Attachment 5

WATERSHED
CONSULTING ASSOCIATES, LLC
Stormwater Management | Erosion Control

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MEMORANDUM

To: Megan Moir, Stormwater Plangineer, City of Burlington

From: Andres Torizzo, CPESC, CPSWQ

Date: 10/31/2012

Re: **Blanchard Beach Water Quality Improvement Project Final Summary**

Cc: Tony Stout, Project Manager, Lakeside Environmental Group

Dear Megan,

Watershed Consulting Associates, LLC (WCA) has prepared this letter report to summarize the methodologies and basis of design for the Blanchard Beach Water Quality Improvement Project, including the stabilization of an eroded swale, installation of a pretreatment hydrodynamic separation device, and restoration of a wetland area, including the implementation of a sequestered water quality treatment cell within the restored wetland. The project site is located at the western end of Flynn Avenue and at the entrance to Oakledge Park in Burlington, VT. This summary memorandum does not include detail related to wetland delineation and permitting though the Army Corps of Engineers but rather focuses on the stormwater aspect of the project.

Methodology

Watershed Delineation

The Blanchard Beach Water Quality Improvement project involved conducting an assessment of stormwater inputs to the Blanchard Beach outfall to determine the key inputs of pollutants in the watershed, and to assess how much of the watershed could be treated given the constraints at the project site. As a first step, the overall watershed and subwatersheds were delineated using 2008 LIDAR-generated topography, site design and as-built plans as available, field investigation using a Trimble GeoXH mapping-grade GPS unit, discussion with City of Burlington Public Works personnel, and mapped stormwater infrastructure data as provided by the City of Burlington.

Runoff & Pollutant Load Modeling

Land uses were quantified for the watershed for input into a HydroCAD runoff model. A shapefile of impervious surface was acquired from the City of Burlington. This shapefile was trimmed to improve accuracy based on 2008 aerial photos. Additional land uses including open space, woods, and wetland were digitized by using aerial photos as a guide. Time of concentration (Tc) lines were drawn for each subwatershed. Data was imported into the HydroCAD project file. A Simple Method model

was prepared within HydroCAD to evaluate the pollutant loads generated from subwatersheds. Water quality volumes (WQv) were also calculated for subwatersheds.

Retrofit Design

After assessing the HydroCAD models it became clear that the peak discharge and volume of runoff generated within the overall watershed could not be adequately managed at the site area. This was due to the large amount of land and impervious surface cover within the watershed, as well as the relatively rapid rate of delivery of flow through the watershed via open channels and pipes. In addition, Vermont Fish & Wildlife made the determination that the main outlfow from the watershed is a stream with habitat significance, and that a retrofit project could not impact the existing condition of that stream. For these reasons, the design team looked to prioritize the subwatersheds targeted for treatment by:

- ✓ Analyzing the pollutant loading analysis and determining the higher load subwatersheds,
- ✓ Evaluating the current level of treatment being provided by natural features in the watershed including vegetative disconnections, grass channels, and wetlands,
- ✓ Evaluating the routing of flow through the watershed, and determining which subwatersheds could most easily be brought to a sequestered, off-line treatment area to provide water quality treatment and pass higher flows through the system.

The subwatersheds targeted for treatment included impervious areas within Oakledge Park and Lower Flynn Avenue (subwatersheds OLP-1, OLP-2, and FA-2). It was determined through the analysis desktop analysis, site investigation, and discussion with the City that these subwatersheds were not receiving treatment prior to discharge, and were in some cases a continued source of pollution. This was the case with subwatersheds OLP-1 and OLP-2, which include the lower parking lot at Oakledge Park. Field investigation and discussion with the City revealed that this lot was continually eroding and delivering sediment to the roadside swale downstream, and ultimately to the Lake. In addition, the roadside swale itself was highly eroded and unstable. FA-2 included lower Flynn Avenue which is a well travelled roadway that is likely generating particulate and dissolved runoff pollution. A total WQv was calculated for the selection of subwatersheds identified for treatment. This calculated WQv was utilized to appropriately size the wetland treatment area. The estimated treatment volume and pollutant loading is summarized in the table on the following page:

Subwatersheds Draining to Downstream Defender & Treatment Wetland					
	WQv (AF)	**WQv (CF)**	**IC (ac)**	**TSS (lbs)**	**TP (lbs)**
OLP1	0.02	871	0.28	73	0.28
OLP2	0.042	1,830	0.56	493	0.82
OLP3*	0.073	3,180	0.94	298	0.91
OLP4*	0.159	6,926	1.13	747	1.67
FA2	0.023	1,002	0.32	389	1.24
without Treatment	**0.085**	**3,703**	**1.16**	**955**	**2.3**
with Treatment	**--**	**--**	**--**	**191**	**1.3**
Pollutants Removed	**--**	**--**	**--**	**764**	**1.1**

*Assumed full treatment given downstream conditions
**Treatment reductions from New Hampshire Stormwater Manual, Appendix E

The treatment system design was based on the premise that the treatment potential of the system would be maximized by splitting "first flush" smaller storm volumes from higher flows, and sequestering these smaller storm volumes within a dedicated area of the wetland. Given the very large flows predicted for the main watershed, as well as the constraint of no manipulation of the stream imposed by Vermont Fish & Wildlife, it was decided that given the constraints with respect to the available land at the project site, the best benefit would be to target pollutant load reduction from the selected subwatersheds only.

A hydrodynamic pretreatment device, a Hydro International Downstream Defender (DD), was selected to remove coarse solids prior to discharge into the wetland system. This device was selected over a conventional forebay for a few reasons. First, the DD has been shown to be effective for removing and sequestering coarse materials and floatables, and can be easily maintained by City personnel. Given that the treatment wetland will be subject to periodic inundation from Lake flooding, the design team wanted to ensure that captured materials would not be easily re suspended and transported. The DD should do a better job to capture and prevent re suspension of materials as compared to a conventional forebay. A conventional forebay would also have been more difficult to maintain as compared to the DD. The DD and flow splitting system was designed by modeling the water quality storm event (0.9") in HydroCAD to generate a predicted peak discharge and volume for this storm event. Given the predicted peak flow value, a 4'-diameter DD was selected (model D4GA). The design team was especially concerned about introducing too much flow into the sequestered wetland area, thereby overloading it and potentially causing erosion or other damage. Therefore, the splitting system was designed to completely manage the water quality storm, and by-pass the majority of the discharge for larger storms, as to only allow up to approximately 1.5 cubic foot per second of flow to pass through the DD and into the sequestered wetland area. By-passed flow was routed directly to the main watershed stream channel.

The permanent pool configuration in the sequestered wetland was designed to pass flow through a series of deep and shallow pools to promote biological uptake of dissolved pollutants and settle of particles. The overall volume of the pools, or "dead" storage of the system, is equal to 2,500 cubic feet. An additional 2,400 cf of extended detention is provided above the permanent pool. It is expected that the DD plus the wetland area will be close to equaling or exceeding complete WQv treatment for the targeted subwatershed areas.

The HydroCAD model prepared for the overall watershed showed that in storm events equal to or greater than the 5-year, 24-hour event, ponded water in the wetland would flood the interior berm. During Lake flooding events, complete ponding of the wetland area would also occur. The design team understood this when assessing the design approach, and the treatment system should be capable of withstanding an event where the wetland area is inundated. Given that the bulk of the particulate material along with floatable material is expected to be removed by the DD prior to discharge into the wetland, the design team does not anticipate that re suspension and transport of material will be a significant issue resulting from inundation of the wetland.

Operation & Maintenance

Inspections of the stormwater system shall occur twice per year, once after snowmelt and again prior to snow cover. Inspections shall also occur after significant rainfall and lake flooding events. Significant rainfall events include greater than 2" in a 24-hour period. Significant lake flooding includes sufficiently elevated stage to flood the main wetland and water quality treatment area. Specific maintenance tasks for the components of the system are described below:

Swale from Park

- ✓ Inspect for erosion, sediment deposition, and poor vegetative cover. Remove accumulated sediment when depth exceeds 3". Smooth erosion area, seed, and cover with erosion blanket.

Downstream Defender

- ✓ During the first year of operation, the unit should be inspected in the spring and in the fall to determine the rate of sediment and floatables accumulation. A probe should be used to determine the level of accumulated solids stored in the sump.
- ✓ Maximum oil depth should not exceed 16" and maximum sediment depth should not exceed 18".
- ✓ For detailed information related to structure access and material removal, refer to the Downstream Defender Operation and Maintenance Manual.

Wetland

- ✓ Check inlets and outlets for blockage, structural integrity, and evidence of erosion. Repair erosion by adding stone or re-vegetating as necessary.

- ✓ Inspect pilot channels and streambank armoring for evidence of undermining, slumping, and scouring. Replace stone material as per specification.
- ✓ Inspect wetland pools for sediment accumulation. Remove sediment when depth exceeds 3" with hand tools and reshape wetland pool per specification. Dispose of sediment material in an upland location away from surface waters.

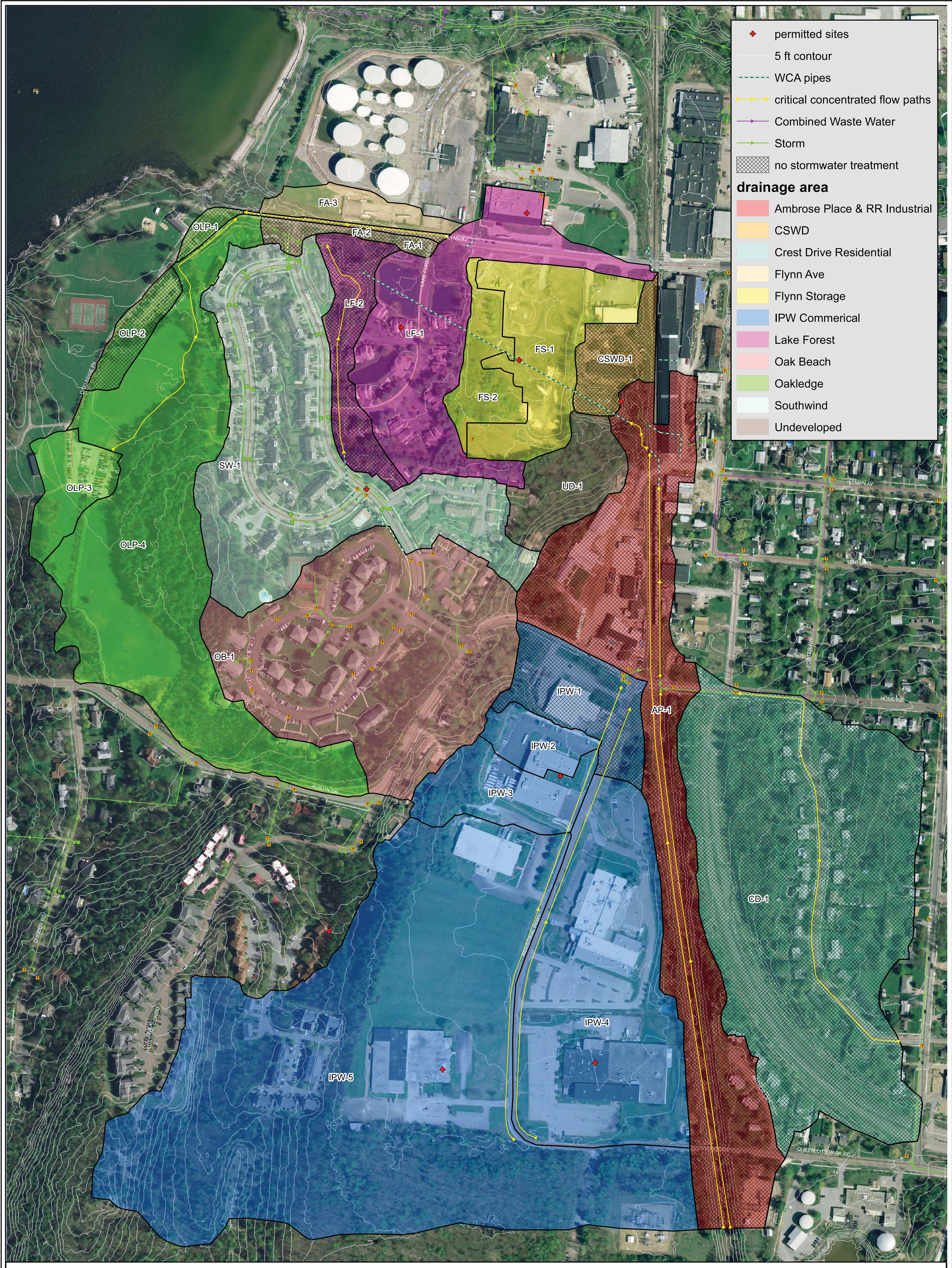
Attachments

- ✓ Overall Watershed Map
- ✓ HydroCAD & Simple Method Model Reports
- ✓ Water Quality Calculation Sheets

Please contact me should you have any questions.

Sincerely,

Andres Torizzo, CPESC, CPSWQ
Principal



Blanchard Beach Stormwater Project
Subwatershed Map

December 12, 2011

N

0 150 300 600 Feet

WATERSHED CONSULTING ASSOCIATES, LLC

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	3.226	3.226		FA-2, OLP-1, OLP-2, OLP-3, OLP-4
0.000	0.000	0.000	9.687	0.000	9.687	>75% Grass cover, Good	OLP-1, OLP-2, OLP-3, OLP-4
0.000	0.000	0.000	11.652	0.000	11.652	Woods, Good	FA-2, OLP-3, OLP-4
0.000	**0.000**	**0.000**	**21.339**	**3.226**	**24.565**	**TOTAL AREA**	

Land-Use Listing (all nodes)

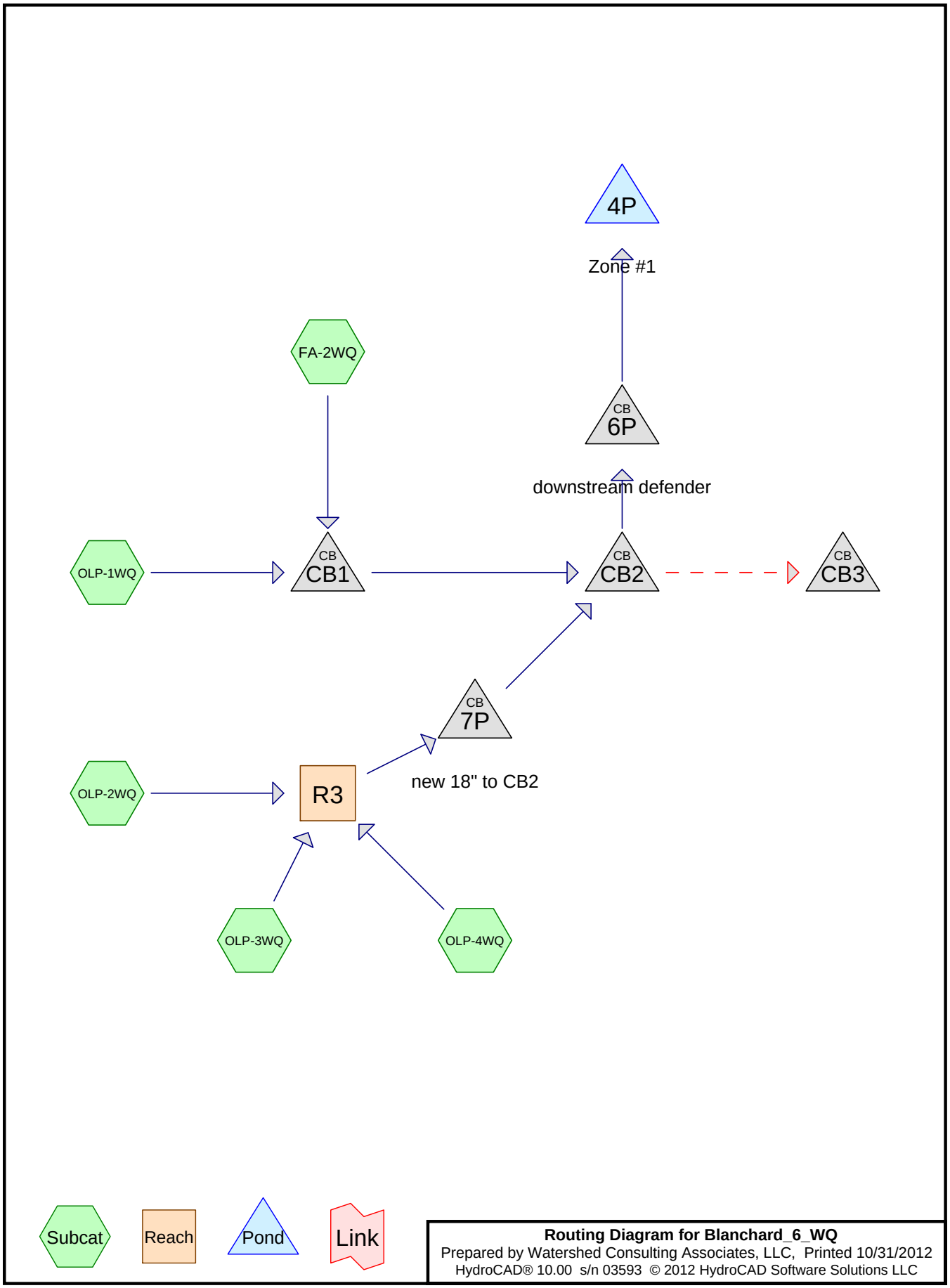
Area (acres)	Land Use	Subcatchment Numbers
1.218	Commercial/Residential Parking	OLP-1, OLP-3
0.340	Industrial Parking	OLP-2
9.687	Open Space	OLP-1, OLP-2, OLP-3, OLP-4
1.130	Residential Roof	OLP-4
0.538	Roadway	FA-2, OLP-2
11.652	Woods	FA-2, OLP-3, OLP-4
24.565	**TOTAL**	

Pollutant Concentrations

Line#	Land Use	TSS (mg/l)	TP (mg/l)	TN (mg/l)
1	Commercial/Residential Parking	27.00	0.15	1.90
2	Industrial Parking	228.00	0.15	1.90
3	Open Space	51.00	0.11	1.74
4	Residential Roof	19.00	0.11	1.50
5	Roadway	172.00	0.55	1.40
6	Woods	51.00	0.11	1.74

Subcatchment Loading

Line#	Subcat Number	TSS (pounds)	TP (pounds)	TN (pounds)
1	FA-2	388.62	1.24	3.18
2	OLP-1	73.26	0.28	3.79
3	OLP-2	493.22	0.82	7.41
4	OLP-3	298.59	0.91	13.02
5	OLP-4	747.28	1.67	26.22
	TOTAL	**2,000.96**	**4.92**	**53.62**



Routing Diagram for Blanchard_6_WQ
Prepared by Watershed Consulting Associates, LLC, Printed 10/31/2012
HydroCAD® 10.00 s/n 03593 © 2012 HydroCAD Software Solutions LLC

Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.320	100	(FA-2WQ)
0.437	96	(OLP-1WQ)
3.698	93	(OLP-2WQ, OLP-3WQ)
20.110	83	(OLP-4WQ)
24.565	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
24.565	Other	FA-2WQ, OLP-1WQ, OLP-2WQ, OLP-3WQ, OLP-4WQ
24.565		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	24.565	24.565		FA-2WQ, OLP-1WQ, OLP-2WQ, OLP-3WQ, OLP-4WQ
0.000	**0.000**	**0.000**	**0.000**	**24.565**	**24.565**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	6P	102.50	101.00	34.0	0.0441	0.013	12.0	0.0	0.0
2	7P	107.70	105.00	40.0	0.0675	0.013	18.0	0.0	0.0
3	CB1	105.00	104.50	20.0	0.0250	0.013	12.0	0.0	0.0
4	CB2	103.50	102.50	12.0	0.0833	0.013	12.0	0.0	0.0
5	CB2	105.00	103.00	78.2	0.0256	0.013	18.0	0.0	0.0
6	CB3	101.00	100.50	44.0	0.0114	0.025	57.0	38.0	0.0

Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment FA-2WQ: Runoff Area=0.320 ac 100.00% Impervious Runoff Depth=0.45"
Flow Length=781' Tc=3.2 min CN=100 Runoff=0.22 cfs 0.012 af

Subcatchment OLP-1WQ: Runoff Area=0.437 ac 0.00% Impervious Runoff Depth=0.17"
Flow Length=367' Tc=19.6 min CN=96 Runoff=0.07 cfs 0.006 af

Subcatchment OLP-2WQ: Runoff Area=1.360 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=597' Tc=23.9 min CN=93 Runoff=0.07 cfs 0.010 af

Subcatchment OLP-3WQ: Runoff Area=2.338 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=452' Tc=78.5 min CN=93 Runoff=0.07 cfs 0.017 af

Subcatchment OLP-4WQ: Runoff Area=20.110 ac 0.00% Impervious Runoff Depth=0.00"
Flow Length=2,651' Tc=105.7 min CN=83 Runoff=0.00 cfs 0.001 af

Reach R3: Avg. Flow Depth=0.10' Max Vel=0.87 fps Inflow=0.09 cfs 0.028 af
n=0.040 L=263.0' S=0.0152 '/' Capacity=5.94 cfs Outflow=0.09 cfs 0.028 af

Pond 4P: Zone #1 Peak Elev=99.86' Storage=506 cf Inflow=0.24 cfs 0.046 af
Primary=0.11 cfs 0.046 af Secondary=0.00 cfs 0.000 af Outflow=0.11 cfs 0.046 af

Pond 6P: downstream defender Peak Elev=102.74' Inflow=0.24 cfs 0.046 af
12.0" Round Culvert n=0.013 L=34.0' S=0.0441 '/' Outflow=0.24 cfs 0.046 af

Pond 7P: new 18" to CB2 Peak Elev=107.83' Inflow=0.09 cfs 0.028 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0675 '/' Outflow=0.09 cfs 0.028 af

Pond CB1: Peak Elev=105.24' Inflow=0.24 cfs 0.018 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0250 '/' Outflow=0.24 cfs 0.018 af

Pond CB2: Peak Elev=103.81' Inflow=0.24 cfs 0.046 af
Primary=0.24 cfs 0.046 af Secondary=0.00 cfs 0.000 af Outflow=0.24 cfs 0.046 af

Pond CB3: Peak Elev=101.00' Inflow=0.00 cfs 0.000 af
57.0" x 38.0", R=28.9"/88.3" Arch Culvert n=0.025 L=44.0' S=0.0114 '/' Outflow=0.00 cfs 0.000 af

Total Runoff Area = 24.565 ac Runoff Volume = 0.046 af Average Runoff Depth = 0.02"
98.70% Pervious = 24.245 ac 1.30% Impervious = 0.320 ac

Summary for Subcatchment FA-2WQ:

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

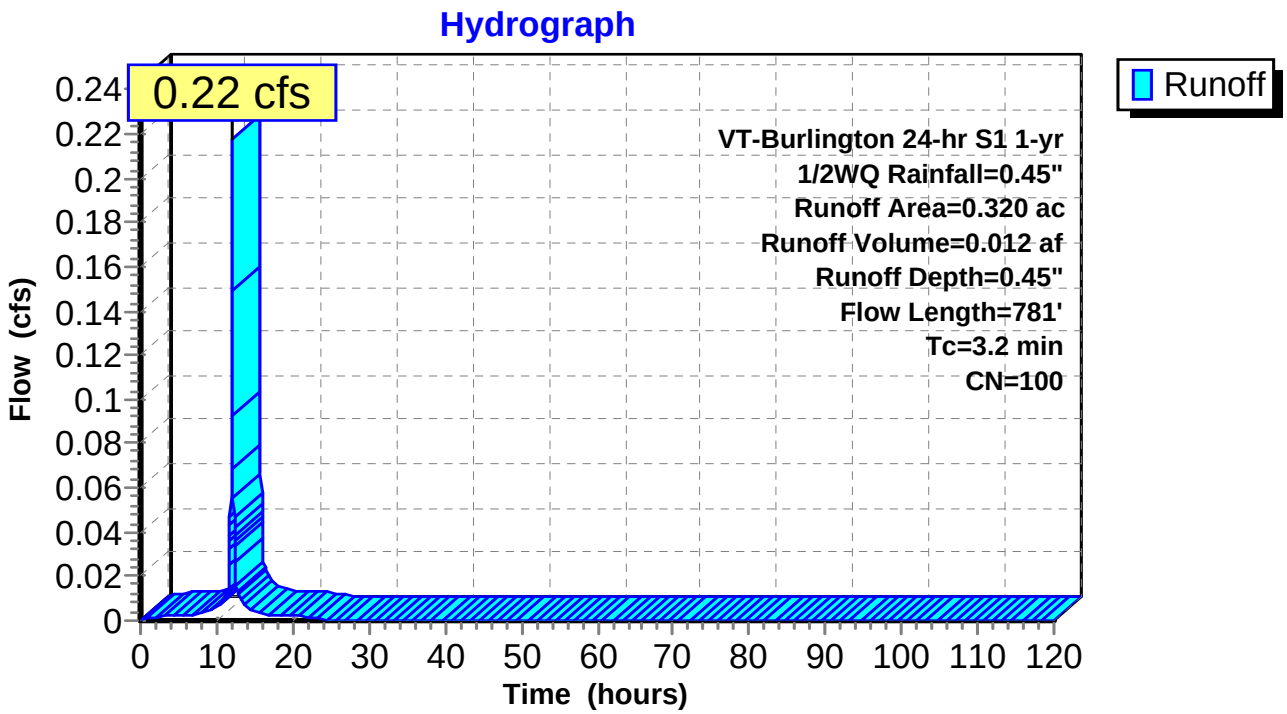
Runoff = 0.22 cfs @ 12.00 hrs, Volume= 0.012 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr 1/2WQ Rainfall=0.45"

	Area (ac)	CN	Description
*	0.320	100	
	0.320		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	100	0.0100	0.86		**Sheet Flow, FA2A** Smooth Surfaces n= 0.011 P2= 2.20"
1.3	681	0.0220	8.94	17.87	**Trap/Vee/Rect Channel Flow, FA2B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
3.2	781	Total			

Subcatchment FA-2WQ:



Summary for Subcatchment OLP-1WQ:

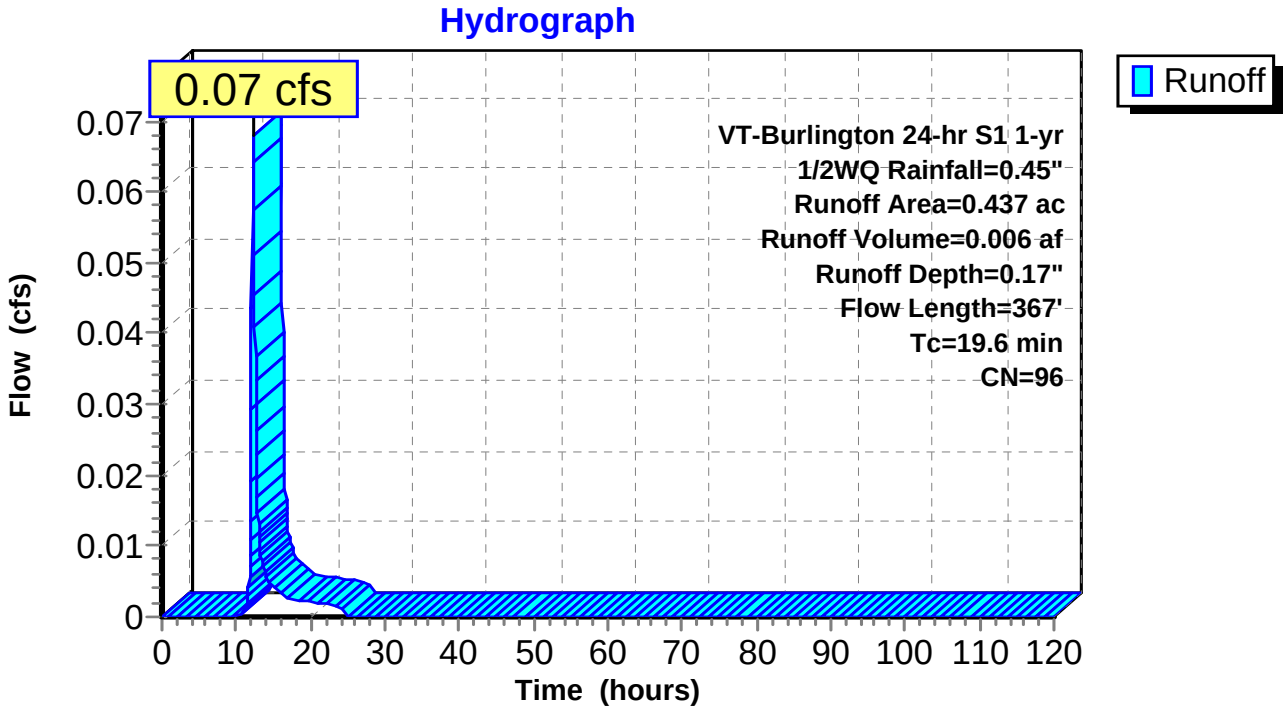
Runoff = 0.07 cfs @ 12.24 hrs, Volume= 0.006 af, Depth= 0.17"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr 1/2WQ Rainfall=0.45"

	Area (ac)	CN	Description
*	0.437	96	
	0.437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	14	0.0100	0.05		**Sheet Flow, OLP1A** Grass: Dense n= 0.240 P2= 2.20"
10.0	63	0.0315	0.11		**Sheet Flow, OLP1B** Grass: Dense n= 0.240 P2= 2.20"
0.6	22	0.0100	0.64		**Sheet Flow, OLP1C** Smooth Surfaces n= 0.011 P2= 2.20"
4.2	267	0.0225	1.05		**Shallow Concentrated Flow, OLP1D** Short Grass Pasture Kv= 7.0 fps
19.6	367	Total			

Subcatchment OLP-1WQ:



Summary for Subcatchment OLP-2WQ:

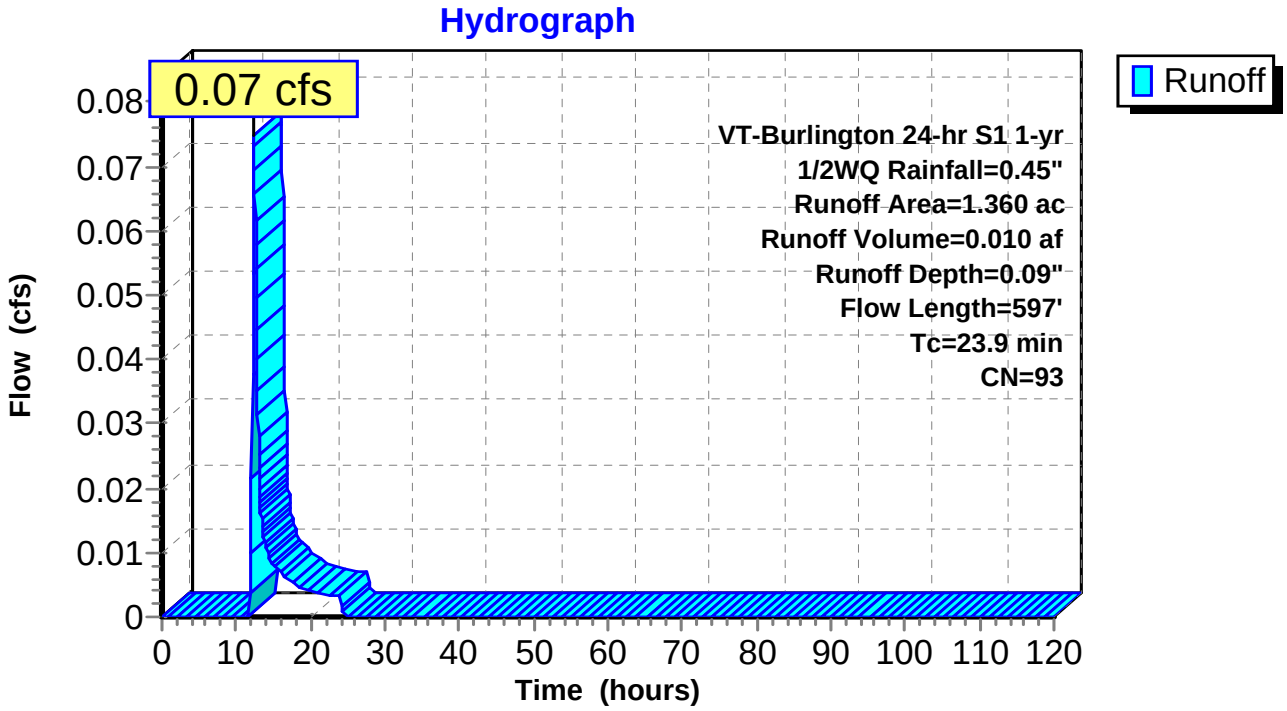
Runoff = 0.07 cfs @ 12.35 hrs, Volume= 0.010 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr 1/2WQ Rainfall=0.45"

	Area (ac)	CN	Description
*	1.360	93	
	1.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	65	0.0308	0.11		**Sheet Flow, OLP2A** Grass: Dense n= 0.240 P2= 2.20"
4.9	35	0.0570	0.12		**Sheet Flow, OLP2B** Grass: Dense n= 0.240 P2= 2.20"
4.8	229	0.0131	0.80		**Shallow Concentrated Flow, OLP2C** Short Grass Pasture Kv= 7.0 fps
3.9	268	0.0261	1.13		**Shallow Concentrated Flow, OLP2D** Short Grass Pasture Kv= 7.0 fps
23.9	597	Total			

Subcatchment OLP-2WQ:



Summary for Subcatchment OLP-3WQ:

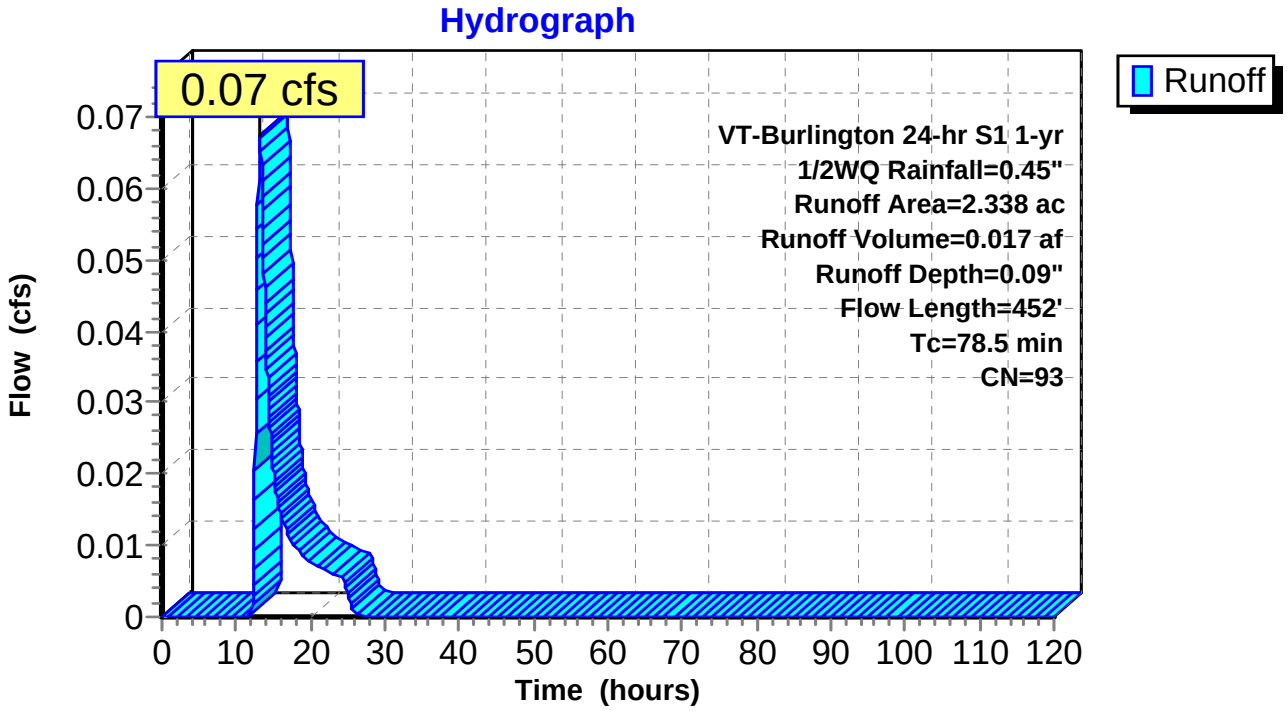
Runoff = 0.07 cfs @ 13.19 hrs, Volume= 0.017 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr 1/2WQ Rainfall=0.45"

	Area (ac)	CN	Description
*	2.338	93	
	2.338		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.4	150	0.0133	0.03		**Sheet Flow, OLP3A** Woods: Dense underbrush n= 0.800 P2= 2.20"
1.7	40	0.0253	0.40		**Shallow Concentrated Flow, OLP3B** Forest w/Heavy Litter Kv= 2.5 fps
0.8	71	0.0424	1.44		**Shallow Concentrated Flow, OLP3C** Short Grass Pasture Kv= 7.0 fps
2.6	191	0.0314	1.24		**Shallow Concentrated Flow, OLP3D** Short Grass Pasture Kv= 7.0 fps
78.5	452	Total			

Subcatchment OLP-3WQ:



Summary for Subcatchment OLP-4WQ:

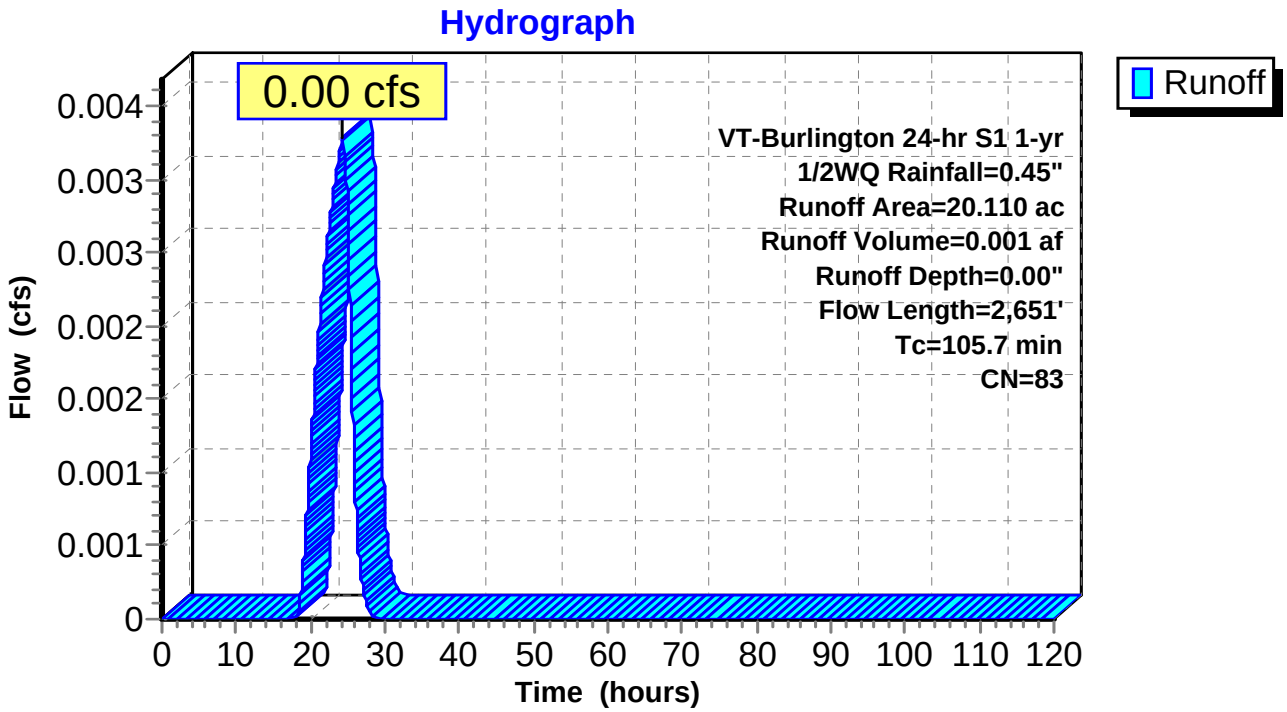
Runoff = 0.00 cfs @ 24.33 hrs, Volume= 0.001 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr 1/2WQ Rainfall=0.45"

	Area (ac)	CN	Description
*	20.110	83	
	20.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	11	0.0100	0.05		**Sheet Flow, OLP4A** Grass: Dense n= 0.240 P2= 2.20"
6.4	20	0.0100	0.05		**Sheet Flow, OLP4B** Grass: Dense n= 0.240 P2= 2.20"
18.4	68	0.0879	0.06		**Sheet Flow, OLP4C** Woods: Dense underbrush n= 0.800 P2= 2.20"
49.3	818	0.0122	0.28		**Shallow Concentrated Flow, OLP4D** Forest w/Heavy Litter Kv= 2.5 fps
18.1	739	0.0095	0.68		**Shallow Concentrated Flow, OLP4E** Short Grass Pasture Kv= 7.0 fps
9.5	994	0.0211	1.75	3.50	**Trap/Vee/Rect Channel Flow, OLP4F** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
105.7	2,651	Total			

Subcatchment OLP-4WQ:



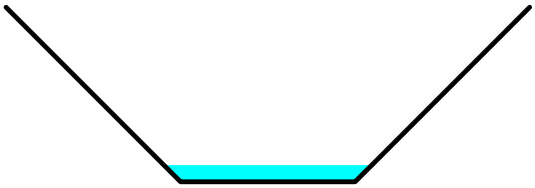
Summary for Reach R3:

Inflow Area = 23.808 ac, 0.00% Impervious, Inflow Depth = 0.01" for 1/2WQ event
Inflow = 0.09 cfs @ 12.73 hrs, Volume= 0.028 af
Outflow = 0.09 cfs @ 12.79 hrs, Volume= 0.028 af, Atten= 0%, Lag= 3.6 min

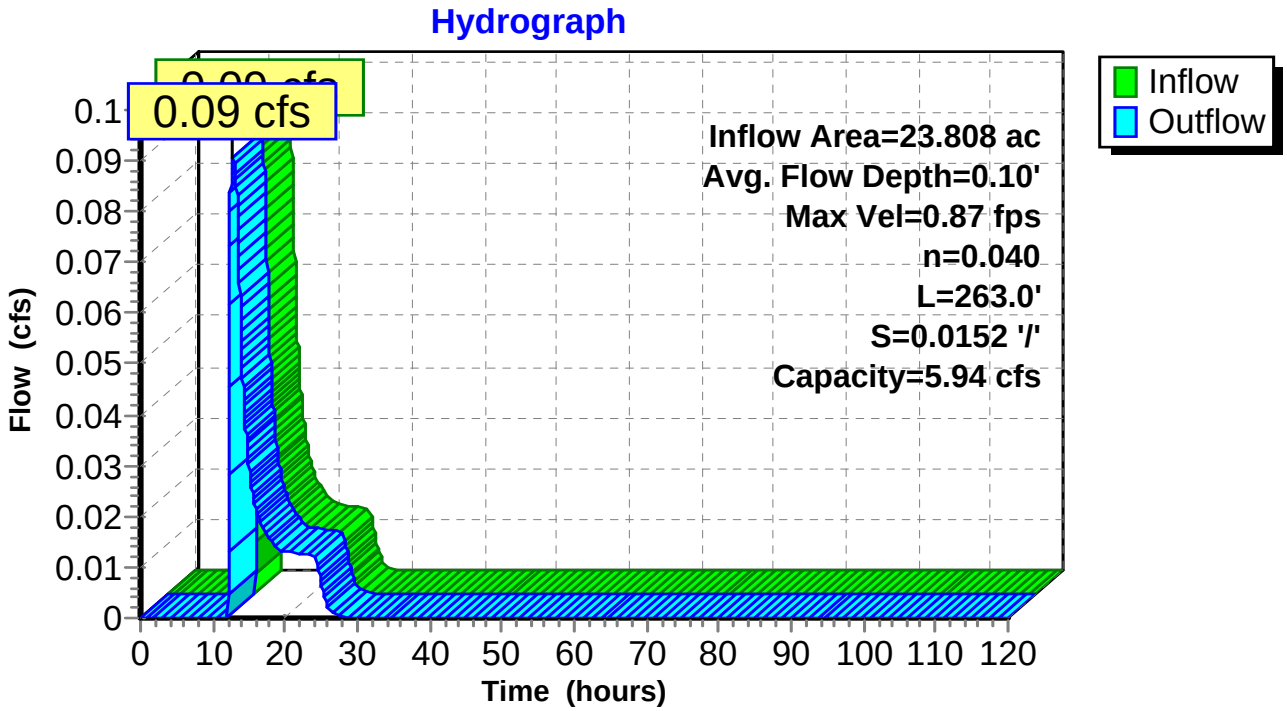
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 0.87 fps, Min. Travel Time= 5.1 min
Avg. Velocity = 0.44 fps, Avg. Travel Time= 10.0 min

Peak Storage= 27 cf @ 12.79 hrs
Average Depth at Peak Storage= 0.10'
Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 5.94 cfs

1.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 3.00'
Length= 263.0' Slope= 0.0152 '/'
Inlet Invert= 116.00', Outlet Invert= 112.00'



Reach R3:



Summary for Pond 4P: Zone #1

Inflow Area = 24.565 ac, 1.30% Impervious, Inflow Depth = 0.02" for 1/2WQ event
Inflow = 0.24 cfs @ 12.00 hrs, Volume= 0.046 af
Outflow = 0.11 cfs @ 12.94 hrs, Volume= 0.046 af, Atten= 52%, Lag= 56.1 min
Primary = 0.11 cfs @ 12.94 hrs, Volume= 0.046 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Starting Elev= 99.50' Surf.Area= 640 sf Storage= 210 cf
Peak Elev= 99.86' @ 12.94 hrs Surf.Area= 1,024 sf Storage= 506 cf (296 cf above start)

Plug-Flow detention time= 155.6 min calculated for 0.041 af (89% of inflow)
Center-of-Mass det. time= 57.0 min (949.2 - 892.1)

Volume	Invert	Avail.Storage	Storage Description
#1	98.50'	9,515 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

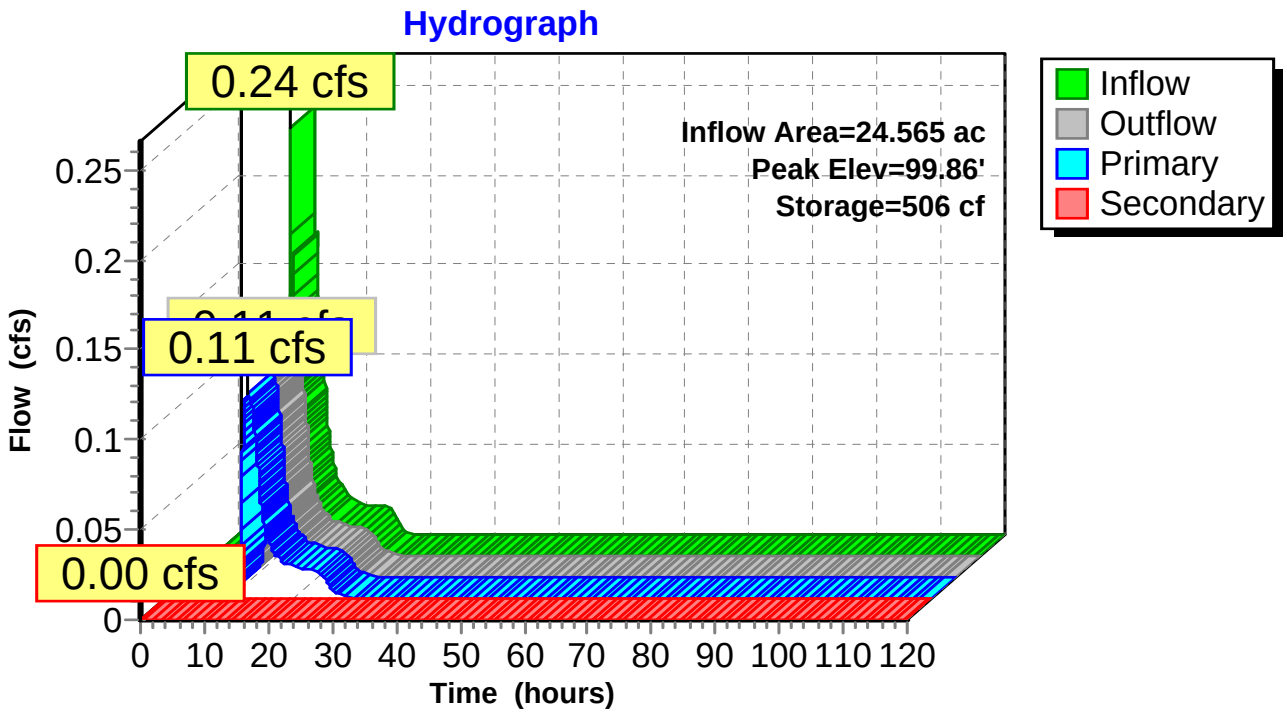
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
98.50	0	0	0
99.00	100	25	25
100.00	1,180	640	665
101.00	2,710	1,945	2,610
102.00	3,550	3,130	5,740
103.00	4,000	3,775	9,515

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	100.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	101.00'	**5.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.11 cfs @ 12.94 hrs HW=99.86' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.11 cfs @ 2.31 fps)
└─**2=Orifice/Grate** (Controls 0.00 cfs)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.50' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Zone #1



Summary for Pond 6P: downstream defender

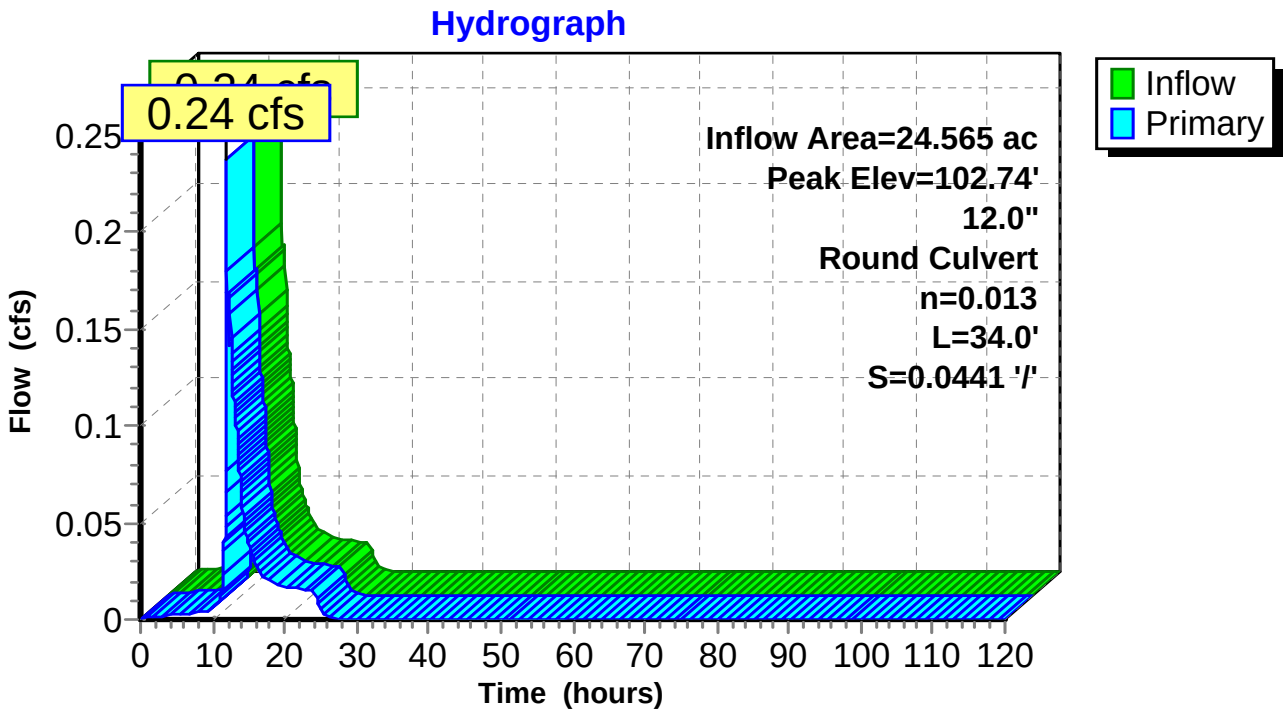
Inflow Area = 24.565 ac, 1.30% Impervious, Inflow Depth = 0.02" for 1/2WQ event
Inflow = 0.24 cfs @ 12.00 hrs, Volume= 0.046 af
Outflow = 0.24 cfs @ 12.00 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min
Primary = 0.24 cfs @ 12.00 hrs, Volume= 0.046 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 102.74' @ 12.00 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.50'	**12.0" Round Culvert** L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 102.50' / 101.00' S= 0.0441 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.23 cfs @ 12.00 hrs HW=102.74' TW=99.68' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.23 cfs @ 1.65 fps)

Pond 6P: downstream defender



Summary for Pond 7P: new 18" to CB2

[57] Hint: Peaked at 107.83' (Flood elevation advised)

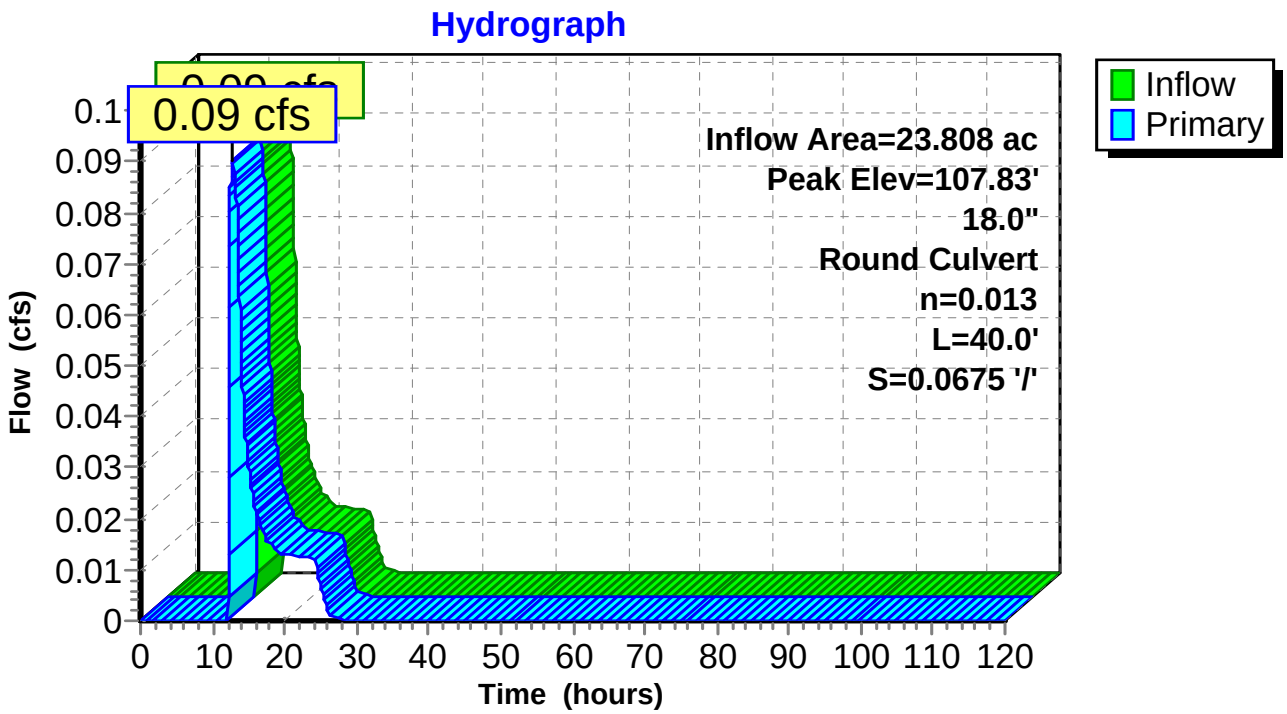
Inflow Area =	23.808 ac,	0.00% Impervious,	Inflow Depth =	0.01"	for 1/2WQ event
Inflow =	0.09 cfs @	12.79 hrs,	Volume=	0.028 af	
Outflow =	0.09 cfs @	12.79 hrs,	Volume=	0.028 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.09 cfs @	12.79 hrs,	Volume=	0.028 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 107.83' @ 12.79 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	107.70'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 107.70' / 105.00' S= 0.0675 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.09 cfs @ 12.79 hrs HW=107.83' TW=103.71' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.09 cfs @ 1.22 fps)

Pond 7P: new 18" to CB2



Summary for Pond CB1:

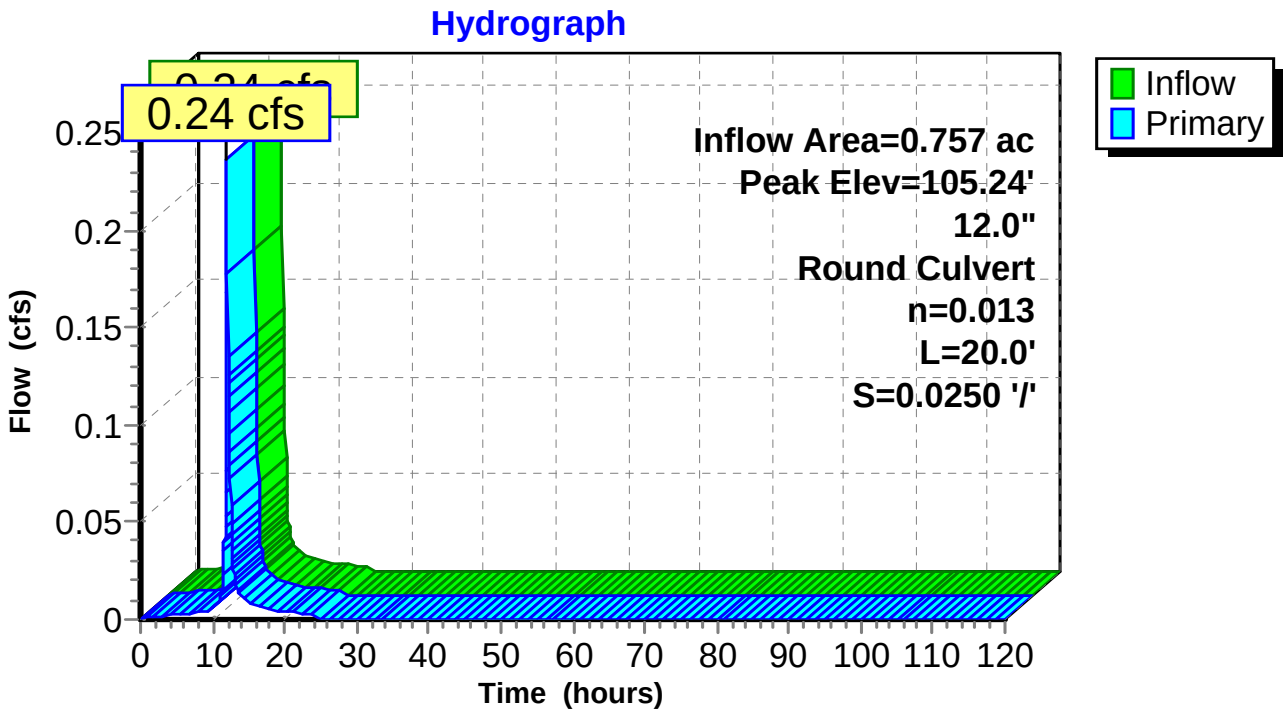
Inflow Area = 0.757 ac, 42.27% Impervious, Inflow Depth = 0.29" for 1/2WQ event
Inflow = 0.24 cfs @ 12.00 hrs, Volume= 0.018 af
Outflow = 0.24 cfs @ 12.00 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min
Primary = 0.24 cfs @ 12.00 hrs, Volume= 0.018 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 105.24' @ 12.00 hrs
Flood Elev= 107.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	105.00'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 104.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.23 cfs @ 12.00 hrs HW=105.24' TW=103.80' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.23 cfs @ 1.65 fps)

Pond CB1:



Summary for Pond CB2:

Inflow Area =	24.565 ac,	1.30% Impervious,	Inflow Depth =	0.02"	for 1/2WQ event
Inflow =	0.24 cfs @	12.00 hrs,	Volume=	0.046 af	
Outflow =	0.24 cfs @	12.00 hrs,	Volume=	0.046 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.24 cfs @	12.00 hrs,	Volume=	0.046 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

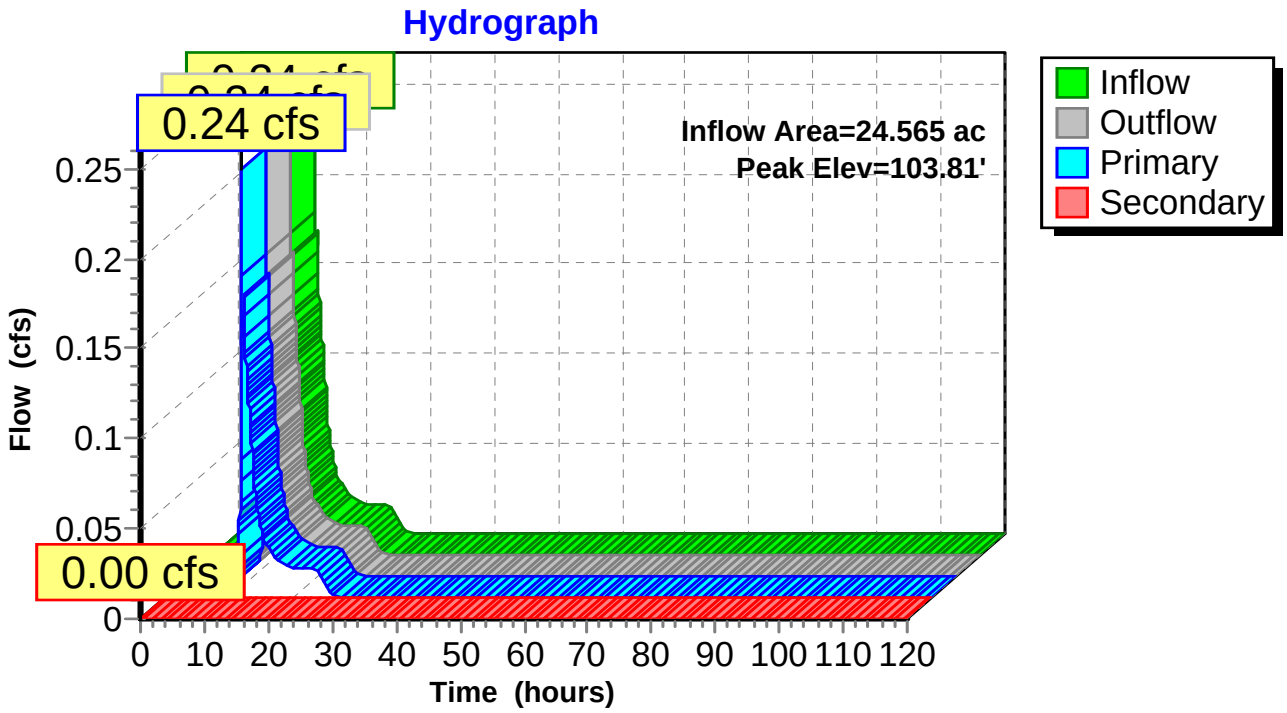
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 103.81' @ 12.00 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**12.0" Round Culvert** L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.50' / 102.50' S= 0.0833 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	103.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	105.00'	**18.0" Round Culvert** L= 78.2' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 103.00' S= 0.0256 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.23 cfs @ 12.00 hrs HW=103.80' TW=102.74' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.23 cfs of 0.38 cfs potential flow)
  └─**2=Orifice/Grate** (Orifice Controls 0.23 cfs @ 1.88 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=103.50' TW=101.00' (Dynamic Tailwater)
└─**3=Culvert** (Controls 0.00 cfs)

Pond CB2:



Summary for Pond CB3:

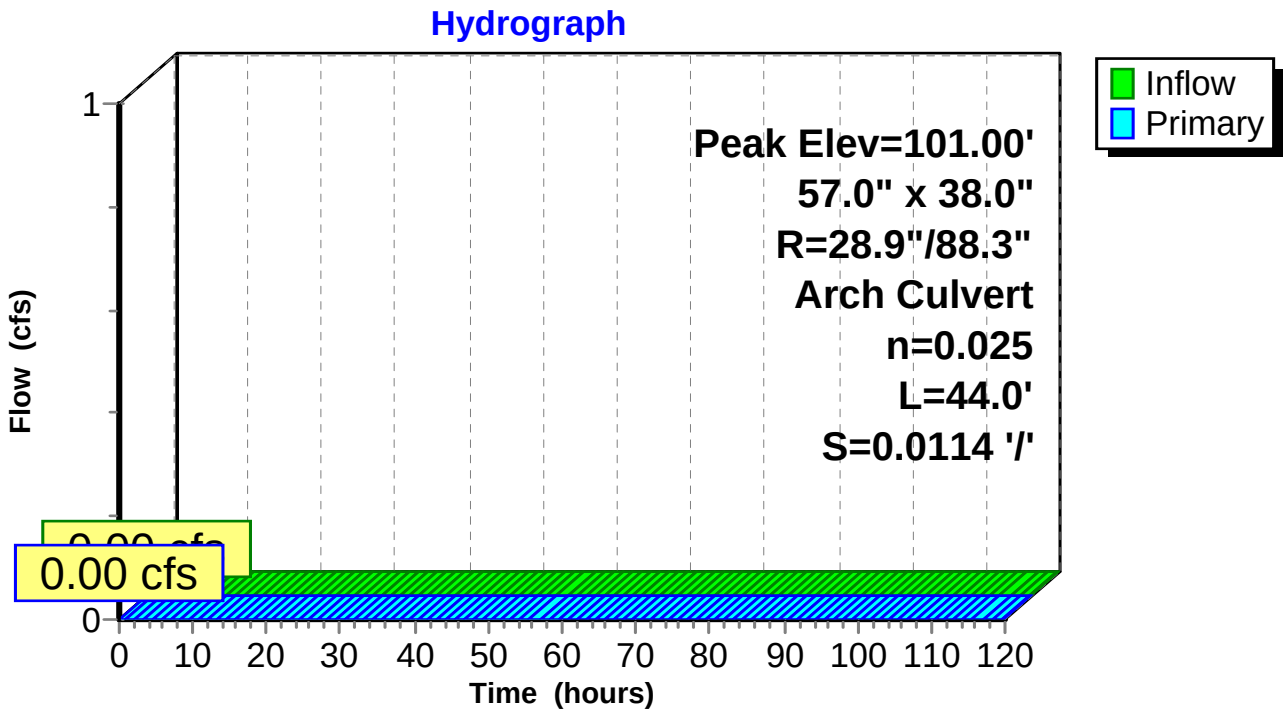
Inflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs,	Volume=	0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 101.00' @ 0.00 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**57.0" W x 38.0" H, R=28.9"/88.3" Arch CMP_Arch_1/2 57x38** L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 101.00' / 100.50' S= 0.0114 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 11.89 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=101.00' (Free Discharge)
└─**1=CMP_Arch_1/2 57x38** (Controls 0.00 cfs)

Pond CB3:



Time span=0.00-120.00 hrs, dt=0.05 hrs, 2401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Dyn-Stor-Ind method - Pond routing by Dyn-Stor-Ind method

Subcatchment FA-2WQ: Runoff Area=0.320 ac 100.00% Impervious Runoff Depth=0.90"
Flow Length=781' Tc=3.2 min CN=100 Runoff=0.44 cfs 0.024 af

Subcatchment OLP-1WQ: Runoff Area=0.437 ac 0.00% Impervious Runoff Depth=0.54"
Flow Length=367' Tc=19.6 min CN=96 Runoff=0.22 cfs 0.020 af

Subcatchment OLP-2WQ: Runoff Area=1.360 ac 0.00% Impervious Runoff Depth=0.37"
Flow Length=597' Tc=23.9 min CN=93 Runoff=0.42 cfs 0.042 af

Subcatchment OLP-3WQ: Runoff Area=2.338 ac 0.00% Impervious Runoff Depth=0.37"
Flow Length=452' Tc=78.5 min CN=93 Runoff=0.36 cfs 0.073 af

Subcatchment OLP-4WQ: Runoff Area=20.110 ac 0.00% Impervious Runoff Depth=0.09"
Flow Length=2,651' Tc=105.7 min CN=83 Runoff=0.42 cfs 0.159 af

Reach R3: Avg. Flow Depth=0.33' Max Vel=1.70 fps Inflow=0.74 cfs 0.274 af
n=0.040 L=263.0' S=0.0152 '/' Capacity=5.94 cfs Outflow=0.74 cfs 0.274 af

Pond 4P: Zone #1 Peak Elev=100.15' Storage=861 cf Inflow=0.79 cfs 0.318 af
Primary=0.78 cfs 0.318 af Secondary=0.00 cfs 0.000 af Outflow=0.78 cfs 0.318 af

Pond 6P: downstream defender Peak Elev=102.95' Inflow=0.79 cfs 0.318 af
12.0" Round Culvert n=0.013 L=34.0' S=0.0441 '/' Outflow=0.79 cfs 0.318 af

Pond 7P: new 18" to CB2 Peak Elev=108.08' Inflow=0.74 cfs 0.274 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0675 '/' Outflow=0.74 cfs 0.274 af

Pond CB1: Peak Elev=105.36' Inflow=0.52 cfs 0.044 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0250 '/' Outflow=0.52 cfs 0.044 af

Pond CB2: Peak Elev=104.44' Inflow=0.79 cfs 0.318 af
Primary=0.79 cfs 0.318 af Secondary=0.00 cfs 0.000 af Outflow=0.79 cfs 0.318 af

Pond CB3: Peak Elev=101.00' Inflow=0.00 cfs 0.000 af
57.0" x 38.0", R=28.9"/88.3" Arch Culvert n=0.025 L=44.0' S=0.0114 '/' Outflow=0.00 cfs 0.000 af

Total Runoff Area = 24.565 ac Runoff Volume = 0.318 af Average Runoff Depth = 0.16"
98.70% Pervious = 24.245 ac 1.30% Impervious = 0.320 ac

Summary for Subcatchment FA-2WQ:

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

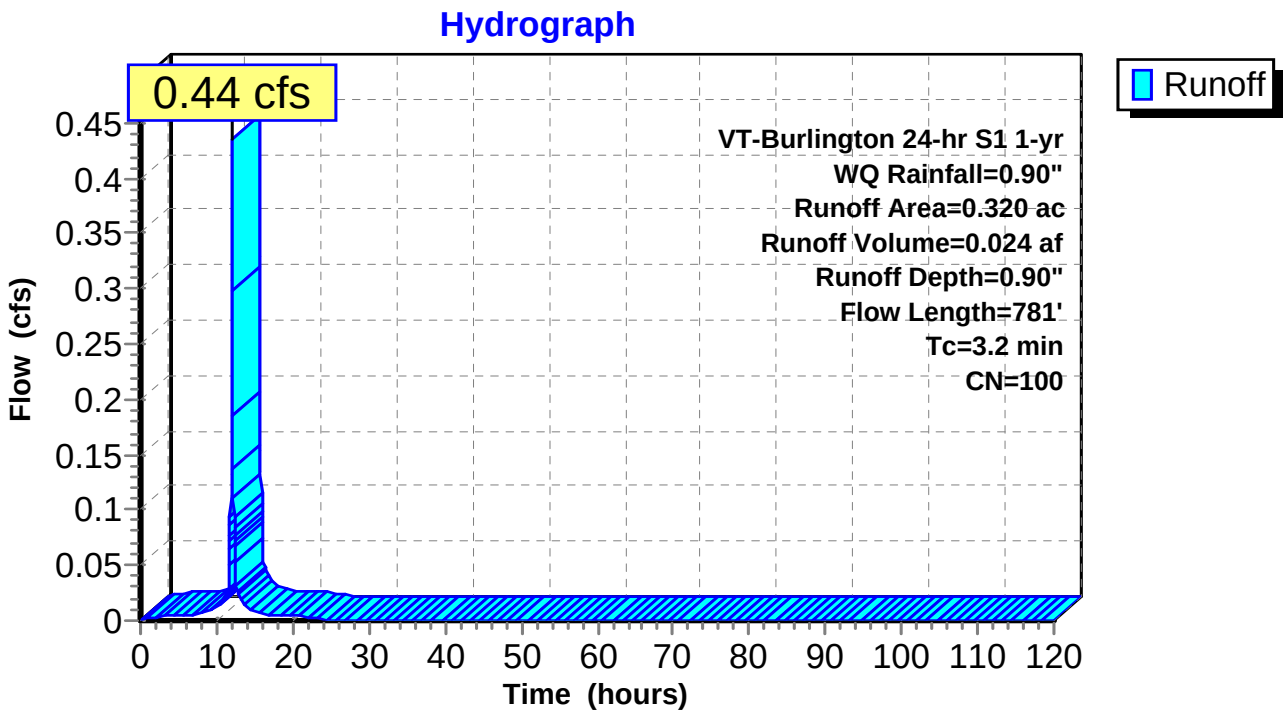
Runoff = 0.44 cfs @ 12.00 hrs, Volume= 0.024 af, Depth= 0.90"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr WQ Rainfall=0.90"

	Area (ac)	CN	Description
*	0.320	100	
	0.320		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	100	0.0100	0.86		**Sheet Flow, FA2A** Smooth Surfaces n= 0.011 P2= 2.20"
1.3	681	0.0220	8.94	17.87	**Trap/Vee/Rect Channel Flow, FA2B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
3.2	781	Total			

Subcatchment FA-2WQ:



Summary for Subcatchment OLP-1WQ:

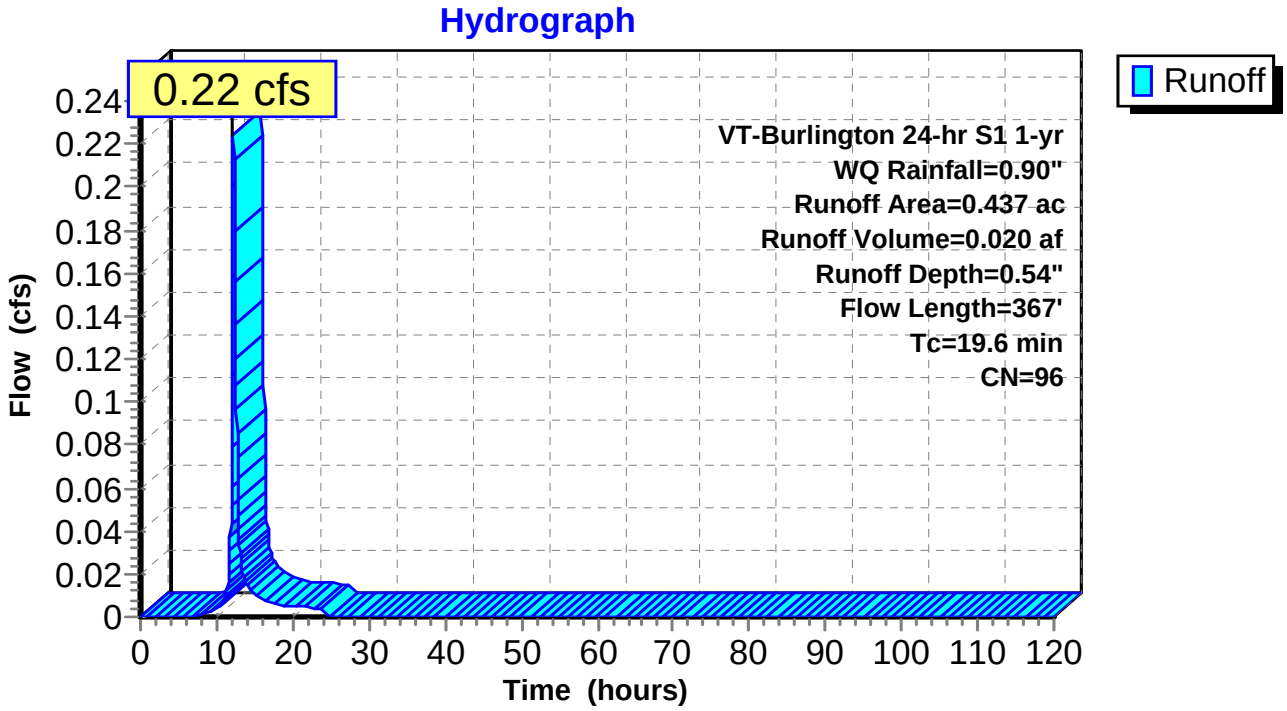
Runoff = 0.22 cfs @ 12.22 hrs, Volume= 0.020 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr WQ Rainfall=0.90"

	Area (ac)	CN	Description
*	0.437	96	
	0.437		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	14	0.0100	0.05		**Sheet Flow, OLP1A** Grass: Dense n= 0.240 P2= 2.20"
10.0	63	0.0315	0.11		**Sheet Flow, OLP1B** Grass: Dense n= 0.240 P2= 2.20"
0.6	22	0.0100	0.64		**Sheet Flow, OLP1C** Smooth Surfaces n= 0.011 P2= 2.20"
4.2	267	0.0225	1.05		**Shallow Concentrated Flow, OLP1D** Short Grass Pasture Kv= 7.0 fps
19.6	367	Total			

Subcatchment OLP-1WQ:



Summary for Subcatchment OLP-2WQ:

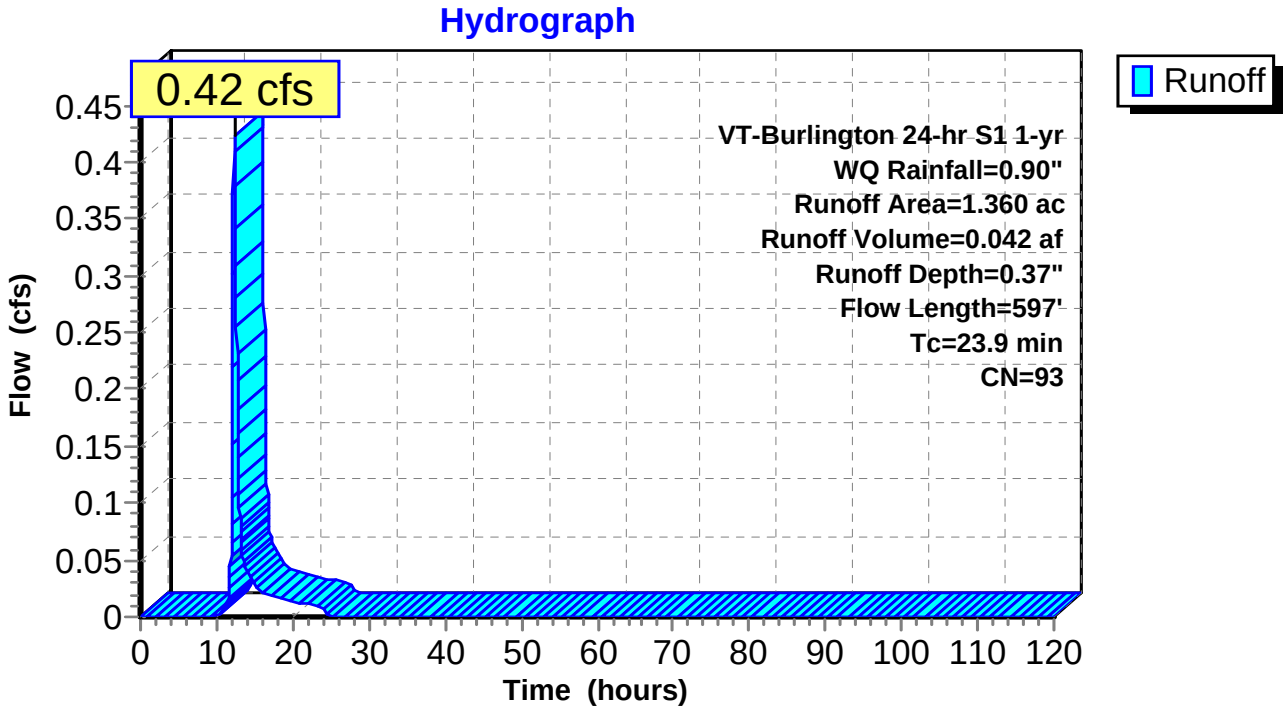
Runoff = 0.42 cfs @ 12.30 hrs, Volume= 0.042 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr WQ Rainfall=0.90"

	Area (ac)	CN	Description
*	1.360	93	
	1.360		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	65	0.0308	0.11		**Sheet Flow, OLP2A** Grass: Dense n= 0.240 P2= 2.20"
4.9	35	0.0570	0.12		**Sheet Flow, OLP2B** Grass: Dense n= 0.240 P2= 2.20"
4.8	229	0.0131	0.80		**Shallow Concentrated Flow, OLP2C** Short Grass Pasture Kv= 7.0 fps
3.9	268	0.0261	1.13		**Shallow Concentrated Flow, OLP2D** Short Grass Pasture Kv= 7.0 fps
23.9	597	Total			

Subcatchment OLP-2WQ:



Summary for Subcatchment OLP-3WQ:

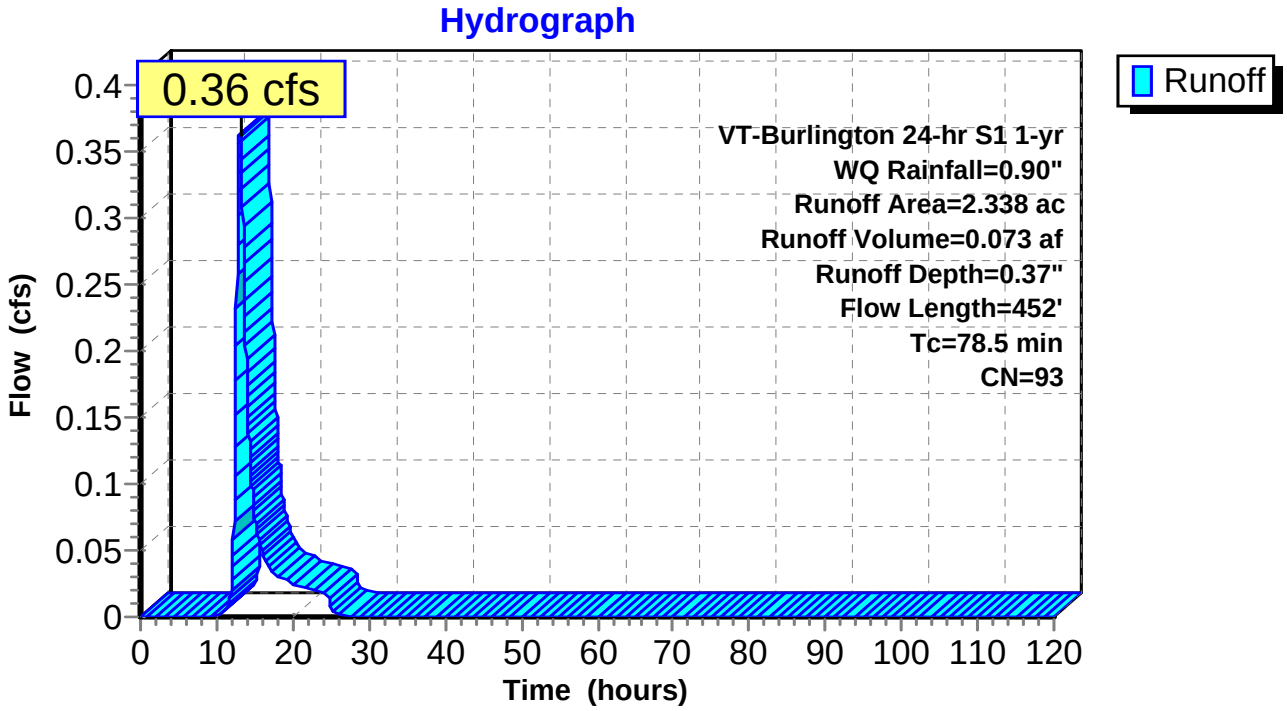
Runoff = 0.36 cfs @ 13.05 hrs, Volume= 0.073 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr WQ Rainfall=0.90"

	Area (ac)	CN	Description
*	2.338	93	
	2.338		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.4	150	0.0133	0.03		**Sheet Flow, OLP3A** Woods: Dense underbrush n= 0.800 P2= 2.20"
1.7	40	0.0253	0.40		**Shallow Concentrated Flow, OLP3B** Forest w/Heavy Litter Kv= 2.5 fps
0.8	71	0.0424	1.44		**Shallow Concentrated Flow, OLP3C** Short Grass Pasture Kv= 7.0 fps
2.6	191	0.0314	1.24		**Shallow Concentrated Flow, OLP3D** Short Grass Pasture Kv= 7.0 fps
78.5	452	Total			

Subcatchment OLP-3WQ:



Summary for Subcatchment OLP-4WQ:

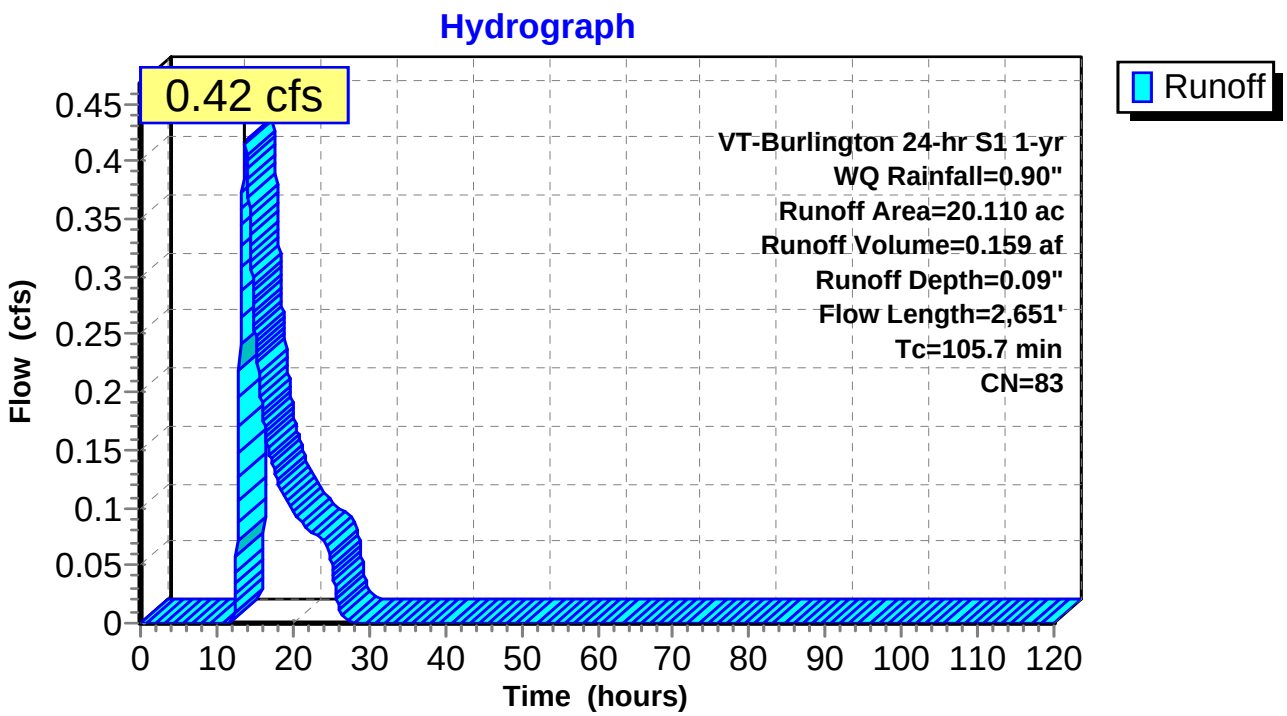
Runoff = 0.42 cfs @ 13.75 hrs, Volume= 0.159 af, Depth= 0.09"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
VT-Burlington 24-hr S1 1-yr WQ Rainfall=0.90"

	Area (ac)	CN	Description
*	20.110	83	
	20.110		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	11	0.0100	0.05		**Sheet Flow, OLP4A** Grass: Dense n= 0.240 P2= 2.20"
6.4	20	0.0100	0.05		**Sheet Flow, OLP4B** Grass: Dense n= 0.240 P2= 2.20"
18.4	68	0.0879	0.06		**Sheet Flow, OLP4C** Woods: Dense underbrush n= 0.800 P2= 2.20"
49.3	818	0.0122	0.28		**Shallow Concentrated Flow, OLP4D** Forest w/Heavy Litter Kv= 2.5 fps
18.1	739	0.0095	0.68		**Shallow Concentrated Flow, OLP4E** Short Grass Pasture Kv= 7.0 fps
9.5	994	0.0211	1.75	3.50	**Trap/Vee/Rect Channel Flow, OLP4F** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
105.7	2,651	Total			

Subcatchment OLP-4WQ:



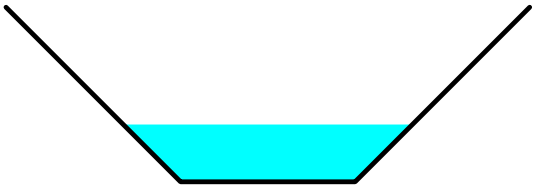
Summary for Reach R3:

Inflow Area = 23.808 ac, 0.00% Impervious, Inflow Depth = 0.14" for WQ event
Inflow = 0.74 cfs @ 13.33 hrs, Volume= 0.274 af
Outflow = 0.74 cfs @ 13.36 hrs, Volume= 0.274 af, Atten= 0%, Lag= 1.7 min

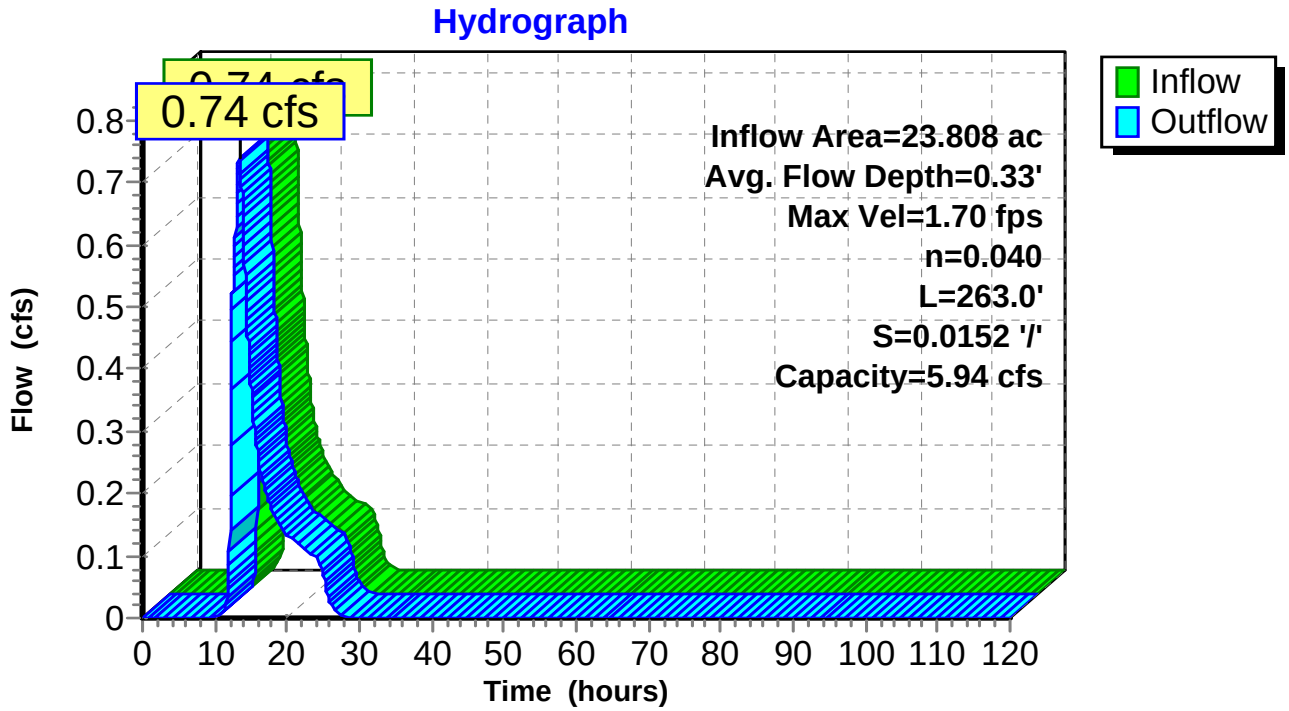
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.70 fps, Min. Travel Time= 2.6 min
Avg. Velocity = 0.86 fps, Avg. Travel Time= 5.1 min

Peak Storage= 115 cf @ 13.36 hrs
Average Depth at Peak Storage= 0.33'
Bank-Full Depth= 1.00' Flow Area= 2.0 sf, Capacity= 5.94 cfs

1.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 3.00'
Length= 263.0' Slope= 0.0152 '/'
Inlet Invert= 116.00', Outlet Invert= 112.00'



Reach R3:



Summary for Pond 4P: Zone #1

Inflow Area = 24.565 ac, 1.30% Impervious, Inflow Depth = 0.16" for WQ event
Inflow = 0.79 cfs @ 12.31 hrs, Volume= 0.318 af
Outflow = 0.78 cfs @ 13.40 hrs, Volume= 0.318 af, Atten= 1%, Lag= 65.2 min
Primary = 0.78 cfs @ 13.40 hrs, Volume= 0.318 af
Secondary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Starting Elev= 99.50' Surf.Area= 640 sf Storage= 210 cf
Peak Elev= 100.15' @ 13.40 hrs Surf.Area= 1,411 sf Storage= 861 cf (651 cf above start)

Plug-Flow detention time= 48.5 min calculated for 0.313 af (98% of inflow)
Center-of-Mass det. time= 30.8 min (978.4 - 947.6)

Volume	Invert	Avail.Storage	Storage Description
#1	98.50'	9,515 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

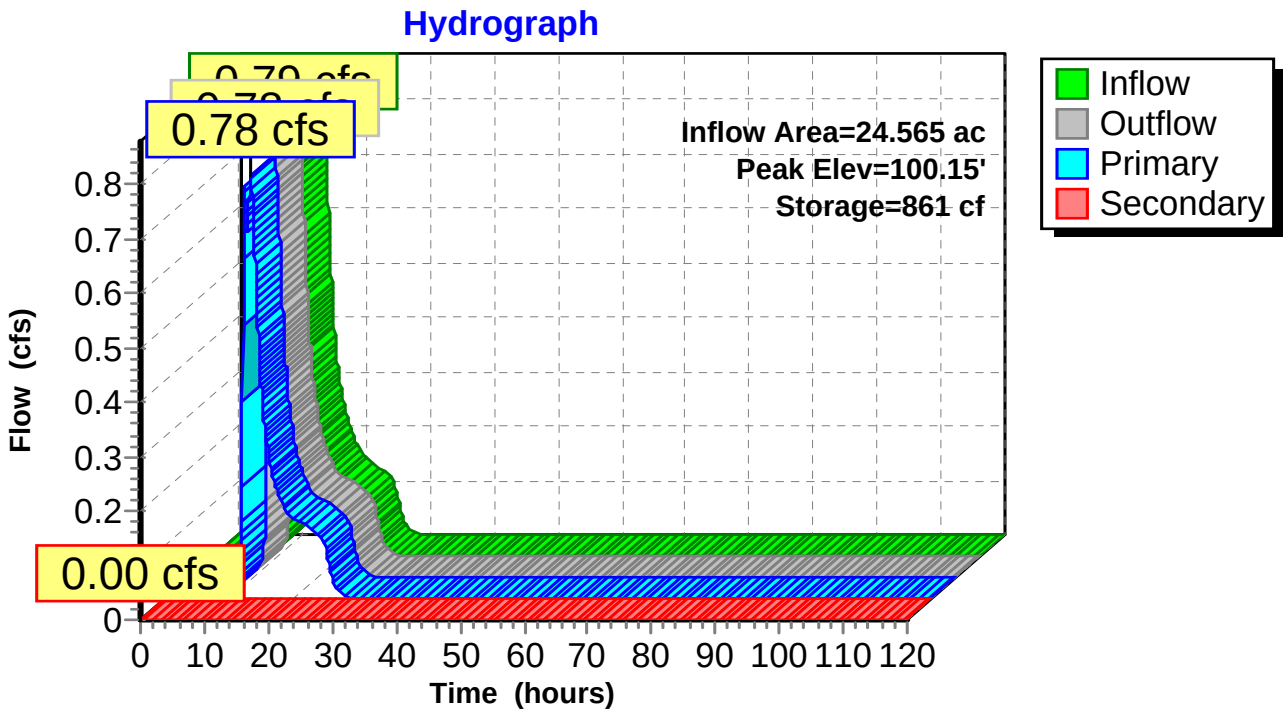
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
98.50	0	0	0
99.00	100	25	25
100.00	1,180	640	665
101.00	2,710	1,945	2,610
102.00	3,550	3,130	5,740
103.00	4,000	3,775	9,515

Device	Routing	Invert	Outlet Devices
#1	Primary	99.50'	**3.0" Vert. Orifice/Grate** C= 0.600
#2	Primary	100.00'	**12.0" Horiz. Orifice/Grate** C= 0.600 Limited to weir flow at low heads
#3	Secondary	101.00'	**5.0' long x 10.0' breadth Broad-Crested Rectangular Weir**
			Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60
			Coef. (English) 2.49 2.56 2.70 2.69 2.68 2.69 2.67 2.64

Primary OutFlow Max=0.78 cfs @ 13.40 hrs HW=100.15' (Free Discharge)
└─**1=Orifice/Grate** (Orifice Controls 0.17 cfs @ 3.49 fps)
└─**2=Orifice/Grate** (Weir Controls 0.60 cfs @ 1.27 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=99.50' (Free Discharge)
└─**3=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 4P: Zone #1



Summary for Pond 6P: downstream defender

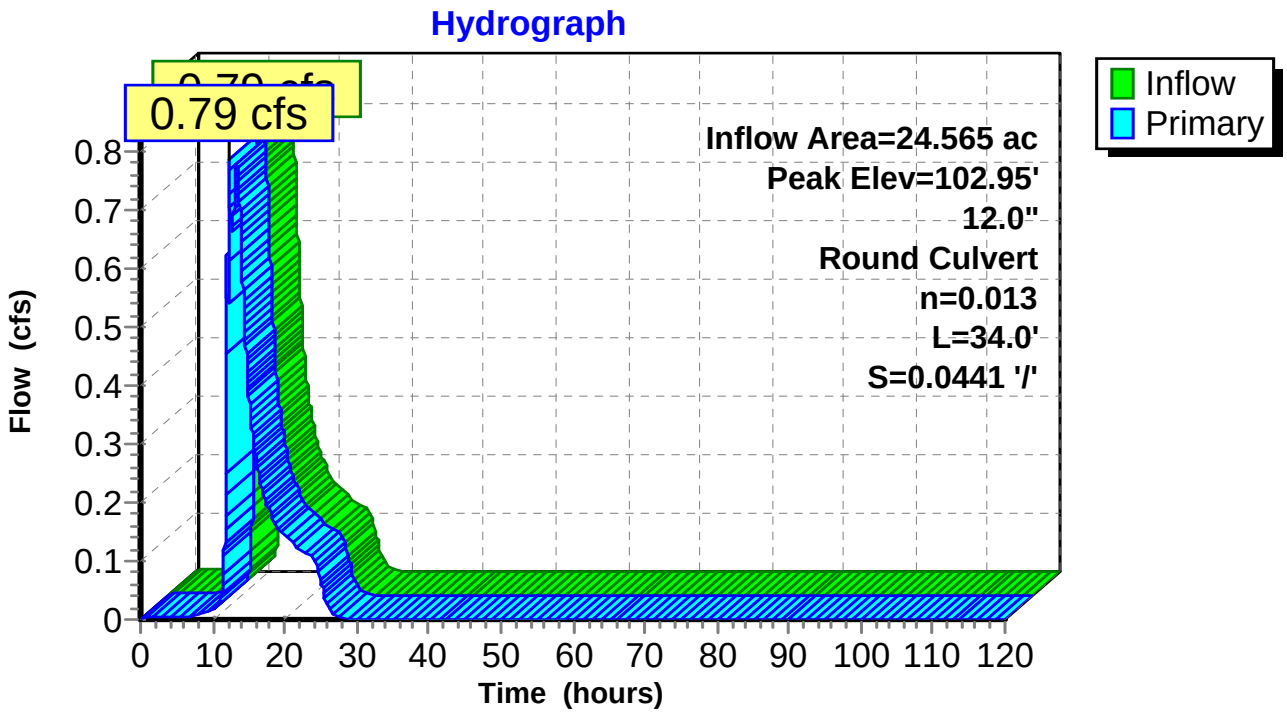
Inflow Area = 24.565 ac, 1.30% Impervious, Inflow Depth = 0.16" for WQ event
Inflow = 0.79 cfs @ 12.31 hrs, Volume= 0.318 af
Outflow = 0.79 cfs @ 12.31 hrs, Volume= 0.318 af, Atten= 0%, Lag= 0.0 min
Primary = 0.79 cfs @ 12.31 hrs, Volume= 0.318 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 102.95' @ 12.31 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	102.50'	**12.0" Round Culvert** L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 102.50' / 101.00' S= 0.0441 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.78 cfs @ 12.31 hrs HW=102.95' TW=100.14' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.78 cfs @ 2.28 fps)

Pond 6P: downstream defender



Summary for Pond 7P: new 18" to CB2

[57] Hint: Peaked at 108.08' (Flood elevation advised)

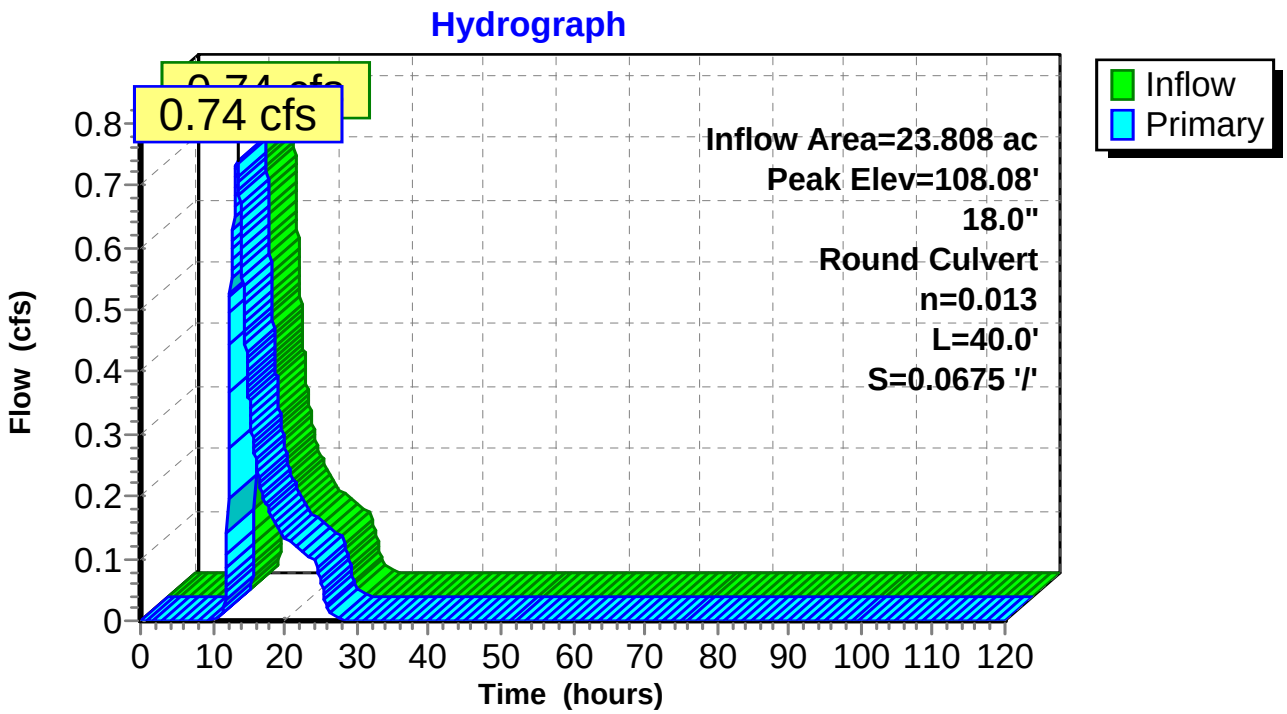
Inflow Area =	23.808 ac,	0.00% Impervious,	Inflow Depth =	0.14"	for WQ event
Inflow =	0.74 cfs @	13.36 hrs,	Volume=	0.274 af	
Outflow =	0.74 cfs @	13.36 hrs,	Volume=	0.274 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.74 cfs @	13.36 hrs,	Volume=	0.274 af	

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 108.08' @ 13.36 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	107.70'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 107.70' / 105.00' S= 0.0675 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.74 cfs @ 13.36 hrs HW=108.08' TW=104.43' (Dynamic Tailwater)
└─**1=Culvert** (Inlet Controls 0.74 cfs @ 2.10 fps)

Pond 7P: new 18" to CB2



Summary for Pond CB1:

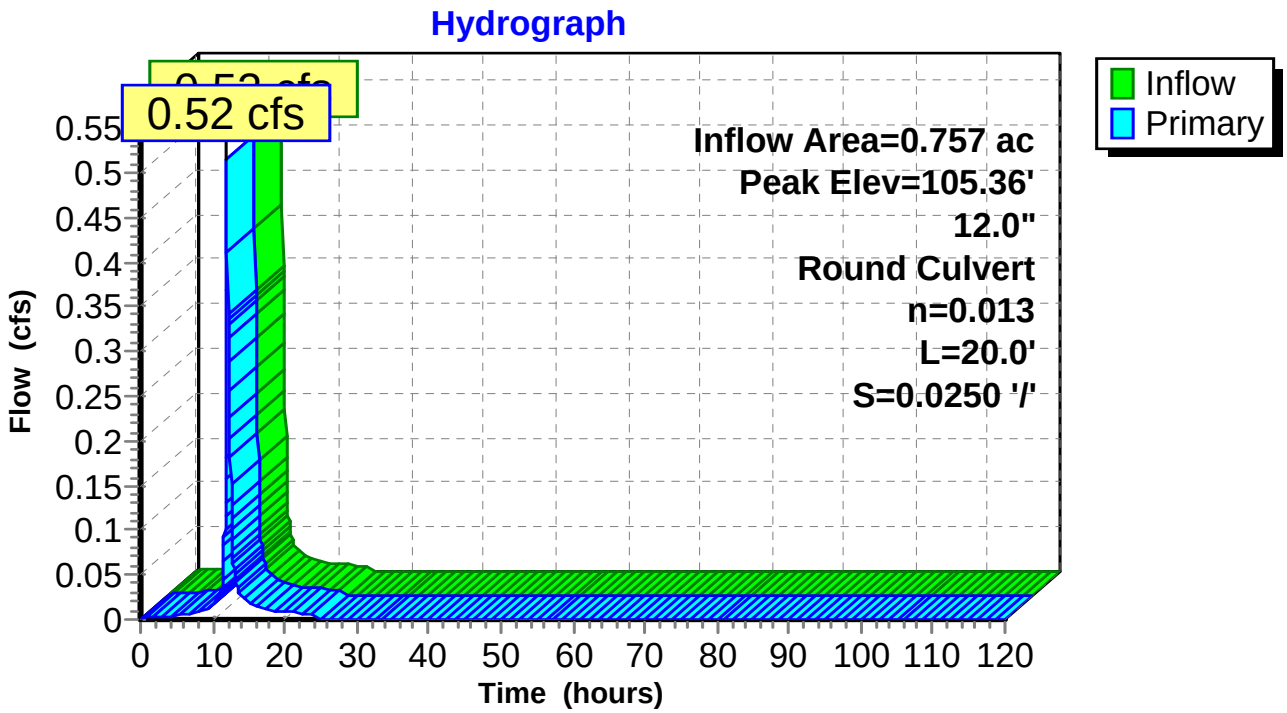
Inflow Area = 0.757 ac, 42.27% Impervious, Inflow Depth = 0.69" for WQ event
Inflow = 0.52 cfs @ 12.00 hrs, Volume= 0.044 af
Outflow = 0.52 cfs @ 12.00 hrs, Volume= 0.044 af, Atten= 0%, Lag= 0.0 min
Primary = 0.52 cfs @ 12.00 hrs, Volume= 0.044 af

Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 105.36' @ 12.00 hrs
Flood Elev= 107.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	105.00'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 104.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.51 cfs @ 12.00 hrs HW=105.35' TW=104.17' (Dynamic Tailwater)
└**1=Culvert** (Inlet Controls 0.51 cfs @ 2.03 fps)

Pond CB1:



Summary for Pond CB2:

Inflow Area =	24.565 ac,	1.30% Impervious,	Inflow Depth =	0.16"	for WQ event
Inflow =	0.79 cfs @	12.31 hrs,	Volume=	0.318 af	
Outflow =	0.79 cfs @	12.31 hrs,	Volume=	0.318 af,	Atten= 0%, Lag= 0.0 min
Primary =	0.79 cfs @	12.31 hrs,	Volume=	0.318 af	
Secondary =	0.00 cfs @	0.00 hrs,	Volume=	0.000 af	

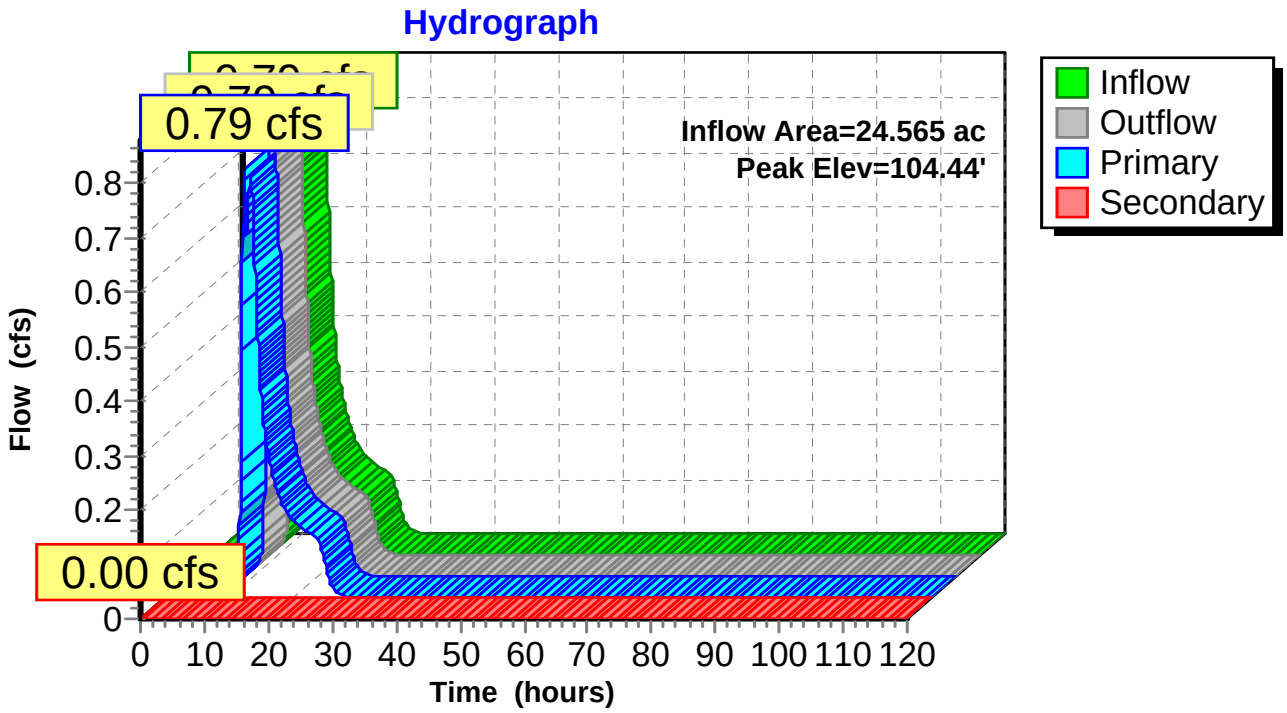
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 104.44' @ 12.31 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**12.0" Round Culvert** L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.50' / 102.50' S= 0.0833 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	103.50'	**6.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	105.00'	**18.0" Round Culvert** L= 78.2' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 103.00' S= 0.0256 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=0.78 cfs @ 12.31 hrs HW=104.43' TW=102.95' (Dynamic Tailwater)
└─**1=Culvert** (Passes 0.78 cfs of 2.51 cfs potential flow)
└─**2=Orifice/Grate** (Orifice Controls 0.78 cfs @ 3.98 fps)

Secondary OutFlow Max=0.00 cfs @ 0.00 hrs HW=103.50' TW=101.00' (Dynamic Tailwater)
└─**3=Culvert** (Controls 0.00 cfs)

Pond CB2:



Summary for Pond CB3:

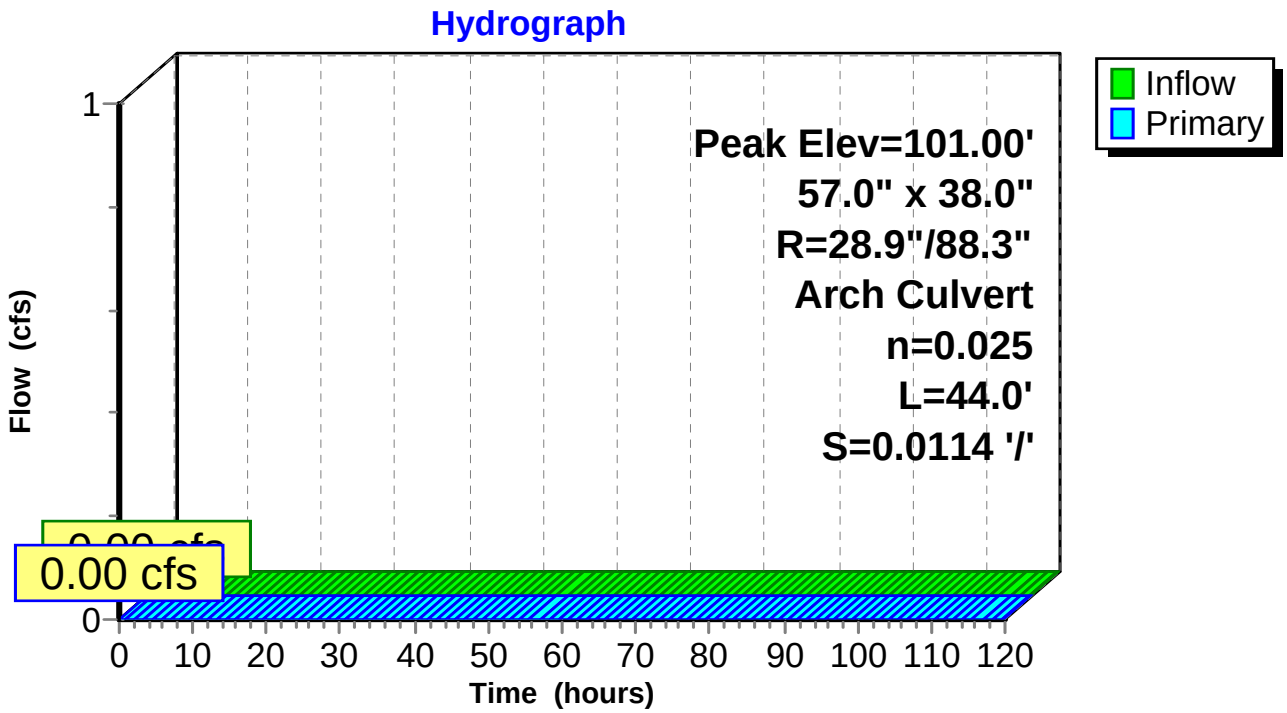
Inflow	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af
Outflow	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af, Atten= 0%, Lag= 0.0 min
Primary	=	0.00 cfs @	0.00 hrs, Volume=	0.000 af

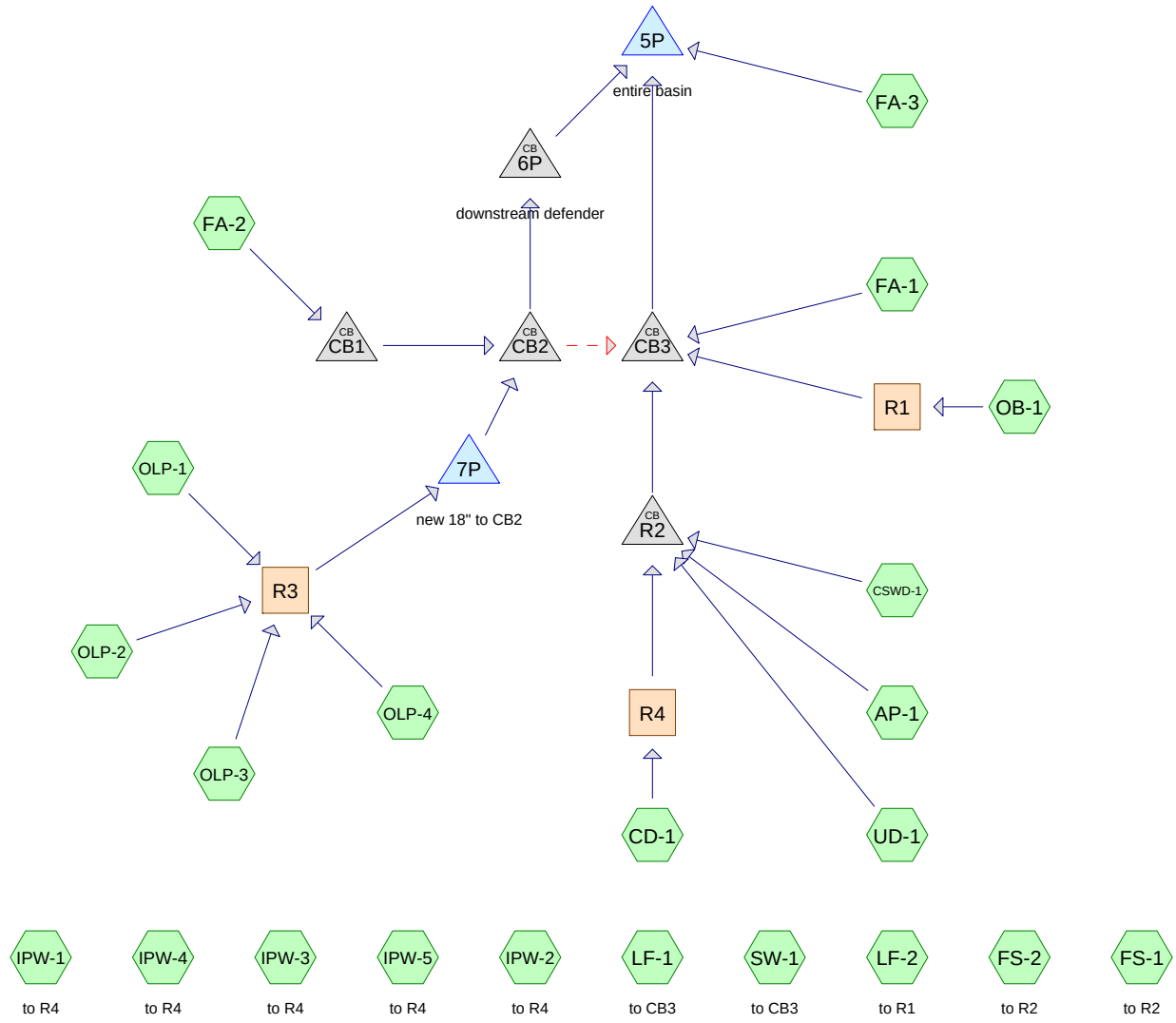
Routing by Dyn-Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.05 hrs
Peak Elev= 101.00' @ 0.00 hrs
Flood Elev= 107.50'

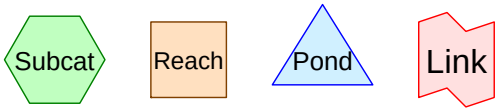
Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**57.0" W x 38.0" H, R=28.9"/88.3" Arch CMP_Arch_1/2 57x38** L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 101.00' / 100.50' S= 0.0114 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 11.89 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=101.00' (Free Discharge)
└─**1=CMP_Arch_1/2 57x38** (Controls 0.00 cfs)

Pond CB3:







Routing Diagram for Blanchard_6
Prepared by Watershed Consulting Associates, LLC, Printed 10/31/2012
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Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
68.194	98	(AP-1, CD-1, CSWD-1, FA-1, FA-2, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-1, OLP-2, OLP-3, OLP-4, SW-1, UD-1)
2.512	61	>75% Grass cover, Good, HSG B (AP-1, CD-1, IPW-4, IPW-5)
3.840	74	>75% Grass cover, Good, HSG C (CD-1, IPW-3, IPW-4, IPW-5, OB-1)
63.935	80	>75% Grass cover, Good, HSG D (AP-1, CD-1, CSWD-1, FA-1, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-1, OLP-2, OLP-3, OLP-4, SW-1, UD-1)
1.790	55	Woods, Good, HSG B (AP-1, IPW-5)
0.255	70	Woods, Good, HSG C (OB-1)
65.431	77	Woods, Good, HSG D (AP-1, CD-1, CSWD-1, FA-1, FA-2, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-3, OLP-4, SW-1, UD-1)
0.940	100	water (LF-1)
206.897	**85**	**TOTAL AREA**

Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.000	HSG A	
4.302	HSG B	AP-1, CD-1, IPW-4, IPW-5
4.095	HSG C	CD-1, IPW-3, IPW-4, IPW-5, OB-1
129.366	HSG D	AP-1, CD-1, CSWD-1, FA-1, FA-2, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-1, OLP-2, OLP-3, OLP-4, SW-1, UD-1
69.134	Other	AP-1, CD-1, CSWD-1, FA-1, FA-2, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-1, OLP-2, OLP-3, OLP-4, SW-1, UD-1
206.897		**TOTAL AREA**

Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.000	0.000	0.000	0.000	68.194	68.194		AP-1, CD-1, CSWD-1, FA-1, FA-2, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-1, OLP-2, OLP-3, OLP-4, SW-1, UD-1
0.000	2.512	3.840	63.935	0.000	70.287	>75% Grass cover, Good	AP-1, CD-1, CSWD-1, FA-1, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-1, OLP-2, OLP-3, OLP-4, SW-1, UD-1
0.000	1.790	0.255	65.431	0.000	67.476	Woods, Good	AP-1, CD-1, CSWD-1, FA-1, FA-2, FA-3, FS-1, FS-2, IPW-1, IPW-2, IPW-3, IPW-4, IPW-5, LF-1, LF-2, OB-1, OLP-3, OLP-4, SW-1, UD-1
0.000	0.000	0.000	0.000	0.940	0.940	water	LF-1
0.000	**4.302**	**4.095**	**129.366**	**69.134**	**206.897**	**TOTAL AREA**	

Pipe Listing (all nodes)

Line#	Node Number	In-Invert (feet)	Out-Invert (feet)	Length (feet)	Slope (ft/ft)	n	Diam/Width (inches)	Height (inches)	Inside-Fill (inches)
1	IPW-5	0.00	0.00	502.0	0.0199	0.020	24.0	0.0	0.0
2	OB-1	0.00	0.00	618.0	0.0291	0.020	18.0	0.0	0.0
3	SW-1	0.00	0.00	1,109.0	0.0216	0.010	15.0	0.0	0.0
4	5P	98.75	98.00	30.0	0.0250	0.011	49.0	33.0	0.0
5	6P	104.50	101.00	34.0	0.1029	0.013	12.0	0.0	0.0
6	7P	107.70	105.00	40.0	0.0675	0.013	18.0	0.0	0.0
7	CB1	105.00	104.50	20.0	0.0250	0.013	12.0	0.0	0.0
8	CB2	103.50	102.50	12.0	0.0833	0.010	6.0	0.0	0.0
9	CB2	105.00	103.00	78.2	0.0256	0.013	18.0	0.0	0.0
10	CB3	101.00	100.50	44.0	0.0114	0.025	57.0	38.0	0.0
11	R2	130.00	106.00	1,307.0	0.0184	0.020	36.0	0.0	0.0

Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment AP-1: Runoff Area=19.690 ac 43.93% Impervious Runoff Depth=0.70"
Flow Length=3,161' Tc=34.1 min CN=84 Runoff=9.35 cfs 1.151 af

Subcatchment CD-1: Runoff Area=27.630 ac 23.85% Impervious Runoff Depth=0.65"
Flow Length=951' Tc=39.8 min CN=83 Runoff=11.03 cfs 1.507 af

Subcatchment CSWD-1: Runoff Area=2.207 ac 62.98% Impervious Runoff Depth=1.11"
Flow Length=580' Tc=34.2 min CN=91 Runoff=1.73 cfs 0.204 af

Subcatchment FA-1: Runoff Area=0.935 ac 42.67% Impervious Runoff Depth=0.86"
Flow Length=609' Tc=12.9 min CN=87 Runoff=0.92 cfs 0.067 af

Subcatchment FA-2: Runoff Area=0.320 ac 99.37% Impervious Runoff Depth=1.71"
Flow Length=781' Tc=3.2 min CN=98 Runoff=0.93 cfs 0.046 af

Subcatchment FA-3: Runoff Area=1.715 ac 53.35% Impervious Runoff Depth=0.98"
Flow Length=386' Tc=21.1 min CN=89 Runoff=1.53 cfs 0.140 af

Subcatchment FS-1: to R2 Runoff Area=5.970 ac 87.94% Impervious Runoff Depth=1.52"
Flow Length=538' Tc=30.0 min CN=96 Runoff=6.72 cfs 0.754 af

Subcatchment FS-2: to R2 Runoff Area=2.322 ac 1.42% Impervious Runoff Depth=0.45"
Flow Length=339' Tc=45.5 min CN=78 Runoff=0.54 cfs 0.087 af

Subcatchment IPW-1: to R4 Runoff Area=4.040 ac 48.51% Impervious Runoff Depth=0.92"
Flow Length=616' Tc=31.2 min CN=88 Runoff=2.72 cfs 0.309 af

Subcatchment IPW-2: to R4 Runoff Area=1.716 ac 72.26% Impervious Runoff Depth=1.26"
Flow Length=462' Tc=34.0 min CN=93 Runoff=1.53 cfs 0.180 af

Subcatchment IPW-3: to R4 Runoff Area=3.559 ac 41.87% Impervious Runoff Depth=0.86"
Flow Length=931' Tc=33.1 min CN=87 Runoff=2.15 cfs 0.255 af

Subcatchment IPW-4: to R4 Runoff Area=15.861 ac 63.42% Impervious Runoff Depth=1.11"
Flow Length=928' Tc=8.1 min CN=91 Runoff=25.34 cfs 1.469 af

Subcatchment IPW-5: to R4 Runoff Area=44.940 ac 17.36% Impervious Runoff Depth=0.57"
Flow Length=2,708' Tc=45.6 min CN=81 Runoff=13.92 cfs 2.123 af

Subcatchment LF-1: to CB3 Runoff Area=9.880 ac 51.42% Impervious Runoff Depth=0.98"
Flow Length=912' Tc=29.2 min CN=89 Runoff=7.41 cfs 0.806 af

Subcatchment LF-2: to R1 Runoff Area=3.202 ac 14.12% Impervious Runoff Depth=0.57"
Flow Length=292' Tc=29.4 min CN=81 Runoff=1.26 cfs 0.151 af

Subcatchment OB-1: Runoff Area=17.975 ac 35.83% Impervious Runoff Depth=0.75"
Flow Length=824' Tc=36.7 min CN=85 Runoff=8.83 cfs 1.126 af

Subcatchment OLP-1: Runoff Area=0.437 ac 64.07% Impervious Runoff Depth=1.18"
Flow Length=367' Tc=19.6 min CN=92 Runoff=0.49 cfs 0.043 af

Subcatchment OLP-2: Runoff Area=1.360 ac 41.18% Impervious Runoff Depth=0.86"
Flow Length=597' Tc=23.9 min CN=87 Runoff=0.99 cfs 0.097 af

Subcatchment OLP-3: Runoff Area=2.338 ac 40.12% Impervious Runoff Depth=0.86"
Flow Length=452' Tc=78.5 min CN=87 Runoff=0.84 cfs 0.167 af

Subcatchment OLP-4: Runoff Area=20.110 ac 5.62% Impervious Runoff Depth=0.49"
Flow Length=2,651' Tc=105.7 min CN=79 Runoff=2.96 cfs 0.817 af

Subcatchment SW-1: to CB3 Runoff Area=17.540 ac 44.64% Impervious Runoff Depth=0.92"
Flow Length=1,572' Tc=43.4 min CN=88 Runoff=9.82 cfs 1.341 af

Subcatchment UD-1: Runoff Area=3.150 ac 10.48% Impervious Runoff Depth=0.53"
Flow Length=449' Tc=36.4 min CN=80 Runoff=1.01 cfs 0.138 af

Reach R1: Avg. Flow Depth=0.64' Max Vel=2.12 fps Inflow=8.83 cfs 1.126 af
n=0.070 L=821.0' S=0.0244 '/' Capacity=486.72 cfs Outflow=8.56 cfs 1.126 af

Reach R3: Avg. Flow Depth=0.45' Max Vel=2.68 fps Inflow=3.79 cfs 1.125 af
n=0.040 L=263.0' S=0.0240 '/' Capacity=18.60 cfs Outflow=3.78 cfs 1.125 af

Reach R4: Avg. Flow Depth=0.55' Max Vel=3.54 fps Inflow=11.03 cfs 1.507 af
n=0.040 L=960.0' S=0.0250 '/' Capacity=29.52 cfs Outflow=10.90 cfs 1.507 af

Pond 5P: entire basin Peak Elev=100.76' Storage=3,221 cf Inflow=32.79 cfs 5.504 af
49.0" x 33.0", R=25.1"/77.3" Arch Culvert n=0.011 L=30.0' S=0.0250 '/' Outflow=32.45 cfs 5.504 af

Pond 6P: downstream defender Peak Elev=105.11' Inflow=1.33 cfs 0.817 af
12.0" Round Culvert n=0.013 L=34.0' S=0.1029 '/' Outflow=1.33 cfs 0.817 af

Pond 7P: new 18" to CB2 Peak Elev=108.63' Storage=150 cf Inflow=3.78 cfs 1.125 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0675 '/' Outflow=3.78 cfs 1.125 af

Pond CB1: Peak Elev=105.50' Inflow=0.93 cfs 0.046 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0250 '/' Outflow=0.93 cfs 0.046 af

Pond CB2: Peak Elev=105.73' Inflow=3.81 cfs 1.170 af
Primary=1.33 cfs 0.817 af Secondary=2.48 cfs 0.354 af Outflow=3.81 cfs 1.170 af

Pond CB3: Peak Elev=102.92' Inflow=30.84 cfs 4.547 af
57.0" x 38.0", R=28.9"/88.3" Arch Culvert n=0.025 L=44.0' S=0.0114 '/' Outflow=30.84 cfs 4.547 af

Pond R2: Peak Elev=132.16' Inflow=21.50 cfs 3.001 af
36.0" Round Culvert n=0.020 L=1,307.0' S=0.0184 '/' Outflow=21.50 cfs 3.001 af

Total Runoff Area = 206.897 ac Runoff Volume = 12.979 af Average Runoff Depth = 0.75"
66.59% Pervious = 137.763 ac 33.41% Impervious = 69.134 ac

Summary for Subcatchment AP-1:

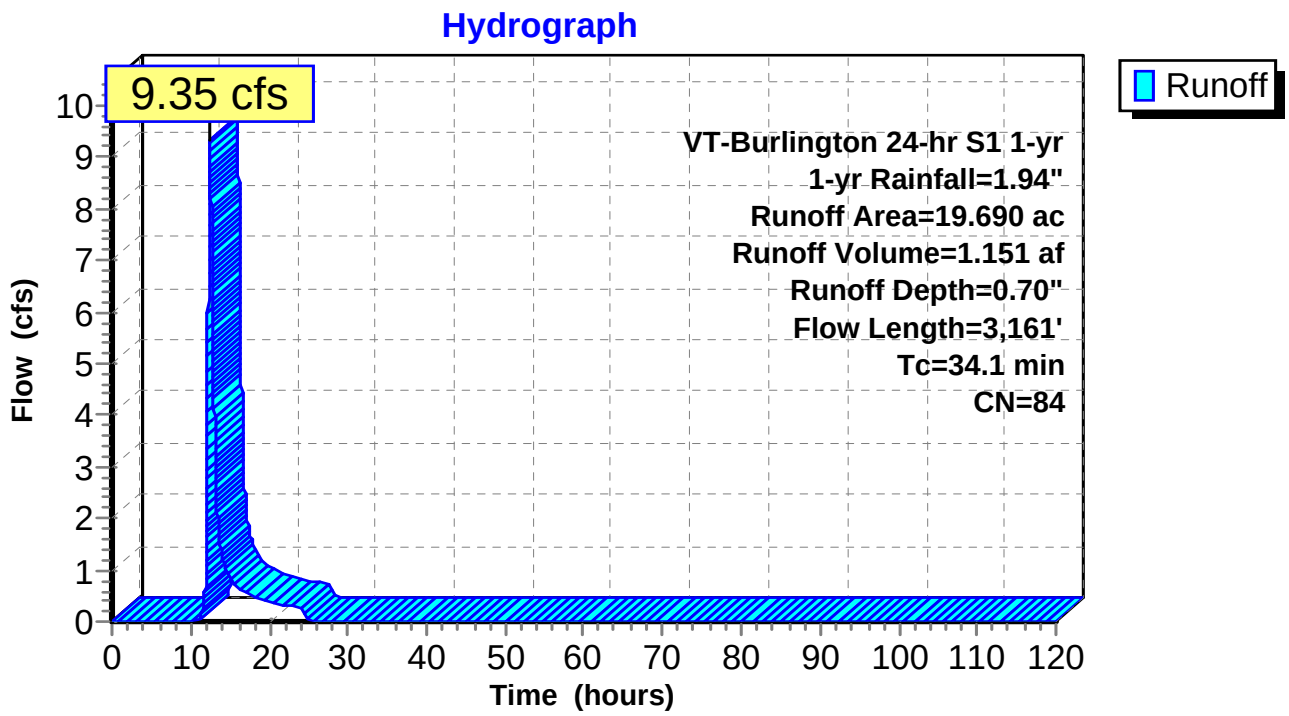
Runoff = 9.35 cfs @ 12.46 hrs, Volume= 1.151 af, Depth= 0.70"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	8.650	98	
	3.740	80	>75% Grass cover, Good, HSG D
	1.610	61	>75% Grass cover, Good, HSG B
	4.550	77	Woods, Good, HSG D
	1.140	55	Woods, Good, HSG B
	19.690	84	Weighted Average
	11.040		56.07% Pervious Area
	8.650		43.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.1	100	0.1500	0.08		**Sheet Flow, AP1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
14.0	3,061	0.0137	3.64	21.85	**Trap/Vee/Rect Channel Flow, AP1B** Bot.W=5.00' D=1.00' Z= 1.0 '/' Top.W=7.00' n= 0.040 Earth, cobble bottom, clean sides
34.1	3,161	Total			

Subcatchment AP-1:



Summary for Subcatchment CD-1:

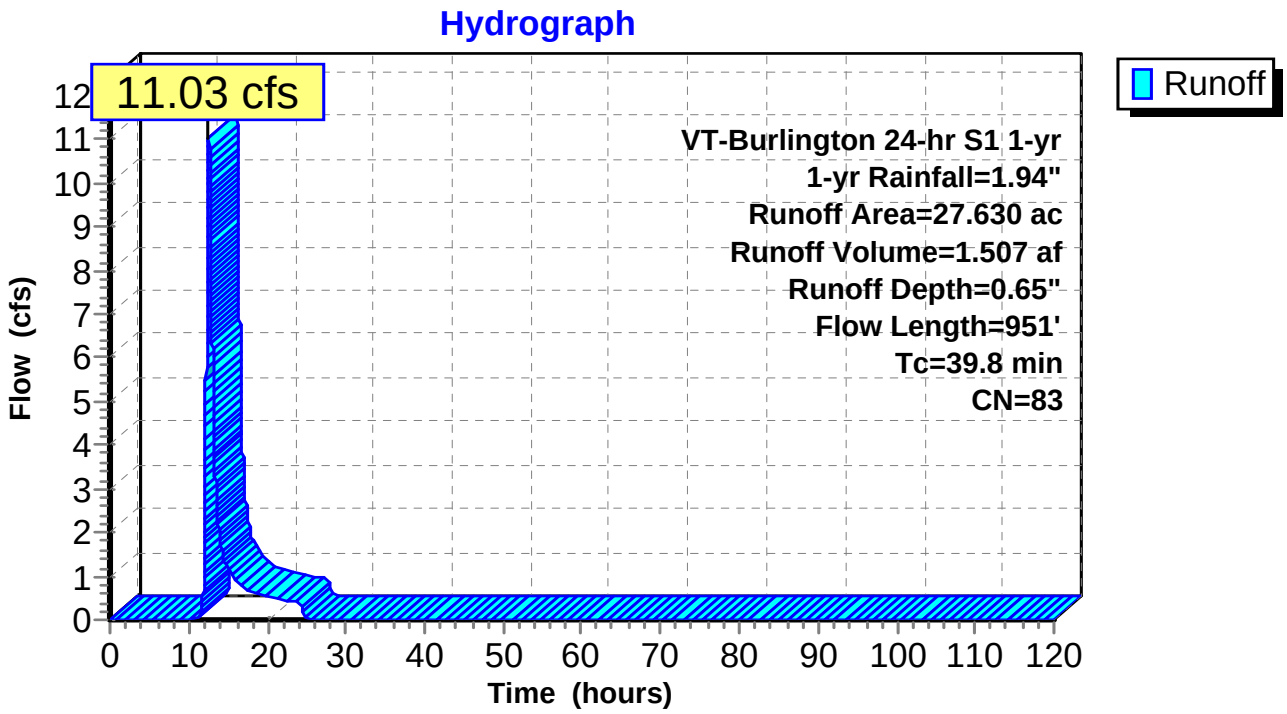
Runoff = 11.03 cfs @ 12.55 hrs, Volume= 1.507 af, Depth= 0.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	6.590	98	
	11.660	80	>75% Grass cover, Good, HSG D
	2.050	74	>75% Grass cover, Good, HSG C
	0.220	61	>75% Grass cover, Good, HSG B
	7.110	77	Woods, Good, HSG D
	27.630	83	Weighted Average
	21.040		76.15% Pervious Area
	6.590		23.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	42	0.0239	0.09		**Sheet Flow, CD1A** Grass: Dense n= 0.240 P2= 2.20"
23.6	58	0.0343	0.04		**Sheet Flow, CD1B** Woods: Dense underbrush n= 0.800 P2= 2.20"
6.1	252	0.0753	0.69		**Shallow Concentrated Flow, CD1C** Forest w/Heavy Litter Kv= 2.5 fps
1.5	165	0.0726	1.89		**Shallow Concentrated Flow, CD1D** Short Grass Pasture Kv= 7.0 fps
0.6	433	0.0370	11.59	23.18	**Trap/Vee/Rect Channel Flow, CD1E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
39.8	951	Total			

Subcatchment CD-1:



Summary for Subcatchment CSWD-1:

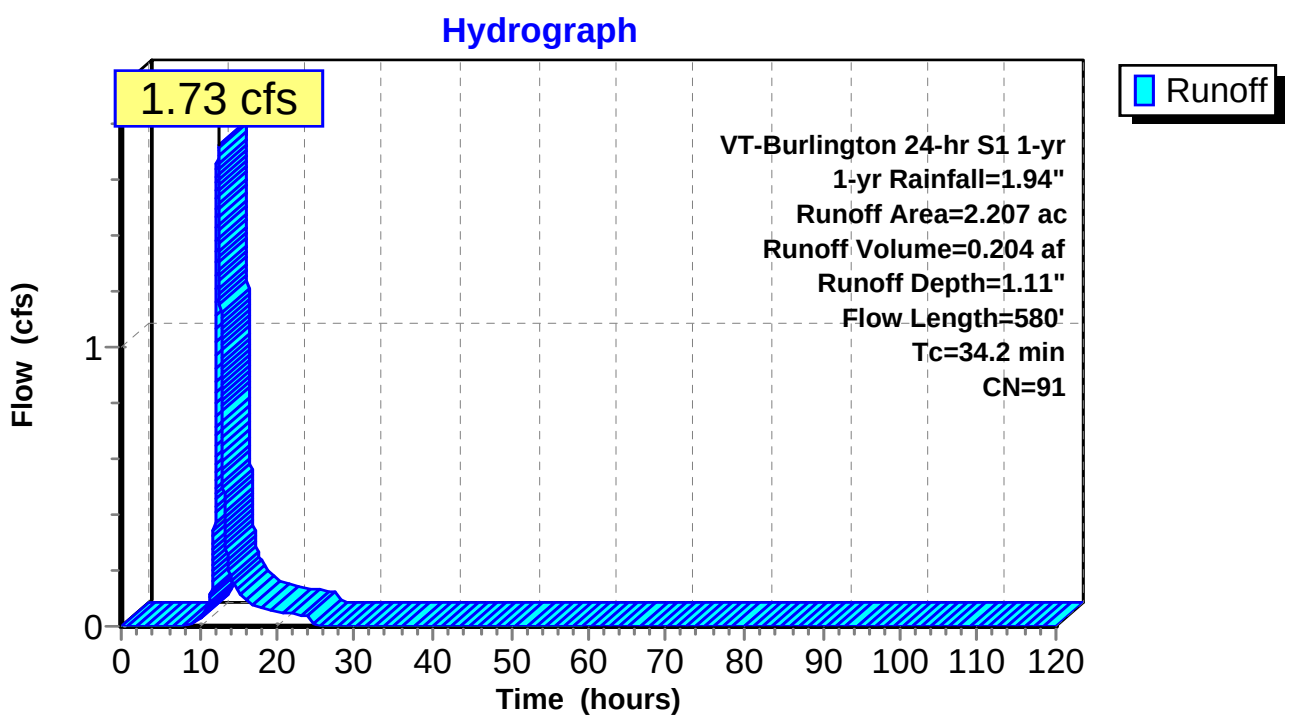
Runoff = 1.73 cfs @ 12.43 hrs, Volume= 0.204 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	1.390	98	
	0.740	80	>75% Grass cover, Good, HSG D
	0.077	77	Woods, Good, HSG D
	2.207	91	Weighted Average
	0.817		37.02% Pervious Area
	1.390		62.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0100	0.07		**Sheet Flow, CSWD1A** Grass: Dense n= 0.240 P2= 2.20"
3.9	166	0.0100	0.70		**Shallow Concentrated Flow, CSWD1B** Short Grass Pasture Kv= 7.0 fps
7.6	314	0.0096	0.68		**Shallow Concentrated Flow, CSWD1C** Short Grass Pasture Kv= 7.0 fps
34.2	580	Total			

Subcatchment CSWD-1:



Summary for Subcatchment FA-1:

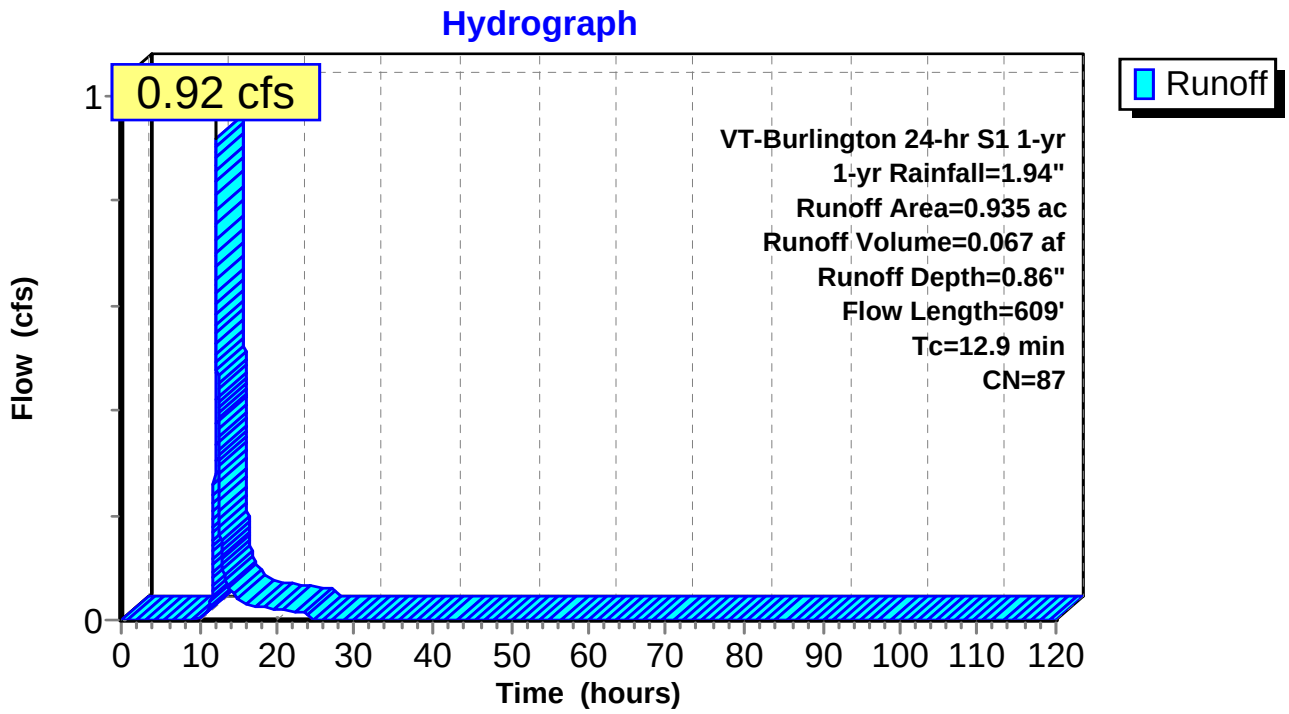
Runoff = 0.92 cfs @ 12.14 hrs, Volume= 0.067 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.399	98	
	0.316	80	>75% Grass cover, Good, HSG D
	0.220	77	Woods, Good, HSG D
	0.935	87	Weighted Average
	0.536		57.33% Pervious Area
	0.399		42.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	42	0.0954	0.06		**Sheet Flow, FA1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
0.9	567	0.0282	10.12	20.23	**Trap/Vee/Rect Channel Flow, FA1B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
12.9	609	Total			

Subcatchment FA-1:



Summary for Subcatchment FA-2:

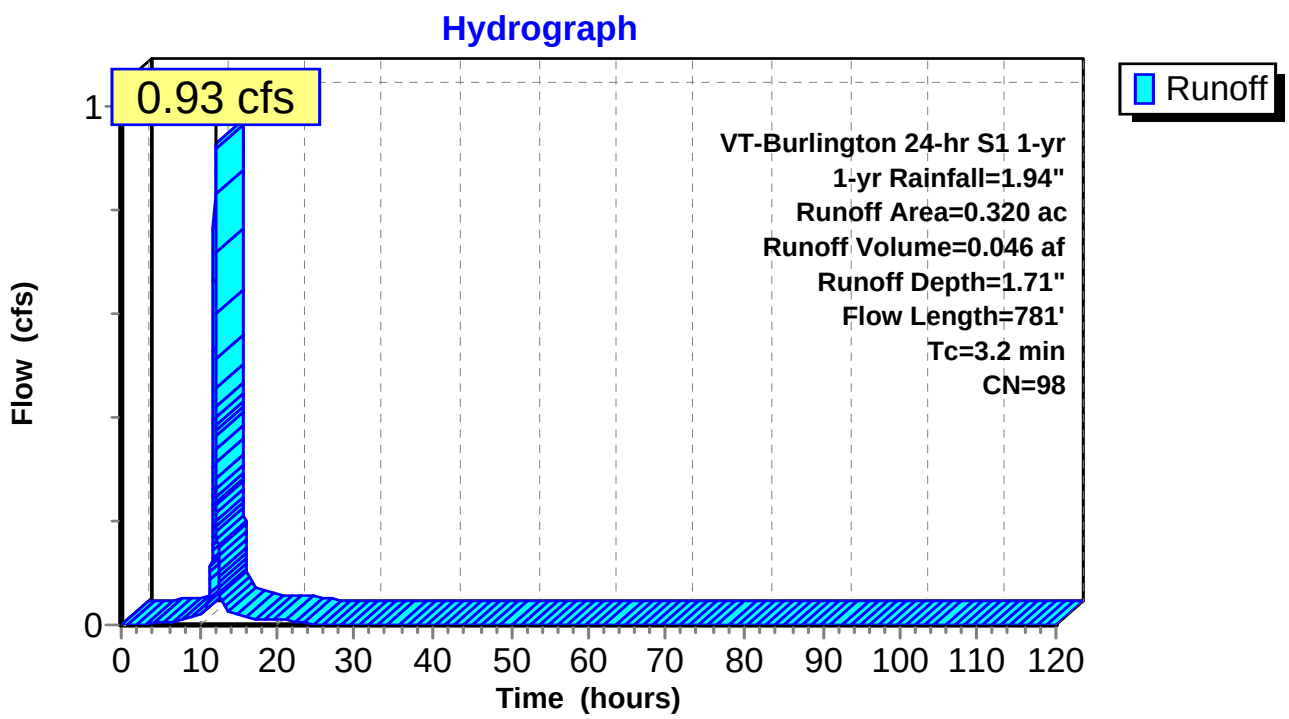
Runoff = 0.93 cfs @ 12.01 hrs, Volume= 0.046 af, Depth= 1.71"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.318	98	
	0.002	77	Woods, Good, HSG D
	0.320	98	Weighted Average
	0.002		0.63% Pervious Area
	0.318		99.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	100	0.0100	0.86		**Sheet Flow, FA2A** Smooth Surfaces n= 0.011 P2= 2.20"
1.3	681	0.0220	8.94	17.87	**Trap/Vee/Rect Channel Flow, FA2B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
3.2	781	Total			

Subcatchment FA-2:



Summary for Subcatchment FA-3:

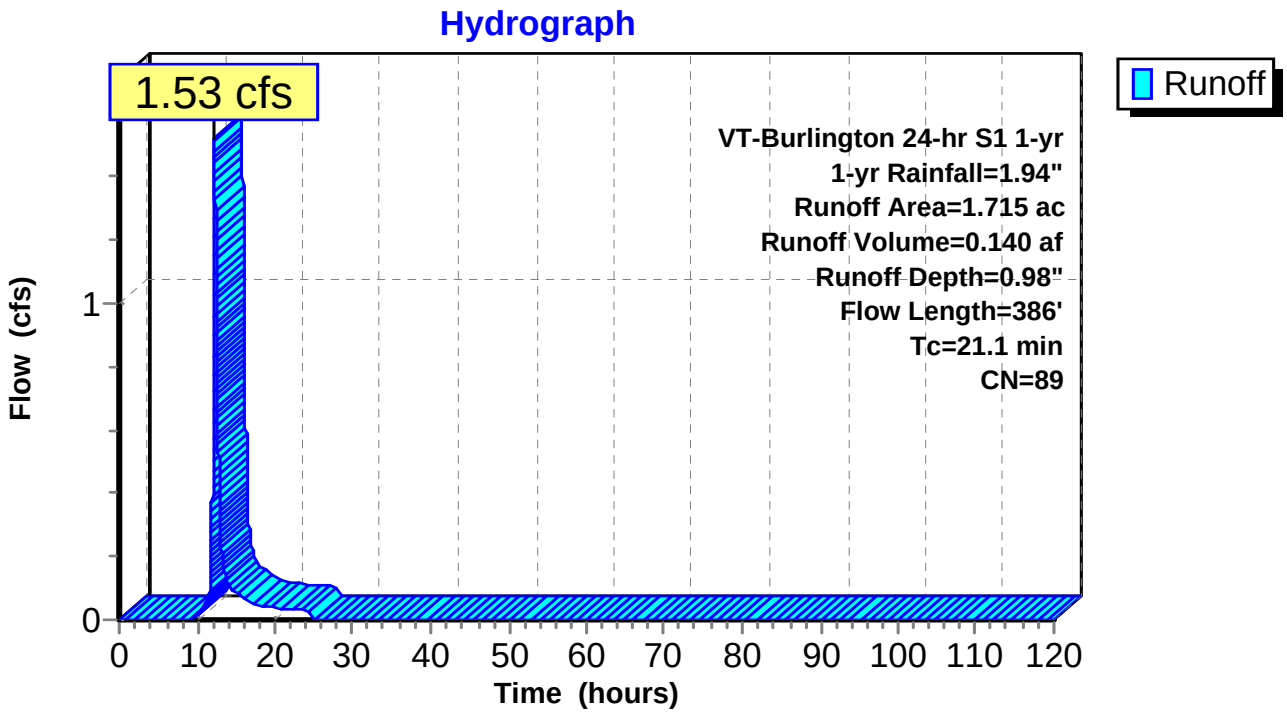
Runoff = 1.53 cfs @ 12.26 hrs, Volume= 0.140 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.915	98	
	0.487	80	>75% Grass cover, Good, HSG D
	0.313	77	Woods, Good, HSG D
	1.715	89	Weighted Average
	0.800		46.65% Pervious Area
	0.915		53.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	60	0.0500	0.13		**Sheet Flow, FA3A** Grass: Dense n= 0.240 P2= 2.20"
10.9	40	0.0100	0.06		**Sheet Flow, FA3B** Grass: Dense n= 0.240 P2= 2.20"
0.7	53	0.0376	1.36		**Shallow Concentrated Flow, FA3C** Short Grass Pasture Kv= 7.0 fps
1.1	43	0.0695	0.66		**Shallow Concentrated Flow, FA3D** Forest w/Heavy Litter Kv= 2.5 fps
0.5	190	0.0578	5.79	11.59	**Trap/Vee/Rect Channel Flow, FA3E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
21.1	386	Total			

Subcatchment FA-3:



Summary for Subcatchment FS-1: to R2

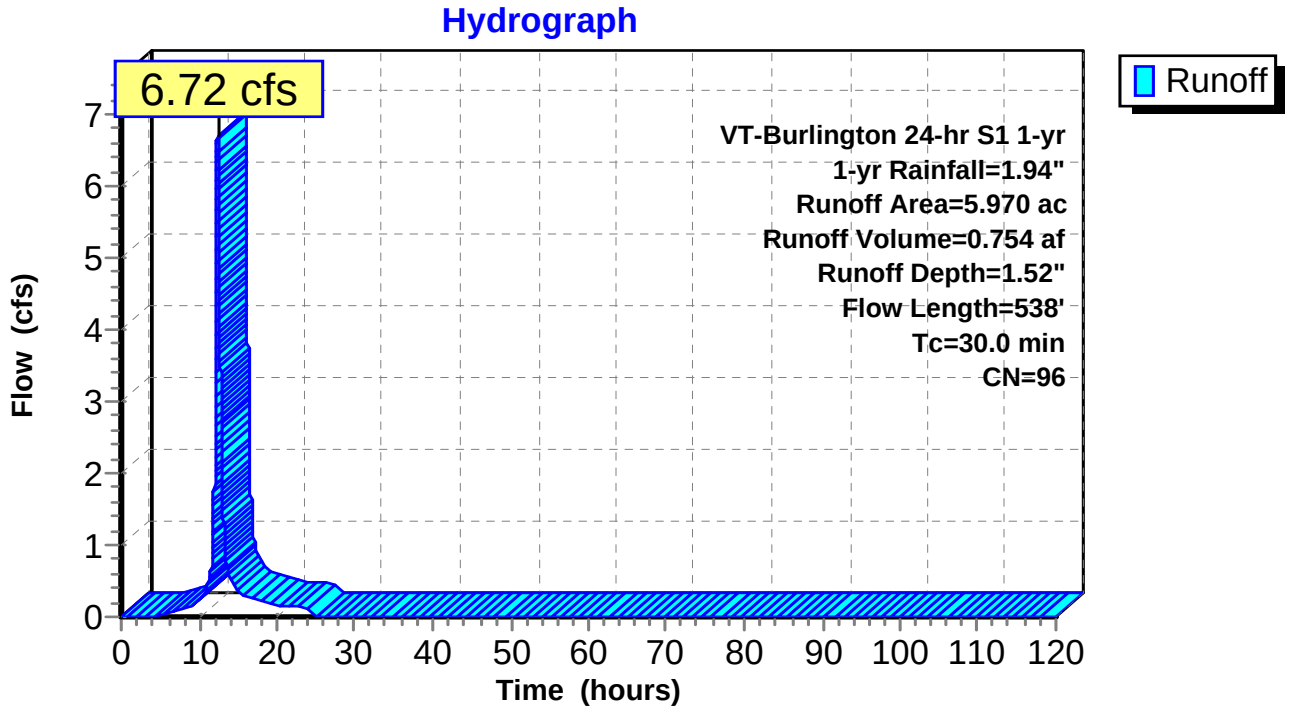
Runoff = 6.72 cfs @ 12.36 hrs, Volume= 0.754 af, Depth= 1.52"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	5.250	98	
	0.570	80	>75% Grass cover, Good, HSG D
	0.150	77	Woods, Good, HSG D
	5.970	96	Weighted Average
	0.720		12.06% Pervious Area
	5.250		87.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0100	0.07		**Sheet Flow, FS1A** Grass: Dense n= 0.240 P2= 2.20"
0.9	39	0.0100	0.70		**Shallow Concentrated Flow, FS1B** Short Grass Pasture Kv= 7.0 fps
1.3	56	0.0100	0.70		**Shallow Concentrated Flow, FS1C** Short Grass Pasture Kv= 7.0 fps
5.1	344	0.0262	1.13		**Shallow Concentrated Flow, FS1D** Short Grass Pasture Kv= 7.0 fps
30.0	538	Total			

Subcatchment FS-1: to R2



Summary for Subcatchment FS-2: to R2

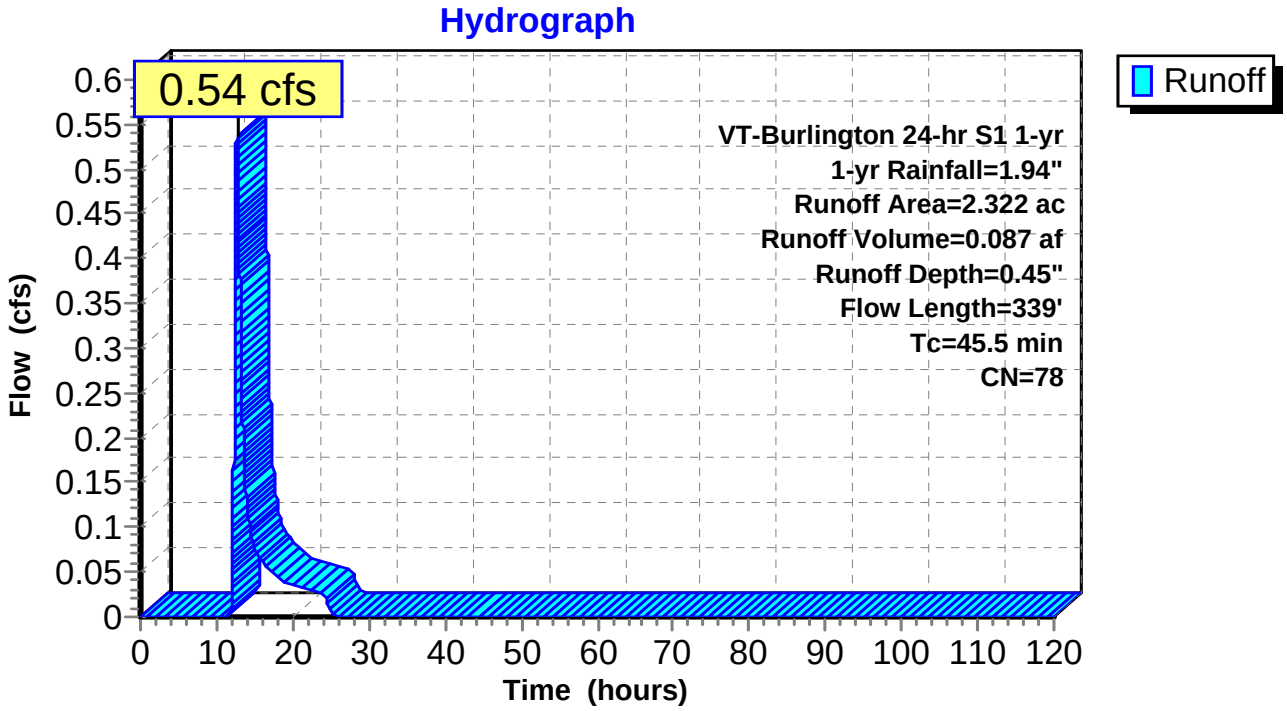
Runoff = 0.54 cfs @ 12.69 hrs, Volume= 0.087 af, Depth= 0.45"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.033	98	
	0.589	80	>75% Grass cover, Good, HSG D
	1.700	77	Woods, Good, HSG D
	2.322	78	Weighted Average
	2.289		98.58% Pervious Area
	0.033		1.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	100	0.0500	0.05		**Sheet Flow, FS2A** Woods: Dense underbrush n= 0.800 P2= 2.20"
14.2	239	0.0125	0.28		**Shallow Concentrated Flow, FS2B** Forest w/Heavy Litter Kv= 2.5 fps
45.5	339	Total			

Subcatchment FS-2: to R2



Summary for Subcatchment IPW-1: to R4

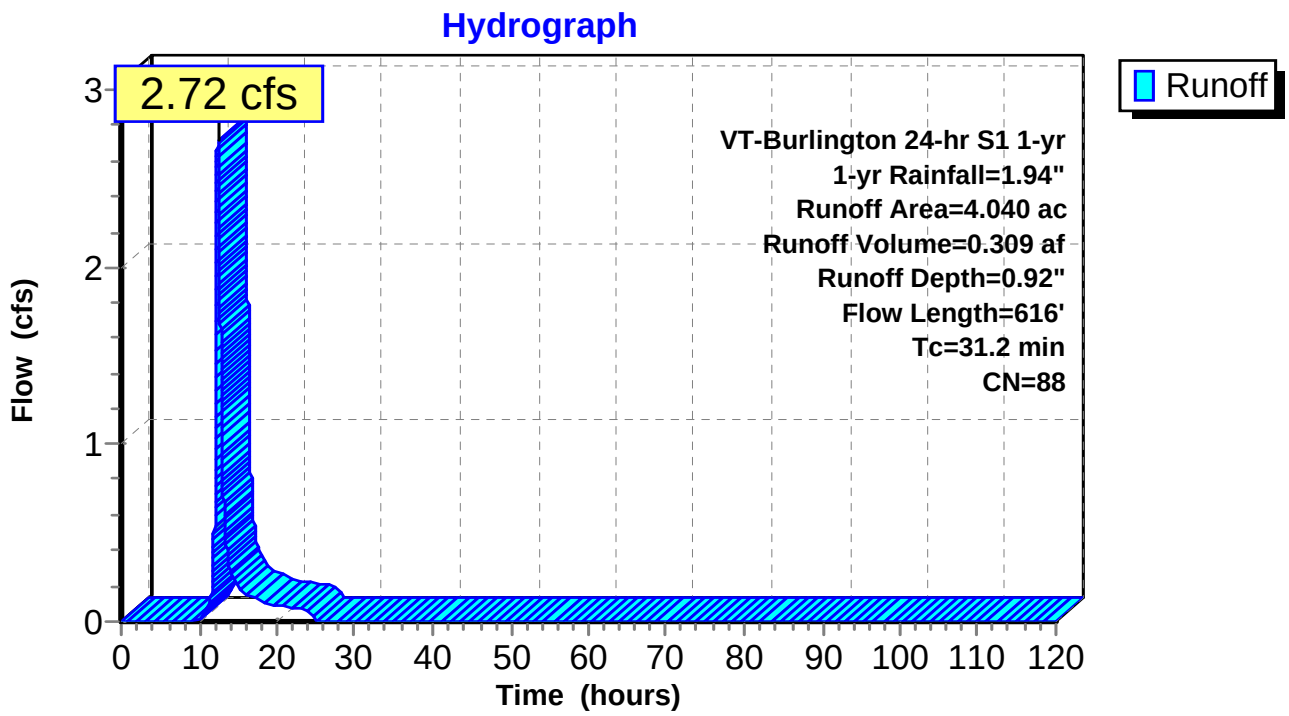
Runoff = 2.72 cfs @ 12.38 hrs, Volume= 0.309 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	1.960	98	
	1.300	80	>75% Grass cover, Good, HSG D
	0.780	77	Woods, Good, HSG D
	4.040	88	Weighted Average
	2.080		51.49% Pervious Area
	1.960		48.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0600	0.06		**Sheet Flow, IPW1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
0.7	40	0.1512	0.97		**Shallow Concentrated Flow, IPW1B** Forest w/Heavy Litter Kv= 2.5 fps
1.4	476	0.0168	5.68	11.36	**Trap/Vee/Rect Channel Flow, IPW1C** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.022 Earth, clean & straight
31.2	616	Total			

Subcatchment IPW-1: to R4



Summary for Subcatchment IPW-2: to R4

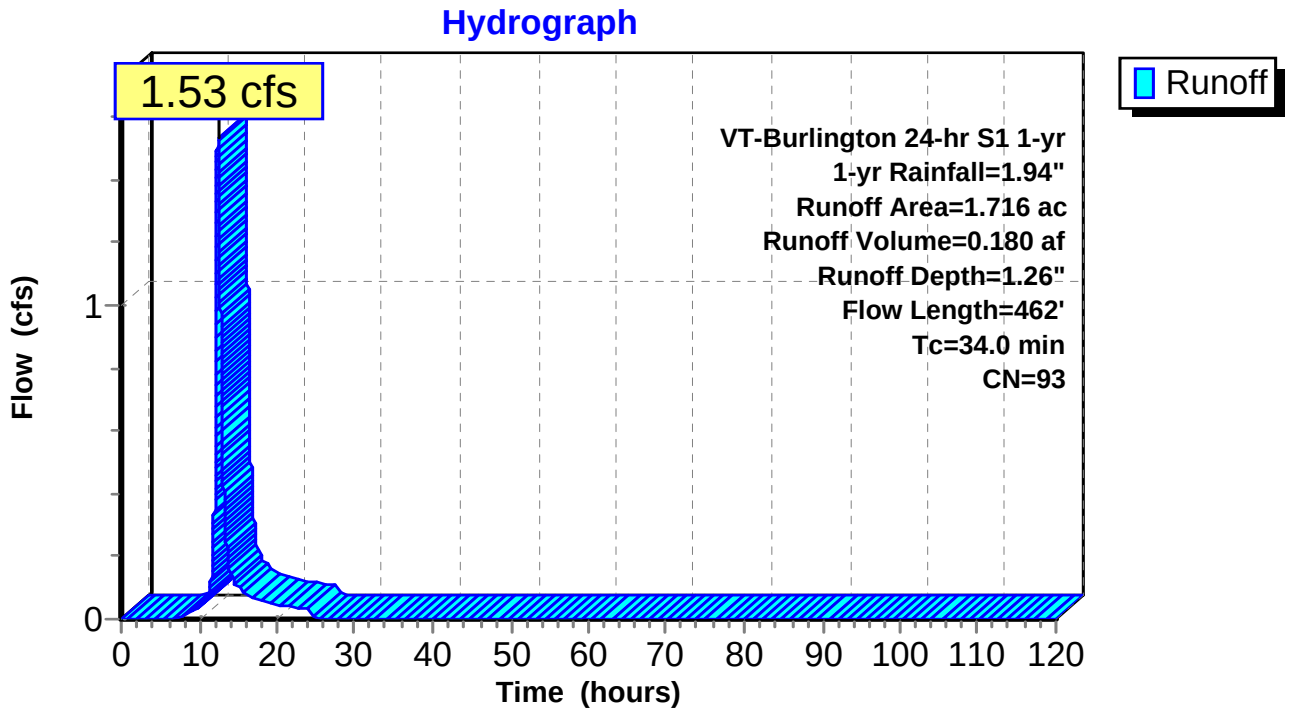
Runoff = 1.53 cfs @ 12.43 hrs, Volume= 0.180 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	1.240	98	
	0.246	80	>75% Grass cover, Good, HSG D
	0.230	77	Woods, Good, HSG D
	1.716	93	Weighted Average
	0.476		27.74% Pervious Area
	1.240		72.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.7	67	0.0300	0.04		**Sheet Flow, IPW2A** Woods: Dense underbrush n= 0.800 P2= 2.20"
3.5	33	0.1202	0.16		**Sheet Flow, IPW2B** Grass: Dense n= 0.240 P2= 2.20"
1.9	138	0.0290	1.19		**Shallow Concentrated Flow, IPW2C** Short Grass Pasture Kv= 7.0 fps
0.9	224	0.0268	3.94	7.89	**Trap/Vee/Rect Channel Flow, IPW2D** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
34.0	462	Total			

Subcatchment IPW-2: to R4



Summary for Subcatchment IPW-3: to R4

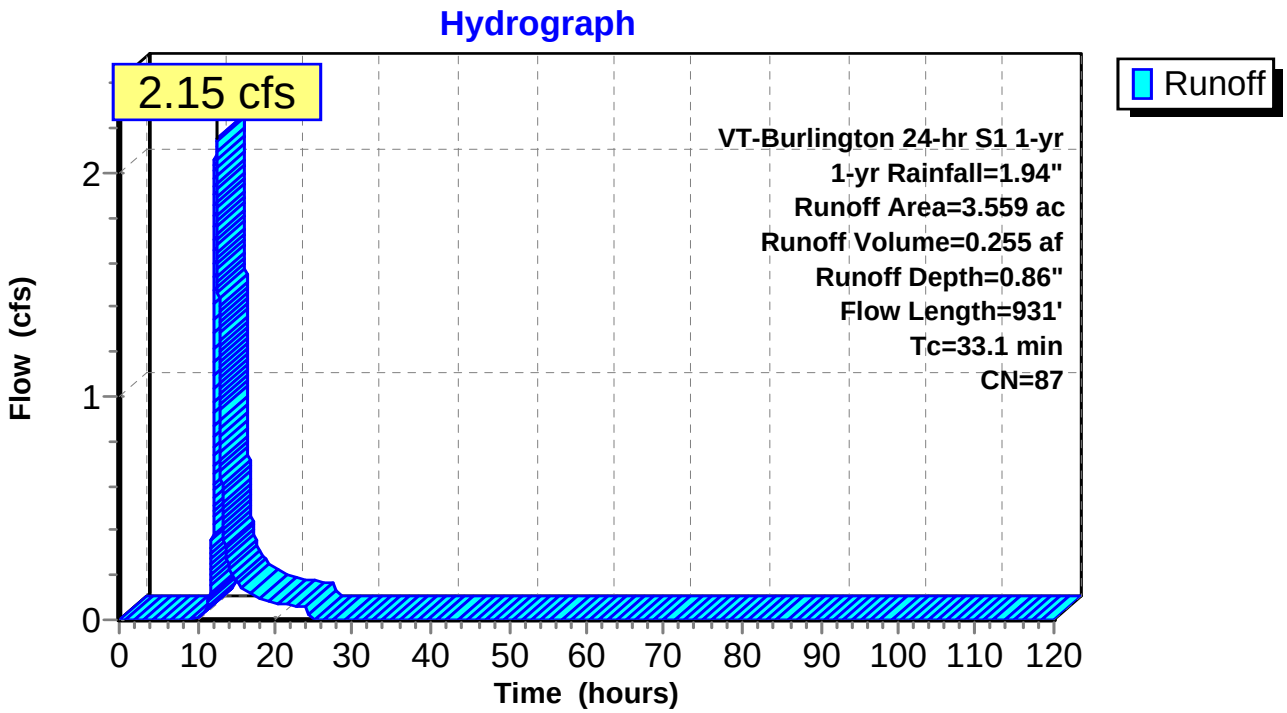
Runoff = 2.15 cfs @ 12.43 hrs, Volume= 0.255 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	1.490	98	
	0.993	80	>75% Grass cover, Good, HSG D
	0.010	74	>75% Grass cover, Good, HSG C
	1.066	77	Woods, Good, HSG D
	3.559	87	Weighted Average
	2.069		58.13% Pervious Area
	1.490		41.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	25	0.3300	0.23		**Sheet Flow, IPW3A** Grass: Dense n= 0.240 P2= 2.20"
6.3	49	0.0610	0.13		**Sheet Flow, IPW3B** Grass: Dense n= 0.240 P2= 2.20"
11.7	26	0.0387	0.04		**Sheet Flow, IPW3C** Woods: Dense underbrush n= 0.800 P2= 2.20"
6.0	224	0.0624	0.62		**Shallow Concentrated Flow, IPW3D** Forest w/Heavy Litter Kv= 2.5 fps
7.3	607	0.0132	1.38	2.77	**Trap/Vee/Rect Channel Flow, IPW3E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
33.1	931	Total			

Subcatchment IPW-3: to R4



Summary for Subcatchment IPW-4: to R4

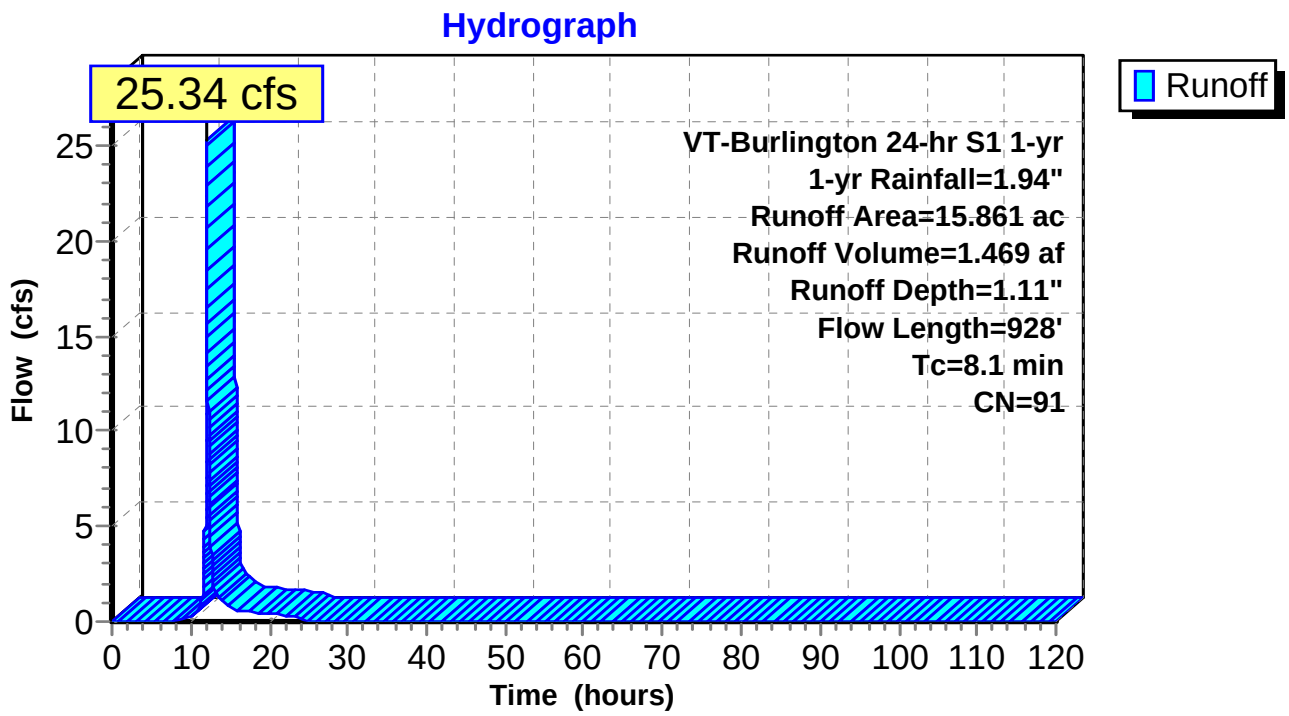
Runoff = 25.34 cfs @ 12.06 hrs, Volume= 1.469 af, Depth= 1.11"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	10.059	98	
	4.197	80	>75% Grass cover, Good, HSG D
	0.920	74	>75% Grass cover, Good, HSG C
	0.352	61	>75% Grass cover, Good, HSG B
	0.333	77	Woods, Good, HSG D
	15.861	91	Weighted Average
	5.802		36.58% Pervious Area
	10.059		63.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	41	0.1459	0.18		**Sheet Flow, IPW4A** Grass: Dense n= 0.240 P2= 2.20"
4.3	887	0.0203	3.43	6.87	**Trap/Vee/Rect Channel Flow, IPW4B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
8.1	928	Total			

Subcatchment IPW-4: to R4



Summary for Subcatchment IPW-5: to R4

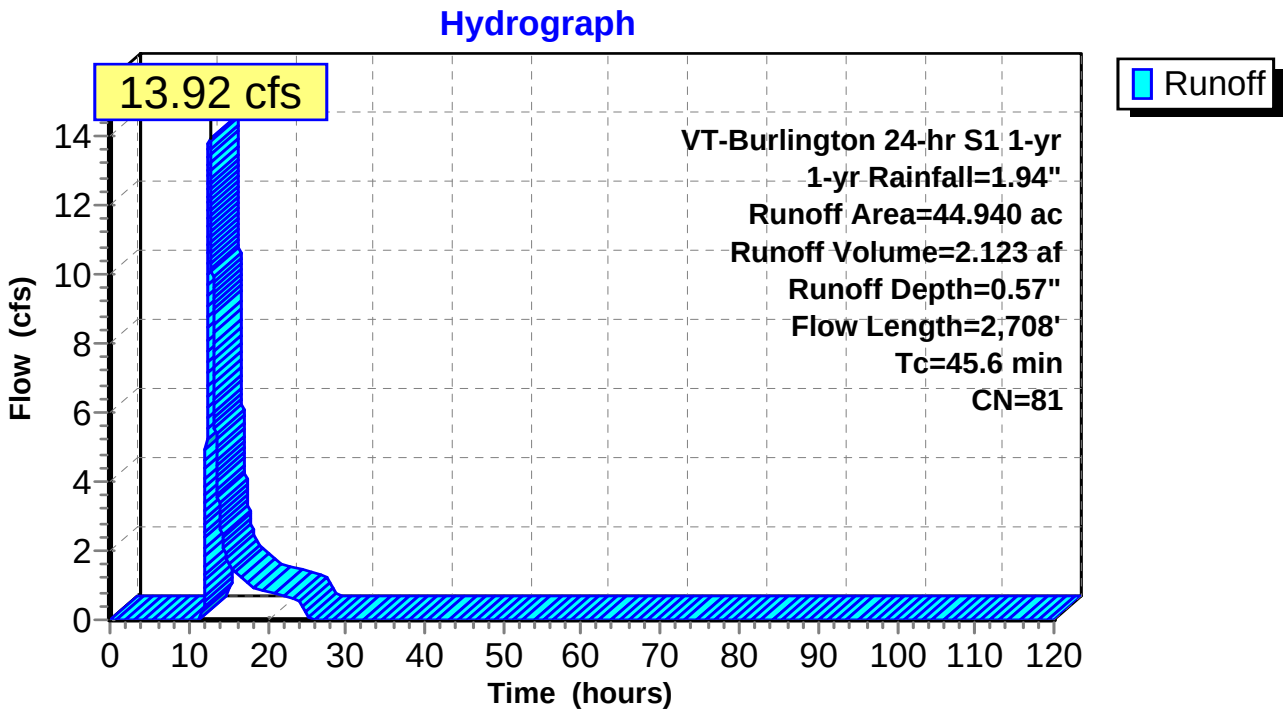
Runoff = 13.92 cfs @ 12.66 hrs, Volume= 2.123 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	7.800	98	
	11.130	80	>75% Grass cover, Good, HSG D
	0.070	74	>75% Grass cover, Good, HSG C
	0.330	61	>75% Grass cover, Good, HSG B
	24.960	77	Woods, Good, HSG D
	0.650	55	Woods, Good, HSG B
	44.940	81	Weighted Average
	37.140		82.64% Pervious Area
	7.800		17.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	150	0.1667	0.09		**Sheet Flow, IPW5A** Woods: Dense underbrush n= 0.800 P2= 2.20"
5.0	264	0.1213	0.87		**Shallow Concentrated Flow, IPW5B** Forest w/Heavy Litter Kv= 2.5 fps
8.3	1,112	0.0342	2.23	4.46	**Trap/Vee/Rect Channel Flow, IPW5C** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
1.3	502	0.0199	6.60	20.74	**Pipe Channel, IPW5D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.020 Corrugated PE, corrugated interior
4.3	680	0.0118	2.62	5.24	**Trap/Vee/Rect Channel Flow, IPW5E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
45.6	2,708	Total			

Subcatchment IPW-5: to R4



Summary for Subcatchment LF-1: to CB3

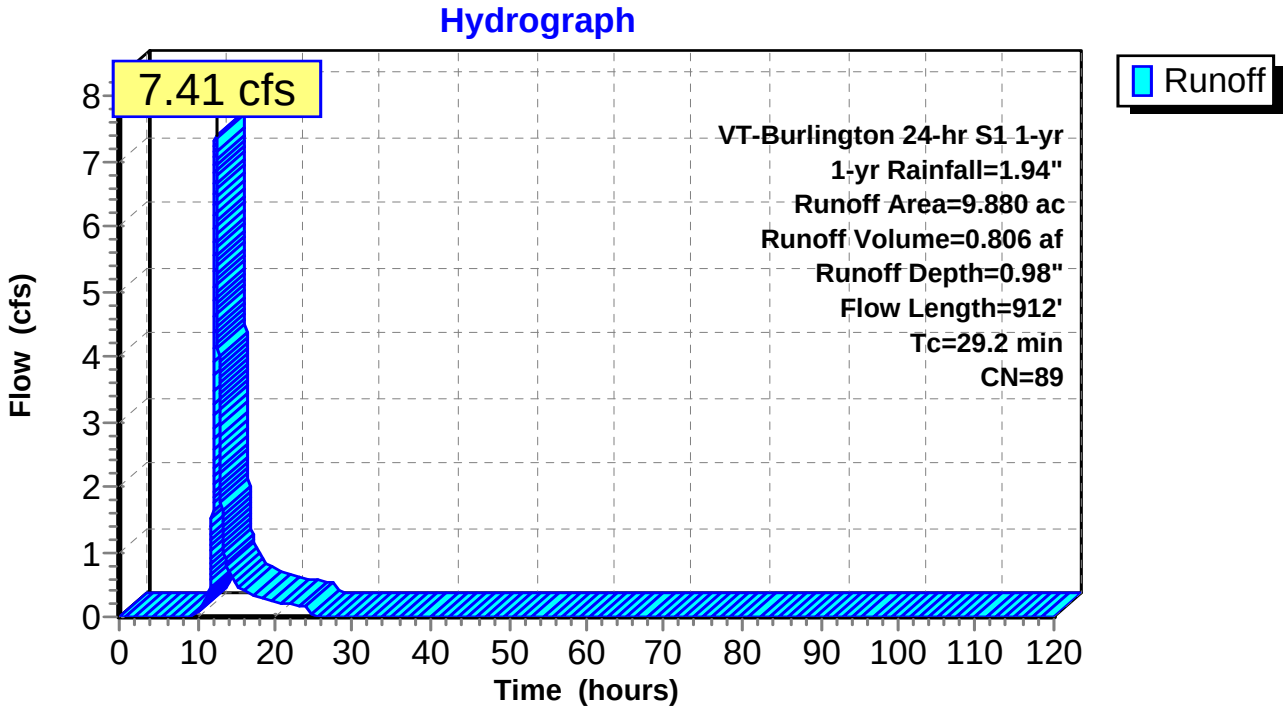
Runoff = 7.41 cfs @ 12.36 hrs, Volume= 0.806 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	4.140	98	
	3.120	80	>75% Grass cover, Good, HSG D
*	0.940	100	water
	1.680	77	Woods, Good, HSG D
	9.880	89	Weighted Average
	4.800		48.58% Pervious Area
	5.080		51.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	25	0.0100	0.06		**Sheet Flow, LF1A** Grass: Dense n= 0.240 P2= 2.20"
18.0	75	0.0100	0.07		**Sheet Flow, LF1B** Grass: Dense n= 0.240 P2= 2.20"
3.6	812	0.0246	3.78	7.56	**Trap/Vee/Rect Channel Flow, LF1C** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
29.2	912	Total			

Subcatchment LF-1: to CB3



Summary for Subcatchment LF-2: to R1

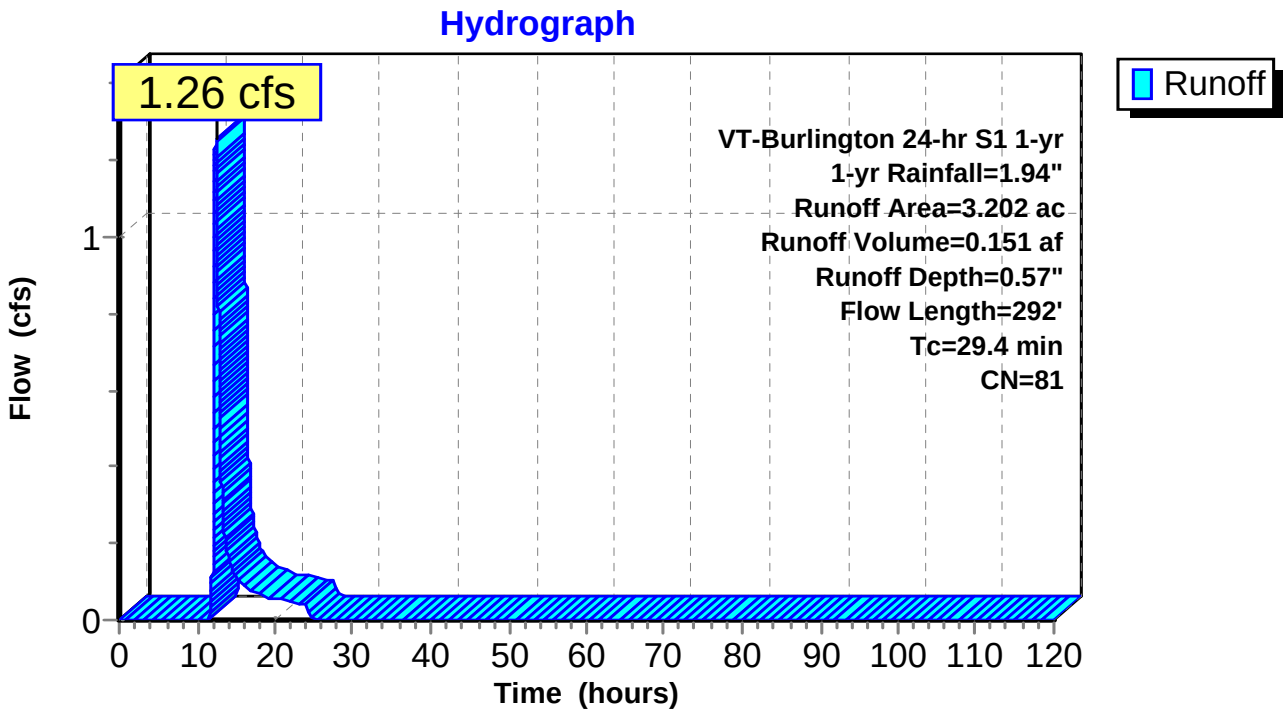
Runoff = 1.26 cfs @ 12.39 hrs, Volume= 0.151 af, Depth= 0.57"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.452	98	
	0.870	80	>75% Grass cover, Good, HSG D
*	0.000	100	water
	1.880	77	Woods, Good, HSG D
	3.202	81	Weighted Average
	2.750		85.88% Pervious Area
	0.452		14.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0100	0.07		**Sheet Flow, LF2A** Grass: Dense n= 0.240 P2= 2.20"
6.7	192	0.0365	0.48		**Shallow Concentrated Flow, LF2B** Forest w/Heavy Litter Kv= 2.5 fps
29.4	292	Total			

Subcatchment LF-2: to R1



Summary for Subcatchment OB-1:

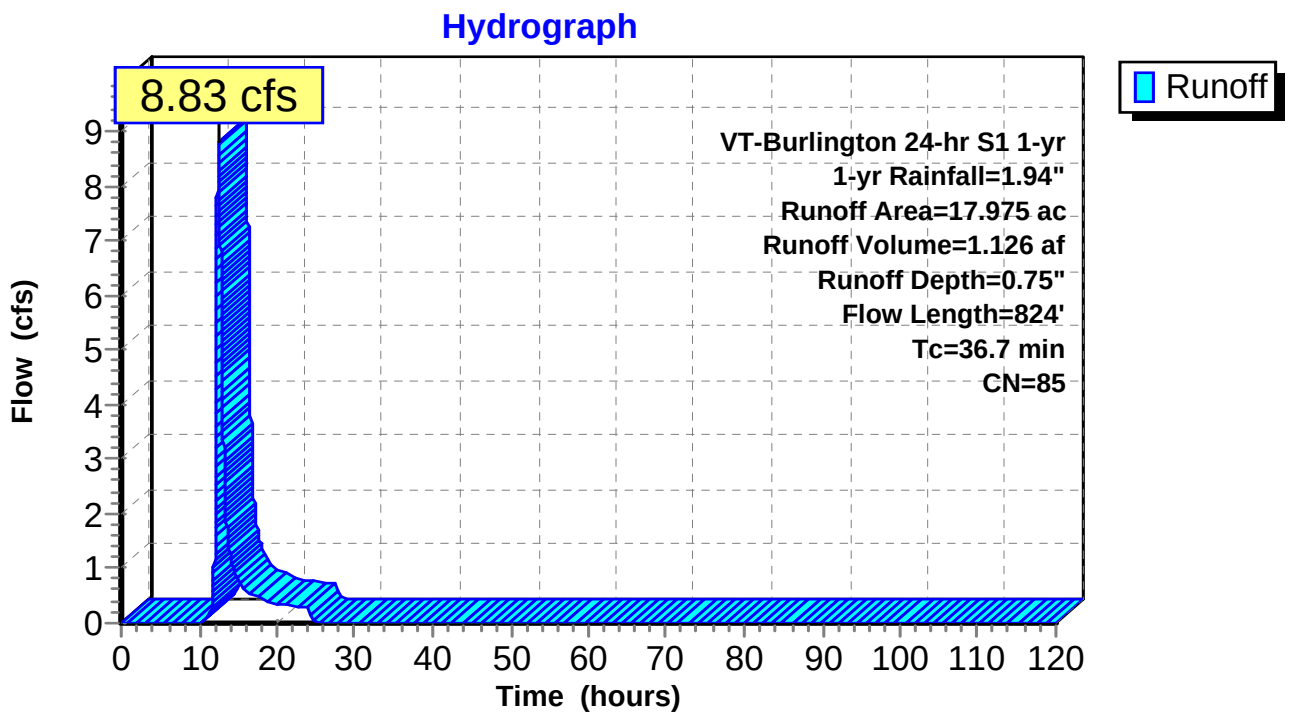
Runoff = 8.83 cfs @ 12.49 hrs, Volume= 1.126 af, Depth= 0.75"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	6.440	98	
	6.500	80	>75% Grass cover, Good, HSG D
	0.790	74	>75% Grass cover, Good, HSG C
	3.990	77	Woods, Good, HSG D
	0.255	70	Woods, Good, HSG C
	17.975	85	Weighted Average
	11.535		64.17% Pervious Area
	6.440		35.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.7	150	0.0933	0.07		**Sheet Flow, OB1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
1.4	56	0.0713	0.67		**Shallow Concentrated Flow, OB1B** Forest w/Heavy Litter Kv= 2.5 fps
1.6	618	0.0291	6.59	11.65	**Pipe Channel, OB1C** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.020 Corrugated PE, corrugated interior
36.7	824	Total			

Subcatchment OB-1:



Summary for Subcatchment OLP-1:

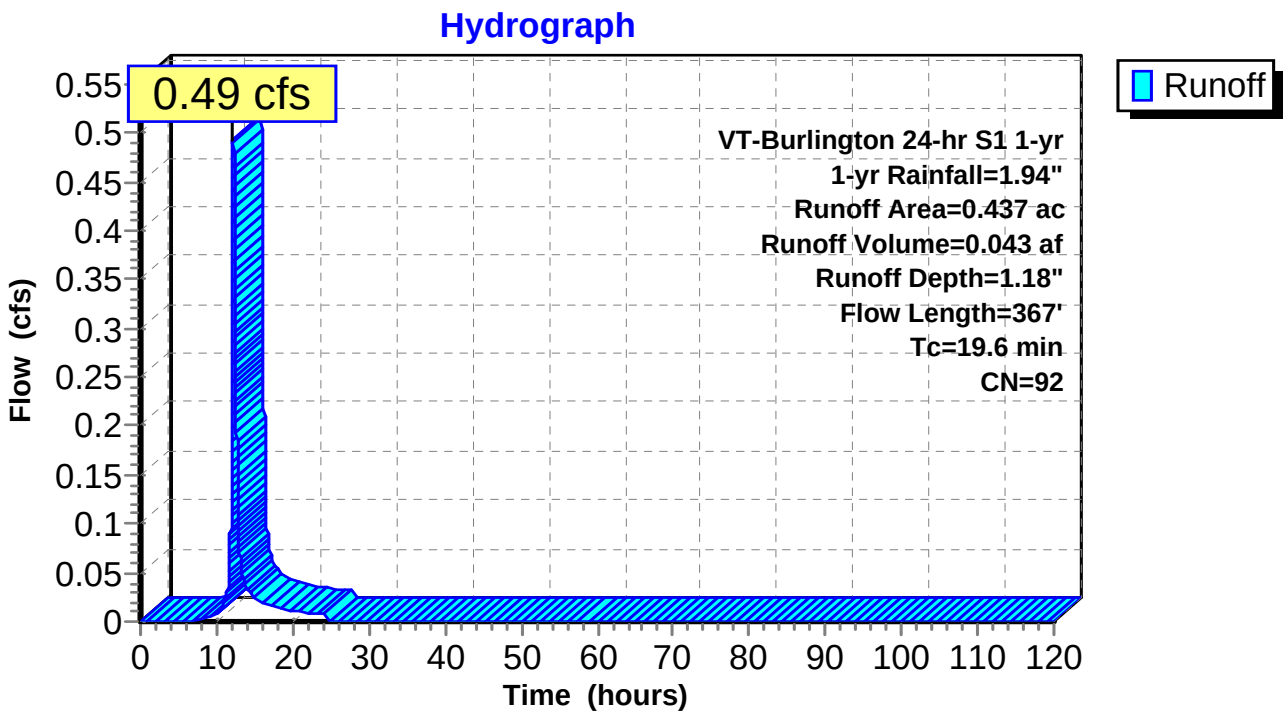
Runoff = 0.49 cfs @ 12.22 hrs, Volume= 0.043 af, Depth= 1.18"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.280	98	
	0.157	80	>75% Grass cover, Good, HSG D
	0.437	92	Weighted Average
	0.157		35.93% Pervious Area
	0.280		64.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	14	0.0100	0.05		**Sheet Flow, OLP1A** Grass: Dense n= 0.240 P2= 2.20"
10.0	63	0.0315	0.11		**Sheet Flow, OLP1B** Grass: Dense n= 0.240 P2= 2.20"
0.6	22	0.0100	0.64		**Sheet Flow, OLP1C** Smooth Surfaces n= 0.011 P2= 2.20"
4.2	267	0.0225	1.05		**Shallow Concentrated Flow, OLP1D** Short Grass Pasture Kv= 7.0 fps
19.6	367	Total			

Subcatchment OLP-1:



Summary for Subcatchment OLP-2:

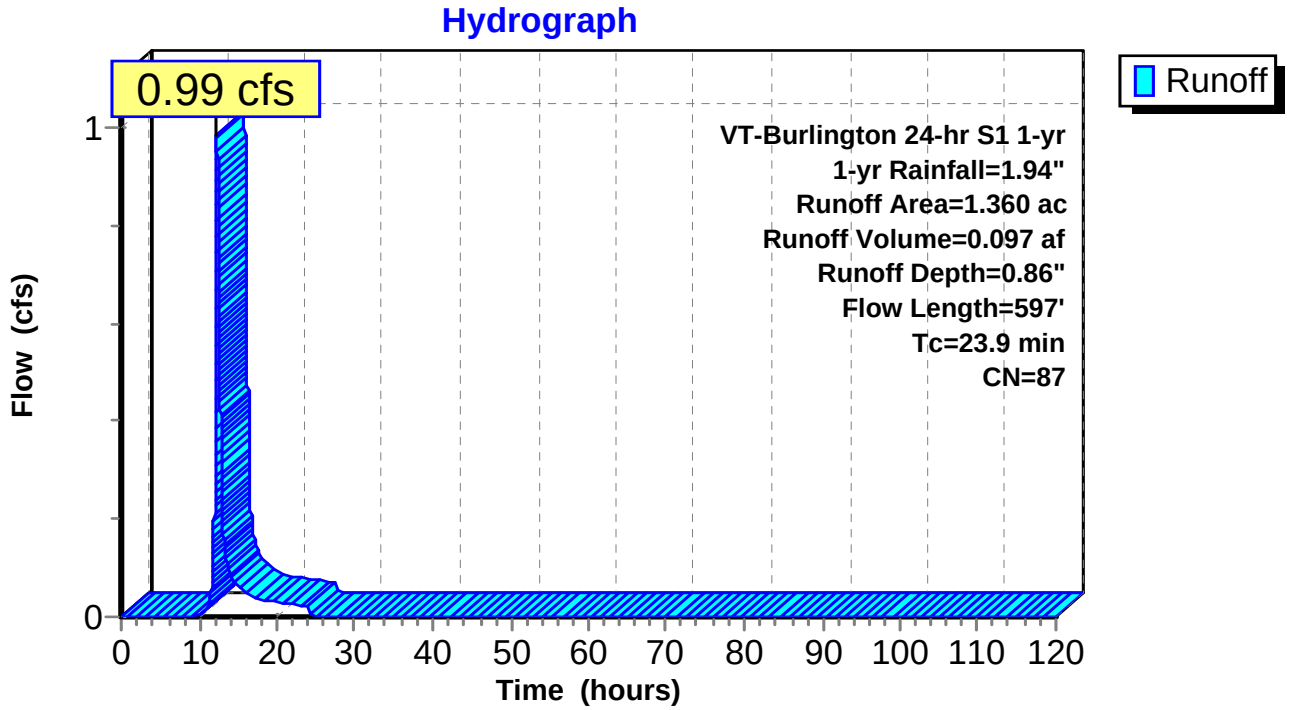
Runoff = 0.99 cfs @ 12.29 hrs, Volume= 0.097 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.220	98	
*	0.340	98	
	0.800	80	>75% Grass cover, Good, HSG D
	1.360	87	Weighted Average
	0.800		58.82% Pervious Area
	0.560		41.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	65	0.0308	0.11		**Sheet Flow, OLP2A** Grass: Dense n= 0.240 P2= 2.20"
4.9	35	0.0570	0.12		**Sheet Flow, OLP2B** Grass: Dense n= 0.240 P2= 2.20"
4.8	229	0.0131	0.80		**Shallow Concentrated Flow, OLP2C** Short Grass Pasture Kv= 7.0 fps
3.9	268	0.0261	1.13		**Shallow Concentrated Flow, OLP2D** Short Grass Pasture Kv= 7.0 fps
23.9	597	Total			

Subcatchment OLP-2:



Summary for Subcatchment OLP-3:

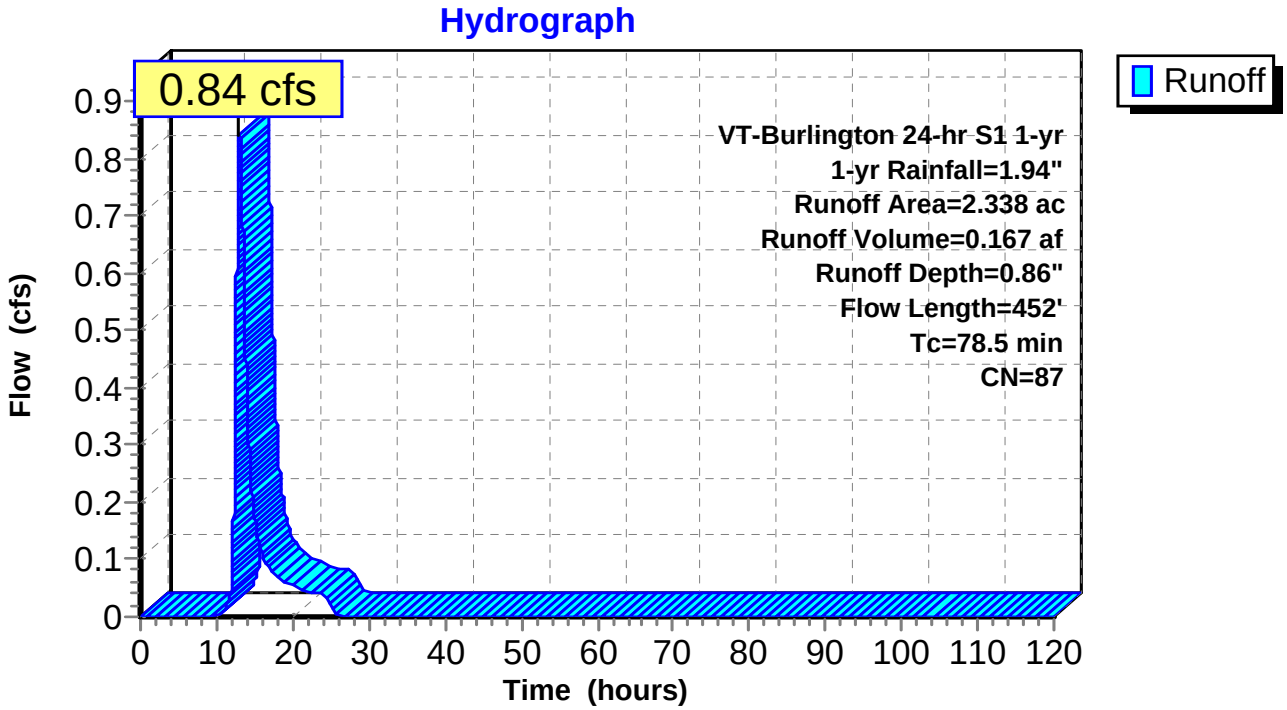
Runoff = 0.84 cfs @ 13.00 hrs, Volume= 0.167 af, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.938	98	
	0.960	80	>75% Grass cover, Good, HSG D
	0.440	77	Woods, Good, HSG D
	2.338	87	Weighted Average
	1.400		59.88% Pervious Area
	0.938		40.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.4	150	0.0133	0.03		**Sheet Flow, OLP3A** Woods: Dense underbrush n= 0.800 P2= 2.20"
1.7	40	0.0253	0.40		**Shallow Concentrated Flow, OLP3B** Forest w/Heavy Litter Kv= 2.5 fps
0.8	71	0.0424	1.44		**Shallow Concentrated Flow, OLP3C** Short Grass Pasture Kv= 7.0 fps
2.6	191	0.0314	1.24		**Shallow Concentrated Flow, OLP3D** Short Grass Pasture Kv= 7.0 fps
78.5	452	Total			

Subcatchment OLP-3:



Summary for Subcatchment OLP-4:

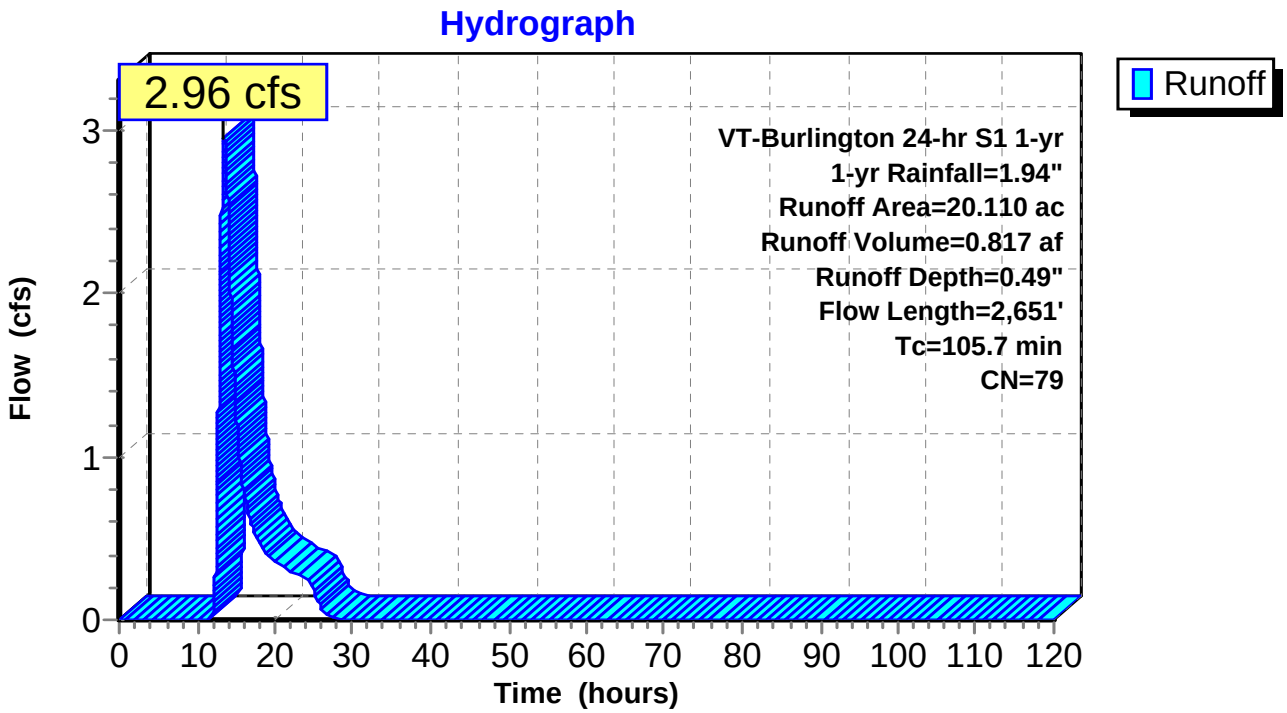
Runoff = 2.96 cfs @ 13.51 hrs, Volume= 0.817 af, Depth= 0.49"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	1.130	98	
	7.770	80	>75% Grass cover, Good, HSG D
	11.210	77	Woods, Good, HSG D
	20.110	79	Weighted Average
	18.980		94.38% Pervious Area
	1.130		5.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	11	0.0100	0.05		**Sheet Flow, OLP4A** Grass: Dense n= 0.240 P2= 2.20"
6.4	20	0.0100	0.05		**Sheet Flow, OLP4B** Grass: Dense n= 0.240 P2= 2.20"
18.4	68	0.0879	0.06		**Sheet Flow, OLP4C** Woods: Dense underbrush n= 0.800 P2= 2.20"
49.3	818	0.0122	0.28		**Shallow Concentrated Flow, OLP4D** Forest w/Heavy Litter Kv= 2.5 fps
18.1	739	0.0095	0.68		**Shallow Concentrated Flow, OLP4E** Short Grass Pasture Kv= 7.0 fps
9.5	994	0.0211	1.75	3.50	**Trap/Vee/Rect Channel Flow, OLP4F** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
105.7	2,651	Total			

Subcatchment OLP-4:



Summary for Subcatchment SW-1: to CB3

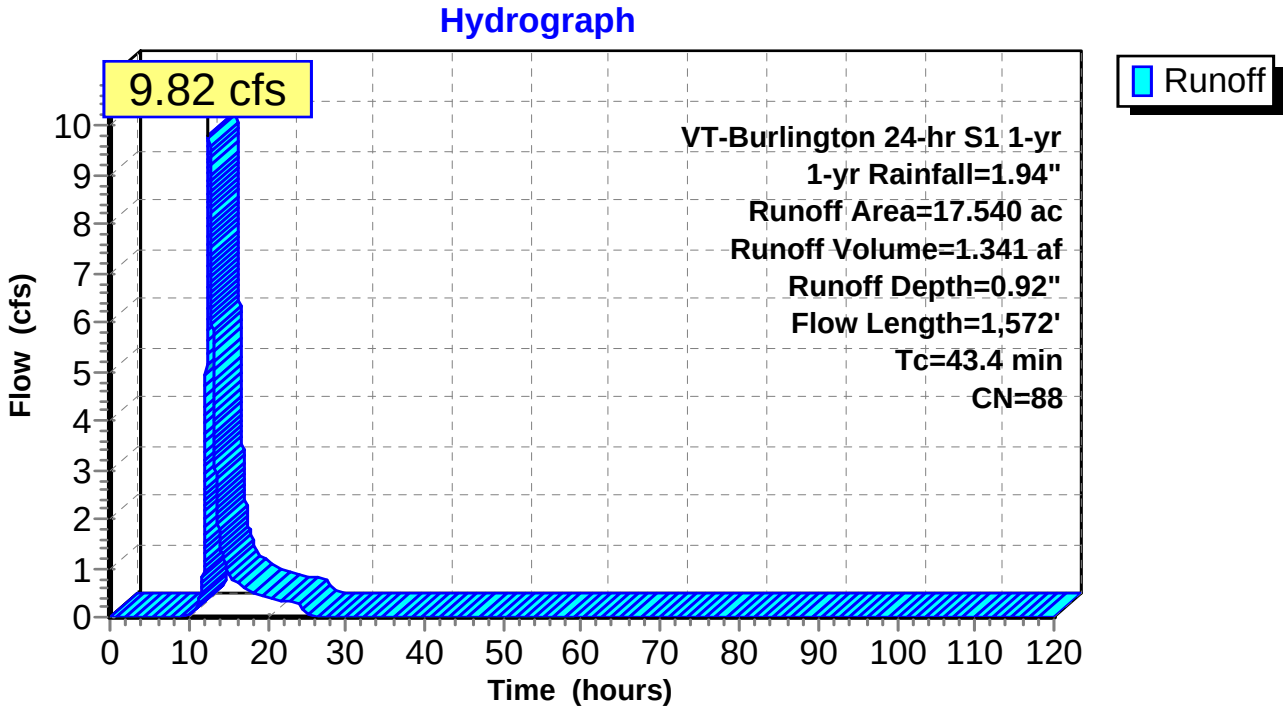
Runoff = 9.82 cfs @ 12.58 hrs, Volume= 1.341 af, Depth= 0.92"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	7.830	98	
	7.440	80	>75% Grass cover, Good, HSG D
	2.270	77	Woods, Good, HSG D
	17.540	88	Weighted Average
	9.710		55.36% Pervious Area
	7.830		44.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	100	0.0500	0.05		**Sheet Flow, SW1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
7.0	164	0.0244	0.39		**Shallow Concentrated Flow, SW1B** Forest w/Heavy Litter Kv= 2.5 fps
3.3	199	0.0201	0.99		**Shallow Concentrated Flow, SW1C** Short Grass Pasture Kv= 7.0 fps
1.8	1,109	0.0216	10.06	12.34	**Pipe Channel, SW1D** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 PVC, smooth interior
43.4	1,572	Total			

Subcatchment SW-1: to CB3



Summary for Subcatchment UD-1:

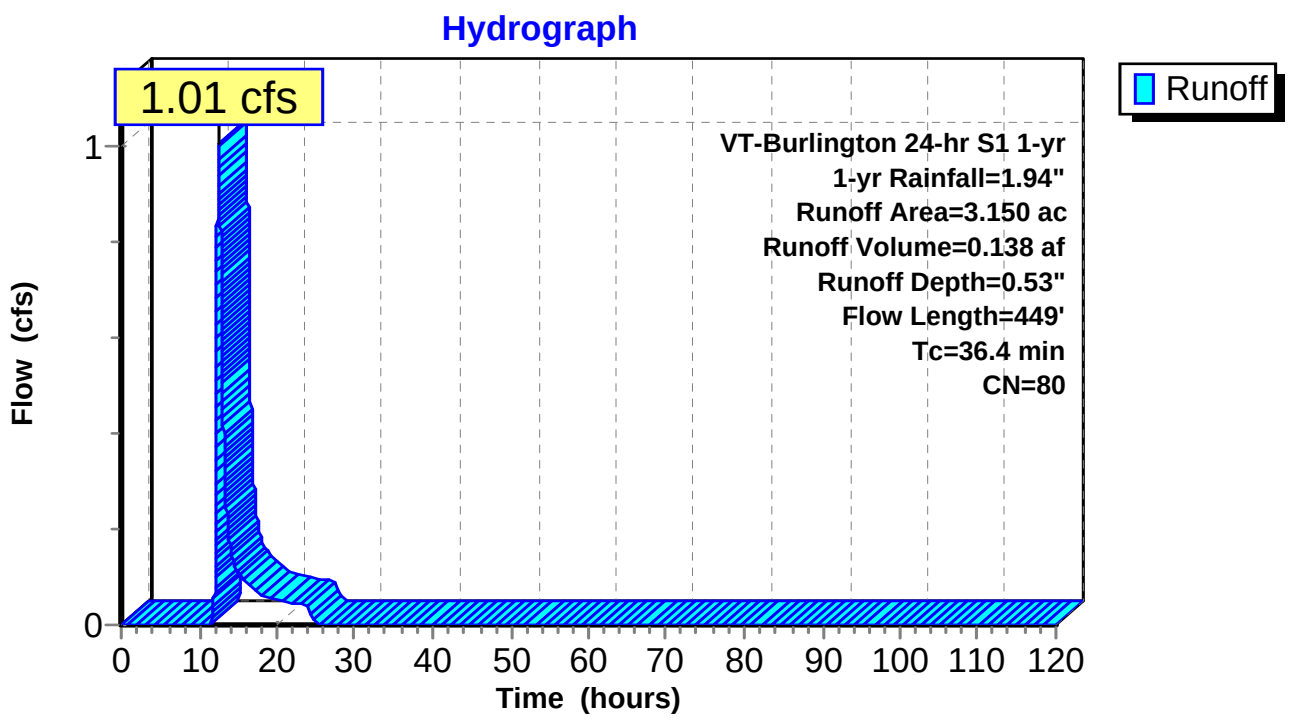
Runoff = 1.01 cfs @ 12.53 hrs, Volume= 0.138 af, Depth= 0.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 1-yr 1-yr Rainfall=1.94"

	Area (ac)	CN	Description
*	0.330	98	
	0.350	80	>75% Grass cover, Good, HSG D
	2.470	77	Woods, Good, HSG D
	3.150	80	Weighted Average
	2.820		89.52% Pervious Area
	0.330		10.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.5	150	0.1867	0.10		**Sheet Flow, UD1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
10.9	299	0.0335	0.46		**Shallow Concentrated Flow, UD1B** Forest w/Heavy Litter Kv= 2.5 fps
36.4	449	Total			

Subcatchment UD-1:



Summary for Reach R1:

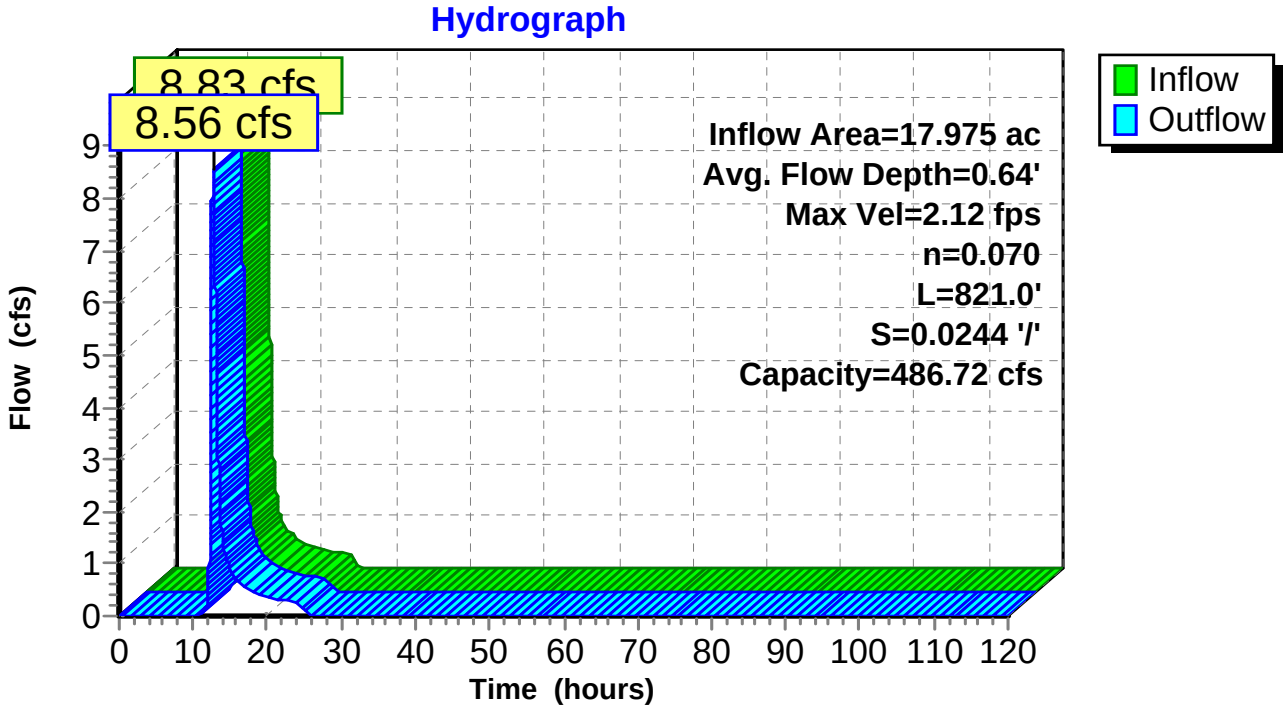
Inflow Area = 17.975 ac, 35.83% Impervious, Inflow Depth = 0.75" for 1-yr event
Inflow = 8.83 cfs @ 12.49 hrs, Volume= 1.126 af
Outflow = 8.56 cfs @ 12.68 hrs, Volume= 1.126 af, Atten= 3%, Lag= 11.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.12 fps, Min. Travel Time= 6.4 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 18.2 min

Peak Storage= 3,310 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.64'
Bank-Full Depth= 5.00' Flow Area= 75.0 sf, Capacity= 486.72 cfs

5.00' x 5.00' deep channel, n= 0.070 Sluggish weedy reaches w/pools
Side Slope Z-value= 2.0 '/' Top Width= 25.00'
Length= 821.0' Slope= 0.0244 '/'
Inlet Invert= 126.00', Outlet Invert= 106.00'

Reach R1:



Summary for Reach R3:

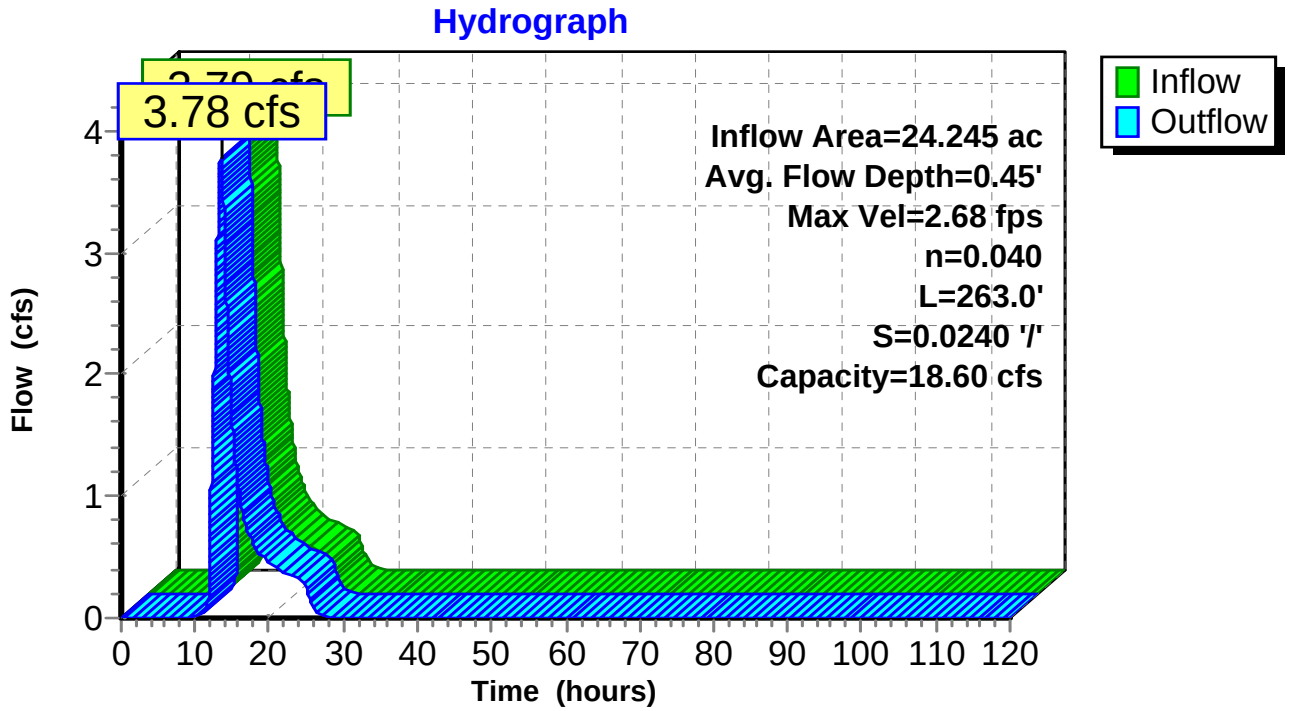
Inflow Area = 24.245 ac, 11.99% Impervious, Inflow Depth = 0.56" for 1-yr event
Inflow = 3.79 cfs @ 13.39 hrs, Volume= 1.125 af
Outflow = 3.78 cfs @ 13.42 hrs, Volume= 1.125 af, Atten= 0%, Lag= 2.3 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.68 fps, Min. Travel Time= 1.6 min
Avg. Velocity = 1.12 fps, Avg. Travel Time= 3.9 min

Peak Storage= 371 cf @ 13.40 hrs
Average Depth at Peak Storage= 0.45'
Bank-Full Depth= 1.00' Flow Area= 4.5 sf, Capacity= 18.60 cfs

2.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.5 '/' Top Width= 7.00'
Length= 263.0' Slope= 0.0240 '/'
Inlet Invert= 114.00', Outlet Invert= 107.70'

Reach R3:



Summary for Reach R4:

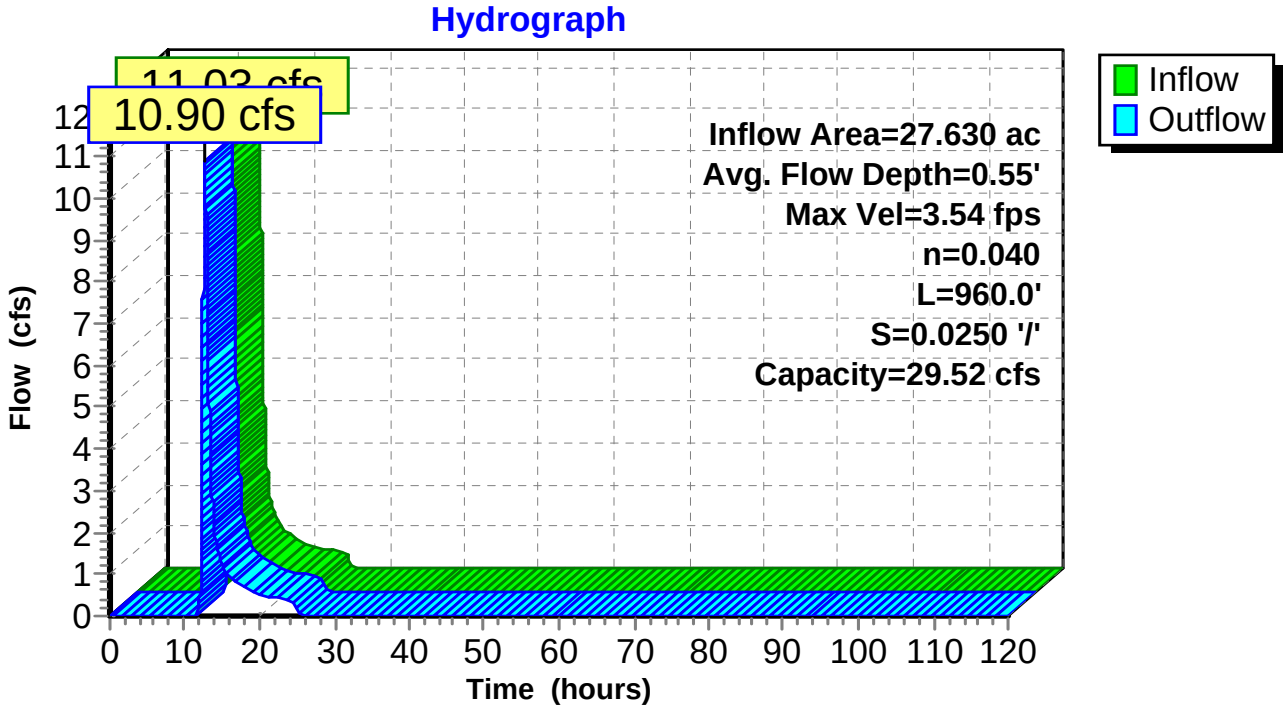
Inflow Area = 27.630 ac, 23.85% Impervious, Inflow Depth = 0.65" for 1-yr event
Inflow = 11.03 cfs @ 12.55 hrs, Volume= 1.507 af
Outflow = 10.90 cfs @ 12.68 hrs, Volume= 1.507 af, Atten= 1%, Lag= 7.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.54 fps, Min. Travel Time= 4.5 min
Avg. Velocity = 1.01 fps, Avg. Travel Time= 15.8 min

Peak Storage= 2,954 cf @ 12.61 hrs
Average Depth at Peak Storage= 0.55'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 29.52 cfs

5.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 960.0' Slope= 0.0250 '/'
Inlet Invert= 150.00', Outlet Invert= 126.00'

Reach R4:



Summary for Pond 5P: entire basin

[79] Warning: Submerged Pond CB3 Primary device # 1 OUTLET by 0.26'

Inflow Area = 97.867 ac, 28.55% Impervious, Inflow Depth = 0.67" for 1-yr event
Inflow = 32.79 cfs @ 12.61 hrs, Volume= 5.504 af
Outflow = 32.45 cfs @ 12.66 hrs, Volume= 5.504 af, Atten= 1%, Lag= 3.2 min
Primary = 32.45 cfs @ 12.66 hrs, Volume= 5.504 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 100.76' @ 12.66 hrs Surf.Area= 4,713 sf Storage= 3,221 cf

Plug-Flow detention time= 1.0 min calculated for 5.503 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (903.3 - 902.4)

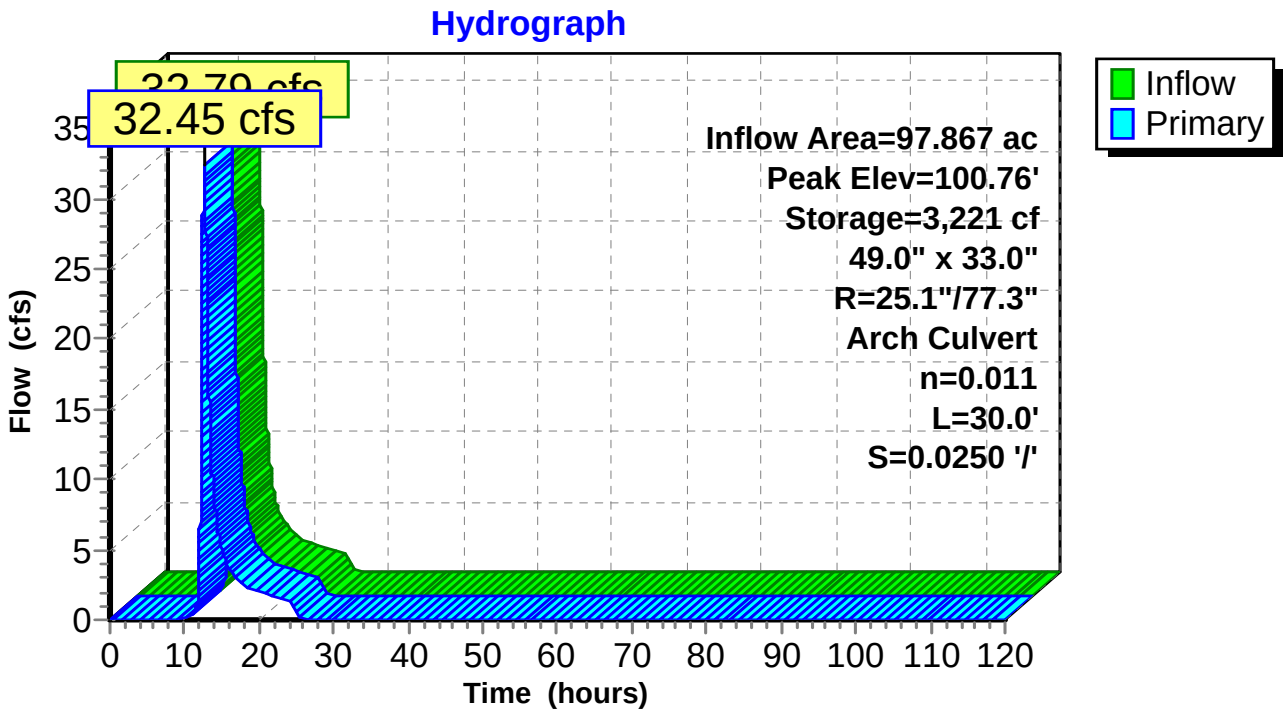
Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	37,190 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
99.00	370	0	0
100.00	1,430	900	900
101.00	5,775	3,603	4,503
102.00	9,175	7,475	11,978
103.00	13,125	11,150	23,128
104.00	15,000	14,063	37,190

Device	Routing	Invert	Outlet Devices
#1	Primary	98.75'	**49.0" W x 33.0" H, R=25.1"/77.3" Arch CMP_Arch_1/2 49x33** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 98.75' / 98.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 8.90 sf

Primary OutFlow Max=32.45 cfs @ 12.66 hrs HW=100.76' (Free Discharge)
└**1=CMP_Arch_1/2 49x33** (Inlet Controls 32.45 cfs @ 4.48 fps)

Pond 5P: entire basin



Summary for Pond 6P: downstream defender

[81] Warning: Exceeded Pond CB2 by 1.00' @ 0.00 hrs

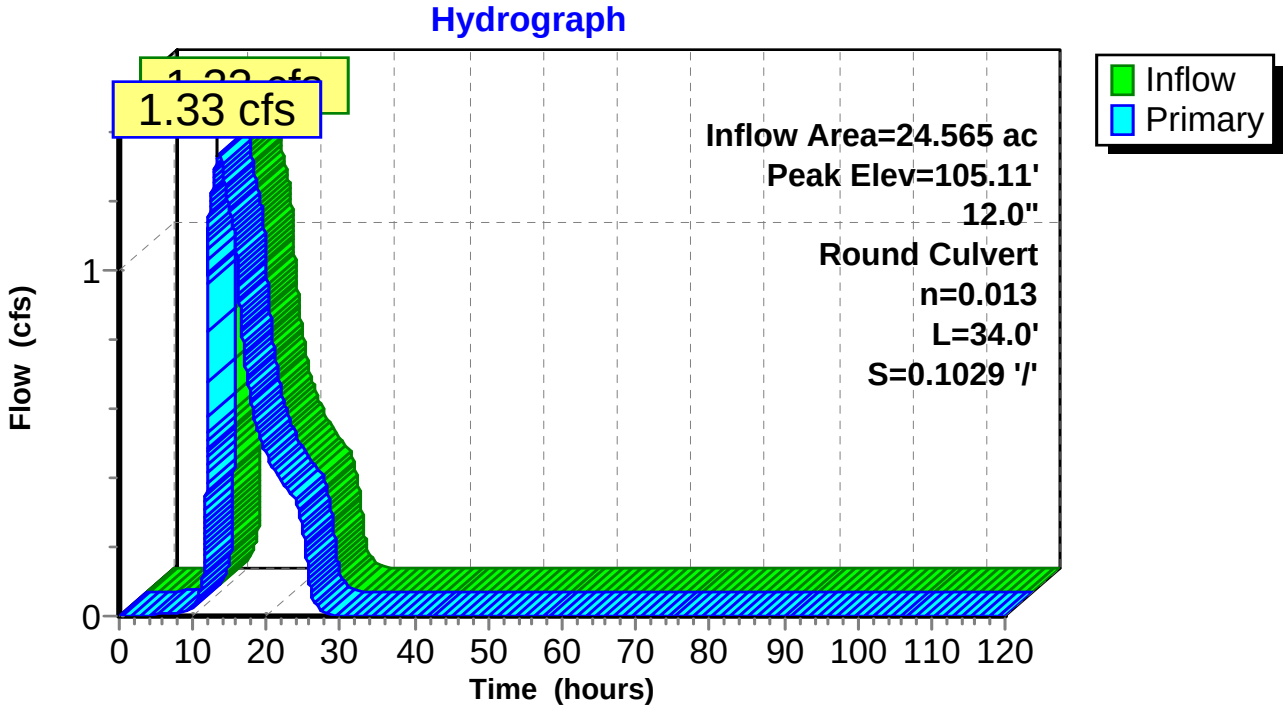
Inflow Area =	24.565 ac,	13.13% Impervious,	Inflow Depth =	0.40"	for 1-yr event
Inflow =	1.33 cfs @	13.43 hrs,	Volume=	0.817 af	
Outflow =	1.33 cfs @	13.43 hrs,	Volume=	0.817 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.33 cfs @	13.43 hrs,	Volume=	0.817 af	

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 105.11' @ 13.43 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	104.50'	**12.0" Round Culvert** L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 104.50' / 101.00' S= 0.1029 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.33 cfs @ 13.43 hrs HW=105.11' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.33 cfs @ 2.66 fps)

Pond 6P: downstream defender



Summary for Pond 7P: new 18" to CB2

[62] Hint: Exceeded Reach R3 OUTLET depth by 0.48' @ 13.44 hrs

Inflow Area = 24.245 ac, 11.99% Impervious, Inflow Depth = 0.56" for 1-yr event
Inflow = 3.78 cfs @ 13.42 hrs, Volume= 1.125 af
Outflow = 3.78 cfs @ 13.43 hrs, Volume= 1.125 af, Atten= 0%, Lag= 0.4 min
Primary = 3.78 cfs @ 13.43 hrs, Volume= 1.125 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 108.63' @ 13.43 hrs Surf.Area= 195 sf Storage= 150 cf

Plug-Flow detention time= 1.4 min calculated for 1.124 af (100% of inflow)
Center-of-Mass det. time= 1.0 min (951.0 - 950.1)

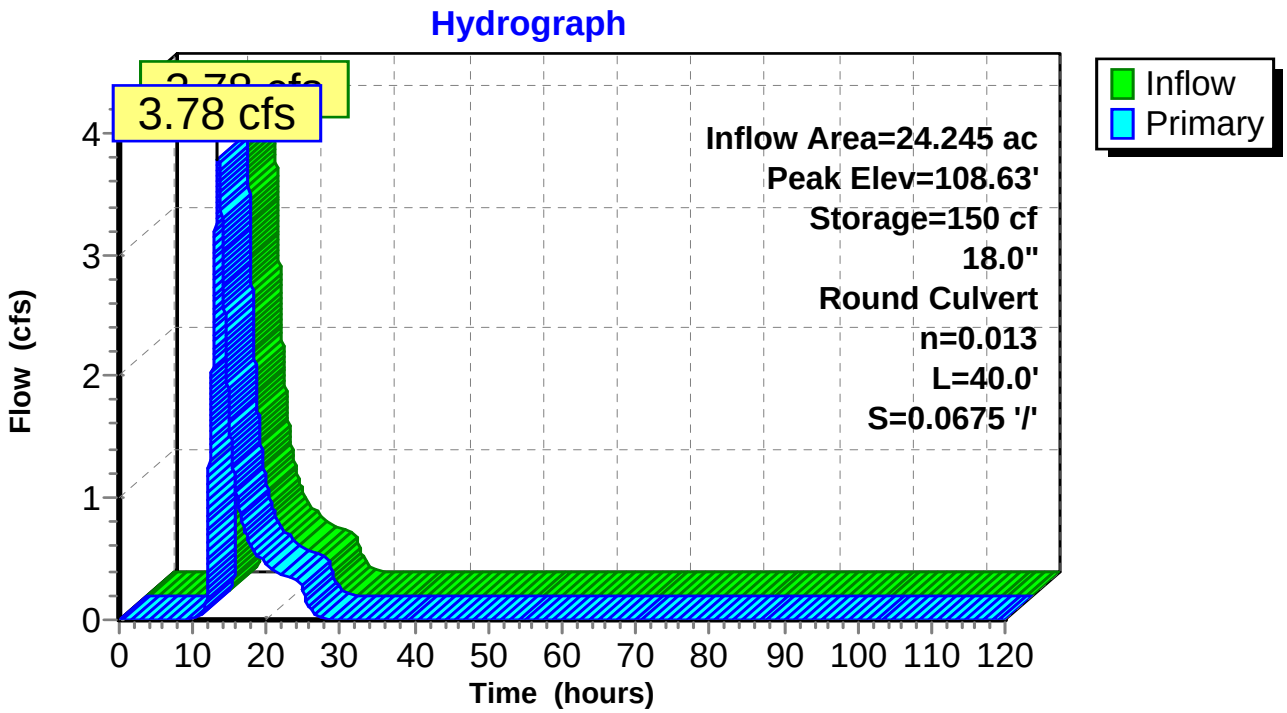
Volume	Invert	Avail.Storage	Storage Description
#1	107.00'	232 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
107.00	0	0	0
108.00	109	55	55
109.00	245	177	232

Device	Routing	Invert	Outlet Devices
#1	Primary	107.70'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 107.70' / 105.00' S= 0.0675 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=3.78 cfs @ 13.43 hrs HW=108.63' (Free Discharge)
└─**1=Culvert** (Inlet Controls 3.78 cfs @ 3.28 fps)

Pond 7P: new 18" to CB2



Summary for Pond CB1:

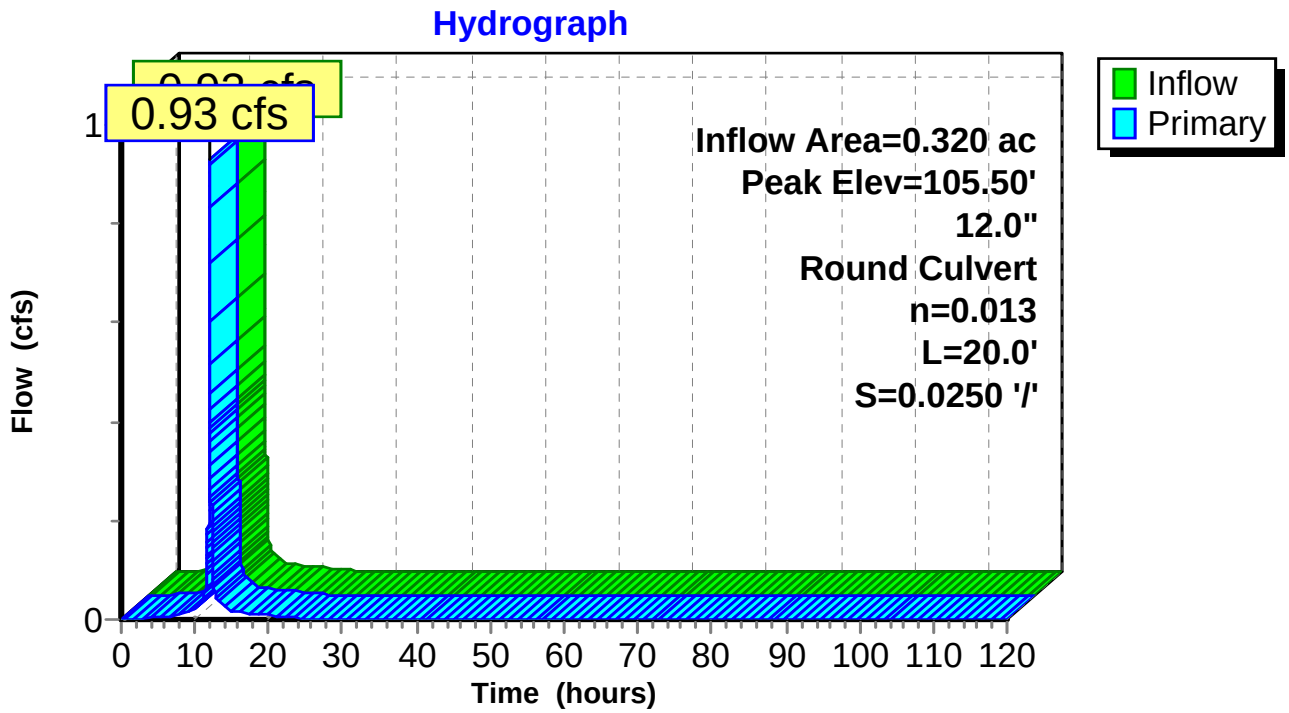
Inflow Area = 0.320 ac, 99.37% Impervious, Inflow Depth = 1.71" for 1-yr event
Inflow = 0.93 cfs @ 12.01 hrs, Volume= 0.046 af
Outflow = 0.93 cfs @ 12.01 hrs, Volume= 0.046 af, Atten= 0%, Lag= 0.0 min
Primary = 0.93 cfs @ 12.01 hrs, Volume= 0.046 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 105.50' @ 12.01 hrs
Flood Elev= 107.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	105.00'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 104.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.93 cfs @ 12.01 hrs HW=105.49' (Free Discharge)
└**1=Culvert** (Inlet Controls 0.93 cfs @ 2.39 fps)

Pond CB1:



Summary for Pond CB2:

[79] Warning: Submerged Pond 7P Primary device # 1 OUTLET by 0.73'
[81] Warning: Exceeded Pond CB1 by 0.65' @ 13.45 hrs

Inflow Area =	24.565 ac,	13.13% Impervious,	Inflow Depth =	0.57"	for 1-yr event
Inflow =	3.81 cfs @	13.43 hrs,	Volume=	1.170 af	
Outflow =	3.81 cfs @	13.43 hrs,	Volume=	1.170 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.33 cfs @	13.43 hrs,	Volume=	0.817 af	
Secondary =	2.48 cfs @	13.43 hrs,	Volume=	0.354 af	

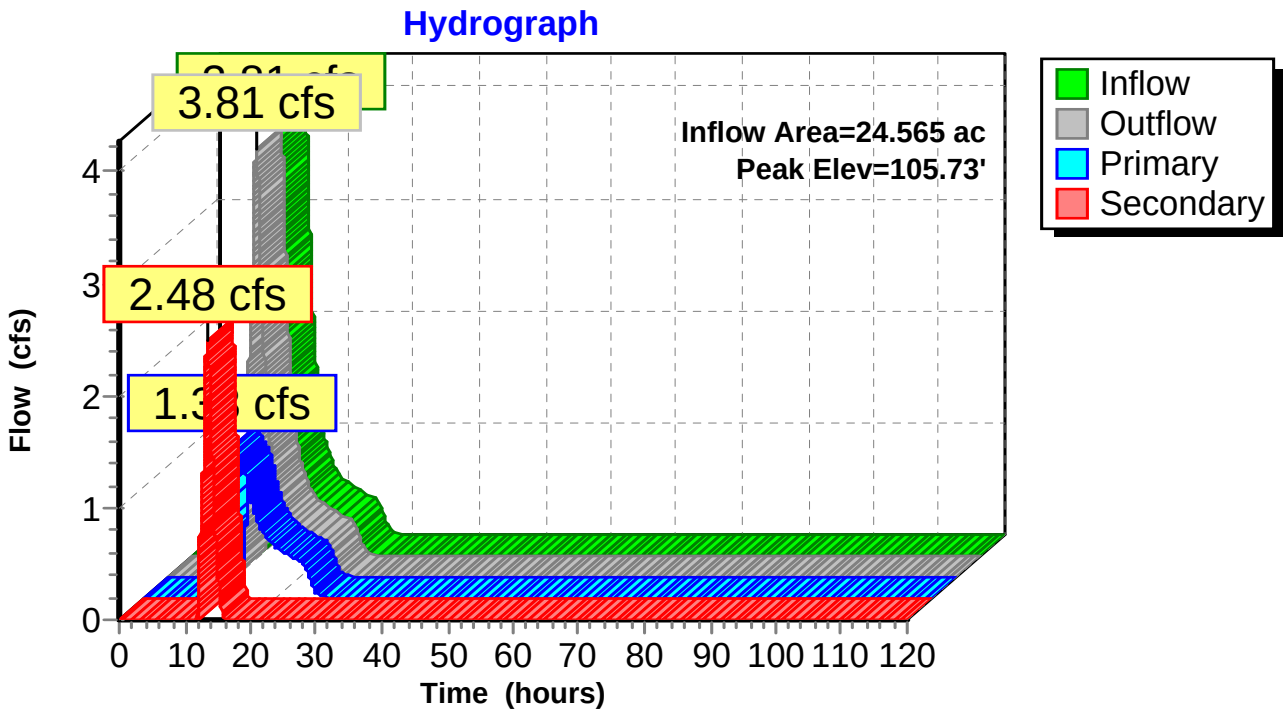
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 105.73' @ 13.43 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**6.0" Round Culvert** L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.50' / 102.50' S= 0.0833 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	103.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	105.00'	**18.0" Round Culvert** L= 78.2' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 103.00' S= 0.0256 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=1.33 cfs @ 13.43 hrs HW=105.73' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.33 cfs @ 6.78 fps)
  └─**2=Orifice/Grate** (Passes 1.33 cfs of 2.31 cfs potential flow)

Secondary OutFlow Max=2.48 cfs @ 13.43 hrs HW=105.73' (Free Discharge)
└─**3=Culvert** (Inlet Controls 2.48 cfs @ 2.91 fps)

Pond CB2:


Hydrograph
3.81 cfs
2.48 cfs
Inflow Area=24.565 ac
Peak Elev=105.73'
Inflow
Outflow
Primary
Secondary
Flow (cfs)
0
1
2
3
4
0 10 20 30 40 50 60 70 80 90 100 110 120
Time (hours)

Summary for Pond CB3:

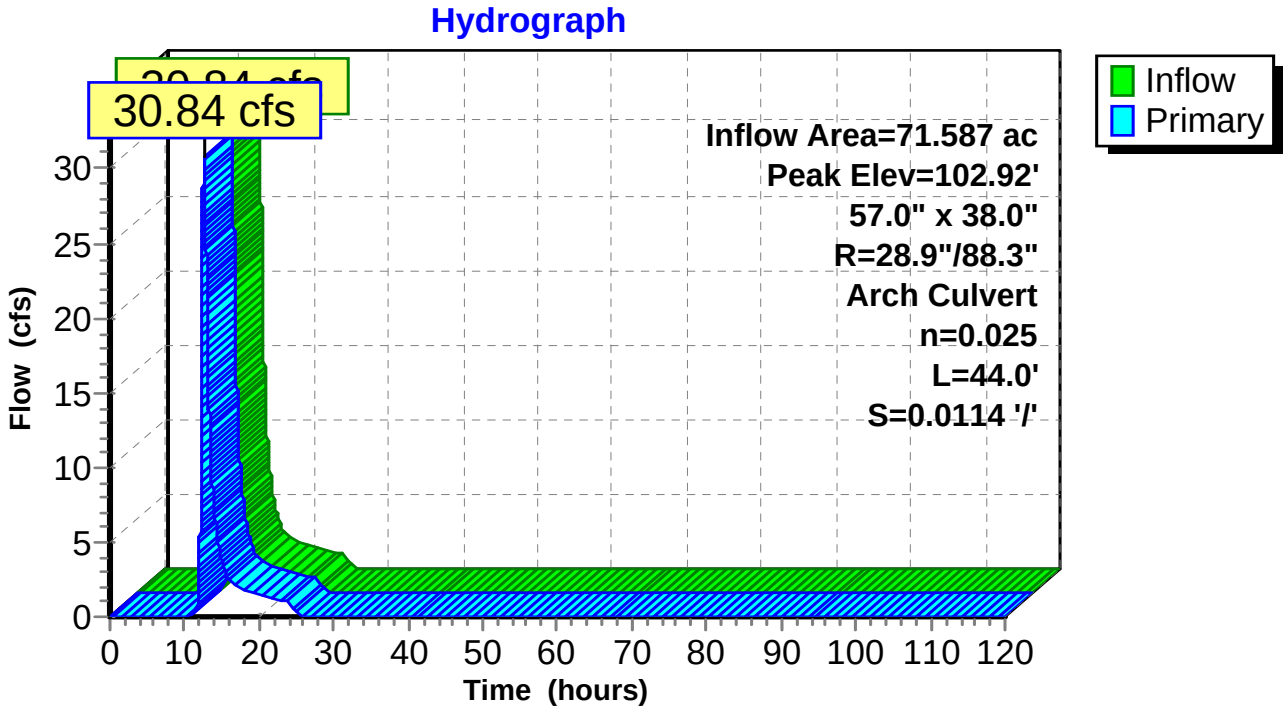
Inflow Area = 71.587 ac, 33.24% Impervious, Inflow Depth = 0.76" for 1-yr event
Inflow = 30.84 cfs @ 12.61 hrs, Volume= 4.547 af
Outflow = 30.84 cfs @ 12.61 hrs, Volume= 4.547 af, Atten= 0%, Lag= 0.0 min
Primary = 30.84 cfs @ 12.61 hrs, Volume= 4.547 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 102.92' @ 12.61 hrs
Flood Elev= 107.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**57.0" W x 38.0" H, R=28.9"/88.3" Arch CMP_Arch_1/2 57x38** L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 101.00' / 100.50' S= 0.0114 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 11.89 sf

Primary OutFlow Max=30.83 cfs @ 12.61 hrs HW=102.92' (Free Discharge)
└─**1=CMP_Arch_1/2 57x38** (Barrel Controls 30.83 cfs @ 5.12 fps)

Pond CB3:



Summary for Pond R2:

[57] Hint: Peaked at 132.16' (Flood elevation advised)
[62] Hint: Exceeded Reach R4 OUTLET depth by 5.61' @ 12.55 hrs

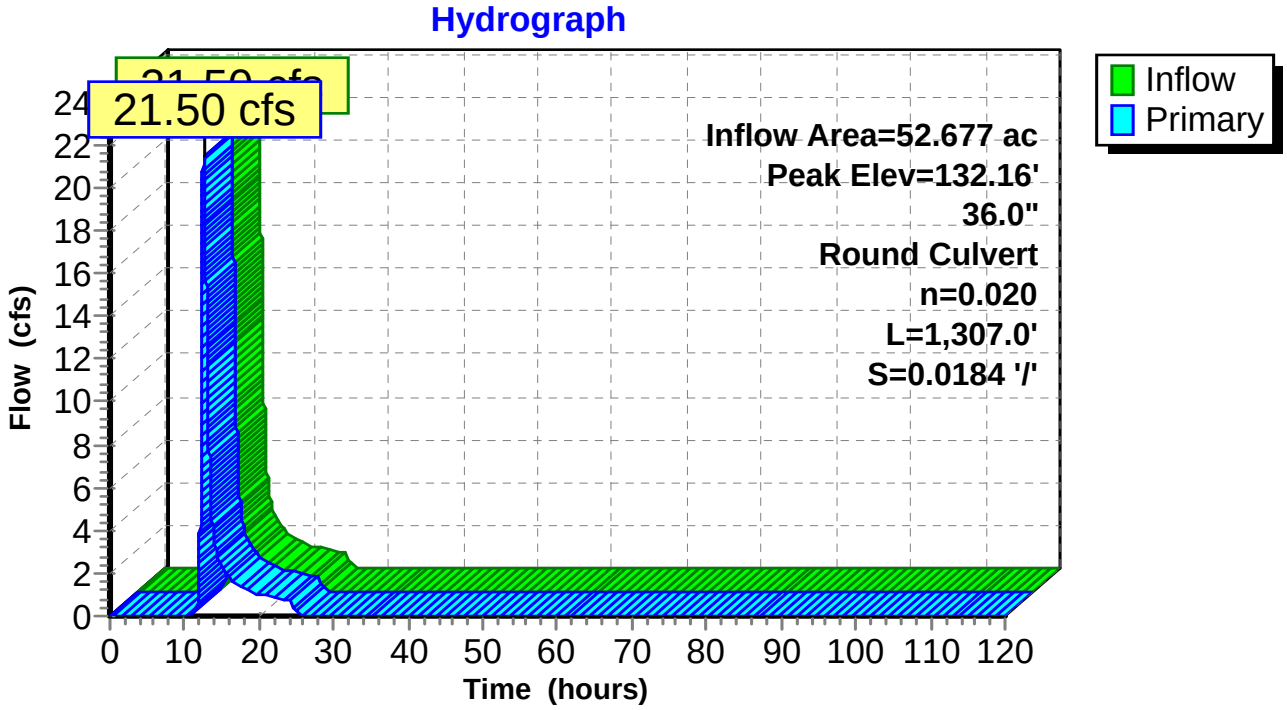
Inflow Area =	52.677 ac, 32.20% Impervious, Inflow Depth = 0.68" for 1-yr event				
Inflow =	21.50 cfs @	12.57 hrs,	Volume=	3.001 af	
Outflow =	21.50 cfs @	12.57 hrs,	Volume=	3.001 af,	Atten= 0%, Lag= 0.0 min
Primary =	21.50 cfs @	12.57 hrs,	Volume=	3.001 af	

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 132.16' @ 12.57 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**36.0" Round Culvert** L= 1,307.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 130.00' / 106.00' S= 0.0184 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 7.07 sf

Primary OutFlow Max=21.50 cfs @ 12.57 hrs HW=132.16' (Free Discharge)
└─**1=Culvert** (Inlet Controls 21.50 cfs @ 3.95 fps)

Pond R2:



Time span=0.00-120.00 hrs, dt=0.01 hrs, 12001 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment AP-1: Runoff Area=19.690 ac 43.93% Impervious Runoff Depth=1.60"
Flow Length=3,161' Tc=34.1 min CN=84 Runoff=22.62 cfs 2.624 af

Subcatchment CD-1: Runoff Area=27.630 ac 23.85% Impervious Runoff Depth=1.53"
Flow Length=951' Tc=39.8 min CN=83 Runoff=27.84 cfs 3.517 af

Subcatchment CSWD-1: Runoff Area=2.207 ac 62.98% Impervious Runoff Depth=2.16"
Flow Length=580' Tc=34.2 min CN=91 Runoff=3.42 cfs 0.398 af

Subcatchment FA-1: Runoff Area=0.935 ac 42.67% Impervious Runoff Depth=1.83"
Flow Length=609' Tc=12.9 min CN=87 Runoff=1.98 cfs 0.142 af

Subcatchment FA-2: Runoff Area=0.320 ac 99.37% Impervious Runoff Depth=2.87"
Flow Length=781' Tc=3.2 min CN=98 Runoff=1.47 cfs 0.076 af

Subcatchment FA-3: Runoff Area=1.715 ac 53.35% Impervious Runoff Depth=1.99"
Flow Length=386' Tc=21.1 min CN=89 Runoff=3.14 cfs 0.284 af

Subcatchment FS-1: to R2 Runoff Area=5.970 ac 87.94% Impervious Runoff Depth=2.65"
Flow Length=538' Tc=30.0 min CN=96 Runoff=11.63 cfs 1.319 af

Subcatchment FS-2: to R2 Runoff Area=2.322 ac 1.42% Impervious Runoff Depth=1.20"
Flow Length=339' Tc=45.5 min CN=78 Runoff=1.66 cfs 0.232 af

Subcatchment IPW-1: to R4 Runoff Area=4.040 ac 48.51% Impervious Runoff Depth=1.91"
Flow Length=616' Tc=31.2 min CN=88 Runoff=5.82 cfs 0.642 af

Subcatchment IPW-2: to R4 Runoff Area=1.716 ac 72.26% Impervious Runoff Depth=2.35"
Flow Length=462' Tc=34.0 min CN=93 Runoff=2.86 cfs 0.336 af

Subcatchment IPW-3: to R4 Runoff Area=3.559 ac 41.87% Impervious Runoff Depth=1.83"
Flow Length=931' Tc=33.1 min CN=87 Runoff=4.75 cfs 0.542 af

Subcatchment IPW-4: to R4 Runoff Area=15.861 ac 63.42% Impervious Runoff Depth=2.16"
Flow Length=928' Tc=8.1 min CN=91 Runoff=47.97 cfs 2.861 af

Subcatchment IPW-5: to R4 Runoff Area=44.940 ac 17.36% Impervious Runoff Depth=1.39"
Flow Length=2,708' Tc=45.6 min CN=81 Runoff=37.91 cfs 5.209 af

Subcatchment LF-1: to CB3 Runoff Area=9.880 ac 51.42% Impervious Runoff Depth=1.99"
Flow Length=912' Tc=29.2 min CN=89 Runoff=15.37 cfs 1.639 af

Subcatchment LF-2: to R1 Runoff Area=3.202 ac 14.12% Impervious Runoff Depth=1.39"
Flow Length=292' Tc=29.4 min CN=81 Runoff=3.41 cfs 0.371 af

Subcatchment OB-1: Runoff Area=17.975 ac 35.83% Impervious Runoff Depth=1.67"
Flow Length=824' Tc=36.7 min CN=85 Runoff=20.77 cfs 2.505 af

Subcatchment OLP-1: Runoff Area=0.437 ac 64.07% Impervious Runoff Depth=2.26"
Flow Length=367' Tc=19.6 min CN=92 Runoff=0.93 cfs 0.082 af

Subcatchment OLP-2: Runoff Area=1.360 ac 41.18% Impervious Runoff Depth=1.83"
Flow Length=597' Tc=23.9 min CN=87 Runoff=2.16 cfs 0.207 af

Subcatchment OLP-3: Runoff Area=2.338 ac 40.12% Impervious Runoff Depth=1.83"
Flow Length=452' Tc=78.5 min CN=87 Runoff=1.89 cfs 0.356 af

Subcatchment OLP-4: Runoff Area=20.110 ac 5.62% Impervious Runoff Depth=1.26"
Flow Length=2,651' Tc=105.7 min CN=79 Runoff=8.75 cfs 2.115 af

Subcatchment SW-1: to CB3 Runoff Area=17.540 ac 44.64% Impervious Runoff Depth=1.91"
Flow Length=1,572' Tc=43.4 min CN=88 Runoff=21.13 cfs 2.788 af

Subcatchment UD-1: Runoff Area=3.150 ac 10.48% Impervious Runoff Depth=1.33"
Flow Length=449' Tc=36.4 min CN=80 Runoff=2.85 cfs 0.348 af

Reach R1: Avg. Flow Depth=1.04' Max Vel=2.77 fps Inflow=20.77 cfs 2.505 af
n=0.070 L=821.0' S=0.0244 '/' Capacity=486.72 cfs Outflow=20.38 cfs 2.505 af

Reach R3: Avg. Flow Depth=0.76' Max Vel=3.57 fps Inflow=10.66 cfs 2.760 af
n=0.040 L=263.0' S=0.0240 '/' Capacity=18.60 cfs Outflow=10.66 cfs 2.760 af

Reach R4: Avg. Flow Depth=0.96' Max Vel=4.82 fps Inflow=27.84 cfs 3.517 af
n=0.040 L=960.0' S=0.0250 '/' Capacity=29.52 cfs Outflow=27.59 cfs 3.517 af

Pond 5P: entire basin Peak Elev=103.06' Storage=23,903 cf Inflow=82.01 cfs 12.658 af
49.0" x 33.0", R=25.1"/77.3" Arch Culvert n=0.011 L=30.0' S=0.0250 '/' Outflow=74.11 cfs 12.658 af

Pond 6P: downstream defender Peak Elev=105.20' Inflow=1.67 cfs 1.242 af
12.0" Round Culvert n=0.013 L=34.0' S=0.1029 '/' Outflow=1.67 cfs 1.242 af

Pond 7P: new 18" to CB2 Peak Elev=110.03' Storage=232 cf Inflow=10.66 cfs 2.760 af
18.0" Round Culvert n=0.013 L=40.0' S=0.0675 '/' Outflow=10.68 cfs 2.763 af

Pond CB1: Peak Elev=105.65' Inflow=1.47 cfs 0.076 af
12.0" Round Culvert n=0.013 L=20.0' S=0.0250 '/' Outflow=1.47 cfs 0.076 af

Pond CB2: Peak Elev=106.88' Inflow=10.73 cfs 2.839 af
Primary=1.67 cfs 1.242 af Secondary=9.06 cfs 1.597 af Outflow=10.73 cfs 2.839 af

Pond CB3: Peak Elev=105.29' Inflow=78.91 cfs 11.132 af
57.0" x 38.0", R=28.9"/88.3" Arch Culvert n=0.025 L=44.0' S=0.0114 '/' Outflow=78.91 cfs 11.132 af

Pond R2: Peak Elev=135.57' Inflow=54.21 cfs 6.887 af
36.0" Round Culvert n=0.020 L=1,307.0' S=0.0184 '/' Outflow=54.21 cfs 6.887 af

Total Runoff Area = 206.897 ac Runoff Volume = 28.594 af Average Runoff Depth = 1.66"
66.59% Pervious = 137.763 ac 33.41% Impervious = 69.134 ac

Summary for Subcatchment AP-1:

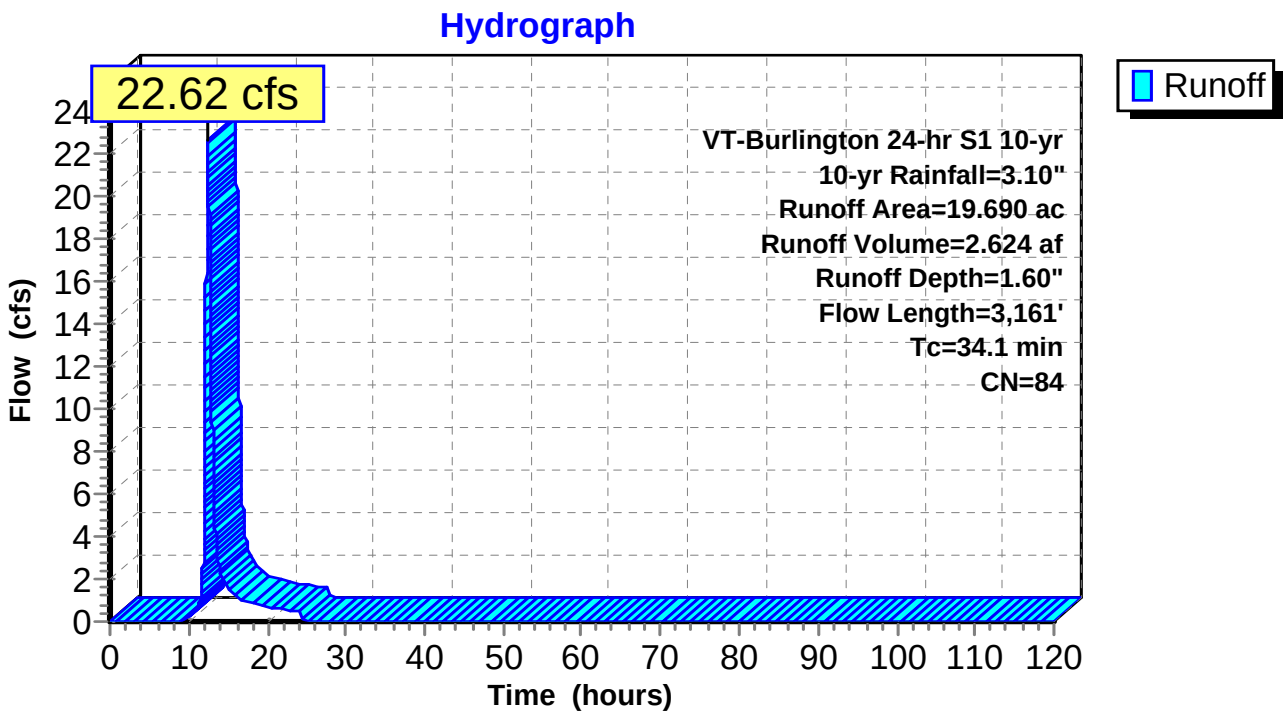
Runoff = 22.62 cfs @ 12.46 hrs, Volume= 2.624 af, Depth= 1.60"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	8.650	98	
	3.740	80	>75% Grass cover, Good, HSG D
	1.610	61	>75% Grass cover, Good, HSG B
	4.550	77	Woods, Good, HSG D
	1.140	55	Woods, Good, HSG B
	19.690	84	Weighted Average
	11.040		56.07% Pervious Area
	8.650		43.93% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.1	100	0.1500	0.08		**Sheet Flow, AP1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
14.0	3,061	0.0137	3.64	21.85	**Trap/Vee/Rect Channel Flow, AP1B** Bot.W=5.00' D=1.00' Z= 1.0 '/' Top.W=7.00' n= 0.040 Earth, cobble bottom, clean sides
34.1	3,161	Total			

Subcatchment AP-1:



Summary for Subcatchment CD-1:

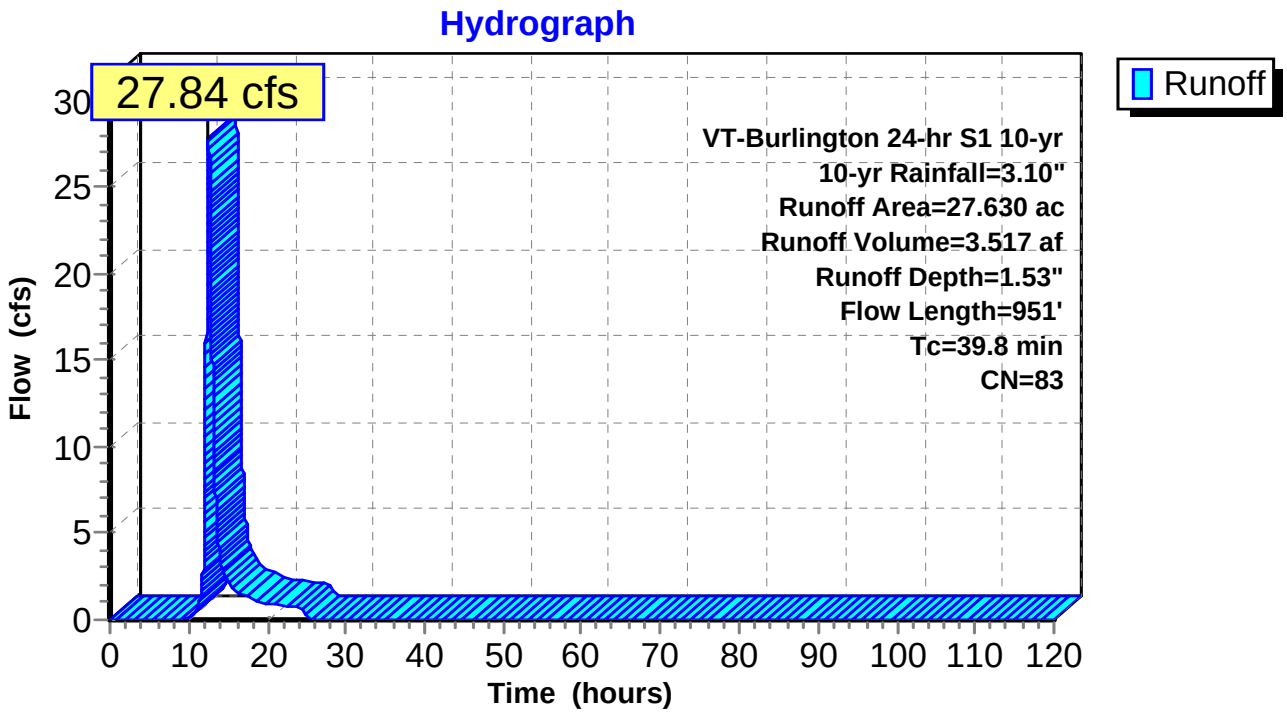
Runoff = 27.84 cfs @ 12.52 hrs, Volume= 3.517 af, Depth= 1.53"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	6.590	98	
	11.660	80	>75% Grass cover, Good, HSG D
	2.050	74	>75% Grass cover, Good, HSG C
	0.220	61	>75% Grass cover, Good, HSG B
	7.110	77	Woods, Good, HSG D
	27.630	83	Weighted Average
	21.040		76.15% Pervious Area
	6.590		23.85% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.0	42	0.0239	0.09		**Sheet Flow, CD1A** Grass: Dense n= 0.240 P2= 2.20"
23.6	58	0.0343	0.04		**Sheet Flow, CD1B** Woods: Dense underbrush n= 0.800 P2= 2.20"
6.1	252	0.0753	0.69		**Shallow Concentrated Flow, CD1C** Forest w/Heavy Litter Kv= 2.5 fps
1.5	165	0.0726	1.89		**Shallow Concentrated Flow, CD1D** Short Grass Pasture Kv= 7.0 fps
0.6	433	0.0370	11.59	23.18	**Trap/Vee/Rect Channel Flow, CD1E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
39.8	951	Total			

Subcatchment CD-1:



Summary for Subcatchment CSWD-1:

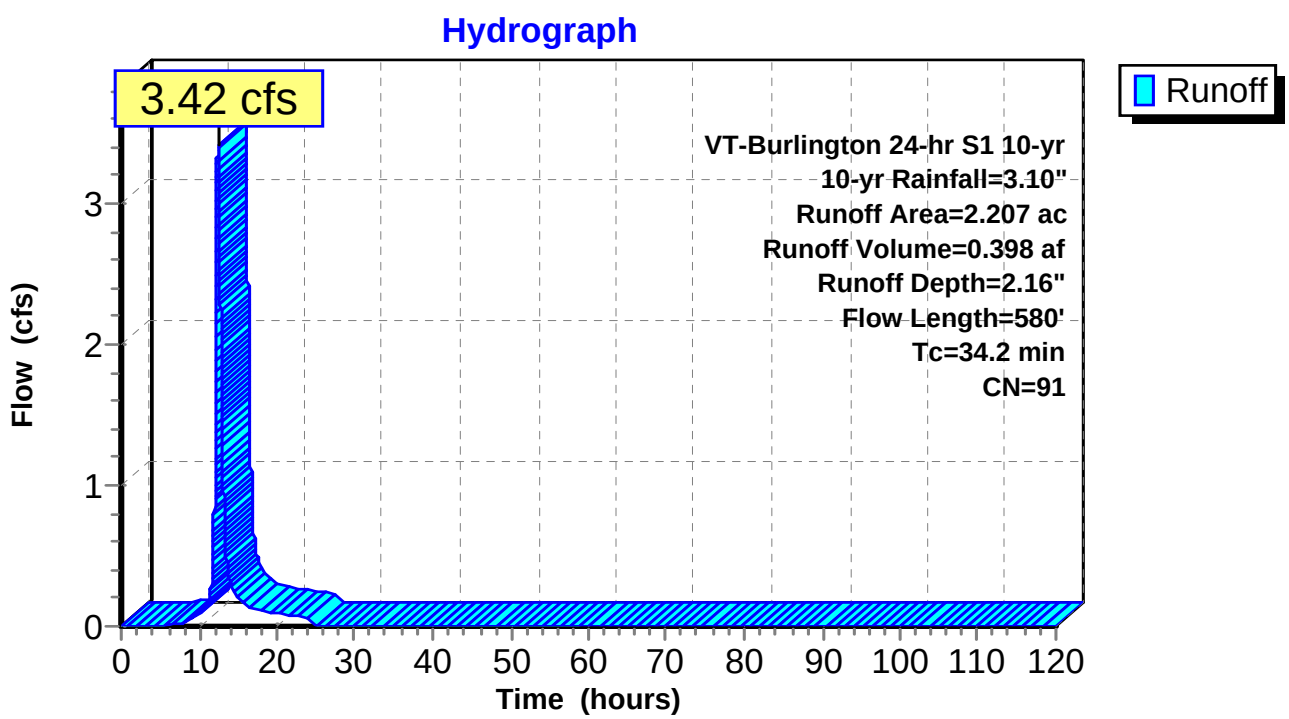
Runoff = 3.42 cfs @ 12.42 hrs, Volume= 0.398 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	1.390	98	
	0.740	80	>75% Grass cover, Good, HSG D
	0.077	77	Woods, Good, HSG D
	2.207	91	Weighted Average
	0.817		37.02% Pervious Area
	1.390		62.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0100	0.07		**Sheet Flow, CSWD1A** Grass: Dense n= 0.240 P2= 2.20"
3.9	166	0.0100	0.70		**Shallow Concentrated Flow, CSWD1B** Short Grass Pasture Kv= 7.0 fps
7.6	314	0.0096	0.68		**Shallow Concentrated Flow, CSWD1C** Short Grass Pasture Kv= 7.0 fps
34.2	580	Total			

Subcatchment CSWD-1:



Summary for Subcatchment FA-1:

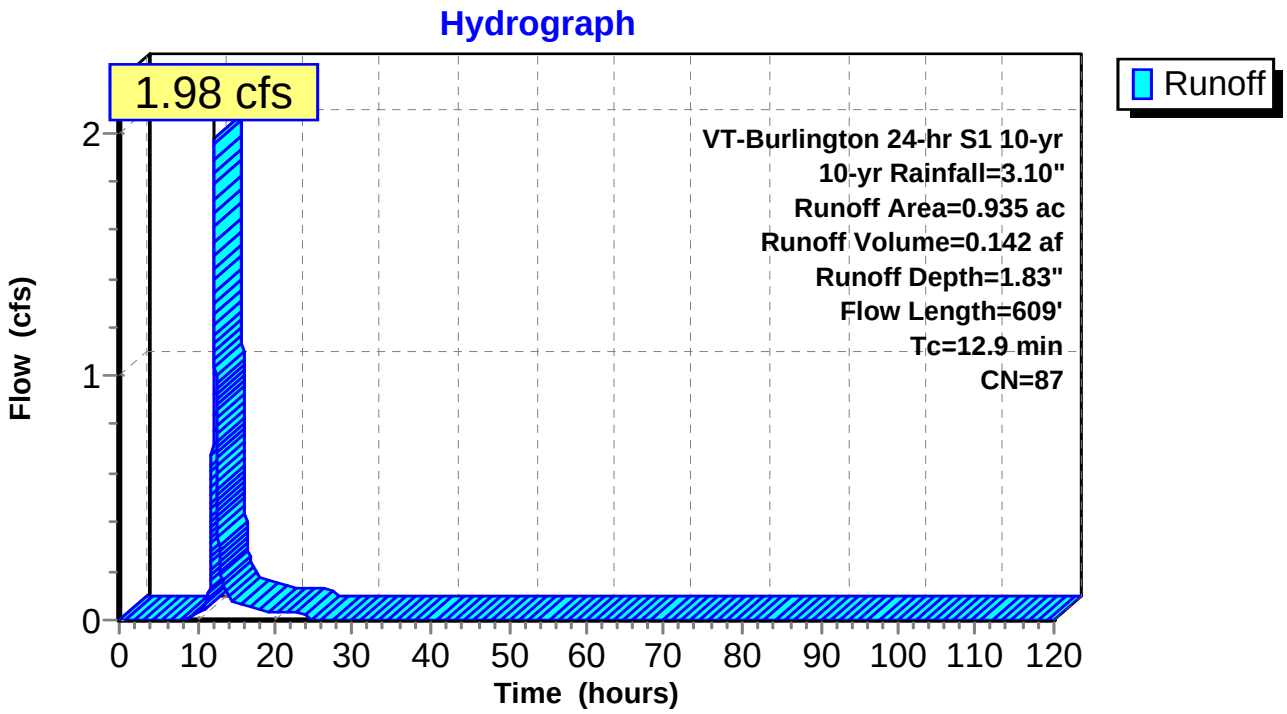
Runoff = 1.98 cfs @ 12.13 hrs, Volume= 0.142 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.399	98	
	0.316	80	>75% Grass cover, Good, HSG D
	0.220	77	Woods, Good, HSG D
	0.935	87	Weighted Average
	0.536		57.33% Pervious Area
	0.399		42.67% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	42	0.0954	0.06		**Sheet Flow, FA1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
0.9	567	0.0282	10.12	20.23	**Trap/Vee/Rect Channel Flow, FA1B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
12.9	609	Total			

Subcatchment FA-1:



Summary for Subcatchment FA-2:

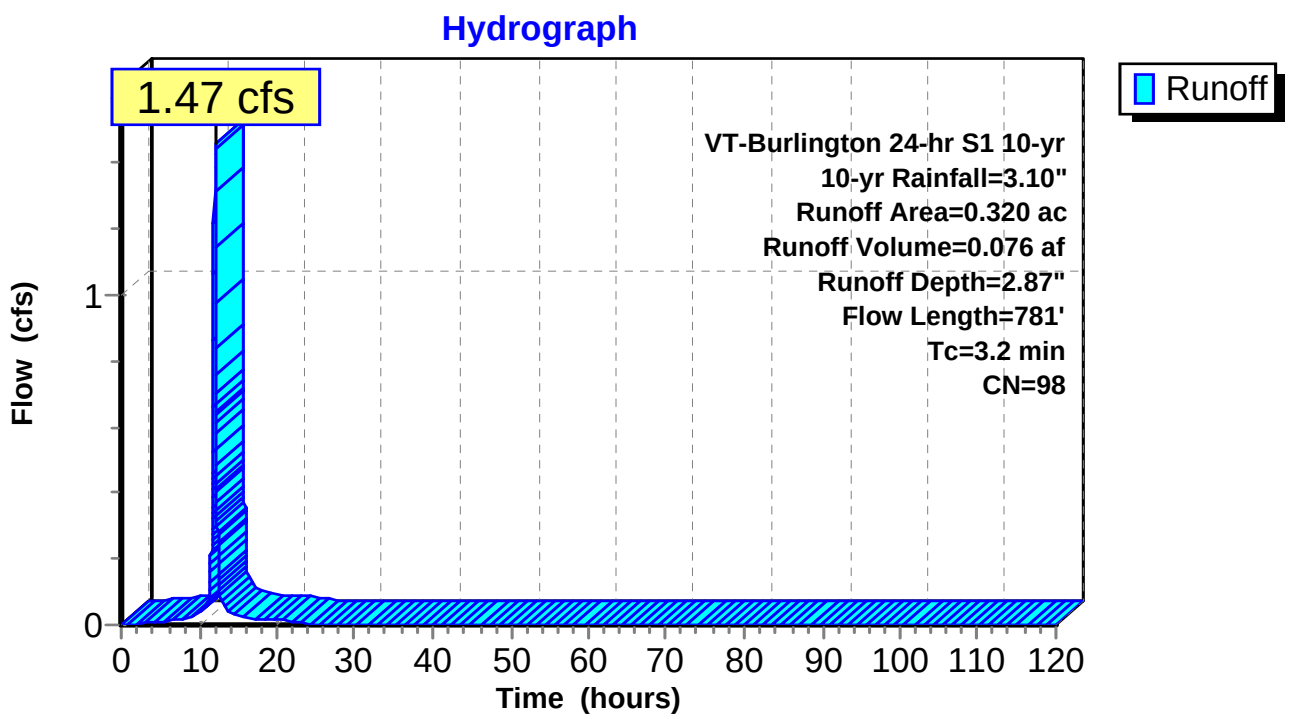
Runoff = 1.47 cfs @ 12.01 hrs, Volume= 0.076 af, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.318	98	
	0.002	77	Woods, Good, HSG D
	0.320	98	Weighted Average
	0.002		0.63% Pervious Area
	0.318		99.37% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	100	0.0100	0.86		**Sheet Flow, FA2A** Smooth Surfaces n= 0.011 P2= 2.20"
1.3	681	0.0220	8.94	17.87	**Trap/Vee/Rect Channel Flow, FA2B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.016 Asphalt, rough
3.2	781	Total			

Subcatchment FA-2:



Summary for Subcatchment FA-3:

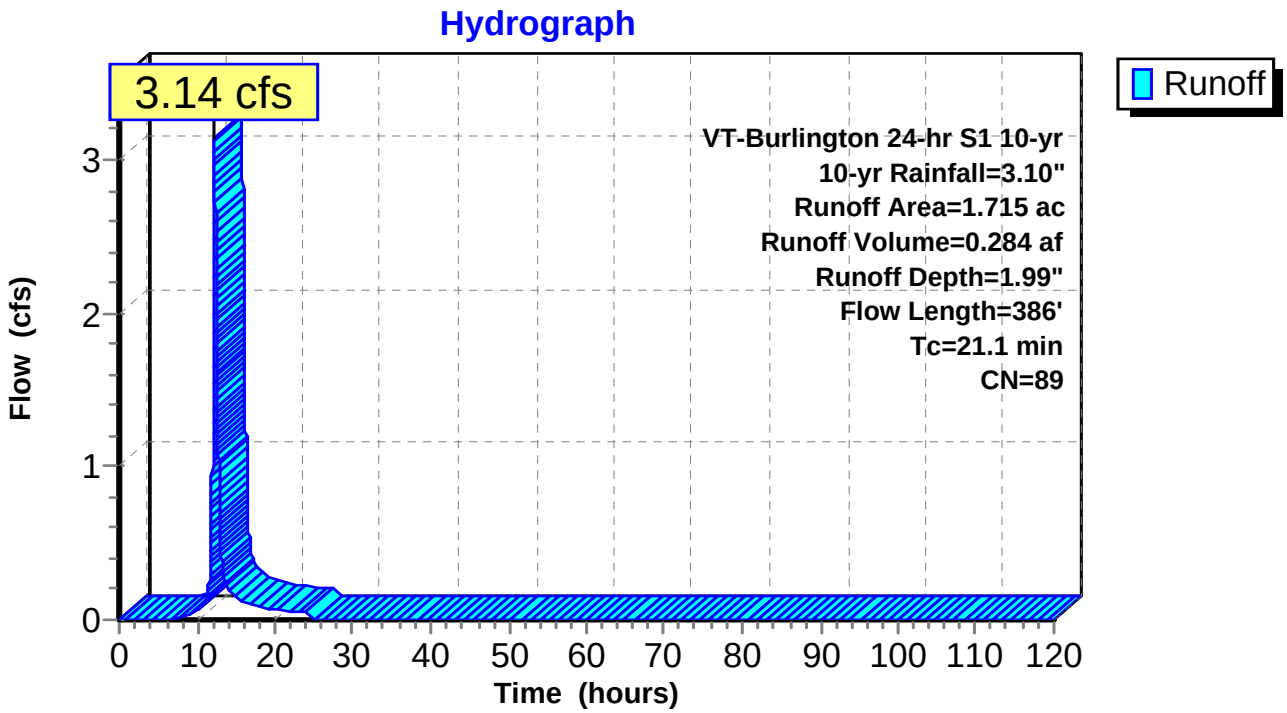
Runoff = 3.14 cfs @ 12.24 hrs, Volume= 0.284 af, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.915	98	
	0.487	80	>75% Grass cover, Good, HSG D
	0.313	77	Woods, Good, HSG D
	1.715	89	Weighted Average
	0.800		46.65% Pervious Area
	0.915		53.35% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.9	60	0.0500	0.13		**Sheet Flow, FA3A** Grass: Dense n= 0.240 P2= 2.20"
10.9	40	0.0100	0.06		**Sheet Flow, FA3B** Grass: Dense n= 0.240 P2= 2.20"
0.7	53	0.0376	1.36		**Shallow Concentrated Flow, FA3C** Short Grass Pasture Kv= 7.0 fps
1.1	43	0.0695	0.66		**Shallow Concentrated Flow, FA3D** Forest w/Heavy Litter Kv= 2.5 fps
0.5	190	0.0578	5.79	11.59	**Trap/Vee/Rect Channel Flow, FA3E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
21.1	386	Total			

Subcatchment FA-3:



Summary for Subcatchment FS-1: to R2

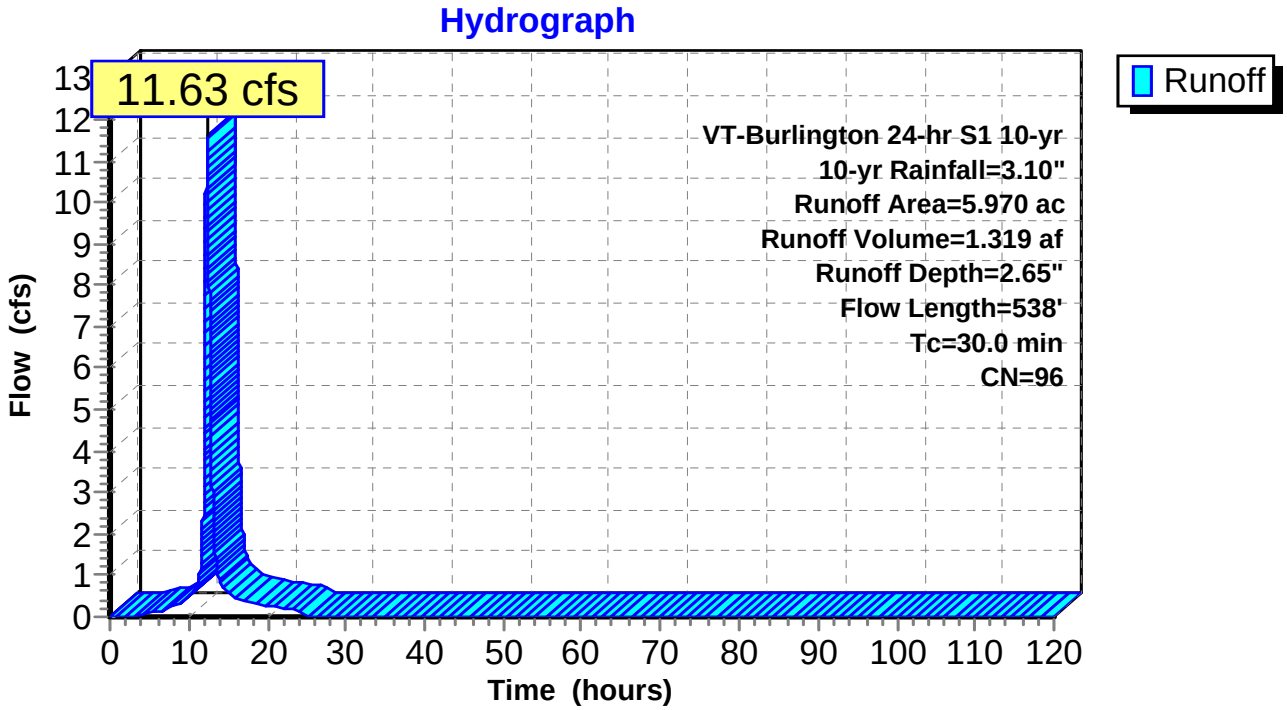
Runoff = 11.63 cfs @ 12.36 hrs, Volume= 1.319 af, Depth= 2.65"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	5.250	98	
	0.570	80	>75% Grass cover, Good, HSG D
	0.150	77	Woods, Good, HSG D
	5.970	96	Weighted Average
	0.720		12.06% Pervious Area
	5.250		87.94% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0100	0.07		**Sheet Flow, FS1A** Grass: Dense n= 0.240 P2= 2.20"
0.9	39	0.0100	0.70		**Shallow Concentrated Flow, FS1B** Short Grass Pasture Kv= 7.0 fps
1.3	56	0.0100	0.70		**Shallow Concentrated Flow, FS1C** Short Grass Pasture Kv= 7.0 fps
5.1	344	0.0262	1.13		**Shallow Concentrated Flow, FS1D** Short Grass Pasture Kv= 7.0 fps
30.0	538	Total			

Subcatchment FS-1: to R2



Summary for Subcatchment FS-2: to R2

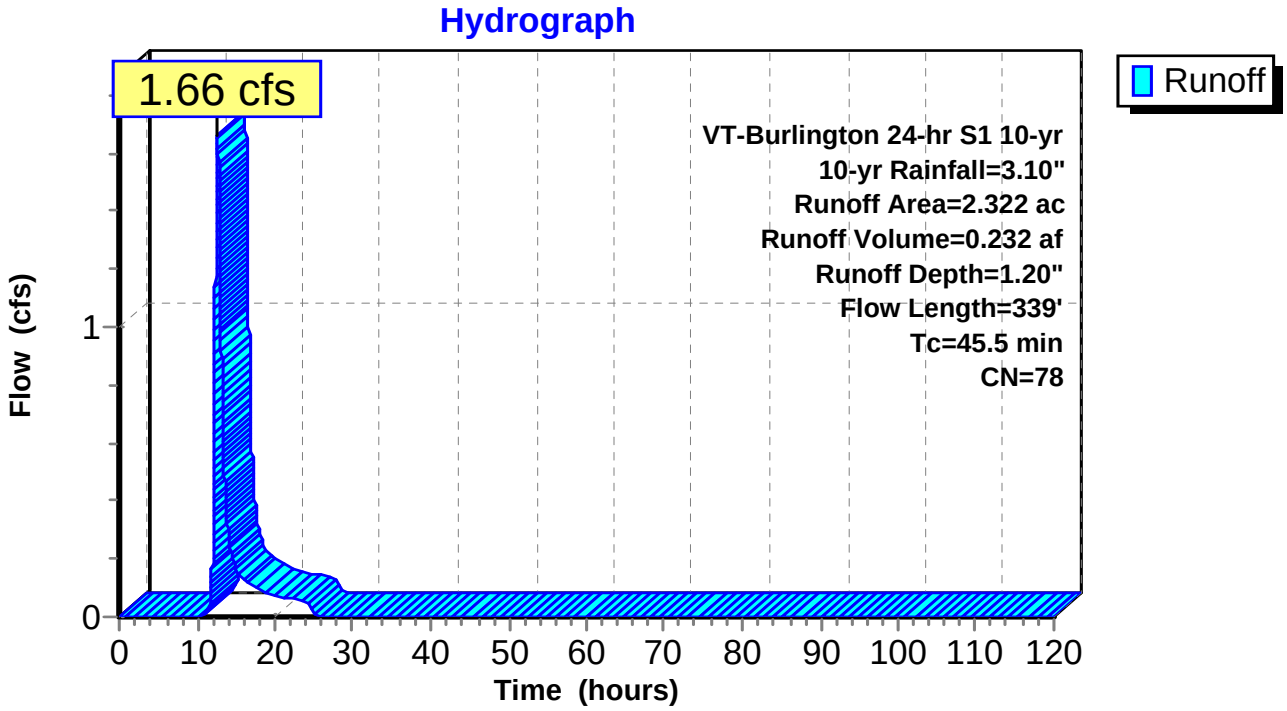
Runoff = 1.66 cfs @ 12.64 hrs, Volume= 0.232 af, Depth= 1.20"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.033	98	
	0.589	80	>75% Grass cover, Good, HSG D
	1.700	77	Woods, Good, HSG D
	2.322	78	Weighted Average
	2.289		98.58% Pervious Area
	0.033		1.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	100	0.0500	0.05		**Sheet Flow, FS2A** Woods: Dense underbrush n= 0.800 P2= 2.20"
14.2	239	0.0125	0.28		**Shallow Concentrated Flow, FS2B** Forest w/Heavy Litter Kv= 2.5 fps
45.5	339	Total			

Subcatchment FS-2: to R2



Summary for Subcatchment IPW-1: to R4

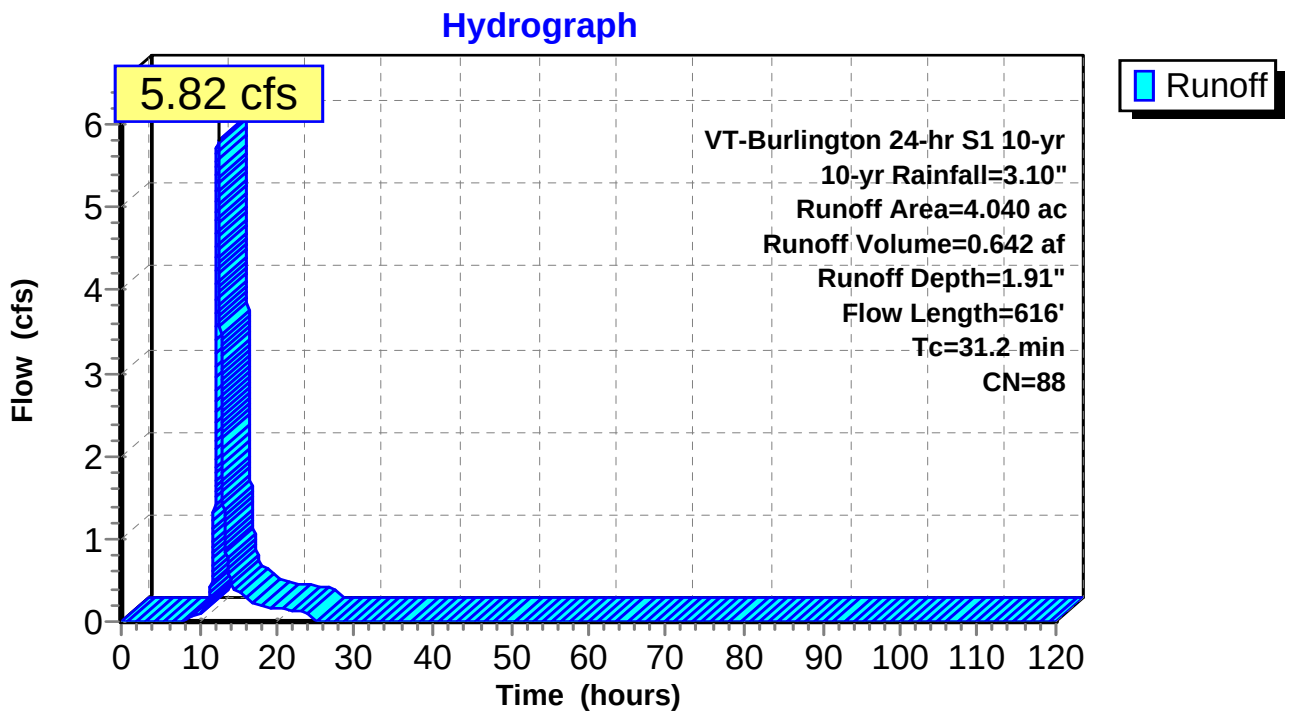
Runoff = 5.82 cfs @ 12.38 hrs, Volume= 0.642 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	1.960	98	
	1.300	80	>75% Grass cover, Good, HSG D
	0.780	77	Woods, Good, HSG D
	4.040	88	Weighted Average
	2.080		51.49% Pervious Area
	1.960		48.51% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
29.1	100	0.0600	0.06		**Sheet Flow, IPW1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
0.7	40	0.1512	0.97		**Shallow Concentrated Flow, IPW1B** Forest w/Heavy Litter Kv= 2.5 fps
1.4	476	0.0168	5.68	11.36	**Trap/Vee/Rect Channel Flow, IPW1C** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.022 Earth, clean & straight
31.2	616	Total			

Subcatchment IPW-1: to R4



Summary for Subcatchment IPW-2: to R4

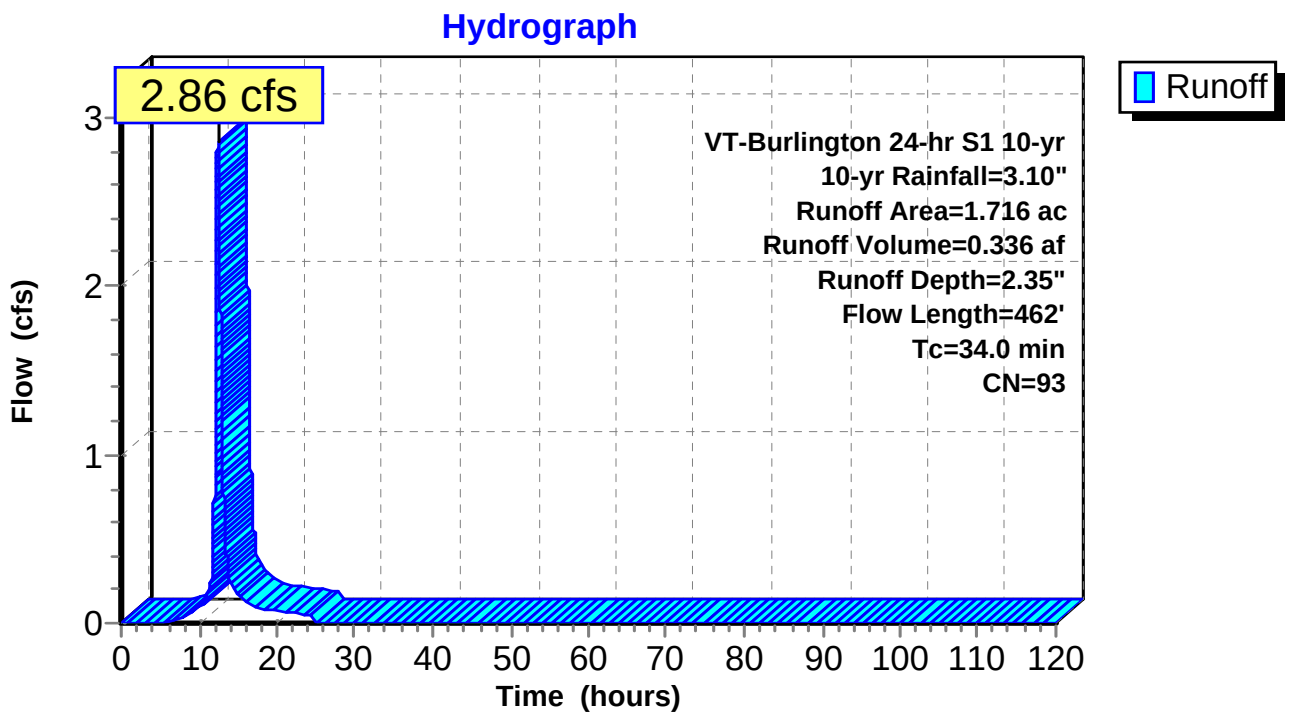
Runoff = 2.86 cfs @ 12.42 hrs, Volume= 0.336 af, Depth= 2.35"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	1.240	98	
	0.246	80	>75% Grass cover, Good, HSG D
	0.230	77	Woods, Good, HSG D
	1.716	93	Weighted Average
	0.476		27.74% Pervious Area
	1.240		72.26% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.7	67	0.0300	0.04		**Sheet Flow, IPW2A** Woods: Dense underbrush n= 0.800 P2= 2.20"
3.5	33	0.1202	0.16		**Sheet Flow, IPW2B** Grass: Dense n= 0.240 P2= 2.20"
1.9	138	0.0290	1.19		**Shallow Concentrated Flow, IPW2C** Short Grass Pasture Kv= 7.0 fps
0.9	224	0.0268	3.94	7.89	**Trap/Vee/Rect Channel Flow, IPW2D** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
34.0	462	Total			

Subcatchment IPW-2: to R4



Summary for Subcatchment IPW-3: to R4

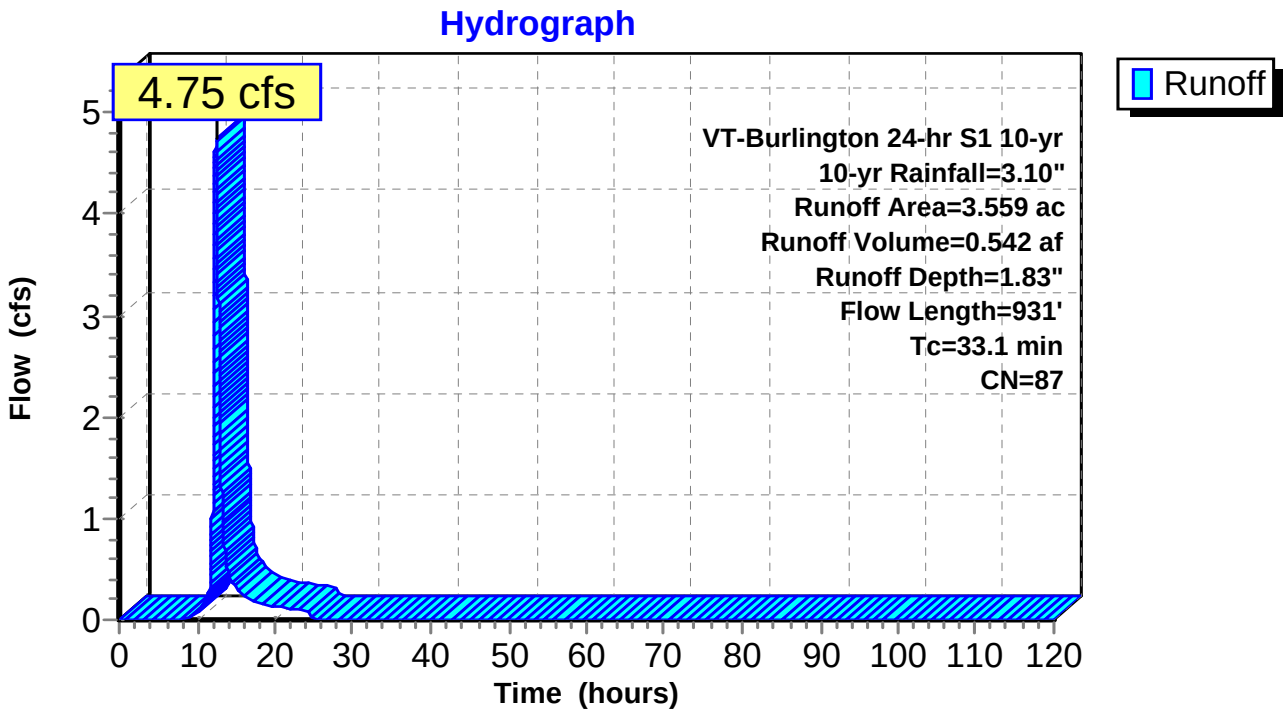
Runoff = 4.75 cfs @ 12.40 hrs, Volume= 0.542 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	1.490	98	
	0.993	80	>75% Grass cover, Good, HSG D
	0.010	74	>75% Grass cover, Good, HSG C
	1.066	77	Woods, Good, HSG D
	3.559	87	Weighted Average
	2.069		58.13% Pervious Area
	1.490		41.87% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.8	25	0.3300	0.23		**Sheet Flow, IPW3A** Grass: Dense n= 0.240 P2= 2.20"
6.3	49	0.0610	0.13		**Sheet Flow, IPW3B** Grass: Dense n= 0.240 P2= 2.20"
11.7	26	0.0387	0.04		**Sheet Flow, IPW3C** Woods: Dense underbrush n= 0.800 P2= 2.20"
6.0	224	0.0624	0.62		**Shallow Concentrated Flow, IPW3D** Forest w/Heavy Litter Kv= 2.5 fps
7.3	607	0.0132	1.38	2.77	**Trap/Vee/Rect Channel Flow, IPW3E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
33.1	931	Total			

Subcatchment IPW-3: to R4



Summary for Subcatchment IPW-4: to R4

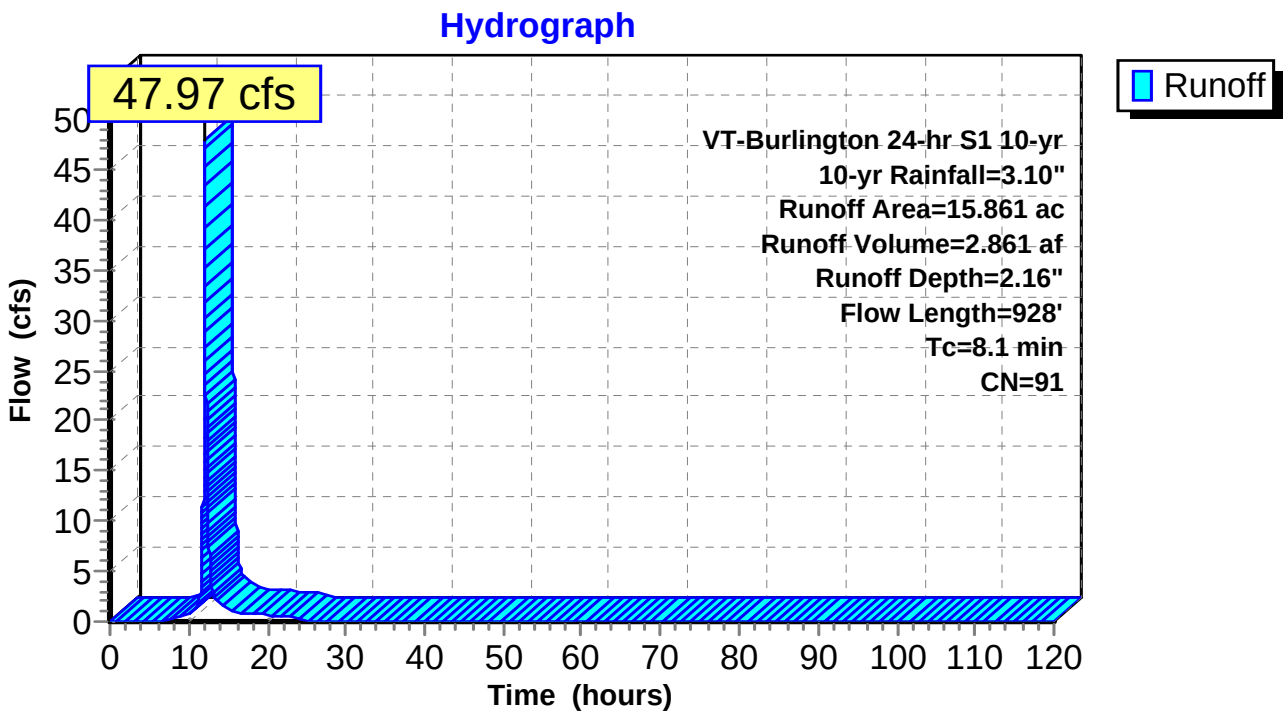
Runoff = 47.97 cfs @ 12.06 hrs, Volume= 2.861 af, Depth= 2.16"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	10.059	98	
	4.197	80	>75% Grass cover, Good, HSG D
	0.920	74	>75% Grass cover, Good, HSG C
	0.352	61	>75% Grass cover, Good, HSG B
	0.333	77	Woods, Good, HSG D
	15.861	91	Weighted Average
	5.802		36.58% Pervious Area
	10.059		63.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.8	41	0.1459	0.18		**Sheet Flow, IPW4A** Grass: Dense n= 0.240 P2= 2.20"
4.3	887	0.0203	3.43	6.87	**Trap/Vee/Rect Channel Flow, IPW4B** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
8.1	928	Total			

Subcatchment IPW-4: to R4



Summary for Subcatchment IPW-5: to R4

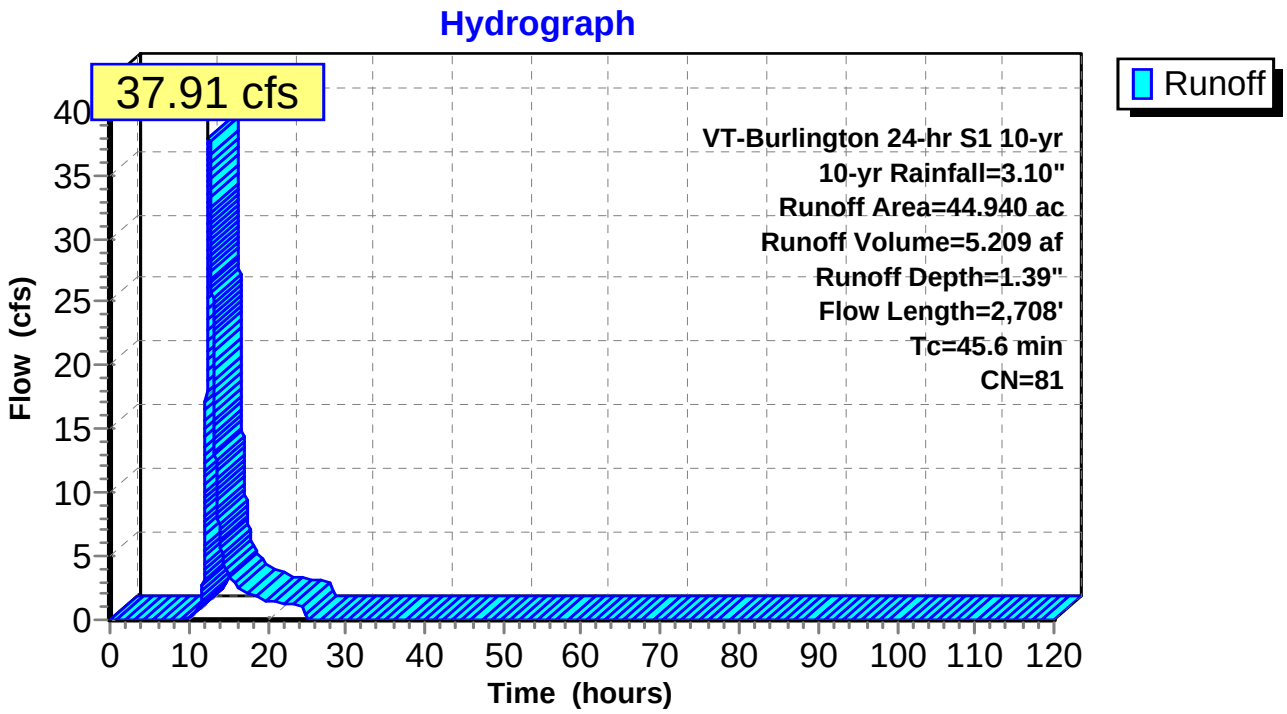
Runoff = 37.91 cfs @ 12.62 hrs, Volume= 5.209 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	7.800	98	
	11.130	80	>75% Grass cover, Good, HSG D
	0.070	74	>75% Grass cover, Good, HSG C
	0.330	61	>75% Grass cover, Good, HSG B
	24.960	77	Woods, Good, HSG D
	0.650	55	Woods, Good, HSG B
	44.940	81	Weighted Average
	37.140		82.64% Pervious Area
	7.800		17.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
26.7	150	0.1667	0.09		**Sheet Flow, IPW5A** Woods: Dense underbrush n= 0.800 P2= 2.20"
5.0	264	0.1213	0.87		**Shallow Concentrated Flow, IPW5B** Forest w/Heavy Litter Kv= 2.5 fps
8.3	1,112	0.0342	2.23	4.46	**Trap/Vee/Rect Channel Flow, IPW5C** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
1.3	502	0.0199	6.60	20.74	**Pipe Channel, IPW5D** 24.0" Round Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.020 Corrugated PE, corrugated interior
4.3	680	0.0118	2.62	5.24	**Trap/Vee/Rect Channel Flow, IPW5E** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
45.6	2,708	Total			

Subcatchment IPW-5: to R4



Summary for Subcatchment LF-1: to CB3

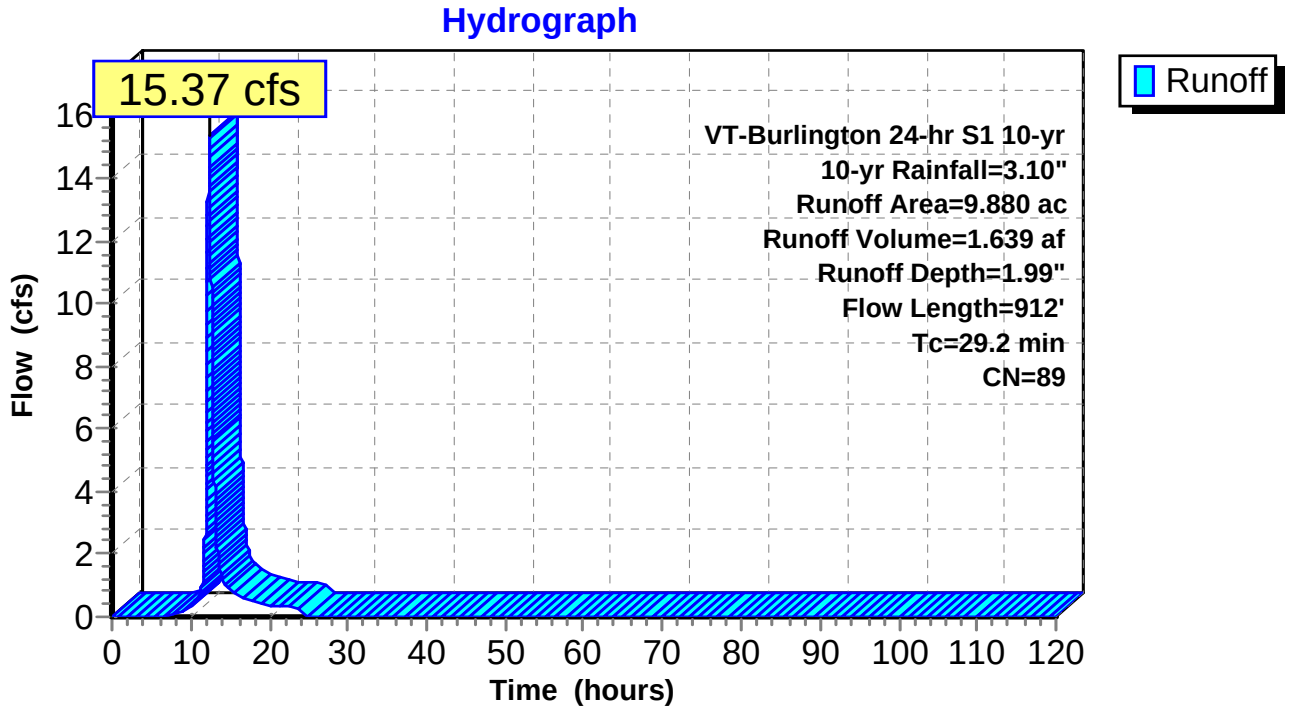
Runoff = 15.37 cfs @ 12.36 hrs, Volume= 1.639 af, Depth= 1.99"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	4.140	98	
	3.120	80	>75% Grass cover, Good, HSG D
*	0.940	100	water
	1.680	77	Woods, Good, HSG D
	9.880	89	Weighted Average
	4.800		48.58% Pervious Area
	5.080		51.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.6	25	0.0100	0.06		**Sheet Flow, LF1A** Grass: Dense n= 0.240 P2= 2.20"
18.0	75	0.0100	0.07		**Sheet Flow, LF1B** Grass: Dense n= 0.240 P2= 2.20"
3.6	812	0.0246	3.78	7.56	**Trap/Vee/Rect Channel Flow, LF1C** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.040 Earth, cobble bottom, clean sides
29.2	912	Total			

Subcatchment LF-1: to CB3



Summary for Subcatchment LF-2: to R1

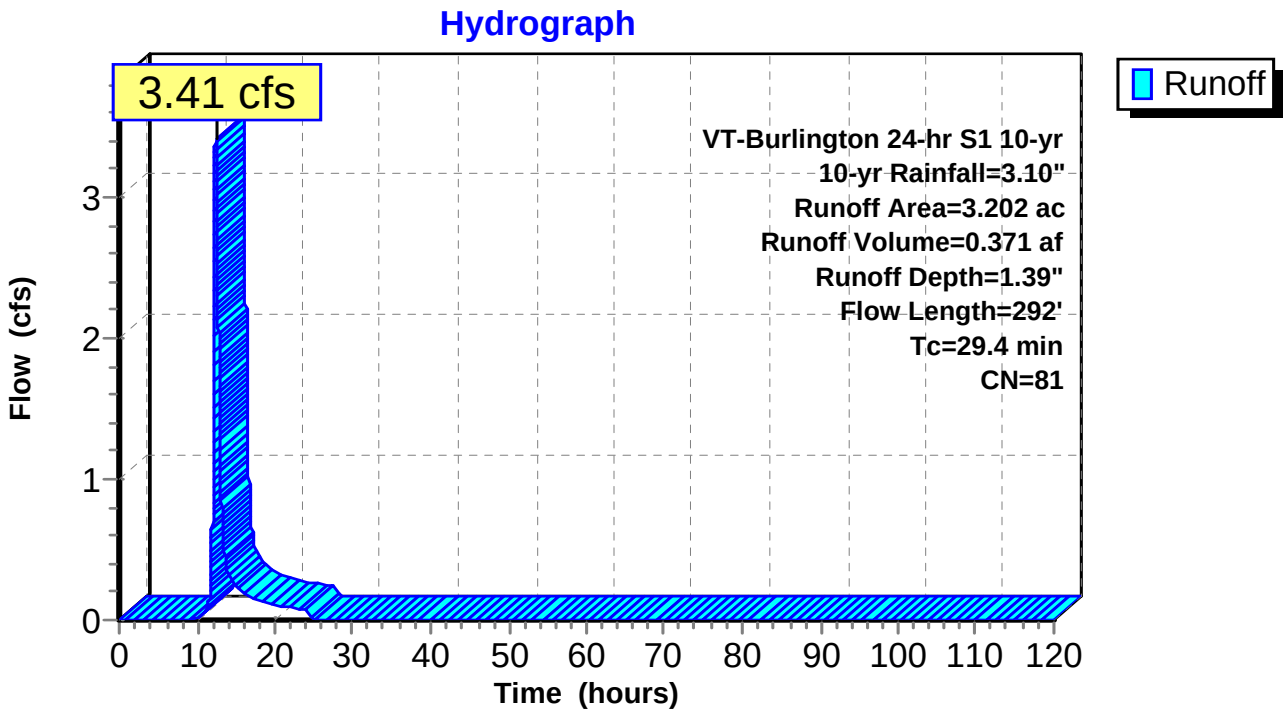
Runoff = 3.41 cfs @ 12.38 hrs, Volume= 0.371 af, Depth= 1.39"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.452	98	
	0.870	80	>75% Grass cover, Good, HSG D
*	0.000	100	water
	1.880	77	Woods, Good, HSG D
	3.202	81	Weighted Average
	2.750		85.88% Pervious Area
	0.452		14.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.7	100	0.0100	0.07		**Sheet Flow, LF2A** Grass: Dense n= 0.240 P2= 2.20"
6.7	192	0.0365	0.48		**Shallow Concentrated Flow, LF2B** Forest w/Heavy Litter Kv= 2.5 fps
29.4	292	Total			

Subcatchment LF-2: to R1



Summary for Subcatchment OB-1:

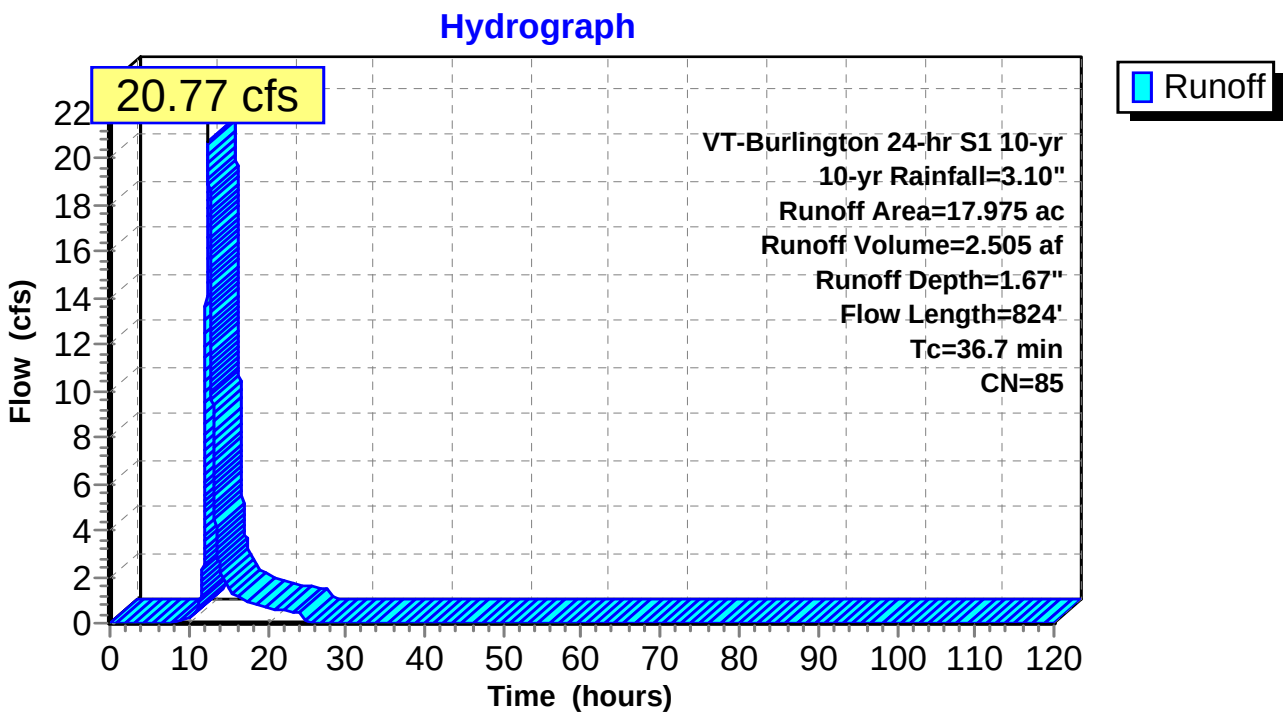
Runoff = 20.77 cfs @ 12.48 hrs, Volume= 2.505 af, Depth= 1.67"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	6.440	98	
	6.500	80	>75% Grass cover, Good, HSG D
	0.790	74	>75% Grass cover, Good, HSG C
	3.990	77	Woods, Good, HSG D
	0.255	70	Woods, Good, HSG C
	17.975	85	Weighted Average
	11.535		64.17% Pervious Area
	6.440		35.83% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
33.7	150	0.0933	0.07		**Sheet Flow, OB1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
1.4	56	0.0713	0.67		**Shallow Concentrated Flow, OB1B** Forest w/Heavy Litter Kv= 2.5 fps
1.6	618	0.0291	6.59	11.65	**Pipe Channel, OB1C** 18.0" Round Area= 1.8 sf Perim= 4.7' r= 0.38' n= 0.020 Corrugated PE, corrugated interior
36.7	824	Total			

Subcatchment OB-1:



Summary for Subcatchment OLP-1:

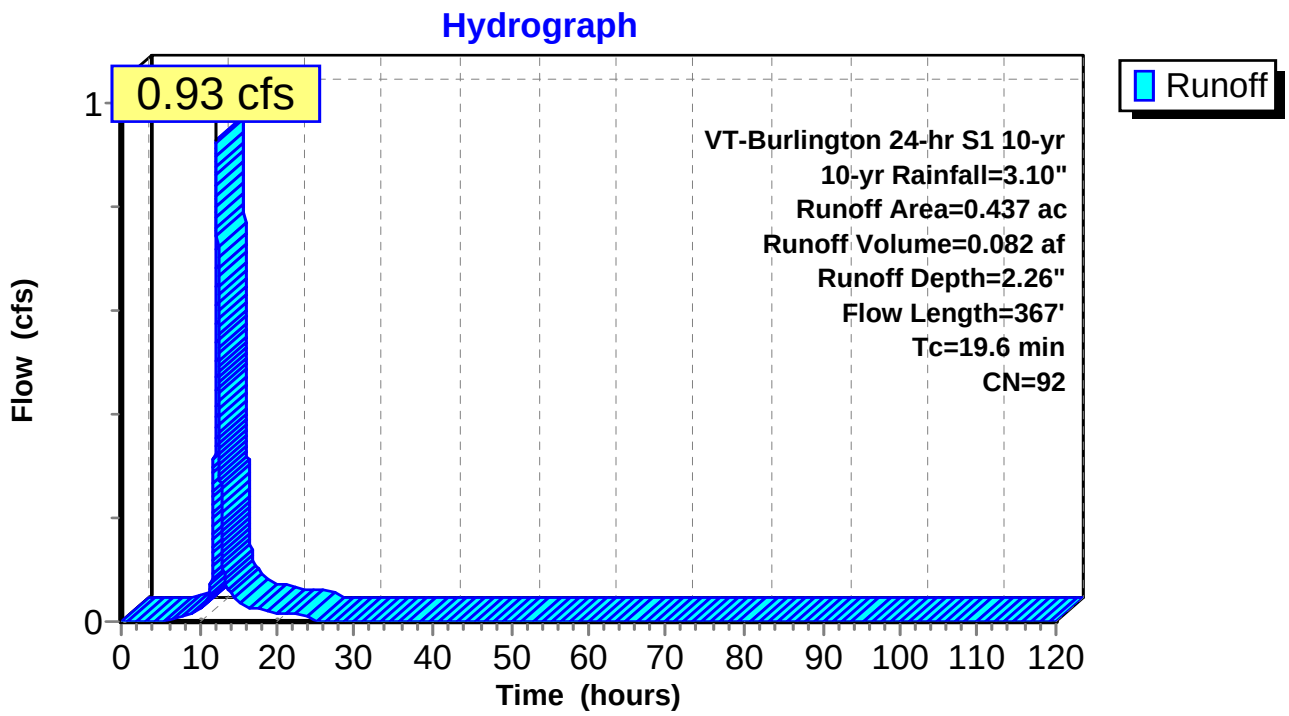
Runoff = 0.93 cfs @ 12.22 hrs, Volume= 0.082 af, Depth= 2.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.280	98	
	0.157	80	>75% Grass cover, Good, HSG D
	0.437	92	Weighted Average
	0.157		35.93% Pervious Area
	0.280		64.07% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.8	14	0.0100	0.05		**Sheet Flow, OLP1A** Grass: Dense n= 0.240 P2= 2.20"
10.0	63	0.0315	0.11		**Sheet Flow, OLP1B** Grass: Dense n= 0.240 P2= 2.20"
0.6	22	0.0100	0.64		**Sheet Flow, OLP1C** Smooth Surfaces n= 0.011 P2= 2.20"
4.2	267	0.0225	1.05		**Shallow Concentrated Flow, OLP1D** Short Grass Pasture Kv= 7.0 fps
19.6	367	Total			

Subcatchment OLP-1:



Summary for Subcatchment OLP-2:

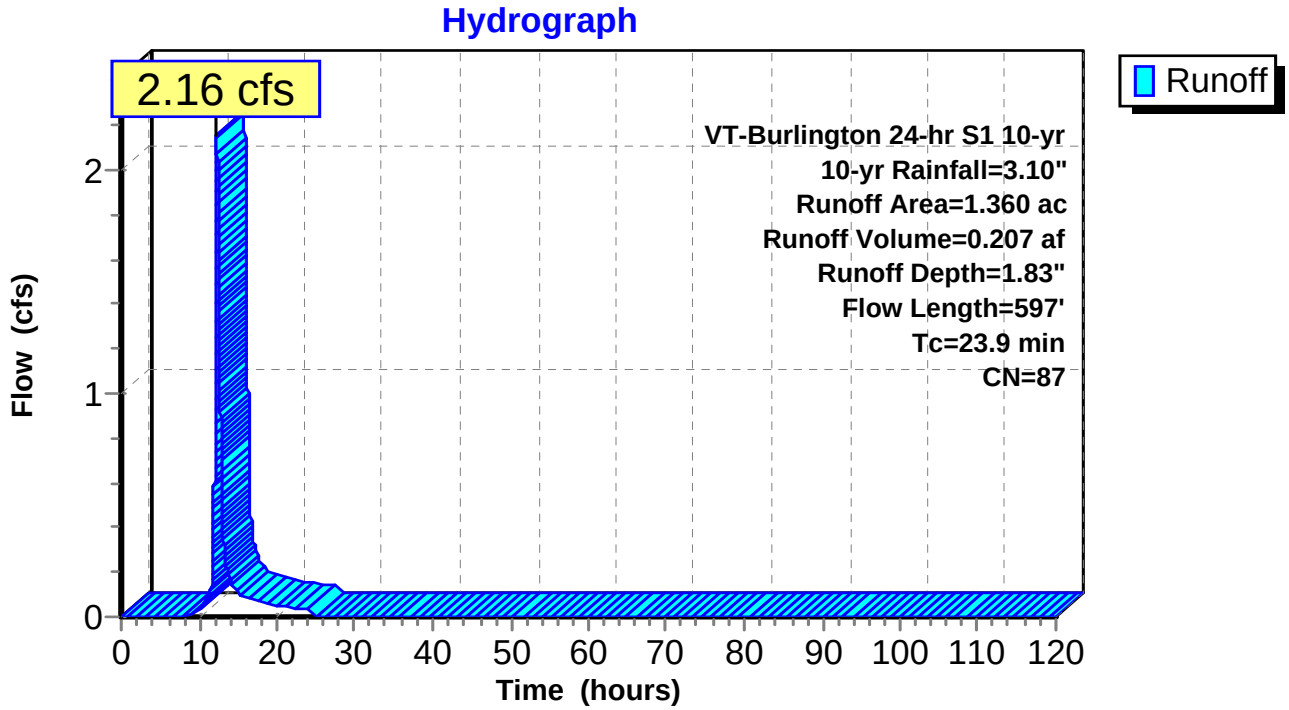
Runoff = 2.16 cfs @ 12.29 hrs, Volume= 0.207 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.220	98	
*	0.340	98	
	0.800	80	>75% Grass cover, Good, HSG D
	1.360	87	Weighted Average
	0.800		58.82% Pervious Area
	0.560		41.18% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
10.3	65	0.0308	0.11		**Sheet Flow, OLP2A** Grass: Dense n= 0.240 P2= 2.20"
4.9	35	0.0570	0.12		**Sheet Flow, OLP2B** Grass: Dense n= 0.240 P2= 2.20"
4.8	229	0.0131	0.80		**Shallow Concentrated Flow, OLP2C** Short Grass Pasture Kv= 7.0 fps
3.9	268	0.0261	1.13		**Shallow Concentrated Flow, OLP2D** Short Grass Pasture Kv= 7.0 fps
23.9	597	Total			

Subcatchment OLP-2:



Summary for Subcatchment OLP-3:

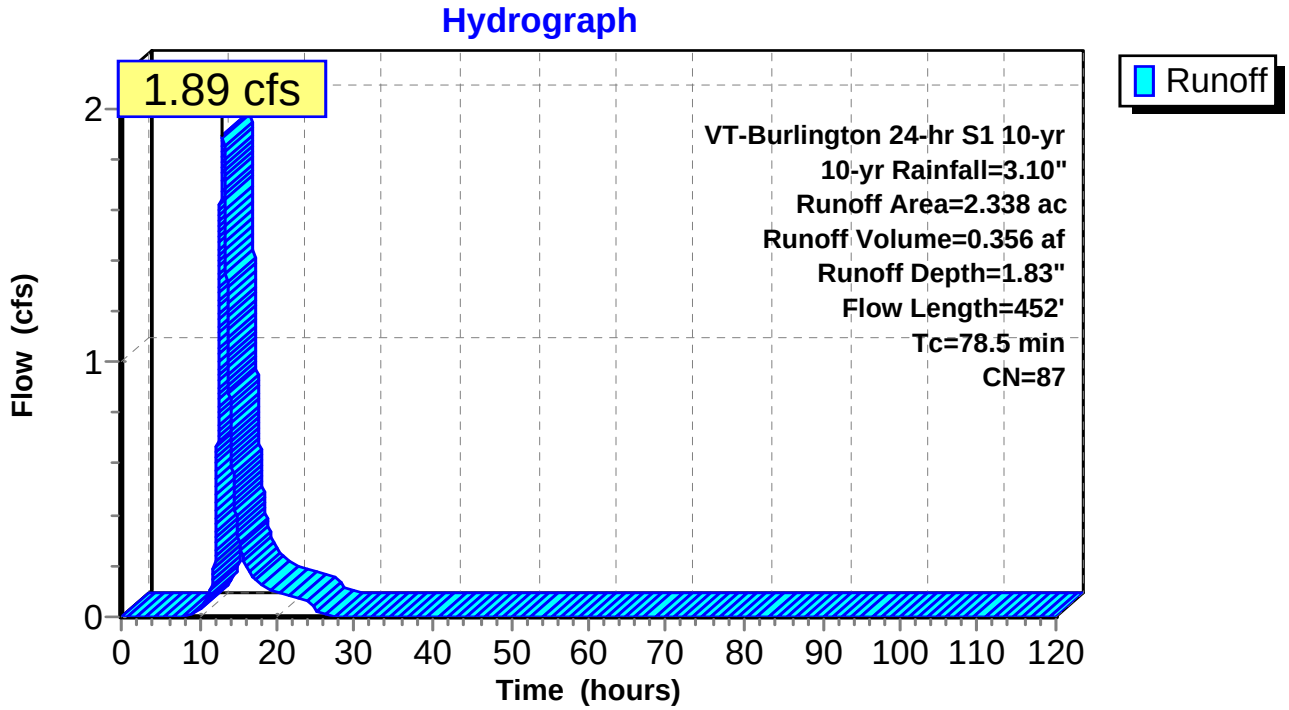
Runoff = 1.89 cfs @ 13.00 hrs, Volume= 0.356 af, Depth= 1.83"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.938	98	
	0.960	80	>75% Grass cover, Good, HSG D
	0.440	77	Woods, Good, HSG D
	2.338	87	Weighted Average
	1.400		59.88% Pervious Area
	0.938		40.12% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
73.4	150	0.0133	0.03		**Sheet Flow, OLP3A** Woods: Dense underbrush n= 0.800 P2= 2.20"
1.7	40	0.0253	0.40		**Shallow Concentrated Flow, OLP3B** Forest w/Heavy Litter Kv= 2.5 fps
0.8	71	0.0424	1.44		**Shallow Concentrated Flow, OLP3C** Short Grass Pasture Kv= 7.0 fps
2.6	191	0.0314	1.24		**Shallow Concentrated Flow, OLP3D** Short Grass Pasture Kv= 7.0 fps
78.5	452	Total			

Subcatchment OLP-3:



Summary for Subcatchment OLP-4:

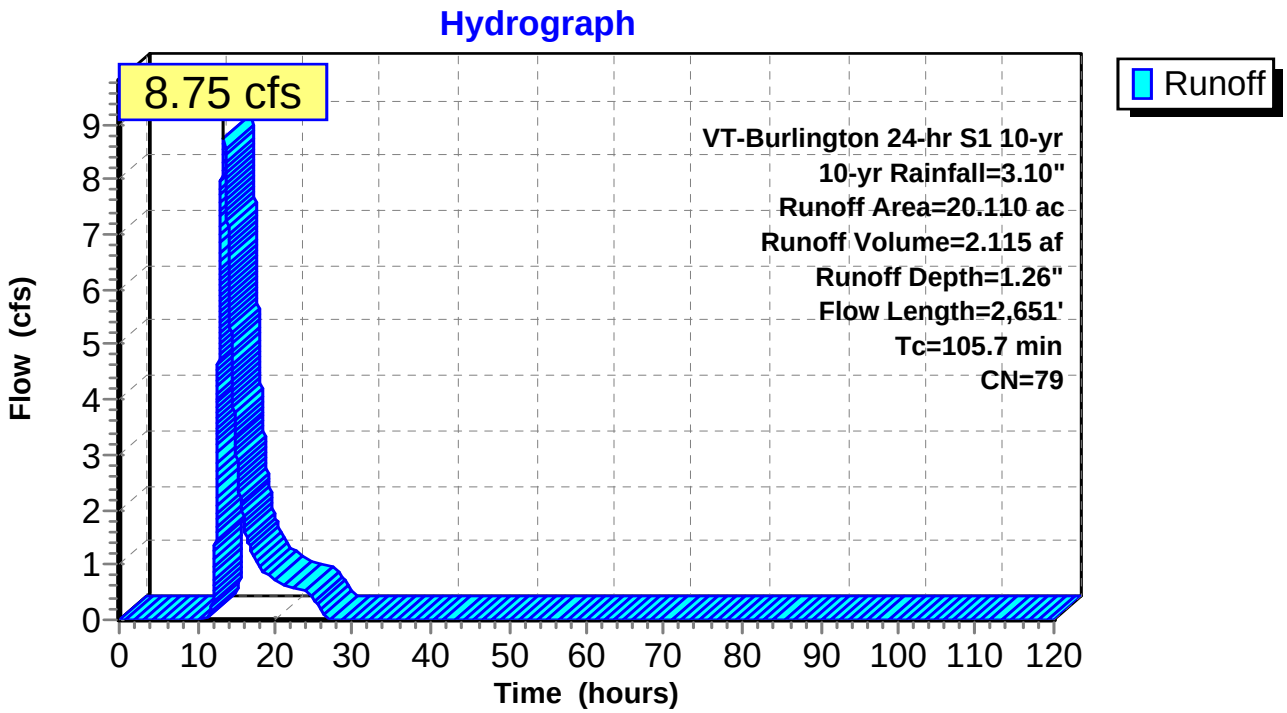
Runoff = 8.75 cfs @ 13.50 hrs, Volume= 2.115 af, Depth= 1.26"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	1.130	98	
	7.770	80	>75% Grass cover, Good, HSG D
	11.210	77	Woods, Good, HSG D
	20.110	79	Weighted Average
	18.980		94.38% Pervious Area
	1.130		5.62% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.0	11	0.0100	0.05		**Sheet Flow, OLP4A** Grass: Dense n= 0.240 P2= 2.20"
6.4	20	0.0100	0.05		**Sheet Flow, OLP4B** Grass: Dense n= 0.240 P2= 2.20"
18.4	68	0.0879	0.06		**Sheet Flow, OLP4C** Woods: Dense underbrush n= 0.800 P2= 2.20"
49.3	818	0.0122	0.28		**Shallow Concentrated Flow, OLP4D** Forest w/Heavy Litter Kv= 2.5 fps
18.1	739	0.0095	0.68		**Shallow Concentrated Flow, OLP4E** Short Grass Pasture Kv= 7.0 fps
9.5	994	0.0211	1.75	3.50	**Trap/Vee/Rect Channel Flow, OLP4F** Bot.W=1.00' D=1.00' Z= 1.0 '/' Top.W=3.00' n= 0.080 Earth, long dense weeds
105.7	2,651	Total			

Subcatchment OLP-4:



Summary for Subcatchment SW-1: to CB3

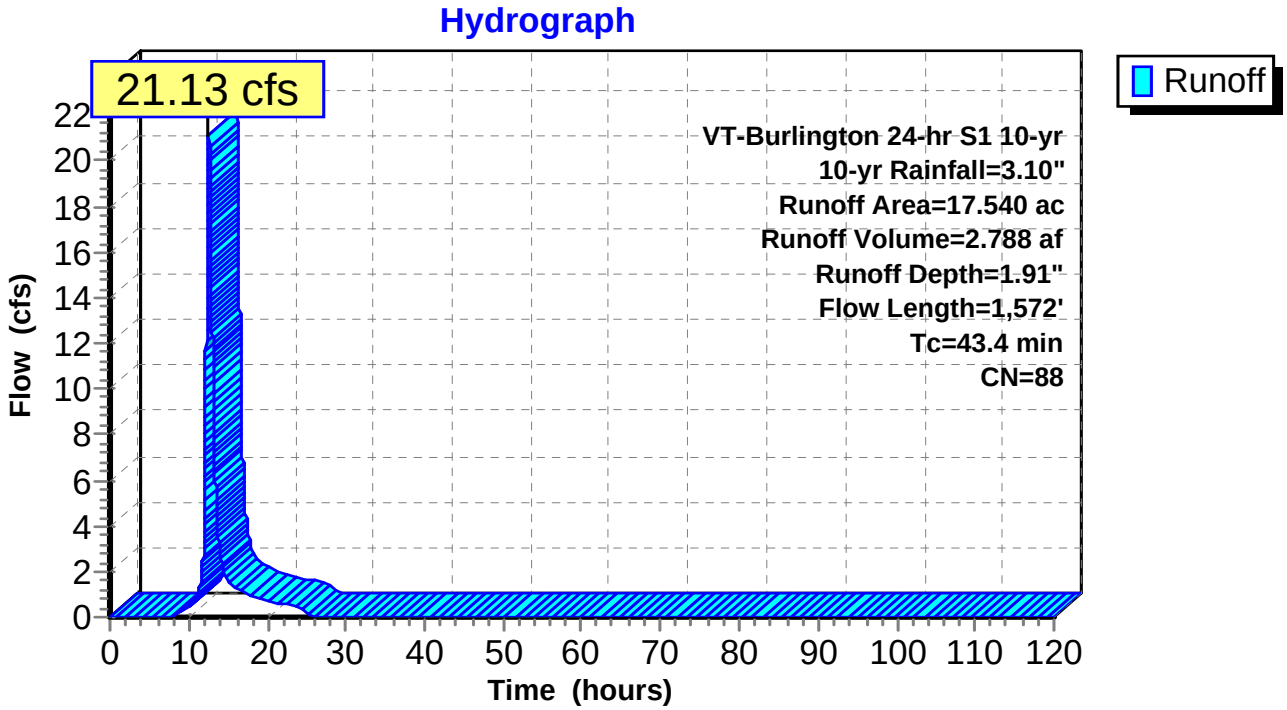
Runoff = 21.13 cfs @ 12.58 hrs, Volume= 2.788 af, Depth= 1.91"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	7.830	98	
	7.440	80	>75% Grass cover, Good, HSG D
	2.270	77	Woods, Good, HSG D
	17.540	88	Weighted Average
	9.710		55.36% Pervious Area
	7.830		44.64% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
31.3	100	0.0500	0.05		**Sheet Flow, SW1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
7.0	164	0.0244	0.39		**Shallow Concentrated Flow, SW1B** Forest w/Heavy Litter Kv= 2.5 fps
3.3	199	0.0201	0.99		**Shallow Concentrated Flow, SW1C** Short Grass Pasture Kv= 7.0 fps
1.8	1,109	0.0216	10.06	12.34	**Pipe Channel, SW1D** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.010 PVC, smooth interior
43.4	1,572	Total			

Subcatchment SW-1: to CB3



Summary for Subcatchment UD-1:

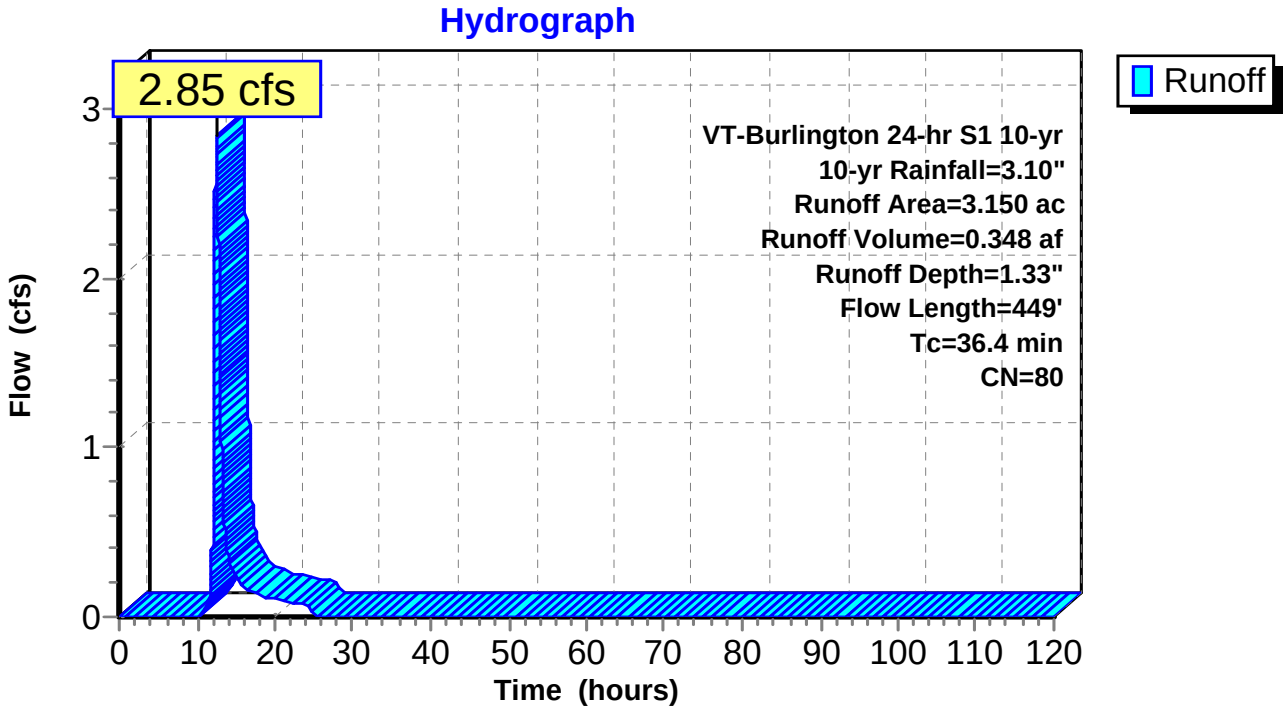
Runoff = 2.85 cfs @ 12.50 hrs, Volume= 0.348 af, Depth= 1.33"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
VT-Burlington 24-hr S1 10-yr 10-yr Rainfall=3.10"

	Area (ac)	CN	Description
*	0.330	98	
	0.350	80	>75% Grass cover, Good, HSG D
	2.470	77	Woods, Good, HSG D
	3.150	80	Weighted Average
	2.820		89.52% Pervious Area
	0.330		10.48% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.5	150	0.1867	0.10		**Sheet Flow, UD1A** Woods: Dense underbrush n= 0.800 P2= 2.20"
10.9	299	0.0335	0.46		**Shallow Concentrated Flow, UD1B** Forest w/Heavy Litter Kv= 2.5 fps
36.4	449	Total			

Subcatchment UD-1:



Summary for Reach R1:

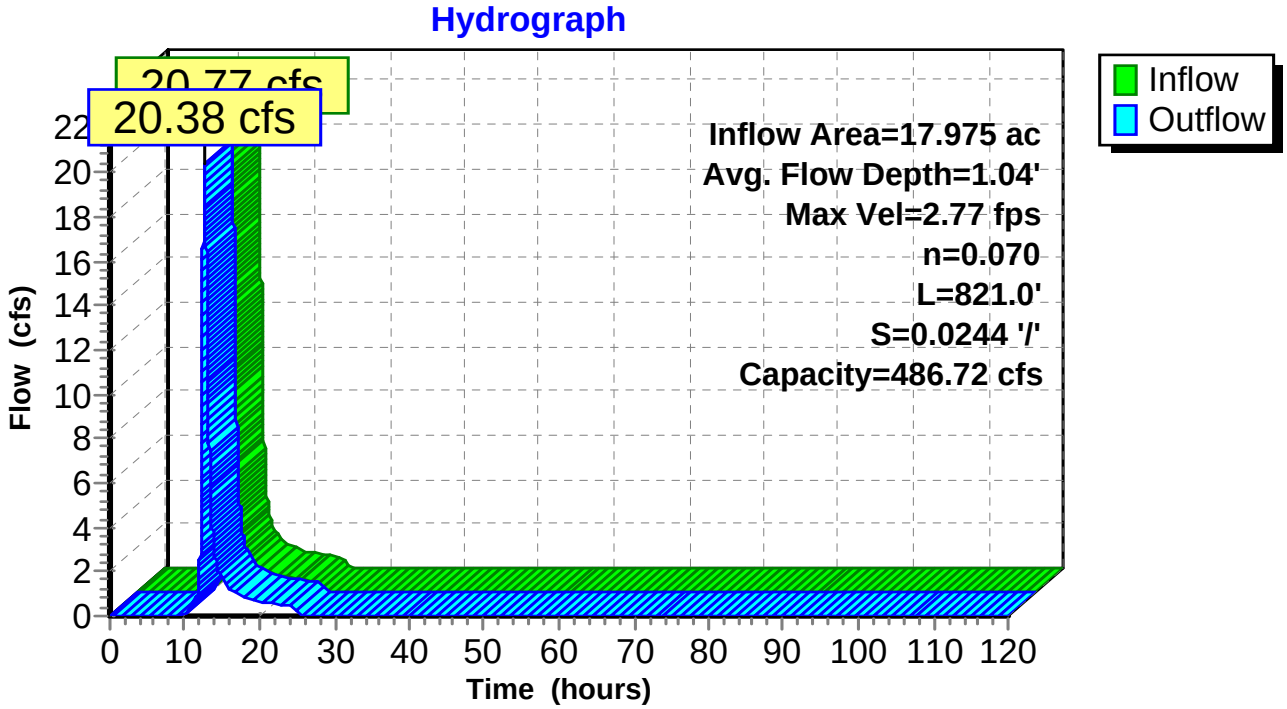
Inflow Area = 17.975 ac, 35.83% Impervious, Inflow Depth = 1.67" for 10-yr event
Inflow = 20.77 cfs @ 12.48 hrs, Volume= 2.505 af
Outflow = 20.38 cfs @ 12.62 hrs, Volume= 2.505 af, Atten= 2%, Lag= 8.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 2.77 fps, Min. Travel Time= 4.9 min
Avg. Velocity = 0.90 fps, Avg. Travel Time= 15.2 min

Peak Storage= 6,047 cf @ 12.54 hrs
Average Depth at Peak Storage= 1.04'
Bank-Full Depth= 5.00' Flow Area= 75.0 sf, Capacity= 486.72 cfs

5.00' x 5.00' deep channel, n= 0.070 Sluggish weedy reaches w/pools
Side Slope Z-value= 2.0 '/' Top Width= 25.00'
Length= 821.0' Slope= 0.0244 '/'
Inlet Invert= 126.00', Outlet Invert= 106.00'

Reach R1:



Summary for Reach R3:

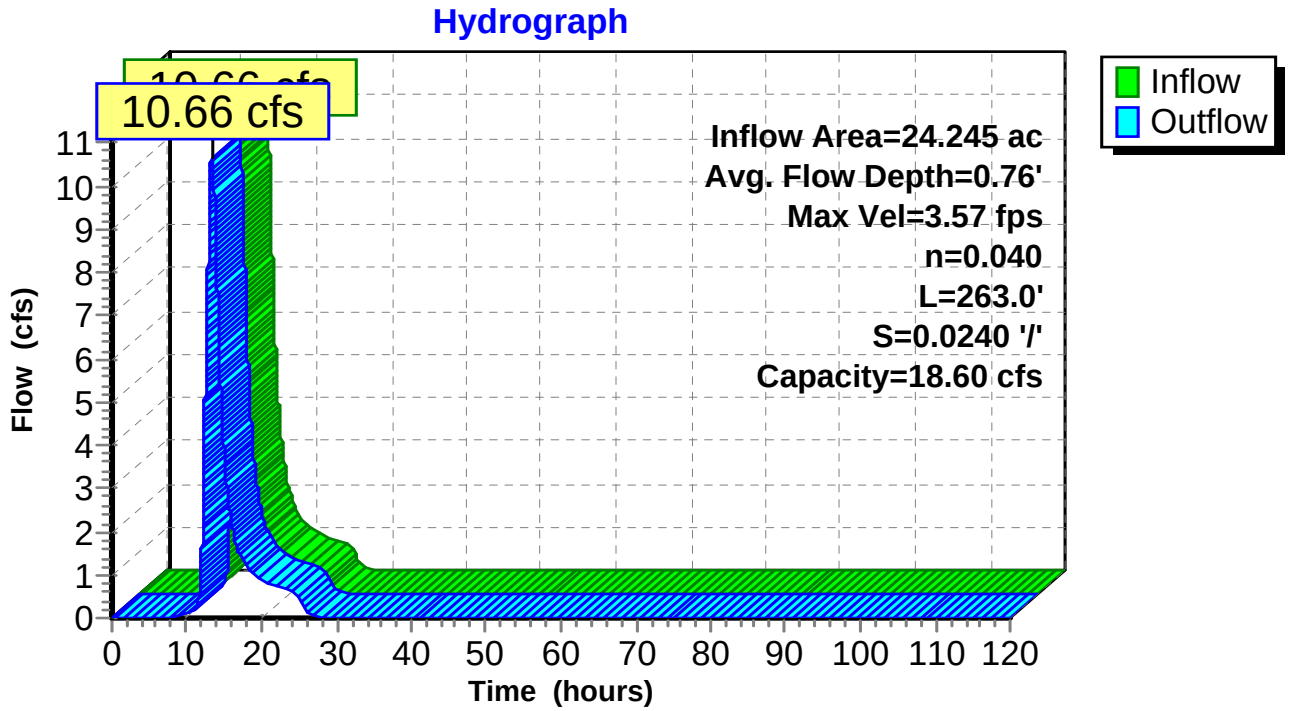
Inflow Area = 24.245 ac, 11.99% Impervious, Inflow Depth = 1.37" for 10-yr event
Inflow = 10.66 cfs @ 13.28 hrs, Volume= 2.760 af
Outflow = 10.66 cfs @ 13.33 hrs, Volume= 2.760 af, Atten= 0%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 3.57 fps, Min. Travel Time= 1.2 min
Avg. Velocity = 1.36 fps, Avg. Travel Time= 3.2 min

Peak Storage= 786 cf @ 13.31 hrs
Average Depth at Peak Storage= 0.76'
Bank-Full Depth= 1.00' Flow Area= 4.5 sf, Capacity= 18.60 cfs

2.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 2.5 '/' Top Width= 7.00'
Length= 263.0' Slope= 0.0240 '/'
Inlet Invert= 114.00', Outlet Invert= 107.70'

Reach R3:



Summary for Reach R4:

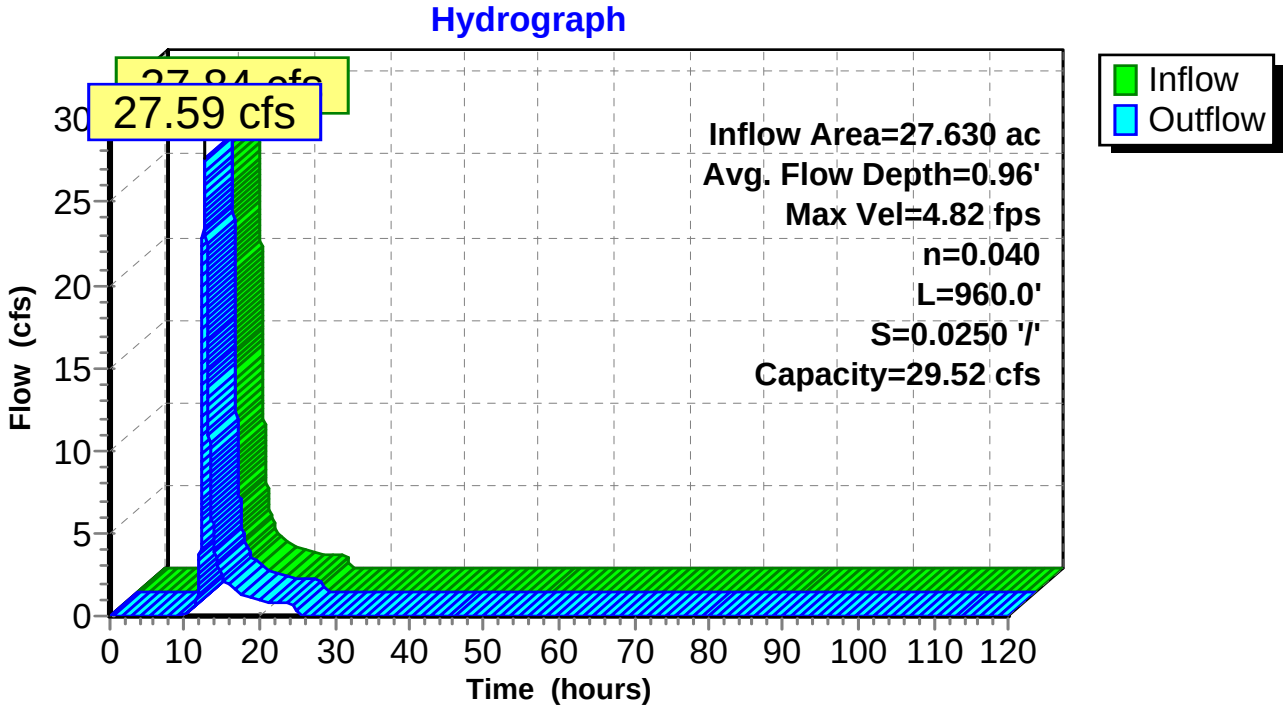
Inflow Area = 27.630 ac, 23.85% Impervious, Inflow Depth = 1.53" for 10-yr event
Inflow = 27.84 cfs @ 12.52 hrs, Volume= 3.517 af
Outflow = 27.59 cfs @ 12.62 hrs, Volume= 3.517 af, Atten= 1%, Lag= 6.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Max. Velocity= 4.82 fps, Min. Travel Time= 3.3 min
Avg. Velocity = 1.27 fps, Avg. Travel Time= 12.6 min

Peak Storage= 5,501 cf @ 12.57 hrs
Average Depth at Peak Storage= 0.96'
Bank-Full Depth= 1.00' Flow Area= 6.0 sf, Capacity= 29.52 cfs

5.00' x 1.00' deep channel, n= 0.040 Earth, cobble bottom, clean sides
Side Slope Z-value= 1.0 '/' Top Width= 7.00'
Length= 960.0' Slope= 0.0250 '/'
Inlet Invert= 150.00', Outlet Invert= 126.00'

Reach R4:



Summary for Pond 5P: entire basin

[79] Warning: Submerged Pond 6P Primary device # 1 OUTLET by 2.06'
[79] Warning: Submerged Pond CB3 Primary device # 1 INLET by 2.06'

Inflow Area = 97.867 ac, 28.55% Impervious, Inflow Depth = 1.55" for 10-yr event
Inflow = 82.01 cfs @ 12.56 hrs, Volume= 12.658 af
Outflow = 74.11 cfs @ 12.74 hrs, Volume= 12.658 af, Atten= 10%, Lag= 11.2 min
Primary = 74.11 cfs @ 12.74 hrs, Volume= 12.658 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs / 3
Peak Elev= 103.06' @ 12.74 hrs Surf.Area= 13,235 sf Storage= 23,903 cf

Plug-Flow detention time= 2.3 min calculated for 12.657 af (100% of inflow)
Center-of-Mass det. time= 2.3 min (876.2 - 873.9)

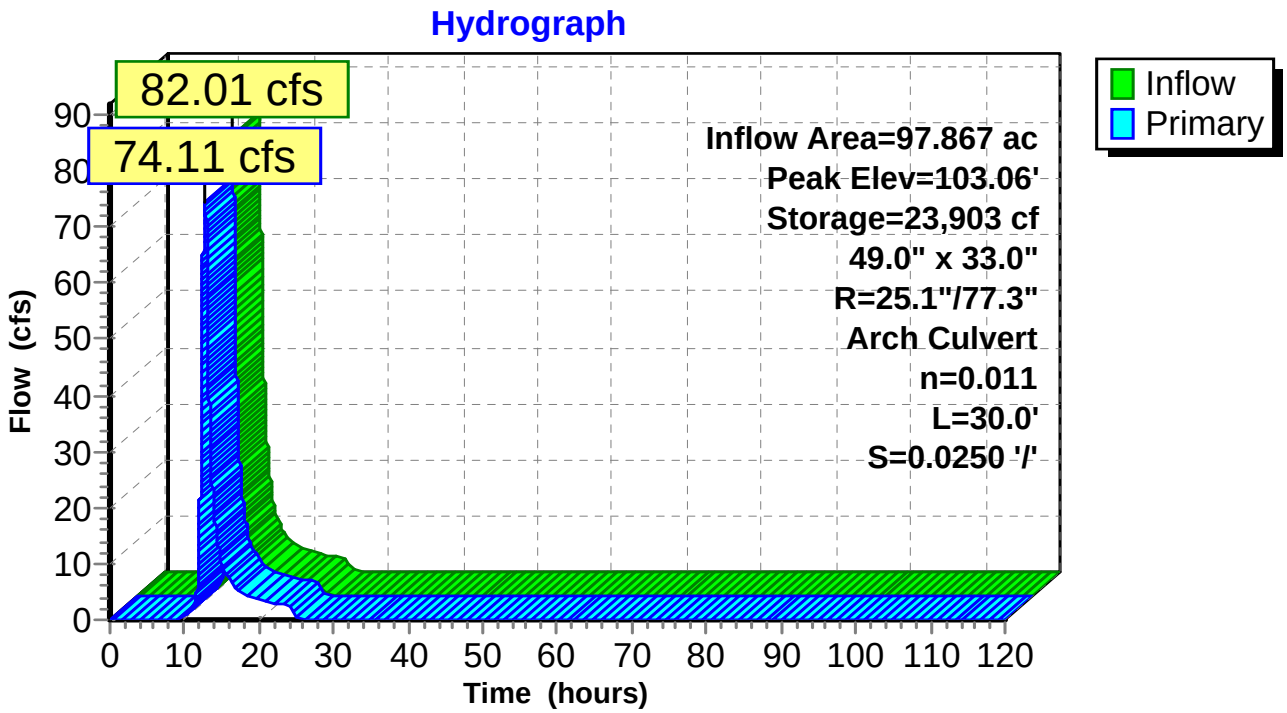
Volume	Invert	Avail.Storage	Storage Description
#1	99.00'	37,190 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
99.00	370	0	0
100.00	1,430	900	900
101.00	5,775	3,603	4,503
102.00	9,175	7,475	11,978
103.00	13,125	11,150	23,128
104.00	15,000	14,063	37,190

Device	Routing	Invert	Outlet Devices
#1	Primary	98.75'	**49.0" W x 33.0" H, R=25.1"/77.3" Arch CMP_Arch_1/2 49x33** L= 30.0' RCP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 98.75' / 98.00' S= 0.0250 '/' Cc= 0.900 n= 0.011 Concrete pipe, straight & clean, Flow Area= 8.90 sf

Primary OutFlow Max=74.11 cfs @ 12.74 hrs HW=103.06' (Free Discharge)
└**1=CMP_Arch_1/2 49x33** (Inlet Controls 74.11 cfs @ 8.33 fps)

Pond 5P: entire basin



Summary for Pond 6P: downstream defender

[81] Warning: Exceeded Pond CB2 by 1.00' @ 51.92 hrs

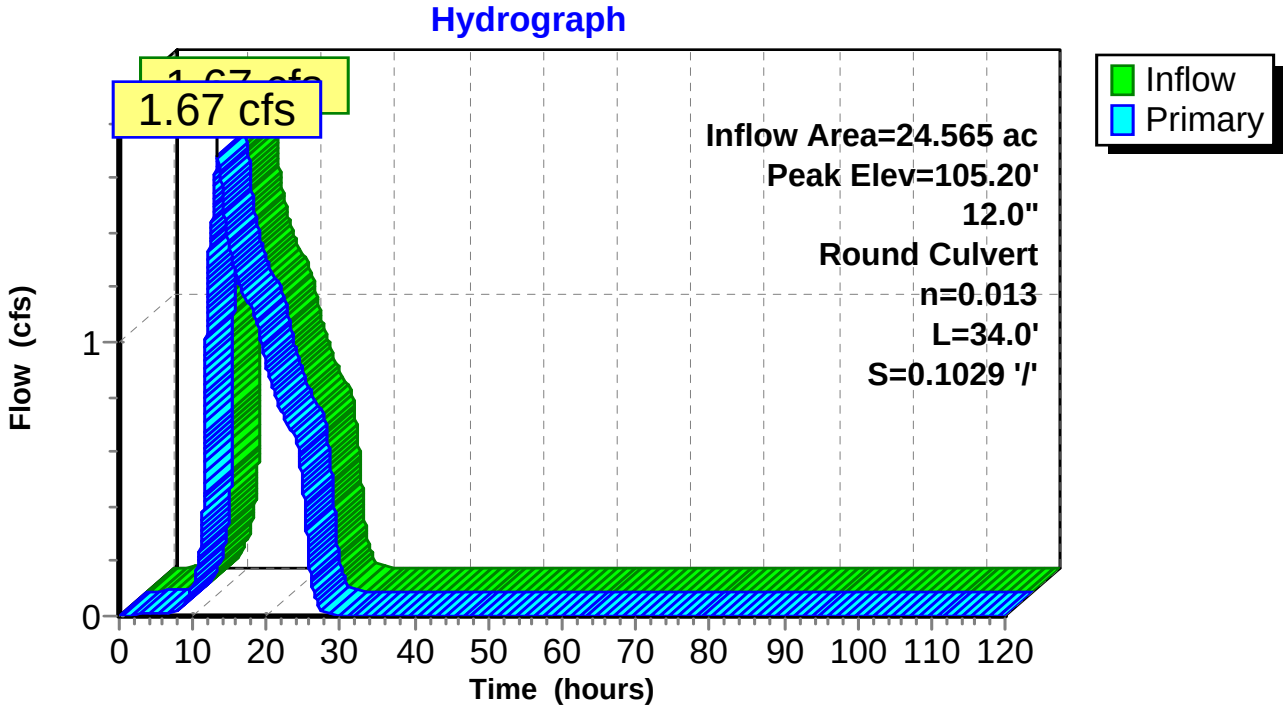
Inflow Area =	24.565 ac,	13.13% Impervious,	Inflow Depth =	0.61"	for 10-yr event
Inflow =	1.67 cfs @	13.33 hrs,	Volume=	1.242 af	
Outflow =	1.67 cfs @	13.33 hrs,	Volume=	1.242 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.67 cfs @	13.33 hrs,	Volume=	1.242 af	

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 105.20' @ 13.33 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	104.50'	**12.0" Round Culvert** L= 34.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 104.50' / 101.00' S= 0.1029 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.67 cfs @ 13.33 hrs HW=105.20' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.67 cfs @ 2.85 fps)

Pond 6P: downstream defender



Summary for Pond 7P: new 18" to CB2

[93] Warning: Storage range exceeded by 1.03'
[88] Warning: Qout>Qin may require Finer Routing>1
[62] Hint: Exceeded Reach R3 OUTLET depth by 1.56' @ 13.33 hrs

Inflow Area = 24.245 ac, 11.99% Impervious, Inflow Depth = 1.37" for 10-yr event
Inflow = 10.66 cfs @ 13.33 hrs, Volume= 2.760 af
Outflow = 10.68 cfs @ 13.33 hrs, Volume= 2.763 af, Atten= 0%, Lag= 0.0 min
Primary = 10.68 cfs @ 13.33 hrs, Volume= 2.763 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 110.03' @ 13.33 hrs Surf.Area= 245 sf Storage= 232 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.5 min (921.1 - 920.5)

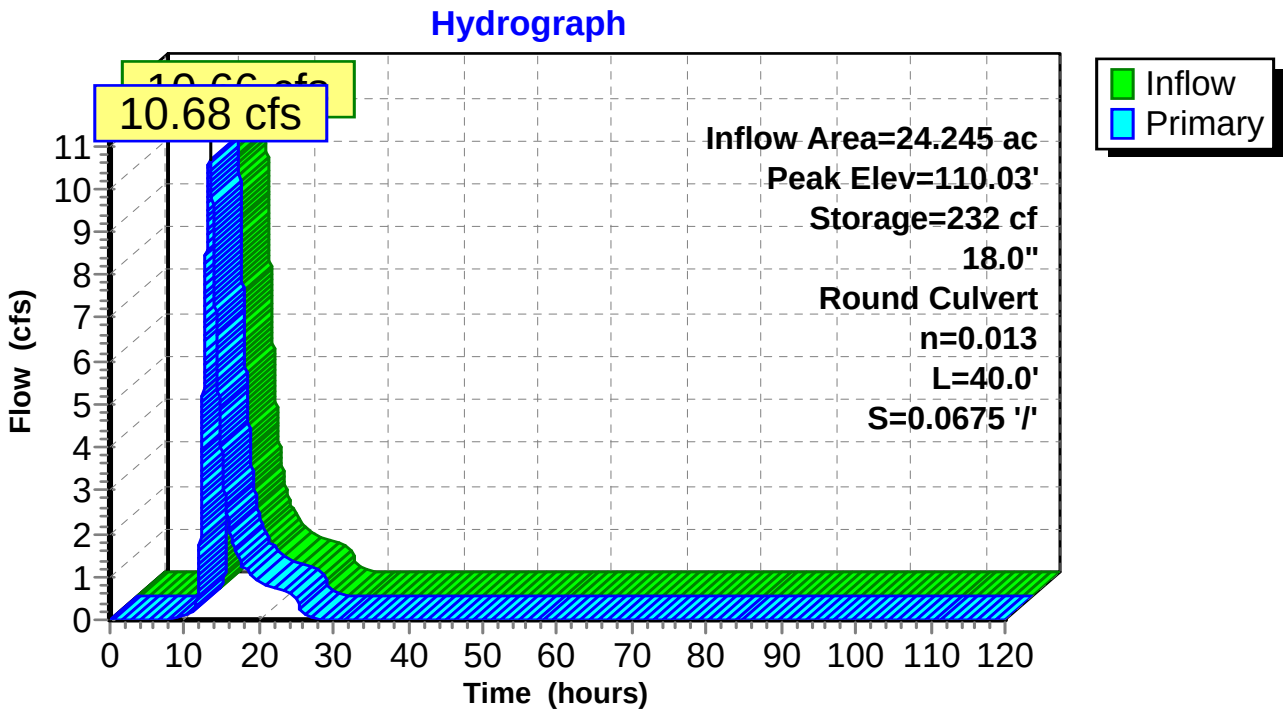
Volume	Invert	Avail.Storage	Storage Description
#1	107.00'	232 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
107.00	0	0	0
108.00	109	55	55
109.00	245	177	232

Device	Routing	Invert	Outlet Devices
#1	Primary	107.70'	**18.0" Round Culvert** L= 40.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 107.70' / 105.00' S= 0.0675 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=10.68 cfs @ 13.33 hrs HW=110.03' (Free Discharge)
└─**1=Culvert** (Inlet Controls 10.68 cfs @ 6.04 fps)

Pond 7P: new 18" to CB2



Summary for Pond CB1:

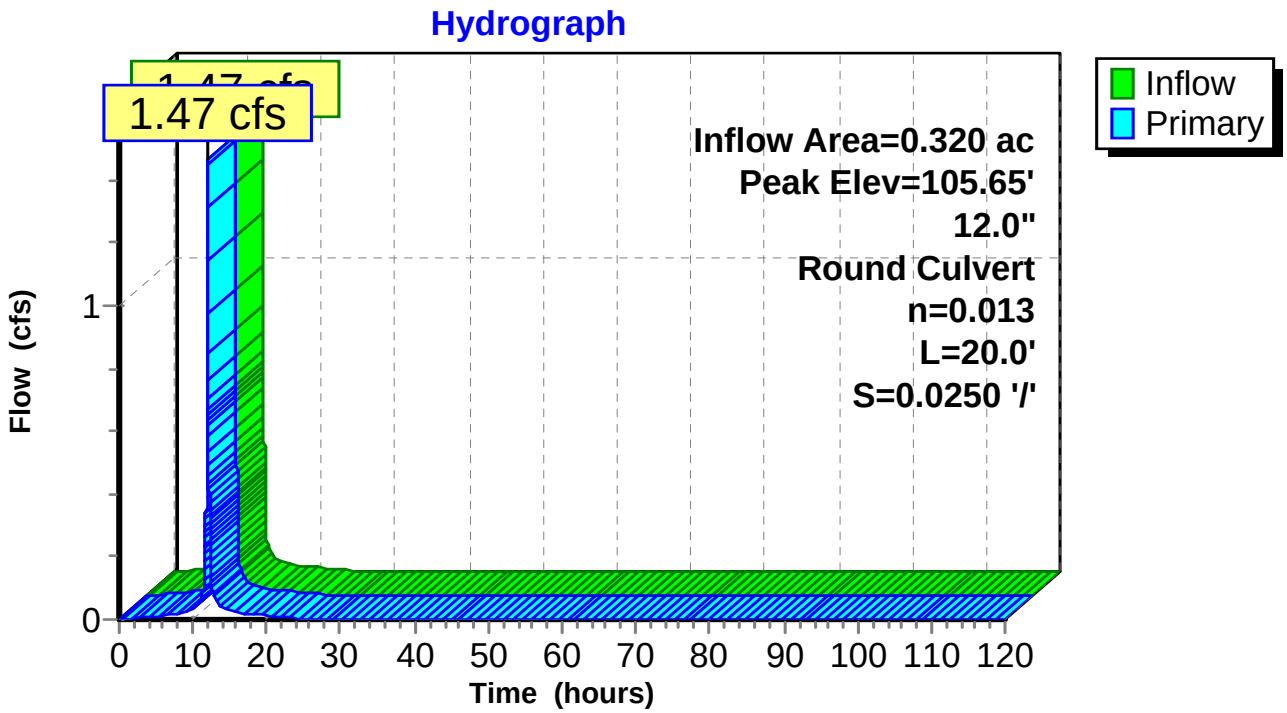
Inflow Area = 0.320 ac, 99.37% Impervious, Inflow Depth = 2.87" for 10-yr event
Inflow = 1.47 cfs @ 12.01 hrs, Volume= 0.076 af
Outflow = 1.47 cfs @ 12.01 hrs, Volume= 0.076 af, Atten= 0%, Lag= 0.0 min
Primary = 1.47 cfs @ 12.01 hrs, Volume= 0.076 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 105.65' @ 12.01 hrs
Flood Elev= 107.30'

Device	Routing	Invert	Outlet Devices
#1	Primary	105.00'	**12.0" Round Culvert** L= 20.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 104.50' S= 0.0250 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=1.46 cfs @ 12.01 hrs HW=105.64' (Free Discharge)
└**1=Culvert** (Inlet Controls 1.46 cfs @ 2.73 fps)

Pond CB1:



Summary for Pond CB2:

[79] Warning: Submerged Pond 7P Primary device # 1 OUTLET by 1.88'
[81] Warning: Exceeded Pond CB1 by 1.77' @ 13.36 hrs

Inflow Area =	24.565 ac,	13.13% Impervious,	Inflow Depth =	1.39"	for 10-yr event
Inflow =	10.73 cfs @	13.33 hrs,	Volume=	2.839 af	
Outflow =	10.73 cfs @	13.33 hrs,	Volume=	2.839 af,	Atten= 0%, Lag= 0.0 min
Primary =	1.67 cfs @	13.33 hrs,	Volume=	1.242 af	
Secondary =	9.06 cfs @	13.33 hrs,	Volume=	1.597 af	

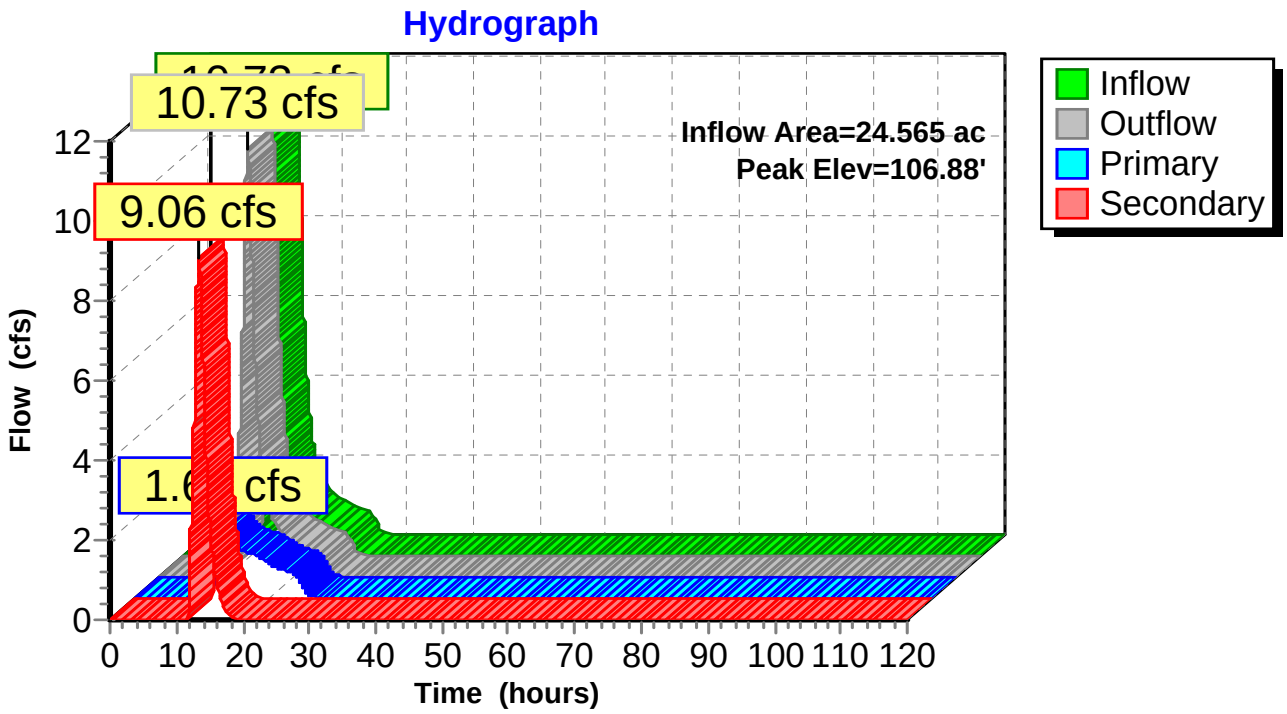
Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 106.88' @ 13.33 hrs
Flood Elev= 107.50'

Device	Routing	Invert	Outlet Devices
#1	Primary	103.50'	**6.0" Round Culvert** L= 12.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 103.50' / 102.50' S= 0.0833 '/' Cc= 0.900 n= 0.010 PVC, smooth interior, Flow Area= 0.20 sf
#2	Device 1	103.50'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Secondary	105.00'	**18.0" Round Culvert** L= 78.2' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 105.00' / 103.00' S= 0.0256 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.77 sf

Primary OutFlow Max=1.67 cfs @ 13.33 hrs HW=106.88' (Free Discharge)
└─**1=Culvert** (Inlet Controls 1.67 cfs @ 8.52 fps)
  └─**2=Orifice/Grate** (Passes 1.67 cfs of 2.94 cfs potential flow)

Secondary OutFlow Max=9.06 cfs @ 13.33 hrs HW=106.88' (Free Discharge)
└─**3=Culvert** (Inlet Controls 9.06 cfs @ 5.13 fps)

Pond CB2:


Hydrograph
10.73 cfs
9.06 cfs
1.6 cfs
Inflow Area=24.565 ac
Peak Elev=106.88'
Inflow
Outflow
Primary
Secondary
Flow (cfs)
0
2
4
6
8
10
12
0 10 20 30 40 50 60 70 80 90 100 110 120
Time (hours)

Summary for Pond CB3:

[79] Warning: Submerged Pond CB2 Secondary device # 3 INLET by 0.29'

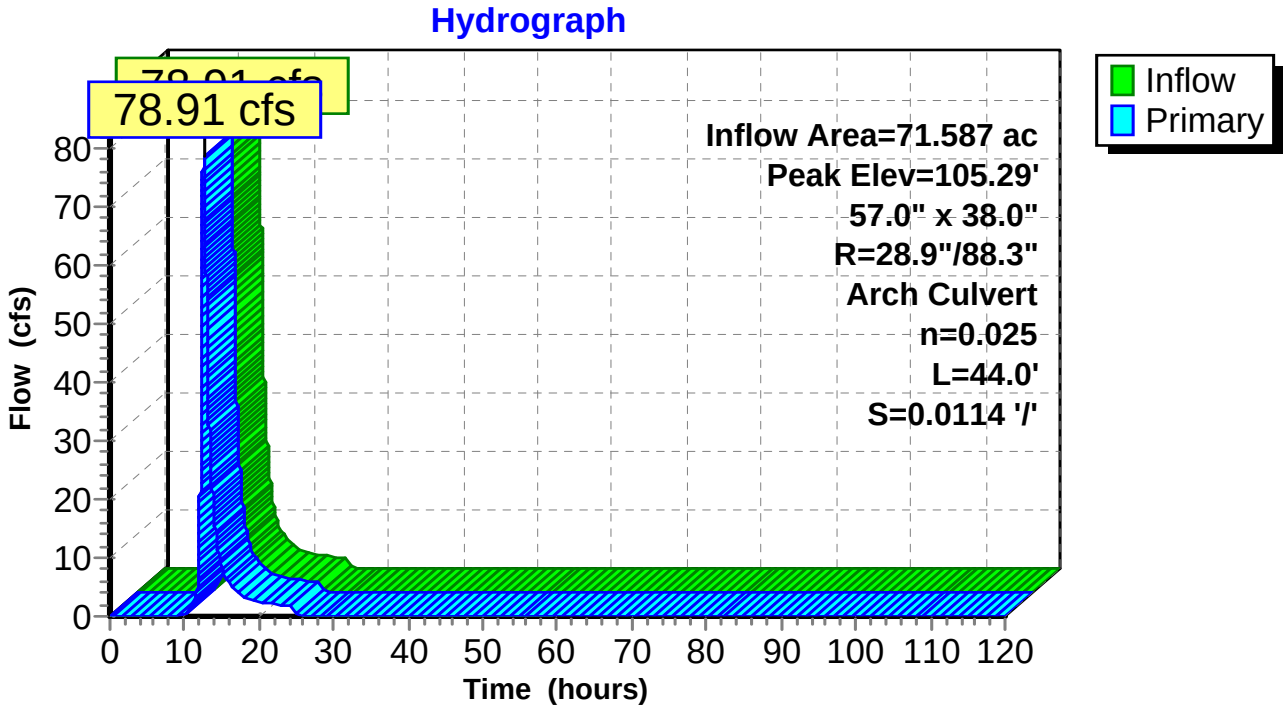
Inflow Area = 71.587 ac, 33.24% Impervious, Inflow Depth = 1.87" for 10-yr event
Inflow = 78.91 cfs @ 12.57 hrs, Volume= 11.132 af
Outflow = 78.91 cfs @ 12.57 hrs, Volume= 11.132 af, Atten= 0%, Lag= 0.0 min
Primary = 78.91 cfs @ 12.57 hrs, Volume= 11.132 af

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs / 2
Peak Elev= 105.29' @ 12.57 hrs
Flood Elev= 107.90'

Device	Routing	Invert	Outlet Devices
#1	Primary	101.00'	**57.0" W x 38.0" H, R=28.9"/88.3" Arch CMP_Arch_1/2 57x38** L= 44.0' CMP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 101.00' / 100.50' S= 0.0114 '/' Cc= 0.900 n= 0.025 Corrugated metal, Flow Area= 11.89 sf

Primary OutFlow Max=78.91 cfs @ 12.57 hrs HW=105.29' (Free Discharge)
└**1=CMP_Arch_1/2 57x38** (Barrel Controls 78.91 cfs @ 6.63 fps)

Pond CB3:



Summary for Pond R2:

[57] Hint: Peaked at 135.57' (Flood elevation advised)
[62] Hint: Exceeded Reach R4 OUTLET depth by 8.61' @ 12.54 hrs

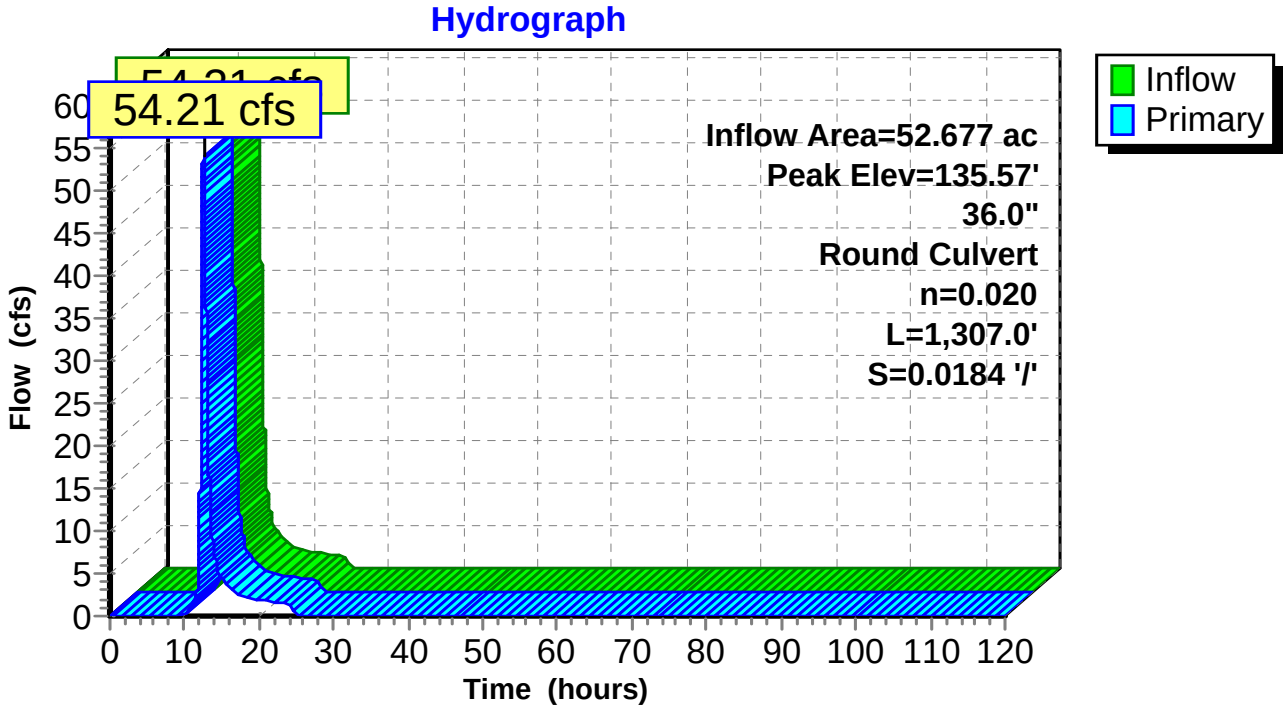
Inflow Area =	52.677 ac, 32.20% Impervious, Inflow Depth = 1.57" for 10-yr event				
Inflow =	54.21 cfs @	12.54 hrs,	Volume=	6.887 af	
Outflow =	54.21 cfs @	12.54 hrs,	Volume=	6.887 af,	Atten= 0%, Lag= 0.0 min
Primary =	54.21 cfs @	12.54 hrs,	Volume=	6.887 af	

Routing by Stor-Ind method, Time Span= 0.00-120.00 hrs, dt= 0.01 hrs
Peak Elev= 135.57' @ 12.54 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	130.00'	**36.0" Round Culvert** L= 1,307.0' CMP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 130.00' / 106.00' S= 0.0184 '/' Cc= 0.900 n= 0.020 Corrugated PE, corrugated interior, Flow Area= 7.07 sf

Primary OutFlow Max=54.20 cfs @ 12.54 hrs HW=135.57' (Free Discharge)
└─**1=Culvert** (Inlet Controls 54.20 cfs @ 7.67 fps)

Pond R2:



Version: 9/06 (calcs embedded)

For the area draining to*: OLP1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		0.437	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.28	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.28	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	64.07	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	0.4	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.627	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.564	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0205	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	895	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.564 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 0.4 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 96.3

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP2

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		1.36	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.56	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.56	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	41.18	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	1.4	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.421	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.379	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0429	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	1869	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP2
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.379 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 1.4 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 93.1

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP3

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		2.338	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.938	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.94	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	40.12	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	2.3	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.411	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.370	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0721	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	3140	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP3
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.370 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 2.3 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 92.9

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP4

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		20.11	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		1.13	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		1.13	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	5.62	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	20.1	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.101	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.091	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.1517	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	6608	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OLP4

Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.091 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 20.1 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 82.7

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FA1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		0.935	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.399	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.40	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	42.67	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	0.9	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.434	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.391	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0304	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	1326	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FA1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.391 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 0.9 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 93.4

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FA2

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		0.32	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.318	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.32	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	99.38	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	0.3	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.944	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.850	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0227	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	987	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FA2
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.850 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 0.3 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 99.6

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FA3

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		1.715	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.915	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.92	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	53.35	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	1.7	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.530	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.477	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0682	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	2971	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FA3
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.477 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 1.7 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 95.0

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: SW-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		17.54	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		7.83	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		7.83	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	44.64	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	17.5	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.452	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.407	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.5943	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	25888	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: SW-1

Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.407 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 17.5 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 93.7

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: LF-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		9.88	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		4.14	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		4.14	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	41.90	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	9.9	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.427	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.384	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.3165	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	13787	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: LF-1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.384 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 9.9 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 93.2

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: LF-2

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		3.202	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.452	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.45	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	14.12	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	3.2	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.177	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.159	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0425	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	1852	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: LF-2
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.159 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 3.2 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 86.4

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		4.04	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		1.96	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		1.96	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	48.51	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	4.0	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.487	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.438	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.1475	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	6423	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.438 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 4.0 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 94.3

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-2

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		1.716	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		1.24	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		1.24	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	72.26	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	1.7	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.700	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.630	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0901	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	3926	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-2
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.630 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 1.7 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 97.2

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-3

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		3.559	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		1.49	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

	Rooftop disconnection		
	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres
	Non-rooftop disconnection		
	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres
6	Total impervious area disconnected (line 4 + line 5)	0.00	acres
7	New impervious area total (line 2 - line 6)	1.49	acres
8	Percent Impervious = [(line 7÷ line 1) * 100] **I =**	41.87	%

Site Area Reductions

	Stream Buffer Credit			
	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2
	Grass Channel Credit			
	Completed credit sheet	yes / no		
10	Enter site area draining to grass channels		acres	
	Natural Area Conservation Credit			
	Completed credit sheet	yes / no		
11	Natural Area to be conserved (in the drainage to this S/N)		acres	
12	Total Site Area Reductions (line 9 + line 10 + line 11)	0.00	acres	
13	New site area total (line 1 - line 12) **A =**	3.6	acres	

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.427	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.384	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.1139	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	4962	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-3

Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.384 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 3.6 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 93.2

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-4

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		15.861	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		10.059	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		10.06	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	63.42	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	15.9	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.621	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.559	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.7385	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	32167	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-4
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.559 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 15.9 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 96.3

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-5

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		44.94	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		7.8	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		7.80	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	17.36	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	44.9	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.206	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.186	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.6950	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	30275	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: IPW-5

Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.186 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 44.9 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 87.5

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: CD1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		27.63	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		6.59	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		6.59	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	23.85	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	27.6	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.265	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.238	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.5484	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	23890	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: CD1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.238 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 27.6 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 89.4

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: AP1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		19.69	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		8.65	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		8.65	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	43.93	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	19.7	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.445	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.401	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.6577	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	28650	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: AP1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.401 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 19.7 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 93.6

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: UD-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		3.15	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.33	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.33	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	10.48	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	3.2	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.144	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.130	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0341	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	1485	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: UD-1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.130 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 3.2 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 85.0

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FS-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		5.97	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		5.25	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		5.25	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	87.94	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	6.0	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.841	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.757	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.3768	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	16412	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FS-1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.757 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 6.0 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 98.7

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FS-2

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		2.322	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		0.033	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		0.03	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	1.42	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	2.3	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.063	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.057	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.0109	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	476	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: FS-2
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.057 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 2.3 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 80.1

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: CSWD-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		2.207	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		1.39	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		1.39	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	62.98	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet	yes / no		
9	Enter area draining to a stream buffer		acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	2.2	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.617	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.555	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.1021	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	4448	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: CSWD-1

Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.555 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 2.2 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 96.2

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OB-1

Located in drainage area for S/N:

WQ Volume and Modified CN calculation (with credit reduction) for Water Quality Treatment in Flow Based Practice

Use *this worksheet to calculate your WQv if you need to determine the Peak Q for the WQ storm (i.e. designing a grass channel, flow-splitter or other flow based practice). See page 2 for "Calculating Peak WQ Discharge Rate (0.9" storm) using the Modified Curve Number." Please note that in the case of grass channels you must include any off-site area draining to the practice as this will affect the peak discharge rate which will ultimately affect the hydraulics, and thus residence time, in your channel.*

Line	*Base values*		value/calculation	units	
1	Site Area (impervious + disturbed pervious) + any off-site area draining to the practice=		17.975	acres	note 1
2	Impervious area (both site and off-site draining to the practice)		6.44	acres	
3	Precipitation	**P =**	0.9	inches	

Impervious Area Reductions

Rooftop disconnection

	Completed credit sheet	yes / no	
4	Enter roof-top area disconnected		acres

Non-rooftop disconnection

	Completed credit sheet	yes/no	
5	Enter non-rooftop area disconnected		acres

6	Total impervious area disconnected (line 4 + line 5)		0.00	acres
7	New impervious area total (line 2 - line 6)		6.44	acres
8	Percent Impervious = [(line 7÷ line 1) * 100]	**I =**	35.83	%

Site Area Reductions

Stream Buffer Credit

	Completed credit sheet		yes / no	
9	Enter area draining to a stream buffer			acres	note 2

Grass Channel Credit

	Completed credit sheet	yes / no	
10	Enter site area draining to grass channels		acres

Natural Area Conservation Credit

	Completed credit sheet	yes / no	
11	Natural Area to be conserved (in the drainage to this S/N)		acres

12	Total Site Area Reductions (line 9 + line 10 + line 11)		0.00	acres
13	New site area total (line 1 - line 12)	**A =**	18.0	acres

	Runoff coefficient calculation = (0.05 + (0.009*I))	**Rv =**	0.372	
14	**Water Quality Volume Calculation =** (P*Rv)	**WQv =**	0.335	Qa (watershed inches or inches of runoff)
15	**Water Quality Volume Calculation** [(line 14* line 13)/12]	**WQv =**	0.5021	ac. ft
16	**Water Quality Volume Calculation =** line 15 *43560	**WQv =**	21872	cu. ft.

Note 1: In most situations, site area = disturbed area (i.e. impervious + disturbed pervious for the project). If using the Natural Area Conservation Credit, the Site Area = (disturbed area [impervious and disturbed pervious] + area to be conserved). For flow based practices, you must include any off-site area in your WQv calculations in order to calculate the correct peak discharge rate for your flow based practice.

Note 2: If using rooftop/ non-rooftop disconnection, credit can only be taken for the pervious area draining to the stream buffer
Addt'l notes: If all impervious has been disconnected and the percent impervious is thus zero (0 %) then WQv and Recharge are assumed to have been met and WQv = 0. If significant use of site design credits has been employed, the designer may treat the reduced WQv and is not required to treat the minimum water quality volume of 0.2 watershed inches.

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)

Version: 9/06 (calcs embedded)

For the area draining to*: OB-1
Located in drainage area for S/N:

Calculating Peak WQ Peak Discharge Rate (0.9" storm) using the Modified Curve Number

Because NRCS methods underestimate the peak discharge for rainfall events of less than 2", simply plugging in 0.9" of rainfall into your hydrologic model with the standard curve numbers will not produce the correct peak discharge during the WQv storm, nor will it produce a volume of runoff equivalent to that which you have calculated using the WQv formula (WQv = P*Rv*A/12). In order to calculate the peak discharge for the 0.9" storm, a modified curve number must be calculated. This modified curve number is based on the runoff (in inches) calculated using the short cut method formula (WQv = P*Rv) that is also the basis of the familiar WQv calculations provided in the 2002 VSWMM (and on the WQv calculation worksheets). Essentially, the curve number that is calculated using the methods below is the curve number that will generate the volume of runoff calculated using the WQv formula.

Above, you should have calculated the **WQv in watershed inches draining to the facility/practice** for which you need to calculate the WQ-peak discharge. As provided in the guidance listed on the grass channel worksheet, please remember that the WQv calculation should include runoff from on-site as well as **off-site area** draining to the grass channel since this will have an impact on the channel hydraulics and thus the velocity and residence time.

Steps:

1. Transfer information from WQv calculation worksheet.

   Enter the Qa (line 14 from page 1 WQv calculation)

   Qa = 0.335 inches

   Enter the area (site +off-site draining to practice) used in calculating the percent impervious (I)

   A = 18.0 acres

2. Use the following equation to calculate a corresponding curve number.

   where P = 0.9 inches

   CN = 1000/(10 +(5*P)+(10*Qa) - (10*(Qa^2 + (1.25*Qa*P))^0.5))

   CN = 92.1

3. If you are using **hand hydrologic runoff calculations,** use the computed CN above along with your calculated time of concentration and the drainage area (A) to calculate the peak discharge (Qwq) for the water quality storm using the TR-55 Graphical Peak Discharge Method.

OR

3. If you are using a **computer aided hydrologic model**, simply revise the curve number for your subwatershed(s) draining to the practice - the computed curve number should be applied to the total area (A) used in the WQv calcuation. As a check, you should note that now when you run the 0.9" storm, your runoff depth should be roughly equal to Qa (WQ runoff in inches) and your total runoff volume roughly equal to your WQv (in ac. ft.). If this is not the case, make sure that the time span for your modelling run is long enough to capture the entire storm. Small variations are likely due to having to round your computed CN to a whole number. Remember that for storms larger than 2", you do not need to use the modified curve number and you should calculate your composite curve number based on the accepted values for different types of land-use (see TR-55).

* Enter the name of the STP (both type and label) which has been designed to treat this particular WQv (e.g. Wet Pond #2)