



**Northeast
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Solutions, Inc.**

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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.
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PROJECT RAIN - 32209
SHEET NO. 1 OF _____
CALCULATED BY LDA DATE 12/7/15
CHECKED BY _____ DATE _____
SCALE RAIN GARDEN CALCULATION

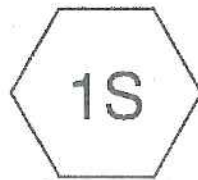
SOIL = H&B: HOLLIS FINE SANDY LOAM

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

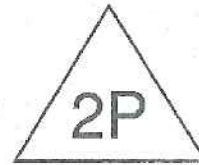
NEW IMPERVIOUS AREA = 1,665 SF

$$\text{TRIAL \#1 RAIN GARDEN AREA} = 200 \text{ SF} = Q_{\text{INFIL}} = .0185 \text{ CFS} = VA (9.26 \times 10^{-5} \text{ FT/SEC})(200 \text{ SF})$$

SEE HYDROCATS DATA Q_1 (FIRST FLUSH) CONTAINED WITHIN RAIN GARDEN



(new Subcat)



Raingarden



Raingarden

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Area Listing (all nodes)

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

Raingarden

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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	
0.038		TOTAL AREA

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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
0.038	0.000	0.000	0.000	0.000	0.038	TOTAL AREA	

Raingarden

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

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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

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

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Summary for Subcatchment 1S: (new Subcat)

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

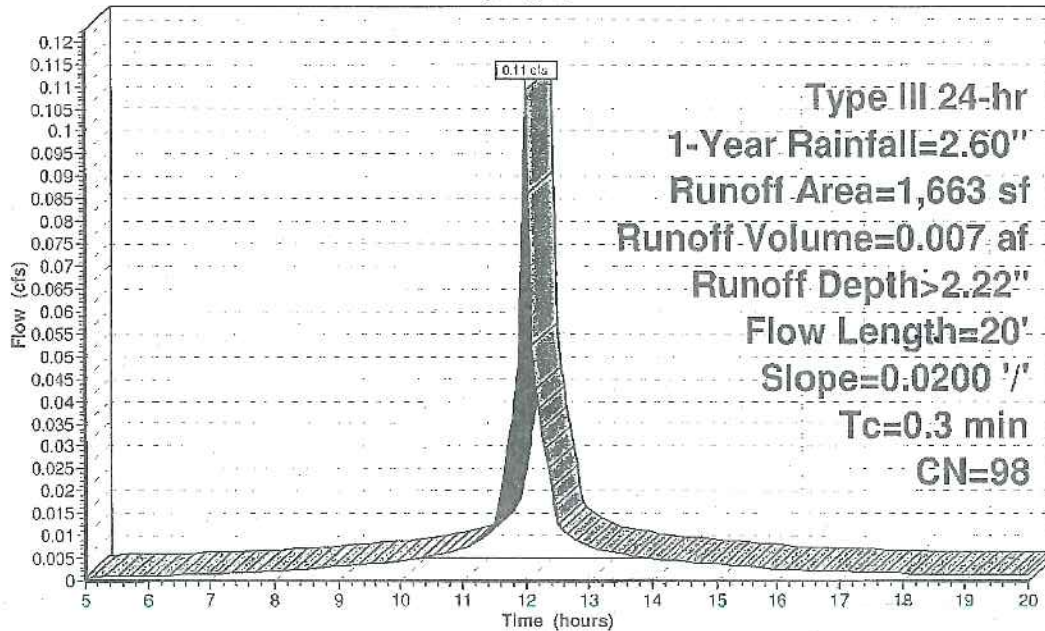
Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 5.00-20.00 hrs, dt= 0.05 hrs
Type III 24-hr 1-Year Rainfall=2.60"

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

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

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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	Custom Stage Data (Prismatic) 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'	5.0' long x 3.0' breadth Broad-Crested Rectangular Weir Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 1.80 2.00 2.50 3.00 3.50 4.00 4.50 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'	0.02 cfs Exfiltration at all elevations

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)

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

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Pond 2P: Raingarden

Hydrograph

