

CHANNEL PROTECTION STANDARD:

THIS CATCHMENT IS ON HSG "D" SOILS - PRIMARILY. TREATMENT PRACTICES IS NOT A RUNOFF REDUCTION STEP \therefore HYDROLOGIC CONDITION METHOD TO SATISFY CP_u IS NOT POSSIBLE.

USE EXTENDED DETENTION METHOD TO SATISFY CP_u

COMPUTE T_c PER SECTION 2.2.4.3 USING WATERSHED LAG METHOD.

EXISTING CONDITIONS:

DRAWING 4 LINES ON TOPO MAP PERPENDICULAR TO CONTOUR LINES AND DETERMINE WEIGHTED SLOPE.

$$\textcircled{1} \text{ slope} = \frac{7}{280} = 0.025$$

$$\textcircled{2} \text{ slope} = \frac{9.5}{525} = 0.0181$$

$$\textcircled{3} s = \frac{6.8}{415} = 0.0164$$

$$\textcircled{4} s = \frac{2.5}{220} = 0.0114$$

$$\Sigma = 0.0708 \div 4 = \underline{\underline{1.77\% = Y}}$$

$$\begin{aligned} T_L & L = 209 A^{0.6} \\ & l = 209 (2.2)^{0.6} \\ & \underline{\underline{l = 387.65 \text{ ft}}} \end{aligned}$$

CN' \rightarrow BASED ON MODEL OF WEIGHTED AREA

$$\underline{\underline{CN = 77}}$$

$$T_c = \frac{(1.48)^{0.58} \left[\left(\frac{1000}{77} - 10 \right) + 1 \right]^{0.7}}{1140 (1.77)^{0.5}}$$

$$\boxed{T_c = 0.2 \text{ hrs.}}$$

CHANNEL PROTECTION:

PROPOSED CONDITIONS: SLOPE OF DEVELOPED WATERSHED.

$$\textcircled{1} \text{ slope} = \frac{7}{280} = 0.025$$

$$\textcircled{2} \text{ slope} = \frac{6.5}{455} = 0.0143$$

$$\textcircled{3} S = \frac{7.25}{485} = 0.0149$$

$$\textcircled{4} S = \frac{7.25}{355} = 0.02$$

$$\Sigma = 0.075 \div 4 = 0.0187 \quad Y = \underline{1.87\%}$$

$$L = 209 A^{0.6}$$

$$L = 209 (2.8)^{0.6}$$

$$\underline{L = 387.65 \text{ ft}}$$

CN' \rightarrow BASED ON WEIGHTED AREA FROM HYDROCAD

$$\underline{CN' = 86}$$

$$T_C = \frac{L^{0.8} \left[\left(\frac{1000}{CN} - 10 \right) + 1 \right]^{0.7}}{1140 (Y)^{0.5}}$$

$$T_C = \frac{387.65^{0.8} \left[\left(\frac{1000}{86} - 10 \right) + 1 \right]^{0.7}}{1140 (1.87)^{0.5}}$$

$$\underline{T_C = 0.148 \text{ hrs} \rightarrow 8.9 \text{ min}}$$

Wet Pond (4.3.6)

Practice Drainage Area		For Permit Coverage	Not for Permit Coverage	Total to Practice
1	Total Area (acres)	2.800	0.000	2.800
2	New Impervious (acres)	0.970	0.000	0.970
3	Redeveloped Impervious	0.000	0.000	0.000
		WQ _V for credit	WQ _V not for credit	Total WQ _V
4	WQ _V to practice	0.0844	0.0000	0.0844
5	Discharges to Cold or Warm Water Fishery?	<input checked="" type="radio"/> Cold <input type="radio"/> Warm		

Modified CN for WQ (1.0") storm

91

↑Enter this value on the Standards Compliance Workbook

Note: Designers may use the Practice Drainage Area Runoff Calculator (second tab) for calculation of practice-specific runoff volumes for other treatment standards.

* Questions preceded by an asterisk (*) may change based on previously entered values

Feasibility (4.3.6.1)

	Response	Attachment location
6 If receiving water from a stormwater hotspot, is the pond lined and prevented from intercepting groundwater?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3

Conveyance (4.3.6.2)

	Response	Attachment location
7 Are inlets stabilized to ensure that non-erosive conditions exist during events up to the 10-year, 24 hour storm?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
8 Does the design specify an outlet that is stable for the Q ₁₀ storm event?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
9 Have the outfalls and the conveyance to the discharge point been designed and protected to avoid erosive velocities?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
10 Is the outlet control structure located within the embankment for maintenance access and safety?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
11 Has a emergency spillway been provided to safely convey the 100-year storm without overtopping the embankment?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3, and Attachment 4
12 Are end walls above pipe outfalls greater than 30 inches in diameter fenced with pipe or rebar at 8 inch intervals?	<input type="radio"/> Yes <input checked="" type="radio"/> No	Pipe outfalls less than 30 in. diameter
13 Has a low flow orifice been provided to meet the WQ _V and CP _V extended detention requirements without clogging?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
14* Has a under-drained stone trench outlet been provided to discharge volumes up to an including the CP _V in accordance with requirements in Section 4.3.6.2?	<input type="radio"/> Yes <input type="radio"/> No	

Pre-Treatment (4.3.6.3)		Response	Attachment location
15	Has pretreatment been provided for non-rooftop runoff?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
16	What type of pretreatment is being used?	<input type="checkbox"/> Swale <input checked="" type="checkbox"/> Forebay (10% WQ _v) <input type="checkbox"/> Proprietary <input type="checkbox"/> Filter Strip <input type="checkbox"/> Deep Sump Catch Basins	

Treatment (4.3.6.4)		Response	Attachment location
17	What is the volume stored in the forebay or other volumetric pre-treatment if used? (minimum 10% WQ _v)	ft ³ 1075	
18	What is the volume stored in the permanent pool?	ft ³ 6245	
19	What is the total WQ _v stored at the normal water level (pre-treatment + permanent pool)?	ft ³ 7320	
20*	Is at least 25% of the WQ _v stored in deep water zones with a depth between four (4) and eight (8) feet?	<input checked="" type="radio"/> Yes <input type="radio"/> No	
21	Does the pre-treatment volume plus the permanent pool equal at least 50% of the WQ _v ?	199.1%	Yes
22	Has the permanent pool been excluded from calculations for storms greater than the water quality event (1" storm)?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Attachment 4
23	Is the remaining WQ _v provided for by extended detention over 24 hours?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a
24	Has a minimum flow path at normal water level of 3:1 been provided?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3

Landscaping (4.3.6.5)		Response	Attachment location
25	Are all deep pool areas of ≥ 4 feet depth with side slopes steeper than 4:1 (H:V) surrounded by a safety bench with ≤6% slope extending 10 feet outward from the normal water edge to the toe of the side slope?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a
26	Has an aquatic been provided that extends at least 5 feet inward from the normal water edge and is no more than 18 inches deep?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
27	Has a planting plan been prepared showing how aquatic and terrestrial areas will be stabilized, including plant species, plant locations, sources of plant material and any required soil amendments?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3
28	Does the planting plan specify that no woody vegetation >2 inches in diameter shall be planted or allowed to grow on or within 15 feet of the dam or the toe of the embankment?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-3

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

Disconnection to Filter Strips or Vegetated Buffers (4.2.3)

Discharge Point: 2

Disconnection Area # 1

Disconnected Area		For Permit Coverage	Not for Permit Coverage	Total to Practice
1	Total Area (acres)	0.391	0.000	0.391
2	Impervious (acres)	0.391	0.000	0.391
		WQ _V for credit	WQ _V not for credit	Total WQ _V
3	WQ _V to practice	0.0310	0.0000	0.0310
				Modified CN for WQ (1.0") storm
				100
4	Runoff conveyed to disconnection area by	<input checked="" type="radio"/> Sheetflow <input type="radio"/> Level Spreader		

* Questions preceded by an asterisk (*) may change based on previously entered values

Feasibility (4.2.3.1)		Response	Attachment location
5	Do the site plans show a permeable vegetated area with the required flow path length, as specified in the Treatment section below?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1 and C-6
6	Do the underlying soils of the disconnection area meet the Post-Construction Soil Depth and Quality Standard?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1 and C-6
7	Do the plans specify that vegetated buffers shall remain in a natural state and must be protected to ensure that no future development, disturbance, or clearing occur within the area?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a, filter strips only
8	Do the plans specify that filter strips shall be identified and protected to ensure that no future development, disturbance, or clearing may occur within the area, except as stipulated in the vegetation maintenance plan?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1 and C-6
9	Is the maximum slope of the filter strip no steeper than 15% or the maximum slope for the vegetated buffer now steeper than 8%?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1
10	Are disconnection areas configured such that there is no overlap between adjacent disconnection areas?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1
11	For sites with septic systems, is the disconnection flow path cross-gradient or down-gradient of the leachfield?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a, no on-site wastewater
12*		<input type="radio"/> Yes <input type="radio"/> No	

Conveyance (4.2.3.2)		Response	Attachment location
13	Is the runoff conveyed as sheet flow across the disconnection area for the applicable design storms and prevented from channelizing?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1
14	Is the disconnection surface directed away from buildings so as to protect foundations and basements?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1

Engineered Level Spreader Requirements (if applicable)

14	What is the peak discharge of the largest storm event routed to the level spreader? (cfs)	0	
15	What type of vegetation covers the disconnection area?	<input checked="" type="radio"/> Grass <input type="radio"/> Forested <input type="radio"/> Mixed	
16			
17	What is the required level spreader length per cfs in feet?	13	
18	What is the required level spreader length in feet?	0	
19	Has the level spreader been designed in accordance with all design requirements in section 4.2.3.2?	<input type="radio"/> Yes <input type="radio"/> No	

Pretreatment (4.2.3.3)

		Response	Attachment location
18	Has pre-treatment been provided for the level either in a forebay sized for 10% of the WQv or otherwise in accordance with Section 4.1?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1

Treatment Volume Calculation

		Response	Attachment location
19	Disconnected Impervious for permit coverage (from question 2) acres	0.391	
21	Soil HSG $f_c \geq 1$ in/hr for $T_V = HC_V$ $f_c \geq 0.5$ in/hr for $T_V = WQ_V$ $f_c < 0.5$ in/hr for $T_V = WQ_V$	<input type="radio"/> A <input type="radio"/> A/B <input checked="" type="radio"/> C/D	
22	What is the slope of the disconnection area?	<input checked="" type="radio"/> <8% <input type="radio"/> 8-15%	
23	What is the required length of the disconnection area? ft	65	
24	What disconnection length is provided? ft	85	
25*	inches	0.0	
26	What is the treatment volume provided by the STP? T_V (cu-ft)	1419.3	
27	What is the treatment volume provided by the STP? T_V (ac-ft)	0.033	

↑ Enter this value on the Standards Compliance Worksheet

Treatment (4.2.3.4)

		Response	Attachment location
28*		<input type="radio"/> Yes <input checked="" type="radio"/> No	

Landscaping (4.3.3.5)		Response	Attachment location
29	Is a dense vegetative cover (minimum 90% coverage) specified for the disconnection area on the plan sheet/detail sheet?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1 and C-6

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

Dry Pond (5.1)

1 Standard(s) Met by Pond ☒ Channel Protection
☒ Overbank/Extreme Flood

2 Discharges to Cold or Warm Water Fishery? ☒ Cold
☐ Warm

Note: Designers may use the Practice Drainage Area Runoff Calculator (second tab) for calculation of practice-specific runoff volumes for treatment standards.

* Questions preceded by an asterisk (*) may change based on previously entered values

		Response	Attachment location
3	Does the pond have side slopes no greater than 2:1 unless site constraints have required the use of retaining walls or similar structural support?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-4
4	Does the design specify an outlet that is stable for the Q ₁₀ storm event?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-4
5	Have the outfalls and the conveyance to the discharge point been designed and protected to avoid erosive velocities?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-4
6	Is the outlet control structure located within the embankment for maintenance access and safety?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
7	Has a emergency spillway been provided to safely convey the 100-year storm without overtopping the embankment?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-4, Modeling
8	Are end walls above pipe outfalls greater than 30 inches in diameter fenced with pipe or rebar at 8 inch intervals?	<input type="radio"/> Yes <input checked="" type="radio"/> No	Outfall less than 30" diameter
9*	Has a low for orifice been provided to meet the and CPV extended detention requirements without clogging?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-4
10*	Has a under-drained stone trench outlet been provided to discharge volumes up to an including the CPv in accordance with requirements in Section 4.3.6.2 unless detention time is less than 500 minutes?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-4 and C-5

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

Practice Drainage Area Runoff Calculator

Project Name: Plaza

Discharge Point: 2

Dry Swale # 1

This tool may be used to calculate the required treatment volumes for the area draining to an individual practice where the practices drainage area is only a portion of the area draining to a discharge point. Where the practice receives runoff from the entire area to a discharge point, this calculator will give the same information as the Standards Compliance Workbook.

Precipitation Data* Precipitation values shall be obtained from [NOAA Atlas 14](#)

Storm	WQ Storm	1 yr, 24 hr	10 yr, 24 hr	100 yr, 24 hr
Precipitation (inches)	1.00	2.20	3.99	6.11

Drainage Area Information

Pre Development Land Use (acres)

Landuse	Hydrologic Soil Group				Total (acres)
	A	B	C	D	
Grass	0.000	0.000	0.000	0.000	0.000
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	1.640	0.800	2.440
Pavement, roofs, and other impervious	0.000	0.000	0.000	0.000	0.000
Total	0.000	0.000	1.640	0.800	2.440

Post Development Land Use (acres)

Landuse	Hydrologic Soil Group				Total (acres)
	A	B	C	D	
Grass	0.000	0.000	0.950	0.690	1.640
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.390	0.020	0.410
Pavement, roofs, and other impervious	0.000	0.000	0.000	0.390	0.390
Total	0.000	0.000	1.340	1.100	2.440

 T_V of upstream practices: 0.033 ac-ft T_V credit of this practice: 0.005 ac-ft

Treatment Standard	Required Treatment Volume	Post Development Runoff Volume	Pre-development Runoff Volume	Post Composite CN (to practice)	CN _{Adj} (with T_V practice credit)	Pre Composite CN
Channel Protection (Hydrologic Condition Method)	0.0034	0.1174	0.0811	77	77	73
Overbank Flood	0.0437	0.3778	0.3011	78	77	72
Extreme Flood	0.0737	0.7404	0.6337	78	77	72

Information for Calculating T_C by the Watershed Lag Method

Average Catchment

Hydraulic

Time of Concentration, T_C

	Slope, Y (%)	Length, l (ft)	1 yr	10 yr	100 yr
Pre Development	0%	0.00	#DIV/0!	#DIV/0!	#DIV/0!
Post Development, upstream of practice	0%	0.00	#DIV/0!	#DIV/0!	#DIV/0!
Post Development, with T _v credit from practice	0%	0.00	#DIV/0!	#DIV/0!	#DIV/0!

Project Name:	East Street Commercial Plaza
Discharge Point:	2
Practice #	n/a

Reforestation (4.2.1)

1 Practice Type

- ☐ Active Reforestation
☒ Passive Reforestation
☐ Individual Tree Plantings

* Questions preceded by an asterisk (*) may change based on previously entered values

Feasibility (4.2.1.1)		Response	Attachment location
2	Is the reforested area under the same ownership or control as the site and identified as protected from development and disturbance on the site plan?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
3	Have tree species been selected that are appropriate for the soil and site conditions?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Passive Reforestation
4*	For reforested areas, is the minimum contiguous area at least 2,500 square feet?	<input checked="" type="radio"/> Yes <input type="radio"/> No	17560 sf, Sheet C-2
5*	For reforested areas, is the minimum width at least 25 feet?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2

Treatment (4.2.1.2)		Response	Attachment location
6	Have tree species been selected that are well-suited to the site and with consideration for natural species composition and diversity of local forests?	<input type="radio"/> Yes <input checked="" type="radio"/> No	Passive Reforestation
7	Does the soil within the reforested area meet the Post-Construction Soil Depth and Quality Standard?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Undisturbed Soils
8	If the reforested area is also being used to receive additional credit through a disconnection practice, has the designer also completed the appropriate worksheet?	<input type="radio"/> Yes <input checked="" type="radio"/> No	

Treatment Volume Calculation		Response	Attachment location
9	Reforested area (excluding impervious surfaces) (acres)	0.400	Sheet C-2
10*	Tv credit per unit area inches	0.05	
11*	What is the treatment volume provided by the STP? T _V (cu-ft)	72.6	
12*	What is the treatment volume provided by the STP? T _V (ac-ft)	0.002	

↑ Enter this value on the Standards Compliance Worksheet

Landscaping (4.3.2.5)		Response	Attachment location
	Has a planting plan been developed in accordance with Section 4.2.1.3?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
	Does the planting plan specify that reforestation areas shall not be maintained as landscaped areas and that leaf litter, duff, saplings, and understory shall not be removed?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

CPV USING HCM
CONT'D

DETERMINE HC_v:

$$HC_v = \frac{(Q_{i, \text{post}} - Q_{i, \text{pre}}) A}{12}$$

$$HC_v = \frac{(\overset{0.74}{\cancel{0.73}} - 0.398) 2.44}{12}$$

$$HC_v = \frac{\cancel{0.0675} \text{ AC} \cdot \text{FT}}{0.069} \rightarrow \frac{\cancel{2940} \text{ FT}^3}{3016}$$

APPLY TV PROVIDED BY REFORESTATION, DISCONNECT TO FILTER,
& DRY SWALE TO HC_v

$$TV_{\text{provided}} = 73 \text{ FT}^3 + 1418 \text{ FT}^3 + 230 \text{ FT}^3$$

$$TV_{\text{provided}} = 1721 \text{ FT}^3$$

$$HC_v - TV_{\text{prov}}$$

$$\frac{\cancel{2940}}{3016} - 1721 = \frac{1295}{3016} \text{ FT}^3 \text{ REMAINING}$$

LP_v TREATMENT STANDARD PARTIALLY MET 750%
USING HCM.

TREAT REMAINING VOLUME USING EXTENDED DETENTION
METHOD.

COMPUTE T_c PER 2.2.4.3 USING WATERSHED LAG.

DEVELOPED FLOW PATH USING 3 TRANSVERSE LINES ON TOPO MAP
AND AVERAGED.

$$\textcircled{1} \text{ SLOPE} = \frac{8.2}{320} = 0.0256$$

$$\textcircled{2} \text{ SLOPE} = \frac{11}{525} = 0.02095$$

$$\textcircled{4} \text{ SLOPE} = \frac{12}{770} = 0.0156$$

$$\Sigma = 0.06216 \div 3 = 0.0207$$

$$\boxed{V = 2.07\%}$$

DETERMINE FLOW LENGTH:

$$L = 209 A^{0.6}$$

$$L = 209 (2.44)^{0.6}$$

$$\underline{L = 356.9 \text{ FT}}$$

~~CN' = BASED ON WEIGHTED AREA FROM MODEL~~
~~CN = 79~~

DETERMINE POST-DEVELOPMENT T_c :

$$T_c = \frac{L^{0.8} (S+1)^{0.7}}{1140 Y^{0.5}}$$

$$T_c = \frac{(356.9)^{0.8} \left(\frac{1000}{79} - 16 \right) + 1}{1140 (2.07)^{0.5}}$$

$$T_c = 0.167 \text{ HRS}$$

$$\rightarrow 10 \text{ MINS}$$

CALCULATE ADJUSTED CURVE NUMBER PER 2.2.5.3
 FOR 1-YR STORM $P=2.2 \text{ IN.}$

$$HC_{VACT} = \sum T_u$$

$$HC_{VACT} = 73 \text{ FT}^3 + 1418 \text{ FT}^3 + 230 \text{ FT}^3$$

$$\underline{HC_{VACT} = 1721 \text{ FT}^3} \rightarrow \underline{0.04 \text{ AC} \cdot \text{FT}}$$

CONVERT HC_{VACT} TO RUNOFF DEPTH:

$$Q_{ACT} = \frac{HC_{VACT} \times 12}{A}$$

$$Q_{ACT} = \frac{0.04 \text{ AC} \cdot \text{FT} \times 12}{2.44 \text{ AC}}$$

$$\underline{Q_{ACT} = 0.194 \text{ INCHES}}$$

DETERMINE T_c EXISTING CONDITION:

CALCULATE SLOPE AVE. OF PRE-DEVELOPED BASIN

$$(A) \text{ SLOPE} = \frac{10.2}{310} = 0.0329$$

$$(B) \text{ SLOPE} = \frac{8.5}{525} = 0.0162$$

$$(C) \text{ SLOPE} = \frac{6.5}{235} = 0.0277$$

$$(D) \text{ SLOPE} = \frac{2.9}{275} = 0.0105$$

$$\Sigma = 0.087 \div 4 = 0.0218$$

$$Y = 2.18\%$$

$$T_c = \frac{L^{0.8} \left[\left(\frac{1000}{72} - 10 \right) + 1 \right]^{0.7}}{1140 (2.18)^{0.5}}$$

$$L = 356.9$$

PRE-DEVELOPED

$$T_c = 0.199 \text{ HRS} \rightarrow 11.9 \text{ MINS}$$

PREDEVELOPED RUNOFF 10-YR 24-HR STORM

$$Q = 5.12 \text{ CFS (FROM HYDROCAD)}$$

Practice Drainage Area Runoff CalculatorProject Name: **Plaza**Discharge Point: **3**Bioretention #: **1**

This tool may be used to calculate the required treatment volumes for the area draining to an individual practice where the practices drainage area is only a portion of the area draining to a discharge point. Where the practice receives runoff from the entire area to a discharge point, this calculator will give the same information as the Standards Compliance Workbook.

Precipitation Data* Precipitation values shall be obtained from [NOAA Atlas 14](#)

Storm	WQ Storm	1 yr, 24 hr	10 yr, 24 hr	100 yr, 24 hr
Precipitation (inches)	1.00	2.20	3.99	6.11

Drainage Area Information

Pre Development Land Use (acres)

Landuse	Hydrologic Soil Group				Total (acres)
	A	B	C	D	
Grass	0.000	0.000	4.590	0.030	4.620
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.400	0.000	0.400
Pavement, roofs, and other impervious	0.000	0.000	1.420	0.000	1.420
Total	0.000	0.000	6.410	0.030	6.440

Post Development Land Use (acres)

Landuse	Hydrologic Soil Group				Total (acres)
	A	B	C	D	
Grass	0.000	0.000	3.060	0.020	3.080
Meadow	0.000	0.000	0.000	0.000	0.000
Woods	0.000	0.000	0.170	0.000	0.170
Pavement, roofs, and other impervious	0.000	0.000	3.190	0.000	3.190
Total	0.000	0.000	6.420	0.020	6.440

 T_v of upstream practices: **0.015** ac-ft T_v credit of this practice: **0.213** ac-ft

Treatment Standard	Required Treatment Volume	Post Development Runoff Volume	Pre-development Runoff Volume	Post Composite CN (to practice)	CN _{Adj} (with T_v practice credit)	Pre Composite CN
Channel Protection (Hydrologic Condition Method)	0.1972	0.6292	0.4170	89	82	82
Overbank Flood	0.2942	1.4106	1.1013	87	82	80
Extreme Flood	0.3595	2.4291	2.0546	86	82	79

Information for Calculating T_c by the Watershed Lag Method

Average Catchment

Hydraulic

Time of Concentration, T_c

	Slope, Y (%)	Length, l (ft)	1 yr	10 yr	100 yr
Pre Development	2%	639.00	2.6	2.8	2.8
Post Development, upstream of practice	1%	639.00	2.6	2.7	2.8
Post Development, with T _v credit from practice	1%	639.00	3.3	3.2	3.2

Disconnection to Filter Strips or Vegetated Buffers (4.2.3)

Discharge Point:

3

Disconnection Area #

2

Disconnected Area		For Permit Coverage	Not for Permit Coverage	Total to Practice
1	Total Area (acres)	0.176	0.000	0.176
2	Impervious (acres)	0.176	0.000	0.176
		WQ _v for credit	WQ _v not for credit	Total WQ _v
3	WQ _v to practice	0.0139	0.0000	0.0139
				Modified CN for WQ (1.0") storm
				100
4	Runoff conveyed to disconnection area by	<input checked="" type="radio"/> Sheetflow <input type="radio"/> Level Spreader		

* Questions preceded by an asterisk (*) may change based on previously entered values

Feasibility (4.2.3.1)		Response	Attachment location
5	Do the site plans show a permeable vegetated area with the required flow path length, as specified in the Treatment section below?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet SW-1
6	Do the underlying soils of the disconnection area meet the Post-Construction Soil Depth and Quality Standard?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
7	Do the plans specify that vegetated buffers shall remain in a natural state and must be protected to ensure that no future development, disturbance, or clearing occur within the area?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a, filter strips only
8	Do the plans specify that filter strips shall be identified and protected to ensure that no future development, disturbance, or clearing may occur within the area, except as stipulated in the vegetation maintenance plan?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
9	Is the maximum slope of the filter strip no steeper than 15% or the maximum slope for the vegetated buffer now steeper than 8%?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
10	Are disconnection areas configured such that there is no overlap between adjacent disconnection areas?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
11	For sites with septic systems, is the disconnection flow path cross-gradient or down-gradient of the leachfield?	<input checked="" type="radio"/> Yes <input type="radio"/> No	No on-site wastewater
12*		<input type="radio"/> Yes <input type="radio"/> No	

Conveyance (4.2.3.2)		Response	Attachment location
13	Is the runoff conveyed as sheet flow across the disconnection area for the applicable design storms and prevented from channelizing?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2
14	Is the disconnection surface directed away from buildings so as to protect foundations and basements?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-2

Engineered Level Spreader Requirements (if applicable)

14	What is the peak discharge of the largest storm event routed to the level spreader? (cfs)	0	
15	What type of vegetation covers the disconnection area?	<input checked="" type="radio"/> Grass <input type="radio"/> Forested <input type="radio"/> Mixed	
16			
17	What is the required level spreader length per cfs in feet?	13	
18	What is the required level spreader length in feet?	0	
19	Has the level spreader been designed in accordance with all design requirements in section 4.2.3.2?	<input type="radio"/> Yes <input type="radio"/> No	

Pretreatment (4.2.3.3)

		Response	Attachment location
18	Has pre-treatment been provided for the level either in a forebay sized for 10% of the WQv or otherwise in accordance with Section 4.1?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a, no level spreader required

Treatment Volume Calculation

		Response	Attachment location
19	Disconnected Impervious for permit coverage (from question 2) acres	0.176	
21	Soil HSG $f_c \geq 1$ in/hr for $T_V = HC_V$ $f_c \geq 0.5$ in/hr for $T_V = WQ_V$ $f_c < 0.5$ in/hr for $T_V = WQ_V$	<input type="radio"/> A <input type="radio"/> A/B <input checked="" type="radio"/> C/D	
22	What is the slope of the disconnection area?	<input checked="" type="radio"/> <8% <input type="radio"/> 8-15%	
23	What is the required length of the disconnection area? ft	65	
24	What disconnection length is provided? ft	65	
25*	inches	0.0	
26	What is the treatment volume provided by the STP? T_V (cu-ft)	638.9	
27	What is the treatment volume provided by the STP? T_V (ac-ft)	0.015	

↑ Enter this value on the Standards Compliance Worksheet

Treatment (4.2.3.4)

		Response	Attachment location
28*		<input type="radio"/> Yes <input checked="" type="radio"/> No	

Landscaping (4.3.3.5)		Response	Attachment location
29	Is a dense vegetative cover (minimum 90% coverage) specified for the disconnection area on the plan sheet/detail sheet?	<input checked="" type="radio"/> Yes <input type="radio"/> No	

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

DETERMINE UNTREATED FOR Q_{10} :

$$Q_{REM} = Q_{10\text{ POST}} - Q_{ACT}$$

$$Q_{REM} = 2.656 - 0.47$$

$$Q_{REM} = 2.186 \text{ INCHES}$$

CALCULATE CN_{Adj} FOR 10 YR EVENT: $P = 3.99$

$$CN_{Adj} = \left(\frac{200}{(P + 2 * (Q_{REM}) + 2)} - \sqrt{(5 * P * Q_{REM} + 4 * Q_{REM}^2)} \right)$$

$$CN_{Adj} = \left(\frac{200}{(3.99 + 2 * (2.186) + 2)} - \sqrt{(5 * 3.99 * 2.186 + 4 * (2.186)^2)} \right)$$

$$CN_{Adj} = 81.89 \text{ USE } 82$$

CALCULATE T_c PER 2.2.4.3 USING WATERSHED LAG.

TAKE AVERAGE OF 4 DEVELOPED FLOW PATHS, ~~AND~~

$$\textcircled{1} \text{ slope} = \frac{4.6}{220} = 0.0209$$

$$\textcircled{2} \text{ slope} = \frac{7.1}{615} = 0.0115$$

$$\textcircled{3} \text{ slope} = \frac{6}{995} = 0.006$$

$$\textcircled{4} \text{ slope} = \frac{4.5}{610} = 0.0074$$

$$\Sigma 0.0458 \div 4 = 0.01145$$

$$Y = 1.15\%$$

DETERMINE FLOW LENGTH (L):

$$L = 209 A^{0.6}$$

$$L = 209 (6.44)^{0.6}$$

$$L = 639 \text{ FT}$$

CALCULATE POST-DEVELOPMENT T_c , 10-YR STORM:

$$T_c = \frac{(L)^{0.8} \left[\left(\frac{1000}{CN} - 10 \right) + 1 \right]^{0.7}}{1140 Y^{0.5}}$$

$$T_c = \frac{639^{0.8} \left[\left(\frac{1000}{82} - 10 \right) + 1 \right]^{0.7}}{1140 (1.15)^{0.5}}$$

$$T_c = 0.32 \text{ HRS} \longrightarrow 19.4 \text{ MINS.}$$

DETERMINE T_c EXISTING CONDITIONS PER SECT. 2.2.4.3

$$\textcircled{A} \text{ SLOPE} = \frac{11.3}{315} = 0.036$$

$$\textcircled{B} \text{ SLOPE} = \frac{9.5}{845} = 0.012$$

$$\textcircled{C} \text{ SLOPE} = \frac{4}{180} = 0.022$$

$$\textcircled{D} \text{ SLOPE} = \frac{4}{355} = 0.0113$$

$$\textcircled{E} \text{ slope} = \frac{4.5}{610} = 0.0074$$

$$\Sigma = 0.088 \div 5 = 0.0176$$

$$Y = 1.76\%$$

CALCULATE PRE-DEVELOPED T_L , 10-YR STORM:

$$T_L = \frac{1^{0.8} \left[\left(\frac{1000}{C_H} - 10 \right) + 1 \right]^{0.7}}{1140(4)^{0.5}}$$

$$T_L = \frac{639^{0.8} \left[\left(\frac{1000}{77} - 10 \right) + 1 \right]^{0.7}}{1140(1.76)^{0.5}}$$

$C_H = 77$
FROM
HYDROCAD.

$$T_L = 0.306 \text{ HR} \rightarrow 18.3 \text{ MIN}$$

71 ALF
136 21.7 min

USE HYDROCAD MODEL TO DEMONSTRATE
COMPLIANCE W/ Q_{P10}

$$Q_{POST 10} < Q_{PRE 10}$$

Q_{P100} STANDARD WAIVED

IMPERVIOUS SURFACE ASSOCIATED W/SITE, COMMON PLAN
OF DEVELOPMENT < 10 ALF'S.

BOREHOLE INFILTRATION TESTING

Project Name: East Street Commercial Plaza
Site: Someplace, Vermont
Date: 8/18/2016
Percolation Test By: Jimmy James, ST #0000
Calculation By: Jimmy James, ST #0000

Infiltration Test No.: I-1

Existing elevation:	98	
Proposed practice area elev.	93	
Thickness of filter bed	2	
Proposed bottom of practice =		91
Test/Bottom of borehole elev =		89 (2 ft below bottom of practice)

Borehole Characteristics: 6" diameter, 24-inch solid casing

Presoak Borehole for 24-hrs.	Presoak Start Time:	<u>8/16/2016</u>	<u>8:00 AM</u>
	Presoak End Time:	<u>8/17/2016</u>	<u>8:15 AM</u>

Cycle No.	Start Time			End Time			Measured drop from top of casing (inches)	Rate (in/hr)
	H	M	S	H	M	S		
1	8	30	0	9	30	0	5.50	5.50
2	9	45	5	10	45	55	7.00	6.90
3	11	0	0	12	1	0	6.50	6.39
4	12	15	48	13	16	0	6.00	5.98
Average Infiltration Rate =								6.19

Design Infiltration Rate = 3.10 (Factor of safety of 2)

Infiltration Test No.: I-2

Existing elevation:	95
Proposed practice area elev.	93
Thickness of filter bed	2
Proposed bottom of practice =	91
Test/Bottom of borehole elev =	89 (2 ft below bottom of practice)

Borehole Characteristics: 6" diameter, 24-inch solid casing

Presoak Borehole for 24-hrs.	Presoak Start Time:	8/16/2016	8:15 AM
	Presoak End Time:	8/17/2016	8:45 AM

Cycle No.	Start Time	End Time	Rate
	H M S	H M S Measured drop from top of casing (inches)	(in/hr)
1	8 45 0	9 50 0 6.25	5.77
2	9 56 5	11 1 0 6.75	6.24
3	12 5 0	13 10 0 4.50	4.15
4	13 15 48	14 20 0 6.50	6.07
Average Infiltration Rate =			5.56

Design Infiltration Rate = 2.78 (Factor of safety of 2)

Infiltration Test No.: I-3

Existing elevation: 97.2

Proposed practice area elev. 96.8

Thickness of filter bed 2

Proposed bottom of practice = 94.8

Test/Bottom of borehole elev = 92.8 (2 ft below bottom of practice)

Borehole Characteristics: 6" diameter, 24-inch solid casing

Presoak Borehole for 24-hrs.

Presoak Start Time: 8/16/2016 8:20 AMPresoak End Time: 8/17/2016 8:50 AM

Cycle No.	Start Time			End Time			Measured drop from top of casing (inches)	Rate (in/hr)
	H	M	S	H	M	S		
1	8	55	0	10	0	0	7.50	6.92
2	10	5	5	11	8	1	7.00	6.67
3	11	15	0	12	15	5	7.00	6.99
4	12	20	48	13	25	0	6.75	6.31
Average Infiltration Rate =								6.72
Design Infiltration Rate =								3.36 (Factor of safety of 2)

Post-Construction Soil Depth and Quality Standard

Feasibility (3.1)		Response	Attachment location
1	Have all areas of disturbance within the site that are subject to the Post-Construction Soil Depth and Quality Standard been identified on a plan sheet? This includes all disturbed areas on slopes $\leq 33\%$ which are not covered by an impervious surface, part of a structural stormwater treatment practice, or engineered as structural fill once development is complete.	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
2	Have all areas that will not be disturbed and areas exempt from the Standard, including the reason for the exemption, been identified on a plan sheet?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6

Treatment (3.2)		Attachment Location
3	Is the minimum topsoil depth specified as: <input checked="" type="checkbox"/> 4 inches <input type="checkbox"/> The depth of the 0 and A horizons on the NRCS Official Soil Series Description of the native mapped soils (provide documentation)	Sheet C-6
4	Which of the following methods are utilized to meet soil quality requirements for this site? <input checked="" type="checkbox"/> Option 1: Leave undisturbed native vegetation and soil, and protect from compaction during construction. <input checked="" type="checkbox"/> Option 2: Amend existing site topsoil or subsoil in place. <input checked="" type="checkbox"/> Option 3: Remove and stockpile existing topsoil during grading. <input checked="" type="checkbox"/> Option 4: Import topsoil mix, or other materials for mixing, including compost, of sufficient organic content and depth.	Sheet C-6 Sheet C-6 Sheet C-6 Sheet C-6

		Response	Attachment location
5	Does the site layout retain the duff layer and native topsoil in an undisturbed state to the maximum extent practicable?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
6	Is the organic matter content of the topsoil layer specified to be at least 4%?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
7	Is compost or other materials used to amend soils specified to have a C:N ratio below 25:1?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
8	Is it specified that compost shall meet the definition of "compost" or meet the contaminant standards in the Vermont Solid Waste Management Rules?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
9	If Exceptional Quality (EQ) biosolids are used as a soil amendment, do they comprise no more than 35% of the total volume of soil, and is it specified that they be well mixed before or during application?	<input type="radio"/> Yes <input checked="" type="radio"/> No	n/a

Vegetation and Landscaping (3.3)		Response	Attachment location
	Does the application include a site-specific plan for soil management that:		
10	Identifies all areas on the site subject to the standard?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
11	Includes construction details and notes on the various methods the contractor may use to meet the Standard?	<input type="radio"/> Yes <input type="radio"/> No	Sheet C-6
12	Includes a statement that soil depth and quality shall be established towards the end of construction, and once established, be protection from compaction?	<input type="radio"/> Yes <input type="radio"/> No	Sheet C-6
13	Includes instructions for contractor verification of the Standard, including a sampling scheme that includes nine 8-inch deep test holes per acre of area subject to the Standard?	<input type="radio"/> Yes <input type="radio"/> No	Sheet C-6
14	Instructions that test holes shall be excavated using only a shovel driven solely by the inspector's weight and shall be at least 50 feet apart from each other?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6
15	Instructions to establish dense and vigorous vegetative cover over turf areas?	<input checked="" type="radio"/> Yes <input type="radio"/> No	Sheet C-6

Attachment location: Indicate the specific location (i.e. appendix, page, plan sheet) where the requisite support documentation has been provided within the application.

Extreme Flood Protection Standard Waiver Worksheet

Fill out this worksheet for each discharge point in which use of this waiver is sought.

Extreme Flood Protection Standard (Q_{P100}) Waiver (*check only one*):

<input type="checkbox"/>	1. A site that has a direct discharge to waters with a drainage area equal to or greater than or equal to 10 square miles and that is less than 5% of the watershed area at the site's upstream boundary.
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;">Name of Waters at Discharge Point:</div> <div style="width: 55%; border: 1px solid black; height: 25px;"></div> </div>	
<div style="display: flex; justify-content: space-between;"> <div style="width: 65%;">Drainage Area of Waters at Discharge Point (square miles):</div> <div style="width: 35%; border: 1px solid black; height: 25px;"></div> </div>	

<input checked="" type="checkbox"/>	2. The impervious on site or otherwise associated within a common plan of development, constructed after 2002, is less than 10 acres.	<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No
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<input type="checkbox"/>	3. A downstream analysis was completed, pursuant to Section 2.5 of the 2017 VSMM, that indicated extreme flood control is not necessary for the site.
<div style="display: flex; justify-content: space-between;"> <div style="width: 75%;">Has adequate conveyance from the site to the discharge point been verified?</div> <div style="width: 25%; text-align: right;"> <input type="checkbox"/> Yes <input type="checkbox"/> No </div> </div>	
<div style="display: flex; justify-content: space-between;"> <div style="width: 75%;">Has supporting information (e.g. narrative description, calculations, modeling) for the completed downstream analysis been included with the application?</div> <div style="width: 25%; text-align: right;"> <input type="checkbox"/> Yes <input type="checkbox"/> No </div> </div>	

For a project that has more than one discharge point and that discharges to different receiving waters, waiver eligibility shall be determined on a "per receiving water" basis. Receiving waters are considered separate if the drainage area at their downstream point of confluence is greater than 10 square miles.

For example, if discharge point S/N 001 drains directly to the Winooski River (greater than 10 square miles), but discharge point S/N 002 drains to a small tributary of the Winooski River, then S/N 001 could be waived from the Extreme Flood Protection Treatment Standard using Waiver 2, but S/N 002 could not. However, S/N002 may be still eligible for Waiver 1.

PROPOSED

PROPORTIONAL LENGTHS.

(2)

$$C = 100 + 199 + 169 + 190$$

$$C = 658$$

$$Y = \frac{100(658)}{3916622} = 3.96\%$$

11

(3)

$$C = 123 + 64 + 548 + 104 + 738 + 643 + 761$$

$$769 + 691 + 291 + 59 + 15 + 44 + 131$$

$$= 4982$$

$$Y = \frac{100(4982)}{135582} = 3.67\%$$

21

(4)

$$1048 + ~~4099~~ 201 + 226 + 761 + 189 + 90 + 310$$

$$131 + 839 + 747 + ~~847~~ 711 + 856 + 929 + 1785$$

$$+ 501 + 360 + 163 + 83 + 265 + 278 + 77$$

$$C = 8851$$

$$Y = \frac{100(8851)}{259089} = 3.42\%$$

(5)

21

$$C = 34 + 88 + 123 + 303 + 187 + 496 + 119 + 199$$

$$863 + 1091 + 709 + 876 + 993 + 1002 + 809 = 390$$

$$256 + 285 + 101 + 153 + 123 = 920$$

E

$$631 + 423 + 263 + 199 = 1516$$

$$227 + 293 + 247 + 255$$

$$= 100(9200)$$

$$323 + 312 + 288 + 278$$

$$512 + 576 + 625 + 626$$

$$634 + 642 + 640 + 653$$

$$= 2647$$

$$R = 100 \left(\frac{17847}{2647} \right)$$

$$305.159$$

$$Y = 2003\%$$

$$5.85\%$$

CATCH (2) 138, 128, 44, 20, 35, 75, 39
EXIST

479

$$Y = 100 (479) (1)$$

$$0.33 \Delta 16622$$

$$Y = 100 \ 2.9\%$$

CATCH (3) 16 segments

$$\begin{aligned} &= 277 + 65 + 759 + 309 + 239 + 482 + 825 \\ &+ 828 + 184 + 665 + 47 + 611 + 479 + 59 \\ &+ 43 + 57 + 43 + 13 + 63 \\ &= 5637 \end{aligned}$$

$$Y = 100 (5637) 1$$

$$\begin{array}{r} 16622 \\ 135582 \end{array}$$

$$Y = 4.16\%$$

④ 23 segments

$$46 + 373 + 130 + 208 + 31 + 358 + 691 + 873 \\ + 1019 + 828 + 813 + 916 + 687 + 35 + 25 \\ + 504 + 363 + 168 + 84 + 201 + 94 + 25 \\ + 53$$

$$C = 8525$$

$$Y = \frac{100(8525)}{259029}$$

$$Y = 3.29$$

⑤

$$C = 40 + 50 + 273 + 121 + 247 + 80 + 273 \\ + 504 + 74 + 34 + 96 + 177 + 166 + 179 + 304 \\ + 1048 + 217 + 267 + 111 + 56 + \\ 86 + 335 + 347 + 301 + 342 + 629 + 625 + 513 \\ 577 + 185 + 120 + 124 + 124 + 117 + 110 + 267 \\ 127 + 123 + 165 + 131 + 178 + 365 + 240 + 278 \\ 289 + 296 + 304 + 314 + 252 + 42 + 81 + 103 \\ 116 + 128 + 144 + 150 + \\ 14 1551 + 1084 + 297 + 59 + 1009 + 1006 \\ 109 + 569 + 354 + 283 + 288 + 96 \\ 89 + 94 = 19833 \\ Y = \frac{100(19833)}{305159} \\ Y = 6.5\%$$

23
④ segments

$$46 + 373 + 130 + 208 + 31 + 358 + 691 + 873 \\ + 1019 + 828 + 813 + 916 + 687 + 35 + 25 \\ + 504 + 363 + 168 + 84 + 201 + 94 + 25 \\ + 53$$

$$C = 8525$$

$$Y = \frac{100(8525)}{259029}$$

$$Y = 3.29$$

⑤

$$C = 40 + 50 + 273 + 121 + 247 + 80 + 273 \\ + 504 + 74 + 34 + 96 + 177 + 166 + 179 + 304 \\ + 1048 + 217 + 267 + 111 + 56 + \\ 86 + 335 + 347 + 301 + 342 + 629 + 625 + 513 \\ 577 + 185 + 120 + 124 + 124 + 117 + 110 + 267 \\ 127 + 123 + 165 + 131 + 178 + 365 + 240 + 278 \\ 289 + 296 + 304 + 314 + 252 + 42 + 81 + 103 \\ 116 + 128 + 144 + 150 +$$

$$14 \quad 1551 + 1084 + 297 + 59 + 1009 + 1006 \\ 109 + 569 + 354 + 283 + 288 + 96$$

$$89 + 94 = 19833 \quad \frac{100(19833)(1)}{305159}$$

$$Y = 6.5\%$$

$$Y = \frac{100(19833)(1)}{305159}$$

SOIL TEST PIT LOG

Project: East Street Commercial Plaza

Ground Surface Slope: 0-6%, varies Logged By: Jimmy James, Site Technician

Test Pit #	Depth (inches)	Texture	Consistence or Density	Color	Mottles	Comments
16-01	0-9	Fine sandy loam	Loose, granular	Dark Brown		Moist, roots. Topsoil.
	9-42	Fine sandy loam	Friable, subangular blocky	Tan and rust brown		Moist, roots.
	42-120	Fine to medium sand	Friable, subangular blocky	Tan brown	Faint rust at 96"	Moist, laminated. SHWT=96" GW seep=110" NLTD
16-02	0-5	Fine sandy loam	Loose, granular	Dark brown		Moist, roots. Topsoil.
	5-37	Fine sandy loam	Friable, subangular blocky	Tan and Rust		Moist, roots to 36"
	37-108	Fine to medium sand	Friable, subangular blocky	Tan brown	Faint rust at 97"	Moist, laminated. SHWT=97" NGWTD, NLTD
16-03	0-12	Fine sandy loam	Loose, granular	Dark brown		Moist, roots. Topsoil.
	12-36	Fine sandy loam	Friable, subangular blocky	Rust brown and tan		
	36-84	Fine sandy loam	Friable to firm, subangular blocky	Tan and brown	Faint at 80"	Moist SHWT=80" NGWTD, NLTD
16-04	0-8	Clay	Medium subangular blocky	Dark grayish brown		Moist, roots. Topsoil.
	8-15	Silty clay	Strong, medium angular blocky	Dark gray	Prominent masses of iron accumulation	Very firm, sticky, roots, clay films

	15-33	Clay	Strong, fine and medium angular blocky	Very dark, grayish brown, some streaks of dark gray	Dark yellowish brown, iron	Very firm, sticky, clay films SHWT=28" NGWTD NLTD
16-05	0-10	Clay/Silty Clay	Medium subangular blocky	Dark grayish brown		Moist, roots. Topsoil.
	10-25	Silty clay	Strong, medium angular blocky	Dark gray	Prominent masses of iron accumulation	Very firm, sticky, roots, clay films
	25-40	Clay	Strong, fine and medium angular blocky	Very dark, grayish brown, some streaks of dark gray	Dark yellowish brown, iron	Very firm, sticky, clay films SHWT=26" GW=36" NLTD
16-06	0-18	Clay	Medium subangular blocky	Dark grayish brown		Moist, roots. Topsoil.
	18-36	Silty clay	Strong, medium angular blocky	Dark gray	Prominent masses of iron accumulation	Very firm, sticky, roots, clay films
	36-40	Clay	Strong, fine and medium angular blocky	Very dark, grayish brown, some streaks of dark gray	Dark brown, iron	Very firm, sticky, clay films SHWT=28" GW=34" NLTD
16-07	0-12	Clay	Medium subangular blocky	Dark grayish brown		Moist, roots. Topsoil.
	12-24	Silty clay	Strong, medium angular blocky	Dark gray	Prominent masses of iron accumulation	Very firm, sticky, roots, clay films
	24-40	Clay	Strong, fine and medium angular blocky	Very dark brown, some streaks of dark gray	Dark yellowish brown, iron	Very firm, sticky, clay films SHWT=40" NLTD

16-08	0-16	Clay	Medium subangular blocky	Dark grayish brown		Moist, roots. Topsoil.
	16-32	Silty clay	Strong, medium angular blocky	Dark brown, streak of dark gray	Prominent masses of iron accumulation	Very firm, sticky, roots, clay films SHWT=30"
	40-50	Clay	Strong, fine and medium angular blocky	Very dark, grayish brown, some streaks of dark gray	Dark yellowish brown, iron	Very firm, sticky, clay films GW=45" NLTD