

ATTACHMENT B. Stormwater Management Resources.

Table A.2 Pollutant Concentrations from Source Areas							
Constituent	TSS ¹	TP ²	TN ³	F Coli ¹	Cu ¹	Pb ¹	Zn ¹
	mg/l	mg/L	mg/l	1,000 col/ ml	ug/l	ug/l	ug/l
Resid Roof	19	0.11	1.5	0.26	20	21	312
Comm Roof	9	0.14	2.1	1.1	7	17	256
Indust Roof	17	-	-	5.8	62	43	1,390
C/R Parking	27	0.15	1.9	1.8	51	28	139
Indust Parking	228	-	-	2.7	34	85	224
Res Street	172	0.55	1.4	37	25	51	173
Comm Street	468	-	-	12	73	170	450
Rural Highway	51	-	22	-	22	80	80
Urban Highway	142	0.32	3.0	-	54	400	329
Lawns	602	2.1	9.1	24	17	17	50
Landscaping	37	-	-	94	94	29	263
Driveway	173	0.56	2.1	17	17	-	107
Gas Station	31	-	-	-	88	80	290
Auto Recycler	335	-	-	-	103	182	520
Heavy Industrial	124	-	-	-	148	290	1600
1: Claytor and Schueler (1996) 2: Average of Steuer et al. (1997),Bannerman (1993) and Waschbusch (2000) 3: Steuer et al. (1997)							



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A.3 Impervious Cover Data

The Simple Method uses different impervious cover values for separate land uses within a subwatershed. Representative impervious cover data, are presented in Table A.3. These numbers are derived from a recent study conducted by the Center for Watershed Protection under a grant from the U.S. Environmental Protection Agency to update impervious cover estimates for a variety of land uses. (Cappiella and Brown, 2001). In addition, some jurisdictions may have detailed impervious cover information if they maintain a detailed land use/land cover GIS database.

Table A.3 Land Use and Impervious Cover Estimates	
Land Use Category	Mean Impervious Cover
Agriculture	2
Open Urban Land*	9
2 Acre Lot Residential	11
1 Acre Lot Residential	14
1/2 Acre Lot Residential	21
1/4Acre Lot Residential	28
1/8 Acre Lot Residential	33
Townhome Residential	41
Multifamily Residential	44
Institutional**	31-38%
Light Industrial	50-56%
Commercial	70-74%
* Open urban land includes developed park land, recreation areas, golf courses, and cemeteries.	
** Institutional is defined as places of worship, schools, hospitals, government offices, and police and fire stations	

A.4 Limitations of the Simple Method

The Simple Method should provide reasonable estimates of changes in pollutant export resulting from urban development activities. However, several caveats should be kept in mind when applying this method.

A.5 SMP Pollutant Removal

The removal efficiencies of various SMP practices also help determine final annual pollutant loads. Table A.4 provides estimates of the average pollutant removal efficiency of the five SMP categories.

Table A.4. Suggested Removal Rates for SMPs					
	TSS	TP	TN	Metals ¹	Bacteria
Wet Ponds	80	50 (51)	35 (33)	60 (62)	70
Stormwater Wetlands	80 ² (76)	50 (49)	30	40 (42)	80 (78)
Filtering Practices	85 (86)	60 (59)	40 (38)	70 (69)	35 (37)
Infiltration Practices⁴	90 ³ (95)	70	50 (51)	90 ³ (99)	90 ⁴
Water Quality Swales	85 (84)	40 (39)	50 ⁵ (84)	70	0 (-25) ⁶
1. Average of zinc and copper. Only zinc for infiltration 2. Many wetland practices in the database were poorly designed, and we consequently adjusted sediment removal upward. 3. It is assumed that no practice is greater than 90% efficient. 4. Data inferred from sediment removal. 5. Actual data is based on only two highly performing practices. 6. Assume 0 rather than a negative removal. Note: Data in parentheses represent median pollutant removal data reported in the <i>National Pollutant Removal Database - Revised Edition</i> (Winer, 2000). These data were adjusted for convenience and to reflect biases in the data.					

These efficiencies represent ideal pollutant removal rates that cannot be achieved at all sites, or at a watershed level. Typically, they need to be “discounted” to account for site constraints, and other factors that reduce practice efficiency. For example, the removal rate should be adjusted to reflect the fraction of runoff captured by a practice on an annual basis (90% if this guidance is followed). For more detail on how to apply these discounts, consult Caraco (2001).

One particularly important consideration is how to account for practices applied in series (e.g., two ponds applied in sequence). If the volume within the practices adds up to the total water quality volume, they are assumed to act as a single practice with that volume. Otherwise, total pollutant removal should be determined by the following equation:

$$R = L [(E_1) + (1 - E_1)E_2 + (1 - (E_1) + (1 - E_1)E_2)E_3 + \dots]$$

Where:

R = Pollutant Removal (lbs)

L = Annual Load from Simple Method (lbs.)

E_i = Efficiency of the ith practice in a series

Another adjustment can be made to these removals to account for loss of effectiveness and “irreducible concentrations.” Evidence suggests that, at low concentrations, SMPs can no longer remove pollutants.

Steuer, J., W. Selbig, N. Hornewer, and J. Prey. 1997. "Sources of Contamination in an Urban Basin in Marquette, Michigan and an Analysis of Concentrations, Loads, and Data Quality." U.S. Geological Survey, *Water-Resources Investigations Report* 97-4242.

Waschbusch. 2000. Sources of phosphorus in stormwater and street dirt from two urban residential basins in Madison, Wisconsin, 1994-1995. In: National Conference on Tools for Urban Water Resource Management and Protection. US EPA February 2000: pp. 15-55.

Winer, R. 2000. National Pollutant Removal Database - Revised Edition. Center for Watershed Protection, Ellicott City, Maryland.

Attachment B. Part II. UNH Stormwater Management Resources on Biofiltration Basins(2009 and 2012 UNH Bierñial Reports, pp 20 to 21in both. Hard copies have been provided separately to the Conservation Commission.

NOTE: Both the 2009 and 2012 UNH Reports are available on line: Performance Testing Results and design guidance for biofiltration basins published by the University of New Hampshire Stormwater Center. PDF's may be downloaded from <https://www.unh.edu/unhsc/pubs-specs-info> and ac company the electronic submission of this report.