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 and Nitrogen 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 higher resolution data and 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.

Municipalities may use the 2016 land use dataset published by MassGIS to conduct their nutrient loading analyses. The crosswalk outlined below can be applied to ensure consistency.

If any questions arise, please contact laura.schifman@mass.gov at MassDEP or Newton Tedder or Michelle Vuto at EPA at tedder.newton@epa.gov or vuto.michelle@epa.gov.

[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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Special Conditions for Pollutant Loading Rate Analysis

Roadways, Highway, and Right of Ways – due to a change in how roadways and highways are represented in the 2005 and 2016 Land Use/Land Cover datasets for Massachusetts, MassDEP and EPA have determined that there will be a change in the "Highway" pollutant load export rate for baseline phosphorus and nitrogen load calculations. In the 2005 LULC dataset only multilane freeways and highways were identified as roadways to which the pollutant load export rate for "Highways" from the MS4 permit were assigned. Other roadways, like residential roadways were aggregated into the residential land use category, and for MS4 permit pollutant load calculations would have been accounted for in the loading rate associated with the adjacent land use. To more accurately represent the impervious surfaces that drain towards roadways in the 2016 Land Use Land Cover dataset, which has significantly higher resolution, EPA and DEP calculated 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 for Phosphorus equals 1.95 lbs P/ac/yr and for Nitrogen equals 13.9 N lbs/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 P/ac/yr and 10.5 lbs N/ac/yr for Phosphorus and Nitrogen loading rates, respectively, developed for the 2005 Land Use category for Highways, which only represented pollutant loadings for roadways that were strictly designated as "Highway". 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. This change is reflected in this guidance document.

Low Density Residential Land Use – due to a change in classification of residential land use classes between the 2005 and 2016 Land Use/Land Cover datasets, EPA and MassDEP determined that there will be a change in how pollutant load export rates will be applied to residential land uses for baseline Phosphorus load calculations. Since the loading rate for Nitrogen was already the same for all three 2005 residential land use categories (14.1 lbs N/ac/yr) no change in Nitrogen loads is suggested for residential land uses.

In the 2005 Land Use/Land Cover dataset three categories for residential land use were included: Low density residential, medium density residential, and high density residential. The pollutant load export rates for the three different residential land uses in the 2016 Massachusetts Small MS4 permit increased based on an increase in density. These three categories were not applied to the dataset in 2016, and instead replaced with the following categories: Single Family Residential, Other Residential, Mixed Primarily Residential, and Multi-Family Residential.

Due to these new categories, the higher resolution of the 2016 dataset, and evidence that leaf litter in residential areas contributes significantly to Phosphorus loads, MassDEP and EPA determined that the pollutant load export rate for "Single Family Residential" and "Other Residential" shall be 1.96 lbs P/ac/yr for Phosphorus, equivalent to the medium density residential pollutant loading rate from the 2005 dataset, and that the pollutant load export rate for "Mixed Primarily Residential" and "Multi-Family Residential" land use categories shall be 2.32 lbs P/ac/yr, equivalent to the high-density residential pollutant loading rate from the 2005 dataset. This results in the "low density residential" pollutant load export rate being omitted from calculations in pollutant load using the 2016 Land Use data. This change is reflected in this guidance document.

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 for Phosphorus and 0.3 lbs N/ac/yr for Nitrogen). The PLER developed for *Developed Land Pervious (DevPERV) - Hydrologic Soil Group C/D (0.29 lbs P/ac/yr for Phosphorus and 3.1 lbs N/ac/yr for Nitrogen) should be omitted.

Pervious areas that have no hydrologic soil group assigned – all pervious 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 (for Phosphorus this is 0.21 lbs P/ac/yr and for Nitrogen this is 2.4 lbs N/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.

[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.

PLERs by Land Use

Table 1. 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 color-coded cells in the crosswalk represent the different assigned Pollutant Load Export Rate categories.

				LAND COVER 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
				2	5	6	7	8	9	10	12	13	14	15	16	17	18	19	20	21	22	23
				DEV	DEV	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND	UND
LAND USE CLASSES	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	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	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	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	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	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	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	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	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	Pervious HSG	Water	Water	Water
	MIXED COMMERCIAL	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	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	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

Updates to Phosphorus PLERs

Table 2. 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. However, this rate shall be applied outside of the Charles River Watershed if the 2016 MassGIS data are used for analysis.

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	~~1.32~~ 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

^ refer to the Special Conditions on Roadways, Highways, and Right-of-Ways above.

Phosphorus PLERs by Land Use

Table 3. Crosswalk of 2016 Land Use and Land Cover categories and 2016 Small MS4 Phosphorus 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 Phosphorus Load Export Rate in lbs/acre/year.

		LAND COVER 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
LAND USE CLASSES	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

Phosphorus Loading Analysis Flow Chart

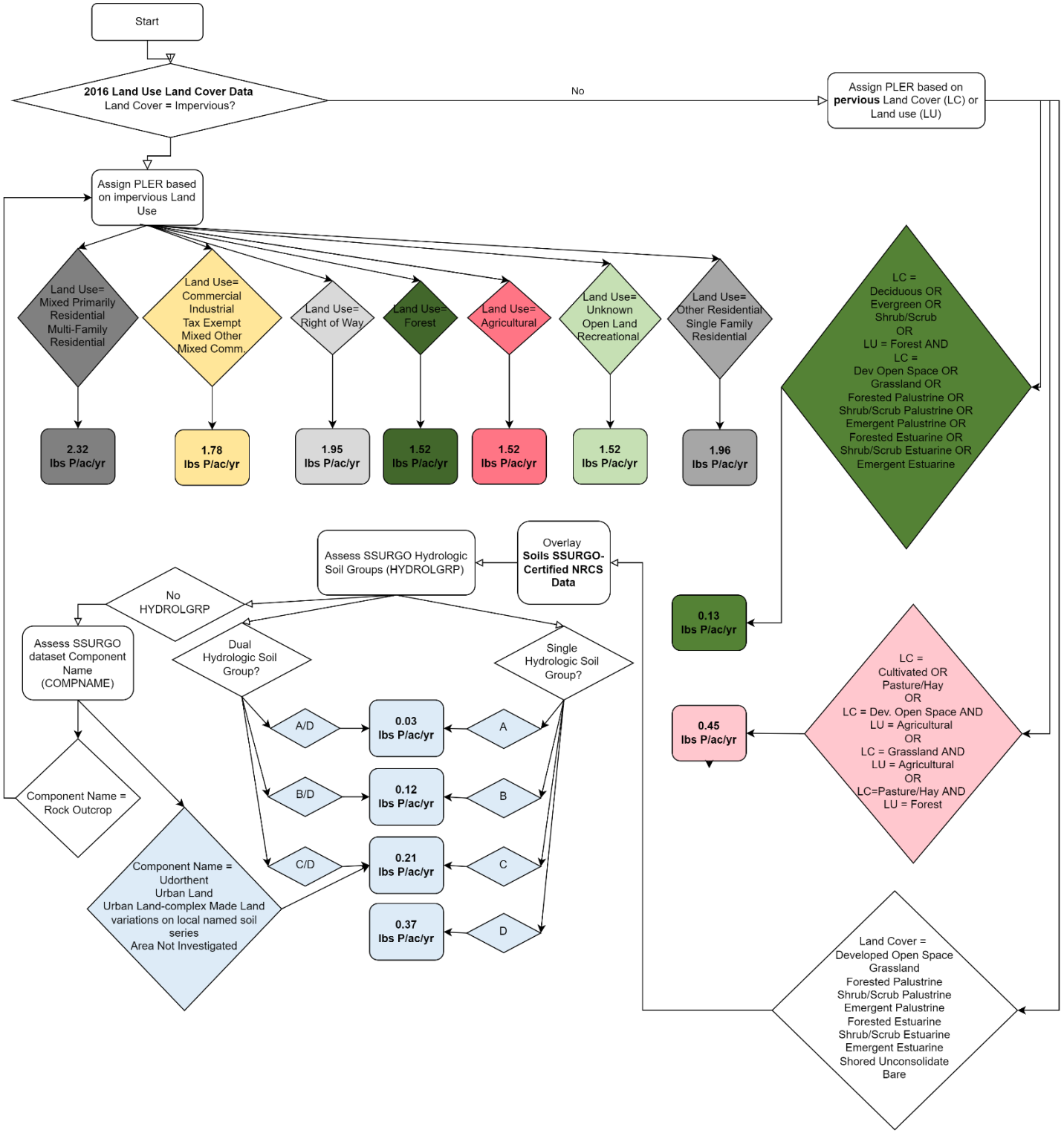

Figure 1. Flowchart depicting the process to carry out the Phosphorus loading analysis in a geographic information system using the 2016 MassGIS Land Use Land Cover dataset.

Updates to Nitrogen PLERs

Table 4. 2016 Massachusetts Small MS4 Permit Nitrogen 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. However, this rate shall be applied outside of the Charles River Watershed if the 2016 MassGIS data are used for analysis.

Nitrogen Source Category by Land Use	Land Surface Cover	N Load Export Rate, lbs/acre/year
Commercial and Industrial	Directly connected impervious	15.0
	Pervious	See* DevPERV
Multi-Family and High-Density Residential	Directly connected impervious	14.1
	Pervious	See* DevPERV
Medium - Density Residential	Directly connected impervious	14.1
	Pervious	See* DevPERV
~~Low Density Residential - "Rural"~~	~~Directly connected impervious~~	~~14.1~~
	~~Pervious~~	~~See* DevPERV~~
Highway	Directly connected impervious	~~10.5~~ 13.9^
	Pervious	See* DevPERV
Forest	Directly connected impervious	11.3
	Pervious	0.5
Open Land	Directly connected impervious	11.3
	Pervious	See* DevPERV
Agriculture	Directly connected impervious	11.3
	Pervious	2.6
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group A	Pervious	0.3
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group B	Pervious	1.2
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C	Pervious	2.4
~~*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C/D~~	~~Pervious~~	~~3.1~~
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group D	Pervious	3.6

^ refer to the Special Conditions on Roadways, Highways, and Right-of-Ways above.

Nitrogen PLERs by Land Use

Table 5. Crosswalk of 2016 Land Use and Land Cover categories and 2016 Small MS4 Nitrogen 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 color-coded cells in the crosswalk represent the different assigned Nitrogen Load Export Rate in lbs/acre/year.

		LAND COVER 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
LAND USE CLASSES	UNKNOWN	11.3	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	OPEN LAND	11.3	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	COMMERCIAL	15	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	INDUSTRIAL	15	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	FOREST	11.3	0.5	0.5	2.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	AGRICULTURAL	11.3	2.6	2.6	2.6	2.6	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	RECREATIONAL	11.3	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	TAX EXEMPT	15	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	MIXED-PRIMARILY RESIDENTIAL	14.1	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	SINGLE FAMILY RESIDENTIAL	14.1	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	MULTI-FAMILY RESIDENTIAL	14.1	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	OTHER RESIDENTIAL	14.1	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	MIXED OTHER	15	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	MIXED COMMMERCIAL	15	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	Water	Water	Water
	RIGHT OF WAY	13.9	0.3 - 3.6 *by HSG	2.6	2.6	0.3 - 3.6 *by HSG	0.5	0.5	0.5	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *by HSG	0.3 - 3.6 *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

Nitrogen Loading Analysis Flow Chart

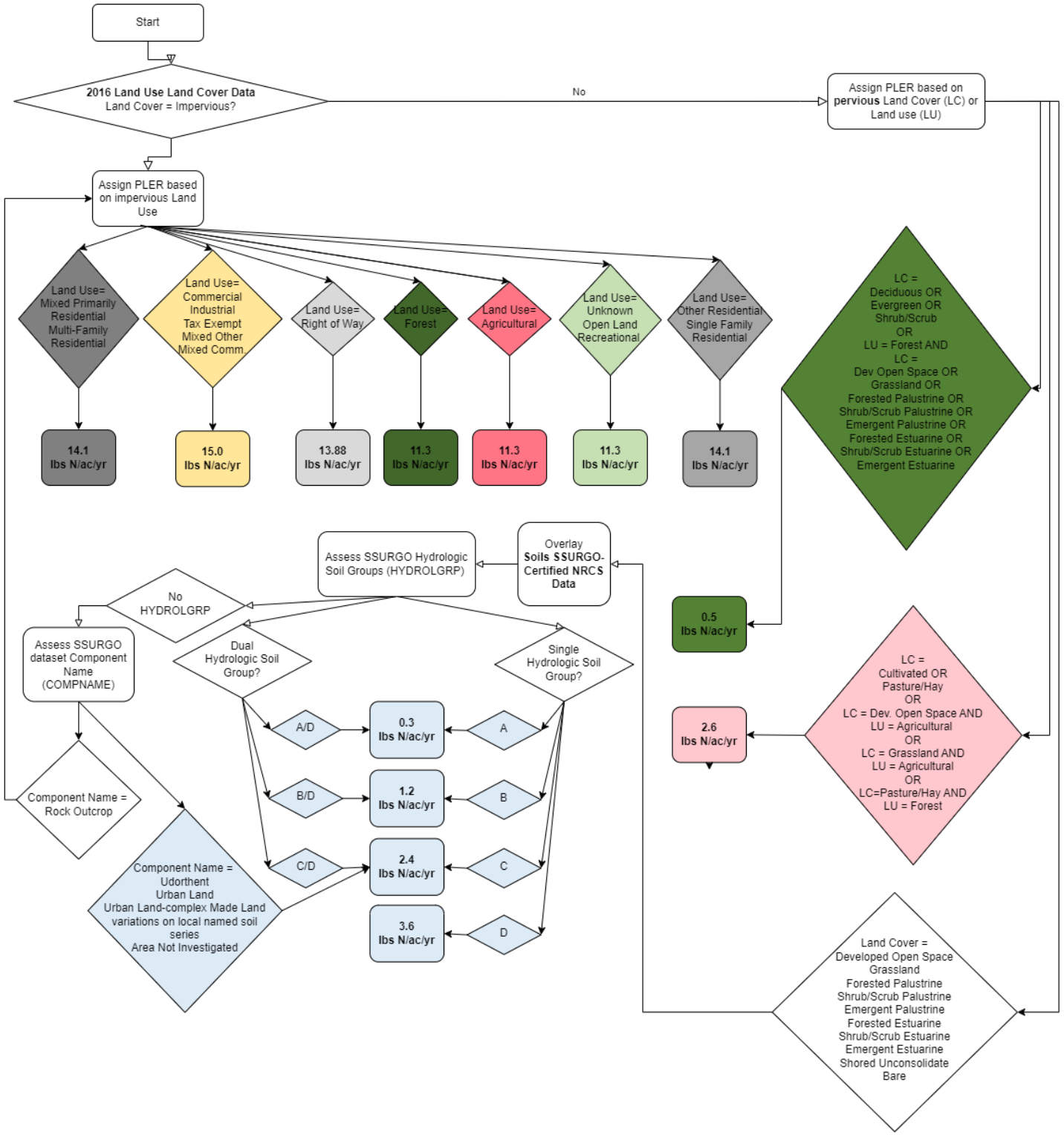

Figure 2. Flowchart depicting the process to carry out the Nitrogen loading analysis in a geographic information system using the 2016 MassGIS Land Use Land Cover dataset.