Chapter 583 Nutrient Criteria for Surface Waters

SUMMARY: This Chapter establishes nutrient criteria for surface waters of the State. Nutrient enrichment can cause negative environmental impacts to surface waters, such as algal blooms, low dissolved oxygen concentrations, excessive growths of filamentous algae or bacteria, and generation of cyanotoxins. Methods described in this Chapter are used to make decisions about attainment or impairment of designated and existing uses of surface waters established in the State's water quality classification system (38 M.R.S.A. §§464-469). This Chapter also describes establishment of site-specific criteria.

PART I. FRESHWATER

1. Definitions. The following terms are defined for use in this Chapter.

A. "Algal bloom" means a planktonic growth of algae that causes Secchi disk transparency to be less than 2.0 meters.

B. "Chlorophyll *a*" means a particular kind of photosynthetic pigment of algae and plants.

C. "Colored" means water having a mean apparent color >25 standard platinum units or equivalent value of true color or dissolved organic carbon.

D. "Cyanotoxins" means lipopolysaccharide endotoxins, hepatotoxins, and neurotoxins produced by cyanobacteria, such as microcystin and anatoxin-a.

E. "Diatoms" means algae in the class Bacillariophyceae.

F. "Impounded waters" means riverine waters upstream of a dam and not classified as GPA where the surface elevation is essentially the same as found at the dam.

G. "Patches of fungi and filamentous bacteria" means visible growths of aquatic fungi or filamentous bacteria. This variable indicates major shifts in trophic state and relates to the designated uses and narrative criteria associated with habitat, recreation, and aquatic life in 38 M.R.S.A. §§ 464(4) and 465.

H. "Percent algal cover" means the amount of stream and river substrate covered by filamentous algae and periphyton mats greater than 1 millimeter thick. It relates to the designated uses and narrative criteria associated with habitat, recreation, and aquatic life in 38 M.R.S.A. §§ 464(4) and 465.

I. "Periphyton" means a layer of microscopic algae, bacteria, and fungi growing on a substrate within a waterbody.

J. "pH" means a measure of water acidity. It relates to designated uses and criteria associated with aquatic life as described in 38 M.R.S.A. §§ 465 and 465-A.

K. "Phytoplankton" means algae suspended in the water column.

L. "ppb" means parts per billion, which is equivalent to micrograms per liter (µg/L).

M. "ppm" means parts per million, which is equivalent to milligrams per liter (mg/L).

N. "Secchi-disk depth" means a measurement of water clarity using a Secchi disk. It is an indicator of phytoplankton blooms and relates to designated uses and criteria in 38 M.R.S.A. § 465-A(1)(B) and the recreation and aquatic life components of § 465-A. Summer (June 1 – September 30) algal blooms usually are dominated by cyanobacteria; however they may also be dominated by other types of algae.

O. "Stressor" means an environmental condition of anthropogenic or natural origin that causes a detrimental change to aquatic life.

P. "Turbid" means that the water is not clear or transparent due to small organic and inorganic particles suspended in the water.

Q. "Water column chlorophyll *a*" means a measurement of the concentration of chlorophyll *a* in a water sample. It is an indicator of phytoplankton blooms and relates to designated uses and criteria in 38 M.R.S.A. § 465-A(1)(B) and the habitat, recreation, and aquatic life components of 38 M.R.S.A. §§ 464(4) and 465.

2. Purpose and applicability. The purpose of this Chapter is to establish nutrient criteria used to determine impairment of a designated or existing use as described in *Water Classification Program,* 38 M.R.S.A. §§ 464(4), 465, and 465-A due to phosphorus or another nutrient. The nutrient criteria decision framework established by Part I of this Chapter are applicable to Class AA, A, B, C, and GPA surface waters of the State. Surface waters may be divided into segments that are evaluated independently.

NOTE: Class GPA waters must have stable or decreasing trophic state (as shown by less nutrient enrichment) as described in 38 M.R.S.A. § 465-A(1)(B). In addition, no change in land use in a watershed of a Class GPA water may result in a water quality impairment or increase in trophic state of the GPA water as described in 38 M.R.S.A. § 465-A(1)(C). These two provisions are addressed in part by Department under *Stormwater Management*, 06-096 CMR 500 (effective December 27, 2006) and by many local ordinances, both of which require certain new developments to incorporate stormwater phosphorus mitigation measures based on lake specific watershed phosphorus budgets and other provisions in "Volume II of the Maine Stormwater Best Practices Manual - Phosphorus Control in Lake Watersheds: A Technical Guide to Evaluating New Development".

3. Total phosphorus criteria (ppb). The total phosphorus criteria for each statutory class are set forth in Table 1. These criteria apply to all fresh waters unless replaced by a site-specific criterion as provided in Part I.5.B. Total phosphorus may either be measured as the annual mean of an established set of total phosphorus concentration samples or determined using the Diatom Total Phosphorus Index (DTPI), which is computed using the protocols described in "Protocols for Calculating the Diatom Total Phosphorus Index (DTPI) and Diatom Total Nitrogen Index (DTNI) for Wadeable Streams and Rivers" (DEPLW-0970A) dated December 1, 2009.

4. Criteria for response indicators. The following response indicators of nutrient enrichment indicate an impairment of a use described in 38 M.R.S.A. §§ 464(4), 465, and 465-A. A variety of response indicators are necessary because of the variety of surface waters in Maine. The Department samples

and evaluates one or more of the most appropriate response indicators from this section and Table 2 depending on the type of surface water being sampled.

A. Secchi disk depth (meters). This indicator is attained if the Secchi disk depth is (1) greater than or equal to 2.0 meters for waterbodies greater than or equal to 2.0 meters deep or (2) equal to the depth of the waterbody for waterbodies less than 2.0 meters deep (Table 2). Secchi disk depth measurements are restricted to still or slow moving waters in which water velocity does not substantially interfere with the measurements. If the water is colored or turbid because of non-algal particles, Secchi disk depth must be accompanied by chlorophyll *a* samples to confirm that algae caused non-attainment conditions.

B. Water column chlorophyll *a* (ppb). This indicator is attained if the water column chlorophyll *a* concentration is less than or equal to the limit set forth in Table 2 for the statutory class of the waterbody. In addition, concentrations of cyanotoxins above appropriate health guidelines for recreational exposure are evidence of exceedance of nutrient criteria.

C. Percent cover of algae. This indicator is attained if the percent of substrate covered by filamentous algae and periphyton mats greater than 1 millimeter thick is less than or equal to the limit set forth in Table 2 for the statutory class of the waterbody.

D. Patches of fungi and filamentous bacteria. This indicator is attained if there are no macroscopically observable patches of fungi and filamentous bacteria on the substrate, excluding iron and manganese bacteria.

E. Dissolved oxygen concentrations (ppm). This indicator is attained if the waterbody attains the dissolved oxygen criteria as described in 38 M.R.S.A. §§ 465 and 465-A.

F. pH. This indicator is attained if the waterbody is within the range of pH, 6.0 – 8.5, or as naturally occurs.

G. Aquatic life use attainment. This indicator is attained if the waterbody attains the narrative and numeric aquatic life use criteria as described in 38 M.R.S.A. §§ 465 and 465-A, and where applicable *Classification Attainment Evaluation Using Biological Criteria for Rivers and Streams,* 06-096 CMR 579 (Effective May 27, 2003).

5. Nutrient Criteria Decision Framework. The Department uses the following decision framework (Figure 1) and criteria (Tables 1 and 2) to determine whether phosphorus or another nutrient has caused or contributed to the impairment of a designated use and to guide site-specific criteria development, where warranted.

A. Not impaired - nutrient criteria are attained (Box A in Figure 1). Nutrient criteria are attained if 1) the mean total phosphorus concentration is less than or equal to the criterion of the assigned class from Table 1 or an established site-specific critterion, and 2) all response indicators that are measured in a waterbody attain the criteria of the assigned class in Table 2.

B. Indeterminate - total phosphorus exceeds the criterion but response criteria are attained (Box B in Figure 1). The result is indeterminate pending further assessment if 1) the mean total phosphorus concentration is greater than or equal to the criterion of the assigned class from Table 1 or an established site-specific critterion, and 2) all response indicators that are measured in a waterbody attain the criteria of the assigned class in Table 2. The Department conducts further

assessment of nutrient concentrations and response indicators to determine if the waterbody is impaired for phosphorus or a site-specific criterion is warranted. Attainment status remains indeterminate until assessments are conclusive.

(1) **Options for establishing a site-specific criterion.** If the mean total phosphorus concentration is no greater than 5.0 ppb above the applicable criterion, then the Department has the option of: 1) using the mean total phosphorus concentration as the new site-specific criterion without conducting further study, or 2) conducting a study as described in Section 5(B)(2) of this Chapter to establish a site-specific criterion. If the mean total phosphorus concentration is greater than 5.0 ppb above the applicable criterion, then the Department shall conduct a study as described in Section 5(B)(2) of this Chapter. The Department considers the factors in Section 5(B)(3) of this Chapter when determining if a site-specific criterion greater than the applicable criterion established in Table 1 is appropriate.

(2) **Study to establish a site-specific criterion**. The study consists of multiple years of data collection, including sampling during critical ambient conditions (i.e., below median seasonal water levels, warm temperatures, etc.). The Department samples total phosphorus concentrations and appropriate response indicators listed in Table 3. The Department may collect and consider other nutrient and response data as necessary. The Department also may collect other types of data (e.g., habitat, water chemistry) to determine if there is a mitigating factor that is 1) limiting algal and plant growth or 2) chemically or physically binding the phosphorus so it is not readily available to plants and algae. Given the potential for total phosphorous concentrations in excess of the limits assigned in Table 1 to cause or contribute to downstream water quality impacts, even if they do not do so in the monitored segment, the Department may monitor downstream waterbodies or segments for adverse effects.

(a) **Interpretation of study results.**

1. **Attains nutrient criteria.** If data collected during the study attain applicable total phosphorus and response indicator criteria (Tables 1 and 2), then the waterbody attains nutrient criteria (see Section 5(A) of this Chapter).

2. **Does not attain response indicator criteria.** If a waterbody does not attain applicable response indicator criteria (Table 2) during the study, then the waterbody is impaired as described in Sections 5(C) or 5(D) of this Chapter.

3. **Site-specific criterion.** If an annual mean of total phosphorus concentrations in a waterbody exceeds the applicable total phosphorus criterion (Table 1), but the waterbody consistently attains applicable response indicator criteria (Table 2) during the study, then the waterbody attains nutrient criteria and the Department may set a site-specific, total phosphorus criterion greater than the applicable criterion in Table 1. The Department subsequently uses the site-specific criterion for decisions regarding attainment of nutrient criteria for that waterbody. The applicable criterion in Table 1 remains in effect until a new site-specific criterion is set. At least three years of data are needed to set a new site-specific criterion, including at least one year with critical ambient conditions (i.e., below median seasonal water levels, warm temperatures, etc.). A site-specific criterion must not be greater than the mean of the annual total phosphorus means.

(3) **Considerations for site-specific criteria.** The Department considers the following when determining if a site-specific criterion is appropriate.

(a) The risk of response indicators not meeting criteria. For example, is a response indicator already close to the applicable criterion? What were conditions in previous years?

(b) Natural environmental conditions mitigating the impact of phosphorus enrichment and the risk of those conditions changing. For example, natural limiting factors can reduce light availability (e.g., shade, turbidity, water color), bind phosphorus (e.g., clay, dissolved organic carbon, aluminum hydroxide can make phosphorus unavailable for plant growth), or reduce habitat quality for algae (e.g., fine substrate, high water velocity).

(c) The risk of adversely impacting downstream waterbodies by adopting a site-specific criterion greater than the applicable criterion in Table 1.

(4) **Qualification.** The Department may reverse a decision that sets a site-specific criterion if environmental conditions or mitigating factors change and a site-specific criterion is no longer protective. The site-specific criterion is replaced by the applicable criterion in Table 1 or a new site-specific criterion that is less than the existing site-specific criterion.

NOTE: **Indeterminate.** Listing the attainment status as indeterminate is based on the desirability to obtain more sampling data to confirm ambient conditions in the the case where insufficient data and information is available to determine if designated uses are attained.

C. Impaired – total phosphorus is less than or equal to the criterion but one or more response indicator criteria are not attained (Box C in Figure 1). The attainment result is impaired with indeterminate cause, if 1) the mean total phosphorus concentration is less than or equal to the criterion of the assigned class from Table 1 or an established site-specific criterion, and 2) one or more response indicators that are measured in a waterbody do not attain the criteria of the assigned class in Table 2. The attainment result is also impaired with indeterminate cause if 1) one or more response indicators that are measured in a waterbody do not attain criteria of the assigned class in Table 2, and 2) total phosphorus data are insufficient.

(1) The Department uses a weight-of-evidence approach to determine if total phosphorus or another nutrient caused or contributed to an impairment of a use.

(2) The Department concludes that total phosphorus caused or contributed to an impairment of a use if it is shown through weight-of-evidence that phosphorus is a plausible cause.

(3) The Department concludes that another nutrient, such as nitrogen or carbon, has caused or contributed to an impairment of a use if it is shown through weight-of-evidence that the nutrient is a plausible stressor responsible for the impairment. The Department may conduct a study similar to those described in Section 5(B) of this Chapter and set site-specific criteria for carbon or nitrogen.

(4) The Department concludes that the impairment was caused by a non-nutrient stressor if it is shown through weight-of-evidence to be the primary cause responsible for the impairment. Nutrient criteria are attained.

(5) The Department concludes that the cause of impairment is indeterminate if there is insufficient information and more data collection is necessary to determine the cause of impairment.

D. Impaired – total phosphorus exceeds the criterion and one or more response indicator criteria are not attained (Box D in Figure 1). Nutrient criteria are not attained if 1) the mean total phosphorus concentration is greater than the criterion of the assigned class from Table 1 or an established site-specific criterion, and 2) one or more response indicators that are measured in a waterbody do not attain the criteria of the assigned class in Table 2.

E. Natural conditions. Similar to 38 M.R.S.A. §464.4.C, the Department uses best professional judgment to interpret decision framework outcomes and make a final determination when natural conditions have contributed to non-attainment of either applicable nutrient criteria or response indicator criteria, such as proximity to unimpaired wetlands, lake outlets, tidal areas, or naturally occurring concentrations of plants, fish or wildlife.

6. Data requirements

A. Responsibility for sampling. In general, it is the responsibility of the Department, or its agents, to conduct sampling for the purpose of making decisions on the attainment of designated uses or maintenance of existing uses. In some circumstances, the Department may require an applicant or holder of a waste discharge license, water quality certification, or other Department issued permit to conduct sampling of effluent or ambient conditions. The decision by the Department to require monitoring may be based on the classification goal of the water, attainment status, existing water quality information, past performance of existing controls for point and nonpoint sources of pollution, and the nature, magnitude, and variability of the activity relative to the affected water. Sampling must be performed by qualified persons; the Department may provide training of Department standard operating procedures. Outside entities shall submit sampling plans to the Department and receive approval from the Department before collecting data.

NOTE: **Data collection.** All data collection must follow Department standard operating protocols and quality assurance procedures.

B. Routine sampling. Routine sampling takes place during the summer months (June 1 – September 30) for streams and rivers and ice free months (May 1 – October 31) for lakes, with exceptions for special circumstances. Routine phosphorus samples are not taken during or soon after storms or flood events. The Department uses best professional judgment and accepted statistical practices to determine the amount of phosphorus data necessary to make an attainment decision. Fewer data may be required if data are consistent and provide clear indications of condition. More data may be required if the data are greatly variable, provide conflicting information, contrary to other observations, or are near phosphorus and response indicator criteria limits.

C. Special circumstances. When routine sampling procedures are not ecologically appropriate or when sampling is necessary outside of the routine sampling period, a quantitative sampling and analysis plan must be developed in accordance with methods established in the scientific literature that are appropriate for the habitat conditions of the sample site or time of year.

D. Data quality. The Department evaluates data quality and sufficiency before making use attainment decisions. The Department evaluates the data quality, ensures that data are

representative of ambient conditions, and identifies potential circumstances of atypical natural conditions as described in Section 5(E) of this Chapter. Data from outside sources may be used if the Department determines them to be of sufficient quantity and quality. Additional sampling may be required after the Department reviews data quality and sufficiency.

NOTE: **Listing impaired waterbodies.** When phosphorous enrichment is accompanied by another stressor that contributes to an impaired use, the Department uses best professional judgment when listing the primary causes of impairment in the biennial Integrated Water Quality Monitoring and Assessment Report (Federal Clean Water Act §§ 305(b), 303(d), and 314). The Department may list another cause of impairment if the Department determines that another stressor is the primary cause of impairment and taking steps to reduce that stressor is an appropriate means of restoring designated uses. The Department may reevaluate any such decision and subsequently list phosphorus as the cause of impairment if impaired uses are not restored. The listing methodology for the Integrated Water Quality Monitoring and Assessment Report is available for review during the public comment period of each report.

NOTE: **NPDES permit limits.** The Department may incorporate phosphorus, nitrogen, or carbon limits in National Pollutant Discharge Elimination System (NPDES) permits after evaluating the relative contributions of point and non-point sources in the contributing watershed and determining that permit limits for a discharge are necessary to ensure attainment of water quality standards. Carbon limits may be in the form of limits of total suspended solids or biochemical oxygen demand. The Department must incorporate nutrient limits if nutrients caused or contributed to impairment or if discharge limits are necessary maintain attainment of water quality standards and ensure compliance with the antidegradation provisions pursuant to 38 M.R.S.A. § 464(4)(F). In the absence of site-specific analysis or criteria, the Department uses the phosphorus criteria in Table 1 to determine appropriate phosphorus limits. The Department may revise nutrient limits after conducting site-specific studies of nutrient loads and response indicator criteria, such as a total maximum daily load study. The Department may also reevaluate and subsequently reduce permit limits if it is determined that the limits are insufficient to ensure attainment of water quality standards. The Department provides for public review and comment for proposed revisions of permit limits. The Department may establish discharge limits for organic material, such as total suspended solids or biochemical oxygen demand, as alternatives to phosphorus limits if organic enrichment accompanies phosphorus enrichment and controlling organic enrichment is an appropriate means of restoring or maintaining water quality standards. If water quality standards are not attained after establishing limits, the Department may reevaluate the permit and may subsequently assign new phosphorous limits in the permit.

Figure 1. Decision framework.

	Mean total phosphorus concentration is less than or equal to the applicable criterion in Table 1 or an established site-specific criterion.	Mean total phosphorus concentration is greater than the applicable criterion in Table 1 or an established site-specific criterion.
All measured response indicators meet criteria in Table 2	Box A. **Not Impaired.** Nutrient criteria attained	Box B. **Indeterminate.** Department conducts a study to determine attainment status and requirement of site-specific criteria.
One or more response indicators do not meet criteria in Table 2	Box C. **Impaired.** Indeterminate cause requires weight-of-evidence analysis to determine cause of impairment.	Box D. **Impaired.** Nutrient criteria not attained.

Table 1. Total phosphorus criteria either measured as an average of water samples or computed by the Diatom Total Phosphorus Index (DTPI).

Statutory Class	Total Phosphorus Criterion (ppb)
AA and A	≤ 18.0
B	≤ 30.0
C	≤ 33.0
GPA	≤ 15.0

Table 2. Criteria for response indicators.

Statutory Class	AA/A	B	C	Impounded A	Impounded B	Impounded C	GPA not colored	GPA colored
Secchi Disk Depth (meters)[a, b]	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0	≥ 2.0 AND
Water Column Chl *a* (µg/L, parts per billion)	≤ 3.5[a] (≤ 5.0[a,c])	≤ 8.0[a]	≤ 8.0[a]	≤ 5.0[a,d]	spatial mean ≤ 8.0[d] and no value > 10.0[d]	spatial mean ≤ 8.0[d] and no value > 10.0[d]	≤ 8.0[a,e]	≤ 8.0[a,e]
Percent of Substrate Covered by Algal Growth[a]	≤ 20.0	≤ 25.0	≤ 35.0	--	--	--	--	--
Patches of Bacteria and Fungi[a]	None observed	None observed	None observed	None observed	None observed	None observed	--	--
Dissolved Oxygen (mg/L, parts per million)[a]	See 38 M.R.S.A. § 465						--	--
pH[a]	6.0 – 8.5							
Aquatic Life[a]	See 38 M.R.S.A. § 465 and where applicable *Classification Attainment Evaluation Using Biological Criteria for Rivers and Streams,* 06-096 CMR 579 (Effective May 27, 2003)						See 38 M.R.S.A. § 465-A	

a - Can be based on single sample following standard protocols and quality control.

b - This variable is attained if the Secchi disk depth is 1) greater than or equal to 2.0 meters for waterbodies greater than or equal to 2.0 meters deep or 2) equal to the depth of the waterbody for waterbodies less than 2.0 meters deep. If the water is colored or turbid because of non-algal particles, Secchi disk depth must be accompanied by chlorophyll *a* samples to confirm nonattainment condition.

c - Applicable to low gradient Class A or AA waters with water velocity less than 5.0 centimeters per second.

d - Chlorophyll *a* samples from impoundments are collected using depth-integrated, photic-zone cores or depth-integrated, epilimnetic cores.

e - GPA chlorophyll *a* samples are collected using depth-integrated, epilimnetic cores.

Table 3. Minimum response indicators that are included in study following an indeterminate attainment decision as described in Section 5(B) of this rule.

Waterbody Type	Required Response Indicators
Class AA, A, B, or C - Wadeable section of stream or river with rocky substrate	• Dissolved oxygen concentration • pH • Percent of substrate covered by algal growth
Class AA, A, B, or C - Non-wadeable river sections, sections without rocky substrate, and impoundments	• Dissolved oxygen concentration • pH • Water column chlorophyll *a* concentration
Class GPA	• Secchi disk depth • Water column chlorophyll *a* concentration

PART II. ESTUARINE AND MARINE WATERS

NOTE: The Department intends to add criteria to Part II of this Chapter at a future date to protect and maintain designated and existing uses of Class SA, SB, and SC waters as described in *Standards of Classification of Eestuarine and Marine Waters*, 38 M.R.S.A. § 465-B.

9 thru 16. Estuarine and marine nutrient criteria. Reserved

PART III. SITE-SPECIFIC NUTRIENT CRITERIA

NOTE: The Department will use this section to list waterbody segments with site-specific nutrient criteria

17. List of site-specific nutrient criteria. Reserved.

AUTHORITY: 38 M.R.S.A §§ 341-D(1-B) and 464(5)
EFFECTIVE DATE: