

North Carolina Nutrient Criteria Implementation Plan

Introduction to Overall North Carolina Approach

North Carolina firmly believes that a proactive management strategy based on adaptive management techniques is the most viable method to control excessive nutrients from point and non-point sources. North Carolina has established itself as a leader in the field of site-specific, flexible nutrient control strategies through the implementation of a comprehensive nutrient management program for its surface waters. This existing program has included nutrient response criteria, ambient monitoring programs, use support methodologies, nutrient TMDLs, nitrogen and phosphorous permit limits, and an innovative supplemental classification of “Nutrient Sensitive Waters (NSW)” for certain waters of the State. The full details of the extent of this current program are presented in Attachment 1 of this document.

The State of North Carolina recognizes that additional proactive nutrient control measures are warranted based upon the latest advances in the science of nutrient management and the continued eutrophication of waters. Accordingly, the North Carolina Division of Water Quality (NCDWQ) has developed a plan for a “second phase” of nutrient control for NC’s surface waters. This follow-on plan is designed to build upon and refine the nutrient control achievements that have already been attained in the State. It is the goal of this plan to reduce and protect surface waters from eutrophication by developing regionally-specific nutrient response criteria that will be augmented by site-specific nitrogen and phosphorous control mechanisms. Additional information that provides a defensible linkage of cause to response to effect will be a prerequisite to a complete understanding of the causal variable data. It is the proactive policy for the development and implementation of this “phase two” nutrient control strategy that is detailed in this implementation plan.

Introduction to “Phase 2” of NC’s Nutrient Control Strategy

For the purposes of the second phase of Nutrient Criteria development and implementation, North Carolina has chosen to divide the waters of the State into two sub-groups. These sub-groups are defined as:

1. Non-Flowing Waters: The non-flowing waters category generally includes:
 - a. Lakes – Lakes are defined as natural (not man-made) geologic features, which impound water. In North Carolina, natural lakes are predominantly located within the Coastal Plains ecoregion and are generally shallow, elliptical lakes referred to as Carolina Bay Lakes.
 - b. Reservoirs – Reservoirs are man-made (not natural) fresh water impoundments. North Carolina reservoirs may be used as sources for drinking water, energy production, flood control, commercial water use, aquatic life habitat, and/or

recreation. Reservoirs are found throughout the State and are the dominant lake form in the Piedmont, Sandhills, and Mountain ecoregions.

- c. Estuaries – Estuaries are natural coastal features where there is an interaction of fresh and salt waters. These waters are tidally influenced, which, in turn, periodically influences changes in salinity, nutrients, water depth, etc. Estuaries along the coast of North Carolina are predominantly drowned river valleys, which became inundated by the rising sea level during the last glacial retreat.

2. Flowing Waters: The flowing waters category includes rivers and streams.

A. Nutrient Criteria Development & Implementation for Non-Flowing Waters in Phase Two

Data Status Inventory

1. **Available data:** Thousands of ambient observations have been taken from approximately 423 stations located in over 150 water bodies grouped by region. Measured parameters include chlorophyll a, total nitrogen (TN), and total phosphorous (TP). The time frame for this data ranges from the early to mid 1980s to present. Data/water bodies are grouped according to the following regions in North Carolina: mountains, piedmont, sandhills, coastal plains, and estuaries. (See Attachment 2 for an overview of inventory of existing data for nutrient criteria development for the non-flowing waters.)
2. **Data needs:** Available data will be evaluated according to the plans proposed under Criteria Development Approach (p. 3). This initial evaluation will be completed under the schedule proposed in the Timeline (p. 5) included in this document and will include the assistance of outside researchers and experts, as necessary. Based upon the advice of these outside experts, and NCDWQ's own evaluation of the data, data gaps and needs will be identified and refined. These data gaps will be filled by subsequent targeted data collection to be completed according to the proposed schedule. Resource requirements for data evaluation and collection are delineated in a later section of this plan (Resource Requirements p. 6).

Projects Planned to Address Data Needs

As discussed above, data gaps will be identified based upon a thorough evaluation and examination of the available data. Only after these data gaps have been identified will it be possible to develop specific data collection plans. Data collection projects can be submitted for review at that time. Data gaps will be identified, data collection plans will be developed, and data collection will be performed in accordance with the schedule presented in the Timeline section of this document (p. 5).

Criteria Development

1. Selected Parameters: For the non-flowing waters category NCDWQ intends to pursue a phytoplankton measure as its primary approach for nutrient criteria development. Towards this end, DWQ intends to develop new instream criteria for chlorophyll a and site-specific TN and TP optimization levels. The State of North Carolina has a predominance of reservoirs, with only six natural lakes. The inclusion of a water clarity parameter, therefore, is subject to further research and evaluation. Common non-algal turbidity has been historically and consistently identified in NC's waters, making the use of a water clarity parameter an ineffective tool as a measurable response variable for nutrients in this State. The selected parameters are proposed to be developed on a region-specific basis. Therefore, the final proposed parameters will have a unique value for each of the following designated non-flowing water regions: mountains, piedmont, sandhills, coastal plains, and estuaries.

2. Parameter Type:

- a. Chlorophyll a: At this time, NCDWQ envisions adopting region-specific, quantitative chlorophyll a criteria. NCDWQ believes that this action will require significant modifications to the current chlorophyll a criteria language. The State intends to conduct a complete scientific evaluation and review in order to determine the most effective methodology available with which to implement a revised chlorophyll a water quality standard for the control of nutrients. Anticipated outcomes of this review may lead to the incorporation of seasonal growing averages, instantaneous maximums, and frequency and distribution response criteria incorporated into the new, revised chlorophyll a standard. As previously discussed, regionally-specific chlorophyll a criteria will be developed for the mountains, piedmont, sandhills, coastal plains, and estuary regions of North Carolina. Based upon the detailed evaluation and analysis of the relationship between TN, TP, chlorophyll a, and trophic status of the water (discussed below in "Approach" p. 4), two categories of quantitative chlorophyll a parameters will be proposed for each of the five regions presented above. One category (the lower numeric value of the two) will be established at a threshold level that, if exceeded, would indicate that the water body in question had become "nutrient enriched" and in danger of eventually becoming impaired. These "nutrient enriched" water bodies would be designated as such and would be subject to the development and implementation of a nutrient management strategy (discussed below in "Nutrient Translator" p. 4). This management strategy and its associated controls on point source and non-point source nutrient loading would be designed to *prevent* further nutrient enrichment and to *preclude* subsequent impairment of the river or stream in question. The second category (the higher value of the two) would be designated as the "impairment level" criteria. Exceedance of this impairment level criterion would indicate that the water body had become impaired and was not maintaining one or more of its designated uses. This "impairment level" chlorophyll a criteria would be applicable for use support attainment and 303(d) listing decisions. Waters on the 303 (d) list will be scheduled for additional study or development of a

TMDL as deemed appropriate.. (Note: The use of the term “nutrient parameters” will be used throughout this document to include both the lower value “nutrient enrichment” threshold level and the higher value “impairment level” nutrient criteria.)

- b. Total Nitrogen (TN) & Total Phosphorous (TP): Site-specific TN and TP control levels will be developed for those waters that are determined to be “nutrient enriched” under the provisions of this plan. When a specific water body equals or exceeds the “nutrient enriched” chlorophyll a quantitative level, a translation process will be required for that specific water body. This translation process (which is described in further detail below) will address both the point and non-point source nutrient loading to the nutrient-enriched waters and will result in the development of site-specific TN and TP control levels that are sufficient to prevent the subsequent nutrient impairment of the water body in question.

Criteria Development Summary: This management strategy and its associated controls on site-specific point source and non-point source nutrient loading would allow NCDWQ to *prevent* further nutrient enrichment, preclude subsequent impairment of the waters (exceedances of the impairment level chlorophyll a criteria) and to *protect* all existing and designated uses.

3. **Nutrient Translator:** As currently planned, NCDWQ will implement the following actions in those non-flowing water bodies that become “nutrient enriched,” as described above:
 - a. NCDWQ will require optimization of TN and TP removal for major dischargers to non-flowing water bodies identified as “nutrient enriched.” These optimization levels will be established to *prevent* further nutrient degradation of the waters while the second part of this translation process is executed.
 - b. As a second step, the Division will develop and implement a comprehensive, site-specific nutrient management strategy for all “nutrient enriched” waters. This strategy and its associated modeling will address both point and non-point nutrient sources and will detail the steps necessary to effectively control those sources in a manner that will prevent further nutrient enrichment and the impairment of the water body in question. NCDWQ will implement the plans developed under this nutrient management strategy to the extent necessary to ensure that all designated and existing uses of the threatened waters remain *protected*. If necessary, nutrient management plans may be extrapolated upstream to flowing waters in order to adequately protect a downstream non-flowing water body.
4. **Approach:** North Carolina’s overall approach for the establishment of nutrient criteria in the non-flowing waters will be founded on the results of a comprehensive cause and effect based study and analysis. The goal of this research study (which is outlined under Timeline, p. 5) will be to categorize the State’s non-flowing water bodies into the previously described five regions and then analyze and evaluate the relationship between TN and TP levels and chlorophyll a levels, trophic state of the water body in

question, and ultimately, designated use impairment. One goal of this study would be to create a regional trophic state matrix that would compare and contrast the regional location of the non-flowing waters with their associated trophic state, ambient level of TN, TP, and chlorophyll a levels. These results will ultimately be utilized to establish regional, multi-leveled quantitative chlorophyll a parameters and will be incorporated into the development and implementation of the nutrient translator. This comprehensive study may be expanded to also include an analysis of the effectiveness of North Carolina's existing nutrient control strategies to determine if any "lessons learned" from the implementation of these programs can be used to improve the effectiveness of the State's future nutrient control programs.

5. **Classification:** At this time, North Carolina anticipates adopting uniform nutrient parameters for all the classifications of the non-flowing waters of a specific region, irrespective of designated use categories. Analysis and evaluation of results of the nutrient cause and effect study may indicate the need to implement site-specific proactive criteria to prevent the occurrence of response variables of identified concern. Different nutrient parameters will be adopted for the rivers and streams located in that same region.
6. **Prioritization of Waters:** Water will be prioritized to the extent that the non-flowing waters of the State (lakes/reservoirs/estuaries) and rivers and streams will have their associated nutrient parameters developed according to the appropriate timeline presented in this Implementation Plan.
7. **N & P Criteria for all Waters:** The successful execution of this implementation plan will result in the development of N and P control levels and translator guidance for all lakes, reservoirs, estuaries, rivers, and streams in the State that become "nutrient enriched."
8. **Timeline:** The following timeline is proposed for the development and implementation of Nutrient Criteria for the non-flowing waters (lakes/reservoirs/estuaries) of North Carolina. The proposed timeline is directly tied to the ability of the Division to obtain sufficient funding to support the plans detailed in this document. 106(b) grants are currently considered to be the primary source for the additional funding necessary to execute this plan. Any delays in funding could limit the implementation of the proposed plan. [This timeline is based upon North Carolina and EPA agreeing to implement this proposed plan by September 2004. Any delay in concluding that agreement will result in a corresponding delay in the dates presented in this timeline.]:

By January 2005: Complete retrieval and compilation of pertinent, existing DWQ data.

By March 2005 – Complete preliminary data evaluation. Identify data gaps. Determination of appropriate research methods (both field and modeling aspects). Determine additional data study needs. Identify financial resource requirements necessary for study completion. Use outside research assistance, if necessary.

By December 2006 – Complete additional data collection required to fill identified data gaps.

By December 2007 – Complete final data analysis and evaluation. Reach conclusions regarding cause and effect relationship between TN and TP levels, chlorophyll a levels, water body trophic status, and impairment of designated uses. Develop draft regional nutrient criteria. Initiate stakeholder process. Use outside research assistance, if necessary.

By June 2008 – Initiate NC Administrative Procedures Act (APA) rulemaking process for the adoption of proposed nutrient criteria for non-flowing waters, including lakes, reservoirs, and estuaries. Develop final plans for implementation of proposed nutrient criteria.

By June 2010 – Nutrient criteria adopted in NC Water Quality Rules. Criteria implementation plans finalized and initiated.

- 9. Resource Requirements:** The following additional resources will be required to complete the implementation of the proposed nutrient control strategy as outlined in this document:

Outside Research Assistance for analysis of data and evaluation of relationship between TN & TP levels, and chlorophyll a levels, water body trophic state, and impairment.

Field data collection to fill identified data gaps and support nutrient cause and effect study. Estimated Cost: Unknown at this time due to the fact that the scope and the extent of the data collection effort have yet to be determined. Execution of proper field data collection is dependent upon obtaining adequate funding for the project.

Potential Funding Sources for additional resource requirements: 106 grants, 104(b) grants, 319 grant funds, and any other grant sources that may be associated with the implementation of nutrient criteria.

B. Nutrient Criteria Development & Implementation for Flowing Waters in Phase Two

Data Status Inventory

- 1. Available data:** Baseline available data consists of the data collected at approximately 175 sites in rivers and streams located throughout North Carolina for which there is both nutrient (ambient) sampling results and benthic macroinvertebrate sampling results. For some sites this data dates from the mid-1980's to the present. Data has

routinely been collected at these benthic/nutrient sites according to the 5-year basinwide planning cycle. These river and stream sites and their associated sampling results will be grouped for evaluation purposes according to the following regions: mountains, piedmont, sandhills, and coastal plains.

2. **Data needs:** Sufficient data concerning the periphyton assemblages of these sites will need to be collected over a period of time to allow NCDWQ research staff to ascertain the relationship between the algal biomass and/or diatom indices of biotic integrity (DIBI) and total nitrogen (TN) & total phosphorous (TP) levels, chlorophyll a levels, and designated use impairment. DWQ projects that a data collection effort spread over several years will be necessary to fill these data requirements.

Projects Planned to Address Data Needs

As discussed above, DWQ expects that an extensive, multi-year biotic data collection effort will be necessary in order to acquire sufficient scientific information to complete the requirements outlined in this implementation plan. An integral part of this research effort will be an algal assessment study at the selected sites, which will be designed to determine the type of algae present at the site, the quantity of algae present, and its associated assemblage structure. In order to reduce the extent and/or completion time of this collection effort, a probabilistic monitoring approach may be considered. All data collection projects will be executed in strict accordance with approved EPA/USGS protocols. Due to the fact that this implementation plan is in the initial stages of development, detailed data collection plans have not yet been formulated. Detailed plans will be developed and executed in accordance with the Timeline for flowing waters presented in this document (p. 9).

Criteria Development

1. **Selected Parameters:** Nutrient parameters for flowing waters will be based upon a quantifiable periphyton assessment. NCDWQ believes that development of a measure of algal biomass for flowing waters would benefit the state's goal of protection for all water bodies. Prior research has shown that chlorophyll a may not be the best estimate of nutrient enrichment in flowing waters. The state therefore intends to evaluate chlorophyll a, percentage coverage, diatom indices of biotic integrity (DIBI) and cell density to determine if alternatives to chlorophyll a would be a scientifically more defensible judgement for nutrient parameters in flowing waters. The research will also investigate the use of combined indices for impact evaluation purposes. Algal biomass is to be measured and assessed through the utilization of the field based rapid periphyton survey. Algal biomass and DIBI parameters will be established with unique values for each of the following regions: mountains, piedmont, sandhills, and coastal plains.
2. **Parameter Type:**
 - a. **Periphyton Assessment:** As previously discussed, a periphyton measurement consisting of either the biomass of algae determined by the field based rapid periphyton

survey and/or the DIBI will be the primary nutrient parameter for flowing waters. These parameters will be quantitative and regionally-specific. Based upon the analysis of the relationship between the algal biomass, DIBI, TN, TP, and designated use impairment, region-unique periphyton assessment criteria values will be established at two category levels for the rivers and streams of the State. These multi-leveled parameters will be implemented in a manner very similar to the methodology already proposed for the implementation of the chlorophyll a parameters for North Carolina's non-flowing waters. The lower category value of the periphyton measurement will be established at a level that, if exceeded, would indicate that the river or stream in question was nutrient enriched and in danger of eventual impairment if no action is taken. Flowing waters exceeding this benchmark would be considered "nutrient enriched" and would be subject to the development and implementation of a nutrient management strategy (discussed below). This management strategy and its associated controls on point source and non-point source nutrient loading would be designed to *prevent* further nutrient enrichment and to *preclude* subsequent impairment of the river or stream in question. The second tier (the higher value of the two categories) would be designated as the "impairment tier" criteria. Exceedance of this second category would indicate that the water body had become impaired and was not maintaining one or more of its designated uses. This "impairment tier" periphyton criterion would be applicable for use support attainment and 303(d) listing decisions.

b. Total Nitrogen (TN) & Total Phosphorous (TP): Site-specific TN and TP control levels will be developed for those flowing waters that are determined to be "nutrient enriched" as described above. A site-specific nutrient translation process will be required whenever the "nutrient enriched" periphyton assessment value is exceeded in a river or stream. This translation process (which is described in further detail below) will address both the point and non-point source nutrient loading to the nutrient-enriched waters and result in the development of site-specific TN and TP control levels.

Criteria Development Summary: This management strategy and its associated controls on site-specific point source and non-point source nutrient loading would allow NCDWQ to *prevent* further nutrient enrichment, *preclude* subsequent impairment of the waters (exceedances of the impairment periphyton criteria) and to *protect* all existing and designated uses.

3. **Nutrient Translator:** As currently planned, NCDWQ will implement the following actions in those flowing waters that become "nutrient enriched," as described above:
 - a. Optimization of TN and TP removal will be required for all major point source dischargers to the waters in question. These levels will be established to prevent further nutrient degradation of the river or stream while the second part of this translation process is executed.
 - b. As a second step, the Division will develop and implement a comprehensive, site-specific nutrient management strategy for all "nutrient enriched" flowing waters. This strategy and its associated modeling will address both point and non-point

nutrient sources and will detail the steps necessary to effectively control those sources in a manner that will prevent further nutrient enrichment and the impairment of the water body in question. NCDWQ will implement the plans developed under this nutrient management strategy to the extent necessary to ensure that all designated and existing uses of the threatened waters remain protected.

- 4 Approach:** North Carolina's nutrient control strategy for flowing waters will be based on the results of comprehensive research and analysis. As currently envisioned, this proposed research will utilize multiple approaches, incorporating elements of both a reference based approach and a cause and effect study. Comprehensive algal assessments will be performed at selected sites along with the collection of data regarding the levels of TN, TP, and chlorophyll a and the attainment of designated uses at these locations. This data will be compared and contrasted with similar data collected at sites identified as the minimally/least-impacted rivers and streams in a given region. It is expected that a thorough analysis and evaluation of this information will provide insight into the relationship between the filamentous algae density, DIBI, TN, TP, chlorophyll a levels, and designated use impairment in NC's rivers and streams on a regional basis. This information will then be utilized to establish regional, multi-leveled, quantitative periphyton parameters and will be further used to develop and implement both elements of the nutrient translator for flowing waters. This comprehensive evaluation may be expanded to also include an analysis of the effectiveness of North Carolina's existing "Nutrient Sensitive Waters (NSW)" management strategies to determine if any "lessons learned" from the implementation of these programs can be used to improve the effectiveness of the State's future nutrient control programs.
- 5. Classification:** At this time, North Carolina anticipates adopting uniform nutrient parameters for all the classifications of the flowing waters of a specific region, irrespective of designated use categories.
- 6. Prioritization of Waters:** Water will be prioritized to the extent that the non-flowing waters of the State (lakes/reservoirs/estuaries) and the flowing waters (rivers and streams) will have their associated nutrient parameters developed according to the appropriate timeline presented in this Implementation Plan.
- 7. N & P Criteria for all Waters:** The successful execution of this implementation plan will result in the establishment of site-specific N and P control levels and translator guidance for all lakes, reservoirs, estuaries, rivers, and streams in the State that are determined to be "nutrient enriched" under the guidelines of this plan.
- 8. Timeline:** The following timeline is proposed for the development and implementation of Nutrient Criteria for the flowing waters of North Carolina [Implementation of the proposed plan, and its associated timeline, are dependent upon the ability of the State to obtain adequate funding from the projects. Any delays in funding, will create associated delays in the research and implementation of the plan.] :

Immediately Following Mutual Agreement between EPA and NCDWQ on Proposed Implementation Plan: Commence efforts to procure suitable funding to support required research, sampling, and data collection.

3 Years Following the Acquisition of Appropriate Funding: All necessary sampling and required data collection completed according the North Carolina's basinwide schedule.

2 to 3 Years Following the Completion of Sampling/Data Collection: Data analysis testing and evaluation completed. Region-specific periphyton assessment benchmarks developed and reviewed. Note: NCDWQ currently envisions initiating the rulemaking process for the adoption of the proposed periphyton criteria in the 2008 timeframe.

2 Years Following the Development and Review of Criteria: Nutrient control strategy for flowing waters fully implemented into North Carolina Water Quality Program.

9. **Resource Requirements:** The following additional resources will be required to complete the implementation of the proposed flowing waters nutrient control strategy as outlined in this document:

Outside Research Assistance for analysis of data and evaluation of relationships between filamentous algae density, DIBI, TN & TP levels, chlorophyll a levels, and designated use impairment. Assistance may be required from the Philadelphia Academy of Sciences. This institution is capable of providing necessary diatom identification, QA/QC, taxa lists, and other information and analysis required for program development.

Field work to perform algal assessments and complete necessary data collection efforts. Estimated Cost: Unknown at this time due to the fact that the scope and the extent of this task have yet to be determined. Execution of proper field data collection is dependent upon obtaining adequate funding for the project. Delays in funding will create delays in both data collection and final implementation of the plan.

Potential Funding Sources for additional resource requirements: 106 grants, 104(b) grants, 319 grant funds, and any other grant sources that may be associated with the implementation of nutrient criteria.