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Frequently Asked Questions: Implementing the 2021 Recommended Clean Water Act Section 304(a) Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs

Notice: This question-and-answer (Q&A) document is intended to support states, authorized tribes[1] and territories (collectively referred to as "states and authorized tribes") interested in adopting and/or implementing the U.S. Environmental Protection Agency's (EPA's) 2021 national Clean Water Act (CWA) Section 304(a) recommended *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs*.[2] Pursuant to 40 CFR 131.11(b), when establishing numeric criteria designed to protect designated uses, states and authorized tribes should base those criteria on (i) 304(a) guidance, (ii) 304(a) guidance modified to reflect site-specific conditions, or (iii) other scientifically defensible methods. States and authorized tribes may also consider other scientifically defensible approaches that are not described in this document.

EPA may update this Q&A document as new information related to EPA's recommended numeric nutrient criteria for lakes and reservoirs becomes available in the future. While this document cites statutes and regulations that contain requirements applicable to water quality standards, it does not itself impose legally binding requirements on EPA, states, tribes, other regulatory authorities, or the regulated community, and its content might not apply to a particular situation, based upon the circumstances. EPA, state, tribal, and other decision makers retain the discretion to adopt approaches that differ from those provided in this document as appropriate and consistent with statutory and regulatory requirements. In addition to this document, EPA has other documents that provide considerations and recommendations that may be relevant to implementing numeric nutrient criteria for lakes and reservoirs, which can be found at the agency's website: Nutrient Pollution Policy and Data.

To minimize repetition, this document focuses on information related to the implementation of EPA's recommended numeric nutrient criteria for lakes and reservoirs that are not otherwise found in existing agency documents.[3] However, EPA provides links to existing documents, websites, and other references to supplement the responses as appropriate.

[1] "Authorized tribes" in this document generally refers to those federally recognized Indian tribes with authority to administer a CWA Section 303(c) WQS program. Under EPA's regulations, a tribe that is eligible to administer WQS is likewise eligible to administer CWA Section 401 water quality certifications. When this document discusses CWA Section 402 implementation authority, "authorized tribe" refers to federally recognized Indian tribes with authority to administer a CWA Section 402 program. When this document discusses CWA Section 303(d) implementation authority, "authorized tribe" refers to federally recognized Indian tribes with authority to administer a CWA Section 303(d) program.

[2] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs* (August 2021)

[3] U.S. Environmental Protection Agency. Link to Tribes and Water Quality Standards

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Acronyms

AML	Average Monthly Limit
CFR	Code of Federal Regulations
CWA	Clean Water Act
DO	Dissolved Oxygen
EPA	U.S. Environmental Protection Agency
FAQ	Frequently Asked Questions
MDL	Maximum Daily Limit
NLA	National Lakes Assessment
NPDES	National Pollutant Discharge Elimination System
RPA	Reasonable Potential Analysis
TMDL	Total Maximum Daily Load
USC	United States Code
WQBEL	Water Quality Based Effluent Limits
WQS	Water Quality Standards

Introduction

On August 13, 2021, EPA published in the Federal Register[4] revised national Clean Water Act (CWA) Section 304(a) recommended nutrient criteria for lakes and reservoirs (hereafter 304(a) recommended nutrient criteria). These replace EPA's previous nutrient criteria recommendations for lakes and reservoirs in 12 ecoregions that were published in 2000 and 2001. The criteria are provided in accordance with the provisions of Section 304(a) of the CWA (Title 33 of the *United States Code* [U.S.C.] § 1314(a)), which directs EPA to publish ambient water quality criteria, and from time to time revise them, to reflect the latest scientific knowledge.

The criteria consist of separate models to address causal (i.e., total nitrogen and total phosphorus) and response (chlorophyll *a*) parameters. The desired outcome is protective values for assessment endpoints supporting aquatic life (i.e., zooplankton biomass, cool/cold-water fish) and human health (i.e., algal toxin ingestion during recreation and from drinking water sources) (Table 1.1). States and authorized tribes input associated parameters like temperature and depth, as well as risk management decisions, into web-based applications (found at https://www.epa.gov/nutrient-policy-data/ambient-water-quality-criteria-address-nutrient-pollution-lakes-and-reservoirs) and identify criteria values. Users first identify chlorophyll *a* criteria that are protective of zooplankton, hypoxia, and microcystin assessment endpoints, and then use those chlorophyll *a* criteria to identify corresponding total nitrogen and total phosphorus criteria. The models are based on National Lake Assessment (NLA) data, but states can work with EPA to insert local lake data to develop locally-specific models. States and authorized tribes can use the models to identify criteria for a lake, lake classes, or lakes statewide.

Table 1.1. Summary of designated uses and associated measures of effect and exposure

Designated use	Assessment endpoint	Risk metric	Applicability
Aquatic life	Zooplankton biomass	Rate of change of zooplankton biomass relative to phytoplankton biomass	All lakes and reservoirs >3m in depth
Aquatic life	Cool- and cold-water fish	Daily depth-averaged DO below the thermocline	Seasonally stratified lakes and reservoirs with cool- or cold-water fish
Recreation	Human health	Microcystin concentration to prevent liver toxicity in children	All lakes and reservoirs
Drinking water	Human health	Microcystin concentration to prevent liver toxicity in children	All lakes and reservoirs

Note: States and authorized tribes that adopt EPA's 304(a) recommended nutrient criteria should identify in their WQS the types of lakes and reservoirs to which the criteria apply.

Unlike other EPA model- or equation-based criteria recommendations, where a state or authorized tribe typically adopts the model or equation directly into state or authorized tribal WQS regulations, EPA

[4] Federal Register Notice 86 FR 44712. *Ambient Water Quality Criteria To Address Nutrient Pollution in Lakes and Reservoirs (August 13, 2021)*.

recommends that states and authorized tribes adopt the criteria for chlorophyll *a*, total phosphorus and total nitrogen identified as protective of the designated use into state or authorized tribal WQS regulations. States and authorized tribes may also use the criteria models to interpret narrative criteria. As with any national CWA Section 304(a) recommended criteria, EPA may revise these criteria recommendations from time to time to reflect the latest scientific knowledge. States and authorized tribes that have CWA-effective and EPA-approved criteria in their water quality standards based on previous recommendations are not required to revise their criteria immediately upon publication of new EPA recommendations; however, states and authorized tribes should consider updated criteria recommendations during their next triennial review to ensure that their designated uses are protected given the latest scientific information available.

States and authorized tribes must adopt water quality criteria that protect the designated uses. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated uses. For water bodies with multiple use designations, criteria shall support the most sensitive use. For these criteria recommendations, states and authorized tribes should identify candidate criteria to protect each applicable designated use and then adopt criteria identified as protective of the most sensitive use as required by 40 CFR 131.11(a). EPA recommends that a state or authorized tribe ultimately adopt both causal (total nitrogen and total phosphorus)[5] and response (chlorophyll *a*) criteria.

EPA selected the ecological- and health-protective responses on which the criterion models are based by applying a risk assessment approach to explicitly link nutrient concentrations to the protection of aquatic life, recreation, and drinking water source protection designated uses. EPA then used statistical stressor-response models to relate the ecological and health protective responses to concentrations of nitrogen and phosphorus. The models are based on previously published EPA technical guidance, as well as scientific peer-reviewed statistical and modeling techniques.[6]

States and authorized tribes can use the EPA-provided criterion models that are based on national data or they can work with EPA to incorporate local data into the national models to develop numeric nutrient criteria that are protective of the three designated uses and consistent with relationships used in national models, while accounting for unique local conditions (discussed herein).

This Frequently Asked Questions (FAQs) document is intended to provide additional guidance to states and authorized tribes that are interested in adopting and implementing EPA's 304(a) recommended nutrient criteria for lakes and reservoirs described above through a state or tribal WQS program. This document is divided into the following sections:

- Section 1 provides information for states and authorized tribes that choose to adopt the 304(a) recommended nutrient criteria into state or tribal WQS.

[5] U.S. Environmental Protection Agency. Link to *Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria*.
[6] U.S. Environmental Protection Agency. Link to Nutrient Policy and Data.

- Section 2 provides information for implementing the 304(a) recommended nutrient criteria through National Pollutant Discharge Elimination System (NPDES) permits.

- Section 3 provides information for implementing the 304(a) recommended nutrient criteria in monitoring and assessing ambient waters, determining whether to list waters as not attaining their WQS, and developing Total Maximum Daily Loads (TMDLs) for those listed waters.

- Section 4 provides information for implementing the 304(a) recommended nutrient criteria for drinking water source protection.

Much of this document focuses on implementation of nutrient criteria under the authority of the CWA. States and authorized tribes may have additional authority to manage nonpoint sources, which are a major contributor of nutrient pollution. As discussed in the 2022 *Accelerating Nutrient Pollution Reduction in the Nation's Waters Office of Water*[7] memo, the challenges of nutrient pollution call for integration of the objectives of both the Safe Drinking Water Act and Clean Water Act in a One Water approach to find durable solutions. Adopting numeric nutrient criteria for lakes and reservoirs can assist in controlling both point and nonpoint sources by providing measurable targets for assessment, modeling, and determining discharge limits. Taking these measures can protect sources of drinking water. EPA encourages states, authorized tribes, and federal agencies to work together in partnership to make progress on reducing nutrient pollution from all sources.[8]

[7] U.S. Environmental Protection Agency. *Accelerating Nutrient Pollution Reductions in the Nation's Waters* (April 2022 Memorandum). For more information, see 2022 EPA Nutrient Reduction Memorandum website. See also U.S. Environmental Protection Agency. State Progress Toward Developing Numeric Nutrient Water Quality Criteria for Nitrogen and Phosphorus for current status.

[8] U.S. Environmental Protection Agency. Collaborative Approaches to Reducing Excess Nutrients.

Section 1: Adopting the 2021 Clean Water Act Section 304(a) *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs*[9] into State or Tribal Water Quality Standards

1.1 What are EPA's CWA Section 304(a) recommended ambient water quality criteria to address nutrient pollution in lakes and reservoirs?

To address nutrient pollution, EPA's CWA Section 304(a) recommended ambient water quality criteria for lakes and reservoirs consist of linked models (found at https://www.epa.gov/nutrient-policy-data/ambient-water-quality-criteria-address-nutrient-pollution-lakes-and-reservoirs) that states and authorized tribes may use to identify numeric criteria for chlorophyll *a*, total nitrogen, and total phosphorus to protect three categories of designated uses: aquatic life, recreation, and drinking water source protection. These criteria (consisting of magnitudes generated by the models and identification of associated duration and frequency components) can then be adopted into state or authorized tribal WQS regulations (Table 1.1). For water bodies with multiple use designations, states and authorized tribes should identify candidate criteria to protect each applicable designated use and then adopt criteria that protect the most sensitive use, as required by 40 CFR 131.11(a).[10] The most sensitive use is the one requiring the most stringent criteria. EPA recommends that states and authorized tribes identify candidate criterion values for chlorophyll *a*, total nitrogen, and total phosphorus to protect each applicable designated use to determine which of the criteria to adopt to protect the most sensitive use. If a state or authorized tribe adopts a single set of criteria for chlorophyll *a*, total nitrogen, and total phosphorus, it should make clear which designated use is the most sensitive and therefore driving the stringency of the adopted criteria. Alternatively, a state or authorized tribe may adopt a set of criteria for each applicable designated use.

CWA Section 304(a) water quality criteria serve as recommendations to states and authorized tribes for defining ambient surface water conditions (e.g., concentrations of particular chemical constituents, levels of certain parameters) that will protect against adverse effects to aquatic life and human health. These criteria recommendations reflect current scientific knowledge using stressor-response relationships and new modeling approaches. These recommended criteria replace the recommended numeric nutrient criteria for lakes and reservoirs that were published for 12 ecoregions in 2000 and 2001, which were based on a reference condition approach. The publication of these recommended criteria does not supersede earlier technical support documents for deriving numeric nutrient criteria. States and authorized tribes may continue to use the approaches described in these technical support

[9] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs* (August 2021).

[10] 40 CFR 131.11(a): (a) *Inclusion of pollutants:* (1) States must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use.

documents[11,12] to derive numeric nutrient criteria that are protective of their designated uses and based on a sound scientific rationale.[13]

Numeric water quality criteria have three components: (1) a magnitude value to express a concentration that is protective of the designated use (i.e., how much), (2) a duration, or the length of time over which exposure at the specified magnitude can occur and still be protective of the designated use (i.e., how long), and (3) a frequency identifying how many times the magnitude/duration combination may be exceeded during a specific time period and still be protective of the designated use (i.e., how often). All three components should be adopted into a state's or authorized tribe's WQS regulations and submitted to EPA for action pursuant to CWA Section 303(c).

- The *magnitude* component of EPA's CWA Section 304(a) recommended nutrient criteria for lakes and reservoirs corresponds to the concentrations (in micrograms per liter or μg/L) of chlorophyll *a*, total nitrogen, and total phosphorus that are identified for each assessment endpoint (i.e., zooplankton, hypoxia, microcystin; See Table 1.1) and designated use, after states and authorized tribes input waterbody specific and risk management parameters into the models.

- The *duration* component is the exposure period associated with a given magnitude that will be protective against adverse effects. Duration is expressed as the time over which a corresponding nutrient concentration is measured. The recommended duration for EPA's recommended nutrient criteria magnitude component is the growing season,[14] with the corresponding magnitude expressed as a geometric mean of measurements over the specified[15] growing season period.

- The *frequency* component guides how to evaluate multiple or repeated instances of magnitude and duration combinations (i.e., a series of growing season or annual geometric means over several years) to ensure protection of the applicable designated use given repeated annual periods of nutrient exposure. The seasonal geometric mean concentrations of chlorophyll *a*, total nitrogen, and total phosphorus may vary over years, and in doing so define a long-term mean. (See Question 1.8 for more information.)

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[11] U.S. Environmental Protection Agency. *Using Stressor-response Relationships to Derive Numeric Nutrient Criteria*. *EPA-820-S-10-001*, November 2010.
[12] U.S. Environmental Protection Agency. *Nutrient Criteria Technical Manual. Lakes and Reservoirs. First Edition. EPA-822-B00-001*, April 2000.
[13] See also: U.S. Environmental Protection Agency. *Response to Public Comments on US EPA's Draft Ambient Water Quality Criteria Recommendations for Lakes and Reservoirs of the Conterminous United States: Information Supporting the Development of Numeric Nutrient Criteria.* EPA 822-R-21-004, August 2021. Response to Category 1.8, page 13.
[14] The growing season is the period of time during the year when algal growth and densities can be observed. This period is marked by physical, chemical, and biological conditions that promote algal growth (e.g., light availability, temperature, nutrient concentration). Generally, the growing season coincides with late spring through early fall. States and authorized tribes often define the time frame for their algal growing season, which could be an expanded period of time (e.g., year-round).
[15] States and tribes should identify the specific dates of the growing season in the WQS (*e.g.,* May 1 – October 30).

1.2 Do EPA's CWA Section 304(a) recommended nutrient criteria for lakes and reservoirs function differently from EPA's other model- or equation-based criteria?

EPA's recommended numeric nutrient criteria for lakes and reservoirs consist of linked models from which candidate numeric nutrient criteria for chlorophyll *a*, total nitrogen, and total phosphorus can be identified. Unlike other EPA model- or equation-based criteria recommendations, where a state or authorized tribe typically adopts the model or equation directly into state or authorized tribal WQS regulations, EPA recommends that states and authorized tribes adopt the identified criteria into state or authorized tribal WQS regulations. States and authorized tribes may also use the criteria models to interpret narrative criteria. When applying the criteria models, states and authorized tribes should identify and explain the rationale for the associated selection of model input parameters and risk management decisions and include this documentation in materials developed for public comment.

1.3 What requirements and options does a state or authorized tribe have when adopting EPA's CWA Section 304(a) recommended nutrient criteria for lakes and reservoirs into its water quality standards?

Consistent with EPA's regulations at 40 CFR part 131.11(a), states and authorized tribes must adopt those water quality criteria that protect the designated use. Such criteria must be based on sound scientific rationale and must contain sufficient parameters or constituents to protect the designated use. For waters with multiple use designations, the criteria shall support the most sensitive use. Finally, pursuant to 40 CFR part 131.10(b), states and authorized tribes must take into consideration the WQS of downstream waters and must ensure that their WQS provide for the attainment and maintenance of WQS of downstream waters. This applies to lakes and reservoirs that discharge to downstream waters. Lakes and reservoirs can be the terminus for flowing waters. As such, nutrient criteria for the lake or reservoir may guide criteria for upstream waters.[16,17,18]

EPA's CWA Section 304(a) recommended nutrient criteria for lakes and reservoirs provide much flexibility for states and authorized tribes to tailor the approach to their specific waterbodies. For example, states and authorized tribes should critically evaluate the geographic scale, groupings, timing, and sequence by which they adopt numeric nutrient criteria for their lakes and reservoirs. For instance, the scale (i.e., state-wide, regional, waterbody-by-waterbody) may depend on the availability of state/tribal water quality data for a lake or group of lakes (i.e., water quality data to refine the national models or to run the models to generate candidate criteria). The sequence for adoption could be based

[16] U.S. Environmental Protection Agency. *Protection of Downstream Waters in Water Quality Standards: Frequently Asked Questions*, EPA-820-F-14-001, June 2014.
[17] U.S. Environmental Protection Agency. Development and Adoption of Nutrient Criteria into Water Quality Standards, Memo by Geoffrey Grubbs, Director, Office of Science and Technology, Office of Water, U.S. EPA, November 14, 2001.
[18] U.S. Environmental Protection Agency. *Nutrient Criteria Technical Guidance Manual: Lakes and Reservoirs*, EPA-822-B00-001, April 2000.

on state/tribal prioritization, such as protection of high-quality lakes and reservoirs, or lakes and reservoirs with the greatest risk for eutrophication. As another example, states and authorized tribes could choose to adopt lake-specific criteria, or ecoregion level criteria, and for one endpoint or multiple endpoints, depending on the applicable designated use for a specific waterbody or a set of lakes and reservoirs. For states and authorized tribes interested in developing criteria at the ecoregional level, EPA recommends working collaboratively with EPA through the N-STEPS program (see Question 1.17). With the publication of the criteria document and this Q&A document, EPA does not intend to prescribe the way states and authorized tribes adopt these numeric nutrient criteria for lakes and reservoirs (see Question 1.7 for additional considerations).[19]

To protect state and tribal waters from the effects of nutrient pollution, EPA recommends that a state or authorized tribe ultimately adopt both causal (total nitrogen and total phosphorus)[20] and response (chlorophyll *a*) criteria protective of the most sensitive designated use for each lake or reservoir, or group of lakes and reservoirs, to ensure protection for waters with multiple use designations.

For more information on how states and authorized tribes can rely on EPA's CWA Section 304(a) recommended nutrient criteria for lakes and reservoirs to develop their own state or regionally informed models or modify the models to reflect state or regionally specific conditions, see Question 1.17, Question 3.3, and the criteria document (Appendix E: Example Workflow for Deriving Lake Nutrient Criteria, page E-1).

1.4 Can states and authorized tribes use the CWA Section 304(a) recommended nutrient criteria to develop combined criteria that integrate causal and response parameters or are the criteria intended to be independently applicable for CWA implementation purposes?

EPA recommends that states and authorized tribes adopt individual criteria for chlorophyll *a*, total nitrogen, and total phosphorus that are independently applicable.

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[19] States and authorized tribes are required by 40 CFR part 131 to review their WQS every three years. 40 CFR 131.20(a). As part of this triennial review, states and authorized tribes must update any criteria for which EPA has published a new or updated CWA Section 304(a) recommendation or must provide an explanation if they decline to update such criteria. Specifically, 40 CFR 131.20(a) requires that "…if a State does not adopt new or revised criteria for parameters for which EPA has published new or updated CWA Section 304(a) criteria recommendations, then the State shall provide an explanation when it submits the results of its triennial review to the Regional Administrator consistent with CWA Section 303(c)(1) and the requirements of paragraph (c) of this section." EPA does not approve or disapprove such explanations pursuant to CWA Section 303(c). Rather, such explanations inform both the public and EPA of the state's or authorized tribe's plans with respect to adopting new or revised criteria in light of the latest science. EPA strongly encourages states and authorized tribes to include their explanation on a publicly accessible website or some other mechanism to inform the public of their decision. EPA also notes that public participation requirements at 40 CFR part 25 must also be met with triennial reviews.

[20] U.S. Environmental Protection Agency. Link to *Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria*

Separately, an optional approach for developing a combined criterion that integrates causal (nitrogen and phosphorus) and response parameters into one water quality criterion is provided in EPA's 2013 document, *Guiding Principles on an Optional Approach for Developing and Implementing a Numeric Nutrient Criterion that Integrates Causal and Response Parameters*[21] and may also be considered. In that document, EPA recognized "that developing numeric values for both nitrogen and phosphorus that prevent adverse effects may be challenging due to temporal and spatial sampling variability, as well as the ability to tie them to environmental outcomes."

With EPA's CWA 304(a) recommended nutrient criteria for lakes and reservoirs, EPA does not foresee these same challenges because the adverse ecological and health effects are explicitly incorporated into the criteria models that identify nutrient concentrations necessary to protect the designated use with sufficient certainty. The criteria models are statistical stressor-response models that relate specific adverse effects to chlorophyll *a* concentrations and then relate targeted chlorophyll *a* concentrations to total nitrogen and total phosphorus concentrations. EPA will evaluate alternate approaches and criteria constructions, such as combined criteria, for sound scientific rationale and protection of the applicable designated uses consistent with EPA's statutory and regulatory requirements.

1.5 Which form of nitrogen does EPA recommend states and authorized tribes adopt for numeric criteria into their water quality standards?

EPA recommends that states and authorized tribes adopt criteria for total nitrogen (TN). EPA's criteria model predicts TN-DIN (i.e., total nitrogen minus dissolved inorganic nitrogen).[22] However, criteria for nitrogen (N) concentrations to address eutrophication are commonly expressed in terms of TN rather than TN-DIN. As a practical matter, TN is the sum of all forms of N in the water (i.e., inorganic and organic, dissolved and particulate). For the purposes of developing criteria, it is reasonable to assume that DIN is near zero and, therefore, a TN criterion is comparable to the TN-DIN prediction from EPA's criteria model.[23] Elevated concentrations of DIN, which may be a concern in areas of high anthropogenic N input, would be detected in elevated TN. Adopting TN into a state or authorized tribe's WQS, as opposed to TN-DIN or other forms of N, should be sufficient to capture issues with nitrogen pollution in surface waters. Finally, EPA notes that there are separate criteria for certain other forms of N, such as

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[21] U.S. Environmental Protection Agency. OW-OST-1071. Document EPA-820-F-13-039. Published September 1, 2013.

[22] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)* (page 61). Total nitrogen (TN) criteria can be based on models that predict TN-DIN (i.e., total nitrogen minus dissolved inorganic nitrogen) when one considers the availability of DIN for phytoplankton uptake. More specifically, the components of DIN (NOx and ammonia) are easily assimilated by phytoplankton and excess concentrations of DIN observed in a lake may indicate that factors other than N availability are limiting phytoplankton growth. Therefore, controlling phytoplankton growth by reducing available N would first require that DIN concentrations are reduced to near zero and, when that occurs, criteria expressed for TN-DIN would be the same as those for TN.

[23] McCarthy M., Pratum T., Hedges J. & Benner R. (1997). Chemical composition of dissolved organic nitrogen in the ocean. *Nature* **390**, 150–154. https://doi.org/10.1038/36535.

ammonia and nitrate, although these criteria address toxic effects to aquatic life and human health, respectively, not eutrophication.

1.6 Which of EPA's criteria models (chlorophyll *a*, total nitrogen, and total phosphorus) results in the most stringent criteria for each designated use (i.e., aquatic life, recreation, and drinking water)?

There is no definitive way to predict which designated use would result in the most stringent criteria without going through an analysis. However, models for all three designated uses are available to a state or authorized tribe to determine which applicable designated use is most sensitive for each lake or reservoir, or group of lakes and reservoirs (in other words, which chlorophyll *a* criterion and resultant total nitrogen and total phosphorus criteria are most stringent and protective of all uses/endpoints). See also Question 1.1 regarding protection of all designated uses, including the most sensitive use.

1.7 What are the physical, chemical, and biological parameters, as well as risk management decisions, to input into the criteria models to derive candidate nutrient criteria? Are there default recommendations within the identified ranges provided in the web-based applications?

The criteria models produce a range of results that depend on the inputs of physical, chemical, and biological parameters, as well as on risk management decisions (i.e., exceedance probability and certainty levels) provided by the states or authorized tribes (Table 1.2). To help simulate and visualize the outcomes of the criteria models, EPA provides users with a user-friendly, interactive tool – a web-based application (or app) – which computes candidate criteria for different combinations of inputs and risk management decisions. States and authorized tribes should use appropriate inputs for physical, chemical, and biological parameters that correspond to the lake or reservoir, or classes of lakes and reservoirs, for which they intend to identify candidate criteria.

EPA has provided recommendations for ranges for the risk management decision inputs to the criteria models (i.e., the range of default values built into the criteria models). EPA has not provided more specific default recommendations. States and authorized tribes should critically evaluate their water resources and document the rationale for their selections of input parameters and decisions in a transparent manner both for public comment and in their submission to EPA, as well as any data for lake water quality and designated use characterization relied upon for the decisions. If states or authorized tribes wish to select input values for the models outside the ranges provided by the criteria models, EPA would expect a corresponding technical justification consistent with regulatory requirements to adopt protective criteria based on sound scientific rationale (See also responses to Questions 1.2, and 1.3). The inputs for water chemistry and physical characteristics should reflect conditions protective of designated uses of a water body or class of similar water bodies. Additional details and considerations are provided

in the EPA criteria document. [24] Further additional details are provided in a description of model updates after consideration of new national lakes data: https://www.epa.gov/system/files/documents/2022-09/description-updates-lake-criterion-models.pdf.

Table 1.2. Input parameters for the models.

Model	Physical, Chemical, and Biological Parameters and Risk Management Inputs
Zooplankton Model – Chlorophyll Criteria	Slope threshold, latitude, longitude, certainty level
Hypoxia Model – Critical Time Window	Latitude, longitude, elevation (m), critical temperature (°C), depth*, lake surface area (km)
Hypoxia Model – Chlorophyll Criteria	Dissolved organic carbon (mg/L), depth below thermocline (m), refugia depth (m), dissolved oxygen (DO) threshold (mg/L), certainty level
Microcystin Model – Chlorophyll Criteria	Target microcystin concentration (μg/L), allowable exceedance probability of the target microcystin concentration, certainty level (%), ecoregion, lake maximum depth (m)
Nitrogen and Phosphorus Criteria	Lake depth (m), dissolved organic carbon (mg/L), Level III Ecoregion, targeted chlorophyll concentration (μg/L), certainty level

* For natural lakes, data were collected from the maximum depth. For reservoirs, data were collected from the midpoint. For natural lakes that fluctuate between depth classes, a seasonal mean value of maximum depth would be appropriate. For reservoirs, a seasonal mean value at the midpoint of the reservoir would be appropriate.

With respect to the dissolved oxygen (DO) threshold input for the hypoxia model, depending on the applicable state or tribal WQS, states and authorized tribes may apply DO criteria to a refugia within the hypolimnion for stratified waters and not throughout the hypolimnion, as fully protective levels of DO may be difficult to attain throughout the hypolimnion during stratification. This refugia depth may be used as a reference point to derive criteria using the hypoxia models, to be maintained for a certain period of time sufficient to protect cool- and cold-water species seeking cooler temperatures at depth.

If an input parameter is not available, EPA recommends working collaboratively with EPA through the N-STEPS program to develop scientifically supported estimated values for these input parameters.

1.8 How could states and authorized tribes express the frequency component of the criteria in their water quality standards?

The criteria document states that "EPA recognizes that seasonal geometric mean concentrations of chlorophyll *a*, total nitrogen, and total phosphorus calculated in different years can vary about their long-term means, and the frequency components of the criteria can be used to account for this

[24] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)*

variability"[25] and includes a supporting technical discussion. In the context of identifying a frequency component of the criteria, consider the following example: an application of one of the criteria models produces a chlorophyll *a* magnitude value of 12 µg/L, and the growing season is determined to be May-October. To express the variation in a long-term mean across years, states and authorized tribes could apply a frequency component to the magnitude value as: "For the waters of Lake ABC, the long-term mean of the annual chlorophyll *a* geometric means during the growing season (May-October) shall not exceed a value of 12 µg/L". Alternatively, a state or authorized tribe could take a more conservative approach and express that an annual or growing season geometric mean may not be exceeded in any year. A state or authorized tribe could also express a frequency component for a specific return interval by accounting for within-year and among-year variation in the criterion data and adjusting the criterion magnitude value, as illustrated in the criteria document in Appendix E.4. EPA encourages states and authorized tribes to work with their respective EPA Regional Office if there is interest in pursuing this approach (EPA Regional Office Nutrient Coordinator).

1.9 With respect to protecting an aquatic life designated use, are EPA's criteria intended to be protective of the entire aquatic community?

Yes, EPA's CWA 304(a) recommended nutrient criteria are intended to be protective of the entire aquatic community. EPA followed the risk assessment paradigm to first define water quality management goals for numeric nutrient criteria, and then define assessment endpoints and metrics that are associated with achieving these goals. Different aspects of aquatic life are used to derive criteria depending on the biota that are expected to be present in different lakes. There are two specific endpoints that lead to two sets of criteria for aquatic life: one based on zooplankton biomass in relation to phytoplankton and one based on hypoxia impacts to cool- and cold-water fish. The zooplankton biomass endpoint-based criteria are appropriate for all lakes and reservoirs (greater than 3 meters in depth per recent model revisions[26]), whereas the hypoxia endpoint is appropriate as an additional consideration for stratified lakes and reservoirs with physical characteristics that provide cool- and cold-water fish habitat (Table 1.1). The zooplankton biomass endpoint addresses the base of the food chain affecting all biological communities, including upper trophic level consumers (which may include "game fish"). The hypoxia endpoint is targeted to protect species that require deep water refugia from elevated surface temperatures. Lakes with high water clarity expectations may require additional considerations beyond those provided by these models (See Question 1.11), as may lakes which provide more specialized aquatic life uses such as salmonid spawning (in the latter case, states may choose to consider adapting the deep-water hypoxia model using tailored critical temperature and DO concentrations for specific species requirements).

[25] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)* (page 64)

[26] See https://www.epa.gov/system/files/documents/2022-09/description-updates-lake-criterion-models.pdf for more information.

1.10 Are EPA's CWA 304(a) recommended nutrient criteria appropriate to derive criteria for all types of lakes and reservoirs?

The criterion models were developed using the National Lakes Assessment (NLA) data. The NLA is a statistical survey that randomly selects lakes, reservoirs, and ponds so the resulting data are representative of the full range of conditions among these waters across the conterminous United States. Relationships estimated in the national criterion models may be informative when interpreting data collected from systems with characteristics (e.g., lake surface area) beyond the range of lake characteristics represented in the NLA data. Some criterion models estimate relationships between measurements at the level of individual samples (i.e., total nitrogen-total phosphorus-chlorophyll *a* and chlorophyll *a*-microcystin models), and therefore, the relationships estimated in these models are more likely to also be applicable in types of lakes and reservoirs beyond those in the sampled population (See Table 1.1). For all models, comparisons of relationships estimated between measurements (e.g., microcystin and chlorophyll *a*) with those predicted from the national criteria models would help establish whether the national models can apply to other types of systems. States and authorized tribes should specify the applicability of adopted criteria to specific types of lakes and reservoirs or to individual waterbodies in their WQS.

Data potentially collected during drought conditions are unlikely to affect the estimation of the stressor-response relationship. This could potentially be an issue if EPA were relying on the distribution of observations to set a criterion (i.e., a reference condition approach). In that case, a severe drought might introduce biased values in a criterion value like chlorophyll-*a* because reference lakes might have higher chlorophyll-*a* concentration during a drought.

With the current models, however, the effects of a drought would be weak because EPA has modeled relationships between variables. A drought might reduce the depth of certain lakes in the data set but would not alter the modeled relationships. For example, the relationship between cyanobacteria biovolume and microcystin would still be applicable in a shallower, drought-affected lake, so the criteria would still be protective. If analysts think of the stressor-response relationship as a line, a drought might move conditions along the line, but would not alter the position of the line.

1.11 Are there additional considerations for identifying criteria protective of oligotrophic lake conditions?

In theory, the slope of the relationship between zooplankton and phytoplankton biomass (Z:P) should approach 1 in oligotrophic lakes. However, although oligotrophic lakes are represented in the data set used to derive the models, the input of a Z:P slope is capped at 0.4 as the models will not yield solutions with higher Z:P slope input values. Such lakes were relatively rare in the NLA data set. A slope less than zero for any lake indicates the loss of food web connectivity and potential for an associated loss of ecological function, and therefore lack of protection of aquatic life designated use. This is the circumstance that the zooplankton endpoint is designed to avoid.

In the EPA criteria document, EPA recommends a threshold of zero for the slope threshold. However, for oligotrophic lakes, collection of additional data can help inform whether selection of a value for the slope threshold that is greater than zero would better maintain desired oligotrophic lake attributes. For example, a state or authorized tribe may collect zooplankton and phytoplankton measurements from an oligotrophic lake of interest and use those data to estimate an appropriate value for the slope threshold.

Oligotrophic lakes, particularly those with a lack of anthropogenic nutrient inputs, typically have attributes such as excellent water clarity that are highly valued by recreators and to which associated aquatic life have adapted. For these lakes, states and authorized tribes may want to consider a more sensitive endpoint than the zooplankton biomass endpoint to ensure protection of designated uses. Identification of alternative water quality endpoints, such as high/very clear water clarity, and their relationship to nutrient concentrations, or the use of historical reference condition to derive alternative numeric nutrient criteria, may be more appropriate for these lakes.

1.12 At what locations and depth(s) within a lake or reservoir do the criteria apply?

These criteria are intended to apply to all parts of a lake or reservoir. States and authorized tribes should adopt criteria to protect the entire lake or reservoir, and design monitoring and assessment to evaluate all parts of the lake or reservoir. This may be accomplished with one or more monitoring locations within the lake or reservoir. If states and authorized tribes find that certain features of a lake or reservoir (e.g., morphology, bathymetry, hydraulics) affect the applicability of the criteria, then the state or tribe should make appropriate adjustments in their standards. States and authorized tribes should specify this general applicability in their WQS, or specify location and depth of applicability if warranted, to avoid any ambiguity for implementation programs.

The modeling approaches used to derive criteria values are not tailored to any specific location and are intended to protect designated uses in all portions of the lake or reservoir. For example, a unit of chlorophyll *a* corresponds to the same unit of microcystin regardless of where the water sample is collected. The water quality data used to derive criteria were integrative samples over the photic zone collected at the deepest location in the lake or the midpoint of the reservoir (See risk characterization section of the criteria document[27]). These samples represent the photic zone up to a 2-meter depth.[28] Data from the littoral zone (approximately 10 meters from the shoreline at a depth of 0.3 meter) supplemented analyses used to derive the chlorophyll *a* criteria from samples collected in the deepest part of the lake. Nutrient criteria derived using the zooplankton biomass endpoint to protect aquatic life uses would be appropriate for the entire lake or reservoir. Likewise, nutrient criteria to protect recreation and drinking water uses derived using microcystin endpoints would likely be appropriate for the entire lake. Nutrient criteria derived using the hypoxia model to protect aquatic life would be appropriate for an entire lake or reservoir that stratifies seasonally and harbors cool- and cold-water fish.

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[27] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)* (pages 65-71).
[28] U.S. Environmental Protection Agency. Link to *2012 National Lake Assessment Field Operations Manual*, version 1.1., May 15, 20212.

1.13 Can states and authorized tribes rely on EPA's CWA 304(a) recommended nutrient criteria as numeric translations of narrative water quality standards?

Yes, states and authorized tribes may rely on the recommended criteria as one approach to derive protective numeric targets to implement narrative criteria (i.e., both general, "free from" and nutrient-specific narrative criteria) for CWA purposes. States and authorized tribes should verify consistency between the recommended criteria and the language of their narrative criteria before pursuing this approach.

EPA recommends that states and authorized tribes currently lacking numeric nutrient criteria in their WQS consider employing EPA's 304(a) recommended criteria as one approach for developing numeric translations of narrative criteria until state or tribal adoption and EPA approval of the state's or tribe's WQS containing numeric nutrient criteria (40 CFR part 131.11(b)).[29]

1.14 How does the publication of the revised CWA Section 304(a) recommended criteria for lakes and reservoirs affect existing numeric nutrient criteria (site-specific or statewide) for lakes and reservoirs adopted using previous guidance or alternative approaches?

Criteria already approved by EPA under CWA Section 303(c)—including criteria developed using previous guidance and methods—remain effective for CWA purposes until EPA approves a change to that WQS or until EPA promulgates a replacement WQS. The publication of the EPA criteria document or this Q&A document does not invalidate any previous criteria adoption and EPA approval. EPA encourages states and authorized tribes to take the opportunity to consider this new information and determine if revisions are warranted as part of the state or authorized tribe's triennial review (See also Question 1.3).

1.15 How does the publication of the revised CWA Section 304(a) recommended criteria for lakes and reservoirs affect existing numeric translations for general narrative criteria (i.e., "free-froms") or narrative nutrient criteria for lakes and reservoirs developed using previous guidance or alternative approaches?

The publication of the revised CWA Section 304(a) recommended criteria does not invalidate the previous numeric translations of existing narrative criteria with respect to nutrients for CWA purposes. Several states and authorized tribes have translated narrative criteria based on various approaches that continue to be protective of the designated use. However, EPA recommends that states and authorized

[29] 40 CFR 131.11(b) *Form of criteria*: In establishing criteria, States should: (1) Establish numerical values based on: (i) 304(a) Guidance; or (ii) 304(a) Guidance modified to reflect site-specific conditions; or (iii) Other scientifically defensible methods; (2) Establish narrative criteria or criteria based upon biomonitoring methods where numerical criteria cannot be established or to supplement numerical criteria.

tribes review any previous numeric translations for general or nutrient-specific narrative criteria for lakes and reservoirs (whether statewide or site-specific) in comparison to the 304(a) recommended criteria when the opportunity arises (e.g., TMDL development or permit reissuance) to ensure the utilization of the latest scientific information and protection of the most sensitive designated use.

1.16 Can states and authorized tribes use these CWA 304(a) recommended nutrient criteria for lakes and reservoirs as a line of evidence in a multiple lines of evidence approach to develop alternative numeric nutrient criteria?

Yes, a state or authorized tribe may use the recommended criteria as a line of evidence in a multiple line of evidence approach for developing numeric nutrient criteria.[30]

1.17 Can states and authorized tribes incorporate state/tribe or region-specific data into the criteria models?

States and authorized tribes can derive criteria to reflect site-specific conditions using the criteria models by selecting waterbody specific values for certain lake variables (e.g., depth, dissolved organic carbon (DOC), elevation). States or tribes that are interested in modifying the models to reflect state/tribe or regionally specific conditions can also work with EPA to combine their monitoring data with the national models. The Bayesian modeling framework allows for the incorporation of new data, and the degree to which local data affects the final model depends on the quantity of local data and on the precision of the relationships observed in the local data. A list of input parameters to inform the models is provided in Table 1.2. The criteria document (see Appendices A, B and C) discusses three examples of case studies in which state monitoring data, including data for additional input parameters, have been combined with national data to refine the criteria models for specific designated uses.

Because of the complexity of the Bayesian modeling approach and expertise needed to incorporate state and tribal data into the criteria models, EPA is available to provide technical assistance with such efforts through its EPA N-STEPS Program. EPA anticipates that this will take additional time and states and authorized tribes should coordinate with an EPA Regional Office Nutrient Coordinator as early as possible in their criteria derivation and adoption process. EPA notes that there is no presumption that states and authorized tribes would choose to incorporate local data into the national models; this is an optional step. EPA expects the national models to produce protective nutrient criteria without the need for additional site-specific data.

[30] In establishing numerical criteria to protect designated uses, states and authorized tribes should base those values on CWA Section 304(a) guidance; CWA Section 304(a) guidance modified to reflect site-specific conditions; or other scientifically defensible methods. (40 CFR 131.11(b)(1)).

1.18 How do EPA's 2021 recommended *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs* relate to EPA's 2019 *Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin*,[31] or EPA's 2015 *Drinking Water Health Advisory for the Cyanobacterial Microcystin Toxins*[32] *and Cylindrospermopsin*[33]?

Excess nutrients flowing into waterbodies from agricultural, industrial, and urban sources can contribute to optimal conditions for cyanobacterial blooms and cyanotoxin production. Preventing nutrient input and reducing nitrogen and phosphorus levels in a waterbody can therefore help to reduce the occurrence of cyanobacterial blooms. EPA's recommended *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs*[34] include endpoints established in the recommended Recreational Criteria and in the Drinking Water Health Advisories to protect these designated uses. The nutrient criteria for lakes and reservoirs are additional tools that states and authorized tribes could use to address the human health impacts of cyanobacterial blooms and cyanotoxins such as microcystin.

To establish recommended numeric nutrient criteria that are protective of recreational designated uses, EPA used the microcystin concentration of 8 µg/L identified in the 2019 Recommended Human Health Recreational Ambient Water Quality Criteria document. At or below 8 ug/L, adverse health effects are not expected to occur in children aged six to ten years (specifically, liver toxicity) after incidental ingestion of water during recreation. The presence of other cyanotoxins (e.g., cylindrospermopsin, anatoxin-a) might also be important for certain lakes or reservoirs, but continental-scale occurrence data for those other cyanotoxins were not available at the time the nutrient criteria were being developed. In general, implementation of numeric nutrient criteria, which lead to reductions in excess total nitrogen and total phosphorus and prevent bloom formation, are likely to limit blooms that produce the other cyanobacterial toxins. However, should lake- or reservoir-specific circumstances indicate that more stringent criteria are needed to prevent other cyanotoxins from reaching concentrations above health-based thresholds, a different approach may be needed.

To establish recommended numeric nutrient criteria that are protective of finished drinking water sources (See also Question 4.3), EPA used the microcystin concentration of 0.3 µg/L identified in the 2015 *Drinking Water Health Advisory for the Cyanobacterial Microcystins Toxins*. This is also the concentration at which adverse health effects are not expected to occur over specific exposure durations in bottle fed infants and young children of pre-school age (10 days; see page 44-45 of EPA's criteria document for additional discussion of how shorter-term conditions are related to criteria derived to reflect prevailing longer-term conditions). For additional information, see Question 4.3.

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[31] U.S. Environmental Protection Agency. Link to *Recommended Human Health Recreational Ambient Water Quality Criteria or Swimming Advisories for Microcystins and Cylindrospermopsin*, EPA 822-R-19-001, May 2019.
[32] U.S. Environmental Protection Agency. Link to *Drinking Water Health Advisory for the Cyanobacterial Microcystin Toxins*, EPA-820R15100, June 2015.
[33] U.S. Environmental Protection Agency. Link to *Drinking Water Health Advisory for the Cyanobacterial Toxin Cylindrospermopsin*, EPA-820R15101, June 2015.
[34] U.S. Environmental Protection Agency. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)*.

1.19 What regulatory mechanisms and resources are available to address attainability challenges and facilitate achievement of numeric nutrient criteria?

Options include adopting WQS variances, revising designated uses, and granting compliance schedules. Additional information can be found in EPA's Water Quality Standards Handbook. States and authorized tribes may also consider the following resources:

- National Study of Nutrient Removal and Secondary Technologies
- Municipal Nutrient Removal Technologies Reference Document (2008)
- *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reductions at Wastewater Treatment Plans* (August 2015)
- *Life Cycle and Cost Assessments of Nutrient Removal Technologies in Wastewater Treatment Plants (2021)*

Section 2: Implementing EPA's CWA 304(a) Recommended Nutrient Criteria for Lakes and Reservoirs in National Pollutant Discharge Elimination System (NPDES) Permitting[35]

2.1 How should EPA's CWA 304(a) recommended nutrient criteria be used to develop Water Quality Based Effluent Limits (WQBELs) in NPDES permits?

These recommended criteria can be used to develop WQBELs in the same way as other EPA CWA Section 304(a) criteria. As a reminder, a WQBEL is an effluent limitation determined by selecting the most stringent of the effluent limits calculated using all applicable water quality criteria (e.g., aquatic life, human health, wildlife, translation of narrative criteria) for a specific point source to a specific receiving water. If a state or authorized tribe adopts and EPA approves numeric nutrient criteria in a water quality standard, or a state or authorized tribe implements the criteria values as narrative criteria translations (see Question 1.13) based on these CWA Section 304(a) criteria for lakes and reservoirs, NPDES permit writers can use NPDES permitting procedures to establish WQBELs in NPDES permits, when necessary. For more information on how to establish WQBELs in NPDES permits, EPA has the following resources:

- Technical Support Document for Water Quality Based Toxics Control
- U.S. EPA NPDES Permit Writers' Manual
- Basic Permit Writers' Online Training
- NPDES Nutrient Permitting Website
- NPDES Permit Writer's Specialty Training: Addressing Nutrient Pollution in NPDES Permits

[35] This guidance pertains to states and authorized tribes that adopt criteria using these recommendations into their WQS or use these recommendations to interpret existing narrative criteria in their WQS.

2.2 Which criteria parameters (nitrogen, phosphorus and/or chlorophyll *a*) are recommended for use in development of effluent limits for NPDES permitting?

In general, where a discharge of nutrients has the reasonable potential to cause or contribute to excursions above WQS, EPA recommends controlling both nitrogen and phosphorus.[36] The permit writer should use the criteria the state or authorized tribe has adopted, and EPA has approved, into their WQS, or a numeric value established by the state or authorized tribe as a translation of the narrative criterion (see Question 1.13) to evaluate whether a facility will cause or has the reasonable potential to cause or contribute to an excursion above WQS, and if so, develop WQBELs (See also Question 2.6).

In most cases, EPA does not anticipate NPDES permit limits for chlorophyll *a* because most facilities subject to NPDES permit requirements do not typically discharge chlorophyll *a* directly.

2.3 How does a permit writer determine if a discharger has "reasonable potential" to cause or contribute to an excursion above these numeric criteria adopted and approved in a state or authorized tribe's water quality standards?

EPA regulations at 40 CFR part 122.44(d)(1)(i) state, "Limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which the Director determines are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any [s]tate WQS, including [s]tate narrative criteria for water quality." EPA and many authorized NPDES states and authorized tribes refer to the process that a permit writer uses to determine whether a WQBEL is required in an NPDES permit as a reasonable potential analysis (RPA). An RPA is used to determine whether a discharge, alone or in combination with other sources of pollutants to a waterbody and under a set of conditions determined by making a series of reasonable assumptions, could lead to an excursion above an applicable WQS.

EPA's regulations at 40 CFR part 122.44(d)(1) provide that when determining whether a discharge causes, has the reasonable potential to cause, or contributes to an in-stream excursion above criteria within a state or tribal WQS, the permitting authority is to use procedures that account for existing controls on point and nonpoint sources of pollution, the variability of the pollutant or pollutant parameter in the effluent, the sensitivity of the species to toxicity testing (when evaluating whole effluent toxicity), and where appropriate, the dilution of the effluent in the receiving water.

As with any parameter, a permit writer can conduct a reasonable potential analysis for nutrients using effluent and receiving water data and modeling techniques (quantitative approach) or using a non-quantitative approach. Both approaches are discussed in more detail in Chapter 6.3 of EPA's NPDES Permit Writers' Manual, Sections 3.2 and 3.3 of the Technical Support Document for Water Quality-based Toxics Control (TSD) and Parts 3 and 4 of the NPDES Permit Writer's Specialty Training: Addressing Nutrient Pollution in NPDES Permits.

[36]U.S. Environmental Protection Agency, *Preventing Eutrophication: Scientific Support for Dual Nutrient Criteria,* EPA 820-S-15-001, February 2015, https://www.epa.gov/sites/production/files/documents/nandpfactsheet.pdf

The same models used to determine reasonable potential can be used to establish permit limits as necessary (See also Question 2.6). Selection of an appropriate model to determine reasonable potential is at the discretion of the Permitting Authority. Some dynamic and steady-state water quality models that have been used for nutrient applications, either to model lakes and reservoirs or nutrient contributions to lakes and reservoirs, are SPARROW, AQUATOX, WASP, MERL, BATHTUB, CE-QUAL-W2, and QUAL 2K. For more information and to access trainings visit the following EPA websites:

- Surface Water Quality Modeling
- Environmental Community of Practice - Surface Water Models to Assess Exposures
- Center for Exposure Assessment Modeling (CEAM)

2.4 What is the appropriate averaging period for WQBELs developed from EPA's CWA Section 304(a) recommended nutrient criteria?

The NPDES regulations at 40 CFR part 122.45(d) require that all effluent limitations for continuous discharges be expressed, **unless impracticable**, as both Average Monthly Limits (AMLs) and Maximum Daily Limits (MDLs) for all dischargers other than publicly owned treatment works (POTWs), and as both AMLs and Average Weekly Limitations (AWLs) for POTWs. Seasonal and annual water quality-based averaging periods for permit limits are not explicitly specified in the NPDES regulations.

EPA recognizes, however, that the long-term nature of the impacts of nutrients, especially in downstream waters, raises questions about whether it is appropriate to establish effluent limitations for nutrients using longer averaging periods. An example of where EPA supports using annual effluent limitations to meet nutrient-related criteria is outlined in the Chesapeake Bay Memorandum (Hanlon 2004). That memorandum discusses circumstances where it is **impracticable** to express effluent limitations for nitrogen and phosphorus discharges in terms of AMLs, AWLs, or MDLs because of a number of issues. While the memo is specific to the Chesapeake Bay and its tidal tributaries, it acknowledges that nutrient dynamics of the Bay may not be unique and that a similar finding of "impracticability" pursuant to 40 CFR part 122.45(d) may be appropriate for the implementation of nutrient criteria in other watersheds. The memo states that it may be appropriate to establish longer averaging periods for permit limits when: attainment of the criteria is dependent on long-term average loadings rather than short-term maximum loadings; the focus is on the far-field effects of such nutrients (rather than the immediate vicinity of the discharge) and the concerns are specific to the average pollutant load rather than the maximum load. Since the recommended criteria have a seasonal geometric mean duration, it may be appropriate to express permit limits derived from these criteria on a longer term basis, in situations where conditions in the waterbody meet the conditions laid out in the Chesapeake Bay Memorandum. These determinations may be made on a case-by-case basis dependent upon how the state or authorized tribe adopts the recommended criteria.

For additional information for how a state might calculate limits with longer averaging periods, see part 5 and 6 of the NPDES Permit Writer's Specialty Training: Addressing Nutrient Pollution in NPDES Permits.

2.5 What additional information might the permitting authority consider when establishing WQBELs derived from these criteria to implement a state or authorized tribe's narrative criterion for nutrients, if applicable, in a permit under 40 CFR part 122.44(d)(1)(vi)(B)?

The permit writer should use any available effluent and receiving water data as well as other information pertaining to the discharge and receiving water (e.g., type of industry, existing technology based effluent limits (TBELs), compliance history, stream surveys) that could be used to develop effluent limitations and other permit conditions. If the permit writer is reissuing an existing permit, additional information about the facility (e.g., current permit requirements, effluent flow and pollutant concentrations) should be available in the permit file or in data tracking systems such as Integrated Compliance Information System (ICIS), or a state effluent data tracking system. When addressing nutrients in the permit, a permit writer should review effluent data to characterize effluent concentrations and loadings of nutrients and review the compliance history of the facility. The permit writer might also wish to discuss compliance issues, changes, or history of complaints with compliance personnel who conducted previous inspections of the facility or with permit writers for other media (e.g., air, solid waste, etc.) and check with other NPDES permit writers who have permitted similar types of facilities to see if there are any special considerations related to the type of facility to be permitted.

Information about the receiving water (e.g., background pollutant concentrations) also should be available in the permit file or in data tracking systems such as EPA's Water Quality Portal or through other reliable and scientifically defensible data sources (e.g., state data tracking systems, U.S. Geological Service (USGS) National Water Information System and National Water Quality Assessment, watershed monitoring consortia reports submitted to the permitting authority). Data on nutrient pollutant concentrations are needed to characterize the potential impact of discharges of nutrients on the receiving water. Other relevant factors may include depth, flushing time, shading, velocity, stratification, total nitrogen:total phosphorus ratio, and temperature.

When developing WQBELs, a permit water should also be familiar with any state policy on allowing mixing zones in lakes and reservoirs. Many state water quality standards have general provisions allowing some consideration of mixing of effluent and receiving water when determining the need for and calculating WQBELs. Depending on the state's water quality standards and implementation policy, such a mixing consideration could be expressed in the form of a dilution allowance or regulatory mixing zone. Section 6.2.5 of the U.S. EPA's Permit Writer Manual discusses dilution allowances and mixing zones in greater detail.

It is important for a permit writer to understand whether a receiving water or downstream water body is not meeting the state's or authorized tribe's nutrient criteria and is listed on the state's or authorized tribe's CWA Section 303(d) list. In these instances, a state may use water quality models to establish the impacts of an upstream discharge's effects on a downstream waterbody. As mentioned above in question 2.3, some dynamic and steady-state water quality models that have been used for nutrient applications, either to model lakes and reservoirs or nutrient contributions to lakes and reservoirs from upstream rivers, are SPARROW, AQUATOX, WASP, MERL, BATHTUB, CE-QUAL-W2, and QUAL 2K. For more information and to access trainings visit the following EPA websites:

- Surface Water Quality Modeling
- Environmental Community of Practice - Surface Water Models to Assess Exposures
- Center for Exposure Assessment Modeling (CEAM)

In the absence of an assessment, the permit writer may also want to consider information about the waterbody that might make it vulnerable to water quality impacts from nutrient discharges. Discharges to or upstream of impaired water bodies or water bodies that are vulnerable to the water quality impacts of nutrient discharges might require individual permits or facility-specific conditions to address nutrients within a general permit. The most recent assessed and impaired waters reports for all U.S. states are available in EPA's Watershed Assessment, Tracking, & Environmental Results (WATERS) database and, of course, through individual state water quality assessment and impaired waters reports.

For more information about what kinds of information a permit writer might need to consider when developing water quality-based effluent limits, see Chapter 6 of the U.S. EPA NPDES Permit Writers' Manual and the NPDES Permit Writer's Specialty Training: Addressing Nutrient Pollution in NPDES Permits.

2.6 Where a state or authorized tribe has not yet adopted a water quality standard containing numeric nutrient criteria, can EPA's CWA Section 304(a) recommended criteria be used to translate a state's or authorized tribe's existing narrative criteria to do a Reasonable Potential Analysis (RPA) and if necessary, develop WQBELs in permits?

Yes, the CWA Section 304(a) recommended criteria may be used by state or authorized tribal permitting authorities to develop procedures for translating their narrative criteria. EPA regulations are clear that NPDES permits must contain provisions that implement both numeric and narrative water quality criteria, including limits for all pollutants for which there is reasonable potential to cause or contribute to an excursion above either numeric or narrative criteria [§§ 122.44(d)(1))]. For some waterbodies, narrative criteria might already have been interpreted through a TMDL or watershed analysis that assigns concentration or loading allocations to individual point source discharges. In the absence of such an analysis, permitting authorities can interpret a narrative criterion using one or more of the options identified in 40 CFR part 122.44(d)(1)(vi):

1) Calculate a numeric criterion for the pollutant of concern, which might be derived using a proposed state or tribal criterion, or an explicit state or tribal policy or regulation interpreting its narrative criterion, supplemented with other relevant information;

2) Use EPA's ambient water quality criteria published under CWA Section 304(a), supplemented where necessary by other relevant information; or

3) Establish effluent limitations on an indicator parameter for the pollutant of concern, provided specified criteria are met.[37]

For additional information for how a state might translate narrative criteria for nutrients in NPDES permits, refer to the NPDES Permit Writer's Specialty Training: Addressing Nutrient Pollution in NPDES Permits.

2.7 Can a state or authorized tribe use watershed-based permitting strategies, trading, or other novel permitting strategies as tools for meeting EPA's CWA Section 304(a) nutrient criteria?

Yes, EPA promotes using innovative or novel approaches, such as an NPDES watershed approach and water quality trading and integrated planning as tools that may provide lower-cost implementation solutions for meeting WQS and may provide multiple environmental benefits in addition to water quality improvement. These approaches are particularly applicable for addressing nutrient pollution. For more information on these and other tools, please refer to the watershed-based permitting website, the water quality trading website, the integrated planning website, and NPDES nutrient permitting website.

2.8 What financing resources are available to states and authorized tribes to support nutrient pollution control activities and regulatory programs?

The U.S. EPA administers a broad set of federal programs to aid nutrient reduction activities and provide technical assistance to support communities across the U.S. Detailed information on these programs, briefly described below, can be found in the Water Finance Clearinghouse - an easily navigable web-based portal to help communities locate information and resources that will assist them in making informed decisions for their drinking water, wastewater, and stormwater infrastructure needs. The Clearinghouse includes two searchable databases: one contains available funding sources for water infrastructure and the second contains resources, such as reports, weblinks, webinars, etc., on financing mechanisms and approaches that can help communities access capital to meet their water infrastructure needs.

EPA Funding Programs:

- **EPA's Clean Water State Revolving** Fund (CWSRF) programs provide low-cost financing to support nutrient pollution reduction efforts across the country, including point source and nonpoint source interventions. With a broad list of eligible project types and borrowers paired with flexible financing options, the CWSRF can play a key role in financing nutrient pollution reduction in all 50 states and Puerto Rico. Many CWSRF programs have assisted communities in targeting nutrient pollution at its sources by implementing treatment plant upgrades, best practices in agriculture, septic system repair, and upgrades and other nutrient reduction

[37] Since multiple forms of nitrogen and phosphorus can be measured and limited directly, this option is generally not applicable to nutrients.

practices. Best practices for using CWSRF financing to address nonpoint source pollution are included in EPA's recent "CWSRF Best Practices Guide for Financing Nonpoint Source Solutions" While CWSRF funds cannot be used to directly purchase nutrient credits, there are several ways that the CWSRF's low-cost financing and flexible financing structures can support water quality trading markets, including those that utilize credits.

- EPA's **Drinking Water State Revolving Fund (DWSRF)** can provide financial assistance to publicly-owned and privately-owned community water systems, as well as non-profit, non-community water systems, for drinking water infrastructure projects for addressing HABs and cyanotoxins in drinking water. DWSRF assistance can be used to fund equipment, some monitoring, training, and source water protection. For more information, and case studies, see these factsheets specific to funding sources available to manage HABs in drinking water supplies and systems.
- See the Funding Integration Tool for Source Waters (FITS), which provides information on many federal funding options available for activities that protect sources of drinking water.
- A learning module covering the Clean Water State Revolving Fund programs can be found here.
- The Bipartisan Infrastructure Law (BIL) was signed on November 15, 2021 and includes $50 billion to the Environmental Protection Agency (EPA) to strengthen the nation's drinking water and wastewater systems—the single largest investment in clean water that the federal government has ever made. A significant portion of water infrastructure dollars will flow through the Clean Water and Drinking Water State Revolving Funds (SRFs). More information on this funding can be found here.
- CWA Section 319 (Nonpoint Source) addresses the need for greater federal leadership to help focus state and local nonpoint source efforts. Under Section 319, states, territories and tribes receive grant money that supports a wide variety of activities including technical assistance, financial assistance, education, training, technology transfer, demonstration projects and monitoring to assess the success of specific nonpoint source implementation projects.

Other EPA funding sources:

- Source Reduction Assistance Grant: Funds support pollution prevention activities through source reduction and resource conservation.
- CWA Section 106 (Water Pollution Control) Monitoring: Funds support water pollution prevention and control programs and activities such as monitoring and assessing water quality, developing water quality standards, and identifying impaired waters.
- Great Lakes Restoration Initiative: Funding for projects that aim to accelerate environmental progress in the Great Lakes, including reducing phosphorus loadings that often cause HABs.
- Chesapeake Bay Program: Funds for restoration projects of all sizes across the Chesapeake watershed.
- EPA Gulf of Mexico Division: Funds and implements projects to protect, maintain, and restore the health and productivity of the Gulf of Mexico.
- Urban Waters Small Grants: Funds to help local residents and their organizations, particularly those in underserved communities, restore their urban waters in ways that also benefit community and economic revitalization.
- National Estuary Program: Funds to protect and restore the water quality and ecological integrity of estuaries of national significance.

EPA Funding Forums:

- In November 2021, EPA hosted a virtual forum designed to help underserved communities with nutrient management challenges identify funding opportunities for their needs, highlighting co-funding between EPA and the U.S. Department of Agriculture (USDA). The forum provides information on the relevant funding programs, the application processes and requirements and how these programs can be used together to fund point source nutrient management projects. EPA and USDA identified sources of technical assistance and other support for small, underserved communities that have struggled to access federal funds for nutrient management due to technical, managerial, or financial constraints. All materials, a summary and recording of the forum are available online.
- In November 2021, EPA hosted a two-day virtual forum to provide state agencies and coastal and inland communities experiencing harmful algal bloom (HABs) related issues with an overview of federal funding programs available to prevent, monitor, and treat HABs and case examples of communities that have utilized those funds. Many of the EPA programs available to help fund nutrient reduction and address regulatory issues were highlighted. Presenters included representatives from EPA, National Oceanic and Atmospheric Administration, U.S. Army Corps of Engineers, U. S. Geological Survey, and U. S. Department of Agriculture. All materials, a summary and recording of the forum are available online.
- See the Funding Integration Tool for Source Waters (FITS), which provides information on many federal funding options available for activities that protect sources of drinking water.

2.9 What additional information does EPA have about cost and performance of nutrient removal technologies?

EPA has developed a variety of resources and tools to assist municipalities when evaluating how best to address nutrient pollution controls.

- *Advanced Wastewater Treatment to Achieve Low Concentration of Phosphorus (2007)* – This document provides information on 15 filtration technologies installed at 23 municipalities in the U.S.
- *Biological Nutrient Removal Process and Costs* (2007) – This document provides information on eight BNR processes from 66 facilities designed to lower total nitrogen and total phosphorus.
- Municipal Nutrient Removal Technologies Reference Document (2008) - This reference document provides information on recent advances in nutrient removal technology and practices. The document provides information to assist local decision makers and regional and state regulators plan cost-effective nutrient removal projects for municipal wastewater treatment facilities.
- *Case Studies on Implementing Low-Cost Modifications to Improve Nutrient Reduction at Wastewater Treatment Plants (2015)* – This report showcases communities where lower cost plant modifications can reduce nutrient discharge levels (ranging from about 20% to 70%), under specific circumstances.
- *Compilation of Cost Data Associated with the Impacts and Control of Nutrient Pollution (2015)* – This report and its associated spreadsheet compile information on the costs associated with the

impacts of nutrient pollution for a number of economic sectors and the costs to control nutrient sources. For the first time, costs of both controlling and not controlling nutrients are combined in one document. This report should help water program managers, legislators, and the public understand the potential costs of action and inaction and form conclusions about appropriate management actions to address nutrient pollution.

- *Life Cycle and Cost Assessments of Nutrient Removal Technologies in Wastewater Treatment Plants (2021)* – This study assesses cost, human health, and ecosystem metrics associated with nine distinct wastewater treatment configurations designed to reduce the nutrient content of effluent from municipal WWTPs.
- *Innovative Nutrient Removal Technologies: Case Studies of Intensified or Enhanced Treatment (2021)* – This report analyzes the long-term performance of five municipal facilities in the U.S. and one in Canada that implemented innovative technologies or process enhancements designed to significantly intensify treatment or enhance the removal of nitrogen or phosphorus species. The analysis centered on assessing technology performance at each facility and statistical variability of plant effluent nutrient concentrations over a three-year period. Each case study presents a process description and performance analysis, assessment of treatment train consistency in meeting permit limits, and lessons learned in process implementation.

Section 3: Implementing EPA's CWA 304(a) Recommended Nutrient Criteria for Lakes and Reservoirs in Monitoring, Assessments, Listings, and Total Maximum Daily Loads (TMDL)[38]

3.1 How frequently and over what time period should states and authorized tribes collect data for chlorophyll *a*, total nitrogen and total phosphorus levels to successfully implement EPA's CWA 304(a) recommended nutrient criteria?

States and authorized tribes should design monitoring strategies to support data assessments that align with the magnitude, duration and frequency components identified in their WQS. Ongoing monitoring should target the growing season (i.e., the duration period for determining geometric means) in order to track water quality conditions and changes over time. In many instances, the growing season may be the period from May to September, but it could be longer, up to year-round in some climates. In general, the greater number of samples collected, the better the characterization of water quality conditions. For example, if feasible, a monitoring approach could include at least monthly sampling during the growing season and plan for more than one year of monitoring to manage the uncertainty associated with individual measurements and interannual variability in the geometric mean. States and authorized tribes should also consider collecting monitoring data outside the growing season as needed to support other CWA purposes (e.g., TMDLs, NPDES permits). The use of continuous monitoring approaches (e.g.,

[38] This guidance pertains to states and authorized tribes that adopt criteria using these recommendations into their WQS or use these recommendations to interpret existing narrative criteria in their WQS.

sensors, remote sensing) is a way of collecting larger amounts of data that may help in estimating variability for the operational approach (See Question 3.12).

3.2 How should states and authorized tribes complete water quality assessments for EPA's CWA Section 304(a) recommended criteria?

States and authorized tribes complete water quality assessments through a combination of site-specific analysis and statewide statistical surveys. Results of state assessments are submitted biennially to EPA in an Integrated Report to meet the requirements of CWA Sections 303(d), 305(b), and 314. Tribes are not subject to CWA Section 305(b). Many tribes have TAS for CWA Section 106 and develop water quality assessment reports. EPA encourages tribes that become authorized for the CWA Section 303(d) program to combine their CWA Sections 303(d) and 106 water quality assessments into a Section 303(d)/106 report. A key component of an Integrated Report or Section 303(d)/106 report is the 303(d) list of assessment units not meeting applicable WQS and requiring a TMDL (CWA Section 303(d)(1)(A)). States and authorized tribes that adopt total nitrogen, total phosphorus, and chlorophyll *a* as independently applicable numeric criteria (see Question 1.4) are required to include assessment units on their Section 303(d) lists where any one of the criteria is exceeded and a TMDL is needed. Under Section 305(b) of the CWA, states are required to prepare reports every two years on the water quality of all navigable waters. States are encouraged to use statewide statistical surveys to efficiently assess the extent of waters supporting CWA goals as a complement to the assessment unit level reporting. EPA encourages states and authorized tribes to utilize recommended chlorophyll *a*, total nitrogen, and total phosphorus criteria for both assessments that are to be included in the Integrated Report or Section 303(d)/106 report.

3.3 Should states and authorized tribes identify the pollutant(s) causing or expecting to cause exceedance of a numeric chlorophyll *a* criterion in their WQS?

As part of their CWA Section 303(d) lists, states and authorized tribes are required to identify the pollutants causing or expected to cause violations of applicable WQS (40 CFR part 130.7(b)(4)). This includes a pollutant that by itself, or in combination with other pollutants, causes or is expected to cause violations of applicable WQS. States and authorized tribes must identify in their lists all pollutants that either are known to be causing or are expected to cause the impairment of a segment. Identifying the pollutant(s) causing or expected to cause an exceedance of the applicable WQS serves to communicate the listing authority's current understanding of the pollutant(s) for which loads will be established in the subsequent TMDLs. The scenarios below provide examples of the types of data and information that may be considered to support identification of the pollutant(s) causing or expected to cause exceedance of a chlorophyll *a* criterion developed from EPA's criteria models.

Scenario 1: A chlorophyll *a* criterion is exceeded, but there are no numeric criteria for causal parameters (e.g., total nitrogen and/or total phosphorus) that may be identified as the pollutant(s) causing or expected to cause the exceedance. For this scenario, the criteria models could be used to predict total nitrogen and total phosphorus values that are protective of the chlorophyll *a* criterion, which could then be compared to site-specific water quality data to support identification of the pollutant(s) causing or

expected to cause the exceedance of the chlorophyll *a* criterion. The state could also use other site-specific data or general scientific information to support identification of the pollutant(s) causing or expected to cause the exceedance of the chlorophyll *a* criterion.

Scenario 2: A chlorophyll *a* criterion is exceeded, and there are numeric criteria for causal parameters that may be identified as the pollutant(s) causing or expected to cause the exceedance. For this scenario, identifying exceedances of criteria for causal parameters that promote elevated chlorophyll *a* levels (e.g., total nitrogen and/or total phosphorus) simultaneously supports identification of the pollutant(s) causing or expected to cause exceedance of the chlorophyll *a* criterion. However, states and authorized tribes should exercise caution in automatically determining that causal parameters meeting their corresponding criteria are not still causing or expected to cause exceedance of the chlorophyll *a* criterion. This circumstance may suggest, for example, that inputs for EPA's criteria models such as dissolved organic carbon or certainty level may need to be revisited as applied to the lake in question to determine causal parameter levels that support the chlorophyll *a* criterion. Despite the total nitrogen and total phosphorus criteria being met, a state or authorized tribe may consider identifying total nitrogen and/or total phosphorus as the pollutant(s) causing or expected to cause exceedance of the chlorophyll *a* criterion based on general scientific information available about the cause-and-effect relationship between certain pollutants (e.g., total nitrogen and/or total phosphorus) and elevated chlorophyll *a* levels. In this circumstance, states and authorized tribes may want to evaluate whether revised site-specific total nitrogen and/or total phosphorus criteria may be warranted.

As a general matter, identifying the pollutant(s) causing or expected to cause exceedance of the applicable WQS can be an iterative process that may span both the 303(d) listing and TMDL development process. States and authorized tribes are encouraged to reassess and make refinements to the pollutant(s) causing or expected to cause a WQS exceedance each Section 303(d) reporting cycle, as additional data and information become available. For example, if a state or authorized tribe determines that nutrients are causing or expected to cause exceedance of a chlorophyll *a* criterion but the available data and information do not support identification of which nutrient(s) (e.g., total nitrogen and/or total phosphorus), the state or authorized tribe may simply identify a general term (e.g., "nutrients") as the pollutant and reassess that determination when additional data and information becomes available. Also, if the available data and information do not support identification of the pollutant(s) causing or expected to cause the chlorophyll *a* exceedance, the state or authorized tribe may identify the pollutant as "unknown" and reassess that determination when additional data and information become available. For both examples, additional data and information may become available during the listing and TMDL development process.

3.4 What data and information should states and authorized tribes assemble and evaluate to complete CWA Section 303(d) water quality assessments for EPA's CWA 304(a) recommended nutrient criteria?

States and authorized tribes are required under 40 CFR part 130.7(b)(5) to assemble and evaluate all existing and readily available water quality-related data and information when determining which waterbodies belong on the state's or authorized tribe's CWA Section 303(d) list. For states and

authorized tribes that have adopted criteria for all three of the parameters to address nutrient pollution (i.e., total nitrogen, total phosphorus, and chlorophyll *a*) for lakes and reservoirs, "readily available data and information" includes water concentrations of chlorophyll *a*, nitrogen, and phosphorus measured using appropriate methods collected by the state, tribe, or other stakeholders (e.g., local governments, federal agencies, university researchers, citizen and community science water monitoring groups).

Total nitrogen and total phosphorus data could be compared directly against the total nitrogen and total phosphorus criteria. In addition, in certain circumstances it may be appropriate to use data on the various forms of nitrogen and phosphorus to conduct assessments. For example, a waterbody would be impaired[39] if one or more species of nitrogen or phosphorus, which are subsets of total nitrogen and total phosphorus, are singularly or cumulatively exceeding the total nitrogen and total phosphorus criteria, respectively. Conversely, a determination that a waterbody is meeting the total nitrogen or total phosphorus criteria would usually necessitate data that cumulatively represent total nitrogen or total phosphorus.

3.5 Should states and authorized tribes that plan to implement EPA's CWA 304(a) recommended nutrient criteria update their assessment methodologies?

Yes, EPA recommends that states and authorized tribes update their assessment methodologies to reflect newly adopted criteria or new approaches for interpretation of narrative criteria. An assessment methodology provides a framework for states and authorized tribes to document how they assemble and use water quality data and information for environmental decision making. The purpose of these data analyses includes determining the extent that all waters are attaining WQS, identifying waters that are impaired and need to be added to the 303(d) list, and identifying waters that can be removed from the list because they are attaining standards. The consolidated assessment and listing methodology should describe how the nutrient and chlorophyll *a* criteria (or interpretation of a narrative criterion) are applied to make individual assessment unit level decisions and to interpret state-wide statistical survey results to report on the extent of lakes and reservoirs across the state meeting the criteria for nitrogen, phosphorus, and chlorophyll *a.*

Updates to the assessment methodology with the Integrated Report should address, as needed, the requirement under 40 CFR part 130.7(b)(6) for states and authorized tribes to provide documentation to EPA to support their determination to include or not include waters on their CWA Section 303(d) list. States and authorized tribes are required to include a description of the methodology used to develop the list; a description of the data and information used to identify waters for the list; and a rationale for any decisions to not use existing and readily available data and information to develop the list (40 CFR part 130.7(b)(6)). [40]

[39] Impairment: Failure to support one or more water quality standards.

[40] EPA will evaluate whether a state, territory, or authorized tribe provides a technical, science-based rationale for decisions not to use data or information. See EPA's 2024 Integrated Reporting memorandum at 8; see also EPA's 2006 Integrated Reporting memorandum at 37 (noting that EPA will evaluate whether the rationale provided is "reasonable" and "technical").

3.6 Should states or authorized tribes provide a rationale for not relying on certain available data and information for making assessment determinations?

EPA regulations require that states and authorized tribes assemble and evaluate all existing and readily available water quality-related data and information to develop their CWA Section 303(d) list (40 CFR part 130.7(b)(5)). As such, EPA expects that states and authorized tribes will be inclusive in the types of data and information they use to make attainment determinations. However, EPA recognizes that there may be circumstances when it is not possible to make an attainment decision because the state or authorized tribe has determined that the readily available data and information are insufficient. With regard to EPA's recommended criteria, examples of these circumstances may include, but are not limited to, determining that the total nitrogen, total phosphorus, and/or chlorophyll *a* data and information were collected using insufficient quality assurance/quality control. If a state or authorized tribe decides not to rely on certain available data and information in making listing decisions, it must provide a rationale. 40 CFR part 130.7(b)(6)(iii).[41] Waters identified as impaired and listed on the Section 303(d) list in the previous reporting cycle should not be removed in the subsequent listing cycle unless the state or authorized tribe can provide a reasonable basis for doing so.

3.7 How should states and authorized tribes approach waterbody assessments for EPA's CWA 304(a) recommended nutrient criteria for a waterbody that is already on the CWA Section 303(d) list?

Consistent with any applicable WQS, states and authorized tribes are required under 40 CFR part 130.7(b)(5) to assemble and evaluate all existing and readily available water quality-related data and information when determining which waterbodies belong on the state's or authorized tribe's CWA Section 303(d) list. EPA expects that waters identified on the Section 303(d) list in the previous reporting cycle will not be removed from the list in the subsequent listing cycle unless the state or authorized tribe can provide a reasonable basis for doing so. The applicable regulations allow states and authorized tribes to decide not to include a waterbody/pollutant combination that was previously identified on a state's or authorized tribe's CWA Section 303(d) list (sometimes referred to as a decision to "delist") for several reasons, including, for example: (a) the WQS is now being met, (b) there were flaws in the original listing, (c) a TMDL was developed and approved by EPA, or (d) other point source or nonpoint source controls are expected to result in water quality that meets WQS, as described in 40 CFR part 130.7(b)(1).[42]

Note that adoption of EPA's CWA 304(a) recommended nutrient criteria may constitute a revision to one or more criteria that previously formed the basis of a waterbody being placed on a state's or authorized tribe's CWA Section 303(d) list. Under these circumstances, the state or authorized tribe must complete future waterbody assessments based on the revised criteria.

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[41] See FN 40.

[42] For additional information on (d) see EPA's Integrated Reporting memoranda regarding Category 4b.

3.8 How should states and authorized tribes implement EPA's CWA 304(a) recommended criteria for lakes and reservoirs when criteria already exist for the parameters used to develop the 304(a) criteria?

States and authorized tribes are required to include waters on their CWA Section 303(d) lists where any applicable water quality standard is not met and a TMDL is needed.[43] For states or authorized tribes with applicable total nitrogen, total phosphorus, and chlorophyll *a* criteria based on the 304(a) recommendations, assessment units must be included on the 303(d) list when any of those criteria are not met and a TMDL is needed. Assessment units must also be included on the 303(d) list when any applicable criteria for any of the risk metrics in the 304(a) models (e.g., dissolved oxygen (DO), microcystin) are not met and a TMDL is needed. Hence, for example, if a state adopts a chlorophyll *a* criterion based on the 304(a) recommendations and also has an existing DO criterion, that state must include a water on their 303(d) list if the DO criterion is not met and a TMDL is needed, regardless of whether the chlorophyll *a* criterion is met.

3.9 How should a TMDL establish loads for EPA's CWA Section 304(a) recommended nutrient criteria?

TMDLs must be established at levels necessary to attain and maintain applicable WQS, including designated uses and numeric and narrative criteria (CFR Section 130.7). For states or authorized tribes that adopt all three parameters to address nutrient pollution (i.e., total nitrogen, total phosphorus, and chlorophyll *a*) as independently applicable numeric criteria, TMDLs must be established for the relevant pollutant(s) at levels necessary to attain and maintain any of the three criteria for which the waterbody is identified as impaired on the state's or authorized tribe's 303(d) list. In addition, if there is information identified during the TMDL development process that indicates other criteria would be exceeded with the pollutant loads being considered, the TMDL must be established at levels necessary to attain and maintain those criteria as well. As a general matter, EPA does not expect TMDL developers to establish loads for response parameters like chlorophyll *a*; rather, loads would be established for relevant causal pollutants (e.g., nitrogen, phosphorus).

3.10 Will a modeling approach be needed to establish TMDLs for EPA's CWA Section 304(a) recommended nutrient criteria?

[43] TMDLs are required for all waters/impairments on the CWA Section 303(d) list. EPA recognizes that in certain circumstances states and authorized tribes may pursue an advance restoration plan (ARP), which is a plan designed to address impairments for waters that will remain on the CWA Section 303(d) list (i.e., Category 5) as restoration activities are implemented prior to TMDL development. For additional information see EPA's 2024 Integrated Reporting memorandum.

Lakes and reservoirs are complex systems and calculating and allocating TMDL loads for lakes and reservoirs may call for the use of one or more site-specific water quality models (that are different from the models used in these CWA Section 304(a) recommended nutrient criteria). Water quality models can help to calculate the nutrient loads coming into a lake or reservoir (e.g., watershed model) and simulate how those loads are distributed and processed in the lake or reservoir over time (e.g., receiving water model). EPA's Center for Exposure Assessment Modeling (CEAM) and Water Model Workgroup (WMW) provide training and resources for choosing, developing, and running some of the available water quality models:

- Environmental Modeling Community of Practice - EPA Center for Exposure Assessment Modeling (CEAM)
- Surface Water Quality Modeling Training

Receiving water models used to establish TMDLs associated with these recommended criteria would simulate nutrient cycling within the waterbody including algal uptake and response. A TMDL model should incorporate site-specific data and information to represent the lake system as best as possible. As such, when developing a site-specific receiving water model for a TMDL, it is possible that the TMDL model may simulate different relationships between the causal and response parameters than the relationships in EPA's CWA 304(a) recommended nutrient criteria. If this circumstance occurs, there are several possible options for the state or authorized tribe to consider. For example, the state or authorized tribe could consider evaluating whether there are opportunities to modify the TMDL model (e.g., incorporating additional data to better represent the system). The state or authorized tribe could also consider pursuing adjustments within the framework of EPA's CWA 304(a) recommended nutrient criteria models or by utilizing alternative scientifically defensible methods (as discussed in Section 1 of this document) to derive revised criteria. Note that the state or authorized tribe could pursue developing revised criteria prior to or after completing the TMDL. Whether or not any modifications are made to the TMDL model or the criteria is revised, TMDL developers should consult the information on establishing TMDL loads provided in Question 3.9.

3. 11 Do existing nutrient TMDLs need to be revised if a state or authorized tribe adopts EPA's CWA Section 304(a) recommended nutrient criteria?

Whether states and authorized tribes that adopt EPA's CWA 304(a) recommended nutrient criteria need to revise existing nutrient TMDLs will be a waterbody specific consideration. Many states have developed nutrient TMDLs (i.e., TMDLs that specify loads for nitrogen and/or phosphorus) to attain WQS for causal (e.g., nitrogen, phosphorus) and/or response (e.g., chlorophyll *a*, dissolved oxygen (DO)) variables. The CWA does not mandate a particular method (e.g., modeling approach) by which TMDLs are developed. As such, the existing nutrient TMDLs have been developed using a variety of methods that vary from state to state, or within a state, and account for site-specific conditions of a waterbody to varying degrees. Also, the existing nutrient TMDLs may be based on water quality endpoints that differ from those derived from the recommended criteria. For example, a state or authorized tribe that developed a nutrient TMDL to address a DO WQS exceedance may find that the nutrient loads identified in the TMDL to achieve the DO criteria may be lower than the nutrient loads needed to achieve a newly adopted total nitrogen and/or total phosphorus numeric criteria based on EPA's CWA 304(a) recommended nutrient criteria, and thus the previously developed TMDL loads would not need to be

revised. EPA recommends that states and authorized tribes that adopt EPA's CWA 304(a) recommended nutrient criteria decide on a case-by-case basis whether an existing nutrient TMDL needs revision.

3.12 How could a state or authorized tribe use the "operational criteria" approach, discussed in Appendix D of the criteria document, for assessment purposes?

Operational criteria,[44] as discussed in Appendix D of the EPA nutrient criteria document, can be utilized in an assessment protocol to account for variability in estimating a mean nutrient concentration for a lake from a limited number of samples. If a state or authorized tribe decides to use the operational criteria approach as an assessment protocol, the value(s) associated with the protocol need to be consistent with the state's or authorized tribe's WQS. When consistent, the assessment protocol values serve to determine whether the criteria are met or whether additional sampling may be warranted. Operational criteria may also be incorporated as part of state or authorized tribal water quality standards.

To illustrate this idea, consider the example from Appendix D of the EPA nutrient criteria document describing a criterion for total phosphorus of 60 µg/L that is not to be exceeded as a long-term mean. Based on national-scale estimates of variability,[45] the distribution of single samples from a lake with a mean total phosphorus of 60 µg/L would have values of 34 and 105 µg/L for the 10th and 90th percentiles, respectively. If, when sampling on a rotating basin schedule, a single sample of total phosphorus from Lake A has a value of 12 µg/L, additional sampling would not be needed to make an assessment decision as the observed total phosphorus measurement of 12 µg/L indicates that it is very unlikely that the long-term mean total phosphorus is greater than 60 µg/L. That is, 12 µg/L is substantially less than the 10th percentile value of 34 µg/L. Similarly, if a single total phosphorus measurement from Lake B has a value of 200 µg/L, additional sampling would not be necessary because it would be very unlikely that this waterbody meets the criterion for the long-term mean. However, if a single sample of total phosphorus from Lake C has a value of 45 µg/L, additional sampling would be useful to lower the uncertainty of the estimate of the mean total phosphorus concentration and more accurately assess whether Lake C is meeting the criterion. This approach could be adapted for any applicable minimum sample size and minimum temporal sampling requirements identified in state or authorized tribal protocols.

Appendix D of the EPA nutrient criteria document presents a formula for calculating standard error in estimates of mean values based on the number of samples collected per year. Similarly, collecting additional samples in more than one year can reduce the inter-annual variability with the following equation:

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[44] Operational criteria are defined in Appendix D of the criteria document as: criteria [that] can be specified to account for this [sampling] variability with adjusted criterion magnitudes and by adopting a frequency component that allows for some excursions of the specified magnitude. Link to *Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)*.

[45] Appendix D of the criteria document (*Ambient Water Quality Criteria to Address Nutrient Pollution in Lakes and Reservoirs (August 2021)*) points out that estimating intra-annual variability from local data collected in the lake of interest would help ensure that the estimate correctly reflects variability in the lake.

$$s.e. = \sqrt{\frac{s^2_{sample}}{N} + \frac{s^2_{interannual}}{N2}}$$

where *N* is the number of samples collected per year, *N2* is the number of years of samples collected, s_{sample} is the sampling variability of the nutrient concentration (estimated as an intra-annual standard deviation), and $s_{interannual}$ is the inter-annual standard deviation. Additional samples in multiple years increases the precision with which the inter-annual mean nutrient concentration can be estimated by reducing the effect of inter-annual variability.

Additional samples can result in various operational criteria values depending on whether the samples are added within the same year or across multiple years and the magnitudes of inter- and intra-annual variability (Tables 3.1 and 3.2). For example, using the estimates of inter- and intra-annual variability from Appendix D in the EPA nutrient criteria document, a single sample in a single year would yield operational criteria of 35 and 104 µg/L (based on the 10th and 90th percentiles of the mean distribution). Adding an additional sampling year changes the operational criteria to 36 and 99 µg/L, and adding a second sample in the same year changes the operational criteria to 38 and 94 µg/L. In the example data from Appendix D, the magnitude of intra-annual variability was greater than that of inter-annual variability and, therefore, collecting additional samples in the same year yields a greater change in the operational criteria as compared to collecting samples over additional years. In this example, the operational criteria window (i.e., the difference between the 90th and 10th percentiles of distribution) is approximately halved by taking 4 samples for 3 years. Information and procedures regarding the use of operational criteria in assessment could be described in a state's or authorized tribe's assessment methodology to accompany criteria specified in the WQS.

Table 3.1: Lower bound operational criteria (µg/L), based on the 10th percentile of the mean distribution in the example data set, when additional samples are added either within the same year across multiple years.

Samples↓ Years→	1	2	3	4	5
1	35	36	37	37	38
2	38	41	42	42	42
3	40	43	44	44	45
4	41	44	45	46	46
5	41	44	46	46	47
6	41	45	46	47	48
7	42	45	47	48	48
8	42	45	47	48	48
9	42	46	47	48	49
10	42	46	47	48	49
11	42	46	48	49	49
12	42	46	48	49	49

Table 3.2: Upper bound operational criteria (μg/L), based on the 90th percentile of the mean distribution in the example data set, when additional samples are added either within the same year across multiple years.

Samples↓ Years→	1	2	3	4	5
1	104	99	97	96	96
2	94	88	86	85	85
3	91	85	82	81	80
4	89	83	80	79	78
5	88	81	79	78	77
6	87	80	78	76	76
7	86	80	77	76	75
8	86	79	77	75	74
9	86	79	76	75	74
10	85	79	76	74	73
11	85	78	76	74	73
12	85	78	75	74	73

3.13 Are there national estimates for intra- and inter-annual variability for total nitrogen and chlorophyll-*a* like there are for total phosphorus in Appendix D of the EPA nutrient criteria document?

Estimates for intra- and inter-annual variability for total nitrogen and chlorophyll *a* can be made using data taken from STORET, similar to the estimates for the variability in total phosphorus in Appendix D of the EPA nutrient criteria document. Total Kjeldahl Nitrogen (TKN), the total concentration of organic nitrogen and ammonia, was used in place of total nitrogen because TKN is more readily available on STORET and is less subject to errors in units. TKN is a close approximation to the measurement that the EPA nutrient criteria document suggests for monitoring total nitrogen. National estimates for the intra- and inter-annual variability of TKN and chlorophyll *a* are listed below in Table 3.3. These values are illustrative, taken from a subset of lakes that are mostly in the Midwest U.S. where long term data sets are currently available. Lakes and reservoirs in other parts of the country may or may not have different characteristics. If available, EPA advises using estimates of variability from lakes known to be representative of those where the criteria are applied.

Table 3.3: Estimates of Variability for Lakes Nutrient Criteria Parameters for Midwest U.S. lakes.

Parameter	Mean Standard Deviation of Intra-annual Variability (range)	Mean Standard Deviation of Inter-annual Variability
Log_e(TP)	0.34 (0.14 – 0.54)	0.27
Log_e(TKN)	0.44 (0.035 – 0.63)	0.17
Log_e(Chl-a)	0.57 (0.25 – 0.89)	0.43

Section 4: Implementing EPA's CWA 304(a) Recommended Nutrient Criteria for Lakes and Reservoirs for Drinking Water and Source Protection[46]

4.1 How can EPA's CWA 304(a) recommended nutrient criteria be used to ensure protection of drinking water?

As part of the CWA 304(a) recommended nutrient criteria development, EPA developed a criteria model specifically to protect the drinking water source designated use from microcystin contamination (see Question 1.1 and 1.18). Although microcystins are unregulated in finished drinking water at the federal level and not subject to federal compliance monitoring or evaluation, adopting and meeting criteria to protect a drinking water source designated use could decrease the occurrence of excess biomass and harmful algal blooms and their associated toxins in drinking water sources and potentially reduce the occurrence of harmful toxins in drinking water. Having criteria also helps drive state and authorized tribal CWA monitoring programs to gather occurrence data and improves state and tribal 305(b)/303(d) assessment methodologies to determine use support.

There are many programs within and outside EPA that can provide resources for protecting sources of drinking water. See Source Water Protection, Cyanobacterial Harmful Algal Blooms (CyanoHABs) in Water Bodies and Managing Cyanotoxins in Public Drinking Water Systems.

4.2 What are the benefits of protecting drinking water sources from nutrient pollution?

Protecting sources of drinking water protects public health and can help public water systems control operational costs and delay or avoid capital investments. Reducing nutrient inputs to lakes and reservoirs can reduce the occurrence of harmful algal blooms and their associated toxins in source waters. Reducing nutrient inputs to surface waters can reduce nutrient contamination to nearby groundwater under the direct influence of surface water. Reducing nutrient inputs can also reduce the levels of organic carbon and suspended solids in source waters. This is important to drinking water treatment plants because excessive suspended solids can impact a plant's filtration effectiveness. Elevated levels of natural organic matter, including carbon, nitrogen and cyanobacteria, can result in harmful disinfection byproduct formation through the treatment process. Reducing nutrient inputs can also limit exposure to harmful contaminants like nitrates in drinking water. Source water protection can also reduce the risks of seasonal or episodic nutrient spikes, such as following a spring flush or a storm event. By protecting the water quality of the drinking water source, communities may be able to avoid adding costly treatment to address degradation in source water quality as they continue meeting drinking water standards. Protecting source water and deferring or avoiding additional treatment and operational costs is particularly important for small water systems – which can face unique financial and

[46] This guidance pertains to states and authorized tribes that adopt criteria using these recommendations into their WQS or use these recommendations to interpret existing narrative criteria in their WQS.

operational challenges. Finally, improvements to the taste and odor of the water served are additional benefits.

4.3 Can states and authorized tribes use a higher water supply microcystin concentration to protect drinking water source designated uses if they consider the known treatment capacity/ability of the drinking water facility?

Yes, states and authorized tribes can use microcystin concentrations that are higher than the health advisory values to protect drinking water source designated use if their drinking water designated use is expressed to protect drinking water "post-treatment." "Post-treatment" drinking water uses outline that the WQS that apply to ambient waters must protect the surface water as a drinking water source that will undergo treatment before humans are exposed to that water. However, the ability of treatment technologies to remove microcystins is too variable for EPA to set a national recommendation for a protective ambient source water concentration that would yield the protective concentration after treatment. If a state or authorized tribe has verified through sufficient documentation and analysis such a post-treatment drinking water translation for microcystins based on state or tribe-specific drinking water treatment technologies, and has established in their WQS post-treatment drinking water uses, they can account for the expected treatment in their state or tribal facilities and potentially select a higher microcystin concentration in the ambient source water that would result in meeting the protective microcystin concentration (0.3 µg/L) in the finished drinking water. Please note that treatments that effectively remove some toxins (e.g., microcystins) are not necessarily effective for other toxins (e.g., anatoxin *a*), therefore, treatment effectiveness will need to be reviewed for the suite of toxins potentially present in a waterbody, and not limited to microcystins. At this time, EPA cannot offer comprehensive guidance on the effectiveness of treatment technologies for all types of cyanotoxins at the national level. For more information on treatment technology efficacy for cyanotoxins removal see Summary of Cyanotoxins Treatment in Drinking Water.

States and authorized tribes should critically evaluate their water resources and document the rationale for their selections of input parameters and decisions in a transparent manner both for public comment and in their submission to EPA. If states or authorized tribes wish to select input values for the models outside the range provided by the criteria models, EPA would expect a corresponding technical justification consistent with regulatory requirements to adopt protective criteria based on sound scientific rationale (see Questions 1.7, 1.11 and 1.17).