

ATTACHMENT 1 TO APPENDIX F

Method to Calculate Baseline Phosphorus Load, Phosphorus Reduction Requirements and Phosphorus load increases due to development (P_{DEVinc})

The methods and annual phosphorus load export rates presented in Attachments 1, 2 and 3 are for the purpose of measuring load reductions for various stormwater BMPs treating runoff from different site conditions (i.e. impervious or pervious) and land uses (e.g. commercial, industrial, residential, etc.). The estimates of annual phosphorus load and load reductions due to BMPs are intended for use by the permittee to measure compliance with its Phosphorus Reduction Requirement under the permit.

This attachment provides the method to calculate a baseline phosphorus load discharging in stormwater for the impaired municipalities subject to Lakes and Ponds TMDL. A complete list of municipalities subject to these TMDLs is presented in Appendix F, Table F-2. This method shall be used to calculate the following annual phosphorus loads:

- 1) Baseline Phosphorus Load for Permittees
- 2) Phosphorus Reduction Requirement

This attachment also provides the method to calculate stormwater phosphorus load increases due to increases in impervious cover from development within the applicable watershed area for the municipalities subject to the Lakes & Ponds TMDL requirements:

- 3) Phosphorus Load Increases Due to Increases in Impervious Cover from Development

The **Baseline Phosphorus Load** is a measure of the annual phosphorus load discharging in stormwater from the impervious and pervious areas of the impaired Lake Phosphorus Control Plan (LPCP) Area.

The **Baseline Phosphorus Pounds Reduction** referred to as the permittee's **Phosphorus Reduction Requirement in mass/year** represents the required reduction in annual phosphorus load in stormwater to meet the WLA for the impaired watershed. The percent phosphorus reduction for each watershed (identified in Appendix F, Table F-2) is applied to the Baseline Phosphorus Load to calculate the Phosphorus Reduction Requirement.

The **Phosphorus load increases due to development (P_{DEVinc})** is the stormwater phosphorus load increases due to development within the Lake Phosphorus Control Plan (LPCP) area over the previous reporting period and incurred to date. Increases in stormwater phosphorus load from development will increase the permittee's baseline phosphorus load and therefore, the phosphorus reduction requirement. Installation of new BMPs including decreases in impervious cover and all associated phosphorus load reductions shall be accounted for as BMPs in accordance with the calculation methodologies in Attachment 3 to Appendix F.

Examples are provided to illustrate use of the methods. Table 1-1 below provides annual composite phosphorus load export rates (PLERs) by land use category for calculating the Baseline Phosphorus Load and the Phosphorus Reduction Requirement. The permittee shall select the land use category that most closely represents the actual use of the watershed. For watersheds with institutional type uses, such as government properties, hospitals, and schools, the permittee shall use the commercial land use category for the purpose of calculating phosphorus loads.

Table 1-2 below provides annual PLERs by land use category for impervious and pervious areas. The permittee shall select the land use category that most closely represents the actual use of the watershed. For pervious areas, if the hydrologic soil group (HSG) is known, use the appropriate value. If the HSG is not known, assume HSG C conditions for the phosphorus load export rate. For watersheds with institutional type uses, such as government properties, hospitals, and schools, the permittee shall use the commercial/industrial land use category for the purpose of calculating phosphorus loads. Table 1-3 below provides a crosswalk table of land use categories in Tables 1-1 and 1-2 and the codes used NH GRANIT and those used in the TMDL reports.

The composite PLERs in Table 1-1 to be used for calculating Baseline Phosphorus Load are based on the specified directly connected impervious area (DCIA). If the permittee determines through mapping and site investigations that the overall DCIA for the collective area for each land use category is different than the corresponding values in Table 1-1, then the permittee is encouraged to submit this information in its annual report and request EPA to recalculate the composite PLERs for the permittees to use in refining the Baseline Phosphorus Load calculation for the LPCP.

(1) Baseline Phosphorus Load: The permittee shall calculate the **Baseline Phosphorus Load** by the following procedure:

- 1) Determine the total MS4 drainage area (acre) associated with the impaired watershed or the permittee's chosen Lake Phosphorus Control Plan (LPCP) area;
- 2) Sort the total area associated with the watershed into land use categories;
- 3) Calculate the annual phosphorus load associated with each land use category by multiplying the total area of land use by the appropriate land use-based composite phosphorus load export rate provided in Table 1-1; and
- 4) Determine the Baseline Phosphorus Load by summing the land use loads.

Example 1-1 to determine Baseline Phosphorus Load:

LPCP area A is 18.0 acres, with 11.0 acres of industrial area (_{IND}) (e.g. access drives, buildings, and parking lots), 3.0 acres of medium-density residential (_{MDR}) and 4.0 acres of unmanaged wooded area (_{FOR}).

The **Baseline Phosphorus Load** = (Baseline P Load _{IND}) + (Baseline P Load _{MDR}) + (Baseline P Load _{FOR})

Where:

Baseline P Load _{IND} = (TA_{IND}) x (PLER for industrial use (Table 1-1))
 = 11.0 acre x 1.27 lbs/acre/year
 = 14.0 lbs P/year

Baseline P Load _{MDR} = (TA_{MDR}) x (PLER for medium density residential (Table 1-1))
 = 3.0 acre x 0.49 lbs/acre/year
 = 1.5 lbs P/year

Baseline P Load _{FOR} = (TA_{FOR}) x (PLER for forest (Table 1-1))

$$\begin{aligned}
 &= 4.0 \text{ acre} \times 0.12 \text{ lbs/acre/year} \\
 &= 0.5 \text{ lbs P/year}
 \end{aligned}$$

$$\begin{aligned}
 \text{Baseline P Load} &= 14.0 \text{ lbs P/year} + 1.5 \text{ lbs P/year} + 0.5 \text{ lbs P/year} \\
 &= \mathbf{16.0 \text{ lbs P/year}}
 \end{aligned}$$

(2) Baseline Phosphorus Pounds Reduction (Phosphorus Reduction Requirement): The Baselines Phosphorus Reduction requirement is the amount of reduction in annual phosphorus load (in pounds) that the permittee is required to achieve in the contributing MS4 drainage area or the permittee's chosen LPCP area. The permittee shall calculate the **Phosphorus Reduction Requirement** by multiplying the **Baseline Phosphorus Load** by the applicable percent phosphorus reduction for that watershed specified in Table F-2 (Appendix F).

Example 1-2 to determine Watershed Phosphorus Reduction Requirement:

Table F-2 identifies LPCP area A's percent phosphorus reduction as 45%; therefore the LPCP Phosphorus Reduction Requirement is:

$$\begin{aligned}
 \text{Phosphorus Reduction Requirement} &= (\text{Baseline Phosphorus Load}) \times (0.45) \\
 &= (16.0 \text{ lbs P/year}) \times (0.45) \\
 &= \mathbf{7.2 \text{ lbs P/year}}
 \end{aligned}$$

(3) Phosphorus load increases due to development (P_{DEVinc}): To estimate the increases in stormwater phosphorus load due to development in the LPCP Area, the permittee will use the procedure described below. Alternatively, the permittee may provide an alternative analysis that uses applicable distinct PLERs provided in Table 1-2 to calculate increases in phosphorus load:

- 1) Determine the total area in which new development has occurred since the most recent baseline phosphorus (P) load analysis and distribute the area according to the land use categories (see Table 1-1) used in the most recent baseline P load analysis;
- 2) Calculate the pre-new development baseline load from each area by land use category using the composite PLERs in Table 1-1 and sum the P loads to determine baseline P load for the area prior to new-development ($P_{BL-PreDEV}$);
- 3) Distribute the total new-development area into impervious and pervious subareas according to the most representative land use land use categories (see Table 1-2) for the new-development use categories;
- 4) Calculate the P load for each new-development land use-based impervious and pervious subarea by multiplying the subarea by the appropriate distinct PLERs provided in Table 1-2 and sum the P loads to determine the new P load for the total area in which new development has occurred ($P_{New-DEV}$); and
- 5) Determine the P load increase due to development (P_{DEVinc}) by subtracting the baseline P load from the new-development P load ($P_{DEVinc} = P_{New-DEV} - P_{BL-PreDEV}$).

Note: If structural BMPs are installed as part of new development to treat runoff, then the revised Phosphorus Reduction Requirement will be subsequently reduced by the amount of BMP load reduced by that BMP as calculated in Attachment 3 and will be tracked and accounted for as an

implemented BMP. For the purpose of the phosphorus load reduction requirement in the permit, the removal of impervious cover in the LPCP area shall be treated as a BMP and shall be accounted for using the methods in Attachment 3 to Appendix F.

Example 1-3 to determine phosphorus load increases due to new development: A Permittee has tracked a total area of 14.5 acres of new development in the LPCA area since the previous Baseline P load calculation. Tables 1-3-1 and 1-3-2 summarize the necessary information for the pre-development areas and resulting new development areas, respectively, to calculate the phosphorus load increase due to new development in the LPCP area.

Table 1-3-1: Pre-development baseline phosphorus loads for new-development areas within LPCP area.

Land Use prior to new development	Area of new development (acres)	Pre-Dev PLER (lbs/acre/yr)*	$\frac{P_{BL-PreDEV}}{Pre-Dev}$ Baseline P load (lbs/yr)	New development Land Use created
Commercial	6.7	1.13	7.6	Commercial
Industrial	4.8	1.27	6.1	Industrial
Forest	3.0	0.12	0.4	High Density Residential
			$\Sigma = 14.1 \text{ lbs/yr}$	

*From Table 1-1

Table 1-3-2: Phosphorus loads from new-development areas within LPCP area.

New Development Land Use	New impervious cover (IC) area (acres)	New pervious cover (PC) area & HSG (acres - HSG)	IC PLER** (lbs/acre/yr)	PC PLER** (lbs/acre/yr)	$\frac{P_{New-DEV}}{New}$ development P load (lbs/yr)
Commercial	6.1	0.6 - B	1.78	0.12	10.9
Industrial	4.4	0.4 - C	1.78	0.21	7.9
High Density Residential	2.1	0.9 - B	2.32	0.12	5.0
					$\Sigma = 23.8 \text{ lbs/yr}$

**From Table 1-2

The increased phosphorus load due to new development in the LPCP area is:

$$\begin{aligned}
 P_{DEVinc} &= P_{New-DEV} - P_{BL-PreDEV} \\
 &= 23.8 \text{ lbs/yr} - 14.1 \text{ lbs/yr} \\
 &= \mathbf{9.3 \text{ lbs P/yr increase}}
 \end{aligned}$$

The increased phosphorus load of 9.3 lbs/yr due to new development in the LPCP area shall be added to the permittee's Baseline Phosphorus Load and the Phosphorus Reduction Requirement shall be increased by multiplying the 9.3 lbs/yr times the applicable percent reduction value from Table F-2. For example, if the percent reduction value is 30% then the increase to the Phosphorus Reduction Requirement ($PRR_{increase}$) would be:

$$\begin{aligned}
 PRR_{increase} &= 9.3 \text{ lbs/yr} \times 0.30 \\
 &= \mathbf{2.8 \text{ lbs/yr}}
 \end{aligned}$$

Table 1-1. Annual composite phosphorus load export rates

Land Cover	Representative DCIA, %	Composite PLERs, lb/ac/yr	Composite PLERs, kg/ha/yr
Commercial	57	1.13	1.27
Industrial	67	1.27	1.42
High Density Residential	36	1.04	1.16
Medium Density Residential	16	0.49	0.55
Low Density Residential	11	0.30	0.34
Highway/Freeway	44	0.73	0.82
Forest	0.1	0.12	0.13
Open Space	8	0.26	0.29
Agriculture	0.4	0.45	0.50

Table 1-2: Average annual distinct P Load export rates for use in estimating P Load reduction credits for the NH MS4 Permit

Phosphorus Source Category by Land Use	Land Surface Cover	P Load Export Rate, lbs/acre/year	P Load Export Rate, kg/ha/yr
Commercial (Com) and Industrial (Ind)	Directly connected impervious	1.78	2.0
	Pervious	See* DevPERV	See* DevPERV
Multi-Family (MFR) and High-Density Residential (HDR)	Directly connected impervious	2.32	2.6
	Pervious	See* DevPERV	See* DevPERV
Medium -Density Residential (MDR)	Directly connected impervious	1.96	2.2
	Pervious	See* DevPERV	See* DevPERV
Low Density Residential (LDR) - "Rural"	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Highway (HWY)	Directly connected impervious	1.34	1.5
	Pervious	See* DevPERV	See* DevPERV
Forest (For)	Directly connected impervious	1.52	1.7
	Pervious	0.13	0.13

Open Land (Open)	Directly connected impervious	1.52	1.7
	Pervious	See* DevPERV	See* DevPERV
Agriculture (Ag)	Directly connected impervious	1.52	1.7
	Cover Crop/Grazing	0.7	0.8
	Row Crop	2.0	2.2
	Hayland- no manure	0.4	0.4
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group A	Pervious	0.03	0.03
*Developed Land Pervious (DevPERV)- Hydrologic Soil Group B	Pervious	0.12	0.13
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C	Pervious	0.21	0.24
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group C/D	Pervious	0.29	0.33
*Developed Land Pervious (DevPERV) - Hydrologic Soil Group D	Pervious	0.37	0.41

Table 1-3: Crosswalk of land use groups for NH MS4 P Load Calculations to NH GRANIT and ENSR-LRM (Lake P TMDL Analysis)

Description of Land Use (LU) Groups for Calculating P Load Using PLERs	NH GRANIT LU Category Codes ²	ENSR-LRM LU ¹
Commercial	1210-1290, 1442, 1146, 1520-30, 1590, 1610-90, and 1790	Urban 3 and 5
Industrial,	1300, 1370, 1410-20, 1460-80, 1510, and 1580	Urban 4
High Density Residential	1110-1120, 1140	Urban 2
Medium Density Residential	1130 and 1150	
Low Density Residential	1190	Urban 1
Highway/Freeway	1440-45, 1447-50 and 1490	Urban 4
Forest	3000, 4000, 6000, 190	Forest 1-4, Open 1
Open Land	1710-90, 1800	Open 2 and 3
Agriculture	2000 and 2900	Agric 1-4

¹Land use codes from lake/pond phosphorus TMDLs

²See Table 1, page 4 at following link:

<http://www.granit.unh.edu/resource/library/GRANITresources/standards/LUStandards-I93-061107.pdf>