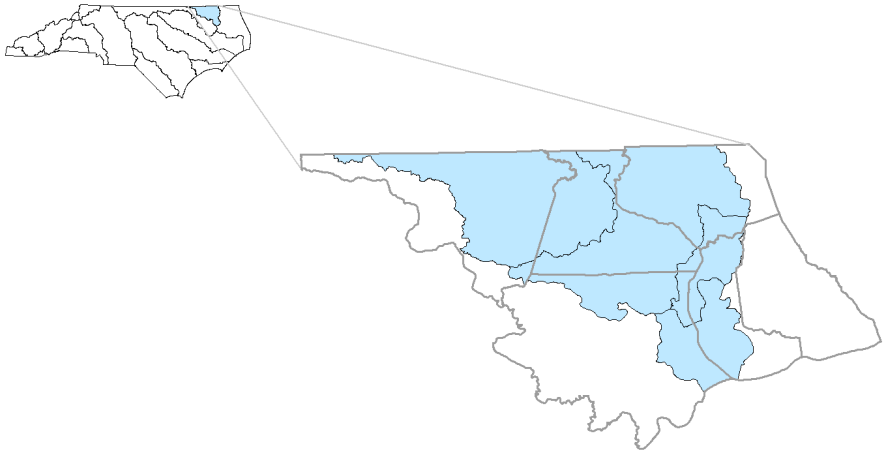
Chowan River Basinwide Water Quality Plan

August 2007



North Carolina Department of
Environment and Natural Resources

Division of Water Quality
Basinwide Planning Unit

CHOWAN RIVER BASINWIDE WATER QUALITY PLAN

2007

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This document was approved and endorsed by the NC Environmental Management Commission on September 13, 2007 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Chowan River basin. This plan is the third five-year update to the Chowan River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in September 1997.

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North Carolina's Basinwide Approach to Water Quality Management

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality (DWQ) for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by the DWQ, the implementation and the protection of water quality entails coordinated efforts of many agencies, local governments and stakeholders in the state.

The goals of DWQ's basinwide program are to:

- Identify water quality problems and restore full use to impaired waters,
- Identify and protect high value resource waters, and
- Protect unimpaired waters while allowing for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Evaluate cumulative effects of pollution,
- Assure equitable distribution of waste assimilative capacity for dischargers,
- Regulate point and nonpoint source pollution where other approaches were unsuccessful,
- Improve public awareness and involvement, and
- Collaborate with other agencies to develop appropriate management strategies to protect and restore water quality. This includes providing agencies information related to financial and funding opportunities.

This document is the third edition of the *Chowan River Basinwide Water Quality Plan* updated on a five-year cycle. The first basinwide plan for the Chowan River basin was completed in 1997 and the second in 2002. The format of this plan was revised in response to comments received during the first planning cycle. DWQ replaced much of the general information in the first two plans with more detailed information specific to the Chowan River basin. For this plan, a greater emphasis was placed on identifying water quality concerns on the watershed level in order to facilitate protection and local restoration efforts.

Chowan River Basin Overview

The Chowan River basin is located in the northeastern coastal plain of North Carolina and southeastern Virginia (Figure *i*). The North Carolina portion includes all or part of Northampton, Hertford, Gates, Bertie and Chowan counties (Figure *ii*). The Chowan River is formed at the border of Virginia and North Carolina by the confluence of the Nottoway and Blackwater Rivers, and its streams flow southeastward towards the Albemarle Sound. Approximately 75 percent (4,061 square miles) of the river's watershed lies within the Virginia border.

The Chowan River basin in North Carolina is composed of two major drainages: Chowan River and Meherrin River. The Chowan River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States. All of the waters in the basin are designated as Nutrient Sensitive Waters. Many waterbodies in this basin are transitional in

nature (i.e., from Coastal A to Swamp) making water quality monitoring difficult. Some creeks and rivers flushing rates are influenced by tides and wind, while others receive swamp drainage. There are four waterbody segments that were not rated because DWQ criteria for Coastal B waters have not been finalized. Overall, water quality in the Chowan River basin is generally good.

Information presented in this basinwide water quality plan is based on information collected from September 2000 to July 2007 to describe water quality conditions and issues in each of the four subbasins. Specific water quality assessments were based on biological, chemical and physical monitoring data collected between September 2000 and August 2005. A discussion of conditions reflecting whether specific waterbodies support their best-intended use and maps of each subbasin are included in each subbasin chapter.

Subbasin 03-01-01

The upper Chowan River is formed at the border of Virginia and North Carolina by the confluence of the Nottoway and Blackwater Rivers. Major tributaries to the Chowan River in this subbasin include the Wiccacon River and Ahoskie Creek, both having land use activities influencing poor water quality conditions. The lower portion of the Wiccacon River is the only Impaired waterbody for aquatic life in the Chowan River basin. Portions of Merchants Millpond State Park and Chowan Swamp State Natural Area are also located in this subbasin. Merchants Millpond supports a diverse assemblage of aquatic plants including several rare species. The largest municipalities in this subbasin include Ahoskie, Aulander, and Winton. Surface water classifications and the amount of miles in subbasin 03-01-01 are listed in Table *i*. Chapter 1 presents specific water quality information for each monitored waterbody in the subbasin.

Table *i* Subbasin 03-01-01 DWQ Classifications

DWQ Classification	Freshwater Miles
B; NSW	39.8
C; NSW	376.5

C = Aquatic life propagation/protection and secondary recreation
B = Primary recreation and Class C uses.
NSW = *Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

Subbasin 03-01-02

Subbasin 03-01-02 contains 494 square miles of the Meherrin River and its tributaries, but much of the river's catchment is in Virginia. Major tributaries to the Meherrin River include Potecasi and Kirbys Creeks. Aquatic habitats include streams that have been channelized and/or swamp areas that cease to flow during dry periods and are expected to have very low dissolved oxygen levels during low-flow periods. Significant natural heritage areas are located within the watershed, including the Meherrin River Swamp and Meherrin River Slopes and Swamp. The largest municipalities in this subbasin include Murfreesboro and Rich Square. Surface water classifications and the amount of miles in subbasin 03-01-02 are listed in Table *ii*. Chapter 2 presents specific water quality information for each monitored waterbody in the subbasin.

Table *ii* Subbasin 03-01-02 DWQ Classifications

DWQ Classification	Freshwater Miles
B; NSW	13.6
C; NSW	272.9

C = Aquatic life propagation/protection and secondary recreation
B = Primary recreation and Class C uses.
NSW = *Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

Subbasin 03-01-03

This subbasin contains the middle section of the Chowan River, below Bennetts Creek (Merchants Millpond) and above Rockyhock Creek and includes the Indian Creek and Catherine Creek tributaries. Tidal Cypress-Gum Swamp, a designated significant natural heritage area, is found along much of the shoreline of the Chowan River and represents an important wetland ecosystem within the Chowan River basin. Land use is mainly forested wetlands and agricultural cropland. The largest municipality in the subbasin is Colerain, which has experienced an overall net population decline since 1990. Surface water classifications and the amount of miles in subbasin 03-01-03 are listed in Table *iii*. Chapter 3 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iii* Subbasin 03-01-03 DWQ Classifications

DWQ Classification	Freshwater Miles
B; NSW	27.0
C; NSW	4.2

C = Aquatic life propagation/protection and secondary recreation
B = Primary recreation and Class C uses.
NSW = *Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

Subbasin 03-01-04

Subbasin 03-01-04 contains the lower Chowan River and small tributaries including Salmon Creek, Edenton Bay and Pembroke Creek. It also includes a small northwest portion of the Albemarle Sound. Edenton is the largest municipality in the subbasin. This region of the Chowan River basin is experiencing growth and development with proposed upscale housing communities, golf courses and marinas. With this growth along the inland waterways, many channels to the Chowan River are losing their riparian buffers and consequently water quality is in jeopardy. Within this subbasin, a portion of the Albemarle Sound to the mouth of the Chowan River is Impaired in the fish consumption category because of a dioxin advisory for these waters. Surface water classifications and the amount of miles and acres in subbasin 03-01-04 are listed in Table *iv*. Chapter 4 presents specific water quality information for each monitored waterbody in the subbasin.

Table *iv* Subbasin 03-01-04 DWQ Classifications by Miles and Acres

DWQ Classification	Freshwater Miles	Freshwater Acres
B; NSW	25.1	15,600.4
C; NSW	50.8	1,370.3

C = Aquatic life propagation/protection and secondary recreation
B = Primary recreation and Class C uses.
NSW = *Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.

Waterbody Classifications and Use Support Assessment of Water Quality

Surface waters are classified according to their best-intended uses. Determining how well a waterbody supports its designated uses (use support rating) is an important method of interpreting water quality data to assess water quality. The terms Impaired and Supporting refer to whether the classified uses (e.g., aquatic life protection, recreation, shellfish harvesting, and fish consumption) of the water are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater) are rated Supporting if data used to determine use support did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as Impaired. A single waterbody could have more than one use support rating corresponding to one or more of the multiple use support categories. Use support assessments based on surface water classifications form the foundation of this basinwide plan. Chapter 5 presents more information about surface water classifications.

DWQ use support methods were developed to assess ecosystem health and human health risk through the development of use support ratings for five categories: aquatic life, fish consumption, recreation, shellfish harvesting, and water supply. These categories are tied to the uses associated with the primary classifications applied to North Carolina rivers, streams and lakes. A full description of the classifications is available in the DWQ document titled *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (www.ncwaterquality.org/csu/).

Use support methodology has changed significantly since the 2002 revision of the *Chowan River Basinwide Water Quality Plan*. In the previous plan, surface waters were rated fully supporting (FS), partially supporting (PS), not supporting (NS) and not rated (NR). The *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* issued by the Environmental Protection Agency (EPA) requests that states no longer subdivide the Impaired category. In agreement with this guidance, North Carolina no longer subdivides the Impaired category and rates waters as Supporting (S), Impaired (I), Not Rated (NR), or No Data (ND). These ratings refer to whether the classified uses of the water are being met. Detailed information on use support methodology is provided in Appendix II.

Aquatic Life/Secondary Recreation

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (810 mi.) in the Chowan River basin. A basinwide summary of current aquatic life/secondary recreation use support ratings is presented in Table *v*.

Table *v* Aquatic Life/Secondary Recreation Use Support Summary Information

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored Streams Only*	
	Miles	%
Supporting	143.4	53.5%
Impaired	22.5	8.4%
Not Rated	102.1	38%
Total	268	-----

* = Percent based on total of all monitored waters.

Approximately 33 percent of stream miles (268 mi.) were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle. Impaired waters account for 2.8 percent of the total stream miles and 8.4 percent of monitored stream miles. Over 22 miles of the Wiccacon River are Impaired for aquatic life due to a Fair bioclassification as described in Chapter 1.

Primary Recreation

There are 105.5 miles currently classified for primary recreation (Class B) and 704.4 miles classified for secondary recreation (Class C) in the Chowan River basin. Approximately 14 percent of stream miles (810 mi.) were monitored for recreational uses by DWQ during this basinwide planning cycle. Of the 73.4 monitored stream miles for primary recreation, all are Supporting.

Fish Consumption

Like the aquatic life/secondary recreation use support category, the fish consumption use support category is also applied to all waters in the state. Approximately one percent of stream miles in the Chowan River basin were monitored for the fish consumption use support category during

this basinwide cycle. Fish consumption use support ratings are based on fish consumption advice and advisories issued by the NC Department of Health and Human Services (NCDHHS). Currently, there is a statewide advice limiting consumption of several fish species, due to the potential for elevated methylmercury levels; see the DHHS website for more information (http://www.epi.state.nc.us/epi/fish/). Because of this advice, all waters are considered Impaired for the fish consumption category on an evaluated basis.

Currently, 7.8 miles of the Chowan River and 15,600 acres of the Albemarle Sound are Impaired due to a dioxin fish consumption advisory by DHHS. The dioxin advisory recommends that women of childbearing age and children should not eat catfish and carp and others should limit their consumption of these bottom feeder fish species.

Water Quality Standards and Classifications

All waters in the basin have the supplemental classification of Nutrient Sensitive Water (NSW). In response to this classification, nitrogen and phosphorus reductions have resulted in water quality improvements with the implementation of agricultural best management practices, the conversion of many wastewater treatment plants to land application systems, and the implementation of more stringent permit limits for nutrients. Water quality standards and classifications are discussed in Chapter 5.

Water Quality Stressors and Sources

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on predominant land use in the watershed. In the Chowan River basin, agriculture and runoff from WWTP land application sites were identified as possible sources of stressors to biological (benthic and fish) communities or where water quality standards have been violated. In the fish consumption category, mercury and dioxin are the noted stressors. However, unknown sources of stressors impact many waterbodies. The accumulation of multiple stressors leads to water quality degradation. In some way, every resident, tourist, landowner, industry and municipality in the basin impacts water quality. Therefore, it is important that all stakeholders play a role in management strategies designed to protect and restore water quality in the Chowan River basin. More information about water quality stressors and sources can be found in Chapter 6.

Impacts from Stormwater Runoff

Stormwater runoff is a primary carrier of nonpoint source pollution in both urbanized and rural areas. Stormwater runoff is a particular concern in the agricultural based Chowan River basin. Previous hydrologic alterations of the landscape have ditched and channelized the land to improve drainage. Stormwater currently moves quickly off the land bypassing swamps and enters directly into creeks and rivers untreated. The impact of stormwater runoff is also severe in developing areas where recently graded lands are highly susceptible to erosion. Water quality impacts are also evident in urbanized areas where stormwater runoff is increased by impervious surfaces and is rapidly channeled through ditches, curb and gutter systems into nearby waterbodies.

The goal of DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs

accomplish this goal by controlling the source(s) of pollution. Currently, there are 23 individual stormwater permit listed for the Chowan River basin. Chapter 7 contains more information federal and state stormwater programs.

Wastewater Management

In the Chowan River basin, wastewater is treated by wastewater treatment plants, non-discharge systems and on-site septic systems. Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Dischargers in North Carolina must apply for and obtain a NPDES permit. Because of the nutrient sensitivity of the waters in this basin, dischargers are permitted with set nitrogen and phosphorus limits at 3 and 1 mg/l, respectively. Currently, there are 10 permitted wastewater dischargers in the Chowan River basin.

Many municipalities, residential developments, and commercial/industrial operations located in northeastern North Carolina utilize wastewater treatment systems that dispose of the wastewater through land application methods. Such systems are referred to as non-discharge systems, as there is no direct discharge to surface water of the state. A large concentration of non-discharge systems are located within the Chowan basin. Although non-discharge systems should not present high potentials for surface water impacts, some systems within the Chowan basins have problems that may result in impaired surface water quality. In the Chowan River basin, 21 non-discharge (non-agricultural) permits have been issued. Some of these facilities have problems due to direct discharges resulting from storm events, run-off, or continued inability to comply with permit conditions.

Within the Chowan basin, it is important to note that there is a direct connection between groundwater and surface water in many places. Drainage ditches and canals are widespread in northeastern NC and function as a direct pathway for groundwater that may be impacted from nutrients and coliform bacteria, especially in rural areas where agriculture is widespread, to enter into the surface water system. In other cases, surface water bodies, directly border areas where groundwater quality may be impaired. In many areas, the time it takes for groundwater to move into the surface water system is brief. Although groundwater quality at non-discharge facilities may be compliant with groundwater quality standards, groundwater flux moving into the surface water system has the ability to transport contaminants into surface water bodies and add to total mass loadings. It is recommended that research be conducted to better establish and understand the relationship between groundwater and surface water in eastern North Carolina. Such understanding would provide for more accurate assessment of surface water impairments resulting from groundwater discharges and enable the state to make sound permitting judgments and recommendations to better protect water quality in general.

On-site septic systems are common throughout the Chowan River basin. However, soil conditions in the basin may limit the functionality of the septic system treatment allowing untreated effluent to reach surface waters. Precautions should be taken by local septic system permitting authorities to ensure that failing systems are repaired, older systems are updated and new systems are sited and constructed properly allowing an adequate repair area.

Chapter 7 provides more information on wastewater permitting regulations.

Population, Land Use Changes and Natural Resources

Based on the 2000 Census, the overall population of the Chowan River basin is 61,153, with approximately 44-persons/square mile. Although this is a decrease from the 1990 census of 62,474 people, population growth and development is expanding inward from the rapidly developing coastal areas. Two of the five counties in the basin are expected to experience growth rates in excess of ten percent by 2020. As the counties in the Chowan River basin continue to grow along the inner waterways there will likely be a loss of natural areas and an increase in the amount of impervious surface associated with new homes and businesses.

Based on 1997 National Resources Inventory data, land cover in the basin is dominated by forestland that covers approximately 54.9 percent of the land area. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 32.8 percent. This ten-year-old data reflects only 2.8 percent of the land area as being developed. To more accurately describe land cover and land use changes updated data is needed. Approximately 86 percent of forestland in the Chowan River basin is privately owned, 12 percent is owned by forest industry and the rest is publicly owned. A small percentage (1.2 percent) of the Chowan River basin is publicly owned conservation land. More information on population, land use and natural resources in the Chowan River basin is found in Chapter 8.

Public Water Supply

In the Chowan River basin, 75 public water supply sources were identified, all of which are groundwater wells. Of the 75 groundwater sources, 4 of them have a Higher, 29 have a Moderate and 42 have a Lower susceptibility rating. It is important to note that a susceptibility rating of Higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated by the identified potential contaminant sources within the assessment area. More information on water supply resources in the Chowan River basin is found in Chapter 8.

Ecological Significance of the Chowan River Basin

Approximately 100 stream miles of the Chowan River are considered an Aquatic Significant Natural Heritage Area by the North Carolina Natural Heritage Program. The Chowan River receives this designation because of the diversity of its freshwater mussel populations, many of which are rare and vulnerable. The Chowan River and its tributaries provide critical habitat for some anadromous fish species and is known for some of the best fishing in the state, with largemouth bass, bluegill, chain pickerel, black crappie, and perch being some of the most sought after species. Recent harvest restrictions were enacted on the river herring fishery due to the declining stock, which may be associated with water quality conditions. The Chowan and Meherrin Rivers still reflect the rural character of the basin where priority conservation activities should include the establishment of buffer strips and conservation easements and continued refinement and monitoring of BMPs on lands used primarily for agriculture and silviculture. These activities are also needed for industrial and residential developments. More information on natural resources in the Chowan River basin is found in Chapter 8.

Agriculture and Water Quality

There are 101 animal operations in the Chowan River basin. Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination, and sedimentation are often associated with agricultural activities, and all can impact water quality. In the Chowan River basin, significant efforts have been made to reduce nitrogen and phosphorus loads originating from agricultural land uses through the implementation of best management practices (BMPs). Additional efforts are needed to redesign drainage from agricultural fields to help filter runoff. During this five-year assessment period, the North Carolina Agricultural Cost Share Program (NCACSP) funded BMPs totaling more than $2,400,000 throughout the Chowan River basin. Chapter 9 provides information related to agricultural activities in the Chowan River basin and also identifies funding opportunities for BMPs.

Land Use Planning and Sea Level Rise

The Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local land use plan in accordance with guidelines established by the Coastal Resources Commission (CRC). A land use plan is a collection of policies, maps, and implementation actions that serves as a community's blueprint for growth. The management goal for water quality is to maintain, protect, and where possible enhance water quality in all coastal wetlands, rivers, streams and estuaries. The CRC's planning objective is for communities to adopt policies for coastal waters within the planning jurisdiction to help ensure that water quality is maintained if not impaired and improved if impaired. Local communities are required to devise policies that help prevent or control nonpoint source discharges (sewage and stormwater) through strategies such as impervious surface limits, vegetated riparian buffers, maintenance of natural areas, natural area buffers, and wetland protection. In the Chowan River basin, Gates County has completed their land use plan and Bertie, Chowan and Hertford Counties are in the process. Chapter 10 presents specific information regarding land use plans in communities of the Chowan River basin.

Sea level rise has the potential to dramatically alter North Carolina's coast and estuary systems. Coastal infrastructure, residential properties and industry are threatened and water quality conditions will change. Research is being conducted by several universities in North Carolina to predict changes in our environmental and economic resources. Links to resources about sea level rise are provided in Chapter 10.

Water Quality Management Strategies

The N.C. Divisions of Water Quality, Coastal Management, Land Resources, Marine Fisheries, Soil and Water Conservation, Parks and Recreation and Environmental Health are responsible for many natural resource use activities and policies including stormwater management, development permits, erosion control programs, agriculture and land preservation, and recreation monitoring. Additional state programs and many interagency and local group partnerships work together to protect the resources found in the Chowan River basin. The Albemarle-Pamlico National Estuary Program (APNEP) has supported a number of research, restoration, and demonstration projects. Recently, in the Chowan River basin, the APNEP funded a Chowan River Riparian Shoreline Assessment, environmental education projects and projects designed to mitigate the effects of stormwater runoff and pollution. Over $20,000,000 in Clean Water Management Trust Funds, and over $270,000 in Section 319 Nonpoint Source Grants have been

allocated for projects in the Chowan River basin. Chapter 10 presents more information local initiative and state programs and strategies to preserve and protect water quality.

Restoring Impaired Waters

The long-range mission of basinwide planning is to provide a means of addressing the complex problem of planning for increased development and economic growth while maintaining, protecting and enhancing water quality and intended uses of the Chowan River basin's surface waters. Within this basinwide plan, DWQ presents management strategies and recommendations for those waters rated Impaired or that exhibit some notable water quality problems.
There are eight waterbody segments consisting of 135 miles in the Chowan River basin that are on the draft 2006 303(d) list of impaired waters. For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a DWQ priority. Section 303(d) of the federal Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. The waters in the Chowan River basin that are on this list are discussed in the individual subbasin chapters. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. EPA issued guidance in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list within 8-13 years. More information on the TMDL process is found in Chapter 11.

Challenges and Recommendations for Achieving Water Quality Improvements

Cumulative Effects
While any one activity may not have a dramatic effect on water quality, the cumulative effect of land use activities in a watershed can have a severe and long-lasting impact.

The cumulative effects of nonpoint source pollution are the primary threat to water quality and habitat degradation in many areas across the state and throughout the Chowan River basin. Nonpoint source pollution can be identified through the basinwide plan, but actions to address these impacts must be taken at the local level. Such actions should include:

- Require stormwater best management practices for existing and new development,
- Develop and enforce buffer ordinances,
- Conduct comprehensive land use planning that assesses and reduces the impact of development on natural resources, and
- Develop and enforce local erosion control ordinances.

Without proactive land use planning initiatives and local water quality strategies, population growth and development in the basin increases the risk of waterbody impairment. Balancing economic growth and water quality protection will continue to be an immense challenge. This basinwide plan presents many water quality initiatives and accomplishments that are underway throughout the basin. These actions provide a foundation on which future initiatives can be built.

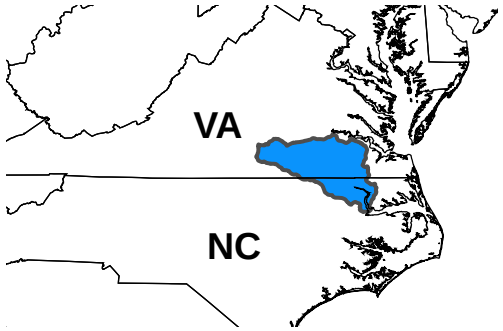
General Recommendations for the Chowan River Basin

Recent water quality data indicates water quality has improved in the Chowan River since the algal bloom events of the 1970's. However, maintenance and continual improvements in water quality are dependent on proactive planning. The following recommendations are compiled

from natural resource agencies and stakeholders working and/or living within the Chowan River basin:

- Conduct additional research to understand possible surface-ground water interactions and possible water quality issues associated with non-discharge wastewater disposal.
- Continue efforts to focus on proper training of facility operators to address non-compliance issues associated with permitted facilities, both non-discharge and discharge, often associated with operator mismanagement.
- Protect human health and maintain water quality by repairing failing septic systems, update older systems, and eliminate straight pipes. Additional monitoring of fecal coliform bacteria throughout tributary watersheds will aid in identifying where straight pipes and failing septic systems are problems. Septic system maintenance outreach is needed in rural areas dependent on on-site wastewater disposal.
- Develop stormwater management programs for new development and to retrofit existing development.
- Develop additional outreach opportunities to incorporate smart growth technologies or low impact development techniques for municipal planners to incorporate into land use plans.
- Establish riparian buffers, as needed throughout the basin, both in residential and agricultural land use areas.
- Reestablish natural drainage and associated wetlands to reduce stormwater runoff, assist with flood control and improve water quality.
- Support the development and implementation of best management practices (BMPs) to help reduce nonpoint source pollution. Monitoring of these BMPs should also be required to improve maintenance, design and functionality. BMPs applicable in residential areas need to be encouraged through public education campaigns.
- Support the implementation of the Coastal Habitat Protection Plan at all levels of government and amongst citizens.
- Continue collaborative efforts between natural resource agencies within North Carolina and Virginia to improve adaptive management and policies on a watershed ecosystem scale.

Figure i General Map of the Entire Chowan River Basin



Butterwood Creek
Warwick Swamp
Blackstone
Victoria
Wsqua Creek
Stony Creek
Assamoosick Swamp
Ivor
Blackwater River
Lawrenceville
Brodnax
Meherrin River
Three Creek
Courtland
Franklin
Emporia
Nottoway River
Fountains Creek
VIRGINIA
NORTH CAROLINA
Kirbys Creek
Murfreesboro
Potecasi Creek
Ahoskie
Ahoskie Creek
CHOWAN RIVER

Legend

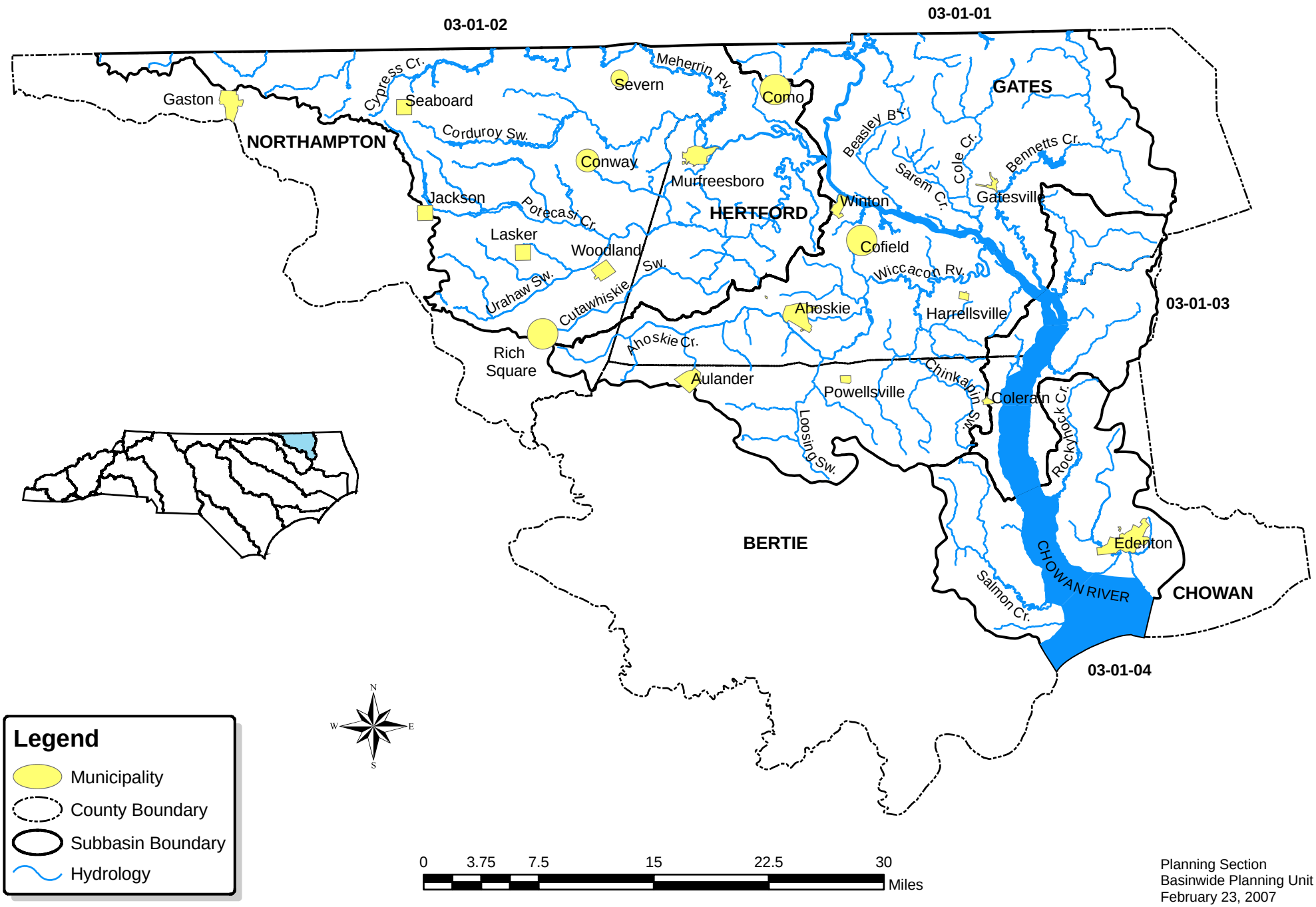
- Municipality
- Chowan River Basin
- Hydrology
- State Boundary

N
W
E
S

0 5 10 20 30 40
Miles

Planning Section
Basinwide Planning Unit
February 23, 2007

Figure ii General Map of the Chowan River Basin in North Carolina

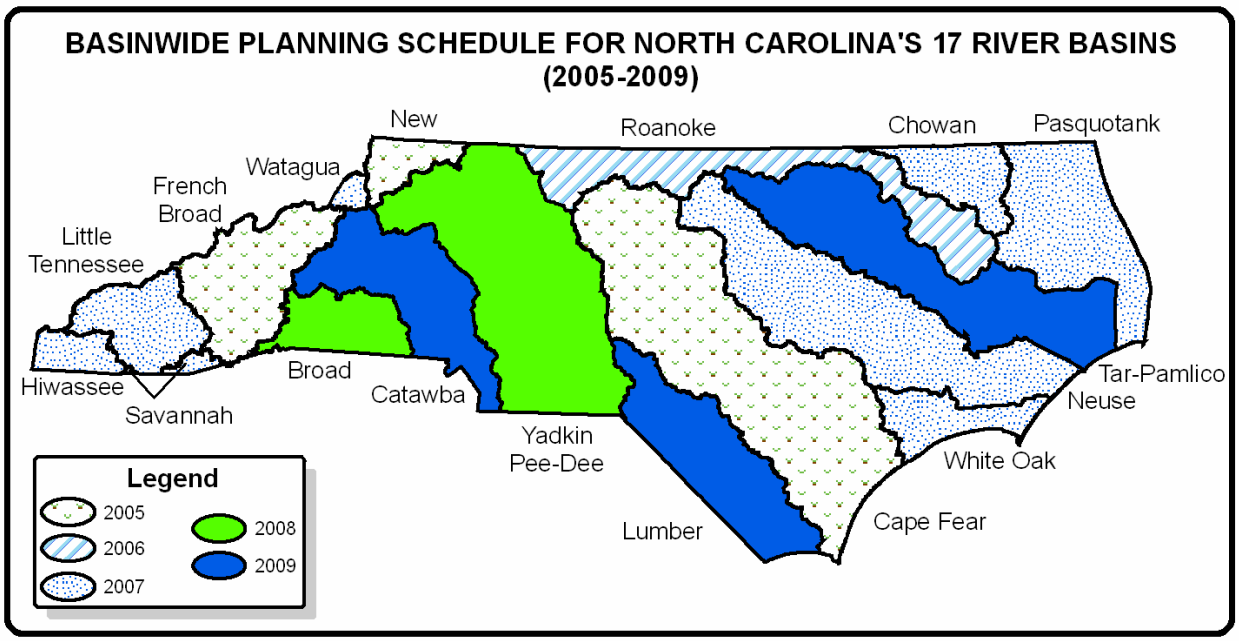


Planning Section
Basinwide Planning Unit
February 23, 2007

What is Basinwide Water Quality Planning?

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. The NC Division of Water Quality (DWQ) prepares Basinwide water quality plans for each of the seventeen major river basins in the state (Figure 1 and Table 1). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 2). While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups throughout the state. The first cycle of plans was completed in 1998. Each plan is updated at five-year intervals.

Figure 1 Basinwide Planning Schedule (2005 to 2009)



Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- Identify water quality problems and restore full use to Impaired waters.
- Identify and protect high value resource waters.
- Protect unimpaired waters yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.
- Assure equitable distribution of waste assimilative capacity for discharges.

- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.
- Regulate point and nonpoint sources of pollution where other approaches are not successful.

Benefits of Basinwide Water Quality Planning

Basinwide planning and management benefits water quality by:

- Focusing resources on one river basin at a time.
- Using sound ecological planning and fostering comprehensive NPDES permitting by working on a watershed scale.
- Ensuring better consistency and equitability by clearly defining the program's long-term goals and approaches regarding permits and water quality improvement strategies.
- Fostering public participation to increase involvement and awareness about water quality.
- Integrating and coordinating programs and agencies to improve implementation of point and nonpoint source pollution reduction strategies.

How You Can Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. You may contact the basinwide planner responsible for your basin anytime during the plan's development. Upon request, the basin planner can also present water quality information and basin concerns to local stakeholder groups.

To make the plan more inclusive, DWQ is coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS), and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can also be involved during the planning process by contacting their county extension service or local SWCD.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate.

Division of Water Quality Functions and Locations

For more information on the basinwide planning process, DWQ activities, or contacts, visit www.ncwaterquality.org/basinwide/ or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. You can also contact the appropriate Regional Office (Figure 2) for additional information. For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

Table 1 Basinwide Planning Schedule (2004 to 2011)

Basin	DWQ Biological Data Collection	Draft Out For Public Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2005	7/2007	9/2007	11/2007
Pasquotank	Summer 2005	7/2007	9/2007	12/2007
Neuse	Summer 2005	11/2007	3/2008	1/2008
Broad	Summer 2005	3/2008	5/2008	7/2008
Yadkin-Pee Dee	Summer 2006	3/2008	5/2008	9/2008
Lumber	Summer 2006	3/2008	5/2008	7/2009
Tar-Pamlico	Summer 2007	3/2009	5/2009	9/2009
Catawba	Summer 2007	3/2009	5/2009	12/2009
French Broad	Summer 2007	3/2009	5/2009	7/2010
New	Summer 2008	6/2010	5/2010	1/2011
Cape Fear	Summer 2008	6/2010	9/2010	2/2011
Roanoke	Summer 2004	7/2006	9/2006	1/2007
White Oak	Summer 2004	3/2007	5/2007	6/2007
Savannah	Summer 2004	1/2007	3/2007	8/2007
Watauga	Summer 2004	11/2006	1/2007	9/2007
Hiwassee	Summer 2004	1/2007	3/2007	8/2007
Little Tennessee	Summer 2004	1/2007	3/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the second cycle (1998 to 2003).

Table 2 Five-Year Planning Process for Development of an Individual Basinwide Plan

Years 1 – 2 **Water Quality Data Collection and Identification of Goals and Issues**	• Identify sampling needs • Conduct biological monitoring activities • Conduct special studies and other water quality sampling activities • Coordinate with local stakeholders and other agencies to continue to implement goals within current basinwide plan
Years 2 – 3 **Data Analysis and Collect Information from State and Local Agencies**	• Gather and analyze data from sampling activities • Develop use support ratings • Conduct special studies and other water quality sampling activities • Work with state and local agencies to establish goals and objectives • Identify and prioritize issues for the next basin cycle • Develop preliminary pollution control strategies • Coordinate with local stakeholders and other state/local agencies
Years 3 – 5 **Preparation of Draft Basinwide Plan, Public Review, Approval of Plan, Issue NPDES Permits, and Begin Implementation of Plan**	• Develop draft basinwide plan based on water quality data, use support ratings, and recommended pollution control strategies • Circulate draft basinwide plan for review and present draft plan for public review • Revise plan (when appropriate) to reflect public comments • Submit plan to Environmental Management Commission for approval • Issue NPDES permits • Coordinate with other agencies and local interest groups to prioritize implementation actions • Conduct special studies and other water quality sampling activities

Reference Materials

There are several reference documents and websites that provide additional information about basinwide planning and the basin's water quality. These include:

- *Supplemental Guide to North Carolina's Watershed Planning: Support Document for Basinwide Water Quality Plans* (January 2007). This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. This document can be viewed at website: http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm .
- *Chowan River Basinwide Assessment Report* (April 2006). This technical report presents physical, chemical, and biological data collected in the Chowan River basin. This report can be found on the DWQ Environmental Sciences Section (ESS) website: http://www.ncwaterquality.org/esb/bar.html.
- *Chowan River Basinwide Water Quality Plan* (September 1997; July 2002). These first basinwide plans for the Chowan River basin present water quality data, information, and recommended management strategies for the first two five-year cycles.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description* (Creager and Baker, 1991). NC DWQ Water Quality Section. Raleigh, NC.

How to Read the Basinwide Plan

Chapters 1 - 4: Subbasin and Watershed Information

Summarizes information and data by subbasin, including:

- **Recommendations from the previous basin plan**
- **Achievements, current priority issues and concerns**
- **Impaired waters and water with notable impacts**
- **Goals and recommendations for the next five years by subbasin**

Chapter 5 – 11

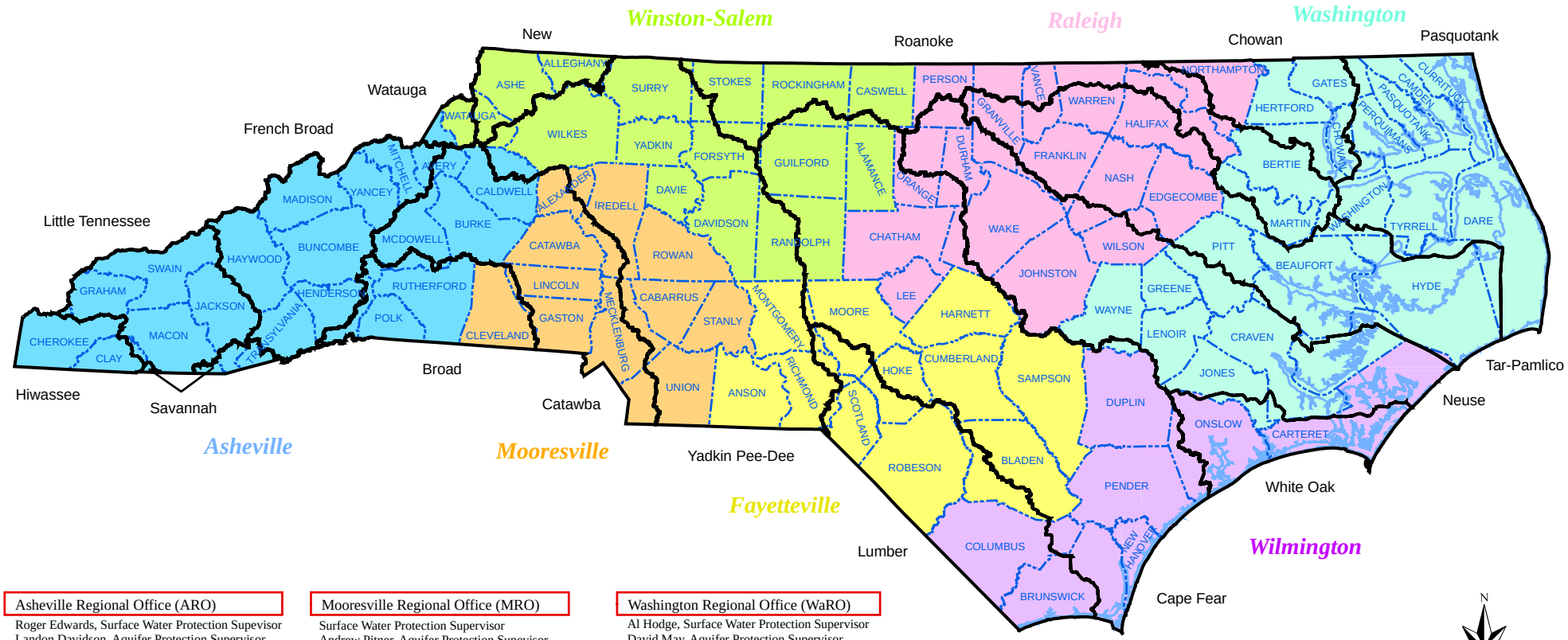
Presents information on various topics of interest to the protection and restoration of water quality in the basin, including:

- **Stream classifications**
- **Water quality stressors**
- **Population and land cover changes**
- **Agricultural, forestry, water and natural resources**
- **Permitting activities in the basin**
- **Local, State and Federal initiatives**
- **Managing Impaired waters and TMDL process**

Appendices

- **Water quality data collected by DWQ**
- **Use support methodology**
- **NPDES discharger, non-discharge and general stormwater permits**
- **Points of contact**
- **Glossary of terms and acronyms**

North Carolina Department of Environment and Natural Resources
Division of Water Quality Regional Offices



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Buncombe	Henderson	Rutherford
Burke	Jackson	Swain
Caldwell	Macon	Transylvania
Cherokee	Madison	Yancey
Clay	McDowell	
Graham	Mitchell	

Mooresville Regional Office (MRO)

Surface Water Protection Supervisor
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Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

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Beaufort	Gates	Pamlico
Bertie	Greene	Pasquotank
Camden	Hertford	Perquimans
Chowan	Hyde	Pitt
Craven	Jones	Tyrrell
Currituck	Lenoir	Washington
Dare	Martin	Wayne

Winston-Salem Regional Office (WSRO)

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Alamance	Forsyth	Watauga
Alleghany	Guilford	Wilkes
Ashe	Randolph	Yadkin
Caswell	Rockingham	
Davidson	Stokes	
Davie	Surry	

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Columbus	Pender
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NCDENR

Planning Section
Basinwide Planning Unit
January 2007

Chapter 1
Chowan River Subbasin 03-01-01

Including: Chowan River (Upper), Wiccacon River, Ahoskie Creek and Bennetts Creek (Merchants Millpond)

1.1 Subbasin Overview

Subbasin 03-01-01 at a Glance

Land and Water Area

Total area:	579 mi²
Land area:	569 mi²
Water area:	10 mi²

Land Cover (percent)

Forest/Wetland:	73%
Cultivated Crop:	24%
Surface Water:	2%
Urban:	<1%
Pasture/ Managed Herbaceous:	1%

Counties

Bertie, Gates and Hertford

Municipalities

Ahoskie, Aulander, Cofield, Como, Gatesville and Winton

Monitored Waterbody Statistics

Aquatic Life:

Total:	137.7 mi
Total Supporting:	70.6 mi
Total Not Rated:	44.6 mi
Total Impaired:	22.5 mi

Recreation:

Total:	39.8 mi
Total Supporting:	39.8 mi

The upper Chowan River subbasin is located in the Middle Atlantic Coastal Plains ecoregion of North Carolina. The Chowan River is formed at the border of Virginia and North Carolina by the confluence of the Nottoway and Blackwater Rivers. It then flows southeastward toward Albemarle Sound. The Chowan River basin includes 1,315 square miles in North Carolina, but the largest part of the drainage basin (3,575 mi^2) drains from Virginia. Major tributaries to the Chowan River in this subbasin include the Wiccacon River and Ahoskie Creek. A map of this subbasin including water quality sampling locations is presented as Figure 3.

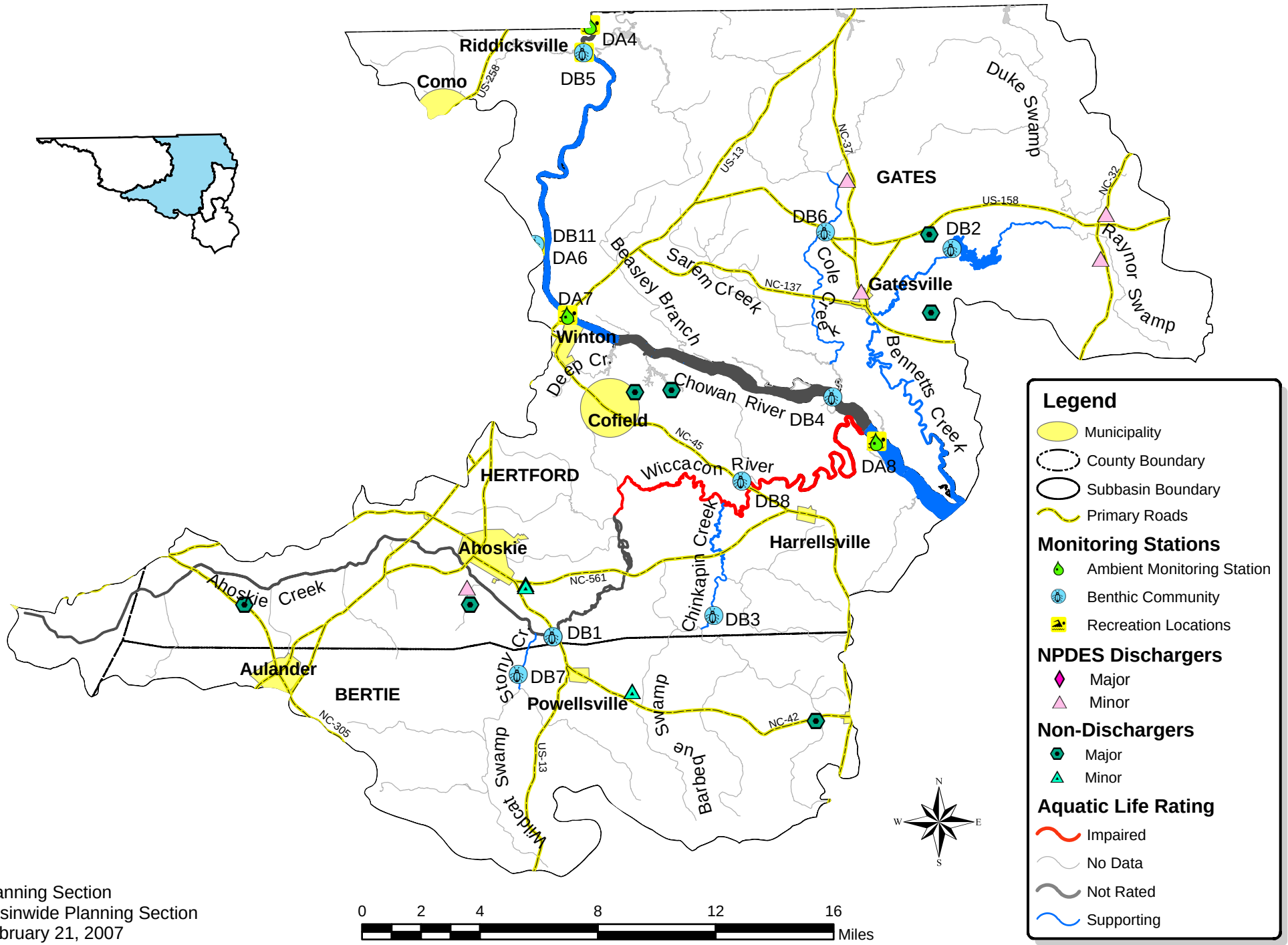
Portions of Merchants Millpond State Park and Chowan Swamp State Natural Area are also located in this subbasin. The Chowan Swamp State Natural Area, administered by the Division of Parks and Recreation, protects more than 6,000 acres. Merchants Millpond supports a diverse assemblage of aquatic plants including several rare species.

The largest municipalities in this subbasin include Ahoskie, Aulander, and Winton. Based on 2000 census data, Winton's population grew 20 percent since 1990, but the other municipalities' populations declined. Refer to Chapter 8 for more information about population growth and trends.

There are five minor National Pollutant Discharge Elimination System (NPDES) wastewater discharge permits in this subbasin with a total permitted flow of 0.04 MGD. The largest facility is Aluminum Casting Technology in Hertford County. Aluminum Casting Technology, permitted to discharge 0.024 MGD of industrial process and commercial waste into Ahoskie Creek (Section 1.4.3), has discontinued its operation and will likely apply to rescind its NPDES permit. There are ten non-discharge permits and nine stormwater permits in this subbasin. Refer to Appendix III for the listing of NPDES permit holders.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 3. Table 3 contains a summary of monitored waterbodies with their associated assessment unit numbers (AU#) and lengths, monitoring data types, locations and results, along with use support ratings.

Figure 3 Chowan River Subbasin 03-01-01



Planning Section
Basinwide Planning Section
February 21, 2007

Table 3 CHO Subbasin 03-01-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Ahoskie Creek (Ahoskie Swamp, Bear Swamp)													
25-14-1	C;NSW	33.3 FW Miles		**NR**									
	From source to Wiccacon River				DB1	NR	2005					Nutrient Impacts	WWTP NPDES
					DB1	NR	2005					Habitat Degradation	Agriculture
Bennetts Creek (Merchants Millpond)													
25-17	C;NSW	23.3 FW Miles		**S**									
	From source to Chowan River				DB2	M	2005						
Chinkapin Creek (Cessons Millpond)													
25-14-3	C;NSW	7.1 FW Miles		**S**									
	From source to Wiccacon River				DB3	N	2005						
CHOWAN RIVER													
25a1	B;NSW	1.8 FW Miles		**NR+**	DA1	NCE			**S**	DA1	NCE	Low Dissolved Oxygen	Unknown
					DA2	NCE				DA2	NCE		
					DA3	CE	Low DO	15.1		DA3	NCE		
					DA4	NCE	Low DO	9.3		DA4	NCE		
	From North Carolina-Virginia State Line to near Riddicksville				DB5	G	2005						
25a2a	B;NSW	24.4 FW Miles		**S**	DA7	NCE			**S**	DA7	NCE		
	From near Riddicksville to Deep Creek												
25a2b	B;NSW	9.5 FW Miles		**NR+**					**S**				
	From Deep Creek to Wiccacon River				DB4	F	2005						
25a2c	B;NSW	4.1 FW Miles		**S**	DA8	NCE			**S**	DA8	NCE		
	From Wiccacon River to the subbasin 03-01-01/03-01-03 boundary												

Table 3 CHO Subbasin 03-01-01

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Cole Creek (Lilleys Millpond)													
25-12-7	C;NSW	9.5	FW Miles	**S**					**NR**			Nutrient Impacts	Agriculture
From source to Sarem Creek					DB6	M	2005					Low Dissolved Oxygen	Agriculture
												Total Suspended Solids	WWTP NPDES
												Fecal Coliform Bacteria	WWTP NPDES
Stony Creek													
25-14-1-6	C;NSW	2.2	FW Miles	**S**									
From source to Ahoskie Creek					DB7	M	2005						
Wiccacon River (Hoggard Swamp)													
25-14	C;NSW	22.5	FW Miles	**I**								Habitat Degradation	Unknown
From source to Chowan River					DB8	F	2005					Nutrient Impacts	Agriculture
												Low Dissolved Oxygen	Unknown

Table 3 CHO Subbasin 03-01-01

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:	**Monitoring data type:**	**Results:**	**Use Support Ratings 2005**:
AL - Aquatic Life	DF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	DB - Benthic Community Survey	G - Good	NR - Not Rated
	DA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	DL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	NR+-Not Rated because draft criteria used for rating
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M- Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S- Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	70.6	FW Miles
NR	m	11.3	FW Miles
NR	m	33.3	FW Miles
I	m	22.5	FW Miles
		278.5	FW Miles

Recreation Rating Summary

S	m	39.8	FW Miles
NR	e	9.5	FW Miles
		367.0	FW Miles

Fish Consumption Rating Summary

I	e	416.3	FW Miles

There were eight benthic macroinvertebrate samples collected during this assessment period. Six of the sites sampled in 2005 were also sampled in 2000. Overall, conditions in the subbasin appear similar to the samples collected in 2000; however, four sites showed a decrease in biotic index. Sites sampled indicated better water quality in the upper Chowan River than in the Wiccacon River or the middle reaches of the Chowan River near Gatesville. The benthic sample collected in the Wiccacon River indicated problems associated with nutrient enrichment and low dissolved oxygen.

All of the basinwide swamp streams in this subbasin were sampled at least twice. Three of the four streams sampled during the winter period rated Moderate in 2005. No swamp water quality trends were identified. Data were also collected from four ambient monitoring stations. Refer to the *2006 Chowan River Basinwide Assessment Report* (http://www.ncwaterquality.org/esb/Basinwide/ChowanBASINWIDEFinal.pdf) and Appendix I for more information on monitoring.

All waters in this subbasin receive the supplemental classification of Nutrient Sensitive Waters (NSW) in addition to the primary classification of Class C or Class B. See Chapter 5 for more information on water classifications.

Waters in the following sections and in Table 3 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

1.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Refer to Table 4 for a summary of use support for waters in subbasin 03-01-01.

In this subbasin, use support was assigned for aquatic life, recreation, and fish consumption categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS).

Table 4 Summary of Use Support Ratings by Category in Subbasin 03-01-01

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	70.6 mi	39.8 mi
Impaired*	22.5 mi (16.3%)	0
Not Rated	44.6 mi	0
Total	**137.7 mi**	**39.8 mi**
Unmonitored Waters		
Not Rated	0	9.5 mi
No Data	278.5 mi	376.0 mi
Total	**278.5 mi**	**376.5 mi**
All Waters	**416.2 mi**	**416.3 mi**

* The noted percent Impaired is the percent of monitored mile/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website:

http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm. Appendix V provides definitions of the terms used throughout this basin plan.

1.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 11.

1.3.1 Chowan River [AU# 25a1, a2a, a2b, a2c]

2002 Status
The Chowan River was listed on the 2002 and 2004 303(d) list of impaired waters for low dissolved oxygen (DO). Potential sources included agriculture and intensive animal feeding operations. Through the Albemarle-Pamlico National Estuary Program, North Carolina signed a Memorandum of Agreement (MOA) with the Virginia Department of Conservation and Recreation to reduce nutrient levels crossing the state line and facilitate discussions to protect and restore water quality along the coastal rivers and sounds. It was recommended that DWQ continue to participate in the MOA and include the upper Chowan River in a swamp water study plan to determine natural DO and pH levels in the river.

Current Status
The upper Chowan River [AU# 25a1], from the Virginia-North Carolina state line to near Riddicksville (1.8 miles), is Not Rated^{+} in the aquatic life category. Site DB5 was sampled using draft criteria for Coastal B Rivers. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. Boat sampling is required for these waters. Site DB5 received a Good benthic bioclassification based on draft criteria for Coastal B rivers. Any bioclassification derived from sampling data should be considered draft and not used for use support decisions; therefore the upper Chowan River is Not Rated (BAU, July 2006).

The four ambient monitoring stations in this subbasin are located in the upper Chowan watershed. Three of these ambient stations are located in Virginia. The fourth is located near Riddicksville, near the benthic sampling site. The sampling locations are approximately one mile downstream of the confluence of the Blackwater and Nottoway Rivers. The drainage area above the sampling point is over 2,400 square miles. The substrate of this large, slow-moving coastal river is mostly sand with some silt. Riparian vegetation appeared natural and undisturbed and the stream banks were stable. No water quality standards were exceeded at the ambient station near Riddicksville (DA4); however, the water quality standard for dissolved oxygen was exceeded near the confluence of the Nottaway and Blackwater Rivers (DA3). This exceedence is likely associated with swamp water drainage and is considered a natural condition. No water quality standards were exceeded further upstream on the Nottaway (DA1) or Blackwater (DA2) Rivers in Virginia. Heavy flooding events have been noted as a reoccurring problem on the

Virginia side of the Chowan River basin. This may be associated with the development and the loss of permeable surface.

The Chowan River [AU# 25a2b], from Deep Creek to the Wiccacon River (9.5 miles), is Not Rated^{+} in the aquatic life category. A Fair benthic bioclassification at site DB4 was given based on draft criteria for Coastal B rivers. This is a decrease of two bioclassifications from the Good rating it received in 2000. In 2000 and 2005, the benthic site was rated on draft criteria for Coastal B rivers. The Gatesville site is located approximately 15 miles downstream of the Riddicksville site, and approximately three miles upstream of where the Wiccacon River joins the Chowan. The drainage area is over 2,500 square miles. This sampling area is within one mile downstream of CF Industries and Nucor Corporation. Currently, CF Industries, a closed fertilizer plant superfund site, is being monitored and considered stable. This section of the river is very different from the Riddicksville site mostly because of the slower velocities and a notably greater depth in the channel. Benthic substrate consisted of mostly sand with some silt, and both banks were dominated by forested wetlands.

Two other segments (AU#s 25a2a and 25a2c) are Supporting due to no criteria exceeded at ambient stations DA7 and DA8.

2007 Recommendations

DWQ recommends that the upper Chowan River [AU# 25a1] be removed from the 2008 303(d) list of impaired waters for water quality standards. Ambient monitoring indicates that no criteria were exceeded beyond natural conditions. Benthic sampling also shows that the biological community has improved since the previous assessment period. Increased interaction and cooperation with Virginia Department of Conservation and Recreation is necessary to develop appropriate strategies to manage potential pollutant runoff associated with increased flooding events in the upper watershed.

1.3.2 Wiccacon River (Hoggard Swamp) [AU# 25-14]

2002 Status

The Wiccacon River was listed on the 2002 and 2004 303(d) list of impaired waters for aquatic life. Potential sources were not identified; however, the watershed consists primarily of agricultural land and many of the tributaries have been channelized throughout the years. DWQ recommended the implementation of nonpoint source best management practices (BMPs) to reduce nutrient and sediment loads.

Current Status

The Wiccacon River (Hoggard Swamp), from source to the Chowan River (22.5 miles), is Impaired in the aquatic life category due to a Fair bioclassification at site DB8. A total of eight benthic samples have been collected from the Wiccacon River since 1983, with all eight samples remaining Fair and/or Poor. Benthic species collected in 2005 suggested nutrient enrichment, degraded water quality and low dissolved oxygen. Further evidence of low dissolved oxygen in the river was the abundance of freshwater sponges growing on snags in both 2000 and 2005.

The sample site for the Wiccacon River is located near a NC Wildlife Resources Commission boat ramp off SR 1433. The drainage area (253 sq mi.) is partially channelized and ditched. The water is cloudy and has a tannic color and conditions reflect an ongoing algal bloom. Benthic substrate is dominated by silt and clay with a small amount of gravel present.

Farming activities are considered more intense here than in other areas of the basin, with predominantly poultry and hog operations. Within in the Wiccacon River watershed, there are 13 poultry operations, with eight of them having poultry litter drystacks, five without drystacks and one is planned for installation in 2007. There are five operating swine facilities and one facility is in the process of closure. Conservation Reserve Enhancement Program (CREP) has contracted to maintain over 851 acres in trees for at least five years within this watershed.

2007 Recommendations

This segment of the Wiccacon River will remain on the draft 2008 303(d) list of impaired waters and will be placed on a schedule for TMDL development. DWQ continues to recommend the use of nonpoint source BMPs to reduce nutrient and sediment loads. Funds should be appropriated to encourage more traditional BMPs (strip planting, no-till, cover crops) and new technologies. DWQ will work closely with other resource agencies to prioritize implementation of efforts to address agriculture impacts within this watershed.

1.4 Status and Recommendations for Waters with Noted Impacts

Based on DWQ's most recent use support methodologies, the surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Refer to Section 1.1 for more information about AU#. Nonpoint source program agency contacts are listed in Appendix IV.

1.4.1 Cole Creek (Lilley's Millpond) [AU# 25-12-7]

Cole Creek, from source to Sarem Creek (9.5 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site DB6. This is the same rating it received in 2000; however, benthic species collected during the 2005 biological sampling indicated nutrient enrichment and lower dissolved oxygen levels. Significant noncompliance issues were also identified at the permitted wastewater treatment facility for Buckland Elementary School (Gates County Schools Permit NC0043974). Levels for total suspended solids (TSS) and fecal coliform bacteria exceeded permit limits during the last two years of the assessment period.

The sampling location of Cole Creek at US 158 in 2000 was erroneously labeled as NC 58 in the prior basinwide report. This swamp stream was sampled at the same location in 2005. It is an eastern tributary of Sarem Creek, and has a braided channel that flows into a single cut (approximately five to seven meters wide) before flowing under US 158. In the past, the creek has been straightened and channelized (>2 meters deep) from this channel cut downstream. The swamp above this point appears to be in a more natural condition, averaging 0.5 to 1 meter in depth. The drainage area here is 32 square miles. The landscape and lack of flow causes this creek to appear lake-like (>20 meters wide) before exiting through an artificial cut. Thick

filamentous algae had formed on woody surfaces such as logs and tree trunks. The benthic surface was a muck of silt and clay.

2007 Recommendations
DWQ will continue to work with the County School System to improve the function and compliance of the permitted WWTP. Agriculture and forestry BMPs are encouraged to limit nutrient and sediment runoff from these predominant land use activities in Cole Creek's watershed. Residential development has increased in this watershed, creating the potential to increase water quality degradation associated with residential areas (e.g., impervious surface runoff, ineffective sewage treatment, lawn runoff). Local governments and agencies are encouraged to proactively plan and implement conservation strategies to prevent water quality degradation.

1.4.2 Ahoskie Creek [AU# 25-14-1]

Ahoskie Creek (Bear Swamp), from source to the Wiccacon River (33.3 miles), is Not Rated in the aquatic life category due to Not Rated benthic bioclassifications at site DB1. Ahoskie Creek was sampled twice in 2005 – once in February during the swamp sampling period and once in August during the summer basinwide sampling period. The stream was rated based on swamp criteria in the past (1995), but due to its transitional nature (from Coastal A to Swamp), a Not Rated bioclassification was assigned until additional data can be collected from this site.
This section of Ahoskie Creek is located at NC 42 and has a drainage area of 125 square feet. The stream has deep carvings and lacks in-stream habitat such as logs, snags and leaf packs. Along one side of the channelized stream, the riparian zone showed little to no native woody vegetation. The benthic substrate was made up of sand.

2007 Recommendations
The Town of Ahoskie holds Permit No. WQ0003855 for the continued operation of a 901,000 GPD wastewater treatment and disposal system that utilizes spray irrigation for disposal purposes. The spray irrigation fields are incapable of handling the amount of wastewater that is land applied. Because the hydraulic loading rates are higher than what the fields can accept, significant runoff occurs. Recent investigations report average daily runoff to be approximately 200,000 to 300,000 GPD. Ahoskie Creek is the receiving waterbody for the runoff. Ahoskie currently operates the facility under a Special Order by Consent due to the inability to maintain permit compliance. Ahoskie has evaluated multiple alternatives or potential modifications to bring the facility into compliance. However, no simple solution has been identified. Improving inflow and infiltration will aid in eliminating non-wastewater from being processed by the WWTP. DWQ will continue to work with the town to develop appropriate long-term wastewater treatment facilities. As of July 2007, a draft permit for the Town of Ahoskie has been issued for discharge into Ahoskie Creek.

The Town of Powellsville received a Clean Water Management Trust Fund grant to construct a wastewater treatment facility that will help reduce pollutant delivery to Ahoskie Creek. The project is to eliminate 168 failing septic tanks in the town by constructing a collection system and land application waste treatment facility.

1.4.3 Stony Creek [AU# 25-14-1-6]

Stony Creek, from source to Ahoskie Creek (2.2 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site DB7. This is the same bioclassification it received in 2000 where no serious water quality problems were identified. As in 2000, no serious water quality problems were identified in 2005 and the biological community did not indicate nutrient enrichment or low dissolved oxygen problems. There were even a few aquatic species that are unique to the Chowan River basin.

Stony Creek is a southern tributary of Ahoskie Creek and drains an area of 39 square miles. The habitat in this stream includes extensive cypress wetlands adjacent to the stream on both banks. This watershed has active forestry operations and clear-cutting can be seen on the eastern riparian zone of this site. The benthic surface consists of about 95 percent silt and fine particles and five percent sand particles.

1.4.4 Bennetts Creek (Merchants Millpond) [AU# 25-17]

Bennetts Creek (Merchants Millpond) was not sampled during the last assessment period; however, aquatic weeds were a noted impact in the 1997 basinwide water quality plan. Bennetts Creek was sampled as part of a special study requested by the DWQ Washington Regional Office (WaRO) during this assessment period to assess biological water quality conditions.

Bennetts Creek (Merchants Millpond), from source to the Chowan River (23.3 miles) is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site DB2, with the lowest total taxa of any stream or river in the Chowan River basin. The benthic community represented a highly pollution tolerant community. Three permitted dischargers (Gatesville and T.S. Cooper Elementary and Sunbury Primary Schools) are located in this watershed and all have a history of noncompliance.

The sampling location of Bennett's Creek is just below the outfall of the millpond, downstream of SR 1400, and drains an area of 74 square miles. The sampling of this site was done in February 2005 (during the swamp sampling period) upstream of one discharger (Gatesville Elementary School WWTP), but downstream of the other two.

The biological community in Bennetts Creek did not contain pollution intolerant species as were found in similar streams nearby. DWQ was unable to determine to what extent the millpond itself was affecting the biological community. Impoundments such as a millpond can result in downstream reaches having lowered dissolved oxygen levels and flows, as well as increased temperatures. In winter, those affects are minimized and this sampling effort would likely not have recorded these effects. Also, the large size of the millpond relative to Bennetts Creek could act as a sink for upstream pollutants and mask the effects from the two dischargers noted above.

2007 Recommendations

Infrastructure and flow problems have been resolved with the Gatesville schools. Gates County middle and high schools have tied into the Department of Correction Prison non-discharge system (WQ0000267). Gully formation outside the facility shows signs of effluent leaking (runoff) to surface waters. Better management of sprayfield operations is needed to help meet compliance standards. DWQ recommends the facility seek additional land to expand sprayfield application and to assess and manage for the amount of flows received from the schools.

Agriculture and forestry are the predominant land use activities in this watershed and the SWCD has identified this drainage as an area of concern. Implementation of agricultural BMPs are needed to continue to protect the waters of Bennett Creek, a popular recreational area.

Chapter 2
Chowan River Subbasin 03-01-02
Including: Meherrin River, Cutawhiskie Swamp and Potecasi Creek

2.1 Subbasin Overview

Subbasin 03-01-02 at a Glance

Land and Water Area

Total area:	494 mi²
Land area:	491 mi²
Water area:	3 mi²

Land Cover (percent)

Forest/Wetland:	65%
Cultivated Crop:	32%
Surface Water:	<1%
Urban:	<1%
Pasture/ Managed Herbaceous:	1%

Counties

Hertford and Northampton

Municipalities

Como, Conway, Murfreesboro, Rich Square, Seaboard, Severn and Woodland

Monitored Waterbody Statistics

Aquatic Life:

Total:	99.3 mi
Total Supporting:	49.6 mi
Total Not Rated:	49.7 mi

Recreation:

Total:	54.2 mi
Total Supporting:	54.2 mi

Subbasin 03-01-02 contains the Meherrin River and its tributaries, but much of the river's catchment is in Virginia. Major tributaries to the Meherrin River include Potecasi and Kirbys Creeks. This subbasin is located in the Middle Atlantic Plain and the Southeastern Plain ecoregions and contains 494 square miles.

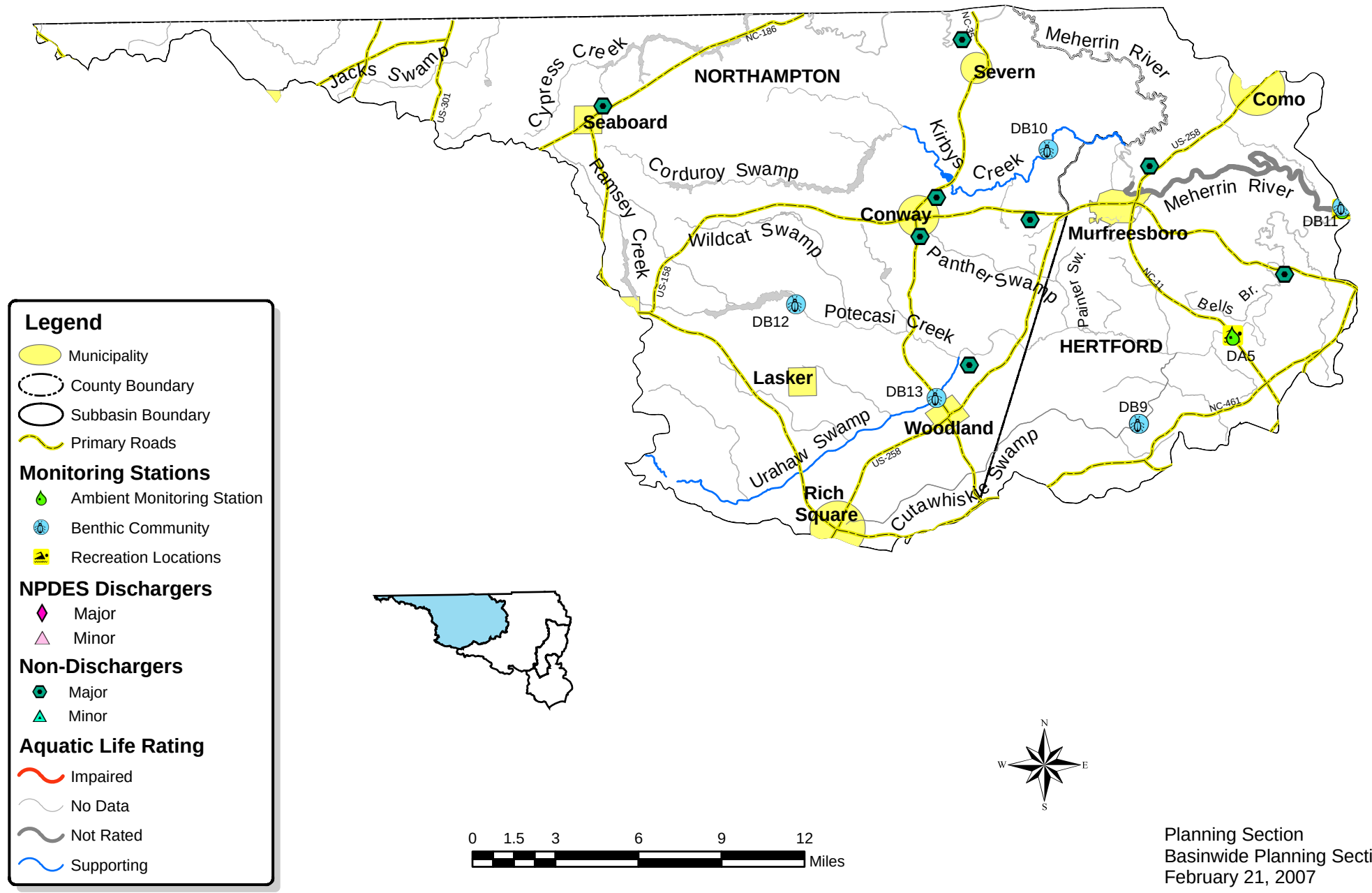
Significant natural heritage areas are located within the watershed, including the Meherrin River Swamp and Meherrin River Slopes and Swamp. Most of the land within this subbasin is forested, but cropland and pasture are also common. Aquatic habitats include streams that have been channelized and/or swamp areas that cease to flow during dry periods and are expected to have very low dissolved oxygen levels during low-flow periods. The northern part of the subbasin contains well-drained, loamy soils, while to the south there are poorly drained clay soils. These regional differences can have substantial effects on both the amount of direct runoff into streams and stream flows throughout the year.

Agriculture waste management is of particular concern in this subbasin. Efforts need to be taken to properly manage poultry application and to provide covered poultry litter storage. Maintaining adequate storage capacity in lagoons to accommodate for high rainfall events also needs to be improved upon. BMP inspections need to occur to ensure the BMPs are properly functioning and to identify areas requiring design improvements.

The largest municipalities in this subbasin include Murfreesboro and Rich Square. Each of these municipalities experienced a net decline in population over the 1990 to 2000 time period. Additional information regarding population and land use changes can be found in Chapter 8. There are no permitted wastewater dischargers in this subbasin, but there are nine permitted stormwater discharges. There are eight non-discharge facilities; four have had direct discharges resulting from storm events, run-off, or continued inability to comply with permit conditions. See Appendix III for a list of NPDES permits.

A map including the locations of the water quality monitoring stations is presented in Figure 4. Table 5 contains a summary of monitored waterbodies with their associated assessment unit numbers (AU#) and lengths, monitoring data types, locations and results, along with use support ratings for waters in the subbasin.

Figure 4 Chowan RIver Subbasin 03-01-02



Planning Section
Basinwide Planning Section
February 21, 2007

Table 5 CHO Subbasin 03-01-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Cutawhiskie Swamp													
25-4-8-8	C;NSW	17.0 FW Miles		**NR**								Habitat Degradation	Unknown
	From source to Potecasi Creek				DB9	NR	2005						
					DB9	NR	2005						
Kirbys Creek													
25-4-4	C;NSW	13.7 FW Miles		**S**									
	From source to Meherrin River				DB10	M	2005						
Meherrin River													
25-4-(5)	B;NSW	11.7 FW Miles		**NR+**	DA6	NCE			**S**	DA6	NCE		
	From a point 1.0 mile upstream from U.S. Highway 258 to Chowan River				DB11	GF	2005						
Potecasi Creek													
25-4-8a	C;NSW	21.5 FW Miles		**S**					**S**				
	From source to Cutawhiskie Creek				DB12	M	2005						
25-4-8b	C;NSW	21.0 FW Miles		**NR**	DA5	CE	Low DO	25.4	**S**	DA5	NCE	Low pH	Natural Conditions
					DA5	CE	Low pH	22				Low Dissolved Oxygen	Natural Conditions
	From Cutawhiskie Creek to Meherrin River												
Urahaw Swamp													
25-4-8-4	C;NSW	14.4 FW Miles		**S**									
	From source to Potecasi Creek				DB13	M	2005						

Table 5 CHO Subbasin 03-01-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2005:
AL - Aquatic Life	DF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	DB - Benthic Community Survey	G - Good	NR - Not Rated
	DA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	DL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	NR+-Not Rated because draft criteria used for rating
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M- Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S- Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	49.6	FW Miles
NR	m	11.7	FW Miles
NR	m	38.0	FW Miles
		187.3	FW Miles

Recreation Rating Summary

S	m	54.2	FW Miles
		232.3	FW Miles

Fish Consumption Rating Summary

I	e	286.5	FW Miles

There were five benthic macroinvertebrate samples collected in this subbasin during this assessment period. Overall, biological data shows little change in the benthic communities since the basin was last sampled in 2000; however, ambient monitoring shows that Potecasi Creek (AU# 25-4-8b) is not meeting water quality standards for dissolved oxygen or pH. Refer to the *2006 Chowan River Basinwide Assessment Report* (http://www.ncwaterquality.org/esb/Basinwide/ChowanBASINWIDEFinal.pdf) and Appendix I for more information on monitoring.

All waters in this subbasin have the supplemental classification of Nutrient Sensitive Waters (NSW) in addition to the primary classification of Class C or Class B. See Chapter 5 for more information on water classifications.

Waters in the following sections and in Table 5 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

2.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Refer to Table 6 for a summary of use support for waters in subbasin 03-01-02.

Table 6 Summary of Use Support Ratings by Category in Subbasin 03-01-02

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	49.6 mi	54.2 mi
Not Rated	49.7 mi	0
Total	**99.3 mi**	**54.2 mi**
Unmonitored Waters		
No Data	187.3 mi	232.3 mi
Total	**187.3 mi**	**232.3 mi**
All Waters**	**286.6 mi**	**286.5 mi**

* The noted percent Impaired is the percent of monitored mile/acres only.
**Total Monitored + Total Unmonitored = Total All Waters.

In subbasin 03-01-02, use support was assigned for aquatic life, recreation and fish consumption categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS).

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website: http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm. Appendix V provides definitions of the terms used throughout this basin plan.

2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 11.

2.3.1 Potecasi Creek [AU# 25-4-8a and AU# 25-4-8b]

2002 Status
The entire length of Potecasi Creek (from source to the Meherrin River) was listed on the 2002 and 2004 303(d) list of impaired waters for aquatic life. Water quality standards for dissolved oxygen (DO) and pH were violated and potential sources included agricultural land use. DWQ recommended that Potecasi Creek be included in a Swamp Waters Study Plan to determine if the low DO and pH were associated with naturally occurring swamp conditions.

Current Status
Upper Potecasi Creek [AU# 25-4-8a], from source to Cutawhiskie Creek (21.5 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site DB12. This location was Not Rated when sampled in 2000. Both the 2000 and 2005 samples used the Swamp criteria. Unlike other swamp sites that have been channelized, Potecasi Creek exhibits natural channel morphology, intact riparian zones with a mature forest on either side, and a large percentage of the reach is available for benthic colonization. Potecasi Creek has a drainage area of 32 square miles at site DB12.

Lower Potecasi Creek [AU# 25-4-8b], from Cutawhiskie Creek to Meherrin River (21.0 miles), is Not Rated in the aquatic life category due to water quality standards violations at the ambient monitoring station DA5 that are likely due to natural swamp conditions. Site DA5 was sampled 59 times over the course of the five-year assessment period. Over 44 percent of the samples were below 5.0 mg/l and over 25 percent were below the 4.0 mg/l standard for dissolved oxygen. The pH was below the standard of 6.0 s.u. in 22 percent of the samples.

2007 Recommendations
DWQ recommends that the upstream portion of Potecasi Creek [AU# 25-4-8a] be removed from the 2008 303(d) list of impaired waters. Potecasi Creek [AU# 25-4-8b], from Cutawhiskie Creek to Meherrin River should remain on the 303(d) list for water quality standards violations for dissolved oxygen and pH, until it can be further determined that these conditions represent natural swamp drainage. Agriculture and intensive livestock operations are potential sources of water quality impacts and therefore BMPs need to be encouraged and implemented.

2.3.2 Bells Branch [AU# 25-4-8-10] and Painter Swamp [AU# 25-4-8-5]

2002 Status
Bells Branch, from source to Potecasi Creek (4.8 miles), and Painter Swamp, from source to Potecasi Creek (3.7 miles), were both listed on the 2002 and 2004 303(d) list of impaired waters for biological integrity. These are historic listings from 1998.

2007 Recommendations
Bells Branch and Painter Swamp will be recommended for removal from the 2008 303(d) list of impaired waters because the waters were likely inappropriately labeled as impaired for biological integrity in previous 303(d) lists of impaired waters. Bells Branch and Painter Swamp were not sampled during the last assessment period and a review of DWQ biological data reflects no previous sampling of these waterbodies has occurred.

2.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

2.4.1 Meherrin River [AU# 25-4-(5)]

The Meherrin River, from a point 1.0 mile upstream from U.S. Highway 258 to the Chowan River (11.7 miles), is Not Rated^{+} in the aquatic life category. A Good-Fair benthic bioclassification at site DB11 was issued based on draft Coastal B criteria. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. Boat sampling is required for these waters. Any bioclassifications derived from sampling data should be considered draft and not used for use support decisions; therefore the Meherrin River is Not Rated (BAU, July 2006). No criteria were exceeded for water quality standards at the ambient monitoring station DA6.

Since 1983, the Meherrin River has been sampled eight times, seven of which were during the summer basinwide sampling period. Over the years, several rare or unusual species have been collected; however, species collected in 2005 indicate that slow-moving or stagnant conditions may persist during long periods of the year.

This sampling site is located at the Meherrin River at SR 1175, upstream of the NC DOT ferry operation. It has a drainage area of 143 square miles and the habitat is mostly forested with few breaks in the riparian zone. The substrate consisted of 70 percent sand and 30 percent silt and other fine particles.

2007 Recommendations

DWQ will work with other agency staff to determine if current conditions represent natural conditions related to swamp drainage or flows, or if there are land use impacts that need to be addressed. The Town of Severn non-discharge facility (WQ0003299) has had noncompliance issues that may be impacting surface water quality. Additional research of possible surface and ground water interactions is recommended.

2.4.2 Urahaw Swamp [AU# 25-4-8-4]

Urahaw Swamp, from source to Potecasi Swamp (14.4 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site DB13. This site was first sampled in 2000 when it also received a Moderate bioclassification. An increase in the biotic index in 2005, however, indicates that there are more pollution tolerant species residing in the swamp.

Urahaw Swamp joins Potecasi Creek near Woodland, approximately 1.5 miles downstream of NC 35. The drainage area of the swamp at NC 35 is 55 square miles. Riparian vegetation was noted as absent from one side of the stream. South of NC 35, the habitat appears to be in a more pristine condition. Benthic substrate consists of an even mixture of sand and silt.

2.4.3 Cutawhiskie Swamp [AU# 25-4-8-8]

Cutawhiskie Swamp, from source to Potecasi Creek (17.0 miles), is Not Rated in the aquatic life category due to Not Rated bioclassifications at site DB9. Cutawhiskie Creek was sampled twice in 2005, once in February during swamp sampling period and once in August during the summer basinwide sampling period. The stream was rated based on swamp criteria in the past (1995), but due to its transitional nature (from Coastal A to Swamp), a Not Rated bioclassification was assigned until additional data can be collected from this site.

Cutawhiskie Creek has been sampled five times, during February and August 1995, in February 2000 and during February and August 2005. Each time, the swamp has been Not Rated. During the most recent sampling, the biotic index indicates that there is a fairly pollution tolerant macroinvertebrate community in Cutawhiskie Swamp.

This sample site has a drainage area of 36 square miles. The riparian zone is lacking adequate tree cover needed to prevent streambank erosion. Incised channels with a lack of pools and turbid waters were found at this site during the February sampling.

Chapter 3
Chowan River Subbasin 03-01-03
Including: Chowan River (Middle)

3.1 Subbasin Overview

Subbasin 03-01-03 at a Glance

Land and Water Area

Total area:	123 mi²
Land area:	100 mi²
Water area:	23 mi²

Land Cover (percent)

Forest/Wetland:	40%
Cultivated Crop:	40%
Surface Water:	19%
Urban:	<1%
Pasture/ Managed Herbaceous:	<1%

Counties

Bertie, Chowan, Hertford and Gates

Municipalities

Colerain

Monitored Waterbody Statistics

Aquatic Life:

Total:	14.1 mi
Total Supporting:	14.1 mi

Recreation:

Total:	14.1 mi
Total Supporting:	14.1 mi

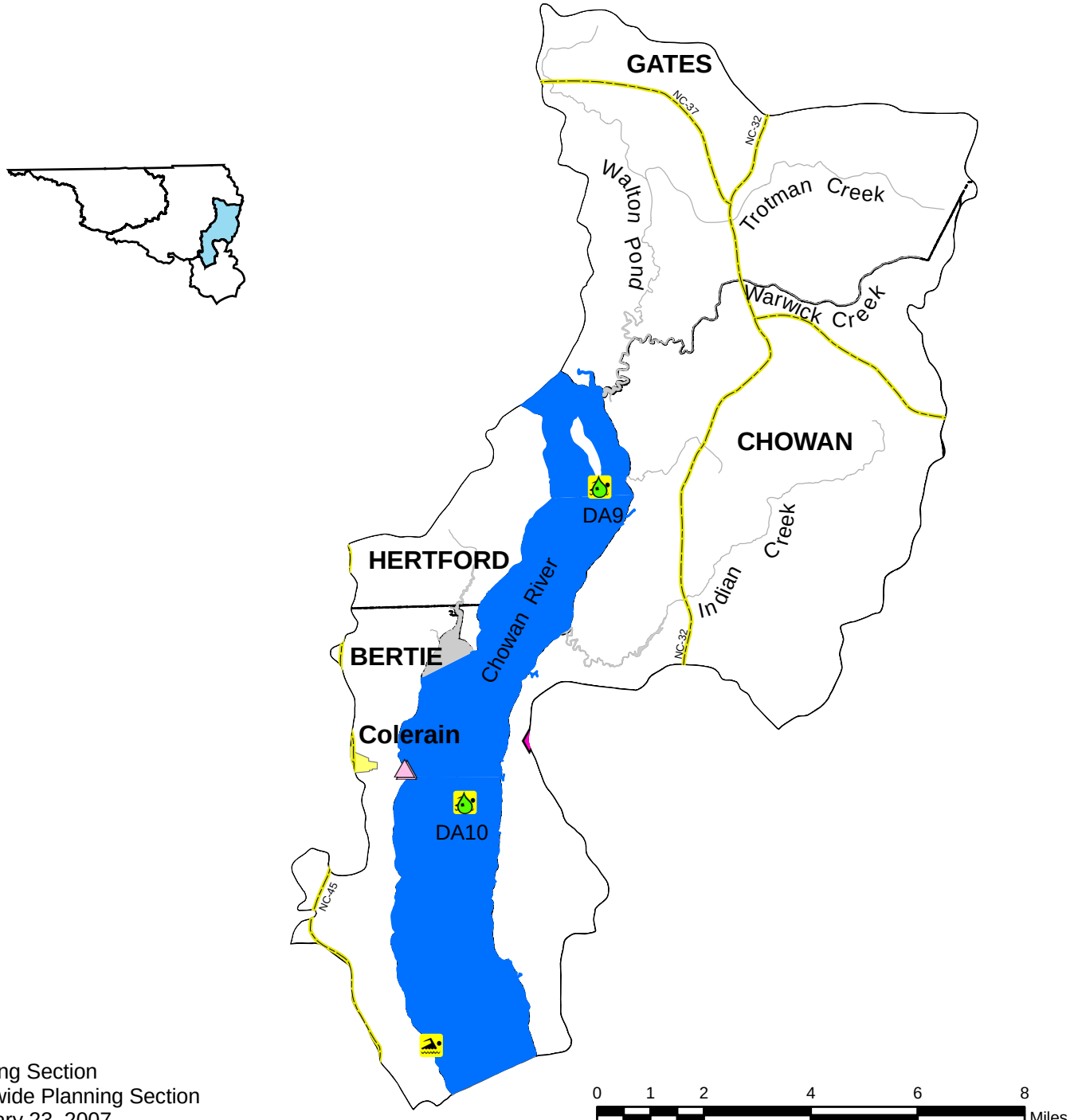
This subbasin contains the middle section of the Chowan River, below Bennetts Creek (Merchants Millpond) and above Rockyhock Creek and includes the Indian Creek and Catherine Creek tributaries. The entire subbasin is designated as Nutrient Sensitive Waters. This subbasin contains the Colerain/Cow Island Swamp and Slopes Natural Heritage Area. Tidal Cypress-Gum Swamp, a designated significant natural heritage area, is found along much of the shoreline of the Chowan River and represents an important wetland ecosystem within the Chowan River basin.

Land use is mainly forested wetlands and agricultural cropland. The largest municipality in the subbasin is Colerain with a population of approximately 221 persons and has experienced an overall net decline since 1990. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 8.

One minor and one major NPDES permit have been issued in this subbasin with a total permitted flow of 1.52 MGD. Perry-Wynns Fish Company in Bertie County is permitted to discharge 0.02 MGD. It is classified as a minor industrial process and commercial NPDES facility and is currently in compliance. Edenton Dyeing and Finishing LLC in Chowan County is permitted to discharge 1.5 MGD. It is classified as a major industrial process and commercial NPDES facility. By permit, Edenton Dyeing and Finishing must also conduct whole effluent toxicity (WET) testing. The facility failed seven WET tests during the last two years of the assessment period and enforcement was taken on five separate occasions. Edenton Dyeing and Finishing is currently in compliance with their permit limits, but the facility has recently closed. There are no permitted non-discharge systems or stormwater discharges in this subbasin. For the listing of NPDES permit holders, refer to Appendix III.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 5. Table 7 contains a summary of monitored waterbodies with their associated assessment unit numbers (AU#) and lengths, monitoring data types, locations and results, along with use support ratings for waters in the subbasin.

Figure 5 Chowan River Subbasin 03-01-03



Planning Section
Basinwide Planning Section
February 23, 2007

Table 7 CHO Subbasin 03-01-03

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
CHOWAN RIVER													
25b	B;NSW	14.1 FW Miles	From the Subbasin 03-01-01/03-01-03 boundary to the Subbasin 03-01-03/03-01-04 Boundary	S	DA9	NCE			S	N59	NCE	Toxic Impacts	WWTP NPDES
					DA10	NCE				DA9	NCE	Ammonia	WWTP NPDES
										DA10	NCE		

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
DF - Fish Community Survey
DB - Benthic Community Survey
DA - Ambient Monitoring Site
DL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired
N- Natural
M- Moderate
S- Severe

Use Support Ratings 2005:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment
NR+-Not Rated because draft criteria used for rating

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	14.1	FW Miles
		17.1	FW Miles

Recreation Rating Summary

S	m	14.1	FW Miles
		17.1	FW Miles

Fish Consumption Rating Summary

I	e	31.2	FW Miles

No biological (benthic or fish community) samples were collected in this subbasin; however, DWQ conducted a reconnaissance in 2005 to identify potential sampling sites during the next basinwide assessment period. These potential sampling sites are listed in Table 8.

Table 8 Potential Biological Sampling Locations in Subbasin 03-01-03

Waterbody	Location	County
Chowan River	Holiday Island	Chowan
Chowan River	Below Arrowhead Beach	Chowan
Indian Creek	NC 32 (Welch Road)	Chowan
UT Warwick Creek	NC 32 (Welch Road	Chowan
Warwick Creek	SR 1232 (Cannon Ferry/Catherine's Creek Road)	Gates/Chowan
Trotman Creek	SR 1100 (Carters Road)	Gates

Data were collected from two ambient monitoring stations (DA9 and DA10). No criteria were exceeded at either site. Some salinity occurs in this stretch of the Chowan River, with readings as high as 3.0 parts per trillion (ppt). Refer to the *2006 Chowan River Basinwide Assessment Report* (http://www.ncwaterquality.org/esb/Basinwide/ChowanBASINWIDEFinal.pdf) and Appendix I for more information on monitoring.

All waters in this subbasin have the supplemental classification of Nutrient Sensitive Waters (NSW) in addition to the primary classification of Class C or Class B. See Chapter 5 for more information on surface water classifications.

Waters in the following sections and in Table 7 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

3.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Refer to Table 9 for a summary of use support for waters in subbasin 03-01-03.

Table 9 Summary of Use Support Ratings by Category in Subbasin 03-01-03

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	14.1 mi	14.1 mi
Total	**14.1 mi**	**14.1 mi**
Unmonitored Waters		
No Data	17.1 mi	17.1 mi
Total	**17.1mi**	**17.1mi**
All Waters**	**31.2 mi**	**31.2 mi**

* The noted percent Impaired is the percent of monitored mile/acres only.
**Total Monitored + Total Unmonitored = Total All Waters.

In subbasin 03-01-03, use support was assigned for aquatic life, recreation and fish consumption categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS).

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website: http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm. Appendix V provides definitions of the terms used throughout this basin plan.

3.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 11.

3.3.1 Chowan River [AU# 25b]

2002 Status
The Chowan River was listed on the 2002 and 2004 303(d) list of impaired waters. It was listed based on 1998 historical listing for nutrients, with industrial and municipal facilities identified as potential sources. Previous basinwide water quality plans had identified historic algal blooms and dioxin as water quality concerns. Algal blooms were the result of excess nutrients and low pH levels; however, the implementation of best management practices (BMPs) and NPDES permitting strategies throughout the watershed resulted in a decrease in nutrients and therefore a reduction in the frequency and intensity of algal blooms.

DWQ recommended that wastewater and land application requirements and permits be evaluated to reduce the impact from point sources and that an analysis of nutrient reduction efforts be conducted throughout the entire river basin.

Current Status
The Chowan River, from the subbasin 03-01-01 and 03-01-03 boundary to the subbasin 03-01-03 and 03-01-04 boundary (14.1 miles), is Supporting in the aquatic life category due to ambient water quality data collected at sites DA9 and DA10. No water quality standards were exceeded at either of the two ambient monitoring stations.

2007 Recommendations
DWQ will recommend removal of this segment of the Chowan River from the 303(d) list of impaired waters based on current noted water quality improvements. However, Edenton Dyeing and Finishing has a history of effluent limit violations; yet, even with recent monitoring and aquatic toxicity violations, the facility is not considered to be causing substantial harm to water quality. The DWQ regional office reports the facility has recently closed.

Chapter 4
Chowan River Subbasin 03-01-04
Including: Chowan River (Lower), Eastmost Swamp and Albemarle Sound

4.1 Subbasin Overview

Subbasin 03-01-04 at a Glance

Land and Water Area

Total area:	177 mi²
Land area:	152 mi²
Water area:	45 mi²

Land Cover (percent)

Forest/Wetland:	41%
Cultivated Crop:	31%
Surface Water:	25%
Urban:	<1%
Pasture/ Managed Herbaceous:	2%

Counties

Bertie and Chowan

Municipalities

Edenton

Monitored Waterbody Statistics

Aquatic Life

Total:	16.9 mi/15,600.4 ac
Total Supporting:	9.1 mi/ 15,600.4 ac
Total Not Rated:	7.8 mi

Recreation:

Total:	7.8 mi/15,600.4 ac
Total Supporting:	7.8 mi/ 15,600.4 ac

Subbasin 03-01-04 contains the lower Chowan River and small tributaries including Salmon Creek, Edenton Bay and Pembroke Creek. It also includes a small northwest portion of the Albemarle Sound. This subbasin contains portions of the Chowan Game Land, a track managed by the Wildlife Resources Commission. This property is one of four publicly owned conservation lands in the subbasin.

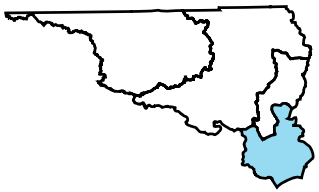
Edenton is the largest municipality in the subbasin with a population of 5,394. Between the years of 1990 and 2000, Edenton grew by approximately 2.4 percent. Additional information regarding population and land use changes throughout the entire basin can be found in Chapter 8.

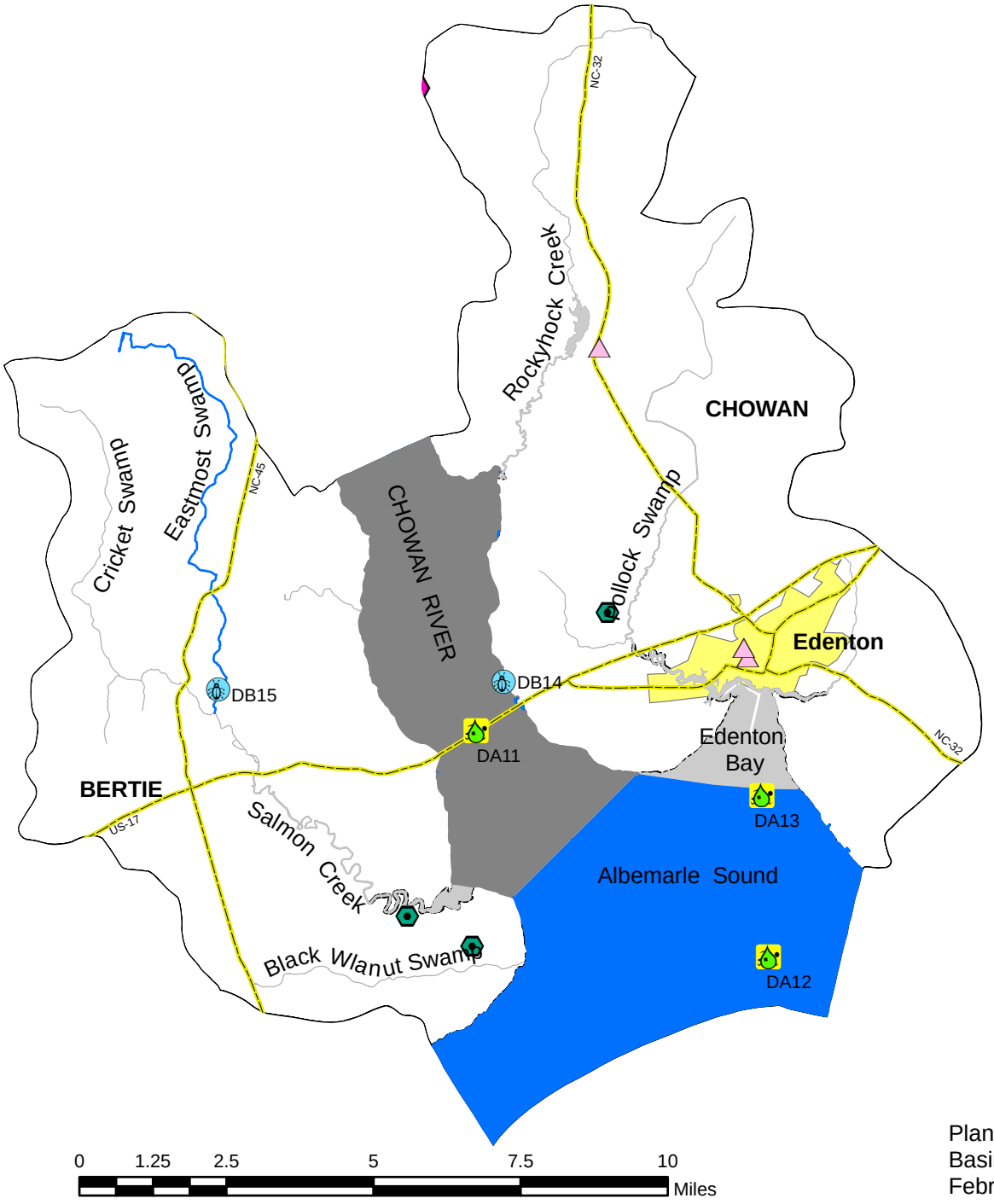
This region of the Chowan River basin is experiencing growth and development with proposed upscale housing communities, golf courses and marinas. With this growth along the inland waterways, many channels to the Chowan River are losing their riparian buffers and consequently water quality is in jeopardy.

There are three minor NPDES dischargers in this subbasin with a total permitted flow of 0.02 MGD. All three permits are associated with water treatment plants (WTP) and all are in compliance with their effluent limits. There are three non-discharge permits and five general stormwater permits in this subbasin (see Appendix III). Many of the permitted discharge violations result from facility mismanagement. Assuring managers have adequate training and understand the financial and environmental repercussions of facility violations are essential to prevent future degradations to water quality.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 6. Table 10 contains a summary of monitored waterbodies with their associated identification assessment unit numbers (AU#) and lengths, monitoring data types, locations and results, along with use support ratings for waters in the subbasin.

Figure 6 Chowan River Subbasin 03-01-04





Legend

- Municipality
- County Boundary
- Subbasin Boundary
- Primary Roads

Monitoring Stations

- Ambient Monitoring Station
- Benthic Community
- Recreation Locations

NPDES Dischargers

- Major
- Minor

Non-Dischargers

- Major
- Minor

Aquatic Life Rating

- Impaired
- No Data
- Not Rated
- Supporting

Planning Section
Basinwide Planning Section
February 23, 2007

Table 10 CHO Subbasin 03-01-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment					
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
ALBEMARLE SOUND													
26	B;NSW	15,600.4 FW Acres		**S**	DA12	NCE			**S**	DA12	NCE	Dioxin	WWTP NPDES
					DA13	NCE				DA13	NCE		
			From mouth of Chowan River, defined by a line extending in a southerly direction from Reedy Point on the north shore of Albemarle Sound to a point of land on the south side of Black Walnut Swamp to a line running across Albemarle Sound in a southerly dire										
CHOWAN RIVER													
25c	B;NSW	7.8 FW Miles		**NR+**	DA11	NCE			**S**	DA11	NCE	Dioxin	WWTP NPDES
					DB14	G	2005						
			From the Subbasin 03-01-03/03-01-04 Boundary to mouth defined by a line extending in a southerly direction from Reedy Point on the north shore of Albemarle Sound to a point of land on the south side of the mouth of Black Walnut Swamp										
Eastmost Swamp													
25-24-1	C;NSW	9.1 FW Miles		**S**									
			From source to Salmon Creek		DB15	M	2005						

Table 10 CHO Subbasin 03-01-04

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment				
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2005:
AL - Aquatic Life	DF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	DB - Benthic Community Survey	G - Good	NR - Not Rated
	DA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	DL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	NR+-Not Rated because draft criteria used for rating
		NI - Not Impaired	
Miles/Acres	m- Monitored	N- Natural	**Results**
FW- Fresh Water	e- Evaluated	M- Moderate	CE-Criteria Exceeded > 10% and more than 10 samples
		S- Severe	NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	9.1	FW Miles
NR	m	7.8	FW Miles
S	m	15,600.4	FW Acres
		58.9	FW Miles
		1,370.3	FW Acres

Recreation Rating Summary

S	m	7.8	FW Miles
S	m	15,600.4	FW Acres
		68.1	FW Miles
		1,370.3	FW Acres

Fish Consumption Rating Summary

I	m	7.8	FW Miles
I	m	15,600.4	FW Acres
I	e	68.1	FW Miles
I	e	1,370.3	FW Acres

There were two benthic macroinvertebrate samples collected in subbasin 03-01-04 during this assessment period, and overall, biological data suggest little change in water quality since the basin was last sampled in 2000. Benthic macroinvertebrates collected in 2005 were diverse and indicated no problems with dissolved oxygen (DO), nutrients or pH. Refer to the *2006 Chowan River Basinwide Assessment Report* (http://www.ncwaterquality.org/esb/Basinwide/ChowanBASINWIDEFinal.pdf) and Appendix I for more information on monitoring.

Four ambient monitoring stations were also sampled during this assessment period. Three are located in the Albemarle Sound (DA12, DA13 and MA13) and one is located in the Chowan River (DA11). DO and pH do not appear to be a problem, but salinity readings have been as high as 3.63 parts per trillion (ppt).

All waters in this subbasin have the supplemental classification of Nutrient Sensitive Waters (NSW) in addition to the primary classification of Class C or Class B. See Chapter 5 for more information on water classifications.

Waters in the following sections and in Table 10 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same.

4.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. Refer to Table 11 for a summary of use support for waters in subbasin 03-01-04.

In subbasin 03-01-04, use support was assigned for aquatic life, recreation and fish consumption. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS).

Table 11 Summary of Use Support Ratings by Category in Subbasin 03-01-04

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	9.1 mi 15,600.4 ac	7.8 mi 15,600.4 ac
Not Rated	7.8 mi	0
Total	**16.9 mi** **15,600.4 ac**	**7.8 mi** **15,600.4 ac**
Unmonitored Waters		
No Data	58.9 mi 1,370.3 ac	68.1 mi 1,370.3 ac
Total	**58.9 mi** **1,370.3 ac**	**68.1 mi** **1,370.3 ac**
All Waters**	**75.8 mi** **16,970.7 ac**	**75.9 mi** **16,970.7 ac**

* The noted percent Impaired is the percent of monitored mile/acres only.
**Total Monitored + Total Unmonitored = Total All Waters.

For more information about use support determinations, refer to Appendix II or the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* found at DWQ's website:

http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm. Appendix V provides definitions of the terms used throughout this basin plan.

4.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Chapter 11.

4.3.1 Albemarle Sound [AU# 26]

The Albemarle Sound is Supporting in both the aquatic life and recreation categories. However, the waters are Impaired for fish consumption based on the dioxin advisory issued by the Department of Health and Human Services in 2001. Dioxins are the byproducts of industrial processes and are formed during the chlorine bleaching process at pulp and paper mills. The advisory is for the consumption of catfish and carp in the Albemarle Sound from Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge (Perquimans, Chowan, Bertie, Washington, and Tyrrell Counties). Women of childbearing age and children should not eat any catfish or carp from this area until further notice. All other persons should eat no more than one meal per month of catfish and carp from this area. For more information on this advisory please visit the DHHS website http://www.epi.state.nc.us/epi/fish/.

4.3.2 Chowan River [AU# 25c]

2002 Status
The lower section of the Chowan River was listed on the 2002 and 2004 303(d) list of impaired waters based on 1998 historical listing for nutrients. No potential sources were identified.

Current Status
The lower Chowan River, from the subbasin boundary to the Albemarle Sound (7.8 miles), is Not Rated^{+} in the aquatic life category. A Good benthic bioclassification at site DB14 was given based on draft Coastal B criteria. Coastal B rivers are defined as waters in the coastal plain that are deep (nonwadeable), freshwater systems with little or no visible current under normal or low flow conditions. Other characteristics may include an open canopy, low pH and low DO. Boat sampling is required for these waters. Any bioclassifications derived from sampling data should be considered draft and not used for use support decisions; therefore the lower Chowan River is Not Rated (BAU, July 2006).

Since 1983, the lower Chowan River has been sampled nine times. Bioclassifications have ranged from Fair to Good. Since 1995, the river has been rated using draft criteria for Coastal B rivers. The 2005 Good bioclassification is an improvement from the Good-Fair it received during 2000. The improvement was noted in the number of species collected in 2005 compared to 2000.

No water quality standards were exceeded at the ambient monitoring station (DA11); however, salinity values over 3.0 parts per trillion (ppt) have been recorded 10 percent of the time. Because salinity can be above 3.0 ppt, the lower Chowan River has historically been classified as both freshwater and oligohaline. Oligohaline is an estuarine classification for waters with salinity between 0.5 and 5.0 ppt. Due to the low salinity during this assessment period, however, the bioclassification at site DB14 was based on draft criteria for Coastal B rivers. The lower Chowan River will continue to be sampled as a freshwater site with saltwater intrusions from 0.5 to 5.0 ppt (oligosaline).

This segment of the Chowan River (7.8 mi.) is Impaired in the fish consumption category because of a dioxin advisory issued by the Department of Health and Human Services in 2001. For more information on this advisory please visit DHHS website http://www.epi.state.nc.us/epi/fish/ and Section 4.3.1 above.

2007 Recommendations
Water quality conditions appear to be improving in the Chowan River, but AU # 25c will remain on the 303(d) list of impaired waters because of the dioxin advisory and until Coastal B rating criteria have been finalized and approved.

4.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix IV.

4.4.1 Eastmost Swamp [AU# 25-24-1]

Eastmost Swamp, from source to Salmon Creek (9.1 miles), is Supporting in the aquatic life category due to a Moderate swamp benthic bioclassification at site DB15. Little water quality or biological changes were noted between the 2000 and 2005 samples.

The drainage area of this site is 12 square miles. Due to a beaver dam (that was present during the 2000 sampling as well as the most recent sampling period), the stream channel has been altered and there are fewer pools downstream of the dam. Riparian and some in-stream habitat has been limited by recent desnagging operations upstream. Other in-stream habitat, such as undercut banks, detritus and aquatic weeds, and filamentous algae are common. The benthic substrate is mostly silt and clay with 30 percent sand.

4.4.2 Pollock Swamp [AU# 26-1-1-1] and Rockyhock Creek [AU# 25-22]

Pollock Swamp drains to Edenton Bay and Rockyhock Creek is a tributary to the Chowan River. These waters were not monitored and are therefore not given use support ratings. Water quality conditions are of concern here because Valhalla WTP (NC0032719) is discharging to an unnamed tributary to the Pollock Swamp when they are permitted to discharge to Rockyhock Creek. The facility is currently out of compliance with toxicity issues; the lagoon is leaking to old borrow pits on the south side and may be contaminating surface waters. The plant holds a temporary permit for the new discharge site, while the renewal permit is being processed for discharge into the unnamed tributary of Pollock Swamp. The new permit will require toxicity monitoring. DWQ recommends the lagoon be repaired and excess solids be cleaned out.

Pollock Swamp drains into Pembroke Creek (AU# 26-1-1) along the western edge of Edenton and Queen Ann's Creek (AU # 26-1-2) flows along the eastern side of Edenton. Resource agencies have identified these creeks as priority in need of riparian buffers, stormwater wetlands and critical area plantings to improve water quality.

Chapter 5
North Carolina Water Quality Classifications and Standards

5.1 Description of Surface Water Classifications and Standards

North Carolina's Water Quality Standards Program adopted classifications and water quality standards for all the state's river basins in 1963. The program remains consistent with the Federal Clean Water Act and its amendments. Water quality classifications and standards have also been modified to promote protection of surface water supply watersheds, high quality waters (HQW), and unique and special pristine waters with outstanding resource values (ORW).

5.1.1 Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table 12 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). Information on this subject is also available at DWQ's website: www.ncwaterquality.org/csu/.

5.1.2 Statewide Water Quality Standards

Each primary and supplemental classification is assigned a set of water quality *standards* that establish the level of water quality that must be maintained in the waterbody to support the uses associated with each classification. Some of the standards, particularly for HQW and ORW waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. These strategies are discussed briefly below. The standards for C and SC waters establish the basic protection level for all state surface waters. The other primary and supplemental classifications have more stringent standards than for C and SC, and therefore, require higher levels of protection.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish, or rare and endangered aquatic species.

Primary Recreation (Class B)
There are 105.5 freshwater miles and 15,600 freshwater acres classified for primary recreation in the Chowan River basin. Waters classified as Class B are protected for primary recreation, including frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes to Class B waters must be treated to avoid potential impacts to the existing water quality.

Table 12 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS	
Class*	**Best Uses**
C and SC	Aquatic life propagation/protection and secondary recreation.
B and SB	Primary recreation and Class C and SC uses.
SA	Suitable for commercial shellfish harvesting and SB and SC uses.
WS	*Water Supply (WS)*: Assigned to watersheds based on land use characteristics. The WS classifications have management strategies to protect the surface water supply. For WS-I through WS-IV, these include limits on point source discharges and local programs to control nonpoint source and stormwater runoff. A WS Critical Area (CA) has more stringent protection measures and is designated within one-half mile from a WS intake or WS reservoir. All WS classifications are suitable for Class C uses.
WS-I	Generally located in natural and undeveloped watersheds.
WS-II	Generally located in predominantly undeveloped watersheds.
WS-III	Generally located in low to moderately developed watersheds.
WS-IV	Generally located in moderately to highly developed watersheds.
WS-V	Generally upstream of and draining to Class WS-IV waters. No categorical restrictions on watershed development or treated wastewater discharges.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Waters that have low velocities and other natural characteristics that are different from adjacent streams (i.e., lower pH, lower levels of dissolved oxygen).
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
HQW	*High Quality Waters*: Waters that have excellent water quality, primary nursery areas and other functional nursery areas, WS-I and WS-II or SA waters.
ORW	*Outstanding Resource Waters*: Unique and special waters of exceptional state or national recreational or ecological significance which require special protection.
NSW	*Nutrient Sensitive Waters*: Waters subject to excessive plant growth and requiring limitations on nutrient inputs.

* Primary classifications beginning with "S" are assigned to saltwaters.

Aquatic Life Propagation and Secondary Recreation (Class C)

There are 704 freshwater miles and 1,370 freshwater acres classified for aquatic life propagation/protection and secondary recreation in the Chowan River basin.

Nutrient Sensitive Waters (Class NSW)

Nutrient sensitive water (NSW) is a supplemental classification that the EMC may apply to surface waters that are experiencing or are subject to growths of microscopic or macroscopic vegetation. In 1979, all waters of the Chowan River basin were designated as NSW. The Chowan River basin was the first waterbody in the state to receive the supplemental classification because of water quality problems associated with nutrient enrichment. In response to nuisance algal blooms and fish kills in North Carolina's waters, the EMC established the NSW supplemental classification in May 1979 as a legal basis for controlling the discharge of nutrients, primarily nitrogen and phosphorus, into surface waters. This classification took effect in September 1979 for the Chowan River; thereby, enabling nutrient limits to be included in the NPDES permits of wastewater treatment plants that discharge in the river basin. Of the Class B and C waters in the Chowan River basin, all receive supplemental NSW classification for a total of 810 miles and 16,970 acres. The implementation of the NSW strategy continues to be successful, with a reduction in Impaired waterbodies from 135 Impaired miles on the 2006 303(d) list to 22.5 miles on the draft 2008 303(d) list of Impaired waters.

5.1.3 Nutrient Sensitive Waters Management

Although there have been gains in nutrient reductions and associated water quality benefits, continued implementation of the nutrient reductions and conservation measures are recommended. A Nutrient Sensitive Waters strategy was initially adopted in 1982 and updated in 1990. Overall, as of 1990, the nitrogen reduction goal of 20 percent had been accomplished and total phosphorus had been reduced by 29 percent (goal of 35 percent). Major points of the 1990 management strategy include:

- Reduction in phosphorus inputs from point and nonpoint sources by 35-40 percent
  - *Point Sources*
    - Land application systems for municipal wastewater treatment plants
    - Phosphorus limits of 1 mg/l in the North Carolina portion of the basin
  - *Nonpoint Sources*
    - Target funds from the Agriculture Cost Share Program to the Chowan River basin
- Reduction of nitrogen inputs from all sources by 20 percent
  - *Point Sources*
    - Land application systems for municipal wastewater treatment plants
    - Nitrogen limits of 3 mg/l in the North Carolina portion of the basin
  - *Nonpoint Sources*
    - Target funds from the Agriculture Cost Share Program to the Chowan River basin

As a result of the NSW strategy, many wastewater treatment plants that were previously discharging to surface waters converted their plants to land application. These non-discharge systems that treat domestic wastewater are required to meet total nitrogen and total phosphorus limits. It is recommended that new dischargers be required to model nutrient impacts on water quality to ensure chlorophyll a standards are not exceeded. Also, Agricultural Cost Share Program monies have resulted in the application of best management practices in the basin (see Chapter 9) and are also contributing to the reduction of over-enrichment conditions. Such efforts need to continue to further improve the water quality of the Chowan River basin.

For more information on NSW waters and nutrient strategies refer to administrative code 15A NCAC 2B .0223 for specifics on NSW rules.

Chapter 6
Water Quality Stressors and Sources of Impairment in the Chowan River Basin

6.1 Stressor and Source Identification

Human activities can negatively impact surface water quality, even when the activity is far removed from the waterbody. The many types of pollution generated by human activities may seem insignificant when viewed separately, but when taken as a whole can result in significant stress to the aquatic ecosystem. Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired, as well as Supporting waters with noted impacts.

For specific discussion of stressors and sources of the Impaired or waters with Noted Impacts, refer to the subbasin chapters. More information regarding aquatic life, recreation, fish consumption and shellfish harvesting stressors and sources can be found in Chapter 3 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm.

6.1.1 Stressors

Identifying stressors is challenging because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations, as well as information from other agencies and the public to identify stressors and their potential sources. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address the stressor.

Stressors to recreational use include pathogenic indicators such as fecal coliform bacteria, *escheria coli* (*E. coli*), and *enterrococci*. In the fish consumption category, mercury and dioxin are the noted stressors. Other substances may also result in the issuance of a fish consumption advisory or advice by the NC Division of Health and Human Services (NCDHHS).

Most stressors to the biological community are a complex grouping of many different stressors that individually may not degrade water quality or aquatic habitat, but together can severely impact aquatic life. Sources of stressors are most often associated with land use in a watershed, as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor, or group of stressors, may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered hydrology.

In the fish consumption category dioxin is a stressor resulting in the Impairment of waters in Albemarle Sound to the mouths of the Chowan and Roanoke Rivers. Dioxins are the byproducts of industrial processes and are formed during the chlorine bleaching process at pulp and paper mills. The current dioxin advisory was issued by the Department of Health and Human Services in 2001. The advisory is for the consumption of catfish and carp in the Albemarle Sound from

Bull Bay to Harvey Point; West to the mouth of the Roanoke River and to the mouth of the Chowan River to the U.S. Highway 17 Bridge (Perquimans, Chowan, Bertie, Washington, and Tyrrell Counties). Women of childbearing age and children should not eat any catfish or carp from this area until further notice. All other persons should eat no more than one meal per month of catfish and carp from this area. For more information on this advisory please visit the DHHS website http://www.epi.state.nc.us/epi/fish/.

6.1.2 Sources

Pollutants fall into two general categories: point sources and nonpoint sources. DWQ identifies the source of a stressor, point or nonpoint, as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Many point sources were removed from the Chowan River due to the NSW management strategy with the conversion of municipal wastewater treatment plants to land application. Stressors sources identified in the Chowan River basin during this assessment period include agriculture and runoff from WWTP land application sites. In addition to these sources, many impacts originate from unknown sources.

Chapter 7
Stormwater and Wastewater Management for Improved Water Quality

7.1 Introduction to Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (e.g., buildings, roads, parking lots, etc.). In some cases, it drains directly into streams, rivers, lakes, and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Storm sewer systems are designed simply to capture the stormwater and convey it to the nearest surface water without treatment. These sewers should not be confused with sanitary sewers, which transport human and industrial wastewater to a treatment plant before discharging into surface waters.

Common stormwater pollutants include sediment, nutrients, organic matter, bacteria, oil and grease, and toxic substances (e.g., metals, pesticides, herbicides, hydrocarbons). Stormwater can also impact the temperature of a surface waterbody, which can affect the water's ability to support certain fish and aquatic communities.

Uncontrolled stormwater runoff has many impacts on both humans and the environment. Cumulative effects include flooding, undercut and eroding streambanks, widened stream channels, threats to public health and safety, impaired recreational use, and increased costs for drinking and wastewater treatment. For more information on stormwater runoff, visit the DWQ Stormwater Permitting Unit at http://h2o.enr.state.nc.us/su/stormwater.html or Chapter 5 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm.

7.2 Stormwater Programs

The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include National Pollutant Discharge Elimination System (NPDES) Phase I and II regulations, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Currently, there are 23 individual stormwater permits listed for the Chowan River basin and Phase I regulations are not applicable. However. there are a few local governments and/or counties that are affected by other water quality protection programs.

DWQ's Stormwater Permitting Unit webpage: http://h2o.enr.state.nc.us/su/index.htm provides links to the stormwater BMP manual, a map tool to identify where file a permit and guidance on North Carolina's evolving stormwater programs. A description of Federal and State stormwater regulations and programs are also described in detail in Chapter 5 of the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans* http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm.

Stormwater Regulation Challenges

One challenge in meeting the goal of enhancing and protecting water quality is the State's inaccurate or lack of location data to identify permitted stormwater discharges. This permit data is important to DWQ for both tracking and renewing permits, assessing the program, and determining potential cumulative impacts. Discharge outfall locations are also important to compliment protection and restoration efforts by other organizations.

To correct this problem, updating discharge locations began in 2005 to include GPS coordinates of outfalls and digital photographs. A temporary administrative staff position has been requested to begin updating or correcting coastal stormwater permit data in DWQ's Basinwide Information Management System (BIMS) database. DWQ is working with regional offices to ensure data entry is consistent and that protocol exists for collecting GPS coordinates in a consistent manner at permitted sites. There were 15 untreated stormwater outfalls detected in Edenton as a result of the 2005-2006 municipal outfalls survey.

2007 Recommendations

DWQ recommends that local government and county officials in the basin develop stormwater management programs for new development and to retrofit existing development. In particular, Chowan County and Edenton would improve water quality in their jurisdiction if they were to voluntarily begin developing stormwater programs with Phase II standards. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government and county stormwater program development.

7.3 Wastewater Management Programs

7.3.1 NPDES Wastewater Discharge Permit Summary

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a NPDES permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency (EPA).

Currently, there are 10 permitted wastewater dischargers in the Chowan River basin. Table 13 provides summary information (by type and subbasin) about the discharges. The types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter, and a complete listing of permitted facilities is included in Appendix III.

Table 13 NPDES Dischargers and Permitted Flows for the Chowan River Basin (August 2006).

Facility Categories	03-01-01	03-01-02	03-01-03	03-01-04	TOTAL
Total Facilities	5	0	2	3	10
Total Permitted Flow (MGD)	44,000	0	1,524,000	20,000	1,588,000
Facilities Grouped by Size					
Major Discharges	0	0	1	0	1
Permitted Flow (MGD)	0	0	1,500,000	0	1,500,000
Minor Discharges	5	0	1	3	9
Permitted Flow (MGD)	44,000	0	24,000	20,000	88,000
Facilities Grouped by Type					
100% Domestic Waste	4	0	0	0	4
Permitted Flow (MGD)	2,000	0	0	0	2,000
Municipal Facilities	0	0	0	0	0
Permitted Flow (MGD)	0	0	0	0	0
Nonmunicipal Facilities	1	0	2	3	0
Permitted Flow (MGD)	24,000	0	1,524,000	20,000	1,568,000

7.3.2 Permitted Non-Discharge Waste Management Strategies

Due to the nutrient sensitivity of the waters in the Chowan River basin and the strict effluent limits on discharges, non-discharge wastewater treatment systems are more common. The Land Application Unit (LAU) in the Aquifer Protection Section of DWQ oversees non-discharge wastewater treatment and recycle systems including land application of wastewater and residuals. The program has operational and monitoring requirements similar to those of the NPDES wastewater program; however, the primary difference is that the treated effluent is not discharged to surface waters. Instead, it is usually discharged to a spray irrigation system for land application. Some other options for the land application of effluent include rapid infiltration basins and drip irrigation systems.

Systems that are reviewed and permitted by LAU include spray irrigation systems, animal waste management systems, rapid infiltration basins, drip irrigation systems, land application of residuals, wastewater collection systems, and beneficial reuse of wastewater effluent. The non-discharge program and all associated permits, is regulated by North Carolina General Statutes 143.215.1 and Administrative Code Section 15A NCAC 2T .0100 - Waste Not Discharged to Surface Waters. These sections not only give DWQ the authority to issue permits; they also provide details on the permitting process and information that must be submitted with a permit application.

Every wastewater treatment facility in the State of North Carolina, including large NPDES facilities, pretreatment systems and non-discharge systems, produce some form and amount of wastewater residuals. DWQ requires a permit for the land application of these residuals. The program was developed around the EPA rules 40 CFR Part 257 and 40 CFR Part 503. These treatment systems are designed to satisfy at least the minimum permitting requirements for protection of the surface and ground waters that they could potentially impact. The new rules for waste not discharged to surface waters can be found at: http://h2o.enr.state.nc.us/admin/rules/documents/2Tbook.pdf as 15A NCAC 02T. Numerous non-discharge systems and necessary treatment requirements are described at this website. These rules replaced the earlier 15A NCAC 02H .0200 rule version.

Setbacks are required for all irrigation sites near for surface waters, drainage ditches and waterways. The land surface provides a final "treatment" phase in the disposal process, allowing for uptake and often vegetative removal of nutrients and/or fecal coliform bacteria that may be present in plant effluent depending on the level of treatment permitted for a given facility. However, the effectiveness of this treatment depends upon the ability of the cover crops to take up the nutrients. In additional, the coarse grain sands do not always provide adequate adsorption, and the retention time before it enters groundwater is minimal so soil bacteria do not provide much treatment. With the promulgation of the Subchapter 02T rules, high-rate systems must meet more stringent effluent limitations and/or increased setbacks.

Within the Chowan basin, it is important to note that there is a direct connection between groundwater and surface water in many places. Non-discharge systems work well when the site is conducive to infiltration. However, problems can arise when the site is a low-lying area with a high groundwater table (thereby inhibiting infiltration), or with nearby wetlands or ditches that can act as a ready conduit for runoff. Most non-discharge spray irrigation sites have storage ponds that would allow the wastewater to be held until appropriate to spray. If the water table is high in a disposal area, water level meters are installed to prevent irrigation until there is a certain vertical separation between the land surface and the water table. Runoff is a real concern at any irrigation site, but it can be prevented with proper hydraulic loading (water balance), buffering, and storage.

It is recommended that research be conducted to better establish and understand the relationship between groundwater and surface water in eastern North Carolina. Such understanding would provide for more accurate assessment of surface water impairments resulting from groundwater discharges and enable the state to make sound permitting judgments and recommendations to better protect water quality in general.

Many non-discharge systems are constructed by the developer and turned over to a homeowners association (HOA) after completion. If there is a major problem, the HOA is responsible for the repair bill and funding the repair can be an issue. For systems that will be or are owned by a HOA, the statutes and rules require special accounts be set up by the HOA for the operation of the treatment system. In addition, the HOA must set up a reserve fund for major repairs.

Non-discharge systems create some challenges for the DWQ regional offices in terms of inspections and assuring permit and compliance conditions are met. DWQ may seek additional staffing resources to meet these challenges. One of DWQs goals is to better review covenants and bylaws upon permit review to make sure that HOAs are adhering to the financial assuredness requirements under the permit.

In the Chowan River basin, 21 non-discharge permits have been issued (Table 14). More information about non-discharge permits can be found on the DWQ LAU Web site (http://h2o.enr.state.nc.us/lau/main.html) and in the *Supplemental Guide to North Carolina's Basinwide Planning* document (http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm).

Table 14 NPDES Non-Dischargers and Permitted Flows for the Chowan River Basin.

Facility Categories	03-01-01	03-01-02	03-01-03	03-01-04	TOTAL
Total Facilities	10	8	0	3	**21**
Total Permitted Flow (MGD)	1,413,692	1,583,204	0	1,176,040	**4,172,936**
Facilities Grouped by Size					
Major Discharges	7	8	0	3	**18**
Permitted Flow (MGD)	1,409,192	1,583,204	0	1,176,040	**4,186,436**
Minor Discharges	3	0	0	0	**3**
Permitted Flow (MGD)	4,500	0	0	0	**4,500**
Facilities Grouped by Type					
Government-Municipal	3	6	0	1	**10**
Permitted Flow (MGD)	1,242,000	1,568,204	0	1,076,000	**3,886,204**
Government-County	2	0	0	0	**2**
Permitted Flow (MGD)	29,500	0	0	0	**29,500**
Government-State	1	0	0	0	**1**
Permitted Flow (MGD)	25,000	0	0	0	**25,000**
Non-Government	4	2	0	2	**8**
Permitted Flow (MGD)	117,192	15,000	0	100,040	**232,232**

7.3.3 On-Site Waste Management

North Carolina has enacted laws and adopted rules that mandate significant requirements for inspection and review of On-site Waste System (OSWS) performance. Siting, sizing, inspections, approvals, and permitting are the responsibilities of County Health Departments through their local authorized agents, but engineers and regional soil specialists are called upon for training, authorization, informal appeals, and consultation with Environmental Health Specialists. Enforcement of on-site wastewater rules and laws is the responsibility of the local environmental health specialists. For more information on State rules pertaining to site evaluations and soil suitability for septic systems see http://www.deh.enr.state.nc.us/osww_new/images/Rules/1900RulesJune2006.pdf.

Septic Systems and Straight Piping

With the increase in development there is an increase in demand for individual wastewater treatment systems requiring higher flows on smaller tracks of land. Wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Instead, it is treated on-site through the use of permitted septic systems. Poorly planned and/or maintained systems can fail and contribute to nonpoint source pollution. Wastewater from some of these homes illegally discharges directly to streams through what is known as a "straight pipe". In other cases, wastewater from failing septic systems makes its way to streams or contaminates groundwater. Straight piping and failing septic systems are illegal discharges of wastewater into waters of the State.

With on-site septic systems, the septic tank unit treats some wastes and the drainfield provides further treatment and filtration of the pollutants and pathogens found in wastewater. A septic system that is operating properly does not discharge untreated wastewater to streams and lakes or to the ground's surface where it can run into nearby surface waters. Septic systems are a safe and effective long-term method for treating wastewater if they are sited, sized and maintained properly. If the tank or drainfield are improperly located or constructed, or the systems are not

maintained, nearby wells and surface waters may become contaminated, causing potential risks to human health. Septic tanks must be properly installed and maintained to ensure they function properly over the life of the system. Information about the proper installation and maintenance of septic tanks can be obtained by calling the environmental health sections of the local county health departments. See Appendix IV for contact information.

The discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Pollutants from illegally discharged household wastewater contain chemicals, nutrients, disease pathogens and endocrine disrupting chemicals. Although DWQ's ambient monitoring of the waters in the Chowan River basin show a relatively small percentage of fecal coliform bacteria samples exceeding state standards for primary recreation, smaller streams may contain a higher concentration of bacteria and other pollutants. The economies of the counties in this basin are highly dependent upon river recreation, especially for tourists and seasonal residents.

2007 Recommendations

In order to protect human health and maintain water quality, failing septic systems should be repaired, older systems must be updated, and straight pipes must be eliminated. Additional monitoring of fecal coliform bacteria throughout tributary watersheds will aid in identifying where straight pipes and failing septic systems are problems. Furthermore, precautions should be taken by local septic system permitting authorities to ensure that new systems are sited and constructed properly and that adequate repair area is also available. County, town and city planners need to understand the economic and human health ramifications caused by unsatisfactory septic systems and plan for long-term septic system sustainability. In areas where soils prevent individual septic systems a collective community septic system in appropriate soils may allow for sustainable development where a centralized sewer system is not available. Educational information should be provided to new septic system owners regarding the maintenance of these systems over time. For more information please see Chapter 9 in the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans*: http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm.

On-going on-site waste management activities in the Chowan Basin are led by the Albemarle Regional Health Services (ARHS), a district Board of Health for Bertie, Gates, Pasquotank, Perquimans, Camden, Tyrrell, and Washington counties, which conducts annual inspections on all 3,500 innovative and alternative systems. In addition, Chowan, Currituck, Hertford, and Martin counties contract with ARHS for their services. They follow-up on all on-site waste system repairs and are responsible for conventional systems within the 7-county district.

DENR On-Site Wastewater System Management

DENR has several initiatives related to on-site wastewater education, including current literature and scientific evaluation of potential pollutants from On-site Wastewater Systems. The DEH On-Site Wastewater Section has an active grant-seeking program. Current successful grants include those to the Wastewater Discharge Elimination (WaDE) program for eliminating straight pipes and failing systems, NPS coordinator grants for fate and transport of microbes in the shellfish areas, endocrine disrupting chemicals and pharmaceuticals, and an on-site management grant. The Division of Waste Management oversees the septage management firms and septage disposal in NC.

Chapter 8
Population and Natural Resources in the Chowan River Basin

8.1 Population Growth and Development

North Carolina's coastal counties are some of the fastest growing areas in the state and the associated development is impacting water quality. Two of the five counties in the basin are expected to experience growth rates in excess of ten percent by 2020 (Table 15). As the counties in the Chowan River basin continue to grow along the inner waterways there will likely be a loss of natural areas and an increase in the amount of impervious surface associated with new homes and businesses.

County population data present projected county growth estimates based on Office of State Planning information (June 2006) (Table 15). Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins with in the basin.

Table 15 County Population and Growth Estimates

County	Percent of County in Basin ♦	1990 Population	2000 Population	Estimated % Growth 1990-2000	Estimated Population 2020	Estimated % Growth 2000-2020
Bertie	30	20,388	19,757	-3.2	18,668	-5.8
Chowan	67	13,506	14,150	4.6	15,154	6.6
Gates	80	9,305	10,516	11.5	12,962	18.9
Hertford	100	22,317	22,977	2.9	25,062	8.3
Northampton	65	21,004	22,086	4.9	25,062	11.9
Subtotals		**86,520**	**89,486**	**20.6**	**96,908**	**39.9**

♦ Source: North Carolina Center for Geographic Information and Analysis (CGIA), 1997.
Note: The numbers reported reflect county population; however, these counties are not entirely within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

Table 16 presents population data from Office of State Planning for municipalities located wholly or partly within the basin. Data presented by municipality summarize information on past growth of urban areas in the basin.

Table 16 Population Data by Municipality in the Chowan River Basin

Municipality	County	April 1980	April 1990	April 2000	Percent Change (1980-1990)	Percent Change (1990-2000)
Ahoskie	Hertford	4,887	4,535	4,523	-7.2	-0.3
Aulander*	Bertie	1,214	1,209	888	-0.4	-26.6
Cofield	Hertford	465	407	347	-12.5	-14.7
Colerain	Bertie	284	241	221	-15.1	-8.3
Como	Hertford	89	102	78	14.6	-23.5
Conway	Northampton	678	759	734	11.9	-3.3
Edenton	Chowan	5,357	5,268	5,394	-1.7	2.4
Gaston*	Northampton	883	1,003	973	13.6	-3.0
Gatesville	Gates	363	308	281	-15.2	-8.8
Harrellsville	Hertford	151	106	102	-29.8	-3.8
Jackson*	Northampton	720	592	695	-17.8	17.4
Lasker	Northampton	96	139	103	44.8	-25.9
Murfreesboro	Hertford	3,007	2,580	2,045	-14.2	-20.7
Powellsville	Bertie	320	279	259	-12.8	-7.2
Rich Square*	Northampton	1,057	1,058	931	0.1	-12.0
Seaboard	Northampton	687	791	695	15.1	-12.1
Severn	Northampton	309	260	263	-15.9	1.2
Winton	Hertford	825	796	956	-3.5	20.1
Woodland	Northampton	861	760	833	-11.7	9.6

* The numbers reported reflect municipality population; however, these municipalities are not entirely within the basin. The intent is to demonstrate growth for municipalities located wholly or partially within the basin

Population trends in the Chowan basin show a decline in rural areas and an increase in population and development along inland waterways. While in most towns population decreased between 1990 and 2000, the overall basinwide population is expected to increase. Planning for sustainable growth in the Chowan River basin requires awareness, understanding and implementation of sound design and management options. The natural resources and waterways contribute to our quality of life while supporting and promoting economic growth. Communities should anticipate growth while incorporating Low Impact Development technologies in their planning to promote long-term sustainability of our natural resources. The NC Division of Coastal Management with NC Sea Grant and NCSU College of Design developed ***The Soundfront Series***, informational guides to assist property owners and community planners and managers. The guides are available in print and on the web. http://www.ncseagrant.org/.

8.2 River Basin Hydrologic Units

Under the federal system, the Chowan River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). Cataloging units are further divided into smaller watershed units (14-digit hydrologic units) that are used for smaller scale (Table 17).

Table 17 Hydrologic Subdivisions in the Chowan River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-digit Codes	USGS 8-digit Hydrologic Units	USGS 14-digit Hydrologic Units*
Chowan River		03010203	010010, 020010, 030010, 030020, 030030, 040010, 040020, 040040, 050010, 050011, 050012, 050020, 050030, 060010, 060011, 060012, 060020, 060030, 060040, 090010, 040030, 070010, 070020, 080020, 090015, 100010
Upper Chowan River and Ahoskie Creek	03-01-01		
Middle Chowan River and tributaries	03-01-03		
Lower Chowan and tributaries	03-01-04		
Meherrin River and tributaries	03-01-02	03010204	140010, 140020, 140030, 180010, 180020, 180030, 180040, 190010, 200010, 210010, 210020, 210030, 210040

*Numbers from the 8-digit and 14-digit column make the full 14-digit HU.

8.3 Water Resources and Water Supply Planning

NC DENR Division of Water Resources (DWR) administers programs for river basin management, water supply assistance, water conservation, and water resources development. The Division conducts special studies on instream flow needs and serves as the State liaison with federal agencies on major water resources related projects. The DWR also administers two environmental education outreach programs, Stream Watch and Project WET. For more information about the Chowan River basin visit http://www.ncwater.org/basins/Chowan/.

8.4 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

The frequency of acute impacts due to nonpoint source pollution (runoff) is actually minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also have water quality impacts during drought conditions even though permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During droughts these wastewater discharges

make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.

As streamflows decrease, there is less habitat available for aquatic insects and fish. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

These are also areas where longer retention times due to decreased flows allow algae to take full advantage of the nutrients present resulting in algal blooms. During the daylight hours, algae greatly increase the amount of dissolved oxygen in the water, but at night, algal respiration and die off can cause dissolved oxygen levels to drop low enough to cause fish kills. Besides increasing the frequency of fish kills, algae blooms can also cause difficulty in water treatment resulting in taste and odor problems in finished drinking water.

8.5 Source Water Assessment of Public Water Supplies

8.5.1 Introduction

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 emphasize pollution prevention as an important strategy for the protection of ground and surface water resources. This focus promotes the prevention of drinking water contamination as a cost-effective means to provide reliable, long-term and safe drinking water sources for public water supply (PWS) systems. In order to determine the susceptibility of public water supply sources to contamination, the amendments also required that all states establish a Source Water Assessment Program (SWAP). Specifically, Section 1453 of the SDWA Amendments require that states develop and implement a SWAP to:

- Delineate source water assessment areas;
- Inventory potential contaminants in these areas; and
- Determine the susceptibility of each public water supply to contamination.

In North Carolina, the agency responsible for the PWS is the Public Water Supply (PWS) Section of the DENR Division of Environmental Health (DEH). The PWS Section received approval from the EPA for their SWAP Plan in November 1999. The SWAP Plan, entitled *North Carolina's Source Water Assessment Program Plan*, fully describes the methods and procedures used to delineate and assess the susceptibility of more than 9,000 wells and approximately 207 surface water intakes. To review the SWAP Plan, visit the PWS website at http://www.deh.enr.state.nc.us/pws/index.htm.

8.5.2 Delineation of Source Water Assessment Areas

The SWAP Plan builds upon existing protection programs for ground and surface water resources. These include the state's Wellhead Protection Program and the Water Supply Watershed Protection Program.

Wellhead Protection (WHP) Program

North Carolinians withdraw more than 88 million gallons of groundwater per day from more than 9,000 water supply wells across the state. In 1996, Congress passed Amendments to the SDWA requiring states to develop wellhead protection programs that reduce the threat to the quality of groundwater used for drinking water by identifying and managing recharge areas to specific wells or wellfields.

Defining a wellhead protection area (WHPA) is one of the most critical components of wellhead protection. A WHPA is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The SWAP uses the methods described in the state's approved WHP Program to delineate source water assessment areas for all public water supply wells. More information related to North Carolina's WHP Program can be found at: http://www.deh.enr.state.nc.us/pws/swap.

Water Supply Watershed Protection (WSWP) Program

DWQ is responsible for managing the standards and classifications of all water supply watersheds. In 1992, the WSWP Rules were adopted by the EMC and require all local governments that have land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps and management plans. SWAP uses the established water supply watershed boundaries and methods established by the WSWP program as a basis to delineate source water assessment areas for all public water surface water intakes. Additional information regarding the WSWP Program can be found at http://www.ncwaterquality.org/wswp/.

8.5.3 Susceptibility Determination – North Carolina's Overall Approach

The SWAP Plan contains a detailed description of the methods used to assess the susceptibility of each PWS intake in North Carolina. The following is a brief summary of the susceptibility determination approach.

Overall Susceptibility Rating

The overall susceptibility determination rates the potential for a drinking water source to become contaminated. The overall susceptibility rating for each PWS intake is based on two key components: a contaminant rating and an inherent vulnerability rating. For a PWS to be determined "susceptible," a potential contaminant source must be present and the existing conditions of the PWS intake location must be such that a water supply could become contaminated. The determination of susceptibility for each PWS intake is based on combining the results of the inherent vulnerability rating and the contaminant rating for each intake. Once combined, a PWS is given a susceptibility rating of higher, moderate or lower (H, M or L).

Inherent Vulnerability Rating

Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. The inherent vulnerability rating of groundwater intakes is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well integrity and construction characteristics. The inherent vulnerability rating of surface water intakes is determined based on an evaluation of the watershed classification (WSWP Rules), intake location, raw water quality data (i.e., turbidity and total coliform) and watershed

characteristics (i.e., average annual precipitation, land slope, land use, land cover, groundwater contribution).

Contaminant Rating
The contaminant rating is based on an evaluation of the density of potential contaminant sources (PCSs), their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area.

Inventory of Potential Contaminant Sources (PCSs)
In order to inventory PCSs, the SWAP conducted a review of relevant and available sources of existing data at federal, state and local levels. The SWAP selected sixteen statewide databases that contained usable geographic information related to PCSs.

8.5.4 Source Water Protection

The PWS Section believes that the information from the source water assessments will become the basis for future initiatives and priorities for public drinking water source water protection (SWP) activities. The PWS Section encourages all PWS system owners to implement efforts to manage identified sources of contamination and to reduce or eliminate potential threats to drinking water supplies through locally implemented programs

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP as well as materials such as:

- Fact sheets outlining sources of funding and other resources for local SWP efforts.
- Success stories describing local SWP efforts in North Carolina.
- Guidance about how to incorporate SWAP and SWP information in Consumer Confidence Reports (CCRs).

Information related to SWP can be found at http://www.deh.enr.state.nc.us/pws/swap.

8.5.5 Public Water Supply Susceptibility Determinations in the Chowan River Basin

In April 2004, the PWS Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. A second round of assessments were completed in April 2005. The results of the assessments can be viewed in two ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on the PWS web page (http://www.deh.enr.state.nc.us/pws/swap). To view a report, select the PWS System of interest by clicking on the "SWAP Reports" icon.

In the Chowan River basin, 75 public water supply sources were identified, all of which are groundwater wells. Of the 75 groundwater sources, 4 of them have a Higher, 29 have a Moderate and 42 have a Lower susceptibility rating. It is important to note that a susceptibility rating of Higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated by the identified PCSs within the assessment area.

8.6 Changes in Land Cover

Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not yet available. Land cover information from the National Resources Inventory (NRI) published by the Natural Resource Conservation Service (NRCS) is presented only at an 8-digit hydrologic unit scale. This information is presented to provide a picture of the different land covers and developing land use trends in the Chowan River basin, while noting that the data is outdated and does not reflect recent development along North Carolina's waterways.

Land cover information in this section is from the most current NRI, as developed by the NRCS (USDA-NRCS, June 2001). The NRI is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997. The USDA is working to provide updates to land cover data in the near future.

In general, NRI protocols and definitions remain fixed for each inventory year. However, part of the inventory process is that the previously recorded data are carefully reviewed as determinations are made for the new inventory year. For those cases where a protocol or definition needs to be modified, all historical data must be edited and reviewed on a point-by-point basis to make sure that data for all years are consistent and properly calibrated. The following excerpt from the *Summary Report: 1997 National Resources Inventory* provides guidance for use and interpretation of current NRI data:

> *The 1997 NRI database has been designed for use in detecting significant changes in resource conditions relative to the years 1982, 1987, 1992 and 1997. All comparisons for two points in time should be made using the new 1997 NRI database. Comparisons made using data previously published for the 1982, 1987 or 1992 NRI may provide erroneous results because of changes in statistical estimation protocols, and because all data collected prior to 1997 were simultaneously reviewed (edited) as 1997 NRI data were collected.*

Table 18 summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover.

Table 18 Land Cover in the Chowan River Basin by Major Watersheds: 1982 vs. 1997

	MAJOR WATERSHED AREAS *								
	Chowan River Watershed		Meherrin River Watershed		1997 TOTALS		1982 TOTALS		% change since 1982
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cultivated. Crop	142.4	30.3	119.6	35.8	262.0	32.6	264.1	32.8	-0.8
Uncultivated. Crop	1.5	0.3	0.0	0.0	1.5	0.2	0.0	0.0	150.0
Pasture	3.1	0.7	4.9	1.5	8.0	1.0	10.5	1.3	-23.8
Forest	266.7	56.7	174.8	52.3	441.5	54.9	445.9	55.4	-1.0
Urban & Built-Up	11.2	2.4	11.5	3.4	22.7	2.8	14.0	1.7	62.1
Federal	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other	45.7	9.7	23.2	6.9	68.9	8.6	70.3	8.7	-2.0
Totals	**470.6**	**100.0**	**334.0**	**100.0**	**804.6**	**100.0**	**804.8**	**100.0**	
Percent of Total Basin		58.5		41.5		100.0			
SUBBASINS	03-01-01 03-01-03 03-01-04 **		03-01-02						
8-Digit Hydraulic Units	03010203		03010204						

* = Watershed areas defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.
** A small portion of subbasin 03-01-04 is contained in hydrologic unit 03010205.
It is not currently feasible to estimate the land use in that portion to include the Chowan land cover estimates.
The hydrologic unit 03010205 is discussed in the Pasquotank River Basin Water Quality Plan.

Forest and wetlands (both private and federal forests) cover approximately 55 percent of the basin. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 34 percent of the land area. The urban and built-up category comprises roughly 3 percent. Cultivated cropland and forestland cover both decreased in the basin. Uncultivated cropland and pastureland cover had the most significant changes.

8.7 Forest Management

Approximately 86 percent of forestland in the Chowan River basin is privately owned;12 percent is owned by forest industry and the rest is publicly owned. These ownership estimates comes from the most recent Forestry Inventory and Analysis data published by the USDA-Forest Service (*Forest Statistics for North Carolina, 2002.* Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

At least 44,933 acres of land were planted or regenerated with forest trees across the basin from September 1, 2000 through August 31, 2005. During this same time period, the North Carolina Division of Forest Resources (DFR) provided individual forest plans for landowners that encompassed over 83,959 acres in the basin. This includes 2,078 plans, such as pre-harvest, rehabilitation and forest stewardship plans, which provide site specific guidance for water quality protection.

The DFR operates a 700+ acre tree nursery in Goldsboro. The nursery grows 9 species of conifers and 51 species of hardwoods that are available for forest management and stream/ wetland restoration projects. There is a distribution center located in Edenton where these seedlings can be picked up once they are purchased. Call 1-888-NC TREES (628-7337) for more information or visit the Web site noted above.

Uncontrolled high intensity fires can combust excessive amounts of ground cover and vegetation and have the potential to negatively impact water quality. DFR performs hazard reduction burns

to reduce fuel load and therefore wild fire hazard. During the period covered by this Plan, nearly 3,000 acres of land were either prepared or burned for the reduction of hazardous fuels.

8.7.1 Forest Practices Guidelines Related to Water Quality (FPGs)

The DFR is delegated the authority to monitor and evaluate forestry operations for compliance with laws and/or rules. Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act (SPCA) of 1973. However, forestry operations are exempt from the permit and plan requirements of the SPCA if the operations meet the compliance standards outlined in the Forest Practices Guidelines Related to Water Quality (FPG) and General Statutes regarding stream obstruction. For more information regarding forest practices guidelines related to water quality please visit Chapter 7 in the *Supplemental Guide to North Carolina's Basinwide Planning: Support Document for Basinwide Water Quality Plans:* http://www.ncwaterquality.org/basinwide/SupplementalGuide.htm.

DFR has personnel in all 100 counties who perform FPG inspections and handle other basic water quality related tasks on a daily basis. In addition, ten of its thirteen Districts across the State also have specialists known as Water Quality Foresters. The entire Chowan River basin now has coverage by Water Quality Foresters, thanks to a new position that was established in 2005, which is based out the Elizabeth City District Office. Water Quality Foresters conduct FPG inspections, survey BMP implementation, check for compliance with forest harvest requirements of state buffer rules, develop pre-harvest plans, provide training opportunities for landowners, loggers, and the public regarding water quality issues related to forestry, and assist other DFR staff with more technical water quality issues.

During the period September 1, 2000 through August 31, 2005 the DFR inspected 1,400 forestry sites for FPG compliance in the basin; 96 percent of the sites inspected were in compliance. In addition, 121 re-inspections were performed to ensure that sites continued to be or were brought into compliance with the FPGs.

8.7.2 Forestry Best Management Practices

Implementing Forestry BMPs is strongly encouraged by DFR in order to efficiently and effectively protect the water resources of North Carolina and help maintain compliance with the FPGs. During this Plan's reporting period, DFR provided 700 written or verbal BMP recommendations on tracts totaling 32,733 acres in the Chowan River Basin. To further assess BMPs, the DFR conducted a detailed, statewide BMP Implementation Survey from March 2000 through March 2003 to evaluate Forestry BMPs on active harvest operations. During that time period, 23 of those surveys were performed in the Chowan River basin. On those sites, implementation of recommended BMPs was 83 percent. Eight percent of the conditions on those sites had potential to degrade water quality. Forestry BMP implementation in the Chowan River basin was close to the statewide survey average of 82 percent. The problems most often cited in this survey relate to stream crossings, skid trails, and site rehabilitation. This survey, and future surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

8.7.3 Bridgemats

To help prevent water quality problems associated with stream crossings, the DFR has been loaning bridgemats to loggers for establishing temporary stream crossings during harvesting activities. Temporary bridges are usually the preferred solution for stream crossings instead of culverts or hard-surfaced 'ford' crossings. Bridgemats are available upon request from any District Office. In 2005, the Albemarle-Pamlico National Estuary Program provided grant funding for the purchase of two steel sets of 30-foot bridgemats for use in northeastern North Carolina, with one set dedicated specifically to the Chowan River basin. There may be situations whereby the bridgemats are used in neighboring river basin areas, if the customer demand warrants. More information about using bridgemats, and the above noted BMP survey, is available on the 'Water Quality' section of the DFR's website: http://www.dfr.state.nc.us/.

8.7.4 Forest Products Industry

The forest industry is a vital economic driver throughout the Chowan River basin, with significant forest industry operations located in the basin. In the Chowan River basin, seven different businesses are considered "Primary Processors" of forest products raw material, which represents three percent of the total number of primary processors in the state. While one of the state's five pulp/paper mills is located in Plymouth, just beyond the boundary of the Chowan River basin, the economic importance of the mill's demand for raw materials and its employment value circulates across river basin boundaries, throughout northeastern North Carolina. Other examples of primary processors in this basin include pine sawmills operated by Weyerhaeuser, International Paper and Georgia Pacific. All primary processors pay an assessment to the State, which is then combined with annual legislative appropriations to fund the "Forest Development Program - FDP", which provides cost-share reforestation assistance for forest landowners.

8.8 Public Lands

A small percentage (1.2 percent) of the Chowan River basin is publicly-owned conservation land. The Chowan Swamp State Natural Area, administered by the Department of Parks and Recreation, protects more than 6,000 acres. Merchants Millpond State Park encompasses about 3,300 acres, and offers an excellent natural experience with a wide variety of plant and animal life. Wildlife Resources Commission has two small game lands within the basin: the Chowan Game Lands and the Chowan Swamp Game Lands.

8.9 Ecological Significance of the Chowan River Basin

The Chowan and Meherrin rivers still reflect the rural character of the basin. The Chowan River is known for some of the best fishing in the state, with largemouth bass, bluegill, chain pickerel, black crappie, perch and herring being some of the most sought after species. However, the Chowan River is noteworthy for more than good fishing with approximately 100 stream miles of the Chowan River are considered an Aquatic Significant Natural Heritage Areas by the North Carolina Natural Heritage Program (NHP). The NHP is working to catalog North Carolina's Aquatic Significant Natural Heritage Areas, identifying stretches of river and streams that contain viable populations of rare aquatic species. The Chowan River receives this designation because of the diversity of its freshwater mussel populations, many of which are rare and vulnerable.

8.9.1 Significant Natural Heritage Areas in the Chowan River Basin

The NHP inventories areas for natural diversity, and catalogs rare plant and animal species and natural communities. As previously mentioned, the Chowan River is for much of its length in North Carolina considered a state significant Aquatic Significant Natural Heritage Area. There are a number of other significant natural areas in the Chowan River basin, some of which are described below. Inclusion on the list does not imply that protection or public access exists. More complete information on natural areas may be obtained from the NHP.

A number of identified natural areas contribute to water quality, including wetland natural communities adjoining tributary streams and the mainstem rivers. Perhaps the most important wetland community in this basin is the Tidal Cypress-Gum Swamp, which is found along much of the shoreline of the Chowan River, extending as far upriver as the Chowan Swamp area of southern Gates County. Tidal swamps are distinguished by flooding caused primarily by regular or irregular (such as wind) tides rather than seasonal river flooding. This situation modifies the water quality of both brownwater and blackwater rivers and produces a different hydrologic regime (Schafale and Weakley 1990).

The **Chowan Swamp/Bennetts Creek/Catherine Creek Swamps** natural area contains some of the largest areas of Tidal Cypress-Gum Swamp in the state. The natural area consists of approximately 16,000 acres along the northern floodplain of the Chowan River.

The **Colerain/Cow Island Swamp and Slopes** natural area is similar to the Chowan Swamp, in that it lies in the floodplain of the Chowan River and features Tidal Cypress-Gum Swamp along the shoreline, as well as other wetland communities farther from the river. This natural area is located downstream from the Chowan Swamp, on the western shore of the river in Hertford and Bertie Counties.

The **Rocky Hock Swamp Forest** contains remnants of an Atlantic White Cedar Forest community. It is significant for having the only population of whisk-fern (*Psilotum nudum*) in North Carolina and represents a major range extension for this species.

The **Chinkapin Creek Hardwood Forest**, is over three square miles in area, contains one of the most extensive areas of mature upland hardwood forest natural communities remaining in the Coastal Plain of North Carolina. It also contains one of the few remnants in the state for Pine/Scrub Oak Sandhill (Northern Subtype).

The **Reedy Point Swamp** is a good example of Pond Pine Woodland, and is among the best in the region north of Albemarle Sound.

The **Wiccacon River Bluffs and Swamp** consists of a series of bluffs and dissected lands along the lower Wiccacon River. The spectacular bluffs support a band of mesic forests, and while no rare plant species are known, the Basic Mesic Forest supports a large number of species that are typical of the Piedmont and even Mountains but are quite rare in the Coastal Plain.

There are six natural areas identified as significant along the Meherrin River. The entire portion of the Meherrin River in North Carolina is also considered a regionally significant Aquatic Significant Natural Heritage Area, primarily due to high quality habitat for rare mussels. Those Significant Natural Heritage Areas important to water quality include the **Meherrin River**

Swamp in Hertford County and the **Meherrin River Slopes and Swamp** in Northampton County.

The **Meherrin River/Banks Creek Natural Area** contains one of the best occurrences of mature mesic mixed hardwood forest in the region. In addition, two outcrops of Yorktown fossil deposits occur in the bluffs.

The **Chowan River/Bartonsville Natural Area** is a State-Significant site that is located along the western margin of the Chowan River floodplain, just north of the confluence with the Meherrin River. The natural area includes representative examples of mature, old-growth swamp forest (with cypress and gum) and upland loblolly pine plant communities. Old-growth examples of these communities are rare on the coastal plain, and within the natural area one can find the former National Champion loblolly as well as significant wildlife habitat. A portion of the site was protected by a 1965 agreement with the Society of American Foresters.

Merchants Millpond was constructed in 1811 as a source of waterpower, but has not been used as such for a long time. Now Merchant's Millpond State Park's shallow pond supports an excellent Piedmont/Coastal Plain Semi-permanent Impoundment community, believed to resemble those in the large, mature beaver ponds that were eliminated from the state when beavers were extirpated. The pond has an open canopy of stunted cypress and tupelo trees, and supports a diverse assemblage of aquatic herbs. Several rare species are present: yellow water-crowfoot (*Ranunculus flabellaris*), American featherfoil (*Hottonia inflata*), pale mannagrass (*Torreyochloa pallida*), and conferva pondweed (*Potamogeton confervoides*). Upstream of the pond, in Lassiter Swamp, is an excellent quality blackwater Cypress--Gum Swamp, including an area of virgin water tupelo. The state champion water tupelo can be found in this area. The diversity of habitat supports a tremendous variety of animal life. Over 190 species of birds have been recorded in the park. Diverse populations of reptiles and amphibians and numerous mammals such as beaver, mink and river otter are also found here.

The **Wyanoke Sandhills** natural area is the northernmost longleaf pine community in the state, unusual in that it lies north of the range of wiregrass (*Aristida stricta*), which is a groundcover commonly associated with longleaf pine communities. The site also contains good examples of other uncommon natural communities, including wetlands, and a significant historical site containing Civil War earthworks.

8.9.2 Rare Aquatic and Wetland-Dwelling Animal Species

Table 19 below lists the rare aquatic species found in the Chowan River basin. For more information on rare plant and animal species, visit the NHP website: www.ncnhp.org.

Table 19 List of Rare Aquatic Species in the Chowan River Basin

Scientific Name	Common Name	State Status	Federal Status
Animals			
Acipenser brevirostrum	Shortnose Sturgeon	E	LE
Alasmidonta undulata	Triangle Floater	T	
Anodonta implicata	Alewife Floater	T	
Lampsilis radiata radiata	Eastern Lampmussel	T	
Leptodea ochracea	Tidewater Mucket	T	
Ligumia nasuta	Eastern Pondmussel	T	
Orconectes virginiensis	Chowanoke Crayfish	SC	FSC
Plants			
Hottonia inflata	Featherfoil	SR	
Bacopa innominata	Tropical water-hyssop	SR	
Potamogeton confervoides	Conferva Pondweed	SR	FSC
Torreyochloa pallida	Pale Mannagrass	SR	

Listing Abbreviations: SR = Significantly Rare; T = Threatened; SC = Special Concern; FSC = Federal Species of Concern; E and LE = Endangered

An endangered taxon is in danger of extinction throughout all or a significant portion of its range. A threatened taxon is likely to become an endangered species within the foreseeable future. Special concern species require monitoring, but may be taken or collected under specific regulations. A significantly rare species is rare in North Carolina, but has no official state status. Federal species of concern refers to a taxon under consideration for listing, but at present there is insufficient information to support listing.

Five of the rare aquatic animals – the Triangle Floater, Alewife Floater, Eastern Lampmussel, Tidewater Mucket, and Eastern Pondmussel – are species of freshwater mussels. Freshwater mussels have an interesting life cycle, with many of them dependent on specific fish to act as hosts for their larvae. Freshwater mussels have surprisingly long life spans – with thicker-shelled river species living 20-40 years, and some up to 100 years. Freshwater mussels are imperiled nationwide, due to degraded physical habitats (e.g. sedimentation) and reduced water quality, as well as declining populations in certain fish species that act as hosts.

The Triangle Floater (*Alasmidonta undulata*) formerly inhabited virtually every North Carolina river system that drained to the Atlantic. However, the populations of this small mussel are declining, and it is not found in many of the locales where it was once collected. It prefers slow moving streams rather than rapids or riffles. The Alewife Floater (*Anodonta implicata*) is usually found in more northern areas, ranging from Nova Scotia to the Potomac River in Virginia and Maryland. The population found in the Chowan River basin appears to be a disjunct. The Alewife Floater gets its name from its association with its main host fish, the alewife. The Eastern Lampmussel (*Lampsilis radiata*) is usually found in medium to coarse sand habitats. Like the Alewife Floater, the Eastern Lampmussel is generally considered a northern species, with a discontinuous range from the Pee-Dee Drainage Basin north to the St. Lawrence Drainage Basin. Little is known about its fish hosts. The Tidewater Mucket (*Leptodea ochracea*) is known from only a few locations within North Carolina, including a large population in Lake Waccamaw, populations in the Tar and Roanoke Rivers, and much smaller populations in the Chowan and Meherrin Rivers. Although not truly restricted to tidal portions of rivers, the Tidewater Mucket is never found far from the Atlantic coast. This suggests that, like the Alewife

Floater, its dominant or preferred fish host is anadromous. The Eastern Pondmussel (*Ligumia nasuta*) reaches its southern range limit in North Carolina. This species is known from the Chowan, Roanoke, and Pamlico drainage basins. Like the other freshwater mussel species discussed, its population appears to be declining, probably due to poor water quality. In North Carolina, this species is known from the Chowan, Roanoke, and Cape Fear River basins. The species has been recently extirpated from the Pamlico River basin.

The Shortnose Sturgeon (*Acipenser brevirostrum*) is a large, anadromous fish that once was common in North Carolina waterways. The shortnose sturgeon may live for up to 30 years, and inhabits the lower sections of larger rivers and estuaries along the Atlantic coast. The species has suffered from excessive harvesting and habitat degradation, and is now in danger of extinction. The fish has not been recorded from the Chowan River for over one hundred years.

Not much is known about the natural history of the Chowanoke Crayfish (*Orconectes virginiensis*). This crustacean reaches the southern end of its range in North Carolina and the only other place it occurs is Virginia. It lives in sluggish streams flowing through woodlands with sandy or gravelly substrates, and is considered one of North Carolina's rarest crayfish.

8.10 Fisheries

8.10.1 River Herring Fisheries Management Plan

The Chowan River and its tributaries provide critical habitat for the anadromous fish species. Good water quality is an essential habitat element and has been identified as a limiting factor in fish stock recovery if water quality does not improve. The draft 2007 River Herring Fisheries Management Plan (FMP) provides an assessment of habitat conditions, recent studies, and recommendations to improve stock conditions. The FMP for the river herring advocates for multi-agency natural resource conservation and preservation. The FMP recommends that agencies collaboratively work to 1) develop stricter nutrient discharge limits to reduce eutrophication, 2) develop sediment discharge limits to protect spawning habitats, 3) reevaluate the oxygen budget in coastal waters to account for low DO waters draining from swamps and 4) require dischargers meet compliance with BOD limitations. The FMP supports the need for improved stormwater management plans and developing requirements for establishing and protecting riparian buffers and wetlands. The FMP discourages interbasin water transfers to prevent exacerbation of existing water quality conditions. The FMP also calls for an assessment of potential contaminates and by-products of reverse osmosis plants. More information on fish habitat requirements, water quality needs and specific recommendations can be found in the draft river herring FMP on the Division of Marine Fisheries website: http://www.ncfisheries.net/fmps/index.html.

8.10.2 Fish Kill Summary

DWQ has systematically monitored and reported fish kill events across the state since 1996. From 2000 to 2005, field investigators reported seven fish kill events in the Chowan River basin. Stagnant water, shallow water, low dissolved oxygen, and possible chemical contamination may have contributed to these fish kill events. Annual fish kill reports can be found at DWQ's Environmental Sciences website http://www.ncwaterquality.org/esb/Fishkill/fishkillmain.htm.

Chapter 9
Agriculture and Water Quality

9.1 Animal Operations

Over the years, key legislative bills were introduced and approved to regulate concentrated animal feeding operations (CAFOs) in the State of North Carolina. In May 2006, the Environmental Management Commission (EMC) adopted Title 15A Subchapter 02T. The rules reflect current policy and provide routine consideration of an applicant's compliance status. Section .1300 of Subchapter 02T applies to all persons proposing to construct, modify, expand or operate an animal waste management system. Animal waste is defined as livestock or poultry excreta or mixture of excreta with feed, litter, bedding or other material generated at a feedlot. Animal waste management systems are defined as a combination of structural and nonstructural practices that collect, treat, store or apply animal waste to the land. An animal waste management plan is defined as a plan to properly collect, store, treat or apply animal waste to the land in an environmentally safe manner developed in accordance with the General Statute §143-215.10C (www.ncleg.net/EnactedLegislation/Statutes/HTML/BySection/Chapter_143/GS_143-215.10C.html).

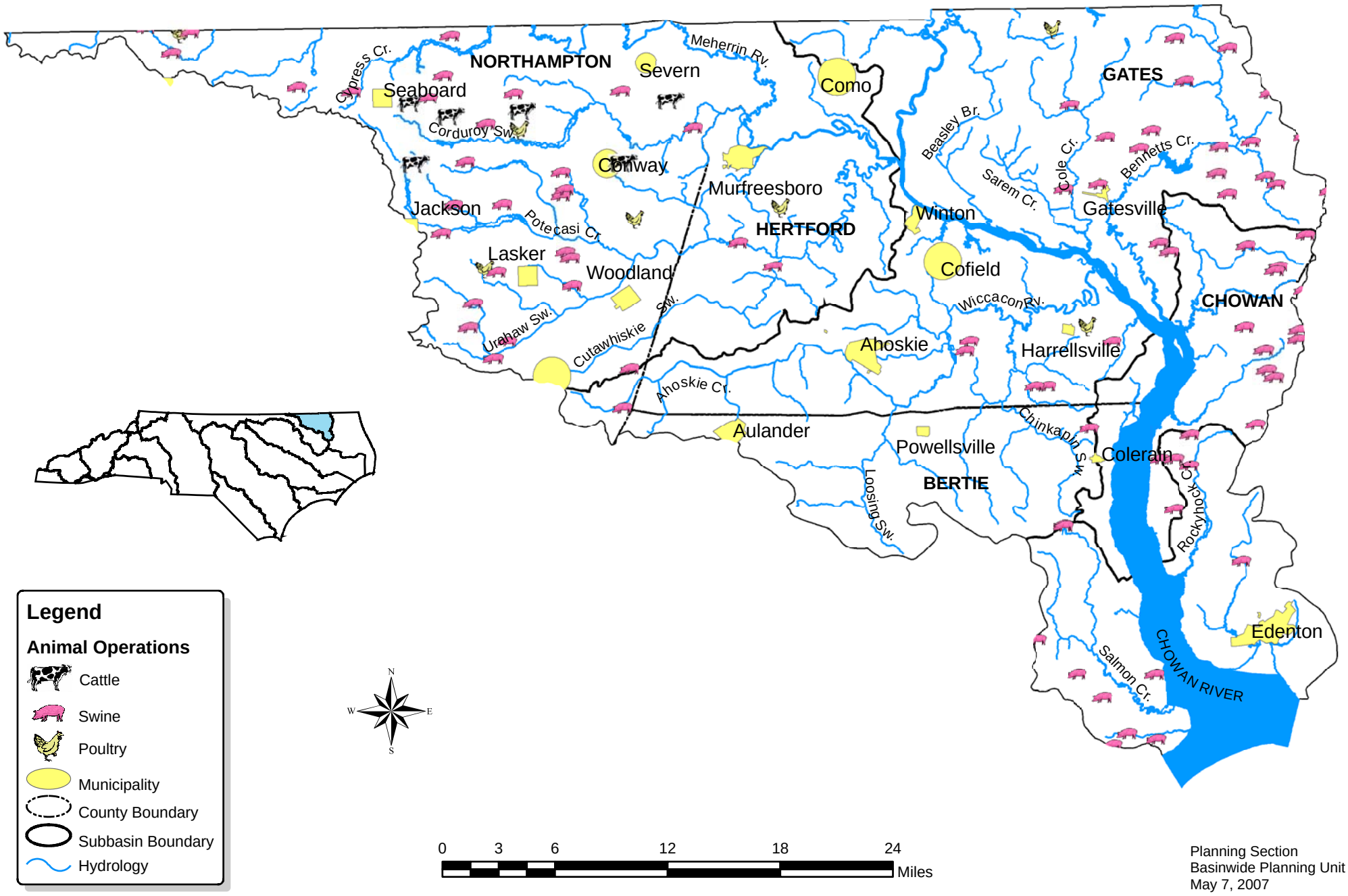
Table 20 summarizes the number of permitted livestock operations, total number of animals, number of facilities, and total steady state live weight. These numbers reflect only operations required by law to be permitted, and therefore, do not represent the total number of animals in each subbasin. The Chowan River basin contains approximately 101 animal operations, including both permitted and nonpermitted cattle, poultry and hog farms, as shown in Figure 7.

Table 20 Permitted Animal Operations.

Subbasin	Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight*
03-01-01	11	23,952	4,904,760
03-01-02	21	47,314	16,603,330
03-01-03	3	2,080	253,500
03-01-04	2	7,216	974,160
Totals	**37**	**80,562**	**227,357,50**

* Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

Figure 7 Animal Operations in the Chowan River Basin



Planning Section
Basinwide Planning Unit
May 7, 2007

9.2 Agricultural Best Management Practices and Funding Opportunities

9.2.1 NC Agriculture Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) was established in 1984 to help reduce agricultural nonpoint runoff into the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using best management practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The NCACSP is implemented by the Division of Soil and Water (DSWC), which divides the approved BMPs into five main purposes or categories:

- *Erosion Reduction/Nutrient Loss Reduction in Fields*
  Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, stripcropping, terraces, and Christmas tree conservation cover.

- *Sediment/Nutrient Delivery Reduction from Fields*
  Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, streambank stabilization, and road repair/stabilization.

- *Stream Protection from Animals*
  Stream protection management measures are planned systems for protecting streams and streambanks. Such measures eliminate livestock access to streams by providing an alternate watering source away from the stream itself. Other benefits include reduced soil erosion, sedimentation, pathogen contamination and pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (i.e., fencing), spring development, stream crossings, trough or watering tanks, wells, and livestock feeding areas.

- *Proper Animal Waste Management*
  A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging area, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost, and waste application system.

- *Agricultural Chemical (Agrichemical) Pollution Prevention*
  Agrichemical pollution prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include: agrichemical handling facilities and fertigation/chemigation back flow prevention systems.

The NCACSP is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned BMP

is completed, inspected and certified according to NRCS standards and specifications and Soil and Water Conservation Commission (SWCC) policies. The annual statewide budget for BMP cost sharing is approximately $8 million. [Note: the annual statewide budget for ACSP cost sharing is $5.6 million; the additional $2.4 million is the annual statewide budget for technical assistance.] During the period from 2000 to 2005, $2,427,390 was provided for projects in the Chowan River basin. Table 21 summaries the cost and total BMPs implemented (i.e., acres, units, linear feet) throughout the Chowan River basin.

Table 21 Summary of NCACSP projects in the Chowan River Basin (2000 to 2005)

Purpose of BMP	Subbasin 03-01-01		Subbasin 03-01-02		Subbasin 03-01-03		Subbasin 03-01-04	
	Total Implemented	Cost	Total Implemented	Cost	Total Implemented	Cost	Total Implemented	Cost
Erosion Reduction/Nutrient Loss	11,873.2 ac	$285,672	5,110.8 ac	$240,041	1,534.5 ac	$212,604	5,009.5 ac	$575,787
Reduction in Fields	1,240.0 l. ft.		20,853.2 l. ft.					
Sediment/Nutrient Delivery	3,968.5 ac	$276,227	2,484.2 ac	$370,525	937.7 ac	$28,606	2,934.1 ac	$139,833
Reduction from Fields	4 units		11 units		1 unit		37 units	
Stream Protection from Animals	1 unit	$4,750	1 unit	$3,021				
	3,375.0 l. ft.							
Proper Animal Waste Management	6 units	$43,893	3 units	$22,691	6 units	$70,344	15 units	$153,396
	1 ton						64 tons	
							1 gallon	
Total Costs		**$610,542**		**$636,278**		**$311,554**		**$869,016**

Benefits	Subbasin 03-01-01	Subbasin 03-01-02	Subbasin 03-01-03	Subbasin 03-01-04
Total Soil Saved (tons)	29,953	44,596	5,499	8,930
Total Nitrogen (N) Saved (lb.)	318,878	210,649	270,690	117,710
Total Phosphorus (P) Saved (lb.)	78,178	42,325	20,645	14,466
Total Waste-N Saved (lb.)	169,884	33,020	32,276	162,967
Total Waste-P Saved (lb.)	154,949	73,450	35,644	77,536

* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the DENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

County Soil and Water Conservation District (SWCD) contacts for the Chowan River basin are included in Appendix IV. BMP definitions and SWCD contact information can be found online at www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html.

9.2.2 USDA – NRCS Environmental Quality Improvement Program (EQIP)

The USDA – Environmental Quality Improvement Program (EQIP) provides technical, educational and financial assistance to eligible farmers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers in complying with Federal and State environmental laws and encourages environmental enhancement. The purposes of the program are achieved through the implementation of a conservation plan that includes structural, vegetative and land management practices on eligible land. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, composters, filter strips, livestock exclusion, and permanent wildlife habitat. Incentive payments can also be made to implement one or more land management practices, such as nutrient management, pest management, grazing land management and long-term conservation tillage. The program is carried out at the county level with base funding levels made available to each county.

During this assessment period in Northampton County, over 265 acres were managed for nutrients and pesticides, 28,400 ft. were reserved as wildlife borders, and on 1,607 acres long-term no-till cultivation was implemented. Five lagoon closures occurred and five litter storage facilities were constructed. Future efforts using EQIP resources in Northampton County will include additional no-till, wildlife and field border acreage, closure of lagoons, construction of fencing, waterers, and wells, and establishing waste storage facilities.

NRCS district contacts for the Chowan River basin are provided in Appendix IV, or information can also be found on NRCS website at http://www.nc.nrcs.usda.gov/programs/EQIP/index.html.

9.2.3 Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program (CREP) is a joint effort of the DSWC, the NC Clean Water Management Trust Fund, the Ecosystem Enhancement Program (EEP), and the USDA Farm Service Agency to address water quality problems in Chowan River basin. CREP is a voluntary program that seeks to protect land along watercourses that is currently in agricultural production. The objectives of the program include: installing forested riparian buffers, grassed filter strips and wetlands; reducing the impacts of sediment and nutrients within the targeted area; and providing substantial ecological benefits for many wildlife species that are declining in part as a result of habitat loss. Program funding will combine the Federal Conservation Reserve Program (CRP) funding with State funding from the Clean Water Management Trust Fund, Agriculture Cost Share Program, and North Carolina Wetlands Restoration Program.

Landowners of existing agricultural land within the Chowan River basin are eligible to participate in CREP. Under CREP, landowners can voluntarily enroll eligible land in 10-year, 15-year, 30-year, and permanent contracts. The state will pay additional bonuses to landowners that enroll land in 30-year and permanent agreements. Cost sharing will be available for installation of forested riparian buffers, grassed filter strips, wetlands restoration practices, water control structures, livestock exclusion, and remote livestock watering in order to increase the efficiency of enrolled practices. Interested landowners should contact their local Soil and Water Conservation District or Farm Service Agency office. The number of acres enrolled in CREP in

the Chowan River basin are listed below in Table 22. More information about CREP can be found on the SWCD website: http://www.enr.state.nc.us/DSWC/pages/crep.html.

Table 22 CREP Acres

County	Total Enrollments (acres)	30 Year Easements (acres)	Permanent Easements (acres)
Bertie	543	30	0
Chowan	379	212	0
Gates	1,646	1,141	414
Hertford	1,771	1,478	64
Northampton	2,188	1,618	30

9.3 SWCD Water Quality Strategy Plan

Agricultural land use and increasing development continue to alter natural hydrology with the need to improve drainage. Currently, most of the swamps and wetlands have been circumvented, routing stormwater through these areas in man-made channels. The water that once flowed through the floodplain is now channeled through man-made ditches directly to the creeks and rivers and is no longer filtered by swamps. In the Chowan River basin, redesigning and reconstructing drainage systems may improve water quality. Drainage redesign involves evaluating the entire watershed to determine where in-stream improvements can compliment farm fields and subdivision improvements such as no-till, land grading to reduce nitrogen, water control, riparian buffers and establishing wetlands.

Better tools to predict water flow are now available and research at NC State University provides examples that demonstrate how drainage systems can be redesigned. Reestablishing degraded swamps can be achieved by improving drainage, while forcing stormwater flow to reassociate with the floodplain. Old floodplains can be restored by establishing in-stream wetlands and building new wetlands where needed directly in the drainage system to reduce the total volume of water flow from these drainage systems.

SWCDs are encouraging the counties to develop Special Use Water Management Districts. Each district is to develop a list of priorities to address stormwater issues and drainage. Plans for each watershed will address the following:

- Volume of stormwater retained and discharged during stormwater events,
- Channel modification to re-associate storm flow with the biology of the flood plain to remove sediment and nutrients,
- Establishment of instream wetlands where needed,
- Drainage improvements required to sustain conservation enhancement and to provide drainage for urban and agricultural areas,
- Clearing and snagging required on five-year intervals to maintain the integrity of the drainage system and
- Demonstration projects illustrating innovative techniques for addressing the water quality issues associated with drainage.

Chapter 10
Water Quality Management Strategies

10.1 The Role of State Government

Several commissions, agencies and programs handle State policies governing actions and activities in coastal areas. The Environmental Management Commission (EMC) is a 19-member panel that is appointed by the Governor and legislative officials responsible for adopting rules for the protection, preservation and enhancement of the state's water and air. Water related rules include stormwater management, basinwide planning, nutrient management strategies and discharge permits.

The North Carolina Coastal Area Management Act (CAMA) established a cooperative program of coastal area management between local and state governments. The Act states that local governments shall have the initiative for planning, while the state government establishes areas of environmental concern. With regard to planning, the State is directed to act primarily in a supportive, standard-setting, and review capacity, except in situations where local governments do not elect to exercise their initiative. In addition, the CAMA established the Coastal Resource Commission (CRC) within DENR, whose duties include approval of Coastal Habitat Protection Plans and designation of Areas of Environmental Concern (AEC). After designation of these areas, the ERC is responsible for issuing all permits and establishes regulations to control development. The CRC is a 15-member board appointed by the governor to adopt rules and policies for coastal development and certify local land use plans for the 20 coastal counties and their communities. These regulations are implemented and permitted by the Division of Coastal Management (DCM) (see website http://dcm2.ehnr.state.nc.us/). An example of these rules is the establishment of a 30-foot buffer zone for building along estuarine waters.

The Division of Marine Fisheries is responsible for the stewardship of the state's marine and estuarine resources, which encompasses all coastal waters and extends to 3 miles offshore. Agency policies are established by the 9-member Marine Fisheries Commission and the Secretary of DENR.

The N.C. Divisions of Water Quality, Coastal Management, Land Resources, Marine Fisheries, Soil and Water Conservation, Parks and Recreation, and Environmental Health are responsible for many coastal activities and policies, including stormwater management, development permits, erosion control programs, agriculture and land preservation, shellfish protection and recreation monitoring, just to name a few. Additional state programs include the Albemarle-Pamlico National Estuary Program (APNEP) and many inter-agency and group partnerships that work together to protect the resources found in coastal waters and communities.

The Coastal Zone Management Act requires National Oceanic and Atmospheric Administration to evaluate the performance of federally approved state coastal management programs. During the review of NC's CAMA specific recommendations call for the assessment of existing state laws and regulations to minimize redundancy and avoid conflict with other regulations, prioritize emerging coastal issues and use adaptive management based on lessons learned.

10.2 Coastal Habitat Protection Plan

North Carolina has approximately 2.9 million acres of estuarine and marine waters, comprising the largest estuarine system of any state along the Atlantic coast. North Carolina has a billion-dollar commercial and recreational fishing industry and ranks among the nation's highest seafood-producing states. Fish and shellfish species important to these industries depend on the quality and quantity of habitats found along our rivers, sounds and ocean waters. Pressures from development, loss of habitat, pollution and degraded water quality threaten fish habitats. Shellfish beds, mud flats, marshes, sea grass beds, freshwater streams and swamps are in jeopardy. The loss of these vital fish habitats threatens fishing industry central to North Carolina's history and economic growth.

Recognizing these threats, the N.C. General Assembly passed the Fisheries Reform Act of 1997. Included within this law is a requirement for three of the state's regulatory commissions (Marine Fisheries, Environmental Management, and Coastal Resources commissions) to adopt a plan to manage and restore aquatic habitats critical to North Carolina's commercial and recreational fisheries resources. The DENR developed the Coastal Habitat Protection Plan (CHPP) through a cooperative, multi-agency effort with public input. The CHPP was adopted by the three commissions in December 2004 and sets the stage for unprecedented improvements in fish habitat protection and restoration in North Carolina.

The CHPP is a detailed document describing the six major fish habitats and providing scientific information on their ecological functions and importance to the species that inhabit them. It identifies threats and management needs for each habitat and recommends administrative, regulatory and non-regulatory steps necessary to protect, restore and enhance each habitat. These recommendations are a result of scientific studies, deliberations of the three commissions and input from citizens who attended 20 public meetings held during the development of the CHPP. The CHPP identifies six habitats that need protection or enhancement:

- Water Column
- Shell Bottom
- Submerged Aquatic Vegetation (SAV)
- Wetlands
- Soft Bottom
- Hard Bottom

DENR and the three commissions developed and adopted specific plans to implement the CHPP recommendations, with a focus on actions that could be taken based on existing resources and within the 2005-2007 budget cycle. The implementation actions are organized according to four habitat management goals:

GOAL 1. Improve effectiveness of existing rules and programs protecting coastal fish habitats

North Carolina has a number of programs already in place to protect coastal fisheries and the natural resources that support them. The Marine Fisheries Commission (MFC) has adopted rules addressing the impacts of certain types of fishing gear and fishing practices that may damage fish habitats. The Coastal Resources Commission (CRC) regulates development impacts on certain types of critical coastal habitats, such as saltwater marshes and primary nursery areas. The Environmental Management Commission (EMC) has issued water quality standards that address

pollution of coastal waters from both direct discharges and runoff. The Coastal Habitat Protection Plan (CHPP) identifies a number of gaps in the protection provided for critical fish habitats under these programs, but also notes that these habitats would benefit from stronger enforcement of existing regulations and better coordination among agencies.

Recommendation 1.1- Enhance enforcement of, and compliance with, Coastal Resources Commission, Environmental Management Commission and Marine Fisheries Commission rules and permit conditions.

Recommendation 1.2 - Coordinate and enhance water quality, physical habitat and fisheries resource monitoring (including data management) from headwaters to the nearshore ocean.

Recommendation 1.3- Enhance and expand educational outreach on the value of fish habitat, threats from human activities, effects of non-native species and reasons for management measures.

Recommendation 1.4- Coordinate rulemaking and enforcement among regulatory commissions and agencies.

GOAL 2. Identify, designate and protect strategic habitat areas

Maintaining healthy coastal fisheries requires consideration of the entire ecosystem and the way different types of fish habitat work together. For example, coastal marshes help prevent erosion of soft bottom habitat. Unobstructed passage through the water column allows certain fish species to reach their spawning grounds in inland wetlands. Fragmenting these habitats, or damaging one of a series of interrelated habitats makes it more difficult for aquatic systems to support strong and healthy coastal fisheries. In 1998, the EMC, CRC, and MFC defined Strategic Habitat Areas. These areas are complexes of fisheries habitat that "provide exceptional functions that are particularly at risk due to imminent threats, vulnerability or rarity." These areas merit special attention and should be given high priority for conservation.

Recommendation 2.1- Evaluate potential Strategic Habitat Areas (SHAs) by a) coordinating, completing and maintaining baseline habitat mapping (including sea grass, shell bottom and other bottom types) using the most appropriate technology; b) selective monitoring of the status of those habitats; and c) assessing effects of land use and human activities on those habitats.

Recommendation 2.2- Identify and designate SHAs using ecologically based criteria, analyze existing rules and enact measures needed to protect SHAs and improve programs for conservation (including voluntary actions) and acquisition of areas supporting SHAs.

GOAL 3. Enhance habitat and protect it from physical impacts

The CHPP identifies a number of ways in which fish habitats can be damaged by direct physical impacts. Some examples include filling of wetlands, dredging of soft bottom habitat, destruction of shell bottom and hard bottom areas, damage to submerged aquatic vegetation by use of certain types of fishing gear, and physical obstructions that block fish movement to and from spawning areas. While large impacts can directly contribute to the loss of habitat functions, the accumulation of many small impacts can make a habitat more vulnerable to damage from which it might otherwise recover quickly. In some cases, historic damage to a habitat can be mitigated through the creation of sanctuaries where the resource can recover. One such program involves creation of protected oyster reefs. In other cases, the cumulative impacts of multiple projects can be more effectively managed through comprehensive planning and plan implementation.

Recommendation 3.1- Greatly expand habitat restoration.
Recommendation 3.2- Prepare and implement a comprehensive beach and inlet management plan that addresses ecologically based guidelines, socioeconomic concerns and fish habitat.
Recommendation 3.3- Protect submerged aquatic vegetation (SAV), shell bottom and hard bottom areas from fishing gear effects through improved enforcement, establishment of protective buffers around habitats and further restriction of mechanical shellfish harvesting.
Recommendation 3.4- Protect fish habitat by revising estuarine and public trust shoreline stabilization rules using best available information, considering estuarine erosion rates, and the development and promotion of incentives for use of alternatives to vertical shoreline stabilization measures.
Recommendation 3.5- Protect and enhance habitat for anadromous fishes by: a) incorporating the water quality and quantity needs of fish in surface water use planning and rule making and b) eliminating obstructions to fish movements, such as dams, locks and road fills.

GOAL 4. Enhance and Protect Water Quality

Good water quality is essential to coastal fisheries because water is the common element in all fish habitats. The water conditions necessary to support coastal fisheries include the right combination of temperature and salinity, as well as the absence of harmful pollutants. Achieving and maintaining good water quality for purposes of fisheries productivity requires management of both direct discharges of pollutants and stormwater runoff. The CHPP provides additional support for policies directed toward better management of point and nonpoint sources of water pollution. In doing so, the CHPP recognizes a need to go beyond relying on regulatory programs alone. Addressing water quality impacts will also require targeted use of land acquisition programs, incentives for conservation, development of effective BMPs, and assistance for local governments to upgrade wastewater and stormwater management infrastructure. Maintaining the water quality necessary to support vital coastal fisheries will not only benefit the commercial fishing industry – it will benefit a large sector of the entire coastal economy built around travel and tourism, and recreational fishing.

Recommendation 4.1- Reduce point source pollution from wastewater.
Recommendation 4.2- Adopt or modify rules or statutes to prohibit ocean wastewater discharges.
Recommendation 4.3- Prohibit new or expanded stormwater outfalls to coastal beaches and to coastal shellfishing waters (EMC surface water classifications SA and SB) except during times of emergency when public safety and health are threatened, and continue to phase out existing outfalls by implementing alternative stormwater management strategies.
Recommendation 4.4- Enhance coordination with, and financial/technical support for, local government actions to better manage stormwater and wastewater.
Recommendation 4.5- Improve land-based strategies throughout the river basins to reduce nonpoint pollution and minimize cumulative losses to wetlands and streams through voluntary actions, assistance and incentives.
Recommendation 4.6- Improve land-based strategies throughout the river basins to reduce nonpoint pollution and minimize cumulative losses to wetlands and streams through rule making.
Recommendation 4.7- Develop and implement a comprehensive coastal marina and dock management plan and policy for the protection of shellfish harvest waters and fish habitat.
Recommendation 4.8- Reduce nonpoint source pollution from large-scale animal operations by the following actions: a) support early implementation of environmentally superior alternatives to the current lagoon and sprayfield systems as identified under the Smithfield

Agreement and continue the moratorium on new/expanded swine operations until alternative waste treatment technology is implemented; b) seek additional funding to phase-out large-scale animal operations in sensitive areas and relocate operations from sensitive areas; and c) use improved siting criteria to protect fish habitat.

Visit http://www.ncdmf.net/habitat/index.html to learn more about the CHPP or to download the plan. Refer questions and comments to chpps@ncmail.net or call (252) 726-7021 or (800) 682-2632.

10.3 NC Coastal Nonpoint Source Program

Section 6217 of the Federal 1990 Coastal Zone Act Reauthorization Amendments (CZARA) requires every state participating in the Coastal Zone Management Act Program to develop a Coastal Nonpoint Source Program (CNPSP). The purpose of this requirement, as stated in the Act, is to "strengthen the links between Federal and State coastal zone management and water quality management programs and to enhance State and local efforts to manage land use activities that degrade coastal waters and coastal habitats." To accomplish these goals, the federal agencies established 56 Management Measures that are to be used by each state to address the following nonpoint source pollution categories (first five items) and that provide tools to address the various sources of nonpoint pollution (last item):

- Agricultural Sources
- Forestry
- Urban Areas *(urban runoff; construction activities; existing development; on-site disposal systems; pollution prevention; and roads, highways and bridges)*
- Marinas and Recreational Boating *(siting and design; and marina and boat operation/maintenance)*
- Hydrologic Modification *(channelization and channel modification; dams; and streambank and shoreline erosion)*
- Wetlands, Riparian Areas and Vegetated Treatment Systems

Detailed descriptions of the management measures, where they are intended to be applied, their effectiveness, and their costs can be found in EPA's *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* at the following website: http://www.epa.gov/owow/nps/MMGI/.

Within North Carolina, Coastal Nonpoint Source Program (CNPSP) is administered by the Division of Water Quality (DWQ) and the Division of Coastal Management (DCM).
The core of the state's CNPSP is increased communication and coordination between DWQ and key state agencies that have regulatory responsibilities for controlling nonpoint sources of pollution. This increased dialogue is facilitated in part by the state's CNPSP Coordinator and promotes identification of gaps, duplications, inadequacies and/or inefficiencies of existing programs and policies. Responsibilities of the state program coordinator also include developing the 15-year Strategy Plan, serving as a liaison between DWQ and DCM, and participating in the development of nonpoint source outreach and educational activities. For more information, contact the NC Coastal Nonpoint Source Program Coordinator at (919) 733-5083, ext. 567.

CNPSP Evaluation
Since obtaining federal approval of its program in 2003, North Carolina made significant progress in implementing the management measures of the state's CNPSP. This finding is based

on a review of a range of programs, actions and initiatives of state agencies, local governments, cooperating federal agencies and regulatory and non-regulatory programs between 2002 (the year the State's plan received preliminary federal approval) and 2006, which focus directly or indirectly on avoiding, reducing, and/or treating nonpoint source pollution in the coastal counties.

North Carolina met three of the four objectives of its CNPSP Five-Year Action Plan: 2004-2008, as a result of program improvements and initiatives listed below:

- Working with other agencies to improve data management capabilities and distribution to more effectively address nonpoint source impacts;
- Improving implementation and enforcement of existing regulations and programs and
- Developing effective and dynamic education and outreach programs.

Progress on the fourth objective, reducing fecal loading into impaired SA waters, continues to be challenging. North Carolina faces enormous environmental challenges as a consequence of population growth and development. With most of the state's oceanfront developed, large tracts along the estuarine shoreline and adjacent to the Intracoastal Waterway are being developed. The CNPSP's greatest challenges for the foreseeable future lie in strengthening the state's stormwater management programs to achieve real protection for unimpaired waters, while facilitating significant restoration of impaired waters coast-wide. The NC CNPSP will continue working to establish and strengthen programs and tools to offset the impacts associated with growth in this sensitive and vital region of the state.

Coastal population growth and development will continue to strain local and state government resources. Of great concern is the fact that current state and local land use planning and environmental management programs are not sufficient to address coastal nonpoint source pollution. Therefore, the NC CNPSP intends to pursue improvements in the following major program areas:

I. Developing Partnerships and NPS Implementation Tools with Local Governments

In North Carolina, local governments have primary responsibility for planning and managing growth within the framework of state law and regulations. Most development activities are reviewed by, approved or denied by appointed and elected local government boards comprised of citizens. They are volunteers often with some or limited training on the technical issues of land use, transportation and stormwater management.

Neither state agencies nor local governments alone can address the complexities of development and environmental sustainability. An integrated approach that incorporates training and the development of implementation tools with more formalized technical assistance and grants, as incentives should be explored. Some excellent building blocks for an integrated local government assistance program include DCM's land use planning program and community planners; the University of North Carolina's School of Government training programs; the NC Chapter of the American Planning Association citizen planners training program, Sea Grant's Water Quality Planner; the NC National Estuarine Research Reserve's Coastal Training Program, the Cooperative Extension Service's Growth Readiness program, the county Cooperative Extension Service programs, the Clean Water Management Trust Fund, the

Ecosystem Enhancement Program's local watershed plans and the Clean Water State Revolving Loan Fund.

II. Improving Stormwater Management

While progress has been significant, major challenges to managing and eliminating stormwater impacts remain. Although North Carolina's coastal stormwater rules have been in effect for over 15 years, DWQ staff, other resource management agencies and many citizens believe the rules are ineffective. In January 2007, DWQ issued rules for a new stormwater program for local governments, the Universal Stormwater Management Program (USMP).

The USMP improves on the current rules by essentially eliminating the ability to avoid use of stormwater best management practices (BMPs) by staying below certain impervious thresholds. USMP strengthens other provisions as well, including treatment of a larger stormwater volume and providing attenuation of larger flows. While USMP would improve protections, it is only a voluntary option.

In recognition of the inability of existing rules to reduce the water quality impacts of stormwater and the need for stronger minimum mandatory measures, the DWQ is proposing changes to the coastal stormwater rules that are similar to the USMP but not quite as protective, requiring instead engineered stormwater treatment devices for all development adjacent to high quality coastal waters that have more than 12 percent built-upon area. The rules will also require the use of control measures that result in fecal coliform die off and control sources of fecal coliform.

Compliance with the stormwater rules is a significant issue. NC CNPSP funded inspections of a significant number of permit renewal sites in DWQ's Wilmington Regional Office region and found that approximately 35 percent were not in compliance. Approximately 8 percent of the sites had installation problems or design deficiencies and 2 percent exceeded the impervious area limits. Lack of routine maintenance was the main cause of non-compliance in the majority of inspected sites.

There is not enough DWQ field staff to inspect every site, and this situation is compounded by insufficient and incorrect information on these sites in DWQ's permit tracking system. A grant from the CNPSP is funding a DWQ effort to develop a field inspection form, inspect a subset of permitted sites that will be up for renewal in 2007 and 2008 and develop a consistent method for processing renewal permits and entering the data in DWQ's tracking system. This work should be completed by December 2007.

The increase in development in the coastal counties has resulted in the construction of hundreds of roads servicing subdivisions. Under current state law the state Department of Transportation (DOT) can be petitioned to designate roads as public and be maintained by DOT. DOT District Engineers review subdivision maps and/or plats for conformance with the state's minimum construction standards. They also review the stormwater facilities operations and maintenance plan required as part of this process. Coordination between the regional offices of DWQ and the appropriate DOT district offices on pending state stormwater permits could result in improvements in the proposed drainage plans and implementation of appropriate stormwater BMPs, including minimizing stormwater through site design.

Local governments have primary responsibility to plan for and manage growth in their jurisdictions. While many coastal counties and municipal governments are making progress on stormwater management, a 2006 UNC School of Government survey of local ordinances found that while 18 of the 20 coastal counties have subdivision ordinances, only eight have stormwater ordinances effective throughout their jurisdiction, two have partial coverage and only seven have erosion and sediment control ordinances. Without improvements to local government development ordinances, local stormwater management and enforcement, coastal water quality will continue to be compromised.

III. Improving Management of Marinas and Recreational Boating

There are approximately 450 marinas in coastal North Carolina and over 100 shops where boats are built. There are thousands of private docks and piers as well. In the first seven months of 2006, DCM approved 53 major permit applications that added 340 private boat slips to coastal waters. Of these almost 90 were new residential multi-slip docking facilities. In addition, DCM issued approximately 1200 general permits in 2006 for small docks/piers of one or two slips (GP 07H .1200). At a minimum, these general permits added 1200 new residential boat slips in the state's coastal waters in one year.

The CNPSP funded a unified marina policy project, and the project Steering Committee concluded that the state should focus on improving management of facilities with 3-10 slips. These multi-slip docking facilities currently are not subject to the more comprehensive state regulatory review required of marinas; yet their locations and numbers are believed to have significant impact on water quality and fragile coastal habitat. The DCM and Marine Fisheries are cooperatively developing guidance on placement of structures in shallow waters and the DCM has made changes to its major permit application for marinas and multi-slip docking facilities to capture more detailed information.

The DWQ is conducting a marina and boatyard study to: 1) better understand the services and activities common to marinas, boatyards, and manufacturers, 2) determine if these facilities are properly covered by a NPDES stormwater permit (NCG190000), 3) understand types/frequency of process wastewater discharges that occur at these facilities and 4) sample process wastewater in order to understand and characterize waste streams.

The state law governing the designation of no-wake zones should be amended to allow designation to protect estuarine and river shorelines and shallow water habitats.

IV. Developing Best Management Practices Guidance for Hydromodification Projects

Many ditches and canals in coastal North Carolina were first excavated for agriculture and forestry. Their management and maintenance continues to be exempt from state environmental review even though many are now managed for flood control purposes. Coastal counties and local governments have developed, or are in the process of developing stormwater management plans that include maintaining some existing drainage canals and ditches to avoid flooding of residential and commercial development. These maintenance activities can adversely impact water quality as well as riparian vegetation and fresh water and estuarine resources. Routine maintenance to remove debris from these canals and ditches, and cleanup in response to storm damage, is done in the absence of comprehensive guidance that could minimize the environmental impacts.

The DENR should establish an interagency working group to develop guidance on best management practices for routine and emergency maintenance activities. Adherence to this guidance should be required, at a minimum, for maintenance and management projects funded under the state's water resources development grants and the Clean Water Management Trust Fund. The working group could also consider developing a hands-on training program for contractors who conduct snagging and clearing activities, similar in intent to the Clear Water Contractor workshops conducted by the Division of Land Resources.

The working group should include representatives of the Divisions of Water Resources, DWQ, Forest Resources, Division of Soil and Water Conservation, Marine Fisheries, DCM, the Wildlife Resources Commission and the Ecosystem Enhancement Program, along with the U.S. Army Corps of Engineers, the Fish and Wildlife Service and the Natural Resources Conservation Service.

V. Updating Information for Decision Making

The most recent land-cover information for North Carolina is based on 1997 imagery. Given the significant increases in population and development in the coastal counties, the use of ten-year old information does not allow for analysis of current conditions. North Carolina needs to update the state's land cover information and develop a funding and planning mechanism for continued updating on a 3-5 year basis.

10.4 Community Conservation Assistance Program

The landscape of North Carolina is changing and Soil and Water Conservation Districts have voiced concern about a void in program areas to address the growing threat of nonpoint source pollution issues on non-agricultural lands. In the summer of 2005, a survey was distributed to all districts to inventory their level of interest and best management practices (BMP) needs on urban, suburban and rural lands. Many districts completed surveys about their needs for this program, and they requested over $6.5 million for local projects. Division staff used the survey responses to develop two grant applications for program funding. In July 2006, while the grant applications were still under review, the legislature unanimously passed H2129, creating the Community Conservation Assistance Program (CCAP). Shortly after, both grants were approved at 100 percent funding. An additional survey was completed in fall 2006, and 40 districts responded with needs for CCAP BMPs. A grant was submitted on behalf of those districts during the March 2007 application cycle for the Clean Water Management Trust Fund. If awarded, this grant will impact several counties in this river basin.

Current Status

CCAP will support the installation of stormwater BMPs. This program is an innovative approach to controlling the amount and quality of stormwater runoff that enters our surface waters. Through locally led conservation, the Division of Soil and Water Conservation (DSWC) and Soil and Water Conservation Districts (SWCD) have been successful in implementing voluntary agricultural BMPs, which have addressed many different water quality parameters. The intent is for CCAP to operate under the same guidance and accountability as the NC Agriculture Cost Share Program and achieve the same successes.

CCAP will focus its efforts on stormwater retrofits to existing land uses. It will not be used to assist in new development sites to meet state and federal stormwater mandates. Districts have the

technical expertise to install stormwater BMPs and a successful history of promoting voluntary conservation practices. The program will give the districts the structure and financial assistance to carry out this mission. CCAP will encourage local governments, individual landowners and businesses to incorporate stormwater BMPs within their landscape. The economic incentive, 75 percent of average installation costs, will encourage voluntary conservation.

Standards and specifications for 15 CCAP BMPs have been approved by the Soil and Water Conservation Commission. These practices include: impervious surface conversion, permeable pavement, grassed swale, critical area planting, bioretention areas, backyard rain gardens, stormwater wetlands, backyard wetlands, diversion, riparian buffer, stream restoration, streambank and shoreline protection, cisterns, abandoned well closure and pet waste receptacles.

Funding
The DSWC was recently awarded two grants that will fund CCAP implementation in 17 counties across the state. The DSWC received a grant from the Clean Water Management Trust Fund in the sum of $557,000 and an award from the Section 319 Clean Water Act grant program for $277,425. Since this is a grant funded program to date, only districts that participated in the surveys will receive an allocation. The maximum amount of assistance per practice is limited to $50,000. It is the program's goal to seek additional funding sources, including recurring state appropriations, to offer this program statewide in the future. The DSWC and districts are excited about the possibilities that this program offers in addressing current stormwater pollution issues.

10.5 The Role of Local Government in Land Use Planning

As residential and commercial development expands inward from the coast, many local governments are now faced with making land use decisions to limit the extent and areas of land development. Several coastal counties do not have zoning ordinances, or have large areas of the county that are not under zoning ordinances. In addition, property owners are being faced with the decision to continue historical uses of their land or sell their property for development. This is happening in both rural and coastal communities. According to a recent survey conducted by the Raleigh News and Observer, more than 34,000 houses and condominiums are planned or underway in the 20-county area of the coast from Currituck County to Brunswick County.

10.5.1 Land Use Plans

The Coastal Area Management Act (CAMA) requires each of the 20 coastal counties to have a local Land Use Plan (LUP) in accordance with guidelines established by the Coastal Resources Commission (CRC). A land use plan is a collection of policies, maps, and implementation actions that serves as a community's blueprint for growth. Each land use plan includes an inventory and assessment of existing environmental conditions along with local policies and a future land use map that address growth issues related to designated Management Topics: land use compatibility, infrastructure carrying capacity, natural hazards, public access, areas of local concern, and water quality.

Inventory and assessments specific to water quality include the identification of existing surface water quality, current situations and trends on permanent and temporary closures of shellfish waters, areas with chronic wastewater treatment system malfunctions, areas with water quality or public health problems related to nonpoint source pollution, and locations where land use and water quality conflicts exist. Policies to address water quality issues are prepared based on the

management goal, CRC planning objective, and land use plan requirements specified for the water quality Management Topic. For water quality, the management goal is to maintain, protect, and where possible, enhance water quality in all coastal wetlands, rivers, streams, and estuaries. The CRC's planning objective is for communities to adopt policies for coastal waters within the planning jurisdiction to help ensure that water quality is maintained if not impaired and improved if impaired. Local communities are required to devise policies that help prevent or control nonpoint source discharges (sewage and stormwater) through strategies such as impervious surface limits, vegetated riparian buffers, maintenance of natural areas, and wetland protection. They are also required to establish policies and future land use map categories that are aimed at protecting open shellfishing waters and restoring closed or conditionally closed shellfishing waters.

The CRC's guidelines provide a common format for each plan and a set of issues that must be considered during the planning process; however, the policies included in the plan are those of the local government, not of the CRC. By law, the role of the CRC is limited to determining that plans have been prepared consistent with State Land Use Plan guidelines, do not conflict with State or Federal rules, and are consistent with the State's Coastal Management program. Once a land use plan is certified by the CRC, the Division of Coastal Management uses the plan in making CAMA permit decisions and federal consistency determinations. Proposed projects and activities must be consistent with the policies of a local land use plan or DCM cannot permit a project to go forward.

At the local level, land use plans provide guidance for both individual projects and a broad range of policy issues, such as the development of regulatory ordinances and public investment programs. Although DCM monitors use of the land use plans through an implementation status report, strict adherence to land use plan policies and implementation actions is largely up to the local government. For this reason, community and local official support of the land use plan is critical to successfully achieving the goals for each management topic, including water quality.

10.5.2 Land Use Plans for Communities in the Chowan River Basin

More information and a list of CAMA LUPs are available from the Division of Coastal Management website: http://www.nccoastalmanagement.net/Planning/planning.htm. The following Table 23 presents counties and their municipalities within the Chowan River Basin and their status on completing a CAMA Land Use Plan.

Table 23 Local Planning Jurisdictions

Locality			CAMA Land Use Plan CRC Certification Progress (as of March 2007)			
Multi-County Planning	**County**	**Municipality**	**CRC Certified**	**Review & Revisions**	**Under State Review**	**In Process**
REGION Q Mid-East Commission	Bertie					X
REGION R: The Albemarle Commission	Chowan	Edenton			X	
REGION R: The Albemarle Commission	Gates		2005			
REGION Q Mid-East Commission	Hertford					X

Chowan County/Town of Edenton LUP

Chowan County and the Town of Edenton are planning for moderate growth over the next 20 years, recognizing that most of this growth with be along the waterways. The LUP recognizes that waterfronts with public access are important to maintain with impending development along the waterways. The LUP specifically identifies current land use trends that conflict with protecting water quality. These land uses include: loss of natural open spaces and riparian buffers, residential development in previous agricultural and forested lands, along major road corridors, near the airport, and in the 100 year floodplains, impact of large scale residential developments and small lot development in areas with soils that have septic system limitations. The LUP recognizes the soil conditions limits urban uses and the suitability of septic tanks and therefore, centralized sewer facilities are needed to support urban development. Water quality management in the LUP includes policy development to limit nonpoint source runoff, limit impervious surfaces, and to protect and maintain vegetated riparian buffers and wetlands. Policies will focus on protecting un-impaired waters and restoring those waters that are impaired. The plan includes support for long-term water and wastewater improvements to provide countywide sewer service. Cluster subdivision designs are supported to help manage growth and only to be allowed in areas serviced by public utilities. Private package wastewater treatment plants are supported but under the conditions that if the system is noncompliant than the plant will become a public facility. A stormwater management plan is proposed, pending funding, to help formulate local ordinances. The LUP identifies a policy dependent on DWQ and Division of Coastal Management guidance for protecting water quality in regards to potential threats of development along waterfronts, wetlands, rivers and streams.

Gates County LUP

The LUP states that water quality protection is an issue with contamination occurring from stormwater runoff and failing septic systems. State and Federal agencies are identified as the main assets to help implement and regulate water quality protection programs. The county plans to maintain its rural character through protecting open spaces, natural resources, and public trust waters, balancing residential and commercial growth with promoting smart growth, and discouraging strip development along State maintained roads. Development is limited without the construction of a central public sewage system because of poor soils conditions, which prevent septic systems from functioning properly. Objective's identified that will protect water quality include establishing criteria to support cluster subdivision design, local buffers, impervious surface limits, innovative stormwater controls and supporting the State's efforts to restore shellfish harvesting waters. However, many of the LUP's goals, objectives and policies are vague and rely on State and Federal laws for enforcement.

Land Use Plan Critiques

After review of several CAMA LUP drafts, DWQ recommends that all communities adopt low impact development strategies and technologies for both new development and as options in retrofitting existing infrastructure. It is important for communities to undertake stronger stormwater controls and to update old or failing wastewater systems (e.g., on-site and treatment plants) to prevent future deterioration in water quality. Communities need to address development issues in regards to water quality by implementing the best available control options and by implementing enforcement. DWQ views LUPs as a tool to improve and protect the water quality that these communities' economies depend on. Unfortunately, many of the reviewed LUPs do not adequately reflect proactive planning above and beyond state minimum criteria. DWQ also recognizes and supports the importance of low impact development and appropriate technologies education for developers and local leaders. Overall, LUP policy

framework is too general. A large number of policies address adoption of ordinances and procedures by the local government, or defer to the State and Federal agencies' rules to meet the LUP requirements. The policies should provide specific guidance to aid in the development of local ordinances and procedures, not merely state that they will be adopted.

An evaluation of 40 CAMA LUPs written during the mid 1990's concluded, "local planning efforts are procedurally strong, addressing the ranges of issues they are required to cover, but analytically and substantively weak, providing little meaningful attention to regional environmental protection concerns" (Norton, 2005). This evaluation found that many LUPs completed the various required analyses in regards to identifying hazards, flood zones, soil limitations and environmentally sensitive areas, but later in the plan made future land classifications for development with no reference to these analyses (e.g., high density development on oceanfront property zoned as high hazard) (Norton, 2005). The plans did not adequately explain how land was determined suitable for future growth and development and did not adequately address potential adverse environmental impacts, beyond state compliance standards (Norton, 2005). Almost all the communities addressed the environmental impacts and thus need for improved wastewater systems, but "they uniformly failed to discuss the potential growth-inducing effects and resulting environmental impacts that come with infrastructure expansions" (Norton, 2005). In addition, stormwater management was addressed for controlling runoff and associated flooding, but did not address the water quality related issues associated with stormwater management (Norton, 2005). In conclusion, regional environmental concerns and cumulative and secondary impacts of development were not addressed with specific management strategies in the LUPs.

10.6 Management Recommendations for Local Governments

Below is a summary of management actions recommended for local authorities, followed by discussions on large, watershed management issues. These actions are necessary to address current sources of impairment and to prevent future degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and in how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated (NCDENR-DWQ, 2003).

(1) Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development (e.g., increased stormwater volumes and increased frequency and duration). This should be viewed as a long-term process.

    (a) Over the short term, currently feasible retrofit projects should be identified and implemented.

(b) In the long term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
(c) Grant funds for these retrofit projects may be available from EPA initiatives, such as EPA Section 319 funds, or the North Carolina Clean Water Management Trust Fund.

(2) A watershed scale strategy to address inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods. As an initial framework for planning input reduction efforts, the following general approach is proposed:

(a) Implementation of available best management practice (BMP) opportunities for control of stormwater volume and velocities. As recommended above to improve aquatic habitat potential, these BMPs will also remove pollutants from stormwater.
(b) Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
(c) Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.
(d) Development and implementation of a broad set of source reduction activities focused on: reducing nonstorm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.

(3) Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic/bacterial loading, and to some extent, its impacts. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use, street sweeping, catch basin clean-out practices, animal and human waste management, and the installation of additional BMPs targeting biological oxygen demand (BOD) and nutrient removal at appropriate sites.

(4) Prevention of further degradation will require effective post-construction stormwater management for all new development in the study area.

(5) Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may also be beneficial.

(6) Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:

(a) Redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters;
(b) Protecting existing woody riparian areas on all streams;
(c) Replanting native riparian vegetation on stream channels where such vegetation is absent;
(d) Reducing and properly managing pesticide and fertilizer use;
(e) Reducing and properly managing animal waste; and
(f) Reducing and properly managing septic systems.

10.7 Planning for Sea Level Changes

Sea level rise will adversely impact North Carolina's coastline and specifically the northern coastline because of its underlying geologic structure (Riggs and Ames, 2003). There is a predicted acceleration in coastal erosion and an increase in estuarine shoreline erosion if oceanic processes are altered by increased barrier island elevation through natural or human modifications (Riggs and Ames, 2003). Major loss of land is predicted in Currituck, Camden, Dare, Hyde, Tyrrell, Pamlico and Carteret counties if glacial melting rates increase significantly, as projected by the Intergovernmental Panel on Climate Change (Riggs and Ames, 2003; IPCC, 2001).

Drowning the North Carolina Coast: Sea-Level Rise and Estuarine Dynamics by S. Riggs and D. Ames (2003) published by North Carolina Sea Grant provides information specifically addressing northeastern NC. This book provides images and figures explaining sea level rise and coastal erosion. This book should be used as a resource for coastal town and municipality planners as new developments, utility infrastructure and other land use decisions are made. Several universities are researching the impacts of sea level rise on North Carolina's coastal economy, more information about their findings can be found at the website: http://econ.appstate.edu/climate/. Information about sea level forecasts being developed by National Oceanic and Atmospheric Association and several universities in North Carolina can be found at: http://www.cop.noaa.gov/stressors/climatechange/current/slr/welcome.html.

10.8 Using Land Use Planning as a Tool to Reduce Impacts of Future Development

Many communities are looking at the challenges and opportunities that development offers to their communities seriously. Outside of the Chowan River basin, the town of Bath approved a 6-month moratorium on new subdivisions to allow them time to assess how the town wanted to develop its remaining waterfronts lots and where the town needed to protect its resources. Camden County extended a moratorium on new subdivisions until a new school can be completed to hold the additional students the county is experiencing. In addition, Pamlico County approved an ordinance to limit density and height of developments along the water. The neighborhood of Woodsong in Shallotte drains to Lockwoods Folly which is Impaired for shellfish harvesting. The development will use pervious concrete to collect stormwater and a man-made wetland to help treat it, as well as courtyard gardens to treat runoff before it goes to a collection system. The developer notes that degradation of the environment does not have to follow development, but believes a quality lifestyle is being sold by clustering home sites and creating large common areas. These types of development activities point to a growing market for developments like these; socially, financially and environmentally viable.

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts can find a balance between water quality protection, natural resource management, and economic growth. These actions are critical to water quality management and the quality of life for the residents of the basin. DWQ's review of draft CAMA Land Use Plans finds that the planning efforts do not adequately protect water quality. Many plans do not consider the cumulative impact from development on water quality. Land Use Plans need to incorporate proactive measures to meet future growth demands to prevent water quality deterioration.

To prevent further impairment in urbanizing watersheds local governments should:

(1) Identify waters that are threatened by development.
(2) Protect existing riparian habitat along streams.
(3) Implement stormwater BMPs during and after development.
(4) Develop land use plans that minimize disturbance in sensitive areas of watersheds.
(5) Minimize impervious surfaces including roads and parking lots.
(6) Develop public outreach programs to educate citizens about stormwater runoff.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking & narrower slots).
- Place sidewalks on only one side of residential streets.
- Minimize culvert pipe and hardened stormwater conveyances.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.

Action needs be taken at the local level to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box (above), refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection, the Center for Watershed Protection website at www.cwp.org, and the Low Impact Development Center website at www.lowimpactdevelopment.org. Additional information regarding environmental stewardship for coastal homeowners is available at http://www.soil.ncsu.edu/assist/coastindex.html. Further public education is also needed in the Chowan River basin in order for citizens to understand the value of urban planning and stormwater management. For an example of local community planning effort to reduce stormwater runoff, visit http://www.charmeck.org/Home.htm.

10.9 The Importance of Local Initiatives

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

An important benefit of local initiatives is that local people make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rulemaking process, and many others.

These local organizations and agencies are able to combine professional expertise in a watershed, which allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities become available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success. Federal and State government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs.

The collaboration of these local efforts are key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state.

10.9.1 Federal Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects, listed in Table 24. Through annual base funding, there is approximately $1 million available for demonstration and education projects across the state. An additional $2 million is available annually through incremental funds for restoration projects. All projects must provide nonfederal matching funds of at least 40 percent of the project's total costs. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution (NPS). Information on the North Carolina Section 319 Grant Program application process is available online at http://h2o.enr.state.nc.us/nps/application_process.htm. Descriptions of projects and general Section 319 Program information are available at http://www.ncwaterquality.org/nps/Section_319_Grant_Program.htm.

Many Section 319 projects are demonstration projects and educational programs that allow for the dissemination of information to the public through established programs at NC State University (NCSU) and the NC Cooperative Extension. Other projects fund stream restoration activities that improve water quality.

Table 24 Section 319 Grant Funded Projects in the Chowan River Basin

Fiscal Year	Name	Description	Agency	Amount
2000	Evaluation and Demo of Stream & Riparian Wetlands Restoration and Construction	Wetlands & Hydrologic Modification	NCSU	$140,000
2000	Background Monitoring & Evaluation for Proposed Golf Course BMPs in Chowan River Basin	Coastal NPS, Monitoring	NCSU	$22,264
2004	Evaluation of Proposed Golf Courses in Chowan River Basin	BMP Implementation	NCSU	$107,124
2004	Gates County Environmental Education Program	Education	Gates County SWCD	$2,965
			Total Funding	**$272,353**

10.9.2 NC Construction Grants and Loans Programs

The NC Construction Grants and Loans Section provides grants and loans to local government agencies for the construction, upgrades and expansion of wastewater collection and treatment systems. As a financial resource, the section administers five major programs that assist local governments. Of these, two are federally funded programs administered by the state, the Clean Water State Revolving Fund (SRF) Program and the State and Tribal Assistance Grants (STAG). The STAG is a direct congressional appropriations for a specific "special needs" project within NC. The High Unit Cost Grant (SRG) Program, the State Emergency Loan (SEL) Program and the State Revolving Loan (SRL) Program are state funded programs, with the later two being below market revolving loan money. In the Chowan River basin, the Town of Rich Square

received a total of $ 2,999,940 in grants and loans to help fund the replacement and rehabilitation of sewer collection system lines and for a wastewater reuse project.

As a technical resource, the Construction Grants and Loan Section, in conjunction with the Environmental Protection Agency, has initiated the Municipal Compliance Initiative Program. It is a free technical assistance program to identify wastewater treatment facilities that are declining but not yet out of compliance. A team of engineers, operations experts and managers from the section work with local officials to analyze the facility's design and operation. For more information, visit the website at http://www.nccgl.net/. You may also call (919)-715-6212 or email Bobby.Blowe@ncmail.net.

10.9.3 North Carolina Ecosystem Enhancement Program

The NC Ecosystem Enhancement Program (EEP) combines an existing wetlands-restoration initiative by the DENR with ongoing efforts by the NC Department of Transportation (DOT) to offset unavoidable environmental impacts from transportation-infrastructure improvements. The U.S. Army Corps of Engineers joined as a sponsor in the historic agreement, which is committed to restoring, enhancing and protecting the wetlands and waterways across the State of North Carolina. EEP can provide:

- High-quality, cost-effective projects for watershed improvement and protection;
- Compensation for unavoidable environmental impacts associated with transportation-infrastructure and economic development; and
- Detailed watershed-planning and project-implementation efforts within North Carolina's threatened or degraded watersheds.

EEP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example EEP efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with Section 319 funded or proposed projects will often improve the overall water quality and habitat benefits of the project. EEP actively seeks landowners throughout the state that have restorable wetland, riparian, and stream restoration sites. For more information about EEP, visit http://www.nceep.net/ or call (919) 715-7452.

10.9.4 Coastal and Estuarine Land Conservation Program

The Coastal and Estuarine Land Conservation Program **(**CELCP) was established by Congress "for the purpose of protecting important coastal and estuarine areas that have significant conservation, recreation, ecological, historical, or aesthetic values, or that are threatened by conversion from their natural or recreational state to other uses." The program provides funding for projects that ensure conservation of these areas for the benefit of future generations, giving priority to lands that can be effectively managed and protected and that have significant ecological value. The Division of Coastal Management administers the CELCP program in North Carolina. For more information on funding opportunities and guidelines see http://www.nccoastalmanagement.net/Facts/CELCP.htm.

10.9.5 Clean Water Management Trust Fund

The Clean Water Management Trust Fund (CWMTF) offers approximately $40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface

waters and establishing a network of riparian buffers and greenways. In the Chowan River basin, 13 projects have been funded for a total of $20,042,810. A description of the projects are listed in Table 25. For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

Table 25 Clean Water Management Trust Fund Projects in the Chowan River Basin

Project Number	Application Name	Proposed Project Description	Amount Funded
1997A-129	Seaboard -WWTP Improvements and Sewer Rehabilitation	Repair and expand failing WWTP (lagoons) and land application system. Expansion needed to deal with excessive I&I. Project finished under budget and Board approved I&I repairs.	$1,037,000
1997B-017	Edenton - Chowan Develop. Corp-Acq/Constructed Wetlands	Acq 54-acre Bayliner tract. Construct 20-ac & 1-ac wetlands to treat runoff from 200 acres. Trade 12 ac of 54-ac Bayliner Tract for 60-ac John Island Tract, incl 1 ac west of airport for conversion to wetland for airport & industrial park runoff.	$880,000
1999A-406	Edenton, Town of - Edenton Bay Watershed Restoration Program	Protect through fee simple puchase and conservation easements 1340 ac. Acquire and remediate George Jones hog farm and Ashley Welding. Remediate former landfill and fertilizer complex and convert fish hatchery ponds to stormwater ponds.	$3,285,810
2001B-702	Chowan County-Stormwater Wetland/ Chowan River & Albemarle Sound	Construct a stormwater wetland and buffers to treat runoff (244 acre watershed) from the Chowan Golf Course & Country Club. Includes a chemical handling facility, donated conservation easment, and water quality monitoring.	$414,000
2002B-606	Powellsville, Town of - Waste Treatment Facility Construction/Ahoskie Cr.	Eliminate 168 failing septic tanks in the Town by constructing a collection system and land application waste treatment facility. Would reduce pollutant delivery to Ahoskie Creek. Includes acquisition of 379 acres for land application.	$475,000
2001B-033	NC Wildlife Resources Commission - Chowan River Tracts	Acquire through fee simple purchase 19 tracts to protect 6,466 acres along the Chowan River and tributaries (Buckhorn, Barnes, Sarem, Cole, Catherine, Warwick, & Keel).	$3,000,000
2004B-504	Colerain, Town of - WW/ Emergency Stand-by Generator	Purchase emergency generator and install at Town's main wastewater pump station. Reduce spills of wastewater from this facility during power outages and impact on Chowan River.	$17,000
2004B-701	Edenton, Town of - Storm/ Stormwater System Design, Queen Ann Creek	Design and permit a stormwater management system to treat runoff from a 40-acre drainage area (55% impervious). If eventually constructed, the system would reduce stormwater discharges and pollutant delivery to Queen Ann Creek.	$68,000
2006A-806	Chowan County-Plan/Storm/ Stormwater Drainage Study	Fund development of a countywide water quality management and improvement plan to establish stormwater infrastructure needs. Adopt ordinances, identify top priorities for implementation, and designate special use water management districts.	$85,000
2006A-501	Ahoskie, Town of - WW/ Nucor Steel Reuse project, Ahoskie Creek	Construct consumptive reuse faclilities and force main to Nucor Steel Plate Mill, which will use from 0.8 to 1.3 MGD reuse water from the Ahoskie WWTP, instead of groundwater. Ahoskie's existing plant flow will be decreased from 0.9 to 0.3 MGD.	$3,000,000
2006A-017	Nature Conservancy, The - Acq/ IP Timber Tracts, Chowan River	Protect through fee simple purchase 8,682 acres, including 1,343 riparian acres, along the Chowan, Meherrin, and Wiccacon Rivers. Project would aid in the protection of an extensive swamp forest system and would become part of the NC Game Land Program.	$7,210,000

2006B-703	Colerain, Town of - Storm/ Constructed Wetland, Chowan River	Design, permit & construct stormwater BMPs to treat stormwater from a 37-ac watershed prior to discharge to the Chowan River & help to control floodwaters into the Town's sewage system. Includes constructed wetlands and stream stabilization.	$71,000
2006A-527	Seaboard, Town of- WW/ I&I Rehabilitation, Ivy Creek	Rehabilitate 7,000 of sewer line along Ivy Creek. Install a standby generator.	$500,000
1997A-129	Seaboard -WWTP Improvements and Sewer Rehabilitation	Repair and expand failing WWTP (lagoons) and land application system. Expansion needed to deal with excessive I&I. Project finished under budget and Board approved I&I repairs.	$1,037,000
1997B-017	Edenton - Chowan Develop. Corp- Acq/Constructed Wetlands	Acq 54-acre Bayliner tract. Construct 20-ac & 1-ac wetlands to treat runoff from 200 acres. Trade 12 ac of 54-ac Bayliner Tract for 60-ac John Island Tract, incl 1 ac west of airport for conversion to wetland for airport & industrial park runoff.	$880,000
1999A-406	Edenton, Town of - Edenton Bay Watershed Restoration Program	Protect through fee simple puchase and conservation easements 1340 ac. Acquire and remediate George Jones hog farm and Ashley Welding. Remediate former landfill and fertilizer complex and convert fish hatchery ponds to stormwater ponds.	$3,285,810
		Total Funded	**$20,042,810**

This list does not include:
- all projects are in the CWMTF's Northern Coastal Plain region
- regional or statewide projects that were in multiple river basins, or
- projects that were funded and subsequently withdrawn.

10.9.6 Albemarle-Pamlico National Estuary Program (APNEP)

In February 1987, Congress established the National Estuary Program (NEP) through amendments to the Clean Water Act. A unique approach to resource management, its hallmark of using science to inform and engage broad-based community involvement, collaborative decision-making, outreach and education, distinguishes the NEP from other programs.

As the first NEP to be designated "an estuary of national significance" in November 1987, the Albemarle-Pamlico National Estuary Program (APNEP) was known then as the Albemarle-Pamlico Estuarine Study (APES). The APNEP has since been joined by 27 other NEPs located in 18 coastal states and Puerto Rico spanning the United States' three coastlines. It is estimated 15 percent of all Americans reside in a NEP designated watershed.

Each NEP is mandated to develop a Comprehensive Conservation and Management Plan (CCMP) that details deteriorating/threatened environmental conditions in their estuarine region and the strategies required for rectifying them. In November 1994, the Administrator of the EPA accepted APNEP's CCMP on behalf of the citizens of the United States, and Governor James B. Hunt, Jr., accepted it on behalf of the citizens of North Carolina.

Estuaries are of significant economic value to the states under whose governance they fall, as well as to the entire nation. It is estimated that estuaries provide habitat for approximately 75 percent of commercial fish catches in the United States and 80-90 percent of the recreational fishery, totaling more than $1.9 billion annually. Recreation and tourism in coastal areas generate an additional $8 to $12 billion annually. Clearly, it behooves the State to protect these fragile, beautiful, and valuable places.

In Chowan River basin, APNEP has supported a number of research, restoration, and demonstration projects. Several demonstration projects are designed to mitigate the effects of stormwater runoff and pollution. Recently, in the Chowan River basin, the APNEP has funded projects in three locations intended to improve water quality and to aid in environmental education: Disputanta, Virginia, and in North Carolina, Gatesville and Edenton.

The JEJ Moore Middle School schoolyard demonstration project in Disputanta, Virginia includes an outdoor classroom, kiosk, signage, and a pedestrian nature trail that accesses an existing natural area near the school. Eagle Scouts, volunteers, teachers and students participated in the planning and building of this community-wide project. An observation platform is planned with separate funding to complete the effort.

The John A. Holmes High School demonstration project in Edenton also utilized the talents of students in its design and installation. Students use flow meters and water quality testing kits to chart improvement of water quality going to a local stream following filtration through two rain gardens. This project is unique because it includes a two-foot deep rock drainage system using popped rock ("Carolina Solite") that has an absorption capacity that is 25 percent higher than crushed rock.

The Gatesville High School project is a collaborative venture led by the Gates County Public Schools, the County of Gates, and local students to plan and construct a boardwalk, bridge and observation platform through a wetland area on the school grounds. This project enhances science teaching and learning for 640 high school students and their teachers, as well as the general public.

APNEP also funded the Chowan River Riparian Shoreline Assessment in coordination with a Comprehensive Coastal Inventory Program at the Virginia Institute of Marine Science. Data was collected along the tidal portion of the Chowan River basin to assist with land use and shoreline management. The program protocol includes a method for collecting, classifying, mapping, and reporting conditions to assess riparian shorelines. The data inventory collected information from three shore zones: 1) the immediate riparian zone, evaluated for land use; 2) the bank, evaluated for height, stability, cover and natural protection; and 3) the shoreline, describing the presence of shoreline structures for shore protection and recreational purposes. For more information about project results and maps please visit http://ccrm.vims.edu/chowan/chowan_disclaimer.htm.

For information on the APNEP, visit http://www.apnep.org/

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Chapter 11
North Carolina's Impaired Waters List

11.1 Introduction to North Carolina's Impaired Waters List

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports. The *305(b) Report* is compiled to meet the Section 305(b) reporting requirement of the Federal Clean Water Act (CWA). The 305(b) portion of the integrated report presents how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely stressors (e.g., sediment, nutrients) and potential sources of impairment. The *303(d) List* is a comprehensive accounting of all Impaired waters and is derived from the 305(b) Report. North Carolina refers to the Impaired Waters List as the *Integrated Report* because it fulfills both the 305(b) and 303(d) requirements.

Section 303(d) of the CWA enacted in 1972 required States, Territories and authorized Tribes to 1) identify and establish a priority ranking for waters for which technology-based effluent limitations are not stringent enough to attain and maintain water quality standards, 2) establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waters, and 3) develop and submit the list of Impaired waters and TMDLs biennially by April 1st of every even numbered year to the US Environmental Protection Agency (EPA). EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each segment Impaired by a pollutant and identified in the 303(d) list, a TMDL must be developed. TMDLs are not required for waters Impaired by pollution. Here, pollution is defined by the EPA as, "man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water," and is related to water control structures.

11.2 Introduction to TMDLs

A TMDL is a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and an allocation of that amount to the pollutant sources. A TMDL is the sum of the allowable loads of a single pollutant from all contributing point and nonpoint sources. The calculation must include a margin of safety to ensure that the waterbody can still attain its designated uses. The calculation must also account for seasonal variation and critical conditions in water quality.

For more information on TMDLs and the 303(d) listing process, visit the TMDL website at http://www.ncwaterquality.org/tmdl/.

11.3 Contents of the Integrated Report

The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the Impaired waters list. New guidance from EPA places all waterbody assessment units into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories. Each category is described in detail below:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waterbody assessment units where all applicable use support categories are rated "Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened. This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated "Supporting" and the other use support categories are rated "Not Rated" or "No Data". Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

Category 3: Insufficient or no data and information to determine if any designated use is attained. This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains three distinct sub-categories:

> **Category 4a: TMDL has been completed**. This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.
>
> **Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future**. This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.
>
> **Category 4c: Impairment is not caused by a pollutant**. This category consists of assessment units that are Impaired by pollution, not by a pollutant. EPA defines

pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA staff have verbally stated that this category is intended to be used for impairments related to water control structures (i.e., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL. This category consists of those waterbody assessment units that are Impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water". When more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

Category 6: Impaired based on biological data. This category consists of waterbody assessment units historically referred to as "Biologically Impaired" waterbodies; these assessment units have no identified cause(s) of impairment although aquatic life impacts have been documented. The waterbody assessment unit will remain in Category 6 until TMDLs have been completed and approved by the EPA.

Category 7: Impaired, but the proper technical conditions do not yet exist to develop a TMDL. As described in the Federal Register, "proper technical conditions" refer to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are assessment units that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has recognized that in some specific situations the data, analyses or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform Impaired shellfishing waters are included in this category.

Categories 5, 6 and 7 constitute the 2004 North Carolina 303(d) List for the State of North Carolina. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website (http://h2o.enr.state.nc.us/tmdl/General_303d.htm).

11.4 How North Carolina Proposes Delisting Waters

Waters appearing on the previously approved Impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- An updated 305(b) use support rating of Supporting, as described in the basinwide management plans.

- Applicable water quality standards are being met (i.e., no longer Impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda.
- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as Impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (i.e., the wrong water was identified).
- EPA has approved a TMDL.

11.5 Scheduling TMDLs

Category 5 waters, those for which TMDLs are required, are at many different stages on the path to an approved TMDL. Some require additional data. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

According to EPA guidance (EPA 2003), prioritization of waterbody assessment units for TMDLs need not be reflected in a "high, medium or low" manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 8-13 years of the original pollutant listing. Other information for each assessment unit is also utilized to determine the priority in the TMDL development schedule. This information includes the following:

- Year listed. Assessment units that have been on the 303(d) list for the longest period of time will receive priority for TMDL development and/or stressor studies.
- Reason for listing. (Applicable to Category 5 AUs only) AUs with an impairment due to a standard violation will be prioritized based on which standard was violated. Standard violations due to bacteria or turbidity currently receive priority for TMDL development.
- Classification. AUs classified for primary recreation (Class B), water supply (Class WS-I through WS-V), trout (Tr), high quality waters (HQW), and outstanding resource waters (ORW) will continue to receive a higher priority for TMDL development and/or stressor studies.
- Basinwide Planning Schedule. (Applicable to Category 6 AUs only). The basinwide schedule is utilized to establish priority for stressor studies.

11.6 Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision.

Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:

- A TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised;
- A change of a water quality standard (e.g., fecal coliform to Echerichia coli). The Division will prioritize review of existing TMDLs and data to determine if a revision to TMDLs will be required;
- The addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling;
- Incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets.

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Appendix I

DWQ Water Quality Monitoring Programs in the Chowan River Basin

DWQ Water Quality Monitoring Programs in the Chowan River Basin

Staff in the Environmental Sciences Section (ESS) and Regional Offices of DWQ collect a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Chowan River basin for that program. For more detailed information on sampling and assessment of streams in this basin, refer to the *Basinwide Assessment Report* for the Chowan River basin, available from the Environmental Sciences Section website at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

DWQ monitoring programs for the Chowan River Basin include:

- Benthic Macroinvertebrates
- Fish Assessments
- Aquatic Toxicity Monitoring
- Ambient Monitoring System

Overview of Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom substrates of rivers and streams. These organisms are primarily aquatic insect larvae. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. Since macroinvertebrates have life cycles of six months to over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs. A Biotic Index (BI) value gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont, coastal plain and swamp) within North Carolina and bioclassifications fall into five categories: Excellent, Good, Good-Fair, Fair and Poor. Swamp stream bioclassifications fall into three categories: Natural, Moderate and Severe.

There were 14 benthic samples collected during this assessment period. The following table lists the total bioclassifications (by subbasin) for all benthos sites in the Chowan River basin. For detailed information regarding the samples collected during this assessment period, refer to the table following this section.

Summary of Bioclassifications for All Freshwater Benthic Macroinvertebrate Sites (using the most recent rating for each site) in the Chowan River Basin

Subbasin	Bioclassifications						Swamp Bioclass.			Total
	Excellent	Good	Good-Fair	Fair	Poor	Not Rated	Natural	Moderate	Severe Stress	
03-01-01		1		2		1	1	2		7
03-01-02			1			1		3		5
03-01-04		1						1		2

Assessing Benthic Macroinvertebrate Communities in the Northeastern Coastal Plain

There are three types of streams in the Chowan River basin, in which biological criteria can be assessed and bioclassifications are assigned. Streams referred to as Coastal A have continuous flow throughout the year, Coastal B streams are deep non-wadeable rivers with minimal flow throughout the year and swamp streams typically only have flow between February to March.

The Biological Assessment Unit defines swamp streams, as those streams that are within the coastal plain ecoregion and that normally have no visible flow during a part of the year. This low flow period usually occurs during the summer, but flowing water should be present in swamp streams during the winter. Sampling during winter, high flow periods provides the best opportunity for detecting differences in communities from what is natural, and only winter (February to early March) benthos data can be used when evaluating swamp streams. The swamp stream must have visible flow in this winter period, with flow comparable to a coastal plain stream that would have acceptable flow for sampling in summer. No waterbodies in the Chowan River Basin have been given the supplemental "Swamp" classification by DWQ. However, for the purposes of biological assessments of waterbodies in the Chowan River basin, the Biological Assessment Unit uses a swamp criterion to assign a bioclassification to waterbodies that have visible flow in winter but stop flowing for some portion of the year.

The Biological Assessment Unit has limited data on Coastal B, thus, draft criteria have been developed based only on EPT taxa richness. However, biotic index values and total taxa richness values were also evaluated for between year and among site comparisons. These criteria will continue to be evaluated and any bioclassifications derived from them should be considered tentative and not used for use support decisions. Four Coastal B waterbody segments were Not Rated during this assessment period because of the draft Coastal B criteria.

The benthic macroinvertebrate community of small streams is naturally less diverse than the streams used to develop the current criteria for flowing freshwater streams. The benthic macroinvertebrate database is being evaluated and a study to systematically look at reference streams in different ecoregions is being developed with the goal of finding a way to evaluate water quality conditions in specific stream types. DWQ will continue to develop criteria to assess water quality in small streams.

Benthic Macroinvertebrate Data Collected in the Chowan River Basin, (Current basinwide sampling sites are in bold print.)

Waterbody	Location	County	Map ID	Index No.	Date	ST	EPTS	BI	BIE PT	BioClass
03-01-01										
Chowan R	nr Riddicksville	Hertford	DB5	25	09/28/05	71	9	7.11	5.61	Good
					07/31/00	46	7	7.33	5.84	Good-Fair
Chowan R	nr Gatesville	Gates	DB4	25	09/27/05	49	5	6.85	4.82	Fair
					08/01/00	62	9	7.22	4.70	Good
Cole Cr	US 158*	Gates	DB6	25-12-7	02/05/05	46	3	7.43	7.7	Moderate
					02/10/00	47	4	7.60	7.00	Moderate
Wiccacon R	SR 1433	Hertford	DB8	25-14	08/22/05	47	3	7.63	7.61	Fair
					08/01/00	66	6	7.88	6.80	Fair
Ahoskie Cr	NC 42	Hertford	DB1	25-14-1	02/09/05	50	7	6.70	4.95	Not Rated
					08/25/05	72	11	6.94	5.94	Not Rated
Stony Cr	SR 1235	Bertie	DB7	25-14-1-6	02/10/05	56	6	7.40	6.46	Moderate
					02/10/00	43	2	7.21	6.34	Moderate
Chinkapin Cr	SR 1432	Hertford	DB3	25-14-3	02/10/05	56	6	7.40	6.46	Natural
					02/10/00	60	8	6.98	6.22	Natural
Bennetts Cr	SR 1400	Gates	DB2	25-17	02/09/05	40	3	8.20	7.82	Moderate
03-01-02										
Kirbys Cr	SR 1362	Northampton	DB10	25-4-4	02/07/05	49	9	6.19	5.04	Moderate
					02/17/00	54	12	6.25	5.10	Natural
Meherrin R	SR 1175	Hertford	DB11	25-4-(5)	09/27/05	45	8	7.42	5.9	Good-Fair
					07/31/00	59	10	7.68	6.41	Good
Potecasi Cr	SR 1504	Northampton	DB12	25-4-8	02/07/05	44	1	7.31	6.40	Moderate
					02/09/00	24	1	6.97	7.78	Not Rated
Urahaw Swp	NC 35	Northampton	DB13	25-4-8-4	02/07/05	52	5	7.19	6.31	Moderate
					02/09/00	20	0	6.83	-	Moderate
Cutawhiskie Swp	SR 1141	Hertford	DB9	25-4-8-7	02/08/05	59	5	6.97	5.50	Not Rated
					08/26/05	71	8	6.70	5.56	Not Rated
					02/02/00	49	3	6.88	5.80	Not Rated
03-01-04										
Chowan R	US 17	Chowan	DB14	25	08/22/05	41	10	6.71	5.54	Good
					08/01/00	29	6	6.61	4.65	Good-Fair
East most Swp	SR 1361	Bertie	DB15	25-24-1	02/10/05	47	3	7.32	6.86	Moderate
					02/22/00	56	5	7.42	6.68	Not Rated

Fish Kill Assessment

DWQ has systematically monitored and reported fish kill events across the state since 1996. From 2000 to 2005, field investigators reported seven kill events in the Chowan River basin. Stagnant water, shallow water, low dissolved oxygen, and possible chemical contamination may have contributed to these fish kill events. Annual fish kill reports can be found at DWQ's Environmental Sciences website http://h2o.enr.state.nc.us/esb/Fishkill/fishkillmain.htm.

Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

Two NPDES permits in the Chowan River basin currently require WET testing. Both facilities have a WET limit. Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1996, the compliance rate has stabilized at approximately 90 percent.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina has more than 378 water chemistry monitoring stations statewide, where between 23 and 32 parameters are collected monthly at each station. During this assessment period (September 1, 2000 through August 31, 2005) chemical and physical measurements were obtained by DWQ from 14 stations located throughout the Chowan River Basin. The N.C. Recreational Water Quality Program monitors one additional location for bacterial issues. Information on the program can be found at http://www.deh.enr.state.nc.us/shellfish/Water_Monitoring/RWQweb/home.htm. Of the 14 ambient monitoring stations are currently operating in the Chowan River basin, six are located on the Chowan River itself in North Carolina and an additional site in Virginia on the Nottoway River approximately three miles before the confluence with the Blackwater River (at which point they become the Chowan River). In the Chowan River basin, two ambient parameters commonly exceed water quality parameters, total iron and dissolved oxygen. The locations of these stations are shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2006 Chowan River Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more detailed analysis of ambient water quality monitoring data.

Many of the waterbodies in the Chowan River basin experience low dissolved oxygen concentrations in summer in violation of water quality standards. Also, pH measurements exceed water quality standards in some of these streams. The fact that many of these streams cease to flow or have low natural pH is not the result of any anthropogenic interference but due to their nature. This area of the Middle Atlantic Coastal Plain ecoregion is classified as Mid-Atlantic Flatwoods and Mid-Atlantic Floodplains, and Low Terraces. Low gradient, poor drainage and swamp conditions are common here.

Specific information on water quality standards and action levels can be found in 15A NCAC 2B.0200 (August 1, 2004) available at http://h2o.enr.state.nc.us/csu/swstdsfaq.html.

Water Quality Parameters

Dissolved Oxygen

Dissolved oxygen (DO) is one of the most important of all the chemical measurements. Dissolved oxygen provides valuable information about the ability of the water to support aquatic life and the capacity of water to assimilate point and nonpoint discharges. Water quality standards for dissolved oxygen vary depending on the classification of the body of water but generally results less than 4.0 mg/L can be problematic. Consistent patterns of low concentrations of dissolved oxygen can be subject to intense management review and corrective actions, although patterns of low dissolved oxygen can occur naturally in and near swamp waters, in estuarine waters under salt wedge conditions, or during droughts.

pH

The pH of natural waters can vary throughout the state. Low values (<< 7.0 s.u.) can be found in waters rich in dissolved organic matter, such as swamp lands, whereas high values (>> 7.0 s.u.) may be found during algal blooms. Point source dischargers can also influence the pH of a stream. The water quality standards for pH in freshwaters consider values less than 6.0 s.u. or greater than 9.0 s.u. to warrant attention; whereas in salt waters pH values less than 6.8 or greater than 8.5 warrant attention.

Turbidity

Turbidity data may denote episodic high values on particular dates or within narrow time periods. These can often be the result of intense or sustained rainfall events; however elevated values can occur at other times. Tidal surges can also disturb shallow estuarine sediments and naturally increase turbidity.

Nutrients

Compounds of nitrogen and phosphorus are major components of living organisms and thus are essential to maintain life. These compounds are collectively referred to as "nutrients." Nitrogen compounds include ammonia-nitrogen (NH_3-N), total Kjeldahl nitrogen (TKN) and nitrite+nitrate nitrogen (NO_2+NO_3-N). Phosphorus is measured as total phosphorus. When nutrients are introduced to an aquatic ecosystem from municipal and industrial treatment processes, or runoff from urban or agricultural land, the excessive growth of algae (algal blooms) and other plants may be accelerated. In addition to the possibility of causing algal blooms, ammonia-nitrogen may combine with high pH water to form NH_4OH, a form toxic to fish and other aquatic organisms.

Bacteria

Concentrations of fecal coliform bacteria can vary greatly. The descriptive statistics used to evaluate fecal coliform bacteria data include the geometric mean and the median depending on the classification of the waterbody. For all sites in the Chowan River Basin, the standard specified in Administrative Code 15A NCAC 02B.0211 (3)(e) (August 1, 2005) is applicable:

"Organisms of the coliform group: fecal coliforms shall not exceed a geometric mean of 200/100ml (MF count) based upon at least five consecutive samples examined during any 30 day period, nor exceed 400/100ml in more than 20 percent of the samples examined during such period; violations of the fecal coliform standard are expected during rainfall events and, in some cases, this violation is expected to be caused by uncontrollable nonpoint source pollution; all coliform concentrations are to be analyzed using the membrane filter technique unless high turbidity or other adverse conditions necessitate the tube dilution method; in case of controversy over results, the MPN 5-tube dilution technique shall be used as the reference method."

Metals

A number of metals are essential micronutrients for the support of aquatic life. However, there are threshold concentrations over which metals can be toxic. DWQ monitors total (not dissolved) concentrations for aluminum, arsenic, cadmium, chromium, copper, iron, lead, mercury, manganese (Water Supply waters only), nickel, and zinc. Aluminum and iron are commonly found in North Carolina soils, therefore high aluminum and iron concentrations are typically correlated with high turbidity.

Conductivity

Conductivity is a measure of the ability of water to conduct an electric current. The presence of ions and temperature are major factors in the ability of water to conduct a current. Clean freshwater has a low conductivity, whereas high conductivities may indicate polluted water or saline conditions. Measurements reported are corrected for temperature, thus the range of values reported over a period of time indicate the relative presence of ions in water. North Carolina freshwater streams have a natural conductance range of 17-65 μmhos/cm, however (USGS 1992).

Conductivity can be used to evaluate variations in dissolved mineral concentrations (ions) among sites with varying degrees of impact resulting from point source discharges. Generally, impacted sites show elevated and widely ranging values for conductivity. However, water bodies that contain saltwater will also have high conductivities. Therefore those wishing to use conductivity as an indicator for problems must first account for salinity.

Locations of DWQ Monitoring stations in the Chowan River Basin, 2000 - 2005.

Subbasin/ Station ID	Map ID	Location	Class
1		**Chowan River - Upper Section and Blackwater River**	
D0000050	DA1	Nottaway River at US 258 near Riverdale, Virginia	II Estuarine
D0001200	DA2	Blackwater River at Horseshoe Bend at Cherry Grove, Virginia	II Estuarine
D0001800	DA3	Blackwater River .5 MI upstream of Mouth near Wyanoke	B NSW
D0010000	DA4	Chowan River near Riddicksville	B NSW
D6250000	DA7	Chowan River at US 13 at Winton	B NSW
D8356200	DA8	Chowan River at CM 16 near Gatesville	B NSW
2		**Meherrin River and Potecasi Creek**	
D4150000	DA5	Potecasi Creek at NC 11 near Union	C NSW
D5000000	DA6	Meherrin River at SR 1175 Parkers Ferry near Como	B NSW
3		**Chowan River - Middle Section**	
D8430000	DA9	Chowan River at CM 12 downstream of Holiday Island	B NSW
D8950000	DA10	Chowan River near CM 7 at Colerain	B NSW
4		**Chowan River - Lower Section and Albemarle Sound**	
D9490000	DA11	Chowan River at US 17 at Edenhouse	B NSW
D999500C	DA12	Albemarle Sound near Edenton Mid-Channel	B NSW
D999500N	DA13	Albemarle Sound near Edenton North Shore	B NSW
D999500S	MA13	Albemarle Sound near Edenton South Shore	SB

Appendix II

Use Support Methodology

Introduction to Use Support

All surface waters of the state are assigned a classification appropriate to the best-intended uses of that water. Waters are assessed to determine how well they are meeting the classified or best-intended uses. The assessment results in a use support rating for the use categories that apply to that water.

Use Support Categories

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the use of five use support categories: aquatic life, recreation, fish consumption, water supply, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. Waters are Supporting if data and information used to assign a use support rating meet the criteria for that use category. If these criteria are not met, then the waters are Impaired. Waters with inconclusive data and information are Not Rated. Waters where no data or information are available to make an assessment are No Data. The table below specifies which use support categories apply to which primary classifications.

A single body of water may have more than one use support rating corresponding to one or more of the use support categories, as shown in the following table. For many waters, a use support category will not be applicable (N/A) to the classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (15A NCAC 2b .0100 and .0200). Information can also be found within each basin plan and at http://h2o.enr.state.nc.us/csu/.

Use Support Categories

Primary Classification	Ecosystem Approach	Human Health Approach			
	Aquatic Life	Fish Consumption	Recreation	Water Supply	Shellfish Harvesting
C	X	X	X	N/A	N/A
SC	X	X	X	N/A	N/A
B	X	X	X	N/A	N/A
SB	X	X	X	N/A	N/A
SA	X	X	X	N/A	X
WS I – WS IV	X	X	X	X	N/A

Assessment Period

Data and information are used to assess water quality and assign use support ratings using a five-year data window that ends on August 31 of the year of basinwide biological sampling. For example, if biological data are collected in a basin in 2004, then the five-year data window for use support assessments would be September 1, 1999 to August 31, 2004. There are occasionally some exceptions to this data window, especially when follow up monitoring is needed to make decisions on samples collected in the last year of the assessment period.

Data and information for assessing water quality and assigning use support ratings for lakes uses a data window of October 1 to September 30. Any data collected by DWQ during the five-year data window that ends on September 30 of the year of biological sampling will be used to develop a Weight-of-Evidence approach to lakes assessment. Refer to page 16 of this appendix for more information.

Assessment Units

DWQ identifies waters by index numbers and assessment unit numbers (AU). The AU is used to track defined stream segments or waterbodies in the water quality assessment database, for the 303(d) Impaired waters list, and in the various tables in basin plans and other water quality documents. The AU is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU indicates that the AU is smaller than the DWQ index segment. No letter indicates that the AU and the DWQ index segment are the same.

Interpretation of Data and Information

It is important to understand the associated limitations and degree of uncertainty when interpreting use support ratings. Although these use support methods are based on data analysis and other information, some best professional judgment is applied during these assessments. Use support ratings are intended to provide an assessment of water quality using a five-year data window, to describe how well surface waters support their classified uses, and to document the potential stressors contributing to water quality degradation and the sources of these contributions.

Use support methods continue to improve over time, and the information and technology used to make use support determinations also continue to become more accurate and comprehensive. These improvements sometimes make it difficult to make generalizations comparing water quality between basin plans. However, technology and methods improvements result in more scientifically sound use support assessments.

Assessment Methodology

Introduction

Many types of data and information are used to determine use support ratings and to identify stressors and sources of water quality degradation. All existing data pertaining to a stream segment for each applicable use support category are entered into a use support database.

Assessments and data entries may include use support ratings for each of the five use support categories, basis of assessment, stressors and potential sources, biological, chemical/physical (ambient monitoring), and lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, swimming advisories and shellfish sanitation growing area classifications from the NC Division of Environmental Health, and available land cover and land use information. The following describes the data and methodologies used to conduct use support assessments. These methods will continue to be refined as additional information and technology become available.

Basis of Assessment

Assessments are made on an overall basis of either monitored (M) or evaluated (E), depending on the level of information available. A monitored rating is based on the most recent five-year data window and site-specific data and is therefore treated with more confidence than an evaluated rating. Evaluated ratings are used when there are no site-specific data.

Rating Basis	Use Support Category	Assessment Applicability*
S/M	AL	Biological community data or ambient water quality parameters do not exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
S/M	REC	Ambient fecal coliform bacteria levels do not exceed criteria in AU or AU with DEH sites is posted with advisories for 61 days or less during assessment period.
S/M	SH	AU is a DEH Approved shellfish growing area.
I/M	AL	Biological community data or ambient water quality parameters exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
I/M	REC	Ambient fecal coliform bacteria levels exceeds criteria in AU or AU with DEH sites is posted with advisories for more than 61 days during assessment period.
I/M	FC	DHHS has established a site-specific advisory for fish consumption and fish tissue data are available.
I/M	SH	AU is a DEH Conditionally-Approved, Prohibited or Restricted shellfish growing area.
NR/M	AL	Biological community is Not Rated or inconclusive, or ambient water quality parameters are inconclusive or there are less than 10 samples in AU during assessment period. Biological and ambient data are independently applied.
NR/M	REC	Ambient fecal bacteria parameter exceeds annual screening criteria, but does not exceed assessment criteria of five samples in 30 days in AU during assessment period.
NR/M	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice; fish tissue data available.
S/E	AL	AU is a tributary to a S/M AU and land use is similar between AUs.
S/E	WS	AU is classified as WS, and DEH report notes no significant closures at time of assessment.
I/E	FC	AU is in basin under a mercury advice or drains to areas within a mercury advice. AU has a site-specific advisory and there is no fish tissue data available.
NR/E	AL	AU is tributary to I/M AU, or AU is in watershed with intensive and changing land use, or other information suggests negative water quality impacts to AU. Discharger in AU has noncompliance permit violations or has failed three or more WET tests during the last two years of the assessment period.
NR/E	REC	Discharger has noncompliance permit violations of fecal bacteria parameter during last two years of assessment period.
NR/E	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to

		areas within a mercury advice, or has no fish tissue data.
ND	AL, REC, SH	No data available in AU during assessment period.

Note: S/M = Supporting/Monitored I/M = Impaired/Monitored NR/M = Not Rated/Monitored
S/E = Supporting/Evaluated I/E = Impaired/Evaluated NR/E = Not Rated/Evaluated
ND = No Data
AL = Aquatic Life REC = Recreation FC = Fish Consumption
SH = Shellfish Harvesting WS = Water Supply
AU = Assessment Unit WET = Whole Effluent Toxicity
DEH = Division of Environmental Health
DHHS = Department of Health and Human Services
* = for lakes assessments, see page 16

Supporting ratings are extrapolated up tributaries from monitored streams when there are no problematic dischargers with permit violations or changes in land use/cover. Supporting ratings may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem stressors or sources are not generally applied to unmonitored tributaries. Impaired ratings are not extrapolated to unmonitored tributaries.

Stressors

Biological and ambient samplings are useful tools to assess water quality. However, biological sampling does not typically identify the causes of impairment, and ambient sampling does not always link water quality standards to a biological response. Linking the causes of impairment and the biological response are a complex process (USEPA, 2000) that begins with an evaluation of physical, chemical or biological entities that can induce an adverse biological response. These entities are referred to as stressors. A stressor may have a measurable impact to aquatic health. Not all streams will have a primary stressor or cause of impairment. A single stressor may not be sufficient to cause impairment, but the accumulation of several stressors may result in impairment. In either case, impairment is likely to continue if the stressor or the various cumulative stressors are not addressed. Use support assessments evaluate the available information related to potential stressors impacting water quality.

A stressor identification process may be initiated after a stream appears on the 303(d) list in order to address streams that are Impaired based on biological data. Intensive studies are required to summarize and evaluate potential stressors to determine if there is evidence that a particular stressor plays a substantial role in causing the biological impacts. Intensive studies consider lines of evidence that include benthic macroinvertebrate and fish community data, habitat and riparian area assessment, chemistry and toxicity data, and information on watershed history, current watershed activities and land uses, and pollutant sources. These studies result in decisions regarding the probable stressors contributing to or causing impairment. The intensity of a stressor study may be limited due to a lack of resources. In these cases, it may still be appropriate to include stressors in use support assessments, but to also note where additional information is needed in order to evaluate other stressors.

Where an ambient parameter is identified as a potential concern, the parameter is noted in the DWQ database and use support summary table. Where habitat degradation is identified as a stressor, DWQ and others attempt to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools or riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion).

Aquatic Life Category

The aquatic life category is an ecosystem approach to assessing the biological integrity of all surface waters of the state. The biological community data and ambient water quality data are used in making assessments in this category. These represent the most important monitoring data for making water quality assessments in the aquatic life category. Evaluation information such as compliance and whole effluent toxicity information from NPDES dischargers, land cover, and other more anecdotal information are also used to identify potential problems and to refine assessments based on the monitoring data. The following is a description of each monitoring data type and the criteria used in assigning use support ratings. Criteria used to evaluate the other information and assign use support ratings are also described. Refer to page 14 for lakes and reservoir assessment methods as applied in the aquatic life category.

Biological Data

Benthic macroinvertebrate (aquatic insects) community and fish community samples are the best way to assess the biological integrity of most waterbodies. Unfortunately, these community measures cannot be applied to every stream size and are further limited by geographic region. These community measures are designed to detect current water quality and water quality changes that may be occurring in the watershed. However, they are only directly applied to the assessment unit where the sample was collected.

Where recent data for both benthic macroinvertebrates and fish communities are available, both are assessed for use support ratings. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit.

Benthic Macroinvertebrate Criteria

Criteria have been developed to assign bioclassifications to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera* (Mayflies), *Plecoptera* (Stoneflies) and *Trichoptera* (Caddisflies) commonly referred to as EPTs; and the Biotic Index (BI), which summarizes tolerance data for all taxa in each sample. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored.

If a Fair macroinvertebrate bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

Use support ratings are assigned to assessment units using benthic macroinvertebrate bioclassifications as follows.

Waterbody Sample Type or Criteria	Benthic Bioclassification	Use Support Rating
Mountain, piedmont, coastal A[3]	Excellent	Supporting
Mountain, piedmont, coastal A[3]	Good	Supporting
Swamp[1]	Natural	Supporting
Mountain, piedmont, coastal A	Good-Fair	Supporting
Smaller than criteria but Good-Fair[2]	Not Impaired	Supporting
Swamp[1]	Moderate Stress	Supporting
Mountain, piedmont, coastal A[3]	Fair	Impaired
Swamp[1]	Severe Stress	Impaired
Mountain, piedmont, coastal A[3]	Poor	Impaired
Criteria not appropriate to assign bioclassification	Not Rated	Not Rated

[1] Swamp streams for benthos sampling are defined as streams in the coastal plain that have no visible flow for a part of the year, but do have flow during the February to early March benthic index period.

[2] This designation may be used for flowing waters that are too small to be assigned a bioclassification (less than three square miles drainage area), but have a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria.

[3] Coastal A streams are those located in the coastal plain that have flow year round and are wadeable.

Fish Community Criteria

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored. Use support ratings are assigned to assessment units using the NCIBI bioclassifications as follows:

NCIBI	Use Support Rating
Excellent	Supporting
Good	Supporting
Good-Fair	Supporting
Fair	Impaired
Poor	Impaired

The NCIBI was recently revised (NCDENR, 2001), and the bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a). NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico

River basins. The definition of "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin -- all waters except for those draining the Sandhills in Moore, Lee and Harnett counties, and the entire basin upstream of Lillington, NC.
- In the Neuse River basin -- the entire basin above Smithfield and Wilson, except for the south and southwest portions of Johnston County and eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

NCIBI criteria have not been developed for:

- Streams in the Broad, Catawba, Yadkin-Pee Dee, Savannah, French Broad, Hiwassee, Little Tennessee, New and Watauga River basins which are characterized as wadeable first to third order streams with small watersheds, naturally low fish species diversity, coldwater temperatures, and high gradient plunge-pool flows. Such streams are typically thought of as "Southern Appalachian Trout Streams".
- Wadeable streams in the Sandhills ecoregion of the Cape Fear, Lumber and Yadkin-Pee Dee River basins.
- Wadeable streams and swamps in the coastal plain region of the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Tar-Pamlico and White Oak River basins.
- All nonwadeable and large streams and rivers throughout the state.

Ambient Water Quality Monitoring Criteria

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring Program statewide and NPDES discharger coalitions in some basins. All samples collected (usually monthly) during the five-year assessment period are used to assign a use support rating. Ambient water quality data are not direct measures of biological integrity, but the chemical/physical parameters collected can provide an indication of conditions that may be impacting aquatic life. Because these data represent water quality conditions with a high degree of confidence, use support ratings assigned using these data are considered monitored. Where both ambient data and biological data are available, each data type is assessed independently.

The parameters used to assess water quality in the aquatic life category include dissolved oxygen, pH, chlorophyll *a* and turbidity. Criteria for assigning use support ratings to assessment units with ambient water quality data of a minimum of ten samples are as follows:

Ratings Criteria	Rating
Numerical standard exceeded in ≤10% of samples	Supporting
Numerical standard exceeded in >10% of samples	Impaired
Less than 10 samples collected	Not Rated
DO and pH standard exceeded in swamp streams	Not Rated

Some standards are written with more specific criteria than others and these specific criteria are used to assess use support. For example, the DO standard for Class C waters is a daily average of 5 mg/l and an instantaneous value of 4 mg/l. Because DWQ does not collect daily DO levels at the ambient stations, the instantaneous value is used for assessment criteria. In areas with continous monitoring, the daily average of 5 mg/l will also be assessed. In addition, pH has a standard of not less than 6 and not greater than 9; each level is assessed. To assess the fecal coliform bacteria standard, five samples must be collected within a 30 day period (see Recreation Category for more information).

Multiple Monitoring Sites

There are assessment units with more than one type of monitoring data. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit. Monitoring data are always used over the evaluation information; however, evaluation information can be used to lengthen or shorten monitored assessment units and to assign use support ratings on an evaluated basis to non-monitored assessment units.

NPDES Wastewater Whole Effluent Toxicity (WET) Information

Whole Effluent Toxicity (WET) tests are required for all major NPDES discharge permit holders, as well as those minor NPDES dischargers with complex effluent (defined as not being of 100 percent domestic waste). WET tests are evaluated to determine if the discharge could be having negative water quality impacts. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient water quality data, and that facility has failed three or more WET tests in the last two years of the assessment period, the assessment unit is Not Rated. Because this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored. Problems associated with WET test failures are addressed through NPDES permits.

NPDES Discharger Daily Monitoring Report (DMR) Information

NPDES effluent data monthly averages of water quality parameters are screened for the last two years of the assessment period. If facilities exceed the effluent limits by 20 percent for two or more months during two consecutive quarters, or have chronic exceedances of permit limits for four or more months during two consecutive quarters, then the assessment unit is Not Rated if no biological or ambient monitoring data are available. Because discharger effluent data is not a direct measure of water quality and data confidence is not as high as for stream monitoring data, the assessment units are considered evaluated rather than monitored. If biological or ambient data are available, that data will be used to develop a use support rating for appropriate stream segments.

Fish Consumption Category

The fish consumption category is a human health approach to assess whether humans can safely consume fish from a waterbody. This category is applied to all waters of the state. The use

support rating is assigned using fish consumption advisories or advice as issued by the NC Department of Health and Human Services (DHHS). The fish consumption category is different from other categories in that assessments are based on the existence of a DHHS fish consumption advice or advisory at the time of use support assessment. The advice and advisories are based on DHHS epidemiological studies and on DWQ fish tissue data. DWQ fish tissue data are used to inform DHHS of potential fish tissue toxicity. DHHS is responsible for proclaiming a fish tissue advisory or advice for any waterbody. Fish tissue monitoring data are not used directly for assigning a use support rating in this category.

If a site-specific fish consumption advisory is posted at the time of assessment, the water is Impaired on either a monitored or evaluated basis dependent upon the availability of monitoring data. The DHHS has developed statewide fish consumption advice for certain fish species shown to have elevated levels of mercury in their tissue. All waters of the state are therefore Impaired/Evaluated in the fish consumption category.

Recreation Category

This human health related category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA. This category also evaluates waters used for secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized or incidental basis. These waters are classified as Class C, SC and WS.

The use support ratings applied to this category are currently based on the state's fecal coliform bacteria water quality standard where ambient monitoring data are available or on the duration of local or state health agencies posted swimming advisories. Use support ratings for the recreation category may be based on other bacteriological indicators and standards in the future.

DWQ conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The Division of Environmental Health (DEH) tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department.

The North Carolina fecal coliform bacteria standard for freshwater is: 1) not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period; and 2) not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period.

Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support. Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

Waters with beach monitoring sites will be Impaired if the area is posted with an advisory for greater than 61 days of the assessment period. Waters with beach monitoring sites with advisories posted less than 61 days will be Supporting. Other information can be used to Not Rate unmonitored waters.

DWQ Ambient Monitoring Fecal Coliform Bacteria Screening Criteria

As with other information sources, all available information and data are evaluated for the recreation category using the assessment period. However, DWQ conducts an annual screening of DWQ ambient fecal coliform bacteria data to assess the need for additional monitoring or immediate action by local or state health agencies to protect public health.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

Due to limited resources and the higher risk to human health, Class B, SB and SA waters will be given monitoring priority for an additional five times within 30 days sampling. Follow-up water quality sampling for Class C waters will be performed as resources permit. Any waters on the 303(d) list of Impaired waters for fecal coliform will receive a low priority for additional monitoring because these waters will be further assessed for TMDL development.

DWQ attempts to determine if there are any swimming areas monitored by state, county or local health departments or by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

Use of Outside Data

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 90 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use

support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and stressors. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

Criteria Levels for Use of Outside Data in Use Support Assessments			
Criteria	**Level 1**	**Level 2**	**Level 3**
Monitoring frequency of at least 10 samples for more than a one-year period	Yes	Yes/No	No
Monitoring locations appropriately sited and mapped	Yes	Yes	No
State certified laboratory used for analysis according to 15A NCAC 2B .0103	Yes	Yes/No	No
Quality assurance plan available describing sample collection and handling	Yes, rigorous scrutiny	Yes/No	No

Lakes and Reservoir Use Assessment

Like streams, lakes are classified for a variety of uses. All lakes monitored as part of North Carolina's Ambient Lakes Monitoring Program carry the Class C (aquatic life) classification, and most are classified Class B and SB (recreation) and WS-I through WS-V (water supply). The surface water quality numeric standard specifically associated with recreation is fecal coliform. For water supplies, there are 29 numeric standards based on consumption of water and fish. Narrative standards for Class B and Class WS waters include aesthetics such as no odors and no untreated wastes. There are other numeric standards that also apply to lakes for the protection of aquatic life and human health. These standards also apply to all other waters of the state and are listed under the Class C rules. One of the major problems associated with lakes and reservoirs is increasing eutrophication related to nutrient inputs. Several water quality parameters help to describe the level of eutrophication.

For nutrient enrichment, one of the main causes of impacts to lakes and reservoirs, a more holistic or weight of evidence approach is necessary since nutrient impacts are not always reflected by the parameters sampled. For instance, some lakes have taste and odor problems associated with particular algal species, yet these lakes do not have chlorophyll *a* concentrations above 40 µg/l frequently enough to impair them based on the standard. In addition, each reservoir possesses unique traits (watershed area, volume, depth, retention time, etc.) that dramatically influence its water quality, but that cannot be evaluated through standards comparisons. In such waterbodies, aquatic life may be Impaired even though a particular indicator is below the standard. Where exceedances of surface water quality standards are not sufficient to evaluate a lake or reservoir, the weight of evidence approach can take into consideration indicators and parameters not in the standards to allow a more sound and robust determination of water quality.

The weight of evidence approach uses the following sources of information to determine the eutrophication (nutrient enrichment) level as a means of assessing lake use support in the aquatic life category:

- Quantitative water quality parameters - dissolved oxygen, chlorophyll *a*, pH, etc.
- Algal bloom reports
- Fish kill reports
- Hydrologic and hydraulic characteristics – watershed size, lake volume, retention time, volume loss, etc.
- Third party reports – citizens, water treatment plant operators, state agencies, etc.
    - Taste and odor
    - Sheens
    - Odd colors
    - Other aesthetic and safety considerations

In implementing the weight of evidence approach for eutrophication, more consideration is given to parameters that have water quality standards (see table). Each parameter is assessed for percent exceedance of the state standard. Parameters with sufficient (ten or more observations), quality-assured observations are compared to surface water quality standards. When standards are exceeded in more than 10 percent of the assessment period, portions or all of the waterbody are rated Impaired.

However, in many cases, the standards based approach is incapable of characterizing the overall health of a reservoir. The eutrophication-related parameters and water quality indicators without numeric standards are reviewed based on interpretation of the narrative standards in 15A NCAC 2B .0211(2) and (3).

A modification to lake use assessment is the evaluation and rating of a lake or reservoir by assessment units (AUs). Each lake or reservoir may have one or more AU based on the classification segments (DWQ index numbers). Each sampling date is considered one sample. Multiple sampling locations within one AU are considered one sample. A minimum of ten samples is needed to assess use support for any AU. Each AU with documented problems (sufficient data, ambient data above standards, and supporting public data) will be rated as Impaired while the other portions are rated as Supporting or Not Rated. The following table lists the information considered during a lake/reservoir use assessment, as well as the criteria used to evaluate that information.

Lake/Reservoir Weight of Evidence Use Assessment for Aquatic Life Category	
Assessment Type	**Criteria**
EUTROPHICATION	
Water Quality Standards (a minimum of 10 samples is required for use support assessment)	
Chl *a*	Above standard in >10% of samples.
DO	Below or above standard in >10% of samples.
pH	Below or above standard in >10% of samples.
Turbidity	Above standard in >10% of samples.
% Total Dissolved Gases	Above standard in >10% of samples.
Temperature	Minor and infrequent excursions of temperature standards due to anthropogenic activity. No impairment of species evident.
Metals (excluding copper, iron and zinc)	Above standard in >10% of samples.
Other Data	
% Saturation DO	>10% of samples above >120%
Algae	Blooms during 2 or more sampling events in 1 year with historic blooms.
Fish	Kills related to eutrophication.
Chemically/ Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.
Aesthetics Complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state agency.
Trophic Status Index (TSI)	Increase of 2 trophic levels from one 5-year period to next.
Historic DWQ Data	Conclusions from other reports and previous use support assessments.
AGPT	Algal Growth Potential Test ≥5 mg/L
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat; clogging intakes.
Taste and Odor	Public complaints; Potential based on algal spp
Sediments	Clogging intakes - dredging program necessary.

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Appendix III

NPDES Discharge, Non-Discharge and Stormwater Permits

NPDES Permits

Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0033782	Gates County Schools	Gatesville Elementary School WWTP	Gates	Washington	100% Domestic < 1MGD	Minor	5000	30101	Bennetts Creek (Merchants Millpond)
NC0033791	Gates County Schools	Sunbury Primary School WWTP	Gates	Washington	100% Domestic < 1MGD	Minor	5000	30101	Raynor Swamp (Hunters Millpond)
NC0033804	Gates County Schools	T.S. Cooper Elementary School WWTP	Gates	Washington	100% Domestic < 1MGD	Minor	4000	30101	Raynor Swamp (Hunters Millpond)
NC0043974	Gates County Schools	Buckland Elementary School	Gates	Washington	100% Domestic < 1MGD	Minor	6000	30101	Cole Creek (Lilleys Millpond)
NC0086231	Aluminum Casting Technology, Inc.	Aluminum Casting Technology / Ahoskie	Hertford	Washington	Industrial Process & Commercial	Minor	24000	30101	Ahoskie Creek (Ahoskie Swamp, Bear Swamp)
NC0002402	Perry-Wynns Fish Company	Perry-Wynns Fish Company	Bertie	Washington	Industrial Process & Commercial	Minor	24000	30103	CHOWAN RIVER
NC0003867	Edenton Dyeing and Finishing LLC	Edenton Dyeing and Finishing	Chowan	Washington	Industrial Process & Commercial	Major	1500000	30103	CHOWAN RIVER
NC0007552	Town of Edenton	Freemason WTP	Chowan	Washington	Water Treatment Plant	Minor	10000	30104	Pembroke Creek
NC0032719	Chowan County	Valhalla WTP	Chowan	Washington	Water Treatment Plant	Minor	not limited	30104	Rockyhock Creek (Bennett Millpond)
NC0086291	Town of Edenton	Beaver Hill WTP	Chowan	Washington	Water Treatment Plant	Minor	10000	30104	Pembroke Creek

General Stormwater Permits				
COC Number	**Facility Name**	**Receiving Stream**	**Subbasin**	**County**
NCG020414	C L W Sand Mine	Ahoskie Creek (Ahoskie Swamp, Bear Swamp)	03-01-01	Hertford
NCG050017	Kerr Group Incorporated	Snake Branch	03-01-01	Hertford
NCG080126	A T Byrum & Son Incorporated	Ahoskie Creek (Ahoskie Swamp, Bear Swamp)	03-01-01	Hertford
NCG080530	NC Nat Gd- Ahoskie/OMS #19	Ahoskie Creek (Ahoskie Swamp, Bear Swamp)	03-01-01	Hertford
NCG080762	North Carolina and Virginia Railroad	Whiteoak Swamp	03-01-01	Hertford
NCG140102	Commerical Ready Mix Products	Ahoskie Creek (Ahoskie Swamp, Bear Swamp)	03-01-01	Hertford
NCG140297	Roanoke Chowan Ready Mix Inc	Stony Creek	03-01-01	Bertie
NCG140331	Ready Mix Inc - Roanoke-Chowan	Stony Creek	03-01-01	Bertie
NCS000167	Perdue Farms Incorporated-Cofield	Deep Creek	03-01-01	Hertford
NCG020367	B & A Sand Mine	Meherrin River	03-01-02	Hertford
NCG020660	Meherrin Mine	Meherrin River (North Carolina Portion)	03-01-02	Hertford
NCG080134	Pilot Travel Centers LLC #68	Jacks Swamp	03-01-02	Northampton
NCG080574	NC Nat Gd- Woodland	Urahaw Swamp	03-01-02	Northampton
NCG100130	Liverman's Automotive Inc	Potecasi Creek	03-01-02	Hertford
NCG190066	Fineline Industries East (Centurion Ski Boats)	Urahaw Swamp	03-01-02	Northampton
NCG200435	Hertford County Recycling Facility	Mill Branch	03-01-02	Hertford
NCG210360	Carolina Bark Products	Cypress Creek (Jordans Millpond)	03-01-02	Northampton
NCS000251	Conway Resins plant	Paddys Delight Creek (Doolittle Millpond)	03-01-02	Northampton
NCG110045	Edenton Town WWTP	Pembroke Creek	03-01-04	Chowan
NCG190053	Ana Boat DOC Incorporated	Pembroke Creek	03-01-04	Chowan
NCG190062	Carolina Classic Boats Inc	Edenton Bay	03-01-04	Chowan
NCG190065	Layton's Custom Boatworks	ALBEMARLE SOUND	03-01-04	Chowan
NCS000134	Avoca Farms	Salmon Creek	03-01-04	Bertie

Non-Discharge NPDES Permits									
Permit	**Owner**	**Facility**	**County**	**Region**	**Owner Type**	**Perm Type**	**Class**	**Flow**	**Subbasin**
WQ0001284	Town of Conway	Conway Town-Spray Systm/WWTP	Northampton	Raleigh	Government - Municipal	Surface Irrigation	Major	150000	03-01-02
WQ0001868	Severn Town	Severn Town-WWTF/Spray Sys	Northampton	Raleigh	Government - Municipal	Surface Irrigation	Major	62000	03-01-02
WQ0002012	Georgia Pacific Resins	Georgia Pacific Resins-Conway	Northampton	Raleigh	Non-Government	Surface Irrigation	Major	0	03-01-02
WQ0003299	Town of Seaboard	Seaboard Town-WWTF/Spray	Northampton	Raleigh	Government - Municipal	Surface Irrigation	Major	134000	03-01-02
WQ0004910	Woodland Town	Woodland Town-Woodland WWTP	Northampton	Raleigh	Government - Municipal	Surface Irrigation	Major	185000	03-01-02
WQ0005192	Perdue Farms Inc	Murfreesboro Hatchery #5	Northampton	Raleigh	Non-Government	Surface Irrigation	Major	15000	03-01-02
WQ0001536	Perdue Farms Inc	Perdue Farms Inc - Cofield Feed Mill	Hertford	Washington	Non-Government	Surface Irrigation	Major	35000	03-01-01
WQ0001602	Town of Winton	Town of Winton WWTP	Hertford	Washington	Government - Municipal	Surface Irrigation	Major	585000	03-01-02
WQ0003885	Town of Ahoskie	Ahoskie Town-WWTP/Spray	Hertford	Washington	Government - Municipal	Surface Irrigation	Major	901000	03-01-01
WQ0006785	Town of Murfreesboro	Murfreesboro Town-WWT Plant	Hertford	Washington	Government - Municipal	Surface Irrigation	Major	452204	03-01-02
WQ0007028	Georgia-Pacific Corporation	Georgia Pacific Corp-Ahos Wet	Hertford	Washington	Non-Government	Wastewater Recycling	Minor	0	03-01-01
WQ0008720	Georgia-Pacific Corporation	Ahoskie CNS Washdown System/Evaporation Pit Wastewater Disposal Recycle System	Hertford	Washington	Non-Government	Wastewater Recycling	Minor	0	03-01-01
WQ0012404	C F Industries Inc	C F Industries Groundwater Remediation Project	Hertford	Washington	Non-Government	Groundwater Remediation, Non-discharge	Major	82192	03-01-01
WQ0000267	NC Department Of Corrections	NC DOC-Gates Co Correctional	Gates	Washington	Government - State	Surface Irrigation	Major	25000	03-01-01

WQ0000550	Currituck County	Currituck County Detention Center	Currituck	Washington	Government - County	Surface Irrigation	Major	25000	03-01-01
WQ0004332	Town of Edenton	Edenton Town-WWTF/Sids	Chowan	Washington	Government - Municipal	Surface Irrigation	Major	1076000	03-01-04
WQ0000777	Town of Aulander	Aulander Town-WWTP/Spray Fac	Bertie	Washington	Government - Municipal	Surface Irrigation	Major	341000	03-01-01
WQ0005910	Avoca Inc	Avoca Farms	Bertie	Washington	Non-Government	Surface Irrigation	Major	50000	03-01-04
WQ0008500	Bertie County Board of Education	C. G. White Elementary School	Bertie	Washington	Government - County	Surface Irrigation	Minor	4500	03-01-01
WQ0011119	Town of Colerain	Colerain Town	Bertie	Washington	Government - Municipal	Surface Irrigation	Major	0	03-01-01
WQ0029653	Rial Corporation	Innsbrook Golf & Marina WWTP	Bertie	Washington	Non-Government	Reuse	Major	50040	03-01-04

Appendix IV

Chowan River Basin
Nonpoint Source Program
Description and Contacts

Agriculture

USDA Natural Resources Conservation Service:

Part of the U.S. Department of Agriculture (USDA), formerly the Soil Conservation Service. Technical specialists certify waste management plans for animal operations; provide certification training for swine waste applicators; work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation systems unique to their land and needs; administer several federal agricultural cost share and incentive programs; provide assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conduct soil surveys; offer planning assistance for local landowners to install best management practices; and offer farmers technical assistance on wetlands identification. www.nc.nrcs.usda.gov/

County	Contact Person	Phone	Address
Area 1 Conservationist	William J. Harrell	919-751-0976	Cashwell Office Park, Suite C, 208 Malloy St., Goldsboro, NC 27534
Bertie County	Paula Ashley	252-794-5305	PO Box 566, Windsor, NC 27983
Chowan County	R. Dwane Hinson	252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932
Gates County	William P. Boone	252-358-7846	PO Box 265, Winton, NC 27986
Hertford County	William P. Boone	252-358-7846	PO Box 265, Winton, NC 27986
Northampton County	Tony R. Short	252-534-2591	PO Box 218, Jackson, NC 27845

Soil and Water Conservation Districts:

Boards and staff under the administration of the NC Soil and Water Conservation Commission (SWCC). Districts are responsible for: administering the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* at the county level; identifying areas needing soil and/or water conservation treatment; allocating cost share resources; signing cost share contracts with landowners; providing technical assistance for the planning and implementation of BMPs; and encouraging the use of appropriate BMPs to protect water quality.

Bertie County		252-794-5305	PO Box 566, Windsor, NC 27983
Chowan County		252-482-4127	730 N. Granville Street, Suite B, Edenton, NC 27932
Gates County		252-358-7846	PO Box 265, Winton, NC 27986
Hertford County		252-358-7846	PO Box 265, Winton, NC 27986
Northampton County		252-534-2591	PO Box 218, Jackson, NC 27845

Division of Soil and Water Conservation:

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil and Water Conservation Districts, provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee. www.enr.state.nc.us/DSWC/

Central Office	David B. Williams	919-733-2302	512 N Salisbury Street, Raleigh NC 27604
Washington Region	David Cash (Area 5 Coordinator)	252-946-6481	943 Washington Square, Washington, NC 27889
Central Office	Jill A. Slankas (Nonpoint Source Planning Coordinator)	919-715-6110	1614 Mail Service Center, Raleigh, NC 27699-1614

NCDA&CS Regional Agronomists:

The NC Department of Agriculture & Consumer Services (NCDA&CS) technical specialists: certify waste management plans for animal operations; provide certification training for swine waste applicators; track, monitor, and account for use of nutrients on agricultural lands; operate the state *Pesticide Disposal Program*, and enforce the state pesticide handling and application laws with farmers. www.ncagr.com/

Central Office	J. Kent Messick	919-733-2655	4300 Reedy Creek Road, Raleigh NC 27607
Region 1	Wayne Nixon	252-426-7210	Rout 2, Box 161-E, Hertford, NC 27944
Region 6	Charles Mitchell	919-562-7700	PO Box 202, Macon, NC 27551
NRCS Resource Conservation & Development (RC&D):			
Albemarle	Mark Powell (Project Coordinator)	252-482-7437	730 N. Granville Street, Suite B Edenton, NC 27932-1735
Education			
NC Cooperative Extension Service: Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities. www.ces.ncsu.edu			
Bertie County		(252) 794-5317	106 Dundee St, Windsor, NC 27983
Chowan County		(252) 482-6585	730 North Granville Street, Suite A, Edenton, NC 27932-1434
Gates County		(252) 357-1400	112 Court Street, Gatesville, NC 27938
Hertford County		(252) 358-7822	301 W Tryon St, P.O. Box 188, Winton, NC 27986
Northampton County		(252) 534-2831	9495 NC 305 Hwy, Jackson, NC 27845
Forestry			
DENR Division of Forest Resources: Develop, protect, and manage the multiple resources of North Carolina's forests through professional stewardship, enhancing the quality of our citizens while ensuring the continuity of these vital resources. www.dfr.state.nc.us			
Elizabeth City District Office (DFR District 7)	Water Quality Forester (Bertie County Office)	(252) 794-3725	113 Wakelon Road, Windsor, NC 27983
Rocky Mount District Office (District 5)	Water Quality Forester	(252) 442-1626	737 Smokey Road Rocky Mount, NC 27804
Griffiths Forestry Center (Statewide)	Water Quality & Wetlands Staff Forester	(919) 553-6178 ext. 230	2411 Old US Hwy 70-West Clayton, NC 27520
Central Office (Statewide)	Forest Hydrologist	(919) 733-2162 ext. 206	1616 Mail Service Center Raleigh, NC 27699-1616
Construction/Mining			
DENR Division of Land Resources: Administers the NC Erosion and Sedimentation Control Program and the Mining Program. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources. www.dlr.enr.state.nc.us			
Central Office (Mining)	Floyd Williams	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Central Office (Sediment)	Gray Hauser	919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Washington Region	Pat McClain	252-946-6481	943 Washington Square, Washington, NC 27889
Local Erosion and Sedimentation Control Ordinances: Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances. For a listing of the most recently approved local programs visit www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html There are no Local Ordinances for the Chowan River Basin.			

General Water Quality			
DENR DWQ Planning Section: Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Neuse and Tar-Pamlico River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; conduct stormwater permitting; model water quality; conduct water quality monitoring; perform wetlands permitting; conduct animal operation permitting and enforcement; and conduct water quality classifications and standards activities. http://h2o.enr.state.nc.us/pb/index.html			
Planning Section Chief	Alan Clark	919-733-5083 x 570	1617 Mail Service Center, Raleigh NC 27699
NPS Planning	Rich Gannon	919-733-5083 x 356	1617 Mail Service Center, Raleigh NC 27699
Modeling/TMDL	Kathy Stecker	919-733-5083 x 505	1617 Mail Service Center, Raleigh NC 27699
Classifications and Standards	Jeff Manning	919-733-5083 x 579	1617 Mail Service Center, Raleigh NC 27699
Basinwide Planning		919-733-5083 x 354	1617 Mail Service Center, Raleigh NC 27699
Groundwater Planning		919-733-5083 x 522	1617 Mail Service Center, Raleigh NC 27699
DWQ Regional Offices: Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring. http://www.enr.state.nc.us/html/regionaloffices.html			
Washington Region	Al Hodge	252-946-6481	943 Washington Square, Washington, NC 27889
NC Wildlife Resources Commission: To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state, and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner. www.ncwildlife.org			
Central Office	Wildlife Management	919-707-0050	1722 Mail Service Center, Raleigh NC 27699
U.S. Army Corps of Engineers: Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits. www.usace.army.mil			
Wilmington Field Office		910-251-4501	69 Darlington Ave., Wilmington, NC 28402-1890
Solid Waste			
DENR Division of Waste Management: Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund, and the Resident Inspectors Program. http://wastenot.enr.state.nc.us			
Central Office	Brad Atkinson	919-508-8409	401 Oberlin Road, Suite 150, Raleigh NC 27605
Washington	Bob Uebler	252-946-6481	943 Washington Square, Washington, NC 27889

On-Site Wastewater Treatment			
Division of Environmental Health and County Health Departments: Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust. Services include: training of and delegation of authority to local environmental health specialists concerning on-site wastewater; engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface; and technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems. www.deh.enr.state.nc.us			
Central Office	Andy Adams	919-715-3274	2728 Capital Boulevard, Raleigh NC 27604
Washington *		252-946-6481	943 Washington Square, Washington, NC 27889
Bertie County	Jerry Parks	252-338-4490	PO Box 189, Elizabeth City, NC 27907
Chowan County	Jerry Parks	252-482-6023	PO Box 189, Elizabeth City, NC 27907
Gates County	Jerry Parks	252-357-1380	PO Box 189, Elizabeth City, NC 27907
Hertford County	Curtis Dickson	252-358-7833	801 N. King Street, Winton, NC 27986
Northampton	Sue Gay	252-534-5841	PO Box 635, Jackson, NC 27845

*** DENR Washington Regional Office covers the following counties:** Beaufort, Bertie, Camden, Chowan, Craven, Currituck, Dare, Gates, Greene, Hertford, Hyde, Jones, Lenoir, Martin, Pamlico, Pasquotank, Perquimans, Pitt, Tyrrell, Washington and Wayne

Appendix V

Glossary
of
Terms and Acronyms

Glossary

§	Section.
30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
balds	Balds are high elevation areas where soils can support a diverse tree population; however, there are no trees present. Grassy balds are dominated by herbaceous plant species. Heath balds are dominated by dense shrub communities. Definition provided by the NC Natural Heritage Program (www.ncnhp.org).
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
CAMA	Coastal Area Management Act
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).

conductivity	A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution.
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
DENR	Department of Environment and Natural Resources.
DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
EEP	Ecosystem Enhancement Program
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.

hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.
impervious	Incapable of being penetrated by water; non-porous.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.

pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.
PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.
riparian zone	Vegetated corridor immediately adjacent to a stream or river. See also SMZ.
river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
sedimentation	The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms).
seeps	Seeps are areas that remain wet due to groundwater seepage. The plant community generally consists of a dense bed of wetland herbs.
silviculture	Care and cultivation of forest trees; forestry.
SOC	Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOCs are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance).
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of “blackwater” streams.
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards.

TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
trophic classification	Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic".
TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant.