Water Quality Analysis

ConTech Stormwater Solutions

2015-C-4 Hydrodynamic Separator

Project: Ball & Socket Development
Location: Cheshire, CT
Prepared For: Cabezas-DeAngelis, LLC / Chris DeAngelis

Purpose: To calculate the first flush runoff flow rate (WQF) over a given site area. In this situation the WQV to be analyzed is the runoff produced by the first 1" of rainfall.

Reference: United States Department of Agriculture Natural Resources Conservation Service TR-55 Manual

Given:

Structure Name	A (acres)	A ($miles^2$)	Runoff Coefficient	Percent Imp. (%)*	t_c (min)	t_c (hr)
WQS	0.65	0.00102	0.75	75.00	5.0	0.083

* Assumes runoff coefficient of 0.3 for pervious areas and 0.9 for impervious areas.

Procedure: The Water Quality Flow (WQF) is calculated using the Water Quality Volume (WQV). This WQV, converted to watershed inches, is substituted for the runoff depth (Q) in the Natural Resources Conservation Service (formerly Soil Conservation Service), TR-55 Graphical Peak Discharge Method.

1. Compute WQV in watershed inches using the following equation:

$$WQV = P * R$$

where: WQV = water quality volume (watershed inches)
P = design precipitation (inches) = (1" for water quality storm)
R = volumetric runoff coefficient = 0.05 + 0.009(I)
I = percent impervious cover

Structure Name	Percent Imp. (%)	R	P (In)	WQV (In)	WQV (ac-ft)
WQS	75.00	0.725	1.0	0.725	0.0393

2. Compute the NRCS Runoff Curve Number (CN) using the following equation, or graphically using Figure 2-1 from TR-55 (USDA, 1986):

$$CN = 1000 / [10+5P+10Q-10(Q^2+1.25QP)^{1/2}]$$

where: CN = Runoff Curve Number
P = design precipitation (inches) = (1" for water quality storm)
Q = runoff depth (watershed inches)

Structure Name	Q (In)	CN
WQS	0.725	97.24

3. Using computed CN, read initial abstraction (I_a) from Table 4-1 in Chapter 4 of TR-55; compute I_a/P, interpolating when appropriate.

Structure Name	I_a (In)	I_a/P
WQS	0.057	0.057

4. Compute the time of concentration (t_c) in hours and the drainage area in square miles.

Structure Name	t_c (hr)	A (miles^2)
WQS	0.083	0.00102

5. Read the unit peak discharge (q_u) from Exhibit 4-III in Chapter 4 of TR-55 for appropriate t_c for type III rainfall distribution.

Structure Name	t_c (hr)	I_a/P	q_u (csm/in)
WQS	0.083	0.056780411	650

6. Substituting WQV (watershed inches) for runoff depth (Q), compute the water quality flow (WQF) from the following equation:

$$WQF = (q_u)*(A)*(Q)$$

where: WQF = water quality flow (cfs)
q_u = unit peak discharge (cfs/mi^2/inch)
A = drainage area (mi^2)
Q = runoff depth (watershed inches)

Structure Name	q_u (csm/in)	A (miles^2)	Q (in)	WQF (cfs)
WQS	650	0.00102	0.725	0.48

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CDS

CDS ESTIMATED NET ANNUAL SOLIDS LOAD REDUCTION BASED ON THE RATIONAL RAINFALL METHOD

BALL & SOCKET DEVELOPMENT CHESHIRE, CT

Area	0.65 ac	Unit Site Designation	WQS
Weighted C	0.75	Rainfall Station #	34
t_c	5 min		
CDS Model	2015-4	CDS Treatment Capacity	1.4 cfs

Rainfall Intensity[1] (In/hr)	Percent Rainfall Volume[1]	Cumulative Rainfall Volume	Total Flowrate (cfs)	Treated Flowrate (cfs)	Incremental Removal (%)
0.02	9.7%	9.7%	0.01	0.01	9.4
0.04	9.7%	19.4%	0.02	0.02	9.3
0.06	9.8%	29.2%	0.03	0.03	9.4
0.08	7.7%	36.9%	0.04	0.04	7.3
0.10	8.0%	44.9%	0.05	0.05	7.6
0.12	5.4%	50.3%	0.06	0.06	5.1
0.14	4.7%	55.0%	0.07	0.07	4.4
0.16	5.5%	60.5%	0.08	0.08	5.1
0.18	3.5%	63.9%	0.09	0.09	3.2
0.20	4.1%	68.0%	0.10	0.10	3.8
0.25	6.5%	74.5%	0.12	0.12	5.9
0.30	5.5%	80.0%	0.15	0.15	4.9
0.35	4.0%	84.0%	0.17	0.17	3.6
0.40	2.0%	86.0%	0.20	0.20	1.7
0.45	2.1%	88.1%	0.22	0.22	1.8
0.50	2.0%	90.2%	0.24	0.24	1.7
0.75	5.1%	95.3%	0.37	0.37	4.1
1.00	2.5%	97.8%	0.49	0.49	1.8
1.50	1.8%	99.5%	0.73	0.73	1.1
2.00	0.5%	100.0%	0.98	0.98	0.2
					91.6
				Removal Efficiency Adjustment[2] =	6.5%
				Predicted % Annual Rainfall Treated =	93.5%
				Predicted Net Annual Load Removal Efficiency =	**85.2%**

1 - Based on 10 years of hourly precipitation data from NCDC station 806, Bridgeport WSO ARPT, Fairfield County, CT
2 - Reduction due to use of 60-minute data for a site that has a time of concentration less than 30-minutes.

Product Flow Rates

CASCADE

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
CS-4	2.00	19
CS-5	3.50	29
CS-6	5.60	42
CS-8	12.00	75
CS-10	18.00	118

CDS

Model	Treatment Rate[2] (cfs)	Sediment Capacity[1] (CF)
1515-3	1.00	14
2015-4	1.40	25
2015-5	1.40	39
2015-6	1.40	57
2020-5	2.20	39
2020-6	2.20	57
2025-5	3.20	39
2025-6	3.20	57
3020-6	3.90	57
3025-6	5.00	57
3030-6	5.70	57
3035-6	6.50	57
4030-8	7.50	151
4040-8	9.50	151

VORTECHS

Model	Treatment Rate (cfs)	Sediment Capacity[3] (CF)
1000	1.60	16
2000	2.80	32
3000	4.50	49
4000	6.00	65
5000	8.50	86
7000	11.00	108
9000	14.00	130
11000	17.5	151
16000	25	192

STORMCEPTOR STC

Model	Treatment Rate (cfs)	Sediment Capacity[1] (CF)
STC 450i	0.40	46
STC 900	0.89	89
STC 2400	1.58	205
STC 4800	2.47	543
STC 7200	3.56	839
STC 11000	4.94	1086
STC 16000	7.12	1677

1 Additional sediment storage capacity available – Check with your local representative for information.

2 Treatment Capacity is based on laboratory testing using OK-110 (average D50 particle size of approximately 100 microns) and a 2400 micron screen.

3 Maintenance recommended when sediment depth has accumulated to within 12-18 inches of the dry weather water surface elevation.

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