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Lumber River

Basinwide Water Quality Plan

North Carolina Department of
Environment and Natural Resources
Division of Water Quality
Water Quality Section • May, 1999

Michael F. Easley, Governor
William G. Ross Jr., Secretary
North Carolina Department of Environment and Natural Resources

Alan W. Klimek, P.E. Director
Division of Water Quality

April 22, 2003

Thank you for your interest in North Carolina's water quality issues. Enclosed is the basinwide water quality plan that you recently requested from the Division of Water Quality (DWQ).

The basinwide planning program aims to identify and restore full use to impaired waters, identify and protect highly valued resource waters, and protect the quality and intended uses of North Carolina's surface waters while allowing for sound economic planning and reasonable growth. North Carolina relies on the input and experience of its public to ensure that the water quality plans are effective. DWQ coordinates plan development; however, plan implementation and effectiveness entails the coordinated efforts and endorsement of many agencies, groups, local governments, and the general public. Your participation is essential for us to achieve our goals.

Our website (http://h2o.enr.state.nc.us/wqs/) provides detailed information on our program, other basin plans, current events, publications, and rules and regulations. Please visit us at this site.

DWQ appreciates your interest in water quality issues, and we hope to continue working with you into the future. Please contact me if you have any further questions or ideas on specific basins at (919) 733-5083, ext. 354.

Sincerely,

Darlene Kucken

Darlene Kucken
Basinwide Planning Program Coordinator

Enclosure

ADDENDUM: Use Support Changes for the Lumber River Basin
January 2000

The fully supporting but threatened (support-threatened, ST) category is no longer used as a use support rating. In the past, ST was used to identify a water that was fully supporting but had some notable water quality problems. ST could represent constant, degrading, or improving conditions. North Carolina's use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that are characterized by declining water quality. In addition, the US EPA requires the inclusion of ST waters on the 303(d) list in its proposed revision (August, 1999) to the 303(d) list rules (Appendix V). Due to the difference between US EPA's and North Carolina's definitions of ST, North Carolina no longer uses this term. Because North Carolina has used fully supporting but threatened as a subset of fully supporting (FS) waters, those waters formerly called ST are now rated FS. This change is reflected in the 305(b) report for 2000. Based on this change, use support ratings for all basins have been altered. Revised use support ratings for the Lumber River basin are presented below.

Freshwater Streams and Rivers

Table A-24 Use Support Summary Information for All Monitored and Evaluated Streams in the Lumber River Basin (1998)
(*Found on p. 62 of the plan.*)

	Monitored and Evaluated Streams			Monitored Streams Only	
	Miles	%		Miles	%
Supporting	2230.9	98		381.6	100
Fully Supporting	2230.9	98		381.6	100
Impaired	0	0		0	0
Partially Supporting	0	0		0	0
Not Supporting	0	0		0	0
Not Rated	51.8	2		0	0

Table A-25 Use Support Determination for Monitored and Evaluated Freshwater Streams in the Lumber River Basin (*Found on p. 63 of this plan.*)

Lumber Use Support Ratings in Miles for 1993-1997					
Subbasin	**Fully Supporting**	**Partially Supporting**	**Not Supporting**	**Not Rated**	**Total Miles**
03-07-50	184.4	0	0	0.0	184.4
03-07-51	391.4	0	0	0.0	391.4
03-07-52	134.5	0	0	0.0	134.5
03-07-53	300.2	0	0	0.0	300.2
03-07-54	136.7	0	0	0.0	136.7
03-07-55	293.6	0	0	12.4	306.0
03-07-56	132.7	0	0	0.0	132.7
03-07-57	350.6	0	0	0.0	350.6
03-07-58	198.0	0	0	0.0	198.0
03-07-59	108.8	0	0	39.4	148.2
Total	2230.9	0	0	51.8	2282.7
Percent	97.7	0	0	2.3	100

Estuaries

Table A-26 Use Support Ratings for Estuarine Waters in the Lumber River Basin (1993-1997)*

Area Name	Total Acres	DEH Area	Overall Use Support			Major Sources		Potential Sources of Pollution
			FS	PS	NS	Point	Nonpoint	
Calabash	1800	A-1	662	1138	0		NPS	urban runoff, septic systems, marinas
Shallotte River	1350	A-2	779	571	0		NPS	urban runoff, septic systems
Lockwoods Folly River	1650	A-3	737	913	0		NPS	urban runoff, septic systems, marinas
Total Acres	4800		2178	2622	0			
Percent	100		45.4	54.6	0			

*Fecal coliform is the only cause of impairment of estuarine waters in this basin.

Major Sources:

NPS indicates that surveys note that nonpoint sources are the major factor influencing water quality, or there are no major point sources.

LUMBER RIVER
BASINWIDE
WATER QUALITY PLAN

May 1999

Prepared by:

North Carolina
Division of Water Quality
Water Quality Section
P.O. Box 29535
Raleigh, NC 27626-0535

(919) 733-5083

This document was approved and endorsed by the NC Environmental Management Commission on May 13, 1999. The plan will be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities on the Lumber River basin.

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Executive Summary

This document is the first five-year update of the original Lumber River Basinwide Water Quality Management Plan as approved by the Environmental Management Commission in May 1994. In response to comments of the Lumber River basin workshop participants and others, the format of this updated plan was revised. Much of the general information contained in the original plan has been replaced by more detailed information specific to the Lumber River basin. This general information is being compiled in a separate document that will soon be available to the public.

Current DWQ Initiatives

Since the original plan, there have been a number of initiatives taken by the Division of Water Quality (DWQ) to obtain more complete knowledge of the complexities of the swamp waters that make up the majority of the waters in the basin. Discussion on these initiatives can be found in Section A, Chapter 4. These initiatives include the following:

- Lumber River basin swamp water quality study (Part 4.2)
- Development of draft biological swamp criteria (Part 4.3)
- Fish community assessment draft criteria (Part 4.4)
- Development of estuarine waters biological criteria (Part 4.5)
- Fish advisories related to mercury contamination (Part 4.6)
- Changes in use support methodologies and the effect on previously impaired waters (Part 4.7)
- Lumber River basin mercury TMDL report (Part 4.8)
- Nonpoint source pollution reduction (Part 4.9)

Lumber River Basin Swamp Water Quality Study

As a means of better addressing concerns about discharges to swamp waters, DWQ initiated a study to assess the ability to model swamps or make effective predictions regarding the impact of discharges on swamp waters. The main purpose of the study was to determine if different levels of impact would be observed as a result of varying degrees of wastewater treatment. Based on the study results, DWQ will continue to evaluate swamps as needed and permit wastewater discharges to swamp streams on a case by case basis.

Development of Draft Biological Swamp Criteria

Of these initiatives, the development of biological criteria better suited to the swamp waters prevalent within this basin has the greatest impact on the information contained within this basinwide plan (Part 4.3, 4.4, 4.5 and 4.7). DWQ has determined that the freshwater biological criteria used at the time of the 1994 basinwide plan was not very applicable to swamp waters. DWQ has developed draft biological criteria ratings more specific to swamp waters. DWQ believes there is insufficient sampling of reference swamp streams to use the ratings for use support determinations. The criteria will remain draft until DWQ is better able to evaluate such things as: year to year variation at reference swamp sites, variation among reference swamp sites, the effect of small changes in pH on the benthos community, whether the habitat evaluation can be improved, and the role fish data should play in the evaluation. In this light, the biological ratings should be used for comparative purposes only and have not been used for use support determinations (see Section A, Chapter 3, Part 3.4 and Chapter 4).

Changes in Use Support Methodologies and the Effect on Previously Impaired Waters

A number of waters were rated impaired in 1994 based on biological ratings that have since been judged inappropriate. Many of these waters remain on the 303(d) list (Appendix V) as required by the Clean Water Act. These waters, though not considered impaired by DWQ, are required to remain on the 303(d) list until DWQ biological criteria are finalized and the waters are reevaluated using the final criteria. Criteria finalization is anticipated to be within this five-year basinwide cycle. At that time, an addendum to the Lumber River Basinwide Plan explaining any use support changes will be developed. Additional changes were made to use support methodology pertaining to estuarine waters. These changes are discussed with the presentation of the use support summaries below.

Fish Advisories Related to Mercury Contamination

Many waters in the Lumber River basin are posted for fish consumption advisories related to elevated mercury levels in fish tissue (Part 4.6). These postings are not unique to the Lumber River basin. Rather the presence and accumulation of mercury in North Carolina's aquatic environment is similar to levels observed in other states. Atmospheric deposition may be a significant source of the observed levels of mercury, but the exact pathways and extent of mercury contamination in North Carolina fish or across the nation have yet to be characterized. DWQ will continue to monitor fish tissue in the Lumber River basin to assess mercury contamination. Given the likelihood that the source of mercury is atmospheric and of a global/regional scale, use support determinations have been revised to not include waters with fish consumption advisories related to mercury (see Section A, Chapter 3, Part 3.4). However, these waters remain on the North Carolina 303(d) List (see Appendix V) and a TMDL approach is being developed (see discussion below).

Lumber River Basin Mercury TMDL Report

The Lumber River basin currently has several waters listed on the North Carolina 303(d) List for fish consumption advisories related to mercury (see Appendix V). 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. The 303(d) process requires that a Total Maximum Daily Load (TMDL) be developed for each of the listed waters, where technically feasible. A draft report, titled *TMDL Study: Mercury Loads to Impaired Waters in the Lumber River Basin, North Carolina* has been prepared by DWQ (1998) to try to address mercury contamination in the Lumber River basin (Part 4.8).

Nonpoint Source Pollution Reduction

DWQ will continue to seek better means of obtaining information for those waters that are believed to have nonpoint source pollution problems (Part 4.9). Voluntary measures will continue to be relied upon for controlling and reducing nonpoint sources of pollution. Several other agencies provide oversight to voluntary measures such as best management practices for various land use activities. More resources are needed to address nonpoint sources of pollution. Identifying nonpoint sources of pollution and developing management strategies for negatively affected waters, given the current limited resources, is an overwhelming task. Therefore, only limited progress towards restoring NPS impaired waters can be expected unless substantial resources are put towards solving NPS problems.

Major Issues in the Lumber River Basin

This plan has also identified some of the major issues facing the future water quality of this basin. In particular, the growth in population and agricultural animal operations has been significant.

Impacts to water quality have been noted in other basins when these types of growth occur at an accelerated pace as seen in this basin or when they occur with minimized management or planning.

Population Growth

The percent population growth over the last ten-year census period (1980-1990) was 8 percent, as compared to the statewide average of 12.7 percent. While the overall growth rate for the basin is lower than the statewide average, it should be noted that two subbasins (03-07-50 and 03-07-59) experienced accelerated growth rates of 33 percent and 48 percent, respectively. These subbasins reflect growth occurring in southeastern Moore County and Brunswick County.

Population growth over the period of 1970-1990 has been significant for these and other subbasins. Southeastern Moore County (subbasin 03-07-50) had a population increase of 89 percent, while Brunswick County (subbasin 03-07-59) increased by 127 percent over this time period. Subbasin 03-07-51, which contains Lumberton, experienced a population increase of 101 percent over this twenty-year period. Subbasin 03-07-52, which covers part of Hoke County and the Town of Red Springs, saw a 53 percent growth increase.

Issues related to accelerated growth include runoff from impervious surfaces, increased storm flow to streams, and excessive demands on wastewater systems during storm events. There is greater potential for runoff to carry toxic substances from roads and parking lots and fecal coliform bacteria from failing septic systems and pet waste.

The recent growth of tourism and residents has fueled an increase in golf course construction. In 1994, there were 18 golf courses in Brunswick County. Currently, there are 30 golf courses with 3 under construction. In general, there are one to three additional golf courses opening per year in the County. Runoff from golf courses can carry nutrients and toxic chemicals to surface waters.

Growth in Animal Operations

Total swine capacity represents only 11 percent of the state total, with higher concentrations in subbasins 03-07-51, 03-07-53 and 03-07-54 (Lumber River drainage), 03-07-55 (Little Pee Dee headwaters drainage) and subbasin 03-07-58 (upper Waccamaw River drainage). With the exception of one subbasin, all other subbasins have experienced a significant increase in swine numbers between 1994 and 1998. Basinwide, the numbers of swine have increased by about 122 percent, with about four times as many swine as humans in the basin. The basin also contains 5 percent of the state total capacity for poultry, with the highest concentrations found in subbasin 03-07-55 in Scotland and Robeson Counties. Recent legislation providing guidance on disposal of animal waste should provide some protection measures against the fecal coliform bacteria and nutrients that these operations can input into waters in the basin. A statewide moratorium is currently in effect on the creation of new hog farms. However, this moratorium is scheduled to end in September 1999. Research is currently underway to determine what effects the hog operations may be having on water quality through stormwater runoff, groundwater contamination and atmospheric nutrient levels.

Use Support Determinations

Although it is currently not possible to provide use support determinations for all the monitored waters in the basin, it is possible to present a summary of use support determinations that looks at most of the freshwater streams and estuaries in the basin (see Section A, Chapter 3, Part 3.4 for further discussion). Of the 2,283 miles of freshwater streams and rivers in the Lumber River basin, use support ratings were determined for 98 percent or 2,231 miles. Upon finalization of the draft biological criteria, this plan will be amended to reflect the revised use support determinations.

Use Support Information for All Monitored and Evaluated Streams in the Lumber River Basin (1998)

	Monitored and Evaluated Streams		Monitored Streams Only	
	Miles	%	Miles	%
Supporting	2230.9	98	381.6	100
Fully Supporting	1122.7	49	242.3	63
Fully Supporting but Threatened	1108.2	49	139.3	37
Impaired	0	0	0	0
Partially Supporting	0	0	0	0
Not Supporting	0	0	0	0
Not Rated	51.8	2	0	0

Use Support Ratings for Estuarine Waters in the Lumber River Basin (1993-1997)*

			Overall Use Support				Major Sources		Potential Sources of Pollution
Area Name	Total Acres	DEH Area	FS	ST	PS	NS	Point	Nonpoint	
Calabash	1800	A-1	0	662	1138	0		NPS	urban runoff, septic systems, marinas
Shallotte River	1350	A-2	445	334	571	0		NPS	urban runoff, septic systems, marinas
Lockwoods Folly River	1650	A-3	482	255	913	0		NPS	urban runoff, septic systems, marinas
Total Acres	4800		927	1251	2622	0			
Percent	100		19.3	26.1	54.6	0			

* Fecal coliform is the only cause of impairment of estuarine waters in this basin.

Major Sources:

NPS indicates that surveys note that nonpoint sources are the major factor influencing water quality, or there are no major point sources.

Many of the estuarine waters remain impaired due to fecal coliform bacteria contamination of these shellfish waters. Changes in use support determination methodology had an influence on the numbers of acres impaired in this plan as compared to the 1994 basinwide plan. In general, estuarine use support ratings were derived similarly to the previous cycle. The only exception is the use of shellfish closure information. Previously, all SA waters authorized by DEH as conditionally approved for shellfish harvesting were given a use support rating of support threatened. Currently, conditionally approved-open areas (waters normally open to shellfish harvesting but closed on a temporary basis in accordance with management plan criteria) continue to be rated support threatened, but conditionally approved-closed areas (waters normally closed to shellfish harvesting but open on a temporary basis in accordance with management plan criteria) are now rated as partially supporting. This change more accurately reflects the status of conditionally approved-closed waters.

Future Water Quality Program Focus

It should be noted that the federal government is placing increased pressures on North Carolina and other states to restore their waters in accordance with Section 303(d) of the federal Clean Water Act. While current mandates to the states are to develop restoration strategies or specify total maximum daily loads (TMDLs) of pollutants for impaired waters, deadlines for restoration may not be far off.

To achieve the goal of restoring impaired waters throughout the state, partnerships need to be developed with local governments, Soil and Water Conservation Districts, industry, property owners and other stakeholders. The goal of these partnerships, in part, will be to work together to identify and control causes and sources of water quality impairment within watersheds. While this task appears daunting statewide in light of the number of impaired waters in the state, it becomes much more manageable when responsibilities are shared across the basin. Several programs have been developed to provide funding for stream restoration and protection projects. The programs include the Clean Water Management Trust Fund, the Wetlands Restoration Program and Section 319 of the Clean Water Act.

Using current information, only a portion of the estuarine waters in the basin are impaired. To address this impairment, DWQ will be looking for opportunities to coordinate with local governments and other agencies to develop management strategies to reduce impairment of the acres of estuarine waters. In the Lockwoods Folly River, DWQ is currently collaborating with the US Army Corps of Engineers on an action plan (see Section B, Chapter 10 for more discussion). Additional projects in the Shallotte and Calabash River area will be pursued.

Section A

General Basinwide Information

Chapter 1
Introduction to Basinwide Water Quality Planning

1.1 What is Basinwide Water Quality Planning

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Under this approach, basinwide water quality plans are prepared by the NC Division of Water Quality for each of the seventeen major river basins in the state. While these plans are prepared by the Division of Water Quality, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first round of plans was completed in 1998. Each plan is now being updated at five-year intervals during round two.

DWQ is applying this approach to each of the seventeen major river basins in the state as a means of:

- better identification of water quality problems;
- development of appropriate management strategies;
- maintenance and protection of water quality and aquatic habitat;
- assuring equitable distribution of waste assimilative capacity for dischargers; and
- improving public awareness and involvement in the management of the state's surface waters.

DWQ prepares basinwide water quality plans for each of the state's major river basins, as shown in Figure A-1 and Table A-1. Preparation of an individual basinwide management plan is a five-year process which is broken down into four major phases as presented in Table A-2.

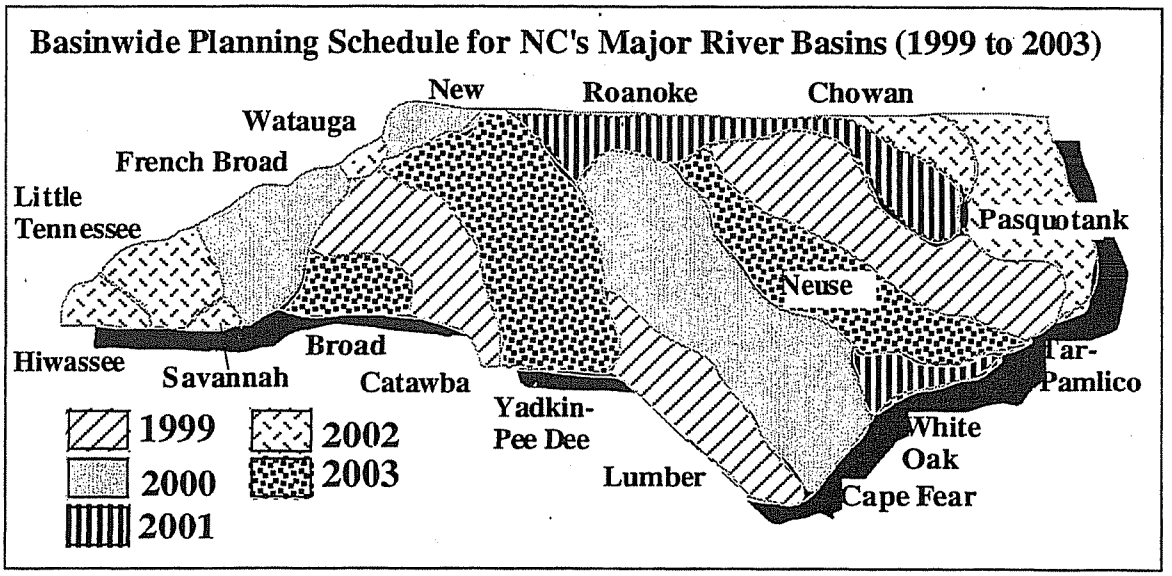


Figure A-1 Basinwide Planning Schedule (1998 to 2003)

Table A-1 Schedule for Second Round of Basinwide Planning (1998 to 2003)

Basin	Begin NPDES Permit Issuance	Final Plan Receives EMC Approval*	Public Mtgs. and Draft out For Review	EMC/WQC Approval For Public Meetings	In-house Draft due for Staff Review	DWQ Biological Data Collection
Neuse	4/1998	**12/1998**	9/1998	7/1998	7/1998	Summer 95
Yadkin	7/1998	**5/1998**	2/1998	12/1997	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	7/1999	2/1999	12/1998	5/1998	Summer 97
Catawba	4/2000	12/1999	9/1999	7/1999	5/1999	Summer 97
Fr. Broad	8/2000	3/2000	11/1999	6/1999	6/1999	Summer 97
New	11/2000	5/2000	2/2000	12/1999	9/1999	Summer 98
Cape Fear	1/2001	7/2000	4/2000	2/2000	10/1999	Summer 98
Roanoke	1/2002	7/2001	2/2001	12/2000	8/2000	Summer 99
White Oak	6/2002	3/2002	9/2001	7/2001	4/2001	Summer 99
Savannah	8/2002	5/2002	2/2002	12/2001	6/2001	Summer 99
Watauga	9/2002	4/2002	12/2002	10/2001	6/2001	Summer 99
Little Tenn.	10/2002	5/2002	2/2002	12/2001	7/2001	Summer 99
Hiwassee	12/2002	5/2002	2/2002	12/2001	7/2001	Summer 99
Chowan	1/2003	9/2002	4/2002	3/2002	11/2001	Summer 2000
Pasquotank	2/2003	9/2002	4/2002	3/2002	11/2001	Summer 2000

* Dates in bold print denote plan approval by the EMC

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

Years 1 to 3 **Water Quality Data Collection and Identification of Goals and Issues**	• Identify sampling needs • Canvass for information • Coordinate with other agencies and local interest groups to establish goals and objectives and identify and prioritize issue • Ambient monitoring stations reviewed/monitored in Year 2 • Conduct biological monitoring activities • Special studies and other water quality sampling activities
Years 3 to 4 **Data Assessment and Model Preparation**	• Data from special studies to prepare models and TMDLs • Develop preliminary pollution control strategies • Coordinate with local stakeholders
Year 4 **Preparation of Draft Basinwide Plan**	• Based on support documents including water quality data, modeling data and recommended pollution control strategies • Preliminary findings are presented at informal meetings or public workshops with comments incorporated in draft
Year 5 **Public Review and Approval of Plan**	• Draft plan circulated for review • Public meetings held after approval by NC Environmental Management Commission's Water Quality Committee • Revisions made after public review period • Final document submitted to EMC for approval • Basinwide permitting begins at end of Year 5

1.2 Goals of Basinwide Water Quality Planning

The goals of basinwide management are to: 1) identify and restore full use to impaired waters; 2) identify and protect highly valued resource waters; and 3) protect the quality and intended uses of North Carolina's surface waters and allow for sound economic planning and reasonable growth. This is done by managing problem pollutants within each basin through development of consistent and effective long-range management strategies.

1.3 Purpose of the Basinwide Plan

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

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

The major activities coordinated by DWQ through basinwide planning are listed in Appendix A-I. Information on the location, address and phone numbers for each branch and regional office are also shown in this appendix.

1.4 Major Components of the Basinwide Plan

The second round of basinwide plans uses a different format from the earlier basinwide plans. Each plan is subdivided into three major sections. The intent of the format changes is to make the plans easier to read and understand, but still comprehensive in content.

Section A: Basinwide Information

- Introduces the basinwide planning approach used by the state.
- Provides an overview of the river basin overview including: hydrology, land use, local government jurisdictions, population and growth trends, natural resources, wastewater discharges, animal operations and water usage.
- Presents general water quality information including summaries of water quality monitoring programs and use support in the basin.

Section B: Subbasin Information

- Summarizes water quality data, other information and recommendations by subbasin.

Section C: Current and Future Initiatives

- Summarizes what was recommended in the first basin plan, what was achieved, what wasn't achieved and why, current priority issues and concerns, and goals and recommendations for the next five years.
- Presents current and future water quality initiatives and success stories by federal, state and local agencies, and corporate, citizen and academic efforts; and describes DWQ goals and initiatives beyond the five-year planning cycle for the basin.

1.5 Features of Basinwide Water Quality Planning

Basinwide water quality planning is a complex and comprehensive effort with many "moving parts". Some major features of this program include:

- increased opportunity for public participation in the state's water quality planing;
- a focused effort on one river basin at a time across the state;
- basinwide National Pollutant Discharge Elimination System (NPDES) permitting;
- integration of existing point and nonpoint source regulatory programs;
- preparation of basinwide water quality plans for each of the state's 17 river basins;
- five-year planning cycles.

1.6 Benefits of Basinwide Water Quality Planning

Several benefits of basinwide planning and management to water quality include:

- *Improved efficiency.* The state's efforts and resources are focused on one river basin at a time.
- *Increased effectiveness.* The basinwide approach is in agreement with basic ecological principles.
- *Better consistency and equability.* By clearly defining the program's long-term goals and approaches, basinwide plans encourage *consistent* decision-making on permits and water quality improvement strategies.
- *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.
- *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 ensure compliance with water quality standards.

1.7 How to Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and other local stakeholders to participate in the planning process. DWQ offers two opportunities for the public to participate in the process:

- Public workshops: Held prior to writing the basinwide plans. DWQ staff present information about basinwide planning and the water quality of the basin. Participants then break into smaller groups where they can ask questions, share their concerns, and discuss potential solutions to water quality issues in the basin.
- Public meetings: Held after the draft basinwide plan has been approved by the Water Quality Committee of the Environmental Management Commission. DWQ staff present more detailed information about the draft basinwide plan and its major recommendations. Then, the public is invited to comment and ask questions.
- Public Comment Period: Held after the draft plan has been approved by the Water Quality Committee of the Environmental Management Commission. The comment period is at least thirty days in length from the date of the first public meeting.

Citizens seeking involvement in efforts to restore and protect water quality can call the DWQ Planning Branch at (919) 733-5083 and ask to speak to the basinwide planner for your river basin.

1.8 Other References

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

- *Lumber River Basinwide Assessment Report.* March 1998. This technical report presents the physical, chemical and biological data in the Lumber River basin. 149 pages.
- *Lumber River Basinwide Water Quality Management Plan.* May 1994. This first basinwide plan for the Lumber River basin presents water quality data, information and recommended management strategies for the first five-year cycle. 181 pages.
- *A Guide to Water Quality in North Carolina.* This document will be available soon. The document will include general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description.* Creager, C.S. and J.P. Baker. 1991. DWQ Water Quality Section. Raleigh, NC.
- NC *Basinwide Wetlands and Riparian Restoration Plan for the Lumber River Basin.* DWQ NC Wetlands Restoration Program.

Anyone interested in receiving these documents can contact the DWQ Planning Branch at (919) 733-5083 or by e-mail http://h2o.enr.state.nc.us/basinwide/basinwide/default.htm.

Chapter 2
Lumber River Basin Overview

2.1 General Description

The Lumber River Basin lies along the North Carolina/South Carolina border at the southeast corner of the state. The basin extends about 150 miles from the Atlantic Ocean coastline in Brunswick County to the Sandhills region in southern Moore and Montgomery Counties (Figure A-2). Streams and rivers in the Lumber River basin (except for the Lockwoods Folly and Shallotte Rivers) flow into South Carolina and are tributaries of the Great Pee Dee River, which flows into the Atlantic Ocean near Georgetown, SC (Figure A-3). The coastal area watershed flows to the Atlantic Ocean through several inlets.

Lumber River Basin Statistics

Area: 3,343 sq. miles
Stream Miles: 2,283
Saltwater Acres: 4,800
No. of Counties: 10
No. of Subbasins: 10
Population (1990): 259,539*
Projected Pop. (2015): 372,199*
% Increase (1990-2015): 43%
Pop. Density (1990): 78 per sq. mi.

* based on % of county land area estimated to be within the basin

The Lumber Basin is the home of Lake Waccamaw in Columbus County, the Lumber River State Park, world-renowned golf resorts in southern Moore County and throughout Brunswick County, and commercial fishing areas in the Brunswick County area. In addition, much of the Lumber River mainstem is designated a state Natural and Scenic River, one of just four in North Carolina. Eighty-one miles of the river is designated a National Wild and Scenic River.

The basin contains all or part of 10 counties including: Brunswick, Columbus, Bladen, Robeson, Cumberland, Hoke, Scotland, Richmond, Moore and Montgomery. Municipalities with a population of 5,000 or more (1990 census data) include Lumberton, Laurinburg, Southern Pines, Pinehurst and Whiteville. Population growth for the basin as a whole from 1980 to 1990 is estimated at 7.9 percent. This compares to a statewide average population increase of 12.7 percent for the same period. Brunswick County is reported to be the second fastest growing county in the state.

According to a 1992 study by the US Department of Agriculture (USDA) Natural Resources Conservation Service, 59 percent of the land area was forested, 29 percent was in agriculture (cultivated, uncultivated and pasturelands), and 6 percent of the basin was in urban and developed areas.

Most of the freshwater streams in the basin (approximately 90 percent) are supplementally classified as swamp waters. The 4,800 acres of waters along the coast are classified as *saltwaters*, of which most are classified as SA (suitable for commercial shellfishing and other tidal saltwater uses). The basin is composed of four major watersheds: Lumber River, Little Pee Dee headwaters, Waccamaw River and the coastal area rivers.

Groundwater is abundant and a major water supply source in the basin, especially southeast of Lumberton. In light of the abundance of groundwater, the flat terrain and the high evapotranspiration rate, there are relatively few surface water impoundments and most major streams are free-flowing. The eastern half of the basin does, however, have natural lakes, the most prominent of which is Lake Waccamaw. These lakes, known as Carolina Bay lakes, are intriguing natural landscape features of unknown origin found throughout the Coastal Plain of North Carolina and other southern Atlantic Coast states.

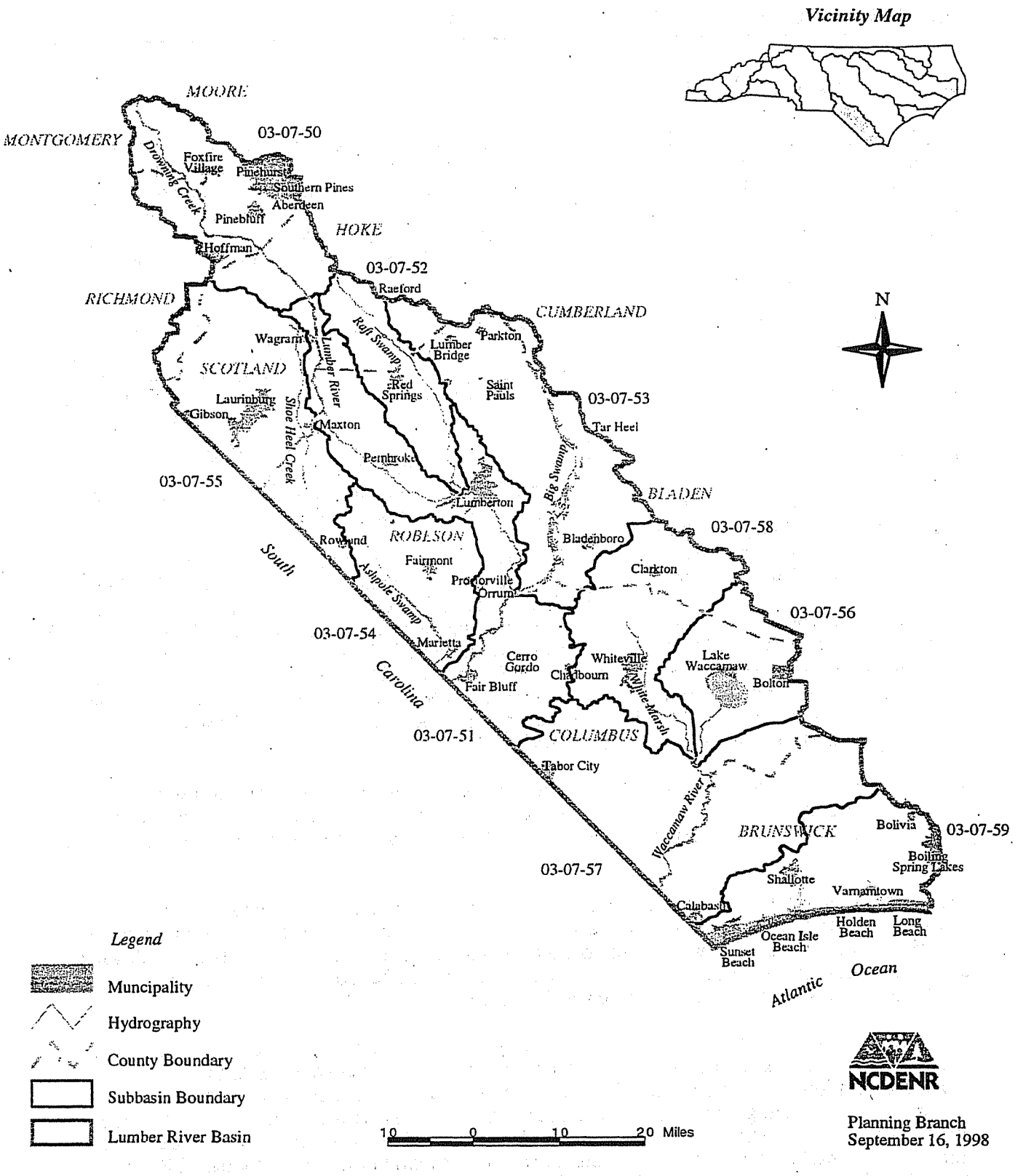


Figure A-2 General Map of the Lumber River Basin

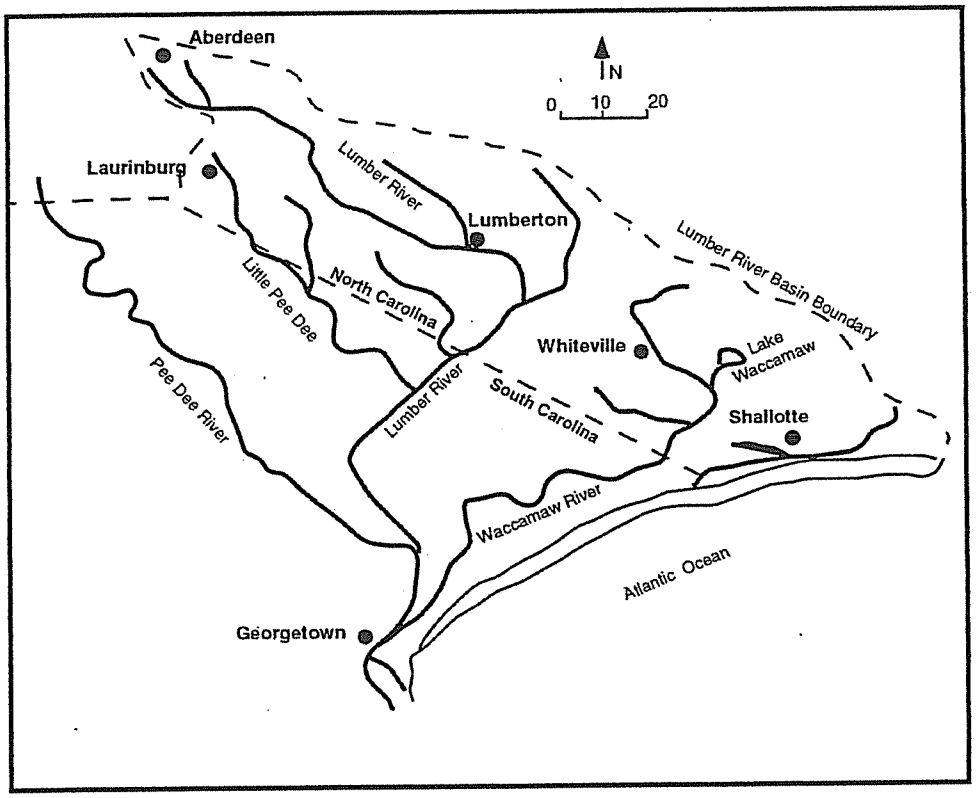


Figure A-3 Lumber River Basin in North and South Carolina

2.2 Local Governments and Planning Jurisdictions in the Basin

The basin encompasses portions of 10 counties (Table A-3), four Lead Regional Organizations (Council of Governments) and 50 municipalities (only 5 of these have a population over 5,000 persons).

2.3 Hydrology

Despite its name, the Lumber River Basin is actually composed of four separate river systems or *watersheds*, as they will be referred to in this plan. The largest of the four watersheds is the **Lumber River Watershed** from which the basin draws its name. The others include the **Waccamaw River Watershed**, the **Little Pee Dee Headwaters Watershed** which includes Shoe Heel and Gum Swamp Creeks, and the **Coastal Area Watershed** which includes the Shallotte and Lockwoods Folly Rivers. All of these watersheds except the coastal area watershed are tributaries, directly or indirectly, of the Great Pee Dee River which flows through South Carolina.

2.3.1 Major Hydrologic Divisions

The Lumber River basin is subdivided into ten subbasins by DWQ. Each subbasin is identified by a 6-digit subbasin code number from 03-07-50 to 03-07-59. The digits 03-07 refer to the Lumber basin, while 50 through 59 identify specific subbasins. Subbasin boundaries are shown in Figure A-2 and Table A-4.

Table A-3 Local Governments and Planning Units by Major Watersheds

County	% of County in basin**	Region	Municipalities
Lumber River			
Bladen *	16	N	Bladenboro, Dublin, Tar Heel
Columbus *	25	O	Boardman, Cerro Gordo, Chadbourn *, Fair Bluff
Cumberland	<5	M	None
Hoke	43	N	Raeford
Montgomery	5	H	Candor
Moore	21	H	Aberdeen, Foxfire Village, Pinebluff, Pinehurst, Southern Pines
Richmond *	10	H	Hoffman, Norman
Robeson *	85	N	Fairmont, Lumber Bridge, Lumberton, Marietta, McDonald, Orrum, Parkton, Pembroke, Proctorville, Raynham, Red Springs, Rennert, Rowland, Saint Pauls
Scotland *	5	N	None
Little Pee Dee River			
Richmond *	9	H	None
Robeson *	15	N	Maxton
Scotland *	99	N	East Laurinburg, Gibson, Laurinburg, Wagram
Waccamaw River			
Bladen *	15	N	Clarkton
Columbus *	64	O	Bolton, Brunswick, Chadbourn *, Lake Waccamaw, Tabor City, Whiteville
Coastal Area			
Brunswick *	55	O	Boiling Springs Lake, Bolivia, Calabash, Holden Beach, Long Beach, Ocean Isle Beach, Shallotte, Sunset Beach, Varnamtown

Key:

* Denotes those counties that are in more than one watershed or river basin

** As estimated by the Center for Geographic Information and Analysis (CGIA)

Region	Name	Location
H	Pee Dee Council of Governments	Rockingham
M	Region M Council of Governments	Fayetteville
N	Lumber River Council of Governments	Lumberton
O	Cape Fear Council of Governments	Wilmington

Lumber River Watershed

With a drainage area of 1,043,300 acres, the Lumber River watershed is the largest of the four watersheds in the Lumber River basin. The river is formed at the confluence of Buffalo Creek and Drowning Creek along the Scotland and Hoke County line. From its origin, the Lumber River flows for approximately 115 miles past Maxton, Lumberton and Fair Bluff before crossing into South Carolina where it joins the Little Pee Dee River. The river was designated a state Natural and Scenic River from Scotland County to the South Carolina line in 1989. In addition, 81 miles of the Lumber River were designated as a National Wild and Scenic River in September 1998. Major tributaries of the Lumber River include Raft Swamp, Big Swamp and Ashpole Swamp. The Lumber River watershed is divided into five subbasins as shown in Table A-4.

Little Pee Dee River Headwaters Watershed

The Little Pee Dee River headwaters watershed is approximately 255,100 acres and encompasses most of Scotland County and small portions of eastern Richmond and western Robeson Counties. Major streams include Big Shoe Heel Creek, Bridge Creek and Gum Swamp Creek. These creeks flow to the south and join with other creeks in South Carolina to form the Little Pee Dee River. The Little Pee Dee River headwaters cover only one subbasin (03-07-55).

Table A-4 Hydrologic Divisions in the Lumber River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ 6-digit Subbasin Codes (See Figure A-2)
Lumber River and Tributaries	03040203	
Naked Creek	"	03-07-50
Drowning Creek	"	03-07-50
Lumber River Mainstem	"	03-07-50 and 51
Raft Swamp	"	03-07-52
Big Swamp	"	03-07-53
Ashpole Swamp	"	03-07-54
Little Pee Dee River Headwaters	03040204	03-07-55
Shoe Heel Creek	"	03-07-55
Bridge Creek	"	03-07-55
Gum Swamp	"	03-07-55
Waccamaw River and Tributaries	03040206	
Lake Waccamaw and Waccamaw River to White Marsh	"	03-07-56
Lower Waccamaw River below White Marsh confluence	"	03-07-57
White Marsh	"	03-07-58
Coastal Drainage	03040207	
Lockwoods Folly River	"	03-07-59
Shallotte River	"	03-07-59
Calabash River	"	03-07-59

Waccamaw River Watershed

The Waccamaw River watershed covers approximately 804,400 acres in Columbus, western Bladen and northern Brunswick Counties. It includes Lake Waccamaw and a large portion of Green Swamp, most of which has been converted from pocosin wetlands to pine plantations. The Waccamaw River originates at Lake Waccamaw and flows southwest through forested wetlands into South Carolina, eventually joining with the Great Pee Dee River. Lake Waccamaw is an important natural resource serving as both a popular recreation and vacation area as well as home to several threatened or endangered species. This watershed is subdivided into three subbasins as shown in Table A-4.

Coastal Area Watershed

This watershed covers a 131,400-acre area and encompasses the southern half of Brunswick County west of Long Beach. It is made up of several small stream systems which flow southward from Green Swamp to the ocean including the Lockwoods Folly River, Shallotte River and the Calabash River. The mainland is protected by a line of barrier islands separated by a series of inlets: Lockwoods Folly Inlet, Shallotte Inlet, Tubbs Inlet and Browns Inlet (in South Carolina). Landward of the islands is a narrow estuary and the Intracoastal Waterway.

2.3.2 Physiography and Geology

One of the many interesting characteristics of the Lumber River basin is its physiography and geology. The basin is within the Coastal Plain physiographic region. This area is characterized by flat lands to gently rolling hills, with a maximum elevation of about 600 feet in the Sand Hills. The Lumber basin is divided into two sub-physiographic regions within the Coastal Plain. The majority of the basin is located within the Inner Coastal Plain. A small portion of the basin, located in Scotland, Hoke, Moore, Richmond and Montgomery counties, lies within the Sandhills region of the Coastal Plain.

Sandhills Characteristics:

- The high percolation rate allows for ample recharge of groundwater reserves.
- Groundwater discharges feed streams with high quality water during low rainfall periods.
- Water quality is generally good to excellent.
- Use of soils for wastewater treatment is somewhat limited by terrain and the low filtering capacity of the sandy soils.
- Care must taken in land development and use of these soils for wastewater treatment to prevent contamination of the underlying groundwater.

Coastal Plain Characteristics:

- The region has relatively flat low-lying terrain with poorly drained soils.
- Streams are sluggish blackwater streams bordered by swamps and bottomland forests.
- Tannic acid released from decomposing plant materials results in a natural tea color, hence the name 'blackwater' streams.
- Soils pose moderate to severe limitations for wastewater disposal because of high water tables, slow percolation rates and/or flooding.

The geology underlying the Lumber River basin has an affect on both stream water quality and water quantity. Ten low flow hydrologic areas (HA1-HA10) were defined for North Carolina by USGS (Figure A-4). Areas were defined by relating topography, geology, mean annual runoff and other features to low flow frequency characteristics including 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded in 9 out of 10 years) and 30Q2 (annual minimum 30-day consecutive low flow, which on average, will be exceeded in 1 out of 2 years). The ten HAs typically form a southwest-northeast band across the state and lie within three physiographic areas - the Coastal Plain, the eastern and central Piedmont and the western Piedmont and mountains (Giese and Mason, 1993).

In general, the lowest potential for sustaining base flow to streams is in the clay and sandy soils area of the Coastal Plain (HA1 and HA2). The following discussion explains the characteristics that reduce the potential for base flow in these regions (Giese and Mason, 1993).

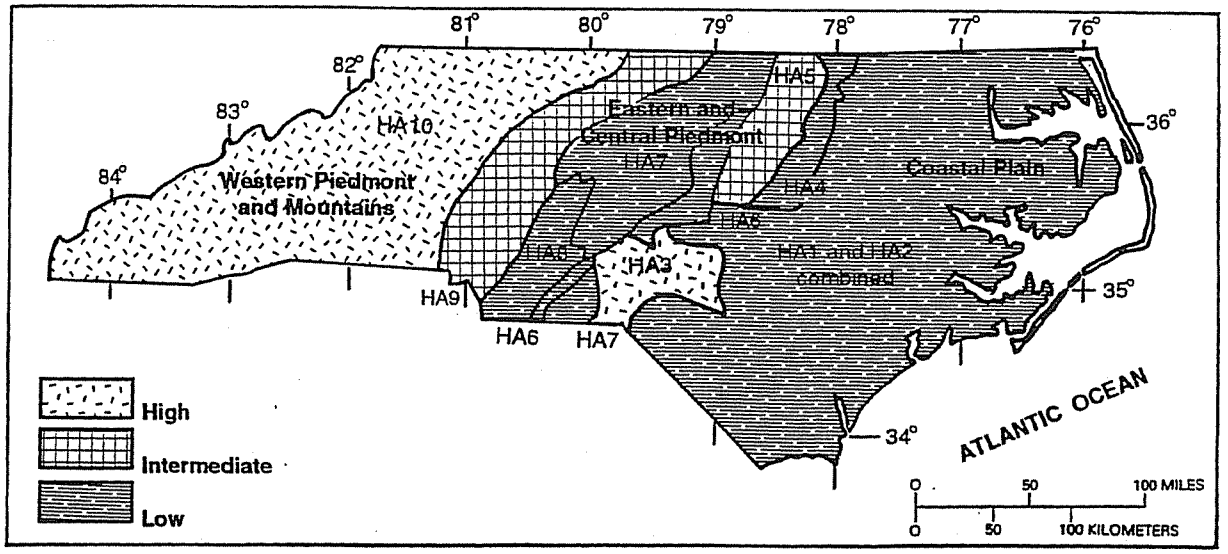


Figure A-4 Hydrologic Areas (HA) of Similar Potential to Sustain Base Flows

The geology of this physiographic area consists of alternating layers of sand, silt, clay and limestone. This area was divided into three HAs based on soil types and topography. These are clay soils (HA1), sandy soils (HA2) and the Sand Hills (HA3). With the exception of the Sand Hills area (HA3), topographic relief is relatively flat, with the land surface dipping coastward at a rate of only a few feet per mile. Topographic relief and hydraulic gradient in the Sand Hills (HA3) is much higher.

The clay soils have the lowest low flow values of the three HAs (median 7Q10 is 0[ft^3/s]/mi^2), sandy soils (HA2) have intermediate values (median 7Q10 is 0.006[ft^3/s]/mi^2), and the Sand Hills (HA3) have the highest values in the state (median 7Q10 is 0.318[ft^3/s]/mi^2).

The low topographic relief of HA1 and HA2 (1 to 2 feet per mile) reflects the low hydraulic gradient and reduced potential to move water to streams than in areas with greater topographic relief (i.e., HA3). The lower low flow values for clay soils versus sandy soils result from the lower permeability of clay soils and that a higher percentage of precipitation that falls on clay soils is not absorbed and runs off directly into streams. Clay soils also have lower hydraulic conductivity than sandy soils and thus contribute less to base flow of streams than sandy soils.

2.3.3 Soil Conditions

A good indicator of the extent of use limitations posed by saturated soil conditions is the percentage of hydric soils in a given area. Hydric soils are defined by the US Soil Conservation Service (1987) as "a soil that is saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions in the upper part." Table A-5 presents the percentage of hydric soils for 8 of the 10 counties in the Lumber Basin. Those four counties comprising most of the coastal plain portion of the basin (Bladen, Brunswick, Columbus and Robeson) have, as a whole, over 50% of their land area classified as hydric soils based on USDA soil classifications. The water content of hydric soils is generally sufficient to support wetlands vegetation. Today, despite drainage for agriculture and forestry, a large percentage of the land area in the lower Lumber Basin is still in wetlands. These wetlands serve many important functions including: wildlife habitat, floodwater retention and water quality protection.

Table A-5 Percentage of Land Surface in Hydric Soils by County in the Lumber Basin

County	Hydric Soils	County	Hydric Soils
Bladen	54.1%	Hoke	18%
Brunswick	58.3%	Richmond	17.6%
Columbus	57.7%	Robeson	47%
Cumberland	33.8%	Scotland	26.7%

2.3.4 Groundwater

The Lumber River Basin encompasses two distinct physiographic regions within the Coastal Plain. The majority of the basin is located within the Inner Coastal Plain, where groundwater is the principal source of public water supply. A small portion of the basin, located in Scotland, Hoke, Moore, Richmond and Montgomery counties, lies within the Sandhills region. Public water supply in the Sandhills region primarily consists of groundwater augmented by surface water intakes.

The principal aquifers in the Inner Coastal Plain are composed of the Black Creek and Peedee geologic formations, as well as extensive areas of younger Tertiary-age sediments (NCDENR Groundwater Section, 1998). The younger formations are the Duplin and Waccamaw formations. The Inner Coastal Plain contains both confined and unconfined aquifers. The regional groundwater flow moves from upland recharge areas along interstream divides to discharge areas along streams, rivers, riparian wetlands and the coast. More than half of the Lumber River's mean streamflow rate can be expected to originate from groundwater discharging to the river bottom. The Waccamaw River has longer peak flows than most other rivers in the state, which suggests that a large majority of the streamflow originates as groundwater discharge.

The Sandhills region contains the Middendorf Formation and less extensive areas of younger sediments (Pinehurst Formation). Both formations commonly consist of medium to coarse grained sands with high rates of permeability. The coarse grained surficial aquifer rests upon a low permeability fractured-rock aquifer system typical of the Piedmont. A clay-rich confining unit of variable thickness may separate the two aquifers. The Sandhills is a region of rapid groundwater recharge and moderate groundwater base flow. Due to steeper slopes, peak streamflows are more pronounced in the Sandhills than in the Inner Coastal Plain.

The general groundwater quality of the Lumber River basin is good for drinking wells and industrial supply. However, deeper aquifers near the coast contain brackish water that creates intolerable conditions for drinking water supply and some industrial uses. Other exceptions include localized hardness associated with a few carbonate deposits in the Duplin and Peedee Formations. There are 175 known point sources of groundwater pollution located in the Lumber River basin, of which 38 contamination plumes have impacted or may soon impact drinking water wells (Figure A-5). Eighty-nine percent of the contamination sites were caused by leaking underground storage tanks.

2.4 Land Use

Land cover information in this section is from the US Department of Agriculture (USDA), Natural Resources Conservation Service (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. It is considered accurate to the 8-digit hydrologic unit scale established by the US Geological Survey (NRCS, 1995).

Table A-6 summarizes acreage and percentage of land cover from the 1992 NRI for the basin as a whole and for the major watersheds within the basin as defined by the USGS 8-digit hydrologic

units (Refer to Section 2.3 for a comparison between state and federal hydrologic divisions). Description of land cover types identified by the NRI can be found in Table A-7.

Forestlands (both private and federal forests) cover approximately 59% of the basin. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 28% of the land area. The urban and built-up category comprises roughly 6% and exhibited the most dramatic change since 1982 (49% increase). Agriculture related land cover decreased by a total of 24% in the basin. It is likely that some of this land was converted to urban and built-up areas. These land cover changes are presented in Figure A-6.

The state's Center for Geographic Information and Analysis (CGIA) has developed statewide land cover information based on 1993-1995 satellite imagery. Figure A-7 provides a summary of this data by subbasin for the three major land cover types. A direct comparison of this data to the NRI data presented above is not possible due to the use of different methodology. However, the more recent satellite imagery provides a good picture of major land cover types. According to this data, the majority of the basin is forested. The Raft Swamp (03-07-52) and the Ashpole Swamp (03-07-54) watersheds are primarily agricultural.

Figure A-5 Groundwater Pollution Sites in the Lumber River Basin

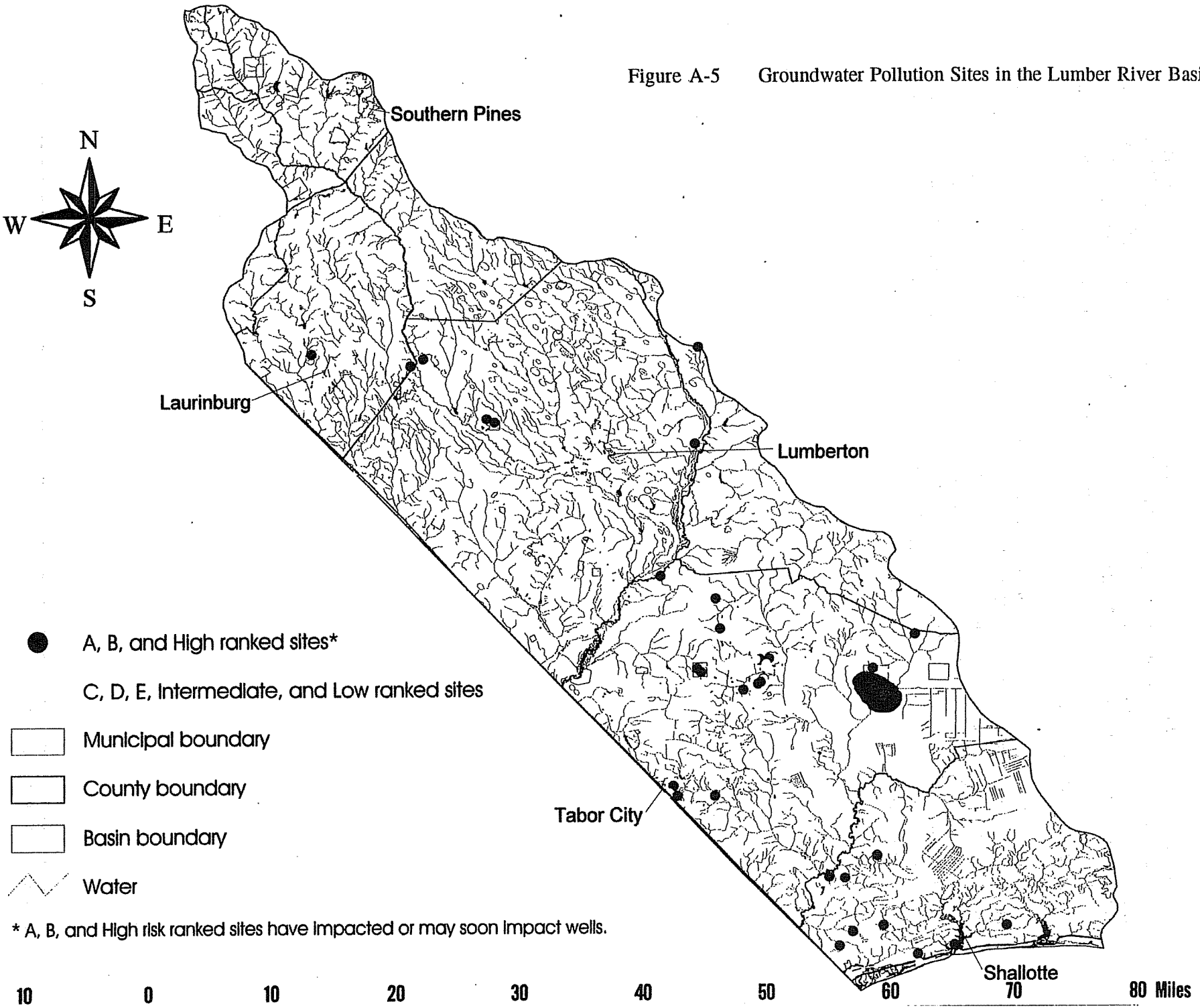


Table A-6 Estimated Acreage by Broad Land Use for the Lumber River Basin - 1982 vs. 1992 (Source: Natural Resources Inventory, 1992)

	MAJOR WATERSHED AREAS *								1992 TOTALS		1982 TOTALS		% Change since 1982
	Lumber		Little Pee Dee		Waccamaw		Coastal						
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of Total	Acres (1000s)	% of Total	
Cult. Crop	326.9	30.2	73.9	31.7	157.1	23.3	9.8	5.4	567.7	26.1	606.4	27.9	-6.4
Uncult. Crop	14.3	1.3	0.8	0.3	0	0.0	0	0.0	15.1	0.7	15.2	0.7	-0.7
Pasture	13.6	1.3	7.6	3.3	7.2	1.1	5.1	2.8	33.5	1.5	40.2	1.8	-16.7
Federal	5.3	0.5	1.7	0.7	9.6	1.4	0	0.0	16.6	0.8	16.6	0.8	0.0
Forest	586.3	54.1	121.3	52.1	448.6	66.5	127.7	69.7	1283.9	59.1	1287.5	59.2	-0.3
Urban & built-up	67.2	6.2	12.9	5.5	22.7	3.4	27.1	14.8	129.9	6.0	87.3	4.0	48.8
Other	70.2	6.5	14.8	6.4	29.1	4.3	13.4	7.3	127.5	5.9	121	5.6	5.4
Totals	1083.8	100.0	233	100.0	674.3	100.0	183.1	100.0	2174.2	100.0	2174.2	100.0	
% of Total Basin		49.8		10.7		31.0		8.4		100.0			
Subbasin Numbers	030750, 030751 030752, 030753 030754		030755, 030757		030756, 030757 030758		030759						
8-Digit Hydraulic Units	03040203		03040204		03040206		03040207						

* = Watershed areas as defined by the 8-Digit Hydraulic Units do not necessarily coincide with subbasin titles used by DWQ.

Table A-7 Description of Land Cover Types (1992 NRI-USDA SCS)

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted.
Pastureland	Forage plants for livestock grazing including land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) 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. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	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. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	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). Small Water Areas: Waterbodies less than 40 acres in size and streams less than one-half mile wide. Census Water: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width. Minor Land: Lands not in one of the other categories.

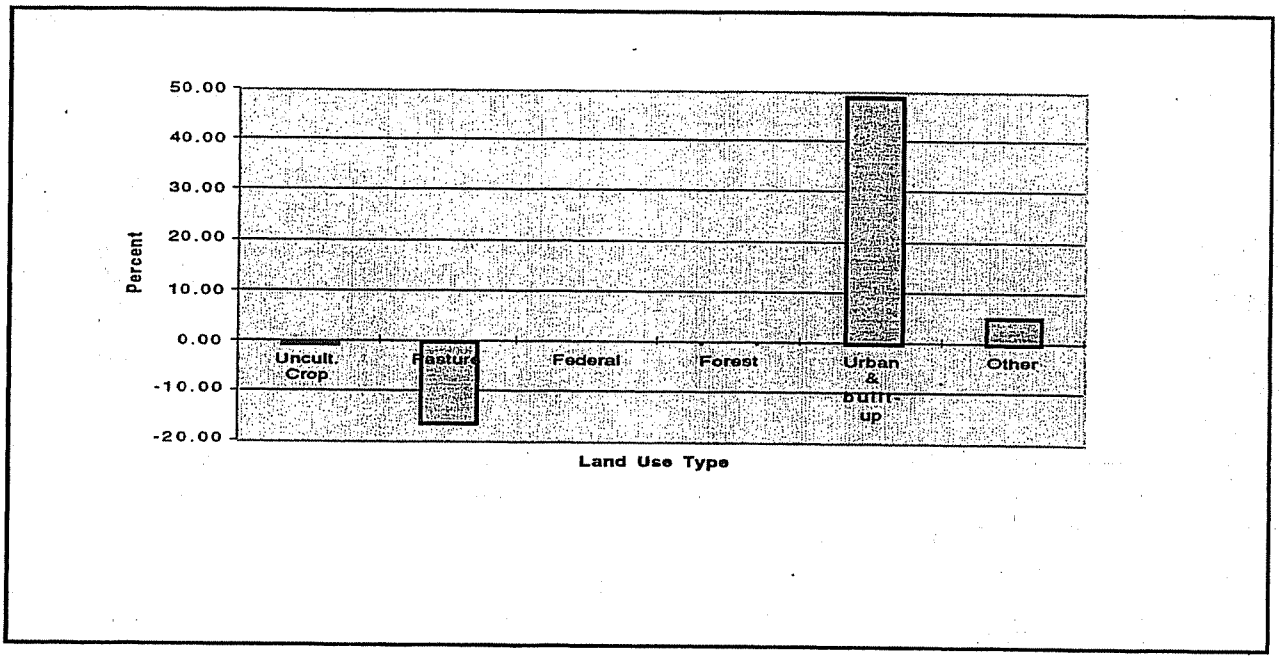
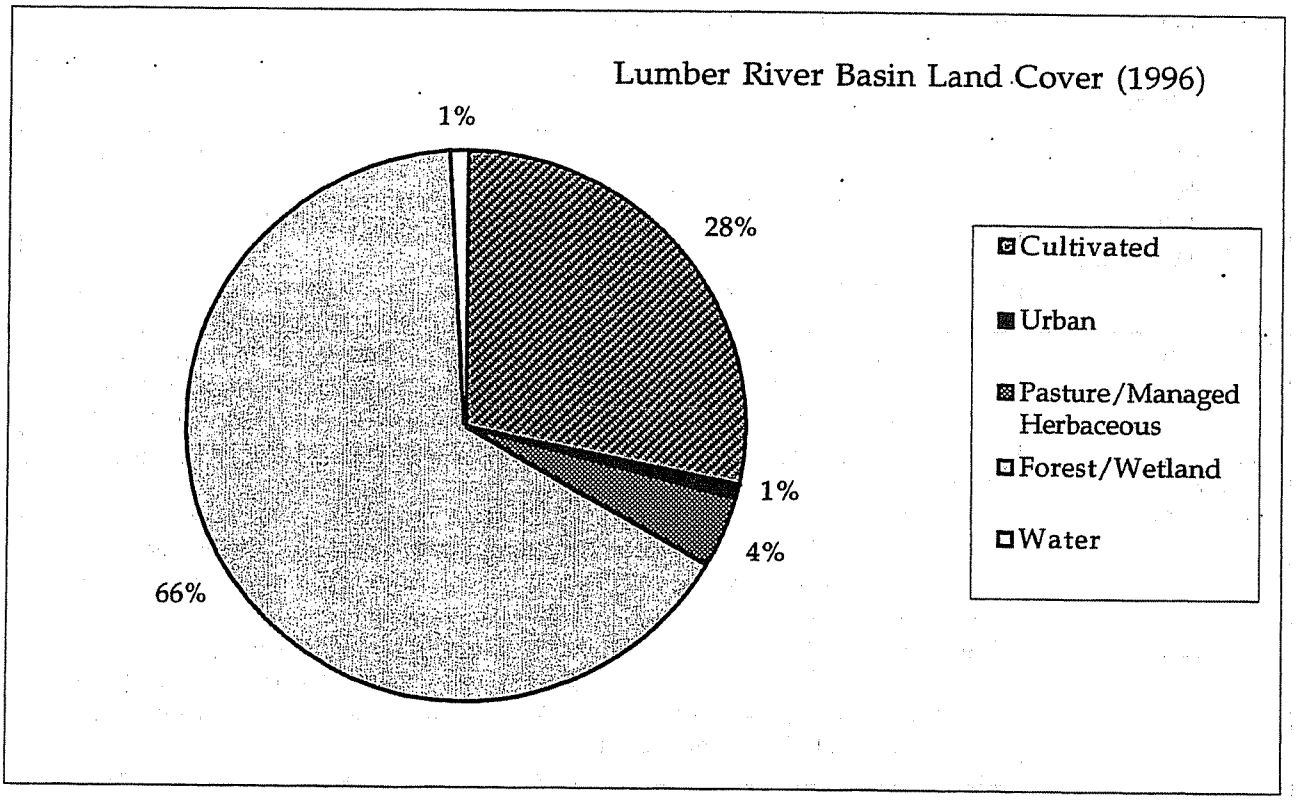


Figure A-6 Land Cover Changes from 1982 to 1992 for the Lumber River Basin (Source of Data: USDA-NRCS 1992 NRI)



(Source: Land Cover Data Coverage from the Center for Geographic Information and Analysis, April 1998. Based on 1993-1995 satellite imagery.)

Figure A-7 Percentage of Land Area within Major Land Cover Types of the Lumber River Basin

2.5 Population and Growth Trends

Population

Based on 1990 census data, approximately 259,539 people live in the basin. Table A-8 presents census data for 1970, 1980 and 1990, the percent population change and population density (persons per square mile) within each subbasin. It also includes land and water area by subbasin.

Figure A-8 shows 1990 population densities by census block group for the Lumber River basin. The overall population density was 78 persons per square mile versus a statewide average of 123 persons per square mile. Subbasin population densities, as of 1990, are higher in the upper portion of the basin.

In using these data, it should be noted that some of 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, the percentage of the population that is located in the subbasin is estimated. This is done by simply estimating 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. This method assumes 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 change each ten years so comparisons between years must be considered approximate.

Table A-8 Lumber River Basin Population (1970, 1980 and 1990), Percent Population Change and Land Area Summaries

	POPULATION (Number of Persons)			POPULATION CHANGE (%)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
										Total Land and Water Area		Water Area	Land Area
SUBBASIN	1970	1980	1990	1970-80	1980-90	1970-90	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-07-50	11,722	16,610	22,133	42	33	89	43	61	81	174,720	273	2	271
03-07-51	31,865	60,037	63,959	88	7	101	60	114	121	337,280	527	1	526
03-07-52	10,695	15,787	16,351	48	4	53	68	100	104	100,480	157	0	157
03-07-53	27,246	28,496	30,035	5	5	10	65	68	71	270,080	422	2	420
03-07-54	15,204	16,760	15,710	10	-6	3	68	75	70	142,720	223	0	223
03-07-55	34,373	40,233	40,415	17	0	18	85	100	100	255,360	399	2	397
03-07-56	5,061	5,761	5,511	14	-4	9	27	31	30	118,400	185	14	171
03-07-57	16,205	18,926	20,080	17	6	24	30	35	37	342,400	535	1	534
03-07-58	21,425	22,830	22,995	7	1	7	66	70	71	207,360	324	1	323
03-07-59	9,856	15,094	22,350	53	48	127	33	50	74	192,000	300	8	292
TOTALS	183,652	240,534	259,539	31	8	41	55	73	78	2,140,800	3,345	31	3,314

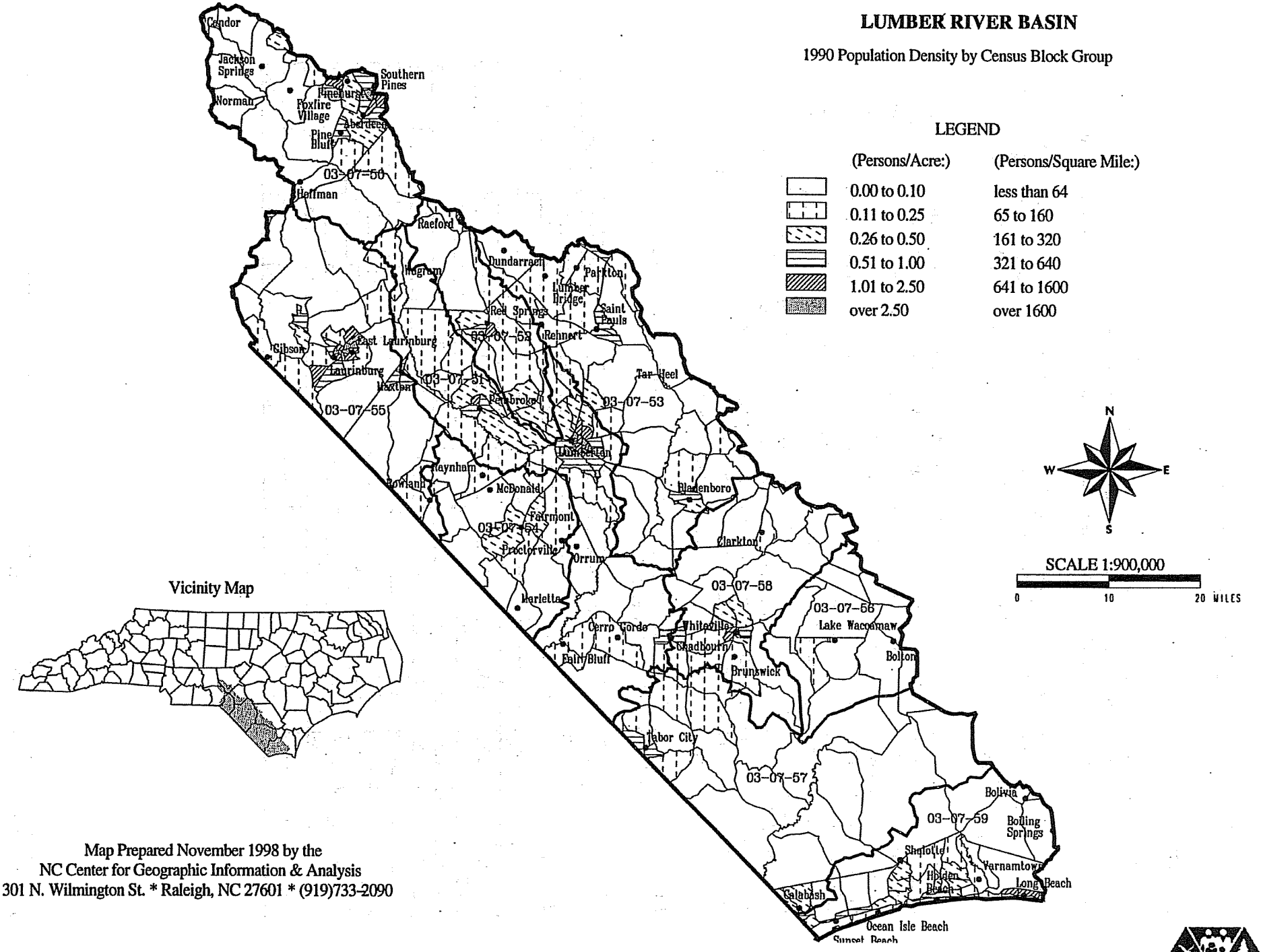


Figure A-8 1990 Population Density by Census Block Group

Growth Trends

Figure A-9 presents population growth by subbasin for the entire Lumber River basin. The percent population growth over the last ten-year census period (1980-1990) was 8 percent, as compared to the statewide average of 12.7 percent. While the overall growth rate for the basin is lower than the statewide average, it should be noted that two subbasins (03-07-50 and 03-07-59) experienced accelerated growth rates of 33 percent and 48 percent, respectively. These subbasins reflect growth occurring in southeastern Moore County and Brunswick County.

Population growth over the period of 1970-1990 has been significant for these and other subbasins. Southeastern Moore County (subbasin 03-07-50) had a population increase of 89 percent, while Brunswick County (subbasin 03-07-59) increased by 127 percent over this time period. Subbasin 03-07-51, which contains Lumberton, experienced a population increase of 101 percent over this twenty-year period. Subbasin 03-07-52, which covers part of Hoke County and the Town of Red Springs, saw a 53 percent growth increase.

Table A-9 presents population data for municipalities located wholly or partly within the basin. There has been significant growth in some of the municipalities during both time periods, with Brunswick County clearly the fastest growing county in the basin.

Table A-10 shows the projected percent change in growth between 1990 and 2015 for counties within the basin (Office of State Planning, 1996). Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Lumber River basin. They are instead presented as an estimate of possible county-wide population changes. Brunswick, Hoke and Moore counties are expected to see the most intense growth by 2015.

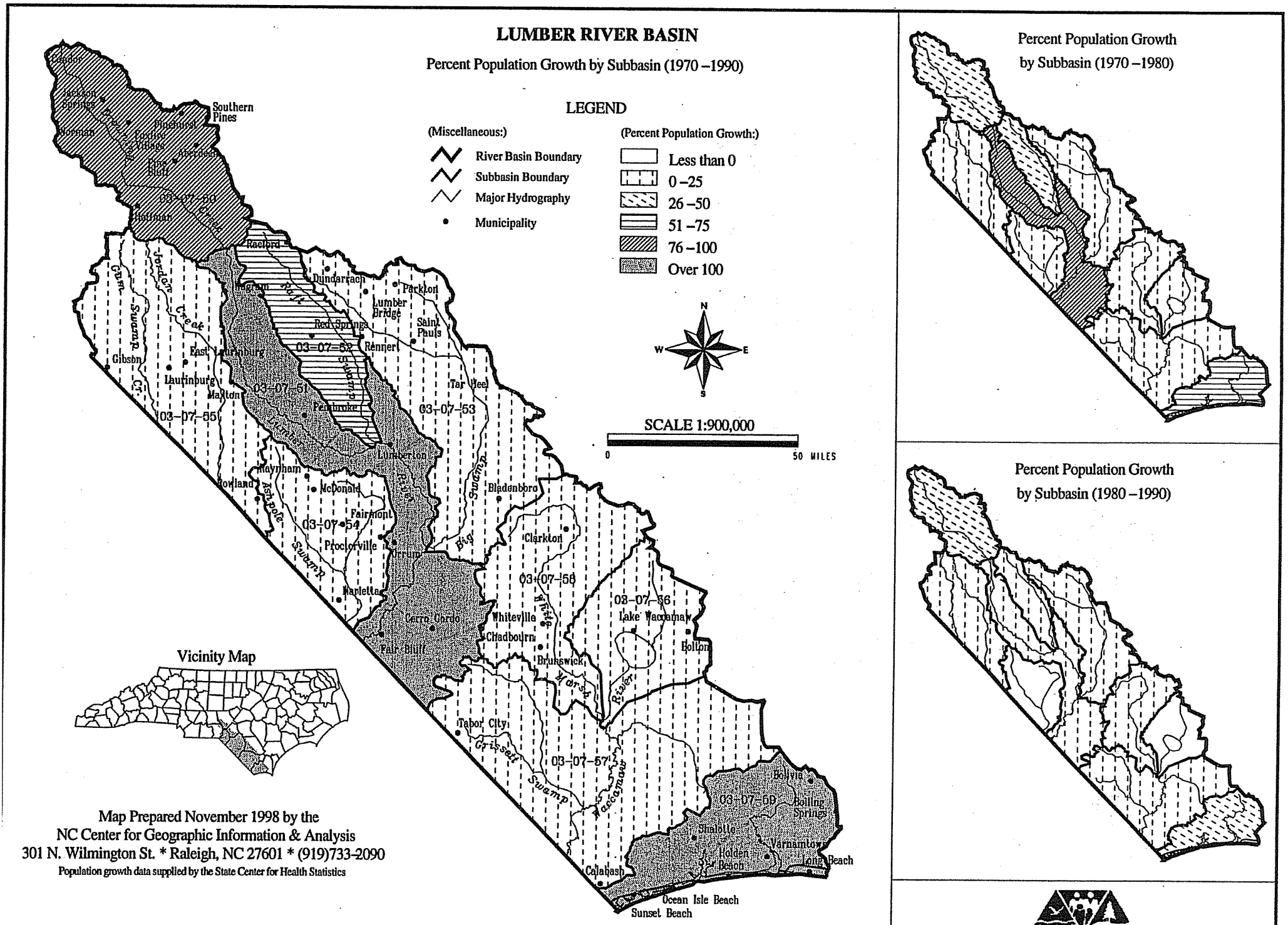


Figure A-9 Percent Population Growth by Subbasin Between 1970 and 1990

Table A-9 Population and Percent Change (1980, 1990, 1996) for Municipalities Greater than 1,000 Located Wholly or Partly in the Lumber River Basin (Source: North Carolina Municipal Population 1995 and 1997)

Municipality	County	Apr-80	Apr-90	Jul-96	Percent Change (1980-90)	Percent Change (1990-96)
Aberdeen	Moore	1,945	2,717	3,378	39.7	24.3
Bladenboro	Bladen	1,428	1,821	1,977	27.5	8.6
Boiling Springs Lake	Brunswick	998	1,650	2,124	65.3	28.7
Calabash	Brunswick	128	1,210	1,561	845.3	29.0
Chadbourn	Columbus	1,975	2,005	2,049	1.5	2.2
Fair Bluff	Columbus	1,095	1,068	1,088	-2.5	1.9
Fairmont	Robeson	2,658	2,519	2,537	-5.2	0.7
Laurinburg	Scotland	11,480	11,643	15,714	1.4	35.0
Long Beach	Brunswick	1,844	3,816	5,072	106.9	32.9
Lumberton	Robeson	18,241	18,733	19,353	2.7	3.3
Maxton	Robeson	2,585	2,576	2,879	-0.3	11.8
Pembroke	Robeson	2,698	2,241	2,564	-16.9	14.4
Pinehurst	Moore	1,746	5,091	7,759	191.6	52.4
Raeford •	Hoke	3,630	3,469	4,029	-4.4	16.1
Red Springs	Robeson	3,607	3,799	3,827	5.3	0.7
Rowland	Robeson	1,841	1,141	1,113	-38.0	-2.5
Saint Pauls	Robeson	1,639	1,992	2,100	21.5	5.4
Shallotte	Brunswick	680	1,073	1,234	57.8	15.0
Southern Pines •	Moore	8,620	9,213	9,860	6.9	7.0
Sunset Beach	Brunswick	304	311	1,908	2.3	513.5
Tabor City	Columbus	2,710	2,330	2,403	-14.0	3.1
Whiteville	Columbus	5,565	5,078	5,607	-8.8	10.4

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

Table A-10 Past and Projected Population and Percent Change (1990 to 2015) by County

County	Population 1990	Estimated Population 1996	Projected % Growth 1990-1996	Projected Population 2015	Projected % Growth 1990-2015
Bladen	28,663	30,090	5.0	30,032	4.8
Brunswick	50,985	62,856	23.3	91,400	79.3
Columbus	49,587	51,852	4.6	51,343	3.5
Hoke	22,856	28,144	23.1	40,134	75.6
Montgomery	23,352	24,382	4.4	25,285	8.3
Moore	59,000	68,126	15.5	87,024	47.5
Richmond	44,518	45,840	3.0	46,254	3.9
Robeson	105,170	112,005	6.5	123,343	17.3
Scotland	33,763	35,030	3.8	36,973	9.5
Total	366,914	458,325	24.9	531,788	44.9

* For counties with >5 percent of land area within the basin (Source: Office of State Planning, 1996)

2.6 Natural Resources

2.6.1 State Parks

Two state parks are located within the Lumber River Basin: Lake Waccamaw and Lumber River State Parks (Figure A-10). The following information was provided by the NC Division of Parks and Recreation. At 8,936 acres, Lake Waccamaw is considered to be the largest Carolina bay lake in North Carolina. The land portion of the park, 1,732 acres in size, is located along the lake's southern and eastern shores. The Waccamaw River begins as outflow from the lake. While most Carolina bay lakes are acidic, limestone outcrops along the northeastern shoreline make the lake water neutral. This helps create a unique aquatic habitat that is home to several rare and endemic species of fish, clams and snails. The rare and unique fauna of Lake Waccamaw makes it one of the state's most significant biological resources.

In 1989, the state legislature designated the 115 mile stretch of Lumber River from "Turnpike" Bridge (SR 1412) in Scotland County to the South Carolina border a State River and Park. A master plan for the Lumber River State Park was approved in 1994. Land acquisition and development of park facilities by the NC Division of Parks and Recreation will occur in three phases. Phases One and Two, covering the southern and northern segments of the river respectively, are well underway. A plan for Phase Three, covering the central river stretch, will be developed in the near future.

The planned size for the first two phases of Lumber River State Park is 7,926 acres. As of July 1998, the park contained 4,007 acres. Although Phase Three is yet to be designed, one of the park goals is to protect lands adjacent to the Lumber River along the entire 115 mile stretch of designated river. This will be accomplished in conjunction with local governments and other organizations using a combination of acquisitions, gifts, conservation easements, leases and cooperative management agreements. A number of natural heritage and recreational benefits in addition to water quality protection will be provided by establishing a protected river corridor.

Another goal of the park is to protect rare species and high quality examples of natural communities that occur along the river. The Division's Natural Heritage Program has identified twelve Significant Natural Heritage Areas adjacent to the designated stretch of river (see Section 2.5.2 for information on Significant Natural Heritage Areas). All twelve sites are slated for protection. Of the eight sites found in Phases One and Two, six have already been added, in full or in part, to the park.

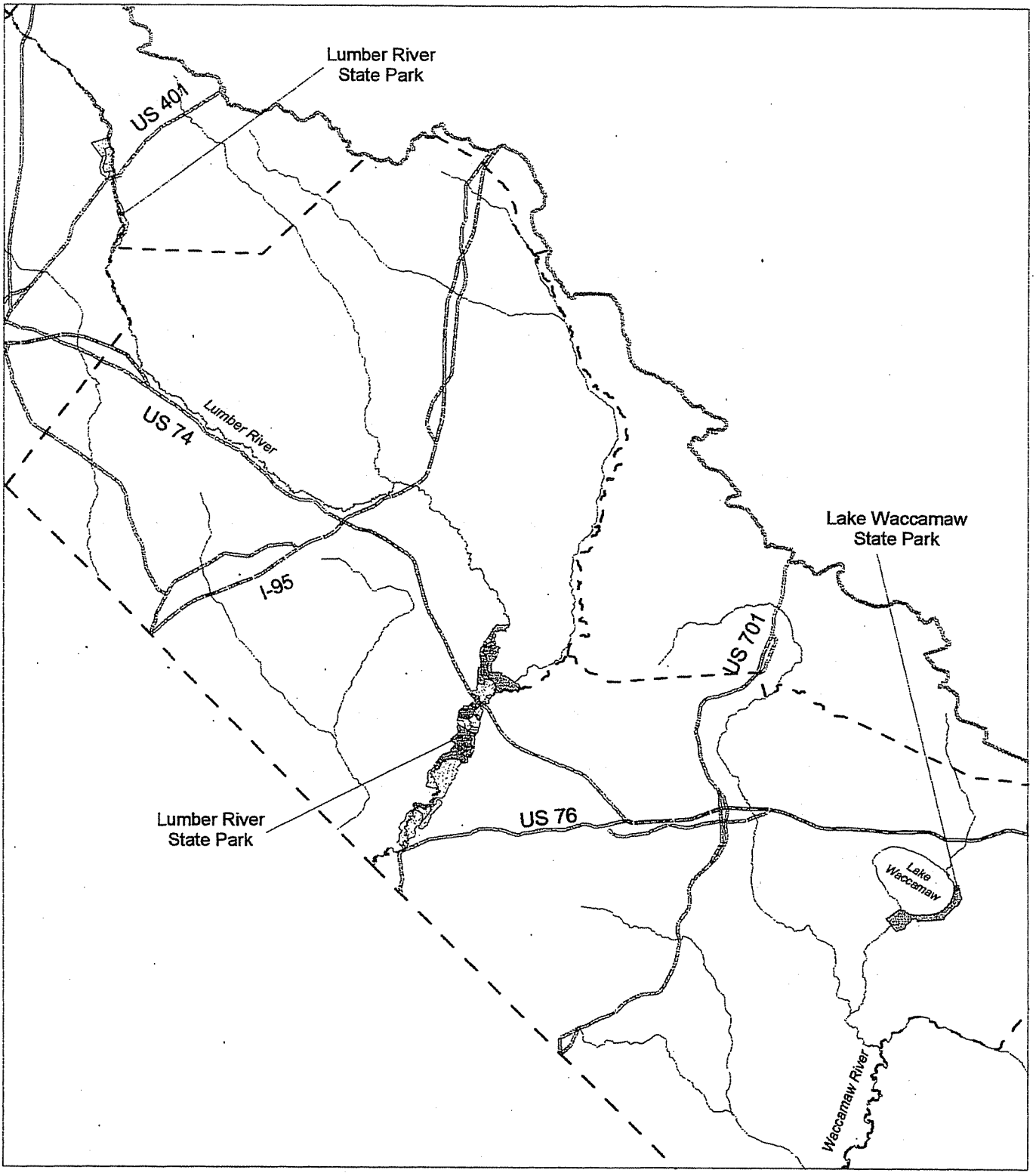


Figure A-10 Lumber River Basin State Parks and Planned Acquisitions

2.6.2 Natural Heritage Areas

The Lumber River basin encompasses three distinct ecological regions in North Carolina: the Southeast Coastal Plain, the Carolina Bay region and the Sandhills. They are arranged along the NC-SC state line, with the Carolina Bay region separating the Southeast Coastal Plain to the east and the Sandhills to the west. This assemblage of ecological regions gives the Lumber River basin a great diversity of natural communities with many unique and rare plants and animals. The Lumber River basin is a showcase of biological diversity; from the vast pocosins of the Green Swamp to Lake Waccamaw to the dry sandy hills that feature magnificent longleaf pines and hardwoods.

Figure A-11 is a map of the Significant Natural Heritage Areas of the Lumber River basin (Division of Parks and Recreation, NHP, 1998). The North Carolina Natural Heritage Program (NHP) compiles this list as required by the Nature Preserve Act. The list is based on the program's inventory of natural diversity in the state. 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 significance. 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.

Sites that directly contribute to the maintenance of water quality in the Lumber basin are highlighted within the appropriate watershed section. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

Lumber River Watershed

The Lumber River watershed drains through portions of the Sandhills and the Carolina Bay ecoregions, which provide the watershed with a range of natural wetland communities. The Lumber River, one of largest blackwater rivers in the state, is flanked by some of the most notable wetland communities in the watershed--the intact, high quality floodplain forests of Cypress-Gum Swamps and Coastal Plain Bottomland Hardwoods. These floodplain forests help act as buffers, preserving the water quality of the Lumber River. Consequently, the river continues to maintain populations of rare animal species.

Of equal note in terms of wetland communities in the Lumber River watershed are clay-based Carolina bays. Located primarily in Robeson, Scotland and southern Hoke counties, clay-based bays may be temporarily filled with water (Vernal Pool communities), permanently filled with water (Small Depression Ponds), or vegetated by natural communities of Nonriverine Swamp Forest or Cypress Savanna. The Cypress Savanna wetland community type is particularly rare and supports a variety of rare plant and animal species. The bays are important breeding sites for many rare amphibians and plants.

Sites that contribute to the maintenance of water quality in the Lumber basin are numbered below and on Figure A-11 grouped into clusters of ecologically similar sites. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

Site 4 - Lower Lumber River floodplain. The floodplain forests of the lower Lumber River are characterized by intact, high quality Cypress-Gum Swamps and blackwater Coastal Plain Bottomland Forests, with names such as Big Sandy Ridge and Swamp, Princess Ann Swamp and Bluff Swamp. This area includes the Lumber River State Park and the Dedicated Nature Preserve known as Lumber River State Park--Piney Island/Net Hole.

Site 5 - Clay-based bays. This area contains a remarkable concentration of clay-based Carolina bays. Carolina bays are oriented, elliptical depressions that are unique to a few states in the

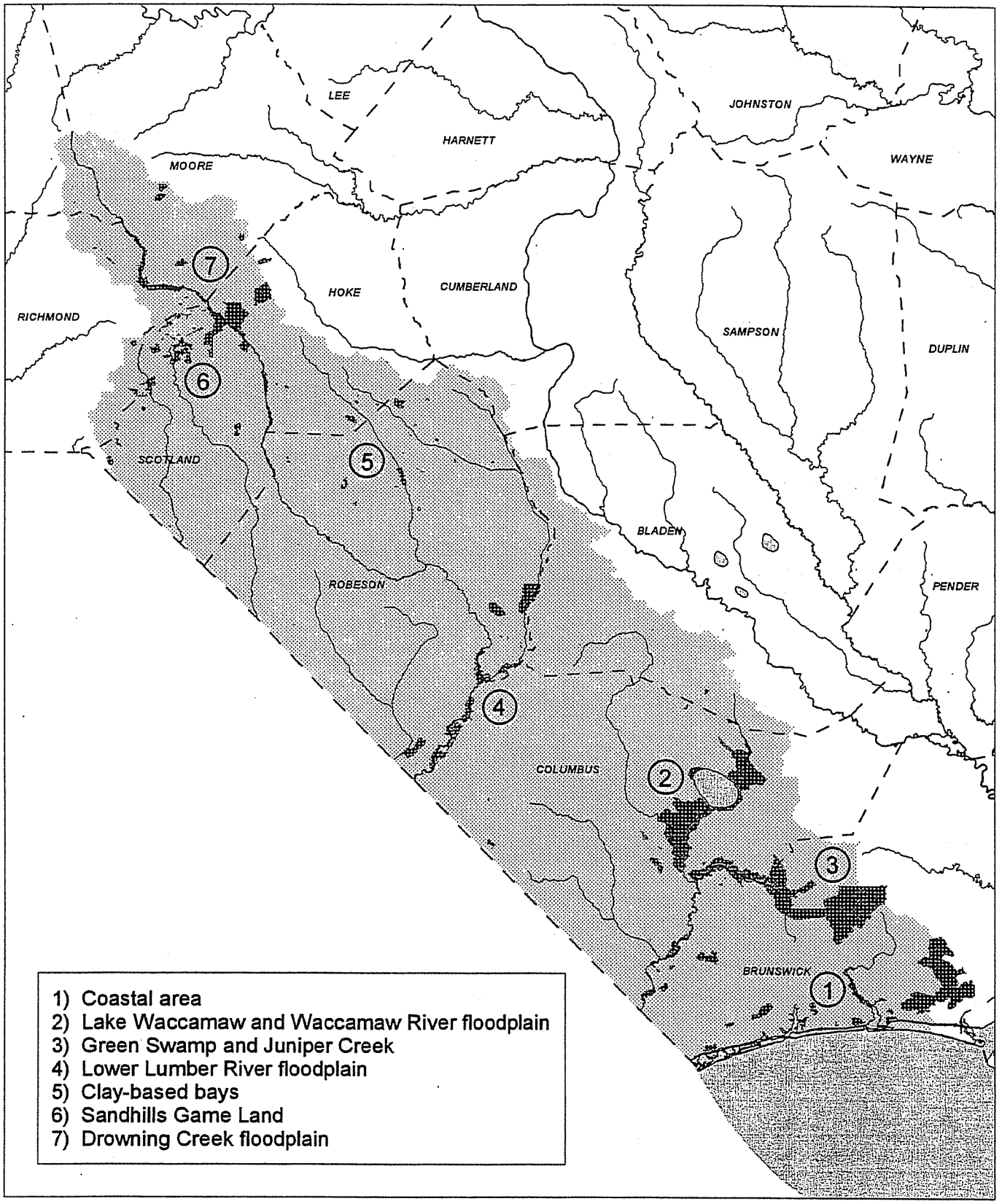


Figure A-11

Significant Natural Heritage Areas in the Lumber River Basin

LEGEND

- County Line
- River Basin
- Significant Natural Heritage Area
- Water

0 10 20 30 Miles

N

NC Natural Heritage Program
Parks and Recreation Department
July 1998

southeastern US. Here, the bays are predominantly clay-based rather than peat-filled and many are vegetated by relatively pure stands of cypress trees. Several in this area are owned by conservation groups for long-term protection.

Site 7 - Drowning Creek floodplain. Much of the length of Drowning Creek is a significant aquatic habitat. The relatively contiguous riverine communities along Drowning Creek are dominated by wetland tree species. The high quality floodplain is a Significant Natural Heritage Area referred to as the Upper Drowning Creek Swamp Forest. Some of this high quality natural area is owned by the NC Wildlife Resources Commission as part of the Sandhills Game Land.

Little Pee Dee River Headwaters Watershed

The most prominent ecological region in the Little Pee Dee River Headwaters watershed is the Sandhills region, which is often associated with extensive natural communities of longleaf pine. The aquatic and wetland communities in the Sandhills are different in character than the large floodplains of the basin's Lumber and Waccamaw rivers. The significant wetland communities of these headwaters consist of Sandhill Seeps, Streamhead Pocosins, Coastal Plain Small Stream Swamps, and Streamhead Atlantic White Cedar Forests.

Although less extensive than wetlands in other areas, wetland and aquatic communities in the Sandhills harbor rare plants and animals, including rare fish such as the pinewoods darter and several rare amphibians and plants.

In the headwaters of the Little Pee Dee River, few of the Significant Natural Heritage Areas are directly tied to wetland or aquatic communities. The most significant natural areas in this watershed are uplands, especially the dry longleaf pine communities of the Sandhills Game Land (Site 6 on the map). However, there are two Dedicated Nature Preserves in this watershed, McIntosh Bay and State Line Prairie Bay, both of which protect high quality, nonriverine Cypress Savanna communities.

Waccamaw River Watershed

Encompassing the Green Swamp, Lake Waccamaw and the Waccamaw River, the Waccamaw River watershed is a showcase of biological richness. Much of its outstanding diversity is based on the extensive wetlands of the watershed, which include High Pocosins, Pine Savannas, blackwater Cypress-Gum Swamps, Peatland Atlantic White Cedar Forests, blackwater Coastal Plain Bottomland Hardwood Forests, and Wet Pine Flatwoods.

While rare species are found throughout the watershed, Lake Waccamaw provides a home for several endemic species which are found nowhere else on earth. Two fishes (the Waccamaw silverside and the Waccamaw darter) and two freshwater mussels (the Waccamaw spike and the Waccamaw fatmucket) are four of the endemic species found in the lake. The many other rare aquatic or wetland animal species in the Waccamaw River watershed include: fishes such as Waccamaw killifish and Carolina pygmy sunfish; mussels such as pod lance and Waccamaw lampmussel; freshwater snails such as Waccamaw snail and Waccamaw siltsnail; and crustaceans such as Pee Dee lotic crayfish.

The most significant natural areas in the Waccamaw River watershed form corridors along major waterbodies; connecting Friar Swamp and Lake Waccamaw to the Green Swamp via Juniper Creek, and connecting all of these areas to a rich South Carolina estuary via the Waccamaw River. In itself, the connectivity of these high quality natural places is an important ecological feature which lends national significance to these already unique and biologically diverse sites.

Sites that contribute to the maintenance of water quality in the Lumber basin are numbered below and on Figure A-11, grouped into clusters of ecologically similar sites. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

Site 2 - Lake Waccamaw and Waccamaw River floodplain. This is an area of prime ecological significance. The site includes Friar Swamp, a protected swamp forest north of the lake, Lake Waccamaw, and the floodplain of the Waccamaw River. The wide floodplain of the Waccamaw River contains several large sites, including the largest blackwater Cypress-Gum Swamp in the state and extensive Bottomland Hardwoods. On sand and mud bars, between the river and the floodplain forests, are several rare plant species that are found nowhere else in North Carolina. Higher terrace islands in the floodplain support Pine Savannas, Cypress Savannas and distinctive communities related to maritime forests. The Waccamaw River is also noted as a high quality aquatic habitat for its diverse and rare aquatic animal species.

Lake Waccamaw is the most ecologically significant lake in the state, and arguably the most significant anywhere on the east coast north of Florida. It is unique among North Carolina lakes in having alkaline waters, and it is home to two endemic fish species and four endemic mussel species. The lake is under consideration for designation as Outstanding Resource Waters, due in part to the existence of the endemic species.

Site 3 - Green Swamp and Juniper Creek. The Green Swamp is comprised mostly of pocosin, which refers to a domed, nonriverine wetland community consisting almost exclusively of dense shrubs. Other wetland communities within the Green Swamp include Wet Pine Flatwoods, High Pocosins and Savannas. The outstanding floral diversity of the Green Swamp includes 16 species of insectivorous plants, 14 species of orchids, and 21 Federal- or state-listed plants.

The Green Swamp straddles two watersheds; a portion of the swamp drains streams to the Waccamaw River, while the other drainage flows south and east into the Lockwoods Folly River in the Coastal Area watershed. This area has over 15,000 acres preserved by the North Carolina chapter of The Nature Conservancy.

Juniper Creek is a main drainage of the Green Swamp to the Waccamaw River. It has a considerable amount of Atlantic White Cedar along its corridor, which is relatively rare in the Lumber River basin. The floodplain is dominated by blackwater Cypress–Gum Swamp wetlands.

Coastal Area Watershed

The Coastal Area watershed includes the barrier islands and peninsulas off southeastern North Carolina, along with a sizable portion of inland Brunswick County including Lockwoods Folly River. The wetland communities of inland Brunswick County are diverse and include many high quality nonriverine communities, such as Pine Savannas, Nonriverine Swamp Forests, and High and Low Pocosins. High quality marshes and tidal wetlands line the edges of the mainland and barrier islands. Wetland communities on the barrier islands are different from those inland, and include rare communities such as Maritime Wet Grassland. The barrier islands are unique habitats for a number of rare species.

Although the important natural areas in the Coastal Area watershed are distinct, they have been grouped into one cluster (Site 1) to simplify the map. Figure A-11 shows the Significant Natural Heritage Areas in the Lumber basin.

One Significant Natural Heritage Area within the Coastal Area is Boiling Spring Lakes Complex at the eastern end of the Coastal Area watershed. Boiling Spring Lakes Complex is a nonriverine wetland assemblage which lies on the border of two watersheds. The natural area is punctuated by long, low ridges of sand, remnants of ancient dunes, interspersed with swales containing shallow peat. Deeper peat fills the large Carolina bays scattered throughout. The site is the largest

hydrologically intact wetland complex in Brunswick County and one of the largest in the Coastal Plain. At least six community types have been identified within this site, and it is estimated that the area contains 400-500 species of vascular plants.

Another significant site within the Coastal Area watershed is the Lockwoods Folly River Tidal Wetlands. Lockwoods Folly Inlet cuts between two barrier islands, Holden Beach and Long Beach. Upstream, the high quality tidal wetlands begin where the river channel narrows. The tidal wetlands are dominated by the Tidal Freshwater Marsh and Tidal Cypress-Gum Swamp community types. Rare aquatic species that inhabit Lockwoods Folly River and its wet floodplains include the American alligator.

2.6.3 Wetlands

Wetlands are transitional areas between land and water, such as swamps and marshes. Some are connected to streams and others, such as low lying pine plantations and pocosins, are not. Over the years, however, approximately half of North Carolina's wetlands have been lost to development, farming and forestry practices. Wetlands now only cover about 25 percent of the state's land area.

Wetlands can be very important in watershed planning because they perform a variety of benefits to society. Wetlands provide important protection for flood prevention to protect property values, streambank stabilization to prevent erosion and downstream sedimentation, water purification (especially for nitrogen and phosphorus), habitat for aquatic life and wildlife and endangered species protection. These values vary greatly with wetlands type. Wetlands adjacent to intermittent and permanent streams are most important to protecting water quality in those streams, as well as downstream lakes and estuaries.

Wetland Fill Activities

In 1989, the EMC passed a rule directing DWQ to review wetland fill using a review sequence of avoidance, minimization and mitigation of wetland fill. After extensive public review, the NC Environmental Management Commission (EMC) passed rules to restructure the 401 Water Quality Certification Program. These rules became effective October 1, 1996. These rules are not a new regulatory program since DWQ has issued approvals for wetland fill since the mid-1980s. These rules consider wetland values - whether or not the wetland is providing significant uses or whether the activity would remove or degrade uses. The rules also specify mitigation ratios, locations and types to make the mitigation process more predictable and certain for the regulated community. The general approach adopted in these rules has been used by DWQ for five years. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality.

Based on DWQ data, Tables A-11 and A-12 show wetland fill activities by subbasin as well as a breakdown of wetland impacts by wetland type.

Table A-11 Wetland Fill Activities (in Acres) Permitted in the Lumber River Basin by Subbasin and Year

Subbasin Number	1994	1995	1996	1997	Total
03-07-50	3.69	3.80	0.98	0.68	9.15
03-07-51	2.80	2.38	8.35	2.60	16.13
03-07-52	0.00	0.00	0.00	0.00	0.00
03-07-53	0.00	1.21	0.21	0.00	1.41
03-07-54	0.00	0.75	6.10	0.09	6.94
03-07-55	0.45	5.14	2.62	0.34	8.54
03-07-56	2.21	1.00	1.10	2.50	6.81
03-07-57	3.90	32.90	7.38	2.24	46.42
03-07-58	12.50	2.75	8.31	1.61	25.17
03-07-59	0.86	9.93	5.94	2.54	19.27
Total Acres	26.41	59.86	40.99	12.60	139.86

Table A-12 Wetland Fill Activities (in Acres) Permitted in the Lumber River Basin by Wetland Type and Year

Wetland Type	1994	1995	1996	1997	Total
Bottomland Hardwood	9.89	5.91	9.53	0.40	25.73
Headwater Forest	0.00	8.63	11.09	4.03	23.75
Saltwater Marsh	0.10	0.06	0.01	0.00	0.17
Swamp Forest	12.10	5.30	1.49	6.02	24.91
Freshwater Marsh	0.08	0.00	0.00	0.60	0.68
Pocosin	0.00	23.80	3.90	0.53	28.23
Wet Flat	3.24	13.69	12.06	0.27	29.26
Estuarine Shrub Fringe Forest	0.00	0.12	0.00	0.00	0.12
Seep	0.00	0.00	2.71	0.00	2.71
Other Wetland Types	1.00	2.35	0.20	0.75	4.30
Total	26.41	59.86	40.99	12.60	139.86

Wetlands Draining and Ditching Activities

Ditching and draining of wetlands in North Carolina have been a restricted activity under oversight from both state and federal environmental regulations since the early 1990s. Generally, approvals have been required from DWQ and the United States Army Corps of Engineers (ACOE) for draining activities that impact one third of an acre or more of wetlands.

A federal court ruling in June 1998 overturned the authority of the ACOE to require permitting for wetlands draining. This decision effectively removed regulatory review of draining unless dirt spoil from the ditch is dumped into the wetlands.

The State of North Carolina has since determined that wetlands ditching and draining still fall under its authority and are an illegal activity if proper approval is not acquired. That authority applies when the hydrology or biology of the wetland is altered or the draining violates downstream water

quality standards such as turbidity, salinity and dissolved oxygen. DWQ has developed and will begin implementing a wetlands draining policy on March 1, 1999. This policy is not a new regulation.

Wetlands draining activities include both ditching and installation of ground pumping systems. Other activities also covered under this policy include pond construction in wetlands, filling of isolated wetlands and off-site sediment erosion into wetlands.

When DWQ discovers any such draining activities, it will notify the landowner in writing that the activity has or is likely to violate the state's wetlands standards. The landowner will be given an opportunity to refute the finding. If DWQ determines that a violation has occurred, it can seek enforcement action and require that the natural hydrology or biology be restored. In some instances, the filling of ditches may require a federal 404 wetlands fill permit.

Ditch maintenance is allowed as long as written documentation can be provided on the ditch's original height and width dimensions. Both DWQ and the Division of Land Resources will review such activities. Ditches created for forestry purposes are allowed if they are designed, constructed and maintained properly to retain the natural wetland hydrology.

DWQ has the authority to review specific wetlands draining projects that began prior to March 1, 1999 to determine whether the draining activities impaired downstream water quality. The Division of Land Resources will check various projects to make sure they have complied with Sedimentation and Erosion Control Plans.

The Department of Environment and Natural Resources is using a multi-agency approach to implement the draining policy, to seek compliance and to pursue enforcement. Involved DENR agencies include DWQ, Division of Land Resources, Forest Resources, Soil and Water Conservation, and Coastal Management. The US Natural Resources Conservation Service will also participate.

When violations are found, regulators can seek injunction relief to cease the draining activity and to restore the wetlands on-site, civil penalties of up to $10,000 per day and possible prosecution.

The Division of Forest Resources is flying reconnaissance missions with various regulatory personnel to identify and assess draining sites. Satellite imagery is also to be used to target problem areas. To further assist in wetlands protection, the public is encouraged to report possible sites where illegal draining has occurred.

To report possible wetlands draining violations in the Lumber River basin, the public can contact the appropriate DWQ regional office: Fayetteville (910) 486-1541 and Wilmington (910) 395-3900.

Wetlands Draining and Ditching in the Lumber River Basin

Extensive wetland ditching occurred in the Lumber River basin prior to March 1, 1999, primarily in Brunswick County. These draining projects are summarized in Table A-13. A summary of the types of wetlands and percentage of total area impacted within the basin are presented in Table A-14. Figure A-12 shows the location of the project areas within Brunswick County.

A substantial amount of wetlands are being converted to upland for future development. Of the project areas, the St. James Plantation and Williamson Tract are the largest. The St. James Plantation is a resort golfing community located along NC Highway 211, approximately 5 miles west of Southport, NC. Over two hundred acres of ditching and land disturbance has occurred on the 2500 acres of future golf course and residential homesites.

On February 15, 1999, the Wilmington Regional Office received a citizen complaint concerning turbidity in Beaverdam Creek (located in the Cape Fear River basin and bordering the St. James project). Staff investigated the complaint and determined that excessive turbidity (over 64 times the state standard) was observed in the surface waters of Beaverdam Creek. The Division of Land Resources (DLR) determined that the development was in violation of the sedimentation and erosion control plan, and therefore, DWQ could cite the development for stream standard violations.

Table A-13 Wetland Draining Project Acres in the Lumber River Basin (Source: DWQ, April 1999)

Project	County	All/Part (in Basin)	Acres** (in basin)
Gary Deese Tract***	Robeson	All	14
Williamson Tract	Brunswick	All	6420
Richard Yang Tract	Brunswick	All	205
2400 Acre Tract (St. James)	Brunswick	Part	1378
St. James Plantation Phase I & II	Brunswick	Part	1506
Total Project Acres			9523

** Project boundaries were compiled from numerous sources and contain differing levels of error. Boundaries and associated numbers are approximate and are intended to give general location information only.

*** No wetland data exists for Robeson County, acres are not included in wetland type breakdown

Table A-14 Wetland Draining Project Types in the Lumber River Basin (Source: DWQ, April 1999)

Wetland Type	Area (m^2)	Acres	% of Total
Salt/Brackish Marsh	433,742.40	107.2	2.0%
Freshwater Marsh	211,908.40	52.4	1.0%
Pocosin	6,915,625.00	1708.9	31.6%
Bottomland Hardwood	482,332.20	119.2	2.2%
Swamp Forest	2,114,839.80	522.6	9.7%
Hardwood Flat (Wet Flat)	15,775.90	3.9	0.1%
Pine Flat (Wet Flat)	2,674,429.90	660.9	12.2%
Managed Pineland (Wet Flat)	9,046,455.50	2235.4	41.3%
Human Impacted	2,562.00	0.6	0.0%
Total Wetlands*	21,897,671.10	5411.0	
Non-Wetland	16,584,015.89	4098.0	

* includes only wetlands that are inside wetland draining project boundaries

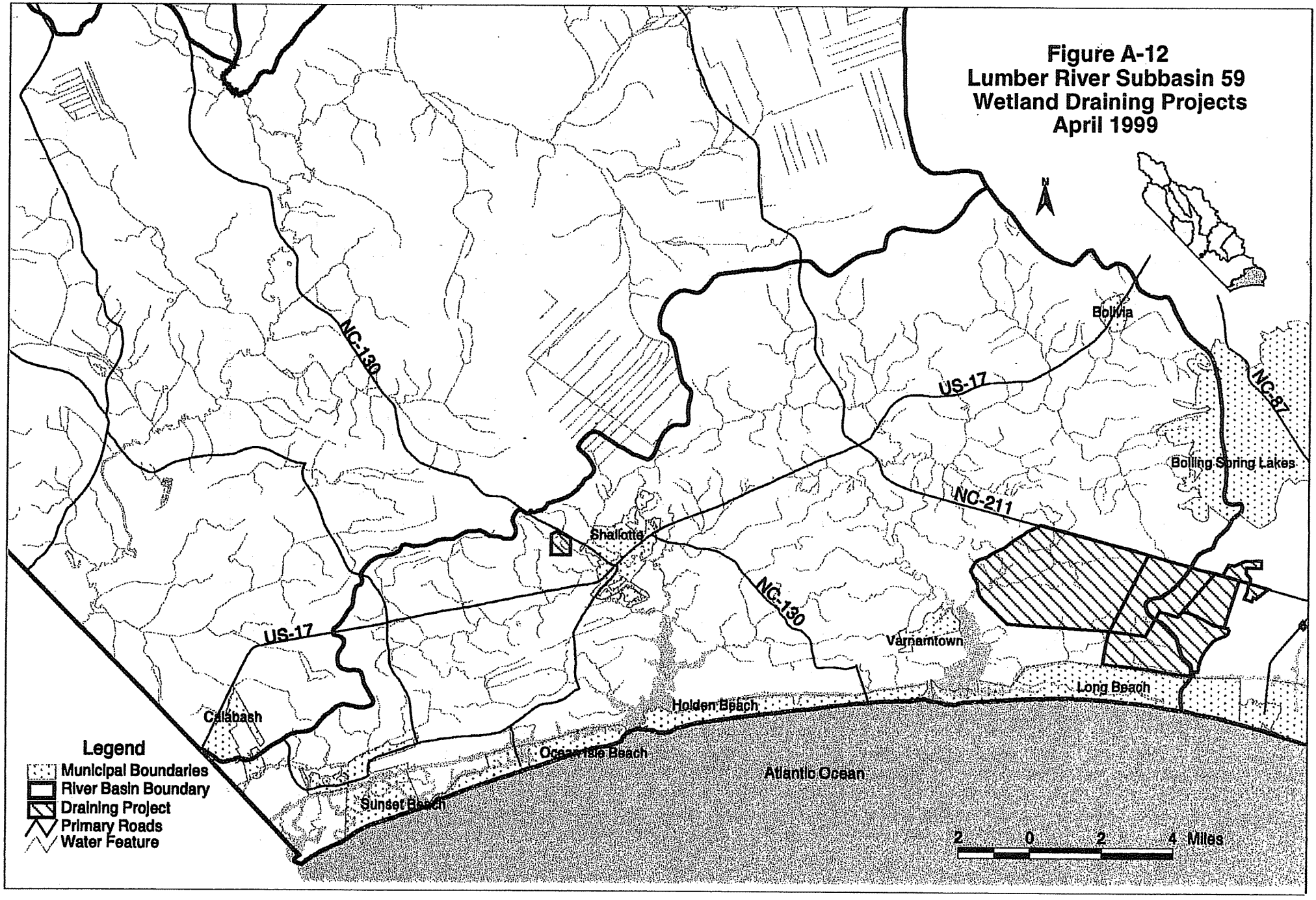


Figure A-12
Lumber River Subbasin 59
Wetland Draining Projects
April 1999
N
NC-130
US-17
Bolivia
NC-87
Bolling Spring Lakes
NC-211
Shallotte
NC-130
US-17
Varnamtown
Long Beach
Holden Beach
Calabash
Ocean Isle Beach
Atlantic Ocean
Sunset Beach
Legend
Municipal Boundaries
River Basin Boundary
Draining Project
Primary Roads
Water Feature
2 0 2 4 Miles

The development constructed ditches with steep embankments, failed to stabilize embankments, failed to construct check dams, exceeded the amount of disturbance, and stockpiled spoil too close to the ditches. An enforcement action was assessed for turbidity standards violations and violations of the general stormwater permit. In addition to the civil penalty assessment, DWQ and DLR are jointly seeking injunctive relief to require the developers to plug and fill some of the ditches which were not included in the sedimentation and erosion control plan.

Recently, Shellfish Sanitation has closed Beaverdam Creek to shellfishing due to elevated fecal coliform bacteria levels. It is uncertain whether extensive ditching within the St. James Plantation caused the closure; however, it is expected that the extensive amount of ditching, added volume of freshwater, disturbed sediment, and wetland drainage was likely to have elevated fecal coliform levels.

There are several uses and limitations that should be considered when reviewing the wetland draining project data in the above tables. These include:

1. Project boundaries were compiled from NC Division of Land Resources permit file information and from aerial surveys conducted by regional staff. This data was transferred onto 1:24,000 scale USGS topo maps and then into GIS. This created inherent and varied inaccuracies in the data.
2. Project boundaries represent approximate size and location only, more precise information will require individual site visits.
3. Wetland data used in this analysis were obtained from NC Division of Coastal Management. For more information on mapping procedures and data accuracy, contact Jim Stanfill of the Division of Coastal Management at (919) 733-2293.
4. The actual extent of wetland draining on individual project sites is unknown. A project may have been permitted through the NC Division of Land Resources, Land Quality Section to drain all wetlands on a given site, most ditching and draining activity ceased prior to March 1, 1999 in compliance with the State's Wetland Draining Policy.
5. The numbers provided in this analysis represent potential wetland loss, not actual wetland loss (potential - assuming a site was to be drained *completely*, and assuming the State's Wetland Draining Policy did not go into effect and ditching/draining activity was allowed to continue through completion).

Wetlands Restoration Efforts

The North Carolina Wetlands Restoration Program (NCWRP) is responsible for implementing wetland and stream restoration projects on a basinwide scale throughout the state. The focus of the program is to enhance water quality, flood prevention, fisheries, wildlife habitat and recreational opportunities. The NCWRP is not a grant program. However, it can compliment grant programs like the Section 319 program by taking on restoration projects identified through Section 319 grant applications. Alternatively, studies funded by Section 319 to identify suitable stream or wetland restoration sites can then be implemented by the NCWRP. The NCWRP can also directly fund other stream or wetland restoration sites provided those sites are located within a priority subbasin, as determined by the NCWRP. Finally, the NCWRP can perform restoration projects cooperatively with other state or federal programs or with environmental groups.

The NCWRP has identified priority subbasins for the Lumber River basin through the *Basinwide Wetlands and Riparian Restoration Plan for the Lumber River Basin.* For more information on this document or the NCWRP, call (919) 733-5208.

2.6.4 Fish and Shellfish Resources

North Carolina's commercial and recreational fishery resources are both nationally and regionally significant. Based on data from 1987-1991, commercial harvest of fish and shellfish in North

Carolina produces an average of 180.6 million pounds of marketable resource each year (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.

Trends from commercial landings in the Lumber River basin were made available from the Division of Marine Fisheries and are presented in Figures A-13 through A-15. Trends data, such as these, should be considered only a general indicator of productivity because the numbers are subject to a variety of influences including market demand, price, fishing effort, weather, availability of alternate species, regulations and data collection procedures (DMF, 1993). In the Lumber River basin, the overall trend in commercial landings of fish and shellfish is fairly stable between 1972 and 1997 (Figure A-13). In 1981, landings records were at a peak. From 1981 to 1988, landings decreased to the pre-peak landings levels. Levels since 1991 have remained between 200,000 and 400,000 pounds. The value of these landings has shown a dramatic increase since the late 1970s. Over the past five years, pounds of landings have remained stable in both the Lockwoods Folly and Shallotte Rivers (Figures A-14 and A-15), with a small increase in the value of landings. Overall landings values since 1990 have ranged from $700,000 to $1,000,000 for the Coastal Area of the Lumber River basin. Given the annual economic value of North Carolina's fisheries resource is $1 billion, the Lumber River basin contains a relatively small amount of this resource.

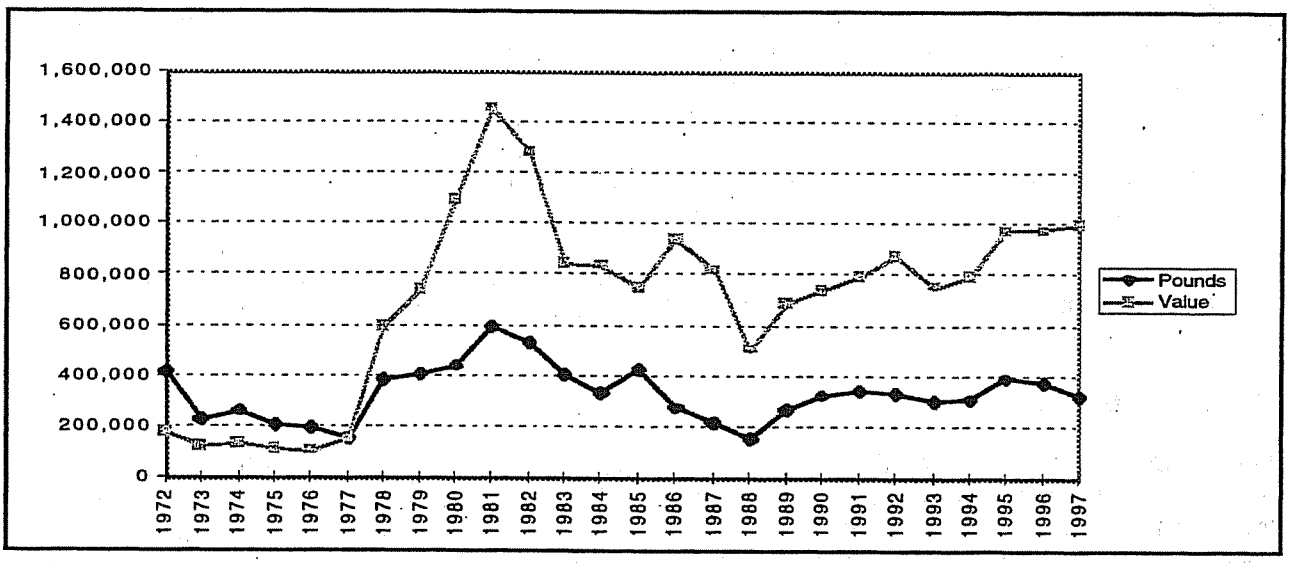


Figure A-13 Overall Trends in Commercial Landings in the Lumber River Basin Coastal Area Watershed by Total Pounds and Total Value Per Year (1993-1997)
Source: NC Division of Marine Fisheries

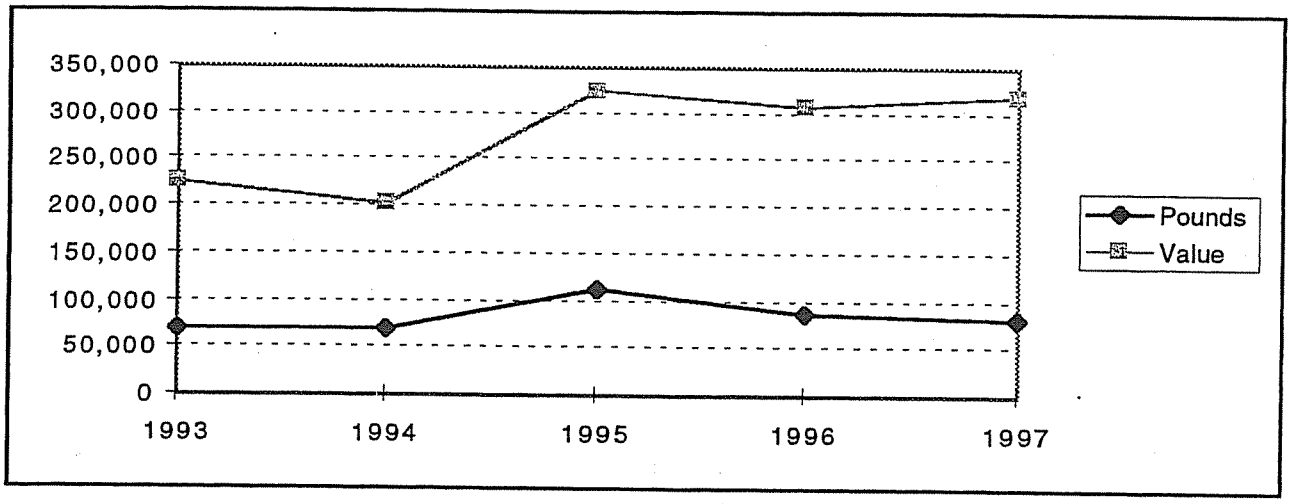


Figure A-14 Trends in Commercial Landings in Lockwoods Folly River by Total Pounds and Total Value Per Year (1993-1997)
Source: NC Division of Marine Fisheries

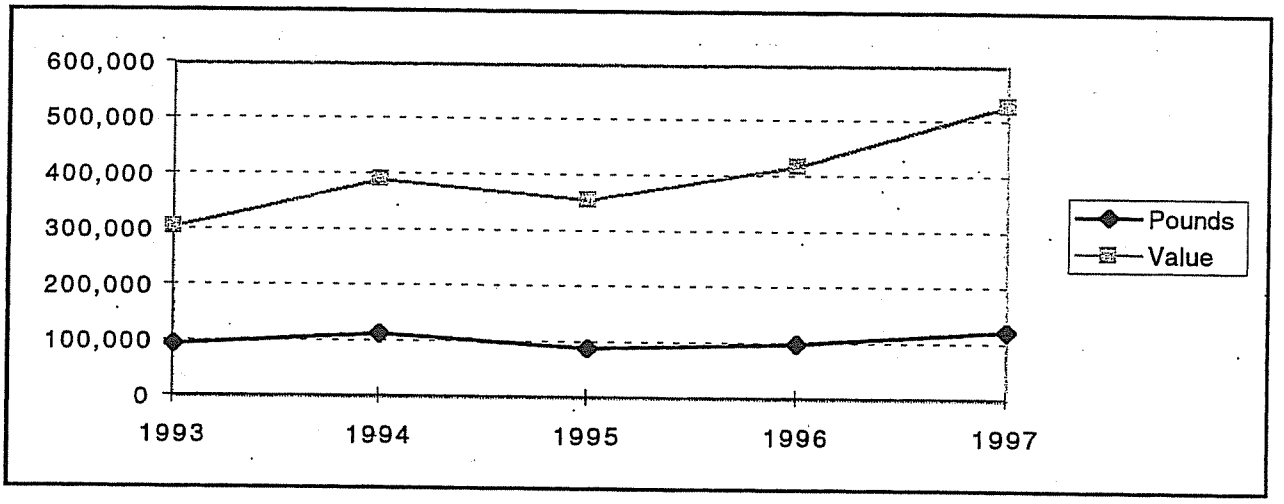


Figure A-15 Trends in Commercial Landings in Shallotte River by Total Pounds and Total Value Per Year (1993-1997)
Source: NC Division of Marine Fisheries

2.7 Permitted Wastewater and Stormwater Discharge Facilities

Discharges that enter surface waters through a pipe, ditch or other well-defined point of discharge are broadly referred to as 'point sources'. Wastewater point source discharges include municipal (city and county) and industrial wastewater treatment plants and small domestic wastewater treatment systems serving schools, commercial offices, residential subdivisions and individual homes. Stormwater point source discharges include stormwater collection systems for municipalities which serve populations greater than 100,000 and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System

The primary pollutants associated with point source discharges are:

* oxygen-consuming wastes,
* nutrients,
* color, and
* toxic substances including chlorine, ammonia and metals.

(NPDES) permit. Discharge permits are issued under the NPDES program, which is delegated to DWQ by the Environmental Protection Agency.

2.7.1 Wastewater Discharges in the Lumber River Basin

There are 53 permitted NPDES wastewater dischargers in the Lumber River basin; all are covered under individual permits. Table A-15 provides a summary of total and average discharge for each major category of permitted facility. The locations of the individual permitted facilities are shown in Figure A-16. A summary of all dischargers in the basin can be found in Appendix II.

Table A-15 Summary of NPDES Dischargers and Permitted Flows for the Lumber River Basin

	Subbasin										
Facility Categories	50	51	52	53	54	55	56	57	58	59	TOTAL
Total Facilities	4	14	2	7	1	10	2	4	6	3	53
Total Permitted Flow (MGD)	6.76	20.83	3.5	1.29	0.5	5.37	0.4	1.64	3.77	0.0	44.08
Major Discharges	1	5	2	1	0	1	0	1	2	0	13
Total Permitted Flow (MGD)	6.7	20.19	3.5	0.09	0.0	4.0	0.0	1.1	3.5	0.0	39.08
Minor Discharges	3	9	0	6	1	9	2	3	4	3	40
Total Permitted Flow (MGD)	0.06	0.64	0.0	1.2	0.5	1.37	0.4	0.54	0.27	0.02	5.00
100% Domestic Waste	1	4	0	3	1	5	1	4	1	1	21
Total Permitted Flow (MGD)	0.02	1.57	0.0	1.2	0.5	1.04	0.4	1.64	0.24	0.01	6.62
Municipal Facilities	1	3	2	3	0	5	1	1	3	0	19
Total Permitted Flow (MGD)	6.7	11.56	3.5	1.2	0.0	5.31	0.4	1.1	3.74	0.0	33.51
Nonmunicipal Facilities	3	8	0	3	0	3	0	3	0	3	23
Total Permitted Flow (MGD)	0.06	0.41	0.0	0.0	0.0	0.02	0.0	0.54	0.0	0.02	1.05
Industrial Facilities	0	3	0	1	0	2	1	0	3	0	10
Total Permitted Flow (MGD)	0.00	8.86	0.0	0.09	0.0	0.03	0.0	0.00	0.03	0.00	9.01
* NC00/Individual Permit Facilities											

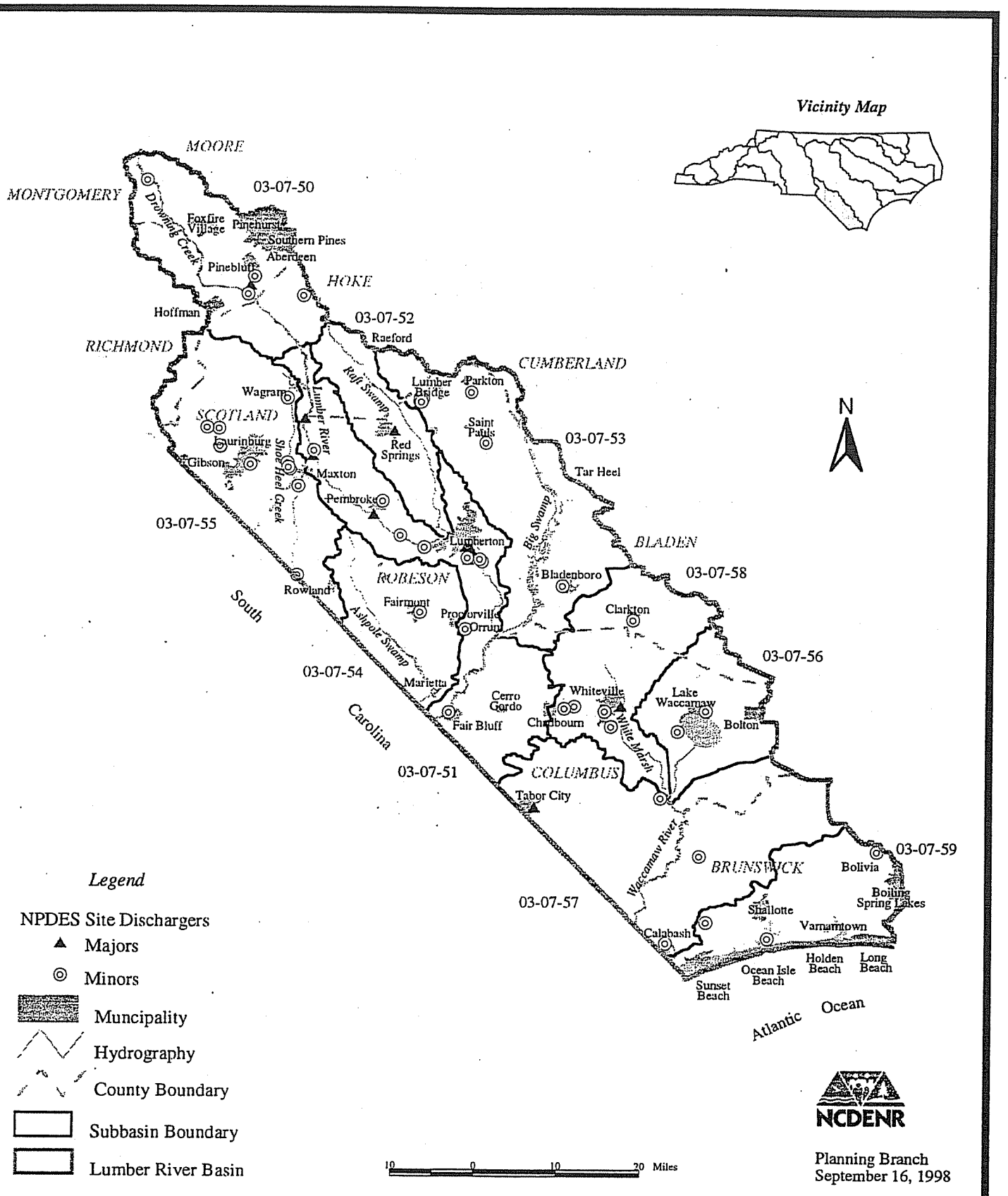


Figure A-16 NPDES Wastewater Permitted Discharges in the Lumber River Basin

2.7.2 Stormwater Discharges in the Lumber River Basin

Amendments to the Clean Water Act pertaining to permit requirements for stormwater discharges associated with industrial activities and municipal storm sewer systems (with population greater than 100,000) became effective in December 1990. DWQ administers these regulations in North Carolina through the state stormwater program. The goal of the DWQ stormwater discharge permitting regulations is to prevent stormwater runoff pollution by controlling the source(s) of pollutants.

The municipal permitting requirements are designed to lead to the formation of comprehensive stormwater management programs for a municipal area. There are no municipalities in the Lumber River basin large enough to require a stormwater discharge 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 waster treatment, storage or disposal facilities. Permits are granted in the form of general stormwater permits (which covers a wide variety of activities) or individual stormwater permits. Excluding construction general permits, there are 115 general stormwater permits and 4 individual stormwater permits issued within the river basin. Individual permit holders are presented in Table A-16.

The primary concern with runoff from industrial facilities is the contamination of stormwater from contact with exposed materials. In addition, poor housekeeping can lead to significant contributions of sediment and other water quality pollutants. To address these issues, each NPDES stormwater permitted facility must develop a Stormwater Pollution Prevention Plan (SPPP) that addresses the facility's potential impacts on water quality. Facilities or activities identified as having significant potential to impact water quality are also required to perform analytical monitoring to characterize the pollutants in their stormwater discharges under individual NPDES stormwater permits.

The state stormwater management rules (15A NCAC 2H .1000) regulate development activities in the 20 coastal counties and in other parts of the state draining to Outstanding Resource Waters and High Quality Waters. Any development activity that disturbs an acre or more of land or requires a CAMA major permit must also obtain a state stormwater management permit. Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of a structural best management practice to control and treat stormwater runoff from the site.

A second phase to the NPDES stormwater program has been proposed by the Environmental Protection Agency to expand coverage of municipal stormwater systems and construction activities. Final rules are expected on the proposed program around March 1999.

Table A-16 Summary of Individual NPDES Stormwater Permits in the Lumber River Basin

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000005	Carolmet, Inc.	Shoe Heel Creek	03-07-55	Scotland
NCS000128	Council Tool Company	UT Lake Waccamaw	03-07-56	Columbus
NCS000236	Industrial and Agricultural Chemical	Walnut Creek	03-07-52	Robeson
NCS000293	Southern States Cooperative- Lumberton	UT Jacob Swamp	03-07-51	Robeson

2.8 Animal Operations

Table A-17 summarizes, by subbasin, the number of registered livestock operations, total animals, total acres in operation and total steady state live weight as of March 1998. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin. Figure A-17 shows the general location of the registered operations in the basin.

Table A-17 Lumber River Basin Registered Animal Operations (as of March 1998)

Subbasin	Cattle Total Animals	Cattle Total Steady State Live Weight	Total Cattle Operations	Swine Total Animals	Swine Total Steady State Live Weight	Total Swine Operations	Total Animals	Total Steady State Live Weight
03-07-50				56,798	7,084,272	11	56,798	7,084,272
03-07-51				96,072	11,660,390	18	96,072	11,660,390
03-07-52				54,080	8,155,000	8	54,080	8,155,000
03-07-53				267,994	29,739,021	38	267,994	29,739,021
03-07-54				91,358	11,787,990	16	91,358	11,787,990
03-07-55				226,682	31,643,760	31	226,682	31,643,760
03-07-56	190	266,000	1	46,400	6,261,500	6	46,590	6,527,500
03-07-57				69,031	9,842,705	20	69,031	9,842,705
03-07-58				238,764	31,936,898	36	238,764	31,936,898
03-07-59				3,750	506,250	1	3,750	506,250
TOTALS	190	266,000	1	1,150,929	148,617,786	185	1,151,119	148,883,786

Steady State Live Weight (SSLW) is the result, in pounds, after a conversion factor has been applied to the number (head count) of swine, cattle or poultry on a farm. The conversion factors, which come from the Natural Resource Conservation Service (NRCS) guidelines, vary depending on the type of animals on the farm and the type of operation (for example, there are five types of hog farms). Since the amount of waste produced varies by hog size, SSLW is the best way to compare the sizes of the farms.

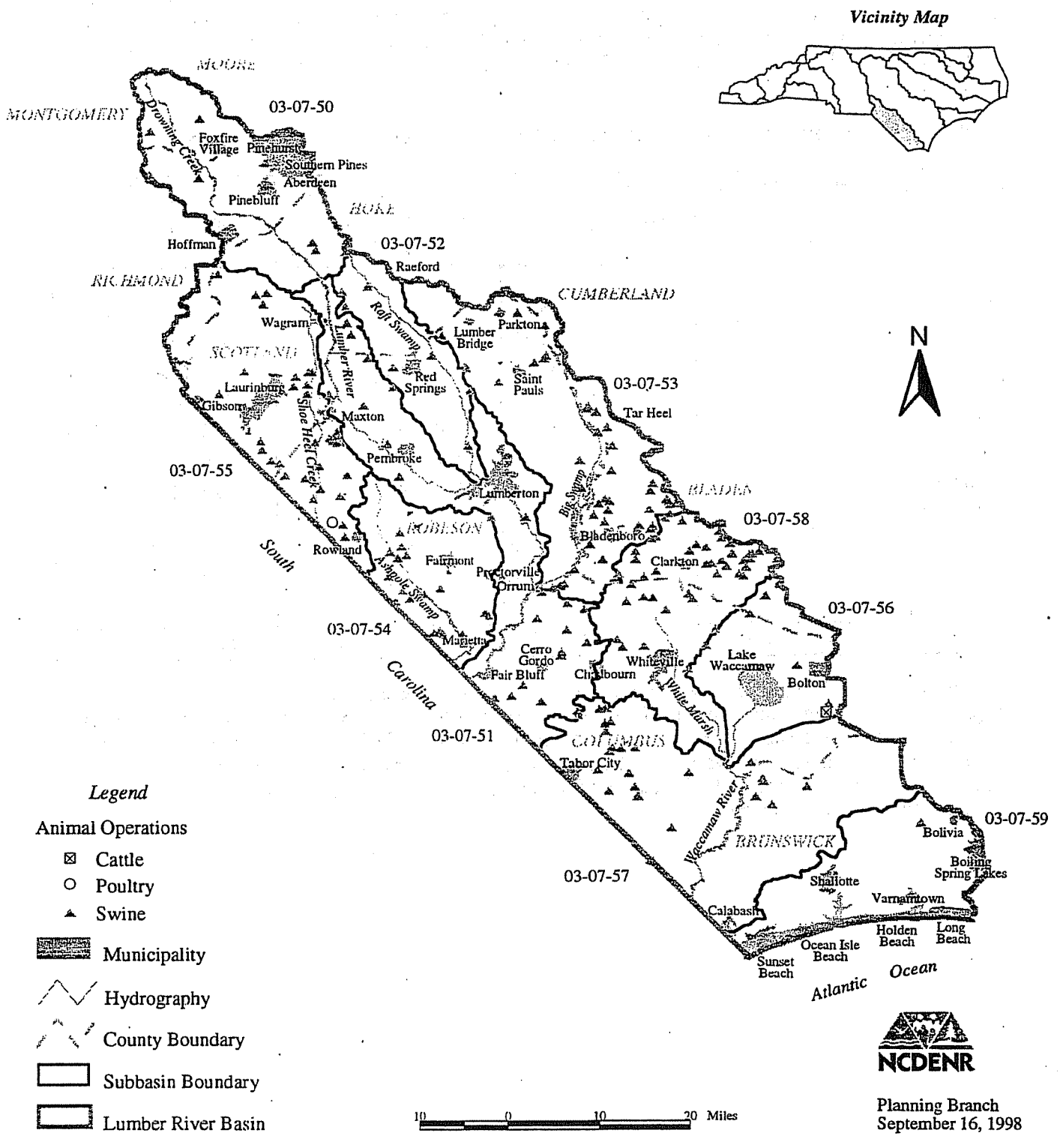


Figure A-17 Registered Animal Operations in the Lumber River Basin (as of March 1998)

Information on animal capacity by subbasin (Table A-18) was provided by the NC Department of Agriculture. Total swine capacity represents only 11 percent of the state total, with higher concentrations in subbasins 03-07-51, 03-07-53 and 03-07-54 (Lumber River drainage), 03-07-55 (Little Pee Dee headwaters drainage), and subbasin 03-07-58 (upper Waccamaw River drainage). With the exception of one subbasin, all other subbasins have experienced a significant increase in swine numbers between 1994 and 1998. Basinwide, the numbers of swine have increased by about 122 percent, with about four times as many swine as humans in the basin. There is only a negligible percentage of the state's total capacity for dairy and dairy animals decreased by about 94 percent between 1994 and 1998. The basin also contains 5 percent of the state total capacity for poultry, with the highest concentrations found in subbasin 03-07-55 in Scotland and Robeson Counties.

Key Livestock Operation Legislation

1992 - the Environmental Management Commission adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system.

1996 - Senate Bill 1217 required any operator of a dry litter animal waste management system involving 30,000 or more birds to develop an animal waste management plan by January 1998. The plan must consist of three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years.

2.9 Water Use

In 1989, the North Carolina General Assembly adopted a law that requires local governments that operate public water supply systems to develop and approve a Local Water Supply Plan. In order to assure the availability of adequate supplies of good water quality to protect public health and to support desirable growth, the North Carolina Division of Water Resources (DWR) is compiling a State Water Supply Plan Database pursuant to GS 143-355(m). The database contains information reported in the Local Water Supply Plans. The State Water Supply Plan will identify potential water use conflicts among water suppliers and identify ways to better coordinate water supply programs.

The information in the State Water Supply Plan database has been submitted by local government water systems in their 1992 Water Supply System Reports and maps which are part of their adopted Local Water Supply Plans. Plans in this database are labeled as "adopted" or "draft" plans. Plans labeled "adopted" have been reviewed by DWR for internal consistency, reasonableness and completeness and have been acknowledged by DWR as meeting the minimum requirements of the law. Plans labeled "draft" have not yet completed this process. None of the data has been field verified. Consistency between plans has not been considered. The State Water Supply Plan database is still receiving data. Information in the database may be corrected or updated at any time by the local government. This data will be updated at least once every five years.

The Local Water Supply Plans, as reported by local governments, indicates total water use for these systems averages 29 million gallons per day (MGD). Comparing this present rate (1992) with projected future consumption shows an expected 64 percent increase in water use by the year 2020 (47 MGD). Note that these estimates reflect only that percentage of systems' water use withdrawn from the Lumber River basin.

Groundwater is the major water supply source in the basin. In light of the abundance of groundwater, the flat terrain and the high evapotranspiration rate, there are relatively few surface

water impoundments used for water supply purposes. Much of the upper portion of the basin overlies the Upper Cape Fear and Black Creek aquifers. The Upper Cape Fear aquifer is a more confined aquifer, meaning that large water withdrawals can cause cones of depression of great distance from the withdrawal. The groundwater resource underlying areas surrounding Lumberton have been shown to be dropping quickly. This loss of groundwater can cause recharge problems

with low flow streams during periods of dry weather. The Brunswick County coastal portion of the basin overlies the Castle Hayne and Pee Dee aquifers. This area experiences saltwater intrusion into wells of the coastal communities.

Table A-18 Estimated Populations of Swine (1990, 1994 and 1998), Dairy (1994 and 1998) and Poultry (1994 and 1998) in the Lumber River Basin (Source: NCDA Veterinary Division, February 1998)

Subbasin	1998 Swine Total Capacity	1994 Swine Total Capacity	1990 Swine Total Capacity	Swine Change 94-98 (%)	1998 Dairy Total Capacity	1994 Dairy Total Capacity	Dairy Change 94-98 (%)	1998 Poultry Total Capacity	1994 Poultry Total Capacity	Poultry Change 94-98 (%)
03-07-50	13,357	1,453	1,529	819	0	0	0	1,760,682	1,683,482	5
03-07-51	189,760	69,136	40,843	174	55	15	267	1,391,000	710,600	96
03-07-52	43,475	32,200	10,645	35	2	0	0	363,300	182,900	99
03-07-53	203,688	97,169	25,633	110	0	4	-100	1,972,650	1,409,350	40
03-07-54	112,060	30,983	13,172	262	0	0	0	1,362,000	738,200	85
03-07-55	181,153	121,675	15,748	49	0	0	0	3,602,500	2,888,500	25
03-07-56	4,394	6,168	3,609	-29	0	0	0	0	0	0
03-07-57	92,833	40,563	32,309	129	0	775	-100	0	0	0
03-07-58	238,516	83,636	9,582	185	0	120	-100	50,300	50,300	0
03-07-59	10,709	7,542	4,968	42	0	0	0	0	0	0
TOTALS	1,089,945	490,525	158,038	122	57	914	-94	10,502,432	7,663,332	37
% of State Total	11%	9%	6%		0.06%	0.7%		5%	4%	

Source : NC Department of Agriculture, Veterinary Division

Chapter 3
Summary of Water Quality Information for the Lumber River Basin

3.1 General Sources of Pollution

Human activities can negatively impact surface water quality, even when the activity is far removed from the waterbody. With proper management of wastes and land use activities, these impacts can be minimized. Pollutants that enter waters fall into two general categories: *point sources* and *nonpoint sources*.

Point sources are typically piped discharges and are controlled through regulatory programs administered by the state. All regulated point source discharges in North Carolina must apply for and obtain a National Pollutant Discharge Elimination System (NPDES) permit from the state.

Point Sources

- Piped discharges from municipal wastewater treatment plants
- Industrial facilities
- Small package plants
- Large urban and industrial stormwater systems

Nonpoint Sources

- Stormwater runoff
- Forestry
- Agricultural lands
- Rural residential development
- Septic systems
- Mining

Nonpoint sources are from a broad range of land use activities. Nonpoint source pollutants are typically carried to waters by rainfall runoff or snowmelt. Sediment and nutrients are most often associated with nonpoint source pollution. Other pollutants associated with nonpoint source pollution include fecal coliform bacteria, heavy metals, oil and grease, and any other substance that may be washed off the ground or deposited from the atmosphere and into surface waters.

Unlike point source pollution, nonpoint pollution sources are very diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given the diffuse nature of nonpoint source pollution, it is very difficult and resource intensive to quantify nonpoint contributions to water quality degradation in a given watershed. While nonpoint source pollution control often relies on voluntary actions, the state has many programs designed to reduce nonpoint source pollution.

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

Every person living in or visiting a watershed contributes to impacts on water quality. Therefore, each individual should be aware of these contributions and take actions to reduce them.

3.2 Description of Surface Water Classifications and Standards

Program Overview

North Carolina established a water quality classification and standards program early in the 1950s, with classification and water quality standards for all the state's river basins adopted by 1963. 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 are applied to provide protection of the waters' best uses.

Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Therefore, while all surface waters are assigned a primary classification, they may also have one or more supplemental classifications. For example, a freshwater stream in the mountains might have a C Tr classification where C is the primary classification followed by the Tr supplemental classification. A full description of the state's primary and supplemental classifications are available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (derived from 15A NCAC 2B .0200). A summary of these classifications can be found in Table A-19.

Table A-19 Primary and Supplemental Surface Water Classifications
(Primary classifications beginning with an "S" are assigned to saltwaters)

Primary Freshwater And Saltwater Classifications	
Class	**Best Uses**
S A	Waters classified for commercial shellfish harvesting
C and SC	Aquatic life propagation/protection and secondary recreation
B and SB	Primary recreation and Class C uses
WS	*Water Supply watershed.* There are five WS classes ranging from WS-I through WS-V. WS classifications are assigned to watersheds based on land use characteristics of the area. Each water supply classification has a set of management strategies to protect the surface water supply. WS-I provides the highest level of protection and WS-IV provides the least protection. A Critical Area (CA) designation is also listed for watershed areas within a half-mile and draining to the water supply intake or reservoir where an intake is located.
Supplemental Classifications	
Class	**Best Uses**
S w	*Swamp Waters*: Recognizes waters that will naturally be more acidic (have lower pH values) and have lower levels of dissolved oxygen.
HQW	*High Quality Waters*: Waters possessing special qualities including excellent water quality, Native or Special Native Trout Waters, Critical Habitat areas, or WS-I and WS-II water supplies.
ORW	*Outstanding Resource Waters*: Unique and special surface waters which are unimpacted by pollution and have some outstanding resource values.
NSW	*Nutrient Sensitive Waters*: Areas with water quality problems associated with excessive plant growth resulting from nutrient enrichment.
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.

Some of North Carolina's surface waters are relatively unaffected by pollution sources and have water quality higher than the standards that are applied to the majority of the waters of the state. In addition, some waters provide habitat for sensitive biota such as trout, juvenile fish or rare and endangered aquatic species. These waters may be rated as HQW or ORW (Figure A-18).

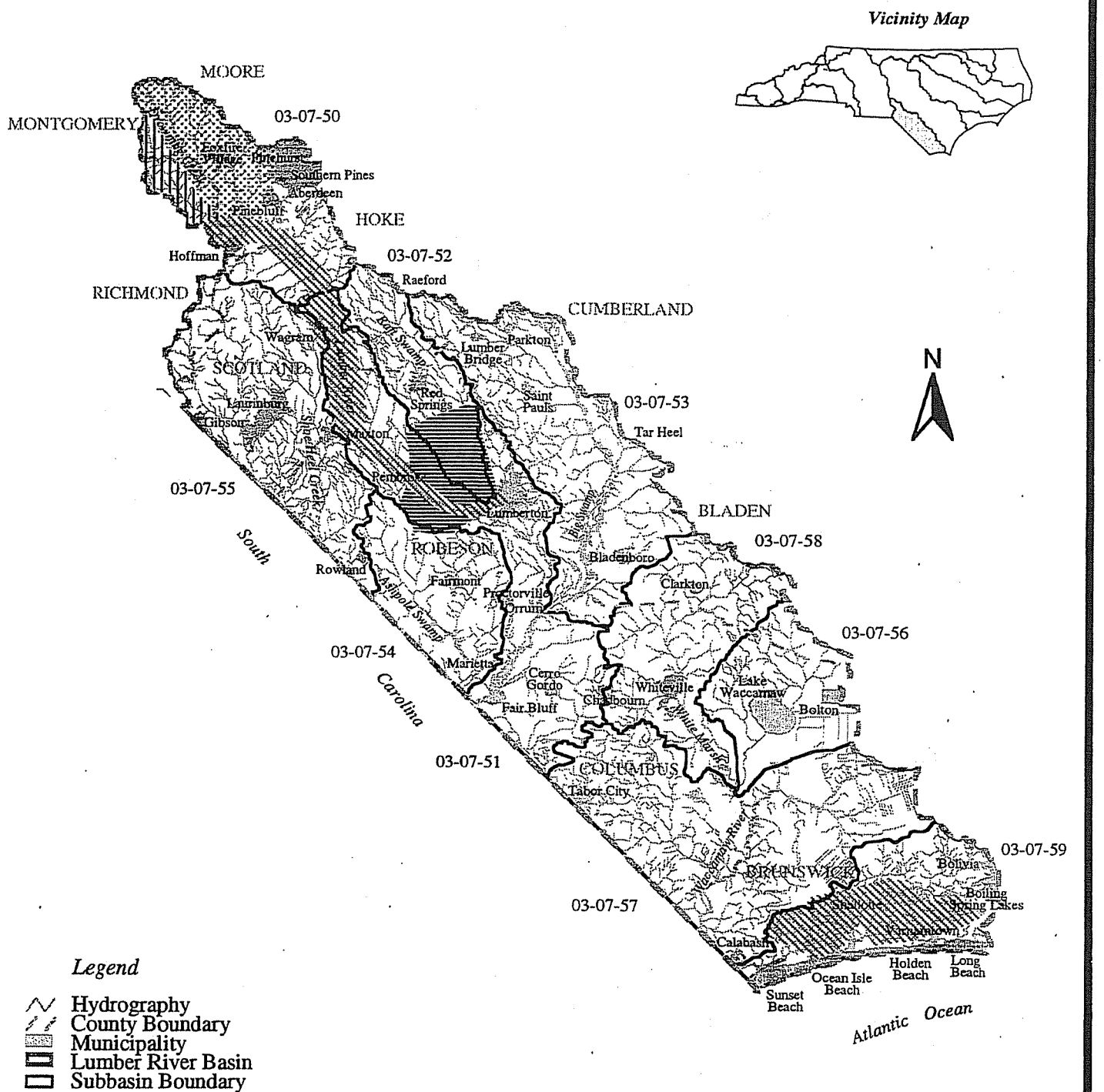


Figure A-18 Outstanding Resource Waters (ORW), High Quality Waters (HQW), and Water Supply Watersheds in the Lumber River Basin

High Quality Waters

Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and 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.

Surface waters qualifying for HQW classification:

- waters rated as Excellent based on DWQ's chemical and biological sampling;
- streams designated as native and special native trout waters or primary nursery areas by the Wildlife Resources Commission;
- waters designated as primary nursery areas by the Division of Marine Fisheries;
- critical habitat areas designated by the Wildlife Resources Commission or the Department of Agriculture;
- waters classified by DWQ as WS-I, WS-II and SA are HQW by definition, but these waters are not specifically assigned HQW classification because the standards for WS-I, WS-II and SA waters are at least as stringent as those for waters classified HQW.

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 approved local erosion and sedimentation control program, and which drain to and are within one mile of HQWs are required to control runoff from the development using either a low density or high density option. In addition, the Division of Land Quality requires more stringent sedimentation controls for land-disturbing projects within one mile and draining to HQWs.

Outstanding Resource Waters

A small percentage of North Carolina's surface waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

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 .0225. At a minimum, no new discharges or expansions are permitted, and stormwater controls are required for most new development. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

The ORW rule defines outstanding resource values as:

- outstanding fishery resource;
- a high level of water-based recreation;
- a special designation such as National Wild and Scenic River or a National Wildlife Refuge;
- being within a state or national park or forest; or
- having special ecological or scientific significance.

Statewide Water Quality Standards

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

Classifications and Standards in the Lumber River Basin

The waters of the Lumber River basin have a variety of surface water quality classifications applied to them. The majority of the surface waters are classified as C waters. Water Supply watersheds range form WS-II to WS-IV (Figure A-19). The majority of waters in the basin (approximately 90%) are also supplementally classified as Sw waters (swamp waters; waters which have low velocities and other natural characteristics which are different from adjacent streams). Along the coastal area, many of the waters are supplementally classified as SA (tidal saltwaters that are suitable for shellfishing for market purposes and any other usage specified by the lower "SB" and "SC" classification) (Figure A-18). Classification and standards for the entire basin can be found in a separate document titled *Classifications and Water Quality Standards Assigned to the Waters of the Lumber River Basin* available by calling the Planning Branch of DWQ at (919) 733-5083.

Pending Reclassifications in the Lumber River Basin

Lake Waccamaw was nominated for reclassification to Outstanding Resource Waters (ORW) by the Division of Water Resources and the Natural Heritage Program. The lake was found to have excellent water quality and exhibit several outstanding resource values. The lake is, therefore, proposed for reclassification from Class B (Primary Recreation) Sw (Swamp) to Class B Sw ORW. DWQ is currently developing an ORW management strategy for the Lake Waccamaw watershed. After the management strategy is complete, the proposed reclassification will be presented to the Environmental Management Commission for its approval to bring the proposal to public hearing for review and comment.

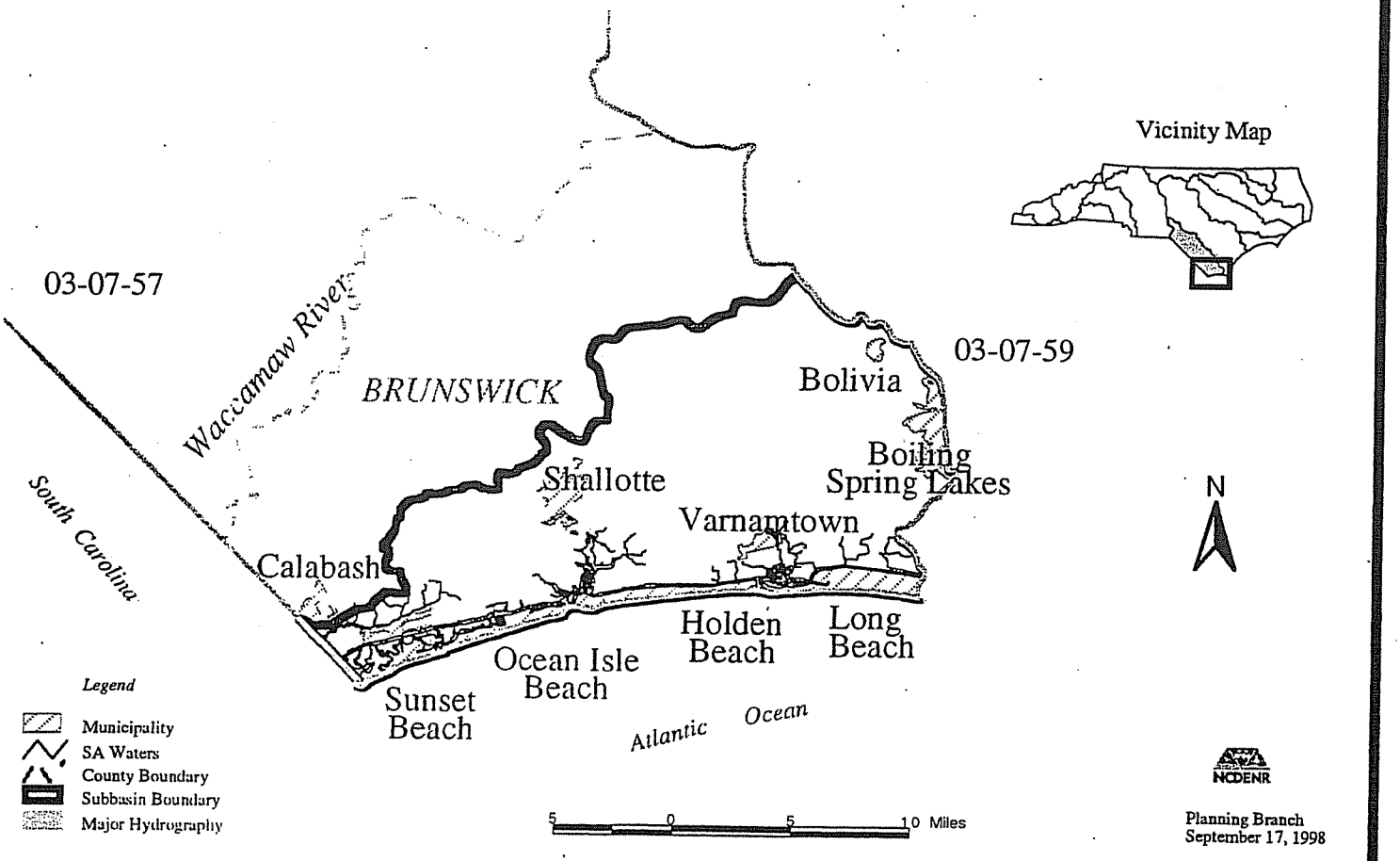


Figure A-19 SA Waters in the Lumber River Basin

3.3 DWQ Water Quality Monitoring Programs in the Lumber River Basin

The Environmental Sciences Branch of DWQ collects a variety of biological, chemical and physical data that can be used in a myriad of ways within the basinwide planning approach. In some areas there may be adequate data from several program to allow a fairly comprehensive analysis of water quality. In other areas, data may be limited to one program, such as only benthic macroinvertebrate data or only fisheries data, with no other information available. Such data may or may not be adequate to provide a definitive assessment of water quality, but can provide general indications of water quality. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Lumber river basin for that program. A more complete discussion on biological and chemical monitoring within the basin can be found in the *Lumber River Basinwide Assessment Report* (DENR, March 1998).

DWQ monitoring programs for the Lumber River Basin include:

* benthic macroinvertebrates (Section 3.3.1),
* fish assessments (Section 3.3.2),
* aquatic toxicity monitoring (Section 3.3.3),
* lakes assessment (Section 3.3.4),
* ambient monitoring system (Section 3.3.5)

3.3.1 Benthic Macroinvertebrates

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

Criteria have been developed to assign a bioclassification rating to each benthic sample based on the number of different species present in the pollution-intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies); or commonly referred to as EPTs. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina. The ratings fall into five categories ranging from Poor to Excellent. Likewise, ratings can be assigned with a North Carolina Biotic Index (BI). 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 are associated with better water quality. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is poorly assessed by a taxa richness analysis.

Recent extensive work on swamp streams suggested that different criteria should be used for slow flowing, swamp-like systems. DWQ has developed draft biological criteria ratings more specific to swamp waters. The criteria are draft and will remain so until DWQ is better able to evaluate several issues. Therefore, the draft criteria are not used for use support determinations. Refer to Section A, Chapter 4 for more information.

Overview of Benthic Macroinvertebrate Data

Appendix A-III lists all the benthic macroinvertebrate collections in the Lumber River basin between 1983 and 1996, giving site location, index number, collection date, taxa richness and biotic index values, and bioclassifications. Final bioclassifications assigned may take into account seasonal correction of both EPT taxa richness and Biotic Index value if the sample was collected

outside of summer. Bioclassifications listed in this report may differ from older reports because evaluation criteria have changed since 1983. Originally, Total taxa richness and EPT taxa richness criteria were used, then just EPT taxa richness, and now BI as well as EPT taxa richness criteria are used for flowing freshwater sites. Refinements of the criteria continue to occur as more data are gathered.

Benthic macroinvertebrates have been collected at 86 sites in the Lumber River basin since 1983. Thirty-eight sites were sampled during the 1996 basinwide surveys, including seven estuarine sites. Some sites that had been planned for 1996 or 1997 could not be sampled because of lack of flow during the normal summer collection period.

There are many high quality streams in the Lumber River basin, but the greatest number of Good and Excellent ratings are in the sandhills portion of subbasins 50 and 51. Subbasin 55 near Laurinburg also includes some high quality sandhills streams. Other high quality areas include Lake Waccamaw and Waccamaw River (Subbasins 56-57). Some swamp streams may eventually be assigned higher ratings as DWQ develops better criteria for rating this type of stream.

Long-term changes in water quality were evaluated at 19 sites in the Lumber River basin. Water quality has remained unchanged at most sites, with a slight improvement in water quality observed only for the Lumber River near Maxton. No sites showed a decline in water quality, although there is not enough data to assess long-term trends in some subbasins.

3.3.2 Fish Assessments

Overview of Fish Community Assessment Data

The fish communities in the Lumber River Basin were sampled in 1996 using methods developed for the application of the North Carolina Index of Biotic Integrity (NCIBI) (NCDEHNR, 1995). The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, et al. (1986). The Index has been subsequently modified and is continually being refined for applicability to wadeable streams in North Carolina.

Based on evaluations of all the accumulated recent coastal fisheries data, the modified NCIBI scoring criteria may be inappropriate for lower coastal plain streams that have a swamp-like character. These systems have natural low productivity and pH and dissolved oxygen stresses that are not found in more typical flowing water streams. Therefore, streams that had these characteristics are not rated. Studies will be undertaken to sample reference swamp streams to evaluate what changes need to be made to the NCIBI metrics to give better evaluations of these streams.

The assessment of biological integrity using the NCIBI is provided by the cumulative assessment of 12 parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Finally, the NCIBI score is then used to determine the ecological integrity class, as proposed by Karr (1981), of the stream from which the sample was collected (Table A-20).

The NCIBI has been revised since the 1994 Lumber River basinwide monitoring was conducted in 1990-1992 (see Section A, Chapter 4). These revisions caused some changes in the Lumber River basin fish community assessments as reported in the first Lumber River Basin Assessment Report.

In 1996, 11 samples were collected from 9 sites in the basin and evaluated using the North Carolina Index of Biotic Integrity (Figure A-20). Of the eight streams sampled earlier in 1991 or 1992 and again in 1996, six of the sites had NCIBI classes which remained unchanged; Little Shoe Heel Creek decreased from Good-Fair to Poor; and Back Swamp increased from Fair to Good (Figure A-21).

Table A-20 Scores, Integrity Classes and Class Attributes for Evaluating a Wadeable Stream Using the North Carolina Index of Biotic Integrity

NCIBI Scores	NCIBI Classes	Class Attributes
56 - 60	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, along with a full array of size classes and a balanced trophic structure.
50 - 54	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant species; some species are present with less than optimal abundance or size distributions; and the trophic structure shows some signs of stress.
44 - 48	Good-Fair	Signs of additional deterioration include the loss of intolerant species, fewer species and a highly skewed trophic structure.
38 - 42	Fair	Dominated by omnivores, tolerant species and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; and diseased fish often present.
<36	Poor	Few fish present, mostly introduced or tolerant species; and disease fin damage and other anomalies are regular.

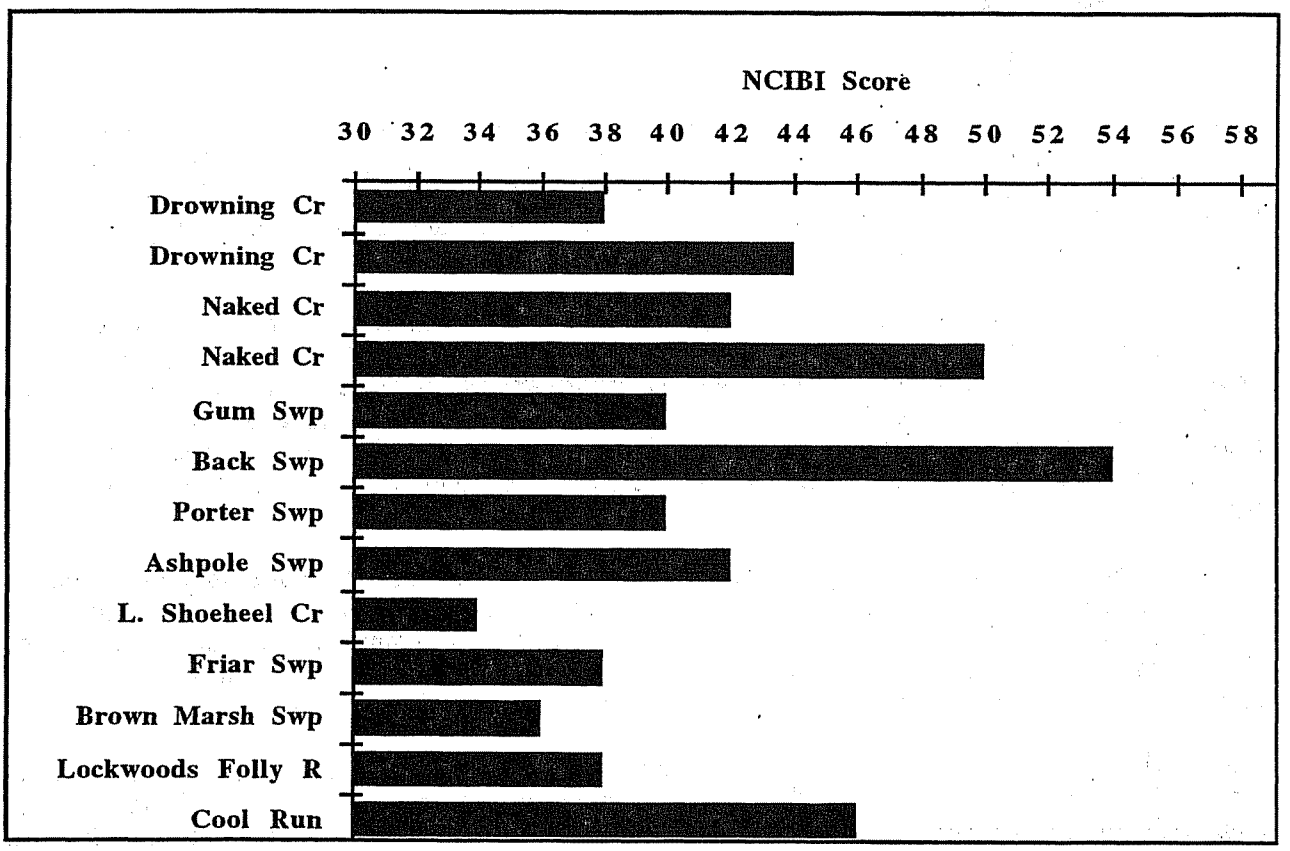


Figure A-20 The North Carolina Index of Biotic Integrity for the Lumber River Basin (1996)

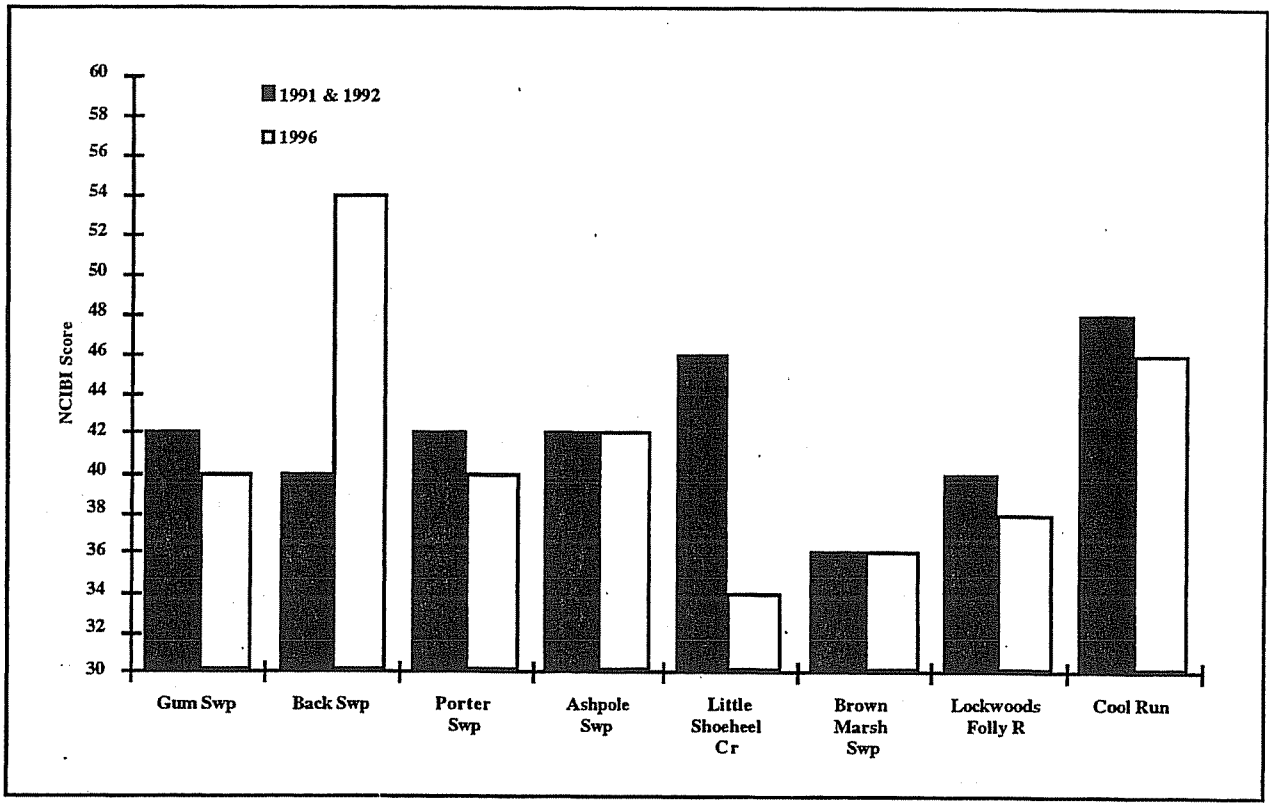


Figure A-21 The NC Index of Biotic Integrity for the Lumber River Basin 1991-92 *vs.* 1996

Overview of Fish Tissue Sampling Data

Since fish spend their entire lives in the aquatic environment, they incorporate chemicals from this environment into their body tissues. Contamination of aquatic resources 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.

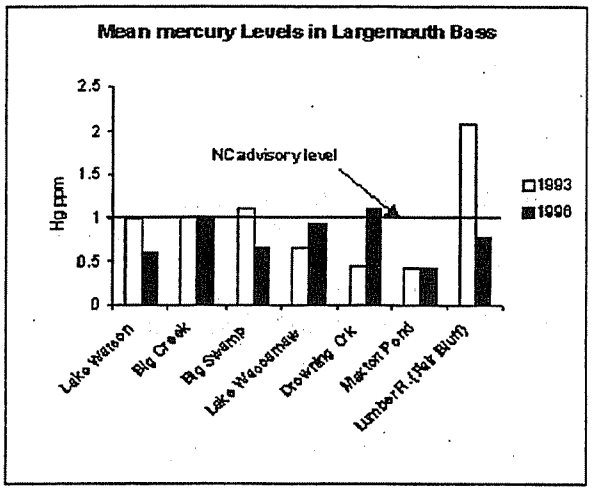
In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with Federal Food and Drug Administration (FDA) action levels, US Environmental Protection Agency (EPA) recommended screening values and criteria adopted by the North Carolina State Health Director.

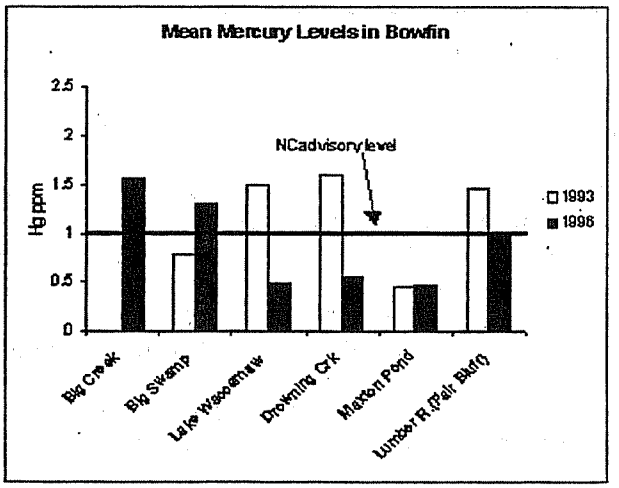
During 1992 and 1993, DWQ conducted extensive fish tissue surveys in southeastern North Carolina in an effort to assess mercury contamination in several fish species associated with the region. The 1992-1993 studies revealed mercury levels approaching or exceeding EPA and FDA criteria in largemouth bass and/or bowfin across a wide geographic area including most Lumber River subbasins. DWQ personnel collected 668 fish tissue samples from 32 stations throughout the Lumber Basin from Richmond to Brunswick County. Of the 32 stations sampled, 15 contained largemouth bass and 8 contained bowfin with mean mercury levels in edible tissue equal to or exceeding the FDA limit of 1.0 ppm. These levels prompted the State Health Director to issue a limited consumption advisory in October 1994 for largemouth bass and bowfin throughout the entire Lumber Basin. Under the advisory, consumption of bass and bowfin is limited to no more

than two meals per month for the general public. Women of childbearing age and children are advised not to consume the two species. This advisory encompasses waters within Moore County and the Waccamaw drainage already under limited consumption advisories issued in 1993 for mercury contamination. Waters previously posted include Watson, Pit Links and Pages lakes, as well as sections of the Waccamaw River drainage.

The presence and accumulation of mercury in North Carolina's aquatic environment is similar to contamination observed in other states where conditions are favorable. Mercury bioaccumulation in North Carolina appears to be most prevalent in top predator fish species found in coastal plain waterbodies (I-95 eastward). Bass and bowfin throughout the state have exhibited total mercury levels exceeding EPA and FDA limits even when these species are associated with remote or minimally impacted waterbodies. Atmospheric deposition may be a significant source for the observed levels of mercury, but the exact pathways and extent of mercury contamination in North Carolina fish, or across the nation, have yet to be characterized.

Fish tissue samples were collected from 8 sites within the Lumber basin in 1996 and analyzed for metals contaminants. Mean mercury levels exceeding EPA limits were measured in at least one fish species from 6 of the 8 sites sampled. Bowfin and largemouth bass continued to show the highest levels of mercury bioaccumulation. Mean mercury levels exceeding 1.0 ppm (the FDA limit and level for North Carolina advisories) were detected in bowfin and/or bass at 4 stations. Results from 1996 continue to show significant mercury bioaccumulation in several fish species throughout the drainage; however, trends in mercury contamination are unclear at the 7 sites revisited from 1992-1993 surveys (see figures below).





Lumber River Basin Fish Kills

Field investigators reported 5 fish kill events in the Lumber River Basin from 1989 to 1995. Mortality estimates ranged from 50 to 1,000 individuals. Causes for these events were cited as unknown or the result of low DO levels and low flows. Investigators reported 4 fish kills in the Lumber Basin during 1996. A kill on the Lumber River near Lumberton and kills in private ponds near Laurinburg and Red Springs were attributed to low DO levels during the aftermath of Hurricane Fran. One kill in the Calabash River drainage was linked to heavy rains following Hurricane Bertha. All the kills were reported as relatively small (less than 200 fish) and isolated events. Three events involving 1,000 fish or less were reported in the Lumber watershed during 1997. The events were associated with runoff of hog waste on spray fields, as well as hot weather and low flow conditions.

3.3.3 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 DWQ's Aquatic Toxicology Laboratory.

The Aquatic 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. A summary of compliance for the Lumber basin from 1987 through 1997 is presented in Table A-21.

Table A-21 Summary of Compliance from Wastewater Dischargers Whole Effluent Toxicity Tests

Year	Number of Facilities	Number of Tests	% Meeting Permit Limit*
1987	8	64	60.9
1988	10	103	69.9
1989	14	140	75
1990	13	147	87.7
1991	13	149	86.6
1992	17	195	85.6
1993	20	243	75.7
1994	20	238	80.2
1995	24	284	82
1996	24	279	86.4
1997	24	276	85.1

*This number was calculated by determining whether a facility was meeting its ultimate permit limit during the given time period, regardless of any SOCs in force. Facilities were not included in any given year unless data were available for the full year.

†"No. Tests" is not the actual number of tests performed, but the number of opportunities for limit compliance evaluation. Assumptions were made about compliance for months where no monitoring took place based on data previous to that month. Facilities compliant in a given month were assumed to be in compliance during months following until the next actual monitoring event. This same policy was applied to facilities in noncompliance.

3.3.4 Lakes Assessment Program

The North Carolina Lakes Assessment Program has conducted assessments at publicly accessible lakes, at 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 of each lake, a relative measure of nutrient enrichment and productivity referred to as eutrophication.

Two lakes, Lake Waccamaw (subbasin 03-07-56) and Lake Tabor (subbasin 03-07-57), were sampled in 1996 as part of the Lakes Assessment Program. Each lake is individually discussed in Section B, Chapter 7 and Chapter 8, with a focus on the most recent available data.

3.3.5 Ambient Monitoring System Program

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. Water quality data for this plan were evaluated for the period 1992-1997. DWQ has 30 stations in the Lumber River Basin (see Table A-22). For the purpose of this report those stations are divided into four drainages, the Shoe Heel Creek drainage (subbasin 03-07-55), the Lumber River drainage (subbasins 03-07-50 -54), the Waccamaw River drainage (subbasins 03-07-56 -58) and the Coastal drainage (subbasin 03-07-59).

Table A-22 Ambient Monitoring System Stations within the Lumber River Basin

Primary No	STORETNo	Station Name	Subbasin
Shoe Heel Creek drainage			
02132269	I0490000	LEITH CREEK AT SR 1609 NEAR JOHNS NC	030755
02132336	I1530000	SHOE HEEL CREEK AT 1101 NR ROWLAND NC	030755
Lumber River drainage			
02133500	I2090000	DROWNING CREEK AT US HWY 1 NEAR HOFFMAN NC	030750
02133616	I2610000	LUMBER RIVER AT US HWY 401 NEAR WAGRAM NC	030751
02133624	I2810000	LUMBER RIVER AT NC HWY 71 NEAR MAXTON NC	030751
02133691	I3050000	LUMBER RIVER AT SR 1003 NEAR PEMBROKE NC	030751
02134128	I3690000	RAFT SWAMP AT SR 1527 NEAR MOSS NECK NC	030752
0213396055	I3730000	RAFT SWAMP AT NC HWY 71 NEAR RED SPRINGS NC	030752
0213423350	I4650000	LUMBER RIVER AT SR 2121 NEAR KINGSDALE NC	030751
02134488	I5370000	BIG SWAMP AT NC HWY 211 NR RICHARDSON NC	030753
02134500	I5690000	LUMBER RIVER AT US HWY 74 AT BOARDMAN NC	030751
0213460809	I6290000	ASHPOLE SWP AT SR 2258 NR BARNESVILLE NC	030754
02134623	I6410000	LUMBER RIVER AT NC HWY 904 AT FAIR BLUFF NC	030751
Waccamaw River drainage			
02108969	I7730000	LAKE WACCAMAW AT DAM SPILLWAY	030756
02109500	I8970000	WACCAMAW RIVER AT NC HWY 130 AT FREELAND NC	030757
02110050	I9310000	SEVEN CREEKS AT NC HWY 905 NR BUG HILL NC	030757
02110500	I9350000	WACCAMAW RIVER AT SC HWY 9 NR LONGS SC	030757
Coastal drainage			
0210887326	I9380000	ICW AT CM R16 AT BEAVERDAM CK NR LONG BEACH NC	030759
02108930	I9385000	MONTGOMERY SLOUGH AT SR 1105 NEAR LONG BEACH NC	030759
02108921	I9420000	LOCKWOODS FOLLY RIVER AT NC HWY 211 AT SUPPLY NC	030759
02108923	I9440000	LOCKWOODS FOLLY RIVER AT VARNUM NC	030759
0210892368	I9450000	LOCKWOODS FOLLY R AT CM R8 AT W CH DS VARNUM NC	030759
0210895690	I9500000	LOCKWOODS FOLLY RIVER AT WEST CHANNEL ISLANDS	030759
02108984	I9510000	ICW AT CM R42 WEST OF LOCKWOODS FOLLY RIVER	030759
02108925	I9530000	ICW AT NC HWY 130 NEAR HOLDEN BEACH NC	030759
0210894250	I9700000	SHALLOTTE RIVER AT US HWY 17 BUS AT SHALLOTTE	030759
0210895150	I9820000	SHALLOTTE RIVER AT SHELL POINT NEAR SHALLOTTE	030759
02108953	I9840000	ICW AT NC HWY 904 NEAR OCEAN ISLE NC	030759
0210895325	I9880000	INTRACOASTAL WATERWAY AT SR 1172 NR SUNSET BEACH	030759
02108954	I9916000	CALABASH CK AT NC HWY 179 NR CALABASH NC	030759

A review of ambient monitoring network data is presented below. This review describes water quality conditions observed in the four major drainages both during this period and in comparison with the previous five-year period. Conditions which were judged significant either in relation to standards or in comparison with previous data are highlighted.

Lumber River drainage

For the most part total phosphorus concentrations were lower in the mainstem than during the last basin assessment period with one station, Lumber River near Pembroke, showing significantly lower median concentrations. The median total nitrogen concentration has remained about the same.

Waccamaw River drainage

The Waccamaw River site at Lake Waccamaw Dam was significantly higher in median total nitrogen concentration from the last assessment period.

Coastal drainage

There were multiple samples that exceeded metals criteria for cadmium, chromium, lead and mercury from the four sites along the Lockwoods Folly River. Four sites on the Intracoastal Waterway (ICWW) also had samples exceeding criteria for cadmium, chromium, lead, nickel and mercury. The ICWW site at Channel Marker R42 also had a significant increase in median total nitrogen concentration over the last assessment period. Most of the other sites had a slight increase in total nitrogen though not significant. Total phosphorus remained about the same at all sites.

Nutrients

There are generally relatively high concentrations of phosphorous and nitrogen in the mainstem Lumber River stations compared to the other stations in the basin. The highest overall nutrient concentrations were found at the Leigh Creek station followed by Shoe Heel Creek, Raft Swamp at Red Springs, Calabash Creek, Big Swamp and Ashpole Swamp. The Lumber River at SR 1003 near Pembroke had a significant decrease in median total phosphorus concentration, ICWW at CM R42 west of Lockwoods Folly River and Lake Waccamaw at Dam Spillway near Lake Waccamaw had a significant increase in median total nitrogen concentration. High nitrogen concentrations were also found at the two stations on the Waccamaw River, Big Swamp and Calabash Creek.

Fecal Coliform Bacteria

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 impacted waters in order that targeting efforts and appropriate management strategies can be developed. 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.

Fecal coliform bacteria are typically associated with the intestinal tract of warm-blooded animals. Common sources of fecal coliform bacteria include leaking or failing septic systems, leaking sewer lines or pump station overflows, runoff from livestock operations, 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) because they are easier and less costly to detect than the actual pathogens. The coliform standard, which has been used to indicate the microbiological quality of drinking water, swimming waters and shellfish harvesting waters for more than 50 years, has often been questioned. Increasing evidence suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water. Yet, the detection and identification of specific bacteria, viruses and parasites, such as *Giardia*, *Cryptosporidium*, and *Shigella* require large volumes of sample and very sophisticated laboratory techniques which are not commonly available.

Fecal coliform water quality standards have been established in order to ensure safe use of waters for water supplies, recreation and shellfish harvesting (refer to Administrative Code Section 15A NCAC 2B .0200). The current state (DWQ) fecal coliform standard for freshwater is 200 colonies/100ml based on at least five consecutive samples during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during such period. The 200 colonies/100ml standard is intended to ensure that waters are safe for water contact recreation. Tidal SA saltwaters (waters that are used for shellfishing for market purposes) have a different standard that requires that fecal coliform counts not exceed a median of 14 colonies/100ml and not more than 10 percent of the samples shall exceed 43 colonies/100ml in those areas most probably exposed to fecal contamination during runoff events associated with rainfall. The 14 colonies/100ml standard in SA waters is intended to ensure that shellfish (oysters) harvested from these waters are safe to eat.

In the saltwater portion of the basin, large areas of water are temporarily or permanently closed to shellfish harvesting because of fecal coliform bacteria. The Division of Environmental Health Shellfish Sanitation Branch monitors fecal coliform levels in coastal waters and, using the results of these data and other information, the Division of Marine Fisheries determines whether or not shellfish can be harvested from actual or potential shellfish growing areas.

The early 1980s saw increasing concern regarding the potential role of stormwater runoff and septic tank failures as a source of fecal coliform contamination to shellfish waters. DWQ released a report documenting high fecal coliform levels in waters draining developed areas of coastal North Carolina and discussing various management options (NCDEM, 1985). The initial coastal stormwater regulations were adopted by the EMC in 1986. DWQ has conducted two intensive investigations of closed shellfish waters: the Lockwoods Folly River (Lumber River basin) in 1989 (NCDEM, 1989), and the South River (Neuse River basin) in 1994 (NCDEM, 1994). Much was learned from these two studies with regard to the site-specific nature of the problem and the difficulty of pinpointing specific sources of contamination. The South River investigation documented contamination in sub-drainages dominated by all types of land uses and practices--residential, agricultural and recently logged forest, as well as undisturbed forest. The Lockwoods Folly River study noted that unacceptable fecal coliform levels were found despite the fact that there were no violations of rules or procedures.

DEH's Shellfish Sanitation Program Relating to Fecal Coliform Bacteria

DEH has subdivided all coastal waters in the state into shellfish growing areas. For each growing area, DEH must conduct a sanitary survey once every three years. A sanitary survey is comprised of a shoreline survey, a hydrographic survey, and a bacteriological survey. The shoreline survey is used to identify potential pollution sources. The hydrographic survey evaluates meteorological and hydrographic features of the area that may affect the distribution of pollutants and the bacteriological survey assesses water quality using fecal coliform sampling. Based on the results of the survey, the waters are classified by DEH into one of the following categories:

- ***Approved Area*** - an area determined suitable for the harvesting of shellfish for direct market purposes.
- ***Conditionally Approved-Open*** - waters that are normally open to shellfish harvesting but are closed on a temporary basis in accordance with management plan criteria.
- ***Conditionally Approved-Closed*** - waters that are normally closed to shellfish harvesting but are open on a temporary basis in accordance with management plan criteria.
- ***Restricted Area*** - an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- ***Prohibited Area*** - an area unsuitable for the harvesting of shellfish for direct market purposes.

An area is considered approved for shellfish harvesting only if the median fecal coliform MPN or the geometric mean MPN does not exceed 14/100 ml and if no more than 10 percent of the samples exceed a MPN of 43/100 ml. Numerous closed areas have median levels below 14 but fail to meet the second criteria due to periodic contamination usually occurring after moderate to heavy rainfall.

Only one site in the Lumber River Basin, with 10 or more fecal coliform samples over the last 5 years, had a geometric mean exceeding 200 colonies/100ml. That was the Shallotte River at Shallotte. During that period the Leith Creek site had a geometric mean of 113.5 colonies/100ml. This new site, active since 1995, does not have the dataset to indicate whether the counts are on the increase or decrease. The Calabash Creek site had a geometric mean of 98.4 colonies/100ml, up from 61.3 colonies/100ml during the last assessment period. This site may require investigation of the source of the increasing counts.

3.4 Use Support Summary

3.4.1 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 Lumber River basin are presented in the appropriate subbasin chapters in Section B.

Use support ratings for streams, lakes or estuaries:

- *fully supporting (FS)*
- *fully supporting but threatened (ST)*
- *partially supporting (PS)*
- *not supporting (NS)*

The use support ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are supported, partially supported or 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 not supporting are considered *impaired.* 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.

Impaired waters categories:

- Partially Supporting
- Not Supporting

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. This rating describes waters for which actual monitored or monitored/evaluated data indicate an apparent declining trend (i.e., water quality conditions have deteriorated compared to earlier assessments, but the waters still support uses). Although these 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 not rated (NR). For a more complete description of use support methodology, refer to Appendix IV.

3.4.2 Revisions to Methodology Since 1992-1993 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.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) or fully supporting but 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 rated (NR).

These changes resulted in a reduction in streams rated on an evaluated basis. In addition, fish consumption advisories are no longer used in determining the use support rating.

3.4.3 Revisions to Methodology Since 1994 Lumber River Basinwide Plan

Freshwater Criteria Changes

In addition to revisions to the statewide use support methodology over the past five years, discussed in Section 3.4.2, several more changes were made to use support methodology to account for local conditions in the Lumber River basin. Swamps and swamp-like systems are common in most of the Lumber River basin. Extensive work on swamp streams has suggested that different biological criteria should be used for slow-flowing, swamp-like waters than for more typical free-flowing streams. DWQ is currently developing methods for rating both fish and benthic macroinvertebrate populations in swamp streams. Benthic criteria are currently in draft form, while fish methods are in an earlier stage of development.

Since appropriate methods of applying biological ratings to these streams have not been finalized, use support ratings for these waters have not been determined. Although numerous sites in the Lumber River basin were sampled during 1996, many were classified as 'not rated' due to the lack of final biological criteria (Table A-23). Additionally, DWQ has determined that biological ratings previously assigned to a number of streams for the 1994 Lumber River Basinwide Plan were inappropriate, due either to insufficient flow at the time of sampling or the use of inappropriate criteria. These sample results have also been changed to 'not rated'.

As a result, fewer stream miles in the Lumber River basin were rated on a monitored basis than in 1994. A number of streams were rated as impaired in 1994 based on biological ratings that have since been judged inappropriate (Table A-24) These streams previously thought to be impaired are now rated as either fully supporting (FS) or fully supporting but threatened (ST) on an evaluated basis. Many of these waters remain on the 303(d) list (Appendix V) as required by the Clean Water Act. These waters, though not currently considered impaired by DWQ, are required to remain on the 303(d) list until DWQ biological criteria are finalized and the waters are reevaluated using the final criteria. The criteria are anticipated to be finalized within this five-year basinwide cycle. When the criteria are finalized, an addendum to the Lumber River Basinwide Plan explaining any use support changes will be developed.

The number of stream miles in several subbasins varies slightly from the figures reported in the previous Lumber River basin plan. While the total number of classified stream miles in the basin as a whole has not changed, more precise delineation of hydrological unit boundaries has resulted in the shifting of some stream segments from one subbasin to another.

Table A-23	Monitored Streams with Samples Not Used for Use Support Determinations**					
Name of Stream	Station Location	Class	Index #	Subbasin	Samples Not Rated	
Quewhiffle Creek*	Quewhiffle Creek at SR 1214, Hoke Co.	C	14-2-14a	030750	Benthic, 89 and 98	
Gum Swamp*	NC 71, Robeson Co.	C	14-5	030751	Fish, 91 and 96	
Bear Swamp	Bear Swp ar SR 1339, Robeson Co.	WS-IV Sw	14-9-(1.5)	030751	Benthic, 96	
Porter Swamp*	Porter Swamp at SR 1503, Robeson Co.	C Sw	14-27	030751	Benthic, 92 and 96; Fish 92 and 96	
Gapway Swamp*	Gapway Swp at SR 1356, Columbus Co.	C Sw	14-31	030751	Benthic, 96	
Burnt Swamp*	Burnt Swamp ab RR, Robeson Co.	WS-IV Sw	14-10-8-4-(0.5)a	030752	Benthic, 91	
Burnt Swamp*	Burnt Swamp SR 1515, Robeson Co.	WS-IV Sw	14-10-8-4-(0.5)b	030752	Benthic, 91	
Big Marsh Swamp	Above and below Croft Metals, Robeson Co.	C Sw	14-22-2a	030753	Benthic, 92	
Jackson Branch	SR 2100, Robeson Co.	C Sw	14-22-3-7	030753	Benthic, 92	
Ashpole Swamp*	NC 41(both) and SR 2455 (fish), Robeson Co.	C Sw	14-30a	030754	Benthic, 91 and 96; Fish, 91-92 and 96	
Ashpole Swamp*	SR-2258, Robeson Co.	C Sw	14-30b	030754	Benthic, 86	
Hog Swamp*	Hog Swamp at SR 2262, Robeson Co.	C Sw	14-30-7	030754	Benthic, 91 and 96	
Indian Swamp	SR 2255, Robeson Co.	C Sw	14-30-8	030754	Benthic, 92	
Little Shoe Heel Creek*	Little Shoe Heel Ck at SR 1405, Scotland Co.	C Sw	14-34-3	030755	Fish, 91 and 96	
Fryer Swamp	Fryer Swp at SR 1740, Columbus Co.	C Sw	15-2-6-3	030756	Benthic 96; Fish 96	
Slap Swamp	Slap Swp at SR 1740, Columbus Co.	C Sw	15-2-6-4	030756	Benthic, 96	
Juniper Creek	Juniper Creek at NC 211, Brunswick Co.	C Sw	15-7a	030757	Benthic, 91	
Juniper Creek	Juniper Creek at SR 1928, Columbus Co.	C Sw	15-7b	030757	Benthic, 91; Fish, 91	
Grissett Swamp	at SR 1173 (benthic) and SR 1141 (fish), Columbus Co.	C Sw	15-17-1-(5)	030757	Benthic, 91; Fish, 92	
Toms Fork*	SR 1118, Columbus Co.	C Sw	15-17-1-10	030757	Fish, 92	
Monie Swamp*	Monie Swamp at SR 1006, Columbus Co.	C Sw	15-17-1-12	030757	Benthic, 91 and 96; Fish, 92	
Cawcaw Swamp	Cawcaw Swp at SR 1305, Brunswick Co.	C Sw	15-23	030757	Benthic, 96	
White Marsh	ab US 74 Bus and at old RR grade, Columbus Co.	C Sw	15-4a	030758	Benthic, 94	
Brown Marsh Swamp*	at SR 1700 (both) and SR 1760 (fish), Bladen Co.	C Sw	15-4-1-1-1	030758	Benthic, 96; Fish 92 and 96	
Elkton Marsh	Elkton Marsh at SR 1710, Bladen Co.	C Sw	15-4-1-1-2	030758	Benthic, 96	
Soules Swamp	Soules Swp at SR 1420, Columbus Co.	C Sw	15-4-8	030758	Benthic, 92	
Lockwoods Folly River	Lockwoods Folly at US 17, Brunswick Co.	C Sw	15-25-1-(1)	030759	Fish, 92 and 96	
Royal Oak Swamp	Royal Oak Swp at NC 211, Brunswick Co.	C Sw	15-25-1-12	030759	Fish, 92	
Cool Run	Cool Run at US 17, Brunswick Co.	C Sw	15-25-2-3	030759	Fish, 92 and 96	
*This stream was previously rated as impaired based on the results of biological samples that have since been changed to 'not rated'.						
** 1996 samples were given a biological rating using the draft swamp criteria. This rating will not be used for use support determinations until criteria are finalized.						

Estuarine Water Criteria Changes

In general, estuarine use support ratings were derived similarly to the previous cycle. The only exception is the use of shellfish closure information. Previously, all SA waters authorized by DEH as conditionally approved for shellfish harvesting were given a use support rating of support-threatened. Currently, conditionally approved-open areas (waters normally open to shellfish harvesting but closed on a temporary basis in accordance with management plan criteria) continue to be rated support threatened, but conditionally approved-closed areas (waters normally closed to shellfish harvesting but open on a temporary basis in accordance with management plan criteria) are now rated as partially supporting. This change more accurately reflects the status of conditionally approved-closed waters.

3.4.4 Use Support Ratings for the Lumber River Basin

Of the 2,283 miles of freshwater streams and rivers in the Lumber River basin, use support ratings were determined for 98 percent, or 2,231 (Table A-24).

Table A-24 Use Support Summary Information for All Monitored and Evaluated Streams in the Lumber River Basin (1998)

	Monitored and Evaluated Streams		Monitored Streams Only	
	Miles	%	Miles	%
Supporting	2230.9	98	381.6	100
Fully Supporting	1122.7	49	242.3	63
Fully Supporting but Threatened	1108.2	49	139.3	37
Impaired	0	0	0	0
Partially Supporting	0	0	0	0
Not Supporting	0	0	0	0
Not Rated	51.8	2	0	0

Table A-25 shows the total number of stream miles and stream miles per each use support category for each subbasin. This table presents use support for both the monitored and evaluated streams in the basin. More detailed information on the monitored stream segments can be found in Appendix IV. The use support ratings for estuarine waters in the basin are presented in Table A-26. Color maps showing use support ratings for the basin are presented in Figure A-22 and Figure A-23.

Table A-25 Use Support Determination for Monitored and Evaluated Freshwater Streams

Lumber Use Support Ratings in Miles for 1993-1997						
Subbasin	**Fully Supporting**	**Fully Supporting but Threatened**	**Partially Supporting**	**Not Supporting**	**Not Rated**	**Total**
03-07-50	178.5	5.9	0	0	0	184.4
03-07-51	296.8	94.6	0	0	0	391.4
03-07-52	1.2	133.3	0	0	0	134.5
03-07-53	48.4	251.8	0	0	0	300.2
03-07-54	133.9	2.8	0	0	0	136.7
03-07-55	141.9	151.7	0	0	12.4	306
03-07-56	132.5	0.2	0	0	0	132.7
03-07-57	0	350.6	0	0	0	350.6
03-07-58	179.8	18.2	0	0	0	198
03-07-59	9.7	99.1	0	0	39.4	148.2
TOTAL	1122.7	1108.2	0	0	51.8	2282.7
%	49.2	48.5	0	0.0	2.3	100

Table A-26 Use Support Ratings for Estuarine Waters in the Lumber River Basin (1993-1997)*

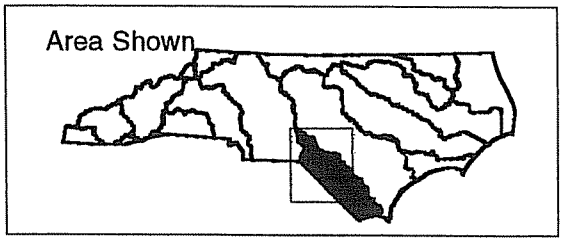
			Overall Use Support				**Major Sources**		**Potential Sources of Pollution**
Area Name	**Total Acres**	**DEH Area**	**FS**	**ST**	**PS**	**NS**	**Point**	**Nonpoint**	
Calabash	1800	A-1	0	662	1138	0		NPS	urban runoff, septic systems, marinas
Shallotte River	1350	A-2	445	334	571	0		NPS	urban runoff, septic systems
Lockwoods Folly River	1650	A-3	482	255	913	0		NPS	urban runoff, septic systems, marinas
Total Acres	4800		927	1251	2622	0			
Percent	100		19.3	26.1	54.6	0			

* Fecal coliform is the only cause of impairment of estuarine waters in this basin.

Major Sources:

NPS indicates that surveys note that nonpoint sources are the major factor influencing water quality, or there are no major point sources.

Figure A-22. Use Support Ratings for the Lumber and Little Pee Dee River Watersheds



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Planning Branch
November, 1998
Draft

Legend

USE SUPPORT RATING

- Fully Supporting
- Fully Supporting but Threatened
- Partially Supporting
- Not Rated

- Subbasin Boundary
- County Boundary
- Primary Road
- Municipality

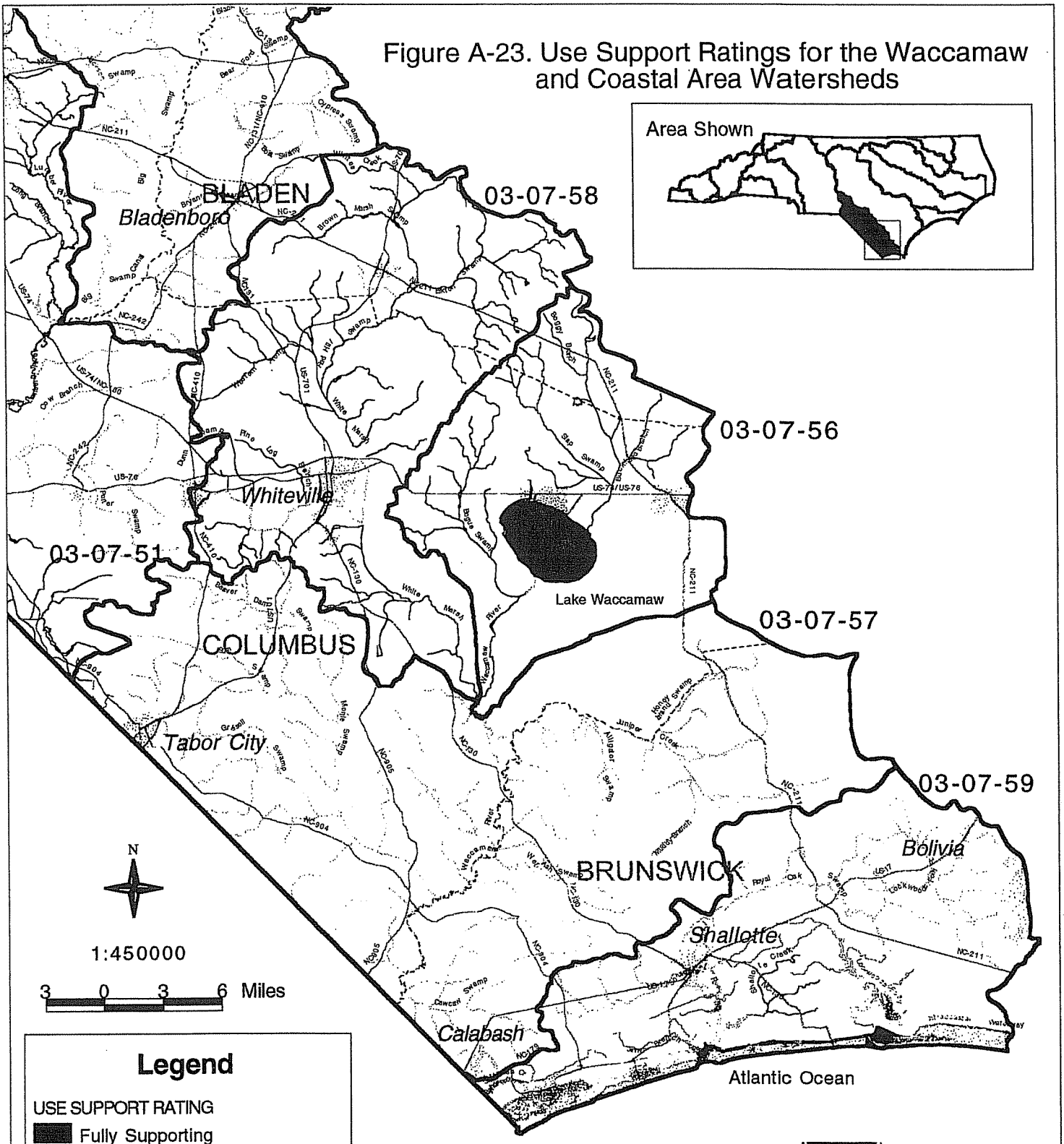
Figure A-23. Use Support Ratings for the Waccamaw and Coastal Area Watersheds
Area Shown
BLADEN
Bladenboro
03-07-58
03-07-56
Whiteville
03-07-51
Lake Waccamaw
03-07-57
COLUMBUS
Tabor City
03-07-59
BRUNSWICK
Bolivia
Shallotte
Calabash
Atlantic Ocean
N
1:450000
3 0 3 6 Miles
Legend
USE SUPPORT RATING
Fully Supporting
Fully Supporting but Threatened
Partially Supporting
Not Rated
Subbasin Boundary
County Boundary
Primary Road
Municipality
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Planning Branch
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Past fish consumption advisories for waters in the Lumber River basin have primarily been in the Lumber and Waccamaw River watersheds. There are four aquatic point source dischargers in the Lumber River watershed and one in the Waccamaw River watershed that analyze effluent for mercury. However, these aquatic point sources are not believed to be the most significant source of mercury to surface waters in these watersheds. Rather, mercury sources are believed to be from atmospheric sources. Mercury emissions to the atmosphere have increased since the industrial revolution. Local deposition of mercury occurs near an atmospheric point source; however, much of the atmospheric mercury can travel across countries and continents.

The North Carolina Division of Air Quality (DAQ) has maintained a mercury atmospheric sampling station at Waccamaw State Park since 1995. Air samples are taken at 15-minute intervals at this station. The DAQ also maintains permits for industries emitting pollutants to the atmosphere. Analysis of air quality data indicate that when the wind blows from an easterly direction, atmospheric mercury concentrations at Waccamaw State Park are significantly higher than background levels. While there is a global source of mercury that deposits at the park, these data show there is also a local effect from sources east of the park. The Holtrachem facility, the largest emitter of mercury in the region, will be changing to a process that will reduce mercury emissions to negligible levels.

Current and future NPDES discharges in the Lumber and Waccamaw River watershed should not be allowed to increase the total mercury already present in the system. Therefore, zero or less than detectable (based on NC's currently accepted measurement standards) mercury levels in NPDES effluent should be allowed. During this basin cycle, permit limits will be issued to facilities that have detected mercury in effluent in recent years. Other facilities may be asked to monitor effluent for mercury if it is likely that mercury is present in the effluent. DWQ and DAQ have formed a team that will attempt to address controls on mercury sources in the Lumber River basin.

Even with restrictions on point sources, mercury levels in the Lumber and Waccamaw River fish are not likely to change appreciably over the next several years. Thus, efforts should be made to educate the public in and around the Lumber and Waccamaw River watersheds with regard to mercury pollution.

The State of North Carolina alone cannot eliminate the atmospheric deposition of mercury over surface waters. Actions for reducing atmospheric mercury will also be needed at the national and international levels. The Mercury Report to Congress (EPA, 1997) lists initiatives under the Clean Air Act that may reduce atmospheric mercury emissions from industrial sources. The most significant initiative is emission limits for municipal waste combustors and medical waste incinerators.

North Carolina, in conjunction with EPA, will need to assess the relative inputs of mercury from within and outside the state using a regional air quality model. Modeling results may indicate that a significant portion of the mercury load to the Lumber and Waccamaw River watersheds is not due to local sources. In this case, assistance will be needed from EPA to address mercury emissions reductions across river basins and state boundaries. DWQ has requested assistance from EPA to conduct regional modeling, but has not received a response.

4.9 Nonpoint Source Pollution Reduction

DWQ will continue to seek better means of obtaining information for those waters that are believed to have nonpoint source pollution problems. Voluntary measures will continue to be relied upon for controlling and reducing nonpoint sources of pollution. Several other agencies, including the Cooperative Extension Service, Division of Soil and Water, Division of Land Quality and Natural Resources Conservation Service, provide oversight to voluntary measures such as the use of best management practices for various land use activities.

More resources are needed to address nonpoint sources of pollution. Identifying nonpoint sources of pollution and developing management strategies for negatively affected waterbodies, given the current limited resources, is an overwhelming task. Therefore, only limited progress towards restoring NPS impaired waterbodies can be expected unless substantial resources are put towards solving NPS problems.

Section B

Water Quality Data and Information by Subbasin

Chapter 1
Lumber River Subbasin 03-07-50
Includes Drowning and Naked Creeks

1.1 Water Quality Overview

Subbasin 03-07-50 at a Glance

Outstanding Resource Waters:
Naked Creek

High Quality Waters:
Drowning Creek

Land and Water Area (sq. mi.)

Total area:	273
Land Area:	271
Water Area:	2

Population

1990 Est. Pop.:	22,133
Pop. Density:	81 pers/sq mi

1996 Land Cover (%)

Forest/Wetland:	80%
Agriculture:	18%
Urban:	1%
Water:	1%

Use Support Summary (stream mi.)

Fully Supporting:	178.5 mi.
Fully Supporting but Threatened:	5.9 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

The headwaters of the Lumber River are located entirely within the sandhills ecoregion which is characterized by swiftly-flowing sandy streams. The high water quality in this subbasin reflects both sandy soil characteristics (which promote groundwater infiltration) and undisturbed, primarily forested catchments. A map of this subbasin including water quality sampling locations is presented in Figure B-1.

Drowning Creek near Hoffman is the only ambient monitoring location in this subbasin. This location reflects conditions in the upper reaches of Drowning Creek, including the entire Naked and Horse Creek catchments. Few exceedences of North Carolina water quality criteria were recorded during this 5-year collection period. Some exceedences were recorded for fecal coliform (16%) and copper (16.7%).

Benthic macroinvertebrate data were collected from four sites (all repeat locations) and fish community samples were collected from two locations (Table B-1). Current and prior data from three of these locations (Naked, Drowning and Horse Creeks) resulted in Excellent bioclassifications, suggesting that water quality has not changed. Based on this data, both Horse Creek and Jackson Creek could be considered for reclassification to HQW, if petitioned.

Fish samples collected from Drowning Creek were from different locations than the benthic samples, while fish sampling from Drowning Creek was from a location close to the benthic location. Differences in the ratings between fish and benthic samples demonstrate that different attributes of the ecosystem are being measured by each group of organisms.

Fish tissue samples were collected from two locations in this subbasin in 1996: Drowning Creek at SR 1225 and Lake Watson. Mercury levels exceeding EPA criteria (0.6 ppm) were detected from fish at both locations and greater than the FDA criteria (1.0 ppm) at Drowning Creek.

There are five permitted discharges in this subbasin and only one large facility: Moore County WWTP which discharges 6.7 MGD to Aberdeen Creek. This facility is currently monitoring effluent toxicity as part of its NPDES permit requirements and has reported successful toxicity tests since early in 1994. All other facilities discharge less than 0.05 MGD or operate under general permit requirements.

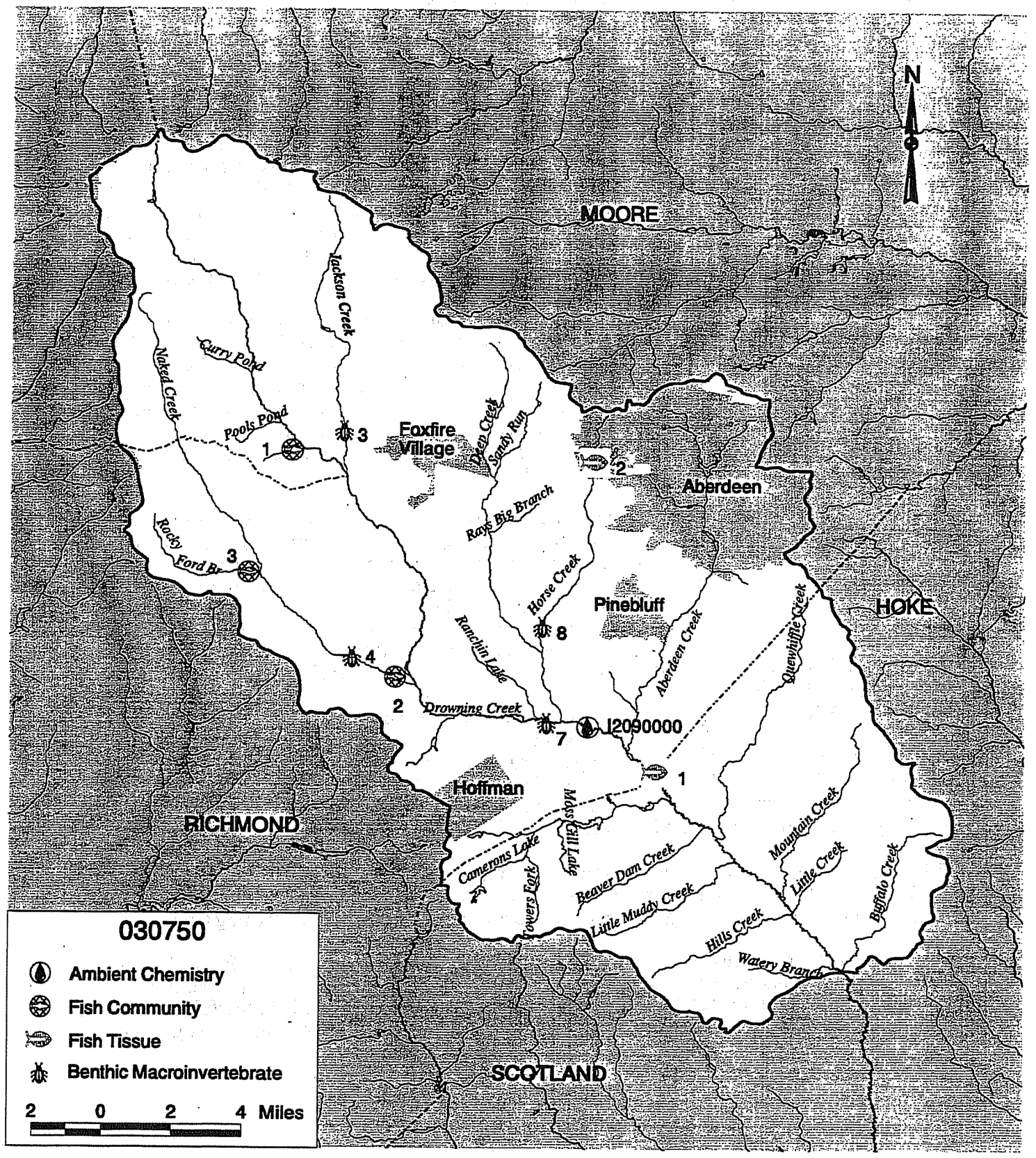

Figure B-1 Sampling Locations within Subbasin 03-07-50

Table B-1 1996 Sampling Locations in the Lumber River Subbasin 03-07-50

Map No.	Stream Name	Sample Type	Rating
3	Jackson Creek	Benthic Macroinvertebrate	Excellent
4	Naked Creek	Benthic Macroinvertebrate	Excellent
7	Drowning Creek	Benthic Macroinvertebrate	Excellent
8	Horse Creek	Benthic Macroinvertebrate	Excellent
1	Drowning Creek	Fish Community	Fair & Good-Fair
2	Naked Creek	Fish Community	Fair & Good

For more detailed information on water quality in subbasin 03-07-50, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

1.2 Prior Basinwide Plan Recommendations (1994) and Achievements

1.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Quewhiffle Creek, a tributary to Drowning Creek, as impaired (partially supporting). Two sites were sampled in 1984 and 1989 below the Carolina Galvanizing discharge to assess the effect of this discharge on the creek. The facility ceased discharging in 1986. While water quality showed improvement three years after the discharge ceased, there was still notable impairment.

The planned management strategy for Quewhiffle Creek was to investigate sources of impairment and to continue existing nonpoint source control programs. In addition, DWQ recognized the need to more accurately determine natural versus impacted swamp conditions.

In addition, management strategies to maintain adequate levels of oxygen in streams were recommended. These strategies were aimed at new or expanding dischargers into the Lumber River mainstem and its tributaries.

1.2.2 What was Achieved?

Benthos sampling was conducted on the creek in 1998 to further assess its water quality. It was determined that the creek size at the sampling location is too small to apply a biological rating using current criteria. Therefore, the previous PS rating was changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 more information). The current rating for the creek, based on 1998 sampling, is also Not Rated. Quewhiffle Creek will be resampled following the finalization of the draft biological criteria.

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2).

Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

1.3 Current Priority Issues and Concerns

Water quality in this subbasin is still in good to excellent condition based on DWQ's sampling efforts over the past five years. This points to the need for continued and expanded efforts to maintain water quality. These efforts are likely to be challenging, given the anticipated growth within this subbasin. Past growth in this subbasin has occurred around Southern Pines, Pinehurst, Aberdeen and Pinebluff in Moore County. These communities are expected to continue to grow at a quick pace (Section A, Chapter 2, Part 2.5). As growth occurs, efforts need to be made to conduct growth in an environmentally sound manner. These efforts should include, but not be limited to, planning green spaces, establishing buffered riparian areas, and implementing land use planning that protects sensitive areas.

Streambanks are primarily vegetated with few breaks in riparian zones. Drowning Creek had visible bank erosion and loss of vegetated buffers during the 1996 sampling. These vegetated buffers are contributing to the high water quality in this subbasin and efforts should be made to maintain these buffer zones.

Drowning Creek is listed on the 303(d) list (see Appendix V) for fish consumption advisories related to mercury contamination. DWQ is developing a management strategy related to mercury contamination (see Section A, Chapter 4, Part 4.8).

Chapter 2
Lumber River Subbasin 03-07-51
Includes mainstem of Lumber River and tributaries from source to South Carolina

2.1 Water Quality Overview

Subbasin 03-07-51 at a Glance

High Quality Waters
Lumber River mainstem to Lumberton

Land and Water Area (sq. mi.)

Total area:	527
Land area:	526
Water area:	1

Population

1990 Est. Pop.:	63,959
Pop. Density:	101 pers/sq mi

1996 Land Cover (%)

Forest/Wetland:	57%
Agriculture:	41%
Urban:	1%
Water:	1%

Use Support Ratings (stream mi.)

Fully Supporting:	296.8 mi.
Fully Supporting but Threatened:	94.6 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

Headwater reaches of the Lumber River are within the sandhills region and reflect many of the characteristics of streams within this region. These characteristics include swift flow, sand or gravel substrate and tannin-colored water. The Lumber river below Lumberton becomes more typical of a coastal plain system, although flows remain swift in most reaches. The tributary sites usually have very little flow during summer months. A map of this subbasin including water quality sampling locations is presented in Figure B-2.

This subbasin contains six ambient monitoring locations, all mainstem Lumber River locations: Wagram, Maxton, Pembroke, Kingsdale, Boardman and Fair Bluff. Water quality data generally indicated good conditions with few exceedences of North Carolina water quality criteria.

Median conductivity levels increase progressively from the Wagram location to Kingsdale and then decline to the Fair Bluff location. Higher conductivity values reflect the effects of upstream point source discharges at both locations. Almost two thirds of all pH samples were below the freshwater aquatic life criterion at the Wagram location and reflect the natural acidic conditions within this reach of the Lumber River. Twenty-five percent of all dissolved oxygen values collected at the Boardman location were below the North Carolina water quality criterion.

In general, the monitoring locations along the Lumber River had higher overall nutrient concentrations than other locations in the basin. However, total phosphorus concentrations were lower at Lumber River locations during this assessment period than they were during the previous monitoring period with one station, Lumber River near Pembroke, showing significantly lower values in 1997. A single mercury sample from the Kingsdale location was above the freshwater aquatic life criterion.

During the 1996 basinwide assessments, benthic macroinvertebrate samples were collected at 10 locations and fish community samples from 3 locations (Table B-2). Seven mainstem Lumber River locations resulted in Excellent bioclassifications at Wagram, Maxton, Pembroke and NC 41. Excellent bioclassifications were given to the Wagram and Pembroke locations during all previous surveys, and data from the Maxton location has been Good to Excellent during previous investigations. Discharges in the Lumberton area result in some degradation of the Lumber River and a Good-Fair bioclassification at NC 72. The Lumber River within this reach is very deep and slow flowing which may account for some of the differences. However, an increase in the bioclassification from Poor in 1986 to Good-Fair in 1996 was recorded. Both of these surveys

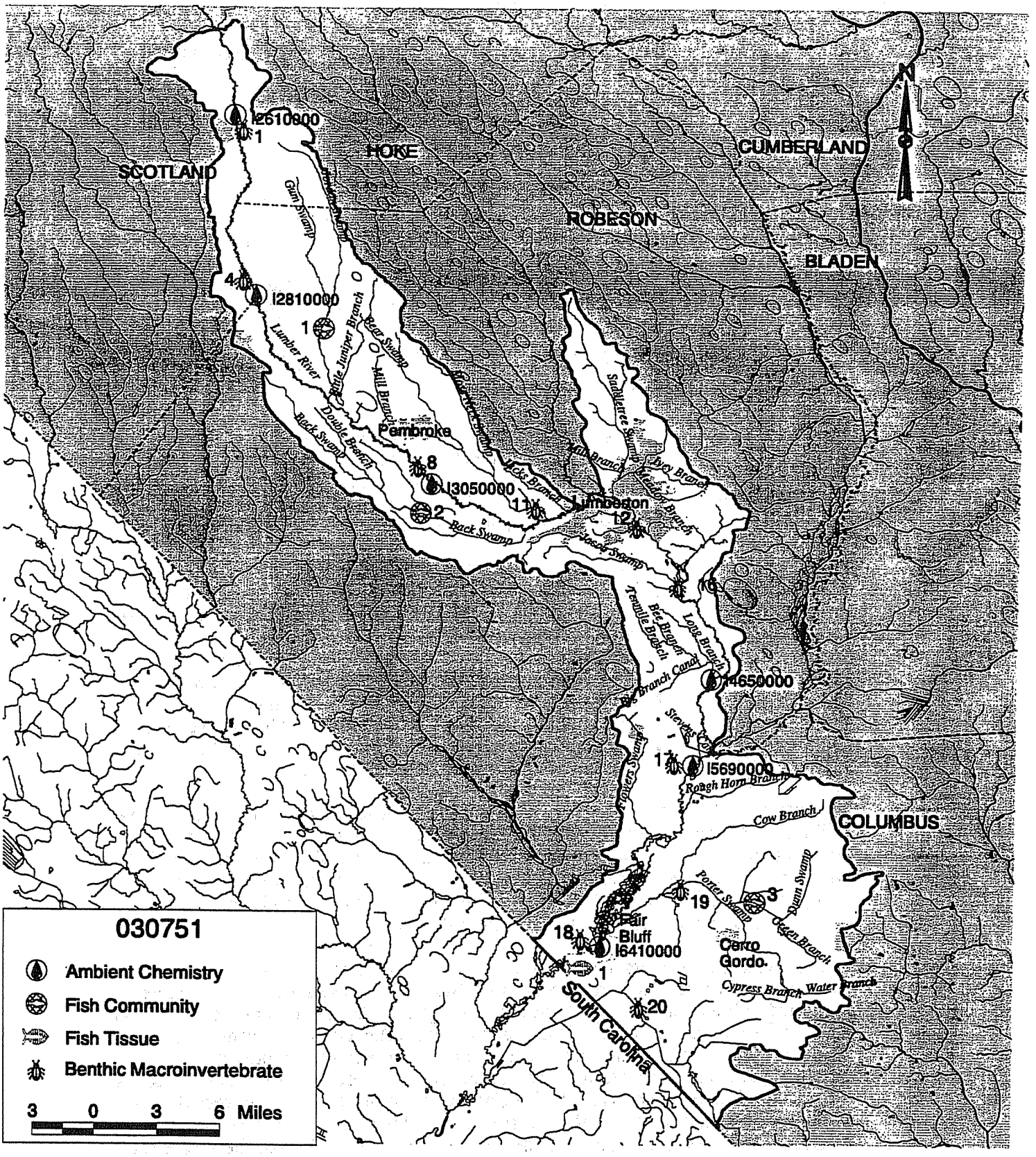

Figure B-2 Sampling Locations within Subbasin 03-07-51

were during low flow conditions. At Boardman, recovery is occurring (Good in 1991 and 1996) and appears to be complete at Fair Bluff (Excellent in 1991 and 1996).

Table B-2 1996 Sampling Locations in the Lumber River Subbasin 03-07-51

Map No.	Stream Name	Sample Type	Rating*
1, 4 & 8	Lumber River	Benthic Macroinvertebrate	Excellent
11	Bear Creek	Benthic Macroinvertebrate	Good*
12 & 18	Lumber River	Benthic Macroinvertebrate	Excellent
16	Lumber River	Benthic Macroinvertebrate	Good-Fair
17	Lumber River	Benthic Macroinvertebrate	Good
19	Porter Swamp	Benthic Macroinvertebrate	Not Rated*
20	Gapway Swamp	Benthic Macroinvertebrate	Fair*
1	Gum Swamp	Fish Community	Not Rated*
2	Back Swamp	Fish Community	Good
3	Porter Swamp	Fish Community	Not Rated

* These sampling locations were given a biological rating based on Draft Swamp Stream criteria. Refer to Section A, Chapter 3, Part 3.4 and Chapter 4 for more information on how biological ratings are used in use support determinations.

Twenty-six fish tissue samples were collected from the Lumber River at Fair Bluff. Over one-half (14 of 26) of the samples contained mercury levels exceeding EPA screening criteria and/or FDA criteria.

There are seven large (>5.0 MGD) dischargers in the subbasin, with Lumberton the only large municipality in the subbasin. There are 21 NPDES permitted facilities currently discharging to streams in this subbasin, thirteen of which discharge directly to the Lumber River. Ten facilities currently monitor effluent toxicity as part of their NPDES permit requirements. Only one facility has had recent toxicity test failures. NCDOC/McCain Hospital which discharges 0.2 MGD to UT Mountain Creek in Hoke County has failed 6 of 8 tests conducted in 1997. Further discussion of this facility can be found in Part 2.3 below. An SOC was given to the Fair Bluff WWTP which discharges 0.23 MGD to a UT of the Lumber River in Columbus County. The SOC was given to this facility for failing toxicity tests and was lifted in October 1997 after the facility was upgraded and again met discharge limits.

For more detailed information on water quality in subbasin 03-07-51, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

2.2 Prior Basinwide Plan Recommendations (1994) and Achievements

2.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified the following waters as impaired: Gum Swamp, Back Swamp, Jacob Swamp, Porter Swamp, Dunn Swamp, Cow Branch, Mill Branch and Gapway Swamp. The planned management strategy for these waters was to investigate sources of impairment and to continue existing nonpoint source control programs. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

In addition, management strategies to maintain adèquate levels of oxygen in streams were recommended. These strategies were aimed at new or expanding dischargers into the Lumber River mainstem and its tributaries.

2.2.2 What was Achieved?

Previous biological ratings for Gum Swamp, Bear Swamp, Porter Swamp and Gapway Swamp were changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). These waters will be resampled following the finalization of the draft biological criteria.

Gum Swamp and Back Swamp are on the 303(d) list (see Appendix V) and will remain on the list until the finalized criteria can be applied to this swamp water.

Back Swamp, Jacob Swamp, Dunn Swamp, Cow Branch, Mill Branch, were listed as impaired in the 1994 basin plan based on evaluated information rather than on monitoring data. Use support methodology has been improved and only monitoring data is now used for use support determination (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information).

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

2.3 Current Priority Issues and Concerns

The Lumber River is a significant and valuable resource for this region. Currently the water quality of the river is good to excellent. Local governments and citizens of this subbasin should seek to maintain this resource in its present state, despite the growth that is likely to occur in its watershed.

As growth occurs, efforts need to be made to conduct growth in an environmentally sound manner. These efforts should include, but not be limited to, planning green spaces, establishing buffered riparian areas, and implementing land use planning that protects sensitive areas.

The Division of Parks and Recreation has developed a two phase Master Plan for the Lumber River State Park (see Section A, Chapter 2, Part 2.6). The plan seeks to protect the river corridor and enhance water quality through a combination of land acquisitions, easements and leases for park facilities along the 115 mile stretch of river from Scotland County to the SC border. A third phase is being planned.

The NCDOC/McCain Hospital has had recent toxicity test failures. The facility has recently done some operation modification including adding a clarifier and UV disinfection. DWQ has recommended that the facility initiate an ongoing toxicity identification and toxicity removal study. DWQ will continue to work with this facility to assure toxicity reduction and permit compliance.

The Lumber River and Porter Swamp are listed on the 303(d) list (see Appendix V) for a fish consumption advisory related to mercury contamination. DWQ is developing a management strategy related to mercury contamination (see Section A, Chapter 4, Part 4.8).

Chapter 3
Lumber River Subbasin 03-07-52
Includes Raft Swamp and tributaries

3.1 Water Quality Overview

Subbasin 03-07-52 at a Glance

Land and Water Area (sq. mi.)	
Total area:	157
Land area:	157
Water area:	0
Population	
1990 Est. Pop.:	16,351
Pop. Density:	104 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	49%
Agriculture:	50%
Urban:	1%
Water:	<1%
Use Support Ratings (stream mi.)	
Fully Supporting:	1.2 mi.
Fully Supporting but Threatened:	133.3 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

This subbasin is within Hoke and Robeson Counties. Riparian zones along Raft Swamp and many of the major tributaries contain wetlands which are not developed, whereas upland sections of the catchments are heavily farmed. Raft Swamp and its tributaries are typical swamp-streams with braided channels, having very little visible current (under summer flow conditions) and tannin-colored water. Red Springs is the only major community completely within the subbasin. A map of this subbasin including water quality sampling locations is presented in Figure B-3.

DWQ maintains two ambient water quality monitoring locations in the subbasin: Raft Swamp near Red Springs and Raft Swamp near Moss Neck. These two monitoring locations bracket the discharge from the Red Springs WWTP, with Moss Neck the downstream sampling site. Somewhat higher median conductivity, total phosphorus and nitrate/nitrite nitrogen values were observed at the Moss Neck location.

Due to high flow conditions during the planned basinwide sampling period, there were no benthic macroinvertebrate or fish samples in this subbasin.

There are three facilities currently permitted to discharge within this subbasin. The only large facility is the Red Springs WWTP, which discharges 2.5 MGD to Little Raft Swamp. Two of these facilities have toxicity requirements as part of their NPDES permit (Red Springs WWTP and Industrial and Agricultural Chemicals). Failures were noted during three of four toxicity tests at the Red Springs facility in 1997 and failure to report test results have been noted at the Industrial and Agricultural Chemical facility. Further discussion on the Red Springs facility can be found in Part 3.3 below.

For more detailed information on water quality in subbasin 03-07-52, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

3.2 Prior Basinwide Plan Recommendations (1994) and Achievements

3.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Burnt Swamp as impaired. The planned management strategy for this water was to investigate sources of impairment and to continue existing nonpoint source control programs. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

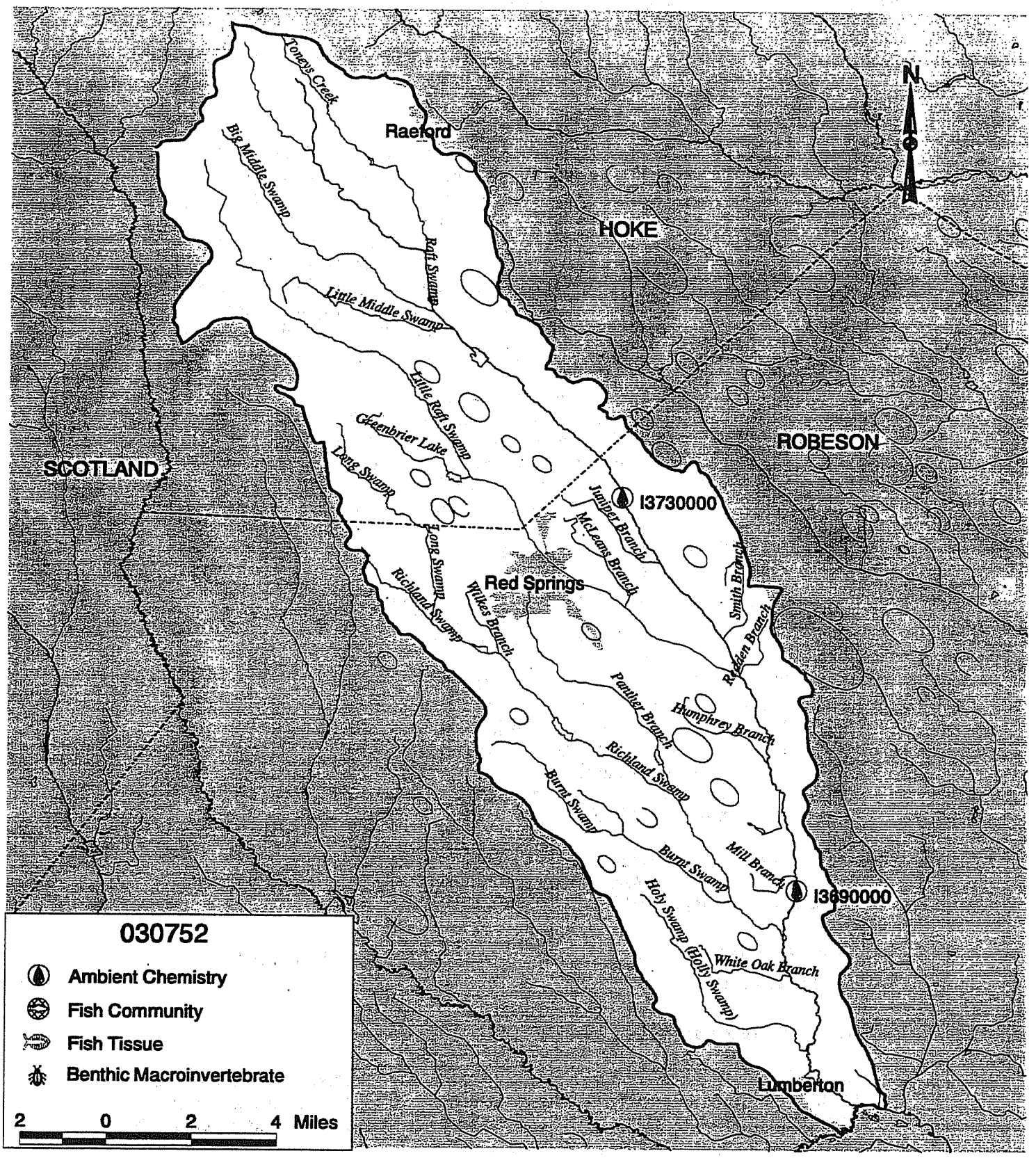

Figure B-3 Sampling Locations within Subbasin 03-07-52

In addition, management strategies to maintain adequate levels of oxygen in stream were recommended. These strategies were aimed at new or expanding dischargers into the Lumber River mainstem and its tributaries.

3.2.2 What was Achieved?

The previous impairment rating for Burnt Swamp was changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). However, this water is on the 303(d) list (see Appendix V) and will be resampled following the finalization of the draft biological criteria.

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

3.3 Current Priority Issues and Concerns

The Town of Red Springs has had chronic problems meeting toxicity permit requirements. DWQ has recently fined the facility for permit violations. Red Springs is making attempts to correct facility problems by working with a textile industry that is the only significant industrial discharger into the municipal collection and treatment works. Red Springs is also attempting to improve WWTP operations and compliance. DWQ will closely monitor the progress of Red Springs and take further actions if necessary.

Chapter 4
Lumber River Subbasin 03-07-53
Includes Big Swamp and tributaries

4.1 Water Quality Overview

Subbasin 03-07-53 at a Glance

Land and Water Area (sq. mi.)	
Total area:	223
Land area:	223
Water area:	0
Population/Growth	
1990 Est. Pop.:	15,710
Pop. Density:	70 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	46%
Agriculture:	37%
Urban:	<1%
Water:	<1%
Use Support Ratings (stream mi.)	
Fully Supporting:	133.9 mi.
Fully Supporting but Threatened:	2.8 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

This large catchment is heavily farmed primarily in soy beans, corn and cotton. Many of the riparian zones along Big Swamp and its major tributaries contain forested pocosin wetlands and are not developed. Big Swamp and its tributaries are typical swamp-streams, with tannin-colored water (a result of pocosin drainage) and very low summer flows. A map of this subbasin including water quality sampling locations is presented in Figure B-4.

There is one ambient monitoring location at Big Swamp at NC 211 near Richardson. Dissolved oxygen and pH levels were low as is typical for the swamp-like flow and habitat character of Big Swamp. All other parameters also appear to be within the normal range for swamp stream systems.

Benthic macroinvertebrates were collected from the ambient monitoring location during July 1997 under very low flow conditions. A Good-Fair rating was assigned to this site which compares to data collected in 1991, suggesting that water quality conditions have not changed in the catchment.

Twenty-six fish tissue samples were collected from Big Swamp at SR 1002. Over one-half (15 of 26) of the samples contained mercury levels exceeding EPA criteria (0.6 ppm) and/or FDA criteria (1.0 ppm).

There are six wastewater treatment facilities currently discharging to streams in this subbasin. Four of these facilities have design flows of greater than 0.05 MGD, and three of these facilities have toxicity requirements as part of their NPDES permit. Further discussion on one of these facilities can be found in Part 4.3 below.

For more detailed information on water quality in subbasin 03-07-53, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

4.2 Prior Basinwide Plan Recommendations (1994) and Achievements

4.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Buck Branch, Crawley Swamp, Bear Ford Swamp and Bryant Swamp as impaired. The planned management strategies for these waters was to investigate sources of impairment and to continue existing nonpoint source control programs. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

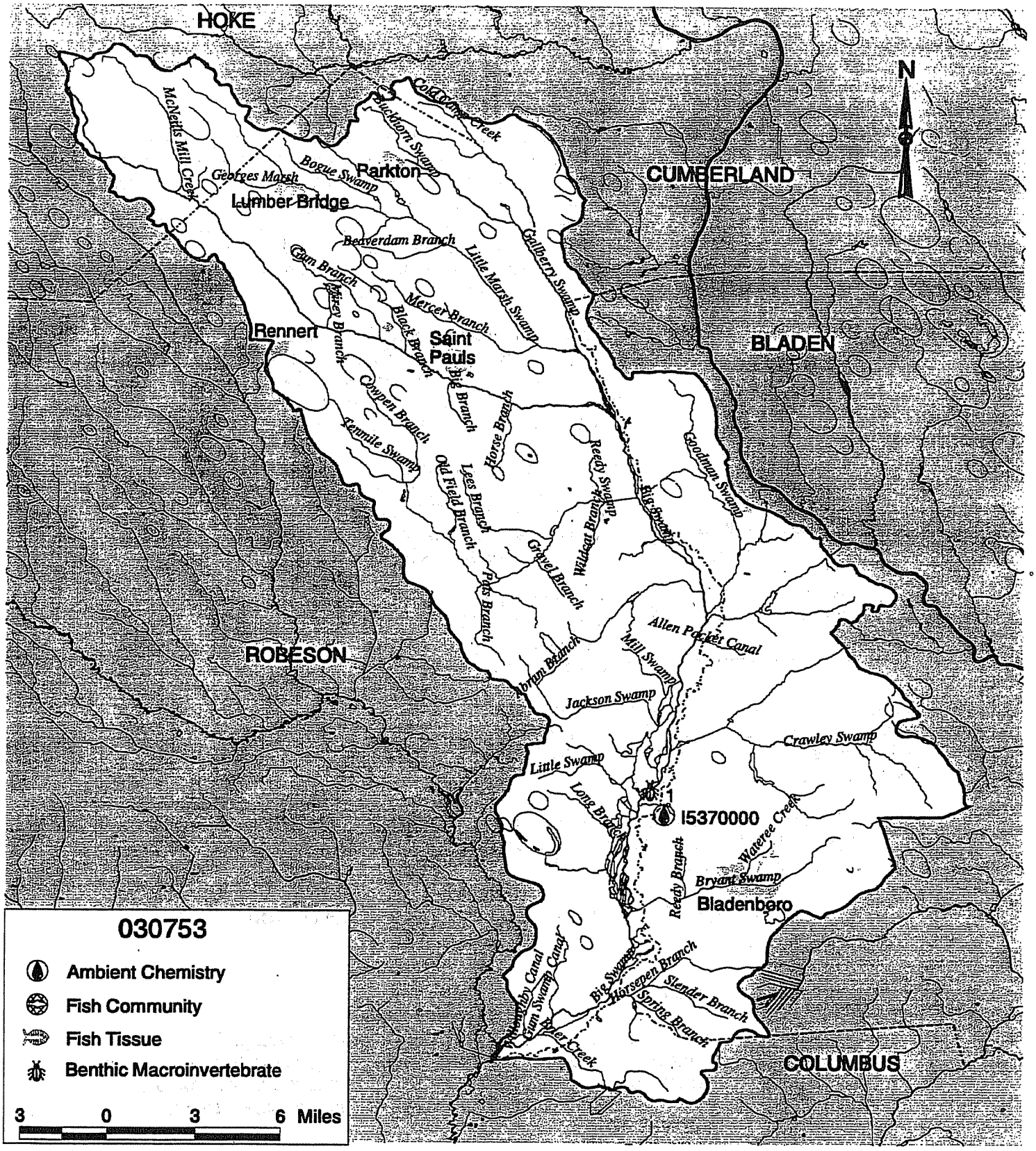

Figure B-4 Sampling Locations within Subbasin 03-07-53

In addition, management strategies to maintain adequate levels of oxygen in stream were recommended. These strategies were aimed at new or expanding dischargers into the Lumber River mainstem and its tributaries.

4.2.2 What was Achieved?

Buck Branch, Crawley Swamp, Bear Ford Swamp and Bryant Swamp, listed as impaired in the 1994 basin plan, were listed based on evaluated information rather than on monitoring data. Use support methodology has been improved and only monitoring data is now used for use support determination (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information).

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

4.3 Current Priority Issues and Concerns

Big Swamp is listed on the 303(d) list (see Appendix V) for a fish consumption advisory related to mercury contamination. DWQ is developing a management strategy related to mercury contamination (see Section A, Chapter 4, Part 4.8).

Croft Metals has had chronic problems meeting permit toxicity requirements. However, the facility has undergone a toxicity identification and toxicity reduction study to determine the source of the problems. As a result of this study, the facility modified production and eliminated potential sources of toxicity in early 1998. The facility in now compliant with permit limits and DWQ will continue to monitor the facility for permit compliance.

Chapter 5
Lumber River Subbasin 03-07-54
Includes Ashpole Swamp and tributaries

5.1 Water Quality Overview

Subbasin 03-07-54 at a Glance

Land and Water Area (sq. mi.)	
Total area:	223
Land area:	223
Water area:	0
Population	
1990 Est. Pop.:	15,710
Pop. Density:	70 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	46%
Agriculture:	52%
Urban:	<1%
Water:	1%
Use Support Ratings (stream mi.)	
Fully Supporting:	133.9 mi.
Fully Supporting but Threatened:	2.8 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

The coastal plain swamp-streams in this subbasin are very wide, with tannin-colored water and little visible current under summer low flow conditions. Fairmont is the largest town in this catchment and the only permitted discharger in the subbasin. Land use is a mixture of agriculture and forest, with small amounts of urban development near Fairmont. A map of this subbasin including water quality sampling locations is presented in Figure B-5.

There is one ambient monitoring station on Ashpole Swamp at SR 2258. Low dissolved oxygen concentrations are often recorded at this station, especially during summer low flow/high temperature periods. Water chemistry data from this site did not show any significant changes in water quality over the last 10 years. Likewise, biological data did not suggest any long-term changes (1991 vs. 1995) in water quality.

Benthos sites sampled in 1996 were selected to compare portions of the subbasin with both urban runoff and a wastewater discharge (Hog Swamp) to an area without these pollution sources (Ashpole Swamp) (Table B-3). Both portions of the catchment have extensive amounts of agricultural land. Since there was no difference in the benthic macroinvertebrate data from these two sites, it appears that nonpoint source runoff is the primary water quality problem in this subbasin.

Table B-3 1996 Sampling Locations in the Lumber River Subbasin 03-07-54

Map No.	Stream Name	Sample Type	Rating*
1	Ashpole Swamp	Benthic Macroinvertebrate	Good*
3	Hog Swamp	Benthic Macroinvertebrate	Good*
1	Ashpole Swamp	Fish Community	Not Rated*

* These sampling locations were given a biological rating based on Draft Swamp Stream criteria. Refer to Section A, Chapter 3, Part 3.4 and Chapter 4 for more information on how biological ratings are used in use support determinations.

The Fairmont WWTP discharges to Pittman Mill Branch (a tributary of Old Field Swamp) and this facility consistently fails self-monitoring toxicity tests. Although biological data shows no effects of this discharger further downstream in Hog Swamp, it is possible that localized impacts occur in Pittman Mill Branch and Old Field Swamp. Further information on this facility can be found in Part 5.3 below.

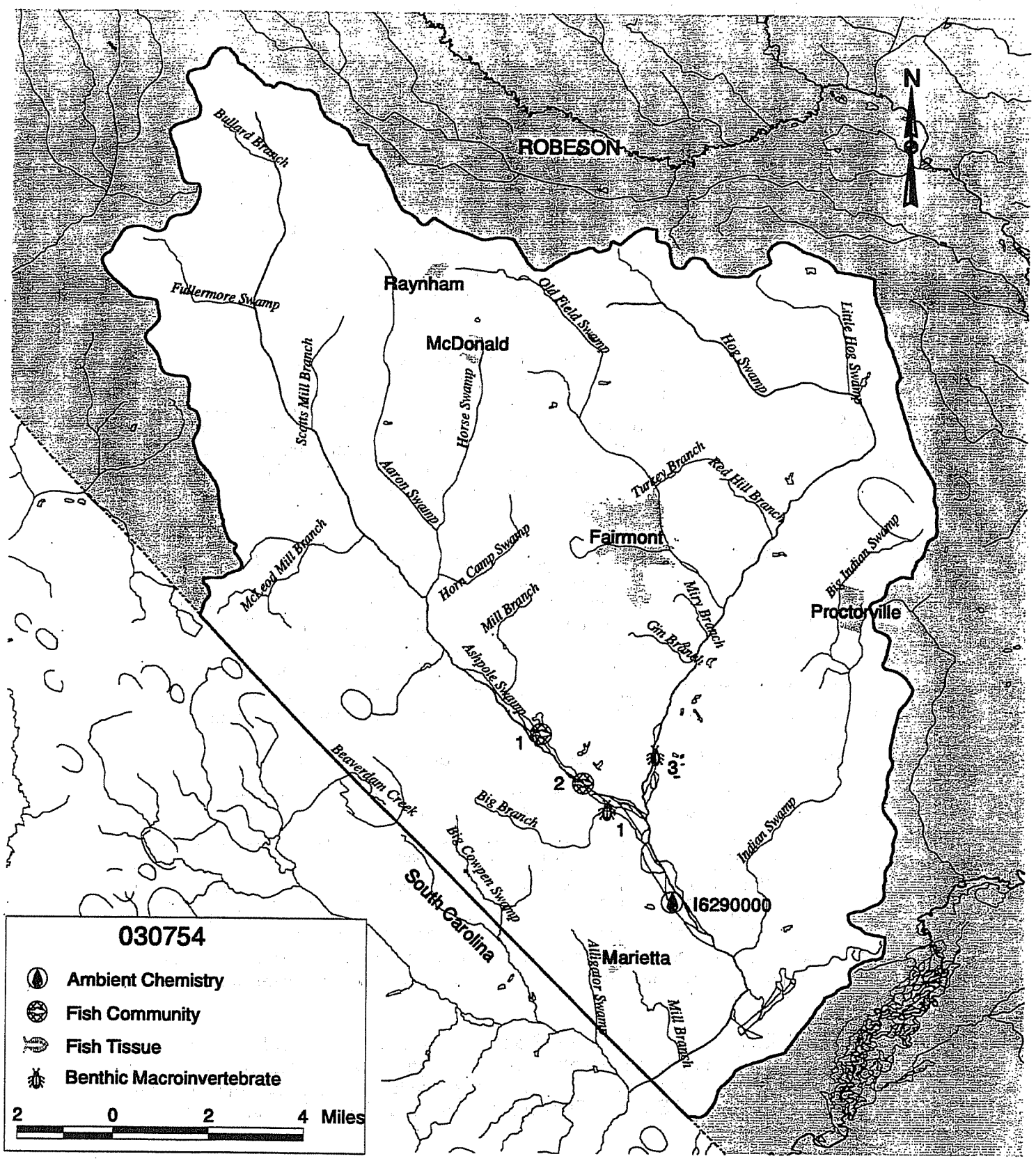

Figure B-5 Sampling Locations within Subbasin 03-07-54

For more detailed information on water quality in subbasin 03-07-54, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

5.2 Prior Basinwide Plan Recommendations (1994) and Achievements

5.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Ashpole Swamp, Hog Swamp and Old Field Swamp as impaired waters. The planned management strategy for these waters was to investigate sources of impairment and to continue existing nonpoint source control programs. In addition, DWQ recognized the need to more accurately determine natural versus impacted swamp conditions.

Low dissolved oxygen levels were noted on Ashpole Swamp and the sources causing the low levels were to be identified. Management strategies to maintain adequate levels of oxygen instream were recommended. These strategies were aimed at new or expanding dischargers into the Lumber River mainstem and its tributaries.

5.2.2 What was Achieved?

Old Field Swamp was previously listed based on evaluated information rather than on monitoring data. Use support methodology has been improved to no longer include evaluated information (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information).

Previous impairment ratings for Ashpole and Hog Swamps were changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). These waters will be resampled following the finalization of the draft biological criteria. Hog Swamp is on the 303(d) list (see Appendix V) and will remain on the list until finalized criteria can be applied to this swamp water.

Low dissolved oxygen levels on Ashpole Creek are likely due to natural swamp conditions specific to this water, especially during periods of low flow and high temperature.

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

5.3 Current Priority Issues and Concerns

Ashpole Swamp is listed on the 303(d) list (see Appendix V) for a fish consumption advisory related to mercury contamination. DWQ is developing a management strategy related to mercury contamination (see Section A, Chapter 4, Part 4.8).

The Fairmont WWTP is currently under a Special Order by Consent (SOC) which specifies chronic toxicity monitoring on a monthly basis. The town discharges to a zero flow stream which makes it difficult for the facility to meet permit limits. The town is relocating its discharge to the Lumber River mainstem by 2000. This new facility will be state-of-the-art and is expected to function as a regional facility that will accept effluent from other small dischargers in the area. This regionalization is encouraged by DWQ, especially (as in this case) where the smaller dischargers

have had periodic problems meeting permit limits. Until this plant is built, Fairmont is conducting toxicity work and an aggressive inflow and infiltration program. The town will remain under the SOC until the new plant comes on line. The Town of Fairmont has received a grant of $1,000,000 from the Clean Water Management Trust Fund and secured loans to finance the improved treatment system to assist with wastewater needs.

Chapter 6
Lumber River Subbasin 03-07-55
Includes Gum Swamp, Leith and Shoe Heel Creeks

6.1 Water Quality Overview

Subbasin 03-07-55 at a Glance

Land and Water Area (sq. mi.)	
Total area:	399
Land area:	397
Water area:	2
Population/Growth	
1990 Est. Pop.:	40.415
Pop. Density:	100 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	61%
Agriculture:	37%
Urban:	1%
Water:	1%
Use Support Ratings (stream mi.)	
Fully Supporting:	141.9 mi.
Fully Supporting but Threatened:	151.7 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

Most of this subbasin lies within the Sandhills ecoregion, characterized by sandy streams with year-round flow. The headwaters of Gum Swamp and Shoe Heel Creek are located in the Sand Hills Game Management Area. Because most of these streams do not stop flowing during summer months, they potentially support a higher diversity of both fish and invertebrates relative to other coastal plain areas in the Lumber River basin. A map of this subbasin including water quality sampling locations is presented in Figure B-6.

Major towns include Laurinburg, Rowland and parts of Maxton. Land use is a mixture of agriculture (especially forageland) and forest, with some urban areas near Laurinburg. Leith Creek receives the greatest amount of urban runoff, and this stream also appears to have the greatest potential for summer low flow problems.

Ambient monitoring data is collected at Leith Creek and Big Shoe Heel Creek. Leith Creek has extremely high nitrogen and phosphorus values. No significant water quality problems were observed at Big Shoe Heel Creek. Neither site showed long-term changes in water quality over the last 10 years.

Macroinvertebrate samples were obtained from four sites in this subbasin (Table B-4). Macroinvertebrate collections from these streams during 1996 did not suggest any changes in water quality since 1991. Big Shoe Heel Creek has been sampled five times since 1985 and has been given an Excellent rating since 1987. If DWQ were petitioned, the Excellent benthic macroinvertebrate rating given to Big Shoe Heel Creek might allow this water to be reclassified as a High Quality Water.

Table B-4 1996 Sampling Locations in the Lumber River Subbasin 03-07-55

Map No.	Stream Name	Sample Type	Rating*
1	Gum Swamp	Benthic Macroinvertebrate	Good-Fair
4	Gum Swamp	Benthic Macroinvertebrate	Good
7	Jordan Creek	Benthic Macroinvertebrate	Good-Fair
8	(Big) Shoe Heel Creek	Benthic Macroinvertebrate	Excellent
1	Little Shoe Heel Creek	Fish Community	Not Rated*

* This sampling location was given a biological rating based on Draft Swamp Stream criteria. Refer to Section A, Chapter 3, Part 3.4 and Chapter 4 for more information on how biological ratings are used in use support determinations.

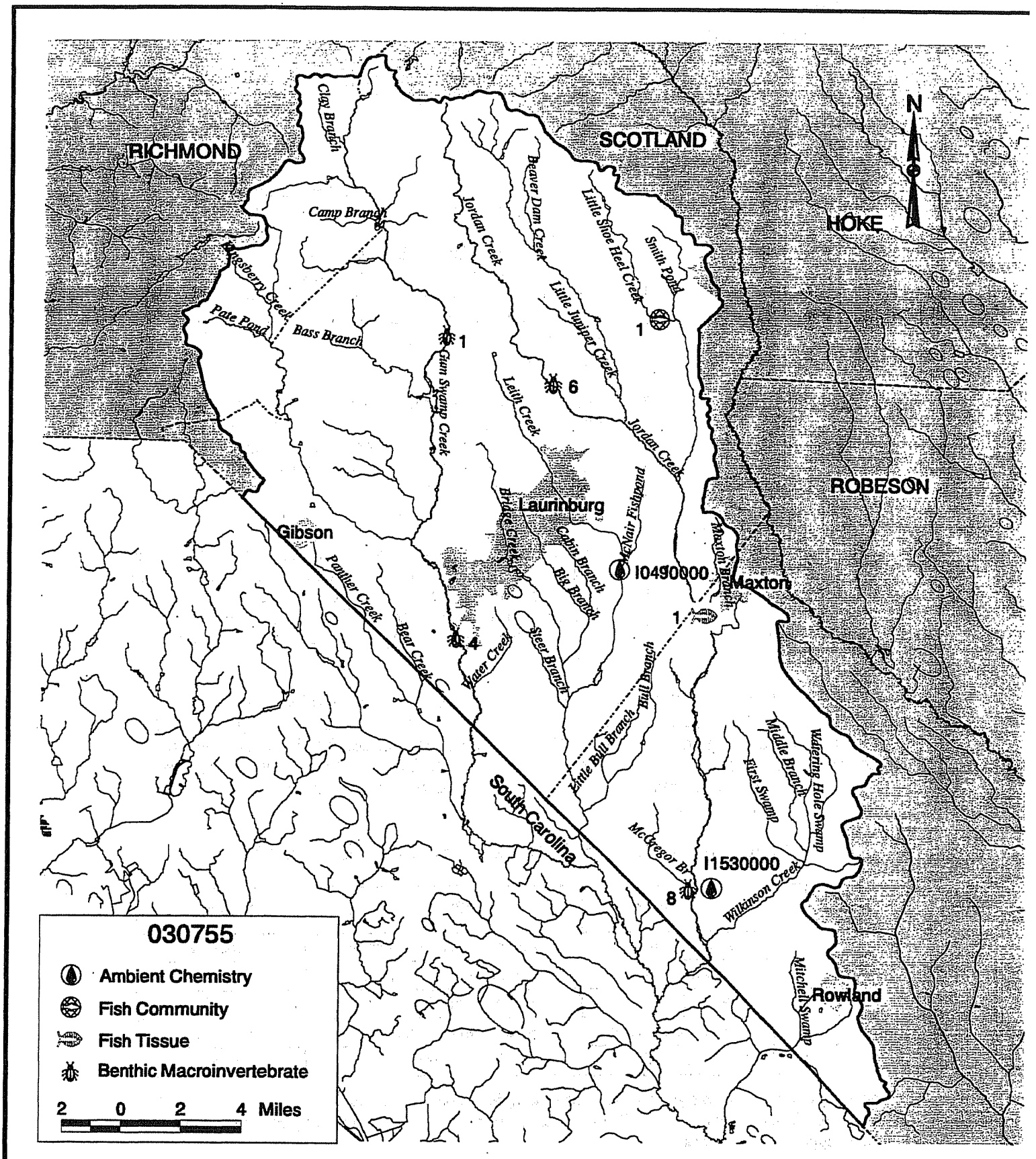

Figure B-6 Sampling Locations within Subbasin 03-07-55

Fish community structure was evaluated only at Little Shoe Heel Creek. This small channelized stream showed declining water quality from 1991 to 1996. Fish community sampling indicated overenrichment. Fish tissue samples from Maxton Pond showed mercury concentrations (3 of 18 samples) above the EPA screening limit, but none of these values exceeded FDA limits.

Of the 13 permitted dischargers in this subbasin, most have a permitted flow of <0.1 MGD. The larger dischargers are clustered on Shoe Heel Creek near Maxton: Laurinburg WWTP (4.0 MGD), Maxton WWTP (0.6 MGD), and Libby Owens Ford (0.2 MGD). None of the facilities required to conduct toxicity testing have had compliance problems.

For more detailed information on water quality in subbasin 03-07-55, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

6.2 Prior Basinwide Plan Recommendations (1994) and Achievements

6.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Little Shoe Heel Creek and Jordan Creek as impaired waters. The planned management strategy for these waters was to investigate sources of impairment and to continue existing nonpoint source control programs. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

In addition, management strategies to maintain adequate levels of oxygen in stream were recommended. These strategies were aimed at new or expanding dischargers into the Lumber River mainstem and its tributaries.

6.2.2 What was Achieved?

The previous biological rating for Little Shoe Heel Creek was changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). The current biological rating is also Not Rated. This water will be resampled following the finalization of the draft biological criteria.

Jordan Creek was previously listed based on evaluated information. Use support methodology has been improved and only monitoring data is now used in use support determinations (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). Recent benthos sampling (1996) on Jordan Creek (at US 401 in Scotland county) indicated the creek is fully supporting but threatened (ST).

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section B, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

Chapter 7
Lumber River Subbasin 03-07-56
Includes Lake Waccamaw, Big Creek and tributaries, upper Waccamaw River and Bogue Swamp

7.1 Water Quality Overview

Subbasin 03-07-56 at a Glance

Land and Water Area (sq. mi.)	
Total area:	185
Land area:	171
Water area:	14
Population/Growth	
1990 Est. Pop.:	5,511
Pop. Density:	30 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	79%
Agriculture:	13%
Urban:	1%
Water:	7%
Use Support Ratings (stream mi.)	
Fully Supporting:	132.5 mi.
Fully Supporting but Threatened:	.2 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

There is some residential development near Lake Waccamaw, but most of the land use in this subbasin is either forest or agriculture. Tributary streams tend to be intermittent, with little or no flow during summer months. This pattern is related to the poorly-drained soils of this region, with little storage of groundwater. After prolonged dry periods, most streams became dry ditches. A map of this subbasin including water quality sampling locations is presented in Figure B-7.

Lake Waccamaw is the largest natural lake in southeastern North Carolina and is widely considered to be one of the most unique lakes in the southeastern United States. The shallow, clear, high water quality of Lake Waccamaw provide a unique habitat for a diverse aquatic community, including a high diversity of endemic species of fish and mollusks. For this reason, Lake Waccamaw was recommended in 1995 for reclassification as an Outstanding Resource Water.

Water chemistry collected at the dam did not indicate any water quality problems and the lake has consistently been rated mesotrophic since 1981. Phytoplankton and chlorophyll *a* levels are very low in the lake, but were found to be very high in the two canals surrounding the northwestern and western shores of the lake (1991 and 1993).

Benthos collections in 1991 resulted in a Good-Fair bioclassification in the Waccamaw River just below the lake with an improvement in water quality to Good further downstream. Benthic macroinvertebrate and fish samples could not be collected in this area of the Waccamaw River during 1996 due to consistently high water levels in the river. There is insufficient information to evaluate any long-term changes in water quality in this subbasin. Two major tributaries to Lake Waccamaw were sampled in 1996 using the draft swamp criteria (Table B-5).

Table B-5 1996 Sampling Locations in the Lumber River Subbasin 03-07-56

Map No.	Stream Name	Sample Type	Rating*
3	Friar Swamp	Benthic Macroinvertebrate	Good*
4	Slap Swamp	Benthic Macroinvertebrate	Fair*
1	Friar Swamp	Fish Community	Not Rated*

* These sampling locations were given a biological rating based on Draft Swamp Stream criteria. Refer to Section A, Chapter 3, Part 3.4 and Chapter 4 for more information on how biological ratings are used in use support determinations.

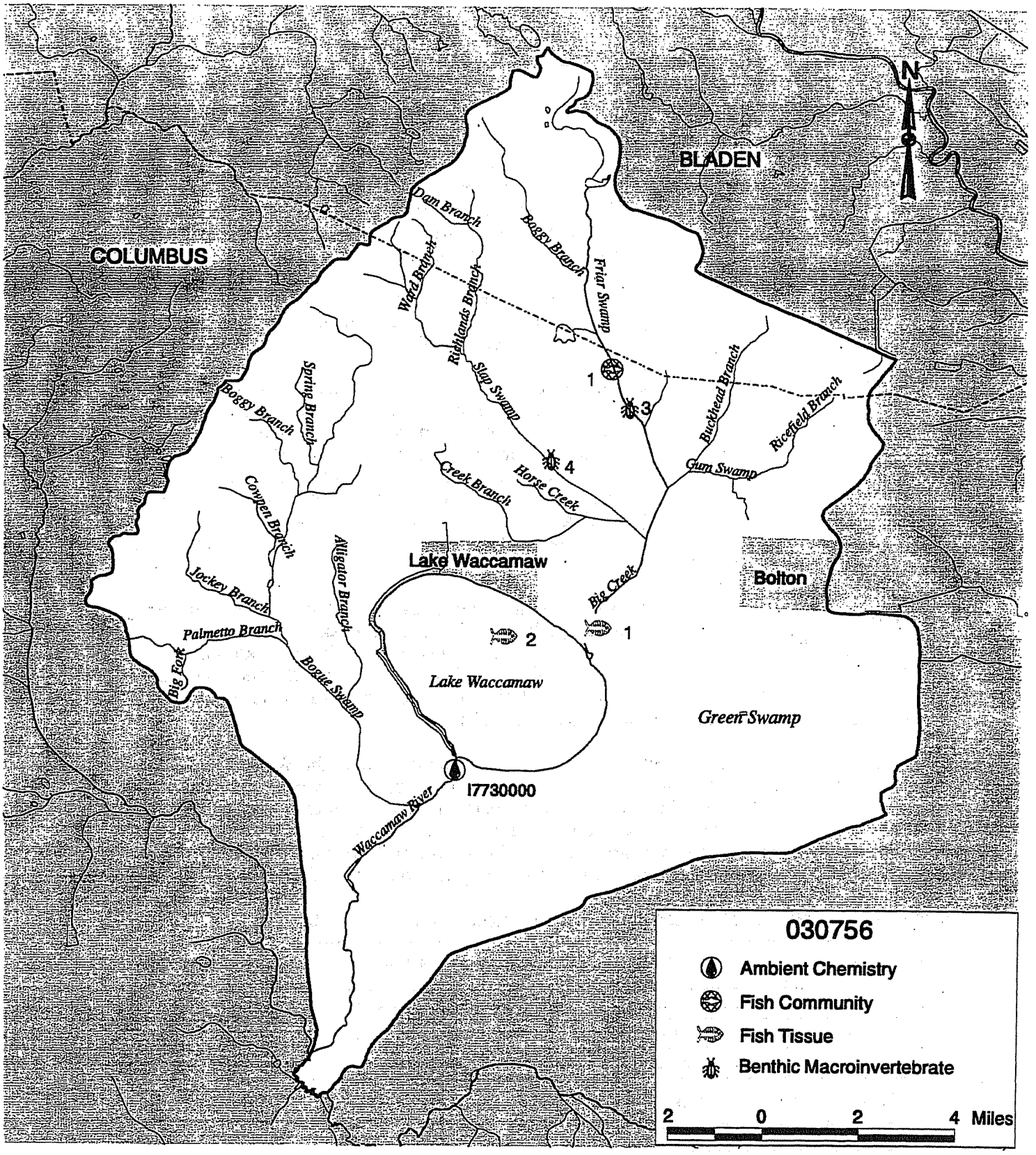

Figure B-7 Sampling Locations within Subbasin 03-07-56

DWQ fish tissue surveys show elevated mercury concentrations in largemouth bass and bowfin throughout the Waccamaw Drainage from Meares Millpond to the South Carolina border. Fish tissue analyses found mercury levels in fish from both Big Creek and Lake Waccamaw above EPA and FDA limits. Mean mercury concentration in largemouth bass from Lake Waccamaw, however, remained below the North Carolina advisory level.

The Town of Lake Waccamaw is the only facility that is required to conduct toxicity testing of effluent. The town conducted inflow and infiltration work on the system, which has improved permit compliance and reduced lift station overflows. This facility has a record of compliance.

For more detailed information on water quality in subbasin 03-07-56, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

Lake Waccamaw Assessment

Lake Waccamaw, located in Columbus County, is one of the state's few natural lakes and is also a state park. Lake Waccamaw is widely used for recreational activities. The physical characteristics of Lake Waccamaw are typical of Carolina Bay lakes. It is a shallow waterbody with a maximum depth of 3.3 meters. The lake has two canals that lie adjacent to the northwestern and western shores of the lake. The exact origins of the canals are unknown, though it is thought they may have been dredged to provide fill material for the road that runs along the shore of the lake. Lake Waccamaw has several unique chemical characteristics that set it apart from other Carolina Bay lakes. In addition to having near neutral pH, it is one of only two bay lakes in the state (Phelps Lake is the other) known to support endemic fish and mollusks.

County:	Columbus	**Classification:**	B Sw
Surface Area:	8950 Acres (3622 Hectares)	**Mean Depth:**	5 Feet (1.5 Meter)
Volume:	54.3 $X10^6 m^3$	**Watershed:**	97 Mi^2 (251 Km^2)

There were no reported public complaints of water quality problems at Lake Waccamaw in 1997 or 1996. The Columbus County Health Department, however, has established a seasonal bacteria monitoring program at the lake which is conducted in the spring and summer when lake use by swimmers is highest. Use of the lake for recreation continues to grow. (Mr. Harry Edwards, State Park Ranger, Lake Waccamaw State Park, May 8, 1997, pers. com.).

Lake Waccamaw was most recently monitored at three locations by DWQ in June, July and August 1996 (Figure B-8) for a range of water quality parameters. Lake Waccamaw's trophic status ranged from mesotrophic to oligotrophic during the three months it was sampled in 1996.

Lake Waccamaw was previously sampled by DWQ in 1981, 1982, 1983, 1986, 1987, 1990 and 1991. Parameter values have been consistent from year to year. The NCTSI scores generally indicate that the lake was consistently evaluated as mesotrophic.

In 1991, a study was begun by the Division of Water Resources to evaluate impacts of canal improvements on water quality in the canals. These improvements included removal of snags and accumulated sediment and trash, connecting the two canals to provide for a water exchange and blocking the existing culverts to the lake to force drainage out the lower canal segment (NCDEHNR, June 24, 1991). Results of this study determined that these modifications had not alleviated nutrient loading problems found in the canals. Although nutrient concentrations were lower in 1993 as compared with 1991, this was attributed to reduced rainfall and runoff in 1993,

along with sewage spills from a broken sewer line and overflows from the lift station at the head of the canal in 1991 (NCDEHNR, January 3, 1994).

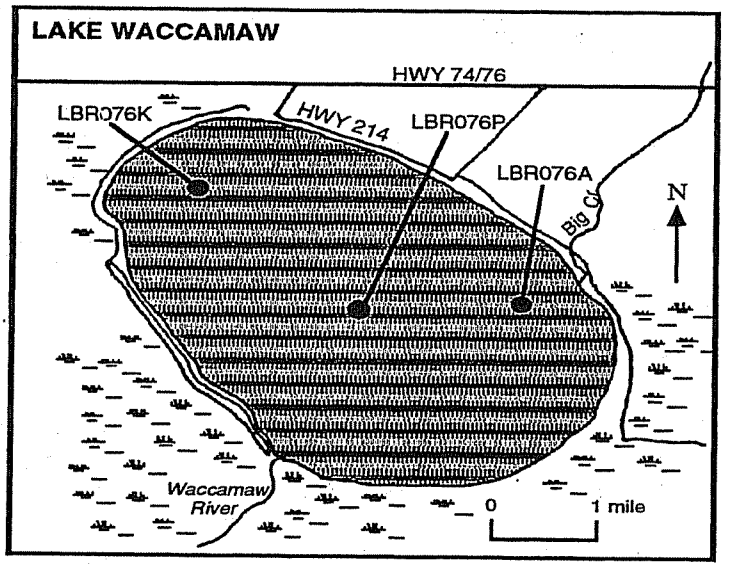

Figure B-8 Lake Waccamaw 1996 Lake Sampling Locations

Lake, canal and drainage ditch sampling conducted in 1995 by the Department of Biological Sciences, University of North Carolina at Wilmington discovered high fecal bacterial counts and elevated phosphorous and nitrogen levels near the northern lakeshore associated with stormwater runoff following rainfall events (Cahoon, June 5, 1996). Pathogenic amoebas were also identified from nearshore sediment samples collected following the rainfall event, suggesting that fecal contamination was entering the lake via drainage ditches along the north shore and the canal near Canal Cove Road. The study, sponsored by the NC Division of Water Resources, was not able to distinguish among possible animal and human sources or determine where contamination entered the ditches. Possible fecal contamination sources were cited as leaks in the Town's sewage system, livestock, domestic animals or wild animals. The study further recommended that as much of the ditch water as possible be routed away from the lake to swamps on either side of the lake through alternate drainage systems. Lake Waccamaw has received a $30,514 grant from the Clean Water Management Trust Fund for a stormwater project to divert some of this flow from the lake.

Lake Waccamaw was recommended for reclassification as an Outstanding Resource Water (ORW) in 1995 (NCDEHNR, March 15, 1995). This reclassification is pending (see Section A, Chapter 3, Part 3.2). Based on evaluation of existing data, Lake Waccamaw was found to have excellent water quality. The lake also supports endemic fish and mollusk species (the Waccamaw silverside is listed as Threatened on the Federal Endangered Species List). Lake Waccamaw, which provides exceptional water based recreation, is on the Registry of Natural Heritage Areas and is owned by the State of North Carolina and administered by the Division of Parks and Recreation. In October 1994, a fish consumption advisory for bass and bowfin (blackfish) was issued for the Lumber River Basin, including Lake Waccamaw.

Waccamaw River Gamefish Assessment

The Division of Water Resources sponsored a project to assess trends in gamefish abundance in the Waccamaw River watershed (Moser and Rohde, 1998). The project involved a gear comparison study (rotenone, backpack electroshocking and seining) at 10 sites in the drainage. This information was then used to compare fish community structure, species richness and

abundance at 23 sites sampled in 1995-97 to the same parameters calculated from 1961 North Carolina Wildlife Resources Commission (NCWRC) rotenone collections at the identical locations.

The results indicated that both fish diversity, abundance and size were significantly lower in recent collections and that DO and current velocity were also significantly lower. The mean pH level was higher than in the previous collection period. These changes in fish abundance and diversity may be attributable to the changes in water quality in the river. As further evidence of effects of water quality on the fisheries in the river, the NC Wildlife Resources Commission found that ten of 33 game fish captured during a study in the Waccamaw River in August 1997 had external parasites and two had sores.

7.2 Prior Basinwide Plan Recommendations (1994) and Achievements

7.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Buckhead Branch, Big Creek and the Waccamaw River as impaired waters. The planned management strategy for these waters was to investigate sources of impairment, to continue existing nonpoint source control programs, and to conduct fish tissue monitoring and investigate sources of mercury in the Waccamaw River. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

In addition, management strategies to maintain adequate levels of oxygen in stream were recommended. These strategies were aimed at new dischargers into the Waccamaw River watershed.

7.2.2 What was Achieved?

Buckhead Branch was previously listed as impaired based on evaluated information. Use support methodology has been improved and only monitoring data is now used for use support determinations (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information).

Revised use support methodology no longer considers waters to be impaired if they have mercury-related fish consumption advisories (see Appendix IV). Therefore, both Big Creek and the Waccamaw River have been removed from the impaired waters list. However, these waters remain on the 303(d) list as required by the Clean Water Act and DWQ is developing a TMDL (Total Maximum Daily Load) strategy that will be applicable to these waters (see Section A, Chapter 4, Part 4.8).

Management strategies for expanding and proposed dischargers were implemented. New discharge facilities received limits of 5 mg/l BOD_5 and 2 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section B, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

7.3 Current Priority Issues and Concerns

Lake Waccamaw and the Waccamaw River are significant resources within this watershed. Using DWQ's methodology of rating waterbodies, these waters are not considered to be impaired. However, this does not mean that these waters are without problems. Residential and development concerns in the Lake Waccamaw watershed are of primary concern.

Careful planning for the growth in this watershed is needed. Additional resources for developing a watershed management plan will need to be secured. This plan should include those waters draining to Lake Waccamaw. The plan should assist the Town of Lake Waccamaw and its residents in decreasing the incidence of elevated fecal coliform bacteria levels and other pollutants in canals draining to the lake. Stormwater management planning, identification of land uses causing impacts, and an education program should be significant components of this watershed plan.

Significant funding is needed to continue to carry out projects that divert stormwater carried to the heavily used recreational area of the northern shore of the lake via ditches and canals. This channelized water has been shown to carry elevated counts of fecal coliform bacteria, sediment and nutrient loads (Cahoon, 1996). Diverting stormwater from these canals will require cooperation from a large number of landowners and could take a number of years to accomplish. Diverting canal water to a more natural flow pattern through swamp waters and wetlands is anticipated to reduce nutrients, sediment and fecal coliform loadings to Lake Waccamaw's northern shore and reduce the potential for human pathogens in this area of the lake. The Town of Lake Waccamaw has begun to contact landowners to present options and seek their participation in a diversion project, while researchers from UNC-Wilmington and the Cape Fear RC&D are searching for sources of funding to complete the project.

Chapter 8
Lumber River Subbasin 03-07-57
Includes lower Waccamaw River in NC

8.1 Water Quality Overview

Subbasin 03-07-57 at a Glance

Land and Water Area (sq. mi.)	
Total area:	535
Land area:	534
Water area:	1
Population	
1990 Est. Pop.:	20,080
Pop. Density:	37 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	74%
Agriculture:	25%
Urban:	<1%
Water:	1%
Use Support Ratings (stream mi.)	
Fully Supporting:	0 mi.
Fully Supporting but Threatened:	350.6 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

Most of the land use in this subbasin is either forest or agriculture. All tributary streams tend to be intermittent, with little or no flow during dry summer months. For this reason, most of the DWQ sampling in this subbasin focused on the Waccamaw River. Many of the Carolina Bays in this subbasin were drained for agricultural land use, especially along Grissett Swamp and Monie Swamp. There are many small communities; however, only Tabor City (discharges to Grissett Swamp) has a permitted discharge (1.1 MGD). A map of this subbasin including water quality sampling locations is presented in Figure B-9.

Water chemistry data is collected from Seven Creeks and from two sites on the Waccamaw River. The principle water quality problem is low dissolved oxygen concentrations, especially during summer low flows.

Because of predicted summer low flow for this subbasin, all macroinvertebrate sampling of tributaries was planned for winter. This area, however, had very high flows during our planned sampling period in March 1996, and samples were collected only from Monie Swamp (Table B-6). Caw Caw Swamp, a channelized stream, was the only tributary stream found to have flowing water during the July 1996 survey. Sampling of Grissett Swamp and Monie Swamp was attempted in July 1996 but water levels were too low.

Table B-6 1996 Sampling Locations in the Lumber River Subbasin 03-07-57

Map No.	Stream Name	Sample Type	Rating*
2	Waccamaw River	Benthic Macroinvertebrate	Good-Fair
6	Monie Swamp	Benthic Macroinvertebrate	Good-Fair*
8	Caw Caw Swamp	Benthic Macroinvertebrate	Not Rated*

* These sampling locations were given a biological rating based on Draft Swamp Stream criteria. Refer to Section A, Chapter 3, Part 3.4 and Chapter 4 for more information on how biological ratings are used in use support determinations.

Since both high flows and low flows interfered with the 1996 biological collections from this subbasin, greater reliance must be placed on the data collected during the 1991 and 1992 basinwide surveys. Benthos data from 1991 indicated Excellent water quality in the Waccamaw River from Lake Waccamaw to Juniper Swamp, with a decline at Freeland and Pireway.

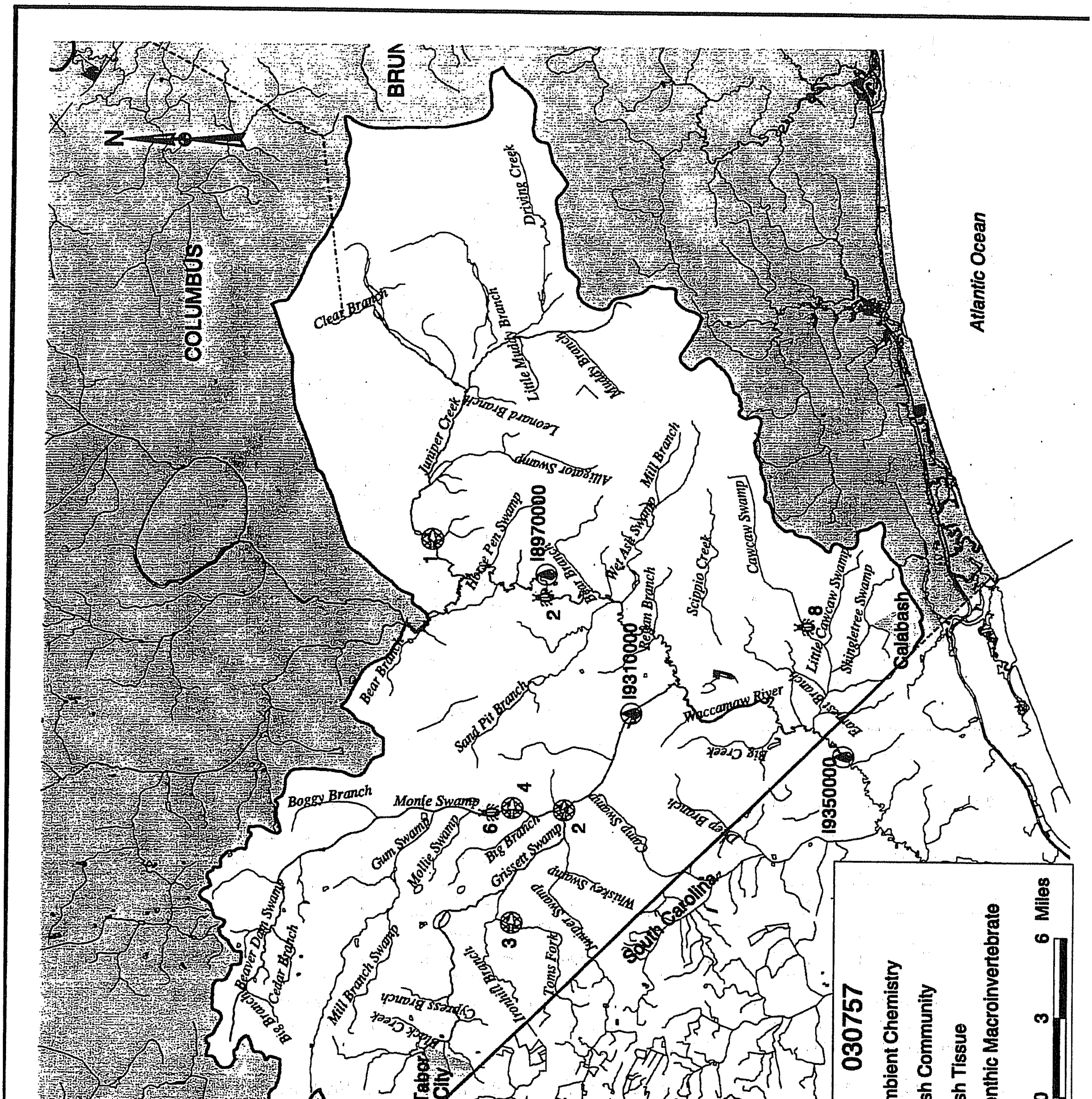

Figure B-9 Sampling Locations within Subbasin 57

Lake Tabor has consistently received a eutrophic rating since 1981. The Lake Tabor dam, however, was breached by Hurricane Fran, and was not repaired as of May 1997.

Only one discharger monitors toxicity: Tabor City, discharging to Town Canal (a tributary of Grisset Swamp). This facility frequently fails self-monitoring tests, suggesting some problems in Town Canal. Further information on this facility can be found in Part 8.3 below.

The NC Division of Water Resources sponsored a project to assess trends in gamefish abundance in the Waccamaw River watershed (Moser and Rohde, 1998). The project involved a gear comparison study (rotenone, backpack electroshocking and seining) at 10 sites in the drainage. This information was then used to compare fish community structure, species richness and abundance at 23 sites sampled in 1995-97 to the same parameters calculated from 1961 North Carolina Wildlife Resources Commission (NCWRC) collections at the identical locations (see Section B, Chapter 7 for more information).

For more detailed information on water quality in subbasin 03-07-57, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

8.2 Prior Basinwide Plan Recommendations (1994) and Achievements

8.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified several stream segments as impaired. These include: the Waccamaw River, Muddy Branch, Bear Branch, Gore Creek (Gore Lake), Gore Branch, Toms Fork, Monie Swamp and Caw Caw Swamp. The planned management strategy for these waters was to investigate sources of impairment, to continue existing nonpoint source control programs, and to conduct fish tissue monitoring and investigate sources of mercury in the Waccamaw River. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

In addition, management strategies to maintain adequate levels of oxygen in stream were recommended. These strategies were aimed at new dischargers into the Waccamaw River watershed.

8.2.2 What was Achieved?

The previous biological ratings for Monie Swamp, Toms Fork and Caw Caw Swamp were changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). These waters will be resampled following the finalization of the draft biological criteria.

Muddy Branch, Bear Branch, Gore Creek (Gore Lake) and Gore Branch were previously listed based on evaluated information. Use support methodology has been improved and only monitoring data is now used for use support determinations (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information).

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

8.3 Current Priority Issues and Concerns

The Waccamaw River is a significant resource within this watershed. While the river is not considered to be impaired, it does have a fish consumption advisory due to mercury accumulation in fish tissue. For this reason, the river remains on the 303(d) list (see Appendix V) as required by the Clean Water Act). DWQ is developing a management strategy related to mercury contamination (see Section A, Chapter 4, Part 4.8).

Tabor City has had chronic problems meeting their permit limits for toxicity. DWQ has worked with this facility to determine the source of toxicity problems. The source(s) has been difficult to isolate and the facility continues to have noncompliance problems associated with toxicity. DWQ has recently recommended enforcement actions to be taken against the facility and these actions are still pending. Tabor City has made some mechanical changes to this facility as an attempt to correct problems. Tabor City was granted $570,000 from the Clean Water Management Trust Fund to improve the wastewater treatment facility and the planned tertiary treatment should help improve overall compliance with permit limits.

Chapter 9
Lumber River Subbasin 03-07-58
Includes White Marsh and tributaries

9.1 Water Quality Overview

Subbasin 03-07-58 at a Glance

Land and Water Area (sq. mi.)	
Total area:	324
Land area:	323
Water area:	1
Population	
1990 Est. Pop.:	22,995
Pop. Density:	71 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	62%
Agriculture:	37%
Urban:	1%
Water:	1%
Use Support Ratings (stream mi.)	
Fully Supporting:	179.8 mi.
Fully Supporting but Threatened:	8.2 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.

The primary land use in this area is forest and agriculture, but this subbasin also contains the towns of Whiteville and Chadbourn. Most streams are humic-colored, with little or no flow during summer months. The lower portion of White Marsh Swamp is braided, with a very wide floodplain area. A map of this subbasin including water quality sampling locations is presented in Figure B-10.

Because this subbasin contains only slow-moving swamp streams, it had never been sampled for macroinvertebrates during normal summer collections. Benthic macroinvertebrate samples were collected from Brown Marsh Swamp and Elkton Swamp during March 1996, a period when these streams normally have flowing water Table B-7. In comparison with other swamp streams sampled in March 1996, Brown Marsh Swamp had the worst water quality. Fish sampling also indicated water quality problems in Brown Marsh Swamp.

A special study of White Marsh Swamp near Whiteville indicated low dissolved oxygen above and below the Whiteville WWTP. Downstream samples suggested the Whiteville effluent was having some effect on the aquatic fauna of this swamp stream.

Three facilities monitor effluent toxicity in this subbasin: the Chadbourn, Clarkton and Whiteville wastewater treatment plants. Both Chadbourn (discharging to Soules Swamp) and Clarkton (discharging to UT Brown Marsh) have had a record of frequently failing self-monitoring tests. Chadbourn is operating under a Special Order of Consent while making improvements in its treatment process. Further information on these facilities can be found in Part 9.3 below.

Table B-7 1996 Sampling Locations in the Lumber River Subbasin 03-07-58

Map No.	Stream Name	Sample Type	Rating*
3	Brown Marsh Swamp	Benthic Macroinvertebrate	Fair*
4	Elkton Swamp	Benthic Macroinvertebrate	Good-Fair*
1	Brown Marsh Swamp	Fish Community	Not Rated*

* These sampling locations were given a biological rating based on Draft Swamp Stream criteria. Refer to Section A, Chapter 3, Part 3.4 and Chapter 4 for more information on how biological ratings are used in use support determinations.

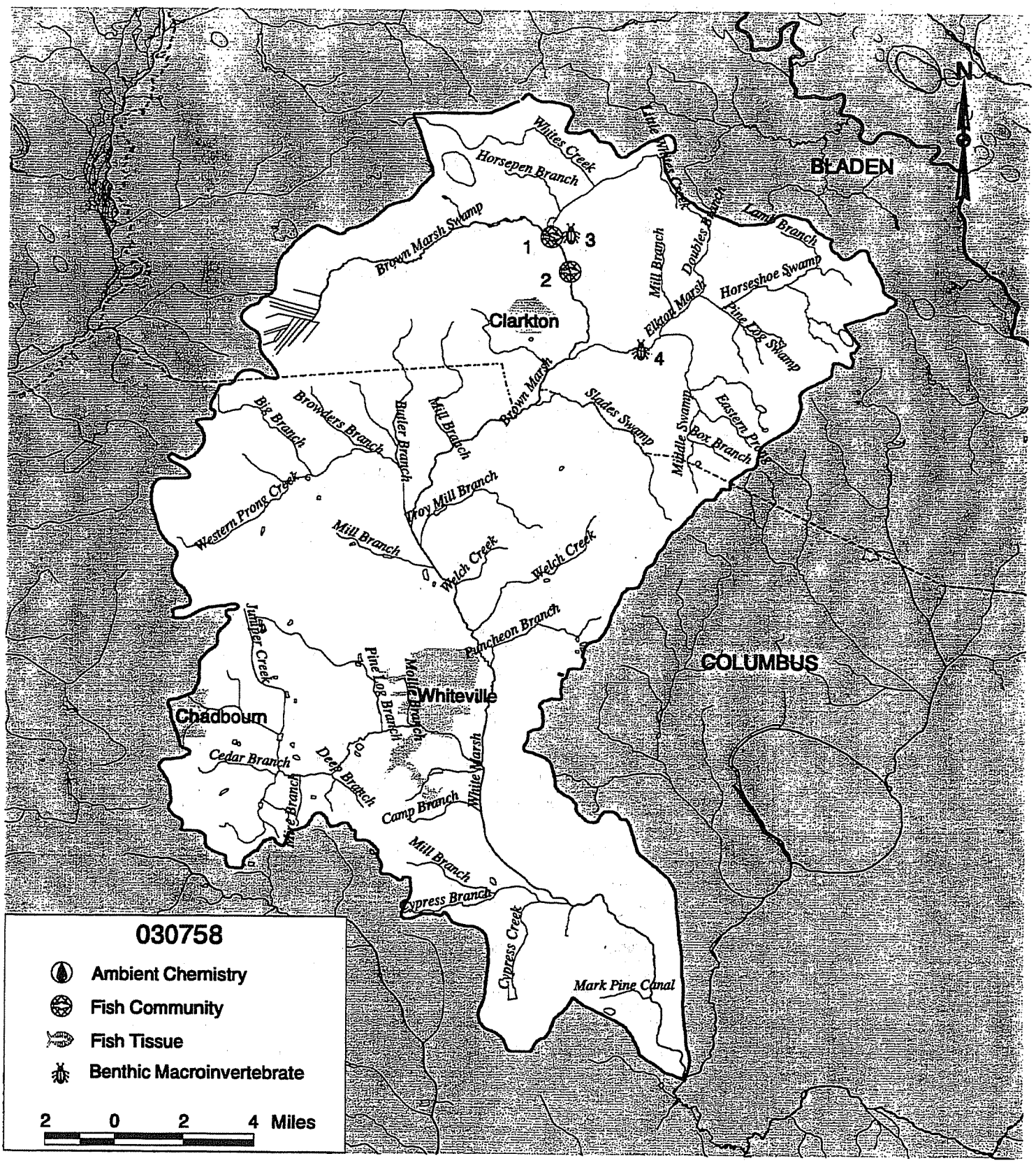

Figure B-10 Sampling Locations within Subbasin 03-07-58

For more detailed information on water quality in subbasin 03-07-58, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

9.2 Prior Basinwide Plan Recommendations (1994) and Achievements

9.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified Brown Marsh, Soules Swamp and Pine Log Swamp as impaired. The management strategy for these waters was to investigate sources of impairment including urban runoff and to continue nonpoint source control programs. DWQ also recognized the need to more accurately determine natural versus impacted swamp conditions.

In addition, management strategies to maintain adequate levels of oxygen were recommended for new dischargers into the Waccamaw River watershed.

9.2.2 What was Achieved?

The previous impairment ratings for Brown Marsh and Soules Swamp were changed to Not Rated (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information). These waters will be resampled following the finalization of the draft biological criteria.

Pine Log Swamp was rated impaired based on evaluated information. Use support methodology has been improved and only monitoring data are now used in use support determinations (see Section A, Chapter 3, Part 3.4 and Chapter 4 for more information).

Management strategies for expanding and proposed dischargers were implemented. Expanding facilities received wasteload allocations at previously existing levels and new facilities received limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

A swamp study was initiated and completed to better evaluate a swamp system's ability to assimilate wasteflow (see Section A, Chapter 4, Part 4.2). Issues relating to progress towards nonpoint source pollution reduction are discussed in Section A, Chapter 4, Part 4.9.

9.3 Current Priority Issues and Concerns

While White Marsh is not considered to be impaired, it does have a fish consumption advisory due to mercury accumulation in fish tissue. For this reason, the river remains on the 303(d) list (see Appendix V) as required by the Clean Water Act. DWQ is developing a management strategy related to mercury contamination (see Section A, Chapter 4, Part 4.8).

The Town of Clarkton has had problems meeting permit limits for toxicity. The town made many improvements to the facility in 1997 that improved the quality of the effluent. Among other things, the town has conducted inflow and infiltration work, rebuilt lift stations, and removed a peanut processor influent believed to contribute to toxicity failures. The town now meets permit limits.

The Town of Chadbourn continues to have problems meeting permit limits and remains under an SOC until December 1999, when a larger facility is expected to be completed. The town is working on reducing inflow and infiltration, which is the primary problem for meeting permit limits. The town is required to submit quarterly reports to DWQ on the progress of inflow and infiltration work. Although the facility had three failures in 1997, there was only one failure in 1998. DWQ will continue to work with this facility to bring it into compliance with permit limits.

Chapter 10
Lumber River Subbasin 03-07-59
Includes Lockwoods Folly and Shallotte Rivers

10.1 Water Quality Overview

Subbasin 03-07-59 at a Glance

Land and Water Area (sq. mi.)	
Total area:	300
Land area:	292
Water area:	8
Estuarine Acres	
Calabash	1800
Shallotte River	1350
Lockwoods Folly River	1650
Total	4800
Population	
1990 Est. Pop.:	22,350
Pop. Density:	74 pers/sq mi
1996 Land Cover (%)	
Forest/Wetland:	75%
Agriculture:	18%
Urban:	4%
Water:	3%
Use Support Ratings (stream mi.)	
Fully Supporting:	9.7 mi.
Fully Supporting but Threatened:	99.1 mi.
Partially Supporting:	0 mi.
Not Supporting:	0 mi.
Estuarine Use Support (acres)	
Fully Supporting:	927
Fully Supporting but Threatened:	1251
Partially Supporting:	2622
Not Supporting:	0

This area is located entirely within the outer coastal plain and contains many swamp streams. A map of this subbasin including water quality sampling locations is presented in Figure B-11.

Most tributary streams are humic-colored, with little flow during summer months. Because of summer low flow conditions, these streams are difficult to compare with streams that have flow throughout the year. The primary land use is forest and agriculture, but recreational development is increasing. The recent growth of tourism and residents has fueled the increase in golf course construction. In 1994, there were 18 golf courses in Brunswick County. Currently, there are 30 eighteen hole golf courses, with 3 under construction. In general, there are one to three additional golf courses opening per year in the County (Martin, 1998). Runoff from golf courses can carry nutrients and toxic chemicals to surface waters.

Downstream portions of both Lockwoods Folly River and the Shallotte River have been assigned an SA classification and are, therefore, (by definition) High Quality Waters (see Section A, Chapter 3, Part 3.2). High fecal coliform levels recorded in 1989 precluded the Lockwoods Folly River from being reclassified to ORW, although the Environmental Management Commission approved a special management strategy for this area in 1996 (refer to Administrative Code Section 15A NCAC 2B .0227). This strategy provided more protection to the Lockwoods Folly River than the SA classification, but has not resulted in reduced closed shellfish acreages.

Most waters in this subbasin have elevated fecal coliform counts and periodically low dissolved oxygen. The highest coliform counts were found in areas with the greatest development: Calabash Creek near Calabash and Shallotte River in Supply. Relative to the last basinwide monitoring cycle (1988-1992), coliform counts are increasing at this site. Calabash Creek also has the highest turbidity and summer phosphorus values in this subbasin. Other areas with median coliform levels above state standards were Lockwoods folly river, Montgomery Slough, and the ICWW near Long Beach and Sunset Beach. All stations in this subbasin (except three on the ICWW) recorded periodic low dissolved oxygen levels.

Benthic macroinvertebrates were collected from ten locations in this subbasin during 1996. Fish samples were collected from Lockwoods Folly River and Cool Run. Benthos collections for freshwater portions of Lockwoods Folly River, Shallotte River and Royal Oak Swamp indicate

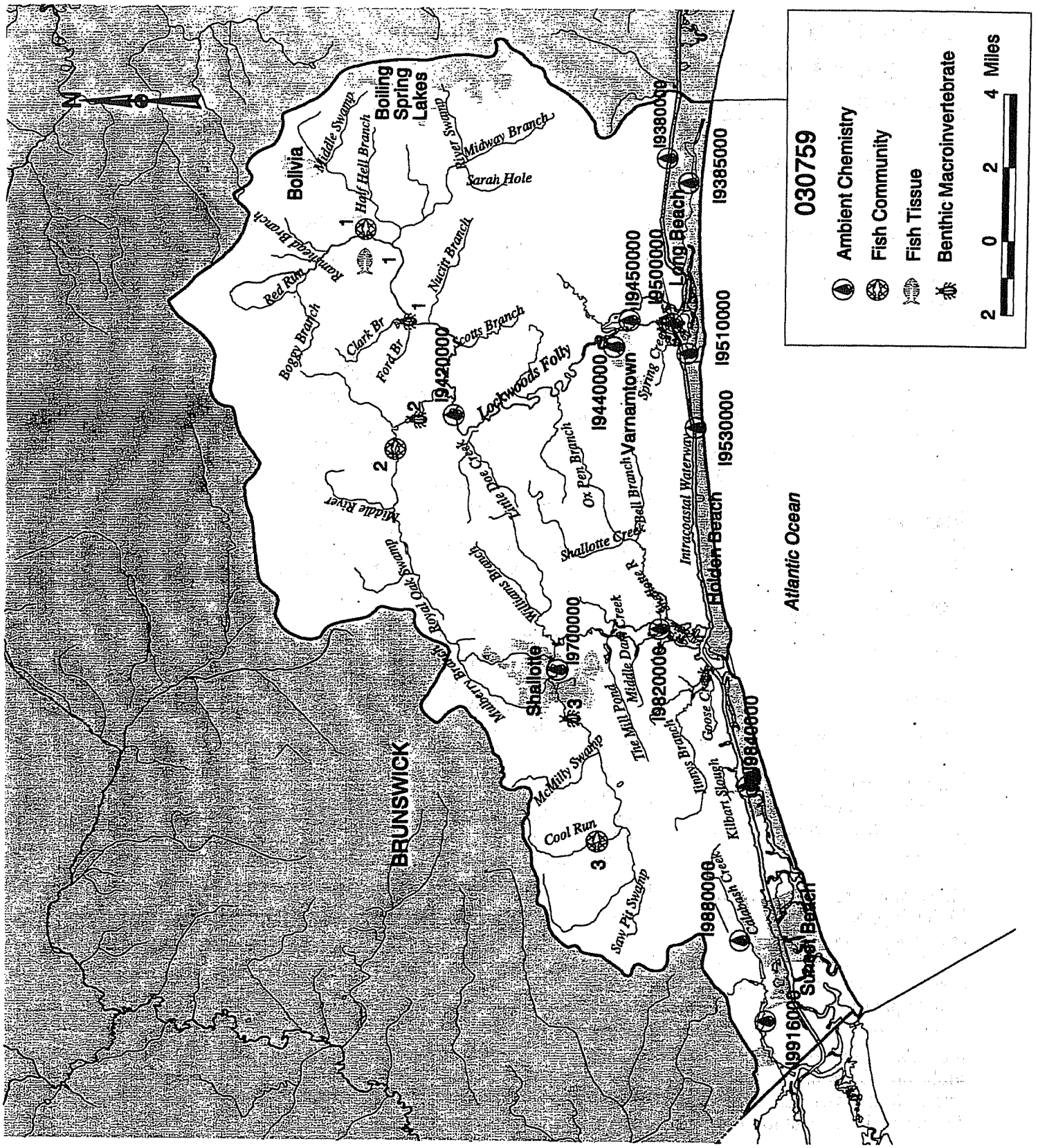

Figure B-11 Sampling Locations within Subbasin 03-07-59

these waters are fully supporting but threatened (ST) based on benthos. Estuarine samples from the Intracoastal Waterway (ICWW) were given a Moderate rating (see Section A, Chapter 4, Part 4.5).

For more detailed information on water quality in subbasin 03-07-59, refer to the *Basinwide Assessment Report - Lumber River Basin - March 1998* (149 pages), available from the DWQ Environmental Sciences Branch at (919) 733-9960.

10.2 Prior Basinwide Plan Recommendations (1994) and Achievements

10.2.1 What was Recommended?

The 1994 Lumber River Basinwide Plan identified the Shallotte River and many saltwaters of Brunswick County as impaired. The planned management strategy for these waters was to investigate sources of impairment and to manage under the Coastal Zone Management Act Amendments and the High Quality Waters regulations. Specifically, the 1994 plan called for increased interagency coordination to improve understanding of the extent and nature of shellfish water closures, to identify existing weaknesses in shellfish water protection, and to outline a strategy of what would be required to protect and reopen shellfish waters (which may include the need for new rules or legislation). It was also recommended that staff should continue to evaluate the sources of bacteria contamination of shellfish waters and to develop necessary statutory and/or rule modifications to provide the necessary means to address situations where standards are not being met or uses being attained.

In addition, management strategies to maintain adequate levels of oxygen instream were recommended. These strategies were aimed at new or expanding dischargers into the coastal area watershed.

10.2.2 What was Achieved?

A management plan was adopted by the Environmental Management Commission in 1990 for the lower Lockwoods Folly River area (defined as an area extending north from the Intracoastal Waterway to a line extending from Genoes Point to Mullet Creek). The plan was amended effective January 1996. This management plan was aimed at controlling sources of fecal coliform bacteria from new development, new or expanding NPDES dischargers, new non-discharge permits, new or expanding marinas, and to limit dredge or fill activities. The management plan was not developed to address existing nonpoint sources of fecal coliform bacteria. DWQ continues to monitor 5 chemical/physical ambient monitoring stations monthly on the mainstem of the river and DEH Shellfish Sanitation Branch continues to conduct shellfish sanitation surveys on the river to determine fecal coliform levels.

DWQ recommended in the first basin plan that discharge permit applications should be evaluated on a case-by-case basis after performing a special water quality study in the area of their proposed discharge. There have been no new permit requests for this area.

10.3 Current Priority Issues and Concerns

Parts of the Lockwoods Folly and Shallotte Rivers, portions of the Intracoastal Waterway (ICWW), and all of Calabash Creek have been closed to shellfishing by the Division of Marine Fisheries (DMF) (based on recommendations by Division of Environmental Health Shellfish Sanitation Section) because of high fecal coliform levels. Of the 4800 acres of estuarine waters in this subbasin, 2622 acres are closed to shellfishing. Urban runoff after rainfall events is the major source of contamination with several marinas, canal systems and septic tanks as minor sources.

DEH reports that 29 percent of the three growing areas in Brunswick County (A1, A2 and A3) were closed to shellfishing in 1980 (Patti Fowler, pers. comm.). Currently, approximately 53 percent of these waters are closed. During 1980, approximately 11 percent of the Shallotte River growing area was closed to shellfishing; now about 42 percent of the river is closed. The same trend is noted for the Lockwoods Folly River. In 1980, 16 percent of the river was closed to shellfishing; now about 55 percent of the river is closed.

In addition to the existing issue of increasing acreages of areas closed to shellfishing, there is a great deal of concern about those areas designated as approved shellfishing areas. These approved areas are under increasing threats due to fishing pressures and development within the watershed draining to these areas. These pressures will affect the quality and quantity of this resource unless growth management, land use controls and best management practices are used to provide protection to this resource.

In the Lumber River basin there are a variety of activities that contribute to the degradation and impairment of shellfish waters. These include, but are not limited to, urban stormwater runoff, failing septic tanks, channelized waters, draining wetlands and marinas. Management measures that address land use activities will be needed to decrease fecal coliform levels and reverse the trend in increasing closed shellfish waters.

Between June 1998 and March 1, 1999, substantial acreages of wetlands in Brunswick County within the Lumber River basin were drained for future growth and development. Some of this acreage is within the headwaters of the Lockwoods Folly River, which has a history of shellfish closures in the estuarine area of the river. More information on the wetlands draining and ditching activities within the basin and DWQ enforcement of the wetlands draining policy is presented in Section A, Chapter 2. The impacts to water quality and flooding potential along the coastal area due to the draining projects are yet to be realized. Some immediate water quality impacts resulting from the draining activities have been noted and are being addressed through enforcement activities. However, the long-term impacts are not as easily quantified. The hydrologic changes in the Lockwoods Folly River watershed will need to be carefully assessed as additional management strategies are developed (refer to Section C, Chapter 1, Part 1.2).

Issues in the Development of Management Strategies for Shellfish Waters

The NC Blue Ribbon Advisory Council

The NC Blue Ribbon Advisory Council on Oysters issued its final Report on Studies and Recommendations in October 1995. In the report, the Council "reaches the inescapable conclusion that oyster harvests have declined sufficiently in North Carolina to justify bold new action and to require initiation of that action immediately. ... Because of the economic, cultural, and environmental value of healthy oyster populations, the council judges the perpetuation of this decline in an important component of our coastal heritage to be unacceptable to the citizens of our state." The report cites a number of reasons for this decline, including outbreaks of oyster diseases (mostly weather driven), physical degradation of oyster reefs, overharvest and to "substantial deterioration of coastal water quality". Both the Albemarle-Pamlico Estuarine Study and Governor Hunt's Coastal Futures Committee, which preceded the council, have also recognized the importance of protecting and restoring shellfish waters.

The Council's report, along with a report from the Council's Public Bottom Production Committee, makes a series of specific water quality recommendations (NC Blue Ribbon Advisory Council on Oysters, 1995). The objective of these recommendations is to "restore and protect coastal water quality to create an environment suitable for oysters that are safe for human consumption". These recommendations include, but are not limited to:

- institution of regulatory mechanisms for control of NPS runoff, particularly fecal coliform bacteria and nutrients,
- mandatory 100-foot buffers along all SA waters,
- reducing the allowable built-upon area for low density development,
- promote and fund research on oyster reefs that documents their positive impact on water quality,
- urge the Marine Fisheries and Environmental Management Commissions to work together to establish and implement a "Use Restoration Waters" classification in order to restore closed shellfish beds, and
- DENR should "augment its basinwide management plans to include mechanisms for controlling both point and nonpoint source nutrient additions" and "develop and fund a coastal water quality monitoring system capable of measuring oxygen levels in bottom waters in historically important shellfish grounds."

Restoring water quality in all closed SA waters may not be an attainable objective, particularly in the short run. Contamination in some waters, especially some of those in which harvesting has been prohibited for a long time, may be due to natural conditions (e.g., poor flushing or fecal coliform inputs from wildlife) or to long-standing inputs from developed areas that cannot be effectively or economically mitigated. Other waters may now be threatened by the growth pressures and runoff associated with urban development.

Development Thresholds

Identifying a development threshold, beyond which contamination of shellfish waters is likely to occur, would be useful. Establishing such a threshold is a difficult task because of the wide variety of factors that must be considered: the amount of development, its type, the specific practices used, and the nature of the land prior to initiation of development. Research has shown that degradation of water quality often becomes significant once watershed development exceeds 10-15% impervious cover (Schueler, 1995). These studies have been conducted primarily on freshwater streams, however, and to date no systematic effort has been undertaken to establish a relationship between shellfish closures and the extent of imperviousness (Schueler, 1995).

Research (Tschetter and Maiolo, 1984) has confirmed the correlation between coastal population growth in North Carolina and the closure of waters to shellfishing, but this work is too general to be useful for management purposes. A study of coastal watersheds in New Hanover County (Duda and Cromartie, 1982) found that closings generally occurred where more than one septic system drainfield was present per every seven acres of watershed. It is not clear how much subsurface drainage networks contributed to the problem or how widely the results of this investigation should be generalized. The bottom line is that there is a strong relationship between land development and shellfish water closures that cannot be ignored if shellfish waters are to be protected or restored.

Construction, Stormwater and Land Use Issues

While no development threshold can be identified at present, it is apparent that closings have increased despite the management policies currently in place. The reasons for this are not clear. There are many aspects of the development process that relate to factors influencing fecal coliform export from urban areas. These aspects include size of disturbed area, length of nonvegetated stage, size of vegetated buffer, impervious level and design of sediment or stormwater control devices.

Shellfish closures due to developed areas may be related to improper installation or maintenance of best management practices, lack of stream buffers, or ditching and piping land areas. Recent closings may be related in part to:

- Developments approved prior to January 1, 1988 (and thus not subject to the current stormwater regulations) which have been gradually built out over the past few years.
- Density levels allowed without stormwater BMPs may be too high.
- Required buffers for both low and high density development may be too small.
- The cumulative impact of numerous small projects that are not subject to the regulations.
- The lack of vegetative buffers or stringent revegetation schedule during the construction phase.
- Animal populations (both wildlife and livestock), timber cutting and associated land disturbance, and crop preparation all may contribute to fecal coliform bacteria levels in adjacent waters.

Most likely recent closings may be attributed to a combination of these factors, but adequate information does not exist to confirm this. DEH shoreline surveys, for example, most often do not verify specific causes of contamination or identify specific aspects of stormwater management or erosion/sediment control which may need attention. Changes in DWQ's stormwater rules became effective at the end of 1995. The intent of these changes was in part to address some of the above issues, including enhancing long-term enforcement and managing the cumulative effects of smaller projects. It is still too early to assess the impact of the modified rules.

Septic System Impacts

Dealing with contamination from septic systems is also a difficult issue, but increasingly local governments around the country are finding innovative ways to address these impacts. In order to protect water quality in the Chesapeake Bay, Arlington County, Virginia has adopted an ordinance requiring that all septic tanks be pumped at least once every 5 years (USEPA, 1993b). In the Puget Sound area, where a significant shellfish resource has been threatened by fecal coliform contamination from a number of sources, most counties have established revolving loan funds to facilitate the repair of failing systems (Center for Watershed Protection, 1995). Experience has shown that widespread community support is generally necessary to mount an effective effort, and that this support is unlikely to be forthcoming in the absence of significant perceived benefits (Herring, 1996).

State and Local Interaction through CAMA

The need for both state and local actions to protect coastal water quality was the basis for establishing the Coastal Area Management Act (CAMA) in the 1970s. Since the enactment of CAMA, the state's role in coastal water quality has continued to evolve, encompassing permitting by the Division of Coastal Management in Areas of Environmental Concern, DWQ's coastal stormwater rules, and the continuing development of the Sedimentation and Erosion Control Program by the Division of Land Resources. Local governments have also implemented the local planning requirements of CAMA.

Since additional limitations on shellfish harvesting have occurred under current policies, it seems clear that simply continuing these activities will not adequately protect water quality. All parties in this state-local partnership, as well as private landowners, must accept more responsibility for protecting coastal resources. The Division of Coastal Management (DCM) is currently assessing the adequacy of existing land use planning requirements for providing water quality protection. DWQ will work cooperatively with DCM to evaluate coastal water quality protection measures.

Actions That Can Reduce Impacts to Shellfish Waters

Improvements to Stormwater Control Programs

Changes to or better enforcement of present stormwater regulations appear to be necessary to ensure that shellfish waters are adequately protected from runoff from developed areas. Changes in regulations which may be worth investigating include:

- modification of the size, nature or extent of vegetative buffers for both the construction and stormwater phase of the project;
- lowering the allowable built upon area for low density development draining to SA waters;
- increasing the size of vegetative filters for outflows from stormwater management devices;
- developing requirements for maximum size of disturbed area or a revegetation schedule; and
- modified design standards for stormwater and sediment control BMPs to maximize fecal coliform die-off.

The South Brunswick Water and Sewer Authority (SBWSA) has been designated by the Director of the Division of Water Quality to receive a NPDES stormwater permit. The SBWSA NPDES permit application should be submitted to the Division in 1999. The permit will require the development of a comprehensive stormwater management program including public education, detection and elimination of illicit discharges, and the development and implementation of stormwater controls.

Local Growth Management Initiatives

Growth management--defined here as local planning and development review requirements designed to maintain or improve water quality (Center for Watershed Protection, 1995)--has often been unpopular among local governments for a variety of reasons. While it is important to acknowledge this, it must also be acknowledged that further improvements in state programs are, by themselves, unlikely to prevent further deterioration of coastal water quality. Local governments should be taking steps to manage growth. Increasingly, local governments in areas such as the Chesapeake Bay and Puget Sound watersheds have recognized that a more proactive approach is essential to protect their coastal resources. Seventy percent of the local governments in the 12 county Puget Sound region, for example, have adopted some form of a stormwater management plan (Dohrmann, 1995).

Over the past several years DWQ, DCM and other agencies have been involved in a number of projects to encourage and assist local governments in carrying out wastewater planning and growth management activities. One of these projects was the development of the *Blueprint to Protect Coastal Water Quality: A Guide to Successful Growth Management in the Coastal Region of North Carolina* (Center For Watershed Protection, 1995). This guide was developed as part of a federal grant project sponsored by DWQ and carried out by the Neuse River Council of Governments. Local governments should consider the application of growth management techniques outlined in the "Blueprint" document. It provides practical concepts and tools that can be implemented at the local level to protect coastal water quality.

Local governments should consider the application of growth management techniques outlined in the *Blueprint to Protect Coastal Water Quality*. This document provides practical concepts and tools that can be implemented at the local level to protect coastal water quality. Copies are available free of charge from DWQ's Planning Branch at (919) 733-5083.

The following two tables summarize key features of the document. Each element listed in Table B-8 can be tailored to both rural and developed areas and to inland, soundside and barrier island

locations. Growth management tools in Table B-9 range from on-the-ground best management practices, such as modifying parking areas to reduce impervious surfaces, to establishing regional wastewater and/or stormwater authorities.

Table B-8 Growth Management Elements Applicable to the North Carolina Coast

• Use Watershed-Based Land Use Planning	• Minimize Impervious Cover in Site Design
• Protect Sensitive Natural Areas	• Limit Erosion During Construction
• Establish Buffer Network	• Maintain Coastal Growth Measures
• Treat Stormwater	• Implement Stormwater Management Plans

Table B-9 Growth Management Tools

• Overlay Zoning	• Greenbelts
• Transfer of Development Rights	• Watershed Impervious Limits
• Marina Siting and Design	• Forest Conservation
• Septic System Siting Criteria	• Shoreline and Wetlands Buffers
• Modification of Street Standards	• Modification of Parking Areas
• Siting Clearing Standards	• Stormwater Treatment
• Cluster Zoning	• Marina Pumpout
• Septic System Alternatives	• Regional CAMA Planning
• Wastewater Authority	• Stormwater Authority
• Wastewater/Stormwater Authority	• Waste Quality Authority
• Sensitive Habitat Protection Ordinance	• Septic System Inspection and Maintenance

The NC Division of Coastal Management has been providing extensive GIS information to local governments to aid in development of local land use plans. These plans must be consistent with state guidelines and address a wide range of issues, including resource protection and conservation, hazard mitigation, economic development and public participation. The 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 the basin plans.

Although Brunswick County has been growing quickly over the past several years, there is still large acreages of prime real estate available. There is no end in sight to the growth potential for the county. Therefore, Brunswick County and its communities are in a position of being able to choose the way in which the county is developed. Certainly offering countywide sewer connections will further stimulate growth in the area, but tremendous growth will likely occur with or without countywide sewer. Careful planning of sewer connections now could help direct growth rather than allow piecemeal growth. In addition, road improvements that will carry additional visitors to the outlying beaches can be planned to reduce the amount of sensitive areas or wetlands that are disturbed. The County should conduct a study of the Highway 17 corridor and design a highway corridor that avoids a bypass that blends into the community rather than bypass the community altogether (Zoe Bruner, 1998, Pers. Comm.). See Section C, Chapter 1 for more information on Brunswick County's Land Use Plan.

State, Federal and Local Cooperation on Lockwoods Folly River Project

Congress has provided funding to the US Army Corps of Engineers (COE) to initiate the development of a plan of action to improve water quality and aquatic resources in the Lockwoods Folly River. A $100,000 reconnaissance study has been completed for the proposed Lockwoods

Folly River Watershed Feasibility Study. The COE Wilmington District office contracted with the Natural Resources Leadership Institute of NCSU in Raleigh to conduct a series of stakeholders meetings intended to bring together individuals, groups and agencies with an interest in the Lockwoods Folly River. The meetings were held in the summer of 1998 to identify resource concerns, potential solutions, and to provide information to the COE that would help in developing a coordinated plan of action. The COE has prepared a draft Project Study Plan to study water resource problems, describe the federal, state and local involvement, and specify cost sharing plans for feasibility planning and implementation phases of the project.

Possible options for improving water quality and the aquatic ecosystem in the watershed include:

- restoration of riparian and wetland habitat, which serve as natural filtering systems;
- restoration of tidal channels, which may improve saltwater circulation and increase salinity;
- correcting failing septic systems; and
- improving tidal exchange in the river through dredging.

DWQ believes this study and the resulting can be a valuable contribution toward improving water quality in the Lockwoods Folly River. The State of North Carolina has expressed interest in sponsoring this feasibility study on a cost sharing agreement with the COE. Recommendations from the study will likely require local government cooperation and commitment to obtain a level of measurable success. DWQ will seek to work closely with the COE, other state agencies and local governments, both in the feasibility phase and the implementation phase.

DWQ's commitment to a cost sharing agreement will depend in part on the level of interest and commitment expressed by local governments to improve water quality in the river. The interest level expressed by Brunswick County is of particular interest to DWQ. The recently approved Brunswick County Land Use Plan Update includes policy statements that, if implemented, will express a significant commitment to water quality by Brunswick County. Policy statements in the land use plan include:

- Outstanding Resource Water (ORW) - 8.1.4(c) - "State and local efforts to restore the water quality of the Lockwoods Folly River, as well as other estuarine waters in the county..."
- Shellfishing Waters - 8.1.4(d) - "...The County shall continue to promote estuarine water quality thought its stormwater management planning and stormwater runoff policies".
- Stormwater Runoff - 8.1.7(a, b and c) -
  (a) "Brunswick County shall take a proactive role in the development of stormwater management and design standards intended to protect the quality of the county's streams, rivers, marshes and estuaries".
  (b) "Brunswick County shall support a program of vegetated buffers adjacent to all streams, rivers, marshes and estuarine water in the county, with the intent of reducing the flow of nutrients and other contaminants into area surface waters".
  (c) "Brunswick County shall advocate a policy of stormwater runoff management in which post-development runoff had a rate of flow and volume which approximates, as closely as practical, predevelopment conditions".

Section C

Current and Future Water Quality Initiatives

Chapter 1
Current Water Quality Initiatives

1.1 Workshop Summaries

Two public workshops were held in the Lumber River basin prior to drafting the basinwide plan. These workshops were held in Bolivia on April 8, 1998 and Lumberton on April 23, 1998. Notices of the workshops were mailed to over 300 persons on the mailing list and to all individual NPDES discharge permit holders. In addition, two press releases were run in local newspapers. A total of 54 people were present at the workshops. Participants included representatives from the agricultural community, local governments, citizens, industry, state agencies and conservation organizations.

The purpose of the workshops was to provide an overview of the basinwide planning approach used by DWQ, to present updates on several issues important to the residents of the basin, and to get public input prior to developing the second basinwide plan for the Lumber River basin.

After presentations, the participants broke out into small discussion groups. Each group was asked to respond to the following questions:

1) What are the water quality related issues specific to the basin?
2) What actions need to be taken to address the top three issues?
3) Are there any local groups that can implement these actions?
4) What initiatives are being taken locally to address water quality?

Responses to these questions were recorded (see Appendix VII) and used to guide the development of the basinwide plan. The concerns of the participants at the Bolivia workshop were clearly oriented at coastal development and shellfish closure issues. Participants at the Lumberton workshop were more concerned with nonpoint source pollution, development and urban growth, the need for public education, and point source discharges. The need for increased public education efforts on water quality issues in general was a focus of much discussion amongst the four groups at the Lumberton workshop.

Good suggestions and ideas for actions that could be taken to address major concerns were presented by the participants, along with identification of many local groups or agencies that could take some initiative towards implementing these suggested actions. DWQ has no regulatory authority that can be used to implement most of these suggested actions. Therefore, the responsibility for implementation of these actions will fall on local groups and agencies. Where possible, DWQ will support these groups and agencies in their efforts.

In addition to the two public workshops, DWQ gave presentations at the annual Friends of Lake Waccamaw State Park workshop on May 8-10, 1998. Presentations were on the basinwide process, fish consumption advisories in the basin, and the potential reclassification of Lake Waccamaw to Outstanding Resource Waters.

1.2 Federal Initiatives

US Army Corps of Engineers (COE)

The COE conducted a study of the Lockwoods Folly River in 1991-1992 in response to local concerns that the intracoastal waterway (ICWW) was causing water circulation problems in the Lockwoods Folly River. The study (COE, 1992) indicated that the ICWW did not significantly

impede water circulation in the Lockwoods Folly River. In 1994, the COE conducted an additional study to evaluate the effects of closing the connection between Lockwoods Folly Inlet and the ICWW on river circulation and dredging a new inlet through the Eastern Channel. This study indicated that no significant improvements in the river would occur as a result of dredging the Eastern Channel.

The Wilmington District COE is currently seeking state and local support for development of a study plan to address water quality, shellfish harvesting and navigational concerns in the Lockwoods Folly River. A draft Project Study Plan has been developed with stakeholder input, and cost sharing arrangements are being explored with the state and Brunswick County. For more information, see Section B, Chapter 10 or contact Sharon Haggette at (910) 251-4441.

1.3 State Initiatives

Section 319

The Coastal Urban and Recreation BMP Demonstration Project Team aims to address the issue of rapid urban and recreational development and the resulting impacts on water quality through the implementation and evaluation of best management practices (BMPs) to protect coastal waters impaired by urban runoff. Team members will inventory pollution problems and sources in the following coastal waters within the Lumber River basin: Calabash Creek, Shallotte River, Lockwoods Folly River and the Intracoastal Waterway.

Surveys of existing data and interviews with local officials and residents will be used to determine sites where BMPs can be installed and evaluated for nonpoint source pollution control. BMPs will include vegetation and other runoff reduction measures, nutrient and pest management to reduce pollutant sources, erosion control measures, and stormwater retention.

Water quality monitoring will include grab samples taken up and downstream from BMPs before and after implementation. Samples will be taken biweekly during the warm season (April - September) and monthly during the cool season (October - March). Stormwater samples will be collected using automatic samplers during 6 storm events at each of 4 BMP sites. The primary constituents of interest will be pathogens, Nitrogen, Phosphorous and specified pesticides. DWQ may conduct annual biological and habitat monitoring. Educational meetings, field days, demonstrations, fact sheets, displays and newsletters will be used to promote BMP implementation throughout the coastal region. Target audiences will include local government officials, developers, builders, lenders, professional landscapers and the general public. The project will be coordinated with ongoing environmental education and demonstration projects being conducted by NCSU and UNC-Wilmington in the coastal region.

Fisheries Reform Act of 1997

The Fisheries Reform Act was signed into law on August 14, 1997. This reform package was developed to ensure healthy fishing stocks, the recovery of depleted stocks and the wise use of fisheries resources. One of the areas of reform requires the Marine Fisheries Commission (MFC), the Environmental Management Commission (EMC) and the Coastal Resources Commission (CRC) to jointly develop and approve Coastal Habitat Protection Plans for wetlands, spawning areas, threatened/endangered species habitat, primary and secondary nursery areas, shellfish beds, submerged aquatic vegetation and outstanding resource waters. All coastal Habitat Protection Plans are to be completed by July 1, 2003 and will be reviewed every five years. The plans must:

- describe and classify biological systems in the habitats;
- evaluate the function, value to coastal fisheries, status and trends of the habitats;
- identify existing and potential threats to the habitats and the impact on coastal fishing; and

- recommend actions to protect and restore habitats.

An interagency working team has formed and worked to develop an outline for developing the plans. The framework for plan development is to be based on ecological communities as defined by three salinity regimes. An analysis of function and value to habitat will be conducted as specified by the law. The Newport River in the White Oak basin is designated as the pilot area for initial assessment of the framework. GIS data will be relied on heavily for analyzing the many existing data layers available from several agencies.

When the Fisheries Reform Act was made into law, no expansion budget was created to support the implementation of the law. Therefore, current staff from the three divisions are required to fit this additional work into existing workloads.

NC Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) has developed a Basinwide Wetlands and Restoration Plan for the Lumber River Basin. Basinwide Wetlands and Restoration Plans are watershed-based strategies for identifying degraded or functioning wetland and restoration areas, which, when restored or protected, could contribute significantly to meeting the needs of protecting and enhancing water quality, fisheries and wildlife habitat, flood prevention and enhancement of recreational opportunities in that watershed. For more information, refer to Section A, Chapter 2, Part 2.6.3.

Clean Water Management Trust Fund

The Clean Water Management Trust Fund (CWMTF) has allotted $7,215,452 of grant funds for several projects within the Lumber River basin as shown below. For more information on the CWMTF or these grants, contact Dave McNaught at (919) 830-3222.

Application Name	Purpose	Amount Funded
Sandhills Area Land Trust	Easements	$ 334,438
UNC-Pembroke	Acquisition-Buffers	$ 280,000
Town of Wagram	Wastewater	$ 400,000
Town of Gibson	Wastewater	$ 286,500
NC DENR Div. of Parks and Recreation	Acquisition-Buffers	$ 950,000
Lake Waccamaw	Stormwater	$ 30,514
Town of Fairmont	Wastewater	$ 1,000,000
Town of Tabor City	Wastewater	$ 570,000
Brunswick County	Coordinate Public Programs	$ 1,500,00
Town of Chadbourn	Wastewater	$ 1,312,000
Town of Southern Pines	Easements	$ 96,000
Town of Long Beach	Acquisition-Buffers	$ 456,000

NC Cooperative Extension Service (CES)

The North Carolina Cooperative Extension Service (CES) serves the golf course superintendents in southeastern North Carolina with programs to educate turfgrass managers on Best Management Practices (BMPs) for golf courses. Listed below are some of the program activities of the CES in Brunswick County:

Southeastern North Carolina Turfgrass Conference: The CES, in cooperation with the Cape Fear Golf Course Superintendents Association and the Turfgrass Council of North Carolina, offer an educational program of seminars and lectures for professional turfgrass and landscape managers. This two-day event offers turfgrass managers the opportunity to hear current research-based information about turfgrass management.

Is Golfing Greener? The Impact of Golf Courses on the Coastal Environment: Public awareness of environmental impacts related to golf courses is a major issue. This conference examined the efforts being made by public agencies and private industry to make golfing an environmentally sound activity. Internationally known speakers discussed issues related to planning and siting golf courses, golf course design, and maintenance and facility operations.

Pesticide Container Recycling for Golf Courses: The Brunswick County CES Plastic Pesticide Container Recycling Program is committed to advancing opportunities for recovery of pesticide containers from golf courses. Plastic pesticide containers are a major component of waste generated by golf courses. In addition to consuming and occupying valuable space in landfills, these containers could possibly lead to groundwater contamination from pesticide residue if left unrinsed. Due to the chemical content in pesticide containers, a specific and directed effort must be made to collect and recycle these materials separate from other plastic containers. Recycling plastic pesticide containers is one way superintendents can help reduce the amount of trash deposited in landfills while also promoting responsible environmental management.

EPA Section 319 Water Quality Grant: Currently the Brunswick County CES is working with two Brunswick County golf courses on an EPA Section 319 Water Quality Grant. This program is designed to improve water quality with best management practice implementation. On-site monitoring on both golf courses has provided data that will assist the turfgrass manager with tools to provide responsible environmental management and still maintain a quality golf course.

Golf Course Workers Safety and Turfgrass Management Training: There is increasing pressure to make the workplace a safer environment. Safety regulations have become complex issues that require full time attention. Golf course workers must also be familiar with the complex environment they work in as it relates to agronomics and environmental stewardship.

The Cape Fear Golf Course Superintendent Association: The Cape Fear Golf Course Superintendents Association is an organization of turfgrass managers, educators and industry representatives committed to advancing the educational opportunities related to golf course management. This organization is a sponsor of the Southeastern North Carolina Professional Turfgrass Conference. Ten monthly meetings provide educational information about turfgrass management in southeastern North Carolina.

Professional Services: The Cooperative Extension Service offers golf course superintendents professional services such as soil, plant tissue, nematode, insect, and disease testing and diagnosis information. Turfgrass managers are provided with on-site visits to provide research-based information and diagnostic services.

For more information on these programs, contact Matthew Martin of the Brunswick County Cooperative Extension Service at (910) 253-2610.

North Carolina Coastal Resources Commission (CRC)

The North Carolina Coastal Resources Commission (CRC) published notice of rule making on May 1, 1998. It was the commission's intent to amend the existing Estuarine Shoreline Area of Environmental Concern (AEC) rules, to extend the shoreline protection rules to public trust waters, and to revise priorities for awarding local planning and management grants to local governments in the coastal area.

In an unanimous vote on March 26, 1999, the CRC chose to set aside earlier proposals for protecting coastal water quality and focus on buffer requirements. The CRC proposes to require a 30-foot buffer on waterfront lots throughout the coastal region, while a group representing interested citizens looks for other solutions to coastal water quality problems. This group will make recommendations and proposals to the CRC, legislators or other environmental commissions.

The buffer would apply to all lots along public trust waters. Public trust waters are those that are considered "navigable" within the 20 coastal counties. Only water-dependent structures, such as piers, boat ramps and erosion control structures would be allowed in the buffer. Property owners will be required to obtain a permit for such structures.

The CRC will continue to examine shoreline stabilization issues as a separate rule making. When the CRC finalizes its draft proposed rules, the text will be published in the *NC Register*. Public hearings on the proposed rules are expected to take place in March 1999. For more information, contact Mike Lopazanski at (919) 733-2293.

1.4 Local Initiatives

The Lumber River Council of Governments

Regional Wastewater Feasibility Study

The Lumber River Council of Governments (LRCOG) initiated a comprehensive regional wastewater feasibility study for Bladen, Columbus, Hoke, Robeson and Scotland Counties in 1994. In the Fall of 1996, the Technical Advisory Group for the project selected two engineering firms to jointly conduct the study. The study, completed in 1998, provides municipalities within these counties a tool for evaluating sewer needs throughout a 20-year planning period. The study identifies specific and general wastewater needs based on existing and projected populations and provides estimates on the cost of providing these facilities. Twenty-five units of local government, 8 industries, a regional airport commission, a public school system and other parties interested in promoting economic development while protecting the environment are involved in the project. The Town of Fairmont served as the leading governmental agency for the project and the LRCOG served as the lead planning and administrative entity.

One of the primary missions of the study was to examine the feasibility of regional sewer services as a more efficient means to provide wastewater treatment. Information in the study includes existing land use, soil types, wetland areas, hydrology, infrastructure and roads as well as current and projected population. The information in the study will allow for planning of wastewater infrastructure to the year 2020.

One of the primary objectives of the study was to identify potential regional wastewater treatment systems. Several potential regional facilities were identified including: 1) Elizabethtown/Bladen County Sub-Regional WWTP; 2) Fairmont/South Robeson County Sub-Regional WWTP; 3) Laurinburg-Maxton Airport Commission-Laurel Hill WWTP; and 4) Laurinburg-Maxton Airport Commission-Lumber River Sub-Regional WWTP.

Regionalization of wastewater will aid in the economic development of the area by providing infrastructure in unsewered areas, eliminate unnecessary discharge points to swamps and rivers, improved economy of scale of pooled resources for small systems, and resolve ongoing compliance problems of some permit holders.

Region N Comprehensive Groundwater Management Plan

The LRCOG has initiated the development of a comprehensive groundwater management plan to focus on local groundwater concerns. The plan has identified several activities to be conducted once funding is obtained for the project. The LRCOG has begun discussion with other agencies to determine the level of interest of local governments in participation.

The first phase of the project will include several main activities including: 1) well location and water level measurements to study effects of withdrawals on groundwater levels; 2) conduct a water supply and demand study to determine amounts of withdrawals and supplies; 3) develop and implement a groundwater quality assessment program to determine if groundwater contamination currently exists and where contamination may potentially occur; 4) develop a hydrologic framework and conduct a modeling study using GIS data with the assistance of the NC Division of Water Resources; 5) seek involvement and develop a regional work group for oversight of groundwater planning and management efforts; and 6) develop regional groundwater planning resources.

Regional Basin Association

The LRCOG will pursue the development of a basin association that will be representative of various interests in the basin. The group is anticipated to contain members from local governments, regional economic development interests, the agricultural community, state and local agencies, the regulated community, and others with an interest in water quality and water quantity issues within the basin. The concept of forming an association is still in the early stages of discussion and meetings of interested persons will begin in the near future.

Land Use Planning and Management Project Reports as Required by CAMA

Local land use plans must be written for those local governments within the North Carolina Coastal Area Management Act (CAMA) Coastal Zone. Land use plans must address several elements of land use planning that balance future economic development and resource protection. Local governments within Brunswick County, including Brunswick County, that have developed land use plans to help achieve this vision include:

- Brunswick County (approved November 1998)
- Town of Long Beach (approved February 1999)
- Town of Holden Beach (approved November 1998)
- Town of Varnamtown (approved July 1995)
- Second Bridge to Oak Island corridor (draft dated September 1997, prepared for Town of Long Beach and Brunswick County)

Brunswick County, in comparison to other local governments, makes up a large portion of the land area within the CAMA zone of the Lumber River basin. Therefore, the Brunswick County plan is critical to water quality protection. Brunswick County, in its current Land Use Plan, has committed to taking a proactive role in the development of stormwater management and to supporting a program of vegetated buffers adjacent to all streams in the county. The stormwater policy is intended to reduce stormwater runoff rates, soil erosion and sedimentation, and point source discharges into area waters. The county is approaching stormwater management in two ways. The first is to establish a Sanitary Sewer and Stormwater Oversight Committee to explore possible stormwater management solutions that looks at placement of sewer lines and the resulting density of development and increased stormwater runoff. The second approach is to incorporate "near source" requirements for retaining stormwater as close to on-site as possible.

One goal of the county is to develop a distinct "town and country" growth pattern to allow for the preservation of open spaces and productive farm and timber lands. This type of growth management policy can provide positive benefits to water quality.

Town of Long Beach

The Town of Long Beach has developed several planning projects with the specific goal of protecting the natural resources within the municipal boundaries. These projects are briefly summarized.

- *Town of Long Beach Land Use Plan Update.* February 1999.
- *Davis Creek Complex Water Quality Restoration Project.* Fall 1998. This project is funded by the Clean Water Management Trust Fund and will result in the acquisition of properties for buffers and preservation along the Davis Creek complex. An additional outcome is an educational program on septic tank maintenance and care.
- *The Point Plan.* July 1998. This management plan was adopted for the protection of a fragile coastal area at the West End of the island. The plan gives an overview of natural features, land use and development policies, community vision for the area, and management strategies for the preservation of the Point.
- *Estuarine and Shoreline Access Plan.* 1991. This plan documents access points and facilities, strategies for land acquisition and development of facilities that will serve the public and still preserve natural areas.
- *Comprehensive Vegetation Ordinance* (Draft). This is a comprehensive ordinance for the preservation of all types of vegetation on the island with the goal of preserving maritime forests, protecting existing vegetation and protecting natural vegetative buffer areas.

South Brunswick Water and Sewer Authority (SBWSA)

The SBWSA is the regional entity formed to preserve water quality in the 55-square mile area of South Brunswick County (SBWSA 201 Facilities Planning Area). The area also includes the Towns of Sunset Beach and Calabash. SBWSA has completed an environmental impact statement (URS Greiner, 1998) for the construction of centralized wastewater collection for the region. The wastewater treatment design includes advanced tertiary treatment. Effluent disposal options include application of treated wastewater on forestland and spray irrigation to participation golf courses.

A centralized wastewater facility is expected to encourage growth within the Planning Area (Towns of Calabash and Sunset Beach and a portion of Brunswick County). The Towns of Sunset Beach and Calabash and Brunswick County entered into an interlocal agreement in March 1995 as sponsors of SBWSA.

Adoption of the SBWSA 201 Facilities Planning Area has been a long and complex process. The SBWSA 201 Facilities Planning Area has a population of 25,107 and is therefore not required to obtain an NPDES stormwater permit under the Phase I EPA rules. However, SBWSA was designated by the Director of the DWQ to receive a stormwater permit and to develop and implement a Storm Water Quality Management Plan as a condition of constructing a centralized wastewater facility. The permit will require the development of a comprehensive stormwater management program including public education, detection and elimination of illicit discharges, and the development and implementation of stormwater controls. SBWSA is required to develop a stormwater management program, in part, because the population of Brunswick County is growing so rapidly. The stormwater and education programs will help protect water quality in the region, including those designated as High Quality Waters - the Calabash River. This river

currently has large acreages closed to shellfishing as a result of elevated fecal coliform bacteria levels due to runoff after rainfall.

SBWSA has adopted three ordinances related to stormwater management and water quality improvements:

1) Storm Water Management Ordinance (1996-03) - The goals of the ordinance are to regulate existing and new developments consistent with the state's and SBWSA goals; to prepare a comprehensive stormwater quality management program; establish the authority for SBWSA to administer and enforce stormwater regulations; and to create public education programs.

2) Water Quality Management Division Ordinance (May 1996) - The ordinance is intended to establish administrative, planning, designing, construction, funding, implementation and enforcement processes for water quality management. To assist in these processes, SBWSA established a Water Quantity Management Board and a Water Quality Management Division.

3) Interim Service Charges and User Fees Ordinance (1996-02) - This ordinance was established to allow SBWSA to collect interim service charges and user fees for implementation of the stormwater program. Fees will be reset after a rate study analysis is complete. This ordinance was amended in April 1998.

Several commitments of the EIS will provide greater protection to the SBWSA area, especially in light of the continued rapid growth expected for the region. These commitments were designed to restrict sewer service in sensitive areas and to control density to the level that is now possible with septic tanks.

SBWSA publishes a quarterly newsletter to inform and educate local citizens about water quality issues in the South Brunswick area served by SBWSA. A Water Quality Management Board, comprised of nine members, has also been formed to assist "the Authority in preparing and implementing comprehensive regional water quality management program to meet the current and future needs of the citizens in the South Brunswick 201 Facilities Planning Area". Educational bulletins and workshops for the family are also prepared by SBWSA. SBWSA is sponsoring a Volunteer Water Quality Monitoring Program for citizens of all ages for water quality testing and data collection of waters in the region. They have also contracted with UNC-Wilmington to conduct extensive fecal coliform bacteria monitoring to try to better assess the actual sources of fecal contamination as a means of prioritizing their project areas.

For further information on SBWSA or its programs, contact Joe Tombro, Executive Director, (910) 579-2828.

Chapter 2
Future Water Quality Initiatives

2.1 Overall DWQ Goals for the Future

The long-term goal of basinwide management is to protect the water quality standards and uses of the 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 part of all involved. With the needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

There are several near-term initiatives underway for the Lumber River basin as described earlier in Section A, Chapter 4. These DWQ initiatives include:

- further development of biological criteria (benthic macroinvertebrate and fish community) better suited to the complexity of swamp waters;
- development of a TMDL for waters with a fish consumption advisory for mercury; and
- nonpoint source pollution identification and reduction.

In addition to these efforts, DWQ will continue to pursue several programmatic initiatives intended to protect or restore water quality across the state. These include NPDES Program Initiatives, better coordination of basinwide planning, and improving database management and use of GIS capabilities. Summaries of these initiatives are provided below.

NPDES Wastewater Program Initiatives

In the next five years, efforts will be continued to:

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

Long-term point source control efforts will stress reduction of wastes entering wastewater treatment plants, seeking more efficient and creative ways of recycling by-products of the treatment process (including reuse of nonpotable treated wastewater), and keeping abreast of and recommending the most advanced wastewater treatment technologies.

DWQ requires all new and expanding dischargers to submit an alternatives analysis as part of its NPDES permit application. Non-discharge alternatives, including connection to an existing WWTP or land-applying wastes, are preferred from an environmental standpoint. If DWQ

determines that there is an economically reasonable alternative to a discharge, the NPDES permit may be denied.

Coordinating Basinwide Planning with Other Programs

The basinwide planning process can be used by other programs as a means of identifying and prioritizing waterbodies in need of restoration or protection efforts and provides a means of disseminating this information to other water quality protection programs. For example, the plan can be used to identify and prioritize wastewater treatment plants in need of funding through DWQ's Construction Grants and Loan Program. The plans can also assist in identifying projects and waterbodies applicable to the goals of the Clean Water Management Trust Fund, Wetlands Restoration Program or Section 319 grants program. Information and finalized basin plans are provided to these offices for their use and to other state and federal agencies.

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, etc.) will be put in a central data center which will then be made accessible to most staff at desktop computer stations. Some of this information is also being submitted into the NC Geographic Data Clearinghouse (Center for Geographic Information and Analysis or CGIA). As this and other information (including land use data from satellite or air photo interpretation) is made available to the GIS system, the potential to graphically display the results of water quality data analysis will be tremendous.

Additional Research and Monitoring Needs

DWQ staff have identified some additional research and monitoring needs that would be useful for assessing, protecting and restoring the water quality of the Lumber River basin. The following list is not inclusive. Rather, it is meant to stimulate ideas for obtaining more information to better address water quality problems in the basin. With the newly available funding programs (Clean Water Management Trust Fund and Wetlands Restoration Program) and the Section 319 grant program, it may be desirable for grant applicants to focus proposals on the following issues:

- More resources are needed to address nonpoint sources of pollution. Identifying nonpoint sources of pollution and developing management strategies for impaired waters, given the current limited resources, is an overwhelming task. Therefore, only limited progress towards restoring NPS impaired waterbodies can be expected unless substantial resources are put towards solving NPS problems.
- Growth management/urban stormwater planning (specifically for the Lake Waccamaw and coastal drainage area) are needed. Increased population in these areas will demand more water and generate more wastewater. In addition, conversion of land from forests and farms will increase impervious surfaces and produce higher than natural streamflows and cause erosion. Streams in these areas will likely become impaired unless this growth is planned for and managed properly.
- There is a lack of data on impacts of summer low flow conditions on aquatic life. The lack of flowing water during summer months can severely reduce the diversity of aquatic fauna. This problem has not been investigated in North Carolina and further research will be required to determine the effect of water withdrawals (e.g., for irrigation) on stream life.

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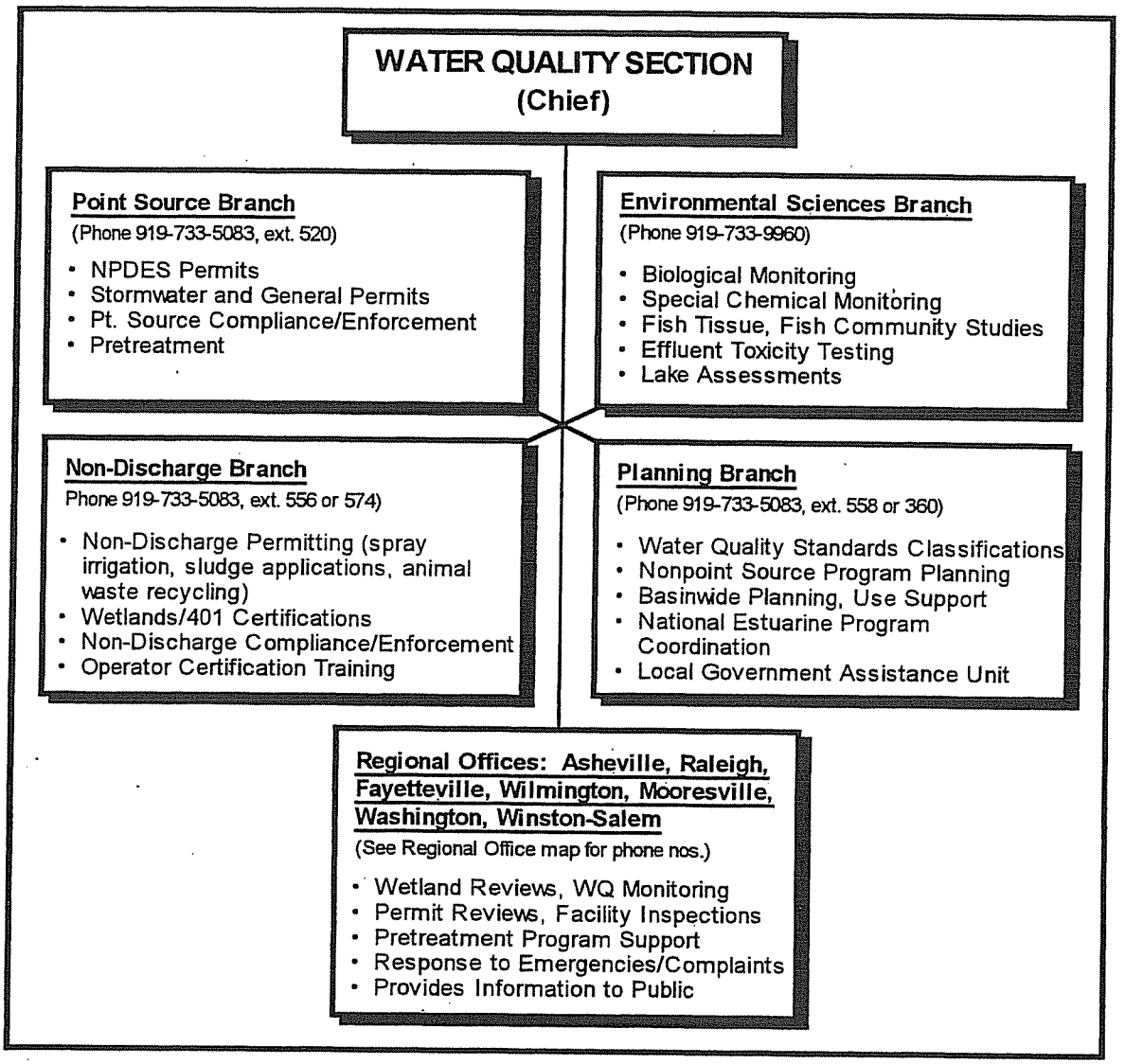
Appendix I

Division of Water Quality
Water Quality Section
Organization Structure


WATER QUALITY SECTION
(Chief)
Point Source Branch
(Phone 919-733-5083, ext. 520)
• NPDES Permits
• Stormwater and General Permits
• Pt. Source Compliance/Enforcement
• Pretreatment
Environmental Sciences Branch
(Phone 919-733-9960)
• Biological Monitoring
• Special Chemical Monitoring
• Fish Tissue, Fish Community Studies
• Effluent Toxicity Testing
• Lake Assessments
Non-Discharge Branch
Phone 919-733-5083, ext. 556 or 574)
• Non-Discharge Permitting (spray irrigation, sludge applications, animal waste recycling)
• Wetlands/401 Certifications
• Non-Discharge Compliance/Enforcement
• Operator Certification Training
Planning Branch
(Phone 919-733-5083, ext. 558 or 360)
• Water Quality Standards Classifications
• Nonpoint Source Program Planning
• Basinwide Planning, Use Support
• National Estuarine Program Coordination
• Local Government Assistance Unit
Regional Offices: Asheville, Raleigh, Fayetteville, Wilmington, Mooresville, Washington, Winston-Salem
(See Regional Office map for phone nos.)
• Wetland Reviews, WQ Monitoring
• Permit Reviews, Facility Inspections
• Pretreatment Program Support
• Response to Emergencies/Complaints
• Provides Information to Public

Appendix II

NPDES Dischargers in the Lumber River Basin

Permit	Facility	County	Region	Type	Ownership	Subbasin
NC0005363	CP&L WEATHERSPOON S.E. (PWR)	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0085413	LENNON OIL COMPANY ***	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0035530	CROFT METALS INC-LUMBER BRIDGE	ROBESON	Fayetteville	Major	Industrial	30753
NC0004618	ALAMAC KNIT FABRICS, LUMBERTON	ROBESON	Fayetteville	Major	Industrial	30751
NC0005479	LAURINBURG/MAXTON AIRPORT CO	SCOTLAND	Fayetteville	Minor	Municipal	30755
NC0076830	LLOYD'S OYSTER COMPANY	BRUNSWICK	Wilmington	Minor	Non-Municipal	30759
NC0074942	GREEN'S OYSTER COMPANY, INC.	BRUNSWICK	Wilmington	Minor	Non-Municipal	30759
NC0036773	LAURINBURG, CITY-WTP	SCOTLAND	Fayetteville	Minor	Non-Municipal	30755
NC0049778	SOUTHERN PINES WTP, TOWN	MOORE	Fayetteville	Minor	Non-Municipal	30750
NC0027651	DHR - SAMARKAND MANOR	MOORE	Fayetteville	Minor	Non-Municipal	30750
NC0084204	ROBESON, CO-WWTP/LUMBERTON	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0048577	ROBESON CO WTP/MAXTON	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0085685	ROBESON CO-LUMBER BRIDGE TRTMT	ROBESON	Fayetteville	Minor	Non-Municipal	30753
NC0086037	HOKE CO. RWS / ARABIA SITE	HOKE	Fayetteville	Minor	Non-Municipal	30753
NC0086045	HOKE CO. RWS/ANTIOCH SITE	HOKE	Fayetteville	Minor	Non-Municipal	30753
NC0005801	GEORGIA PACIFIC-WHITEVILLE/PLY	COLUMBUS	Wilmington	Minor	Industrial	30758
NC0072168	GEORGIA PACIFIC-WHITEVILLE/TBR	COLUMBUS	Wilmington	Minor	Industrial	30758
NC0005321	BUCKEYE LUMBERTON, INC.	ROBESON	Fayetteville	Major	Industrial	30751
NC0058301	COGENTRIX - LUMBERTON	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0006858	COUNCIL TOOL COMPANY	COLUMBUS	Wilmington	Minor	Industrial	30756
NC0005754	SPRINGS INDUSTRIES-SPRINGFLD	SCOTLAND	Fayetteville	Minor	Industrial	30755
NC0049514	LIBBEY-OWENS-FORD CO./PLANT#75	SCOTLAND	Fayetteville	Minor	Industrial	30755
NC0052477	CAMP MACKALL (DEPT. OF ARMY)	RICHMOND	Fayetteville	Minor	Non-Municipal	30750
NC0029769	DOC - SCOTLAND COUNTY SUBSID.	SCOTLAND	Fayetteville	Minor	Non-Municipal	30755
NC0035904	DOC - MCCAIN HOSPITAL #3700	HOKE	Fayetteville	Minor	Non-Municipal	30751
NC0044873	CAROLINA BLYTHE UTILITY CO.	BRUNSWICK	Wilmington	Minor	Non-Municipal	30757
NC0034070	ROBESON CO SCH-DEEP BRANCH	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0034100	ROBESON CO SCH-ORRUM HIGH SCH	ROBESON	Fayetteville	Minor	Non-Municipal	30751
NC0035777	SCOTLAND CO SCH-CARVER MIDDLE	SCOTLAND	Fayetteville	Minor	Non-Municipal	30755
NC0045276	BRUNSWICK CO BOE-WACCAMAW ELEM	BRUNSWICK	Wilmington	Minor	Non-Municipal	30757
NC0043745	COLUMBUS CO SCH-OLD DOCK ELEM	COLUMBUS	Wilmington	Minor	Non-Municipal	30757
NC0045250	BRUNSWICK CO BOE-BOLIVIA ELEM	BRUNSWICK	Wilmington	Minor	Non-Municipal	30759
NC0005762	WESTPOINT/STEVENS, INC.	SCOTLAND	Fayetteville	Major	Industrial	30751
NC0021661	LAURINBURG, CITY-LIBBY/OWENS FORD WWTP	SCOTLAND	Fayetteville	Minor	Municipal	30755
NC0006785	NATIONAL SPINNING CO - W'VILLE	COLUMBUS	Wilmington	Minor	Industrial	30758
NC0037508	MOORE CO WWTP	MOORE	Fayetteville	Major	Municipal	30750
NC0020729	FAIR BLUFF WWTP, TOWN OF	COLUMBUS	Wilmington	Minor	Municipal	30751
NC0024571	LUMBERTON, CITY-WWTP	ROBESON	Fayetteville	Major	Municipal	30751
NC0027103	PEMBROKE, TOWN-WWTP	ROBESON	Fayetteville	Major	Municipal	30751
NC0025577	RED SPRINGS, TOWN - WWTP	ROBESON	Fayetteville	Major	Municipal	30752
NC0044725	LAURINBURG-MAXTON AIRPORT	SCOTLAND	Fayetteville	Major	Municipal	30752
NC0020095	ST. PAULS WWTP, TOWN OF	ROBESON	Fayetteville	Minor	Municipal	30753
NC0026921	PARKTON WWTP, TOWN OF	ROBESON	Fayetteville	Minor	Municipal	30753
NC0026352	BLADENBORO WWTP, TOWN OF	BLADEN	Fayetteville	Minor	Municipal	30753
NC0021059	FAIRMONT, TOWN - REGIONAL WWTP	ROBESON	Fayetteville	Minor	Municipal	30754
NC0069612	ROWLAND, TOWN - WWTP	ROBESON	Fayetteville	Minor	Municipal	30755
NC0020656	LAURINBURG, CITY-LEITHS CRK WWTP	SCOTLAND	Fayetteville	Major	Municipal	30755
NC0027120	MAXTON WWTP, TOWN OF	ROBESON	Fayetteville	Minor	Municipal	30755
NC0021881	LAKE WACCAMAW, TOWN-WWTP	COLUMBUS	Wilmington	Minor	Municipal	30756
NC0026000	TABOR CITY, TOWN-WWTP/BYPASS	COLUMBUS	Wilmington	Major	Municipal	30757
NC0021610	CLARKTON WWTP, TOWN OF	BLADEN	Fayetteville	Minor	Municipal	30758
NC0021920	WHITEVILLE, CITY-WWTP	COLUMBUS	Wilmington	Major	Municipal	30758
NC0021865	CHADBOURN, TOWN - WWTP	COLUMBUS	Wilmington	Major	Municipal	30758

Appendix III

Water Quality Data Collected by DWQ

- **Benthic Macroinvertebrate Collections**
- **Fish Community Assessments**

Benthic macroinvertebrate collections in the Lumber River basin, 1983-1996.

LUM 50

Site	Map #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Drowning Cr, SR1124, Moore	B-1	14-2-(1)	02/89	-/35	-/3.45	Good
White Cedar Br, nr SR 1465, Richmond	B-2	14-2-(1)*	03/86	47/10	5.01/2.97	Good
			02/84	35/10	4.59/2.78	Good
Jackson Cr, SR1122, Moore	B-3	14-2-5	07/96	-/25	-/2.88	Excellent
			02/89	-/26	-/3.39	Good
Naked Cr, SR1003, Richmond	B-4	14-2-6	07/96	81/33	4.60/3.46	Excellent
			09/91	94/35	4.55/2.89	Excellent
			11/90	83/31	5.12/3.89	Excellent
			07/90	80/34	4.50/3.02	Excellent
			05/90	-/39	-/3.45	Excellent
			04/90	92/42	4.77/3.15	Excellent
			01/90	94/46	4.44/3.29	Excellent
			01/90	-/37	-/3.13	Excellent
			02/89	-/46	-/3.20	Excellent
			10/86	98/33	4.66/2.95	Excellent
			03/85	101/35	4.28/2.78	Excellent
			12/84	93/37	4.55/2.95	Excellent
			02/84	85/35	4.25/2.72	Excellent
			05/83	86/32	4.59/3.12	Excellent
Joe's Br, nr SR 1003, Richmond	B-5	14-2-6	05/90	-/16	-/3.10	Excellent
			03/85	40/14	4.59/3.60	Good
			02/84	45/13	4.74/3.35	Good
Rocky Ford Br, SR 1424, Richmond	B-6	14-2-6-1	05/90	-/27	-/3.93	Excellent
Drowning Cr, SR 1004, Richmond	B-7	14-2-(6.5)	07/96	74/34	4.46/3.09	Excellent
			09/91	90/39	4.50/2.81	Excellent
			02/89	-/40	-/2.65	Excellent
			07/88	87/30	4.68/2.77	Excellent
			09/85	74/28	4.36/2.76	Excellent
Horse Cr, SR 1102, Moore	B-8	14-2-10	07/96	-/28	-/2.78	Excellent
			09/91	-/26	-/2.39	Excellent
UT Deep Cr, nr SR 1004, Moore	B-9	14-2-10-1-(1)!	03/86	48/13	5.07/2.90	Excellent
			02/84	49/12	4.64/2.72	Excellent
Aberdeen Cr, SR 1102, ab WWTP Moore	B-10	14-2-11-(6)	10/87	-/23	-/3.17	Good
Aberdeen Cr, below WWTP, Moore	B-11	14-2-11-(6)	10/87	-/21	-/3.92	Good
Quewhiffle Cr, SR 1214, Hoke	B-12	14-2-14	04/89	40/12	4.94/3.46	Fair
			01/84	27/4	6.47/3.75	Fair
Quewhiffle Cr, Sr 1225, Hoke	B-13	14-2-14	04/89	73/26	4.69/2.99	Good
			01/84	79/22	4.74/3.06	Good

! very small stream, index number of the receiving stream is listed.

LUM 51

Site	Map#	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Lumber R, SR 1404 nr Wagram, Scotland	B-1	14-(3)	07/96	75/33	4.04/2.97	Excellent
			05/94	104/46	4.49/3.17	Excellent
			09/91	83/30	5.12/3.19	Excellent
			10/86	85/36	4.96/3.64	Excellent
			07/86	88/30	5.06/3.69	Excellent
			10/85	89/34	4.98/2.84	Excellent
Buffalo Cr, SR 1203, Hoke	B-2	14-2.5	01/84	69/22	5.30/4.03	Good

LUM 51 (cont'd)

Site	Map#	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Lumber R, SR 1433, below JP Stevens, Scotland	B-3	14-(3)	07/86	89/30	5.02/3.59	Excellent
			10/85	90/29	5.28/3.29	Good
Lumber R nr Maxton, NC 71, Robeson	B-4	14-(4.5)	07/96	69/27	4.75/3.49	Excellent
			05/94	85/29	4.91/3.51	Good
			09/91	77/22	5.51/4.05	Good
			08/90	91/25	8.84/4.39	Good
			07/88	88/29	5.23/3.58	Excellent
			10/86	69/27	5.05/3.49	Excellent
			07/85	74/22	5.18/4.01	Good
			04/85	97/36	5.77/3.85	Excellent
Lumber R, SR 1303, Robeson	B-5	14-(4.5)	04/85	79/32	5.43/3.48	Excellent
Lumber R, SR 1153, Robeson	B-6	14-(4.5)	04/85	88/38	5.44/3.91	Excellent
Lumber R, SR 1354, Robeson	B-7	14-(4.5)	10/86	73/26	5.14/3.63	Excellent
			07/86	71/25	4.92/3.94	Excellent
Lumber R nr Pembroke, SR 1003, Robeson	B-8	14-(7)	07/96	71/31	4.72/3.78	Excellent
			09/91	86/30	5.73/3.85	Excellent
			08/90	87/28	5.26/4.09	Excellent
			07/88	88/28	5.14/4.22	Excellent
			10/86	82/31	5.22/3.56	Excellent
			07/86	84/32	5.21/4.03	Excellent
			07/85	84/30	5.25/4.24	Excellent
			07/83	95/30	5.39/3.90	Excellent
Lumber R, NC 72, Robeson	B-9	14-(7)	09/91	67/27	5.96/4.48	Good
Back Swp, US 301, Robeson	B-10	14-8	09/91	- /15	-/4.85	Good-Fair
Bear Swp, SR 1339, Robeson	B-11	14-9-(1.5)	03/96	58/20	6.11/5.26	Good*
Lumber R, NC 41, Robeson	B-12	14-(13)	07/96	73/30	5.33/4.19	Excellent
Lumber R ab Lumberton, SR 2289, Robeson	B-13	14-(13)	09/91	84/29	5.67/3.86	Good
			07/86	73/28	5.80/4.21	Good
			10/85	91/29	5.57/3.97	Good
			07/85	78/28	6.03/4.56	Good
Lumber R ab Alpha Cellulose, SR 2202, Robeson	B-14	14-(13)	07/85	62/15	6.56/3.71	Good-Fair
Lumber R ab WWTP, Robeson	B-15	14-(13)	07/86	77/22	6.75/4.31	Good-Fair
			10/85	75/19	6.63/3.59	Good-Fair
Lumber R be WWTP, SR 1620/NC 72, Robeson	B-16	14-(13)	07/96	57/15	6.33/4.38	Good-Fair
			07/86	43/5	8.08/7.03	Poor
			07/85	65/15	7.35/4.18	Good-Fair
Lumber R, US 74, Robeson	B-17	14-(21)	07/96	82/26	5.34/4.26	Good
			09/91	53/20	4.86/4.01	Good
			07/88	92/27	5.46/4.27	Excellent
			06/86	73/27	5.70/4.43	Good
Lumber R, NC 904, Robeson	B-18	14-(21)	07/96	81/30	5.05/3.65	Excellent
			09/91	69/23	4.79/3.94	Excellent
Porter Swp, SR 1503, Columbus	B-19	14-27	03/96	41/6	7.34/3.20	Fair*
			03/92	60/6	7.66/6.94	Not Rated
			09/91	- /3	-/6.59	Not Rated
Gapway Swp, SR 1356, Columbus	B-20	14-31	03/96	57/16	7.08/5.88	Fair*

LUM 52

Site	Map#	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Raft Swamp, NC 211, Robeson	B-1	14-10-(1)	09/91	-/16	-/4.64	Good-Fair
		14-10-(1)	12/88	75/24	6.28/4.86	Good-Fair
Raft Swamp, SR 1526, Robeson	B-2	14-10-(5.5)	12/88	87/30	6.24/5.02	Good-Fair
Burnt Swamp, ab RR, Robeson	B-3	14-10-8-4-(0.5)	06/91	41/4	7.09/5.88	Not Rated
Burnt Swamp, SR 1515, Robeson	B-4	14-10-8-4-(0.5	06/91	44/5	7.40/5.59	Not Rated

LUM 53

Site	Map#	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Big Swamp, NC 211, Robeson	B-1	14-22	07/96	-/15	-/4.24	Good-Fair
			09/91	59/14	6.20/3.93	Good-Fair
Big Swamp, SR 1002, Robeson	B-2	14-22	09/91	61/15	6.10/3.77	Good-Fair
Gallberry Swp, NC 20, Robeson	B-3	14-22-1	09/91	-/19	-4.40	Good
Big Marsh Swp, ab Croft Metals, Robeson	B-4	14-22-2	08/92	45/10	6.76/6.11	Not Rated
Big Marsh Swp, be Croft Metals, Robeson	B-5	14-22-2	08/92	49/10	6.85/5.87	Not Rated
Big Marsh Swp, SR 1924, Robeson	B-6	14-22-2	09/91	-/16	-/4.67	Good-Fair
Jackson Swp, SR 2100, Robeson	B-7	14-22-3-7	03/92	69/10	7.61/5.65	Not Rated

LUM 54

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Ashpole Swp, NC 41, Robeson	B-1	14-30	03/96	51/10	6.67/5.84	Good*
			09/91	-/8	-/5.64	Not Rated
Ashpole Swp, SR 2258, Robeson	B-2	14-30	06/86	45/3	8.08/7.79	Not Rated
Hog Swamp, SR 2262, Robeson	B-3	14-30-7	03/96	51/13	6.66/6.10	Good*
			09/91	-/8	-/6.62	Not Rated
Indian Swp, SR 2255, Robseson	B-4	14-30-8	03/92	57/4	8.27/5.75	Not Rated

LUM 55

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Gum Swp Cr, SR 1323, Scotland	B-1	14-32-(7)	07/96	-/15	-/2.71	Good-Fair
			09/91	-/17	-/2.86	Good-Fair
Gum Swp Cr, SR 1319, Scotland	B-2	14-32-(10)	02/90	51/16	5.37/4.53	Good-Fair
Gum Swp Cr, be Fieldcrest Mills, Scot.	B-3	14-32-(10)	02/90	39/17	6.31/4.63	Good-Fair
Gum Swp Cr, US15/401, Scotland	B-4	14-32-(12)	07/96	100/21	3.52/3.45	Good
			09/91	90/24	3.90/3.85	Excellent
Leiths Cr, SR 1610, Scotland	B-5	14-33	09/91	-/12	-/5.95	Good-Fair
Jordan Cr nr Silver Hill, Scotland	B-6	14-34-4-(1)	03/86	43/13	4.83/2.96	Good
			02/84	39/11	4.75/3.24	Good
Jordan Cr, US 401, Scotland	B-7	14-34-4-(2)	07/96	-/15	-/3.17	Good-Fair
(Big) Shoeheel Cr, SR 1369, Scotland	B-8	14-34	09/90	82/27	2.95/1.91	Good
(Big) Shoeheel Cr, SR 1612, Scotland	B-9	14-34	09/90	76/19	3.20/2.57	Good-Fair
(Big) Shoeheel Cr, SR 1101, Robeson	B-10	14-34	07/96	68/25	4.51/3.54	Excellent
			09/91	75/26	5.41/3.67	Excellent
			08/90	80/28	5.31/3.78	Excellent
			07/87	73/24	4.83/3.58	Excellent
			09/85	70/22	5.03/3.94	Good

LUM 56

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Waccamaw River, below dam, Columbus	B-1	15-(1)	06/91	55/13	6.39/4.92	Good-Fair
Waccamaw River, Crusoe Is., Columbus	B-2	15-(1)	06/91	84/28	5.88/4.47	Good
Friar Swp, SR 1740, Columbus	B-3	15-2-6-3	03/96	48/12	6.32/6.11	Good*

LUM 56 (Cont'd)

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Slap Swp, SR 1740, Columbus	B-4	15-2-6-4	03/96	45/6	7.34/6.20	Fair*

LUM 57

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Waccamaw River, SR 1928, Columbus	B-1	15-(1)	06/91	78/27	5.30/4.14	Excellent
Waccamaw River, NC 130, Columbus	B-2	15-(1)	09/97	54/19	6.38/4.55	Good-Fair
			06/91	94/27	6.08/4.23	Good
			08/90	78/19	6.43/4.06	Good-Fair
			06/87	72/19	6.08/4.83	Good-Fair
			07/84	89/21	6.24/4.70	Good-Fair
Juniper Cr, NC 211, Brunswick	B-3	15-7	06/91	30/3	6.62/5.62	Not Rated
Juniper Cr, SR 1928, Columbus	B-4	15-7	06/91	50/10	6.53/4.29	Not Rated
Grissett Swp, SR 1173, Columbus	B-5	15-17-1-(5)	09/91	-/5	-/6.92	Not Rated
Monie Swp, SR 1006, Columbus	B-6	15-17-1-12	03/96	33/6	7.34/6.75	Good-Fair*
			09/91	-/5	-/7.04	Not Rated
Waccamaw River, NC 904, Columbus	B-7	15-1	09/91	57/19	6.03/4.58	Good-Fair
Caw Caw Swp, SR 1305, Brunswick	B-8	15-23	07/96	-/5	-/5.72	Not Rated

LUM 58

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
White Marsh, ab US 74 Bus, Columbus	B-1	15-4	09/94	49/3	7.48/3.93	Not Rated
White Marsh, at old RR grade, Columbus	B-2	15-4	09/94	38/2	8.27/7.42	Not Rated
Brown Marsh Swp, SR 1700, Bladen	B-3	15-4-1-1-1	03/96	41/2	7.95/4.92	Fair*
Elkton Marsh, SR 1710, Bladen	B-4	15-4-1-1-2	03/96	37/5	7.33/6.44	Good-Fair*
Soules Swp, SR 1420, Columbus	B-5	15-4-8	03/92	63/6	8.27/7.42	Not Rated

LUM 59

Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Freshwater sites						
Lockwoods Folly, SR 1501, Brunswick	B-1	15-25-1-(1)	07/96	66/14	6.33/5.39	Good-Fair
			07/84	67/17	7.80/7.33	Good-Fair
Lockwoods Folly ab NC 211, Brunswick	B-2	15-25-1-(11)	09/91	38/2	7.64/6.77	Estuarine
Royal Oak Swp, NC 211, Brunswick	B-3	15-25-1-12	07/96	-/15	-/3.45	Good-Fair
Shallotte R nr US 17, Brunswick	B-4	15-25-2-(5)	07/96	50/9	6.32/5.59	Good-Fair
			09/91	58/11	6.80/5.79	Good-Fair
			07/83	48/7	6.86/5.59	Good-Fair
Estuarine sites						
ICWW, W Mkr 105, Brunswick	B-1	15-25	06/96	62/-	2.04/-	Moderate
ICWW, nr Mkr 105, Brunswick	B-2	15-25	06/96	79/-	1.95/-	Moderate
ICWW, Mkr 105, Brunswick	B-3	15-25	06/96	92/-	2.13/-	Moderate
ICWW, Ocean Isle Canal, Brunswick	B-4	15-25	06/96	105/-	2.18/-	Moderate
Lockwoods Folly R, Mkr 14, Brunswick	B-8	15-25-1-(16)	06/96	51/-	1.59/-	Moderate
Shallotte R, Shallotte Cr, Brunswick	B-10	15-25-2-(10)	06/96	106/-	2.27/-	Moderate
Calabash Cr, Mkr 7, Brunswick	B-11	15-25-5	06/96	48/-	1.57/-	Moderate

* Denotes streams rated with draft swamp criteria (ratings not used for use support)

Fish community assessments in the Lumber River Basin, 1990-1996.

Subbasin 50								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Drowning Cr	NC 73	Moore	1	14-2-(1)	31.9	5/31/96	44	G-F
						3/25/96	38	F
Naked Cr	SR 1003	Richmond	2	14-2-6	38	5/31/96	50	G
						3/25/96	42	F
Rocky Ford Br	SR 1424	Richmond	3	14-2-6-1	5.7	8/20/90	40	F
Subbasin 51								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Gum Swp	NC 71	Robeson	1	14-5	8.3	3/26/96	40	NR
						9/30/91	42	NR
Back Swp	SR 1003	Robeson	2	14-8-(2.5)	17	3/26/96	54	G
						7/24/91	40	F
Porter Swp	SR 1503	Columbus	3	14-27	65	3/27/96	40	NR
						4/29/92	42	NR
Subbasin 54								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Ashpole Swp	SR 2455	Robeson	1	14-30	76.7	10/22/92	42	NR
						7/25/91	44	NR
	NC 41	Robeson	2		94	3/26/96	42	NR
Subbasin 55								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
L Shoeheel Cr	SR 1405	Scotland	1	14-34-3	9.4	3/25/96	34	NR
						9/30/91	46	NR
Subbasin 56								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Friar Swp	SR 1740	Columbus	1	15-2-6-3	21.5	3/27/96	38	NR
Subbasin 57								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Juniper Cr	SR 1928	Columbus	1	15-7	150	12/11/91	46	NR
Grissett Swp	SR 1141	Columbus	2	15-17-1-(5)	69	4/29/92	46	NR
Toms Fork Cr	SR 1118	Columbus	3	15-17-1-10	16	4/29/92	42	NR
Monie Swp	SR 1006	Columbus	4	15-17-1-12	76	4/29/92	42	NR
Subbasin 58								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Brown Marsh Swp	SR 1700	Bladen	1	15-4-1-1	43	3/27/96	36	NR
	SR 1760	Bladen	2	15-4-1-1	52.4	8/11/92	36	NR
Subbasin 59								
Site	**Road**	**County**	**Map #**	**Index #**	**D.A. (mi^2)**	**Date**	**NCIBI**	**Class**
Lockwoods Folly R	US 17	Brunswick	1	15-25-1-(1)	20.6	4/2/96	38	NR
						4/28/92	40	NR
Royal Oak Swp	NC 211	Brunswick	2	15-25-1-12	31	4/25/92	52	NR
Cool Run	US 17	Brunswick	3	15-25-2-3	4.4	4/2/96	46	NR
						4/28/92	48	NR

[1] The NCIBI Classes are: NR=Not Rated, G = Good, G-F = Good-Fair, F = Fair, and P = Poor.

Appendix IV

Use Support Methodology

Use Support: Definitions And Methodology

A. 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 are presented in Section A, Chapter 3 and for each subbasin in Section B.

Surface waters (streams, lakes or estuaries) are rated as either *fully supporting* (FS), *fully supporting but 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 for freshwaters or SC for saltwaters) 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, but has some notable water quality problems. 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 not rated (NR).

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.

B. Interpretation of Data

The assessment of water quality presented in this document involved evaluation of available water quality data to determine a waterbody'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 and DEH shellfish sanitation surveys (as appropriate). 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 DWQ 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, DWQ 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, in many areas nonpoint source pollution has been determined to be 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.

C. 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 these data and translating the values to use support ratings corresponds closely to the 305(b) guidelines with some minor modifications.)

1. Biological Data

Benthic Macroinvertebrate Bioclassification

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 (EPTs) and the Biotic Index (BI) which summarizes tolerance data for all taxa in each collection. The bioclassifications are translated to use support ratings as follows:

Bioclassification	Rating
Excellent	Fully Supporting
Good	Fully Supporting
Good-Fair	Fully Supporting but 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	Fully Supporting
Good	Fully Supporting
Good-Fair	Fully Supporting but Threatened
Fair	Partially Supporting
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. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms, associated fish kills or interference with recreation or water supply uses are all considered.

Chemical/Physical Data

Chemical/physical water quality data are collected through the Ambient Monitoring System as discussed in Section A, Chapter 3. These data are 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

Assessments have been made for all publicly accessible lakes, lakes which supply domestic drinking water, and lakes where water quality problems have been observed.

2. 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.

a. 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 has failed its whole effluent toxicity tests 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 receive 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 potential source of impairment.

b. 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), land use reviews, and workshops held at the beginning of each basin cycle.

c. 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 was used if it was available.

3. Monitored vs. Evaluated

Assessments were made on either monitored (M) or evaluated (E) basis, whichever, depending on the level of information that was available. Streams are rated on a monitored basis if the data are 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.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) or fully supporting but 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 rated (NR).
- Because a monitored rating is based on more recent and site-specific data, it is treated with more confidence than an evaluated rating.

Refer to the following summary for an overview of assigning use support ratings.

Summary of Basis for Assigning Use Support Ratings to Freshwater Streams		
Overall Basis	**Specific Basis**	**Description**
Monitored	Monitored (M)	Monitored stream segments* with data** <5 years old.
	Monitored/Evaluated (ME)	Stream segment* is unmonitored but is assigned a use support rating based on another segment of same stream for which data** <5 years old are available.
Evaluated	Evaluated (E)	Unmonitored streams that are direct or indirect tributaries to stream segments rated FS or ST.
	Evaluated/Old Data (ED)	Monitored stream segments* with available data** >5 years old.
Not Rated	Not Rated (NR)	No data available to determine use support. Includes unmonitored streams that are direct or indirect tributaries to stream segments rated PS or NS.

* A stream segment is a stream, or a portion thereof, listed in the Classifications and Water Quality Standards for a river basin. Each segment is assigned a unique identification number (Index No.).

** Major data sources include: Benthic Macroinvertebrate Bioclassification; Fish Community Structure (NCIBI); Chemical/Physical Monitoring Data.

D. Assessment Methodology - Saltwater Bodies

Estuarine area are assess by the Division of Environmental Health (DEH) shellfish management areas. The following data sources are used when assessing estuarine areas.

1. DEH Sanitary Surveys

The DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Growing areas are sampled continuously and reevaluated every three years to determine if their classification is still applicable. Growing waters are classified as follows:

- *Approved Area* - an area determined suitable for the harvesting of shellfish for direct market purposes.
- *Conditionally Approved-Open* - waters that are normally open to shellfish harvesting but are closed on a temporary basis in accordance with management plan criteria.
- *Conditionally Approved-Closed* - waters that are normally closed to shellfish harvesting but are open on a temporary basis in accordance with management plan criteria.
- *Restricted Area* - an area from which shellfish may be harvested only by permit and subjected to an approved depuration process or relayed to an approved area.
- *Prohibited Area* - an area unsuitable for the harvesting of shellfish for direct market purposes.

2. Chemical/Physical Data

Water quality data are collected from estuarine ambient monitoring stations. Parameters are evaluated based on the salt waterbody classification and corresponding water quality standards.

3. 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 algae may discolor the water or form visible mates 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 5000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentrations approaching or exceeding 40 micrograms per liter (the NC standard) constitutes a bloom. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms, associated fish kills or interference with recreation or water supply uses are all considered.

Saltwaters are classified according to their best use. When assigning a use support rating, the waterbody's assigned classification is used with the above parameters to make a determination of use support. The following table describes how these factors are combined in use support determination.

DWQ Classification	DEH Shellfish Classification	Chemical/ Physical Data	Phytoplankton Data
Fully Supporting			
SA	Approved	standard exceeded ≤10% of measurements	no blooms
SB & C	Does not Apply	standard exceeded ≤10% of measurements	no blooms
Fully Supporting but Threatened			
SA	Conditionally Approved-Open	no criteria	no blooms
SB & SC	Does not Apply	no criteria	no blooms
Partially Supporting			
SA	Prohibited, Restricted or Conditionally Approved-Closed	standard exceeded 11-25% of measurements	blooms
SB & SC	Does not Apply	standard exceeded 11-25% of measurements	blooms
Not Supporting			
SA	Prohibited or Restricted	standard exceeded >25% of measurements	blooms
SB & SC	Does not Apply	standard exceeded >25% of measurements	blooms

In addition to the above categories, SA estuarine waters are not rated when categorized by DEH as prohibited because DEH does not sample them due to the absence of a shellfish resource. It is a federal requirement that DEH prohibit harvesting in such areas, although actual coliform concentrations are unknown.

It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) as to their suitability for shellfish harvesting, but different DWQ use classifications may be assigned to separate segments within DEH management areas. In determining use support, the DEH classifications and management strategies are only applicable to those areas that DWQ had assigned the use classification of SA. This will result in a difference of acreage between DEH areas classified as Prohibited or Restricted and DWQ waterbodies rated as PS. For example, if DEH classifies a 20-acre waterbody as prohibited, but only 10 acres have a DWQ use classification of SA, only those 10 acres classified as SA will be rated as partially supporting their uses. DWQ areas classified as SB and SC are rated using chemical/physical data and phytoplankton data.

E. Assigning Use Support Ratings

At the beginning of each assessment, all data are reviewed by subbasin with the monitoring staff, and data are 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 FS while the NCIBI may be PS). To resolve this, the final rating may defer to one of the samples (resulting in FS 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 FS 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 NR rating.

F. Revisions to Methodology Since 1992-1993 305(b) Report

Two significant changes to use support methodology have been made since the 1992-1993 305(b) report pertaining to the use of older information and fish consumption advisories.

Methodology for determining use support has been revised to more accurately reflect water quality conditions. In the 1992-1993 305(b) report, information from older reports and workshops were included in making use support determinations. Streams assessed using this information were rated on an evaluated basis, because the reports were considered outdated, and the workshops relied on best professional judgment since actual monitoring data were not available. In place of these older reports and workshop information, DWQ is now relying more heavily on data from its expanded monitoring network. 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. See the discussion above for more information on how 'monitored' versus 'evaluated' is defined.

Mercury levels in surface waters are primarily related to increases in atmospheric mercury deposition from global/regional sources, rather than from local surface water discharges. As a result, fish consumption advisories due to mercury have been posted in many areas (primarily coastal areas) of the state.

Waters with fish consumption advisories (mercury, dioxin, etc.) are no longer considered for use support determination. However, these waters will continue to appear on the 303(d) list, and management strategies will be developed for these waters as required by the Clean Water Act.

Use Support Information for Monitored Stream Segments in the Lumber River Basin, 1998

Name of Stream	Ambient Station	Station Location	Class	Index #	Miles	Chem. Rating, 94-97	Bioclassification 94	95	96	97	Fish Commun. Bioclass. 1996	Use Support Rating	Basis	Potential Sources (P,NP)
SUBBASIN 030750														
Jackson Creek		Jackson Creek at SR 1122, Moore Co.	WS-II	14-2-5	9.4				Excellent			S	M	
Naked Creek/UT Naked Creek		Naked/UT Naked Creek at/near SR 1003, Richmond Co .	WS-II ORW	14-2-6	16				Excellent		Good-Fair	S	M	
Drowning Creek		Drowning Creek near Hoffman at SR 1004, Richmond Co.	WS-II Sw	14-2-(6.5)	5.4				Excellent			S	M	
Drowning Creek			WS-II Sw CA	14-2-(9)	0.6							S	ME	
Horse Creek (Pinehurst Lake)		Horse Creek at SR 1102, Moore Co.	WS-II	14-2-10	10.2				Excellent			S	M	
Drowning Creek	02133500	Drowning Cr. at US HWY 1, near Hoffman, Richmond Co.	C Sw HWQ	14-2-(10.5)	6.9	S						S	M	
SUBBASIN 030751														
LUMBER RIVER			WS-V Sw HQW	14-(1)	4.3							S	ME	
LUMBER RIVER	02133616	Lumber River near Wagram at SR 1404, Scotland Co.	WS-IV B Sw HQW	14-(3)a	2.2	S	Excellent		Excellent			S	M	
LUMBER RIVER		Lumber River below JP Stevens at SR 1433, Scotland Co.	WS-IV B Sw HQW	14-(3)b	11.2							ST	M	P
LUMBER RIVER			WS-IV B Sw CA HQW	14-(4)	5.5							S	ME	
LUMBER RIVER	02133624	Lumber River near Maxton, NC Hwy. 71, Robeson Co.	B Sw HQW	14-(4.5)a	0.5	S			Excellent			S	M	
LUMBER RIVER		Lumber R. SR 1303 Robeson Co.	B Sw HQW	14-(4.5)b	2.5							S	M	
LUMBER RIVER		Lunber R. SR 1153 Robeson Co.	B Sw HQW	14-(4.5)c	2.4							S	M	
LUMBER RIVER		Lumber R. SR 1354 Robeson Co.	B Sw HQW	14-(4.5)d	5.9							S	M	
LUMBER RIVER	02133691	Lumber River near Pembroke at SR 1003, Robeson Co.	WS-IV B Sw HQW	14-(7)a	20	S			Excellent			S	M	
Back Swamp			C SW	14-8-(0.5)	9.1							S	ME	
Back Swamp		Back Swamp at US 301, Robeson Co. (91 bugs); at SR1003 (fis	WS-IV Sw	14-8-(2.5)	7.7						Good	S	M	
LUMBER RIVER			WS-IV Sw CA HQW	14-(10.3)	0.7							S	ME	
LUMBER RIVER			B Sw CA HQW	14-(11)	0.5							S	ME	
LUMBER RIVER		Lumber River atNC41(in 1996); SR 2289(earlier), Robeson Co.	C Sw	14-(13)a	2.7				Excellent			S	M	
LUMBER RIVER		Lumber R. above Alpha Cellulose, SR 2202, Robeson	C Sw	14-(13)b	0.7							ST	ME	
LUMBER RIVER		Lumber R. ab WWTP, Robeson	C Sw	14-(13)c	0.6							ST	ME	P
LUMBER RIVER		Lumber R. be WWTP, SR 1620/NC 72, Robeson	C Sw	14-(13)d	1.3				Good-Fair			ST	M	P
LUMBER RIVER	0213423350	Lumber R at SR2121,Lumber R. NC 74, Robeson	C Sw	14-(13)e	16.6	S			Good			S	M	
	02134500					S								
LUMBER RIVER	02134623	Lumber RiverNC 904, Robeson	C Sw	14-(13)f	18.4	S			Excellent			S	M	
LUMBER RIVER			B Sw	14-(28)	3.8							ST	ME	P
SUBBASIN 030753														
Big Swamp	02134488	Big Swamp near Richardson, NC Hwy. 211, Robeson Co.	C Sw	14-22a	15.4	S			Good-Fair			ST	M	
Big Swamp		Big Swamp, SR 1002, Robeson Co.	C Sw	14-22b	9.5							ST	M	
SUBBASIN 030754														
Ashpole Swamp		Ashpole Swamp at NC 41, Robeson Co.	C Sw	14-30a	18.8				NR(G)			S	ME	
Ashpole Swamp	0213460809	Ashpole Swamp at SR-2258, Robeson Co.	C Sw	14-30b	6.9	S						S	M	
SUBBASIN 030755														
Gum Swamp Creek (Pine L.)			C	14-32-(1)	8.5							ST	ME	
Gum Swamp Creek (Richmond Mill L.)		Gum Swamp at SR 1323, Scotland Co.	B	14-32-(7)	7.4				Good-Fair			ST	M	
Gum Swamp Creek (Lytchs Pond)		Gum Swamp at US 15-401, Scotland Co.	B Sw	14-32-(12)	12.6				Good			S	M	
Leith Creek (Johns Pond)	02132269	Leith Creek, SR 1610/1609, Scotland Co.	C Sw	14-33	20.7	S						ST	M	
Shoe Hill Creek		Big Shoe Heel Creek at SR 1369, Scotland	C SW	14-34a	12.3							S	M	
Shoe Heel Creek		Shoe Heel Creek at SR 1612, Scotland Co.	C Sw	14-34b	2.3							ST	M	

	Shoe Heel Creek	02132336	Shoe Heel Creek near Rowland at SR-1101, Robeson Co.	C Sw	14-34c	15.4	S						S	M	
	Jordan Creek		Jordan Ck at US 401, Scotland	C Sw	14-34-4-(2)	11.4				Good-Fair			ST	M	
SUBBASIN 030756															
	WACCAMAW RIVER	02108969	Waccamaw River , below dam, Columbus	C Sw	15-(1)a	0.2	S						ST	M	
	Lake Waccamaw			B Sw	15-2	28.8							S	M	
SUBBASIN 030757															
	WACCAMAW RIVER	02109500	Waccamaw River at NC 130, Columbus Co.	C Sw	15-(1)d	8.9	S				Good-Fair		ST	M	
	WACCAMAW RIVER			B Sw	15-(18)	8.4							ST	ME	
SUBBASIN 030759															
	Lockwoods Folly River		Lockwoods Folly at SR1501, Brunswick	C Sw	15-25-1-(1)	10				Good-Fair			ST	M	
	Royal Oak Swamp		Royal Oak Swp at NC211, Brunswick	C Sw	15-25-1-12	10				Good-Fair			ST	M	
	Shallotte River		Shallotte River near NC 17, Brunswick Co.	C Sw HQW	15-25-2-(1)	9				Good-Fair			ST	ME	

Appendix V

List of 303(d) Waters in the Lumber River Basin

LIST OF 303(D) WATERS IN THE LUMBER 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 improve water quality to the point that standards or uses are being met. Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters. A summary of the 303(d) process follows. More complete information can be obtained from *North Carolina's 1998 303(d) List* (DENR, 1998), which can be obtained by calling the Planning Branch of DWQ at (919) 733-5083.

303(d) List Development

Generally, there are four steps to preparing North Carolina's 303(d) list. They are: 1) gathering information about the quality of North Carolina's waters; 2) screening those waters to determine if any are impaired and should be listed; 3) determining if a total maximum daily load (TMDL) has been developed; and 4) prioritizing impaired waters for TMDL development. This document also indicates whether the Division of Water Quality (DWQ) intends to develop a TMDL as part of a Management Strategy (MS) to restore the waterbody to its intended use. The following subsections describe each of these steps in more detail.

Sources of Information

For North Carolina, the primary sources of information are the basinwide management plans, 305(b) reports and accompanying assessment documents, which are prepared on a five-year cycle. Basinwide management plans include information concerning permitting, monitoring, modeling and nonpoint source assessment by basin for each of the 17 major river basins within the state. Basinwide management allows the state to examine each river basin in detail and to determine the interaction between upstream and downstream, point and nonpoint pollution sources. As such, more effective management strategies can be developed across the state.

Listing Criteria

Waters whose use support ratings were not supporting (NS), partially supporting (PS) and fully supporting but threatened (ST), based on monitored information in the 305(b) report, were considered as initial candidates for the 303(d) list. Although support threatened waters currently meet their intended uses, if sufficient data indicate that they will become impaired in the next two years, they will be included on the 303(d) list.

Fish consumption advisory information was then reviewed to determine if other waters should be added to the list. Fish consumption advisories are no longer considered when determining use support since a fish advisory for mercury contamination in Bowfin was posted for the entire state in June 1997. While fish consumption advisories do indicate impairment, DWQ did not want to mask other causes and sources of impairment by having the entire state (or an entire basin) listed as impaired due to fish consumption advisories. However, DWQ believes that advisories on specific waters are cause to include the water on the 303(d) list; therefore, advisories other than the statewide Bowfin posting were considered when developing North Carolina's 303(d) list. Waters listed due to fish consumption advisories may have overall ratings of fully supporting (FS) or fully supporting but threatened (ST) because fish advisories are not considered in the 305(b) use support process.

Guidance from EPA on developing 1998 303(d) lists indicates that impaired waters without an identifiable problem parameter should not be included on the 303(d) list. However, DWQ feels

that waters listed in the 305(b) report as impaired for biological reasons, where problem parameters have not been identified, should remain on the 303(d) list. The Clean Water Act states that chemical, physical and biological characteristics of waters shall be restored. The absence of a problem parameter does not mean that the waterbody should not receive attention. Instead, DWQ should resample or initiate more intensive studies to determine why the waterbody is impaired. Thus, biologically impaired waters without identifiable problem parameters are on the 1998 303(d) list.

Assigning Priority

North Carolina is required to prioritize its 303(d) list in order to direct resources to those waters in greatest need of management. The CWA states that the degree of impairment (use support rating) and the uses to be made of the water (stream classification) are to be considered when developing the prioritization. In addition, DWQ reviews the degree of public interest and the probability of success when developing its prioritization schemes. Waters harboring endangered species are also given additional priority. A method to assign ratings to freshwaters that have recent data indicating impairment has been devised based on these criteria.

Estuarine areas were also prioritized. Fecal coliforms have impacted shellfish water use in the Lumber River basin. Estuarine responses to fecal coliform loads are difficult to capture using deterministic water quality models, and the results tend to be more suspect than results for processes that are better understood such as those for nutrients. The probability of developing a defensible numeric loading target may be low for fecal coliforms.

The prioritization process results in ratings of high, medium and low. Generally, waters rated with the highest priority are classified for water supply, rated not supporting, and harbor an endangered species. Waters receiving a high priority are important natural resources for the State of North Carolina and generally serve significant human and ecological uses. High priority waters will likely be addressed first within their basin cycles.

EPA recently issued guidance that suggested states should develop TMDLs and management strategies on all of their impaired waters within the next eight to thirteen years. To meet this federal guidance, the DWQ is striving to address all waters on the 1998 303(d) list that have a priority of high, medium or low within the next 10 years. Numeric TMDLs, if proper technical conditions exist, and management strategies will be developed for these waters. The DWQ is currently reviewing its resource needs in order to meet this aggressive schedule.

Other priorities have also been assigned to waters. A monitor priority indicates that the waterbody is listed based on: 1) data older than 5 years; 2) biological monitoring and no problem pollutant has been identified; or 3) biological monitoring that occurred in waters where we now have evidence that the biological criteria should not have been applied. These waters will be resampled before a restorative approach is developed because more information is required about the actual use support or cause of impairment. Further information on the monitoring approaches that have a monitor priority is provided in the next section.

The final priority listed on the 303(d) list is N/A for not applicable. This priority was assigned to waters that DWQ believes will meet their uses based on the current management strategies. DWQ will not develop a new TMDL or management strategy for these waters unless data continue to indicate impairment, and sufficient time has passed for the waterbody to respond to the management action. An example of this priority is a water impaired by a point source, and the pollutant causing the impairment has been completely removed from the point source.

Targeted Waters for TMDL Initiation by April 2000

Draft numeric TMDLs have been calculated for the majority of the mercury impaired waters in the Lumber River basin and are available for review. Once these TMDLs are approved by EPA, these waters will be removed from the 303(d) list. North Carolina will continue to monitor these waters for mercury.

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 15A NCAC 2B .0300.

Subbasin – 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(s) – These may be a potential cause of impairment as identified in the use support. When a chemical problem parameter is identified, the parameter listed exceeded the state's water quality standards for that parameter. Biological impairment is based on data relating to benthic and fish habitat as well as community structure. Problem parameter(s) show a potential cause of impairment. There may be other unidentified causes contributing to the impairment. Problem parameters included in the 303(d) list are listed below:

Chla – chlorophyll *a*
Cl – chlorine
Cu – copper
DO – dissolved oxygen
Fecal – fecal coliform bacteria
Hg – mercury
NH_3 – ammonia
Nutr – nutrients
Pb – lead
pH – pH
Tox – toxicity
Turb – turbidity
Aq. Weeds – aquatic weeds
Biological Impairment – Impairment based on benthic/fish data
Fish Advisory – Fish advisory issued by DEH

Overall Rating – This column lists the overall use support rating. These values may be **NS** (not supporting), **PS** (partially supporting), **ST** (fully supporting but threatened), **FS** (fully supporting) and **NR** (not rated). A rating of not rated is typically assigned to waters that were sampled using biocriteria that may not apply, or there is no data available on the water. These waters appeared on earlier lists, and they continue to be listed for administrative reasons, but no TMDL or management strategy will be developed until we have updated information that the water continues to be impaired. For waters listed solely on the basis of fish consumption advisories, the rating may also be fully supporting (FS) or fully supporting but threatened (ST). The 305(b) report describes these use support ratings further. On 303(d) list of lakes, the overall use support rating is found in the column entitled "Overall Use Rating." Ratings for specific uses are found in the columns entitled "Fish Consumption", "Aquatic Life and Secondary Contact", "Swimming" and "Drinking Water."

Source – This column indicates which sources are the probable major sources of impairment.

Approach – This column indicates the approach DWQ will take to restore the waterbody. More than one approach may be listed. TMDLs are typically developed for DO, nutrients, ammonia and metals. Management strategies are typically done for pH, sediment, turbidity and fecal coliforms. Further information on each approach is provided below.

TMDL – A numeric TMDL (total, maximum, daily, load), as defined by EPA, will be developed.

MS – Management Strategy. These waters are on the list based on data collected within the five years prior to when the use support assessment was completed. A problem pollutant has been identified, but North Carolina cannot develop a numeric TMDL as EPA defines it. A management strategy may contain the following elements: further characterization of the causes and sources of impairment, numeric water quality goals other than TMDLs, and best management practices to restore the water.

RES – Resample. This waterbody was identified as being impaired based on water quality data that were greater than 5 years old at the time the use support assessment was performed. This waterbody will be resampled prior to TMDL or management strategy development to ensure the impairment continues to exist.

PPI – Problem Parameters Identification. Available chemical data do not show any parameters in violation of applicable standards, but biological impairment has been noted within the five years prior to use support assessment. DWQ will resample these waters for chemical and biological data to attempt to determine the potential problem pollutants. TMDLs or management strategies will be developed within 2 basin cycles of problem parameter identification.

SWMP – Swamp waters. This water may not actually be impaired. Swamp waters previously evaluated using freshwater criteria will continue to be monitored and will be reevaluated when swamp criteria are available.

Priority – Priorities of high, medium and low were assigned for waters identified as being impaired based on data that were not greater than 5 years of age at the time the use support assessment was done and for which a problem pollutant has been identified. All waters assigned a priority of high, medium or low will be addressed within the next two basin cycles. Priorities of monitor and N/A have also been assigned where appropriate. Further explanation on each of these is provided below:

High – Waters rated high are important resources for the state in terms of human and ecological uses. Typically, they are classified as water supplies, harbor federally endangered species, and are rated as not supporting. These waters will be addressed first within their basin cycles.

Medium – Waters rated medium may be classified for water supply or primary recreational use, may have state endangered or other threatened species, and may be rated as partially or not supporting.

Low – Waters rated low generally are classified for aquatic life support and secondary recreation (i.e., Class C waters) and harbor no endangered or threatened species.

Monitor – The waterbody is included on the 303(d) list based on:

1. data which is greater than 5 years of age when use support assessment is done (denoted by RES in approach column);
2. biological data collected within 5 years of use support assessment, but no problem pollutant has been identified (available chemical data show full use support – denoted by PPI in approach column);
3. freshwater biological criteria applied to swamp waters.

In general, waters given this priority based on recent biological data will be sampled prior to waters listed based on older information. All waters with this priority will be resampled as resources allow. Waters with a monitor priority will not have a management strategy or TMDL developed for it before updated sampling or analyses of the biological criteria is complete. Once updated sampling is done and problem pollutants have been identified, these waters will be addressed by either a management strategy or TMDL within two basin planning cycles (10 years).

N/A – DWQ believes that its current management strategy will address the water quality impairment, but it may take a number of years before standards are met. In this case, DWQ plans to continue monitoring the water to determine if improvements are occurring, but no new management strategy or TMDL will be developed unless sufficient time has passed for improvement to occur, and data indicate the water is still impaired.

The lakes table column entitled "Trophic Status" refers to the trophic status of the lake, a relative description of the biological productivity of the lake. The lake may be hypereutrophic, eutrophic, mesotrophic or oligotrophic. Oligotrophic lakes are nutrient poor and biologically unproductive. Mesotrophic lakes have intermediate nutrient availability and biological productivity. Eutrophic lakes are nutrient rich and highly productive. Hypereutrophic lakes are extremely eutrophic.

Table 1: Source Categories

ID	*Category*	*ID*	*Category*
0	POINT SOURCES	53	Placer mining
01	PS, Industrial	54	Dredge mining
02	PS, Municipal	55	Petroleum activities
03	PS, Municipal pretreatment (indirect dischargers)	56	Mill tailings
		57	Mine tailings
04	PS, Combined sewer overflows (end-of-pipe control)	58	Abandoned mines
05	PS, Storm Sewers (end-of-pipe control)	60	LAND DISPOSAL (Runoff /Leachate from permitted areas)
06	PS, Schools		
08	PS, Minor non-municipal	61	Sludge
		62	Wastewater
1	NONPOINT SOURCES	63	Landfills
10	AGRICULTURE	64	Industrial land treatment
11	Non-irrigated crop production	65	On-site wastewater systems (septic tanks, etc.)
12	Irrigated crop production	66	Hazardous waste
13	Specialty crop production (e.g., truck farming and orchard)	70	HYDROLOGIC /HABITAT MODIFICATIOI
14	Pasture land	71	Channelization
15	Range lots	72	Dredging, sand dipping
16	Feedlots – all types	73	Dam construction
17	Aquaculture	74	Flow regulation
18	Animal holding /management areas	75	Bridge construction
		76	Removal of riparian vegetation
20	SILVICULTURE	77	Streambank modification /destabilization
21	Harvesting, reforestation, residue management	78	Collapsed dam
22	Forest management	80	OTHER
23	Road construction/maintenance	81	Atmospheric deposition
		82	Waste storage /storage tank leaks
30	CONSTRUCTION	83	Highway maintenance and runoff
31	Highway /road/bridge	84	Spills
32	Land development	85	In-place contaminants
		86	Natural
40	URBAN RUNOFF	87	Marinas, harbors
41	Storm sewers (source control)	88	Airport
42	Combined sewers (source control)	89	Military activities (off-road)
43	Surface runoff		
44	Finger canals	90	SOURCE UNKNOWN
45	Industrial	91	General erosion (road erosion)
50	RESOURCE EXTRACTION /EXPLORATION /DEVELOPMENT		
51	Surface mining		
52	Subsurface mining		

RES – Resample. This waterbody was identified as being impaired based on water quality data that were greater than 5 years old at the time the use support assessment was performed. This waterbody will be resampled prior to TMDL or management strategy development to ensure the impairment continues to exist.

Lumber River Basin 303(d) List: Streams

Name of Stream	Description	Class	Index #	Subbasin	Miles	Problem parameter(s)	Overall rating	Sources	Approach	List Priority	TMDL Status
Drowning Creek	From source to Naked Creek	WS-II Sw	14-2-(1)	30750	20.5	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
Drowning Creek	From Naked Creek to Horse Creek	WS-II Sw	14-2-(6.5)	30750	5.4	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
Drowning Creek	From Horse Cr to point .4 mi upstream of US Hwy 1	WS-II Sw	14-2-(9)	30750	0.6	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
Drowning Creek	From a point .4 mi upstream of US Hwy 1 to Lumber R	C Sw	14-2-(10.5)	30750	6.9	pH,Cu Fish advisory (Hg)	S	81	TMDL, MS	Low	Drafted
Quewhiffle Creek	From Source to SR-1214, Hoke Co./SR-1214	C	14-2-14a	30750	2.8	Biologically impaired	S		SWMP	Monitor	
LUMBER RIVER	From NC Hwy 71 to SR 1303	B Sw	14-(4.5)b	30751	2.5	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
LUMBER RIVER	SR-1303 to SR-1153, Robeson Co./SR-1153	B Sw	14-(4.5)c	30751	2.4	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
LUMBER RIVER	SR-1153 to Seaboard Coast Line RR Bridge near Pembroke	B Sw	14-(4.5)d	30751	5.9	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
Gum Swamp	From source to Lumber River	C	14-5	30751	13	Biologically impaired	S		SWMP	Monitor	
LUMBER RIVER	From Seaboard Coast Line RR bridge to .5 mi upstream of Powell Br.	WS-IV B Sw	14-(7)a	30751	20	pH,Cu,Zn Fish advisory (Hg)	S	81	TMDL, MS	Low	Drafted
Back Swamp	From Roberson Co SR 1157 to Lumber River	WS-IV Sw	14-8-(2.5)	30751	7.7	Biologically impaired	S		SWMP	Monitor	
Burnt Swamp	From NC Hwy 72 to point above RR, Robeson Co	WS-IV Sw	14-10-8-4-(0.5)a	30752	1	Biologically impaired	ST		SWMP	Monitor	
Burnt Swamp	From point above RR to Richland Swamp	WS-IV Sw	14-10-8-4-(0.5)b	30752	3.3	Biologically impaired	ST		SWMP	Monitor	
LUMBER RIVER	From .5 mi upstream of Powell Br to Raw Water Supp, Intake for Lumberton	WS-IV Sw	14-(10.3)	30751	0.7	Fish advisory (Hg)	S	81	TMDL	Low	Drafted

Name of Stream	Description	Class	Index #	Subbasin	Miles	Problem parameter(s)	Overall rating	Sources	Approach	List Priority	TMDL Status
LUMBER RIVER	From Raw Water Supply Intake for City	B Sw	14-(11)	30751	0.5	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
LUMBER RIVER	HWY 301 to SR2289 /SR-2289, Robeson Co.	C Sw	14-(13)a	30751	2.7	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
LUMBER RIVER	From SR 2289 to Lumber R above Alpha Cellulose, SR 2202	C Sw	14-(13)b	30751	0.7	Fish advisory (Hg)	ST	81	TMDL	Low	Drafted
LUMBER RIVER	Lumber R. above Alpha Cell. at 2202 to above WWTP, Robeson Co.	C Sw	14-(13)c	30751	0.6	Fish advisory (Hg)	ST	02;81	TMDL	Low	Drafted
LUMBER RIVER	Above WWTP to below WWTP at SR-1620/72 Robeson Co.	C Sw	14-(13)d	30751	1.3	Fish advisory (Hg)	ST	02;81	TMDL	Low	Drafted
LUMBER RIVER	SR 1620 to NC 74, Robeson Co	C Sw	14-(13)e	30751	16.6	DO,pH,Cu,Zn Fish advisory (Hg)	S	02;81	TMDL, MS	Low	Drafted
LUMBER RIVER	From NC 74 to NC 904	C Sw	14-(13)f	30751	18.4	DO,pH Fish advisory (Hg)	S	02;81	TMDL	Low	Drafted
Big Swamp	From source to NC 211	C Sw	14-22a	30753	15.4	DO,pH,Fe Fish advisory (Hg)	ST	81	TMDL, MS	Low	Drafted
Big Swamp	From NC 211 to Lumber River	C Sw	14-22b	30753	9.5	Fish advisory (Hg)	ST	81	TMDL	Low	Drafted
Porter Swamp	From source to Lumber River	C Sw	14-27	30751	16.4	Fish advisory (Hg)	ST	81	TMDL, PPI	Low	Drafted
LUMBER RIVER	From N.C. Hwy. 904 to North Carolina-	B Sw	14-(28)	30751	3.8	Fish advisory (Hg)	ST	02;81	TMDL	Low	Drafted
Ashpole Swamp	From source to Hog Swamp	C Sw	14-30a	30754	18.8	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
Ashpole Swamp	From Hog Swamp to North Carolina-	C Sw	14-30b	30754	6.9	DO,pH,Fe,Zn Fish advisory (Hg)	S	81	TMDL, SWMP	Low	Drafted
Hog Swamp	From source to Ashpole Swamp	C Sw	14-30-7	30754	17.3	Biologically impaired	S		SWMP	Monitor	
Little Shoe Heel Creek	From source to Shoe Heel Creek	C Sw	14-34-3	30755	7.6	Biologically impaired	S		SWMP	Monitor	

Name of Stream	Description	Class	Index #	Subbasin	Miles	Problem parameter(s)	Overall rating	Sources	Approach	List Priority	TMDL Status
WACCAMAW RIVER	From source at dam at Lake Waccamaw to 0.1 mi below Lake Waccamaw	C Sw	15-(1)a	30756	0.2	Cu,Zn Fish advisory (Hg)	ST	81	TMDL	Low	Drafted
WACCAMAW RIVER	From 0.1 mile below dam to off SR 1930	C Sw	15-(1)b	30756	6.8	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
WACCAMAW RIVER	From site off SR 1930 to SR 1928	C Sw	15-(1)c	30756	3.5	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
WACCAMAW RIVER	From SR 1928 to NC 130	C Sw	15-(1)d	30757	8.9	DO,pH,Cu,Fe Fish advisory (Hg)	ST	02;81	TMDL, MS	Low	Drafted
WACCAMAW RIVER	From NC 130 to NC 904	C Sw	15-(1)e	30757	18.1	DO,pH,Fe,Zn Fish advisory (Hg)	ST	02;81	TMDL, MS	Low	Drafted
Big Creek	From source to Lake Waccamaw	C Sw	15-2-6	30756	5	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
White Marsh	From source to Welch Creek	C Sw	15-4c	30758	5.2	Fish advisory (Hg)	S	81	TMDL	Low	Drafted
White Marsh	Welch Creek to Richardson Swamp	C Sw	15-4a	30758	5.7	Fish advisory (Hg)	ST	02;81	TMDL	Low	Drafted
White Marsh	From Richardson Swamp to Waccamaw River	C Sw	15-4b	30758	12.6	Fish advisory (Hg)	S	02;81	TMDL	Low	Drafted
Brown Marsh	From source to Red Hill Swamp	C Sw	15-4-1-1	30758	4.8	Biologically impaired	S		SWMP	Monitor	
Toms Fork	From North Carolina-South Carolina border to Grisset Sw.	C Sw	15-17-1-10	30757	6.2	Biologically impaired	ST		SWMP	Monitor	
Monie Swamp	From source to Grissett Swamp	C Sw	15-17-1-12	30757	7.8	Biologically impaired	ST		SWMP	Monitor	
WACCAMAW RIVER	From N.C. Hwy. 904 to North Carolina-South Carolina Border	B Sw	15-(18)	30757	8.4	Fish advisory (Hg)	ST	81	TMDL	Low	Drafted

Number of stream segments: 42 **Total miles appearing on list:** 322.4

Lumber River Basin 303(d) List: Lakes

Name of Lake	Index # (or County)	Subbasin	Size (Acres)	Class	Overall Use Rating	Fish Consumption	Aquatic Life & Secondary Contact	Swimming	Drinking Water	Trophic Status	Problem Parameter(s)	Approach	Priority	TMDL Status
Lake Tabor	15-17-1-(1)	30757	70	B Sw	NS	PS	ST	N/A	N/A		Drained	N/A	N/A	
Pages Lake	14-2-11-(5)	30750	40	B	NS	PS	ST	N/A	N/A	Eutrophic	Drained, Fish Advisory-Hg	TMDL	Low	Drafted
Pit Links Lake	Moore	30750	Unknown		NE	NE	NE	NE	NE	NE	Fish Advisory-Hg	TMDL	Low	Drafted
Watson Lake	14-2-11-2	30750	Unknown	B	NE	NE	NE	NE	NE	NE	Fish Advisory-Hg	TMDL	Low	Drafted

Approach:
TMDL - Proper technical conditions exist to develop a TMDL for this waterbody/pollutant. Usual approach for nutrients, DO, Chla, and metals.
MS - A management strategy will be developed for this waterbody/pollutant.
N/A - Not applicable.

Lumber River Basin 303(d) List: Estuarine Areas

		Use Support (Acres)		Major Causes (Acres)				Major Sources (Acres)				
Area Name	DEH Area	Partially Supporting (PS)	Not Supporting (NS)	Fecal	DO	Chla	Metals	Point	Nonpoint	Source Descriptions	Approach	Priority
Calabash	A-1	1138	0	1138				0	1138	Urban runoff, septic systems, marinas	MS	Low
Shallotte River	A-2	571	0	571				0	571	Urban runoff, septic systems	MS	Low
Lockwoods Folly River	A-3	913	0	913				0	913	Urban runoff, septic systems, marinas	MS	Low
Total Acres		2622	0	2622				0	2622			
Percent		54.6%	0.0%	54.6%				0.0%	100.0%			

Major Sources:
Fecal coliform is the only cause of impairment of estuarine waters in this basin.
DEH surveys note that nonpoint sources are the major factor influencing water quality.
Point sources (WWTP) discharge into these waters but are operating efficiently, or it is noted that they are not negatively affecting shellfish waters.

Approach:

MS - A management strategy will be developed for this waterbody/pollutant.

Appendix VI

Lumber River Basin Nonpoint Source Program Description and Contacts

Agriculture

U.S. Department of Agriculture Natural Resources Conservation Service (NRCS):

This agency was formerly called the Soil Conservation Service. NRCS district conservationists:

- Certify waste management plans for animal operations.
- Provide certification training for swine waste applicators.
- Work with landowners on private lands to conserve natural resources and install BMPs.
- Help farmers and ranchers develop conservation systems unique to their land and needs.
- Administer several federal agricultural cost-share and incentive programs.
- Assist rural and urban communities to conserve and protect natural resources.
- Conduct soil surveys and offer farmers technical assistance on wetlands identification.

County/Area	Contact Person	Phone	Address
Area 2	Thomas Wetmore	336-637-2400	530 W. Innes St., Salisbury 28144
Area 3	David Combs	919-734-0961	134 N Johns St., Goldsboro 27530
Bladen	Donna Register	910-862-6936	Rm. 122, Ag. Services Ctr., Ice Pland Rd., Elizabethtown 28337
Brunswick	Joshua Spencer	910-253-2830	P.O. Box 26, Bolivia 28422
Columbus	Donna Register	910-642-2348	112 W. Smith St., Suite 120, Whiteville 28472
Hoke	John Ray	910-875-8685	Rm. 202, 122 W. Elwood Ave. Raeford 28376
Montgomery	Daryll Harrington	910-572-2700	2270 N. Main St., Troy 27371
Moore	Angela Hill	910-947-5183	Ag. Ctr., 707 Pinehurst Ave., Carthage 28372
Richmond	Vilma Marra	910-997-8244	125 S. Hancock St., Box 2, Rockingham 28379
Robeson	Ed Holland	910-739-5478	County Office Bldg., Hwy 72, Lumberton 28358
Scotland	Ed Holland	910-277-2433	231 E. Cronly St., Suite 800, Laurinburg 28352

County Soil and Water Conservation Districts:

District technicians:

- Administer the *Agriculture Cost Share Program for Nonpoint Source Pollution Control.*
- Identify areas needing soil and/or water conservation treatment.
- Allocate cost share resources and sign cost-share contracts with landowners.
- Provide technical assistance for planning and implementation of BMPs.
- Encourage the use of appropriate BMPs to protect water quality.

County	District Chairman	Phone	Address
Bladen	Greg Davis	919-862-6936	Rm. 122, Ag. Services Ctr., Ice Pland Rd., Elizabethtown 28337
Brunswick	Mamie Cason	910-253-2830	P.O. Box 26, Bolivia 28422
Columbus	Pamela Spivey	910-642-2348	112 W. Smith St., Suite 120, Whiteville 28472
Hoke	Kay Hendrix	910-875-8685	Rm. 202, 122 W. Elwood Ave. Raeford 28376
Montgomery	Lauri Thompson	910-572-2700	227-D N. Main St., Troy 27371
Moore	Jerry Hall	910-947-5183	Ag. Ctr., 707 Pinehurst Ave., Carthage 28372
Richmond	Larry Chandler	910-997-8244	P.O. Box 727, Rockingham 28379
Robeson	vacant	910-739-5478	County Office Bldg., Hwy 72, Lumberton 28358
Scotland	Bunny Anderson	910-277-2433	231 E. Cronly St., Suite 800, Laurinburg 28352

Agriculture (continued)

N.C. Division of Soil and Water Conservation (DSWC):

DSWC staff:

- Administer the *Agriculture Cost Share Program for Nonpoint Source Pollution Control* (ACSP).
- Allocate ACSP funds to the Soil & Water Conservation Districts.
- Provide administrative and technical assistance related to soil science and engineering.
- Distribute Wetlands Inventory maps for a small fee.

Office/Area	Contact	Phone	Address
Central Office	Dewey Botts (ACSP)	919-715-6108	512 N. Salisbury St. Raleigh 27626
Area 8	Sandra Weitzer	910-395-3900	127 Cardinal Dr. Ext., Wilmington 28405
Area 7	Kevin Williams	910-486-1541	Wachovia Bldg, # 714, Fayetteville 28301

N.C. Department of Agriculture (NCDA) Regional Agronomists:

NCDA technical specialists:

- Certify waste management plans for animal operations.
- Provide certification training for swine waste applicators.
- Track and monitor the use of nutrients on agricultural lands.
- Operate the state *Pesticide Disposal Program.*
- Enforce the state pesticide handling and application laws.

Office	Contact	Phone	Address
Central Office	Tom Ellis	919-733-7125	Box 27647 Raleigh 27611
Regional Office	Rick Morris	910-866-5485	3184 Old NC 41, Bladenboro, NC 28320
	David Dycus	919-776-9338	5022 Henley Rd, Sanford, NC 27330

Education

N.C. State University Cooperative Extension Service (CES):

CES staff provide practical, research-based information and programs to help individuals, families, farms, businesses and communities.

County	Contact Person	Phone	Address
Bladen	Kathy Dugan	910-862-4591	450 Smith Dr. Circle, Elizabethtown
Brunswick	Phil Ricks	910-253-2610	Government Ctr., P.O. Box 109, Bolivia 28422
Columbus	Dalton Dockery	910-640-6606	P..O. Box 569, Whiteville 28472
Hoke	J. Gary Warren	910-875-3461	116 W. Prospect Ave., Raeford 28376
Montgomery	Roger Galloway	910-576-6011	203 W. Main St., Troy 27371
Moore	Al Cooke	910-947-3188	Ag. Ctr., 707 Pinehurst Ave., Carthage 28372
Richmond	M. Todd Lowe	910-997-8255	P.O. Box 1358, 114 Franklin St., Rockingham 28379
Robeson	Everett Davis	910-671-3276	Owens Agriculture Ctr., 455 Caton Rd., P.O. Box 2280, Lumberton 28359-2280
Scotland	David Morrison	919-277-2422	231 E. Cronly St., Laurinburg 28352

Forestry

N.C. Division of Forest Resources (DFR):

DFR staff:

- Develop, protect, and manage the multiple resources of North Carolina's forests through professional stewardship.
- Enhance the quality of life for our citizens while ensuring the continuity of these vital resources.

Office/District	Contact Person	Phone	Address
Central Office	Moreland Gueth	919-733-2162	P.O. Box 29581 Raleigh 27626-0581
District 8	Bob Hausman	910-642-5093	1413 Chadburn Hwy., Whiteville 28472
District 6	Hunter Burkehead	910-437-2620	221 Airport Rd., Fayetteville 28306
District 3	Dave Andres	910-997-9220	1163 N. US Hwy. 1, Rockingham 28379

General Water Quality

N.C. Division of Water Quality, Water Quality Section (DWQ):

DWQ Water Quality Section staff:

- Implement water quality protection from point sources (municipal and industrial wastewater discharges) and from nonpoint sources (for example, land application of waste).
- Issue permits for both wastewater discharges and on-site wastewater treatment systems.
- Conduct compliance inspections.
- Monitor water quality throughout the state.
- Administer Section 319 grant projects statewide.

Office/Region	Contact Person	Phone	Address
Central Office	Greg Thorpe	919-733-5083	P.O. Box 29535 Raleigh 27626
Fayetteville Region	Paul Rawls	910-486-1541	Wachovia Bldg, # 714, Fayetteville 28301
Wilmington Region	Rick Shiver	910-395-3900	127 Cardinal Dr. Ext., Wilmington 28405

N.C. Wildlife Resources Commission (WRC):

WRC staff:

- Manage, restore, cultivate, conserve, protect, and regulates the State's wildlife resources.
- Administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fish, and other wildlife resources in a constructive, comprehensive, continuing, and economical manner.

Office/Region	Contact Person	Phone	Address
Central Office	Frank McBride	919-528-9886	1142 I-85 Service Rd., Creedmoor 27522
District Office	Keith Ashley	910-866-4250	102 Hillcrest Dr., Elizabethtown 28337

General Water Quality, continued

U.S. Army Corps of Engineers:

Corps staff:

- Investigate, develop and maintain the nation's water and related environmental resources.
- Construct and operate projects for navigation, flood control, major drainage, shore and beach restoration and protection.
- Develop hydropower.
- Conserve and enhance water supplies, fish and wildlife and outdoor recreation
- Respond to emergency relief activities directed by other federal agencies.
- Administer laws for the protection of navigable waters, emergency flood control and shore protection.
- Issue wetlands and 404 Federal Permits.

Office/Region	Contact Person	Phone	Address
Wilmington District	W.C. Long II	910-251-4745	P.O. Box 1890, Wilmington 28402-1890

N.C. Division of Water Quality, Groundwater Section:

DWQ Groundwater Section staff:

- Enforce groundwater quality protection standards and cleanup requirements
- Review permits for wastes discharged to groundwater.
- Issue permits for well construction
- Control underground injections.
- Administer and develop the well head protection program.
- Monitor ambient groundwater.

Office/Region	Contact Person	Phone	Address
Central Office	Carl Bailey	919-733-3221	P.O. Box 29578 Raleigh 27626-0578
Fayetteville Region	Art Barnhardt	910-486-1541	Wachovia Bldg, # 714, Fayetteville 28301
Wilmington Region	Charlie Stamen	910-395-3900	127 Cardinal Dr. Ext., Wilmington 28405

Construction/Mining

N.C. Division of Land Resources (DLR):

DLR staff administer the NC Erosion and Sedimentation Control Program for construction and mining operations.

Office/Region	Contact Person	Phone	Address
Central Office	Mell Nevils, Chief	919-733-4574	512 N. Salisbury St., Raleigh 27626
	Tracy Davis, Mining	919-733-4574	512 N. Salisbury St., Raleigh 27626
Fayetteville Region	Toby Vinson	910-486-1541	Wachovia Bldg, # 714, Fayetteville 28301
Wilmington Region	Dan Sams	910-395-3900	127 Cardinal Dr. Ext., Wilmington 28405

Solid Waste

N.C. Division of Waste Management (DWM):

DWM staff:

- Manage solid waste in a way that protects public health and the environment.
- Implement three programs -- Hazardous Waste, Solid Waste, Superfund, and the Resident Inspectors program.

Office/Region	Contact Person	Phone	Address
Central Office	Brad Atkinson	919-733-0692	401 Oberlin Rd, Suite 150, Raleigh 27605
Fayetteville Region	Terry Dover	910-486-1541	Wachovia Bldg, # 714, Fayetteville 28301
Wilmington Region	Anthony Foster	704-663-1699	127 Cardinal Dr. Ext., Wilmington 28405

On-Site Wastewater Treatment

N.C. Division of Environmental Health (DEH) and County Health Departments:

DEH and County Health Department staff:

- Safeguard life, promote human health and protect the environment through modern environmental health science, the use of technology, rules, public education and dedication to the public trust.
- Train and delegate authority to local environmental health specialists concerning on-site wastewater.
- Conduct engineering reviews for wastewater systems and industrial process wastewater systems with below-ground discharges.
- Provide technical assistance to local health departments, state agencies and industry.

County/Office	Contact Person	Phone	Address
Central	Martha Cardona	919-715-0141	2728 Capital Blvd., Raleigh 27604
Bladen	Troy Harrelson	910-862-6900	P.O. Box 188 Windsor 27983
Brunswick	Robert Odette	910-253-2250	P.O. Box 9, Bolivia 28422
Columbus	William Horne	910-642-5700	P.O. Box 810, Whiteville 28472
Hoke	Charles Eudy	910-875-8407	429 E. Central Ave., Raeford 28376
Montgomery	David Ezzell	910-572-8175	217 S. Main St., Troy 27371
Moore	Samuel Fields	910-947-2858	P.O. Box 279, Carthage 28327
Richmond	Partick Montgomery	910-997-8320	125 Caroline St., P.O. Box 429 Rockingham 28380
Robeson	Hugh Cole	910-671-3200	460 Country Club Rd, Lumberton 28358
Scotland	Teddy Locklear	910-277-2440	P.O. Box 69, Laurinburg 28352

- DENR Fayetteville Region covers the following counties within the Lumber basin: Bladen, Hoke, Montgomery, Moore, Richmond, Robeson and Scotland
- DENR Wilmington Region covers the following counties within the Lumber basin: Columbus and Brunswick

Appendix VII

Lumber River Basin Workshop Summaries

Public Workshop - - April 8, 1998 - - Bolivia, NC

Question 1 - What are the water quality related issues specific to the basin?

SHELLFISH CLOSURE	1. Shellfish Area Closures 2. Shellfish Closures 3. Shellfish Area Closures on the increase 4. Shellfish Closures
MERCURY / FISH TISSUE	1. Defining impacts in airshed 2. Contaminants in fish tissues - necessitating consumption advisories 3. Water Quality conditions adversely affecting aquatic ecosystems -i.e. contaminants
COASTAL DEVELOPMENT	1. Coastal Development 2. Population Growth 3. Development & Associated impacts
STORMWATER / NPS	1. Nutrient Loading 2. Stormwater 3. Riparian Corridor Impairment 4. Sedimentation 5. Nonpoint Source Pollution 6. Military Installations (Clean-Up)
POINT SOURCE IMPACTS	1. Assimilative Capacity Limits 2. Urban Waste Water

After prioritizing the top three issues from question #1, responses were provided to questions #2 and #3.

3 Top Issues	2. Actions That Can Be Taken to Address Each Issue	3. Groups That Can Implement Actions
Stormwater / NPS	1. Better determination / definition of NPS Sources 2. Educational outreach - educate public on BMP 3. They can use - regulation terminology interpretation 4. Local government develop stormwater plans if not in place	Extension Service Local Government
Coastal Development	1. Education for contractors 2. Enforcement / Development of regulations at local level	
Shellfish Closure	1. Public education of BMPs they can implement 2. Municipal comprehensive planning to address increasing population	Save Our Shellfish

Public Workshop - April 23, 1998 - Lumberton - Group 1

Question 1 - What are the water quality related issues specific to the basin?

NONPOINT SOURCE	1. Nonpoint Source Pollution 2. Point Source Pollution 3. Nonpoint Source Impact Qualification 4. Sediment and Erosion Runoff 5. Stormwater Runoff 6. Pollution and it's Source 7. NPS Discharge 8. Erosion Control along Construction Sites 9. Stormwater and Septic Tank Failure 10. Water Runoff of Urban Areas - Golf Courses 11. Groundwater Contamination from Swine Operations 12. Hog Factories
POINT SOURCE	1. Point Source Discharge - City and Industrial 2. City Sewage 3. Operation of Treatment Systems under a Single Authority
WATER QUANTITY	1. Supply of Groundwater for Irrigation 2. Low Flow / Assimilative Capacity 3. Lack of Adequate Low Flow / Swamp Model for Discharge Permits
WATER QUALITY	1. Excellent Conditions in my Area 2. Dissolved Oxygen Levels 3. Testing of Groundwater 4. Mercury Concentrations in Fish
POPULATION GROWTH / ECONOMIC DEVELOPMENT	1. Population / Urban Growth 2. Population Where in County 3. Economic Development 4. Why Public Attention Wasn't Requested Before Now - Since 1994

Public Workshop - April 23, 1998 - Lumberton - Group 1

After prioritizing the top three issues from question #1, responses were provided to questions #2 and #3.

Issues	Actions Needed For Each Issue	Local Groups to Initiate Actions For Each Issue
Nonpoint Source	1. Better Monitoring 2. Enforcement 3. Funding to Assess Current Environment 4. Isotope Testing 5. Identify Sources 6. Housekeeping / BMPs => Prevention 7. Education 8. Communication Between All Parties (Regulators and Public) 9. Determining Impact of NPS on Water Quality 10. Septic Tanks	1. County Government (Land Use Planning) 2. Cooperative Extension Service 3. Farm Bureau 4. Local Civic Clubs 5. Commodity Organizations 6. Environmental Groups / Organizations 7. State / Regional Governments 8. Media Organizations 9. Regional / Basinwide Stakeholders Group 10. Public Education System
Point Source	1. Enforcement (Better) 2. Funding Sources 3. Facility Improvement 4. Better Modeling of Receiving Waters 5. Regionalization 6. Improve Certification Process / Operator Sharing 7. Distribute Cost of Using Resource	
Water Quantity / Water Quality	1. Define Water Quality Classifications / STDS (Better Education) 2. Public Input into Management / Use Water Resources (Reuse Water)	

Public Workshop - April 23, 1998 - Lumberton - Group 2

Question 1 - What are the water quality related issues specific to the basin?

MUNICIPAL WASTE	1. Sewers from Small Towns 2. Rural Discharges in Rivers from Municipalities 3. Municipal Sanitary Sewer Upgrades 4. Better Sewer Discharges 5. Raw Sewage Leaked or Spilled 6. City Waste (Urban) - Agriculture Waste and Timber Construction
ANIMAL OPERATIONS	1. Livestock Production Facilities 2. Animal and Conventional Agriculture 3. Agricultural Runoff in Ditches, then to Streams - Pesticides, Fertilizers 4. Agricultural Runoff Croplands 5. Control Application Rates of Fertilizers in Agricultural Operations (mainly Nitrogen) 6. Groundwater and Surface Water Contamination - Livestock Operations
GOLF	1. Runoff from Golf Courses
INDUSTRIAL WASTE	1. Industrial Waste 2. Control Discharge from Industrial Facilities
MERCURY	1. Mercury in Water 2. Mercury
SHELLFISH	1. Closing of Shellfish Areas
EROSION	1. Erosion
GROWTH	1. Population Growth 2. Increasing Urbanization 3. Increase Housing and Manufacturing 4. Septic Tanks, Development
WETLANDS	1. Loss of Wetland Habitat
VOLUNTARY vs. MANDATORY REGULATIONS	1. How to Clean Up Quality of Water without Impairing Controls on Landowners
EDUCATION	1. Educating General Public on Importance of Keeping Basin Healthy

Public Workshop - April 23, 1998 - Lumberton - Group 2

After prioritizing the top three issues from question #1, responses were provided to questions #2 and #3.

Issues Each Issue	Actions Needed For Each Issue	Local Groups to Initiate Actions For
Education	1. Environmental Week 2. Public School Curriculum 3. Public Handout on Environment for Citizens 4. Public Handout on Environment for all Ethnic Groups	1. NC Forestry Environmental Camp 2. American Forestry Association (SAF) 3. 4-H (Soil and Water) 4. Lumber River Basin Committee
Municipal Wastes	1. Money ! 2. Education to Public	1. Clean Water Bowl 2. DWQ Construction Grants 3. Boy Scouts of America
Agriculture	1. Money ! 2. Education to Public	1. Farmers for Fairness 2. County Extension Offices 3. Farm Bureau 4. Soil and Water District 5. Banks
Growth	1. Land Use Planning 2. BMP's (Erosion Controls) 3. Septic Tank Development 4. Loss of Wetlands	1. League of Municipalities 2. ECU - Economic Center 3. Good Public Officials 4. UNCP

Public Workshop - April 23, 1998 - Lumberton - Group 3

Question 1 - What are the water quality related issues specific to the basin?

URBAN RUNOFF	1. Stormwater Runoff 2. Urban Growths Impact 3. Runoff from Urban and Suburban Areas a. Autos b. Fertilizer and Pesticides
NONPOINT SOURCE	1. Lumber Industry Runoff 2. Agricultural Runoff 3. Agriculture 4. Sediment 5. Sedimentation as Result of Development
ANIMAL OPERATIONS	1. Effluent from Hog Lagoons 2. Livestock Operations 3. NPS - Specifically the Growth of Animal Intensive Forms vs. Traditional Row-Crop Agriculture
MERCURY	1. Mercury Contamination 2. Mercury 3. Other Heavy Metals - Detrimental Impact 4. Atmospheric Deposition
POINT SOURCE	1. Municipal Supplies 2. Assimilative Capacity 3. Overflows

Public Workshop - April 23, 1998 - Lumberton - Group 3

After prioritizing the top three issues from question #1, responses were provided to questions #2 and #3.

3 Top Issues	Actions Needed For Each Issue	Local Groups to Initiate Actions For Each Issue
Sediments	1. Ag BMPs (no-till, etc.) 2. Continue Existing Program and Initiatives 3. Enforce Regulations	1. Extension Service 2. NCDA 3. SWC and NRCS 4. Local Zoning Department 5. Land Quality Section 6. American Canoe Association 7. Parks and Recreation
Animal Operations	1. Improved Waste Management, Approaches, and Treatment	1. Local Environmental Groups
Mercury / Other Atmospheric Deposition	1. Continue Monitoring and Studies	1. Existing Agencies
Urban Runoff	1. Collection and Treatment	1. Local Zoning Department

Public Workshop - April 23, 1998 - Lumberton - Group 4

Question 1 - What are the water quality related issues specific to the basin?

NONPOINT NUTRIENTS AND OTHER POLLUTANTS	1. Swampy Water Quality a. Low DO b. Assimilative Capacity c. Does not meet other biological specs (Hard to classify impaired or not) 2. Growth of Confined Livestock Operations - Disposal of Waste 3. Nutrient Level 4. Discharge of Pollutants such as Fertilizers 5. Sediment / Pollutants from Runoff
NATURAL FLOW ISSUES	1. Hurricanes 2. Beavers 3. Flooding / Damage Concerns
WASTEWATER TREATMENT / DISPOSAL	1. Sewage 2. Septic Tank Problems 3. Old Systems - Wastewater
DEVELOPMENT ISSUES	1. Urban Runoff 2. Flooding 3. Industrial Discharge 4. Industrial Waste 5. Challenges of Increased Use a. Population b. Recreation c. Development

Public Workshop - April 23, 1998 - Lumberton - Group 4

After prioritizing the top three issues from question #1, responses were provided to questions #2 and #3.

Issues	Actions That Can be Taken	Groups That Can Implement Actions to Address Each Issue
Nonpoint Nutrients and Other Pollutants	1. Increase BMP Use 2. Improve Treatment Facilities - Runoff from Animal Operations may be Problem - Needs BMPs 3. Groundwater Testing 4. Education is Key, e.g. Fertilizer - Home Fertilizer / Pesticide Use	1. Agencies 2. Business Community 3. Industry
Natural Flow Issues	1. Need to Restore Flows where impacted by Beavers / Storms 2. Manage Beaver Population	1. Cooperative Extension Service 2. Fertilizer Companies and Manufacturers 3. Merchants 4. Pesticide Licenses
Wastewater	1. Countywide / Regional Wastewater is Needed 2. Cost-Effectiveness vs. Development Density 3 Concentrate WWTPs around Population Centers	
Development Issues	1. Zoning / Land Use Planning should be a Local Issue - Each Area has its own Characteristics 2. Most Local Governments in Basin have Zoning / Planning 3. Increased Loads from Industry - Timber, Manufacturing Wastewater, Stormwater 4. Will be hard to handle Regulations under "Phase 2" and potentially "Phase 3" 5. Need $ Money $ 6. Increase Industrial BMP Use 7. Pretreatment	

Appendix VIII

Glossary of Terms and Acronyms

Glossary

30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The lowest average flow for a seven-day period that is expected to occur once every ten years. The 7Q10 flow is used to allocate the discharge of toxic substances to a stream. 7Q10 flows are typically obtained from the US Geological Survey.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
BMPs	See *best management practices.*
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.

coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
drainage area	An alternate name for a watershed.
DO	Dissolved oxygen.
DENR	Department of Environment and Natural Resources.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.

FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
MGD	Million Gallons Per Day.
NCIBI	North Carolina Index of Biotic Integrity. A measure of water quality factors affecting the fish in a given waterbody.
NH_3-N	Ammonia nitrogen.

nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.

river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins. These include the Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
ST	Fully supporting but threatened. A rating given to a waterbody that fully supports it designated uses, but has notable water quality problems.
sedimentation	The sinking and deposition of waterborne particles (e.g., sediment, algae and dead organisms).
Silviculture	Care and cultivation of forest trees; forestry.
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of "blackwater" streams.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses.

TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent testing. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant.