2016 Massachusetts Small MS4 Permit Pollutant Loading Export Rates applied to the 2016 Massachusetts Land Use/Land Cover GIS Dataset

Introduction

The 2016 Massachusetts Small Municipal Separate Storm Sewer Systems General Permit[1] requires municipalities to calculate nutrient loading contributions to surface water bodies. EPA Region 1 developed land-use dependent pollutant load export rates for Phosphorus that were based on land use categories identified in the 2005 Massachusetts Land Use dataset[2]. A 2016 update in the land use and land cover dataset for Massachusetts[3] resulted in land use categories that differed from the pollutant loading export rates that EPA Region 1 developed. To allow municipalities to apply the 2016 land use dataset for their pollutant loading analyses, MassDEP and EPA Region 1 have developed a crosswalk between the 2016 land use land cover dataset and the EPA Region 1 Pollutant Load Export Rates developed as part of the 2016 MS4 permit.

To maintain consistency in applying pollutant loading export rates in nutrient loading analyses and municipalities should use the 2016 land use dataset published by MassGIS. The crosswalk outlined below can be applied to ensure consistency. If any questions arise, please contact laura.schifman@mass.gov.

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[1] https://www3.epa.gov/region1/npdes/stormwater/ma/2016fpd/final-2016-ma-sms4-gp-mod.pdf
[2] https://www.mass.gov/info-details/massgis-data-land-use-2005
[3] https://www.mass.gov/info-details/massgis-data-2016-land-coverland-use

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Table 1. 2016 Massachusetts Small MS4 Permit Phosphorus Load Export Rates for Aggregated Land Uses. Please note that the Highway PLER from the 2016 Small MS4 Permit was adjusted to reflect a weighted average pollutant load export rate from all impervious area land uses in the Charles River Watershed.

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs/acre/year
Commercial and Industrial	Directly connected impervious	1.78
	Pervious	See* DevPERV
Multi-Family and High-Density Residential	Directly connected impervious	2.32
	Pervious	See* DevPERV
Medium -Density Residential	Directly connected impervious	1.96
	Pervious	See* DevPERV
Low Density Residential - "Rural"	Directly connected impervious	1.52
	Pervious	See* DevPERV
Highway	Directly connected impervious	1.95^
	Pervious	See* DevPERV
Forest	Directly connected impervious	1.52
	Pervious	0.13
Open Land	Directly connected impervious	1.52
	Pervious	See* DevPERV
Agriculture	Directly connected impervious	1.52
	Pervious	0.45
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group A	Pervious	0.03
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group B	Pervious	0.12
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C	Pervious	0.21
~~*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C/D~~	~~Pervious~~	~~0.29~~
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group D	Pervious	0.37

Special Conditions for Pollutant Loading Rate analysis

Roadways, Highway, and Right of Ways – to more accurately represent the impervious surfaces that drain towards roadways, EPA has carried out an analysis that represents the weighted average pollutant load expert rate of all impervious area land uses, excluding forested and agricultural land uses in the Charles River Watershed. This weighted average loading rate equals 1.95 lbs P/ac/yr and should be applied to all Roads, Right of Ways, and Highways regardless of whether roadways are residential roads or highways. This is an increase from the 1.32 lbs/yr/ac pollutant loading export rate developed for the 2005 Land Use category for Highways, which only represented highway pollutant loadings. Because most roadways are not "Highways", but other roadway types that collect runoff from adjacent impervious areas EPA and DEP developed this new pollutant loading export rate for planning municipal purposes.

Pervious areas that have dual hydrologic soil groups assigned – all pervious areas that have dual hydrologic soil groups assigned in the attribute HYDROLGRP of the MassGIS Soils SSURGO-Certified NRCS[4] dataset should use the PLER that corresponds to the primary hydrologic soil group. For example, soils classified as A/D should apply the PLER for Developed Land Pervious (DevPERV)-Hydrologic Soil Group A (0.03 lbs P/ac/yr). The PLER developed for *Developed Land Pervious (DevPERV) - Hydrologic Soil Group C/D (0.29 lbs/ac/yr) should be omitted.

Pervious areas that have no hydrologic soil group assigned – all <u>pervious</u> areas that do not have a hydrologic soil group assigned but are classified as one of the following {Udorthents, Urban Land, Urban Land-complex, Made Land variations on local named soil series, or Area Not Investigated} in the attribute COMPNAME (Component Name) in the MassGIS Soils SSURGO-Certified NRCS[4] dataset should apply the PLER for Developed Land Pervious (DevPERV) - Hydrologic Soil Group C (0.21 lbs p/ac/yr)[5,6].

Outcrops and bedrock
In cases where the attribute in the MINSURFTEXT (Mineral Surface Texture) in the MassGIS Soils SSURGO-Certified NRCS[4] contains "bedrock" the PLER for the impervious land use for the area should be applied.
Alternatively, if users do not want to interact with the SSURGO dataset more than is needed, users can assign the PLER for Developed Land Pervious (DevPERV) - Hydrologic Soil Group C. The reasoning is that most bedrock or rock outcrops are likely not directly connected to the drainage infrastructure.

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[4] https://www.mass.gov/info-details/massgis-data-soils-ssurgo-certified-nrcs
[5] Schifman, L.A. and Shuster, W.D., 2019. Comparison of measured and simulated urban soil hydrologic properties. Journal of hydrologic engineering, 24(1), p.04018056.
[6] Herrmann, D.L., Schifman, L.A. and Shuster, W.D., 2020. Urbanization drives convergence in soil profile texture and carbon content. Environmental Research Letters, 15(11), p.114001.

Table 2. Crosswalk of 2016 Land Use and Land Cover categories and 2016 Small MS4 Pollutant Loading Export Rate Categories. The red and blue categories in the frame of the table are the 2016 Land Cover classes and Land Use classes, respectively. The colorcoded cells in the crosswalk represent the different assigned Pollutant Load Export Rate categories.

LAND USE CLASS	Code	Cat	IMPERVIOUS (2) DEV	DEVELOPED SPACE OPEN (5) DEV	CULTIVATED (6) UND	PASTURE/ HAY (7) UND	GRASSLAND (8) UND	DECIDUOUS (9) UND	EVERGREEN (10) UND	SHRUB/ SCRUB (12) UND	FORESTED PALUSTRINE (13) UND	SHRUB/SCRUB PALUSTRINE (14) UND	EMERGENT PALUSTRINE (15) UND	FORESTED ESTUARINE (16) UND	SHRUB/SCRUB ESTUARINE (17) UND	EMERGENT ESTUARINE (18) UND	SHORED UNCONSOLIDATE (19) UND	BARE (20) UND	WATER (21) UND	BED AQUATIC PALUSTRINE (22) UND	BED AQUATIC ESTUARINE (23) UND
UNKNOWN	0	-	Open Land	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
OPEN LAND	2	UND	Open Land	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
COMMERCIAL	3	DEV	Commercial and Industrial	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
INDUSTRIAL	4	DEV	Commercial and Industrial	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
FOREST	6	UND	Forest	Forest Pervious	Forest Pervious	Agriculture Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Water	Water	Water
AGRICULTURAL	7	UND	Agriculture	Agriculture Pervious	Agriculture Pervious	Agriculture Pervious	Agriculture Pervious	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
RECREATIONAL	8	DEV	Open Land	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
TAX EXEMPT	9	-	Commercial and Industrial	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
MIXED-PRIMARILY RESIDENTIAL	10	DEV	Multi-Family and High-Density Residential	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
SINGLE FAMILY RESIDENTIAL	11	DEV	Medium -Density Residential	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
MULTI-FAMILY RESIDENTIAL	12	DEV	Multi-Family and High-Density Residential	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
OTHER RESIDENTIAL	13	DEV	Medium -Density Residential	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
MIXED OTHER	20	-	Commercial and Industrial	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
MIXED COMMMERCIAL	30	DEV	Commercial and Industrial	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
RIGHT OF WAY	55	DEV	Weighted Avg PLER	Pervious HSG	Agriculture Pervious	Agriculture Pervious	Pervious HSG	Forest Pervious	Forest Pervious	Forest Pervious	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Pervious HSG	Water	Water	Water
WATER	88	UND	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water

Table 3. Crosswalk of 2016 Land Use and Land Cover categories and 2016 Small MS4 Pollutant Loading Export Rates in lbs/acre/year. The red and blue categories in the frame of the table are the 2016 Land Cover classes and Land Use classes, respectively. The colorcoded cells in the crosswalk represent the different assigned Pollutant Load Export Rate in lbs/acre/year.

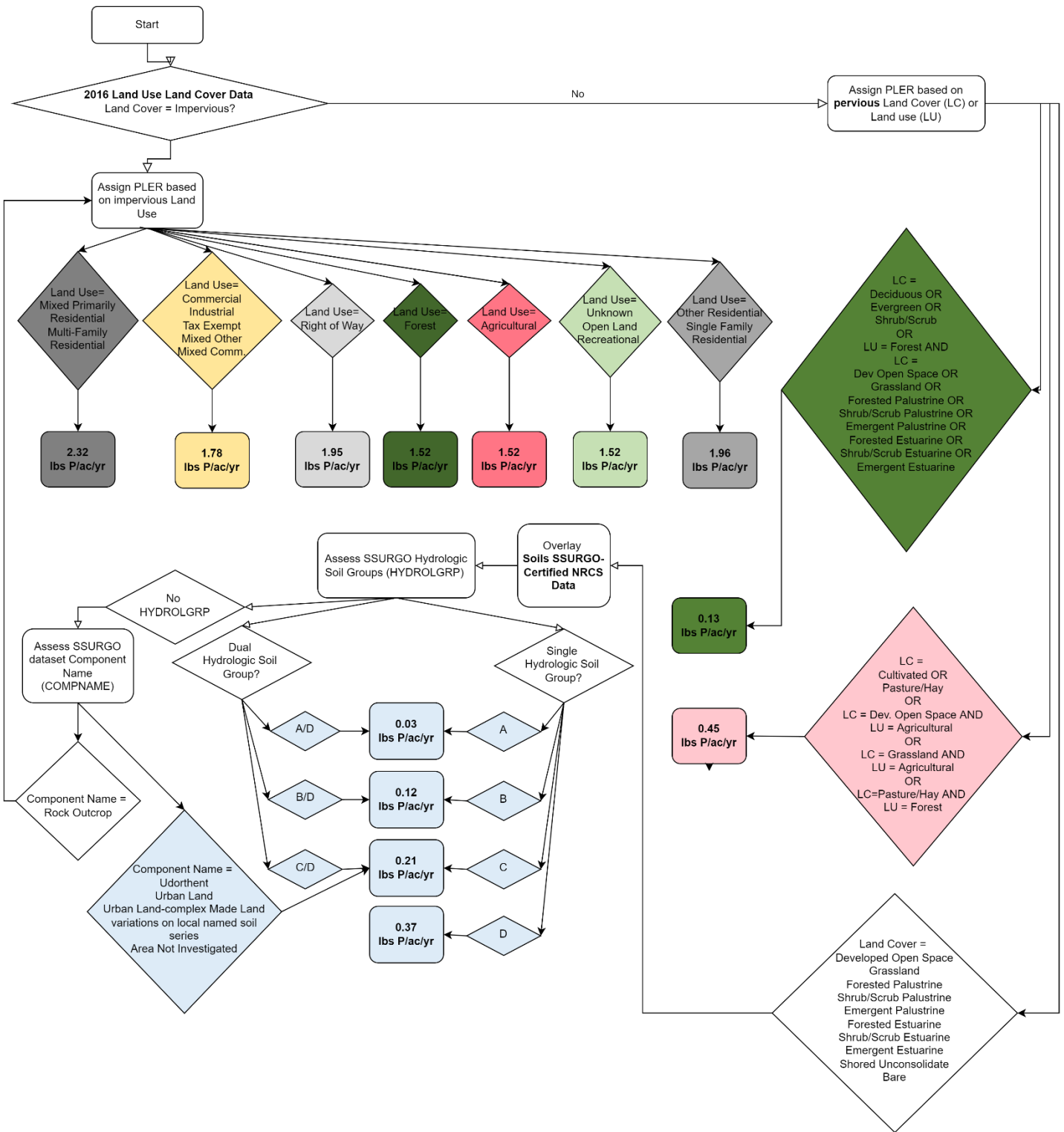| LAND USE CLASSES	IMPERVIOUS	DEVELOPED SPACE OPEN	CULTIVATED	PASTURE/ HAY	GRASSLAND	DECIDUOUS	EVERGREEN	SHRUB/ SCRUB	FORESTED PALUSTRINE	SHRUB/SCRUB PALUSTRINE	EMERGENT PALUSTRINE	FORESTED ESTUARINE	SHRUB/SCRUB ESTUARINE	EMERGENT ESTUARINE	SHORED UNCONSOLIDATE	BARE	WATER	BED AQUATIC PALUSTRINE	BED AQUATIC ESTUARINE
UNKNOWN	1.52	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
OPEN LAND	1.52	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
COMMERCIAL	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
INDUSTRIAL	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
FOREST	1.52	0.13	0.13	0.45	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
AGRICULTURAL	1.52	0.45	0.45	0.45	0.45	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
RECREATIONAL	1.52	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
TAX EXEMPT	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MIXED- PRIMARILY RESIDENTIAL	2.32	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
SINGLE FAMILY RESIDENTIAL	1.96	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MULTI-FAMILY RESIDENTIAL	2.32	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
OTHER RESIDENTIAL	1.96	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MIXED OTHER	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
MIXED COMMMERCIAL	1.78	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
RIGHT OF WAY	1.95	0.03 - 0.37 *by HSG	0.45	0.45	0.03 - 0.37 *by HSG	0.13	0.13	0.13	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	0.03 - 0.37 *by HSG	Water	Water	Water
WATER	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water	Water

Figure 1. Flowchart depicting the process to carry out the pollutant loading analysis in a geographic information system.