

STORMWATER DRAINAGE REPORT

For:

**6465 Sawmill Road
City of Dublin, Ohio**

Prepared For:

Christoff

Prepared By:



AMERICAN
STRUCTUREPOINT
INC.

**2550 Corporate Exchange Drive, Suite 300
Columbus, Ohio 43231**

**Prepared: October 2013
Revised: November 2013**

Prepared By:



AMERICAN
STRUCTUREPOINT
INC.

**2550 Corporate Exchange Drive, Suite 300
Columbus, Ohio 43231**

Shawn L. Goodwin, PE

Date

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STORMWATER DRAINAGE REPORT
for
6465 Sawmill Road
City of Dublin, Ohio

I. PROJECT DESCRIPTION

The proposed project is located on the west side of Sawmill Road just north of State Route 161 in the City of Dublin, Ohio. The project consist of re-development of 0.448 acres of urban residential single-family to a 3,064 square foot commercial building along with associated parking and drives.

An aerial map can be found in Appendix A and a soils map can be found in Appendix B of this report.

II. PRE-DEVELOPED DRAINAGE

The “pre-developed” drainage for the re-developed area drains overland to Sawmill Road to the east, to an alley to the west and to commercial parking lots to the north and south, respectively. The subject parcel is relatively flat and consists of 0.118 acres of existing pavement and 0.330 acres urban grasses, which results in “pre-developed” a weighted runoff coefficient (CN) of 80. Additionally, a 10.0 minute time of concentration was assumed.

A pre-developed tributary area map can be found in Appendix C of this report. Additionally, pre-developed runoff calculations using HydroCAD Version 9.00 by HydroCAD Software Solutions, LLC, and can be found in Appendix D of this report.

III. POST-DEVELOPED DRAINAGE

An onsite storm sewer system designed for the 2-year design storm will be installed to convey stormwater for the re-development to the provided detention areas. Since the storm sewer system is being used as detention a 5-year check storm is not valid and has not been provided. Storm sewer calculations can be found in Appendix G of this report. The overall “post-developed” area consists of 0.338 acres of building/pavement/sidewalk and 0.110 acres of grassed open space, which results in a weighted runoff coefficient (CN) of 92.

Per chapter 2 of the *City of Dublin Stormwater Management design manual*, the percent of increase in runoff volume due to development was calculated by comparing the 1-year, 24-hour storm event using the SCS Type II distribution curve for existing and proposed conditions. The percent increase from the pre-developed total runoff volume to post-developed total runoff is shown below:

Location	Pre-Dev 1-year Release Rate (cfs)	Post-Dev 1-year Release Rate (cfs)
Site	0.46	0.96

$$\frac{[(\text{Total 1 yr Post-Dev}) - (\text{Total 1 yr Pre-Dev})]/[\text{Total 1 yr Pre-Dev}] \times 100\% = \% \text{ Increase}}{[0.96 \text{ cfs} - 0.46 \text{ cfs}]/[0.46 \text{ cfs}] \times 100\% = \mathbf{109\% (25\text{-year Critical Storm)}}$$

Using Table 2-5 in the *City of Dublin Stormwater Management Design Manual*, a 109% increase in runoff volume assigns the critical storm for this project as the 25-year storm event. Additionally, Storms of less frequent occurrence than the 25-year storm event shall have the allowable peak rate of runoff not greater than the allowable peak rate of runoff for the same storm under predeveloped conditions. See the pre-development and post-development release rate table on page 3.

STORMWATER MANAGEMENT SUMMARY			
Storm Event	Allowable Release Rates	Post-Developed Release Rates	Ponding Elevation
	(cfs)	(cfs)	(feet)
1-year	0.46	0.41	907.17
2-year	0.46	0.42	907.30
5-year	0.46	0.43	907.45
10-year	0.46	0.43	907.54
25-year	0.46	0.44	907.66
50-year	2.00	0.44	907.74
100-year	2.36	0.45	907.82

STORMWATER STORAGE SUMMARY	
Storage Elevation	Volume Provided
(feet)	(ac-ft)
906.85	0.000
907.35	0.013
907.85	0.058
Total Storage Utilized:	0.056 ac-ft
Total Storage Provided:	0.058 ac-ft

A 2.8 inch orifice plates will be used to provide detention and to control the release rate. Refer to Sheet 5 of Minor Site Plan for the outlet control structure and orifice plate details.

Post-Developed Tributary Area Exhibits can be found in Exhibit E of this report. Post-developed runoff calculations using HydroCAD Version 9.00 by HydroCAD Software Solutions, LLC, and can be found in Appendix F of this report.

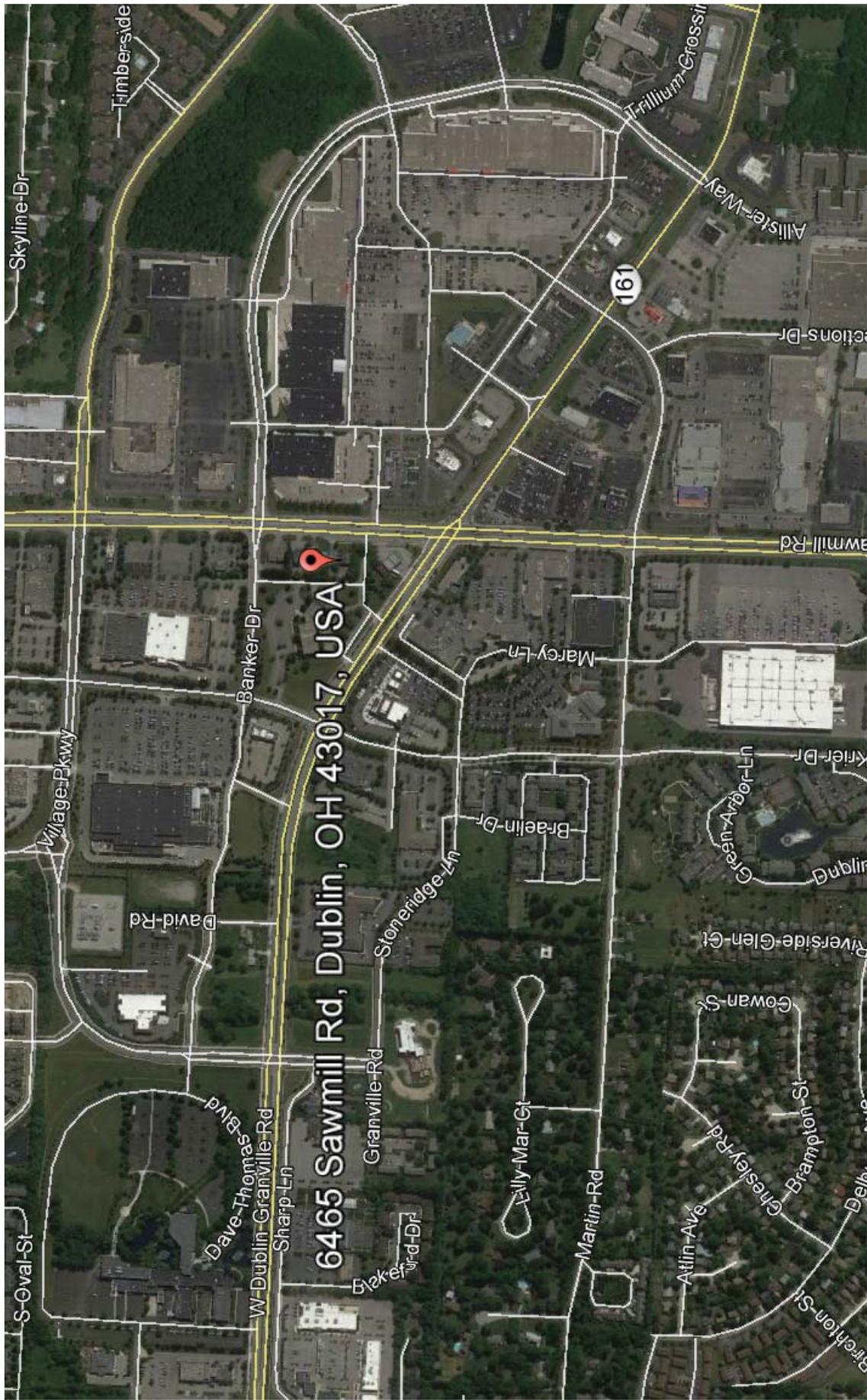
Water quality for the re-development project will utilize a grass filter strip located in the center parking lot island. Two 5-foot curb cuts on the east and west side of the island will allow stormwater to enter into the grass filter strip. Rock channel protection has been provided at these curb cuts to dissipate the velocity into the grass filter strip which flows to the south at a 1.0% slope to catch basin #1. Additionally, the roof drains will be daylighted through the curb on the west side of the building to ensure that stormwater from the roof will be directed to the grass filter strip.

IV. SUMMARY AND CONCLUSIONS

The re-development of this property meets or exceeds water quality requirements for and detention requirements per the *City of Dublin Stormwater Management Design Manual*.

Accordingly, we believe the proposed improvements will not adversely affect this site, adjacent property owners or the City of Dublin.

APPENDIX A
PROJECT LOCATION MAP



APPENDIX B
SOILS MAP

Soil Map—Franklin County, Ohio



MAP LEGEND

-  Area of Interest (AOI)
-  Soil Map Unit Polygons
-  Soil Map Unit Lines
-  Soil Map Unit Points
- Special Point Features**
-  Blowout
-  Borrow Pit
-  Clay Spot
-  Closed Depression
-  Gravel Pit
-  Gravelly Spot
-  Landfill
-  Lava Flow
-  Marsh or swamp
-  Mine or Quarry
-  Miscellaneous Water
-  Perennial Water
-  Rock Outcrop
-  Saline Spot
-  Sandy Spot
-  Severely Eroded Spot
-  Sinkhole
-  Slide or Slip
-  Sodic Spot
-  Spoil Area
-  Stony Spot
-  Very Stony Spot
-  Wet Spot
-  Other
-  Special Line Features
- 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 1:15,800.

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: Franklin County, Ohio
 Survey Area Data: Version 10, Mar 16, 2012

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

Date(s) aerial images were photographed: Feb 27, 2012—Mar 10, 2012

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.

Map Unit Legend

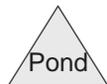
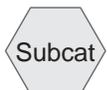
Franklin County, Ohio (OH049)			
Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
CrA	Crosby silt loam, 0 to 2 percent slopes	0.6	100.0%
Totals for Area of Interest		0.6	100.0%

APPENDIX C
PRE-DEVELOPED TRIBUTARY AREA EXHIBIT

APPENDIX D
PRE-DEVELOPED RUNOFF CALCULATIONS



Overall Pre-Developed



02013.01025 Detention.Current Revised Layout *Type II 24-hr 1-year, 24 HR Rainfall=2.20"*

Prepared by American Structurepoint

Printed 11/14/2013

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Page 2

Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=0.69"
Tc=10.0 min CN=80 Runoff=0.46 cfs 0.026 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.026 af Average Runoff Depth = 0.69"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

Runoff = 0.46 cfs @ 12.03 hrs, Volume= 0.026 af, Depth= 0.69"

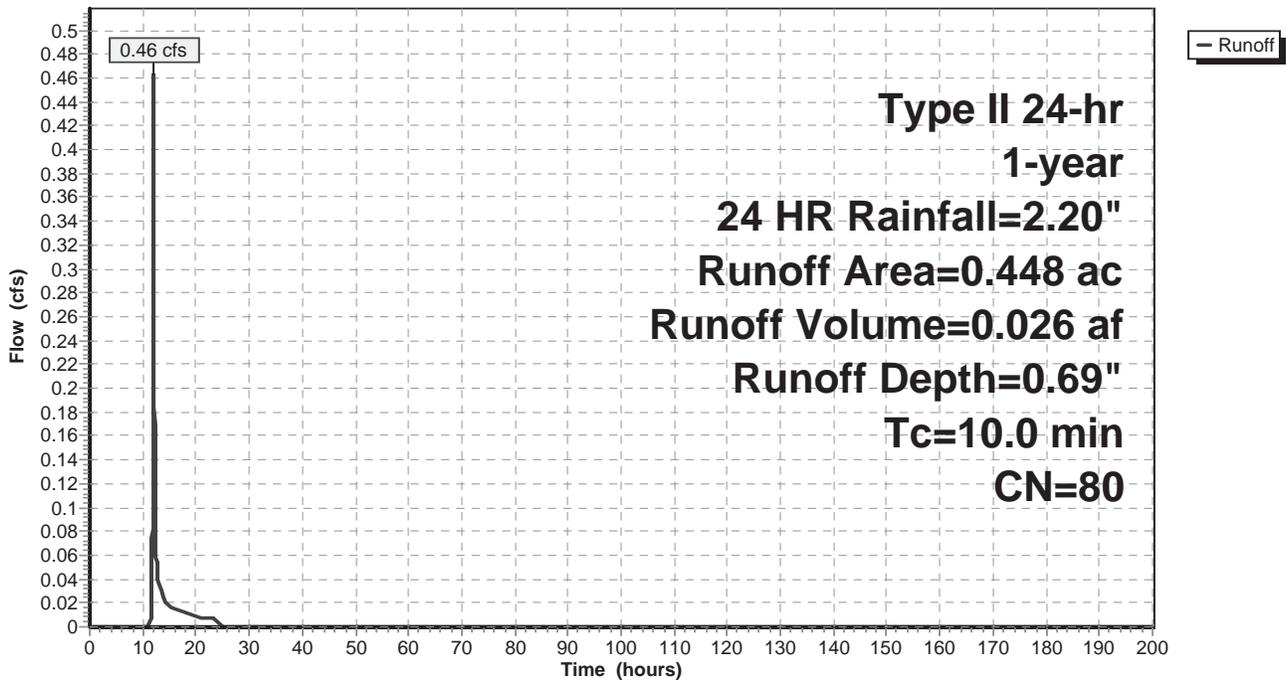
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 1-year, 24 HR Rainfall=2.20"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed

Hydrograph



02013.01025 Detention.Current Revised Layout *Type II 24-hr 2-year, 24 HR Rainfall=2.63"*

Prepared by American Structurepoint

Printed 11/14/2013

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=0.98"
Tc=10.0 min CN=80 Runoff=0.67 cfs 0.037 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.037 af Average Runoff Depth = 0.98"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

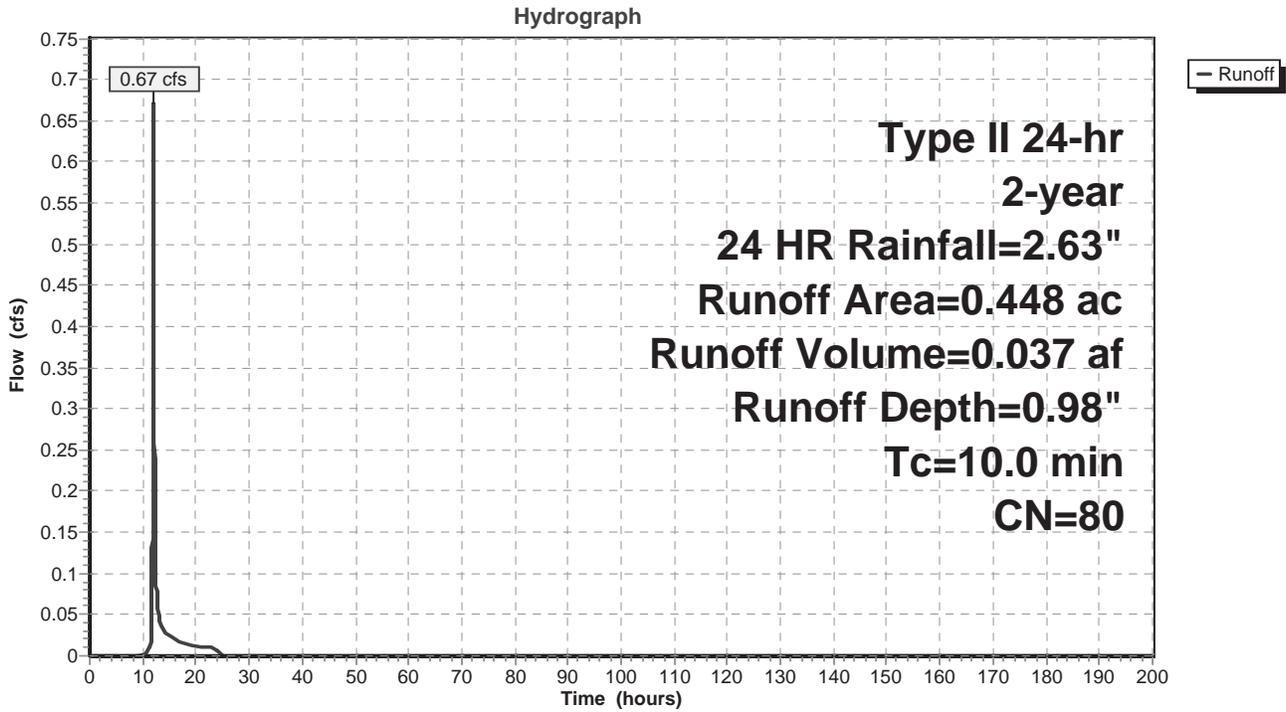
Runoff = 0.67 cfs @ 12.02 hrs, Volume= 0.037 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 2-year, 24 HR Rainfall=2.63"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed



02013.01025 Detention.Current Revised Layout *Type II 24-hr 5-year, 24 HR Rainfall=3.24"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=1.43"
Tc=10.0 min CN=80 Runoff=0.99 cfs 0.053 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.053 af Average Runoff Depth = 1.43"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

Runoff = 0.99 cfs @ 12.02 hrs, Volume= 0.053 af, Depth= 1.43"

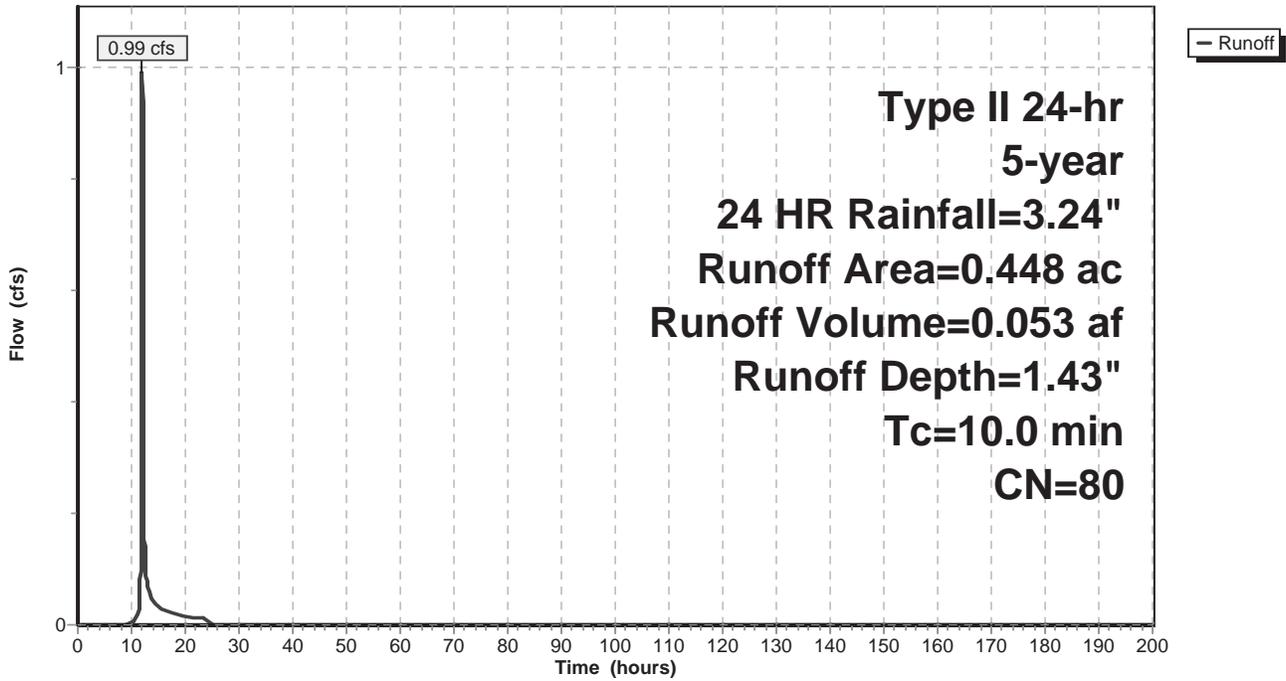
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 5-year, 24 HR Rainfall=3.24"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed

Hydrograph



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=1.83"
Tc=10.0 min CN=80 Runoff=1.26 cfs 0.068 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.068 af Average Runoff Depth = 1.83"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

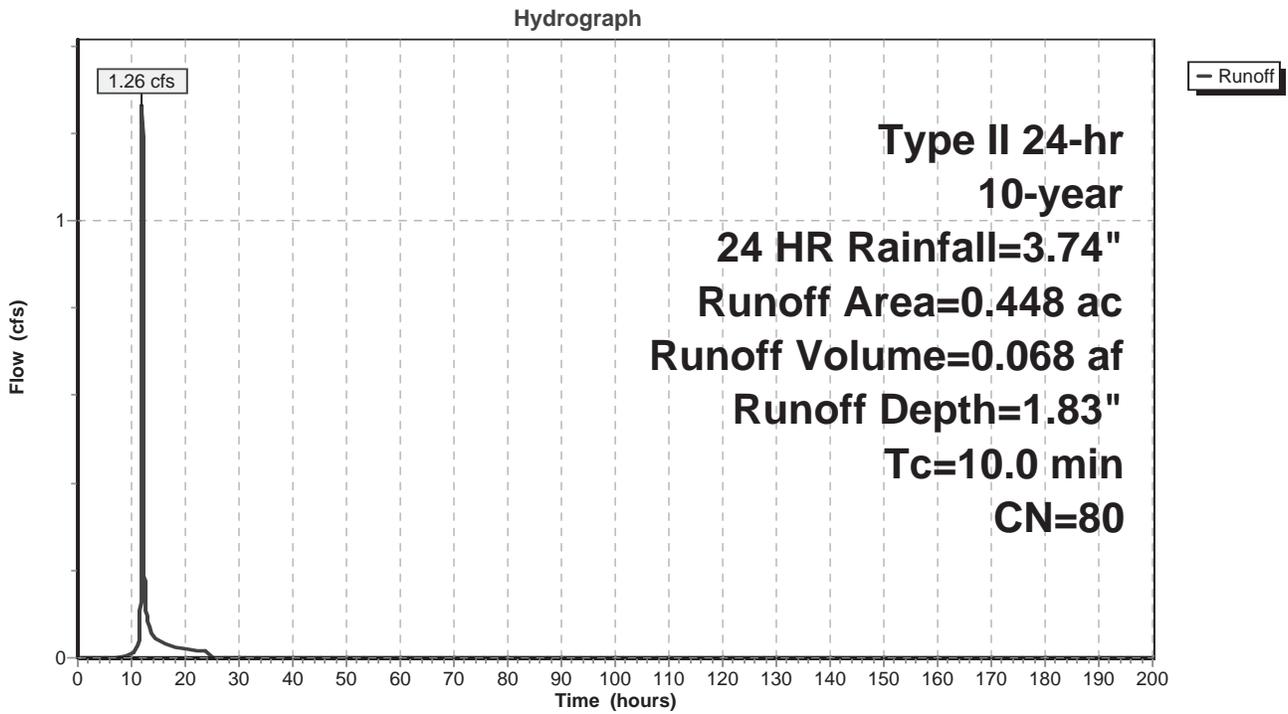
Runoff = 1.26 cfs @ 12.02 hrs, Volume= 0.068 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-year, 24 HR Rainfall=3.74"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed



02013.01025 Detention.Current Revised Layout *Type II 24-hr 25-year, 24 HR Rainfall=4.44"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=2.41"
Tc=10.0 min CN=80 Runoff=1.66 cfs 0.090 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.090 af Average Runoff Depth = 2.41"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

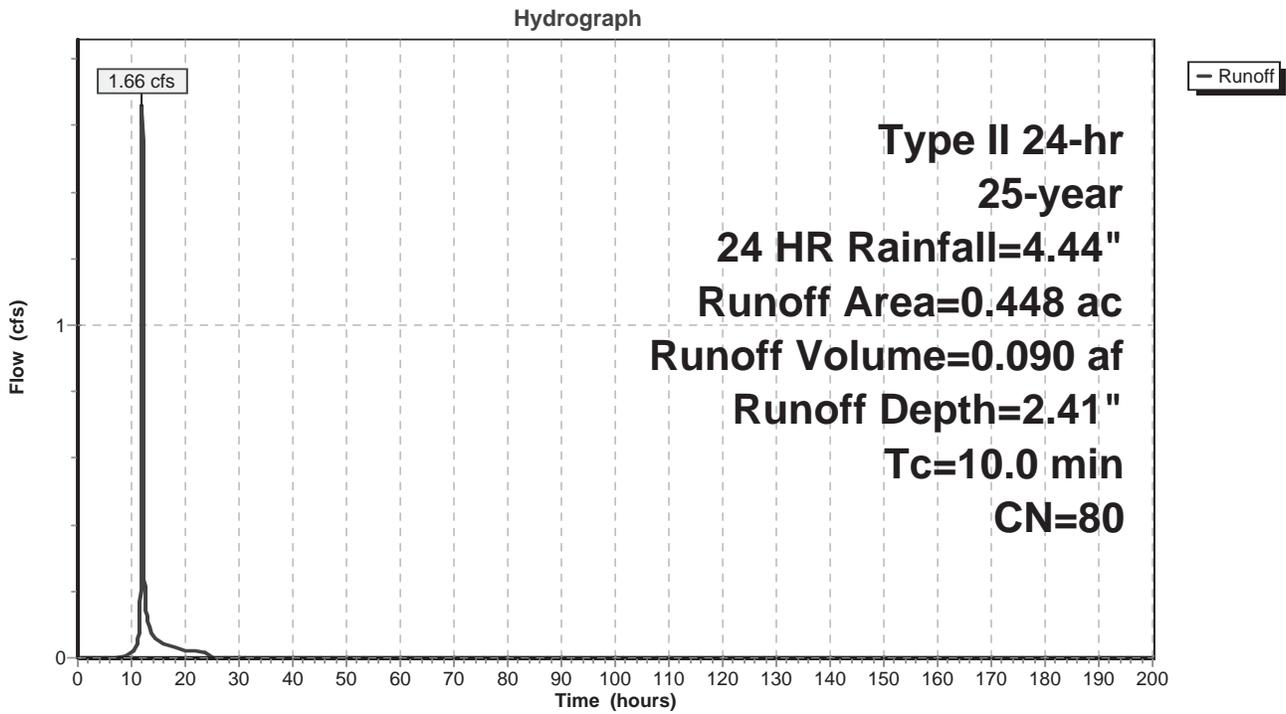
Runoff = 1.66 cfs @ 12.02 hrs, Volume= 0.090 af, Depth= 2.41"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-year, 24 HR Rainfall=4.44"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed



02013.01025 Detention.Current Revised Layout *Type II 24-hr 50-year, 24 HR Rainfall=5.02"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=2.91"
Tc=10.0 min CN=80 Runoff=2.00 cfs 0.109 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.109 af Average Runoff Depth = 2.91"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

Runoff = 2.00 cfs @ 12.02 hrs, Volume= 0.109 af, Depth= 2.91"

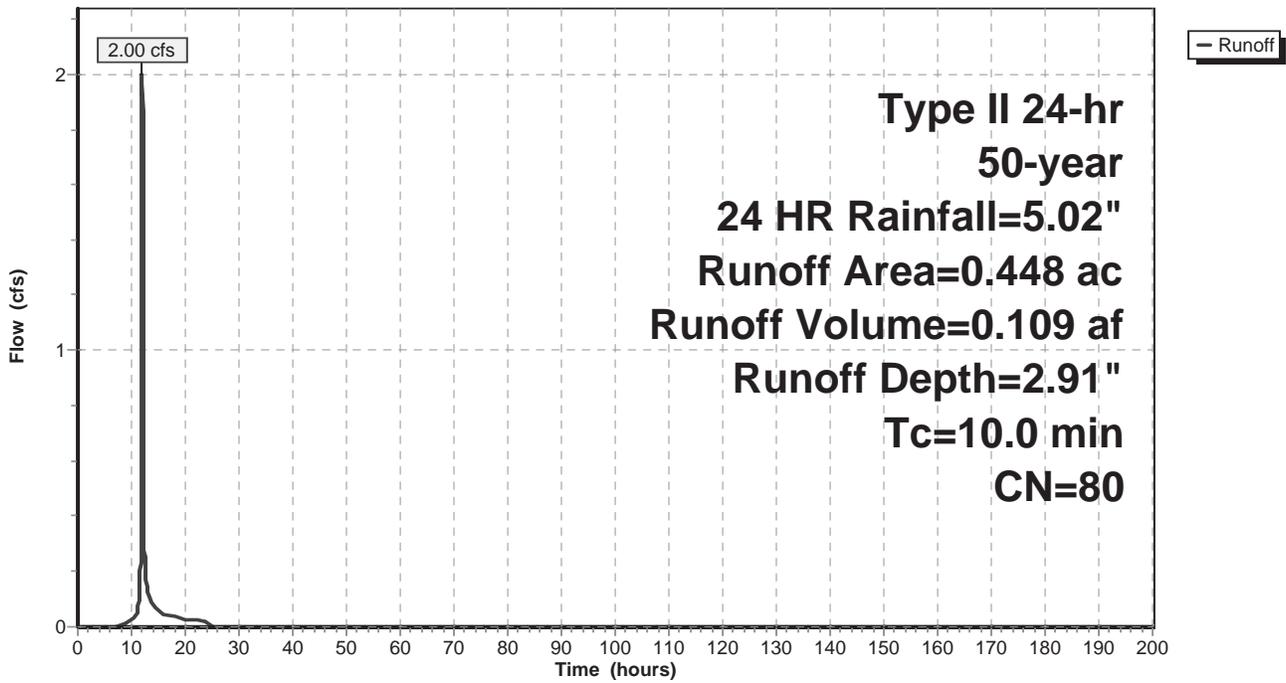
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-year, 24 HR Rainfall=5.02"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed

Hydrograph



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 1S: Overall Pre-Developed Runoff Area=0.448 ac 25.00% Impervious Runoff Depth=3.45"
Tc=10.0 min CN=80 Runoff=2.36 cfs 0.129 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.129 af Average Runoff Depth = 3.45"
75.00% Pervious = 0.336 ac 25.00% Impervious = 0.112 ac

Summary for Subcatchment 1S: Overall Pre-Developed

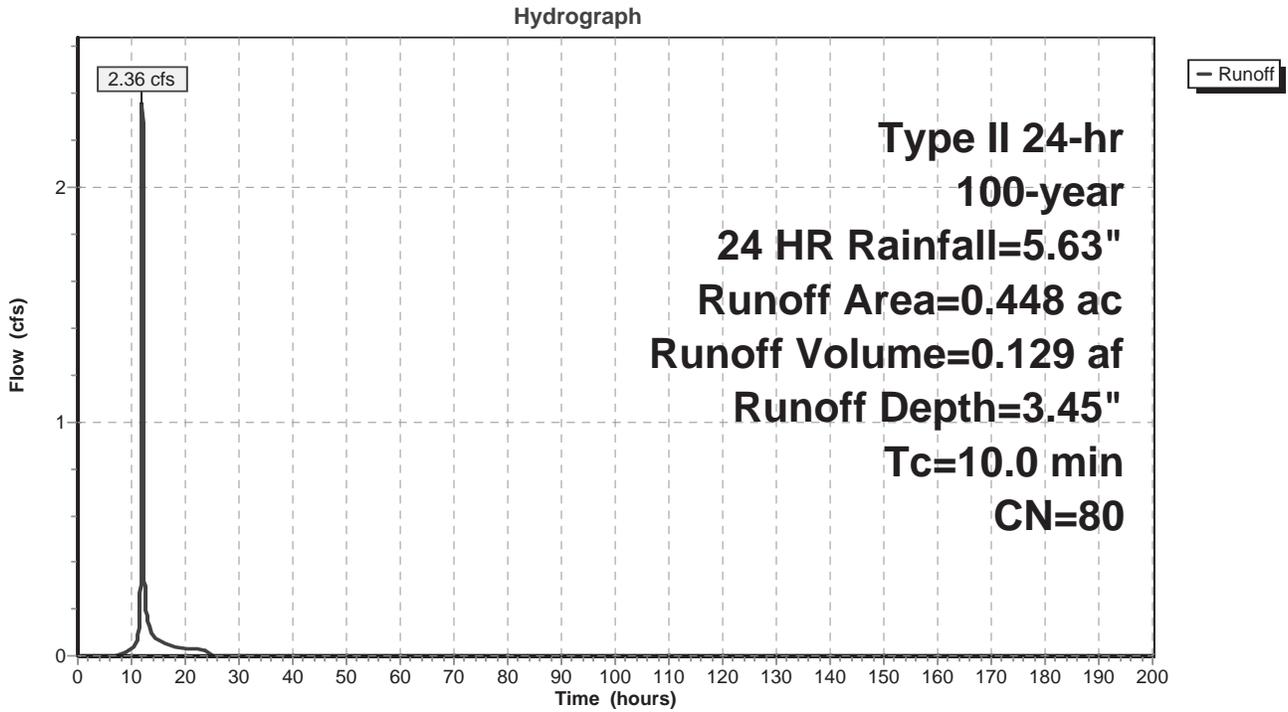
Runoff = 2.36 cfs @ 12.01 hrs, Volume= 0.129 af, Depth= 3.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 100-year, 24 HR Rainfall=5.63"

Area (ac)	CN	Description
0.448	80	1/2 acre lots, 25% imp, HSG C
0.336		75.00% Pervious Area
0.112		25.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.0					Direct Entry, Pre-Developed

Subcatchment 1S: Overall Pre-Developed

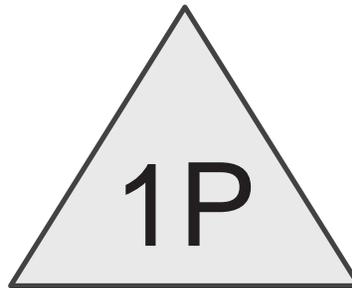


APPENDIX E
POST-DEVELOPED TRIBUTARY AREA EXHIBIT

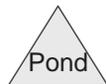
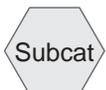
APPENDIX F
POST-DEVELOPED RUNOFF CALCULATIONS



Overall Post-Developed



Site Detention



Routing Diagram for 02013.01025 Detention.Current Revised Layout with swale

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02013.01025 Detention.Current Revised Layout *Type II 24-hr 1-year, 24 HR Rainfall=2.20"*

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Page 2

Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=1.42"
Tc=10.0 min CN=92 Runoff=0.96 cfs 0.053 af

Pond 1P: Site Detention

Peak Elev=907.17' Storage=0.008 af Inflow=0.96 cfs 0.053 af
Outflow=0.41 cfs 0.053 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.053 af Average Runoff Depth = 1.42"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

Runoff = 0.96 cfs @ 12.01 hrs, Volume= 0.053 af, Depth= 1.42"

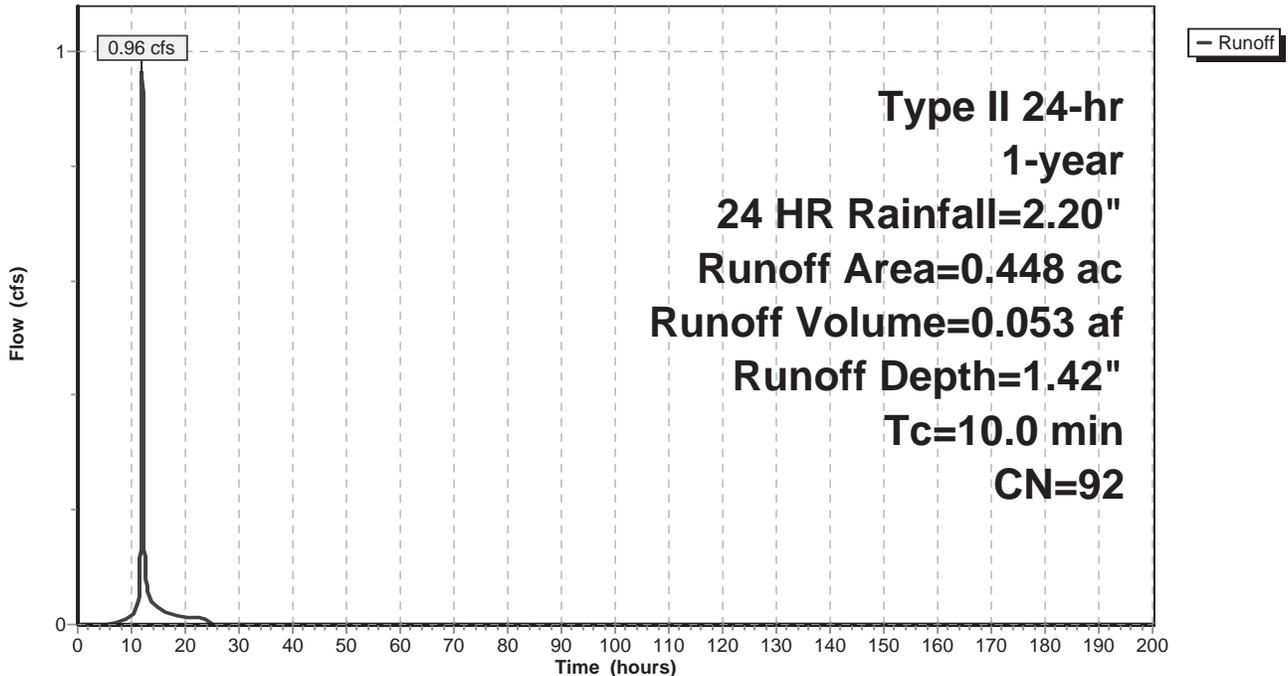
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 1-year, 24 HR Rainfall=2.20"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed

Hydrograph



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 1.42" for 1-year, 24 HR event
 Inflow = 0.96 cfs @ 12.01 hrs, Volume= 0.053 af
 Outflow = 0.41 cfs @ 12.15 hrs, Volume= 0.053 af, Atten= 57%, Lag= 8.1 min
 Primary = 0.41 cfs @ 12.15 hrs, Volume= 0.053 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.17' @ 12.15 hrs Surf.Area= 0.034 ac Storage= 0.008 af

Plug-Flow detention time= 3.6 min calculated for 0.053 af (100% of inflow)
 Center-of-Mass det. time= 3.6 min (816.3 - 812.6)

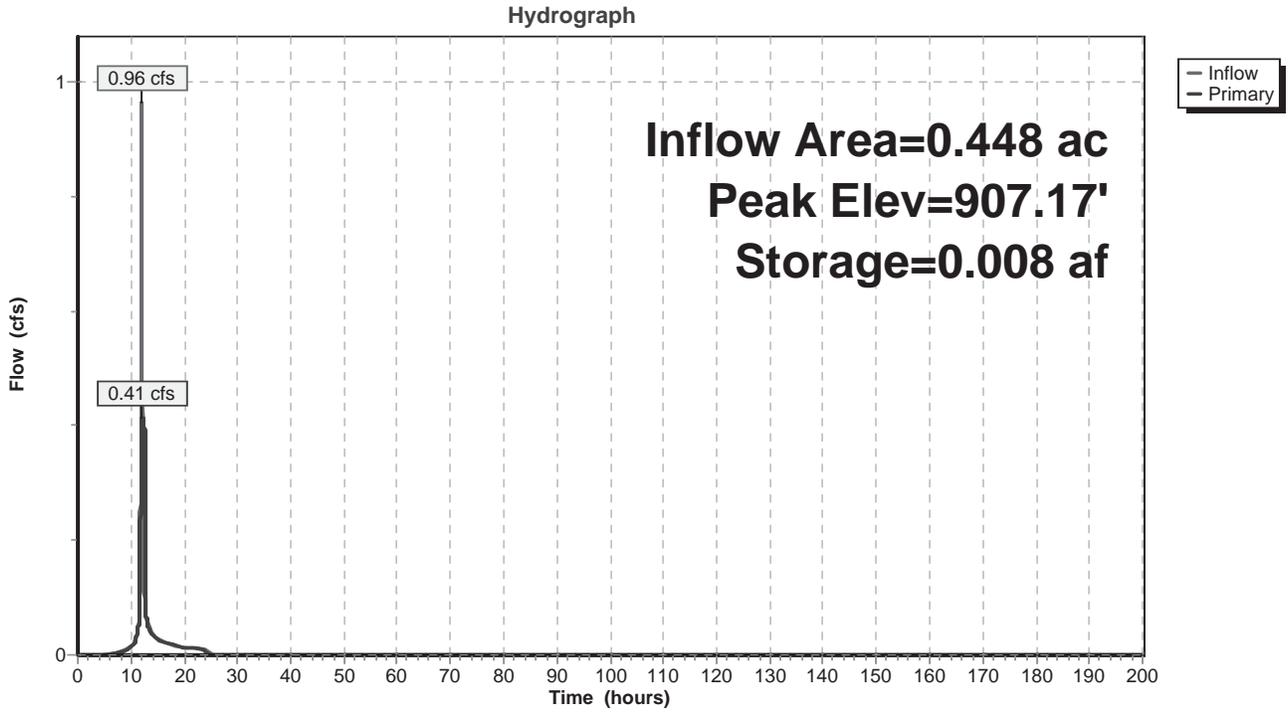
Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

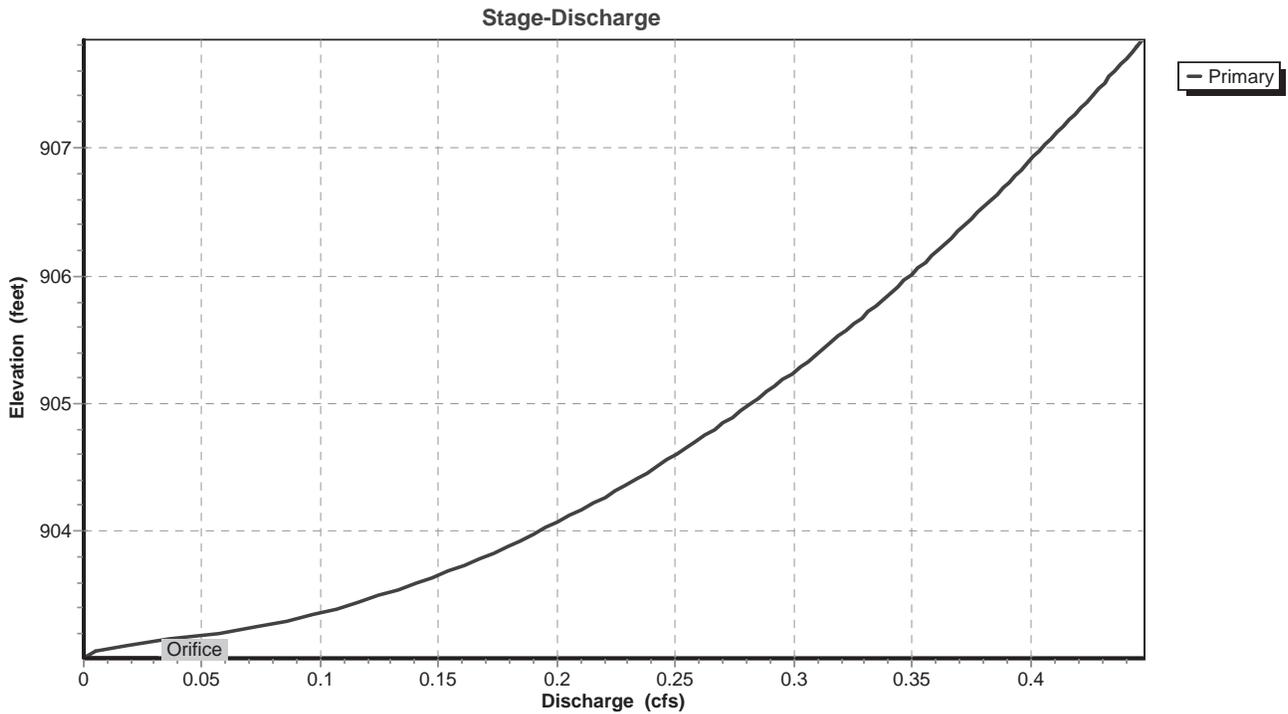
Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

Primary OutFlow Max=0.41 cfs @ 12.15 hrs HW=907.17' (Free Discharge)
 ↑**1=Orifice** (Orifice Controls 0.41 cfs @ 9.69 fps)

Pond 1P: Site Detention

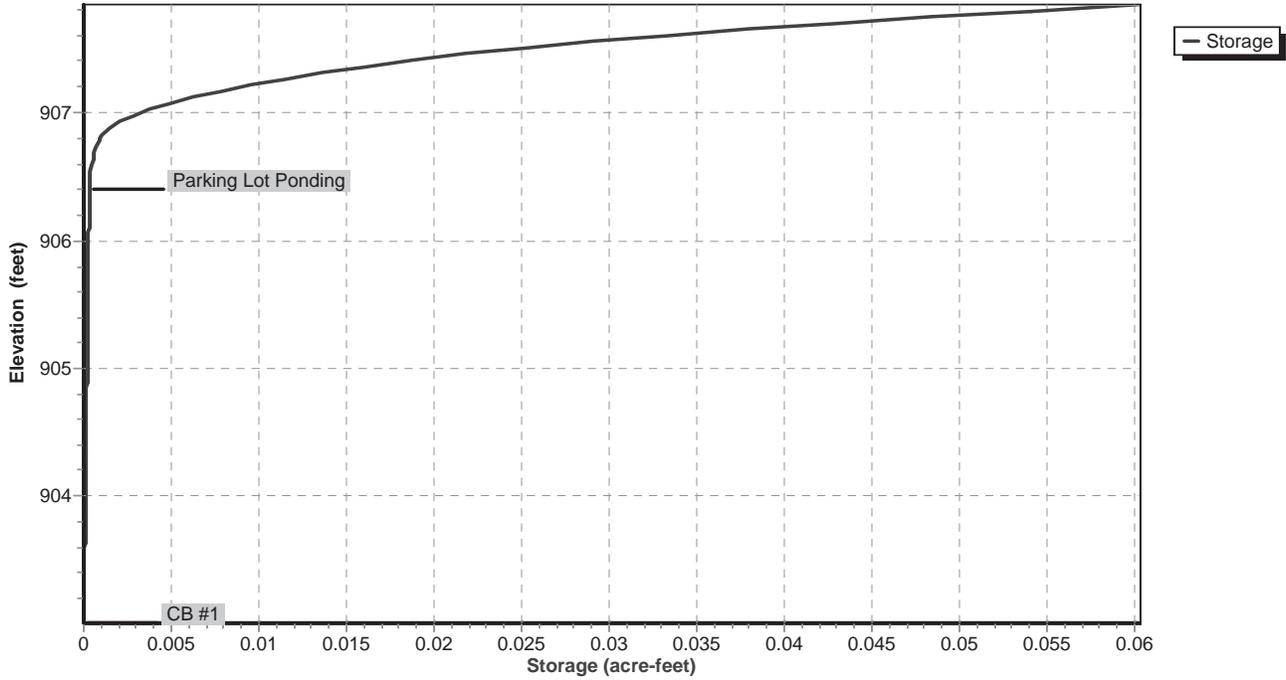


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



02013.01025 Detention.Current Revised Layout *Type II 24-hr 2-year, 24 HR Rainfall=2.63"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=1.81"
Tc=10.0 min CN=92 Runoff=1.22 cfs 0.068 af

Pond 1P: Site Detention Peak Elev=907.30' Storage=0.013 af Inflow=1.22 cfs 0.068 af
Outflow=0.42 cfs 0.068 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.068 af Average Runoff Depth = 1.81"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

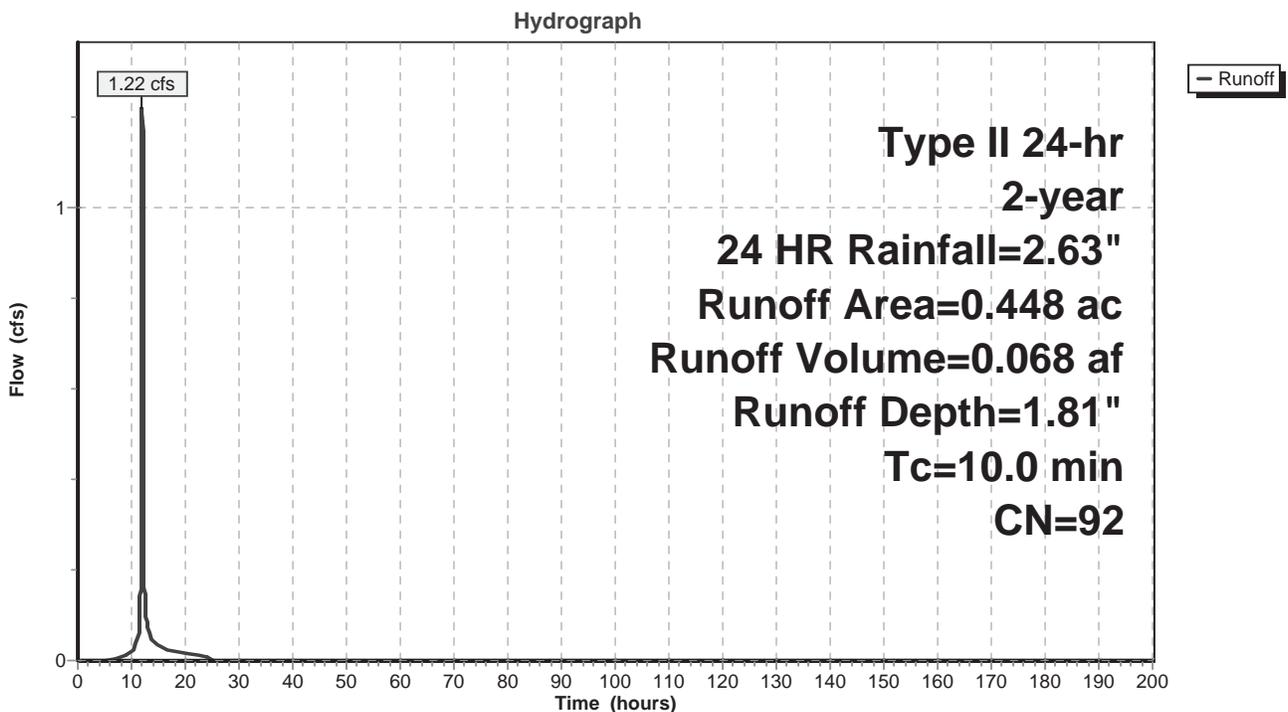
Runoff = 1.22 cfs @ 12.01 hrs, Volume= 0.068 af, Depth= 1.81"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 2-year, 24 HR Rainfall=2.63"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 1.81" for 2-year, 24 HR event
 Inflow = 1.22 cfs @ 12.01 hrs, Volume= 0.068 af
 Outflow = 0.42 cfs @ 12.17 hrs, Volume= 0.068 af, Atten= 65%, Lag= 9.6 min
 Primary = 0.42 cfs @ 12.17 hrs, Volume= 0.068 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.30' @ 12.17 hrs Surf.Area= 0.045 ac Storage= 0.013 af

Plug-Flow detention time= 6.5 min calculated for 0.068 af (100% of inflow)
 Center-of-Mass det. time= 6.2 min (811.9 - 805.6)

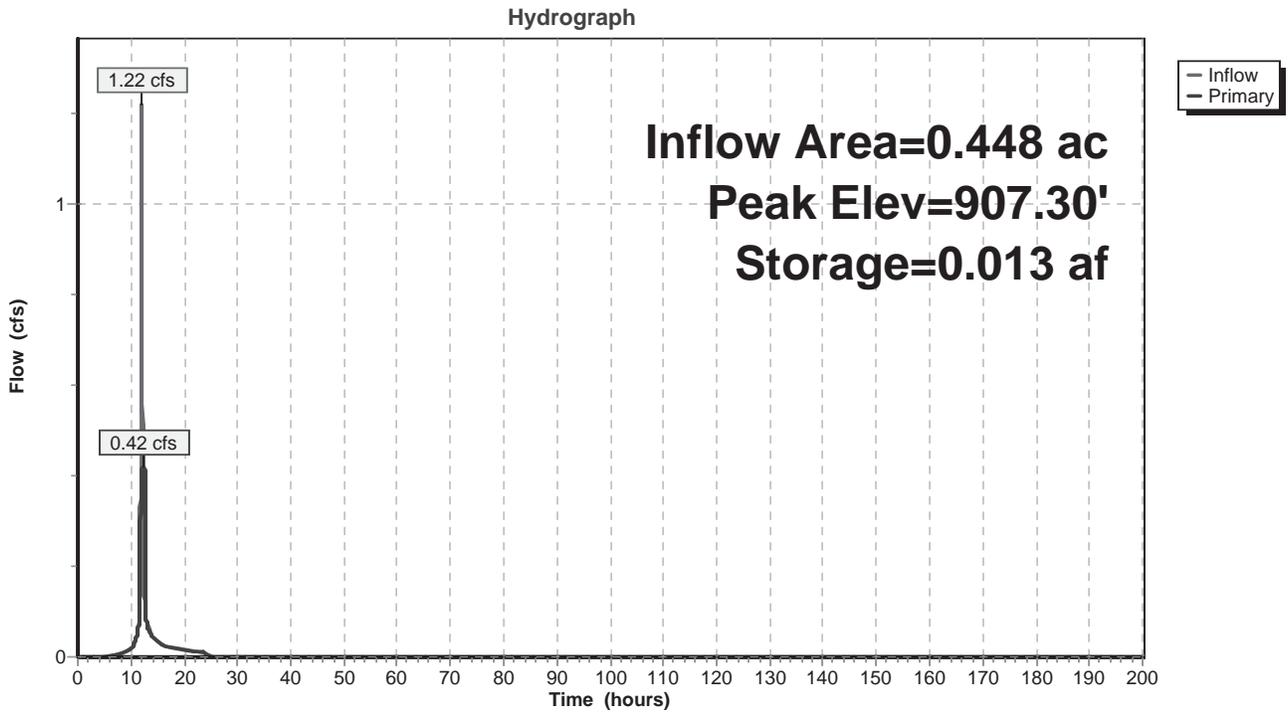
Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

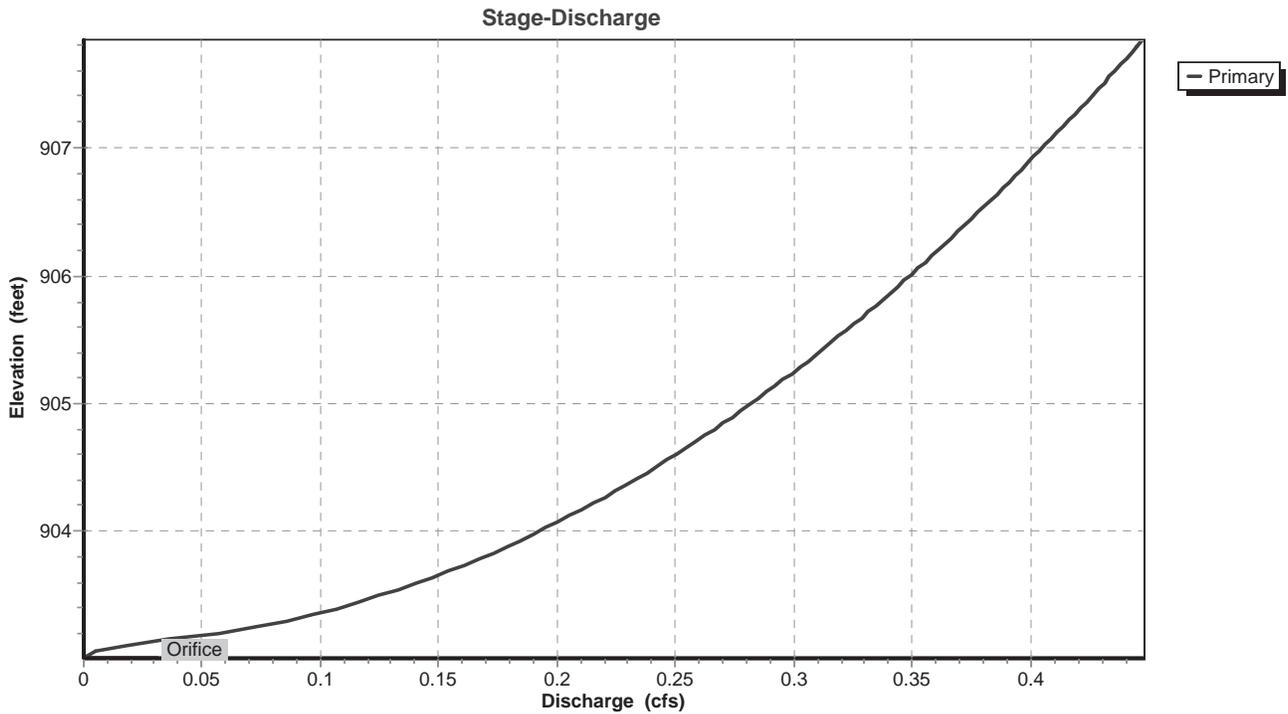
Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

Primary OutFlow Max=0.42 cfs @ 12.17 hrs HW=907.30' (Free Discharge)
 ↑**1=Orifice** (Orifice Controls 0.42 cfs @ 9.84 fps)

Pond 1P: Site Detention

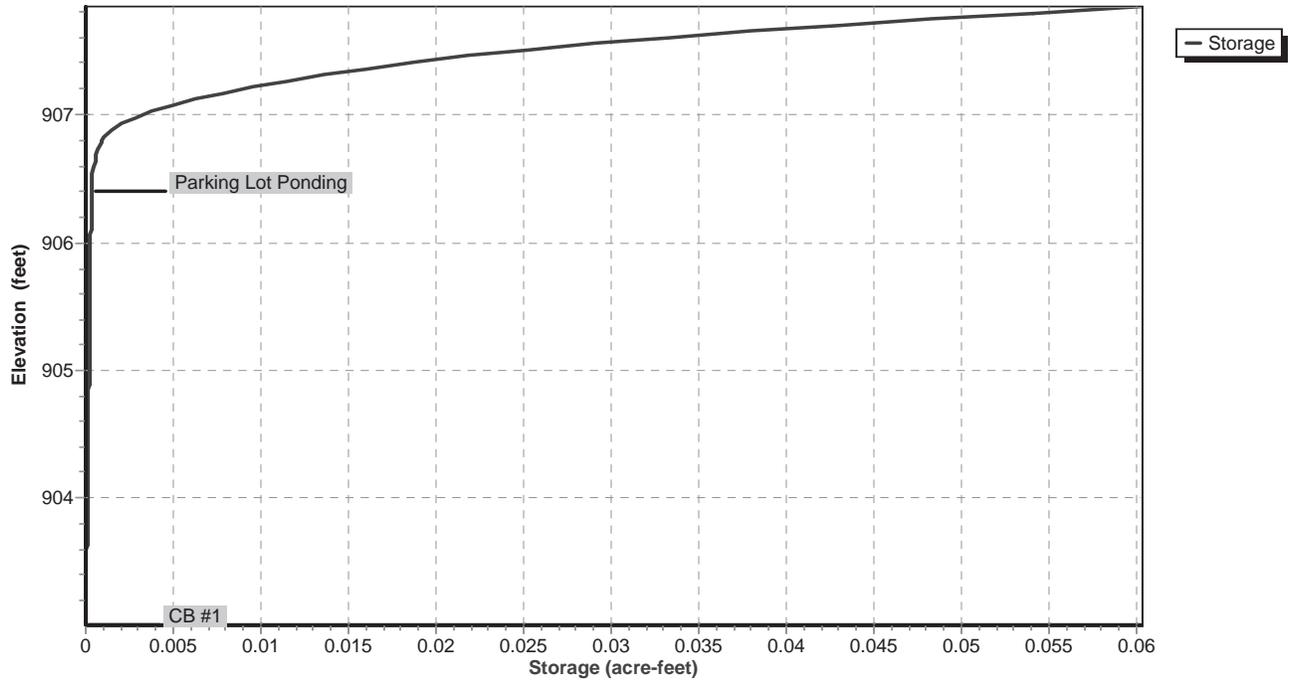


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



02013.01025 Detention.Current Revised Layout *Type II 24-hr 5-year, 24 HR Rainfall=3.24"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=2.39"
Tc=10.0 min CN=92 Runoff=1.58 cfs 0.089 af

Pond 1P: Site Detention

Peak Elev=907.45' Storage=0.021 af Inflow=1.58 cfs 0.089 af
Outflow=0.43 cfs 0.089 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.089 af Average Runoff Depth = 2.39"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

Runoff = 1.58 cfs @ 12.01 hrs, Volume= 0.089 af, Depth= 2.39"

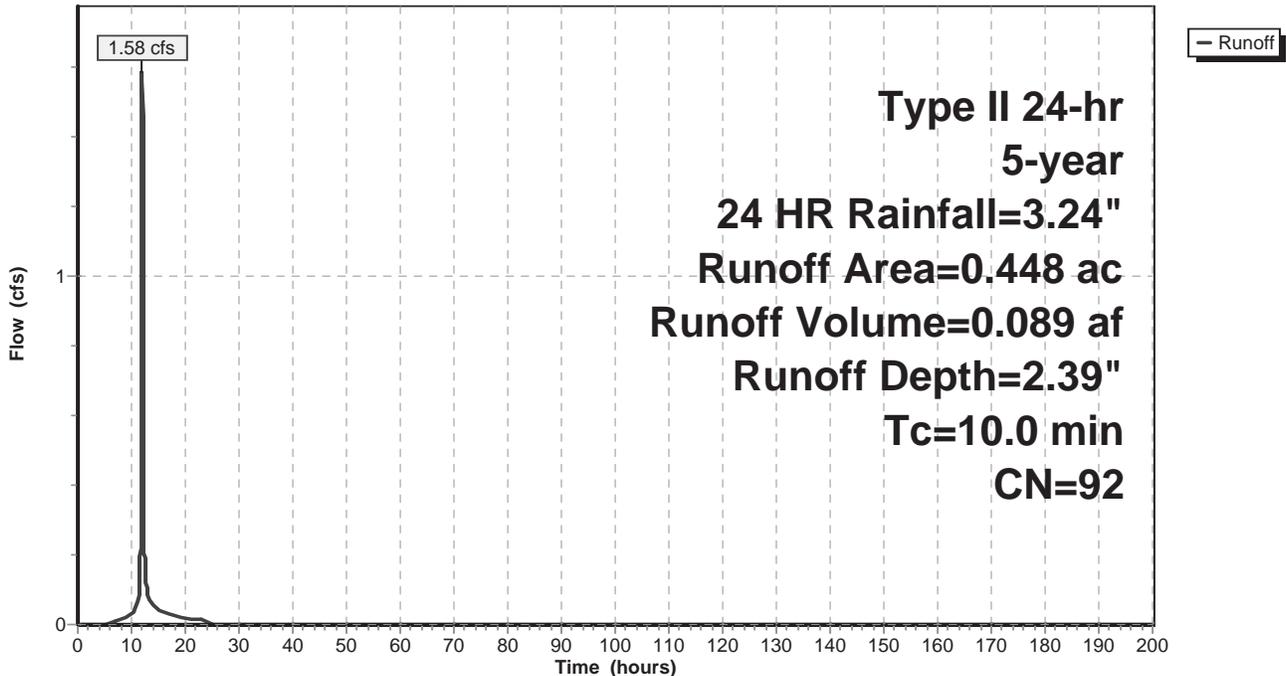
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 5-year, 24 HR Rainfall=3.24"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed

Hydrograph



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 2.39" for 5-year, 24 HR event
 Inflow = 1.58 cfs @ 12.01 hrs, Volume= 0.089 af
 Outflow = 0.43 cfs @ 12.20 hrs, Volume= 0.089 af, Atten= 73%, Lag= 11.5 min
 Primary = 0.43 cfs @ 12.20 hrs, Volume= 0.089 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.45' @ 12.20 hrs Surf.Area= 0.065 ac Storage= 0.021 af

Plug-Flow detention time= 10.9 min calculated for 0.089 af (100% of inflow)
 Center-of-Mass det. time= 10.6 min (808.5 - 797.9)

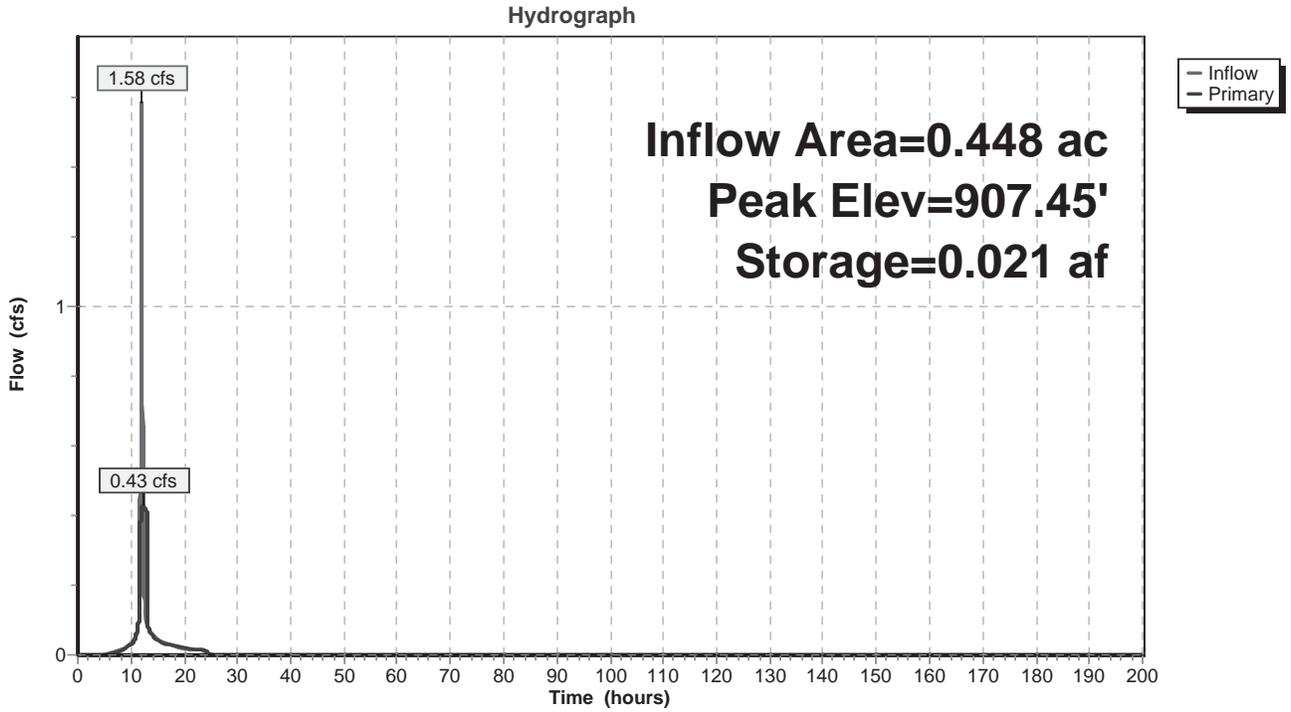
Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

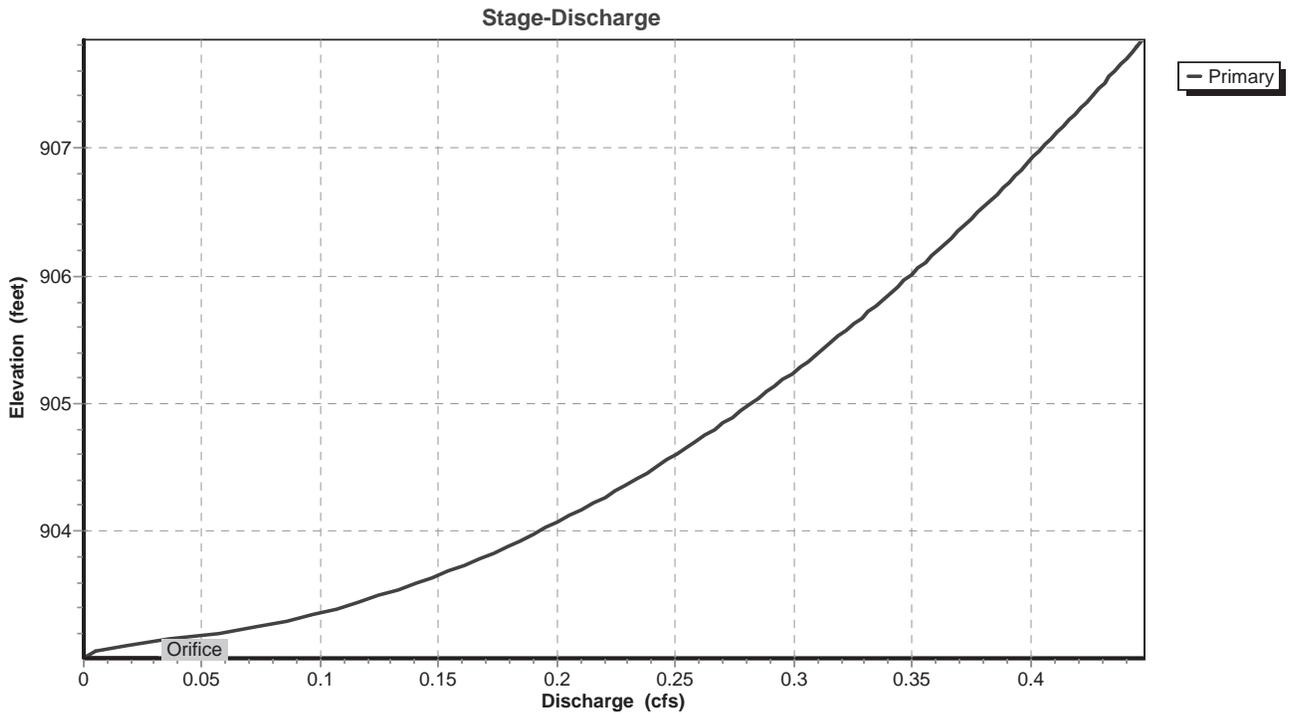
Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

Primary OutFlow Max=0.43 cfs @ 12.20 hrs HW=907.45' (Free Discharge)
 ↑**1=Orifice** (Orifice Controls 0.43 cfs @ 10.01 fps)

Pond 1P: Site Detention

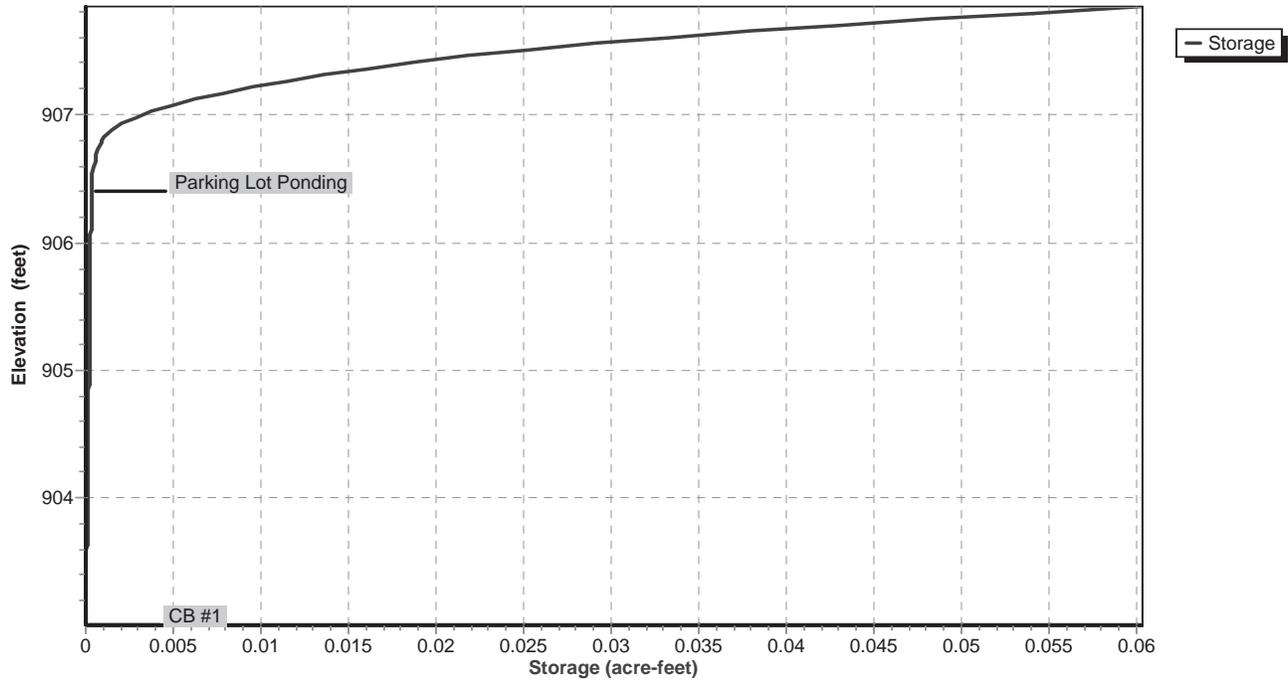


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=2.87"
Tc=10.0 min CN=92 Runoff=1.88 cfs 0.107 af

Pond 1P: Site Detention Peak Elev=907.54' Storage=0.028 af Inflow=1.88 cfs 0.107 af
Outflow=0.43 cfs 0.107 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.107 af Average Runoff Depth = 2.87"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

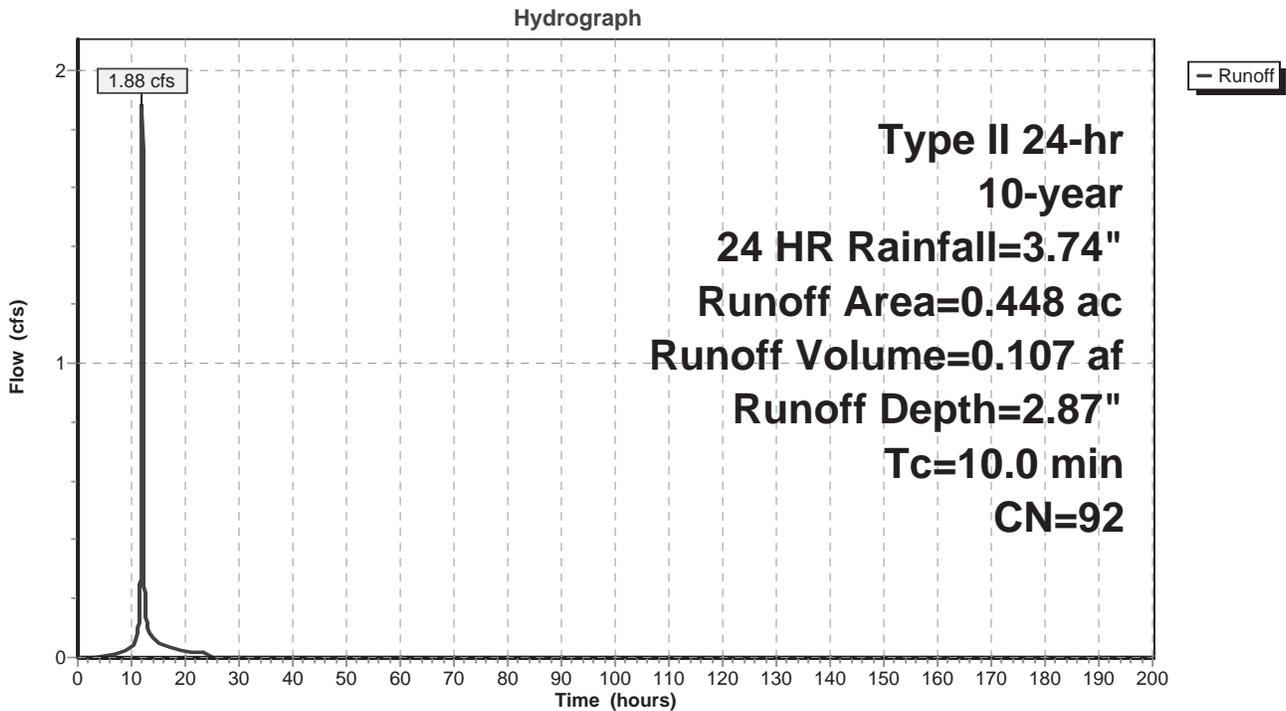
Runoff = 1.88 cfs @ 12.01 hrs, Volume= 0.107 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 10-year, 24 HR Rainfall=3.74"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 2.87" for 10-year, 24 HR event
 Inflow = 1.88 cfs @ 12.01 hrs, Volume= 0.107 af
 Outflow = 0.43 cfs @ 12.23 hrs, Volume= 0.107 af, Atten= 77%, Lag= 13.0 min
 Primary = 0.43 cfs @ 12.23 hrs, Volume= 0.107 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.54' @ 12.23 hrs Surf.Area= 0.081 ac Storage= 0.028 af

Plug-Flow detention time= 14.7 min calculated for 0.107 af (100% of inflow)
 Center-of-Mass det. time= 14.7 min (807.5 - 792.8)

Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

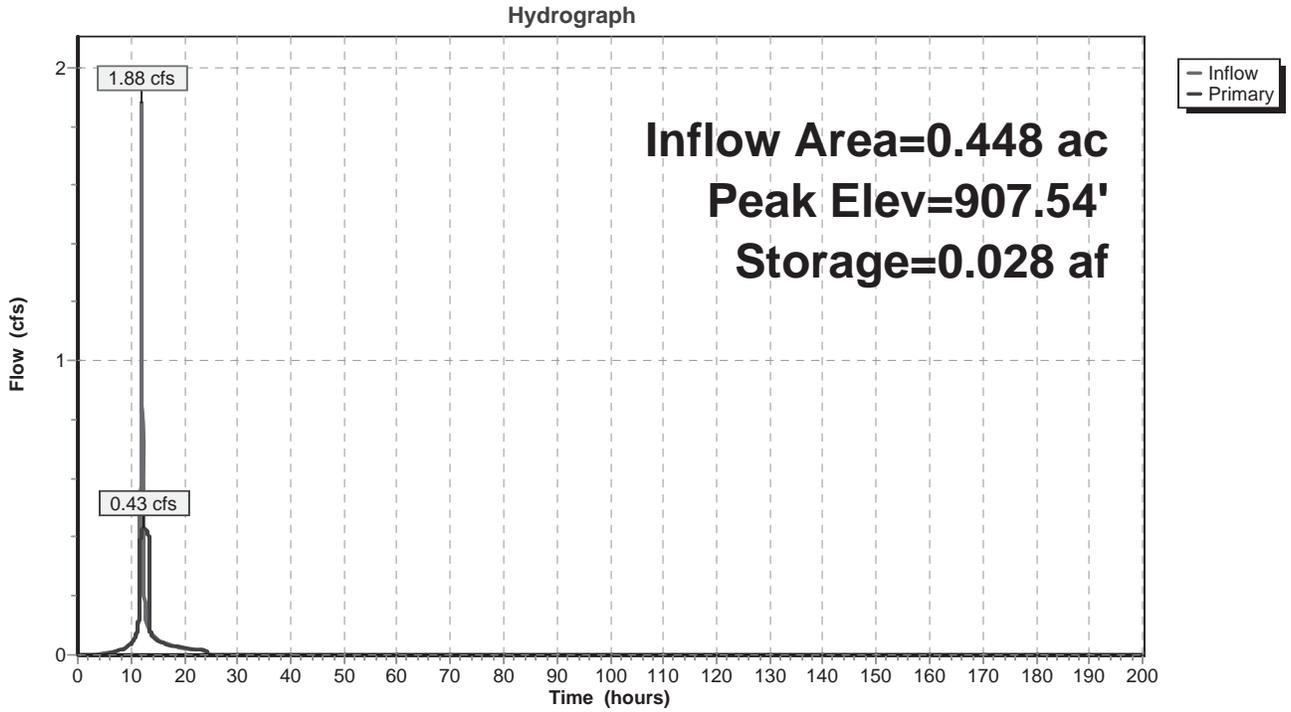
Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

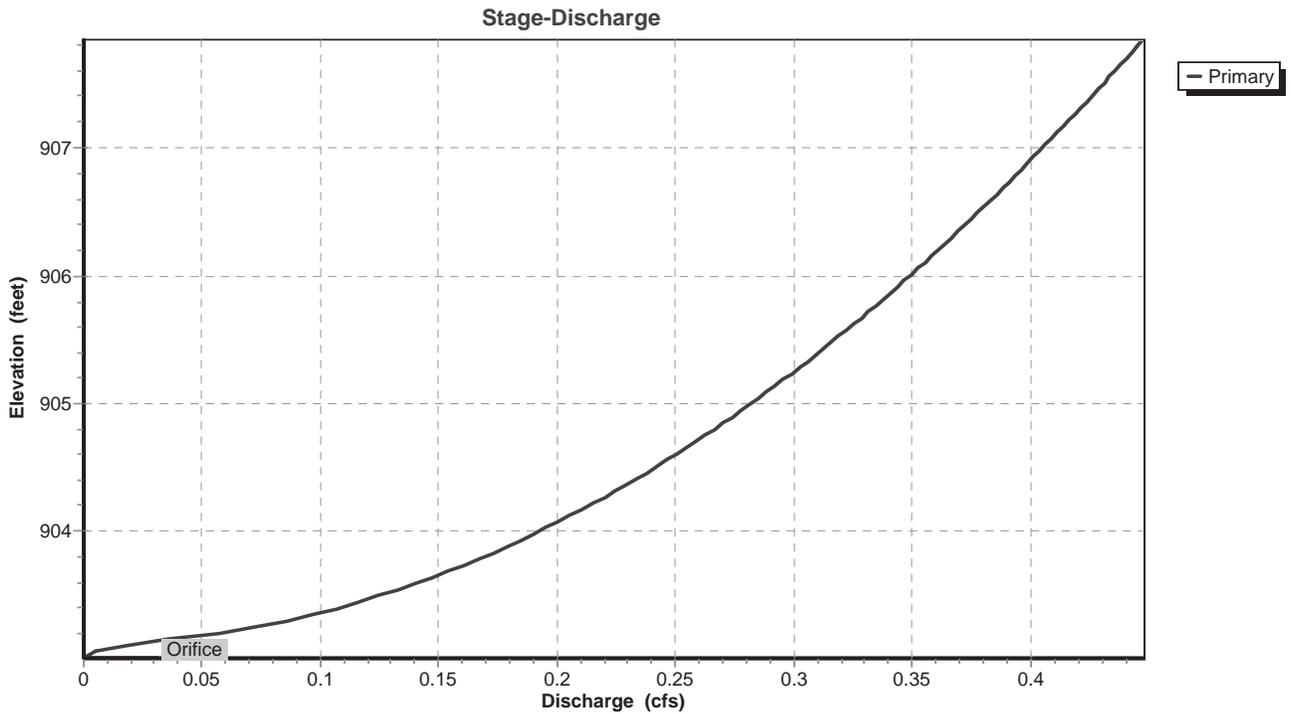
Primary OutFlow Max=0.43 cfs @ 12.23 hrs HW=907.54' (Free Discharge)

↑**1=Orifice** (Orifice Controls 0.43 cfs @ 10.12 fps)

Pond 1P: Site Detention

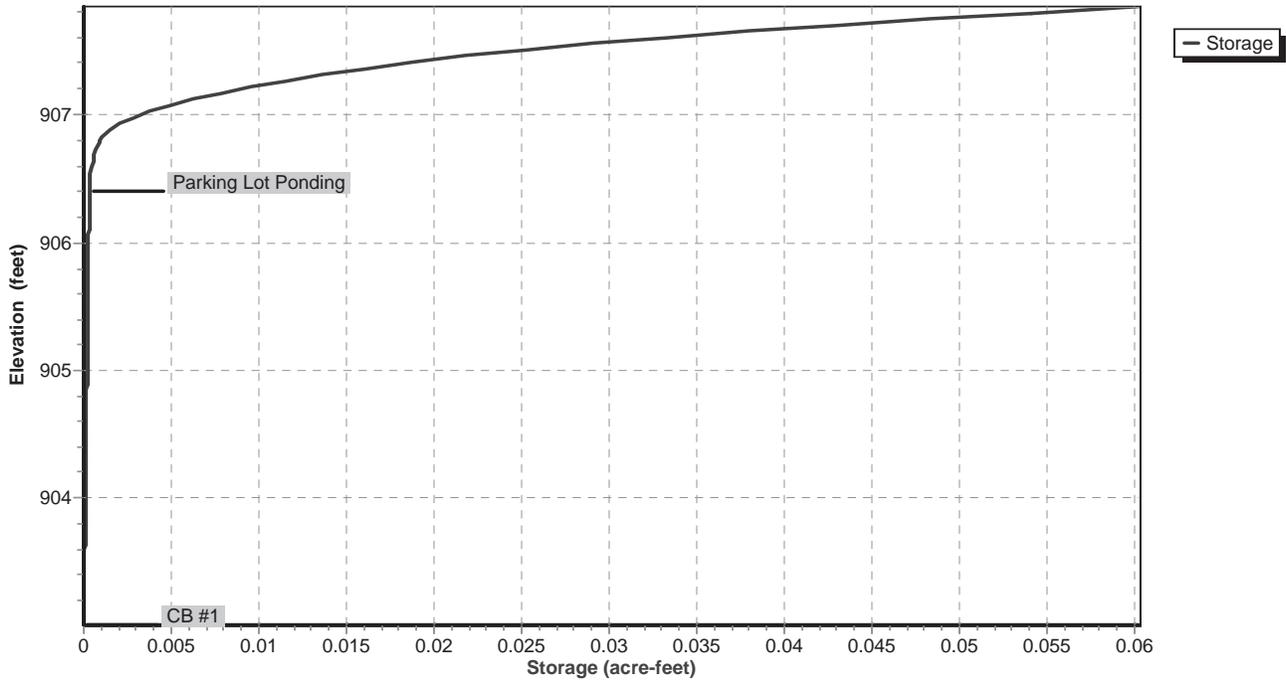


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



02013.01025 Detention.Current Revised Layout *Type II 24-hr 25-year, 24 HR Rainfall=4.44"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=3.54"
Tc=10.0 min CN=92 Runoff=2.29 cfs 0.132 af

Pond 1P: Site Detention

Peak Elev=907.66' Storage=0.038 af Inflow=2.29 cfs 0.132 af
Outflow=0.44 cfs 0.132 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.132 af Average Runoff Depth = 3.54"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

Runoff = 2.29 cfs @ 12.01 hrs, Volume= 0.132 af, Depth= 3.54"

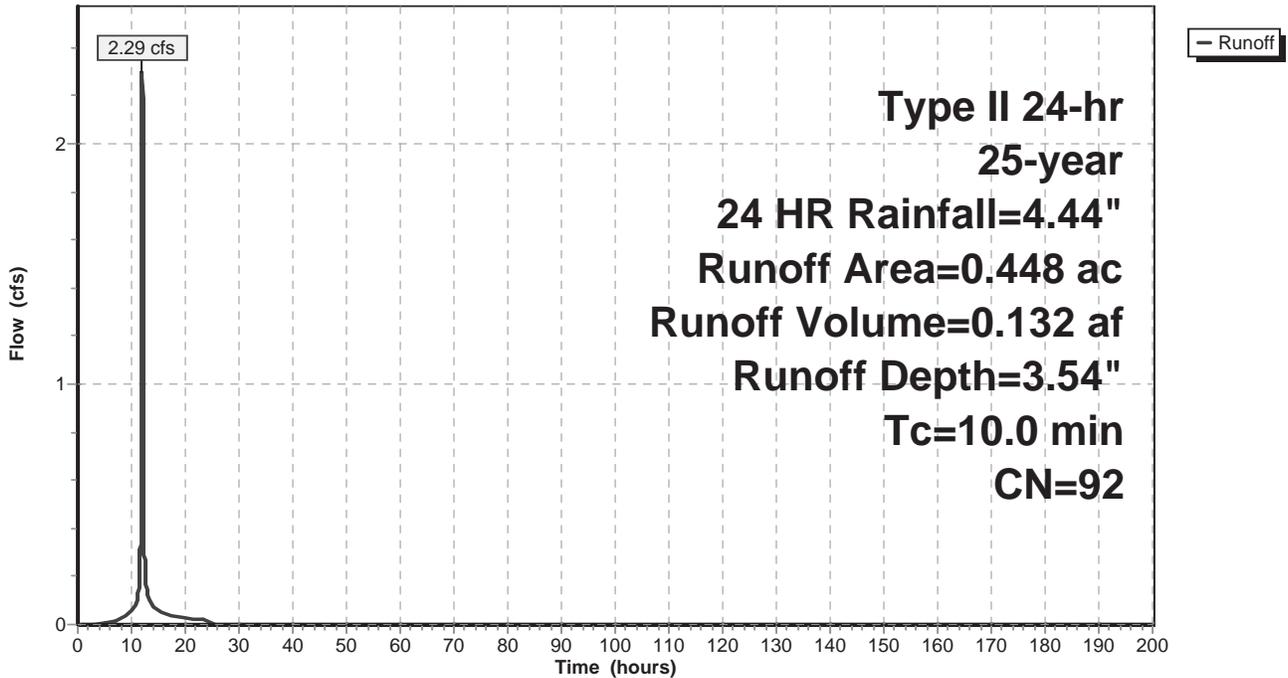
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 25-year, 24 HR Rainfall=4.44"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed

Hydrograph



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 3.54" for 25-year, 24 HR event
 Inflow = 2.29 cfs @ 12.01 hrs, Volume= 0.132 af
 Outflow = 0.44 cfs @ 12.26 hrs, Volume= 0.132 af, Atten= 81%, Lag= 15.2 min
 Primary = 0.44 cfs @ 12.26 hrs, Volume= 0.132 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.66' @ 12.26 hrs Surf.Area= 0.099 ac Storage= 0.038 af

Plug-Flow detention time= 21.2 min calculated for 0.132 af (100% of inflow)
 Center-of-Mass det. time= 20.9 min (807.9 - 786.9)

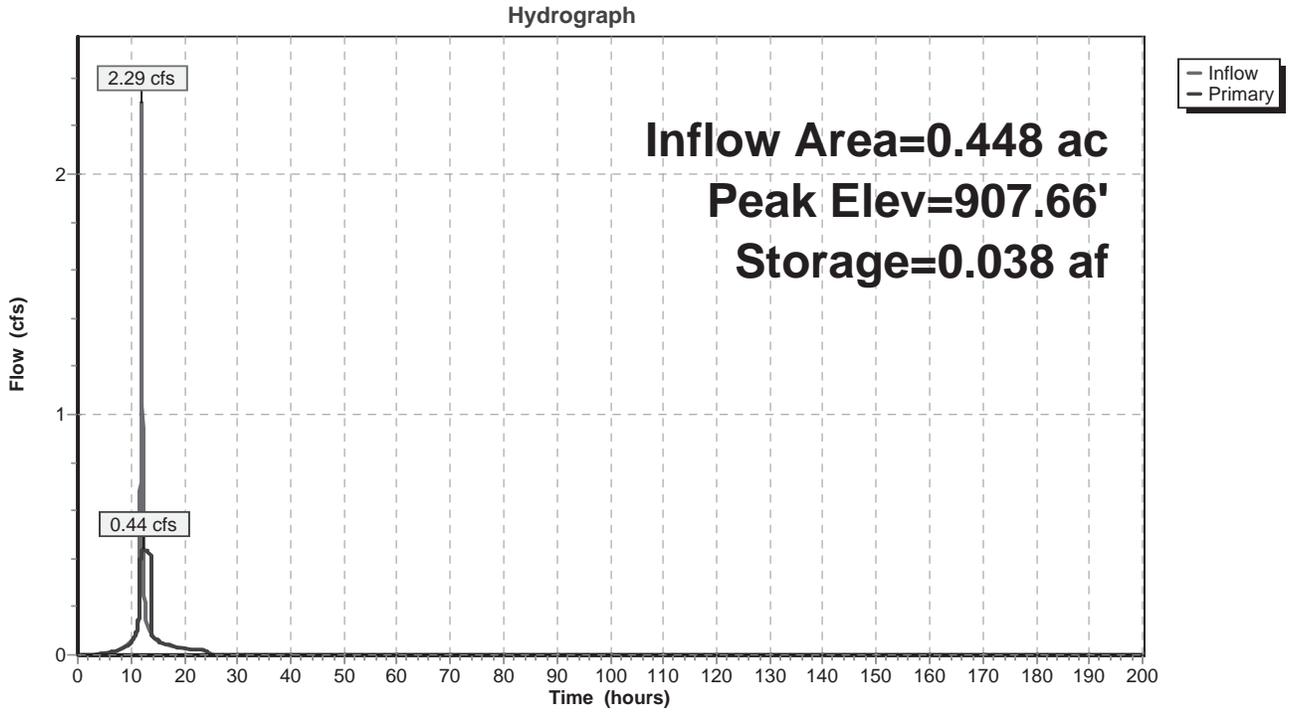
Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

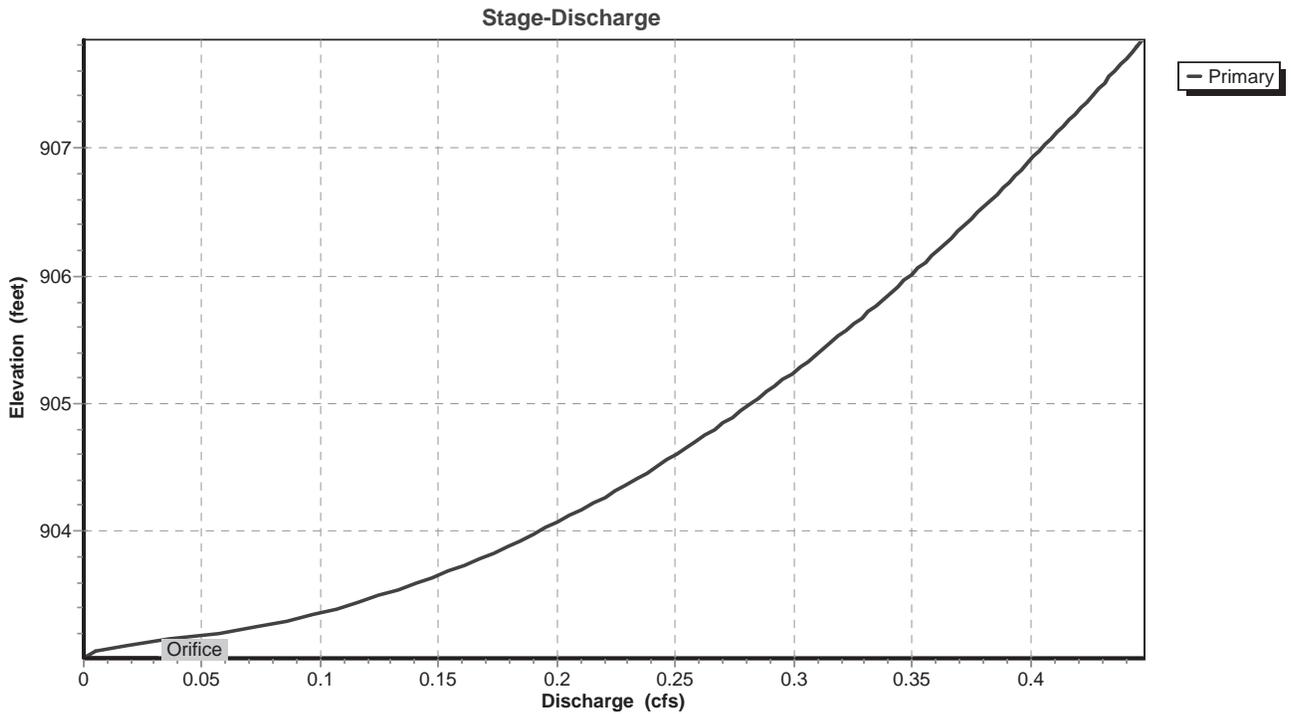
Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

Primary OutFlow Max=0.44 cfs @ 12.26 hrs HW=907.66' (Free Discharge)
 ↑**1=Orifice** (Orifice Controls 0.44 cfs @ 10.25 fps)

Pond 1P: Site Detention

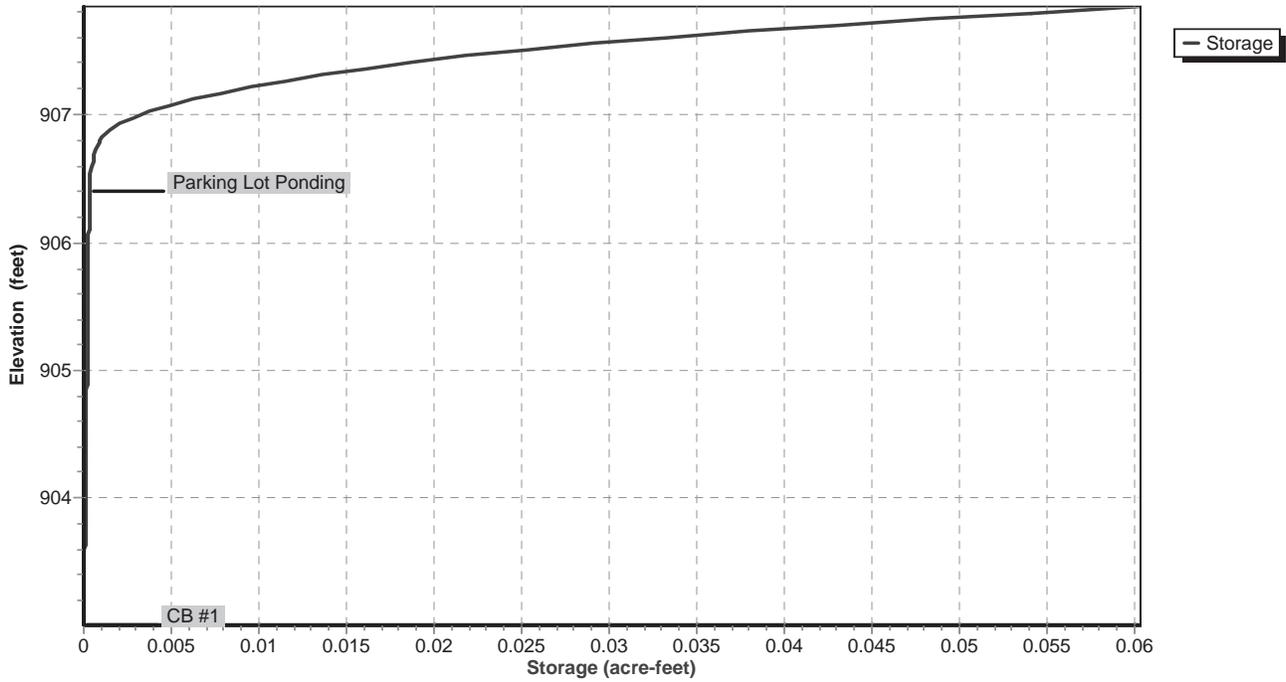


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



02013.01025 Detention.Current Revised Layout *Type II 24-hr 50-year, 24 HR Rainfall=5.02"*

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Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3

Runoff by SCS TR-20 method, UH=SCS

Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=4.11"
Tc=10.0 min CN=92 Runoff=2.64 cfs 0.153 af

Pond 1P: Site Detention

Peak Elev=907.74' Storage=0.047 af Inflow=2.64 cfs 0.153 af
Outflow=0.44 cfs 0.153 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.153 af Average Runoff Depth = 4.11"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

Runoff = 2.64 cfs @ 12.01 hrs, Volume= 0.153 af, Depth= 4.11"

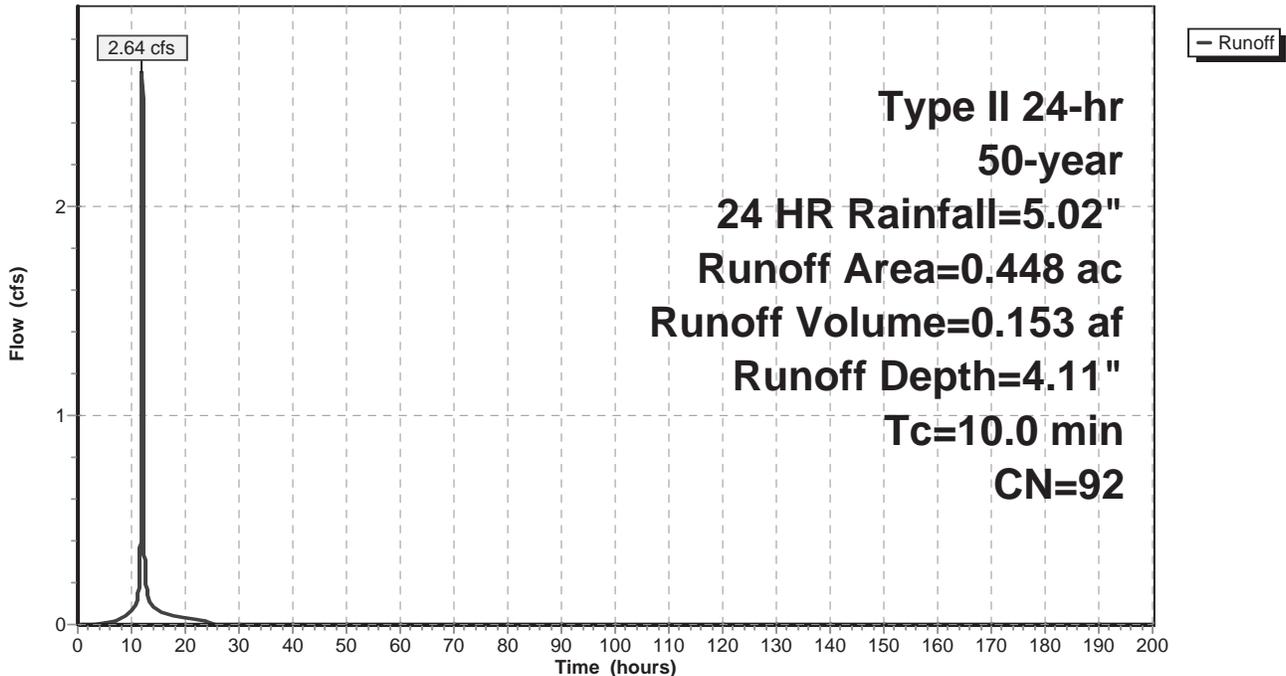
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 50-year, 24 HR Rainfall=5.02"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed

Hydrograph



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 4.11" for 50-year, 24 HR event
 Inflow = 2.64 cfs @ 12.01 hrs, Volume= 0.153 af
 Outflow = 0.44 cfs @ 12.30 hrs, Volume= 0.153 af, Atten= 83%, Lag= 17.1 min
 Primary = 0.44 cfs @ 12.30 hrs, Volume= 0.153 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.74' @ 12.30 hrs Surf.Area= 0.113 ac Storage= 0.047 af

Plug-Flow detention time= 26.7 min calculated for 0.153 af (100% of inflow)
 Center-of-Mass det. time= 26.4 min (809.4 - 782.9)

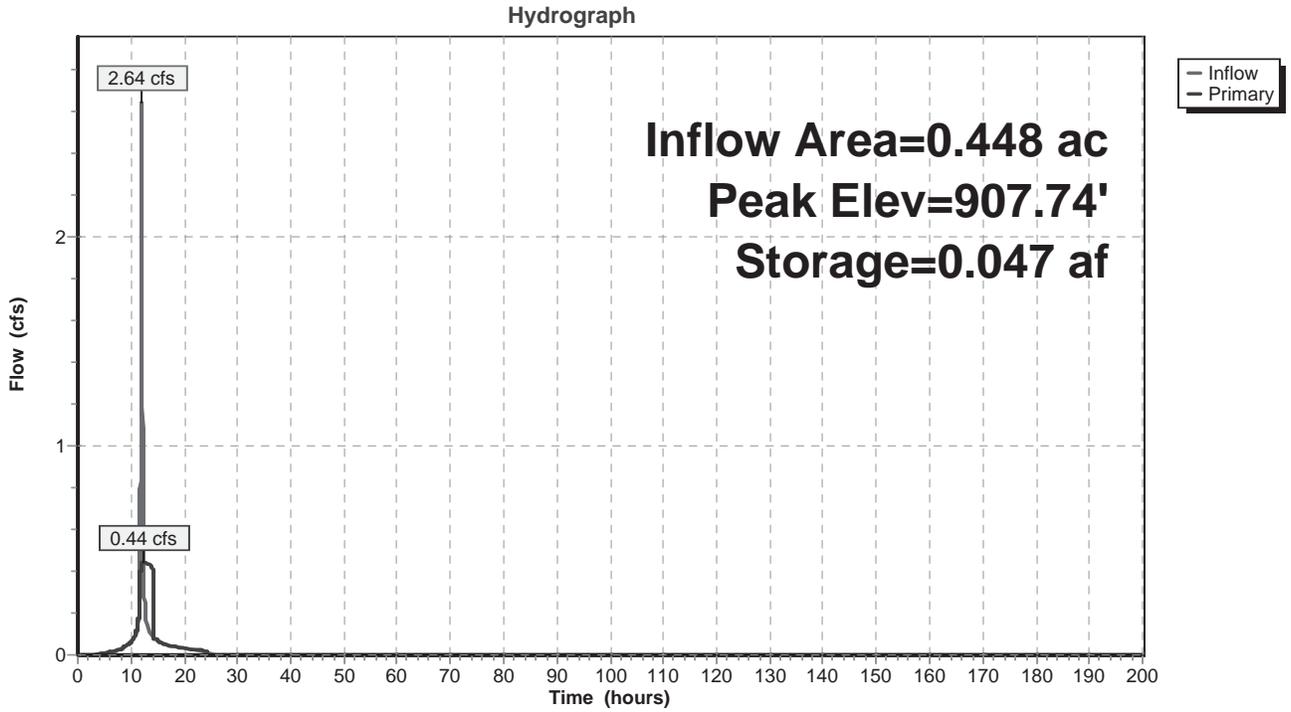
Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

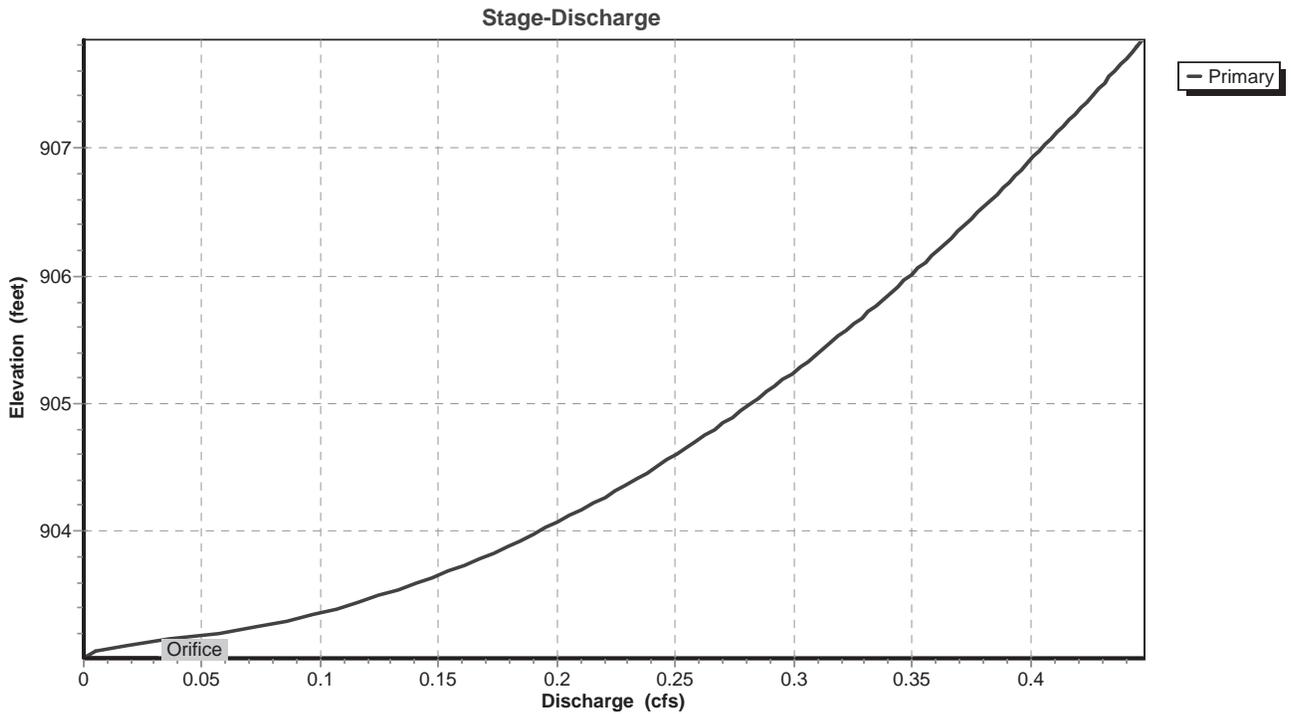
Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

Primary OutFlow Max=0.44 cfs @ 12.30 hrs HW=907.74' (Free Discharge)
 ↑**1=Orifice** (Orifice Controls 0.44 cfs @ 10.34 fps)

Pond 1P: Site Detention

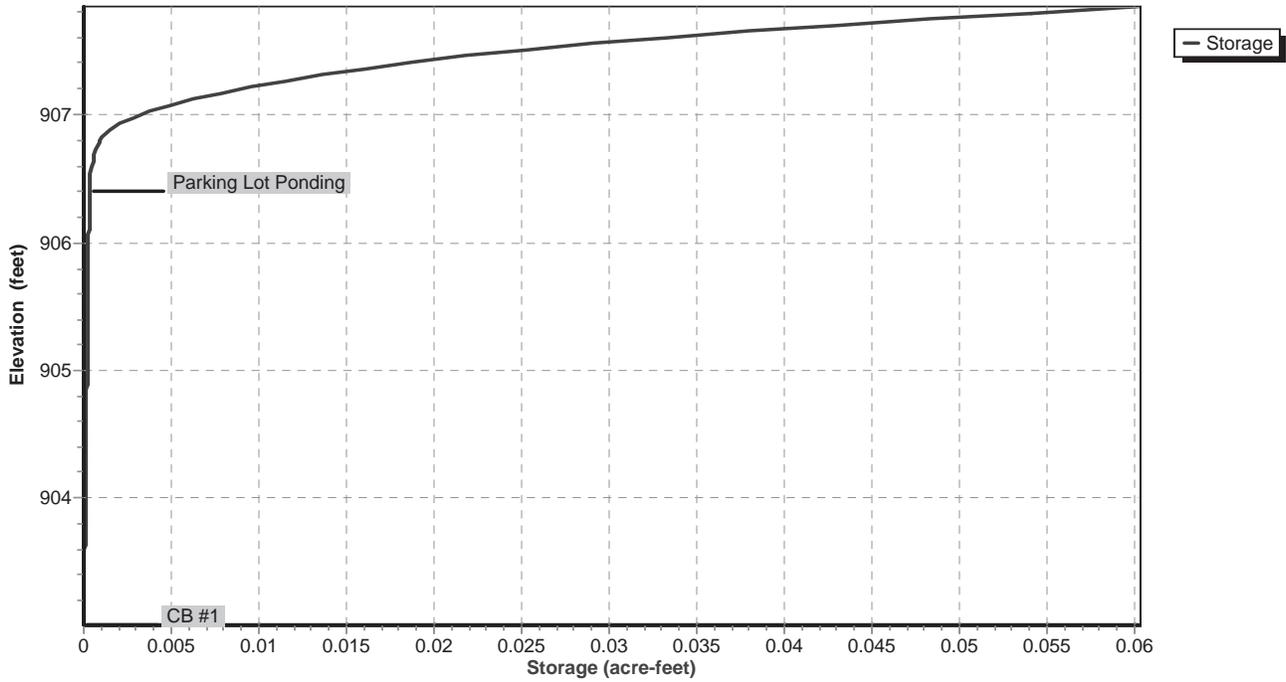


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



Time span=0.00-200.00 hrs, dt=0.01 hrs, 20001 points x 3
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment 2S: Overall Post-Developed Runoff Area=0.448 ac 75.45% Impervious Runoff Depth=4.71"
Tc=10.0 min CN=92 Runoff=2.99 cfs 0.176 af

Pond 1P: Site Detention Peak Elev=907.82' Storage=0.056 af Inflow=2.99 cfs 0.176 af
Outflow=0.45 cfs 0.176 af

Total Runoff Area = 0.448 ac Runoff Volume = 0.176 af Average Runoff Depth = 4.71"
24.55% Pervious = 0.110 ac 75.45% Impervious = 0.338 ac

Summary for Subcatchment 2S: Overall Post-Developed

Runoff = 2.99 cfs @ 12.01 hrs, Volume= 0.176 af, Depth= 4.71"

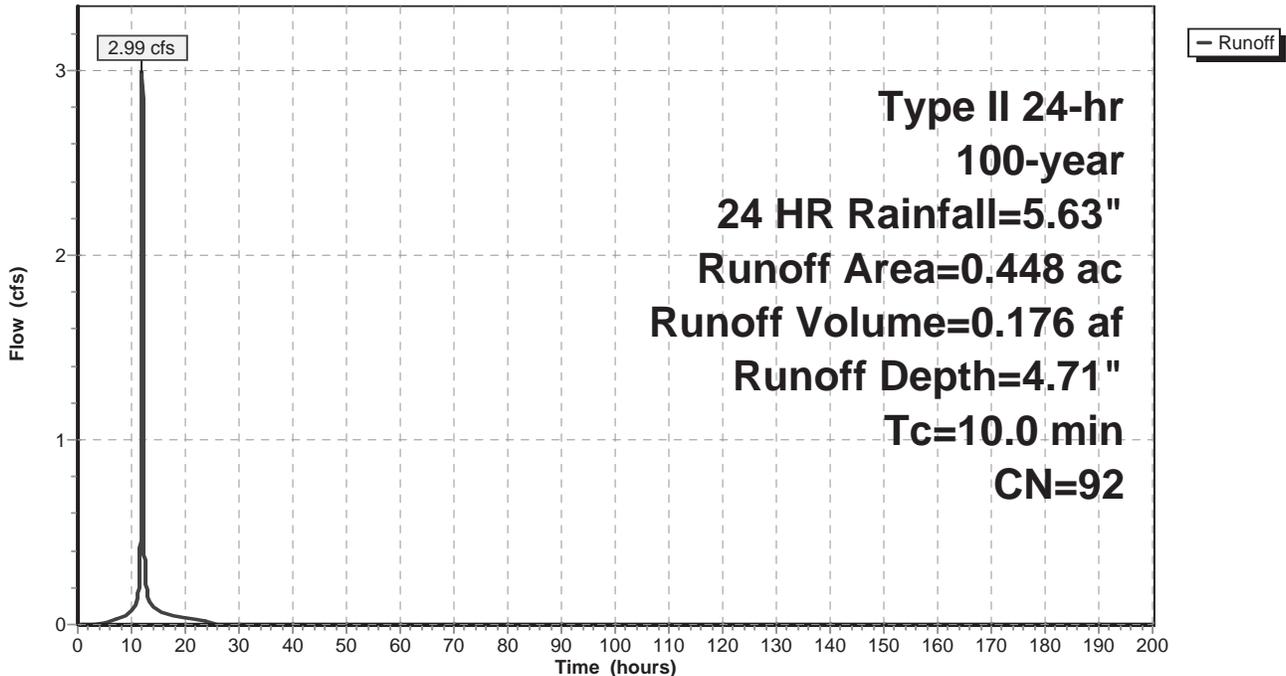
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs
 Type II 24-hr 100-year, 24 HR Rainfall=5.63"

Area (ac)	CN	Description
0.338	98	Paved parking, HSG C
0.110	74	>75% Grass cover, Good, HSG C
0.448	92	Weighted Average
0.110		24.55% Pervious Area
0.338		75.45% Impervious Area

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

Subcatchment 2S: Overall Post-Developed

Hydrograph



Summary for Pond 1P: Site Detention

Inflow Area = 0.448 ac, 75.45% Impervious, Inflow Depth = 4.71" for 100-year, 24 HR event
 Inflow = 2.99 cfs @ 12.01 hrs, Volume= 0.176 af
 Outflow = 0.45 cfs @ 12.33 hrs, Volume= 0.176 af, Atten= 85%, Lag= 19.2 min
 Primary = 0.45 cfs @ 12.33 hrs, Volume= 0.176 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-200.00 hrs, dt= 0.01 hrs / 3
 Peak Elev= 907.82' @ 12.33 hrs Surf.Area= 0.126 ac Storage= 0.056 af

Plug-Flow detention time= 32.7 min calculated for 0.176 af (100% of inflow)
 Center-of-Mass det. time= 32.4 min (811.8 - 779.4)

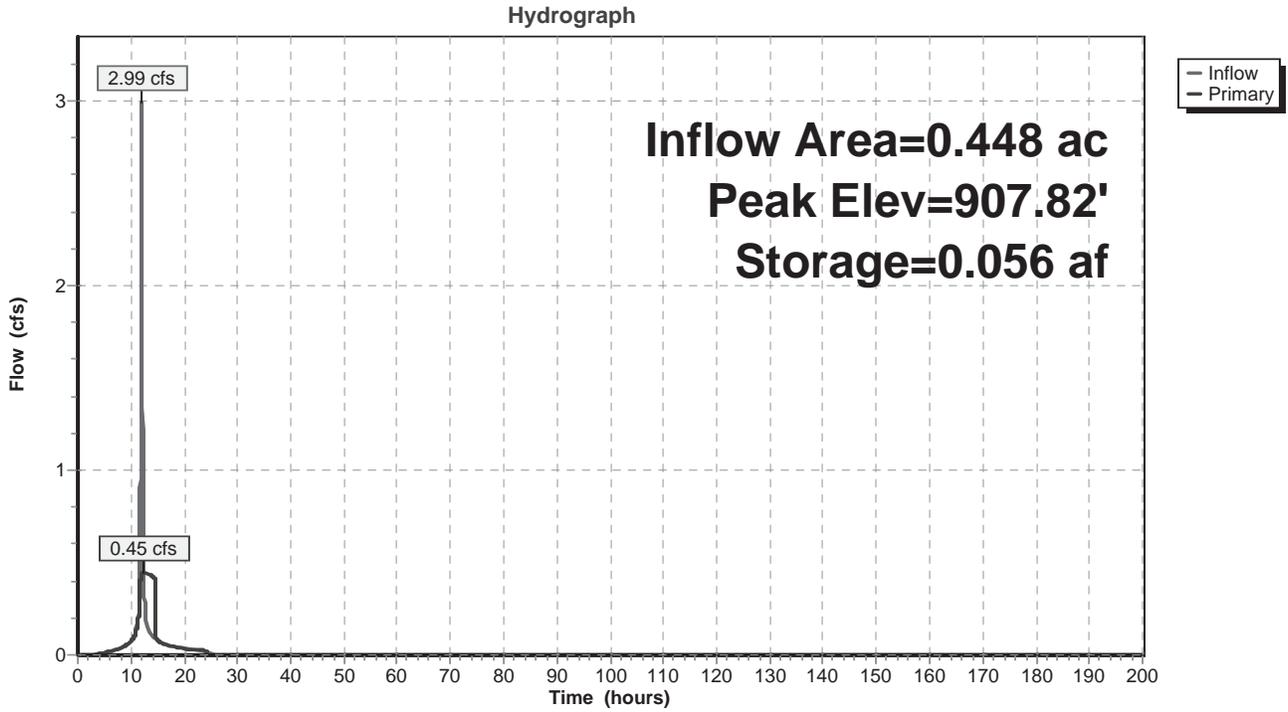
Volume	Invert	Avail.Storage	Storage Description
#1	903.01'	0.000 af	2.00'W x 2.00'L x 3.39'H CB #1
#2	906.40'	0.060 af	Parking Lot Ponding (Prismatic) Listed below (Recalc)
		0.060 af	Total Available Storage

Elevation (feet)	Surf.Area (acres)	Inc.Store (acre-feet)	Cum.Store (acre-feet)
906.40	0.000	0.000	0.000
906.80	0.003	0.001	0.001
907.35	0.049	0.014	0.015
907.85	0.131	0.045	0.060

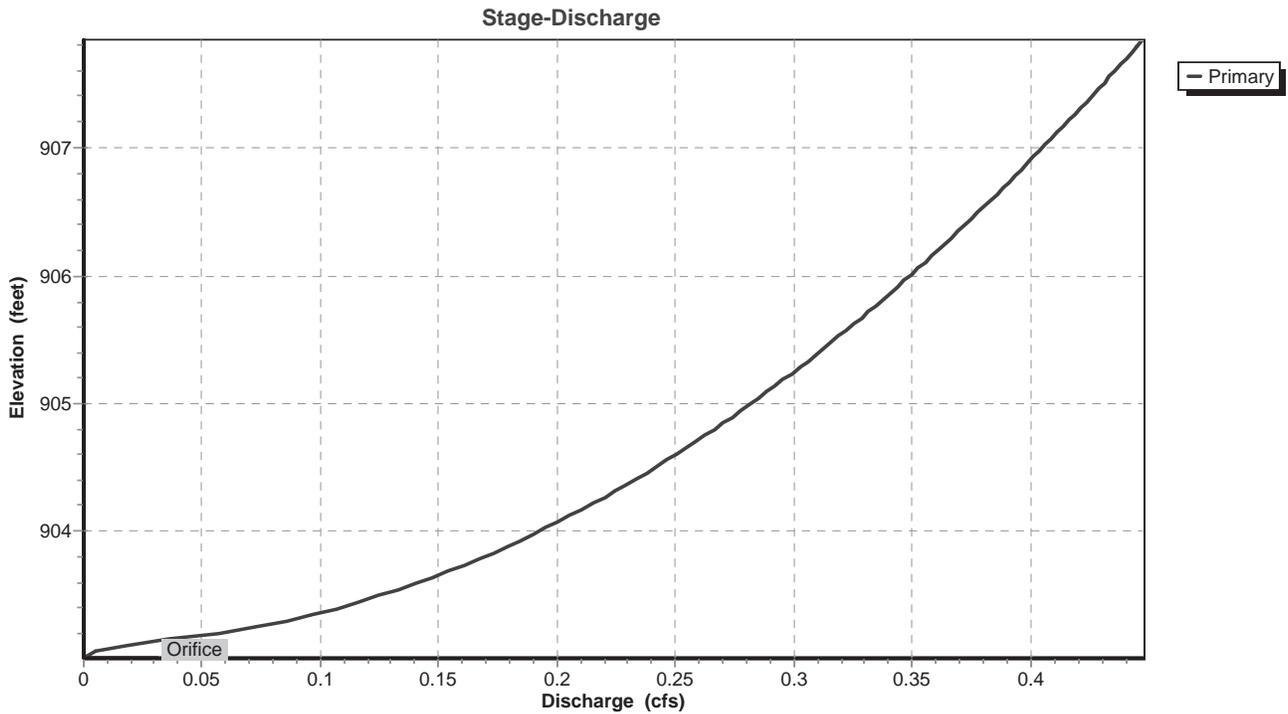
Device	Routing	Invert	Outlet Devices
#1	Primary	903.01'	2.8" Vert. Orifice C= 0.600

Primary OutFlow Max=0.45 cfs @ 12.33 hrs HW=907.82' (Free Discharge)
 ↑**1=Orifice** (Orifice Controls 0.45 cfs @ 10.43 fps)

Pond 1P: Site Detention

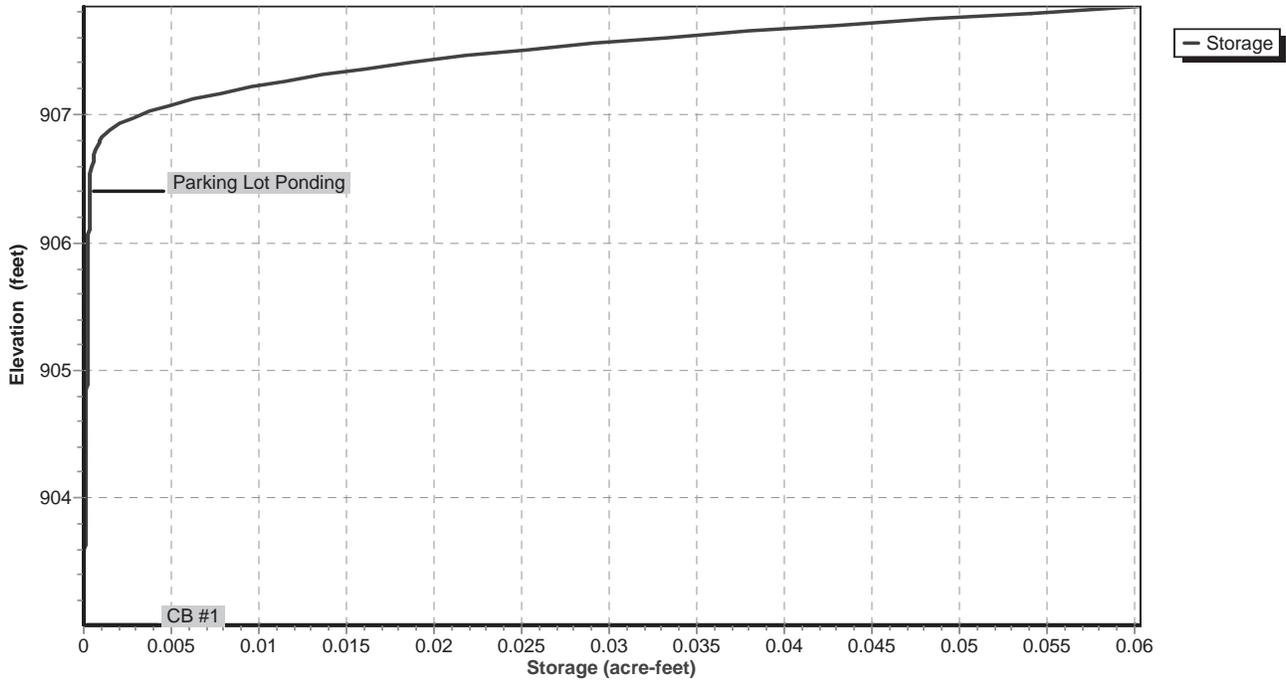


Pond 1P: Site Detention



Pond 1P: Site Detention

Stage-Area-Storage



APPENDIX G
STORM SEWER CALCULATIONS

