Appendix

D

Pollutant Load Calculations

D.1 Pollutant Load Calculations

For all development sites, the following calculations must be performed and certified by a professional engineer (civil or environmental engineer) licensed to practice in the District of Columbia.

1. Estimate the post-development pollutant export of total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS)
2. Estimate the annual TN, TP, and TSS loads which should be removed by the application of approved BMP(s).

All new development is required to provide these calculations by using the methods outlined below. The loading calculation sheets should be submitted at the 85% project design completion stage to be reviewed by the District of Columbia storm water management reviewers before the submission for final approval.

D.2 Estimating Post-Development Pollutant Export

The Simple Method is used for estimating pollutant export from new construction sites (Schueler, 1987). This method shall be used on development sites less than one square mile in area. For larger developments, the engineer is required to provide a more detailed analysis, based on the latest water quality models. The pollutant load is evaluated by the following equation:

$$L = P * P_j * R_v * C * A * 0.226$$

Where:
- L = annual pollutant load from site (lbs/year)
- P = average rainfall depth (use 40 inches/year)
- P_j = factor that corrects P for storms that produce no runoff (use 0.9)
- C = flow weighted mean concentration of pollutant, see Tables D.1 & D.2 (mg/l)
- A = area of development sites (acres)
- R_v = runoff coefficient, which expresses the fraction of rainfall converted into runoff
  - = 0.05 + 0.009 * (percent of site imperviousness)
  - e.g. For 20% imperviousness, use 20, not 0.20
- 0.226 = unit conversion factor.

Table D.1 Concentration Values (C) for Selected Levels of Impervious Cover for Use in Estimating Pollutant Loads from New or Redevelopment Sites in the District of Columbia

Land Use	Site Imperviousness (%)	TP (mg/l)	TN (mg/l)	BOD (mg/l)	Pb (mg/l)	Zn (mg/l)
Rural Residential	0	0.11	0.8	2.1	0.02	0.01
	5	0.20	1.6	4.0	0.03	0.01
	10	0.30	2.3	5.8	0.04	0.02
	15	0.39	3.0	7.7	0.06	0.03
	20	0.49	3.8	9.6	0.07	0.04
	25	0.58	4.5	11.4	0.08	0.05
	30	0.68	5.2	13.3	0.10	0.05
	35	0.77	6.0	15.2	0.11	0.06
Townhouse, Garden Apartment	40	0.87	6.7	17.1	0.12	0.07
	45	0.97	7.4	18.9	0.14	0.07
	50	1.06	8.2	20.8	0.15	0.08
	55	1.16	8.4	22.7	0.16	0.09
	60	1.25	9.6	24.6	0.18	0.09
High Rise, Light Commercial, Industrial	65	1.35	10.4	26.4	0.19	0.10
	70	1.44	11.1	28.3	0.21	0.10
	75	1.54	11.8	30.2	0.22	0.11
	80	1.63	12.6	32.0	0.23	0.11
Heavy Commercial, Downtown Shopping Center	85	1.73	13.3	33.9	0.25	0.12
	90	1.82	14.0	35.8	0.26	0.13
	95	1.92	14.8	37.7	0.27	0.13
	100	2.00	15.4	39.2	0.28	0.14

Table D.2 Concentration Values (C) of Sediment for Selected Levels of Impervious Cover for Use in Estimating Pollutant Loads from New or Redevelopment Sites in the District of Columbia

Land Use	Site Imperviousness (%)	Clay Loam (mg/l)	Silt Loam (mg/l)	Loam (mg/l)	Sandy Loam (mg/l)
Residential	20%	0.16	0.16	0.15	0.12
	25%	0.19	0.18	0.17	0.15
	35%	0.23	0.23	0.22	0.22
	40%	0.29	0.29	0.27	0.21
	50%	0.33	0.33	0.31	0.28
	60%	0.18	0.18	0.18	0.16
	75%	0.29	0.29	0.29	0.28
Central Business District	95%	0.25	0.25	0.25	0.25
	90%	0.24	0.24	0.24	0.24
Industrial	60%	0.18	0.18	0.18	0.18
	80%	0.22	0.22	0.22	0.22
Idle Land	1%	0.07	0.06	0.05	0.01

D.3 Estimating Annual Pollutant Removal Based on BMP Efficiency

This section provides a standard method of estimating annual pollutant loads which should be removed by the application of approved BMP(s). This procedure should only apply to the calculation of a post-development condition. This technique only provides for the general planning estimate of likely BMP(s) installed at sites less than 50 acres. More sophisticated methods may be needed to analyze larger and more complex developments.

To estimate the annual TN, TP, and TSS loads which should be removed by the application of approved BMP(s) use the following equation:

$$T_r = L * \%BMP_{RE}$$

Where: T_r = total annual pollutant removal (lbs/yr)
L = annual pollutant load from site (lbs/year) (see previous section)
$\%BMP_{RE}$ = BMP removal efficiency (see Table D.3)

Table D.3 Post-Construction BMP Effectiveness Summary

Best Management Practice (BMP)	Median % Removal					Main Removal Efficiency Factors
	TSS	TP	TN	Cu	Zn	
Filtering Systems						
Surface Sand Filter	87	59	32	49	80	■ Treatment volume ■ Filter media ■ Sediment storage volume ■ Depth of filter
One-Chamber Underground Sand Filter	ND	ND	ND	ND	ND	
Three-Chamber Underground Sand Filter	ND	ND	ND	ND	ND	
Perimeter Sand Filter[1]	79	41	47	25	69	
Vertical Sand Filter[1]	58	45	5	32	56	
Organic Filter	88	61	41[1]	66[1]	89	
Bioretention[1]	ND	65	49	97	95	
Roof Downspout System	ND	ND	ND	ND	ND	
Infiltration Practices						
Infiltration Trench[1]	ND	100	42	ND	ND	■ Percolation ■ Basin surface area ■ Storage volume
Infiltration Basin	ND	ND	ND	ND	ND	■ Percolation ■ Basin surface area ■ Storage volume
Storm Water Ponds						
Micropool Extended Detention Pond	ND	ND	ND	ND	ND	■ Pool volume ■ Pond shape ■ Detention time
Wet Pond	79	49	32	58	65	
Wet Extended Detention Pond	80	55	35	44	69	
Pocket Pond[2]	87	78	28[1]	55	65	

Table D.3 Post-Construction BMP Effectiveness Summary

Best Management Practice (BMP)	Median % Removal					Main Removal Efficiency Factors
	TSS	TP	TN	Cu	Zn	
Storm Water Wetlands						
Shallow Wetland	83	43	26	33	42	■ Storage volume ■ Detention time ■ Pool shape ■ Wetland biota ■ Seasonal variation
Extended Detention Shallow Wetland[1]	69	39	56	ND	-74	
Pocket Wetland[2]	57[1]	57[1]	44[1]	25[1]	52[1]	
Open Channels						
Dry Swale[1]	93	83	92	70	86	■ Runoff volume ■ Infiltration rates ■ Slope, length ■ Roughness ■ Geometry
Wet Swale[1]	74	28	40	11	33	
Grass Channel[1]	68	29	ND	42	45	

1. Data based on fewer than five data points
2. Drainage area < 10 acres

NOTES:

- ND indicates that the data is not available.
- Micropool ED Ponds are presumed to have removal rates similar to the Wet ED Pond. While this practice has not been monitored the pollutant removal mechanisms are similar.
- Infiltration practices are difficult to monitor, but are presumed to have high removal rates based on filtration processes of the soil and pollutant land application studies.
- One-Chamber Underground Sand Filter, Three-Chamber Underground Sand Filter, Roof Downspout System are presumed to have similar removal to other filtering practices.
- TSS = Total Suspended Solids; TP = Total Phosphorus; TN = Total Nitrogen; Cu = Copper; Zn = Zinc

Source: Winer, 2000