

GRAZ Engineering, LLC

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STORMWATER REPORT

**Map-9 Lot-383 Roberts Way,
Winchendon, Massachusetts**

July 11, 2022



PREPARED FOR:

**Barkley Enterprises, LLC
1032 N.H. Rt. 119, Rindge NH 03461**

Lock'd Up Storage Site Plan
Stormwater Hydrology Impact Analysis

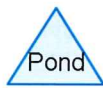
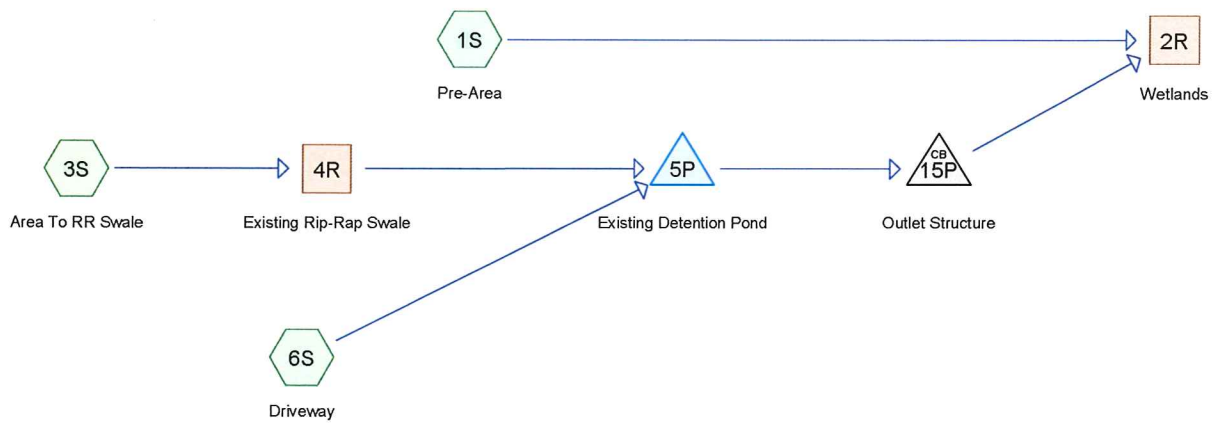
The enclosed analyses document the 'pre' and 'post' development stormwater runoff for the 2, 10 and 100-year storms from the entire site. The pre-development and post-development hydrology summaries are attached to show the decrease in peak flow in each storm scenario with the proposed stormwater system.

In addition to the flow calculations, TSS removal calculations are also provided showing the provided removal of 90% of total suspended solids through the use of sediment forebay, grass swale, and infiltration basin. Further calculations show sizing methodologies for each type of stormwater treatment practice and how the required recharge volume has been achieved.

Furthermore, per Standard 10 of the Massachusetts Stormwater Handbook, there shall be no illicit discharges to the stormwater management system.

The following table summarizes the data in the hydrology, showing the decrease in peak flow in each storm scenario.

	Peak Flow (cfs)		
Post Construction	0.73	3.31	11.84
Pre Construction	0.80	3.40	12.30
2YR			100YR
		10YR	



Routing Diagram for Roberts Way - New Development
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Roberts Way - New Development

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Area

Runoff Area=3.724 ac 0.00% Impervious Runoff Depth>0.34"
Flow Length=1,022' Slope=0.0714'/' Tc=20.4 min CN=61 Runoff=0.80 cfs 0.105 af

Subcatchment 3S: Area To RR Swale

Runoff Area=0.853 ac 0.00% Impervious Runoff Depth>0.44"
Flow Length=467' Slope=0.1156'/' Tc=7.9 min CN=64 Runoff=0.49 cfs 0.031 af

Subcatchment 6S: Driveway

Runoff Area=0.081 ac 0.00% Impervious Runoff Depth>2.49"
Flow Length=239' Slope=0.0586'/' Tc=2.2 min CN=96 Runoff=0.34 cfs 0.017 af

Reach 2R: Wetlands

Inflow=0.80 cfs 0.105 af
Outflow=0.80 cfs 0.105 af

Reach 4R: Existing Rip-Rap Swale

Avg. Flow Depth=0.20' Max Vel=1.49 fps Inflow=0.49 cfs 0.031 af
n=0.069 L=167.0' S=0.0665'/' Capacity=14.84 cfs Outflow=0.44 cfs 0.031 af

Pond 5P: Existing Detention Pond

Peak Elev=1,041.03' Storage=1,492 cf Inflow=0.48 cfs 0.048 af
Discarded=0.01 cfs 0.014 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.014 af

Pond 15P: Outlet Structure

Peak Elev=1,042.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.012 L=81.0' S=0.0519'/' Outflow=0.00 cfs 0.000 af

Total Runoff Area = 4.658 ac Runoff Volume = 0.153 af Average Runoff Depth = 0.40"
100.00% Pervious = 4.658 ac 0.00% Impervious = 0.000 ac

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Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Subcatchment 1S: Pre-Area

Runoff = 0.80 cfs @ 12.20 hrs, Volume= 0.105 af, Depth> 0.34"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
2.474	55	Woods, Good, HSG B
1.250	73	Woods, Fair, HSG C
3.724	61	Weighted Average
3.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	1,022	0.0714	0.83		Lag/CN Method, TC

Roberts Way - New Development

Type II 24-hr 2-Year Rainfall=2.94"
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Summary for Subcatchment 3S: Area To RR Swale

Runoff = 0.49 cfs @ 12.02 hrs, Volume= 0.031 af, Depth > 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
0.420	55	Woods, Good, HSG B
0.433	73	Woods, Fair, HSG C
0.853	64	Weighted Average
0.853		100.00% Pervious Area
Tc Length (min)		Description
7.9	467	Slope Velocity Capacity (cfs)
	0.1156	(ft/ft)
	0.98	(ft/sec)
		Lag/CN Method, tc

Roberts Way - New Development

Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Subcatchment 6S: Driveway

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

Runoff = 0.34 cfs @ 11.92 hrs, Volume= 0.017 af, Depth> 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
0.081	96	Gravel surface, HSG C
0.081		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	239	0.0586	1.80		Lag/CN Method, TC

Summary for Reach 2R: Wetlands

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

Inflow Area =	4.658 ac,	0.00% Impervious,	Inflow Depth > 0.27"	for 2-Year event
Inflow	=	0.80 cfs @	12.20 hrs,	Volume=
Outflow	=	0.80 cfs @	12.20 hrs,	Volume=
			0.105 af,	Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

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Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Reach 4R: Existing Rip-Rap Swale

Inflow Area = 0.853 ac, 0.00% Impervious, Inflow Depth > 0.44" for 2-Year event
Inflow = 0.49 cfs @ 12.02 hrs, Volume= 0.031 af
Outflow = 0.44 cfs @ 12.08 hrs, Volume= 0.031 af, Atten= 10%, Lag= 3.6 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.49 fps, Min. Travel Time= 1.9 min
Avg. Velocity = 0.57 fps, Avg. Travel Time= 4.9 min

Peak Storage= 52 cf @ 12.05 hrs
Average Depth at Peak Storage= 0.20'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 14.84 cfs

1.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 7.00'
Length= 167.0' Slope= 0.0665 '/'
Inlet Invert= 1,055.00', Outlet Invert= 1,043.90'



Roberts Way - New Development

Summary for Pond 5P: Existing Detention Pond

Inflow Area = 0.934 ac, 0.00% Impervious, Inflow Depth > 0.62" for 2-Year event
 Inflow = 0.48 cfs @ 12.07 hrs, Volume= 0.048 af
 Outflow = 0.01 cfs @ 24.00 hrs, Volume= 0.014 af, Atten= 97%, Lag= 715.9 min
 Discarded = 0.01 cfs @ 24.00 hrs, Volume= 0.014 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,041.03' @ 24.00 hrs Surf.Area= 1,703 sf Storage= 1,492 cf

Plug-Flow detention time= 337.9 min calculated for 0.014 af (29% of inflow)
 Center-of-Mass det. time= 155.7 min (1,017.4 - 861.7)

Volume	Invert	Avail. Storage	Storage Description
#1	1,040.00'	7,186 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
1,040.00	1,206	0	0
1,040.90	1,625	1,274	1,274
1,042.00	2,282	2,149	3,423
1,043.40	3,094	3,763	7,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,040.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	1,043.13'	12.0" Vert. Orifice/Grate C= 0.600

Discarded Outflow Max=0.01 cfs @ 24.00 hrs HW=1,041.03' (Free Discharge)
 ↳1=Exfiltration (Controls 0.01 cfs)

Primary Outflow Max=0.00 cfs @ 0.00 hrs HW=1,040.00' (Free Discharge)
 ↳2=Orifice/Grate (Controls 0.00 cfs)

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Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Pond 15P: Outlet Structure

[57] Hint: Peaked at 1,042.00' (Flood elevation advised)

Inflow Area = 0.934 ac, 0.00% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	12.0" Round Culvert L= 81.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,042.00' / 1,037.80' S= 0.0519 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,042.00' (Free Discharge)

↑1=Culvert (Controls 0.00 cfs)

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Area

Runoff Area=3.724 ac 0.00% ImperVIOUS Runoff Depth>0.97"
Flow Length=1.022' Slope=0.0714 '/ Tc=20.4 min CN=61 Runoff=3.40 cfs 0.300 at

Subcatchment 3S: Area To RR Swale

Runoff Area=0.853 ac 0.00% ImperVIOUS Runoff Depth>1.15"
Flow Length=467' Slope=0.1156 '/ Tc=7.9 min CN=64 Runoff=1.54 cfs 0.082 at

Subcatchment 6S: Driveway

Runoff Area=0.081 ac 0.00% ImperVIOUS Runoff Depth>3.85"
Flow Length=239' Slope=0.0586 '/ Tc=2.2 min CN=96 Runoff=0.51 cfs 0.026 at

Reach 2R: Wetlands

Inflow=3.40 cfs 0.300 at
Outflow=3.40 cfs 0.300 at

Reach 4R: Existing Rip-Rap Swale

Avg. Flow Depth=0.35' Max Vel=2.04 fps Inflow=1.54 cfs 0.082 at
n=0.069 L=167.0' S=0.0665 '/ Capacity=14.84 cfs Outflow=1.44 cfs 0.081 at

Pond 5P: Existing Detention Pond

Peak Elev=1,042.15' Storage=3,765 cf Inflow=1.55 cfs 0.107 at
Discarded=0.02 cfs 0.021 at Primary=0.00 cfs 0.000 at Outflow=0.02 cfs 0.021 at

Pond 15P: Outlet Structure

Peak Elev=1,042.00' Inflow=0.00 cfs 0.000 at
12.0" Round Culvert n=0.012 L=81.0' S=0.0519 '/ Outflow=0.00 cfs 0.000 at

Total Runoff Area = 4.658 ac Runoff Volume = 0.408 at Average Runoff Depth = 1.05"
100.00% Pervious = 4.658 ac 0.00% ImperVIOUS = 0.000 ac

Roberts Way - New Development

Type II 24-hr 10-Year Rainfall=4.31"

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Summary for Subcatchment 1S: Pre-Area

Runoff = 3.40 cfs @ 12.16 hrs, Volume= 0.300 af, Depth> 0.97"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
2.474	55	Woods, Good, HSG B
1.250	73	Woods, Fair, HSG C
3.724	61	Weighted Average
3.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	1,022	0.0714	0.83		Lag/CN Method, TC

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Summary for Subcatchment 3S: Area To RR Swale

Runoff = 1.54 cfs @ 12.00 hrs, Volume = 0.082 af, Depth > 1.15"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.420	55	Woods, Good, HSG B
0.433	73	Woods, Fair, HSG C
0.853	64	Weighted Average
0.853		100.00% Pervious Area
Tc Length (min)		Description
7.9	467	0.1156
Slope (ft/ft)		0.98
Velocity (ft/sec)		
Capacity (cfs)		
Lag/CN Method, tc		

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Type II 24-hr 10-Year Rainfall=4.31"

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Summary for Subcatchment 6S: Driveway

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

Runoff = 0.51 cfs @ 11.92 hrs, Volume= 0.026 af, Depth> 3.85"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.081	96	Gravel surface, HSG C
0.081		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	239	0.0586	1.80		Lag/CN Method, TC

Summary for Reach 2R: Wetlands

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

Inflow Area = 4.658 ac, 0.00% Impervious, Inflow Depth > 0.77" for 10-Year event
Inflow = 3.40 cfs @ 12.16 hrs, Volume= 0.300 af
Outflow = 3.40 cfs @ 12.16 hrs, Volume= 0.300 af, Atten=0%, Lag=0.0 min
Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

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Type II 24-hr 10-Year Rainfall=4.31"

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Summary for Reach 4R: Existing Rip-Rap Swale

Inflow Area = 0.853 ac, 0.00% Impervious, Inflow Depth > 1.15" for 10-Year event
Inflow = 1.54 cfs @ 12.00 hrs, Volume= 0.082 af
Outflow = 1.44 cfs @ 12.05 hrs, Volume= 0.081 af, Atten= 7%, Lag= 2.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.04 fps, Min. Travel Time= 1.4 min
Avg. Velocity = 0.75 fps, Avg. Travel Time= 3.7 min

Peak Storage= 121 cf @ 12.02 hrs
Average Depth at Peak Storage= 0.35'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 14.84 cfs

1.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 7.00'
Length= 167.0' Slope= 0.0665 '/'
Inlet Invert= 1,055.00', Outlet Invert= 1,043.90'



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Type II 24-hr 10-Year Rainfall=4.31"

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Summary for Pond 5F: Existing Detention Pond

Inflow Area = 0.934 ac, 0.00% Impervious, Inflow Depth > 1.38" for 10-Year event
 Inflow = 1.55 cfs @ 12.03 hrs, Volume= 0.107 af
 Outflow = 0.02 cfs @ 24.00 hrs, Volume= 0.021 af, Atten= 99%, Lag= 718.4 min
 Discarded = 0.02 cfs @ 24.00 hrs, Volume= 0.021 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.15' @ 24.00 hrs Surf.Area= 2,367 sf Storage= 3,765 cf

Plug-Flow detention time= 345.8 min calculated for 0.021 af (19% of inflow)
 Center-of-Mass det. time= 167.9 min (1,013.9 - 846.0)

Volume Invert Avail.Storage Storage Description

#1 1,040.00' 7,186 cf Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,040.00	1,206	0	0
1,040.90	1,625	1,274	1,274
1,042.00	2,282	2,149	3,423
1,043.40	3,094	3,763	7,186

Device Routing Invert Outlet Devices

#1 Discarded 1,040.00' 0.270 in/hr Exfiltration over Surface area
 #2 Primary 1,043.13' 12.0" Vert. Orifice/Grate C= 0.600

Discarded Outflow Max=0.02 cfs @ 24.00 hrs HW=1,042.15' (Free Discharge)
 ←1=Exfiltration (Controls 0.02 cfs)

Primary Outflow Max=0.00 cfs @ 0.00 hrs HW=1,040.00' (Free Discharge)
 ←2=Orifice/Grate (Controls 0.00 cfs)

Roberts Way - New Development

Type II 24-hr 10-Year Rainfall=4.31"

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Summary for Pond 15P: Outlet Structure

[57] Hint: Peaked at 1,042.00' (Flood elevation advised)

Inflow Area = 0.934 ac, 0.00% Impervious, Inflow Depth = 0.00" for 10-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	12.0" Round Culvert L= 81.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,042.00' / 1,037.80' S= 0.0519 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,042.00' (Free Discharge)
 ↑1=Culvert (Controls 0.00 cfs)

Roberts Way - New Development

Type II 24-hr 100-Year Rainfall=7.51"

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Pre-Area

Runoff Area=3.724 ac 0.00% Impervious Runoff Depth>3.06"
Flow Length=1.022' Slope=0.0714 1/1 Tc=20.4 min CN=61 Runoff=12.30 cfs 0.949 af

Subcatchment 3S: Area To RR Swale

Runoff Area=0.853 ac 0.00% Impervious Runoff Depth>3.39"
Flow Length=467' Slope=0.1156 1/1 Tc=7.9 min CN=64 Runoff=4.76 cfs 0.241 af

Subcatchment 6S: Driveway

Runoff Area=0.081 ac 0.00% Impervious Runoff Depth>7.03"
Flow Length=239' Slope=0.0586 1/1 Tc=2.2 min CN=96 Runoff=0.91 cfs 0.047 af

Reach 2R: Wetlands

Inflow=12.30 cfs 1.053 af
Outflow=12.30 cfs 1.053 af

Reach 4R: Existing Rip-Rap Swale

Avg. Flow Depth=0.60' Max Vel=2.76 fps Inflow=4.76 cfs 0.241 af
n=0.069 L=167.0' S=0.0665 1/1 Capacity=14.84 cfs Outflow=4.48 cfs 0.240 af

Pond 5P: Existing Detention Pond

Peak Elev=1,043.40' Storage=7,178 cf Inflow=4.81 cfs 0.288 af
Discarded=0.03 cfs 0.032 af Primary=0.30 cfs 0.104 af Outflow=0.32 cfs 0.135 af

Pond 15P: Outlet Structure

Peak Elev=1,042.27' Inflow=0.30 cfs 0.104 af
12.0" Round Culvert n=0.012 L=81.0' S=0.0519 1/1 Outflow=0.30 cfs 0.104 af

Total Runoff Area = 4.658 ac Runoff Volume = 1.237 af Average Runoff Depth = 3.19"
100.00% Pervious = 4.658 ac 0.00% Impervious = 0.000 ac

Roberts Way - New Development

Type II 24-hr 100-Year Rainfall=7.51"

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Summary for Subcatchment 1S: Pre-Area

Runoff = 12.30 cfs @ 12.14 hrs, Volume= 0.949 af, Depth> 3.06"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
2.474	55	Woods, Good, HSG B
1.250	73	Woods, Fair, HSG C
3.724	61	Weighted Average
3.724		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
20.4	1,022	0.0714	0.83		Lag/CN Method, TC

Roberts Way - New Development

Type II 24-hr 100-Year Rainfall=7.51"

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Summary for Subcatchment 3S: Area To RR Swale

Runoff = 4.76 cfs @ 12.00 hrs, Volume= 0.241 af, Depth > 3.39"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.420	55	Woods, Good, HSG B
0.433	73	Woods, Fair, HSG C
0.853	64	Weighted Average
0.853		100.00% Pervious Area
Tc Length (min)		Description
7.9	467	Slope Velocity Capacity (cfs)
	0.1156	(ft/ft) (ft/sec)
	0.98	Lag/CN Method, tc

Roberts Way - New Development

Type II 24-hr 100-Year Rainfall=7.51"

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Summary for Subcatchment 6S: Driveway

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

Runoff = 0.91 cfs @ 11.92 hrs, Volume= 0.047 af, Depth> 7.03"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.081	96	Gravel surface, HSG C
0.081		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
2.2	239	0.0586	1.80		Lag/CN Method, TC

Summary for Reach 2R: Wetlands

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

Inflow Area =	4.658 ac,	0.00% ImperVIOUS, Inflow Depth > 2.71" for 100-Year event
Inflow =	12.30 cfs @	12.14 hrs, Volume= 1.053 af
Outflow =	12.30 cfs @	12.14 hrs, Volume= 1.053 af, Atten=0%, Lag=0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

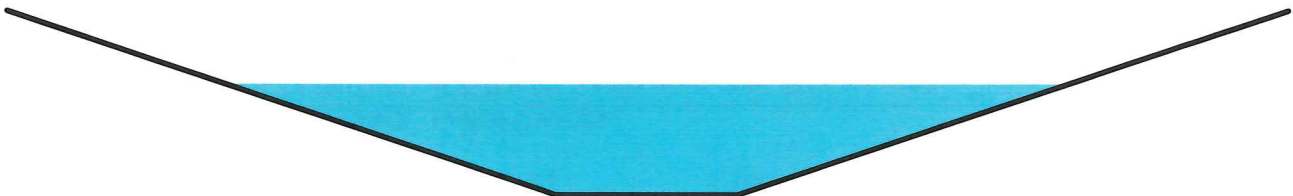
Summary for Reach 4R: Existing Rip-Rap Swale

Inflow Area = 0.853 ac, 0.00% Impervious, Inflow Depth > 3.39" for 100-Year event
Inflow = 4.76 cfs @ 12.00 hrs, Volume= 0.241 af
Outflow = 4.48 cfs @ 12.02 hrs, Volume= 0.240 af, Atten= 6%, Lag= 1.7 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.76 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.95 fps, Avg. Travel Time= 2.9 min

Peak Storage= 282 cf @ 12.01 hrs
Average Depth at Peak Storage= 0.60'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 14.84 cfs

1.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 ' / ' Top Width= 7.00'
Length= 167.0' Slope= 0.0665 ' / '
Inlet Invert= 1,055.00', Outlet Invert= 1,043.90'



Summary for Pond 5F: Existing Detention Pond

Inflow Area = 0.934 ac, 0.00% Impervious, Inflow Depth > 3.70" for 100-Year event
 Inflow = 4.81 cfs @ 12.01 hrs, Volume = 0.288 af
 Outflow = 0.32 cfs @ 13.11 hrs, Volume = 0.135 af, Atten = 93%, Lag = 66.3 min
 Discarded = 0.03 cfs @ 13.11 hrs, Volume = 0.032 af
 Primary = 0.30 cfs @ 13.11 hrs, Volume = 0.104 af

Routing by Stor-Ind method, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Peak Elev = 1,043.40' @ 13.11 hrs Surf.Area = 3,093 sf Storage = 7,178 cf
 Plug-Flow detention time = 276.4 min calculated for 0.135 af (47% of inflow)
 Center-of-Mass det. time = 150.0 min (974.6 - 824.6)

Volume	Invert	Avail. Storage	Storage Description
#1	1,040.00'	7,186 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
1,040.00	1,206	0	0
1,040.90	1,625	1,274	1,274
1,042.00	2,282	2,149	3,423
1,043.40	3,094	3,763	7,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,040.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	1,043.13'	12.0" Vert. Orifice/Grate C = 0.600

Discarded Outflow Max=0.03 cfs @ 13.11 hrs HW=1,043.40' (Free Discharge)
 ←1=Exfiltration (Controls 0.03 cfs)
 Primary Outflow Max=0.30 cfs @ 13.11 hrs HW=1,043.40' (Free Discharge)
 ←2=Orifice/Grate (Orifice Controls 0.30 cfs @ 1.76 fps)

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Summary for Pond 15P: Outlet Structure

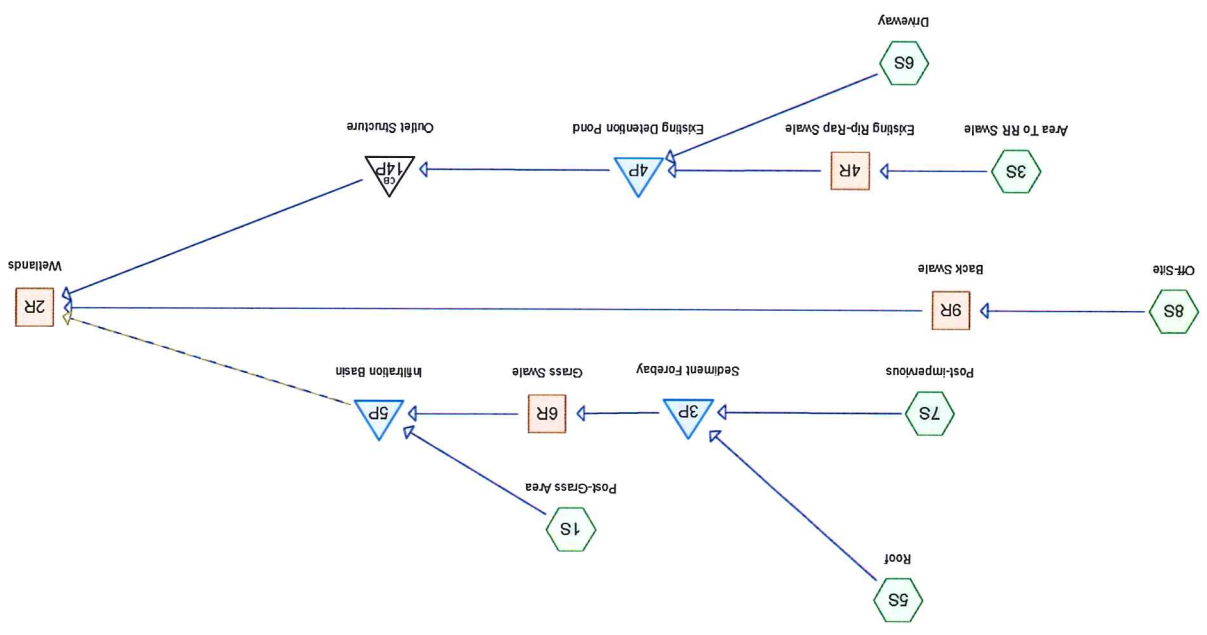
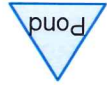
[57] Hint: Peaked at 1,042.27' (Flood elevation advised)

Inflow Area = 0.934 ac, 0.00% Impervious, Inflow Depth > 1.33" for 100-Year event
 Inflow = 0.30 cfs @ 13.11 hrs, Volume= 0.104 af
 Outflow = 0.30 cfs @ 13.11 hrs, Volume= 0.104 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.30 cfs @ 13.11 hrs, Volume= 0.104 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.27' @ 13.11 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	12.0" Round Culvert L= 81.0' RCP, sq.cut end projecting, Ke= 0.500 Inlet / Outlet Invert= 1,042.00' / 1,037.80' S= 0.0519 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.30 cfs @ 13.11 hrs HW=1,042.27' (Free Discharge)
 ↑1=Culvert (Inlet Controls 0.30 cfs @ 1.76 fps)



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Type II 24-hr 2-Year Rainfall=2.94"

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-Grass Area Runoff Area=0.478 ac 0.00% Impervious Runoff Depth>0.72"
 Flow Length=300' Slope=0.0100 '/' Tc=15.8 min CN=71 Runoff=0.39 cfs 0.029 af

Subcatchment 3S: Area To RR Swale Runoff Area=0.223 ac 0.00% Impervious Runoff Depth>0.82"
 Flow Length=110' Slope=0.1273 '/' Tc=1.9 min CN=73 Runoff=0.35 cfs 0.015 af

Subcatchment 5S: Roof Runoff Area=0.267 ac 100.00% Impervious Runoff Depth>2.71"
 Tc=0.0 min CN=98 Runoff=1.25 cfs 0.060 af

Subcatchment 6S: Driveway Runoff Area=0.138 ac 63.04% Impervious Runoff Depth>1.76"
 Flow Length=239' Slope=0.0586 '/' Tc=3.2 min CN=88 Runoff=0.46 cfs 0.020 af

Subcatchment 7S: Post-impervious Runoff Area=0.265 ac 100.00% Impervious Runoff Depth>2.71"
 Flow Length=276' Slope=0.0120 '/' Tc=4.9 min CN=98 Runoff=1.12 cfs 0.060 af

Subcatchment 8S: Off-Site Runoff Area=3.289 ac 0.00% Impervious Runoff Depth>0.23"
 Flow Length=1,036' Slope=0.0743 '/' Tc=22.4 min CN=57 Runoff=0.29 cfs 0.062 af

Reach 2R: Wetlands Inflow=0.73 cfs 0.135 af
 Outflow=0.73 cfs 0.135 af

Reach 4R: Existing Rip-Rap Swale Avg. Flow Depth=0.16' Max Vel=1.35 fps Inflow=0.35 cfs 0.015 af
 n=0.069 L=167.0' S=0.0665 '/' Capacity=14.84 cfs Outflow=0.31 cfs 0.015 af

Reach 6R: Grass Swale Avg. Flow Depth=0.24' Max Vel=0.98 fps Inflow=2.15 cfs 0.118 af
 n=0.030 L=70.0' S=0.0030 '/' Capacity=25.03 cfs Outflow=2.04 cfs 0.117 af

Reach 9R: Back Swale Avg. Flow Depth=0.05' Max Vel=1.27 fps Inflow=0.29 cfs 0.062 af
 n=0.033 L=450.0' S=0.0444 '/' Capacity=51.29 cfs Outflow=0.27 cfs 0.061 af

Pond 3P: Sediment Forebay Peak Elev=1,055.86' Storage=125 cf Inflow=2.16 cfs 0.120 af
 Outflow=2.15 cfs 0.118 af

Pond 4P: Existing Detention Pond Peak Elev=1,040.77' Storage=1,060 cf Inflow=0.73 cfs 0.035 af
 Discarded=0.01 cfs 0.012 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.012 af

Pond 5P: Infiltration Basin Peak Elev=1,053.86' Storage=2,872 cf Inflow=2.19 cfs 0.146 af
 Discarded=0.02 cfs 0.032 af Primary=0.53 cfs 0.074 af Outflow=0.55 cfs 0.106 af

Pond 14P: Outlet Structure Peak Elev=1,042.00' Inflow=0.00 cfs 0.000 af
 12.0" Round Culvert n=0.012 L=81.0' S=0.0519 '/' Outflow=0.00 cfs 0.000 af

Total Runoff Area = 4.660 ac Runoff Volume = 0.246 af Average Runoff Depth = 0.63"
86.72% Pervious = 4.041 ac 13.28% Impervious = 0.619 ac

Summary for Subcatchment 15: Post-Grass Area

Runoff = 0.39 cfs @ 12.10 hrs, Volume = 0.029 af, Depth > 0.72"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description		
0.478	71	Meadow, non-grazed, HSG C		
0.478		100.00% Pervious Area		
Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	300	0.0100	0.32	Lag/CN Method, TC

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Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Subcatchment 3S: Area To RR Swale

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

Runoff = 0.35 cfs @ 11.93 hrs, Volume= 0.015 af, Depth> 0.82"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
0.223	73	Woods, Fair, HSG C
0.223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	110	0.1273	0.98		Lag/CN Method, tc

Summary for Subcatchment 5S: Roof

[46] Hint: Tc=0 (instant runoff peak depends on dt)

Runoff = 1.25 cfs @ 11.89 hrs, Volume = 0.060 af, Depth > 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
0.267	98	Unconnected roofs, HSG C
0.267		100.00% Impervious Area
0.267		100.00% Unconnected

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Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Subcatchment 6S: Driveway

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

Runoff = 0.46 cfs @ 11.94 hrs, Volume= 0.020 af, Depth> 1.76"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
0.087	98	Paved parking, HSG C
0.051	71	Meadow, non-grazed, HSG C
0.138	88	Weighted Average
0.051		36.96% Pervious Area
0.087		63.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	239	0.0586	1.26		Lag/CN Method, TC

Summary for Subcatchment 75: Post-imperious

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

Runoff = 1.12 cfs @ 11.95 hrs, Volume= 0.060 af, Depth> 2.71"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
0.265	98	Paved parking, HSG C
0.265		100.00% Impervious Area
Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)
4.9	276	0.0120
		0.94
Lag/CN Method, TC		

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Type II 24-hr 2-Year Rainfall=2.94"

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Summary for Subcatchment 8S: Off-Site

Runoff = 0.29 cfs @ 12.27 hrs, Volume= 0.062 af, Depth> 0.23"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 2-Year Rainfall=2.94"

Area (ac)	CN	Description
2.894	55	Woods, Good, HSG B
0.395	73	Woods, Fair, HSG C
3.289	57	Weighted Average
3.289		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.4	1,036	0.0743	0.77		Lag/CN Method, TC

Summary for Reach 2R: Wetlands

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

Inflow Area =	4.660 ac, 13.28% Impervious, Inflow Depth > 0.35" for 2-Year event
Inflow =	0.73 cfs @ 12.40 hrs, Volume= 0.135 af
Outflow =	0.73 cfs @ 12.40 hrs, Volume= 0.135 af, Atten=0%, Lag=0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

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Summary for Reach 4R: Existing Rip-Rap Swale

Inflow Area = 0.223 ac, 0.00% Impervious, Inflow Depth > 0.82" for 2-Year event
Inflow = 0.35 cfs @ 11.93 hrs, Volume= 0.015 af
Outflow = 0.31 cfs @ 11.99 hrs, Volume= 0.015 af, Atten= 12%, Lag= 3.4 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Max. Velocity= 1.35 fps, Min. Travel Time= 2.1 min

Avg. Velocity = 0.42 fps, Avg. Travel Time= 6.7 min

Peak Storage= 41 cf @ 11.95 hrs

Average Depth at Peak Storage= 0.16'

Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 14.84 cfs

1.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch

Side Slope Z-value= 3.0 '/' Top Width= 7.00'

Length= 167.0' Slope= 0.0665 '/'

Inlet Invert= 1,055.00', Outlet Invert= 1,043.90'



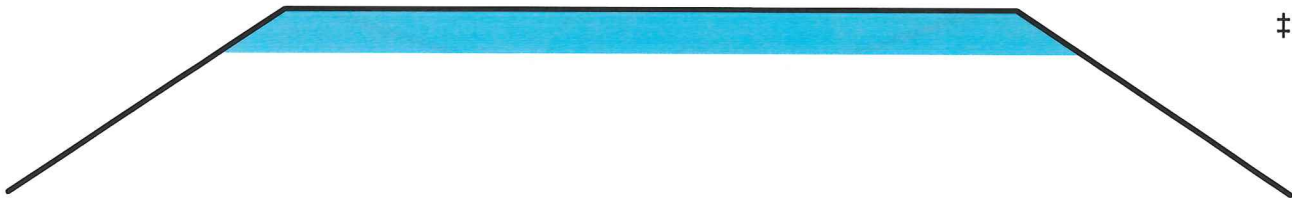
Summary for Reach 6R: Grass Swale

Inflow Area = 0.532 ac, 100.00% Impervious, Inflow Depth > 2.65" for 2-Year event
 Inflow = 2.15 cfs @ 11.91 hrs, Volume = 0.118 af
 Outflow = 2.04 cfs @ 11.94 hrs, Volume = 0.117 af, Atten = 5%, Lag = 2.0 min

Routing by Stor-Ind+Trans method, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Max. Velocity = 0.98 fps, Min. Travel Time = 1.2 min
 Avg. Velocity = 0.23 fps, Avg. Travel Time = 5.1 min

Peak Storage = 147 cf @ 11.92 hrs
 Average Depth at Peak Storage = 0.24'
 Bank-Full Depth = 1.00', Flow Area = 11.0 sf, Capacity = 25.03 cfs

8.00' x 1.00' deep channel, n = 0.030 Earth, grassed & winding
 Side Slope Z-value = 3.0', Top Width = 14.00'
 Length = 70.0', Slope = 0.0030 %
 Inlet Invert = 1,054.70', Outlet Invert = 1,054.49'



Summary for Reach 9R: Back Swale

Inflow Area = 3.289 ac, 0.00% Impervious, Inflow Depth > 0.23" for 2-Year event
Inflow = 0.29 cfs @ 12.27 hrs, Volume= 0.062 af
Outflow = 0.27 cfs @ 12.45 hrs, Volume= 0.061 af, Atten= 7%, Lag= 11.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.27 fps, Min. Travel Time= 5.9 min
Avg. Velocity = 0.70 fps, Avg. Travel Time= 10.7 min

Peak Storage= 95 cf @ 12.36 hrs
Average Depth at Peak Storage= 0.05'
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 51.29 cfs

4.00' x 1.00' deep channel, n= 0.033 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 10.00'
Length= 450.0' Slope= 0.0444 '/'
Inlet Invert= 1,070.00', Outlet Invert= 1,050.00'



Summary for Pond 3P: Sediment Forebay

Inflow Area = 0.532 ac, 100.00% Impervious, Inflow Depth > 2.71" for 2-Year event
 Inflow = 2.16 cfs @ 11.90 hrs, Volume= 0.120 af
 Outflow = 2.15 cfs @ 11.91 hrs, Volume= 0.118 af, Atten= 1%, Lag= 0.1 min
 Primary = 2.15 cfs @ 11.91 hrs, Volume= 0.118 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,055.86' @ 11.91 hrs Surf.Area= 205 sf Storage= 125 cf

Plug-Flow detention time= 23.8 min calculated for 0.117 af (98% of inflow)
 Center-of-Mass det. time= 11.1 min (761.9 - 750.8)

Volume	Invert	Avail. Storage	Storage	Storage Description
#1	1,055.00'	472 cf	472 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf. Area (sq-ft)	Inc. Store (cubic-feet)	Cum. Store (cubic-feet)
1,055.00	92	0	0
1,055.50	152	61	61
1,056.00	225	94	155
1,056.50	313	135	290
1,057.00	414	182	472

Device	Routing	Invert	Outlet Devices
#1	Primary	1,055.75'	20.0' long (Profile 1) Broad-Crested Rectangular Weir

Primary Outflow Max=2.11 cfs @ 11.91 hrs HW=1,055.86' (Free Discharge)
 1=Broad-Crested Rectangular Weir (Weir Controls 2.11 cfs @ 0.97 fps)

Head (feet) 0.49 0.98 1.48
 Coef. (English) 2.92 3.37 3.59

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Summary for Pond 4P: Existing Detention Pond

Inflow Area = 0.361 ac, 24.10% Impervious, Inflow Depth > 1.18" for 2-Year event
 Inflow = 0.73 cfs @ 11.95 hrs, Volume= 0.035 af
 Outflow = 0.01 cfs @ 19.34 hrs, Volume= 0.012 af, Atten= 98%, Lag= 443.4 min
 Discarded = 0.01 cfs @ 19.34 hrs, Volume= 0.012 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,040.77' @ 19.34 hrs Surf.Area= 1,562 sf Storage= 1,060 cf

Plug-Flow detention time= 349.0 min calculated for 0.012 af (33% of inflow)
 Center-of-Mass det. time= 211.9 min (1,048.4 - 836.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,040.00'	7,186 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,040.00	1,206	0	0
1,040.90	1,625	1,274	1,274
1,042.00	2,282	2,149	3,423
1,043.40	3,094	3,763	7,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,040.00'	0.270 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 1,035.00'
#2	Primary	1,043.13'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.01 cfs @ 19.34 hrs HW=1,040.77' (Free Discharge)
 ↕ **1=Exfiltration** (Controls 0.01 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,040.00' (Free Discharge)
 ↕ **2=Orifice/Grate** (Controls 0.00 cfs)

Summary for Pond 5P: Infiltration Basin

Inflow Area = 1.010 ac, 52.67% Impervious, Inflow Depth > 1.74" for 2-Year event
 Inflow = 2.19 cfs @ 11.95 hrs, Volume= 0.146 af
 Outflow = 0.55 cfs @ 12.22 hrs, Volume= 0.106 af, Atten=75%, Lag= 16.5 min
 Discarded = 0.02 cfs @ 12.22 hrs, Volume= 0.032 af
 Primary = 0.53 cfs @ 12.22 hrs, Volume= 0.074 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,053.86' @ 12.22 hrs Surf.Area= 3,630 sf Storage= 2,872 cf

Plug-Flow detention time= 181.2 min calculated for 0.106 af (73% of inflow)
 Center-of-Mass det. time= 84.2 min (872.4 - 788.2)

Volume	Invert	Avail.Storage	Storage	Storage Description
#1	1,053.00'	9,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,053.00	3,036	0	0
1,054.00	3,725	3,381	3,381
1,055.00	4,470	4,098	7,478
1,055.50	4,863	2,333	9,811

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,053.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	1,053.50'	12.0" Vert. Orifice/Gate C= 0.600

Discarded Outflow Max=0.02 cfs @ 12.22 hrs HW=1,053.86' (Free Discharge)
 ←1=Exfiltration (Controls 0.02 cfs)

Primary Outflow Max=0.52 cfs @ 12.22 hrs HW=1,053.86' (Free Discharge)
 ←2=Orifice/Gate (Orifice Controls 0.52 cfs @ 2.05 fps)

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Summary for Pond 14P: Outlet Structure

[57] Hint: Peaked at 1,042.00' (Flood elevation advised)

Inflow Area = 0.361 ac, 24.10% Impervious, Inflow Depth = 0.00" for 2-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	12.0" Round Culvert L= 81.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,042.00' / 1,037.80' S= 0.0519 '/' Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,042.00' (Free Discharge)
 ↳1=Culvert (Controls 0.00 cfs)

Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-Grass Area
Runoff Area=0.478 ac 0.00% ImperVIOUS Runoff Depth>1.60"
Flow Length=300' Slope=0.0100'/' Tc=15.8 min CN=71 Runoff=0.94 cfs 0.064 af

Subcatchment 3S: Area To RR Swale
Runoff Area=0.223 ac 0.00% ImperVIOUS Runoff Depth>1.75"
Flow Length=110' Slope=0.1273'/' Tc=1.9 min CN=73 Runoff=0.75 cfs 0.033 af

Subcatchment 5S: Roof
Runoff Area=0.267 ac 100.00% ImperVIOUS Runoff Depth>4.07"
Tc=0.0 min CN=98 Runoff=1.84 cfs 0.091 af

Subcatchment 6S: Driveway
Runoff Area=0.138 ac 63.04% ImperVIOUS Runoff Depth>3.02"
Flow Length=239' Slope=0.0586'/' Tc=3.2 min CN=88 Runoff=0.76 cfs 0.035 af

Subcatchment 7S: Post-ImperVIOUS
Runoff Area=0.265 ac 100.00% ImperVIOUS Runoff Depth>4.07"
Flow Length=276' Slope=0.0120'/' Tc=4.9 min CN=98 Runoff=1.65 cfs 0.090 af

Subcatchment 8S: Off-Site
Runoff Area=3.289 ac 0.00% ImperVIOUS Runoff Depth>0.75"
Flow Length=1,036' Slope=0.0743'/' Tc=22.4 min CN=57 Runoff=1.95 cfs 0.206 af

Reach 2R: Wetlands
Inflow=3.31 cfs 0.369 af
Outflow=3.31 cfs 0.369 af

Reach 4R: Existing Rip-Rap Swale
Avg. Flow Depth=0.25' Max Vel=1.69 fps Inflow=0.75 cfs 0.033 af
n=0.069 L=167.0' S=0.0665'/' Capacity=14.84 cfs Outflow=0.68 cfs 0.032 af

Reach 6R: Grass Swale
Avg. Flow Depth=0.30' Max Vel=1.14 fps Inflow=3.17 cfs 0.178 af
n=0.030 L=70.0' S=0.0030'/' Capacity=25.03 cfs Outflow=3.02 cfs 0.178 af

Reach 9R: Back Swale
Avg. Flow Depth=0.16' Max Vel=2.62 fps Inflow=1.95 cfs 0.206 af
n=0.033 L=450.0' S=0.0444'/' Capacity=51.29 cfs Outflow=1.91 cfs 0.205 af

Pond 3P: Sediment Forebay
Peak Elev=1,055.89' Storage=132 cf Inflow=3.19 cfs 0.181 af
Outflow=3.17 cfs 0.178 af

Pond 4P: Existing Detention Pond
Peak Elev=1,041.43' Storage=2,217 cf Inflow=1.42 cfs 0.067 af
Discarded=0.01 cfs 0.016 af Primary=0.00 cfs 0.000 af Outflow=0.01 cfs 0.016 af

Pond 5P: Infiltration Basin
Peak Elev=1,054.18' Storage=4,064 cf Inflow=3.49 cfs 0.242 af
Discarded=0.03 cfs 0.035 af Primary=1.60 cfs 0.164 af Outflow=1.62 cfs 0.199 af

Pond 14P: Outlet Structure
Peak Elev=1,042.00' Inflow=0.00 cfs 0.000 af
12.0" Round Culvert n=0.012 L=81.0' S=0.0519'/' Outflow=0.00 cfs 0.000 af

Total Runoff Area = 4.660 ac Runoff Volume = 0.518 af Average Runoff Depth = 1.33"

86.72% Pervious = 4.041 ac 13.28% ImperVIOUS = 0.619 ac

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Type II 24-hr 10-Year Rainfall=4.31"

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Summary for Subcatchment 1S: Post-Grass Area

Runoff = 0.94 cfs @ 12.09 hrs, Volume= 0.064 af, Depth> 1.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.478	71	Meadow, non-grazed, HSG C
0.478		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
15.8	300	0.0100	0.32		Lag/CN Method, TC

Summary for Subcatchment 3S: Area To RR Swale

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

Runoff = 0.75 cfs @ 11.92 hrs, Volume = 0.033 af, Depth > 1.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.223	73	Woods, Fair, HSG C
0.223		100.00% Pervious Area
Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)
1.9	110	0.1273
		0.98
Lag/CN Method, tc		

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Summary for Subcatchment 5S: Roof

[46] Hint: Tc=0 (Instant runoff peak depends on dt)

Runoff = 1.84 cfs @ 11.89 hrs, Volume= 0.091 af, Depth> 4.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.267	98	Unconnected roofs, HSG C
0.267		100.00% Impervious Area
0.267		100.00% Unconnected

Summary for Subcatchment 6S: Driveway

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

Runoff = 0.76 cfs @ 11.94 hrs, Volume = 0.035 af, Depth > 3.02"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.087	98	Paved parking, HSG C
0.051	71	Meadow, non-grazed, HSG C
0.138	88	Weighted Average
0.051		36.96% Pervious Area
0.087		63.04% Impervious Area
Tc Length (min)		
3.2	239	0.0586
(ft/ft)		1.26
(ft/sec)		
Slope Velocity (cfs)		
Capacity		
Description		
Lag/CN Method, TC		

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Summary for Subcatchment 7S: Post-impervious

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

Runoff = 1.65 cfs @ 11.95 hrs, Volume= 0.090 af, Depth> 4.07"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
0.265	98	Paved parking, HSG C
0.265		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
4.9	276	0.0120	0.94		Lag/CN Method, TC

Summary for Subcatchment 8S: Off-Site

Runoff = 1.95 cfs @ 12.20 hrs, Volume = 0.206 af, Depth > 0.75"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Type II 24-hr 10-Year Rainfall=4.31"

Area (ac)	CN	Description
2.894	55	Woods, Good, HSG B
0.395	73	Woods, Fair, HSG C
3.289	57	Weighted Average
3.289		100.00% Pervious Area
Tc Length	Slope	Velocity
(min)	(feet)	(ft/sec)
22.4	1,036	0.0743
		0.77
Lag/CN Method, TC		

Summary for Reach 2R: Wetlands

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

Inflow Area = 4.660 ac, 13.28% Impervious, Inflow Depth > 0.95" for 10-Year event
Inflow = 3.31 cfs @ 12.26 hrs, Volume= 0.369 af
Outflow = 3.31 cfs @ 12.26 hrs, Volume= 0.369 af, Atten= 0%, Lag= 0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

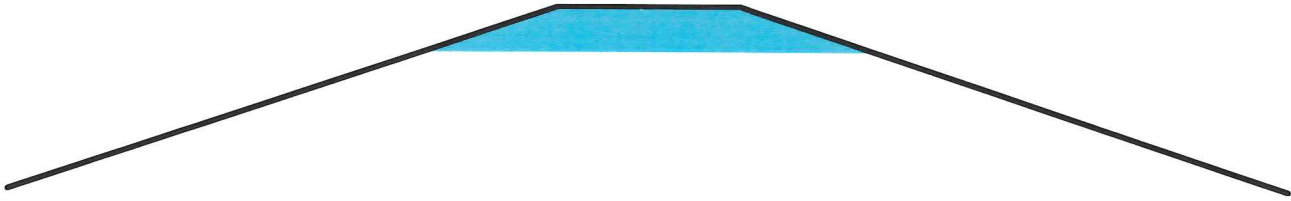
Summary for Reach 4R: Existing Rip-Rap Swale

Inflow Area = 0.223 ac, 0.00% Impervious, Inflow Depth > 1.75" for 10-Year event
 Inflow = 0.75 cfs @ 11.92 hrs, Volume = 0.033 af
 Outflow = 0.68 cfs @ 11.97 hrs, Volume = 0.032 af, Atten = 9%, Lag = 2.5 min

Routing by Stor-Ind+Trans method, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Max. Velocity = 1.69 fps, Min. Travel Time = 1.6 min
 Avg. Velocity = 0.51 fps, Avg. Travel Time = 5.5 min

Peak Storage = 72 cf @ 11.94 hrs
 Average Depth at Peak Storage = 0.25'
 Bank-Full Depth = 1.00' Flow Area = 4.0 sf, Capacity = 14.84 cfs

1.00' x 1.00' deep channel, n = 0.069 Riprap, 6-inch
 Side Slope Z-value = 3.0 ' / ' Top Width = 7.00'
 Length = 167.0' Slope = 0.0665 ' / '
 Inlet Invert = 1,055.00', Outlet Invert = 1,043.90'



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Summary for Reach 6R: Grass Swale

Inflow Area = 0.532 ac, 100.00% Impervious, Inflow Depth > 4.02" for 10-Year event
Inflow = 3.17 cfs @ 11.91 hrs, Volume= 0.178 af
Outflow = 3.02 cfs @ 11.93 hrs, Volume= 0.178 af, Atten= 5%, Lag= 1.8 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 1.14 fps, Min. Travel Time= 1.0 min
Avg. Velocity = 0.26 fps, Avg. Travel Time= 4.4 min

Peak Storage= 190 cf @ 11.92 hrs
Average Depth at Peak Storage= 0.30'
Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 25.03 cfs

8.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
Side Slope Z-value= 3.0 '/' Top Width= 14.00'
Length= 70.0' Slope= 0.0030 '/'
Inlet Invert= 1,054.70', Outlet Invert= 1,054.49'



Summary for Reach 9R: Back Swale

Inflow Area = 3.289 ac, 0.00% Impervious, Inflow Depth > 0.75" for 10-Year event
 Inflow = 1.95 cfs @ 12.20 hrs, Volume= 0.206 af
 Outflow = 1.91 cfs @ 12.28 hrs, Volume= 0.205 af, Atten=2%, Lag=5.0 min

Routing by Stor-Ind+Trans method, Time Span=0.00-24.00 hrs, dt=0.05 hrs
 Max. Velocity=2.62 fps, Min. Travel Time=2.9 min
 Avg. Velocity = 1.03 fps, Avg. Travel Time=7.3 min

Peak Storage=328 cf @ 12.23 hrs
 Average Depth at Peak Storage=0.16'
 Bank-Full Depth=1.00' Flow Area=7.0 sf, Capacity=51.29 cfs

4.00' x 1.00' deep channel, n=0.033 Earth, grassed & winding
 Side Slope Z-value=3.0 ' / ' Top Width=10.00'
 Length=450.0' Slope=0.0444 ' / '
 Inlet Invert=1,070.00', Outlet Invert=1,050.00'



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Summary for Pond 3P: Sediment Forebay

Inflow Area = 0.532 ac, 100.00% Impervious, Inflow Depth > 4.07" for 10-Year event
 Inflow = 3.19 cfs @ 11.90 hrs, Volume= 0.181 af
 Outflow = 3.17 cfs @ 11.91 hrs, Volume= 0.178 af, Atten= 0%, Lag= 0.1 min
 Primary = 3.17 cfs @ 11.91 hrs, Volume= 0.178 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,055.89' @ 11.91 hrs Surf.Area= 209 sf Storage= 132 cf

Plug-Flow detention time= 16.8 min calculated for 0.178 af (98% of inflow)
 Center-of-Mass det. time= 8.1 min (751.2 - 743.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,055.00'	472 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,055.00	92	0	0
1,055.50	152	61	61
1,056.00	225	94	155
1,056.50	313	135	290
1,057.00	414	182	472

Device	Routing	Invert	Outlet Devices
#1	Primary	1,055.75'	20.0' long (Profile 1) Broad-Crested Rectangular Weir Head (feet) 0.49 0.98 1.48 Coef. (English) 2.92 3.37 3.59

Primary OutFlow Max=3.12 cfs @ 11.91 hrs HW=1,055.89' (Free Discharge)
 ↳ **1=Broad-Crested Rectangular Weir** (Weir Controls 3.12 cfs @ 1.10 fps)

Summary for Pond 4P: Existing Detention Pond

Inflow Area = 0.361 ac, 24.10% Impervious, Inflow Depth > 2.23" for 10-Year event
 Inflow = 1.42 cfs @ 11.95 hrs, Volume = 0.067 af
 Outflow = 0.01 cfs @ 22.82 hrs, Volume = 0.016 af, Atten = 99%, Lag = 652.1 min
 Discarded = 0.01 cfs @ 22.82 hrs, Volume = 0.016 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume = 0.000 af

Routing by Stor-Ind method, Time Span = 0.00-24.00 hrs, dt = 0.05 hrs
 Peak Elev = 1,041.43' @ 22.82 hrs Surf.Area = 1,941 sf Storage = 2,217 cf
 Plug-Flow detention time = 351.3 min calculated for 0.016 af (24% of inflow)
 Center-of-Mass det. time = 210.0 min (1,030.0 - 820.0)

Volume	Invert	Avail.Storage	Storage	Storage Description
#1	1,040.00'	7,186 cf	Custom Stage Data (Prismatic) Listed below (Recalc)	

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,040.00	1,206	0	0
1,040.90	1,625	1,274	1,274
1,042.00	2,282	2,149	3,423
1,043.40	3,094	3,763	7,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,040.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	1,043.13'	12.0" Vert. Orifice/Gate C = 0.600

Discarded Outflow Max=0.01 cfs @ 22.82 hrs HW=1,041.43' (Free Discharge)
 ↳1=Exfiltration (Controls 0.01 cfs)

Primary Outflow Max=0.00 cfs @ 0.00 hrs HW=1,040.00' (Free Discharge)
 ↳2=Orifice/Gate (Controls 0.00 cfs)

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Summary for Pond 5P: Infiltration Basin

Inflow Area = 1.010 ac, 52.67% Impervious, Inflow Depth > 2.87" for 10-Year event
 Inflow = 3.49 cfs @ 11.95 hrs, Volume= 0.242 af
 Outflow = 1.62 cfs @ 12.12 hrs, Volume= 0.199 af, Atten= 53%, Lag= 10.5 min
 Discarded = 0.03 cfs @ 12.12 hrs, Volume= 0.035 af
 Primary = 1.60 cfs @ 12.12 hrs, Volume= 0.164 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,054.18' @ 12.12 hrs Surf.Area= 3,859 sf Storage= 4,064 cf

Plug-Flow detention time= 139.1 min calculated for 0.199 af (82% of inflow)
 Center-of-Mass det. time= 62.8 min (844.0 - 781.2)

Volume	Invert	Avail.Storage	Storage Description
#1	1,053.00'	9,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,053.00	3,036	0	0
1,054.00	3,725	3,381	3,381
1,055.00	4,470	4,098	7,478
1,055.50	4,863	2,333	9,811

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,053.00'	0.270 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 1,040.00'
#2	Primary	1,053.50'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.03 cfs @ 12.12 hrs HW=1,054.18' (Free Discharge)
 ↑1=Exfiltration (Controls 0.03 cfs)

Primary OutFlow Max=1.59 cfs @ 12.12 hrs HW=1,054.18' (Free Discharge)
 ↑2=Orifice/Grate (Orifice Controls 1.59 cfs @ 2.80 fps)

Summary for Pond 14P: Outlet Structure

[57] Hint: Peaked at 1,042.00' (Flood elevation advised)

Inflow Area = 0.361 ac, 24.10% Impervious, Inflow Depth = 0.00" for 10-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten=0%, Lag=0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	12.0" Round Culvert

L= 81.0' C/P, square edge headwall, Ke= 0.500
 Inlet / Outlet Invert= 1,042.00' / 1,037.80' S= 0.0519' / Cc= 0.900
 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary Outflow Max=0.00 cfs @ 0.00 hrs HW=1,042.00' (Free Discharge)
 ←1=Culvert (Controls 0.00 cfs)

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Time span=0.00-24.00 hrs, dt=0.05 hrs, 481 points
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN
 Reach routing by Stor-Ind+Trans method - Pond routing by Stor-Ind method

Subcatchment 1S: Post-Grass Area Runoff Area=0.478 ac 0.00% Impervious Runoff Depth>4.14"
 Flow Length=300' Slope=0.0100 '/' Tc=15.8 min CN=71 Runoff=2.48 cfs 0.165 af

Subcatchment 3S: Area To RR Swale Runoff Area=0.223 ac 0.00% Impervious Runoff Depth>4.38"
 Flow Length=110' Slope=0.1273 '/' Tc=1.9 min CN=73 Runoff=1.84 cfs 0.081 af

Subcatchment 5S: Roof Runoff Area=0.267 ac 100.00% Impervious Runoff Depth>7.27"
 Tc=0.0 min CN=98 Runoff=3.22 cfs 0.162 af

Subcatchment 6S: Driveway Runoff Area=0.138 ac 63.04% Impervious Runoff Depth>6.09"
 Flow Length=239' Slope=0.0586 '/' Tc=3.2 min CN=88 Runoff=1.47 cfs 0.070 af

Subcatchment 7S: Post-impervious Runoff Area=0.265 ac 100.00% Impervious Runoff Depth>7.27"
 Flow Length=276' Slope=0.0120 '/' Tc=4.9 min CN=98 Runoff=2.88 cfs 0.160 af

Subcatchment 8S: Off-Site Runoff Area=3.289 ac 0.00% Impervious Runoff Depth>2.64"
 Flow Length=1,036' Slope=0.0743 '/' Tc=22.4 min CN=57 Runoff=8.71 cfs 0.724 af

Reach 2R: Wetlands Inflow=11.84 cfs 1.121 af
 Outflow=11.84 cfs 1.121 af

Reach 4R: Existing Rip-Rap Swale Avg. Flow Depth=0.39' Max Vel=2.15 fps Inflow=1.84 cfs 0.081 af
 n=0.069 L=167.0' S=0.0665 '/' Capacity=14.84 cfs Outflow=1.72 cfs 0.081 af

Reach 6R: Grass Swale Avg. Flow Depth=0.42' Max Vel=1.38 fps Inflow=5.56 cfs 0.320 af
 n=0.030 L=70.0' S=0.0030 '/' Capacity=25.03 cfs Outflow=5.32 cfs 0.319 af

Reach 9R: Back Swale Avg. Flow Depth=0.39' Max Vel=4.34 fps Inflow=8.71 cfs 0.724 af
 n=0.033 L=450.0' S=0.0444 '/' Capacity=51.29 cfs Outflow=8.54 cfs 0.721 af

Pond 3P: Sediment Forebay Peak Elev=1,055.96' Storage=146 cf Inflow=5.58 cfs 0.322 af
 Outflow=5.56 cfs 0.320 af

Pond 4P: Existing Detention Pond Peak Elev=1,042.80' Storage=5,435 cf Inflow=3.17 cfs 0.151 af
 Discarded=0.02 cfs 0.026 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.026 af

Pond 5P: Infiltration Basin Peak Elev=1,054.81' Storage=6,636 cf Inflow=6.70 cfs 0.484 af
 Discarded=0.03 cfs 0.039 af Primary=3.40 cfs 0.399 af Outflow=3.43 cfs 0.438 af

Pond 14P: Outlet Structure Peak Elev=1,042.00' Inflow=0.00 cfs 0.000 af
 12.0" Round Culvert n=0.012 L=81.0' S=0.0519 '/' Outflow=0.00 cfs 0.000 af

Total Runoff Area = 4.660 ac Runoff Volume = 1.362 af Average Runoff Depth = 3.51"
86.72% Pervious = 4.041 ac 13.28% Impervious = 0.619 ac

Summary for Subcatchment 15: Post-Grass Area

Runoff = 2.48 cfs @ 12.08 hrs, Volume= 0.165 af, Depth > 4.14"
 Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.478	71	Meadow, non-grazed, HSG C
0.478		100.00% Pervious Area
Tc Length (min)	Slope (ft/ft)	Velocity (ft/sec)
15.8	300	0.0100
		0.32
Lag/CN Method, TC		

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Summary for Subcatchment 3S: Area To RR Swale

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

Runoff = 1.84 cfs @ 11.92 hrs, Volume= 0.081 af, Depth> 4.38"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.223	73	Woods, Fair, HSG C
0.223		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
1.9	110	0.1273	0.98		Lag/CN Method, tc

Summary for Subcatchment 5S: Roof

[46] Hint: Tc=0 (instant runoff peak depends on dt)

Runoff = 3.22 cfs @ 11.89 hrs, Volume = 0.162 af, Depth > 7.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.267	98	Unconnected roofs, HSG C
0.267		100.00% Impervious Area
0.267		100.00% Unconnected

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Type II 24-hr 100-Year Rainfall=7.51"

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Printed 7/11/2022

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Summary for Subcatchment 6S: Driveway

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

Runoff = 1.47 cfs @ 11.93 hrs, Volume= 0.070 af, Depth> 6.09"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.087	98	Paved parking, HSG C
0.051	71	Meadow, non-grazed, HSG C
0.138	88	Weighted Average
0.051		36.96% Pervious Area
0.087		63.04% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
3.2	239	0.0586	1.26		Lag/CN Method, TC

Summary for Subcatchment 75: Post-imperious

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

Runoff = 2.88 cfs @ 11.95 hrs, Volume= 0.160 af, Depth> 7.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
0.265	98	Paved parking, HSG C
0.265		100.00% Impervious Area
Tc Length	Slope	Velocity
(min)	(ft/ft)	(ft/sec)
4.9	276	0.0120
		0.94
Lag/CN Method, TC		

Roberts Way - New Development - POST

Type II 24-hr 100-Year Rainfall=7.51"

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Summary for Subcatchment 8S: Off-Site

Runoff = 8.71 cfs @ 12.17 hrs, Volume= 0.724 af, Depth> 2.64"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Type II 24-hr 100-Year Rainfall=7.51"

Area (ac)	CN	Description
2.894	55	Woods, Good, HSG B
0.395	73	Woods, Fair, HSG C
3.289	57	Weighted Average
3.289		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
22.4	1,036	0.0743	0.77		Lag/CN Method, TC

Summary for Reach 2R: Wetlands

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

Inflow Area =	4.660 ac, 13.28% Impervious, Inflow Depth > 2.89" for 100-Year event
Inflow =	11.84 cfs @ 12.21 hrs, Volume= 1.121 af
Outflow =	11.84 cfs @ 12.21 hrs, Volume= 1.121 af, Atten=0%, Lag=0.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

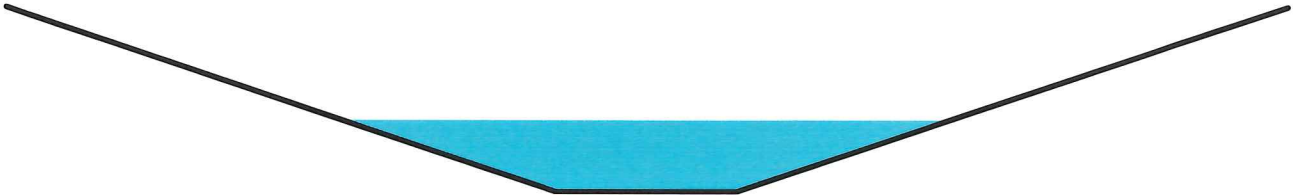
Summary for Reach 4R: Existing Rip-Rap Swale

Inflow Area = 0.223 ac, 0.00% Impervious, Inflow Depth > 4.38" for 100-Year event
Inflow = 1.84 cfs @ 11.92 hrs, Volume= 0.081 af
Outflow = 1.72 cfs @ 11.95 hrs, Volume= 0.081 af, Atten= 6%, Lag= 2.0 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
Max. Velocity= 2.15 fps, Min. Travel Time= 1.3 min
Avg. Velocity = 0.63 fps, Avg. Travel Time= 4.4 min

Peak Storage= 141 cf @ 11.93 hrs
Average Depth at Peak Storage= 0.39'
Bank-Full Depth= 1.00' Flow Area= 4.0 sf, Capacity= 14.84 cfs

1.00' x 1.00' deep channel, n= 0.069 Riprap, 6-inch
Side Slope Z-value= 3.0 '/' Top Width= 7.00'
Length= 167.0' Slope= 0.0665 '/'
Inlet Invert= 1,055.00', Outlet Invert= 1,043.90'



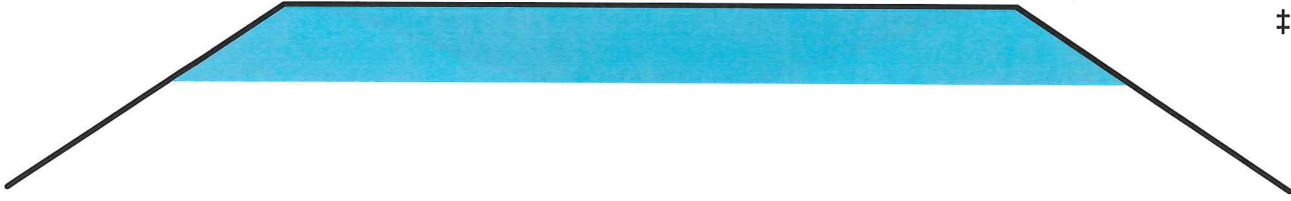
Summary for Reach 6R: Grass Swale

Inflow Area = 0.532 ac, 100.00% ImperVIOUS, Inflow Depth > 7.21" for 100-Year event
 Inflow = 5.56 cfs @ 11.91 hrs, Volume= 0.320 af
 Outflow = 5.32 cfs @ 11.93 hrs, Volume= 0.319 af, Atten= 4%, Lag= 1.5 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Max. Velocity= 1.38 fps, Min. Travel Time= 0.8 min
 Avg. Velocity = 0.32 fps, Avg. Travel Time= 3.6 min

Peak Storage= 274 cf @ 11.92 hrs
 Average Depth at Peak Storage= 0.42'
 Bank-Full Depth= 1.00' Flow Area= 11.0 sf, Capacity= 25.03 cfs

8.00' x 1.00' deep channel, n= 0.030 Earth, grassed & winding
 Side Slope Z-value= 3.0' /', Top Width= 14.00'
 Length= 70.0' Slope= 0.0030' /'
 Inlet Invert= 1,054.70', Outlet Invert= 1,054.49'



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Summary for Reach 9R: Back Swale

Inflow Area = 3.289 ac, 0.00% Impervious, Inflow Depth > 2.64" for 100-Year event
Inflow = 8.71 cfs @ 12.17 hrs, Volume= 0.724 af
Outflow = 8.54 cfs @ 12.22 hrs, Volume= 0.721 af, Atten= 2%, Lag= 3.1 min

Routing by Stor-Ind+Trans method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs

Max. Velocity= 4.34 fps, Min. Travel Time= 1.7 min

Avg. Velocity = 1.49 fps, Avg. Travel Time= 5.0 min

Peak Storage= 895 cf @ 12.19 hrs

Average Depth at Peak Storage= 0.39'

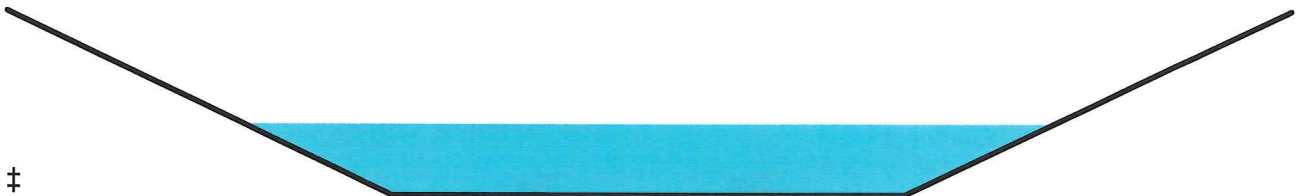
Bank-Full Depth= 1.00' Flow Area= 7.0 sf, Capacity= 51.29 cfs

4.00' x 1.00' deep channel, n= 0.033 Earth, grassed & winding

Side Slope Z-value= 3.0 '/' Top Width= 10.00'

Length= 450.0' Slope= 0.0444 '/'

Inlet Invert= 1,070.00', Outlet Invert= 1,050.00'



Summary for Pond 3F: Sediment Forebay

Inflow Area = 0.532 ac, 100.00% Impervious, Inflow Depth > 7.27" for 100-Year event
 Inflow = 5.58 cfs @ 11.90 hrs, Volume= 0.322 af
 Outflow = 5.56 cfs @ 11.91 hrs, Volume= 0.320 af, Atten=0%, Lag=0.1 min
 Primary = 5.56 cfs @ 11.91 hrs, Volume= 0.320 af

Routing by Stor-Ind method, Time Span=0.00-24.00 hrs, dt=0.05 hrs
 Peak Elev=1,055.96' @ 11.91 hrs Surf.Area=219 sf Storage=146 cf

Plug-Flow detention time=10.0 min calculated for 0.319 af (99% of inflow)
 Center-of-Mass det. time=5.0 min (739.3 - 734.3)

Volume	Invert	Avail.Storage	Storage Description
#1	1,055.00'	472 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,055.00	92	0	0
1,055.50	152	61	61
1,056.00	225	94	155
1,056.50	313	135	290
1,057.00	414	182	472

Device	Routing	Invert	Outlet Devices
#1	Primary	1,055.75'	20.0' long (Profile 1) Broad-Crested Rectangular Weir

Primary Outflow Max=5.48 cfs @ 11.91 hrs HW=1,055.96' (Free Discharge)
 1=Broad-Crested Rectangular Weir (Weir Controls 5.48 cfs @ 1.33 fps)

Head (feet) 0.49 0.98 1.48
 Coef. (English) 2.92 3.37 3.59

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Summary for Pond 4P: Existing Detention Pond

Inflow Area = 0.361 ac, 24.10% Impervious, Inflow Depth > 5.03" for 100-Year event
 Inflow = 3.17 cfs @ 11.94 hrs, Volume= 0.151 af
 Outflow = 0.02 cfs @ 24.00 hrs, Volume= 0.026 af, Atten= 99%, Lag= 723.5 min
 Discarded = 0.02 cfs @ 24.00 hrs, Volume= 0.026 af
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.80' @ 24.00 hrs Surf.Area= 2,746 sf Storage= 5,435 cf

Plug-Flow detention time= 380.3 min calculated for 0.026 af (17% of inflow)
 Center-of-Mass det. time= 209.0 min (1,008.0 - 799.0)

Volume	Invert	Avail.Storage	Storage Description
#1	1,040.00'	7,186 cf	Custom Stage Data (Prismatic) Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,040.00	1,206	0	0
1,040.90	1,625	1,274	1,274
1,042.00	2,282	2,149	3,423
1,043.40	3,094	3,763	7,186

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,040.00'	0.270 in/hr Exfiltration over Surface area Conductivity to Groundwater Elevation = 1,035.00'
#2	Primary	1,043.13'	12.0" Vert. Orifice/Grate C= 0.600

Discarded OutFlow Max=0.02 cfs @ 24.00 hrs HW=1,042.80' (Free Discharge)
 ↖1=Exfiltration (Controls 0.02 cfs)

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,040.00' (Free Discharge)
 ↖2=Orifice/Grate (Controls 0.00 cfs)

Summary for Pond 5P: Infiltration Basin

[62] Hint: Exceeded Reach 6R OUTLET depth by 0.18' @ 12.15 hrs

Inflow Area = 1.010 ac, 52.67% Impervious, Inflow Depth > 5.76" for 100-Year event
 Inflow = 6.70 cfs @ 11.95 hrs, Volume= 0.484 af
 Outflow = 3.43 cfs @ 12.13 hrs, Volume= 0.438 af, Atten=49%, Lag= 10.8 min
 Discarded = 0.03 cfs @ 12.13 hrs, Volume= 0.039 af
 Primary = 3.40 cfs @ 12.13 hrs, Volume= 0.399 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,054.81' @ 12.13 hrs Surf.Area= 4,327 sf Storage= 6,636 cf

Plug-Flow detention time= 101.9 min calculated for 0.438 af (91% of inflow)
 Center-of-Mass det. time= 51.7 min (823.2 - 771.6)

Volume	Invert	Avail.Storage	Storage Description
#1	1,053.00'	9,811 cf	Custom Stage Data (Prismatic) Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
1,053.00	3,036	0	0
1,054.00	3,725	3,381	3,381
1,055.00	4,470	4,098	7,478
1,055.50	4,863	2,333	9,811

Device	Routing	Invert	Outlet Devices
#1	Discarded	1,053.00'	0.270 in/hr Exfiltration over Surface area
#2	Primary	1,053.50'	12.0" Vert. Orifice/Gate Conductivity to Groundwater Elevation = 1,040.00' C = 0.600

Discarded Outflow Max=0.03 cfs @ 12.13 hrs HW=1,054.81' (Free Discharge)
 ←1=Exfiltration (Controls 0.03 cfs)

Primary Outflow Max=3.39 cfs @ 12.13 hrs HW=1,054.81' (Free Discharge)
 ←2=Orifice/Gate (Orifice Controls 3.39 cfs @ 4.32 fps)

Summary for Pond 14P: Outlet Structure

[57] Hint: Peaked at 1,042.00' (Flood elevation advised)

Inflow Area = 0.361 ac, 24.10% Impervious, Inflow Depth = 0.00" for 100-Year event
 Inflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af
 Outflow = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af, Atten= 0%, Lag= 0.0 min
 Primary = 0.00 cfs @ 0.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 0.00-24.00 hrs, dt= 0.05 hrs
 Peak Elev= 1,042.00' @ 0.00 hrs

Device	Routing	Invert	Outlet Devices
#1	Primary	1,042.00'	12.0" Round Culvert L= 81.0' CPP, square edge headwall, Ke= 0.500 Inlet / Outlet Invert= 1,042.00' / 1,037.80' S= 0.0519 '/ Cc= 0.900 n= 0.012 Corrugated PP, smooth interior, Flow Area= 0.79 sf

Primary OutFlow Max=0.00 cfs @ 0.00 hrs HW=1,042.00' (Free Discharge)
 ↳1=Culvert (Controls 0.00 cfs)

Extreme Precipitation Tables

Northeast Regional Climate Center

Data represents point estimates calculated from partial duration series. All precipitation amounts are displayed in inches.

Smoothing	Yes
State	Massachusetts
Location	
Longitude	72.044 degrees West
Latitude	42.687 degrees North
Elevation	0 feet
Date/Time	Sun, 10 Jul 2022 21:57:10 -0400

Extreme Precipitation Estimates

	5min	10min	15min	30min	60min	120min	1hr	2hr	3hr	6hr	12hr	24hr	48hr	1day	2day	4day	7day	10day	1yr	2yr	5yr	10yr	25yr	50yr	100yr	200yr	500yr	
	0.29	0.44	0.55	0.72	0.90	1.12	1.12	1.37	1.10	0.87	0.66	0.53	0.35	0.29	0.44	0.55	0.72	0.90	1.12	1.37	1.72	2.05	2.56	3.05	3.63	4.32	5.42	
1yr	0.29	0.44	0.55	0.72	0.90	1.12	1.12	1.37	1.10	0.87	0.66	0.53	0.35	0.29	0.44	0.55	0.72	0.90	1.12	1.37	1.72	2.05	2.56	3.05	3.63	4.32	5.42	
2yr	0.35	0.53	0.66	0.87	1.10	1.37	1.37	1.72	1.55	1.18	0.95	0.77	0.57	0.41	0.35	0.41	0.57	0.77	1.03	1.29	1.57	1.98	2.44	2.98	3.63	4.32	5.42	
5yr	0.41	0.64	0.80	1.07	1.37	1.72	1.72	2.05	1.83	1.39	1.09	0.84	0.64	0.49	0.41	0.49	0.64	0.84	1.09	1.39	1.72	2.05	2.56	3.05	3.63	4.32	5.42	
10yr	0.46	0.72	0.91	1.24	1.61	2.05	2.05	2.56	2.27	1.73	1.39	1.09	0.84	0.64	0.49	0.41	0.49	0.64	0.84	1.09	1.39	1.72	2.05	2.56	3.05	3.63	4.32	5.42
25yr	0.54	0.86	1.10	1.51	2.00	2.56	2.56	3.05	2.77	2.09	1.61	1.24	0.95	0.77	0.64	0.64	0.84	1.09	1.39	1.72	2.05	2.56	3.05	3.63	4.32	5.42		
50yr	0.61	0.98	1.25	1.76	2.37	3.05	3.05	3.63	3.27	2.49	1.91	1.46	1.09	0.84	0.64	0.64	0.84	1.09	1.39	1.72	2.05	2.56	3.05	3.63	4.32	5.42		
100yr	0.70	1.13	1.46	2.06	2.80	3.63	3.63	4.32	3.87	2.91	2.24	1.61	1.18	0.95	0.77	0.64	0.84	1.09	1.39	1.72	2.05	2.56	3.05	3.63	4.32	5.42		
200yr	0.79	1.29	1.68	2.40	3.32	4.32	4.32	5.42	4.69	3.58	2.86	2.14	1.57	1.18	0.95	0.77	0.64	0.84	1.09	1.39	1.72	2.05	2.56	3.05	3.63	4.32	5.42	
500yr	0.95	1.56	2.04	2.96	4.14	5.42	5.42	6.62	5.06	3.88	3.06	2.33	1.76	1.39	1.09	0.84	0.64	0.49	0.35	0.29	0.41	0.57	0.77	0.95	1.18	1.46	1.76	2.05

Lower Confidence Limits

	5min	10min	15min	30min	60min	120min	1hr	2hr	3hr	6hr	12hr	24hr	48hr	1day	2day	4day	7day	10day	1yr	2yr	5yr	10yr	25yr	50yr	100yr	200yr	500yr
	0.22	0.33	0.41	0.55	0.68	0.92	0.58	0.90	1.07	1.42	1.75	2.18	2.33	1.93	2.24	2.20	3.22	3.76	1yr	0.34	0.52	0.64	0.72	0.79	0.87	0.95	1.09
1yr	0.22	0.33	0.41	0.55	0.68	0.92	0.58	0.90	1.07	1.42	1.75	2.18	2.33	1.93	2.24	2.20	3.22	3.76	1yr	0.34	0.52	0.64	0.72	0.79	0.87	0.95	1.09
2yr	0.34	0.52	0.64	0.72	0.92	1.22	0.92	1.19	1.38	1.77	2.26	2.83	3.16	2.50	3.04	3.51	4.23	4.84	2yr	0.38	0.58	0.72	0.84	0.92	0.98	1.05	1.12
5yr	0.38	0.58	0.72	0.92	1.22	1.44	1.09	1.41	1.63	2.08	2.65	3.37	3.75	2.98	3.61	4.10	4.95	5.63	5yr	0.42	0.64	0.80	0.92	1.00	1.05	1.10	
10yr	0.42	0.64	0.80	1.11	1.44	1.63	1.24	1.60	1.82	2.34	2.96	3.84	4.29	3.40	4.13	4.62	5.59	6.32	10yr	0.47	0.72	0.90	1.00	1.05	1.10	1.15	
25yr	0.47	0.72	0.90	1.28	1.69	1.92	1.46	1.88	2.13	2.71	3.43	4.57	5.10	4.04	4.91	5.44	6.60	7.35	25yr	0.52	0.79	0.98	1.10	1.15	1.20	1.25	
50yr	0.52	0.79	0.98	1.42	1.91	2.19	1.64	2.14	2.40	3.03	3.84	5.25	5.87	4.64	5.64	6.18	7.49	8.24	50yr	0.63	0.95	1.21	1.35	1.40	1.45	1.50	
100yr	0.57	0.87	1.09	1.57	2.15	2.48	1.86	2.42	2.70	3.21	4.30	6.03	6.71	5.34	6.45	7.09	8.52	9.28	100yr	0.73	1.09	1.40	1.55	1.60	1.65	1.70	
200yr	0.63	0.95	1.21	1.75	2.44	2.81	2.10	2.74	3.04	3.50	4.83	6.95	7.73	6.15	7.43	8.12	9.74	10.51	200yr	0.89	1.34	1.68	1.85	1.90	1.95	2.00	
500yr	0.73	1.09	1.40	2.04	2.90	3.32	2.50	3.24	3.55	3.96	5.63	8.46	9.34	7.49	8.98	9.81	11.69	12.42	500yr	1.05	1.58	2.00	2.18	2.25	2.30	2.35	

Upper Confidence Limits

	5min	10min	15min	30min	60min	120min	1hr	2hr	3hr	6hr	12hr	24hr	48hr	1day	2day	4day	7day	10day	1yr	2yr	5yr	10yr	25yr	50yr	100yr	200yr	500yr
	0.32	0.49	0.60	0.81	1.00	1.19	0.86	1.17	1.31	1.67	2.11	2.71	2.97	2.40	2.86	3.22	4.23	4.80	1yr	0.36	0.56	0.69	0.79	0.83	0.89	0.95	
1yr	0.32	0.49	0.60	0.81	1.00	1.19	0.86	1.17	1.31	1.67	2.11	2.71	2.97	2.40	2.86	3.22	4.23	4.80	1yr	0.36	0.56	0.69	0.79	0.83	0.89	0.95	
2yr	0.36	0.56	0.69	0.93	1.15	1.31	0.99	1.28	1.48	1.93	2.42	3.04	3.46	2.69	3.33	3.87	4.61	5.27	2yr	0.44	0.67	0.83	0.91	0.95	1.00	1.05	
5yr	0.44	0.67	0.83	1.14	1.46	1.71	1.26	1.67	1.92	2.44	3.04	3.89	4.54	3.45	4.37	5.10	5.95	6.66	5yr	0.52	0.79	0.98	1.05	1.10	1.15	1.20	
10yr	0.51	0.79	0.97	1.36	1.76	2.09	1.52	2.05	2.34	2.96	3.65	4.71	5.62	4.17	5.41	6.33	7.26	7.95	10yr	0.63	0.95	1.21	1.30	1.35	1.40	1.45	
25yr	0.64	0.97	1.20	1.72	2.26	2.74	1.95	2.68	3.06	3.83	4.65	6.04	7.46	5.35	7.17	8.40	9.42	10.14	25yr	0.73	1.09	1.40	1.50	1.55	1.60	1.65	
50yr	0.75	1.14	1.42	2.04	2.75	3.36	2.37	3.29	3.74	4.66	5.58	7.29	9.21	6.46	8.86	10.37	11.46	12.16	50yr	0.89	1.34	1.68	1.80	1.85	1.90	1.95	
100yr	0.89	1.34	1.68	2.43	3.33	4.13	2.88	4.03	4.58	5.76	6.70	8.81	11.39	7.79	10.96	12.81	13.95	14.59	100yr	1.05	1.58	2.00	2.15	2.20	2.25	2.30	
200yr	1.05	1.58	2.00	2.89	4.03	5.06	3.48	4.94	5.60	7.04	8.06	10.63	14.07	9.41	13.53	15.78	16.95	17.48	200yr	1.32	1.96	2.52	2.35	2.40	2.45	2.50	
500yr	1.32	1.96	2.52	3.66	5.21	6.62	4.50	6.48	7.33	9.23	10.26	13.61	18.60	12.05	17.88	20.77	21.85	22.21	500yr	1.68	2.43	3.33	3.50	3.55	3.60	3.65	



Custom Soil Resource Report
Soil Map



Map Scale: 1:4,070 if printed on A landscape (11" x 8.5") sheet.

0 50 100 200 300 Meters

0 150 300 600 900 Feet

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil klap may not be valid at this scale.
 Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
 Web Soil Survey URL: <http://websoilsurvey.sc.egov.usda.gov>

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Northwestern Part
 Survey Area Data: Version 15, Sep 3, 2021

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger

Date(s) aerial images were photographed: Oct 15, 2020—Oct 31, 2020

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background

MAP LEGEND

- Area of Interest (AOI)
- Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points
- Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Soil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features
- Streams and Canals
- Water Features
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads
- Background
 - Aerial Photography

MAP LEGEND

MAP INFORMATION

imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
59A	Bucksport and Wonsqueak mucks, 0 to 2 percent slopes	10.9	12.4%
280B	Adams loamy sand, 3 to 8 percent slopes, wooded	0.9	1.0%
282B	Colton gravelly loamy sand, 3 to 8 percent slopes	24.0	27.4%
908C	Becket-Skerry association, 0 to 15 percent slopes, extremely stony	27.7	31.6%
917B	Pilisbury-Peacham association, 0 to 8 percent slopes, extremely stony	0.9	1.0%
924C	Tunbridge-Lyman-Berkshire association, 3 to 15 percent slopes, extremely stony	23.4	26.7%
Totals for Area of Interest			100.0%

Map Unit Descriptions

The map units delineated on the detailed soil maps in a soil survey represent the soils or miscellaneous areas in the survey area. The map unit descriptions, along with the maps, can be used to determine the composition and properties of a unit. A map unit delineation on a soil map represents an area dominated by one or more major kinds of soil or miscellaneous areas. A map unit is identified and named according to the taxonomic classification of the dominant soils. Within a taxonomic class there are precisely defined limits for the properties of the soils. On the landscape, however, the soils are natural phenomena, and they have the characteristic variability of all natural phenomena. Thus, the range of some observed properties may extend beyond the limits defined for a taxonomic class. Areas of soils of a single taxonomic class rarely, if ever, can be mapped without including areas of other taxonomic classes. Consequently, every map unit is made up of the soils or miscellaneous areas for which it is named and some minor components that belong to taxonomic classes other than those of the major soils. Most minor soils have properties similar to those of the dominant soil or soils in the map unit, and thus they do not affect use and management. These are called noncontrasting, or similar, components. They may or may not be mentioned in a particular map unit description. Other minor components, however, have properties and behavioral characteristics divergent enough to affect use or to require different management. These are called contrasting, or dissimilar, components. They generally are in small areas and could not be mapped separately because of the scale used. Some small areas of strongly contrasting soils or miscellaneous areas are identified by a special symbol on the maps. If included in the database for a given area, the contrasting minor components are identified in the map unit

Site Recharge to Groundwater

"Static Method"

Soil type: C
 Impervious Area (A1): 11,558 s.f.

Rawls Rate: 0.27 In./Hr.

Soil type: D
 Impervious Area (A2): 0 s.f.

Hydrologic Group	Target Depth Factor (F)	
A	0.60	inches
B	0.35	inches
C	0.25	inches
D	0.1	inches

Determine the required recharge volume:

$R_v = F \times \text{impervious area}$

Rv = Required Recharge Volume
 F = Target Depth Factor

$$R_v = \frac{F \text{ "HSGC" } \times A_1}{12 \text{ in. / ft.}} + \frac{F \text{ "HSGD" } \times A_2}{12 \text{ in. / ft.}} = \frac{0.25 \times 11,558}{12} + \frac{0.1 \times 0}{12} = 241 \text{ Cu.Ft.}$$

From Hydrocad determine the elevation that will hold back the required recharge volume:

Below is a excerpt from the stage storage table of Infiltration Pond 71P.

Required Site Rv= 241 Cu.Ft., the minimum low level outlet required = 1053.14

Stage Storage Volumes

Elevation (Ft.)	Surface Area (Sq.Ft.)	Cum. Storage (Cu. Ft.)
1053	1,563	0
1053.5	1,829	848
1054	2,110	1,833
1054.5	2,405	2,962
1055	2,713	4,241

← 1053.14 El. At Rv Min.
 ← 848.00 Rv at LLO

The Low Level Outlet (LLO) has been designed at elevation: 1,053.50

Determine if the infiltration BMP will drain completely within 72 hours:

Time drawdown = $\frac{R_v}{(K) (\text{Bottom Area})}$

Rv = Storage Volume at Low Level Outlet (LLO) Elevation
 K = Saturated Hydraulic Conductivity (Rawls Rate)
 Bottom area = Bottom surface area not including sidewall

$$\text{Time drawdown} = \frac{848}{\frac{0.27}{12 \text{ in. / ft.}} * 1,563} = 24 \text{ hours}$$

Result is satisfactory for design purposes

24 hrs. < 72 hrs.

Non-automated TSS Calculation Sheet
 must be used if Proprietary BMP Proposed
 1. From MassDEP Stormwater Handbook Vol. 1

Project: Roberts Way Site Plan
 Prepared By: Joshua Joslyn
 Date: 7/8/2022

*Equals remaining load from previous BMP (E)
 which enters the BMP

Separate Form Needs to
 be Completed for Each
 Outlet or BMP Train

90%

Total TSS Removal =

TSS Removal
 Calculation Worksheet

BMP ¹	TSS Removal Rate ¹	Starting TSS Load*	Removed (C*D)	Remaining Load (D-E)
B	C	D	E	F
Grass Channel	0.50	1.00	0.50	0.50
Infiltration Basin	0.80	0.50	0.40	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10
	0.00	0.10	0.00	0.10

Location: 22 Roberts Way

- INSTRUCTIONS:
1. In BMP Column, click on Blue Cell to Activate Drop Down Menu
 2. Select BMP from Drop Down Menu
 3. After BMP is selected, TSS Removal and other Columns are automatically completed.

Stormwater runoff volumes to be treated for water quality

- Sediment Forebay Design Criteria: 0.1-inch of runoff x total impervious area of post-development site

Sediment Forebay 1FB

Required Storage Volume:

Subcatchment	Impervious Area (SF)	Imp. Area x 0.1 in runoff (Cu.Ft.)
16S	11,558	
	11,558	97
		Required Storage

From Hydrocad determine the elevation that will hold back the required storage volume:

Below is a excerpt from the stage storage table of Sediment Forebay.

Based on a req. storage = 97 (cu.Ft) Min. Storage El. Req'd= 1055.69

Elevation (Ft.)	Surface Area (Sq.Ft.)	Cum Storage (Cu. Ft.)
1055	92	0
1055.5	152	61
1056	225	155
1056.5	313	290
1057	414	472

← 1055.69 El. At Req. Storage Volume

*No weir proposed - assumed at top of check dam

The Weir Elevation has been designed at elevation: 1,055.75

Supplied Storage Volume: 104 Cu.Ft.

Stormwater runoff volumes to be treated for water quality

Stormwater Policy Standard 4: 0.5-inch of runoff x total impervious area of post-development site

Extended Detention Basin 6P

Required Water Quality Volume:

Subcatchment	1s	
Impervious Area (SF)	11,558	
Imp. Area x 0.5 in runoff (Cu.Ft.)		482
		Required W.Q.V.

From Hydrocad determine the elevation that will hold back the required Water Quality Volume (WQV):

Below is a excerpt from the stage storage table of the infiltration basin.

From Hydrocad determine the elevation that will hold back the required Water Quality Volume (WQV):

411 Cu. Ft. min. W.Q.V. storage elev req'd = 1035.18

Stage Storage Volumes

Elevation (Ft.)	1053	1053.5	1054	1054.5	1055
Surface Area (Sq.Ft.)	1,563	1,829	2,110	2,405	2,713
Cum. Storage (Cu. Ft.)	0	848	1,833	2,962	4,241

1053.28 El. At Req. W.Q.V. → 1035.69 - El @ Lowest Outlet

Lowest Outlet Elevation = 1,053.50

Supplied Water Quality Volume (Detention Basin): 848 C.F.

INSPECTION & MAINTENANCE MANUAL
For Jamison VanDyke
Robert's Way Industrial Subdivision
Gardner Rd; Winchendon, MA

This following manual outlines the inspection and maintenance requirements associated with stormwater management elements (best management practice) existing and/or proposed at the site. The owners, Jamison VanDyke shall provide for on-going inspections and maintenance (I&M) as described herein. The I&M activities shall be initiated immediately following the construction/implementation of the practice and/or the completion of terrain alteration activities that direct stormwater to a particular practice. If ownership of the property is transferred, the new owner(s) shall be responsible for the I&M.

The following site stormwater practices are enumerated below. Inspection and maintenance sheets are provided for each location. In addition to the individual sheets, a "Stormwater Construction Site Inspection Report" is enclosed which should also be filled out for each periodic site inspection. The two page "Site-specific BMP's checklist should also be completed along with the "Overall Site Issues" checklist

Refer to the 'BMP I.D. Plan' for the location of the site BMP's.

A- Grassed Swales

B- Sediment Forebays

C- Infiltratio Basins

D- Drain Outfalls

E- Erosion Controls

low velocities can act as sediment traps, add extra capacity to address sediment accumulation without reducing design capacity. Add an extra 0.3 to 0.5 feet of freeboard depth, if sediment accumulation is expected. Use side slopes of 3:1 or flatter to prevent side slope erosion. Make the longitudinal slope of the channel as flat as possible and not greater than 5%.

Install check dams in drainage channels when necessary to achieve velocities of 5 feet per second or less. See check dam section of this Handbook <<LINK>>. Do not use earthen check dams because they tend to erode on the downstream side, and it is difficult to establish and maintain grass on the dams. The maximum ponding time behind the check dam should not exceed 24 hours. Use outlet protection at discharge points from a drainage channel to prevent scour at the outlet.

The design for the drainage channel must include access for maintenance. When located along a highway, provide a breakdown lane with a width of 15 feet. When located along a street, off-street parking can be doubled up as the access, provided signs are posted indicating no parking is allowed during maintenance periods. When locating drainage channels adjacent to pervious surfaces, include a 15-foot wide grass strip to provide access for maintenance trucks.

Construction

Use temporary erosion and sediment controls during construction. Soil amendments, such as using aged compost that contains no biosolids, may be needed to encourage vegetation growth. Select a vegetation mix that suits the characteristics of the site. Seeding will require mulching with appropriate materials, such as mulch matting, straw, wood chips, other natural blankets, or synthetic blankets. Anchor blanket immediately after seeding. Provide new seedlings with adequate water until they are well established. Refer to the "Massachusetts Erosion and Sediment Control Guidelines for Urban and Suburban Areas: A Guide for Planners, Designers, and Municipal Officials" <<LINK>> on sediment/erosion control for information regarding seeding, mulching, and use of blankets.

Maintenance

The maintenance and inspection schedule should take into consideration the effectiveness of the drainage channel. Inspect drainage channels the first few months after construction to make sure that there is no rilling or gullying, and that vegetation in the channels is adequate. Thereafter, inspect the channel twice a year for slope integrity, soil moisture, vegetative health, soil stability, soil compaction, soil erosion, ponding, and sediment accumulation.

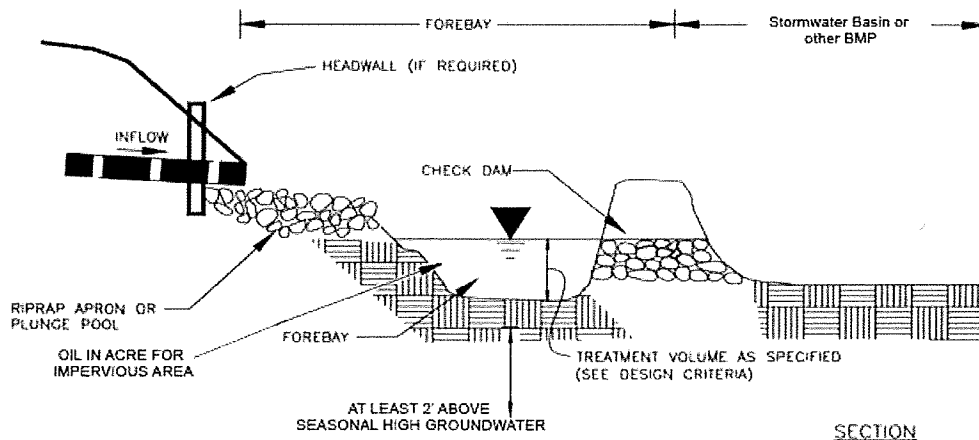
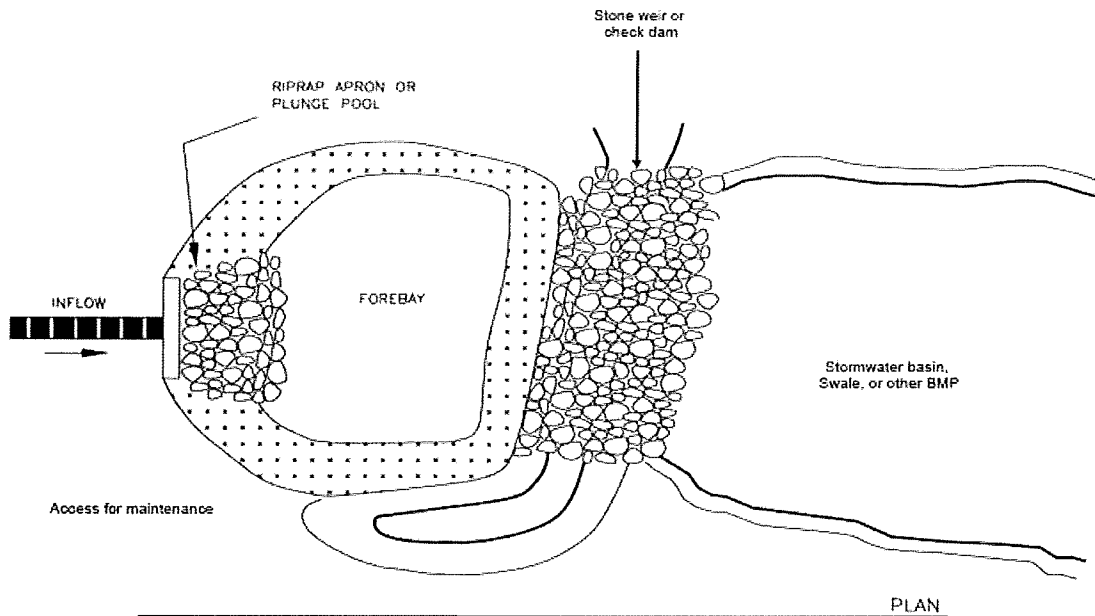
Regular maintenance tasks include mowing, fertilizing, liming, watering, pruning, weeding, and pest control. Mow channels at least once per year. Do not cut the grass shorter than three to four inches. Keep grass height under 6 inches to maintain the design depth necessary to serve as a conveyance. Do not mow excessively, because it may increase the design flow velocity.

Remove sediment and debris manually at least once per year. Re-seed periodically to maintain the dense growth of grass vegetation. Take care to protect drainage channels from snow removal procedures and off-street parking. When drainage channels are located on private residential property, the operation and maintenance plan must clearly specify the private property owner who is responsible for carrying out the required maintenance. If the operation and maintenance plan calls for maintenance of drainage channels on private properties to be performed by a public entity or an association (e.g. homeowners association), maintenance easements must be obtained.

Maintenance

Sediments and associated pollutants are removed only when sediment forebays are actually cleaned out, so regular maintenance is essential. Frequently removing accumulated sediments will make it less likely that sediments will be resuspended. At a minimum, inspect sediment forebays monthly and clean them out at least four times per year. Stabilize the floor and sidewalls of the sediment forebay before making it operational, otherwise the practice will discharge excess amounts of suspended

sediments. When mowing grasses, keep the grass height no greater than 6 inches. Set mower blades no lower than 3 to 4 inches. Check for signs of rilling and gullying and repair as needed. After removing the sediment, replace any vegetation damaged during the clean-out by either reseeding or re-sodding. When reseeding, incorporate practices such as hydroseeding with a tackifier, blanket, or similar practice to ensure that no scour occurs in the forebay, while the seeds germinate and develop roots.



CONSTRUCTION PERIOD SEDIMENT FOREBAYS SIZED 0.5"/ACRE PER ENTIRE CONTRIBUTING DRAINAGE AREA

adapted from the Vermont Stormwater Handbook

To limit smearing or compacting soils, never construct the basin in winter or when it is raining. Use light earth-moving equipment to excavate the infiltration basin because heavy equipment compacts the soils beneath the basin floor and side slopes and reduces infiltration capacity. Because some compaction of soils is inevitable during construction, add the required soil amendments and deeply till the basin floor with a rotary tiller or a disc harrow to a depth of 12 inches to restore infiltration rates after final grading.

Use proper erosion/sediment control during construction. Immediately following basin construction, stabilize the floor and side slopes of the basin with a dense turf of water-tolerant grass. Use low maintenance, rapidly germinating grasses, such as fescues. Do not sod the basin floor or side slopes. After the basin is completed, keep the basin roped or fenced off while construction proceeds on other parts of the site. Never direct construction period drainage to the infiltration basin. After construction is completed, do not direct runoff into the basin until the bottom and side slopes are fully stabilized.

Maintenance

Infiltration basins are prone to clogging and failure, so it is imperative to develop and implement aggressive maintenance plans and schedules. Installing the required pretreatment BMPs will significantly reduce maintenance requirements for the basin.

The Operation and Maintenance Plan required by Standard 9 must include inspections and preventive maintenance at least twice a year, and after every time drainage discharges through the high outlet orifice. The Plan must require inspecting the pretreatment BMPs in accordance with the minimal requirements specified for those practices and after every major storm event. A major storm event is defined as a storm that is equal to or greater than the 2-year, 24-hour storm (generally 2.9 to 3.6 inches in a 24-hour period, depending in geographic location in Massachusetts).

Once the basin is in use, inspect it after every major storm for the first few months to ensure it is stabilized and functioning properly and if necessary take corrective action. Note how long water remains standing in the basin after a storm; standing water within the basin 48 to 72 hours after a storm indicates that the infiltration capacity may

have been overestimated. If the ponding is due to clogging, immediately address the reasons for the clogging (such as upland sediment erosion, excessive compaction of soils, or low spots).

Thereafter, inspect the infiltration basin at least twice per year. Important items to check during the inspection include:

- Signs of differential settlement,
- Cracking,
- Erosion,
- Leakage in the embankments
- Tree growth on the embankments
- Condition of riprap,
- Sediment accumulation and
- The health of the turf.

At least twice a year, mow the buffer area, side slopes, and basin bottom. Remove grass clippings and accumulated organic matter to prevent an impervious organic mat from forming. Remove trash and debris at the same time. Use deep tilling to break up clogged surfaces, and revegetate immediately.

Remove sediment from the basin as necessary, but wait until the floor of the basin is thoroughly dry. Use light equipment to remove the top layer so as to not compact the underlying soil. Deeply till the remaining soil, and revegetate as soon as possible. Inspect and clean pretreatment devices associated with basins at least twice a year, and ideally every other month.

References:

Center for Watershed Protection, http://www.stormwatercenter.net/Manual_Builder/Construction%20Specifications/Infiltration%20Trench%20Specifications.htm

Center for Watershed Protection, http://www.stormwatercenter.net/Manual_Builder/Performance%20Criteria/Infiltration.htm

Center for Watershed Protection, Stormwater Management Fact Sheet, Infiltration Basin, http://www.stormwatercenter.net/Assorted%20Fact%20Sheets/Tool6_Stormwater_Practices/Infiltration%20Practice/Infiltration%20Basin.htm

