On-Site Engineering INC.
Civil & Environmental Engineering
Registered in CT, RI & MA

April 25, 2022

Mr. Jason Parker
Principle Planner
Town of South Kingstown
180 High Street
South Kingstown, Rhode Island 02879

RE: Drainage Calculations, Minor Subdivision Application
Applicant: Lee G. Hemmerle, Trust
AP 74, Parcel 7
350 Ministerial Road, South Kingstown, RI

Dear Mr. Parker:

Per requirements of the Preliminary Checklist for a Minor Subdivision On-Site Engineering, Inc. (OSE) has conducted drainage calculations to support a new residential house lot located at 350 Ministerial Road in South Kingstown. The existing lot is approximately 7.9 acres and contains an existing single-family dwelling located approximately 300 feet westerly from Ministerial Road. This minor subdivision application will involve the creation of two lots. Lot 1 will be 2.97 acres and contain the existing house and paved access driveway. Lot 2 will measure 4.92 acres and will be located at the rear of the Subject Parcel. In order to access Lot 2, an 850-foot-long driveway consisting of both gravel and bituminous pavement will be constructed along the southerly boundary line. Grassed swales are also proposed along north and south sides of the driveway

The BMP's were designed per requirements of the *State of Rhode Island Stormwater Management Guidance for Individual Single-Family Residential Lot Development.* The following are the narrative and design calculations for the stormwater BMP's.

Watershed Description

The Subject Property is divided into three watersheds. The limits of DA-1 is approximately 3.63 acres and follows an existing ridge line located approximately 680 feet from Ministerial Road and discharges to a natural low point. DA-1 contains the existing residential house and paved driveway. DA-2 is approximately 2.85 acres and also follows an existing ridge line located just east of the westerly property line. DA-2

discharges to the south off site. DA-3 is approximately 0.56 acres and discharges to a natural low point at the southeast corner of the Subject Parcel. DA-1 is a developed residential lot while DA-2 and DA-3 is heavily wooded with slopes ranging from 5-35%. The surrounding land use consists of developed residential lots, undeveloped wooded areas and roadways.

Table 1 summarizes the pre-development watershed characteristics as well as the runoff generated for the 2, 10, 25 and 100 year storm events.

Table 1: Summary of Input Parameters – Existing Conditions

SubArea	Area (acres)	CN	Tc (Min.)
DA-1	3.63	34	20
DA-2	2.85	30	41
DA-3	0.56	34	18

Table 2: Summary of HydroCadd Output Results, Total Offsite – Existing Conditions

	DA-1		DA-2/DA-3-Total Offsite	
Storm Event	Peak Flow (cfs)	Total Volume (ac-ft.)	Peak Flow (cfs)	Total Volume (ac-ft.)
2	---	---	---	---
10	0.02	0.015	---	---
25	0.12	0.069	0.04	0.030
100	1.39	0.268	0.44	0.170

Attachment 1 contains the HydroCadd input parameters as well as the output results for the existing conditions.

Soils and Landuse

The Subject Property contains Gloucester-Hinckley (GhD and GhC) soils. GhD and GhC soils are excessively drained to somewhat excessively drained soils located on hills and ridges. Typically, Gloucester/Hinckley soils have a surface layer of dark brown gravelly sandy loam about 2-inches thick. The subsoil is approximately 20-inches thick and consists of a brownish yellow to light yellowish gravelly sandy loam. The substratum is light brownish gray very gravelly loamy sand to a depth of 60-inches and greater. The permeability of GhD and ChC soils is rapid in the surface and subsoil and very rapid in the substratum with engineering properties of 6-20 inches per hour.

Water Quality

The BMP's were designed to treat the runoff generated from the proposed impervious areas. The proposed driveway will discharge to grassed swales with check dams and the roof area for the proposed house will be directed towards underground infiltration practices for water quality treatment.

The drainage calculations were conducted with the driveway as an impervious surface. The driveway is within DA-2A and DA-2B with a total area of 10,200 s.f (0.23 acres)

Water Quality Calculations

The impervious area associated with the proposed roofed area is 3,240 s.f. and will be collected and allowed to infiltrate into four UIC's consisting of a 5'x12' stone trench, 36-inches deep. The proposed driveway will be graded in a manner as to direct runoff into grassed swales along the edges of the driveway. The swales will have stone check dams to allow infiltration and reduce the velocity within the channel. The swales measure 1 foot deep, 1 foot wide with 3:1 side slopes. Based upon an impervious area of 10,200, the minimum surface area of the bio-retention swale is 245 s.f. Based upon a wetted perimeter of 2.2 feet and the total length of the swale of 850 feet, the area of the swale is 1,870 s.f. which is much greater than 245 s.f. that is required. Attachment 2 contains the both the stormwater and water quality calculations for the grassed swales.

Conveyance and Natural Channel Protection

Due to the proposed driveway, the drainage areas for the developed conditions were divided into four drainage areas. DA-1 remains the same as the existing conditions, which contains the existing single family dwelling. The contributing drainage area is 2.43 acres, which is less than the 3.63 acres for the existing conditions. Again, this is due to the proposed driveway redirecting runoff from DA-1 to DA-2A. DA-2A contributes area to the swale located on the north side of the driveway. DA-2B follows the same ridge along the westerly property line and contributes to the swale located on the south side of the driveway. Both DA-2A and DA-2B ultimately discharges to the southeasterly corner of the Subject Parcel. DA-2C contributes off-site at the southwesterly corner of the Subject Parcel. Table 3 summarizes the input parameters for the developed conditions.

Table 3: Summary of Input Parameters – Developed Conditions

SubArea	Area (acres)	CN	Tc (Min.)
DA-1	2.43	35	18
DA-2A	1.20	37	50
DA-2B	0.60	41	38
DA-2C	0.93	32	18

The drainage calculations were conducted to illustrate that there is no increase in runoff from the 100-year storm event for the proposed single family residential lot. The pre-development 100-year discharge for DA-2/DA-3 was calculated as 0.44 cfs, while the post development 100-year discharge for DA-2A/DA-2B was calculated as 0.43 cfs. The BMP's that were implemented to control the peak runoff was bioretention swales with check dams and directing the runoff to an infiltration area located at the beginning of the driveway. The check dams within the grassed swales allow infiltration, slow the velocities to an acceptable value to prevent erosion and increase the overall time of concentration by "daming" the runoff behind the stone structures. Supporting drainage calculations are attached with this report. The infiltration area located at the beginning of the driveway provides both surface storage as well as underground storage. The subsurface storage/infiltration system consists of (4) 4'x4' concrete galleys with 12-inches of stone on the bottom and sides. For the extreme storm events an emergency spillway was incorporated into the design. Table 4 illustrates that the post development discharge for the 100-year storm event is 0.43 cfs, which is equivalent to the pre-development conditions. The runoff generated for the 2, 10 and 25-year storm events all are contained within the infiltration area.

Table 4: Summary of HydroCadd Output Results, Total Offsite – Existing Conditions

	DA-1		DA-2A/DA-2B-Total Offsite	
Storm Event	**Peak Flow (cfs)**	**Total Volume (ac-ft.)**	**Peak Flow (cfs)**	**Total Volume (ac-ft.)**
2	---	---	---	---
10	0.03	0.019	---	---
25	0.16	0.072	---	---
100	1.47	0.260	0.43	0.018

Attachment 3 contains the HydroCadd input parameters as well as the output results for the developed conditions and Attachment 4 contains the pre and post development drainage maps.

Thank you for your consideration and assistance in this matter. Should you have any questions or need additional information please feel free to call me at 401-348-6831.

Sincerely,

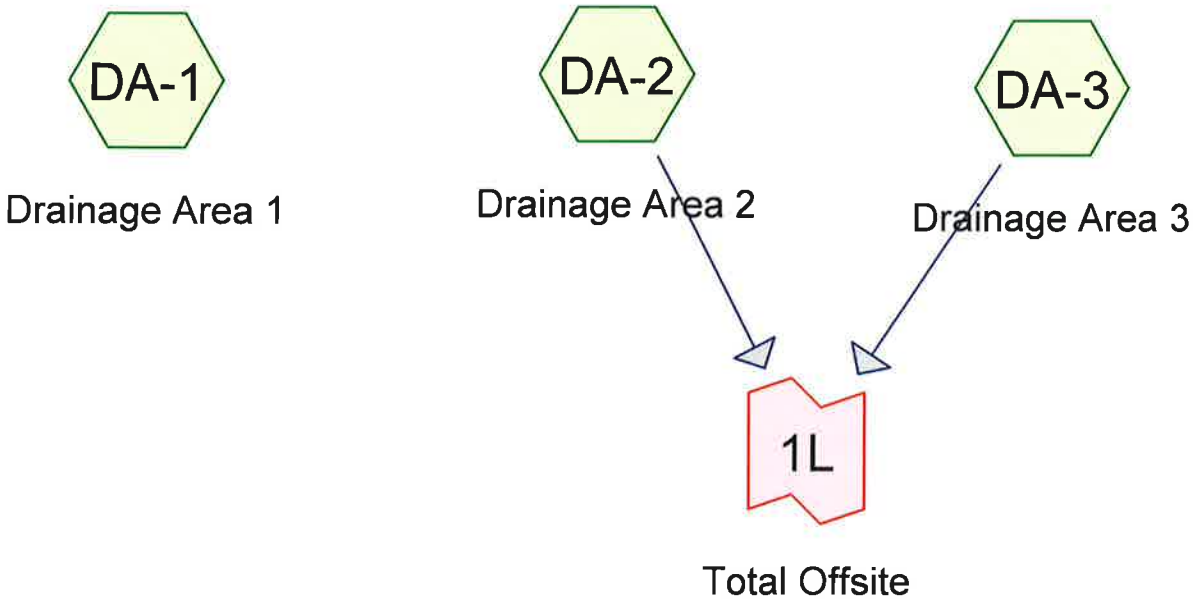
Anthony A. Nenna, P.E.
President

Attachments

cc: A. DiOrio

ATTACHMENT 1

PRE-DEVELOPMENT DRAINAGE CALCULATIONS



Subcat Reach Pond Link

Routing Diagram for Hemmerle Trust-Pre Dev
Prepared by On-Site Engineering, Inc., Printed 4/25/2022

Summary for Subcatchment DA-1: Drainage Area 1

[45] Hint: Runoff=Zero

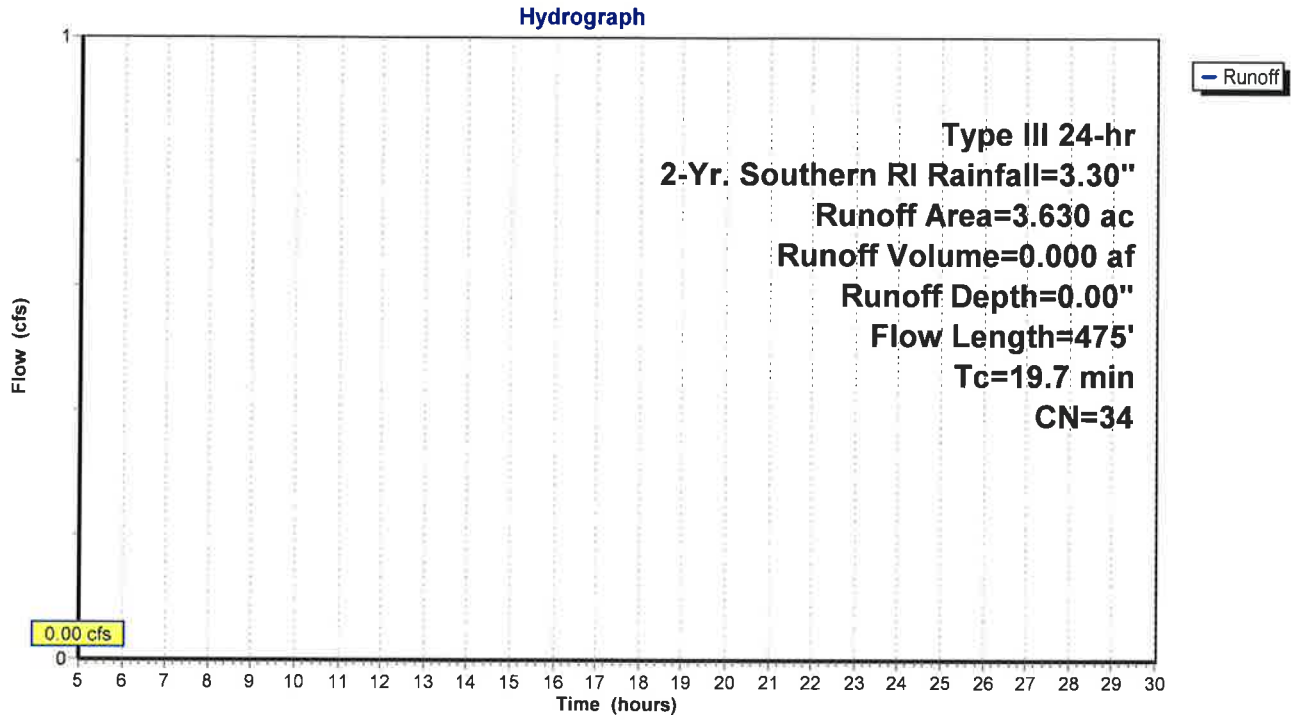
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
2.880	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.630	34	Weighted Average
3.500		96.42% Pervious Area
0.130		3.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	115	0.1800	0.11		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	95	0.3800	3.08		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.5	125	0.0800	1.41		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
0.9	140	0.0280	2.69		**Shallow Concentrated Flow, Tt4** Unpaved Kv= 16.1 fps
19.7	475	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2: Drainage Area 2

[45] Hint: Runoff=Zero

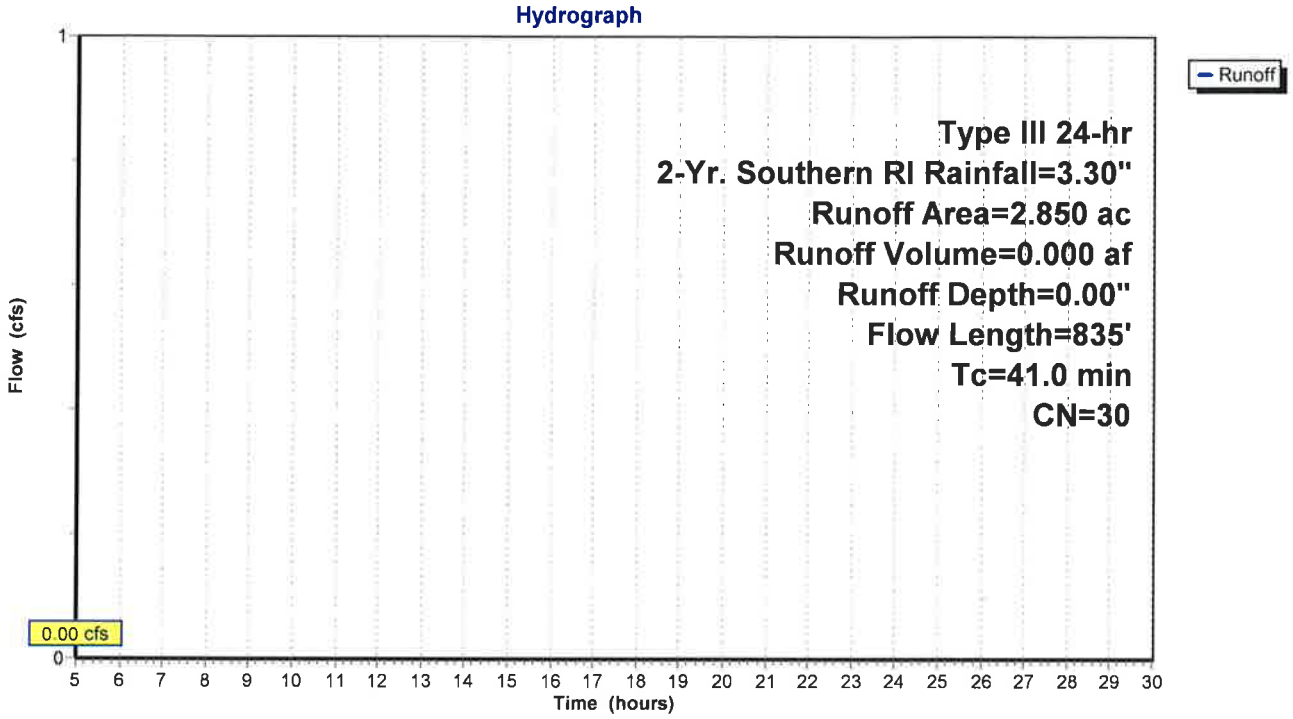
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
2.850	30	Woods, Good, HSG A
2.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.5	155	0.1160	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.8	125	0.0480	0.55		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
6.8	345	0.0290	0.85		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
2.0	100	0.1100	0.83		**Shallow Concentrated Flow, Tt3** Forest w/Heavy Litter Kv= 2.5 fps
2.9	110	0.0640	0.63		**Shallow Concentrated Flow, Tt4** Forest w/Heavy Litter Kv= 2.5 fps
41.0	835	Total			

Subcatchment DA-2: Drainage Area 2



Summary for Subcatchment DA-3: Drainage Area 3

[45] Hint: Runoff=Zero

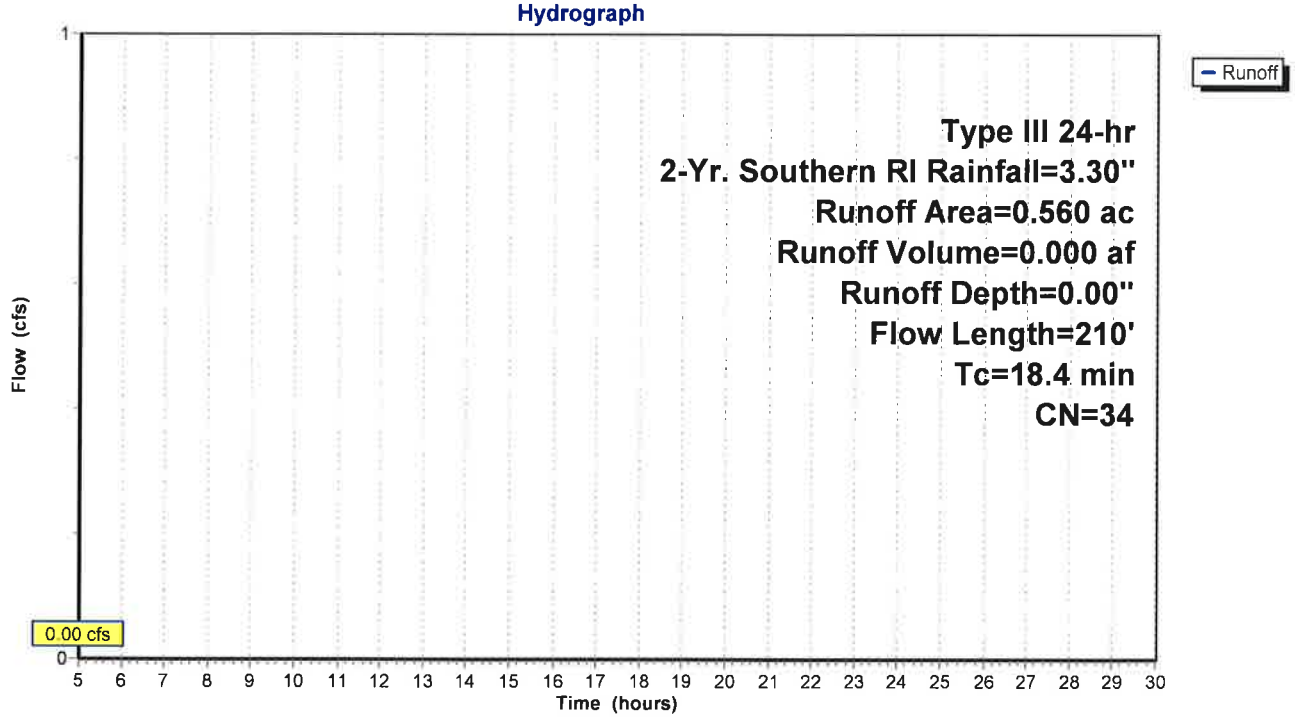
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.030	98	Paved parking, HSG A
0.020	39	>75% Grass cover, Good, HSG A
0.560	34	Weighted Average
0.530		94.64% Pervious Area
0.030		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	110	0.0540	0.12		**Sheet Flow, Tt1** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	100	0.0100	0.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
18.4	210	Total			

Subcatchment DA-3: Drainage Area 3

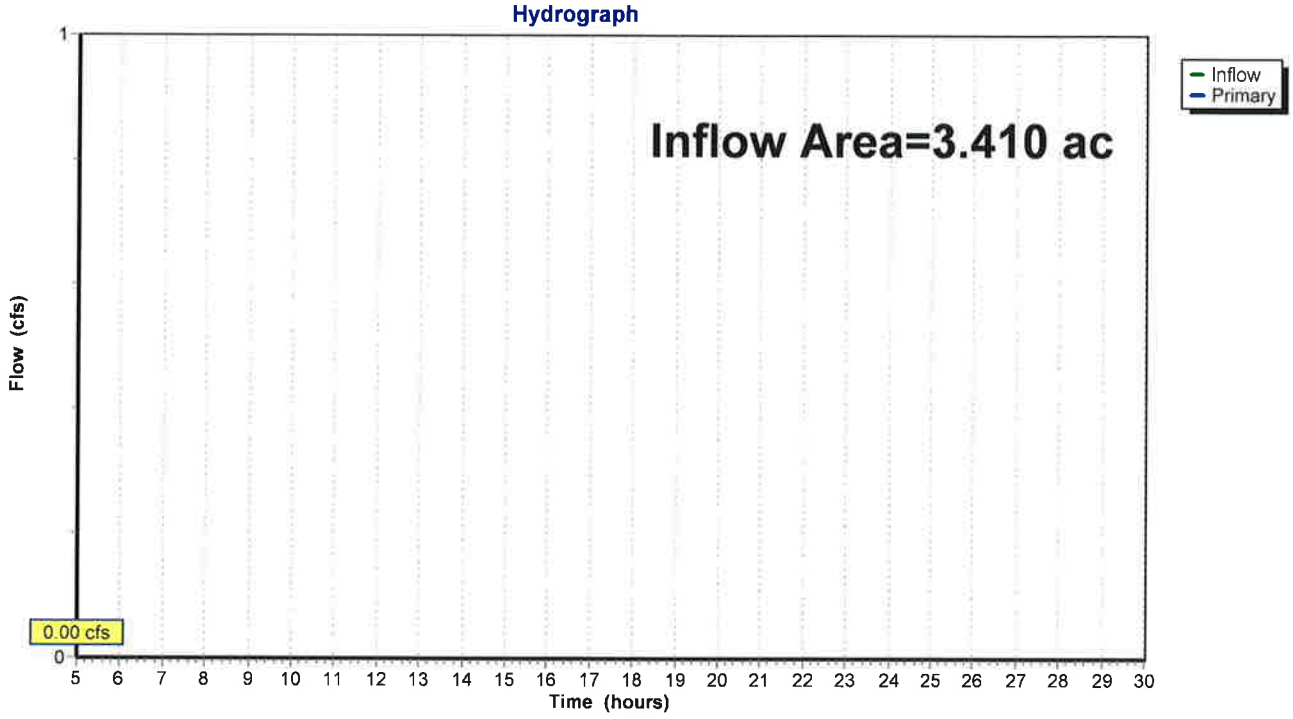


Summary for Link 1L: Total Offsite

Inflow Area = 3.410 ac, 0.88% Impervious, Inflow Depth = 0.00" for 2-Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



Summary for Subcatchment DA-1: Drainage Area 1

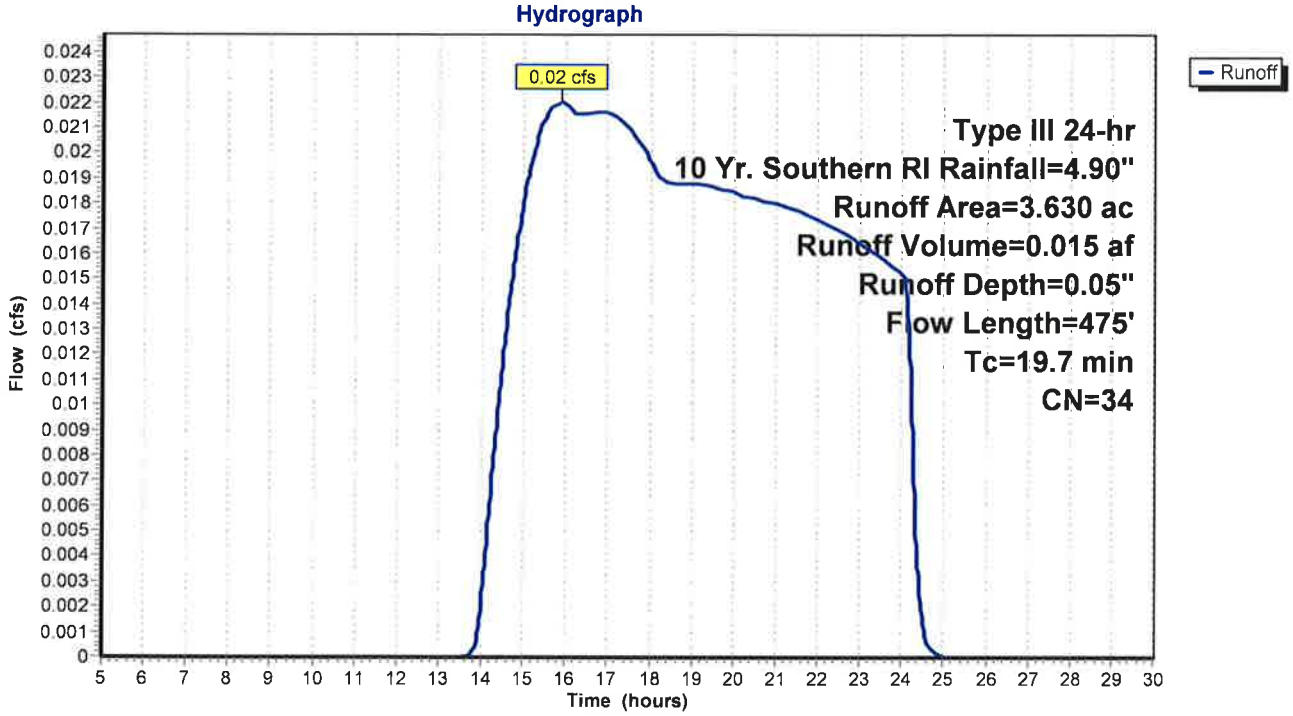
Runoff = 0.02 cfs @ 15.87 hrs, Volume= 0.015 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
2.880	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.630	34	Weighted Average
3.500		96.42% Pervious Area
0.130		3.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	115	0.1800	0.11		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	95	0.3800	3.08		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.5	125	0.0800	1.41		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
0.9	140	0.0280	2.69		**Shallow Concentrated Flow, Tt4** Unpaved Kv= 16.1 fps
19.7	475	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2: Drainage Area 2

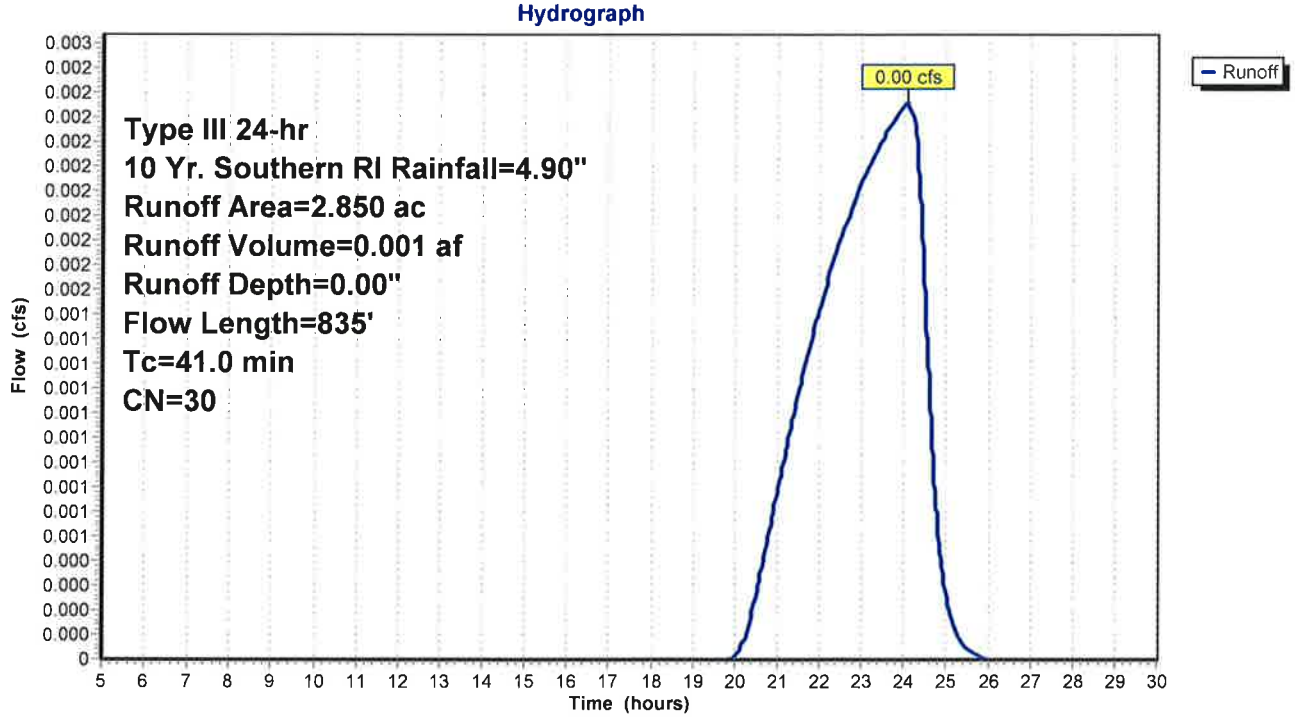
Runoff = 0.00 cfs @ 24.10 hrs, Volume= 0.001 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
2.850	30	Woods, Good, HSG A
2.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.5	155	0.1160	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.8	125	0.0480	0.55		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
6.8	345	0.0290	0.85		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
2.0	100	0.1100	0.83		**Shallow Concentrated Flow, Tt3** Forest w/Heavy Litter Kv= 2.5 fps
2.9	110	0.0640	0.63		**Shallow Concentrated Flow, Tt4** Forest w/Heavy Litter Kv= 2.5 fps
41.0	835	Total			

Subcatchment DA-2: Drainage Area 2



Summary for Subcatchment DA-3: Drainage Area 3

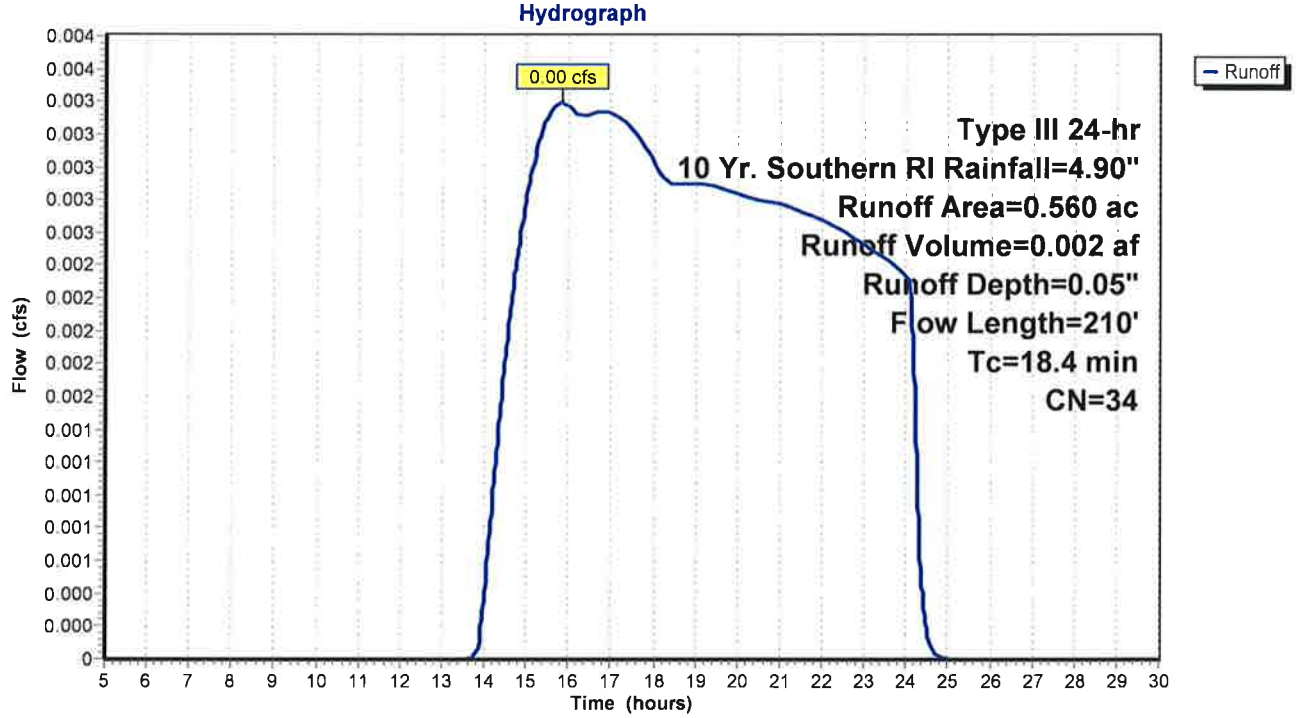
Runoff = 0.00 cfs @ 15.84 hrs, Volume= 0.002 af, Depth= 0.05"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.030	98	Paved parking, HSG A
0.020	39	>75% Grass cover, Good, HSG A
0.560	34	Weighted Average
0.530		94.64% Pervious Area
0.030		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	110	0.0540	0.12		**Sheet Flow, Tt1** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	100	0.0100	0.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
18.4	210	Total			

Subcatchment DA-3: Drainage Area 3

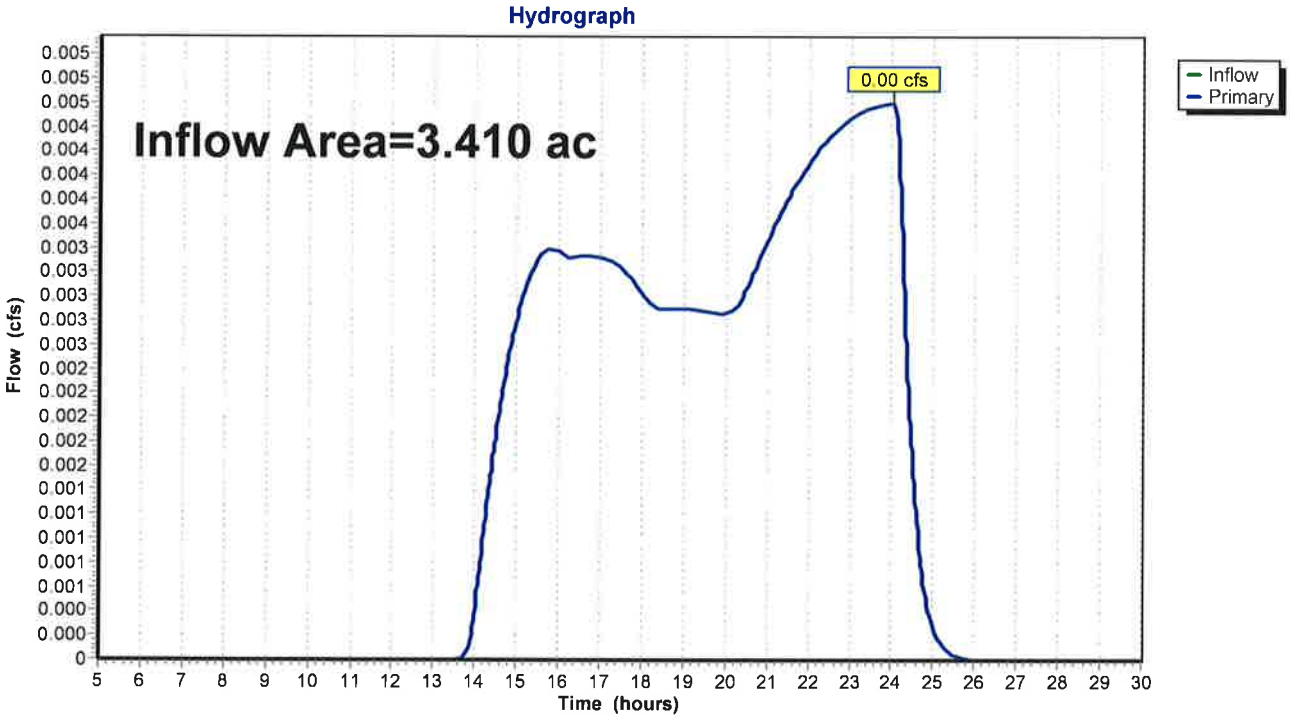


Summary for Link 1L: Total Offsite

Inflow Area = 3.410 ac, 0.88% Impervious, Inflow Depth = 0.01" for 10 Yr. Southern RI event
Inflow = 0.00 cfs @ 24.02 hrs, Volume= 0.003 af
Primary = 0.00 cfs @ 24.02 hrs, Volume= 0.003 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



Summary for Subcatchment DA-1: Drainage Area 1

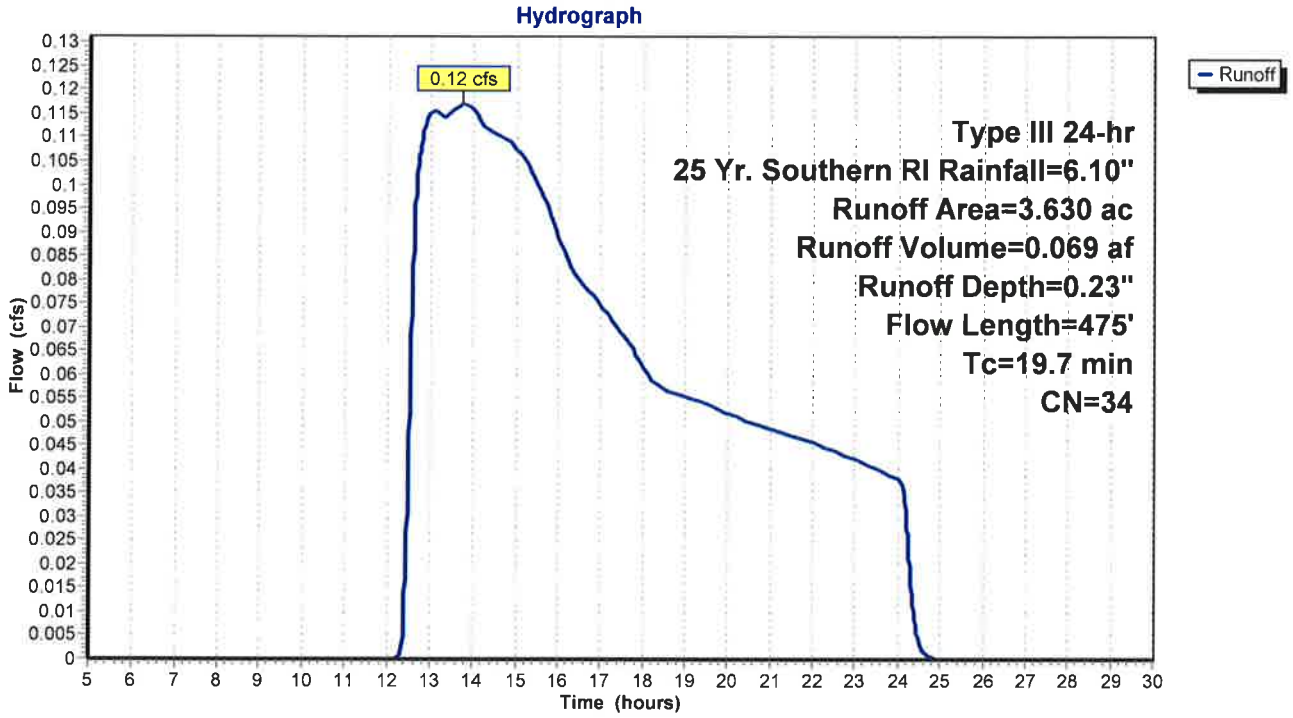
Runoff = 0.12 cfs @ 13.77 hrs, Volume= 0.069 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
2.880	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.630	34	Weighted Average
3.500		96.42% Pervious Area
0.130		3.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	115	0.1800	0.11		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	95	0.3800	3.08		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.5	125	0.0800	1.41		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
0.9	140	0.0280	2.69		**Shallow Concentrated Flow, Tt4** Unpaved Kv= 16.1 fps
19.7	475	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2: Drainage Area 2

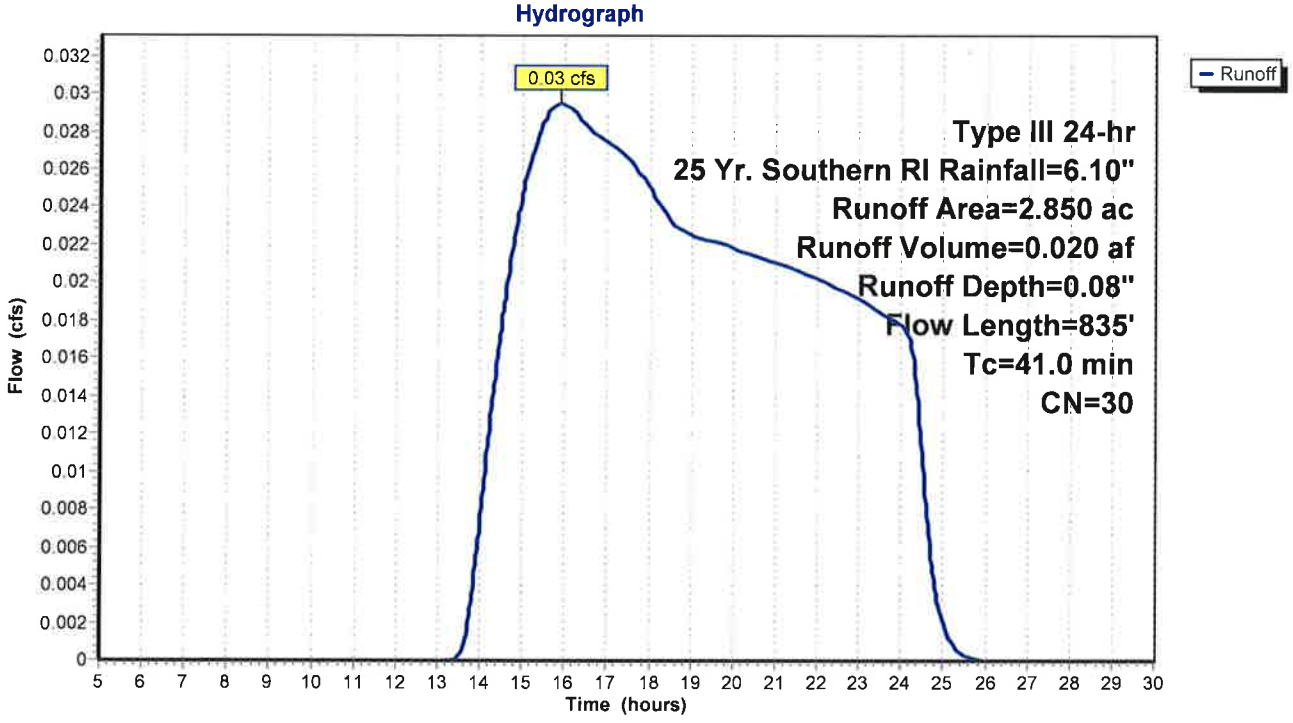
Runoff = 0.03 cfs @ 15.90 hrs, Volume= 0.020 af, Depth= 0.08"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
2.850	30	Woods, Good, HSG A
2.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.5	155	0.1160	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.8	125	0.0480	0.55		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
6.8	345	0.0290	0.85		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
2.0	100	0.1100	0.83		**Shallow Concentrated Flow, Tt3** Forest w/Heavy Litter Kv= 2.5 fps
2.9	110	0.0640	0.63		**Shallow Concentrated Flow, Tt4** Forest w/Heavy Litter Kv= 2.5 fps
41.0	835	Total			

Subcatchment DA-2: Drainage Area 2



Summary for Subcatchment DA-3: Drainage Area 3

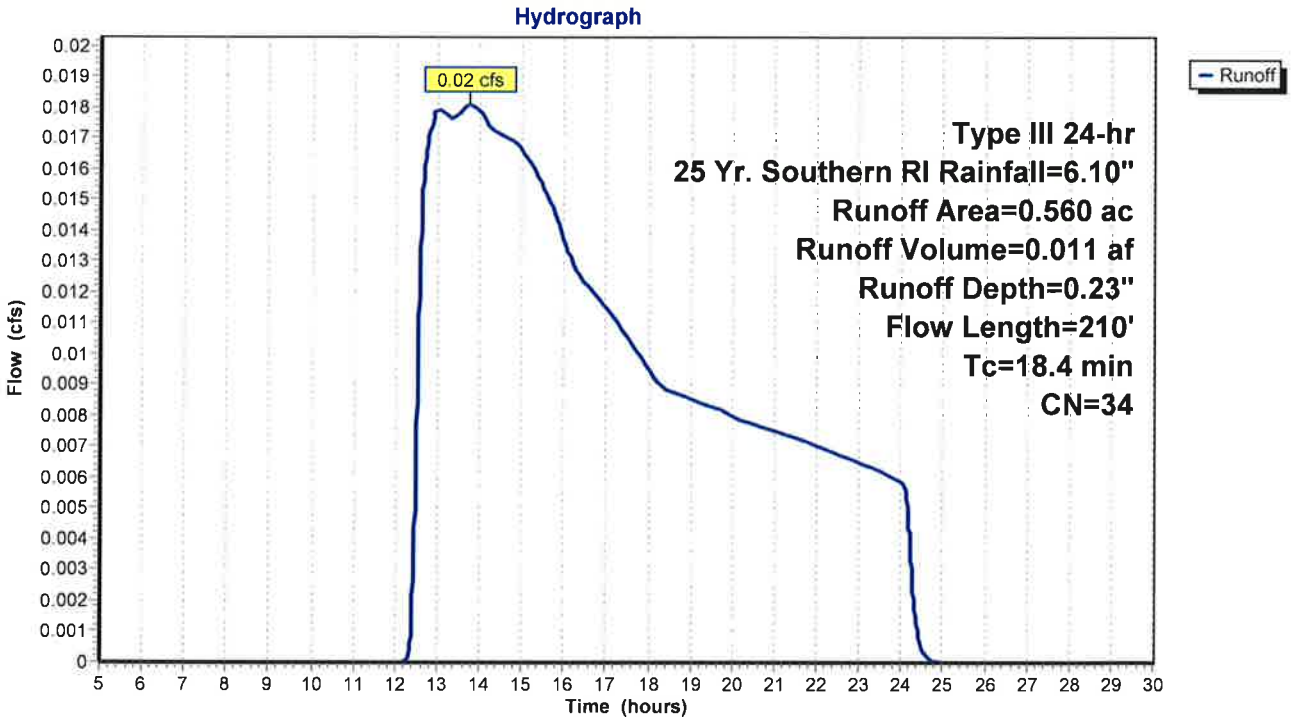
Runoff = 0.02 cfs @ 13.76 hrs, Volume= 0.011 af, Depth= 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.030	98	Paved parking, HSG A
0.020	39	>75% Grass cover, Good, HSG A
0.560	34	Weighted Average
0.530		94.64% Pervious Area
0.030		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	110	0.0540	0.12		**Sheet Flow, Tt1** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	100	0.0100	0.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
18.4	210	Total			

Subcatchment DA-3: Drainage Area 3

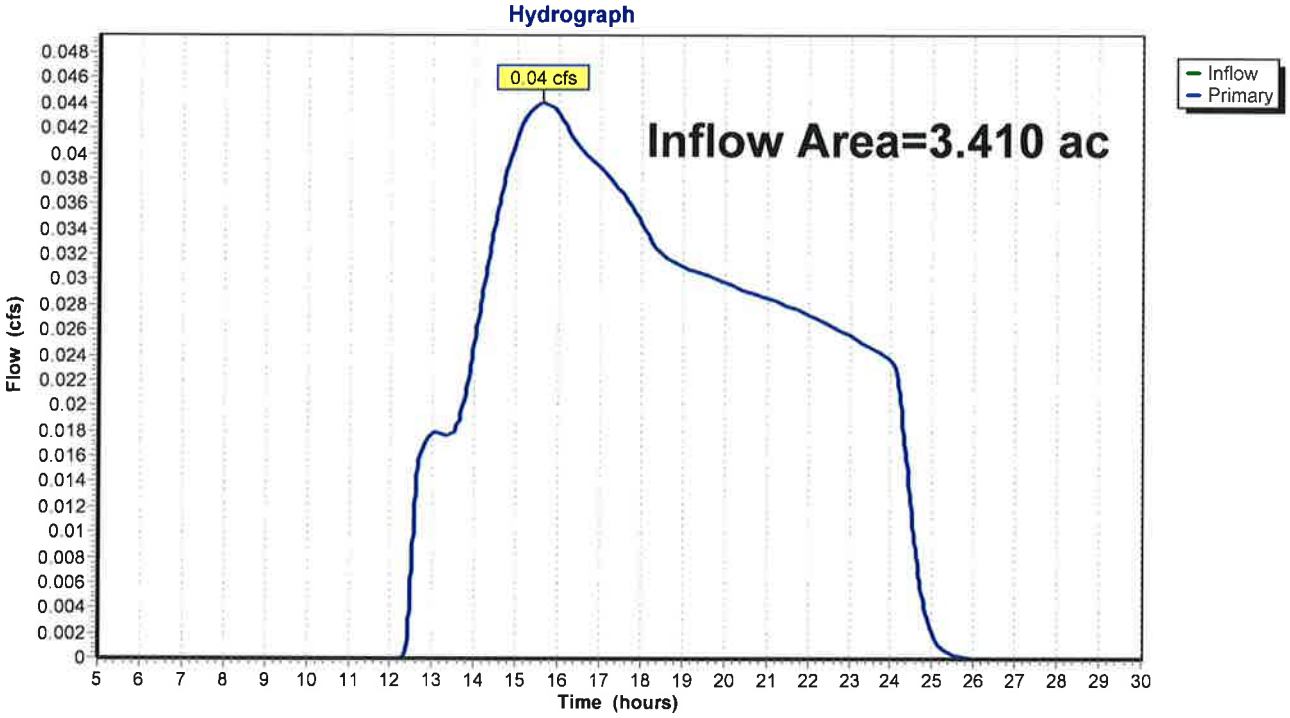


Summary for Link 1L: Total Offsite

Inflow Area = 3.410 ac, 0.88% Impervious, Inflow Depth = 0.11" for 25 Yr. Southern RI event
Inflow = 0.04 cfs @ 15.63 hrs, Volume= 0.030 af
Primary = 0.04 cfs @ 15.63 hrs, Volume= 0.030 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



Summary for Subcatchment DA-1: Drainage Area 1

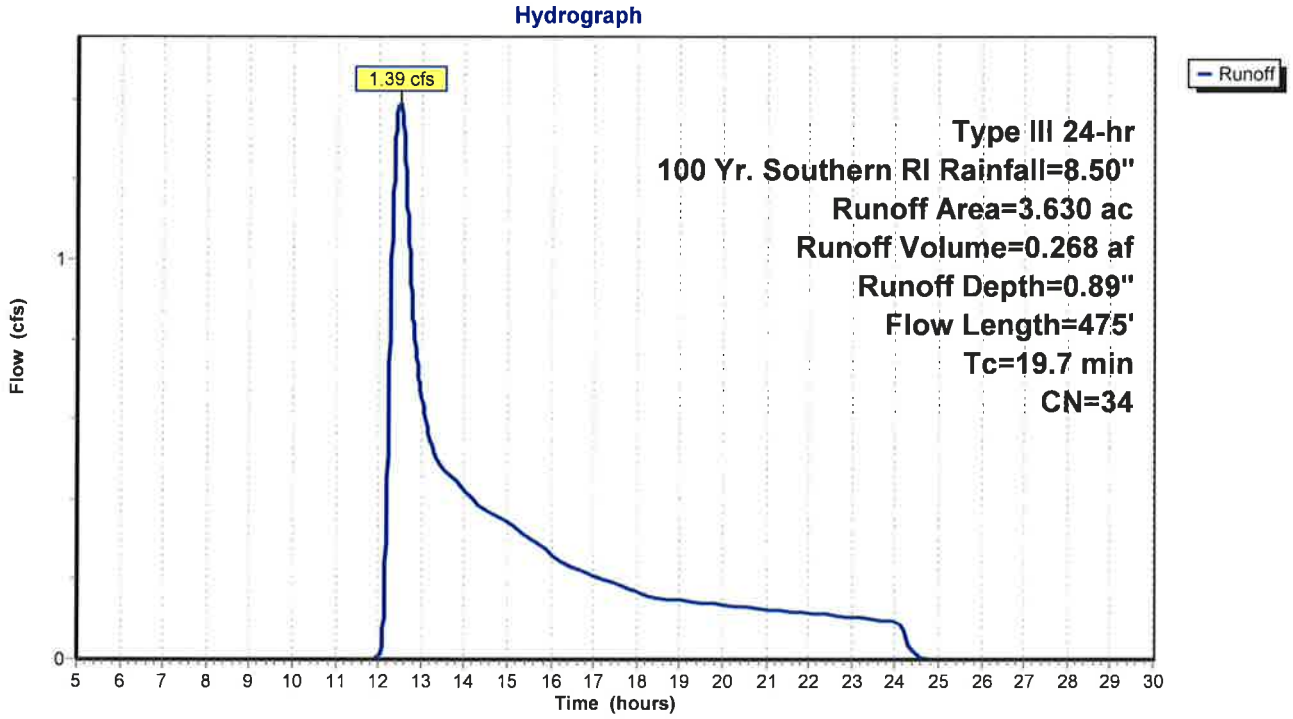
Runoff = 1.39 cfs @ 12.48 hrs, Volume= 0.268 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
2.880	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.630	34	Weighted Average
3.500		96.42% Pervious Area
0.130		3.58% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
16.8	115	0.1800	0.11		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	95	0.3800	3.08		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.5	125	0.0800	1.41		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
0.9	140	0.0280	2.69		**Shallow Concentrated Flow, Tt4** Unpaved Kv= 16.1 fps
19.7	475	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2: Drainage Area 2

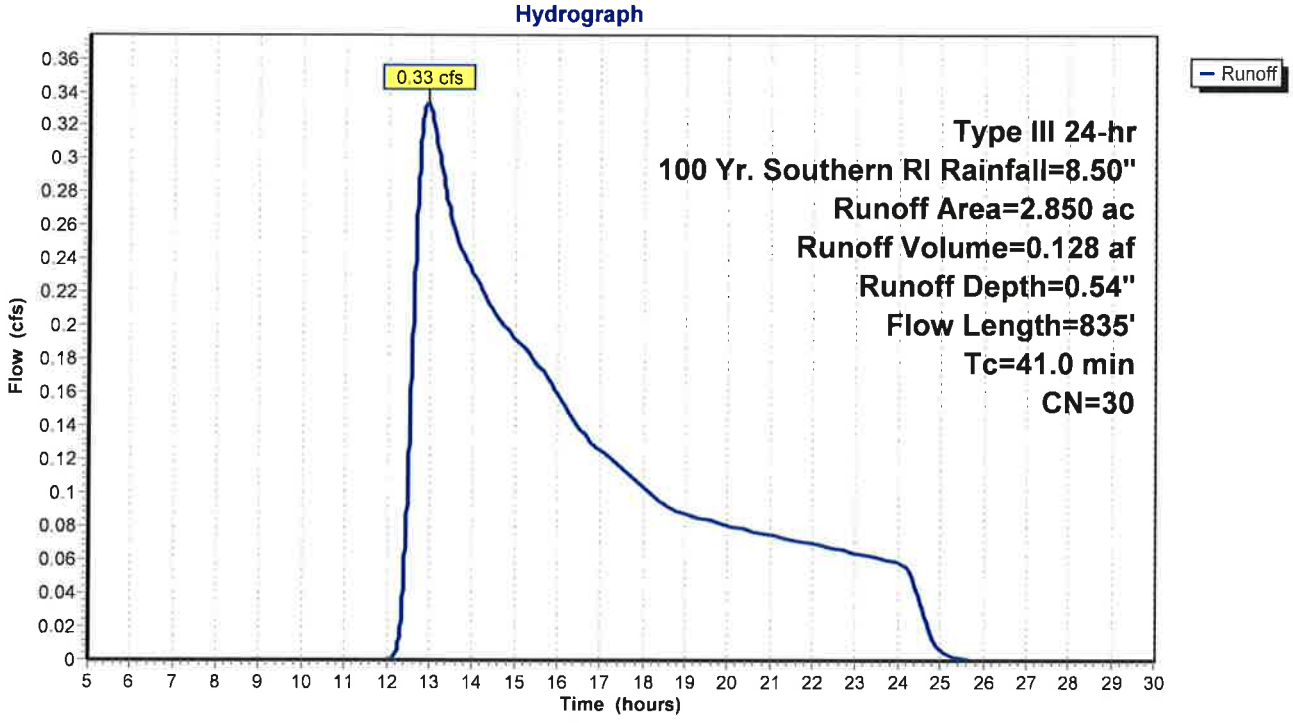
Runoff = 0.33 cfs @ 12.94 hrs, Volume= 0.128 af, Depth= 0.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
2.850	30	Woods, Good, HSG A
2.850		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.5	155	0.1160	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.8	125	0.0480	0.55		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
6.8	345	0.0290	0.85		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
2.0	100	0.1100	0.83		**Shallow Concentrated Flow, Tt3** Forest w/Heavy Litter Kv= 2.5 fps
2.9	110	0.0640	0.63		**Shallow Concentrated Flow, Tt4** Forest w/Heavy Litter Kv= 2.5 fps
41.0	835	Total			

Subcatchment DA-2: Drainage Area 2



Summary for Subcatchment DA-3: Drainage Area 3

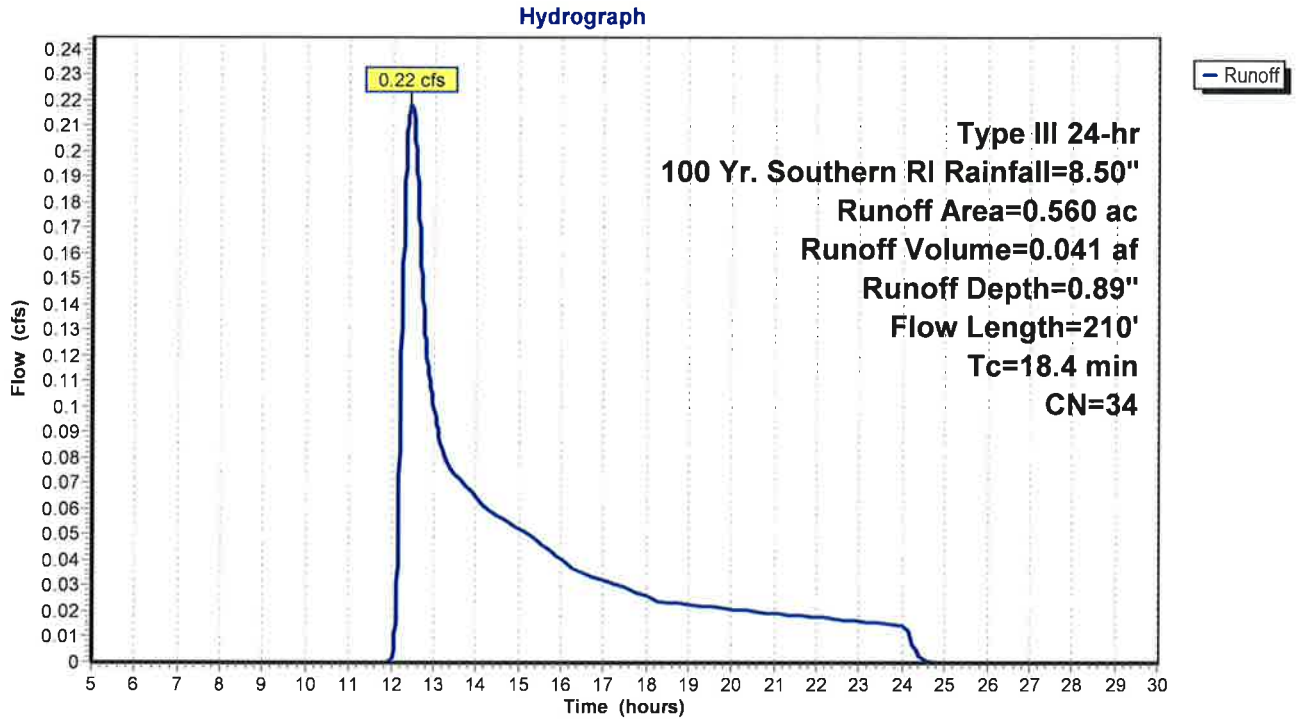
Runoff = 0.22 cfs @ 12.45 hrs, Volume= 0.041 af, Depth= 0.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
0.510	30	Woods, Good, HSG A
0.030	98	Paved parking, HSG A
0.020	39	>75% Grass cover, Good, HSG A
0.560	34	Weighted Average
0.530		94.64% Pervious Area
0.030		5.36% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.1	110	0.0540	0.12		**Sheet Flow, Tt1** Woods: Light underbrush n= 0.400 P2= 3.40"
3.3	100	0.0100	0.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
18.4	210	Total			

Subcatchment DA-3: Drainage Area 3

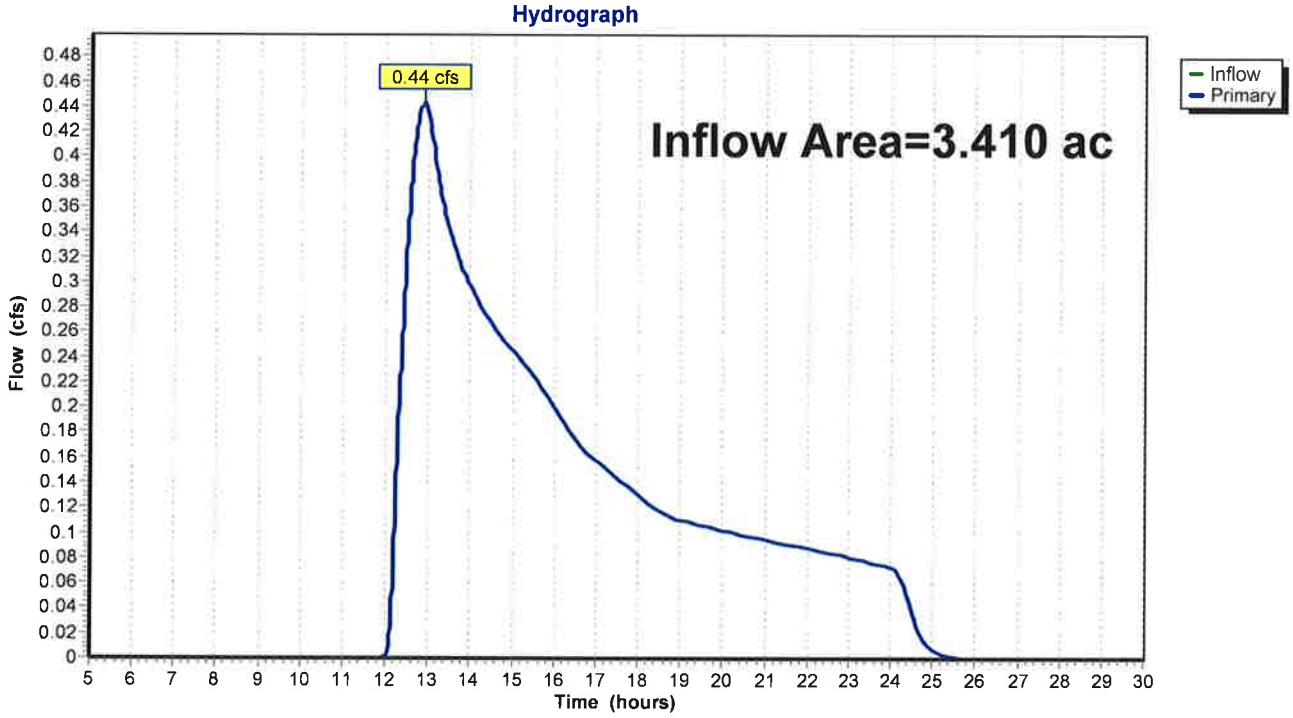


Summary for Link 1L: Total Offsite

Inflow Area = 3.410 ac, 0.88% Impervious, Inflow Depth = 0.60" for 100 Yr. Southern RI event
Inflow = 0.44 cfs @ 12.89 hrs, Volume= 0.170 af
Primary = 0.44 cfs @ 12.89 hrs, Volume= 0.170 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



ATTACHMENT 2

WATER QUALITY CALCULATIONS FOR SWALE AND GRASSED SWALE SIZING CALCULATIONS

WATER QUALITY CALCULATIONS FOR DRIVEWAY
BioRetention Swale Along Road Edge

Note: The driveway is 850 feet long by 12 feet wide
Each roadside swale will treat half of the road.

BMP: Bio-Retention Swale to Infiltration Basin

Impervious Area =	10,200.0 ft^2	0.23416	acres
WQV Rainfall Depth	1.2	inches	
F (A soils)	0.6		
F (B soils)	0.35		
F (C soils)	0.25		
F (D soils)	0.1		
WQV=	850.0 ft^3	0.01951	ac.-ft.
Rev=	510.0 ft^3	0.01171	ac.-ft.

Sizing Bio-Retention Area

Minimum Filter Bed Surface Area

$$Af=(WQv)(df)/[(k)(hf+df)(tf)$$

df=	0.25	ft.
k=	1	ft/day
hf=	0.183	ft.
tf=	2	days
Af=	245.4	s.f.
Af (Prov)=	**1870**	**s.f.**

(2.2 ft. wetted perimeter x 850 ft. swale length, 1,870 s.f.>245 s.f.)
(Each swale capacity)

Grassed Swale Receiving Runoff from DA-2A (Slope=2%)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.040
Channel Slope	2.000 %
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft
Discharge	0.92 cfs

Results	
Normal Depth	3.4 in
Flow Area	0.5 ft²
Wetted Perimeter	2.8 ft
Hydraulic Radius	2.3 in
Top Width	2.72 ft
Critical Depth	2.8 in
Critical Slope	4.425 %
Velocity	1.73 ft/s
Velocity Head	0.05 ft
Specific Energy	0.33 ft
Froude Number	0.690
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.4 in
Critical Depth	2.8 in
Channel Slope	2.000 %
Critical Slope	4.425 %

Grassed Swale Receiving Runoff from DA-2A (Slope=11%)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.040
Channel Slope	11.000 %
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft
Discharge	0.92 cfs

Results	
Normal Depth	2.2 in
Flow Area	0.3 ft²
Wetted Perimeter	2.2 ft
Hydraulic Radius	1.6 in
Top Width	2.11 ft
Critical Depth	2.8 in
Critical Slope	4.424 %
Velocity	3.20 ft/s
Velocity Head	0.16 ft
Specific Energy	0.34 ft
Froude Number	1.530
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.2 in
Critical Depth	2.8 in
Channel Slope	11.000 %
Critical Slope	4.424 %

Grassed Swale Receiving Runoff from DA-2B (Slope=2%)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.040
Channel Slope	2.000 %
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft
Discharge	0.83 cfs

Results	
Normal Depth	3.3 in
Flow Area	0.5 ft²
Wetted Perimeter	2.7 ft
Hydraulic Radius	2.2 in
Top Width	2.63 ft
Critical Depth	2.7 in
Critical Slope	4.489 %
Velocity	1.68 ft/s
Velocity Head	0.04 ft
Specific Energy	0.32 ft
Froude Number	0.685
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	3.3 in
Critical Depth	2.7 in
Channel Slope	2.000 %
Critical Slope	4.489 %

Grassed Swale Receiving Runoff from DA-2B (Slope=11%)

Project Description	
Friction Method	Manning Formula
Solve For	Normal Depth

Input Data	
Roughness Coefficient	0.040
Channel Slope	11.000 %
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft
Discharge	0.83 cfs

Results	
Normal Depth	2.1 in
Flow Area	0.3 ft²
Wetted Perimeter	2.1 ft
Hydraulic Radius	1.5 in
Top Width	2.05 ft
Critical Depth	2.7 in
Critical Slope	4.490 %
Velocity	3.11 ft/s
Velocity Head	0.15 ft
Specific Energy	0.33 ft
Froude Number	1.518
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	2.1 in
Critical Depth	2.7 in
Channel Slope	11.000 %
Critical Slope	4.490 %

Worksheet for Hemmerle Trust-Grassed Swale at 2.0% Slope

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.040
Channel Slope	2.000 %
Normal Depth	12.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft

Results	
Discharge	14.04 cfs ← MAX. DISCHARGE CAPACITY OF SWALE
Flow Area	4.0 ft²
Wetted Perimeter	7.3 ft
Hydraulic Radius	6.6 in
Top Width	7.00 ft
Critical Depth	11.0 in
Critical Slope	3.064 %
Velocity	3.51 ft/s ← MAX VELOCITY
Velocity Head	0.19 ft
Specific Energy	1.19 ft
Froude Number	0.819
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	11.0 in
Channel Slope	2.000 %
Critical Slope	3.064 %

Worksheet for Hemmerle Trust-Grassed Swale at 2.6% Slope

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.040
Channel Slope	2.600 %
Normal Depth	12.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft

Results	
Discharge	16.01 cfs ← MAX DISCHARGE CAPACITY OF SWALE
Flow Area	4.0 ft²
Wetted Perimeter	7.3 ft
Hydraulic Radius	6.6 in
Top Width	7.00 ft
Critical Depth	11.6 in
Critical Slope	3.012 %
Velocity	4.00 ft/s ← MAX. VELOCITY
Velocity Head	0.25 ft
Specific Energy	1.25 ft
Froude Number	0.933
Flow Type	Subcritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	11.6 in
Channel Slope	2.600 %
Critical Slope	3.012 %

Worksheet for Hemmerle Trust-Grassed Swale at 11% Slope

Project Description	
Friction Method	Manning Formula
Solve For	Discharge

Input Data	
Roughness Coefficient	0.040
Channel Slope	11.000 %
Normal Depth	12.0 in
Left Side Slope	3.000 H:V
Right Side Slope	3.000 H:V
Bottom Width	1.00 ft

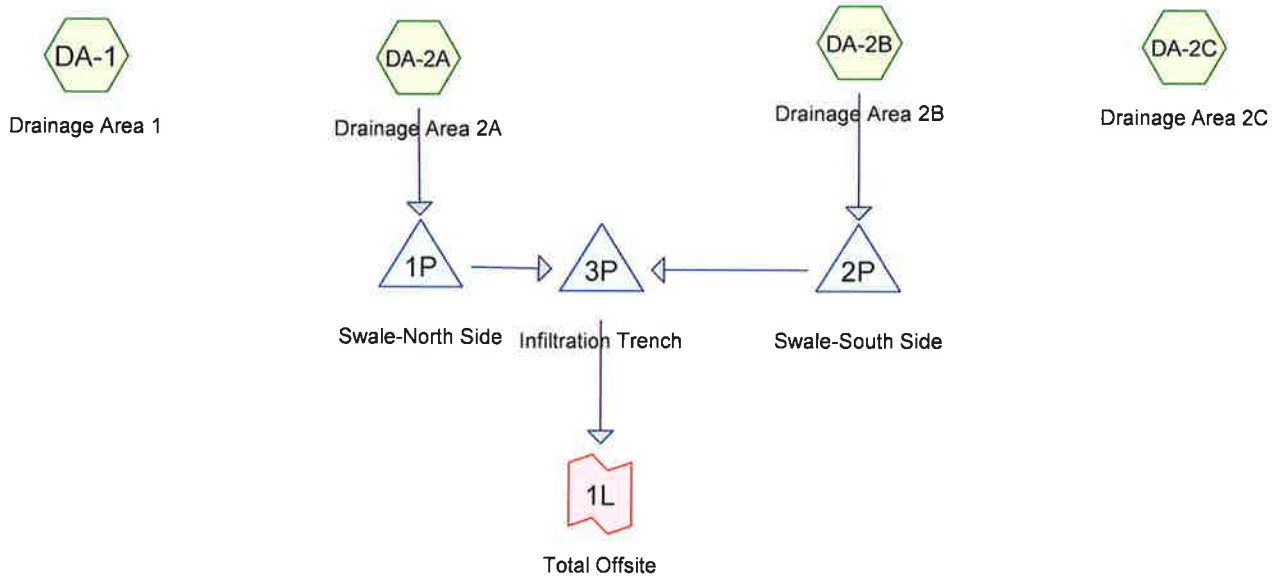
Results	
Discharge	32.93 cfs ← MAX. DISCHARGE CAPACITY OF SWALE
Flow Area	4.0 ft²
Wetted Perimeter	7.3 ft
Hydraulic Radius	6.6 in
Top Width	7.00 ft
Critical Depth	16.1 in
Critical Slope	2.739 %
Velocity	8.23 ft/s ← MAX VELOCITY
Velocity Head	1.05 ft
Specific Energy	2.05 ft
Froude Number	1.920
Flow Type	Supercritical

GVF Input Data	
Downstream Depth	0.0 in
Length	0.0 ft
Number Of Steps	0

GVF Output Data	
Upstream Depth	0.0 in
Profile Description	N/A
Profile Headloss	0.00 ft
Downstream Velocity	Infinity ft/s
Upstream Velocity	Infinity ft/s
Normal Depth	12.0 in
Critical Depth	16.1 in
Channel Slope	11.000 %
Critical Slope	2.739 %

ATTACHMENT 3

POST DEVELOPMENT DRAINAGE CALCULATIONS



Subcat Reach Pond Link

Routing Diagram for Hemmerle Trust-Post Dev
Prepared by On-Site Engineering, Inc., Printed 4/26/2022

Summary for Subcatchment DA-1: Drainage Area 1

[45] Hint: Runoff=Zero

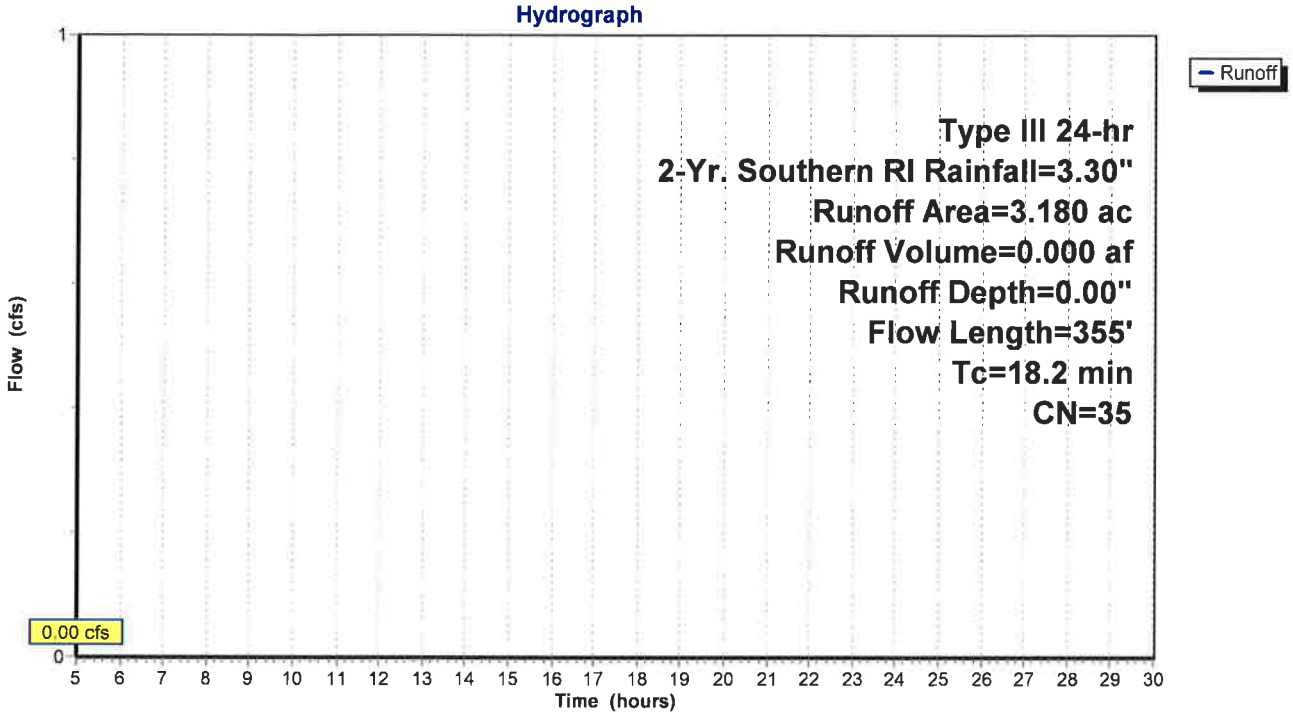
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
2.430	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.180	35	Weighted Average
3.050		95.91% Pervious Area
0.130		4.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	150	0.3600	0.16		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	80	0.2500	2.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.9	125	0.0480	1.10		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
18.2	355	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2A: Drainage Area 2A

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

[45] Hint: Runoff=Zero

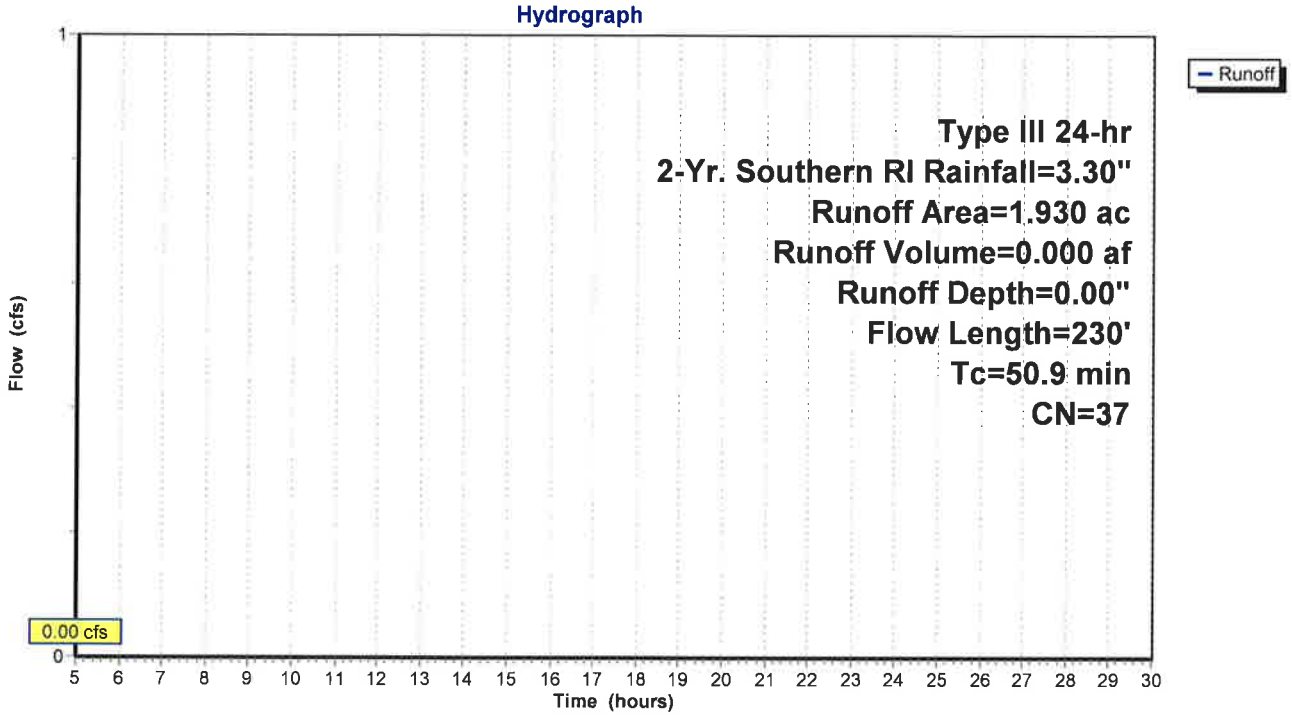
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
1.200	30	Woods, Good, HSG A
0.610	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
1.930	37	Weighted Average
1.810		93.78% Pervious Area
0.120		6.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	120	0.0330	0.06		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
1.6	110	0.0270	1.15		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
50.9	230	Total			

Subcatchment DA-2A: Drainage Area 2A



Summary for Subcatchment DA-2B: Drainage Area 2B

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

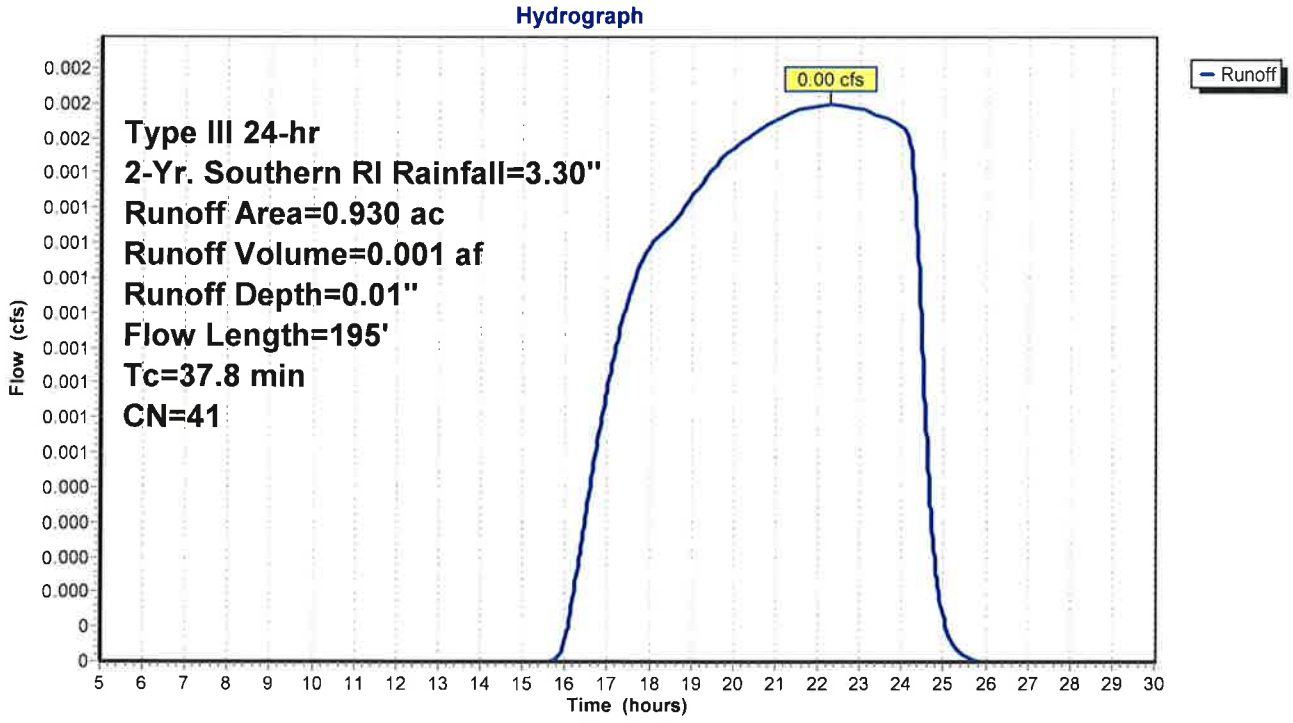
Runoff = 0.00 cfs @ 22.30 hrs, Volume= 0.001 af, Depth= 0.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
0.600	30	Woods, Good, HSG A
0.210	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
0.930	41	Weighted Average
0.810		87.10% Pervious Area
0.120		12.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	130	0.1150	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.6	65	0.0600	1.71		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
37.8	195	Total			

Subcatchment DA-2B: Drainage Area 2B



Summary for Subcatchment DA-2C: Drainage Area 2C

[45] Hint: Runoff=Zero

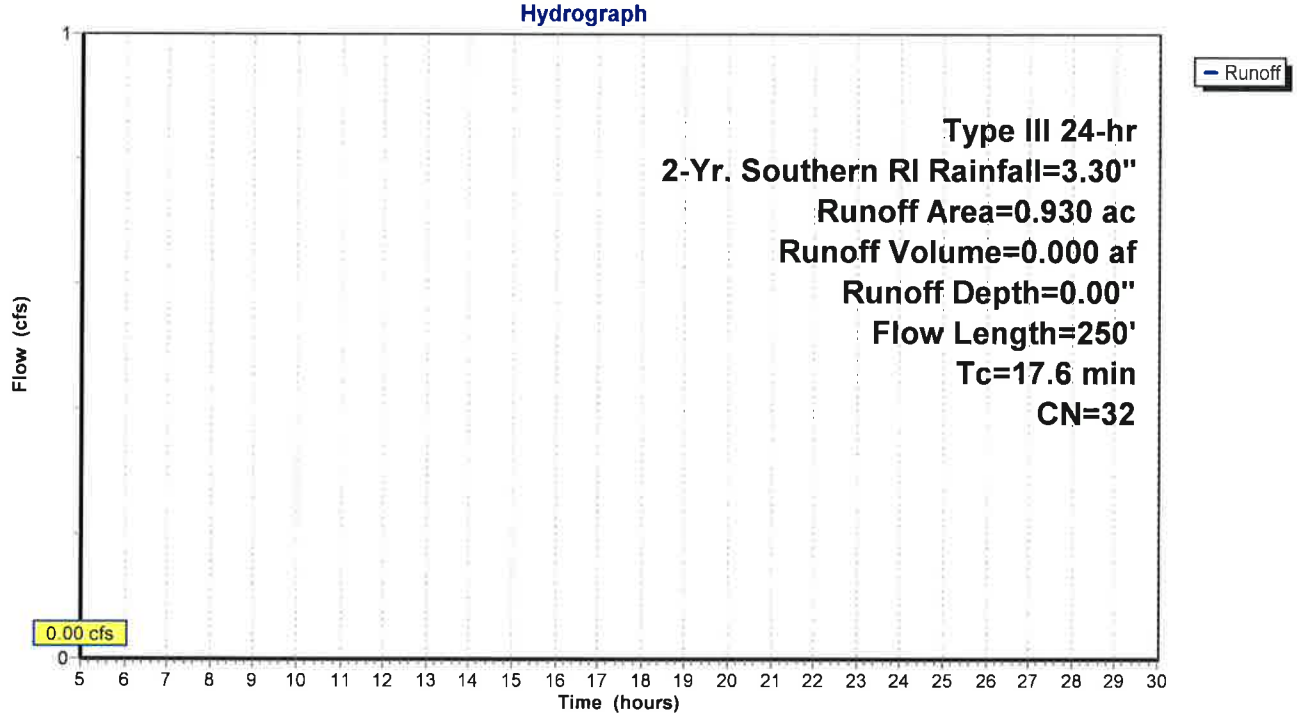
Runoff = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Depth= 0.00"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 2-Yr. Southern RI Rainfall=3.30"

Area (ac)	CN	Description
0.700	30	Woods, Good, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.930	32	Weighted Average
0.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.2200	0.12		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.7	150	0.0730	0.68		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
17.6	250	Total			

Subcatchment DA-2C: Drainage Area 2C



Summary for Pond 1P: Swale-North Side

Inflow Area = 1.930 ac, 6.22% Impervious, Inflow Depth = 0.00" for 2-Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 102.70' @ 5.00 hrs Surf.Area= 200 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

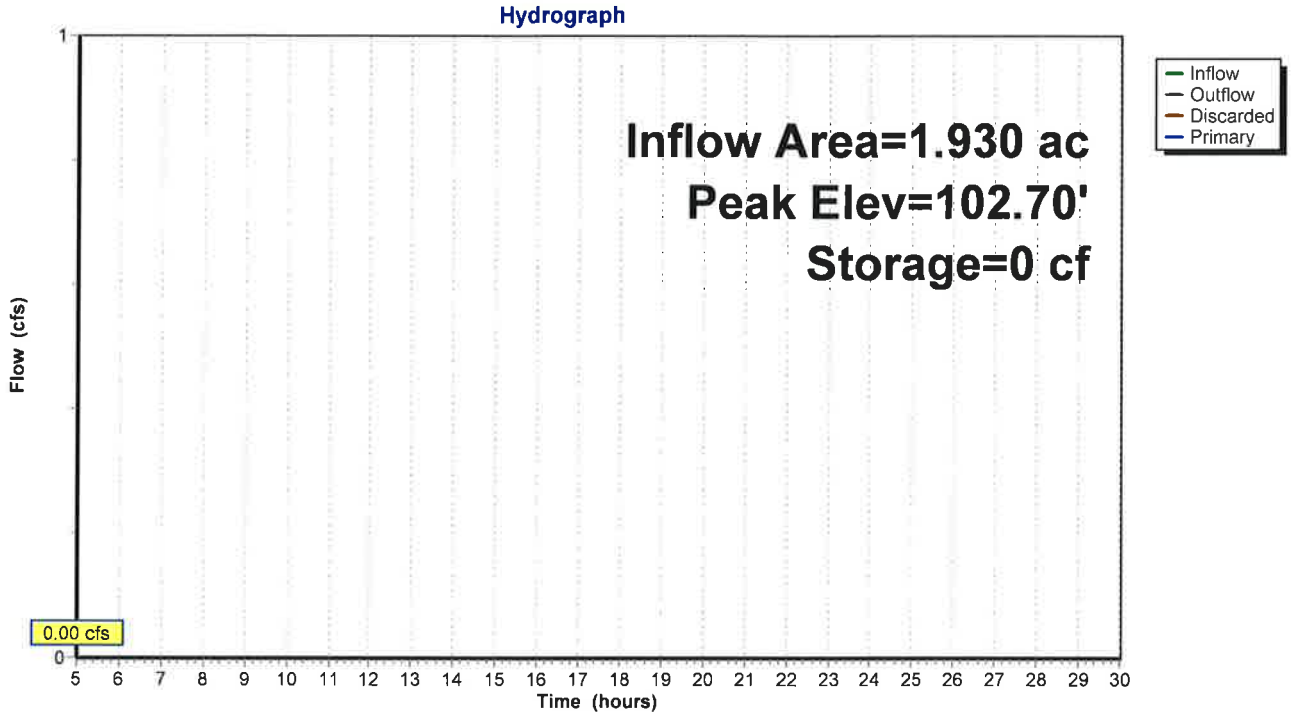
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=102.70' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.04 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=102.70' TW=96.75' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Swale-North Side



Summary for Pond 2P: Swale-South Side

Inflow Area = 0.930 ac, 12.90% Impervious, Inflow Depth = 0.01" for 2-Yr. Southern RI event
Inflow = 0.00 cfs @ 22.30 hrs, Volume= 0.001 af
Outflow = 0.00 cfs @ 22.30 hrs, Volume= 0.001 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 22.30 hrs, Volume= 0.001 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 102.70' @ 5.00 hrs Surf.Area= 200 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (1,252.3 - 1,252.3)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

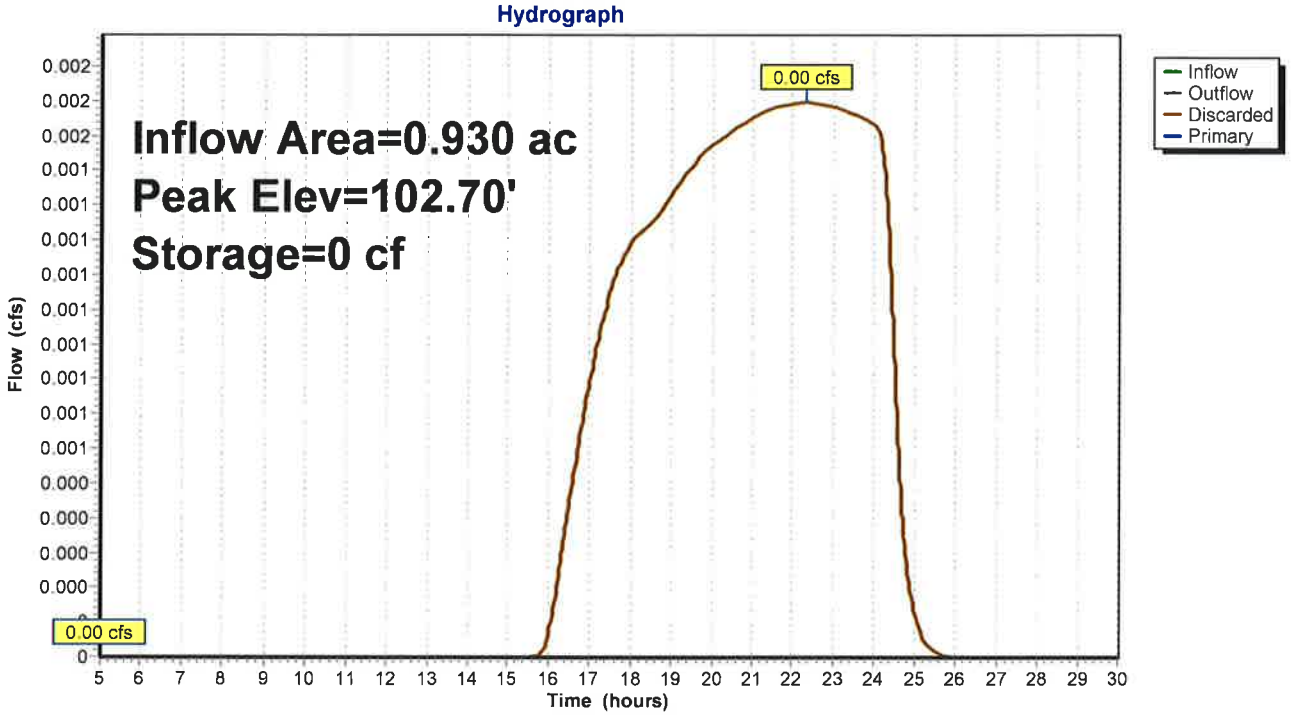
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.00 cfs @ 22.30 hrs HW=102.70' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.04 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=102.70' TW=96.75' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Swale-South Side



Summary for Pond 3P: Infiltration Trench

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.00" for 2-Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 96.75' @ 5.00 hrs Surf.Area= 108 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	96.75'	133 cf	**6.00'W x 18.00'L x 5.25'H Prismatoid** 567 cf Overall - 236 cf Embedded = 331 cf x 40.0% Voids
#2	97.75'	177 cf	**Concrete Galley 4x4x4** x 4 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	102.00'	1,728 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,038 cf	Total Available Storage

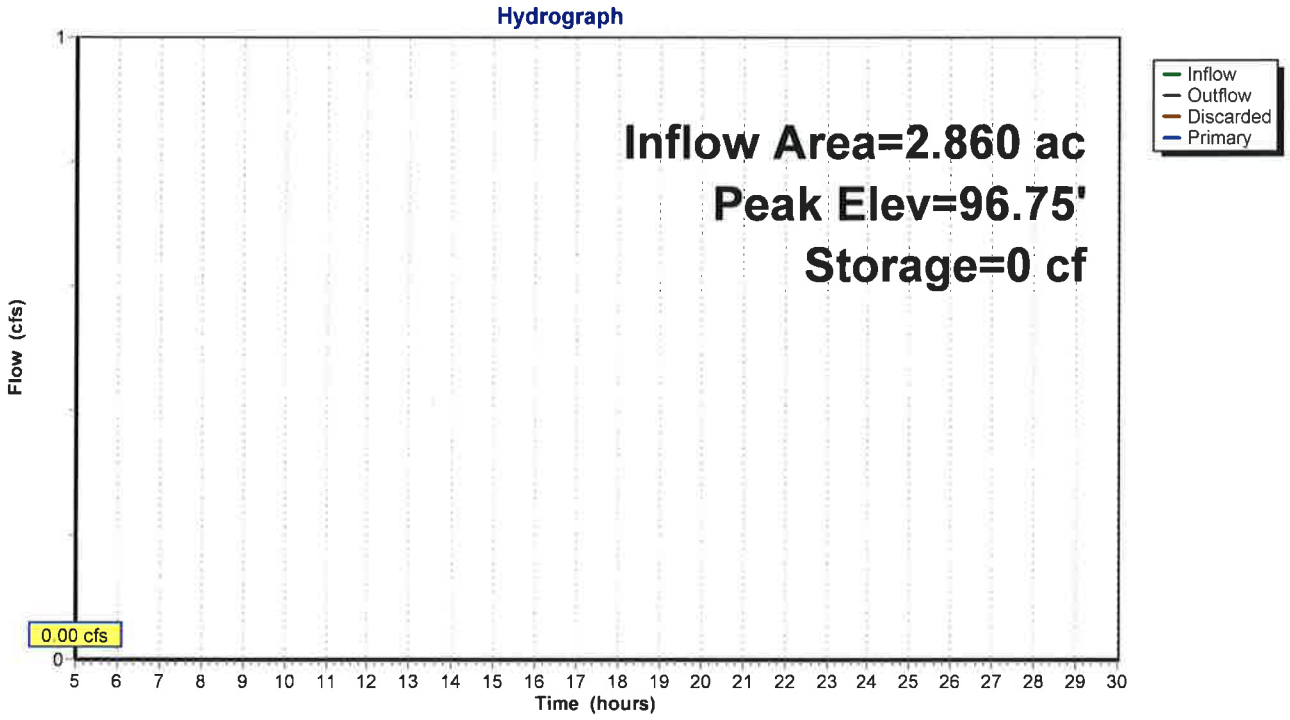
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.00	300	0	0	300
102.50	385	171	171	391
103.00	520	225	396	531
103.35	620	199	595	636
104.00	3,200	1,133	1,728	3,217

Device	Routing	Invert	Outlet Devices
#1	Discarded	96.75'	**12.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=96.75' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.03 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=96.75' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Infiltration Trench

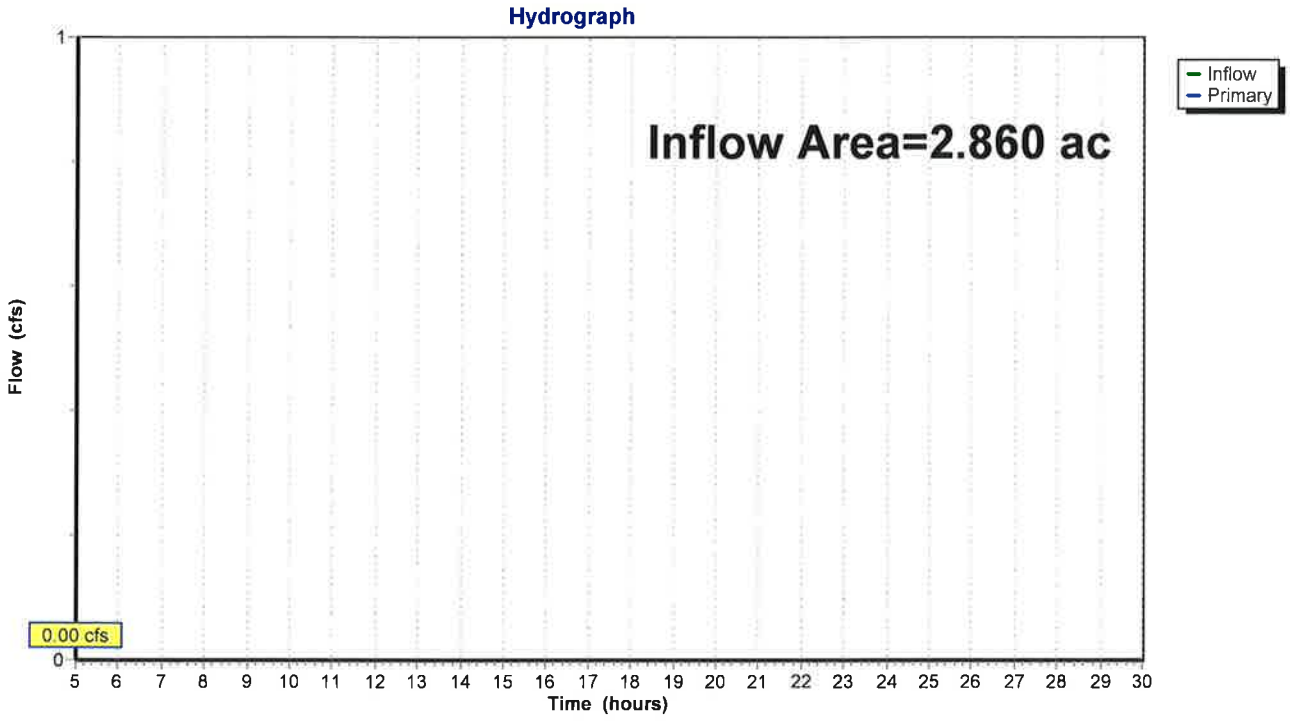


Summary for Link 1L: Total Offsite

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.00" for 2-Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



Summary for Subcatchment DA-1: Drainage Area 1

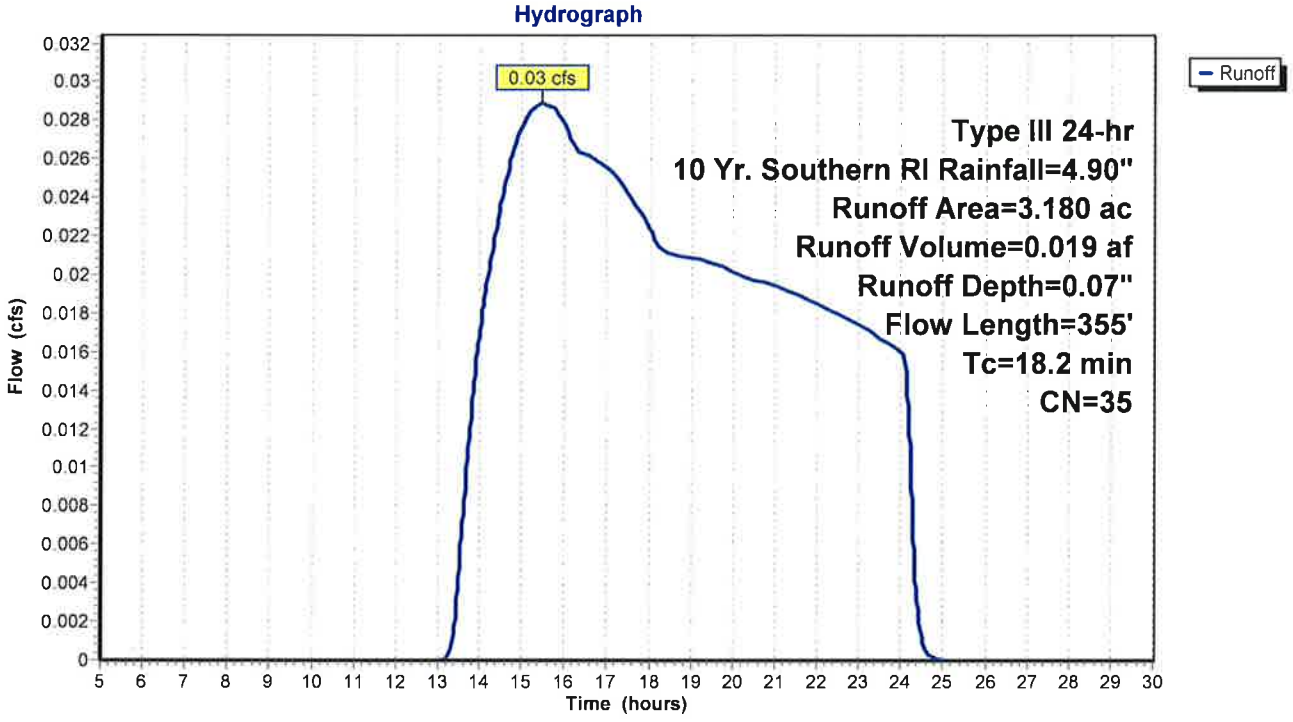
Runoff = 0.03 cfs @ 15.47 hrs, Volume= 0.019 af, Depth= 0.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
2.430	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.180	35	Weighted Average
3.050		95.91% Pervious Area
0.130		4.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	150	0.3600	0.16		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	80	0.2500	2.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.9	125	0.0480	1.10		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
18.2	355	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2A: Drainage Area 2A

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

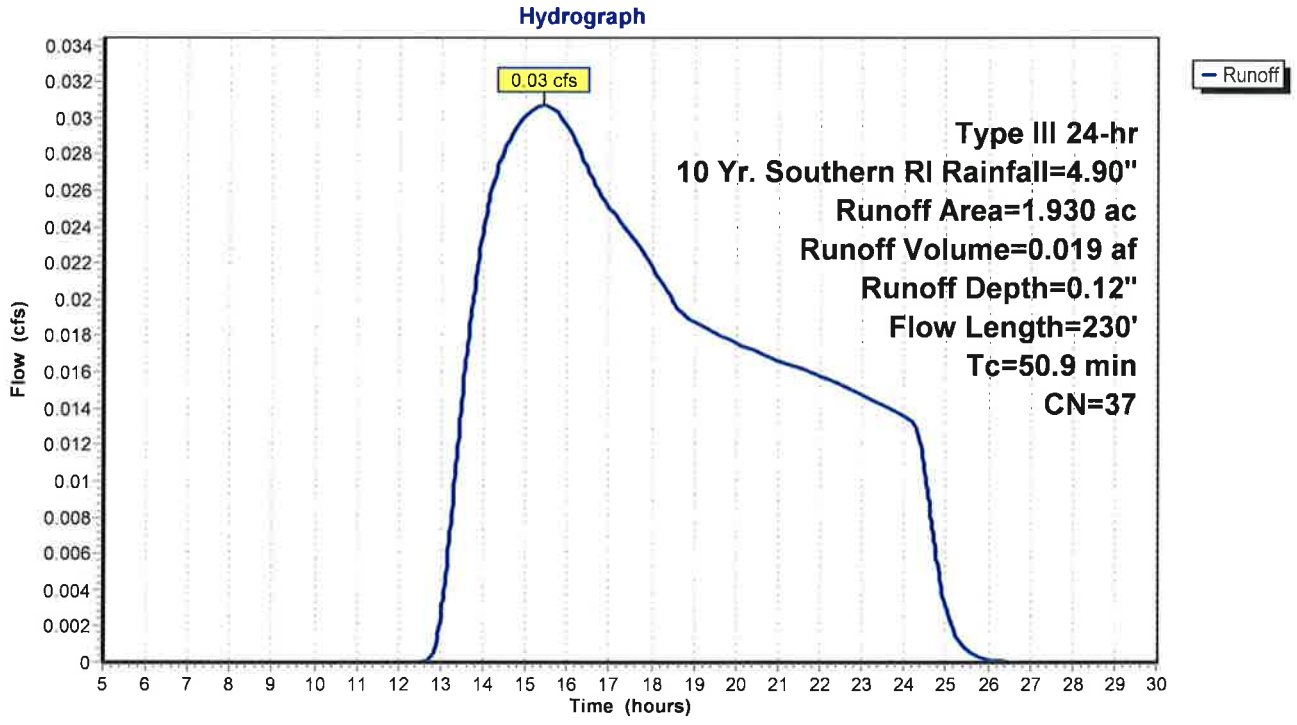
Runoff = 0.03 cfs @ 15.44 hrs, Volume= 0.019 af, Depth= 0.12"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
1.200	30	Woods, Good, HSG A
0.610	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
1.930	37	Weighted Average
1.810		93.78% Pervious Area
0.120		6.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	120	0.0330	0.06		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
1.6	110	0.0270	1.15		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
50.9	230	Total			

Subcatchment DA-2A: Drainage Area 2A



Summary for Subcatchment DA-2B: Drainage Area 2B

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

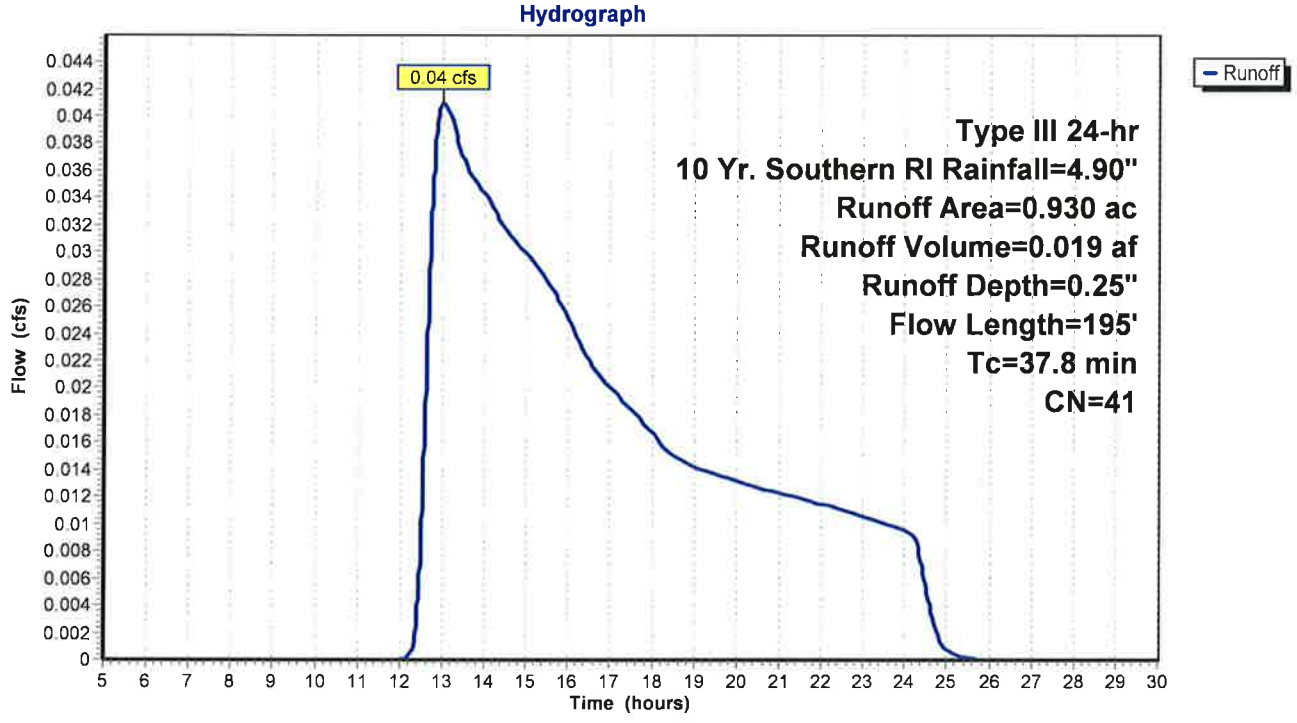
Runoff = 0.04 cfs @ 12.98 hrs, Volume= 0.019 af, Depth= 0.25"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
0.600	30	Woods, Good, HSG A
0.210	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
0.930	41	Weighted Average
0.810		87.10% Pervious Area
0.120		12.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	130	0.1150	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.6	65	0.0600	1.71		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
37.8	195	Total			

Subcatchment DA-2B: Drainage Area 2B



Summary for Subcatchment DA-2C: Drainage Area 2C

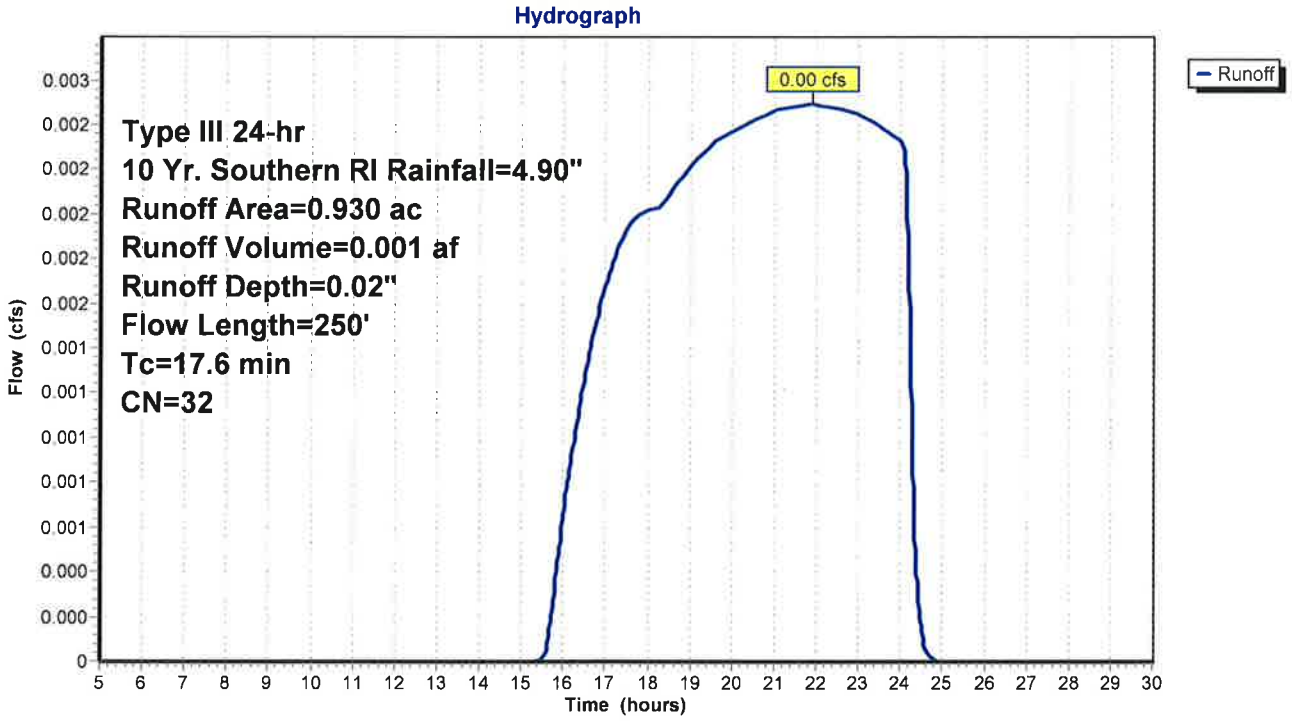
Runoff = 0.00 cfs @ 21.88 hrs, Volume= 0.001 af, Depth= 0.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 10 Yr. Southern RI Rainfall=4.90"

Area (ac)	CN	Description
0.700	30	Woods, Good, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.930	32	Weighted Average
0.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.2200	0.12		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.7	150	0.0730	0.68		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
17.6	250	Total			

Subcatchment DA-2C: Drainage Area 2C



Summary for Pond 1P: Swale-North Side

Inflow Area = 1.930 ac, 6.22% Impervious, Inflow Depth = 0.12" for 10 Yr. Southern RI event
Inflow = 0.03 cfs @ 15.44 hrs, Volume= 0.019 af
Outflow = 0.03 cfs @ 15.44 hrs, Volume= 0.019 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.03 cfs @ 15.44 hrs, Volume= 0.019 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 102.70' @ 15.44 hrs Surf.Area= 200 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (1,095.3 - 1,095.3)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

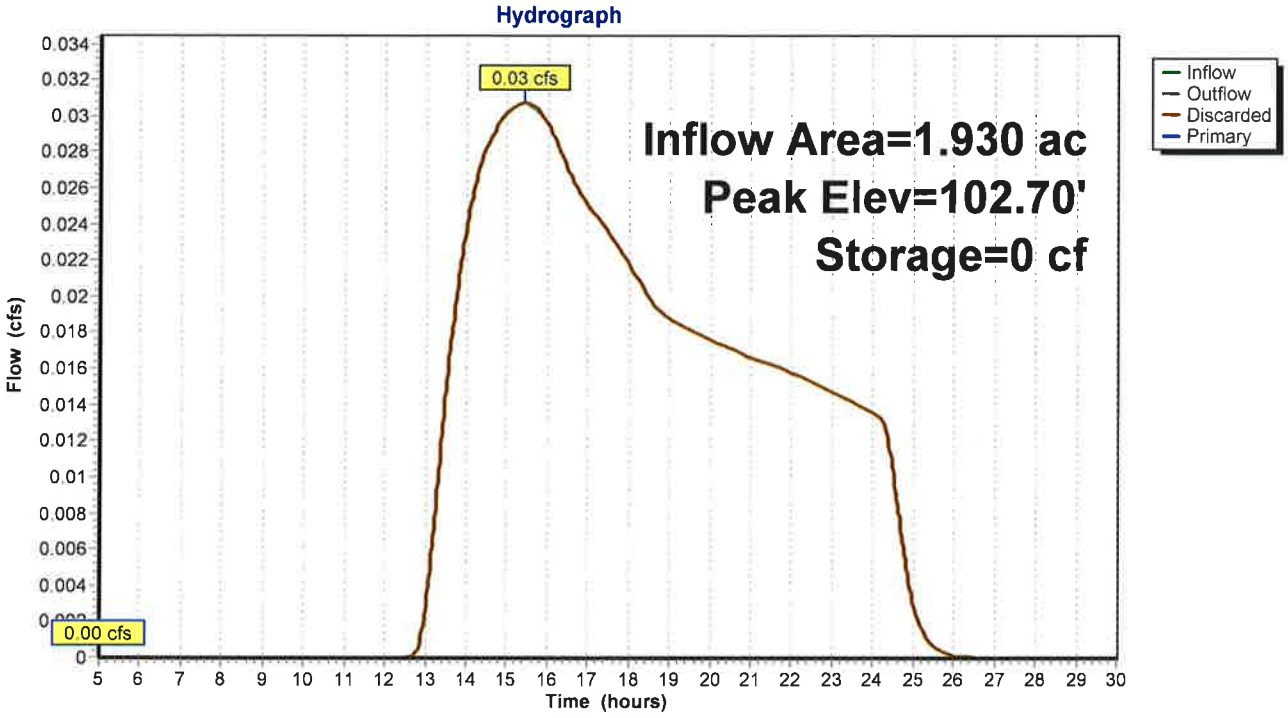
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.04 cfs @ 15.44 hrs HW=102.70' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=102.70' TW=96.75' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 1P: Swale-North Side



Summary for Pond 2P: Swale-South Side

Inflow Area = 0.930 ac, 12.90% Impervious, Inflow Depth = 0.25" for 10 Yr. Southern RI event
Inflow = 0.04 cfs @ 12.98 hrs, Volume= 0.019 af
Outflow = 0.04 cfs @ 13.25 hrs, Volume= 0.019 af, Atten= 4%, Lag= 16.3 min
Discarded = 0.04 cfs @ 13.25 hrs, Volume= 0.019 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 102.71' @ 13.25 hrs Surf.Area= 204 sf Storage= 2 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.1 min (1,019.5 - 1,019.4)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

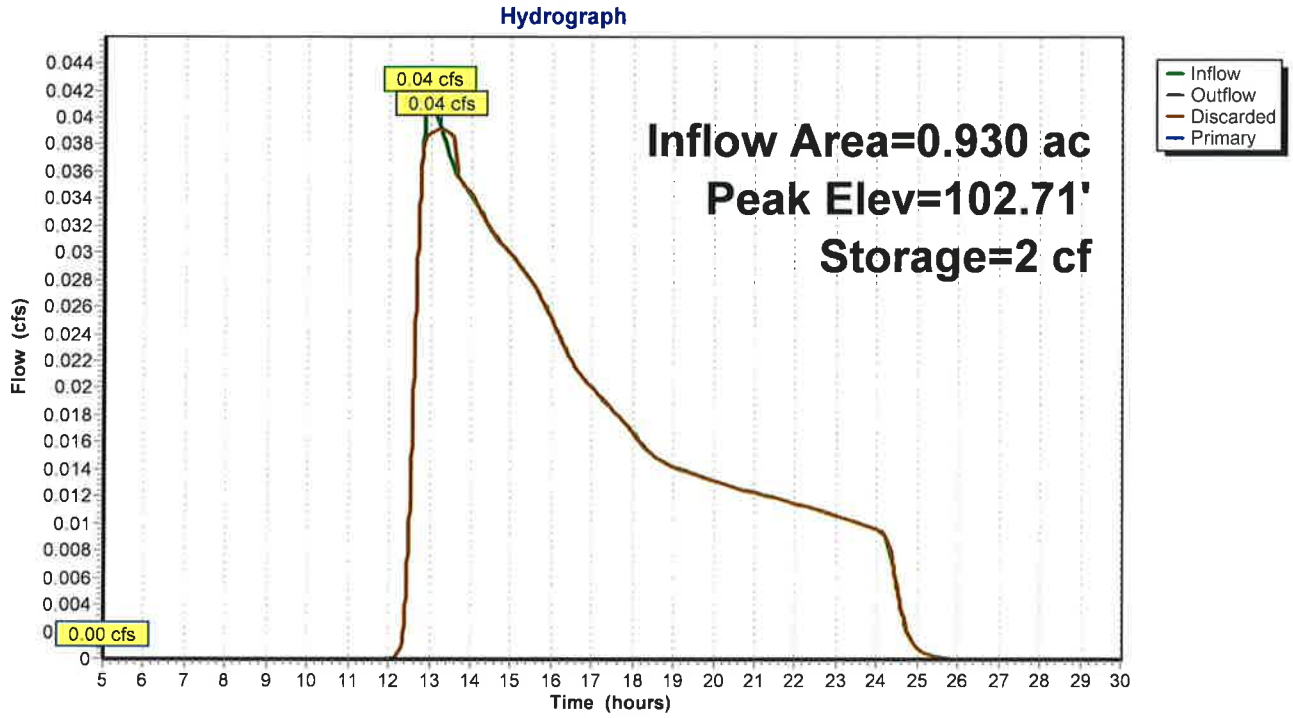
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.04 cfs @ 13.25 hrs HW=102.71' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.04 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=102.70' TW=96.75' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Swale-South Side



Summary for Pond 3P: Infiltration Trench

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.00" for 10 Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Outflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 96.75' @ 5.00 hrs Surf.Area= 108 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: initial storage exceeds outflow)
Center-of-Mass det. time= (not calculated: no inflow)

Volume	Invert	Avail.Storage	Storage Description
#1	96.75'	133 cf	**6.00'W x 18.00'L x 5.25'H Prismatoid** 567 cf Overall - 236 cf Embedded = 331 cf x 40.0% Voids
#2	97.75'	177 cf	**Concrete Galley 4x4x4** x 4 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	102.00'	1,728 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,038 cf	Total Available Storage

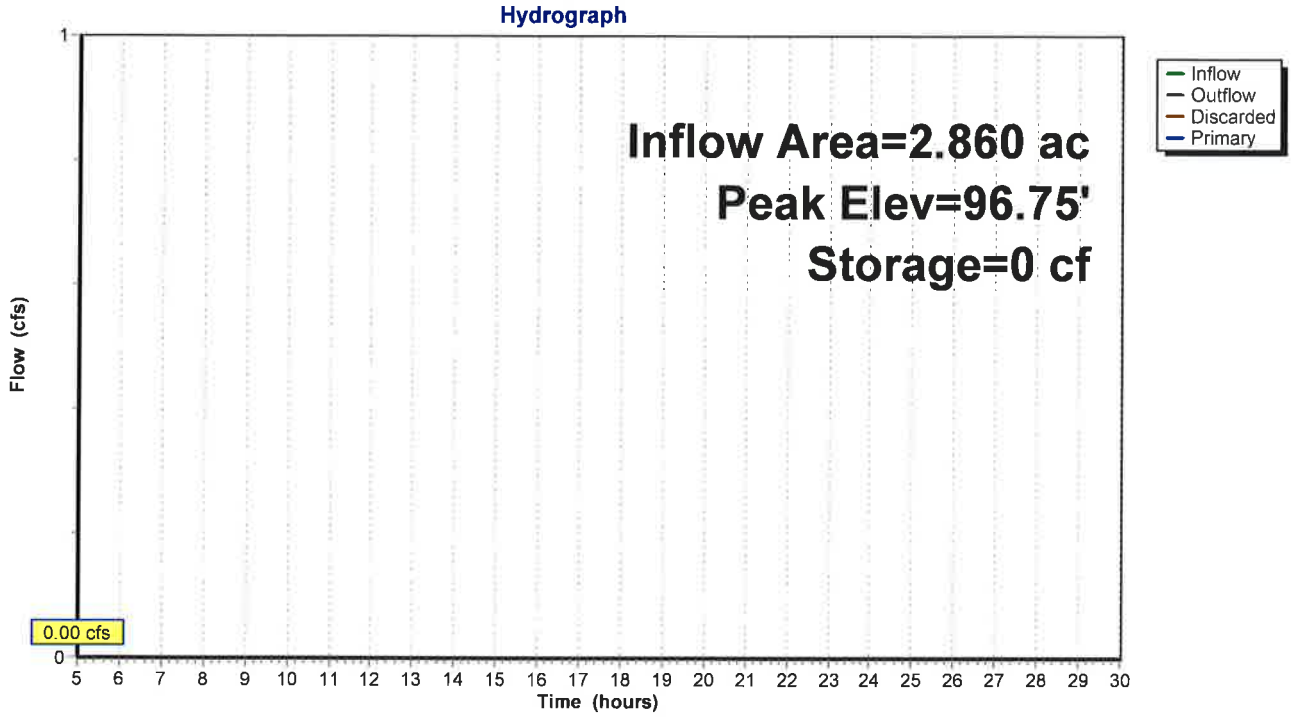
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.00	300	0	0	300
102.50	385	171	171	391
103.00	520	225	396	531
103.35	620	199	595	636
104.00	3,200	1,133	1,728	3,217

Device	Routing	Invert	Outlet Devices
#1	Discarded	96.75'	**12.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.00 cfs @ 5.00 hrs HW=96.75' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.03 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=96.75' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Infiltration Trench

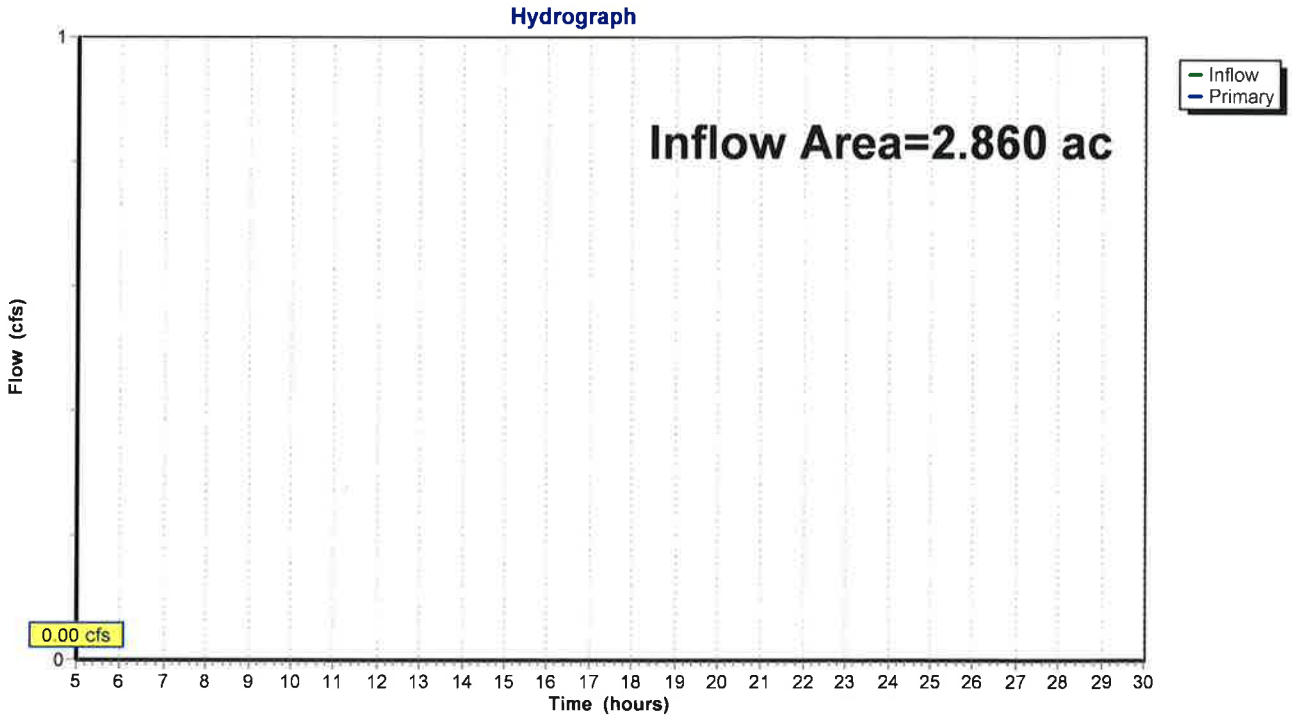


Summary for Link 1L: Total Offsite

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.00" for 10 Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



Summary for Subcatchment DA-1: Drainage Area 1

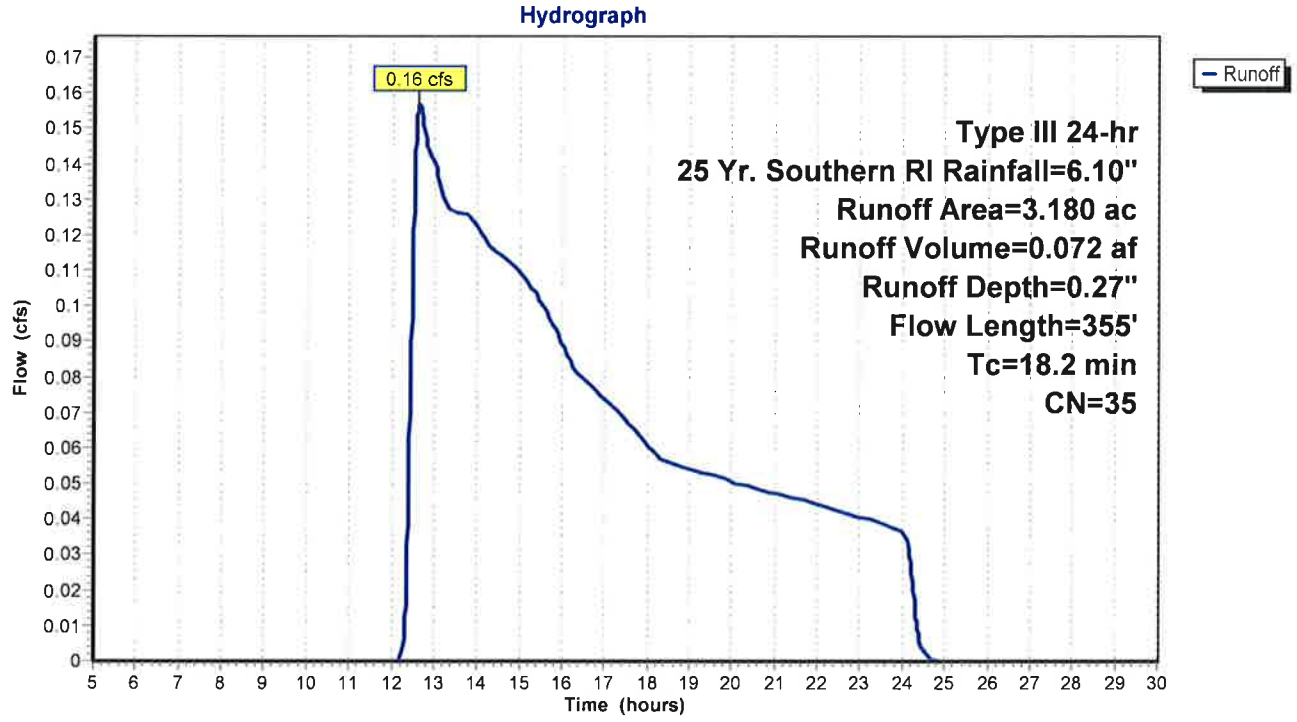
Runoff = 0.16 cfs @ 12.64 hrs, Volume= 0.072 af, Depth= 0.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
2.430	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.180	35	Weighted Average
3.050		95.91% Pervious Area
0.130		4.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	150	0.3600	0.16		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	80	0.2500	2.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.9	125	0.0480	1.10		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
18.2	355	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2A: Drainage Area 2A

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

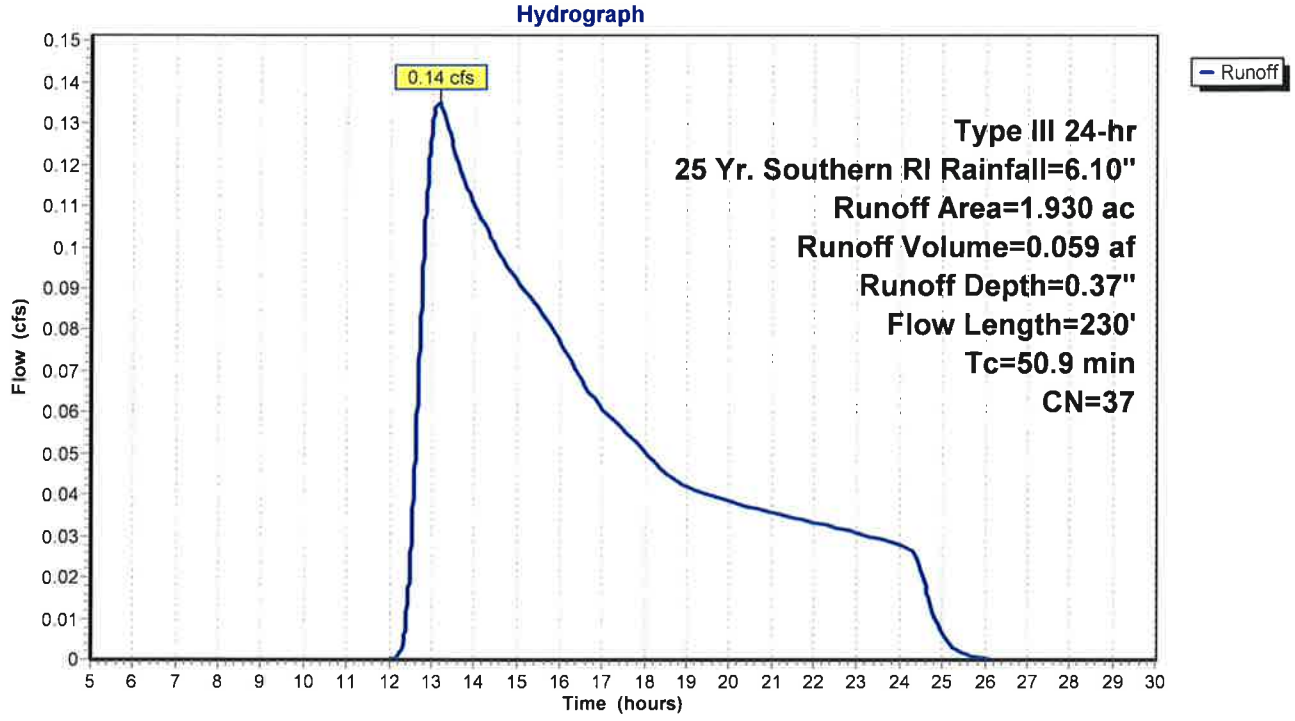
Runoff = 0.14 cfs @ 13.17 hrs, Volume= 0.059 af, Depth= 0.37"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
1.200	30	Woods, Good, HSG A
0.610	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
1.930	37	Weighted Average
1.810		93.78% Pervious Area
0.120		6.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	120	0.0330	0.06		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
1.6	110	0.0270	1.15		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
50.9	230	Total			

Subcatchment DA-2A: Drainage Area 2A



Summary for Subcatchment DA-2B: Drainage Area 2B

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

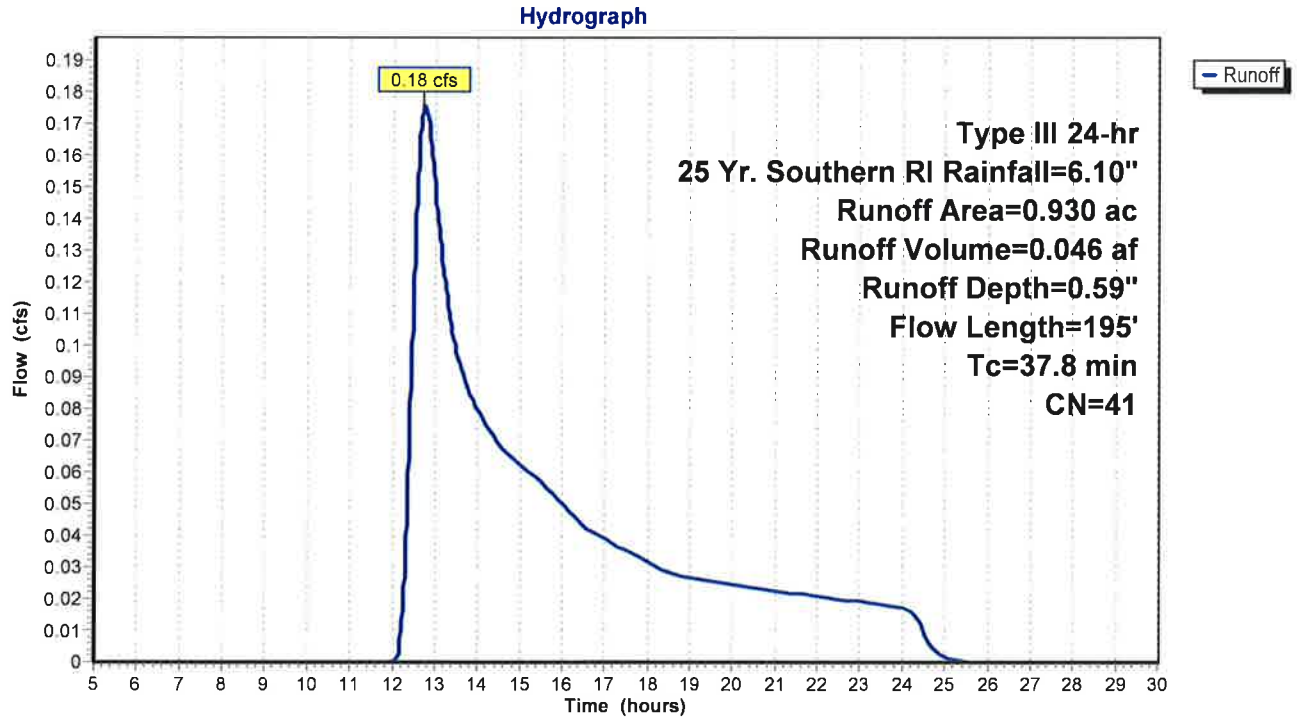
Runoff = 0.18 cfs @ 12.73 hrs, Volume= 0.046 af, Depth= 0.59"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
0.600	30	Woods, Good, HSG A
0.210	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
0.930	41	Weighted Average
0.810		87.10% Pervious Area
0.120		12.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	130	0.1150	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.6	65	0.0600	1.71		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
37.8	195	Total			

Subcatchment DA-2B: Drainage Area 2B



Summary for Subcatchment DA-2C: Drainage Area 2C

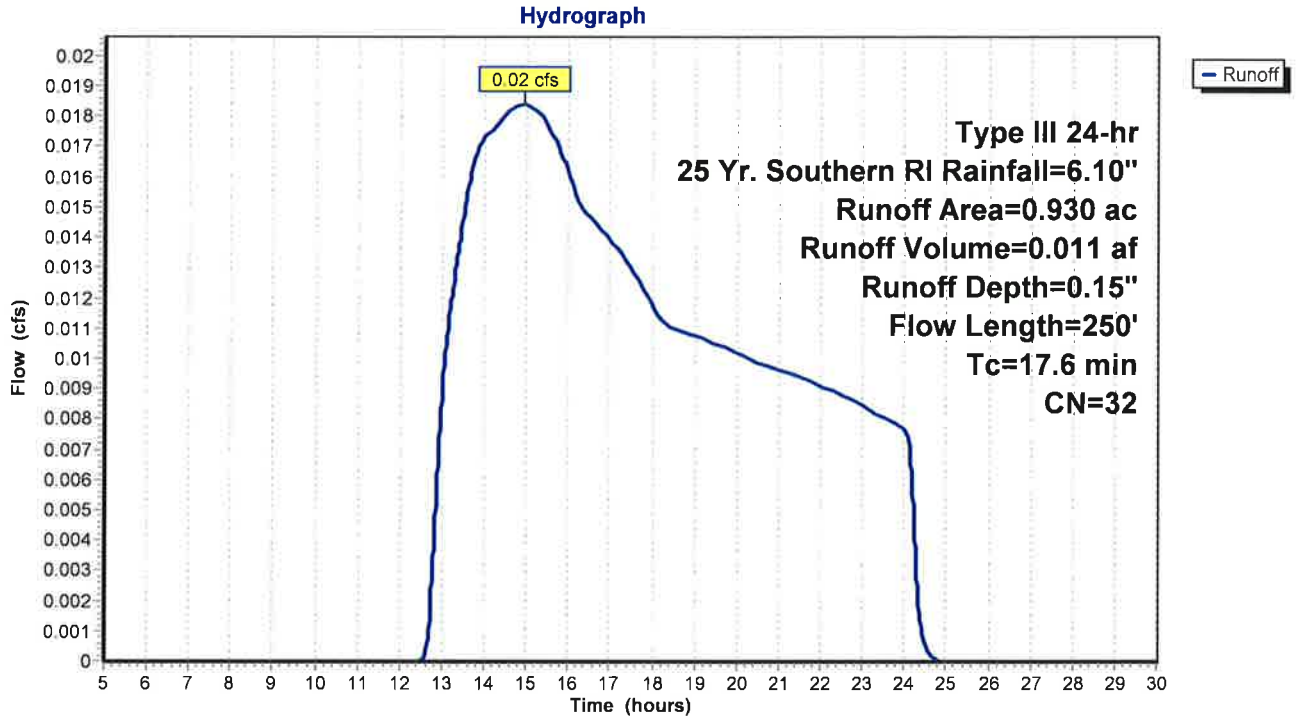
Runoff = 0.02 cfs @ 14.92 hrs, Volume= 0.011 af, Depth= 0.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 25 Yr. Southern RI Rainfall=6.10"

Area (ac)	CN	Description
0.700	30	Woods, Good, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.930	32	Weighted Average
0.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.2200	0.12		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.7	150	0.0730	0.68		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
17.6	250	Total			

Subcatchment DA-2C: Drainage Area 2C



Summary for Pond 1P: Swale-North Side

Inflow Area = 1.930 ac, 6.22% Impervious, Inflow Depth = 0.37" for 25 Yr. Southern RI event
Inflow = 0.14 cfs @ 13.17 hrs, Volume= 0.059 af
Outflow = 0.10 cfs @ 14.57 hrs, Volume= 0.059 af, Atten= 27%, Lag= 83.7 min
Discarded = 0.09 cfs @ 14.57 hrs, Volume= 0.059 af
Primary = 0.01 cfs @ 14.57 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 103.46' @ 14.57 hrs Surf.Area= 450 sf Storage= 259 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 26.7 min (1,044.3 - 1,017.5)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

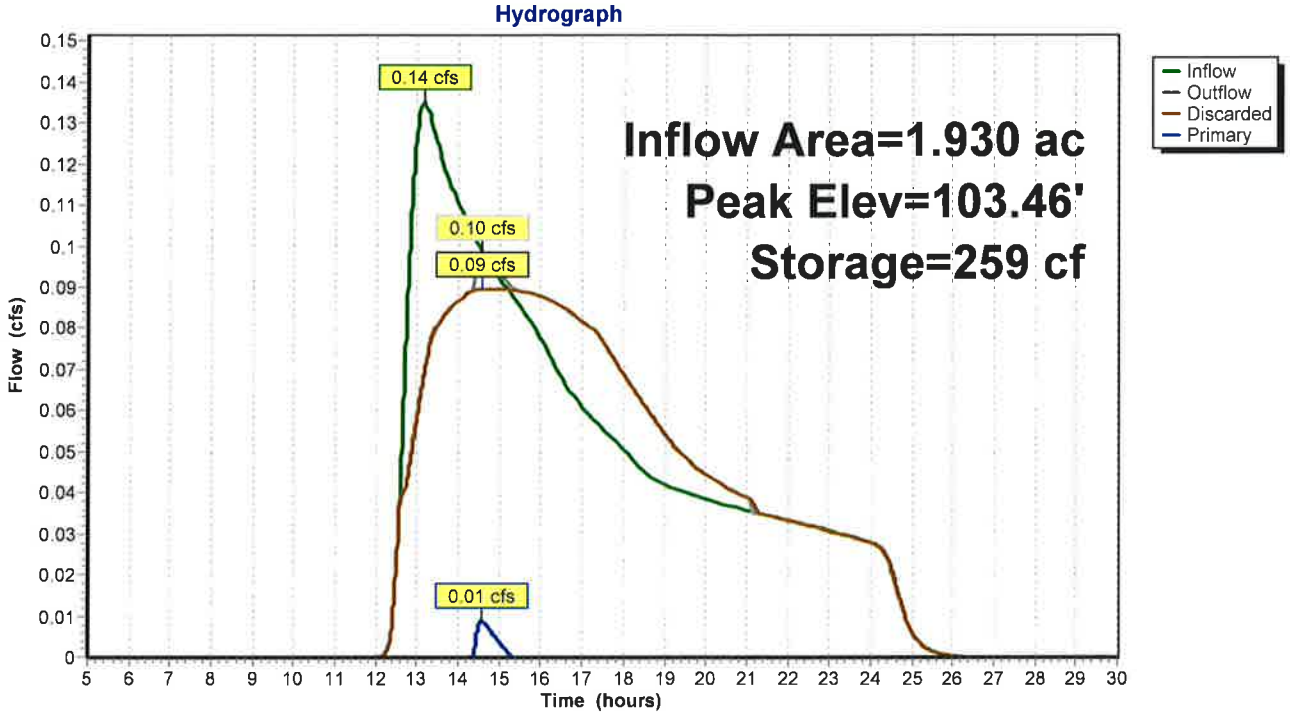
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.09 cfs @ 14.57 hrs HW=103.46' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.01 cfs @ 14.57 hrs HW=103.46' TW=96.75' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.01 cfs @ 0.23 fps)

Pond 1P: Swale-North Side



Summary for Pond 2P: Swale-South Side

Inflow Area = 0.930 ac, 12.90% Impervious, Inflow Depth = 0.59" for 25 Yr. Southern RI event
Inflow = 0.18 cfs @ 12.73 hrs, Volume= 0.046 af
Outflow = 0.09 cfs @ 13.67 hrs, Volume= 0.046 af, Atten= 49%, Lag= 56.3 min
Discarded = 0.09 cfs @ 13.67 hrs, Volume= 0.046 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 103.44' @ 13.67 hrs Surf.Area= 447 sf Storage= 251 cf

Plug-Flow detention time= 23.1 min calculated for 0.046 af (100% of inflow)
Center-of-Mass det. time= 23.0 min (992.4 - 969.3)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

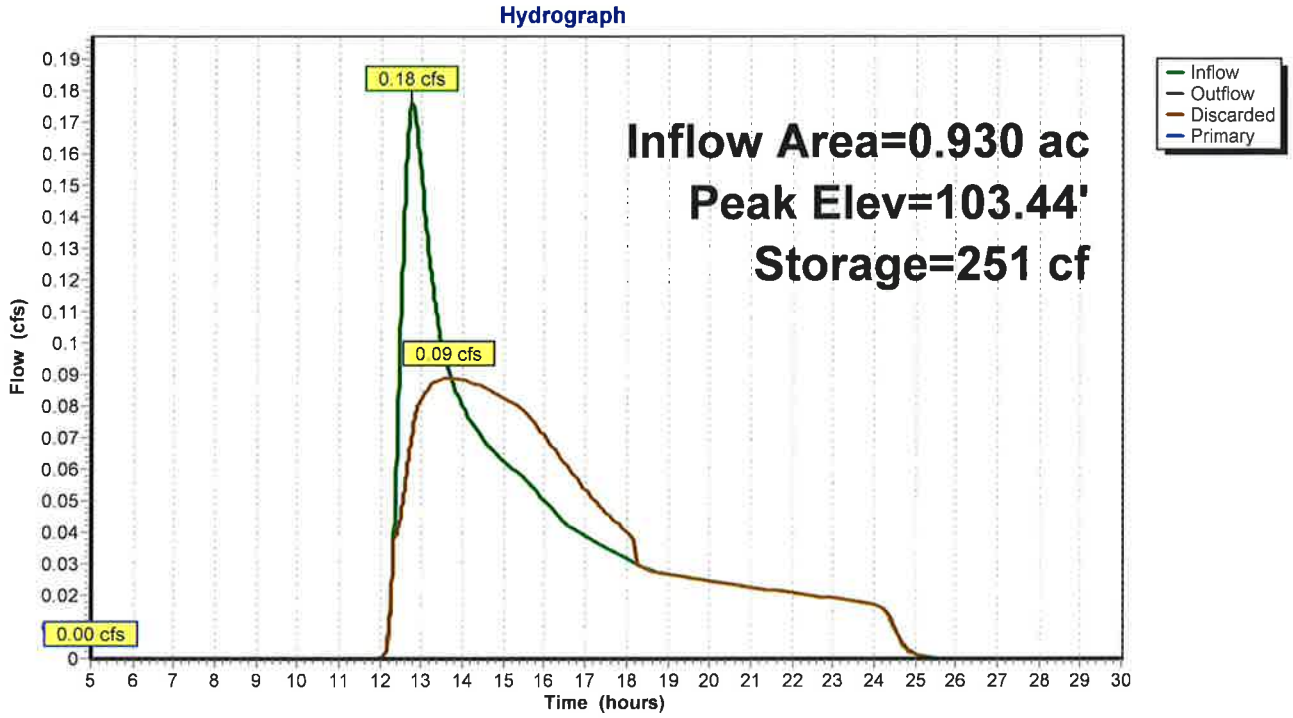
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.09 cfs @ 13.67 hrs HW=103.44' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.09 cfs)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=102.70' TW=96.75' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 2P: Swale-South Side



Summary for Pond 3P: Infiltration Trench

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.00" for 25 Yr. Southern RI event
Inflow = 0.01 cfs @ 14.57 hrs, Volume= 0.000 af
Outflow = 0.01 cfs @ 14.57 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
Discarded = 0.01 cfs @ 14.57 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 96.75' @ 5.00 hrs Surf.Area= 108 sf Storage= 0 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 0.0 min (883.8 - 883.8)

Volume	Invert	Avail.Storage	Storage Description
#1	96.75'	133 cf	**6.00'W x 18.00'L x 5.25'H Prismatoid** 567 cf Overall - 236 cf Embedded = 331 cf x 40.0% Voids
#2	97.75'	177 cf	**Concrete Galley 4x4x4** x 4 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	102.00'	1,728 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,038 cf	Total Available Storage

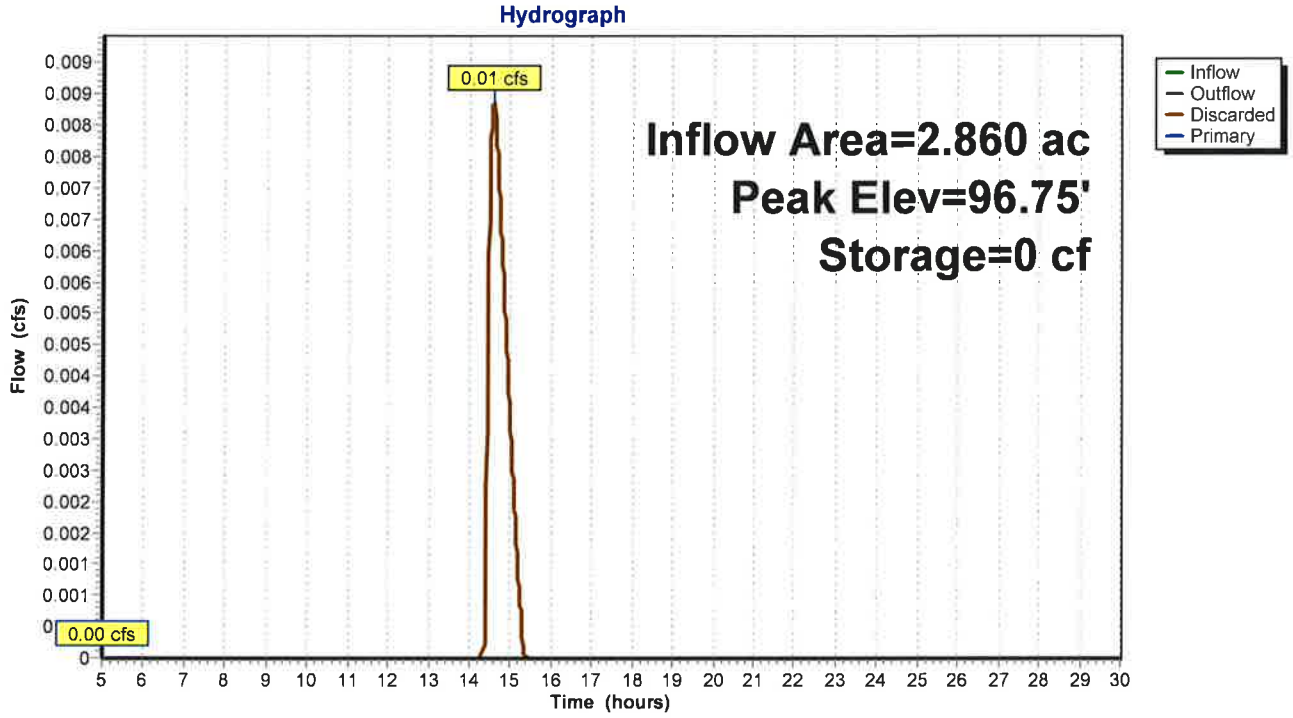
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.00	300	0	0	300
102.50	385	171	171	391
103.00	520	225	396	531
103.35	620	199	595	636
104.00	3,200	1,133	1,728	3,217

Device	Routing	Invert	Outlet Devices
#1	Discarded	96.75'	**12.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.00 cfs @ 14.57 hrs HW=96.75' (Free Discharge)
↑—**1=Exfiltration** (Passes 0.00 cfs of 0.03 cfs potential flow)

Primary OutFlow Max=0.00 cfs @ 5.00 hrs HW=96.75' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Pond 3P: Infiltration Trench

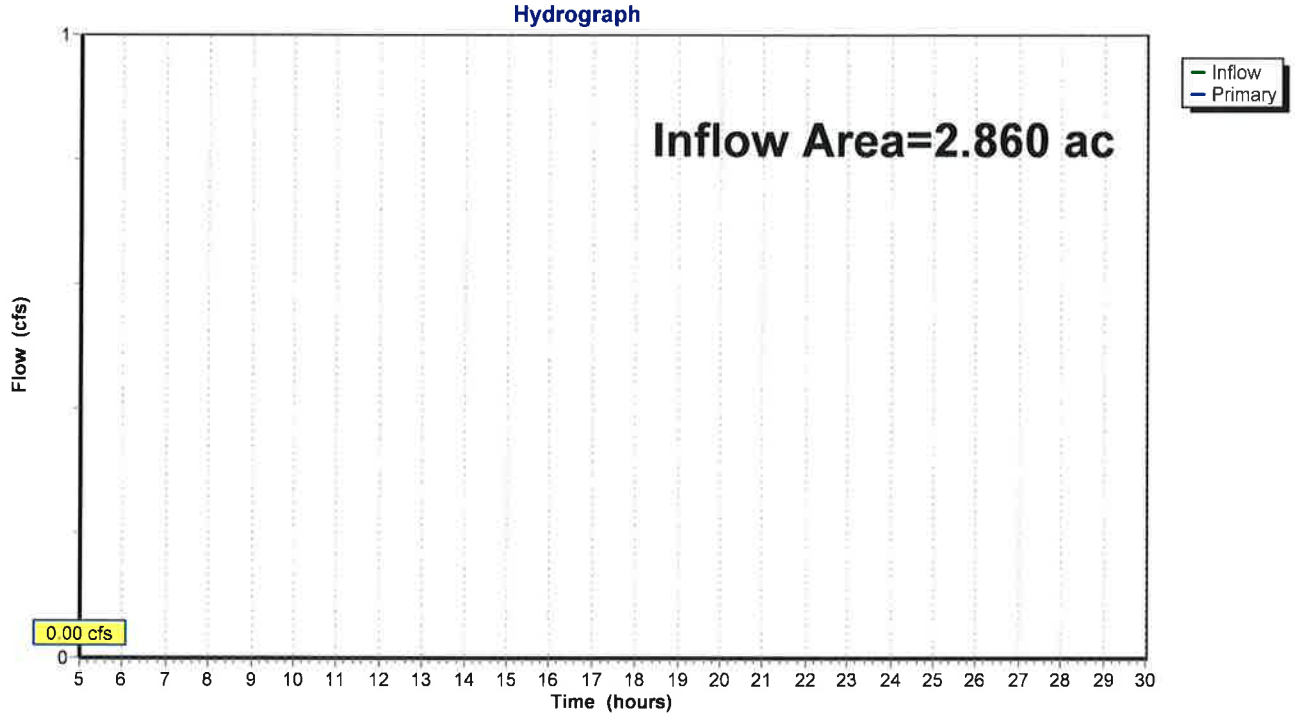


Summary for Link 1L: Total Offsite

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.00" for 25 Yr. Southern RI event
Inflow = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af
Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



Summary for Subcatchment DA-1: Drainage Area 1

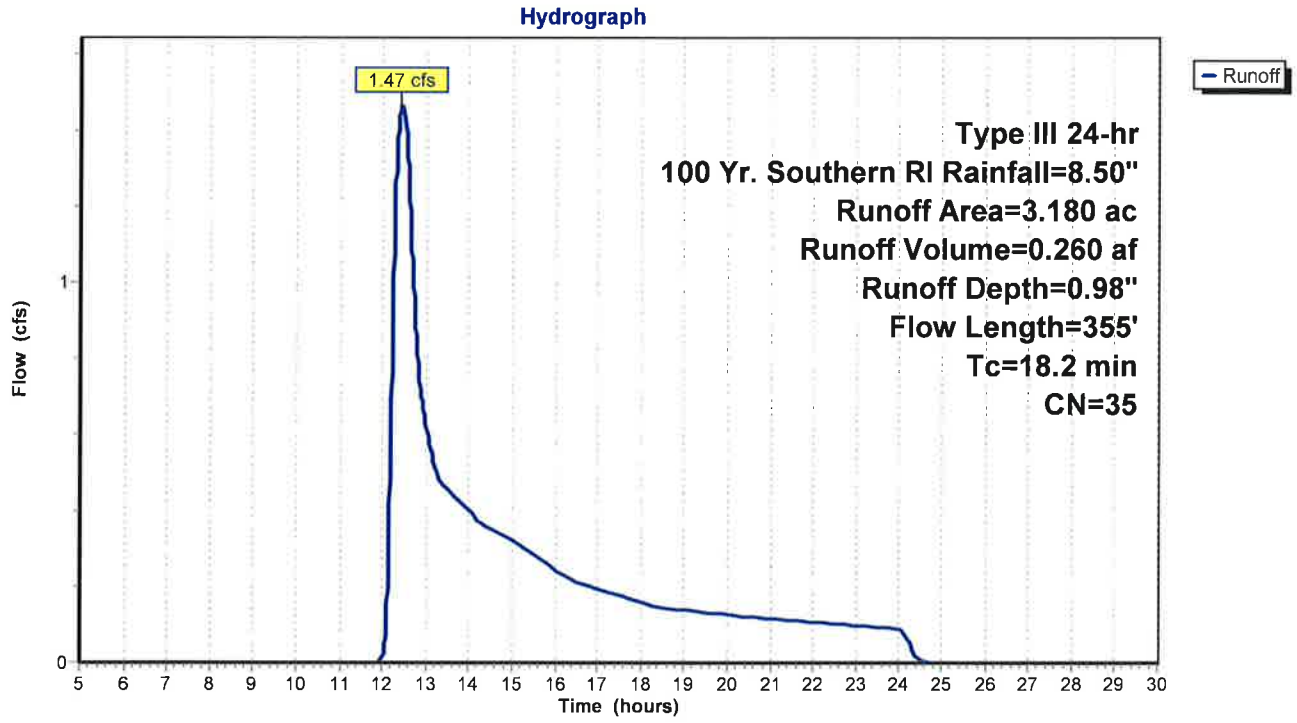
Runoff = 1.47 cfs @ 12.43 hrs, Volume= 0.260 af, Depth= 0.98"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
2.430	30	Woods, Good, HSG A
0.080	98	Paved parking, HSG A
0.050	98	Roofs, HSG A
0.620	39	>75% Grass cover, Good, HSG A
3.180	35	Weighted Average
3.050		95.91% Pervious Area
0.130		4.09% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	150	0.3600	0.16		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.5	80	0.2500	2.50		**Shallow Concentrated Flow, Tt2** Woodland Kv= 5.0 fps
1.9	125	0.0480	1.10		**Shallow Concentrated Flow, Tt3** Woodland Kv= 5.0 fps
18.2	355	Total			

Subcatchment DA-1: Drainage Area 1



Summary for Subcatchment DA-2A: Drainage Area 2A

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

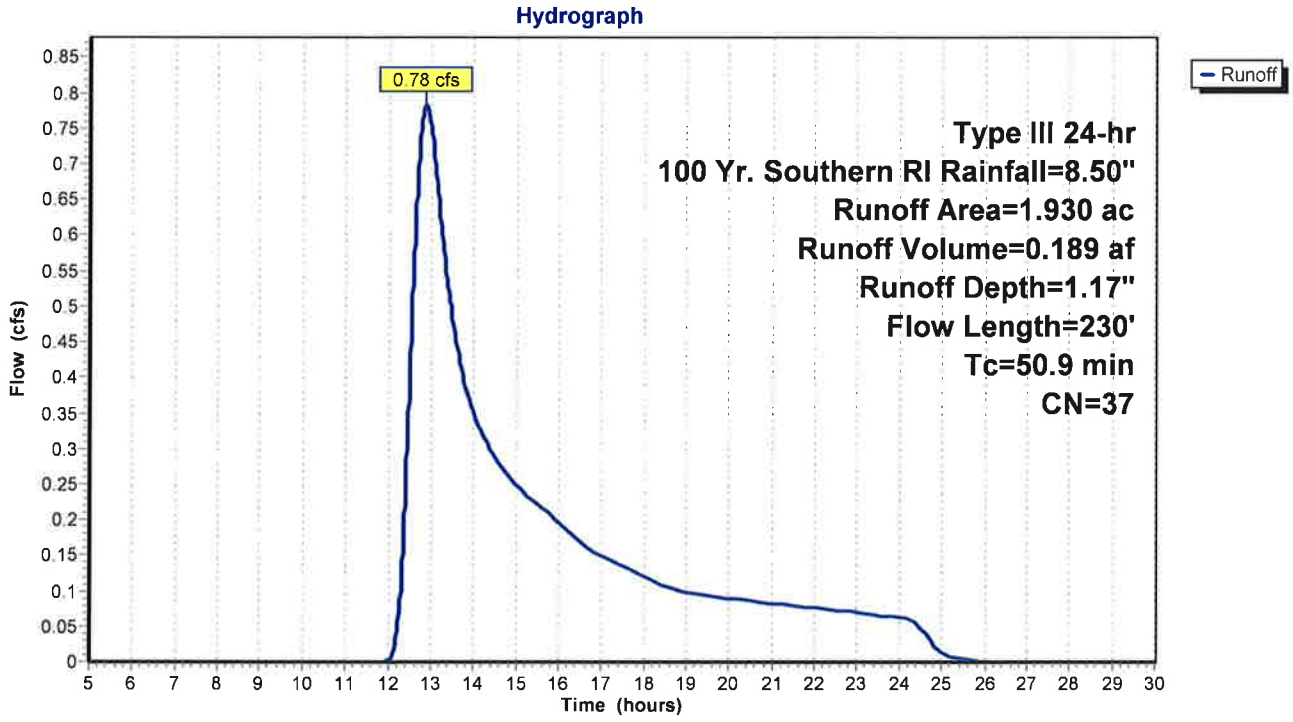
Runoff = 0.78 cfs @ 12.89 hrs, Volume= 0.189 af, Depth= 1.17"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
1.200	30	Woods, Good, HSG A
0.610	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
1.930	37	Weighted Average
1.810		93.78% Pervious Area
0.120		6.22% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
34.3	120	0.0330	0.06		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
1.6	110	0.0270	1.15		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
50.9	230	Total			

Subcatchment DA-2A: Drainage Area 2A



Summary for Subcatchment DA-2B: Drainage Area 2B

A direct input of a Tc of 12 minutes was utilized to account for check dams within the grassed swales

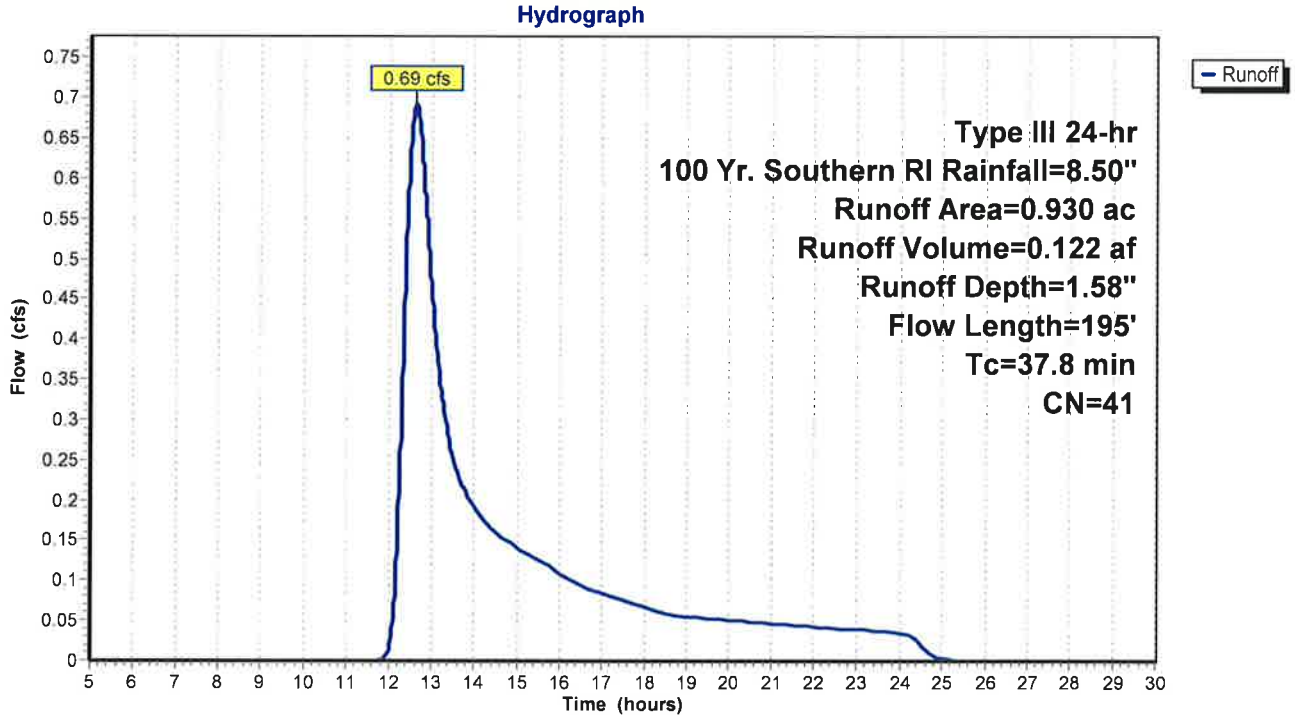
Runoff = 0.69 cfs @ 12.64 hrs, Volume= 0.122 af, Depth= 1.58"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
0.600	30	Woods, Good, HSG A
0.210	39	>75% Grass cover, Good, HSG A
0.120	98	Paved parking, HSG A
0.930	41	Weighted Average
0.810		87.10% Pervious Area
0.120		12.90% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.2	130	0.1150	0.10		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
0.6	65	0.0600	1.71		**Shallow Concentrated Flow, Tt2** Short Grass Pasture Kv= 7.0 fps
15.0					**Direct Entry, Tt3-5**
37.8	195	Total			

Subcatchment DA-2B: Drainage Area 2B



Summary for Subcatchment DA-2C: Drainage Area 2C

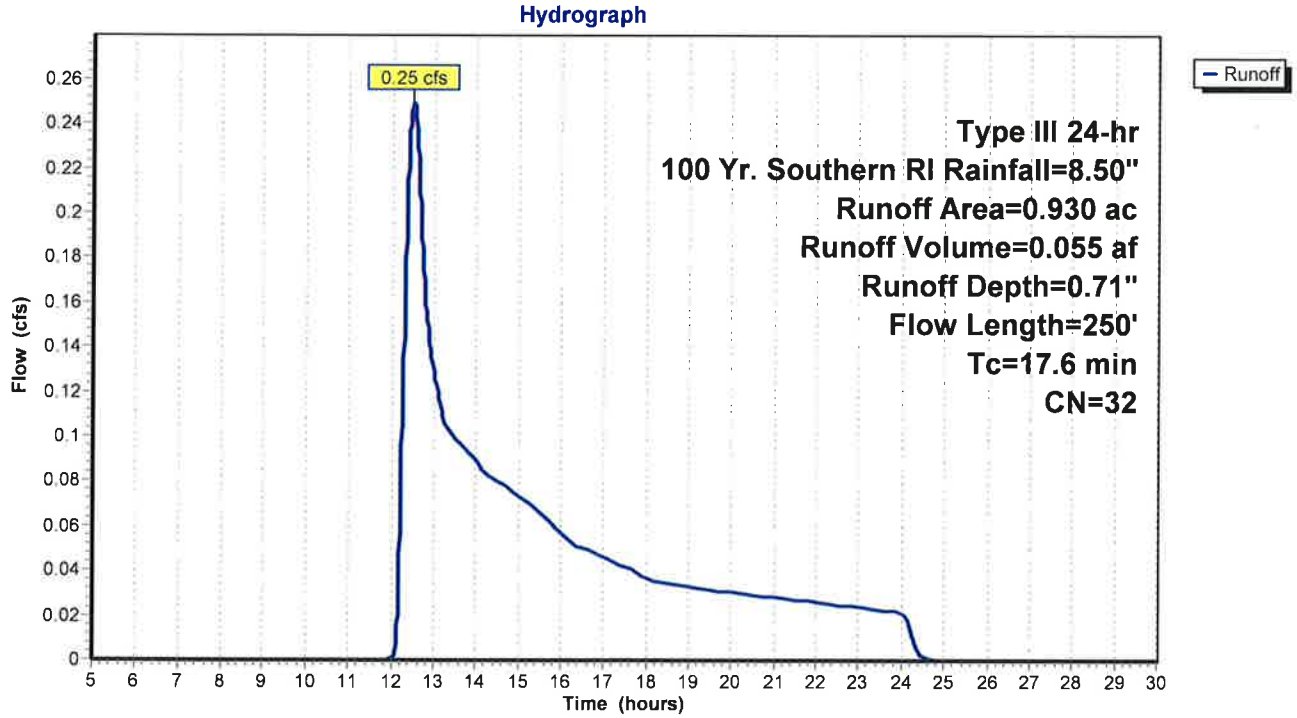
Runoff = 0.25 cfs @ 12.50 hrs, Volume= 0.055 af, Depth= 0.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Type III 24-hr 100 Yr. Southern RI Rainfall=8.50"

Area (ac)	CN	Description
0.700	30	Woods, Good, HSG A
0.230	39	>75% Grass cover, Good, HSG A
0.930	32	Weighted Average
0.930		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
13.9	100	0.2200	0.12		**Sheet Flow, Tt1** Woods: Dense underbrush n= 0.800 P2= 3.40"
3.7	150	0.0730	0.68		**Shallow Concentrated Flow, Tt2** Forest w/Heavy Litter Kv= 2.5 fps
17.6	250	Total			

Subcatchment DA-2C: Drainage Area 2C



Summary for Pond 1P: Swale-North Side

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=15)

Inflow Area = 1.930 ac, 6.22% Impervious, Inflow Depth = 1.17" for 100 Yr. Southern RI event
Inflow = 0.78 cfs @ 12.89 hrs, Volume= 0.189 af
Outflow = 0.78 cfs @ 12.84 hrs, Volume= 0.189 af, Atten= 1%, Lag= 0.0 min
Discarded = 0.10 cfs @ 13.03 hrs, Volume= 0.093 af
Primary = 0.68 cfs @ 12.84 hrs, Volume= 0.095 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 103.64' @ 13.03 hrs Surf.Area= 488 sf Storage= 346 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 22.2 min (979.0 - 956.8)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

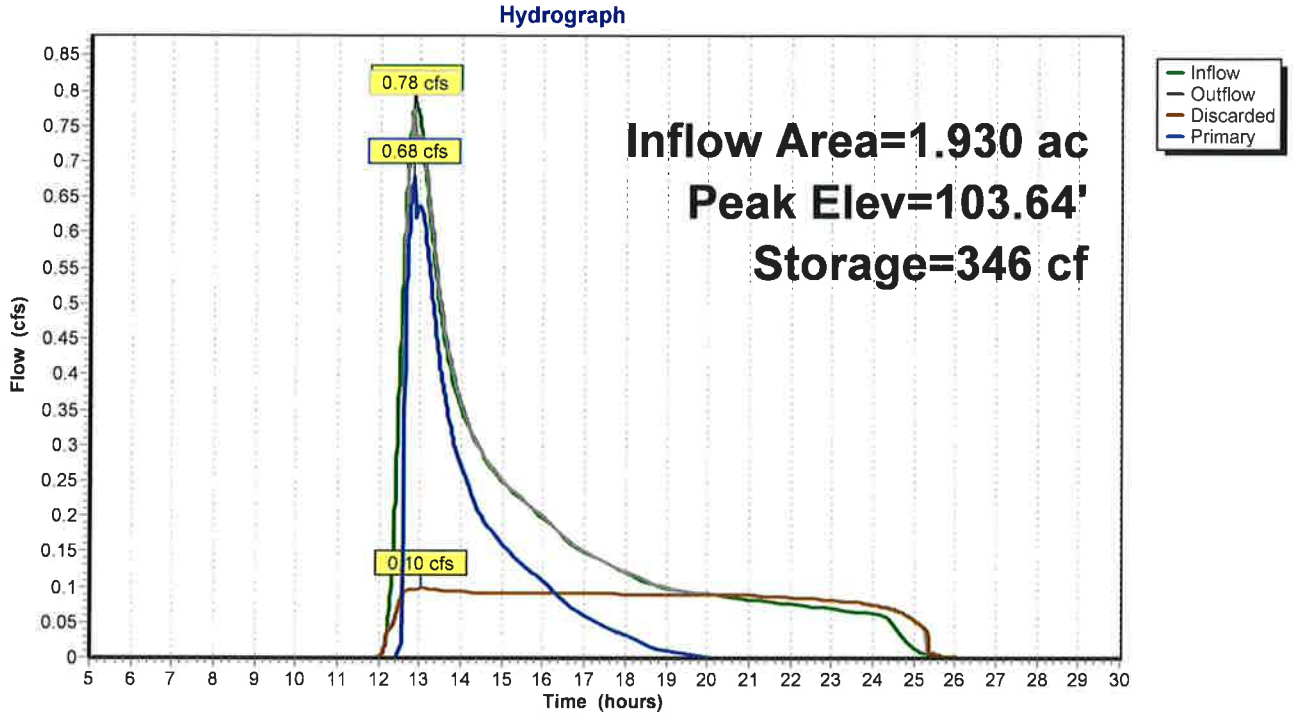
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.10 cfs @ 13.03 hrs HW=103.64' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=0.66 cfs @ 12.84 hrs HW=103.59' TW=103.47' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.66 cfs @ 0.93 fps)

Pond 1P: Swale-North Side



Summary for Pond 2P: Swale-South Side

Inflow Area = 0.930 ac, 12.90% Impervious, Inflow Depth = 1.58" for 100 Yr. Southern RI event
Inflow = 0.69 cfs @ 12.64 hrs, Volume= 0.122 af
Outflow = 0.69 cfs @ 12.65 hrs, Volume= 0.122 af, Atten= 0%, Lag= 0.8 min
Discarded = 0.10 cfs @ 13.04 hrs, Volume= 0.074 af
Primary = 0.60 cfs @ 12.65 hrs, Volume= 0.049 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 103.62' @ 13.04 hrs Surf.Area= 483 sf Storage= 335 cf

Plug-Flow detention time= 21.8 min calculated for 0.122 af (100% of inflow)
Center-of-Mass det. time= 21.8 min (947.3 - 925.5)

Volume	Invert	Avail.Storage	Storage Description
#1	102.70'	374 cf	**Custom Stage Data (Conic)** Listed below (Recalc)

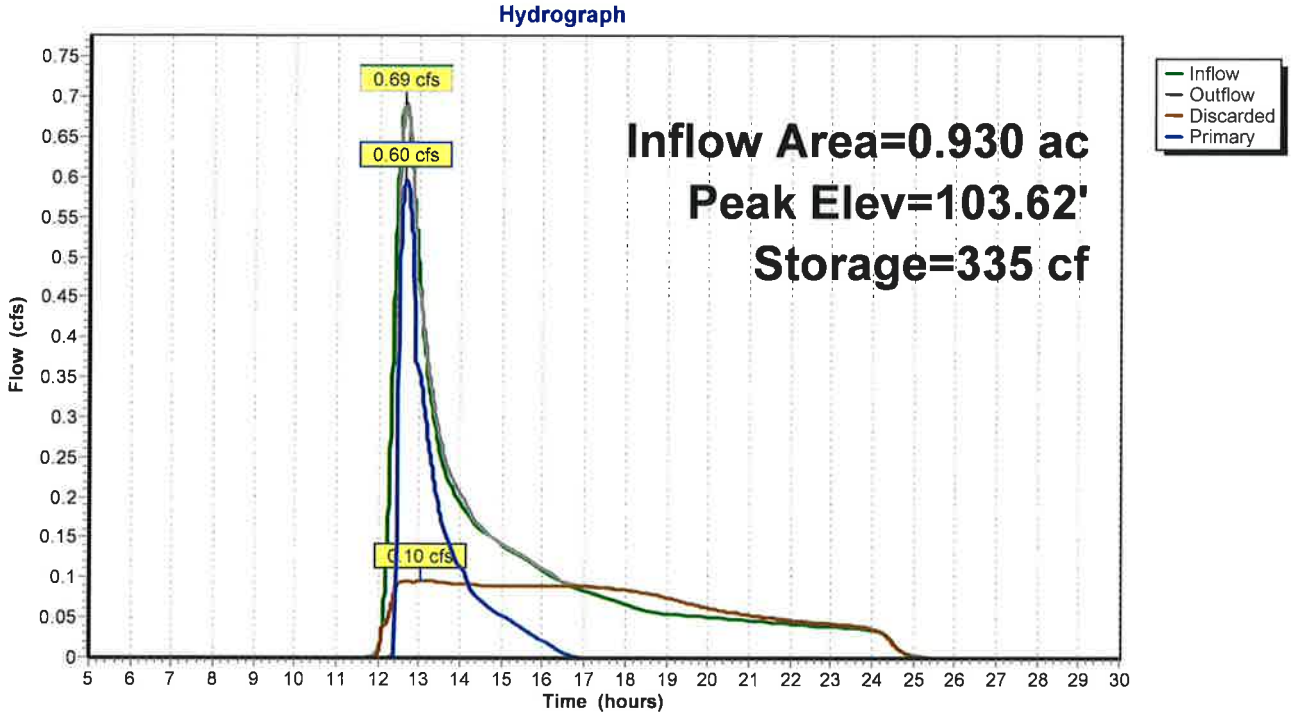
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.70	200	0	0	200
102.95	300	62	62	301
103.20	400	87	149	402
103.70	500	225	374	509

Device	Routing	Invert	Outlet Devices
#1	Discarded	102.70'	**8.300 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.45'	**5.0' long x 2.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 Coef. (English) 2.54 2.61 2.61 2.60 2.66 2.70 2.77 2.89 2.88 2.85 3.07 3.20 3.32

Discarded OutFlow Max=0.10 cfs @ 13.04 hrs HW=103.62' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.10 cfs)

Primary OutFlow Max=0.60 cfs @ 12.65 hrs HW=103.58' TW=102.29' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.60 cfs @ 0.92 fps)

Pond 2P: Swale-South Side



Summary for Pond 3P: Infiltration Trench

[87] Warning: Oscillations may require smaller dt or Finer Routing (severity=30)

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.60" for 100 Yr. Southern RI event
Inflow = 1.20 cfs @ 12.78 hrs, Volume= 0.144 af
Outflow = 0.97 cfs @ 13.05 hrs, Volume= 0.144 af, Atten= 19%, Lag= 16.1 min
Discarded = 0.54 cfs @ 13.05 hrs, Volume= 0.126 af
Primary = 0.43 cfs @ 13.05 hrs, Volume= 0.018 af

Routing by Dyn-Stor-Ind method, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs
Peak Elev= 103.61' @ 13.05 hrs Surf.Area= 1,523 sf Storage= 1,164 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)
Center-of-Mass det. time= 34.0 min (868.8 - 834.8)

Volume	Invert	Avail.Storage	Storage Description
#1	96.75'	133 cf	**6.00'W x 18.00'L x 5.25'H Prismatoid** 567 cf Overall - 236 cf Embedded = 331 cf x 40.0% Voids
#2	97.75'	177 cf	**Concrete Galley 4x4x4** x 4 Inside #1 Inside= 42.0"W x 43.0"H => 12.67 sf x 3.50'L = 44.3 cf Outside= 52.8"W x 48.0"H => 14.72 sf x 4.00'L = 58.9 cf
#3	102.00'	1,728 cf	**Custom Stage Data (Conic)** Listed below (Recalc)
		2,038 cf	Total Available Storage

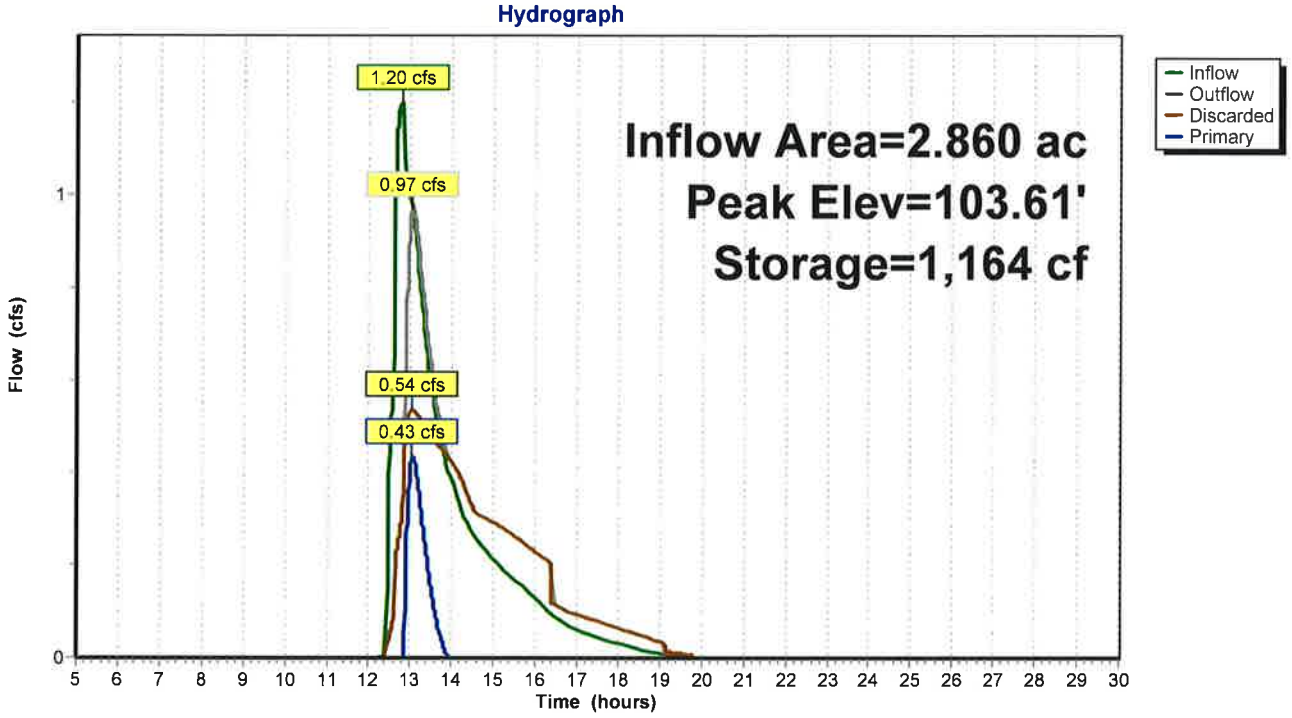
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
102.00	300	0	0	300
102.50	385	171	171	391
103.00	520	225	396	531
103.35	620	199	595	636
104.00	3,200	1,133	1,728	3,217

Device	Routing	Invert	Outlet Devices
#1	Discarded	96.75'	**12.000 in/hr Exfiltration over Wetted area** Conductivity to Groundwater Elevation = 80.00'
#2	Primary	103.50'	**5.0' long x 5.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 5.00 5.50 Coef. (English) 2.34 2.50 2.70 2.68 2.68 2.66 2.65 2.65 2.65 2.65 2.67 2.66 2.68 2.70 2.74 2.79 2.88

Discarded OutFlow Max=0.54 cfs @ 13.05 hrs HW=103.61' (Free Discharge)
↑—**1=Exfiltration** (Controls 0.54 cfs)

Primary OutFlow Max=0.43 cfs @ 13.05 hrs HW=103.61' TW=0.00' (Dynamic Tailwater)
↑—**2=Broad-Crested Rectangular Weir** (Weir Controls 0.43 cfs @ 0.78 fps)

Pond 3P: Infiltration Trench

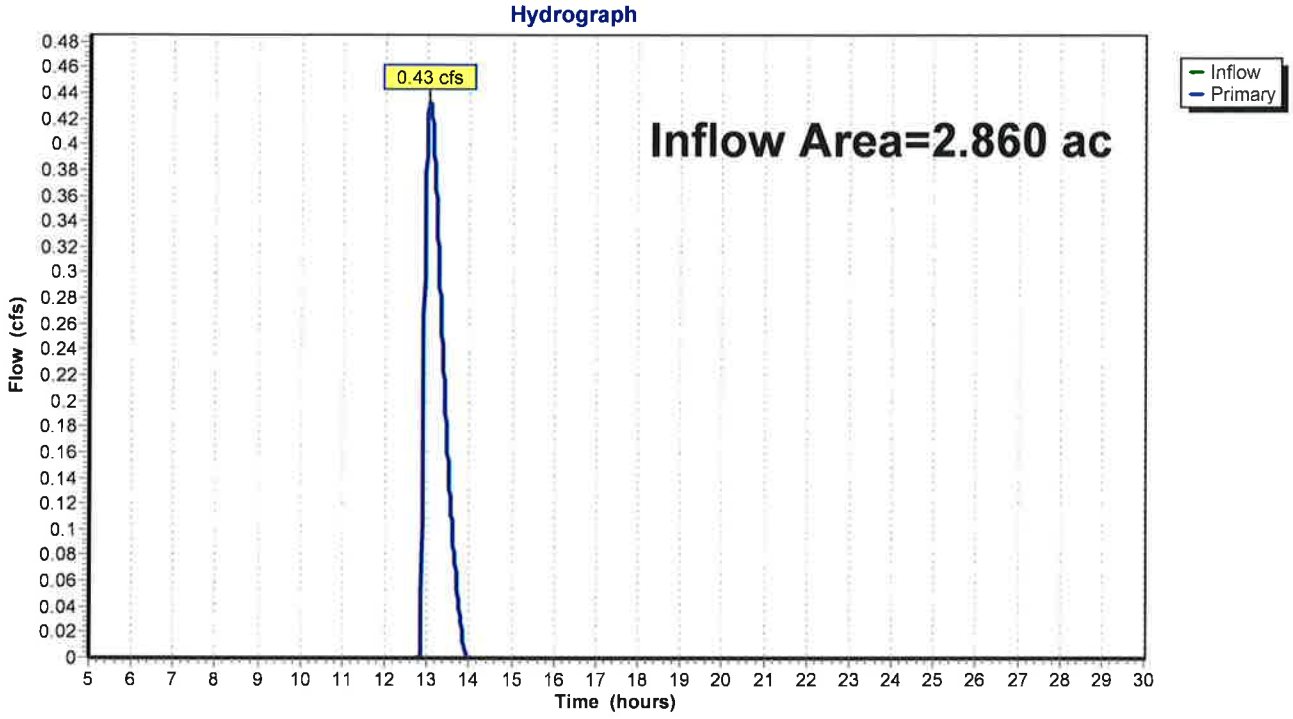


Summary for Link 1L: Total Offsite

Inflow Area = 2.860 ac, 8.39% Impervious, Inflow Depth = 0.08" for 100 Yr. Southern RI event
Inflow = 0.43 cfs @ 13.05 hrs, Volume= 0.018 af
Primary = 0.43 cfs @ 13.05 hrs, Volume= 0.018 af, Atten= 0%, Lag= 0.0 min

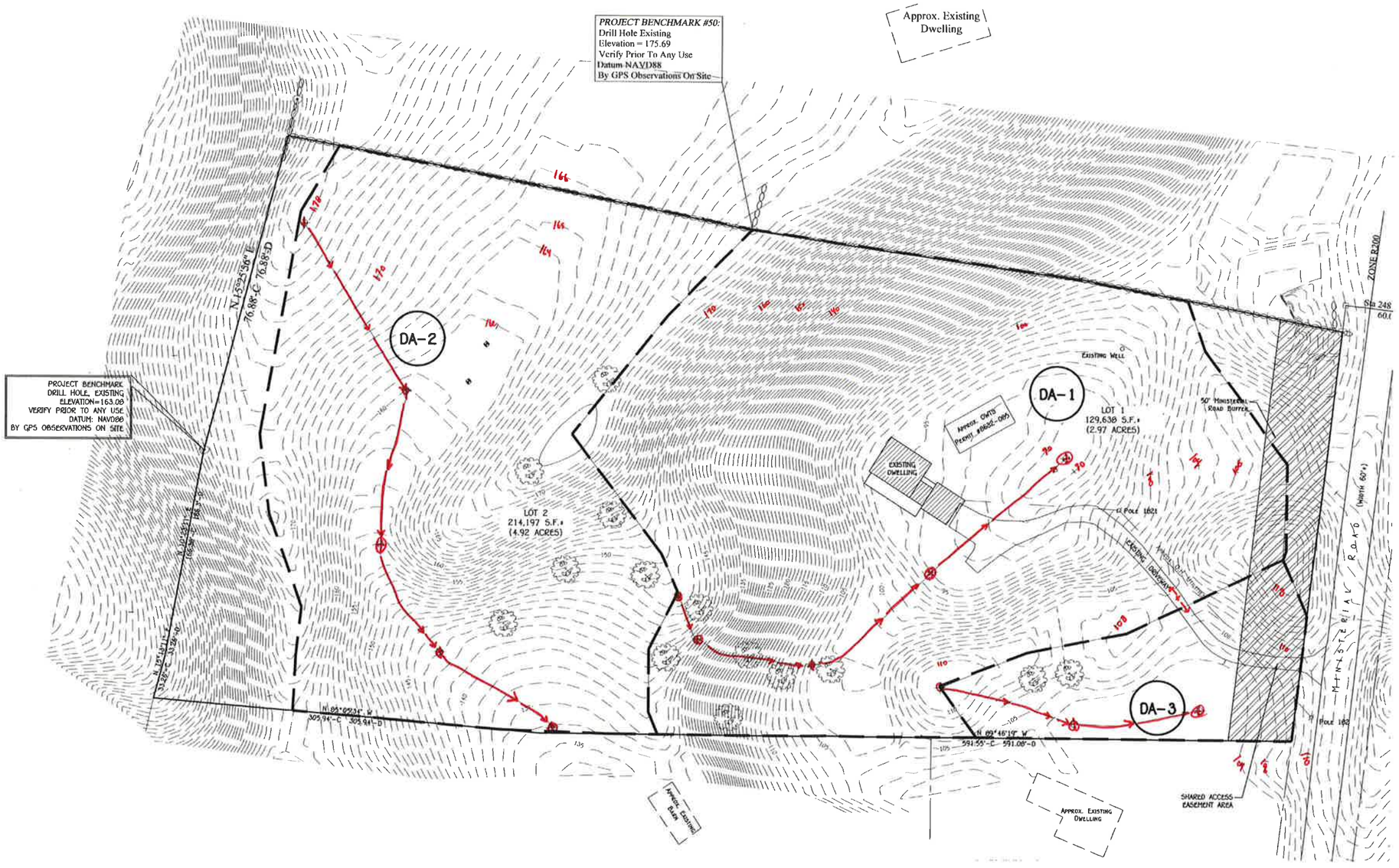
Primary outflow = Inflow, Time Span= 5.00-30.00 hrs, dt= 0.01 hrs

Link 1L: Total Offsite



ATTACHMENT 4

DRAINAGE AREA MAPS



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CIVIL

PRE DEVELOPMENT DRAINAGE AREA MAP

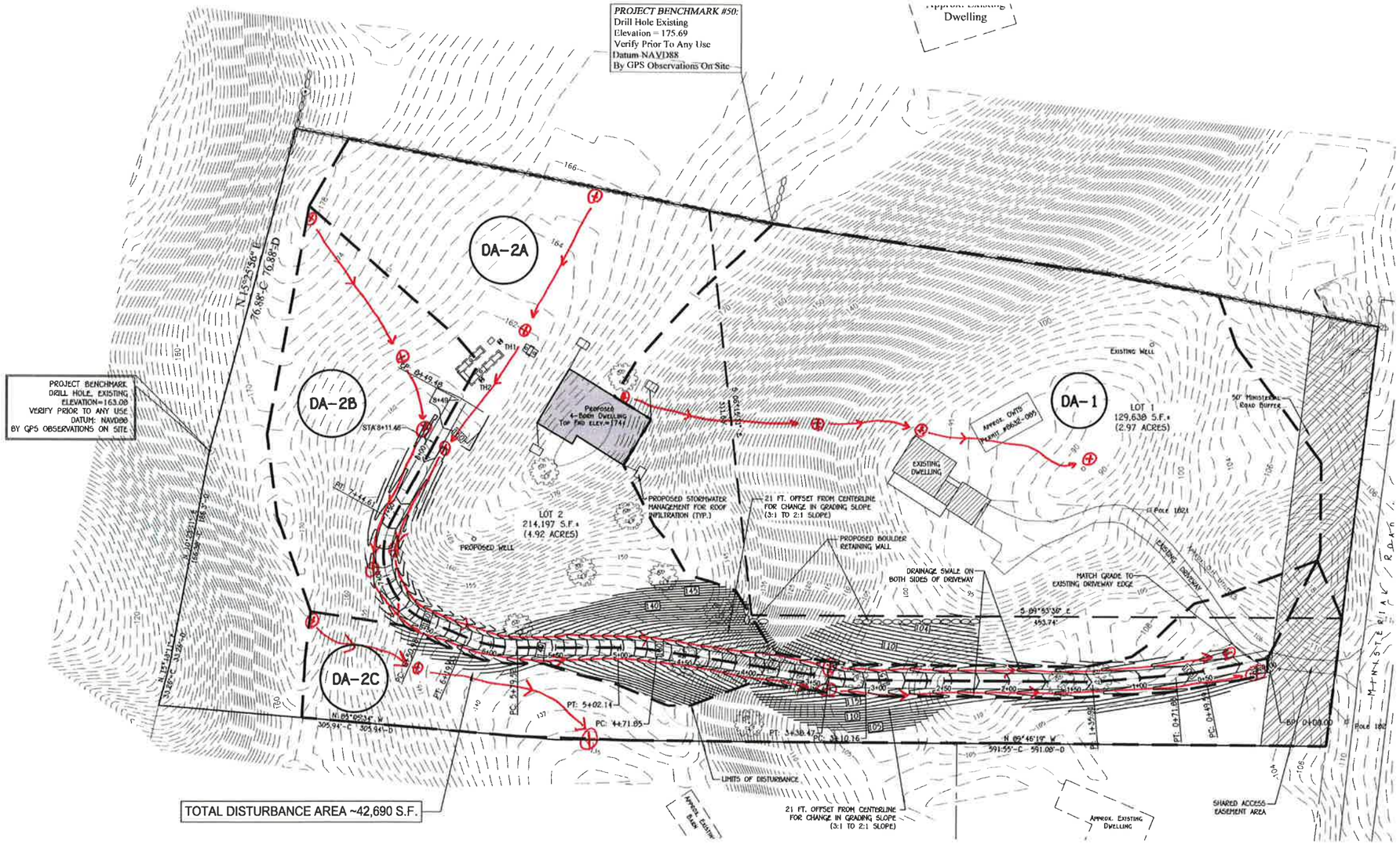
PREPARED FOR

LEE G. HEMMERLE, TRUST

350 MINISTERIAL ROAD – PLAT 74, LOT 7
SOUTH KINGSTOWN, RHODE ISLAND

SCALE: 1"=40' APRIL 20, 2022 JOB I.D. NO. 21-032

PREPARED BY
ON-SITE ENGINEERING, INC.
3 CRESTVIEW DRIVE
WESTERLY, RHODE ISLAND 02891
TELE.: 401-348-6831



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POST DEVELOPMENT DRAINAGE AREA MAP

PREPARED FOR

LEE G. HEMMERLE, TRUST

350 MINISTERIAL ROAD – PLAT 74, LOT 7

SOUTH KINGSTOWN, RHODE ISLAND

SCALE: 1"=40' APRIL 20, 2022 JOB I.D. NO. 21-032

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