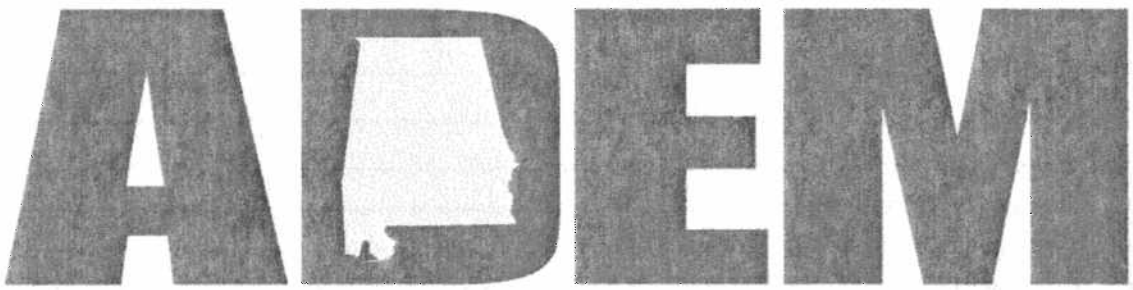

NUTRIENT CRITERIA IMPLEMENTATION PLAN

STATE OF ALABAMA

Alabama Department of Environmental Management
September 2007

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1.0 Introduction

Nutrients serve a very important role in our environment. They provide the essential building blocks necessary for growth and development of healthy aquatic ecosystems. However, if not properly managed, nutrients in excessive amounts can have detrimental effects on human health and the environment, creating such water quality problems as excessive growth of macrophytes and phytoplankton, harmful algal blooms, dissolved oxygen depletion, and imbalance of flora and fauna. Based on water quality reports to Congress, nutrient over-enrichment has been identified as one of the leading causes of designated use impairments to surface waters throughout the Nation. According to the 2000 305(b) Report to Congress, excess levels of nutrients were the second leading cause of impairments to all surface waters of the United States. In the same reporting period, nutrients accounted for 30% of Alabama's impaired rivers and streams and were the leading cause of impairment (44%) to the state's lakes and reservoirs.

The Alabama Department of Environmental Management (ADEM) has prepared this plan to serve as a roadmap for development and implementation of nutrient criteria for surface waters of Alabama. Additionally, the purpose of this document is to provide ADEM, EPA, interested stakeholders, and the public with an understanding of the methodologies, processes, and schedules that the Department intends to employ to effectively manage issues relating to nutrient enrichment of waters within Alabama. The plan will be updated as progress is made and as methodologies and schedules change.

2.0 Overview of Alabama's Nutrient Criteria Strategy

Water resources of Alabama are both abundant and diverse. Types of waterbodies include coastal and estuarine waters, extensive wetlands, abundant rivers and streams, a vast network of reservoirs and even some natural lakes. These waterbodies are contained within 14 major river basins and 25 different sub-ecoregions representing some of the most biologically diverse aquatic ecosystems in the United States.

Due to the complex nature of nutrients within each of these waterbody types, it is imperative to classify such waters in a manner that will allow for effective evaluation and management of issues associated with nutrient criteria development and implementation. ADEM's approach is to divide all waters of the State into four major waterbody types as follows.

1. Lakes and Reservoirs
2. Rivers and Streams
3. Estuarine and Coastal Marine Waters
4. Wetlands

The above waterbody-type classification system is based on the approach EPA uses in its National Nutrient Strategy[1]. The Department realizes that each of these four waterbody types will require different approaches and strategies in regards to nutrient criteria development and implementation; thus, this implementation plan has been structured to address each waterbody-type on an individual basis. It is also recognized that each of the four waterbody types may be further subdivided to better understand and evaluate the effects of nutrient enrichment.

[1] National Strategy for the Development of Regional Nutrient Criteria, USEPA-June 1998.

3.0 Lakes and Reservoirs

3.1 Goals of Nutrient Program

ADEM's primary goals for developing and adopting nutrient criteria for Alabama's lakes and reservoirs are consistent with the Clean Water Act and EPA's National Nutrient Strategy. These goals are as follows:

1) Develop and adopt nutrient criteria that support the beneficial uses designated for each lake and reservoir and that protect these waters from potential adverse effects associated with over-enrichment.
2) Restore and maintain the chemical, physical, and biological integrity of each lake and reservoir.
3) Maintain the diversity and uniqueness of Alabama's lakes and reservoirs.

3.2 Conceptual Approach to Nutrient Criteria Development

In developing nutrient criteria, the Department's objective is to determine nutrient levels that are protective of the beneficial uses designated for each reservoir. Keeping in mind that these reservoirs serve a variety of uses, including swimming and recreation, sport-fishing, and public water supply, while also supporting a wide diversity of aquatic life, nutrient criteria are targeted that support the designated uses and are protective of aquatic communities. Thus, the Department's rationale is to establish nutrient criteria consistent with the "fishable/swimmable" goal of the Clean Water Act.

Located within 14 major river basins and 25 different sub-ecoregions, Alabama's surface waters represent some of the most biologically diverse aquatic ecosystems in the United States. Because of the large diversity in geographic and climatic conditions from one region to another, as well as the significant variability in dam operations between reservoirs, the Department used best professional judgment to develop nutrient criteria on a lake-specific basis rather than on a more aggregate basis such as an ecoregional approach. The lake-specific approach captures the large variability inherent in man-made reservoirs, where chlorophyll a concentrations are typically affected by such factors as reservoir depth, reservoir retention time, and scheduling of power generation.

During the criteria development process, historical data were studied to provide an overall perspective of the condition of each reservoir. This information was analyzed to determine trends in trophic conditions, the degree to which reservoir conditions remained stable over time, and whether any impairment has occurred due to nutrient over-enrichment. From this data, nutrient levels (expressed as seasonal means of chlorophyll a concentrations) were targeted that correlate with reservoir conditions that support the designated beneficial uses. The historical data depicts the diversity of reservoir conditions in Alabama, from lakes in the Tallapoosa River Basin that are naturally oligotrophic-mesotrophic, such as lakes Martin, Yates and Thurlow, to lakes that tend to be more eutrophic in nature, such as the mainstem reservoirs on the Tennessee and Coosa Rivers.

The Department recognizes that using reference condition analysis to establish nutrient criteria in reservoirs can be limited due to the fact that there is uncertainty regarding what constitutes "natural" conditions in a man-made water body. Therefore, in developing nutrient criteria, the Department has selected to analyze historical ambient data on an individual reservoir basis to determine if each reservoir continues to support its designated uses. If so, the nutrient concentrations that have historically corresponded to that reservoir's use support are evaluated to determine a chlorophyll a target specific to that reservoir. This same approach is used regardless of the reservoir's trophic state (i.e. eutrophic, oligotrophic, or mesotrophic). Thus, the intent is that the selected chlorophyll a criteria values are specifically associated with a condition of full use support in each respective reservoir, taking into account the factors unique to various trophic conditions.

Nutrient criteria were developed to support the existing uses that define each reservoir system and protect the aquatic communities that inhabit them. Data were analyzed to determine the ranges of chlorophyll a and total phosphorus concentrations historically occurring in each reservoir. To maintain nutrient levels within the ranges associated with full use-support conditions, best professional judgment was used to derive criteria values that "cap" each reservoir system with a protective chlorophyll a concentration. In establishing chlorophyll a targets, the variability occurring within the growing season was taken into account. The cooler months are generally less productive and lower chlorophyll a values are usually recorded while the warmer months are generally more productive with higher values typically recorded.

To determine what constitutes healthy conditions in various types of reservoirs and how trophic gradients relate to use attainment, the Department utilizes research conducted by Dr. David Bayne at Auburn University. This research examines how the quality of fisheries correlates to varying trophic conditions in Alabama reservoirs. The study assesses the potential impacts of reverse eutrophication and nutrient reduction on reservoir fisheries and calculates target levels of primary production that provide both quality fishing and satisfactory water clarity for other recreational users, while protecting all aquatic communities. This research ("Compatibility between Water Clarity and Quality Black Bass and Crappie Fisheries in Alabama"; American Fisheries Society Symposium 16:296-305. 1996) provides substantial evidence that fish biomass and sport-fish harvesting are positively correlated to algal production in reservoirs.

The research by Dr. Bayne demonstrates that the size, growth rates and condition of certain species of sports fish are generally higher in eutrophic than in oligo-mesotrophic reservoirs. This study, along with case studies of reservoirs in other regions, raises the concern that the reversal of eutrophication and improvement in water clarity in some reservoirs can be deleterious to its warm-water sports fisheries by reducing fish production and biomass. The Department, therefore, believes that when establishing nutrient criteria it is vital to set water quality standards that adequately consider all the beneficial uses of the reservoir, fishing and swimming alike. Thus, caution is warranted when regulatory actions can potentially result in an undesirable shift in fish species. If, historically, a reservoir has supported all of its uses, including high-quality fisheries and other aquatic communities, nutrient criteria were targeted to preserve these reservoir conditions.

The typical hydraulic regime and flow characteristics of each reservoir were other key factors considered during criteria development. The relationship between water quality, biomass accumulation, and hydraulic residence time (or retention time), which is the average amount of time required to completely renew a reservoir's water volume, was taken into account when

establishing the chlorophyll a criteria. For example, reservoirs associated with "run-of-the-river" dams typically have small hydraulic head, limited storage area and short retention times and are less likely to be susceptible to conditions that can lead to eutrophication or promote excessive algal growth. In contrast, reservoirs associated with larger dams, such as storage or hydroelectric dams, are more likely to have longer retention times, providing a greater potential for incoming nutrients to stimulate increased algal production. Increased algal biomass can potentially deplete dissolved oxygen levels within the reservoir through bacterial decomposition and photosynthetic respiration.

The relationship between reservoir water retention times and phytoplankton algae production was examined in a study by Dr. Bayne on Weiss Lake during the summer of 2001. Dr. Bayne, along with Auburn University professor Dr. Mike Maceina, assessed the potential water quality effects on Weiss Lake of the draft Coosa River water-sharing agreement between Alabama and Georgia. Their study showed that reservoirs with typically short retention times, such as reservoirs on the Coosa River, are more susceptible to hypereutrohic effects and higher chlorophyll a concentrations when retention times are increased even moderately. Historical data shows that higher chlorophyll a concentrations in Weiss Lake have consistently corresponded to longer retention times. Hydrologic models in their study indicated that longer retention times in the reservoir would likely increase phytoplankton algae production and algal biomass accumulation, assuming that other factors remain unchanged. This result is particularly evident during drought periods, such as occurred in 2000 and in 2006.

Also, the nutrient criteria were developed to reflect downstream transport of nutrients and the processes by which nutrient uptake occurs in streams. Nutrient concentrations generally tend to decrease as they move downstream. This attenuation occurs as nutrients are absorbed by micro-organisms and plants (biotic uptake) or as they adsorb onto sediment particles (abiotic uptake) and settle out of the water column. Thus, in developing nutrient criteria, the chlorophyll a targets were set so that along certain stretches of river, each successive reservoir has a lower criteria value as you move downstream. This approach takes into account natural processes that determine nutrient concentrations and is protective of downstream water quality.

3.3 Chlorophyll a

The Department has elected to use chlorophyll a as the primary indicator of cultural eutrophication. (The term "cultural eutrophication" is used to differentiate between over-enrichment caused by human activities and natural nutrient loading from soils and parent materials indigenous to each watershed.) Chlorophyll a criteria serve as the primary tool used by the Department to protect the designated uses of lakes and reservoirs from nutrient over-enrichment. These criteria are used to assess reservoir conditions (i.e. trophic state) and to determine use-support status (i.e. 303(d) listing and 305(b) reporting). The chlorophyll a criteria are also used as water quality targets necessary for Total Maximum Daily Load (TMDL) development. For example, when a reservoir is determined to be nutrient-impaired, the pollutant load reductions (i.e. total phosphorus loads) necessary to achieve the lake-specific chlorophyll a criteria are determined through various modeling techniques. Chlorophyll a was selected as the candidate response variable because it is widely accepted among limnologists, scientists, and federal/state agencies as an effective surrogate for estimating the primary production response to nutrient loading. Chlorophyll a is also relatively easy and inexpensive to collect and analyze.

The chlorophyll a criteria are established on a growing-season basis, which is defined as April through October for all reservoirs with the exception of the mainstem reservoirs in the

Tennessee River basin. These reservoirs have a defined growing season of April through September. The chlorophyll a criteria are represented as the mean of samples (taken as photic-zone composites) collected monthly during the growing season. Criteria for each reservoir were selected using historical data and best professional judgment, recognizing the seasonal variations that occur.

The numeric chlorophyll a criteria are selected to protect the designated uses in the majority of the reservoir but are typically established at specific locations within each reservoir. For example, a criterion established at a location in a dam forebay is expected to be protective of all the forebay area and a significant portion of the main reservoir body upstream of the dam. The criteria values are not intended to be applied as lake-wide averages or as chlorophyll a concentrations that shall be maintained at all locations within the lake at any given time. When the Department believes it to be appropriate, criteria are established at additional stations upstream of the dam forebay to recognize changing limnological conditions and to provide protection of existing uses in the majority of the reservoir. Because of the non-uniform, complex nature of embayments and the fact they are directly interrelated with tributaries, it is difficult to derive a single criterion value that is protective of an entire reservoir including its embayments. A "one size fits all" approach truly oversimplifies the complex nature of these reservoir systems and is not the preferred method of protecting designated uses. To address this complexity, the Department intends to continue embayment sampling as a part of the Reservoir Monitoring Program. Information obtained will be evaluated to determine the degree to which nutrients may be affecting designated use support and, where appropriate (i.e. where designated uses are threatened or impaired), criteria may be established to protect those designated uses. Until numeric criteria are developed for embayments, they remain addressed by the Department's narrative criteria.

At the present time, the Department does not believe it is necessary to develop numeric criteria for other nutrient indicators such as total phosphorus (TP), total nitrogen (TN), or Secchi depth. However, these and many other parameters have and will continue to be routinely monitored as part of the Department's Reservoir Monitoring Program. The significance of these variables and their relation to nutrient loading will continually be evaluated as new data is collected. While chlorophyll a provides a reliable depiction of primary production levels and thus gives a fairly accurate assessment of nutrient conditions in a waterbody, it is uncertain how effective the other parameters are in assessing nutrient over-enrichment. For example, because there is such variability in how each waterbody responds to nutrient loading, it is difficult to determine what concentrations of TP and TN correlate to undesirable levels of primary production. Also, establishing meaningful relationships between causal and response variables is often problematic. Low concentrations of TP, for example, can correlate to both low and high phytoplankton biomass levels; the latter occurring when originally high TP (this would only occur with dissolved phosphorus) concentrations are significantly reduced as excessive nutrients are assimilated within the growing phytoplankton biomass. Algal Growth Potential Tests (AGPT) are conducted on each reservoir to determine if the limiting nutrient is phosphorus, nitrogen, or a combination of both. The Department continues to measure TP and TN concentrations as a part of its routine reservoir monitoring program and has compiled the information in spreadsheets. Data collected through 2006 has not revealed significant relationships between growing season average chlorophyll a concentrations and mean TP or TN concentrations.

Establishing meaningful relationships between chlorophyll a and Secchi depth is also problematic. Poor water clarity can result from a number of causes other than nutrient over-

enrichment. A low Secchi-depth measurement might be caused by abiogenic turbidity consisting of suspended non-algal particulate matter such as clay. The Department will continue to examine linkages between chlorophyll a and other nutrient parameters as more data is collected. Also, because the relationships between nutrient impairment and chlorophyll a levels are not always well understood, it may be necessary to revise the criteria as additional water quality data and improved assessment tools (water quality models) become available.

3.4 Use Support Determination

The chlorophyll a criteria provide an effective decision-making tool for resource management and planning. Based on seasonal means of chlorophyll a concentrations, the Department will determine if reservoir conditions are supportive of designated uses or if the reservoir is impaired due to nutrient over-enrichment and should be added to Alabama's 303(d) list of impaired waters. The same criteria will be used to determine when remediation of an impaired water body has achieved water quality standards.

The Department will continue to monitor all of the state's major reservoirs on a routine basis through its Rivers and Reservoirs Water Quality Monitoring (RRMP) Program. While reservoir sampling will be most intense in the river basins that are the focus of the rotational monitoring, all reservoirs are expected to be sampled at least once per year at a minimum as part of the RRMP Program. These once per year samples will be used in the long-term trend analysis to distinguish increasing or decreasing trends.

Because chlorophyll a is a response variable influenced by a wide variety of factors, the Department may rely on examination of multiple growing seasons when assessing compliance with the established criteria. A reservoir or portion of a reservoir will be considered to have a nutrient impairment when a growing season mean criterion has been exceeded in two consecutive years or three times during the previous six years. In making this determination, chlorophyll a values in excess of the criterion which are due to extreme hydrologic events (i.e., droughts and floods) may not be considered as an exceedance of the criterion. Extreme hydrologic events do not include significant changes to reservoir operation. For Alabama's large hydropower reservoirs, such changes would require a modification of the operating license issued by the Federal Energy Regulatory Commission and would be subject to review and water quality certification by this Department. One exceedance of the chlorophyll a criterion may be sufficient justification for inclusion of a water in Category 5 of the Integrated Water Quality Report when the exceedance is determined to be the result of increasing nutrient loading from anthropogenic sources. In any case, when a growing season mean chlorophyll a value exceeds the criterion, the reservoir will be identified for re-sampling the following year and enough samples will be collected to ensure that the minimum data requirements necessary to calculate a growing season mean are met. The assessment of chlorophyll a data for reservoirs will be consistent with the procedures described in Alabama's Water Quality Assessment and Listing Methodology, which received public review and comment prior to being finalized in December 2005.

When a reservoir is determined to be nutrient-impaired in accordance with the assessment and listing methodology, the Department will gather the data and information necessary to evaluate the potential causes and sources of the impairment, consistent with the TMDL development schedule. Assessment tools, including hydrologic and water quality modeling, will be utilized to assess the cause and effect relationships leading to the water quality standards

violation and to determine the nutrient loads necessary for the water body to fully support its designated uses.

3.5 Designated Uses of Alabama's Publicly Owned Lakes/Reservoirs

The use classifications (designated uses) utilized by the State for all surface waters of Alabama are as follows:

(1) Outstanding Alabama Water (OAW)
(2) Public Water Supply (PWS)
(3) Swimming and Other Whole Body Water-Contact Sports (S)
(4) Shellfish Harvesting (SH)
(5) Fish and Wildlife (F&W)
(6) Limited Warmwater Fishery (LWF)
(7) Agricultural and Industrial Water Supply (A&I)

As shown in Table 3-1 below, the designated use(s) of Alabama's publicly-owned lakes and reservoirs primarily consist of one or more of the three following uses; Public Water Supply, Swimming and Other Whole Body Water-Contact Sports, and Fish and Wildlife. All three of these uses are considered "fishable/swimmable" uses as defined by Section 101(a) of the Clean Water Act. Currently, all lakes and reservoirs within Alabama are classified as Fish and Wildlife or higher. According to Alabama's 2006 303(d) list, there are 8 reservoirs impaired for nutrients, totaling 86,428 acres of the 480,000 publicly-owned lake acres within Alabama. This represents approximately 18% of total lake acres currently impaired due to nutrient over-enrichment.

Table 3-1: Designated Uses of Alabama's Publicly Owned Lakes and Reservoirs.

Reservoir Name	Major River Basin	Designated Use(s)	Size (acres)	Impaired for Nutrients?
Claiborne	Alabama	S, F&W	5,930	no
Dannelly	Alabama	S, F&W	17,200	no
Woodruff	Alabama	S, F&W	12,510	no
Purdy	Cahaba	PWS, F&W	1,050	no
Walter F. George[1]	Chattahoochee	S, F&W	45,200	no
Harding[2]	Chattahoochee	PWS, S, F&W	5,850	no
West Point[3]	Chattahoochee	S, F&W	25,864	no
Jordan	Coosa	PWS, S, F&W	6,800	no
Mitchell	Coosa	PWS, S, F&W	5,850	yes[4]
Lay	Coosa	PWS, S, F&W	12,000	yes[4]
Logan Martin	Coosa	PWS, S, F&W	15,263	yes[4]
Neely Henry	Coosa	PWS, S, F&W	11,235	yes[4]
Weiss	Coosa	PWS, S, F&W	30,200	yes[5]
Big Creek	Escatawpa	PWS, F&W	3,600	no
Coffeeville	Lower Tombigbee	PWS, S, F&W	8,800	no
Demopolis	Lower Tombigbee	S, F&W	10,000	no
Point A	Perdido/Escambia (Conecuh Sub-basin)	S, F&W	900	no
Gantt	Perdido/Escambia (Conecuh Sub-basin)	F&W	2,767	no
Frank Jackson	Perdido/Escambia (Conecuh Sub-basin)	F&W	1,000	no
Jackson	Perdido/Escambia (Yellow Sub-basin)	S, F&W	350	no
Thurlow	Tallapoosa	PWS, S, F&W	585	no
Yates	Tallapoosa	PWS, S, F&W	1,980	yes (224 acres)[6]
Martin	Tallapoosa	PWS, S, F&W	40,000	no
Harris	Tallapoosa	PWS, S, F&W	10,660	no
Pickwick[7]	Tennessee	PWS, S, F&W	43,100	no
Wilson	Tennessee	PWS, S, F&W	15,930	no
Wheeler	Tennessee	PWS, S, F&W	67,100	no
Guntersville[8]	Tennessee	PWS, S, F&W	69,700	no

[1] W.F. George Lake has a surface area of 45,200 acres at full pool, of which 18,672 acres are within Alabama.
[2] Lake Harding has a surface area of 5,850 acres at full pool, of which 2,180 acres are within Alabama.
[3] West Point Lake has a surface area of 25,864 acres at full pool, of which 2,765 acres are within Alabama.
[4] Draft TMDL completed.
[5] Final TMDL is being revised.
[6] Draft TMDL completed.
[7] Pickwick Lake has a surface area of 43,100 acres at full pool, of which 33,700 acres are within Alabama.
[8] Guntersville Lake has a surface area of 69,700 acres at full pool, of which 67,900 acres are within Alabama.

Table 3-1 cont'd: Designated Uses of Alabama's Publicly Owned Lakes and Reservoirs.

Reservoir Name	Major River Basin	Designated Use(s)	Size (acres)	Impaired for Nutrients?
Bear Creek	Tennessee	PWS, S, F&W	670	no
Upper Bear Creek	Tennessee	PWS, S, F&W	2,100	no
Cedar Creek	Tennessee	PWS, S, F&W	4,200	no
Little Bear Creek	Tennessee	PWS, S, F&W	1,600	yes
Gainesville	Upper Tombigbee	S, F&W	6,400	no
Aliceville	Upper Tombigbee	S, F&W	8,300	yes
Warrior	Warrior	F&W	7,800	no
Oliver	Warrior	S, F&W	800	no
Holt	Warrior	S, F&W	3,296	no
Bankhead	Warrior	PWS, S, F&W	9,200	no
Tuscaloosa	Warrior	PWS, S, F&W	5,885	no
Lewis Smith	Warrior	PWS, S, F&W	21,200	no
Inland	Warrior	PWS, S	1,095	no

As stated earlier, the Department's major goal in developing nutrient criteria for lakes is to protect designated uses while maintaining the physical, chemical, and biological integrity that defines each of these systems.

3.6 Water Quality Data

Water quality data used to establish numeric nutrient criteria will primarily come from ADEM as part of the Reservoir Water Quality Monitoring Program and by the Tennessee Valley Authority (TVA) as part of its Vital Signs Monitoring Program. Additional data resources include Auburn University, EPA Region 4, and Alabama Water Watch.

3.61 ADEM's Reservoir Water Quality Monitoring (RWQM) Program

In 1985, the need for information on the trophic state of Alabama's publicly owned lakes led to an initial survey conducted by ADEM with the assistance of EPA Region 4. The survey established limited baseline information on the lakes and was used to rank them according to trophic condition. In 1989, ADEM conducted water quality assessments of 34 publicly owned lakes in the state and submitted the collected information as part of the 1990 305(b) Water Quality Report to Congress (ADEM 1989). Trophic state index (TSI) values calculated from this data indicated potentially significant increases when compared to TSI values from the study conducted in 1985.

In 1990, the Reservoir Water Quality Monitoring (RWQM) Program was initiated by the Special Studies Section of the Field Operations Division of ADEM. Objectives of the RWQM Program are as follows:

a) Develop an adequate water quality database for all publicly-owned lakes in the state.

b) Establish trends in lake trophic status that can only be established through long-term monitoring efforts.

c) Satisfy the requirement of Section 314 of the Clean Water Act which requires states to conduct water quality assessments of publicly-owned lakes and report the findings as part of their biennial Water Quality Report to Congress.

Thirty-one publicly owned lakes in the state were monitored at least once during the three-year period of 1990-1992. In 1991, additional funding received through the Clean Lakes Program enabled the expansion of the RWQM Program to include all publicly owned lakes in the state, with the exception of those in the Tennessee River Basin (see TVA Program). Expansion of the program allowed more extensive monitoring of certain lakes and included Alabama/Georgia border lakes. Beginning in 1994, the frequency of reservoir monitoring in the RWQM Program was increased to a minimum of once every two years so that the water quality database and trends in trophic status could be developed more rapidly. In 1997, intensive monitoring of reservoirs using a basin rotation approach was initiated with Coosa and Tallapoosa reservoirs. Intensive monitoring consists of monthly sampling of mainstem and tributary embayment sites during the algal growing season (April through October). Basins sampled to date are as follows:

a) 1997 – Coosa and Tallapoosa River basins

b) 1998 – Warrior River basin

c) 1999 – Chattahoochee and Conecuh River basins

d) 2000 – Coosa, Tallapoosa, Alabama River basins

e) 2001 – Escatawpa, Tombigbee River basins

f) 2002 – Warrior and Cahaba River basins

g) 2003 – Tennessee River basin

h) 2004 – Chattahoochee, Chipola, Choctawhatchee, Perdido, Escambia River basins

i) 2005 – Coosa, Tallapoosa, Alabama River basins

j) 2006 – Escatawpa, Mobile, Tombigbee River basins

k) 2007 – Warrior and Cahaba River basins

Table 3-2: Water quality variables collected as part of ADEM's RWQM Program.

Variable	Method	Reference	Detection Limit
Physical			
Vertical illumination	Photometer, Secchi disk	Lind, 1979	---
Temperature	Thermistor	APHA et al. 1992	---
Turbidity	Nephelometer	APHA et al. 1992	---
Total dissolved solids	Filtration, drying	EPA-600/4-79-020	1 mg/l
Total suspended solids	Filtration, drying	EPA-600/4-79-020	1 mg/l
Specific conductance	Wheatstone bridge	APHA et al. 1992	---
Hardness	Titrametric, EDTA	EPA-600/4-79-020	1 mg/l
Alkalinity	Potentiometric titration	EPA-600/4-79-020	1 mg/l
Chemical			
Dissolved oxygen	Membrane electrode	APHA et al. 1992	---
pH	Glass electrode	APHA et al. 1992	---
Ammonia	Automated phenate	EPA-600/4-79-020	0.015 mg/l
Nitrate + Nitrite	Cadmium reduction	EPA-600/4-79-020	0.003 mg/l
Total Kjeldahl Nitrogen	Automated colorimetric	EPA-600/4-79-020	0.15 mg/l
Soluble reactive phosphorus	Automated single reagent	EPA-600/4-79-020	0.004 mg/l
Total phosphorus	Persulfate digestion	EPA-600/4-79-020	0.004 mg/l
Total organic carbon	Persulfate-ultraviolet	EPA-600/4-79-020	0.50 mg/l
Biological			
Chlorophyll a	Spectrophotometric	APHA et al. 1992	0.1
Algal growth potential test	Printz Algal Assay Test	ADEM 1993	---
Fecal coliform	Membrane filter	APHA et al. 1992	---

3.62 TVA Reservoir Vital Signs Monitoring Program

Water quality monitoring of reservoirs of the Tennessee River system is conducted by the Tennessee Valley Authority (TVA) through its Reservoir Vital Signs Monitoring Program. Objectives of the program are to provide basic information on the "health" or integrity of the aquatic ecosystem in each TVA reservoir and to provide screening level information for describing how well each reservoir meets the "fishable" and "swimmable" goals of the Clean Water Act. Sampling activities involve examination of appropriate physical, chemical, and biological indicators in the forebay, mid-region, and headwaters areas of each reservoir. Initiated in 1990, the TVA program provides results of monitoring activities to ADEM on an annual basis via Excel™ spreadsheets and its Vital Signs Monitoring Reports. Water quality variables collected by TVA are similar to those collected by ADEM.

3.63 Other Lake Data Resources

Auburn University-Department of Fisheries and Allied Aquacultures
EPA Region 4-Environmental Services Division
Alabama Power Company
U.S. Army Corps of Engineers
Alabama Water Watch

3.7 Prioritization of Nutrient Criteria Development for Lakes/Reservoirs

In an effort to protect Alabama reservoirs from nutrient over-enrichment, the Department intends to develop numeric nutrient criteria for 41 separate reservoirs by the end of 2011. Chlorophyll a criteria were established for Weiss Lake, West Point Lake, R.L. Harris Lake, and Walter F. George Lake in 2000 and the following nine reservoirs in 2002: Guntersville, Wheeler, Wilson, Pickwick, Little Bear Creek, and Cedar Creek in the Tennessee River Basin and Yates, Thurlow, and Lake Martin in the Tallapoosa River Basin. In 2004, the Department established chlorophyll a criteria for eleven reservoirs, including Claiborne and Dannelly in the Alabama River Basin; Harding in the Chattahoochee River Basin; Point A and Gantt in the Perdido/Escambia River Basin; and Warrior, Oliver, Holt, Tuscaloosa, Bankhead and Smith in the Warrior River Basin. In 2005, the Department adopted chlorophyll a criteria for Gainesville and Demopolis in the Upper Tombigbee River Basin; Coffeeville in the Lower Tombigbee River Basin; Lake Jackson in the Perdido-Escambia River Basin; and Inland Lake in the Black Warrior River Basin. In 2008, the Department expects to develop chlorophyll a criteria for 8 of Alabama's remaining 12 reservoirs (see Table 3-3). In 2009, a nutrient criterion for Lake Purdy is projected to be developed after completion of a water quality model currently under development for Lake Purdy and its watershed. Nutrient criteria for the remaining 3 reservoirs are expected by 2011.

These 41 reservoirs represent the most significant of the publicly owned reservoirs in the state of Alabama. The Department defines publicly owned lakes/reservoirs as those that are of a multiple-use nature, publicly accessible, and exhibit physical and chemical characteristics typical of impounded waters. Figure 3-1 on the following page depicts the 41 lakes and the corresponding Level IV Ecoregion in which they are located.

Together, these 41 reservoirs comprise a total of 480,000 acres in 11 of the 14 major river basins and represent a diverse range of trophic conditions as well as lake sizes. Figure 3-2 demonstrates the trophic diversity of Alabama's lakes. The largest of these lakes, Guntersville Reservoir, has a surface area of 66,365 acres and the smallest, Lake Jackson, has an area of 256 acres. These 41 reservoirs together represent approximately 80% of the reservoir surface waters in the state. The remaining lakes or reservoirs in Alabama are typically privately owned or are waterbodies maintained by the Alabama Department of Conservation and Natural Resources (ADCNR), many of which are maintained as fisheries and thus are fertilized periodically. The ADCNR manages 23 public lakes that range in size from 13 to 184 acres for a total of 1,912 surface acres in 20 counties. Some of the remaining reservoirs are smaller water supply reservoirs with limited public access. For these remaining reservoirs, it is likely that narrative criteria will be applied to support the designated uses.

Figure 3-1: Alabama's Publicly Owned Lakes within Level IV Ecoregion.

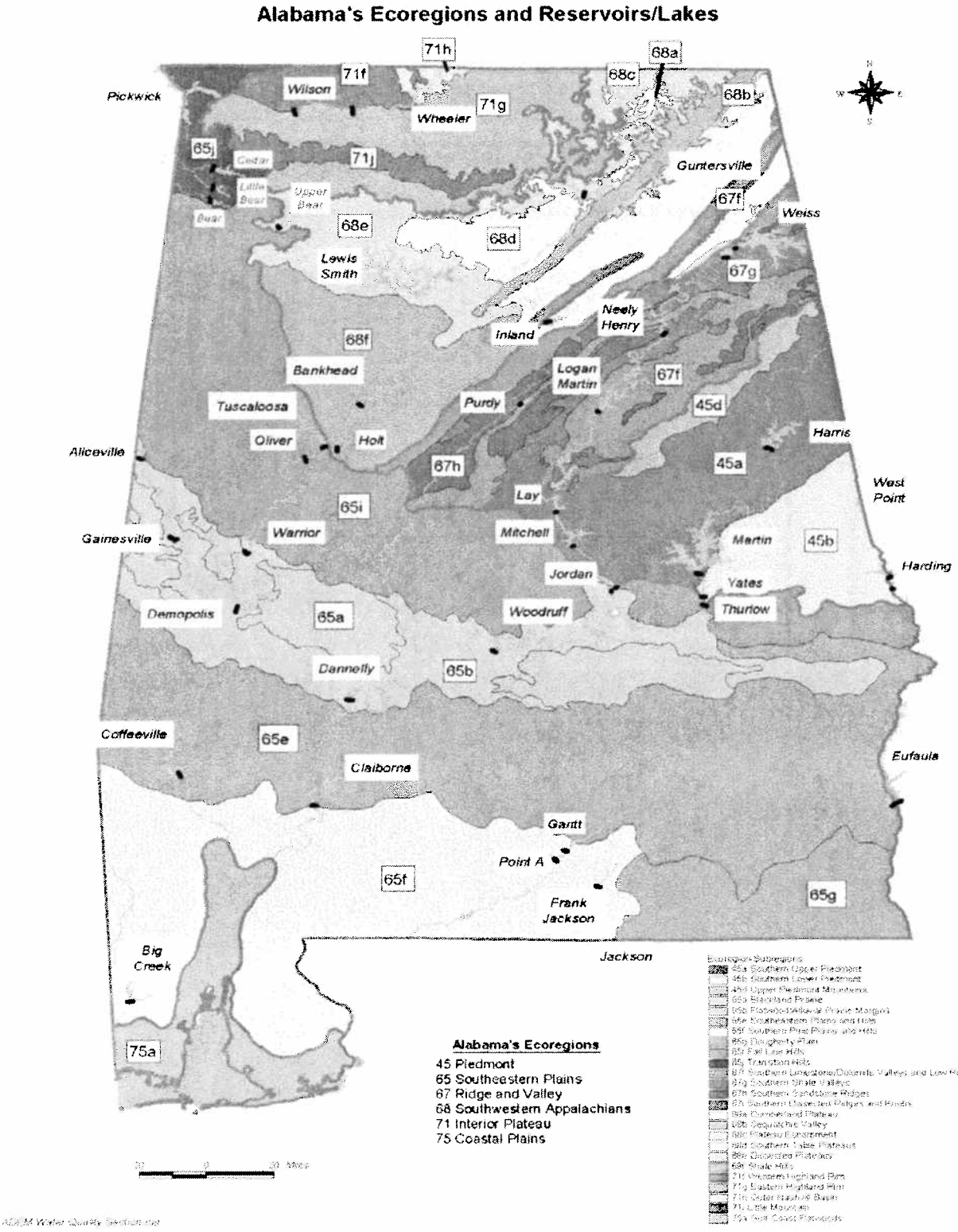
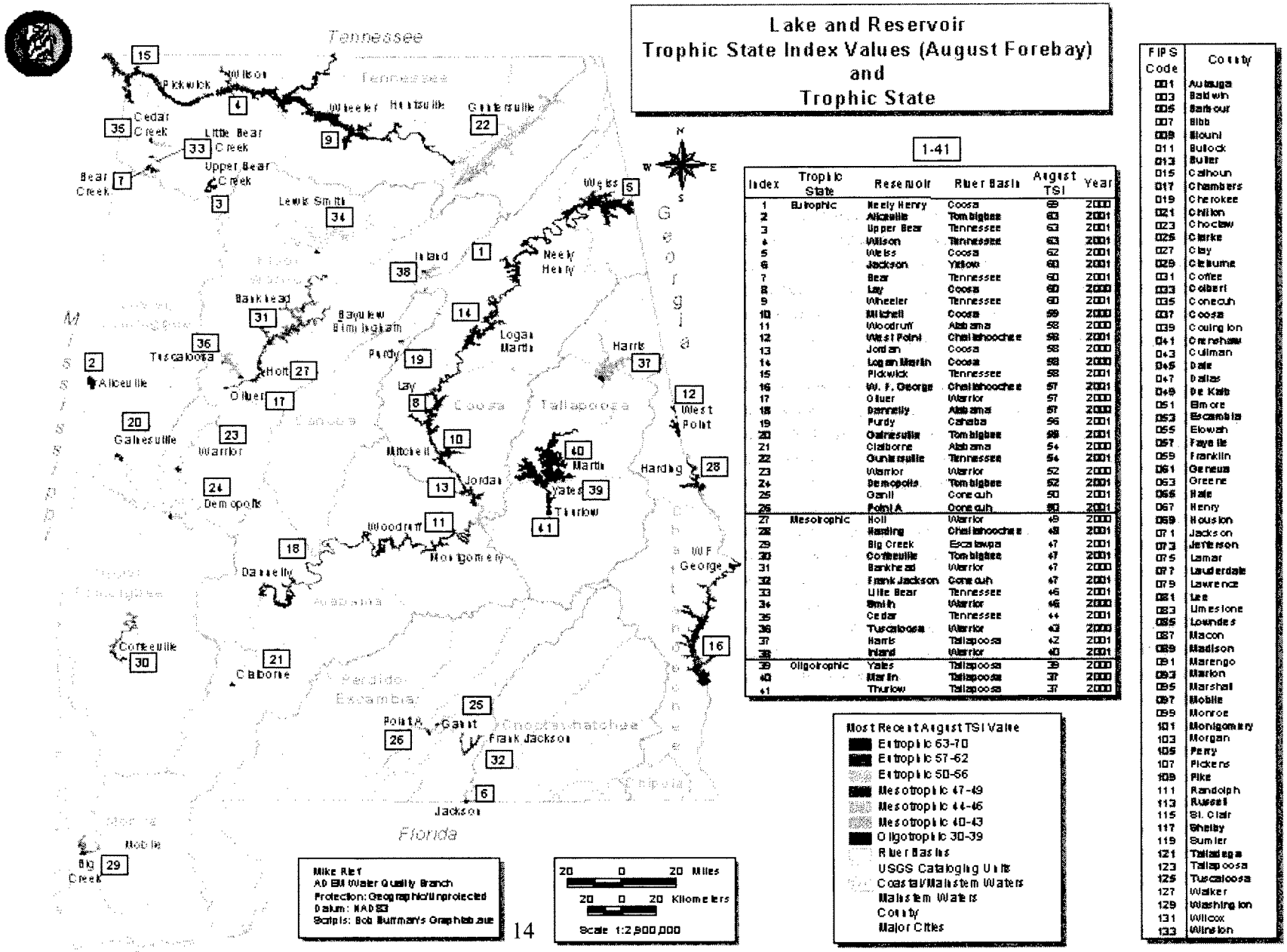


Figure 3-2: Trophic State Index of Alabama Lakes/Reservoirs



Index	Trophic State	Reservoir	River Basin	August TSI	Year
1	Eutrophic	Neely Henry	Coosa	69	2001
2		Aliceville	Tombigbee	63	2001
3		Upper Bear	Tennessee	63	2001
4		Wilson	Tennessee	63	2001
5		Weiss	Coosa	62	2001
6		Jackson	Yellow	60	2001
7		Bear	Tennessee	60	2001
8		Lay	Coosa	60	2000
9		Wheeler	Tennessee	60	2001
10		Mitchell	Coosa	59	2000
11		Woodruff	Alabama	58	2000
12		West Point	Chattahoochee	58	2001
13		Jordan	Coosa	58	2000
14		Logan Martin	Coosa	58	2000
15		Pickwick	Tennessee	58	2001
16		W. F. George	Chattahoochee	57	2001
17		Oliver	Warrior	57	2000
18		Demopolis	Alabama	57	2000
19		Purdy	Cahaba	56	2001
20		Gainesville	Tombigbee	55	2001
21		Claiborne	Alabama	54	2000
22		Guntersville	Tennessee	54	2001
23		Warrior	Warrior	52	2000
24		Demopolis	Tombigbee	52	2001
25		Ganlt	Conecuh	50	2001
26		Point A	Conecuh	50	2001
27	Mesotrophic	Holt	Warrior	49	2000
28		Harding	Chattahoochee	48	2001
29		Big Creek	Escatawpa	47	2001
30		Coffeeville	Tombigbee	47	2001
31		Bankhead	Warrior	47	2000
32		Frank Jackson	Conecuh	47	2001
33		Little Bear	Tennessee	46	2001
34		Smith	Warrior	46	2000
35		Cedar	Tennessee	44	2001
36		Tuscaloosa	Warrior	43	2000
37		Harris	Tallapoosa	42	2001
38		Inland	Warrior	40	2001
39	Oligotrophic	Yates	Tallapoosa	39	2000
40		Martin	Tallapoosa	37	2000
41		Thurlow	Tallapoosa	37	2000

FIPS Code	County
001	Autauga
003	Baldwin
005	Barbour
007	Bibb
009	Blount
011	Bullock
013	Butler
015	Calhoun
017	Chambers
019	Cherokee
021	Chilton
023	Choctaw
025	Clarke
027	Clay
029	Cleburne
031	Coffee
033	Colbert
035	Conecuh
037	Coosa
039	Covington
041	Crenshaw
043	Cullman
045	Dale
047	Dallas
049	De Kalb
051	Elmore
053	Escambia
055	Etowah
057	Fayette
059	Franklin
061	Geneva
063	Greene
065	Hale
067	Henry
069	Houston
071	Jackson
073	Jefferson
075	Lamar
077	Lauderdale
079	Lawrence
081	Lee
083	Limestone
085	Lowndes
087	Macon
089	Madison
091	Marengo
093	Marion
095	Marshall
097	Mobile
099	Monroe
101	Montgomery
103	Morgan
105	Perry
107	Pickens
109	Pike
111	Randolph
113	Russell
115	St. Clair
117	Shelby
119	Sumter
121	Talladega
123	Tallapoosa
125	Tuscaloosa
127	Walker
129	Washington
131	Wilcox
133	Winston

In developing numeric nutrient criteria, ADEM prioritized all lakes/reservoirs based on several factors such as public priority, available data, use-impairment status (i.e. 303(d) list), complexity of lake system, and modeling requirements. After careful consideration of these factors, the Department developed the schedule shown in Table 3-3. The schedule is primarily driven by the available water quality data for each lake and the timeframe it will take to gather additional data and complete development of water quality models where necessary.

Table 3-3: Nutrient Criteria Implementation Schedule for Lakes and Reservoirs

Year	Number of Reservoirs	Major Basin(s)	Name of Reservoirs
2001	4	Chattahoochee, Coosa, Tallapoosa	West Point, W.F. George, Weiss, R.L. Harris
2002	9	Tallapoosa, Tennessee	Martin, Yates, Thurlow, Guntersville, Wheeler, Wilson, Pickwick, Little Bear, Cedar
2004	11	Alabama Black Warrior Chattahoochee Perdido-Escambia	Claiborne, Dannelly Bankhead, Holt, Lewis Smith, Oliver, Tuscaloosa, Warrior Harding Gantt, Point A
2005	5	Black Warrior Perdido-Escambia Lower Tombigbee Upper Tombigbee	Inland Jackson Coffeeville Demopolis, Gainesville
2008	8	Alabama Coosa Escatawpa Upper Tombigbee	Woodruff Jordan, Lay, Logan Martin, Mitchell, Neely Henry Big Creek Aliceville
2009	1	Cahaba	Purdy
2010	1	Perdido-Escambia	Frank Jackson
2011	2	Tennessee Tennessee	Bear Creek Upper Bear

3.8 Public Participation and Peer Review Process

In general, public participation for nutrient criteria development is conducted as part of ADEM's rule revision/adoption process. This involves publishing notices, holding public hearings, and receiving comments from the public regarding the proposed changes to Administrative Rules.

In addition, the Department has formed a Lakes and Reservoirs Workgroup for the purpose of gathering input and peer review from people who have certain expertise and knowledge in limnology and other fields relating to nutrient criteria development. These stakeholders are typically from academia, federal agencies, and other state agencies of Alabama.

ADEM has dedicated time and staff to actively participate as a state member of the EPA Region 4-Regional Technical Advisory Workgroup (RTAG).

3.9 Timeline for Adoption of Nutrient Criteria

In 2008 ADEM expects to propose nutrient criteria in the form of chlorophyll a criteria for 8 of the State's remaining 12 reservoirs. Development of nutrient criterion for Lake Purdy is also scheduled in 2009. The Department expects to propose nutrient criteria for the remaining 3 reservoirs by 2011. The significant milestones in this process are described in the following table.

Table 3-4: Timeline for Development of Nutrient Criteria in Reservoirs - 2008 and Beyond

Task / Description	Completion Date
Compile and analyze available reservoir data for Woodruff Reservoir, Lake Jordan, Lay Lake, Logan Martin Lake, Lake Mitchell, Lake Neely Henry, Big Creek Lake, and Aliceville Reservoir	March 2008
Complete ADEM internal review of potential criteria for the 8 reservoirs listed above	June 2008
Initiate public comment period for proposed nutrient criteria for the 8 reservoirs listed above	August 2008
Present proposed nutrient criteria for the 8 reservoirs listed above to the AEMC	October 2008
Complete watershed and reservoir models for Lake Purdy	August 2008
Complete ADEM internal review of potential criteria for Lake Purdy	November 2008
Initiate public comment period for proposed nutrient criteria for Lake Purdy	January 2009

Table 3-4: (continued)

Task / Description	Completion Date
Present proposed nutrient criteria for Lake Purdy to the AEMC	April 2009
Compile and analyze available reservoir data for Frank Jackson Reservoir	June 2010
Complete ADEM internal review of potential criteria for Frank Jackson Reservoir	August 2010
Initiate public comment period for proposed nutrient criteria for Frank Jackson Reservoir	September 2010
Present proposed nutrient criteria for Frank Jackson Reservoir to the AEMC	December 2010
Compile and analyze available reservoir data for Bear Creek and Upper Bear Creek Reservoirs	June 2010
Initiate watershed and reservoir modeling for Bear Creek and Upper Bear Creek Reservoirs, if necessary	July 2010
Complete watershed and reservoir models for Bear Creek and Upper Bear Creek Reservoirs	January 2011
Complete ADEM internal review of potential criteria for Bear Creek and Upper Bear Creek Reservoirs	March 2011
Initiate public comment period for proposed nutrient criteria for Bear Creek and Upper Bear Creek Reservoirs	April 2011
Present proposed nutrient criteria for Frank Jackson Reservoir to the AEMC	August 2011
Initiate evaluation of reservoir embayment data and identify remaining data gaps	February 2009
Prioritize embayments for nutrient criteria development	June 2010

4.0 River and Streams

4.1 Goals of Nutrient Program

ADEM's primary goals for developing and adopting nutrient criteria for Alabama's rivers and streams are consistent with the Clean Water Act and EPA's National Nutrient Strategy. These goals are as follows:

1) Develop and adopt nutrient criteria that support the beneficial uses designated for rivers and streams and that protect these waters from potential adverse effects associated with over-enrichment.
2) Restore and maintain the chemical, physical, and biological integrity of rivers and streams.
3) Maintain the diversity and uniqueness of Alabama's rivers and streams.

4.2 Conceptual Approach to Nutrient Criteria Development

Nutrient impairment of streams and rivers is an important water quality issue as evident by recent water quality assessments. EPA estimates that 40% of streams and rivers in the United States are contaminated by nutrient runoff. In Alabama, thirty-seven of the total 191 stream segments (19%) appear on Alabama's 2006 CWA 303(d) list due to nutrient impairment. These segments together encompass approximately 375 stream miles.

The Department's primary goal in developing nutrient criteria for rivers and streams is to ensure that nutrient over-enrichment does not result in impairment of designated uses. A significant step in this process will be the development of relationships describing a waterbody's response to nutrients.

In practice, achieving this goal is difficult. This approach requires a significant amount of resources and an adequate quantity of collected data. From previous water quality studies conducted on waterbodies considered impaired from over-enrichment, the Department has found little, if any, correlation between nutrient loading and response variables—even when substantial data was available. Because fluctuations in primary production levels are the result of natural processes involving a complex interplay of numerous factors, it is very difficult to relate concentrations of chlorophyll a or periphyton coverage to a single parameter alone. Many factors other than nutrient loading can lead to fluctuations in algal biomass, including sunlight levels, water clarity, stream velocity, stream depth, and quantity of precipitation.

In developing nutrient criteria, the Department may also use a "reference condition approach" such as that described in the U.S. Environmental Protection Agency's publication, "Nutrient Criteria Technical Guidance Manual (Rivers and Streams)." This approach uses data collected at a reference, or "least impacted," site which lies within the same ecoregion or bioregion as the targeted waterbody or which shares many of the same physical, chemical, and biological attributes. The Department is evaluating the use of Level IV Ecoregions as a method of *a priori* classification to facilitate program planning and development of reference conditions. This approach should help ensure that factors potentially affecting biotic communities are monitored. Analysis of this data may allow the Department to determine if biotic communities differ significantly among Level III and IV Ecoregions or if some of these Ecoregions can be lumped into bioregions.

In the reference condition approach, an upper percentile of the reference data is used to derive the numeric criteria. Although this method employs a statistical approach, it has a major shortcoming in that it does not establish a definitive link between nutrient concentrations and levels of impairment and is primarily applicable only to wadeable streams. Nor does this method provide information regarding the waterbody's capacity to assimilate nutrient loads. Without this type of information, it is difficult to determine if a derived numeric criterion will be under- or over-protective. Thus there is a credible risk that a waterbody may be listed as impaired even though its designated uses are being attained.

While the Department believes an "effects-based" approach is best suited for nutrient criteria development, it realizes that time constraints and resource limits may require the use of a reference condition approach as a "fallback" method. In developing nutrient criteria for rivers and streams, effort will be given to establishing cause-and-effect relationships between nutrient concentrations and response variables, such as primary production. If a meaningful relationship cannot be determined for a waterbody, the reference approach recommended by EPA will be used to derive numeric criteria.

The Department anticipates that TMDL work relating to rivers and stream considered nutrient-impaired (i.e. occurrence of nuisance algae or low dissolved oxygen levels), in conjunction with data collected from reference sites, will provide helpful insight when developing nutrient criteria. As in nutrient criteria development, a major goal of TMDL studies is to find meaningful correlations in collected data that reveal how the waterbody responds to different levels of nutrient loading. If it can be determined at what nutrient concentrations impacts from eutrophication begin to occur, this concentration can be considered a good approximate target and a numeric criterion below this value should protect the waterbody from any potential adverse effects of over-enrichment. However, if meaningful correlations between causal and response variables cannot be elucidated, then the fallback approach of a reference waterbody might be used. The Department may also consider other scientifically defensible methods and types of data analyses depending on the unique conditions of each waterbody being studied.

In developing nutrient criteria for streams and rivers, the Department expects to first target those stream segments currently identified as being impaired due to excess nutrient enrichment. This strategy is desirable for several reasons. First, it focuses efforts and resources on those segments that are currently impaired and should receive the highest priority in regards to determining assimilative capacities and establishing effective nutrient targets. Second, a significant amount of data is typically generated from TMDL studies, including computer modeling, which can potentially provide insight into how the waterbody and its aquatic ecosystems respond to different nutrient concentrations. The Department anticipates that this type of information, potentially combined with data collected at appropriate reference sites, will provide an adequate framework within which numeric nutrient criteria protective of the waterbody's designated uses can be established. Furthermore, data collected on a waterbody to determine the effectiveness of the remediation strategies outlined in the TMDL could provide additional insight into how nutrient loadings relate to water quality and use support. It is the Department's strategy to extrapolate much of the experience and knowledge gained from nutrient criteria development in impaired stream segments to surrounding unimpaired stream segments within the same ecoregions. As data is collected over time, it is hoped that correlations between causal parameters, such as nutrient loading, and response parameters, such as periphyton biomass or algal blooms, will become better elucidated and that appropriate trends are

discovered in the data that might allow a finer delineation of ecoregions and the development of criteria that reflect local conditions.

A complicating factor in developing nutrient criteria for rivers and streams is the limitation of assessment methods that can effectively monitor biological impairment from nutrients. Biological indicators capable of linking nutrient concentrations to aquatic community responses would facilitate efforts to develop nutrient criteria that are protective of stream communities and ecosystem processes. In the past, the Department has successfully used macroinvertebrate assessment to characterize aquatic life support. If this tool can be made more sensitive to nutrient stress by adding periphyton assessment, it would likely provide a more effective means of measuring responses to nutrients and give additional insight into the relationship between nutrient concentrations and instream effects. The Department's Aquatic Assessment Unit has conducted studies to evaluate three different algal bioassessment techniques to determine which provides the most effective indication of nutrient enrichment. The three bioassessment methods being evaluated include periphyton biomass as chlorophyll a, diatom community assessment, and a field-based rapid periphyton survey. These methods were tested at 20 stream segments with known or suspected impairment from nutrient over-enrichment as well as at 14 ecoregional reference sites for comparison. To provide the most complete characterization of water quality conditions, habitat quality and macroinvertebrate and fish communities were also assessed at the reference and study reaches.

The preliminary results of the studies suggest that periphyton chlorophyll a, total chlorophyll a, and percent coverage of suitable substrate (CSS) can effectively indicate water quality problems associated with nutrient enrichment. Correlation between reference reaches was variable but may improve as additional data are collected and the method and delineation of ecoregions are further refined. It was determined that periphyton as chlorophyll a was significantly correlated ($p = 0.05$; $r = 0.88$) with average total phosphorus (TP) concentrations. The correlation between the CSS method and average TP was not as strong ($p = 0.02$; $r = 0.64$). In addition, several macroinvertebrate and fish bioassessment metrics were correlated with mean total phosphorus and nitrogen concentrations, suggesting that these metrics may be effective indicators of nutrient enrichment and changes in nutrient loading in streams. The Department anticipates that these correlations will become better defined as more appropriate reference conditions are developed. The Department continues to work closely with EPA Region 4 to refine periphyton assessment methods with the goal of establishing regional protocols. Periphyton monitoring efforts were conducted on selected waterbodies between 2004 and 2007 and have become a routine component of the Department's monitoring strategy. Water quality data collected through the Department's ambient monitoring program, 303(d) assessments, and randomized sampling will continue to be evaluated with the goal of determining natural variability and identifying data trends relative to distinct areas such as ecoregions or river basins. If such differentiation can be sufficiently clarified, it might allow single nutrient criterion values to be applied to other waters within the same geographical or ecoregional area. The potential benefits would be increased criteria coverage of waters and more efficient allocation of resources. The intended goal is to be able to develop criteria according to some type of regionalized strata, such as ecoregions or basins, or specific parameters, such as stream size and land use characteristics. Another aim is to determine the largest spatial and temporal gaps in the databases. This information will be helpful when planning future monitoring activities.

4.3 Designated Uses of Alabama's Rivers and Streams

The use classifications (designated uses) utilized by the State for all surface waters of Alabama are as follows:

(1) Outstanding Alabama Water (OAW)
(2) Public Water Supply (PWS)
(3) Swimming and Other Whole Body Water-Contact Sports (S)
(4) Shellfish Harvesting (SH)
(5) Fish and Wildlife (F&W)
(6) Limited Warmwater Fishery (LWF)
(7) Agricultural and Industrial Water Supply (A&I)

4.4 Prioritization of Nutrient Criteria Development for Rivers and Streams

Nutrient criteria development for rivers and streams is expected to begin in those waterbodies impaired by nutrients since, in most cases, adequate data will already be available and a nutrient target will be needed in the TMDL. Nutrient target development is already underway in several watersheds throughout the state. Nutrient criteria for unimpaired streams will proceed as data becomes available as described in Section 4.2. The following list shows the expected sequence of nutrient criteria development in rivers and streams in Alabama. However, it is likely that data collection, evaluation, and the nutrient criteria development process could proceed simultaneously in some of the following waterbodies.

(1) Waterbodies with EPA-approved nutrient TMDLs
(2) Waterbodies designated as Outstanding National Resource Water
(3) Waterbodies with the OAW designated use and ecoregional reference waterbodies
(4) Waterbodies contributing significant nutrient loads to reservoir embayments as indicated from embayment monitoring data
(5) Other rivers and streams as data and resources allow

4.5 Data Collection and Assessment

ADEM's data collection efforts involve a number of programs with specific data collection goals and requirements. These various programs are discussed in detail in "*ADEM's Strategy for Sampling Environmental Indicators of Surface Water Quality Status*" (ASSESS). The sampling programs that are expected to contribute significantly to nutrient criteria development in rivers and streams include the following:

(1) Reference Reach Program (Ecoregional Reference Monitoring)
(2) Ambient Monitoring Program
(3) §303(d) Monitoring/Nonpoint Source Assessment Program
(4) Coastal Watershed Survey Program
(5) Rivers and Reservoirs Water Quality Monitoring Program
(6) Revised ALAMAP Probabilistic Monitoring Program (Monitoring Unit Assessment)

In general, monitoring in each of these programs follows a five-year rotating river basin schedule. Data gathered during each year of the cycle are stored in various databases and

evaluation and assessment generally occur over a one- to three-year period following data collection. ADEM's rotating river basin monitoring schedule is shown in the following table.

Table 4-1: Alabama's Rotating River Basin Monitoring Cycle

River Basin Group	Year
Cahaba, Black Warrior	2007
Tennessee	2008
Chattahoochee, Chipola, Choctawhatchee, Perdido-Escambia	2009
Alabama, Coosa, Tallapoosa	2010
Escatawpa, Tombigbee, Mobile	2011

4.6 Public Participation and Peer Review

In general, public participation for nutrient criteria development will be conducted as part of ADEM's rule adoption process. This involves publishing notices, holding public hearings, and receiving comments from the public regarding the proposed changes to our water quality regulations.

A Rivers and Streams Workgroup has been established by the Department to provide input and peer review from individuals who have certain expertise and knowledge in nutrient relationships in rivers and streams. These stakeholders are typically from academia, federal agencies, and other state agencies of Alabama.

4.7 Timeline and Milestones

Because the following schedule is subject to the availability of resources, and further assessments may provide additional insight to the nutrient criteria development process as well as the identification of data gaps, the scheduled dates might be revised in the future.

Table 4-2: Timeline for Development of Nutrient Criteria in Rivers and Streams – 2009 and Beyond

Task / Description	Date
Update list of EPA-approved nutrient TMDLs and evaluate nutrient targets	June 2009
Complete ADEM internal review / peer review of potential criteria based on nutrient targets in approved TMDLs	October 2009
Evaluate data availability / data gaps for OAW and ONRW waterbodies	December 2009
Complete ADEM internal review / peer review of potential criteria for OAW and ONRW waterbodies	March 2010
Prepare proposed changes to ADEM Rule 335-6-10 to assign nutrient criteria to waterbodies with approved nutrient TMDLs, OAW designated use, and the ONRW designation	June 2010
Issue Public Notice	August 2010
Present proposed criteria to AEMC	December 2010
Initiate evaluation of data for rivers and streams contributing to reservoir embayments	January 2011
Propose nutrient criteria for rivers and streams contributing to reservoir embayments where sufficient data has been collected	April 2011
Initiate evaluation of data for rivers and streams not previously addressed	June 2012
Propose nutrient criteria for remaining rivers and streams, where necessary	December 2012

5.0 Estuarine and Coastal Marine Waters

5.1 Goals of Nutrient Program

Consistent with the Clean Water Act and EPA's National Nutrient Strategy, ADEM's primary goals for developing and adopting nutrient criteria for Alabama's estuarine and coastal marine waters are as follows:

1) Develop and adopt nutrient criteria that support the beneficial uses designated for estuarine and coastal marine waters and that protect these waters from potential adverse effects associated with over-enrichment.
2) Restore and maintain the chemical, physical, and biological integrity of estuarine and coastal marine water.
3) Maintain the diversity and uniqueness of Alabama's estuarine and coastal marine water.

5.2 Conceptual Approach

In developing strategies relating to nutrient criteria in coastal and estuarine waters, the Department anticipates utilizing much of the information contained in EPA's Nutrient Criteria Technical Guidance Manual for Estuarine and Coastal Marine Waters along with other approaches that may be developed through collaboration with other Gulf of Mexico states. Because coastal systems are often very complex in nature, a localized approach with the development of site-specific criteria may be more effective than a broad geographical approach.

Estuaries and near-shore coastal waters naturally vary in the type, abundance, and geographic coverage of biological communities at risk to nutrient over-enrichment, largely because of habitat differences. Because of these differences and the overall complexity of estuarine water systems, is especially difficult developing a single national criterion or a regional criterion applicable to all estuaries. Therefore, it is necessary to focus on historical data to assess water quality in localized regions and to select appropriate reference conditions.

The Department participated in a nutrient pilot study coordinated by the Gulf of Mexico Program Office to study responses to excess nutrients in the Northern Gulf of Mexico. The goal of this study was to gather, qualify, and analyze relevant historical data and to determine meaningful characterizations and ecosystem assessments of nutrient load/responses for the near-coastal waters and associated estuaries of the northern Gulf of Mexico. The area of study extends from the Mississippi River-Gulf outlet through Mobile Bay and contains waterbodies in the states of Louisiana, Mississippi and Alabama. The final objective of the pilot study was to provide information that can be used by states and federal managers in the development of nutrient criteria and management responses that protect the integrity of coastal ecosystems from the adverse effects of cultural eutrophication.

The Department is also an active participant in the Gulf of Mexico Alliance (GOMA). GOMA is a partnership, initiated in 2004, by the states of Alabama, Florida, Louisiana, Mississippi, and Texas, with the goal of significantly increasing regional collaboration to enhance the environmental and economic health of the Gulf of Mexico. The Alliance currently

coordinates closely with the Gulf of Mexico States Accord, to facilitate eventual collaboration with the six Mexican Gulf of Mexico states.

The Gulf States identified five priority issues that are regionally significant and can be effectively addressed through increased collaboration at state, local, and federal levels. These priorities represent a focus for initial action through the Alliance:

- Water quality for healthy beaches and shellfish beds;
- Wetland and coastal conservation and restoration;
- Environmental education;
- Identification and characterization of Gulf habitats; and
- Reducing nutrient inputs to coastal ecosystems.

In March 2006, the Alliance published the *Governors' Action Plan for Healthy and Resilient Coasts* which establishes specific goals to be accomplished by March 2009 in each of the five priority areas listed above. For the nutrient reduction priority issue the following goals were identified.

- N-1: Increase regional coordination in the development of nutrient criteria
- N-2: Implement nutrient reduction activities during Gulf recovery and rebuilding
- N-3: Assert an aligned fi ve Gulf State position on the need to address Gulf of Mexico hypoxia

An implementation activities matrix has been constructed to track progress towards each of these goals. For goal N-1, several workshops and regular conference calls have been held to educate each of the Gulf of Mexico states about ongoing monitoring and nutrient criteria development activities within the other states. In January of 2007 a workshop was held in Gulf Breeze, Florida as an initial step toward understanding what states were already doing in their monitoring programs and were each state was in its nutrient criteria implementation plan process. As a follow up to the January 2007 workshop, a second workshop was held in St. Petersburg, Florida in conjunction with the Governors' Action Plan Implementation and Integration Workshop on July 10 – 12, 2007. An outcome of the workshop was the selection of several water quality parameters, including chlorophyll a, for which the five Gulf states would standardize collection and analysis protocols to facilitate data comparability around the Gulf. Monitoring standardization will be the topic of a workshop scheduled for September 24 – 26, 2007 in Spanish Fort, Alabama.

The anticipated outcome of this process is a consistent framework that the five Gulf states can use to develop nutrient criteria for their coastal and estuarine waters. The Nutrient Reduction workgroup has grown to include experts from many different state, federal, educational, and research organizations. The collaboration among the states and their federal partners leverages resources to address the very challenging technical issue of nutrient criteria development.

5.3 Designated Uses of Alabama's Estuarine and Coastal Marine Waters

The use classifications (designated uses) utilized by the State for all surface waters of Alabama are as follows:

(1) Outstanding Alabama Water (OAW)
(2) Public Water Supply (PWS)
(3) Swimming and Other Whole Body Water-Contact Sports (S)
(4) Shellfish Harvesting (SH)
(5) Fish and Wildlife (F&W)
(6) Limited Warmwater Fishery (LWF)
(7) Agricultural and Industrial Water Supply (A&I)

5.4 Prioritization of Nutrient Criteria Development

Nutrient criteria development for coastal and estuarine waters is expected to begin in those waterbodies where adequate data exists to evaluate nutrient assimilative capacity. In addition, waters with identified use impairments caused by nutrients will be addressed early in the process, especially those waterbodies with EPA-approved nutrient TMDLs. The following list shows the expected sequence of nutrient criteria development in coastal and estuarine waters in Alabama. However, it is likely that data collection, evaluation, and the nutrient criteria development process could proceed simultaneously in some of the following waterbodies.

(1) Waterbodies with EPA-approved nutrient TMDLs
(2) Waterbodies with sufficient data to establish use-appropriate nutrient criteria
(3) Nutrient-sensitive waters as characterized by the Gulf of Mexico Program Nutrient Pilot Study, Mobile Bay National Estuary Program, or other monitoring program

5.5 Data Collection & Assessment

The Department participates in studies conducted by the National Coastal Assessment program, the National Estuary Program, and the Gulf of Mexico Program. In addition, ADEM's data collection efforts involve a number of programs with specific data collection goals and requirements. These various programs are discussed in detail in "*State of Alabama Water Quality Monitoring Strategy*", 2005. The sampling programs that are expected to contribute significantly to nutrient criteria development in estuarine and coastal waters include the following:

(1) Ambient Monitoring Program
(2) §303(d) Monitoring Program / TMDL Development Program
(3) Section 319 Nonpoint Source Intensive Survey Program
(4) Coastal Sub-watershed Assessment Program
(5) National Coastal Assessment Program

5.6 Public Participation and Peer Review

In general, public participation for nutrient criteria development will be conducted as part of ADEM's rule adoption process. This involves publishing notices, holding public hearings, and receiving comments from the public regarding the proposed changes to our water quality regulations.

5.7 Timeline and Milestones

Because the following schedule is subject to the availability of resources, and further assessments may provide additional insight to the nutrient criteria development process as well as the identification of data gaps, the scheduled dates might be revised in the future.

Table 5-1: Timeline for Development of Nutrient Criteria in Estuarine and Coastal Waters - 2007 and Beyond

Task / Description	Date
Participate in the Gulf of Mexico Alliance (GOMA) Nutrient Reduction Workgroup	2007 - 2009
Compile and evaluate data, including results from GMP Nutrient Pilot Study and Mobile Bay Water Quality Model	2008
Complete ADEM internal review / peer review of potential criteria for waters with EPA-approved TMDLs or other identified nutrient-sensitive coastal waters consistent with the goals / recommendations of the GOMA Nutrient Reduction Workgroup	2009
Propose nutrient criteria for selected coastal waters	2010
Initiate evaluation of data for estuarine and coastal waters not previously addressed	2011
Propose nutrient criteria for estuarine and coastal waters not previously addressed, where appropriate	2013

6.0 Wetlands

6.1 Goals of Nutrient Program

Consistent with the Clean Water Act and EPA's National Nutrient Strategy, ADEM's primary goals for developing and adopting nutrient criteria for Alabama's wetlands are as follows:

1) Develop and adopt nutrient criteria that support the beneficial uses designated for wetlands and that protect these waters from potential adverse effects associated with over-enrichment.
2) Restore and maintain the chemical, physical, and biological integrity of wetlands.
3) Maintain the diversity and uniqueness of Alabama's wetlands.

6.2 Conceptual Approach

In developing strategies relating to nutrient criteria and wetlands, the Department anticipates utilizing the information contained in EPA's finalized Nutrient Criteria Technical Guidance Manual for Wetlands. Because this document is currently in draft form and the overall science of wetland assessment and monitoring is still in the early stages, the Department will continue to follow closely any new developments.

6.3 Designated Uses of Alabama's Wetlands

The use classifications (designated uses) utilized by the State for all surface waters of Alabama are as follows:

(1) Outstanding Alabama Water (OAW)
(2) Public Water Supply (PWS)
(3) Swimming and Other Whole Body Water-Contact Sports (S)
(4) Shellfish Harvesting (SH)
(5) Fish and Wildlife (F&W)
(6) Limited Warmwater Fishery (LWF)
(7) Agricultural and Industrial Water Supply (A&I)

6.4 Prioritization of Nutrient Criteria Development

Because Alabama does not recognize wetlands as a distinct waterbody type within its water quality standards, ADEM has not targeted wetlands for monitoring within its monitoring programs. Therefore, very little data regarding water quality in wetlands is available in Alabama. As a result, much initial work will be required to gain an understanding of wetland functions relative to nutrient processes and responses to nutrient loading. The State will rely on EPA guidance as it develops a strategy for obtaining the information needed to proceed with nutrient criteria development in this waterbody type.

6.5 Data Collection & Assessment

ADEM will rely upon available EPA guidance for monitoring and assessing wetlands. Wetlands monitoring will be incorporated into the Department's overall monitoring strategy.

6.6 Public Participation and Peer Review

In general, public participation for nutrient criteria development will be conducted as part of ADEM's rule adoption process. This involves publishing notices, holding public hearings, and receiving comments from the public regarding the proposed changes to our water quality regulations.

6.7 Timeline and Milestones

Because wetland assessment and monitoring is in an early stage and the science is still evolving, this timeline is more extended with less definite dates.

Table 6-1: Timeline for Development of Nutrient Criteria in Wetlands - 2009 and Beyond

Task / Description	Date
Establish the Wetlands Monitoring and Assessment Workgroup	2009
Incorporate wetlands monitoring into the Department's monitoring strategy	2010
Gather and compile available wetlands water quality data	2012
Establish the Wetlands Nutrient Criteria Workgroup	2012
Initiate evaluation of data for wetlands and identification of nutrient-sensitive wetlands	2013
Complete ADEM internal review / peer review of potential criteria for selected nutrient-sensitive wetlands	2014
Propose nutrient criteria for selected nutrient-sensitive wetlands	2015