North Carolina Nutrient Criteria Development Plan

INTERNAL REVIEW Draft August 14, 2013

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Executive Summary

North Carolina has established site-specific, flexible nutrient control strategies through the implementation of a comprehensive nutrient management program for its surface waters. This existing program has included numeric nutrient response criteria, ambient monitoring programs, assessment methodologies, nutrient TMDLs, regulatory control of nonpoint sources, nitrogen and phosphorus permit limits, and an innovative supplemental classification of "Nutrient Sensitive Waters (NSW)" for certain waters of the State.

The State of North Carolina recognizes that additional nutrient control measures are warranted based upon the latest advances in the science of nutrient management. A careful review of current capabilities by the North Carolina Division of Water Resources (DWR or the Division), including stakeholder input, revealed the need for additional criteria to assess, protect and restore rivers and streams, estuaries and surface water supply sources, including lakes and reservoirs. The Nutrient Criteria Development Plan (NCDP) has been designed to assist in addressing those needs. Additionally, the NCDP serves to meet the State's Clean Water Act Section 106 Workplan commitment of developing a revised mutually agreed upon nutrient criteria development plan with the United States Environmental Protection Agency (EPA). This plan is mandated in the NC 106 workplan as all states are required to develop a NCDP, and to get the EPA's mutual agreement on the plan, through a federal register notice that was issued in 2001. NC developed a plan in response to this register notice and the EPA mutually agreed upon that plan in 2004. However, the State and the EPA have determined that the original plan needs to be revised. This revised NCDP provides an overview of nutrient criteria related activities within the State since the 2001 federal register notice and also describes actions that the State will take to develop additional nutrient control criteria.

The Division has identified four tasks that will need to be completed as the State moves towards criteria development. These tasks include a systematic parameter review to determine which one(s) to investigate further toward criteria development; studies to compile additional data, if necessary, based on the parameter(s) selected; analysis of the available data or study results to determine appropriate parameter(s) for criteria development; and criteria development (includes implementation considerations and fiscal analyses).

Twelve parameters are identified in the NCDP as priorities for potential criteria development consideration. Eleven of the parameters are considered response variables as they reflect a water's chemical and biological reaction to nutrient inputs: chlorophyll *a*, phytoplankton community, periphyton community, macrophytes, diurnal dissolved oxygen (DO) range, minimum DO, diurnal pH range, total organic carbon, algal toxins, and taste and odor phytoplankton species. The final two parameters identified for consideration are the causal variables nitrogen and phosphorus. Parameters expected to be more representative of rivers and streams will be addressed first. The Division also intends to work collaboratively with the Albemarle - Pamlico National Estuary Partnership (APNEP) to explore parameters that could potentially be used in the development of revised nutrient criteria for estuaries. Another

priority in the Division's review will be parameters more specifically addressing surface drinking water supplies.

Execution of this plan requires collaborative work with other state and federal agencies, local governments, other stakeholders, and universities. The timeline and tasks may be adjusted based on the results of each activity and resource availability. Stakeholder involvement and updates to the North Carolina Environmental Management Commission are built into the timeline, which projects having the first potential criteria proposed by around 2020.

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1.0 Introduction

The State of North Carolina has a long history of requiring management practices to control for nutrient over-enrichment (known as eutrophication) from both point and nonpoint sources. North Carolina has established site specific, flexible nutrient control strategies through the implementation of a comprehensive nutrient management program for its surface waters. This existing program has included numeric water quality standards for nutrient response parameters, ambient monitoring programs, assessment methodologies, nutrient TMDLs, regulatory control of nonpoint sources, nitrogen and phosphorus permit limits, and an innovative supplemental classification of "Nutrient Sensitive Waters (NSW)" for certain waters of the State. This plan focuses specifically on strengthening the portion of North Carolina's nutrient management program that relates to the development of water quality standards to control nutrients. Water quality standards are defined in federal regulation as "provisions of State or Federal law which consist of a designated use or uses for the waters of the United States and water quality criteria for such waters based upon such uses." The inset box below provides more information on this definition.

What is a water quality standard?

Water quality standards define the goals for a waterbody by designating its uses, setting criteria to protect those uses, and establishing provisions to protect water quality from pollutants.

A water quality standard consists of four basic elements:

1. the designated uses of the state's waters, such as public water supply, recreation, propagation of aquatic life and wildlife, or navigation;
2. the water quality criteria specifying the amounts of various pollutants, in either numeric or narrative form, that may be present in those waters without impairing the designated uses (note - criteria include any one or more of three components: magnitude, duration, and frequency);
3. antidegradation requirements to maintain and protect existing uses and high quality waters, and
4. general policies addressing implementation issues (e.g., low flows, variances, mixing zones).

Example: Designated use – recreation in salt waters. Water quality criteria – Enterococcus not to exceed a geometric mean of 35 enterococci per 100 ml based upon a minimum of five samples within any consecutive 30-day period. The use and criteria are both components of the water quality standards for salt waters.

North Carolina recognizes that additional nutrient criteria are warranted as the current criteria may not adequately address protections for all waters (and associated current designated uses) of the State. Accordingly, the North Carolina Division of Water Resources (DWR or the Division) has developed this plan, the Nutrient Criteria Development Plan (NCDP), to address weaknesses in existing nutrient criteria for NC's surface waters. The NCDP lays out a process by which criteria will be developed to address nutrient enrichment in North Carolina waterways. While

the NCDP describes the process NC intends to take towards deriving appropriate numeric nutrient criteria, any criteria that are developed through the use of this document will have to follow the State's normal rulemaking procedures in order to be formally adopted into State rules. The NCDP is a plan of action not a rulemaking effort in itself.

The NCDP builds on existing research, within and outside of the State, to determine a defensible linkage of cause to response to effect. This plan is one piece of an ongoing effort by the State to develop water quality management programs based upon the latest advances in nutrient management and the interests of many stakeholders. With this in mind, the North Carolina NCDP is subject to change based upon the results of planned studies and emerging scientific knowledge on the subject of nutrient management.

1.1 Clean Water Act Obligations

North Carolina receives monetary assistance from the federal government to manage various water quality programs through Section 106 funds. Section 106 of the Clean Water Act (CWA) authorizes the US Environmental Protection Agency (EPA) to provide federal assistance to states to establish and implement ongoing water pollution control programs. Prevention and control measures supported by Section 106 funds include activities such as permitting, development of water quality standards and total maximum daily loads, ambient water quality monitoring, and enforcement. The State enters into a cooperative agreement (106 Workplan) with the EPA under this program to provide appropriate water quality management under the Clean Water Act.

Under the North Carolina Department of Environment and Natural Resources (NC DENR) current Section 106 Workplan agreement – the State is obligated to *"continue progress toward development of Numeric Nutrient Water Quality Standards"* by:

- Revising the State's Nutrient Criteria Development Plan (NCDP), previously identified as the Nutrient Criteria Implementation Plan (NCIP) and to reflect current and proposed activities toward establishment of numeric nutrient criteria.
- Developing and meeting scheduled milestones for submitting a revised NCIP.
- Coordinating with EPA on the development of a revised NCIP and proposed nutrient criteria and provide status report on the drafts.
- Reporting performance milestone information on progress toward adoption of water quality standards for total nitrogen (TN) and total phosphorus (TP) for each water body type (lakes/reservoirs, rivers/streams, and estuaries).

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2.0 Background on Federal and State Development of Nutrient Criteria Development Plans

The following is a brief overview of actions leading up to the drafting of this NCDP. A more detailed history is provided in Appendix A. Please note that the Division of Water Quality (DWQ) merged with DWR and is now referred to as DWR as of August 1, 2013. DWQ is referenced rather than DWR for actions taking place prior to the merger.

In 2001 the EPA, under the CWA, published ecoregional Section 304(a) criteria for total nitrogen, total phosphorus, chlorophyll *a* and Secchi depth in the Federal Register and specifically stated that the states were expected to adopt these criteria, or a revised version, into their surface water quality standards regulations. The federal register notice also indicated that the states were to develop plans by the end of 2001 for the establishment of state nutrient criteria if the state opted to not adopt federal 304(a) criteria into their regulations. According to the notice, the nutrient criteria development plan would outline the process a state would use towards adoption of nutrient criteria. The notice stated that the plan should "address items such as the criteria development process, staffing of personnel who will undertake specific tasks, and setting the internal schedule to complete the adoption process within the State and Tribal triennial review or another process". The notice went on to specify that nutrient criteria should be adopted into state regulations by 2004 and that EPA may begin promulgation of nutrient criteria in those states that had not met this deadline.

North Carolina's first plan was called the NC Nutrient Criteria Implementation Plan (NCIP) and was approved by the EPA in 2004[1]. It included anticipated timelines for development of nutrient related actions, an overview of the State's nutrient management strategies and a data inventory summary for NC's non flowing waters (lakes, reservoirs and estuaries). DWQ revised the NCIP in October 2005 to extend the milestone timelines and requested that the updated plan become the mutually agreed upon plan. This modification was approved in 2006.

In accordance with the revised NCIP timelines, DWQ began the more formalized stakeholder process by presenting to the Environmental Management Commission (EMC) in November 2008 an information item on the NCIP, including a state-wide approach to address nutrients, planned rule revisions and proposed rules for technology-based nitrogen and phosphorus controls. The proposed rules that were drafted as a result of the stakeholder process were presented to the EMC in November 2009 and January 2010. The rules were not adopted. The EMC requested that additional information be gathered regarding eutrophication and what other states were doing with respect to nutrient control regulations.

In response to the EMC's request, the North Carolina Forum on Nutrient Over-Enrichment was conducted in May 2012. This forum provided attendees with a review of the relevant science, regulatory issues, economic considerations, and other policy issues related to nutrient over-

[1] http://portal.ncdenr.org/web/wq/ps/csu/swstandards - scroll down to NC Nutrient Criteria Plan (1 Jun 2004).

enrichment and options for avoiding water body impairments. Recognized experts presented their ideas and experience with nutrient issues to a Forum panel (consisting of two EMC members, one representative of local government and one environmental advocacy group representative) and the Forum's attendees. The Division is maintaining a website that provides information from the Forum as well as other nutrient related activities.[2]

In July 2012, DWQ staff and EMC Chairman Stephen Smith presented an information item to the EMC that summarized the materials presented at the Forum. The EMC assigned DWQ the task of revisiting the original NCIP, taking into consideration the information gathered at the Nutrient Forum and additional stakeholder input.

In response to this request, the DWQ began work on a revised nutrient criteria plan, renamed the Nutrient Criteria Development Plan (NCDP), in October of 2012. DWQ was guided by their Section 106 commitments, US EPA memorandums and federal register publications, knowledge gained from the Nutrient Forum, public input, national activities, and directives from the EMC. The goals were to identify, prioritize, and select options for criteria development to include in a revised NCDP for North Carolina. Specifically, the NCDP was to identify research project needs with specific questions to be answered, methods to be used and timelines and milestones to be met.

DWQ staff presented an update on the progress towards developing a revised NCDP at the November 2012 EMC meeting. The presentation informed the Commission about the State's CWA obligations related to nutrients under the Fiscal Year (FY)12 and FY13 Section 106 Workplans and its proposed path forward. Additionally, staff provided a timeline for submitting the proposed plan to US EPA staff for review by June 30, 2013.

The DWQ hosted three public meetings on development of the NCDP in early December 2012. The meetings were held at various locations across the state to encourage stakeholder participation. Each meeting provided background information and allowed for questions and comments. The DWQ also accepted written comments on the NCDP development process from December 4, 2012 through February 4, 2013.

Written public comments were submitted by 20 individuals and 15 organizations. All comments are provided in their entirety on the following website: http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria.

Comments covered many topics including the following:

- Limitation of nutrients in discharges (19 individuals)
- Public review of the draft plan before taking to the EMC
- Establishment of a criteria development advisory group (although suggestions varied from a larger stakeholder process to an expert technical advisory group)

[2] http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria

- Site specific approach for establishing criteria (comments for and against)
- Establishment of criteria for streams and rivers (comments for and against)
- Establishment of criteria for response variables in conjunction with nitrogen and phosphorus
- Establishment of criteria for response variables only
- Establishment of numeric criteria for nitrogen and phosphorus
- Inclusion of cost benefit analysis as part of the criteria development process
  Suggestions for specific locations/watersheds to focus on for criteria development

After considering the comments received from stakeholders regarding the general NCDP process, a draft NCDP was completed by DWQ. This draft was released for public comment on April 17, 2013. The comment period was open until May 24, 2013. Comments were received from 20 individuals and organizations and incorporated into this version of the draft NCDP where applicable. Comments can be found in their entirety on the following website: http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria.

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3.0 NCDP Priorities

This section presents the areas that the Division intends to prioritize during the criteria development process. These areas were initially developed by the Division through an examination of strengths and weaknesses of existing regulatory frameworks and then modified as appropriate in response to input from stakeholders.

3.1 Evaluation of Current Nutrient -Related Criteria

To evaluate the strengths and weaknesses of North Carolina's current regulations with regard to nutrient control, the Division examined the regulatory tools currently available through the state's water quality standards (WQS) regulations. The review focused on evaluating the presence or absence of nutrient WQS regulations to allow for the assessment, restoration, and protection North Carolina's waters. This review also considered the ability of the Division to implement these regulations.

The review identified that, using North Carolina's existing current chlorophyll *a*, dissolved oxygen, and pH standards, nutrient impacts on lakes and reservoirs can be assessed and restoration success can be measured. There are existing nutrient management strategies and rules in place for several watersheds to address nutrient over-enrichment that, when fully implemented, will result in reductions in nutrient loading and achieve WQS in the water(s) of concern.[3] Due to the flexibility provided by the existing nutrient management strategies, it is not a priority to modify those targets.

In terms of protection of lakes and reservoirs, the current standards provide protection for most lakes and reservoirs, except for those in the mountains and upper piedmont. Chlorophyll *a* concentrations in the mountain and upper piedmont lakes and reservoirs are lower than other parts of the state and there is concern that the 40 µg/L chlorophyll *a* standard is too high to prevent excessive nutrient over-enrichment and its impacts in these waters (DWQ Ambient Lakes Data 1981-2007). This potential weakness is already being addressed through new chlorophyll *a* criteria that are proposed for this region of the state as part of the current triennial review process.

The evaluation identified a weakness in the current regulations in the Division's ability to effectively use the current water quality standards for chlorophyll *a*, dissolved oxygen, or pH to fully assess nutrient impacts in free-flowing waters (rivers and streams). In free-flowing waters, phytoplankton (algae that grow in the water column) may not have the time or other requirements necessary to grow excessively in the water column; therefore, phytoplankton (as measured by chlorophyll *a*, dissolved oxygen, and pH) are not one of the best indicators of adverse impacts of nutrient enrichment in those waters. For example, excess nutrients can result in over-growths of periphyton (algae that grow on substrates) that the public find a

[3] http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=521753&name=DLFE-38782.pdf

nuisance; however, DWR's ambient water quality sampling indicates that chlorophyll *a* in the water column is below the existing criterion.

The evaluation also recognized a potential weakness of the current WQS regulations towards assessing, restoring, and protecting NC's drinking water supplies. The WQS regulations could possibly contain additional standards to further protect public health from the impacts of nutrients on drinking water. The Division determined that this potential weakness in the regulations does warrant further exploration and made drinking water supply standards a priority for further study through this plan.

A third potential weakness in the regulations was identified through public comments received by the Division during the comment period for the draft NCDP. Many stakeholders indicated that estuary criteria should also be a priority for review under this plan. The Division has applied the current WQS in NC's estuaries and has developed and implemented restoration plans for estuaries that have been found to be impacted by excessive nutrients. However, the Division acknowledges that the state of the science in estuaries has advanced and has determined the estuary criteria should also be a priority for review under this plan.

The evaluation of existing WQS regulations was performed in order to try to focus the Division's efforts and thereby enhance the effectiveness of the NCDP. The availability of only limited financial and staffing resources requires the Division to prioritize the development of nutrient criteria, as described in this plan. This evaluation helped to form the priorities for a focused review during the early stages of the NCDP but in no way precludes other water types or parameters from being reviewed by the Division as the need arises.

Based on the results of the Division's evaluation of existing WQS regulations and the stakeholder comments received, **the Division determined that developing criteria that strengthens the ability to assess, protect, and restore rivers, streams, estuaries and waters that are classified as a drinking water supplies should be the Division's priority.** This iteration of the NCDP will focus on these criteria.

3.2 Parameters Targeted for Evaluation

Rivers and streams are flowing water bodies. As noted above, flowing waters can be difficult to assess for nutrient impacts using the State's current water quality standards. Also from a regulatory perspective, readily measurable substances like chlorophyll *a*, dissolved oxygen, and pH can be inadequate standalone tools in water supplies.

In general, nutrient enrichment can cause increased biomass production, phytoplankton species composition changes, nuisance conditions such as taste and odor or surface scums, the establishment of nuisance species such as algae that produce toxins, dissolved oxygen depletion, changes to pH, increased carbon dioxide production, and fish kills. In rivers and streams, these impacts can be episodic or manifested in downstream settings where flow slows. Further, environmental factors like temperature, streambed substrate, canopy cover, precipitation, and wind can support or hinder the expression of severe nutrient responses.

In North Carolina, the terrestrial habitats, land uses, and respective aquatic systems are extremely diverse and the rates at which nutrients are available for plant uptake vary spatially and temporally. Therefore, a single criterion, benchmark or tool that is protective for all waters, including flowing waters, throughout the entire state is not appropriate.

Accordingly, multiple parameters and approaches towards the development of nutrient criteria will be explored. The causative and response parameters shown in Table 1 are DWR's priorities for consideration in the development of nutrient criteria. A review of estuary criteria was added to the NCDP based on stakeholder input; the Division anticipates that specific parameters will be selected after a broad review of the applicable literature/data. Based on resources and the need for better tools for assessing streams and rivers, parameters most appropriate for those waters will be the top priority. Estuaries and waters classified for drinking water supply are covered fairly well by the current standards; therefore, further refinement of criteria for those waters will addressed following refinement of the criteria for streams and rivers. As discussed above, Table 1 provides the parameters which the Division has identified as priorities to explore for potential use in deriving new nutrient related criteria; however other parameters may be considered as a result of information gathered during the initial research stage of this plan.

Table 1. Priority Parameters for Investigation

Streams and Rivers	**Waters Classified for Drinking Water Supply**
Response Parameters: • Chlorophyll *a* • Phytoplankton community • Periphyton community • Macrophytes • Diurnal DO range • Minimum DO • Diurnal pH range	*Response Parameters*: • Total Organic Carbon • Algal Toxins • Taste and odor species
Causal Parameters: • Nitrogen • Phosphorus	*Causal Parameters*: • Nitrogen • Phosphorus

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4.0 Investigation Approach

The Division is proposing a process for criteria development to ensure that the criteria developed have strong scientific merit. The process consists of the following four tasks:

- Task 1 – Systematic Parameter Review
- Task 2 – Design and Implement Study Plans
- Task 3 – Determine Appropriate Parameters for Criteria Development
- Task 4 – Develop Criteria

This process also provides defined break points to allow for stakeholder participation and EMC review before proceeding to the next task. Depending on the results of each task, the plan may be modified to adjust timelines or priorities.

Each task is discussed in detail below.

4.1 Task 1. Systematic Parameter Review

The primary purpose of Task 1 is to assure that there are established scientific relationships between the various indicators of eutrophication and the concentrations of nitrogen and phosphorus. Task 1 will focus on gathering existing information to include literature review, review of progress in other states as they work to develop nutrient criteria, and an analysis of existing NC data for the priority parameters identified above. Information gathered at the NC Nutrient Criteria Forum will be included in this review. Task 1 will summarize what research is already available, what has worked well in other states, and highlight where there are data or research gaps to be addressed in Task 2. The NCDP literature and data review efforts will consider the applicability of the research to North Carolina.

Two full time staff positions are expected to be used for this step over a one year period (Table 2). The proposed investigation approach is discussed in more detail below.

4.1.1 Literature Review

This phase of Task 1 is focused on identifying and reviewing current literature (scientific papers, reports, federal and state documents) which have established relationships between the parameters being investigated and the responses seen in the waters. Other state and federal agencies will be asked to contribute to this review. The Division intends to collaborate with the local universities and academic community to further this review effort (e.g., North Carolina State University, University of North Carolina, Duke University, and others). The Division also anticipates collaborating with the Albemarle - Pamlico National Estuary Partnership (APNEP) regarding the literature review for estuary criteria.

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4.1.2 Review of Progress in Other States

Ongoing nutrient criteria development efforts of other states will be investigated in this phase of Task 1, focusing initially on states with federally approved nutrient criteria or acceptable assessment methodologies, and southeastern states. This review aspect is anticipated to be an ongoing effort to gain a better understanding of approaches that could be used by North Carolina towards the development of new or revised nutrient criteria.

4.1.3 Review of Available Data

The Division will conduct a review of available NC data. These efforts are intended to complement ongoing literature review efforts, data collection, and findings. Requests for existing data and the respective review may include the following sources:

- Division of Water Resources (DWR). The Division will review existing in-house data. This includes ambient monitoring data, NPDES effluent data, NPDES upstream and downstream monitoring data, Coalition monitoring data, and DWR lake monitoring data.
- NC Department of Environment and Natural Resources (DENR). The Division will request other Divisions within DENR (e.g. Coastal Management, Marine Fisheries, Wildlife Resources, and Energy Mineral and Land Resources) to provide information and data that may be available for further review and analysis.
- Federal resource agencies such as the United States Geological Survey (USGS) and the US Fish and Wildlife Service will be asked to participate in NCDP efforts.
- Collaboration with universities to discuss both past and ongoing research, monitoring data, models and other efforts will be pursued.
- Other. There are a variety of other sources that may have access to appropriate data (e.g., local governments, environmental groups, drinking water treatment plants etc.). DWR will investigate ongoing monitoring and research efforts of other States to determine the utility and applicability of these data for North Carolina.

These efforts are anticipated to identify statistical analysis needs from data sets that are currently available and information or data gaps that remain to be addressed. Additional resources may be required to complete the statistical evaluation of the data collected. These resources may be in the form of outside research assistance to conduct data analysis, including evaluation of the relationship between the multiple causal and response parameters identified above.

A systematic investigation of the available data from permitted surface water intake locations and data in proximity to intake locations will be conducted to determine additional monitoring needs. Water treatment plants receive their source water in a variety of ways including direct river and lake intakes or intake from rivers or lakes and then storage in holding ponds; therefore, use of water quality data from these facilities requires a clear understanding of their operation and sampling protocols.

It is currently unclear if an adequate amount of "near intake" surface water data is available for analysis, especially during low flow growing season conditions. Accordingly, based on the literature and available data review results, a study designed to address data collection needs may be initiated.

4.1.4 Geographic Scale

The geographic scope of Task 1 is intended to be broad as it is exploratory in nature. The applicability of parameters or combinations of parameters for investigation will be considered on the following descending (landscape size) spatial scales:

1. Regional physiographic application (e.g., Mountains, Piedmont, Coastal Plain physiographic regions),
2. River basins,
3. Differentiation of flowing stream vs. main-stem rivers by physiographic region,
4. A narrower habitat-related scale, and/or
5. Ecoregion and land use approach.

As a result of the investigation, other scales or categories of waters may be considered. Some waters may need to be treated more site-specifically.

4.1.5 Results of Task 1

The information provided by the literature, state, and data review will result in refinement and focus on parameter(s) where it is possible to establish scientific linkage of cause to response and effect. Task 1 is expected to result in a more complete understanding of data gaps and should help identify other parameters that have significant utility and merit consideration. For example, these analyses may include consideration of seasonal effects, physical water quality parameters, chemical water quality parameters, severity of nuisance conditions, and morphology of the water body.

The completion of Task 1 will result in the availability of two documents containing the results of the scientific review. The Division intends to compile documents summarizing both the results of the literature review and the review of the available data. These documents will be made available to the public.

It is understood that these efforts may illuminate other functional approaches that are beyond the scope of what is presented in this current plan. If this occurs and a more suitable pathway is revealed, the DWR intends to revisit and modify this NCDP with mutual agreement from the EMC and EPA. This modification will accommodate new information and address any new investigation priorities. This information will be communicated to the EMC and the public for consideration of application suitability.

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4.2 Task 2. Design and Implement Study Plans

Task 2 will build off of the results of Task 1 by designing and implementing study plans at the appropriate geographic scale to address any identified data gaps for parameters that were deemed appropriate for continued development. Rather than evaluating parameters individually, the intent is to complete Task 1 and design studies that can evaluate multiple parameters.

If the results of Task 1 indicate the need for additional data collection to accommodate the identified data gaps in order to support the nutrient criteria investigation, resources may be sought. These funding sources may include 106 grants, 104(b) grants, 319 grant funds, and other sources that may be available for nutrient criteria development efforts.

4.3 Task 3. Determine Appropriate Parameters for Criteria Development

Based on the results of Tasks 1 and 2, parameters and the appropriate geographic region for applicability will be selected for development of criteria. Stakeholder participation and education will be conducted to ensure that environmental, regulatory and economic concerns are documented and addressed in determining the appropriate parameters for criteria development.

4.4 Task 4. Develop Criteria

This task involves development of appropriate magnitude, duration, frequency, rule language, implementation plans and fiscal analyses to finalize the criteria for the intended protected uses. Stakeholder, EPA and EMC input will be included. Once nutrient criteria and the supporting information are developed a formalized rulemaking process will begin.

5.0 Timeline

It is anticipated that the NCDP will require collaborative work with other agencies, local governments, and universities. Additionally, the literature review, data review, analysis of existing data, and implementation of investigation approaches will require staff and resource allocations. The resources that have been estimated by the Division to be necessary to organize and manage a multidiscipline investigation / development plan of this scale are listed in Table 2. The estimated timeline may change in future revisions of the NCDP given research or resource changes.

6.0 Conclusion

It is the goal of North Carolina to protect surface waters from eutrophication by developing additional nutrient criteria that can be used for sound evaluation of nutrient related impacts

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and for development of appropriate management strategies. This Plan is designed to build upon and refine the effective nutrient control that has already been achieved by the State.

Table 2. Estimated Task Duration and Full Time Employee (FTE) Needs.

Plan Components (Tasks)	Time	FTEs
EPA approval of NCDP	3 months	
Initial NCDP Organizational efforts	6 months	1
EMC update(s)	Annual	
Task 1 - Systematic Parameter Review		
Literature Review • Review and assess literature • Criteria development plan review from other states	1 year	2
Available Data (concurrent) • Review • Statistical Analysis and assessment		
Stakeholder & EMC Update	2 months	
Task 2 – Design and Implement Study Plans		
Study Design Development	9 months	1
Stakeholder & EMC Update	2 months	
Implementation of Study	2 years	2
Task 3 – Determine Appropriate Parameters for Criteria Development		
Analysis, assessment and write up of results	6 months	2
Stakeholder & EMC Update	2 months	
Task 4 - Develop Criteria		
Criteria Development	1 year	1
Stakeholder & EMC Update	2 months	
Total	**6.7 years**	

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Appendix A
History of the North Carolina Nutrient Criteria Development Plan

Please note that the Division of Water Quality (DWQ) merged with the Division of Water Resources (DWR) and is now referred to as DWR as of August 1, 2013. DWQ is referenced rather than DWR for actions taking place prior to the merger.

2001

In January of 2001, the US Environmental Protection Agency (EPA), under the Federal Water Pollution Control Act (Clean Water Act or CWA) authority initiated efforts for states to adopt nutrient standards, specifically total nitrogen, total phosphorus, chlorophyll *a* and Secchi depth, into their state water quality standards by publishing Section 304(a) criteria in the Federal Register. These published criteria were aimed at reducing and preventing eutrophication on a national scale. The Federal Register notice specifically outlines that states are "expected to adopt or revise EPA ecoregional nutrient criteria … into State … water quality standards by 2004." The notice includes directives for states to complete a plan for this adoption by the end of 2001. If states had not met this obligation by the end of 2004, EPA proposed to promulgate protective nutrient criteria in those states/tribes.

Division of Water Quality (DWQ) staff initiated meetings to determine the applicability and utility of the published federal ecoregional documents and immediately questioned the science of the recommended concentrations for chlorophyll *a*, total phosphorus and total nitrogen. These concerns were expressed by NC and other states to US EPA regional and national staff. The US EPA recognized the problems associated with the short compliance timelines and in November 2001 issued a memorandum known as the 'Grubbs memo'[4] that clarified the requirements for states to derive an EPA "*mutually agreed upon*" "*plan of action*" by 2004 with the intended purpose to reduce nutrients. The guidance noted that if a state had developed a plan of action or initiated its administrative process to adopt nutrient criteria by the end of 2004, EPA would conclude that a federal promulgation of rules was not appropriate.

2002 - 2004

From early 2002 through June 1, 2004, DWQ staff drafted the 'North Carolina Nutrient Criteria Implementation Plan' (NCIP) to accomplish the federal mandate of developing a *"plan of action"* for submission to the EPA Region IV. The US EPA Region IV provided a *"mutual agreement"* letter approving North Carolina's initial plan on September 4, 2004. This submittal included anticipated timelines for development of nutrient related actions, an overview of the State's nutrient management strategies and a data inventory summary for NC lakes and reservoirs. The first NCIP for NC was finalized in September 2004.

[4] http://water.epa.gov/scitech/swguidance/standards/criteria/nutrients/upload/nutrient_2001_Grubbs_Memo.pdf

2005 - 2006

In October 2005 the DWQ staff informed the EMC about the Triennial Review of water quality standards and the relationship of the proposed chlorophyll *a* standards and the NCIP.

On October 25, 2005, the passage of NC General Assembly Session Law 2005-190 pertaining to the protection of drinking water supply reservoirs created significant demands on staff resources. DWQ revised the NCIP in October 2005 to extend the milestone timelines and requested that the updated plan become the mutually agreed upon plan. This request was made in accordance with the Grubbs memo and timelines were adjusted to meet both the needs of SL 2005-190 and the Federal Register 2001 requirements. The US EPA Region IV agreed with the request in July 2006.

2007

The US EPA continued to stress the importance of taking appropriate actions and on May 25, 2007, Benjamin Grumbles, Assistant Administrator, US EPA issued a 'Memorandum on Nutrients'[5], which further encouraged states to "accelerate" adoption of nitrogen and phosphorus (as causal variables), and chlorophyll *a* and transparency (as response variables) into states' water quality standards. North Carolina responded to this memo by submitting clarifying information to explain our proactive nutrient management approach.

2008 - 2009

In accordance with the proposed NCIP timelines, the DWQ began the more formalized stakeholder process by presenting to the Environmental Management Commission (EMC) in November 2008 an information item on the NCIP, including a state-wide approach to address nutrients, planned rule revisions and proposed rules for technology based nitrogen and phosphorus controls.

Beginning in January 2009, stakeholder groups and EMC information items provided the public and the EMC with:

1. Proposals to change water quality standards, including chlorophyll *a*,
2. Overviews of the proactive nutrient management approach which included chlorophyll *a* thresholds levels derived from the NCIP,
3. Water bodies identified through the NCIP investigations that would likely be affected by any proposed changes to water quality standards or to regulations pertaining to point and nonpoint source control.

The proposed thresholds and proactive strategies were not water quality standards and were not subject to EPA approval. They were, however, a result of the mutual agreement with the

[5] (http://portal.ncdenr.org/c/document_library/get_file?folderId=521753&name=DLFE-13932.pdf)

EPA for actions to be undertaken to achieve stronger controls on nutrients as directed by the January 2001 Federal Register notice and subsequent memorandums. The review of the chlorophyll *a* standards was required under the CWA Triennial Review process and the NCIP mutual agreement.

In November 2009, DWQ submitted a request to EPA Region IV staff to further extend NCIP timelines for adopting revised chlorophyll *a* standards and the establishment of chlorophyll *a* threshold rules with their associated management strategies. These revisions to the timelines provide additional time for the administrative rule making process. Approval of this timeline modification has not been granted, so 'mutual agreement' has not been re-established.

DWQ continued to pursue proposed changes to the chlorophyll *a* water quality standards (15A NCAC 2B .0200) in conjunction with proposed chlorophyll *a* threshold rules (15A NCAC 2B.0600) and presented these proposals in November 2009 to the EMC. Commission members requested that additional stakeholder meetings occur on the proposed chlorophyll *a* threshold regulations before moving forward.

2010

Planning staff requested and obtained permission to proceed with changes to water quality standards in 15A NCAC 2B .0200, which included the modifications to the existing chlorophyll *a* standards. In accordance with the NCIP proposals, these draft rules included a regionally specific chlorophyll *a* standard for the mountains and upper Piedmont. Permission was granted by the EMC in March 2010 to take the rule package to public hearing. This package did not include the proposed nutrient chlorophyll *a* threshold rules. As part of the rule-making process, the state began to document the potential fiscal impacts of the proposals. That process is still underway.

Separately, the EMC requested that additional meetings be held regarding the proposed nutrient chlorophyll *a* threshold rules. Two meetings were held in October 2010 to gain insight from a number of interested parties, including representatives of the League of Municipalities, Home Builders Association, Association of County Commissioners, North Carolina Conservation Network and agricultural interest groups. As a result of these meetings, staff presented additional revisions and modifications of the nutrient chlorophyll *a* threshold regulations to the EMC. The EMC did not approve the proposals to move forward and directed staff to address six specific areas of concern in greater detail:

1. Review alternatives to threshold rules and indicators/criteria for determining eutrophication
2. Develop a clearer statement of the underlying science in the form of a white paper or other form
3. Provide more detailed review of costs and cost savings
4. Consider basing the threshold on something other than chlorophyll *a*
5. Consider other indicators of trending or change
6. Increase education on nutrient over-enrichment

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2011

To more closely consider the EMC's concerns, the DWQ proposed holding a public scientific nutrient forum to obtain relevant knowledge as to the environmental and economic impact of implementation of proactive management of nutrients. The EMC agreed with the plan and subsequently, the DWQ and the EMC hosted 'The North Carolina Forum on Nutrient Over-Enrichment' (Forum)[6] in May 2012.

In March 2011, the US EPA issued an additional memorandum to states "Working in Partnership with States to Address Phosphorus and Nitrogen Pollution through Use of a Framework for State Nutrient Reductions", (Nancy Stoner, Acting Assistant Administrator). The memorandum reaffirmed EPA's commitment to make greater progress in accelerating the reduction of nitrogen and phosphorus loadings to the nation's waters. The memorandum indicated eight principals that are guiding and that have guided the US EPA in working with states to achieve near-term reductions in nutrient loadings. DWQ concurred with several elements of the memorandum particularly that states need to provide leadership in addressing nutrients and that there must be room to innovate and respond to local situations.

2012 to Present

The North Carolina Forum on Nutrient Over-Enrichment' was conducted in May 2012. This forum provided attendees with a review of the relevant science, regulatory issues, economic considerations, and other policy issues related to nutrient over-enrichment and options for avoiding water body impairments.

Recognized experts presented their ideas and experience with nutrient issues to a Forum panel (consisting of two EMC members, one representative of local government and one environmental advocacy group representative) and the Forum's attendees. The Division is maintaining a website that provides information from the Forum as well as other nutrient related activities.[7]

In July 2012, DWQ staff and EMC Chairman Stephen Smith presented an information item to the EMC that summarized the materials presented at the Forum. DWQ was assigned the task of revisiting the original NCIP, taking into consideration the Nutrient Forum and additional stakeholder input.

The DWQ began work in October 2012 towards development of a revised NCDP. DWQ was guided by the Section 106 commitments, US EPA memorandums and federal register publications, knowledge gained from the Nutrient Forum, public input, national activities, and directives from the EMC. The goals were to identify, prioritize, and select the options that may

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[6] http://www.ncsu.edu/mckimmon/cpe/opd/NCFONOE/index.html

[7] http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria

work best for North Carolina. Specifically, to identify research project needs with specific questions to be answered, methods to be used and timelines and milestones to be met.

DWQ staff presented an update on the progress towards developing a revised NCDP at the November 2012 EMC meeting. The presentation informed the Commission about the state's federal water pollution control act obligations related to nutrients under the FY12 and FY13 Section 106 Workplans and its proposed path forward. Additionally, staff provided a timeline for submitting the proposed plan to US EPA staff for review by June 30, 2013.

The DWQ hosted three public meetings on development of the NCDP in early December 2012. The meetings were held at various locations across the state to encourage stakeholder participation. Each meeting provided background information and allowed for questions and comments. DWQ also accepted written comments from December 4, 2012 through February 4, 2013.

Written public comments were submitted by 20 individuals and 15 organizations. All comments can be reviewed on the following website: http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria.

Comments covered many topics including the following:

- Nineteen (19) of the individuals urged action to limit nutrients in discharges
- Public review of the draft plan before taking to the EMC
- Establishment of a criteria development advisory group (although suggestions varied from a larger stakeholder process to an expert technical advisory group)
- Site specific approach for establishing criteria (comments for and against)
- Establishment of criteria for streams and rivers (comments for and against)
- Establishment of criteria for response variables in conjunction with nitrogen and phosphorus
- Establishment of criteria for response variables only
- Establishment of numeric criteria for nitrogen and phosphorus
- Inclusion of cost benefit analysis as part of the criteria development process
  Suggestions for specific locations/watersheds to focus on for criteria development

After considering the comments received from stakeholders regarding the general NCDP process, a draft NCDP was completed by DWQ. This draft was released for public comment on April 17, 2013. The comment period was open until May 24, 2013. Comments were received from 20 individuals and organizations and incorporated into the draft NCDP where applicable. Comments can be found in their entirety on the following website: http://portal.ncdenr.org/web/wq/ps/mtu/nutrientcriteria.

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