PRELIMINARY DRAINAGE REPORT

For

Wren Heights Subdivision

Jim Seely
Encore Development LLC
941 Player Drive N.
Keizer, OR 97307

Prepared for:

City of Salem
555 Liberty St SE
Salem, OR 97301

Date:
December 2016

Site Location:
500, 525, 575, 625 Salem Heights Avenue
083W04AA 10400, 10500, 10601,10600, 10700, 10800

Prepared by:

Project Delivery Group, LLC
3772 Portland Road NE
Salem, Oregon 97301

Table of Contents

Project Overview and Description

Size and Location of Project

The proposed project is approximately 9.1 acres in size not including the right-of-way for Salem Heights Avenue and is located at addresses 500, 525, 575, 625 Salem Heights Avenue in Salem, Oregon in Marion County. Refer to the preliminary drawings for the site map.

Brief Description of Project Scope and Proposed Improvements

The project consists of a 36-Lot residential subdivision and a single lot for a detention pond with water quality swale. The subdivision with include public streets and public utilities. The project is being designed to 2014 City of Salem Stormwater Design Standards. The development incorporates storm laterals and grassy swales through some of the lots backyards, which will accept roof and landscape runoff from the lots and a Dry Detention Pond containing a Vegetated Swale sized to detain and treat the applicable storm events.

The stormwater design for the site is in conformance with the 2014 City of Salem Stormwater Design Standards for volume based facilities. The Drainage Map is included in Appendix A of this document.

Description and size of the watershed draining to the site

The site is located in Salem along the north side of Salem Heights Avenue. The site slopes downhill from Salem Heights Avenue in a Northeasterly direction with grades of approximately 2% to a maximum of 20%. The site contains two single family residences with associated landscaping that will remain. The remainder of the site is lightly forested with trees and light underbrush. The watershed consists of generally only the site area, but there is a small area of off-site stormwater runoff that flows onto the site along the west side of the subdivision. The off-site area will flow onto the new portion of Felton Street and flow north onto the existing portion of Felton Street. In addition, there is approximately 150 lineal feet of Felton Street to be constructed as part of this development that will naturally slope to the north and onto the existing portion of Felton Street. This area of Felton Street will drain to the existing catch basins on Missouri Avenue. In addition, the roof drains from Lot 24 will drain through weep holes onto Earhart Street. All remaining areas of the site will be conveyed to the dry detention pond and the vegetated swale, including the future road improvements to Salem Heights Avenue.

Summary of the manner in which existing trees and native vegetation are impacted and/or preserved

The site is vacant, except for the 2 single family residences mentioned earlier in this report. The site contains approximately 191 trees, native and non-native vegetation, and a variety of field grasses. As a result of the required site grading due to topographic constraints of the site, as well as the type and condition of the existing trees, we are proposing preservation of approximately 69 (36%) of the trees. See the Tree Conservation Plan and application for proposed tree conservation.

Summary of the extent in which MEF criteria are met

This project is classified as a Large Project because of land disturbance over 10,000 square feet in area. Large projects are required to use GSI/MEF to meet flow control and treatment performance standards. Green Stormwater Infrastructure (GSI) consisting of the use of a Vegetated Swale will be used to meet the GSI/MEF criteria. A Vegetated Swale, which is a form of GSI will be used to provide water quality treatment per section 4.4 (b) of the 2014 City of Salem Stormwater Design Standards.

A dry detention pond will be used for Flow Control per section 4.5(b)(3) of the 2014 City of Salem Stormwater Design Standards. Due to the type of soil at the site, infiltration is not feasible.

Regulatory permits required

A 1200-C permit from the Oregon Department of Environmental Quality (DEQ) is required along with City of Salem permits. There are not any environmental constraints on the site or any wetlands; therefore, no additional regulatory permits are required.

Escape route for the 100-year storm

The escape route for the stormwater runoff from the site due to a 100-year storm event will be via the overflow weir in the detention pond, which will discharge into the downstream conveyance system.

Methodology

Depth to Groundwater

A geotechnical report is being completed for the site. Groundwater encounters and applicable depths to groundwater will be included after completion of the geotechnical report.

Delineation of existing trees and native vegetation

The site is vacant and has 191 trees, native and non-native vegetation, and a variety of field grasses. As a result of the required site grading due to topographic constraints of the site, as well as the type and condition of the existing trees, we are proposing preservation of approximately 69 (36%) of the trees. See the Tree Conservation Plan and application for proposed tree conservation.

Demonstration of maximized infiltration and vegetative treatment - attached infiltration testing results

Infiltration testing is currently being performed at the site by the geotechnical engineer. Results will be included in this report after completion of the testing. It is anticipated that infiltration at the site will not be feasible due to the soil type at the site; therefore infiltration analysis is not included in this report.

Description of soil types and any other geologic features impacting stormwater infrastructure design

Per the Natural Resource Conservation Service (NRCS) Soil Survey, the site consists of NeB Nekia Silty Clay Loam 2% - 7% slopes, hydrologic soil group C, NeC Nekia Silty Clay Loam 7% - 12% slopes, hydrologic soil group C and NeD Nekia Silty Clay Loam 12% - 20% slopes, hydrologic soil group C. See Appendix B for the NRCS soils report for this site. There are not any other geological features impacting stormwater infrastructure design for the site. However, once the geotechnical investigation is completed at the site, it will be confirmed whether or not bedrock exists and if it may impact the design.

Identification of any hazardous materials based on past use of the project site

No hazardous materials are expected on this site.

Analysis

Computational methods utilized and software utilized

In accordance with City of Salem 2014 Stormwater Design Standards, the TR-55 method Hydrograph Type 1A, 24-hour Storm was used to model the required design storms. HydroCAD modeling software was used to size the stormwater facilities. The design storms used were:

- Salem water quality storm (1.38 inches)
- 2 year 24 hour storm (2.2 inches)
- 10 year 24 hour storm (3.2 inches)
- 100 year 24 hour storm (4.4 inches)

Design assumptions

It is assumed that there are no downstream capacity problems in the existing system in Cooke Street and Doughton Street. The vegetated swale is incorporated into the dry detention pond and is located at an elevation above the water surface level in the detention pond during a water quality storm event. This allows the swale to function as designed during the water quality storm event. Landscaping of the pond and the vegetated swale will be as required in the 2014 City of Salem Stormwater Design Standards, Section 4B.7(b) for vegetated swales utilized in conjunction with dry detention ponds.

Hydrology calculations

See HydroCAD calculations in Appendix C.

Conveyance capacity calculations

Pipe conveyance calculations are included in Appendix D. Pipe conveyance calculations are based on the 10-year storm event for local streets as required in the 2014 City of Salem Stormwater Design Standards. The overflow piping from the dry detention pond is designed based on the 100-year storm event.

Treatment and flow control sizing calculations

Vegetated Swale and Dry Detention Pond

Data for treatment and flow control as requested in the 2014 Design Standards are shown below in Table 1. The following summary describes the treatment and flow control facilities designed for the site.

In conformance with the 2014 Design Standards, the combined treatment and flow control facilities for the site are sized to function based on one-half of the post-development peak runoff rate of the two-year storm being equal to or less than one-half of the peak runoff rate of the pre-developed two-year, 24-hour storm; and the peak runoff rate of the post-development ten-year, 24-hour storm being equal to or less than the peak runoff rate of the pre-developed ten-year, 24-hour storm event. In addition, because the site utilizes a dry detention pond for flow control, which is considered a volume based facility, the detention pond will be sized to detain up to the 100-year storm event. A flow control structure will be installed at the outfall from the detention pond to control discharge based on the pre-developed conditions for the design storm events. See Appendix C for Orifice Sizing.

The Vegetated swale is designed to treat the runoff from a water quality storm event without over topping of the swale banks. Water depth and residence time in the swale conforms to the requirements in Section 4.4(b)(2). See Appendix C for the water quality calculations for the site.

See Appendix C for the detention calculations for the site.

Table 1: Catchment and Facility Table

Catchment/ Facility ID	Source (roof/road/other)	Impervious Area (AC)	Pervious Area (AC)	Ownership (Private/Public)	Facility Type	Facility Size	Weighted Curve Number
Vegetated Swale	Pavement, Roof, Drives, Sidewalk & Landscaping	3.40	5.55	Public	Vegetated Swale	100 L.F.	N/A
Dry Detention Pond	Pavement, Roof, Drives, Sidewalk & Landscaping	3.40	5.55	Public	Dry Detention Pond	15,986 C.F.	83

Table source: HydroCAD calculations, Appendix C

The Pre and Post Construction Flow Rates for the site are shown below in Table 2. As can be seen below in the Table 2 data, the Post Construction Flow Rates for the site do not exceed the Pre Developed Flow Rates for the site based on the city required storm events. The stormwater facilities for this site have been designed to detain and provide treatment of the stormwater runoff. The Pre-Developed and Post-Developed runoff CN used for the site is based on Appendix D of the 2014 City of Salem Stormwater Design Standards:

- ¼ acre Residential (Hydrologic Soil Group C) CN=83
- City of Salem Pre-Development (Hydrologic Soil Group C) CN=72

Table 2: Pre vs. Post Construction Flow Rates

Facility ID	2 Year Storm				
Project Site	**Pre-Peak (cfs)**	**One-Half of 2 Yr Pre-Peak (cfs)**	**Post Before Detention (cfs)**	**One-Half of 2 Yr Post-Peak (cfs)**	**Post After Detention (cfs)**
	0.23	**0.12**	1.56	**0.78**	**0.12**
	10 Year Storm				
	Pre-Peak (cfs)	**Post Before Detention (cfs)**		**Post After Detention (cfs)**	
	1.15	3.41		**1.15**	
	100 Year Storm				
	Pre-Peak (cfs)	**Post Before Detention (cfs)**		**Post After Detention (cfs)**	
	2.76	5.90		**2.77**	

Table source: HydroCAD calculations, Appendix C

Table 3 shows the orifice sizes and elevations for the detention pond flow control structure. The elevations shown in this report in Table 3 are assumed elevations, which were used in the modeling.

Table 3: Orifice Sizes for Flow Control Structure

Facility ID	One-Half of 2 Yr Pre- Peak			10 Yr Pre Peak			100 Yr Pre Peak		
Structure I.D.	Orifice Size Dia. (Inches)	Orifice Elev. (Ft)*	Discharge (cfs)	Orifice Size Dia. (Inches)	Orifice Elev. (Ft)*	Discharge (cfs)	Orifice Size Dia. (Inches	Orifice Elev. (Ft)*	Discharge (cfs)
Detention Pond	1.6	391.10	0.12	6.6	394.17	1.15	6.4	394.98	2.77

*** Elevations** *are assumed based on Top of pond elevation of 396'*

GSI Analysis

Implementation of GSI to Maximum Extent Feasible

This project implements Green Stormwater Infrastructure (GSI) to at least 80% of the Maximum Extent Feasible (MEF).

Stormwater Facility Details/Exhibits

See Drainage Map in Appendix A.

Source Control / Downstream Analysis Report / Open Channel Hydraulic Modeling / Floodway and Floodplain Analysis

Source control, downstream analysis, open channel hydraulic modeling, and floodway and floodplain analysis are not required for this project. Potential pollution sources are expected to be those typical for residential developments. A downstream analysis report is not expected to be a concern since the stormwater runoff from this site is being limited to match the Pre-Developed flow rates. There are no significant open channels in the vicinity of the project which require modeling for downstream analysis purposes. No floodway or floodplain analysis will be required for this project since the property is not in a mapped FEMA floodplain.

Conclusion

The stormwater treatment and flow control for the site have been designed and sized to be in compliance with the 2014 City of Salem Stormwater Design Standards.

Flow control for the site is designed and sized so that the entire site is in compliance with the city standards of one-half of the post-development peak runoff rate of the two-year storm being equal to or less than one-half of the peak runoff rate of the pre-developed two-year, 24-hour storm; and the peak runoff rate of the post-development ten-year, 24-hour storm being equal to or less than the peak runoff rate of the pre-developed ten-year, 24-hour storm event. In addition, because the site utilizes a dry detention pond for flow control, which is considered a volume based facility, the detention pond will be sized to detain up to the 100-year storm event.

Water quality treatment for the site is provided through the use of a Vegetated Swale.

Appendix A—Drainage Map

PREPARED BY:

PROJECT DELIVERY GROUP
Engineers | Land Surveyors | Project Managers

REGISTERED PROFESSIONAL ENGINEER
16670PE
OREGON
JULY 20, 1993
DAVID CHARLES NICHOLS
REVIEW

DATE SIGNED:

PREPARED FOR:
ENCORE DEVELOPMENT, LLC

941 Player Drive N

REVISIONS

NO.	DESCRIPTION	DATE	BY

PROJECT NO:	15128
HORIZ DATUM:	NAD83 (2011)
VERT DATUM:	NAVD 1988
HORIZ SCALE:	AS SHOWN
VERT SCALE:	AS SHOWN
DESIGN:	DN
DRAWN:	SS
CHECKED:	----
APPROVED:	

SHEET TITLE

DRAINAGE MAP

EXH-0.01

P:\2015 Projects\15128 Salem Heights Subdivision\The CAD\Civil\Tentative Subdivision Plan\15128 Drainage Basins.dwg 7/29/2016 11:20:10 AM

APPENDIX B— NRCS SOILS REPORT

Soil Map—Marion County Area, Oregon

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- 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 1:20,000.

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: Marion County Area, Oregon
Survey Area Data: Version 12, 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: Jun 15, 2015—Jun 23, 2015

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

Marion County Area, Oregon (OR643)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
NeB	Nekia silty clay loam, 2 to 7 percent slopes	28.8	57.5%
NeC	Nekia silty clay loam, 7 to 12 percent slopes	12.7	25.3%
NeD	Nekia silty clay loam, 12 to 20 percent slopes	8.6	17.2%
Totals for Area of Interest		**50.0**	**100.0%**

Marion County Area, Oregon

NeB—Nekia silty clay loam, 2 to 7 percent slopes

Map Unit Setting

National map unit symbol: 24qt
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: All areas are prime farmland

Map Unit Composition

Nekia and similar soils: 85 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 2 to 7 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

Minor Components

Aquults

Percent of map unit: 2 percent
Landform: Hills

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 12, Sep 18, 2015

Marion County Area, Oregon

NeC—Nekia silty clay loam, 7 to 12 percent slopes

Map Unit Setting

National map unit symbol: 24qv
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nekia and similar soils: 86 percent
Minor components: 2 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 7 to 12 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C
Other vegetative classification: Well drained < 15% Slopes (G002XY002OR)

Minor Components

Aquults

Percent of map unit: 2 percent
Landform: Hills

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 12, Sep 18, 2015

Marion County Area, Oregon

NeD—Nekia silty clay loam, 12 to 20 percent slopes

Map Unit Setting

National map unit symbol: 24qw
Elevation: 300 to 1,000 feet
Mean annual precipitation: 40 to 60 inches
Mean annual air temperature: 52 to 54 degrees F
Frost-free period: 190 to 210 days
Farmland classification: Farmland of statewide importance

Map Unit Composition

Nekia and similar soils: 90 percent
Estimates are based on observations, descriptions, and transects of the mapunit.

Description of Nekia

Setting

Landform: Hills
Landform position (two-dimensional): Footslope
Landform position (three-dimensional): Base slope
Down-slope shape: Linear
Across-slope shape: Linear
Parent material: Residuum weathered from tuffs and basalt

Typical profile

H1 - 0 to 9 inches: silty clay loam
H2 - 9 to 36 inches: clay
H3 - 36 to 40 inches: unweathered bedrock

Properties and qualities

Slope: 12 to 20 percent
Depth to restrictive feature: 20 to 40 inches to lithic bedrock
Natural drainage class: Well drained
Capacity of the most limiting layer to transmit water (Ksat): Moderately high (0.20 to 0.57 in/hr)
Depth to water table: More than 80 inches
Frequency of flooding: None
Frequency of ponding: None
Available water storage in profile: Low (about 5.2 inches)

Interpretive groups

Land capability classification (irrigated): 3e
Land capability classification (nonirrigated): 3e
Hydrologic Soil Group: C

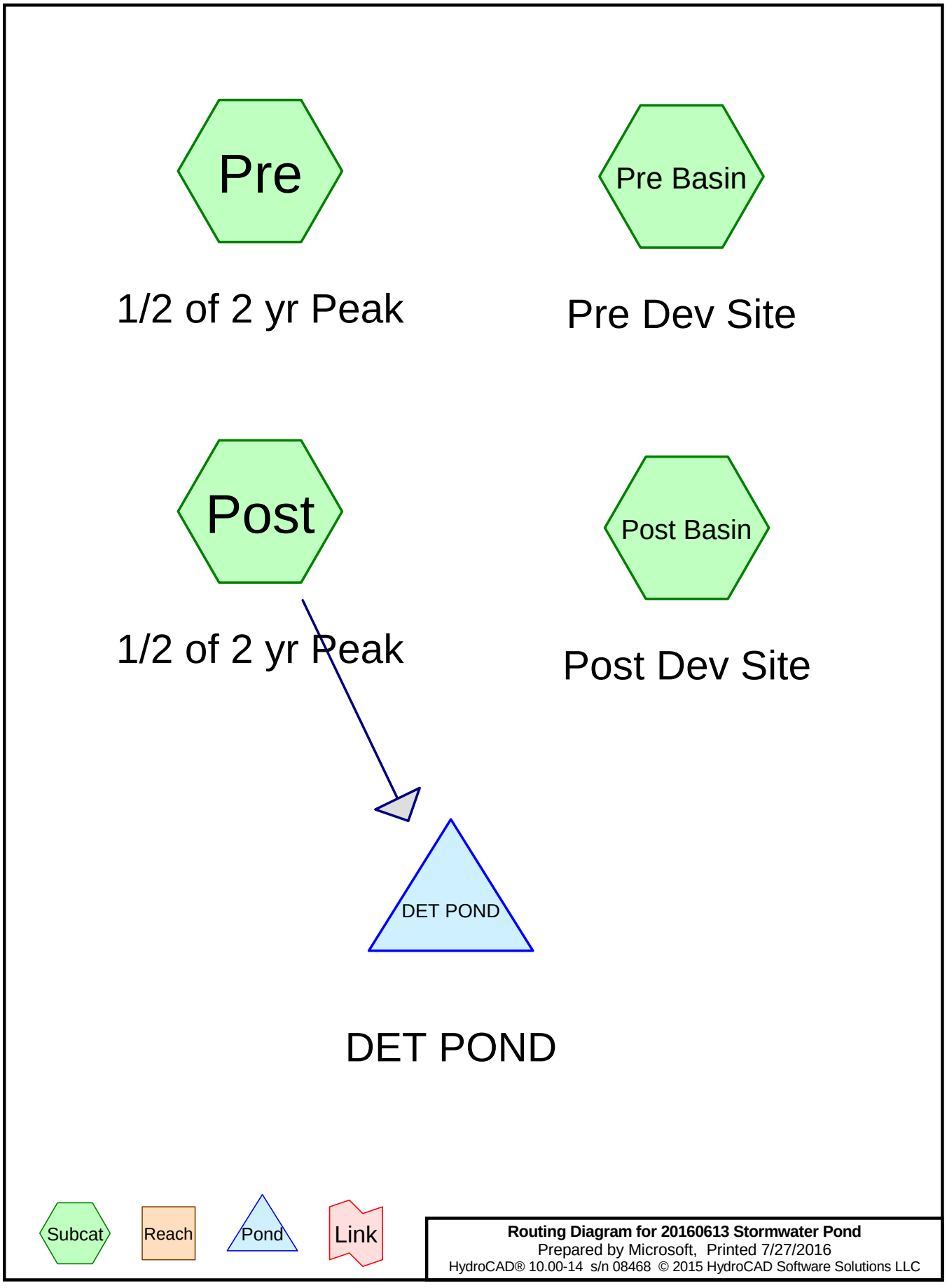
Other vegetative classification: Well Drained > 15% Slopes (G002XY001OR)

Data Source Information

Soil Survey Area: Marion County Area, Oregon
Survey Area Data: Version 12, Sep 18, 2015

APPENDIX C – HYDROCAD ANALYSIS RESULTS

Detention
Pre & Post Development of 50% of 2-Year Peak



Routing Diagram for 20160613 Stormwater Pond
Prepared by Microsoft, Printed 7/27/2016

Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post: 1/2 of 2 yr Peak Runoff Area=4.480 ac 38.00% Impervious Runoff Depth=0.84"
Flow Length=700' Slope=0.1000 '/' Tc=7.8 min CN=83 Runoff=0.78 cfs 0.312 af

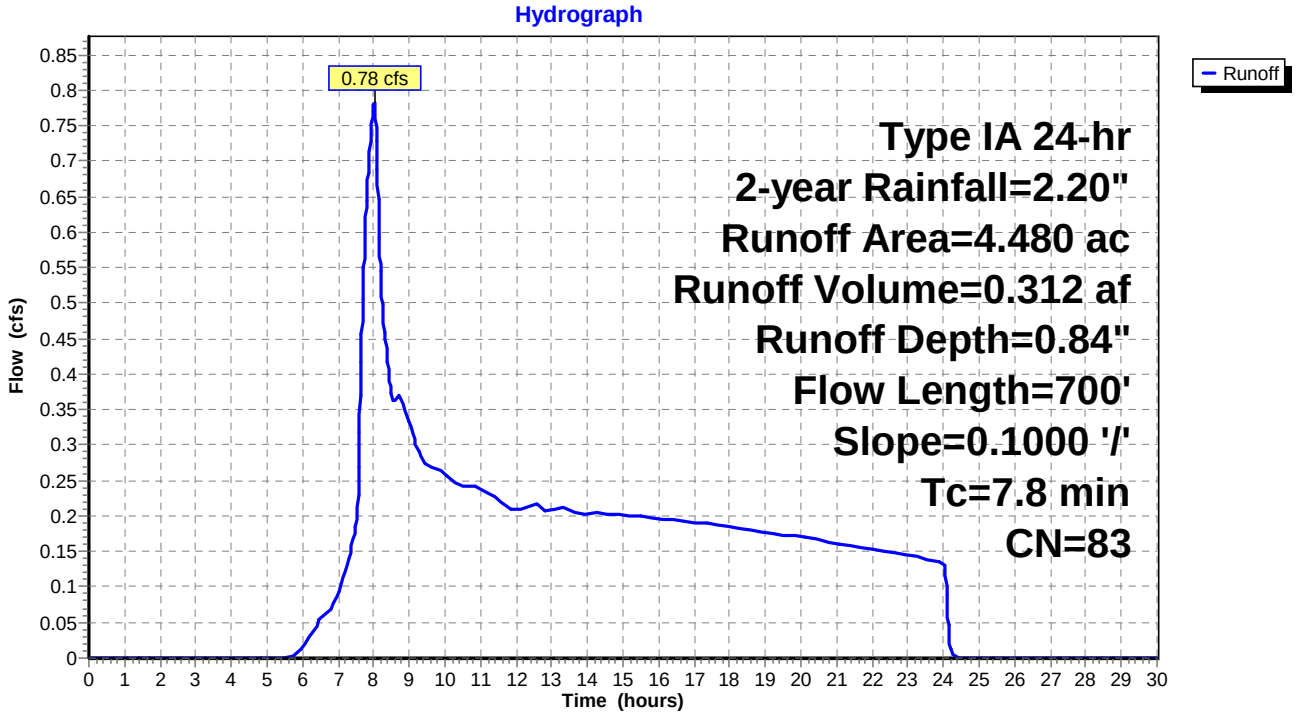
Subcatchment Post Basin: Post Dev Site Runoff Area=8.950 ac 38.00% Impervious Runoff Depth=0.84"
Flow Length=700' Slope=0.1000 '/' Tc=7.8 min CN=83 Runoff=1.56 cfs 0.623 af

Subcatchment Pre: 1/2 of 2 yr Peak Runoff Area=4.480 ac 0.00% Impervious Runoff Depth=0.38"
Flow Length=600' Slope=0.1500 '/' Tc=29.7 min CN=72 Runoff=0.12 cfs 0.142 af

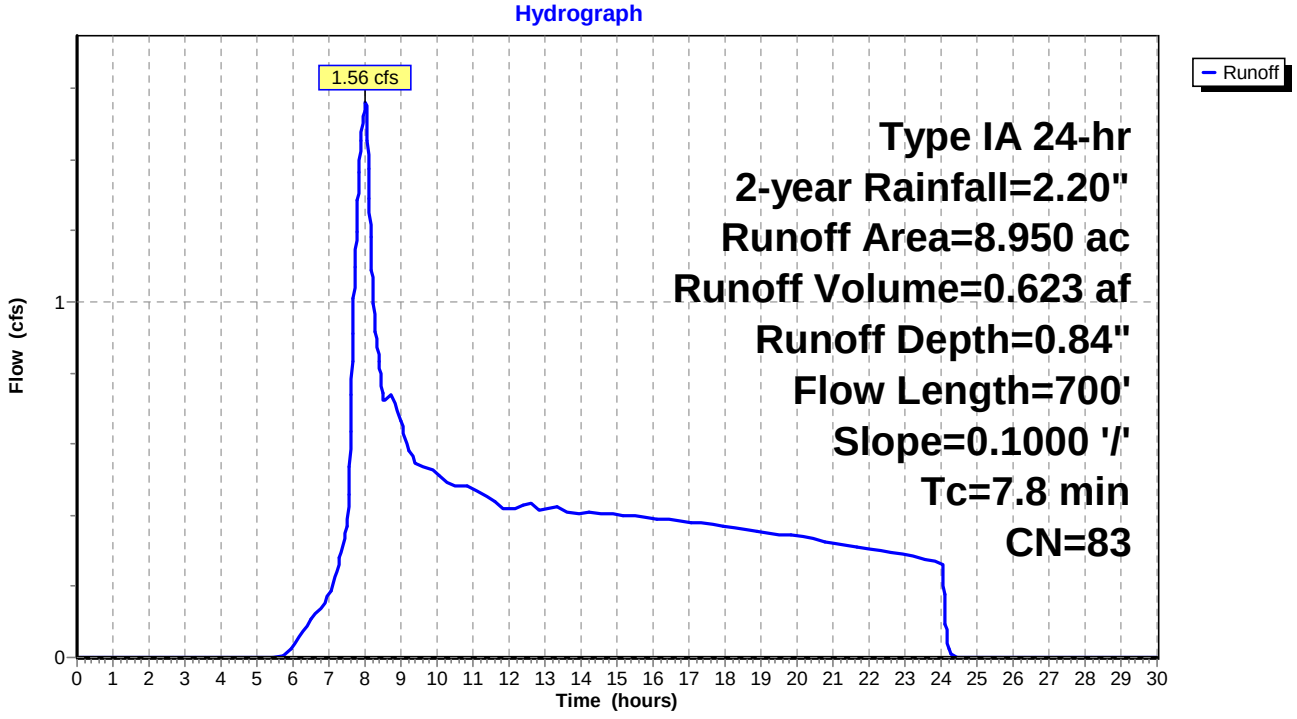
Subcatchment Pre Basin: Pre Dev Site Runoff Area=8.950 ac 0.00% Impervious Runoff Depth=0.38"
Flow Length=600' Slope=0.1500 '/' Tc=29.7 min CN=72 Runoff=0.23 cfs 0.284 af

Pond DET POND: DET POND Peak Elev=394.16' Storage=7,395 cf Inflow=0.78 cfs 0.312 af
Primary=0.12 cfs 0.196 af Secondary=0.00 cfs 0.000 af Tertiary=0.00 cfs 0.000 af Outflow=0.12 cfs 0.196 af

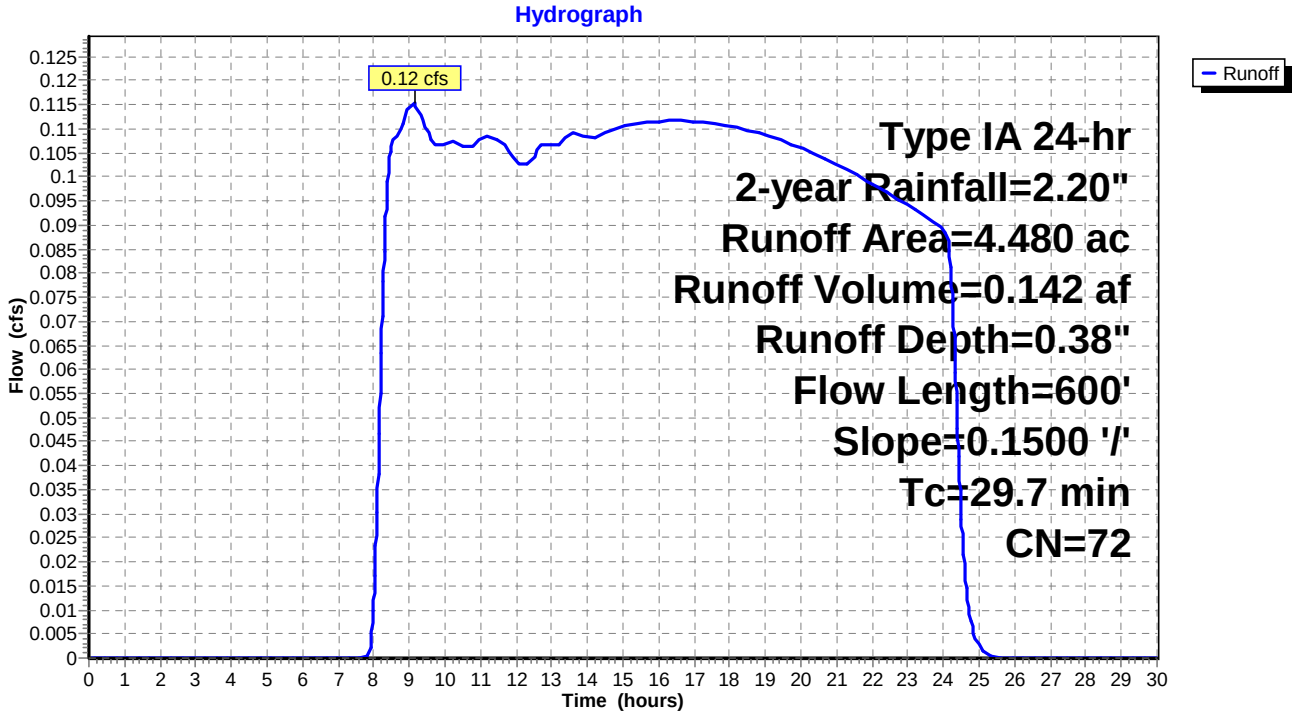
Subcatchment Post: 1/2 of 2 yr Peak



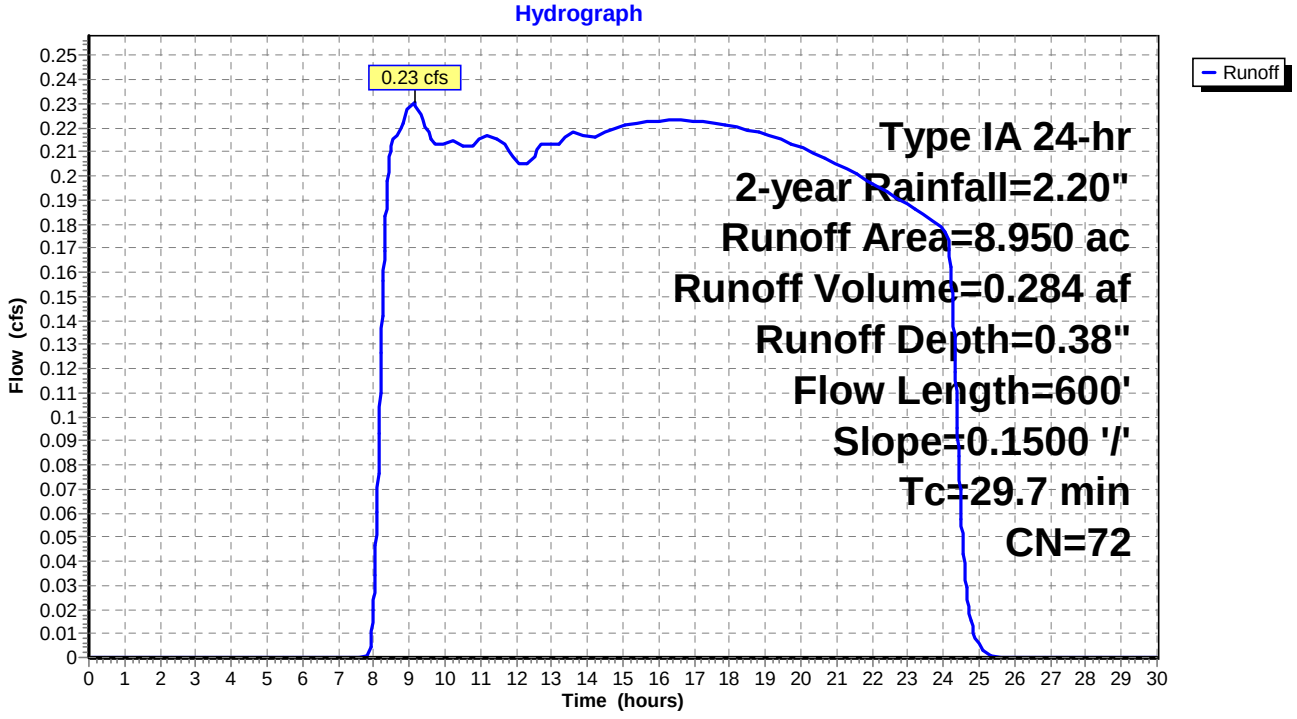
Subcatchment Post Basin: Post Dev Site



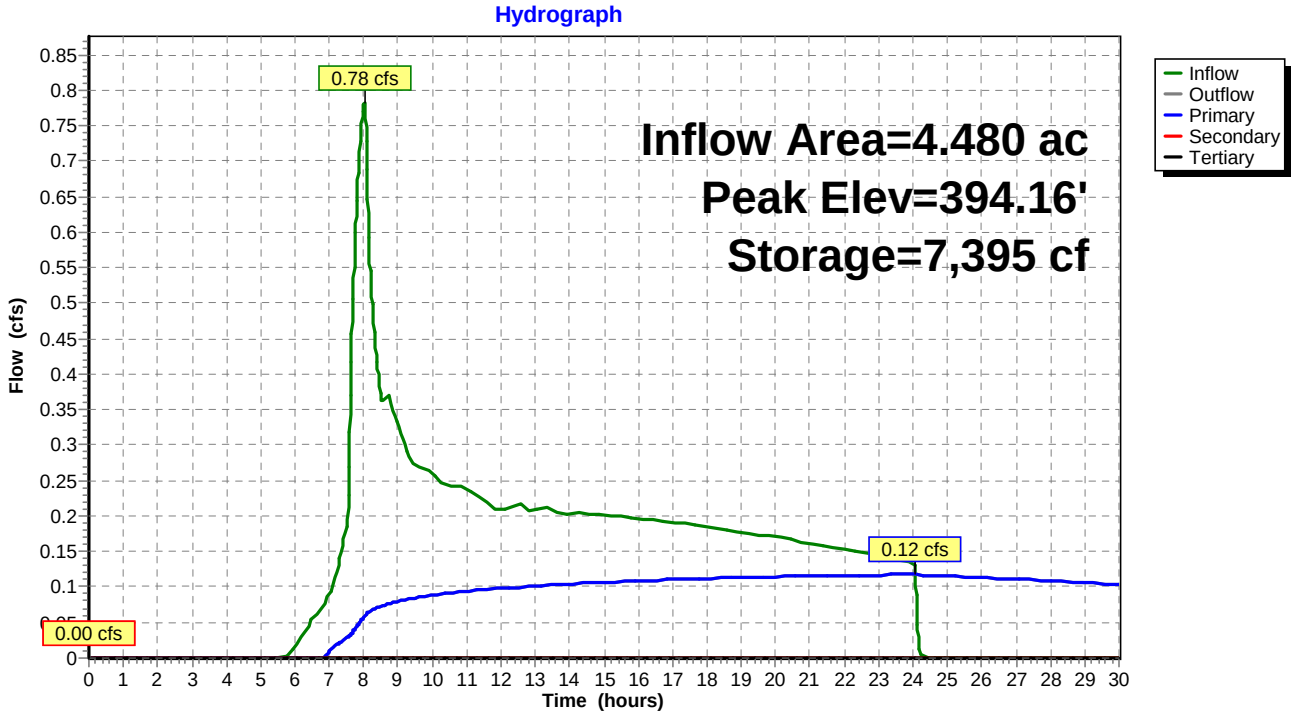
Subcatchment Pre: 1/2 of 2 yr Peak



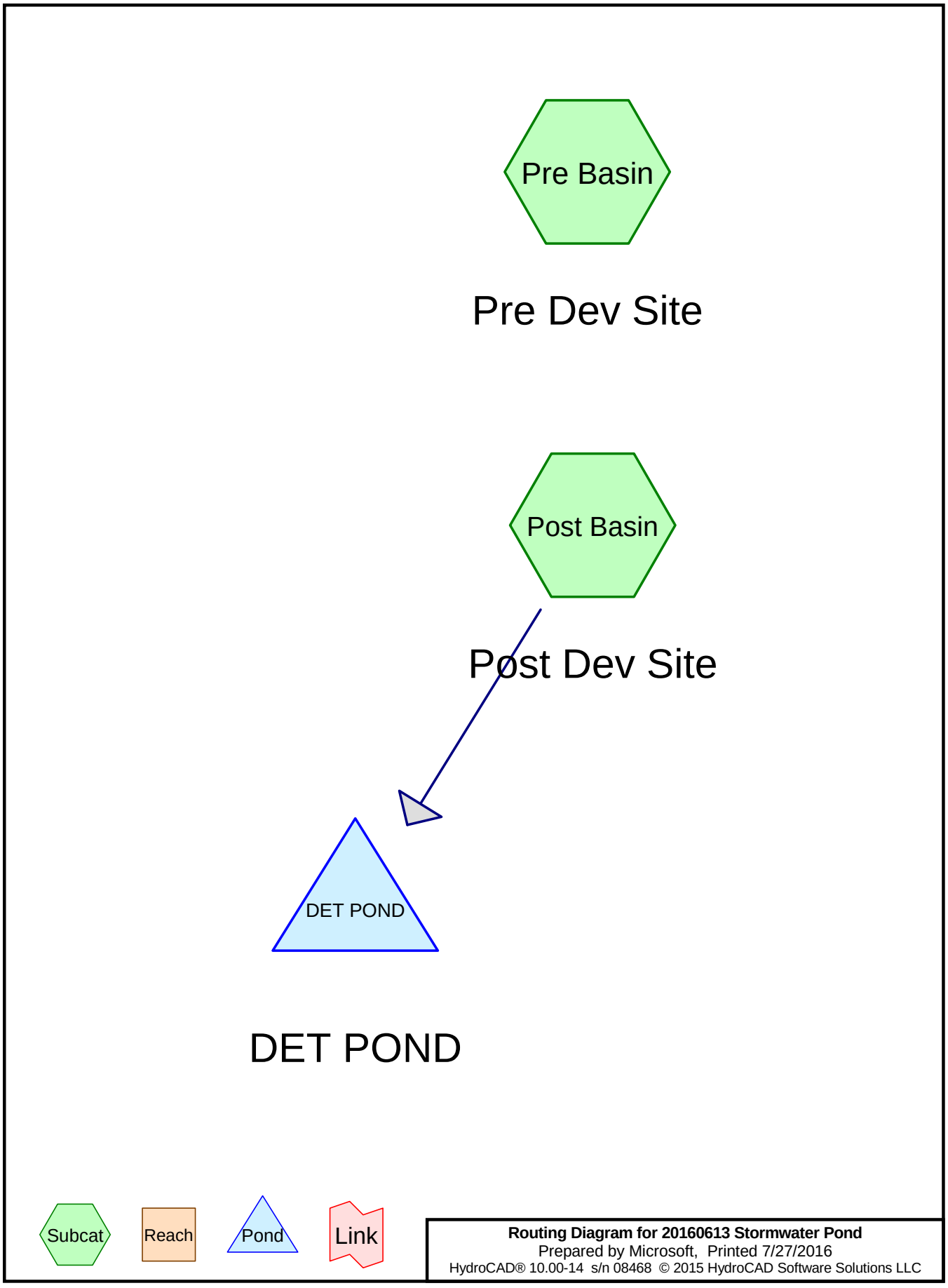
Subcatchment Pre Basin: Pre Dev Site



Pond DET POND: DET POND



Detention
Pre & Post Development of 10-Year Peak



Routing Diagram for 20160613 Stormwater Pond
Prepared by Microsoft, Printed 7/27/2016

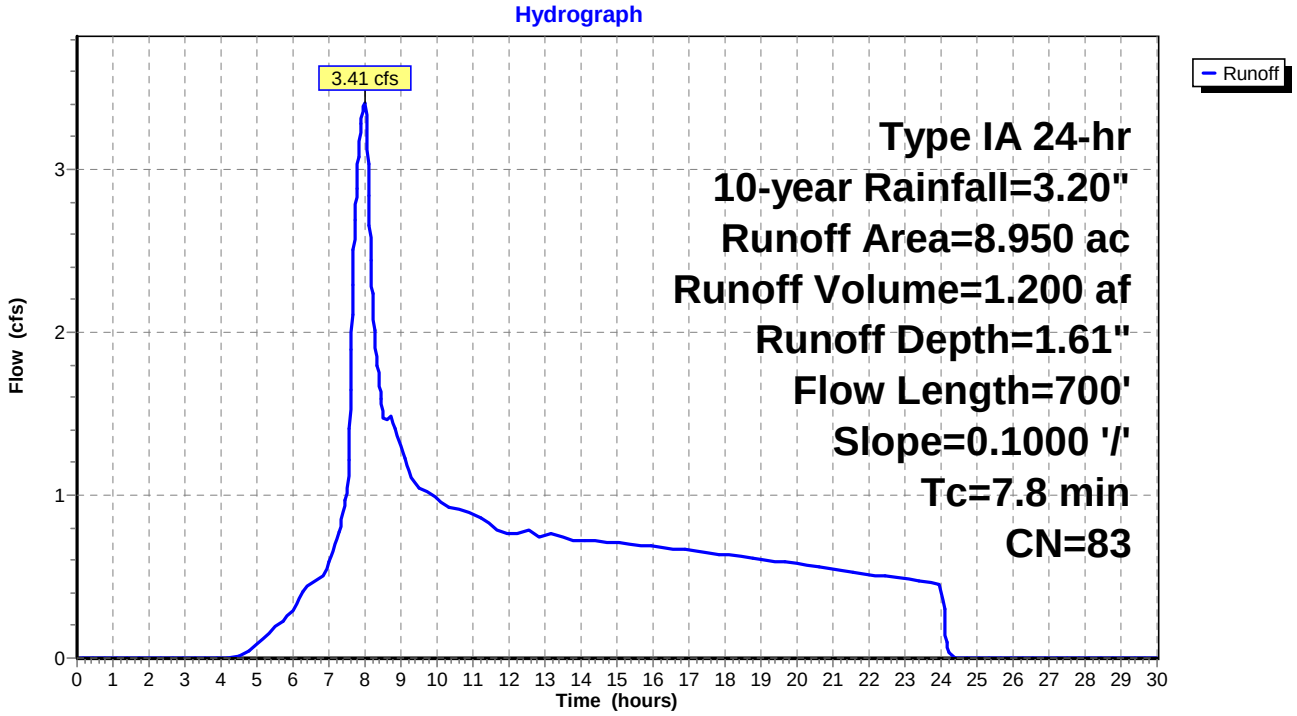
Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post Basin: Post Dev Site Runoff Area=8.950 ac 38.00% Impervious Runoff Depth=1.61"
Flow Length=700' Slope=0.1000 '/' Tc=7.8 min CN=83 Runoff=3.41 cfs 1.200 af

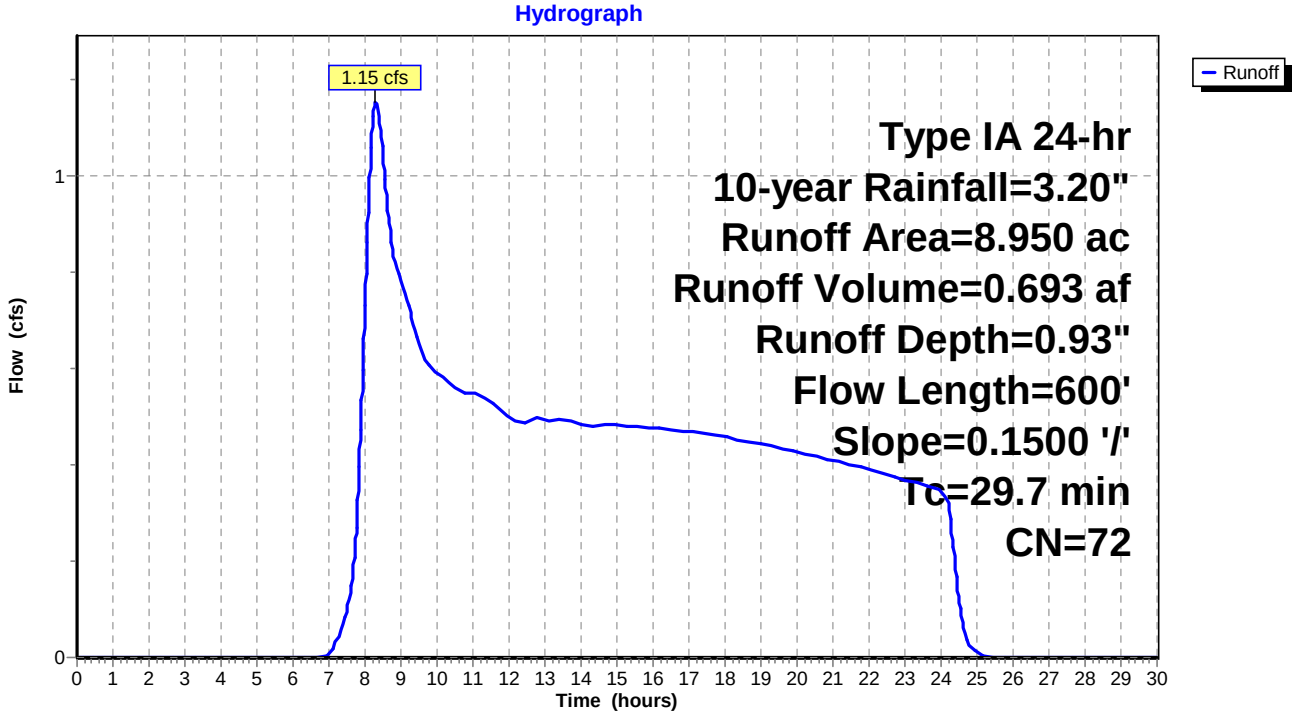
Subcatchment Pre Basin: Pre Dev Site Runoff Area=8.950 ac 0.00% Impervious Runoff Depth=0.93"
Flow Length=600' Slope=0.1500 '/' Tc=29.7 min CN=72 Runoff=1.15 cfs 0.693 af

Pond DET POND: DET POND Peak Elev=394.97' Storage=10,794 cf Inflow=3.41 cfs 1.200 af
Primary=0.13 cfs 0.234 af Secondary=1.02 cfs 0.842 af Tertiary=0.00 cfs 0.000 af Outflow=1.15 cfs 1.077 af

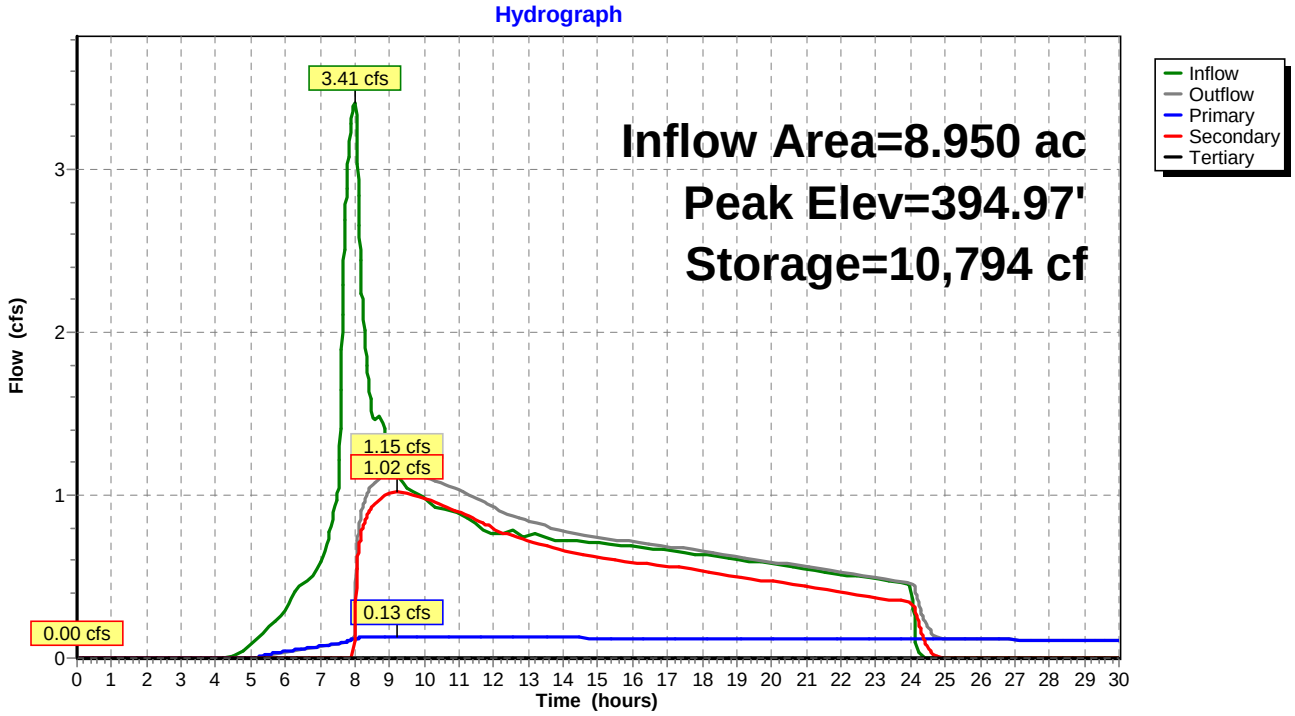
Subcatchment Post Basin: Post Dev Site



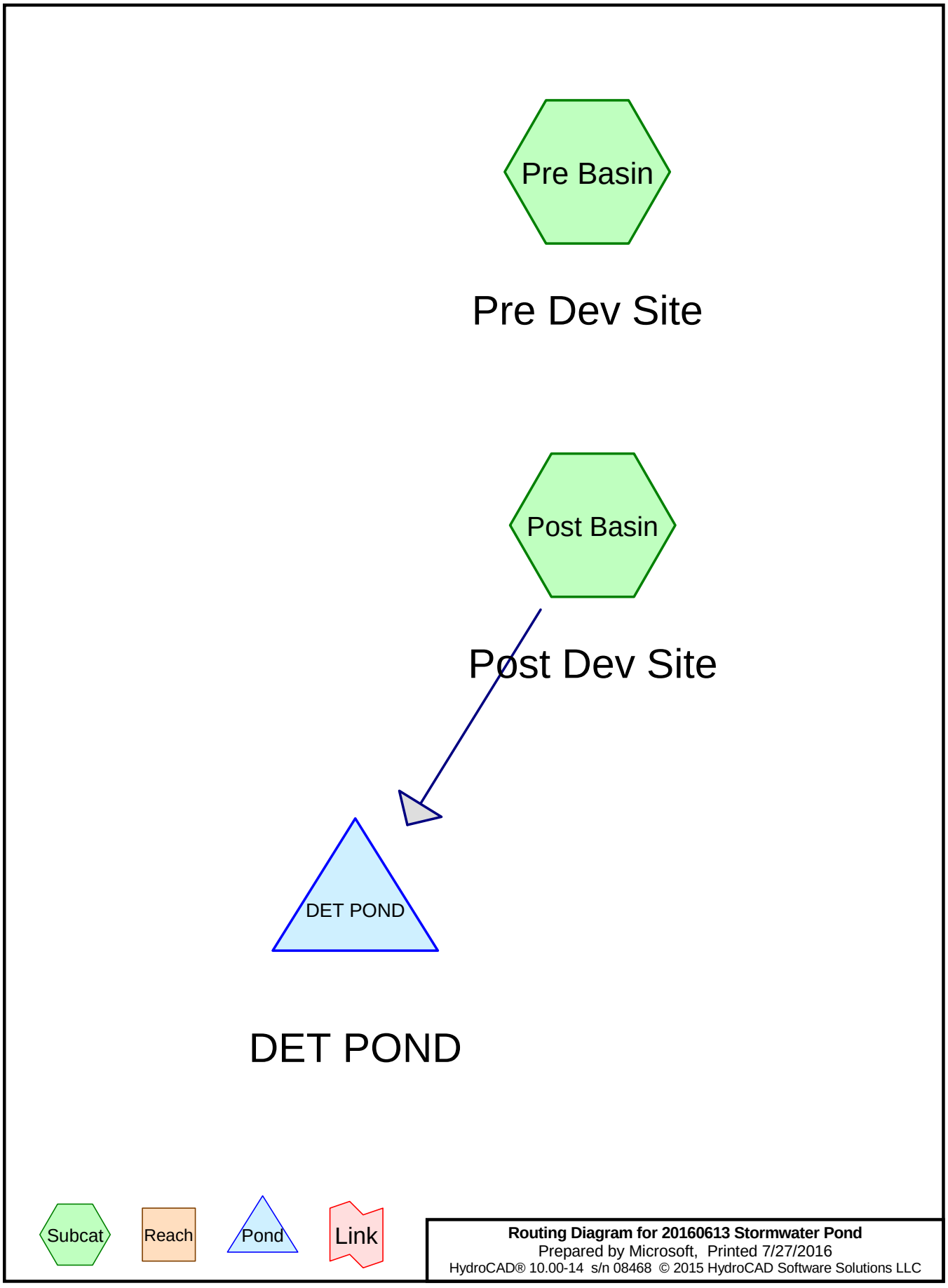
Subcatchment Pre Basin: Pre Dev Site



Pond DET POND: DET POND



Detention
Pre & Post Development of 100-Year Peak



Routing Diagram for 20160613 Stormwater Pond
Prepared by Microsoft, Printed 7/27/2016

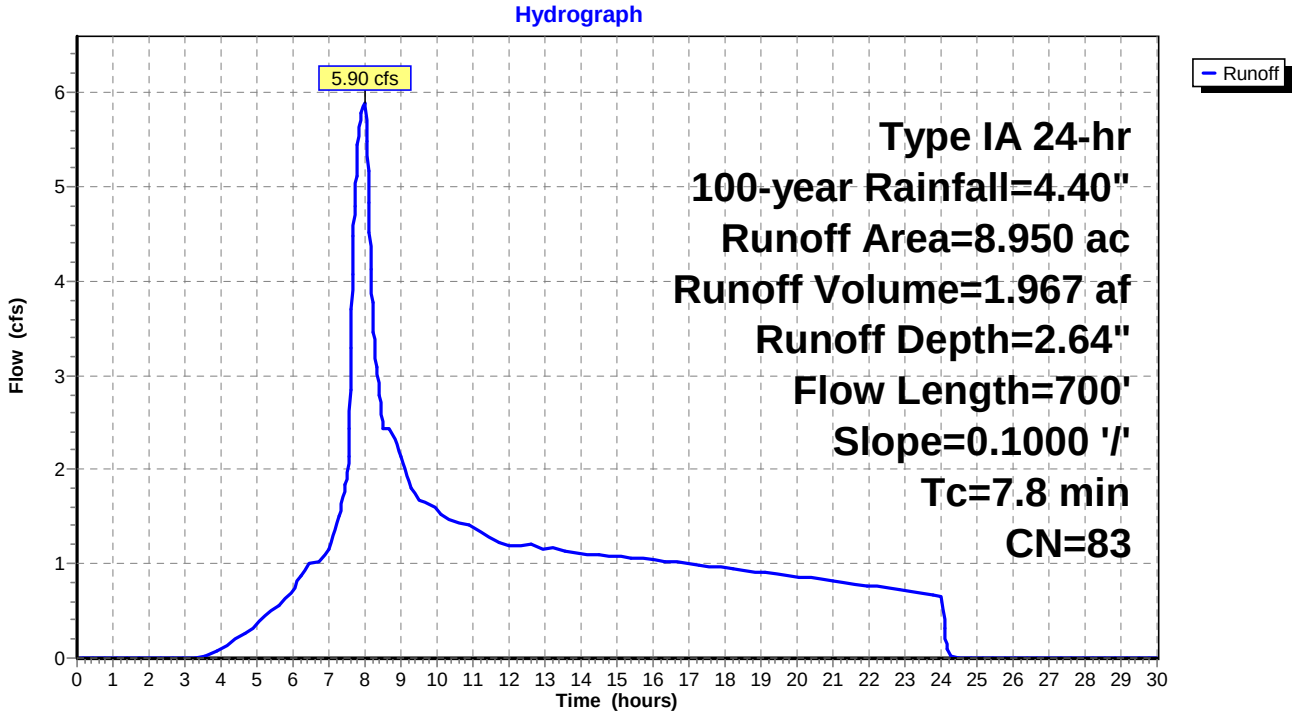
Time span=0.00-30.00 hrs, dt=0.01 hrs, 3001 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment Post Basin: Post Dev Site Runoff Area=8.950 ac 38.00% Impervious Runoff Depth=2.64"
Flow Length=700' Slope=0.1000 '/' Tc=7.8 min CN=83 Runoff=5.90 cfs 1.967 af

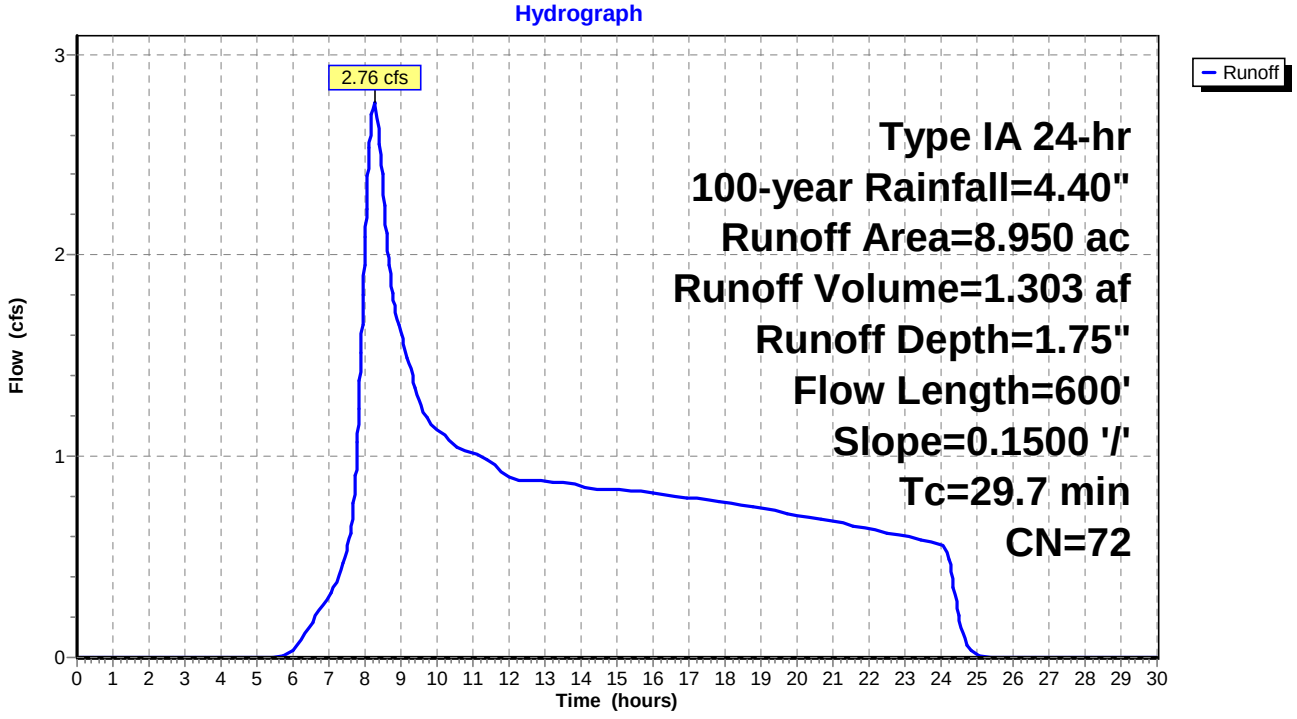
Subcatchment Pre Basin: Pre Dev Site Runoff Area=8.950 ac 0.00% Impervious Runoff Depth=1.75"
Flow Length=600' Slope=0.1500 '/' Tc=29.7 min CN=72 Runoff=2.76 cfs 1.303 af

Pond DET POND: DET POND Peak Elev=395.99' Storage=15,986 cf Inflow=5.90 cfs 1.967 af
Primary=0.15 cfs 0.255 af Secondary=1.54 cfs 1.356 af Tertiary=1.08 cfs 0.230 af Outflow=2.77 cfs 1.841 af

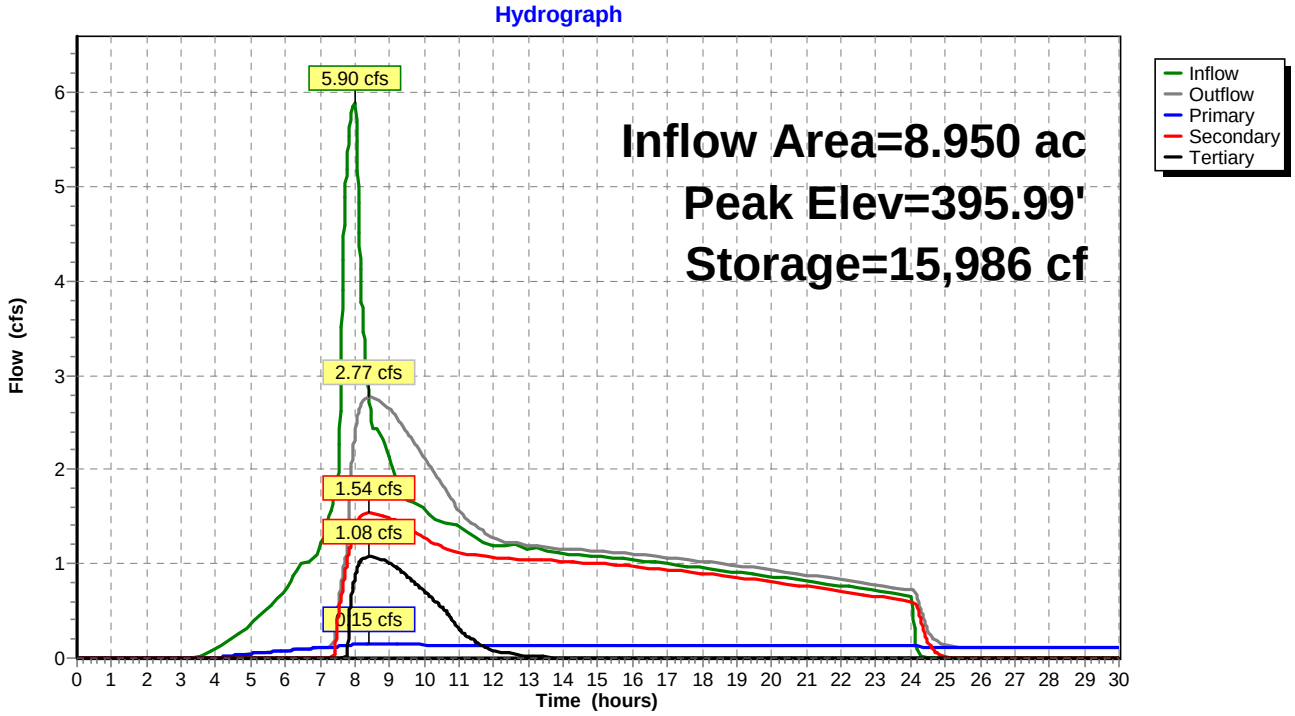
Subcatchment Post Basin: Post Dev Site



Subcatchment Pre Basin: Pre Dev Site



Pond DET POND: DET POND



Orifice Sizing for Pre-Development Flow Rate
50% of 2-Year Peak, 10-Year Peak, 100-Year Peak

Summary for Pond DET POND: DET POND

Inflow Area = 8.950 ac, 38.00% Impervious, Inflow Depth = 2.64" for 100-year event
Inflow = 5.90 cfs @ 7.98 hrs, Volume= 1.967 af
Outflow = 2.77 cfs @ 8.41 hrs, Volume= 1.841 af, Atten= 53%, Lag= 25.8 min
Primary = 0.15 cfs @ 8.41 hrs, Volume= 0.255 af
Secondary = 1.54 cfs @ 8.41 hrs, Volume= 1.356 af
Tertiary = 1.08 cfs @ 8.41 hrs, Volume= 0.230 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 395.99' @ 8.41 hrs Surf.Area= 5,508 sf Storage= 15,986 cf

Plug-Flow detention time= 141.3 min calculated for 1.841 af (94% of inflow)
Center-of-Mass det. time= 99.8 min (872.1 - 772.3)

Volume	Invert	Avail.Storage	Storage Description
#1	390.99'	16,030 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Voids (%)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
390.99	1,300	0.0	0	0
391.00	1,300	100.0	13	13
392.00	1,870	100.0	1,585	1,598
393.00	2,500	100.0	2,185	3,783
394.00	3,580	100.0	3,040	6,823
395.00	4,660	100.0	4,120	10,943
396.00	5,515	100.0	5,088	16,030

Device	Routing	Invert	Outlet Devices		
#1	Primary	391.10'	**1.6" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#2	Secondary	394.17'	**6.6" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads
#3	Tertiary	394.98'	**6.4" Horiz. Orifice/Grate**	C= 0.600	Limited to weir flow at low heads

Primary OutFlow Max=0.15 cfs @ 8.41 hrs HW=395.99' (Free Discharge)
└**1=Orifice/Grate** (Orifice Controls 0.15 cfs @ 10.65 fps)

Secondary OutFlow Max=1.54 cfs @ 8.41 hrs HW=395.99' (Free Discharge)
└**2=Orifice/Grate** (Orifice Controls 1.54 cfs @ 6.50 fps)

Tertiary OutFlow Max=1.08 cfs @ 8.41 hrs HW=395.99' (Free Discharge)
└**3=Orifice/Grate** (Orifice Controls 1.08 cfs @ 4.84 fps)

Water Quality

Summary for Reach WQ: WQ Swale

Inflow Area = 8.950 ac, 38.00% Impervious, Inflow Depth = 0.31" for Water Quality event
Inflow = 0.37 cfs @ 8.05 hrs, Volume= 0.233 af
Outflow = 0.33 cfs @ 8.27 hrs, Volume= 0.233 af, Atten= 12%, Lag= 13.6 min

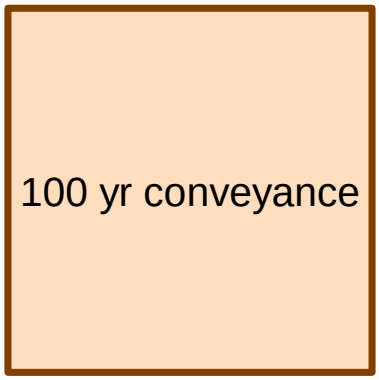
Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 0.19 fps, Min. Travel Time= 9.0 min
Avg. Velocity = 0.11 fps, Avg. Travel Time= 14.5 min

Peak Storage= 177 cf @ 8.12 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 0.50' Flow Area= 2.8 sf, Capacity= 0.62 cfs

4.00' x 0.50' deep channel, n= 0.250
Side Slope Z-value= 3.0 '/' Top Width= 7.00'
Length= 100.0' Slope= 0.0052 '/'
Inlet Invert= 391.00', Outlet Invert= 390.48'

‡

APPENDIX D – PIPE CONVEYANCE CALCULATIONS



15" Pipe

Subcat Reach Pond Link

Routing Diagram for 20160613 Stormwater Pond
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Summary for Reach 100 yr conveyance: 15" Pipe

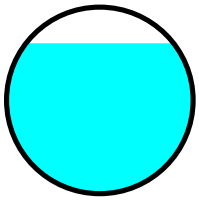
[52] Hint: Inlet/Outlet conditions not evaluated
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

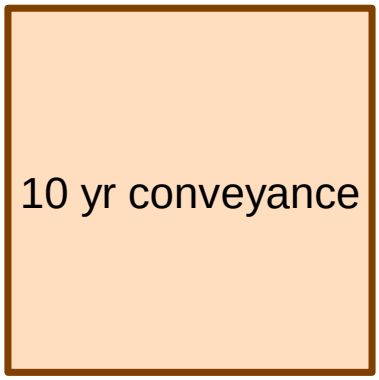
Inflow	=	5.90 cfs @	0.00 hrs,	Volume=	14.633 af, Incl. 5.90 cfs Base Flow
Outflow	=	6.09 cfs @	0.02 hrs,	Volume=	14.627 af, Atten= 0%, Lag= 1.2 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 6.71 fps, Min. Travel Time= 0.2 min
Avg. Velocity = 6.56 fps, Avg. Travel Time= 0.2 min

Peak Storage= 85 cf @ 0.01 hrs
Average Depth at Peak Storage= 1.01'
Bank-Full Depth= 1.25' Flow Area= 1.2 sf, Capacity= 7.22 cfs

15.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 80.0' Slope= 0.0125 '/'
Inlet Invert= 100.00', Outlet Invert= 99.00'





12" Pipe

Subcat Reach Pond Link

Routing Diagram for 20160613 Stormwater Pond
Prepared by Microsoft, Printed 7/27/2016

Summary for Reach 10 yr conveyance: 12" Pipe

[52] Hint: Inlet/Outlet conditions not evaluated
[88] Warning: Qout>Qin may require smaller dt or Finer Routing

Inflow	=	3.40 cfs @	0.00 hrs, Volume=	8.433 af,	Incl. 3.40 cfs Base Flow
Outflow	=	3.41 cfs @	0.03 hrs, Volume=	8.428 af,	Atten= 0%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.01 hrs
Max. Velocity= 5.31 fps, Min. Travel Time= 0.3 min
Avg. Velocity = 5.30 fps, Avg. Travel Time= 0.3 min

Peak Storage= 64 cf @ 0.02 hrs
Average Depth at Peak Storage= 0.59'
Bank-Full Depth= 1.50' Flow Area= 1.8 sf, Capacity= 10.50 cfs

18.0" Round Pipe
n= 0.013 Corrugated PE, smooth interior
Length= 100.0' Slope= 0.0100 '/'
Inlet Invert= 100.00', Outlet Invert= 99.00'