

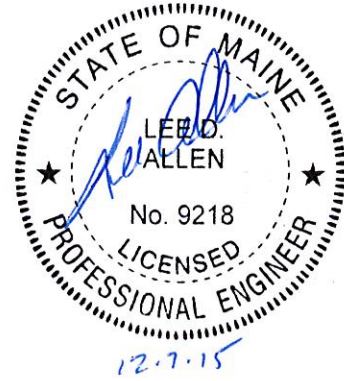


***Northeast  
Civil  
Solutions, Inc.***

381 Payne Road  
Scarborough, Maine 04074  
(800) 882-2227/ (207) 883-1000  
FAX: (207) 883-1001

***Memorandum***

TO: Jean Fraser  
FROM: Lee Allen, P.E.  
DATE: December 7, 2015  
RE: 171 Warren Avenue – Stormwater Design (Pocket Raingarden)



.....

Following please find calculations and data that support the design of a pocket raingarden for the proposed expansion of 5 parking spaces at 171 Warren Avenue. The parking expansion introduces 1,663 sf of new impervious area to the site. A 200 sf “pocket raingarden” has been proposed to treat runoff from the new impervious surface. Stormwater runoff is proposed to be collected in a swale and directed to the raingarden. The raingarden was sized to contain and treat runoff from the 1-year storm event (first flush). The soil in this area was found to be Hollis Fine Sandy Loam (HrB) with saturated infiltration rate of 28.23 micrometer/sec. This infiltration rate was converted to an exfiltration rate over the bottom of the raingarden for the purposes of the HydroCAD analysis to size the raingarden. As can be seen from the HydroCAD data the raingarden will hold approximately 7” of water during the 1-year rain event without discharging over the spillway.

**NORTHEAST CIVIL SOLUTIONS, INC.**

Surveying Engineering Land Planning

381 Payne Road, Scarborough, Maine 04074

Tel: 207-883-1000 • Fax: 207-883-1001

PROJECT Pool - 32209

SHEET NO. 1 OF \_\_\_\_\_

CALCULATED BY LDA DATE 12/7/15

CHECKED BY \_\_\_\_\_ DATE \_\_\_\_\_

SCALE RAIN GARDEN CALCULATION

Soil = HFR: HOLLY FINE SANDY LOAM

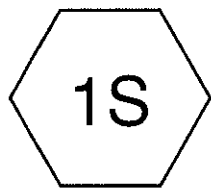
$$\begin{aligned}
 K_{SAT} = \text{SATURATED HYDRAULIC CONDUCTIVITY} &= \text{MICRO M/SEC} = 28.23 \text{ MICRO M/SEC} \\
 &= 2.823 \times 10^{-5} \text{ M/SEC} \\
 &= .0002823 \text{ M/SEC} \\
 &= 9.26 \times 10^{-5} \text{ FT/SEC}
 \end{aligned}$$

NEW IMPERVIOUS AREA = 1,663 SF

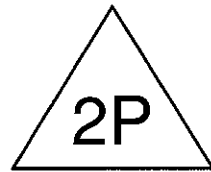
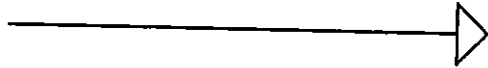
$$\text{TOTAL RAIN GARDEN AREA} = 200 \text{ SF} = Q_{INFIL} = .0185 \text{ CFS} = \sqrt{A} (9.26 \times 10^{-5} \text{ FT/SEC})(200 \text{ SF})$$

SEE HYDROCAT DATA  $Q_1$  (FIRST FLUSH) CONTAINED WITHIN RAIN GARDEN

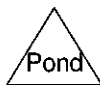




(new Subcat)



Raingarden



# Raingarden

Prepared by Microsoft

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Printed 12/7/2015

Page 2

## Area Listing (all nodes)

Area (acres)	CN	Description (subcatchment-numbers)
0.038	98	Paved parking, HSG A (1S)
<b>0.038</b>	<b>98</b>	<b>TOTAL AREA</b>

# Raingarden

Prepared by Microsoft

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Printed 12/7/2015

Page 3

## Soil Listing (all nodes)

Area (acres)	Soil Group	Subcatchment Numbers
0.038	HSG A	1S
0.000	HSG B	
0.000	HSG C	
0.000	HSG D	
0.000	Other	
<b>0.038</b>		<b>TOTAL AREA</b>

# Raingarden

Prepared by Microsoft

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Printed 12/7/2015

Page 4

## Ground Covers (all nodes)

HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatchment Numbers
0.038	0.000	0.000	0.000	0.000	0.038	Paved parking	1S
<b>0.038</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.000</b>	<b>0.038</b>	<b>TOTAL AREA</b>	

**Raingarden**

Type III 24-hr 1-Year Rainfall=2.60"

Prepared by Microsoft

Printed 12/7/2015

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Page 5

Time span=5.00-20.00 hrs, dt=0.05 hrs, 301 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: (new Subcat)**

Runoff Area=1,663 sf 100.00% Impervious Runoff Depth>2.22"  
Flow Length=20' Slope=0.0200 '/' Tc=0.3 min CN=98 Runoff=0.11 cfs 0.007 af

**Pond 2P: Raingarden**

Peak Elev=101.06' Storage=74 cf Inflow=0.11 cfs 0.007 af  
Discarded=0.02 cfs 0.007 af Primary=0.00 cfs 0.000 af Outflow=0.02 cfs 0.007 af

**Total Runoff Area = 0.038 ac Runoff Volume = 0.007 af Average Runoff Depth = 2.22"**  
**0.00% Pervious = 0.000 ac 100.00% Impervious = 0.038 ac**



# Raingarden

Prepared by Microsoft

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Type III 24-hr 1-Year Rainfall=2.60"

Printed 12/7/2015

Page 6

## Summary for Subcatchment 1S: (new Subcat)

Runoff = 0.11 cfs @ 12.00 hrs, Volume= 0.007 af, Depth> 2.22"

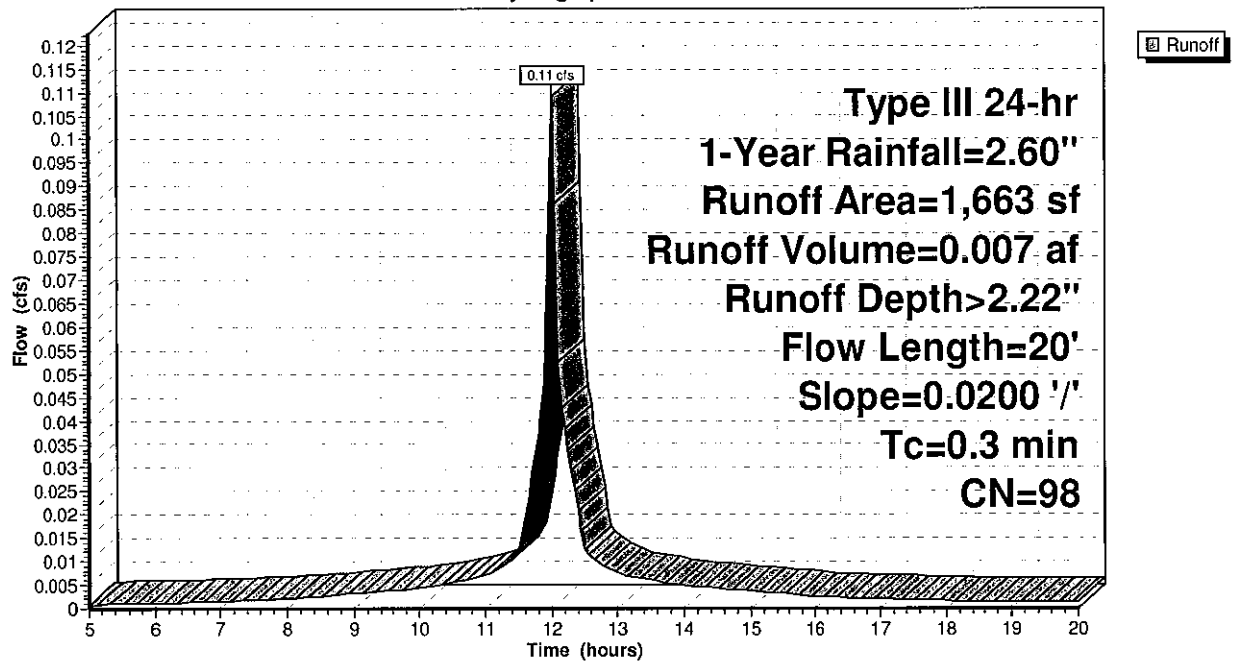
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
Type III 24-hr 1-Year Rainfall=2.60"

Area (sf)	CN	Description
1,663	98	Paved parking, HSG A
1,663		100.00% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
0.3	20	0.0200	0.98		Sheet Flow, SHEET Smooth surfaces n= 0.011 P2= 3.10"

## Subcatchment 1S: (new Subcat)

Hydrograph



**Raingarden**

Type III 24-hr 1-Year Rainfall=2.60"

Prepared by Microsoft

Printed 12/7/2015

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Page 7

**Summary for Pond 2P: Raingarden**

Inflow Area = 0.038 ac, 100.00% Impervious, Inflow Depth > 2.22" for 1-Year event  
 Inflow = 0.11 cfs @ 12.00 hrs, Volume= 0.007 af  
 Outflow = 0.02 cfs @ 11.65 hrs, Volume= 0.007 af, Atten= 82%, Lag= 0.0 min  
 Discarded = 0.02 cfs @ 11.65 hrs, Volume= 0.007 af  
 Primary = 0.00 cfs @ 5.00 hrs, Volume= 0.000 af

Routing by Stor-Ind method, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs  
 Peak Elev= 101.06' @ 12.41 hrs Surf.Area= 206 sf Storage= 74 cf

Plug-Flow detention time= (not calculated: outflow precedes inflow)  
 Center-of-Mass det. time= 19.2 min ( 755.8 - 736.5 )

Volume	Invert	Avail.Storage	Storage Description
#1	100.50'	175 cf	<b>Custom Stage Data (Prismatic)</b> Listed below (Recalc)
Elevation (feet)	Surf.Area (sq-ft)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)
100.50	50	0	0
101.00	200	63	63
101.50	250	113	175

Device	Routing	Invert	Outlet Devices
#1	Primary	101.10'	<b>5.0' long x 3.0' breadth Broad-Crested Rectangular Weir</b> Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 Coef. (English) 2.44 2.58 2.68 2.67 2.65 2.64 2.64 2.68 2.68 2.72 2.81 2.92 2.97 3.07 3.32
#2	Discarded	100.50'	<b>0.02 cfs Exfiltration at all elevations</b>

**Discarded OutFlow** Max=0.02 cfs @ 11.65 hrs HW=100.52' (Free Discharge)  
 ↳ **2=Exfiltration** (Exfiltration Controls 0.02 cfs)

**Primary OutFlow** Max=0.00 cfs @ 5.00 hrs HW=100.50' (Free Discharge)  
 ↳ **1=Broad-Crested Rectangular Weir** ( Controls 0.00 cfs)

# Raingarden

Prepared by Microsoft

HydroCAD® 10.00-13 s/n 02173 © 2014 HydroCAD Software Solutions LLC

Type III 24-hr 1-Year Rainfall=2.60"

Printed 12/7/2015

Page 8

## Pond 2P: Raingarden

Hydrograph

