# CHOWAN RIVER BASINWIDE WATER QUALITY MANAGEMENT PLAN

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**This document was approved and endorsed by the NC Environmental Management Commission on September 11, 1997 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.**

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All photographs were taken by the NC Wildlife Resources Commission
Top left: Fishing for Shad
Bottom left: Soundview
Right: Boating on the Chowan River

# FOREWORD

The Chowan River was the first waterbody in North Carolina to be designated as Nutrient Sensitive Waters (NSW). This classification was applied to the basin in 1979 because of the occurrence of nuisance algal blooms. A management strategy to control the input of nutrients to the river from both wastewater treatment plant discharges and agricultural runoff was applied. Water quality data indicate that the combined effects of actions taken by farmers and dischargers have led to significant improvements. These improvements are evident in the decrease in the frequency of algae blooms and a decrease in the duration of blooms that do occur. An evaluation of the progress of the implementation of the NSW strategy conducted in 1990 revealed that the goal of a 20% reduction in nitrogen loads had been achieved and that there had been a 29% reduction in phosphorus loads (goal of 35%). Continued efforts to reduce nutrients in the basin should produce further improvements in water quality.

Improvements have also been seen in reducing dioxin levels in the tissue of fish in the river. While a fish consumption advisory is still in place for some fish species, the source of the dioxin has been eliminated and continued improvement could lead to the eventual lifting of this advisory.

Despite progress, however, protection of surface waters in the Chowan River Basin continues to be a major challenge. The majority of the basin is contained within the state of Virginia and waters flow from there into North Carolina. It will be important for North Carolina to promote interstate cooperation to control nutrients, as well as to continue to work on reducing loads in the lower basin contained in North Carolina.

The Chowan is a scenic, freshwater coastal river that flows freely through a landscape of wooded swamps and expansive agricultural lands. Of the 788 miles of freshwater streams and rivers in the Chowan basin, use support ratings were determined for 64% or 507 miles of water. Twenty-two percent of these waters are considered impaired (partially supporting their uses). None were determined to be not supporting their uses. Agricultural activities, including animal operations, are thought to be the primary source of impairment throughout much of the basin with nutrients from Virginia being a likely contributor to impairment in the Chowan River mainstem.

Preserving and enhancing the quality of water in the basin is beyond the capabilities of any one agency or group. State and federal government regulatory programs will play an important part, but much of the responsibility will be at the local level. Those who live, work and recreate in the basin have the most at stake.

This document provides a summary of the causes and sources of water pollution in the basin, the status of the basin's water quality, a summary of water quality rules and statutes that apply to water quality protection in the basin, and recommended measures to protect and enhance the quality of the surface waters and aquatic resources in the Chowan River Basin. The Chowan Basinwide Water Quality Management Plan will be used as a guide by the NC Division of Water Quality in carrying out its water quality program responsibilities in the basin. Beyond that, it is hoped that the plan will provide a framework for cooperative efforts between the various stakeholders in the basin toward a common goal of protecting the basin's water resources while accommodating reasonable economic growth.

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# EXECUTIVE SUMMARY

## NORTH CAROLINA'S BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT - PURPOSE OF CHOWAN RIVER BASIN PLAN

Basinwide management is a watershed-based approach to water quality protection. The plan is being prepared by the North Carolina Division of Water Quality (DWQ), however implementation of the plan and protection of water quality involved the efforts of all stakeholders in the basin. The *Chowan Basinwide Water Quality Management Plan* (Chowan Plan) is the fourteenth in a series of basinwide water quality management plans that will be prepared by DWQ for all seventeen of the state's major river basins by the year 1998. The plan will be used as a guide by DWQ in carrying out its water quality program duties and responsibilities in the Chowan River Basin.

A basinwide management plan report is prepared for each basin in order to communicate to policy makers, the regulated community and the general public the state's rationale, approaches and recommended long-term water quality management strategies for each basin. The draft plans are circulated for public review and comment and are presented at public meetings in each basin. The plan for a given basin is completed and approved prior to the scheduled date for basinwide discharge permit renewals in that basin. The plans are then to be evaluated, based on follow-up water quality monitoring, and updated at five-year intervals.

The Chowan Plan is due for completion in September of 1997 and will be updated in the year 2002. Basinwide NPDES permitting is scheduled to commence in January of 1998.

## BASINWIDE GOALS

The primary goals of DWQ's basinwide program are to 1) identify and restore full use to impaired waters, 2) identify and protect highly valued resource waters, and 3) manage problem pollutants throughout the basin to protect water quality standards while accommodating reasonable economic growth. In addition, DWQ is applying this approach to each of the major river basins in the state as a means of better identifying water quality problems; developing appropriate management strategies; maintaining and protecting water quality and aquatic habitat; assuring equitable distribution of waste assimilative capacity for dischargers; and improving public awareness and involvement in management of the state's surface waters.

## PUBLIC WORKSHOPS

A public workshop was conducted in the Chowan River basin on the morning of July 25, 1996. Attendance at the workshop was strong, exceeding 60 people. The purpose of the workshop was to familiarize stakeholders in the basin with DWQ's basinwide approach and to solicit their input about what they see as the major water quality issues in the basin. The workshops were co-sponsored by the North Carolina Cooperative Extension Service (CES), the North Carolina League of Municipalities and DWQ. A summary of the comments received at these workshops is provided in Chapter 6 of the plan. DWQ examined the comments received at the workshop and grouped them into eight broad categories: monitoring and data-related issues; cooperation and coordination between States, state agencies, and local governments; nonpoint source pollution; point source issues; resource concerns; regulatory issues; education; and site-specific concerns. Some of the specific comments that were presented by more than one of the breakout groups include:

- Need for better monitoring coverage;
- Need for better communication and cooperation between North Carolina and Virginia;
- Need for increased public education and involvement of local stakeholders; and
- Nonpoint source pollution concerns.

These issues are presented in more detail in Chapter 6 of the plan.

## CHOWAN BASIN OVERVIEW

The Chowan River basin is located in the northeastern coastal plain of North Carolina and southeastern Virginia. The North Carolina portion includes all or parts of Northampton, Hertford, Gates, Bertie and Chowan Counties. The Chowan River is formed at the border of Virginia and North Carolina by the confluence of the Nottoway and Blackwater Rivers. The Chowan basin includes 1,315 square miles in North Carolina, but the largest part of the drainage basin (3,575 square miles-approximately 76% ) lies in Virginia (Figure 1). Major tributaries to the Chowan River include the Meherrin River and its largest tributary, Potecasi Creek, as well as the Wiccacon River and its largest tributary, Ahoskie Creek. The Meherrin River flows into North Carolina from Greensville County, Virginia.

Based on data from the US Department of Agriculture, Natural Resources Conservation Service (NRCS), land cover in the basin is dominated by forest and agriculture which together make up 87% of the total area. In looking at land cover changes between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 59% increase. During that same time period, there were reductions seen in the amount of forested land (-1%) and cultivated cropland (-2%), and pastureland (-23%), and there was a slight increase in the amount of uncultivated cropland. The increase in swine numbers from 1990 to 1994 has been dramatic in the subbasins encompassing the upper portion of the Chowan River in North Carolina (327% increase) and the Meherrin River and tributaries (446% increase).

Population in the North Carolina portion of the basin declined by 1% from 1970 - 1990. Murfreesboro, Ahoskie, and Edenton are the largest urban areas in the basin. Population growth in the basin is low to moderate, with most growth occurring around the larger municipalities and in the vicinity of the lower Chowan River. Rural areas are seeing declines in population. Based on projections from 1990 into the year 2020, Chowan County is expected to see a 17% increase and Gates County may see a 19% increase. Other areas within the basin are expected to see decreases in numbers of residents.

Important natural resources in the basin include wetlands, anadromous fish spawning areas and Merchant's Millpond State Park. River herring (alewife and blueback herring) and shad (Hickory shad and American shad) migrate into the river from the ocean to reproduce. There are seven aquatic species that are listed by North Carolina as either Threatened, Special Concern, or Significantly Rare. No species in this basin have been listed as Endangered.

Most of the water used in the basin comes from ground water sources. Projected use estimates indicate that there will be modest increases in water use over the next couple of decades.

The Chowan River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States. In 1987 this estuarine system became part of the Environmental Protection Agency's National Estuary Program and was the subject of a major study known as the Albemarle-Pamlico Estuarine Study (APES). The results of research conducted as part of APES culminated in the Comprehensive Conservation and Management Plan (CCMP) which is currently being implemented, and is discussed further in Chapters 5 and 6. Basinwide management is part of this implementation.

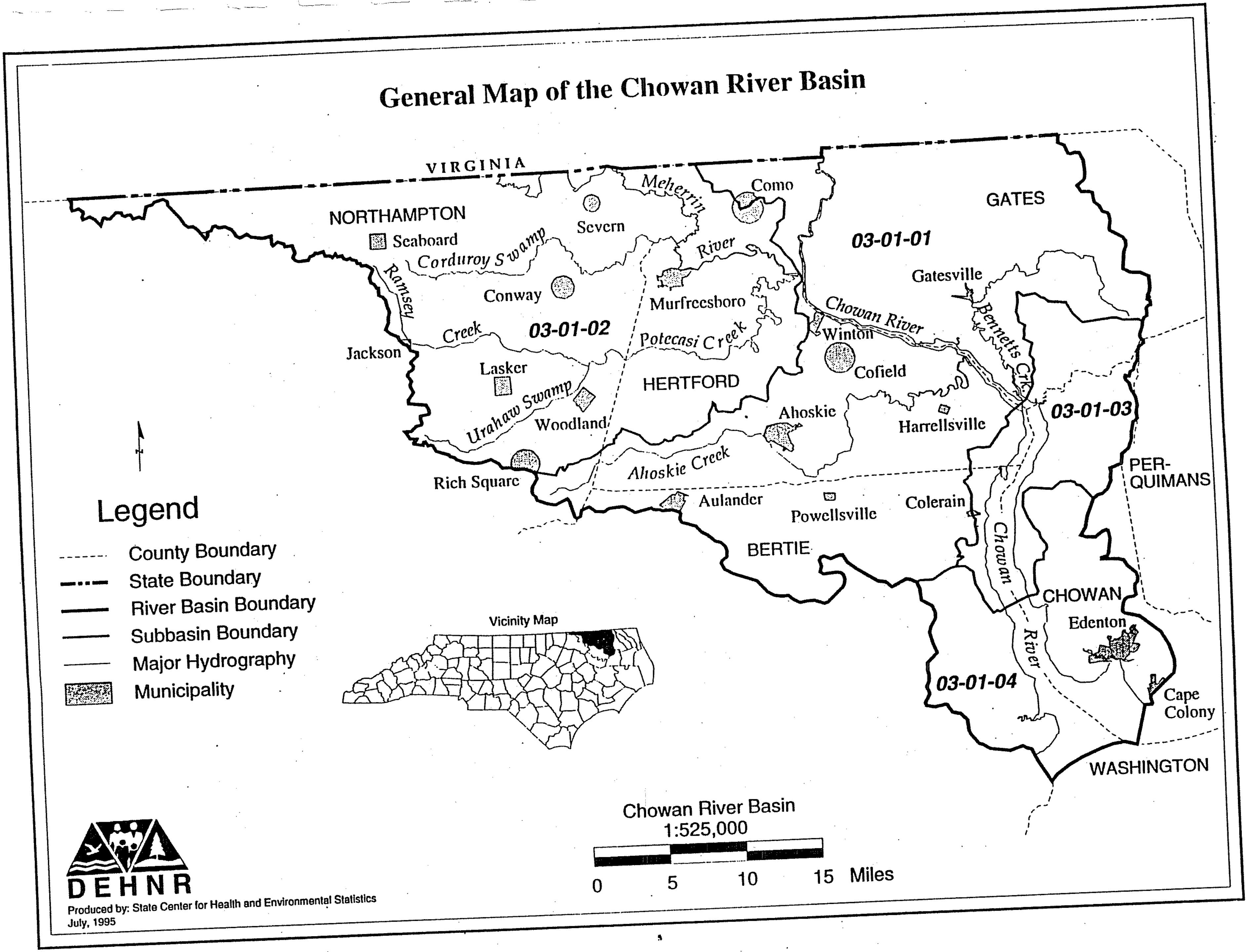


**Figure 1.** General Map of the Chowan River Basin

## ASSESSMENT OF WATER QUALITY IN THE CHOWAN RIVER BASIN

An assessment of water quality data collected by DWQ and others reveals that the Chowan River Basin has seen improvements in water quality over the years since the application of the Nutrient Sensitive Waters management strategy. There are areas however that are impaired and in need of attention. Below is a summary of some key monitoring data that reflect water quality in the basin. A more detailed presentation of this information can be found in Chapter 4.

### Summary of Biological Indicators

Benthic Macroinvertebrates - In freshwaters, benthic macroinvertebrates (or benthos) are primarily bottom-dwelling aquatic insect larvae such as species of stoneflies, mayflies and caddisflies. Measurements of the number, types and diversity of these organisms at strategic sampling sites is an important means of assessing water quality. Benthic macroinvertebrate sampling has been conducted at ten sites throughout the Chowan basin with results ranging from poor to excellent. In some cases, the swampy nature of the sampling site prevented the assignment of a rating (an index for swampy systems is currently under development). Based on benthic macroinvertebrate data from 1995, bioclassifications were Fair for the Wiccacon River and Ahoskie Creek and Good-Fair for the Chowan River at Riddicksville. General water quality in the Meherrin River is Good and Fair for Potecasi Creek.

Fish Community Evaluations - Fish community structure (IBI) analyses were performed on data from 2 sites in the Chowan River Basin collected by DWQ. One site received a rating of Fair. The other site, although sampled, did not receive a rating because of its swampy nature.

Fish Tissue Analyses - Fish tissue samples were collected at 10 sites from 1983 to 1995 within the Chowan River Basin consisting of 226 observations. Samples were collected as part of the DWQ's ambient fish tissue monitoring program or as part of special mercury studies.

The Chowan River from the Virginia border to Albemarle Sound remains under a fish consumption advisory due to dioxin contamination. The Union Camp Fine Paper mill in Franklin, Virginia is believed to have contributed to the dioxin contamination of fish in the Chowan River. This advisory has been in place since August of 1990 and currently recommends that the general population consume no more than two meals of any fish except herring, shellfish and shad (including roe) in one month and that children and child-bearing women consume no fish until further notice. Yearly monitoring by Union Camp in North Carolina indicates that dioxin levels are gradually decreasing in fish from the Chowan and Meherrin Rivers since new bleaching technologies were instituted by the company to improve effluent quality and eliminate the formation of dioxin.

Lakes Studies - Merchants Millpond is the only lake which has been monitored in the Chowan River Basin as part of the Lakes Assessment Program. Merchants Millpond was sampled most recently in 1995. Results indicate that the lake is eutrophic. The proliferation of aquatic weeds, which cover the lake's surface, is not uncommon in millponds. However, the growth of these plants is threatening some of the lake's recreational uses (such as canoeing) which is of concern since this is a popular state park. The lake has received a use support rating of Support-Threatened. Problems stem from an overabundance of nutrients draining to the pond from the nearby watershed. The primary source appears to be agriculture.

## Use-Support Ratings

Another important method for assessing surface water quality is to determine whether the quality is sufficient to support the uses for which the waterbody has been classified by the state. All surface waters in the state have been assigned a classification. These classifications are discussed in Section 2.7 of Chapter 2. The word *uses* refers to activities such as swimming, fishing and water supply. DWQ has collected extensive chemical and biological water quality monitoring data throughout the basin, some of which is summarized above. All data for a particular stream segment have been assessed to determine the overall *use support* rating; that is, whether the waters are *fully supporting*, *partially supporting* or *not supporting* their uses. A fourth rating, *support-threatened,* applies where all uses are currently being supported but water quality conditions are marginal. Streams referred to as *impaired* are those rated as either partially supporting or not supporting their uses. Use support ratings in the Chowan River basin, described more fully in Chapter 4, are summarized below for freshwater streams and lakes.

Freshwater Streams and Rivers - Of the 788 miles of freshwater streams and rivers in the Chowan basin, use support ratings were determined for 64% or 507 miles of water. The relative breakdown of percentages for the use support categories is as follows:

SUPPORTING ........................ 42%
  Fully supporting (17%)
  Support-threatened (25% )
IMPAIRED ............................ 22%
  Partially supporting (22%)
  Not supporting (0%)
NOT EVALUATED: .................. 36%

These use support values are different from the values in the 1992-1993 305(b) Report. The total waters supporting their uses appear to have increased, while those that are impaired appear to have decreased. While the water quality may have improved since the 1992-1993 305(b) report, the changes in values are due to revisions in the methodology for assigning use support (this is discussed in section 4.6.5 of Chapter 4).

## MAJOR WATER QUALITY ISSUES AND RECOMMENDATIONS

Several water quality issues emerge as being of particular importance in light of factors such as the degree of water quality degradation, the value of the resources being impacted and the number of users potentially affected. Those issues considered most significant on a basinwide scale are presented below. Chapter 6 of the Chowan Plan provides recommendations for many other issues including managing inputs of fecal coliform bacteria, sediment and oxygen consuming wastes. Those presented here are of most concern to the Chowan basin.

### A. CONTROLLING NUTRIENTS

Nutrient enrichment in the Chowan River Basin continues to be a primary water quality concern. Since the application of the Nutrient Sensitive Waters (NSW) management strategy, reductions in nutrient loads have been achieved and algal blooms have been less frequent and last for shorter periods of time. Chapters 3 and 4 of this document present summaries of nutrient-related studies conducted over the years and an investigation into changes in chlorophyll *a* concentrations over time. As of 1990, installation of control measures for agricultural nonpoint sources through the Agricultural Cost Share Program had resulted in a six percent reduction in North Carolina's total phosphorus input (DEM, 1990). Also, many point source discharges in the basin have converted their facilities to land application operations, reducing nutrient loads to the surface waters. Overall, as of

1990, the nitrogen reduction goal of 20% had been accomplished and total phosphorus had been reduced by 29% (goal of 35%).

**Recommendation**
Although there have been gains in nutrient reductions and associated water quality benefits, continued implementation of the NSW strategy is recommended since the lower Chowan remains susceptible to algal blooms. The major components of the strategy include recommendations for point and nonpoint sources of pollution. To address point source discharges, municipal or industrial wastewater facilities are required to either land apply their waste (for municipal plants) or meet stringent discharge limits for nitrogen and phosphorus. Nonpoint sources have been addressed by targeting Agricultural Cost Share funds to the basin for the application of best management practices (BMPs). Since the inception of the cost share program in 1985, $391,254 have been spent in the basin to control nonpoint source pollution.

## B. WORKING WITH THE NPS TEAM TO CONTROL NPS POLLUTION

Pollution from nonpoint sources is identified as the major contributor to water quality impairment in the Chowan River Basin. It will be important during this basinwide planning cycle to actively work with the NPS team to better identify nonpoint source pollution contributions and to improve conditions where feasible. It is recognized that in some cases the information that DWQ has on the probable contributions from land uses such as agriculture is dated and sketchy. Accomplishments in managing runoff from agriculture and animal operations that have occurred during the last five years or so (such as Conservation Management Plans in compliance with the Farm Bill, or improved management of waste from animal operations in compliance with new regulations) are not reflected in this information. It is important for the progress that has been made in BMP implementation to be identified and acknowledged. Team members can assist in consolidating this information. However, agriculture and animal operations remain prominent in the landscape of the river basin and it will be important to work toward further gains in this area in order to protect water quality.

**Recommendation**
Addressing nonpoint source pollution is best accomplished by a knowledgeable team of local professionals and stakeholders - the NPS team. Therefore, the primary recommendation for impaired waters in the Chowan basin is to work with this team to prioritize areas for restoration and target available resources toward them. The NPS team is further discussed in section 6.2.3 and in Chapter 7.

## FUTURE INITIATIVES IN THE CHOWAN RIVER BASIN

FURTHER EVALUATION OF SWAMP SYSTEMS
Many of the waterbodies in the eastern third of the State are classified as swamp waters. It is difficult to evaluate monitoring data in these systems to determine if a waterbody is impaired. For example, a swamp may have low dissolved oxygen concentrations, but these may be due to natural conditions rather than from impacts from point and nonpoint sources. DWQ will continue its efforts to evaluate these systems using chemical and biological data and to recommend reclassification of these waters to swamp as appropriate.

USE RESTORATION WATERS

The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program will allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program will include a mix of voluntary and mandatory programs. The voluntary and mandatory programs will be coordinated on a watershed-specific basis by DWQ and a group of stakeholders who have an interest in the impaired water body and associated watershed. In addition, the URW program will attempt to develop cooperative relationships among these agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

WETLANDS RESTORATION

The NC General Assembly approved the establishment of a wetland restoration program in this state. North Carolina will begin a concentrated effort to inventory and digitally map wetlands throughout the state. As the program progresses, it is envisioned that a restoration plan will be developed for each river basin and incorporated into the basinwide planning process. Through this, the water quality protection function of wetlands can be used more effectively in areas prioritized during basinwide planning.

NONPOINT SOURCE TEAMS

DWQ has begun setting up nonpoint source teams in each of the state's 17 major river basins. One has been set up for the Chowan Basin and will be reconvened in the near future. These teams will have representatives from agriculture, urban stormwater, construction, mining, on-site wastewater disposal, forestry, solid waste, wetlands, groundwater, local governments and other interested organizations. These teams will provide descriptions of NPS activities within a basin, conduct assessments of NPS controls in targeted watersheds, identify future monitoring sites, develop five-year action plans for priority NPS issues and NPS watersheds, and develop Section 319 project proposals for priority watersheds.

REGIONAL COUNCILS

The Comprehensive Conservation and Management Plan (CCMP) for the Albemarle/Pamlico (A/P) Sounds region recommended that regional councils be formed in each of the A/P region's five river basins. An Executive Order was signed by Governor Hunt in April 1995 calling for the establishment of the five regional councils. The Neuse Basin Regional Council was the first formed (November 1995). The other four, including one for the Chowan, are currently being established.

Each council will include local government representation (one municipal and one county rep from each county in the basin) as well as representation from non-governmental stakeholder groups in each basin. The groups would have the potential to help target and address the water quality and resources issues of greatest concern to stakeholders in the basin and to forge the link between the APES program, the CCMP and basinwide planning.

IMPROVED MONITORING AND INTERAGENCY COORDINATION

DWQ has been discussing with other environmental agencies the potential for coordination of field resources. If individuals from another environmental agency are visiting certain streams or rivers or lakes to investigate fish populations or wetland areas, they could also collect water quality data from that area.

GENERAL NPDES PROGRAM INITIATIVES
In the next five years, efforts will be continued to:

- improve compliance with permitted limits;
- improve pretreatment of industrial wastes to municipal wastewater treatment plants so as to reduce the toxicity in effluent wastes;
- encourage pollution prevention at industrial facilities in order to reduce the need for pollution control;
- require dechlorination of chlorinated effluents or use of alternative disinfectants;
- require multiple treatment trains at wastewater facilities; and
- require plants to begin plans for expansion well before they reach capacity.

Longer-term objectives will include refining overall management strategies after obtaining feedback on current management efforts during the next round of water quality monitoring. Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling byproducts of the treatment process (including nonpotable reuse of treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

# CHAPTER 1

# INTRODUCTION

## 1.1 PURPOSE OF THIS DOCUMENT

The purpose of this Basinwide Water Quality Management Plan is to report to citizens, policy makers and the regulated community on:

- the current status of surface water quality in the basin,
- major water quality concerns and issues,
- projected trends in development and water quality,
- the long-range water quality goals for the basin, and
- recommended point and nonpoint source management options.

This Plan presents strategies for management of both point and nonpoint sources of pollution. The Division of Water Quality (previously Division of Environmental Managment) is preparing a basinwide water quality management plan for each of the state's 17 major river basins, as shown in Figure 1.1.

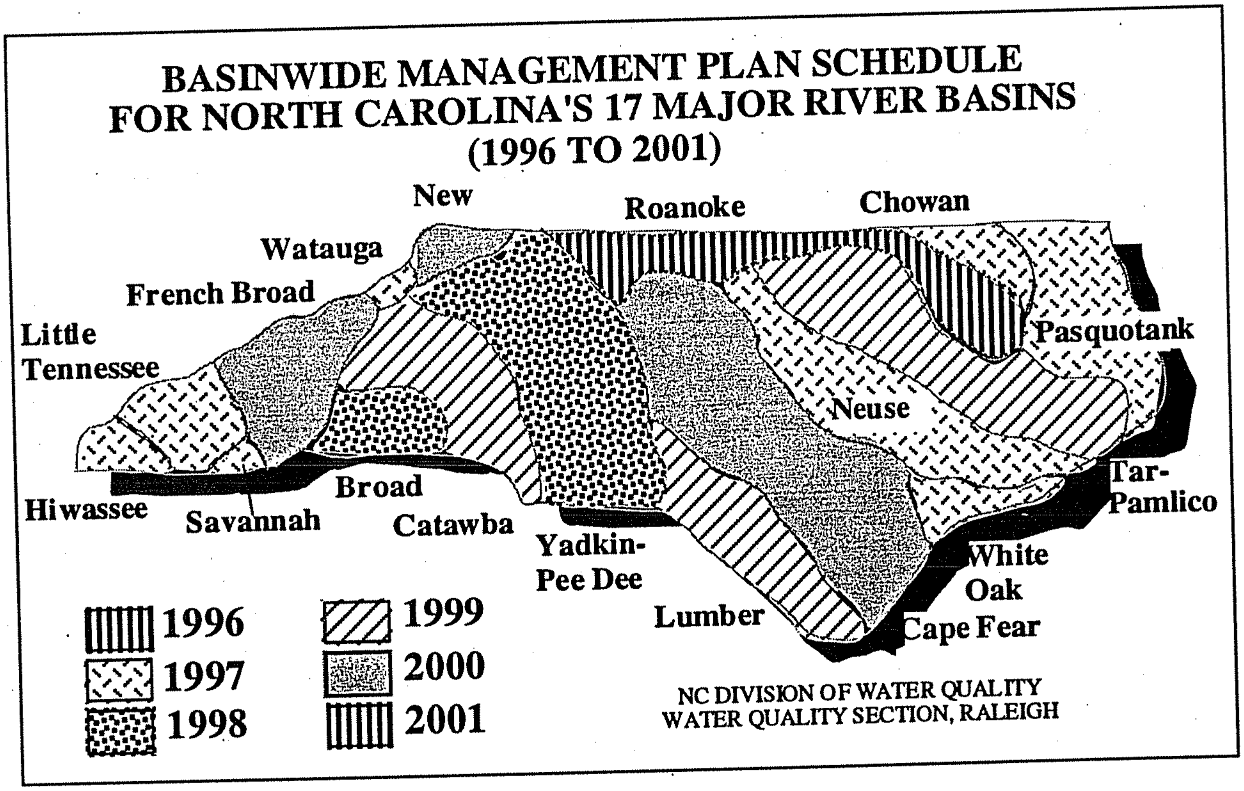


Figure 1.1 Basinwide Management Plan Schedule (1996 to 2001)

## 1.2 GUIDE TO USE OF THIS DOCUMENT

**CHAPTER 1: Introduction** - This chapter provides a non-technical description of the purpose of this plan, the basinwide water quality management approach and how this approach will be administered. The description of the basinwide management approach is based primarily on a 54-page framework document entitled *North Carolina's Basinwide Approach to Water Quality Management: Program Description - Final Report/August 1991* (Creager and Baker, 1991).

**CHAPTER 2: General Basin Description**- Some of the specific topics covered in this chapter include:

- an overview of the major features such as location, rainfall, population, physiography, etc.
- hydrology of the basin and its subbasins
- a summary of land cover within the basin based on results of a 1982 and 1992 Nationwide Resources Inventory (NRI) conducted by the US Department of Agriculture Natural Resources Conservation Service.
- population growth trends and densities by subbasin using 1970, '80 and '90 census data.
- major water uses in the basin and DWQ's program of water quality classifications and standards.

**CHAPTER 3: Causes and Sources of Water Pollution** - This chapter describes both point and nonpoint sources of pollution. It also describes a number of important causes of water quality impacts including sediment, biochemical oxygen demand (BOD), toxic substances, nutrients, color, fecal coliform bacteria and others. Pollutant loading in the basin and general water quality problem areas are discussed.

**CHAPTER 4: Water Quality and Use Support Ratings** - This chapter describes the various types of water quality monitoring conducted by DWQ, summarizes water quality in each of the subbasins in the basin and presents a summary of use support ratings for those surface waters that have been monitored or evaluated.

**CHAPTER 5: Existing Water Quality Programs and Program Initiatives in the Basin** - Chapter 5 summarizes the existing point and nonpoint source control programs available to address water quality problems. These programs are management tools available for addressing the priority water quality concerns and issues that are identified in Chapter 6. Chapter 5 also describes the concept of Total Maximum Daily Loads (TMDLs). TMDLs represent management strategies aimed at controlling point and nonpoint source pollutants. This chapter also describes various program initiatives being implemented in the basin to address water quality problems.

**CHAPTER 6: Major Water Quality Concerns and Recommended Management Strategies** - Water quality issues identified in Chapters 2, 3 and 4 are evaluated and prioritized based on use-support ratings, degree of impairment, and the sensitivity of the aquatic resources being affected. Recommended management strategies, or TMDLs, are presented that describe how the available water quality management tools and strategies described in Chapter 5 will be applied in the basin. This includes generalized wasteload allocations for dischargers and recommended programs and best management practices for controlling nonpoint sources.

**CHAPTER 7: Future Initiatives** - This chapter presents future initiatives for protecting or improving water quality in the basin. These may include both programatic initiatives such as improving permit compliance, or basin-specific initiatives such as developing strategies for restoring impaired waters.

## 1.3 NORTH CAROLINA'S BASINWIDE MANAGEMENT APPROACH

**Introduction** - Basinwide water quality management is a watershed-based management approach being implemented by DWQ which features basinwide permitting, integrating existing point and nonpoint source control programs, and preparing basinwide management plans. DWQ is applying this approach to each of the seventeen major river basins in the state as a means of better identifying water quality problems, developing appropriate management strategies, maintaining and protecting water quality and aquatic habitat, and assuring equitable distribution of waste assimilative capacity for dischargers.

After conducting public workshops to identify areas of concern and major issues, a basinwide management plan is prepared for each basin. The plans are circulated for public review and are presented at public meetings in each river basin. The management plan for a given basin is completed and approved preceding the scheduled date for basinwide discharge permit renewals in that basin. The plans are then evaluated, based on followup water quality monitoring, and updated at five year intervals.

DWQ began formulating the idea of basinwide management in the late 1980s, established a basin permitting schedule in 1990, began basinwide monitoring activities in 1990, and published a basinwide program description in August 1991. Basinwide management entails coordinating and integrating, by major river basin, DWQ's water quality program activities. These activities, which are discussed further in Section 1.4, include permitting, monitoring, modeling, nonpoint source assessments, and planning.

**Water Quality Program Benefits** - Several benefits of basinwide planning and management to North Carolina's Water quality program include:

- ***Improved program efficiency.*** By reducing the area of the state covered each year, monitoring, modeling, and permitting efforts can be focused. As a result, *efficiency increases* can be achieved for a given level of funding and resource allocation.
- ***Increased effectiveness.*** The basinwide approach is in consonance with basic ecological watershed management principles, leading to *more effective* water quality assessment and management. Linkages between aquatic and terrestrial systems are addressed (e.g., contributions from nonpoint sources). All inputs to aquatic systems and potential interactive, synergistic and cumulative effects are considered.
- **Better *consistency and equitability*.** By clearly defining the program's long-term goals and approaches, basinwide plans will encourage *consistent* decision-making on permits and water quality improvement strategies. Consistency and greater attention to long-range planning will promote a *more equitable* distribution of assimilative capacity, explicitly addressing the trade-offs among pollutant sources and allowances for economic growth.
- ***Increased public awareness of the state's water quality protection programs.*** The basinwide plans are an educational tool for increasing public awareness of water quality issues within the basin.
- **Basinwide management promotes *integration* of point and nonpoint source pollution assessment and controls.** Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to prevent overloading of the receiving waters and to allow for a reasonable margin of safety to ensure compliance with water quality standards.

**Basinwide Planning Schedule** - The following table presents the overall basin schedule for all 17 major river basins in the state. Included are the dates for permit reissuance and the dates by which management plans are to be completed for each basin.

Table 1.1. Basinwide Permitting and Planning Schedule for North Carolina's 17 Major River Basins.

| Basin | Begin NPDES Permit Issuance | *Final Plan Receives EMC Approval | Public Mtgs. and Draft out For Review | EMC/WQC Approval For Public Meetings | Inhouse Draft due for Staff Review | DEM Biological Data Collection |
|---|---|---|---|---|---|---|
| **Neuse** | 4/1993 | **2/1993** | 11/1992 | 9/1992 | 7/1992 | Summer 91 |
| **Lumber** | 11/1994 | **6/1994** | 2/1994 | 11/1993 | 7/1993 | Summer 91 |
| **Tar-Pamlico** | 1/1995 | **12/1994** | 9/1994 | 7/1994 | 5/1994 | Summer 92 |
| **Catawba** | 4/1995 | **2/1995** | 11/1994 | 9/1994 | 7/1994 | Summer 92 |
| **Fr. Broad** | 8/1995 | **5/1995** | 2/1995 | 12/1994 | 10/1994 | Summer 92 |
| **New** | 11/1995 | **7/1995** | 6/1995 | 4/1995 | 3/1994 | Summer 93 |
| **Cape Fear** | 1/1996 | **9/1995** | 6/1995 | 5/1995 | 4/1995 | Summer 93 |
| **Roanoke** | 1/1997 | **9/1996** | 4/1996 | 2/1996 | 9/1995 | Summer 94 |
| **White Oak** | 6/1997 | **2/1997** | 9/1996 | 7/1996 | 4/1996 | Summer 94 |
| **Savannah** | 8/1997 | **5/1997** | 2/1997 | 12/1996 | 6/1996 | Summer 94 |
| **Watauga** | 9/1997 | **4/1997** | 12/1997 | 10/1996 | 6/1996 | Summer 94 |
| **Little Tenn.** | 10/1997 | **5/1997** | 2/1997 | 12/1996 | 7/1996 | Summer 94 |
| **Hiwassee** | 12/1997 | **5/1997** | 2/1997 | 12/1996 | 7/1996 | Summer 94 |
| **Chowan** | 1/1998 | **9/1997** | 6/1997 | 3/1997 | 11/1996 | Summer 95 |
| **Pasquotank** | 2/1998 | **9/1997** | 6/1997 | 3/1997 | 11/1996 | Summer 95 |
| **Neuse** | 4/1998 | 12/1997 | 7/1997 | 5/1997 | 2/1997 | Summer 95 |
| **Yadkin** | 7/1998 | 2/1998 | 10/1997 | 5/1997 | 2/1997 | Summer 96 |
| **Broad** | 11/1998 | 5/1998 | 2/1998 | 12/1997 | 7/1997 | Summer 95 |
| **Lumber** | 11/1999 | 5/1999 | 2/1999 | 12/1998 | 8/1998 | Summer 96 |
| **Tar-Pamlico** | 1/2000 | 5/1999 | 2/1999 | 12/1998 | 5/1998 | Summer 97 |
| **Catawba** | 4/2000 | 10/1999 | 6/1999 | 4/1999 | 12/1998 | Summer 97 |
| **Fr. Broad** | 8/2000 | 2/2000 | 10/1999 | 7/1999 | 3/1999 | Summer 97 |
| **New** | 11/2000 | 5/2000 | 2/2000 | 12/1999 | 8/1999 | Summer 98 |
| **Cape Fear** | 1/2001 | 7/2000 | 2/2000 | 12/1999 | 8/1999 | Summer 98 |
| **Roanoke** | 1/2002 | 7/2001 | 2/2001 | 12/2000 | 8/2000 | Summer 99 |

* Dates in bold print denote plan approval by the EMC

The number of plans to be developed each year varies from one to six and is based on the total number of permits to be issued each year. For example, the Cape Fear basin, the state's largest, has about as many dischargers as all six of the small basins in 1997. This has been done in order to balance the permit processing workload from year to year. In years where more than one basin is scheduled to be evaluated, an effort has been made to group at least some of the basins geographically in order to minimize travel time and cost for field studies and public meetings.

**Plans to be updated every five years** - The earliest basin plans will likely not achieve all of the long-term objectives for basinwide management outlined above. However, plans are updated every 5 years. Updated plans will incorporate additional data and new assessment tools (e.g., basinwide water quality modeling) and management strategies (e.g., for reducing nonpoint source contributions) as they become available.

**Basinwide Plan Preparation, Review and Public Involvement** - Preparation of an individual basinwide management plan is a five year process which is broken down into four phases as described below.

| **Year** | **Activity** |
|---|---|
| Year 1 to 3 | Water Quality Data Collection/Identification of Goals and Issues: Year 1 entails identifying sampling needs and canvassing for information. It also entails coordinating with other agencies, the academic community and local interest groups to begin establishing goals and objectives and identifying and prioritizing problems and issues. Biomonitoring, fish community and tissue analyses, special studies and other water quality sampling activities are conducted in Years 2 and 3 by DWQ's Environmental Sciences Branch (ESB). These studies provide information for assessing water quality status and trends throughout the basin and provide data for computer modeling. |
| Year 3 to 4 | Data Assessment and Model Preparation: Modeling priorities are identified early in this phase and are refined through assessment of water quality data from the ESB. Data from special studies are then used by DWQ's Technical Support Branch (TSB) to prepare models for estimating potential impacts of waste loading from point and nonpoint sources using the TMDL approach. Preliminary water quality control strategies are developed based on modeling, with input from local governments, the regulated community and citizen groups during this period. |
| Year 4 | Preparation of Draft Basinwide Plan: The draft plan, which is prepared by DWQ's Planning Branch, is due for completion by the end of year 4. It is based on support documents prepared by DWQ's Environmental Sciences Branch (water quality data) and the Technical Support Branch (modeling data and recommended pollution control strategies). Preliminary findings are presented at informal meetings through the year with local governments and interested groups, and comments are incorporated into the draft. |
| Year 5 | Public Review and Approval of Plan: At the beginning of year 5, the draft plan, after approval of the Environmental Management Commission (EMC), is circulated for review and public meetings are held. Revisions are made to the document, based on public comments, and the final document is submitted to the EMC for approval midway through year 5. Basinwide permitting begins at the end of year 5. |

**Implementation** - The implementation of basinwide planning and management will occur in phases. Permitting activities and associated routine support activities (field sampling, modeling, wasteload allocation calculations, etc.) have already been rescheduled by major river basin. All National Pollutant Discharge Elimination System (NPDES) permit renewals within a basin occur within a prescribed time period after completion of the final basin plan, and will be repeated at five year intervals.

Nonpoint source management proposals will be implemented by several different avenues. The Water Quality Section is setting up nonpoint source (NPS) teams for each basin. These teams are made up of representatives of nonpoint source agencies, resource agencies, and special interest groups. The NPS teams are responsible for prioritizing specific watersheds for follow-up investigations, educational efforts, and best management practice (BMP) implementation. Funding for BMP implementation will be sought from sources such as existing cost-share monies or from federal Section 319 grants. In addition to projects in specific watersheds, the NPS team will develop programmatic action plans for each category of nonpoint source pollution. The action plans detail voluntary actions that agencies and groups have committed to complete to protect and improve water quality in the basin. Many of the action plan items involve increased educational efforts or enforcement of existing programs.

## 1.4 BASINWIDE RESPONSIBILITIES WITHIN THE DWQ WATER QUALITY SECTION

The Division of Water Quality is the lead state agency for the regulation and protection of the state's surface waters. The Division is comprised of four sections: Water Quality, Groundwater, Construction Grants and Loans, and the Water Quality Laboratory.

The primary responsibilities of the Division of Water Quality are to maintain or restore an aquatic environment to sufficient quality to protect the existing and best intended uses of North Carolina's surface waters and to ensure compliance with state and federal water quality standards. The Division receives both state and federal allocations as well as funding through permit fee collections. Policy guidance is provided by the Environmental Management Commission. The major areas of responsibility are water quality monitoring, permitting, planning, modeling (wasteload allocations) and compliance oversight.

The Central office is divided into five branches, each branch is subdivided into units (Figure 1.2). The Planning Branch is responsible for developing surface water quality standards and classifications, nonpoint source program planning, administering the basinwide management program, modeling nonpoint pollution sources, developing use support ratings and supporting related GIS capabilities. It also coordinates the development of TMDLs and wasteload allocations for dischargers, provides primary computer modeling support, and coordinates EPA water quality planning grants and the implementation of the Comprehensive Conservation and Management Plan (CCMP) that resulted from the Albemarle-Pamlico Estuarine Study (APES).

The Regional Program Management Coordination Branch is responsible for providing increased communication and coordination of the water quality program. The responsibilities include the water supply watershed protection program, State Environmental Policy Act coordination for the Section, the operator training and certification program, emergency response, the development and administration of the enterprise wide database management system, and coordination and program management activities between the central and seven regional offices. The Environmental Technologies Unit is responsible for providing better access to data managed by the Water Quality Section so as to facilitate information exchange and analysis with the public as well as internal users. The Technical Assistance and Certification Unit rates the complexity of operation of wastewater treatment plants, provides training and operator certification commensurate with the plant operating needs, and provides technical assistance as requested by wastewater treatment systems. The Local Government Assistance Unit assists local governments in meeting the requirements of the water supply watershed protection program, managing the collection system permitting program, coordinating water quality state environmental policy act responsibilities and managing the EPA 205(j) grants program. The Branch also has the responsibility of ensuring program coordination through the seven Regional Offices.

The Environmental Sciences Branch is responsible for all biological and chemical water quality monitoring, discharger coalition water quality monitoring, and evaluations including benthic macroinvertebrate monitoring (biomonitoring), fish tissue, and fish community studies. The Branch is also responsible for effluent toxicity testing and evaluations, biological laboratory certification, algal and aquatic macrophyte analyses, long term biochemical and sediment oxygen demand, and lakes assessments. The Branch interacts heavily in 305(b) use-support assessments and in water quality standards review and development. The Neuse River Rapid Response Team is coordinated through the Environmental Sciences Branch. The Branch is in the process of developing simplified public access to water quality information via the World Wide Web.

The Point Source Branch is responsible for permitting, compliance and enforcement of wastewater discharges into our state's surface waters. Permitting and enforcement programs include the municipal industrial pretreatment program, state and federal stormwater programs, and the National

Pollutant Discharge Elimination System (NPDES) program. Modeling is conducted to determine the receiving stream's ability to assimilate the discharge and protect the streams uses and surface water standards.

The Non-discharge Branch is responsible for permitting, compliance and enforcement of wastewater discharges that are **not** directly into our state's surface waters. Examples of these include spray irrigation systems, sludge applications, reuse systems and groundwater remediation projects. This branch also handles the section's activities related to wetlands including 401 certifications, wetland policy and mitigation, and DOT and dredging project reviews.

The seven Regional Offices carry out activities such as wetland reviews, compliance evaluations, permit reviews and facility inspections for both discharging and nondischarging systems, ambient water quality monitoring, state environmental policy act reviews, stream reclassification reviews, pretreatment program support and operator training and certification assistance. In addition, they respond to water quality emergencies such as oil spills and fish kills, investigate complaints and provide information to the public. Figure 1.3 shows the location of the regional offices and the counties that they serve.

## REFERENCES CITED: CHAPTER 1

Creager, C.S., and J. P. Baker, 1991, North Carolina's Basinwide Approach to Water Quality Management: Program Description, DWQ Water Quality Section, Raleigh, NC.

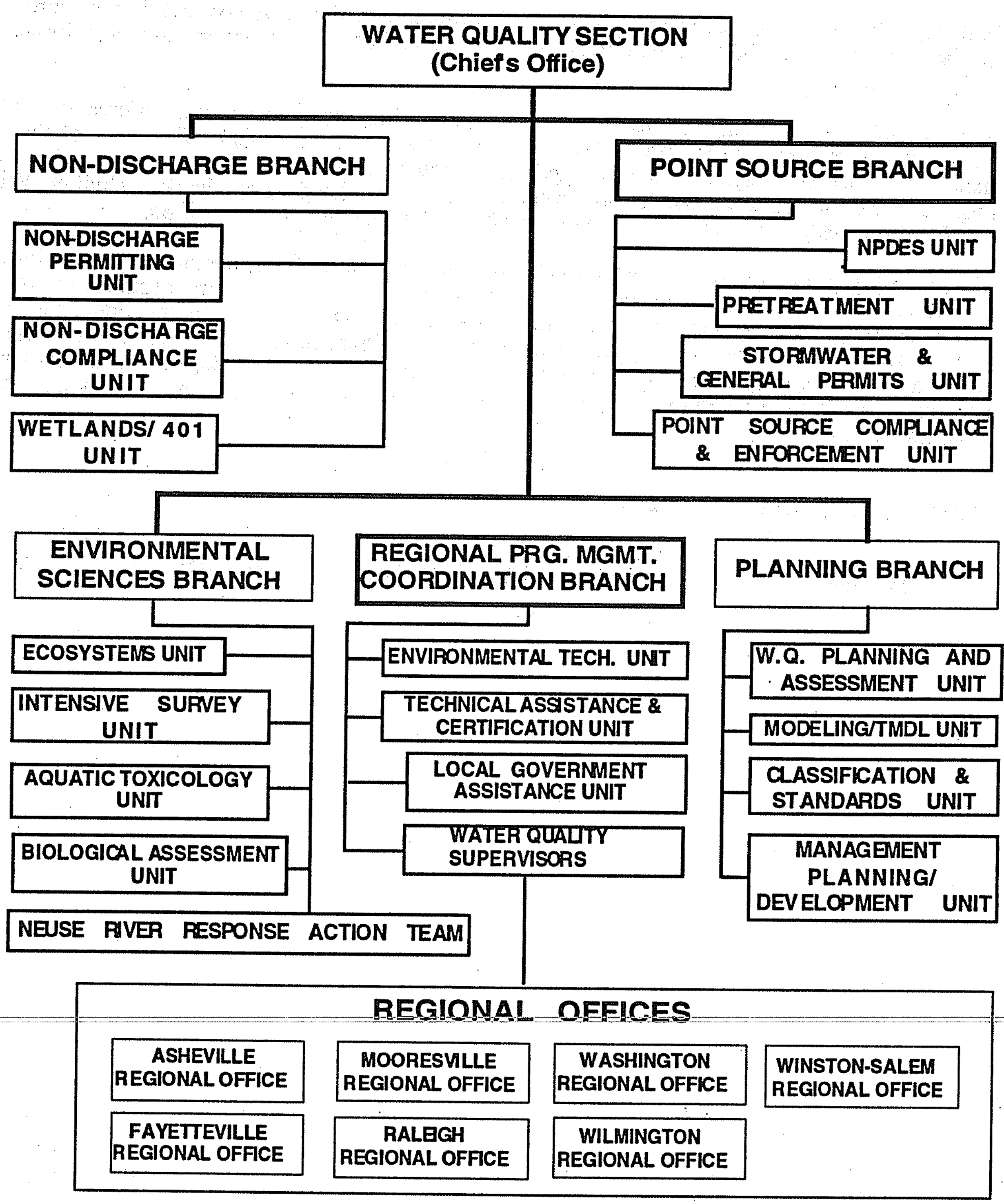


Figure 1.2 Organizational Structure of the DWQ Water Quality Section

# REGIONAL OFFICES

## N. C. Department of Environment, Health, and Natural Resources

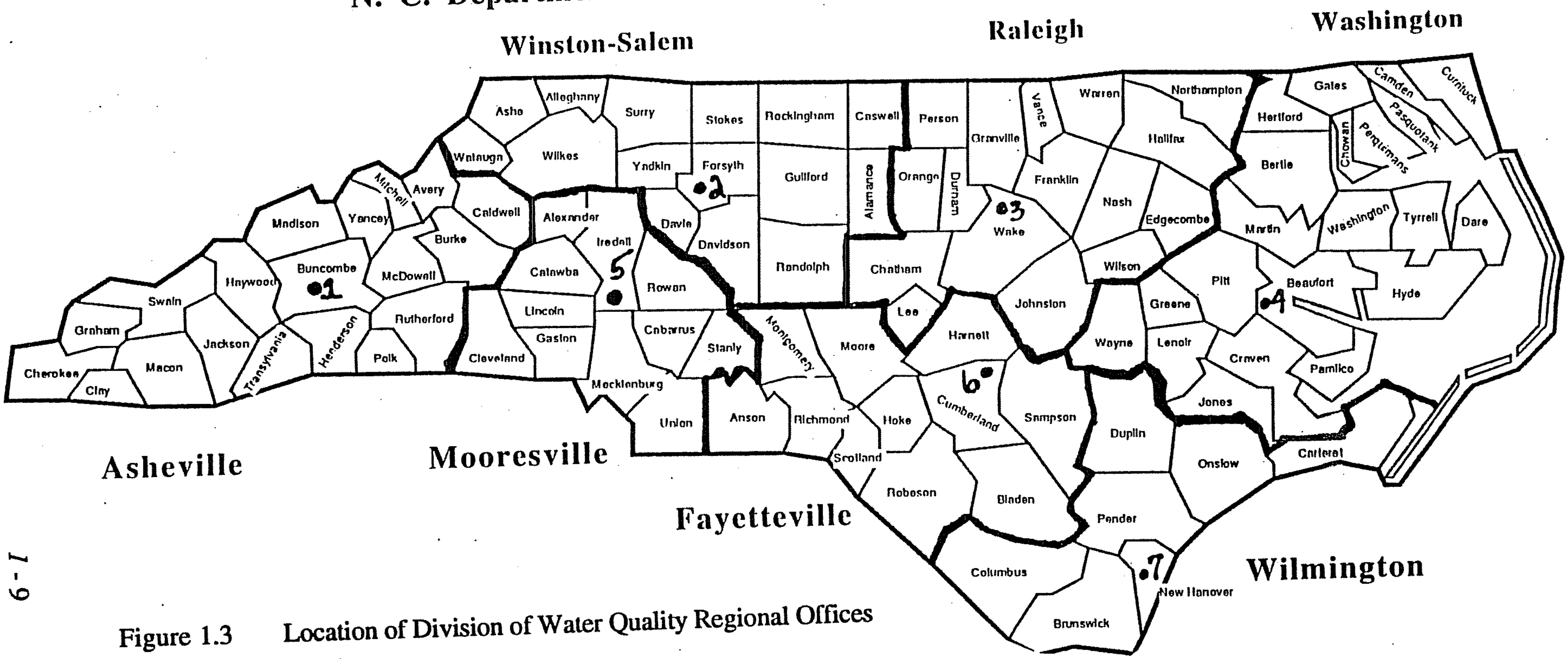


Figure 1.3 Location of Division of Water Quality Regional Offices

(1) **ARO**
Mr. Roy Davis
DWQ Regional Supervisor
59 Woodfin Place
Asheville, NC 28801
(704) 251-6208
FAX (704) 251-6098

(2) **WSRO**
Mr. Larry Coble
DWQ Regional Supervisor
585 Waughtown Street
Winston-Salem, NC 27107
(910) 771-4600
FAX (910) 771-4632

(3) **RRO**
Mr. Ken Schuster
DWQ Regional Supervisor
3800 Barrett Drive
Raleigh, NC 27609
(919) 571-4700
FAX (919) 571-4718

(4) **WaRO**
Mr. Jim Mulligan
DWQ Regional Supervisor
943 Washington Square Mall
Washington, NC 27889
(919) 946-6481
FAX (919) 975-3716

(5) **MRO**
Mr. Keith Overcash
DWQ Regional Supervisor
919 North Main Street
Mooresville, NC 28115
(704) 663-1699
FAX (704) 663-6040

(6) **FRO**
Mr. Tommy Stevens
DWQ Regional Supervisor
Wachovia Bldg, Suite 714
Fayetteville, NC 28301
(910) 486-1541
FAX (910) 486-0707

(7) **WiRO**
Mr. Rick Shiver
DWQ Regional Supervisor
127 Cardinal Drive Extension
Wilmington, NC 28405-3845
(910) 395-3900
FAX (910) 350-2004

# CHAPTER 2

# GENERAL BASIN DESCRIPTION

## 2.1 CHOWAN BASIN OVERVIEW

The Chowan River basin is located in the northeastern coastal plain of North Carolina and southeastern Virginia. The North Carolina portion includes all or parts of Northampton, Hertford, Gates, Bertie and Chowan Counties. 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. The Chowan basin includes 1,315 square miles in North Carolina, but the largest part of the drainage basin (3,575 square miles-approximately 76% ) lies in Virginia (Figure 2.1). Major tributaries to the Chowan River include the Meherrin River and its largest tributary, Potecasi Creek, as well as the Wiccacon River and its largest tributary, Ahoskie Creek. The Meherrin River flows into North Carolina from Greensville County, Virginia.

Based on data from the US Department of Agriculture, Natural Resources Conservation Service (NRCS), land cover in the basin is dominated by forest and agriculture which together make up 87% of the total area. In looking at land cover changes between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 59% increase. During that same time period, there were reductions seen in the amount of forested land (-1%) and cultivated cropland (-2%), and pastureland (-23%), and there was a slight increase in the amount of uncultivated cropland.

Population in the North Carolina portion of the basin declined by 1% from 1970 - 1990. Murfreesboro, Ahoskie, and Edenton are the largest urban areas in the basin. Population growth in the basin is low to moderate, with most growth occurring around the larger municipalities and in the vicinity of the lower Chowan River. Rural areas are seeing declines in population. Based on projections from 1990 into the year 2020, Chowan County is expected to see a 17% increase and Gates County may see a 19% increase. Other areas within the basin are expected to see decreases in numbers of residents.

Important natural resources in the basin include wetlands, anadromous fish spawning areas and Merchant's Millpond State Park. River herring and shad migrate into the river from the ocean to reproduce. There are seven species that are listed by North Carolina as either Threatened, Special Concern, or Significantly Rare. No species in this basin have been listed as Endangered.

Most of the water used in the basin comes from ground water sources. Projected use estimates indicate that there will be modest increases in water use over the next couple of decades.

The Chowan River basin is part of the Albemarle-Pamlico Estuarine system, the second largest estuarine system in the United States. In 1987 this estuarine system became part of the Environmental Protection Agency National Estuary Program and was the subject of a major study known as the Albemarle-Pamlico Estuarine Study (APES). The results of research conducted as part of APES culminated in the Comprehensive Conservation and Management Plan (CCMP) which is currently being implemented, and is discussed further in Chapters 5 and 6. Basinwide management is part of this implementation.

CHOWAN RIVER BASIN

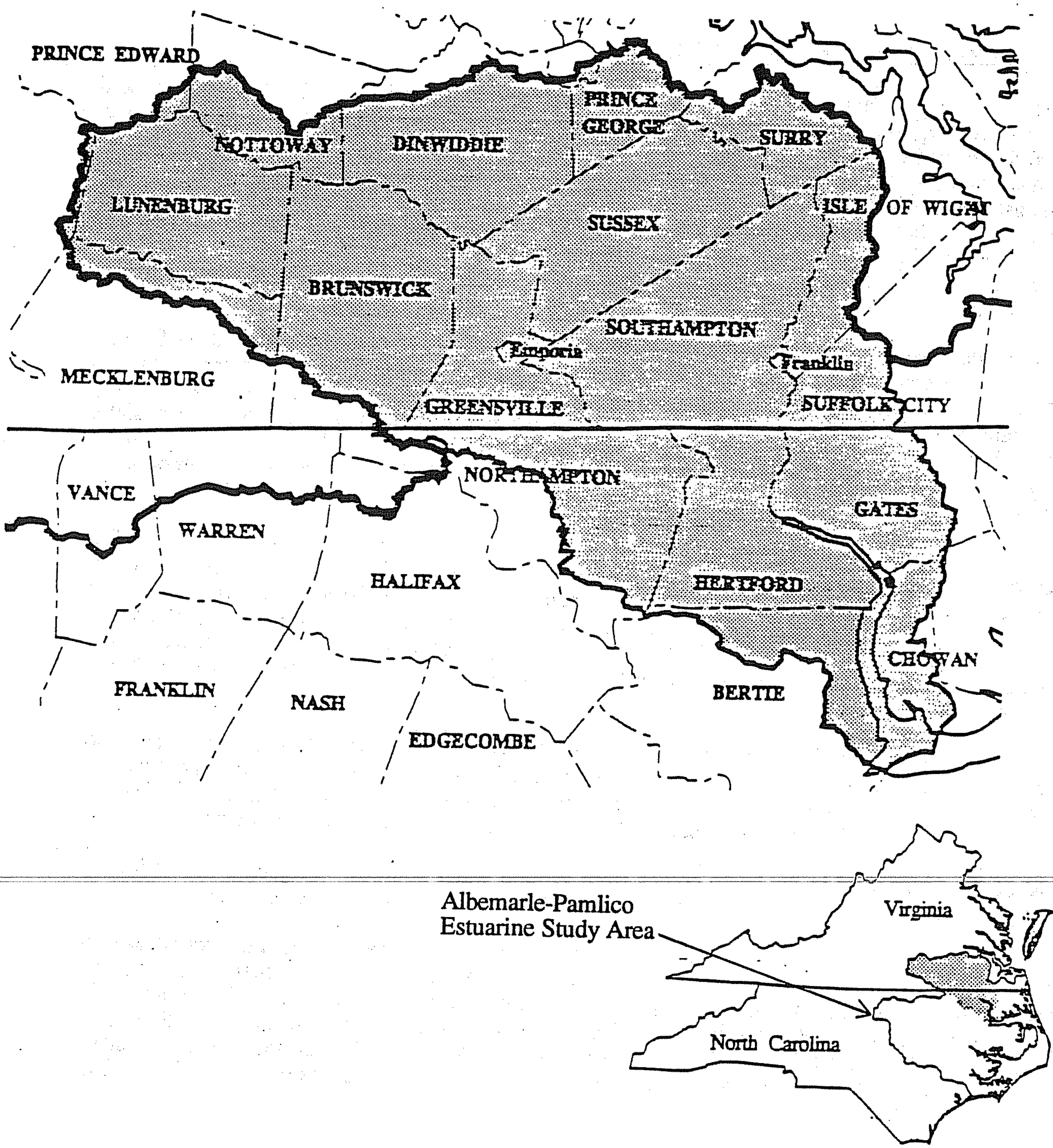


Figure 2.1. Map Showing Chowan River Basin Boundary in North Carolina and Virginia (Source: APES Comprehensive Conservation and Management Plan, 1994)

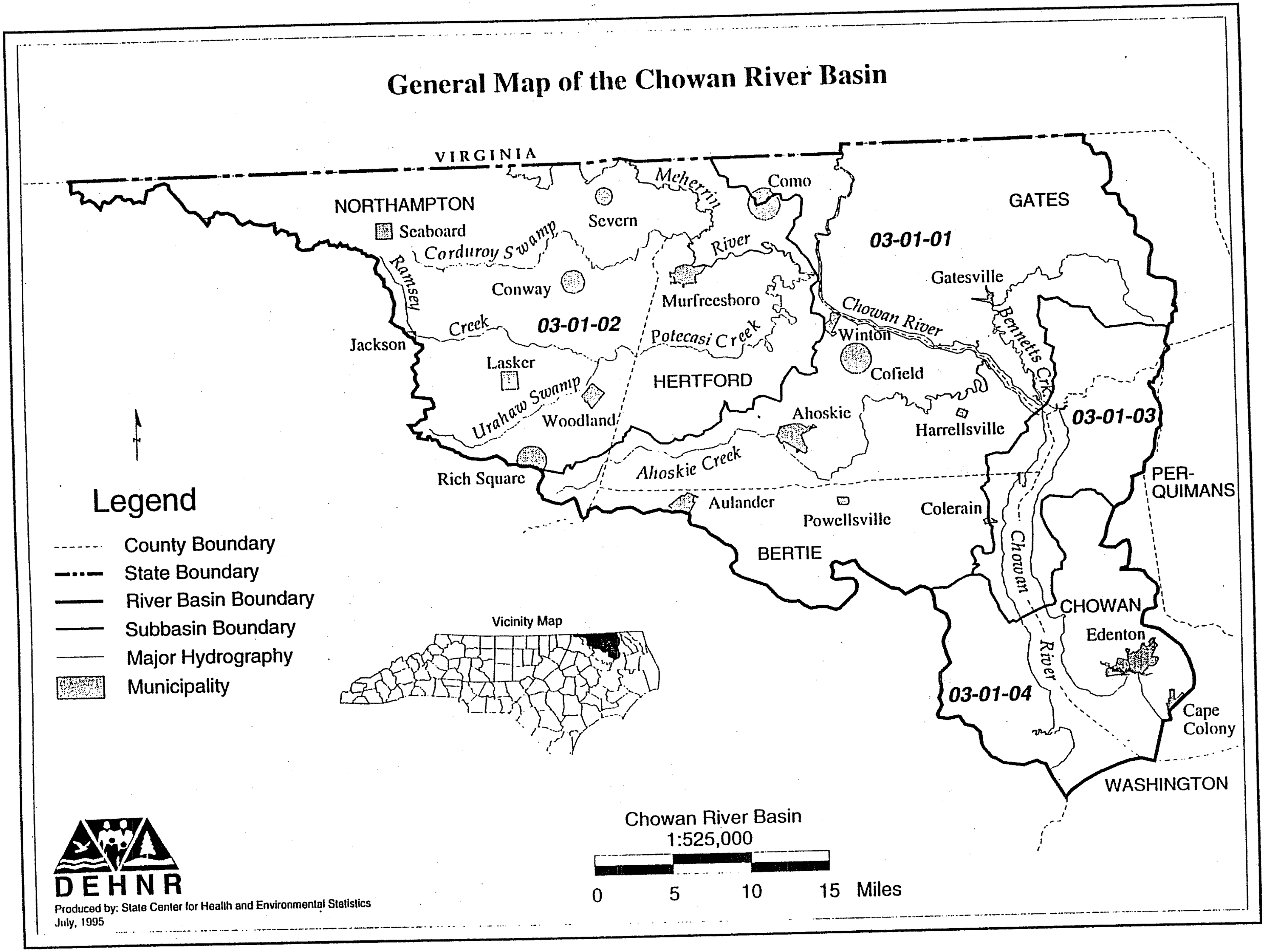


Figure 2.2. General Map of the Chowan River Basin

## 2.2 COMPARISON OF STATE AND FEDERAL HYDROLOGIC AREAS IN THE CHOWAN BASIN

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS) use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. DWQ has a two-tiered system in which the state is subdivided into 17 river basins, and each basin is subdivided into subbasins. The Chowan River basin is subdivided by DWQ into 4 subbasins. By contrast, a nationally uniform hydrologic unit system was developed in 1974 by the US Geological Survey's Office of Water Data Coordination (USDA, NRCS, Nov 1995). This system divides the country into 21 regions, 222 sub-regions, 352 accounting units and 2,149 cataloging units based on surface hydrologic features. Under the federal system, the North Carolina portion of the Chowan basin is divided into two hydrologic areas referred to as cataloging units. Each cataloging unit is defined by an 8-digit number. One of these units includes the Meherrin River and all of its tributaries, and is assigned the number 03010204. This area corresponds exactly to DWQ subbasin 030102. The other cataloging unit includes the remaining three DWQ subbasins in the Chowan and is assigned the number 03010203. These subbasins basically split the Chowan River into three sections (upper, middle and lower) and include tributaries to those sections. Table 2.1, below, compares the two systems. Maps of each subbasin are included in Chapter 4.

Table 2.1. Hydrologic Divisions in the Chowan River Basin

| Watershed Name and Major Tributaries | Federal Cataloging Unit. 8-digit Hydrologic Units | DWQ Subbasin 6-digit codes Figure 2.3 |
|---|---|---|
| Meherrin River and Tributaries | 03010204 | 030102 |
| Upper Chowan River and Ahoskie Cr. | 03010203 | 030101 |
| Middle Chowan River and Tribs. | " | 030103 |
| Lower Chowan River and Tribs. | " | 030104 |

These comparisons are presented to aid in the interpretation of land cover data summaries in Section 2.4. That section presents land cover information developed by the US NRCS which is summarized for each of the two cataloging units in the basin.

## 2.3 LOCAL GOVERNMENT AND PLANNING JURISDICTIONS

The basin encompasses parts of Bertie, Chowan, Gates, Hertford and Northampton counties and 18 municipalities as presented in Table 2.2. Also included in the table are abbreviations for the Lead Regional Organizations (Council of Governments) and Districts of the North Carolina League of Municipalities.

Table 2.2. Local Governments and Local Planning Units within the Chowan River Basin

| County | % of county in basin* | Lead Regional Organization | NC League of Munic. Dist. | Municipality |
|---|---|---|---|---|
| Bertie | 25% | Region Q | I | Aulander<br>Colerain<br>Powellsville |
| Chowan | 90% | Region R | I | Edenton# |
| Gates | 60% | Region R | I | Gatesville# |
| Hertford | 100% | Region Q | I | Ahoskie<br>Cofield<br>Como<br>Harrellsville<br>Murfreesboro<br>Winton# |
| Northampton | 85% | Region L | V | Conway<br>Jackson#<br>Lasker<br>Rich Square<br>Seaboard<br>Severn<br>Woodland |

*percentages are approximate        # - denotes county seat

Region L = Region L Council of Governments
Region Q = Mid-East Commission
Region R = Albemarle Regional Planning and Development Commission

## 2.4 LAND COVER, POPULATION AND GROWTH TRENDS

### 2.4.1 General Land Cover

Land cover information in this section is derived from two sources. The first is the US Department of Agriculture (USDA), Natural Resources Conservation Service's (NRCS) National Resources Inventory (NRI) of 1992 and 1982 (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. According to the NRCS 1992 NRI Instructions booklet, the 1982 NRI was the most comprehensive study of our nation's natural resources ever conducted. The inventory is considered accurate to the 8-digit cataloging unit scale established by the US Geological Survey (NRCS, 1993). A 1992 update of these data was recently released.

Table 2.3 summarizes acreages and percentage of land cover from the 1992 and 1982 NRI for the basin as a whole and for the two major watershed areas within the basin. Land cover types identified in Table 2.4 by the NRI as occurring in the Chowan River basin include cultivated cropland, uncultivated cropland, pastureland, forest land, urban and built-up lands, rural transportation, open water (small water areas and census waters), federal lands and other.

Land cover in the basin, as presented in Table 2.3, is dominated by forest and agriculture which make up 87% of the total area. Between 1982 and 1992, the most significant change was seen in the urban/built-up category with a 59% increase. During that same time period, there were slight changes seen in the amount of forested land (-1%) and cultivated crop (-2%), and there was a

Table 2.3. Estimated Acreage by Broad Land Use for the Chowan River Basin in 1992 and 1982. (Source: USDA, NRCS, 1994)

1992 NRI

| LAND COVER | Meherrin Riv. 03010204 Acres (1000s) | % | Chowan R. + tribs 03010203 Acres (1000s) | % | TOTAL ACRES (1000s) | % of TOTAL |
|---|---|---|---|---|---|---|
| Cult. Crop | 121.3 | 37 | 140.9 | 30 | 262.2 | 33 |
| Uncult. Crop | 0.0 | 0 | 1.4 | <1 | 1.4 | <1 |
| Pasture | 4.9 | 1 | 4.3 | 1 | 9.2 | 1 |
| Forest | 164.9 | 50 | 273.0 | 57 | 437.9 | 54 |
| Urban/Built-up | 10.7 | 3 | 8.7 | 2 | 19.4 | 2 |
| Other | 28.1 | 9 | 47.8 | 10 | 75.9 | 9 |
| Totals | 329.9 | 100.0 | 476.1 | 100.0 | 806.0 | 100.0 |
| % of Basin | | 41 | | 59 | | 100.0 |
| DWQ Subbasins | 03-01-02 | | 03-01-01, 03, & 04 | | | |

1982 NRI

| LAND COVER | Meherrin Riv. 03010204 Acres (1000s) | % | Chowan R. + tribs 03010203 Acres (1000s) | % | TOTAL ACRES (1000s) | % of TOTAL |
|---|---|---|---|---|---|---|
| Cult. Crop | 125.6 | 38 | 141.4 | 30 | 267.0 | 33 |
| Uncult. Crop | 0.0 | 0 | 0.0 | 0 | 0.0 | 0 |
| Pasture | 4.9 | 1 | 7.0 | 1 | 11.9 | 1 |
| Forest | 165.8 | 50 | 274.9 | 58 | 440.7 | 55 |
| Urban/Built-up | 6.6 | 2 | 5.6 | 1 | 12.2 | 2 |
| Other | 27.0 | 8 | 47.2 | 10 | 74.2 | 9 |
| Totals | 329.9 | 100.0 | 476.1 | 100.0 | 806.0 | 100.0 |
| % of Basin | | 41 | | 59 | | 100.0 |
| DWQ Subbasins | 03-01-02 | | 03-01-01, 03 & 04 | | | |

Table 2.4 Description of Land Cover Types (1992 NRI - USDA NRCS)

| Land Cover Type (No.) | Land Cover Description |
|---|---|
| 1) Cultivated Cropland | Land used for the production of adapted crops for harvest, including row crops, small-grain crops, hay crops, nursery crops, orchard crops, and other specialty crops. The land may be used continuously for these crops or they may be grown in rotation with grasses and legumes. |
| 2) Uncultivated Cropland | Summer fallow, aquaculture in crop rotation, or other cropland not planted (may include cropland in USDA set-aside or similar short-term program). |
| 3) Pastureland | Land used primarily for production of introduced or native forage plants for livestock grazing. This category includes land that has a vegetative cover of grasses, legumes, and /or forbs, regardless of whether or not it is being grazed by livestock. |
| 4) Forest Land | Land at least 10 percent stocked by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover and not currently developed for non-forest use. Ten percent stocked, when viewed from a vertical direction, is a canopy cover of leaves and branches of 25 percent or greater. The minimum area for classification of forest land is 1 acre, and the area must be at least 1,000 feet wide. |
| 5) Urban and Built-up Land | Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Highways, railroads, and other transportation facilities are considered part of this category if surrounded by other urban and built-up areas. Tracts of less than 10 acres that do not meet this category's definitions (e.g., small parks or water bodies) but are completely surrounded by urban and built-up lands are placed in this category. |
| 6) Other: | This category includes rural transportation, water areas and federal lands. Rural Transportation consists of all highways, roads, railroads, and associated rights-of-way outside Urban and Built-up areas; private roads to farmsteads, logging roads; and other private roads (but not field lanes). Water consists of small water bodies (water bodies less than 40 acres in size and streams less than one-half mile wide) and census water (large water bodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width). There are no lands owned by the Federal Government in the Chowan Basin. |

1,400 acre increase in the amount of uncultivated crop and a 2,700 acre decrease in the amount of pasture land.

The second land cover source is derived from interpretation of LANDSAT satellite data. This information is based on interpretation of 1987 Landsat satellite data that was made available through the North Carolina Center for Geographic Information and Analysis (CGIA) and Research Triangle Institute. The eight land cover types presented in this section are a composite of 20 land cover categories available through CGIA. Table 2.5 defines the categories into which this data is divided.

Table 2.5. Landsat Land Cover Categories and Descriptions.

| Land Cover Type | Land Cover Description |
|---|---|
| 1) Agriculture | Agriculture, Bare Soil, Grass and Disturbed Land |
| 2) Urban | Greater than 25% paved surfaces |
| 3) Forest | Pine, Hardwood and Mixed Upland Forest |
| 4) Wetlands | Bottomland Hardwoods, Riverine Swamp, Evergreen Hardwood/Conifer, Atlantic White Cedar Low Pocosin, High Marsh, Low Marsh |
| 5) Scrub | Low Density Vegetation |
| 6) Water | Lakes, Reservoirs, Ponds, Estuaries, Sounds |
| 7) Barren | Sand |
| 8) Shadow | Areas in shadows or appearing to be in shadows and where actual cover types are indiscernible. |

Table 2.6 presents the figures for Landsat data in the Chowan River basin in North Carolina, divided by DWQ subbasin. Unlike the NRI data, this information provides an estimate of the amount of wetlands in the basin. Approximately 20% of the land cover in the Chowan basin is wetland area as defined in the table above. Consistent with the NRI data, the Landsat data indicates that the majority of the basin is covered by forest and agriculture (33% and 37% respectively).

### 2.4.2 Population and Growth Trends in the Basin

The Chowan River basin has an estimated population of 62,474 people based on 1990 census data. Table 2.7 presents census data for 1970, 1980, and 1990 for each of the subbasins. It also includes land and water areas and population densities (persons/square mile of land area) by subbasin. Figure 2.3 shows the percent population growth by subbasin. The subbasins that encompass the lower and larger portion of the Chowan River have experienced all of the growth in the North Carolina portion of the basin. The two upper subbasins (030101 and 030102) have actually experienced a slight loss of population (-2% and -8% respectively). Growth in the lower Chowan has been most pronounced in subbasin 03 which experienced a 29% increase in population between 1970 and 1990.

Two of the five counties that are in the Chowan Basin are expected to see an increase in population by the year 2020 (NC Department of Administration). Based on projections from 1990 to the year 2020, Chowan County will see a 17% increase and Gates County will see a 19% increase. Other areas within the basin are expected to see 6% to 20% a decrease in numbers of residents. Therefore, overall population growth in the basin is anticipated to be minimal.

Table 2.6. Land Cover in the Chowan Basin and Subbasins by Acreage and Percent Cover

| SUBBASIN | Agriculture (acres) | Forest (acres) | Urban (acres) | Wetland (acres) | Water (acres) | Scrub (acres) | Barren (acres) | Shadow (acres) | TOTAL ACRES | TOTAL PERCENT |
|---|---|---|---|---|---|---|---|---|---|---|
| 03 01 01 | 95,869 | 108,142 | 165 | 93,553 | 5,630 | 17,041 | 1 | 444 | 320,845 | 42.6% |
| 03 01 02 | 105,354 | 105,522 | 534 | 28,289 | 904 | 4,571 | 0 | 527 | 245,701 | 32.6% |
| 03 01 03 | 33,272 | 9,699 | 247 | 14,897 | 15,070 | 1,455 | 91 | 52 | 74,783 | 9.9% |
| 03 01 04 | 40,891 | 22,647 | 714 | 18,087 | 23,767 | 4,802 | 968 | 122 | 111,998 | 14.9% |
| | | | | | | | | | | |
| TOTAL ACRES | 275,386 | 246,010 | 1,660 | 154,826 | 45,371 | 27,869 | 1,060 | 1,145 | 753,327 | |
| PERCENTAGES | 36.6% | 32.7% | 0.2% | 20.6% | 6.0% | 3.7% | 0.1% | 0.2% | | 100.0% |

Table 2.7 Chowan River Basin Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

| SUBBASIN | POPULATION (Number of Persons) | | | POPULATION CHANGE (%) | | | POPULATION DENSITY (Persons/Square Mile) | | | LAND AND WATER AREAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Total Land and Water Area | | Water Area | Land Area |
| | 1970 | 1980 | 1990 | 1970-80 | 1980-90 | 1970-90 | 1970 | 1980 | 1990 | (Acres) | (Sq. Miles) | (Sq. Miles) | (Sq. Miles) |
| 03-01-01 | 25,469 | 26,191 | 24,884 | 2 | -4 | -2 | 44 | 46 | 43 | 371,289 | 580 | 12 | 568 |
| 03-01-02 | 24,723 | 23,168 | 22,713 | -6 | -1 | -8 | 50 | 47 | 46 | 317,137 | 496 | 3 | 493 |
| 03-01-03 | 3,659 | 4,028 | 4,731 | 10 | 17 | 29 | 34 | 37 | 44 | 79,124 | 124 | 17 | 107 |
| 03-01-04 | 9,428 | 10,249 | 10,146 | 8 | -1 | 7 | 68 | 74 | 73 | 114,221 | 178 | 41 | 137 |
| Totals | 63,279 | 63,636 | 62,474 | 1 | -2 | -1 | 48 | 49 | 48 | 881,771 | 1,378 | 73 | 1,305 |

Note: Population, land area and water area were derived from 1970, 1980 and 1990 census data.

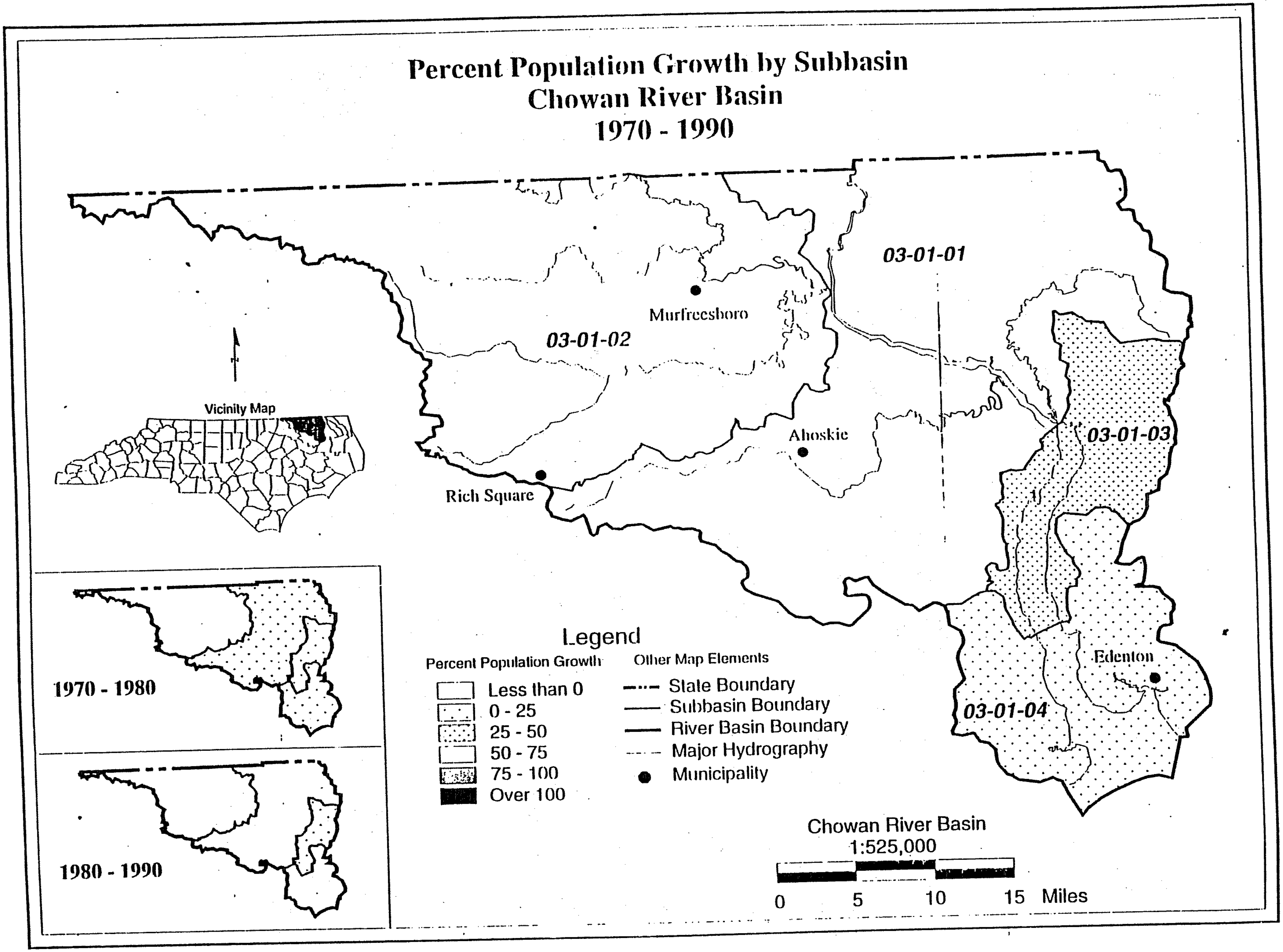


Figure 2.3. Percent Population Growth by Subbasin

The municipalities in the Chowan basin are relatively small in size, ranging in size from 104 people in Como to 5,407 people in Edenton (1994 figures from the NC Office of State Planning, 1995). Growth in municipal areas have generally been modest. The largest municipalities, Edenton and Ahoskie, grew by 2.6% an 0.6% respectively between 1990 and 1994. The most growth was in Gatesville which added 65 people between 1990 and 1994, which translates to a 21.1% increase.

Figure 2.4 demonstrates population density by census block group for the Chowan basin. The majority of the basin is rural, but there are pockets of more densely populated areas. These pockets are centered around Edenton, Ahoskie, Colerain and Murfreesboro. It is also interesting to note that these areas are located near major waterways in the basin including portions of the Chowan River, the Meherrin River and Ahoskie Creek.

In using these data, it should be noted that the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate has to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups may change for each census so comparisons between years must be considered approximate.

## 2.5 AGRICULTURAL ACTIVITIES IN THE CHOWAN RIVER BASIN

Agriculture is an extremely important industry in the Chowan River basin. Based on a 1995 report from the North Carolina Department of Agriculture, there are a total of 1,726 farms in counties that overlap the Chowan River Basin (see Table 2.8). These farms comprise a total of 495,934 acres with the overall average farm size for all of the counties being 301 acres. In 1993, cash receipts for agricultural products in these counties, including both livestock and crop production, totaled $293,980,000. The following sections focus more specifically on livestock operations and crop production in the Chowan basin.

Table 2.8. Summary of 1992 Agricultural Statistics for Counties in the Chowan River Basin (Source:NC Department of Agriculture, 1995)

| County (approx. % of Co.in basin) | Number of Farms | Acres of Land in Farms | Average Size of Farm (Acres) | Total Cash Receipts (1993) |
|---|---|---|---|---|
| ~~Bertie (25%)~~ | ~~456~~ | ~~170,006~~ | ~~373~~ | ~~$89,278,000~~ |
| Chowan (90%) | 179 | 53,902 | 301 | $29,378,000 |
| Gates (60%) | 199 | 64,532 | 324 | $37,111,000 |
| Hertford (100%) | 511 | 52,281 | 102 | $69,034,000 |
| Northampton (85%) | 381 | 155,213 | 407 | $69,179,000 |
| TOTALS | 1,726 | 495,934 | 301 | $293,980,000 |

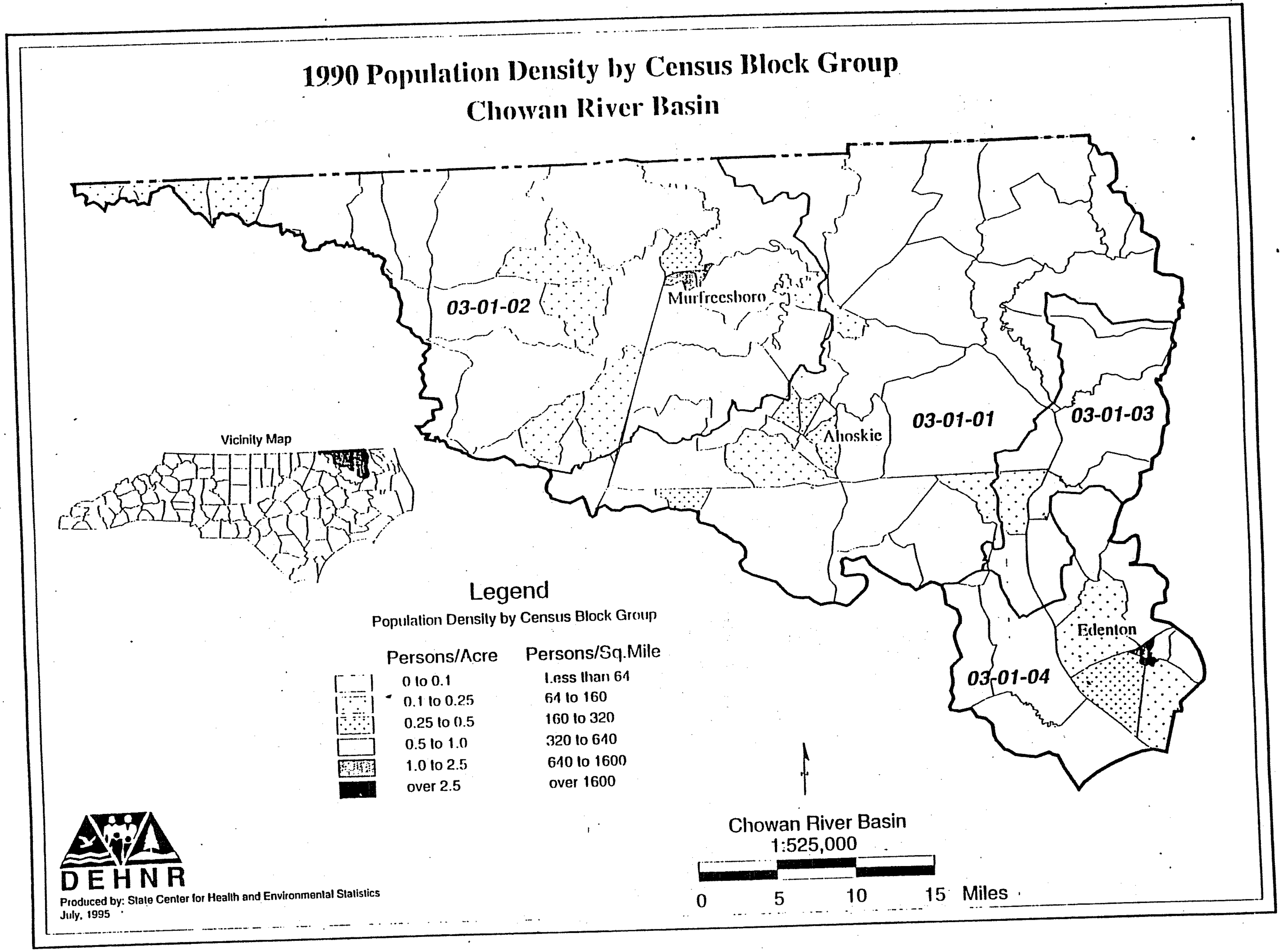


Figure 2.4. 1990 Population Density by Census Block Group for the Chowan River Basin

### 2.5.1 Livestock Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for managing and reusing animal wastes from intensive livestock operations (See section 5.3.1 for additional information on rule requirements). The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993.

In the counties that overlap the Chowan River basin, there are a total of 191 registered livestock operations. Thirty-eight (38) of these (or 20%) are certified, meaning they have approved waste management plans (the remainder must have approved plans in place before the end of 1997). The majority of the operations (68%) are raising swine, but there are some cattle and poultry operation in these counties also. Locations of registered animal operations in the Chowan basin are illustrated in Figure 2.5. This map is intended to provide a general idea of locations of registered operations in the basin.

The increase in swine numbers from 1990 to 1994 has been dramatic in subbasins 01 and 02 (NCDA Veterinary Division, 1995). In subbasin 01, which includes the upper portion of the Chowan River in North Carolina, there was a 327% increase in the number of swine during this four year time period. And in the adjoining subbasin (02) which encompasses the Meherrin River and tributaries, there was a 446% increase. The other two subbasins of the Chowan saw 30% and 40% decreases in the number of swine, but the large growth in 01 and 02 far outweighs these relatively modest declines. The basin as a whole experienced a 196% increase in the number of swine between 1990 and 1994.

### 2.5.2 Crop Production

According to the NC Department of Agriculture (1995), there are a variety of crops grown in the Chowan River basin (based on data from counties that overlap that basin). The biggest crop in this region is peanuts. In fact, all five counties in the Chowan basin are within the top ten producers of peanuts in the state, with Northampton County being the highest. Northampton County is also ranked statewide as the second highest producer of sorghum and the third highest producer of cotton. Other crops grown in the area include corn, tobacco and potatoes.

## 2.6 NATURAL RESOURCES IN THE CHOWAN RIVER BASIN

### 2.6.1 Fisheries

North Carolina's commercial and recreational fishery resources are both nationally and regionally significant. Commercial harvest of fish and shellfish in North Carolina produces an average of 180.6 million pounds of marketable resource each year (based on figures from 1987 - 1991) (Division of Marine Fisheries, 1993). The annual economic value of this resource is $1 billion and is a critical component of North Carolina's coastal economy. Management of these fisheries resources has recently become a critical issue in the state as fisheries are threatened by overfishing, habitat loss, and water quality decline.

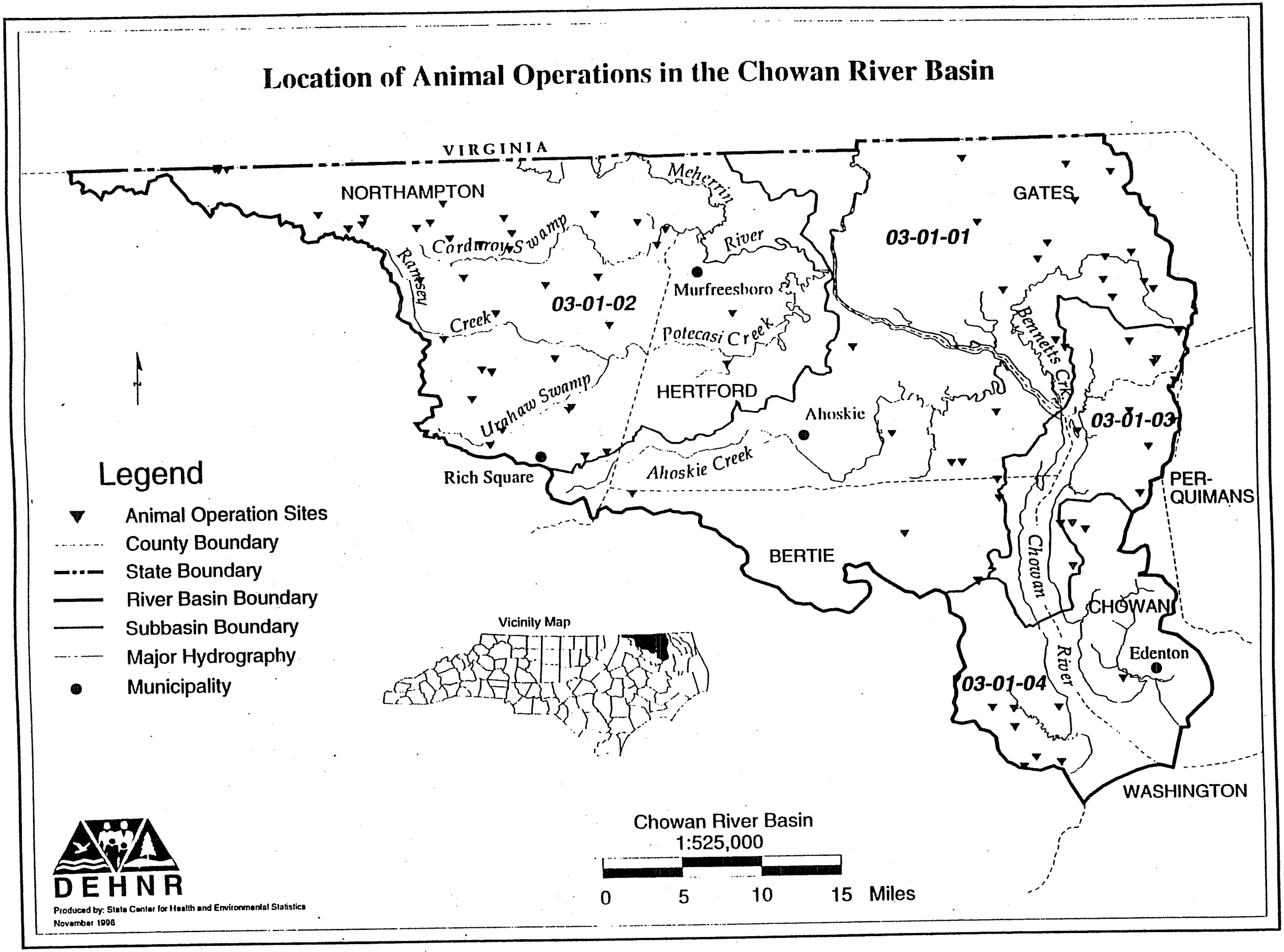


Figure 2.5. Location of Registered Livestock Operations in the Chowan River Basin

Estuarine fishery resources can be described by how fish live their lives. There are three major types (DMF, 1993): anadromous fish, resident fish and migratory fish. Anadromous fish spend most of their lives in saltwater but spawn in freshwater streams. Examples of these include river herrings and striped bass. Resident fish stay in the same area for their whole life because they need a certain kind of habitat in which to live. Examples of these include catfish and clams. Migratory species spawn in the ocean and around inlets and some migrate seasonally along the Atlantic coast. These fish are the most prominent in the estuaries and include menhaden, croaker, spot, flounder and blue crab.

Recreationally important gamefish species that are resident within the Chowan River include largemouth bass (*Micropterus salmoides*), black crappie (*Pomoxis nigromaculatus*) and numerous sunfish species. Total sport fishing effort on Chowan River averaged approximately 201,600 angler hours per year from 1977-1980 (Mullis and Guier, 1982). Although current angler effort figures are unavailable, the Chowan River largemouth bass population continues to be subjected to intense fishing pressure. North Carolina Wildlife Resources Commission fisheries and law enforcement personnel estimate that at least 4 - 6 organized largemouth bass tournaments occur on the river each weekend from March through October in addition to non-tournament fishing (Kornegay, 1991). Although specific economic data is not available for recreational fishing on the Chowan River, anecdotal evidence suggests local and regional economies within the basin are often strengthened by fuel, lodging, food, bait and tackle purchases made by recreational fishermen.

The Chowan River is an important habitat for several anadromous fish species. These species include blueback herring (*Alosa aestivalis*), alewife (*Alosa pseudoharengus*), hickory shad (*Alosa mediocris*), American shad (*Alosa sapidissima*), Atlantic sturgeon *(Acipenser oxyrhynchus)* and striped bass *(Morone saxatilis)*. The first two species (blueback herring and alewife) are often generally referred to as 'river herring'. All of these fish have a very large range extending along the Atlantic from Canada to northern Florida. Blueback herring that were tagged during the summer in Canada have been recaptured in the Roanoke River in North Carolina, and fish tagged in North and South Carolina waters have been recaptured in Georges Bank, Canada (DMF, 1993). Figure 2.6 provides a map illustrating the location of anadromous fish spawning areas in the Chowan River basin.

There are two types of fisheries data that have been examined to determine the status of the populations in the Chowan River and Albemarle Sound into which the river flows. One is commercial landings which is a measure of the number of pounds of fish caught by commercial fishermen. The other is 'catch per unit effort', or CPUE, which is derived from the amount of commercial landings and how much gear, such as pound nets, was used to catch those fish.

Commercial landings and CPUE data indicate that populations of anadromous fish species in the Chowan River are stressed or depressed. A publication of the NC State Museum of natural history lists the migratory Atlantic sturgeon, herrings and shads as "depleted" (Cooper et. al., 1977). More recent stock information from NC DMF lists American shad as "stressed declining", hickory shad as "stressed recovering", and Atlantic sturgeon and river herring in the Albemarle/Chowan Basin as "depressed". Looking at landings of river herring in the Chowan River, which accounts for approximately 85% of the state's total landings for these fish (DMF, 1993), there is a clear downward trend in landings (Figure 2.7). A similar trend is being seen in the Albemarle sound for American shad (Winslow, 1994). Although landings data is influenced by a variety of factors including, but not limited to, market demand, fishing effort and the weather, they can provide a general indicator of fishery trends.

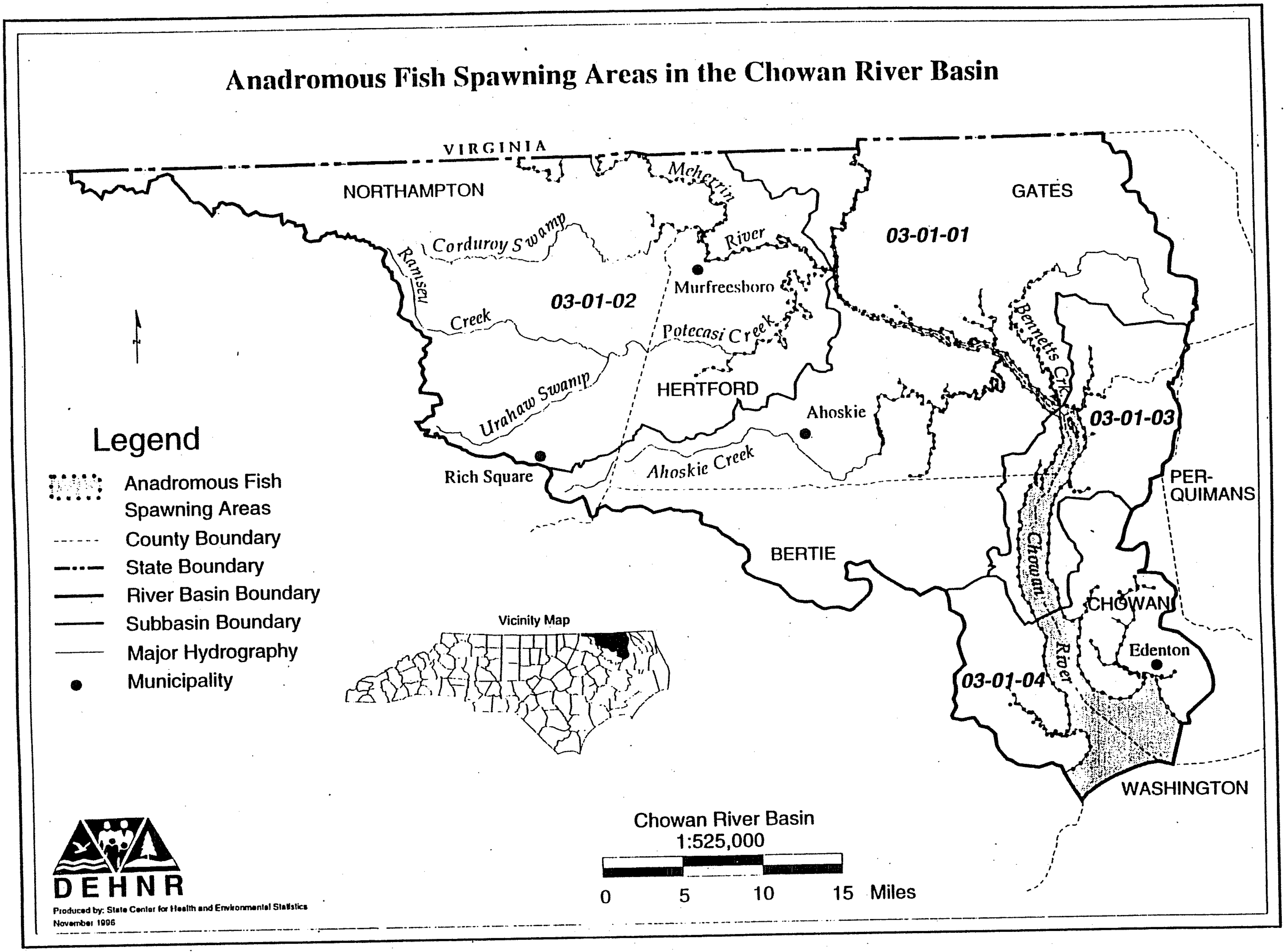


Figure 2.6. Anadromous fish spawning areas in the Chowan River Basin.

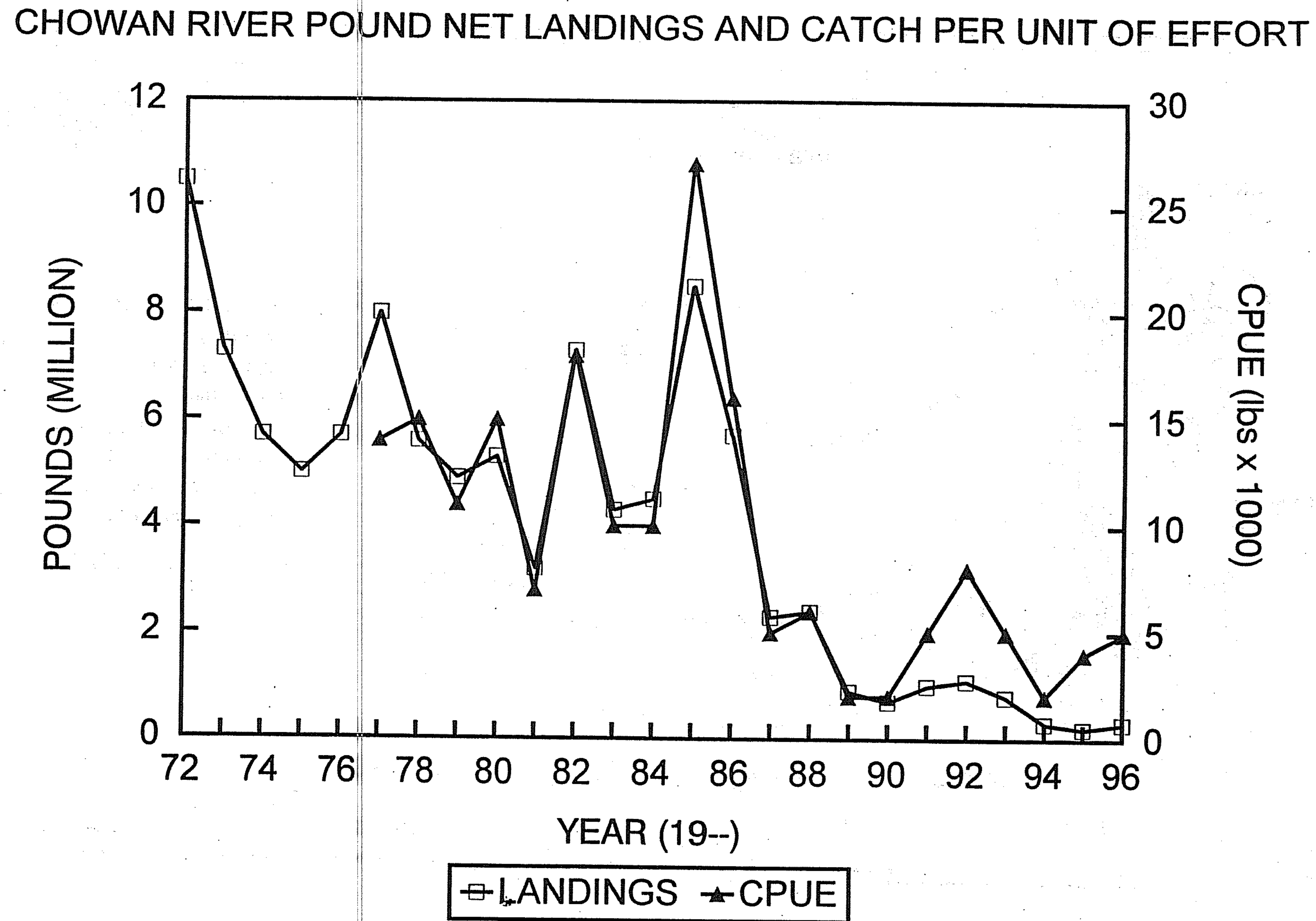


**Figure 2.7.** **Commercial landings of river herring pound nets (all species) in Chowan River, 1972 -1996, and CPUE for river herring in Chowan River pound nets, 1977 - 1996. (Source: DMF).**

Factors influencing the decline in abundance of these species include loss of spawning habitat and nursery areas, overfishing and water quality. Specifically with regard to water quality, several conditions including algae blooms and low dissolved oxygen levels have been identified as possible contributors to declines in these fisheries (Winslow, 1994; DMF, 1993).

The extensive Chowan River watersheds that contain intermittent and tidally flooded wetlands, swamp, hardwood forests, shallow open waters and areas of emergent and submerged aquatic vegetation are considered very important as spawning, nursery, and feeding areas for anadromous and resident species. Maintenance of the water quality benefits provided by these habitats is critical to fishery resources. Channelization and drainage projects have severely impacted many of these areas and downstream water quality.

### 2.6.2 Merchants Millpond State Park and Chowan Swamp Natural Area

<u>Merchants Millpond State Park</u>

The North Carolina state parks system exists for the enjoyment, education, health and inspiration of all citizens and visitors. The mission of the state parks system is to conserve and protect representative examples of the natural beauty, ecological features, and recreational resources of statewide significance; to provide outdoor recreational opportunities in a safe and healthy environment; and to provide environmental education opportunities that promote stewardship of the state's natural heritage.

The Chowan River basin contains a popular state park. Merchants Millpond State Park is located in the Coastal Plain province of the state in central Gates County. It was established in 1973 and covers 2,922 acres of land and water (NC DPR, 1994). The park provides opportunities for canoeing, nature study, picnicking, camping, fishing and hiking. The millpond, (originally known as Norfleets Millpond), was formed when Bennetts Creek was impounded to serve a grist and saw mill in 1811. The park contains many important biological resources representative of a coastal millpond and southern swamp. Examples include old-growth stands of cypress-gum forests and a Mesic Mixed Hardwood Forest dominated by beech. An unusual feature of the millpond is the thick scattering of massive stumps within the millpond which provide habitats for complex ecosystems. Many plant species are at or near the limits of their range, with mountain species and northern species coexisting with the typical southern varieties.

Merchants Millpond is currently experiencing a problem with an overabundance of aquatic weeds. The water quality of the pond and the status of the weeds is discussed further in section 4.5.1 of Chapter 4.

<u>Chowan Swamp Natural Area</u>

Downstream of Merchants Millpond State Park and located adjacent to the Chowan River is Chowan Swamp Natural Area. A tributary to the Chowan River, called Sarem Creek, runs through the middle of it. The area is considered valuable for recreation, although recreational activities are limited to water areas because there is no high ground to support campgrounds or shoreline activities. The area supports a wide variety of vegetation and fish and wildlife.

### 2.6.3 Wetlands

There are a number of wetland natural communities found in the Chowan Basin. 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. This community blends with the Cypress--Gum Swamp (Blackwater subtype) farther away from the river, but still within the Chowan River floodplain. The Meherrin River extends into the Piedmont in Virginia and has areas of brownwater communities, whereas the forests along the Chowan are generally of the blackwater subtype (of cypress--gum swamp). The most common wetland community in the Chowan Basin is the Coastal Plain Small Stream Swamp, which is found along most of the tributary streams and creeks; such sites generally have narrow floodplains with no natural levees, backswamps, and other fluvial features found on the larger rivers.

A somewhat rare community is the Tidal Freshwater Marsh, which is found at a few sites along the Chowan River and adjacent lower portions of tributary streams. There is a scattering of millponds in the basin, and the Coastal Plain Semipermanent Impoundment is the community present at such sites. Though not truly a "natural" community, these plant associations -- commonly bald-cypress in standing water over a wide variety of aquatic herbs -- are repeated at many sites, highlighted by Merchants Millpond State Park. There are a few small stands of Atlantic white cedar, and a few areas of pocosin vegetation. All in all, however, most of the pocosins in the basin have been cleared or converted to other types of forests.

Wetlands can be very important in watershed planning because they perform a variety of services beneficial to society. These systems are able to process sediments, nutrients, and other pollutants, provide wildlife habitat, store organic matter and provide other means to protect habitat as well as downstream and on-site water quality. In some instances, wetlands serve as spawning and nursery areas for anadromous fish. Each of the actions that a wetland performs, regardless of human recognition of that action, is called a function. When these actions are declared important to society as a whole, they are called values. The following discussion primarily concerns wetland values. Some wetland values are ubiquitous to most wetland types, such as wildlife habitat. However, wetland values are ultimately tied to specific wetlands because they depend on site specific factors such as landscape position, size, soil type, and land use. Table 2.9 lists those wetland types that are most common in the Chowan basin and provides acreages for those types. These figures were generated by the NC Division of Coastal Management (DCM). DCM is currently working to identify and digitize into GIS wetland areas (by type) in the NC coast. Only the Northhampton County portion of the Chowan basin has not been completed. Table 2.10 provides a brief description of typical values associated with the different wetland types.

Table 2.9. Number of acres of wetlands in the Chowan River Basin (not including Northhampton County).

| Wetland Type | Not Drained or Cleared | Drained | Cleared | Total | Percent of Total |
|---|---|---|---|---|---|
| Freshwater Marsh | 579 | 18 | 85 | 682 | 1 |
| Bottomland Hardwood | 20,560 | 737 | 1,244 | 22,541 | 16 |
| Swamp Forest | 55,418 | 1,364 | 2,465 | 59,247 | 43 |
| Hardwood Flat | 3,183 | 1,419 | 576 | 5,177 | 4 |
| Pine Flat | 1,455 | 290 | 47 | 1,792 | 1 |
| Managed Pineland | 46,094 | n/a | n/a | 46,094 | 34 |
| Headwater Swamp | 1,449 | 0 | 220 | 1,670 | 1 |
| **TOTAL** | 128,738 | 3,828 | 4,637 | 137,203 | 100 |
| **PERCENT** | 94 | 3 | 3 | 100 | |

Table 2.10. Wetland types common in the Chowan Basin.

| Wetland Type | Values |
|---|---|
| Headwater Forests | overland pollutant removal, wildlife habitat, timber production |
| Bottomland Hardwood Forests | water storage, shoreline stabilization, pollutant removal, wildlife habitat, aquatic habitat, outdoor recreation/ education, timber production, hunting leases |
| Swamp Forests | water storage, overland and overbank pollutant removal, wildlife habitat, aquatic habitat, outdoor recreation/ education, timber production, hunting leases |
| Wet Flats | special ecological attributes, wildlife habitat, outdoor recreation/education, timber production, hunting leases |

Bottomland hardwood and headwater wetlands perform valuable water quality functions including flood water storage, nutrient and sediment retention and nutrient transformation. However, their effectiveness is diminished if the stream waters can no longer inundate adjacent floodplains or if nutrient loads exceed the assimilative capacity of the wetland. As these wetlands are lost upstream, the potential for erosion, flooding, sedimentation, algal blooms, and fish kills increase downstream. Those wetlands adjacent to intermittent streams are especially important in filtering nonpoint pollution from agricultural and urban runoff.

Wet flats and pocosins in the coastal plain also may have a considerable influence on the water quality of the region. In general, wet flats and pocosins do not store as much water or retain as many pollutants as wetlands directly associated with streams, such as bottomland hardwood forests. However, wet flats and pocosins occupy extensive areas of interstream divides, and, based on sheer magnitude of coverage in the coastal plain, the cumulative effects of these wetlands may be vital to water quality of coastal plain streams. Consequently, the conversion of these wetlands may significantly affect the hydrology or water quality of the region. Between 1994 and 1996, the 'other' category (which in the Chowan basin includes primarily headwater forest and swamp forest) received the greatest impacts from permitted wetland fill activities in the basin (Table 2.11). The majority of the conversions were related to DOT projects and the creation of ponds. The Division of Water Quality is currently assessing the cumulative impacts on water quality of incremental fill of wet flats and pocosins.

Table 2.11. Fill activities in the Chowan Basin by wetland type (1994-1996).

| Wetland Type | Acres Wetland Fill Permitted |
|---|---|
| Bottomland Hardwood Forest | 5.54 |
| Salt Marsh | 0 |
| Wet Flat | 11.91 |
| Pocosin | 0 |
| Other | 30.74 |
| TOTAL | 48.19 |

*Note: Numbers have not yet been completely QA'd. However, it is not anticipated that they will change significantly upon completion of that process.*

### 2.6.4 Threatened and Endangered Aquatic Faunal Species

In the Chowan River basin, there are seven species that are listed by North Carolina as either Threatened, Special Concern, or Significantly Rare. In the Chowan basin, only the bald eagle is

Federally listed. Threatened species are considered likely to become endangered within the foreseeable future. Endangered species are those species that are in danger of becoming extinct. Species of Special Concern have limited numbers and vulnerable populations and are in need of monitoring. Significantly Rare species are those whose numbers are small and whose populations need monitoring. The American Alligator has received the classification of 'Threatened Due to Similarity of Appearance' due to the similarity between the alligator and the endangered crocodile. Locations of rare species are shown in Figure 2.8. Table 2.12 lists the species in the Chowan River basin that have received a State or Federal listing because of limited or vulnerable populations.

Table 2.12. Threatened and Endangered Species in the Chowan River Basin (Source: NC Natural Heritage Program)

| Common Name | Scientific Name | Subbasins where found | Listing Status: State | Listing Status: Federal |
|---|---|---|---|---|
| RARE AQUATIC ANIMALS | | | | |
| Alewife Floater | *Anodonta implicata* | All | SC | |
| Eastern Lampmussel | *Lamsilis radiata* | 01, 03, 04 | SC | |
| Tidewater Mucket | *Leptodea ochracea* | All | SC | |
| Eastern Pondmussel | *Ligumia nasuta* | All | SC | |
| American Alligator | *Alligator mississippiensis* | 01 | T | T(S/A) |
| Triangle Floater | *Alasmidonta undulata* | 01, 03, 04 | T | |
| Chowanoke Crayfish | *Orconectes virginiensis* | 02 | SR | SC |
| RARE AQUATIC-DEPENDENT ANIMALS | | | | |
| Bald Eagle | *Haliaeetus leucocephalus* | | E T | |
| Black Bear | *Ursus americanus* | | SR | |

Abbreviations: E = Endangered, T = Threatened, SR = Significantly Rare, SC = Species of Concern, T(S/A) = Threatened Due to Similarity of Appearance.

### 2.6.5 Natural Heritage Priority Areas

The North Carolina Natural Heritage Program (NHP) compiles the N.C. Department of Environment, Health and Natural Resources' (DEHNR) priority list of Natural Heritage Areas as required by the Nature Preserve Act (NCGS Chapter 113-A-164 of Article 9A). The list is based on the program's inventory of natural diversity in the state (DEHNR 1995). Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high-quality natural communities, and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determines a site's priority rating. The sites included on this list are the best representatives of the natural diversity of the state, and therefore have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Figure 2.8 shows the Natural Heritage Priority Areas in the Chowan Basin. The numbers on the map correspond to the numbered areas described in this section. Certain priority areas that contribute to the maintenance of water quality in the Chowan Basin are highlighted below. More complete information on the natural areas may be obtained from the NHP.

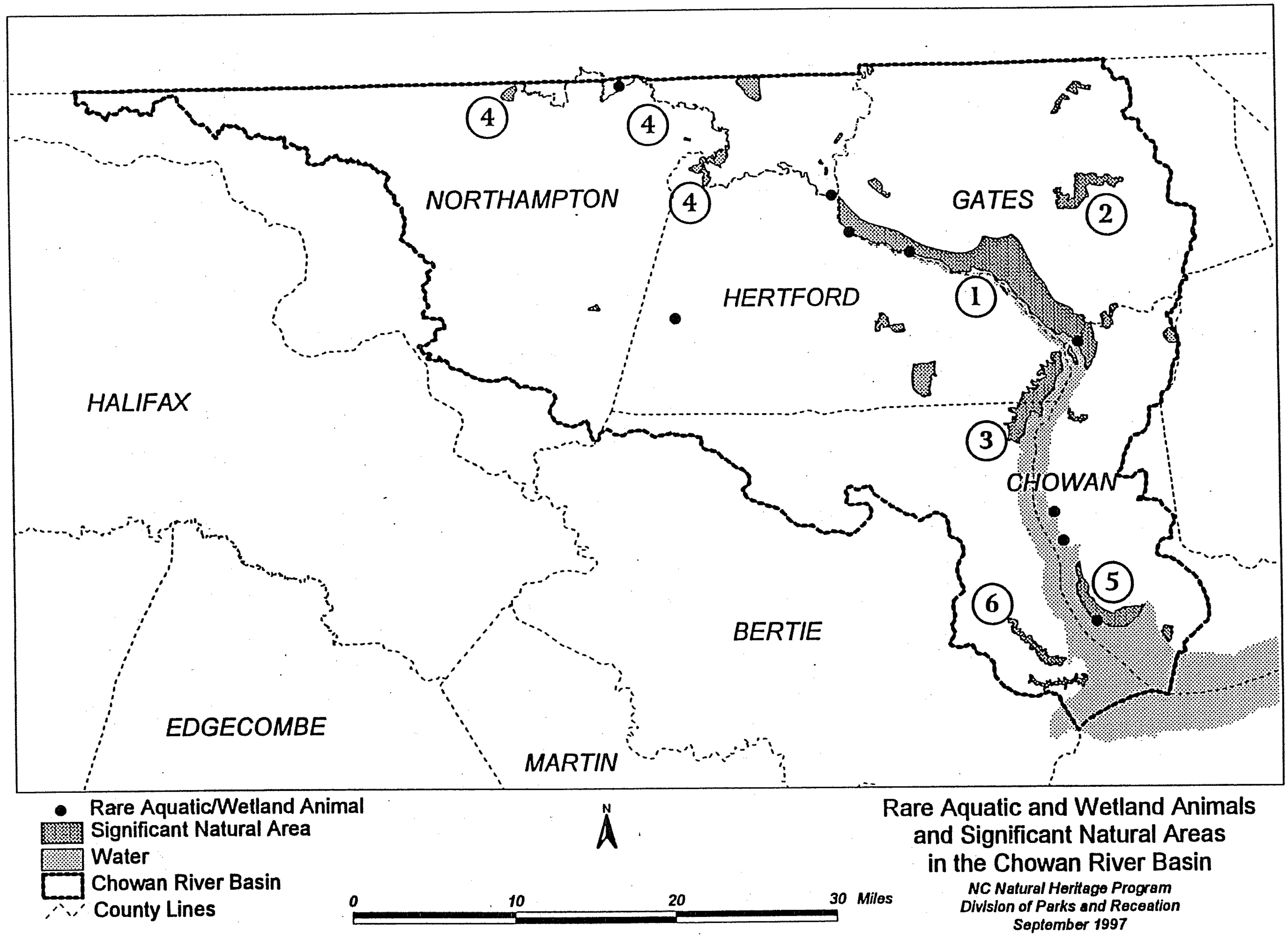


Figure 2.8. Rare species within 500 feet of water and Priority Natural Areas in the Chowan River Basin.

**Natural Heritage Priority Areas in the Chowan Basin that are Important to Water Quality**

1.Chowan Swamp/Bennetts Creek/Catherine Creek Swamps. This natural area consists of approximately 16,000 acres along the northern floodplain of the Chowan River, in southern Gates and adjacent Chowan counties. The Chowan Swamp State Natural Area, administered by the N.C. Division of Parks and Recreation, covers more than 6000 acres of this larger site. Additional lands in this swamp are administered by the Wildlife Resources Commission as the Chowan Swamp Game Land. The remainder of the site is privately owned and is not protected. The entire natural area contains some of the most extensive acreage in the state of Tidal Cypress--Gum Swamp.

2. Merchants Millpond State Park. This park contains perhaps the best example of the Coastal Plain Semipermanent Impoundment natural community in the state. There is an impressive array of floating aquatic plants at the park. The swamp along Bennetts Creek, at the head of the millpond, contains a stand of old-growth cypress--gum forest. The park also contains good stands of upland forests, including several beech-dominated slopes.

3. Colerain/Cow Island Swamp and Slopes. This 3500-acre site 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 and Cypress--Gum Swamp, Blackwater subtype farther from the river. It is located downstream from the Chowan Swamp, on the western shore of the river in Hertford and Bertie counties. A small portion of the site is protected by a registry agreement with a timber company, but fuller protection of the site is needed.

4. Meherrin River natural areas. There are six Natural Heritage Priority sites located along the Meherrin River. Those important to water quality include the Meherrin River Swamp in Hertford County (505 acres) and the Meherrin River Slopes and Swamp (360 acres) in Northampton County. These sites contain good to excellent examples of Cypress--Gum Swamp, Brownwater subtype communities. All sites need protection.

5. Reedy Point Swamp. This 1850-acre site lies along the northern shore of the Chowan River, just west of Edenton. In addition to Tidal Cypress--Gum Swamp, there is some Pond Pine Woodland natural community present in this site. Protection of this site is needed.

6. Salmon Creek Swamp. This site consists of approximately 2000 acres in the lower floodplain of Salmon Creek, in eastern Bertie County. Most or all of this site consists of Coastal Plain Small Stream Swamp natural community. Protection of this site is needed.

## 2.7 SURFACE WATER CLASSIFICATIONS AND STANDARDS

### 2.7.1 Program Overview

North Carolina has established a water quality classification and standards program pursuant to G.S. 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B.0100 - Procedures for Assignment of Water Quality Standards. Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of water bodies (which included all named water bodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses, and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be 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 and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards have been broadly interpreted to provide protection of uses from both point and nonpoint source pollution.

### 2.7.2 Statewide Classifications and Water Quality Standards

All surface waters in the state are assigned a primary water classification, and they may also be assigned one or more supplemental classifications (Table 2.13).

Table 2.13. Primary and Supplemental Classifications Applicable to the Chowan River Basin

| | |
|---|---|
| PRIMARY CLASSIFICATIONS | |
| Class | Best Uses |
| C | Aquatic life propagation/protection and secondary recreation |
| B | Primary recreation and class C uses |
| SUPPLEMENTAL CLASSIFICATIONS | |
| Class | Best Uses |
| Sw | Swamp Waters: recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen |
| NSW | Nutrient Sensitive Waters: Waters that are subject to growths of microscopic or macroscopic vegetation that require the control of nutrient inputs. |

As noted above, classifications are assigned to protect uses of the waters such as swimming, aquatic life propagation or water supplies. For each classification, there is a set of water quality standards that must be met in order to protect the uses. Appendix I provides a more detailed summary of the state's primary and supplemental classifications including, for each classification, the best usage, water quality standards, stormwater controls and other protection requirements as appropriate. This information is derived from 15A NCAC 2B .0200 - Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.

### 2.7.3 Surface Water Classifications in the Chowan River Basin

The waters of the Chowan River basin have a few surface water quality classifications applied to them. The whole basin (approximately 1,564 stream miles) has been designated as Nutrient Sensitive Waters since 1979. This area was the first in North Carolina to receive this designation because the Chowan River was experiencing problems with algae blooms. More information on the history of nutrient enrichment in the Chowan is contained in the nutrient section of Chapter 3. The majority of the basin (approximately 92% or 1,439 stream miles) has a primary classification of C to protect for aquatic life. There are some waters in the basin, including the Chowan River, that have been classified as Class B to protect primary recreational uses. These waters represent about 8% (125 stream miles) of all waters in the basin.

Although no waters in this basin are supplementally classified as swamp (Sw) waters, there are many that exhibit characteristics associated with that classification (such as low dissolved oxygen levels and low pH). Due to limited resources, this is an issue that DWQ has not addressed through intensive studies and regulatory revision (reclassification). However, it is recognized that there are areas in the basin that may need to be reclassified to reflect their naturally having swamp characteristics. As priorities and resources allow, potential reclassification of appropriate waters will be investigated.

A complete listing of classifications for all surface waters in the basin can be found in a DWQ publication entitled "Classifications and Water Quality Standards Assigned to the Waters of the Chowan River Basin". This is available from the Division of Water Quality's Water Quality Section (919/733-5083, ext. 564). Pending reclassifications are discussed in Chapter 6.

## 2.8 WATER USE IN THE CHOWAN RIVER BASIN

### 2.8.1 State Water Supply Plan Database

The Division of Water Resources is compiling a State Water Supply Plan (SWSP) Database that contains information from Local Water Supply Plans pursuant to GS 143-355 (l) and (m). As of July 30, 1996, 15 of an expected 27 systems that are wholly (or partly) in the Chowan River basin are represented in the Sate Water Supply Plan Database. The following summary of current and future population and water use is based on these 15 water systems.

Table 2.14 presents the 1992 and projected serviced population for these systems through to the year 2020. Based on this table it may be expected that the population serviced by these systems will increase by 42% percent over the next few decades.

Table 2.14. 1992 and Projected Service Populations for Water Suppliers in the Chowan River Basin that have Provided Information to the NC Division of Water Resources.

| SYSTEM NAME YEAR | 1992 | 2000 | 2010 | 2020 |
|---|---|---|---|---|
| AULANDER | 1,366 | 1,450 | 1,500 | 1,550 |
| COLERAIN | 238 | 250 | 250 | 250 |
| POWELLSVILLE | 672 | 656 | 634 | 611 |
| BERTIE CO WATER DIST IV | 0 | 2,307 | 2,934 | 2,815 |
| BERTIE CO WATER DIST I | 0 | 3,093 | 2,990 | 2,881 |
| BERTIE CO WATER DIST II | 0 | 2,866 | 3,514 | 3,374 |
| EDENTON | 5,600 | 5,768 | 5,941 | 6,119 |
| CHOWAN CO | 8,253 | 8,665 | 9,098 | 9,553 |
| GATES CO | 8,394 | 8,871 | 9,379 | 9,938 |
| AHOSKIE | 4,583 | 5,533 | 5,588 | 5,643 |
| WINTON | 796 | 797 | 781 | 762 |
| SEVERN | 310 | 350 | 400 | 425 |
| CONWAY | 758 | 588 | 545 | 501 |
| SEABOARD | 805 | 885 | 973 | 1,070 |
| WOODLAND | 1,000 | 1,000 | 1,000 | 1,000 |
| TOTALS | 32,775 | 43,079 | 45,527 | 46,492 |

SOURCE: SWSP Database, Division of Water Resources, DEHNR, Not Published

Based on the information submitted by the water suppliers, total average daily use is 260,000 gallons per day. Approximately 65% of the total amount of water supplied goes to residences, while the remaining 35% is used for industrial and commercial purposes.

As Figure 2.9 illustrates, overall projected water use in million gallons per day is expected to increase modestly in the next two decades approaching a high of 5 MGD. The forecast between 1992 and 2020 is for a 27% increase in water use.

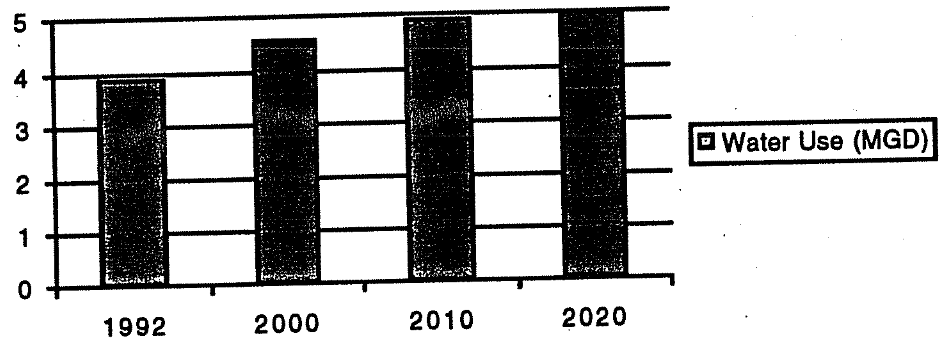


Figure 2.9. Total Projected Water Use in MGD for Water Suppliers in the Chowan River Basin. (Source: SWSP Database, Division of Water Resources, Not Published.)

## 2.8.2 US Geological Survey Water Use Information

The US Geological Survey (USGS) maintains a water use database that characterizes whether the source of the water is surface or ground water, as well as what the purpose for which the water is used. Table 2.15 summarizes the USGS data for the Chowan River Basin.

Table 2.15. 1990 Water Withdrawals in the Chowan River Basin in MGD. (Source: USGS Water Use Database, Not Published, file retrieved from ftp site at... 130.11.144.77 in /var/ftp/pub)

| Withdrawal Category | Ground Water | Surface Water | Ground + Surface | Percent of Total |
|---|---|---|---|---|
| Public Water Supply | 29.7 | 0.0 | 29.7 | 83% |
| Commercial | 0.01 | 0.0 | 0.01 | <1% |
| Domestic | 1.31 | 0.0 | 1.31 | 4% |
| Industrial | 1.65 | 0.0 | 1.65 | 5% |
| Livestock | 0.58 | 0.1 | 0.68 | 2% |
| Irrigation | 0.07 | 2.2 | 2.27 | 6% |
| **Totals** | **33.32** | **2.3** | **35.62** | **100** |
| **Percent** | **94%** | **6%** | **100** | |

Note: All withdrawal categories other than Public Water Supply are self-supplied. For example, the domestic category represents residents that supply their own water.

The information contained in table 2.15 indicates that the vast majority (94%) of water used in the basin is coming from groundwater sources. Surface water is only used for agricultural purposes such as the maintenance of livestock and irrigation. Most of the water used in the basin is directed toward supplying people with water in their homes.

### 2.8.3 Other Water Resource Issues in the Chowan River Basin

One area of concern is the City of Norfolk's withdrawals from the Blackwater and Nottoway Rivers. Norfolk has historically pumped up to 24 mgd from the Blackwater and up to 22 mgd from the Nottoway to augment its municipal water supply. The Blackwater pumping station is located 2 miles west of Burdette, Virginia. The Nottoway facility is located near Courtland, Virginia. Both pump transmission systems discharge into the upstream end of Lake Prince.

Under current operating procedures, Norfolk maintains a minimum instream flow of 25 cfs (16 MGD) at its pumping stations on both the Blackwater and Nottoway. In addition, peak pumping usually occurs during periods of low flow. Previous reports have assumed different flowby requirements in calculating the potential pumping rates. Flowby requirements were 25 cfs (16 mgd) for the Blackwater, and 25 to 50 cfs (16 to 32 mgd) for the Nottoway. Minimum pumping rates vary from 0 to 10 mgd.

A recent report by Norfolk's consultant suggests that with minor improvements to the pumping stations, up to 26.0 and 23.5 mgd could be pumped from the Blackwater and Nottoway, respectively (Gannett Fleming, Safe Yield Study, April 1996). The consultant assumed no minimum flowby requirement.

The Division of Water Resources is concerned that current and proposed operating policies pose a threat to instream aquatic habitat and water quality. The Chowan River and its tributaries act as a spawning and nursery area for species of herring and shad. River flows are related to the upstream migration of these fish. In addition, the Blackwater and Nottoway are classified as nutrient enriched waters. Maintaining minimum flows will decrease the detention time in the Chowan River, reduce the chance of algal blooms, and improve river water quality at low flows. The effects of the Norfolk pumping have never been adequately studied. An investigation of downstream flow requirements is needed to determine reasonable pumping rates for the Blackwater and Nottoway.

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# CHAPTER 3

# CAUSES AND SOURCES OF WATER POLLUTION

## 3.1 INTRODUCTION

Water pollution is caused by a number of substances including sediment, nutrients, bacteria, oxygen-demanding wastes, metals, color and toxic substances. *Sources* of these pollution-causing substances are divided into broad categories called *point* sources and *nonpoint* sources. Point sources are typically piped discharges from wastewater treatment plants and large urban and industrial stormwater systems. Nonpoint sources can include stormwater runoff from urban areas, forestry, mining, agricultural lands and others. **Section 3.2** identifies and describes the major causes of pollution in the Chowan River basin. **Sections 3.3** and **3.4** describe point and nonpoint source pollution in the basin, respectively.

## 3.2 CAUSES OF POLLUTION

*Causes* of pollution refers to the substances which enter surface waters from point and nonpoint sources and result in water quality degradation and impairment. The major causes of water quality impairment include biochemical oxygen demand (BOD), sediment, nutrients, toxicants (such as heavy metals, dioxin, chlorine, pH and ammonia) and fecal coliform bacteria. Table 3.1 provides a general overview of causes of impairment and the activities that typically lead to their introduction into surface waters. Each of these causes is discussed in the following sections.

Table 3.1 Causes and Sources of Water Pollution

| Cause of Impairment | Potential Source of Pollution |
|---|---|
| Sediment | Construction and mining sites, disturbed land areas, streambank erosion and alterations, cultivated farmland |
| Nutrients | Fertilizer on agricultural, residential, commercial and recreational lawns, animal wastes, effluent from aquaculture facilities, leaky sewers and septic tanks, atmospheric deposition, municipal wastewater |
| Toxic and Synthetic Chemicals | Pesticide applications, disinfectants (chlorine), automobile fluids, accidental spills, illegal dumping, urban stormwater runoff, industrial effluent |
| Oxygen-Consuming Substances | Wastewater effluent, organic matter, leaking sewers and septic tanks, animal waste |
| Fecal Coliform Bacteria | Failing septic tanks, animal waste, runoff from livestock operations, wildlife, improperly disinfected wastewater effluent |
| Road Salt | Applications to snow and ice |
| Oil and Grease | Leaky automobiles, industrial areas, illegal dumping |
| Thermal Impacts | Heated landscape areas, runoff from impervious areas, tree removal along streams, wet detention ponds |

### 3.2.1 Nutrients

The term *nutrients* in this document refers to two major plant nutrients, phosphorus and nitrogen. These are common components of fertilizers, animal and human wastes, vegetation, aquaculture facilities and some industrial processes. Nutrients in surface waters come from both point and nonpoint sources. Nutrients are beneficial to aquatic life in small amounts. However, in overabundance and under favorable conditions, they can stimulate the occurrence of algal blooms and excessive plant growth in quiet waters such as ponds, lakes, reservoirs, creeks, rivers and estuaries.

<u>**Nutrients in the Chowan River Basin**</u>

Nutrients have been and continue to be a significant issue in the Chowan River basin. In fact, the Chowan basin was the first waterbody in the state to receive the supplemental Nutrient Sensitive Waters (NSW) classification because of water quality problems associated with nutrient enrichment. Extensive resources have been targeted toward investigating nutrients in the Chowan River. This section will present a summary of water quality investigations that have occurred over the years and an estimation of current nutrient loads in the basin.

***Historical Review of Water Quality Studies in the Chowan River***

The Chowan River was the first coastal river in North Carolina recognized to experience problems with eutrophication. Early reports (NC-DNRCD, 1982) indicated that major nuisance algal blooms occurred in 1972 and 1978 in the lower portion of the Chowan River. In addition to algal blooms, the occurrence of fish kills and catches of fish infected with red sore disease also implicated water quality problems.

Nuisance algal growths or algal blooms occur when factors limiting algal growth increase in concentration or value. One important factor is the concentration of nutrients such as nitrogen or phosphorus. During the early 1970's a discharge of large quantities of nitrogen, an algal nutrient, was attributed to a fertilizer plant in Tunis, NC. Howells (1990) indicates that this facility may have been discharging as much as 4,000 pounds of nitrogen per day. The discharge was stopped by state action in 1972 and no severe algal blooms developed in the river during the next few years. However, in 1976, small pulse blooms appeared. These blooms were thought to be the result of high nitrogen laden water seeping from storage ponds at a fertilizer plant into the river.

The deterioration of water quality led to specialized multidisciplinary studies and the development of water quality management programs to address the problem. One of the first management programs was established in 1973. This program, known as the Chowan River Project, stimulated some of the first formal studies of the river.

One of the earliest studies was a one-dimensional deterministic flow model of the Chowan River (Daniel, 1977). This model provided daily average discharges for nine sites along the Chowan river for the period April 1974 to March 1976. The study, however, described the flow of water in the Chowan. Both lunar tides and wind tides are present within the Chowan River system. Although lunar tides are small (ca. 1 foot) and are buffered by the Outer Banks, during periods of low flow these tides may exert an influence as far upstream as six miles north of Franklin VA on the Blackwater River. Wind tides are more common and important in the hydrodynamics of the river. These tides can be as much as four feet. Saltwater intrusion into the estuary occurs infrequently.

Subsequent studies focused on nutrients and algal growth. Nitrogen was clearly implicated as a cause of the blooms and was the focus of a study conducted by Stanly and Hobbie (1977). The objectives of this study were to determine: 1) how significant recycling of nitrogen is for algal growth in the river, and 2) what factors limit algal growth in the Chowan during different seasons of the year. The study concluded that the release of nitrogen from decomposing organic matter in the sediments provided much of the nitrogen needed to sustain algal growth in the summer. During the summer, dissolved inorganic nitrogen concentrations were often undetectable. River flow was found to exert a strong negative influence on algal biomass during the winter when flow rates are high. Nitrogen limited algal growth only during the summer.

A study of the response of phytoplankton to water quality was conducted between 1974 and 1977 (Witherspoon, et al., 1979). This study found three periods of relatively high algal growth: 1) a short-lived, late-winter peak, 2) a midspring peak, and 3) a summer peak that was sustained through September to early October.

Data showed that the river could be divided into two biotic sections. The upper river usually contained concentrations of nutrients sufficient to support algal biomass. However, river flow rates usually were high enough to prevent high phytoplankton growth. The algae in this upper section were primarily composed of motile unicellular and colonial species. The lower river had more stagnant flows that provided conditions for nutrient and algal interactions. Blue-green algae were dominant in the lower section.

One of the specific conclusions of this study (Witherspoon, et al., 1979) stated that "low nutrient levels coupled with high algal biomass during the mid-summer indicated that when environmental conditions are favorable algal growth quickly depletes nitrogen and phosphorus; yet, algal growth during this season continues. Nutrient recycling, nitrogen fixation, physiological utilization or organic nitrogen and/or phosphorus in high concentration in the river or a combination of all three processes may be providing these essential nutrients during that period."

Amein and Galler (1979) developed a mathematical model to predict concentrations of dissolved oxygen, biochemical oxygen demand, various species of nitrogen and algal biomass. Phosphorus was not included in the study since, at this time, phosphorus was not identified as a limiting nutrient. The model showed that increases in nitrogen concentrations due to low flow cause algal concentrations to increase in the summer.

In response to nuisance algal blooms and fish kills in North Carolina's waters, the North Carolina Environmental Management Commission established the Nutrient Sensitive Water (NSW) supplemental classification on May 10, 1979 as a legal basis for controlling the discharge of nutrients (nitrogen and phosphorus) into surface waters (Howells, 1990). Nutrient Sensitive Waters were defined as waters subject to excessive growths of microscopic or macroscopic vegetation requiring limitations on nutrient inputs. This classification was applied to the Chowan River and took effect in September 1979. This enabled nutrient limits to be included in the NPDES permits of wastewater treatment plants discharging in the watershed (1 ppm total phosphorus and 3 ppm nitrogen).

Studies conducted during the early 1980's expanded on the findings of earlier studies. Phosphorus was first identified as a limiting nutrient in the algal assay studies conducted by Sauer and Kuenzler (1981). Both nitrogen and phosphorus simultaneously limited total algal growth in most experiments, but phosphorus was found to be the more critical limiting nutrient for Anabaena and Aphanizomenon, the nitrogen fixing blue-green species that dominated algal blooms in the lower river.

Paerl (1982) confirmed that both nitrogen and phosphorus were important nutrients that contributed to the blue-green algal blooms. In particular, high nitrogen inputs during the spring were identified as creating a potential for spring algal (non blue-green) blooms. Oxygen from bottom water was depleted when the organic matter from these blooms decomposed. The anaerobic conditions then would release phosphorus that stimulated the growth of blue-green algae during the summer.

Kuenzler, et al. (1982) addressed phytoplankton uptake and sediment release of nitrogen and phosphorus. Ratios of nitrogen to phosphorus in the water as nutrients and as seston (living and nonliving suspended matter), and ratios at which nitrogen and phosphorus are taken from the water by seston indicated that both nutrients may limit algal growth at different times and places in the river. However, this study concluded that phosphorus most likely was the more important limiting nutrient.

Kuenzler, et al. (1982) found that nitrogen and phosphorus were abundant in the sediments, but the rates of exchanges to the overlying water were too low to be the basic cause of the eutrophic condition of the water column. However, efflux rates were determined only once during the summer, and phosphorus efflux rates from the sediments could increase greatly during periods when the bottom water becomes anoxic.

Additional information on nutrient recycling was provided by Lauritsen and Mozley (1983). They showed that the Asian clam (Corbicula fluminea) was able to rapidly recycle nutrients important for phytoplankton growth. Excretion rates of these nutrients were significantly higher than sediment flux rates in parts of the river where this species was abundant.

The studies conducted by Sauer and Kuenzler (1981), Paerl (1982), and Kuenzler, et al. (1982) concluded that controls of nitrogen and phosphorus inputs were necessary to reduce the frequency and magnitude of algal blooms. Witherspoon and Pearce (1982) provided quantitative estimates of the needed reductions in nutrients to achieve particular chlorophyll *a* concentrations or biomass (wet weight) reductions. For example, to achieve a chlorophyll *a* concentration of 40 µg/l, nitrate, ammonium and orthophosphate would need to be reduced by 48%, 23% and 27% respectively.

Specifically, Witherspoon and Pearce (1982) recommended that: 1) reductions in nitrogen and phosphorus be done simultaneously, and 2) the ratio between nitrogen and phosphorus should promote competition for each nutrient by a diverse number of algal species. This could ensure that no one species would gain dominance and would promote conditions favorable to a balanced algal community.

In 1982 the North Carolina Department of Natural Resources and Community Development (NC DNRCD) developed the Chowan/Albemarle Action Plan (NC DNRCD, 1982a) and the Chowan River Water Quality Management Plan (NC DNRCD, 1982b). These plans addressed the water quality problems in the area with a particular focus on the problems in the Chowan River.

The Chowan River Water Quality Management Plan (NC DNRCD, 1982b) provided management goals and a strategy to meet those goals. Goals included nutrient reductions of 30 to 40 percent for phosphorus and 15 to 25 percent reduction in nitrogen. These reductions were hoped to achieve a reduction in chlorophyll *a* concentrations with peak levels not to exceed 40 µg/l. To meet these goals, a combination of point and nonpoint control measures were required. In order to achieve nitrogen and phosphorus reductions in the range of the target levels control measures also needed to be implemented in Virginia. Approximately 76% of the drainage basin is in Virginia.

Craig and Kuenzler (1983) examined changes in land use since 1950 and trends in fertilizer usage for the entire Chowan watershed. Specifically they noted that farm acreage decreased but yields for all major crops increased due to mechanization and increases in fertilizer usage. The usage of fertilizer in North Carolina was significantly higher than fertilizer usage in Virginia. Approximately 67% of the farmland in North Carolina was drained compared to 6% in Virginia by 1983. They also found a 30% decrease in oak-gum-cypress forested wetlands in the North Carolina portion of the Chowan basin within the period 1964-1974.

Mass balance models were developed for agricultural land, upland forest and wetland forest (Craig and Kuenzler 1983). These models suggested that agriculture, forest and wetlands and point sources contributed 62%, 21% and 7% respectively of the annual nitrogen inputs to the Chowan basin. The respective annual phosphorus inputs were estimated to be 72%, 22% and 6%. Swamp forests were estimated to remove 83% of the total nitrogen and 51% of the total phosphorus from streams passing through these wetlands.

A three year study was conducted in the Chowan River Basin to measure water quality changes resulting from the implementation of best management practices (BMPs) to reduce agricultural nonpoint sources (Humenik, et al., 1982). An important conclusion of this study was the need for educational and technical assistance on soil testing for farmers in the Chowan basin. No producers were found to be adjusting commercial fertilizer application rates to account for the nutrient value of animal waste that was being applied.

In 1985 the North Carolina Agricultural Cost Share Program (NCACSP) was implemented in the Chowan River watershed. The purpose of the NCACSP was to assist agricultural landowners in reducing nutrient, sediment and pesticide runoff through the application of best management practices (BMPs).

An update to the 1982 management plan (NC DNRCD, 1982b) was written in 1990 (NC DEHNR, 1990) and is the most recent synopsis and assessment of the nutrient reduction strategies implemented since the 1982 management plan. The update concluded that North Carolina achieved its goal of 20 percent reduction for nitrogen and reduced its phosphorus load by 29 percent (goal of 35%). These reductions were largely due to the elimination of municipal wastewater discharges, the departure of one industrial source (the Tunis fertilizer plant), and the implementation of agricultural BMPs. Calculations for point source dischargers were based on actual data collected from wastewater treatment facilities in 1989. Calculations for nonpoint source dischargers were based on assumptions, such as removal efficiency.

This update (NC DEHNR, 1990) noted that Virginia was assessing its progress on implementing its Nutrient Control Plan. Nutrient data from water quality monitoring stations near the Virginia/North Carolina boundary were used to evaluate nutrient loads from Virginia. The report (NC DEHNR, 1990) concludes "while the data are limited and somewhat variable, no significant reductions in nutrients could be ascertained by analyzing years of similar flow."

Between 1988 and 1992 the North Carolina Division of Water Quality participated in the Albemarle-Pamlico Estuarine Study (APES). The study involved various federal and state agencies with one goal of obtaining comprehensive water quality data for the area. The Chowan River is part of this estuarine system. Data for 14 stations within the watershed (primarily NC watershed) are summarized in NC-DEHNR 1992a and 1992b.

Nutrient data show high median total nitrogen concentrations for stations located on the Blackwater River near Wyanoke, VA and Ahoskie Creek near Ahoskie, NC. The greatest concentration of total nitrogen, ammonia nitrogen, total phosphorus and orthophosphate occurred at the monitoring station near Wyanoke, VA. This station is near to and downstream of the discharge canal from Union Camp. This facility stores waste in a settling pond and then releases wastewater during the early part of winter when flow is generally the greatest. High nutrients levels occur as waste is being released from the settling pond, generally in January. Data also show that the highest median concentrations of total nitrogen and nitrite-nitrate nitrogen are found in Ahoskie Creek near Ahoskie. Chapter 4 presents a detailed review of flow, chlorophyll *a* and phytoplankton data for selected stations on the Chowan River. Results indicate that there are no chlorophyll *a* concentrations exceeding 25 μg/l which was one of the target levels specified in the 1982 Chowan River Water Quality Management Plan.

***Nutrient Comparisons from 1982 to 1989 and 1996***

As mentioned in the above literature review, in September, 1990 the Water Quality Section released a report titled the "Chowan River Water Quality Management Plan - 1990 Update". The document's purpose was to update the results of the management strategy for the Chowan River which was originally developed in 1982. Data showing nutrient reductions for point and nonpoint sources in North Carolina through 1989 are presented in the 1990 update. In summary, the data show a substantial reduction in Total Phosphorus and Total Nitrogen loads from 1982 to 1989. Total loads were calculated yearly for phosphorus and nitrogen for all point sources. Phosphorus loads for point sources in 1982 were 55,556 pounds per year and in 1989 were 1,323 pounds per year showing a 98% reduction. Nitrogen loads for point sources in 1982 were 612,880 pounds per year and in 1989 were 39,680 pounds per year showing a 94% reduction.

More current nutrient loads from 1996 discharge monitoring reports in the Chowan River have shown a slight increase in phosphorus and nitrogen loads from the 1989 data due to increases in wasteflow for a few of the remaining point sources. However, even with these increases in recent years, the point source contribution to nutrient load for the entire basin remains less than 1% (except for subbasin 030103 where United Piece Dye Works is located). Please refer to Table 3.2 for the estimated contribution of nutrient loading from point sources.

***Estimated Nutrient Loads in the Chowan River Basin***

In the interest of characterizing the relative contributions of nutrients to the Chowan River Basin from different sources within the entire watershed, an updated nutrient budget was developed for the total basin. Phosphorus and nitrogen loading estimates were calculated and summarized for each of the four Chowan subbasins. Table 3.2 summarizes the loading estimates and relative contributions within each subbasin according to the land uses/areas and point source discharges. Point source loads represent the annual loads from permitted dischargers in the basin under current conditions (calendar year 1996). Nonpoint source loads represent the net export of nutrients from areas of varying land use or land cover within each subbasin. The nonpoint source loads were calculated using an export coefficient model utilizing land cover information derived from 1988 Landsat (satellite image) data and nutrient export estimates derived from previous studies in central and eastern North Carolina. Atmospheric loadings from areas of open water were also calculated using export coefficients. The specific methodology utilized is discussed in further detail in Appendix VII.

It is important to note that these loading estimates do not take into account any contribution from the Virginia portion of the basin which comprises approximately 76% of the land area. (DWQ has endeavored to obtain this information from the Virginia Department of Environmental Quality, but this information was not made available in time for inclusion in this analysis). It is also important to note that this method of calculating nutrient loads does not estimate the amount of a nutrient delivered to a certain point in the river. For instance, if a pound of nitrogen is put in the headwaters of Ahoskie Creek the entire pound will not be carried down to the estuarine portion of the river. Rather, some portion of that pound will be broken down and/or utilized by the natural system as it is being transported. Interpretation of the satellite data also introduces some uncertainty into the export coefficient approach. For example, most large areas of open land such as golf courses and school yards are grouped into the agricultural land cover category. By the same token, cotton fields are often lumped into the Scrub Land category which is grouped in with forests in terms of the export coefficient that is applied yielding a lower estimate of nutrients delivered than would be appropriate.

## TABLE 3.2
## NUTRIENT LOADS FOR FOUR SUBBASINS IN THE CHOWAN RIVER BASIN

| | PHOSPHORUS LB/YR | PHOSPHORUS % of Load | NITROGEN LB/YR | NITROGEN % of Load | AREA % |
|---|---|---|---|---|---|
| **Subbasin 03 01 01 (320,845 ac)** | | | | | |
| DEVELOPED LAND | 157 | <1% | 1,107 | <1% | <1% |
| AGRICULTURE | 84,365 | 74% | 837,895 | 62% | 30% |
| FOREST/WETLAND | 26,248 | 23% | 454,971 | 34% | 68% |
| POINT SOURCE | 72 | <1% | 265 | <1% | |
| ATMOSPHERIC DEPOSITION | 3,265 | 3% | 62,268 | 5% | 2% |
| **Total** | 114,107 | 100% | 1,356,506 | 100% | 100% |
| **Subbasin 03 01 02 (245,701 ac)** | | | | | |
| DEVELOPED LAND | 507 | <1% | 3,583 | <1% | <1% |
| AGRICULTURE | 92,712 | 84% | 920,794 | 75% | 43% |
| FOREST/WETLAND | 16,606 | 15% | 287,835 | 24% | 56% |
| POINT SOURCE | 177 | <1% | 1,048 | <1% | |
| ATMOSPHERIC DEPOSITION | 524 | <1% | 9,998 | 1% | <1% |
| **Total** | 110,526 | 99% | 1,223,258 | 100% | 100% |
| **Subbasin 03 01 03 (74,783 ac)** | | | | | |
| DEVELOPED LAND | 235 | 1% | 1,657 | <1% | <1% |
| AGRICULTURE | 29,279 | 66% | 290,797 | 53% | 45% |
| FOREST/WETLAND | 3,126 | 7% | 54,186 | 10% | 35% |
| POINT SOURCE | 2,677 | 6% | 38,752 | 7% | |
| ATMOSPHERIC DEPOSITION | 8,741 | 20% | 166,674 | 30% | 20% |
| **Total** | 44,058 | 100% | 552,066 | 100% | 100% |
| **Subbasin 03 01 04 (111,998 ac)** | | | | | |
| DEVELOPED LAND | 678 | 1% | 4,791 | 1% | 1% |
| AGRICULTURE | 35,984 | 64% | 357,387 | 50% | 37% |
| FOREST/WETLAND | 5,464 | 10% | 94,715 | 13% | 41% |
| POINT SOURCE | 0 | 0% | 0 | 0% | |
| ATMOSPHERIC DEPOSITION | 13,785 | 25% | 262,863 | 37% | 21% |
| **Total** | 55,911 | 100% | 719,756 | 100% | 100% |

Point source estimates based on annual loads, 1996.
Nonpoint source estimates developed from 1988 Landsat data.

As shown in Figures 3.1 and 3.2, as with past estimates of nutrient loads to the basin, the current nutrient budget indicates that loading to the North Carolina portion of the basin is dominated by contributions from agriculture. However the magnitude and proportion of the agricultural contribution may be overestimated by this method because it does not account for specific land management practices on a localized basis. As a result, reductions obtained from the use of agricultural BMPs, such as no-till farming or flow control structures, are not reflected in the load estimates. Even with such reductions taken into account, agriculture would remain the dominant source of nitrogen and phosphorus in the Chowan River basin due to the prevalence of agricultural land area in the watershed.

Due to the elimination of several municipal wastewater discharges in favor of spray irrigation systems the portion of the nutrient load from point sources has declined steadily over the past 10-15 years to the current estimate of about 1% of the total load for nitrogen or phosphorus. Of the 2,900 lbs/yr TP (total phosphorus) and 40,000 lbs/yr TN (total nitrogen) contributed by point sources, the discharge from United Piece Dye Works (UPDW) contributes 2,300 and 37,000 lbs/yr of the TP and TN, respectively, or roughly 80-90% of the point source load. UPDW is currently allowed a variance from the total nitrogen limit that would be imposed by the Chowan NSW strategy on the basis that most of the nitrogen in the discharge is not in a form that is biologically available to the natural system. Further discussion of the UPDW discharge is presented in Chapter 6.

Figures 3.3 and 3.4 illustrate the estimated nutrient loads per unit area for each of the four subbasins. The largest phosphorus and nitrogen loads proportional to land area come from subbasin 030103, largely due to the fact that it has the highest percentage of agricultural land (45%) and the smallest overall land area. The area proportional contribution of subbasin 030103 is also increased by a substantial area of open water, 20% of the land area, which results in a significant contribution of nutrients from atmospheric deposition. Atmospheric deposition is also a factor in the relatively high loading per unit area in subbasin 030104. Subbasin 030101 has by far the largest overall land area and as a result is estimated to produce the largest total nutrient loads, but due to a high proportion of forest/wetland area (23%), subbasin 030101 produces the lowest loading per unit area.

### 3.2.2 Toxic Substances

A toxicant is defined in the North Carolina Administrative Code (Regulation 15A NCAC 2B. 0202(36)) as "any substance or combination of substances ... which after discharge and upon exposure, ingestion, inhalation, or assimilation into any organism, either directly from the environment or indirectly by ingestion through food chains, has the potential to cause death, disease, behavioral abnormalities, cancer, genetic mutations, physiological malfunctions (including malfunctions or suppression in reproduction or growth) or physical deformities in such organisms or their offspring or other adverse health effects".

Toxic substances frequently encountered in water quality management include chlorine, ammonia, organics (hydrocarbons and pesticides) heavy metals and pH. These materials are toxic to different organisms in varying amounts, and the effects may be evident immediately or may only be manifested after long-term exposure or accumulation in living tissue.

North Carolina has adopted standards and *action levels* for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually, limits are not assigned for parameters which have action levels unless 1) monitoring indicates that the parameter may be causing toxicity or, 2) federal guidelines exist for a given discharger for an action level substance. This process of determining action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics

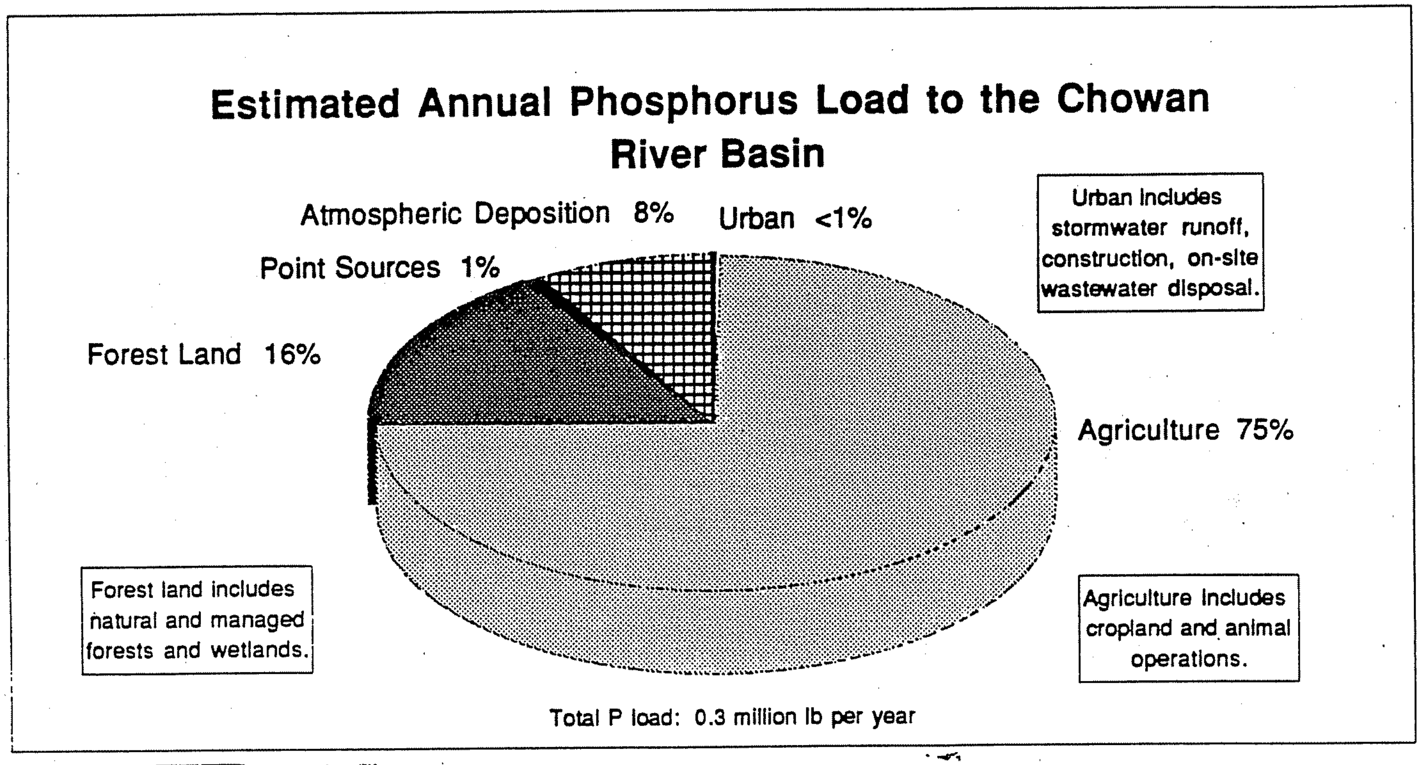


Figure 3.1. Estimated annual phosphorus load to the Chowan River basin.

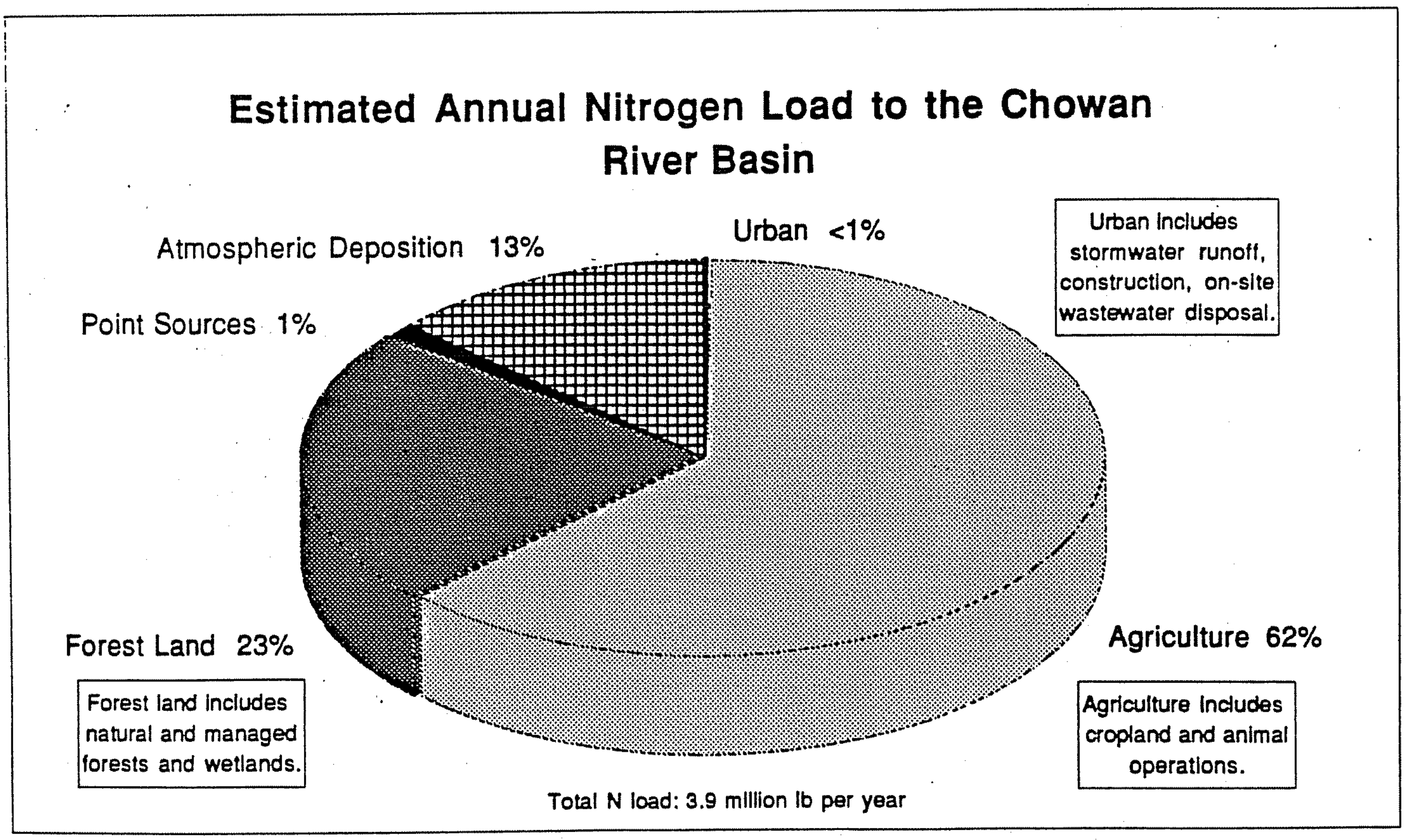


Figure 3.2. Estimated annual nitrogen load to the Chowan River basin.

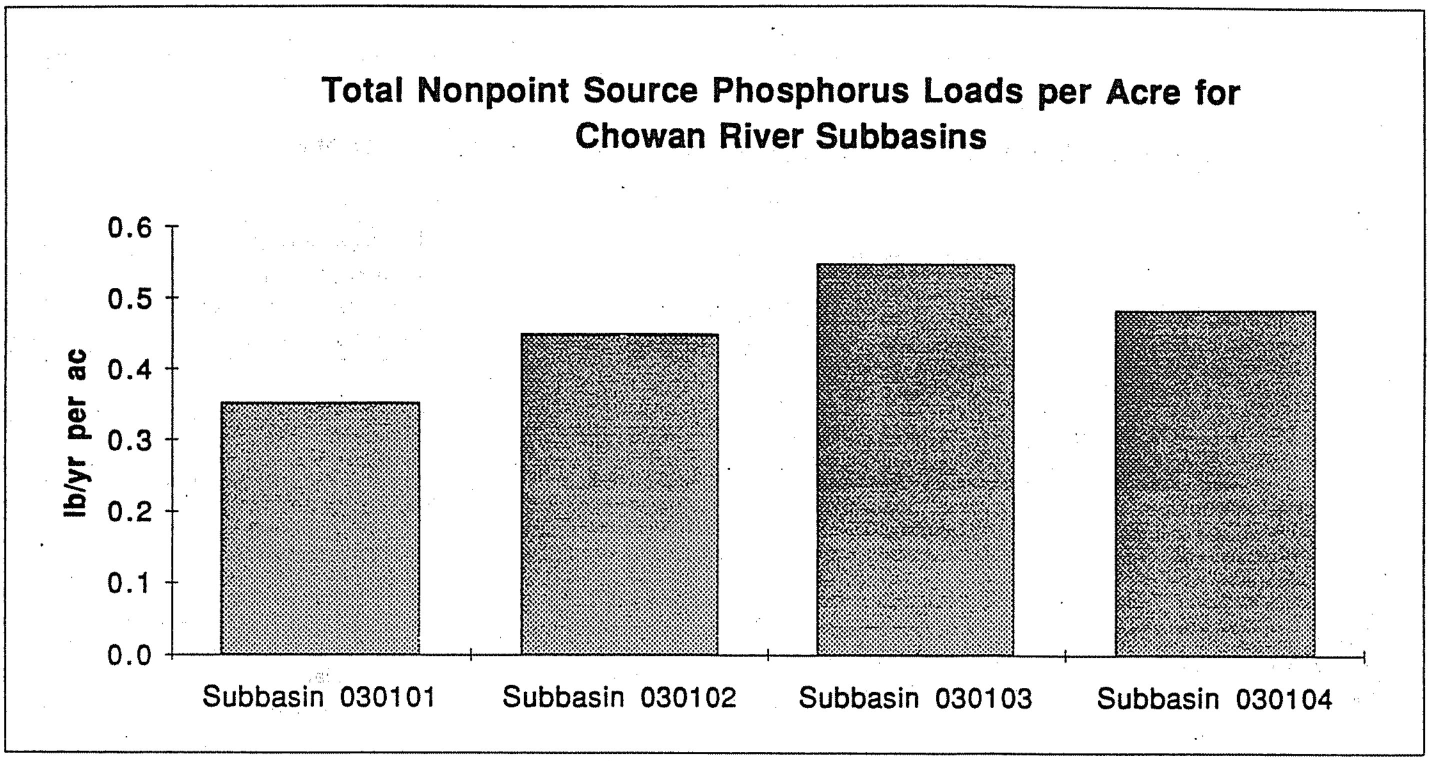


Figure 3.3. Total nonpoint source phosphorus loads per acre for Chowan River subbasins.

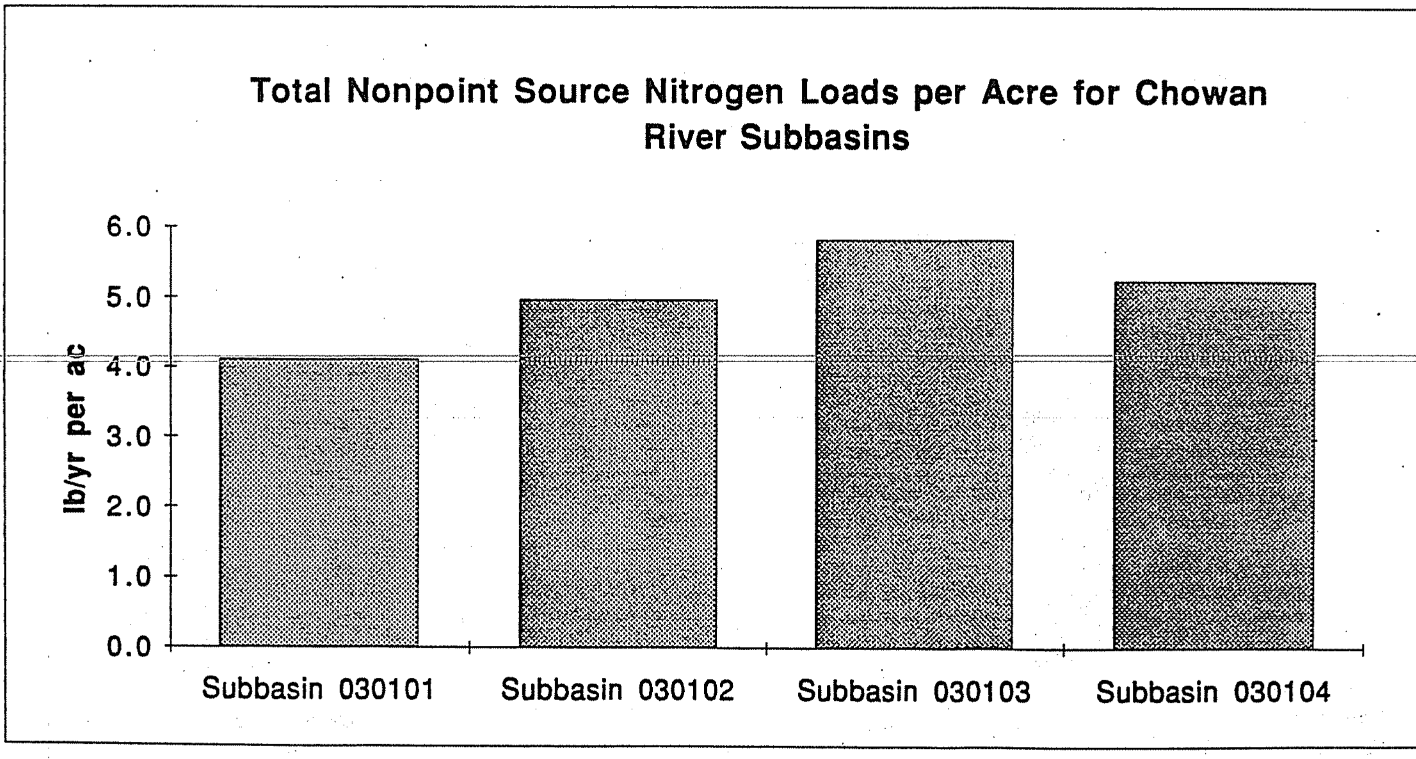


Figure 3.4. Total nonpoint source nitrogen loads per acre for Chowan River subbasins.

and/or associated waste characteristics. Water quality based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion but no water quality standard.

Whole effluent toxicity (WET) testing is required on a quarterly basis for major NPDES dischargers ($\geq$ 1 MGD) and any discharger containing complex (industrial) wastewater. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. This follow-up testing is called a toxicity reduction evaluation (TRE). WET testing is discussed in Sections 4.2.4 and 5.2.5 of Chapters 4 and 5 respectively. Other testing, or monitoring, done to detect aquatic toxicity problems include fish tissue analyses, chemical water quality sampling and assessment of fish community and bottom-dwelling organisms such as aquatic insect larvae. These monitoring programs are discussed in Chapter 4.

Each of the substances below can be toxic in sufficient quantity or concentration.

### Dioxin

Dioxin contamination is found throughout the world. Dioxins and similar contaminants such as furans and polychlorinated benzenes (PCB) are present as trace impurities in some commercial products. Dioxin is generated through processes such as:

- Production of chlorinated phenols and their derivatives (i.e. herbicides),
- High temperature combustion processes (i.e. incinerators), and
- Chemical bleaching of pulp (in the production of paper).

Dioxins are not intentionally generated, but are unwanted by-products in the production of other items. These contaminants occur everywhere in the environment from sediment and living organisms to consumer products such as bleached paper products. Due to recent research and tighter standards, production of dioxins has been greatly reduced.

Dioxin is chemically stable and bioaccumulates in animal tissues. This means that organisms higher up in the food chain tend to have greater concentrations of the chemical. The biological effects on humans that have been associated with dioxin include, but are not limited to:

- death (high doses),
- chloracne (similar to skin rash) from direct contact to skin,
- carcinogenicity (cancer),
- wasting syndrome,
- thymus atrophy, and
- reproductive impairment including fetal toxicity and testicular atrophy.

Dioxin is very hydrophobic (does not mix with water) and, as a result, it binds tightly with sediment, food particles and organic matter in the water column, leaving extremely low concentrations dissolved in water. When these particles are taken into an aquatic organism such as fish, the dioxin tends to accumulate in the organism's lipids (fats). Due to dioxin's low rate of breakdown, organisms exposed to continuous sources of dioxin tend to bioaccumulate dioxin. That fact is why larger fish such as bowfin and bass tend to have higher levels of dioxin in their bodies than fish which eat lower in the food chain (algae or plants) and higher in the water column.

#### *Dioxin in the Chowan River Basin*

The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. The Albemarle Sound is under a separate (although identical) consumption advisory. DWQ basin boundaries are drawn such that a portion of the upper Albemarle Sound is considered a part of the Chowan River Basin. Figure 3.6 shows the location of the Chowan River and Albemarle Sound fish consumption advisory areas as they occur in the Chowan River basin.

In the mid 1980's, paper mills which employ chlorine bleaching were recognized by the US EPA as contributors to dioxin detected in fish caught downstream of paper mills. The Union Camp Fine Paper mill in Franklin, Virginia is believed to contribute to the dioxin contamination of fish in the Chowan River. However, the Albemarle sound and the lower portion of the Chowan River experience tidal action and it is possible that the fish in this area have been impacted by other discharges of dioxin into waters that flow into the upper end of the sound. The Union Camp facility discharges effluent into the Blackwater River (which joins with the Nottoway River to form the Chowan River) daily during the months of November or December through March. Total annual discharge varies from 10 to 12 billion gallons with the daily discharges being adjusted to prevent adverse impacts to the river system. Union Camp has been performing voluntary fish tissue dioxin monitoring in Virginia and North Carolina waters since 1989, shortly after the discover of dioxin in fish downstream of paper mills that employ chlorine bleaching. The voluntary monitoring became a Virginia VPDES Permit requirement for Virginia waters in 1994. Union Camp continues to perform voluntary fish tissue monitoring in North Carolina. In 1990, the company voluntarily instituted process operating measures aimed at controlling the generation of dioxin. They further reduced the dioxin generation in 1992 by completing construction of the first commercial application of their patented C-Free™ bleaching technology to replace two older conventional chlorine bleach lines. These efforts resulted in a reduction of dioxin content in the effluent to a non-detectable level by 1992.

Union Camp's monitoring data demonstrates the significant reductions in fish tissue dioxin levels achieved as a result of their efforts (see Figure 3.5). Dioxin levels (as TEQ) in gamefish species (largemouth bass and bluegill sunfish) collected from Virginia and North Carolina waters have largely been below the 3 ppt (as TEQ) NC action level since 1989. TEQ is a toxicity equivalency factor and is a measure of how toxic a particular form of dioxin is relative to 2,3,7,8 TCDD (tetrachlorodibenzo-p-dioxin). Channel catfish dioxin levels have decreased to below the 3 ppt NC action level at all stations except at Chowan Marker 9, the Highway 17 bridge and at Marker 2. It should be noted that the Albemarle Sound and the lower portion of the Chowan River experience tidal action as evidenced by elevated salinity levels (see Figure 4-20). Therefore, it is possible that the fish in that area have been impacted other discharges of dioxin into waters which flow into the upper end of the sound.

### pH

Changes in pH to surface waters is primarily through point source discharges, although pH levels can be naturally low in areas of the coastal plain, including the Chowan River basin. As the pH of a water decreases, metals are more bioavailable within the water column and are therefore more toxic to the aquatic organisms. As the pH increases, metals are precipitated out of the water column and less toxic to aquatic organisms. If a surface water has had chronic introductions of metals and the pH gradually or dramatically decreases, the metals in the substrate will become more soluble and be readily available in the water column. While lower pH values may not be toxic to the aquatic organisms, the lower values can have chronic effects on the community structure of macroinvertebrates, fish, and phytoplankton. Macroinvertebrates will show a shift from tolerant species to intolerant species and have less community diversity.

The NC standard for pH in surface waters is 6.0 to 9.0 for most waters. The supplemental 'swamp' (Sw) classification is applied to waters that have naturally acidic waters and allows for lower pH levels.

# *1992-1996 CATFISH FILLET DIOXIN AND TEQ LEVELS WINTON*

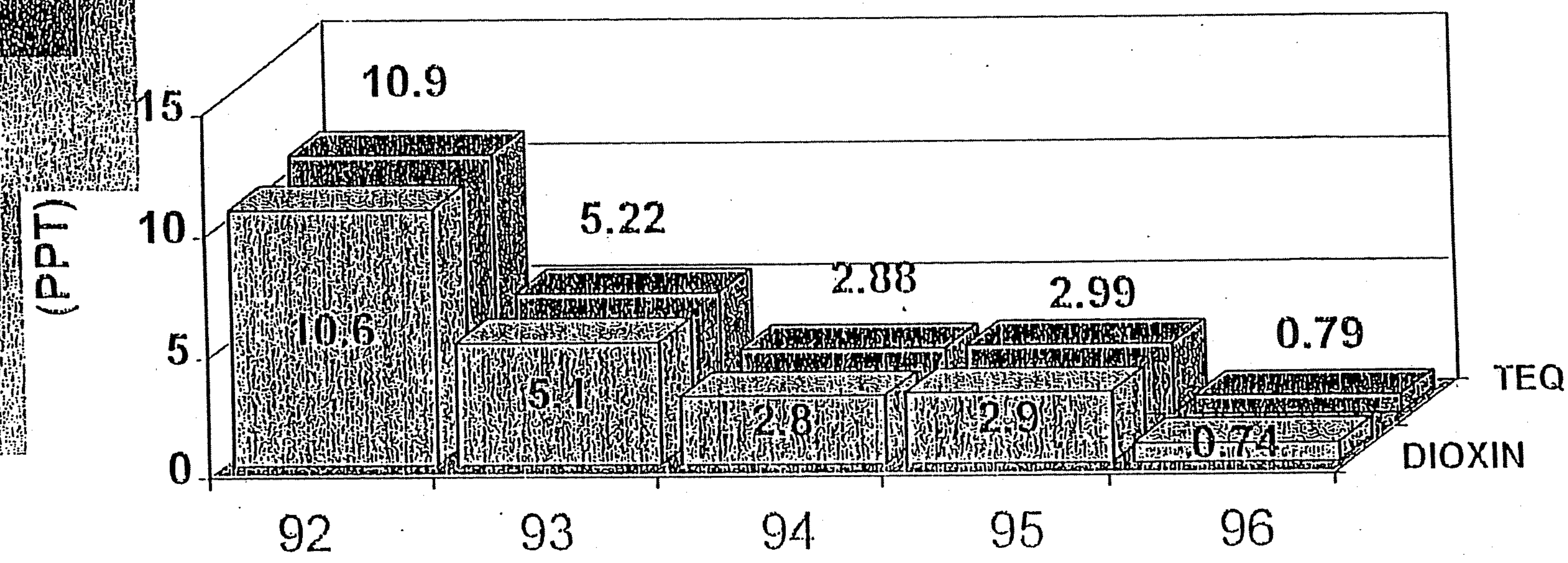


Figure 3.5. Levels of Dioxin and TEQ (ppt) in catfish fillets at Winton, NC; 1992 - 1996.

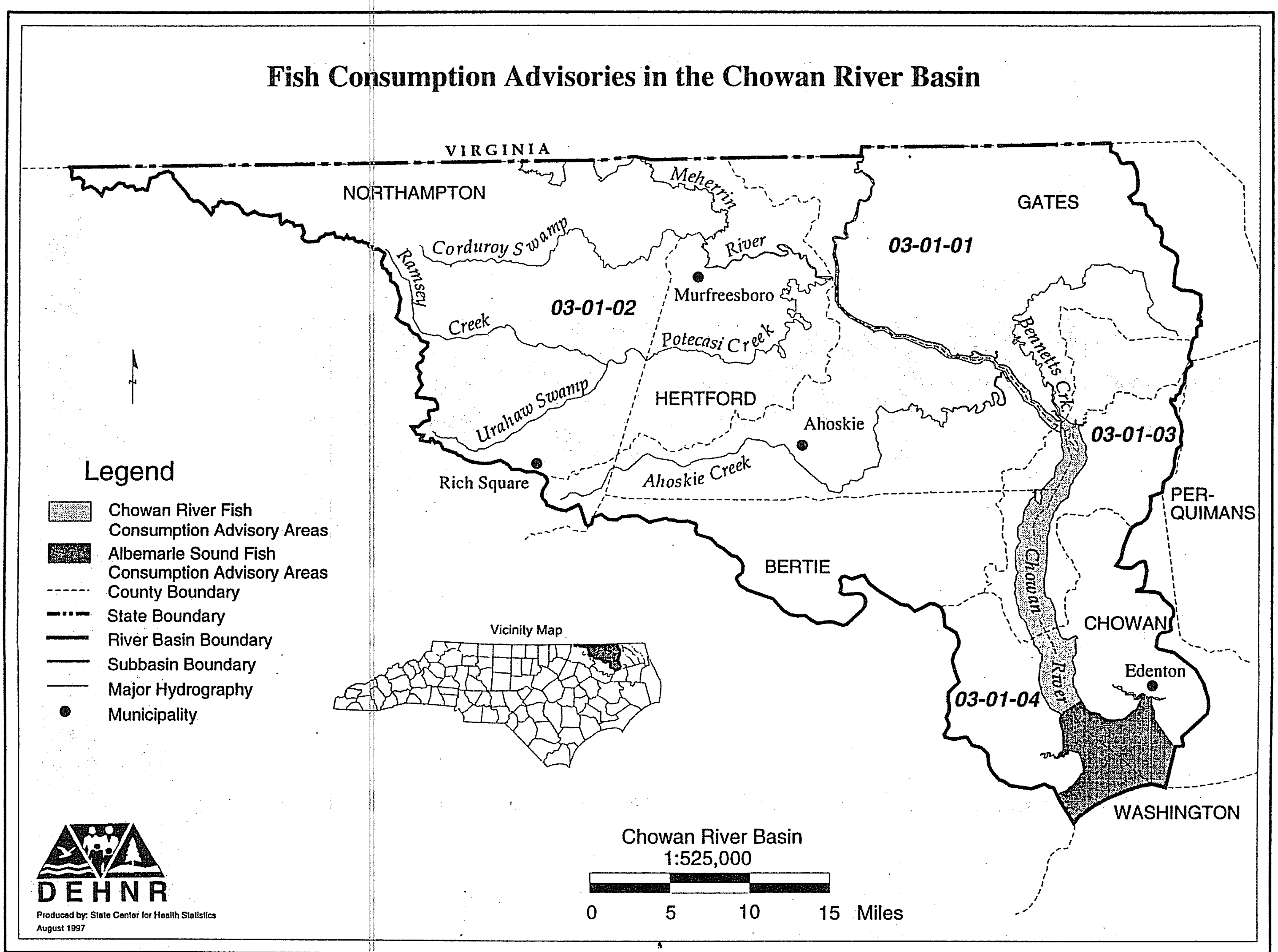


Figure 3.6. Location of area of Dioxin Fish Consumption Advisory in the Chowan River Basin

***pH in the Chowan Basin***

No waters in the Chowan are supplementally classified as swamp waters, but there are clearly areas that exhibit characteristics of swamps, including low pH levels. Many of the small tributary creeks, including Potecasi Creek and the Chowan River near Colerain, have exhibited pH levels below the standard of 6 SU (standard units).

**Metals**

Municipal and industrial dischargers and urban runoff are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals, but the most common ones in municipal permits are cadmium, chromium, copper, nickel, lead, mercury, silver and zinc. Standards are listed in Appendix I. Each of these, with the exception of silver, is also monitored through the ambient network along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Mass balance models are employed to determine allowable concentrations for a permit limit. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals from these industries through a *pretreatment program*. Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution are controlled through best management practices.

In North Carolina, as well as many other areas of the country, mercury contamination in fish is causing the need to post widespread fish consumption advisories. The source of the mercury, which is found all along the east coast from Maine to Florida, is unclear. There is suspicion that it is entering surface waters through atmospheric sources, and there are studies underway to determine whether or not this is the case.

***Metals in the Chowan Basin***

Instances of elevated levels of mercury found in fish in the Chowan River basin have been sporadic. However, on June 12, 1997, a statewide consumption advisory on bowfin was issued due to unsafe mercury levels. The advisory recommends that the general population consume no more than 2 meals of the fish per month, and child-bearing women and children consume no fish.

Along the Chowan River, an abandoned fertilizer plant is now a hazardous waste site because of chromium contamination. Groundwater in the area is contaminated with low concentrations of chromium. However, even though concentrations are low, there is enough contaminated water to exceed the threshold for RCRA designation which is based on pounds of contaminant. DWQs primary concern with this site is the high nitrogen levels in the groundwater and its proximity to the nutrient-enriched Chowan River.

**Chlorine**

Chlorine is a commonly used disinfectant at NPDES discharge facilities which have a domestic (i.e., human) waste component. These discharges are a major source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but its toxic effects can have a significant impact on sensitive aquatic life such as trout and mussels. At this time, no standard exists for chlorine in waters supplementally classified as trout waters and an action level has been established for all other waters. A standard for all waters may be adopted in the future. In the meantime, all new and expanding dischargers are required to dechlorinate their effluent if chlorine is used for disinfection. If a chlorine standard is developed for North Carolina, chlorine limits may be assigned to all dischargers in the State that use chlorine for disinfection.

**Ammonia ($NH_3$)**

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste also contribute to the level of ammonia in a waterbody. At this time, there is no numeric standard for ammonia in North Carolina. However, DWQ has developed an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). These interim criteria are under review, and the State may adopt a standard in the near future.

### 3.2.3 Oxygen-Consuming Wastes

Oxygen-consuming wastes include decomposing organic matter or chemicals which reduce dissolved oxygen in the water column through chemical reactions or biological activity. Raw domestic wastewater contains high concentrations of oxygen-consuming wastes that need to be removed from the wastewater before it can be discharged into a waterway. Maintaining a sufficient level of dissolved oxygen in the water is critical to most forms of aquatic life.

The concentration of dissolved oxygen (DO) in a water body is one indicator of the general health of an aquatic ecosystem. Dissolved oxygen concentrations are affected by a number of factors. Higher dissolved oxygen is produced by turbulent actions, such as waves, rapids and water falls, which mix air and water. Lower water temperatures also generally allows for retention of higher dissolved oxygen concentrations. Therefore, the cool swift-flowing streams of the mountains are generally high in dissolved oxygen. Low dissolved oxygen levels tend to occur more often in warmer, slow-moving waters. In general, the lowest dissolved oxygen concentrations occur during the warmest summer months and particularly during low flow periods. Water depth is also a factor. In deep slow-moving waters, such as reservoirs or estuaries, dissolved oxygen concentrations may be very high near the surface due to wind action and plant (algae) photosynthesis but may be entirely depleted (anoxic) at the bottom.

Sources of dissolved oxygen depletion include wastewater treatment plant effluent, the decomposition of organic matter (such as leaves, dead plants and animals) and organic waste matter that is washed or discharged into the water. Sewage from human and household wastes is high in organic waste matter. Bacterial decomposition can rapidly deplete dissolved oxygen levels unless these wastes are adequately treated at a wastewater treatment plant. In addition, some chemicals may react with and bind up dissolved oxygen. Industrial discharges with oxygen consuming wasteflow may be resilient instream and continue to use oxygen for a long distance downstream.

**Oxygen-Consuming Waste in the Chowan River Basin**

In the Chowan River basin, Potecasi Creek is considered impaired and one of the problem parameters identified is dissolved oxygen. From 1990-1995, 42% of the 67 samples taken from Potecasi Creek violated the minimum DO requirement of 4 mg/l. Agriculture and channelization are the activities suspected to be contributing to the impairment.

In addition, 2 sites on the Blackwater River and 1 site on the Chowan River showed violations of the dissolved oxygen criteria greater than 10% of the time. Some violations may be due to natural swamp conditions.

***Flow and BOD Changes from 1987 to 1996***

Wasteflow and BOD data from the discharge monitoring reports (DMR) for 1987 and 1996 were evaluated for point source trends in the basin. The estimated wasteflow increased from 268 million gallons per year in 1987 to 416 million gallons per year in 1996 (36% increase). Estimated BOD loads also increased from 34,548 pounds per year in 1987 to 70,141 pounds per year in 1996 (51% increase). Average daily loads for BOD were pulled from the DMRs, multiplied by 365 and added together to get the annual point source loadings for BOD. The increases in flow and BOD loading to the system are primaily due to increased wastefow from the Colrain WWTP and United Piece Dye Works facilities. No new surface water discharges have come into the basin since 1987.

### 3.2.4 Sedimentation

Sedimentation is the most widespread cause of nonpoint source pollution in the state and results from land-disturbing activities including agriculture, building and highway construction, uncontrolled urban runoff which erodes streambanks, mining and timber harvesting. Unpaved roads and driveways on steep slopes are also significant sources of sediment. Sedimentation is often divided into two categories: *suspended load* and *bed load*. Suspended load is composed of small particles that remain in suspension in the water. Bed load is composed of larger particles that slide or roll along the stream bottom. Suspension of load types depends on water velocity and stream characteristics. Biologists are primarily concerned with the *concentration* of the suspended sediments and the *degree of sedimentation* on the streambed (Waters 1995).

The concentration of suspended sediments affects the availability of light for photosynthesis, as well as the ability of aquatic animals to see their prey. Several researchers have reported reduced feeding and growth rates by fish in waters with high suspended solids. In some cases it was noted that young fish left those stream segments with turbid conditions. Suspended sediments can clog the gills of fish and reduce their respiratory abilities. These forms of stress may reduce the tolerance level of fish to disease, toxicants and chronic turbid conditions. Suspended solids are reported as Total Suspended Solids or as Turbidity. They are measured in parts per million or milligrams per liter (Waters 1995).

The degree of sedimentation affects both the habitat of aquatic macroinvertebrates and the quality and amount of fish spawning and rearing habitat. Degree of sedimentation can be estimated by observing the amount of streambed covered, the depth of sedimentation, and the percent saturation of interstitial space or embeddedness. Eggs and fry in interstitial spaces may be suffocated by the sediments thereby reducing reproductive success (Waters 1995).

The impact of sedimentation on fish populations depends on both concentration and degree of sedimentation, but impact severity can also be affected by the duration (or dose) of sedimentation. Suspended sediments may occur at high concentrations for short periods of time, or at low concentrations for extended periods of time. The greatest impacts to fish populations will be seen at high concentrations for extended time periods. The use of a dose-response matrix in combination with field investigations can help predict the impact of suspended sediments on various life stages of fish populations (Newcombe 1996).

Sedimentation impacts streams in several other ways. Eroded sediments may gradually fill lakes and navigable waters and may increase drinking water treatment costs. Sediment also serves as a carrier for other pollutants including nutrients (especially phosphorus), toxic metals, pesticides, and road salts.

Statistics compiled by the US Department of Agriculture, Natural Resource Conservation Service (formerly known as the Soil Conservation Service) indicate a statewide decline in erosion from 1982 to 1992 (USDA, NRCS, 1992) as shown in Table 3.3.

Table 3.3. Overall Erosion Trends in North Carolina

| | 1982 | 1987 | 1992 |
|---|---|---|---|
| Area (1,000 acres) | 33,708.2 | 33,708.2 | 33,708.2 |
| Gross Erosion (1,000 tons/yr) | 46,039.5 | 43,264.6 | 36,512.9 |
| Erosion Rate (Tons/Yr/Ac) | 1.1 | 1.4 | 1.3 |

The NRCS statistics also indicate a statewide reduction per acre on cropland erosion using the Universal Soil Loss Equation (Table 3.4).

Table 3.4. USLE Erosion on Cultivated Cropland in North Carolina

| | 1982 | 1987 | 1992 |
|---|---|---|---|
| Cropland Area (1,000 acres) | 6,318.7 | 5956.8 | 5538.0 |
| Gross Erosion (1,000 tons/yr) | 40,921.4 | 37475.3 | 30,908.3 |
| Erosion Rate (Tons/Yr/Ac) | 6.5 | 6.3 | 5.6 |

As can be seen in Table 3.5, compared to other areas of the state, erosion in the eastern North Carolina (tidewater area, Atlantic coast flatwoods, southern coastal plain) is much lower than in mountain areas where slopes are greater.

Table 3.5. North Carolina Erosion on Major Land Resource Areas (MLRA) (in tons/acre/year)

| | 1982 | 1987 | 1992 |
|---|---|---|---|
| Blue Ridge Mountains | 12.7 | 20.8 | 18.3 |
| Southern Piedmont | 12.3 | 12.0 | 10.5 |
| Carolina and Georgia Sand Hills | 6.0 | 5.6 | 5.1 |
| Southern Coastal Plain | 3.9 | 3.9 | 4.0 |
| Atlantic Coast Flatwoods | 3.2 | 3.1 | 3.2 |
| Tidewater Area | 1.4 | 1.5 | 1.6 |

Streambank erosion is a natural process, but one that is accelerated by human activities. Streambank erosion results from two processes: high flows and bank failures. Growth is associated with an increase in impervious surfaces, resulting in higher volumes and rates of flow into receiving streams. Bank failures can occur due to these high flows, or from heavy use of streambanks for cattle or vehicle crossings. Loss of buffer strips along streambanks can greatly contribute to bank erosion. The use of structural techniques such as: bank sloping, use of tree roots for stabilization, buffer strips, and fencing cattle out of streams can greatly reduce streambank erosion. Average annual soil loss has been shown to be decreased by 40% after cattle were fenced away from streams. This decrease resulted in nearly a 60% reduction in average sediment concentration during stormflow events (Owens, et al 1996). Stormwater management measures for urban development areas can also lessen the potential for streambank erosion.

Most sediment-related impacts are associated with nonpoint source pollution. Recommendations aimed at addressing sedimentation are listed in Chapter 6 and programs are briefly described under nonpoint source pollution controls in Chapter 5. Nonpoint sources are considered to be in compliance with the turbidity standard if approved best management practices (BMPs) have been implemented.

**Sedimentation and Erosion in the Chowan River Basin**

Although sedimentation has not been identified as a source of impairment for water bodies in the Chowan River basin, that does not mean that there are no localized impacts from sediment runoff. Sedimentation is more difficult to identify in coastal plain areas because of the waters' naturally sandy substrate.

### 3.2.5 Fecal Coliform Bacteria

Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals. These bacteria are widely used as an indicator of the potential presence of pathogenic, or disease-causing, bacteria and viruses. Common potential sources of fecal coliform bacteria include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations and wildlife, and improperly disinfected wastewater effluent.

Fecal coliform bacteria are widely used as indicators of the potential presence of waterborne pathogenic organisms (which cause such diseases as typhoid fever, dysentery, and cholera). Fecal coliform bacteria in treatment plant effluent are controlled through disinfection methods including chlorination (sometimes followed by dechlorination), ozonation or ultraviolet light radiation.

Fecal Coliform Bacteria in the Chowan River Basin

Fecal coliform bacteria have not been identified as a problem parameter for any impaired waters in the Chowan basin. However, DWQ will continue to monitor bacterial concentrations at ambient locations in the basin to measure any changes that may occur.

## 3.3 POINT SOURCES OF POLLUTION (Including Non-discharging Land-Application Facilities)

### 3.3.1 Defining Point Sources

Point sources refers to discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge. The term applies to wastewater and stormwater discharges from a variety of sources. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems that may serve schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for medium and large municipalities which serve populations greater than 100,000 and stormwater discharges associated with industrial activity as defined in the Code of Federal Regulations [40 CFR 122.26(a)(14)]. The primary pollutants associated with point source discharges are oxygen-demanding wastes, nutrients, sediment, color and toxic substances including chlorine, ammonia and metals.

Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state. Discharge permits are issued under the NPDES program which is delegated to North Carolina by the US Environmental Protection Agency (EPA). See Chapter 5 for a description of the NPDES program and permitting strategies.

Although not technically a "point" source of pollution, some treatment facilities apply their waste to the land as opposed to discharging it to surface waters. These facilities are also required to obtain a non-discharge permit from the state for these operations. They are described in more detail in subsection 3.3.4.

### 3.3.2 Point Source Discharges in the Chowan River Basin

There are 58 permitted NPDES wastewater dischargers in the Chowan River basin. Only one facility (United Piece Dye Works) is considered a "major" facility. These are facilities that are either large (> 1 MGD (million gallons per day)) or industrial discharges that have toxic material in its discharge (this latter category is determined to be major on a discretionary basis). There are 14 dischargers covered under individual permits, 30 covered under general stormwater permits and 14 covered under other general permits. Figure 3.7 shows the location of permitted facilities in the basin (not including stormwater permits which are discussed below). Permit renewals are conducted at five year intervals. Permits for the Chowan River basin are scheduled to be renewed in January of 1998.

Total permitted flow for all facilities is 1.68 million gallons per day (MGD). The average actual flow from all facilities is 1.11 MGD. Table 3.7 provides the total and average discharge for each category of permitted facility. Definitions and examples of the various categories can be found in Table 3.6.

### 3.3.3 Stormwater Point Source Discharges in the Chowan River Basin

Excluding construction general permits, there are 28 general permits and 2 individual stormwater permits issued within the river basin. Activities covered under the general stormwater permits include: construction; mining/borrow pits; metal waste recycling and manufacture of metal products and equipment; manufacture of timber products; apparel, printing, paper, leather, and rubber products manufacturing; vehicle maintenance, transportation, and postal service activities, public warehousing and petroleum bulk stations and terminals; used automobile parts and scrap yards; ready mixed concrete production; manufacture of asphalt paving mixtures and blocks; production of textile mill products; ship and boat building/repairing and marinas. Activities covered under individual permits include resin manufacturers. There are currently no municipalities in the Chowan River basin that are subject to NPDES stormwater permitting.

The primary source of concern from industrial facilities is the contamination of stormwater from contact with exposed materials. In addition, poor site management can lead to significant contributions of sediment and other pollutants which have a detrimental effect on the water quality in receiving streams. There have been no reported water quality concerns associated with permitted stormwater dischargers in this basin.

Table 3.6. Definitions of Categories of NPDES Permits

| CATEGORY | DEFINITION | EXAMPLES |
|---|---|---|
| **Major vs. Minor discharges (NCOO Facilities)** | For publicly owned treatment works, any facility discharging over 1 MGD is defined as a Major discharge.<br>For industrial facilities, the EPA provides evaluation criteria including daily discharge, toxic pollutant potential, public health impact and water quality factors.<br>Any facilities which do not meet the criteria for Major status are defined as Minor discharges. | United Piece Dye Works is the only major permitted facility in the Chowan River basin. |
| **100% Domestic** | A system which treats wastewater containing household-type wastes (bathrooms, sinks, washers, etc.). | Housing subdivision WWTPs, schools, Mobile Home Parks, |
| **Municipal** | A system which serves a municipality of any size. | NC0020630 - Colerain WWTP |
| **Process Industrial** | Water used in an industrial process which must be treated prior to discharge. | Perry-Wynns Fish Company |
| **Nonprocess Industrial** | Wastewater which requires no treatment prior to discharging[1]. | NCG500046 - R.J. Reynolds Tobacco Co. (Non-contact cooling water and cooling tower blowdown) |
| **Stormwater Facilities[2]** | Discharges of runoff from rainfall or snow melt.<br><br>NPDES permits are required for "stormwater discharges associated with industrial activity" and from municipal stormwater systems for towns over 100,000 in population. | "Stormwater discharges associated with industrial activity" include most types of manufacturing plants. Light manufacturing is subject only if they process or store materials outdoors.<br>Landfills, mines, junkyards, steam electric plants, transportation terminals and any construction activity which disturbs 5 acres or more during construction. |

1: Non-contact cooling water may contain biocides; however, the biocides must be approved by our Aquatic Survey and Toxicology Unit. The approval process verifies that the chemicals involved have no detrimental effect on the stream when discharged with the non-contact cooling water.

2: Stormwater facilities are covered by General Permits NCG010000 through NCG190000. Facilities which do not fit the categories of these permits are covered under individual stormwater permits NCS000000.

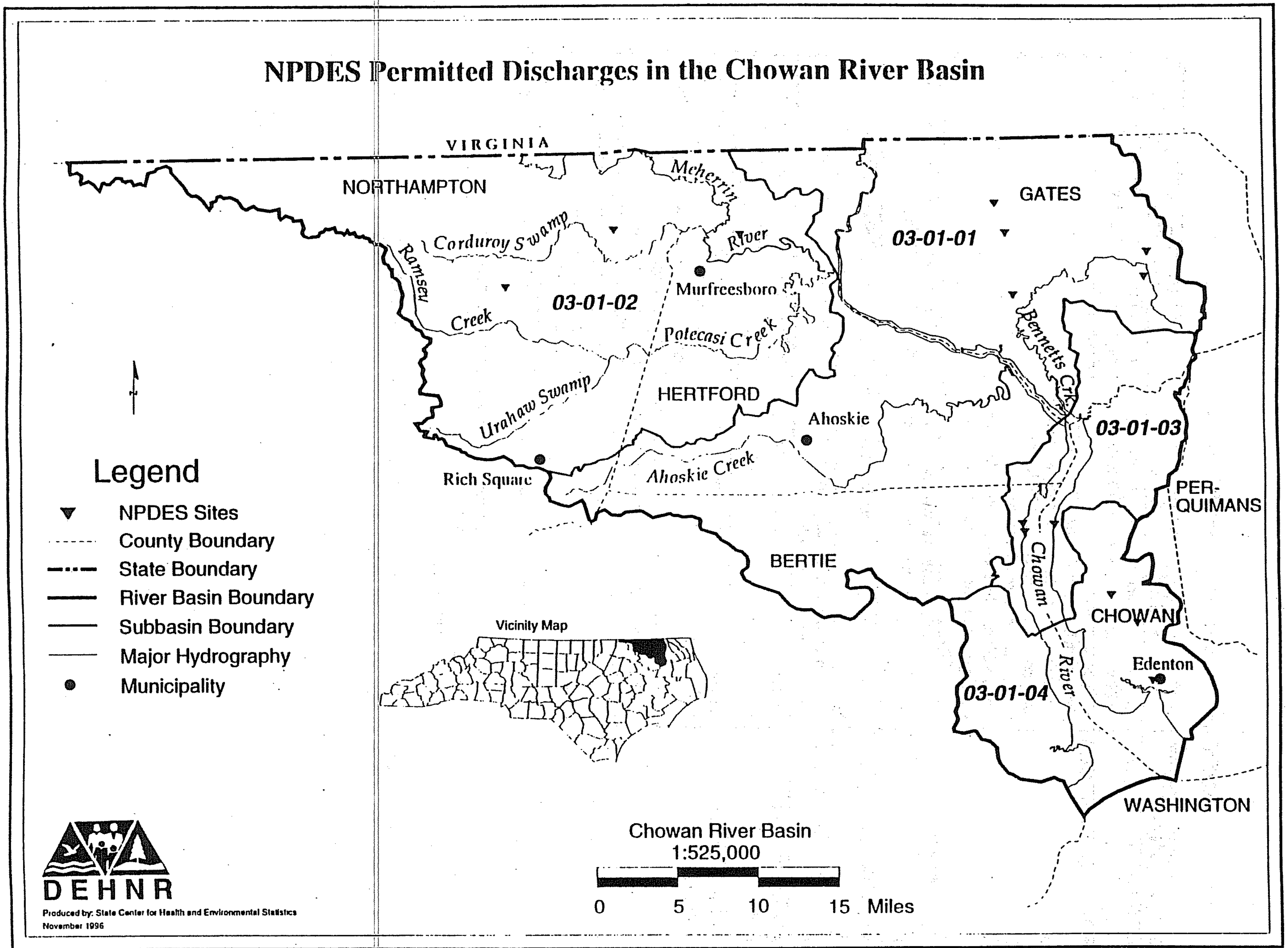


Figure 3.7. Location of NPDES Permitted Wastewater Discharges in the Chowan River Basin

Table 3.7. Summary of Major/Minor NPDES Dischargers and Permitted and Actual Flows by Subbasin for the Chowan River Basin

| FACILITY CATEGORIES | SUBBASIN 01 | 02 | 03 | 04 | TOTALS |
|---|---|---|---|---|---|
| NC00 Individual Facilities | 5 | 3 | 3 | 3 | 14 |
| Stormwater Facilities | 15 | 5 | 2 | 8 | 30 |
| NCG General Permit Facilities | 6 | 6 | 1 | 1 | 14 |
| **Total Facilities** | 26 | 14 | 6 | 12 | **58** |
| Total Permitted Flow (MGD) | 0.02 | 0.04 | 1.60 | 0.02 | **1.68** |
| # of Facilities Reporting | 4 | 2 | 3 | 1 | **10** |
| Total Avg. Flow (MGD) | 0.01 | 0.01 | 1.07 | 0.02 | **1.11** |
| ***Major Discharges** | 0 | 0 | 1 | 0 | **1** |
| Total Permitted Flow (MGD) | 0 | 0 | 1.5 | 0 | **1.5** |
| # of Facilities Reporting | 0 | 0 | 1 | 0 | **1** |
| Total Avg. Flow (MGD) | 0.00 | 0.00 | 0.97 | 0.00 | **0.97** |
| ***Minor Discharges** | 5 | 3 | 2 | 3 | **13** |
| Total Permitted Flow (MGD) | 0.02 | 0.04 | 0.10 | 0.02 | **0.18** |
| # of Facilities Reporting | 4 | 2 | 2 | 1 | **9** |
| Total Avg. Flow (MGD) | 0.01 | 0.01 | 0.10 | 0.02 | **0.14** |
| **100% Domestic Wastewater** | 4 | 2 | 0 | 0 | **6** |
| Total Permitted Flow (MGD) | 0.02 | 0.04 | 0.00 | 0.00 | **0.06** |
| # of Facilities Reporting | 4 | 2 | 0 | 0 | **6** |
| Total Avg. Flow (MGD) | 0.01 | 0.01 | 0.00 | 0.00 | **0.02** |
| **Municipal Facilities** | 0 | 0 | 1 | 0 | **1** |
| Total Permitted Flow (MGD) | 0 | 0 | 0.08 | 0 | **0.08** |
| # of Facilities Reporting | 0 | 0 | 1 | 0 | **1** |
| Total Avg. Flow (MGD) | 0.00 | 0.00 | 0.09 | 0.00 | **0.09** |
| **Major Process Industrial** | 0 | 0 | 1 | 0 | **1** |
| Total Permitted Flow (MGD) | 0 | 0 | 1.5 | 0 | **1.5** |
| # of Facilities Reporting | 0 | 0 | 1 | 0 | **1** |
| Total Avg. Flow (MGD) | 0.00 | 0.00 | 0.97 | 0.00 | **0.97** |
| **Minor Process Industrial** | 0 | 0 | 0 | 1 | **1** |
| Total Permitted Flow (MGD) | 0 | 0 | 0 | 0.00 | **0.00** |
| # of Facilities Reporting | 0 | 0 | 0 | 1 | **1** |
| Total Avg. Flow (MGD) | 0.00 | 0.00 | 0.00 | 0.02 | **0.02** |
| **Nonprocess Industrial** | 0 | 0 | 1 | 0 | **1** |
| Total Permitted Flow (MGD) | 0 | 0 | 0.02 | 0.02 | **0.04** |
| # of Facilities Reporting | 0 | 0 | 1 | 0 | **1** |
| Total Avg. Flow (MGD) | 0.00 | 0.00 | 0.03 | 0.00 | **0.03** |

*** NC00 Individual permit facilities**

### 3.3.4 Non-discharging (Land-application) Wastewater Treatment Facilities

The Division of Water Quality also issues permits for the construction and operation of wastewater treatment systems that utilize non-discharging disposal systems. The following are examples of systems that are regulated and permitted:

- wastewater collection systems
- groundwater remediation facilities
- spray irrigation disposal systems
- reuse of reclaimed water disposal systems,
- land application and surface disposal of residuals,
- animal waste management systems.

DWQs review and permitting of these systems insures construction and operation of these facilities will be completed in accordance with the non-discharge regulations (15A NCAC 2H .0200) and the North Carolina General Statutes. Included in this review are details into the assurance that the facility will not discharge when operated. Senate Bill 1217 which was passed by the 1996 NC General Assembly, requires DWQ to permit animal waste facilities over a certain size. All regulated facilities are currently deemed permitted but will be required to receive coverage under animal waste general permits over the next five years.

In the Chowan basin, there are 17 permitted non-discharge facilities (not including regulated animal operations). These facilities are comprised primarily of industrial spray irrigation and municipal waste spray irrigation systems.

## 3.4 NONPOINT SOURCES OF POLLUTION

Nonpoint source (NPS) pollution refers to runoff that enters surface waters through stormwater, snowmelt or atmospheric deposition (e.g., acid rain). There are many types of land use activities that can serve as sources of nonpoint source pollution including land development, construction, mining operations, timber harvesting, crop production, animal feeding lots, failing septic systems, landfills, roads and parking lots. As noted earlier, stormwater from large urban areas (>100,000 people) and from certain industrial sites is technically considered a point source since NPDES permits are required for piped discharges of stormwater from these areas. However, a discussion of urban runoff will be included in this section.

Sediment and nutrients are major pollution-causing substances associated with nonpoint source pollution. Others include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or removed from the atmosphere and carried into surface waters. Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur at random time intervals depending on rainfall events. Below is a brief description of major areas of nonpoint sources of pollution in the Chowan River Basin.

### 3.4.1 Agriculture

There are a number of activities associated with agriculture that can serve as sources of water pollution. Land clearing and plowing make soils susceptible to erosion, which can then cause stream sedimentation. Pesticides and fertilizers (including chemical fertilizers and animal wastes) can be washed from fields, nursery farms or improperly designed storage or disposal sites. Construction of drainage ditches on poorly drained soils enhances the movement of soluble nutrients into groundwater.

Concentrated animal operations can be a significant source of nutrients, biochemical oxygen demand and fecal coliform bacteria if wastes are not properly managed (see Section 5.3.1 of Chapter 5 for discussion of animal waste rules). Impacts can result from over-application of wastes to fields, from leaking lagoons and from unpermitted flows of lagoon liquids to surface waters from improper waste lagoon management. Also there are potential concerns associated with nitrate-nitrogen movement through the soil from poorly constructed lagoons and from wastes applied to the soil surface.

Sediment production and transport is greatest from row crops and cultivated fields (Waters 1995; Lenat et al. 1979). Contour plowing, terracing, grassed waterways, conservation tillage, and no-till practices are several common methods used by most farmers to minimize soil loss. Maintaining a vegetated buffer between fields and streams is another excellent way to minimize soil loss to streams. Implementing Nondischarge Rule for Animal Waste Management System decreases the introduction of nutrients and fecal coliform bacteria from animal waste.

In the Chowan River basin, agriculture is thought to be the primary source of impairment. The Wiccacon River, Ahoskie Creek, Potecasi Creek and Cutawhiskie Swamp are all partially supporting their uses due to agriculture and channelization. Chapter 5 discusses agricultural nonpoint source control programs. A list of BMPs for addressing agricultural runoff is presented in Appendix V.

### 3.4.2 Urban/Residential

It is commonly known that urban streams are often degraded or impaired streams. Some potential impacts of stormwater runoff include:

- Polluted water: Numerous pollutants may be present in urban stormwater, including sediment, nutrients, bacteria, oxygen demanding substances, oil and grease, trace metals, road salt, and toxic/synthetic chemicals. These pollutants can impair aquatic life, reduce recreational value and threaten public health if drinking water sources and fish tissue become contaminated.
- Flooding: Flooding damages public and private property, including infrastructure. It can also threaten public safety.
- Eroded streambanks: Sediment clogs waterways and fills lakes and reservoirs. It can also smother the plants and animals in waterbodies and destroy the habitat necessary for reproduction of fish and aquatic animals. The erosion of streambanks causes loss of valuable property as stream width grows.
- Economic impacts: The economy can be impacted from a loss of recreation-related business and an increase in drinking water treatment costs.

Runoff from urbanized areas, as a rule, is more localized but can often be more severe than agricultural runoff. Any type of land-disturbing activity such as land clearing or excavation can result in soil loss and cause sedimentation into the waters in the watershed. The rate and volume of runoff in urban areas is much greater due both to the high concentration of impervious surface areas and to storm drainage systems that rapidly transport stormwater to nearby surface waters. This increase in volume and rate of runoff can result in streambank erosion and sedimentation in surface waters.

These drainage systems, including curb and guttered roadways, also allow urban pollutants to reach surface waters quickly and with little or no filtering. Pollutants include lawn care products such as pesticides and fertilizers; automobile-related pollutants such as fuel, lubricants, abraded tire and brake linings; lawn and household wastes (often dumped in storm sewers); road salts, and fecal coliform bacteria (from animals and failing septic systems). The diversity of these pollutants makes it very challenging to attribute water quality degradation to any one pollutant.

Replacement of natural vegetation with pavement, removal of streamside buffers and managed lawns reduce the ability of the watershed to filter pollutants before they enter the stream. The chronic introduction of these pollutants and increased flow and velocity into a stream results in degraded waters. Many urban streams are rated as biologically poor.

The population density map presented in Chapter 2 is an indicator of where urban development and potential urban stream impacts are likely to occur. Between 1982 and 1992, the most significant land use change in the basin was seen in the urban/built-up category with a 59% increase. Although population growth in the basin has been and is projected to be moderate, it will be important to properly manage the growth that will likely occur in the larger municipal areas. Management strategies for addressing urban runoff are presented in Chapter 6. A list of BMPs for addressing urban runoff is presented in Appendix V.

### 3.4.3 Construction

Construction activities that entail excavation, grading or filling (such as road construction or land clearing for development) can produce significant sedimentation if not properly controlled. Sedimentation from developing urban areas can be a major source of pollution due to the cumulative number of acres disturbed in a basin. Construction of single family homes in rural areas can also be a source of sedimentation when homes are placed in or near stream corridors. This latter form of development can be seen throughout the Chowan River basin.

As a pollution source, construction activities are typically temporary, but the impacts can be severe and long lasting (see discussion in sediment section above). Construction activities tend to be concentrated in the more rapidly developing areas of the basin. However, road construction is widespread and often involves stream crossings in remote or undeveloped areas of the basin. In addition, resort development in relatively undeveloped areas can be devastating to previously unimpacted streams.

Construction-related sedimentation is addressed through the Sedimentation Pollution Control Act (see Section 5.5.3 in Chapter 5). A list of BMPs for controlling erosion and sedimentation is presented in Appendix V.

### 3.4.4 Timber Harvesting

Undisturbed forested areas are an ideal land cover for water quality protection. They stabilize the soil, filter rainfall runoff and produce minimal loadings of organic matter to waterways. In addition, forested stream buffers can filter impurities from runoff from adjoining nonforested areas.

Improper forest management practices can adversely impact water quality in a number of ways. Without proper BMPs, large clearcutting operations can change the hydrology of an area and significantly increase the rate and flow of stormwater runoff. This results in both downstream flooding and stream bank erosion. Clearcutting, when compared to selective cutting, can cause a much higher rate of erosion (Waters 1995). Some experts have concluded that sedimentation from timber harvesting is more related to raods and skid trails than it is to the method of harvest (Stone, et. al., 1978).

Careless harvesting and road and stream crossing construction can transport sedimentation to downstream waters. Streams with sedimentation may require many years to restore. Removing riparian vegetation along stream banks can cause water temperature to rise, destabilize the shoreline and minimize or eliminate the runoff protection benefits of the buffer. Sedimentation due to forestry practices is most often associated with the construction and use of logging roads, particularly when roads are built near streams (Waters 1995). Density and length of logging roads can be major factors in the amount of sedimentation produced.

Timber harvesting is an important industry in the Chowan River basin and is sometimes done at the onset of clearing for site development and agricultural activities. However, it is critical that all efforts be made to minimize sediment loss and runoff so as to protect other natural resources in this basin. These resources include anadromous and resident fish spawning areas and habitat, recreational uses and aesthetics. This is especially important in light of a trend toward increased logging in North Carolina and in the southeast United States, in general.

The NC Division of Forest Resources (DFR) is implementing various measures for protecting water quality statewide. These measures began with the creation of voluntary *Forest Practices Guidelies Related to Water Quality* (FPGs). These measures were voluntarily applied best management practices, which had no enforcement power by any agency. In 1989, the Sedimentation Pollution Control Act (SPCA) was amended to require compliance with nine performance standards in order to remain exempt from the SPCA's permitting requirements. These nine standards are the FPGs whose complinace is accomplished throught the use of BMPs. The *Forestry Best Practices Manual* was published in September, 1989 to guide forestry operations in protecting water quality. The manual and the FPGs are available from the DFR office at no charge.

FPG/BMP inspections are carried out continuously by DFR field personnel in the course of their normal duties. Examinations of 3,318 sites in FY 1995-96 revealed an initial compliance rate of 94%. Two systematic surveys by a DFR staff hydrologist in 1995 and 1996 examined 196 and 223 sites respectively. Compliance with FPGs and BMPs was found to be 92% and 95% for the two years, respectively. A summary of activities and past accomplishments in the Chowan River basin is reported in Chapter 5.

Section 5.6.3 describes several programs that are aimed at either encouraging or requiring utilization of forest best management practices at the state and federal level. A list of forest FPGs is presented in Appendix V.

### 3.4.5 Mining

Mining is a common activity in the Piedmont and Coastal Plain regions and can produce high localized levels of stream sedimentation. Sediment may be washed from mining sites or it may enter streams from the wash water used to rinse some mined products. In addition, abandoned gold mined lands are suspected of being the sources of mercury in stream waters because of its historic use for the amalgamation of gold. Mining has not been identified as a source of pollution in the Chowan basin. A list of BMPs to address mining is presented in Appendix V.

### 3.4.6 Onsite Wastewater Disposal

Septic systems contain all of the wastewater from a household or business. The septic tank removes some wastes, but the soil drainfield provides further absorption and treatment. Septic tanks can be a safe and effective method for treating wastewater if they are sized, sited, and maintained properly. However, if the tank or drainfield malfunction or are improperly placed, constructed or maintained, nearby wells and surface waters may become contaminated.

Some of the potential problems from malfunctioning septic system include:

- Polluted groundwater: Pollutants in sewage include bacteria, nutrients, toxic substances, and oxygen-consuming wastes. Nearby wells can become contaminated by septic tanks.
- Polluted surface water: Often, groundwater carries the pollutants mentioned above into surface waters, where they can cause serious harm to aquatic ecosystems. Septic tanks can also leak into surface waters both through or over the soil.
- Risks to human health: Septic system malfunctions can endanger human health when they contaminate nearby wells, drinking water supplies, and fishing and swimming areas.

Pollutants associated with onsite wastewater disposal may also be discharged directly to surface waters through *straight pipes* (i.e., illegal direct pipe connections between the septic system and surface waters). These types of discharges, if unable to be eliminated, must be permitted under the NPDES program and be capable of meeting effluent limitations specified to protect the receiving stream water quality, including disinfection.

Onsite wastewater disposal is most prevalent in rural portions of the basin and at the fringes of urban areas. Fecal coliform contamination from failing septic systems is of particular concern in waters used for swimming, water supply and other related activities (Chapter 4). Regulatory programs and BMPs pertaining to onsite wastewater disposal are presented in Appendix V.

### 3.4.7 Solid Waste Disposal

Solid wastes (usually disposed of in landfills) may include household wastes, commercial or industrial wastes, refuse or demolition waste, infectious wastes or hazardous wastes. Improper disposal of these types of wastes can serve as a source of a wide array of pollutants. The major water quality concern associated with modern solid waste facilities is controlling the leachate and stabilizing the soils used for covering many disposal facilities. Properly designed, constructed and operated facilities should not significantly effect water quality.

Groundwater and surface water monitoring is required at all permitted Municipal Solid Waste Sites (MSW) and all Construction and Demolition landfills. Monitoring efforts have been required since July 1989. All MSW landfills must have a liner system in place by January 1, 1998. All existing unlined landfills must close at this same time.

Section 5.3.5 briefly summarizes state, local and federal solid waste recycling programs.

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# CHAPTER 4

# WATER QUALITY AND USE SUPPORT RATINGS IN THE CHOWAN RIVER BASIN

## 4.1 INTRODUCTION

This chapter provides a detailed overview of water quality and use support ratings in the Chowan River Basin. It is divided into two major parts and six sections.

Water Quality Monitoring and Assessment

- **Section 4.2** describes seven water quality monitoring programs conducted by the Environmental Sciences Branch of the Division of Water Quality's (DWQ's) Water Quality Section as well as other programs local to the basin (Section 4.2.2). Basinwide data summaries are presented for several of the DWQ programs.
- **Section 4.3** presents a summary of the ambient monitoring data for the basin.
- **Section 4.4** presents a more detailed investigation into flow, chlorohyll *a* and phytoplankton data for the Chowan River to assess the current status of nutrient enrichment.
- **Section 4.5** presents a narrative summary of water quality findings for each of the subbasins in the basin. This summary is based on the DWQ monitoring programs described in Section 4.2 Also included are watershed maps which show the locations of monitoring sites.

Use-Support Ratings

- **Section 4.6** introduces the concept of use-support ratings and describes how they are derived. Using this approach, water quality for specific surface waters in the basin is assigned one of the following four use-support ratings: fully supporting uses, fully supporting but threatened, partially supporting or not supporting uses.
- **Section 4.7** presents the use support ratings for many streams and estuaries in the Chowan basin through a series of tables and figures. Included is a color-coded use support map of the basin (Figure 4.20).

## 4.2 WATER QUALITY MONITORING PROGRAMS

### 4.2.1 DWQ Programs

DWQ's monitoring program integrates biological, chemical, and physical data assessment to provide information for basinwide planning. Below is a list of the six major monitoring programs, each of which is briefly described in the following text and Appendix II.

- Benthic macroinvertebrate monitoring,
- Fish population and tissue monitoring,
- Lakes assessment (including phytoplankton monitoring),
- Aquatic toxicity monitoring,
- Special studies and chemical/physical water quality investigations, and
- Ambient water quality monitoring (covering the period 1991-1995).

## Benthic Macroinvertebrate Monitoring

Benthic macroinvertebrates, or benthos, are organisms that live in and on the bottom of rivers, streams and estuaries. The benthic organisms collected most often in freshwater monitoring are aquatic insect larvae. In estuarine (saltwater) systems the benthic organisms most often collected include molluscs (such as clams and snails), crustaceans (such as crabs and shrimp) and polychaetes (worms). The use of benthos data has proven to be a reliable water quality assessment tool (especially in freshwaters), as these organisms are relatively immobile and sensitive to subtle changes in water quality. Since many organisms in a community have life cycles of six months to one year, the effects of short term pollution (such as an oil or chemical spill) will generally not be overcome until the following generation appears. The benthic community also responds to, and shows the effects of, a wide array of potential pollutant mixtures.

For *freshwater* streams and rivers, criteria have been developed to assign five bioclassifications ranging from Poor to Excellent to each benthic sample. The bioclassifications include Excellent, Good, Good- Fair, Fair and Poor. The bioclassifications are based on the number of different kinds of species (taxa) present in three groups of pollution-intolerant insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). These three groups are used to develop EPT ratings. Likewise, ratings can be assigned with a Biotic Index (Appendix II). This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification. Higher taxa richness values (i.e. a greater number of different kinds of species) are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is inadequately assessed by a taxa richness analysis alone. Different classification criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina.

For *estuarine* waters the effort to develop a method to assess water quality based on macroinvertebrates started in North Carolina in late 1990. An Estuarine Biotic Index designed for Florida was modified to create the North Carolina Estuarine Biotic Index (EBI) which more closely reflects taxa and tolerences in North Carolina and can accurately rank sites of different water quality. Biocriteria based on these metrics are still being developed, so at the present time estuarine samples cannot be given a water quality rating.

### <u>Benthic Macroinvertebrate Sampling in the Chowan Basin</u>

Benthic macroinvertebrate sampling has been conducted at ten sites throughout the Chowan basin with results ranging from poor to excellent. In some cases, the swampy nature of the sampling site prevented the assignment of a rating (however, an index is being developed for swamp streams). Based on benthic macroinvertebrate data from 1995, bioclassifications were Fair for the Wiccacon River and Ahoskie Creek and Good-Fair for the Chowan River at Riddicksville. General water quality in the Meherrin River is Good and Fair for Potecasi Creek. The results of benthic macroinvertebrate sampling for all sites in the Chowan River Basin are presented in the individual subbasin discussion in sections 4.5.1 - 4.5.4.

## Fisheries Monitoring

To the public, the condition of the fishery is one of the most meaningful indicators of ecological integrity. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web will affect the abundance, species composition, and condition of the fish population. Two types of fisheries monitoring are conducted by DWQ and described briefly below. The first, called Fish Community Structure, involves assessing the overall health of the fish community. The second, called Fish Tissue

Analysis, involves analyzing fish tissues to determine whether they are accumulating metals or organic chemicals. This information is useful as an indicator of water quality and is also used to determine whether human consumption of these fish poses a potential health risk.

## Fish Community Structure

As noted above, fish community structure involves assessing the overall health of the fish community as a means of assessing the quality of the ecosystem in which the fish reside. Fish community structure is assessed using a method called the North Carolina Index of Biotic Integrity (NCIBI). This method, which is a modification of Karr's IBI (1981), was developed as a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The index, (which is described in more detail in Appendix II), incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. At this time there is no Index of Biotic Integrity calculated for fish populations in lakes.

The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

### *Fish Community Structure in the Chowan Basin*

Fish community structure (IBI) analyses were performed on data from 2 sites in the Chowan River Basin collected by DWQ. One site received a rating of Fair. The other site, although sampled, did not receive a rating because of its swampy nature. Table 4.1 presents this data.

Table 4.1. Fish Community Structure Collections in the Chowan River Basin, 1995.

| Site | Index # | Drainage Area ($mi^2$) | Date | NCIBI Score | NCIBI Rating |
|---|---|---|---|---|---|
| Ahoskie Cr | 25-14-1 | 63.3 | 02/28/95 | 44 | Fair |
| Cutawhiskie Swamp | 25-4-8-8 | 36.8 | 02/28/95 | 38 | NR-Swamp |

## Fish Tissue Analysis

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Therefore, by analyzing fish tissue, determinations about what chemicals are in the water can be made. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species has been documented for heavy metals, pesticides, and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation either directly or through aquatic food webs and may accumulate in fish and shellfish tissues. Therefore, results from fish tissue monitoring can serve as an important indicator of contamination of sediments and surface water. Fish tissue analysis results are also used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem.

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with federal Food and Drug Administration (FDA) *action levels* and U.S. Environmental Protection Agency (EPA) recommended *screening values* for contaminants.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue parameters accompanied by their FDA criteria are presented in Appendix II. At present, the FDA has only developed metals action level criteria for mercury (1.0 ppm). Individual parameters which appear to be of potential human health concern are evaluated by the N.C. Division of Epidemiology by request of DWQ.

***Fish Tissue Analyses in the Chowan Basin***

Fish tissue samples were collected at 10 sites from 1983 to 1995 within the Chowan River Basin consisting of 226 observations. These obervations are summarized in Table 4.2. Samples were collected as part of the DWQ's ambient fish tissue monitoring program or as part of special mercury studies.

The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. Yearly monitoring by Union Camp in North Carolina indicates that dioxin levels are gradually decreasing in fish from the Chowan and Meherrin Rivers since new bleaching technologies were instituted by the company to improve effluent quality. A map of the dioxin advisory area as well as further details on this subject are contained in Section 3.2.2 of Chapter 3.

**Lakes Assessment Program (including Phytoplankton)**

Lakes are valued for the multiple benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lakes Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, at lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed.

One way to evaluate the health of a lake is to examine the growth of phytoplankton. Phytoplankton are microscopic algae found in the water column of lakes, rivers, streams, and estuaries. Phytoplankton populations respond to the availability of nutrients (phosphorus and nitrogen) and other environmental factors such as light, temperature, pH, salinity, water velocity, and grazing by organisms in higher trophic levels. Phytoplankton may be useful as indicators of nutrient overenrichment (see following paragraph on trophic status) and are often collected with water quality samples from lakes. Prolific growths of phytoplankton sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mats on top of the water. These blooms, which are often due to high concentrations of nutrients, may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An Algal Bloom Program was initiated in 1984 to document suspected algal blooms with species identification, quantitative biovolume, and density estimates. Usually, an algal sample with a biovolume larger than 5000 $mm^3/m^3$, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 µg/l (the North Carolina state standard) constitutes a

Table 4.2. **Fish Tissue Sampling Sites and Data Summary for the Chowan River Basin**

| Location | Subbasin | Year(s) sampled | Total samples | Samples > EPA Criteria * | Samples > FDA Criteria * | Samples > NC Dioxin Crit. * |
|---|---|---|---|---|---|---|
| Chowan R. near Riddicksville | 01 | 80-95 | 95 | 28 mercury | 12 mercury | |
| Chowan R. near Winton | 01 | 88-95 | 9 | | | |
| Merchants Millpond | 01 | 95 | 14 | 1 mercury | | |
| Wiccacon R. at NC-45 | 01 | 94-95 | 43 | 20 mercury | 4 mercury | |
| Chowan R. at Gatlington | 01 | 90-95 | 17 | | | 5 |
| Mehherin R. at Rt. 258 | 02 | 89-95 | 33 | 3 mercury | | 5 |
| Chowan R. at Holiday Island | 03 | 95 | 14 | 1 mercury | | |
| Chowan R. at Colerain | 03 | 80-94 | 28 | 1 mercury | 1 mercury | |
| Chowan R. at Marker 16 | 03 | 89-95 | 29 | | | 10 |
| Chowan R. at Marker 9 | 03 | 89-95 | 15 | | | 13 |
| Chowan R. at Marker 5 | 03 | 89-95 | 26 | | | 10 |
| Pembroke Creek at Edenton | 04 | 95 | 18 | 2 mercury | | |
| Salmon Creek | 04 | 95 | 13 | 1 mercury | 1 mercury | |
| Chowan R. at Edenhouse | 04 | 80,81,90 | 63 | | | 27 |
| Chowan R. at Marker 2 | 04 | 90-95 | 11 | | | 9 |

* Number of samples greater than listed criteria. For EPA and FDA criteria, the parameter violated is listed with the number of violations.

bloom. Bloom samples may be collected as a result of complaint investigations, fish kills, or during routine monitoring if a bloom is suspected.

Another measure of water quality in lakes is the North Carolina Trophic State Index (NCTSI). This is a numerical index that is used to evaluate the trophic status of lakes, and it can be used to determine whether the designated uses of a lake have been threatened or impaired by pollution. Trophic status is a relative measure of nutrient enrichment and productivity. The NCTSI index is based on total phosphorus, total organic nitrogen, secchi depth (water clarity indicator) and chlorophyll *a*. Based on this index, a lake is assigned one of five trophic status classifications: Oligotrophic, Mesotrophic, Eutrophic, Hypereutrophic and Dystrophic. Oligotrophic lakes are those that have the lowest levels of enrichment and generally have good clarity and no problems with algal blooms. At the other end of the spectrum are eutrophic and hypereutrophic lakes which have a lot of plant productivity which can cause nuisance problems and have little clarity in the water column. Dystrophic lakes are acidic blackwater lakes scattered throughout the coastal plain. Their NCTSI scores are highly skewed because of their natural discoloration. Further details of the NCTSI can be found in Appendix II.

**Lakes Studies in the Chowan**

Merchants Millpond is the only lake which has been monitored in the Chowan River Basin as part of the Lakes Assessment Program. Merchants Millpond was sampled most recently in 1995. The mean depth of the millpond is four feet (1.2 meters), the surface area is 450 acres (182 hectares) and the volume is 0.2 $\times 10^6 m^3$. Land use is mostly forest or wetlands and agriculture with scattered residential areas. A heavy growth of aquatic macrophyte infestation throughout the lake along with elevated nutrient concentrations characterizes this impoundment.

In 1995, Merchant's Millpond had a NCTSI score of 2.5, indicating that the lake is eutrophic. The proliferation of aquatic macrophytes, which cover the lake's surface, is not uncommon in millponds. Both shallow depth and the long retention time of these ponds encourage the growth of aquatic macrophytes. This is the case with Merchants Millpond. The abundance of these plants in Merchants Millpond has been determined as a threat to designated uses (primarily canoeing and fishing). Low dissolved oxygen values also indicate that the uses of this lake are threatened. In 1995 the park had 85,000 visitors (Tingley, personal communication). During summers when macrophytes are abundant, park visitation could be affected due to the difficulty of maneuvering canoes through the vegetation.

Merchants Millpond was previously sampled by DWQ in 1981, 1983, 1984, 1985 and 1986. Total phosphorus and total kjeldahl nitrogen have been consistently elevated during these years. Since 1981, consistent concerns have been expressed for the heavy growth of aquatic macrophytes and the accumulation of sediment in the lake. Mean surface dissolved oxygen was consistently below the 5.0 mg/l level for each of these sampling years except for 1983 when the mean value was 6.1 mg/l (range = 5.2 to 7.0 mg/l).

## Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of wastewater treatment 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. The Aquatic Survey and Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update 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.

Aquatic Toxicity Monitoring in the Chowan

United Piece Dye Works is the only facility in the basin that is required to monitor whole effluent toxicity by their NPDES permit. Other facilities may be tested by DWQ's Aquatic Toxicology Laboratory.

**Special Studies and Chemical/Physical Characterizations**

Water quality simulation models are often used for the purpose of determining wasteload allocations. These models must accurately predict water body responses to different waste loads so that appropriate effluent limits can be included as requirements in National Pollutant Discharge Elimination System (NPDES) permits. Where large financial expenditures or the protection of water quality is at risk, models should be calibrated and verified with actual in-stream data. Because sufficient historical data are often lacking, intensive water quality surveys are required to provide the field data necessary to accomplish model calibration and verification. Intensive water quality surveys are performed on water bodies below existing or proposed wastewater dischargers and usually consist of a time-of-travel dye study, flow measurements, physical and chemical samples, long-term biochemical oxygen demand ($BOD_{lt}$) analysis, water body channel geometry, and effluent characterization analysis.

Special Studies and Chemical/Physical Characterizations in the Chowan River Basin

Over the years, the Chowan River has been the subject of several special studies. Most of these have been related to the problems with nutrient enrichment, although one was part of a study of selected marinas to investigate water quality, sediment quality and clam tissue. The nutrient section of Chapter 3 provides a thorough review of special nutrient studies conducted on the Chowan River.

**Ambient Monitoring System**

The Ambient Monitoring System (AMS) is a network of stream, lake, and estuarine stations strategically located for the collection of physical and chemical water quality data or water quality parameters. Sampling stations are sited under one or more of the following monitoring designations:

Fixed Monitoring Stations
Point source
Nonpoint source
Baseline Water Supply

Rotating Monitoring Stations
Basinwide Information
HQW & ORW

Parametric coverage is tiered by the waterbody's assigned surface water quality classification and corresponding water quality standards. Under this arrangement, core parameters are based on Class C waters with additional parameters added based on other classifications. Table 4.3 presents the parameters monitored for the classifications assigned to waters in the Chowan River Basin. The next section (4.3) summarizes the results of ambient monitoring done in the Chowan basin.

Table 4.3. Ambient Monitoring System Freshwater Parametric Coverage.

<u>Class C and Class B Waters (minimum monthly coverage for all stream stations)</u>

***Field Parameters*:** dissolved oxygen, pH, conductivity, temperature, chlorine,
***Nutrients*:** total phosphorus, ammonia, total Kjeldahl nitrogen, nitrate+nitrite
***Physical Measurements:*** total suspended solids, turbidity, hardness
***Bacterial:*** fecal coliforms (Membrane Filter method)
***Metals:*** aluminum (no present water quality standard), arsenic, cadmium, chromium, copper*, iron*, lead, mercury, nickel, silver*, zinc*

<u>Nutrient Sensitive Waters</u>
Chlorophyll *a* (where appropriate)

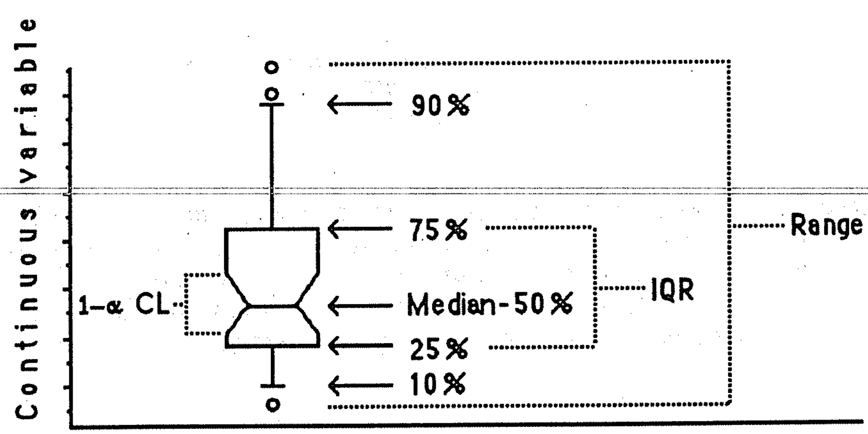
**PLUS** any additional parameters of concern for individual station locations.

*Action level water quality standard.

Ambient water quality data are often summarized using box and whisker plots (for example see Figure 4.8). Figure 4.1 provides an explanation of how to interpret the plots.

Figure 4.1 Box and Whisker Plots

Box and whisker plot are useful for the visual comparison of single variable data sets. After the data have been ordered from low to high, the 10th, 25th, 50th, 75th, and 90th percentiles are calculated for plot construction. Box and whisker plots display the following important information: 1) the interquartile range (IQR) which measures the distribution and variability of the bulk of the data (located between the 25th and 75th percentiles), 2) the desired confidence interval (1- CL) for measuring the statistical significance of the median (50th percentile), 3) indication of skew from comparing the symmetry of the box above and below the median, 4) the range of the data from the lowest to highest values, and 5) the extreme values below the 10th percentile and above the 90th percentile (depicted as dots).




Visual comparison of confidence level notches about the medians of two or more box plots can be used to roughly perform hypothesis testing. If the box plots represent data from samples assumed to be independent, then overlapping notches indicate no significant difference in the samples at a prescribed level of confidence. Formal tests should subsequently be performed to verify preliminary conclusions based on visual inspection of the plots.

### 4.2.2 Local Water Quality Monitoring Programs

**Citizen Monitoring Program**

The Albemarle-Pamlico Citizen's Water Quality Monitoring Program (APMP) is a volunteer estuary monitoring program begun in 1987 with funding from the Albemarle-Pamlico Estuarine Study. Approximately 65 volunteers monitor water quality from over 100 monitoring sites in the Albemarle-Pamlico Estuary located in southeastern Virginia and northeastern North Carolina. Housed at East Carolina University (ECU), the program has two basic goals: to promote stewardship of the region's water resources by encouraging public participation in volunteer monitoring, and to collect high quality scientific data to provide a baseline characterizing the condition of the estuary's water quality.

The APMP is a perfect example of how everyone concerned with water quality can benefit from volunteer monitoring. The program director, Patrick Stanforth, works closely with the Department of Environment Health and Natural Resources regional office providing data to the Division of Water Quality. The program is actively involved in education involving school children, scouting clubs, and camps in monitoring efforts. The data are also used by graduate and undergraduate students at ECU in class projects and the program utilizes several work-study students. In addition, there is coordination with local nonprofit organizations including the Pamlico Tar River Foundation, Pungo River Fisherman Association, Carteret Crossroads, and the North Carolina Coastal Federation. These are just a few examples of the people the APMP is involved with.

Water quality samples are collected weekly during the summer and twice monthly during the winter. The samples are taken at the same site, at approximately the same time of day, and on the same day of the week. This ensures that the data are easily compared and any changes (at the site) are quickly made apparent. The parameters monitored are: Air and water temperature, turbidity, water depth, salinity, dissolved oxygen, pH, rainfall and other observations. These are tested from a bucket of surface water collected at the site. Figure 4.2 illustrates the location of sampling sites in the Chowan River Basin.

Data are received monthly by the director from the volunteers. The data are then verified and entered in to a database. The data are stored on the database and it is available to anyone caring to use it.

**State of Virginia Water Quality Program**

The Virginia Department of Environmental Quality has a surface water quality monitoring program that includes 896 monitoring locations (VDEQ, 1994). These stations are sampled for chemical and physical parameters on a variable basis to determine water quality conditions. In an average year, approximately 35,000 samples are collected to perform approximately 247,000 analyses. A subset of 51 of these stations form a portion of the Core Monitoring Program. These stations are sampled for pesticides, metals and organics in fish tissue and sediment on a three year cycle. Approximately 150 biological monitoring stations were sampled to determine the health of the bottom dwelling invertebrate population and ability of the stream to support a balanced aquatic community. In the Chowan-Dismal Swamp Basin of Virginia, there are 64 ambient monitoring stations and 8 biological monitoring stations.

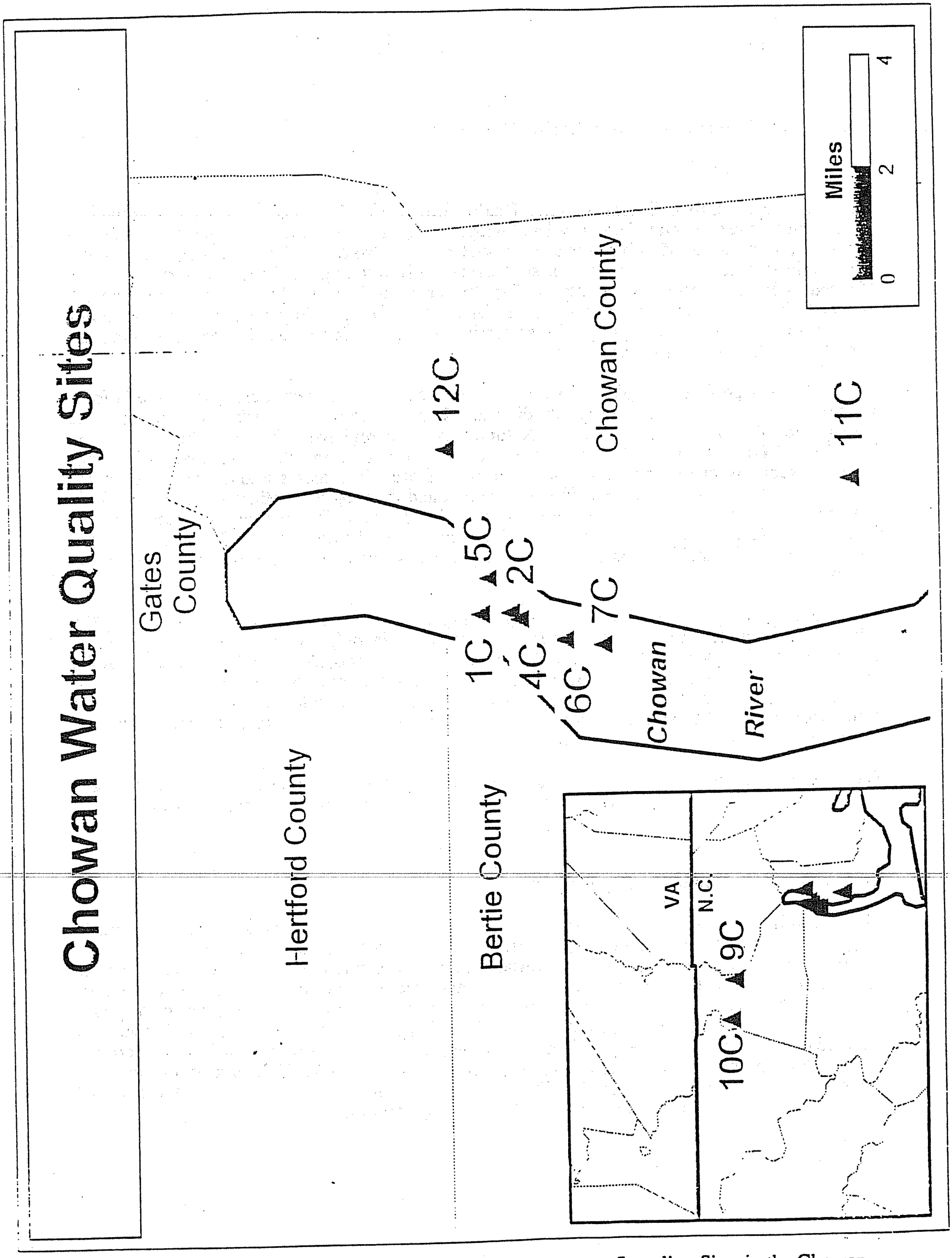



Figure 4.2. Location of Citizen Monitoring Program Sampling Sites in the Chowan River Basin

## 4.3 SUMMARY OF AMBIENT MONITORING DATA FOR THE CHOWAN RIVER BASIN

AMS stations for the basin are listed in Table 4.4 below. North Carolina has 12 stations in the Chowan River Basin. Seven stations are located on the mainstem of the Chowan River (one of these being at the mouth of the river in the Albemarle Sound) and three stations located on the Blackwater and Nottaway Rivers which form the Chowan. Also, there is one station at the mouth of the Meherrin River, a major tributary and one on Potecasi Creek. The locations of these stations are illustrated in the map on the next page (Figure 4.3).

Table 4.4. Ambient Monitoring System Stations Within the Chowan Basin.

| Primary No | STORETNo | Station Name | Subbasin |
|---|---|---|---|
| Chowan River Drainage | | | |
| 02047370 | D0000050 | NOTTAWAY RIVER AT US 258 NEAR RIVERDALE VA | 030101 |
| 02050065 | D0001200 | BLACKWATER RIVER AT HORSESHOE BEND AT CHERRY GROVE VA | 030101 |
| 0205007750 | D0001800 | BLACKWATER RIVER 150 YARDS ABOVE MOUTH NEAR WYANOKE NC | 030101 |
| 02050079 | D0010000 | CHOWAN RIVER NEAR RIDDICKSVILLE NC | 030101 |
| 02053200 | D4150000 | POTECASI CREEK NEAR UNION NC | 030102 |
| 0205321790 | D5000000 | MEHERRIN RIVER AT SR 1175 PARKERS FERRY NR COMO NC | 030102 |
| 02053244 | D6250000 | CHOWAN RIVER AT US 13 AT WINTON NC | 030101 |
| 02053574 | D8356200 | CHOWAN RIVER AT MARKER 16 NEAR GATESVILLE NC | 030101 |
| 0205360615 | D8430000 | CHOWAN RIVER 200 YARDS BELOW HOLIDAY ISLAND | 030103 |
| 02053632 | D8950000 | CHOWAN RIVER AT MARKER 17 AT COLERAIN NC | 030103 |
| 02053652 | D9490000 | CHOWAN RIVER AT US 17 AT EDENHOUSE NC | 030105 |
| 02081145 | D9995000 | ALBEMARLE SOUND NEAR EDENTON NC | 030104 |

Table 4.5 summarizes by parameter data collected at ambient stations in the Chowan Basin where there are one or more excursions (or deviation) from the numerical water quality criteria. Each station includes the following information:

- parameter that exceeds the criterion
- total number of samples
- number of samples with less than the detection level recorded
- the number of samples for that paramter that represented an excursion from a water quality criterion

It should be noted that there are limitations to ambient water quality data. Because of the limited sampling frequency, the water quality sample may not be taken during a significant water quality event. It also should be noted that the criteria are presented as numerical and represent instantaneous measurements. The actual standard may include a narrative, such as turbidity, and, as in some metals criteria, may be based on extended exposure at or above the criteria to expect chronic toxicity of the most sensitive species of organism. Therefore the table is useful for relative comparisons between locations and screening areas where frequent excursions of individual or multiple parameters suggest waters that might be targeted for more detailed evaluations and/or specific management strategies. A more thorough evaluation can include review of temporal and spatial trends, association of concentrations to flow, degree of excursion from the criterion, or use of other analytical methods. Table 4.6 shows totals from Table 4.5 as total samples, total excursions and percent excursions of total samples for each ambient station.

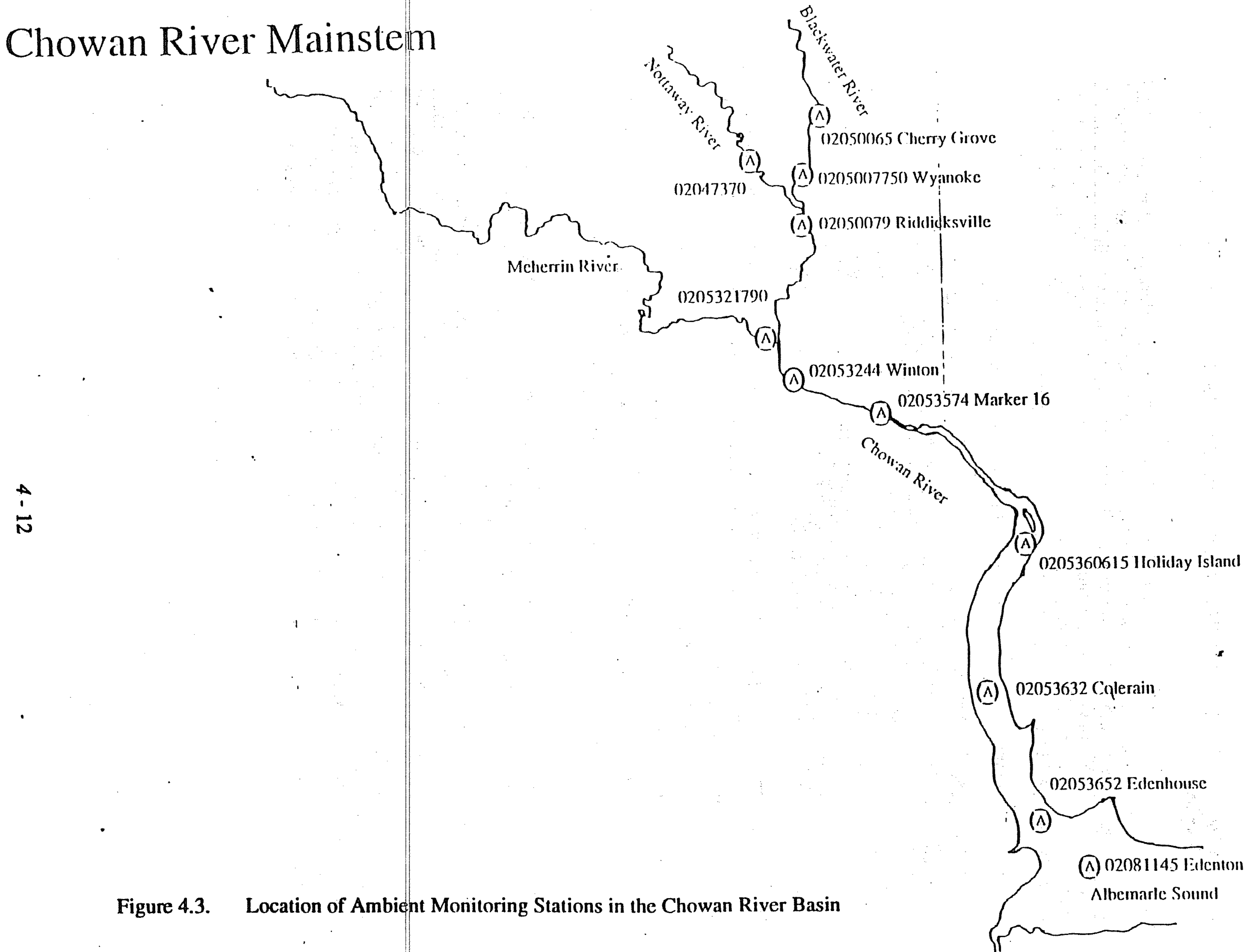



Figure 4.3. Location of Ambient Monitoring Stations in the Chowan River Basin

Table 4.5. Summary of Ambient Monitoring System Station Data Excursions from the NC Water Quality Criteria by Parameter. January 1990 to December 1994.

| Station Number | Station Name | Parameter/Criterion | Samples All | Samples <Det | Samples Excur |
|---|---|---|---|---|---|
| 0205360615 | CHOWAN RIVER 200 YDS BELOW HOLIDAY ISLAND | Chlorophyll a (Corr)(µg/l)(40) | 60 | 25 | 1 |
| 020253632 | CHOWAN RIVER AT MARKER 17 AT COLERAIN NC | Chlorophyll a (Corr)(µg/l)(40) | 62 | 23 | 3 |
| 020247370 | NOTTAWAY RIVER AT US 258 NEAR RIVERDALE VA | Dissolved Oxygen (mg/l)(4) | 64 | 0 | 3 |
| 020250065 | BLACKWATER RIVER AT HORSESHOE BEND AT CHERRY GR | Dissolved Oxygen (mg/l)(4) | 64 | 0 | 23 |
| 0205007750 | BLACKWATER RIVER 150 YDS AB MTH NEAR WYANOKE NC | Dissolved Oxygen (mg/l)(4) | 59 | 0 | 11 |
| 020250079 | CHOWAN RIVER NEAR RIDDICKSVILLE NC | Dissolved Oxygen (mg/l)(4) | 65 | 0 | 11 |
| 020253200 | POTECASI CREEK NEAR UNION NC | Dissolved Oxygen (mg/l)(4) | 67 | 0 | 29 |
| 0205321790 | MEHERRIN RIVER AT SR 1175 PARKERS FERRY NR COMO NC | Dissolved Oxygen (mg/l)(4) | 64 | 0 | 4 |
| 020253244 | CHOWAN RIVER AT US 13 AT WINTON NC | Dissolved Oxygen (mg/l)(4) | 64 | 0 | 2 |
| 020253574 | CHOWAN RIVER AT MARKER 16 NEAR GATESVILLE NC | Dissolved Oxygen (mg/l)(4) | 64 | 0 | 2 |
| 02050065 | BLACKWATER RIVER AT HORSESHOE BEND AT CHERRY GR | Fecal Coliform (#/100ml)(200) | 62 | 18 | 1 |
| 0205007750 | BLACKWATER RIVER 150 YARDS ABMTH NEAR WYANOKE NC | Fecal Coliform (#/100ml)(200) | 59 | 17 | 1 |
| 02053200 | POTECASI CREEK NEAR UNION NC | Fecal Coliform (#/100ml)(200) | 6 | 1 | 1 |
| 0205321790 | MEHERRIN RIVER AT SR 1175 PARKERS FERRY NR COMO NC | Fecal Coliform (#/100ml)(200) | 63 | 32 | 1 |
| 02053574 | CHOWAN RIVER AT MARKER 16 NEAR GATESVILLE NC | Fecal Coliform (#/100ml)(200) | 57 | 41 | 1 |
| 0205360615 | CHOWAN RIVER 200 YARDS BELOW HOLIDAY ISLAND | Fecal Coliform (#/100ml)(200) | 58 | 36 | 1 |
| 020253652 | CHOWAN RIVER AT US 17 AT EDENHOUSE NC | Lead (µg/l)(25) | 23 | 22 | 1 |
| 020247370 | NOTTAWAY RIVER AT US 258 NEAR RIVERDALE VA | pH (SU)(6.0-9.0) | 63 | 0 | 5 |
| 020250065 | BLACKWATER RIVER AT HORSESHOE BEND AT CHERRY GR | pH (SU)(6.0-9.0) | 63 | 0 | 6 |
| 0205007750 | BLACKWATER RIVER 150 YDS AB MTH NEAR WYANOKE NC | pH (SU)(6.0-9.0) | 59 | 0 | 4 |
| 020250079 | CHOWAN RIVER NEAR RIDDICKSVILLE NC | pH (SU)(6.0-9.0) | 65 | 0 | 5 |
| 020253200 | POTECASI CREEK NEAR UNION NC | pH (SU)(6.0-9.0) | 67 | 0 | 12 |
| 0205321790 | MEHERRIN RIVER AT SR 1175 PARKERS FERRY NR COMO NC | pH (SU)(6.0-9.0) | 63 | 0 | 5 |
| 020253244 | CHOWAN RIVER AT US 13 AT WINTON NC | pH (SU)(6.0-9.0) | 63 | 0 | 7 |
| 020253574 | CHOWAN RIVER AT MARKER 16 NEAR GATESVILLE NC | pH (SU)(6.0-9.0) | 64 | 0 | 4 |
| 0205360615 | CHOWAN RIVER 200 YDS BELOW HOLIDAY ISLAND | pH (SU)(6.0-9.0) | 67 | 0 | 5 |
| 020253632 | CHOWAN RIVER AT MARKER 17 AT COLERAIN NC | pH (SU)(6.0-9.0) | 68 | 0 | 8 |
| 020253652 | CHOWAN RIVER AT US 17 AT EDENHOUSE NC | pH (SU)(6.0-9.0) | 67 | 0 | 1 |
| 020281145 | ALBEMARLE SOUND NEAR EDENTON NC | pH (SU)(6.8-8.5) | 123 | 0 | 11 |
| 020253200 | POTECASI CREEK NEAR UNION NC | Turbidity (NTU)(50) | 66 | 0 | 2 |

Table 4.6. Summary of Ambient Monitoring System Station Data Excursions from the NC Water Quality Criteria by Total Samples. January 1990 to December 1994.

| Station Number | Station Name | Total | <Det | Samples Excursions | %Excursions |
|---|---|---|---|---|---|
| 02047370 | NOTTAWAY RIVER AT US 258 NEAR RIVERDALE VA | 279 | 49 | 8 | 2.9 |
| 02050065 | BLACKWATER RIVER AT HORSESHOE BEND AT CHERRY GR | 335 | 81 | 30 | 9.0 |
| 0205007750 | BLACKWATER RIVER 150 YARDS AB MTH NEAR WYANOKE NC | 315 | 77 | 16 | 5.1 |
| 02050079 | CHOWAN RIVER NEAR RIDDICKSVILLE NC | 311 | 83 | 16 | 5.1 |
| 02053200 | POTECASI CREEK NEAR UNION NC | 295 | 68 | 44 | 14.9 |
| 0205321790 | MEHERRIN RIVER AT SR 1175 PARKERS FERRY NR COMO NC | 634 | 411 | 10 | 1.6 |
| 02053244 | CHOWAN RIVER AT US 13 AT WINTON NC | 335 | 82 | 9 | 2.7 |
| 02053574 | CHOWAN RIVER AT MARKER 16 NEAR GATESVILLE NC | 330 | 92 | 7 | 2.1 |
| 0205360615 | CHOWAN RIVER 200 YARDS BELOW HOLIDAY ISLAND | 342 | 85 | 7 | 2.0 |
| 02053632 | CHOWAN RIVER AT MARKER 17 AT COLERAIN NC | 315 | 90 | 11 | 3.5 |
| 02053652 | CHOWAN RIVER AT US 17 AT EDENHOUSE NC | 453 | 192 | 2 | 0.4 |
| 02081145 | ALBEMARLE SOUND NEAR EDENTON NC | 618 | 169 | 11 | 1.8 |
| | Grand total | 4562 | 1479 | 171 | 3.7 |

As the data from Tables 4.5 and 4.6 show, within the Chowan drainage there have been some excursions from the water quality criterion. The parameters with the majority of the excursions are dissolved oxygen and pH. The dissolved oxygen excursions occurred on the Blackwater River and in the upper Chowan River, and pH excursions occurred on Potecasi Creek and in the Albemarle Sound at the mouth of the Chowan River. In addition to Potecasi Creek and Albemarle Sound there are a number of low pH excursions distributed more or less equally throughout the drainage. Due to the swampy nature of this basin, these acidic conditions are likely natural. Discussion of fecal coliform excursions and conditions will take place in the last part of this section.

Examining the dissolved oxygen data over the past five years for the mainstem of the Chowan River, several excursions below the criterion were recorded at the upper sites at Riddicksville, Winton and Marker 16. However, as Figure 4.4 illustrates, many of the low dissolved oxygen readings occurred seasonally during the warmer months and these dips are natural for slow-moving, swampy, black-water systems such as the Chowan. The same seasonal fluctuation is evident when dissolved oxygen levels for the Chowan River are viewed for data going back to 1980 (Figure 4.5).

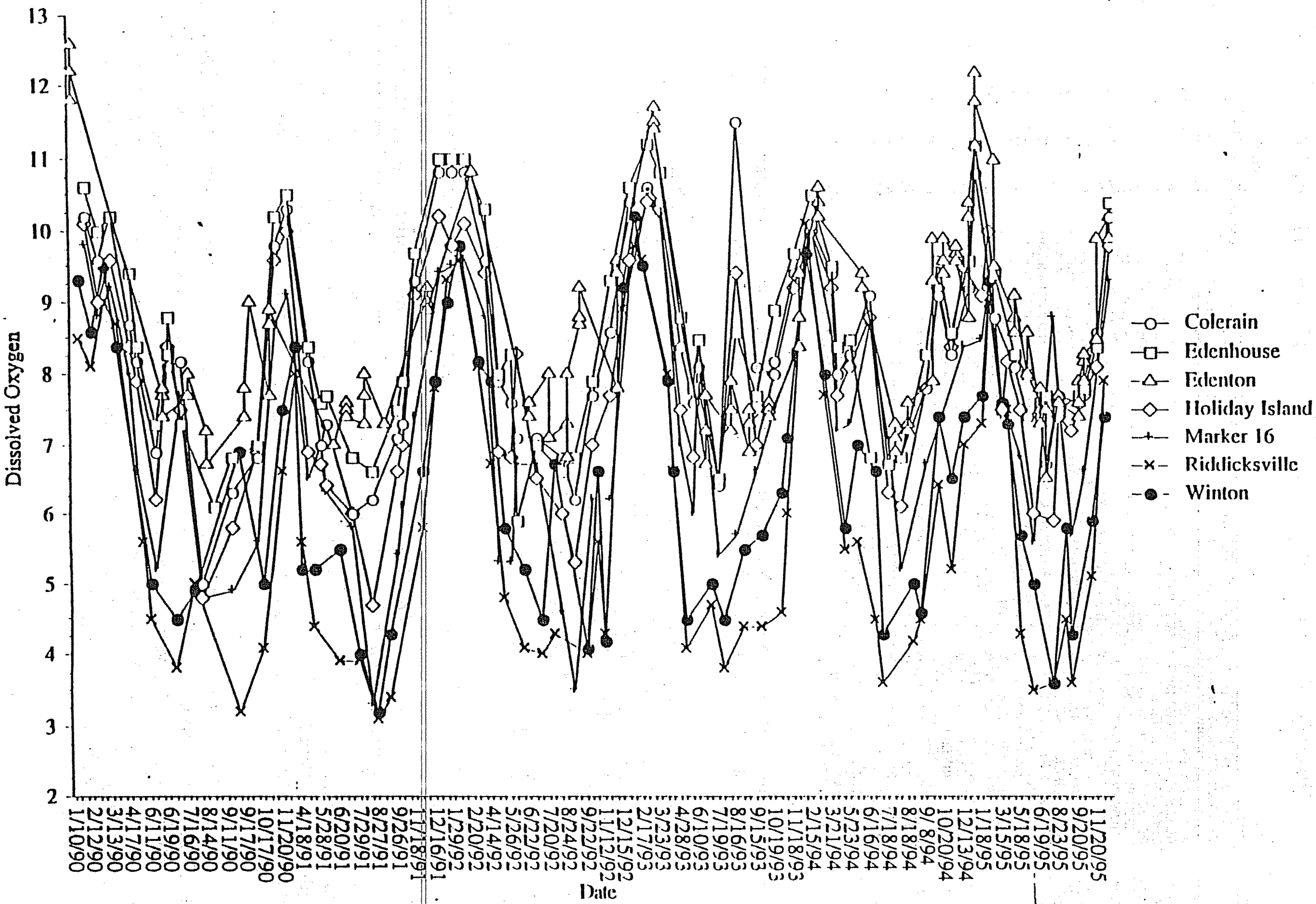



Figure 4.4. Chowan River Basin Mainstem Ambient Monitoring Sites. Dissolved Oxygen (mg/l) data - 1990 to 1995.

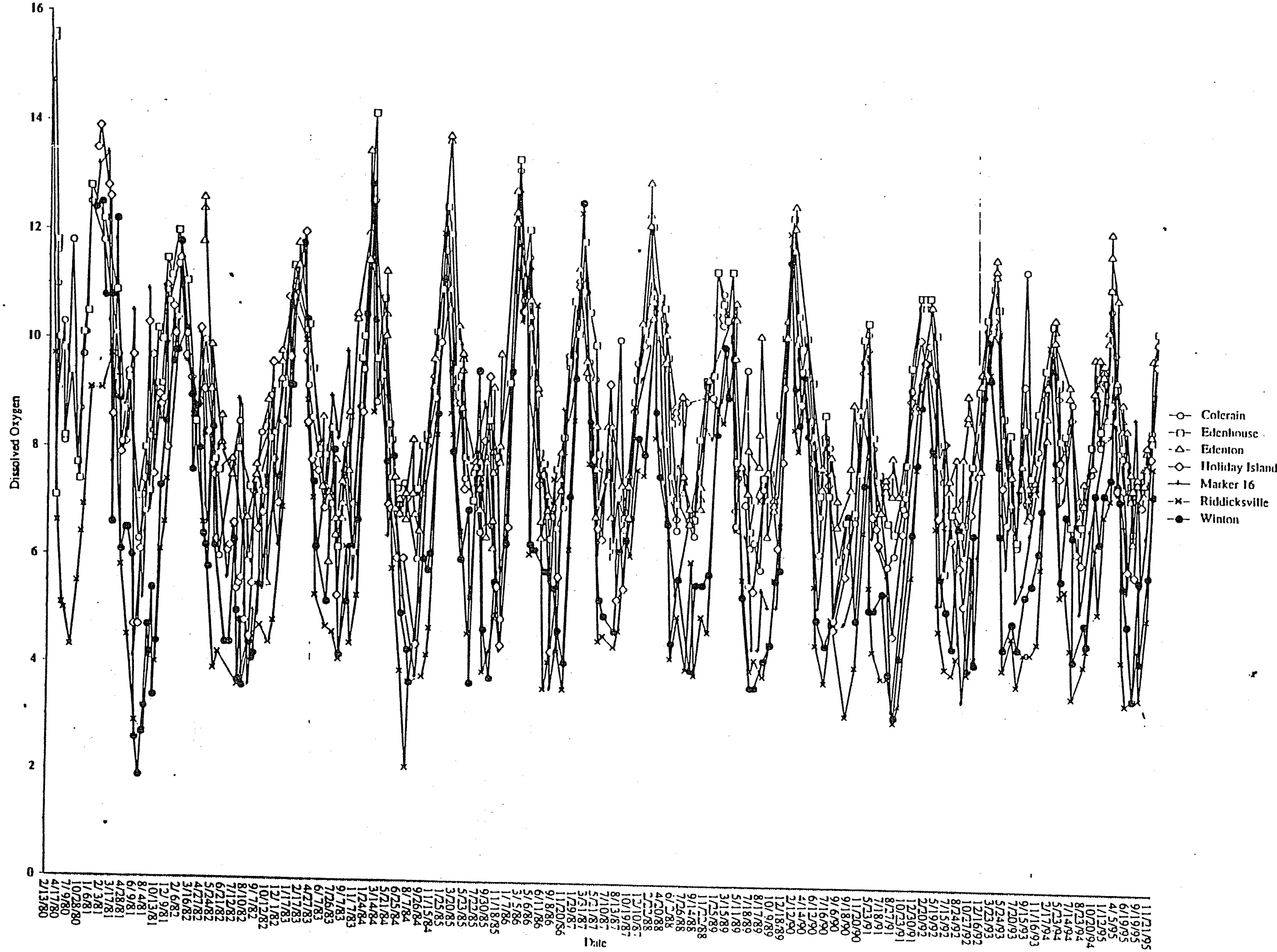



Figure 4.5. Chowan River Basin Mainstem Ambient Monitoring Sites. Dissolved Oxygen (mg/l) data - 1980 to 1995.

Chlorophyll *a* also fluctuates seasonally. Chlorophyll *a* is a measure of plant productivity or algal growth in surface waters. Figure 4.6 presents a graphic summarization of monthly chlorophyll *a* data from the Chowan River between the years of of 1980 and 1995. A steady increase in concentrations as the summer approaches, peaking in August and then tapering off in the fall is an evident pattern. When the same data is viewed by site (Figure 4.7), it is illustrated that the pattern remains the same at all sites, with varying degrees of magnitude. For example, the site at Riddicksville shows that there is an increase in chlorophyll *a* concentrations during the summer, but at the Marker 16 site, the increase is much greater.

Union Camp Corporation has a major discharge from a paper mill into the Blackwater River just north of the North Carolina-Virginia border. Union Camp's 13 billion gallon effluent treatment system is designed to store effluent during periods of low river flow, typically April through October, when conditions are poor for discharge due to low dissolved oxygen levels. The treated effluent is then released during the months of November through March. In the past, due to the volume of the release, the effluent was visible with the river system. Recent process improvements have reduced the effluent color to the point that, for the past 2 to 3 years, the effluent has not been visible in the Chowan River past the confluence with the Meherrin River. Union Camp conducts frequent monitoring during their discharge period to ensure adequate river flow is available for assimilative capacity. There are two ambient sites on the Blackwater River. One above the discharge (Cherry Grove) and one below (Wyanoke). When the data are viewed in the context of the discharge period, several parameters show an effect from the effluent. These are conductivity, total phosphorus, phosphate-phosphorus, total ammonia-nitrogen and total Kjeldahl nitrogen. Using conductivity as an example, a plot of the monthly distribution of the data illustrates the increasing levels during the period of discharge for the site downstream of the facility (Figure 4.8). Three-dimensional graphs show how the effects of the discharge resonate downstream. Conductivity (Figure 4.9) concentrations are elevated during the discharge months downstream to the Colerain site where the salinity begins to mask it. There are also high concentrations of total phosphorus (Figure 4.10) to the Colerain site. These high concentrations appear around November or December and begin to disappear by March or April.

<u>Fecal Coliform Bacteria</u>

Fecal coliform bacteria behave differently than most other water quality parameters, and these differences must be considered when using them to evaluate water quality. Available information was reviewed to identify potentially impaired waters and locate potential sources of pollutants in order to target efforts and develop appropriate management strategies. As sampled in the ambient monitoring system, fecal coliform bacteria are most useful as a screening tool to estimate the cumulative inputs from multiple sources, but in some instances can be used to locate a single large source of bacteria. Therefore, the data presented here are useful in identifying areas that may require some management action or further investigation.

Summary fecal coliform information is listed in Table 4.7. The primary screening tool used in establishing priority is the geometric mean. Sites with 10 or more fecal coliform samples within the last 5 years, that have a geometric mean exceeding 200/100ml, are considered highest priority. This information will be reflected in the use support designation for that stream or river (see sections 4.6 and 4.7 at the end of this chapter).

Data from the Chowan River Basin show only a few high bacterial concentrations through the five year period. There were no stations with a geometric mean greater than 200/100ml and only one with over two percent total samples over the 200/100ml criterion (Potecasi Creek). However, the geometric mean at this site is well below 200 and there are only eight samples that have been collected there thus far. Any conclusion about bacterial problems in this area should be withheld pending the collection of more samples. Sampling of fecal coliform bacteria from this site was added in the spring of 1995 and will continue. As more data is collected, a better assessment of bacterial conditions can and will be made.

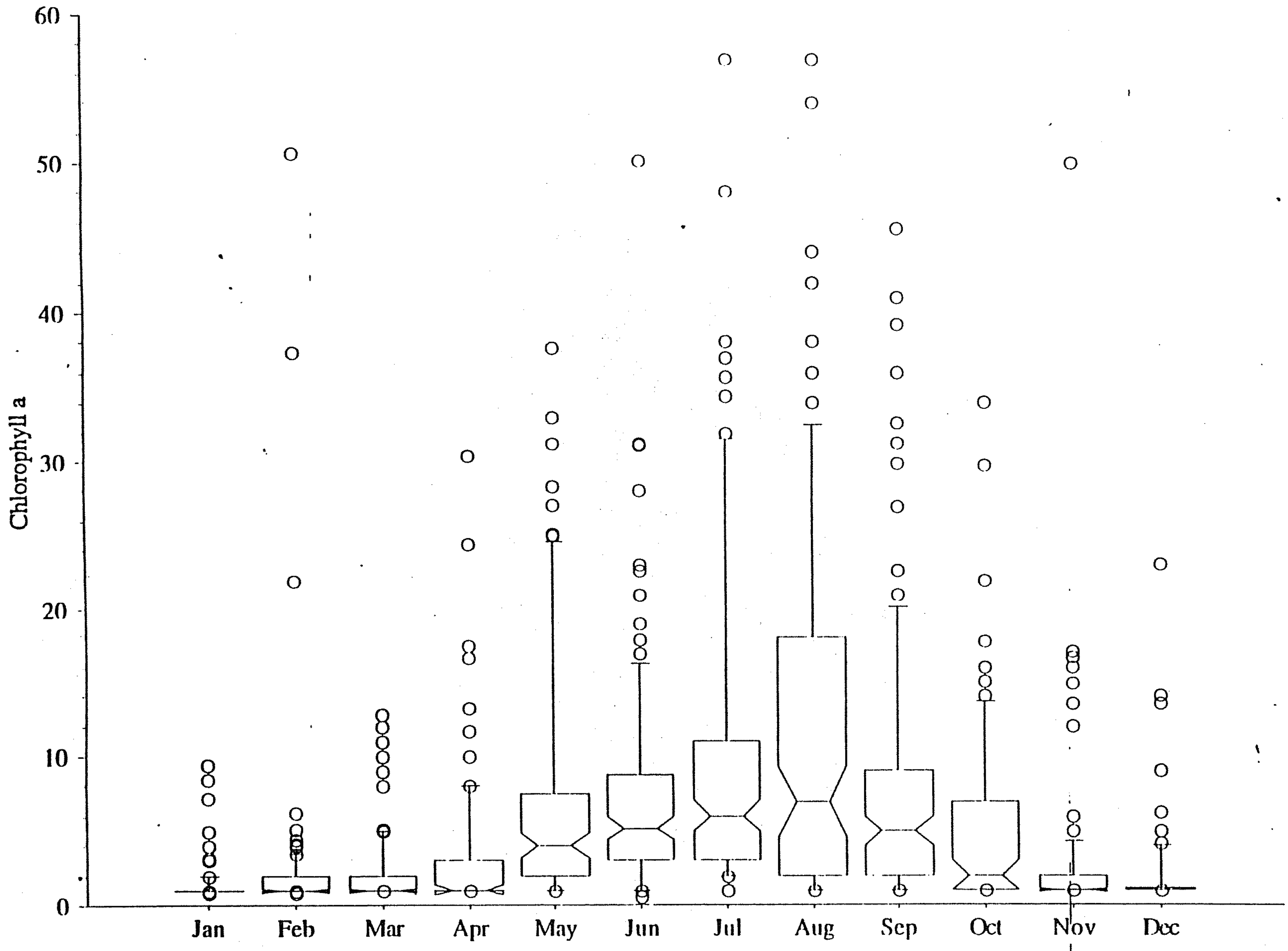



**Figure 4.6.** **Chowan River Basin Mainstem Ambient Monitoring Sites. Chlorophyll *a* (µg/l) data distribution - 1980 to 1995.**

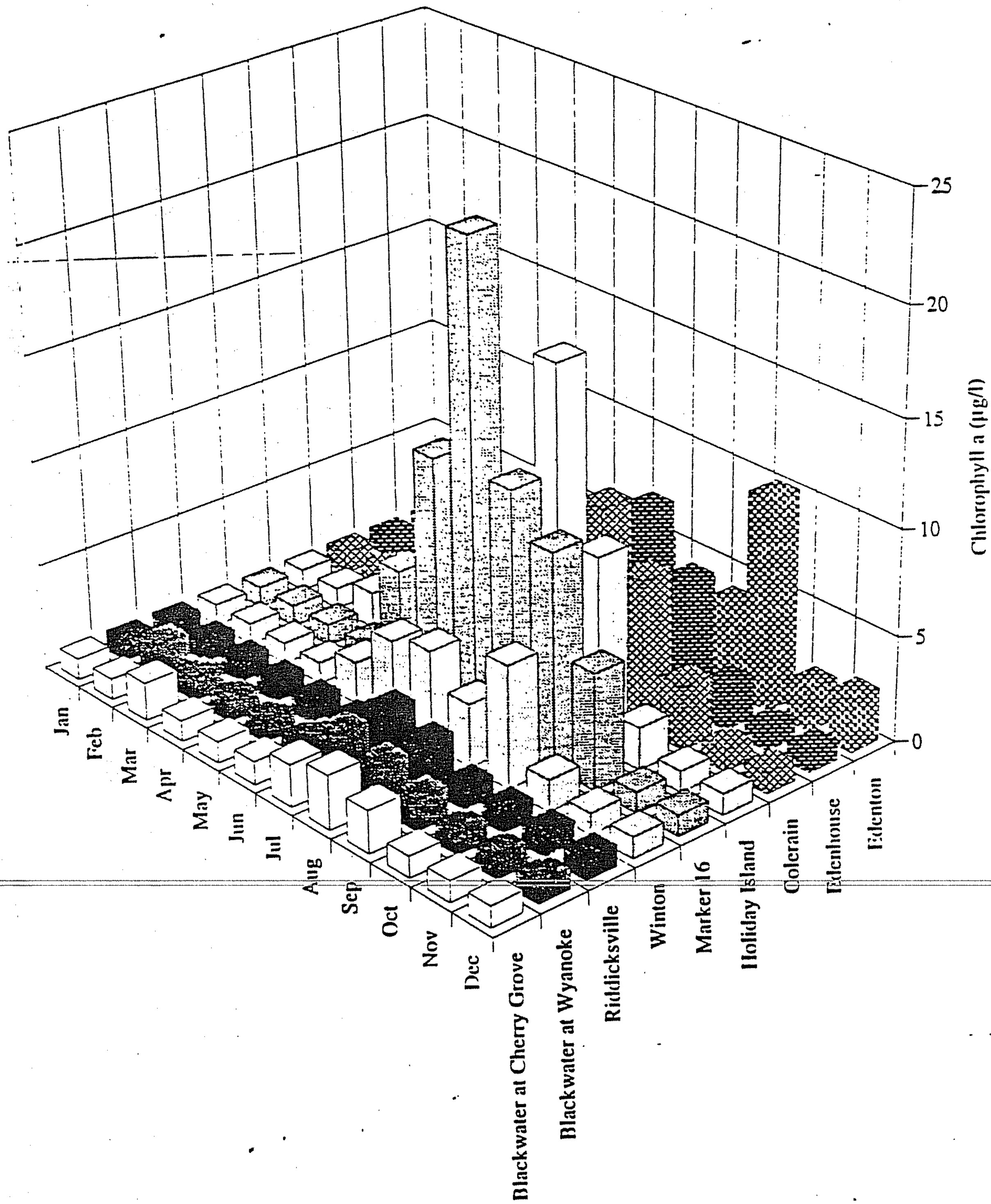



Figure 4.7. Chowan River Basin mainstem Ambient Monitoring Sites. Monthly Median Chlorophyll *a* (µg/l) - 1980 to 1996.

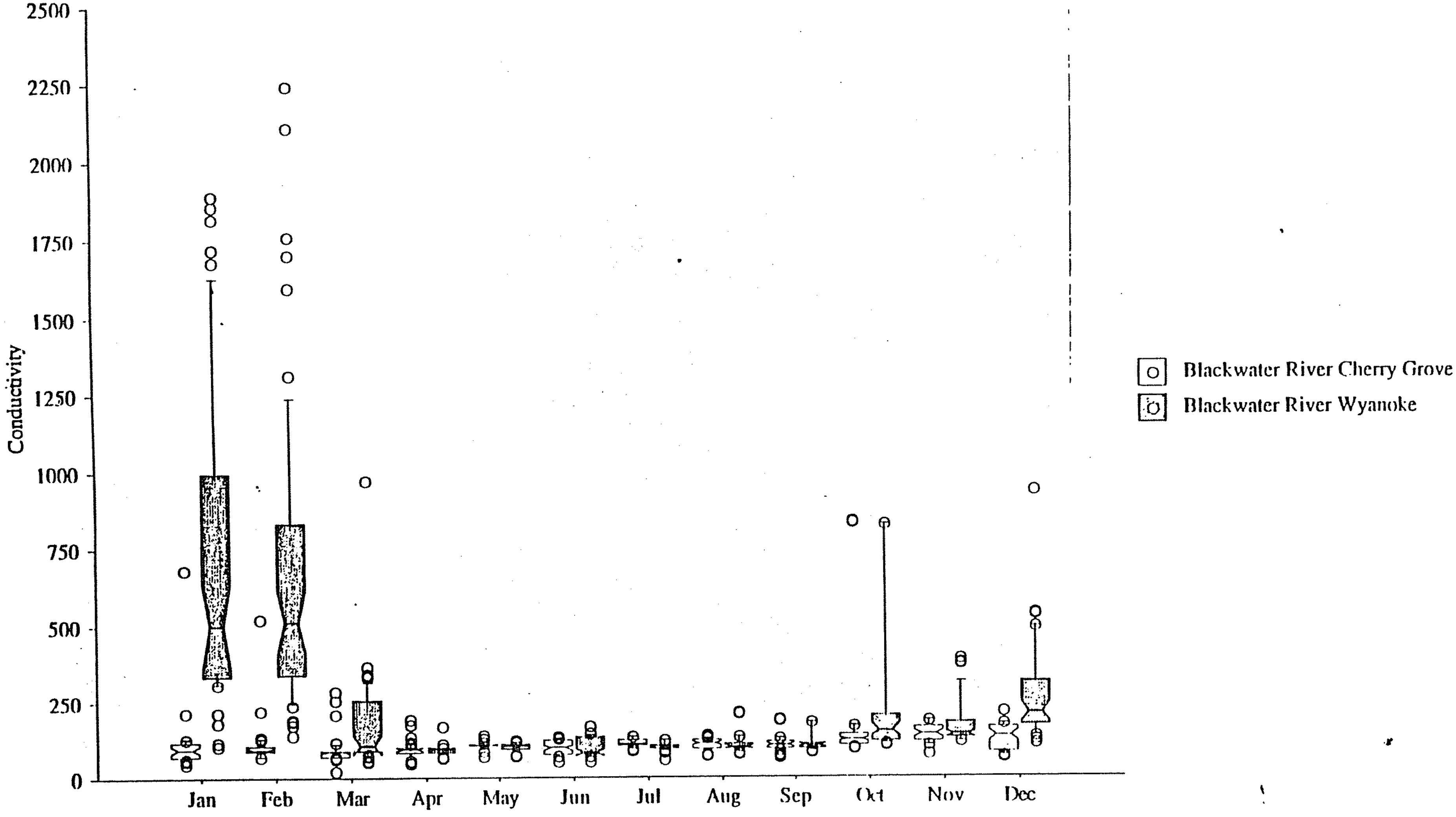



**Figure 4.8. Blackwater River Ambient Monitoring Sites. Conductivity (µMhos) data distribution - 1980 to 1995.**

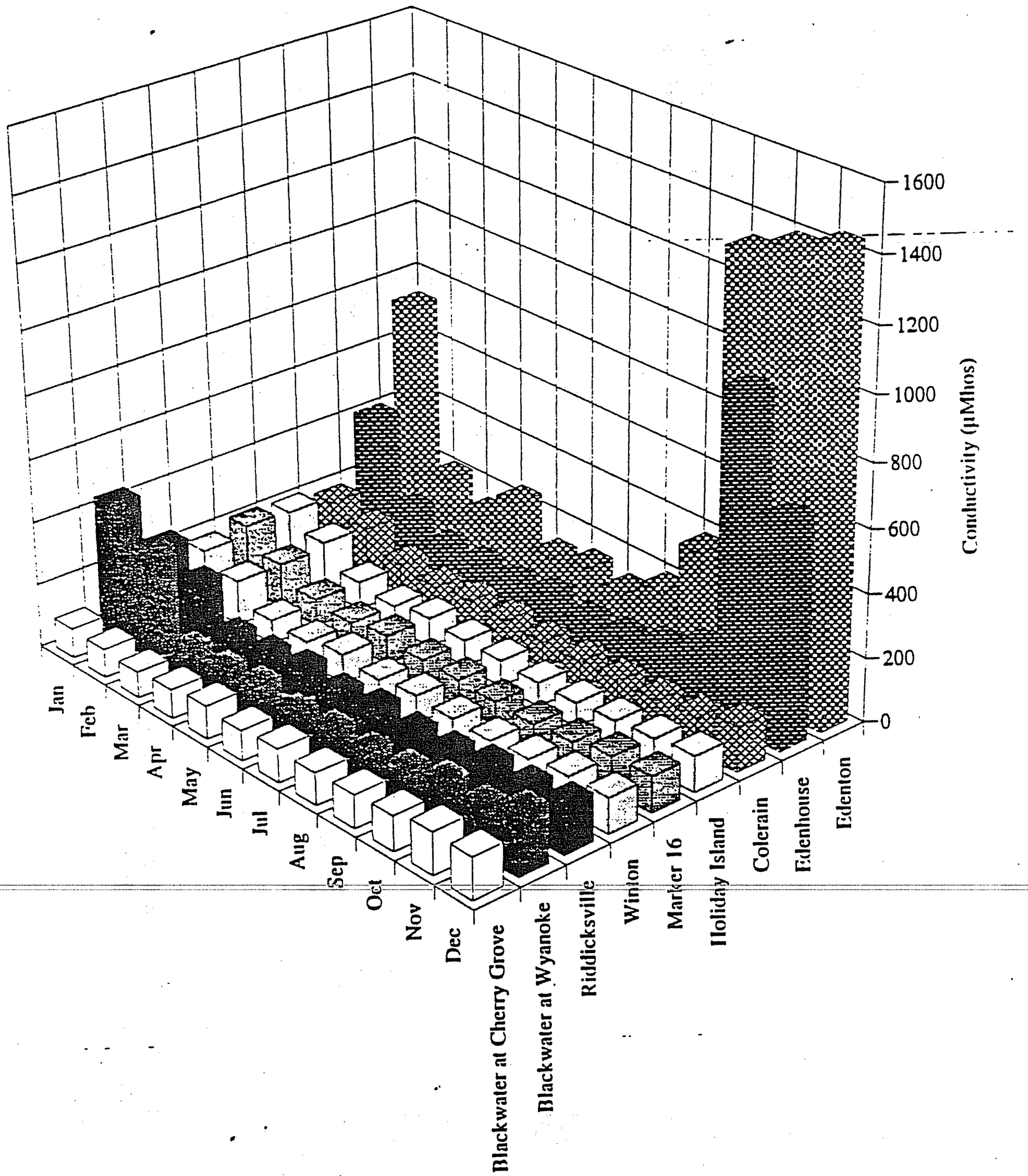



Figure 4.9. Chowan Basin Mainstem Monitoring Sites. Monthly Median Conductivity (μMhos) - 1980 to 1996.

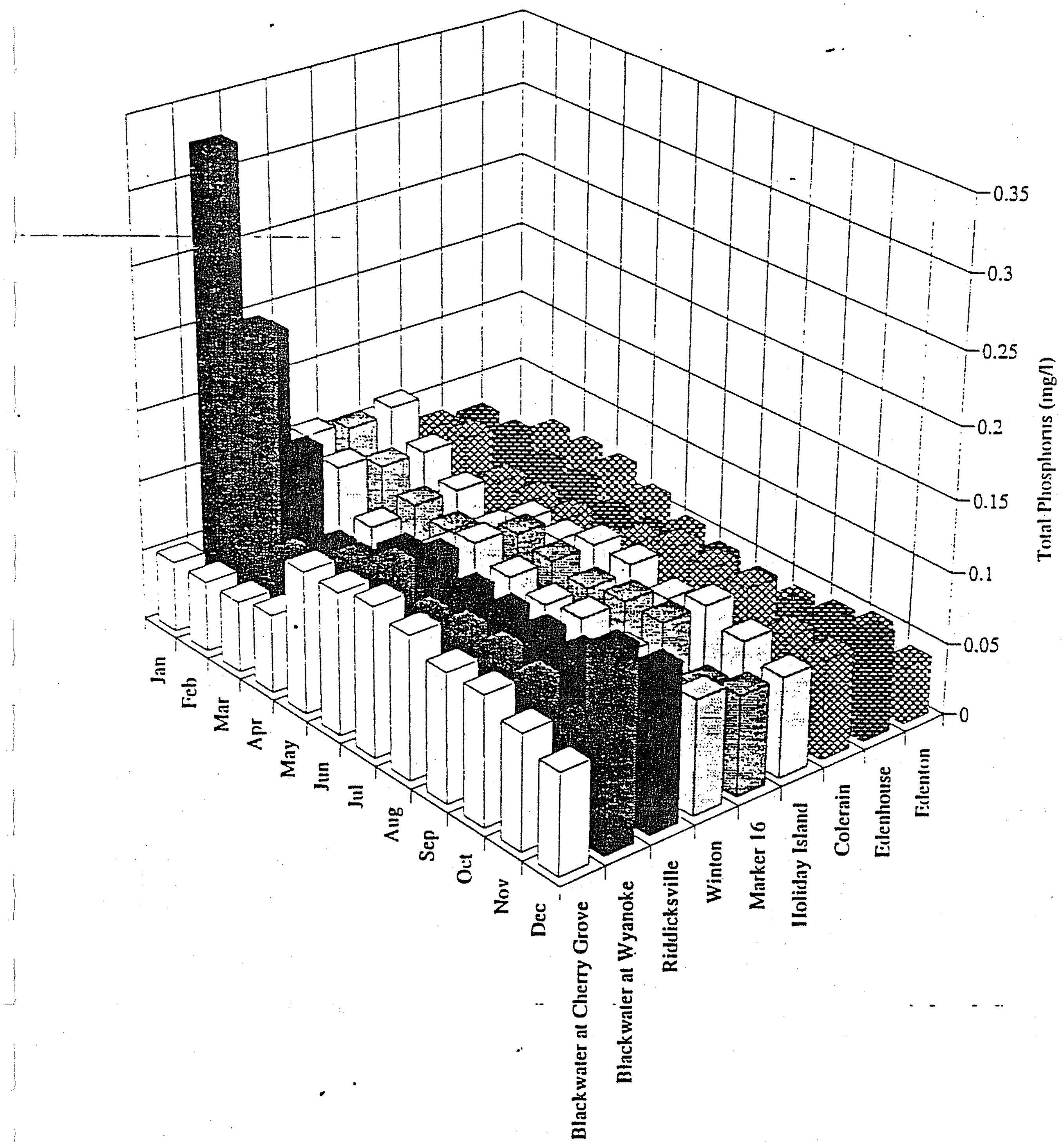



Figure 4.10. Chowan Basin Mainstem Monitoring Sites. Monthly Median Total Phosphorus (mg/l) - 1980 to 1995.

Table 4.7. Fecal Coliform summary data for the Chowan River Basin. 1990 to 1995.

| Site | Total Samples | Geometric Mean | Samples > 200/100ml | Percent >200/100ml | First Sample | Last Sample |
|---|---|---|---|---|---|---|
| Nottaway River | 66 | 16.38 | 0 | 0.0 | 1/24/90 | 5/14/96 |
| Balckwater at Cherry Gr | 65 | 24.20 | 1 | 1.5 | 1/24/90 | 5/14/96 |
| Blackwater at Wyanoke | 62 | 20.71 | 1 | 1.6 | 1/24/90 | 5/14/96 |
| Chowan at Riddicksville | 62 | 16.12 | 0 | 0.0 | 1/24/90 | 5/14/96 |
| Potecasi Creek | 8 | 36.68 | 2 | 25.0 | 5/24/95 | 5/28/96 |
| Meherrin River | 66 | 16.30 | 1 | 1.5 | 1/24/90 | 5/14/96 |
| Chowan at Winton | 62 | 13.49 | 0 | 0.0 | 1/24/90 | 5/14/96 |
| Chowan at Marker 16 | 60 | 11.63 | 1 | 1.7 | 1/25/90 | 5/13/96 |
| Chowan at Holiday Is | 61 | 13.53 | 1 | 1.6 | 1/25/90 | 5/13/96 |
| Chowan at Colerain | 60 | 11.56 | 0 | 0.0 | 1/25/90 | 5/13/96 |
| Chowan at Edenhouse | 60 | 12.26 | 0 | 0.0 | 1/25/90 | 5/13/96 |
| Chowan at Edenton | 106 | 10.83 | 0 | 0.0 | 1/10/90 | 5/13/96 |

## 4.4 REVIEW OF FLOW, CHLOROPHYLL A AND PHYTOPLANKTON DATA FOR SELECTED STATIONS ON THE CHOWAN RIVER

This section discusses flow data from the US Geological Survey (USGS) and chlorophyll *a* and phytoplankton data obtained through the ambient water quality network. Although there are many monitoring stations within the basin, only data from the lower mainstem stations are evaluated here in order to look into the current status of nutrient enrichment in the Chowan River.

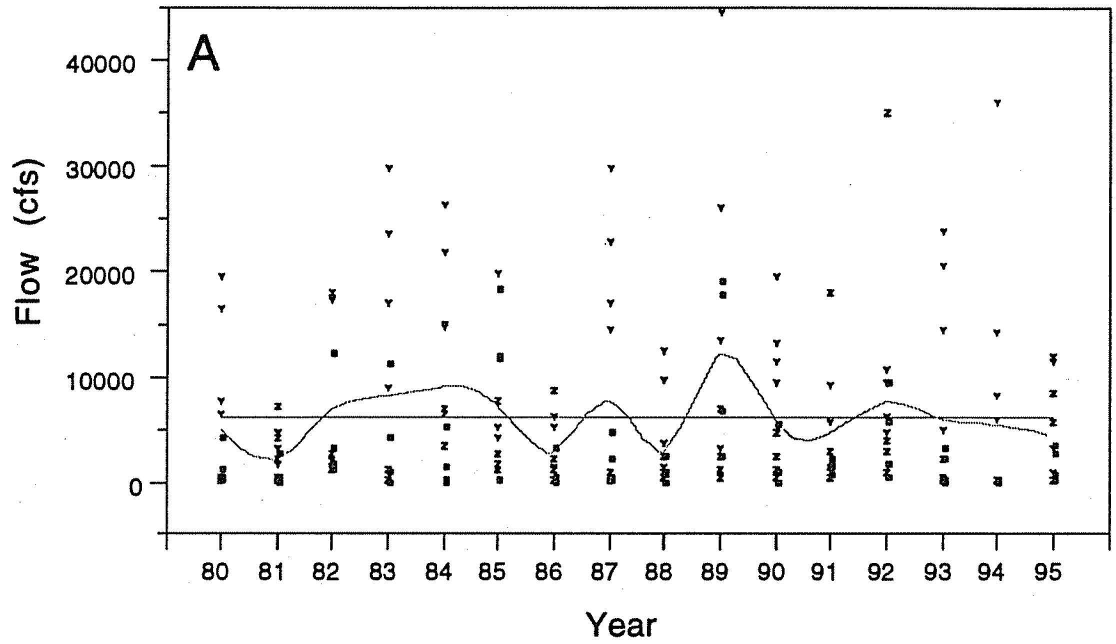
### 4.4.1 Regional Flow Patterns

In interpreting water quality data, some consideration needs to be given to flow or variations in flow among years. Since flow measurements are not available for the Chowan River, flow records for two tributary stations were used to determine temporal flow patterns (Figure 4.11) for the region. Flow data for Potecasi and Ahoskie Creeks (1980-1995) were obtained from the US Geological Survey (USGS). Similar temporal patterns existed for these two stations. Figure 4.11A groups monthly flow totals by year for Potecasi Creek. The curved line reveals yearly deviations from the average flow (horizontal line) for the period 1980-1995. In general low flows occurred during 1981, 1986, 1988 and 1990-1991. High flow occurred during 1982-1985, 1987 and 1989.

Monthly flow data from both creeks were used to develop an index showing flow variations within and among years (Figure 4.11B). The index represents the average of the standardized (z-) scores for each creek. (Standardized scores have a mean of zero and a standard deviation of one.) Standardization provides a common scale for data with different means and variation. In Figure 4.11B, the curved line reveals the variation in flow within each year. Note, for example, that during 1981, 1988 and 1991 high flows for the years were close to or below normal for the period 1980-1995. Also note that extreme variations in flow (high winter, low summer) occur within some years, for example 1983, 1984, 1987 and 1989.

### 4.4.2 Chlorophyll *a*

Chlorophyll *a* is a plant pigment that is used for assessing phytoplankton biomass. It has been measured in the Chowan River since the 1970's, however before 1980 there are many years without records. A more consistent data collection program began in 1980. Although sample size varies among stations and years, the data provide a good base upon which observations can be made.



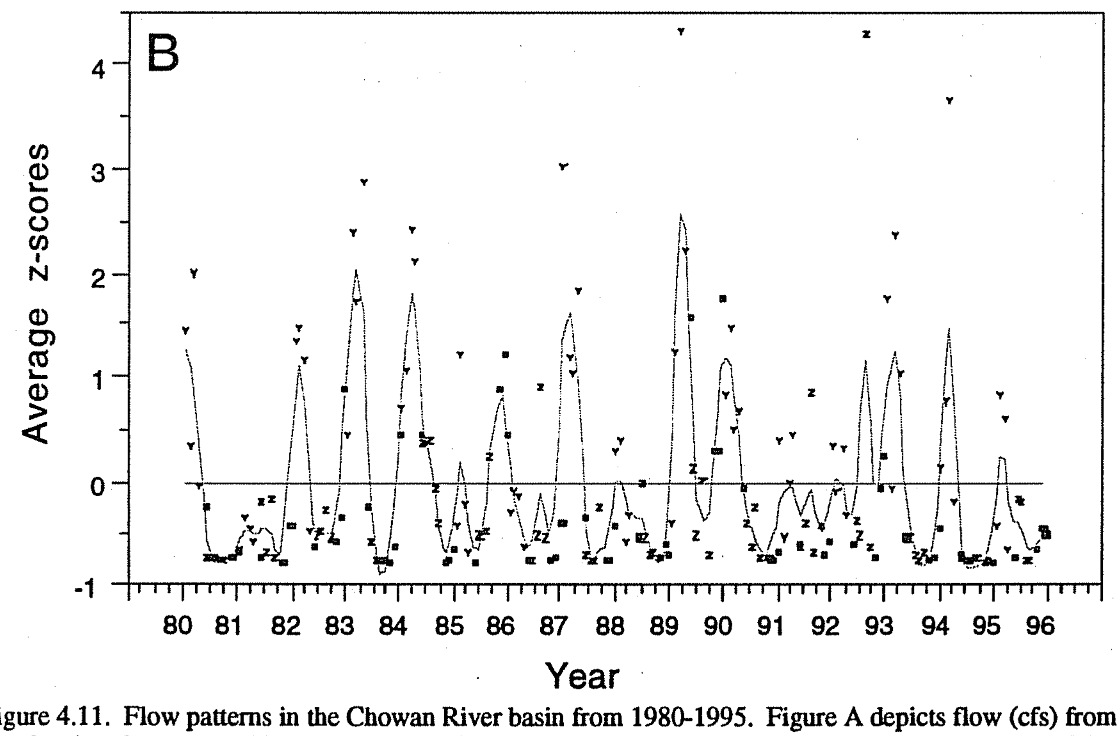




Figure 4.11. Flow patterns in the Chowan River basin from 1980-1995. Figure A depicts flow (cfs) from Potecasi Creek using data grouped by calendar year. Figure B depicts seasonal variations using the average of the standardized (z-) scores for Potecasi Creek and Ahoskie Creek (text provides details). The horizontal lines represent the mean for the period 1980-1995. The curved lines were fit using a smoothing spline (lambda=0.001). In Figure A the curved line accentuates yearly patterns, whereas in Figure B the seasonal patterns are highlighted. (Symbols Y=months Jan., Feb., Mar., Apr.; Z=Jun., Jul., Aug., Sep.)

The 1982 Chowan River Water Quality Management Plan (NC DNRCD 1982) states that chlorophyll *a* is a parameter to use for the assessment of eutrophication in the river. Specific goals include that peak chlorophyll *a* levels not exceed 40 µg/l and that average summer chlorophyll *a* concentrations not exceed 25 to 30 µg/l. Yearly concentrations of chlorophyll *a* at four mainstem ambient water quality stations are shown in Figure 4.12. Note that very few measurements are above 40 µg/l (the state's water quality standard) and all are below 45 µg/l. In general, the highest concentrations of chlorophyll *a* occurred during the mid 1980's. This pattern is seen by observing either the scatter of the data points, or the curved line. (The curved line was fit by a smoothing algorithm and is presented solely to elicit any temporal patterns.) Linear patterns, fitted by standard linear regression techniques, show a slight decrease in chlorophyll *a* concentrations over time. The largest decrease was only 0.57 µg/l per year and occurred at Winton, NC, but this represents a 7.4 µg/l decrease since 1983.

The scatter graph of summer chlorophyll *a* (June, July and August) concentrations is depicted in Figure 4.13. The ambient data show no concentrations exceeding 25 µg/l which was one of the target levels specified in the 1982 Chowan River Water Quality Management Plan (NC DNRCD 1982). Temporal patterns of chlorophyll *a* can be detected among the four ambient water quality stations (Figures 4.12 and 4.13). Most of the highest concentrations of chlorophyll *a* occurred during 1984 with significant decreases occurring by 1986. After 1986, chlorophyll *a* concentrations increased again and peaked during 1989 and 1990.

The temporal patterns of concentrations of chlorophyll *a* concentrations (Figure 4.12) are similar to the patterns of high and low flows (Figure 4.11). Relationships between flow and chlorophyll *a* concentrations indicate that years of high flows, particularly high spring flows, are the same years of high chlorophyll *a* concentrations. Flow and chlorophyll *a* concentrations were low during 1981, 1986, and 1991 (Figures 4.11 and 4.12).

One limitation of the trend analysis presented above is that it does not take into account the seasonal variation of chlorophyll a data. In an effort to address the seasonal nature of the data, a Seasonal Kendall Test was performed on chlorophyll a data from the four ambient monitoring stations presented in Figures 4.12 and 4.13 for the period of 1982-1996. The Seasonal Kendall Test is a statistical analysis designed to determine if a trend (upward or downward) is present over time in data subject to seasonal variation (Gilbert, 1987). The test determined that a slight, but statistically significant downward trend had occurred at the Gatesville station, but that no trend could be detected at the other stations.

One of the chief constraints of either of these analyses is the high degree of variability in the chlorophyll a data due to variability in flow and tidal fluctuation. If a more rigorous effort could be made to factor out the variability caused by flow, tests such as the Seasonal Kendall may be able to detect a more substantial trend over the 15 year period. It should be noted that the reported incidence of algal blooms in the Chowan River over the past 5-6 years presents a more encouraging outlook than the results of this statistical test. In recent years reported algal blooms have declined in both frequency and duration, with significant blooms occurring only twice in the past 5 years. A more detailed account of algal blooms in the Chowan River basin is presented in Section 4.4.4 of this chapter.

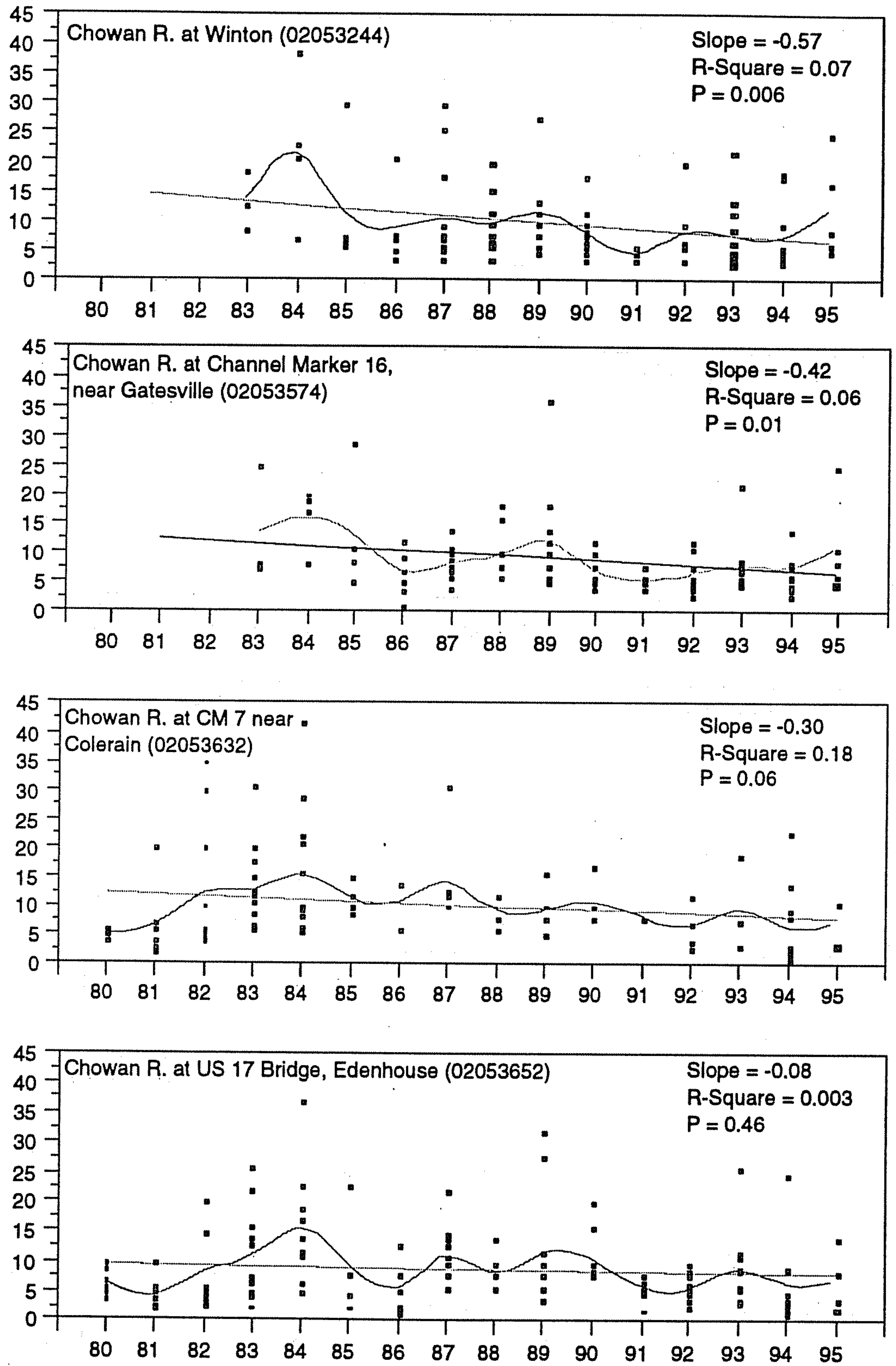



Figure 4.12. Patterns of the concentrations of chlorophyll-a (Y-axis, µg/l; X-axis = Year) at four ambient stations on the Chowan River. Curved line represents a smoothing spline fit (lambda=0.1). Slopes, R-squared values, and P-values for the linear fits are within each chart.

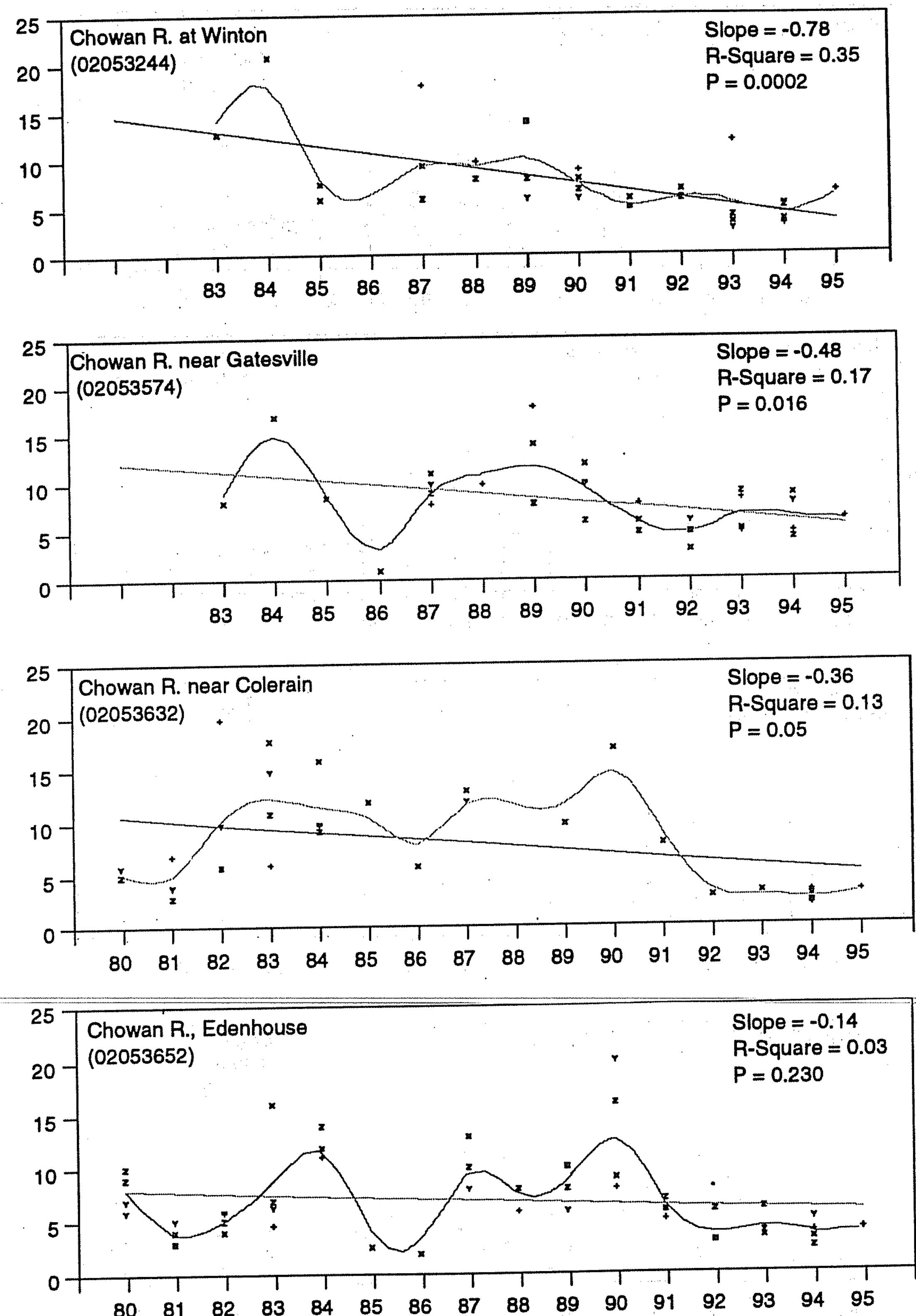



Figure 4.13. Patterns of summer (June +, July x, Aug. Y Sept. z) concentrations of chlorophyll a (Y-axis, µg/l; X-axis = Year) at four ambient stations on the Chowan R. Statistics for the linear fit are within each chart. Curved line represents a smoothing spline fit (lambda=0.1)

### 4.4.3 Phytoplankton

DWQ has collected and analyzed phytoplankton samples from the Chowan River since 1983. Samples include those collected in conjunction with ambient water quality samples and those associated with algal blooms. Sample analyses include identification of species at the lowest taxonomic level and an estimate of species density and biovolume. How often species occur (i.e. frequency), and a comparison of densities (cells or individuals per unit volume) and biovolume (size per unit volume) among species is how phytoplankton communities and monitoring stations can be compared. Changes in community structure can often be related to year, season, climate, and other environmental factors such as nutrient levels.

This section provides a summary of the phytoplankton samples collected as part of the ambient monitoring system. A description of the phytoplankton communities is presented first. The description focuses on the relative contribution a species provides to the phytoplankton community. An index that integrates measures of species frequency, density and biovolume is used to describe the communities and rank species. Secondly a summary of the sample parameters (total densities and total biovolume) is presented.

<u>Phytoplankton communities and species composition</u>
The phytoplankton sampling effort has varied over the years. That is, not all ambient stations have been sampled at the same time. Therefore, the following summary is based only on samples collected within the same time period for three stations on the Chowan River (Winton (02053244), Colerain (02053632) and Edenhouse (02053652)). By selecting a subset of samples in this manner, biases are not introduced into the analyses based upon unequal sample sizes. Since communities change as a result of seasons, samples were grouped by months into seasonal categories. Sampling did not occur every month and the greatest sampling effort was during the summer. Thus, there are differences in the number of months combined into the seasonal categories. The summer season represents a composite of samples collected from June through September (4 months). Likewise, the winter season included November , December, and February (3 months) and the spring season included April and May (2 months).

A species ranking index (Importance Value; IV) was developed based on the information provided by the number of samples in which a species occurred, the sum of the biovolume ($mm^3/m^3$) and density (individuals/ml; Table 4.8) for the species and the total sum of these parameters for all species. Further explanation of the information in Table 4.8 is provided by using *Anabaena portoricensis* as an example. A total of 87 samples were included in the summer seasonal category. *Anabaena portoricensis* occurred in 18 (21%) samples. Its total biovolume and density were 150, 871 ($mm^3/m^3$) and 23,429 (individuals/ml) respectively. Thus, it contributed 65% (0.65) and 13% (0.13) of the total biovolume and density respectively.

The relative frequency of a species represents the probability of selecting that species from a pool of all species sampled, weighted by the number of samples in which that species occurred. For example, *Anabaena portoricensis* occurred in 18 samples, however there was a total of 1429 species occurrences. Thus, the probability of selecting *Anabaena portoricensis* from the pool of all species occurrences is 0.01 (18/1429). All relative values are scaled from 0 to 1. A species ranking index (often called a species importance value, IV) was developed by averaging the three relative values. Table 4.8 presents the ten species with the highest importance value for each seasonal category.

The data (Table 4.8) show seasonal differences based on the biovolume provided by one species, *Anabaena portoricensis*. It is clear that when *Anabaena portoricensis* is present it dominates the community. This species was present in only 21% (n=18) of the summer samples and 4% (n=1)

Table 4.8. Phytoplankton species composition of the Chowan R. (Summer = Jun.- Sep., Winter = Nov., Dec., Feb., Spring = Apr. & May; Absolute biovolume (Bvol) in $mm^3/m^3$; absolute density (Den) in units/ml; Freq=frequency; see text for details).

| SUMMER (n=87)[1] | | Absolute | | | Relative[2] | | | |
|---|---|---|---|---|---|---|---|---|
| Species | N[4] | Freq (%) | Bvol | Density | Freq | Bvol | Den | IV[3] |
| Anabaena portoricensis | 18 | 21 | 150,871 | 23,429 | 0.01 | 0.65 | 0.13 | 0.27 |
| Chroomonas minuta | 83 | 95 | 1,396 | 37,147 | 0.06 | 0.01 | 0.21 | 0.09 |
| Ochromonas species 3 | 43 | 49 | 622 | 23,025 | 0.03 | 0.00 | 0.13 | 0.05 |
| Cryptomonas erosa | 78 | 90 | 6,129 | 9,890 | 0.06 | 0.03 | 0.06 | 0.05 |
| Chroomonas caudata | 71 | 82 | 2,079 | 11,908 | 0.05 | 0.01 | 0.07 | 0.04 |
| Vacuolaria virescens | 21 | 24 | 16,186 | 2,225 | 0.02 | 0.07 | 0.01 | 0.03 |
| Skelotonema potamos | 43 | 49 | 2,745 | 8,955 | 0.03 | 0.01 | 0.05 | 0.03 |
| Chlorella vulgaris | 16 | 18 | 2,599 | 9,390 | 0.01 | 0.01 | 0.05 | 0.03 |
| Mallomonas akrokomos | 58 | 67 | 229 | 3,929 | 0.04 | 0.00 | 0.02 | 0.02 |
| Cryptomonas ovata | 35 | 40 | 4,115 | 2,165 | 0.02 | 0.02 | 0.01 | 0.02 |
| Others (n=200)[5] | 963 | 1,102 | 45,335 | 44,197 | 0.67 | 0.20 | 0.25 | 0.37 |
| TOTAL | 1,429 | 1,637 | 232,306 | 176,260 | 1.00 | 1.00 | 1.00 | 1.00 |
| WINTER (n=27)[1] | | | | | | | | |
| Ochromonas species 3 | 11 | 41 | 86 | 3,184 | 0.04 | 0.02 | 0.26 | 0.11 |
| Chroomonas minuta | 25 | 93 | 77 | 2,044 | 0.09 | 0.02 | 0.17 | 0.09 |
| Chroomonas caudata | 21 | 78 | 226 | 1,326 | 0.07 | 0.05 | 0.11 | 0.08 |
| Anabaena portoricensis | 1 | 4 | 1,044 | 23 | 0.00 | 0.22 | 0.00 | 0.08 |
| Cryptomonas ovata | 12 | 44 | 623 | 327 | 0.04 | 0.13 | 0.03 | 0.07 |
| Cryptomonas erosa | 17 | 63 | 266 | 431 | 0.06 | 0.06 | 0.04 | 0.05 |
| Ochromonas species | 10 | 37 | 62 | 554 | 0.04 | 0.01 | 0.05 | 0.03 |
| Chlorella vulgaris | 5 | 19 | 116 | 419 | 0.02 | 0.03 | 0.04 | 0.03 |
| Rhizosolenia species 2 | 1 | 4 | 72 | 680 | 0.00 | 0.02 | 0.06 | 0.03 |
| Vacuolaria virescens | 2 | 7 | 267 | 38 | 0.01 | 0.06 | 0.00 | 0.02 |
| Others (n=79)[4] | 182 | 1,248 | 1,825 | 3,031 | 0.64 | 0.39 | 0.25 | 0.41 |
| TOTAL | 287 | 1,637 | 4,663 | 12,057 | 1.00 | 1.00 | 1.00 | 1.00 |
| SPRING (n=18)[1] | | | | | | | | |
| Chroomonas minuta | 17 | 94 | 281 | 7,596 | 0.09 | 0.03 | 0.32 | 0.14 |
| ~~Chlamydomonas species~~ | 1 | 6 | 1,642 | 2,746 | 0.01 | 0.16 | 0.11 | 0.09 |
| Chroomonas caudata | 12 | 67 | 580 | 3,412 | 0.06 | 0.06 | 0.14 | 0.09 |
| Cryptomonas erosa | 15 | 83 | 874 | 1,418 | 0.08 | 0.08 | 0.06 | 0.07 |
| Peridinium cinctum | 3 | 17 | 2,003 | 243 | 0.02 | 0.19 | 0.01 | 0.07 |
| Cryptomonas ovata | 15 | 83 | 756 | 386 | 0.08 | 0.07 | 0.02 | 0.05 |
| Mallomonas majorensis | 3 | 17 | 645 | 1,202 | 0.02 | 0.06 | 0.05 | 0.04 |
| Ochromonas species 3 | 8 | 44 | 44 | 1,619 | 0.04 | 0.00 | 0.07 | 0.04 |
| Skelotonema costatum | 2 | 11 | 705 | 673 | 0.01 | 0.07 | 0.03 | 0.04 |
| Cryptomonas erosa reflexa | 6 | 33 | 272 | 219 | 0.03 | 0.03 | 0.01 | 0.02 |
| Others (n=63)[4] | 115 | 639 | 2,785 | 4,559 | 0.59 | 0.26 | 0.19 | 0.35 |
| TOTAL | 197 | 1,094 | 10,586 | 24,072 | 1.00 | 1.00 | 1.00 | 1.00 |

[1]Total number of samples; [2]Number represents the absolute value divided by total (scaling from 0 to 1);
[3]Importance value (IV) is the average of relative values; [4]Number of samples in which the species occurred;
[5]Total number of the remaining species (add 10 to obtain total number of species sampled.)

of the winter samples, but contributed 65% and 22% of the total species biovolume during these seasons, respectively. Apparently, it is extremely unlikely to occur during the winter or spring.

When *Anabaena portoricensis* is absent, the phytoplankton communities are dominated by the chrysophytes *Chroomonas minuta, C. caudata, Cryptomonas erosa* and *C. ovata.* During the winter a few dinoflagellates may occur (*Gymnodinium sp.* and *Peridinium cinctum*) along with the diatoms *Skelotonema potamos* and *S. costatum.*

Summary of Phytoplankton Samples

In the previous section, a subset of the total number of phytoplankton samples was used. However, here all the ambient phytoplankton samples are used except the five collected from the station near Gatesville (Station #02053574). Table 4.9 provides quantile measures and the means and standard errors of phytoplankton density and biovolume for three ambient water quality stations.

A quantile summary provides information on the percentage of values that are less or equal to that value. For example, the biovolume data for the station at Winton (02053244) show that 50% of the samples had biovolumes less than or equal to 200 $mm^3/m^3$ (Table 4.9). The summary shows clearly that the station at Colerain (02053632) has elevated biovolumes. In general a biovolume greater than 5000 $mm^3/m^3$ or a density greater than 10,000 individuals/ml reflects algal bloom conditions. Elevated biovolumes and densities almost always occur between April and September; the highest values occur between June and September.

Table 4.9. Summary of phytoplankton samples at three ambient stations in the Chowan River.

| | | Station | |
|---|---|---|---|
| | 02053244 | 02053632 | 02053652 |
| Sample size (n) | 134 | 144 | 64 |
| Biovolume ($mm^3/m^3$) | | | |
| maximum 100% | 9,450 | 63,030 | 11,570 |
| 90% | 1,740 | 5,020 | 3,050 |
| 75% | 670 | 1,840 | 1,210 |
| median 50% | 200 | 420 | 340 |
| 25% | 90 | 140 | 110 |
| 10% | 50 | 70 | 60 |
| minimum 0% | 2 | 15 | 36 |
| Mean: | 700 | 2,820 | 1,070 |
| Std Err Mean: | 120 | 690 | 240 |
| Density (units/ml) | | | |
| maximum 100% | 18,440 | 13,810 | 8,560 |
| 90% | 3,260 | 4,550 | 3,270 |
| 75% | 1,140 | 2,610 | 1,920 |
| median 50% | 430 | 860 | 810 |
| 25% | 210 | 330 | 300 |
| 10% | 110 | 150 | 190 |
| minimum 0% | 29 | 35 | 111 |
| Mean: | 1,180 | 1,820 | 1,410 |
| Std Err Mean: | 190 | 190 | 190 |

### 4.4.4 Algal Blooms

Blue green algae blooms in the Chowan River are more severe, cover wider areas, and last longer during years with heavy winter and spring rains and dry summers. As discussed earlier, over the last 15 years there is a slight but statistically significant downward trend in chlorophyll *a* and nutrients. In addition, the frequency and duration of reported surface blooms has declined in recent years. Blooms do continue to occur, however, and the annual meteorological patterns remain important.

Flow data is not available from the Chowan River. Therefore, flow measurements from Ahoskie Creek were examined in comparing flow to algal response. During the past 5 years, significant blue green algal blooms occurred only in 1990 and 1993. Figures 4.14 and 4.15 depict flow measurements from Ahoskie Creek in those years. Both years recorded significant flow in the winter and late spring providing nutrient delivery, followed by low flow periods, enabling bloom development.

In 1990, "green flecks" were first noted in June, and extended from Holiday Island to the US 17 bridge near Edenton. The bloom was heaviest in mid July with chorophyll *a* values from surface grab samples as high as 350µg/L. The bloom persisted throughout August and into September, however it was confined to the lower river downstream of Colerain due to rainfall in late August. Anabaena portoricensis and to a lesser extent Anacystis cyanea were dominant phytoplankton species throughout the summer.

Blooms in 1993 were less severe, and not as long lived as in 1990, but affected the same area. Bloom conditions were not present until August and September. Associated chlorophyll *a* measurements were relatively low with the exception of a sample near Colerain on September 15 which contained 110 ug/L. One fish kill was associated with a blue green bloom in Deep Swamp Branch on September 5. Anabaena portoricensis comprised 97% of total phytoplankton biovolume.

One important concern associated with blue green algal blooms appears to be disruption of the food chain. Evidence suggests that blue green algae, which are not a suitable food source for small aquatic animals, can disrupt the food chain by replacing normal algal populations. Small aquatic animals are the basic food item for important fish species in the Chowan River. Therefore, blue green algae blooms can have a negative impact on fishery populations by affecting the food source of the small aquatic animals upon which fish feed.

Although the Chowan River has demonstrated measurable improvements in water quality, it remains sensitive to nutrients and supports blue green algal blooms on certain years. As in the past, when heavy spring rains are followed by dry summers, blooms are most prevalent. This suggests that continued implementation of Best Management Practices to further reduce nonpoint inputs during periods of heavy rain is an important strategy in minimizing the severity, extent, and duration of blooms in the lower Chowan River.

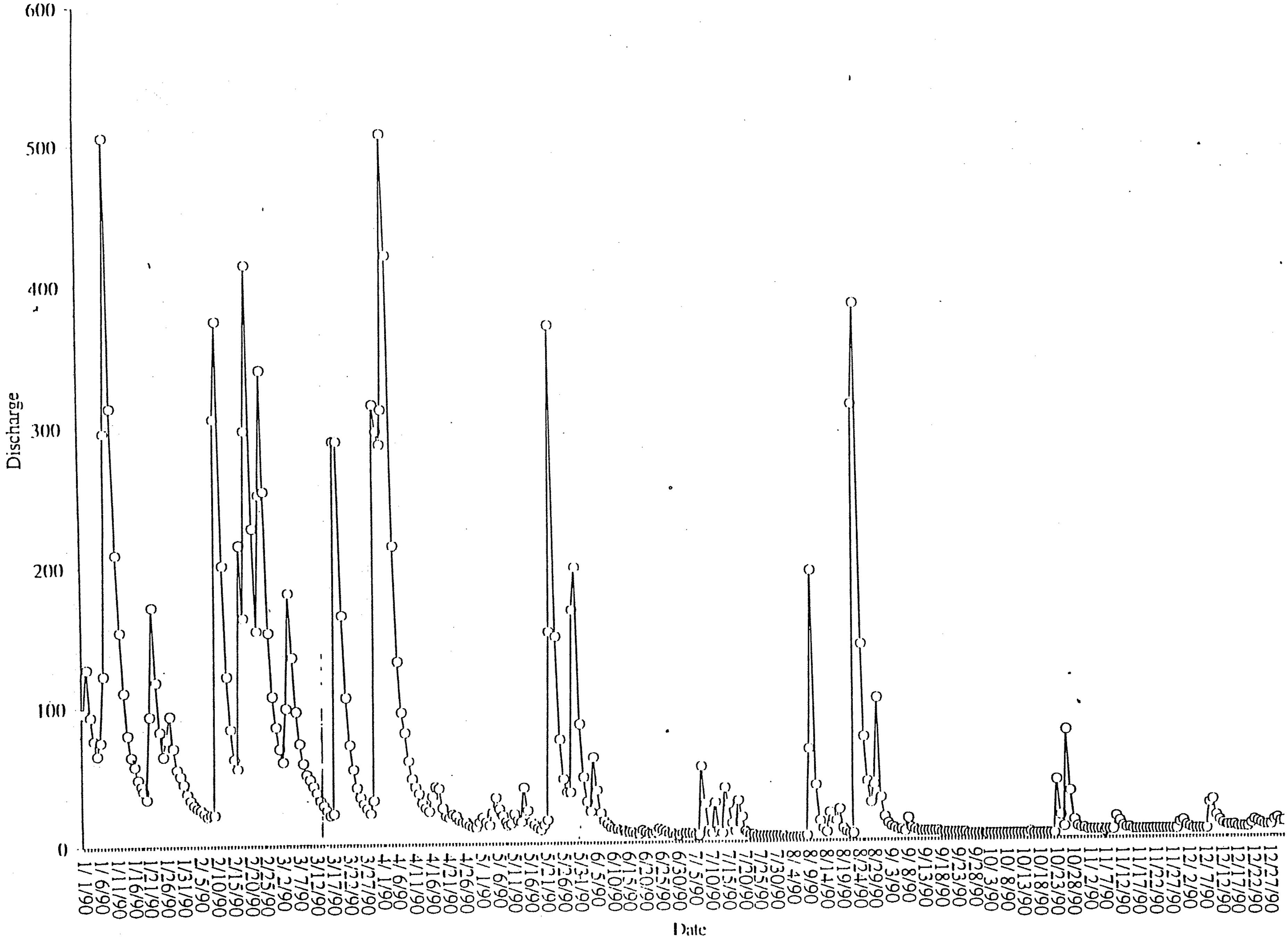



**Figure 4.14.** **Mean Daily Discharge from USGS Flow Station 02053500, Ahoskie Creek at Ahoskie, NC, 1990.**

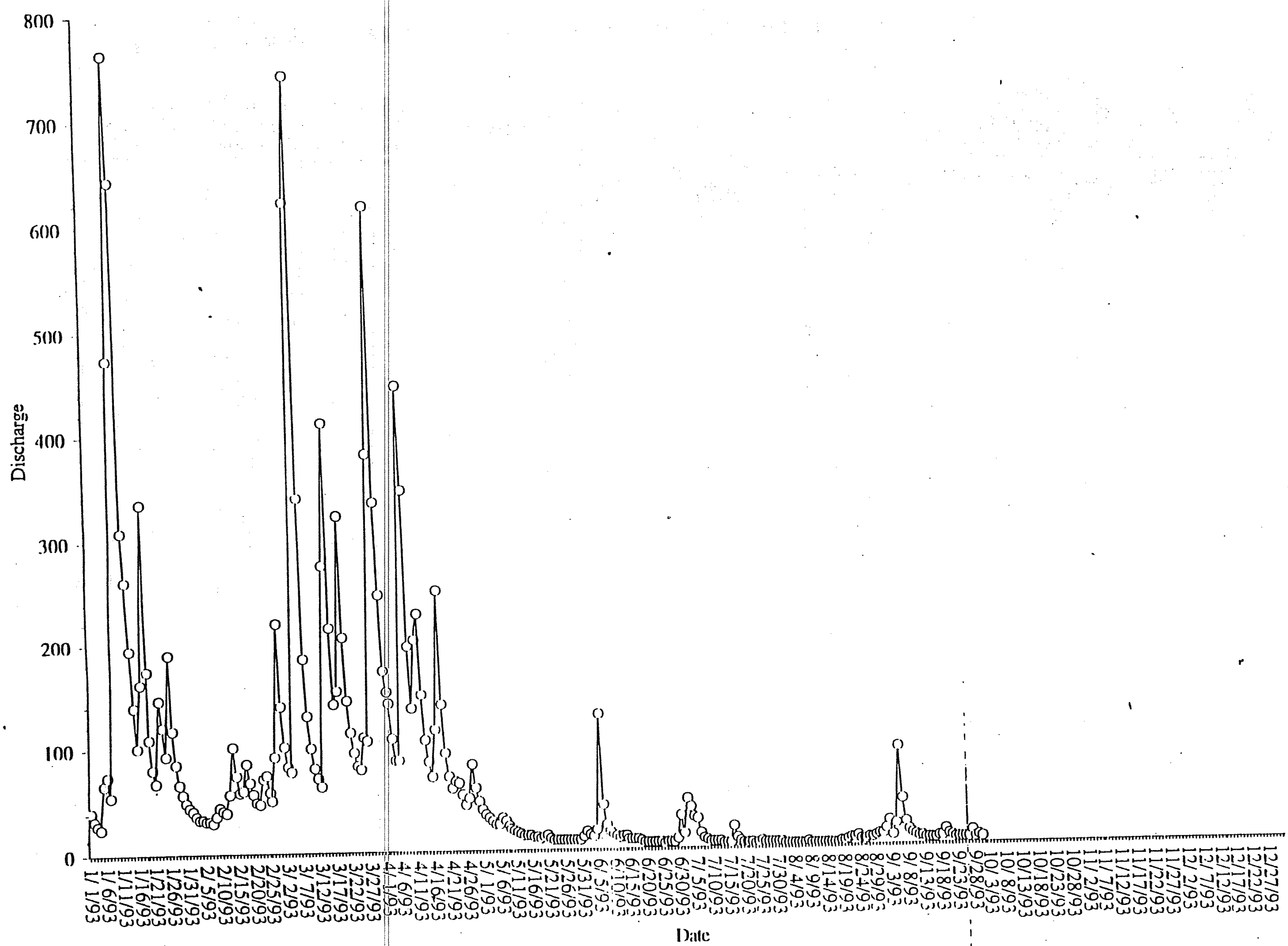



Figure 4.15. Mean Daily Discharge from USGS Flow Station 02053500, Ahoskie Creek at Ahoskie, NC, 1993.

## 4.5 NARRATIVE WATER QUALITY SUMMARIES BY SUBBASIN

### 4.5.1 Subbasin 01 - Upper Chowan River in North Carolina, Wiccacon River and Ahoskie Creek

**Description**

Chowan subbasin 01 is located in the northeastern coastal plain of North Carolina. The Chowan River originates in Virginia and its streams flow southeastward toward Albemarle Sound. The Chowan River is formed at the border of Virginia and North Carolina by the confluence of the Nottoway and Blackwater Rivers. The Chowan basin includes 1315 square miles in North Carolina, but the largest part of the drainage basin (3575 square miles) lies in Virginia. Major tributaries to the Chowan River in subbasin 01 include the Wiccacon River and Ahoskie Creek. The largest urban area in this subbasin is Ahoskie. Land use within this subbasin is mainly wetlands and agriculture. Figure 4.16 provides a map showing major streams and the location of DWQ's sampling locations in this subbasin.

**Overview of Water Quality**

There are 10 permitted dischargers in subbasin 01, all with a flow of $\leq$ 0.05 MGD. Bioclassifications of sites in this subbasin were Fair for the Wiccacon River and Ahoskie Creek and Good-Fair for the Chowan River at Riddicksville based on benthic macroinvertebrate data from 1995 (Table 4.10 presents all benthic macroinvertebrate sampling results for this subbasin). Fish community structure data was also collected from Ahoskie Creek, resulting in a NCIBI rating of Fair. The water quality problems encountered in this subbasin are thought to be due to nonpoint source runoff. From 1990-1995, 50% of the samples taken from the Wiccacon River had DO values above the minimum requirement of 4 mg/l. Only 14% of samples collected from the Chowan River at Riddicksville were above this minimum.

Table 4.10. Benthic Macroinvertebrate Data, Chowan Subbasin 01, 1983 through 1995.

| Site | Map # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Chowan R, SR 1319, Hertford | B-1 | 25 | 08/95 | 53/8 | 7.81/4.17 | Good-Fair |
| | | | 07/90 | 58/14 | 7.46/5.39 | Excellent |
| | | | 07/88 | 66/10 | 7.31/6.15 | Good |
| | | | 07/86 | 63/10 | 7.62/6.27 | Good |
| | | | 07/84 | 65/9 | 6.88/5.37 | Good |
| Wiccacon R, NC 45, SR 1433, Hertford | B-2 | 25-14 | 08/95 | 56/5 | 7.59/7.44 | Fair |
| | | | 02/95 | 27/2 | 8.60/6.82 | Poor |
| | | | 07/89 | 48/2 | 8.12/7.34 | Poor |
| | | | 07/87 | 60/3 | 8.07/7.95 | Fair |
| | | | 07/85 | 59/5 | 7.96/7.18 | Fair |
| | | | 07/83 | 56/4 | 7.93/6.72 | Fair |
| Ahoskie Cr, NC 42, Hertford | B-3 | 25-14-1 | 08/95 | 61/7 | 7.67/6.19 | Fair |
| | | | 02/95 | 59/8 | 6.95/5.66 | Swamp NR |
| UT Chinkapin Cr, SR 1432, Hertford | B-4 | 25-14-3-1 | 04/86 | 36/1 | 8.34/5.78 | Swamp NR |

*Note: Map # refers to number on subbasin map; Index # refers to number in Schedule of Classifications for the Chowan River Basin; the ratings are described in section 4.2.1 of this chapter and Appendix II.*

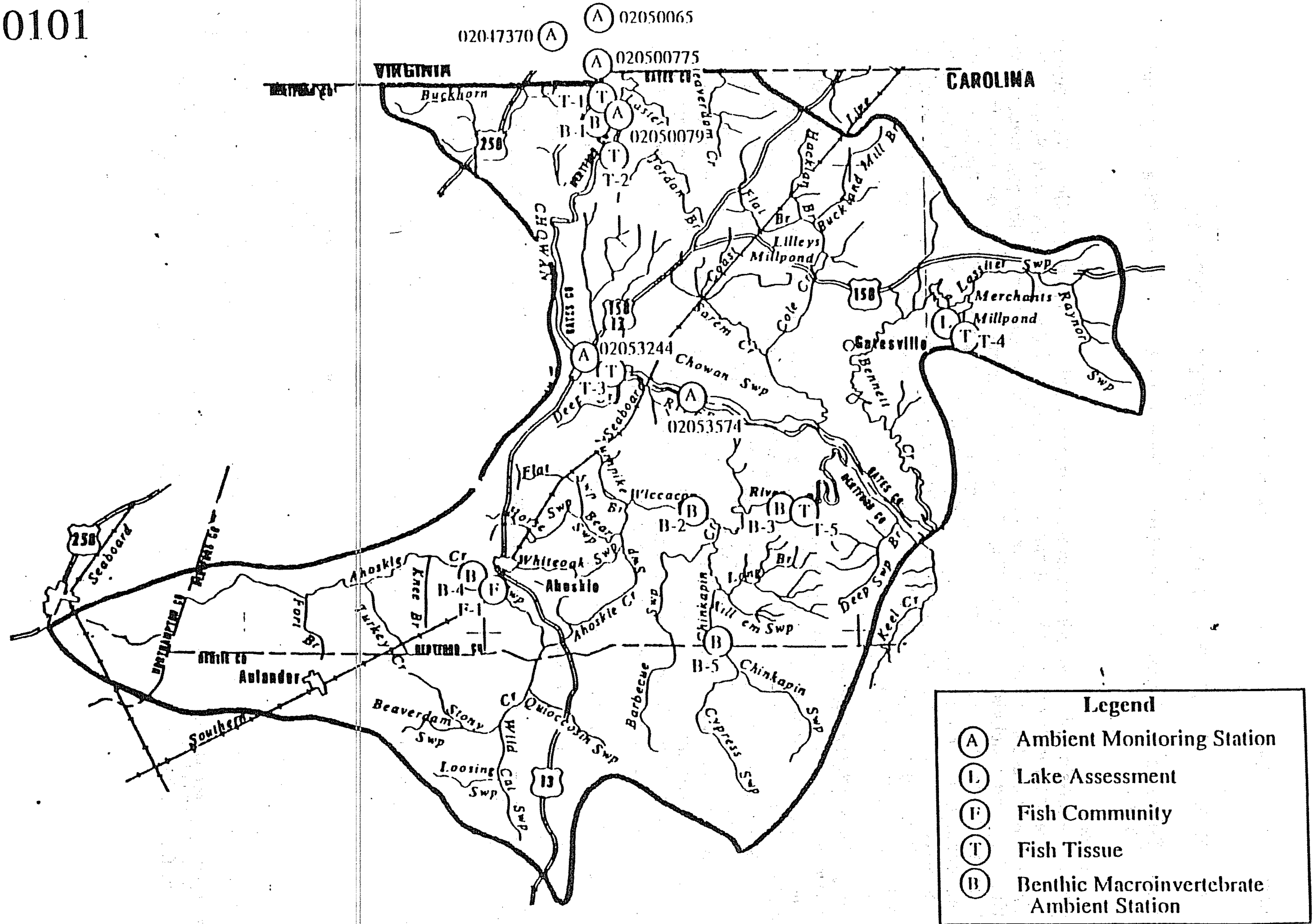



Figure 4.16. Locations of Sampling Stations for Subbasin 01

Fish tissue samples were collected at 5 sites within the Chowan 01 subbasin. The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. The Union Camp Fine Paper mill in Franklin, Virginia is believed to contribute to the dioxin contamination of fish in the Chowan River. Yearly voluntary monitoring conducted by Union Camp shows that dioxin levels (as TEQ) in gamefish species collected at Gatlington and Winton in Chowan subbasin 01 and from Virginia locations on the Backwater and Nottoway Rivers have been below the 3 ppt (as TEQ) NC action level since monitoring was begun there in 1989. Channel catfish dioxin levels (as TEQ) from those same locations have been below the action level since 1994. Mercury contamination in the Chowan 01 subbasin is most prevalent near Riddicksville and the Wiccacon River near NC 45, with levels exceeding FDA and/or EPA criteria in 48 of 132 samples. Other metals results throughout the subbasin were non detectable or at levels below those of human health or ecological concern.

Merchants Millpond (the only significant lake in the Chowan Basin), located in Gates County was originally called Norfleets Millpond when it was constructed in 1811 and contained a grist mill, a wheat mill and a saw mill. Currently, the millpond is part of the Merchants Millpond State Park. The proliferation of aquatic macrophytes, which cover the lake's surface, is not uncommon in millponds. Both shallow depth and the long retention time of these ponds encourage the growth of aquatic macrophytes. This is the case with Merchants Millpond. The over abundance of these plants in Merchants Millpond has been determined as a threat to designated uses (primarily canoeing and fishing). Low dissolved oxygen values also indicate that the uses of this lake are threatened.

This subbasin contains the location of an abandoned fertilizer plant that historically contributed significant amounts of nutrient to the Chowan River. Sometime subsequent to the abandonment of the site, it was found that old holding ponds that had been capped with clay were leaking. Chromium was found in sufficient quantities to trigger the Resource Conservation and Recovery Act (RCRA), but with respect to water quality, the nutrients contained in the waste presented a continued concern. The details of a non-discharge permit to begin remediation are still being worked out among involved agencies, including DWQ.

### 4.5.2 Subbasin 02 - Meherrin River and Potecasi Creek

Description

This Chowan subbasin includes the Meherrin River and its tributary streams. The largest of these tributaries is Potecasi Creek. Murfreesboro is the largest urban area in this subbasin. Land use within the subbasin is mainly forest and agriculture. The Meherrin River flows into North Carolina from Greensville County, Virginia. Figure 4.17 provides a map showing the major hydrological features and the location of DWQ's sampling sites in this subbasin.

Overview of Water Quality

There are 5 permitted dischargers in subbasin 02, the largest of which is Resinall Corporation (0.325 MGD) which discharges into an unnamed tributary to Kirby's Creek in Northhampton County. General water quality in the Meherrin River is Good based on benthic macroinvertebrate data and Fair for Potecasi Creek (see Table 4.11 for complete list of benthic macroinvertebrate sampling results). From 1990-1995, 42% of the samples taken from Potecasi Creek violated the minimum DO requirement of 4 mg/l.

# Chowan River Basin
# 030102

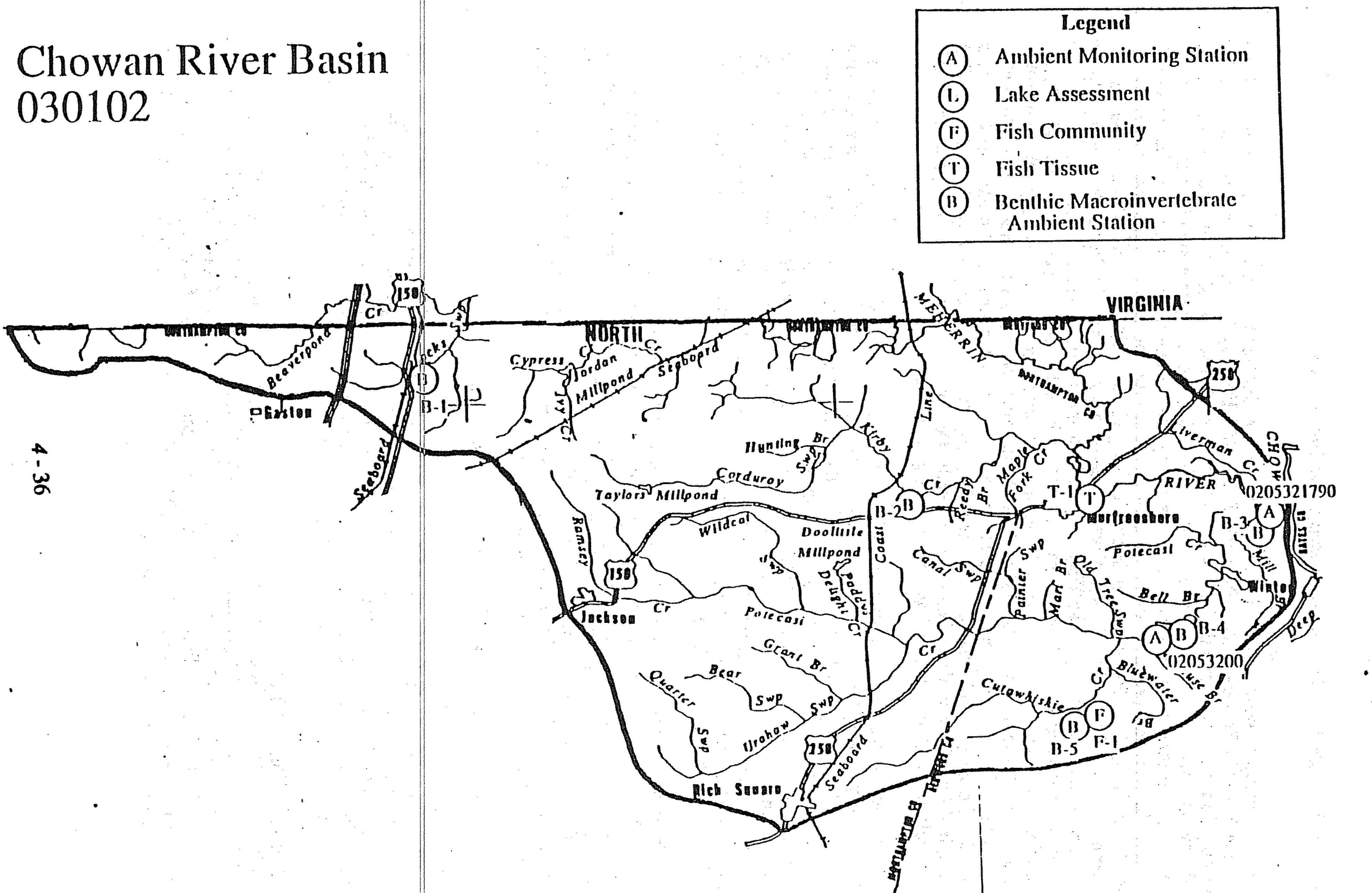



Figure 4.17. DWQ Sampling Sites in Subbasin 02.

Table 4.11. Benthic Macroinvertebrate Data, Chowan Subbasin 02, 1983 through 1995.

| Site | Map # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Jacks Swp, SR 1301, Northampton | B-1 | 25-4-2-3 | 11/84 | 45/10 | 7.11/3.03 | Good-Fair |
| Kirby's Cr, SR 1362, Northampton | B-2 | 25-4-4 | 02/95 | 62/11 | 6.52/5.86 | Swamp NR |
| Meherrin R, SR 1175, Hertford | B-3 | 25-4-(5) | 08/95 | 48/9 | 7.10/3.90 | Good |
| | | | 02/95 | 49/9 | 7.25/5.46 | Good |
| | | | 07/89 | 61/9 | 7.30/6.15 | Good |
| | | | 07/87 | 73/10 | 7.41/5.85 | Good |
| | | | 07/85 | 74/12 | 7.77/6.32 | Excellent |
| | | | 07/83 | 60/9 | 7.39/6.32 | Good |
| Potecasi Cr, NC 11, Hertford | B-4 | 25-4-8 | 07/89 | 66/11 | 7.28/6.07 | Fair |
| | | | 07/86 | 53/6 | 7.39/5.95 | Fair |
| | | | 07/84 | 53/7 | 6.87/5.05 | Fair |
| | | | 07/83 | 60/9 | 7.39/6.32 | Good |
| Cutawhiskie Cr, SR 1141, Hertford | B-5 | 25-4-8-7 | 08/95 | 49/4 | 6.80/6.13 | Fair |
| | | | 02/95 | 46/3 | 7.24/5.70 | Swamp NR |

*Note: Map # refers to number on subbasin map; Index # refers to number in Schedule of Classifications for the Chowan River Basin; the ratings are described in section 4.2.1 of this chapter and Appendix II.*

Fish community structure data were collected from Cutawhiskie Creek. The low NCIBI score (36) was attributed to a combination of only one sunfish species collected and an absence of piscivorous species. Both of these metrics are sensitive to degradation of pool habitats and quality of instream cover. No rating was given to this swamp stream.

Fish tissue samples were collected only from the Meherrin River at NC 258. The Meherrin River and Potecasi Creek are not under a fish consumption advisory due to dioxin contamination. Yearly voluntary monitoring conducted by Union Camp on channel catfish from the Meherrin River at NC 258 shows that dioxin levels (as TEQ) have been below the 3 ppt NC action level since 1991. Mercury contamination in samples collected from the Meherrin River was minimal, with only 3 samples exceeding the EPA screening value. Other metals results were non detectable or at levels below those of human health or ecological concern.

### 4.5.3 Subbasin 03 - Chowan River from Catherine Creek to Rockyhock Creek

<u>Description</u>

Chowan subbasin 03 contains the middle section of the Chowan River, above Rockyhock Creek and below Bennett Creek, including the tributaries Indian Creek and Catharine Creek. Land use is mainly forested wetlands. Figure 4.18 provides a visual description of the area and shows where DWQ's sampling sites in the subbasin are located.

<u>Overview of Water Quality</u>

Most of the information about water quality in this subbasin comes from water chemistry and phytoplankton sampling and is summarized previously in this chapter. No benthos or fish community structure collections have been made in this subbasin.

The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. Further discussion of this is in Section 3.2.2 in Chapter 3.

# Chowan River Basin
# 030103

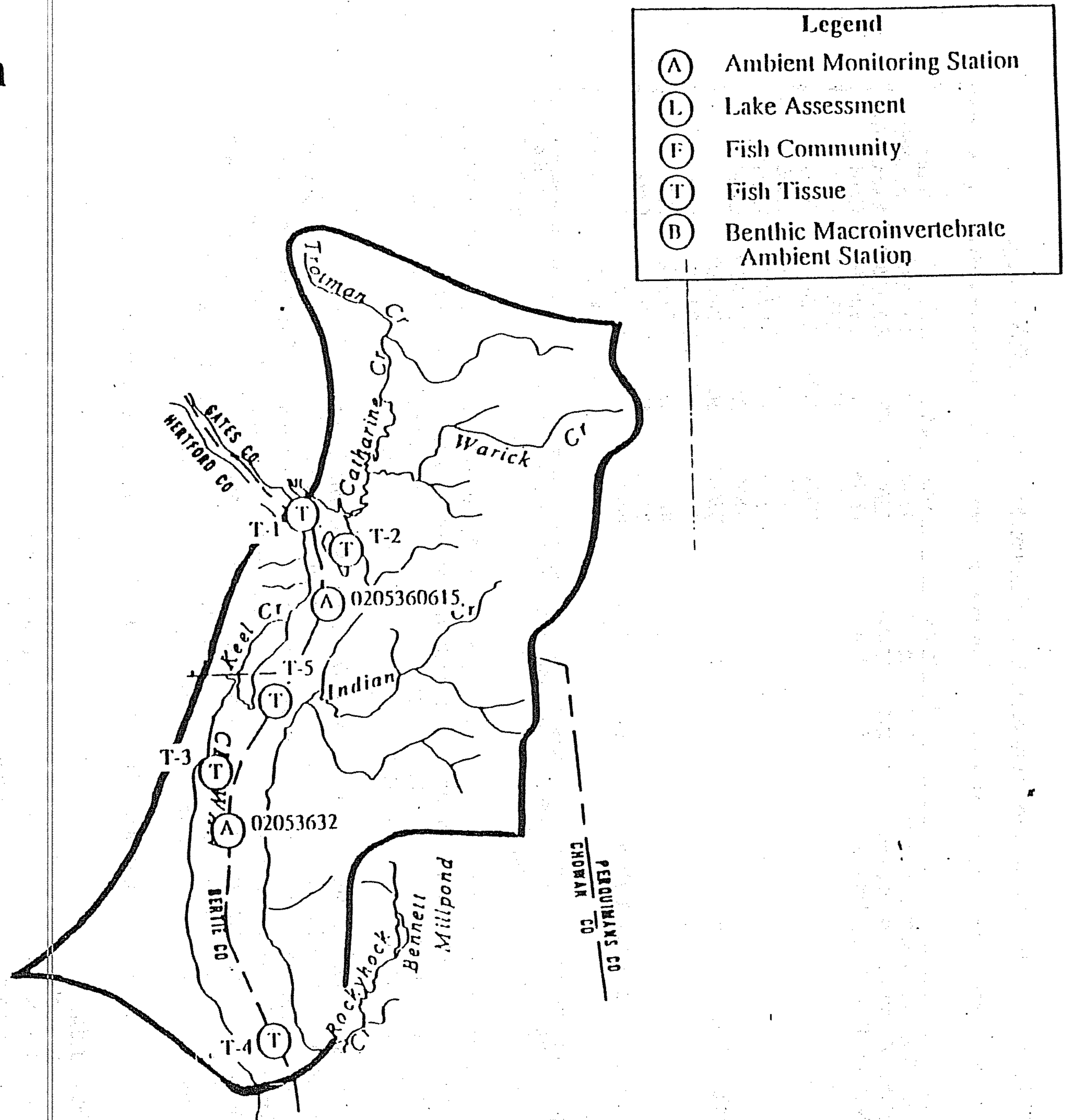



Figure 4.18. DWQ Sampling Sites in Subbasin 03.

Yearly voluntary gamefish monitoring conducted by Union Camp at Marker 16 and Marker 5 in subbasin 03 shows that largemouth bass and bluegill sunfish dioxin levels (as TEQ) have been below the 3 ppt NC action level since monitoring was begun there in 1990. Union Camp's monitoring further shows that channel catfish dioxin levels (as TEQ) have been below the NC action level at Marker 16 since 1994, and have been below the NC action level at Marker 5 since 1993. Marker 9 channel catfish levels were below the action level during 1995 and 1996, but have increased to slightly above the action level for 1997. It should be noted that the Albemarle Sound and the lower portion of the Chowan River experience tidal action and that the fish in this area may be impacted by other discharges of dioxin into waters that flow into the sound.

### 4.5.4 Subbasin 04 - Chowan River from Rockyhock Creek to Albemarle Sound

**Description**

Chowan subbasin 04 includes a small northwest portion of the Albemarle Sound, including Salmon Creek, Edenton Bay and Pembroke Creek, and the west side of the mouth of the Chowan River, below US 17. There are no large urban areas in this subbasin. Land use is mainly forested wetlands. Figure 4.19 shows the location of DWQ's sampling sites in the subbasin.

**Overview of Water Quality**

The only permitted discharger in subbasin 04 is the R. J. Reynolds Tobacco Company with a flow of 0.25 MGD. The only benthos site sampled in this subbasin is the Chowan River at US 17, where water quality has generally remained Good-Fair, based on benthic macroinvertebrate data, since 1983. Table 4.12 the results of all benthic samples taken at this location.

Table 4.12. Benthic Macroinvertebrate Data, Chowan Subbasin 04, 1983 through 1995.

| Site | Map # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Chowan R, US 17, Hertford | B-1 | 25 | 08/95 | 34/8 | 6.50/5.40 | Good-Fair |
| | | | 06/90 | 41/11 | 6.32/4.87 | Good |
| | | | 07/88 | 45/7 | 6.72/5.55 | Good-Fair |
| | | | 07/86 | 38/6 | 6.81/5.55 | Good-Fair |
| | | | 07/85 | 37/5 | 7.04/4.91 | Fair |
| | | | 07/84 | 41/8 | 6.61/4.91 | Good-Fair |
| | | | 07/83 | 42/8 | 7.07/5.06 | Good-Fair |

*Note: Map # refers to number on subbasin map; Index # refers to number in Schedule of Classifications for the Chowan River Basin; the ratings are described in section 4.2.1 of this chapter and Appendix II.*

Fish tissue samples were collected at four sites within this subbasin. Mercury contamination was minimal in these fish with only 3 of 47 samples containing mercury above human health criteria. Other metals and organics results were non-detectable or at levels below those of human health or ecological concern.

The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. Further discussion of this is in Section 3.2.2 in Chapter 3.

Union Camp has conducted voluntary fish tissue monitoring for channel catfish at the Highway 17 bridge since 1989 and at marker 2 (within the Albemarle Sound advisory area) since 1990. Union Camp performed no gamefish monitoring n Chowan subbasin 04 until 1997. 1997 data

# Chowan River Basin
# 030104

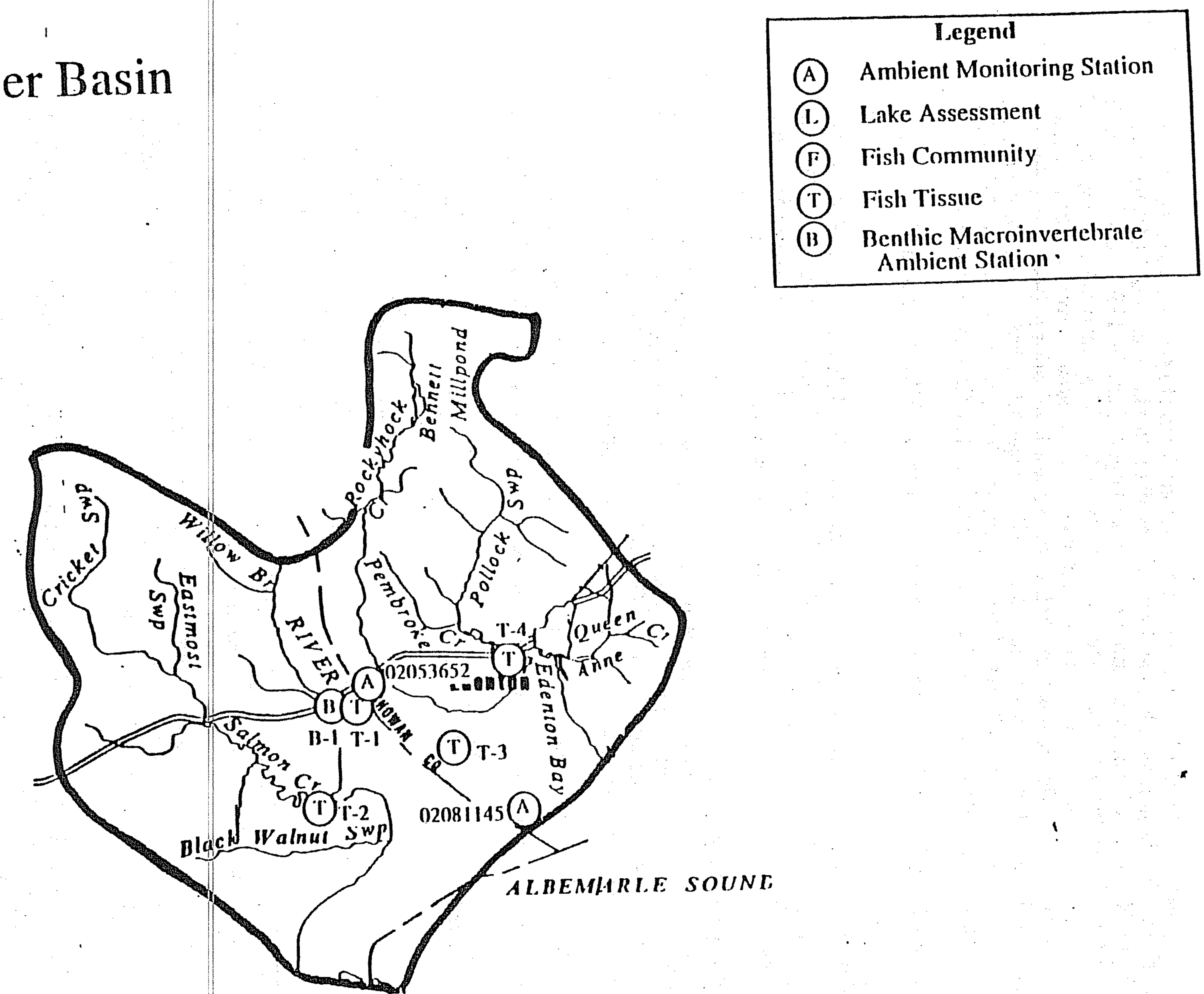



Figure 4.19. DWQ Sampling Sites in Subbasin 04.

for fish collected at the Highway 17 bridge shows that largemouth bass and bluegill sunfish dioxin levels (as TEQ) are below the 3 ppt NC action level. The channel catfish dioxin levels in Chowan subbasin 04 were below the action level during 1996, but have increased slightly above the action level for 1997. It should be noted that the Albemarle Sound and lower portion of the Chowan River experience tidal action and the fish in this area may be impacted by other discharges of dioxin into waters that flow into the sound.

## 4.6 USE-SUPPORT: DEFINITIONS AND METHODOLOGY

### 4.6.1 Introduction to Use Support

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses (*use support* status) is another important method of interpreting water quality data and assessing water quality. Use support assessments for the Chowan River basin are presented in Section 4.5.

Surface waters (streams, lakes or estuaries) are rated as either *fully supporting* (S), *support-threatened* (ST), *partially supporting* (PS), or *not supporting* (NS). The terms refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are fully supported, partially supported or are not supported. For instance, waters classified for fishing and water contact recreation (class C) are rated as fully supporting if data used to determine use support (such as chemical/physical data collected at ambient sites or benthic macroinvertebrate bioclassifications) did not exceed specific criteria. However, if these criteria were exceeded, then the waters would be rated as ST, PS or NS, depending on the degree of exceedence.

Streams rated as either partially supporting or nonsupporting are considered *impaired*. A waterbody is fully supporting but threatened (ST) for a particular designated use when it fully supports that use now, but may not in the future unless pollution prevention or control action is taken. Although threatened waters are currently supporting uses, they are treated as a separate category from waters fully supporting uses. Streams which had no data to determine their use support were listed as non-evaluated (NE).

For the purposes of this document, the term *impaired* refers to waters that are rated either partially supporting or not supporting their uses based on specific criteria discussed more fully below. There must be a specified degree of degradation before a stream is considered impaired. This differs from the word impacted, which can refer to any noticeable or measurable change in water quality, good or bad.

### 4.6.2 Interpretation of Data

The assessment of water quality presented below involved evaluation of available water quality data to determine a water body's use support rating. In addition, an effort was made to determine likely causes (e.g., sediment or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of pollution for impaired waters. Data used in the use support assessments include biological data, chemical physical data, lakes assessment data, DEH shellfish sanitation surveys, and monitoring data. Although there is a general procedure for analyzing the data and determining a waterbody's use support rating, each stream segment is reviewed individually, and best professional judgment is applied during these determinations.

Interpretation of the use support ratings compiled by DEM should be done with caution. The methodology used to determine the ratings must be understood, as should the purpose for which the ratings were generated. The intent of this use-support assessment was to gain an overall picture of the water quality, how well these waters support the uses for which they were classified, and the relative contribution made by different categories of pollution within the basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DEM used the data mentioned above.

The data are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Since the assessment methodology is geared toward general conclusions, it is important not to manipulate the data to support policy decisions beyond the accuracy of these data. For example, according to this report, nonpoint source pollution is the greatest source of water quality degradation. However, this does not mean that there should be no point source control measures. All categories of point and nonpoint source pollution have the potential to cause significant water quality degradation if proper controls and practices are not utilized.

The threat to water quality from all types of activities heightens the need for point and nonpoint source pollution control. It is important to consider any source (or potential source) of pollution in developing appropriate management and control strategies. The potential for further problems remains high as long as the activity in question continues carelessly. Because of this potential, neglecting one pollution source in an overall control strategy can mask the benefits achieved from controlling all other sources.

### 4.6.3 Assessment Methodology - Freshwater Bodies

Many types of information were used to determine use support assessments and to determine causes and sources of use support impairment. A use support data file is maintained for each of the 17 river basins. In these files stream segments are listed as individual records. All existing data pertaining to a stream segment (from the above list) is entered into its record. In determining the use support rating for a stream segment, corresponding ratings are assigned to data values where this is appropriate. The following data and the corresponding use support ratings are used in the process: (note: The general methodology for using this data and translating the values to use support ratings corresponds closely to the 305(b) guidelines with some minor modifications.)

**Biological Data**

<u>**Benthic Macroinvertebrate Bioclassification**</u>
Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPT S) and the Biotic Index which summarizes tolerence data for all taxa in each collection. The bioclassifications are translated to use support ratings as follows:

| Bioclassification | Rating |
|---|---|
| Excellent | Supporting |
| Good | Supporting |
| Good-Fair | Support Threatened |
| Fair | Partially Supporting |
| Poor | Not Supporting |

**Fish Community Structure**

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a streams biological integrity by examining the structure and health of its fish community. The index incorporates information about species richness and composition, trophic composition, fish abundance and fish condition. The index is translated to use support ratings as follows:

| NCIBI | Rating |
|---|---|
| Excellent | Supporting |
| Good-Excellent | Supporting |
| Good | Supporting |
| Fair-Good | Support Threatened |
| Fair | Partially Supporting |
| Poor-Fair | Partially Supporting |
| Poor | Not Supporting |
| Very Poor - Poor | Not Supporting |
| Very Poor | Not Supporting |

**Phytoplankton and Algal Bloom Data**

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of alga may discolor the water or form visible mats on top of the water. blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5,000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 micrograms per liter (the NC state standard) constitutes a bloom. A waterbody is rated ST if the biovolume, density and chlorophyll a concentrations are approaching bloom concentrations. If an algal bloom occurs, the waterbody is rated PS.

**Chemical/Physical Data**

Chemical/physical water quality data is collected through the Ambient Monitoring System as discussed in section 4.2.7. This data is downloaded from STORET to a desktop computer for analysis. Total number of samples and percent exceedences of the NC state standards are used for use support ratings. Percent exceedences correspond to use support ratings as follows:

| Standards Violation | Rating |
|---|---|
| Criteria exceeded < 10% | Fully Supporting |
| Criteria exceeded 11-25% | Partially Supporting |
| Criteria exceeded >25% | Not Supporting |

It is important to note that some waters may exhibit characteristics outside the appropriate standards due to natural conditions. These natural conditions do not constitute a violation of water quality standards.

**Lakes Program Data**

As discussed in section 4.2.3, assessments have been made for all publicly accessible lakes, lakes which supply domestic drinking water, and lakes where water quality problems have been observed.

**Sources and Cause Data**

In addition to the above data, existing information was entered for potential sources of pollution (point and nonpoint). It is important to note that not all impaired streams will have a potential source and/or cause listed for them. Staff and resources do not currently exist to collect this level of information. Much of this information is obtained through the cooperation of other agencies (federal, state and local), organizations, and citizens.

**Point Source Data**

**Whole Effluent Toxicity Data**
Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Streams that receive a discharge from a facility that have failed its whole effluent toxicity test may be rated ST (unless water quality data indicated otherwise), and have that facility listed as a potential source of impairment.

**Daily Monitoring Reports**
Streams which received a discharge from a facility significantly out of compliance with permit limits may be rated ST (unless water quality data indicated otherwise), and have that facility listed as a Point Source potential source of impairment.

**Nonpoint Source Data**

Information related to nonpoint source pollution (i.e., agricultural, urban and construction) was obtained from monitoring staff, other agencies (federal, state and local), 1988 nonpoint source workshops, land-use reviews, and workshops held at the beginning of each basin cycle.

**Problem Parameters**

Causes of use support impairment (problem parameters) such as sedimentation and low dissolved oxygen, were also identified for specific stream segments. For ambient water quality stations, those parameters which exceeded the water quality standard > 10% of the time for the review period were listed as a problem parameter. For segments without ambient stations, information from reports, other agencies, and monitoring staff were used if it was available.

**Monitored vs. Evaluated**

Assessments were made on either monitored (M) or evaluated (E) basis depending on the level of information that was used. Streams are rated on a monitored basis if the data is less than five years old. Streams are rated on an evaluated basis under the following conditions:

> If the only existing data for a stream is more than five years old, this data is used to rate the stream on an evaluated basis.
>
> If a stream is a tributary to a monitored (segment of a) stream rated fully supporting (S) or support threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored (segment of a) stream rated partially supporting (PS) or not supporting (NS), the stream is considered not evaluated (NE).

### 4.6.4 Assigning Use Support Ratings

At the beginning of each assessment, all data is reviewed by subbasin with the monitoring staff, and data is adjusted where necessary based on best professional judgment. Discrepancies between data sources are resolved during this phase of the process. For example, a stream may be sampled for both benthos and fish community structure, and the bioclassification may differ from the NCIBI (i.e. the bioclassification may be S while the NCIBI may be PS). To resolve this, the final rating may defer to one of the samples (resulting in S or PS), or, it may be a compromise between both of the samples (resulting in ST).

After reviewing the existing data, ratings are assigned to the streams. If one data source exists for the stream, the rating is assigned based on the translation of the data value as discussed above. If more than one source of data exists for a stream, the rating is assigned according to the following hierarchy:

Benthic Bioclassification / Fish Community Structure
Chemical/Physical Data
Monitored Data > 5 years old
Compliance / Toxicity Data

This is only a general guideline for assigning use support ratings and not meant to be restrictive. Each segment is reviewed individually and the resulting rating may vary from this process based on best professional judgment which takes into consideration site specific conditions.

After assigning ratings to streams with existing data, streams with no existing data were assessed. Streams that were direct or indirect tributaries to streams rated S or ST received the same rating (with an evaluated basis) if they had no known significant impacts, based on a review of the watershed characteristics and discharge information. Streams that were direct or indirect tributaries to streams rated PS or NS, or that had no data were assigned a Not Evaluated (NE) rating.

### 4.6.5 Revisions to Methodology Since 1992 - 93 305(b) Report

Methodology for determining use support has been revised. In the 1992-1993 305(b) Report, evaluated information from older reports and workshops were included in the use support process. Streams rated using this information were considered to be rated on an evaluated basis. In the current use support process, this older, evaluated information has been discarded, and streams are now rated using only monitored information (including current and older monitoring data). Streams are rated on a monitored basis if the data is less than five years old. Streams are rated on an evaluated basis under the following conditions:

If the only existing data for a stream is more than five years old, this data is used to rate the stream on an evaluated basis.

> If a stream is a tributary to a monitored segment of a stream rated fully supporting (S) or support threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored segment rated partially supporting (PS) or not supporting (NS), the stream is considered not evaluated (NE).

These changes resulted in a reduction in streams rated on an evaluated basis.

The basinwide process allows for concentrating more resources on individual basins during the monitoring phase. Therefore, more streams were monitored, and more information was available to use in the use support process.

Fish consumption advisories are no longer used in determining the use support rating. They are now shown on a separate map, and discussed in Chapter 3. This will more clearly show what types of advisories are in effect, and where they are occurring.

## 4.7 USE SUPPORT RATINGS FOR THE CHOWAN RIVER BASIN

Use Support ratings for all monitored and evaluated surface waters in the basin are presented on color-coded maps in Figure 4.20. The following sections describe the assignment of ratings to both the fresh and salt waters in the basin.

### 4.7.1 Freshwater Streams and Rivers

Of the 788 miles of freshwater streams and rivers in the Chowan basin, use support ratings were determined for 64% or 507 miles of water. The relative breakdown of percentages for the use support categories is as follows:

SUPPORTING ................................ 42%
- Fully supporting (17%)
- Support-threatened (25% )

IMPAIRED...................................... 22%
- Partially supporting (22%)
- Not supporting (0%)

NOT EVALUATED: ...................... 36%

These use support values are different from the values in the 1992-1993 305(b) Report. The total waters supporting their uses appear to have increased, while those that are impaired appear to have decreased. While the water quality may have improved since the 1992-1993 305(b) report, the changes in values may also be due to revisions in the methodology for assigning use support (discussed earlier in section 4.4.5).

Table 4.13 provides information on streams and stream segments that were monitored. Streams with data that was collected during the time period of 1991 through 1995 are considered to be monitored. This includes bioclassification and collection date for macrobenthic invertebrate samples, fish community structure samples, ambient monitoring station information, problem parameters such as sediment, potential sources of pollution (point or nonpoint), and the overall use support rating. All remaining streams in the basin were rated on an evaluated basis, or, if no data exists, were considered not evaluated. Table 4.14 presents the overall use support determinations by subbasin.

Impaired Freshwater Streams

In determining sources of pollution for impaired waters, observation from field staff, information from the 1988 nonpoint source workshops, and discharger daily monitoring reports were used. This does not provide a complete explanation for all potential sources of pollution in the basin. Recently, multi-agency teams have been assigned to address nonpoint source pollution in each of the river basins. As the different agencies work together within these teams, they will eventually provide more complete information on the nonpoint sources affecting the impaired waters.

In subbasin 030101, 64 stream miles were rated partially supporting. Approximately 44 miles (the Ahoskie Creek and several tributaries) is thought to be impaired from agriculture and channelization, while the source was unknown for the remaining 20 miles (the Wiccacon River).

In subbasin 030102, 66 stream miles were rated partially supporting. Potecasi Creek, Cutawhiskie Swamp, and Chapel Branch are all thought to be impaired due to agriculture and channelization.

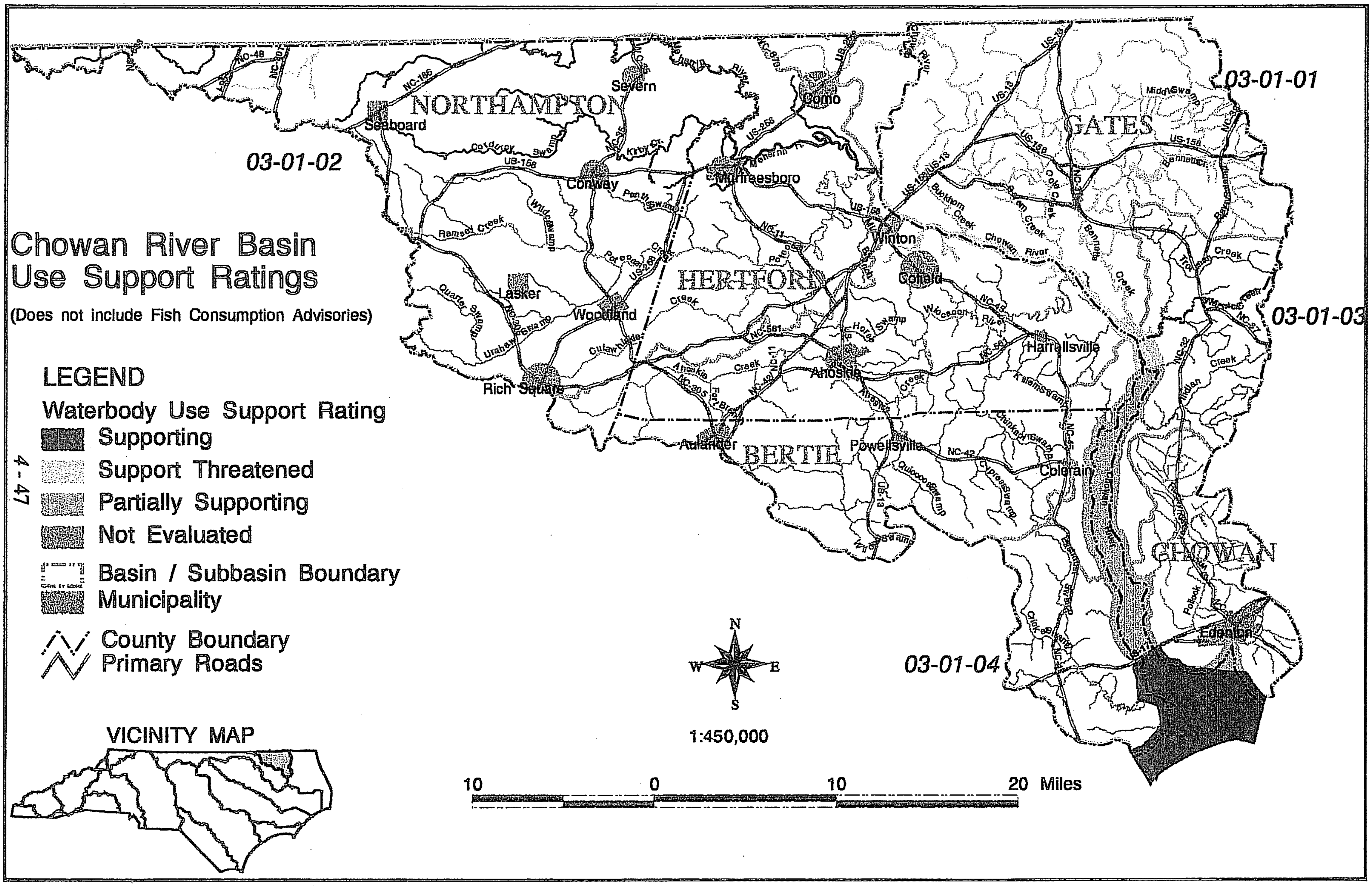



Figure 4.20. Use Support Map of the Chowan River Basin

## Table 4.13. Use Support Status for Freshwater Streams in the Chowan River Basin

| Station Number | Station Location | Classification | Index Number | Miles | Chem. Rating 90-94 | Biological Rating 1991 | 1992 | 1993 | 1994 | 1995 | Fish | OVERALL RATING Prob. Param. | Use Support | Major Source |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **30101** | | | | | | | | | | | | | | |
| 2050079 | Chowan River at Riddicksville, bugs at SR 1319, Hertford | B NSW | 25a | 1.8 | PS | | | | | Good-Fair | | DO | ST | NP |
| 2053244 | Chowan River at Hwy 13, Winston, NC | B NSW | 25b | 10.1 | S | | | | | | | | ST | NP |
| 2053574 | Chowan River at channel marker #16 near Gatesville, NC | B NSW | 25c | 14.5 | S | | | | | | | | ST | NP |
| | Wiccacon River NC 45, SR 1433, Hertford | C NSW | 25-14 | 20.8 | | | | | | Fair | | | PS | NP |
| | Ahoskie Creek at NC 42, Hertford | C NSW | 25-14-1 | 27.8 | | | | | | Fair | Fair | | PS | NP |
| **30102** | | | | | | | | | | | | | | |
| 0205321790 | Meherrin River near Como, SR-1175 | B NSW | 25-4-(5) | 13.2 | S | | | | | Good | | | S | |
| 2053200 | Potecasi Creek NC 11 near Union | C NSW | 25-4-8 | 45.6 | NS | Fair('89) | | | | | | DO,pH | PS | NP |
| | Cutawhiskie Swamp, SR 1141, Hertford | C NSW | 25-4-8-8 | 17.8 | | | | | | Fair | NR-Swamp | | PS | NP |
| **30103** | | | | | | | | | | | | | | |
| 205360615 | Chowan River 200 yards below Holiday Island | B NSW | 25d | 4.5 | S | | | | | | | | ST | NP |
| 2053632 | Chowan R. at marker 17 at Collerain | B NSW | 25e | 5.5 | PS | | | | | | | Nutr,pH | PS | P |
| **30104** | | | | | | | | | | | | | | |
| 2053652 | Chowan River at Edenhouse, U.S. Hwy. 17 | B NSW | 25f | 14.5 | S | | | | | Good-Fair | | Nutr | PS | NP |

## Table 4.14. Overall Use Support Determinations by Subbasin.

| USE SUPPORT STATUS FOR FRESHWATER STREAMS (MILES) (1990-1994) | | | | | | |
|---|---|---|---|---|---|---|
| **Subbasin** | **S** | **ST** | **PS** | **NS** | **NE** | **Total Miles** |
| 30101 | 0 | 180.1 | 64 | 0 | 104.6 | 348.7 |
| 30102 | 132.5 | 10.9 | 66.3 | 0 | 109.5 | 319.2 |
| 30103 | 0 | 4.5 | 9.6 | 0 | 35.7 | 49.8 |
| 30104 | 4.3 | 0 | 34.8 | 0 | 31.3 | 70.4 |
| TOTAL | 136.8 | 195.5 | 174.7 | 0 | 281.1 | 788.1 |
| PERCENTAGE | 17 | 25 | 22 | 0 | 36 | |

In subbasin 030104, 39 stream miles were rated partially supporting, including the lower part of the Chowan which is discussed below. Sources of impairment are thought to be agriculture and channelization. Edenton Bay, like the lower portion of the Chowan River, is rated PS due to the nuisance algal blooms.

The Chowan River (particularly the portion downstream of Holiday Island) has historically had problems with eutrophication. Nuisance algal blooms have been documented as far back as the early 1970s. Although the NSW strategy has been in place since 1982 and reductions in phosphorus and nitrogen have been documented, this portion of the river is still susceptible to blooms. The blooms almost always occur during warm, dry summers preceded by high spring river flows. Significant blooms were documented in 1990 and 1993. This portion of the Chowan River was rated partially supporting due to these blooms and the continued sensitivity to nutrients. This impairment is attributed to both point (Colerain WWTP and United Piece Dye Works) and nonpoint (agriculture) sources.

### 4.7.2 Lakes

**Subbasin 030501**

Merchants Millpond, located in Gates County, is the only significant lake in the Chowan basin. It is currently classified as C NSW and has a surface area of 450 acres. It was sampled in August 1995 and the proliferation of aquatic macrophytes resulted in a support threatened rating.

### 4.7.3 Use Support Ratings for Waters in Virginia

The State of Virginia has assigned use support ratings for the Chowan River-Dismal Swamp Basin in their state. The area is made up primarily of the Chowan drainage, but includes a small area that drains into what NC DWQ defines as the Pasquotank basin. Table 4.15 presents the results of their use support assessment for rivers in the Chowan-Dismal Swamp River Basin.

Table 4.15. Use Support Ratings for the Rivers of the Chowan River-Dismal Swamp Basin - Presented in Terms of Percent of Waters Representing Support Category (Source: Virginia DEQ, 1994)

| Use | Fully Supporting | Threatened | Partially Supporting | Not Supporting | Not Assessed |
|---|---|---|---|---|---|
| Aquatic Life | 99% | <1% | <1% | <1% | 0% |
| Fish Consumption | 99% | 0% | <1% | 0% | 0% |
| Swimming | 100% | 0% | 0% | 0% | 0% |
| Drinking Water | 78% | 0% | 0% | 0% | 21% |

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### 5.2.2 State Authorities for NC's Water Quality Program

- **G.S. 143-214.1** - Directs and empowers the NC Environmental Management Commission (EMC) to develop a water quality standards and classifications program.
  **G.S. 143-214.2** - Prohibits the discharge of wastes to surface waters of the state without a permit.
- **G.S. 143-214.5** - Provides for establishment of the state Water Supply Watershed Protection Program.
- **G.S. 143-214.7** - Directs the EMC to establish a Stormwater Runoff Program.
- **G.S. 143-215** - Authorizes and directs the EMC to establish effluent standards and limitations.
- **G.S. 143-215.1** - Outlines methods for control of sources of water pollution (NPDES and nondischarge permits, statutory notice requirements, public hearing requirements, appeals, etc.).
- **G.S. 143-215.1** - Empowers the EMC to issue *special orders* to any person whom it finds responsible for causing or contributing to any pollution of the waters of the state within the area for which standards have been established.
- **G.S. 143-215.3(a)** - Outlines additional powers of the EMC including provisions for adopting rules, charging permit fees, delegating authority, investigating fish kills and investigating violations of rules, standards or limitations adopted by the EMC.
- **G.S. 143-215.6A, 143-215.6B and 143-215.6C** - Includes enforcement provisions for violations of various rules, classifications, standards, limitations, provisions or management practices established pursuant to G.S. 143-214.1, 143-214.2, 143-214.5, 143-215, 143-215.1, 143-215.2. 6A describes enforcement procedures for civil penalties. 6B outlines enforcement procedures for criminal penalties. 6C outlines provisions for injunctive relief.
- **G.S. 143-215.75** - Outlines the state's Oil Pollution and Hazardous Substances Control Program.

## 5.3 Surface Water Classifications and Standards

North Carolina has established a water quality classification and standards program pursuant to G.S. 143-214.1. Classifications and standards are developed pursuant to 15A NCAC 2B.0100 - Procedures for Assignment of Water Quality Standards. Waters were classified for their "best usage" in North Carolina beginning in the early 1950's, with classification and water quality standards for all the state's river basins adopted by 1963. The effort to accomplish this included identification of water bodies (which included all named water bodies on USGS 7.5 minute topographic maps), studies of river basins to document sources of pollution and appropriate best uses, and formal adoption of standards/classifications following public hearings.

The Water Quality Standards program in North Carolina has evolved over time and has been modified to be 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 and the protection of unique and special pristine waters with outstanding resource values. Classifications and standards have been broadly interpreted to provide protection of uses from both point and nonpoint source pollution.

Some of the classifications, particularly for HQW, ORW and WS waters, outline protective management strategies aimed at controlling point and nonpoint source pollution. Special HQW protection management strategies are presented in 15A NCAC 2B.0201(d), which is included in its entirety in Appendix I under Antidegradation Policy. These measures are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater facilities and for existing facilities which expand beyond their currently permitted loadings address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances. For oxygen-consuming wastes, for example, effluent limitations for new or expanding facilities are as follows: $BOD_5$ = 5 mg/l; $NH_3$-N = 2 mg/l; DO = 6 mg/l (except for those expanding discharges which expand with no increase in permitted pollutant loading).

For nonpoint source pollution, development activities which require an Erosion and Sedimentation Control Plan in accordance with rules established by the NC Sedimentation Control Commission or local erosion and sedimentation control program approved in accordance with 15A NCAC 4B .0218, and which drain to and are within one mile of High Quality Waters will be required to control runoff from the one-inch design storm using either a low density or high density option described in the rules.

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0216 (most of which is included in Appendix I). At a minimum, no new discharges or expansions of existing discharges are permitted, and stormwater controls for most development needing an Erosion and Sedimentation Control Plan are required.

The requirements for WS waters vary significantly from WS-I to WS-V. The WS-I classification carries the most stringent requirements for dischargers and surrounding land use activities while WS-V carries the least.

## 5.4 NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAM

North Carolina does not allow point source discharges without a permit. Discharge permits are issued under the authority of North Carolina General Statute (NCGS) 143.215.1 and the National Pollutant Discharge Elimination System (NPDES) program. The NPDES program was delegated to North Carolina from the US Environmental Protection Agency. These permits serve as both state and federal permits. North Carolina has a comprehensive NPDES program which includes the permitting of both wastewater and stormwater discharges. Information on permitted NPDES dischargers within the Chowan River basin can be found in Section 3.3.

NPDES permits are issued in two categories; individual or general. Individual permits are issued to a specific facility, contain site specific requirements, and incorporate recommendations from the basinwide water quality management plan. Individual NPDES permits are typically issued for a five year cycle with all permits in a river basin expiring at the same time. This permitting strategy allows for comprehensive review of individual dischargers within the basin and implementation of recommendations contained in the basinwide water quality management plan. New discharge permits issued during an interim period are given a shorter permit cycle so that expiration coincides with the basin cycle. Individual permits in the Pasquotank River basin are scheduled for expiration and renewal in February and March of 1998.

General permits are developed for specific types of industries. Each general permit contains requirements that are appropriate for a typical facility within a specific industrial classification. Facilities that are considered atypical or have a history of water quality problems are required to obtain an individual permit. Because general permits are specific to a type of industrial activity and are issued statewide they do not contain basin specific measures. A general permit is typically issued for a five year cycle, which expires statewide on the same date. All general permits have a permit number that begins with "NCG".

### 5.4.1 NPDES Permits for Wastewater Discharges

Under the NPDES wastewater permitting program, each NPDES discharger is assigned either *major* or *minor* status. For municipalities, all dischargers with a flow of greater than 1 million gallons per day (MGD) are classified as major.

All new wastewater discharge permit applications must include an engineering proposal which includes a description of the origin, type, and flow of wastewater, a summary of waste treatment and disposal options, and a narrative description of the proposed treatment works and why the proposed system and point of discharge were selected. The summary must contain sufficient detail to assure that the most environmentally sound alternative was selected from the reasonably cost effective options. An assessment report describing the impact on waters in the area must be submitted for all applications of new discharges in excess of 500,000 gallons per day or 10 million gallons per day of cooling water or any other proposed discharge of 1 million gallons per day or more.

Under the NPDES program, wastewater treatment systems must be operated by a certified operator. Training and certification of operators is conducted by the DWQ. It is the goal of the program to provide competent and conscientious professionals that will protect both the environment and public health.

The amount or loading of specific pollutants that are allowed to be discharged into surface waters are defined in the NPDES permit and are called *effluent limits*. Point source discharges generally have the most impact on a stream during low flow conditions when the percentage of treated effluent within the stream is greatest. Effluent limits are generally set to protect the stream during these low flow conditions. The standard low flow used for determining point source impacts is called the *7Q10*. This is the lowest flow which occurs over seven consecutive days and which has an average recurrence of once in ten years. Computer modeling may be used to determine the fate and transport of pollutants, reduction goals for contaminants, and to derive effluent limits for NPDES permits. A wasteload allocation is performed to ensure the effluent limits are set at levels that can be safely assimilated by the receiving stream.

Most dischargers are required to periodically sample their treated effluent. This process is called self-monitoring. Larger and more complex dischargers are also required to sample both upstream and downstream of the discharge point. NPDES facilities are required to monitor for all pollutants for which they have permit limits as well as other pollutants which may be present in their wastewater. Sampling results are submitted to DWQ each month for compliance evaluations. If limits are not being met, various legal actions may be taken against the discharger to ensure future compliance.

All domestic wastewater dischargers are required to monitor flow, dissolved oxygen, temperature, fecal coliform, BOD, ammonia, and chlorine (if they use it as a disinfectant). In addition, wastewater treatment facilities with industrial sources may have to monitor for chemical specific toxicants and/or whole effluent toxicity, and all dischargers with design flows greater than 50,000 gallons per day (GPD) monitor for total phosphorus and total nitrogen. Minimum NPDES wastewater monitoring requirements are provided in 15A NCAC 2B .0500.

Other methods of collecting point source information include effluent sampling by DWQ during inspections and special studies. The regional offices may collect data at a given facility if they believe there may be an operational problem or as a routine compliance check. DWQ may collect effluent data during intensive surveys of segments of streams. Extensive discharger data have been collected during on-site toxicity tests.

A pretreatment program is aimed at protecting municipal wastewater treatment plants and the environment from the adverse impacts that may occur when hazardous or toxic wastes are discharged into a public system. This program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging into a public wastewater system.

environment from the adverse impacts that may occur when hazardous or toxic wastes are discharged into a public system. This program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging into a public wastewater system.

### 5.4.2 NPDES Permits for Stormwater Discharges

As currently defined by the NPDES program, stormwater point source discharges originate from two distinct sources; municipalities and selected industrial facilities. Subject municipalities are defined as those incorporated areas that encompass a population of 100,000 or more. Subject industrial activities are those where stormwater discharges directly related to manufacturing, processing or raw materials storage areas occur. A complete definition of "stormwater discharge associated with industrial activity" including a comprehensive listing of subject industries can be found in 40 CFR 122.26. The types of industrial activities that are subject to stormwater permitting are typically defined by Standard Industrial Classification (SIC) codes. SIC codes have been developed by the federal Office of Management and Budget to define industries in accordance with the composition and structure of the economy.

There are currently 19 general stormwater permits available for specific types of industrial activities across the state. As previously explained, the general permits define stormwater controls and monitoring for a typical facility within a specific industrial classification. General stormwater permits incorporate requirements determined to be appropriate based upon an analysis of available analytical monitoring data, input from industry and associations, site visits, and review of federal and other documents providing guidance on specific types of industries, pollutants, and stormwater discharges.

The North Carolina Department of Transportation (DOT) is subject to the NPDES stormwater permitting program. The permit, when issued, will cover stormwater runoff from DOT's non-administrative activities throughout the state including the state roadway network, construction, vehicle maintenance, and materials storage facilities. The draft permit is currently scheduled to be sent to public notice in 1998.

Stormwater permits may specify monitoring and reporting requirements for both quantitative and qualitative assessment of the stormwater discharge as well as operational inspections of the entire facility. The specific pollutant parameters for which sampling must be performed are based upon the types of materials used and produced in the manufacturing processes and the potential for contamination of the stormwater runoff at a typical facility.

All NPDES stormwater permits require the development and implementation of a Stormwater Pollution Prevention Plan (SPPP). The SPPP requires the permitted facility to develop a comprehensive stormwater management plan. This plan is the basis for evaluating the pollution potential of the site and implementing best management practices (BMPs) to reduce pollutants in runoff from the site.

All stormwater permits specify qualitative monitoring of each stormwater outfall for the purposes of evaluating the effectiveness of the Stormwater Pollution Prevention Plan and assessing new sources of stormwater pollution. Qualitative monitoring parameters include color, odor, clarity, floating and suspended solids, foam, oil sheen, and other obvious indicators of stormwater pollution.

Stormwater permits may provide for the use of cut-off concentrations in order to minimize the required analytical monitoring for facilities which are not significant contributors to stormwater pollution. These cut-off concentrations are not intended to be effluent limits (as used in wastewater permitting), but provide guidelines for determining which facilities are major contributors to stormwater pollution and need further monitoring. The arithmetic mean of all monitoring data collected during the term of the permit must be calculated for each parameter and compared to the permitted cut-off concentration. If the mean is below the cut-off concentration, then the facility may discontinue analytical monitoring for that parameter until the final year of the permit unless changes occur at the facility. This approach prevents facilities from using the cut-off concentrations as target concentrations for evaluating the effectiveness of the Stormwater Pollution Prevention Plan while also ensuring that problem facilities continue to collect analytical data on their discharges.

## 5.5 NONPOINT SOURCE CONTROL PROGRAMS

Nonpoint source pollution occurs when rainfall or snowmelt runs off the ground or impervious surfaces like buildings and roads and drains into waterways. Some of the most common nonpoint source pollutants and their causes are presented in Chapter 3.

The two approaches that are used to address nonpoint source pollution are prevention and engineered controls. Some of the methods of pollution prevention include optimum site planning, use of natural drainage systems rather than curb and gutter, nutrient management plans, public/farmer education, storm drain stenciling, and hazardous waste collection sites. It is generally more cost-effective to prevent and minimize pollution than to build engineered controls. For example, developers who are subject to stormwater requirements often choose to build low density developments rather than bearing the expense of building engineered BMPs. Engineered BMPs also have on-going expenses associated with long-term operation and maintenance.

Engineered BMPs generally work by capturing, retaining, and treating runoff before it leaves an area. Some commonly used types of BMPs include stormwater wetlands, wet detention ponds, water control structures, bioretention areas, and infiltration basins. Often higher levels of pollutant removal can be achieved by using a combination of different control systems. The main advantage of engineered controls is that they can treat runoff from high density developments.

The current trend is toward a more comprehensive "systems approach" to managing nonpoint source pollution. This involves using an integrated system of preventive and control practices to accomplish nonpoint pollution reduction goals. This approach emphasizes site planning, protecting important natural areas such as wetlands, and finding the most cost-effective engineered controls for high density areas. Programs which are currently using the systems approach include the animal waste regulations and the regulations for coastal stormwater management and water supply watersheds. In general, the goals of the nonpoint source management program include the following:

- Continue to build and improve existing programs,
- Develop new programs to control nonpoint pollution sources that are not addressed by existing programs,
- Continue to target geographic areas and waterbodies for protection,
- Integrate the NPS Program with other state programs and management studies (e.g., Albemarle-Pamlico Estuarine Study), and
- Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

Table 5.1 lists a number of federal and state programs that address nonpoint source pollution. These programs are listed by category based on the type of activity. A complete program description can be found in Appendix VI for nonpoint source control programs. Refer to Table 5.2 for a brief description of each program and the contact persons within the basin for each program.

Table 5.1 List of Nonpoint Source Programs

| PROGRAM | LOCAL | STATE | FEDERAL |
|---|---|---|---|
| AGRICULTURE: | | | |
| Agriculture Cost Share Program | SWCD | SWCC, DSWC | |
| N.C. Pesticide Law of 1971 | | NCDA | |
| Pesticide Disposal Program | | NCDA | |
| Animal Waste Management | SWCD | DWQ,DSWC, CES | NRCS |
| Laboratory Testing Services | | NCDA | |
| Watershed Protection (PL-566) | | | NRCS |
| 1985 ,1990 and 1995 Farm Bills | | | USDA |
| - Conservation Reserve Program | | | |
| - Conservation Compliance | | | |
| - Sodbuster | | | |
| - Swampbuster | | | |
| - Conservation Easement | | | |
| - Wetland Reserve | | | |
| - Water Quality Incentive Program | | | |
| URBAN | | | |
| Coastal Stormwater Program | | DWQ | |
| ORW, HQW, NSW Management Strategies | | DWQ | |
| Water Supply Watershed Protection Program | city, county | DWQ | |
| Stormwater Control Program | city, county | DWQ | EPA |
| CONSTRUCTION | | | |
| Sedimentation and Erosion Control | ordinance | DLR, DOT | |
| Coastal Area Management Act | ordinance | DCM | |
| Coastal Stormwater Program | | DWQ | |
| ON-SITE WASTEWATER DISPOSAL | | | |
| Sanitary Sewage Systems Program | county | DEH | |
| SOLID WASTE DISPOSAL | | | |
| Resource Conservation and Recovery Act | | | EPA |
| Solid Waste Management Act of 1989 | city, county | DSWM | |
| FORESTRY | | | |
| Forest Practice Guidelines | | DFR | |
| National Forest Management Act | | | USDA-FS |
| Forest Stewardship Program | | DFR | |
| MINING | | | |
| Mining Act of 1971 | | | DLR |
| HYDROLOGIC MODIFICATION | | | |
| Clean Water Act (Section 404) | | DCM, DWQ | COE |
| Rivers and Harbors Act of 1899 | | | COE |
| Dam Safety Permit | | DLR | |
| WETLANDS: | | | |
| Clean Water Act (Sections 401 and 404) | | DWQ | COE |
| Wetland Reserve Program | | | USDA |

**COE**: US Army Corps of Engineers
**DWQ**: Division of Water Quality
**DFR**: Division of Forest Resource
**DSW**: Division of Soil and Water
**USDA**: US Department of Agriculture
**DCM**: Division of Coastal Management
**DLR**: Division of Land Resources
**DOT**: Department of Transportation
**DSWM**: Division of Solid Waste Mgt.
**USDA-FA**: US Department of Agriculture-Forestry Service
**NCDA**: NC Department of Agriculture
**NRCS**: Natural Resources Conservation Service
**SWCC**: Soil and Water Cons. Commission
**SWCD**: Soil and Water Conservation District

Table 5.2 Chowan River Basin Nonpoint Source Contacts

**Agriculture**

**USDA Natural Resources Conservation Service:**

Formerly the Soil Conservation Service; provides technical specialist for certifying waste management plans; certified trainers for swine applicators training sessions works with landowners on private lands to conserve natural resources helping farmers and ranchers develop conservation systems uniquely suited to their land and individual ways of doing business; provides assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conducts site evaluations and soil surveys; administers the Wetlands Reserve Program; offers planning assistance for local landowners for installing best management practices; offers technical assistance for the determination of wetlands on agricultural lands.

| | | | |
|---|---|---|---|
| Bertie County | Junius B. Russell | (919)794-5305 | P.O. Box 566, Windsor, NC27986-0566 |
| Chowan County | R. Dwane Hinson | (919)482-4127 | 414 West Queen St., Edenton, NC27932 |
| Gates County | W. Paul Boone | (919)358-7846 | P.O. Box 265, Winton, NC27986-0265 |
| Hertford County | W. Paul Boone | (919)358-7846 | P.O. Box 265, Winton, NC27986-0265 |
| Northhampton County | Tony R. Short | (919)534-2591 | P.O. Box 218, Jackson, NC27845-0218 |

**Soil & Water Conservation Districts:**

The local Soil and Water Conservation District Boards function under the administration of the North Carolina Soil and Water Conservation Commission (SWCC). The districts are responsible for administer the Agricultural Cost Share Program, identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality

| | | | |
|---|---|---|---|
| Bertie County | John Stallings | (919)794-2183 | 1001 Stoke Ave., Windsor, NC 27983 |
| Chowan County | W. Earl White | (919)482-2659 | RR 2 Box 379, Edenton, NC 27932 |
| Gates County | R. E. Miller, Jr. | (919)357-1013 | P.O. Box 42, Gatesville, NC 27938 |
| Hertford County | Greg Hughes | (919)358-7846 | P.O. Box 265, Winton, NC 27984 |
| Northhampton County | Edward M. Lanier | (919)585-0031 | Rt 1 Box 261, Conway, NC 27820 |

**Division of Soil and Water Conservation:**

Provides administrative and technical assistance to the Soil & Water Conservation Districts in areas pertaining to soil science and engineering; distributes Wetlands Inventory maps for a small fee. Administers the Agriculture Cost Share Program (ACSP).

| | | | |
|---|---|---|---|
| Central Office | Donna Moffitt (ACSP) | (919)715-6108 | 512 N. Salisbury St. Raleigh NC 27626 |

**NCDA Regional Agronomists:**

Provides technical specialists for certifying waste management plans. Provides certified trainers for animal waste applicators training sessions. Tracks, monitors, and accounts for use of nutrients on agricultural lands. Identifies and evaluates the use of nutrient management plans.

| | | | |
|---|---|---|---|
| Central Office | Tom Ellis | (919)733-7125 | Box 27647 Raleigh, NC 27611 |
| Regional Office | Charlie Tyson | (919)443-4404 | Rt. 3, Box 254B, Nashville, NC 27856 |

Table 5.2 Chowan River Basin Nonpoint Source Contacts, continued

| | | | |
|---|---|---|---|
| **Education** | | | |
| **NC Cooperative Extension Service:** Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities. | | | |
| Bertie County | William J. Griffin Jr. | (919)794-5317 | P.O. Box 280, Windsor, NC 27983 |
| Chowan County | J. Michael Williams | (919)482-8431 | P.O. Box 1030, Edention, NC 27932 |
| Gates County | Wayne Nixon | (919)357-1400 | Co. Agri. Bldg., Gateville, NC 27938 |
| Hertford County | Deborah Howard | (919)358-7822 | Tyson St., Winton, NC 27986 |
| Northhampton County | Mark D. Keating | (919)534-2711 | P.O. Box 636, Jackson, NC 27845 |
| **Forestry** | | | |
| **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. | | | |
| Central Office | Moreland Gueth | (919)733-2162 ext. 225 | P.O. Box 29581 Raleigh, NC 27626-0581 |
| **Fish and Wildlife Resources** | | | |
| **Division of Marine Fisheries** The North Carolina Division of Marine Fisheries (DMF) is responsible for stewardship of the state's marine and estuarine resources. The DMF's jurisdiction encompasses all coastal waters and extends to 3 miles offshore. Agency policies are established by the 17-member Marine Fisheries Commission and the Secretary of the Department of Environment, Health and Natural Resources. | | | |
| Central Office | Pasquale Wojciechowski | (919)726-7021 | P.O. Box 769, Morehead City, NC 28557 |
| Elizabeth City Office | Sara Winslow | (919)264-3911 | 1367 US HWY 17, Elizabeth City, NC 27909 |
| **Wildlife Resources Commission:** To manage, restore, develop, cultivate, conserve, protect, and regulate the wildlife resources of the State, and to administer the laws relating to game, game and freshwater fishes, and other wildlife resources enacted by the General Assembly to the end that there may be provided a sound, constructive, comprehensive, continuing, and economical game, game fish, and wildlife program. | | | |
| Central Office | Frank McBride | (919)528-9886 | P.O. Box 118 Northside, NC 27564 |

**Section 319**

Clean Water Act Section 319(h) grant moneys are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP demonstrations, watershed water quality monitoring and improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and others.

**Use Restoration Waters**

The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program would allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program would include a mix of mandatory and voluntary programs. The voluntary and mandatory programs would be coordinated on a watershed-specific basis by DWQ and a group of stakeholders who have an interest in the impaired waterbody and associated watershed. In addition, the URW program would attempt to develop cooperative relationships among these agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

## 5.6 PROGRAM INITIATIVES IN THE CHOWAN RIVER BASIN

Through the development of this plan, efforts were made to identify efforts that have been undertaken within the basin to protect water quality. The following discussion focuses on program initiatives that have been implemented or are underway within the Chowan River basin. These initiatives demonstrate a tremendous effort to protect surface waters in the basin. There may be other initiatives underway in the basin of which we are not yet aware. Table 5.3 presents a summary of the agency or organizations that have program initiatives in the basin.

Table 5.3 Program Initiatives in the Chowan River Basin

| Level of Agency | Name of Agency | Type of Initiative |
|---|---|---|
| Federal and State | National Estuary Program - APES Study; DWQ | See Page 5-14 |
| Federal | US Department of Agriculture - National Resource Conservation Service | See Page 5-15 |
| State | NC Division of Soil and Water Conservation | Various Projects |
| State | NC Division of Environmental Health | See Page 5-16 |
| State | NC Department of Agriculture | See Page 5-16 |
| State | NC Division of Forest Resource | Forest Practices Guidelines |
| State | Cooperative Extension Service | See Page 5-15 |
| State | NC Division of Land Resources | Sedimentation Pollution Control Act |
| Local Govt. and Citizen Groups | Albemarle Resource, Conservation and Development Council | Wetland Demonstration Project |
| Local Govt. and Citizen Groups | Bertie County | Various Projects |
| Local Govt. and Citizen Groups | Hertford County | Land Use Plan |
| Academic | North Carolina State University | Impacts of Road Maintenance BMPs on Water Quality |

### 5.6.1 National Estuary Program - Albemarle-Pamlico Estuarine Study (APES)

Inclusion of North Carolina in the US EPA's National Estuary Program (NEP) carried with it the responsibility of protecting the local, state and national interest in maintaining the ecological integrity of this country's second largest estuarine system, the Albemarle-Pamlico.

Important components of NEP membership are the consideration of water quality, fisheries resources, land and water habitats, and the interaction of humans with the natural resources of the estuarine system. This focus shaped the research and public involvement phases of the Albemarle Pamlico Estuarine Study. This holistic approach to ecological management was employed when writing the Comprehensive Conservation and Management Plan (CCMP) and was further reflected in the basinwide strategy of water quality management, initiated by the Division of Water Quality. This strategy permeates the various component plans that make up the CCMP.

The CCMP is the product of collaborative, consensus-building effort involving numerous federal, state, and local agencies, interest groups, organizations, and individuals. The Management Conference which guided the Study, was composed of approximately 95 members who were divided into four committees: The Policy Committee, Technical Committee and two Citizens' Advisory Committees (one for the Albemarle area and one for the Pamlico). The members comprising these committees represented a variety of interests: government agencies, university researchers and the public. The committees were responsible for identifying problems in the estuarine system, generating research where gaps in knowledge existed, increasing public awareness of environmental issues, and identifying solutions to address those issues. As a result of their efforts, more is known about the Albemarle-Pamlico estuary than ever before.

The CCMP contains five general management plans to address regional concerns: The Water Quality Plan, Vital Habitats Plan, Fisheries Plan, Stewardship Plan and the Implementation Plan. Each plan contains a goal statement, objectives, strategies, management actions and critical steps necessary in attaining the recommended outcome. Potential economic costs and other considerations are also described. Appendix IV presents the implementation status of the components of the Water Quality Plan.

### 5.6.2 Federal Initiatives

<u>US Department of Agriculture, Natural Resource Conservation Service (NRCS)</u>:

- Assist farmers in obtaining Agriculture Cost Share funds for no-till farming practices.
- Organizes Environmental Field Days at local schools.

### 5.6.3 State Agency Initiatives

<u>Cooperative Extension Service:</u>

- Conducts ongoing IPM programs for farmers in Northeastern NC to reduce pesticide and fertilizer use, promotes good stewardship of agricultural chemicals.
- Conducts Master Gardener training in IPM for Master Gardeners to use when they work with their home-owner and home garden clientele.
- Organizes annual Consultant's Roundtable to present up-to-date research information on IPM to area crop consultants to use when they work with their clientele.
- Trains area crop scouts in scouting procedures consistent with IPM principles.
- Educates the non-farm general public about IPM and pesticide safety through newspaper articles, radio programs, educational programs for civic groups, etc.
- Designed a display board (what is IPM?) for use at meetings, workshops, and other public display opportunities.

- Assists in conducting Commercial Pesticide Rectification training classes for holders of commercial pesticide licenses-focusing on IPM principles and applications.
- Assists in training of Certified Waste Management System operators.
- Participates in Environmental Field Days organized by NRCS at local schools.

**North Carolina State University:**

- Conducting Impacts of Road Maintenance BMPs on Water Quality in a Coastal Watershed Project. This project, funded by Section 319 grant, focuses on the installation and evaluation of both agricultural and silvicultural road maintenance BMPs. BMPs will be implemented on thirty thousand feet of roads in the Kendricks Creek watershed. The water quality in road side canals will be studied and educational meetings will be held to demonstrate the effectiveness of the BMPs.

**NC Department of Agriculture:**

- Provides soil testing service to farmers, homeowners and turf managers. This ensures that agronomic productivity is maximized while at the same time reducing indiscriminate nutrient applications. Recommendation are both site and crop specific. Total 22,856 soil samples submitted by farmers and homeowners from the Chowan River Basin in 1996 for fertility evaluation and nutrient recommendations. The number of soil samples submitted from each county is 4767, 3089, 3130, 4586 and 7284 for Bertie, Chowan, Gates, Hertford and Northampton county respectively.
- Provides nematode management strategies to farmers, homeowners and turf managers. The strategies include crop rotation, resistant crop varieties and the use of nematicides. Plant parasitic nematodes have to be managed in order to maintain the productivity of crops in eastern North Carolina.
- Provides plant analysis service to farmers. This service provides the opportunity for farmers to monitor the nutritional status of growing crops. This provides farmers with the necessary information to select and apply only those nutrients that are needed.
- Various types of waste materials including industrial waste and livestock waste are analyzed and evaluated for their agronomic value. With this information, the waste is seen and utilized as a source instead of a liability.
- Eight regional agronomists provide on-site assistance to help growers implement management recommendations in a cost-effective and environmentally sound manner.

**NC Division of Environmental Health:**

- Conducts annual onsite sewage conference to update engineers and state agents (environmental health specialists in health departments) on latest technology to abate pollution from septic tank systems.
- Reviews two health department septic tank programs per year for quality assurance.
- Provides an annual 3 day Advanced Soils or Advanced Septic Tank Systems Course to health department agents.

**NC Division of Land Quality:**

The NC Division of Land Resources (DLR) is responsible for administering the Sedimentation Pollution Control Act of 1973 (SPCA). Since the inception of the SPCA, the Sedimentation control Commission has funded extensive workshops and educational programs aimed at children throughout the state. During fiscal year 1996, the DLR conducted workshops and symposiums, funded research and intern programs, reprinted manuals and developed video modules and produced newsletters on a budget of over $270,000 for the entire state. The DLR has the following materials available.

- ◊ Erosion and Sediment Control Field Manual
- ◊ Erosion and Sediment Control Practices: Video Modules
- ◊ Erosion and Sediment Control "Inspector's Guide"
- ◊ Erosion and Sediment Control Planning and Design Manual
- ◊ "Erosion Patrol" Package for Grade 3

The DLR is also implementing various measures for protecting water quality statewide. These measures include

- Coordinates the targeting and tracking of BMPs implementation in the basin.
- Conducts two workshops for public, regulated community and local governments on sediment reductions achievable through the requirements of the Sedimentation and Erosion Control Act.
- Enforces existing sediment related rules and evaluate need for additional mandatory measures.

<u>NC Division of Soil and Water Conservation (SWCD):</u>

- The NC Division of Soil and Water Conservation administers the *NC Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP)*. This program provides incentives to farmers to install best management practices (BMPs) by offering to pay up to 75% of the average cost of approved BMPs. The NC Agriculture Cost Share Program funding totals for the Chowan River basin from 1985 through 1995 is $391,254. Farmers in the basin have spent up to $130,418 in matching funds for cost share money. The cost share figures include a wide array of BMPs including conservation tillage, sod based rotation, diversions, critical area planting, crop conversion to grass, trees, spring development, stock trails, land application of waste, livestock exclusion, waste management.

<u>NC Division of Forest Resources:</u>
The DFR is implementing various measures for protecting water quality statewide. These measures began with the creation of voluntary *Forest Practice Guidelines (FPGs) Related to Water Quality*. The measures were voluntary applied best management practices, which had no enforcement power by any agency. In 1989, the SPCA was amended to require compliance with nine performance standards in order to remain exempt from the SPCA's permitting requirements. These nine standards are the *Forest Practice Guidelines Related to Water Quality (FPGs)* whose compliance is accomplished through the use of BMPs. The *Forestry Best Management Practices Manual* was published in September, 1989, to guide forestry operations in protecting water quality. The manual and the FPGs are available for any DFR office at no charge.

### 5.6.4 Local Government and Citizen Initiatives

<u>Albemarle Resource, Conservation and Development Council:</u>

- Conducting Constructed Wetlands Demonstration for Nonpoint Source Pollution on Urban/Agricultural Land Project. This project is funded by Section 319 grant. This project, in the nutrient-sensitive Chowan Basin, focuses on the design, installation, and evaluation of riparian-type wetlands systems constructed in and parallel to channelized streams/drainageways.

**Bertie County:**

- Administers local irrigation scheduling and pesticide education programs.
- Provides soil testing and analysis service and information on precision farming.
- Trains and certifies animal waste application operators in the county.

**Hertford County:**
Hertford County has taken an active role in developing land use plan to protect and improve water quality.

## 5.7 Integrating Point And Nonpoint Source Pollution Control Strategies

Integrating point and nonpoint source pollution controls and determining the amount and location of the remaining assimilative capacity in a basin are key long-term objectives of basinwide management. The information is used for a number of purposes including: determining if and where new or expanded municipal or industrial wastewater treatment facilities can be allowed; setting the recommended treatment level at these facilities; and identifying where point and nonpoint source pollution controls must be implemented to restore capacity and maintain water quality standards.

Total Maximum Daily Loads

The U.S. Environmental Protection Agency (USEPA) has developed the means to help accomplish these objectives. The approach, called *total maximum daily loads (TMDL)*, uses the concept of determining the total waste (pollutant) loading from point and nonpoint sources that a waterbody (such as a stream, lake or estuary) can assimilate while still maintaining its designated uses. USEPA requires the TMDL approach pursuant to Section 303(d) of the Clean Water Act.

Under the TMDL approach, waterbodies that do not meet water quality standards are identified. States establish priorities for action, and then determine reductions in pollutant loads or other actions needed to meet water quality goals. The approach is flexible and promotes a watershed approach driven by local needs and States priorities. The overall goal in establishing the TMDL is to establish the management actions on point and nonpoint sources of pollution necessary for a waterbody to meet water quality standards.

As DWQ improves its abilities to quantify and predict the impacts of point and nonpoint source pollution, the basinwide approach will make more innovative management strategies possible.

Other Possible Strategies

- *Agency banking* refers to the concept of holding assimilative capacity in reserve by DEM for future growth and development in the basin.
- *Pollution trading* involves trading of waste loading and stream assimilative capacity among permitted dischargers, or between point and nonpoint sources, adding flexibility to the permitting system and using the free market system as an aid to identifying the most cost effective solution to water quality protection.
- *Industrial recruitment mapping* involves providing specific recommendations on the types of industry and land development best suited to the basin's long-term water quality goals and an individual basin's ability to assimilate a particular type or quantity of discharge or nonpoint source pollutants.
- *Consolidation of wastewater discharges*, also referred to as regionalization, entails combining several dischargers into one facility. Local authorities, regulated industries, landowners, and other interested parties are encouraged to provide ideas to develop these strategies. By accommodating, to the degree possible, local needs and preferences, the probability of the plan's long-term success will be increased.

## 5.8 POTENTIAL SOURCES OF FUNDING FOR WATER QUALITY PROJECTS

There are numerous sources of funding for all types of water quality projects. The sources of funding include federal and state agencies, nonprofits, and private funding. Funds may be loans, cost-shares, or grants. Section 319(h) grants are discussed in some detail in Section 5.8.1. Other funding sources are listed in Section 5.8.2.

If a local government, environmental group, university researcher, or other individual or agency wants to find funding to address a local water quality problem, it is well worth the time to prepare a thorough but concise proposal and submit it to applicable funding agencies. The list of goals for Section 319(h) proposals can be used as a guideline for other funding agencies. Even if a project is not funded, persistence may be beneficial when funding agencies observe several consecutive proposals from the same group.

### 5.8.1 Section 319(h) Grants

EPA offers the state Clean Water Act Section 319(h) grant moneys on an annual basis. These grants must be used to fund projects that address nonpoint source pollution issues. Some projects which DWQ has funded with this money in the past include BMP demonstrations, watershed water quality improvements, data management, educational programs, modeling, stream restoration, and riparian buffer establishment. Agencies, environmental groups, university researchers, and others in the state that have expertise in nonpoint source pollution problems are invited to submit Section 319(h) proposals to DWQ.

DWQ established a Workgroup process in 1995 for prioritizing and selecting projects from the pool of cost-share proposals and includes this list in its annual application to EPA. The Workgroup consists of representatives from the state and federal agencies that deal with NPS issues, including agricultural, silvicultural, on-site wastewater, mining, solid waste and resource protection.

DWQ staff first reviews proposals for minimum 319 eligibility criteria such as:

- Does it support the state NPS Management Program milestones?
- Does the project address targeted, high priority watersheds (See Table 5.4)?
- Is there sufficient nonfederal cost-share match available (40% of project costs)?
- Is the project period adequate?
- Are measurable outputs identified?
- Is monitoring required? Is there a QA/QC plan for monitoring?
- If GIS is used, is it compatible with those of the state?
- Is there a commitment for educational activities and a final report?

Workgroup members separately review and rank each proposal which meets the minimum 319 eligibility criteria. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; degree of balance lent to the statewide NPS Program in terms of project type; and competence/reliability of contracting agency. They then convene to discuss individual projects' merits, to pool all rankings and to arrive at final rankings for the projects. The Workgroup seeks a balance between geographic regions of the state and types of projects. All proposals that rank above the funding target are included in the annual grant application to EPA, with DWQ reserving the right to make final changes to the list. Actual funding depends on approval from EPA and yearly Congressional appropriations.

Table 5.4 Nonpoint Source (NPS) 319 Priority Ratings for Coastal Waters

<u>**High priority waters**</u>:

- monitored waters that have an overall use support rating of non-supporting,
- monitored waters that have a use support rating of partially supporting but have a high predicted loading for one or more pollutants,
- highly valued resource waters as documented by special studies
  - High Quality Waters
  - Outstanding Resource Waters
  - Water Supply I, Water Supply II, Critical areas of WS-II, WS-III or WS-IV
  - Shellfish Waters (Class SA) having a significant shellfish resource and moderate bacteriological problems, as identified by the Division of Environmental Health, in which harvesting is prohibited or restricted
  - Shellfish Waters (Class SA) that drains to ORW and in which shellfish harvesting is prohibited or restricted
  - Shellfish Waters (Class SA) in which harvesting is conditionally approved by DEH and a significant shellfish resource exists

<u>**Medium priority waters**</u>:

- monitored waters that have an overall use support rating of partially supporting,

<u>**Low priority waters**</u>:

- Shellfish Waters (Class SA) in which harvesting is prohibited or restricted but which are not considered to have a significant shellfish resource
- All other waters not considered high or medium priority

To obtain more information about applying for a Section 319(h) grant, contact:

Linda Hargrove, DWQ - Planning Branch
P.O. Box 29535, Raleigh, NC 27626-0535
(919) 733-5083 ext. 352

## 5.8.2 Other Sources of Funding

Besides Section 319(h) funding, there are numerous sources of funding for all types of water quality projects. The sources of funding include federal and state agencies, nonprofit, and private funding. Funds may be loans, cost-shares, or grants.

If a local government, environmental group, university researcher, or other individual or agency wants to find funding to address a local water quality problem, it is well worth the time to prepare a thorough but concise proposal and submit it to applicable funding agencies. The list of goals for Section 319(h) proposals can be used as a guideline for other funding agencies. Even if a project is not funded, persistence may be beneficial when funding agencies observe several consecutive proposals from the same group.

Tables 5.5 and Appendix VI provide summaries of the agencies that are potential sources of funds for point sources of pollution. Table 5.6 and Appendix VI provide summaries of the agencies that are potential funding sources for nonpoint sources of pollution.

In addition to these sources, the Clean Water Trust Fund will be another source of funding for both point and nonpoint sources of pollution. The 1996 General Assembly earmarked 6.5% annually of the year end General Fund credit balance to help finance projects that address water pollution problems and focus on upgrading surface waters, eliminating pollution and protecting and preserving unpolluted surface waters. Contact Norma Ware at (919) 733-6854 and refer to Appendix VI for more details on this program.

Table 5.5 Funding Agencies for Assistance With Point Sources

| Source | Agency and Name of Funding Source |
|---|---|
| Federal | U.S. Rural Utilities Service:<br>Water and Wastewater Loan and Grant Program<br>Rural Business and Cooperative Service:<br>Rural Business Enterprise Grants<br>Appalachian Regional Commission:<br>Supplements to Other Federal Grants in Aid<br>U.S. Economic Development Administration:<br>Public Works and Development Facilities Grant Program |
| State | NC Division of Water Quality:<br>Construction Grants and Loans Program<br>NC Division of Community Assistance:<br>Small Cities Community Development Block Grant<br>NC Commerce Finance Center:<br>Industrial Development Fund |
| Private | Rural Economic Development Center, Inc.:<br>Supplemental and Capacity Grants Program |

Table 5.6 Funding Agencies for Assistance with Nonpoint Sources

| Type of Assistance | Agency and Name of Funding Source |
|---|---|
| Agriculture | NC Agriculture Cost Share Program for NPS Pollution Control (NCACSP)<br>Environmental Quality Incentives Program (EQIP)<br>Conservation Reserve Program (CRP)<br>Wetland Reserve Program (WRP)<br>Small Watershed Program, PL-566<br>Conservation Easement<br>Soil and Water Conservation Loan Program |
| Education | GTE Foundation<br>Toyota TAPESTRY Grants<br>National Environmental Education and Training Foundation (NEETF) |
| Water Quality Planning | Section 205(j) Water Quality Planning Grants |
| Stream Restoration | NC Division of Water Resources Stream Repair Funding |
| Forestry | Forestry Stewardship Incentive Program<br>Forestry Incentives Program |
| Land Conservation | National Wetland Priority Conservation Plan<br>NC Conservation Tax Credit Program<br>Federal Wild and Scenic Rivers Program<br>Emergency Wetlands Resources Act of 1986 |

## REFERENCES - CHAPTER 5

NCDEHNR, 1990. Chowan River Water Quality Management Plan - 1990 Update. Report No.90-06.

# CHAPTER 6

# MAJOR BASINWIDE WATER QUALITY CONCERNS AND RECOMMENDED MANAGEMENT STRATEGIES

## 6.1 INTRODUCTION

Major concerns for water quality in this basin include algal blooms, dioxin contamination of fish and nonpoint source pollution. Nutrient enrichment, and associated algal blooms, is the major water quality problem identified in the basin. A lot has been accomplished in the last decade since the application of the Nutrient Sensitive Waters (NSW) strategy. Water quality data indicate that chlorophyll-a levels are going down and that, although still occurring, blooms are becoming less frequent and lasting for shorter periods of time. Continuing actions toward reducing the amount of nutrients entering the surface waters should further reduce the occurrence of algal blooms in the river.

The long range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Chowan River basin's surface waters. Nutrients and other priority issues are discussed in Section 6.2, below. In striving towards its mission, DWQ's highest priority near-term goals are as follows:

- To identify and restore impaired waters in the basin. Section 6.3 discusses impaired and threatened waters and how these waters are prioritized for restoration and protection. Priority Issues and Recommended Management Strategies are presented for each subbasin in Section 6.4.
- To identify and protect high value resource waters and biological communities of special importance. Section 6.5 discusses management strategies for protecting important biological communities in the basin.
- To manage the causes and sources of pollution so as to ensure the protection of those waters currently supporting their uses while allowing for reasonable economic growth. Major water quality issues addressed under this topic in Section 6.6 include, management strategies for controlling nonpoint source pollution from agriculture, urban and industrial stormwater control, fecal coliform bacteria, toxic substances, oxygen-consuming wastes and sedimentation.

## 6.2 MAJOR WATER QUALITY CONCERNS AND PRIORITY ISSUES

### 6.2.1 Controlling Nutrients

Nutrient enrichment in the Chowan River Basin continues to be a primary water quality concern. Since the application of the Nutrient Sensitive Waters (NSW) management strategy, reductions in nutrient loads have been achieved and algal blooms have been less frequent and last for shorter periods of time. Chapters 3 and 4 of this document present summaries of nutrient-related studies conducted over the years and an investigation into changes in chlorophyll *a* concentrations over time. As of 1990, installation of control measures for agricultural nonpoint sources through the Agricultural Cost Share Program had resulted in a six percent reduction in North Carolina's total phosphorus input (DEM, 1990). Also, many point source discharges in the basin have converted their facilities to land application operations, reducing nutrient loads to the surface waters. Overall, as of 1990, the nitrogen reduction goal of 20% had been accomplished and total phosphorus had been reduced by 29% (goal of 35%).

Although there have been gains in nutrient reductions and associated water quality benefits, continued implementation of the NSW strategy is recommended since the lower Chowan remains susceptible to algal blooms. The strategy was initially adopted in 1982 and updated in 1990 using more recent data. The major points of the 1990 management strategy are as follows:

- 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 was discussed in Chapter 3, many wastewater treatment plants that were previously discharging to surface waters, converted their plants to land application. This reduced contributions of nutrients to the Chowan and helped to improve enrichment conditions. Also, Agricultural Cost Share Program monies have resulted in the application of best management practices in the basin (see Chapter 5), also contributing to the improvement of enrichment conditions. Such efforts need to continue in order to make further gains in improving the water quality of the Chowan River basin.

### 6.2.2 Working with the NPS Team to Control NPS Pollution

Pollution from nonpoint sources is identified as the major contributor to water quality impairment in the Chowan River Basin. It will be important during this basinwide planning cycle to actively work with the NPS team to better identify nonpoint source pollution contributions and to improve conditions where feasible. It is recognized that in some cases the information that DWQ has implicating nonpoint source contributions from land uses such as agriculture are dated and sketchy. Accomplishments in managing runoff from agriculture and animal operations that have occurred during the last five years or so (such as Conservation Management Plans in compliance with the Farm Bill, or improved management of waste from animal operations in compliance with new regulations) are not reflected in this information. The reason for this is that the implementation of these programs is just beginning to occur or has occurred subseqent to the purview of assessments available. However, agriculture and animal operations remain prominent in the landscape of the river basin and it will be important to work toward further gains in this area in order to protect water quality.

As is evident in section 6.3.1 which identifies the impaired waters in the basin, and section 6.4.1 which outlines water quality issues and recommendations by subbasin, agriculture, animal operations and channelization are believed to be the primary contributor to impairment of water quality in the basin. Addressing these problems is best accomplished by a knowledgeable team of local professionals and stakeholders - the NPS team. Therefore, the primary recommendation for impaired waters in the Chowan basin is to work with this team to prioritize areas for restoration and target available resources toward them.

DWQ has begun setting up nonpoint source teams in each of the state's 17 major river basins. These teams will have representatives from agriculture, urban stormwater, construction, mining, on-site wastewater disposal, forestry, solid waste, wetlands, groundwater, natural resource agencies, local governments, special interest groups and citizens. These teams will provide descriptions of current NPS management activities within a basin, conduct assessments of NPS controls in targeted watersheds, prioritize impaired waters for development and implementation (including funding) of restoration strategies and NPS issues for remedial action. The team will develop five year action plans to reflect these priorities.

At their first meeting in 1996, the Chowan basin NPS Team members described their vision of priority issues and comments for water quality problems in the basin. A summary of these issues and comments is presented in Table 6.1. Issues and comments presented by the NPS team members will be incorporated into the five-year action plan being developed by the team. DWQ will continue to work with the NPS team to clarify the water quality issues of the Chowan River basin and formulate implementable strategies to deal with these issues.

Table 6.1. Priority NPS Issues Identified by the Chowan Basin NPS Team

| Category | Comments |
|---|---|
| Agriculture | We need to expand the use of BMPs.<br>More education programs are needed for nonpoint source controls.<br>Nutrient issue is still a big concern in the basin. |
| Animal Operation | Solution is needed for abandoned old swine lagoons. |
| Development | Increased development in the basin is leading to problems with sedimentation and wastewater discharge.<br>Water table is decreasing in many areas in the basin.<br>Rural wastewater treatment (septic systems) can be a potential problem in the basin. |

### 6.2.3 Priority Issues and Recommended Actions Identified by Workshop Participants

A public workshop was conducted in the Chowan River basin on the morning of July 25, 1996. Attendance at the workshop was strong, exceeding 60 people. Participants were asked to identify what they saw as the priority issues for the Chowan River basin. DWQ examined the comments received at the workshop and grouped them into eight broad categories:

- monitoring and data-related issues;
- cooperation and coordination between States, state agencies, and local governments;
- nonpoint source pollution;
- point source issues;
- resource concerns;
- regulatory issues;
- education; and
- site-specific concerns.

These categories and associated specific comments are presented in Table 6.2 along with reference to sections of this basinwide management plan where applicable. While each identified issue may not be directly responded to in the plan, an effort has been made to consider these issues within the

Table 6.2. Priority Water Quality Issues Identified by Workshop Participants and Reference Sections in the Chowan River Basinwide Water Quality Management Plan

| General Category | Specific Comments | Reference Section |
|---|---|---|
| Monitoring/Data Issues | -better review of water quality data<br>-target sampling above and below known sources<br>- improve monitoring coverage<br>- develop strategy for non-DWQ monitoring<br>- need before and after data for animal operations implementing new permit program | 4.2.1, 4.2.2 |
| Cooperation and Coordination between States, State Agencies and Local Governments | - improve communication with Virginia (create a seamless basin area)<br>- support legislation to promote multijurisdictional cooperation with the basinwide plan<br>- communicate with other agencies about other types of pollution contributions (air and groundwater)<br>- consolidate efforts and studies | 6.4.1 |
| Nonpoint Source Pollution | -rural wastewater treatment concerns (septic systems)<br>-provide a good summary of how BMPs are being implemented (nutrient management plans, animal waste management plans<br>- problems with animal operations (including dry litter)<br>- runoff from residential subdivisions<br>- need stream buffers<br>- need to investigate drainage districts<br>- better characterization of nonpoint contributions needed<br>- maintenance of on-site wastewater systems<br>- BMP development should be site-specific<br>- a cost/benefit analysis of BMPs should be done | 5.5, 5.6, 6.2.3, Appendix V, Appendix VI |
| Point Source Issues | - review operation and maintenance of point sources<br>- problems with municipal plants | 3.3.2 |
| Resource Concerns | - maintain recreational resources<br>- low dissolved oxygen<br>- nutrients<br>- bring back herring<br>- address tourism benefits of environmental protection | 2.6.1, 3.2.1, 3.2.3, 6.2.1, 6.6.5 |
| Regulatory Issues | - over-regulation<br>- government should provide assistance for the repair of septic systems<br>- overlap of CAMA, APES and other programs a concern | 5.6.1, 5.8, Appendix IV |
| Education | - need more public education<br>- support existing programs that are working (like Beach Sweep)<br>- educate all levels of the population | |
| Site - Specific Concerns | - Tunis fertilizer plant: Superfund site<br>- Merchants Millpond: aquatic weeds | 2.6.2, 3.2.2 |

framework of the basinwide approach. Where there has been some discussion about the category or specific comments within the plan, the table provides this reference.

### 6.2.4 Priority Issues and Recommended Actions Identified by the APES Comprehensive Conservation and Management Plan (CCMP)

The Chowan River Basin is part of a broader region defined as the Albemarle-Pamlico Estuary area which has been included in EPA's National Estuary Program. The Albemarle-Pamlico Estuarine Study (APES) investigated the region intensively and produced the Comprehensive Conservation and Management Plan (CCMP). Within the CCMP, there are several recommendations made with regard to water quality issues, including the implementation of a basinwide approach to water quality management which this plan represents. The goal of the Water Quality Plan section of the CCMP is to "restore, maintain or enhance water quality in the Albemarle-Pamlico region so that it is fit for fish wildlife and recreation". (NC EHNR, 1994) Within the Water Quality Plan there are five broad objectives that are listed and briefly described below. A description of the status of the implementation of the APES CCMP is contained in Chapter 5 of this document. A detailed status report is reproduced in Appendix IV.

<u>Objective A: Implement a Comprehensive Approach to Water Quality Management</u>

<u>Objective B: Reduce Sediments, Nutrients and Toxicants from Nonpoint Sources</u>

<u>Objective C: Reduce Pollution from Point Sources, such as Wastewater Treatment Facilities and Industry</u>

<u>Objective D: Reduce the Risk of Toxic Contamination to Aquatic Life and Human Health</u>

<u>Objective E: Evaluate Indicators of Environmental Stress in the Estuary and Develop New Techniques to Better Assess Water Quality Degradation</u>

## 6.3 IDENTIFICATION AND RESTORATION OF IMPAIRED WATERS

### 6.3.1 What Are the Impaired Waters?

Impaired waters are those waters identified in Chapter 4 as partially supporting or not supporting their designated uses. Table 6.3 presents partially supporting (impaired) waterbodies in the Chowan River basin, the probable source of impairment, a summary of recommended management strategy and the section in Chapter 6 that discusses the issue in more detail. There are no non-supporting waters in the basin. See Chapter 4 for explanation of use support ratings.

Table 6.3. Impaired waters in the Chowan River Basin.

| Waterbody (subbasin) | Probable Source of Impairment | Recommended Management Strategy | Chapter 6 Reference Section |
|---|---|---|---|
| Wiccacon River (030101) | general nonpoint | The origin of the nonpoint source pollution is unknown (it is known that there are no point source contributions to these waters). One focus of the NPS team should be to investigate NPS issues in watershed. | 6.4.1 |
| Ahoskie Creek (030101) | agriculture, channelization | In this creek and the following two creeks, agriculture and channelization are suspected to be contributing to water quality conditions. The NPS team should consider these areas for targeting of their efforts. | 6.4.1 |
| Potecasi Creek (030102) | agriculture, channelization | See above for Ahoskie Creek. | 6.4.2 |
| Cutawhiskie Creek (030102) | agriculture, channelization | See above for Ahoskie Creek. | 6.4.2 |
| lower Chowan River (030103 and 04) | point and nonpoint | This area continues to be susceptible to algal blooms although improvements have been documented since the implementation of the NSW strategy. Continued implementation of point and nonpoint source pollution controls should result in further progress in water quality improvement. | 6.4.3 |

## 6.3.2 What are the "Threatened Waters"?

Some waters in the basin have notable water quality problems but the impact of the problem is not severe enough to cause the stream to be considered impaired under the state use-support designation described in Chapter 4. These waters are rated Support-Threatened. The identification of Support-Threatened waters can be used to determine the sources and causes of degradation and to determine if management strategies can be used to reduce or eliminate the causes of pollution before impairment occurs. In the Chowan basin, the upper parts of the Chowan River and Merchants Millpond are considered threatened. Biological data in the upper Chowan indicates that the system is slightly stressed and resulted in its threatened status. Merchants Millpond is eutrophic lake that is experiencing problems with aquatic weeds which threaten some of its uses.

### 6.3.3 How are Waters Prioritized for Restoration or Protection?

There are several different ways that waters are prioritized for restoration and protection depending upon the purpose of the prioritization. The three primary methods strategies for prioritization of waters based on water quality concerns are described below.

**Priority Waters for Nonpoint Source (NPS) Management Strategies**

DWQ has developed criteria for assisting in the selection of NPS-impaired waters for prioritization by the NPS Team. The NPS Team will use both primary and additional criteria to select the priority NPS-impaired waterbodies. An NPS-impaired waterbody that meets a primary criteria and one or more of the additional criteria is a good candidate for prioritization by the NPS Team.

*The primary criteria are* (in order of importance):

- Highly-valued resource waters, such as High Quality Waters and Water Supplies I-IV, that have a demonstrated pollution problem.
- Monitored waters that have an overall use support rating of non-supporting.
- Monitored waters that have a use support rating of partially supporting but have a high predicted loading for one or more pollutants.
- Tributaries of highly-valued resource waters.

*The additional criteria for selecting the priority NPS-impaired waterbodies are*:

- Waters that pose a potential threat to human health,
- Waters that are important for ecological reasons not reflected in their classification and use support ratings (such as endangered species, unique habitats, or significant biological resources),
- Waters that are highly eroded or have other evidence of serious erosion problems that are not reflected in the use support ratings,
- Waters that have experienced a recent, rapid decline in water quality, and
- Waters that have identifiable pollution sources and a high likelihood of successful restoration.

Waters that meet the above criteria form a list of potential candidates for targeting by the NPS team. A summary of these potential priority waterbodies in the Chowan basin are presented in Table 6.4.

Table 6.4. Potential NPS Priority Waterbodies in the Chowan River Basin.

| | |
|---|---|
| Waterbody: | Potecasi Creek, including tributaries (Chapel Branch) |
| Subbasin: | 030102 |
| Use Classification: | C, Nutrient Sensitive Waters (NSW) |
| Notable Features: | drains to Partially Supporting waters |
| Use Rating: | Partially Supporting |
| Length Affected: | 48.5 miles |
| Problem Parameters: | DO, pH |
| Waterbody: | Wiccacon River |
| Subbasin: | 030101 |
| Use Classification: | C, NSW |
| Notable Features: | drains to Partially Supporting waters |
| Use Rating: | Partially Supporting |
| Length Affected: | 20.8 miles |
| Problem Parameters: | DO, pH |
| Waterbody: | Ahoskie Creek, including tributaries (Mills Branch, Fort Branch, Tuckey Creek, and Knee Branch) |
| Subbasin: | 030101 |
| Use Classification: | C, NSW |
| Notable Features: | drains to Partially Supporting waters |
| Use Rating: | Partially Supporting |
| Length Affected: | 43.2 miles |
| Problem Parameters: | DO, pH |
| Waterbody: | Cutawhiskie Creek |
| Subbasin: | 030102 |
| Use Classification: | C, NSW |
| Notable Features: | drains to Partially Supporting waters |
| Use Rating: | Partially Supporting |
| Length Affected: | 17.8 miles |
| Problem Parameters: | DO, pH |
| Waterbody: | Chowan River |
| Subbasin: | 030104 |
| Use Classification: | B, NSW |
| Notable Features: | drains to Partially Supporting waters |
| Use Rating: | Partially Supporting |
| Length Affected: | 50.9 miles |
| Problem Parameters: | DO, Dioxin, pH |

Abbreviations:
B = Class B Waters, waters used for primary recreation, including swimming, skin diving, water skiing, and other uses suitable for Class C. NSW = Nutrient Sensitive Waters. DO = dissolved oxygen

## Section 319 of the Clean Water Act (CWA) NPS Priority

Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects are prioritized as either High, Medium or Low based on criteria presented in Table 5.4 of Chapter 5.

## Section 303(d) of the Clean Water Act (CWA)

States are required to develop a list of waters not meeting water quality standards or which have impaired uses (Partially Supporting or Not Supporting) under Section 303(d) of the Clean Water Act. Waters may be excluded from the list if existing control strategies are expected to achieve the standards or uses. Control strategies may be both point or nonpoint programs. Waterbodies which are listed must be prioritized and a management strategy or Total Maximum Daily Load (TMDL) must be developed.

Use support ratings for the 303(d) list are based on monitoring data collected in the last five years. Further information on the 303(d) program and a complete list of 303(d) waters in the Chowan River basin can be found in Appendix VIII. The list includes use support ratings, major causes and sources of impairment, descriptions of potential sources of pollution and the stream priority rating.

## 6.4 PRIORITY ISSUES AND RECOMMENDED MANAGEMENT STRATEGIES BY SUBBASIN

### 6.4.1 Upper Chowan River in North Carolina, Wiccacon River and Ahoskie Creek (Subbasin 030101)

#### Overview

This subbasin includes the upper Chowan River as it enters North Carolina from Virginia. Major tributaries on the on the southwestern side of the river are Ahoskie Creek and the Wiccacon River, both of which are considered impaired (partially supporting their uses).

#### Issues and Recommended Management Strategies

Wiccacon River and Ahoskie Creek
Both of these streams are rated as partially supporting their uses based on biological sampling data. Both streams received a fair rating based on benthic macroinvertebrate sampling. Ahoskie Creek also received a Fair rating based on a fish community assessment.

The watersheds of these creeks are mainly made up of wetlands and agriculture. Channelization and nonpoint source pollution from agricultural activities are suspected to be contributing to impairment. Increasing numbers of animal operations in the watershed are also potentially contributing to impairment. It is recommended that the nonpoint source team help to further clarify and characterize agricultural activities in these watersheds and consider them for targeting of their remediation efforts. Both of these waters are on the list of potential NPS priority waterbodies for the basin to be considered by the NPS team for targeting of resources.

Upper Chowan River
This area of the Chowan River is considered support-threatened. Biological data suggests that there is stress to the aquatic system and there remains a threat of algal blooms in the Nutrient Sensitive Waters designated area although there have been improvements over the years. Implementation of the NSW strategy should continue with focus on the application of BMPs for nonpoint source contributions of nutrients. The Nottoway and Blackwater Rivers in Virginia come together to form the Chowan River. Both of these watersheds exhibit elevated levels of phosphorus near the state line (Virginia DCR, 1993). Also, areas of the Blackwater River subbasin have received a high priority rating in Virginia for agricultural nonpoint source concerns. DWQ intends to improve communication with the State of Virginia in order to promote actions to reduce nutrient levels entering North Carolina from Virginia.

The Chowan River is also under a limited fish consumption advisory for dioxin because of earlier contamination from the Union Camp paper mill in Virginia (see Chapter 3 for further discussion). Union Camp has been monitoring dioxin in fish tissue in North Carolina and Virginia since 1989 on a voluntary basis. Process control efforts to reduce dioxin were initiated in 1990 and as a result reduced the dioxin content in the effluent to a non-detectable level by 1992. By 1996 the Union Camp facility was 100% non-chorine based due to the initiation of a chlorine dioxide generation process. Therefore, the monitoring data reflected a significant reduction in channel catfish dioxin levels for the Chowan River sampling location at Winton. In 1994 the once voluntary fish tissue monitoring became a Virginia (VPDES) permit requirement for Virginia waters. Union Camp continues to go beyond these requirements with voluntary fish tissue monitoring in North Carolina.

The dioxin levels (2,3,7,8-TCDD or TEQ) in channel catfish samples from all locations are below the 7 ppt EPA fish advisory action level. The samples have all been below the 7 ppt in Virginia since 1993 and around the 3 ppt NC action level in 1994. Present levels in the River are below 3 ppt. In light of these facts, Union Camp is recommending removal of the Blackwater/ Nottoway Rivers fish Advisory which was issued by the Va. Department of Health in 1990. In addition Union Camp believes the data justifies similar actions for the Chowan River advisory.

The NC Division of Epidemiology is continuing to evaluate fish tissue data for the Chowan River. When it is shown that levels are consistently below the NC action level for an extended period of time (several months), Epidemiology may lift the fish consumption advisory.

DWQ is currently working with CF Industries to issue a non-discharge permit to remediate contaminated groundwater from an old fertilizer plant near the Chowan River. Under the permit as proposed, nitrogen-enriched groundwater would be pumped and hauled to sites where it will be land applied as fertilizer. The goal is to keep the groundwater from seeping into the Chowan River which is still susceptible to algal blooms under certain conditions.

Merchants Millpond

This is the only significant lake in the Chowan River basin. Merchants Millpond is part of North Carolina's State Park's system and is an important environmental resource. The lake's trophic status is eutrophic, and it is infested with aquatic weeds. The over abundance of these plants has been determined to be a threat to its designated uses (mostly canoeing and fishing). The most important action that can be taken to improve conditions in the long-term is to control inputs of nutrients upstream (Tingley, personal communication, 1996). Because of its importance as a State Park, the NPS team should consider choosing this area as a target for some of its efforts in order to prevent any further degradation.

### 6.4.2 Meherrin River and Potecasi Creek (Subbasin 030102)

**Overview**

This subbasin includes the Meherrin River as it flows into North Carolina from Virginia and into the Chowan River. The largest tributary to the Meherrin is Potecasi Creek. Potecasi Creek and its tributary Cutawhiskie Creek are considered impaired (partially supporting their uses). The Meherrin River has received a biological rating of Good and is considered to be fully supporting its uses.

**Issues and Recommended Management Strategies**

Potecasi Creek and Cutawhiskie Creek

Potecasi and Cutawhiskie Creeks are swampy coastal plain streams where biological sampling indicate that water quality is depressed. In both streams benthic macroinvertebrate data indicate that water quality is Fair. As a result, these waters are considered impaired. The source of impairment is thought to be nonpoint source runoff from agriculture (especially increasing numbers of animal operations) and channelization. Is should be recognized however that conditions in these waters exhibit swampy characteristics and low pH values and DO concentrations may be due in part to natural conditions. It is recommended that the nonpoint source team help to further clarify and characterize agricultural activities in these watersheds and consider them for targeting remediation efforts. These creeks are on the list of potential NPS priority waterbodies in the Chowan basin that will be considered by the NPS team for targeting of resources.

### 6.4.3 Chowan River from Catherine Creek to Albemarle Sound (Subbasins 030103 and 030104)

Overview

These subbasins contain the lower section of the Chowan River below Bennett Creek all the way to the Albemarle Sound. This section of the Chowan River is considered impaired based on nutrient-related concerns.

Issues and Recommended Management Strategies

Chowan River
This section of the Chowan River is partially supporting its uses due to continued problems with nuisance algal blooms. Although the NSW management strategy which has been in place since 1982 has resulted in documented reductions in nutrients, the river is still susceptible to blooms. The continued implementation of the NSW management strategy is recommended with focus on the reduction of nutrient inputs from nonpoint sources of pollution. The strategy is outlined in Section 6.2.1 earlier in the Chapter.

United Piece Dye Works (UPDW) discharges to this section of the Chowan River in Chowan County. At the discharge location the river is tidally influenced and classified B-NSW. The discharge is required to meet limits for a number of conventional pollutants including BOD, TSS and COD. Limits are also required for toxics - chromium, phenol and sulfide. Nutrient limits are also required due to the NSW designation of the river.

In 1981 DEM's former Director granted an exception to the established effluent limitation for total nitrogen. The exception was based on additional information submitted by the company in their amended NPDES application which included documentation that most of the nitrogen being discharged was bioresistant and not available for biological utilization. Therefore the UPDW discharge was issued a nitrogen variance allowing them to discharge up to 20 mg/l total nitrogen. In more recent renewals of the permit, recommendations were made for monitoring the nitrogen series to provide DEM with more information on the nitrogen being discharged that may be available for biological utilization.

In 1993, DWQ reviewed 3 years of both effluent data and annual pollutant analyses which raised questions concerning biologically unavailable nitrogen. Review of the data indicated that the nitrogen may be biologically available. At the last permit renewal in 1994, UPDW was required to perform an economic feasibility study regarding the reduction of Total Nitrogen from 20 mg/l to 3 mg/l. In addition, the facility was to submit any further study results on the bio-availability of the nitrogen. DWQ is currently waiting for this information.

The affect of biologically unavailable nitrogen discharged to the Chowan River system is in question. If the results of the study performed by UPDW indicate that discharged nitrogen is biologically unavailable, then further information will need to be obtained on the conditions of the river system and its ability to accept and use this nitrogen. In addition, the UPDW facility should continue annual studies on the bioavailablity of the nitrogen in order to determine the changes in nitrogen when different dyes are used.

The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. The Union Camp Fine Paper mill in Franklin, Virginia is believed to contribute to the dioxin contamination of fish in the Chowan River. Union Camp has taken significant steps to improve the quality of their effluent and to eliminate the discharge of dioxin into the surface waters, More details on this subject are contained in Section 3.2.2 of Chapter 3. Union Camp has also voluntarily conducted monitoring in the Chowan River. Results of this have been discussed in Chapter 4 under the specific subbasin discussions. Levels of dioxin have been decreasing and many results indicate that they are below North Carolina's action level for this pollutant. When levels are found to consistently fall below EPA and FDA criteria, the consumption advisory will be lifted.

## 6.5 IDENTIFICATION AND PROTECTION OF HIGHLY VALUED RESOURCE WATERS

### 6.5.1 Overview of Special Classifications and Habitats

Waters considered to be biologically sensitive or of high resource value may be given protection through reclassification to HQW (high quality waters), ORW (outstanding resource waters) or WS (water supply), or they may be protected through more stringent NPDES permit conditions. Waters eligible for reclassification to HQW or ORW may include native trout waters, designated critical habitat for threatened or endangered species (as designated by the NC Wildlife Resources Commission), waters having Excellent water quality or those classified for domestic water supply purposes (WS I and II). The HQW, ORW and WS classifications generally require more stringent point and nonpoint source pollution controls than do basic water quality classifications such as C or SC. Refer to Chapter 2 and Appendix I for more information on classifications and standards. The Chowan River basin does not contain any water with a protective surface water classification, but it does contain seven aquatic species that are considered Threatened, Significantly Rare or of Special Concern. These species are given special protection status by the North Carolina Wildlife Resources Commission and/or the North Carolina State Endangered Species Act (G.S. 113-331 to 113-337). The species and the status of each can be found in Section 2.5.

Where waters are known to support state or federally listed endangered or threatened species or species of concern, consideration will be given during the NPDES permitting process to minimize impacts to habitat areas consistent with the requirements of the federal Endangered Species Act and North Carolina's endangered species statutes. Possible protection measures may include but are not limited to dechlorination or alternative disinfection, tertiary or advanced tertiary treatment, outfall relocation, and backup power provisions to minimize accidental plant spills. The need for special provisions will be determined on a case-by-case basis during review of individual permit applications and take into account the degree of impact and the costs of protection.

The Chowan River basin also contains a State Park, Merchants Millpond, which has its aquatic features as its centerpiece. This park has been described in Chapter 2.

## 6.6 GENERAL MANAGEMENT STRATEGIES FOR PROTECTING WATER QUALITY IN THE BASIN

### 6.6.1 Management Strategies for Controlling Nonpoint Source Pollution from Agriculture

Agricultural nonpoint source (NPS) pollution is reported as the leading probable source of water quality impacts to surveyed rivers and lakes, and the third largest probable source of impairments to surveyed estuaries. And it is also a major contributor to ground water contamination and wetlands degradation.

Agricultural activities that may cause NPS pollution include confined animal facilities, grazing, plowing, pesticide spraying, irrigation, fertilizing, planting and harvesting. The major agricultural NPS pollutants that result from these activities are sediment, nutrients, pathogens, pesticide, and salts. Agricultural activities also can damage habitat and stream channels. Agricultural impacts on surface and groundwater can be minimized by properly managing activities the can cause NPS pollution. The following table is a list of recommendations for state and federal agencies, and farmers.

Table 6.5. Recommended Actions to Address NPS Pollution from Agriculture

| | |
|---|---|
| State and Federal Agencies | <u>Target funds to control agricultural NPS pollution.</u> State and federal agencies should work with the Nonpoint Source Team to target funds toward the areas where they are most needed and would be most effective.<br><u>Promote agricultural best management practices (BMPs).</u> State and federal agencies should increase programs which provide cost-share, technical assistance, and economic incentives to implement agricultural BMPs.<br><u>Generate more "on-the-ground" water quality improvement demonstration projects.</u> These projects will help to generate enthusiasm for more cooperative effects between farmers and various agencies.<br><u>Create education programs.</u> These programs increase farmers awareness of water quality impact of agricultural NPS pollution. And the programs also provide farmers a set of tools to control agricultural NPS pollution. Topics can include environmentally sound BMPs for agriculture and numerous field days for local and regional interests. |
| Farmers | <u>Participate in the NPS team process.</u> The NPS team process will provide a good opportunity to influence state policy in basinwide planning. The NPS team will describe current water quality initiatives, identify priority NPS-impaired waterbodies and implement solutions addressing these waterbodies.<br><u>Participate in North Carolina Agricultural Cost Share program.</u> The North Agricultural Cost Share program provides technical assistance and cost sharing to landowners in implementing BMPs.<br><u>Practice a number of cost effective agricultural BMPs through the basin.</u> |

<u>References/Resources:</u>

Nonpoint Source Planning Group of the Division of Water Quality at (919)733-5083

### 6.6.2 Management Strategies For Urban and Industrial Stormwater Control

<u>**Recommendations for Controlling Industrial Stormwater**</u>

Within the Chowan basin various types of industrial activities with point source discharges of stormwater are required to be permitted under the NPDES stormwater program. These include facilities engaged in construction; mining/borrow pits; metal waste recycling and manufacture of metal products and equipment; manufacture of timber products; apparel, printing, paper, leather, and rubber products manufacturing; vehicle maintenance, transportation, and postal service activities, public warehousing and petroleum bulk stations and terminals; used automobile parts and scrap yards; ready mixed concrete production; manufacture of asphalt paving mixtures and blocks; production of textile mill products; ship and boat building/repairing and marinas.

Surface waters can be significantly impacted by stormwater runoff from industrial facilities, particularly those that store or transfer materials out of doors. The types of chemicals, industrial operations and various ancillary sources influence the pollution potential of each individual facility. As such, industrial facilities can reduce stormwater impacts by developing a comprehensive site-specific Stormwater Pollution Prevention Plan (SPPP or Plan) which is based on an accurate understanding of the pollution potential of the site. The Plan provides a flexible basis for developing site-specific measures to minimize and control the amounts of pollutants in stormwater runoff by implementing best management practices (BMPs). With respect to stormwater, the ultimate BMP is the elimination of exposure of any significant materials to rainfall or runoff.

Facilities subject to NPDES stormwater permitting are required to develop and implement a SPPP. The SPPP approach focuses on two major objectives: 1) to identify sources of pollution potentially affecting the quality of stormwater discharges from the facility; and 2) to describe and ensure that practices are implemented to minimize and control pollutants in stormwater discharges from the facility. The basic components of a SPPP include a site plan detailing the facility layout and locations of potential pollutant sources, a stormwater management plan describing materials management practices and feasibility of employing best management practices, a spill prevention and response plan, a preventive maintenance and housekeeping plan, annual employee training and semi-annual facility inspections. The facility SPPP must be periodically reviewed and updated to reflect changes at the facility.

In addition to the SPPP, all permitted facilities are required to perform qualitative monitoring. This monitoring requires the periodic visual inspection of each stormwater outfall. Inspections are performed for parameters including color, odor, clarity, floating and suspended solids, foam, oil sheen, and other obvious indicators of stormwater pollution. Facilities with significant stormwater pollution potential are also required to perform quantitative analytical monitoring.

## Recommendations for Urban Stormwater Control

Urban stormwater runoff can be a significant contributor to water quality problems. In the Chowan basin, urban development is relatively limited at present. As land is converted to impervious surfaces with construction of housing developments and commercial areas, careful attention to stormwater control will be more important. Stormwater problems are likely to be centered around the urban areas in the basin. There are no municipalities in the Chowan River Basin required to obtain permits to manage stormwater runoff within their jurisdiction.

The best time to address urban stormwater impacts are when it is most effective and least costly to do so -- before development occurs. Numerous studies have demonstrated a serious decline in the health of receiving waters when 10 to 15 percent of a watershed is turned into impervious surfaces (Schueler 1995).

The entire community plays a role in controlling the quality and quantity of urban stormwater. Table 6.6 is a list of recommendations for local governments, citizens, businesses, developers, and state agencies.

Table 6.6. Recommendations for Urban Stormwater Control

| | |
|---|---|
| Local governments | Create public education programs. These programs advise citizens about how to care for their homes, businesses, and neighborhoods while minimizing stormwater pollution. Topics that can be covered include environmentally sensitive methods of caring for lawns and vehicles.<br>Support stream clean-up programs. Clean-up programs such as Big Sweep remove harmful debris from streams and instill a sense of pride that will protect the waterbody in the long-term.<br>Create and enforce strict penalties for improper waste disposal. In addition, local governments should protect dumpsters by fencing around them and cleaning them regularly.<br>Institute land use planning to protect water quality. Through planning, local governments can reduce flooding by limiting the total area of impervious surfaces and directing runoff into vegetated areas or stormwater control devices. In addition, planning can be used to protect surface waters by directing growth away from sensitive areas/waters such as floodplains, steep slopes, wetlands, high quality waters, and water supplies.<br>Review local ordinances pertaining to parking and curb and gutter. Local ordinances often require larger parking lots than are needed. Parking lots should be designed to handle the average parking needs with overflow areas in grass. When possible, it is best to eliminate curbs and gutters to allow runoff to flow off the street or parking lot in sheet flow.<br>Protect open spaces and streamside buffers in and around urban areas. This will preserve recreational areas and significant natural resources near the town or city.<br>Attend stormwater workshops for local government officials. Various agencies like DWQ offer workshops on stormwater management or reference materials. For more information, contact the DWQ stormwater group at (919)733-5083.<br>Map the storm sewer system. If local governments map the inlets, pipes, and outlets that make up their storm drain system, they will be well equipped to identify the source of any observed stormwater problems.<br>Offer hazardous waste collection days. |
| Citizens | Participate in stream clean-up programs. Clean-up programs remove harmful debris from streams and instill a sense of pride that will protect the waterbody in the long-term. An annual Big Sweep event is held each year in September. Stream clean-up is a great service activity for groups such as Scouts, 4-H, Rotary Clubs, etc.<br>Practice environmentally-friendly lawn care. Table 6.7 has a list of suggestions for keeping a green lawn while minimizing harm to the environment.<br>When possible, use less-harmful substances in the home for cleaning or painting. Any time hazardous substances are used, there is a risk that they can enter the water by interfering with the proper functioning of septic tanks, leaking out of sanitary sewers, etc. When possible, use less hazardous substances such as latex instead of oil paint (see Table 6.8).<br>Educate adults and children about how to protect water quality. Educational materials can be obtained from the NC Office of Environmental Education, (919)733-0711.<br>Utilize hazardous waste collection centers for paints, petroleum products, and other chemicals.<br>Never dispose of oil, yard wastes, or other materials in storm drain inlets or dump these materials on lands. Storm drains connect directly to nearby streams without any treatment of the water.<br>Maintain and protect riparian buffers on private property. Buffers provide a critical right of way for streams during storms. When buffers contain the 100-year floodplain, they are an extremely cost-effective form of flood insurance. Buffers remove a wide array of pollutants, including sediment, nutrients, and toxic substances. They can also increase property value.<br>Support your local government's land use planning initiatives. |
| Developers | Incorporate stormwater management in the planning of projects. Plan developments to reduce impervious areas (roads, driveways, and roofs). Do not build in environmentally sensitive areas such as floodplains and wetlands. (This is also a flood insurance policy.)<br>Maintain natural drainageways and buffers along streams. |

Table 6.6
Continued:

| | |
|---|---|
| Businesses | Maintain and protect riparian buffers on commercial property. Buffers provide a critical right of way for streams during storms. When buffers contain the 100-year floodplain, they are an extremely cost-effective form of flood insurance. Buffers remove sediment, nutrients, and toxic substances.<br>Cover and contain waste materials. This will prevent runoff from the disposal area from becoming contaminated and polluting the receiving water.<br>Practice good housekeeping. A clean and litter-free facility will promote good water quality.<br>Institute hazardous waste collection sites. Automobile service centers, hardware stores, and other pertinent businesses can institute hazardous waste collection sites for used oil, antifreeze, paint, and solvents. |
| State and Federal Agencies | Provide technical information about urban stormwater. State and federal agencies should strive to increase their communication with local governments, businesses, and citizens.<br>Create and maintain stormwater wetlands along streams. Like buffers, stormwater wetlands treat stormwater and reduce flows. Stormwater wetlands must be designed and maintained properly to be effective. |

Table 6.7. How to Take Care of Your Lawn and Car and Protect Water Quality

| If you are caring for... | This is the environmentally-friendly practice. |
|---|---|
| your lawn | • Use only fertilizers that are needed, based on soil tests and plant needs.<br>• Keep fertilizers off driveways and sidewalks.<br>• Avoid using fertilizers within 75 feet of any waterbody.<br>• If you use a lawn service, request natural rather than chemical management.<br>• Plant hardy, native species that do not require chemical inputs.<br>• Contact your Cooperative Extension Agent for more information. |
| your vehicle | • Maintain motor vehicles and repair leaks promptly.<br>• Dispose of used motor oil and antifreeze in recycling centers.<br>• Avoid gas tank overflows during refueling. |

from S.C. Dept. of Health and Environmental Control, "Turning the Tide" (1995)

Table 6.8. Substitutions for Household Hazardous Substances

| Instead of... | Try... |
|---|---|
| • Ammonia-based Cleaners | • Vinegar + Salt + Water |
| • Abrasive Cleaners | • Lemon Dipped in Borax or Salt + Baking Soda |
| • Furniture Polish | • Lemon Juice + Olive Oil |
| • Toilet Cleaner | • Baking Soda + Toilet Brush |
| • Oven Cleaner | • Liquid Soap + Borax + Warm Water |
| • Drain Cleaners | • Boiling Water + Baking Soda + Vinegar |
| • Upholstery Cleaners | • Dry Cornstarch |
| • Mothballs | • Cedar Chips or Lavender Flowers |
| • Window Cleaner | • White Vinegar + Water |
| • Oil-Based Paints and Stains | • Water-based Paints and Stains |

from S.C. Dept. of Health and Environmental Control, "Turning the Tide" (1995)

<u>References/Resources for Urban Stormwater</u>:

- *Stormwater Management Guidance Manual*, 1993, Cooperative Extension Service
- *Stormwater Management in North Carolina: A Guide for Local Officials*, 1994, Land-of-Sky Regional Council, Asheville, NC (Eaker 1994)
- Stormwater Fact Sheets by Land-of-Sky Regional Council, 1994
  1. *Stormwater Problems and Impacts: Why all the Fuss?*
  2. *Stormwater Control Principles and Practices*
  3. *Stormwater Management Roles and Regulations*
  4. *Local Stormwater Program Elements and Funding Alternatives*
  5. *Municipal Pollution Prevention*
  6. *Managing Stormwater in Small Communities: How to Get Started*
  7. *Maintaining Wet Detention Ponds*
  8. *Plan Early for Stormwater in Your New Development*
  9. *How Citizens Can Help Control Stormwater Pollution*
- *Stormwater Best Management Practices*, 1995, NC Division of Environmental Management.
- Washington Regional Office of DWQ, Stormwater Group: (704)251-6208.

### 6.6.3 Management Strategies for Controlling Fecal Coliform Bacteria

Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals and are widely used as an indicator of the potential presence of disease-causing bacteria and viruses. They enter surface waters from a number of sources including failing onsite wastewater systems, broken sewer lines, improperly treated discharges of domestic wastewater, pump station overflows, straight piping and runoff carrying livestock and wildlife wastes.

There are no monitored waterbodies in the Chowan basin where fecal coliform bacteria standards have been exceeded in more than 25% of the samples taken by DWQ.

Several general management strategies for addressing fecal coliform contamination include:

- Proper maintenance and annual inspections of onsite waste disposal systems such as septic tanks.
- Maintenance and repair of sanitary sewer lines by WWTP authorities.
- Maintenance and establishment of riparian vegetative buffers.
- Maintenance of natural drainage patterns to maximize filtration and minimize runoff.
- Elimination of direct illegal discharges of domestic waste (also known as "straight piping").
- Proper management of livestock to keep wastes from reaching surface waters.
- Encouragement of local health departments to routinely monitor waters known to be used for body contact recreation (e.g., swimming and tubing).

The 1996 General Assembly established a program designed to eliminate domestic sewage or wastewater discharges from both direct (straight pipe) and from overland flow of failing septic systems. The focus of the program contains three components:

1) the identification and elimination of domestic sewage discharges into streams proposed or currently used for public water supplies,
2) an amnesty period to end December 31, 1997 during which time violations for identification of domestic dischargers will not be incurred, and
3) a public education program about the amnesty period will be implemented. The majority of the funds allocated to this program are recurring funds.

Septic tanks are used widely throughout this basin, particularly since many citizens live outside of the service area of a regional wastewater treatment plant. Unfortunately, many citizens are not aware of how to care for their septic tanks. Some of the actions that homeowners, local governments, and state and federal agencies can take to reduce pollution from septic tanks are listed in Table 6.9.

Table 6.9. Recommended Actions for Proper Maintenance of Septic Tanks

| | |
|---|---|
| Homeowners | Do not put harmful substances in your septic tank. These substances include: cooking grease, oils, fats, pesticides, paints, solvents, disinfectants, and other household chemicals. These substances can kill the microorganisms that help purify the groundwater and can themselves pollute groundwater.<br>Know the location of your system and keep heavy vehicles and plant roots away from drain field pipes. These things can compact soils and inhibit the proper functioning of the system.<br>Conserve water and stagger intensive uses. Some intensive water uses include showers, laundry, dishwasher, etc. Look for ways to reduce (e.g.., full loads) and to not use all at once.<br>Have the septic system inspected annually and pumped out every three to five years. This is a small price to pay to ensure that your household has functioning wastewater treatment.<br>Look for "greener grass over the septic tank." This could be a sign that the septic tank is failing.<br>Divert overland runoff from your property away from the drainfield area. This will reduce the likelihood of saturating the soil and causing malfunctions. |
| County Health Departments | Require regular inspections of septic systems.<br>Enforce severe penalties for uncorrected septic system malfunctions.<br>Ensure that citizens understand how to maintain their septic tank when they first obtain property in the county. |
| NC Div. of Environmental Health | Provide leadership to county health offices. Encourage county health offices to require regular inspections.<br>Provide public education materials. |

References/Resources:

Please contact the local county heath department for more specific advice.

### 6.6.4 Management Strategies For Controlling Toxic Substances

Toxic substances, or toxicants, routinely regulated by DWQ include dioxin, metals, organics, chlorine, and ammonia, as described in Chapter 3.

The Chowan River from the Virginia Border to the Albemarle Sound (at Highway 17 bridge) remains under a fish consumption advisory for all fish except herring, shellfish and shad (including roe). The advisory has been in place since August 1990 and currently recommends that the general population consume no more than two meals of any fish except those noted above in one month and that children and pregnant or nursing women consume no fish except those noted above. The Union Camp Fine Paper mill in Franklin, Virginia is believed to contribute to the dioxin contamination of fish in the Chowan River. Union Camp has taken significant steps to improve the quality of their effluent and to eliminate the discharge of dioxin into the surface waters, More details on this subject are contained in Section 3.2.2 of Chapter 3. Union Camp has also voluntarily conducted monitoring in the Chowan River. Results of this have been discussed in Chapter 4 under the specific subbasin discussions. Levels of dioxin have been decreasing and many results indicate that they are below North Carolina's action level for this pollutant. When levels are found to consistently fall below EPA and FDA criteria, the consumption advisory will be lifted.

North Carolina has adopted standards and *action levels* for several toxic substances. These are contained in 15A NCAC 2B .0200. Usually, limits are not assigned for parameters which have action levels, such as copper, unless monitoring indicates that the parameter may be causing toxicity or federal guidelines exist for a given discharger for an action level substance. This process of determining action levels exists because these toxic substances are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility, stream characteristics and/or associated waste characteristics. Water quality-based limits may also be assigned to a given NPDES permit if data indicate that a substance is present for which there is a federal criterion but no state water quality standard.

*Whole effluent toxicity* (WET) testing is required on a quarterly basis for all major dischargers (≥1 MGD) and any discharger releasing complex (industrial) wastewater. There is one such discharger in the Chowan River Basin. This test shows whether the effluent from a treatment plant is toxic, but it does not identify the specific cause of toxicity. If the effluent is found to be toxic, further testing is done to determine the specific cause. This follow-up testing is called a *toxicity reduction evaluation* (TRE). In the Chowan River Basin, there is only one facility that is required to monitor effluent toxicity and that is United Piece Dye Works.

**Metals**

Municipal and industrial dischargers along with urban runoff, and possibly atmospheric deposition, are the main sources of metals contamination in surface water. North Carolina has stream standards for many heavy metals. The most common metals limited in municipal permits are cadmium, chromium, nickel, lead, mercury, silver and zinc. Each of these is monitored at the 21 ambient monitoring stations in the basin along with aluminum and arsenic. Point source discharges of metals are controlled through the NPDES permit process. Mass balance models (Appendix III) are employed to determine appropriate limits. Municipalities with significant industrial users discharging wastes to their treatment facilities limit the heavy metals coming to them from their industries through their *pretreatment program.* Source reduction and wastewater recycling at WWTPs also reduces the amount of metals being discharged to a stream. Nonpoint sources of pollution are controlled through best management practices.

### Chlorine

Chlorine is commonly used as a disinfectant at NPDES discharge facilities which have a domestic (i.e., human) component. These discharges are a major source of chlorine in the State's surface waters. Chlorine dissipates fairly rapidly once it enters the water, but it can have significant toxic effects on sensitive aquatic life such as trout and mussels. North Carolina has adopted a freshwater standard for trout waters of 17 ug/l (micrograms per liter). For all other waters an action level of 17 ug/l is applied to protect against chronic toxicity. It is recommended that new and expanding discharges provide dechlorination or alternate disinfection of wastewater. A total residual chlorine limit is assigned based on the freshwater action level of 17 ug/l or a maximum concentration of 28 ug/l for protection against acute effects in the mixing zone. Federal guidelines for residual chlorine of 8 ug/l for chronic effects and 13 ug/l for acute effects are used in saltwaters. In 1993, letters were sent to existing facilities with chlorine monitoring requirements. These letters encouraged permittees to examine their effluent chlorine levels and noted that limits may be implemented in the future. At this time, the State requires chlorine limits for all trout waters and any new or expanding facilities using chlorine for disinfection.

### Ammonia ($NH_3$)

Point source dischargers are one of the major sources of ammonia. In addition, decaying organisms which may come from nonpoint source runoff and bacterial decomposition of animal waste products also contribute to the level of ammonia in a waterbody. At this time, there is no numeric standard for ammonia in North Carolina. However, DWQ has agreed to address ammonia toxicity through an interim set of instream criteria of 1.0 mg/l in the summer (April - October) and 1.8 mg/l in the winter (November - March). Currently, limits will be given no less than 2 mg/l in summer and 4 mg/l in winter, unless dissolved oxygen problems or modeling analysis dictate stricter limits. These interim criteria are under review, and the State may adopt a standard in the future.

## Assimilative Capacity

The assimilative capacity (that is, the amount of a substance a waterbody can assimilate under designated flow conditions) available for toxicants in the Chowan basin varies from one waterbody to another. In streams, the 7Q10 is used as the flow condition for aquatic life based standards, while average flow is used for carcinogens. In larger streams where more dilution flow exists there is more assimilative capacity for toxics. In areas with little dilution, facilities will receive chemical specific limits which are close to the water quality standard. In estuarine waters assimilative capacity can be difficult to determine since it is generally dependent on tidal forces, wind-driven mixing and proximity to inlets and not primarily on freshwater discharge. Toxics from nonpoint sources typically enter a waterbody during storm events. All waters must be protected from both immediate acute impacts and longer term chronic effects.

## Control Strategies

Chemical specific toxics limits and monitoring requirements for point source dischargers will be determined using the techniques discussed in the Instream Assessment Unit's Standard Operating Procedures manual and discussed in Appendix III of this report. These methods utilize an EPA recommended approach which considers the maximum predicted effluent concentration and the amount of variation in effluent monitoring data. Whole effluent toxicity limits are assigned to all major dischargers and to any discharger of complex wastewater.

Nonpoint source strategies being implemented through the industrial NPDES stormwater program should also be helpful in reducing toxic substance loading to surface waters. Agricultural BMPs implemented to reduce nutrient and sediment loading from cropland are likely to result in lower pesticide inputs.

### 6.6.5 Management Strategies For Oxygen-Consuming Wastes

Maintenance of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. The daily average dissolved oxygen standard for most waters in the state, except for waters classified as trout and swamp waters is 5.0 mg/l. Although no waters in the Chowan Basin have the supplemental swamp classification which allows for DO level below 5.0 mg/l, the basin does contain waters that have swamp characteristics, including naturally low DO levels.

Biochemical oxygen demand (BOD) and ammonia nitrogen ($NH_3$-N) associated with wastewater treatment plants are generally the types of oxygen-consuming wastes of greatest concern. During summertime conditions, when temperature is high and stream flow is low, point source BOD and $NH_3$-N have the greatest impact on instream dissolved oxygen concentrations. NPDES permits for wastewater facilities generally limit $BOD_5$ (or $CBOD_5$) and $NH_3$-N in point source discharge effluents to ensure protection of the DO standard during warm, low flow conditions. Under these conditions, nonpoint source pollution input, which typically occurs as a result of rainfall events, has a minor impact.

Where residual BOD is significant, management of nonpoint sources to reduce loading is recommended by implementation of best management practices. Additionally, constructed wetlands can be strategically engineered and positioned in the landscape to reduce the input of oxygen demanding wastes. Constructed wetland treatment systems can remove between 50% and 90% of the $BOD_5$ from primary effluent (Bastian and Benforado 1988).

BOD/DO models are used by DWQ to determine NPDES permit limits for oxygen-consuming wastes. The choice of model in free-flowing streams, North Carolina's desktop empirical model (Level B) or the field calibrated, QUAL2E model, is determined by the amount of data available for a given stream reach (Appendix III). Modeling is not conducted in some instances, such as for discharges into zero flow streams and HQW stream segments where NPDES permit limitations are determined by special procedures and regulations.

<u>Discharges to Low Flow Streams</u>
Many low flow streams exist across the state. In 1980 studies were performed on zero flow streams (7Q10 and 30Q2 = 0 cfs) to determine the effect of wastewater discharges to these waterbodies. The studies concluded that:

- steady-state models do not apply to zero flow streams, particularly those receiving waste from small discharges;
- the pool/riffle configuration of these small streams results in violations of the DO standard even when the wastewater is well treated;
- small streams receiving wastes from schools, mobile home parks, subdivisions, etc. flow through populated areas where children have easy access to the streams;
- noxious conditions were found in the low flow streams that were part of the study.

As a result of the study, regulations were developed that prohibit new or expanded discharges of oxygen-consuming wastes to zero flow streams. Existing facilities discharging to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge and some facilities built new treatment plants to meet advanced tertiary limits for $BOD_5$ and $NH_3$-N. Facilities that currently discharge to a zero flow stream but which have not yet been evaluated will receive the following language in their NPDES permit:

*Removal of the discharge will be required if a more environmentally sound and economically achievable alternative is available.* ***An engineering report evaluating alternatives to discharge is due 180 days prior to permit expiration along with the permit renewal application.*** *As part of the report, the cost of constructing a treatment facility to meet limits of 5 mg/l $BOD_5$, 2 mg/l $NH_3$-N, 6 mg/l dissolved oxygen and 17 ug/l chlorine must also be included if there are no alternatives to a surface water discharge. Upon review of the results of the engineering report, the Division may reopen and modify this NPDES permit to require removal of the discharge, modified treatment designs, and/or revised effluent limitations within a specified time schedule.*

This policy typically covers small discharges, i.e., schools, mobile home parks, rest homes, subdivisions, etc. which discharge to zero flow streams in headwater areas. While these discharges may not cause severe water quality problems in mainstem reaches of the Chowan Basin they can cause localized problems in their low flow receiving streams.

The results of the 1980 study were extrapolated for facilities discharging to low flow streams with a 7Q10 = 0 and a 30Q2 > 0 since similar adverse impacts are expected in the receiving streams. Regulations were developed to set effluent limitations for new and expanded discharges of oxygen consuming waste at 5 mg/l BOD5, 2 mg/l NH3-N, and 6 mg/l DO, unless it is determined that these limitations will not protect water quality standards.

**Discharges to Swamp Waters**

Although no streams in the Chowan Basin are classified as swamp waters, many streams have swamp-like characteristics. At this time, DWQ does not have a good tool to evaluate the ability of these waters to assimilate oxygen-consuming wastes as our desktop dissolved oxygen model assumes a steady-state, one-dimensional flow, and these conditions may not exist in swamp waters. In addition, data analyses from a previously studied system in the Lumber River Basin indicated that critical conditions in a swamp system are not necessarily limited to low flow conditions. Inadequate flow and water quality data prevent verification of the relationship between flow and dissolved oxygen in many of the tributaries with swamp-like characteristics.

Given the difficulty of determining assimilative capacity in these waters, DWQ has identified the need to develop a better tool to evaluate a swamp system's ability to assimilate waste flow. Since many swamp systems are very slow moving and naturally have low dissolved oxygen concentrations, the criteria to determine the impact from a wastewater discharge is currently being reevaluated. A work group has been formed in the Water Quality Section to determine wastewater impacts given various treatment levels and flow conditions in a swamp. Instream data above and below several facilities will be used as part of the study. The focus of the study is to evaluate discharge impacts during various hydrologic regimes within the swamps in question. Emphasis will be placed on data collected during high, low and medium flows and during a falling hydrograph event when swamp backwaters drain to the mainstem carrying potentially lower dissolved oxygen concentrations.

Until these studies are completed, new discharges will not be permitted at limits less stringent than 15 mg/l $BOD_5$ and 4 mg/l $NH_3$-N. More stringent limits may be needed on a case-by-case basis if existing data or conditions suggest that adverse impacts are occurring. Existing facilities will receive current permit limits unless they expand or site specific information is available which indicates more stringent limits are needed. Upon expansion, they will receive existing loading (mass basis).

### 6.6.6 Management Strategies For Controlling Sedimentation

Sedimentation is a widespread nonpoint source-related water quality problem that results from land-disturbing activities. The most significant of these activities include agriculture and land development (e.g., highways, shopping centers, and residential subdivisions). For each of these major types of land-disturbing activities, there are programs being implemented by various government agencies at the state, federal and/or local level to minimize soil loss and protect water quality. Some of these programs are listed in Table 6.10 and are briefly described in Appendix VI.

Table 6.10. State and Federal Sediment Control-Related Programs

| | |
|---|---|
| Agricultural Nonpoint Source (NPS) Control Programs | North Carolina Agriculture Cost Share Program<br>NC Cooperative Extension Service and Agricultural Research Service<br>Watershed Protection and Flood Prevention Program (PL 83-566)<br>Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA). (Includes Conservation Reserve Program, Conservation Compliance, Sodbuster, Swampbuster, Conservation Easement, Wetland Reserve and Water Quality Incentive Program) |
| Construction, Urban and Developed Lands | Sediment Pollution Control Act<br>Federal Urban Stormwater Discharge Program<br>Water Supply Protection Program<br>ORW and HQW Stream Classification |
| Forestry NPS Programs | Forest Practice Guidelines<br>National Forest Management Act<br>Forest Stewardship Program |
| Mining | The Mining Act of 1971 |
| Wetlands Regulatory NPS Programs | Section 10 of the Rivers and Harbors Act of 1899<br>Section 404 of the Clean Water Act<br>Section 401 of the Water Quality Certification (from CWA)<br>North Carolina Dredge and Fill Act (1969) |

Construction activities, private access roads, and state road construction are discussed below. These sources are discussed separately below. Golf courses, urban stormwater, and agriculture are other potential sources of sediment that are discussed in separate sections.

#### Construction Activities

Construction activities are controlled under the Sedimentation and Erosion Control Act administered by the NC Division of Land Resources (DLR). This act requires anyone disturbing more than one acre of land to submit a Sedimentation and Erosion Control Plan to DLR. One of the major requirements is that there are adequate erosion control measures to retain all sediment on a development site during the 25-year storm. Generally, a land owner must install acceptable Best Management Practices (BMPs) when the land is disturbed by construction or development activities. Management practices may include barriers, filters, or sediment traps to reduce the amount of sediment that leaves a site. Under this act, local governments may take responsibility for reviewing and enforcing the Sedimentation and Erosion Control Program within their jurisdiction; however, their program must be at least as stringent as DLR's.

In the Chowan River basin, development will likely continue to occur in areas around growing municipalities. In order to match the pace of land disturbing activity, more staff hours will be needed within the DLR in order to effectively administer and fully enforce the provisions of the

Act. At present, planning and inspection staff are stretched thinly across large geographic areas and a wide variety of projects. Careful planning prior to construction, perhaps the most important part of erosion control, may often be neglected due to lack of available staff time.

The responsibility for controlling sediment from construction activities falls on many shoulders. The parties with the greatest responsibility include: homeowners, developers/contractors, local governments, and the NC Division of Land Resources. Table 6.11 presents actions that will help to address sediment problems associated with construction activities.

References/Resources:

- The following can be ordered from the NC Division of Land Resources at P.O. Box 27687, Raleigh, NC 27611, (919)733-3833:
  1) *NC Erosion and Sediment Control "Planning and Design Manual"* ($55 for in-state, $75 for out-of-state)
  2) *NC Erosion and Sediment Control "Inspector's Guide"* ($20 for in-state or out-of-state)
  3) *NC Erosion and Sediment Control "Field Manual"* ($20 for in-state or out-of-state)
  4) *NC Erosion and Sediment Control "Video Modules"* ($15 for in-state, $50 for out-of-state)
- Washington Regional Office of the Division of Land Resources at (919)251-6208.

No sediment control measures are 100% effective so some level of sedimentation will occur with land-disturbing activities. Education and promotion of stewardship are keys to reducing sedimentation, along with judicious strengthening of regulations and enforcement.

Table 6.11. Recommended Actions to Address Construction-Related Sediment Problems

| | |
|---|---|
| Homeowners | Fit the development to existing site conditions. When a development follows natural contours and avoids areas subject to flooding and highly erodible soils, it is much easier to control erosion and sedimentation.<br>Establish, maintain, and protect vegetation beside streams on your property. Buffers provide a filter for sediment and other pollutants.<br>Carefully monitor the construction process.<br>Ensure that permanent vegetation is established and maintained on the construction site as soon as possible.<br>Continue to control sediment after construction is complete. |
| Developers/ Contractors | Fit the development to existing site conditions. When a development follows natural contours and avoids areas subject to flooding and highly erodible soils, it is much easier to control erosion and sedimentation.<br>Minimize the extent and duration of exposure. Schedule construction according to weather and season. Try to pick dry times.<br>Protect areas to be disturbed from stormwater runoff. Use dikes, diversions, and waterways to intercept runoff and divert it away from cut-and-fill slopes or other disturbed areas. To reduce erosion, install these measures before clearing and grading.<br>Keep runoff velocities low. Convey stormwater away from steep slopes to stabilized outlets, preserving natural vegetation when possible.<br>Inspect and maintain control structures during the construction process. If not properly maintained, some erosion control measures can cause more damage than they correct.<br>Retain sediment on-site. Protect low points below disturbed areas by building barriers to reduce sediment loss. When possible, plan and construct sediment traps before other land disturbing activities.<br>Stabilize disturbed areas as soon as possible after construction. Apply mulch and vegetation to land and line channels for protection. Consider future repairs and maintenance of these measures.<br>Train equipment operators to execute erosion and sediment control practices. |

Table 6.11 continued:

| | |
|---|---|
| Citizens | Report any serious sediment problems on construction sites. This would include bare soil that has not been stabilized within 30 days, brown or red runoff during a storm, or obviously malfunctioning erosion/sediment controls. |
| Local Govts. Without Delegated Sediment/ Erosion Control Programs | Educate citizens as to the importance of erosion and sediment control before they begin construction activities.<br>Report any serious problems on construction sites. This would include bare soil that has not been stabilized within 30 days, brown or red runoff during a storm, or obviously malfunctioning erosion/sediment controls.<br>If your resources allow, consider taking responsibility for sediment and erosion control in your jurisdiction. This will allow greater control over implementation and enforcement of the program. It will also offer the opportunity to require sediment control on developments disturbing under one acre.<br>Maintain publicly-owned open space. This will prevent sediment contributions from certain tracts of land. |
| Local Govts. With Delegated Sediment/ Erosion Control Programs | Educate citizens as to the importance of erosion and sediment control before they begin construction activities.<br>Maintain publicly-owned open space. This will prevent sediment contributions from certain tracts of land.<br>Evaluate the effectiveness of current sediment control enforcement.<br>Identify staff resource needs.<br>When possible, coordinate efforts with other agencies such as the Dept. of Transportation, Div. of Forest Resources, and Soil and Water Conservation Districts. |
| NC Div. of Land Quality | Continue to promote effective implementation and maintenance of erosion and sediment control measures on construction sites.<br>Research innovative new ways to control sediment on construction sites.<br>Evaluate the effectiveness of current sediment control enforcement.<br>Identify staff resource needs.<br>When possible, coordinate efforts with other agencies such as the Dept. of Transportation, Div. of Forest Resources, and Soil and Water Conservation Districts.<br>Encourage more delegated programs by local governments where resources allow, especially in rapidly developing areas. |

## State Road Construction

Like any impervious surface, roadway systems have the potential to generate stormwater runoff problems. Various types of pollutants from the road surface can be carried to surface waters by rainfall. In addition, roadway construction, roadside vegetation management and roadway operation and maintenance activities can contribute to stormwater pollution problems.

The Division of Water Quality is currently working with the NC Department of Transportation (DOT) to finalize a stormwater management permit for DOT activities. This permit will address pollution from stormwater runoff related to roadways, road construction, vegetation management, operation and maintenance and other related DOT activities throughout the state. The major permit requirements are the implementation of a comprehensive stormwater management program, monitoring programs to direct the stormwater program and annual reports to outline the effectiveness and direction of the program.

The initial emphasis of the stormwater programs will be on high volume roadway segments in sensitive water areas such as coastal areas and water supply watersheds. The stormwater management programs will try to locate and characterize pollutant problems and to develop and implement appropriate best management practices to protect surface waters.

DOT is responsible for its own sedimentation and erosion control program. DOT has a number of projects with effective sedimentation and erosion control in mountain areas. Table 6.12 presents recommended road construction measures.

6.12. Recommended State Road Construction Measures

| | |
|---|---|
| NC Dept. of Transportation | Implement high quality sediment and erosion control. This is extremely important in areas with steep slopes.<br>Increase training for DOT staff to ensure that sedimentation and erosion control devices are properly sized and installed. It is also important to include specific instructions for sediment and erosion control and phasing on the plans so that contractors can understand their responsibility.<br>Inspect sedimentation and erosion control devices frequently. This is particularly important when contractors are responsible for the work.<br>Implement pre-, during, and post-construction water quality monitoring at selected sites. This is the only way to tell for sure if sediment and erosion controls are working effectively.<br>Reduce the threshold of exposed area when roads are constructed on steep slopes. |
| Citizens and Local Governments | Contact the district DOT office if you observe sediment problems at a road construction site. Some things to watch out for include: bare soil that is not mulched and/or planted within 30 days, washed-out sediment basins and filter cloths, and soil disposal sites that are placed in or directly adjacent to creeks. |

References/Resources:

- G.R. Shirley, Jr., District Office of DOT, (919) 830-3490

## REFERENCES - CHAPTER SIX

NC Department of Transportation. June 1996. Transportation Improvement Program, 1997 - 2003.

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Schueler, Thomas. 1994. "Assessing the Potential for Urban Watershed Restoration" in Watershed Protection Techniques, ed. Thomas Schueler, Vol. 1, No. 4.

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Virginia Department of Conservation and Recreation, 1993. Nonpoint Source Pollution Watershed Assessment Report.

# CHAPTER 7

# FUTURE INITIATIVES

## 7.1 OVERVIEW OF CHOWAN RIVER BASINWIDE GOALS AND OBJECTIVES

Near-term objectives, or those achievable at least in part during the next five years, include coordinating with various agencies to implement the control strategies outlined in Chapter 6. These strategies are aimed at reducing point and nonpoint source loadings of nutrients and other pollutants. These steps are necessary to progress towards restoring impaired waters, protecting threatened waters from further degradation, protecting waters with a high resource value and maintaining the quality of other waters currently supporting their uses.

The long-term goal of basinwide management is to protect the water quality standards and uses of the basin's surface waters while accommodating reasonable economic growth.

Attainment of these goals and objectives will require determined, widespread public support; the combined cooperation of state, local and federal agencies, agriculture, forestry, industry and development interests; and considerable financial expenditure on the parts of all involved. However, with the needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

## 7.2 FUTURE ACTIVITIES IN THE CHOWAN RIVER BASIN

### 7.2.1 Nonpoint Source Control Strategies and Priorities/Nutrient Reduction Efforts

Improving our knowledge of and controlling nonpoint source pollution will be a high priority over the next five years. Nonpoint source pollution is primarily responsible for the impaired and threatened waters in the Chowan River Basin. The following initiatives (described in Section 7.2.2, 7.2.3 and 7.2.4) are underway to address the protection of surface waters from nonpoint sources of pollution.

### 7.2.2 Chowan River Basin Nonpoint Source (NPS) Team

In July 1996, DWQ contacted potential NPS Team Members in the Chowan River basin. NPS Team Members met to describe what is known about nonpoint sources in the basin and to obtain local input on issues and recommendations for addressing nonpoint source pollution. The team will work toward creating Action Plans consisting of voluntary commitments made by the various agencies to address nonpoint source pollution. A list of agencies which comprise the NPS Team is presented in Table 7.1.

The Action Plans will be evaluated and updated every five years as part of the basinwide planning process. The responsibilities of the NPS Team members can be summarized as follows.

- Describe existing programs for nonpoint source pollutant control.
- Prioritize impaired waters for development and implementation of restoration strategies.
- Prioritize NPS issues for remedial action.
- Develop five-year Action Plan for improving water quality in targeted watersheds.

- Determine what is needed to address the priority waters and NPS issues.
- Implement Action Plans.
- Monitor effectiveness of management strategies.

Table 7.1 Chowan River Basin NPS Team Members

| Category | Agency/Group |
|---|---|
| Agriculture | NC Department of Agriculture<br>USDA - Natural Resources Conservation Service<br>NCSU - Cooperative Extension Service<br>NC Division of Soil and Water Conservation<br>Soil and Water Conservation District<br>NC Farm Bureau |
| Construction/Mining | NC Division of Land Resources |
| Forestry | NC Division of Forest Resources |
| Groundwater | NC Division of Water Quality - Groundwater Section |
| On-site wastewater treatment | NC Division of Environmental Health |
| Solid waste | NC Division of Solid Waste Management |
| Surface water | US Fish and Wildlife Service<br>NC Division of Water Quality<br>NC Division of Coastal Management<br>NC Division of Marine Fisheries<br>NC Wildlife Resources Commission<br>U.S. Army Corps of Engineers |
| Urban | Division of Water Quality<br>NC Department of Transportation |
| Local Government | NC League of Municipalities<br>Bertie County<br>Chowan County<br>Gates County<br>Hertford County<br>Northampton County |
| Additional | NC Coastal Federation<br>NC Wildlife Federation<br>Natural Resources Leadership Institute<br>Roanoke - Chowan Wildlife Council<br>Sierra Club |

### 7.2.3 Use Restoration Waters

The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program will allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program will include a mix of voluntary and mandatory programs. The voluntary and mandatory programs will be coordinated on a watershed-specific basis by DWQ and a group of stakeholders who have an interest in the impaired water body and associated watershed. In addition, the URW program will attempt to develop cooperative relationships among these agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

### 7.2.4 Further Evaluation Of Swamp Systems

Many of the waterbodies in the eastern third of the State are classified as swamp waters. It is difficult to evaluate monitoring data in these systems to determine if a waterbody is impaired. For example, a swamp may have low dissolved oxygen concentrations, but these may be due to natural background concentrations rather than from impacts from point and nonpoint sources. DWQ will continue its efforts to evaluate these systems using chemical and biological data.

### 7.2.5 Wetlands Restoration

The NC General Assembly approved the establishment of a wetland restoration program in this state. North Carolina is beginning a concentrated effort to inventory and digitally map wetlands throughout the state. As the program progresses, a restoration plan will be developed for each river basin and incorporated into the basinwide planning process. Through this, the water quality protection function of wetlands can be used more effectively in areas prioritized during basinwide planning.

### 7.2.6 Regional Councils

The Comprehensive Conservation and Management Plan (CCMP) for the Albemarle/Pamlico (A/P) Sounds region recommended that regional councils be formed in each of the A/P region's five river basins. An Executive Order was signed by Governor Hunt in March 1995 calling for the establishment of the five regional councils. The Neuse River Basin Regional Council was the first formed (November 1995). The other four, including one for the Chowan, are to be formed in 1997.

Each council will include local government representation (one municipal and one county rep from each county in the basin) as well as representation from non-governmental stakeholder groups in each basin. The groups would have the potential to help target and implement the water quality and resources issues of greatest concern to stakeholders in the basin and to forge the link between the APES program, the CCMP and basinwide planning.

### 7.2.7 Improved Monitoring Coverage and Coordination with Other Agencies

Monitoring of the chemical and biological status of receiving waters will provide critical feedback on the success of the basin management strategy. As discussed in Chapter 4, monitoring data will be collected from (1) ambient water chemistry, (2) sediment chemistry, (3) biological communities, (4) contaminant concentrations in fish and other biota, (5) ambient toxicity, and (6) facility self-monitoring data. The specific parameters measured will relate directly to the long-term water quality goals and objectives defined within the basinwide management strategy.

In addition to this, DWQ and other environmental agencies have been discussing the potential for coordination of field resources. One of the principal constraints with the frequency of ambient water quality monitoring is that significant water quality events could be missed because the monitoring did not occur during the event. If individuals from another environmental agency are visiting certain waterbodies to investigate fish populations or wetland areas, they could also collect water quality data from these areas. The coordination of these activities should help to better blend the activities of the various agencies as well as increase the frequency and coverage of the monitoring.

## 7.3 PROGRAMMATIC INITIATIVES

### 7.3.1 NPDES Program Initiatives

In the next five years, efforts will be continued to:

- improve compliance with permitted limits;
- improve pretreatment of industrial wastes to municipal wastewater treatment plants so as to reduce the toxicity in effluent wastes;
- encourage pollution prevention at industrial facilities in order to reduce the need for pollution control;
- require dechlorination of chlorinated effluents or use of alternative disinfectants;
- require multiple treatment trains at wastewater facilities; and
- require plants to begin plans for enlargement well before they reach capacity.

Longer-term objectives will include refining overall management strategies after obtaining feedback on current management efforts during the next round of water quality monitoring. Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling byproducts of the treatment process (including nonpotable reuse of treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

### 7.3.2 Promotion of Non-Discharge Alternatives/Regionalization

DWQ requires all new and expanding dischargers to submit an alternatives analysis as part of its NPDES permit application. Non-discharge alternatives, including tying on to an existing WWTP or land-applying wastes are preferred from an environmental standpoint. If the Division determines that there is an economically reasonable alternative to a discharge, DWQ may recommend denial of the NPDES permit.

### 7.3.3 Addressing Inflow and Infiltration (I&I) Problems at Municipal Wastewater Treatment Plants

There is a need to provide financial assistance to local governments in the Chowan and other basins for correction of inflow and infiltration (I & I) problems in municipal wastewater sewage collection systems. Virtually every municipal wastewater treatment plant in the basin has deteriorating sewer lines that are either allowing groundwater to seep in (infiltration) and/or that have lines that receive excessive flows of surface waters from cross-connections with stormwater systems or flooding of manholes (inflow). I & I problems can overwhelm the hydrologic capacity of waste treatment plants causing both raw wastewater overflows and upsetting of the plant's biology which impacts it's ability to treat wastes for some time after the event. Many towns have to construct oversized waste treatment plants to compensate for this problem (it's often cheaper to build a bigger plant than correct the I & I problem).

Most municipal wastewater treatment facilities in the Chowan Basin use land application systems instead of discharging to surface waters in order to reduce the amount of nutrients reaching surface waters. These facilities have been running into problems when the amount of water getting into the system exceeds the hydrologic capacity of the land onto which the treated effluent is applied. Unless corrected, towns will be seeking permission to discharge their wastewater to streams instead of land-applying it. Correcting this problem will be very costly, but ultimately necessary in order to protect the river.

Because of the cost and widespread nature of the problem, this is an issue that will probably require attention by the general assembly to address.

### 7.3.4 Coordinating Basinwide Management With the Construction Grants and Loans Program

The potential exists to use the basinwide planning process as a means of identifying and prioritizing wastewater treatment plants in need of funding through DWQ's Construction Grants and Loan Program. Completed basin documents are provided to this office for their use.

### 7.3.5 Improved Data Management and Expanded Use of Geographic Information System (GIS) Computer Capabilities

DWQ is in the process of centralizing and improving its computer data management systems. Most of its water quality program data including permitted dischargers, waste limits, compliance information, water quality data, stream classifications, and so on, will be put in a central data center which will then be made accessible to most staff at desktop computer stations. Much of this information is also being entered into the state's GIS computer system (Center for Geographic Information and Analysis or CGIA). As this and other information is made available to the GIS system, including land use data from satellite or air photo interpretation, and as the system becomes more user friendly, the potential to graphically display the results of water quality data analysis will be tremendous.

Research Triangle Institute performed a pilot study in the Tar-Pamlico River Basin in which high priority waterbodies for nonpoint source control programs were mapped. These maps were used by the various nonpoint source agencies for planning purposes. As resources become available, this tool will be developed for other basins.

## 7.4 WATER QUALITY RECOMMENDATIONS OF THE FISHERIES MORATORIUM STEERING COMMITTEE

Depending upon legislative actions that may occur in 1997, DWQ may be required to perform some new duties with regard to coastal water quality management fisheries resource protection.

In July 1994, the North Carolina General Assembly declared a two-year moratorium on new vessel, crab and shellfish licenses and non-vessel endorsements to sell fish. The moratorium was extended in 1995 to last until 1997 to allow for the development of recommendations and the solicitation of public comment on those recommendations. The moratorium resulted from the concerns of fishermen, fisheries managers and others regarding the health of the state's coastal fisheries resources.

The General Assembly also appointed an 18 member panel of commercial and recreational fishermen, scientists, fisheries managers and representatives of legislature. The panel, known as the Moratorium Steering Committee, was instructed to study the problems and provide recommendations for solutions. The Committee divided into five working groups (subcommittees) to tackle specific issues - License, Marine Fisheries Commission and Division of Marine Fisheries Organization, Law Enforcement, Habitat and Gear.

In August 1996, the Committee approved a set of draft recommendations. They subsequently held 19 hearings across the state in August and September. In late October, the recommendations were finalized after revisions were made based on public input. In February of 1997, the Joint Legislative Commission on Seafood and Aquaculture considered these recommendations and by a close vote (7 - 6), decided not to forward them for further consideration by the General Assembly.

However, recommendations made by the Moratorium Steering Committee may be considered in whole or in part at a later date.

Some of the recommendations of the Habitat Subcommittee directly relate to water quality protection. Highlights of some of the recommendations made by the Habitat Subcommittee include, but are not limited to, (from Report of the Habitat Subcommittee to the Moratorium Steering Committee - Adopted by the Moratorium Steering Committee for Recommendation to the "Joint Legislative Commission on Seafood and Aquaculture" on October 24, 1996"):

- the General Assembly should amend appropriate legislation to give more weight to Division of Marine Fisheries objections to permits approved by other state agencies [such as NPDES permits issued by DWQ];

- the General Assembly should require the Coastal Resources Commission, Environmental Management Commission and Marine Fisheries Commission to adopt a Habitat Protection Plan for critical coastal fishery habitats as soon as possible but no later than July 1, 1999; and

- the General Assembly should establish and fund a comprehensive state program to acquire, preserve, and restore habitats critical to marine and/or estuarine fisheries.

# APPENDIX I

Summary of North Carolina's Water Quality Classifications and Standards

Antidegradation Policy

Nutrient Sensitive Waters Rule

High Quality Waters

Outstanding Resource Waters

# SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS

| PRIMARY CLASSIFICATIONS | BEST USAGE | DISCHARGE RESTRICTIONS[1] | STORMWATER MANAGEMENT | OTHER REQUIREMENTS[2] |
|---|---|---|---|---|
| **Freshwater:** | | | | |
| C (standards apply to all freshwaters, unless pre-empted by more stringent standard for more protective classification) | Secondary recreation (including swimming on an unorganized or infrequent basis); wildlife; fish and other aquatic life propagation and survival; agriculture and any other usage, except for primary recreation, water supply or other food-related ruses | Domestic and industrial wastewater dischargers allowed | Stormwater Management Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000 | |
| B | Primary recreation (swimming on an organized or frequent basis) and all uses specified for Class C (and not water supply or other food-related uses) | Same as for Class C; wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124) | Same as for Class C | |
| **WS-I** Water Supply | Water supplies in natural and undeveloped watersheds | No point source discharges | Not applicable since watershed is undeveloped | No landfills; residual or petroleum contaminated soils application not allowed in the watershed |
| **WS-II** Water Supply | Water supplies in predominantly undeveloped watersheds | Only general permit wastewater discharges allowed in watershed | Local land management program required as per 15A NCAC 2B .0214; 6% built upon area in Critical Area; 12% built upon area in the Balance of the Watershed; up to 24% built upon area in the Critical Area and 30% in the Balance of the Watershed allowed with engineered stormwater controls for the 1" storm[3] | Buffers required along perennial waters; no new landfills allowed in the Critical Area and no new discharging landfills outside of Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area |
| **WS-III** Water Supply | Water supplies in low to moderately developed watersheds | General permits allowed throughout watershed; domestic and non-process industrial discharges allowed outside of the Critical Area | Local land management program required as per 15A NCAC 2B .0215; 12% built upon area in Critical Area; 24% built upon area outside of Critical Area; up to 30% in Critical Area and 50% built upon area outside Critical Area allowed with engineered stormwater controls for the 1" storm[3] | Buffers required along perennial waters; no new landfills allowed in the Critical Area and no new discharging landfills outside of the Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area |

| PRIMARY CLASSIFICATIONS | BEST USAGE | DISCHARGE RESTRICTIONS[1] | STORMWATER MANAGEMENT | OTHER REQUIREMENTS[2] |
|---|---|---|---|---|
| WS-IV Water Supply | Water supplies in moderately to highly developed watersheds | General permits, domestic and industrial discharges allowed throughout watershed[4] | Local land management program required as per 15A NCAC 2B .0216: 24% built upon area in Critical Area and Protected Area [5,6]; up to 50% in Critical Area and 70% built upon area outside Critical Area with engineered stormwater controls for the 1" storm[3] | Buffers required along perennial waters; no new landfills allowed in the Critical Area; no new residual or petroleum contaminated soils application allowed in the Critical Area |
| WS-V Water Supply | Former or industrial use water supplies | No categorical restrictions on development or wastewater dischargers | Stormwater Management Rules apply in the 20 coastal counties as described in 15A NCAC 2H .1000 | Instream water quality standards for water supply waters are applicable |

NOTES: Please refer to 15A NCAC 2B .0101, .0104, .0202, .0211 and .0301 for more specific requirements for surface water supply protection.

1 Groundwater remediation discharges allowed when no alternative exists.
2 See attached tables: *Water Quality Standards for Freshwater Classes* and *Water Quality Standards for Saltwater Classes* for numeric standards associated with specific classes.
3 If the high density option is utilized engineered stormwater control systems must be designed for 85% TSS removal. Refer to Stormwater Management Rules (15 A NCAC 2H .1000) for specific design information.
4 New industrial process wastewater discharges in the Critical Area are allowed but must meet additional treatment requirements.
5 Applies to projects requiring an Erosion/Sedimentation Control Plan.
6 36% built-upon area is allowed for projects without a curb and gutter street system in the Protected Area.

- Critical area is 1/2 mile and draining to water supplies from normal pool elevation of reservoirs, or 1/2 mile and draining to a river intake.
- Protected Area is 5 miles and draining to water supplies from normal pool elevation of reservoirs, or 10 miles upstream of and draining to a river intake.
- Agricultural activities are subject to provisions of the Food Security Act of 1985 and the Food, Agriculture, Conservation and Trade Act of 1990. In WS-I watersheds and Critical Areas of WS-II, WS-III and WS-IV areas, agricultural activities must maintain a 10 foot vegetated buffer or equivalent control as determined by the Soil and Water Conservation Commission.
- Silviculture activities are subject to the provisions of the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0101-.0209).
- The Department of Transportation must use BMPs as described in their document, "Best Management Practices for Protection of Surface Waters".

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

| PRIMARY CLASSIFICATIONS | BEST USAGE | DISCHARGE RESTRICTIONS | STORMWATER MANAGEMENT | OTHER REQUIREMENTS |
|---|---|---|---|---|
| **Saltwater:** | | | | |
| SC | Saltwaters protected for secondary recreation, aquatic life propagation and survival and other uses as described for Class C | Domestic and industrial wastewater discharges allowed | Stormwater Management Rules (15A NCAC 2H .1000) apply to all waters in the 20 coastal counties; low density option: 30% built upon area or structural stormwater controls with higher density, as specified | |
| SB | Saltwaters protected for primary recreation and all Class SC uses (similar to Class B) | Same as Class SC; wastewater treatment reliability requirements (dual train design; backup power capability) may apply to protect swimming uses (15A NCAC 2H .0124) | Same as for Class SC | |
| SA | Shellfishing and all Class SC and SB uses | No domestic discharges and only non-process industrial discharges such as seafood packing houses or cooling water discharges | Same as for Class SC except low density option is 25% built upon area | |

Supplemental Classifications are added to the primary classifications as appropriate (Examples include Class C-NSW, Class SA-ORW, Class B-Trout, etc.) and impose additional requirements.

| SUPPLEMENTAL CLASSIFICATIONS | BEST USAGE | DISCHARGE RESTRICTIONS | STORMWATER MANAGEMENT | OTHER REQUIREMENTS |
|---|---|---|---|---|
| HQW<br>High Quality Waters | Waters rated as Excellent by DEM; Primary Nursery Areas; Native or Special Native Trout Waters; WS-I, WS-II and SA waters are HQW by definition | For new or expanded discharges advanced treatment requirements are: $BOD_5$=5 mg/l; $NH_3$-N= 2 mg/l; DO=6 mg/l | For projects requiring Erosion/ Sedimentation Control Plan and that are within 1 mile and draining to HQW waters: 12% built upon area or higher density with engineered structural controls allowed; WS-I, WS-II and 20 coastal counties exempt since stormwater control requirements already apply | Other treatment requirements may apply, dependent upon type of discharge and characteristics of receiving waters (see Antidegradation Policy: Rule 15A: NCAC 2B .0201) |

SUMMARY OF NORTH CAROLINA'S WATER QUALITY CLASSIFICATIONS AND STANDARDS (continued)

| SUPPLEMENTAL CLASSIFICATIONS | BEST USAGE | DISCHARGE RESTRICTIONS | STORMWATER MANAGEMENT | OTHER REQUIREMENTS |
|---|---|---|---|---|
| **ORW** Outstanding Resource Waters | Unique and special waters having exceptional water quality and being of an exceptional state or national ecological or recreational significance; must meet other conditions and have 1 or more of 5 outstanding resource value criteria as described in Rule 15A NCAC 2B .0225 | Water quality must clearly maintain and protect uses, including outstanding resource values; management strategies must include at a minimum: no new or expanded discharges to freshwater ORWs; some discharges may be allowed in coastal areas | Same as for High Quality Waters for Freshwater ORWs; for Saltwater ORWs, development activities within a 575' buffer must comply with the low density option of the Stormwater Management Rules (generally 25% built upon area around SA waters and 30% around other waters) | Other management strategy components as described in 15A NCAC 2B .0225 |
| **TR** Trout Waters | Protected for natural trout propagation and survival of stocked trout | Domestic and industrial wastewater discharges allowed with stricter treatment requirements | | More protective standards for cadmium, total residual chlorine, chlorophyll-a, dissolved oxygen, turbidity and toluene to protect these sensitive species |
| **NSW** Nutrient Sensitive Waters | Waters needing additional nutrient management due to their being subject to excessive growth of microscopic and macroscopic vegetation | No increase of nutrients over background levels permitted; domestic and industrial wastewater discharges allowed | Nutrient management strategies developed on a case-by-case basis | Nutrient management strategies developed on a case-by-case basis |
| **SW** Swamp Waters | Waters with low velocities and other characteristics different from other waterbodies (generally, low pH, DO, high organic content) | | | pH as low as 4.3 and DO less than 5 mg/l allowed if due to natural conditions |
| **FWS** Future Water Supply | Waters designated for future water supply use | Discharge restrictions will be reflective of those of primary water supply classification | Stormwater management options will be reflective of those of primary water supply classification; not required until after FWS supplemental classification is removed | Requirements for landfill permits, NPDES wastewater discharges, land application of residuals and road construction activities in Critical Area and Balance of Watershed or Protected Area as appropriate (15A NCAC 2H .0101) |

## Water Quality Standards For Freshwater Classifications

August 2, 1995

| Parameters (ug/l unless noted) | Standards for All Freshwater * | | Standards to Support Additional Uses | | | |
|---|---|---|---|---|---|---|
| | Aquatic Life | Human Health[1] | WS Classes[2] | Trout Waters | HQW | Swamp Waters |
| Arsenic | 50 | | | | | |
| Barium | | | 1000 | | | |
| Benzene | | 71.4 | 1.19 | | | |
| Beryllium | 6.5 | 0.117 | 0.0068 | | | |
| Cadmium | 2.0 | | | 0.4 | | |
| Carbon tetrachloride | | 4.42 | 0.254 | | | |
| Chloride | 230000 (AL) | | 250000 | | | |
| Chlorinated benzenes | | | 488 (N) | | | |
| Chlorine, total residual | 17 (AL) | | | 17 | | |
| Chlorophyll a, corrected | 40 (N) | | | 15 (N) | | |
| Chromium, total | 50 | | | | | |
| Coliform, total (MFTCC/100ml)[3] | | | 50 (N)[4] | | | |
| Coliform, fecal (MFFCC/100ml)[3] | | 200 (N) | | | | |
| Copper, total | 7 (AL) | | | | | |
| Cyanide | 5.0 | | | | | |
| Dioxin | | 0.000000014 | 0.000000013 | | | |
| Dissolved gases | (N) | | | | | |
| Dissolved oxygen (mg/l) | 5.0[5] | | | 6.0 | | (N)[6] |
| Fluoride | 1800 | | | | | |
| Hardness, total (mg/l) | | | 100 | | | |
| Hexachlorobutadiene | | 49.7 | 0.445 | | | |
| Iron (mg/l) | 1000 (AL) | | | | | |
| Lead | 25 (N) | | | | | |
| Manganese | | | 200 | | | |
| MBAS (Methylene-Blue-Active-Substances) | 500 | | | | | |
| Mercury | 0.012 | | | | | |
| Nickel | 88 | | 25 | | | |
| Nitrate nitrogen | | | 10 | | | |
| Pesticides | | | | | | |
| Aldrin | 0.002 | 0.000136 | 0.000127 | | | |
| Chlordane | 0.004 | 0.000588 | 0.000575 | | | |
| DDT | 0.001 | 0.000591 | 0.000588 | | | |
| Demeton | 0.1 | | | | | |
| Dieldrin | 0.002 | 0.000144 | 0.000135 | | | |
| Endosulfan | 0.05 | | | | | |
| Endrin | 0.002 | | | | | |
| Guthion | 0.01 | | | | | |
| Heptachlor | 0.004 | 0.000214 | 0.000208 | | | |
| Lindane | 0.01 | | | | | |
| Methoxychlor | 0.03 | | | | | |
| Mirex | 0.001 | | | | | |
| Parathion | 0.013 | | | | | |
| Toxaphene | 0.0002 | | | | | |
| 2,4-D | | | 100 | | | |
| 2,4,5-TP (Silvex) | | | 10 | | | |
| pH (units) | 6.0-9.0 | | | | | (N)[6] |
| Phenolic coumpounds | | (N) | 1.0 (N) | | | |
| Polychlorinated biphenyls[7] | 0.001 | 0.000079 | | | | |
| Polynuclear aromatic hydrocarbons [8] | | 0.0311 | 0.0028 | | | |
| Radioactive substances | | (N) | | | | |
| Selenium | 5 | | | | | |
| Silver | 0.06 (AL) | | | | | |
| Solids, total dissolved (mg/l) | | | 500 | | | |
| Solids, total suspended (mg/l) | | | | | 10 Tr, 20 other | |
| Solids, settleable | (N) | | | | | |
| Sulfates | | | 250000 | | | |
| Temperature | (N) | | | | | |
| Tetrachloroethane (1,1,2,2) | | 10.8 | 0.172 | | | |
| Tetrachlorethylene | | | 0.8 | | | |
| Toluene | 11 | | | 0.36 | | |
| Toxic substances | (N) | | | | (N) | |
| Trialkyltin | 0.008 | | | | | |
| Trichloroethylene | | 92.4 | 3.08 | | | |
| Turbidity (NTU) | 50; 25 (N) | | | 10 (N) | | |
| Vinyl chloride | | 525 | 2.0 | | | |
| Zinc | 50 (AL) | | | | | |

* These standards apply to all freshwater classifications. For the protection of WS and supplemental classifications, standards listed under Standards to Support Additional Uses should be used unless standards for aquatic life or human health are listed and are more stringent.

(AL) Values represent action levels as specified in 2B .0211(4). WS Classes - Water Supply Classifications, same standards for all WS Classes. Tr - Trout Waters.

(N) See 2B .0211(3) for narrative description of limits. HQW - High Quality Waters, standards for HQW areas only.

1 Human health standards are based on consumption of fish only unless dermal contact studies available. See 2B .0208 for equation.

2 Water Supply standards are based on consumption of fish and water. See 2B .0208 for equation.

3 MFTCC/100ml means membrane filter total coliform count per 100 ml of sample. MFFCC/100ml means membrane filter fecal coliform count per 100 ml of sample.

4 Applies only to unfiltered water supplies.

5 An instantaneous reading may be as low as 4.0 mg/l, but the daily average must be 5.0 mg/l or more.

6 Designated swamp waters may have a dissolved oxygen less than 5.0 mg/l and a pH as low as 4.3, if due to natural conditions.

7 Applies to total PCBs present and includes PCB 1242, 1254, 1221, 1232, 1248, 1260, and 1016. See 2B .0208 & .0211.

8 Applies to total PAHs present and includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. See 2B .0208, .0212, .0214, .0215, .0216, & .0218.

Water Quality Standards For Saltwater Classifications April 1, 1995

| Parameters (ug/l unless noted) | Aquatic Life | Human Health[1] | Class SA | HQW | Swamp Waters |
|---|---|---|---|---|---|
| | Standards for All Saltwater | | Standards to Support Additional Uses | | |
| Arsenic | 50 | | | | |
| Benzene | | 71.4 | | | |
| Beryllium | | 0.117 | | | |
| Cadmium | 5.0 | | | | |
| Carbon tetrachloride | | 4.42 | | | |
| Chlorophyll *a* | 40 (N) | | | | |
| Chromium, total | 20 | | | | |
| Coliform, fecal (MFFCC/100ml)[2] | | 200 (N) | 14 (N) | | |
| Copper | 3 (AL) | | | | |
| Cyanide | 1.0 | | | | |
| Dioxin | | 0.000000014 | | | |
| Dissolved gases | (N) | | | | |
| Dissolved oxygen (mg/l) | 5.0 | | | 6.0 | (N)[3] |
| Hexachlorobutadiene | | 49.7 | | | |
| Lead | 25 (N) | | | | |
| Mercury | 0.025 | | | | |
| Nickel | 8.3 | | | | |
| Pesticides | | | | | |
| Aldrin | 0.003 | 0.000136 | | | |
| Chlordane | 0.004 | 0.000588 | | | |
| DDT | 0.001 | 0.000591 | | | |
| Demeton | 0.1 | | | | |
| Dieldrin | 0.0002 | 0.000144 | | | |
| Endosulfan | 0.009 | | | | |
| Endrin | 0.002 | | | | |
| Guthion | 0.01 | | | | |
| Heptachlor | 0.004 | 0.000214 | | | |
| Lindane | 0.004 | | | | |
| Methoxychlor | 0.03 | | | | |
| Mirex | 0.001 | | | | |
| Parathion | 0.178 | | | | |
| Toxaphene | 0.0002 | | | | |
| pH (units) | 6.8-8.5 | | | | (N)[3] |
| Phenolic compounds | | (N) | | | |
| Polychlorinated biphenyls[4] | 0.001 | 0.000079 | | | |
| Polynuclear aromatic hydrocarbons[5] | 0.0311 | | | | |
| Radioactive substances | | (N) | | | |
| Salinity | (N) | | | | |
| Selenium | 71 | | | | |
| Silver | 0.1 (AL) | | | | |
| Solids, total suspended (mg/l) | | | | 10 PNA, 20 other | |
| Solids, settleable (mg/l) | (N) | | | | |
| Temperature | (N) | | | | |
| Tetrachloroethane (1,1,2,2) | | 10.8 | | | |
| Toxic substances | (N) | | | (N) | |
| Trialkyltin | 0.002 | | | | |
| Trichloroethylene | | 92.4 | | | |
| Turbidity (NTU) | 25 (N) | | | | |
| Vinyl chloride | | 525 | | | |
| Zinc | 86 (AL) | | | | |

(AL) Values represent action levels as specified in 2B .0220(4).
(N) See 2B .0220 for narrative description of limits.
HQW - High Quality Waters, standards for HQW areas only.
Class SA - shellfishing waters see 2B .0101(d)(3) for description.
PNA - Primary Nursery Areas

1 Human health standards are based on consumption of fish only unless dermal contact studies are available. See 2B .0208 for equation.

2 MFFCC/100ml means membrane filter fecal coliform count per 100 ml of sample.

3 Designated swamp waters may have a dissolved oxygen less than 5.0 mg/l and a pH as low as 4.3. if due to natural conditions.

4 Applies to total PCBs present and includes PCB 1242, 1254, 1221, 1232, 1248, 1260, and 1016. See 2B .0208 & .0220.

5 Applies to total PAHs present and includes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene. See 2B .0208.

**.0201 ANTIDEGRADATION POLICY**

(a) It is the policy of the Environmental Management Commission to maintain, protect, and enhance water quality within the State of North Carolina. Pursuant to this policy, the requirements of 40 CFR 131.12 are hereby incorporated by reference including any subsequent amendments and editions. This material is available for inspection at the Department of Environment, Health, and Natural Resources, Division of Environmental Management, Water Quality Planning Branch, 512 North Salisbury Street, Raleigh, North Carolina. Copies may be obtained from the U.S. Government Printing Office, Superintendent of Documents, Washington, DC 20402-9325 at a cost of thirteen dollars ($13.00). These requirements will be implemented in North Carolina as set forth in Paragraphs (b), (c) and (d) of this Rule.

(b) Existing uses, as defined by Rule .0202 of this Section, and the water quality to protect such uses shall be protected by properly classifying surface waters and having standards sufficient to protect these uses. In cases where the Commission or its designee determines that an existing use is not included in the classification of waters, a project which will affect these waters will not be permitted unless the existing uses are protected.

(c) The Commission shall consider the present and anticipated usage of waters with quality higher than the standards, including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of waters with quality higher than the standards below the water quality necessary to maintain existing and anticipated uses of those waters. Waters with quality higher than the standards are defined by Rule .0202 of this Section. The following procedures will be implemented in order to meet these requirements:

(1) Each applicant for an NPDES permit or NPDES permit expansion to discharge treated waste will document an effort to consider non-discharge alternatives pursuant to 15A NCAC 2H .0105(c)(2).

(2) Public Notices for NPDES permits will list parameters that would be water quality limited and state whether or not the discharge will use the entire available load capacity of the receiving waters and may cause more stringent water quality based effluent limitations to be established for dischargers downstream.

(3) The Division may require supplemental documentation from the affected local government that a proposed project or parts of the project are necessary for important economic and social development.

(4) The Commission and Division will work with local governments on a voluntary basis to identify and develop appropriate management strategies or classifications for waters with unused pollutant loading capacity to accommodate future economic growth.

Waters with quality higher than the standards will be identified by the Division on a case-by-case basis through the NPDES permitting and waste load allocation processes (pursuant to the provisions of 15A NCAC 2H .0100). Dischargers affected by the requirements of Paragraphs (c)(1) through (c)(4) of this Rule and the public at large will be notified according to the provisions described herein, and all other appropriate provisions pursuant to 15A NCAC 2H .0109. If an applicant objects to the requirements to protect waters with quality higher than the standards and believes degradation is necessary to accommodate important social and economic development, the applicant can contest these requirements according to the provisions of General Statute 143-215.1(e) and 150B-23.

(d) The Commission shall consider the present and anticipated usage of High Quality Waters (HQW), including any uses not specified by the assigned classification (such as outstanding national resource waters or waters of exceptional water quality) and will not allow degradation of the quality of High Quality Waters below the water quality necessary to maintain existing and anticipated uses of those waters. High Quality Waters are a subset of waters with quality higher than the standards and are as described by 15A NCAC 2B .0101(e)(5). The procedures described in Rule .0224 of this Section will be implemented in order to meet the requirements of this part.

(e) Outstanding Resource Waters (ORW) are a special subset of High Quality Waters with unique and special characteristics as described in Rule .0225 of this Section. The water quality of waters classified as ORW shall be maintained such that existing uses, including the outstanding resource values of said Outstanding Resource Waters, will be maintained and protected.

*History Note: Authority G.S. 143-214.1; 143-215.1; 143-215.3(a)(1);*
*Eff. February 1, 1976;*
*Amended Eff. October 1, 1995; February 1, 1993; April 1, 1991; August 1, 1990.*

## .0223 NUTRIENT SENSITIVE WATERS

(a) In addition to existing classifications, the Commission may classify any surface waters of the state as nutrient sensitive waters (NSW) upon a finding that such waters are experiencing or are subject to excessive growths of microscopic or macroscopic vegetation. Excessive growths are growths which the Commission in its discretion finds to substantially impair the use of the water for its best usage as determined by the classification applied to such waters.

(b) NSW may include any or all waters within a particular river basin as the Commission deems necessary to effectively control excessive growths of microscopic or macroscopic vegetation.

(c) For the purpose of this Rule, the term "nutrients" shall mean phosphorous or nitrogen. When considering the assignment of this classification, the Commission may specify as a "nutrient" any other chemical parameter or combination of parameters which it determines to be essential for the growth of microscopic and macroscopic vegetation.

(d) Those waters additionally classified as nutrient sensitive shall be identified in the appropriate schedule of classifications as referenced in Section .0300 of this Subchapter.

(e) For the purpose of this Rule, the term "background levels" shall mean the concentration(s), taking into account seasonal variations, of the specific nutrient or nutrients upstream of a nutrient source.

(f) Quality standards applicable to NSW: no increase in nutrients over background levels unless it is shown to the satisfaction of the Director that the increase:

(1) is the result of natural variations; or

(2) will not endanger human health, safety or welfare and that preventing the increase would cause a serious economic hardship without equal or greater benefit to the public.

*History Note:* *Authority G.S. 143-214.1;*
*Eff. October 1, 1995.*

(e) Listing of Waters Classified ORW with Specific Actions. Waters classified as ORW with specific actions to protect exceptional resource values are listed as follows:

(1) Roosevelt Natural Area [White Oak River Basin, Index Nos. 20-36-9.5-(1) and 20-36-9.5-(2)] including all fresh and saline waters within the property boundaries of the natural area shall have only new development which complies with the low density option in the stormwater rules as specified in 15A NCAC 2H .1005(2)(a) within 575 feet of the Roosevelt Natural Area (if the development site naturally drains to the Roosevelt Natural Area).

(2) Chattooga River ORW Area (Little Tennessee River Basin and Savannah River Drainage Area): the following undesignated waterbodies that are tributary to ORW designated segments shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section. However, expansions of existing discharges to these segments shall be allowed if there is no increase in pollutant loading:
  - (A) North and South Fowler Creeks,
  - (B) Green and Norton Mill Creeks,
  - (C) Cane Creek,
  - (D) Ammons Branch,
  - (E) Glade Creek, and
  - (F) Associated tributaries.

(3) Henry Fork ORW Area (Catawba River Basin): the following undesignated waterbodies that are tributary to ORW designated segments shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section:
  - (A) Ivy Creek,
  - (B) Rock Creek, and
  - (C) Associated tributaries.

(4) South Fork New and New Rivers ORW Area [New River Basin (Index Nos. 10-1-33.5 and 10)]: the following management strategies, in addition to the discharge requirements specified in Subparagraph (c)(1) of this Rule, shall be applied to protect the designated ORW areas:
  - (A) Stormwater controls described in Subparagraph (c)(1) of this Rule shall apply within one mile and draining to the designated ORW areas;
  - (B) New or expanded NPDES permitted wastewater discharges located upstream of the designated ORW shall be permitted such that the following water quality standards are maintained in the ORW segment:
    - (i) the total volume of treated wastewater for all upstream discharges combined shall not exceed 50 percent of the total instream flow in the designated ORW under 7Q10 conditions;
    - (ii) a safety factor shall be applied to any chemical allocation such that the effluent limitation for a specific chemical constituent shall be the more stringent of either the limitation allocated under design conditions (pursuant to 15A NCAC 2B .0206) for the normal standard at the point of discharge, or the limitation allocated under design conditions for one-half the normal standard at the upstream border of the ORW segment;
    - (iii) a safety factor shall be applied to any discharge of complex wastewater (those containing or potentially containing toxicants) to protect for chronic toxicity in the ORW segment by setting the whole effluent toxicity limitation at the higher (more stringent) percentage effluent determined under design conditions (pursuant to 15A NCAC 2B .0206) for either the instream effluent concentration at the point of discharge or twice the effluent concentration calculated as if the discharge were at the upstream border of the ORW segment;
  - (C) New or expanded NPDES permitted wastewater discharges located upstream of the designated ORW shall comply with the following:
    - (i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD = 5 mg/l, and $NH_3$-N = 2 mg/l;
    - (ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 10 mg/l for trout waters and to 20 mg/l for all other waters;
    - (iii) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs;
    - (iv) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(5) Old Field Creek (New River Basin): the undesignated portion of Old Field Creek (from its source to Call Creek) shall comply with Paragraph (c) of this Rule in order to protect the designated waters as per Rule .0203 of this Section.

(6) In the following designated waterbodies, no additional restrictions shall be placed on new or expanded marinas. The only new or expanded NPDES permitted discharges that shall be allowed shall be non-domestic, non-process industrial discharges. The Alligator River Area (Pasquotank River Basin) extending from the source of the Alligator River to the U.S. Highway 64 bridge including New Lake Fork, North West Fork Alligator River, Juniper Creek, Southwest Fork Alligator River, Scouts Bay, Gum Neck Creek, Georgia Bay, Winn Bay, Stumpy Creek Bay, Stumpy Creek, Swann Creek (Swann Creek Lake), Whipping Creek (Whipping Creek Lake), Grapevine Bay, Rattlesnake Bay, The Straits, The Frying Pan, Coopers Creek, Babbitt Bay, Goose Creek, Milltail Creek, Boat Bay, Sandy Ridge Gut (Sawyer Lake) and Second Creek, but excluding the Intracoastal Waterway (Pungo River-Alligator River Canal) and all other tributary streams and canals.

(7) In the following designated waterbodies, the only type of new or expanded marina that shall be allowed shall be those marinas located in upland basin areas, or those with less than 30 slips, having no boats over 21 feet in length and no boats with heads. The only new or expanded NPDES permitted discharges that shall be allowed shall be non-domestic, non-process industrial discharges.

(A) The Northeast Swanquarter Bay Area including all waters northeast of a line from a point at Lat. 35• 23• 51• and Long. 76• 21• 02• thence southeast along the Swanquarter National Wildlife Refuge hunting closure boundary (as defined by the 1935 Presidential Proclamation) to Drum Point.

(B) The Neuse-Southeast Pamlico Sound Area (Southeast Pamlico Sound Section of the Southeast Pamlico, Core and Back Sound Area); (Neuse River Basin) including all waters within an area defined by a line extending from the southern shore of Ocracoke Inlet northwest to the Tar-Pamlico River and Neuse River basin boundary, then southwest to Ship Point.

(C) The Core Sound Section of the Southeast Pamlico, Core and Back Sound Area (White Oak River Basin), including all waters of Core Sound and its tributaries, but excluding Nelson Bay, Little Port Branch and Atlantic Harbor at its mouth, and those tributaries of Jarrett Bay that are closed to shellfishing.

(D) The Western Bogue Sound Section of the Western Bogue Sound and Bear Island Area (White Oak River Basin) including all waters within an area defined by a line from Bogue Inlet to the mainland at SR 1117 to a line across Bogue Sound from the southwest side of Gales Creek to Rock Point, including Taylor Bay and the Intracoastal Waterway.

(E) The Stump Sound Area (Cape Fear River Basin) including all waters of Stump Sound and Alligator Bay from marker Number 17 to the western end of Permuda Island, but excluding Rogers Bay, the Kings Creek Restricted Area and Mill Creek.

(F) The Topsail Sound and Middle Sound Area (Cape Fear River Basin) including all estuarine waters from New Topsail Inlet to Mason Inlet, including the Intracoastal Waterway and Howe Creek, but excluding Pages Creek and Futch Creek.

(8) In the following designated waterbodies, no new or expanded NPDES permitted discharges and only new or expanded marinas with less than 30 slips, having no boats over 21 feet in length and no boats with heads shall be allowed.

(A) The Swanquarter Bay and Juniper Bay Area (Tar-Pamlico River Basin) including all waters within a line beginning at Juniper Bay Point and running south and then west below Great Island, then northwest to Shell Point and including Shell Bay, Swanquarter and Juniper Bays and their tributaries, but excluding all waters northeast of a line from a point at Lat. 35• 23• 51• and Long. 76• 21• 02• thence southeast along the Swanquarter National Wildlife Refuge hunting closure boundary (as defined by the 1935 Presidential Proclamation) to Drum Point and also excluding the Blowout Canal, Hydeland Canal, Juniper Canal and Quarter Canal.

(B) The Back Sound Section of the Southeast Pamlico, Core and Back Sound Area (White Oak River Basin) including that area of Back Sound extending from Core Sound west along Shackleford Banks, then north to the western most point of Middle Marshes and along the northwest shore of Middle Marshes (to include all of Middle Marshes), then west to Rush Point on Harker's Island, and along the southern shore of Harker's Island back to Core Sound.

(C) The Bear Island Section of the Western Bogue Sound and Bear Island Area (White Oak River Basin) including all waters within an area defined by a line from the western most point on Bear Island to the northeast mouth of Goose Creek on the mainland, east to the southwest mouth of Queen Creek, then south to green marker No. 49, then northeast to the northern most point on Huggins Island, then southeast along the shoreline of Huggins Island to the southeastern most point of Huggins Island, then south to the northeastern most point on Dudley Island, then southwest along the shoreline of Dudley Island to the eastern tip of Bear Island.

(D) The Masonboro Sound Area (Cape Fear River Basin) including all waters between the Barrier Islands and the mainland from Carolina Beach Inlet to Masonboro Inlet.

(9) Black and South Rivers ORW Area (Cape Fear River Basin) [Index Nos. 18-68-(0.5), 18-68-(3.5), 18-68-(11.5), 18-68-12-(0.5), 18-68-12-(11.5), and 18-68-2]: the following management strategies, in addition to the discharge requirements specified in Subparagraph (c)(1) of this Rule, shall be applied to protect the designated ORW areas:

(A) Stormwater controls described in Subparagraph (c)(1) of this Rule shall apply within one mile and draining to the designated ORW areas;

(B) New or expanded NPDES permitted wastewater discharges located one mile upstream of the stream segments designated ORW (upstream on the designated mainstem and upstream into direct tributaries to the designated mainstem) shall comply with the following discharge restrictions:

(i) Oxygen Consuming Wastes: Effluent limitations shall be as follows: BOD = 5 mg/l and NH3-N = 2 mg/l;

(ii) Total Suspended Solids: Discharges of total suspended solids (TSS) shall be limited to effluent concentrations of 20 mg/l;

(iii) Emergency Requirements: Failsafe treatment designs shall be employed, including stand-by power capability for entire treatment works, dual train design for all treatment components, or equivalent failsafe treatment designs;

(iv) Nutrients: Where nutrient overenrichment is projected to be a concern, appropriate effluent limitations shall be set for phosphorus or nitrogen, or both.

(v) Toxic substances: In cases where complex discharges (those containing or potentially containing toxicants) may be currently present in the discharge, a safety factor shall be applied to any chemical or whole effluent toxicity allocation. The limit for a specific chemical constituent shall be allocated at one-half of the normal standard at design conditions. Whole effluent toxicity shall be allocated to protect for chronic toxicity at an effluent concentration equal to twice that which is acceptable under flow design criteria (pursuant to 15A NCAC 2B .0206).

*History Note:* *Authority G.S. 143-214.1;*
*Eff. October 1, 1995;*
*Amended Eff. April 1, 1996; January 1, 1996*

# APPENDIX II

DWQ Water Quality Monitoring Programs:

- Benthic Macroinvertebrate Sampling
- Fisheries Studies
- Lakes Assessment
- Effluent Toxicity Testing

## A - II.1 BENTHIC MACROINVERTEBRATES

*Freshwaters*

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 in freshwater systems, and polychaetes, crustacea, and mollusks in estuarine systems. The use of benthos data has proven to be a reliable monitoring tool, as benthic macroinvertebrates are sensitive to subtle changes in water quality. The benthic community also integrates the effects of a wide array of potential pollutant mixtures. Criteria have been developed for freshwater to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera, and Trichoptera (EPT S). Higher taxa richness values are associated with better water quality. Likewise, ratings can be assigned with a Biotic Index. This index summarizes tolerance data for all taxa in each collection. The two rankings are given equal weight in final site classification for qualitative samples. Taxa richness alone is used to assign bioclassifications for EPT samples. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis. Different criteria have been developed for different ecoregions (mountains, piedmont, and coastal) within North Carolina. Criteria are being developed for estuarine benthos samples, but at the present time estuarine samples cannot be given a water quality evaluation.

Classification Criteria by Ecoregion*

A. EPT taxa richness values

| | 10-sample Qualitative Samples | | | 4-sample EPT Samples | | |
|---|---|---|---|---|---|---|
| | Mountains | Piedmont | Coastal | Mountains | Piedmont | Coastal |
| Excellent | >41 | >31 | >27 | >35 | >27 | >23 |
| Good | 32-41 | 24-31 | 21-27 | 28-35 | 21-27 | 18-23 |
| Good-Fair | 22-31 | 16-23 | 14-20 | 19-27 | 14-20 | 12-17 |
| Fair | 12-21 | 8-15 | 7-13 | 11-18 | 7-13 | 6-11 |
| Poor | 0-11 | 0-7 | 0-6 | 0-10 | 0-6 | 0-5 |

B. Biotic Index Values (Range = 0-10)

| | Mountains | Piedmont | Coastal |
|---|---|---|---|
| Excellent | <4.05 | <5.19 | <5.47 |
| Good | 4.06-4.88 | 5.19-5.78 | 5.47-6.05 |
| Good-Fair | 4.89-5.74 | 5.79-6.48 | 6.06-6.72 |
| Fair | 5.75-7.00 | 6.49-7.48 | 6.73-7.73 |
| Poor | >7.00 | >7.48 | >7.73 |

*These criteria apply to flowing water systems only. Biotic index criteria are only used for full-scale (10-sample) qualitative samples.

*Saltwaters*

The effort to develop a method to assess water quality based on estuarine macroinvertebrates started in North Carolina in late 1990. By 1992, several standard methods of sampling and data analysis had been tested and found to be inadequate for North Carolina waters. In 1993, it was demonstrated that an Estuarine Biotic Index designed for Florida could also be used in North Carolina to accurately rank sites of varying water quality. It was also shown that sampling by epibenthic trawl was more effective at ranking sites than infaunal sampling with a petite ponar. Even so, using the Florida Estuarine Biotic Index (FEBI) on ponar-collected data was found to yield accurate results more often than not and more consistently than any other metric tested. It was also found that another Florida sampling technique, a semi-quantitative timed sweep, yielded results comparable to our historical samples, so a change in methods would not necessarily nullify previous estuarine work. Sampling for long term databases after December 1993 used the semi-quantitative sweep.

In 1994, further use of this semi-quantitative sweep method and FEBI suggested that they might also be useful at low salinities. A separate test in 1994 suggested that the FEBI was the only one of 17 metrics to accurately rank variably impacted sites for each of three sampling methods (petite ponar, epibenthic trawl, semi-quantitative sweep). Additionally, it was found that for semi-quantitative sweeps, the metrics Total taxa (S) and Amphipoda and Caridian shrimp (A+) taxa could also correctly rank the sites. In an early attempt at biocriteria development, it appeared that in high salinity waters, Total taxa (S), Biotic Index (BI), and Amphipoda and Caridian shrimp (A+) were most useful for delineating the highest quality areas.

These observations were confirmed with additional sampling during which it was also found that the metrics % Crustacean taxa and % Spionid and Capitellid polychaete taxa correctly ranked petite ponar samples 75% of the time. The FEBI was modified to create the North Carolina Estuarine Biotic Index (EBI) which more closely reflects taxa and tolerances in North Carolina.

## A - II.2 FISHERIES

*Fish Communtiy Structure Assessment*

The North Carolina Index of Biotic Integrity (NCIBI) is a modification of the Index of Biotic Integrity (Karr, 1981; Karr et al., 1986). The method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not necessarily directly correlate to water quality. A stream with excellent water quality, but poor to fair habitat would not rate excellent in this index; however, a stream which rates excellent on the NCIBI would be expected to have excellent water quality. The NCIBI is not applicable to high elevation trout streams, lakes, or estuaries.

The Index incorporates information about species richness and composition, trophic composition, fish abundance, and fish condition. The NCIBI summarizes the effects of all classes of factors influencing aquatic faunal communities (water quality, energy source, habitat quality, flow regime, and biotic interactions). The assessment of biological integrity using the NCIBI is provided by the cumulative assessment of 12 parameters, or metrics. While any change in a fish community can be caused by many factors, certain aspects of the community are generally more responsive to specific influences. Species composition measurements reflect habitat quality effects. Information on trophic composition reflects the effect of biotic interactions and energy supply. Fish abundance and condition information indicates additional water quality effects. It should be noted, however, that these responses may overlap. For example, a change in fish abundance may be due to decreased energy supply or a decline in habitat quality, not necessarily a change in water quality.

NCIBI scores and integrity classes are presented in Tables A-II.1 and A-II.2.

Table A-II.1 <u>NCIBI Scores and Integrity Classes</u>

| | |
|---|---|
| Excellent | 58-60 |
| Good-Excellent | 53-57 |
| Good | 48-52 |
| Fair-Good | 45-47 |
| Fair | 40-44 |
| Poor-Fair | 35-39 |
| Poor | 28-34 |
| Very Poor - Poor | 23-27 |
| Very Poor | 12-22 |
| No Fish | |

Classes listed above, but not below, have attributes of two classes.

Table A-II.2 **NCIBI Integrity Classes and attributes of those classes** (modified from Karr et al., 1986)

| Integrity Class | Attributes |
|---|---|
| Excellent | Comparable to the best situations without human disturbance; all regionally expected species for the habitat and stream size, including the most intolerant forms, are present with a full array of size classes; balanced trophic structure. |
| Good | Species richness somewhat below expectation, especially due to the loss of the most intolerant forms; some species are present with less than optimal abundances or size distributions; trophic structure shows some signs of stress. |
| Fair | Signs of additional deterioration include loss of intolerant forms, fewer species, highly skewed trophic structure. |
| Poor | Dominated by omnivores, tolerant forms, and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; diseased fish often present. |
| Very poor | Few fish present, mostly introduced or tolerant forms, disease fin damage and other anomalies regular |
| No fish | Repeated sampling finds no fish. |

Streams with larger watersheds or drainage areas are expected to support more fish species and a larger number of fish.

*Fish TIssue*

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Contamination of aquatic resources, including freshwater, estuarine, and marine fish and shellfish species, have been documented for heavy metals, pesticides, and other complex organic compounds. Once these contaminants reach surface waters, they may be available for bioaccumulation either directly or through aquatic food webs and may accumulate in fish and shellfish tissues. Results from fish tissue monitoring can serve as an important indicator of further contamination of sediments and surface water.

Fish tissue analysis results are used as indicators for human health concerns, fish and wildlife health concerns, and the presence and concentrations of various chemicals in the ecosystem.

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels, U. S. Environmental Protection Agency (EPA) recommended screening values, and criteria adopted by the North Carolina Division of Epidemiology.

The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs and thus employ a "safe level" approach to fish tissue consumption. A list of fish tissue analytes accompanied by their FDA criteria are presented below. At present, the FDA has only developed metals criteria for mercury. Individual parameters which appear to be of potential human health concern are evaluated by the North Carolina Division of Epidemiology by request of the Water Quality Section.

## Food and Drug Administration (FDA) Action Levels

**Metals**

| | | | |
|---|---|---|---|
| Mercury | 1.0 ppm | | |

**Organics**

| | | | |
|---|---|---|---|
| Aldrin | 0.3 ppm | o,p DDD | 5.0 ppm |
| Dieldrin | 0.3 ppm | p,p DDD | 5.0 ppm |
| Endrin | 0.3 ppm | o,p DDE | 5.0 ppm |
| Methoxychlor | None | p,p DDE | 5.0 ppm |
| Alpha BHC | None | o,p DDT | 5.0 ppm |
| Gamma BHC | None | p,p DDT | 5.0 ppm |
| PCB-1254 | 2.0 ppm | cis-chlordane | 0.3 ppm |
| Endosulfan I | None | trans-chlordane | 0.3 ppm |
| Endosulfan II | None | Hexachlorobenzene | None |

In the guidance document, Fish Sampling and Analysis: Volume 1 (EPA823-R-93-002), the EPA has recommended screening values for target analytes which are formulated from a risk assessment procedure. EPA screening values are the concentrations of analytes in edible fish tissue that are of potential public health concern. The DEM compares fish tissue results with EPA screening values to evaluate the need for further intensive site specific monitoring. A list of target analytes and EPA recommended screening values for the general adult population is presented below.

The North Carolina Division of Epidemiology has adopted a selenium limit of 5 ppm for issuing fish consumption advisories. Total DDT includes the sum of all its isomers and metabolites (i.e. p,p DDT, o,p DDT, DDE, and DDD). Total chlordane includes the sum of cis-and trans- isomers as well as nonachlor and oxychlordane. Although the EPA has suggested a screening value of 7.0 x 10-7 ppm for dioxins, the State of North Carolina currently uses a value of 3.0 ppt in issuing fish consumption advisories.

## Environmental Protection Agency (EPA) Screening Values

**Metals**

| | |
|---|---|
| Cadmium | 10.0 ppm |
| Mercury | 0.6 ppm |
| Selenium | 50.0 ppm |

**Organics**

| | |
|---|---|
| Chlorpyrifos | 30.0 ppm |
| Total chlordane | 0.08 ppm |
| Total DDT | 0.3 ppm |
| Dieldrin | 0.007 ppm |
| Dioxins | $7.0 \times 10^{-7}$ ppm |
| Endosulfan (I and II) | 20.0 ppm |
| Endrin | 3.0 ppm |
| Heptachlor epoxide | 0.01 ppm |
| Hexachlorobenzene | 0.07 ppm |
| Lindane | 0.08 ppm |
| Mirex | 2.0 ppm |
| Total PCB's | 0.01 ppm |
| Toxaphene | 0.1 ppm |

Results of fish tissue analyses for the Chowan River Basin have been presented in Chapter 4.

## A - II.3 LAKES ASSESSMENT PROGRAM

Lakes are valued for the multitide of benefits they provide to the public, including recreational boating, fishing, drinking water, and aesthetic enjoyment. The North Carolina Lake Assessment Program seeks to protect these waters through monitoring, pollution prevention and control, and restoration activities. Assessments have been made at all publicly accessible lakes, lakes which supply domestic drinking water, and lakes (public or private) where water quality problems have been observed. Data are used to determine the trophic state (a relative measure of nutrient enrichment and productivity) of each lake, and whether the designated uses of the lake have been threatened or impaired by pollution.

Tables presented in each subbasin summarize data used to determine the trophic state and use support status of each lake. These determinations are based on information from the most recent summertime sampling (date listed). The most recent North Carolina Trophic State Index (NCTSI) value is shown followed by the descriptive trophic state classification (O=oligotrophic, M=mesotrophic, E=eutrophic, H=hypereutrophic, D=dystrophic).

Numerical indices are often used to evaluate the trophic state of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NCDNRCD, 1982). The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll-a (CHL in µg/l). Lakewide means for these parameters are manipulated to produce a NCTSI score for each lake using the following equations:

$$\text{TON score} = \frac{\text{Log(TON)} + (0.45)}{0.24} \times 0.90$$

$$\text{TP score} = \frac{\text{Log(TP)} + (1.55)}{0.35} \times 0.92$$

$$\text{SD score} = \frac{\text{Log(SD)} - (1.73)}{0.35} \times -0.82$$

$$\text{CHL score} = \frac{\text{Log(CHL)} - (1.00)}{0.43} \times 0.83$$

$$\text{NCTSI} = \text{TON score} + \text{TP score} + \text{SD score} + \text{CHL score}$$

In general, NCTSI scores relate to trophic classifications as follows: less than -2.0 is oligotrophic, -2.0 to 0.0 is mesotrophic, 0.0 to 5.0 is eutrophic, and greater than 5.0 is hypereutrophic. When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores may be skewed by highly colored water typical of dystrophic lakes. Some variation in the trophic state of a lake between years is not unusual due to the potential variability of data collections which usually involve sampling on a single day during the growing season. This survey methodology does not adequately evaluate changes which might occur throughout the year between lake samplings. More intensive (monthly) monitoring is required to identify lake specific variability. However, monitoring a lake once per growing season does provide a relatively valuable assessment of water quality conditions on a large number of lakes.

Lakes are classified for their "best usage" and are subject to the state's water quality standards. Primary classifications are C (suited for aquatic life propagation/protection and secondary recreation such as wading), B (primary recreation, such as swimming, and all class C uses), and WS-I through WS-V(water supply source ranging from highest watershed protection level I to lowest watershed protection V, and all class C uses). Lakes with a CA designation represent water supplies with watersheds that are considered to be Critical Areas (i.e., an area within 1/2 mile and draining to water supplies from the normal pool elevation of reservoirs, or within 1/2 mile and draining to a river intake). Supplemental classifications in the New Fear River basin may include SW (slow moving Swamp Waters where certain water quality standards may not be applicable), NSW (Nutrient Sensitive Waters subject to excessive algal or other plant growth where nutrient controls are required), HQW (High Quality Waters which are rated excellent based on biological and physical/chemical characteristics), and ORW (Outstanding Resource Waters which are unique and special waters of exceptional state or national recreational or ecological value). A complete listing of these water classifications and standards can be found in Title 15 North Carolina Administrative Code, Chapter 2B, Section .0100 and .0200.

The summary tables presented within the body of this document list lakewide averages of total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), chlorophyll *a* (CHLA in µg/l), and Secchi depth, followed by surface water classification. Causes of use impairment are explained below each table. Algal Growth Potential Tests (AGPT) have not been conducted on these lakes. Merchants Millpond in Subbasin 030501 is the only lake which has been monitored in the Chowan River Basin as part of the Lakes Assessment Program. This lake was sampled most recently in 1995 and is discussed in detail in Chapter 4.

## A-II.4 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 by their NPDES permit or by administrative letter. Other facilities may be tested by DEM's Aquatic Toxicology Laboratory. The Aquatic Survey andToxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DEM administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

# APPENDIX III

Modeling Information

# Modeling Information

## INTRODUCTION

In order to assess the impact of pollutants on surface water quality, the Division must often develop and apply water quality models. A water quality model is a simplified representation of the physical, chemical, and biological processes which occur in a water body. The type of model used is dependent on the purpose for which it is needed, the amount of information that is available or attainable for its development, and the degree of accuracy or reliability that is warranted. In most cases, the Division develops and applies a given model to predict the response of the system to a given set of inputs that reflect various management strategies. For example, water quality models such as QUAL2E or the Division's Level B model are used to predict what the instream dissolved oxygen concentration will be under various sets of NPDES wasteflows and discharge limits. The following sections briefly summarize the types of models used by the Division.

### Oxygen-Consuming Waste Models

Several factors are considered when choosing an oxygen-consuming waste model including: the type of system (stream, lake, or estuary), whether one, two, or three dimensions are needed, the temporal resolution needed, and the type of data available. Many of the factors are related. For example, in streams, flow usually occurs in one direction and one can assume that a steady state model will result in adequate predictions. A steady state model is one in which the model inputs do not change over time. However, in open water estuaries, the tide and wind affect which way water moves, and they must often be represented by 2 or 3 dimensional models. In addition, the wind and tide can affect the model reaction rates, and therefore a dynamic model must be used rather than one which is steady state. The last factor, the amount of data available, dictates whether an empirical or calibrated model will be used. An empirical model is used when little water quality information is available for a given water body, and hydraulics and decay rates are estimated through the use of equations. For example, in North Carolina's empirical stream model (referred to as a Level B analysis) velocity is determined through a regression equation developed from North Carolina stream time-of-travel (TOT) studies which includes stream slope and flow estimates as independent variables. Stream slope can be measured from a topographic map, and flow is estimated at a given site by the U.S. Geological Survey. Therefore, the empirical model can be run without TOT information specific to a given stream since parameters are estimated through the use of information which can easily be obtained in the office environment. More information regarding the empirical dissolved oxygen model used by DEM can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Field calibration of a BOD/DO model requires collection of a considerable amount of data. For example, in order to develop hydraulics equations specific to a given stream, TOT studies using rhodamine dye are recommended under at least two flow scenarios including one summer low flow period. In addition, during one summer low flow study, dissolved oxygen, temperature, long term BOD and nitrogen series data are collected. Sediment oxygen demand (SOD) data may also be collected. These data are then used to calibrate reaction rates specific to the stream. QUAL2E is the most commonly used calibrated DO/BOD model for streams in North Carolina. A copy of the model guidance can be obtained from EPA's Environmental Research Lab in Athens, Georgia, and further information on North Carolina's calibration procedures can be found in the Instream Assessment Unit's Standard Operating Procedures Manual.

Data collection for an estuary DO model is even more extensive. Since the system is multi-dimensional and not steady-state, many more data are needed. Dye is often injected into a system over a period of time, and the dye cloud is then followed for a period of time which may last for days. In addition, several tide gages may need to be set up. Due to the stratification which occurs in an estuary, depth integrated data must also be collected. Calibrated estuary models which have been used by DEM include WASP and GAEST. WASP is also supported by EPA, and a user manual may be obtained from them. You should note that both GAEST is a one dimensional and is not applicable to many of North Carolina's estuaries.

Lakes are rarely modeled for BOD. Tributary arms of lakes are modeled as slow-moving streams if it is clearly indicated that the flow goes in one direction at all times. Depending on the system, a one, two, or three dimensional model may be used. If a one dimensional model is needed, the modeler may choose the Level B (if little or no data), or QUAL2E. In multidimensional lake systems, WASP will be used.

The calibrated model will be more accurate than the empirical model since it is based on data collected specifically for a given stream in the State. However, it is much more expensive to develop a calibrated model. Not only do a number of staff spend several days to weeks collecting field data (sometimes having to wait months for appropriate conditions), but it also takes the modeling staff several months to develop and document the calibrated model. An empirical model can be developed and applied in a matter of hours. Therefore, due to resource constraints, the majority of the BOD/DO models developed in North Carolina are empirical.

**Eutrophication Models**

Eutrophication models are used to develop management strategies to control trophic response of a system to nutrient inputs (usually total phosphorus (TP) or total nitrogen (TN)). Nutrient management strategies are typically needed in areas which are sensitive to nutrient inputs due to long residence times, warm temperature, and adequate light penetration. These characteristics are found in deep slow moving streams, ponds, lakes, and estuaries. Modeling and insitu research are used to relate nutrient loading to the trophic response to the system allowing the manager to establish nutrient targets. Models which may be used include the Southeastern Lakes Model (Reckhow, 1987), Walker's Bathtub Model (Walker, 1981), QUAL2E, and WASP.

Once the nutrient targets are known, watershed nutrient budgets are developed to evaluate the relative nutrient loadings from various point and nonpoint sources. Land use data are obtained for the basin, and export coefficients based on literature values are applied to each land use. An export coefficient is an estimate of how may pounds of nutrient will runoff from each acre of land in a given year.

**Toxics Modeling**

Toxics modeling is done to determine chemical specific limits which will protect to the "no chronic" level in a completely mixed stream. The standards developed for the State of North Carolina are based on chronic criteria. These chemical specific toxics limits are developed through the use of mass balance models:

(Cup)(Qup) + (Cw)(Qw) = (Cd)(Qd) where

Cup = concentration upstream
Qup = flow upstream
Cw = concentration in wastewater
(known being solved for in WLA)
Qw = wasteflow

Cd = concentration downstream
(set = to standard or criteria)
Qd = flow downstream (= Qup + Qw)

When no data are available concerning the upstream concentration, it is assumed to be equal to zero. The upstream flow is the 7Q10 at the discharge point unless the parameter's standard is based on human health concerns, in which case the average flow is used.

**REFERENCES CITED - MODELING APPENDIX**

Reckhow, K. H., 1987. "A Cross-Sectional Analysis of Trophic State Relationships in Southeastern Lakes." Duke University School of Forestry and Environmental Studies, Durham, N.C.

Walker, W. W., Jr. 1981. "Empirical Methods for Predicting Eutrophication in Impoundments," Technical Report E-81-9, prepared by William W. Walker, Jr., Environmental Engineer, Concord, Mass., for the U.S. Army Engineer Waterways Experiment Station, CE, Vicksburg, Miss.

# APPENDIX IV

## STATUS OF THE IMPLEMENTATION OF THE WATER QUALITY RECOMMENDATIONS CONTAINED IN THE COMPREHENSIVE CONSERVATION AND MANAGEMENT PLAN

# IMPLEMENTATION of the CCMP:
## Summary of the CCMP's Water Quality Plan for the Chowan River Basinwide Management Plan

## WATER QUALITY PLAN

**GOAL: Restore, maintain or enhance water quality in the Albemarle-Pamlico region so that it is fit for fish, wildlife and recreation.**

**OBJECTIVE A: IMPLEMENT A COMPREHENSIVE BASINWIDE APPROACH TO WATER QUALITY MANAGEMENT.**

Effective management of water resources ultimately relies on the consideraton of system-wide processes and the cumulative impacts of activities across a river basin. The Division of Water Quality is approaching water quality research, management, and discharge permitting from a basinwide scale. This approach allows for a better balancing of point and nonpoint source contributions and control strategies.

**Management Action 1: Develop and begin implementing basinwide plans to protect and restore water quality in each basin according to the schedule established by the Division of Environmental Management's Water Quality Section. The plans would include provisions for basinwide wetland protection and restoration.**

The Division of Water Quality (DWQ) continues to develop basinwide management plans for all seventeen major river basins in the state according to schedule. DWQ coordinates with appropriate state and federal agencies to develop comprehensive basinwide plans that provide mechanisms to characterize water quality and biological resources within basins, target problematic watersheds, and manage water resources to support long-term growth. DWQ is currently incorporating wetland protection initiatives and targeting sites for wetland restoration, whenever wetland inventories are available, into the basinwide water quality management plans. This initiative began with the Roanoke River Basin Plan and has been incorporated in the Chowan River Basin Plan. This effort will become more comprehensive as additional wetland resource information is developed.

**Management Action 2: Establish total maximum daily loads (TMDLs) and associated control strategies for all impaired streams in the Albemarle-Pamlico region by 1999.**

DWQ uses TMDLs (total maximum daily loads) as a strategy for establishing water quality based controls on point and nonpoint sources of a given pollutant identified as contributing to a waterbody's impairment. TMDLs for exact locations are completed each time the DWQ performs a Waste Load Allocation for a NPDES permit. There are approximately 2000 of these completed for state waters at this time. The basinwide water quality management plans developed by the Division of Water Quality, contains information on specific and general TMDLs located in each respective river basin.

General TMDLs for specific water quality parameters have been completed for many locations. An example is the total nitrogen control target established for the Chowan River Basin.

**<u>Management Action 3</u>: Renew all discharge permits in a river basin simultaneously by 1999.**

DWQ's scheduled basinwide plans allow for synchronous renewal of discharge permits within respective river basins of the state. Under this approach, a basinwide NPDES permitting cycle was established in 1990. This is part of the basinwide management process currently underway in the Chowan River Basin. In January 1998, all NPDES permits will be issued to dischargers within this river basin. All NPDES permit renewals in the Albemarle-Pamlico region will be handled in this manner by 1999.

**<u>Management Action 4</u>: Consider the potential for long-term growth and its impacts when determining how a basin's assimilative capacity will be used.**

Integrating point and nonpoint source pollution controls and determining the amount and location of the remaining assimilative capacity in a basin are key long-term objectives of basinwide management. The information can be used for a number of purposes including determining if and where new or expanded municipal or industrial wastewater treatment facilities can be allowed; setting the recommended treatment level at these facilities; and identifying where point and nonpoint source pollution controls must be implemented to restore capacity and maintain water quality standards.

Wasteload allocations (WLAs) are performed by DWQ using models of varying scope and complexity, depending on the type of waste of interest and the characteristics of the receiving waters. DWQ uses models to determine the fate and transport of pollutants, reduction goals for point and nonpoint sources of environmental contaminants, and to derive effluent limits for NPDES permits. For new dischargers or for expanding dischargers, DWQ utilizes models to determine the existing assimilative capacity for that waterbody.

**<u>Management Action 5</u>: Improve the scientific models for understanding the estuarine system, the effects of human activities on the system and the viability of alternative management strategies.**

DWQ is working to enhance scientific modeling capabilities in the Neuse River Basin. The goal of the current Neuse River Basin modeling efforts is to provide tools to assist with efforts to determine appropriate and effective nitrogen control measures that will protect water quality in the Neuse River Estuary. To achieve this goal, three major modeling efforts are underway. Land Use Models will be used with point source discharge data to estimate total nitrogen loading to the river basin. A Fate and Transport Model will then be used to estimate how much of the total nitrogen load will arrive at the Estuary. And finally, a Nutrient Response Model will be used to predict how changes in nitrogen loading will impact water quality. Perhaps the information resulting from this modeling effort can be applied in the Chowan River Basin to enhance our understanding of that system.

<u>Management Action 6</u>: **Continue long-term, comprehensive monitoring of water quality in the APES system, collecting data to assess general system health and target regional problems.**

DWQ's water quality monitoring programs continue to monitor water quality through a network of fixed stations within the Chowan River Basin. DWQ's monitoring program integrates biological, chemical, and physical data assessment to provide information for basinwide planning. DWQ has also benefitted from data collected by the US Geological Survey under that agency's NAWQUA water quality sampling program.

The Albemarle-Pamlico Citizen Water Quality Monitoring Program, a volunteer effort established in 1987, has also contributed to water quality monitoring efforts in the Chowan Basin. Currently, there are eight sites (predominately located near Arrowhead Beach) being monitored by citizens in this basin.

## OBJECTIVE B: REDUCE SEDIMENTS, NUTRIENTS AND TOXICANTS FROM NONPOINT SOURCES.

Nonpoint sources of pollution are varied and are usually difficult to regulate. Targeted reductions can be accomplished by building on present programs and efforts. To accomplish true reductions, the CCMP recommends a three-pronged approach consisting of research and demonstration projects, incentive-based programs, and regulatory action and enforcement.

<u>Management Action 1</u>: **For each river basin, develop and implement a plan to control nonpoint source pollution as part of the basinwide management plans.**

A river basin nonpoint source team has been established for the Chowan River Basin. The nonpoint source team will work toward creating Action Plans to address nonpoint source concerns for the Chowan River Basin. The Action Plans will be an integral part of the basinwide planning process being implemented by DWQ.

<u>Management Action 2</u>: **Expand funding to implement nonpoint source pollution controls, particularly agricultural best management practices through the N.C. Agriculture Cost Share Program, and also to develop a broader Water Quality Cost Share Program. Expand the cost share programs to include wetlands restoration. Increase cost share funds to problem areas.**

The 1996 NC General Assembly increased the amount of money available to farmers under the NC Agriculture Cost Share Program by $1,750,000 for the Neuse River Basin and an additional $5,750,000 for the remaining river basins of the state. The Division of Soil & Water Conservation (DSWC) and Soil & Water Conservation Districts will target funding and technical assistance to priority areas identified through the basinwide nonpoint source control plans. DSWC has hired additional personnel to provide technical assistance to farmers in implementing BMPs to control runoff.

Though it is not considered a cost share program, the General Assembly has recently approved the establishment of a Wetlands Restoration Program within the state. With initial funding of over $9 million, this program is intended to help restore the functions and values to degraded wetland areas located across the state.

**<u>Management Action 3</u>: Continue to research and develop alternative septic systems and new best management practices to reduce nonpoint source pollution.**

Failing septic tanks have been identified as a source of fecal coliform bacteria in some surface waters of the Chowan River Basin. The Division of Environmental Health (DEH) has established a research/education facility in Chatham County to determine the effectiveness of alternative septic systems and to train personnel regarding the installation, maintenance, and repair of the various types of systems. DEH plans to establish similar sites near Asheville (mountains) and Plymouth (coastal plain) that would facilitate efforts by the On-site Wastewater Section to develop and demonstrate alternative septic systems under a variety of site and soil conditions.

BMPs for urban, agricultural, and forestry settings have been evaluated for their cost-effectiveness in controlling nutrients. Much emphasis is placed on nutrient management planning and controlled drainage as important BMPs used to control nutrients. Several projects have recently received funding to improve knowledge of effectiveness of various traditional and innovative BMPs in improving water quality.

**<u>Management Action 4</u>: Strengthen current enforcement to detect and correct ground and surface water quality violations from nonpoint sources.**

The NC General Assembly (summer 1995) approved eight new positions (three for Use Restoration Waters; five for animal operations) to enhance inspection and enforcement of DWQ's surface water and ground water protection efforts.

**<u>Management Action 5:</u> Strengthen implementation of forestry best management practices through training, education, technical assistance and enforcement.**

The Division of Forest Resources (DFR) received limited, temporary funding to hire three BMP foresters statewide. This funding occurred in FY 1994-95 and 1995-96. These temporary positions were used to provide on-the-ground training, classroom education, technical assistance, and enforcement efforts. The need to hire permanent water quality (BMP) foresters exists statewide as well as in the five DFR districts which encompass the Albemarle-Pamlico region .

The DFR examined 3318 tracts statewide for FPG/BMP compliance in FY 1995-96. Of the 192 initially in a non-compliance status, nine had to be referred to either the Division of Land Resources or Division of Water Quality for enforcement action.

In a joint statewide educational effort, the DFR, the NC Forestry Association, the Cooperative Extension Service and forest industry have worked to provide forest management and water quality protection training to more than 1550 loggers and timber buyers through the ProLogger Program.

<u>Management Action 6</u>: **Enhance stormwater runoff control by strengthening existing regulations and developing new ones, if needed, by 1995. Improve enforcement to ensure that stormwater management systems are properly installed and regularly maintained.**

The Chowan River Basin is predominately a rural watershed. Presently, urban development in the basin is relatively limited. There are no municipalities in the Chowan River Basin required to obtain permits to manage stormwater runoff within their jurisdiction. Also within this basin, various types of industrial activities with point source discharges of stormwater are required to be permitted under the NPDES stormwater program.

<u>Management Action 7</u>: **Implement an inter-agency state policy that addresses marina siting and integrates best management practices through permitting and better public education.**

The current permitting process allows for inter-agency coordination for the review of new marina permits. However, there has been no formal organization of an inter-agency marinas policy committee to address the cumulative impacts of marina sittings in the coastal zone as referred to in this management action.

The Division of Coastal Management (DCM) has geo-located all marina and dockage facilities throughout the coastal area. GIS information include size, number of wet and dry slips, services, and support facilities. In addition to this information being made available to local governments for land use planning purposes, staff are using it to assess cumulative and secondary impacts of proposed new marinas and additions. DCM has also worked to develop a coordinated SEPA review and public trust lease review for all marinas with the Division of Water Quality, the Division of Marine Fisheries, the Wildlife Resources Commission and other state agencies.

To strengthen marina BMPs, DCM (via a grant from The Clean Vessel Act) provided funding to marina operators to install pump-out stations at their facilities. In 1995, 24 marinas were equipped with pump-out stations -- 12 of these marinas were located in the Albemarle-Pamlico region. This initiative continued through 1996.

## OBJECTIVE C: REDUCE POLLUTION FROM POINT SOURCES, SUCH AS WASTEWATER TREATMENT FACILITIES AND INDUSTRY.

In addition to the reduction of point source impacts gained through the utilization of basinwide management planning, the CCMP indicates that further gains can be made through the use of proactive management strategies such as pollution prevention and increased emphasis on facility inspections and monitoring.

<u>Management Action 1</u>: **Promote pollution prevention planning and alternatives to discharge, where feasible, for all point sources to reduce the volume and toxicity of discharges.**

All of the state's major municipal dischargers, and most of the minor municipal dischargers, utilize pretreatment programs. There is increased coordination between the Office of Waste Reduction's Pollution Prevention Program and DWQ's Pretreatment Program to help reduce/improve inputs and operating costs from point source dischargers.

However, there is a need to improve pretreatment of the industrial wastes received by the wastewater treatment plants and to encourage pollution prevention at the various industrial facilities located in the Chowan River basin.

Municipal or industrial wastewater facilities are required to either land apply their waste (for municipal plants) or meet discharge limits for nitrogen and phosphorus. During the last fifteen years, several facilities in the Chowan River basin have removed their discharge to surface waters and began applying their waste to the land. These conversions have been instrumental in reducing the nutrient load to the nutrient-enriched Chowan River system.

<u>Management Action 2</u>: **Expand and strengthen enforcement of National Pollutant Discharge Elimination System (NPDES) permits. Increase site inspections and review of self-monitoring data to improve facility compliance by 1995.**

A future initiative (as identified in this plan) for the Chowan River basin is to improve compliance with permitted dischargers. However, in order to be more proactive in preventing permit violations and resulting water quality degradation, DWQ's Compliance Group requires more staff for review of monitoring data and for conducting inspections. Increased inspections provide the benefit of improved communication between DWQ and dischargers and early detection of potential problems which prevents some violations before they occur. Due to budget limitations, DWQ's Compliance Group has not been able to increase staff to enhance this effort.

## OBJECTIVE D: REDUCE THE RISK OF TOXIC CONTAMINATION TO AQUATIC LIFE AND HUMAN HEALTH.

The CCMP indicates that several sites within the Chowan River basin were identified as exceeding levels of concern for toxic contaminants in ambient water, sediment, and/or fish tissue. State and federal agencies should coordinate monitoring efforts for these environmental media to provide the maximum geographic and most cost-effective monitoring coverage. It is important to further evaluate the potential impact to aquatic life, wildlife, and human health, and to identify additional contaminated sites.

**Management Action 1: Increase efforts to assess and monitor the extent of estuarine sediment contamination, fish and shellfish tissue contamination, water quality violations, and to identify the causes and sources of these problems.**

Utilizing data from its monitoring program, DWQ is working to better identify the causes and sources of contaminants in the Chowan River basin. DWQ's Intensive Survey Group continues to monitor for water quality at those sites identified as being most contaminated. DWQ's Biological Assessment Group continues to monitor and analyze for chemical contaminants in fish tissues. Much of the analyses of fish tissues focuses on metals and dioxins. The Group conducts basin assessments of fish tissue contamination according to the schedule established by the Basinwide Management Program. When necessary, special studies are conducted in areas of concern. Over the years, special studies have been conducted in the Chowan River -- most have been related to the problems with nutrient enrichment.

DWQ and other environmental agencies are discussing ways to improve monitoring coverage through better coordination of field resources. Enhanced inter-agency coordination and cooperation would help create a more effective and comprehensive monitoring initiative in the Chowan River basin.

**Management Action 2: Continue to issue fish advisories as necessary to protect public health. Improve communication and education about the risks associated with eating contaminated fish and shellfish.**

As stated above, DWQ's Biological Assessment Group continues to monitor and analyze for chemical contaminants in fish tissues and special studies are conducted in the basin as necessary. When analysis of fish tissues result in levels exceeding FDA or EPA screening levels, the Biological Assessment Group notifies the Division of Epidemiology's Occupational and Environmental Epidemiology Section (OEES). The OEES reviews the fish tissue analysis and issues a fish consumption advisory as necessary. Currently, fish consumption advisories for dioxin are in effect for the Chowan River from the Virginia line to Albemarle Sound.

**Management Action 3: Remediate toxic contamination where necessary and feasible.**

Currently, no remedial action has occurred involving the removal of contaminated sediment. Known contaminated sediment sites are being monitored.

## OBJECTIVE E: EVALUATE INDICATORS OF ENVIRONMENTAL STRESS IN THE ESTUARY AND DEVELOP NEW TECHNIQUES TO BETTER ASSESS WATER QUALITY DEGRADATION.

Several highly visible indications of environmental stress in the Albemarle-Pamlcio esturay include chronic algal blooms, fish and shellfish kills, and fish and shellfish disease. To provide the widest geographic and most cost-effective monitoring coverage and to better track these environmental stress indicators, the CCMP calls for improved coordination of monitoring efforts by state and federal agencies and citizen groups. Resources should be concentrated to establish a response network to identify and collect data on algal blooms, fish and shellfish kills, and fish and shellfish disease outbreaks; improve management tools to address shellfish contamination; and accelerate the development and application of new bio-assessment techniques to evaluate cumulative environmental impacts to estuarine waters.

**Management Action 1: Continue to track and evaluate indicators of environmental stress, including algal blooms, fish kills, and fish and shellfish diseases.**

There has been no formal organization of an environmental stress indicators response network as referred to by this management action. However, the Division of Water Quality, Division of Water Resources, and the Wildlife Resources Commission's Division of Boating and Inland Fisheries, within their existing field personnel structure, are in the process of creating a standardized fish kill information form that would incorporate all data by those agencies who are investigating fish kill episodes. This information will help to establish a single and more comprehensive data base on fish kills. A fish kill database comprised of data from these agencies will provide a more complete and accurate picture of the cause and extent of the kills. This should, in turn, lead to development of measures to help prevent future kills.

**Management Action 2: Improve the techniques for evaluating the overall environmental health of estuarine waters.**

DWQ's Biological Assessment Group recently developed an Estuarine Biotic Index to help improve techniques used to evaluate indicators of water quality degradation in estuarine waters. A final report was submitted to EPA in July 1995.

Based on habitat heterogeneity studies, conducted for preparation of the Estuarine Biotic Index, DWQ has learned that the best habitat for monitoring changes in water quality is sea grasses. Man-made structures, rocks, wood, crab pots and nets all scored as well as sea grasses for being inhabited by water quality sensitive taxa. Oyster bars appear to be the least useful place to sample. Despite the large number of taxa that can be collected near oyster bars, most are very pollution tolerant so differentiation of changes in water quality are difficult. DWQ has recently received additional funding from EPA to continue this effort.

**Management Action 3: Develop and adopt better indicators of shellfish contamination as soon as possible.**

Due to a lack of federal funding, efforts by NOAA's National Indicator Study to develop better indicators of shellfish contamination have been put on hold. Even if this program should receive future funding, it would take several more years of scientific research to develop the necessary indicators.

# APPENDIX V

Lists of Best Management Practices (BMPs) For:

- Agriculture
- Urban Runoff
- Erosion and Sedimentation Control
- Onsite Wastewater Disposal
- Solid Waste Disposal
- Forestry
- Mining
  - Hydrologic Modifications

## BMPs FOR AGRICULTURE

**Detailed Implementation Plan***
**September 1996 (Revised)**

**Definition of Practices**

(1) An agrichemical handling facility means a permanent structure that provides an environmentally safe means of mixing agrichemicals and filling tanks with agrichemicals for the application and storage of agrichemicals to prevent accidental degradation of surface and ground water.

(2) A conservation tillage system means any tillage and planting system in which at least (30) thirty percent of the soil surface is covered by plant residue to reduce soil erosion and improve the quality of surface water.

(3) A critical area planting means an area of highly erodible land which can not be stabilized by ordinary conservation treatment on which permanent perennial vegetative cover is established and protected to reduce soil erosion and sedimentation and to improve the quality of surface water.

(4) A cropland conversion practice means to establish and maintain a conservation cover of grasses, trees, or wildlife plantings on fields previously used for crop production to reduce soil erosion and sedimentation and to improve the quality of surface water.

(5) A diversion means a channel constructed across a slope with a supporting ridge on the lower side to control drainage by diverting excess water from an area to reduce soil erosion and sedimentation and to improve the quality of surface water.

(6) A field border means a strip of perennial vegetation established at the edge of the field that provides a stabilized outlet for row water to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(7) A filter strip means an area of permanent perennial vegetation for removing sediment, organic matter, and other pollutants from runoff and waste water to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(8) A grade stabilization structure means a structure (earth embankment, mechanical spillway, detention-type, etc.) used to control the grade and head cutting in natural or artificial channels to reduce erosion and sedimentation and to improve the quality of surface water.

(9) A grassed waterway means a natural or constructed channel that is shaped or graded to required dimensions and established in suitable vegetation for the stable conveyance of runoff to reduce erosion and sedimentation and to improve the quality of surface water.

(10) A heavy use protection area means an area used frequently and intensively by animals which must be stabilized by surfacing with suitable materials to reduce erosion, sedimentation and nutrient pollution to improve the quality of surface water.

(11) A livestock exclusion system means a system of permanent fencing (board, barbed, high tensile or electric wire) installed to exclude livestock from streams and critical areas not intended for grazing to reduce erosion, sedimentation and to improve the quality of surface water.

(12) A long term no-till practice means planting all crops for five consecutive years in at least 80 percent plant residue from preceding crops to reduce soil erosion and sedimentation and improve the quality of surface water.

(13) A pastureland conversion practice means establishing trees or perennial wildlife plantings on excessively eroding Class VII land being used for pasture that is too steep to mow or maintain with conventional equipment to reduce soil erosion and sedimentation and to improve the quality of surface water.

(14) A nutrient management practice means a definitive plan to manage the amount, form, placement, and timing of applications nutrients to minimize entry of nutrient to surface and groundwater and to improve water quality.

(15) A rock-lined outlet means a waterway having an erosionresistant lining of concrete, stone or other permanent material where an unlined or grassed waterways would be inadequate to provide safe disposal of runoff, reduce erosion and sedimentation and to improve the quality of surface water.

(16) A sediment basin means a basin constructed to trap and store waterborne sediment where physical conditions or land ownership preclude treatment of a sediment source by the installation of other erosion control measures to improve the quality of surface water.

(17) A sod-based rotation practice means an adapted sequence of crops and grasses established and maintained for a definite number of years which is designed to provide adequate organic residue for maintenance or improvement of soil filth to help reduce erosion and improve surface water quality.

(18) A stock trail or walkway means to provide a stable area used frequently and intensively for livestock movement by surfacing with suitable material to reduce erosion sedimentation and nutrient pollution to improve the quality of surface water.

(19) A stream protection system means a planned system for protecting streams and streambanks which eliminates the need for livestock to be in streams by providing an alternative watering source for livestock to reduce erosion and sedimentation and to improve the quality of surface water. System components may include:

- (A) A spring development means improving springs and seeps by excavating, cleaning, capping or providing collection and storage facilities.
- (B) A trough or tank means devices installed to provide drinking water for livestock at a stabilized location.
- (C) A well means constructing a drilled, driven or dug well to supply water from an underground source.
- (D) A windmill means erecting or constructing a mill operated by the wind's rotation of large vanes and is used as a source of power for pumping water.

(E) A stream crossing means a trail constructed across a stream to allow livestock to cross without disturbing the bottom or causing erosion on the banks.

(20) A stripcropping practice means to grow crops and sod in a systematic arrangement of alternating strips on the contour to reduce soil erosion and sedimentation and to improve the quality of surface water.

(21) A terrace means an earth embankment, a channel, or a combination ridge and channel constructed across the slope to reduce erosion, reduce sediment content in runoff water, and to improve the quality of surface water.

(22) A waste management system means a planned system in which all necessary components are installed for managing liquid and solid waste to prevent or minimize degradation of soil and water resources. System components may include:

(A) A waste storage pond means an impoundment made by excavation or earthfill for temporary storage of animal waste, waste water and polluted runoff.
(B) A drystack means a fabricated structure for temporary storage of animal waste.
(C) A composter/storage structure means a facility for the biological treatment, stabilization and environmentally safe storage of organic waste material (such as livestock and poultry manure and dead animal carcasses) to produce a material that can be recycled as a soil amendment and fertilizer substitute.
(D) A waste treatment lagoon means an impoundment made by excavation or earthfill for biological treatment and storage of animal waste.
(E) A waste application system means an environmentally safe system (such as solid set, dry hydrant, mobile irrigation equipment, etc.) for the conveyance and distribution of animal wastes from waste treatment and storage structures to agricultural field as part of an irrigation and nutrient management plan.
(F) A constructed wetlands for land application practice means an artificial wetland area into which liquid animal waste from a waste storage pond or lagoon is dispersed over time to lower the nutrient content of the liquid animal waste.
(G) A controlled livestock lounging area means a planned, stabilized and vegetated area in which livestock are kept for a short duration.
(H) A closure of abandoned waste treatment lagoons and waste storage ponds practice means the safe removal of existing waste and waste water and the application of this waste on land in an environmentally safe manner.
(I) A storm water management system means a system of collection and diversion practices (buttering, collection boxes, diversions, etc.) to prevent unpolluted storm water from flowing across concentrated waste area on animal operations.

(23) A water control structure means to provide control of surface and subsurface water through the use of permanent structures which increase infiltration and reduce runoff to improve the quality of surface and ground water.

(24) A waste utilization plan means a plan of using animal waste on land in an environmentally acceptable manner while maintaining or improving soil and plant resources to safeguard water resources.

(25) An insect control practice means an method of pest management used in an integrated pest management program to control target organisms and minimize contamination of soil, water, and air, and minimize impacts to non-target organisms through cultural, biological and physical practices including safe and prudent use of pesticides.

(26) A riparian buffer means an area adjacent to solid blue line streams as shown on 7.5 minute USGS maps where a permanent, long-lived vegetative cover (sod, shrubs, trees, or a combination of vegetation types) is established to reduce soil erosion, sedimentation, nutrient and pesticide pollution, and to improve the quality of surface water and shallow ground water.

(27) An odor control management system means a practice or combination of practices (planting windbreaks, precharging structures, incorporation of waste into soil, etc.) which manages or controls odors from confined animal operations, waste treatment and storage structures and waste applied to agricultural land.

*To be used in conjunction with the most recent version of the APA Rules for the North Carolina Agriculture Cost Share Program for Nonpoint Source Pollution Control and the NCACSP Manual.

## Best Management Practices Eligible for Cost Share Payments

Best Management Practices eligible for cost sharing include the following practices and any approved District BMPs. District BMPs shall be reviewed by the Division for technical merit in achieving the goals of this program. Upon approval by the Division, the District BMPs will be eligible to receive cost share funding.

The minimum life expectancy of the BMPs is listed below. Practices designated by a District shall meet the life expectancy requirement established by the Division for that District BMP. The list of BMPs eligible for cost sharing may be revised by the Commission as deemed appropriate in order to meet program purpose and goals.

| Practice | Minimum Life Expectancy (years) |
|---|---|
| Agrichemical Handling Facility | 10 |
| Conservation Tillage System | 10 |
| Critical Area Planting | 10 |
| Cropland Conversion | 10 |
| Diversion | 10 |
| Field Border | 10 |
| Filter Strip | 10 |
| Grade Stabilization Structure | 10 |
| Grassed Waterway | 10 |
| Heavy Use Area Protection | 10 |
| Insect Control | 5 |
| Livestock Exclusion | 10 |
| Long Term No-Till | 5 |
| Mobile Irrigation Equipment | 10 |
| Pastureland Conversion | 10 |
| Nutrient Reduction Management System | 3 |
| ~~Rock-lined Waterway or Outlet~~ | ~~10~~ |
| Sediment Control Structure | 10 |
| Sod-based Rotation | 4 or 5 |
| Stock Trail and Walkway | 10 |
| Stream Protection System | |
| Spring Development | 10 |
| Trough or Tank | 10 |
| Well | 10 |
| Windmills | 10 |
| Stream Crossing | 10 |
| Stripcropping | 5 |

| | |
|---|---|
| Riparian Buffer | 10 |
| Terrace | 10 |

**Best Management Practices Eligible for Cost Share Payments (continued)**

| | |
|---|---|
| Waste Management System | |
| Waste Storage Pond | 10 |
| Waste Storage Structure | 10 |
| Waste Treatment Lagoon | 10 |
| System for Land Application of Animal Waste | 10 |
| Wetlands Development for Land Application | 10 |
| Controlled Livestock Lounging Area | 10 |
| To-Be-Abandoned or Abandoned Confined | |
| Animal Operation (CAO) | 5 |
| Odor Control | 1 to 10 |
| Water Control Structure | 10 |

## Agricultural Best Management Practices

I. Crop and Pasture Lands

A. BMPs for Sediment Control
- Conservation Tillage System
- Critical Area Planting
- Cropland Conversion
- Diversion
- Field Border
- Filter Strip
- Grade Stabilization Structure
- Grassed Waterway
- Rock-lined Waterways or Outlets
- Sediment Control Structure
- Sod-based Rotation
- Stripcropping
- Terrace
- Water Control Structure
- Pastureland Conversion

B. BMPs for Nutrient Control
- Legumes in Rotation
- Soil Testing
- Liming
- Setting Realistic Crop Yield Goals (determines fertilization rates)
- Fertilizer Waste Application (method, rate, and timing)
- Sediment Control BMPs

C. BMPs for pesticide control
- Alternative Pesticides
- Optimize Pesticide Formulation, Amount, Placement Timing, Frequency
- Crop Rotation
- Resistant Crop Varieties
- Other Cultural or Biological Controls
- Optimize Crop Planting Time
- Plant Pest Quarantines
- Proper Disposal of Obsolete Pesticides and Containers
- Certification of Applicators
- Sediment Control BMP's

II. Animal Production (esp. Confined Animal Operations)

BMPs for bacteria and nutrient control
- Grade Stabilization Structures
- Heavy Use Area Protection
- Livestock Exclusion
- Spring Development
- Stock Trails and Walkways
- Trough or Tank
- Waste Management System
- Waste Storage Pond
- Waste Storage Structure
- Waste Treatment Lagoon
- Land Application of Waste
- Water Control Structure

## BMPs FOR URBAN STORMWATER

Structural Best Management Practices for urban runoff control are typically designed to reduce sediment, its attached pollutants, and nutrients. In addition, other BMPs protect the riparian ecosystem, provide streambank stabilization, provide shade to water bodies and reduce the likelihood of excessive water temperatures. Non-structural BMPs, such as a design manual or a public education program, encourage the comprehensive and effective implementation of structural BMPs. The table below contains a list of both structural and non-structural BMPs. This list is taken from the *Stormwater Management Guidance Manual*, published by DWQ's Water Quality Planning Branch in 1995. The *Manual* provides a detailed discussion of each of the BMPs, including its characteristics, pollutant-specific effectiveness, reliability, feasibility, costs, unknown use factors, design considerations, and references for further information.

| |
|---|
| **STRUCTURAL BMPs** |
| I. Wet Detention Basin |
| II. Constructed Wetlands |
| • Wet Retention Basin |
| • Dry Detention Basin |
| • Infiltration Basin |
| • Vegetative Practices |
| ◊ Filter Strips |
| ◊ Grassed Swales with Check Dams |
| • Sand Filter |
| • Oil and Grease Separator |
| • Rollover-Type Curbing |
| **NON-STRUCTURAL BMPs** |
| I. Preventive Measures |
| II. Pollutant Minimization |
| • Exposure Reduction (proper scheduling, etc. - see Manual) |
| • Landscaping and Lawn Maintenance Controls |
| • Animal Waste Collection |
| • Curb Elimination |
| • Parking Lot and Street Cleaning |
| • Road Salt Application Control |
| • Catch Basin Cleaning |
| III. Riparian area protection |
| IV Design Manual for Urban BMPs |
| V Public Education |
| VI. Identification and Enforcement of Illegal Discharges |
| VII. Land-Use Control |
| • Low-Density Development |
| • Comprehensive Site Planning |
| • Buffer Zone |
| • Sanitary Waste Management |
| VIII. Conservation Easement |

Structural BMPs may affect groundwater quality in certain situations. Devices that recharge groundwater pose the risk of passing soluble pollutants into groundwater systems. It is not currently known whether pollutant concentrations in recharged groundwater areas pose a significant environmental or health risk. USGS is presently studying groundwater quality effects of urban BMPs. In addition, if funds are made available, DWQ may conduct a similar study in North Carolina.

## BMPs FOR EROSION AND SEDIMENTATION CONTROL

Best Management Practices suggested pursuant to the NC Sedimentation Pollution Control Act of 1973 are selected on the basis of performance in providing protection from the maximum peak rate of runoff from a 10-year storm. This allows the developer/designer of the control measures, structures, or devices to determine and submit for approval the most economical and effective means of controlling erosion and preventing sedimentation damage. Practices are therefore reviewed for acceptability based upon the characteristics of each individual site and its erosion potential. Ideally, the erosion control plan will employ both practices and construction management techniques which will provide the most effective and reasonable means of controlling erosion while considering the uniqueness of each site. The following table provides a list of practices commonly used in sedimentation and erosion control plans across North Carolina.

| | |
|---|---|
| Check Dam | Sand Fence (Wind Fence) |
| Construction Road Stabilization | Sediment Basin |
| Dust Control | Sediment Fence |
| Grade Stabilization Structure | Sod Drop Inlet Protection |
| Grass-lined Channels | Sodding |
| Grass Channels with Liner | Structural Streambank Stabilization |
| Land Grading | Subsurface Drain |
| Level Spreader | Surface Roughening |
| Mulching | Temporary Block & Gravel Inlet Protection |
| Outlet Stabilization Structure | Temporary Diversions |
| Paved Channels | Temporary Excavated Drop Inlet Protection<br>Fabric Drop Inlet Protection |
| Paved Flume (Chutes) | Temporary Gravel Construction Entrance/Exit |
| Perimeter Dike | Temporary Sediment Trap |
| Permanent Diversions | Temporary Seeding |
| Permanent Seeding | Temporary Slope Drains |
| Permanent Stream Crossing | Temporary Stream Crossing |
| Right-Of-Way Diversions | Topsoiling |
| Riprap | Tree Preservation & Protection |
| Riprap-lined Channels | Trees, Shrubs, Vines & Ground Covers |
| Rock Dam | Vegetative Dune Stabilization |
| | Vegetative Streambank Stabilization |

## BMPs FOR ON-SITE WASTEWATER DISPOSAL

To protect public health and water quality, best management practices (BMPs) need to be implemented throughout the life cycle of an on-site wastewater disposal system. Life-cycle management problems can be addressed in three phases (Steinbeck, 1984). The first phase includes system siting, design, and installation. The second phase involves the operation of the system and phase three involves maintenance and repair when the system malfunctions or fails. As BMPs are applied in each life-cycle phase, the primary factor the success of the system is the participation of the local influencing health department and the cooperation of the developer, owner, design engineer, system operator, and the state. The table that follows gives a summary of the current life-cycle management practices and penalties utilized in North Carolina to implement the on-site sewage systems program (Steinbeck, 1984).

| |
|---|
| 1. Application -- The developer or property owner meets with the staff of the local health department to review the project proposal and submits an application to the local health department that contains information regarding ownership, plat of property, site plan, type of facility, estimated sewage flow, and proposed method of sewage collection, treatment, and disposal. |
| 2. Site Evaluation -- The local health department, with technical assistance from the state, evaluates the proposed sewage effluent disposal site for several factors, including slope, landscape position, soil morphology, soil drainage, soil depth, and space requirements. Next, the local health department will assign a site suitability classification, establish the design sewage flow, and the design loading rate for the soil disposal system. |
| 3. Design Review --The applicant is required to submit plans and specifications for the sewage collection, treatment, and disposal system prepared by a professional engineer, for complex systems, or for systems exceeding 3,000 gal/day. Reviews are made by both state and local health departments. The designer must also include in the plans and specifications, installation procedures, phasing schedules, operation and maintenance procedures, monitoring requirements, and designate the responsible agents for operation and maintenance. |
| 4. Legal Document Review -- For systems with multiple ownership or off-site disposal, the applicant must prepare and submit to state and local health departments for their legal review documents applicable to the project. |
| 5. Improvement Permit -- Issued only after a successful review of the proposed project, including each of the items discussed above and allows construction to begin for the on-site sewage system. The improvement permit must be issued prior to other construction permits and allows only temporary electrical power to the site. This permit contains the necessary conditions for construction of the projects with the plans, specifications, and legal documentation appended to it. |
| 6. Operation Permit -- Issued to the owner of the on-site sewage system by the local health department when it determines that all the requirements in the rules, plans and specifications are met; all conditions on the improvement permit are met; and the design engineer for the sewage collection, treatment, and disposal system certifies in writing to the local health department that the on-site system has been installed in accordance with the approved plans and specifications. The operation permit is also conditioned to establish performance requirements and may be issued for a specific period of time. It allows the on-site sewage system to be placed into use, prevents permanent electrical service to the project and prevents occupancy of the facilities until issued. The operation permit applies to systems larger than 480 gallons per day. A certificate of completion is required for conventional septic tank systems when the design sewage flow is less than 480 gal/day. |

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| 7. | Surveillance -- Once an on-site sewage system is placed into operation the local health department must make routine inspections at least annually for large systems to determine that the system is performing satisfactorily and not creating a public health nuisance or hazard. Additionally, required monitoring reports are routinely submitted to the local health department as required in the permits. The state provides technical assistance to the local health department and the system operator in assuring adequate performance. While annual inspections are required, frequent performance checks must be made by the local health department. |
| 8. | Remedies -- When voluntary compliance with the performance requirements for the on-site system is unsuccessful, the General Statutes (1983) provide for the following remedies: |
| a) | Right of Entry -- Allows the state or local health department to enter the premises to determine compliance with the laws and rules and provides for an administrative search and inspection warrant when entry is denied. |
| b) | Injunction -- The state or local health department may institute an action for injunctive relief against the owner to bring the on-site sewage system into compliance. |
| c) | Order of Abatement -- The state or local health department is empowered to issue an order of abatement directing the owner to take any necessary action to bring the system into compliance. However, if the on-site system is determined to be creating an imminent health hazard, the state or local health department may, after previous unsuccessful attempts at correction, take the necessary action to correct the problem and recover any costs for abatement from the owner. This is the least frequently applied remedy. |
| d) | Administrative Penalties -- The state may impose administrative penalties up to $300 per day for violation of the laws, rules, or any permit condition for on-site sewage systems serving multi-family residences with a flow greater than 480 gal/day. A penalty of up to $50 per day can be assessed for malfunctioning systems where the flow is less than or equal to 480 gal/day. |
| e) | Suspension and Revocation of Permits -- The state may suspend or revoke a permit for violations of the laws, rules, or permit conditions upon a finding that a violation has occurred. |
| f) | Misdemeanor -- The owner who violates the sewage laws or rules shall be guilty of a misdemeanor and punishable by a fine or imprisonment as determined by the courts. This is the most frequently used remedy. |

## BMPs FOR SOLID WASTE MANAGEMENT

Best Management Practices for solid waste management address the water quality impacts of leachate migration and surface erosion. A list of BMPs for controlling solid waste impacts on water quality can be found in the table below.

The BMPs offer significant benefits for groundwater quality. Landfill liners will prohibit or greatly decrease the volume of leachate entering groundwater. In turn, leachate collection systems capture leachate for subsequent treatment rather than groundwater disposal. For even greater protection, groundwater and surface water monitoring should detect failures in the liner or collection system.

| |
|---|
| Reduce, Recover, and Recycle Solid Waste to Maximum Extent |
| Incineration with Energy Recovery |
| North Carolina Water Quality Monitoring Guidance Document for Solid Waste Facilities, 1987 |
| Liners (Clay or Synthetic) for All New Landfills |
| Leachate Collection Systems |
| Erosion Control Plan |
| Operation and Maintenance Plan |
| Buffers Between Landfill and Streams, Property Lines and Dwellings |
| Groundwater Quality Monitoring |
| Surface Water Quality Monitoring |
| Public Education |
| Stormwater Runoff Control |
| Sedimentation Control |

## BMPs FOR FORESTRY

### A. Performance Standards for Forestry Site Disturbing Activities in North Carolina

Forest Practices Guidelines Related to Water Quality (15A NCAC 1I.0101-.0209) have been adopted as published in the NCR, Volume 4, Issue 11, pages 601-604, and were effective January 1, 1990. These guidelines are summarized below.

| |
|---|
| **Streamside Management Zone(SMZ)** |
| • Must establish SMZ along natural, intermittent and perennial streams and water bodies. (Not required along man-made ditches and canals, although erosion protection is needed). |
| • Must have sufficient width and adequate ground cover to confine visible sediment (usually best to protect existing ground cover). |
| • Place roads, trails and decks outside of SMZ. |
| • Limited cutting(harvesting) is permitted within the SMZ. |
| **Prohibition of Debris Entering Streams** |
| • Prevent debris(logging slash, soil) of all types that can cause stream flow impediment or water quality degradation from entering intermittent and perennial streams and water bodies. |
| • Remove debris that accidentally enters streams. |
| **Access Road and Skid Trail Stream Crossing** |
| • Avoid crossing streams where possible. |
| • Avoid using stream channels as roads or trails. |
| • Construct crossings to minimize sediment entering streams. |
| • Protect stream banks and channels from damage. |
| • Provide water control devices and/or structures and, within 10 working days of initial disturbance provide ground cover sufficient to restrain accelerated erosion and prevent stream sedimentation. |
| **Access Road Entrance** |
| • Prevent soil and debris from being deposited on public highways which may result in stream sedimentation. |
| **Keep Waste from Entering Streams, Water bodies and Groundwater** |
| • Prevent oil, fuels, fertilizer and other chemical waste from entering streams, water bodies and groundwater. |
| **Pesticide Application** |
| • Application must follow labeling and N.C. Pesticides Board rules. Includes insecticides, fungicides, herbicides, and rodenticides. |
| **Fertilizer Application** |
| • Apply in a manner to prevent adverse impacts on water quality. |
| **Stream Temperature** |
| • Retain shade sufficient to prevent temperature fluctuations which result in a violation. |
| **Rehabilitation of Project Site** |
| • Within 30 working days after ceasing operations, provide sedimentation control measures to prevent water quality damage. |
| • Permanently stabilize SMZ areas and other areas that may directly contribute visible sediment to streams. |

The Forestry Best Management Practices Manual was prepared to provide the means of meeting the above standards. The Manual is available from any DFR office at no charge.

## B. BMPs for Forestry Operations in Wetlands

The Division of Forest Resources is in the process of developing BMPs for forested wetlands. Economic pressure to expand forestry activities in wetlands continues to increase. This expansion will require a sound strategy to protect these environmentally sensitive areas.

A Forested Wetlands BMP Committee was established in the winter of 1987. Committee members represent federal and state agencies, industry, education, and environmental groups who have a role in the fate of wetlands.

A Forested Wetlands BMP Committee was established in 1987. The members represented state and federal agencies, industry, education and conservation groups which have an interest or role in the fate of wetlands. In 1990, the *Best Management Practices for Forestry in the Wetlands of North Carolina* was published. The committee has been reconvened and is currently working to revise and update the wetland BMPs. This update will take into account the Corps of Engineer's and EPA's Application of Best Management Practices to Mechanical Site Preparation Activities for the Establishment of Pine Plantations in the Southeast. This EPA guidance restricts the areas that can be mechanically site prepared for planting in loblolly pine without a Section 404 permit.

In addition to the state's voluntary wetland BMPs, the Corps of Engineers has produced 15 mandatory BMPs for forest and farm road construction and maintenance in forested wetlands. These BMPs must be followed, or else a Section 404 permit is required for the road construction or maintenance. The 15 BMPs are listed below.

| |
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| • Permanent roads (for forestry), temporary access roads (for forestry), and skid trails ( for logging) in waters of the U.S. shall be held to the minimum feasible number, width, and total length consistent with silvicultural and local topographic and climatic conditions; |
| • All roads shall be located sufficiently far from streams or other water bodies (except for portions of such roads that must cross water bodies) to minimize discharges of dredged or fill material into waters of the U.S.; |
| • Road fill shall be bridged, culverted, or otherwise designed to prevent the restriction of expected flood flows; |
| • Fill shall be properly stabilized and maintained to prevent erosion during and following construction; |
| • Discharges of dredged or fill material into waters of the U.S. to construct road fills shall be made in a manner that minimizes encroachment of trucks, tractors, bulldozers, and other heavy equipment into waters of the U.S. (including adjacent wetlands that lie outside the lateral boundaries of the fill itself); |
| • In designing, constructing, an maintaining roads, vegetative disturbance in waters of the U.S. shall be kept to a minimum; |
| • Design, construction and maintenance of road crossings shall not disrupt the migration or other movement of those aquatic species inhabiting the water body; |
| • Borrow material shall be taken from upland sources whenever feasible; |
| • The discharge shall not take, or jeopardize the continued existence of, a threatened or endangered species as defined under the Endangered Species Act, or adversely modify or destroy the critical habitat of such species; |
| • Discharges into breeding and nesting areas for migratory waterfowl, spawning areas, and wetlands shall be avoided if practical alternatives exist; |
| • Discharge shall not be located in proximity to a public water supply intake; |
| • The discharge shall not occur in areas of concentrated shellfish production; |
| • Discharge shall not occur in a designated National Wild and Scenic River; |
| • Discharge shall be of suitable material free from toxic pollutants in toxic amounts; and |
| • All temporary fills shall be removed in their entirety and the area restored to its original elevation. |

## BMPs FOR MINING OPERATIONS

Significant environmental damage can and often times does occur during land-disturbing activities of mining operations, especially during the initial stages. The potential for such damage can be substantially reduced with the installation of BMPs. Once the mining has terminated, BMPs are used to reclaim or reasonably rehabilitate the site (for mined lands after June 11, 1971). The basic objective of the reclamation is to establish on a continuing basis the vegetative cover, soil stability, and water and safety conditions appropriate to the area. The BMPs are performance-oriented, allowing a mining permit applicant to design and propose the most economical and effective means of a) controlling erosion and preventing off-site sedimentation damage; b) preventing contamination of surface waters and groundwater; and, c) preventing any condition that will have unduly adverse effects on wildlife or freshwater, estuarine, or marine fisheries. BMP selection is site-specific and controlled in part by the pre- and post-mining land use(s). The acceptability of a BMP is therefore based upon the characteristics of the individual site and its potential for off-site damage.

The table which follows provides a list of BMPs used for activities associated with mining activities in North Carolina. This list is essentially the same as that provided for Sedimentation and Erosion Control, due to the similar nature of activities in both programs.

| | |
|---|---|
| Check Dam | Sediment Basin |
| Construction Road Stabilization | Sediment Fence |
| Dust Control | Sod Drop Inlet Protection |
| Grade Stabilization Structure | Sodding |
| Grass-lined Channel | Structural Streambank Stabilization |
| Grass Channels with Liner | Subsurface Drain |
| Groundwater Monitoring Wells | Surface Roughening |
| Land Grading | Temporary Block and Gravel Inlet Protection |
| Level Spreader | Temporary Diversions |
| Mulching | Temporary Excavated Drop Inlet Protection |
| Outlet Stabilization Structure | Temporary Fabric Drop Inlet Protection |
| Paved Flume (Chutes) | Temporary Gravel Construction Entrance/Exit |
| Perimeter Dike | Temporary Sediment Trap |
| Permanent Diversions | Temporary Seeding |
| Permanent Seeding | Temporary Slope Drains |
| Permanent Stream Crossing | Temporary Stream Crossing |
| Right-of-Way Diversions | Topsoiling |
| ~~Riprap~~ | ~~Tree Preservation and Protection~~ |
| Riprap-lined Channels | Trees, Shrubs, Vines & Ground Covers |
| Rock Dam | Vegetative Dune Stabilization |
| Sand Fence (Wind Fence) | Vegetative Streambank Stabilization |

## BMPs FOR HYDROLOGIC MODIFICATION (related to mining operations)

### BMPs for Discharges of Dredged or Fill Material (Adapted from 40 CFR 230 - Guidelines for Specification of Disposal Sites for Dredged or Fill Material)

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| **1. Actions concerning the location of the discharge.** |
| a) Minimize smothering of organisms; |
| b) Avoid disruption of periodic water inundation patterns; |
| c) Select a previously used disposal site; |
| d) Select a disposal site with substrate similar in composition to the material being disposed; |
| e) Minimize extent of any plume; and |
| f) Minimize or prevent creation of standing bodies of waters in areas of normally fluctuating water levels. |
| **2. Actions concerning the material to be discharged.** |
| a) Maintain physiochemical conditions and reduce potency and availability of pollutants; |
| b) Limit solid, liquid and gaseous components; |
| c) Add treatment substances; and |
| d) Utilize chemical flocculants in diked disposal areas. |
| **3. Actions controlling the materials after discharge.** |
| a) Reduce potential for erosion, slumping or leaching by |
| i) using containment levees, sediment basins and cover crops to reduce erosion; and |
| ii) using lined containment areas to reduce leaching. |
| b) Cap in-place contaminated material with clean material; |
| c) Prevent point and nonpoint sources of pollution; and |
| d) Time the discharge to minimize impact, especially during unusual high water flows, wind, wave and tidal actions. |
| **4. Actions affecting the method of dispersion.** |
| a) Maintain natural substrate contours and elevation; |
| b) Minimize undesirable obstruction to the water current or circulation pattern; |
| c) Confine suspended particulate/turbidity to a small area where settling can occur; |
| d) Mix, dilute and disperse the discharge; |
| e) Minimize water column turbidity; |
| f) Maintain light penetration for organisms; and |
| g) Set limitations on the amount of material to be discharged per unit of time or volume of receiving water. |
| **5. Actions related to technology.** |
| a) Use appropriate equipment and machinery, including protective devices; |
| b) Employ appropriate operation and maintenance of machinery, including training, staffing and working procedures; |
| c) Use machinery and techniques designed to reduce damage to wetlands, including devices that scatter rather than mound excavated materials, machines with specially designed wheels or tracks, and the use of mats under heavy machinery to reduce compaction and rutting; and |
| d) Design access roads and channel spanning structures to accommodate fluctuating water levels and circulation patterns. |

**BMPs for Hydrologic Modification (continued)**

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| **6. Actions affecting plant and animal populations.** |
| a) Avoid changes in water current and circulation patterns; |
| b) Prevent or avoid creating habitat conducive to the development of undesirable predators or species; |
| c) Avoid sites having unique habitat or other value, including endangered or threatened species; |
| d) Institute habitat development and restoration; |
| e) Avoid spawning or migration seasons and other biologically critical time periods; and |
| f) Avoid destruction of remnant natural sites within areas already affected by development. |
| **7. Actions affecting human use.** |
| a) Prevent or minimize damage to the aesthetically pleasing features of an aquatic site, including water quality; |
| b) Avoid disposal sites valuable as natural aquatic areas; |
| c) Avoid seasons or periods when human recreational activity associated with the aquatic site is most important; |
| d) Avoid sites which will increase incompatible human activity or require frequent dredge or fill maintenance in remote fish and wildlife areas; and |
| e) Locate disposal site outside of the vicinity of a public water supply intake. |

# APPENDIX VI

## Existing Point And Nonpoint Source Water Quality Programs

# APPENDIX VI

# EXISTING POINT AND NONPOINT SOURCE POLLUTION CONTROL PROGRAMS

## NORTH CAROLINA'S POINT SOURCE CONTROL PROGRAMS

Discharge permits are issued under the authority of North Carolina General Statute (NCGS) 143.215.1 and the National Pollutant Discharge Elimination System (NPDES) program. NPDES permits establish effluent limitations on the maximum level of wastes or pollutants, that may be discharged into surface waters. North Carolina has a very comprehensive NPDES program that includes the following major components:

1. NPDES Permit Review and Processing,
2. Wasteload Allocation Modeling,
3. Compliance Monitoring and Enforcement,
4. Aquatic Toxicity Testing,
5. Pretreatment,
6. Operator Certification and Training and
7. Nondischarge and Regional Wastewater Treatment Alternatives.

Below is a brief summary of key components of North Carolina's NPDES program

### NPDES Permit Review and Processing

In North Carolina, the issuance of discharge permits is coordinated with the basinwide planning process. Thus, DWQ issues all discharge permits within a given basin at approximately the same time. These permits are valid for five years. New discharge permits issued during an interim period between cycles will have a shorter expiration period in order to coincide with the next basin permitting cycle. Thus, DWQ can more effectively monitor and modify its permitting system consistently across the river basins.

DWQ will not process a permit application until the application is complete. The requirements for discharge permit application and processing are outlined in Administrative Code Section: 15A NCAC 2H .0100 - Wastewater Discharges to Surface Waters. Under this rule, all applications must include a feasibility analysis on alternative disposal options, such as spray irrigation, and justification for the selection of the discharge option.

Applications for new discharges greater than 500,000 gallons per day of wastewater, 10 million gallons per day (MGD) of cooling water, or 1 MGD of any other type of effluent must include an *assessment* report in addition to the normal permit application. The assessment is to provide sufficient information to describe the impact of the proposed action on the waters in the area. DWQ may also require an Environmental Impact Statement or Environmental Assessment, under the NC Environmental Policy Act for certain publicly funded projects.

DWQ staff establish waste limits for permit applications based on a wasteload allocation process (described in the following section). The staff review also includes a site inspection (for existing facilities up for renewal, the inspection may be conducted prior to submittal of a complete application). If DWQ finds the application acceptable, it will issue a public notice (called a Notice of Intent to Issue) in newspapers having wide circulation in the local area. The Notice of Intent includes all of the permit applications for a particular subbasin (or subbasins) that will be issued within a given month. The public then has a 30-day period to comment on the proposed permit. If the public expresses sufficient interest in one or more of the applications, DWQ may hold a public hearing.

DWQ also sends copies of the Notice of Intent to a number of state and federal agencies for comment. For example, the Division of Environmental Health reviews the applications for their potential impact on surface water sources of drinking water. Once DWQ received and evaluates the comments, the Director of DWQ decides whether to issue or deny the permit. The final permit will include recommended waste limits and other special conditions that may be necessary to ensure protection of water quality standards.

## Establishing Discharge Permit Effluent Limitations/Wasteload Allocations

Effluent limitations, also called waste limits, dictate the amounts of wastes (pollutants), that the permittee is allowed to discharge into surface waters under an NPDES permit. Before DWQ issues a discharge permit, it evaluates the projected impact of the discharge on the receiving waters. This determination, called a wasteload allocation (WLA), is usually based on a computer model which considers many factors, including the characteristics of the waste (e.g., flow and type) and the characteristics of the receiving waters (e.g., flow, waste assimilative capacity, channel configuration, rate of reaeration, water quality classification). DWQ determines permit limits using models called water quality-based limits. DWQ also bases some permit limits based on federal effluent guidelines established by the USEPA.

DWQ performs wasteload allocations by using various models, depending on the parameter (type of pollutant) of interest and the characteristics of the receiving waters. Model frameworks (discussed in more detail in Appendix IV) can range from simple mass balance analyses to 3-dimensional dynamic water quality models. Modeling fits into the basin plan by drawing on the current conditions within the basin and evaluating the effects of various management strategies. DWQ uses models for a number of objectives, including determining the fate and transport of pollutants, setting reduction goals for point and nonpoint sources, and to derive effluent limits for NPDES permits. For example, models can be used to predict concentrations of a parameter at a given site, such as instream DO or chlorophyll *a* in a lake.

Models can also be a tool for determining the level of pollutant reductions needed to protect instream standards. In addition, DWQ performs uncertainty analyses of water quality models to expand their predictive capabilities and increase confidence in results. Waste limits may vary from summer to winter for some parameters, such as nutrients and ammonia, with winter limits being somewhat less stringent than summer limits due to higher instream flows during the winter months.

When point sources are responsible for water quality problems, WLAs can yield appropriate permit limits that offer adequate water quality protection. Where a sole discharge is responsible for the water quality impacts, DWQ can perform a simple WLA without considering other discharges. In this case, DWQ will establish limits in accordance with the state's Standard Operating Procedures (SOP) for Wasteload Allocations manual. The SOP manual has been developed to support State and Federal regulations and guidelines and has been approved by the EPA.

A critical factor in determining the wasteload for an individual discharge is whether the receiving waters have a flow during 7Q10 or 30Q2 conditions. DWQ's policy prohibits new or expanded discharges into "no flow" streams that have a 7Q10 and a 30Q2 equal to zero. In addition, DWQ will look for ways to remove existing discharges on such streams unless it is determined that there are no reasonable alternatives. If it is not feasible to remove the discharge, then the facility will be required to meet limits of 5 mg/l $BOD_5$ and 2 mg/l $NH_3N$ in summer (and 10 mg/l $BOD_5$ and 4 mg/l $NH_3N$ in winter).

When numerous discharges affect water quality, the Environmental Management Commission is required to consider the cumulative impacts of all of the permitted discharges to a water body (pursuant to NCGS 143-215.1(b)(2)). Such areas are identified and discussed in Chapter 6. Generally, these are areas where the SOP alone does not provide adequate guidance. Since the SOP addresses mostly single discharge or relatively simple interaction of multiple discharges, WLA procedures outside the realm of the SOP represent the larger, basinwide strategy that DWQ is implementing.

## Compliance Monitoring and Enforcement

Most dischargers are required to periodically sample the treated effluent from their discharge pipes. Also, many larger and more complex dischargers are required to sample points in the receiving waters both up and downstream from the discharge point. This process is called self-monitoring and it is typically required five days a week for some parameters (Monday through Friday) for major facilities. The sampling results (contained in a daily monitoring report or DMR) are then submitted each month to DWQ for compliance evaluations.

If a plant does not meet its permitted limits, DWQ may take one or more of the following actions: issue a notice of violation, initiate enforcement action, place the facility on moratorium, and/or enter into a Special Order by Consent (SOC). An SOC is a legal commitment entered into by the state and the discharger that establishes a time schedule for bringing the wastewater treatment plant back into compliance. During this time period, interim waste limits may be assigned to the facility until the improvements can be made. These interim limits may be less stringent than those in the permit although they are still required to protect water quality in the receiving waters.

In addition to the DMR data, illegal or improperly treated discharges may be identified in other ways including through third party reports, routine DWQ site inspections, and water quality monitoring conducted by DWQ staff.

## Aquatic Toxicity Testing

There are thousands of chemicals and compounds that can enter wastewater systems and potentially be discharged to surface waters. Treatment plants are unable to monitor each of these chemicals individually due to limited funds and time, and limits in the ability of current analytical techniques to detect some pollutants. Even if the existence and potential effects of every constituent of a wastewater were known, the combined effects of these constituents could not be predicted.

North Carolina uses an integrated approach to aquatic toxicity testing that includes monitoring specific chemicals, assessing resident aquatic populations, and analyzing whole effluent toxicity (WET). Whole effluent toxicity limits predict the impacts of toxicants by measuring those impacts in a laboratory setting. It is from this same foundation of aquatic toxicity laboratory tests that chemical specific limits and criteria are derived for the majority of chemical toxicants.

In February 1987, North Carolina implemented a policy to incorporate WET limits for all major and complex minor permits. As of June 1996, 567 permitted NPDES discharges were required to perform WET monitoring, and over 15,000 individual toxicity analyses had been performed for plants across the state. WET limits were developed to protect aquatic life from the discharge of substances in toxic amounts as prescribed by 15 NCAC 2B. 0208 (i.e. so as not to result in chronic toxicity at permitted discharge flow and 7Q10 receiving flow volumes). Since the inception of the program, a change in WET limitations has been observed. Previously, DWQ had predicted that approximately 25% of the facilities tested to be acutely toxic instream; however, DWQ has lowered that prediction to ten percent.

Aquatic toxicity testing, like other complex analytical techniques, requires a great deal of quality assurance and control to achieve reliable results. In 1988, North Carolina initiated a program that requires all laboratories performing NPDES analyses in North Carolina to be certified by the state as a biological laboratory. As of June 1996, 22 commercial, municipal, and industrial laboratories had achieved this certification in either aquatic toxicity analyses and/or aquatic population survey. The NC Biological Laboratory Certification Program, much like WET permitting in North Carolina, is looked at as a national leader in its field.

## Pretreatment Program

The goal of pretreatment program is to protect municipal treatment plants or publicly-owned treatment works (POTWs) as well as the environment from the discharge of hazardous or toxic wastes into a public sewage system. The pretreatment program regulates non-domestic (e.g., industrial) users of POTWs that discharge toxic wastes under the Domestic Sewage Exclusion of the Resource Conservation and Recovery Act (RCRA). In essence, the program requires that businesses and other entities that use or produce toxic wastes pretreat their wastes prior to discharging their wastewater into the sewage collection system of POTW. State-approved pretreatment programs are typically administered by local governments that operate POTWs.

Local pretreatment program address four areas of concern: (1) interference with POTW operations, (2) pass-through of pollutants to a receiving stream, (3) municipal sludge contamination, and (4) exposure of workers to chemical hazards. Interference refers to any problem with plant operation, including physical obstruction and inhibition of biological activity. DWQ and the local government develop local pretreatment limits by determining the maximum amount of each pollutant the plant can accept at the influent (or headworks) and still protect the receiving water, the POTW itself, and the POTW's sludge disposal options.

## Operator Certification and Training Program

Water pollution control systems must be operated by individuals certified by the North Carolina Water Pollution Control System Operators Certification Commission (WPCSOCC). The level of training and certification that the operator must have is based on the type and complexity of the wastewater treatment system. These systems include: wastewater treatment plants, wastewater collection systems and "non-discharge" ground absorption systems, such as alternative on-site disposal technologies and spray irrigation facilities. The Commission currently certifies operators in four grades of wastewater treatment, four grades of collection system operation, subsurface operation, spray irrigation operation, animal waste management and a variety of specialized conditional exams for specific technologies (e.g. oil/water separators).

The Technical Assistance and Certification Group of the North Carolina Division of Water Quality provides staff support for the Commission and assists in organizing training for operators in cooperation with the North Carolina University System, the North Carolina Community College System and through the professional associations for operators and pollution control professionals. Specialty courses and seminars for operators are also offered by the North Carolina combined Section Of The Water Environment Association/American Water Works Association (WEA/AWWA).

Training and certification of operators is essential to the proper operation and maintenance of pollution control systems. Without proper operation and maintenance, even the most effectively designed treatment system will not function efficiently. The goal of the WPCSOCC is to train competent and conscientious professionals that will provide the best wastewater treatment and thus protect the environment and public health.

## Nondischarge and Regional Wastewater Treatment Alternatives

DWQ requires NPDES permit applicants to consider alternatives for disposal of wastewater effluent other than discharge to a stream. For some, there may be no other economically feasible alternatives. However, for others, particularly smaller dischargers, there are a number of potentially cost-effective and environmentally sound alternatives. There are several types of non-discharging wastewater treatment systems including spray irrigation, rapid infiltration, trickling systems and underground injection. Researchers in North Carolina are evaluating artificial wetlands as wastewater treatment systems. Permit requirements for nondischarging systems are listed in Administrative Code Section 15 NCAC 2H .0200 - Waste Not Discharged to Surface Waters.

Another alternative to a surface water discharge is to tie into an existing wastewater treatment system. Where possible, DWQ is encouraging smaller dischargers to connect to large established municipal systems. Regionalization, as this is called, has several advantages. Large municipal facilities, unlike smaller package-type plants, have a larger and better-trained staff, thereby reducing the potential for plant malfunctions. When malfunctions do occur in a large plant, they can be caught and remedied more quickly than in a small plant. Larger facilities provide a higher level of treatment more economically and more consistently than can smaller plants. Larger plants are monitored daily. Additionally, centralizing the discharges reduces the number of streams receiving effluent. As DWQ evaluates future permit expansion requests from regional facilities, it will look favorably upon plants that accept flows from smaller discharges.

Nondischarge permits are required for alternative methods of wastewater treatment. Nondischarge permits are also issued for the land application of residual solids (sludge) from wastewater treatment processes.

# NONPOINT SOURCE CONTROL PROGRAMS

## Agricultural Nonpoint Source (NPS) Control Programs

Agricultural BMPs have been developed largely to control the five major agriculturally-related causes of pollution: nutrients, sediment, pesticides, oxygen-demanding substances and bacteria. BMPs vary from site to site and are dependent upon a particular pollutant but include practices such as grassed waterways and vegetated buffers, nondischarging animal waste lagoons, integrated crop and pest management and soil testing. BMPs may be administered through one or more of the agricultural programs described below. Common agricultural BMPs are listed in Appendix VI.

- **North Carolina Agriculture Cost Share Program**
  In 1984, the North Carolina General Assembly budgeted approximately $2 million to assist landowners in 16 counties within the "Nutrient Sensitive Water" (NSW) watersheds including the Upper Neuse River (Falls Lake) and the New River in Onslow County to implement BMPs for agricultural and silvicultural activities. These funds were increased in May 1987 to include 17 additional coastal counties by the passage of a General Statute formally creating the *Agriculture Cost Share Program for Nonpoint Source Pollution Control (NCACSP)*. In 1989 the NCACSP became a statewide program. The NCACSP will pay a farmer 75 percent of the average cost of implementing approved BMPs and offer technical assistance to the landowners or users which would provide the greatest benefit for water quality protection. The primary purpose of this voluntary program is water quality protection.

The local Soil and Water Conservation District Boards under the administration of the North Carolina Soil and Water Conservation Commission (SWCC) are responsible for identifying treatment areas, allocating resources, signing contractual agreements with landowners, providing technical assistance for the planning and implementation of BMPs and generally encouraging the use of appropriate BMPs to protect water quality. The criteria for allocating funds to the District is "based on the identified level of agricultural related nonpoint source pollution problems and the respective District's BMP installation goals and available technical services as demonstrated in the Districts annual strategy plan" (NC Administrative Code, Title 15, Chapter 6, Section 6E). This local participation is crucial to the success of the program.

The DEHNR-Division of Soil and Water Conservation (DSWC) provides staff, administrative and technical support to the SWCC. The DSWC also coordinates the efforts of various associated Program committees and acts as the clearinghouse for District strategy plans, contracts, etc. A legislated Technical Review Committee meets quarterly "to review the progress of the Program" (G.S. 143-215.74B) and to make technical recommendations to the Commission.

Technical assistance for the implementation of approved BMPs is provided to the Districts through a 50:50 cost share provision for technical positions to be filled at the District level. The USDA-Natural Resources Conservation Service also provides technical assistance.

- **North Carolina Pesticide Law of 1971**

In 1971 the General Assembly created and authorized the North Carolina Pesticide Board to regulate the use, application, sale, disposal and registration of pesticides for the protection of the health, safety, and welfare of the people and for the promotion of a healthy and safe environment. Some of the responsibilities of the Pesticide Board and the North Carolina Department of Agriculture include registering all pesticides prior to distribution and sale in North Carolina, sampling pesticides to insure that all products are up to guaranteed analysis and unadulterated by any other pesticide, sampling pesticides at time of application to insure that the applicator is following label instructions, and certifying the competency of applicators and dealers of restricted use pesticides.

The Pesticide Section of the North Carolina Department of Agriculture conducts mandatory annual inspections of all aircraft used in pesticide application and conducts random inspections of ground application equipment and chemigation systems (application of pesticides through irrigation systems). These inspections are intended to encourage proper calibration and use of equipment in order to avoid excessive application rates and accidental spills from faulty systems. Stop use orders are issued for noncompliance with the regulations.

Inspections are also required for bulk storage tanks prior to filling. All commercial pesticide storage facilities are required to have an approved Pre-fire Plan. In addition, each large commercial storage facility is required to develop and maintain an Emergency Contingency Plan. This plan describes the actions facility personnel shall take to respond to fires, explosions, spills, or any other sudden or gradual release of pesticides or pesticide contaminated materials to air, soil, or surface waters. The Contingency Plan is designed to minimize hazards to human health and the environment.

Penalties are assessed to careless pesticide applicators. Enforcement of the law is based on where the pesticide is deposited rather than just where it is applied. For example, if a pesticide is found in a stream as a result of wind drift, the applicator is subject to legal action. The Raleigh Office staff of the NCDA Pesticide Section is comprised of 20 employees. There are 10 Inspectors who conduct field-level compliance monitoring and investigation services. The annual budget for pesticide control and analytical work is $1.4 million.

- **NCDA Pesticide Disposal Program**

In 1976, the North Carolina Pesticide Board adopted regulations governing the disposal of pesticides. These regulations make it illegal in North Carolina to dispose of hazardous waste (which includes certain pesticides) in sanitary landfills. While households and farms which generate less than 220 pounds of hazardous waste and less than 2 pounds of acutely hazardous waste are exempt from federal disposal requirements, the regulations prohibiting the disposal of these wastes in sanitary landfills still applies to them. The option to use commercial hazardous waste disposal companies is too expensive and most companies will not pickup small quantities. As a result of this dilemma, the NCDA created the Pesticide Disposal Program in 1980 through appropriations from the General Assembly.

The goal of the Program is to provide an available, affordable and environmentally acceptable mechanism in which any homeowner, farmer, or institution can dispose of unwanted or unusable pesticides. It is mandatory, however, that all pesticide products are labeled correctly before NCDA will pick them up. An EPA permitted hazardous waste treatment or disposal facility (TSD) requires proper identification before the products can be disposed.

The Food and Drug Division of the North Carolina Department of Agriculture administers the Pesticide Disposal Program. The same staff used for enforcing the North Carolina Pesticide Law of 1971 are used in the Disposal Program.

- **Animal Waste Management**

*Regulations*

On December 10, 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H .0217) to establish procedures for properly managing and reusing animal wastes from intensive livestock operations. The goal of the rule is for intensive animal operations to operate so that animal waste is not discharged to waters of the state. This means that if criteria are met and no waste is discharged to surface waters, then an individual permit from DWQ is not required. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve more than or equal to the following animal populations: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds with a liquid waste system. These operations are deemed permitted if a signed registration and an approved waste management plan certification are submitted to DWQ by the appropriate deadlines.

The deadline for submittal of registrations to DWQ for existing facilities was December 31, 1993. Animal waste management plans for existing facilities must be certified by a technical specialist designated by the Soil and Water Conservation Commission and submitted to DWQ by December 31, 1997. The standards and specifications of the USDA Natural Resources Conservation Service are the minimum criteria used for plan approval by the local Soil and Water Conservation Districts.

*Operator Training and Certification*

The North Carolina General Assembly ratified Senate Bill 974 (NCGS 143-215.74C - E) on July 29, 1995, which requires that the Department of Environment, Health and Natural Resources, in cooperation with the Cooperative Extension Service, develop and administer a training and certification program for operators of swine facilities with more than 250 swine that land apply animal waste. The Department assigned the task of developing and administering this program to the Technical Assistance and Certification Group of the Water Quality Section. The purpose of this program is to reduce nonpoint source pollution associated with the operation of animal waste management systems. Animal waste management systems are defined as a combination of structural and non-structural practices that collect, treat, store, or apply animal waste to the land. All animal operations with 250 or more swine (Sus scrofa) are required to designate an Operator in Charge who has primary responsibility for the operation of the animal waste management system. There are approximately 4,000 animal operations in the state that are required to designate an Operator in Charge.

A steering committee was established that includes representatives from the animal agriculture industry, environmental groups, North Carolina Department of Agriculture, Natural Resources Conservation Service, Division of Soil and Water Conservation, North Carolina Cooperative Extension Service and the Division of Environmental Management. The primary purpose of this committee was to develop the instructional manual and exam questions for the training and certification program. The manual has been completed and is being used in the training sessions that are primarily being conducted by the Cooperative Extensive Service in each county. Also involved in the training will be personnel from the NC Department of Agriculture, Natural Resources Conservation Service and pork producers. The training sessions for the operators began in April 1996. The examinations will be administered by the Technical Assistance and Certification Group in eighteen locations throughout the state beginning in May, 1996.

Persons who wish to be certified as operators of animal waste management systems must attend a minimum of six hours of training and demonstrate competence in the operation of animal waste management systems by passing an examination. The training and certification requirements must be completed once every five years. Participants in the training program will receive instruction in the following areas: 1) proper operation of animal waste management system components such as lagoons and irrigation systems; 2) waste utilization plans and proper waste, soil and tissue sampling techniques; 3) proper application of waste including calculation of application rates and calibration of equipment; and 4) consequences of improper management and environmental stewardship.

*Inspection and Enforcement*

Prior to July, 1995, DWQ's limited compliance resources were mostly directed toward getting existing facilities registered, insuring that new and existing facilities had approved waste management plans and responding to citizen complaints.

Following major lagoon dike breaks in late June and July, 1995, DWQ and the Department's natural resources divisions made a major commitment to inspecting all animal operations. As of December 1, 1995, over 4,000 operations were inspected.

These inspections have found a very high percentage of these facilities with problems. DWQ is currently working with these problem facilities to get them into compliance. These efforts include technical assistance, Notices of Violations, notification of loss of deemed permitted status and other appropriate enforcement actions. Approximately 1,800 out of the 3,922 reports entered in the Division's database indicate a compliance problem. As of May 13, 1996, approximately 200 facilities were found to have a discharge during an inspection.

As of May 13, 1996, 40 civil penalty cases were assessed and 8 court injunctions have been filed. Eighty-five facilities have lost their deemed permitted status and are required to obtain a certified waste management plan prior to the December 31, 1997 deadline.

Animal Inspection Database
May 13, 1996

| Inspections | Total | Swine | Cattle | Poultry |
|---|---|---|---|---|
| Reports Entered | 3922 | 3,012 | 803 | 107 |
| Inadequate Freeboard | 579 | 449 | 87 | 43 |
| Seepage observed from lagoon | 118 | 85 | 26 | 7 |
| Erosion observed | 426 | 376 | 32 | 18 |
| Inadequate acreage available for spray | 112 | 96 | 3 | 13 |
| Cover crop inadequate | 225 | 206 | 4 | 15 |
| Man made conveyance of wastes | 154 | 99 | 52 | 3 |
| Inadequate Records | 1,078 | 868 | 162 | 48 |
| Non-Man made conveyance of wastes | 59 | 43 | 8 | 8 |

**This is preliminary information based on only the inspection reports entered as of the date of the report. These numbers are not considered accurate until a quality assurance procedure is in place. These numbers will change daily based on the entry of new reports and quality assurance checks of the information in the data base.**

*Swine Farm Siting Act*

The Swine Farm Siting Act, SB 1080, was adopted on July 11, 1995 to minimize adverse impacts on property adjoining concentrated animal operations. The Act specifies that a swine house or lagoon of a new farm sited on or after October 1, 1995 is required to be at least 1,500 feet from any occupied residence; at least 2,500 feet from any school, hospital, or church; and at least 100 feet from any property boundary. The Act restricts the application of lagoon effluent to land at least 50 feet from a residential property line and from any perennial stream or river, excluding irrigation ditches and canals. If written permission is given by the property owner and recorded with the Register of Deeds, a swine house or lagoon may locate closer to a residence, school, hospital, church, or property boundary.

- **NC Cooperative Extension Service and Agricultural Research Service**

  Crop and animal production programs are administered under the research and education activities of the NC Agricultural Research Service (ARS) and the NC Cooperative Extension Service (CES). The research and education efforts are broad and include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development and irrigation. Guidelines for most agricultural enterprises have been developed and made available to farmers. A more intensified water quality emphasis is being incorporated in these areas and many other projects undertaken by ARS and CES. The local contact that county CES agents have with farmers and homeowners provides an excellent opportunity for dialogue and education in nonpoint source pollution control. This network of contacts can be used to inform people about BMPs and to provide some structure for a general NPS education program.

  The NC Agricultural Research Service and the NC Cooperative Extension Service conduct broad research and education efforts that include areas such as variety development, crop fertilizer requirements, soil testing, integrated pest management, animal housing, animal waste management, machinery development, and irrigation. County Cooperative Extension agents work closely with farmers and homeowners, providing an excellent opportunity for dialogue and education in nonpoint source pollution control. In addition, CES has begun assisting DWQ in holding a series of public workshops in each river basin prior to DWQ's preparation of the draft basin plan.

- **Soil, Plant Tissue, and Animal Waste Testing Program**

  These services provide farmers with information necessary to improve crop production efficiency, to manage the soil properly and to protect environmental quality. The Soil, Plant

Tissue and Animal Waste Testing Program is administered by the Agronomic Division of the North Carolina Department of Agriculture. Water and wastewater from lagoons is also tested for irrigation and fertilizer use.

- **Watershed Protection and Flood Prevention Program (PL 83-566)**
The purpose of the Watershed Protection and Flood Prevention Program is to provide technical and financial assistance in planning, designing, and installing improvement projects for protection and development of small watersheds. The Program is administered by the USDA-Natural Resources Conservation Service in cooperation with the NC Division of Soil and Water Conservation, the State Soil and Water Conservation Commission, the U.S. Forest Service, Soil and Water Conservation Districts, and other project sponsors.

The emphasis of the Program over the past three decades has been to provide flood control. However, legislation has shifted emphasis of PL-566 land treatment projects so that a project proposal must demonstrate off-site water quality benefits in order to have any chance of funding.

- **Food Security Act of 1985 (FSA) and the Food, Agriculture, Conservation and Trade Act of 1990 (FACTA)**
There are several provisions authorized by the federal Food Security Act of 1985 (FSA) and re-authorized by the Food, Agriculture, Conservation, and Trade Act of 1990 (FACTA) which offer excellent opportunities for the abatement of agricultural nonpoint source pollution. The FSA and FACTA make the goals of the USDA farm and conservation programs more consistent by encouraging the reduction of soil erosion and production of surplus commodities and the retention of wetlands. At the same time, the provisions can serve as tools to remove from production those areas which critically degrade water quality by contributing to sedimentation. Important water quality-related provisions are known as the Conservation Reserve, Conservation Compliance, Sodbuster, Swampbuster, and Conservation Easement, Wetland Reserve, and Water Quality Incentive Program. These provisions are administered by the USDA.

Conservation Reserve Program
The Conservation Reserve Program (CRP) is administered by the USDA Agricultural Stabilization and Conservation Service (ASCS) and the USDA Natural Resources Conservation Service (NRCS). Other cooperating agencies include the NC CES, NC Division of Forest Resources and local Soil and Water Conservation Districts. The CRP was established to encourage removing highly erodible land from crop production and to promote planting long-term permanent grasses and tree cover. The ASCS will share up to half of the cost of establishing this protective cover. The intention of the program is to protect the long term ability of the US to produce food and fiber by reducing soil erosion, improving water quality and improving habitat for fish and wildlife. Additional objectives are to curb the production of surplus commodities and to provide farmers with income supports through rental payments over a 10 year contract period for land entered under the CRP.

Conservation Compliance
The Conservation Compliance provision of the FSA and FACTA discourages the production of crops on highly erodible cropland where the land is not carefully protected from erosion. Highly erodible land is defined as land where the potential erosion (erodibility index) is equal to eight times or greater than the rate at which the soil can maintain continued productivity. This rate is determined by the Natural Resources Conservation Service.

A farmer had until January 1, 1990 to develop and begin applying a conservation plan on highly erodible land. Plans were required to be operational by January 1, 1995. If a conservation plan is not developed and implemented, the farmer loses eligibility in price and income supports, crop insurance, FHA loans, Commodity Credit Corporation storage payments, farm storage facility loans, Conservation Reserve Program annual payments, and other programs under which USDA makes commodity-related payments. In other words, Conservation Compliance is an economic disincentive, quasi-regulatory program.

Sodbuster

The Sodbuster provision of the FSA and FACTA is aimed at discouraging the conversion of highly erodible land for agricultural production. It applies to highly erodible land that was not planted in annually tilled crops during the period 1981-85. As with the other provisions of the FSA, the Natural Resources Conservation Service determines if a field is highly erodible. If a highly erodible field is planted in an agricultural commodity without an approved conservation system, the landowner (or farmer) becomes ineligible for certain USDA program benefits.

Swampbuster

The purpose of Swampbuster is to discourage the conversion of wetlands to cropland use. Wetlands are defined as areas that have a predominance of hydric soils that are inundated or saturated by surface water or groundwater at a frequency or duration sufficient to support a prevalence of hydrophytic (water loving) vegetation. It is the responsibility of the Natural Resources Conservation Service to determine if an area is a wetland. Like the other provisions of the FSA and FACTA, a farmer will lose eligibility for certain USDA program benefits on all the land which is farmed if a wetland area is converted to cropland.

Conservation Easement

The Conservation Easement provision encourages producers whose FHA loans are in or near default to place their wetland, highly erodible land, and fragile land in conservation, recreation, or wildlife uses for periods of at least 50 years. The producer benefits by having the FHA loan partially canceled. The environment benefits by reducing the level of soil disturbing activities and the threat of agricultural pollutants.

Wetland Reserve

FACTA established a voluntary program for farmers to grant the federal government a 30-year or perpetual easement to wetlands. Eligible land includes farmed or converted wetlands which could be restored to their highest wetland function and value. The goal is to enroll one million acres by the end of 1995.

Water Quality Incentive Program

FACTA established this cost sharing program to help farmers control pollution problems associated with agricultural activities. A producer could receive up to $3,500 in cost share assistance to implement approved BMPs. The goal is to enroll 10 million acres by 1995.

## Nonpoint Source Programs for Urban and Developed Lands

- **Federal Urban Stormwater Discharge Program / NC NPDES Stormwater Program**

In 1987, Congress passed the Water Quality Act Amendments to the Clean Water Act requiring the U.S. Environmental Protection Agency (EPA) to develop regulations on permit application requirements for stormwater discharges associated with industrial activities as well as those associated with large and medium municipal separate storm sewer systems (population greater than 100,000). These regulations became effective in December 1990.

The goal of the stormwater discharge permitting regulations in North Carolina is to prevent stormwater runoff pollution by controlling the source(s) of pollutants. Defining the potential pollutant sources and establishing controls of the sources that will reduce and minimize pollutant availability will result in an improvement to the water quality of the receiving streams, consistent with the overall goal of the water quality program. Authority to administer these

regulations has been delegated to the North Carolina Division of Water Quality (DWQ). The NPDES stormwater regulations require that facilities with stormwater point source discharges associated with industrial activity and municipalities defined as either large or medium municipal separate storm sewer systems be permitted.
The municipal permitting requirements are designed to lead to the formation of site-specific stormwater management programs for a municipal area. Therefore, the permits issued to municipalities for their municipal separate storm sewer systems will be explicitly written for each individual municipality. Municipal permits of this type in North Carolina are currently required for Charlotte, Durham, Greensboro, Raleigh, Winston-Salem and Fayetteville/Cumberland County. The municipalities will develop and implement comprehensive stormwater quality management programs to reduce the discharge of pollutants in stormwater to the maximum extent practicable (MEP). MEP will be defined separately for each municipality required to be permitted. Industrial facilities discharging through a municipal separate storm sewer system are required to submit a permit application to the state and receive their own NPDES stormwater permit.

Industrial activities which require permitting are defined in eleven categories in the federal regulations ranging from sawmills and landfills to phosphate manufacturing plants and hazardous waste treatment, storage or disposal facilities. The regulations cover point source discharges that are related to manufacturing, processing, or material storage areas at an industrial facility. Stormwater discharges associated with industrial activities are required to be covered by permits which contain technology based controls based on Best Available Technology (BAT)/Best Conventional Pollutant Control Technology (BCT) considerations or water quality controls, if necessary. Through monitoring and regulating stormwater discharge quality, the goal of the NPDES stormwater program is to reduce the pollutant load in stormwater runoff.

The permitting requirements described here represent Phase I of the stormwater program. EPA and Congress are currently involved in studies to determine the scope of additional stormwater coverage under Phase II of the stormwater program. Further stormwater NPDES coverage could include additional industrial activities or additional municipal areas. If additional areas of coverage are added under the federal stormwater programs, DWQ will be responsible for the appropriate permitting of these areas within North Carolina.

- **Water Supply Watershed Protection Program**
  Approximately 50 percent of North Carolina's population depends on surface water supplies for drinking, commercial, and industrial uses. Water supplies have become more important in recent years because of increased demand for water, concern over potential contamination by toxic substances, and protection of human health. As a result, the General Assembly passed the Water Supply Watershed Protection Act of 1989 (NCGS 143-214.5). This Act requires all local governments that have land-use jurisdiction within surface water supply watersheds, or a portion thereof, to be responsible for implementation and enforcement of nonpoint source management requirements related to urban development, according to minimum standards adopted by the state. NPS control strategies are included in the rules for urban, agricultural, silvicultural, and Department of Transportation activities. The Water Supply Watershed Protection Rules were adopted by the Environmental Management Commission on February 13, 1992 and became effective on August 3, 1992. These rules were recently revised (effective August 1, 1995) to give local governments more flexibility in the implementation of water supply protection programs.

  The purpose of the Water Supply Watershed Protection Program is to encourage communities to work with the state to provide enhanced protection for their water supply from nonpoint pollution sources. There are five water supply classes that are defined according to existing land use and the amount and types of permitted wastewater discharges. (See Appendix I for a summary of the management requirements for the five water supply classifications.) By classifying a watershed as a water supply watershed, local governments with land use jurisdiction within the watershed will take steps to control nonpoint sources of pollution and thereby reduce the potential of pollutants contaminating drinking water supplies. In turn, the state limits the point source discharges that can locate within the watershed which reduces the potential of contamination of the water supply.

This dual approach of state and local government action to preclude potential impacts from stormwater runoff and wastewater discharges is important since only a small fraction of the pollutants that enter water supplies from nonpoint sources have water quality standards. As more is learned about the types and effects of pollutants in our drinking waters, the state will be forced to adopt additional water quality standards. If these additional standards are imposed, one effect may be that water treatment facilities will be required to apply additional technology and possibly more expensive treatment facilities or operation to ensure safe drinking water. It is, therefore, very important for the state and local governments to consider alternative means of preventing nonpoint source pollution from entering drinking water supplies in the first place. The land-use requirements, including density controls, buffers along perennial streams and stormwater control requirements for high density developments are but a few ways to accomplish this.

The Water Supply Protection Program is administered by staff in the Operations Branch of the DWQ. These staff coordinate with the Division of Community Assistance (NCDCA) which helps local governments develop land-use ordinances, the Division of Environmental Health, which certifies that a proposed water supply is suitable for drinking water, and DWQ staff in NCDEHNR regional offices who are responsible for water quality sampling. Statewide, the compliance rate for submittals is 100%.

- **Coastal Stormwater Management**

In November 1986, the EMC adopted rules which required new development in a limited zone (575 feet) around Class SA (shellfish) waters to control stormwater either by limiting density or completely controlling a 4.5 inch, 24-hour storm with the use of a stormwater treatment system. The regulations applied to development activities which required either a CAMA major permit or a Sediment/Erosion Control Plan (generally development disturbing more than one acre). The design storm, low density limits, and aerial coverage were all quite controversial and the adopted rules represented a compromise by all parties. A sunset provision was added to the rules to force the staff and Commission to reconsider the rules after a year. These rules expired December 31, 1987, but new stormwater regulations were adopted having an effective date of January 1, 1988. These regulations are administered by the DWQ. Approximately five man-years are allocated to implementing this program. Planning Branch staff are responsible ~~for providing guidance and interpretation to promote consistent implementation of the rules.~~ DWQ regional staff review and approve plans and enforce the requirements of the regulations.

Perhaps the most important measure accomplished with the regulations has been the applicability of stormwater controls to development activities within the 20 CAMA coastal counties. Certainly the near-water impact of stormwater as addressed in the original rules is important, but the staff believed the cumulative impact of stormwater runoff throughout the coastal zone also needed to be addressed. Therefore, the expanded area of coverage helps provide better protection of both shellfish waters and coastal water quality in general.

Other major items specified in the rules address the sizing of stormwater treatment systems. For developments adjacent to SA waters, infiltration systems must be able to retain 1.5 inches of rainfall, whereas development in other areas must control one inch of rainfall. Wet detention ponds are not allowed for stormwater control near SA waters and must be sized for 85 percent TSS removal in other areas. In addition, porous pavement is considered an innovative infiltration system (only five are allowed until they are proven to work) as evidence has not been provided regarding its effectiveness in coastal areas. A low density option of the new regulations applies a built-upon limit of 25 percent for SA areas and 30 percent for other coastal areas rather than a limit on effective impervious cover. Development exceeding these levels is required to have a engineered stormwater system as indicated.

In summary, the regulations which have an expanded aerial coverage increases the annual number of projects affected from approximately 50 (original rules) to 500. This increase is coincident with a reduction in design storm that is comparable to requirements in other states. In addition, the low density option, retained from the original regulations, is encouraged as operation and maintenance concerns associated with stormwater controls are not applicable.

- **Coastal Nonpoint Pollution Control Programs**
  As part of the Coastal Zone Act Reauthorization Amendments of 1990, Congress enacted a new section 6217 entitled "Protecting Coastal Waters". This provision requires states with coastal zone management programs (which includes North Carolina) that have received Federal approval under section 306 of the Coastal Zone Management Act (CZMA) to develop and implement Coastal Nonpoint Pollution Control Programs. The coastal nonpoint programs will provide additional control for sources of nonpoint pollution that impair coastal water quality. Sources subject to the 6217 Coastal NPS Program include: agriculture, forestry operations, urban and developing areas, marinas, hydromodification projects, and wetlands and riparian areas.

  Section 6217 requires coastal states to submit their coastal nonpoint control programs to the National Oceanic and Atmospheric Administration (NOAA) and the U.S. EPA for approval by July 1995. The programs are to be implemented by January, 1999. Failure to submit an approvable program by July 1995 will result in a state losing substantial portions of its Federal funding under section 306 of the CZMA and section 319 of the Clean Water Act. The coastal nonpoint program will be developed and administered jointly by the NC Division of Coastal Management and DWQ.

**Summary of Changes Since 1989**

- The N.C. DWQ has developed programs for the administration of NPDES stormwater permits for industries and municipalities.
- The N.C. DWQ has developed and issued eighteen general permits to cover a variety of facilities that discharge stormwater associated with industrial activity.
- Water Supply Protection Legislation was passed in N.C. which has resulted in the development and implementation of statewide water supply watershed protection requirements. This program is described in detail in the previous section.
- The stormwater management rules governing coastal areas, High Quality Waters and Outstanding Resource Waters have been modified. These rules were finalized and effective on September 1, 1995. These programs are described in more detail in the previous section.
- Educational Efforts: The N.C. DWQ has instituted a number of educational efforts related to stormwater management across the state. These efforts have included:

\- Guidance Manuals:
1 *Stormwater Management Guidance Manual*
2 *Stormwater Management In North Carolina: A Guide For Local Officials*
\- Fact Sheets on Stormwater Management
1 *Stormwater Problems and Impacts*
2 *Stormwater Control Principles and Practices*
3 *Stormwater Management Roles and Regulations*
4 *Local Stormwater Program Elements and Funding Alternatives*
\- Statewide Stormwater Conference - (1994)

- Statewide Workshops on The Water Supply Protection Program (1994 & 95)
- Statewide Workshops on Stormwater Management (1995)

- **ORW and HQW Stream Classifications**
  Outstanding Resource Waters (ORW) and High Quality Waters (HQW) have management strategies that address handling of urban stormwater. Controls for urban stormwater, either through development density limitations or stormwater treatment systems, are required by DWQ. Other NPS management agencies are expected to place priority on protecting these waters as well. For example, the NC Department of Transportation and the NC Division of Land Resources require more stringent sediment control on construction sites in ORW and HQW areas.

- **CAMA Land Use Plans**
  The Coastal Area Management Act (CAMA), passed in 1974, requires the development of land use plans by each of the 20 coastal counties that fall within the coastal area. These plans must be consistent with state guidelines and address a wide range of issues, including resource protection and conservation, hazards mitigation, economic development and public participation. Land use plans must be updated every five years. 1995 revisions to the land use planning guidelines strengthened the connection between land use planning and surface water quality. Future land use plan updates must consider water quality use classifications, watershed planning and problems identified in basinwide plans. There are 91 jurisdictions that have prepared and adopted CAMA land use plans.

  A land use plan is a "blueprint" used by local leaders to help guide the decisions that affect their community. Through land use planning, local jurisdictions can influence how growth will affect surface water quality by adopting policies supported by local ordinances, promoting better sedimentation and erosion control standards, stream buffers and lower levels of impervious surface cover. Although land use plans are required only in the state's coastal area, these land use planning tools for the protection of water quality are available to any jurisdiction which chooses to implement them.

## Construction - Sedimentation and Erosion Control Nonpoint Source Program

In 1973, the North Carolina General Assembly enacted the Sedimentation Pollution Control Act (SPCA). The Act authorized the establishment of a sediment control program to prevent accelerated erosion and off-site sedimentation caused by land-disturbing activities other than agriculture, forestry, and mining. The Land Quality Section of the Division of Land Resources is responsible for administration and enforcement of the requirements of the Act under the authority of the NC Sedimentation Control Commission.

The sediment control program requires, prior to construction, the submission and approval of erosion control plans on all projects disturbing one or more acres. On-site inspections are conducted to determine compliance with the plan and to evaluate the effectiveness of the BMPs which are used. The intent is to offer permanent downstream protection for stream banks and channels from damages caused by increased runoff velocities. If voluntary compliance with the approved plan is not achieved and violations occur, the Land Quality Section will pursue enforcement through civil penalties and injunctive relief. House Bill 448, passed in 1991, authorized the issuance of stop-work orders for violations of the SPCA. This additional enforcement mechanism will help improve the overall performance of the program.

Sedimentation control rules are more stringent for areas draining to waters supplementally classified as Trout or High Quality Waters.

Local programs are reviewed annually for compliance with the requirements of the Sedimentation Pollution Control Act. The Land Quality Section also conducts educational programs directed toward state and local government officials in order to strengthen the local programs. Persons engaged in land-disturbing activities and interested citizen groups are included in the educational effort.

The Sedimentation Control Commission has delegated to the Division of Highways of the North Carolina Department of Transportation (DOT) the authority to approve erosion and sedimentation control plans for land-disturbing activity conducted by that agency or by other persons under highway contracts with that agency. The DOT sedimentation control program has been reviewed by the Division of Land Resources under the authority of the Sedimentation Control Commission. DOT uses more stringent sedimentation controls in areas adjacent to High Quality Waters and Outstanding Resource Waters. The NC Department of Environment, Health, and Natural Resources (NCDEHNR) has established a position to evaluate environmental aspects of DOT highway projects and programs. DOT, in cooperation with DWQ, has developed and adopted formal BMPs for protection of surface waters. These BMPs and other efforts are significant improvements in developing a proactive system at DOT toward environmental issues.

**On-Site Wastewater Disposal - Sanitary Sewage Systems Nonpoint Source Program**

Septic tank soil absorption systems are the most widely used method of on-site domestic wastewater disposal in North Carolina. More than 52 percent of all housing units in the state are served by septic tank systems or other systems besides public or community sewage systems. A conventional septic system consists of a septic tank, a distribution box or equivalent branching lines, and a series of subsurface absorption lines consisting of tile or perforated pipes laid in a bed of gravel. All subsurface sanitary sewage systems are under the jurisdiction of the Commission for Health Services (CHS) of the Department of Environment, Health, and Natural Resources. The CHS establishes the rules for on-site sewage systems which are administered by the Division to Environmental Health. BMPs for onsite sewage systems are listed in Appendix VI.

According to GS 130A-335(e) and (f), the rules of the CHS and the rules of the local board of health shall address at least the following: sewage characteristics; design unit; design capacity; design volume; criteria for the design, installation, operation, maintenance, and performance of sanitary sewage collection, treatment, and disposal systems; soil morphology and drainage; topography and landscape position; depth to seasonally high water table, rock, and water impeding formations; proximity to water supply wells, shellfish waters, estuaries, marshes, wetlands, areas subject to frequent flooding, streams, lakes, swamps, and other bodies of surface or groundwaters; density of sanitary sewage collection, treatment, and disposal systems in a geographical area; requirements for issuance, suspension, and revocation of permits; and other factors which affect the effective operation in performance of sanitary sewage collection treatment and disposal systems.

The rules also must provide construction requirements, standards for operation, and ownership requirements for each classification of sanitary systems of sewage collection, treatment, and disposal in order to prevent, as far as reasonably possible, any contamination of the land, groundwater, and surface waters. There exists a strict permitting procedure which regulates site selection, system design, and installation of on-site sewage systems. Privately owned subsurface sewage discharging systems are governed by NCDEHNR through local county health departments. Authorized local sanitariums serve as agents of NCDEHNR and assist in implementing the state sewage rules. Local boards of health may adopt by reference the state rules and append to those rules more stringent laws and local criteria which they desire. These amendments, however, must be approved by the state. Only nine counties in the state currently operate under local rules. The 1983 amendments of the state public health laws eliminated the co-mingling of state rules with local rules except by state approval.

The Straight Pipe Elimination Amnesty Program was established in 1996 for the purpose of eliminating domestic sewage or wastewater discharges, from both straight pipes and overland flow of failing septic systems. The program contains three components: identification and elimination of domestic sewage discharges into streams currently or proposed to be used for public water supplies; an amnesty period to end on December 31, 1997 during which time violations of State rules and laws on domestic sewage and wastewater discharges identified as a result of this program will not result in legal consequences; and a public education effort on the program and the amnesty period.

## Solid Waste Disposal NPS Programs

- **Federal Program**
  The major federal legislation in the area of solid waste management is the Resource Conservation and Recovery Act (RCRA) administered by the U.S. Environmental Protection Agency (EPA). RCRA deals almost entirely with hazardous waste management but it does require that states meet minimum standards for solid waste facilities. EPA does not have permitting authority over solid waste management facilities.

- **State Program**
  States are accorded a major role in solid waste management by RCRA. North Carolina now operates under revisions by the General Assembly to Chapter 130A of the General Statutes. The Division of Solid Waste Management (DSWM) in the Department of Environment Health and Natural Resources is authorized as the single state agency for the management of solid waste. DSWM is responsible for the development of the state's solid waste management plan, has permitting authority over all solid waste management facility siting and operation, inspects permitted facilities, provides technical assistance, investigates complaints, responds to emergencies, monitors ground water quality at facilities, promotes the state's recycling effort, and closes non-conforming sites.

  The Solid Waste Management Act of 1989 established the policies and goals of the state to recycle at least 25 percent of the total waste stream by January 1, 1993. This Act created a Solid Waste Management Trust Fund to promote waste reduction and fund research and demonstration projects to manage solid waste. In 1991, the Solid Waste Management Act of 1989 was amended to broaden the goal to reduce the solid waste stream by 40 percent through source reduction, reuse, recycling, and composting by June 30, 2001.

  The state adopted solid waste management rules, effective February 1, 1991, requiring liner, leachate collection, and final cover systems at all new landfills, lateral expansions of existing landfills, and at all active landfills by January 1, 1998. Septage rules and regulations also have been adopted and are administered through a permit program.

- **Local Program**
  Solid waste collection and disposal has long been a municipal function. The operation of solid waste collection and disposal facilities is among the enterprises which municipalities are expressly authorized by statute to operate (G.S. 160A-311 through 160A-321). Municipalities are also authorized to regulate the disposal of solid waste within their corporate limits. Such regulations may specify the location and type of receptacles to be used for collection (G.S. 160A-192).

  Outside municipal limits, counties are authorized to operate solid waste collection and disposal facilities either as a function of county government or through establishment of a special service district (G.S. 153A-292 and 301). Since 1970, county governments have increasingly accepted responsibility for solid waste disposal activities and most disposal facilities in the state are now operated by counties or with county financial assistance.

## Forestry NPS Programs

- **Forest Practice Guidelines Related to Water Quality**
  Prior to January 1, 1990, all forestry operations were exempt from the permitting requirements of the Sedimentation Pollution Control Act (SPCA). Effective January 1, SPCA was amended to require all forestry operations to comply with nine performance standards in order to remain exempt from the permitting requirements of the SPCA. The nine performance standards are the *Forest Practice Guidelines related to Water Quality.* The FPGs, like the SPCA, are performance based. They require measures such as establishment of a streamside management zone along intermittent and perennial streams and waterbodies to restrain accelerated erosion and prevent visible sediment from entering intermittent and perennial streams and waterbodies.

  Use of Best Management Practices (BMPs) is encouraged to meet the FPG requirements. A *Forestry Best Management Practices Manual* and other publications are available to provide guidance in meeting the FPGs. DFR personnel work with landowners, timber buyers, and loggers when requested to help plan and prevent water quality problems. Under MOAs with the DLR, DWQ and NCDA, the DFR monitors compliance with the FPGs. If a potential violation is found, the DFR will attempt to get it corrected by the responsible party(ies) within a reasonable time frame. If it is not corrected, a referral of the project is made to the appropriate regulatory agency for enforcement action. If this happens, the project is deemed out of compliance with the FPGs and subject to permitting requirements of the SPCA.

- **National Forest Management Act (NFMA)**
  The National Forest Management Act was passed in 1976 and applies to all lands owned or administered by the National Forest System. The Act stipulates that land management plans be prepared which consider economic and environmental aspects of forest resources. The Act further states that timber will be harvested from National Forest lands only where soil, slope, or other watershed conditions will not be irreversibly damaged; and where protection is provided for streams, streambanks, shorelines, lakes, wetlands, and other bodies of water from detrimental changes in water temperatures, blockages of watercourses, and deposits of sediment, where harvests are likely to seriously and adversely affect water conditions or fish habitat.

- **Forest Stewardship Program**
  The Forest Stewardship Program was begun in 1991 by the US Forest Service, with the DFR as the lead agency in North Carolina. In cooperation with other natural resource agencies, the Forest Stewardship Program is intended to bring more forest land under management. Identifying four resource categories, (timber, fisheries and wildlife habitat improvement, recreation and aesthetics, and soil and water conservation), Forest Stewardship Plans are developed for landowners based on their individual goals and objectives. A landowner mush own at least 10 acres of woodland, and agree to manage it to improve at least three of the four resources while maintaining the fourth in at least the same condition. Primary cooperating agencies with the DFR are the NC WRC, USDA-NRCS, NC CES, and USDA-FSA.

## Mining NPS Program

In 1971 the North Carolina General Assembly passed the Mining Act to ensure that the usefulness, productivity, and scenic values of all land and waters involved in mining will receive the greatest practical degree of protection and restoration. The Mining Commission is the rule-making body for the Act and has designated authority to administer and enforce the rules and regulations of the

Act to the Mining Program within the Land Quality Section of the NCDEHNR Division of Land Resources.

The Mining program has four major areas of responsibility. First, the Program requires submission and approval of a mining permit application prior to initiating land disturbing activity if the mining operation is one (1) or more acres in surface area. The mining permit application must have a reclamation plan for these operations. Second, the Program conducts on-site inspections to determine compliance with the approved application and whether or not the plan is effective in protecting land and water quality. Third, the program pursues enforcement action through civil penalties, injunctive relief, and/or bond forfeiture to gain compliance when voluntary compliance is not achieved. Finally, the Mining Program conducts educational efforts for mine operators.

## Wetlands Regulatory NPS Programs

There are numerous reasons for preserving wetlands, but of special interest within the context of basinwide planning is their role in protecting water quality. Because of their intrinsic characteristics and location within the landscape, wetlands function to protect water quality in a number of ways. These functions include the retention and removal of pollutants, stabilization of shorelines, and storage of flood waters.

Numerous authors have studied the effectiveness of riparian wetland forests for nutrient retention and transformation (Jones et al. 1976; Yates and Sheridan 1983; Brinson et al. 1984; Lowrance et al. 1984; Peterjohn and Correll 1984; Jacobs and Gilliam 1985; Budd et al. 1987; and Groffman et al. 1991). The location of riparian wetlands allows them the opportunity to receive nutrients from the surrounding landscape as well as through overbank flooding. In addition to the storage of nutrients in wetland vegetation, the microbial and chemical processes within wetland soils may function to completely remove nutrients from the system.

Headwater riparian wetlands are extremely important and effective in terms of sediment and associated nutrient and toxicant retention and transformation. Since small streams comprise most of the total stream length within a watershed (Leopold 1974), these areas intercept the greatest proportion of eroded sediments and associated substances from uplands before these pollutant reach waters downstream. Novitzki (1978) found that approximately 80% of the sediments entering a stream were retained in headwater wetlands.

Wetlands adjacent to streams, rivers and lakes stabilize shorelines and help protect these bodies of water from erosive forces. This function is particularly important in urbanized watersheds where the prevalence of impervious surfaces contributes to greater peak storm flows. Wetland vegetation serves to dissipate erosive forces and anchors the shoreline in place preventing sediments and associated pollutants from entering waterways. Wetlands by their very nature of being "wet" are also vital for water storage. Those wetlands adjacent to surface waters, that have the opportunity to receive flood waters and surface runoff, are most important to water storage. Wetlands located in headwaters generally minimize peak flood waters in tributaries and main channels. Lakes and wetlands with restricted outlets hold back flood waters and attenuate flood peaks (Carter et al. 1978).

Several important state and federal wetland protection programs are described below. In addition to the following wetlands programs, provisions of the 1985 and 1990 Farm Bills, discussed in Section 5.3.1, should also help reduce wetlands impacts. Agriculture conversions should be reduced by the "swampbuster" provision of the 1985 Farm Bill, which encourages farmers not to convert wetlands for agriculture to prevent the loss of their USDA subsidies, loans, and price supports. Silviculture is exempted from the swampbuster provision and therefore, conversion of wetlands for intensive or managed forestry is not affected by this provision. A Wetland Reserve

Program was established by the 1990 Farm Bill with the goal of allowing one million acres of prior-converted wetlands to revert back to wetlands by 1995.

- **Section 10 of the Rivers and Harbors Act of 1899**
This act, administered by the US Army Corps of Engineers, provides the basis for regulating dredge and fill activities in navigable waters of the United States. Originally, this Act was administered to protect navigation and the navigation capacity of the nation's waters. In 1968, due to growing environmental concerns, the review of permit applications was changed to include factors other than navigation including fish and wildlife conservation, pollution, aesthetics, ecology, and general public interest. Activities which may be covered under the Act include dredging and filling, piers, dams, dikes, marinas, bulkheads, bank stabilization and others.

- **Section 404 of the Clean Water Act**
The U.S. Army Corps of Engineers administers a national regulatory program under Section 404 of the Clean Water Act aimed at controlling the discharge of dredged or fill material into waters of the United States. Section 404 applies to the discharge of dredged or fill materials into waters of the United States including dredging. Waters of the United States refers to navigable waters, their tributaries, and adjacent wetlands. Activities covered under Section 404 include dams, dikes, marinas, bulkheads, utility and power transmission lines and bank stabilization. Although the 404 program does not fully protect wetlands, it is nonetheless the only existing federal tool for regulating wetland development statewide. State legislation has not been adopted to protect inland freshwater wetlands in North Carolina, as has been done for coastal wetlands, but the EMC in March of 1996 adopted rules which will formalize the wetlands protection measures associated with the 401 Water Quality Certification review process.

- **Section 401 Water Quality Certification (from CWA)**
The Division of Water Quality is responsible for the issuance of 401 Water Quality Certifications. Section 401 of the federal Clean Water Act provides that no federal agency can issue any license or permit to conduct any activity that may result in a discharge to navigable waters unless the state in which the discharge may occur certifies that the discharge will not result in a violation of any state water quality or related standards. Thus, a 401 certification is required for, among other things, a discharge into surface waters or wetlands for projects that require a section 404 permit. A federal permit cannot be issued if a 401 certification is denied. Any conditions added to the 401 certification become conditions of the 404 permit. The 401 certification process is coordinated with the 404 and CAMA processes in the 20 counties of CAMA jurisdiction.

- **North Carolina Dredge and Fill Act (1969)**
This act requires permits for "excavation or filling begun in any estuarine waters, tidelands, marshlands, or state-owned lake". This law is currently administered with North Carolina's Coastal Area Management Act (CAMA) (1974).

- **Wetlands Restoration Program/Funds**
The Wetlands Restoration Program was established in 1996 as a nonregulatory program "...for the acquisition, maintenance, restoration, enhancement, and creation of wetland and riparian resources that contribute to the protection and improvement of water quality, flood prevention, fisheries, wildlife habitat, and recreational opportunities". The purposes of the program include: the restoration of wetlands function and values; to provide a consistent and simplified approach to mitigation requirements associated with permits or Corps of Engineers authorizations; to streamline the permitting process; to increase the ecological effectiveness of mitigation efforts; to achieve a net increase in wetlands acres, functions and values for each major river basin; to promote a comprehensive approach to environmental protection.

Through the Wetlands Restoration Program, basinwide plans for wetlands and riparian area restoration will be developed. The goals of the plans are to protect and enhance "...water quality, flood prevention, fisheries, wildlife habitat, and recreational opportunities..." These plans will be developed for each of the seventeen major river basins in the state beginning in July 1997. Compensatory mitigation ( a required condition of section 404 permits issued by the U.S. Corps of Engineers) options will be addressed within the plans.

A Wetlands Restoration Fund has been established under the program. The Fund is a trust fund designed as a repository for monetary contributions and dedication of interest to real property under the compensatory mitigation options. These funds will primarily be used to restore, enhance, preserve or create wetlands and riparian areas in accordance with the basinwide plan.

## Hydrologic Modification

Hydrologic modification is defined as channelization, dredging, dam construction, flow regulation and modification, bridge construction, removal of riparian vegetation, streambank modification/destabilization, and dam collapse. By its very nature hydrologic modification is closely tied to wetland issues. It is not surprising then that the U.S. Army Corps of Engineers (Corps) is the agency most involved in issuing permits for land-disturbing activities in wetlands. These permits are issued through Section 404 and the Rivers and Harbors Act discussed above.

In addition to wetland issues, dam construction and the lack of low flow releases into streams can severely impact downstream aquatic resources. Dam construction, repair, modification, and removal are regulated by the NC Division of Land Resources under the Dam Safety Law of 1967. A dam safety permit is required for any dam which is 15 feet or greater in height (from top of dam to lowest point on downstream toe) and the impoundment capacity is 10-acre-feet or greater at the top of the dam. Low-flow release requirements to maintain adequate instream flows are established in permits where appropriate. Instream flows are recommended by the NC Division of Water Resources.

There are several other programs which can affect hydrologic modification. The Forest Practice Guidelines Related to Water Quality requires streamside management zones to be maintained during logging operations. The Water Supply Watershed Protection Program also has requirements to maintain buffers for certain activities. The Conservation Reserve Program encourages the establishment of vegetative filter strips (66-99 feet wide) for farming operations. A significant number of local governments have established greenway programs within urban settings in order to maintain and protect riparian areas.

## Water Supply Legislation in North Carolina

- **Water Supply Planning Law**
  The Water Supply Planning law (G.S. 143-355 (l) and (m)) was adopted in 1989 and amended in 1993. It requires all local governments that supply or plan to supply water to prepare a local water supply plan. In their plans, local governments are to include present and projected population, industrial development and water use within the service area, present and future water supplies, an estimate of technical assistance needs and other information that may be required by the Department. All local plans are to be approved and submitted to DWR by January 1, 1995. Information in those local plans is to be included in a State Water Supply Plan. The State Plan will also investigate the extent to which the various local plans are compatible.

- **Registration of Water Withdrawals and Transfers Law**
  The Registration of Water Withdrawals and Transfers law (G.S. 143-215.22H) requires any person who withdraws or transfers 1 MGD or more of surface water or groundwater to register the average daily and maximum daily withdrawal or transfer with the Environmental Management Commission (EMC). The law also provides that if a local government has an approved local water supply plan on file with DWR, it does not have to register that withdrawal, thereby reducing duplication of effort by local governments that otherwise would be subject to both laws. In addition, the law includes a 5-year renewal requirement, which will ensure that the data is regularly updated.

- **Regulation of Surface Water Transfers Act**
  In 1993, the legislature adopted the Regulation of Surface Water Transfers Act (G.S. 143-215.22I et seq.). This law was designed to regulate large surface water transfers by requiring a certificate from the EMC and by repealing several other laws that had previously affected interbasin transfers. The law applies to anyone initiating a transfer of 2 MGD from one river basin to another and to anyone increasing an existing transfer by 25 percent or more if the total transfer is 2 MGD or more. Applicants for certificates must petition the EMC and include a description of the transfer facilities, the proposed water uses, water conservation measures to assure efficient use and any other information desired by the EMC. A certificate will be granted for the transfer if the Commission concludes that the overall benefits of the transfer outweigh its detriments. The Commission may grant the petition in whole or in part, or deny it, and it may require mitigation measures to minimize detrimental effects. The law also provides for a $10,000 civil penalty for violating various statutes.

- **Capacity Use Act**
  DWR administers the Capacity Use Act (G.S. 143-215.11 et seq.), which allows the EMC to establish a Capacity Use Area where it finds that the use of ground water, surface water or both requires coordination and limited regulation. If after an investigation and public hearings a Capacity Use Area is designated, the EMC may adopt regulations within the area, including issuance of permits for water users. In the near future, DWR plans to review the rules for implementation of the Capacity Use statute and develop a model of the aquifer system, in coordination with the Groundwater Section of DWQ, for Capacity Use Area 1, which was created to regulate surface water and ground water withdrawals in an area surrounding Texasgulf, Inc. in Aurora, N.C. A new ground water flow model will be used to simulate Capacity Use Area 1 as a basis for permitting withdrawals.

- **Dam Safety law**
  The Dam Safety law (G.S. 143-215.24) was amended in 1993, and rules are being developed for implementation of these amendments. Among the changes, the amendment defines "minimum stream flow" as a quantity and quality sufficient in the judgment of the Department of Environment, Health and Natural Resources (DEHNR) to meet and maintain stream classifications and water quality standards established by DEHNR and to maintain aquatic habitat in the affected stream length.

  The Dam Safety Law applies to dams that are 15 feet or more high or with impoundment capacity of 10 acre feet or more. The law requires that the EMC adopt rules specifying minimum stream flow in the length of the stream affected by a dam and sets specific parameters for minimum stream flow for dams operated by small power producers that divert water from 4,000 feet or less of a natural stream bed and return the water to the same stream.

## Section 319 Nonpoint Source Management and Other Programs

- **Section 319**
  Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP demonstrations, watershed water quality improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and others. North Carolina DWQ established a Workgroup process in 1995 for prioritizing and selecting projects from the pool of cost-share proposals for inclusion in its annual application to EPA. DWQ staff first reviews proposals for minimum 319 eligibility criteria such as:
  - support state Program milestones;
  - address targeted, high priority watersheds;
  - provide sufficient cost-share match (40% of project costs);
  - propose adequate time periods;
  - identify measurable outputs;
  - use compatible GIS products with those of the state; and
  - make commitment for educational activities and a final report.

  Workgroup members separately review and rank each proposal which meets the minimum 319 eligibility criteria. The Workgroup consists of representatives from the state and federal agencies that deal with NPS issues, including agricultural, silvicultural, on-site wastewater, mining, solid waste and resource protection. In their review, members consider such factors as: technical soundness; likelihood of achieving water quality results; degree of balance lent to the state Program in terms of project type; and competence/reliability of contracting agency. They then convene to discuss individual projects' merits, to pool all rankings and to arrive at final rankings for the projects. All proposals that rank above the funding target are included in the annual grant application to EPA, with DWQ reserving the right to make final changes to the list. Actual funding depends on approval from EPA and yearly Congressional appropriations.

- **Use Restoration Waters**
  The North Carolina Division of Water Quality is currently developing the Use Restoration Waters (URW) program to restore surface waters to their designated uses. If adopted, this program will allow the state to work with local governments, businesses, and residents to develop management strategies appropriate for the area. In order to be effective, the URW program will include a mix of mandatory and voluntary programs. The voluntary and mandatory programs will be coordinated on a site-specific basis by DWQ and a group of stakeholders who have an interest in the impaired water body and associated watershed. In addition, the URW program will attempt to develop cooperative relationships among these agencies so that overlapping efforts can be consolidated and targeted to restore designated water body uses.

  The URW Program will apply to polluted surface waters where the following conditions apply:
  - Biological, physical and/or chemical data indicate the specific sources of pollution.
  - A use attainment study indicates that the sources of pollution are not transitory.
  - It is possible to control the sources of pollution by implementing appropriate management strategies under the existing authority of the North Carolina Environmental Management Commission (EMC), other state commissions, and local agencies or voluntary actions implemented by citizens and other groups.

Based on current water quality data, there are approximately 4,300 miles of freshwater streams (or about 1.4 percent of total miles) and about 40,000 saltwater acres (or about 2 percent of total saltwater acres) that would be potential candidates for URW consideration.

The restoration strategies developed under the URW Program will be site-specific to the watershed of the nonsupporting or impaired water body. DWQ and the stakeholders will coordinate each URW strategy with other agencies' programs to create a holistic approach to address the array of pollution problems in the watershed.

- **The Nonpoint Source (NPS) Team Process**

Successfully managing NPS pollution requires not only a knowledge of science and technology, but also an understanding of the local resources and economy. Although there are some general management guidelines, there is no single technique for controlling NPS pollution. The most efficient and effective NPS solutions will be site-specific. Formulating NPS solutions often requires cooperation between different interested parties. Each group that contributes to the NPS problem must be part of the solution.

DWQ will coordinate the Watauga NPS Team to include a wide variety of stakeholders interested in the basin. This team will take the lead in identifying NPS problems and implementing solutions. The NPS Team process is discussed below and in Chapter 7.

**1. Coordinate the NPS Team.**
DWQ's goal in forming the Watauga NPS Team is to choose predominantly locally-based members that represent the federal, local, and state agencies, local governments, industries, and citizens' groups that have interests and responsibilities pertaining to NPS pollution. DWQ will consult local groups to determine which interests should be represented on the team.

Once the NPS Team is formed, DWQ and the team will work as partners to identify, prioritize, and address the NPS problems in the basin. DWQ will offer information from the state's water quality monitoring program and its staffs' knowledge of technical and financial resources. The NPS Team will describe current NPS initiatives, identify priority NPS-impaired waterbodies, and analyze NPS issues and needs. One of the most important missions of the DWQ-NPS Team partnership is to foster coordination and cooperation between the basin's diverse interest groups and agencies. The eventual goal of the NPS Team is to create and implement Action Plans that will address priority *NPS-impaired waterbodies* and *NPS issues* as part of the basinwide planning process. The implementation schedule will be determined as the plans are developed.

**2. Take inventory of the initiatives and programs in place to address NPS pollution.**
Each member of the NPS Team will describe the existing initiatives and programs of the agency or group he/she represents. A list of these initiatives is included in the basinwide plan to show readers some of the potential resources for addressing their NPS problems (see Chapter 5). This effort will provide an opportunity for mutual education, understanding and coordination with other stakeholders. An important responsibility of the NPS Teams will be to assess whether existing initiatives and programs in the basin are successfully improving water quality.

**3. Choosing the priority NPS-impaired waterbodies and NPS issues.**
Since the NPS Team will not be able to address all of the *NPS-impaired waterbodies* and *NPS issues* in the basin, it will have to follow a system for prioritization. The NPS Team will use the following process to target NPS-impaired waterbodies and select NPS issues.

*Selecting the Priority NPS-impaired Waterbodies*

Within the guidelines described below, the NPS Team will select at least one NPS-impaired waterbody for which an Action Plan will be developed. More than one waterbody may be selected if time and resources allow. The goal of the Action Plan will be to restore the designated use of the selected waterbody using a comprehensive, site-specific, and coordinated approach. The Actions Plans will be a prime candidate for funding under the federal Section 319(h) program.

The NPS Team will use both primary and secondary criteria to select the *priority NPS-impaired waterbodies*. The primary criteria are (in order of importance):

- Highly-valued resource waters, such as High Quality Waters and Water Supplies I-IV, that have a demonstrated pollution problem.
- Monitored waters that have an overall use support rating of non-supporting.
- Monitored waters that have a use support rating of partially supporting but have a high predicted loading for one or more pollutants.
- Highly valued resource waters, such as High Quality Waters and Water Supplies I-IV, that are in need of protection.
- Monitored waters that have an overall use support rating of partially supporting.

DWQ will provide a list of waterbodies that meet the primary criteria to the NPS Team.

The secondary criteria for selecting the priority *NPS-impaired waterbodies* are:

- Waters that pose a potential threat to human health,
- Waters that are important for ecological reasons not reflected in their classification and use support ratings (such as endangered species, unique habitats, or significant biological resources),
- Waters that are highly eroded or have other evidence of serious erosion problems that are not reflected in the use support ratings,
- Waters that have experienced a recent, rapid decline in water quality, and
- Waters that have identifiable pollution sources and a high likelihood of successful restoration.

An NPS-impaired waterbody that meets the primary criteria as well as one or more of the secondary criteria listed above is a good candidate for prioritization by the NPS Team. However, the NPS Team may select a priority NPS-impaired waterbody that does not meet the primary criteria but meets *several* of the secondary criteria. This allows the team to select waters that DWQ did not monitor or waters for which the use support rating failed to describe the extent of the NPS problem.

*Selecting the Priority NPS Issues*

In order to address problems in the remaining NPS-impaired or threatened waterbodies (ones not prioritized for specific Action Plans), the follwing criteria will be used to target NPS issues throughout the basin:

- Issues that apply throughout a significant portion of the basin <u>or</u> address one or more impaired waters that were not selected as a *priority NPS-impaired waterbody,*
- Issues that have a clearly defined "problem" and "solution," and
- Issues that are within the team's ability to address through educational efforts, improved coordination between stakeholders, focused new initiatives, or involvement of additional stakeholders.

**4. Determine what is needed to address the priority NPS-impaired waterbody and the NPS issues the team selects.**

The NPS Team will decide which actions are likely to restore the priority NPS-impaired waterbodies and address the NPS issues. Some of the possible needs include:

- Public education. When water quality problems result from citizens' lack of knowledge about how their local actions affect water quality or from land use decisions, public education is a key component of the solution.
- Implementation of best management practices (BMPs). BMPs are structural or nonstructural management practices used to reduce nonpoint source inputs to receiving waterbodies in order to achieve water quality protection goals. Often higher levels of pollutant removal can be achieved by using a combination of different BMPs.
  * Structural BMPs generally work by capturing, retaining, and treating runoff before it leaves an area. Some examples of structural BMPs include constructed wetlands and wet detention ponds in urban settings and controlled drainage on agricultural lands. Structural BMPs require regular maintenance.
  * There are a variety of nonstructural BMPs. One nonstructural BMP is source reduction, which reduces the amount of pollutants that are introduced into the environment. Some types of source reduction are nutrient management plans for crop production and hazardous waste collection sites in urban areas. Another nonstructural BMP is maintaining natural drainageways to allow the vegetation and soil to cleanse runoff before it enters a waterbody.
- Ecosystem restoration and management. If a stream's ecosystem is badly damaged, removing pollutants alone will not always restore the water's uses. In cases like these, it will be necessary to restore the ecosystem through measures such as riparian revegetation and streambank stabilization.
- Local water quality planning. Development sites can be planned in order to reduce their risk of harming water quality. Some planning techniques include steering development towards less environmentally sensitive areas, using natural drainage systems rather than curb and gutter, and planning for development densities that allow for open space, greenways, and wildlife corridors.

**5. Develop comprehensive Action Plans consisting of management strategies to address the priority NPS-impaired waterbody and the NPS issues.**

The NPS Team members will work together to develop "Action Plans." These Action Plans will consist of a list of Action Items that form a coordinated, comprehensive effort to address each priority NPS-impaired waterbody and NPS issue. Each Action Item will include lead contacts, goals, and a schedule for completion and may utilize one or more of the following vehicles for implementation:

- Efforts by NPS Team members: The NPS Team members can make commitments to target their agency's/group's existing resources to address the priority NPS-impaired waterbody or NPS issues. Team members can also agree to share their expertise on a volunteer basis.
- Section 319: Clean Water Act Section 319(h) grant monies are made available to the states on an annual basis by EPA. Agencies in the state that deal with NPS problems submit proposals to DWQ each year for use of these funds in various projects. Projects that have been funded in the past include BMP demonstrations, watershed water quality improvement projects, data management, educational activities, modeling, stream restoration efforts, riparian buffer establishment, and others. Refer to Section 5.7 for a complete program description.

- Agriculture Cost Share Program: Provides a number of cost-share practices designed to solve soil, water, and related environmental problems in agricultural areas including forested buffer strips.
- Wetlands Restoration Program. A bill recently ratified by the NC General Assembly establishes a statewide Wetland Restoration Program that will provide a leadership role in targeting and consolidating all wetland and riparian area restoration initiatives in NC.
- Proposed Use Restoration Waters (URW) Program. DWQ is currently developing the URW program to restore surface waterbodies to their designated uses. If adopted, this program would allow the state to work with local governments, businesses, and residents to develop focused management strategies appropriate for the area. Those affected by the URW program will be requested to meet well-defined milestones and goals for water quality improvement. If these milestones are not met on a voluntary basis within an established schedule, mandatory controls may be considered by the Environmental Management Commission.
- Federal Initiatives: There are a number of federal programs and resources that may be available to address the Priority NPS-impaired waterbody and NPS issues. These include US Fish and Wildlife Service funds, the USDA-NRCS Wetland Reserve Program, and the Environmental Quality Initiative Program (EQIP) provisions of the Farm Bill.
- Other Programs: There are numerous other programs sponsored by private and state agencies that could be initiated to address the NPS Team's priority waterbodies and issues. Some of these programs include corporate funding for educational programs, the Small Watershed Program, and US Fish and Wildlife Grants. A complete list of funding sources for NPS pollution is listed in Appendix VIII.

**6. Implement Action Plans.**

Implementation is the most important part of the state's NPS program since it is the only way to restore the priority NPS-impaired waterbody and address NPS issues. Most, if not all, members of the NPS Team will be involved with the implementation of one or more of the Action Items. During the implementation phase, the NPS Team will continue to meet on a regular basis. The purpose of these meetings will be for the team to update each other on their progress toward completing the Action Items and provide a forum for continuing the coordination between team members. When some of the team members experience setbacks in implementing an Action Item, the rest of the team can advise and/or provide additional help so that the item can be completed successfully.

**7. Monitor to evaluate the effectiveness of management strategies.**

The NPS Team will identify where additional water quality monitoring sites may be needed to document the effectiveness of its Action Plans. DWQ and the NPS Team will cooperate to assure that pre- and post-monitoring is in place before a new program, initiative or BMP is implemented. In order to supplement DWQ's monitoring programs, the team may seek the involvement of citizens' groups. Any agencies that receive 319 grants will be required to conduct pre- and post-evaluations as a part of their project.

**8. Consider additional management strategies if the voluntary approaches do not result in an improvement in water quality.**

If the NPS Team's management strategies do not show progress in improving water quality according to the designated schedule, DWQ and the team will work together to identify the reason for the lack of progress. Some of the potential courses of action are:

- Reevaluate the source of impairment.
- Increase and/or redirect voluntary measures.
- Consider additional measures.

# APPENDIX VII

## ESTIMATION OF NUTRIENT LOADS FOR WATERSHEDS IN THE CHOWAN BASIN

# ESTIMATION OF NUTRIENT LOADS FOR FOUR NORTH CAROLINA SUBBASINS IN THE CHOWAN RIVER BASIN

## Introduction

In 1979, after frequent and persistent algal blooms in the preceding years, the Environmental Management Commission adopted a Nutrient Sensitive Waters classification for the Chowan River. As a result of the of the reclassification NC DEM (Division of Environmental Management) produced the Chowan River Water Quality Management Plan (1982) which called for nutrient reduction goals of 20% for total nitrogen and 35% for total phosphorus. DEM also released 1990 update of the plan which stipulated that the 20% nitrogen reduction had been met and that a 29% reduction of total phosphorus had been achieved by 1989. (An in depth history of Chowan River nutrient management and algal bloom studies and reports is presented in Chapter 3 of this basin plan.)

At each subsequent update of the water quality management plan estimates of total nitrogen and phosphorus loading where developed for the basin. However, due to changing methods of estimating watershed wide nutrient loading, there is little or no opportunity for comparison between loading estimates. For purposes of the 1997 Chowan River Basinwide Water Quality Management Plan a comprehensive nutrient loading budget was developed for North Carolina portion of the watershed utilizing the most up to date methods and data that where available. The nutrient budget was developed to estimate nutrient loadings from the four DEHNR subbasins that comprise the Chowan basin, and for the basin as a whole.

Both point and nonpoint source loads are included in the nutrient budget. Point source loads represent the annual loading from permitted dischargers in the watershed under current conditions (1996). Nonpoint source loads represent the net export of nutrients from areas of varying land use within each watershed. These loads were calculated using an export coefficient model utilizing land cover information derived from LANDSAT data and nutrient export estimates derived from the literature. Atmospheric loadings were also calculated using export coefficients. The specific methodology used is discussed below.

## Point Source Loads

Discharge monitoring data for the period from January to December, 1996 were obtained from the DWQ (Division of Water Quality) Compliance Monitoring System data base via FOCUS retrieval for all facilities in the basin. Average daily nitrogen and phosphorus loads for facilities with available N and P data were calculated in the process of the retrieval and multiplied by 365 to determine annual loads. Calculations and loads for all facilities are shown in Table VII-2.

## Nonpoint Source Loads

The nutrient export coefficient approach (Reckhow et al, 1989; Novotny and Olem, 1994) calculates mass nutrient export from a given parcel of land as the product of land area and a unit load. The unit load, or nutrient export coefficient, is a measure of the nutrient export (mass load) per unit area per unit time, for example, pounds of N per acre per year). Unit loads will vary by the type of land cover and the nature of land use practices in a particular area. Numerous field studies have been conducted to estimate the amount of nitrogen and phosphorus entering surface waters from various land uses.

The land use/land cover data set used to develop the nutrient loading estimates discussed here was developed by the NC Center for Geographic Information and Analysis (CGIA) utilizing 1988 LANDSAT data. CGIA classified the Albemarle-Pamlico Estuarine Study area into 18 land use/land cover categories, as described by Khorram et al (1992). In the near future CGIA will release an updated land use/land cover data set based on 1993 LANDSAT imagery, but that information was not available in time for use in publication of this basin plan. The 1988 LANDSAT data was the most recent data suitable for characterizing land cover at the scale of subbasins.

The export coefficients used for the various land cover categories (Table VII-2) are based upon a recent study carried out by RTI (Research Triangle Institute) under a contract with the DCM (Steven Stichter, NCDCM, personal communication, 1995). The RTI project involved a literature review of nutrient export studies performed on the eastern piedmont and coastal plain, updating similar work conducted by RTI in 1992 (Dodd et al). The median or most likely values from the literature were used.

Forested areas include both natural and managed forests. It was not feasible to develop separate estimates for each forest type, and all forest and freshwater wetland categories were assigned the median forest values. Nutrient export from urban areas includes runoff from residential and commercial areas, industrial facilities, on-site wastewater disposal and solid waste facilities. The median export values for urban areas were assigned to all three categories of developed land because the land cover data could not distinguish between low, medium and high density developed areas with sufficient accuracy (see Khorram et al, 1992). Agricultural land includes row crops, pasture land and confined animal operations. However the land cover data could not distinguish between these types of agricultural activities, and the export coefficient used represents the median unit load from a cross-section of agricultural activities.

Atmospheric deposition includes wet and dry deposition of nutrients from all sources, including nitrogen from the burning of fossil fuels and ammonium from sources such as fertilizer and animal waste lagoons. Values for atmospheric deposition were taken from Dodd et al (1992) and are applied to open water as well as sand and salt marsh. This assumes that all nutrients falling on bare sand and salt marsh from atmospheric sources is exported to surface waters, and that on average no net export otherwise occurs from these areas.

As shown in Table VII-2, the detailed categories were aggregated into 4 major classes. Disturbed land was classified as agricultural because these areas were found to consist primarily of recently plowed fields (Khorram et al, 1992).

No land use/land cover data were available for some areas because of cloud cover or difficulty in classification. Such land was apportioned to the various land cover categories in proportion to the area of known land cover in each hydrologic unit. The amount of unclassifiable land was not significant (<1% of each hydrologic unit).

**Discussion**

The export coefficient approach has a number of limitations. Some of these are inherent in the method itself, while others result from the specific data used.

(1) The available land use/land cover information is based on 1988 data, and significant land use changes may have occurred in some areas since that time. Land use/land cover data for the 1993-1995 period is under development and will be available in March 1997. This data set should provide greater refinement in characterizing types of agricultural and urban areas.

(2) Land management practices can affect the export of nutrients from a given category of land use. The export coefficient approach does not take into account variations in loading resulting from different land management practices (such as no-till farming) on a localized basis.

(3) The export coefficients are not based upon site-specific studies of the Chowan River basin area, but rely on literature estimates. These estimates are based on studies conducted in the piedmont and coastal plan regions, but soils and other features of the study sites may differ from areas in the Chowan basin.
(4) Export estimates for urban areas do not explicitly account for inputs from septic systems or other on-site disposal systems such as spray irrigation systems for animal operations or municipalities.
(5) As mentioned earlier, the current land use data do not allow us to distinguish between types of agricultural activity, and it is thus not possible to separately evaluate loads from cropland, pasture and confined animal operations.
(6) The export coefficient approach does not take nutrient fate and transport into account, but rather, yields an estimate of the total nutrient load to surface waters within a watershed. It does not estimate the load exerted at any particular location. Only a portion of the nutrients which enter streams in the upper part of these watersheds will actually reach the estuarine sections of the river.

The use of export coefficients to estimate nutrient loads is the best method available given that detailed watershed models have not been developed for any of the areas examined here. Despite the limitations of this approach, the results provide a rough approximation of the loading to particular watersheds and indicate the general sources of that loading. As noted above, future applications of nutrient export methods to these watersheds will be enhanced by the acquisition of more recent and detailed land use/land cover data.

## References Cited


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Reckhow KH, Hartigen JP and Coffey S, 1989. Lake Nutrient Budget Development for State-Level Applications. pp 45-52, Proceedings of a National Conference on Enhancing State's Lake Management Programs. North American Lake Management Society. Washington, DC

Stichter S, 1995. Personal Communication. NC Division of Coastal Management

## TABLE VII-1
## CALCULATED POINT SOURCE TP AND TN LOADS
CHOWAN BASIN

| PERMIT NUMBER | FACILITY NAME | SUB - BASIN | PERMITTED FLOW MGD | AVERAGE FLOW MGD | AVERAGE TN LBS / DAY | ANNUAL TN LBS/YR | AVERAGE TP LBS / DAY | ANNUAL TP LBS/YR |
|---|---|---|---|---|---|---|---|---|
| NC0033782 | GATES CO SCH - GATESVILLE ELEM | 03-01-01 | 0.017 | 0.000 | 0.008 | 2.77 | 0.002 | 0.57 |
| NC0033791 | GATES CO SCH - SUNBURY PRIMARY | 03-01-01 | 0.022 | 0.003 | 0.209 | 76.35 | 0.037 | 13.58 |
| NC0033804 | GATES CO SCH - T S COOPER ELEM | 03-01-01 | 0.017 | 0.002 | 0.234 | 85.30 | 0.036 | 13.24 |
| NC0043974 | GATES CO SCH - BUCKLAND ELEM | 03-01-01 | 0.033 | 0.003 | 0.275 | 100.35 | 0.121 | 44.15 |
| | TOTAL LOAD | | | | | 264.78 | | 71.54 |
| NC0031330 | NORTHAMPTON CO SCH-NCHS EAST | 03-01-02 | 0.180 | 0.008 | 2.872 | 1048.23 | 0.484 | 176.76 |
| NC0003867 | UNITED PIECE DYE WKS LP-EDENTO | 03-01-03 | 9.000 | 1.008 | 101.244 | 36954.01 | 6.350 | 2317.65 |
| NC0020630 | COLERAIN WWTP, TOWN OF | 03-01-03 | 0.450 | 0.114 | 4.926 | 1797.82 | 0.986 | 359.71 |
| | | | | | | 38751.83 | | 2677.36 |

## TABLE VII-2

## EXPORT COEFFICIENTS USED IN CALCULATION OF NONPOINT SOURCE LOADS, BY LANDSAT CATEGORY (lb/ac/yr)

| Code | LANDSAT Category | TP Export | TN Export |
|---|---|---|---|
| URBAN | | 0.95 | 6.71 |
| 3 | Low Density Developed | | |
| 4 | Medium Density Developed | | |
| 5 | High Density Developed | | |
| AGRICULTURE | | 0.88 | 8.74 |
| 6 | Agriculture, Bare Soil and Grass | | |
| 12 | Disturbed Land | | |
| FOREST | | 0.12 | 2.08 |
| 7 | Low Density Vegetation | | |
| 8 | Pine Forest | | |
| 9 | Bottomland Hardwoods | | |
| 10 | Hardwood Forest | | |
| 11 | Pine/Hardwood | | |
| 14 | Riverine Swamp | | |
| 15 | Evergreen Hardwood/Conifer | | |
| 16 | Atlantic White Cedar | | |
| 17 | Low Pocosin | | |
| ATMOSPHERIC DEPOSITION | | 0.58 | 11.06 |
| 2 | Open Water | | |
| 18 | Low Marsh | | |
| 19 | High Marsh | | |

Source: NC Division of Coastal Management

# APPENDIX VIII

## List of 303(d) Waters in the Chowan River Basin

# APPENDIX VIII

## List of 303(d) Waters in the Chowan River Basin

What is the 303(d) list?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and nonpoint source pollution will achieve the standards or uses. Waterbodies which are listed must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters.

303(d) List Development

The 305(b) report was used as a basis for developing the 303(d) list. Section 305(b) of the CWA requires states to report biennially to the U.S. Environmental Protection Agency (EPA) on the quality of waters in their state. In general, the report describes the quality of the state's surface waters, groundwaters, and wetlands, and existing programs to protect water quality. Information on use support, likely causes (e.g., sediment, nutrients, etc.) and sources (point sources, agriculture, etc.) of impairment are also presented in the report.

Many types of information were used to make use support assessments and to determine causes and sources of use support impairment. Chemical, physical, and biological data were the primary sources of information used to make use support assessments. North Carolina has an extensive ambient and biological monitoring network throughout the state. Benthic macroinvertebrate data which indicate taxa richness of pollution intolerant groups are an important data source. North Carolina also collects fish tissue and fish community structure data and phytoplankton bloom data that are used in the assessments. In addition, shell fish closure data, information from other agencies, workshops, and reports, predictive modeling results, toxicity data, and self monitoring data is considered when making final use support determinations. Data from all readily available sources are used when the Division's standard operating procedures are followed when collecting and analyzing data. Where the list has no problem parameter listed, the use support rating was based on biological data, and available chemical data showed no impairment. It should be noted that where a problem parameter has been identified, the water quality standard for that parameter was exceeded. This parameter is a potential cause of the impairment, but there may be other unidentified causes contributing to the impairment as well.

Only those waterbodies whose use support rating were not supporting (NS) or partially supporting (PS) in the 305(b) report were considered as candidates for the 303(d) list. Of those waterbodies that showed impairment (PS or NS rating) only those waterbodies that had a use support rating based on monitoring data collected in the last five years were included on the 303(d) list. Since many changes can occur within a watershed in a five year period, conclusive information about a waterbody's use support cannot be made with older data. However, North Carolina will be collecting information on as many of these evaluated waterbodies as staffing and time permit for subsequent updates of the basin plans and 303(d) list. As more conclusive information on streams rated using older data or best professional judgment is obtained, evaluated waterbodies will be added to the list if the data indicate impairment. Finally, those waterbodies which were rated as NS or PS were then examined to determine if there were management strategies in place. If so, the streams were eliminated from the list. Management strategies that were considered included the following:

1. Miscellaneous nonpoint programs - Any waterbodies where DWQ was aware of nonpoint management studies (e.g. 319 or similar program) were eliminated if nonpoint sources were the only problem.

2. Point sources - All waters where point sources were the only problem were eliminated if the facility was under SOC, under schedule for removal, recently upgraded, or some other strategy was in place.

Two segments of the Chowan River were removed from the list that are impacted by nutrients. The Chowan River Basin is classified as nutrient sensitive waters (NSW), and goals established in a 1982 management plan and updated in 1990 for the basin included nutrient reductions of 35 to 40 percent for phosphorus and 20% for nitrogen. Point sources in the basin have been assigned limits for both parameters, and nonpoint sources are prioritized for agricultural cost share funds. Further information on nutrients in the Chowan River are provided in Chapters 3, 4, and 6.

The entire Chowan River in North Carolina has been removed from the 303(d) list for dioxin due to the implementation of point source strategies in Virginia. Further information is provided below with the fish consumption advisory information.

Changes in the Chowan River Basin's 303(d) list from earlier lists are based on updated chemical and biological monitoring results. If updated information indicated no impairment, a previously listed waterbody was removed. No waters were removed from the previous Chowan 303(d) list for this reason. If previously supporting waterbodies had new data that indicated impairment, these waterbodies were added to the list. Ahoskie Creek was added (not monitored in past) based on biological data collected in 1995. In addition, if no new data were collected on a given waterbody, and all available data were greater than 5 years old, the waterbody was excluded from the list. If future data indicate impairment, the stream will be added to the list. Cypress Creek, Painter Swamp, and Bells Branch have had no data collected on them. Under today's use support methods they would never have been listed. Finally, Big Woods was included on the last version of the list. No listing of a stream of this name was found in the use support. Big Woods may be a local name. The Chowan River Basin 303(d) list is shown in Table 1.

Fish consumption advisories are no longer considered when determining use support since the entire state was posted in June 1997 for the consumption of bowfin from mercury contamination. It should be noted that bowfin do not occur statewide; they are found primarily within the coastal plain. While DWQ considers fish consumption advisories as impairment, we did not want to mask other causes and sources of impairment by having the entire state listed as impaired due to advisories. Therefore, they are discussed in Chapter 3 and summarized on Figure 3.2.

Although, fish consumption advisories are not considered when determining use support, the advisory information is considered when developing the state's 303(d) list, and further information is provided below. The Chowan River from the Virginia state line to the mouth is under fish consumption advisory due to dioxin in fish. There is a pulp and paper mill in Virginia upstream of the advisory area. This facility has eliminated dioxin in its discharge, but it will take time before use support is restored. Since no other management strategy is warranted in the basin to control dioxin, the waterbody is not included on the 303(d) list. In the prior 303(d) list for the Chowan River Basin, the entire river was included on the list because of the dioxin issue.

Mercury advisories were also reviewed. Other than the recent statewide ban on bowfin no waters have been closed for other species in the basin due to mercury contamination. Only those waters that are listed for species other than bowfin will be included on the 303(d) list. Listing all waters in the basin will only mask other areas of impairment. North Carolina will continue to work on the mercury problem, but developing load numbers for the parameter will not help solve the problem.

Instead, North Carolina has implemented monitoring to help determine the sources. At this time, it appears that the atmosphere is the main source, and studies have begun to examine this theory.

The DWQ has formed a nonpoint source team in the Chowan River Basin, and Chapter 7 contains a list of the members. DWQ and the team will work as partners to identify, prioritize, and address the nonpoint source problems in the basin. DWQ believes that using these teams is the best way to manage many of the nonpoint source impacted areas of the state, since an understanding of the local resources and economy and support from local stakeholders will be fundamental to successfully manage nonpoint source pollution. Although there are some general management guidelines, there is no single technique for controlling nonpoint source pollution. The most efficient and effective nonpoint source strategies will be site specific. The number of waterbodies that can be addressed within a basin planning cycle will be dependent on available resources.

In order to provide some funds for the nonpoint source teams, the statewide NPS workgroup decided to allocate up to $100,000 to each basin's NPS team on a 5 year rotating schedule. The Chowan NPS team must submit a proposal by the end of March 1997 to be eligible for funds.

The Chowan NPS team has identified one impaired stream as a high priority: Ahoskie Creek. Ahoskie Creek has a diversity of impacts and land use in the basin, and the team felt that it could evaluate the impacts from different land practices in the basin. In addition, Ahoskie Creek is a headwater creek that drains to other impaired waterbodies. Beginning with impaired headwater streams may be the most efficient method to address nonpoint source impairment in larger watersheds.

The final requirement for 303(d) is to prioritize the list. The Clean Water Act requires that the prioritization be based on the degree of impairment (use support rating) and the uses to be made of the waterbody (stream classification). Since all use support ratings and stream classifications are identical, these criteria did not help in prioritization. Since the NPS team has identified Ahoskie Creek as a potential area in which to focus its efforts, it was given the highest rating for TMDL development. The NPS team is still reviewing the waterbodies in the basin. If the NPS team chooses other priority watersheds, the priorities may be revised. The NPS teams will be DWQ's main method of addressing these small impaired watersheds, and the management strategies they develop will be done in lieu of numeric TMDLs. All other waterbodies were rated as low. The amount of work that will be completed in time for the 2003 Chowan Basin Plan will depend on available resources.

Additional Guidance on Using the 303(d) List

The column headings in the 303(d) list refer to the following:

Class - The information in this column indicates the classification assigned to the particular waterbody. Stream classifications are based on the existing and anticipated best usage of the stream as determined through studies and information obtained at public hearings. The stream classifications are described in 15 A NCAC 2B .0300, and a copy of the pertinent pages of these regulations is attached in Appendix I.

Wtrbdy - The number in this column refers to the DWQ subbasin in which the waterbody is located. The NRCS 14 digit hydrologic units nest within the DWQ subbasins.

Problem Parameter - These are the causes of impairment as identified in the 305(b) report. Where no cause is listed, the rating was based on biological data, and available chemical data showed no impairment. These biological data may include benthic, fish habitat, and fish tissue information. It should also be noted that where a problem parameter is identified, the parameter listed exceeded the state's water quality standards for that substance. This parameter is a potential cause of the impaired stream, but there may be other, unidentified causes contributing to the impairment as well. Problem parameters included in the Chowan 303(d) list are outlined below:

DO - dissolved oxygen

Rating - This column lists the overall use support rating. These values may be NS (not supporting) or PS (partially supporting). The 305(b) report describes these use support ratings further.

Major Sources (P,NP) - This column indicates whether point (P) or nonpoint (NP) sources are the major sources of impairment.

Subcategory - This column breaks the point and nonpoint sources down further. A list describing what each number means is provided after the list.

Table 1: 303(d) List for the Chowan River Basin

| Name of Stream | Description | Class | Wtrbdy | Problem Parameters | Rating | Major Sources (P,NP) | Major Sources Subcategory | Priority |
|---|---|---|---|---|---|---|---|---|
| Potecasi Creek * | From source to Meherrin River | C NSW | 30102 | DO,pH | PS | NP | 10 | Low |
| Cutawhiskie Swamp * | From source to Potecasi Creek | C NSW | 30102 | | PS | NP | 10,71 | Low |
| Wiccacon River * | From source to Chowan River | C NSW | 30101 | | PS | NP | 90 | Low |
| Ahoskie Creek * | From source to Wiccacon River | C NSW | 30101 | | PS | NP | 10,71 | High |

* DWQ believes the best way to manage these waterbodies is through the NPS team process. Management strategies developed by these teams will be in lieu of a numeric TMDL. The number of waterbodies addressed during each basin cycle will depend on available resources. Ahoskie Creek has been identified as a potential high priority waterbody by the Chowan NPS team.

**Subcategory Codes**

0 Point Sources
- 01: Industrial
- 02: Municipal
- 03: Municipal Pretreatment (indirect dischargers)
- 04: Combined sewer overflows (end-of-pipe control)
- 05: Storm sewers (end-of-pipe control)
- 06: Schools
- 07: Other non-municipal

1 Nonpoint Sources

10 Agriculture
- 11: Non-irrigated crop production
- 12: Irrigated crop production
- 13: Specialty crop production (e.g., truck farming and orchards)
- 14: Pasture land
- 15: Range Lots
- 16: Feedlots - all types
- 17: Aquaculture
- 18: Animal holding/management areas

20 Silviculture
- 21: Harvesting, reforestation, residue management
- 22: Forest Management
- 23: Road Construction/maintenance

30 Construction
- 31: Highway road/bridge
- 32: Land Development

40 Urban Runoff
- 41: Storm Sewers (source control)
- 42: Combined sewers (source control)
- 43: Surface runoff
- 44: Finger Canals
- 45: Industrial

50 Resource Extraction/Exploration/Development
- 51: Surface mining
- 52: Subsurface mining
- 53: Placer mining
- 54: Dredge mining
- 55: Petroleum activities
- 56: Mill tailings
- 57: Mine tailings
- 58: Abandoned mines

60 Land Disposal / Runoff / Leachate From Permitted Areas)
- 61: Sludge
- 62: Wastewater
- 63: Landfills
- 64: Industrial land treatment
- 65: On-site wastewater systems (septic tanks, etc.)
- 66: Hazardous Waste

70 Hydrologic/Habitat Modification
- 71: Channelization
- 72: Dredging, sand dipping
- 73: Dam construction
- 74: Flow regulation
- 75: Bridge construction
- 76: Removal of riparian vegetation
- 77: Streambank modification/destabilization
- 78: Collapsed dam

80 Other
- 81: Atmospheric deposition
- 82: Waste storage/storage tank leaks
- 83: Highway maintenance and runoff
- 84: Spills
- 85: In-place contaminants
- 86: Natural
- 87: Marinas, harbors
- 88: Airport
- 89: Military activities (off road)

90 Source Unknown
- 91: General Erosion (road erosion)

**References for Abbreviations**

| | |
|---|---|
| AQTox | Aquatic Toxicology Group (DWQ) |
| ARO | Asheville Regional Office (DWQ) |
| BMAN | Benthic Macroinvertebrate Survey (DWQ) |
| Comp | Compliance Group (DWQ) |
| DEM | Division of Environmental Management |
| DFR | Division of Forest Resources |
| DWQ | Division of Water Quality (formerly DEM) |
| DWR | Division of Water Resources |
| FAC | Food and Agriculture Committee |
| FRO | Fayetteville Regional Office (DWQ) |
| LQ | Division of Land Quality |
| Meck Co | Mecklenburg County |
| MRO | Mooresville Regional Office (DWQ) |
| NCFS | North Carolina Forest Services |
| RRO | Raleigh Regional Office (DWQ) |
| SCS | USDA Soil Conservation Service |
| SWCD | Soil and Water Conservation District |
| Topo | Topographic Map |
| WaRo | Washington Regional Office (DWQ) |
| WiRo | Wilmington Regional Office (DWQ) |
| WRC | Wildlife Resource Commission |
| WRRI | Water Resources Research Institute |
| WSR | Winston-Salem Regional Office (DWQ) |
| USGS | United States Geological Survey |

# APPENDIX IX

## LIST OF NPDES DISCHARGES IN THE BASIN

Permitted Wastewater Discharges in the Chowan River Basin

| Data as of 6/13/96 | | | Design | Issued | Expiration | | | |
|---|---|---|---|---|---|---|---|---|
| Permit Type | Permit # | Facility Name | Flow | Date | Date | Basin | Pipe # | Receiving Stream Description |
| MAJOR | NC0003867 | UNITED PIECE DYE WKS LP-EDENTO | 1.5 | 94/05/31 | 98/01/31 | 30103 | 1 | CHOWAN RIVER/CHOWAN RIVER BASIN |
| NON-MUNICIPAL | NC0003867 | UNITED PIECE DYE WKS LP-EDENTO | 1.5 | 94/05/31 | 98/01/31 | 30103 | 2 | CHOWAN RIVER/ CHOWAN RIVER BASIN |
| | NC0003867 | UNITED PIECE DYE WKS LP-EDENTO | 1.5 | 94/05/31 | 98/01/31 | 30103 | 3 | CHOWAN RIVER/ CHOWAN RIVER BASIN |
| | NC0003867 | UNITED PIECE DYE WKS LP-EDENTO | 1.5 | 94/05/31 | 98/01/31 | 30103 | 4 | CHOWAN RIVER/ CHOWAN RIVER BASIN |
| | NC0003867 | UNITED PIECE DYE WKS LP-EDENTO | 1.5 | 94/05/31 | 98/01/31 | 30103 | 5 | CHOWAN RIVER/ CHOWAN RIVER BASIN |
| | | | | | | | | |
| MINOR | NC0020630 | COLERAIN WWTP, TOWN OF | 0.075 | 93/04/23 | 98/01/31 | 30103 | 1 | CHOWAN RIVER/CHOWAN RIVER BASIN |
| MUNICIPAL | | | | | | | | |
| | | | | | | | | |
| MINOR | NC0002402 | PERRY-WYNNS FISH CO. (BERTIE) | 0.024 | 93/04/30 | 98/01/31 | 30103 | 1 | CHOWAN RIVER/CHOWAN RIVER BASIN |
| NON-MUNICIPAL | NC0031330 | NORTHAMPTON CO SCH-NCHS EAST | 0.03 | 94/08/31 | 98/01/31 | 30102 | 1 | UT POTECASI CREEK/CHOWAN RIVER BASIN |
| | NC0032719 | CHOWAN CO. WATER PLT.-VALHALLA | 0 | 93/03/19 | 98/01/31 | 30104 | 1 | UT ROCKYHOCK CREEK/CHOWAN RIVER BASN |
| | NC0032719 | CHOWAN CO. WATER PLT.-VALHALLA | 0 | 93/03/19 | 98/01/31 | 30104 | 2 | UT BURNT MILL CRK/PASQUOTANK RIV BAS |
| | NC0032719 | CHOWAN CO. WATER PLT.-VALHALLA | 0 | 93/03/19 | 98/01/31 | 30104 | 3 | UT POLLOCK SWAMP/CHOWAN RIVER BASIN |
| | NC0033782 | GATES CO SCH - GATESVILLE ELEM | 0.005 | 93/04/08 | 98/01/31 | 30101 | 1 | BENNETT CREEK/CHOWAN RIVER BASIN |
| | NC0033791 | GATES CO SCH - SUNBURY PRIMARY | 0.005 | 93/04/08 | 98/01/31 | 30101 | 1 | UT RAYNOR SWAMP/CHOWAN RIVER BASIN |
| | NC0033804 | GATES CO SCH - T S COOPER ELEM | 0.004 | 93/04/08 | 98/01/31 | 30101 | 1 | UT RAYNOR SWAMP/CHOWAN RIVER BASIN |
| | NC0043974 | GATES CO SCH - BUCKLAND ELEM | 0.006 | 93/08/13 | 98/01/31 | 30101 | 1 | UT COLE CREEK/CHOWAN RIVER BASIN |
| | NC0047112 | GATES CO BD OF COMM. WTP | 0 | 93/03/12 | 98/01/31 | 30101 | 1 | UT HACKLEY BRANCH/CHOWAN RIVER BASIN |
| | NC0049603 | WILLIS HARE ELEMENTARY SCHOOL | 0.0057 | 95/04/07 | 98/01/31 | 30102 | 1 | UT KIRBY CREEK/CHOWAN RIVER BASIN |
| | NC0080632 | CHOWAN CO. WATER PLANT-BRAHALL | 0 | 93/03/19 | 98/01/31 | 30104 | 1 | POLLOCKS SWAMP/CHOWAN RIVER BASIN |

# APPENDIX X

## Summary of Comments Received at Public Workshop

## Summary of Comments Received at a Workshop Held on the Chowan River Basin

**July 25, 1996 9:00 a.m. to 12:00 p.m. - Ahoskie, NC**

### Group 1

Major issues:

1. Greater review of water quality data
   - -relating data to management strategies
   - -identify correlations
2. Target sampling below/above known sources
3. Review operation and maintenance of point sources
4. Improve communication with Virginia
   - -VA is implementing tributary strategies
5. Rural wastewater treatment
   - -septic systems
6. Assure appropriate authority for programs
   - -support legislation to promote multijurisdictional cooperation with the plan
7. Good summary of how BMP's are being implemented.
   - -nutrient management plans (e.g. % being implemented)
   - -animal waste management plans
8. Improve capability to acquire water quality samples
9. Need to develop a strategy for non-D.W.Q. monitoring
10. Communicate with other agencies on other types of contributions (e.g. air & groundwater)

Local Projects, efforts:

1. Check cooperative extension, soil & water
2. Ag-forestry demo project (Tidewater)
   - -highways
3. 319 wetland & other projects in Edenton
4. APES research
5. No till project in Chowan County
6. Ag cost share projects in basin
7. Operator in charge training for animal waste
8. Increased local demonstration ag. projects, e.g. no till
9. D.W.Q. become involved in testing/monitoring local projects
10. Project designed to study urban contributions/impacts
11. Cost share money to upgrade commercial applicator's equipment
12. Continuous w.q. monitoring station & flow measurements at the state line

How is the state doing?:

-Not enough technical assistance
-Appropriate legislation
-Civil penalties put back into programs
-Implementing & following through of existing regulations

**Group 2**

Major Issues:

1. Fertilizer plant holding ponds (closed down) in Winton
   -Superfund site
2. Chowan - Albemarle document '82
3. Merchant Millpond - submerged aquatics; new hog farm in watershed
4. Animal operations - some have problems
5. Public awareness for farmers
6. New permit program for animal ops.
   Need before and after data
7. Need to define what the limiting nutrient is. Should coordinate with animal permitting program.
8. Subdivisions - maintaining water quality
9. Public education
10. Pumpout station for large holding tanks in upper Chowan
11. Future development, recreation
12. Stream buffers
13. Education programs
    - existing programs are working (i.e. Beach Sweep); use these as a vehicle for education

Local Projects, Efforts:

1. Clean Sweep - over 100 people
   Chowan County
2. Day camps
3. Mary Walter Romley - environmental educator in Washington region
4. Wildlife Club - Roanoke-Chowan
   - educational programs, scholarships
   - top club in NC 5 out of 8 years
   - 180 members
5. Agencies need to offer speakers

**Group 3**

Major Issues:

-Low Do
-Lead
-Livestock facilities
-Drainage districts
-Nutrients
-Urbanization/growth
-Cooperation - interstate (create a seamless basin area)
-Consolidation of efforts and studies - communication
-Tunis facility (former fertilizer plant)
-Better causal information (location specific)
-Over - regulation
-Bring back herring
-Better characterization of non-point sources
-Maintenance of on-site wastewater systems
-Educate all levels of population (improve materials - gear them better to the audience)

-Improve monitoring and tracking of problems for basin modeling needs
-BMP development - specific to the area
-Automobiles
-Citizens monitoring
-Government assistance for repair of on-site wastewater systems
-Cost/benefit analysis of BMP's
-Better information-sharing among agencies
-Better mapping of information
-Prioritize concerns
-Address tourism benefits

Local Projects, Efforts:

-Hertford Co. CAMA Land use plans upgrade
-Citizens monitoring
-Chowan Basin Foundation (private)
-Health dept. ordinance addresses livestock North Hampton Co.
-Colerain land-application system
-Arrowhead Beach Property Owners Association monitoring
-Roanoke -Chowan Wildlife Club (Winton, NC)
-County soil & water conservation offices
-Union camp & other industries monitoring

What do Agencies Need to do?

-Better cooperation inter-state, inter-county, inter-agency
    -share data
-Communications
-Improve internet use and access
-Utilize citizens as a resource for monitoring, stream analysis, etc...
-More monitoring/refinement of monitoring
-Use citizens as watch dogs for violations and water quality problems
-Acquire funds to expand their efforts
-Need a statewide, coordinated monitoring program
-More causal information on sources of problems
-More outreach for local governments - what can they do to address problems specific to their
    basin/region
-Better monitoring and characterization of atmospheric sources
- Reevaluate TMDL approach relative to non-point sources

**Group 4**

Major Issues

1. Nutrients
2. Concentrated Animal Operations
   (including dry litter)
3. Non-point source controls
4. CAMA requirements, APES work, and this program
   (Too much overlap? Poor coordination.)
5. Septic tanks - Clay soils
6. Discoloration of River from seasonal paper mill (Historically)
7. Effects on resources in river/estuary

8. Problems with municipal wastewater treatment plants
9. Application rates / practices for dry litter
10. Input mechanisms/sources for basin plan

<u>Local Projects, Efforts:</u>

1. Paper mill upgrade
2. Nutrient Management strategy in VA & BMP cost share program
   - -federal money comes in for BMP
   - -animal waste plan development support
3. Ag cost share/BMP's in NC
4. Large animal operation regulations - improved operator training/nutrient management plans
5. Buffer zones on tribs - Meherrin river runs clearer
6. No till farming and irrigation schedules
7. Small independent swine operations gone in Bertie
   - - Dry litter operations have persisted
8. Buffer zones with forestry

<u>How is the State doing?</u>

1. Poor coordination / Overlap of programs
2. Disproportionate enforcement of rules
3. Involve broader & more local expertise
4. Go out to local group meetings rather than having just this one
5. Foster more communication between agencies, stakeholders & interest groups
6. Better information needed for the agricultural community
7. More information for new programs in advance

# APPENDIX XI

## Glossary

**GLOSSARY**

Legend of Acronyms, List of Abbreviations

7Q10- a value which represents the lowest average flow for a seven day period that will recur on a ten year frequency. This value is applicable at any point on a stream. 7Q10 flow (in cfs) is used to allocate the discharge of toxic substances to streams.

AGPT-Algal Growth Potential Test.

AMS-Ambient Monitoring System.

BI(BIEPT)-Biotic Index, Biotic Index for EPT groups. A summary measure of the tolerance values of organisms found in the sample, relative to their abundance. Sometimes noted as the NCBI or NCBIEPT.

Bioclassification-Criteria have been developed to assign five bioclassifications (Poor, Fair, Good-Fair, Good, Excellent) to each benthic sample based on the number of taxa present in the intolerant groups (EPT) and the Biotic Index value.

BMAN-Biological Monitoring Ambient Network.

BODlt-Biochemical Oxygen Demand, long term.

cfs-Cubic feet per second, generally the unit in which stream flow is measured.

CHLA-Chlorophyll A.

ChV-Chronic Value. Of a toxicity test, defined as the geometric mean of the Lowest Observed Effect Concentration and the No Observed Effect Concentration.

DWQ-Division of Water Quality (became the Division of Water Quality on July 1, 1996)

DO-Dissolved Oxygen.

Ecoregion: An area of relatively homogeneous environmental conditions, usually defined by elevation, geology, and soil type. Examples include mountains, piedmont, coastal plain, sandhills and slate belt.

EHNR-N.C. Dept. of Environment, Health, and Natural Resources.

EPT-The insect orders Ephemeroptera, Plecoptera, Trichoptera-as a whole the most intolerant insects present in the benthic community.

EPT N- The abundance of Ephemeroptera, Plecoptera, Trichoptera insects present, using values of 1 for Rare, 3 for Common and 10 for Abundant.

EPT S-Taxa richness of the orders Ephemeroptera, Plecoptera and Trichoptera. Higher taxa richness values are associated with better water quality.

HQW-High Quality Waters

IWC- Instream Waste Concentration. The percentage of a stream comprised of an effluent calculated using permitted flow of the effluent and 7Q10 of the receiving stream.

JOC-Judicial Order by Consent- An administrative order issued by an administrative law judge which in some way modifies limitations of an NPDES permit by consent of both parties which provides interim limitations and conditions.

LC50- The concentration of a toxicant or percentage dilution of an effluent that is predicted to be lethal to 50% of a test population of organisms.

LOEC-In a toxicity test, the Lowest Observed Effect Concentration.

NOEC-In a toxicity test, the No Observed Effect Concentration.

~~MGD-Million Gallons per Day, generally the unit in which effluent discharge flow is measured.~~

MSD-Metropolitan Sewerage District.

NPDES-National Pollutant Discharge Elimination System.

NCIBI-North Carolina Index of Biotic Integrity-a summary measure of the effects of factors influencing the fish community

NCTSI-North Carolina Trophic State Index.

NSW-Nutrient Sensitive Waters.

NTU-Nephelometric Turbidity Unit.

ORW-Outstanding Resource Water.

PF-Permitted flow, of an NPDES permit.

POTW-Publicly Owned Treatment Works.

Secchi- a standard measure of water transparency as determined by lowering of a black and white Secchi disk to the depth that the disk is no longer visible.

Total S-the number of different taxa present in a benthic macroinvertebrate sample

WTP-Water treatment plant

WWTP-Wastewater treatment plant