Technical Memorandum

otak

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To: Mike Peebles, PE (Otak)

From: Karina Nordahl, PE

Copies: File

Date: February 10, 2017

Subject: The Ridge at South Cooper Mountain
Preliminary Drainage Report

Project No.:   17849

Introduction

The Ridge at South Cooper Mountain subdivision project is a proposed residential development in the City of Beaverton, with stormwater jurisdiction through Clean Water Services (CWS). The development will consist of 29 attached single-family lots, 81 detached single-family lots, and one large parcel for future multi-family residential development. The development also includes sidewalks, public roadways, private driveways, utilities, and a stormwater management system. The stormwater management system will include a conveyance system and two regional stormwater management facilities.

The purpose of this memorandum is to outline compliances of the South Cooper Mountain Heights stormwater management system with the U.S. Army Corps of Engineers *SLOPES V for Stormwater, Transportation and Utilities* (USACOE, 2014), the City of Beaverton (COB) *Engineering Design Manual* (COB, 2007) and the Clean Water Services *Design and Construction Standards for Sanitary Sewer and Surface Water Management* (CWS, 2007). Descriptions of the pre-development and proposed hydrologic conditions as well as preliminary documentation showing the onsite stormwater management system's compliance with SLOPES V and COB standards for water quality and quantity are included in this report.

Design Criteria

Design of the proposed stormwater system will meet the following design criteria:
* *SLOPES V for Stormwater, Transportation and Utilities* (USACOE, 2014)
* *Design and Construction Standards for Sanitary Sewer and Surface Water Management* (CWS, 2007)
* *Engineering Design Manual* (COB, 2007)
* *Low Impact Development Approaches Handbook* (CWS, 2016)

The City of Beaverton has adopted the CWS *Design and Construction Standards for Sanitary Sewer and*

Surface Water Management. All City standards in the *Engineering Design Manual* meet or exceed the CWS stormwater requirements. Additionally, the City of Beaverton is in the process of updating their *Engineering Design Manual,* and any changes to the *Engineering Design Manual* may apply to the Ridge at South Cooper Mountain subdivision project. The City of Beaverton's anticipated design standards will meet or exceed the current COB standards, and therefore were considered in this stormwater analysis.

Project Phasing

The Ridge at South Cooper Mountain subdivision project will be constructed in two phases, as shown in Figures 2A through 2C. The Phase 1 improvements will include the single-family portion of the development located on the west side of the project site and half of the SW Scholls Ferry Road improvements. Phase 2 will include a single multi-family development on the east side of the site and the east half of the SW Scholls Ferry Road improvements.

Site Description

Location
The proposed Ridge at South Cooper Mountain development is located in the City of Beaverton, Oregon. The development site is bordered to the south by SW Scholls Ferry Road and to the west by Strobel Road (see Vicinity Map). The majority of the site is currently being used for agriculture. However, the area around the natural drainage that runs southwest through the site is wooded, and there is also a wooded area along the eastern edge of the site.

Vicinity Map
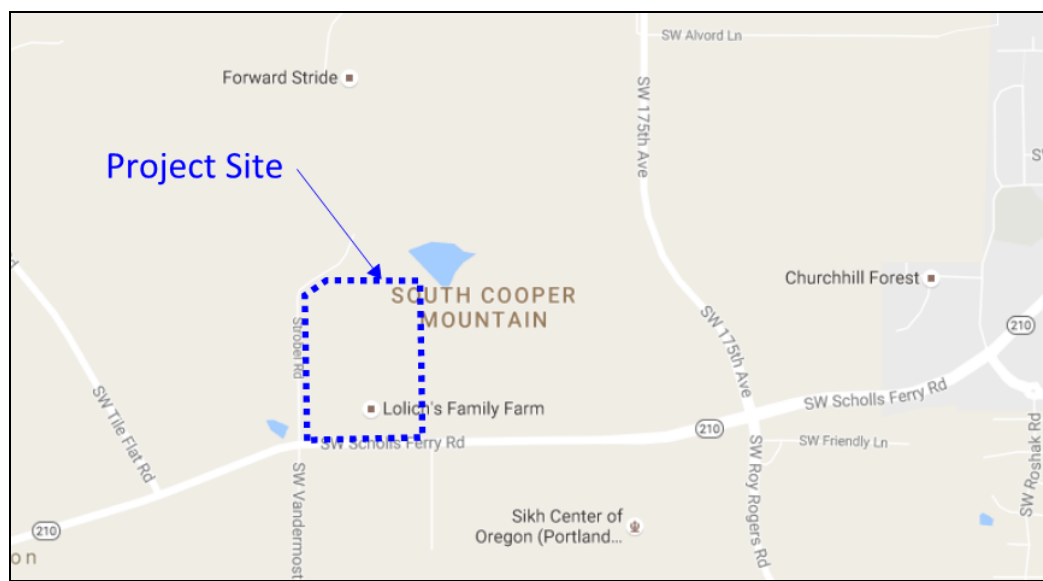
The 27.96-acre Ridge at South Cooper Mountain development lies within Washington County Tax Map 2S106, Lots 500 (Bellairs property) and 600 (Lolich property). Lot 301 (Bartholemy property) which is north of Lots 500 and 600, also has a narrow strip to provide access to SW Scholls Ferry Road. Half of Strobel Road improvements along western edge of the project will be constructed on the narrow strip of Lot 301. Lot 301 is expected to develop in the future but is not related to this project.

Topography

The Ridge at South Cooper Mountain project will be constructed on land with slopes ranging from 2 to 20 percent. Existing elevations on the property vary between approximately 240 feet in the southeast corner to 276 feet on the northwest corner property boundary.

Drainage Basins

Existing Conditions

The project site is located within the Rock Creek/Tualatin River sub-watershed (hydrologic unit code [HUC] 170900100503). The site drains to two unnamed natural drainage channels. The majority of the site drains to the unnamed natural drainage channel that flows southwest through the site. However, a small portion of the of the site drains to a channel that runs west to east on the southern edge of the site adjacent to SW Scholls Ferry Road, see Figure 1. In separate 36-inch culverts, the drainage channels cross under SW Schools Ferry Road and then combine into a single unnamed natural drainage channel on the south side of the road. From there, the drainage channel flows approximately 1.3 miles south before it outfalls into the Tualatin River.

The site has a two existing drainage basin areas within the proposed area of impact (see Figure 1). Existing Basin 1 is approximately 21.91 acres and includes the Phase 1 improvements and approximately half of the SW Scholls Ferry Road modifications. Existing Basin 1 also includes a small area that is outside of the project site in the northwest corner. This area will be developed in the future and will connect into the Ridge at South Cooper Mountain stormwater system. The project has committed to providing offsite water quality and detention for 12 detached single-family homes to be developed in the future. Runoff from Existing Basin 1 drains to both channels, the channel that runs through the site and the channel along SW Scholls Ferry Road. Existing Basin 2 is comprised of 5.05 acres and includes the Phase 2 improvements and the rest of the SW Scholls Ferry Road modifications. Runoff from Existing Drainage Basin 2 drains to the channel that runs southwest through the site.

Both drainage channels have an unmapped floodplain. A flood study carried by Otak (Otak, 2016) modeled the channels under existing conditions to determine the limits of the regulatory base flood (100-year event). These floodplain limits are shown on Figure 1.

Proposed Conditions

The proposed development will consist of 29 attached single-family lots, 81 detached single-family lots, and one large parcel for future multi-family residential development. Per COB and CWS standards, an impervious area of 2,640 square feet was assumed for each detached single-family residential lot within the project limits. For attached single-family residential lots and multi-family buildings, impervious rooftop areas were calculated using the building footprints. The project will add approximately 17.33 acres of new impervious area, including rooftops, roadways, sidewalks, and driveways.

The widening and redevelopment of SW Scholls Ferry Road will be constructed over the drainage channel along the north side of the road. Under the proposed conditions, the drainage channel will be piped to an outfall on the south side of SW Scholls Ferry Road.

Under proposed conditions, the site was divided into five drainage basins that will drain to two extended dry detention ponds. The ponds will meet the water quality and water quantity requirements for the project. Basin P1 will include the Phase 1 single-family development and Q1 includes the public right-of-way (ROW) improvements on SW Scholls Ferry Road associated with Phase 1. Basin X1 includes the offsite area at the northwest corner of the site that will be developed into 12 detached single-family residential lots. Basins P1, Q1, and R1 will be treated and detained in Pond 1.

Basin P2 includes the future multi-family residential development and Q2 includes the Phase 2 SW Scholls Ferry Road public ROW improvements. Basins P1 and Q2 will be treated and detained in Pond 2. See Figures 2A through 2C for onsite and offsite drainage basins under proposed conditions and the pond locations. See Table 1 for a summary of the basin areas under pre-development and proposed conditions.

Table 1: Basin Areas							
		Pre-development Conditions			Proposed Conditions		
Basin	Phase	Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)	Impervious Area (ac)	Pervious Area (ac)	Total Area (ac)
P1	Phase 1	0.00	17.32	17.32	11.40	5.93	17.32
Q1	Phase 2	0.00	0.82	0.82	0.76	0.06	0.82
X1	Phase 1	0.00	3.77	3.77	0.73	3.04	3.77
P2	Phase 2	0.00	4.06	4.06	3.11	0.95	4.06
Q2	Phase 1	0.00	1.60	1.60	1.34	0.26	1.60
Total		**0.00**	**27.57**	**27.57**	**17.33**	**10.24**	**27.57**

Hydrology

For this preliminary analysis, the proposed development was divided into pervious and impervious areas within each drainage basin, as shown above in Table 1. Peak runoff rates generated from each development phase were calculated using the Santa Barbara Urban Hydrograph (SBUH) method in HydroCAD v10.0. Precipitation depths for this project site, listed in Table 2, were obtained from the COB *Engineering Design Manual.* These depths were determined to be more conservative than both the CWS and NOAA precipitation depths, and were therefore used to calculate site rainfall and runoff rates based on the NRCS Type 1A rainfall distribution.

Table 2: City of Beaverton Precipitation Depths	
Recurrence Interval	Precipitation Depth (in)
2-Year	2.50
10-Year	3.50
25-Year	4.00
100-Year	4.50

Soils

Soils are categorized by the National Resource Conservation Service (NRCS) as hydrologic soil group types C and D, which consist of silt loams (See Appendix A). These soils generally exhibit moderate to low infiltration rates and relatively high runoff rates. Type C soils are located generally within the areas of proposed development, while Type D soils are shown to be located in stream and wetland corridors.

Curve Number

Curve Numbers (CN) for impervious and pervious areas during pre-development and proposed conditions were selected using Table 2-2a – Runoff Curve Numbers for Urban Areas from Technical Release 55: Urban Hydrology for Small Watersheds (TR-55) (See Appendix A). SLOPES V standards require release rates from detention facilities to match pre-development discharge rates. As such, the project site is to be modeled using CNs under pre-development conditions (the site's natural groundcover and grade before any development occurred). Table 3 provides a summary of the runoff curve numbers under pre-development, existing and proposed conditions.

Table 3: Runoff Curve Numbers			
Category	Cover Type	Hydrologic Soil Group	Curve Number
Impervious Area	Pavement, roofs, sidewalks	C/D	98
Pervious Area, Pre-development Conditions	Woods/grass combination - Good Condition	C/D	75
Pervious Area, Proposed Conditions	50-75% Grass cover - Fair Condition	C/D	81

Time of Concentration

The time of concentration (Tc) represents the maximum time needed for all areas of the basin to contribute to the outflow hydrograph. Time of concentration values for each contributing drainage basin during pre-development, existing and proposed conditions were calculated using the method provided by the SCS Technical Release 55 (SCS, 1986) (see Appendix A). A time of concentration of five minutes, the minimum allowable, was assumed for all proposed conditions as a conservative design approach.

Water Quality

Per the Oregon Department of Environmental Quality (DEQ) *Stormwater Management Plan Submission Guidelines for Removal/Fill Permit Applications*, the pollutants of concern for a commercial/residential development are as follows:
• Nutrients
• Pesticides, Herbicides, Fungicides
• Metals (Zinc, Copper, Lead, etc.)
• Oil, Grease & Other Petroleum
• Sediment

The water quality volume for compliance with SLOPES V standards is determined by multiplying 50 percent of the 2-year, 24-hour precipitation depth by the entire contributing impervious area for each drainage basin. COB standards require water quality treatment for runoff from contributing impervious areas in each drainage basin generated by 0.36 inches of precipitation falling in a 4-hour period. The SLOPES V standards are more conservative than the COB standards and therefore the extended dry detention basins have been sized to treat the water quality volume for compliance with SLOPES V standards.

For all onsite basins (P1, P2, Q1, and Q2), and offsite basin (X1) water quality treatment will be provided with two regional stormwater management facilities. Each facility has an orifice sized to detain the water quality volume and release it over a 48-hour period. See Appendix B for water quality treatment sizing calculations for the onsite extended dry basins.

Water Quantity

SLOPES V Detention Standards

SLOPES V standards require flow duration matching for storm event frequencies between 50 percent of the 2-year storm event through the 10-year storm event. Flow duration matching requires a continuous simulation hydrologic model; a type of modeling which has not yet been adopted by CWS or the City of Beaverton. In the absence of an adopted continuous simulation model, a target peak flow matching method was used to approximate the results of the flow duration standard. The target peak flow matching is as follows:

- Provide water quality treatment and flow control for 50% of the 2-year, 24-hour design storm (size the first orifice to release the water quality runoff volume over 48 hours).
- Limit the peak rate from the 2-year, 24-hour design storm to the pre-developed condition peak rate from the 2-year, 24-hour design storm.
- Limit the peak rate from the 10-year, 24-hour design storm to the pre-developed condition peak rate from the 10-year, 24-hour design storm.
- Limit the peak rate from the 25-year, 24-hour design storm to the pre-developed condition peak rate from the 25-year, 24-hour design storm.

The proposed stormwater facilities in have been sized to meet detention requirements for compliance with SLOPES V standards using HydroCAD v10.0 software (see Appendix C). Table 4 provides the pre-development peak runoff rates and the detained peak discharge rates under proposed conditions for each basin within the Ridge at South Cooper Mountain project site. Table 5 contains the sizing parameters for the two proposed extended dry basins.

Table 4: Facility Flow Control Summary						
	Peak Flow Rate (cfs)					
	2-year		10-year		25-year	
Catchment/ Facility ID	Predev	Proposed (Detained)	Predev	Proposed (Detained)	Predev	Proposed (Detained)
Ex. Basin 1	1.45	1.38	4.13	3.34	5.72	5.61
Ex. Basin 2	0.37	0.36	1.05	0.81	1.45	1.38

Table 5: Extended Dry Detention Basin Design Parameters				
		SLOPES V Standards		
Name	Phase	Top Surface Area (sf)	Active Volume (cf)	Total Depth (ft)
Pond 1	Phase 1	26,943	107,848	7
Pond 2	Phase 2	12,216	32,903	5

The ponds are designed with 1 foot of freeboard above the maximum depth during the 25-year storm event. The active volume storage shown in Table 5 does not include the 1-foot of freeboard or the 0.4-foot of dead storage at the bottom of the pond.

Conveyance

Preliminary pipe layouts are shown in the construction plan sets (to be provided in final Stormwater Management Plan document). Inlets, manholes, and pipes were located based on COB design criteria and the proposed layout of parking lots, roadways, and buildings. During final design, the stormwater conveyance network will be sized using the 25-year, 24-hour storm event with the condition that the hydraulic grade line remains at least 1 foot below the rim elevations at manholes and catch basins. Storm outfalls will be armored to protect channel banks.

Operations and Maintenance

An Operations and Maintenance Plan will be compiled during final design for the use of the private property owner and responsible party. The plan will identify the responsible party, describe the stormwater management system, provide information on inspecting and maintaining the extended dry basins and the water quality and flow control manholes, and include inspection logs. The inspection log will be kept onsite and available for audit. In accordance with SLOPES V standards, inspection and maintenance will be required at least quarterly for the first three years, at least twice per year thereafter, and within 48 hours of a storm event greater than or equal to 1.0 inch of rain during a 24-hour period. The Operations and Maintenance Plan will be included with the Final Stormwater Management Plan.

Conclusions

The proposed Ridge at South Cooper Mountain development project will include a stormwater management system designed to meet the requirements of SLOPES V and the City of Beaverton. The development will create approximately 17.33 acres of new impervious area. Combined water quality and water quantity facilities will meet SLOPES V standards. SLOPES V water quantity

requirements will be met using the two proposed detention ponds (Pond 1 and Pond 2) located within the project limits. The onsite conveyance system will be sized during the final design phase using standards set by the City of Beaverton.

References

COB, 2007. City of Beaverton Engineering Design Manual and Standard Drawings, City of Beaverton, January 2007.

CWS, 2007. Design and Construction Standards for Sanitary Sewer and Surface Water Management, Clean Water Services, June 2007.

CWS, 2016. Low Impact Development Approaches Handbook, Clean Water Services, July 2009.

Otak, 2016. Lolich and Bellairs Existing Drainages Technical Memorandum, January 4, 2016.

SCS, 1986. Technical Release 55: Urban Hydrology for Small Watersheds, United States Department of Agriculture Soil Conservation Service, June 1986.

USACE, 2014. *SLOPES V for Stormwater, Transportation or Utilities*, United States Army Corps of Engineers, March 14, 2014.
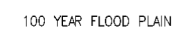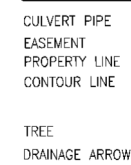
Figures

BARTHOLEMY
DOC. NO. 94-030668

BARTHOLEMY
DOC. NO. 2003-010937

BARTHOLEMY
DOC. NO. 94-030668

BIERLY
DOC. NO. 2011-053131

PARCEL 2
BELLAIRS PROPERTY
DOC. NO. 2011-089128

EDMONDS
DOC. NO. 2005-010806

LOLICH PROPERTY
DOC. NO. 2015-095295

PARCEL 1
BELLAIRS PROPERTY
DOC. NO. 2011-089128

STROBEL RD

SW SCHOLLS FERRY RD

LEGEND

CULVERT PIPE

EASEMENT

PROPERTY LINE

CONTOUR LINE ———700———

TREE

DRAINAGE ARROW

WETLAND LIMIT

CWS VEGETATED CORRIDOR

100 YEAR FLOOD PLAIN

SCALE   IN FEET
100'   0'   100'   200'

LAND USE SUBMITTAL – FEBRUARY 10, 2017

THE RIDGE AT SOUTH COOPER MOUNTAIN
BEAVERTON, OREGON

EXISTING CONDITIONS

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17849   17849_Existing_
Project No   Drawing No.

Fig.1
Sheet No.

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LEGEND

STORM LINE	—————— SD ——————
STORM MANHOLE	●
BASIN BOUNDARY	▬▬▬▬▬▬▬▬
WETLAND LIMIT	
CWS VEGETATED CORRIDOR	
100 YEAR FLOODPLAIN	

X1

BARTHOLEMY
DOC. NO. 2003-010937

BARTHOLEMY
DOC. NO. 94-030668

BASIN 1
PHASE 1

STROBEL RD

TRACT A

EDMONDS
DOC. NO. 2008-010806

P1

STREET D

STREET A

BIERLY
DOC. NO. 2011-053131

1 22 23 24
20 25
3 26
4 19
5 18 27
6 17
7 16 28
15
14 29
8 9 10 11 12 13
30
31
32
33
49 48 47 46 45 44 43 34
35
36
37

TRACT B

TRACT C

NORTH

40'	0'	40'	80'

SCALE   IN FEET

THE RIDGE AT SOUTH COOPER MOUNTAIN
BEAVERTON, OREGON

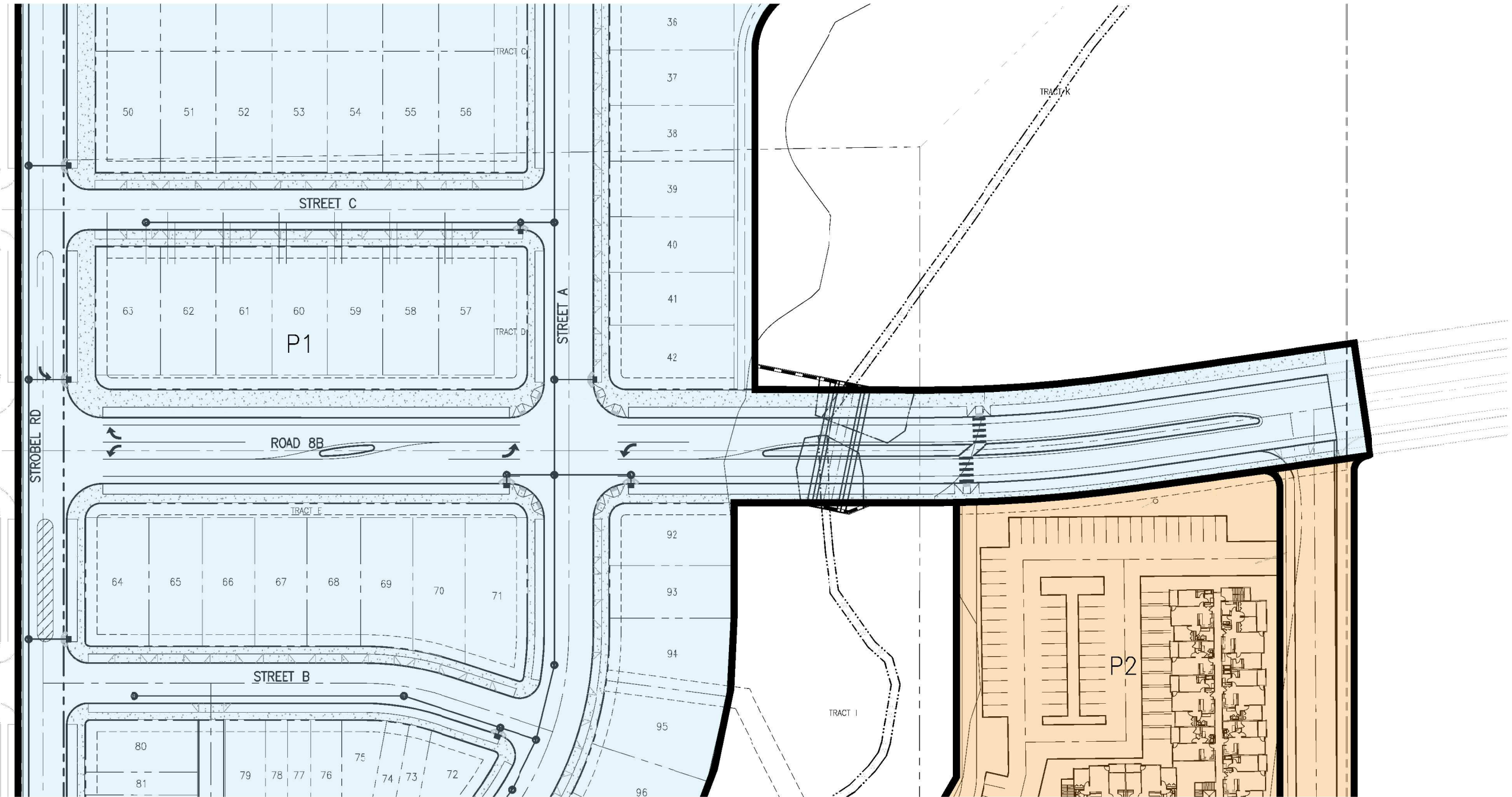PRELIMINARY STORMWATER MANAGEMENT PLAN
CENTRAL

XREF LIST

Ltscale: 40

Resolved
P17849X001
S17849X190
S17849X360
P17849X230
O17849X101
P17849X430
P17849X600

BIERLY
IOC. NO. 2C11-053131

TRACT C

TRACT K

50 51 52 53 54 55 56

36
37
38
39

STREET C

63 62 61 60 59 58 57

40
41

P1

TRACT D

STREET A

42

STROBEL RD

ROAD 8B

92

TRACT E

93

64 65 66 67 68 69 70 71

94

P2

STREET B

95

TRACT I

80
81 79 78 77 76 75 74 73 72

96

LEGEND

STORM LINE	SD
STORM MANHOLE	●
BASIN BOUNDARY	
WETLAND LIMIT	
CWS VEGETATED CORRIDOR	
100 YEAR FLOODPLAIN	

40' 0' 40' 80'

SCALE   IN FEET

NO. DATE BY REVISION COMMENTS

Design Drawn Checked Initial Issue Date:
BDS MDH MAP
DATUM: COP (NGVD 29-COP-1.37')

STREET B

P1

STROBEL RD

80
81
82
83
84
85
86
87

79 78 77 76 75 74 73 72

TRACT G

TRACT F

88 89 90 91

STREET A

94
95
96
97
98
99
100
101

102
103
104
105 106 107 108 109 1110

POND 1
TRACT H

SW SCHOLLS FERRY RD

Q1

TRACT I

BASIN 2
PHASE 2

P2

POND 2
TRACT J

Q2

LEGEND

STORM LINE	—— SD ——
STORM MANHOLE	●
BASIN BOUNDARY	▬▬▬▬
WETLAND LIMIT	
CWS VEGETATED CORRIDOR	
100 YEAR FLOODPLAIN	

SCALE   IN FEET
40' 0' 40' 80'

Appendix A—Hydrologic
Information

otak
HanmiGlobal Partner

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

Map Scale: 1:3,090 if printed on A portrait (8.5" x 11") sheet.

Map projection: Web Mercator   Corner coordinates: WGS84   Edge tics: UTM Zone 10N WGS84

MAP LEGEND

MAP INFORMATION

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

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: Washington County, Oregon
Survey Area Data: Version 13, Sep 18, 2015

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

Date(s) aerial images were photographed: Jul 8, 2010—Sep 4, 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.

Table—Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Washington County, Oregon (OR067)				
Map unit symbol	**Map unit name**	**Rating**	**Acres in AOI**	**Percent of AOI**
7B	Cascade silt loam, 3 to 7 percent slopes	C	2.3	7.1%
7C	Cascade silt loam, 7 to 12 percent slopes	C	10.1	30.9%
11D	Cornelius and Kinton silt loams, 12 to 20 percent slopes	C	2.8	8.6%
16C	Delena silt loam, 3 to 12 percent slopes	D	17.5	53.4%
Totals for Area of Interest			**32.7**	**100.0%**

Rating Options—Hydrologic Soil Group

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Existing Conditions

Table 2-2c   Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72 ← 75	79 ←
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1]   Average runoff condition, and $I_a = 0.2S$.

[2]   *Poor:*   <50%) ground cover or heavily grazed with no mulch.
     Fair: 50 to 75% ground cover and not heavily grazed.
     Good: > 75% ground cover and lightly or only occasionally grazed.

[3]   *Poor*:   <50% ground cover.
     Fair: 50 to 75% ground cover.
     Good: >75% ground cover.

[4]   Actual curve number is less than 30; use CN = 30 for runoff computations.

[5]   CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6]   *Poor:*   Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
     Fair: Woods are grazed but not burned, and some forest litter covers the soil.
     Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Basin Areas

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Pre-development Drainage Basins

Basin Name	Single Family Units	Impervious Area					Pervious Area		Total Area	
		Sidewalk (sf)	Roadway (sf)	Roof (sf)	Total (sf)	Total (ac)	(sf)	(ac)	(sf)	(ac)
Ex. Basin 1	0	0	0	0	0	0.00	954,344	21.91	954,344	21.91
Ex. Basin 2	0	0	0	0	0	0.00	246,593	5.66	246,593	5.66
Subtotal	**0**	**0**	**0**	**0**	**0**	**0.00**	**1,200,937**	**27.57**	**1,200,937**	**27.57**

Basin Areas
17849 The Ridge at South Cooper Mountain

Proposed Drainage Basins (Public and Private):

Basin Name	Proposed Single Family Units	Impervious Area							Pervious Area		Total Area		Notes
		Public Sidewalk (sf)	Public Roadway (sf)	Private Sidewalk (sf)	Private Roadway (sf)	Private Roof (sf)	Total (sf)	Total (ac)	(sf)	(ac)	(sf)	(ac)	
P1	81	66,060	179,131	0	6,515	244,796	496,502	11.40	258,120	5.93	754,622	17.32	
Q1		6,072	26,860	0	0	0	32,932	0.76	2,649	0.06	35,581	0.82	
X1	12	0	0	0	0	31,680	31,680	0.73	132,461	3.04	164,141	3.77	Offsite
Pond 1 Total	**93**	**72,132**	**205,991**			**276,476**	**561,114**	**12.88**	**393,230**	**9.03**	**954,344**	**21.91**	
P2		6,213	0	2,970	57,019	69,096	135,298	3.11	41,461	0.95	176,759	4.06	
Q2		12,670	45,914	0	0	0	58,584	1.34	11,250	0.26	69,834	1.60	
Pond 2 Total	**0**	**18,883**	**45,914**	**2,970**	**57,019**	**69,096**	**193,882**	**4.45**	**52,711**	**1.21**	**246,593**	**5.66**	
TOTAL	**93**	**91,015**	**251,905**	**2,970**	**57,019**	**345,572**	**754,996**	**17.33**	**445,941**	**10.24**	**1,200,937**	**27.57**	

Time of Concentration Calculations

Project Name: The Ridge at South Cooper Mountain		By: KRN	Date: 1/23/17
Project Number: 17849		Check:	Date:

BASINS		**Ex. Basin 1**		
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Dense Grass		
Manning's Roughness Coefficient		0.24		
Flow Length , L (<300 ft)	ft	300		
2-Year, 24-Hour Rainfall, P_2	in	2.5		
Land Slope, s	ft/ft	0.117		
OUTPUT				
Travel Time	hr	0.32		
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved		
Flow Length, L	ft	1318		
Watercourse Slope, s	ft/ft	0.074		
OUTPUT				
Average Velocity, V	ft/s	4.38		
Travel Time	hr	0.08		
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	8.0		
Wetted Perimeter, p_w	ft	8		
Channel Slope, s	ft/ft	0.017		
Manning's Roughness Coefficient		0.08		
Flow Length, L	ft	240		
OUTPUT				
Average Velocity, V	ft/s	2.48		
Hydraulic Radius, $r = a/p_w$	ft	1.04		
Travel Time	hr	0.00		
Basin Time of Concentration, T_c	**hrs**	**0.40**		
	min	**24.2**		

Time of Concentration Calculations

Project Name: The Ridge at South Cooper Mountain		By: KRN	Date: 1/23/17
Project Number: 17849		Check:	Date:

BASINS		Ex. Basin 2		
SHEET FLOW				
INPUT				
Surface Description (from Table 3-1)		Dense Grass		
Manning's Roughness Coefficient		0.24		
Flow Length , L (<300 ft)	ft	300		
2-Year, 24-Hour Rainfall, P_2	in	2.5		
Land Slope, s	ft/ft	0.060		
OUTPUT				
Travel Time	hr	0.42		
SHALLOW CONCENTRATED FLOW				
INPUT				
Surface Description (paved or unpaved)		Unpaved		
Flow Length, L	ft	67		
Watercourse Slope, s	ft/ft	0.179		
OUTPUT				
Average Velocity, V	ft/s	6.83		
Travel Time	hr	0.00		
CHANNEL FLOW				
INPUT				
Cross Sectional Flow Area, a	ft^2	8.0		
Wetted Perimeter, p_w	ft	8		
Channel Slope, s	ft/ft	0.054		
Manning's Roughness Coefficient		0.08		
Flow Length, L	ft	240		
OUTPUT				
Average Velocity, V	ft/s	4.46		
Hydraulic Radius, $r = a/p_w$	ft	1.04		
Travel Time	hr	0.00		
Basin Time of Concentration, T_c	**hrs**	**0.42**		
	min	**25.2**		

Appendix B—Water Quality
Calculations

otak

Hanmi Global Partner

Water Quality Calculations

17849 The Ridge at South Cooper Mountain   Pond 1

Impervious Area:

IA   12.88 ac   Proposed Impervious

                561,114 ft^2

SLOPES V Standards

$$WQV = (1.25\ inch\ )\left(\frac{1\ ft}{12\ inch}\right)(Proposed\ Impervious\ Area, ft^2)$$

WQV   58,449 ft^3 Water Quality Volume

Elevation (ft)	Depth (ft)	Area (sf)	Area (ac)	Volume (cf)	
246.00	0.0	5.1984	0.0001	0	WQ Orifice Invert*
247.99	1.99	5.1984	0.0001	0	
248	2.00	11,895	0.2731	0	Bottom of Pond
248.01	2.01	11,914	0.2735	119	
249	3.00	13,825	0.3174	12,860	
250	4.00	15,755	0.3617	27,650	
251	5.00	17,857	0.4099	44,456	
251.75	5.75	19,435	0.4462	58,449	WQV
252	6.00	19,960	0.4582	63,365	
253	7.00	22,242	0.5106	84,466	
254	8.00	24,523	0.5630	107,848	25-Year Max WSE
255	9.00	26,943	0.6185	133,581	Top of Pond

*The orifice is submerged (24-inches below FC outlet) and thereby controled by the FC outlet IE

WQ Orifice Sizing:

D = 24*[(Q/(C[2gH]^0.5)/3.14]^0.5

Q	**0.34**	ft^3/s	Water Quality Orifice Flow
C	0.62		Constant
g	32.2	ft/s^2	Gravitational acceleration
WQ OR depth	**5.75**	ft	From pond table above
H	**3.83**	ft	Head
D	**2.52**	in	Water Quality Orifice Diameter (48-hour draw down)

Water Quality Calculations

17849 The Ridge at South Cooper Mountain   Pond 2

Impervious Area:

IA   4.45 ac   Proposed Impervious

       193,882 ft^2

SLOPES V Standards

$$WQV = (1.25\ inch\ )\left(\frac{1\ ft}{12\ inch}\right)(Proposed\ Impervious\ Area, ft^2)$$

WQV   20,196 ft^3 Water Quality Volume

Elevation (ft)	Depth (ft)	Area (sf)	Area (ac)	Volume (cf)	
252.00	0.0	5.1984	0.0001	0	WQ Orifice Invert*
253.99	1.99	5.1984	0.0001	0	
254	2.00	5,873	0.1348	0	Bottom of Pond
254.01	2.01	5,884	0.1351	59	
255	3.00	6,978	0.1602	6,426	
256	4.00	8,164	0.1874	13,997	
256.72	4.72	9,077	0.2084	20,196	WQV
257	5.00	9,433	0.2166	22,795	
258	6.00	10,783	0.2475	32,903	25-Year Max WSE
259	7.00	12,216	0.2804	44,403	Top of Pond

*The orifice is submerged (24-inches below FC outlet) and thereby controled by the FC outlet IE

WQ Orifice Sizing:

D = 24*[(Q/(C[2gH]^0.5)/3.14]^0.5

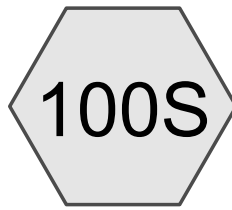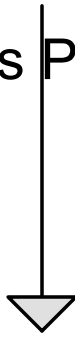|			
Q	0.12	ft^3/s	Water Quality Orifice Flow
C	0.62		Constant
g	32.2	ft/s^2	Gravitational acceleration
WQ OR depth	4.72	ft	From pond table above
H	3.15	ft	Head
D	1.56	in	Water Quality Orifice Diameter (48-hour draw down)

Appendix C—HydroCAD Output
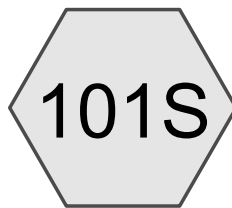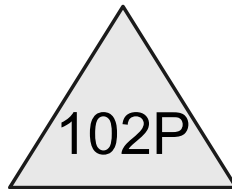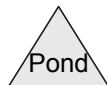
100S

E - Basin POC 1

101S

P - Basins P1, Q1, X1

102P

P - Pond 1

Subcat   Reach   Pond   Link

Summary for Subcatchment 100S: E - Basin POC 1

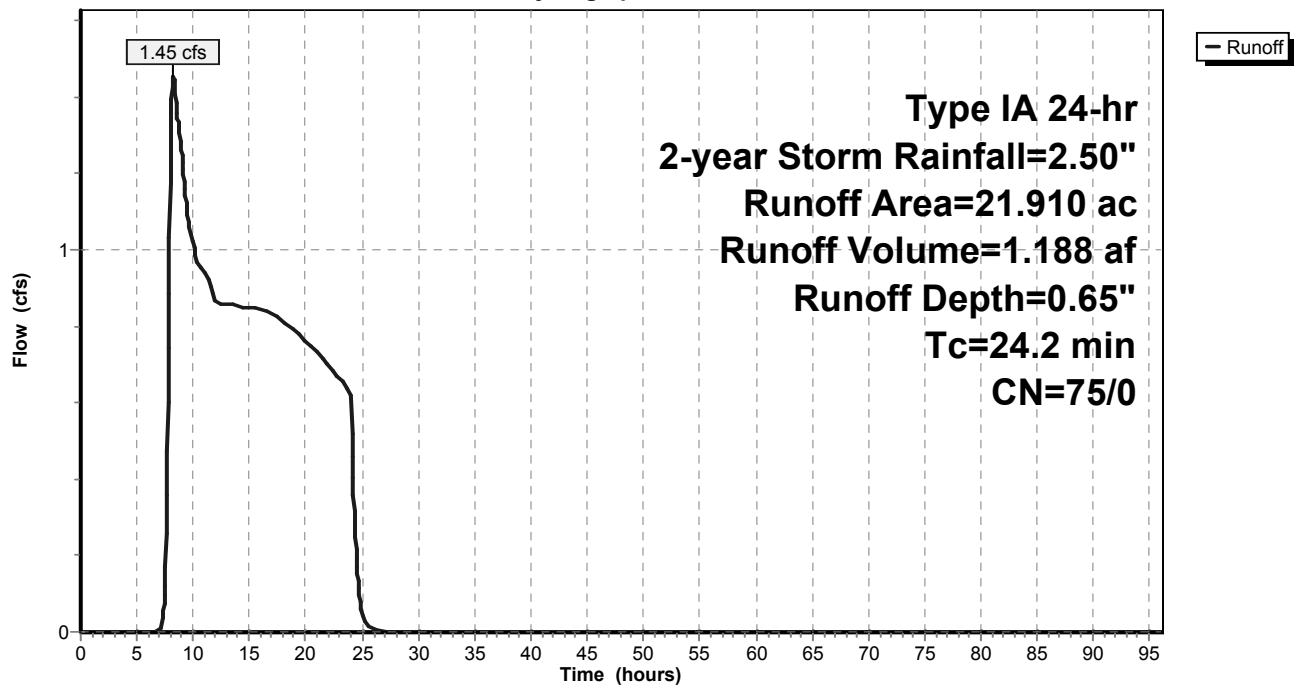Runoff   =   1.45 cfs @   8.22 hrs, Volume=   1.188 af, Depth= 0.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Storm Rainfall=2.50"

	Area (ac)	CN	Description
*	21.910	75	Woods/grass comb., Good, HSG C/D
	21.910		100.00% Pervious Area

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

Subcatchment 100S: E - Basin POC 1

Hydrograph

Type IA 24-hr
2-year Storm Rainfall=2.50"
Runoff Area=21.910 ac
Runoff Volume=1.188 af
Runoff Depth=0.65"
Tc=24.2 min
CN=75/0

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 2-year Storm Rainfall=2.50"
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Summary for Subcatchment 101S: P - Basins P1, Q1, X1

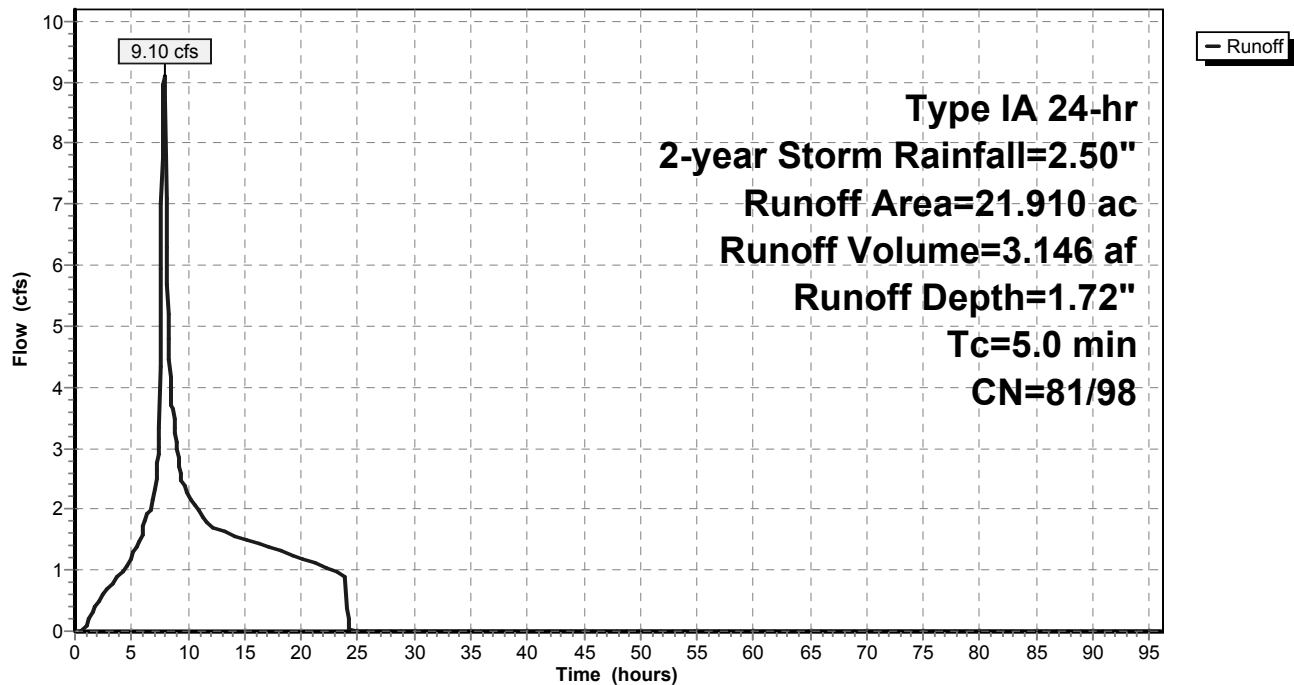Runoff   =   9.10 cfs @   7.93 hrs, Volume=   3.146 af, Depth= 1.72"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Storm Rainfall=2.50"

	Area (ac)	CN	Description
*	12.880	98	Paved roads w/curbs & sewers, HSG C/D
*	9.030	81	50-75% Grass cover, Fair, HSG C/D
	21.910	91	Weighted Average
	9.030		41.21% Pervious Area
	12.880		58.79% Impervious Area

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

Subcatchment 101S: P - Basins P1, Q1, X1

Hydrograph

Type IA 24-hr
2-year Storm Rainfall=2.50"
Runoff Area=21.910 ac
Runoff Volume=3.146 af
Runoff Depth=1.72"
Tc=5.0 min
CN=81/98

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Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 2-year Storm Rainfall=2.50"
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Summary for Pond 102P: P - Pond 1

Inflow Area =   21.910 ac, 58.79% Impervious, Inflow Depth = 1.72"   for 2-year Storm event
Inflow   =   9.10 cfs @   7.93 hrs, Volume=   3.146 af
Outflow   =   1.38 cfs @   17.19 hrs, Volume=   3.147 af, Atten= 85%, Lag= 555.5 min
Primary   =   1.38 cfs @   17.19 hrs, Volume=   3.147 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 252.41' @ 17.19 hrs   Surf.Area= 20,891 sf   Storage= 71,701 cf

Plug-Flow detention time= 1,216.7 min calculated for 3.145 af (100% of inflow)
Center-of-Mass det. time= 1,217.9 min (1,930.0 - 712.1)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	133,581 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	11,895	0	0
249.00	13,825	12,860	12,860
250.00	15,755	14,790	27,650
251.00	17,857	16,806	44,456
252.00	19,960	18,909	63,365
253.00	22,242	21,101	84,466
254.00	24,523	23,383	107,848
255.00	26,943	25,733	133,581

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 246.00' / 245.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	244.00'	**2.5" Vert. WQ Orifice** C= 0.600
#3	Device 1	251.75'	**8.0" Vert. 2-yr Orifice** C= 0.600
#4	Device 1	252.65'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.38 cfs @ 17.19 hrs HW=252.41'   (Free Discharge)
└─**1=Culvert** (Passes 1.38 cfs of 7.41 cfs potential flow)
  ├─**2=WQ Orifice** (Orifice Controls 0.42 cfs @ 12.19 fps)
  ├─**3=2-yr Orifice** (Orifice Controls 0.96 cfs @ 2.76 fps)
  └─**4=Broad-Crested Rectangular Weir**(Controls 0.00 cfs)

17849 PrelimDetention

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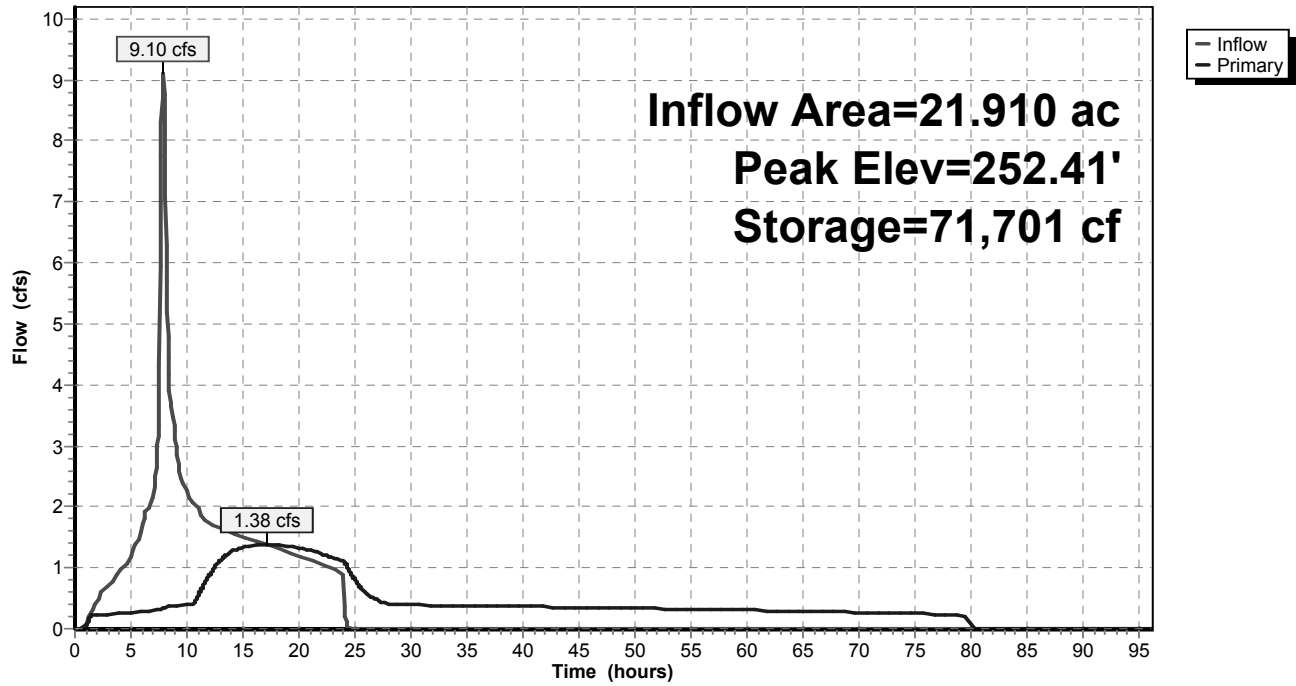HydroCAD® 10.00-14 s/n 05775 © 2015 HydroCAD Software Solutions LLC

Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 2-year Storm Rainfall=2.50"
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Pond 102P: P - Pond 1

Hydrograph

Inflow Area=21.910 ac
Peak Elev=252.41'
Storage=71,701 cf

9.10 cfs
1.38 cfs

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 10-year Storm Rainfall=3.50"
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Summary for Subcatchment 100S: E - Basin POC 1

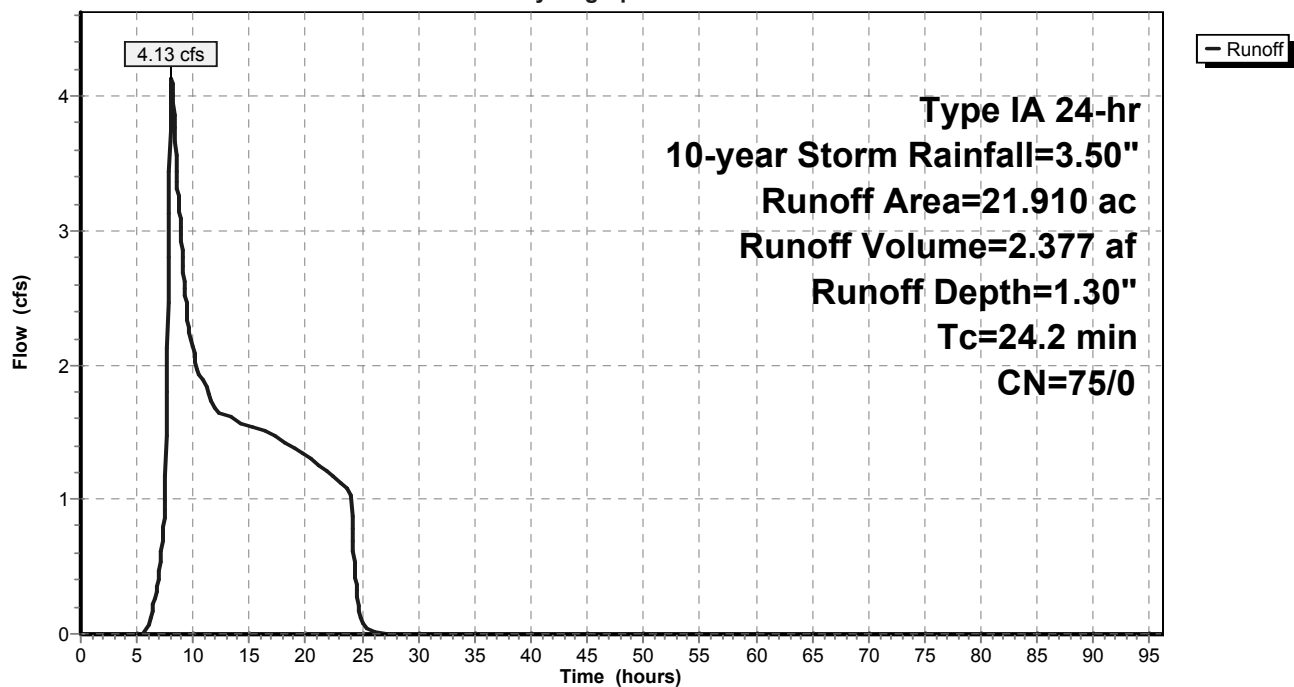Runoff   =   4.13 cfs @   8.07 hrs, Volume=   2.377 af, Depth= 1.30"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Storm Rainfall=3.50"

	Area (ac)	CN	Description
*	21.910	75	Woods/grass comb., Good, HSG C/D
	21.910		100.00% Pervious Area

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

Subcatchment 100S: E - Basin POC 1

Hydrograph

4.13 cfs

**Type IA 24-hr
10-year Storm Rainfall=3.50"
Runoff Area=21.910 ac
Runoff Volume=2.377 af
Runoff Depth=1.30"
Tc=24.2 min
CN=75/0**

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 10-year Storm Rainfall=3.50"
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Summary for Subcatchment 101S: P - Basins P1, Q1, X1

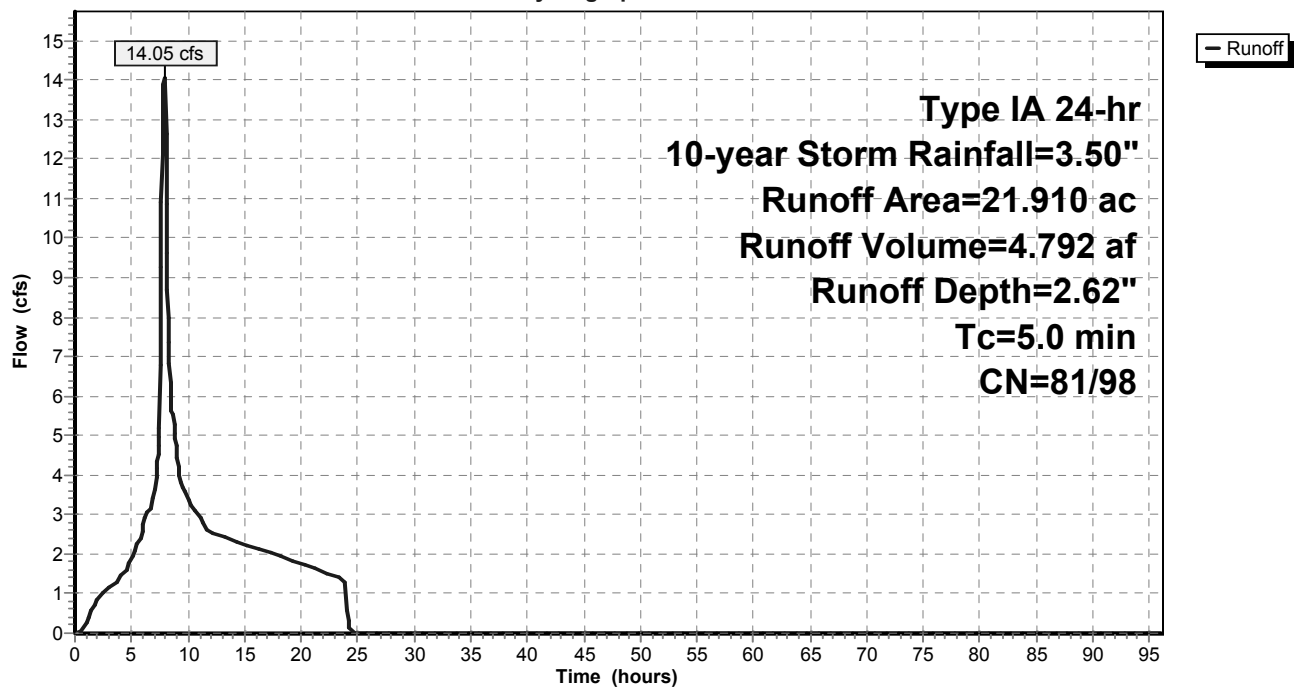Runoff   =   14.05 cfs @   7.92 hrs, Volume=   4.792 af, Depth= 2.62"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Storm Rainfall=3.50"

	Area (ac)	CN	Description
*	12.880	98	Paved roads w/curbs & sewers, HSG C/D
*	9.030	81	50-75% Grass cover, Fair, HSG C/D
	21.910	91	Weighted Average
	9.030		41.21% Pervious Area
	12.880		58.79% Impervious Area

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

Subcatchment 101S: P - Basins P1, Q1, X1

Hydrograph

17849 PrelimDetention

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Summary for Pond 102P: P - Pond 1

Inflow Area =   21.910 ac, 58.79% Impervious, Inflow Depth = 2.62"   for 10-year Storm event
Inflow   =   14.05 cfs @   7.92 hrs, Volume=   4.792 af
Outflow   =   3.34 cfs @   10.08 hrs, Volume=   4.792 af, Atten= 76%, Lag= 129.2 min
Primary   =   3.34 cfs @   10.08 hrs, Volume=   4.792 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 252.84' @ 10.08 hrs   Surf.Area= 21,888 sf   Storage= 81,039 cf

Plug-Flow detention time= 892.4 min calculated for 4.789 af (100% of inflow)
Center-of-Mass det. time= 893.7 min (1,595.7 - 702.0)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	133,581 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	11,895	0	0
249.00	13,825	12,860	12,860
250.00	15,755	14,790	27,650
251.00	17,857	16,806	44,456
252.00	19,960	18,909	63,365
253.00	22,242	21,101	84,466
254.00	24,523	23,383	107,848
255.00	26,943	25,733	133,581

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 246.00' / 245.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	244.00'	**2.5" Vert. WQ Orifice** C= 0.600
#3	Device 1	251.75'	**8.0" Vert. 2-yr Orifice** C= 0.600
#4	Device 1	252.65'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=3.34 cfs @ 10.08 hrs HW=252.84'   (Free Discharge)
└─**1=Culvert** (Passes 3.34 cfs of 7.66 cfs potential flow)
 ├─**2=WQ Orifice** (Orifice Controls 0.43 cfs @ 12.60 fps)
 ├─**3=2-yr Orifice** (Orifice Controls 1.47 cfs @ 4.20 fps)
 └─**4=Broad-Crested Rectangular Weir** (Weir Controls 1.44 cfs @ 1.24 fps)

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 10-year Storm Rainfall=3.50"

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Pond 102P: P - Pond 1

Hydrograph
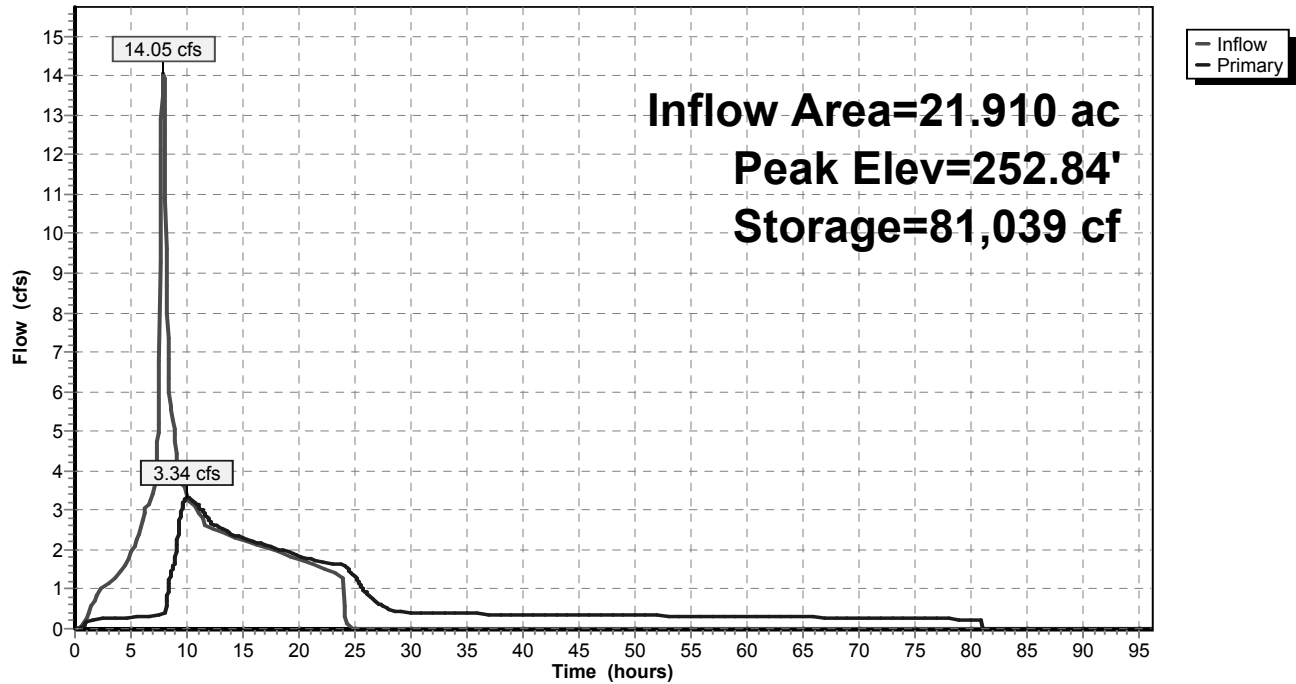
— Inflow
— Primary

14.05 cfs

3.34 cfs

Inflow Area=21.910 ac
Peak Elev=252.84'
Storage=81,039 cf

Flow (cfs)

Time (hours)

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 25-year Storm Rainfall=4.00"

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Summary for Subcatchment 100S: E - Basin POC 1

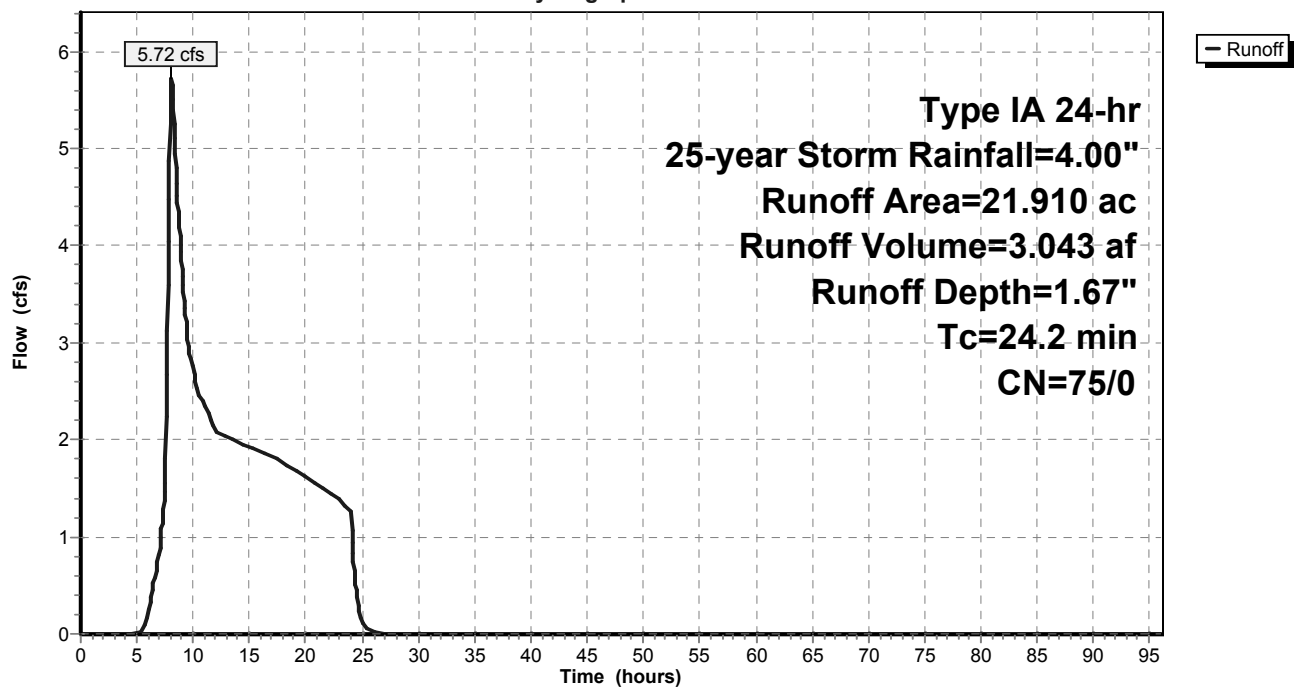Runoff   =   5.72 cfs @   8.06 hrs, Volume=   3.043 af, Depth= 1.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Storm Rainfall=4.00"

Area (ac)	CN	Description
* 21.910	75	Woods/grass comb., Good, HSG C/D
21.910		100.00% Pervious Area

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

Subcatchment 100S: E - Basin POC 1

Hydrograph

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 25-year Storm Rainfall=4.00"
Printed 2/10/2017
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Summary for Subcatchment 101S: P - Basins P1, Q1, X1

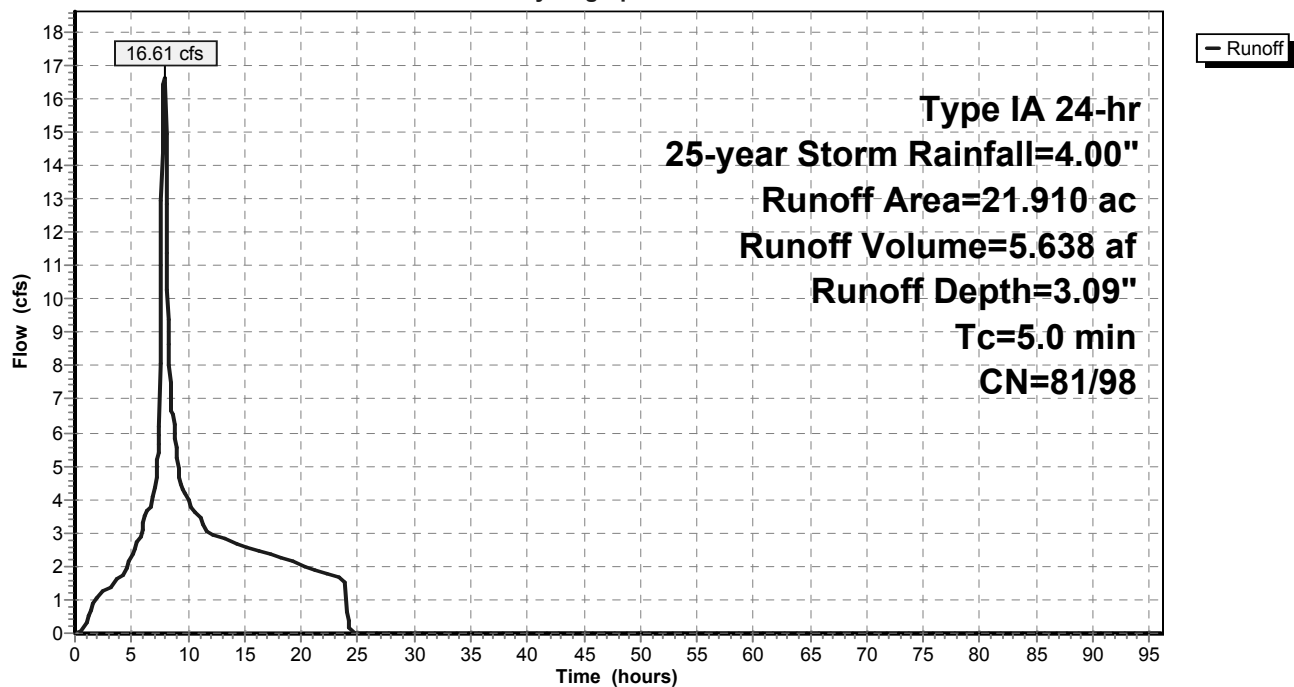Runoff   =   16.61 cfs @   7.92 hrs, Volume=   5.638 af, Depth= 3.09"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Storm Rainfall=4.00"

	Area (ac)	CN	Description
*	12.880	98	Paved roads w/curbs & sewers, HSG C/D
*	9.030	81	50-75% Grass cover, Fair, HSG C/D
	21.910	91	Weighted Average
	9.030		41.21% Pervious Area
	12.880		58.79% Impervious Area

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

Subcatchment 101S: P - Basins P1, Q1, X1

Hydrograph

Type IA 24-hr
25-year Storm Rainfall=4.00"
Runoff Area=21.910 ac
Runoff Volume=5.638 af
Runoff Depth=3.09"
Tc=5.0 min
CN=81/98

Summary for Pond 102P: P - Pond 1

Inflow Area =   21.910 ac, 58.79% Impervious, Inflow Depth = 3.09"   for 25-year Storm event
Inflow   =   16.61 cfs @   7.92 hrs, Volume=   5.638 af
Outflow   =   5.61 cfs @   8.96 hrs, Volume=   5.638 af, Atten= 66%, Lag= 62.2 min
Primary   =   5.61 cfs @   8.96 hrs, Volume=   5.638 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 253.00' @ 8.96 hrs   Surf.Area= 22,239 sf   Storage= 84,434 cf

Plug-Flow detention time= 776.2 min calculated for 5.635 af (100% of inflow)
Center-of-Mass det. time= 777.6 min (1,475.6 - 698.0)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	133,581 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	11,895	0	0
249.00	13,825	12,860	12,860
250.00	15,755	14,790	27,650
251.00	17,857	16,806	44,456
252.00	19,960	18,909	63,365
253.00	22,242	21,101	84,466
254.00	24,523	23,383	107,848
255.00	26,943	25,733	133,581

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 246.00' / 245.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	244.00'	**2.5" Vert. WQ Orifice** C= 0.600
#3	Device 1	251.75'	**8.0" Vert. 2-yr Orifice** C= 0.600
#4	Device 1	252.65'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=5.61 cfs @ 8.96 hrs HW=253.00'   (Free Discharge)
└─**1=Culvert** (Passes 5.61 cfs of 7.74 cfs potential flow)
   ├─**2=WQ Orifice** (Orifice Controls 0.43 cfs @ 12.74 fps)
   ├─**3=2-yr Orifice** (Orifice Controls 1.61 cfs @ 4.61 fps)
   └─**4=Broad-Crested Rectangular Weir** (Weir Controls 3.57 cfs @ 1.71 fps)

17849 PrelimDetention

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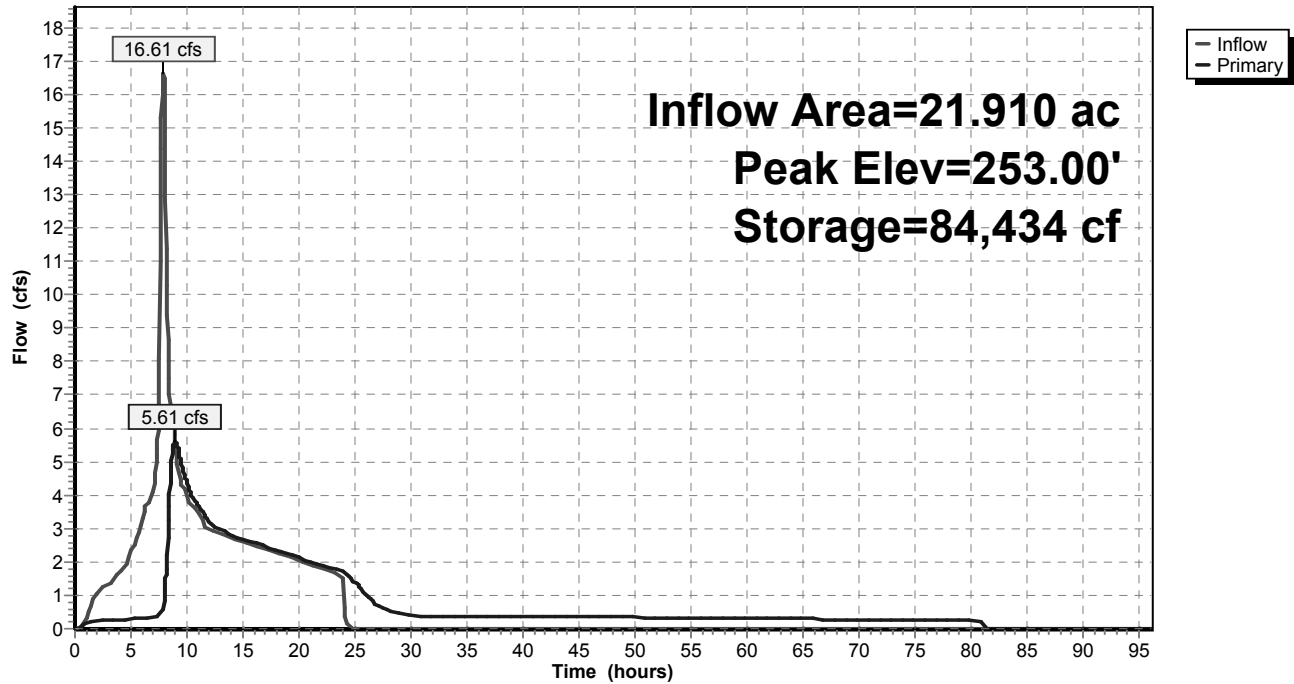HydroCAD® 10.00-14 s/n 05775 © 2015 HydroCAD Software Solutions LLC

Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 25-year Storm Rainfall=4.00"
Printed 2/10/2017
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Pond 102P: P - Pond 1

Hydrograph

Inflow Area=21.910 ac
Peak Elev=253.00'
Storage=84,434 cf

16.61 cfs

5.61 cfs

— Inflow
— Primary

Summary for Subcatchment 100S: E - Basin POC 1

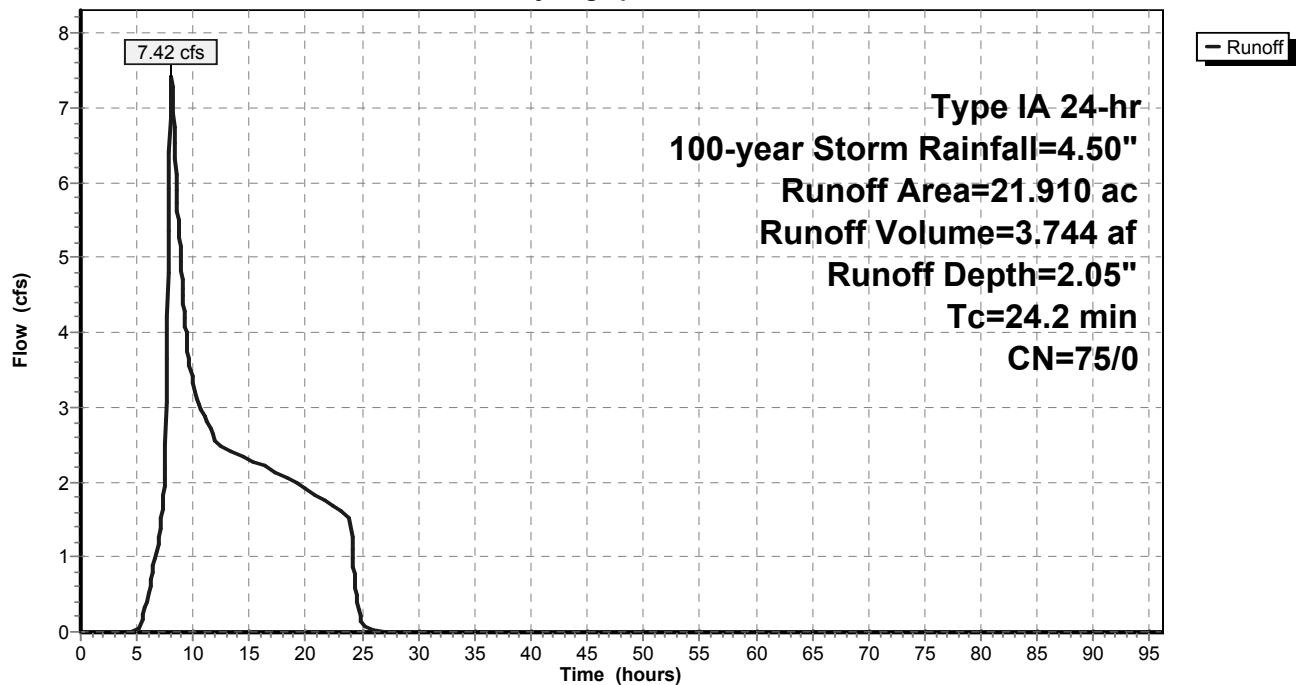Runoff   =   7.42 cfs @   8.06 hrs, Volume=   3.744 af, Depth= 2.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

Area (ac)	CN	Description
* 21.910	75	Woods/grass comb., Good, HSG C/D
21.910		100.00% Pervious Area

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

Subcatchment 100S: E - Basin POC 1

Hydrograph

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 1
Type IA 24-hr 100-year Storm Rainfall=4.50"
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Summary for Subcatchment 101S: P - Basins P1, Q1, X1

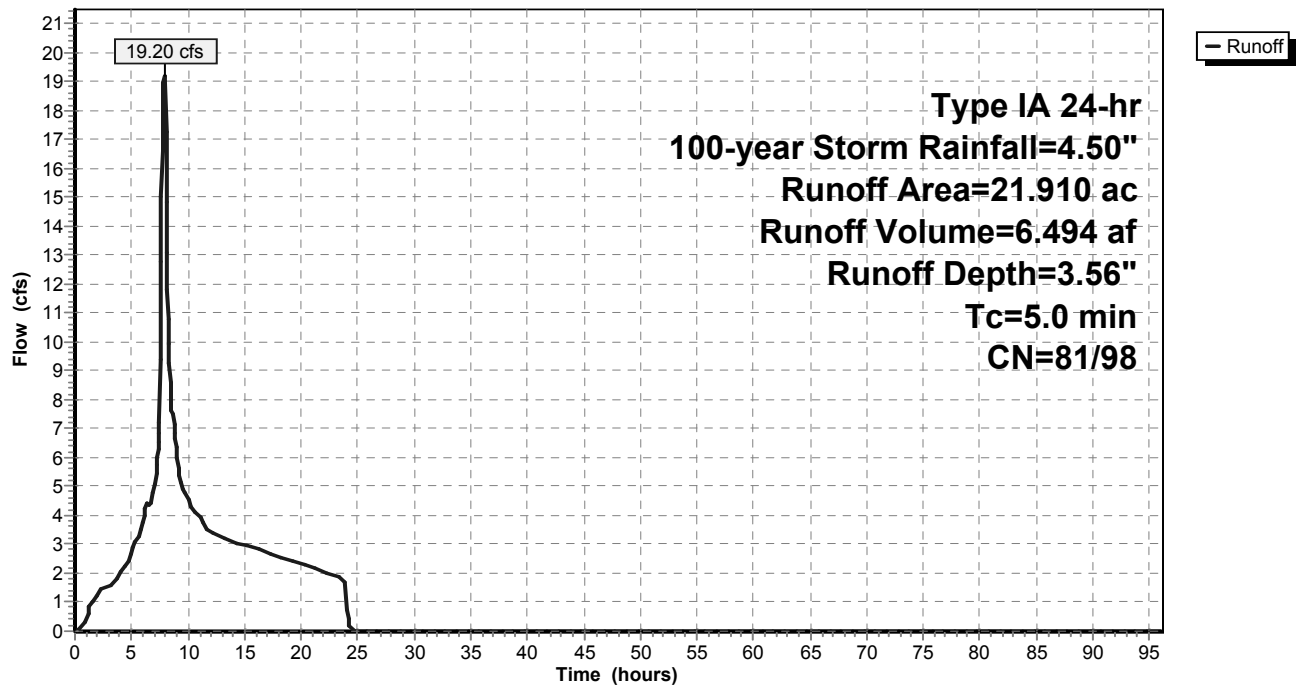Runoff   =   19.20 cfs @   7.92 hrs, Volume=   6.494 af, Depth= 3.56"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

	Area (ac)	CN	Description
*	12.880	98	Paved roads w/curbs & sewers, HSG C/D
*	9.030	81	50-75% Grass cover, Fair, HSG C/D
	21.910	91	Weighted Average
	9.030		41.21% Pervious Area
	12.880		58.79% Impervious Area

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

Subcatchment 101S: P - Basins P1, Q1, X1

Hydrograph

Type IA 24-hr
100-year Storm Rainfall=4.50"
Runoff Area=21.910 ac
Runoff Volume=6.494 af
Runoff Depth=3.56"
Tc=5.0 min
CN=81/98

Ridge at South Cooper Mountain - POC 1
17849 PrelimDetention
Type IA 24-hr 100-year Storm Rainfall=4.50"
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Summary for Pond 102P: P - Pond 1

Inflow Area = 21.910 ac, 58.79% Impervious, Inflow Depth = 3.56" for 100-year Storm event
Inflow   =   19.20 cfs @   7.92 hrs, Volume=   6.494 af
Outflow =   7.85 cfs @   8.48 hrs, Volume=   6.494 af, Atten= 59%, Lag= 33.4 min
Primary =   7.85 cfs @   8.48 hrs, Volume=   6.494 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 253.20' @ 8.48 hrs   Surf.Area= 22,704 sf   Storage= 89,022 cf

Plug-Flow detention time= 685.1 min calculated for 6.491 af (100% of inflow)
Center-of-Mass det. time= 686.6 min (1,381.1 - 694.5)

Volume	Invert	Avail.Storage	Storage Description
#1	248.00'	133,581 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
248.00	11,895	0	0
249.00	13,825	12,860	12,860
250.00	15,755	14,790	27,650
251.00	17,857	16,806	44,456
252.00	19,960	18,909	63,365
253.00	22,242	21,101	84,466
254.00	24,523	23,383	107,848
255.00	26,943	25,733	133,581

Device	Routing	Invert	Outlet Devices
#1	Primary	246.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 246.00' / 245.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	244.00'	**2.5" Vert. WQ Orifice** C= 0.600
#3	Device 1	251.75'	**8.0" Vert. 2-yr Orifice** C= 0.600
#4	Device 1	252.65'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=7.85 cfs @ 8.48 hrs HW=253.20' (Free Discharge)
└─**1=Culvert** (Barrel Controls 7.85 cfs @ 10.00 fps)
 ├─**2=WQ Orifice** (Passes < 0.44 cfs potential flow)
 ├─**3=2-yr Orifice** (Passes < 1.78 cfs potential flow)
 └─**4=Broad-Crested Rectangular Weir** (Passes < 7.49 cfs potential flow)

17849 PrelimDetention

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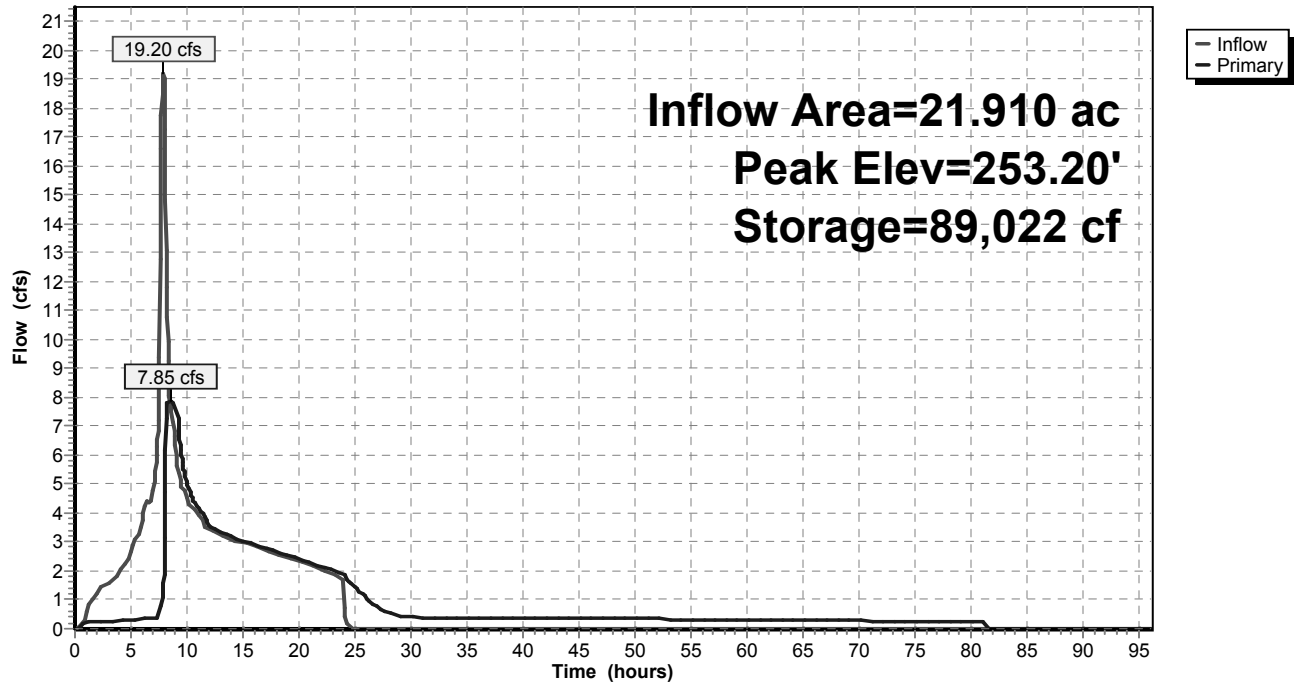HydroCAD® 10.00-14 s/n 05775 © 2015 HydroCAD Software Solutions LLC

Ridge at South Cooper Mountain - POC 1

Type IA 24-hr 100-year Storm Rainfall=4.50"

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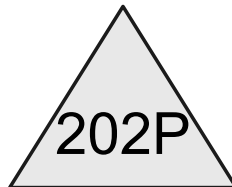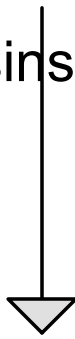Page 17
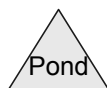
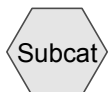## Pond 102P: P - Pond 1

Hydrograph

Inflow Area=21.910 ac
Peak Elev=253.20'
Storage=89,022 cf

19.20 cfs

7.85 cfs

— Inflow
— Primary

Flow (cfs)

Time (hours)

200S

E - Basin POC 2

201S

P - Basins P2, Q2

202P

P - Pond 2

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Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 2-year Storm Rainfall=2.50"
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Page 2

Summary for Subcatchment 200S: E - Basin POC 2

Runoff   =   0.37 cfs @   8.24 hrs, Volume=   0.307 af, Depth= 0.65"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Storm Rainfall=2.50"

Area (ac)	CN	Description
* 5.660	75	Woods/grass comb., Good, HSG C/D
5.660		100.00% Pervious Area

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

Subcatchment 200S: E - Basin POC 2

Hydrograph

Type IA 24-hr
2-year Storm Rainfall=2.50"
Runoff Area=5.660 ac
Runoff Volume=0.307 af
Runoff Depth=0.65"
Tc=25.2 min
CN=75/0

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 2-year Storm Rainfall=2.50"
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Summary for Subcatchment 201S: P - Basins P2, Q2

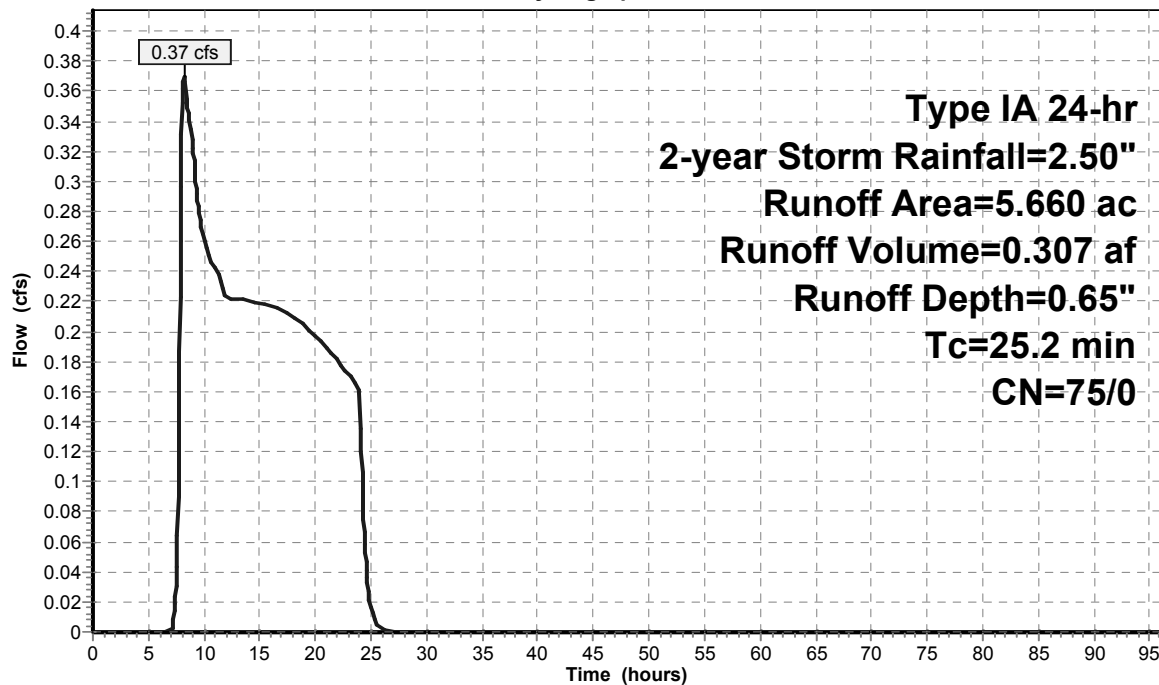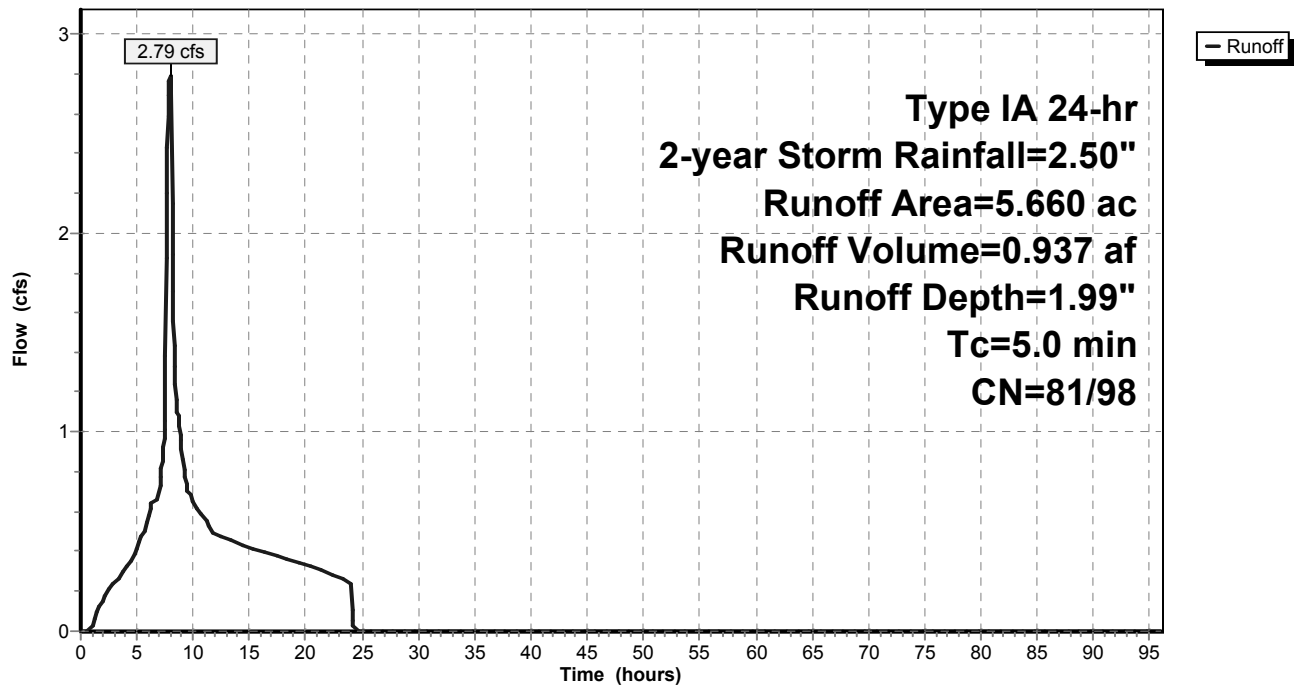Runoff   =   2.79 cfs @   7.91 hrs, Volume=   0.937 af, Depth= 1.99"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 2-year Storm Rainfall=2.50"

	Area (ac)	CN	Description
*	4.450	98	Paved roads w/curbs & sewers, HSG C/D
*	1.210	81	50-75% Grass cover, Fair, HSG C/D
	5.660	94	Weighted Average
	1.210		21.38% Pervious Area
	4.450		78.62% Impervious Area

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

Subcatchment 201S: P - Basins P2, Q2

Hydrograph

Type IA 24-hr
2-year Storm Rainfall=2.50"
Runoff Area=5.660 ac
Runoff Volume=0.937 af
Runoff Depth=1.99"
Tc=5.0 min
CN=81/98

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 2-year Storm Rainfall=2.50"

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Summary for Pond 202P: P - Pond 2

Inflow Area = 5.660 ac, 78.62% Impervious, Inflow Depth = 1.99" for 2-year Storm event
Inflow = 2.79 cfs @ 7.91 hrs, Volume= 0.937 af
Outflow = 0.36 cfs @ 18.49 hrs, Volume= 0.937 af, Atten= 87%, Lag= 634.5 min
Primary = 0.36 cfs @ 18.49 hrs, Volume= 0.937 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 257.06' @ 18.49 hrs Surf.Area= 9,513 sf Storage= 23,359 cf

Plug-Flow detention time= 1,274.5 min calculated for 0.937 af (100% of inflow)
Center-of-Mass det. time= 1,275.5 min (1,966.5 - 691.0)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	44,403 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
254.00	5,873	0	0
255.00	6,978	6,426	6,426
256.00	8,164	7,571	13,997
257.00	9,433	8,799	22,795
258.00	10,783	10,108	32,903
259.00	12,216	11,500	44,403

Device	Routing	Invert	Outlet Devices
#1	Primary	252.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 252.00' / 251.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	250.00'	**1.6" Vert. WQ Orifice** C= 0.600
#3	Device 1	256.72'	**4.5" Vert. 2-yr Orifice/Grate** C= 0.600
#4	Device 1	257.30'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.36 cfs @ 18.49 hrs HW=257.06' (Free Discharge)
└─**1=Culvert** (Passes 0.36 cfs of 6.58 cfs potential flow)
 ├─**2=WQ Orifice** (Orifice Controls 0.15 cfs @ 10.83 fps)
 ├─**3=2-yr Orifice/Grate** (Orifice Controls 0.21 cfs @ 1.98 fps)
 └─**4=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 2-year Storm Rainfall=2.50"

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Pond 202P: P - Pond 2

Hydrograph

Inflow Area=5.660 ac
Peak Elev=257.06'
Storage=23,359 cf

2.79 cfs

0.36 cfs

Flow (cfs)

Time (hours)

— Inflow
— Primary

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 10-year Storm Rainfall=3.50"

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Summary for Subcatchment 200S: E - Basin POC 2

Runoff   =   1.05 cfs @   8.07 hrs, Volume=   0.614 af, Depth= 1.30"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Storm Rainfall=3.50"

	Area (ac)	CN	Description
*	5.660	75	Woods/grass comb., Good, HSG C/D
	5.660		100.00% Pervious Area

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

Subcatchment 200S: E - Basin POC 2

Hydrograph

Type IA 24-hr
10-year Storm Rainfall=3.50"
Runoff Area=5.660 ac
Runoff Volume=0.614 af
Runoff Depth=1.30"
Tc=25.2 min
CN=75/0

17849 PrelimDetention

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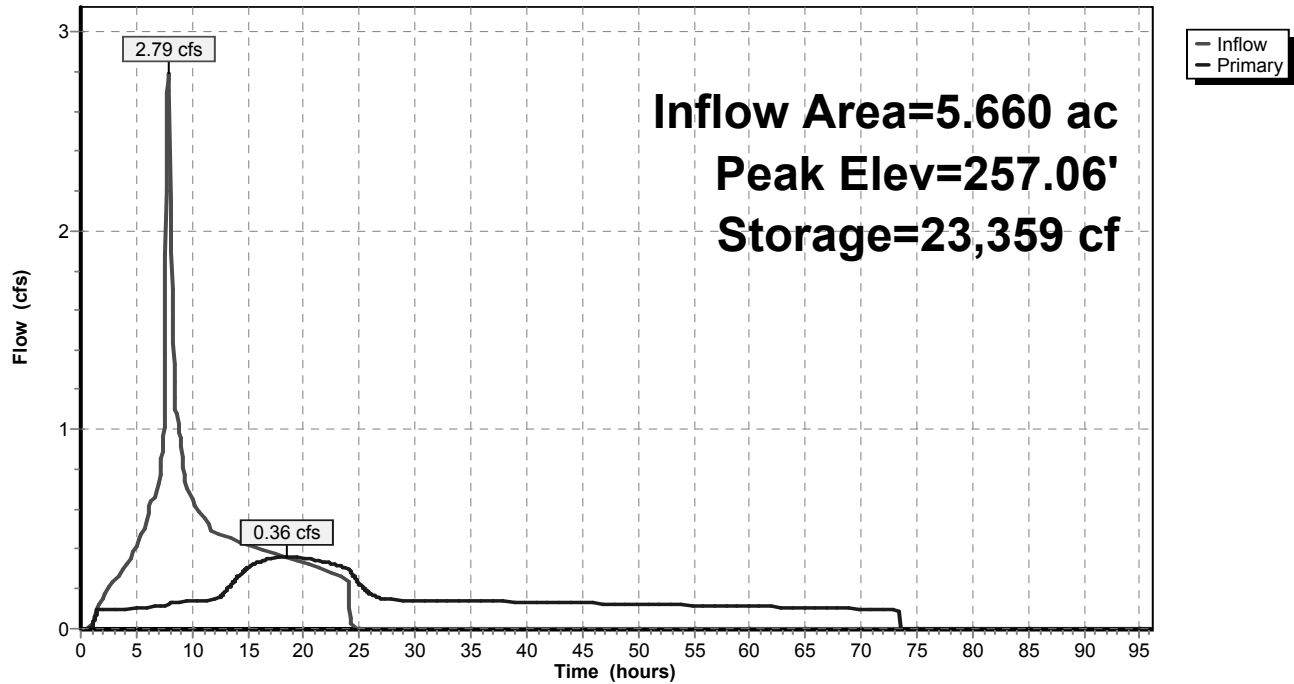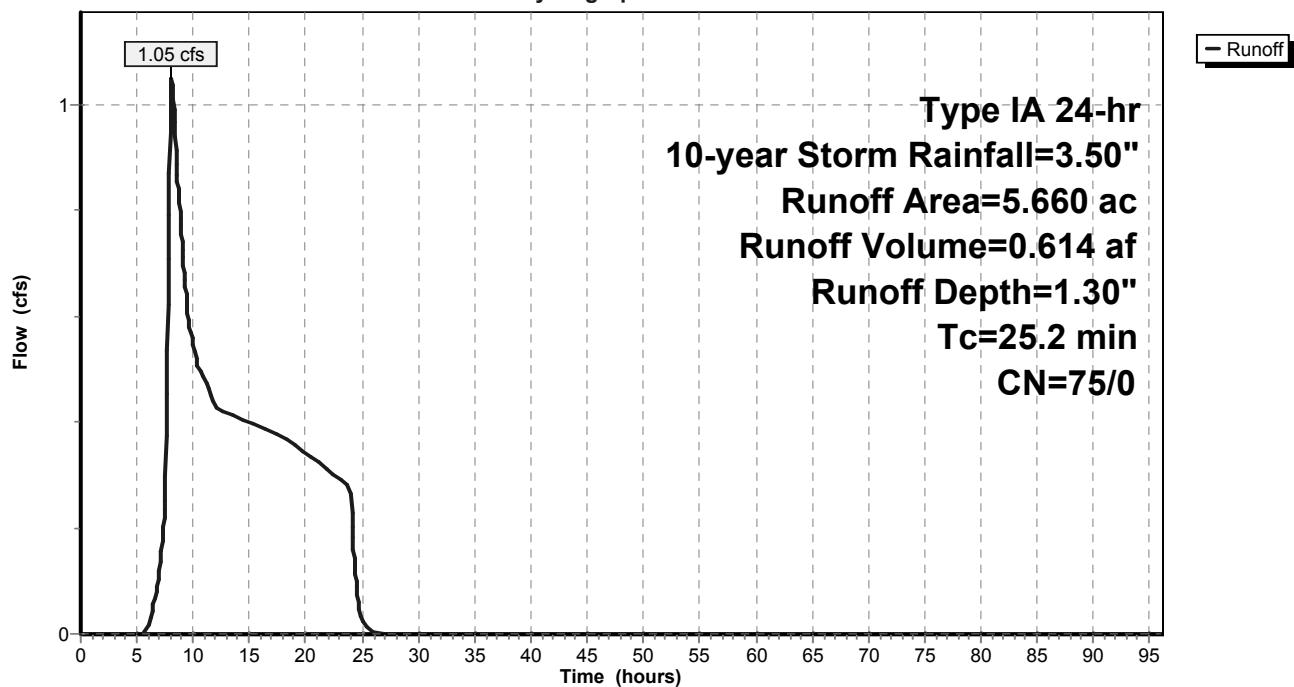Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 10-year Storm Rainfall=3.50"
Printed 2/10/2017
Page 7

Summary for Subcatchment 201S: P - Basins P2, Q2

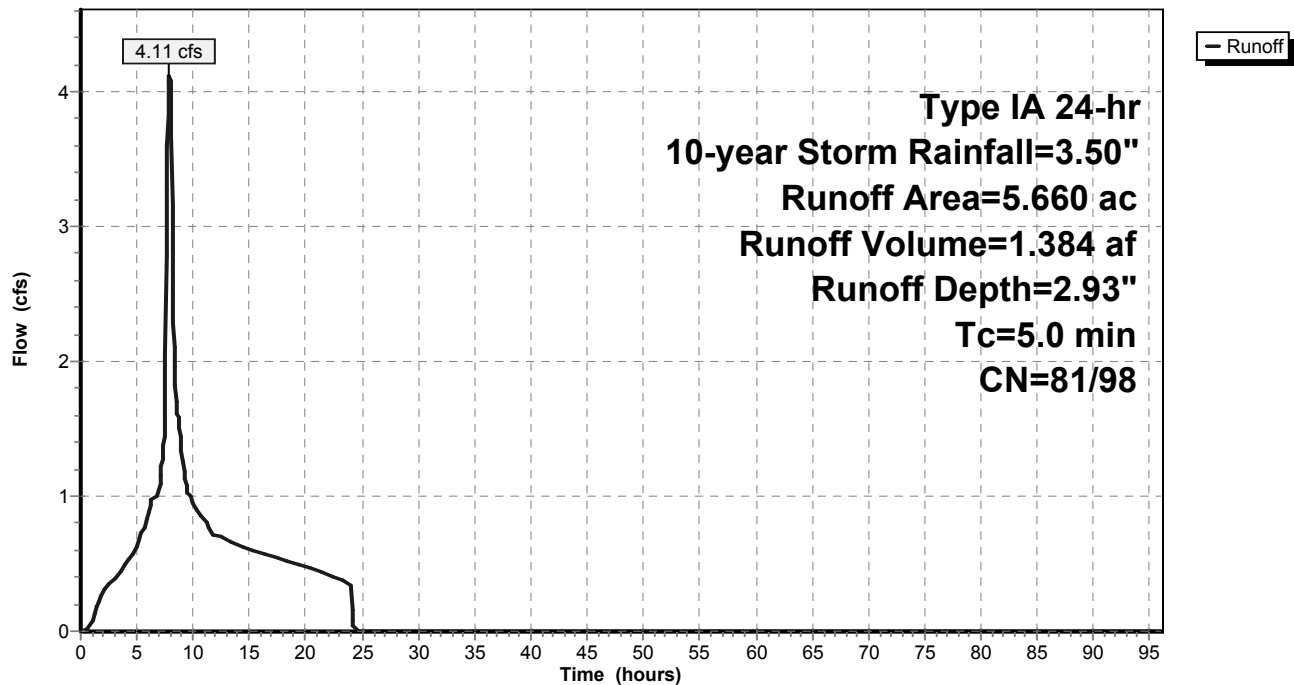Runoff   =   4.11 cfs @   7.91 hrs, Volume=   1.384 af, Depth= 2.93"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 10-year Storm Rainfall=3.50"

	Area (ac)	CN	Description
*	4.450	98	Paved roads w/curbs & sewers, HSG C/D
*	1.210	81	50-75% Grass cover, Fair, HSG C/D
	5.660	94	Weighted Average
	1.210		21.38% Pervious Area
	4.450		78.62% Impervious Area

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

Subcatchment 201S: P - Basins P2, Q2

Hydrograph

Type IA 24-hr
10-year Storm Rainfall=3.50"
Runoff Area=5.660 ac
Runoff Volume=1.384 af
Runoff Depth=2.93"
Tc=5.0 min
CN=81/98

Ridge at South Cooper Mountain - POC 2
17849 PrelimDetention
Type IA 24-hr 10-year Storm Rainfall=3.50"
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Summary for Pond 202P: P - Pond 2

Inflow Area = 5.660 ac, 78.62% Impervious, Inflow Depth = 2.93" for 10-year Storm event
Inflow = 4.11 cfs @ 7.91 hrs, Volume= 1.384 af
Outflow = 0.84 cfs @ 10.93 hrs, Volume= 1.384 af, Atten= 80%, Lag= 181.5 min
Primary = 0.84 cfs @ 10.93 hrs, Volume= 1.384 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 257.37' @ 10.93 hrs Surf.Area= 9,934 sf Storage= 26,387 cf

Plug-Flow detention time= 983.0 min calculated for 1.383 af (100% of inflow)
Center-of-Mass det. time= 984.2 min (1,665.8 - 681.7)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	44,403 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
254.00	5,873	0	0
255.00	6,978	6,426	6,426
256.00	8,164	7,571	13,997
257.00	9,433	8,799	22,795
258.00	10,783	10,108	32,903
259.00	12,216	11,500	44,403

Device	Routing	Invert	Outlet Devices
#1	Primary	252.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 252.00' / 251.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	250.00'	**1.6" Vert. WQ Orifice** C= 0.600
#3	Device 1	256.72'	**4.5" Vert. 2-yr Orifice/Grate** C= 0.600
#4	Device 1	257.30'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=0.84 cfs @ 10.93 hrs HW=257.37' (Free Discharge)
└─**1=Culvert** (Passes 0.84 cfs of 6.78 cfs potential flow)
 ├─**2=WQ Orifice** (Orifice Controls 0.16 cfs @ 11.16 fps)
 ├─**3=2-yr Orifice/Grate** (Orifice Controls 0.36 cfs @ 3.28 fps)
 └─**4=Broad-Crested Rectangular Weir** (Weir Controls 0.32 cfs @ 0.75 fps)

17849 PrelimDetention

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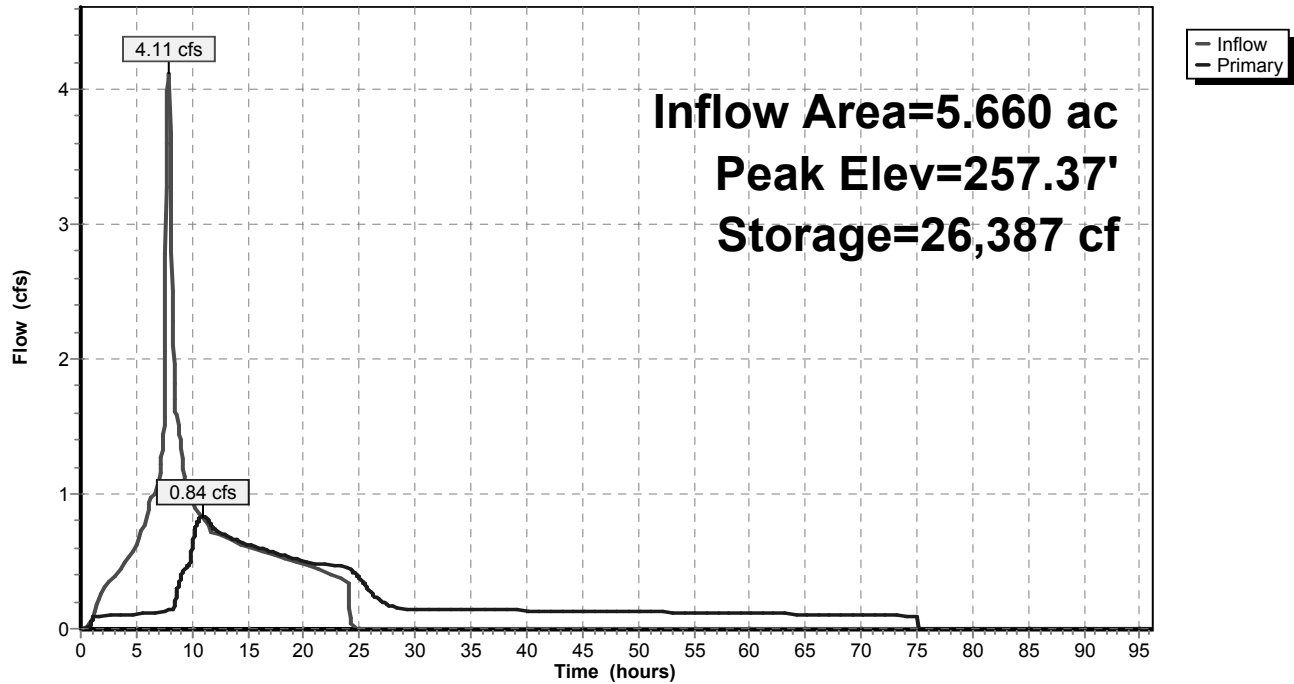
Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 10-year Storm Rainfall=3.50"
Printed 2/10/2017
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Pond 202P: P - Pond 2

Hydrograph

Inflow Area=5.660 ac
Peak Elev=257.37'
Storage=26,387 cf

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 25-year Storm Rainfall=4.00"

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Summary for Subcatchment 200S: E - Basin POC 2

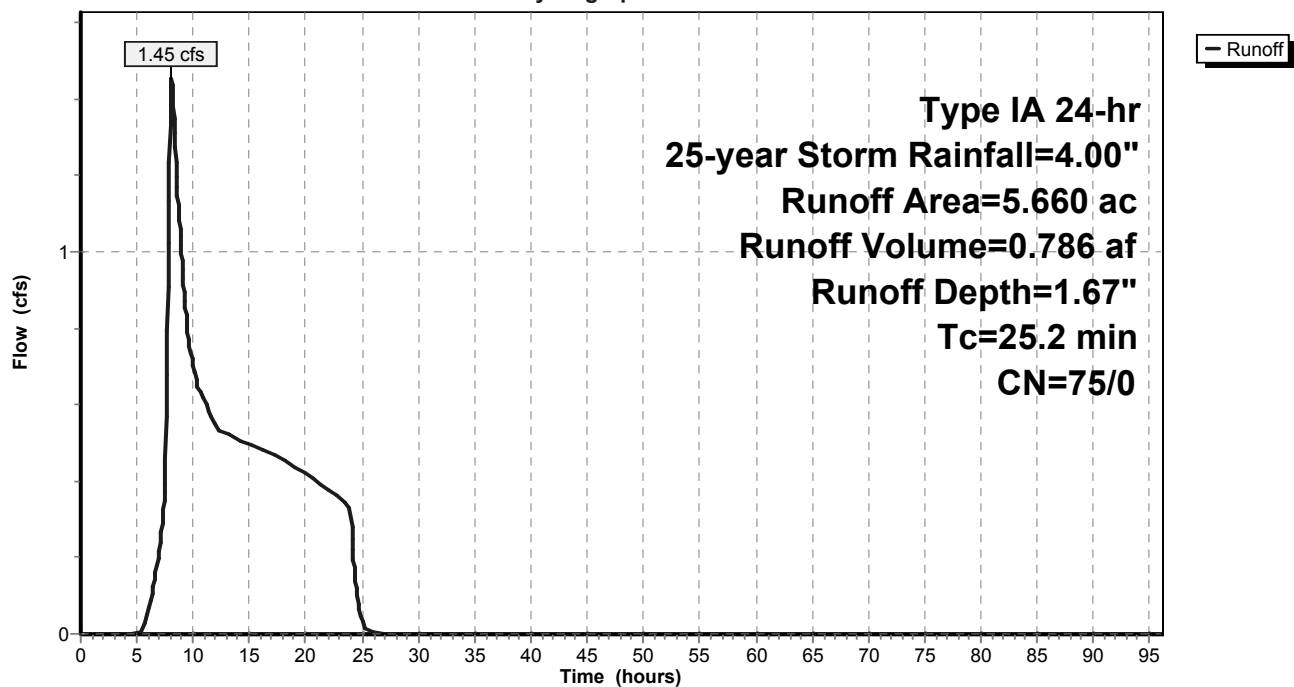Runoff   =   1.45 cfs @   8.07 hrs, Volume=   0.786 af, Depth= 1.67"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Storm Rainfall=4.00"

Area (ac)	CN	Description
* 5.660	75	Woods/grass comb., Good, HSG C/D
5.660		100.00% Pervious Area

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

Subcatchment 200S: E - Basin POC 2

Hydrograph

1.45 cfs

**Type IA 24-hr
25-year Storm Rainfall=4.00"
Runoff Area=5.660 ac
Runoff Volume=0.786 af
Runoff Depth=1.67"
Tc=25.2 min
CN=75/0**

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 25-year Storm Rainfall=4.00"
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Summary for Subcatchment 201S: P - Basins P2, Q2

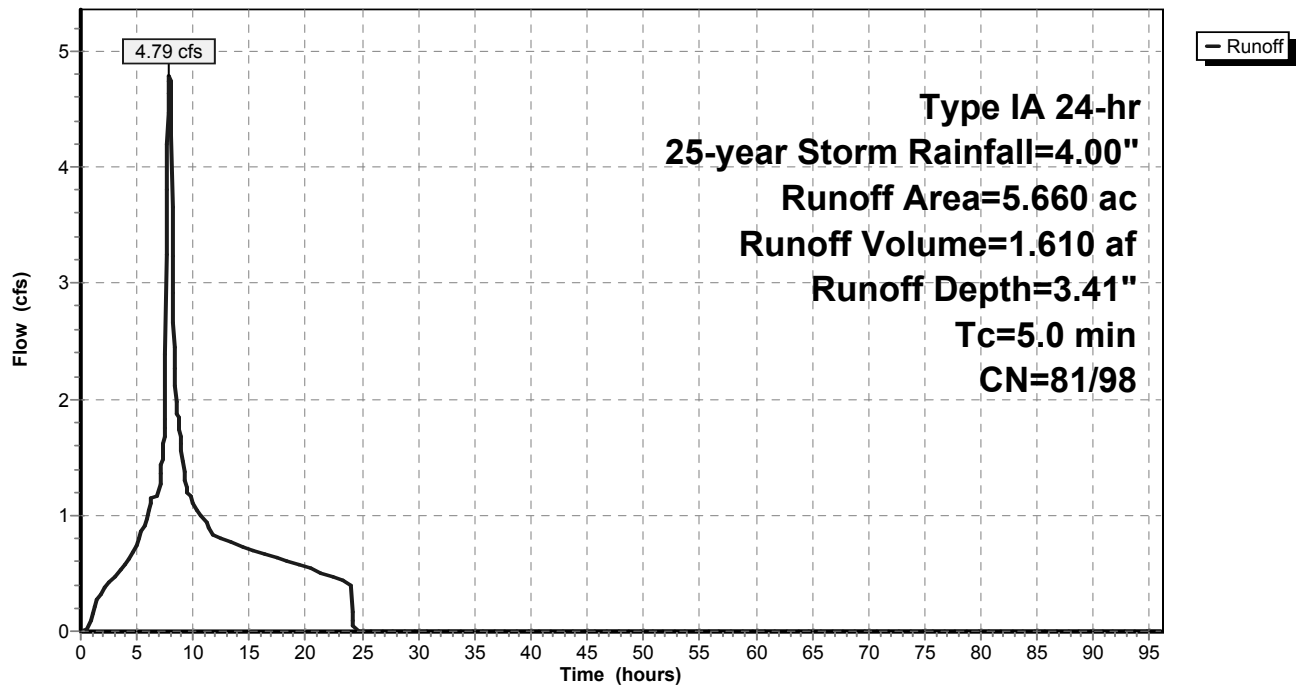Runoff   =   4.79 cfs @   7.91 hrs, Volume=   1.610 af, Depth= 3.41"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 25-year Storm Rainfall=4.00"

	Area (ac)	CN	Description
*	4.450	98	Paved roads w/curbs & sewers, HSG C/D
*	1.210	81	50-75% Grass cover, Fair, HSG C/D
	5.660	94	Weighted Average
	1.210		21.38% Pervious Area
	4.450		78.62% Impervious Area

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

Subcatchment 201S: P - Basins P2, Q2

Hydrograph

Type IA 24-hr
25-year Storm Rainfall=4.00"
Runoff Area=5.660 ac
Runoff Volume=1.610 af
Runoff Depth=3.41"
Tc=5.0 min
CN=81/98

17849 PrelimDetention
Prepared by Otak, Inc.
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Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 25-year Storm Rainfall=4.00"
Printed 2/10/2017
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Summary for Pond 202P: P - Pond 2

Inflow Area =   5.660 ac, 78.62% Impervious, Inflow Depth = 3.41"   for 25-year Storm event
Inflow   =   4.79 cfs @   7.91 hrs, Volume=   1.610 af
Outflow   =   1.38 cfs @   9.16 hrs, Volume=   1.610 af, Atten= 71%, Lag= 75.4 min
Primary   =   1.38 cfs @   9.16 hrs, Volume=   1.610 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 257.44' @ 9.16 hrs   Surf.Area= 10,021 sf   Storage= 27,033 cf

Plug-Flow detention time= 866.1 min calculated for 1.609 af (100% of inflow)
Center-of-Mass det. time= 867.4 min (1,545.6 - 678.2)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	44,403 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
254.00	5,873	0	0
255.00	6,978	6,426	6,426
256.00	8,164	7,571	13,997
257.00	9,433	8,799	22,795
258.00	10,783	10,108	32,903
259.00	12,216	11,500	44,403

Device	Routing	Invert	Outlet Devices
#1	Primary	252.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 252.00' / 251.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	250.00'	**1.6" Vert. WQ Orifice** C= 0.600
#3	Device 1	256.72'	**4.5" Vert. 2-yr Orifice/Grate** C= 0.600
#4	Device 1	257.30'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=1.38 cfs @ 9.16 hrs HW=257.44'   (Free Discharge)
└—**1=Culvert** (Passes 1.38 cfs of 6.82 cfs potential flow)
  ├—**2=WQ Orifice** (Orifice Controls 0.16 cfs @ 11.23 fps)
  ├—**3=2-yr Orifice/Grate** (Orifice Controls 0.39 cfs @ 3.50 fps)
  └—**4=Broad-Crested Rectangular Weir** (Weir Controls 0.84 cfs @ 1.03 fps)

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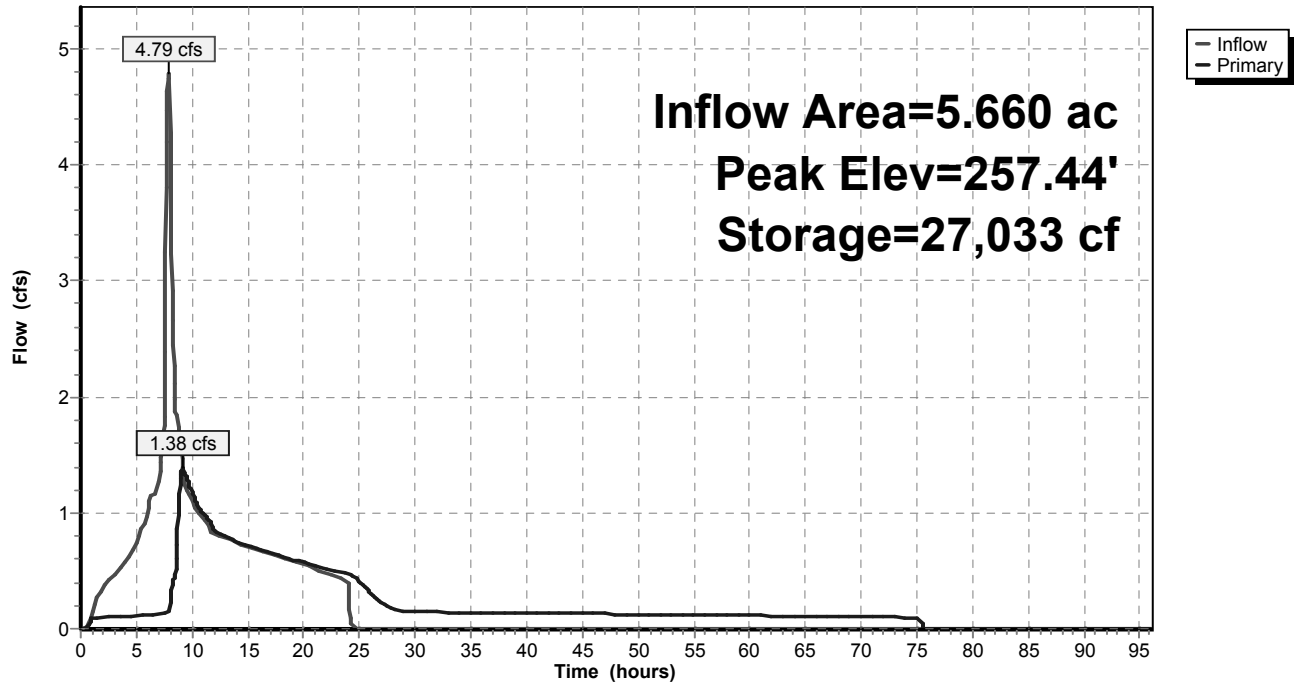HydroCAD® 10.00-14 s/n 05775 © 2015 HydroCAD Software Solutions LLC

Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 25-year Storm Rainfall=4.00"
Printed 2/10/2017
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Pond 202P: P - Pond 2

Hydrograph

Inflow Area=5.660 ac
Peak Elev=257.44'
Storage=27,033 cf

4.79 cfs

1.38 cfs

Flow (cfs)

Time (hours)

— Inflow
— Primary

17849 PrelimDetention

Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 100-year Storm Rainfall=4.50"

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Summary for Subcatchment 200S: E - Basin POC 2

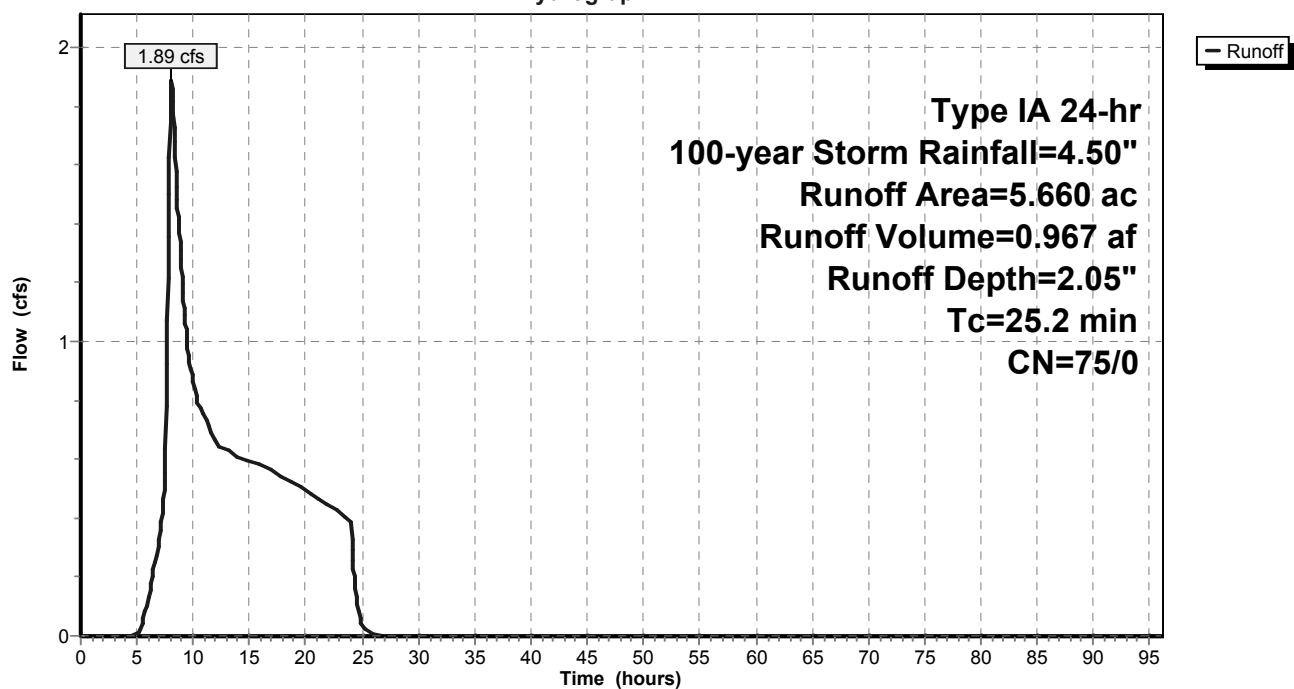Runoff = 1.89 cfs @ 8.06 hrs, Volume= 0.967 af, Depth= 2.05"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

	Area (ac)	CN	Description
*	5.660	75	Woods/grass comb., Good, HSG C/D
	5.660		100.00% Pervious Area

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

Subcatchment 200S: E - Basin POC 2

Hydrograph

Type IA 24-hr
100-year Storm Rainfall=4.50"
Runoff Area=5.660 ac
Runoff Volume=0.967 af
Runoff Depth=2.05"
Tc=25.2 min
CN=75/0

17849 PrelimDetention

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Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 100-year Storm Rainfall=4.50"
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Summary for Subcatchment 201S: P - Basins P2, Q2

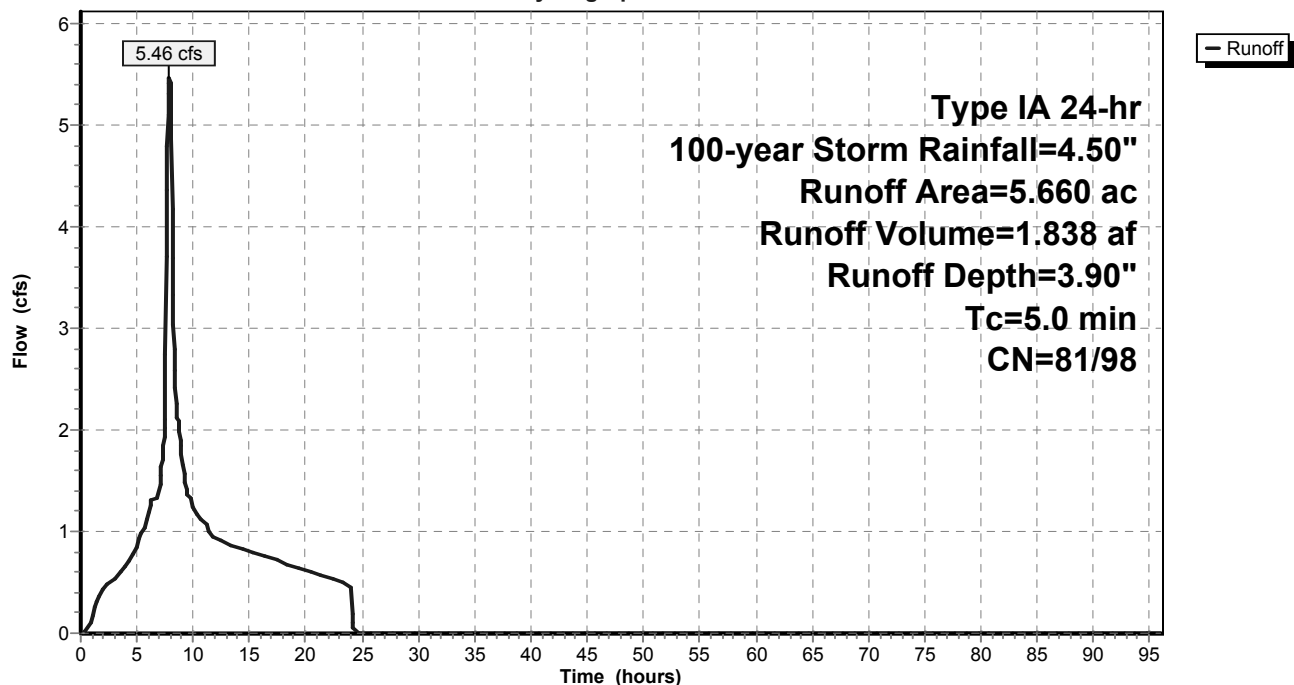Runoff   =   5.46 cfs @   7.91 hrs, Volume=   1.838 af, Depth= 3.90"

Runoff by SBUH method, Split Pervious/Imperv., Time Span= 0.00-96.00 hrs, dt= 0.05 hrs
Type IA 24-hr 100-year Storm Rainfall=4.50"

	Area (ac)	CN	Description
*	4.450	98	Paved roads w/curbs & sewers, HSG C/D
*	1.210	81	50-75% Grass cover, Fair, HSG C/D
	5.660	94	Weighted Average
	1.210		21.38% Pervious Area
	4.450		78.62% Impervious Area

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

Subcatchment 201S: P - Basins P2, Q2

Hydrograph

Ridge at South Cooper Mountain - POC 2

17849 PrelimDetention
Type IA 24-hr 100-year Storm Rainfall=4.50"
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Summary for Pond 202P: P - Pond 2

Inflow Area =   5.660 ac, 78.62% Impervious, Inflow Depth = 3.90"   for 100-year Storm event
Inflow   =   5.46 cfs @   7.91 hrs, Volume=   1.838 af
Outflow   =   2.17 cfs @   8.49 hrs, Volume=   1.838 af, Atten= 60%, Lag= 34.8 min
Primary   =   2.17 cfs @   8.49 hrs, Volume=   1.838 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-96.00 hrs, dt= 0.05 hrs / 3
Peak Elev= 257.51' @ 8.49 hrs   Surf.Area= 10,120 sf   Storage= 27,768 cf

Plug-Flow detention time= 771.1 min calculated for 1.837 af (100% of inflow)
Center-of-Mass det. time= 772.4 min (1,447.7 - 675.3)

Volume	Invert	Avail.Storage	Storage Description
#1	254.00'	44,403 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
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259.00	12,216	11,500	44,403

Device	Routing	Invert	Outlet Devices
#1	Primary	252.00'	**12.0" Round Culvert** L= 100.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 252.00' / 251.00' S= 0.0100 '/' Cc= 0.900 n= 0.013, Flow Area= 0.79 sf
#2	Device 1	250.00'	**1.6" Vert. WQ Orifice** C= 0.600
#3	Device 1	256.72'	**4.5" Vert. 2-yr Orifice/Grate** C= 0.600
#4	Device 1	257.30'	**6.0' long x 0.5' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 Coef. (English) 2.80 2.92 3.08 3.30 3.32

Primary OutFlow Max=2.17 cfs @ 8.49 hrs HW=257.51'   (Free Discharge)
└─**1=Culvert** (Passes 2.17 cfs of 6.87 cfs potential flow)
  ├─**2=WQ Orifice** (Orifice Controls 0.16 cfs @ 11.30 fps)
  ├─**3=2-yr Orifice/Grate** (Orifice Controls 0.41 cfs @ 3.73 fps)
  └─**4=Broad-Crested Rectangular Weir** (Weir Controls 1.60 cfs @ 1.28 fps)

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Ridge at South Cooper Mountain - POC 2
Type IA 24-hr 100-year Storm Rainfall=4.50"
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Pond 202P: P - Pond 2

Hydrograph

Inflow Area=5.660 ac
Peak Elev=257.51'
Storage=27,768 cf