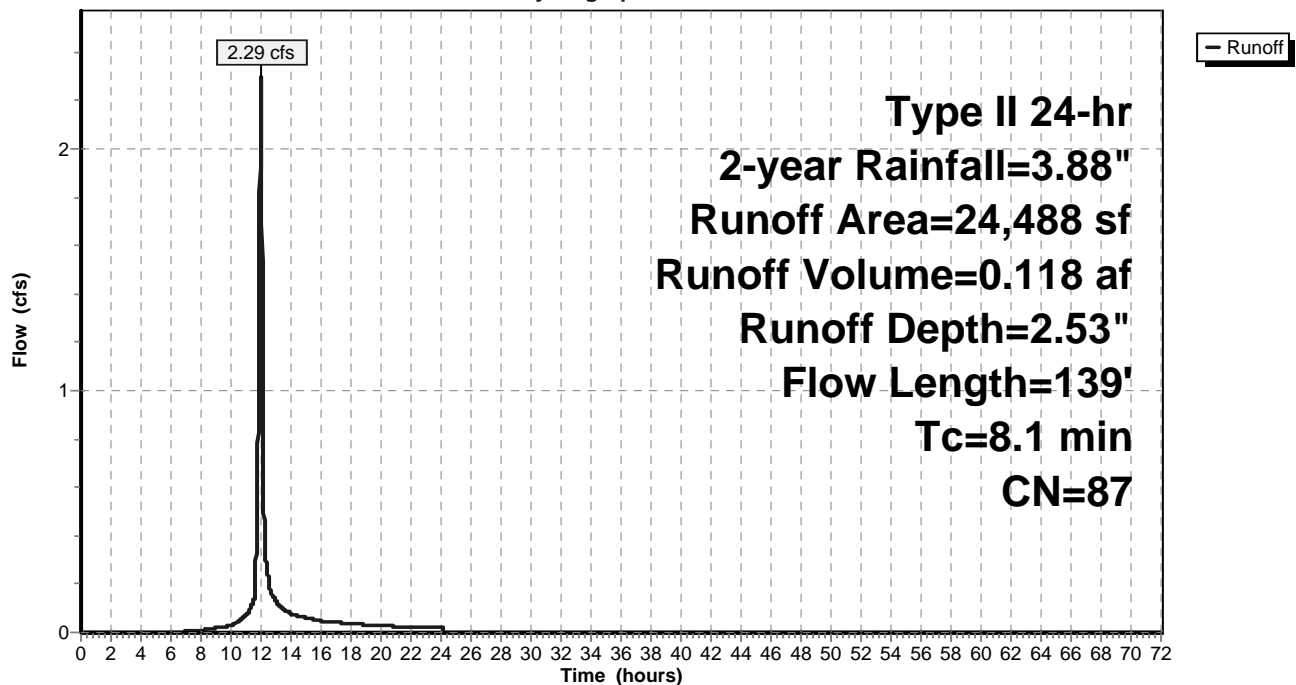
Area (sf)	CN	Description
18,684	84	50-75% Grass cover, Fair, HSG D
5,354	98	Paved parking, HSG C
450	89	Gravel roads, HSG C
24,488	87	Weighted Average
19,134		78.14% Pervious Area
5,354		21.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0703	0.22		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 4.08"
0.5	39	0.0410	1.42		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
8.1	139	Total			

**Subcatchment E2: AREA E2**

Hydrograph



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

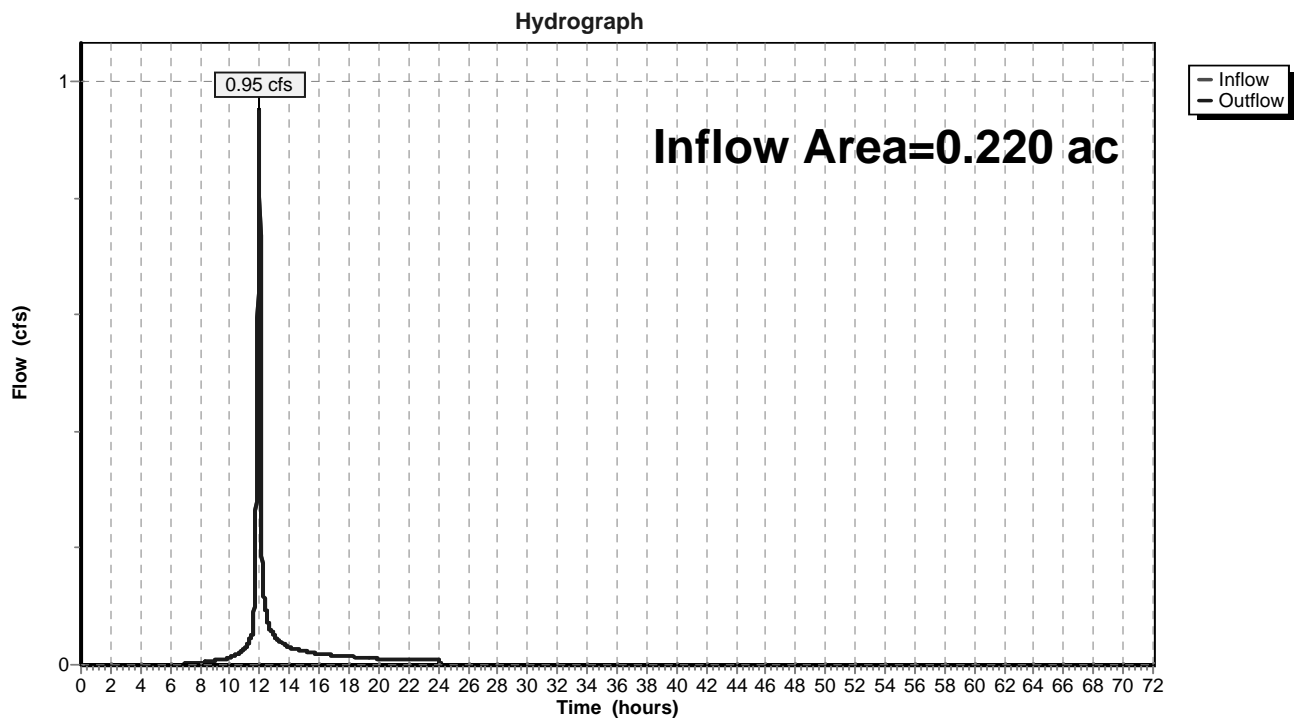
Page 4

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.220 ac, 37.42% Impervious, Inflow Depth = 2.53" for 2-year event  
Inflow = 0.95 cfs @ 11.98 hrs, Volume= 0.046 af  
Outflow = 0.95 cfs @ 11.98 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

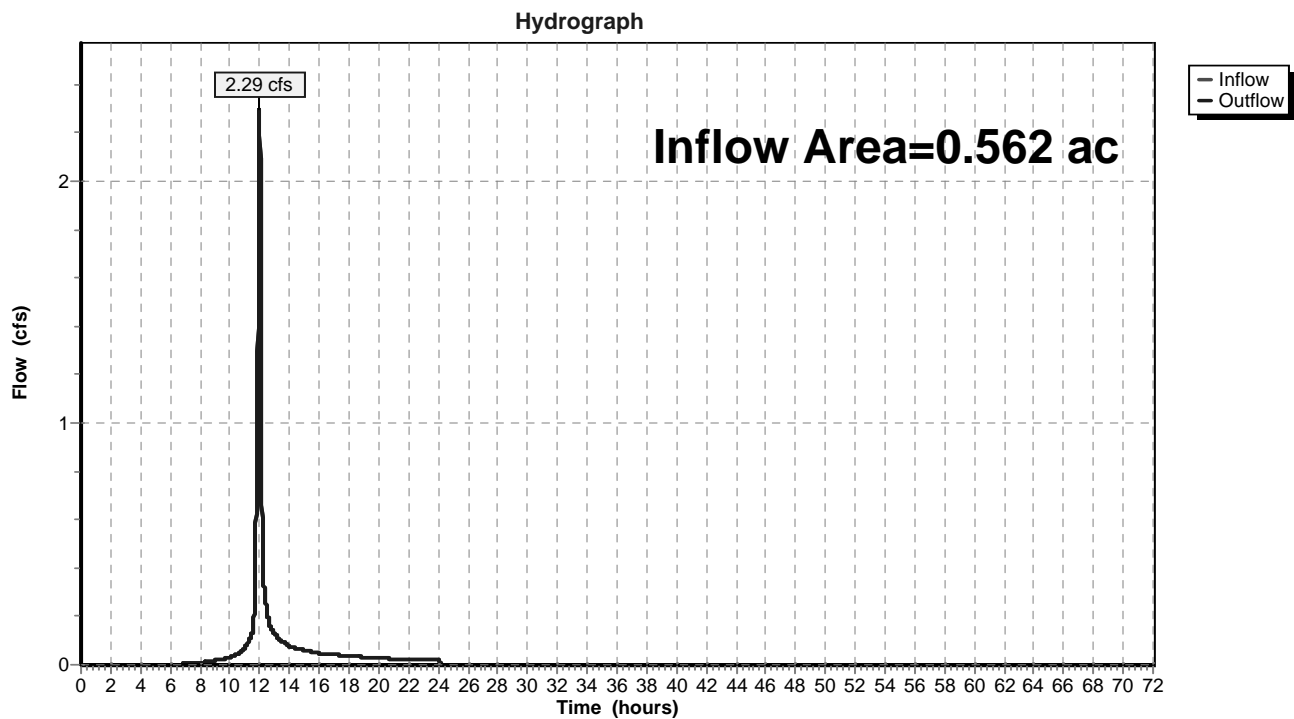
Page 5

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.562 ac, 21.86% Impervious, Inflow Depth = 2.53" for 2-year event  
Inflow = 2.29 cfs @ 11.99 hrs, Volume= 0.118 af  
Outflow = 2.29 cfs @ 11.99 hrs, Volume= 0.118 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

Page 6

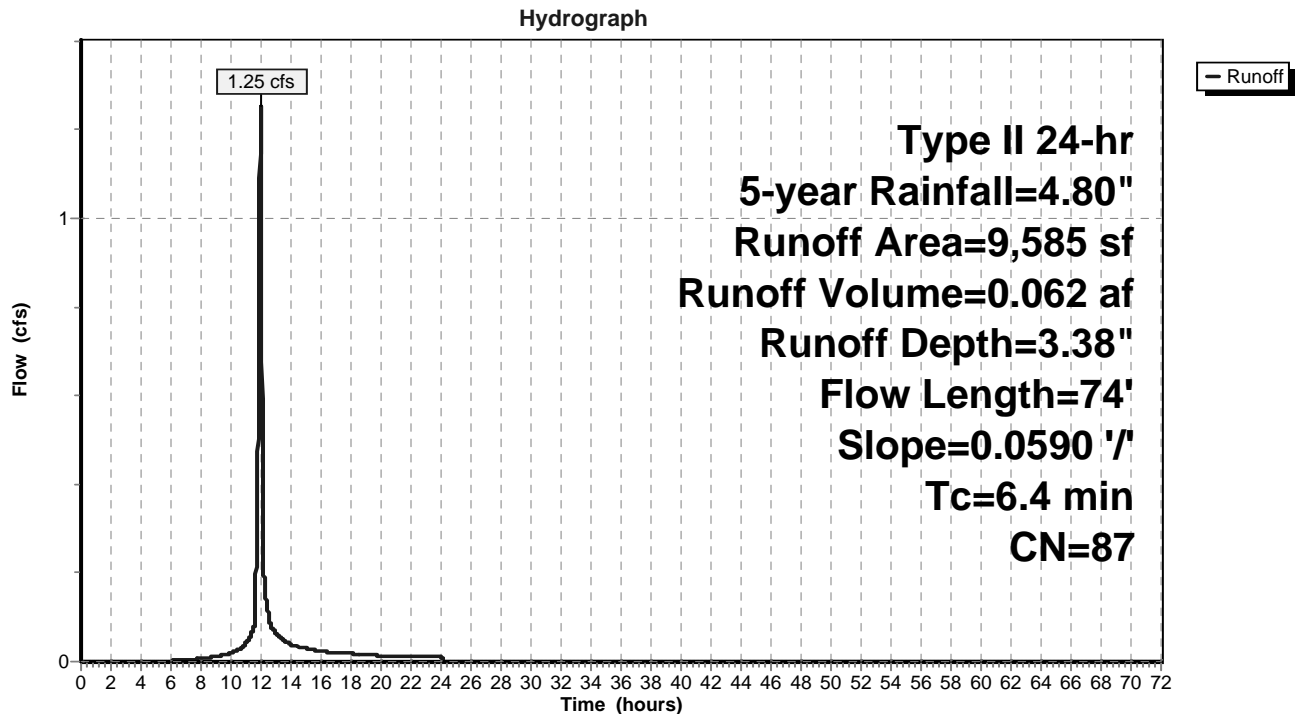
**Summary for Subcatchment E1: AREA E1**

Runoff = 1.25 cfs @ 11.97 hrs, Volume= 0.062 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 5-year Rainfall=4.80"

Area (sf)	CN	Description
3,587	98	Paved parking, HSG C
788	89	Gravel roads, HSG C
5,210	79	50-75% Grass cover, Fair, HSG C
9,585	87	Weighted Average
5,998		62.58% Pervious Area
3,587		37.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	74	0.0590	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 4.08"

**Subcatchment E1: AREA E1**

**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

Page 7

**Summary for Subcatchment E2: AREA E2**

Runoff = 3.02 cfs @ 11.99 hrs, Volume= 0.158 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 5-year Rainfall=4.80"

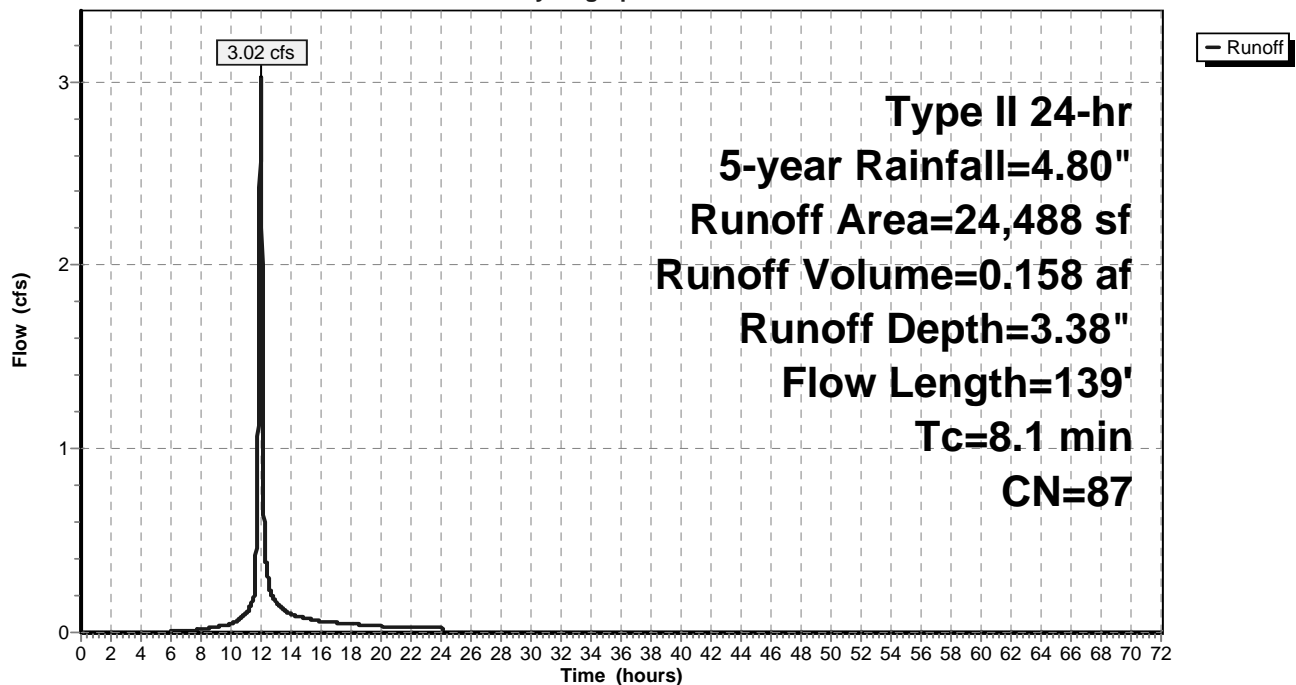
Area (sf)	CN	Description
18,684	84	50-75% Grass cover, Fair, HSG D
5,354	98	Paved parking, HSG C
450	89	Gravel roads, HSG C
24,488	87	Weighted Average
19,134		78.14% Pervious Area
5,354		21.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0703	0.22		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 4.08"
0.5	39	0.0410	1.42		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
8.1	139	Total			

**Subcatchment E2: AREA E2**

Hydrograph



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

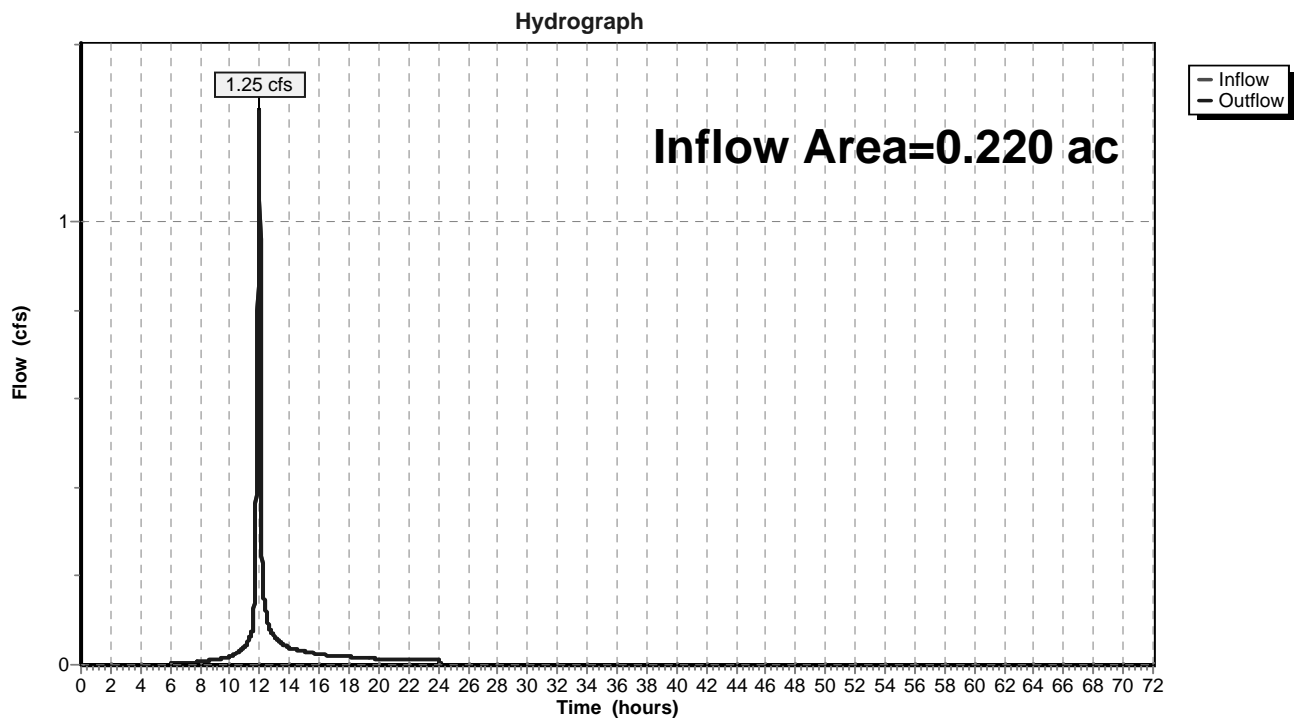
Page 8

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.220 ac, 37.42% Impervious, Inflow Depth = 3.38" for 5-year event  
Inflow = 1.25 cfs @ 11.97 hrs, Volume= 0.062 af  
Outflow = 1.25 cfs @ 11.97 hrs, Volume= 0.062 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1





## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

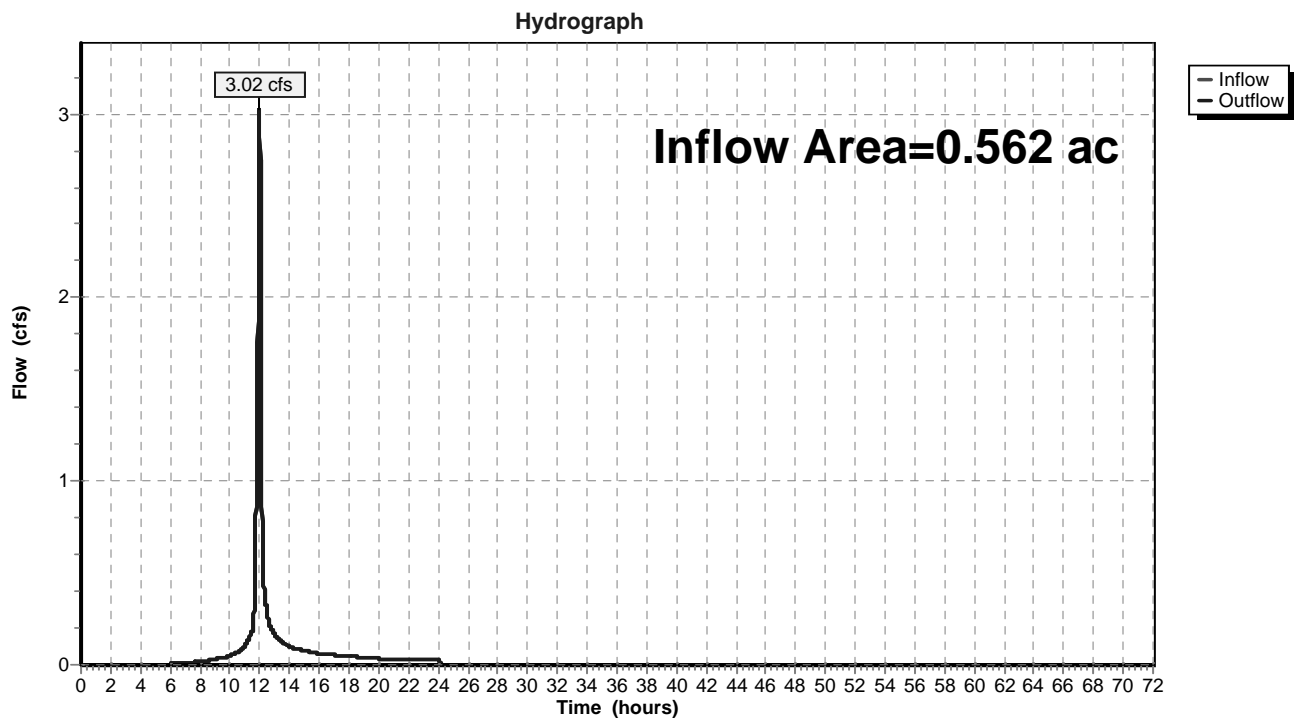
Page 9

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.562 ac, 21.86% Impervious, Inflow Depth = 3.38" for 5-year event  
Inflow = 3.02 cfs @ 11.99 hrs, Volume= 0.158 af  
Outflow = 3.02 cfs @ 11.99 hrs, Volume= 0.158 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

Page 10

**Summary for Subcatchment E1: AREA E1**

Runoff = 1.51 cfs @ 11.97 hrs, Volume= 0.075 af, Depth= 4.12"

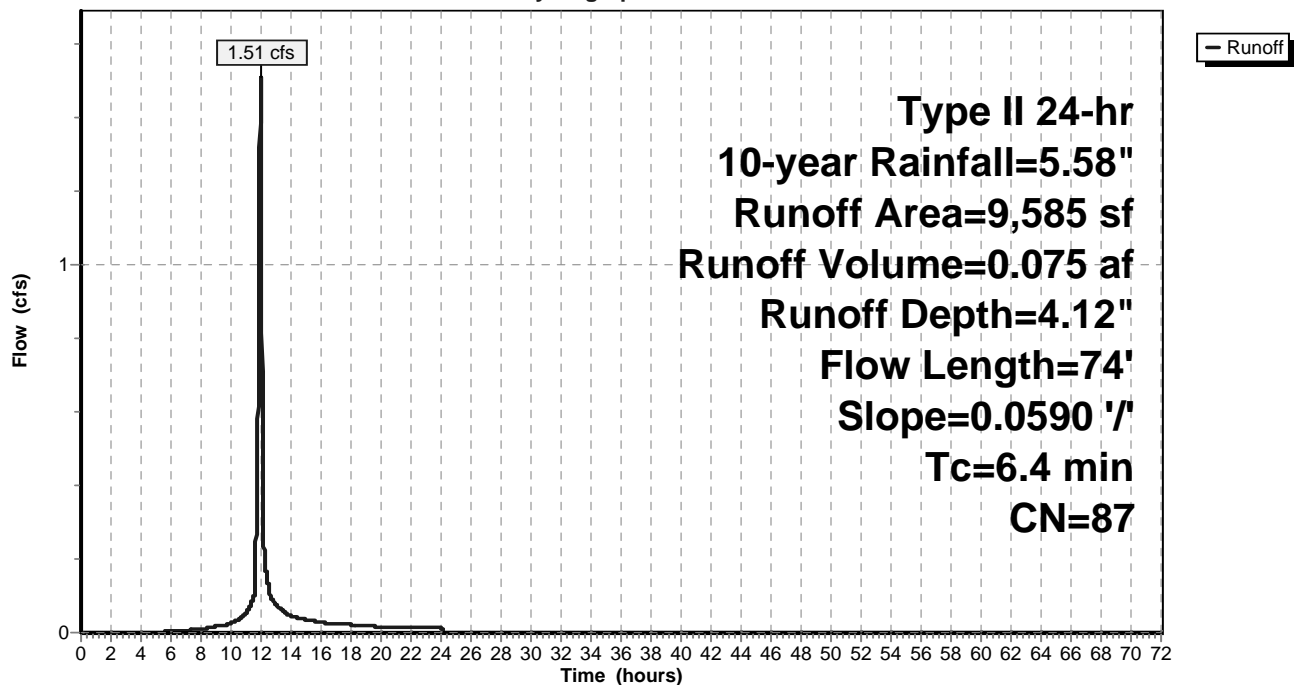
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 10-year Rainfall=5.58"

Area (sf)	CN	Description
3,587	98	Paved parking, HSG C
788	89	Gravel roads, HSG C
5,210	79	50-75% Grass cover, Fair, HSG C
9,585	87	Weighted Average
5,998		62.58% Pervious Area
3,587		37.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	74	0.0590	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 4.08"

**Subcatchment E1: AREA E1**

Hydrograph



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

Page 11

**Summary for Subcatchment E2: AREA E2**

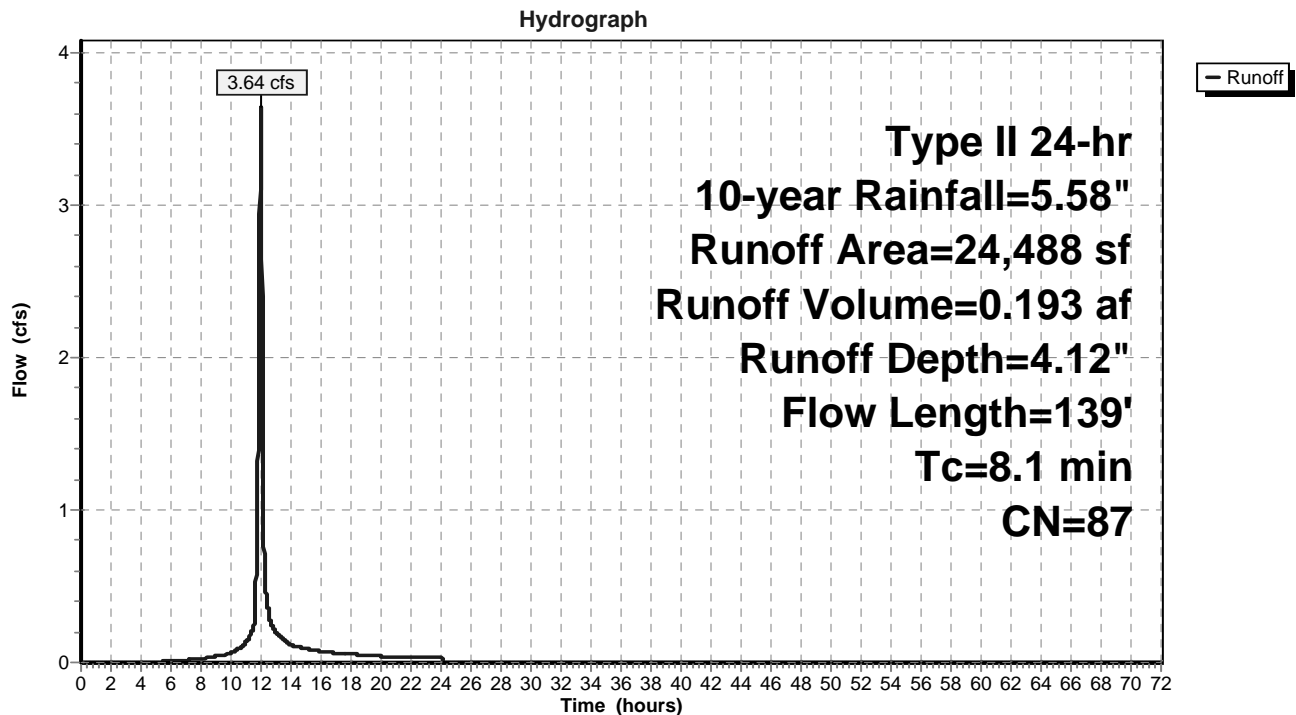
Runoff = 3.64 cfs @ 11.99 hrs, Volume= 0.193 af, Depth= 4.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 10-year Rainfall=5.58"

Area (sf)	CN	Description
18,684	84	50-75% Grass cover, Fair, HSG D
5,354	98	Paved parking, HSG C
450	89	Gravel roads, HSG C
24,488	87	Weighted Average
19,134		78.14% Pervious Area
5,354		21.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0703	0.22		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 4.08"
0.5	39	0.0410	1.42		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
8.1	139	Total			

**Subcatchment E2: AREA E2**

## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

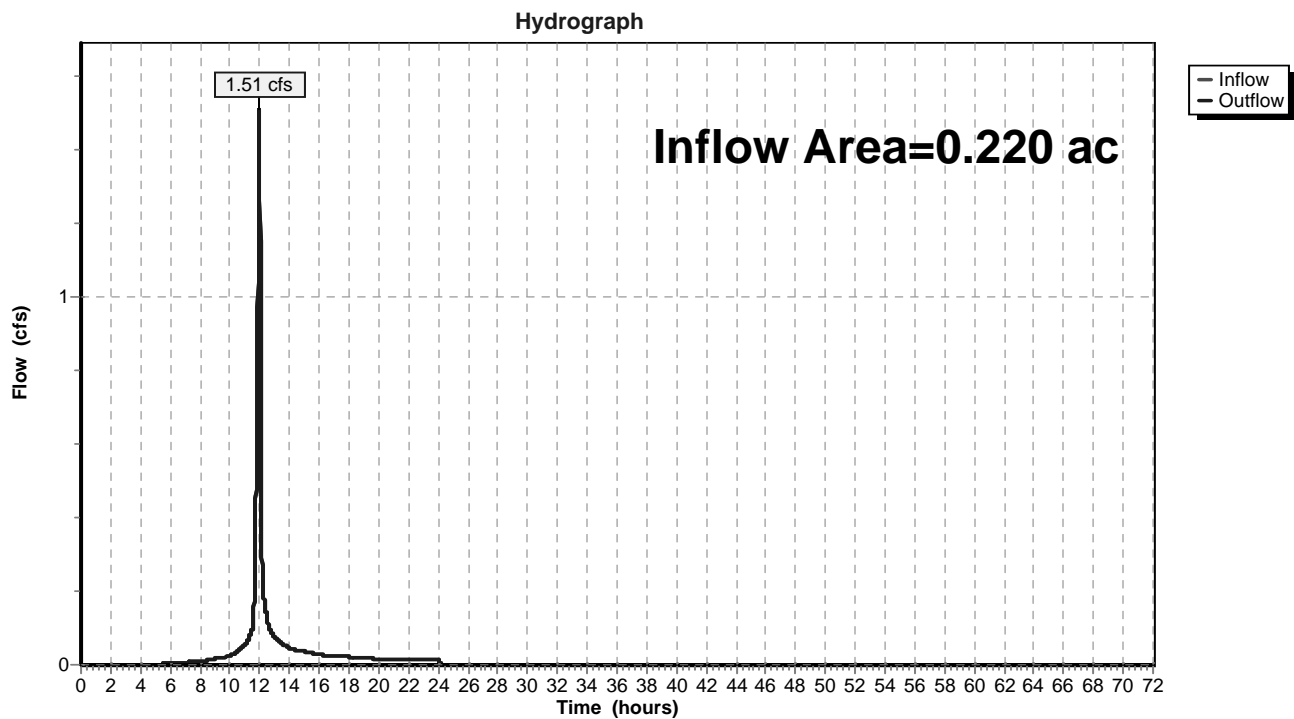
Page 12

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.220 ac, 37.42% Impervious, Inflow Depth = 4.12" for 10-year event  
Inflow = 1.51 cfs @ 11.97 hrs, Volume= 0.075 af  
Outflow = 1.51 cfs @ 11.97 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

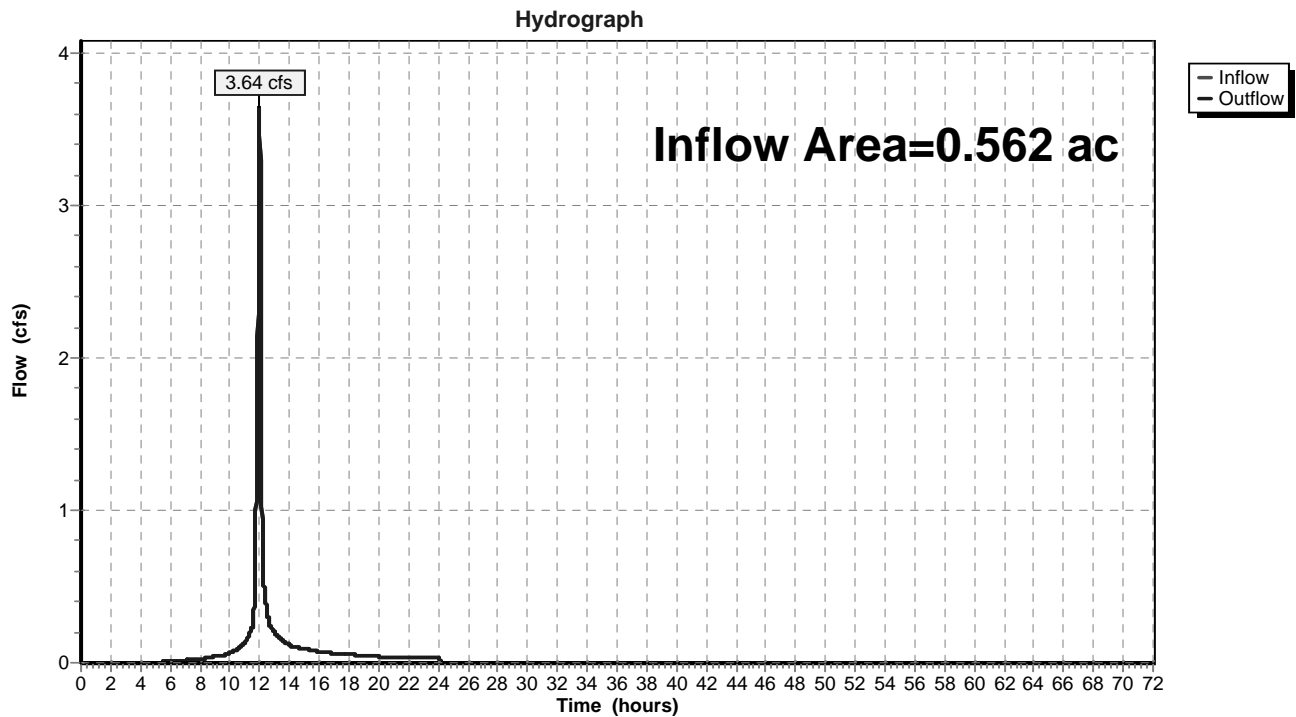
Page 13

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.562 ac, 21.86% Impervious, Inflow Depth = 4.12" for 10-year event  
Inflow = 3.64 cfs @ 11.99 hrs, Volume= 0.193 af  
Outflow = 3.64 cfs @ 11.99 hrs, Volume= 0.193 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

Page 14

**Summary for Subcatchment E1: AREA E1**

Runoff = 1.76 cfs @ 11.97 hrs, Volume= 0.089 af, Depth= 4.85"

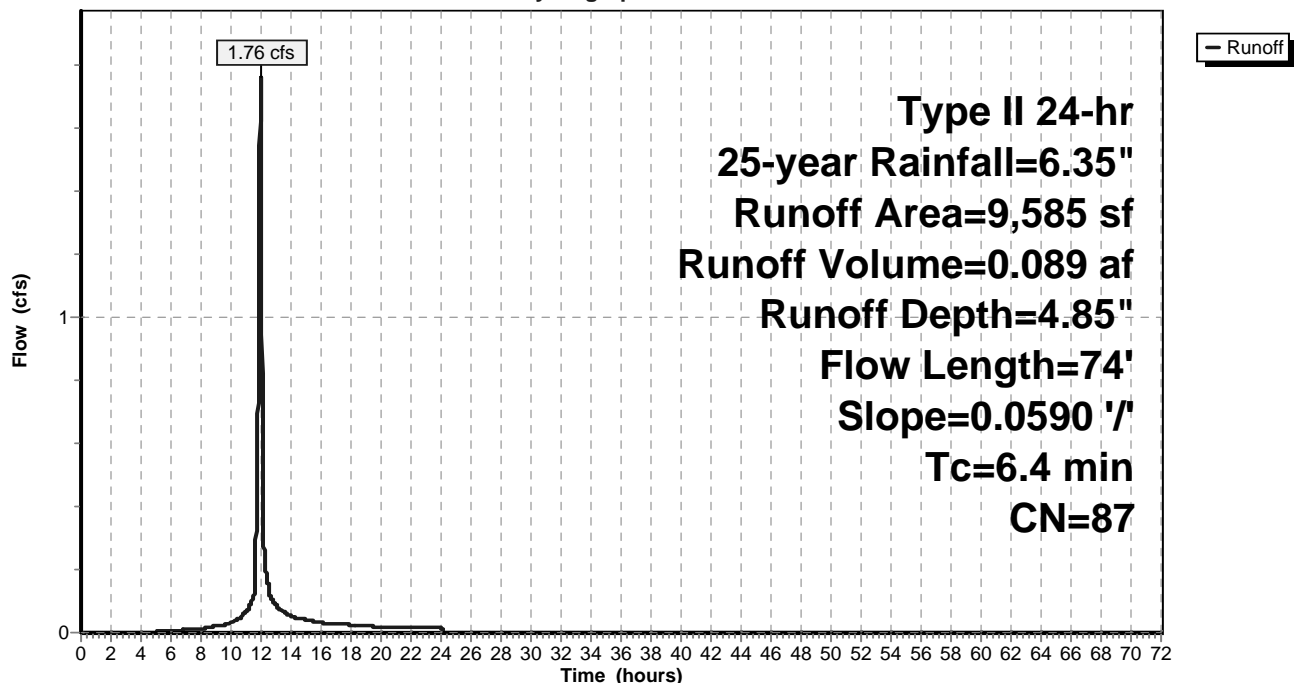
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 25-year Rainfall=6.35"

Area (sf)	CN	Description
3,587	98	Paved parking, HSG C
788	89	Gravel roads, HSG C
5,210	79	50-75% Grass cover, Fair, HSG C
9,585	87	Weighted Average
5,998		62.58% Pervious Area
3,587		37.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	74	0.0590	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 4.08"

**Subcatchment E1: AREA E1**

Hydrograph





**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

Page 15

**Summary for Subcatchment E2: AREA E2**

Runoff = 4.25 cfs @ 11.99 hrs, Volume= 0.227 af, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 25-year Rainfall=6.35"

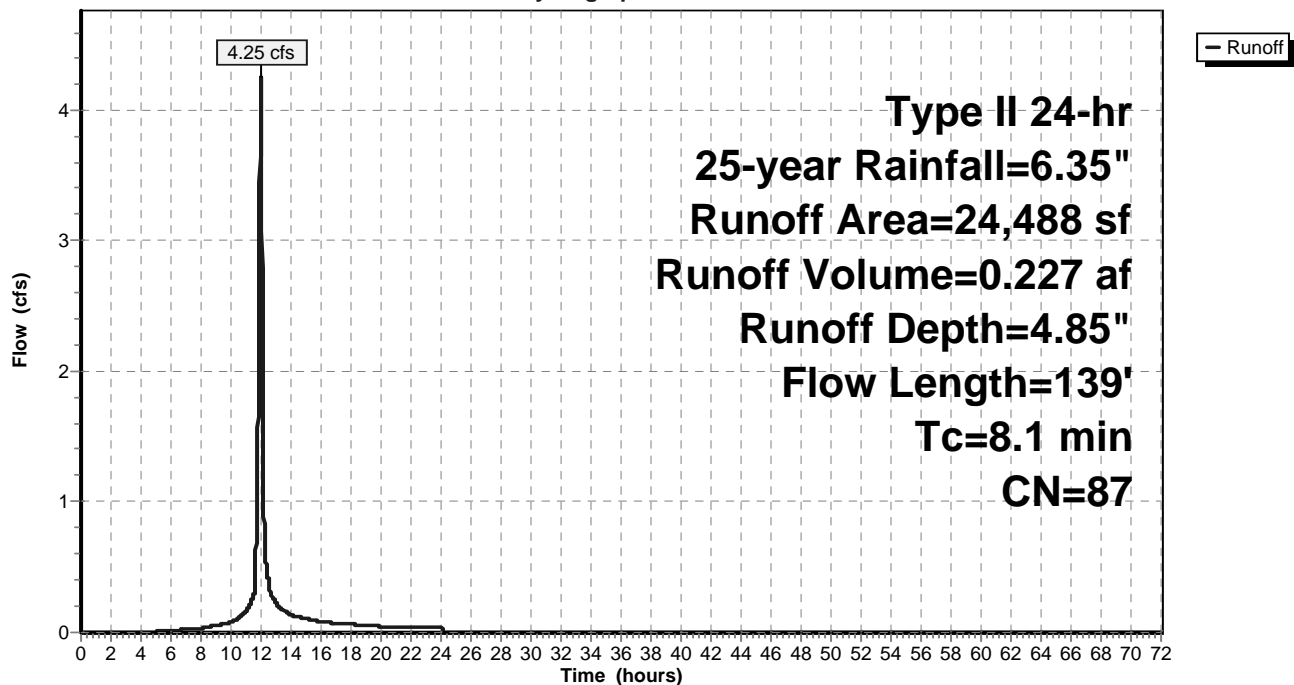
Area (sf)	CN	Description
18,684	84	50-75% Grass cover, Fair, HSG D
5,354	98	Paved parking, HSG C
450	89	Gravel roads, HSG C
24,488	87	Weighted Average
19,134		78.14% Pervious Area
5,354		21.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0703	0.22		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 4.08"
0.5	39	0.0410	1.42		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
8.1	139	Total			

**Subcatchment E2: AREA E2**

Hydrograph



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

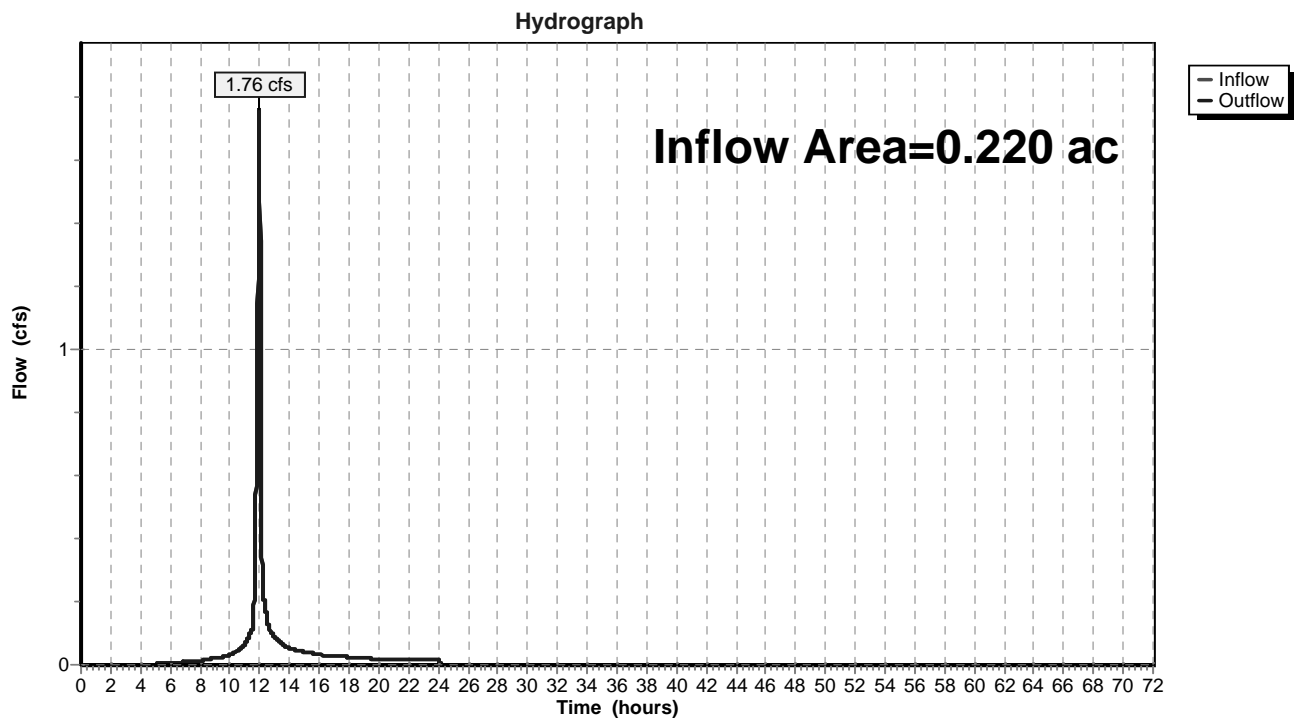
Page 16

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.220 ac, 37.42% Impervious, Inflow Depth = 4.85" for 25-year event  
Inflow = 1.76 cfs @ 11.97 hrs, Volume= 0.089 af  
Outflow = 1.76 cfs @ 11.97 hrs, Volume= 0.089 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

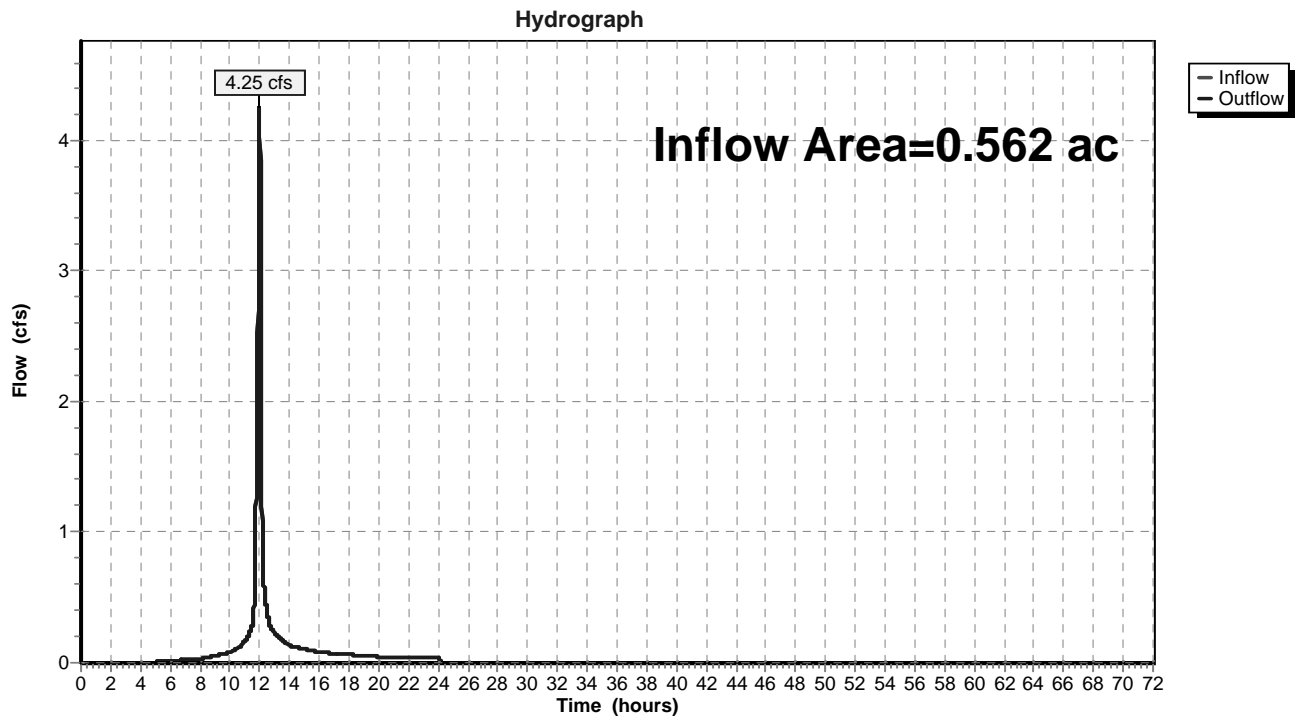
Page 17

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.562 ac, 21.86% Impervious, Inflow Depth = 4.85" for 25-year event  
Inflow = 4.25 cfs @ 11.99 hrs, Volume= 0.227 af  
Outflow = 4.25 cfs @ 11.99 hrs, Volume= 0.227 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

Page 18

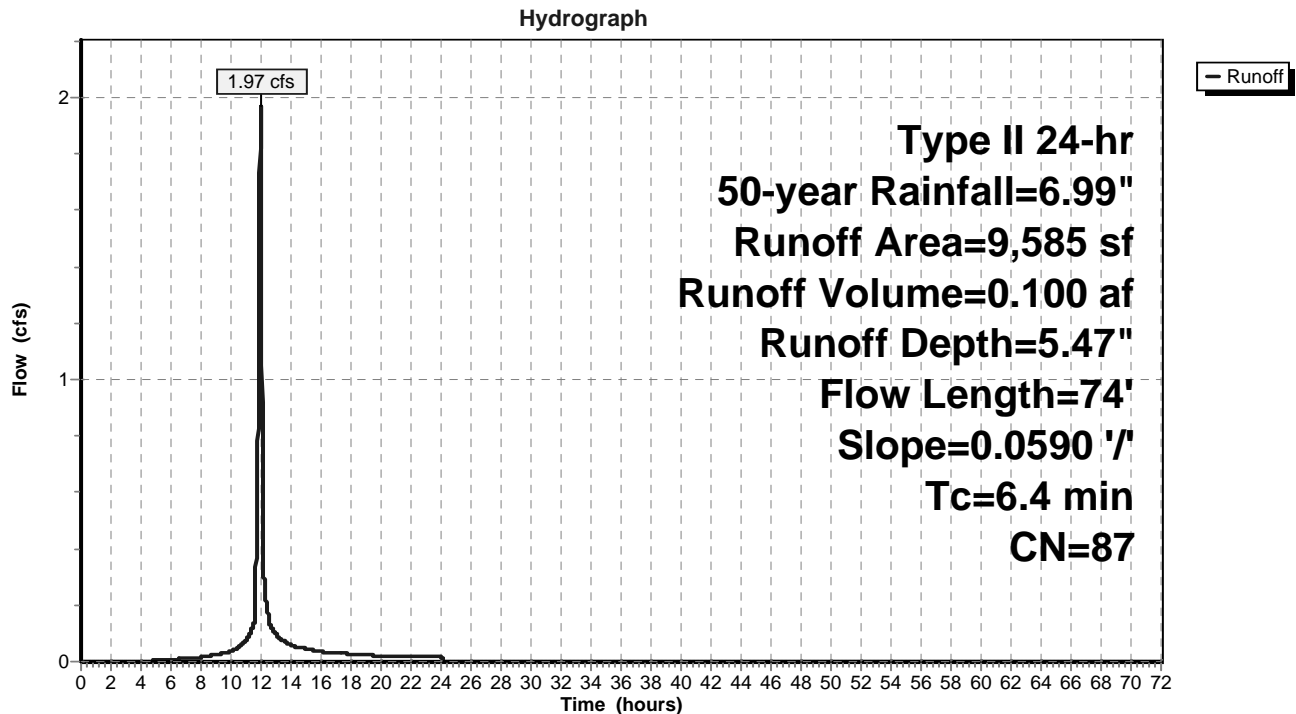
**Summary for Subcatchment E1: AREA E1**

Runoff = 1.97 cfs @ 11.97 hrs, Volume= 0.100 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 50-year Rainfall=6.99"

Area (sf)	CN	Description
3,587	98	Paved parking, HSG C
788	89	Gravel roads, HSG C
5,210	79	50-75% Grass cover, Fair, HSG C
9,585	87	Weighted Average
5,998		62.58% Pervious Area
3,587		37.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	74	0.0590	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 4.08"

**Subcatchment E1: AREA E1**

**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

Page 19

**Summary for Subcatchment E2: AREA E2**

Runoff = 4.76 cfs @ 11.99 hrs, Volume= 0.256 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 50-year Rainfall=6.99"

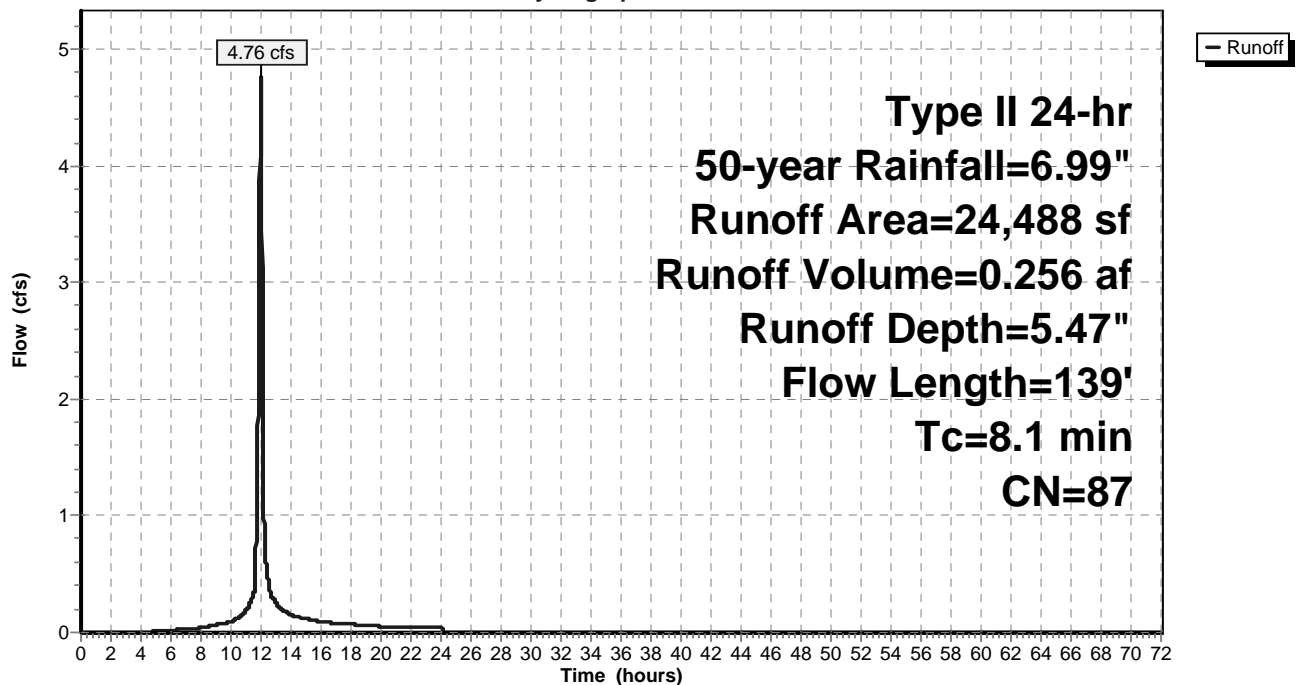
Area (sf)	CN	Description
18,684	84	50-75% Grass cover, Fair, HSG D
5,354	98	Paved parking, HSG C
450	89	Gravel roads, HSG C
24,488	87	Weighted Average
19,134		78.14% Pervious Area
5,354		21.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0703	0.22		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 4.08"
0.5	39	0.0410	1.42		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
8.1	139	Total			

**Subcatchment E2: AREA E2**

Hydrograph



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

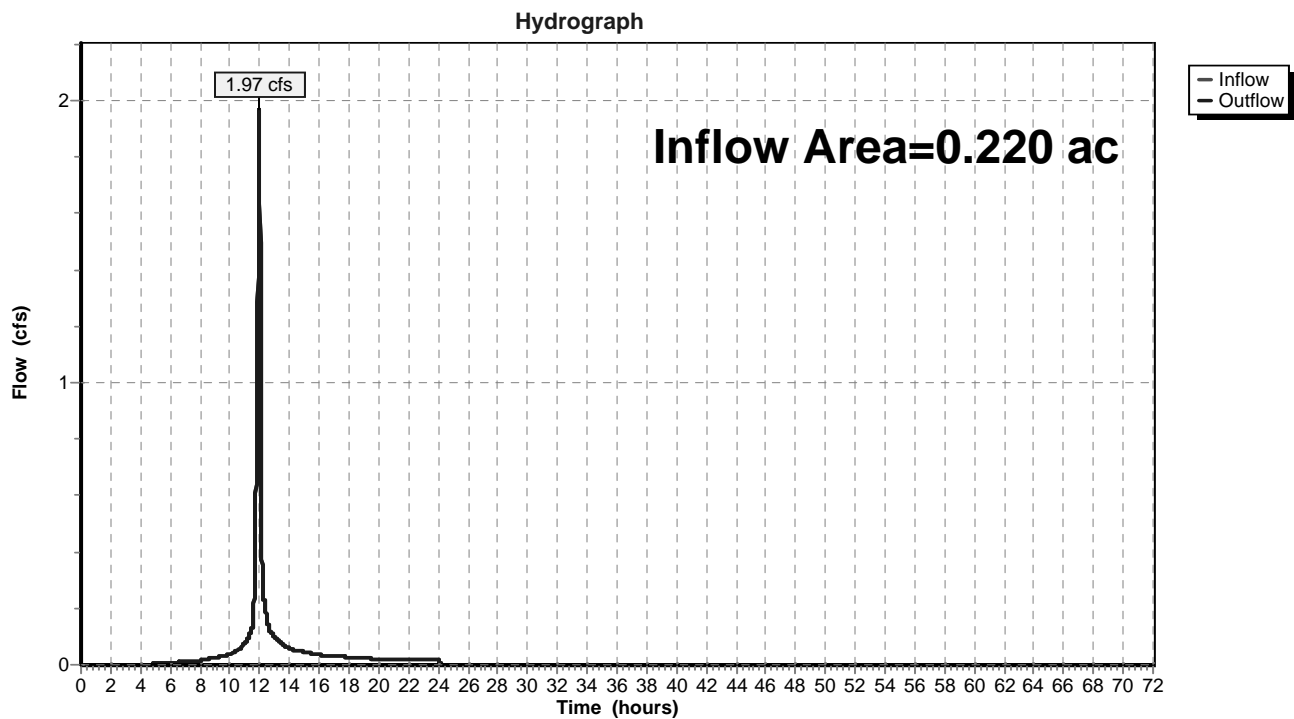
Page 20

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.220 ac, 37.42% Impervious, Inflow Depth = 5.47" for 50-year event  
Inflow = 1.97 cfs @ 11.97 hrs, Volume= 0.100 af  
Outflow = 1.97 cfs @ 11.97 hrs, Volume= 0.100 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1





## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

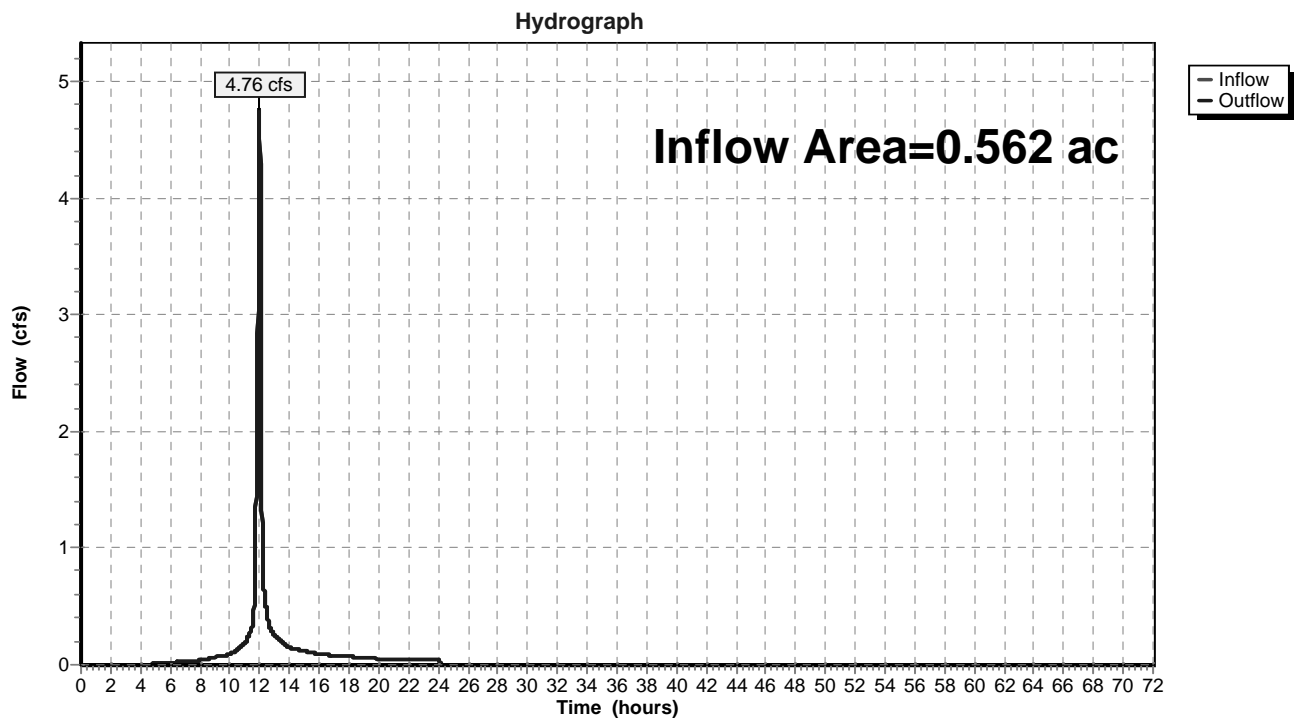
Page 21

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.562 ac, 21.86% Impervious, Inflow Depth = 5.47" for 50-year event  
Inflow = 4.76 cfs @ 11.99 hrs, Volume= 0.256 af  
Outflow = 4.76 cfs @ 11.99 hrs, Volume= 0.256 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

Page 22

**Summary for Subcatchment E1: AREA E1**

Runoff = 2.20 cfs @ 11.97 hrs, Volume= 0.113 af, Depth= 6.16"

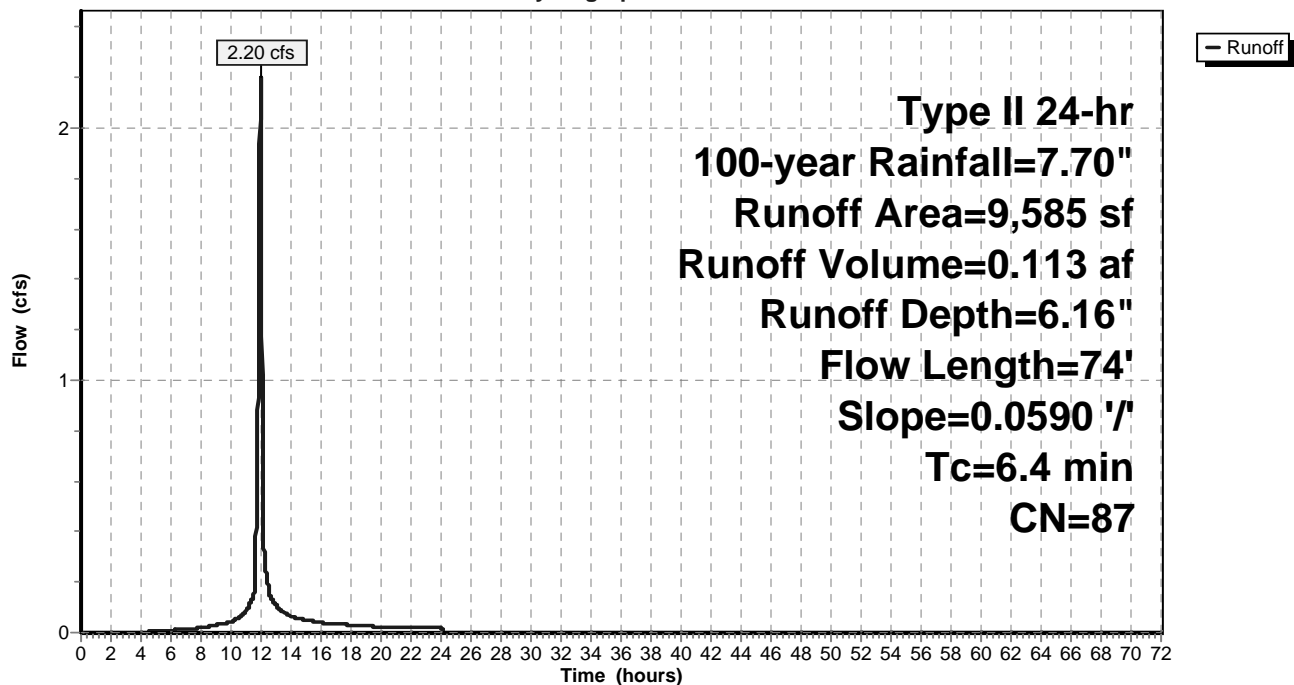
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 100-year Rainfall=7.70"

Area (sf)	CN	Description
3,587	98	Paved parking, HSG C
788	89	Gravel roads, HSG C
5,210	79	50-75% Grass cover, Fair, HSG C
9,585	87	Weighted Average
5,998		62.58% Pervious Area
3,587		37.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.4	74	0.0590	0.19		Sheet Flow, Grass: Dense n= 0.240 P2= 4.08"

**Subcatchment E1: AREA E1**

Hydrograph



**16-029\_Pre-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

Page 23

**Summary for Subcatchment E2: AREA E2**

Runoff = 5.32 cfs @ 11.99 hrs, Volume= 0.288 af, Depth= 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 100-year Rainfall=7.70"

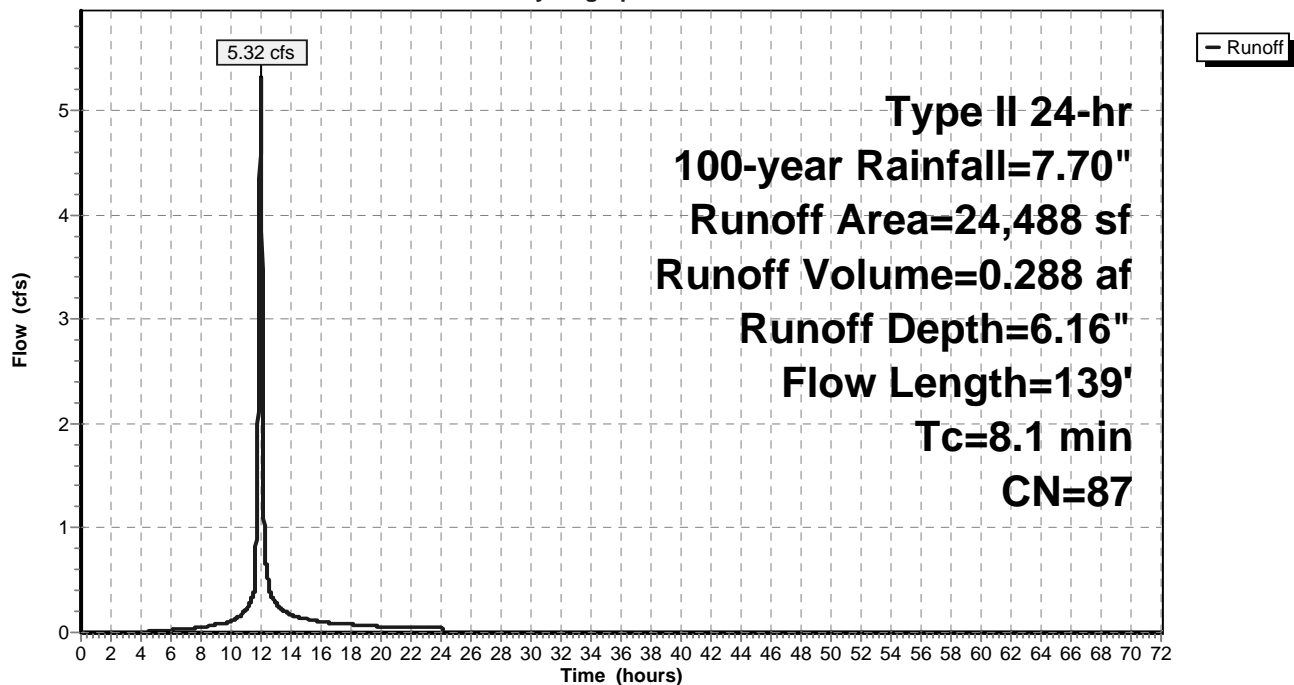
Area (sf)	CN	Description
18,684	84	50-75% Grass cover, Fair, HSG D
5,354	98	Paved parking, HSG C
450	89	Gravel roads, HSG C
24,488	87	Weighted Average
19,134		78.14% Pervious Area
5,354		21.86% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	100	0.0703	0.22		<b>Sheet Flow,</b> Grass: Dense n= 0.240 P2= 4.08"
0.5	39	0.0410	1.42		<b>Shallow Concentrated Flow,</b> Short Grass Pasture Kv= 7.0 fps
8.1	139	Total			

**Subcatchment E2: AREA E2**

Hydrograph



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

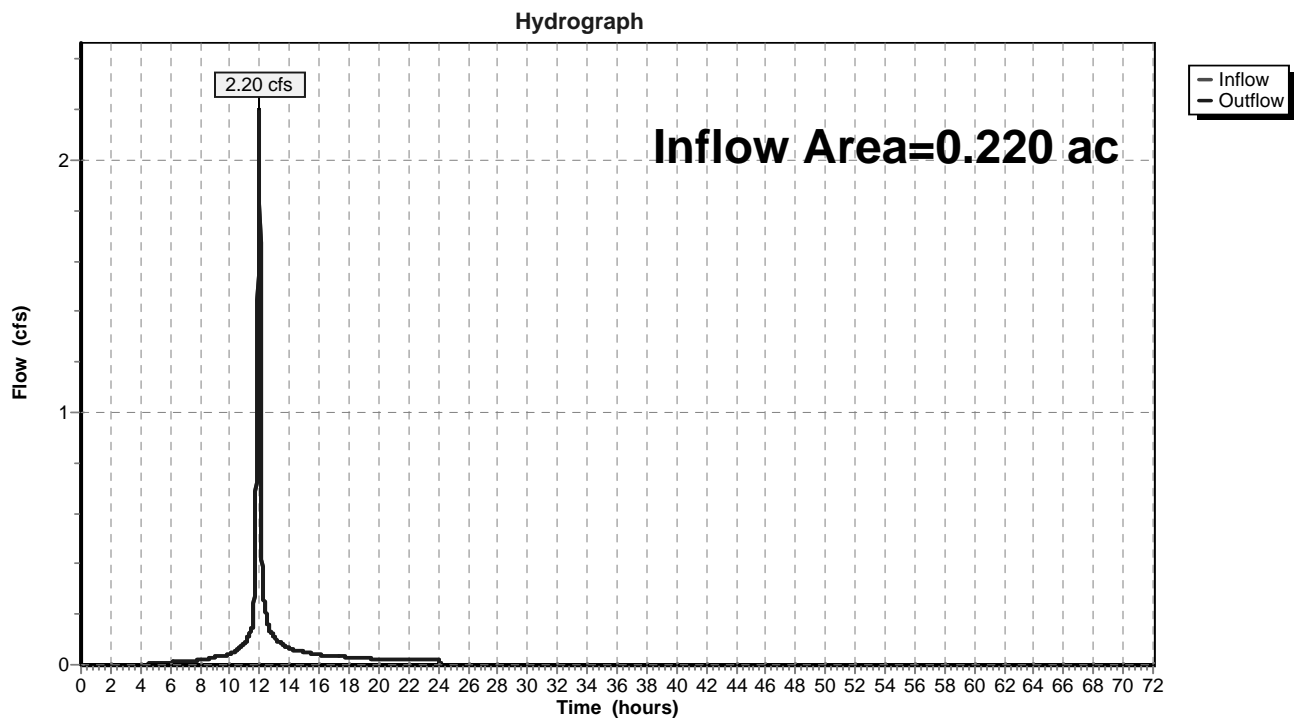
Page 24

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.220 ac, 37.42% Impervious, Inflow Depth = 6.16" for 100-year event  
Inflow = 2.20 cfs @ 11.97 hrs, Volume= 0.113 af  
Outflow = 2.20 cfs @ 11.97 hrs, Volume= 0.113 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Pre-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

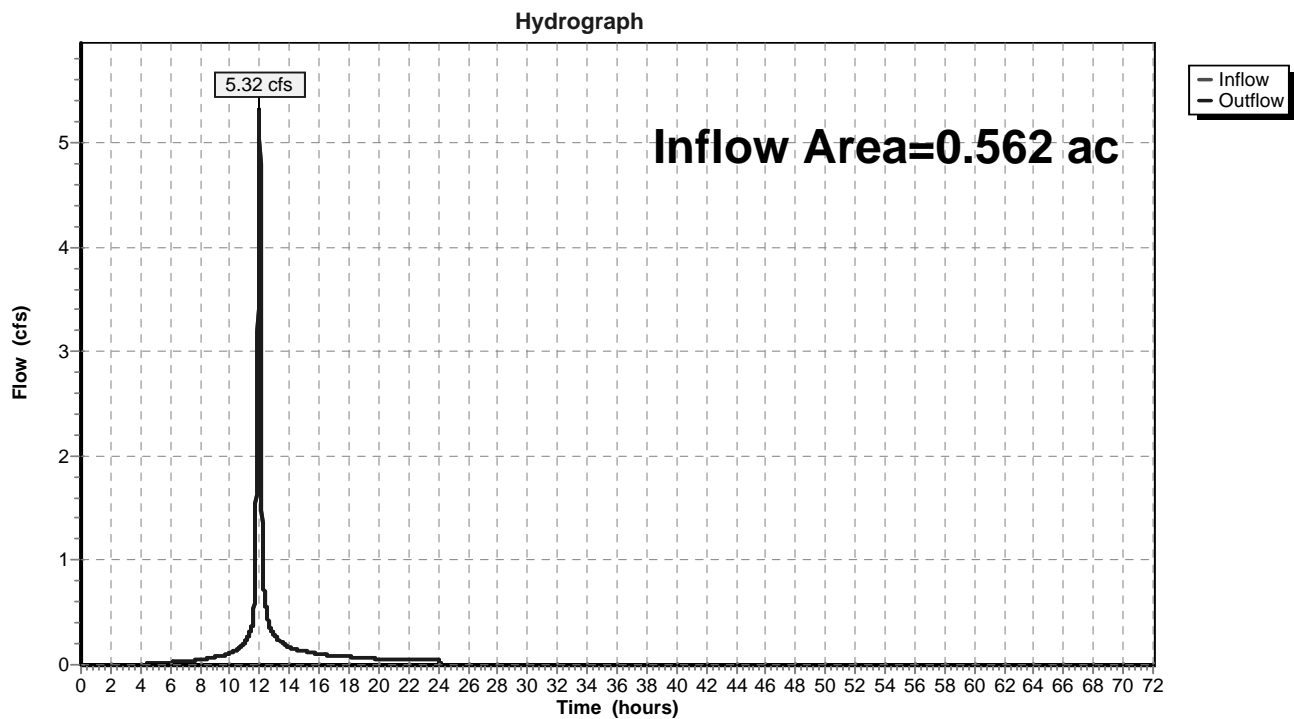
Page 25

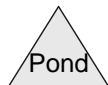
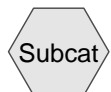
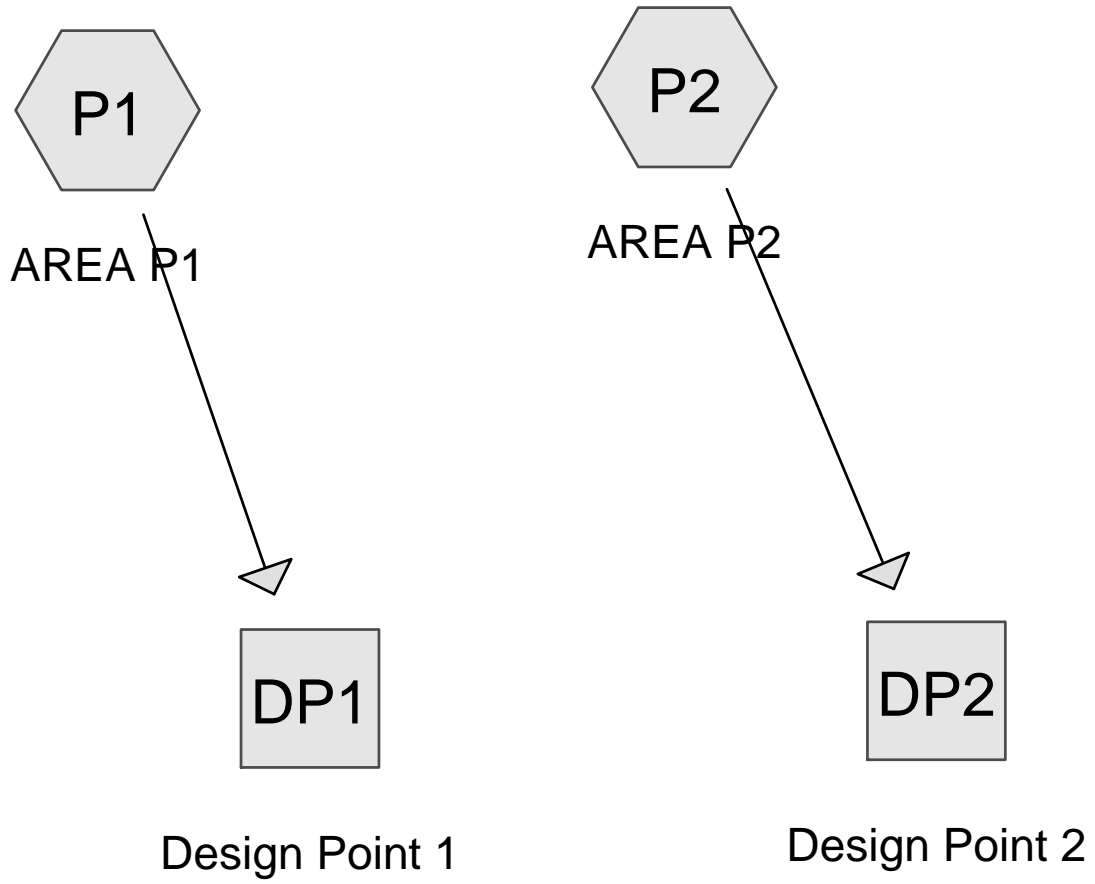
### Summary for Reach DP2: Design Point 2

Inflow Area = 0.562 ac, 21.86% Impervious, Inflow Depth = 6.16" for 100-year event  
Inflow = 5.32 cfs @ 11.99 hrs, Volume= 0.288 af  
Outflow = 5.32 cfs @ 11.99 hrs, Volume= 0.288 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2







**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

Page 2

**Summary for Subcatchment P1: AREA P1**

Runoff = 0.72 cfs @ 11.97 hrs, Volume= 0.035 af, Depth= 2.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 2-year Rainfall=3.88"

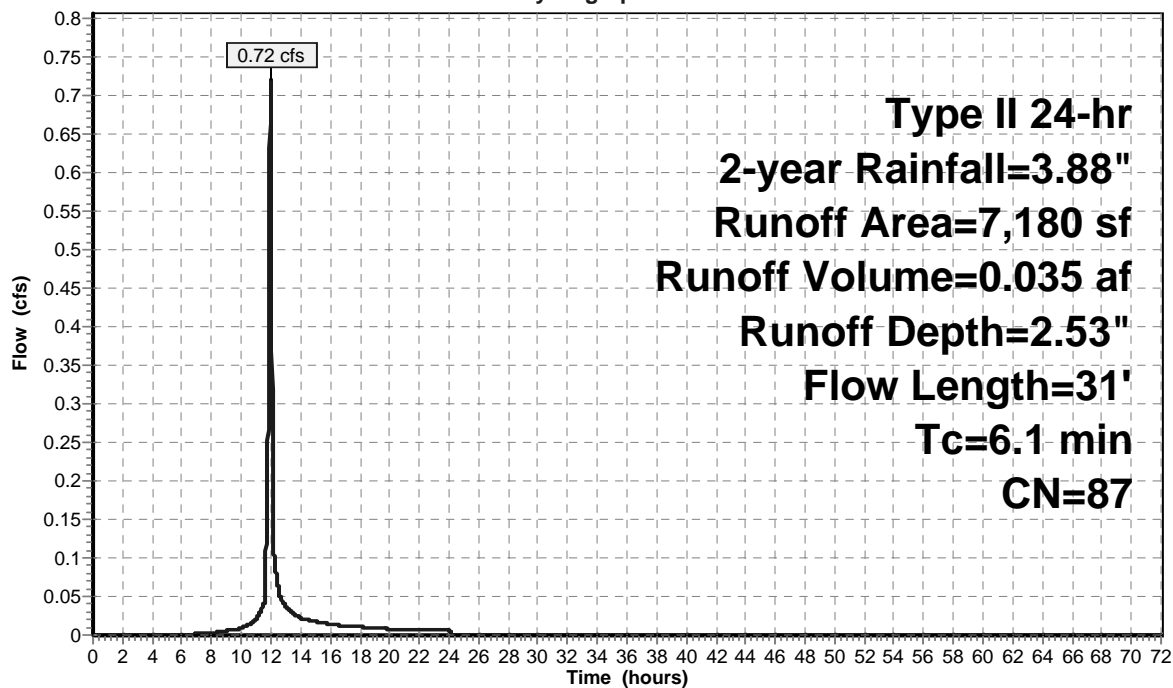
Area (sf)	CN	Description
4,016	98	Paved parking, HSG C
3,164	74	>75% Grass cover, Good, HSG C
7,180	87	Weighted Average
3,164		44.07% Pervious Area
4,016		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	17	0.0200	0.06		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.9	6	0.1670	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.4	4	0.4760	0.16		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.1	4	0.0200	0.82		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
6.1	31	Total			

**Subcatchment P1: AREA P1**

Hydrograph



— Runoff

**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

Page 3

**Summary for Subcatchment P2: AREA P2**

Runoff = 2.21 cfs @ 12.06 hrs, Volume= 0.142 af, Depth= 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 2-year Rainfall=3.88"

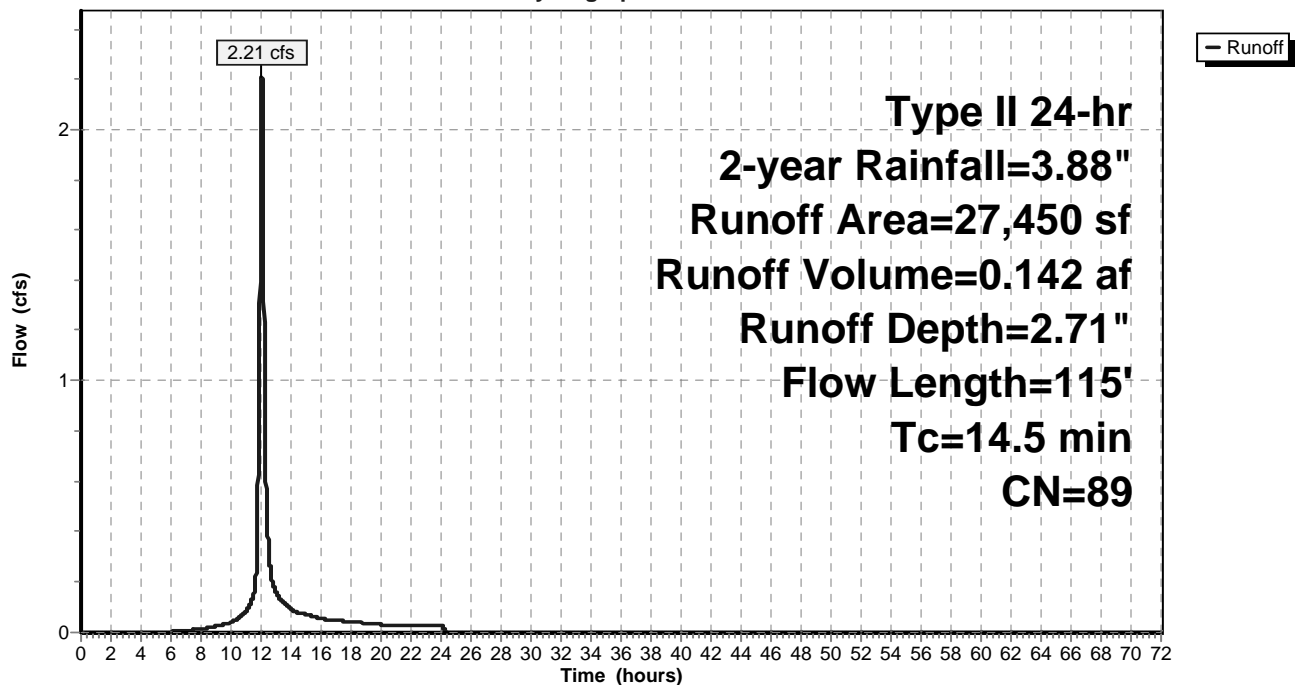
Area (sf)	CN	Description
15,979	98	Paved parking, HSG C
10,090	74	>75% Grass cover, Good, HSG C
1,381	89	Gravel roads, HSG C
27,450	89	Weighted Average
11,471		41.79% Pervious Area
15,979		58.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	94	0.0425	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.6	6	0.5000	0.18		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.2	15	0.0500	1.53		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
14.5	115	Total			

**Subcatchment P2: AREA P2**

Hydrograph



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

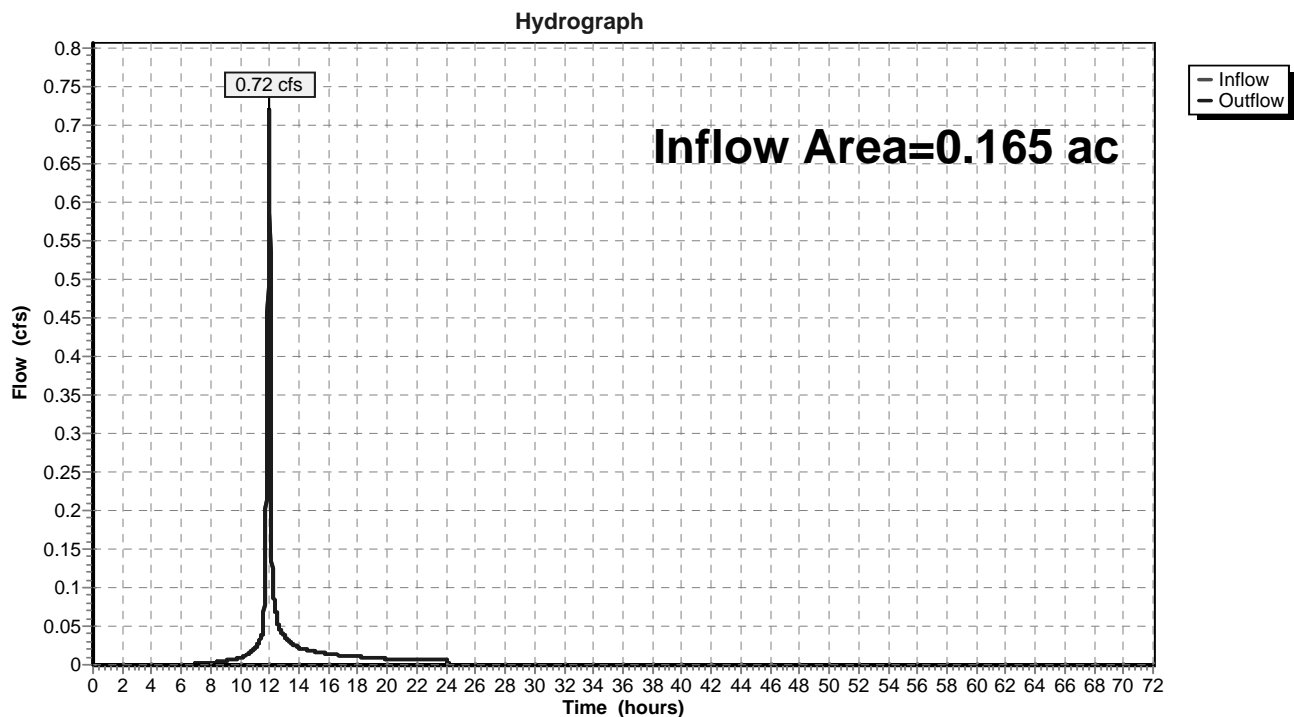
Page 4

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.165 ac, 55.93% Impervious, Inflow Depth = 2.53" for 2-year event  
Inflow = 0.72 cfs @ 11.97 hrs, Volume= 0.035 af  
Outflow = 0.72 cfs @ 11.97 hrs, Volume= 0.035 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 2-year Rainfall=3.88"

Printed 9/13/2016

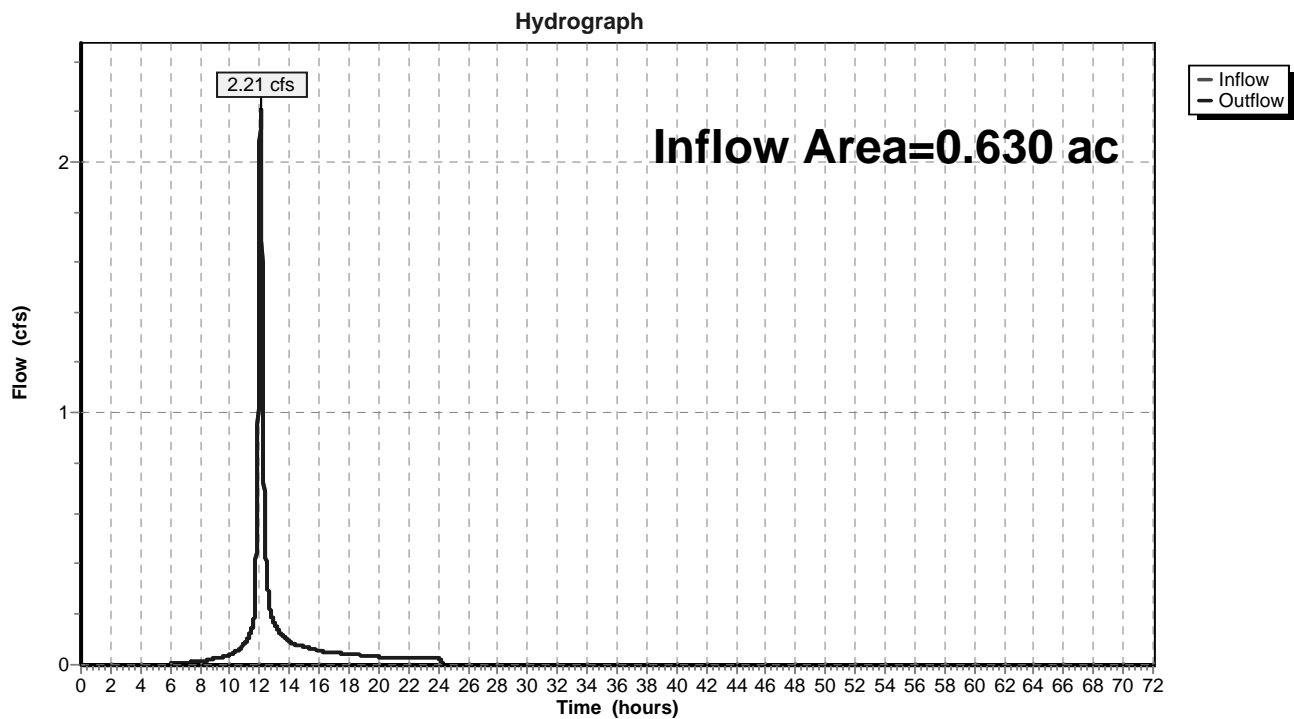
Page 5

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.630 ac, 58.21% Impervious, Inflow Depth = 2.71" for 2-year event  
Inflow = 2.21 cfs @ 12.06 hrs, Volume= 0.142 af  
Outflow = 2.21 cfs @ 12.06 hrs, Volume= 0.142 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

Page 6

**Summary for Subcatchment P1: AREA P1**

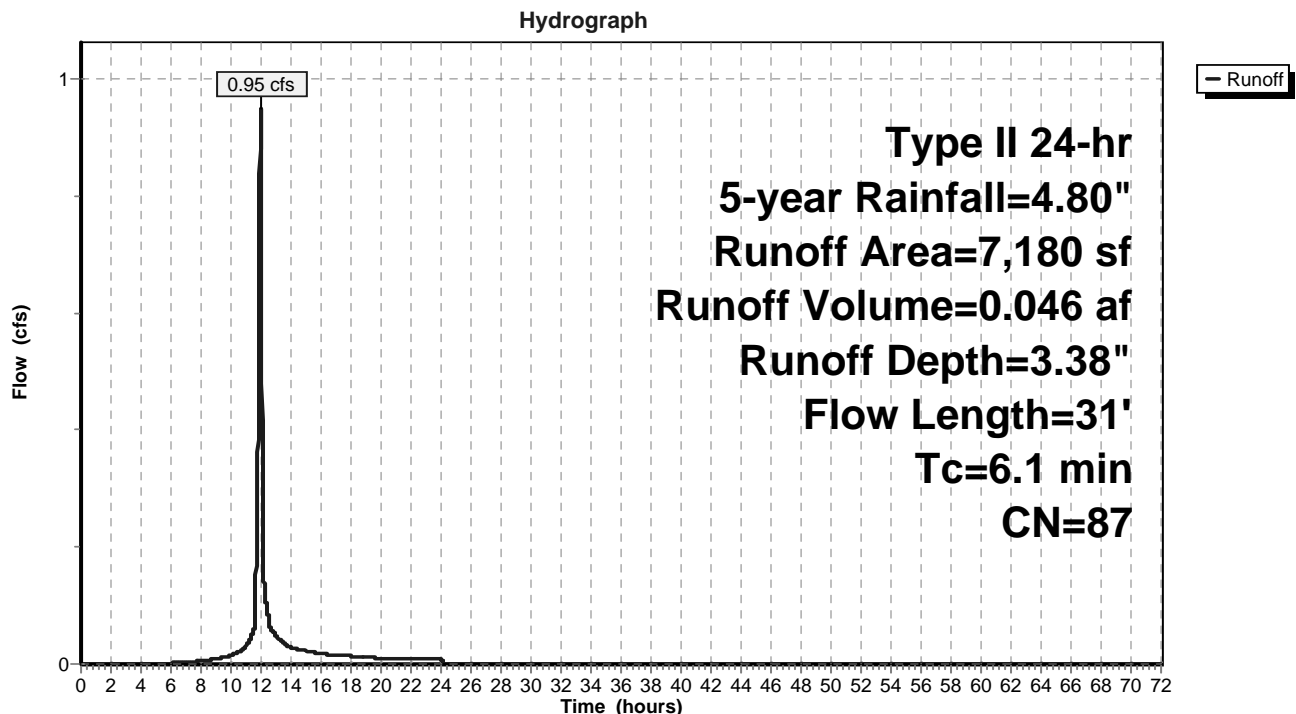
Runoff = 0.95 cfs @ 11.97 hrs, Volume= 0.046 af, Depth= 3.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 5-year Rainfall=4.80"

Area (sf)	CN	Description
4,016	98	Paved parking, HSG C
3,164	74	>75% Grass cover, Good, HSG C
7,180	87	Weighted Average
3,164		44.07% Pervious Area
4,016		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	17	0.0200	0.06		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.9	6	0.1670	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.4	4	0.4760	0.16		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.1	4	0.0200	0.82		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
6.1	31	Total			

**Subcatchment P1: AREA P1**

**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

Page 7

**Summary for Subcatchment P2: AREA P2**

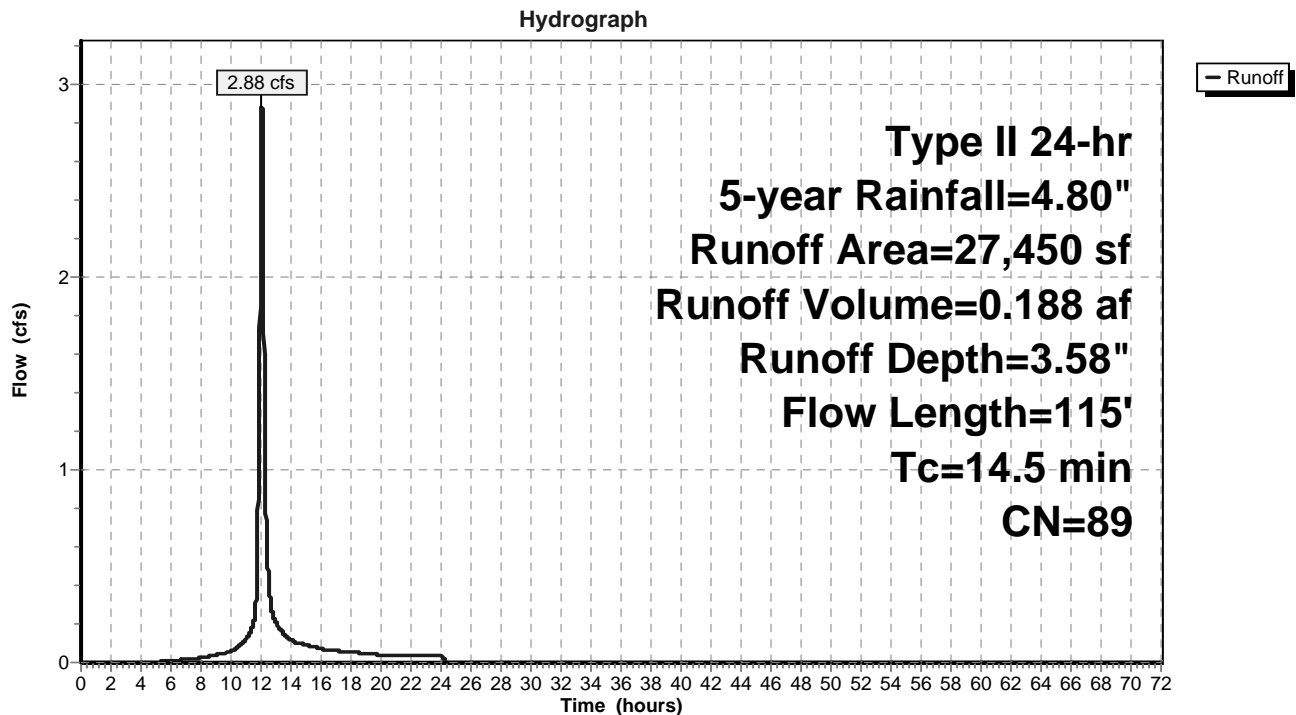
Runoff = 2.88 cfs @ 12.06 hrs, Volume= 0.188 af, Depth= 3.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 5-year Rainfall=4.80"

Area (sf)	CN	Description
15,979	98	Paved parking, HSG C
10,090	74	>75% Grass cover, Good, HSG C
1,381	89	Gravel roads, HSG C
27,450	89	Weighted Average
11,471		41.79% Pervious Area
15,979		58.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	94	0.0425	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.6	6	0.5000	0.18		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.2	15	0.0500	1.53		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
14.5	115	Total			

**Subcatchment P2: AREA P2**

## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

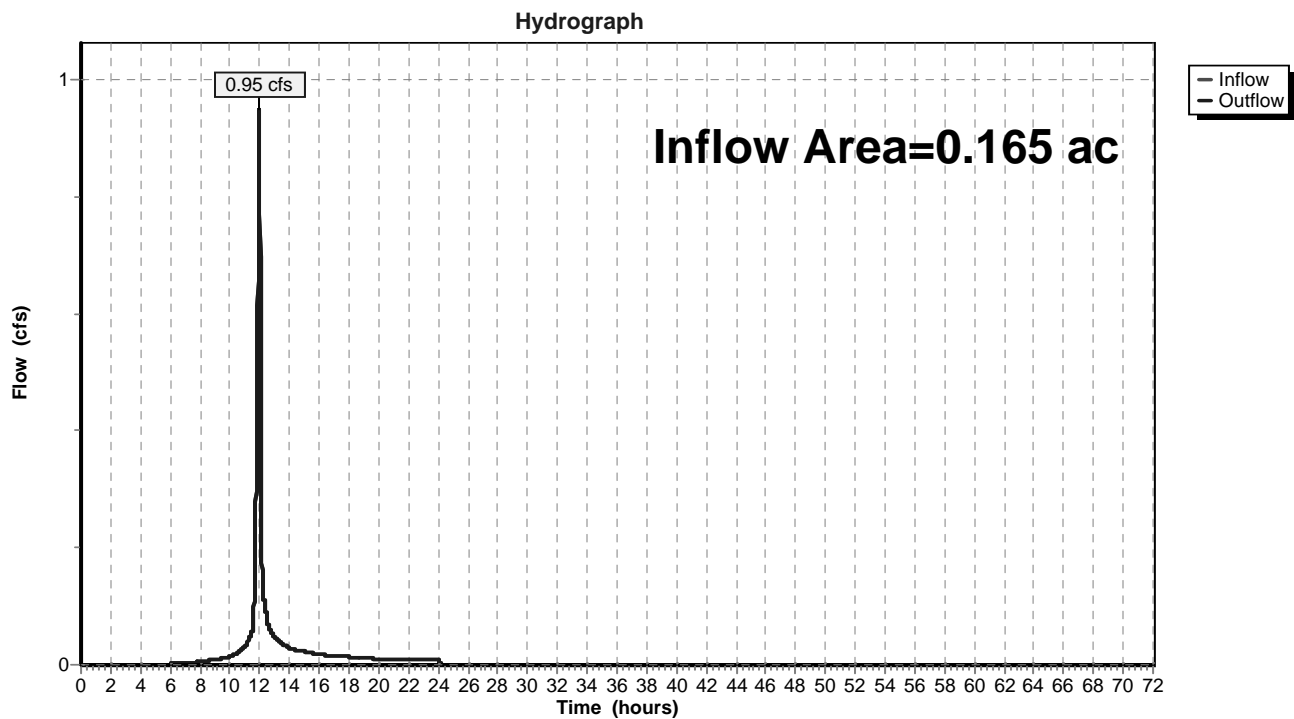
Page 8

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.165 ac, 55.93% Impervious, Inflow Depth = 3.38" for 5-year event  
Inflow = 0.95 cfs @ 11.97 hrs, Volume= 0.046 af  
Outflow = 0.95 cfs @ 11.97 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 5-year Rainfall=4.80"

Printed 9/13/2016

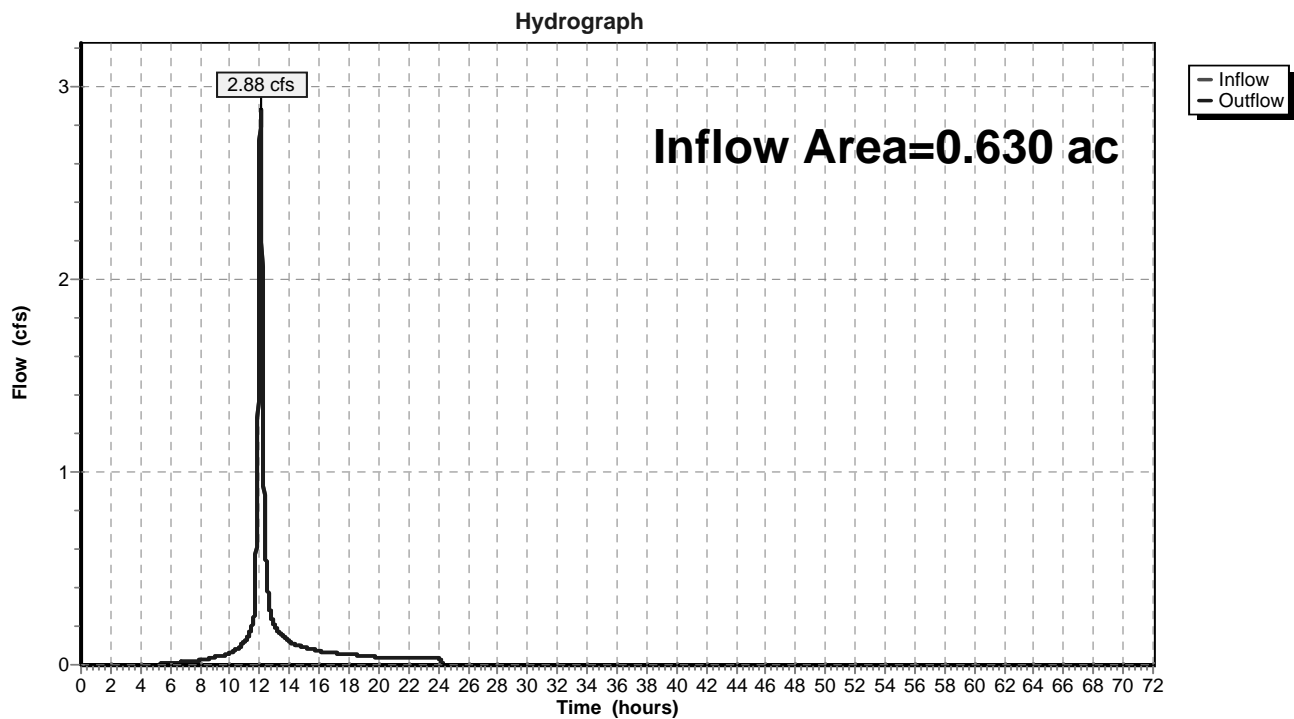
Page 9

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.630 ac, 58.21% Impervious, Inflow Depth = 3.58" for 5-year event  
Inflow = 2.88 cfs @ 12.06 hrs, Volume= 0.188 af  
Outflow = 2.88 cfs @ 12.06 hrs, Volume= 0.188 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2





**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

Page 10

**Summary for Subcatchment P1: AREA P1**

Runoff = 1.14 cfs @ 11.97 hrs, Volume= 0.057 af, Depth= 4.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 10-year Rainfall=5.58"

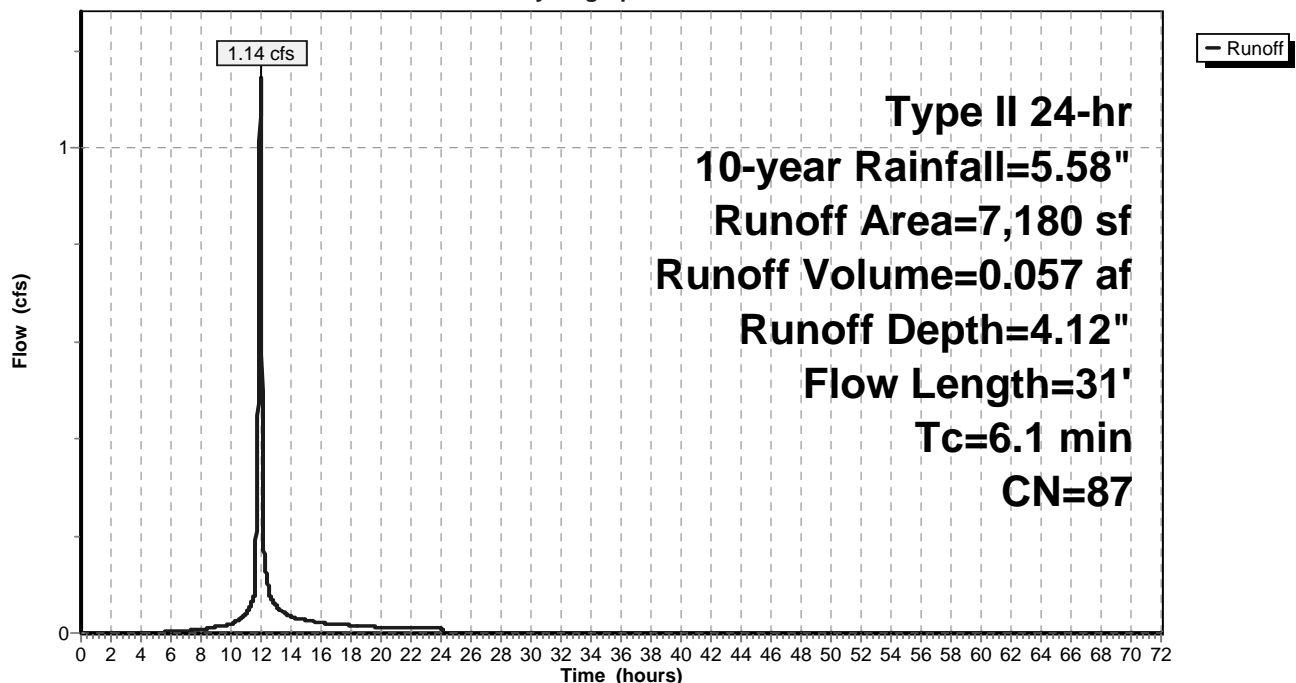
Area (sf)	CN	Description
4,016	98	Paved parking, HSG C
3,164	74	>75% Grass cover, Good, HSG C
7,180	87	Weighted Average
3,164		44.07% Pervious Area
4,016		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	17	0.0200	0.06		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.9	6	0.1670	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.4	4	0.4760	0.16		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.1	4	0.0200	0.82		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
6.1	31	Total			

**Subcatchment P1: AREA P1**

Hydrograph



**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

Page 11

**Summary for Subcatchment P2: AREA P2**

Runoff = 3.44 cfs @ 12.06 hrs, Volume= 0.227 af, Depth= 4.33"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 10-year Rainfall=5.58"

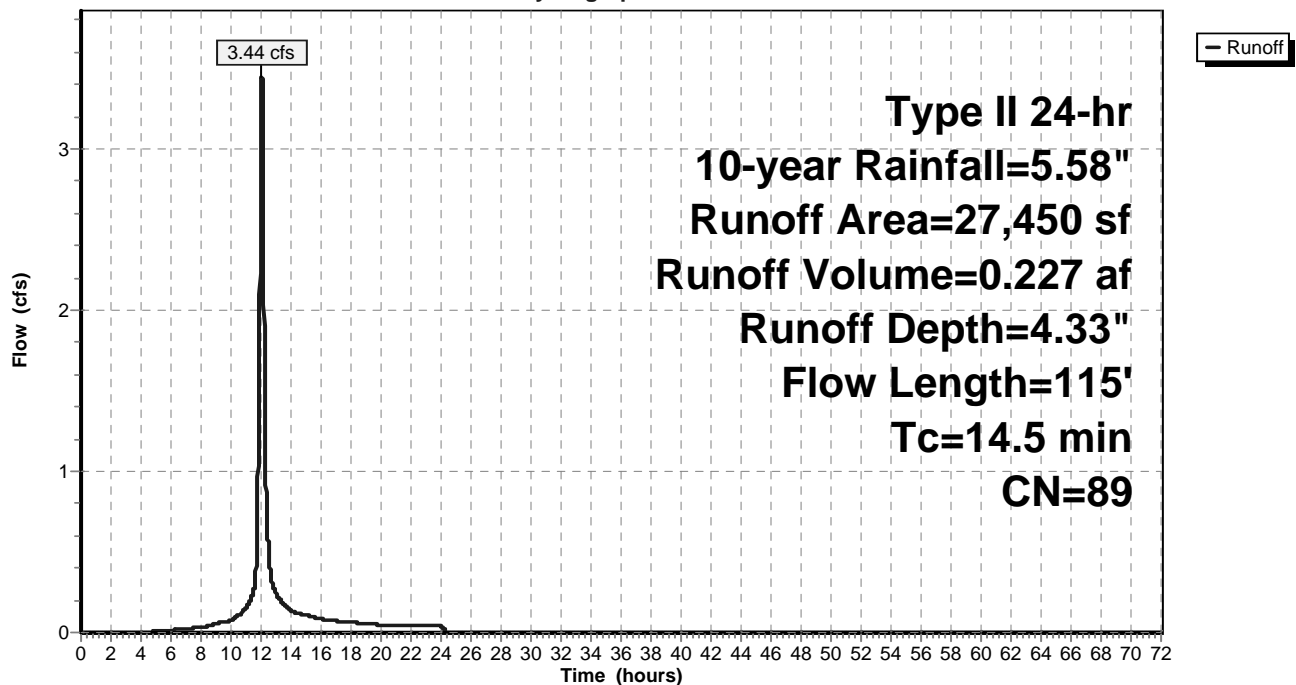
Area (sf)	CN	Description
15,979	98	Paved parking, HSG C
10,090	74	>75% Grass cover, Good, HSG C
1,381	89	Gravel roads, HSG C
27,450	89	Weighted Average
11,471		41.79% Pervious Area
15,979		58.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	94	0.0425	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.6	6	0.5000	0.18		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.2	15	0.0500	1.53		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
14.5	115	Total			

**Subcatchment P2: AREA P2**

Hydrograph



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

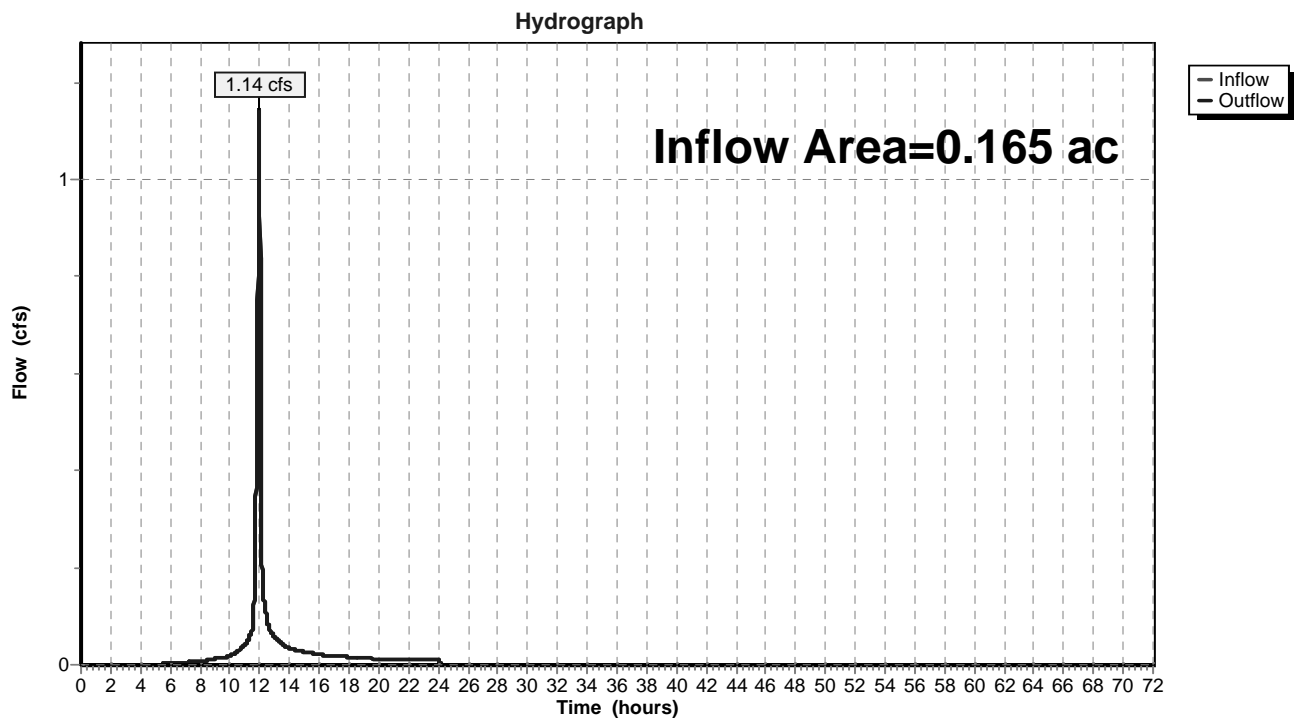
Page 12

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.165 ac, 55.93% Impervious, Inflow Depth = 4.12" for 10-year event  
Inflow = 1.14 cfs @ 11.97 hrs, Volume= 0.057 af  
Outflow = 1.14 cfs @ 11.97 hrs, Volume= 0.057 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 10-year Rainfall=5.58"

Printed 9/13/2016

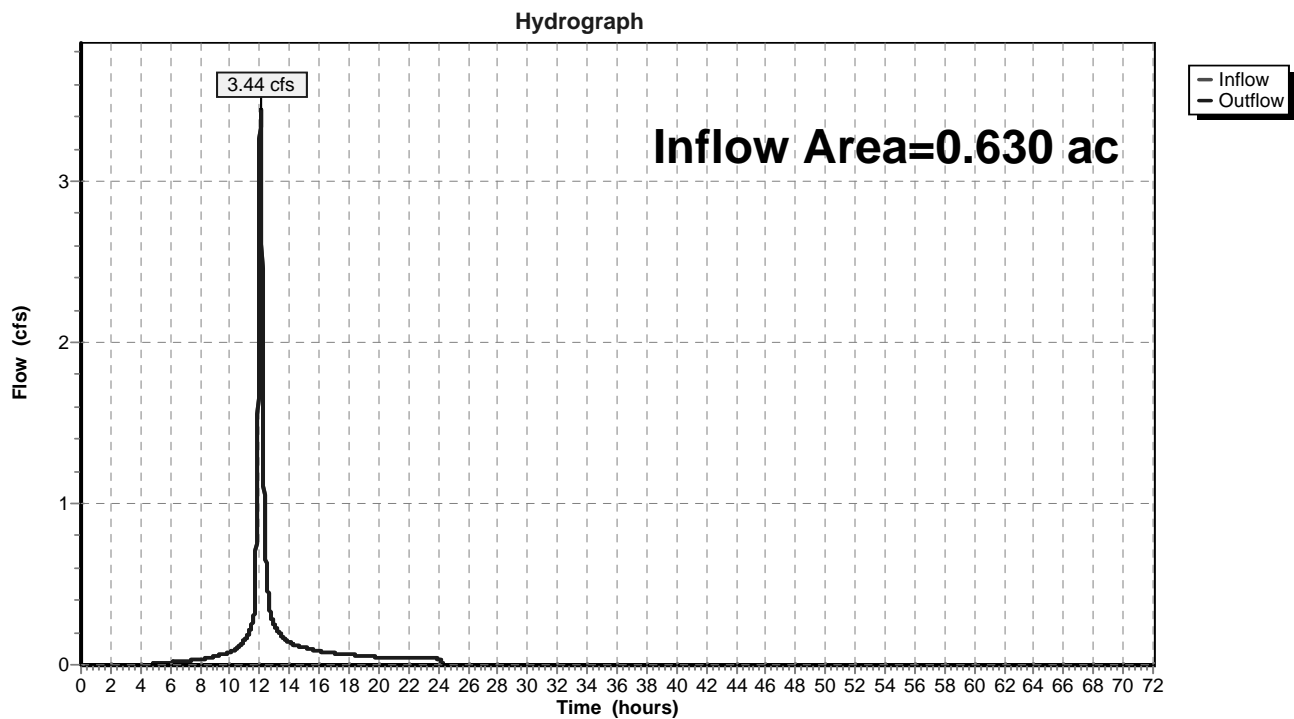
Page 13

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.630 ac, 58.21% Impervious, Inflow Depth = 4.33" for 10-year event  
Inflow = 3.44 cfs @ 12.06 hrs, Volume= 0.227 af  
Outflow = 3.44 cfs @ 12.06 hrs, Volume= 0.227 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

Page 14

**Summary for Subcatchment P1: AREA P1**

Runoff = 1.33 cfs @ 11.97 hrs, Volume= 0.067 af, Depth= 4.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 25-year Rainfall=6.35"

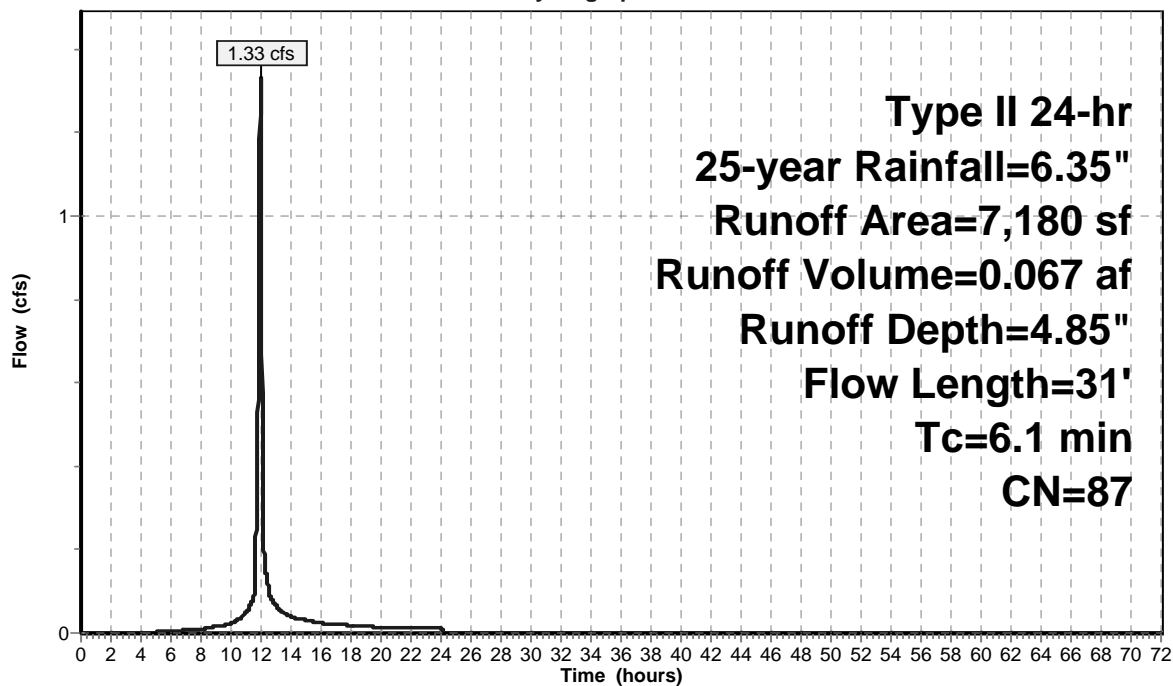
Area (sf)	CN	Description
4,016	98	Paved parking, HSG C
3,164	74	>75% Grass cover, Good, HSG C
7,180	87	Weighted Average
3,164		44.07% Pervious Area
4,016		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	17	0.0200	0.06		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.9	6	0.1670	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.4	4	0.4760	0.16		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.1	4	0.0200	0.82		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
6.1	31	Total			

**Subcatchment P1: AREA P1**

Hydrograph



**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

Page 15

**Summary for Subcatchment P2: AREA P2**

Runoff = 4.00 cfs @ 12.06 hrs, Volume= 0.267 af, Depth= 5.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 25-year Rainfall=6.35"

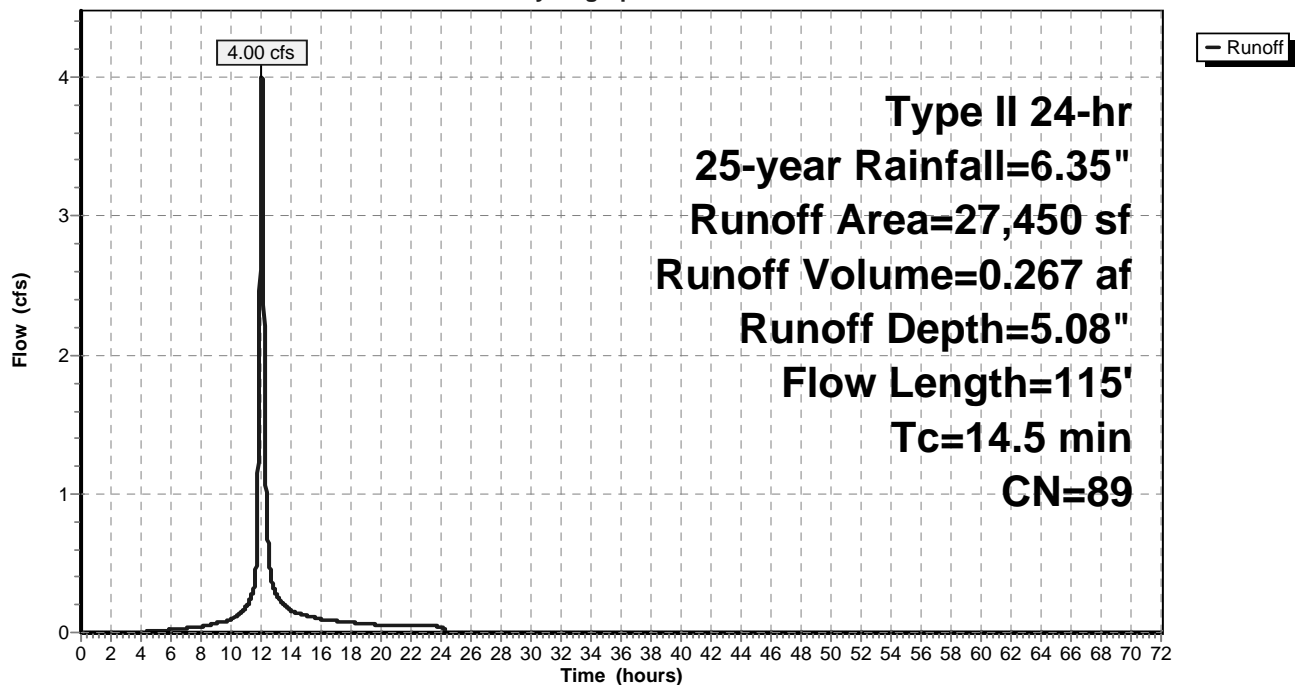
Area (sf)	CN	Description
15,979	98	Paved parking, HSG C
10,090	74	>75% Grass cover, Good, HSG C
1,381	89	Gravel roads, HSG C
27,450	89	Weighted Average
11,471		41.79% Pervious Area
15,979		58.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	94	0.0425	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.6	6	0.5000	0.18		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.2	15	0.0500	1.53		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
14.5	115	Total			

**Subcatchment P2: AREA P2**

Hydrograph



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

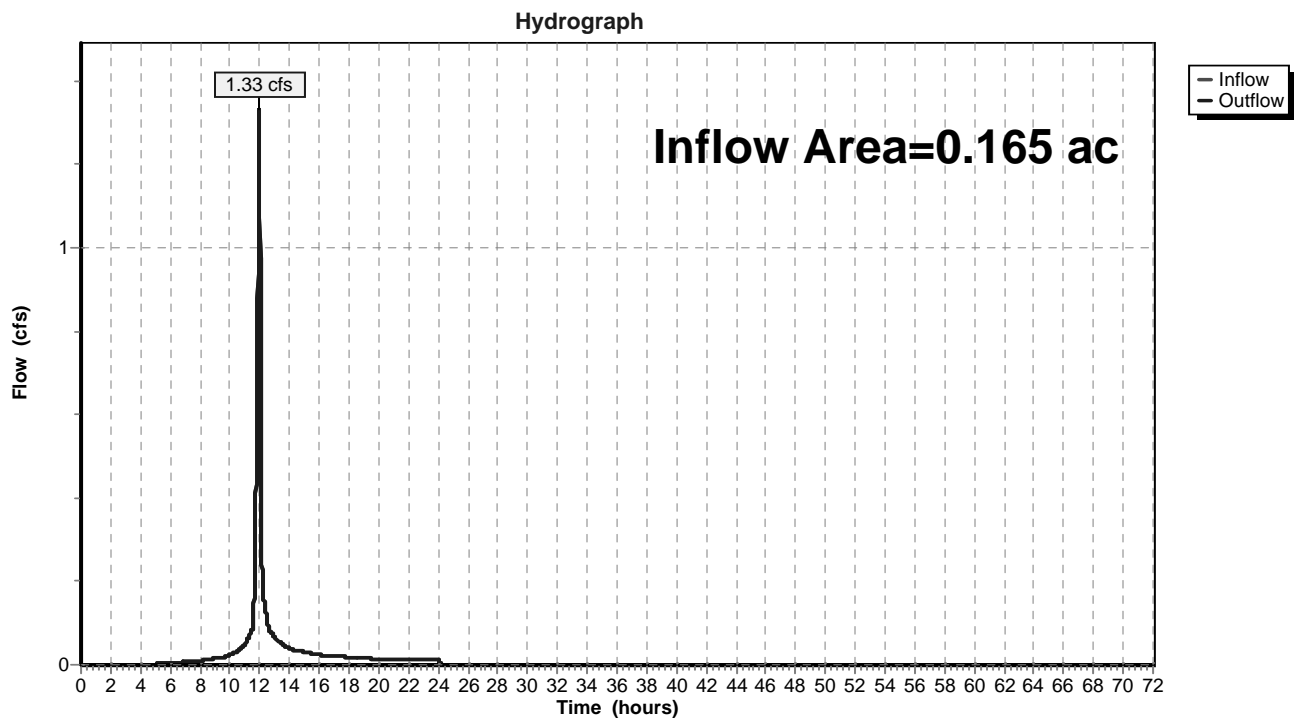
Page 16

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.165 ac, 55.93% Impervious, Inflow Depth = 4.85" for 25-year event  
Inflow = 1.33 cfs @ 11.97 hrs, Volume= 0.067 af  
Outflow = 1.33 cfs @ 11.97 hrs, Volume= 0.067 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 25-year Rainfall=6.35"

Printed 9/13/2016

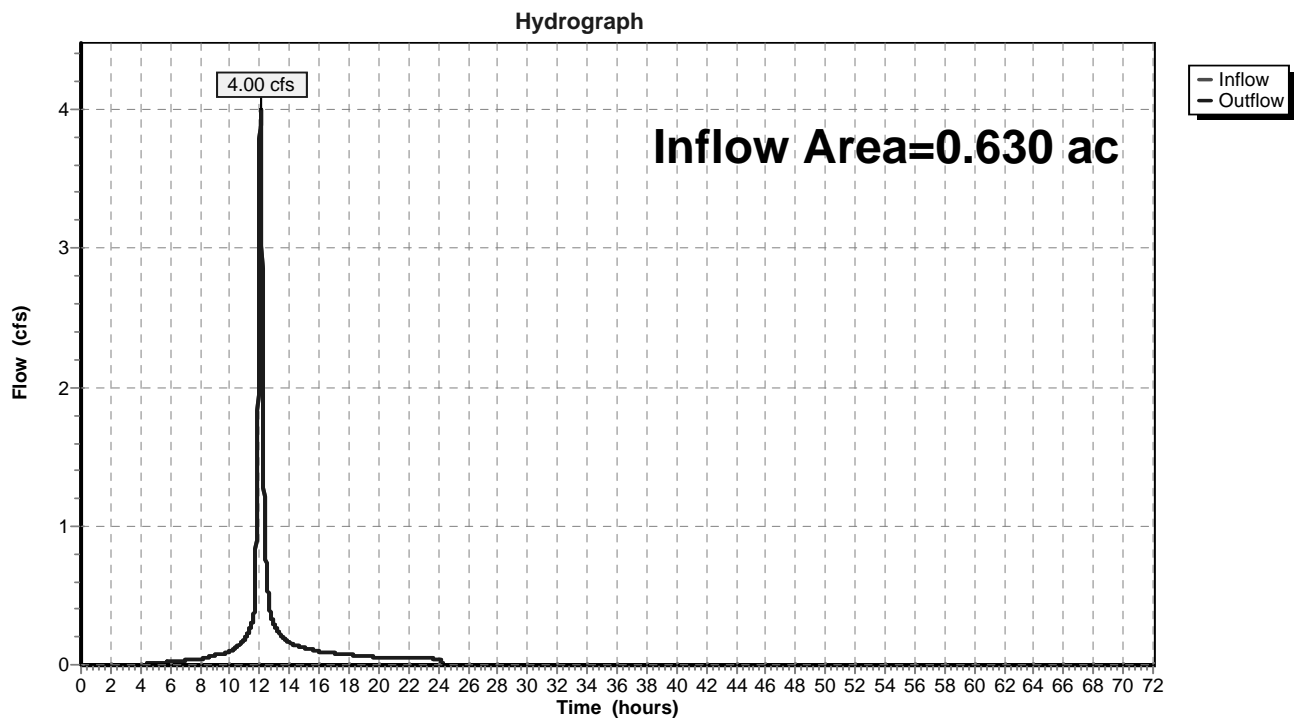
Page 17

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.630 ac, 58.21% Impervious, Inflow Depth = 5.08" for 25-year event  
Inflow = 4.00 cfs @ 12.06 hrs, Volume= 0.267 af  
Outflow = 4.00 cfs @ 12.06 hrs, Volume= 0.267 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2





**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

Page 18

**Summary for Subcatchment P1: AREA P1**

Runoff = 1.49 cfs @ 11.97 hrs, Volume= 0.075 af, Depth= 5.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 50-year Rainfall=6.99"

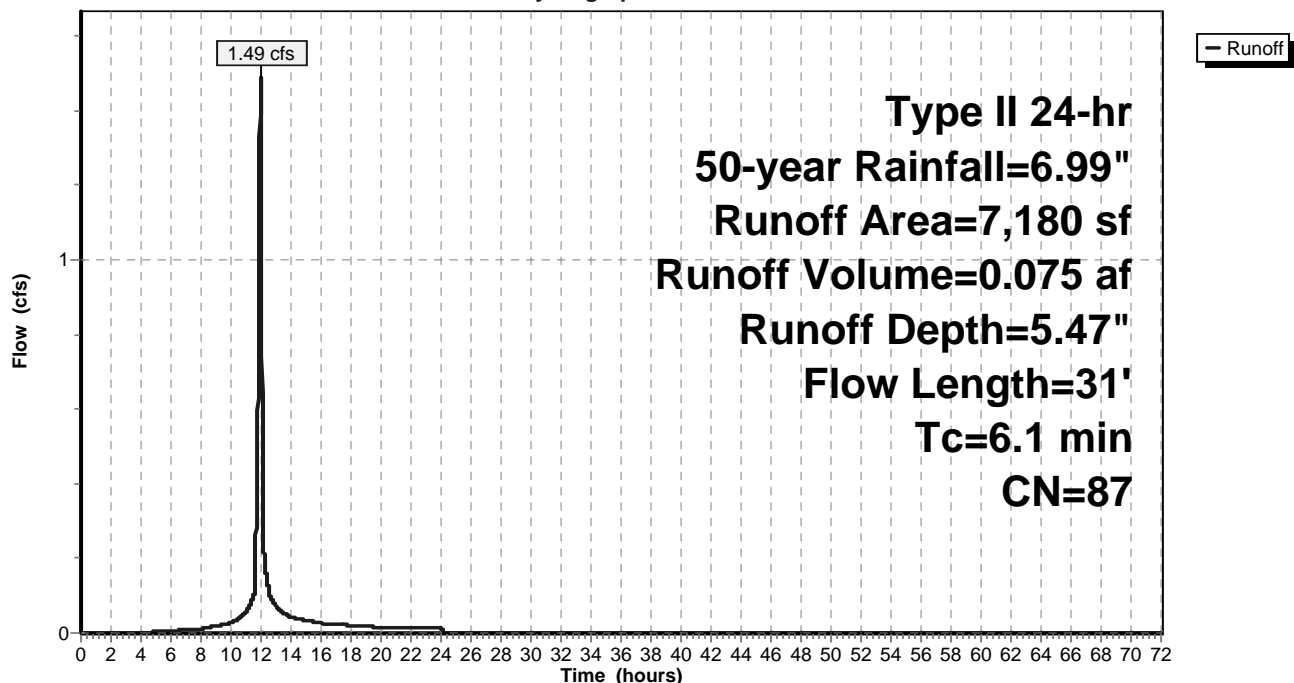
Area (sf)	CN	Description
4,016	98	Paved parking, HSG C
3,164	74	>75% Grass cover, Good, HSG C
7,180	87	Weighted Average
3,164		44.07% Pervious Area
4,016		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	17	0.0200	0.06		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.9	6	0.1670	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.4	4	0.4760	0.16		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.1	4	0.0200	0.82		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
6.1	31	Total			

**Subcatchment P1: AREA P1**

Hydrograph



**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

Page 19

**Summary for Subcatchment P2: AREA P2**

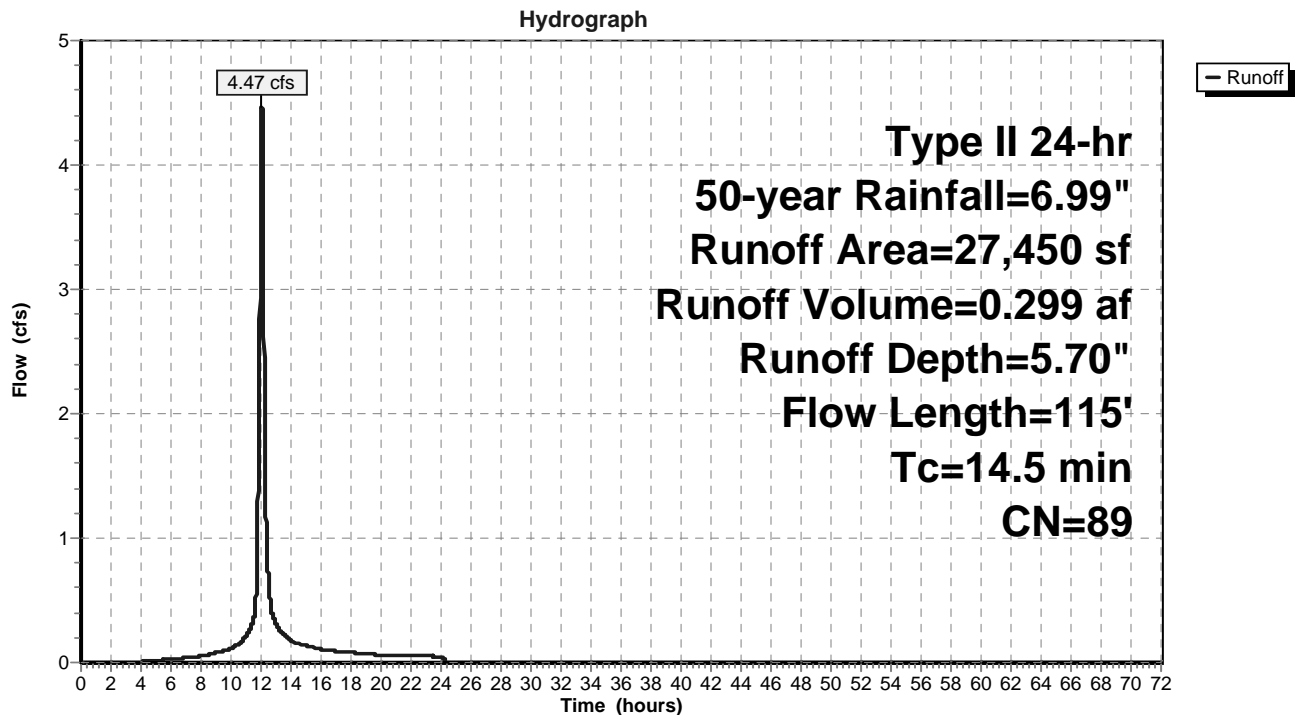
Runoff = 4.47 cfs @ 12.06 hrs, Volume= 0.299 af, Depth= 5.70"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 50-year Rainfall=6.99"

Area (sf)	CN	Description
15,979	98	Paved parking, HSG C
10,090	74	>75% Grass cover, Good, HSG C
1,381	89	Gravel roads, HSG C
27,450	89	Weighted Average
11,471		41.79% Pervious Area
15,979		58.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	94	0.0425	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.6	6	0.5000	0.18		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.2	15	0.0500	1.53		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
14.5	115	Total			

**Subcatchment P2: AREA P2**

## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

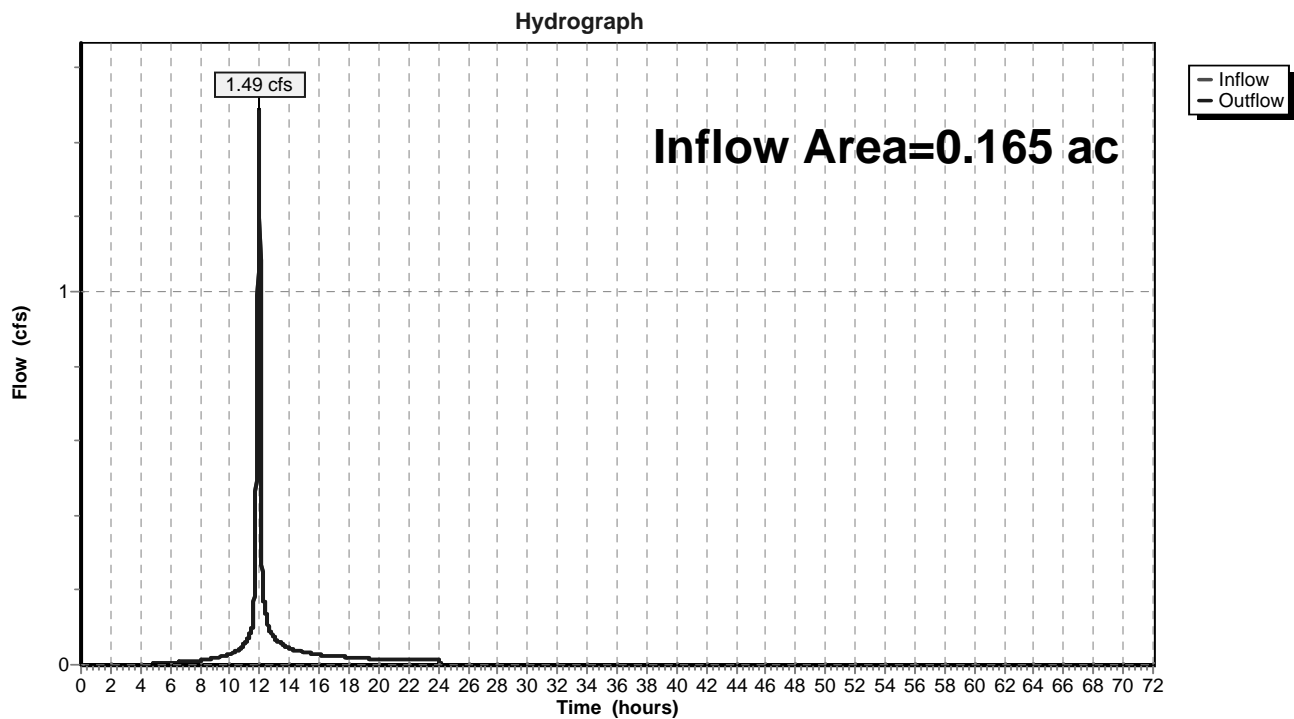
Page 20

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.165 ac, 55.93% Impervious, Inflow Depth = 5.47" for 50-year event  
Inflow = 1.49 cfs @ 11.97 hrs, Volume= 0.075 af  
Outflow = 1.49 cfs @ 11.97 hrs, Volume= 0.075 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 50-year Rainfall=6.99"

Printed 9/13/2016

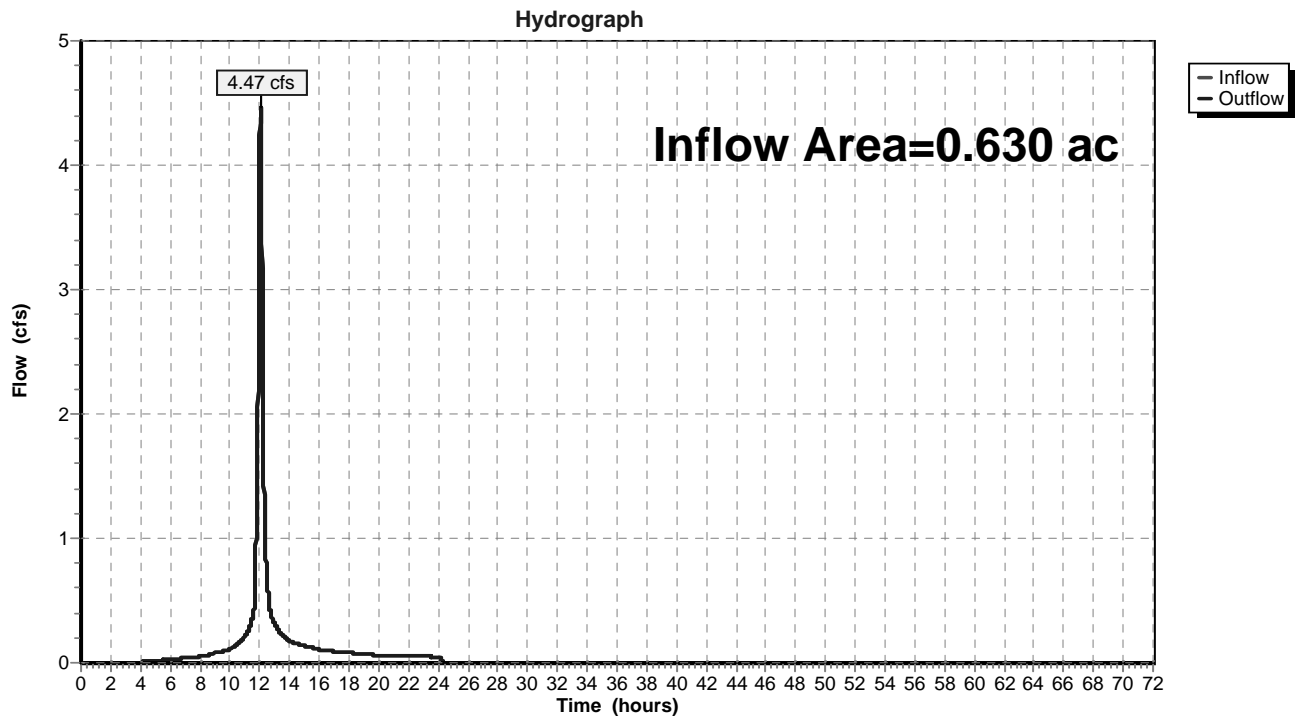
Page 21

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.630 ac, 58.21% Impervious, Inflow Depth = 5.70" for 50-year event  
Inflow = 4.47 cfs @ 12.06 hrs, Volume= 0.299 af  
Outflow = 4.47 cfs @ 12.06 hrs, Volume= 0.299 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2



**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

Page 22

**Summary for Subcatchment P1: AREA P1**

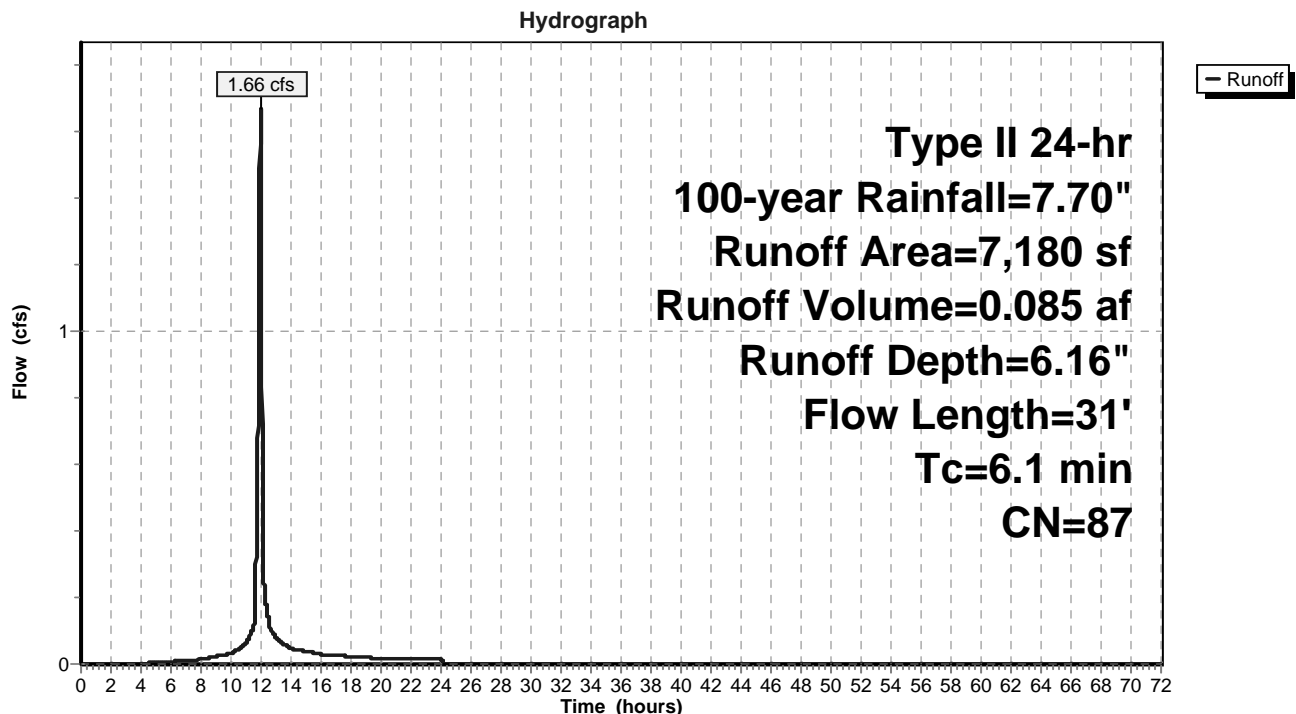
Runoff = 1.66 cfs @ 11.97 hrs, Volume= 0.085 af, Depth= 6.16"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 100-year Rainfall=7.70"

Area (sf)	CN	Description
4,016	98	Paved parking, HSG C
3,164	74	>75% Grass cover, Good, HSG C
7,180	87	Weighted Average
3,164		44.07% Pervious Area
4,016		55.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.7	17	0.0200	0.06		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.9	6	0.1670	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.4	4	0.4760	0.16		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.1	4	0.0200	0.82		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
6.1	31	Total			

**Subcatchment P1: AREA P1**

**16-029\_Post-Development**

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

Page 23

**Summary for Subcatchment P2: AREA P2**

Runoff = 4.98 cfs @ 12.06 hrs, Volume= 0.336 af, Depth= 6.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs  
Type II 24-hr 100-year Rainfall=7.70"

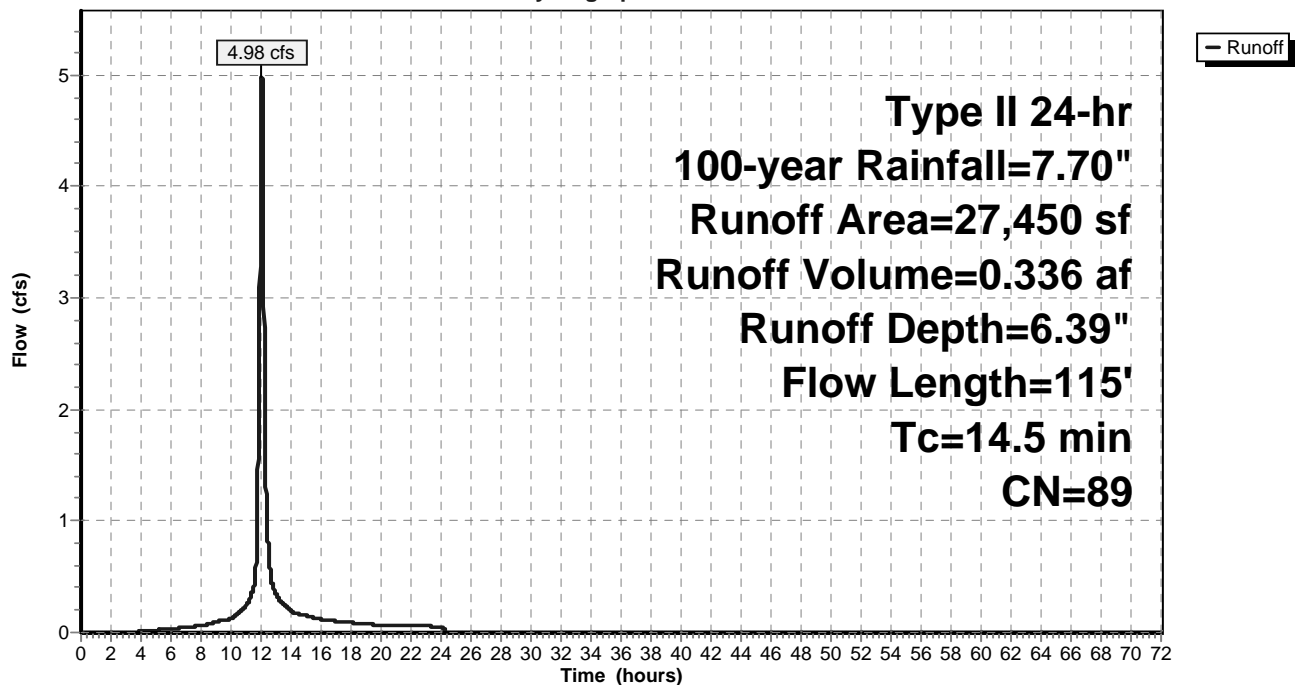
Area (sf)	CN	Description
15,979	98	Paved parking, HSG C
10,090	74	>75% Grass cover, Good, HSG C
1,381	89	Gravel roads, HSG C
27,450	89	Weighted Average
11,471		41.79% Pervious Area
15,979		58.21% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	94	0.0425	0.11		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.6	6	0.5000	0.18		<b>Sheet Flow,</b> Grass: Bermuda n= 0.410 P2= 4.08"
0.2	15	0.0500	1.53		<b>Sheet Flow,</b> Smooth surfaces n= 0.011 P2= 4.08"
14.5	115	Total			

**Subcatchment P2: AREA P2**

Hydrograph



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

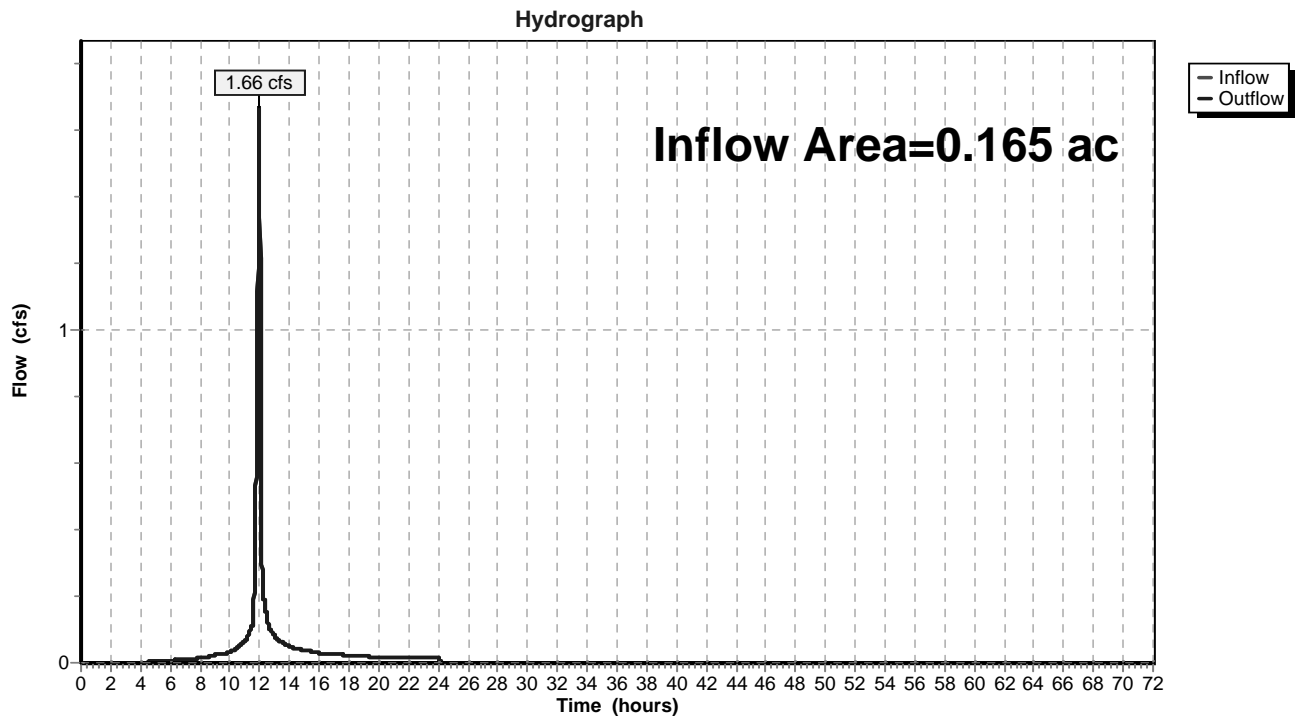
Page 24

### Summary for Reach DP1: Design Point 1

Inflow Area = 0.165 ac, 55.93% Impervious, Inflow Depth = 6.16" for 100-year event  
Inflow = 1.66 cfs @ 11.97 hrs, Volume= 0.085 af  
Outflow = 1.66 cfs @ 11.97 hrs, Volume= 0.085 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP1: Design Point 1



## 16-029\_Post-Development

Prepared by Hewlett-Packard Company

HydroCAD® 10.00 s/n 07912 © 2013 HydroCAD Software Solutions LLC

Type II 24-hr 100-year Rainfall=7.70"

Printed 9/13/2016

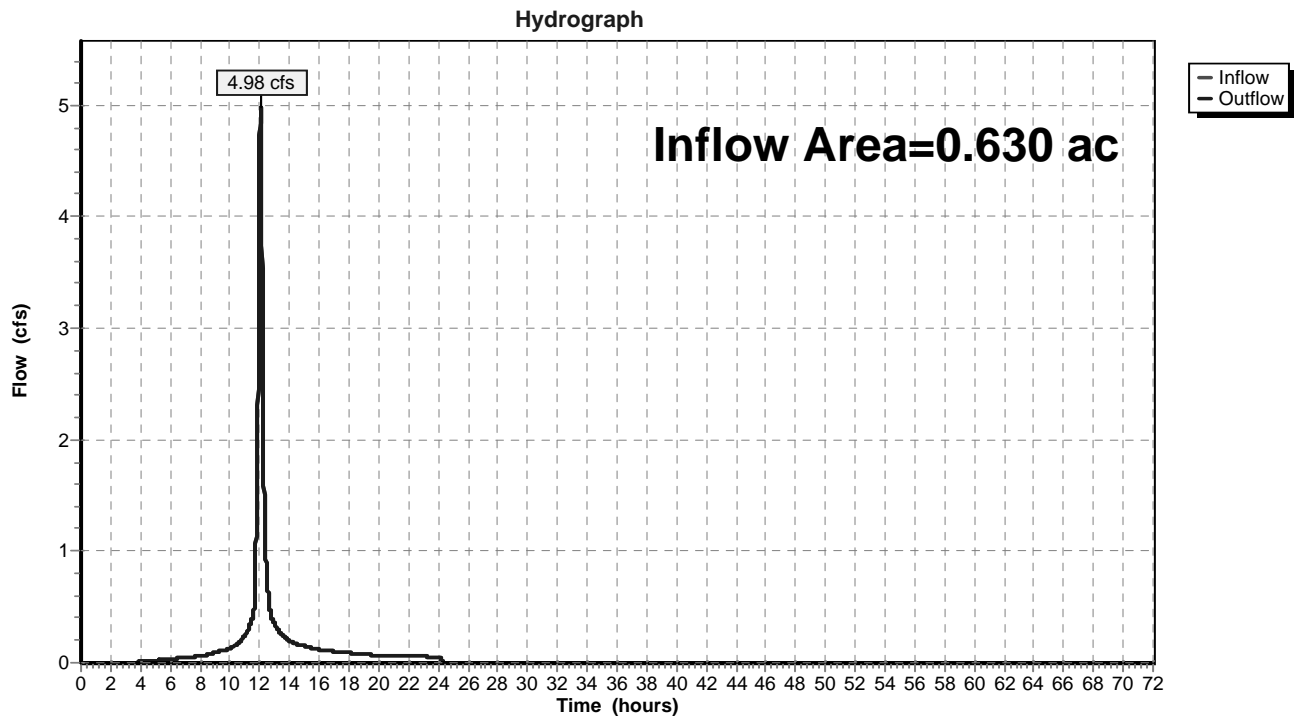
Page 25

### Summary for Reach DP2: Design Point 2

Inflow Area = 0.630 ac, 58.21% Impervious, Inflow Depth = 6.39" for 100-year event  
Inflow = 4.98 cfs @ 12.06 hrs, Volume= 0.336 af  
Outflow = 4.98 cfs @ 12.06 hrs, Volume= 0.336 af, Atten= 0%, Lag= 0.0 min

Routing by Dyn-Stor-Ind method, Time Span= 0.00-72.00 hrs, dt= 0.01 hrs / 2

### Reach DP2: Design Point 2






# APPENDIX

- **IN-SITU SOIL ANALYSIS**
- **VICINTY MAP**
- **AERIAL MAP**















**MAP LEGEND****Area of Interest (AOI)**
 Area of Interest (AOI)
**Soils****Soil Rating Polygons**





-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available

**Soil Rating Lines**






-  A
-  A/D
-  B
-  B/D
-  C
-  C/D
-  D
-  Not rated or not available


**Soil Rating Points**

-  A
-  A/D
-  B
-  B/D

-  C
-  C/D
-  D
-  Not rated or not available

**Water Features**
 Streams and Canals
**Transportation**

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

**Background**
 Aerial Photography
**MAP INFORMATION**

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

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

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

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

Source of Map: Natural Resources Conservation Service  
 Web Soil Survey URL: <http://websoilsurvey.nrcs.usda.gov>  
 Coordinate System: Web Mercator (EPSG:3857)

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

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

Soil Survey Area: Craighead County, Arkansas  
 Survey Area Data: Version 15, Sep 28, 2015

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

Date(s) aerial images were photographed: Feb 22, 2011—Oct 9, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

## Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Craighead County, Arkansas (AR031)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
30	Loring silt loam, 3 to 8 percent slopes	C	4.5	46.2%
31	Loring silt loam, 8 to 12 percent slopes	C	5.2	53.8%
<b>Totals for Area of Interest</b>			<b>9.7</b>	<b>100.0%</b>

## Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

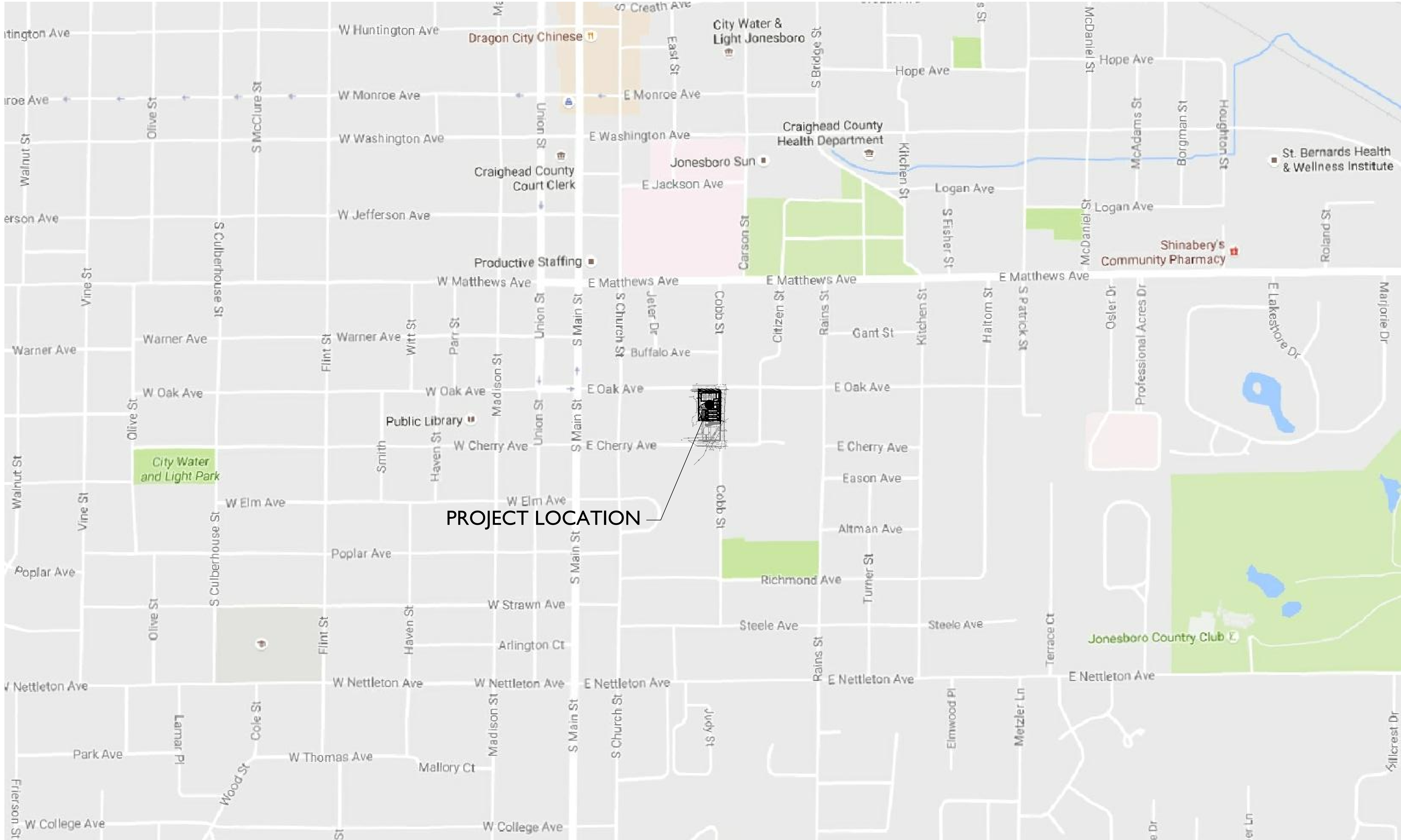
If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

## Rating Options

*Aggregation Method:* Dominant Condition

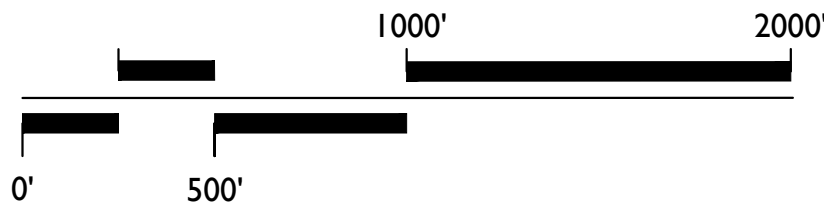
*Component Percent Cutoff: None Specified*

*Tie-break Rule: Higher*



1 VICINITY MAP

SCALE: 1" = 500'



Know what's below.  
Call before you dig.

REVISIONS

SHEET TITLE

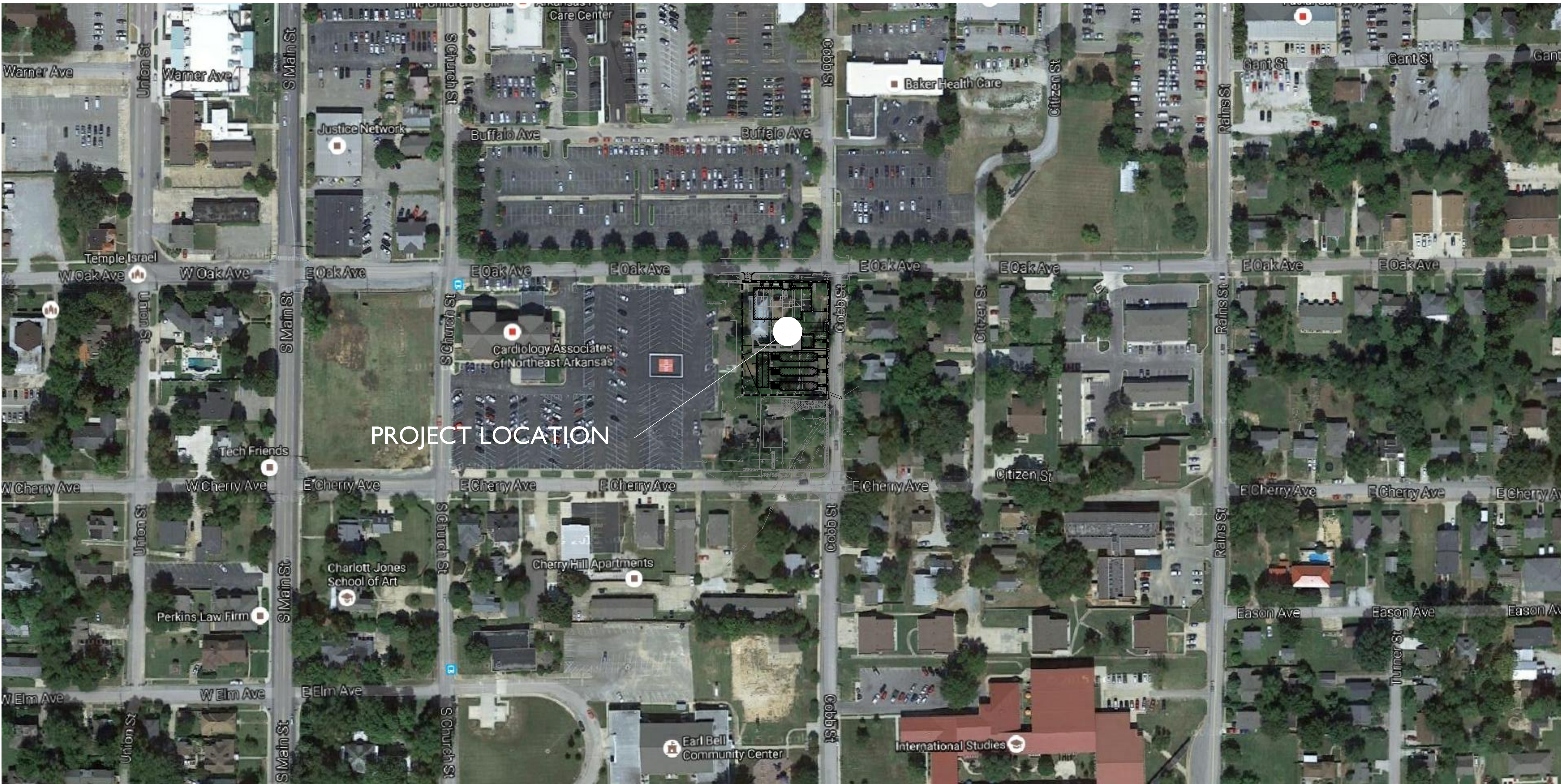
ISSUE DATE  
9-13-16

SHEET NO.

# Oak & Cobb Jonesboro, Arkansas

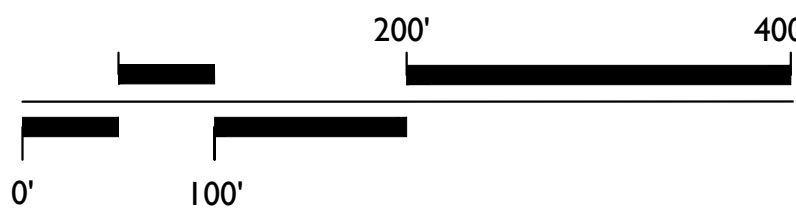
**EDG**  
Ecological Design Group, Inc.  
130 S. Izard Street  
Little Rock, AR 72201  
p 501.378.0200  
f 501.378.0201  
314 South 3rd Street  
Rogers, AR 72756  
p 479.935.4826  
210 E. Meridian Ave.  
Wynne, AR 72396  
p 870.588.4226  
f 870.238.8310





1 AERIAL MAP

SCALE: 1" = 100'



Know what's below.  
Call before you dig.

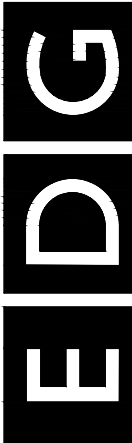
REVISIONS

SHEET TITLE

ISSUE DATE  
9-13-16

SHEET NO.

## Oak & Cobb Jonesboro, Arkansas



Ecological Design Group, Inc.  
130 S. Izard Street  
Little Rock, AR 72201  
P 501.378.0200  
F 501.378.0201  
314 South 3rd Street  
Rogers, AR 72756  
P 479.935.4826  
210 E. Merriam Ave.  
Wynne, AR 72396  
P 870.558.6426  
F 870.238.5710