

Overview of High Rock Lake (HRL) Chlorophyll a Site-Specific Standard Proposal and Assessment Methodology Recommendation

N.C. Division of Water Resources

Introduction

After a multiyear evaluation process conducted in accordance with North Carolina's Nutrient Criteria Development Plan (NCDP), the N.C. Division of Water Resources (DWR) is proposing a site-specific chlorophyll a standard for High Rock Lake (HRL) for adoption by the Environmental Management Commission (EMC).

The NCDP was mutually agreed upon by North Carolina and the U.S. Environmental Protection Agency (EPA) in 2014 and was renewed in 2019 with minor revisions. The plan commits North Carolina to evaluate site-specific nutrient-related criteria for three pilot water bodies, each representing a distinct water body type. Those pilot water bodies include High Rock Lake (lake), Albemarle Sound (estuary), and the Middle Cape Fear river system (river and streams). Based upon lessons learned from these site-specific evaluations, North Carolina will be better positioned to reevaluate nutrient-related criteria statewide.

The NCDP also established two advisory bodies to assist with criteria development. The Scientific Advisory Council (SAC) comprises experts in the fields of water quality, water quality engineering, nutrient biogeochemistry, nutrient response variables, nutrient management and point and non-point source nutrient abatement. The Criteria Implementation Committee (CIC) advises on the social and economic implications of implementing proposed nutrient criteria to inform and assist DWR with fiscal note preparation.

The SAC reviewed several nutrient-related parameters to determine if changes were warranted or if criteria for new parameters should be adopted into standards. For High Rock Lake the parameters reviewed included dissolved oxygen, clarity, algal assemblages, pH, cyanotoxins, chlorophyll a, nitrogen, and phosphorus. No new criterion parameters were recommended, and the only standard recommended for amendment was chlorophyll a.

The chlorophyll a site-specific standard proposal and DWR's recommendations for an associated assessment methodology, contained herein, reflect a combination of the SAC's recommendations to DWR, CIC input, and the expertise of DWR staff.

High Rock Lake Chlorophyll a Criterion Proposal

Overview

The Scientific Advisory Council began its work to evaluate site-specific criteria for High Rock Lake in 2015, ultimately concluding its recommendations in a report published in May 2020 (Appendix I). DWR staff reviewed the SAC's recommendation, considered all components brought forward by the SAC, and has proposed a scientifically-based site-specific chlorophyll a standard for High Rock Lake. The SAC's report provides detailed justification for the necessary components of a water quality standard.

DWR has carried forward the SAC's chlorophyll a standard proposal with a magnitude of 35 ug/L and a seasonal duration, calculated as a geometric mean (or geomean). The DWR recommendation includes the spatial extent and depth to which the site-specific standard would apply within a waterbody and identifies the waterbodies to which the proposed site-specific standard would be applicable, as is required. The proposed language, to amend 15A NCAC 02B .0211(4), is as follows:

(4) Chlorophyll a (corrected): except as specified in Sub-Item (a) of this Item, not greater than 40 ug/l for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation not designated as trout waters, and not greater than 15 ug/l for lakes, reservoirs, and other waters subject to growths of macroscopic or microscopic vegetation designated as trout waters (not applicable to lakes or reservoirs less than 10 acres in surface area). The Commission or its designee may prohibit or limit any discharge of waste into surface waters if the surface waters experience or the discharge would result in growths of microscopic or macroscopic vegetation such that the standards established pursuant to this Rule would be violated or the intended best usage of the waters would be impaired;

(a) Site-specific High Rock Lake Reservoir [Index Numbers 12-(108.5), 12-(114), 12-117-(1), 12-117-(3), and 12-118.5] Chlorophyll a (corrected): not greater than a growing season geometric mean of 35 ug/L in the photic zone based on samples collected in a minimum of five different months during the growing season. For the purpose of this Sub-Item, the growing season is April 1 through October 31 and the photic zone is represented by a composite sample taken from the water surface down to twice the measured Secchi depth. Chlorophyll a shall not occur in amounts that result in an adverse impact as defined in 15A NCAC 02H .1002.¹

DWR's recommendations adopt the SAC's recommendation with some pragmatic adjustments based on CIC and DWR input. Specifically, DWR has recommended refinements regarding three issues: supplemental narrative standard language, applicability of the proposed standard in shallow waters, and an exceedance frequency. Table 1 below provides a comparison of SAC and DWR recommendations.

¹ Adverse impact, as defined in 15A NCAC 02H .1002, means a detrimental effect upon water quality or best usages, including a violation of water quality standards, caused by or contributed to by a discharge or loading of a pollutant or pollutants.

Table 1: SAC and DWR chlorophyll a criterion and assessment recommendations.

Component	SAC Recommendation	SAC Notes on Selection	DWR Recommendation	DWR Notes on Selection
Magnitude	35 ug/L	Selected from a range of chlorophyll a concentrations deemed to be protective of HRL designated uses.	Same	Selection of 35 ug/L derived by SAC from a station by station analysis deemed to be protective of HRL designated uses.
Period/ Duration	Seasonal Geomean	Calculated geomean based on all data from growing season.	Same	None
Growing Season/ Duration	April-October	Include samples collected in at least five different growing season months for each year of data included in the analysis.	Same	None
Frequency	Maximum Exceedance Frequency of one- in-three years	Compute the geometric mean for each year of individual data and apply a frequency component of not more than one exceedance out of three years of data.	The frequency component is a "shall not exceed" value. A minimum dataset of two seasonal geometric means is needed for assessment purposes.	Acknowledges year-to-year variability in chlorophyll a concentrations and the need for more than one year of exceedance before making an assessment decision. Requiring consistent results based on data from two or more growing seasons for listing or delisting will provide greater certainty that the "shall not exceed" standard is indeed impaired or no longer impaired, respectively.
Spatial Considerations	Open Waters	Photic zone composite based on twice the Secchi depth; shallow waters and isolated coves exempt from numeric criteria; all data within each assessment unit would be incorporated into the calculated geomean.	All waters within the associated index numbers (12-(108.5), 12-(114), 12-117-(1), 12-117-(3), and 12-118.5).	Same as SAC recommendation except no shallow water/isolated coves exemption. Station by station assessment consistent with methodology used to develop the 35 ug/L geometric mean.

Narrative Criterion

The SAC recommended the use of a narrative criterion for shallow waters and isolated coves but did not offer specific narrative language. DWR agrees that a narrative component of the criterion is appropriate and proposes to supplement the quantitative site-specific, seasonal standard with the following narrative language: *“Chlorophyll a shall not occur in amounts that result in an adverse impact as defined in 15A NCAC 02H .1002.”* The DWR recommendation makes reference to “adverse impact” because this term has been previously adopted by the EMC in its rules and has been approved by the Rules Review Commission. As noted above, adverse impact is defined in rule as a detrimental effect upon water quality or best usages, including a violation of water quality standards, caused by or contributed to by a discharge or loading of a pollutant or pollutants.

DWR’s supplemental narrative component recommendation provides protection to any shallow waters and isolated coves, seasons, or instances not covered by the site-specific, seasonal geomean. This is consistent with the SAC’s recommendation for shallow waters to be addressed by narrative criteria.

Shallow Water Areas

The SAC recommended the categorical exclusion of shallow waters and isolated coves from the proposed numeric criterion, with a parenthetical suggestion of all waters less than ten feet deep. This recommendation was included in the final SAC report but was not discussed as part of the 2018 meeting during which the SAC voted upon its criteria recommendation. DWR does not recommend incorporating this exclusion for several reasons.

First, reducing coverage of numeric nutrient-related standards in state waters is not the NCDP’s goal. The NCDP’s purpose is to refine and expand the use of numeric standards to address nutrient issues, not to reduce Clean Water Act (CWA) protections. If the recommended site-specific criterion including the narrative component were not to apply to all waters under consideration, then the existing standard in 15A NCAC 02B .0211(4) would apply to any waters not subject to a site-specific standard. Shallow waters are often the very places in need of numeric standards, particularly for recreational and fishing uses.

Second, the definition of shallow waters as being less than 10 feet deep (3.0 m) raises substantial pragmatic and operational issues. Water levels in High Rock Lake fluctuate 10 feet or more, making the application of this limitation uncertain in relation to many fixed sampling locations.

Third, the Monte Carlo analysis used to derive this site-specific magnitude recommendation did not exclude data based on depth. Of four monitoring stations chosen for that analysis, station HRL051 was included to represent riverine waters despite being well below the recommended ten-foot depth threshold. The SAC noted that *“waters at HRL051 reflect turbid river conditions, and the average chlorophyll a is lower than in downstream waters.”*² Thus, the analysis, at least in part, supports applying the derived site-specific criterion in shallower waters.

While not incorporating the exclusion of shallow waters from the application of this criterion, DWR understands the underlying concern that segments may be CWA Section 303(d) listed as impaired based

² N.C. Nutrient Criteria Scientific Advisory Council, page 65. A Chlorophyll a Criterion for High Rock Lake. May 26, 2020.

on nonrepresentative sampling. Current monitoring, quality assurance and transparency protocols are sufficient to ensure representative sampling in High Rock Lake.

DWR recommends that any new monitoring efforts in High Rock Lake, whether by DWR or by third parties, comply with the following existing protocols:

- Photic zone composite and boat- or bridge-based sampling, which provide natural access and depth limitations
- DWR or third-party compliance with the DWR Ambient Lakes Monitoring Program Quality Assurance Project Plan, which provides:

“Actual sampling points are generally located within the center or main-stem of the lake, or as determined by field staff as representative of the lake or specific areas of concern within the lake.”

- Submission of third-party data for public review during biannual integrated reports and associated Quality Assurance Protocol Procedures requirements

These safeguards ensure nonrepresentative shallow water samples are not used for assessment purposes in High Rock Lake or statewide.

Assessment Frequency

DWR’s proposed 303(d) assessment methodology implements the SAC’s premise that data included in the assessment be collected in two or more years to incorporate year-to-year variability in chlorophyll a concentrations. The SAC noted that *“Limited available data with which to assess compliance with a seasonal geomean criterion for chlorophyll a presents an obvious challenge to considering a frequency component to the standard. The most common frequencies used by states are instantaneous or a frequency based on some limited number of exceedances...”*³

The SAC recommended a “greater than 1 in 3”⁴ approach for assessment purposes to implement the recommendation of a seasonal geomean for chlorophyll a in High Rock Lake. However, the SAC provided no justification to support the recommendation other than stating that some other states apply the “greater than 1 in 3” approach to non-toxic parameters including seasonally averaged chlorophyll a. Also, the SAC did not address delisting recommendations, which is a required component of an assessment methodology.

DWR’s proposed assessment methodology represents the SAC’s proposal in a practical and implementable format. The intent behind the SAC’s “greater than 1 in 3” proposal for impairment determination is to verify that there is the persistence of a problem by capturing variability. DWR incorporated this concept into the proposed assessment methodology, but also ensured the assessment approach balanced impairment listing as well as delisting decisions.

³ N.C. Nutrient Criteria Scientific Advisory Council, page 61. A Chlorophyll a Criterion for High Rock Lake. May 26, 2020.

⁴ The “greater than 1 in 3” approach means that a water body would be considered impaired if there were greater than 1 in 3 exceedances of the seasonal geomean.

DWR's proposed assessment methodology, as described below, requires at least two years of seasonal geometric means for decision-making and is designed to ensure that the proposed site-specific standard protects the lake's designated uses. The requirement of two seasonal geometric means recognizes concerns with data variability and allows for defensible delisting as well as listing decisions. Impairment determinations will require at least two years exceeding the seasonal geometric mean within an assessment period. Conversely, delisting or meeting criteria determinations will require at least two years meeting the seasonal geometric mean within an assessment period.

An additional concern with the SAC's recommendation of an impairment listing frequency of "greater than 1 in 3" is that it is inconsistent with DWR's current monitoring resources for High Rock Lake and does not provide a pathway to assess water quality in High Rock Lake without additional resources, a point that was also made by the CIC. DWR's assessment window is five years. The SAC did not explicitly address how "greater than 1 in 3" can apply to a five-year data window with existing resources. DWR's proposed assessment methodology is flexible enough to apply to the current monitoring schedule, but also provides an assessment pathway when there is more frequent data collection.

In summary, DWR's proposed 303(d) assessment methodology implements the SAC's recommended seasonal average geometric mean approach. DWR has drafted an assessment approach that balances listing and delisting decisions and incorporates the SAC's premise that more than one year of data is needed for regulatory decision making for assessment purposes.

High Rock Lake Chlorophyll a Assessment Methodology Recommendation

DWR is not proposing a change to the assessment methodology as part of the site-specific standard adoption process. After the adoption of a site-specific standard for High Rock Lake, DWR will incorporate the complementary site-specific assessment methodology into the state's comprehensive 303(d) listing and delisting assessment methodology for EMC approval.

However, there are several reasons to preview assessment recommendations in this document. First, it clarifies assumptions necessary to conduct a Regulatory Impact Analysis and therefore to assess potential fiscal impacts. Second, review of the assessment methodology ensures that the recommended standard can be practically and functionally assessed, once adopted. Finally, this document will serve as the reference framework to explain the necessity of the proposed methodology and the intended implementation of the proposed High Rock Lake chlorophyll a site-specific standard.

DWR recommends the following assessment method to assess the proposed site-specific chlorophyll a criterion:

Minimum Data Requirements

- Growing season geomean calculation requires a minimum of 5 samples per growing season, collected during 5 separate months.
- At least 2 full growing seasons are needed to make listing or delisting decision. Data can be augmented if there is only 1 growing season in current data window. To augment, step year by year back until there are a total of 2 years of geomeans including the current data window, only as far as previous 5 years.

List for Impairment – at least 2 years of data needed to confirm Exceedance of Criteria

- If there is 1 growing season geomean in current data window – both current and augmented year exceed growing season geomean of 35 ug/L.
- If there are 2 or more growing season geomeans in current data window – more than 1 growing season geomean exceeds 35 ug/L.

Delist for Impairment – at least 2 years of data needed to confirm Meeting Criteria

- If there is 1 growing season geomean in current data window – both current and augmented year do not exceed growing season geomean of 35 ug/L.
- If there are 2 or more growing season geomeans in current data window – zero years exceed growing season geomean of 35 ug/L. Unless there is a full 5 years of data – then zero exceedances in most recent 2 years of data (and maximum of one exceedance of geomean in 3 older years).

In order to be considered “meeting criteria,” there can be no exceedances in two out of two years (the smallest dataset scenario) and no exceedances in the two most recent years, assuming no more than one exceedance in the first three years (the largest dataset scenario). In summary, for assessment purposes, when a minimum dataset of two growing seasons are available, two or more exceedances result in an impairment decision, one exceedance is considered data inconclusive, and zero exceedances means the standard is being met.