



ENGINEERING DESIGN ASSOCIATES, P.A.

ENGINEERS ENVIRONMENTAL PLANNERS LANDSCAPE ARCHITECTS

**STORMWATER MANAGEMENT
REPORT
FOR
BLOCK 262, LOT 11.14
TOWNSHIP OF DENNIS
CAPE MAY COUNTY, NJ**

EDA #10024

A handwritten signature in black ink, appearing to read 'Joseph H. Maffei', is written over a horizontal line. The signature is stylized and cursive.

Joseph H. Maffei P.E., R.P.

4/30/24
Date
N.J.P.E. License #37894

STORMWATER MANAGEMENT CALCULATIONS
19 CLERMONT DRIVE SITE PLAN
BLOCK 262, LOT 11.14, DENNIS TOWNSHIP

Existing Conditions

The 1.04 acre property IS vacant and partially wooded. The remainder of the lot is cleared and covered with broken stone, used as a parking area. The existing soil is Downer sandy loam. A small section of woods towards the north of the property also flows onto the site. Runoff from the site flows in a southerly direction to an existing inlet in Clermont Drive.

Drainage Design

It is the intent of the applicant to construct a 3,000 SF building and 1,500 SF lean-to. Fourteen parking spaces and a large loading area will be paved with stone and/or clamshells. Stormwater runoff will be directed overland to two infiltration basins. The basins will release runoff at a controlled rate to the Clermont Drive right-of-way where it will follow existing drainage patterns.

Drainage Calculations

The drainage calculations were derived using the Delmarva TR-55 Method of Hydrology for 24 Hour Type II Storms. The NJDEP Current Precipitation Adjustment Factors were applied to NOAA Type C rainfall depths. The attached summary and calculations demonstrate that the proposed drainage system meets or exceeds the standards set for runoff quality, quantity and infiltration.

Stormwater Runoff Summary per Subchapter 5

Stormwater Rate Reduction per NJAC 7:8-5.4(a)3.iii

Storm	Pre Development Peak Rate	Post Development Peak Flow	Post Development Routed Flow	% of Pre Development (Routed Flow)
2	0.64	1.56	0.01	1.6%
10	1.47	3.5	0.41	27.9%
100	3.44	6.55	2.73	79.4%

The drainage system releases stormwater stored in the basin #1 at rates less than 50%, 75% and 80% of the pre-development peak rate.

Stormwater Infiltration per NJAC 7:8-5.4(a)2.1(2)

2 Year Storm	Pre Development Volume	Post Development Volume	Difference	Basin Volume prior Release
Basin 2	1220	4772	3552	4,758

The volume of the basins prior to the release is greater than the volume of difference between the post and pre-development storms.

Stormwater Quality per NJAC 7:8-5.5

1.25" over 2 Hr.

Storm	Peak Elev.	Orifice Elevation	Release
Basin 2	18.48	20.28	0

The 1.25 inch of rainfall in two hours water quality design storm is retained in both basins, meeting the 80% TSS removal requirement for the storm event. Runoff from this storm will be infiltrated into the surrounding soil.



NOAA Atlas 14, Volume 2, Version 3
 Location name: Cape May Court House, New Jersey, USA*
 Latitude: 39.1485°, Longitude: -74.7601°
 Elevation: 21 ft**
 * source: ESRI Maps
 ** source: USGS



POINT PRECIPITATION FREQUENCY ESTIMATES

G.M. Bonnin, D. Martin, B. Lin, T. Parzybok, M.Yekta, and D. Riley

NOAA, National Weather Service, Silver Spring, Maryland

[PF tabular](#) | [PF graphical](#) | [Maps & aerals](#)

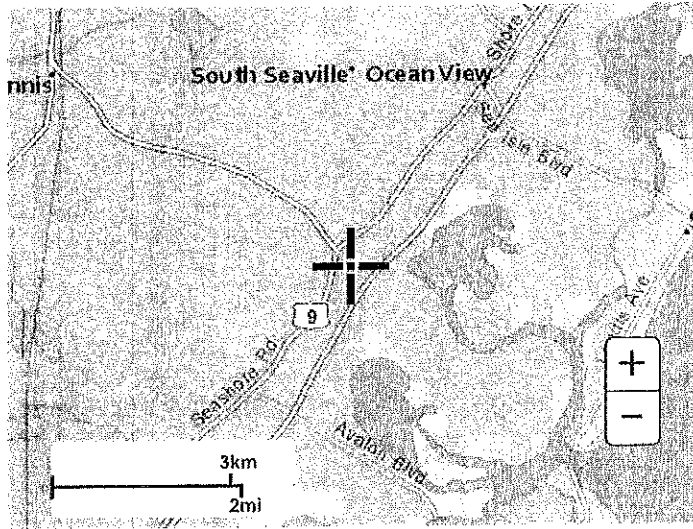
PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)¹										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.348 (0.312-0.387)	0.405 (0.363-0.448)	0.461 (0.412-0.510)	0.534 (0.478-0.591)	0.601 (0.536-0.667)	0.663 (0.589-0.737)	0.716 (0.634-0.796)	0.766 (0.673-0.855)	0.821 (0.714-0.922)	0.877 (0.755-0.991)
10-min	0.556 (0.498-0.618)	0.647 (0.581-0.716)	0.738 (0.661-0.817)	0.854 (0.764-0.946)	0.958 (0.855-1.06)	1.06 (0.938-1.17)	1.14 (1.01-1.26)	1.21 (1.07-1.36)	1.30 (1.13-1.46)	1.38 (1.19-1.56)
15-min	0.694 (0.623-0.773)	0.814 (0.730-0.901)	0.933 (0.836-1.03)	1.08 (0.966-1.20)	1.21 (1.08-1.35)	1.34 (1.19-1.48)	1.44 (1.27-1.60)	1.53 (1.34-1.71)	1.64 (1.42-1.84)	1.73 (1.49-1.96)
30-min	0.952 (0.854-1.06)	1.12 (1.01-1.24)	1.33 (1.19-1.47)	1.56 (1.40-1.73)	1.80 (1.60-2.00)	2.01 (1.79-2.24)	2.20 (1.95-2.45)	2.38 (2.09-2.66)	2.60 (2.26-2.92)	2.81 (2.42-3.17)
60-min	1.19 (1.06-1.32)	1.41 (1.26-1.56)	1.70 (1.52-1.88)	2.04 (1.82-2.26)	2.40 (2.14-2.66)	2.73 (2.42-3.03)	3.03 (2.68-3.37)	3.34 (2.94-3.73)	3.73 (3.24-4.19)	4.10 (3.53-4.63)
2-hr	1.45 (1.29-1.63)	1.72 (1.52-1.94)	2.09 (1.85-2.34)	2.52 (2.23-2.84)	2.99 (2.63-3.37)	3.43 (3.00-3.87)	3.85 (3.35-4.35)	4.27 (3.70-4.85)	4.82 (4.12-5.50)	5.33 (4.51-6.13)
3-hr	1.59 (1.42-1.80)	1.89 (1.68-2.13)	2.29 (2.03-2.58)	2.78 (2.45-3.13)	3.31 (2.91-3.74)	3.83 (3.34-4.32)	4.32 (3.74-4.89)	4.84 (4.15-5.48)	5.51 (4.66-6.28)	6.15 (5.14-7.05)
6-hr	1.97 (1.75-2.24)	2.33 (2.07-2.64)	2.81 (2.50-3.19)	3.41 (3.02-3.87)	4.11 (3.61-4.66)	4.80 (4.18-5.43)	5.47 (4.73-6.21)	6.19 (5.29-7.05)	7.15 (6.01-8.20)	8.10 (6.70-9.34)
12-hr	2.36 (2.10-2.69)	2.78 (2.49-3.15)	3.38 (3.00-3.82)	4.13 (3.67-4.67)	5.05 (4.45-5.71)	5.98 (5.22-6.77)	6.93 (5.98-7.87)	7.97 (6.77-9.09)	9.42 (7.82-10.8)	10.9 (8.86-12.6)
24-hr	2.73 (2.47-3.03)	3.32 (3.01-3.69)	4.31 (3.90-4.79)	5.17 (4.66-5.73)	6.48 (5.79-7.16)	7.63 (6.77-8.40)	8.93 (7.85-9.81)	10.4 (9.04-11.4)	12.6 (10.8-13.8)	14.6 (12.3-15.9)
2-day	3.14 (2.83-3.49)	3.82 (3.44-4.26)	4.96 (4.47-5.52)	5.94 (5.34-6.59)	7.43 (6.63-8.21)	8.72 (7.73-9.63)	10.2 (8.95-11.2)	11.8 (10.3-13.0)	14.3 (12.3-15.7)	16.4 (14.0-18.1)
3-day	3.30 (3.01-3.64)	4.01 (3.66-4.43)	5.19 (4.72-5.72)	6.20 (5.62-6.81)	7.70 (6.95-8.45)	9.02 (8.08-9.87)	10.5 (9.32-11.5)	12.1 (10.7-13.2)	14.6 (12.7-15.9)	16.7 (14.4-18.3)
4-day	3.46 (3.18-3.78)	4.20 (3.87-4.60)	5.42 (4.97-5.92)	6.45 (5.90-7.03)	7.98 (7.27-8.69)	9.31 (8.43-10.1)	10.8 (9.69-11.7)	12.4 (11.1-13.5)	14.9 (13.1-16.1)	17.0 (14.8-18.4)
7-day	4.00 (3.71-4.36)	4.84 (4.48-5.26)	6.13 (5.67-6.67)	7.23 (6.66-7.85)	8.85 (8.10-9.59)	10.2 (9.33-11.1)	11.8 (10.6-12.7)	13.4 (12.1-14.5)	15.9 (14.1-17.2)	18.1 (15.8-19.5)
10-day	4.50 (4.19-4.86)	5.40 (5.03-5.84)	6.73 (6.26-7.27)	7.84 (7.26-8.45)	9.43 (8.70-10.2)	10.8 (9.89-11.6)	12.2 (11.1-13.1)	13.7 (12.5-14.8)	16.1 (14.5-17.3)	18.2 (16.2-19.5)
20-day	6.01 (5.65-6.41)	7.15 (6.72-7.62)	8.65 (8.12-9.22)	9.86 (9.24-10.5)	11.6 (10.8-12.3)	12.9 (12.0-13.8)	14.3 (13.3-15.3)	15.8 (14.6-16.8)	17.9 (16.4-19.0)	19.5 (17.8-20.8)
30-day	7.50 (7.07-7.95)	8.89 (8.38-9.42)	10.6 (9.97-11.2)	11.9 (11.2-12.7)	13.8 (13.0-14.6)	15.3 (14.3-16.2)	16.7 (15.6-17.7)	18.3 (17.0-19.3)	20.3 (18.8-21.5)	21.9 (20.1-23.3)
45-day	9.49 (9.02-10.0)	11.2 (10.6-11.8)	13.1 (12.5-13.8)	14.6 (13.8-15.4)	16.5 (15.6-17.4)	18.0 (17.0-18.9)	19.4 (18.3-20.5)	20.8 (19.6-22.0)	22.7 (21.2-23.9)	24.0 (22.4-25.4)
60-day	11.3 (10.7-11.8)	13.3 (12.6-13.9)	15.3 (14.6-16.1)	16.9 (16.1-17.8)	18.9 (17.9-19.8)	20.3 (19.3-21.4)	21.7 (20.6-22.8)	23.0 (21.8-24.2)	24.7 (23.2-26.0)	25.9 (24.3-27.3)

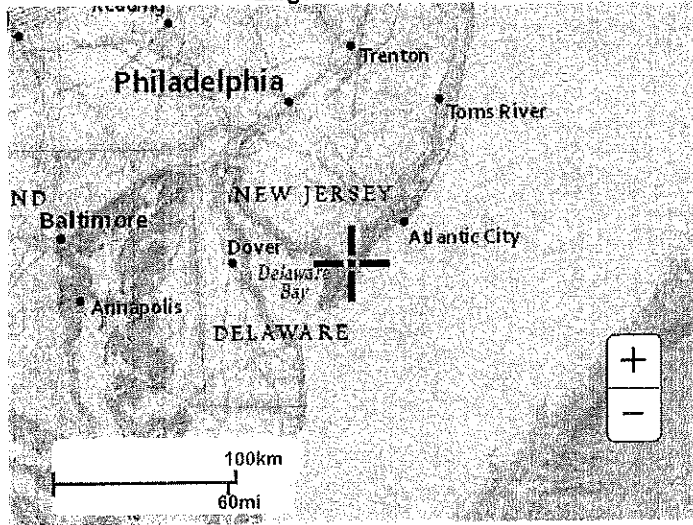
¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values. Please refer to NOAA Atlas 14 document for more information.

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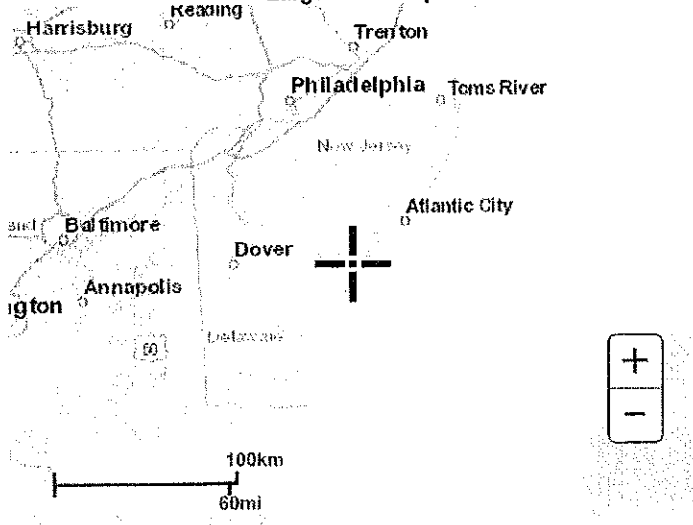
PF graphical



Large scale terrain



Large scale map

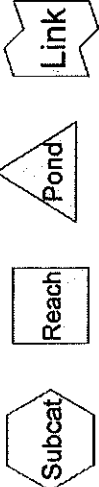
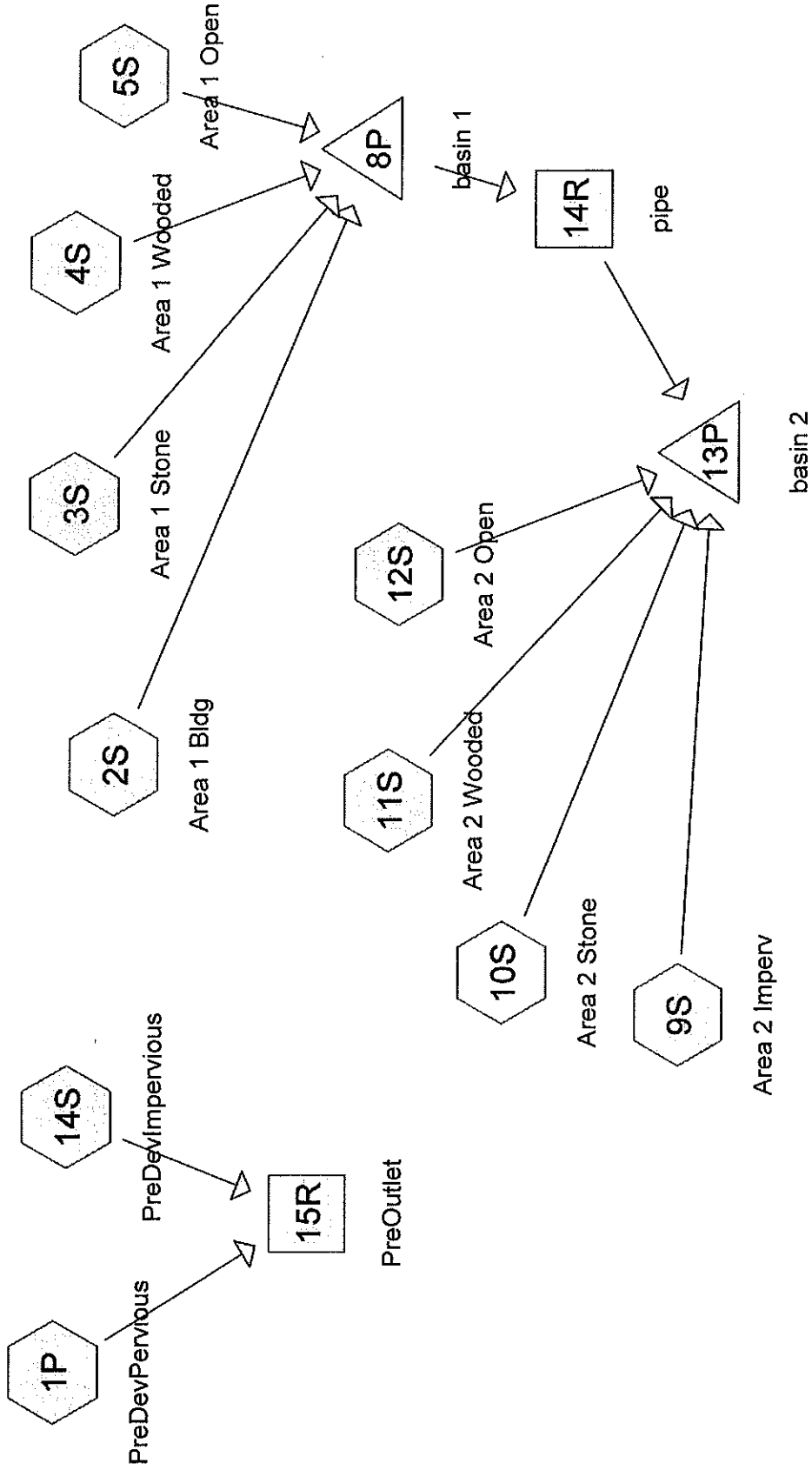


Large scale aerial

- b. N.J.A.C.7:8-5.7(c) requires the precipitation depths of the current 2-, 10- and 100-year storm events be determined by multiplying the NOAA rainfall data with the current precipitation adjustment factors in Table 5-5 at N.J.A.C.7:8-5.7(c)2. N.J.A.C.7:8-5.7(d) requires the precipitation depths of the projected 2-, 10- and 100-year storm events be determined by multiplying the NOAA rainfall data with the future precipitation change factors in Table 5-6 at N.J.A.C.7:8-5.7(d). Table 5-5 and Table 5-6 from the Rules are reproduced below.

Current Precipitation Adjustment Factors at N.J.A.C. 7:8-5.7(c) as Table 5-5

County	Current Precipitation Adjustment Factors		
	2-year Design Storm	10-year Design Storm	100-year Design Storm
Atlantic	1.01	1.02	1.03
Bergen	1.01	1.03	1.06
Burlington	0.99	1.01	1.04
Camden	1.03	1.04	1.05
Cape May	1.03	1.03	1.04
Cumberland	1.03	1.03	1.01
Essex	1.01	1.03	1.06
Gloucester	1.05	1.06	1.06
Hudson	1.03	1.05	1.09
Hunterdon	1.02	1.05	1.13
Mercer	1.01	1.02	1.04
Middlesex	1.00	1.01	1.03
Monmouth	1.00	1.01	1.02
Morris	1.01	1.03	1.06
Ocean	1.00	1.01	1.03
Passaic	1.00	1.02	1.05
Salem	1.02	1.03	1.03
Somerset	1.00	1.03	1.09
Sussex	1.03	1.04	1.07
Union	1.01	1.03	1.06
Warren	1.02	1.07	1.15



Routing Diagram for Stormwater Report
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PreDevelopment Runoff

Stormwater Report

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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Summary for Subcatchment 1P: PreDevPervious

Runoff = 0.42 cfs @ 12.12 hrs, Volume= 0.067 af, Depth= 1.07"
Routed to Reach 15R : PreOutlet

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
27,008	32	Woods/grass comb., Good, HSG A
5,945	39	>75% Grass cover, Good, HSG A
32,953	33	Weighted Average
32,953		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	26	0.0110	0.05		Sheet Flow, woods sheet Woods: Light underbrush n= 0.400 P2= 3.42"
2.1	65	0.0110	0.52		Shallow Concentrated Flow, shallow woods Woodland Kv= 5.0 fps
1.6	155	0.0064	1.62		Shallow Concentrated Flow, shallow stone Paved Kv= 20.3 fps
12.7	246	Total			

Stormwater Report

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Type II 24-hr 100 Yr Rainfall=9.28"

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Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
27,008	32	Woods/grass comb., Good, HSG A
5,945	39	>75% Grass cover, Good, HSG A
32,953	33	Weighted Average
32,953		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	26	0.0110	0.05		Sheet Flow, woods sheet Woods: Light underbrush n= 0.400 P2= 3.42"
2.1	65	0.0110	0.52		Shallow Concentrated Flow, shallow woods Woodland Kv= 5.0 fps
1.6	155	0.0064	1.62		Shallow Concentrated Flow, shallow stone Paved Kv= 20.3 fps
12.7	246	Total			

Stormwater Report

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Type II 24-hr 2 Yr Rainfall=3.42"

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Summary for Reach 15R: PreOutlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	1.076 ac,	0.00% Impervious,	Inflow Depth = 0.32"	for 2 Yr event
Inflow =	0.64 cfs @	11.94 hrs,	Volume=	0.028 af
Outflow =	0.64 cfs @	11.94 hrs,	Volume=	0.028 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Stormwater Report

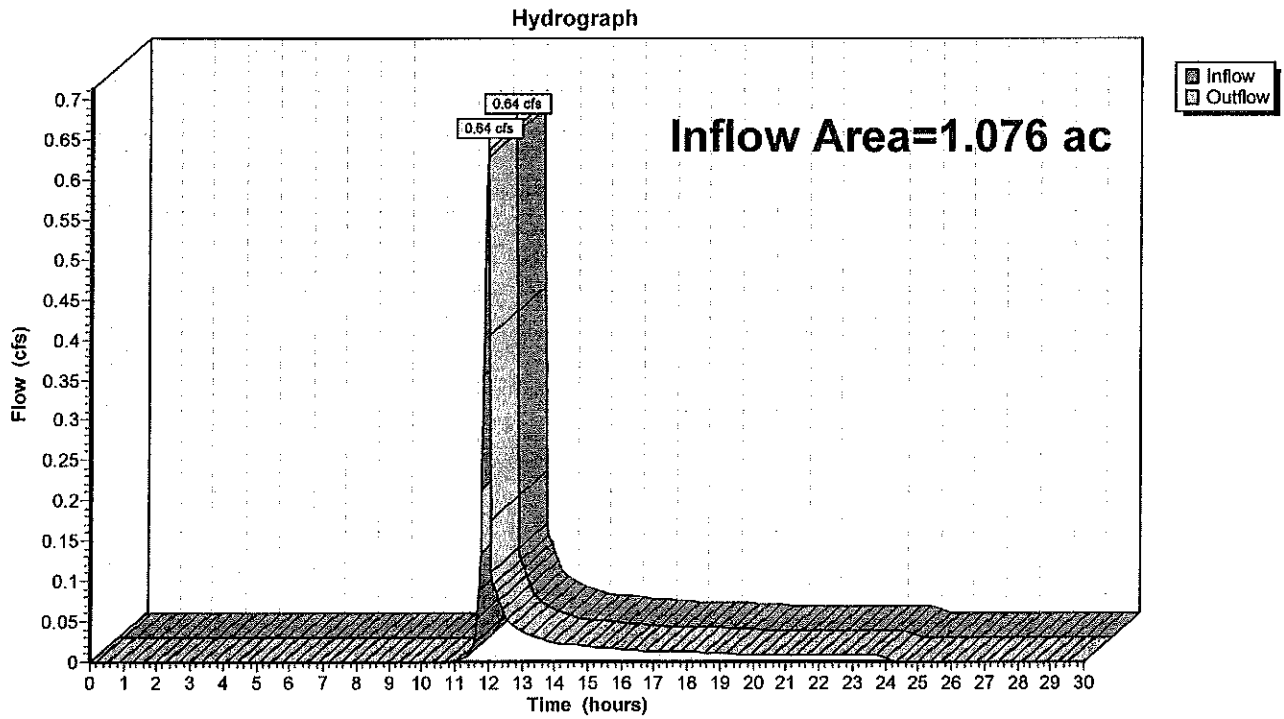
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Type II 24-hr 2 Yr Rainfall=3.42"

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Reach 15R: PreOutlet



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Type II 24-hr 10 Yr Rainfall=5.32"

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Summary for Reach 15R: PreOutlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	1.076 ac,	0.00% Impervious,	Inflow Depth = 0.78"	for 10 Yr event
Inflow =	1.47 cfs @	11.93 hrs,	Volume=	0.070 af
Outflow =	1.47 cfs @	11.93 hrs,	Volume=	0.070 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Stormwater Report

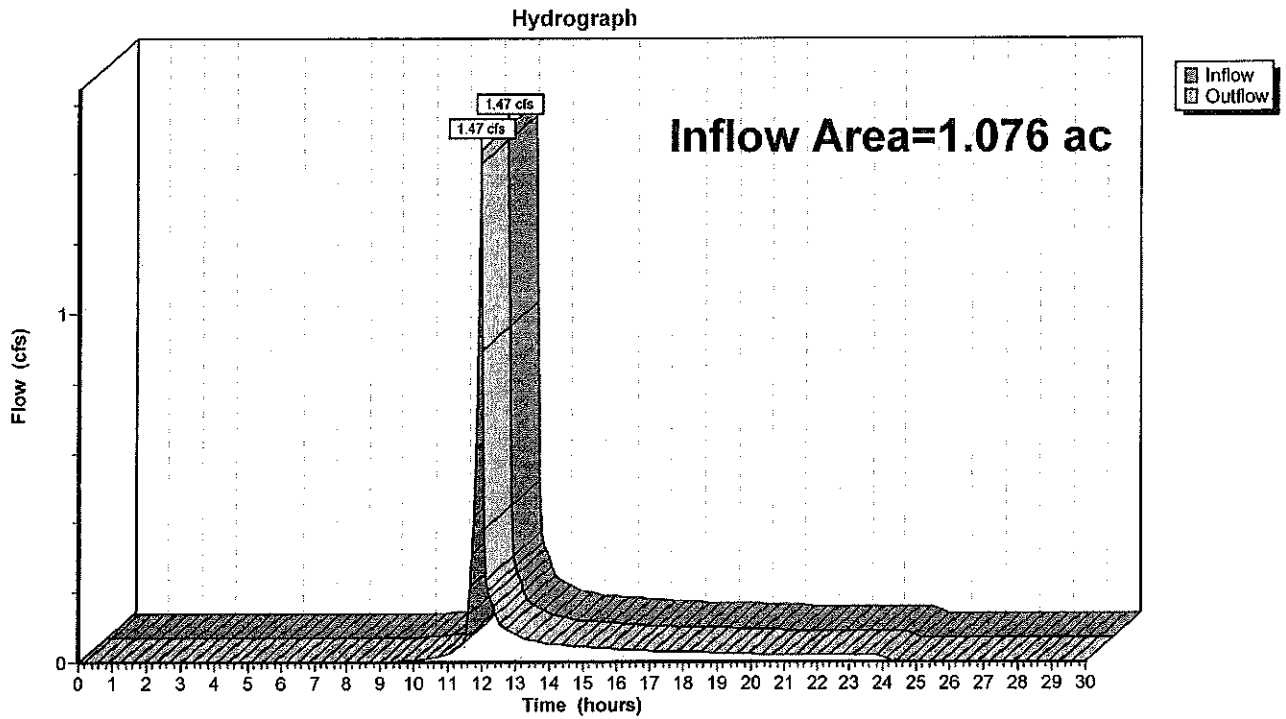
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Type II 24-hr 10 Yr Rainfall=5.32"

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Reach 15R: PreOutlet



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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Summary for Reach 15R: PreOutlet

[40] Hint: Not Described (Outflow=Inflow)

Inflow Area =	1.076 ac,	0.00% Impervious,	Inflow Depth = 2.48"	for 100 Yr event
Inflow =	3.44 cfs @	11.93 hrs,	Volume=	0.223 af
Outflow =	3.44 cfs @	11.93 hrs,	Volume=	0.223 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs

Stormwater Report

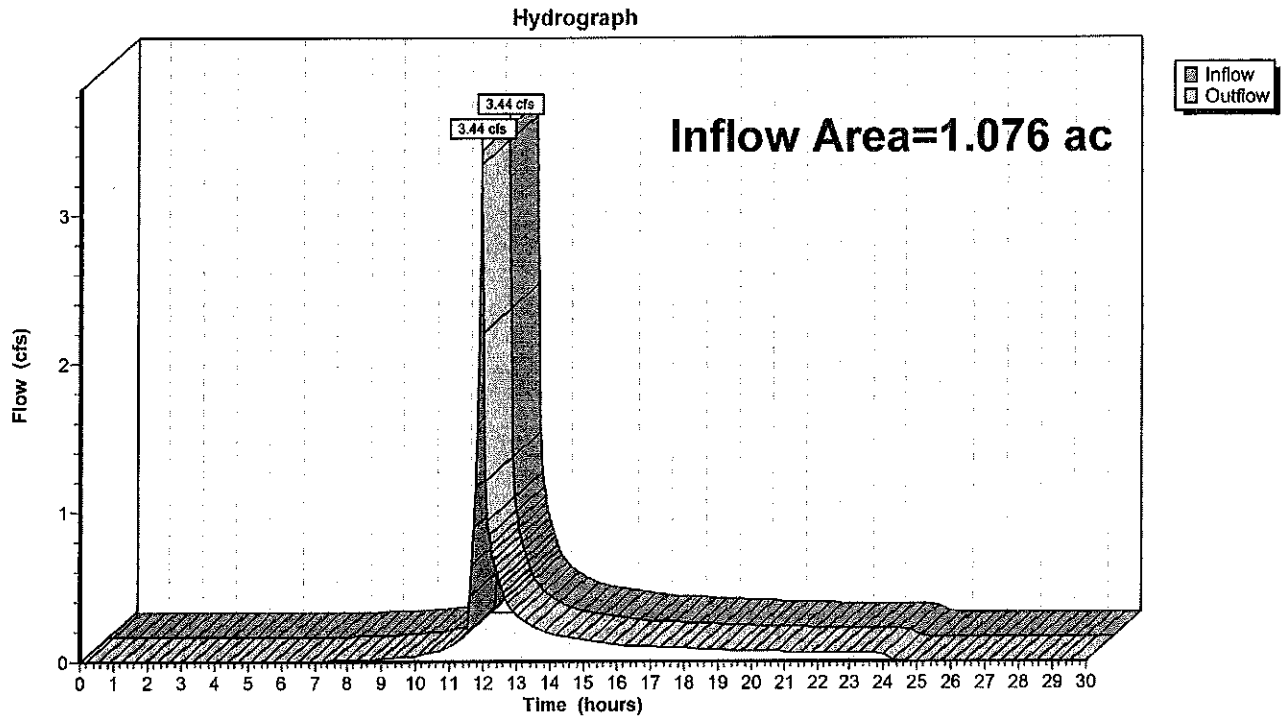
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Type II 24-hr 100 Yr Rainfall=9.28"

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Reach 15R: PreOutlet



PostDevelopment Runoff Area 1

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 2S: Area 1 Bldg

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.73 cfs @ 11.92 hrs, Volume= 0.041 af, Depth= 9.04"
Routed to Pond 8P : basin 1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
2,358	98	Roofs, HSG A
2,358		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.6	80	0.0063	0.86		Sheet Flow, stone sheet Smooth surfaces n= 0.011 P2= 3.42"

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 3S: Area 1 Stone

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 3.45 cfs @ 11.93 hrs, Volume= 0.188 af, Depth= 8.80"
Routed to Pond 8P : basin 1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, $dt= 0.05$ hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
11,165	96	Gravel surface, HSG A
11,165		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.7	100	0.0078	0.98		Sheet Flow, stone sheet Smooth surfaces $n= 0.011$ $P2= 3.42"$
0.3	30	0.0078	1.79		Shallow Concentrated Flow, stone shallow Paved $Kv= 20.3$ fps
2.0	130	Total			

Stormwater Report

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 4S: Area 1 Wooded

Runoff = 0.03 cfs @ 12.11 hrs, Volume= 0.005 af, Depth= 0.76"

Routed to Pond 8P : basin 1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
3,710	30	Woods, Good, HSG A
3,710		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	22	0.0080	0.04		Sheet Flow, woods sheet Woods: Light underbrush n= 0.400 P2= 3.42"
0.3	8	0.0080	0.45		Shallow Concentrated Flow, woods shallow Woodland Kv= 5.0 fps
1.0	105	0.0078	1.79		Shallow Concentrated Flow, stone shallow Paved Kv= 20.3 fps
10.2	135	Total			

Stormwater Report

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 5S: Area 1 Open

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 0.33 cfs @ 12.00 hrs, Volume= 0.022 af, Depth= 1.74"
Routed to Pond 8P : basin 1

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
6,673	39	>75% Grass cover, Good, HSG A
6,673		100.00% Pervious Area

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

Stormwater Report

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NJ DEP 2-hr WQ Rainfall=1.25"

Printed 1/25/2024

Summary for Pond 8P: basin 1

Inflow Area = 0.549 ac, 9.86% Impervious, Inflow Depth = 0.50" for WQ event
Inflow = 0.82 cfs @ 1.06 hrs, Volume= 0.023 af
Outflow = 0.11 cfs @ 1.50 hrs, Volume= 0.010 af, Atten= 86%, Lag= 26.1 min
Primary = 0.11 cfs @ 1.50 hrs, Volume= 0.010 af
Routed to Pond 13P : basin 2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 19.15' @ 1.50 hrs Storage= 760 cf

Plug-Flow detention time= 61.2 min calculated for 0.010 af (43% of inflow)
Center-of-Mass det. time= 49.8 min (119.3 - 69.5)

Volume	Invert	Avail.Storage	Storage Description
#1	18.00'	3,753 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
18.00	0
19.00	573
20.00	1,804
21.00	3,753

Device	Routing	Invert	Outlet Devices
#1	Primary	19.00'	7.0" W x 6.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.11 cfs @ 1.50 hrs HW=19.15' (Free Discharge)
↑1=Orifice/Grate (Orifice Controls 0.11 cfs @ 1.25 fps)

Stormwater Report

Prepared by Engineering Design Associates

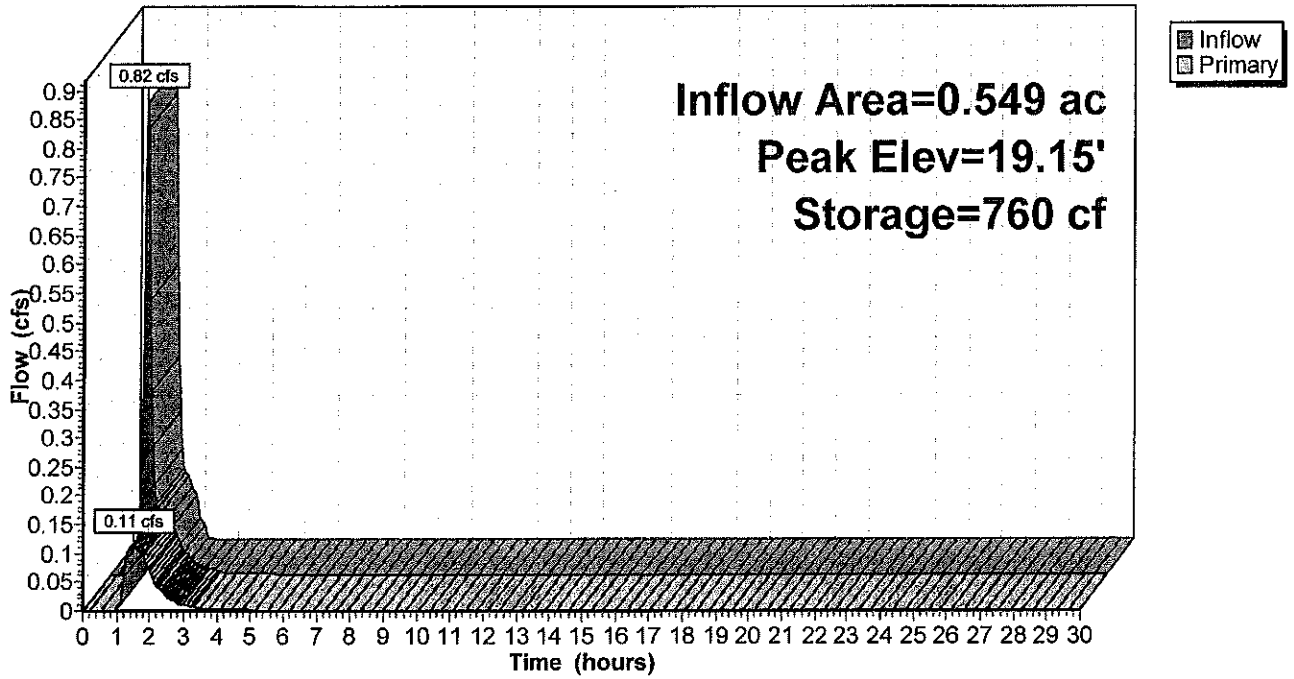
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NJ DEP 2-hr WQ Rainfall=1.25"

Printed 1/25/2024

Pond 8P: basin 1

Hydrograph



Stormwater Report

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Type II 24-hr 2 Yr Rainfall=3.42"

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Summary for Pond 8P: basin 1

Inflow Area = 0.549 ac, 9.86% Impervious, Inflow Depth = 1.70" for 2 Yr event
Inflow = 1.50 cfs @ 11.93 hrs, Volume= 0.078 af
Outflow = 0.86 cfs @ 12.01 hrs, Volume= 0.065 af, Atten= 43%, Lag= 4.8 min
Primary = 0.86 cfs @ 12.01 hrs, Volume= 0.065 af
Routed to Pond 13P : basin 2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 19.64' @ 12.01 hrs Storage= 1,364 cf

Plug-Flow detention time= 150.3 min calculated for 0.065 af (83% of inflow)
Center-of-Mass det. time= 77.3 min (840.6 - 763.3)

Volume	Invert	Avail.Storage	Storage Description
#1	18.00'	3,753 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
18.00	0
19.00	573
20.00	1,804
21.00	3,753

Device	Routing	Invert	Outlet Devices
#1	Primary	19.00'	7.0" W x 6.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=0.86 cfs @ 12.01 hrs HW=19.64' (Free Discharge)
↳ 1=Orifice/Grate (Orifice Controls 0.86 cfs @ 2.94 fps)

Stormwater Report

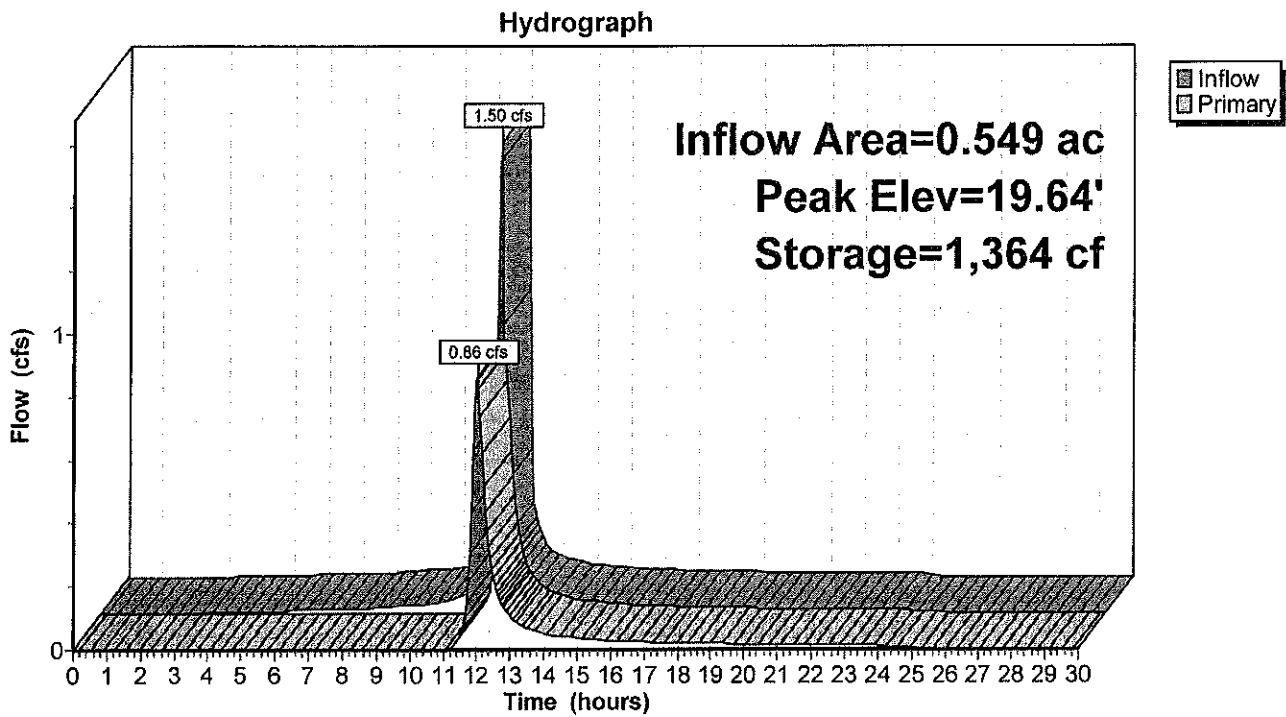
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Type II 24-hr 2 Yr Rainfall=3.42"

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Pond 8P: basin 1



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Type II 24-hr 10 Yr Rainfall=5.32"

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Summary for Pond 8P: basin 1

Inflow Area = 0.549 ac, 9.86% Impervious, Inflow Depth = 2.84" for 10 Yr event
Inflow = 2.38 cfs @ 11.93 hrs, Volume= 0.130 af
Outflow = 1.23 cfs @ 12.02 hrs, Volume= 0.117 af, Atten= 48%, Lag= 5.5 min
Primary = 1.23 cfs @ 12.02 hrs, Volume= 0.117 af
Routed to Pond 13P : basin 2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 20.02' @ 12.02 hrs Storage= 1,845 cf

Plug-Flow detention time= 119.0 min calculated for 0.117 af (90% of inflow)
Center-of-Mass det. time= 65.6 min (824.6 - 758.9)

Volume	Invert	Avail.Storage	Storage Description
#1	18.00'	3,753 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
18.00	0
19.00	573
20.00	1,804
21.00	3,753

Device	Routing	Invert	Outlet Devices
#1	Primary	19.00'	7.0" W x 6.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.22 cfs @ 12.02 hrs HW=20.01' (Free Discharge)
↳1=Orifice/Grate (Orifice Controls 1.22 cfs @ 4.17 fps)

Stormwater Report

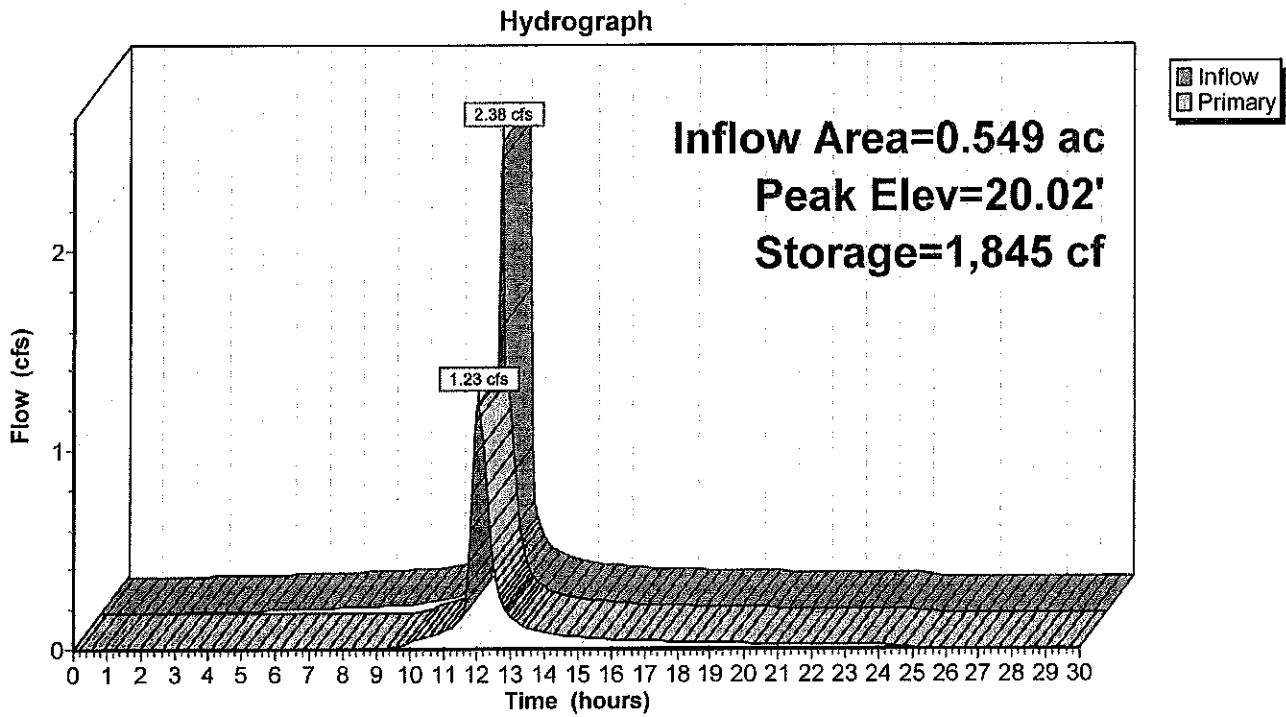
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Type II 24-hr 10 Yr Rainfall=5.32"

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Pond 8P: basin 1



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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Summary for Pond 8P: basin 1

Inflow Area = 0.549 ac, 9.86% Impervious, Inflow Depth = 5.60" for 100 Yr event
Inflow = 4.43 cfs @ 11.93 hrs, Volume= 0.256 af
Outflow = 1.69 cfs @ 12.05 hrs, Volume= 0.243 af, Atten= 62%, Lag= 7.1 min
Primary = 1.69 cfs @ 12.05 hrs, Volume= 0.243 af
Routed to Pond 13P : basin 2

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 20.70' @ 12.05 hrs Storage= 3,166 cf

Plug-Flow detention time= 82.3 min calculated for 0.243 af (95% of inflow)
Center-of-Mass det. time= 51.2 min (810.3 - 759.1)

Volume	Invert	Avail.Storage	Storage Description
#1	18.00'	3,753 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
18.00	0
19.00	573
20.00	1,804
21.00	3,753

Device	Routing	Invert	Outlet Devices
#1	Primary	19.00'	7.0" W x 6.0" H Vert. Orifice/Grate C= 0.600 Limited to weir flow at low heads

Primary OutFlow Max=1.69 cfs @ 12.05 hrs HW=20.70' (Free Discharge)
↑1=Orifice/Grate (Orifice Controls 1.69 cfs @ 5.79 fps)

Stormwater Report

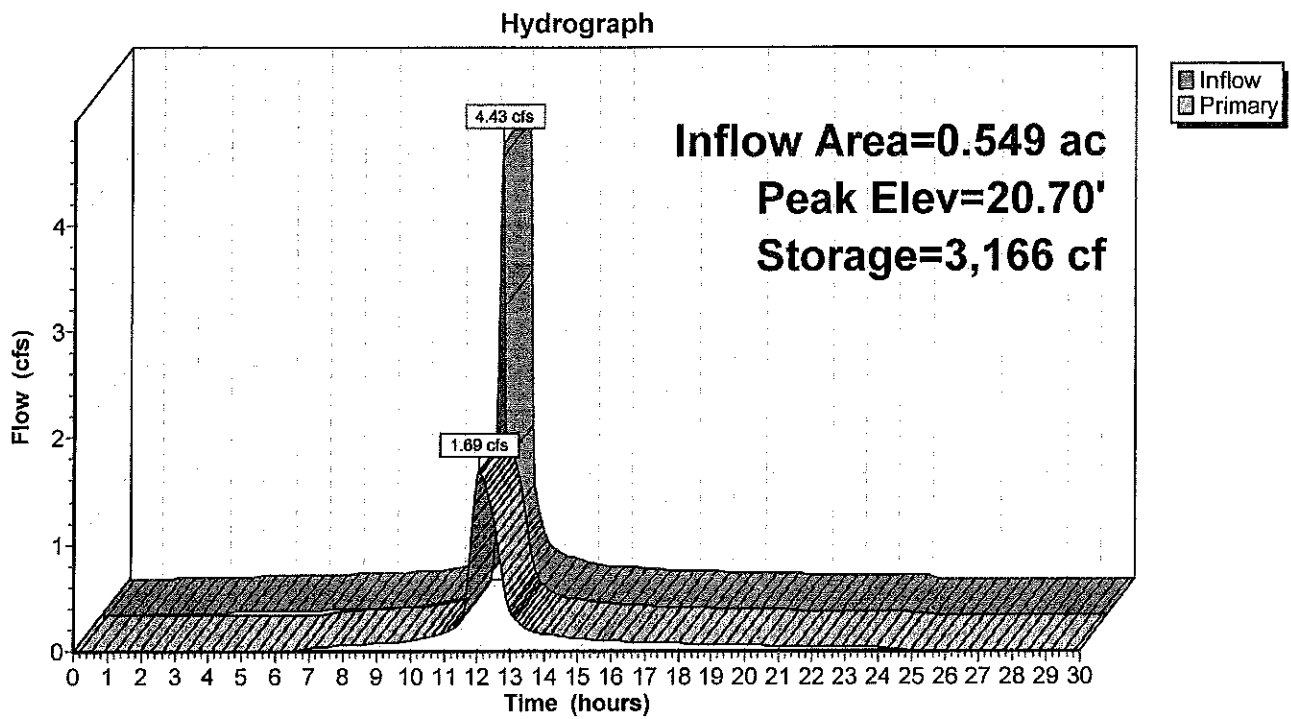
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Type II 24-hr 100 Yr Rainfall=9.28"

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Pond 8P: basin 1



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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Summary for Reach 14R: pipe

[52] Hint: Inlet/Outlet conditions not evaluated

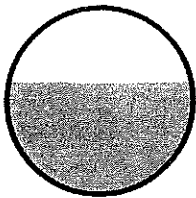
[79] Warning: Submerged Pond 8P Primary device # 1 by 0.30'

Inflow Area = 0.549 ac, 9.86% Impervious, Inflow Depth = 5.32" for 100 Yr event
Inflow = 1.69 cfs @ 12.05 hrs, Volume= 0.243 af
Outflow = 1.68 cfs @ 12.07 hrs, Volume= 0.243 af, Atten= 0%, Lag= 1.1 min
Routed to Pond 13P : basin 2

Routing by Stor-Ind+Trans method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Max. Velocity= 3.44 fps, Min. Travel Time= 0.6 min
Avg. Velocity = 1.30 fps, Avg. Travel Time= 1.5 min

Peak Storage= 59 cf @ 12.06 hrs
Average Depth at Peak Storage= 0.60' , Surface Width= 0.98'
Bank-Full Depth= 1.00' Flow Area= 0.8 sf, Capacity= 2.52 cfs

12.0" Round Pipe
n= 0.013
Length= 120.0' Slope= 0.0050 1/
Inlet Invert= 18.70', Outlet Invert= 18.10'



PostDevelopment Runoff Area 2

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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Summary for Subcatchment 9S: Area 2 Imperv

Runoff = 0.67 cfs @ 12.02 hrs, Volume= 0.056 af, Depth= 9.04"
Routed to Pond 13P : basin 2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
3,264	98	Roofs, HSG A
3,264		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	41	0.0100	0.08		Sheet Flow, lawn sheet Grass: Dense n= 0.240 P2= 3.42"
0.5	51	0.0100	1.61		Shallow Concentrated Flow, lawn shallow Unpaved Kv= 16.1 fps
9.4	92	Total			

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 10S: Area 2 Stone

[49] Hint: $T_c < 2dt$ may require smaller dt

Runoff = 1.44 cfs @ 11.92 hrs, Volume= 0.078 af, Depth= 8.80"
Routed to Pond 13P : basin 2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, $dt=0.05$ hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
4,628	96	Gravel surface, HSG A
4,628		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.5	80	0.0075	0.92		Sheet Flow, stone sheet Smooth surfaces n= 0.011 P2= 3.42"

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 11S: Area 2 Wooded

Runoff = 0.04 cfs @ 12.12 hrs, Volume= 0.008 af, Depth= 0.76"
 Routed to Pond 13P : basin 2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
 Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
5,414	30	Woods, Good, HSG A
5,414		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	22	0.0080	0.04		Sheet Flow, wood sheet Woods: Light underbrush n= 0.400 P2= 3.42"
1.3	35	0.0080	0.45		Shallow Concentrated Flow, woods shallow Woodland Kv= 5.0 fps
0.9	90	0.0100	1.61		Shallow Concentrated Flow, stone lawn Unpaved Kv= 16.1 fps
11.1	147	Total			

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Type II 24-hr 100 Yr Rainfall=9.28"

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Summary for Subcatchment 12S: Area 2 Open

Runoff = 0.34 cfs @ 12.06 hrs, Volume= 0.032 af, Depth= 1.74"
Routed to Pond 13P : basin 2

Runoff by SCS TR-20 method, UH=Delmarva, Weighted-CN, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Type II 24-hr 100 Yr Rainfall=9.28"

Area (sf)	CN	Description
9,671	39	>75% Grass cover, Good, HSG A
9,671		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
9.0	36	0.0075	0.07		Sheet Flow, sheet lawn Grass: Dense n= 0.240 P2= 3.42"
0.6	56	0.0100	1.61		Shallow Concentrated Flow, shallow lawn Unpaved Kv= 16.1 fps
9.6	92	Total			

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NJ DEP 2-hr WQ Rainfall=1.25"

Printed 1/25/2024

Summary for Pond 13P: basin 2

Inflow Area = 1.076 ac, 11.99% Impervious, Inflow Depth = 0.27" for WQ event
Inflow = 0.38 cfs @ 1.08 hrs, Volume= 0.024 af
Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 100%, Lag= 0.0 min
Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 18.48' @ 30.00 hrs Storage= 1,043 cf

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

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	6,950 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
17.50	0
18.00	407
19.00	1,726
20.00	3,887
21.00	6,950

Device	Routing	Invert	Outlet Devices
#1	Primary	20.28'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 1.5' Crest Height

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=17.50' (Free Discharge)
↳1=Sharp-Crested Rectangular Weir (Controls 0.00 cfs)

Stormwater Report

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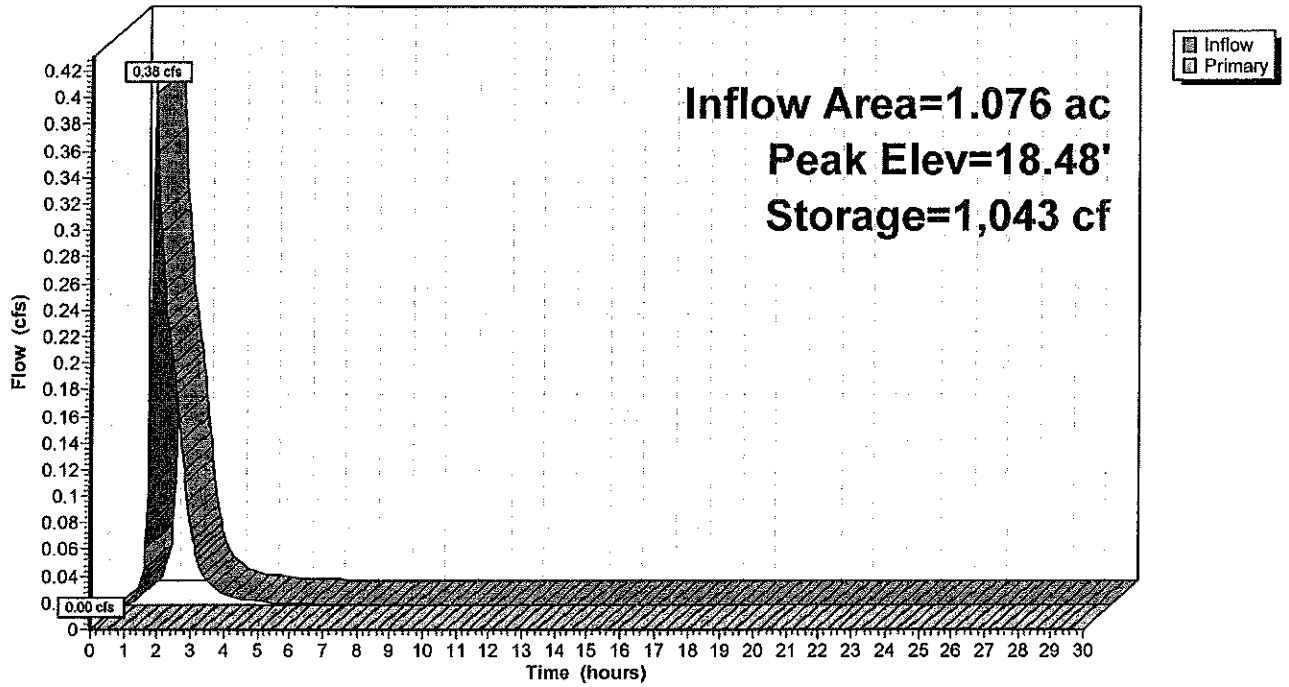
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NJ DEP 2-hr WQ Rainfall=1.25"

Printed 1/25/2024

Pond 13P: basin 2

Hydrograph



Stormwater Report

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Type II 24-hr 2 Yr Rainfall=3.42"

Printed 1/25/2024

Summary for Pond 13P: basin 2

[81] Warning: Exceeded Pond 8P by 1.28' @ 29.95 hrs

Inflow Area = 1.076 ac, 11.99% Impervious, Inflow Depth = 1.24" for 2 Yr event
Inflow = 1.49 cfs @ 11.96 hrs, Volume= 0.111 af
Outflow = 0.01 cfs @ 24.15 hrs, Volume= 0.002 af, Atten= 99%, Lag= 731.8 min
Primary = 0.01 cfs @ 24.15 hrs, Volume= 0.002 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 20.29' @ 24.15 hrs Storage= 4,772 cf

Plug-Flow detention time= 1,181.2 min calculated for 0.002 af (2% of inflow)
Center-of-Mass det. time= 693.0 min (1,501.8 - 808.7)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	6,950 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
17.50	0
18.00	407
19.00	1,726
20.00	3,887
21.00	6,950

Device	Routing	Invert	Outlet Devices
#1	Primary	20.28'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 1.5' Crest Height

Primary OutFlow Max=0.01 cfs @ 24.15 hrs HW=20.29' (Free Discharge)
↳ 1=Sharp-Crested Rectangular Weir (Weir Controls 0.01 cfs @ 0.31 fps)

Stormwater Report

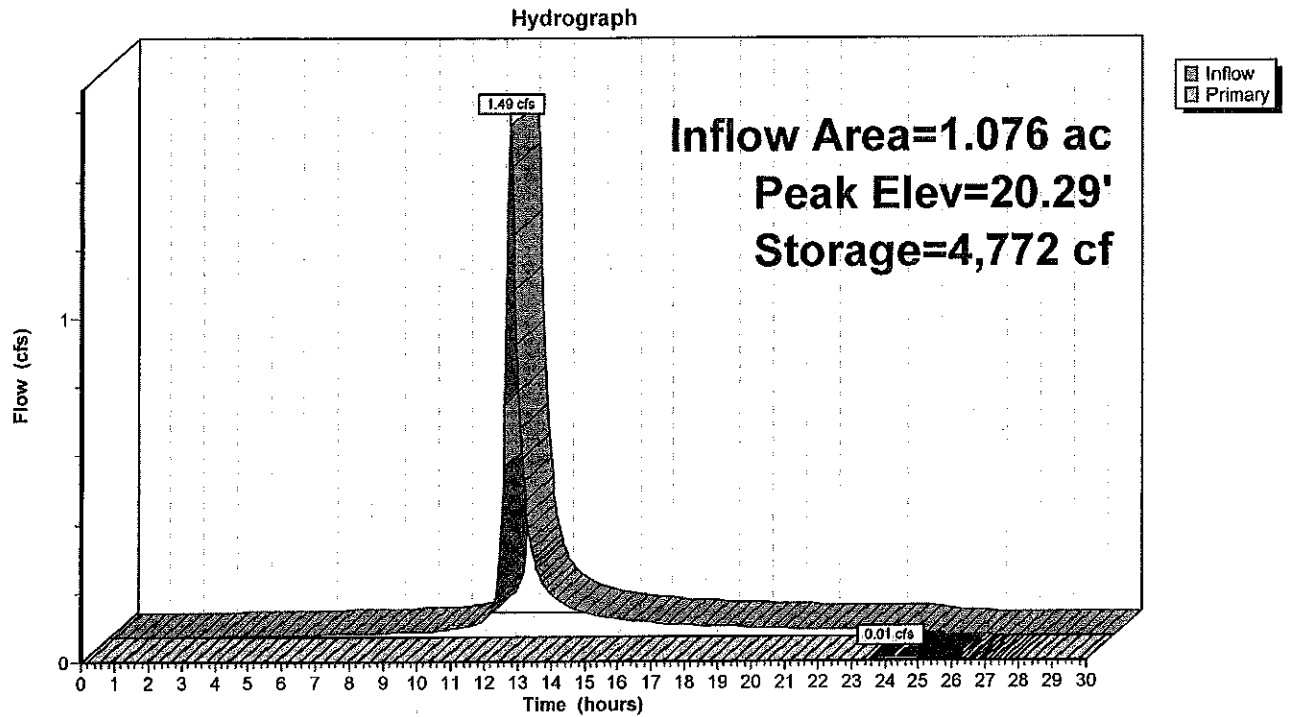
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Type II 24-hr 2 Yr Rainfall=3.42"

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Pond 13P: basin 2



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Type II 24-hr 10 Yr Rainfall=5.32"

Printed 1/25/2024

Summary for Pond 13P: basin 2

[81] Warning: Exceeded Pond 8P by 1.28' @ 29.95 hrs

Inflow Area = 1.076 ac, 11.99% Impervious, Inflow Depth = 2.19" for 10 Yr event
Inflow = 2.24 cfs @ 11.95 hrs, Volume= 0.197 af
Outflow = 0.41 cfs @ 12.62 hrs, Volume= 0.088 af, Atten= 82%, Lag= 40.1 min
Primary = 0.41 cfs @ 12.62 hrs, Volume= 0.088 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 20.40' @ 12.62 hrs Storage= 5,110 cf

Plug-Flow detention time= 304.2 min calculated for 0.088 af (45% of inflow)
Center-of-Mass det. time= 172.4 min (974.7 - 802.3)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	6,950 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
17.50	0
18.00	407
19.00	1,726
20.00	3,887
21.00	6,950

Device	Routing	Invert	Outlet Devices
#1	Primary	20.28'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 1.5' Crest Height

Primary OutFlow Max=0.40 cfs @ 12.62 hrs HW=20.40' (Free Discharge)
↑=Sharp-Crested Rectangular Weir (Weir Controls 0.40 cfs @ 1.14 fps)

Stormwater Report

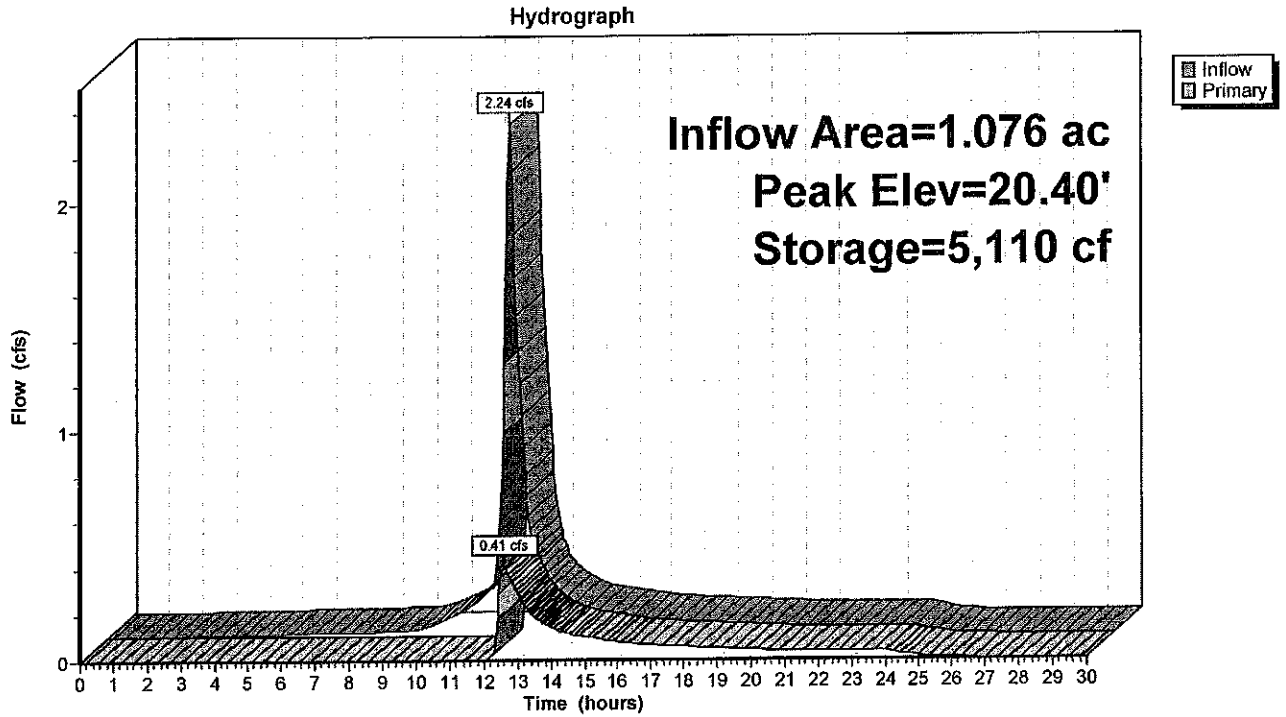
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Type II 24-hr 10 Yr Rainfall=5.32"

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Pond 13P: basin 2



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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Summary for Pond 13P: basin 2

[81] Warning: Exceeded Pond 8P by 1.28' @ 29.95 hrs

Inflow Area = 1.076 ac, 11.99% Impervious, Inflow Depth = 4.65" for 100 Yr event
Inflow = 3.66 cfs @ 11.95 hrs, Volume= 0.417 af
Outflow = 2.73 cfs @ 12.12 hrs, Volume= 0.309 af, Atten= 26%, Lag= 9.8 min
Primary = 2.73 cfs @ 12.12 hrs, Volume= 0.309 af

Routing by Stor-Ind method, Time Span= 0.00-30.00 hrs, dt= 0.05 hrs
Peak Elev= 20.70' @ 12.12 hrs Storage= 6,044 cf

Plug-Flow detention time= 180.2 min calculated for 0.308 af (74% of inflow)
Center-of-Mass det. time= 81.0 min (879.7 - 798.7)

Volume	Invert	Avail.Storage	Storage Description
#1	17.50'	6,950 cf	Custom Stage Data Listed below

Elevation (feet)	Cum.Store (cubic-feet)
17.50	0
18.00	407
19.00	1,726
20.00	3,887
21.00	6,950

Device	Routing	Invert	Outlet Devices
#1	Primary	20.28'	3.0' long Sharp-Crested Rectangular Weir 2 End Contraction(s) 1.5' Crest Height

Primary OutFlow Max=2.71 cfs @ 12.12 hrs HW=20.70' (Free Discharge)
↑1=Sharp-Crested Rectangular Weir (Weir Controls 2.71 cfs @ 2.20 fps)

Stormwater Report

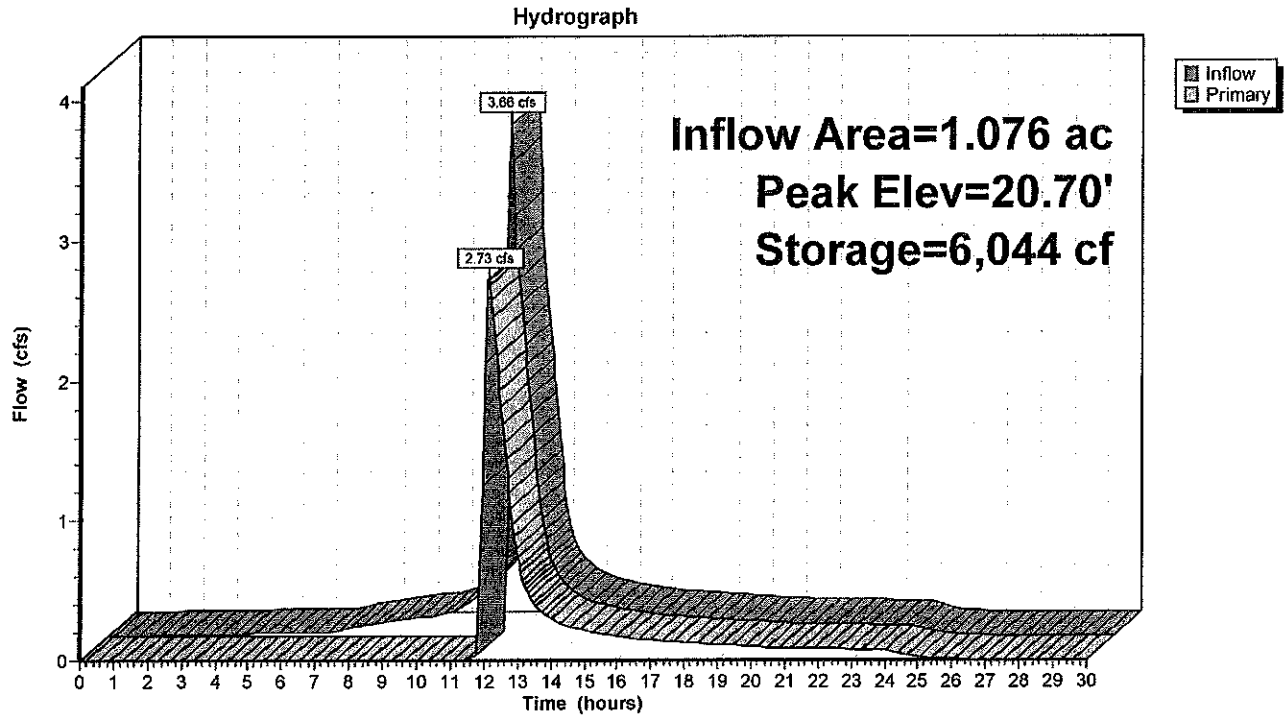
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Type II 24-hr 100 Yr Rainfall=9.28"

Printed 1/25/2024

Pond 13P: basin 2



DURATION OF INFILTRATION CALCULATIONS

Soil Type	Permeability Class	Permeability (in/hr)	Safety Factor (in/hr)
Sand	K5	>20	10
Loamy Sand	K4	6 to 20	3
Sandy Loam	K3	2 to 6	1
Sandy Clay Loam / Loam	K2	0.6 to 2	0.3
Sandy Clay / Clay Loam / Silt Loam	K1	0.2 to 0.6	0.1

Basin #1 (Borings #1 & 2)

Soil Type	Sand
K Rating	K5
Recharge Rate (in/hr)	10
Volume of Runoff at Weir (CF)	573
Infiltration Area (SF)	714

$$\begin{aligned}
 \text{Duration of Infiltration (hours)} &= \frac{\text{Volume of Runoff} * 12 \text{ in/hr}}{\text{Infiltration Area (SF)} * \text{Recharge Rate (in/hr)}} \\
 &= \frac{6876}{7140} \\
 \text{Hours} &= 0.96
 \end{aligned}$$

Basin #2 (Borings #3 & 4)

Soil Type	Sand
K Rating	K5
Recharge Rate (in/hr)	10
Volume of Runoff at Weir (CF)	3887
Infiltration Area (SF)	8636

$$\begin{aligned}
 \text{Duration of Infiltration (hours)} &= \frac{\text{Volume of Runoff} * 12 \text{ in/hr}}{\text{Infiltration Area (SF)} * \text{Recharge Rate (in/hr)}} \\
 &= \frac{46644}{86360} \\
 \text{Hours} &= 0.54
 \end{aligned}$$

Input Values

10.00
0.150
5.00
47.000
1.500
0.96
10.00

R Recharge rate (permeability rate) (in/hr)
Sy Specific yield, Sy (dimensionless)
 default value is 0.15; max value is 0.2 provided that a lab test data is submitted
Kh Horizontal hydraulic conductivity (in/hr)
 Kh = 5xRecharge Rate (R) in the costal plan; Kh=R outside the costal plan
x 1/2 length of basin (x direction, in feet)
y 1/2 width of basin (y direction, in feet)
t Duration of infiltration period (hours)
hi(0) Initial thickness of saturated zone (feet)

11.488
1.488

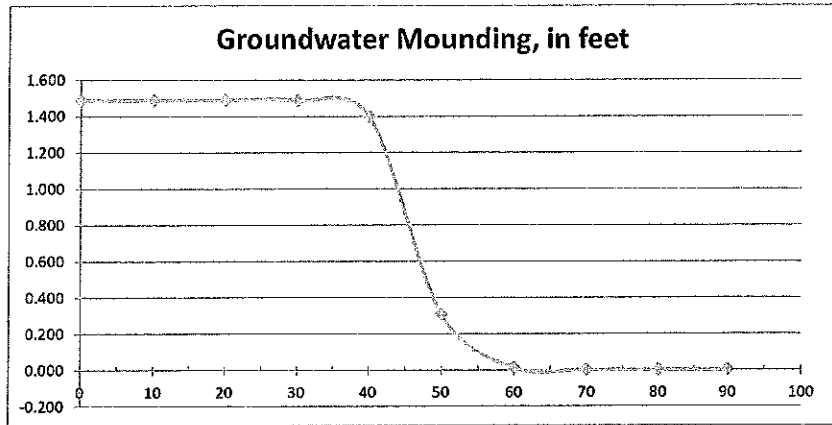
h(max) Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
Δh(max) Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Ground-water Mounding, in feet

Distance from center of basin in x direction, in feet	Mounding, in feet
0	1.488
10	1.488
20	1.488
30	1.486
40	1.398
50	0.307
60	0.012
70	0.002
80	0.002
90	0.002



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.

Input Values

10.00
5.00
0.150
22.000
9.000
0.54
10.00

R Recharge rate (permeability rate) (in/hr)
Sy Specific yield, S_y (dimensionless)
 default value is 0.15; max value is 0.2 provided that a lab test data is submitted
Kh Horizontal hydraulic conductivity (in/hr)
 $Kh = 5 \times \text{Recharge Rate (R)}$ in the costal plan; $Kh=R$ outside the costal plan
x 1/2 length of basin (x direction, in feet)
y 1/2 width of basin (y direction, in feet)
t Duration of infiltration period (hours)
hi(0) Initial thickness of saturated zone (feet)

12.875
2.875

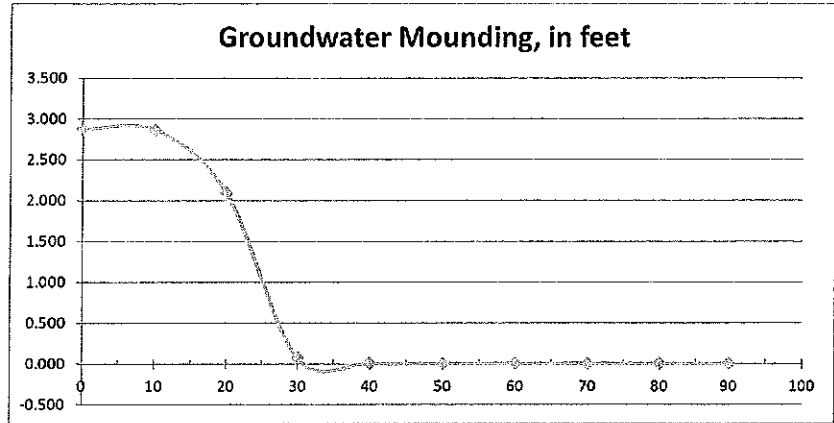
h(max) Maximum thickness of saturated zone (beneath center of basin at end of infiltration period)
 $\Delta h(\text{max})$ Maximum groundwater mounding (beneath center of basin at end of infiltration period)

Distance from
 Ground-water center of basin in x
 Mounding, in feet direction, in feet

2.875	0
2.862	10
2.091	20
0.073	30
0.001	40
0.001	50
0.001	60
0.001	70
0.001	80
0.001	90



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