ProTerra
DESIGN GROUP, LLC

January 12, 2024

Ms. Breeka Lí Goodlander, Agent
Town of Franklin
Conservation Commission
355 East Central Street
Franklin, MA 02038

RE: Notice of Intent (NOI) Application BETA Review Comment Response
Franklin Bent Street
Bent Street
Franklin, MA 02038

Dear Ms. Goodlander:

ProTerra Design Group, LLC (ProTerra) received a copy of the BETA Group, Inc. (BETA) review comments dated November 14, 2023. This letter is provided as a response to the questions and/or concerns and offer additional information in regards to the review of the "Franklin Bent Street" project located within Parcel 206-103 in Franklin, Massachusetts. Numbers below correspond to comments within the letter, and responses are in blue.

Plan and General Comments:

A1. MassDEP has issued a file number (DEP File No. 159-1280) with no technical comments.
Acknowledged.

A2. Existing woody plants to be removed within Buffer Zone that are larger than 1 inch in diameter should be depicted on the plans (Bylaw Section 7.18.1.5.).
All existing woody plants within the Wetland Buffer Zone were surveyed by Northeast Survey Consultants on November 30, 2023. Existing plant locations are shown on the "Existing Conditions" (Sheet C-2). The "Buffer Zone Removal Plan" (Sheet A-3) was prepared showing the locations of woody plant removal within the Wetland Buffer Zone. A total of 45 plants (>1"Ø) are proposed to be removed within the Wetland Buffer Zone.

A3. The Existing Conditions Plan (Sheet C-2) cuts off the northwest portion of the Site along Bent Street. Since work is not proposed in that area, BETA defers to the Commission on whether sufficient existing conditions information has been provided.
The entire Locus property boundary is shown on the "Abutters Plan" (Sheet C-1). The portion of the property cut off from the "Existing Conditions" (Sheet C-2) is over 250 LF from the limits of work. The Applicant requests the Commission accept the plans as shown without having to add another plan sheet to show this area outside of the limits of work.

Resource Area and Boundary Comments:

W1. BETA observed saturated soils and hydrophytic vegetation including dense stands of sweet pepperbush (Clethra alnifolia) upgradient of portions of the A Series BVW boundary (flags A30 to A42); however, no hydric soil indicators were observed. Therefore, BETA concurs with the Applicant's delineation of the A Series BVW.
Acknowledged.

W2. The flagged boundaries of the B Series and C Series BVW appear to be correct based on observations of hydrophytic vegetation, hydric soils, and indicators of hydrology.
Acknowledged.

W3. BETA observed saturated soils and water-stained leaves as well as hydrophytic vegetation including royal fern (Osmunda regalis), grass-leaved goldenrod (Euthamia graminifolia), and rough-stem goldenrod (Solidago rugosa) upgradient of the southern portion of the D Series BVW. However, no hydric soil indicators were observed. Therefore, BETA concurs with the Applicant's delineation of the D-Series BVW.

Acknowledged.

W4. BETA observed a shallow, isolated depression southeast of the 95 Bent Street parcel with evidence of hydrology including surface saturation and water staining. This area is vegetated with hydrophytic vegetation including red maple (Acer rubrum) and tupelo (Nyssa sylvatica); however, no hydric soil indicators were observed. Therefore, this isolated depression would not be Subject to Jurisdiction as a Freshwater Wetland under the Bylaw.

Acknowledged.

Construction & Mitigation Comments:

W5. Proposed erosion controls include use of armored silt fence with a silt sock as shown on the Project plans. Silt fence is not a permitted erosion control measure in the Town of Franklin (Pg. 13 of Town of Franklin Best Development Practices Guidebook). The Applicant should coordinate with the Conservation Commission to determine the appropriate erosion control measures for the Site. Twelve (12)-inch diameter compost filter tubes may be an appropriate option commensurate with the scope of the Project.

Silt fence and straw bales have been removed from the erosion control design (Sheet EC-1). The erosion control barrier detail has been updated to only show silt sock, straw wattle, or approved equal (Sheet EC-2)

W6. The Applicant should consider extending erosion controls along the eastern limit of work to provide a clear limit of work and reduce the likelihood of additional disturbances.

Erosion control barriers have been shown around the entire limits of work to delineate the work zone for the contractor (Sheet EC-2).

Bylaw Regulatory Comments:

W7. A Bylaw Variance request has been submitted for work within the 25-foot No Disturb Zone. The Applicant has provided an Alternatives Analysis to demonstrate that impacts to jurisdictional areas have been avoided and minimized to the extent feasible as required by the Bylaw. The Alternatives Analysis generally focuses on the siting of the Project as a whole and provides what appears to be a reasonable justification for the use of the Site as the location of the Project. However, in consideration of the access road being the work proposed closest to Resource Areas and within the 25-foot No Disturb Zone, the Applicant should include an assessment of whether the access road can be shifted further west away from the BVW and maintain compliance with any Site constraints including zoning setbacks. In addition, the Applicant should consider shifting the proposed overhead wires to the western side of the access road in order to minimize clearing closest to the BVW.

The utility poles and overhead lines have been moved to the other side of the access driveway opposite the wetland resource area. During the site development process, the Applicant agreed with the owners of 97 Bent Street to provide a vegetated screen along the property line west of the proposed driveway. As such, the driveway will remain at the same location as currently designed to allow for the vegetated screen.

W8. The Applicant should provide a Construction Sequence and Schedule per Section 7.15 of the Bylaw Regulations. This schedule should also be included on the Project plans.

Attached is a "Construction Sequence & Schedule" outline document. This schedule is also included on Sheet EC-2 for contractor reference.

W9. The Erosion & Sedimentation Control Plan should be revised to include contact information of the person(s) responsible for inspecting and maintaining erosion controls, and the requirement to inspect erosion controls weekly, or following significant rain events per Section 7.12.1 of the Bylaw Regulations.

The contact information for the responsible party has been added to Sheet EC-1. At this time, a contractor has not been selected for the work; however, the responsible party shall hire a contractor to install, inspect, and maintain the erosion controls through the entirety of the project. A note requiring inspections of erosion controls weekly and after significant rain events has also been added to Sheet EC-1.

General:

G1. The Project summary in the HydroCAD printout should include watershed area totals to confirm that the existing and proposed conditions analysis are the same area.

See attached HydroCAD calculations. Watershed area totals are included as requested. The total existing watershed area is 300,971 SF, and the total proposed watershed area is 300.971 SF.

G2. If the intent of the subdrain system is to convey runoff away from the tower, then the runoff from impervious surfaces in this area must be treated in accordance with the MassDEP Stormwater Standards. Directing this runoff outside the limit of the proposed stormwater treatment facilities will bypass the treatment provided by the stormwater improvements in direct violation of the Standards. This drain should discharge directly into the forebay.

The subdrain around the tower foundation is not intended to collect stormwater runoff from the surface. It is intended to convey groundwater away from the tower's concrete footing below grade; therefore, it does not require treatment by the stormwater system.

MassDEP Stormwater Standards:

SW1. As previously noted, the runoff from the proposed impervious surfaces around the tower must be treated in accordance with the Standards. The proposed subdrain system cannot bypass the stormwater treatment facilities.

Runoff from the proposed impervious surfaces will flow overland to the stormwater treatment facilities. The proposed subdrain system is a foundation drain around the tower's concrete footing and intended to collect groundwater and daylight it away from the tower's foundation.

SW2. The maximum flow length for sheet flow is 50 feet. Revise the calculations as needed to reduce this sheet flow length.

The maximum flow length for sheet flow has been adjusted to 50 feet. See revised and attached HydroCAD calculations.

SW3. The time of concentration (Tc) calculation for the watersheds should be longest time not longest distance. BETA recommends that the Designer review flow paths.

The time of concentration (Tc) flow paths were reviewed and adjusted as necessary. See attached Pre- and Post-Development Drainage Plans. Revised HydroCAD calculations are also attached for review.

SW4. The outlet control structures at the two basins are multistage inlets. Provide construction details for these two structures.

The outlet control structures are detailed on Sheet D-2.

SW5. The starting water surface elevation for the pocket wetland/wet basin should be consistent with the low-level outlet invert.

The starting water surface elevation for the pocket wetland has been revised to match the low-level outlet invert.

SW6. The discharge from the proposed wetland pocket/wet basin will flow across the property line prior to discharge into the D-series wetlands. BETA recommends that the flow from the basin be maintained onsite prior to discharge into the wetlands.

Stormwater released from the pocket wetland outlet culvert will flow through a riprap apron prior discharging toward the D-Series wetland. The riprap apron has been designed to spread the stormwater flow and reduce its erosive nature before it travels through the existing wooded area for supplementary treatment from the vegetated buffer. In order to maintain the outlet flow onsite, additional clearing within the wetland buffer would be required along the driveway to channelize the outlet flows toward the D-Series wetland. The current design follows existing drainage patterns into the wetland buffer and away from the existing driveways and residential homes.

SW7. Test Pit SW-1 indicates that groundwater is present at 3.5 feet below the surface. The floor of the proposed infiltration basin is being set approximately 15 inches below existing grade. Therefore, based on the test pit results, the bottom of the basin is less than 4' above Estimated Seasonal High Groundwater. Since it is being used for both recharge and peak discharge rate control, a mounding analysis is required.

Estimated Seasonal High Groundwater (SHGW) at the compound basin is at elevation 285.00±, and the basin bottom is designed at elevation 287.20. The compound basin is designed as a partial exfiltration system. The lowest orifice elevation (287.46) is set to hold the required Water Quality Volume treatment volume and infiltrate the required recharge volume based on the new impervious area at the tower compound. This volume below the lowest orifice will draindown within the required 72 hours between storm events as previously shown in the drainage calculations.

Within the post-development analysis, the model does not allow infiltration to occur for the 10-year and 100-year design storm events. This makes the assumption that stormwater entering the basin will attenuate in the basin before a controlled release from the outlet structure. There is not any credit given for discarded stormwater runoff volume at the larger storm events. Using this design, the pre- and post-development calculations show that the compound basin provides enough detention volume for the developed site to meet pre-runoff conditions.

By means of the *Hantush Spreadsheet* available from the USGS, a mounding analysis was completed using the equivalent to the 10-year discarded volume within the compound basin (646 CF). By using this volume, the mounding analysis will exceed the required recharge volume provided by the compound basin.

R = Recharge Rate over one day = 646 CF / 264 SF = 2.4470 FT / DAY
Sy = Specific Yield = 0.150 (Assumed Worst Case)
K = Horizontal Hydraulic Conductivity = 3.00 FT / DAY
t = Duration of Infiltration = 1 DAY
hi(0) = Initial Thickness of Saturation Zone
= 30 FT boring depth – 3.5 FT SHGW = 26.5 FT

A groundwater mounding of 2.041 FT is estimated under the compound basin. The groundwater mounding elevation at the center of the basin will reach 287.04±, and it will not breakout above the basin bottom. See attached mounding calculations.

SW8. The only impervious surfaces proposed which will require treatment are the concrete pads around the tower. See comment SW9 below.

Acknowledged. See response to SW9.

SW9. As noted in the Notice of Intent, a Potential Vernal Pool is located within the A Series BVW along the western extent of the Site. Accordingly, the discharge from Basin 2 will be to a Critical Area. The calculations should document that 44% total suspended solids (TSS) pretreatment will be provided for the runoff into Basin 2.

The Applicant concurs that a Potential Vernal Pool (PVP) is located downstream of the site (390± LF). However, per descriptions on the Mass.gov website, "Potential vernal pools identified in this survey do not receive protection under the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.00), or under any other state or federal wetlands protection laws." The Massachusetts Stormwater Handbook, Volume 1, Chapter 1 also states, "A list of Outstanding Resource Waters is published in the Surface Water Quality Standards, 314 CMR 4.00. This list includes Class A public water supplies approved by MassDEP and their tributaries, active and inactive reservoirs approved by MassDEP, certain waters within Areas of Critical Environmental Concern, certified vernal pools, and wetlands bordering Class A waters."

Based on these descriptions, it is our understanding that the PVP would not be considered a critical area; therefore; the additional 44% TSS pretreatment would not be required at the tower site.

SW10. Provide a cost estimate for the O&M Budget.

A long-term estimated annual inspection, operation and maintenance budget for the stormwater system is attached.

SW11. Provide the owners signature on the O&M Plan.

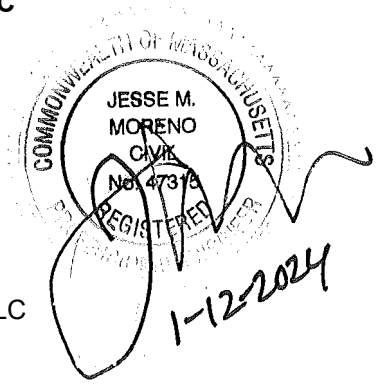
The owner's signature will be provided on the O&M Plan once it is fully approved and finalized by the Town.

If you have any questions or need further information, please do not hesitate to call Jesse Moreno at (413) 320-4918 or Ben Messersmith at (720) 480-2171.

Sincerely,
ProTerra Design Group, LLC

Jesse Moreno, PE
Digitally signed by Jesse Moreno, PE
Date: 2024.01.12 17:45:43 -05'00'

Jesse Moreno, PE
Managing Partner



Enclosures

Cc: KJS Realty
Lucas Environmental, LLC
MassDEP

Drainage Plans

BENT STREET

OHW

OHW

DP-1

310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)

DP-2

EX-1

100–FOOT
BVW BUFFER

EX-2

40' WIDE R.O.W.

DELINEATED
WETLAND
LINE, TYP.

310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)

300B
HSG 'C'

N

PRE-DEVELOPMENT DRAINAGE PLAN

60 30 0 60 120

BENT STREET

OHW

DP-10

310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)

DP-20

P-1

P-2

1P

P-5

100–FOOT
BVW BUFFER

P-3

2P

P-4

40' WIDE R.O.W.

DELINEATED
WETLAND
LINE, TYP.

310B
HSG 'C/D'
(ASSUMED 'C' OUTSIDE
OF WETLAND AREAS)

300B
HSG 'C'

N

POST-DEVELOPMENT DRAINAGE PLAN

60 30 0 60 120

Drainage Summary
Hydrologic & Hydraulic Calculations

ProTerra
DESIGN GROUP, LLC

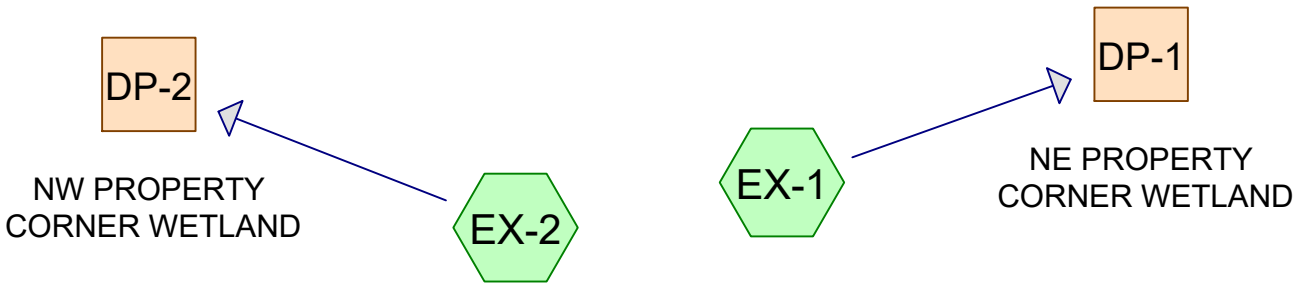
TOTAL RUNOFF PEAK (CFS) FROM THE SITE TO DESIGN POINT 1/10

Type III SCS 24-HR STORM	EXISTING (DP#1)	PROPOSED (DP#10)	DIFFERENCE
2 – YEAR	2.7	2.6	-0.1
10 – YEAR	6.3	6.0	-0.3
100 – YEAR	16.3	16.0	-0.3

TOTAL RUNOFF PEAK (CFS) FROM THE SITE TO DESIGN POINT 2/20

Type III SCS 24-HR STORM	EXISTING (DP#2)	PROPOSED (DP#20) *	DIFFERENCE
2 – YEAR	1.2	1.2	0.0
10 – YEAR	3.1	2.9	-0.2
100 – YEAR	8.3	7.3	-1.0

* Infiltration was not allowed in the model for the 10-year and 100-year proposed analysis.



Subcat Reach Pond Link

Routing Diagram for KJS_Franklin Bent Street_Drainage-PRE & POST_REV

Prepared by ProTerra Design Group, LLC, Printed 1/10/2024

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
32,558	74	>75% Grass cover, Good, HSG C (EX-1)
3,492	89	Gravel roads, HSG C (EX-1)
2,416	98	Paved parking, HSG C (EX-1)
3,150	98	Roofs, HSG C (EX-1)
259,355	70	Woods, Good, HSG C (EX-1, EX-2)
300,971	**71**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
300,971	HSG C	EX-1, EX-2
0	HSG D	
0	Other	
300,971		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	0	32,558	0	0	32,558	>75% Grass cover, Good	
0	0	3,492	0	0	3,492	Gravel roads	
0	0	2,416	0	0	2,416	Paved parking	
0	0	3,150	0	0	3,150	Roofs	
0	0	259,355	0	0	259,355	Woods, Good	
0	**0**	**300,971**	**0**	**0**	**300,971**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=199,749 sf 2.79% Impervious Runoff Depth=0.96"
Flow Length=830' Slope=0.0200 '/' Tc=30.6 min CN=72 Runoff=2.7 cfs 15,994 cf

Subcatchment EX-2: Runoff Area=101,222 sf 0.00% Impervious Runoff Depth=0.86"
Flow Length=390' Slope=0.0100 '/' Tc=27.4 min CN=70 Runoff=1.2 cfs 7,232 cf

Reach DP-1: NE PROPERTY CORNER WETLAND Inflow=2.7 cfs 15,994 cf
Outflow=2.7 cfs 15,994 cf

Reach DP-2: NW PROPERTY CORNER WETLAND Inflow=1.2 cfs 7,232 cf
Outflow=1.2 cfs 7,232 cf

Total Runoff Area = 300,971 sf Runoff Volume = 23,225 cf Average Runoff Depth = 0.93"
98.15% Pervious = 295,405 sf 1.85% Impervious = 5,566 sf

Summary for Subcatchment EX-1:

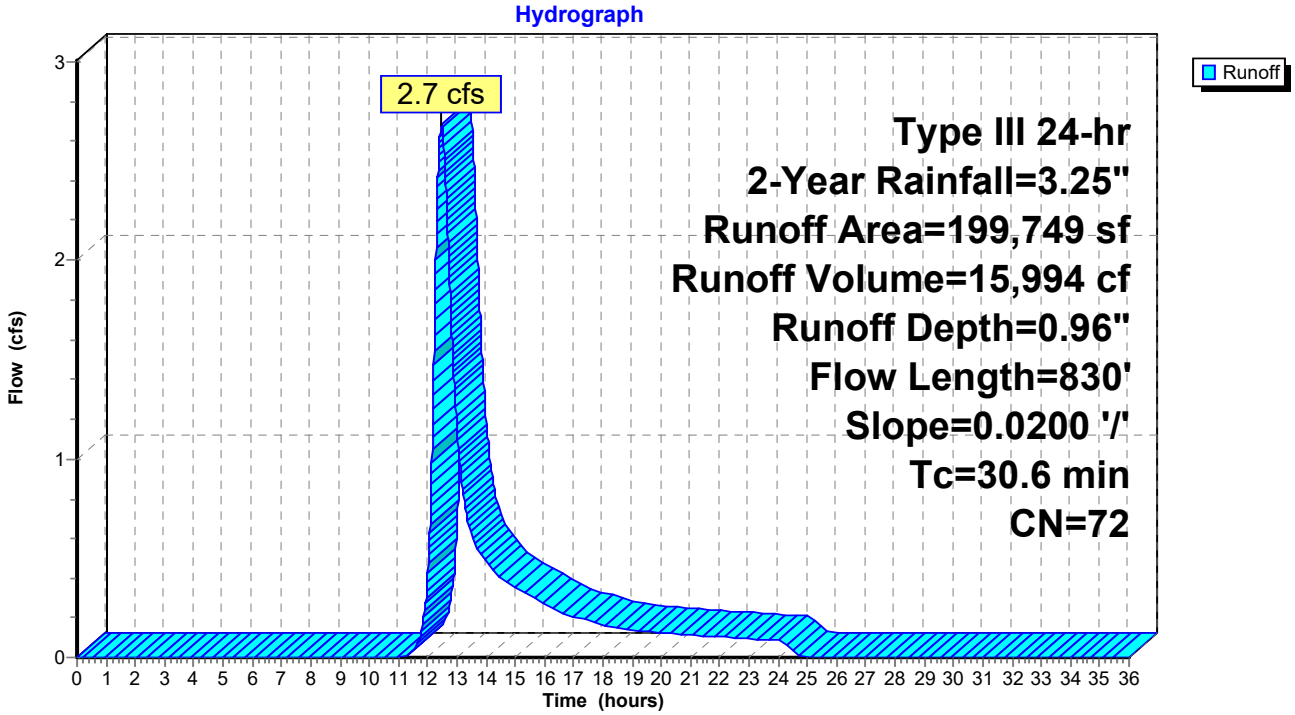
Runoff = 2.7 cfs @ 12.48 hrs, Volume= 15,994 cf, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,416	98	Paved parking, HSG C
32,558	74	>75% Grass cover, Good, HSG C
3,492	89	Gravel roads, HSG C
158,133	70	Woods, Good, HSG C
199,749	72	Weighted Average
194,183		97.21% Pervious Area
5,566		2.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
18.4	780	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
30.6	830	Total			

Subcatchment EX-1:



Summary for Subcatchment EX-2:

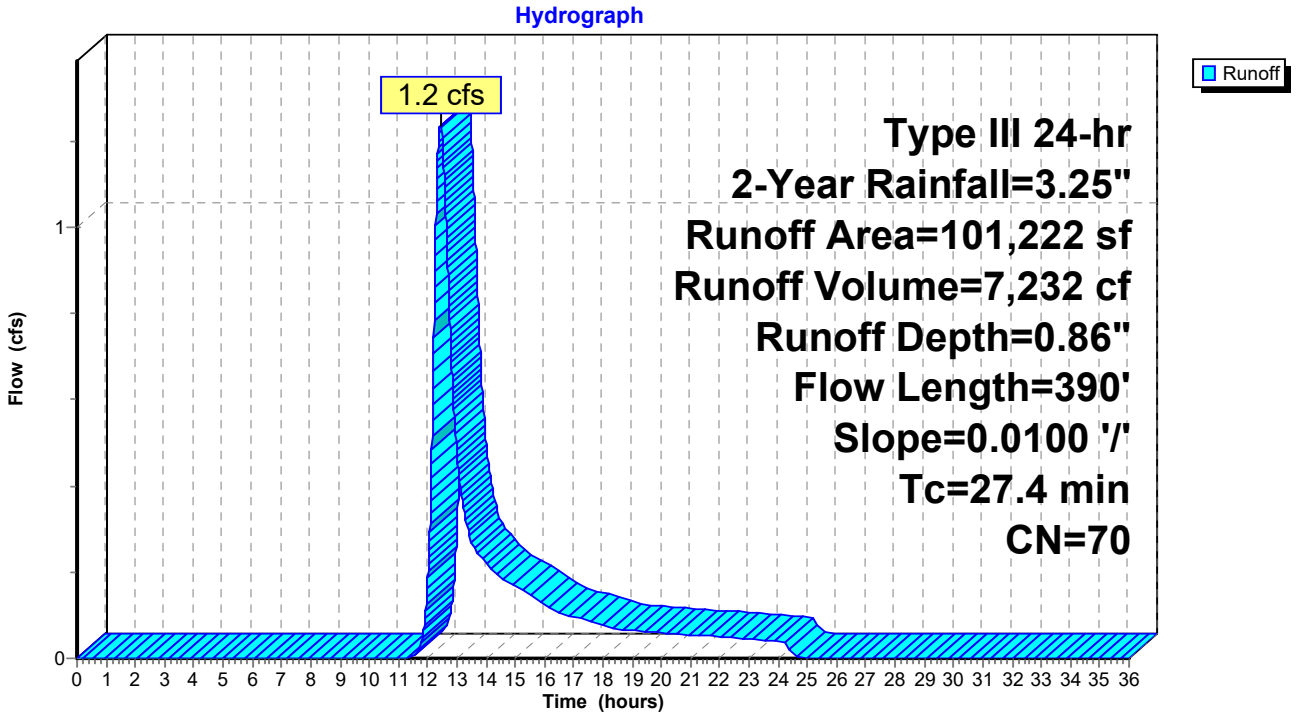
Runoff = 1.2 cfs @ 12.44 hrs, Volume= 7,232 cf, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
101,222	70	Woods, Good, HSG C
101,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
11.3	340	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.4	390	Total			

Subcatchment EX-2:

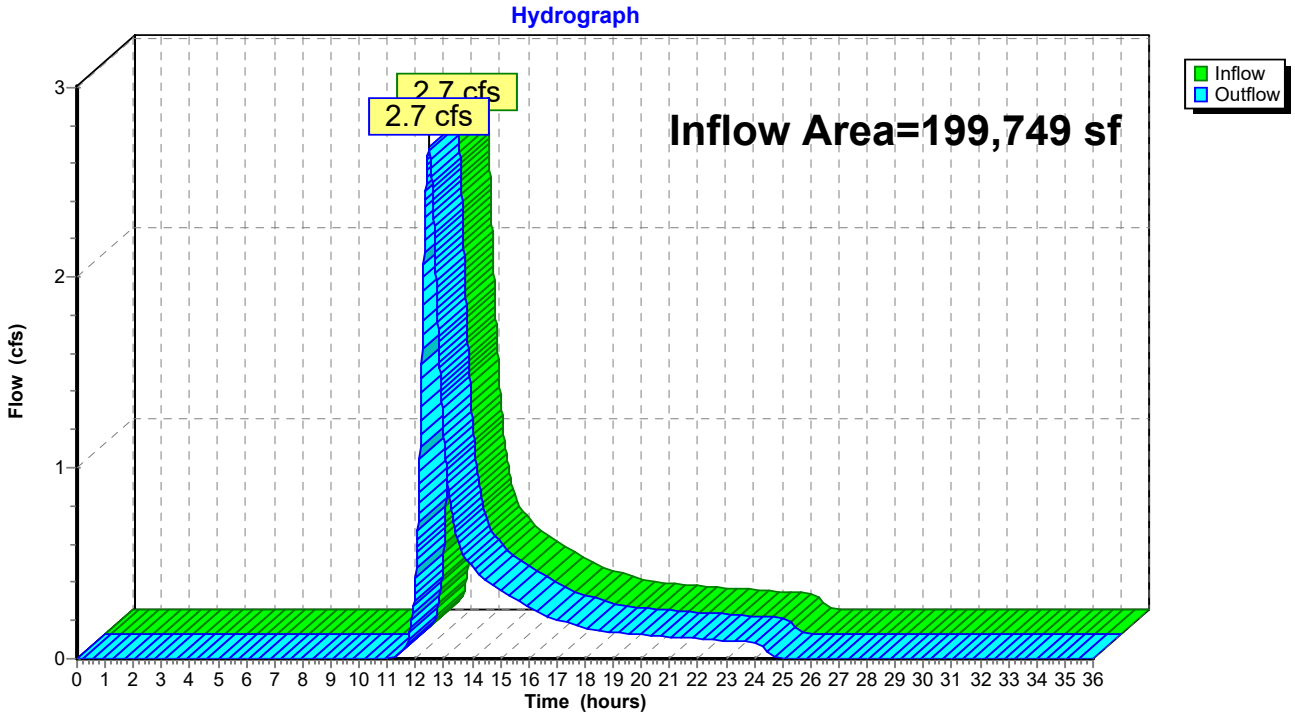


Summary for Reach DP-1: NE PROPERTY CORNER WETLAND

Inflow Area = 199,749 sf, 2.79% Impervious, Inflow Depth = 0.96" for 2-Year event
Inflow = 2.7 cfs @ 12.48 hrs, Volume= 15,994 cf
Outflow = 2.7 cfs @ 12.48 hrs, Volume= 15,994 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-1: NE PROPERTY CORNER WETLAND

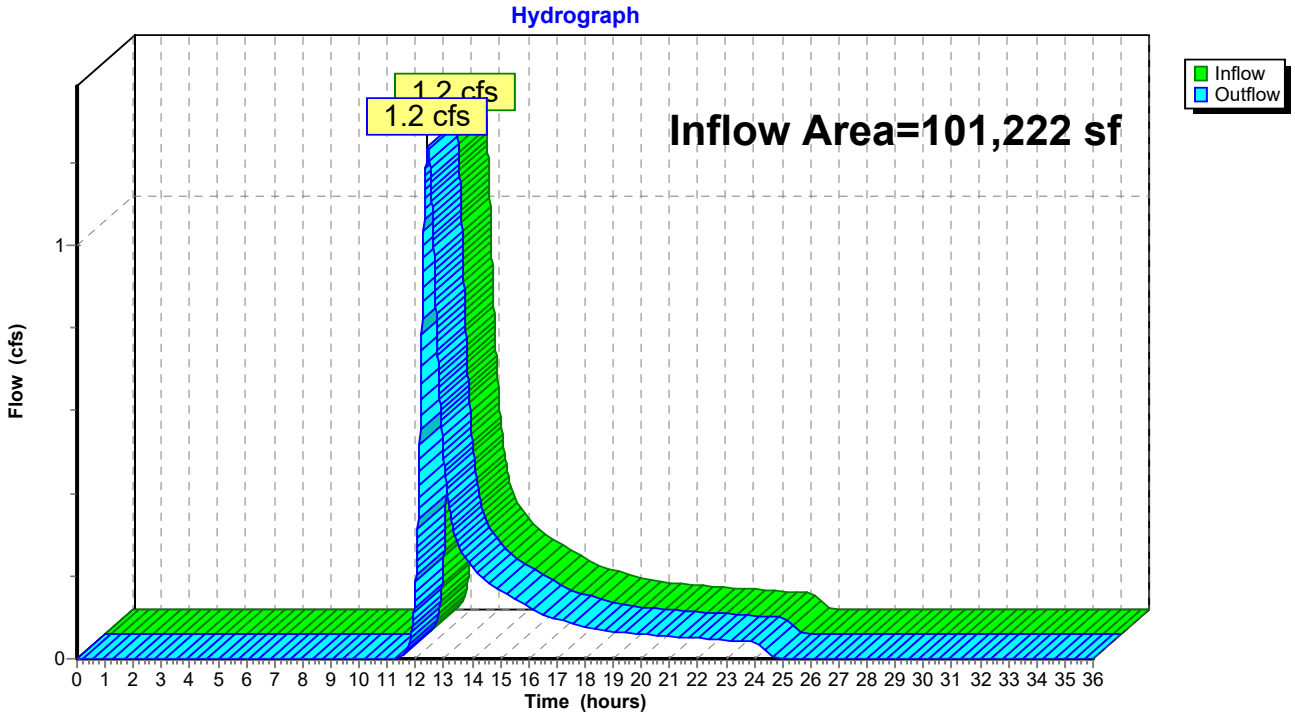


Summary for Reach DP-2: NW PROPERTY CORNER WETLAND

Inflow Area = 101,222 sf, 0.00% Impervious, Inflow Depth = 0.86" for 2-Year event
Inflow = 1.2 cfs @ 12.44 hrs, Volume= 7,232 cf
Outflow = 1.2 cfs @ 12.44 hrs, Volume= 7,232 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-2: NW PROPERTY CORNER WETLAND



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=199,749 sf 2.79% Impervious Runoff Depth=2.11"
Flow Length=830' Slope=0.0200 '/' Tc=30.6 min CN=72 Runoff=6.3 cfs 35,181 cf

Subcatchment EX-2: Runoff Area=101,222 sf 0.00% Impervious Runoff Depth=1.96"
Flow Length=390' Slope=0.0100 '/' Tc=27.4 min CN=70 Runoff=3.1 cfs 16,492 cf

Reach DP-1: NE PROPERTY CORNER WETLAND Inflow=6.3 cfs 35,181 cf
Outflow=6.3 cfs 35,181 cf

Reach DP-2: NW PROPERTY CORNER WETLAND Inflow=3.1 cfs 16,492 cf
Outflow=3.1 cfs 16,492 cf

Total Runoff Area = 300,971 sf Runoff Volume = 51,673 cf Average Runoff Depth = 2.06"
98.15% Pervious = 295,405 sf 1.85% Impervious = 5,566 sf

Summary for Subcatchment EX-1:

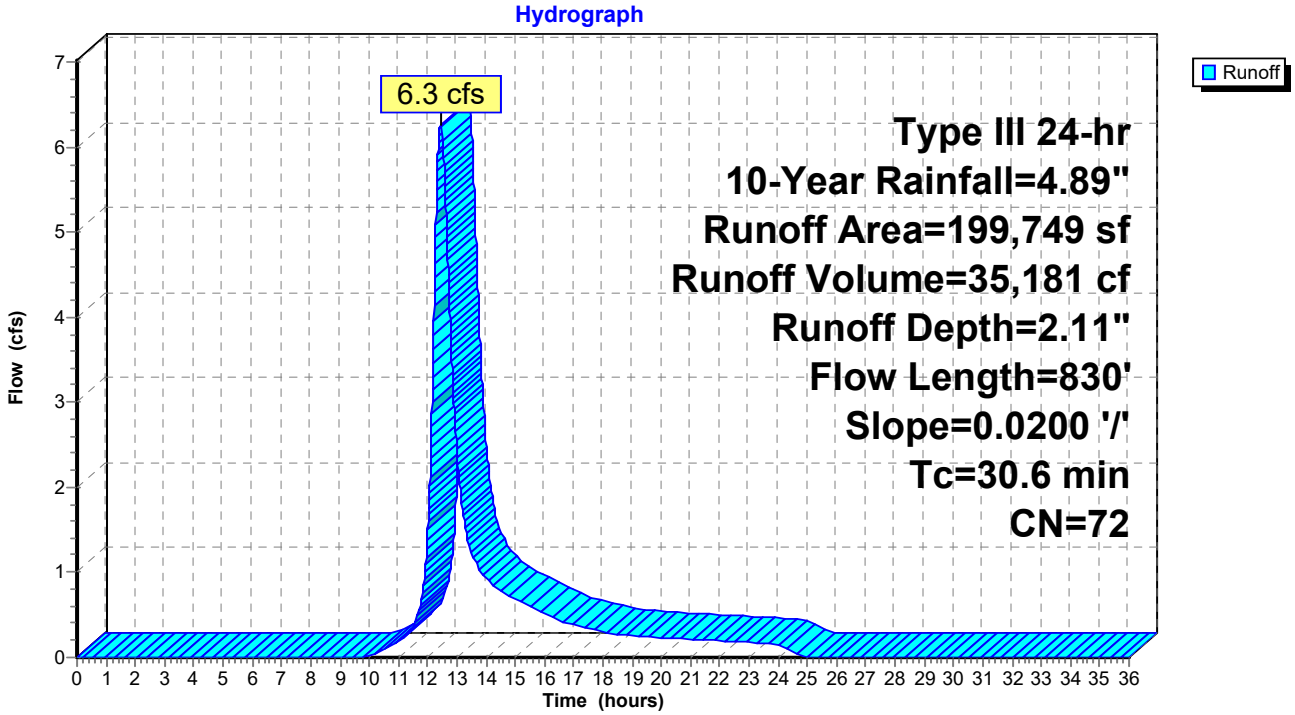
Runoff = 6.3 cfs @ 12.44 hrs, Volume= 35,181 cf, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,416	98	Paved parking, HSG C
32,558	74	>75% Grass cover, Good, HSG C
3,492	89	Gravel roads, HSG C
158,133	70	Woods, Good, HSG C
199,749	72	Weighted Average
194,183		97.21% Pervious Area
5,566		2.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
18.4	780	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
30.6	830	Total			

Subcatchment EX-1:



Summary for Subcatchment EX-2:

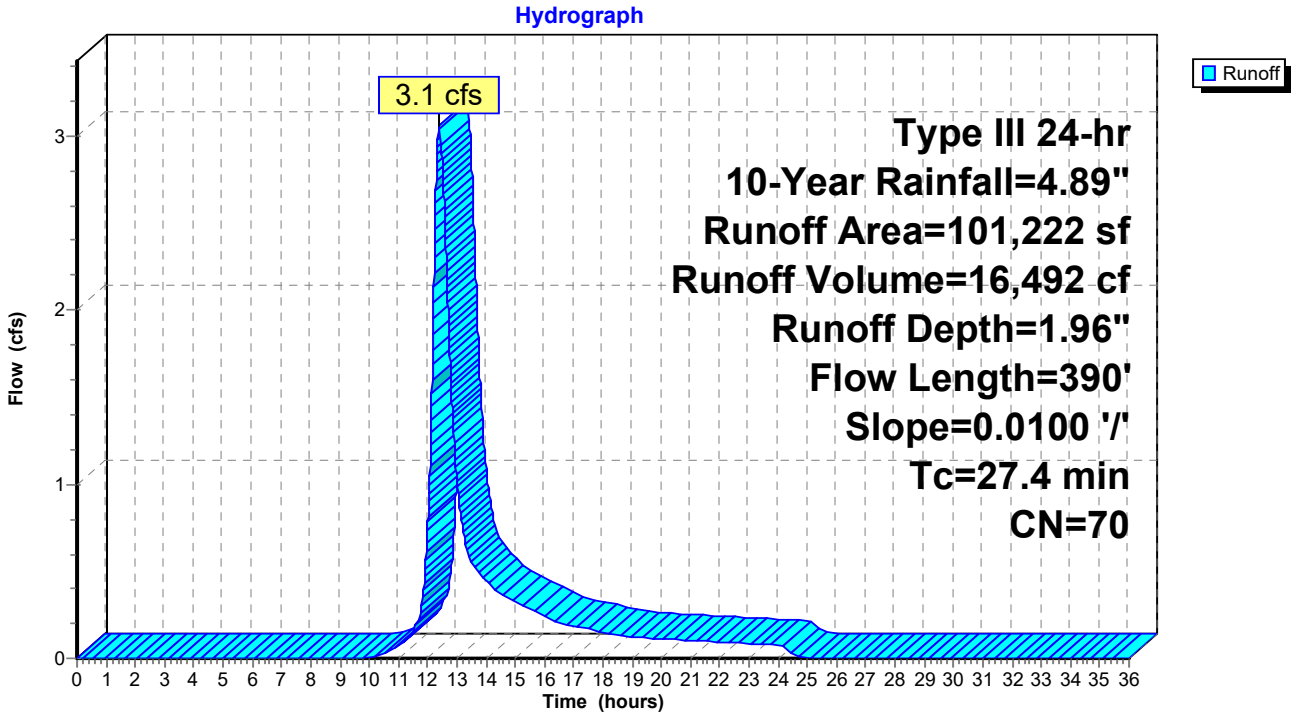
Runoff = 3.1 cfs @ 12.39 hrs, Volume= 16,492 cf, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

Area (sf)	CN	Description
101,222	70	Woods, Good, HSG C
101,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
11.3	340	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.4	390	Total			

Subcatchment EX-2:

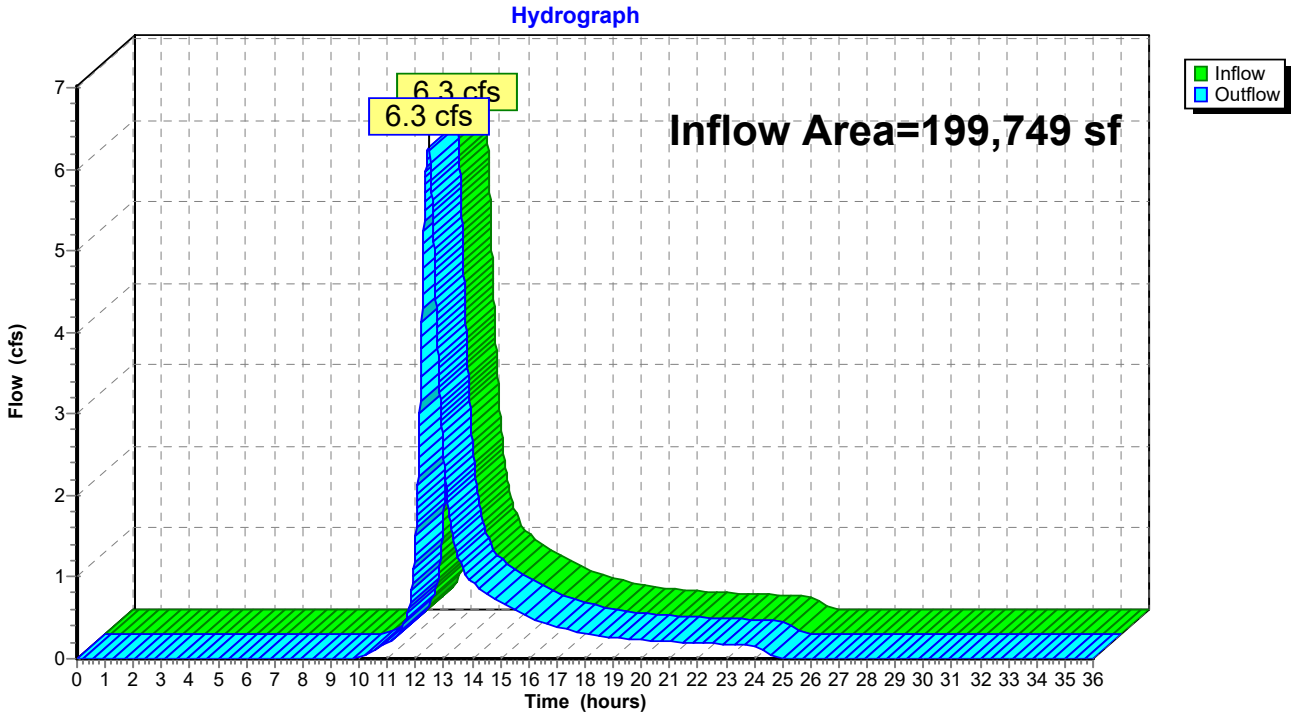


Summary for Reach DP-1: NE PROPERTY CORNER WETLAND

Inflow Area = 199,749 sf, 2.79% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 6.3 cfs @ 12.44 hrs, Volume= 35,181 cf
Outflow = 6.3 cfs @ 12.44 hrs, Volume= 35,181 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-1: NE PROPERTY CORNER WETLAND

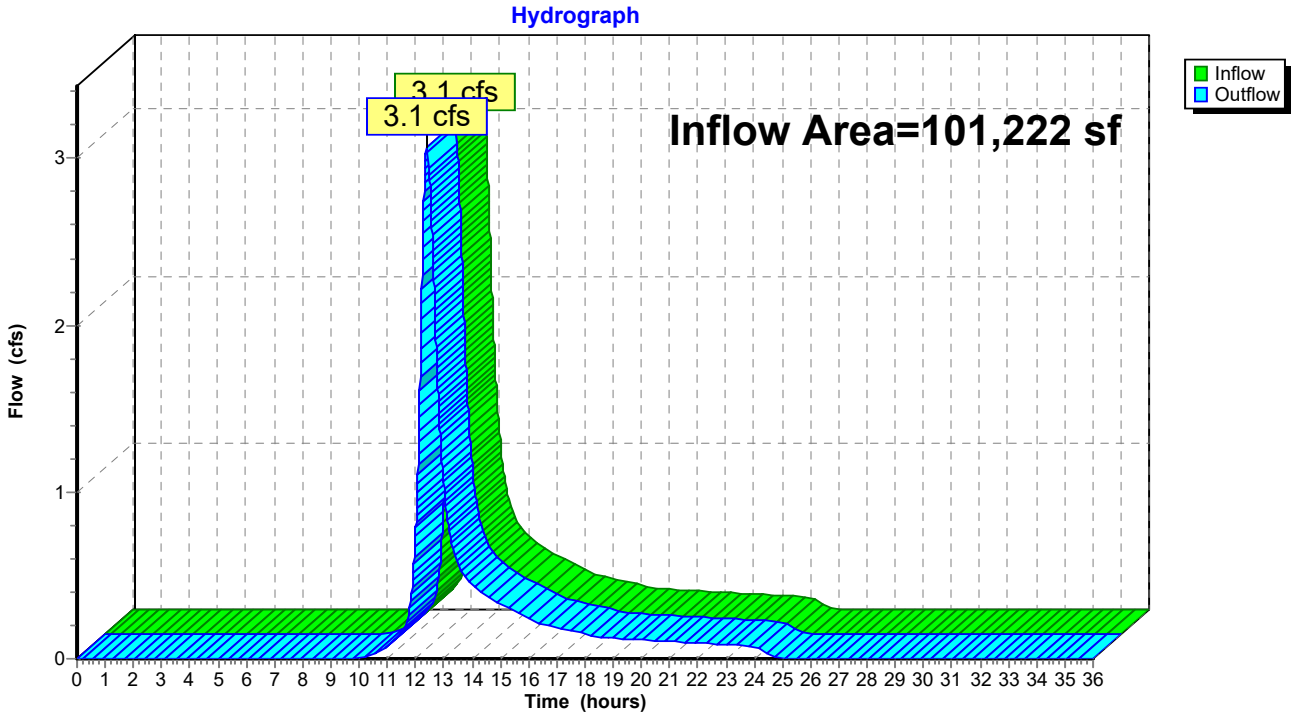


Summary for Reach DP-2: NW PROPERTY CORNER WETLAND

Inflow Area = 101,222 sf, 0.00% Impervious, Inflow Depth = 1.96" for 10-Year event
Inflow = 3.1 cfs @ 12.39 hrs, Volume= 16,492 cf
Outflow = 3.1 cfs @ 12.39 hrs, Volume= 16,492 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-2: NW PROPERTY CORNER WETLAND



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment EX-1: Runoff Area=199,749 sf 2.79% Impervious Runoff Depth=5.41"
Flow Length=830' Slope=0.0200 '/' Tc=30.6 min CN=72 Runoff=16.3 cfs 90,086 cf

Subcatchment EX-2: Runoff Area=101,222 sf 0.00% Impervious Runoff Depth=5.17"
Flow Length=390' Slope=0.0100 '/' Tc=27.4 min CN=70 Runoff=8.3 cfs 43,592 cf

Reach DP-1: NE PROPERTY CORNER WETLAND Inflow=16.3 cfs 90,086 cf
Outflow=16.3 cfs 90,086 cf

Reach DP-2: NW PROPERTY CORNER WETLAND Inflow=8.3 cfs 43,592 cf
Outflow=8.3 cfs 43,592 cf

Total Runoff Area = 300,971 sf Runoff Volume = 133,678 cf Average Runoff Depth = 5.33"
98.15% Pervious = 295,405 sf 1.85% Impervious = 5,566 sf

Summary for Subcatchment EX-1:

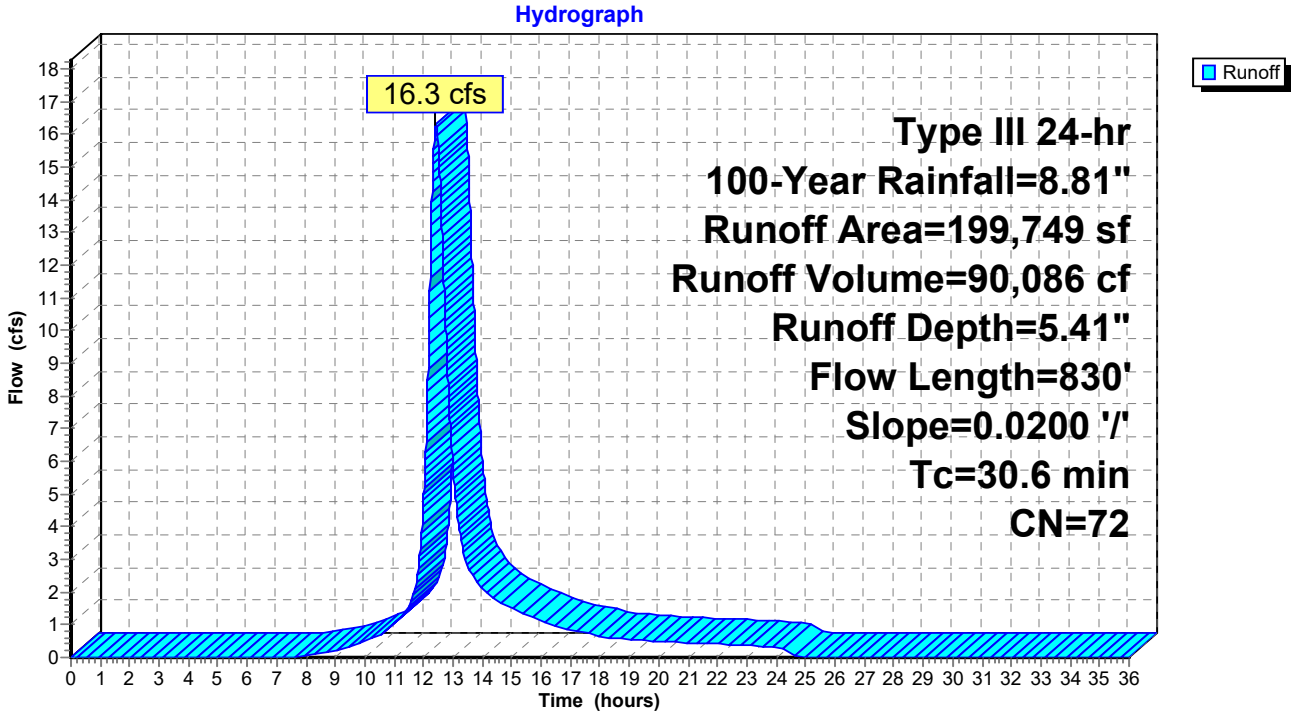
Runoff = 16.3 cfs @ 12.41 hrs, Volume= 90,086 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,416	98	Paved parking, HSG C
32,558	74	>75% Grass cover, Good, HSG C
3,492	89	Gravel roads, HSG C
158,133	70	Woods, Good, HSG C
199,749	72	Weighted Average
194,183		97.21% Pervious Area
5,566		2.79% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
18.4	780	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
30.6	830	Total			

Subcatchment EX-1:



Summary for Subcatchment EX-2:

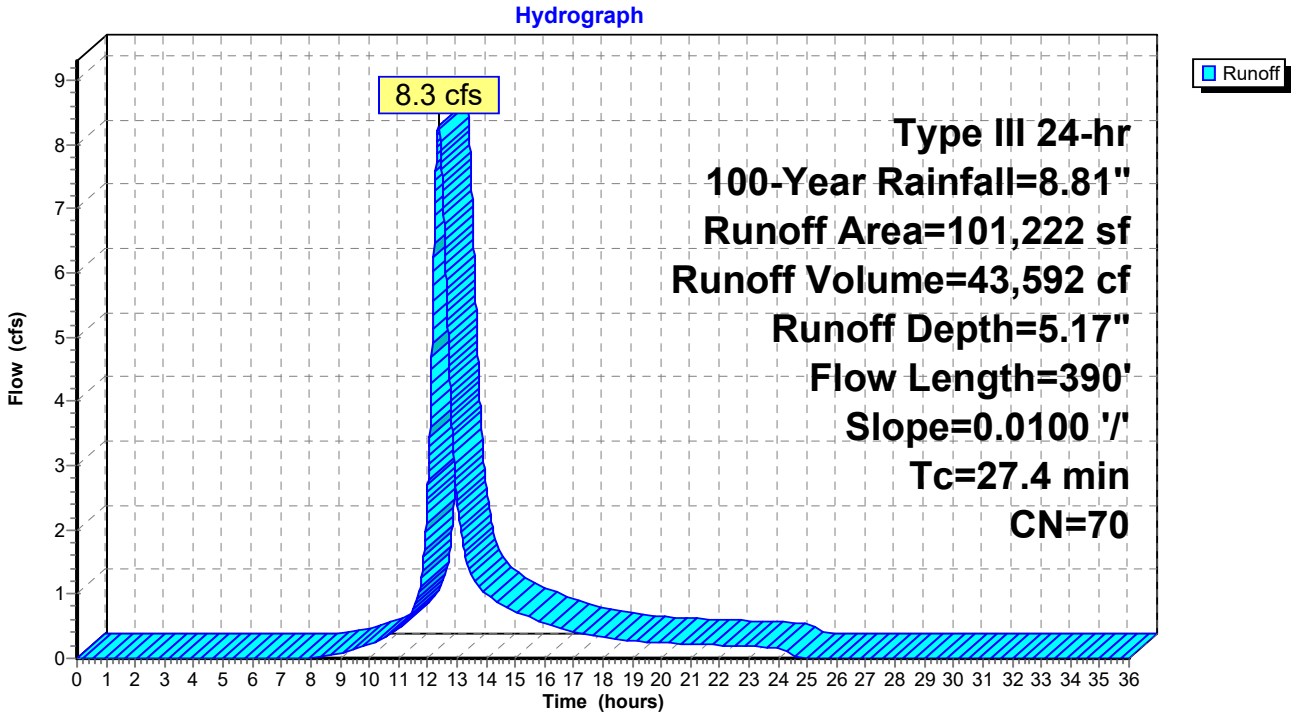
Runoff = 8.3 cfs @ 12.39 hrs, Volume= 43,592 cf, Depth= 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

Area (sf)	CN	Description
101,222	70	Woods, Good, HSG C
101,222		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
11.3	340	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.4	390	Total			

Subcatchment EX-2:

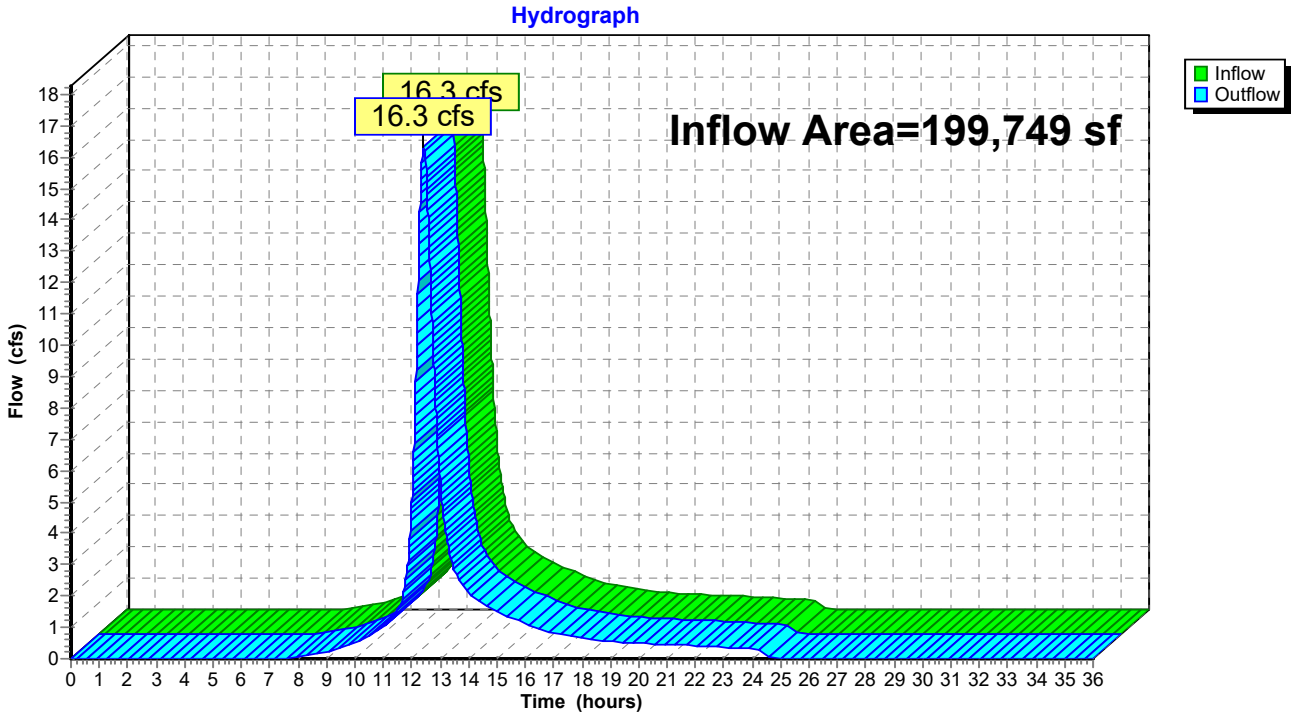


Summary for Reach DP-1: NE PROPERTY CORNER WETLAND

Inflow Area = 199,749 sf, 2.79% Impervious, Inflow Depth = 5.41" for 100-Year event
Inflow = 16.3 cfs @ 12.41 hrs, Volume= 90,086 cf
Outflow = 16.3 cfs @ 12.41 hrs, Volume= 90,086 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-1: NE PROPERTY CORNER WETLAND

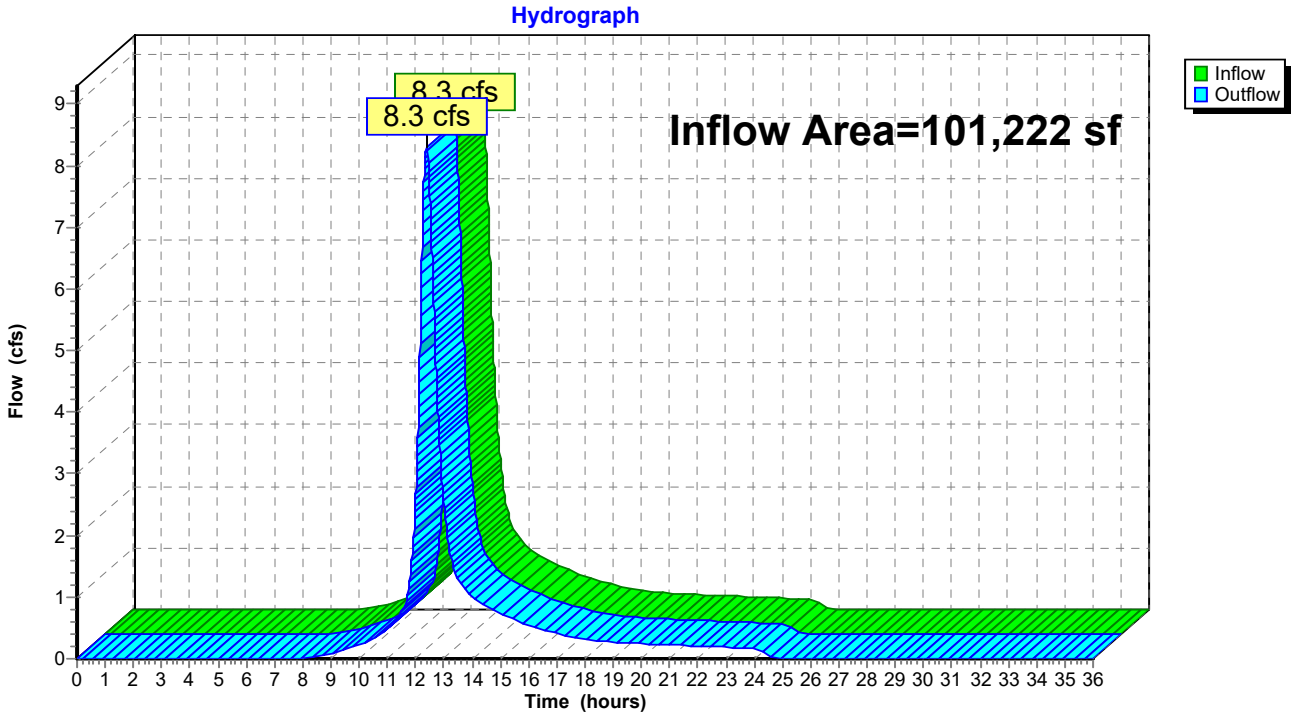


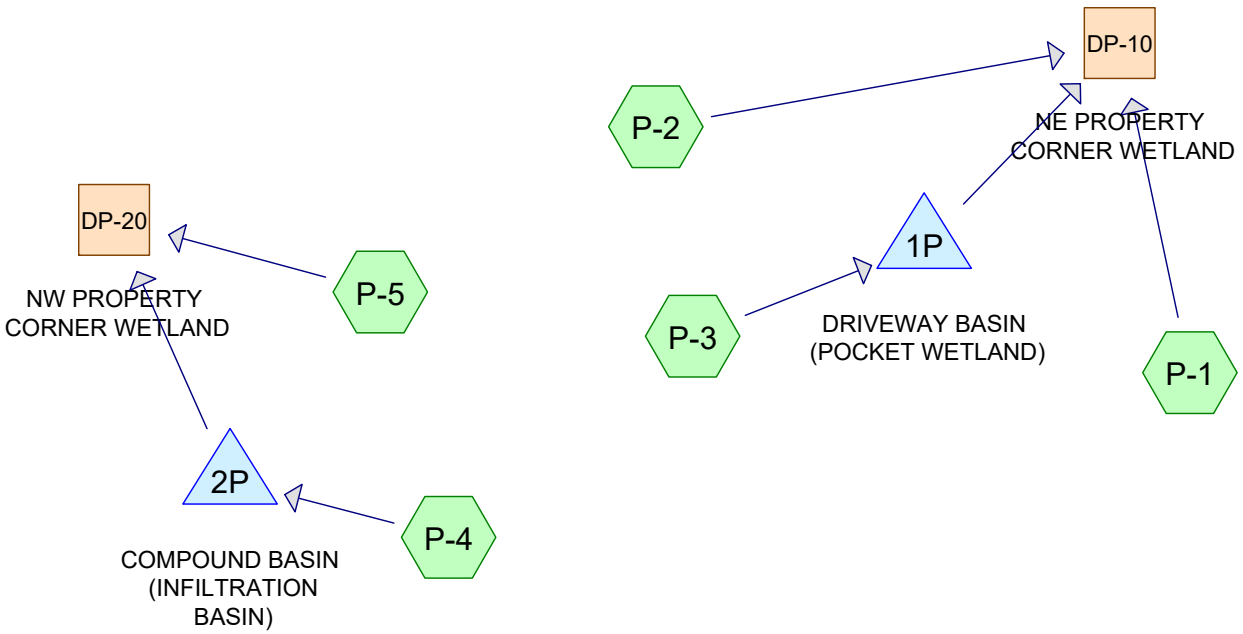
Summary for Reach DP-2: NW PROPERTY CORNER WETLAND

Inflow Area = 101,222 sf, 0.00% Impervious, Inflow Depth = 5.17" for 100-Year event
Inflow = 8.3 cfs @ 12.39 hrs, Volume= 43,592 cf
Outflow = 8.3 cfs @ 12.39 hrs, Volume= 43,592 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-2: NW PROPERTY CORNER WETLAND





Subcat Reach Pond Link

Routing Diagram for KJS_Franklin Bent Street_Drainage-PRE & POST_REV

Prepared by ProTerra Design Group, LLC, Printed 1/10/2024

Area Listing (selected nodes)

Area (sq-ft)	CN	Description (subcatchment-numbers)
60,610	74	>75% Grass cover, Good, HSG C (P-1, P-2, P-3, P-4, P-5)
13,520	89	Gravel roads, HSG C (P-2, P-3, P-4)
4,186	98	Paved parking, HSG C (P-2, P-3, P-4)
807	89	Riprap, HSG C (P-1, P-3, P-4, P-5)
3,150	98	Roofs, HSG C (P-2)
218,698	70	Woods, Good, HSG C (P-1, P-2, P-3, P-4, P-5)
300,971	**72**	**TOTAL AREA**

Soil Listing (selected nodes)

Area (sq-ft)	Soil Group	Subcatchment Numbers
0	HSG A	
0	HSG B	
300,971	HSG C	P-1, P-2, P-3, P-4, P-5
0	HSG D	
0	Other	
300,971		**TOTAL AREA**

Ground Covers (selected nodes)

HSG-A (sq-ft)	HSG-B (sq-ft)	HSG-C (sq-ft)	HSG-D (sq-ft)	Other (sq-ft)	Total (sq-ft)	Ground Cover	Sub Num
0	0	60,610	0	0	60,610	>75% Grass cover, Good	
0	0	13,520	0	0	13,520	Gravel roads	
0	0	4,186	0	0	4,186	Paved parking	
0	0	807	0	0	807	Riprap	
0	0	3,150	0	0	3,150	Roofs	
0	0	218,698	0	0	218,698	Woods, Good	
0	**0**	**300,971**	**0**	**0**	**300,971**	**TOTAL AREA**	

Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Runoff Area=7,999 sf 0.00% Impervious Runoff Depth=1.01"
Flow Length=160' Tc=14.0 min CN=73 Runoff=0.2 cfs 677 cf

Subcatchment P-2: Runoff Area=120,294 sf 4.98% Impervious Runoff Depth=1.07"
Flow Length=663' Tc=25.7 min CN=74 Runoff=2.0 cfs 10,732 cf

Subcatchment P-3: Runoff Area=82,885 sf 0.42% Impervious Runoff Depth=0.96"
Flow Length=680' Slope=0.0200 '/' Tc=27.0 min CN=72 Runoff=1.2 cfs 6,636 cf

Subcatchment P-4: Runoff Area=11,367 sf 8.80% Impervious Runoff Depth=1.31"
Flow Length=83' Slope=0.0200 '/' Tc=13.0 min CN=78 Runoff=0.3 cfs 1,241 cf

Subcatchment P-5: Runoff Area=78,426 sf 0.00% Impervious Runoff Depth=0.86"
Flow Length=284' Slope=0.0100 '/' Tc=23.9 min CN=70 Runoff=1.0 cfs 5,603 cf

Reach DP-10: NE PROPERTY CORNER WETLAND Inflow=2.6 cfs 18,035 cf
Outflow=2.6 cfs 18,035 cf

Reach DP-20: NW PROPERTY CORNER WETLAND Inflow=1.2 cfs 6,325 cf
Outflow=1.2 cfs 6,325 cf

Pond 1P: DRIVEWAY BASIN (POCKET Peak Elev=284.99' Storage=2,461 cf Inflow=1.2 cfs 6,636 cf
Outflow=0.7 cfs 6,627 cf

Pond 2P: COMPOUND BASIN (INFILTRATION Peak Elev=287.81' Storage=256 cf Inflow=0.3 cfs 1,241 cf
Discarded=0.0 cfs 519 cf Primary=0.2 cfs 722 cf Outflow=0.2 cfs 1,241 cf

Total Runoff Area = 300,971 sf Runoff Volume = 24,889 cf Average Runoff Depth = 0.99"
97.56% Pervious = 293,635 sf 2.44% Impervious = 7,336 sf

Summary for Subcatchment P-1:

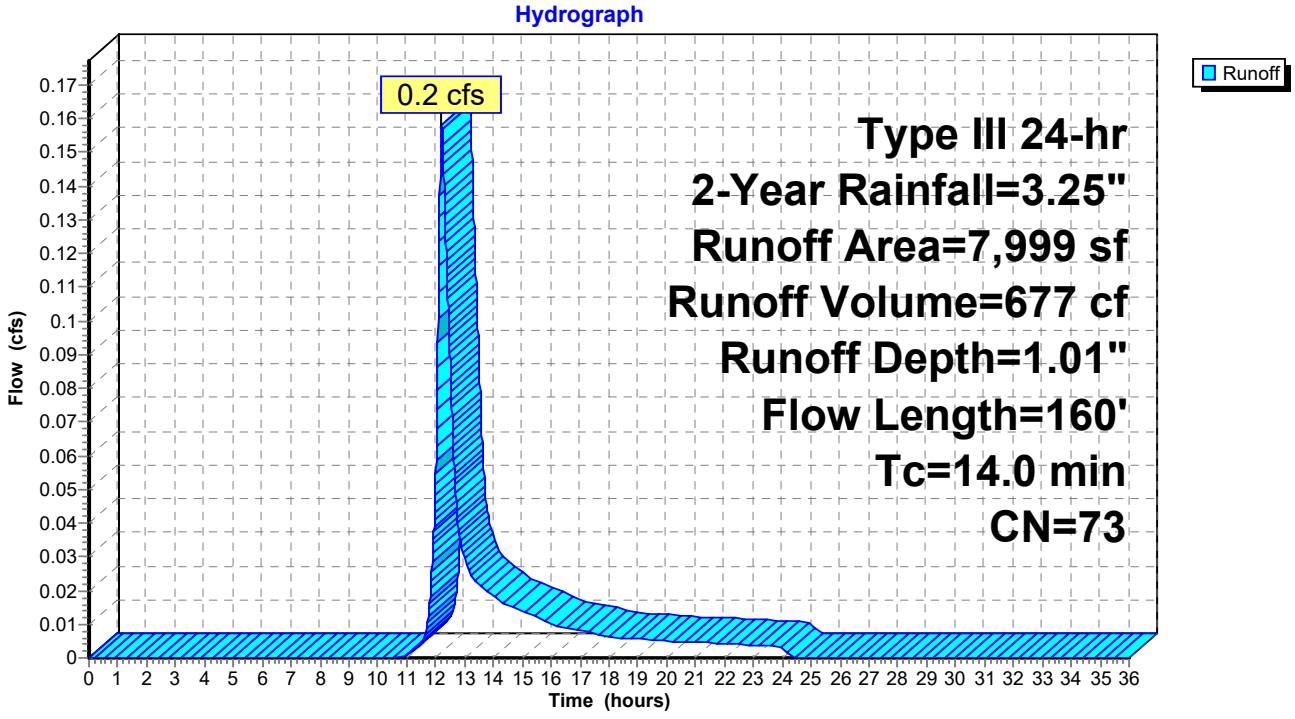
Runoff = 0.2 cfs @ 12.21 hrs, Volume= 677 cf, Depth= 1.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	3,984	74	>75% Grass cover, Good, HSG C
	3,688	70	Woods, Good, HSG C
*	327	89	Riprap, HSG C
	7,999	73	Weighted Average
	7,999		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0210	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
2.0	110	0.0330	0.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	160	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

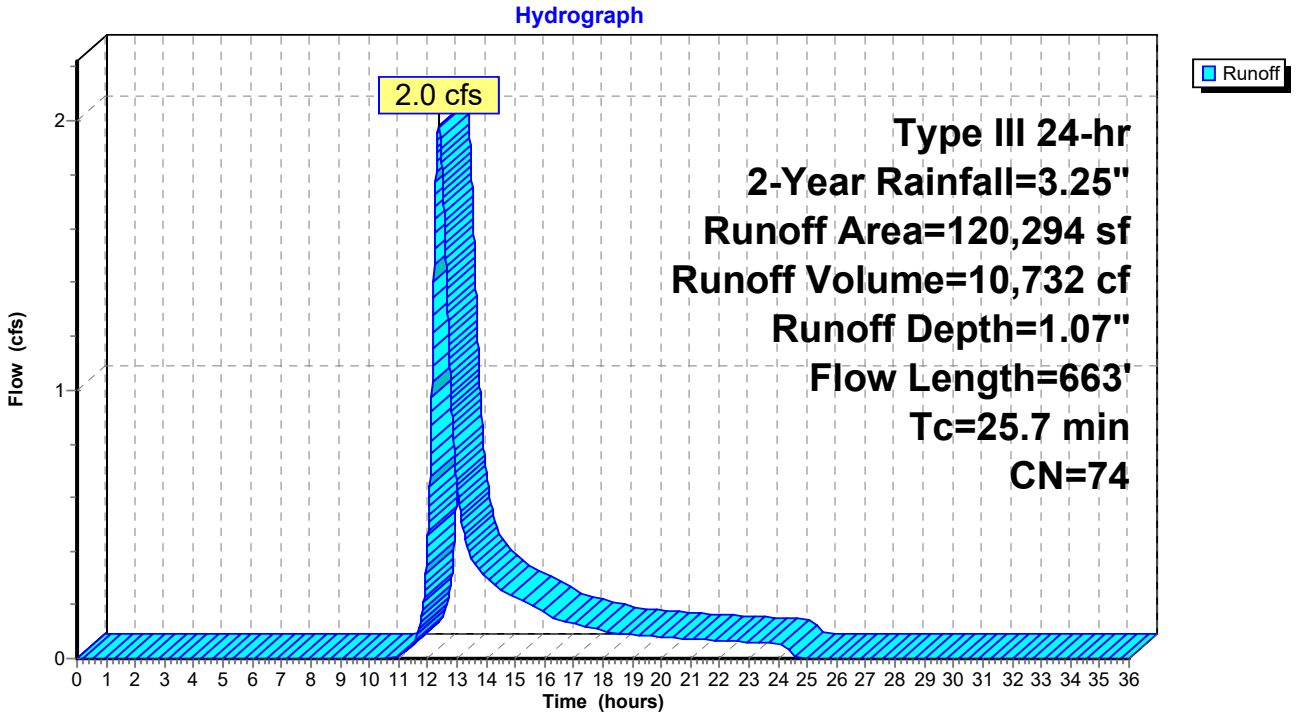
Runoff = 2.0 cfs @ 12.39 hrs, Volume= 10,732 cf, Depth= 1.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,836	98	Paved parking, HSG C
36,006	74	>75% Grass cover, Good, HSG C
6,592	89	Gravel roads, HSG C
71,710	70	Woods, Good, HSG C
120,294	74	Weighted Average
114,308		95.02% Pervious Area
5,986		4.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	50	0.0150	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
9.5	338	0.0140	0.59		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	77	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	168	0.0160	5.37	26.85	**Channel Flow,** Area= 5.0 sf Perim= 5.0' r= 1.00' n= 0.035 Earth, dense weeds
0.2	30	0.0100	2.74	3.36	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.025 Corrugated metal
25.7	663	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

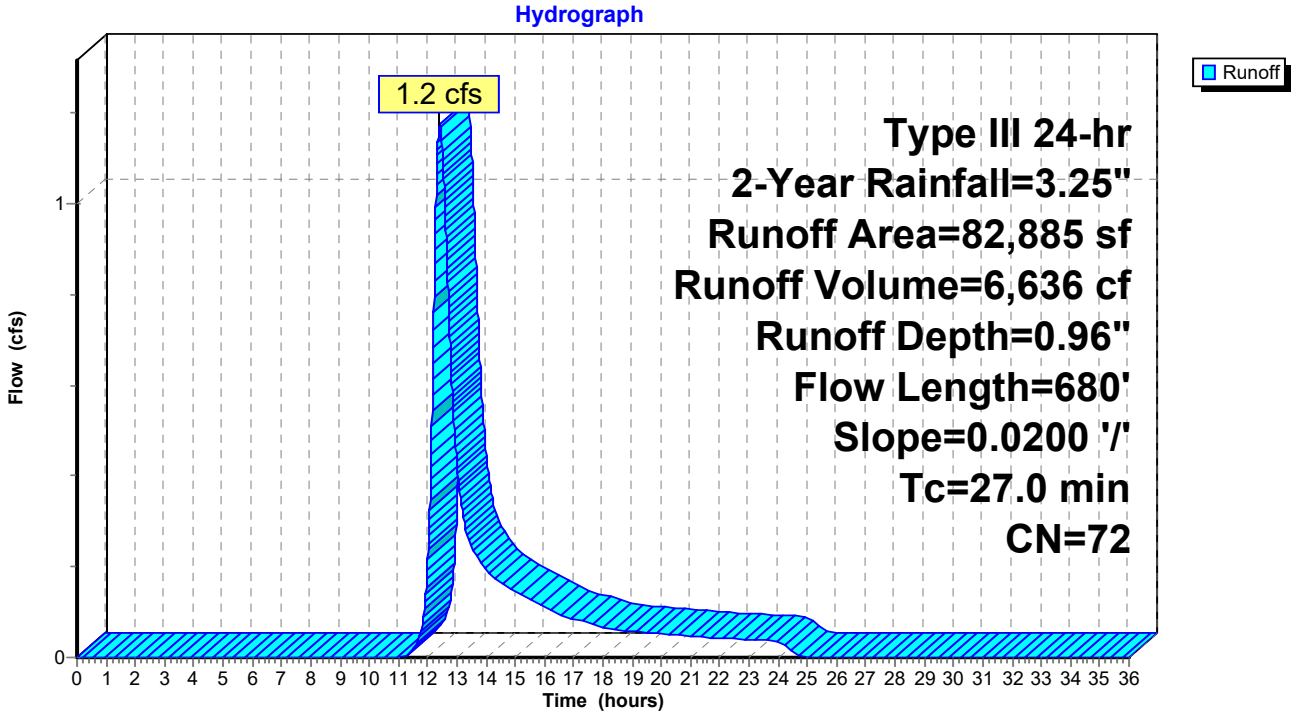
Runoff = 1.2 cfs @ 12.42 hrs, Volume= 6,636 cf, Depth= 0.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	350	98	Paved parking, HSG C
	10,443	74	>75% Grass cover, Good, HSG C
	5,265	89	Gravel roads, HSG C
	66,692	70	Woods, Good, HSG C
*	135	89	Riprap, HSG C
	82,885	72	Weighted Average
	82,535		99.58% Pervious Area
	350		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
14.8	630	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.0	680	Total			

Subcatchment P-3:



Summary for Subcatchment P-4:

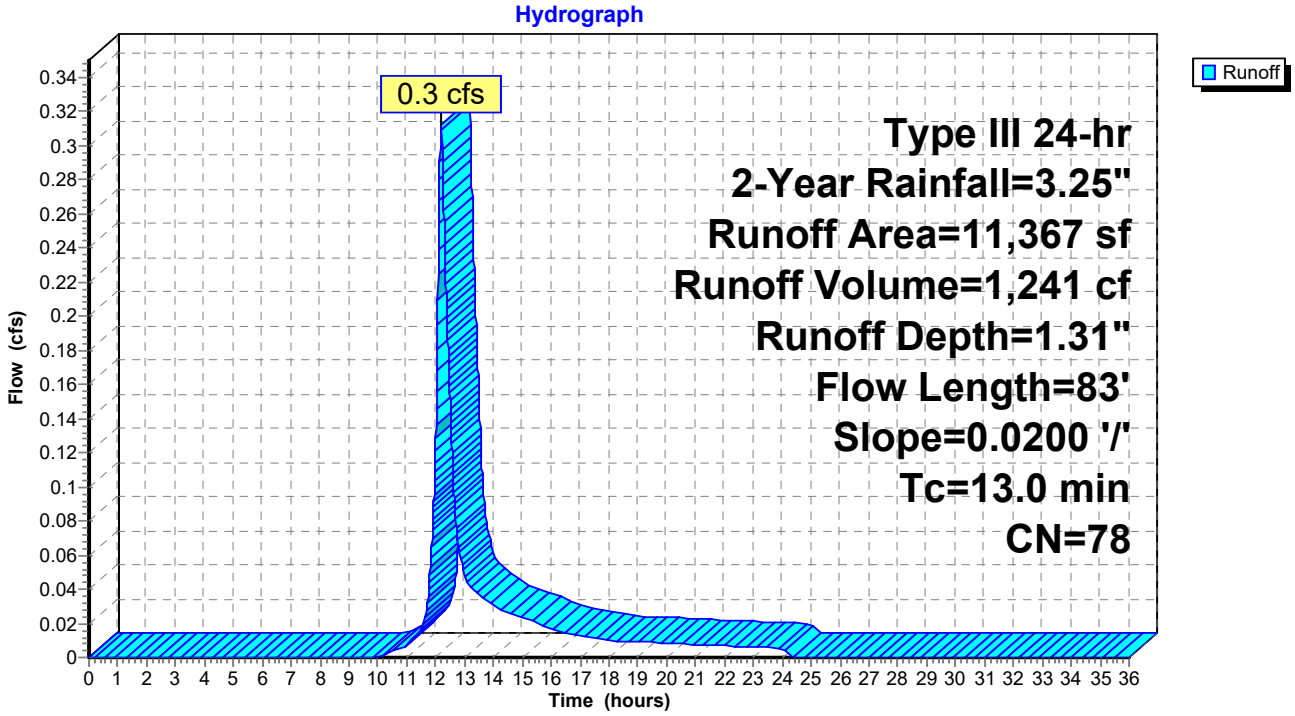
Runoff = 0.3 cfs @ 12.18 hrs, Volume= 1,241 cf, Depth= 1.31"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	1,000	98	Paved parking, HSG C
	6,403	74	>75% Grass cover, Good, HSG C
	1,663	89	Gravel roads, HSG C
	2,067	70	Woods, Good, HSG C
*	234	89	Riprap, HSG C
	11,367	78	Weighted Average
	10,367		91.20% Pervious Area
	1,000		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
0.8	33	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	83	Total			

Subcatchment P-4:



Summary for Subcatchment P-5:

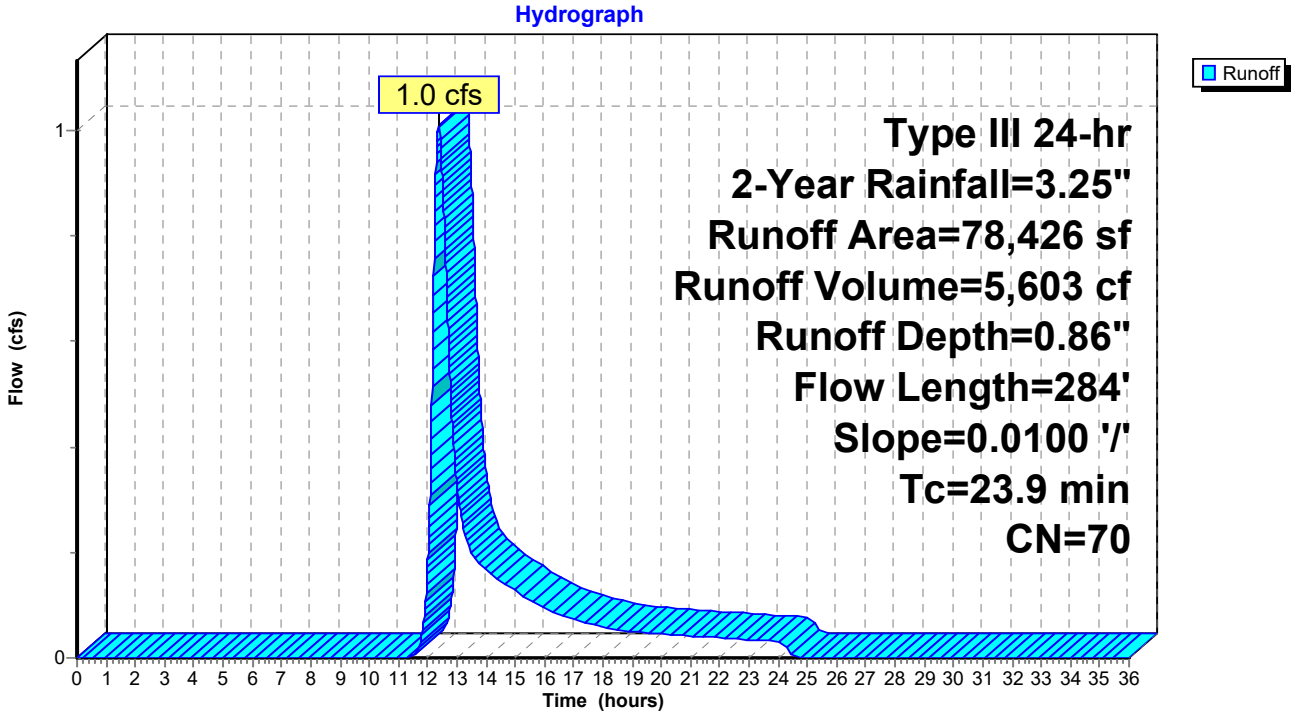
Runoff = 1.0 cfs @ 12.38 hrs, Volume= 5,603 cf, Depth= 0.86"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Year Rainfall=3.25"

	Area (sf)	CN	Description
	3,774	74	>75% Grass cover, Good, HSG C
	74,541	70	Woods, Good, HSG C
*	111	89	Riprap, HSG C
	78,426	70	Weighted Average
	78,426		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
7.8	234	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.9	284	Total			

Subcatchment P-5:

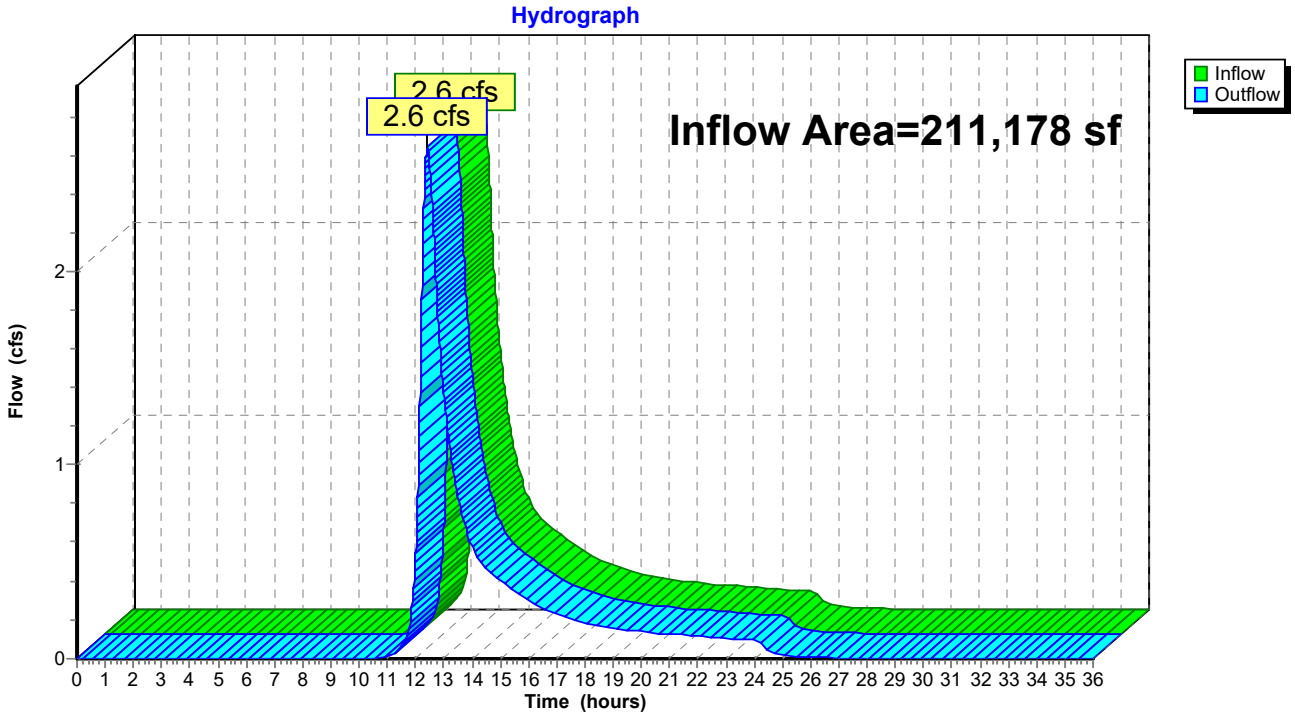


Summary for Reach DP-10: NE PROPERTY CORNER WETLAND

Inflow Area = 211,178 sf, 3.00% Impervious, Inflow Depth > 1.02" for 2-Year event
Inflow = 2.6 cfs @ 12.42 hrs, Volume= 18,035 cf
Outflow = 2.6 cfs @ 12.42 hrs, Volume= 18,035 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-10: NE PROPERTY CORNER WETLAND

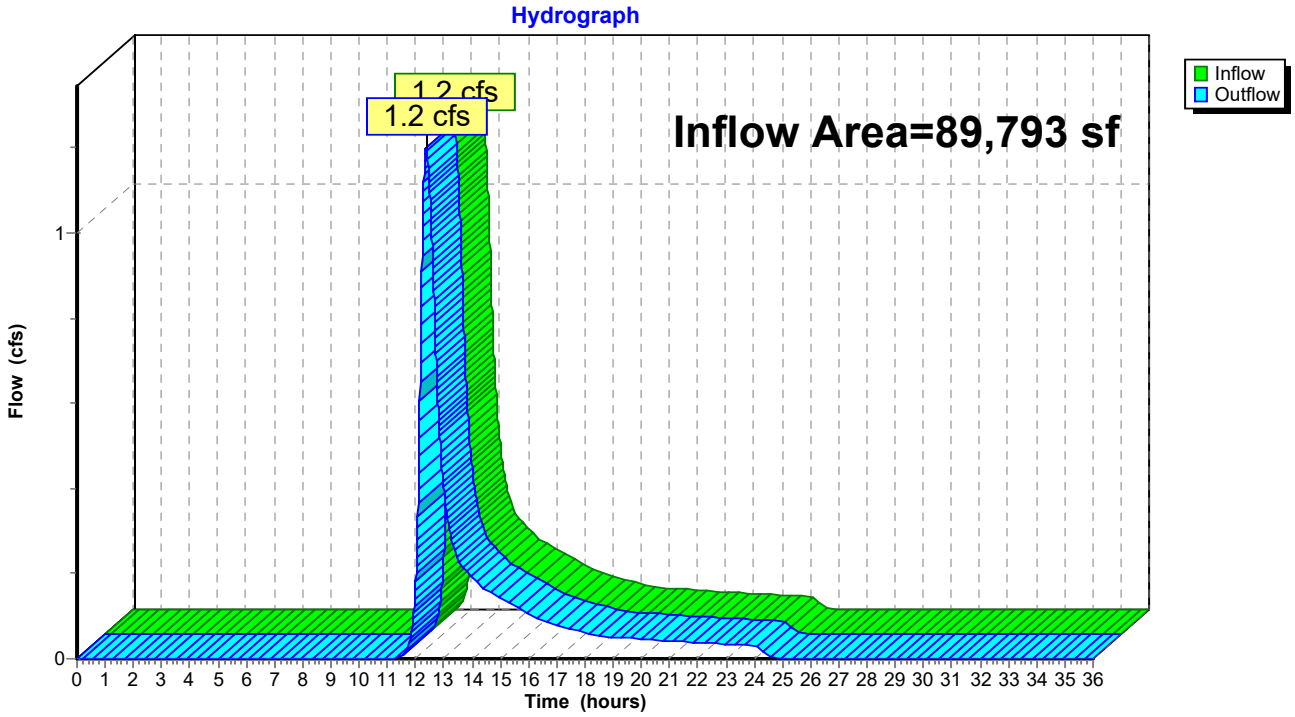


Summary for Reach DP-20: NW PROPERTY CORNER WETLAND

Inflow Area = 89,793 sf, 1.11% Impervious, Inflow Depth = 0.85" for 2-Year event
Inflow = 1.2 cfs @ 12.38 hrs, Volume= 6,325 cf
Outflow = 1.2 cfs @ 12.38 hrs, Volume= 6,325 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-20: NW PROPERTY CORNER WETLAND



Summary for Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)

Inflow Area = 82,885 sf, 0.42% Impervious, Inflow Depth = 0.96" for 2-Year event
Inflow = 1.2 cfs @ 12.42 hrs, Volume= 6,636 cf
Outflow = 0.7 cfs @ 12.75 hrs, Volume= 6,627 cf, Atten= 39%, Lag= 20.2 min
Primary = 0.7 cfs @ 12.75 hrs, Volume= 6,627 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 284.17' Surf.Area= 1,306 sf Storage= 1,213 cf
Peak Elev= 284.99' @ 12.75 hrs Surf.Area= 1,720 sf Storage= 2,461 cf (1,248 cf above start)

Plug-Flow detention time= 153.1 min calculated for 5,414 cf (82% of inflow)
Center-of-Mass det. time= 36.4 min (923.5 - 887.2)

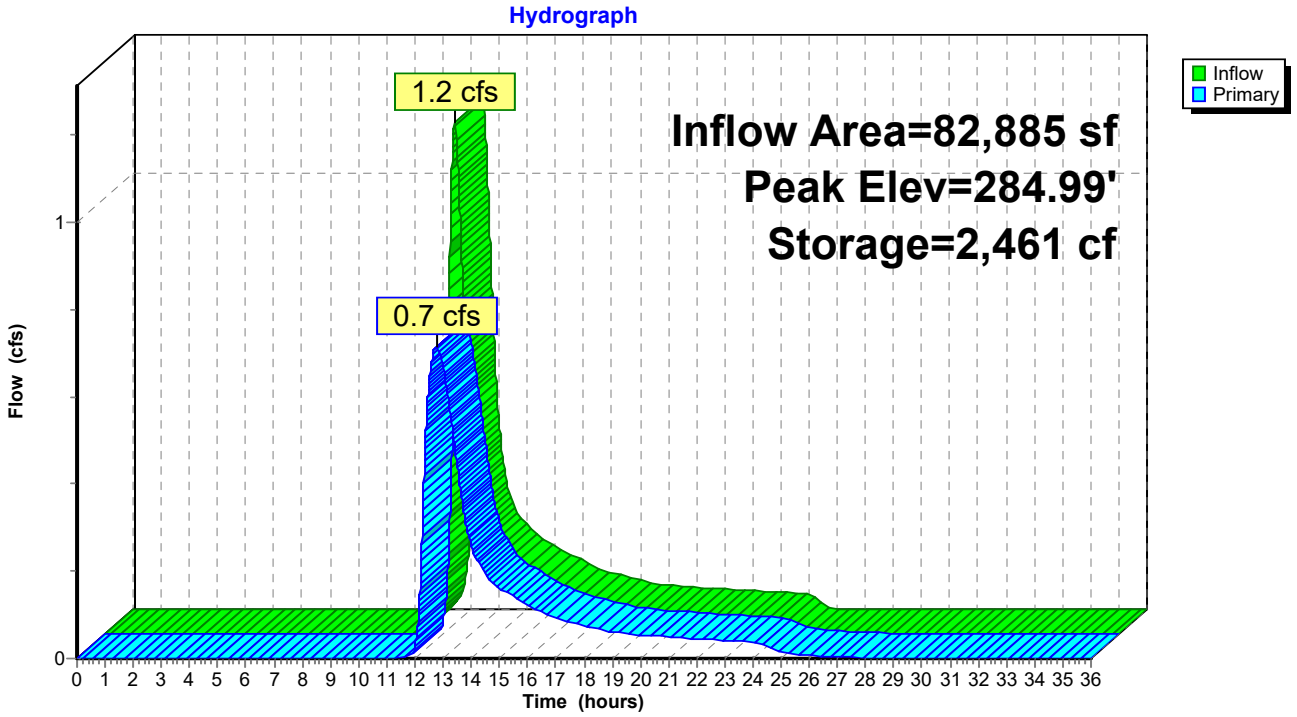
Volume	Invert	Avail.Storage	Storage Description
#1	283.00'	12,279 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.00	775	0	0
284.00	1,221	998	998
285.00	1,723	1,472	2,470
286.00	2,282	2,003	4,473
287.00	2,897	2,590	7,062
288.00	4,068	3,483	10,545
288.40	4,606	1,735	12,279

Device	Routing	Invert	Outlet Devices
#1	Primary	287.35'	**10.0' long x 11.4' 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) 2.54 2.60 2.70 2.68 2.67 2.68 2.66 2.64
#2	Primary	284.17'	**15.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 284.17' / 284.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#3	Device 2	284.17'	**6.0" Vert. Orifice** C= 0.600
#4	Device 2	285.00'	**6.0" Vert. Orifice** C= 0.600
#5	Device 2	287.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.7 cfs @ 12.75 hrs HW=284.99' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
- **2=Culvert** (Passes 0.7 cfs of 1.8 cfs potential flow)
  - **3=Orifice** (Orifice Controls 0.7 cfs @ 3.65 fps)
  - **4=Orifice** (Controls 0.0 cfs)
  - **5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)



Summary for Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)

Inflow Area = 11,367 sf, 8.80% Impervious, Inflow Depth = 1.31" for 2-Year event
Inflow = 0.3 cfs @ 12.18 hrs, Volume= 1,241 cf
Outflow = 0.2 cfs @ 12.39 hrs, Volume= 1,241 cf, Atten= 36%, Lag= 12.1 min
Discarded = 0.0 cfs @ 12.39 hrs, Volume= 519 cf
Primary = 0.2 cfs @ 12.39 hrs, Volume= 722 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 287.81' @ 12.39 hrs Surf.Area= 575 sf Storage= 256 cf

Plug-Flow detention time= 65.5 min calculated for 1,241 cf (100% of inflow)
Center-of-Mass det. time= 65.5 min (920.3 - 854.8)

Volume	Invert	Avail.Storage	Storage Description
#1	287.20'	4,318 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

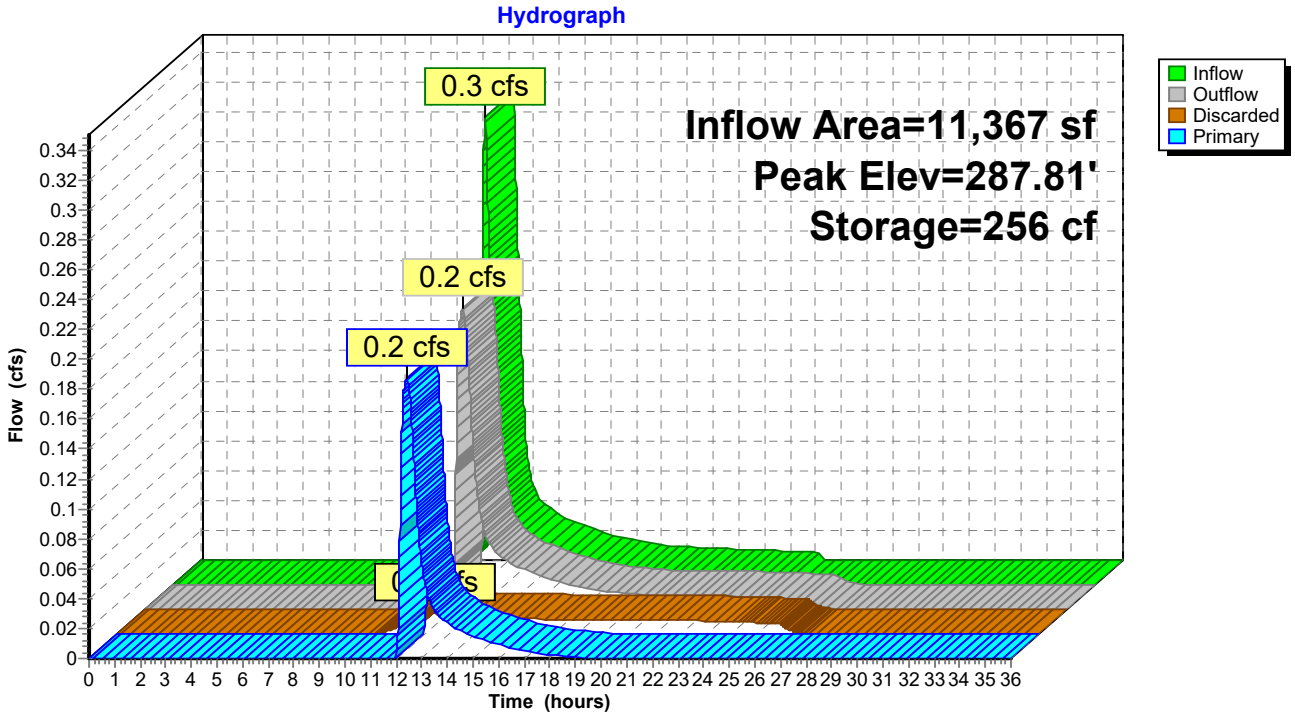
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.20	264	0	0
288.00	671	374	374
289.00	1,542	1,107	1,481
289.50	2,132	919	2,399
290.00	3,012	1,286	3,685
290.20	3,314	633	4,318

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.20'	**1.020 in/hr Exfiltration over Surface area**
#2	Primary	289.05'	**10.0' long x 11.9' 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) 2.56 2.61 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	287.28'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 287.28' / 287.13' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	287.46'	**4.1" Vert. Orifice** C= 0.600
#5	Device 3	289.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 12.39 hrs HW=287.81' (Free Discharge)
└**1=Exfiltration** (Exfiltration Controls 0.0 cfs)

Primary OutFlow Max=0.2 cfs @ 12.39 hrs HW=287.81' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.2 cfs of 0.7 cfs potential flow)
└**4=Orifice** (Orifice Controls 0.2 cfs @ 2.04 fps)
└**5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Runoff Area=7,999 sf 0.00% Impervious Runoff Depth=2.19"
Flow Length=160' Tc=14.0 min CN=73 Runoff=0.4 cfs 1,463 cf

Subcatchment P-2: Runoff Area=120,294 sf 4.98% Impervious Runoff Depth=2.28"
Flow Length=663' Tc=25.7 min CN=74 Runoff=4.4 cfs 22,824 cf

Subcatchment P-3: Runoff Area=82,885 sf 0.42% Impervious Runoff Depth=2.11"
Flow Length=680' Slope=0.0200 '/' Tc=27.0 min CN=72 Runoff=2.8 cfs 14,598 cf

Subcatchment P-4: Runoff Area=11,367 sf 8.80% Impervious Runoff Depth=2.62"
Flow Length=83' Slope=0.0200 '/' Tc=13.0 min CN=78 Runoff=0.6 cfs 2,480 cf

Subcatchment P-5: Runoff Area=78,426 sf 0.00% Impervious Runoff Depth=1.96"
Flow Length=284' Slope=0.0100 '/' Tc=23.9 min CN=70 Runoff=2.5 cfs 12,778 cf

Reach DP-10: NE PROPERTY CORNER WETLAND Inflow=6.0 cfs 38,875 cf
Outflow=6.0 cfs 38,875 cf

Reach DP-20: NW PROPERTY CORNER WETLAND Inflow=2.9 cfs 15,172 cf
Outflow=2.9 cfs 15,172 cf

Pond 1P: DRIVEWAY BASIN (POCKET Peak Elev=285.80' Storage=4,025 cf Inflow=2.8 cfs 14,598 cf
Outflow=1.8 cfs 14,588 cf

Pond 2P: COMPOUND BASIN (INFILTRATION Peak Elev=288.22' Storage=547 cf Inflow=0.6 cfs 2,480 cf
Discarded=0.0 cfs 0 cf Primary=0.3 cfs 2,394 cf Outflow=0.3 cfs 2,394 cf

Total Runoff Area = 300,971 sf Runoff Volume = 54,143 cf Average Runoff Depth = 2.16"
97.56% Pervious = 293,635 sf 2.44% Impervious = 7,336 sf

Summary for Subcatchment P-1:

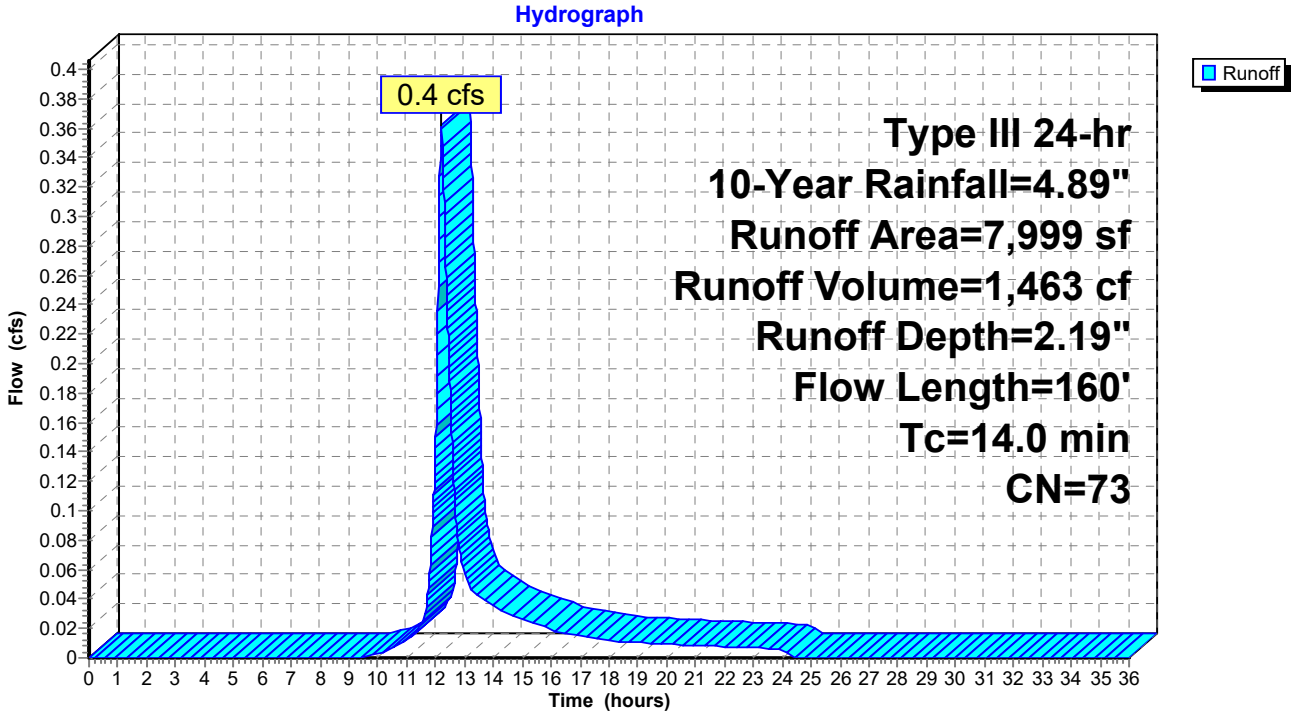
Runoff = 0.4 cfs @ 12.20 hrs, Volume= 1,463 cf, Depth= 2.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	3,984	74	>75% Grass cover, Good, HSG C
	3,688	70	Woods, Good, HSG C
*	327	89	Riprap, HSG C
	7,999	73	Weighted Average
	7,999		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0210	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
2.0	110	0.0330	0.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	160	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

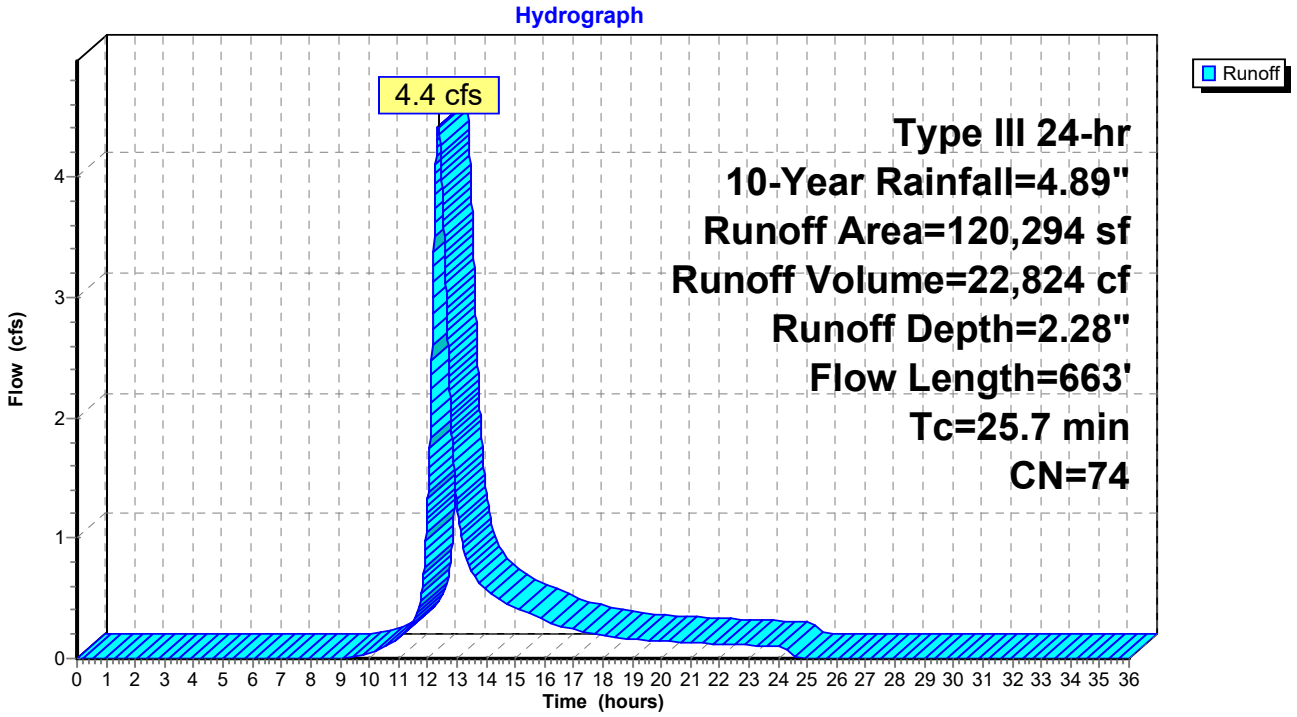
Runoff = 4.4 cfs @ 12.37 hrs, Volume= 22,824 cf, Depth= 2.28"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,836	98	Paved parking, HSG C
36,006	74	>75% Grass cover, Good, HSG C
6,592	89	Gravel roads, HSG C
71,710	70	Woods, Good, HSG C
120,294	74	Weighted Average
114,308		95.02% Pervious Area
5,986		4.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	50	0.0150	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
9.5	338	0.0140	0.59		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	77	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	168	0.0160	5.37	26.85	**Channel Flow,** Area= 5.0 sf Perim= 5.0' r= 1.00' n= 0.035 Earth, dense weeds
0.2	30	0.0100	2.74	3.36	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.025 Corrugated metal
25.7	663	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

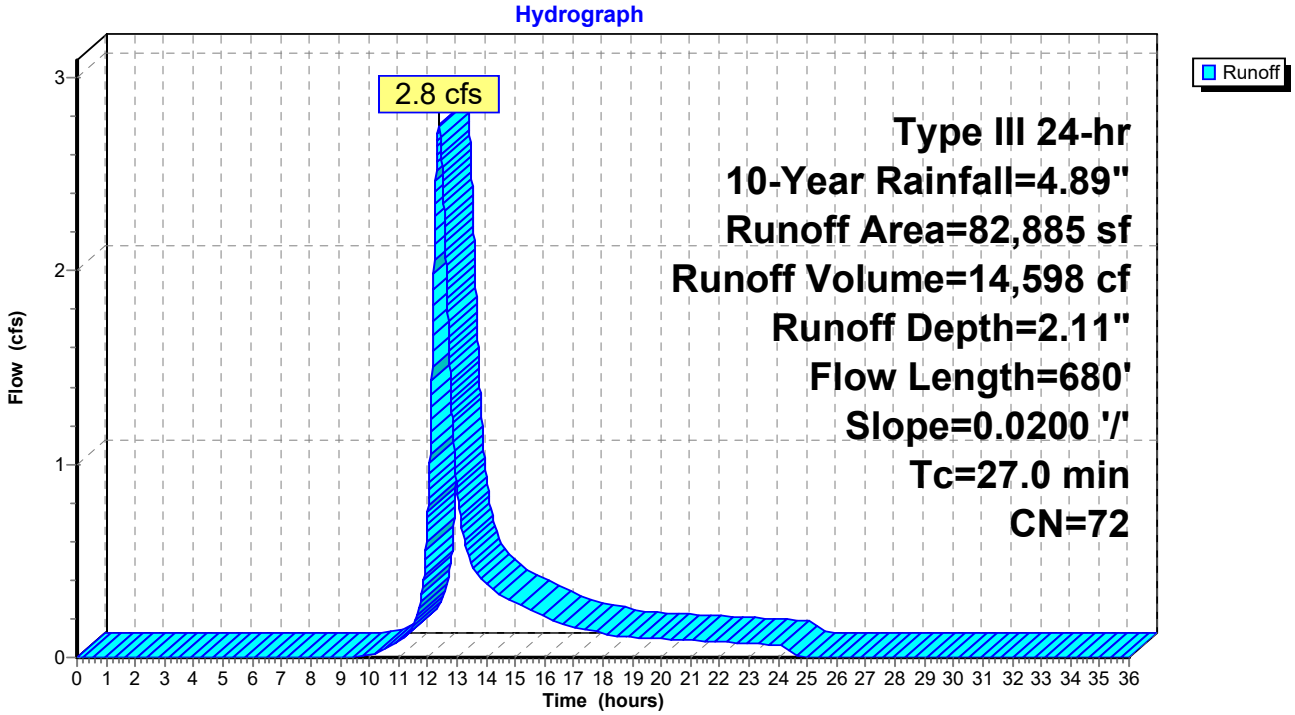
Runoff = 2.8 cfs @ 12.39 hrs, Volume= 14,598 cf, Depth= 2.11"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	350	98	Paved parking, HSG C
	10,443	74	>75% Grass cover, Good, HSG C
	5,265	89	Gravel roads, HSG C
	66,692	70	Woods, Good, HSG C
*	135	89	Riprap, HSG C
	82,885	72	Weighted Average
	82,535		99.58% Pervious Area
	350		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
14.8	630	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.0	680	Total			

Subcatchment P-3:



Summary for Subcatchment P-4:

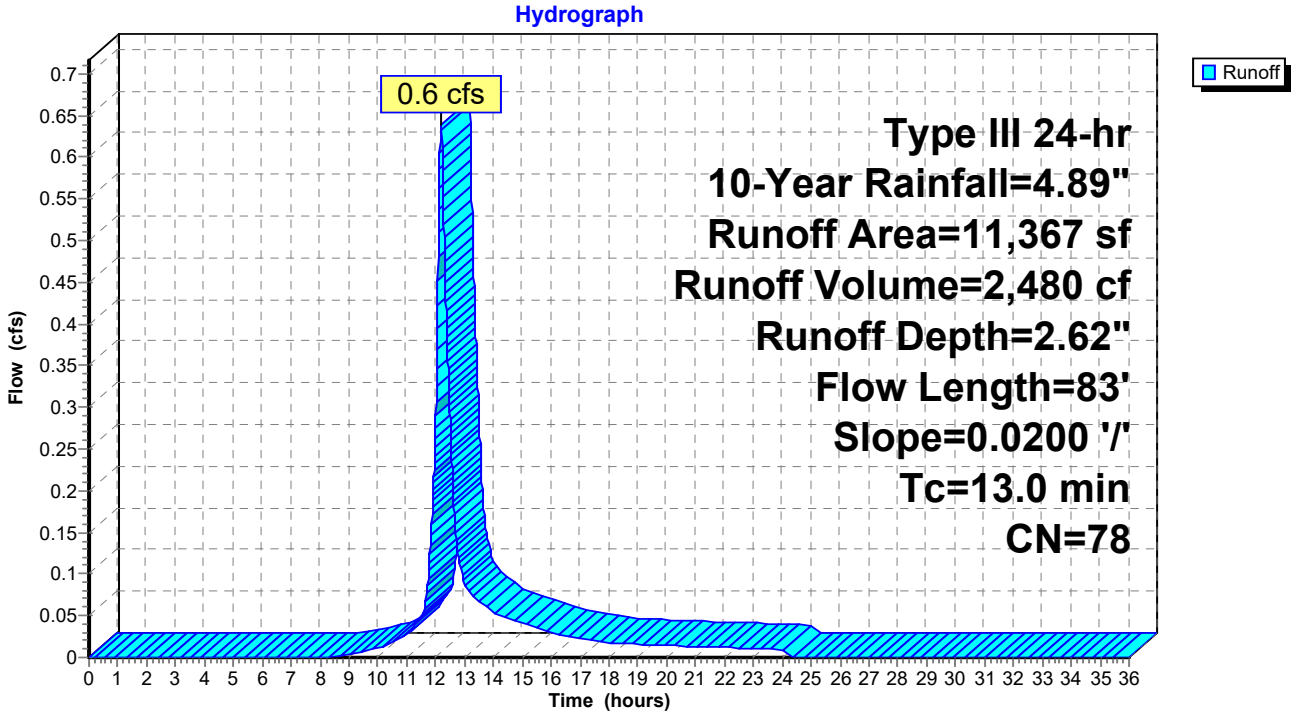
Runoff = 0.6 cfs @ 12.18 hrs, Volume= 2,480 cf, Depth= 2.62"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	1,000	98	Paved parking, HSG C
	6,403	74	>75% Grass cover, Good, HSG C
	1,663	89	Gravel roads, HSG C
	2,067	70	Woods, Good, HSG C
*	234	89	Riprap, HSG C
	11,367	78	Weighted Average
	10,367		91.20% Pervious Area
	1,000		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
0.8	33	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	83	Total			

Subcatchment P-4:



Summary for Subcatchment P-5:

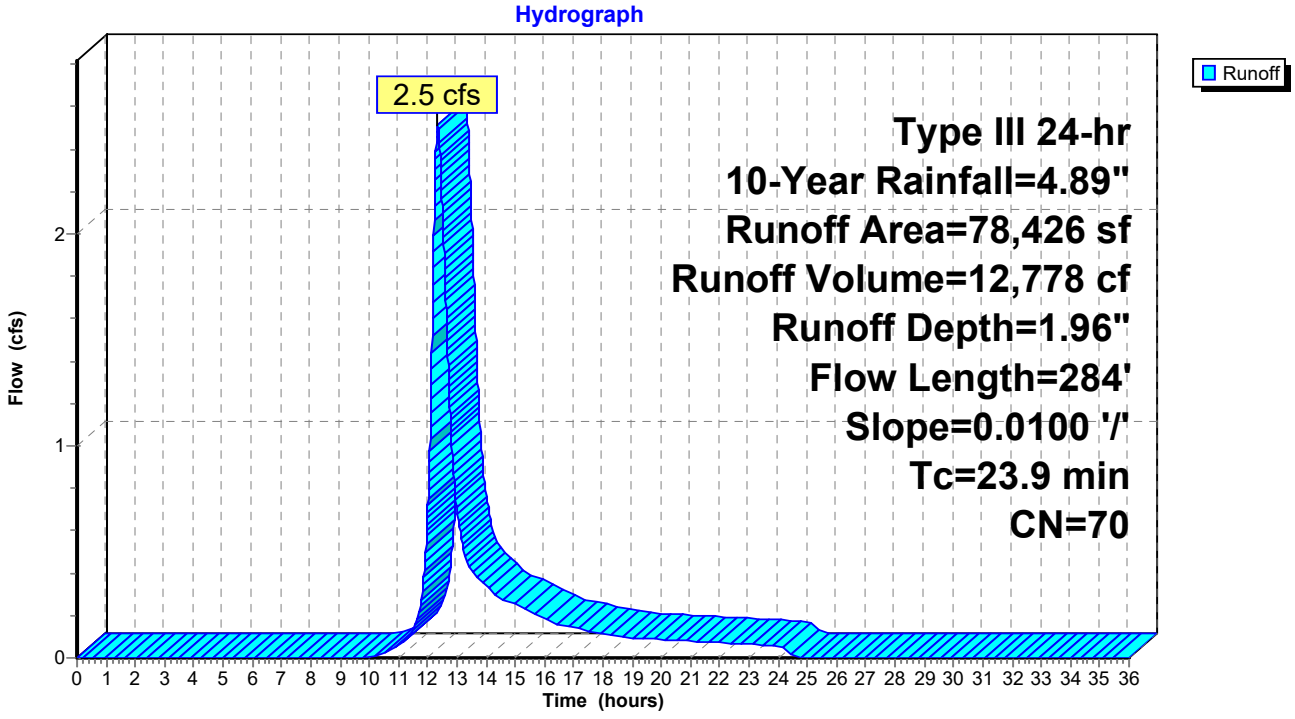
Runoff = 2.5 cfs @ 12.35 hrs, Volume= 12,778 cf, Depth= 1.96"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 10-Year Rainfall=4.89"

	Area (sf)	CN	Description
	3,774	74	>75% Grass cover, Good, HSG C
	74,541	70	Woods, Good, HSG C
*	111	89	Riprap, HSG C
	78,426	70	Weighted Average
	78,426		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
7.8	234	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.9	284	Total			

Subcatchment P-5:

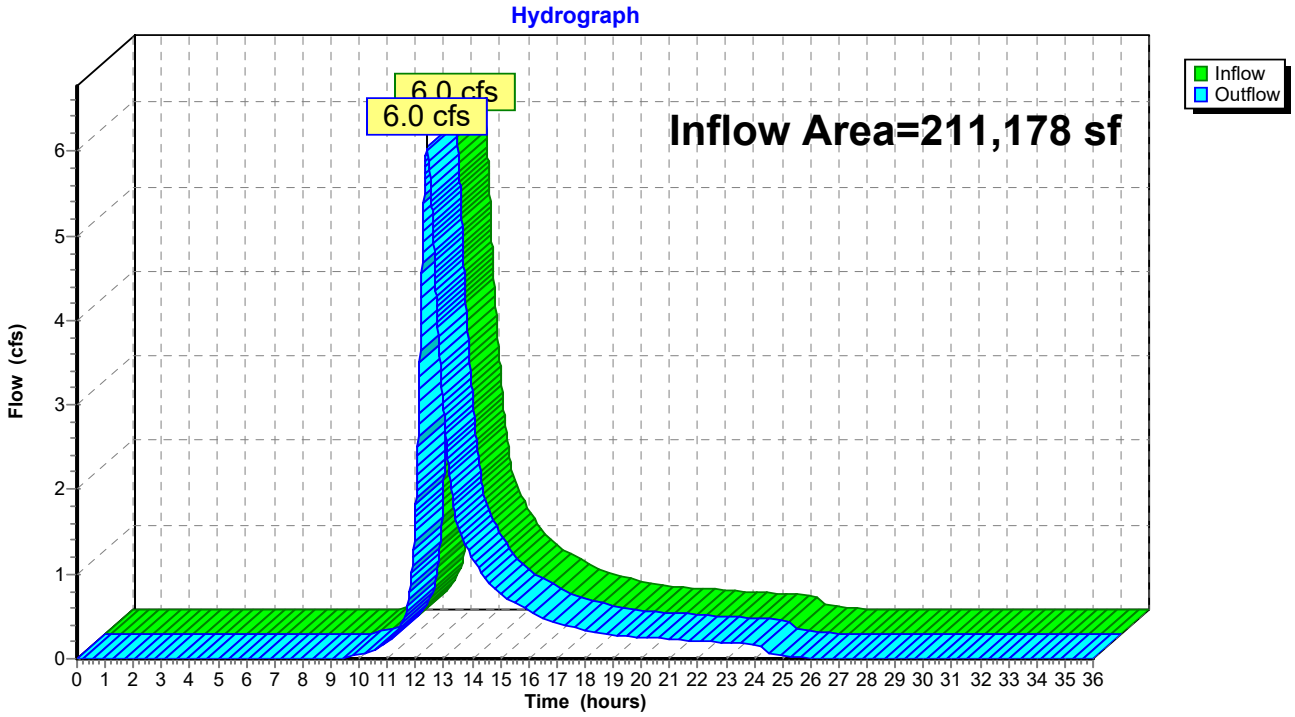


Summary for Reach DP-10: NE PROPERTY CORNER WETLAND

Inflow Area = 211,178 sf, 3.00% Impervious, Inflow Depth = 2.21" for 10-Year event
Inflow = 6.0 cfs @ 12.41 hrs, Volume= 38,875 cf
Outflow = 6.0 cfs @ 12.41 hrs, Volume= 38,875 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-10: NE PROPERTY CORNER WETLAND

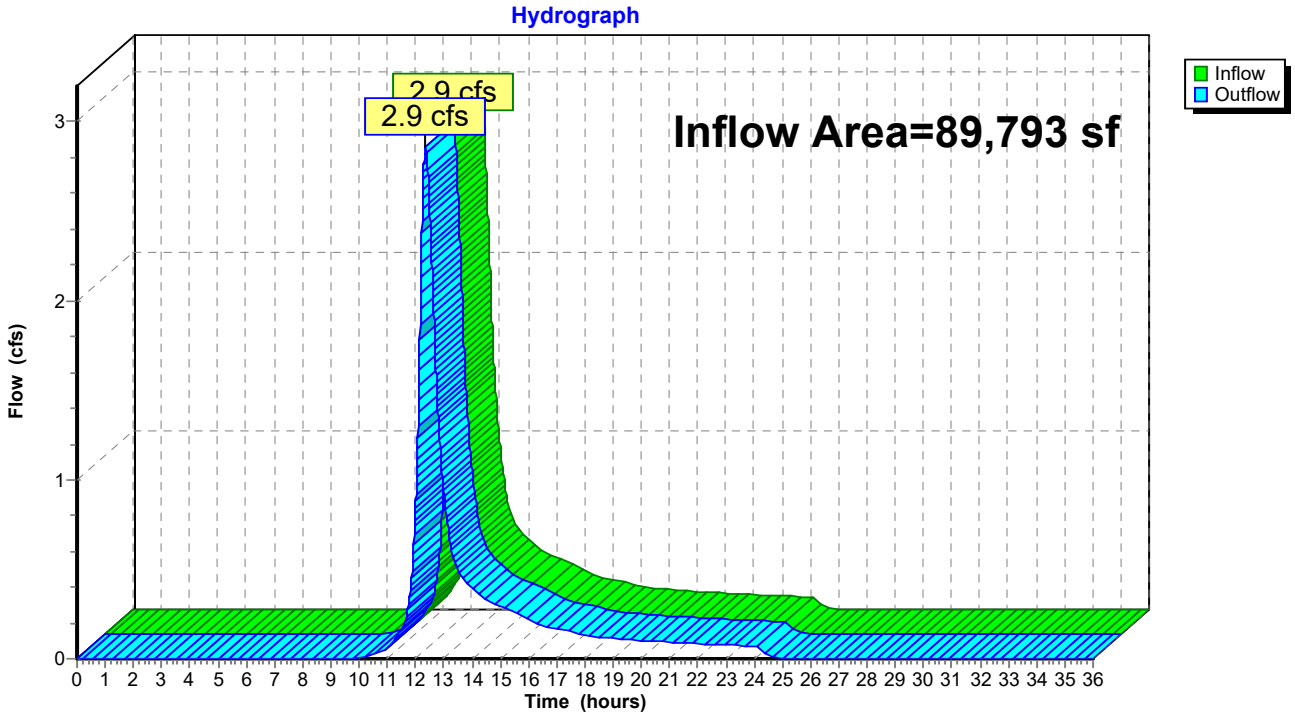


Summary for Reach DP-20: NW PROPERTY CORNER WETLAND

Inflow Area = 89,793 sf, 1.11% Impervious, Inflow Depth = 2.03" for 10-Year event
Inflow = 2.9 cfs @ 12.35 hrs, Volume= 15,172 cf
Outflow = 2.9 cfs @ 12.35 hrs, Volume= 15,172 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-20: NW PROPERTY CORNER WETLAND



Summary for Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)

Inflow Area = 82,885 sf, 0.42% Impervious, Inflow Depth = 2.11" for 10-Year event
Inflow = 2.8 cfs @ 12.39 hrs, Volume= 14,598 cf
Outflow = 1.8 cfs @ 12.68 hrs, Volume= 14,588 cf, Atten= 34%, Lag= 17.5 min
Primary = 1.8 cfs @ 12.68 hrs, Volume= 14,588 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 284.17' Surf.Area= 1,306 sf Storage= 1,213 cf
Peak Elev= 285.80' @ 12.68 hrs Surf.Area= 2,170 sf Storage= 4,025 cf (2,812 cf above start)

Plug-Flow detention time= 88.6 min calculated for 13,375 cf (92% of inflow)
Center-of-Mass det. time= 30.5 min (893.7 - 863.2)

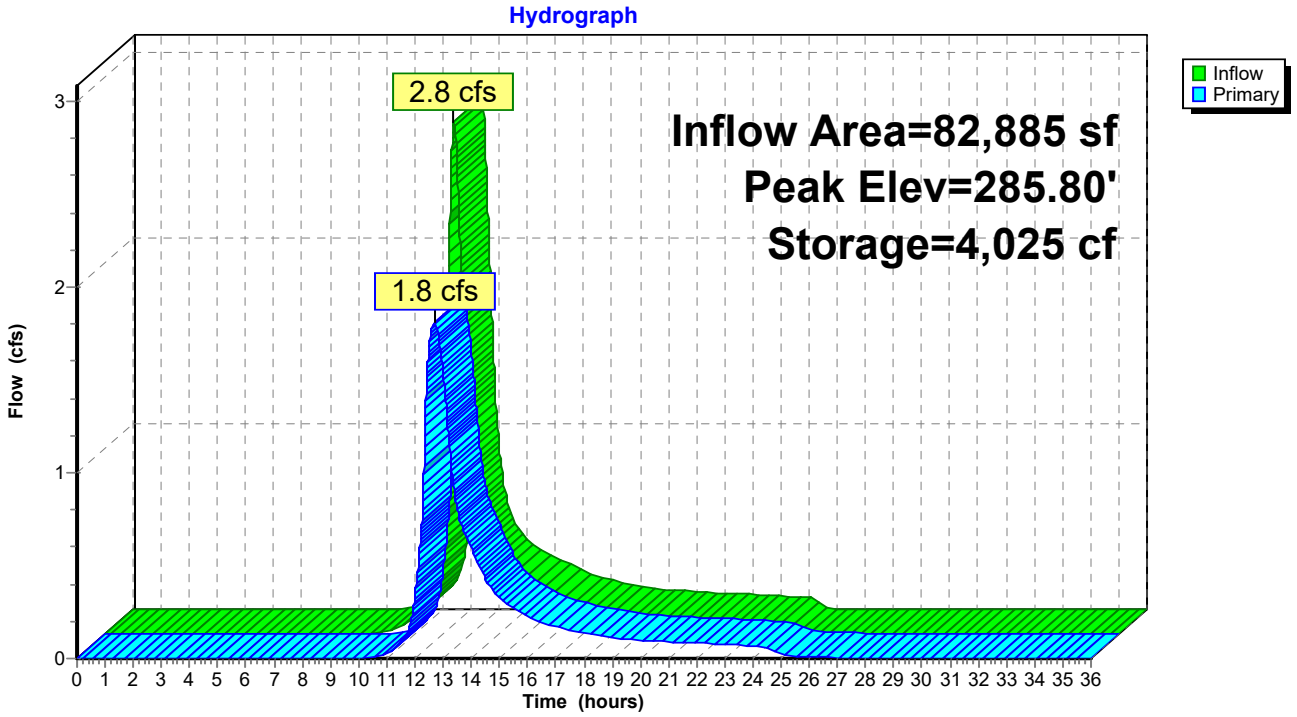
Volume	Invert	Avail.Storage	Storage Description
#1	283.00'	12,279 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.00	775	0	0
284.00	1,221	998	998
285.00	1,723	1,472	2,470
286.00	2,282	2,003	4,473
287.00	2,897	2,590	7,062
288.00	4,068	3,483	10,545
288.40	4,606	1,735	12,279

Device	Routing	Invert	Outlet Devices
#1	Primary	287.35'	**10.0' long x 11.4' 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) 2.54 2.60 2.70 2.68 2.67 2.68 2.66 2.64
#2	Primary	284.17'	**15.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 284.17' / 284.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#3	Device 2	284.17'	**6.0" Vert. Orifice** C= 0.600
#4	Device 2	285.00'	**6.0" Vert. Orifice** C= 0.600
#5	Device 2	287.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.8 cfs @ 12.68 hrs HW=285.80' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
- **2=Culvert** (Passes 1.8 cfs of 4.6 cfs potential flow)
  - **3=Orifice** (Orifice Controls 1.1 cfs @ 5.65 fps)
  - **4=Orifice** (Orifice Controls 0.7 cfs @ 3.57 fps)
  - **5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)



Summary for Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)

Inflow Area = 11,367 sf, 8.80% Impervious, Inflow Depth = 2.62" for 10-Year event
Inflow = 0.6 cfs @ 12.18 hrs, Volume= 2,480 cf
Outflow = 0.3 cfs @ 12.44 hrs, Volume= 2,394 cf, Atten= 47%, Lag= 15.4 min
Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.3 cfs @ 12.44 hrs, Volume= 2,394 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 288.22' @ 12.44 hrs Surf.Area= 866 sf Storage= 547 cf

Plug-Flow detention time= 51.0 min calculated for 2,394 cf (97% of inflow)
Center-of-Mass det. time= 31.3 min (865.9 - 834.6)

Volume	Invert	Avail.Storage	Storage Description
#1	287.20'	4,318 cf	**Custom Stage Data (Prismatic)** Listed below (Recalc)

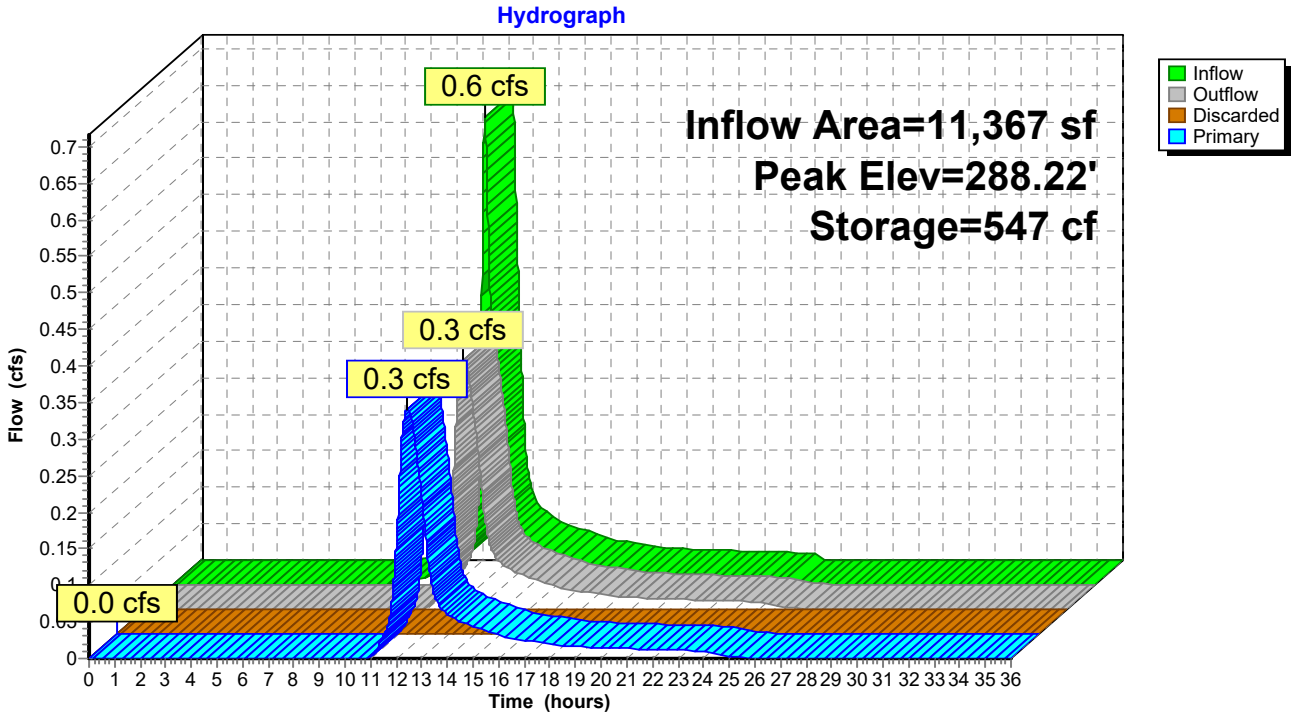
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.20	264	0	0
288.00	671	374	374
289.00	1,542	1,107	1,481
289.50	2,132	919	2,399
290.00	3,012	1,286	3,685
290.20	3,314	633	4,318

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.20'	**1.020 in/hr Exfiltration X 0.00 over Surface area**
#2	Primary	289.05'	**10.0' long x 11.9' 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) 2.56 2.61 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	287.28'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 287.28' / 287.13' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	287.46'	**4.1" Vert. Orifice** C= 0.600
#5	Device 3	289.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=287.20' (Free Discharge)
└**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.3 cfs @ 12.44 hrs HW=288.22' (Free Discharge)
└**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.3 cfs of 1.8 cfs potential flow)
└**4=Orifice** (Orifice Controls 0.3 cfs @ 3.71 fps)
└**5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)



Time span=0.00-36.00 hrs, dt=0.01 hrs, 3601 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment P-1: Runoff Area=7,999 sf 0.00% Impervious Runoff Depth=5.53"
Flow Length=160' Tc=14.0 min CN=73 Runoff=0.9 cfs 3,689 cf

Subcatchment P-2: Runoff Area=120,294 sf 4.98% Impervious Runoff Depth=5.66"
Flow Length=663' Tc=25.7 min CN=74 Runoff=11.1 cfs 56,699 cf

Subcatchment P-3: Runoff Area=82,885 sf 0.42% Impervious Runoff Depth=5.41"
Flow Length=680' Slope=0.0200 '/' Tc=27.0 min CN=72 Runoff=7.1 cfs 37,381 cf

Subcatchment P-4: Runoff Area=11,367 sf 8.80% Impervious Runoff Depth=6.14"
Flow Length=83' Slope=0.0200 '/' Tc=13.0 min CN=78 Runoff=1.5 cfs 5,820 cf

Subcatchment P-5: Runoff Area=78,426 sf 0.00% Impervious Runoff Depth=5.17"
Flow Length=284' Slope=0.0100 '/' Tc=23.9 min CN=70 Runoff=6.8 cfs 33,775 cf

Reach DP-10: NE PROPERTY CORNER WETLAND Inflow=16.0 cfs 97,759 cf
Outflow=16.0 cfs 97,759 cf

Reach DP-20: NW PROPERTY CORNER WETLAND Inflow=7.3 cfs 39,509 cf
Outflow=7.3 cfs 39,509 cf

Pond 1P: DRIVEWAY BASIN (POCKET Peak Elev=287.33' Storage=8,093 cf Inflow=7.1 cfs 37,381 cf
Outflow=6.1 cfs 37,370 cf

Pond 2P: COMPOUND BASIN (INFILTRATION Peak Elev=289.05' Storage=1,552 cf Inflow=1.5 cfs 5,820 cf
Discarded=0.0 cfs 0 cf Primary=0.5 cfs 5,734 cf Outflow=0.5 cfs 5,734 cf

Total Runoff Area = 300,971 sf Runoff Volume = 137,364 cf Average Runoff Depth = 5.48"
97.56% Pervious = 293,635 sf 2.44% Impervious = 7,336 sf

Summary for Subcatchment P-1:

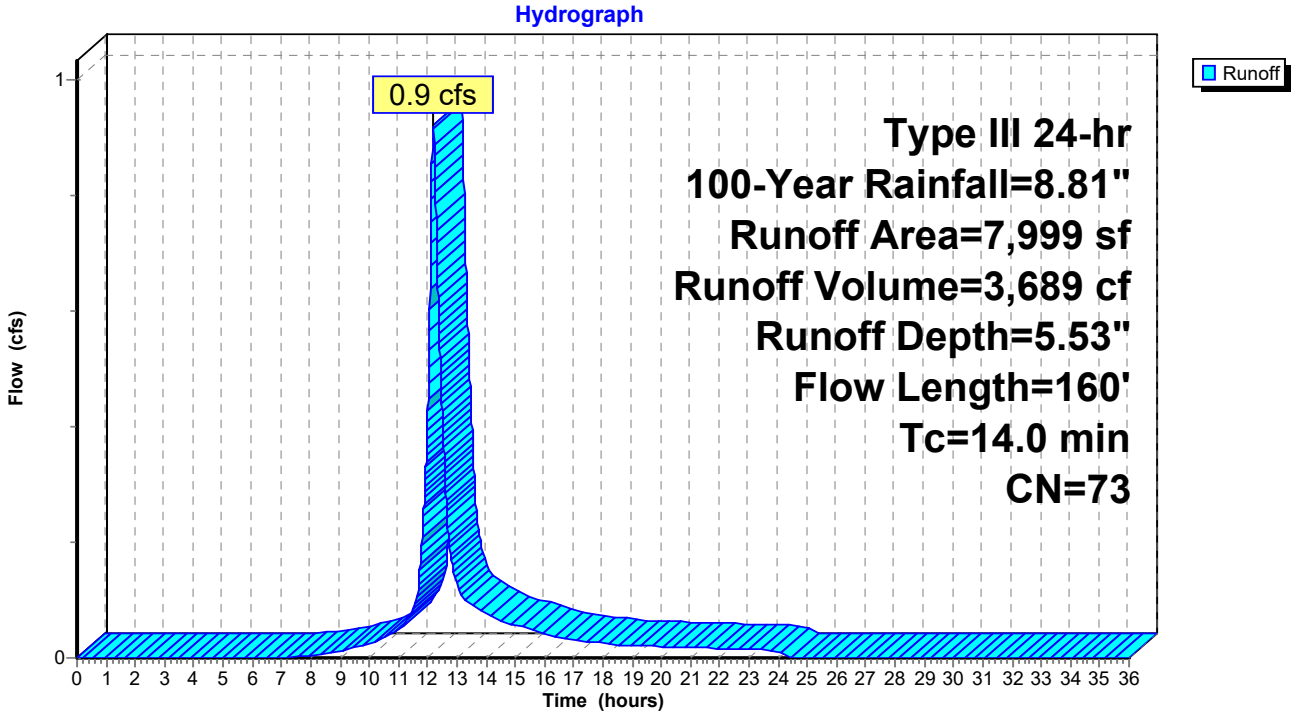
Runoff = 0.9 cfs @ 12.19 hrs, Volume= 3,689 cf, Depth= 5.53"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	3,984	74	>75% Grass cover, Good, HSG C
	3,688	70	Woods, Good, HSG C
*	327	89	Riprap, HSG C
	7,999	73	Weighted Average
	7,999		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.0	50	0.0210	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
2.0	110	0.0330	0.91		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
14.0	160	Total			

Subcatchment P-1:



Summary for Subcatchment P-2:

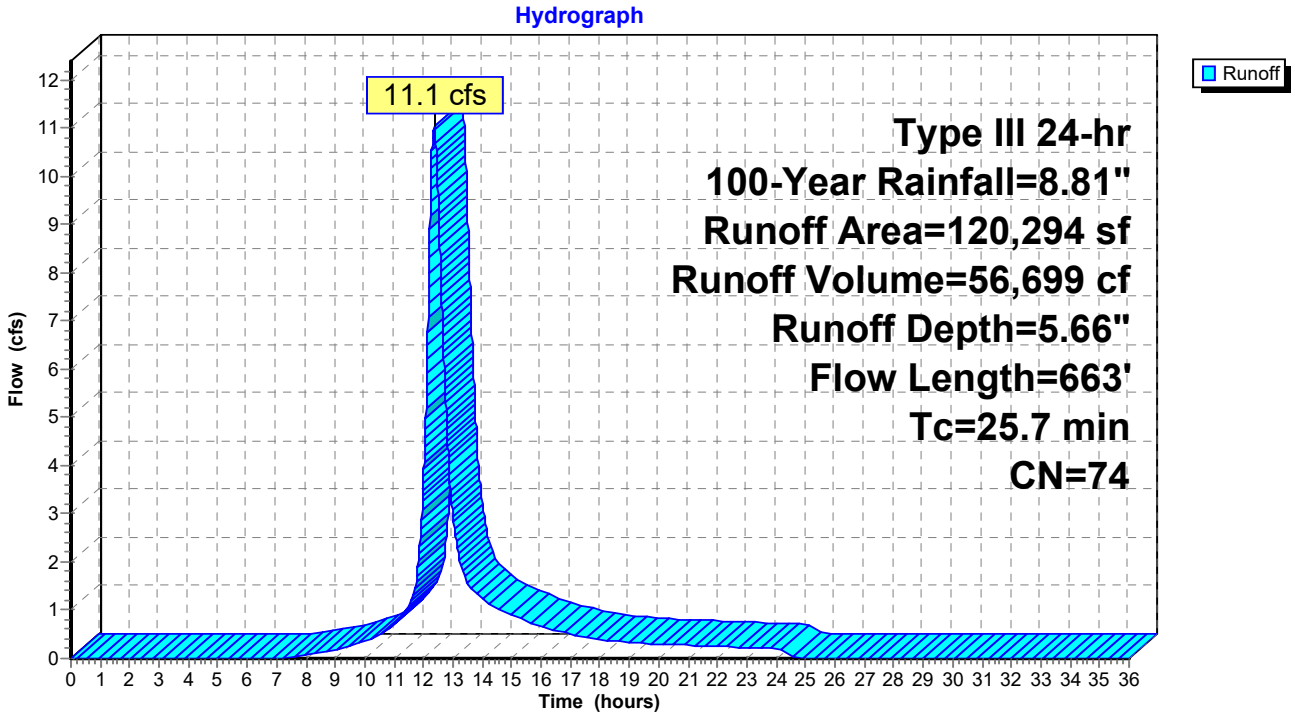
Runoff = 11.1 cfs @ 12.36 hrs, Volume= 56,699 cf, Depth= 5.66"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

Area (sf)	CN	Description
3,150	98	Roofs, HSG C
2,836	98	Paved parking, HSG C
36,006	74	>75% Grass cover, Good, HSG C
6,592	89	Gravel roads, HSG C
71,710	70	Woods, Good, HSG C
120,294	74	Weighted Average
114,308		95.02% Pervious Area
5,986		4.98% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.7	50	0.0150	0.06		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
9.5	338	0.0140	0.59		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
1.8	77	0.0100	0.70		**Shallow Concentrated Flow,** Short Grass Pasture Kv= 7.0 fps
0.5	168	0.0160	5.37	26.85	**Channel Flow,** Area= 5.0 sf Perim= 5.0' r= 1.00' n= 0.035 Earth, dense weeds
0.2	30	0.0100	2.74	3.36	**Pipe Channel,** 15.0" Round Area= 1.2 sf Perim= 3.9' r= 0.31' n= 0.025 Corrugated metal
25.7	663	Total			

Subcatchment P-2:



Summary for Subcatchment P-3:

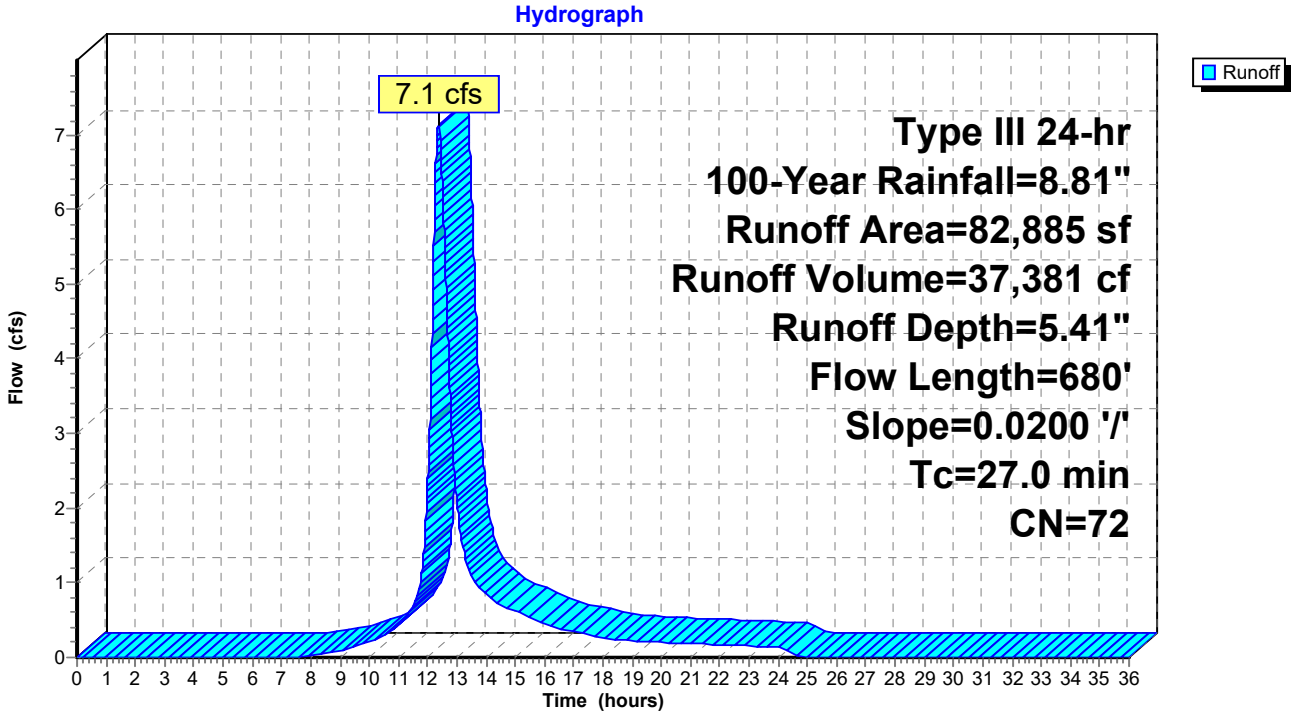
Runoff = 7.1 cfs @ 12.38 hrs, Volume= 37,381 cf, Depth= 5.41"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	350	98	Paved parking, HSG C
	10,443	74	>75% Grass cover, Good, HSG C
	5,265	89	Gravel roads, HSG C
	66,692	70	Woods, Good, HSG C
*	135	89	Riprap, HSG C
	82,885	72	Weighted Average
	82,535		99.58% Pervious Area
	350		0.42% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
14.8	630	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
27.0	680	Total			

Subcatchment P-3:



Summary for Subcatchment P-4:

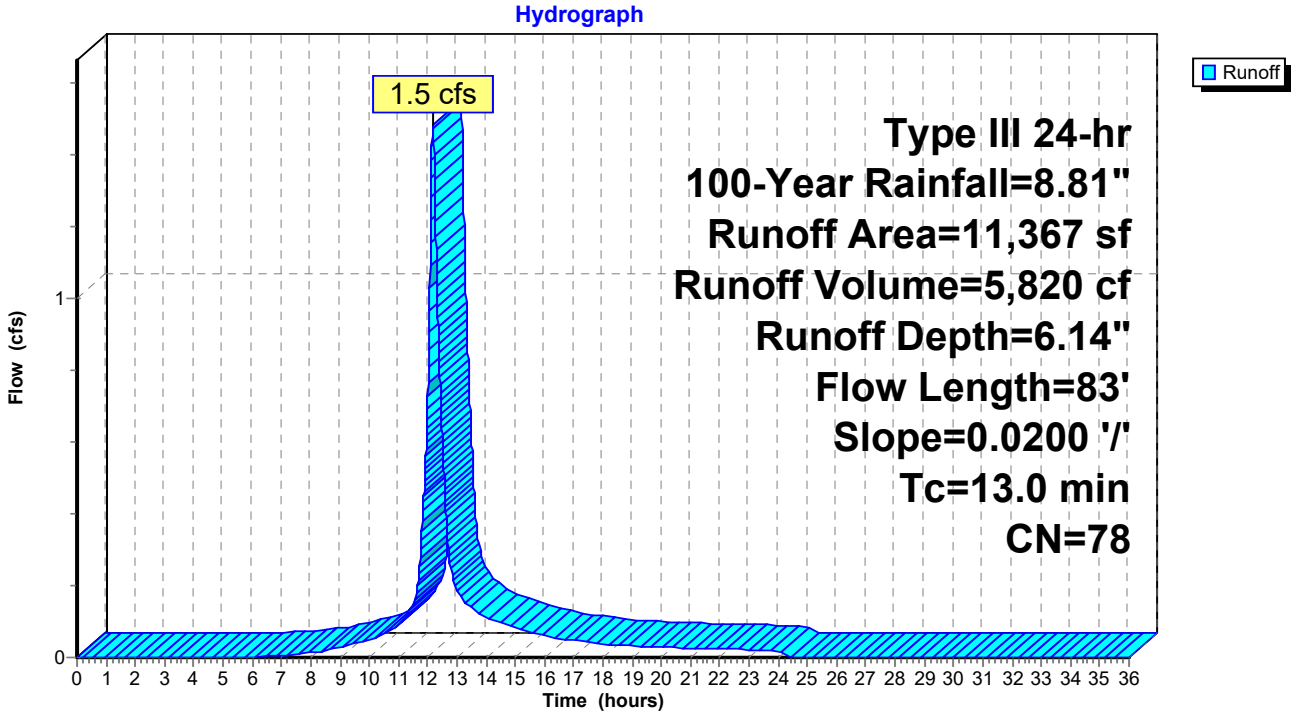
Runoff = 1.5 cfs @ 12.18 hrs, Volume= 5,820 cf, Depth= 6.14"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	1,000	98	Paved parking, HSG C
	6,403	74	>75% Grass cover, Good, HSG C
	1,663	89	Gravel roads, HSG C
	2,067	70	Woods, Good, HSG C
*	234	89	Riprap, HSG C
	11,367	78	Weighted Average
	10,367		91.20% Pervious Area
	1,000		8.80% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
12.2	50	0.0200	0.07		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
0.8	33	0.0200	0.71		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
13.0	83	Total			

Subcatchment P-4:



Summary for Subcatchment P-5:

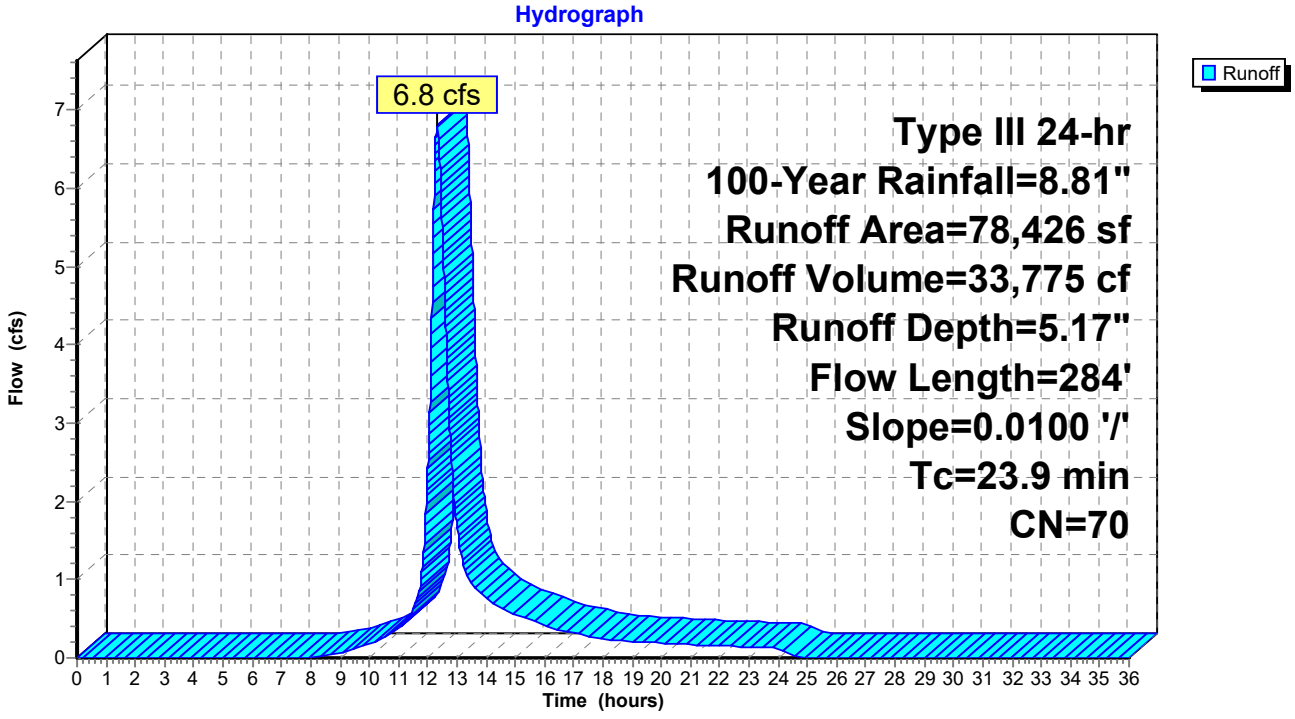
Runoff = 6.8 cfs @ 12.33 hrs, Volume= 33,775 cf, Depth= 5.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Type III 24-hr 100-Year Rainfall=8.81"

	Area (sf)	CN	Description
	3,774	74	>75% Grass cover, Good, HSG C
	74,541	70	Woods, Good, HSG C
*	111	89	Riprap, HSG C
	78,426	70	Weighted Average
	78,426		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.1	50	0.0100	0.05		**Sheet Flow,** Woods: Light underbrush n= 0.400 P2= 3.25"
7.8	234	0.0100	0.50		**Shallow Concentrated Flow,** Woodland Kv= 5.0 fps
23.9	284	Total			

Subcatchment P-5:

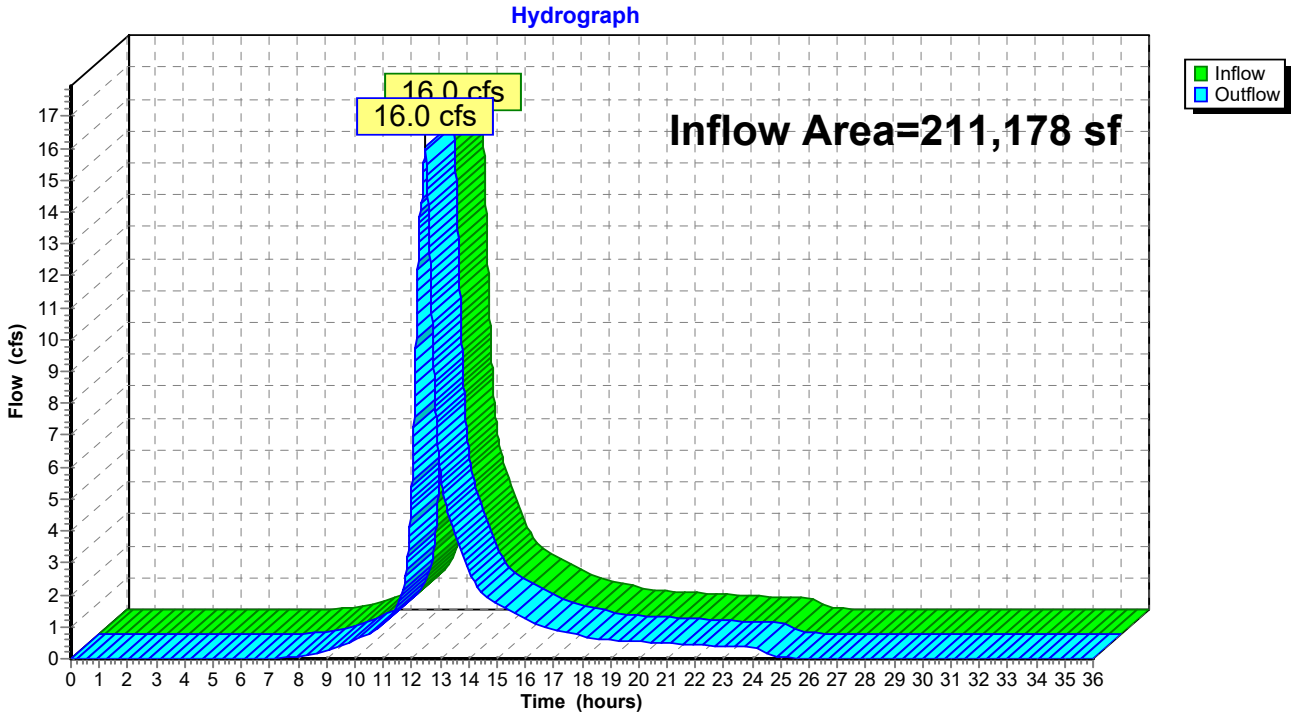


Summary for Reach DP-10: NE PROPERTY CORNER WETLAND

Inflow Area = 211,178 sf, 3.00% Impervious, Inflow Depth = 5.56" for 100-Year event
Inflow = 16.0 cfs @ 12.47 hrs, Volume= 97,759 cf
Outflow = 16.0 cfs @ 12.47 hrs, Volume= 97,759 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-10: NE PROPERTY CORNER WETLAND

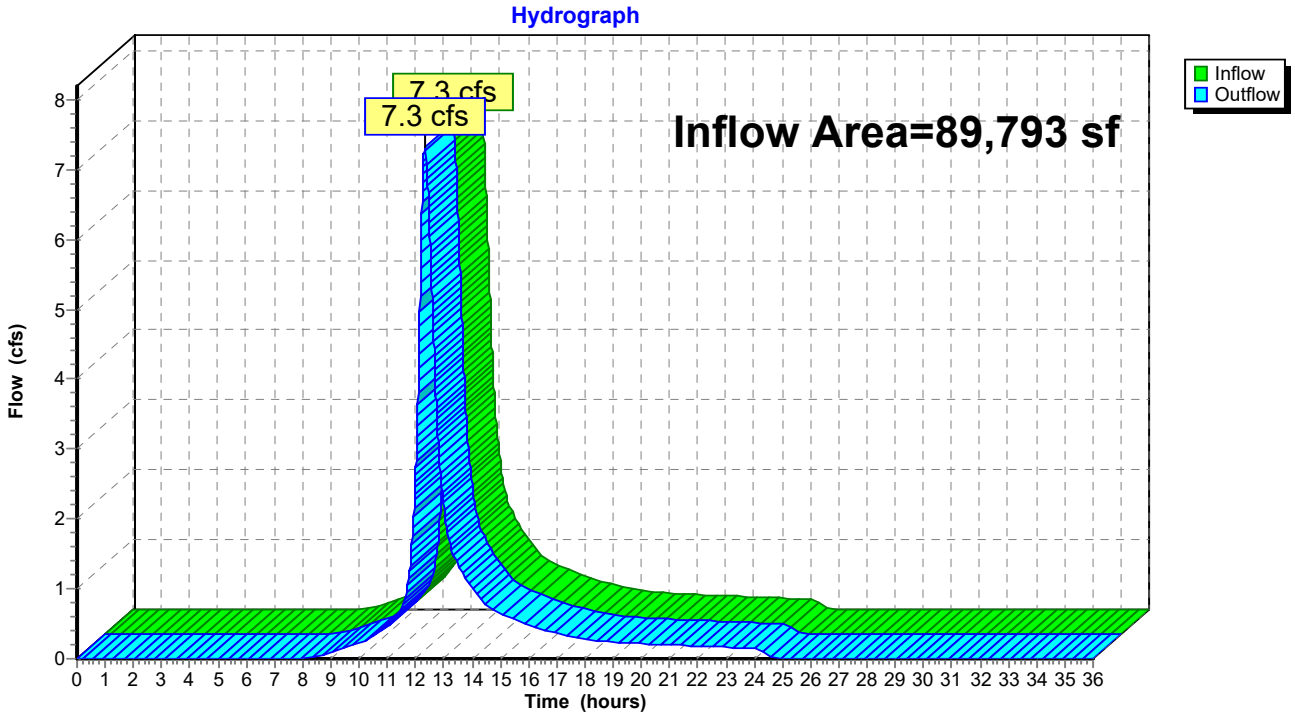


Summary for Reach DP-20: NW PROPERTY CORNER WETLAND

Inflow Area = 89,793 sf, 1.11% Impervious, Inflow Depth = 5.28" for 100-Year event
Inflow = 7.3 cfs @ 12.34 hrs, Volume= 39,509 cf
Outflow = 7.3 cfs @ 12.34 hrs, Volume= 39,509 cf, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs

Reach DP-20: NW PROPERTY CORNER WETLAND



Summary for Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)

Inflow Area = 82,885 sf, 0.42% Impervious, Inflow Depth = 5.41" for 100-Year event
Inflow = 7.1 cfs @ 12.38 hrs, Volume= 37,381 cf
Outflow = 6.1 cfs @ 12.53 hrs, Volume= 37,370 cf, Atten= 15%, Lag= 9.0 min
Primary = 6.1 cfs @ 12.53 hrs, Volume= 37,370 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Starting Elev= 284.17' Surf.Area= 1,306 sf Storage= 1,213 cf
Peak Elev= 287.33' @ 12.53 hrs Surf.Area= 3,288 sf Storage= 8,093 cf (6,880 cf above start)

Plug-Flow detention time= 55.8 min calculated for 36,157 cf (97% of inflow)
Center-of-Mass det. time= 28.2 min (864.2 - 836.0)

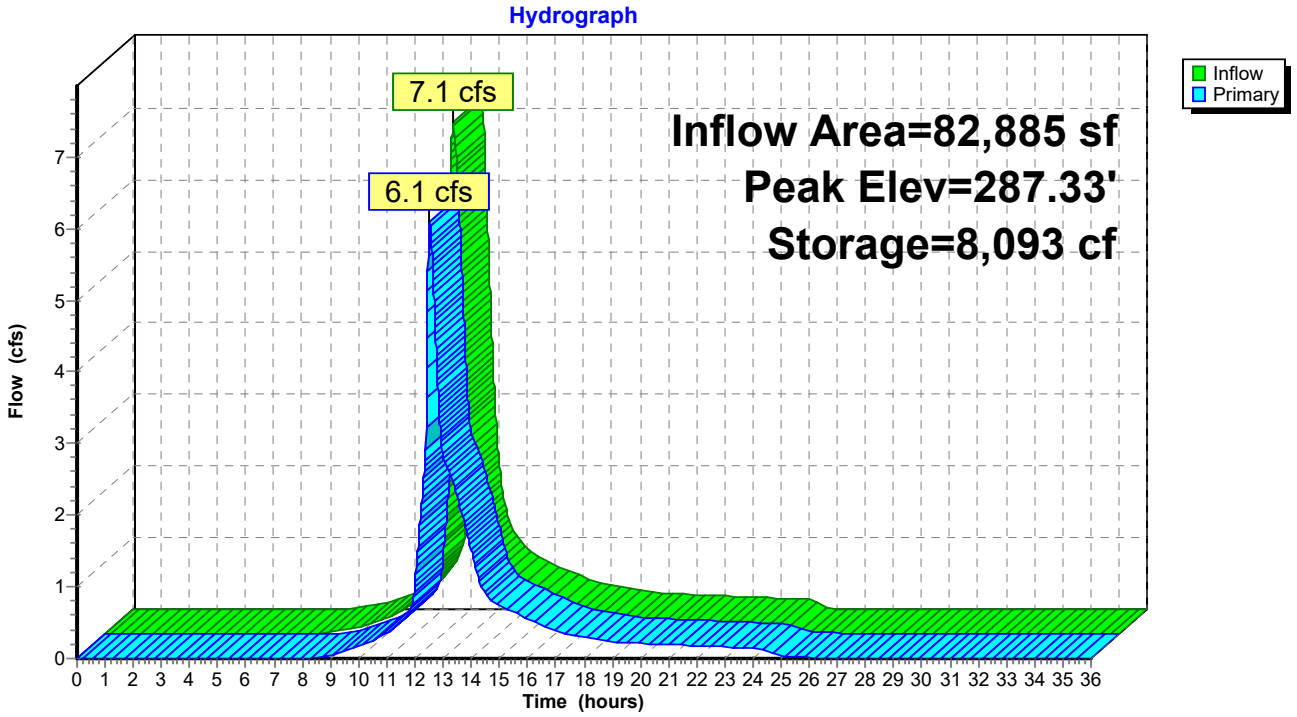
Volume	Invert	Avail.Storage	Storage Description
#1	283.00'	12,279 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
283.00	775	0	0
284.00	1,221	998	998
285.00	1,723	1,472	2,470
286.00	2,282	2,003	4,473
287.00	2,897	2,590	7,062
288.00	4,068	3,483	10,545
288.40	4,606	1,735	12,279

Device	Routing	Invert	Outlet Devices
#1	Primary	287.35'	**10.0' long x 11.4' 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) 2.54 2.60 2.70 2.68 2.67 2.68 2.66 2.64
#2	Primary	284.17'	**15.0" Round Culvert** L= 34.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 284.17' / 284.00' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 1.23 sf
#3	Device 2	284.17'	**6.0" Vert. Orifice** C= 0.600
#4	Device 2	285.00'	**6.0" Vert. Orifice** C= 0.600
#5	Device 2	287.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=6.1 cfs @ 12.53 hrs HW=287.33' (Free Discharge)
- **1=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
- **2=Culvert** (Passes 6.1 cfs of 7.4 cfs potential flow)
  - **3=Orifice** (Orifice Controls 1.6 cfs @ 8.22 fps)
  - **4=Orifice** (Orifice Controls 1.4 cfs @ 6.95 fps)
  - **5=Orifice w/Trash Rack** (Weir Controls 3.1 cfs @ 1.74 fps)

Pond 1P: DRIVEWAY BASIN (POCKET WETLAND)



Summary for Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)

Inflow Area = 11,367 sf, 8.80% Impervious, Inflow Depth = 6.14" for 100-Year event
Inflow = 1.5 cfs @ 12.18 hrs, Volume= 5,820 cf
Outflow = 0.5 cfs @ 12.55 hrs, Volume= 5,734 cf, Atten= 65%, Lag= 22.4 min
Discarded = 0.0 cfs @ 0.00 hrs, Volume= 0 cf
Primary = 0.5 cfs @ 12.55 hrs, Volume= 5,734 cf

Routing by Stor-Ind method, Time Span= 0.00-36.00 hrs, dt= 0.01 hrs
Peak Elev= 289.05' @ 12.55 hrs Surf.Area= 1,596 sf Storage= 1,552 cf

Plug-Flow detention time= 42.9 min calculated for 5,734 cf (99% of inflow)
Center-of-Mass det. time= 33.8 min (844.1 - 810.3)

Volume	Invert	Avail.Storage	Storage Description
#1	287.20'	4,318 cf	**Custom Stage Data (Prismatic)**Listed below (Recalc)

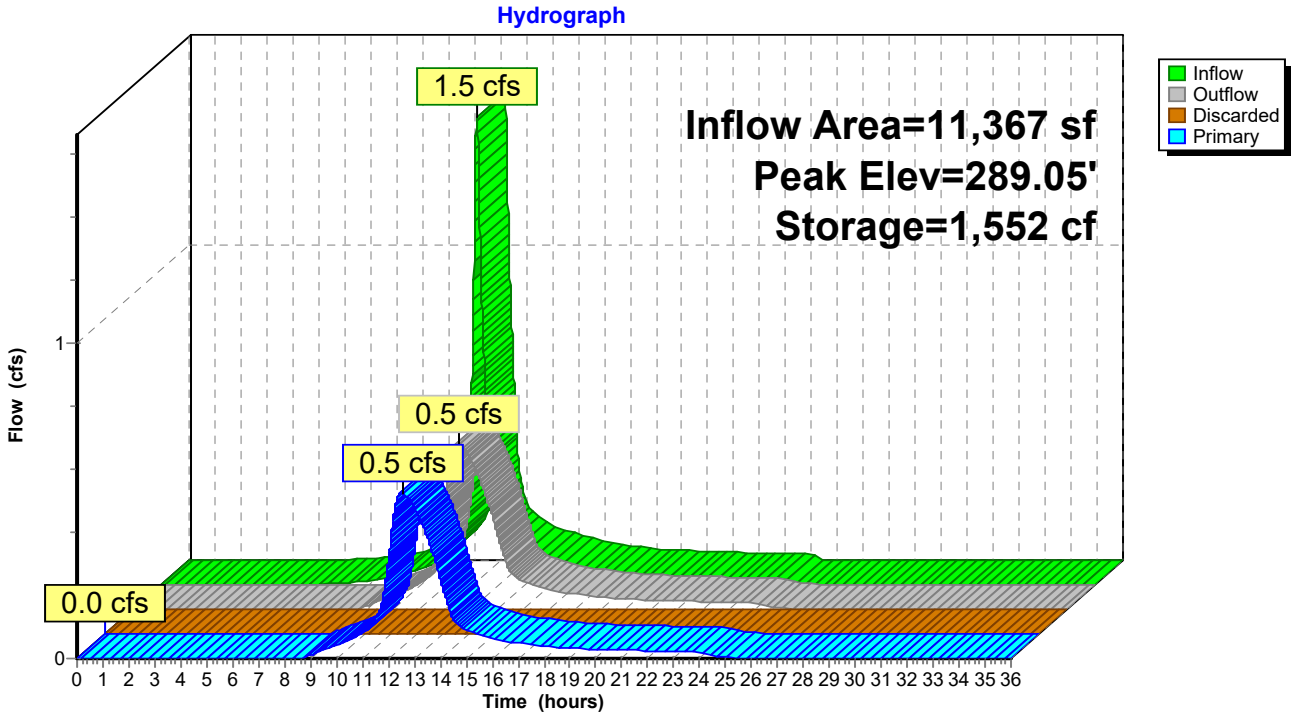
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
287.20	264	0	0
288.00	671	374	374
289.00	1,542	1,107	1,481
289.50	2,132	919	2,399
290.00	3,012	1,286	3,685
290.20	3,314	633	4,318

Device	Routing	Invert	Outlet Devices
#1	Discarded	287.20'	**1.020 in/hr Exfiltration X 0.00 over Surface area**
#2	Primary	289.05'	**10.0' long x 11.9' 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) 2.56 2.61 2.70 2.67 2.66 2.67 2.66 2.64
#3	Primary	287.28'	**12.0" Round Culvert** L= 30.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 287.28' / 287.13' S= 0.0050 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#4	Device 3	287.46'	**4.1" Vert. Orifice** C= 0.600
#5	Device 3	289.05'	**24.0" Horiz. Orifice w/Trash Rack** C= 0.600 Limited to weir flow at low heads

Discarded OutFlow Max=0.0 cfs @ 0.00 hrs HW=287.20' (Free Discharge)
└**1=Exfiltration** (Controls 0.0 cfs)

Primary OutFlow Max=0.5 cfs @ 12.55 hrs HW=289.05' (Free Discharge)
├**2=Broad-Crested Rectangular Weir** (Controls 0.0 cfs)
└**3=Culvert** (Passes 0.5 cfs of 3.4 cfs potential flow)
  ├**4=Orifice** (Orifice Controls 0.5 cfs @ 5.73 fps)
  └**5=Orifice w/Trash Rack** (Controls 0.0 cfs)

Pond 2P: COMPOUND BASIN (INFILTRATION BASIN)



Driveway Culvert (Sta. 0+38) Outlet Riprap Apron Design

Apron Length

$$L_a = \frac{1.8 * Q}{D_o * 1.5} + 7 * D_o$$

Q_{10} =	4.4	CFS
D_o =	1.25	FT
TW =	0.25	FT
L_a =	13	FT

Apron Width

$$W_{\text{outlet end of apron}} = 3 * D_o + L_a$$

$W_{\text{outlet end of apron}}$ =	17	FT

$$W_{\text{culvert end of apron}} = 3 * D_o$$

$W_{\text{culvert end of apron}}$ =	4	FT

Riprap Diameter

$$D_{50} = \frac{0.02 * Q^{1.5}}{TW * D_o}$$

D_{50} =	0.44	FT	
D_{50} =	5	IN	**USE D_{50} = 8" min.**

Driveway Basin (Pocket Wetland [1P]) Outlet Riprap Apron Design

Apron Length

$$L_a = \frac{1.8 * Q}{D_o * 1.5} + 7 * D_o$$

Q_{100} =	6.1	CFS
D_o =	1.25	FT
TW =	0.25	FT
L_a =	15	FT

Apron Width

$$W_{\text{outlet end of apron}} = 3 * D_o + L_a$$

$W_{\text{outlet end of apron}}$ =	19	FT

$$W_{\text{culvert end of apron}} = 3 * D_o$$

$W_{\text{culvert end of apron}}$ =	4	FT

Riprap Diameter

$$D_{50} = \frac{0.02 * Q^{1.3}}{TW * D_o}$$

D_{50} =	0.67	FT	
D_{50} =	8	IN	**USE D_{50} = 8" min.**

Construction Sequence & Schedule
Long Term O&M Costs

ProTerra
DESIGN GROUP, LLC

CONSTRUCTION SEQUENCE & SCHEDULE

The phasing of construction for the tower compound and gravel access driveway shall generally follow the following sequence; however, items may be completed concurrently depending on their location.

- Construction of temporary construction exit point
    - Installation of stabilized construction entrance
- Installation of temporary erosion and sediment control measures along the perimeter of the site (i.e., inlet protection, straw wattle, etc.)
- Establishment of schedules for good housekeeping BMPs
- Clearing and grubbing of vegetation within limits of work
- Rough grading of access driveway & drainage facilities
- Installation of driveway culverts
- Installation of utilities to tower compound
- Backfill operations for utility trenches
- Installation of driveway subbase and trap rock surface
    - Driveway shall be stabilized within 72 hours of achieving finished grade
- Excavation/Fill tower foundation
- Installation of tower foundation
- Backfill operations for tower foundation
- Construction of tower above ground
- Installation of perimeter compound fence
- Over-lot grading & final drainage facility grading (i.e., stone channels, stone diaphragm)
- Final grading
    - Cut/fill slopes shall be seeded/loamed within 72 hours of achieving finished grade
- Re-vegetation in disturbed areas for final stabilization
- Remove temporary BMPs that are no longer required

EROSION & SEDIMENT CONTROL PHASING

The phasing of erosion and sediment control during construction for the tower compound and gravel access driveway shall generally follow the following sequence.

- Pre-Disturbance/Site Preparation
    - Install stabilized construction entrance
    - Install perimeter BMPs (i.e., straw wattle, inlet protection, etc.)
    - Install slope interceptor BMPs (i.e., straw wattle, coir log, etc.)
    - Prepare stabilized staging area including concrete washout pit
    - Limit access to areas that are not to be disturbed
- Construction
    - Locate stockpiles in work areas with perimeter controls
    - Leave disturbed area of site in a surface roughened condition when feasible
    - Close excavations as soon as possible
    - Protect and repair BMPs, as necessary
    - Perform street sweeping, as needed

- Backfill and Compacting
    - Remove temporary BMPs where appropriate
    - Remove limited stored materials and equipment from the site
- Final Stabilization
    - Install seed/mulch
    - Install erosion control blanket, hydro-seeding with tackifier, or riprap stabilization as required by conditions
    - Remove all non-biodegradable temporary BMPs when applicable

ProTerra
DESIGN GROUP, LLC

LONG-TERM ESTIMATED ANNUAL INSPECTION, OPERATION, AND MAINTENANCE BUDGET

BMP	Frequency	Unit Cost	Subtotal
Vegetated Swales	2 visits per year	$300	$600
Culvert Outlet Energy Dissipaters / Plunge Pools	1 visit per year	$800	$800
Forested Vegetated Filter Strips	1 visit per year	$300	$300
Constructed Pocket Wetland	2 visits per year	$350	$700
Infiltration Basin	2 visits per year	$350	$700
		Total:	$3100

The annual maintenance cost does not include the owner's regular maintenance of the grounds that would consist of mowing & debris pickup.

Mounding Analysis

This spreadsheet will calculate the height of a groundwater mound beneath a stormwater infiltration basin. More information can be found in the U.S. Geological Survey Scientific Investigations Report 2010-5102 "Simulation of groundwater mounding beneath hypothetical stormwater infiltration basins".

The user must specify infiltration rate (R), specific yield (Sy), horizontal hydraulic conductivity (Kh), basin dimensions (x, y), duration of infiltration period (t), and the initial thickness of the saturated zone (hi(0), height of the water table if the bottom of the aquifer is the datum). For a square basin the half width equals the half length (x = y). For a rectangular basin, if the user wants the water-table changes perpendicular to the long side, specify x as the short dimension and y as the long dimension. Conversely, if the user wants the values perpendicular to the short side, specify y as the short dimension, x as the long dimension. All distances are from the center of the basin. Users can change the distances from the center of the basin at which water-table aquifer thickness are calculated.
Cells highlighted in yellow are values that can be changed by the user. Cells highlighted in red are output values based on user-specified inputs. The user MUST click the blue "Re-Calculate Now" button each time ANY of the user-specified inputs are changed otherwise necessary iterations to converge on the correct solution will not be done and values shown will be incorrect. Use consistent units for all input values (for example, feet and days)

use consistent units (e.g. feet & days **or** inches & hours)

Conversion Table

inch/hour	feet/day
0.67	1.33
2.00	4.00

hours	days
36	1.50

In the report accompanying this spreadsheet (USGS SIR 2010-5102), vertical soil permeability (ft/d) is assumed to be one-tenth horizontal hydraulic conductivity (ft/d).

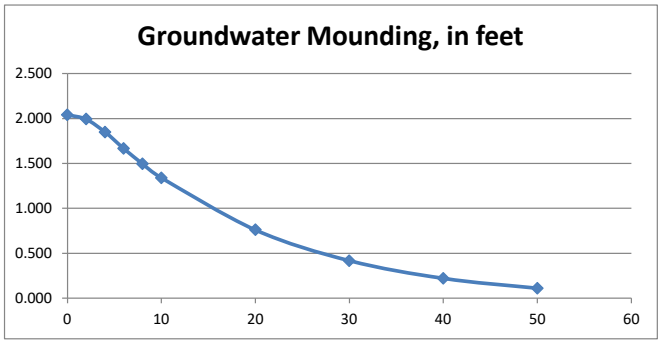
Input Values

2.4470	***R***	**Recharge (infiltration) rate (feet/day)**
0.150	**Sy**	**Specific yield, Sy (dimensionless, between 0 and 1)**
3.00	**K**	**Horizontal hydraulic conductivity, Kh (feet/day)***
4.000	**x**	**1/2 length of basin (x direction, in feet)**
17.375	**y**	**1/2 width of basin (y direction, in feet)**
1.000	**t**	**duration of infiltration period (days)**
26.500	**hi(0)**	**initial thickness of saturated zone (feet)**

28.541	**h(max)**	**maximum thickness of saturated zone (beneath center of basin at end of infiltration period)**
2.041	**Δh(max)**	**maximum groundwater mounding (beneath center of basin at end of infiltration period)**

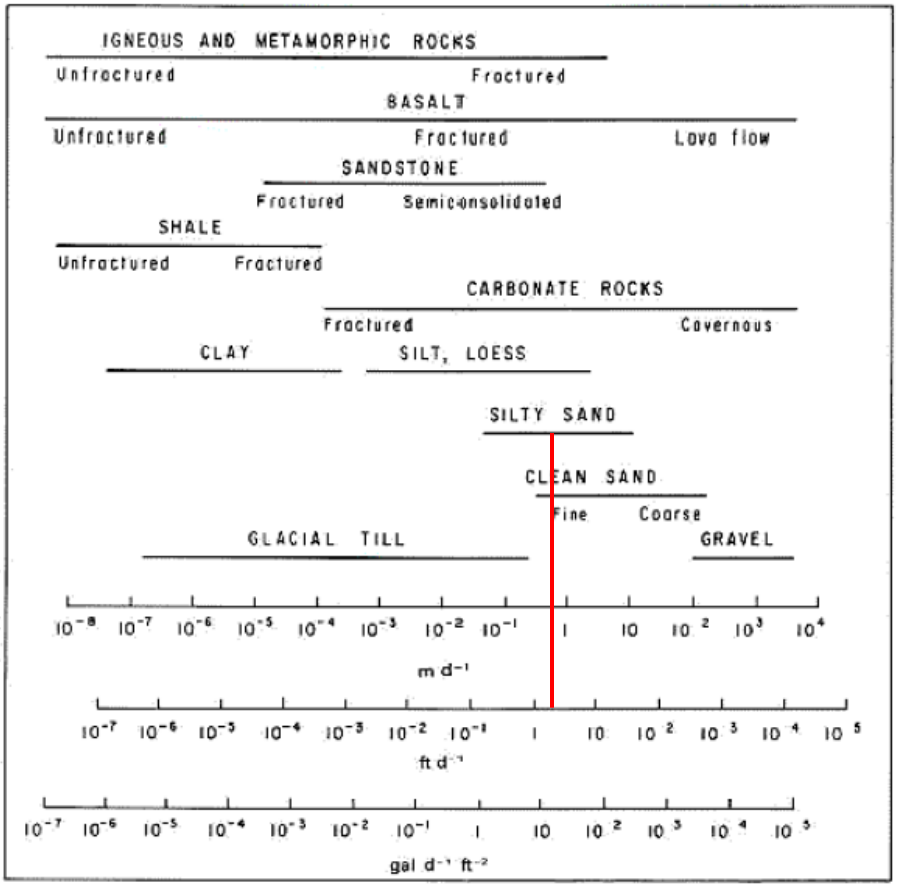
Ground-water Mounding, in feet	Distance from center of basin in x direction, in feet
2.041	0
1.993	2
1.849	4
1.665	6
1.495	8
1.340	10
0.760	20
0.417	30
0.220	40
0.111	50

Re-Calculate Now



Disclaimer

This spreadsheet solving the Hantush (1967) equation for ground-water mounding beneath an infiltration basin is made available to the general public as a convenience for those wishing to replicate values documented in the USGS Scientific Investigations Report 2010-5102 "Groundwater mounding beneath hypothetical stormwater infiltration basins" or to calculate values based on user-specified site conditions. Any changes made to the spreadsheet (other than values identified as user-specified) after transmission from the USGS could have unintended, undesirable consequences. These consequences could include, but may not be limited to: erroneous output, numerical instabilities, and violations of underlying assumptions that are inherent in results presented in the accompanying USGS published report. The USGS assumes no responsibility for the consequences of any changes made to the spreadsheet. If changes are made to the spreadsheet, the user is responsible for documenting the changes and justifying the results and conclusions.



Hydraulic conductivity of selected consolidated and unconsolidated geologic materials from Heath, R.C., 1983. Basic ground-water hydrology, U.S. Geological Survey Water-Supply Paper 2220, 86p.