

ATTACHMENT 1 TO APPENDIX D

Method to Calculate Annual Phosphorus Load for the Designated Discharge (DD) Site

The methods and annual phosphorus export load 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). The estimates of annual phosphorus load and load reductions resulting from BMP implementation are intended for use by the permittee to measure compliance with its Phosphorus Reduction Requirement under the permit. It may also be used by a municipality in whose CMPP a permittee is participating for the purpose of gauging the municipality's compliance with phosphorus reduction requirements under its MS4 permit.

This attachment provides the method to calculate the annual phosphorus load discharging in stormwater from a DD Site. This method shall be used to calculate the following annual phosphorus loads:

- 1) DD Site Phosphorus Load;
- 2) DD Site Phosphorus Pounds Reduction (Phosphorus Reduction Requirement); and
- 3) BMP Load.

The **DD Site Phosphorus Load** is a measure of the annual phosphorus load discharging in stormwater from the developed impervious and pervious areas of the DD Site.

The **DD Site Phosphorus Pounds Reduction** referred to as the permittee's **Phosphorus Reduction Requirement** represents the required reduction in annual phosphorus load in stormwater from the DD and equals 65% of the DD Site Phosphorus Load ($0.65 \times \text{DD Site Phosphorus Load}$).

The **BMP Load** is the annual phosphorus load from the drainage area tributary to each proposed or existing BMP used by permittee to claim credit against its Phosphorus Reduction Requirement. The BMP Load is the starting point from which the permittee calculates the reduction in phosphorus load achieved by each existing and proposed BMP. Attachments 2 and 3 to Appendix D provide the methods for calculating annual phosphorus load reductions for enhanced non-structural BMPs and structural BMPs, respectively.

Examples are provided to illustrate use of the methods. Table 1-1 below provides annual phosphorus load export rates 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 DD Site. For DD Sites 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.

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

- 1) Determine the total developed area (acre) associated with the DD Site (Developed area on the DD site shall mean all impervious area and all landscaped and/or managed pervious area such as gardens and grassed areas that are actively managed);
- 2) Sort the total developed area associated with the DD Site into two categories: total impervious area (IA) and total landscaped and/or managed pervious area (PA);
- 3) Calculate the annual phosphorus load associated with impervious area (DD Site P Load $_{IA}$) and the landscaped and/or managed pervious area (DD Site P Load $_{PA}$) by multiplying the IA and PA by the appropriate land use-based phosphorus load export rate provided in Table 1-1; and
- 4) Determine the DD Site Phosphorus Load by adding the DD Site P Load $_{IA}$ to the DD Site P Load $_{PA}$.

Example 1-1 to determine DD Site Phosphorus Load: A 15.11 acre industrial site has 11.06 acres of impervious surfaces (e.g. access drives, buildings, and parking lots), 3.04 acres of landscaped gardens and grass areas, and 1.01 acre of unmanaged wooded area. In calculating the DD Site Phosphorus Load, the unmanaged wooded area can be disregarded because it is not considered to be part of the developed portion of the DD Site.

The **DD Site Phosphorus Load** = (DD Site Load $_{IA}$) + (DD Site Load $_{PA}$)

Where:

DD Site P Load $_{IA}$ = (IA) x (impervious cover phosphorus export loading rate for industrial use (Table 1-1))
= 11.06 acre x 1.78 lbs/acre/year
= 19.69 lbs P/year

DD Site P Load $_{PA}$ = (PA) x (pervious cover phosphorus export loading rate for industrial use (Table 1-1))
= 3.04 acre x 0.27 lbs/acre/year
= 0.82 lbs P/year

The DD Site Phosphorus Load = 19.69 lbs P/year + 0.82 lbs P/year
= **20.51 lbs P/year**

(2) DD Site Phosphorus Pounds Reduction (Phosphorus Reduction Requirement):

The DD site Phosphorus Reduction requirement is the amount of reduction in annual phosphorus load (in pounds) that the permittee is required to achieve at the DD Site and/or through participation in a Certified Municipal Phosphorus Program (“CMPP”). The permittee shall calculate the **Phosphorus Pounds Reduction** by multiplying the **DD Site Phosphorus Load** by 0.65 (i.e., 65% of the DD Site Phosphorus Load).

Example 1-2 to determine DD Site Phosphorus Pounds Reduction: Using the same industrial DD Site as specified in example 1-1, the DD Site Phosphorus Reduction Pounds is:

$$\begin{aligned}\text{Phosphorus Pounds Reduction} &= (\text{DD Site Phosphorus Load}) \times (0.65) \\ &= (20.51 \text{ lbs P/year}) \times (0.65) \\ &= \mathbf{13.33 \text{ lbs P/year}}\end{aligned}$$

(3) BMP Load: To estimate the annual phosphorus load reduction that a storm water BMP can achieve, it is first necessary to estimate the amount of annual phosphorus load that the BMP will receive or treat (BMP Load).

For a given BMP:

- 1) Determine the total drainage area tributary to the BMP;
- 2) Distribute the total drainage area into impervious and pervious subareas by land use category;
- 3) Calculate the phosphorus load for each land use-based impervious and pervious subarea by multiplying the subarea by the appropriate phosphorus load export rate provided in Table 1-1; and
- 4) Determine the total annual phosphorus load tributary to the BMP by summing the calculated impervious and pervious subarea phosphorus loads.

Example 1-3 to determine phosphorus load tributary to a proposed BMP:

For the same 15.11 acre industrial site as specified in Example 1-1, a permittee is proposing a storm water infiltration system that will treat runoff from 8.23 impervious acres, 1.51 acres of landscaped pervious area and 0.57 acres of the wooded area. The tributary information for the proposed BMP is:

BMP Subarea ID	Land Use Category	Cover Type	Area (acre)	P export rate (lbs P/acre/year)*
1	industrial	impervious	8.23	1.78
2	industrial	pervious	1.51	0.27
3	forest	pervious	0.57	0.09

*From Table 1-1

Solution continued:

The phosphorus load tributary to the proposed BMP (BMP Load) is calculated as:

$$\begin{aligned}\text{BMP Load} &= (\text{industrial impervious area (acre)} \times \text{P export rate}) + (\text{industrial} \\ &\quad \text{pervious area} \times \text{P export rate}) + (\text{forest pervious area} \times \text{P export} \\ &\quad \text{rate}) \\ &= (8.23 \times 1.78) + (1.51 \times 0.27) + (0.57 \times 0.09) \\ &= \mathbf{15.11 \text{ lbs P/year}}\end{aligned}$$

Table 1-1. Annual phosphorus load export rates for DD Sites in Bellingham, Franklin, and Milford

Land use	Land surface cover	Annual P load export rate (lb/acre/yr)
Agriculture	Pervious	0.45
Commercial	Impervious	2.23
	Pervious	0.27
Forest	Impervious*	0.89
	Pervious	0.09
Freeway	Impervious	1.34
	Pervious	0.27
High-density residential	Impervious	2.23
	Pervious	0.27
Industrial	Impervious	1.78
	Pervious	0.27
Low-density residential (rural)	Impervious	0.89
	Pervious	0.13
Medium-density residential	Impervious	1.34
	Pervious	0.27
Open space	Impervious	0.89
	Pervious	0.22

*Impervious surfaces within the forest land use category are typically roadways adjacent to forested pervious areas.