# CAPE FEAR RIVER BASINWIDE WATER QUALITY PLAN

July 2000

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***This document was approved and endorsed by the NC Environmental Management Commission on July 13, 2000 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Cape Fear River basin. This plan is the first five-year update to the Cape Fear River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in 1995.***

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# Executive Summary

## North Carolina's Basinwide Approach to Water Quality Management

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality for each of the seventeen major river basins in the state. Each basinwide plan is revised at five-year intervals. 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 stakeholders in the state. The first basinwide plan for the Cape Fear River basin was completed in 1996.

This document is the first five-year update of the *Cape Fear River Basinwide Water Quality Plan*. The format of this plan was revised in response to comments received during the first planning cycle. Much of the general information in the first plan was replaced by more detailed information specific to the Cape Fear River basin. A greater emphasis was placed on identifying causes and sources of pollution for individual streams in order to facilitate local restoration efforts.

Comments from three pubic workshops held in the basin were seriously considered during plan development. While all of the comments may not have been addressed to the satisfaction of the commentors, this input will help guide continuing DWQ activities in the basin.

## Goals of the Basinwide Approach

The primary goals of DWQ's basinwide program are to:

- identify water quality problems and restore full use to impaired waters;
- identify and protect high value resource waters;
- protect unimpaired waters while allowing for reasonable economic growth;
- develop appropriate management strategies to protect and restore water quality;
- assure equitable distribution of waste assimilative capacity for dischargers; and
- improve public awareness and involvement in the management of the state's surface waters.

## Cape Fear River Basin Overview

The Cape Fear River basin is the state's largest river basin. The river basin is located entirely within the state's boundaries and flows southeast from the north central piedmont region near Greensboro to the Atlantic Ocean near Wilmington.

The Cape Fear River is formed at the confluence of the Haw and Deep Rivers on the border of Chatham and Lee counties, just below the B. Everett Jordan Reservoir dam. From there, the river flows across the coastal plain past Fayetteville through three locks and dams to Wilmington before entering the ocean. The Black and Northeast Cape Fear Rivers are blackwater systems that meet the Cape Fear River in Brunswick County.

The basin includes four coastal Outstanding Resource Waters (Stump Sound, Middle and Topsail Sounds, and Masonboro Sound) and one inland ORW (a portion of the Black River basin).

Over one-half of the land in the river basin is forested. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service (NRCS), indicate that during the 10-year period from 1982 to 1992, there was a significant increase in the amount of developed land (43%). The basin contains 54% of the state's swine operations, and swine populations in the basin have increased 90% between 1994 and 1998.

There are many different aquatic ecosystems in the Cape Fear River basin with a wide variety commercial and recreational fisheries. Wetlands, estuaries, blackwater rivers and rocky streams support 30 endangered species in the basin.

The most populated regions of the basin are in and near the Triad area (Greensboro-Burlington-High Point), the Durham-Chapel Hill area and Fayetteville. The overall population density is 160 persons per square mile compared to a statewide average of 139 persons per square mile. The percent population growth over the 7-year period from 1990 to 1997 was 13.2% compared to a statewide increase of 12.0%. Estimated water usage in the basin is expected to increase nearly 95% (193 MGD in 1992 to 376 MGD by 2020).

**Assessment of Water Quality in the Cape Fear River Basin**

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses is an important method of interpreting water quality data and assessing water quality. This determination results in a use support rating. The use support ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are fully 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 are rated as partially supporting or not supporting, depending on the degree of exceedence. Streams rated as either partially supporting or not supporting are considered *impaired*.

Twenty percent of the monitored waters in the Cape Fear River basin are rated as impaired according recent data (Table 1). Most of the impaired stream miles are located near urbanized areas. Approximately 34% (2,037.1 miles) of the named freshwater streams in the basin are monitored.

Table 1 Use Support Summary Information for All Monitored and Evaluated Streams in the Cape Fear River Basin (1999)

| | Monitored and Evaluated Streams | | | Monitored Streams Only | |
|---|---|---|---|---|---|
| | **Miles** | **%** | | **Miles** | **%** |
| **Fully Supporting** | 4295.6 | 71 | | 1647.3 | 81 |
| **Impaired** | 403.2 | 7 | | 389.8 | 19 |
| *Partially Supporting* | *285.8* | *5* | | *276.2* | *13* |
| *Not Supporting* | *117.4* | *2* | | *113.6* | *6* |
| **Not Rated** | 1349.3 | 22 | | | |
| **Total Miles** | 6048.1 | | | 2037.1 | |

## Jordan Reservoir

Nutrient over enrichment is a continuing potential source of impairment to the waters in the B. Everett Jordan Reservoir watershed. The Clean Water Responsibility Act (House Bill 515) was enacted in 1997 to further address ongoing problems associated with waters classified as NSW. The Act sets limits for nitrogen (TN) and phosphorus (TP) discharges to NSW waters. The limits apply to facilities discharging more than 0.5 MGD and that were in operation or had authorization to construct prior to July 1, 1997 and all facilities issued authorization to construct after that date.

Senate Bill 1366 granted extensions to compliance dates in watersheds affected by House Bill 515. The extension includes conditions that the dischargers must meet, including development of a calibrated nutrient response model. The municipalities of Greensboro, Mebane, Reidsville, Graham, Pittsboro, Burlington, and the Orange Water and Sewer Authority requested compliance extensions from the nutrient limits, primarily because of nitrogen. Compliance extension requests were received by DWQ prior to the statutory deadline of January 1, 1999. South Durham, Durham RTP and Cone Mills did not apply for the extension. Triangle J and Piedmont Council of Governments are administering the project and have to hired a consultant to perform the modeling tasks. They will report to the EMC two times a year.

## Randleman Reservoir

In November 1998, waters in the proposed Randleman Reservoir watershed were reclassified to WS-IV CA. Rules have been adopted (15A NCAC 2B .0248 through .0251) to help prevent potential water quality problems in the proposed reservoir. The rules address point source discharges by not allowing new or expanding discharges into the watershed except for High Point Eastside WWTP. This facility will have to meet phosphorus limits established to protect water quality standards. The rules also address nonpoint source pollution in the Randleman Reservoir watershed with management strategies that maintain and protect riparian areas and require urban stormwater programs to be developed by local governments having land use authority in the watershed.

Highpoint Eastside WWTP will have to relocate its discharge point 1.5 miles downstream and establish effluent limits for phosphorus at a monthly average of 0.5 mg/l at a maximum flow of 26 MGD. Also, the facility would have to involve the EMC in any future decisions that might increase phosphorus above mass loading at 26 MGD and 0.5 mg/l.

Local governments are required to develop ordinances or modify existing water supply ordinances to protect riparian areas and implement stormwater management plans by January 1, 2000. All of the affected local governments have submitted their revised ordinances to meet the specifications set forth in the Randleman Lake Water Supply Watershed Nutrient Management Strategy (15A NCAC 2B .0248 through .0251) for approval by the EMC's Water Quality Committee.

**Recommended Management Strategies for Restoring Impaired Waters**

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

- identify and restore impaired waters in the basin;
- identify and protect high value resource waters and biological communities of special importance; and
- protect unimpaired waters while allowing for reasonable economic growth.

Impaired waters in the Cape Fear River basin and recommended strategies are summarized briefly in Table 2. For information on each stream segment refer to Section B.

Water quality problems are primarily attributed to nonpoint source pollution (NPS) and include urban runoff and sedimentation (resulting primarily from land clearing activities, loss of riparian vegetation and stormwater surges). However, some streams are degraded by point source pollution. For these streams, the plan presents a management strategy to reduce that pollutant source.

The task of quantifying nonpoint sources of pollution and developing management strategies for these impaired waters is very resource intensive. It is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments. Therefore, only limited progress towards restoring waters that are impaired by nonpoint sources can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems.

DWQ plans to further evaluate impaired waters in the Cape Fear River basin in conjunction with other agencies that deal with nonpoint source pollution issues and develop management strategies for a portion of these impaired waters for the next *Cape Fear River Basinwide Water Quality Plan*.

Table 2 Impaired Waters in the Cape Fear River Basin*

| Subbasin | Name of Stream | Miles | Rating | Major Source* | Management Strategy |
|---|---|---|---|---|---|
| 03-06-01 | Haw River | 7.7 | PS | NP | DWQ will monitor to evaluate extent of nonpoint source impacts from agricultural land uses. |
| 03-06-01 | Haw River | 20.1 | PS | NP | |
| 03-06-01 | Troublesome Creek | 15.6 | PS | NP | |
| 03-06-01 | Little Troublesome Creek | 3.3 | PS | NP | DWQ will monitor implementation of Phase II stormwater program. |
| 03-06-01 | Little Troublesome Creek | 5.0 | NS | NP | Develop TMDL for fecal coliform bacteria and stormwater program. |
| 03-06-02 | Haw River | 19.2 | PS | NP | Develop TMDL for fecal coliform bacteria and monitor to determine extent of nonpoint source pollution. |
| 03-06-02 | Brush Creek | 5.6 | PS | NP | Continue to monitor streams to evaluate implementation of Greensboro stormwater program. |
| 03-06-02 | Horsepen Creek | 6.1 | PS | NP | |
| 03-06-02 | Horsepen Creek | 1.6 | PS | NP | |
| 03-06-02 | Reedy Fork | 8.6 | PS | NP, P | Monitor to evaluate implementation of TMDL and Greensboro stormwater program in Buffalo Creek watershed. |
| 03-06-02 | North Buffalo Creek | 8.7 | NS | NP, P | Develop TMDL for fecal coliform bacteria and Greensboro stormwater program. |
| 03-06-02 | North Buffalo Creek | 8.1 | NS | NP, P | Develop TMDL to address ammonia and Greensboro stormwater program. |
| 03-06-02 | South Buffalo Creek | 14.8 | PS | NP | Greensboro stormwater program. |
| 03-06-02 | South Buffalo Creek | 3.3 | NS | NP | |
| 03-06-02 | South Buffalo Creek | 4.0 | NS | NP | Develop TMDL to address ammonia and Greensboro stormwater program. |
| 03-06-03 | Little Alamance Creek (Alamance County) | 12.3 | NS | NP | DWQ will monitor implementation of Phase II stormwater program. |
| 03-06-04 | Marys Creek | 9.7 | PS | NP | DWQ will monitor to evaluate extent of nonpoint source impacts from agricultural land use. |
| 03-06-04 | Robeson Creek | 5.6 | PS | NP, P | Develop TMDL to address nutrients. Local initiatives needed to address nonpoint source pollution. |
| 03-06-04 | Robeson Creek | 0.6 | PS | NP,P | |
| 03-06-05 | New Hope Creek | 0.5 | PS | NP | Develop TMDL for fecal coliform bacteria and Durham stormwater program. |
| 03-06-05 | New Hope Creek | 24.5 | PS | NP, P | |
| 03-06-05 | Northeast Creek | 2.6 | PS | NP, P | Develop TMDL for fecal coliform bacteria and Durham stormwater program. |
| 03-06-05 | Northeast Creek | 5.8 | PS | NP, P | |
| 03-06-06 | Little Creek | 5.4 | NS | NP | DWQ will monitor implementation of Phase II stormwater program. |
| 03-06-06 | Bolin Creek | 1.0 | PS | NP | |
| 03-06-06 | Booker Creek (Eastwood Lake) | 3.6 | PS | NP | |
| 03-06-06 | Booker Creek | 1.2 | PS | NP | |
| 03-06-06 | Booker Creek | 0.8 | PS | NP | |
| 03-06-06 | Little Creek | 0.7 | PS | NP | |
| 03-06-06 | Morgan Creek | 4.5 | PS | NP, P | |
| 03-06-06 | Meeting of the Waters | 1.4 | NS | NP | |
| 03-06-06 | Morgan Creek (including the Morgan Creek Arm of New Hope River Arm of Jordan Reservoir) | 0.6 | PS | NP, P | |
| 03-06-07 | Kenneth Creek | 3.7 | NS | NP, P | Local initiatives needed to address nonpoint source pollution. |
| 03-06-07 | Kenneth Creek | 3.6 | NS | NP, P | |

Table 2 Impaired Waters in the Cape Fear River Basin* (con't)

| Subbasin | Name of Stream | Miles | Rating | Major Source* | Management Strategy |
|---|---|---|---|---|---|
| 03-06-08 | East Fork Deep River | 6.5 | PS | NP | Monitor to evaluate continued implementation Greensboro stormwater program and evaluate nonpoint source impacts. |
| 03-06-08 | East Fork Deep River | 0.6 | PS | NP | |
| 03-06-08 | DEEP RIVER | 1.3 | PS | NP | |
| 03-06-08 | DEEP RIVER | 0.9 | PS | NP | |
| 03-06-08 | DEEP RIVER | 2.0 | PS | NP | Develop TMDL for fecal coliform bacteria and management strategy to address turbidity. |
| 03-06-08 | DEEP RIVER | 6.8 | PS | NP | |
| 03-06-08 | Richland Creek | 6.4 | NS | NP | Develop TMDL for fecal coliform bacteria and High Point stormwater program. |
| 03-06-08 | Richland Creek | 2.6 | NS | NP,P | |
| 03-06-09 | Haskett Creek | 5.9 | NS | NP | DWQ will monitor implementation of Phase II stormwater program. |
| 03-06-09 | Haskett Creek | 1.3 | NS | NP | |
| 03-06-10 | Cotton Creek | 2.2 | NS | P | DWQ will work with Star WWTP to evaluate and eliminate toxicity and determine extent of nonpoint source pollution. |
| 03-06-10 | Cotton Creek | 3.9 | PS | P | |
| 03-06-12 | Rocky River | 10.6 | PS | NP | DWQ will monitor to evaluate extent of nonpoint source impacts from agricultural land use. |
| 03-06-12 | Loves Creek | 2.8 | PS | NP | Local initiatives needed to address urban nonpoint source pollution. |
| 03-06-12 | Loves Creek | 0.5 | NS | NP, P | |
| 03-06-14 | Crane Creek (Crains Creek) | 28.3 | PS | NP | DWQ will monitor to evaluate extent of nonpoint source impacts from agricultural land use. |
| 03-06-15 | Cross Creek (Big Cross Creek) | 9.0 | NS | NP | DWQ will monitor to evaluate continued implementation of the Fayetteville stormwater program. |
| 03-06-15 | Cross Creek (Big Cross Creek | 0.5 | NS | NP | |
| 03-06-15 | Cross Creek (Big Cross Creek) | 3.5 | NS | NP | |
| 03-06-15 | Little Cross Creek | 7.0 | PS | NP | |
| 03-06-15 | Little Cross Creek | 0.5 | PS | NP | |
| 03-06-15 | Little Cross Creek | 0.3 | PS | NP | |
| 03-06-16 | Browns Creek (Cross Pond) | 8.5 | NS | NP | Local initiatives to address nonpoint source pollution. |
| 03-06-17 | CAPE FEAR RIVER | 3.8 | PS | P, NP | DWQ will monitor to evaluate source of impairment. |
| 03-06-19 | Stewarts Creek | 15.0 | PS | NP | DWQ will monitor to evaluate recovery from hurricanes. |
| 03-06-21 | Northeast Cape Fear River | 3.3 | NS | P | DWQ will continue to monitor impacts of discharges. |
| 03-06-22 | Muddy Creek | 14.0 | PS | NP | DWQ will monitor to evaluate recovery from hurricanes. |
| 03-06-22 | Rock Fish Creek (New Kirk Pond) | 5.3 | PS | NP, P | DWQ will monitor to evaluate recovery from hurricanes and desnagging operations. |
| 03-06-22 | Rock Fish Creek (New Kirk Pond) | 3.4 | PS | NP, P | |
| 03-06-23 | Burgaw Creek | 9.5 | NS | NP, P | DWQ will monitor to evaluate nonpoint source pollution. |
| 03-06-23 | Burnt Mill Creek | 4.8 | NS | NP | DWQ will monitor to evaluate nonpoint source pollution. |

Key: NS = Not Supporting PS = Partially Supporting
NP = Nonpoint sources P = Point Sources

+ = Only limited progress towards developing and implementing NPS strategies for these impaired waters can be expected without additional resources.

* = These waters are also on the 303(d) list, and a TMDL and/or management strategy will be developed to remove the water from the list.

### Addressing Waters on the State's 303(d) List

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a DWQ priority. Section 303(d) of the federal Clean Water Act requires states to develop a list of waters not meeting water quality standards or which have impaired uses. (The waters in the Cape Fear River basin that are on this list are discussed in the individual subbasin descriptions in Section B.) States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. EPA issued guidance in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list within 8-13 years.

There are approximately 2,387 impaired stream miles on the 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each listed water during a 13-year time frame will require the focus of many resources. It will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters. This task will be accomplished through the basinwide planning process and schedule.

### Challenges Related to Achieving Water Quality Improvements

To achieve the goal of restoring impaired waters throughout the basin, DWQ will need to work more closely with other state agencies and stakeholders to identify and control pollutants. The costs of restoration will be high, but several programs exist to provide funding for restoration efforts. These programs include the Clean Water Management Trust Fund, the NC Agricultural Cost Share Program, the Wetlands Restoration Program, and the federally funded Conservation Reserve Enhancement Program.

With increased development occurring, there will be significant challenges ahead in balancing economic growth with the protection of water quality. Point source impacts on surface waters can be measured and addressed through the basinwide planning process. Nonpoint sources of pollution can be identified through the basinwide plan, but actions to address these impacts must be taken at the local level. Such actions should include: development and enforcement of local erosion control ordinances; requirement of stormwater best management practices for existing and new development; development and enforcement of buffer ordinances; and land use planning that assesses impacts on natural resources. This basinwide plan presents many water quality initiatives and accomplishments that are underway within the basin. These actions provide a foundation on which future initiatives can be built.

# 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. Basinwide water quality plans are prepared by the NC Division of Water Quality for each of the seventeen major river basins in the state, 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. 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.

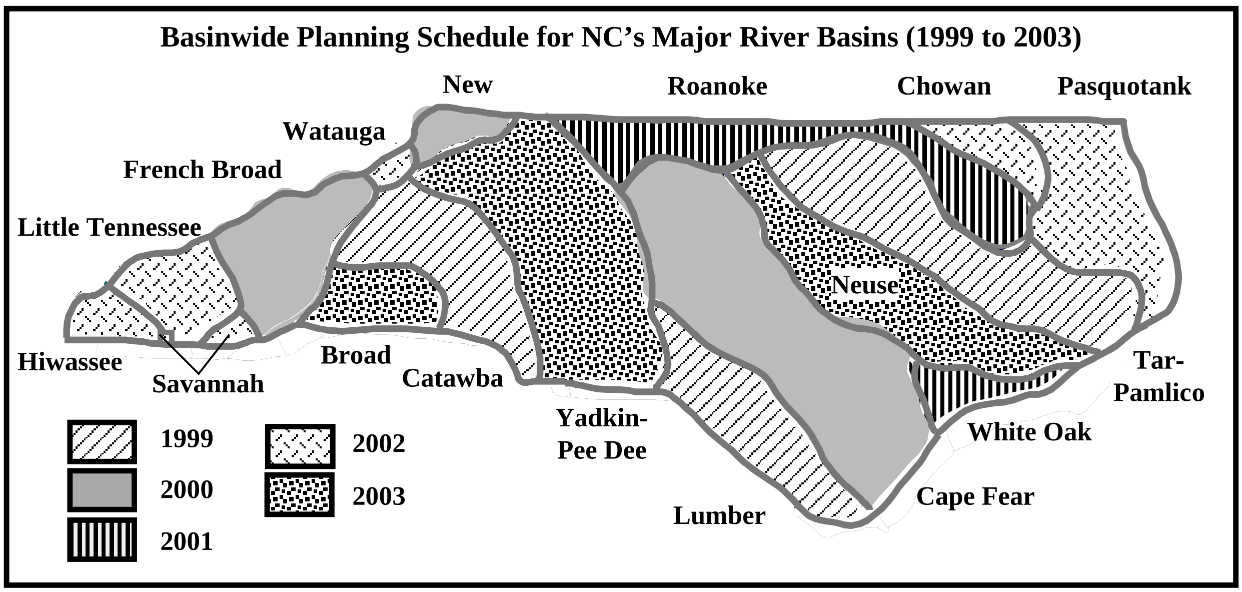


Figure A-1 Basinwide Planning Schedule (1999 to 2003)

## 1.2 Goals of Basinwide Water Quality Planning

The goals of basinwide management are to:

- identify water quality problems and restore full use to impaired waters;
- identify and protect high value resource waters;
- protect unimpaired waters while allowing for reasonable economic growth;
- develop appropriate management strategies to protect and restore water quality;
- assure equitable distribution of waste assimilative capacity for dischargers; and
- improve public awareness and involvement in the management of the state's surface waters.

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

| Basin | DWQ Biological Data Collection | River Basin Public Workshops | Public Mtgs. and Draft Out For Review | Final Plan Receives EMC Approval | Begin NPDES Permit Issuance |
|---|---|---|---|---|---|
| **Neuse** | Summer 95 | 3/1997 | 9/1998 | 12/1998 | 1/1999 |
| **Lumber** | Summer 96 | 4/1998 | 2/1999 | 5/1999 | 11/1999 |
| **Tar-Pamlico** | Summer 97 | 6/1998 | 4/1999 | 7/1999 | 1/2000 |
| **Catawba** | Summer 97 | 2/1999 | 9/1999 | 12/1999 | 3/2000 |
| **French Broad** | Summer 97 | 5/1999 | 2/2000 | 5/2000 | 8/2000 |
| **New** | Summer 98 | 6/1999 | 4/2000 | 7/2000 | 11/2000 |
| **Cape Fear** | **Summer 98** | **7/1999** | **4/2000** | **7/2000** | **12/2000** |
| **Roanoke** | Summer 99 | 4/2000 | 3/2001 | 7/2001 | 1/2002 |
| **White Oak** | Summer 99 | 10/2000 | 7/2001 | 10/2001 | 6/2002 |
| **Savannah** | Summer 99 | 10/2000 | 12/2001 | 3/2002 | 8/2002 |
| **Watauga** | Summer 99 | 11/2000 | 12/2001 | 3/2002 | 9/2002 |
| **Little Tennessee** | Summer 99 | 3/2001 | 11/2001 | 2/2002 | 10/2002 |
| **Hiwassee** | Summer 99 | 10/2000 | 12/2001 | 3/2002 | 8/2002 |
| **Chowan** | Summer 2000 | 3/2001 | 2/2002 | 5/2002 | 11/2002 |
| **Pasquotank** | Summer 2000 | 3/2001 | 2/2002 | 5/2002 | 12/2002 |
| **Broad** | Summer 2000 | 11/2001 | 9/2002 | 12/2002 | 7/2003 |
| **Yadkin** | Summer 2001 | 11/2001 | 11/2002 | 3/2003 | 9/2003 |

Note: A basinwide plan was completed for all 17 basins during Round 1 (1993 to 1998).

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

| | |
|---|---|
| **Years 1 to 3**<br><br>**Water Quality Data Collection and Identification of Goals and Issues** | • Identify sampling needs<br>• Canvass for information<br>• Coordinate with other agencies and local interest groups to establish goals and objectives and identify and prioritize issues<br>• Summarize data from ambient monitoring stations<br>• Conduct biological monitoring activities<br>• Conduct special studies and other water quality sampling activities |
| **Years 3 to 4**<br><br>**Data Assessment and Model Preparation** | • Gather data from special studies to prepare models and TMDLs<br>• Develop preliminary pollution control strategies<br>• Coordinate with local stakeholders and other agencies<br>• Develop use support ratings |
| **Year 4**<br><br>**Preparation of Draft Basinwide Plan** | • Develop draft basinwide plan based on water quality data, use support ratings, modeling data and recommended pollution control strategies<br>• Present preliminary findings at informal meetings and incorporate comments into draft plan |
| **Year 5**<br><br>**Public Review and Approval of Plan** | • Circulate draft plan for review<br>• Hold public meetings after approval by NC Environmental Management Commission's Water Quality Committee<br>• Revise plan after public review period<br>• Submit final document to Environmental Management Commission for approval<br>• Begin basinwide permitting and implementation at end of Year 5 |

## 1.3 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 change 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 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 ratings in the basin.

**Section B: Subbasin Information**

- Summarizes recommendations from first basin plan, achievements made, what wasn't achieved and why, current priority issues and concerns, and goals and recommendations for the next five years by subbasin.

**Section C: Current and Future Initiatives**

- Presents current and future water quality initiatives and success stories by federal, state and local agencies, and corporate, citizen and academic efforts.
- Describes DWQ goals and initiatives beyond the five-year planning cycle for the basin.

## 1.4 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 participation in the state's water quality protection programs*. The basinwide plans are an educational tool for increasing public involvement and awareness of water quality issues.
- *Increased 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.

## 1.5 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.

## 1.6 Other References

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

- *Cape Fear River Basinwide Assessment Report*. June 1999. This technical report presents the physical, chemical and biological data in the Cape Fear River basin. 420 pages.
- *Cape Fear River Basinwide Water Quality Management Plan*. October 1996. This first basinwide plan for the Cape Fear River basin presents water quality data, information and recommended management strategies for the first five-year cycle. 238 pages.
- NC Division of Water Quality Basinwide Planning Website at http://h2o.enr.state.nc.us/basinwide.
- NC Division of Water Quality Environmental Sciences Branch Website at http://esb.ehnr.state.nc.us/.
- *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 Cape Fear River Basin.* DWQ NC Wetlands Restoration Program. Raleigh, NC.

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

## 1.7 Division of Water Quality Functions and Locations

The major activities coordinated by DWQ through basinwide planning are listed in Figure A-2. Information on the location, address and phone numbers for each branch and regional office are also shown in Figure A-2 and Figure A-3.

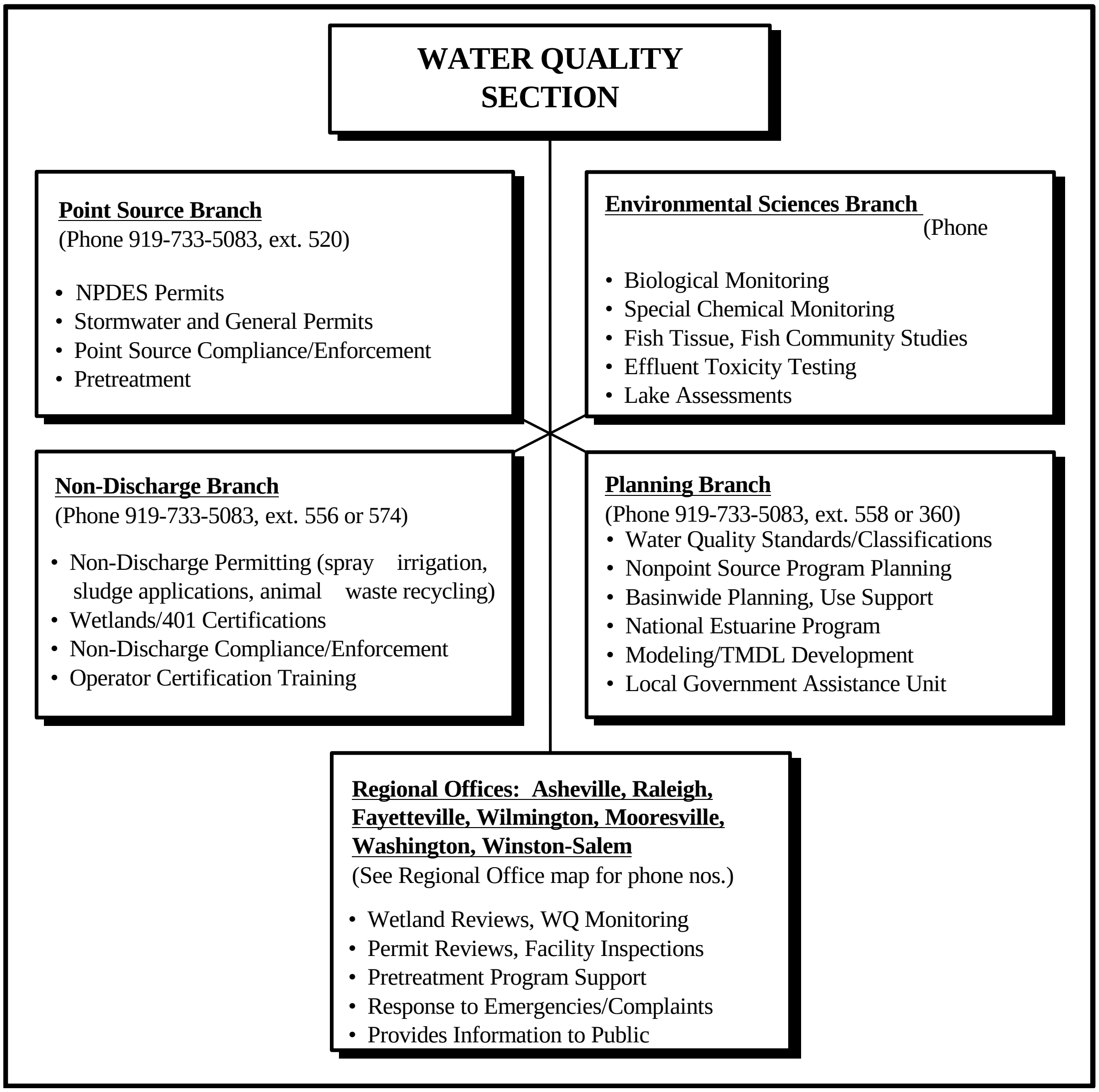


Figure A-2 Water Quality Section Organization Structure

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# Chapter 2 -
# Basin Overview

## 2.1 General Overview

The Cape Fear River basin is the state's largest river basin. The river basin is located entirely within the state's boundaries and flows southeast from the north central piedmont region near Greensboro to the Atlantic Ocean near Wilmington (Figure A-4).

***Cape Fear Basin Statistics***

Total Area: 9,322 sq. miles
Stream Miles: 6,049
Saltwater Acres: 39,200
No. of Counties: 26
No. of Municipalities: 116
No. of Subbasins: 24
Population (1990): 1,465,451 *
Estimated Pop. (2010): 1,992,128 *
% Increase (1997-2010): 17.8
Pop. Density (1990): 160 persons/sq. mi.

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

The Cape Fear River is formed at the confluence of the Haw and Deep Rivers on the border of Chatham and Lee counties, just below the B. Everett Jordan Reservoir dam. From there, the river flows across the coastal plain past Fayetteville through three locks and dams to Wilmington before entering the ocean. The Black and Northeast Cape Fear Rivers are blackwater rivers that meet the Cape Fear River in Brunswick County.

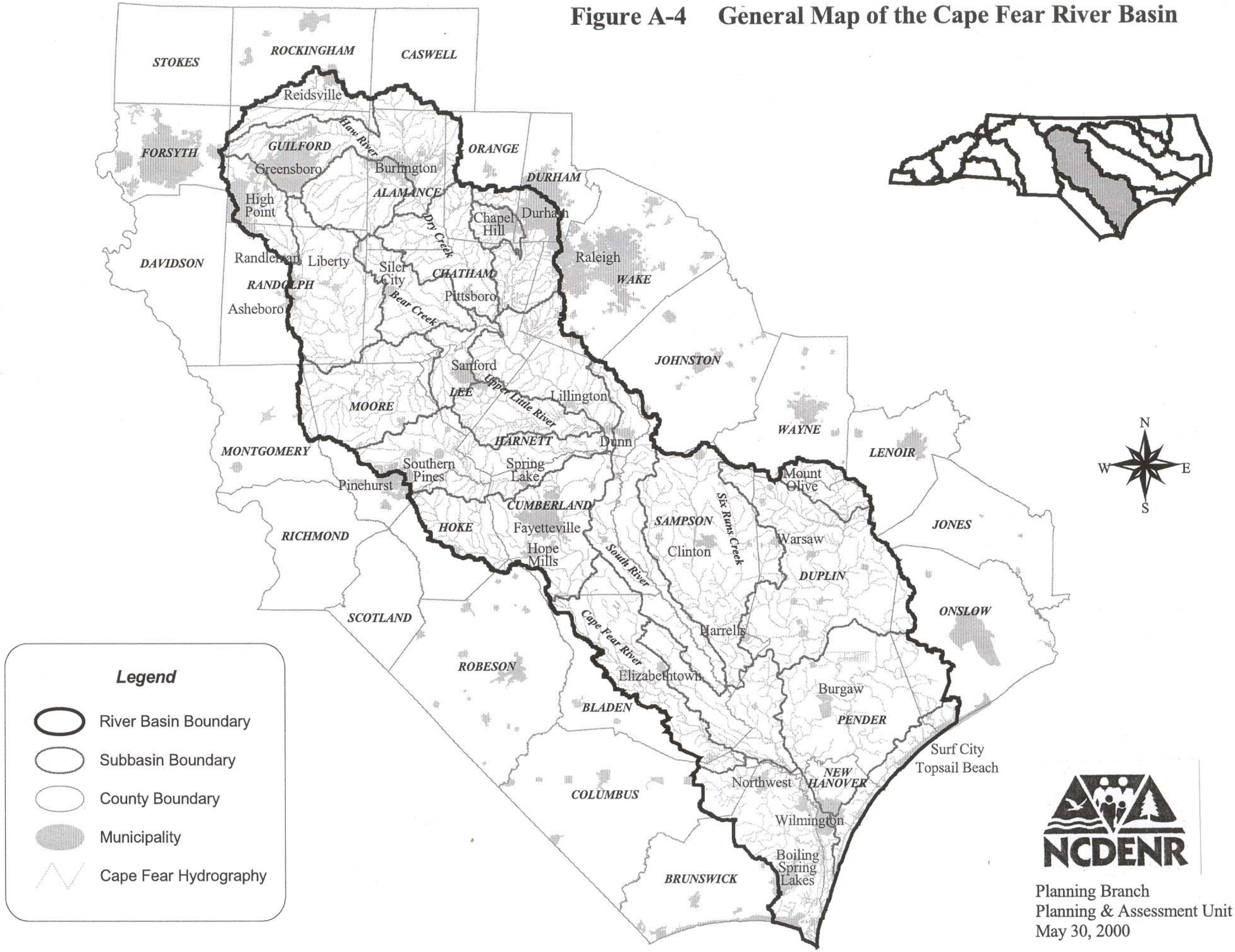
The basin includes four coastal Outstanding Resource Waters (Stump, Middle, Topsail and Masonboro Sounds) and one inland ORW (a portion of the Black River).

The most populated regions of the basin are in and near the Triad area (Greensboro-Burlington-High Point), the Durham-Chapel Hill area and Fayetteville. The overall population density is 160 persons per square mile compared to a statewide average of 139 persons per square mile. The percent population growth over the 7-year period from 1990 to 1997 was 13.2% compared to a statewide increase of 12.0%. Estimated water usage in the basin is expected to increase nearly 95% (193 MGD in 1992 to 376 MGD by 2020).

Over one-half of the land in the river basin is forested. Statistics provided by the US Department of Agriculture, Natural Resources Conservation Service (NRCS), indicate that during the 10-year period from 1982 to 1992, there was a significant increase in the amount of developed land (43%). The basin contains 54% of the state's swine operations, and swine populations in the basin have increased 90% between 1994 and 1998.

There are many different aquatic ecosystems in the Cape Fear River basin that support a wide variety of commercial and recreational fisheries. Wetlands, estuaries, blackwater rivers and rocky streams support 30 endangered species in the basin.

# Figure A-4 General Map of the Cape Fear River Basin



## 2.2 Local Governments and Planning Jurisdictions in the Basin

The basin encompasses all or part of the following 26 counties and 116 municipalities (Table A-3). Lenoir, Jones and Robeson counties have less than 1% of their land areas and no municipalities in the Cape Fear basin. Also included in the table are abbreviations for the Lead Regional Organizations (Councils of Government).

Table A-3 Local Governments and Planning Units within the Cape Fear River Basin

| County | % of County in Basin * | Council of Government Region | Municipalities |
|---|---|---|---|
| Alamance | 100% | G | Alamance, Burlington, Elon College, Gibsonville**, Graham, Green Level, Haw River, Mebane**, Swepsonville |
| Bladen | 69% | N | Dublin, East Arcadia, Elizabethtown, Tar Heel, White Lake |
| Brunswick | 45% | O | Bald Head Island, Belville, Boiling Spring Lakes, Caswell Beach, Leland, Long Beach, Navassa, Northwest, Sandy Creek, Southport, Yaupon Beach |
| Caswell | 10% | G | None |
| Chatham | 100% | J | Goldston, Pittsboro, Siler City |
| Columbus | 11% | O | Bolton, Sandyfield |
| Cumberland | 98% | M | Falcon**, Fayetteville, Godwin, Hope Mills, Linden, Spring Lake, Stedman, Wade |
| Duplin | 100% | P | Beulaville, Calypso, Faison, Greenevers, Harrells**, Kenansville, Magnolia, Mount Olive**, Rose Hill, Teachey, Wallace, Warsaw |
| Durham | 27% | J | Chapel Hill**, Durham |
| Forsyth | 2% | I | Kernersville** |
| Guilford | 97% | G | Archdale**, Gibsonville**, Greensboro, High Point**, Jamestown, Kernersville**, Oak Ridge, Pleasant Garden, Sedalia, Stokesdale, Summerfield, Whitsett |
| Harnett | 100% | M | Angier, Broadway**, Coats, Dunn, Erwin, Lillington |
| Hoke | 57% | N | Raeford |
| Johnston | 2% | J | Benson |
| Lee | 100% | J | Broadway**, Sanford |
| Montgomery | 6% | H | Biscoe, Candor, Star |
| Moore | 79% | H | Cameron, Carthage, Pinehurst, Robbins, Southern Pines, Taylortown, Vass, Whispering Pines |
| New Hanover | 100% | O | Carolina Beach, Kure Beach, Wilmington, Wrightsville Beach |
| Onslow | 22% | P | Holly Ridge, North Topsail Beach, Surf City** |
| Orange | 49% | J | Carrboro, Chapel Hill**, Mebane** |
| Pender | 100% | O | Atkinson, Burgaw, Saint Helena, Surf City**, Topsail Beach, Watha |
| Randolph | 56% | G | Archdale**, Asheboro, Franklinville, High Point**, Liberty, Ramseur, Randleman, Seagrove, Staley |
| Rockingham | 19% | G | Reidsville |
| Sampson | 99% | M | Autreyville, Clinton, Falcon**, Garland, Harrells**, Newton Grove, Roseboro, Salemburg, Turkey |
| Wake | 15% | J | Apex, Cary, Fuquay-Varina, Holly Springs, Morrisville |
| Wayne | 9% | P | Mount Olive** |

* Source: North Carolina Center for Geographic Information and Analysis

** Located in more than one county

Key:

| Region | Name | Location |
|---|---|---|
| G | Piedmont Triad Council of Government | Greensboro |
| H | Pee Dee Council of Government | Rockingham |
| I | Northwest Piedmont Council of Government | Winston-Salem |
| J | Triangle J Council of Government | Research Triangle Park |
| M | Region M Council of Government | Fayetteville |
| N | Lumber River Council of Government | Lumberton |
| O | Cape Fear Council of Government | Wilmington |
| P | Neuse River Council of Government | New Bern |

## 2.3 Surface Water Hydrology

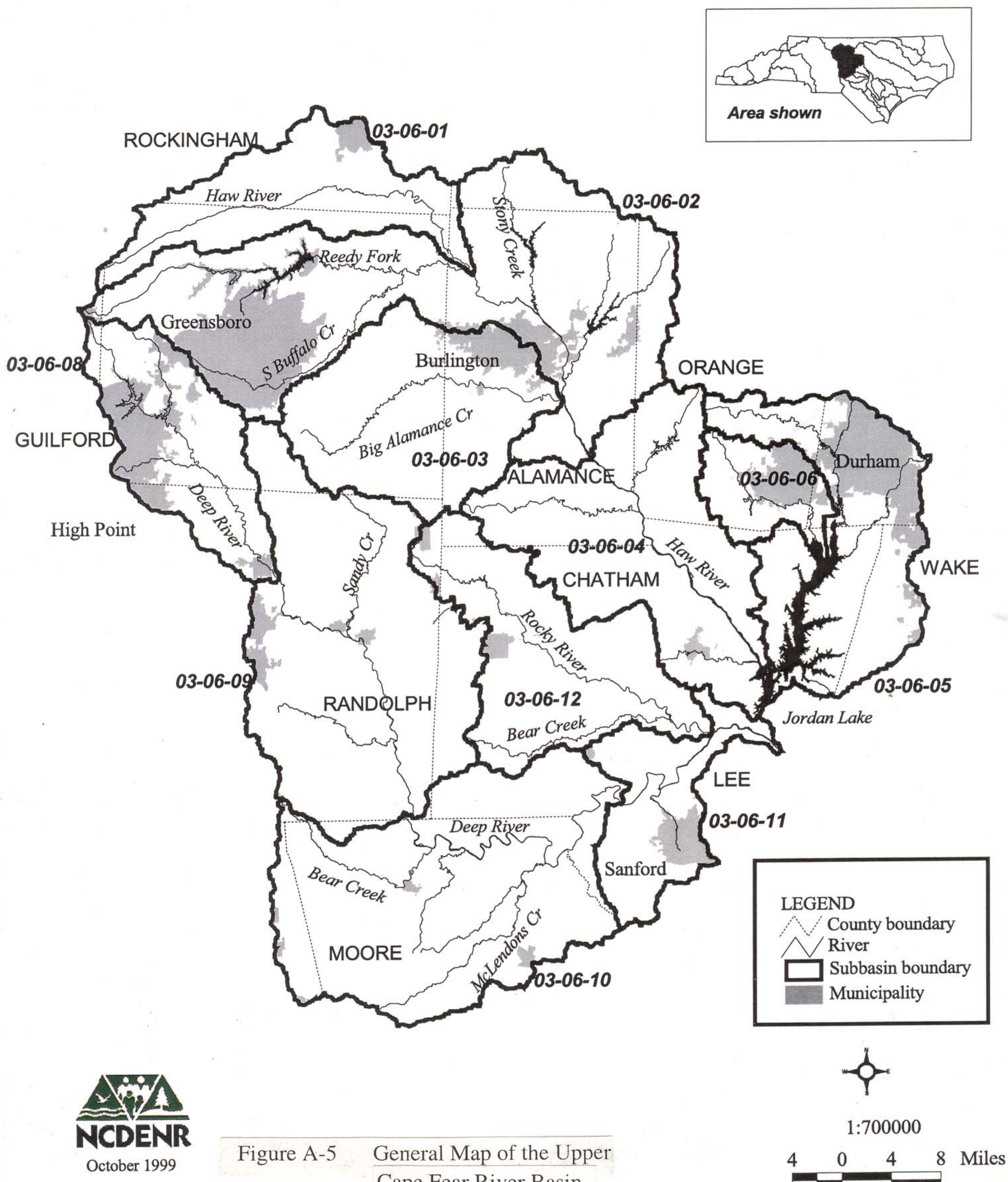
### 2.3.1 Major Hydrologic Divisions

The Cape Fear River basin is the largest river basin in North Carolina, and its watershed is contained entirely within the state. The mainstem of the river is formed by the confluence of the Deep and Haw Rivers just downstream of the B. Everett Jordan Reservoir dam. The Deep River originates near High Point and the Haw River near Greensboro. The mainstem of the river flows in a southeasterly direction until it empties into the Atlantic Ocean at Cape Fear, south of Wilmington.

The watershed is divided into 6 major hydrologic areas (*8-digit hydrologic units*) by the US Geologic Survey (USGS). These include the Haw River/Jordan Reservoir watershed, the Deep River, the upper Cape Fear, the Black River, the Northeast Cape Fear and the lower Cape Fear, and coastal waters. These major hydrologic areas are further subdivided by DWQ for management purposes into 24 subbasins (Figures A-5 to A-7) denoted by 6-digit numbers (03-06-01 to 03-06-24). Table A-4 shows the breakdown of USGS hydrologic units and DWQ's corresponding subbasins. Maps of DWQ's subbasins are included in Section B of the basinwide plan.

The Cape Fear River basin, which has a total land area of 9,322 square miles and 6,049 stream miles, has an average drainage area of 1.5 square miles per stream mile. A variety of aquatic systems are represented in the basin as the terrain changes from the piedmont to the coastal plain, including large freshwater rivers, blackwater swamps and estuaries.

# General Map of the Upper Cape Fear River Basin

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October 1999

Figure A-5 General Map of the Upper Cape Fear River Basin

# General Map of the Middle Cape Fear River Basin

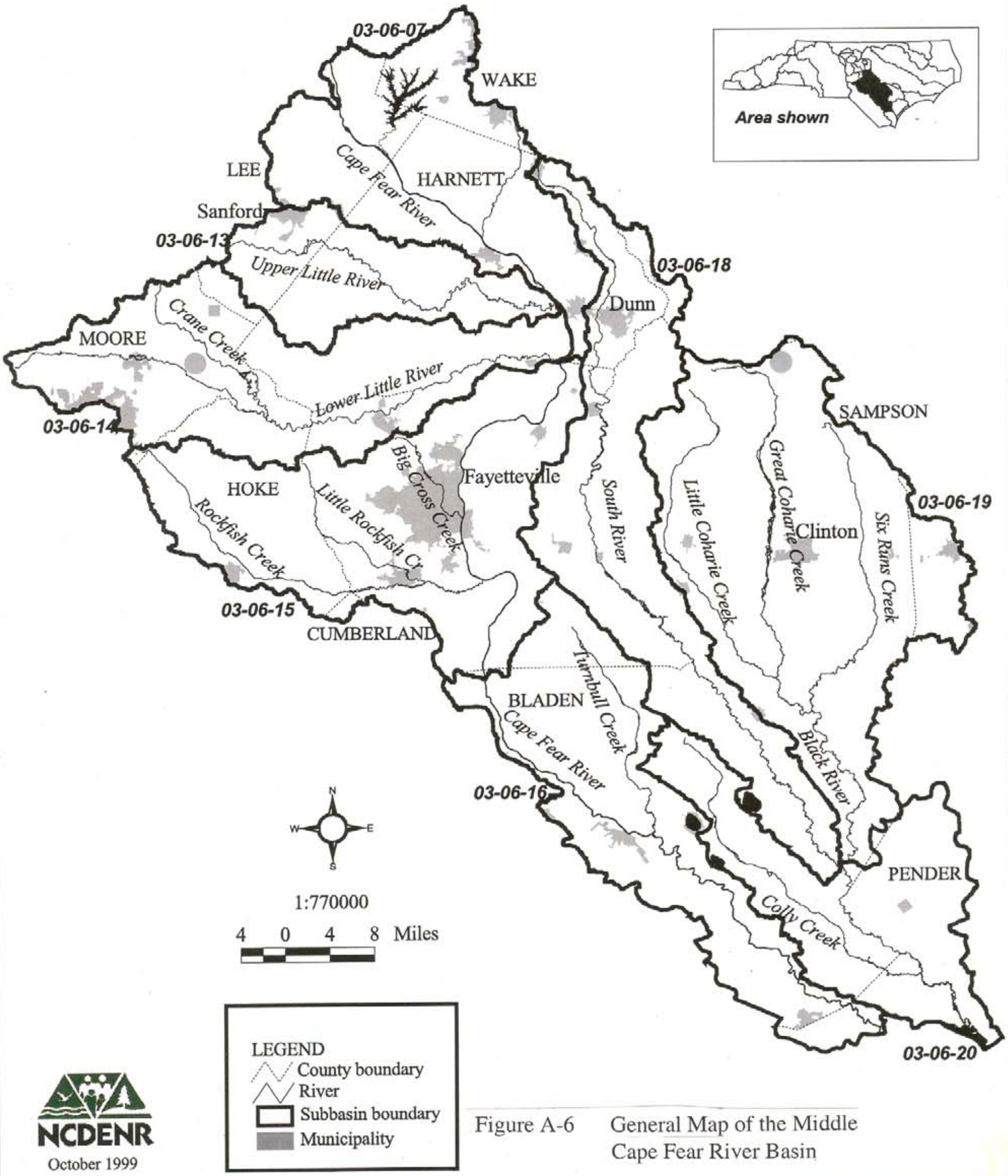



Figure A-6 General Map of the Middle Cape Fear River Basin

# General Map of the Lower Cape Fear River Basin

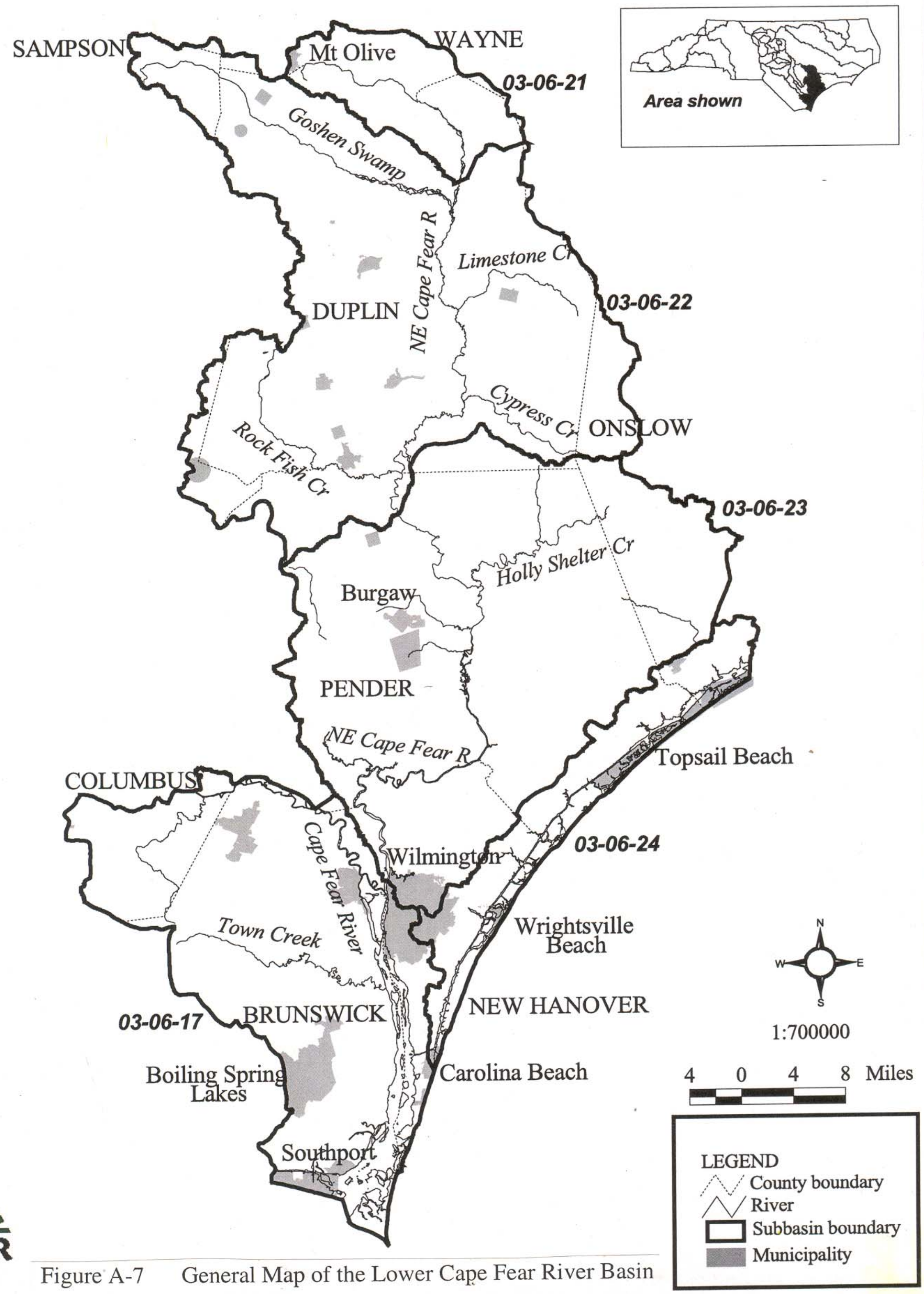



Figure A-7 General Map of the Lower Cape Fear River Basin

Table A-4 Hydrologic Subdivisions in the Cape Fear River Basin

| Watershed Name and Major Tributaries | USGS 8-digit Hydrologic Units | DWQ 6-digit Subbasin Codes |
|---|---|---|
| *Haw River and Jordan Reservoir* | 03030002 | 030601, 030602, 030603, 030604, 030605, 030606 |
| Upper Haw River | " | 01 |
| Reedy Fork, Stony Creek and Haw River (middle) | " | 02 |
| Big and Little Alamance Creeks | " | 03 |
| Haw River (lower) | " | 04 |
| New Hope Creek and Jordan Reservoir | " | 05 |
| Morgan Creek and University Lake | " | 06 |
| *Deep River* | 03030003 | 030608, 030609, 030610, 030611, 030612 |
| Deep River (upper) and Muddy Creek | " | 08 |
| Deep River (middle) and Richland Creek | " | 09 |
| Deep River (middle), Cabin Creek and McLendons Creek | " | 10 |
| Deep River (lower) | " | 11 |
| Rocky River | " | 12 |
| *Upper Cape Fear River* | 03030004 | 030607, 030613, 030614, 030615 |
| Cape Fear River (upper) | " | 07 |
| Upper Little River | " | 13 |
| Little River | " | 14 |
| Rockfish Creek and Cape Fear River | " | 15 |
| *Lower Cape Fear River* | 03030005 | 030616, 030617, 030624 |
| Cape Fear River | " | 16 |
| Town Creek, Brunswick River and Cape Fear River (extreme lower) | " | 17 |
| Topsail, Middle, Masonboro and Stump Sounds | " | 24 |
| *Black River* | 03030006 | 030618, 030619, 030620 |
| South River | " | 18 |
| Great Coharie Creek, Six Runs Creek and upper Black River | " | 19 |
| Black River | " | 20 |
| *Northeast Cape Fear River* | 03030007 | 030621, 030622, 030623 |
| Upper Northeast Cape Fear River | " | 21 |
| Middle Northeast Cape Fear River, Goshen Swamp, Rockfish Creek | " | 22 |
| Lower Northeast Cape Fear River | " | 23 |

## 2.3.2 Physiography and Geology of the Cape Fear River Basin

The headwaters of the Cape Fear River are at nearly 1000 feet above sea level in Forsyth County and drain to sea level in Brunswick County before entering the Atlantic Ocean. The upper Cape Fear River basin is mostly in the piedmont, and the lower Cape Fear River basin lies in the coastal plain.

The geology underlying the Cape Fear 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-8). Areas were defined by relating topography, geology, mean annual

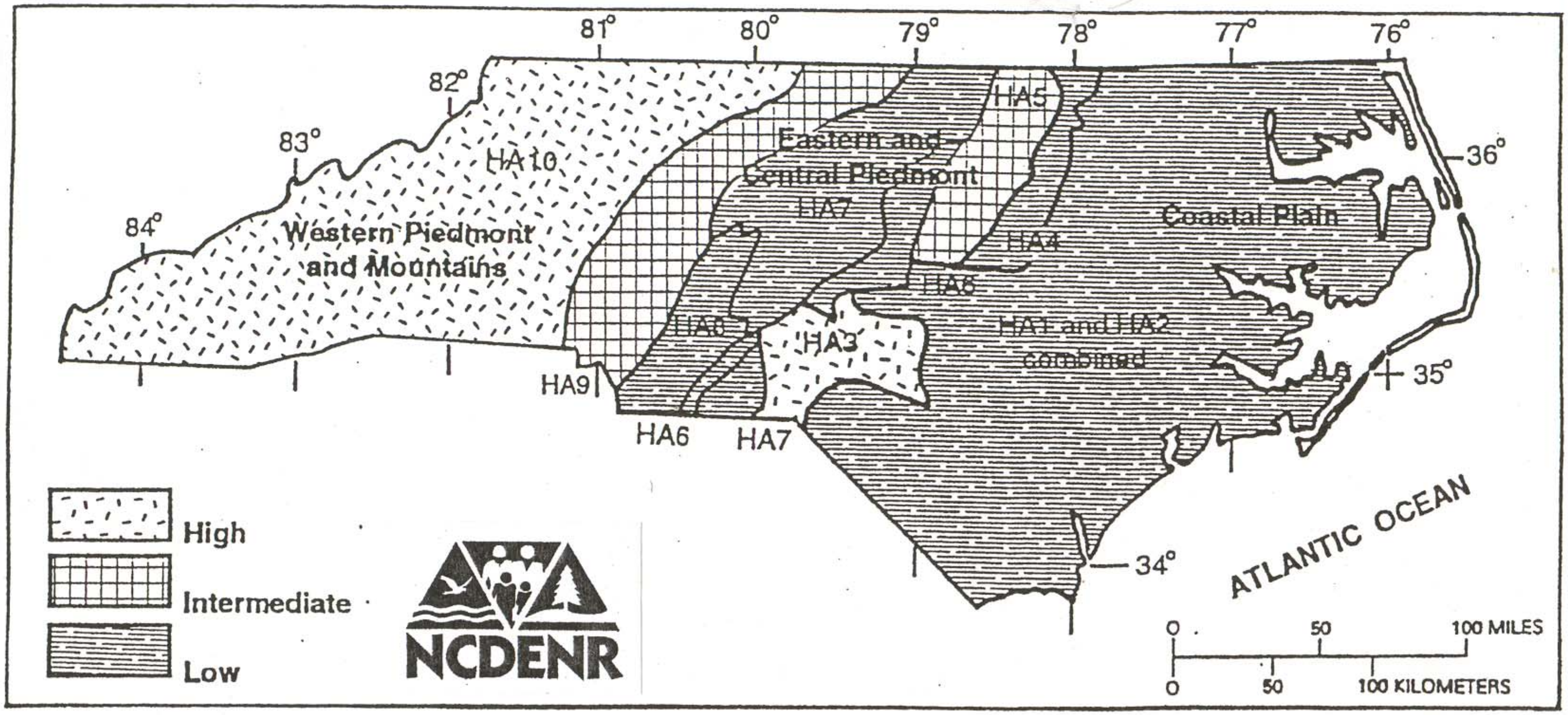



Figure A-8 Hydrologic Areas (HA) of Similar Potential to Sustain Base Flows runoff, and other features to low flow frequency characteristics including 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded 9 out of 10 years) and 30Q2 (annual minimum 30-day consecutive low 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, 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) and the eastern and central piedmont (HA4, HA6, HA7 and HA8). The following discussion explains the characteristics that reduce the potential for base flow in these regions.

**Coastal Plain Physiographic Area**

The geology of this 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.

**Eastern and Central Piedmont Physiographic Area**

Topography in this area is characterized by rolling hills and geologic formations consisting of crystalline or sedimentary rocks. This area was divided into six HAs based on soil types, topography and underlying bedrock type: the Eastern Slate Belt (HA4), the Raleigh Belt (HA5), the Triassic Basin (HA6), the Carolina Slate Belt (HA7 and HA8), and the Charlotte Belt and Milton Belt (HA9).

Of particular interest within this area is the fact that the sedimentary rocks underlying the Triassic Basin have the lowest average yield of water to wells of all rock types in the state. This low yield implies the rocks have low permeability, and thus, result in low base flows of streams in the region.

The 7Q10 values for HA6 are zero for all but the largest drainages. In addition, the Carolina Slate Belt region is associated with low to zero flow streams. DWQ limits discharges of oxygen-consuming wastewater to these low base flow streams.

In addition, the overall low permeability of residual soils derived from the Triassic sedimentary rocks results in low percolation rates for septic systems. This low permeability promotes surface runoff and shallow discharge during storm flow events.

The goal of DWQ for streams determined to be zero flow streams is to remove all discharges, or if removal is not possible, advanced treatment will be required. DWQ management strategies for wastewater discharges into zero flow streams are presented in Section A, Part 4.12.

## 2.4 Land Cover

Land cover information in this section is derived from the National Resources Inventory (NRI) of 1992 and 1982, as developed by the Natural Resources Conservation Service (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 (USDA, 1994).

Table A-5 summarizes acreages and percentage of land cover from the 1992 NRI for the entire basin and for the major watershed areas within the basin (USGS hydrologic unit 03030001 is not included in the table because only a small portion of the area is within the Cape Fear River basin). Land cover types identified by the NRI as occurring in the Cape Fear River basin are presented in Table A-6.

Land cover in the basin, as presented in Table A-5, is dominated by forestland that covers approximately 56% of the land area. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 24% of the area. The urban category comprises roughly 9% of the area and exhibited the most dramatic change since 1982, with a 43% increase of land area in this category. Other categories that showed substantial changes since 1982 were uncultivated cropland and "other" with increases of 18% and 17%, respectively. These land cover changes are summarized in Figure A-9.

The most recent land cover information for the Cape Fear River basin is based on satellite imagery collected from the North Carolina Corporate Geographic Database. The state's Center for Geographic Information and Analysis (CGIA) developed statewide land cover information based on this 1993-1995 satellite imagery. This land cover data is divided into 24 categories. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-7. Figure A-10 provides an illustration of the relative amount of land area that falls into each major cover type for the Cape Fear River basin.

Table A-5 Land Cover in the Cape Fear River Basin by Major Watersheds (8-Digit USGS Hydrologic Units) (Source: USDA, Soil Conservation Service - 1982 and 1992 NRI)

| | MAJOR WATERSHED AREAS | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Haw River and Jordan Lake | | Deep River | | Upper Cape Fear River | | Lower Cape Fear River | | Black River | | Northeast Cape Fear River | | 1992 TOTALS | | 1982 TOTAL | | % change since 1982 |
| LAND COVER | Acres (1000s) | % | Acres (1000s) | % | Acres (1000s) | % | Acres (1000s) | % | Acres (1000s) | % | Acres (1000s) | % | Acres (1000s) | % of TOTAL | Acres (1000s) | % of TOTAL | |
| Cult. Crop | 140.8 | 13.0 | 87.8 | 9.5 | 167.9 | 16.4 | 73.4 | 10.7 | 367.9 | 36.8 | 230.5 | 20.1 | 1068 | 18.2 | 1163 | 19.8 | -8 |
| Uncult. Crop | 15.8 | 1.5 | 18.3 | 2.0 | 13.7 | 1.3 | 2.6 | 0.4 | 5.4 | 0.5 | 10.0 | 0.8 | 65.8 | 1.1 | 55.7 | 0.9 | +18 |
| Pasture | 133.6 | 12.3 | 85.8 | 9.3 | 31.7 | 3.1 | 5.1 | 0.7 | 0.0 | 0.0 | 24.6 | 2.2 | 280.8 | 4.8 | 288.3 | 5.0 | -3 |
| Forest | 464.5 | 42.9 | 577.5 | 62.7 | 462.4 | 45.0 | 492.0 | 71.9 | 550.3 | 55.0 | 741.7 | 64.8 | 3288 | 56.1 | 3444 | 59.0 | -5 |
| Urban & Built-up | 186.8 | 17.3 | 93.4 | 10.2 | 120.3 | 11.7 | 35.5 | 5.2 | 29.6 | 2.9 | 46.4 | 4.1 | 512.0 | 8.8 | 358.7 | 6.0 | +43 |
| Other | 140.5 | 13.0 | 57.7 | 6.3 | 230.8 | 22.5 | 76.0 | 11.1 | 47.9 | 4.8 | 91.9 | 8.0 | 644.8 | 11.0 | 550.8 | 9.3 | +17 |
| Totals | 1082.0 | 100.0 | 920.5 | 100.0 | 1027 | 100.0 | 684.6 | 100.0 | 1001 | 100.0 | 1145.1 | 100.0 | 5860 | 100.0 | 5860 | 100.0 | |
| % of Total Basin | | 18.5 | | 15.7 | | 17.5 | | 11.7 | | 17.1 | | 19.5 | | 100.0 | | | |
| SUBBASINS | 01 to 06 and 07* | | 08 to 12 | | 07*, 13 to 15* | | 15*, 16 and 17 | | 18, 19 and 20 | | 21, 22 and 23 | | | | | | |
| 8- Digit Hydraulic Units | 03030002 | | 03030003 | | 03030004 | | 03030005 | | 03030006 | | 03030007 | | | | | | |

* These subbasins are found within more than one 8-Digit Hydraulic Unit.

Table A-6 Description of Land Cover Types (1992 NRI - USDA SCS)

| Land Cover Type | Land Cover 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 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 Land | Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. 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).<br>*Small Water Areas*: Waterbodies less than 40 acres in size and streams less than one-half mile wide.<br>*Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width.<br>*Minor Land*: Lands not in one of the other categories. |

Figure A-9 Land Cover Changes from 1982 to 1992 for the Cape Fear River Basin (Source: USDA-NCRS 1992 NRI)

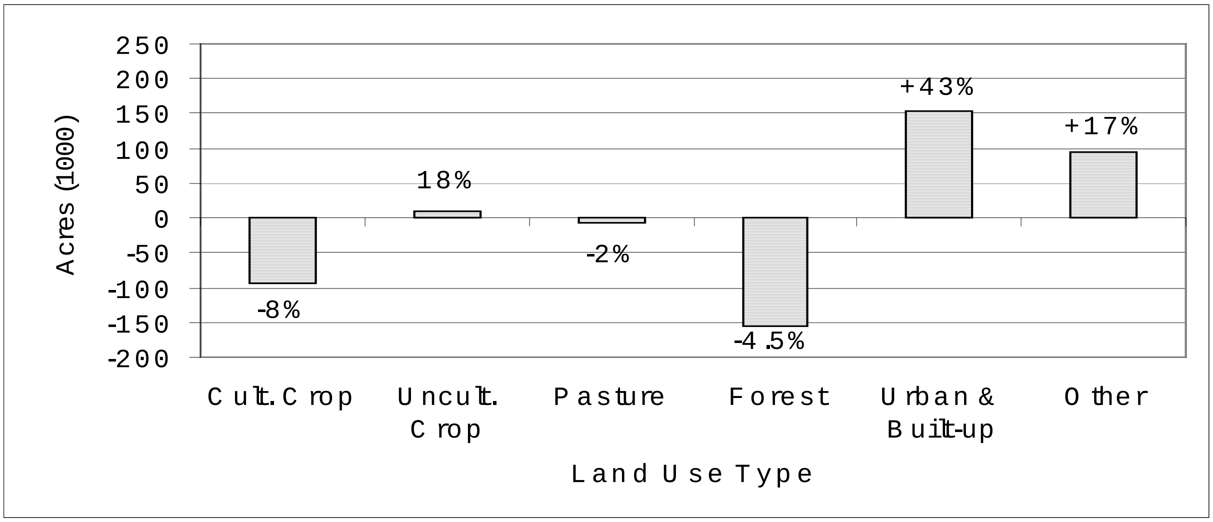
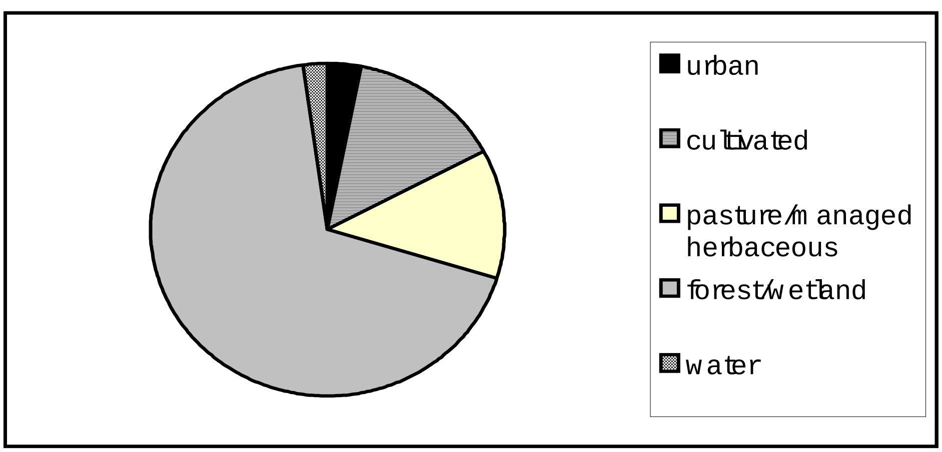



Table A-7 Description of Land Cover Categories

| Land Cover Type | Land Cover Description |
|---|---|
| Urban | Greater than 50% coverage by synthetic land cover (built-upon area) and municipal areas. |
| Cultivated | Areas that are covered by crops that are cultivated in a distinguishable pattern (such as rows). |
| Pasture/Managed Herbaceous | Areas used for the production of grass and other forage crops and other managed areas such as golf courses and cemeteries. Also includes upland herbaceous areas not characteristic of riverine and estuarine environments. |
| Forest/Wetland | Includes salt and freshwater marshes, hardwood swamps, shrublands and all kinds of forested areas (such as needleleaf evergreens, conifers, deciduous hardwoods). |
| Water | Areas of open surface water, areas of exposed rock, and areas of sand or silt adjacent to tidal waters and lakes. |

Figure A-10 Percentages within Major Land Cover Categories in the Cape Fear Basin



## 2.5 Population and Growth Trends

**Population**

The Cape Fear River basin has an estimated population of 1,465,451 people based on 1990 census data. Table A-8 presents census data for 1970, 1980 and 1990 for each of the subbasins. It also includes land areas and population densities (persons/square mile) by subbasin based on the land area (excludes open water) for each subbasin. Densely populated areas are scattered across the basin and include the Burlington-Greensboro-High Point area in the upper part of the basin (Figure A-11), the Fayetteville area in the middle part of the basin, and the Wilmington area in the lower portion of the basin (Figure A-12). The subbasin that encircles the Chapel Hill area is the most densely populated with 783 persons/square mile compared to a basinwide average of 160 persons/square mile. This density compares to a statewide average of 139 persons/square mile.

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, an estimate has to be made on the percentage of the population that is located in the subbasin. This is done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change every ten years, so comparisons between years must be considered approximate.

**Growth Trends**

The percentage increase in population for the entire basin was 29.3% from 1970-1990 and 11.5% from 1980-1990. This latter percentage is almost equal to a statewide increase of 12.7% over the same ten-year period. Population increases by subbasin are presented in Figure A-13 and Table 8.

Table A-9 shows the estimated percent changes in growth between 1990 and 1997 and projected percent change in growth between 1997 and 2010 for counties in the basin (Office of State Planning, 1999). Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Cape Fear River basin. They are instead presented as an estimate of possible countywide population changes.

Population growth trends for the basin between 1990 and 1997 indicate growth rates for six of the 26 counties of 20 to 30 percent and a basinwide population increase of nearly 13.2%. Projections for population growth from 1997 to 2010 indicate five counties with growth rates in excess of 30 percent and seven counties with growth rates of 20 to 30 percent with a total population increase in the basin of 17.8%.

Table A-8 Cape Fear Subbasin Population (1970, 1980 and 1990) and Land Area Summaries

| SUBBASIN | POPULATION (Number of Persons) | | | POPULATION DENSITY (Persons/Square Mile) | | | LAND AND WATER AREAS | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Total Land and Water Area | | Water Area | Land Area |
| | 1970 | 1980 | 1990 | 1970 | 1980 | 1990 | (Acres) | (Sq. Miles) | (Sq. Miles) | (Sq. Miles) |
| 03-06-01 | 20,250 | 21,894 | 25,897 | 108 | 117 | 138 | 120,794 | 189 | 2 | 187 |
| 03-06-02 | 222,954 | 254,617 | 279,034 | 402 | 459 | 503 | 359,634 | 562 | 7 | 555 |
| 03-06-03 | 61,354 | 59,377 | 66,593 | 235 | 227 | 255 | 167,494 | 262 | 1 | 261 |
| 03-06-04 | 13,600 | 18,949 | 20,213 | 42 | 58 | 62 | 211,750 | 331 | 4 | 327 |
| 03-06-05 | 69,772 | 77,357 | 102,058 | 278 | 308 | 407 | 171,940 | 269 | 18 | 251 |
| 03-06-06 | 37,469 | 47,017 | 57,917 | 506 | 635 | 783 | 47,695 | 75 | 1 | 74 |
| 03-06-07 | 35,520 | 37,704 | 39,713 | 88 | 94 | 99 | 266,019 | 415 | 12 | 403 |
| 03-06-08 | 87,537 | 91,778 | 101,430 | 495 | 519 | 573 | 114,385 | 179 | 2 | 177 |
| 03-06-09 | 40,171 | 51,405 | 55,755 | 90 | 116 | 125 | 285,450 | 446 | 1 | 445 |
| 03-06-10 | 19,222 | 21,691 | 21,107 | 43 | 49 | 47 | 287,088 | 448 | 2 | 446 |
| 03-06-11 | 14,599 | 21,083 | 22,221 | 111 | 160 | 168 | 84,842 | 133 | 1 | 132 |
| 03-06-12 | 14,622 | 14,326 | 16,015 | 60 | 59 | 66 | 155,909 | 244 | 1 | 243 |
| 03-06-13 | 15,743 | 16,443 | 23,913 | 72 | 75 | 109 | 141,134 | 221 | 2 | 219 |
| 03-06-14 | 51,713 | 60,635 | 67,587 | 108 | 127 | 141 | 309,699 | 484 | 6 | 478 |
| 03-06-15 | 186,209 | 222,582 | 247,765 | 313 | 374 | 416 | 384,138 | 600 | 5 | 595 |
| 03-06-16 | 12,424 | 15,992 | 14,811 | 29 | 37 | 34 | 280,559 | 438 | 8 | 430 |
| 03-06-17 | 38,646 | 48,954 | 56,467 | 78 | 98 | 113 | 349,828 | 547 | 49 | 498 |
| 03-06-18 | 32,256 | 38,068 | 39,895 | 65 | 77 | 81 | 316,587 | 495 | 2 | 493 |
| 03-06-19 | 39,703 | 43,577 | 40,575 | 54 | 59 | 55 | 473,136 | 739 | 2 | 737 |
| 03-06-20 | 4,556 | 5,229 | 5,231 | 13 | 15 | 15 | 219,740 | 343 | 5 | 338 |
| 03-06-21 | 7,076 | 9,271 | 7,582 | 59 | 78 | 64 | 76,297 | 119 | 0 | 119 |
| 03-06-22 | 35,696 | 39,552 | 39,144 | 43 | 48 | 47 | 530,335 | 829 | 1 | 828 |
| 03-06-23 | 41,623 | 60,632 | 64,540 | 53 | 77 | 82 | 508,688 | 795 | 6 | 789 |
| 03-06-24 | 33,295 | 36,748 | 49,988 | 234 | 259 | 352 | 103,962 | 162 | 20 | 142 |
| TOTALS | 1,136,010 | 1,314,881 | 1,465,451 | 124 | 143 | 160 | 5,967,103 | 9,325 | 158 | 9,167 |

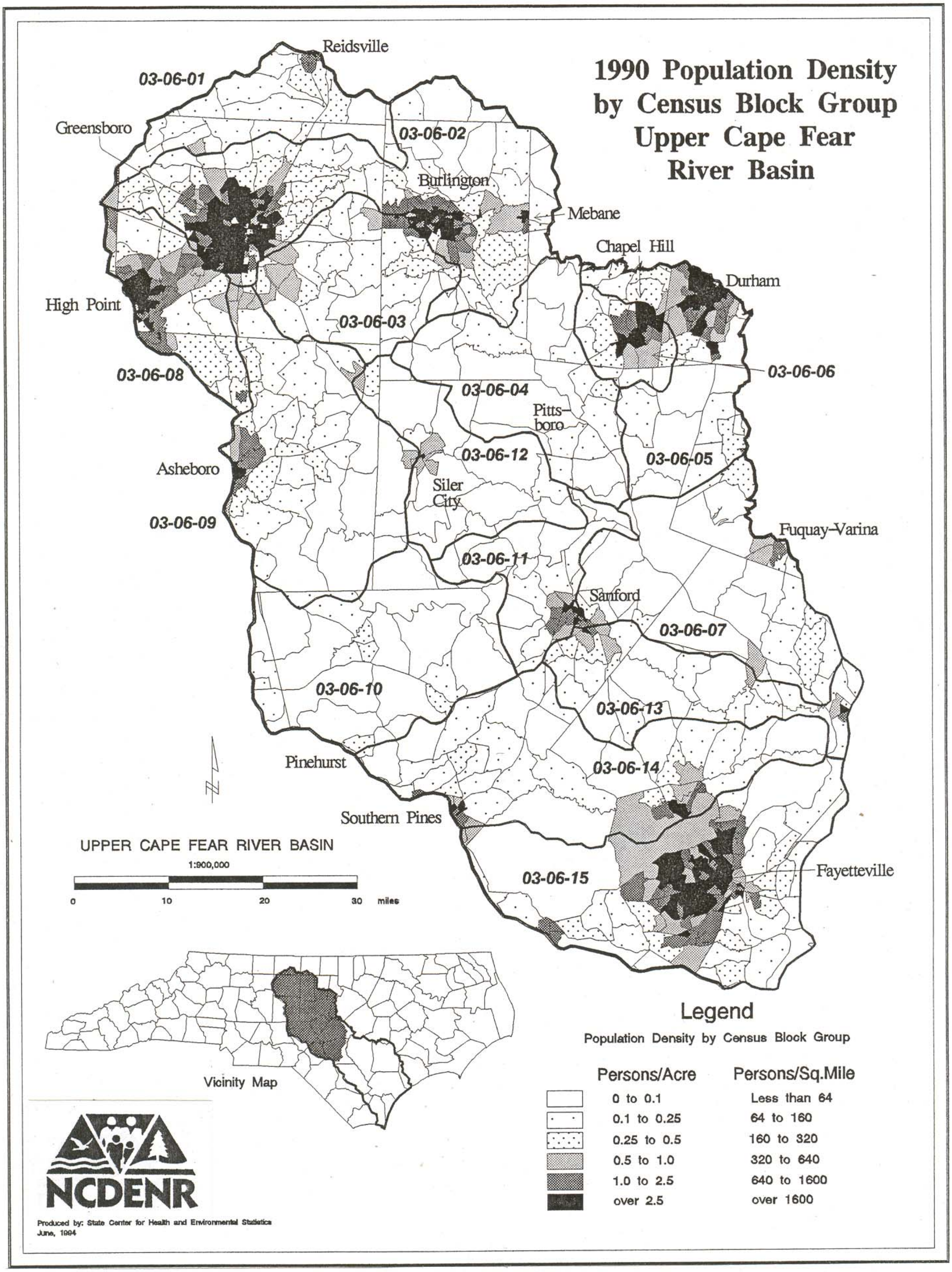



Figure A-11 1990 Population Density by Census Block Group Upper Cape Fear River Basin

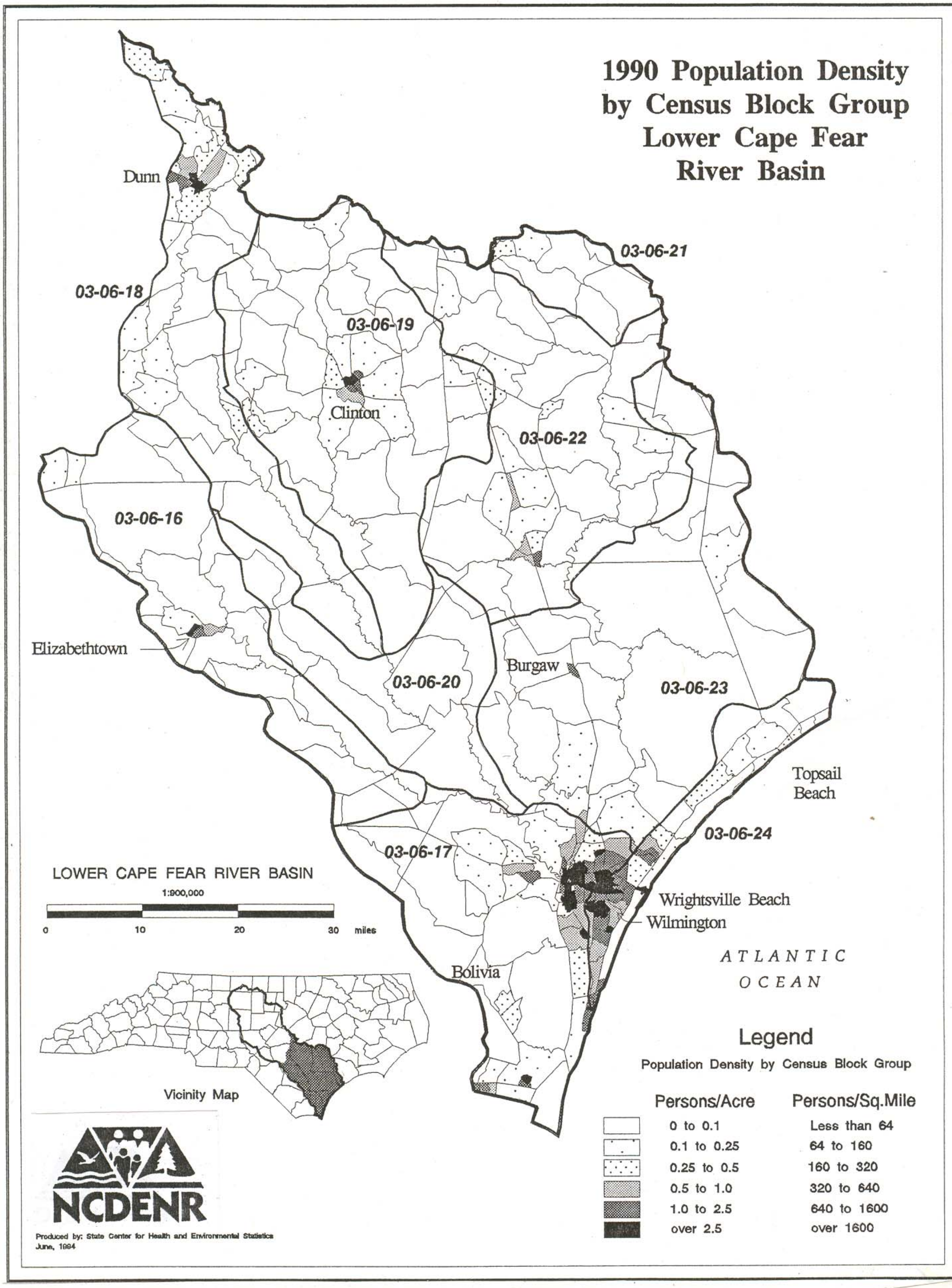



Figure A-12 1990 Population Density by Census Block Group Lower Cape Fear River B

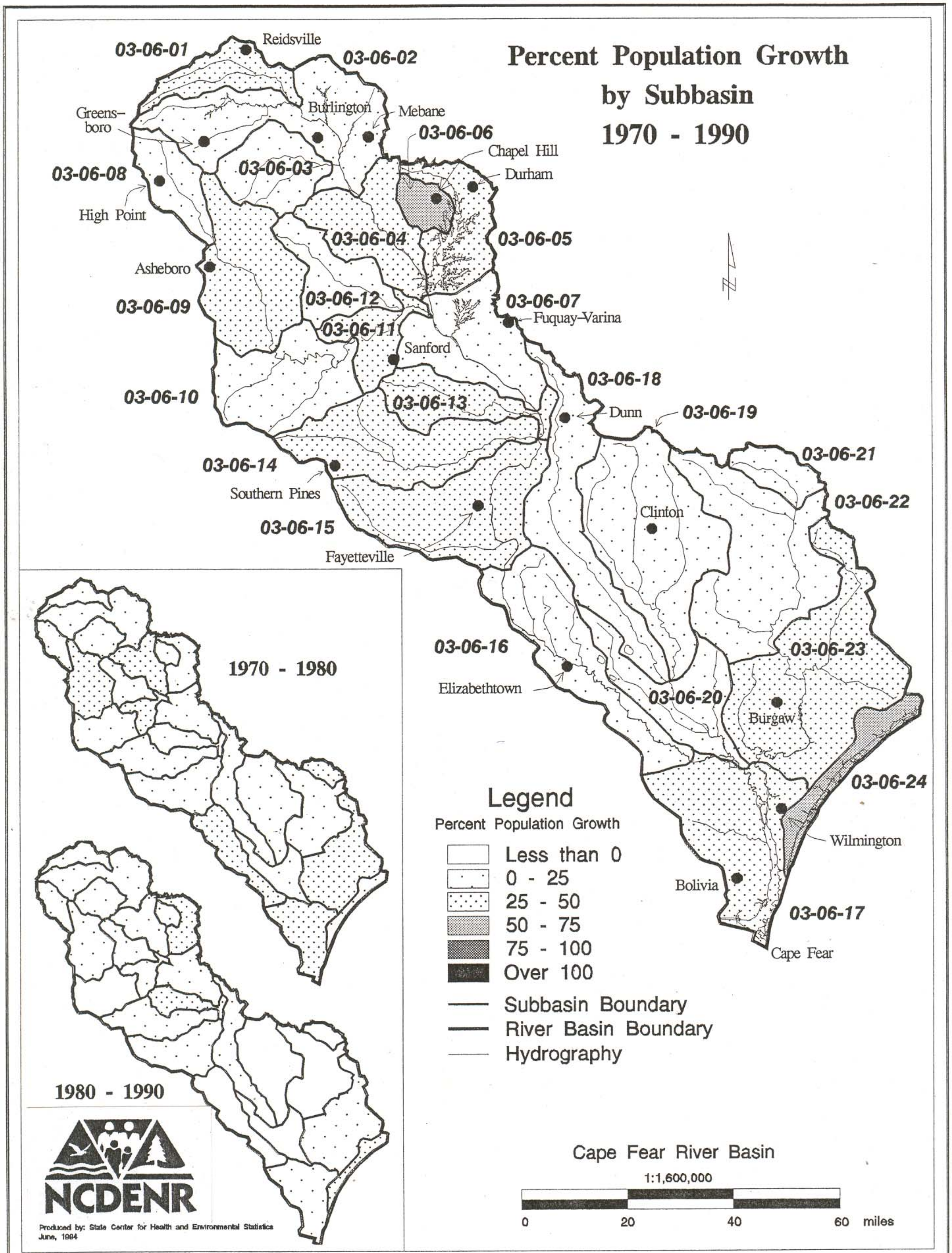



Figure A-13 Population Growth by Subbasin (1970 to 1990)

Table A-9 Estimated Population Statistics for the Years 1990, 1997 and 2010 for Counties in the Cape Fear River Basin

| County | Population in 1990 | Population in 1997 | Estimated % Growth 1990-1997 | Estimated Population in 2010 | Estimated % growth 1997-2010 |
|---|---|---|---|---|---|
| Alamance | 108,213 | 119,820 | 10.7 | 135,794 | 13.3 |
| Bladen | 19,777 | 20,917 | 5.8 | 21,698 | 3.7 |
| Brunswick | 22,943 | 29,340 | 27.9 | 39,317 | 34.0 |
| Caswell | 2,069 | 2,206 | 6.6 | 2,336 | 5.9 |
| Chatham | 38,759 | 45,130 | 16.4 | 54,433 | 20.6 |
| Columbus | 5,455 | 5,714 | 4.7 | 5,874 | 2.8 |
| Cumberland | 269,219 | 289,350 | 7.5 | 321,450 | 11.1 |
| Duplin | 39,995 | 44,080 | 10.2 | 48,786 | 10.7 |
| Durham | 49,101 | 53,382 | 8.7 | 61,512 | 15.2 |
| Forsyth | 5,318 | 5,743 | 8.0 | 6,387 | 11.2 |
| Guilford | 336,997 | 371,690 | 10.3 | 420,591 | 13.2 |
| Harnett | 67,833 | 81,358 | 19.9 | 102,301 | 25.7 |
| Hoke | 13,028 | 16,463 | 26.4 | 21,621 | 31.3 |
| Johnston | 1,626 | 2,064 | 26.9 | 2,747 | 33.1 |
| Lee | 41,370 | 48,369 | 16.9 | 58,645 | 21.2 |
| Montgomery | 1,401 | 1,468 | 4.8 | 1,554 | 5.8 |
| Moore | 46,610 | 54,907 | 17.8 | 66,068 | 20.3 |
| New Hanover | 120,284 | 146,601 | 21.9 | 183,112 | 24.9 |
| Onslow | 32,964 | 32,417 | -1.7 | 38,629 | 19.2 |
| Orange | 45,987 | 52,554 | 14.3 | 63,882 | 21.6 |
| Pender | 28,855 | 37,208 | 28.9 | 49,954 | 34.3 |
| Randolph | 59,666 | 68,068 | 14.1 | 81,927 | 20.4 |
| Rockingham | 16,352 | 16,940 | 3.6 | 17,489 | 3.2 |
| Sampson | 46,824 | 52,124 | 11.3 | 58,317 | 11.9 |
| Wake | 63,945 | 83,528 | 30.6 | 116,602 | 39.6 |
| Wayne | 9,420 | 10,186 | 8.1 | 11,102 | 9.0 |
| Totals | 1,494,011 | 1,691,627 | 13.2 | 1,992,128 | 17.8 |

## 2.6 Natural Resources

### 2.6.1 Lakes

There are 32 reservoirs in the Cape Fear River basin monitored by DWQ. Over half the total lakes are located in the upper portion of the basin (subbasins 03-06-01 through 03-06-08). These impoundments serve as water supplies for communities such as Greensboro, Burlington, Durham and Chapel Hill.

B. Everett Jordon Reservoir, located mostly in Chatham County south of Durham and west of Raleigh, is the largest lake in the basin and is used for water supply, flood control and recreation area in one of the fastest growing regions of the state.

There are five natural lakes, (the Carolina Bays), in the lower portion of the basin. Carolina Bays are of unknown origin located along the East Coast. The lakes are between 30,000 and 100,000 years old and, because of the unique chemistry and productivity, are home to many endemic species. The lakes are shallow, fed by surface and shallow groundwater, and function as wetlands. Agricultural and forestry practices, prior to 1970, have left undisturbed only about 10 percent of these lakes (Krajick, 1997).

### 2.6.2 Fish and Shellfish

Over 95 fish species have been found in the Cape Fear River basin including a variety with recreational and commercial importance. Popular sportfish species found in the freshwater portion of the river and reservoirs include largemouth bass, sunfish, crappie, catfish and pickerel. Recreationally and commercially important anadromous species, including striped bass, American and hickory shad and herring, migrate into freshwater portions of the Cape Fear River and tributaries to spawn during the spring. The Cape Fear River below Wilmington supports valuable recreational and commercial fisheries for striped bass, speckled sea trout, croaker, flounder and spot. Commercial finfish landings within the Cape Fear River basin have declined since 1996 from 108,764 pounds valued at $117,990 to 74,514 pounds valued at $64,191 (Figure A-14). Non-finfish commercial landings within the Cape Fear River basin include shrimp, blue crabs, squid, scallops and oysters. This fishery has had similar declines in recent years (Figure A-15). Figure A-16 shows shellfish growing areas in the Cape Fear River basin.

A total of 30 endangered, threatened or special concern species, including fish, amphibians, mammals, crustaceans and mollusks, are listed by federal and state agencies for the Cape Fear River basin. Atlantic and shortnose sturgeon were once plentiful in the Cape Fear River, but the population levels for both species are currently at low levels, with the few remaining individuals located primarily in the lower Cape Fear and Brunswick Rivers. The last shortnose sturgeon to be captured in the Cape Fear River was collected in 1993 (Fisheries Management Plan for the Cape Fear River, March 1998).

Figure A-14 Recent Overall Trends in Commercial Landings of Finfish in the Cape Fear River Basin Coastal Areas by Total Pounds and Total Value Per Year (1994-1998) Source: NC Division of Marine Fisheries

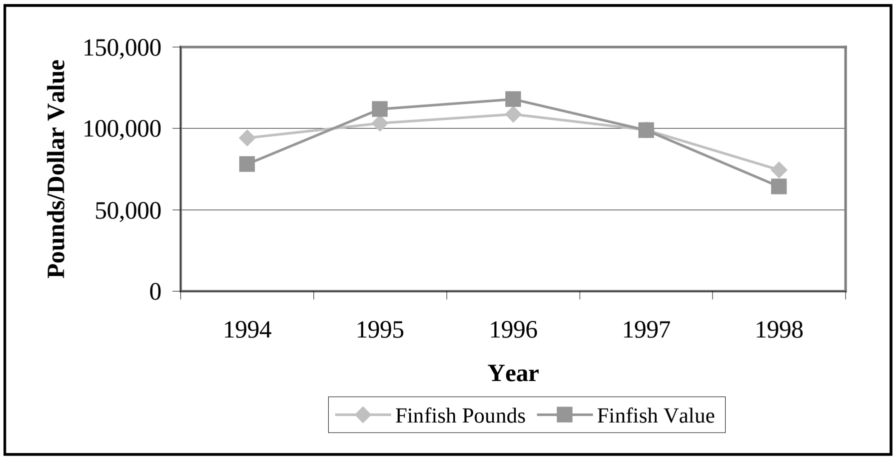
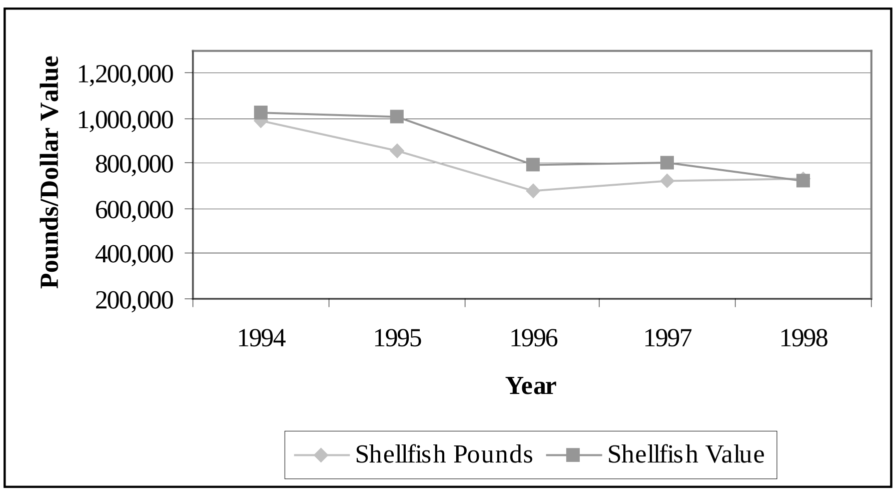



Figure A-15 Recent Overall Trends in Commercial Landings of Non-Finfish in the Cape Fear River Basin Coastal Areas by Total Pounds and Total Value Per Year (1994-1998) Source: NC Division of Marine Fisheries




### 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.

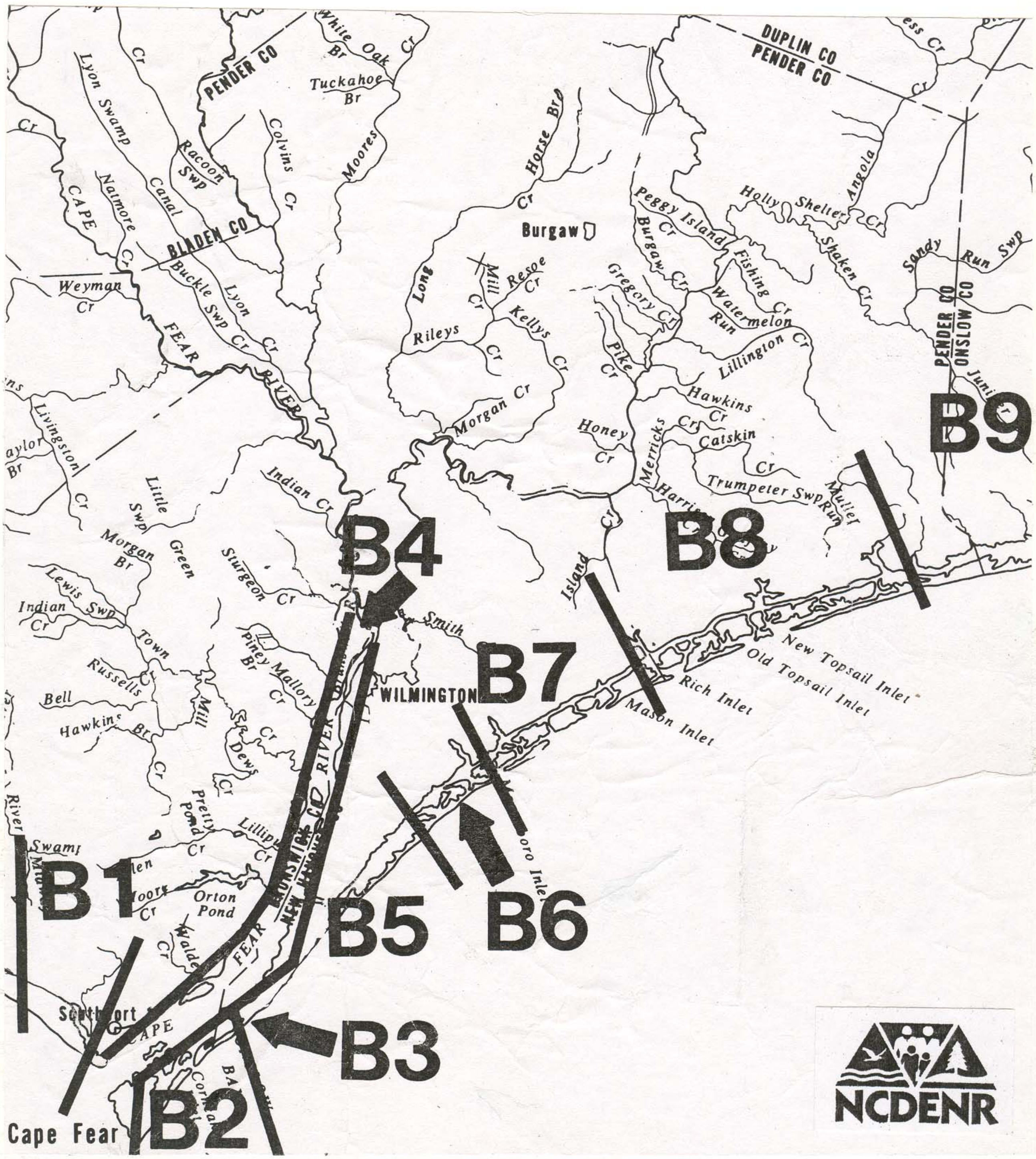



Figure A-16 Shellfish Growing Areas in the Cape Fear River Basin

Wetlands provide a variety of benefits to society and are very important in watershed planning because of the functions they perform. Wetlands provide important protection for flood prevention to protect property values; streambank stabilization to prevent erosion and downstream sedimentation; water purification and pollutant removal (especially for nitrogen and phosphorus); habitat for aquatic life and wildlife and endangered species protection. These values vary greatly with wetland 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. However, wetlands located landward or away from streams also have important water storage capacity and pollutant removal potential.

## Wetland Fill Activities

In 1989, the Environmental Management Commission 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 EMC passed rules, effective October 1, 1996, to restructure the 401 Water Quality Certification Program. These rules are not a new regulatory program since DWQ has issued approvals for wetland fill since the mid-1980s. The 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. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality. Table A-10 shows wetland fill activities by subbasin.

## Wetland 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 a ditch is dumped into jurisdictional wetlands.

The State of North Carolina has since determined that wetland 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 developed and began implementing the wetland draining policy on March 1, 1999.

Wetland 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.

Table A-10 Wetland Fill Activities (in Acres) Permitted in the Cape Fear River Basin by Subbasin and Year

| Subbasin Number | 1994 | 1995 | 1996 | 1997 | Total |
|---|---|---|---|---|---|
| 03-06-01 | 5.27 | 0.68 | 4.69 | 0 | 10.64 |
| 03-06-02 | 1.42 | 9.08 | 10.85 | 3.74 | 25.09 |
| 03-06-03 | 3.3 | 0.25 | 0.33 | 0.83 | 4.71 |
| 03-06-04 | 0 | 0.56 | 3.28 | 0 | 3.84 |
| 03-06-05 | 20.23 | 7.44 | 5.99 | 8.57 | 42.23 |
| 03-06-06 | 0.89 | 0.5 | 5.91 | 0 | 7.3 |
| 03-06-07 | 1.88 | 5.08 | 1.59 | 1.24 | 9.79 |
| 03-06-08 | 9.68 | 8.94 | 4.72 | 0.18 | 23.52 |
| 03-06-09 | 1.97 | 1.53 | 0 | 1.15 | 4.65 |
| 03-06-10 | 0 | 8.95 | 0 | 3.19 | 12.14 |
| 03-06-11 | 0 | 0.29 | 0 | 0 | 0.29 |
| 03-06-12 | 0 | 0 | 0.54 | 0.35 | 0.89 |
| 03-06-13 | 0.09 | 4.03 | 1.15 | 2.58 | 7.85 |
| 03-06-14 | 13.55 | 30.26 | 20.54 | 2.93 | 67.28 |
| 03-06-15 | 20.18 | 48.1 | 13.17 | 12.02 | 93.47 |
| 03-06-16 | 27.48 | 3.8 | 3.76 | 0.7 | 35.74 |
| 03-06-17 | 31.67 | 53.68 | 57.83 | 30.37 | 173.55 |
| 03-06-18 | 1.83 | 1.69 | 0.4 | 1.46 | 5.38 |
| 03-06-19 | 7.26 | 17.28 | 7.38 | 2.54 | 34.46 |
| 03-06-20 | 7 | 0.01 | 0.66 | 0.91 | 8.58 |
| 03-06-21 | 2.6 | 4.57 | 1.3 | 0 | 8.47 |
| 03-06-22 | 62.68 | 22.58 | 4.67 | 7.05 | 96.98 |
| 03-06-23 | 31.21 | 6.43 | 7.85 | 18.14 | 63.63 |
| 03-06-24 | 6.05 | 28.76 | 94.9 | 13.06 | 142.77 |
| Total Acres | 256.24 | 264.49 | 251.51 | 111.01 | 883.25 |

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 wetland 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 wetland 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. Refer to *Best Management Practices for Forestry in the Wetlands of North Carolina.*

DWQ has the authority to review specific wetland 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 multiagency 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 wetland 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 used to target problem areas. To further assist in wetland protection, the public is encouraged to report possible sites where illegal draining has occurred.

To report possible wetlands draining violations in the Cape Fear River basin, the public can contact the appropriate DWQ regional office: Fayetteville (910) 486-1541, Wilmington (910) 395-3900, Raleigh (919) 571-7400 and Winston-Salem (336) 771-4600.

Wetland draining project acres and types are summarized in Table A-11. Figure A-17 shows the locations of project areas in the Cape Fear River basin.

Table A-11 Wetland Acreage Impacted by Wetland Ditching and Draining Activities in the Cape Fear River Basin Separated by Wetland Type (September 1999)

| Wetland Type | Acres | % of Total |
|---|---|---|
| Wet Flat | 3,559 | 54% |
| Pocosin | 2,769 | 42% |
| Bottomland Hardwood/Swamp Forest | 254 | 4% |
| Human Impacted Wetland | 22 | minor |
| Freshwater Marsh | 8 | minor |
| **Total Wetlands** | **6,612** | |
| Non-Wetland | 2,419 | |

Note: These boundaries and associated acreage values are approximate and are intended to give general location information only. The wetland data used in this analysis were developed by the Division of Coastal Management and are *not* intended to represent jurisdictional wetland boundaries.

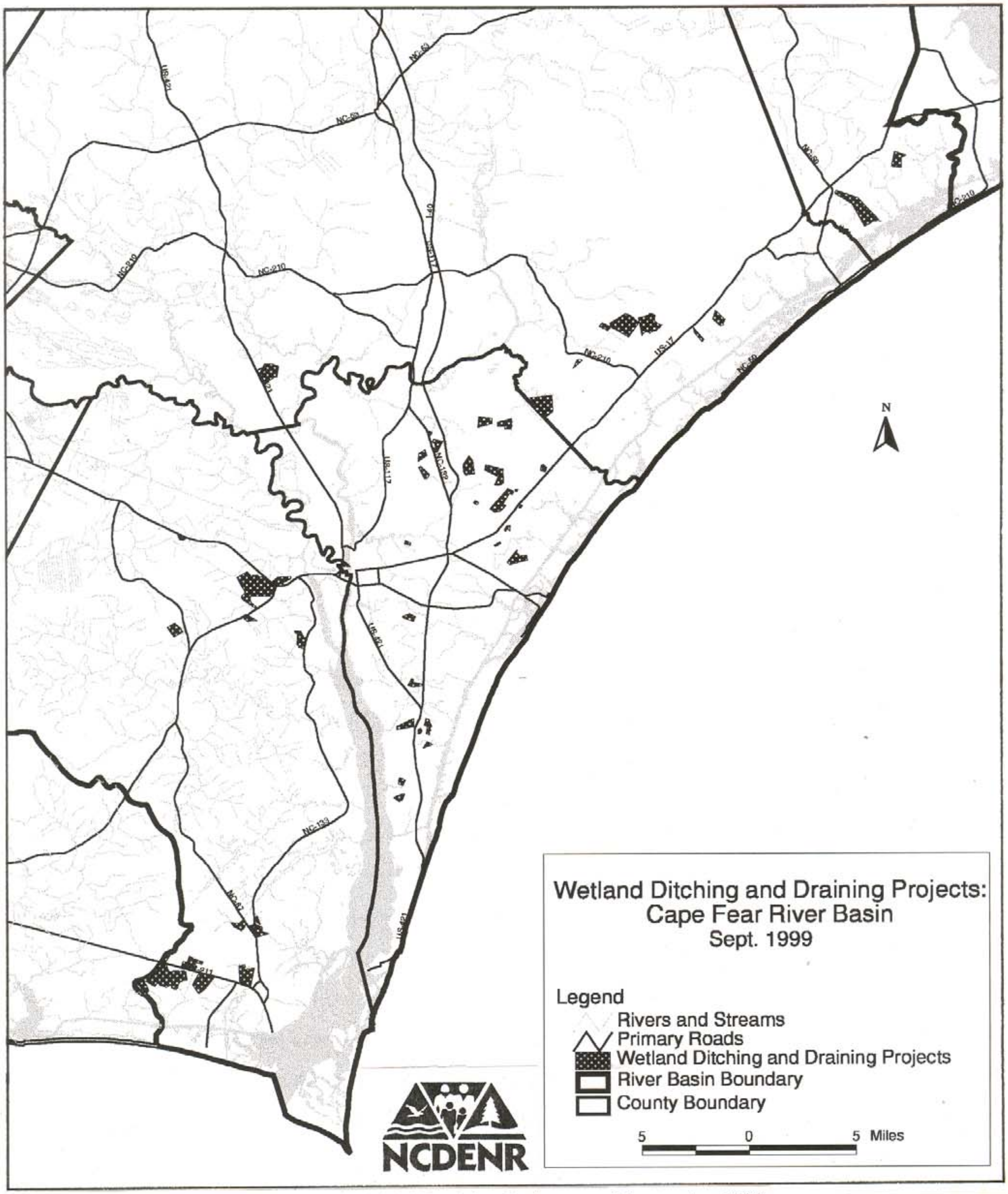



Figure A-17 Cape Fear River Basin Wetland Draining Projects as of September 1999

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 Resource's permit file information, aerial surveys conducted by regional office staff, low altitude color infrared photography, and on-site investigations. These methods created inherent and varied inaccuracies in the data.
2. Project boundaries represent approximate size and location only; more precise information will require more extensive 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 numbers provided in this analysis represent potential wetland impacts, not actual wetland "loss".

**Wetland 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 Cape Fear River basin through the *Basinwide Wetlands and Riparian Restoration Plan for the Cape Fear River Basin*. For more information on this document or the NCWRP, call (919) 733-5208 or visit http://h2o.enr.state.nc.us/wrp/index.htm.

## 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 and stormwater discharges associated with certain industrial activities. Point source dischargers in North Carolina must apply for and obtain a National

***The primary pollutants associated with point source discharges are:***

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

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

### 2.7.1 Wastewater Discharges in the Cape Fear River Basin

***Types of Wastewater Discharges***

**Major Facilities**: Municipal Wastewater Treatment Plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts on public health and water quality).
**Minor Facilities**: Any facilities not meeting the definition of Major.
**100% Domestic Waste**: Facilities that only treat domestic-type waste (water from bathrooms, sinks, washers).
**Municipal Facilities**: Facilities that serve a municipality. Can treat waste from homes and industries.
**Industrial Facilities**: Facilities with wastewater from industrial processes such as textiles, mining, seafood processing, glass-making and power generation.
**Other Facilities**: This category includes a variety of facilities such as schools, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

There are 280 permitted wastewater discharges in the Cape Fear River basin. Table A-12 provides summary information (numbers of facilities and permitted flows) regarding the discharges by type and subbasin. The various types of dischargers characterized in the table are described in the inset box. A summary of all dischargers can be found in Appendix I.

Figures A-18, A-19 and A-20 show the location of major and minor permitted wastewater discharges within the basin. The number of triangles on the map depicting major discharges do not correspond exactly to the number of major facilities listed in Table A-12, since some major facilities have more than one outfall point. Each outfall point received its own triangle.

### 2.7.2 Stormwater Discharges in the Cape Fear River Basin

Amendments to the Clean Water Act in 1990 provided requirements for NPDES stormwater permits for municipal, industrial and construction activities (Phase I of the NPDES stormwater program). Permit requirements were established for ten categories of industrial activity ranging from vehicle maintenance facilities to textile manufacturers. Permit requirements were also established for construction activities which disturb 5 or more acres of land area. Permit application requirements were established for municipalities with a population of 100,000 or more. The focus of the NPDES stormwater program is pollution prevention and source control.

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.

Table A-12 Summary of NPDES Dischargers and Permitted Flows for the Cape Fear River Basin (as of April 1999)

| | Subbasin | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Facility Categories | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 08 | 09 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | TOTAL |
| Total Facilities | 13 | 35 | 8 | 8 | 9 | 8 | 15 | 27 | 15 | 6 | 7 | 4 | 6 | 11 | 6 | 8 | 55 | 3 | 7 | 2 | 3 | 14 | 6 | 4 | 280 |
| Total Permitted Flow (MGD) | 5.4 | 69.9 | 0.1 | 0.8 | 26.3 | 8.3 | 13.9 | 28.0 | 9.8 | 1.6 | 6.0 | 4.0 | 9.0 | 3.0 | 39.9 | 14.0 | 93.0 | 0.1 | 4.7 | 0.0 | 1.4 | 10.6 | 2.5 | 0.1 | 352.6 |
| Major Discharges | 2 | 8 | 0 | 0 | 2 | 2 | 5 | 2 | 1 | 1 | 2 | 1 | 3 | 2 | 4 | 3 | 13 | 0 | 1 | 0 | 2 | 3 | 1 | 0 | 58 |
| Total Permitted Flow (MGD) | 5.2 | 67.3 | 0.0 | 0.0 | 26.0 | 8.0 | 11.6 | 17.7 | 9.0 | 1.0 | 6.0 | 4.0 | 6.7 | 1.5 | 39.9 | 7.5 | 88.9 | 0.0 | 3.0 | 0.0 | 1.4 | 8.0 | 1.1 | 0.0 | 313.7 |
| Minor Discharges | 11 | 27 | 8 | 8 | 7 | 6 | 10 | 25 | 14 | 5 | 5 | 3 | 3 | 9 | 2 | 5 | 42 | 3 | 6 | 2 | 1 | 11 | 5 | 4 | 222 |
| Total Permitted Flow (MGD) | 0.2 | 2.6 | 0.1 | 0.8 | 0.3 | 0.3 | 2.4 | 10.3 | 0.8 | 0.6 | 0.0 | 0.0 | 2.3 | 1.5 | 0.0 | 6.5 | 4.1 | 0.1 | 1.7 | 0.0 | 0.0 | 2.6 | 1.4 | 0.1 | 38.8 |
| 100% Domestic Waste | 9 | 14 | 6 | 5 | 4 | 3 | 8 | 10 | 8 | 5 | 2 | 4 | 2 | 7 | 2 | 2 | 21 | 1 | 6 | 2 | 1 | 4 | 4 | 1 | 131 |
| Total Permitted Flow (MGD) | 0.2 | 0.5 | 0.1 | 0.8 | 0.3 | 0.2 | 3.0 | 0.2 | 9.2 | 1.0 | 0.0 | 4.0 | 1.5 | 3.0 | 14.0 | 0.8 | 9.9 | 0.1 | 1.7 | 0.0 | 1.0 | 2.0 | 0.7 | 0.1 | 54.4 |
| Municipal Facilities | 1 | 6 | 0 | 2 | 2 | 1 | 5 | 2 | 3 | 2 | 1 | 1 | 2 | 2 | 3 | 2 | 6 | 0 | 5 | 0 | 1 | 4 | 1 | 1 | 53 |
| Total Permitted Flow (MGD) | 5.0 | 66.0 | 0.0 | 0.8 | 26.0 | 8.0 | 2.9 | 17.7 | 9.5 | 1.6 | 5.0 | 4.0 | 4.2 | 1.6 | 39.0 | 1.5 | 28.1 | 0.0 | 1.7 | 0.0 | 1.0 | 2.0 | 0.5 | 0.1 | 226.3 |
| Non-Municipal Facilities | 12 | 29 | 8 | 6 | 7 | 7 | 10 | 25 | 12 | 4 | 6 | 3 | 4 | 9 | 3 | 6 | 49 | 3 | 2 | 2 | 2 | 10 | 5 | 3 | 227 |
| Total Permitted Flow (MGD) | 0.4 | 3.9 | 0.1 | 0.0 | 0.3 | 0.3 | 11.0 | 10.3 | 0.3 | 0.0 | 1.0 | 0.0 | 4.8 | 1.5 | 0.9 | 12.5 | 64.9 | 0.1 | 3.0 | 0.0 | 0.4 | 8.6 | 2.0 | 0.0 | 126.3 |

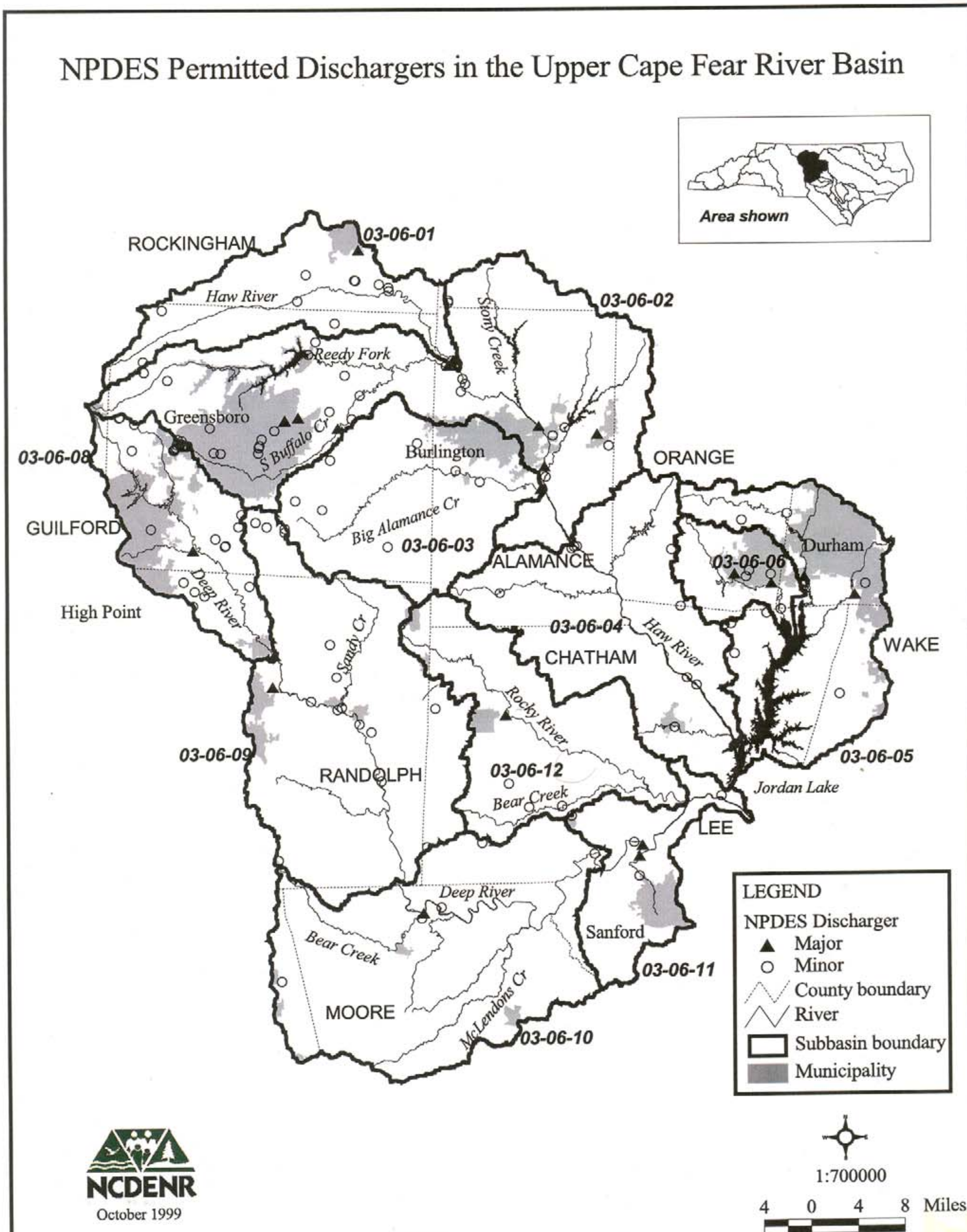



Figure A-18 Location of NPDES Permitted Dischargers in the Upper Cape Fear River Basin

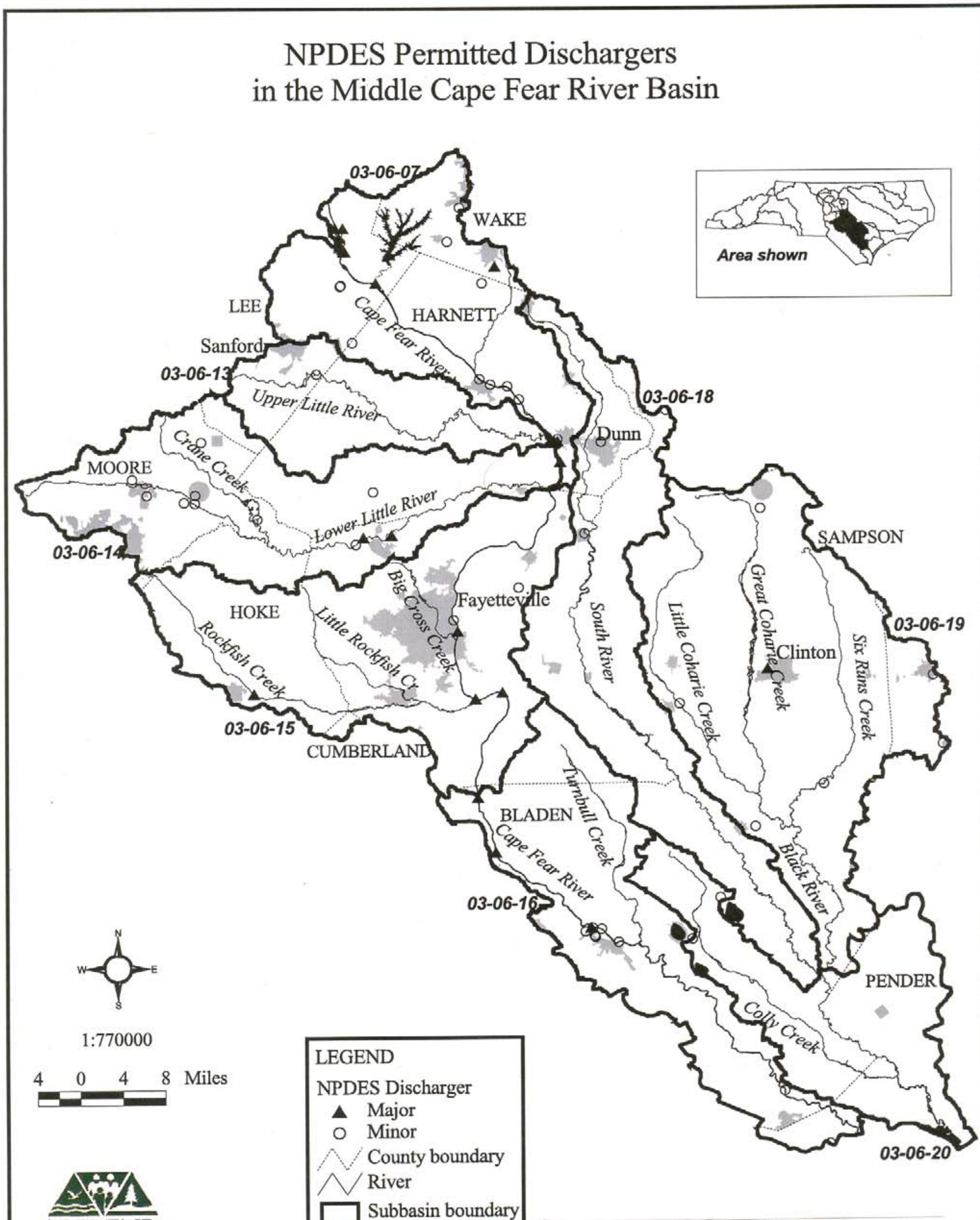
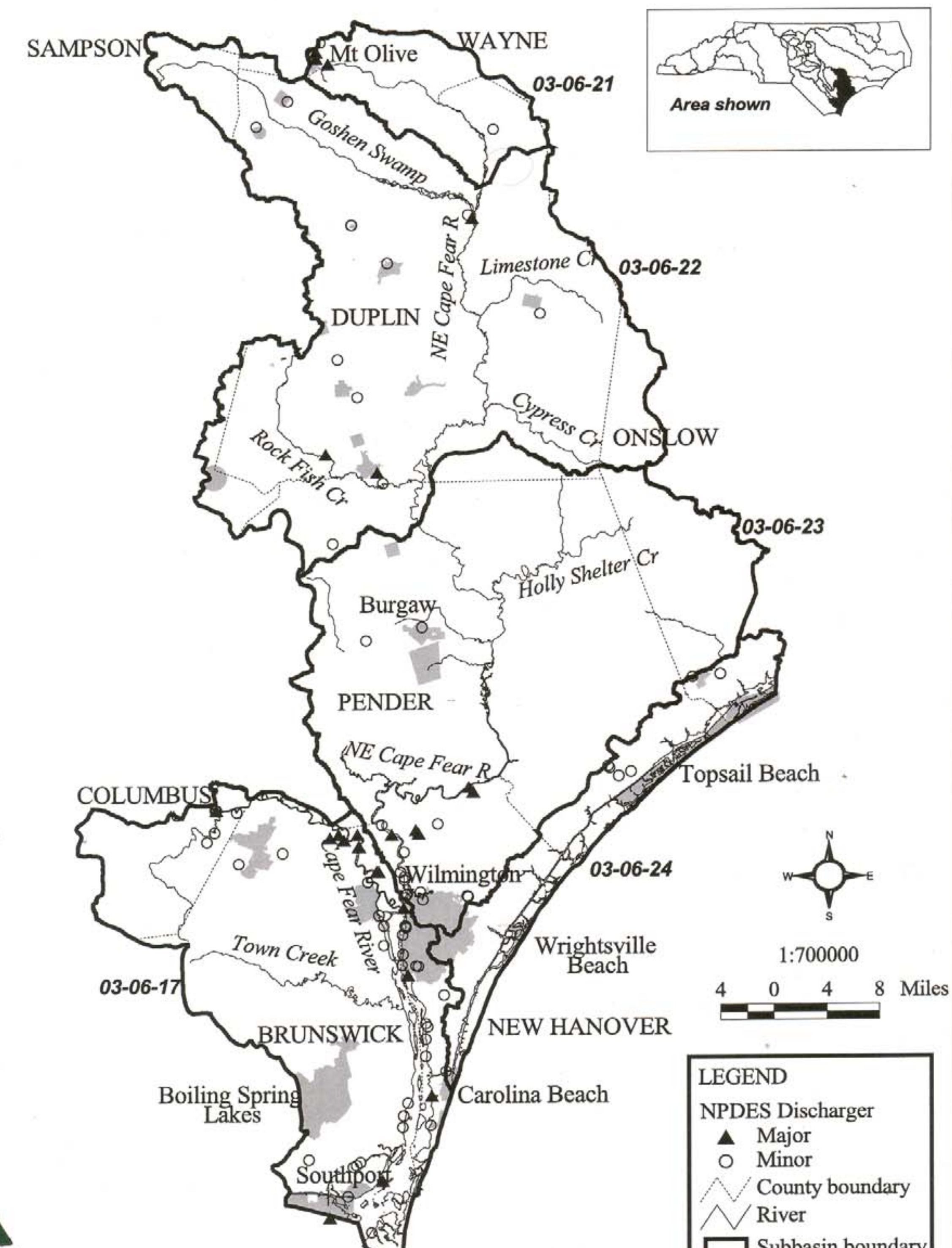



Figure A-19 Location of NPDES Permitted Dischargers in the Middle Cape Fear River Basin

# NPDES Permitted Dischargers in the Lower Cape Fear River Basin

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October 1999

Figure A-20 Location of NPDES Permitted Dischargers in the Lower Cape Fear River Basin

**_EPA Stormwater Rules_**

Phase I – December 1990

- Requires a NPDES permit for municipal storm sewer systems serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for eleven categories of industry.
- Requires a NPDES stormwater permit for construction sites that are 5 acres or more.

Phase II – November 1999

- Requires a NPDES permit for municipal storm sewer systems serving populations under 100,000 that are located in urbanized areas.
- Provides incentives to industrial facilities covered under Phase I for protecting operations from stormwater exposure.
- Requires a NPDES stormwater permit for construction sites that are 1-5 acres.

Permits are granted in the form of general stormwater permits (covering a wide variety of activities) or individual stormwater permits. Excluding construction general permits, there are 623 general stormwater permits and 48 individual stormwater permits issued within the river basin. Individual permit holders are presented in Table A-13.

The municipalities covered by the NPDES stormwater regulations are called Municipal Separate Storm Sewer Systems (MS4s). Phase I covers large and medium MS4s (population of 100,000 or more). There are six permitted Phase I MS4s in North Carolina. The cities of Greensboro, Durham and Fayetteville (which also includes Cumberland County) are the only Phase I MS4s in the Cape Fear River Basin.

On October 29, 1999, a second phase of the NPDES stormwater program was signed into law. Phase II lowers the construction activity threshold to 1 or more acres of land disturbance and allows a permitting exemption for industrial facilities that do not have significant materials or activities exposed to stormwater.

Phase II also pulls many small local governments into the NPDES stormwater program. The federal regulations require that small MS4s with a population of 50,000 or more and a density of 1,000 people per square mile be covered under a NPDES stormwater permit. This includes small municipalities that, when clustered together, are considered an urbanized area that collectively meets the 50,000/1,000 criteria. In addition, DWQ is required to develop designation criteria that pull in other small MS4s. The designation criteria must include, at a minimum, all MS4s with a population of 10,000 or more and a density of 1,000 people per square mile. At a minimum, the local governments listed in Table A-14 will be covered under Phase II of the NPDES stormwater program. It is highly likely that additional local governments will be required to seek a permit through designation. Phase II MS4 permit applications must be submitted to DWQ by March 1, 2003.

Table A-13 Summary of Individual NPDES Stormwater Permits in the Cape Fear River Basin

| Permit # | Facility Name | Receiving Stream | Subbasin | County |
|---|---|---|---|---|
| NCS000030 | Air Products and Chemicals, Inc. | UT Little Troublesome Creek | 03-06-01 | Rockingham |
| NCS000085 | Safety-Kleen (TS) | UT Troublesome Creek | 03-06-01 | Rockingham |
| NCS000010 | Stockhausen, Inc. | Mile Run Creek | 03-06-02 | Guilford |
| NCS000048 | Chemol Co., Inc. | Mile Run Creek | 03-06-02 | Guilford |
| NCS000077 | Dow Corning Corporation | UT South Buffalo Creek | 03-06-02 | Guilford |
| NCS000107 | Unitex Chemical Corporation | South Buffalo Creek | 03-06-02 | Guilford |
| NCS000119 | Unichem, Inc. | Haw River | 03-06-02 | Alamance |
| NCS000155 | GKN Automotive Components, Inc. | Buffalo Creek | 03-06-02 | Lee |
| NCS000206 | Duke Power Fairfax Ops Center | UT South Buffalo Creek | 03-06-02 | Guilford |
| NCS000253 | Southern Foundries Corporation | North Buffalo Creek | 03-06-02 | Guilford |
| NCS000308 | Air Products & Chemicals, Inc. | UT Little Buffalo Creek | 03-06-02 | Guilford |
| NCS000353 | H B Fuller Company - Guilford Co. | UT South Buffalo Creek | 03-06-02 | Guilford |
| NCS000090 | Burlington Chemical Company | Gum Creek | 03-06-03 | Alamance |
| NCS000017 | Glaxo Wellcome, Inc. - Durham Co. | UT Northeast Creek | 03-06-05 | Durham |
| NCS000046 | National Specialty Gases | UT Northeast Creek | 03-06-05 | Durham |
| NCS000050 | SCM Metal Products, Inc. | UT Northeast Creek & Stirrup Iron Creek | 03-06-05 | Durham |
| NCS000084 | South Atlantic Services, Inc. | Fishing Creek | 03-06-05 | New Hanover |
| NCS000201 | Univ. of North Carolina - Chapel Hill | UT Bolin Creek | 03-06-06 | Orange |
| NCS000087 | PAC-FAB, Inc. | Little Buffalo Creek | 03-06-07 | Lee |
| NCS000100 | Allied Signal, Inc. | Shaddox Creek & Haw River | 03-06-07 | Chatham |
| NCS000150 | Neste Resins Corporation | Haw River | 03-06-07 | Chatham |
| NCS000151 | Weyerhaeuser Company | Shaddox Creek | 03-06-07 | Chatham |
| NCS000078 | Novartis Crop Protection, Inc. | East Fork Long Branch Creek | 03-06-08 | Guilford |
| NCS000092 | Marsh Furniture Company | UT Richland Creek | 03-06-08 | Guilford |
| NCS000280 | Lester Group, Inc. - Fortress Wood Prod. | UT Bull Run Creek | 03-06-08 | Guilford |
| NCS000319 | Marlowe-Van Loan Corporation | Richland Creek | 03-06-08 | Guilford |
| NCS000242 | Ultracraft Company | UT Sandy Creek | 03-06-09 | Randolph |
| NCS000023 | Pioneer Southern, Inc. | Rita Branch | 03-06-10 | Montgomery |
| NCS000123 | Perdue Farms, Inc. | Bear Creek & Buck Creek | 03-06-10 | Moore |
| NCS000122 | General Timber, Inc. | George's Creek | 03-06-11 | Chatham |
| NCS000056 | ICI Americas, Inc. | Cape Fear River | 03-06-15 | Cumberland |
| NCS000088 | Borden Packaging & Industrial Products | Cape Fear River | 03-06-15 | Cumberland |
| NCS000147 | Fiber Industries | UT Cape Fear River | 03-06-15 | Cumberland |
| NCS000187 | Black & Decker (US), Inc. | UT Lake Lynn | 03-06-15 | Cumberland |
| NCS000076 | Corning, Inc. | Spring Branch | 03-06-17 | New Hanover |
| NCS000101 | Federal Paper Board Co. - Riegelwood | Cape Fear River | 03-06-17 | Columbus |
| NCS000156 | Wright Corporation | Mill Creek & Livingston Creek | 03-06-17 | Columbus |
| NCS000174 | NC State Ports Authority - Wilmington | Cape Fear River | 03-06-17 | New Hanover |
| NCS000208 | Military Ocean Terminal - Sunny Point | Cape Fear River | 03-06-17 | Brunswick |
| NCS000244 | American Distillation Co. | Cape Fear River | 03-06-17 | Brunswick |
| NCS000258 | National Starch & Chemical Co .- Leland | Alligator Branch | 03-06-17 | Brunswick |
| NCS000344 | American Crane Corp - New Hanover | UT Barnards Creek | 03-06-17 | New Hanover |
| NCS000309 | Schindler Elevator Corporation | Old Williams Mill Branch | 03-06-19 | Sampson |
| NCS0000003 | Occidental Chemical Company | Northeast Cape Fear River | 03-06-23 | New Hanover |
| NCS000022 | GE Wilmington | Prince George Creek | 03-06-23 | New Hanover |
| NCS000118 | Arteva Specialties, Sarl | Northeast Cape Fear River | 03-06-23 | New Hanover |
| NCS000214 | Royster Clark, Inc. | Northeast Cape Fear River | 03-06-23 | New Hanover |
| NCS000222 | General Wood Preserving Co., Inc. | UT Sturgeon Creek | 03-06-23 | Brunswick |

Table A-14 Cities and Counties Included in State Stormwater Program

| | | | |
|---|---|---|---|
| **Phase I Cities** | | | |
| Durham | Fayetteville | Greensboro | |
| | | | |
| **Phase II Cities** | | | |
| Apex | Cary | High Point | Reidsville |
| Archdale | Chapel Hill | Hope Mills | Sanford |
| Asheboro | Elon College | Jamestown | Spring Lake |
| Belville | Gibsonville | Kernersville | Wilmington |
| Burlington | Graham | Leland | Wrightsville Beach |
| Carrboro | Haw River | Mebane | |
| | | | |
| **Phase II Counties** | | | |
| Alamance | Forsyth | New Hanover | Randolph |
| Brunswick | Guilford | Onslow | Wake |
| Durham | Harnett | Orange | Wayne |

## 2.8 Animal Operations

Table A-15 summarizes, by subbasin, the number of registered livestock operations, total animals and total steady state live weight as of September 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. Figures A-21, A-22 and A-23 show the general location of the registered operations in the basin.

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.

The NC Department of Agriculture provided information on animal capacity by subbasin (Table A-16).

### ***Key Animal Operation Legislation (1995-1999)***

1995 – Senate Bill 974 requires owners of swine facilities with 250 or more animals to hire a certified operator. Operators are required to attend a six-hour training course and pass an examination for certification. Senate Bill 1080 established buffer requirements for swine houses, lagoons and land application areas for farms sited after October 1, 1995.

1996 – Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address 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. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.

1997 – House Bill 515 placed a moratorium on new or existing swine farm operations and allows counties to adopt zoning ordinances for swine farms with a design capacity of 600,000 pounds (SSLW) or more. In addition, owners of potential new and expanding operations are required to notify the county (manager or chair of commission) and local health department, as well as adjoining landowners. DENR was required to develop and adopt economically feasible odor control standards by March 1, 1999.

1998 – House Bill 1480 extended the moratorium on construction or expansion of swine farms. The bill also requires owners of swine operations to register with DWQ any contractual relationship with an integrator.

1999 – House Bill 1160 extended (again) the moratorium on new construction or expansion of swine farms, required DENR to develop an inventory of inactive lagoons, and requires owners/operators of an animal waste treatment system to notify the public in the event of a discharge to surface waters of the state of 1,000 gallons or more of untreated wastewater.

Table A-15 Registered Animal Operations in the Cape Fear River Basin (as of 9/98)

| Subbasin | Swine | | | Cattle | | |
|---|---|---|---|---|---|---|
| | No. of Facilities | No. of Animals | Total Steady State Live Weight | No. of Facilities | No. of Animals | Total Steady State Live Weight |
| 03-06-01 | 1 | 2,850 | 493,620 | 5 | 2,599 | 2,598,200 |
| 03-06-02 | 1 | 1,000 | 130,500 | 6 | 2,010 | 2,154,000 |
| 03-06-03 | 3 | 9,660 | 776,580 | 2 | 400 | 560,000 |
| 03-06-04 | 3 | 23,544 | 2,432,520 | 17 | 2,505 | 2,507,000 |
| 03-06-05 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03-06-06 | 0 | 0 | 0 | 1 | 125 | 175,000 |
| 03-06-07 | 2 | 5,616 | 866,112 | 0 | 0 | 0 |
| 03-06-08 | 0 | 0 | 0 | 5 | 2,325 | 3,255,000 |
| 03-06-09 | 13 | 43,435 | 6,222,528 | 3 | 625 | 875,000 |
| 03-06-10 | 2 | 12,253 | 924,090 | 1 | 200 | 280,000 |
| 03-06-11 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03-06-12 | 1 | 400 | 52,200 | 2 | 250 | 350,000 |
| 03-06-13 | 6 | 27,815 | 3,251,025 | 0 | 0 | 0 |
| 03-06-14 | 5 | 32,152 | 4,157,160 | 1 | 700 | 980,000 |
| 03-06-15 | 13 | 55,550 | 6,753,860 | 0 | 0 | 0 |
| 03-06-16 | 42 | 254,353 | 32,063,197 | 0 | 0 | 0 |
| 03-06-17 | 7 | 45,216 | 6,381,110 | 0 | 0 | 0 |
| 03-06-18 | 82 | 450,398 | 57,856,987 | 0 | 0 | 0 |
| 03-06-19 | 306 | 1,538,402 | 182,351,532 | 0 | 0 | 0 |
| 03-06-20 | 12 | 88,672 | 10,888,120 | 0 | 0 | 0 |
| 03-06-21 | 69 | 240,648 | 27,261,539 | 0 | 0 | 0 |
| 03-06-22 | 404 | 787,900 | 217,781,138 | 0 | 0 | 0 |
| 03-06-23 | 46 | 204,757 | 25,636,095 | 0 | 0 | 0 |
| 03-06-24 | 1 | 1,800 | 243,000 | 0 | 0 | 0 |
| Totals | 1,019 | 3,826,421 | 586,522,913 | 43 | 11,739 | 13,734,200 |

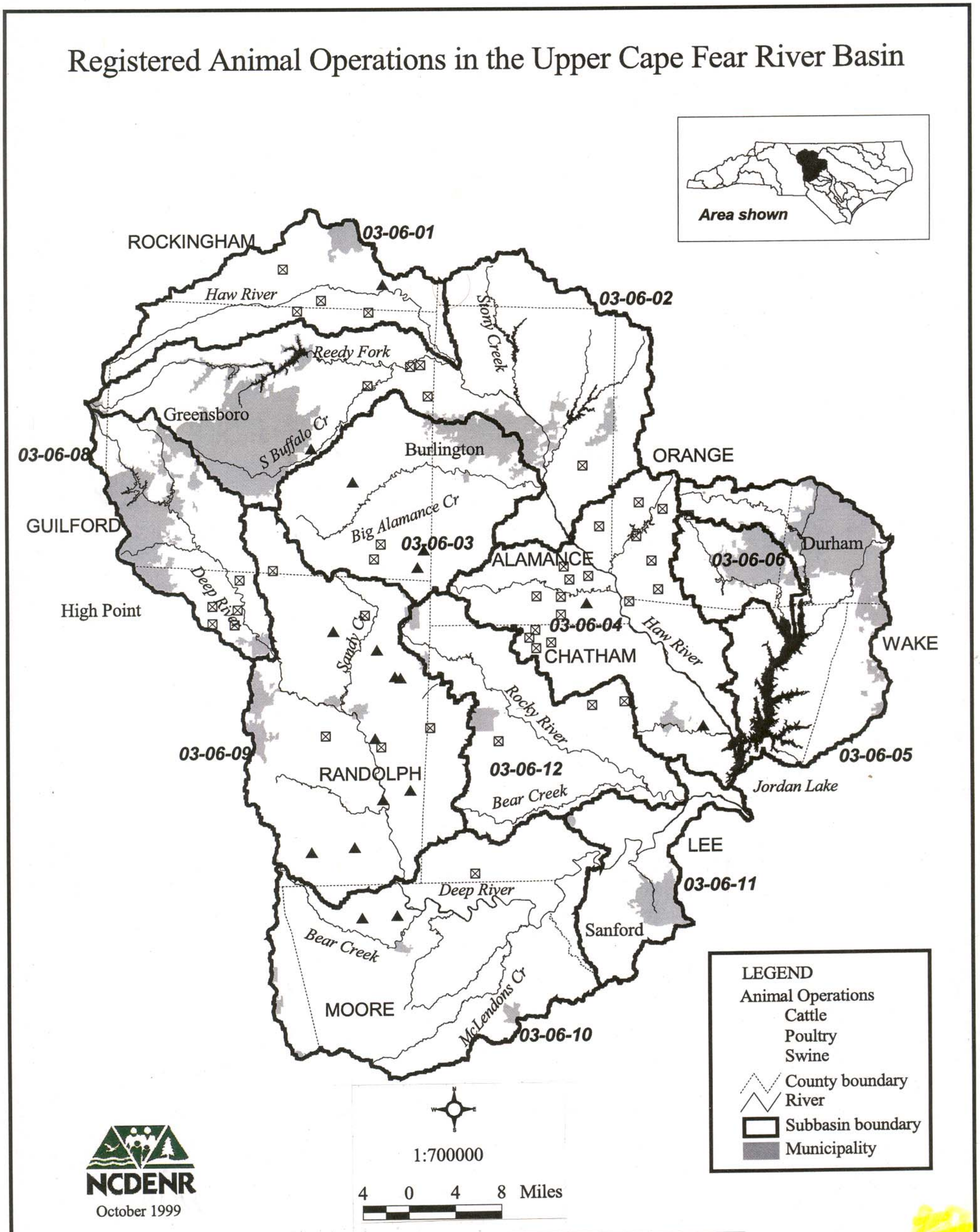



Figure A-21 Registered Animal Operations in the Upper Cape Fear River Basin

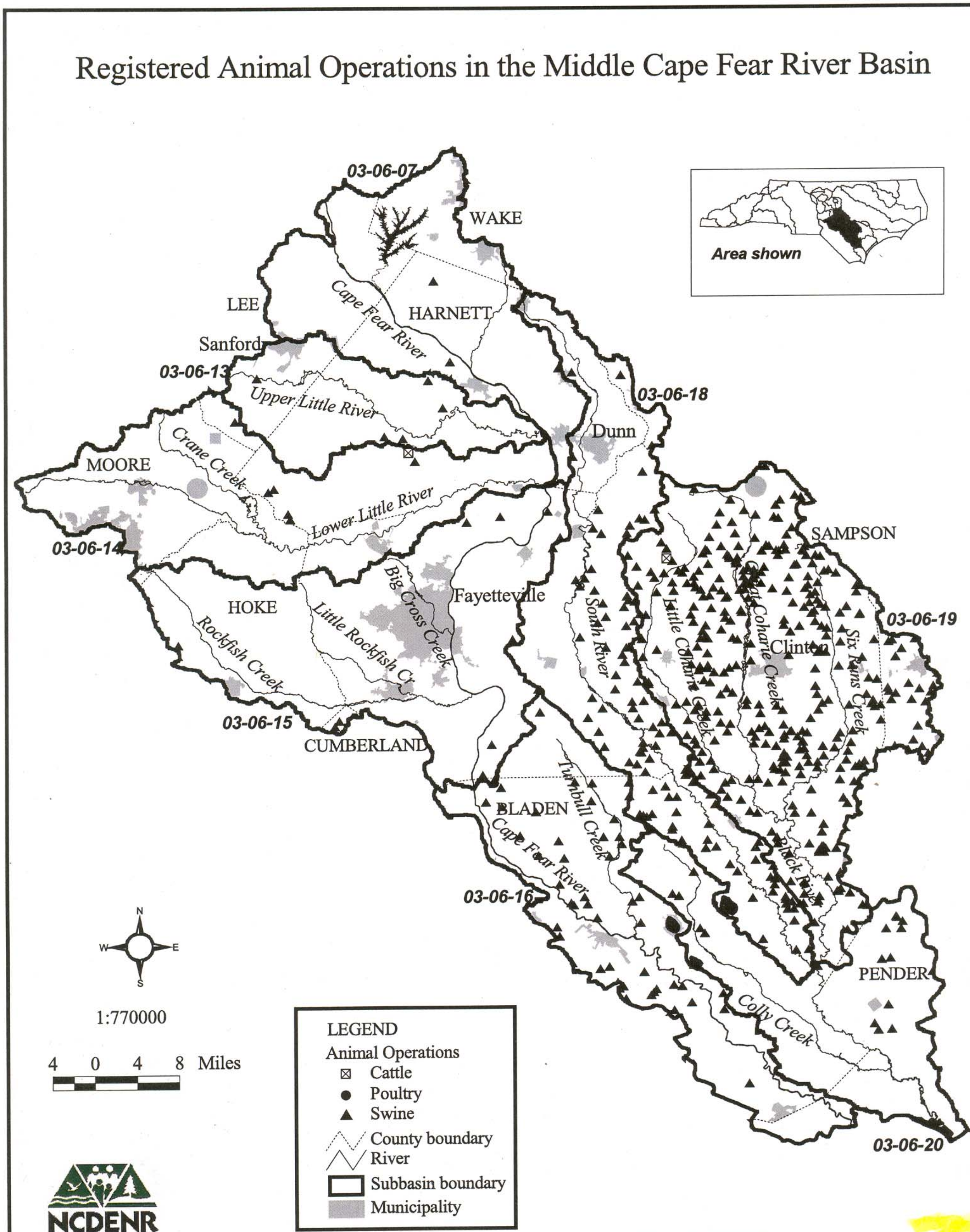
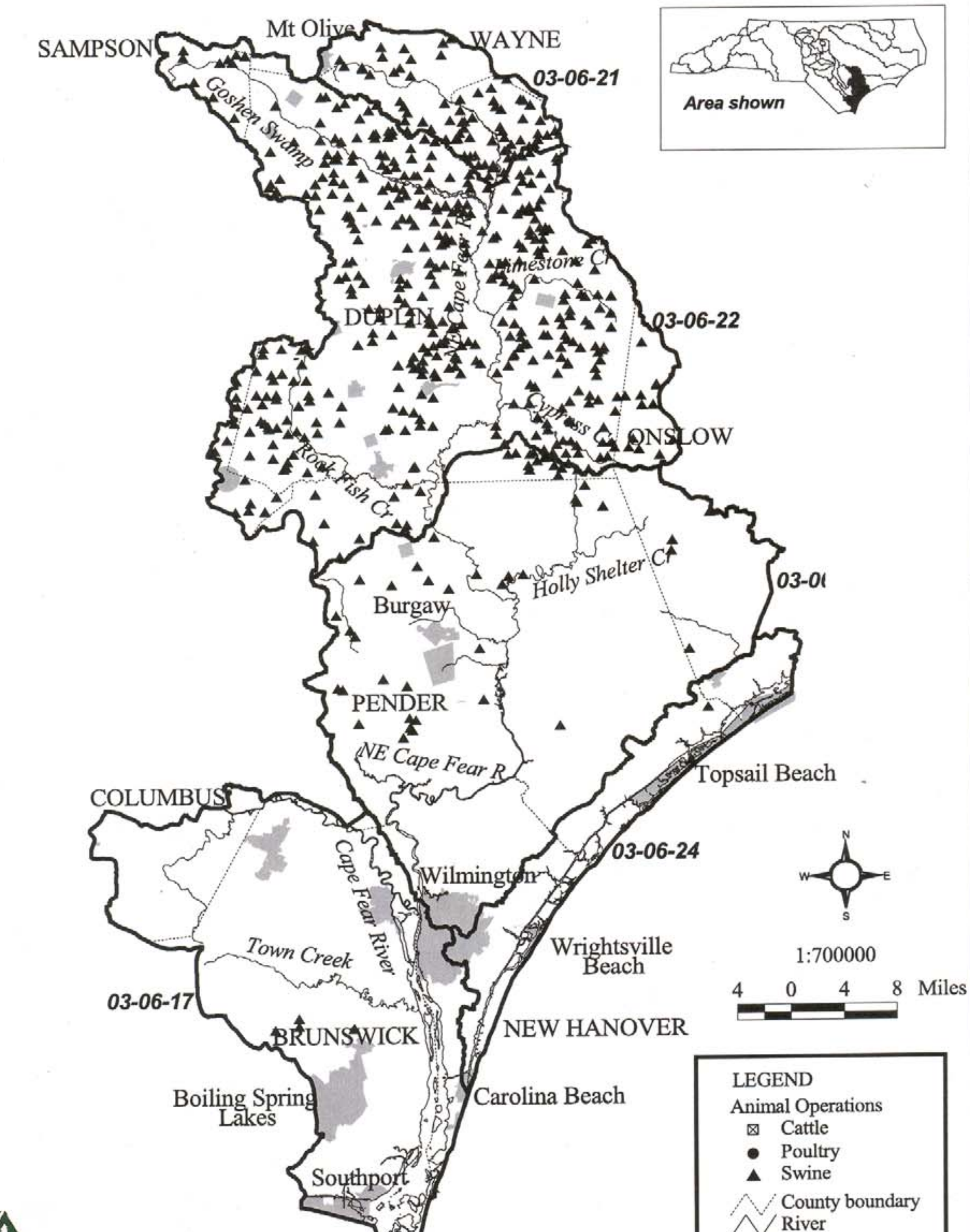



Figure A-22 Registered Animal Operations in the Middle Cape Fear River Basin

# Registered Animal Operations in the Lower Cape Fear River Basin




NCDENR
October 1999

Figure A-23 Registered Animal Operations in the Lower Cape Fear River Basin

Table A-16 Estimated Populations of Swine (1998, 1994 and 1990), Dairy (1998 and 1994) and Poultry (1998 and 1994) in the Cape Fear River Basin (NCDA Veterinary Division)

| Subbasin | Total Swine Capacity | | | Swine Change | Total Dairy Capacity | | Dairy Change | Poultry Capacity | | Poultry Change |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1998 | 1994 | 1990 | 94-98 (%) | 1998 | 1994 | 94-98 (%) | 1998 | 1994 | 94-98 (%) |
| 03-06-01 | 2,884 | 1,798 | 1,052 | 60 | 1,223 | 1,629 | -25 | 63,300 | 100 | 63,200 |
| 03-06-02 | 1,944 | 2,342 | 2,995 | -17 | 2,181 | 3,656 | -40 | 286,849 | 86,773 | 231 |
| 03-06-03 | 2,112 | 3,357 | 2,918 | -37 | 1,058 | 1,353 | -22 | 522,070 | 482,144 | 8 |
| 03-06-04 | 3,310 | 3,354 | 1,469 | -1 | 5,698 | 6,153 | -7 | 4,865,029 | 1,855,294 | 162 |
| 03-06-05 | 300 | 209 | 167 | 44 | 640 | 213 | 200 | 10,000 | 22,000 | -55 |
| 03-06-06 | 300 | 120 | 167 | 150 | 640 | 641 | 0 | 10,000 | 50 | 19,900 |
| 03-06-07 | 4,202 | 4,109 | 3,256 | 2 | 255 | 1,020 | -75 | 1,857,430 | 1,653,430 | 12 |
| 03-06-08 | 118 | 129 | 228 | -9 | 2,604 | 2,677 | -3 | 465,889 | 415,789 | 12 |
| 03-06-09 | 37,997 | 40,443 | 8,233 | -6 | 2,933 | 3,113 | -6 | 13,185,379 | 12,049,038 | 9 |
| 03-06-10 | 28,585 | 21,454 | 18,920 | 33 | 405 | 405 | 0 | 9,640,013 | 9,311,324 | 4 |
| 03-06-11 | 963 | 1,042 | 1,220 | -8 | 0 | 127 | -100 | 2,219,382 | 2,080,230 | 7 |
| 03-06-12 | 3,466 | 4,524 | 6,978 | -23 | 1,117 | 1,483 | -25 | 5,950,459 | 5,955,399 | 0 |
| 03-06-13 | 19,353 | 3,342 | 1,686 | 479 | 0 | 12 | -100 | 967,800 | 753,600 | 28 |
| 03-06-14 | 20,809 | 8,192 | 4,437 | 154 | 585 | 589 | -1 | 3,765,400 | 3,279,900 | 15 |
| 03-06-15 | 43,395 | 38,306 | 24,657 | 13 | 0 | 0 | 0 | 486,811 | 413,911 | 18 |
| 03-06-16 | 293,021 | 137,777 | 38,281 | 113 | 0 | 0 | 0 | 125,000 | 155,000 | -19 |
| 03-06-17 | 39,343 | 20,614 | 9,231 | 91 | 0 | 0 | 0 | 0 | 0 | 0 |
| 03-06-18 | 474,316 | 192,309 | 98,466 | 147 | 0 | 0 | 0 | 1,820,288 | 1,440,488 | 26 |
| 03-06-19 | 1,647,410 | 954,060 | 353,427 | 73 | 1,875 | 1,875 | 0 | 8,582,910 | 6,092,850 | 41 |
| 03-06-20 | 95,950 | 29,170 | 9,404 | 229 | 0 | 0 | 0 | 77,300 | 47,030 | 64 |
| 03-06-21 | 275,767 | 145,138 | 50,280 | 90 | 155 | 155 | 0 | 1,526,230 | 1,415,500 | 8 |
| 03-06-22 | 1,804,152 | 920,839 | 277,130 | 96 | 0 | 0 | 0 | 7,944,900 | 8,416,850 | -6 |
| 03-06-23 | 440,628 | 229,490 | 65,424 | 92 | 0 | 0 | 0 | 3,251,100 | 3,052,100 | 7 |
| 03-06-24 | 1,067 | 1,051 | 276 | 2 | 0 | 0 | 0 | 2,000 | 3,000 | -33 |
| TOTALS | 5,241,392 | 2,763,169 | 980,302 | 90 | 21,369 | 25,101 | -15 | 67,625,539 | 58,981,800 | 15 |
| % of State Total | 54% | 51% | 39% | | 22% | 19% | | 32% | 32% | |

Source : NC Department of Agriculture, Veterinary Division

## 2.9 Water Use and Minimum Streamflow

### 2.9.1 Local Water Supply Planning

The North Carolina General Assembly has mandated a local and state water supply planning process under North Carolina General Statute §143-355(l) and (m) to assure that communities have an adequate supply of water for future needs. Under this statute all units of local government that provide or plan to provide public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs. The current LWSPs are based on 1992 data. Updated plans based on 1997 water supply and water use information were completed in 1999.

In 1992, 130 systems that use water from the Cape Fear River basin provided an average of 208.77 million gallons per day (MGD) to 1.3 million people (Table A-17). Projections of future need show that these systems expect their service populations to increase by 66% to 2.1 million people by 2020. Average daily water use for these systems is expected to increase by 86 percent to 388 MGD by the year 2020. These data only represent systems submitting a LWSP and do not reflect the needs of the public water systems in this basin that are not required to prepare a plan because they are not operated by a unit of local government. The information is self-reported and has not been field verified. However, plans have been reviewed by staff engineers for consistency and reasonableness. More information is available for these and other systems across the state that submitted a Local Water Supply Plan from the Division of Water Resources' website at: www.dwr.ehnr.state.nc.us/home.htm.

### 2.9.2 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. Hydropower dams that are subject to FERC authority are exempt from Division of Land Resources (DLR) authority. Conditions may be placed on dam operations specifying mandatory minimum releases in order to maintain adequate quantity and quality of water in the length of a stream affected by an impoundment. Table A-18 lists hydroelectric projects with minimum releases. The Division of Water Resources (DWR), in conjunction with the Wildlife Resources Commission, recommends conditions relating to release of flows to satisfy minimum instream flow requirements. The permits are issued by the Division of Land Resources. Table A-19 lists minimum instream flow studies in this basin.

Table A-17 Population and Water Use for Water Systems in the Cape Fear River Basin

| County | Population 1992 | Population 2000 | Population 2020 | Average Daily Water Use 1992 MGD | Average Daily Water Use 2000 MGD | Average Daily Water Use 2020 MGD |
|---|---|---|---|---|---|---|
| Alamance | 64,394 | 76,447 | 94,023 | 15.334 | 19.587 | 24.32 |
| Bladen | 11,593 | 13,935 | 18,395 | 1.291 | 2.352 | 2.77 |
| Brunswick | 83,658 | 119,138 | 159,007 | 11.353 | 19.005 | 26.006 |
| Chatham | 14,864 | 17,867 | 26,156 | 3.724 | 5.111 | 7.277 |
| Columbus | 320 | 350 | 425 | 0.474 | 0.109 | 0.133 |
| Cumberland | 151,684 | 179,675 | 249,315 | 23.191 | 27.012 | 43.377 |
| Duplin | 16,607 | 32,104 | 39,530 | 5 | 7 | 8 |
| Durham | 140,000 | 195,000 | 279,000 | 23 | 30 | 42 |
| Forsyth | 12,276 | 18,739 | 46,780 | 1 | 2 | 6 |
| Guilford | 271,057 | 288,565 | 317,715 | 43 | 52 | 75 |
| Harnett | 46,223 | 65,390 | 107,142 | 7 | 12 | 18 |
| Hoke | 5,755 | 15,735 | 18,567 | 2 | 3 | 5 |
| Johnston | 2,880 | 3,300 | 4,630 | 1 | 1 | 1 |
| Lee | 20,515 | 23,531 | 26,643 | 5 | 6 | 7 |
| Montgomery | 6,443 | 6,927 | 7,929 | 3 | 4 | 7 |
| Moore | 24,073 | 31,015 | 27,680 | 4 | 8 | 10 |
| New Hanover | 71,449 | 101,525 | 111,596 | 20 | 48 | 36 |
| Orange | 68,900 | 81,900 | 115,300 | 8 | 10 | 14 |
| Onslow | 99,329 | 111,705 | 153,475 | 8.567 | 9.962 | 14.175 |
| Pender | 11,203 | 14,051 | 15,362 | 1 | 1 | 1 |
| Randolph | 36,169 | 41,252 | 52,782 | 7 | 12 | 19 |
| Rockingham | 14,011 | 14,825 | 15,400 | 3 | 5 | 5 |
| Sampson | 14,205 | 17,818 | 19,878 | 2.344 | 3.078 | 3.745 |
| Wake | 58,487 | 92,353 | 166,178 | 7 | 9 | 20 |
| Wayne | 25,579 | 37,311 | 39,772 | 2 | 4 | 4 |
| TOTALS | 1,271,674 | 1,600,458 | 2,112,680 | 208.278 | 300.216 | 399.803 |

Table A-18 Minimum Streamflow Projects in the Cape Fear River Basin

| HYDROELECTRIC DAMS | | | | |
|---|---|---|---|---|
| **Hydropower Dam** | **Regulatory Authority** | **Bypass Reach (ft)** | **Drainage Area (sq. mi.)** | **Min. Release (cu.ft/sec)** |
| ***Deep River*** | | | | |
| Coltrane | unlicensed | 320 | 124 | |
| Worthville | Federal Energy Regulatory Comm (FERC | None | 223 | None* |
| Cox Lake | FERC | 506 | 250 | 42 |
| Cedar Falls | FERC | 2112 | 257 | 32 |
| Franklin/ Randolph Mills | FERC | 480 | 278 | None* |
| Ramseur | FERC | 1430 | 343 | 45 |
| Coleridge | FERC | 500 | 391 | 35 |
| High Falls | FERC | 2844 | 748 | 108 |
| Carbonton | FERC | None | 970 | None* |
| Lockville | FERC | 700 | 1380 | 70 |
| ***Haw River*** | | | | |
| Altamahaw | unlicensed | 800 | 226 | |
| Glencoe Mills | FERC | 1815 | 495 | 57 |
| Swepsonville | | | 700 | |
| Saxapahaw | FERC | 5200 | 1020 | 10 |
| Bynum | FERC | 3000 | 1270 | 80 |
| B.E. Jordan | FERC | | 1690 | |
| ***Rockfish Creek*** | | | | |
| Raeford | FERC | None | 179 | None* |
| ***Rocky River*** | | | | |
| Rocky River | FERC | None | 181 | None* |

Notes:

* Even though there is no minimum flow, the project must still operate in a run-of-river mode; i.e., instantaneous inflow equals instantaneous outflow. A noncompliant project can alter noticeably the streamflow.

Table A-19 Minimum Instream Flow Studies in the Cape Fear River Basin

| WATER SUPPLY IMPOUNDMENTS/WITHDRAWALS | | |
|---|---|---|
| **Dam** | **Study Cooperators** | **Purpose of Study** |
| Big Alamance Creek | DWR | The Town of Burlington's water supply, Lake Mackintosh, has a tiered release with a maximum flow release of 9 cfs at full pool. The recommendation was based on a wetted perimeter study done by DWR. |
| Back Creek | DWR | DWR requested, following the review of the environmental assessment for the expansion of the Graham-Mebane water treatment plant from 6 to 12 MGD, a tiered release with a maximum low flow release of 5 cfs at full pool from Graham-Mebane Lake. The flow recommendation was based on a wetted perimeter study by DWR. |
| Bones Creek | DWR and NCWRC | Lake Rim is used by the NC Wildlife Resources Commission as a fish hatchery storage pond. DWR requested a minimum flow as a stipulation for dam repair. The Division assisted the Commission in determining a tiered release of 18 cfs from the impoundment in all months except July, when the release is 10.5 cfs. The releases are based on a hydrologic desktop investigation. A calibrated gage is required to monitor releases. |
| Branson Creek | NCWRC | A stipulation for repairs to Forest Lake dam in Fayetteville was a minimum flow requirement of 3.4 cfs. The recommendation is based on a NC Wildlife Resources Commission habitat evaluation and a hydrologic desktop investigation. |
| Little Cross Creek | DWR, NCWRC and DWQ | DWR participated in an aquatic habitat assessment of Little Cross Creek below Glenville Lake (Fayetteville's reserve water source) with the NC Wildlife Resources Commission and DWQ. A minimum flow of 3.6 cfs, based on a hydrologic desktop investigation, was established. |
| Deep River | DWR | The proposed Randleman reservoir will serve the cities of Greensboro and High Point. The reservoir will have a tiered minimum release ranging from a high of 30 cfs at full pool, 20 cfs when below 60 percent full pool, and 10 cfs when below 30 percent full pool. The minimum flow recommendations are based on a wetted perimeter study. The project will divert up to 30.5 MGD (47.1 cfs) which will reduce the average annual flow. The natural low flows in the lower Deep River will be increased by the minimum release. There will be some interbasin transfer (see Part 2.9.3). Randleman Reservoir will impact hydropower generation in the Deep River. The Coltrane Mill project will be inundated by the impoundment. DWR estimates that hydropower generation will be reduced by 5 to 15 percent depending on the amount of withdrawal from the reservoir, proximity of the generation facility to Randleman, and the minimum flow requirement at each project.<br>The City of High Point's primary sources for water, High Point City Lake and Oak Hollow Reservoir, do not have minimum release requirements. The Dam Safety Law restricts minimum flow requirements for existing reservoirs to 10 percent of the safe yield. This corresponds to 1.3 cfs and 1.9 cfs for High Point City Lake and Oak Hollow Reservoir, respectively. |
| Mill Creek | NCWRC | Reservoir Park dam in Southern Pines has a minimum flow requirement of 0.5 cfs based upon consultation with the NC Wildlife Resources Commission and a hydrologic desktop investigation. |
| Nick's Creek | DWR and Town of Carthage | DWR will be cooperating with the Town of Carthage on an instream flow study of Nick's Creek to evaluate a proposal to expand their withdrawal from 0.5 to 1.0 MGD. |
| Reedy Fork | DWR | Lake Townsend in Greensboro has a minimum flow requirement of 7.1 cfs at full pool as a stipulation for expansion of the water treatment plant from 20 to 30 MGD. The recommended flow is based upon a wetted perimeter study done by DWR. |
| Rocky River | DWR, Town of Siler City and other agencies | The Town of Siler City has a tiered release at their water withdrawal structure based on an instream flow study performed by DWR. The minimum release from December through May is 3.5 cfs when the town's reservoir is at 40 percent capacity or greater. The town has installed gages to monitor the release. DWR and other resource agencies are now participating in discussions with the town on a proposal to raise the evaluation of the withdrawal pond by 12. 5 feet. |

### 2.9.3 Interbasin Transfer

Water users in North Carolina are required to register their water withdrawals and transfers with the Division of Water Resources if the amount is 100,000 gallons per day or more, according to NCGS §143-215.22H. In addition, transfers of one million gallons per day or more require certification from the Environmental Management Commission, according to NCGS §143-215.22I. Table A-20 lists the parties that have registered withdrawals in the Cape Fear River basin as of January 1, 1999.

The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Subbasins in North Carolina* that was filed in the Office of the Secretary of State on April 16, 1991. Within the Cape Fear basin, six subbasins are delineated: the Haw River, the Deep River, the Cape Fear River, the South River, Northeast Cape Fear River and the New River (Figure A-24). (Note: The New River is not considered part of the Cape Fear River basin under the basinwide management approach which utilizes basin definitions adopted by the Department of Water and Air Resources in 1974. The New River will be addressed as part of the White Oak River Basinwide Water Quality Plan in 2001.)

Figure A-25 shows the approximate location of transfers of 1.0 MGD or greater. Table A-21 lists all potential transfers within the basin. Unless otherwise noted, the transfer amounts are 1992 average daily amounts in million gallons per day (MGD) based on Local Water Supply Plans and registered withdrawal/transfer information. Many of the transfers cannot be quantified due to undocumented consumptive losses (examples: septic, lawn irrigation). Note: Under a provision of Senate Bill 1299 (ratified by the General Assembly on September 23, 1988), all local water systems are now required to report existing and anticipated interbasin transfers as part of the Local Water Supply Planning process. This information will be available for future updates of this management plan and will allow an assessment of cumulative impacts.

Currently, there are two permitted transfers in the Cape Fear basin. The first permit is for Cary/Apex's 16 MGD transfer from the Haw River subbasin to the Neuse River subbasin. Cary and Apex are currently preparing environmental documentation to support an application for increasing the transfer amount. The second permit is for Piedmont Triad Water Authority's 30.5 MGD transfer from the Deep River subbasin to the Haw and Yadkin River subbasins. This permit covers anticipated transfers resulting from the operation of the proposed Randleman dam.

Other large transfers in the Cape Fear basin include Durham (18.0 MGD), Asheboro (4.7 MGD), and High Point (3.5 MGD).

## Table A-20 Water Withdrawal Registrations in the Cape Fear River Basin

**Cape Fear River Basin**
Water Withdrawal Registrations pursuant to NCGS 143-215.22H.
Data is self-reported and has not been field verified.

| County | Facility # | Capacity MGD | Facility |
|---|---|---|---|
| ALAMANCE | 01-003 | 3.000 | CONE MILLS CORPORATION - GRANITE PLANT |
| ALAMANCE | 01-006 | 229.000 | GLENCOE MILLS |
| CHATHAM | 19-002 | 180.000 | CAROLINA POWER & LIGHT COMPANY |
| CHATHAM | 19-007 | 0.860 | WEYERHAEUSER COMPANY |
| GUILFORD | 41-001 | 5.000 | CONE MILLS CORPORATION - WHITE OAK PLANT |
| GUILFORD | 41-002 | 2.000 | CONE MILLS CORPORATION - WHITE OAK PLANT |
| GUILFORD | 41-003 | 0.000 | VULCAN MATERIALS COMPANY |
| GUILFORD | 41-004 | 0.000 | VULCAN MATERIALS COMPANY |
| GUILFORD | 41-008 | 1.555 | JAMESTOWN PARK GOLF COURSE |
| LEE | 53-001 | 1.440 | WAKE STONE CORPORATION - KNIGHTDALE QUARRY |
| LEE | 53-003 | 1.500 | FLOYD BROWNE & ASSOCIATION WTP |
| LEE | 53-004 | 1.009 | GOLDEN POULTRY COMPANY, INC |
| MOORE | 63-002 | 1.270 | SANDY RIDGE FARMS |
| MOORE | 63-003 | 1.270 | SANDY RIDGE FARMS |
| MOORE | 63-004 | 1.270 | SANDY RIDGE FARMS |
| MOORE | 63-012 | 2.000 | TRIPLE H FARMS (SANDHILL TURF) |
| MOORE | 63-013 | 4.000 | SANDHILL TURF, INC |
| RANDOLPH | 76-006 | 0.000 | PIEDMONT TRIAD WATER AUTHORITY |
| BLADEN | 09-003 | 17.000 | E. I. DUPONT DENEMOURS - FAYETTEVILLE |
| BLADEN | 09-004 | 1.240 | COGENTRIX OF NORTH CAROLINA |
| BLADEN | 09-006 | 2.100 | ALAMAC KNITS - WEST POINT STEVENS |
| BRUNSWICK | 10-001 | 4.000 | ARCHER DANIELS MIDLAND COMPANY |
| BRUNSWICK | 10-003 | 1600.000 | CAROLINA POWER & LIGHT COMPANY |
| BRUNSWICK | 10-004 | 2.000 | BALD HEAD ISLAND GOLF CLUB |
| BRUNSWICK | 10-006 | 0.000 | COGENTRIX - BRUNSWICK COUNTY |
| BRUNSWICK | 10-006 | 4.140 | COGENTRIX OF NORTH CAROLINA |
| BRUNSWICK | 10-007 | 18.000 | E. I. DUPONT |
| COLUMBUS | 24-001 | 50.000 | FEDERAL PAPER BOARD COMPANY, INC |
| CUMBERLAND | 26-001 | 1.500 | KIRBY PUGTT |
| CUMBERLAND | 26-002 | 1.680 | MONSANTO AGRICULTURE COMPANY |
| CUMBERLAND | 26-003 | 11.000 | HQ XVIII AIRBORNE CORPS & FORT BRAGG |
| CUMBERLAND | 26-008 | 5.800 | BROOKWOOD COMMUNITY WS |
| CUMBERLAND | 26-009 | 3.000 | BLAKE FARMS, INC |
| HARNETT | 43-001 | 2.050 | NELLO L. TEER COMPANY |
| HARNETT | 43-003 | 8.000 | ERWIN MILLS |
| MOORE | 63-010 | 1.610 | PINEHURST RESORT AND COUNTRY CLUB |
| NEW HANOVER | 65-001 | 0.000 | CAPE INDUSTRIES |
| NEW HANOVER | 65-002 | 49.000 | CAROLINA POWER & LIGHT COMPANY |
| NEW HANOVER | 65-007 | 3.100 | HOECHST CELANESE-WILMINGTON PLANT |
| WAKE | 92-005 | 28.000 | CAROLINA POWER & LIGHT COMPANY |
| WAKE | 92-019 | 1.400 | RONNIE BETTS |
| SAMPSON | 82-017 | 1.000 | DL & B ENTERPRISES, INC |
| DUPLIN | 31-001 | 1.700 | GUILFORD MILLS, INC - GUILFORD EAST SITE |
| DUPLIN | 31-002 | 3.240 | CAROLINA TURKEYS |
| DUPLIN | 31-003 | 2.090 | COGENTRIX OF NORTH CAROLINA |
| DUPLIN | 31-004 | 2.520 | STEVCOKNIT FABRICS COMPANY, INC |
| DUPLIN | 31-005 | 2.000 | BUTTERBALL TURKEY COMPANY |
| NEW HANOVER | 65-003 | 5.760 | OCCIDENTAL CHEMICAL CORPORATION |
| NEW HANOVER | 65-006 | 4.450 | CAPE FEAR INDUSTRIES |
| NEW HANOVER | 65-008 | 2.110 | GENERAL ELECTRIC COMPANY |
| NEW HANOVER | 65-025 | 15.840 | MARTIN MARIETTA |
| PENDER | 71-002 | 17.760 | MARTIN MARIETTA |
| NEW HANOVER | 65-004 | 2.700 | LANDFALL CLUB |
| NEW HANOVER | 65-005 | 1.500 | LANDFALL CLUB |
| ONSLOW | 67-001 | 5.322 | CAMP LEJEUNE MCB |
| ONSLOW | 67-002 | 8.464 | CAMP LEJEUNE MCB |
| ONSLOW | 67-003 | 4.710 | CAMP LEJEUNE MCB |
| | **Total Capacity** | **2330.96** | **MGD** |

Figure A-24 River Basins Subject to Surface Water Transfers Act

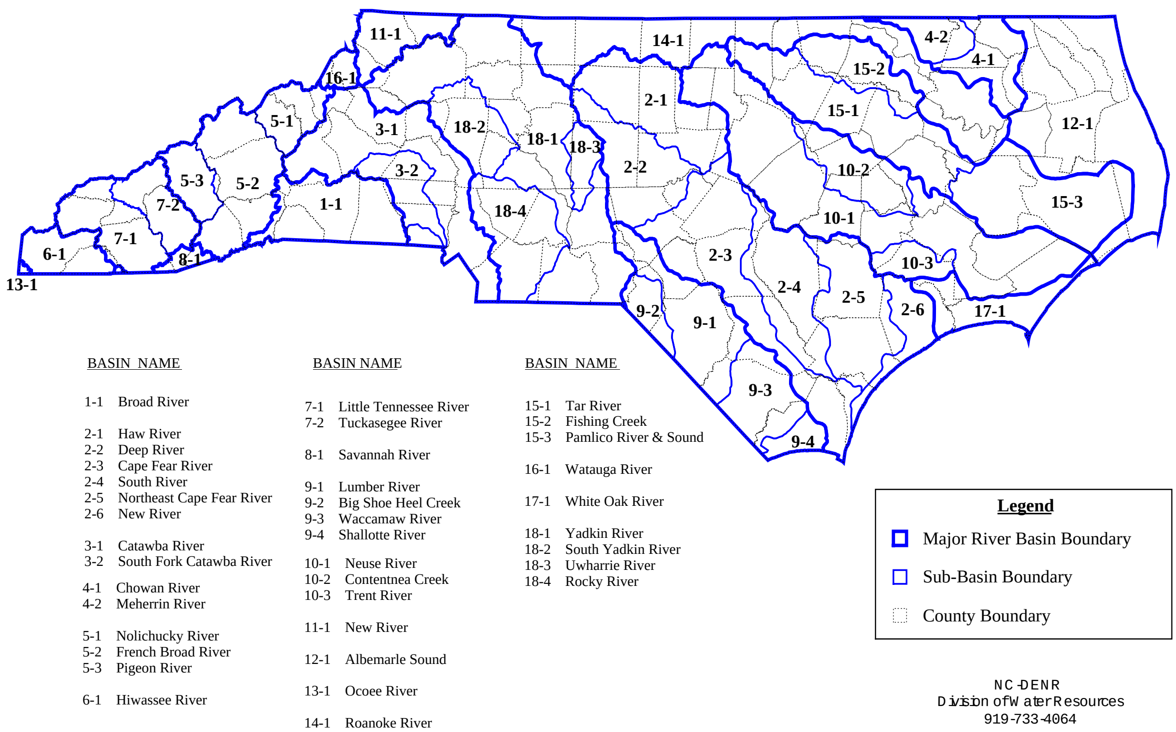


Figure A-25 Interbasin Transfers (>1.0 MGD) in the Cape Fear River Basin

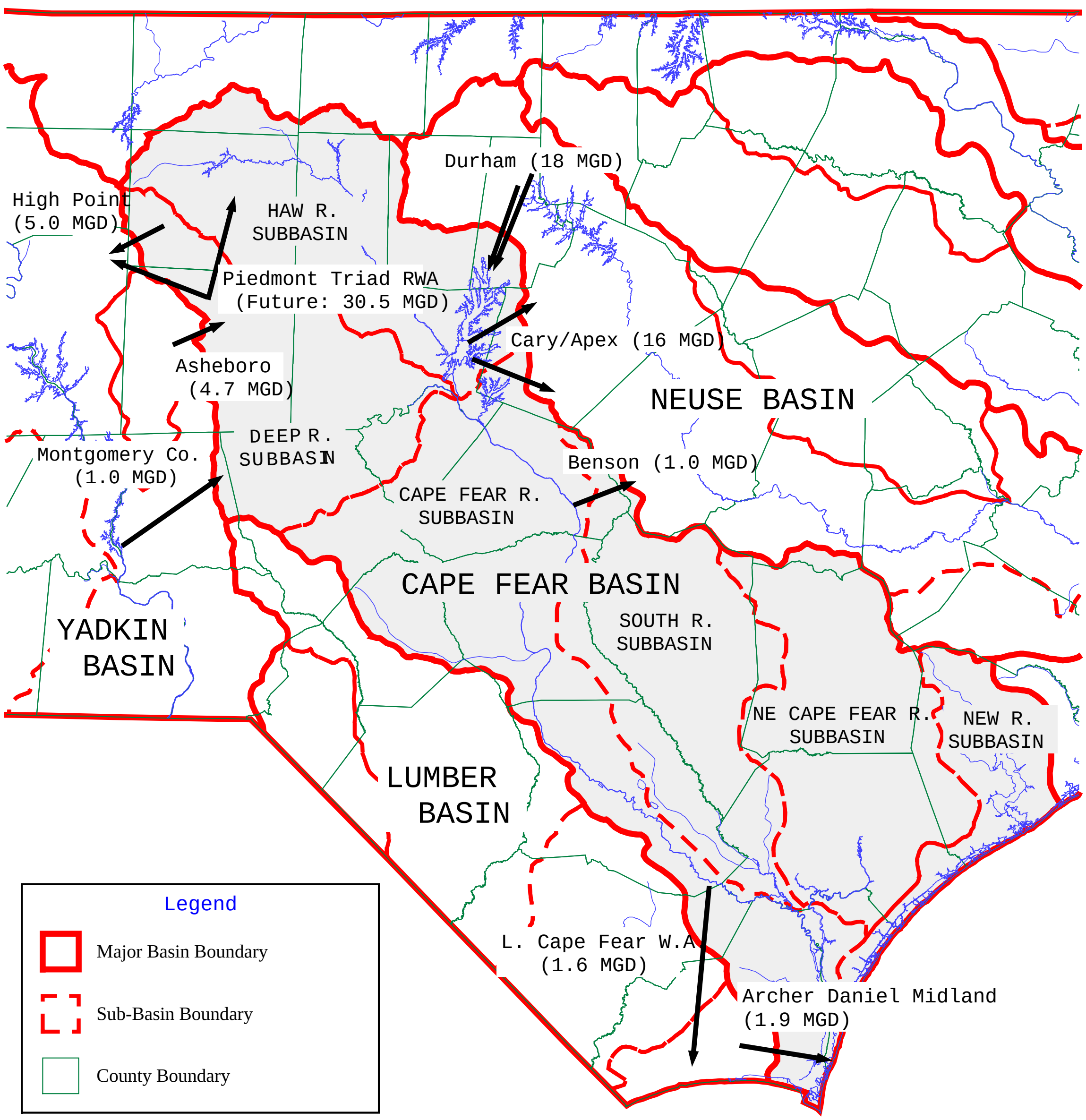


Table A-21 Interbasin Transfers in the Cape Fear River Basin

| Source System | Receiving System | Source Subbasin | Receiving Subbasin | Estimated Transfer (MGD)[1,2,3] |
|---|---|---|---|---|
| **Permitted Transfers** | | | | |
| Cary/Apex | Cary/Apex | Haw | Neuse | 16.0[4] |
| Piedmont Triad WA | Piedmont Triad WA | Deep | Haw, Yadkin | 30.5[5] |
| **Other Transfers** | | | | |
| Graham | Orange-Alamance | Haw | Neuse | Emergency |
| Greensboro | Jamestown | Haw | Deep | 0.09 |
| Greensboro | Greensboro | Haw | Deep | Unknown |
| OWASA | Hillsborough | Haw | Neuse | Emergency |
| Reidsville | Reidsville | Haw | Roanoke | Unknown |
| High Point | Greensboro | Deep | Haw | Unknown |
| High Point | Thomasville | Deep | Yadkin | Emergency |
| High Point | High Point | Deep | Yadkin | 3.5 |
| Lower Cape Fear WSA | Brunswick County | Cape Fear | Shallotte | Unknown |
| Carthage | Carthage | Cape Fear | Deep | Unknown |
| Dunn | Benson | Cape Fear | Neuse | 1.0 |
| Dunn | Dunn | Cape Fear | South | Unknown |
| Dunn | Benson | Cape Fear | South | Unknown |
| Harnett | Fuquay-Varina | Cape Fear | Neuse | Unknown |
| Harnett | Angier | Cape Fear | South | Unknown |
| Harnett | Coats | Cape Fear | South | Unknown |
| Harnett | Dunn | Cape Fear | South | Emergency |
| Sanford | Chatham County East | Cape Fear | Deep | Unknown |
| Sanford | Sanford | Cape Fear | Deep | Unknown |
| Sanford | Lee County - Tramway | Cape Fear | Deep | Emergency |
| Wilmington | Wilmington | Cape Fear | New | Unknown |
| General Electric | General Electric | NE Cape Fear | Cape Fear | 0.75 |
| Southern Pines | Southern Pines | Lumber | Cape Fear | Unknown |
| Archer Daniel Midland | Archer Daniel Midland | Shallotte | Cape Fear | 1.89 |
| Durham | OWASA | Neuse | Haw | Emergency |
| Durham | Durham | Neuse | Haw | 18.0[6] |
| Goldsboro | Wayne WD | Neuse | NE Cape Fear | Emergency |
| Hillsborough | Orange-Alamance WS | Neuse | Haw | Emergency |
| Orange-Alamance WS | Mebane | Neuse | Haw | Emergency |
| Orange-Alamance WS | Orange-Alamance WS | Neuse | Haw | Unknown |
| Raleigh | Holly Springs | Neuse | Cape Fear | 0.8 |
| Davidson | Archdale | Yadkin | Deep | Unknown |
| Davidson | Davidson | Yadkin | Deep | Unknown |
| Montgomery County | Montgomery County | Yadkin | Deep | 1.0 |
| North Wilkesboro | Broadway | Yadkin | Cape Fear | Unknown |
| Winston Salem | Kernersville | Yadkin | Haw | Unknown |
| Winston Salem | Winston Salem | Yadkin | Deep | Unknown |
| Winston Salem | Winston Salem | Yadkin | Haw | Unknown |
| Asheboro | Randleman | Uwharrie | Deep | Emergency |
| Asheboro | Asheboro | Uwharrie | Deep | 4.7 |

1 Transfer amounts are based on average daily water use reported in 1992 Local Water Supply Plans, and the 1993 Water Withdrawal and Transfer Registration Database.

2 "Unknown" refers to undocumented consumptive use.

3 "Emergency" refers to emergency connections.

4 Transfer amount for Cary/Apex are based on its permitted transfer.

5 Transfer amount for Piedmont Triad Regional Water Authority is based on its permitted transfer, but will not become effective until completion of Randleman dam.

6 The estimated transfer amount for Durham is based on information in their Jordan Lake allocation application.

# Chapter 3 -
# Summary of Water Quality Information for the Cape Fear 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_**

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

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.

**_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 into surface waters.

Unlike point source pollution, nonpoint pollution sources are diffuse in nature and occur intermittently, depending on rainfall events and land disturbance. Given the diffuse nature of nonpoint source pollution, it is difficult and resource intensive to quantify nonpoint source 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.

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.

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.

## 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 waterbody. In addition to primary classifications, surface waters may be assigned a *supplemental* classification (Table A-22). Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. For example, a stream in the mountains might have a C Tr classification, where C is the primary classification followed by the Tr (Trout) 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). Information on this subject is also available at DWQ's Water Quality Section website: http://h2o.enr.state.nc.us/wqhome.html.

**Statewide Water Quality Standards**

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

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.

Table A-22 Primary and Supplemental Surface Water Classifications
(Primary classifications beginning with an "S" are assigned to saltwaters)

| PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS | |
|---|---|
| **Class** | **Best Uses** |
| **C and SC** | Aquatic life propagation/protection and secondary recreation. |
| **B and SB** | Primary recreation and Class C uses. |
| **SA** | Waters classified for commercial shellfish harvesting. |
| **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** |
| **Sw** | *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. |

## 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.

For nonpoint source pollution, development activities which require a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or approved local erosion and sedimentation control program, and which

***Criteria 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 the HQW classification because the standards for WS-I, WS-II and SA waters are at least as stringent as those for waters classified HQW.

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 ORW rule defines outstanding resource values as:***

- outstanding fisheries 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.

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 for most new developments are required. 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.

## Classifications and Standards in the Cape Fear River Basin

The waters of the Cape Fear River basin have a variety of surface water quality classifications applied to them. Water Supply watersheds range from WS-II to WS-IV. Maps of water supply watersheds, Outstanding Resource Waters and High Quality Waters are presented in Figures A-26 to A-28.

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 Cape Fear River Basin*, available by calling the Planning Branch of DWQ at (919) 733-5083. They can also be accessed through DWQ's Water Quality Section website: http://h2o.enr.state.nc.us/wqhome.html.

## Pending and Recent Reclassifications in the Cape Fear River Basin

There is one pending reclassification in the Cape Fear River basin on Mill Creek in Moore County. The proposed reclassification is from WS-III to WS-III HQW. DWQ will continue to assess the proposed reclassification.

Recent reclassifications in the basin include Buckhorn Creek (Harris Lake) in Wake and Lee counties (from C to WS-V) and streams within the proposed Randleman Reservoir Critical Area to WS-IV CA. These recent reclassifications became effective in April 1999. There were three reclassifications in 1998.

# Water Supply Watersheds, High Quality Waters, and Outstanding Resource Waters in the Upper Cape Fear River Basin

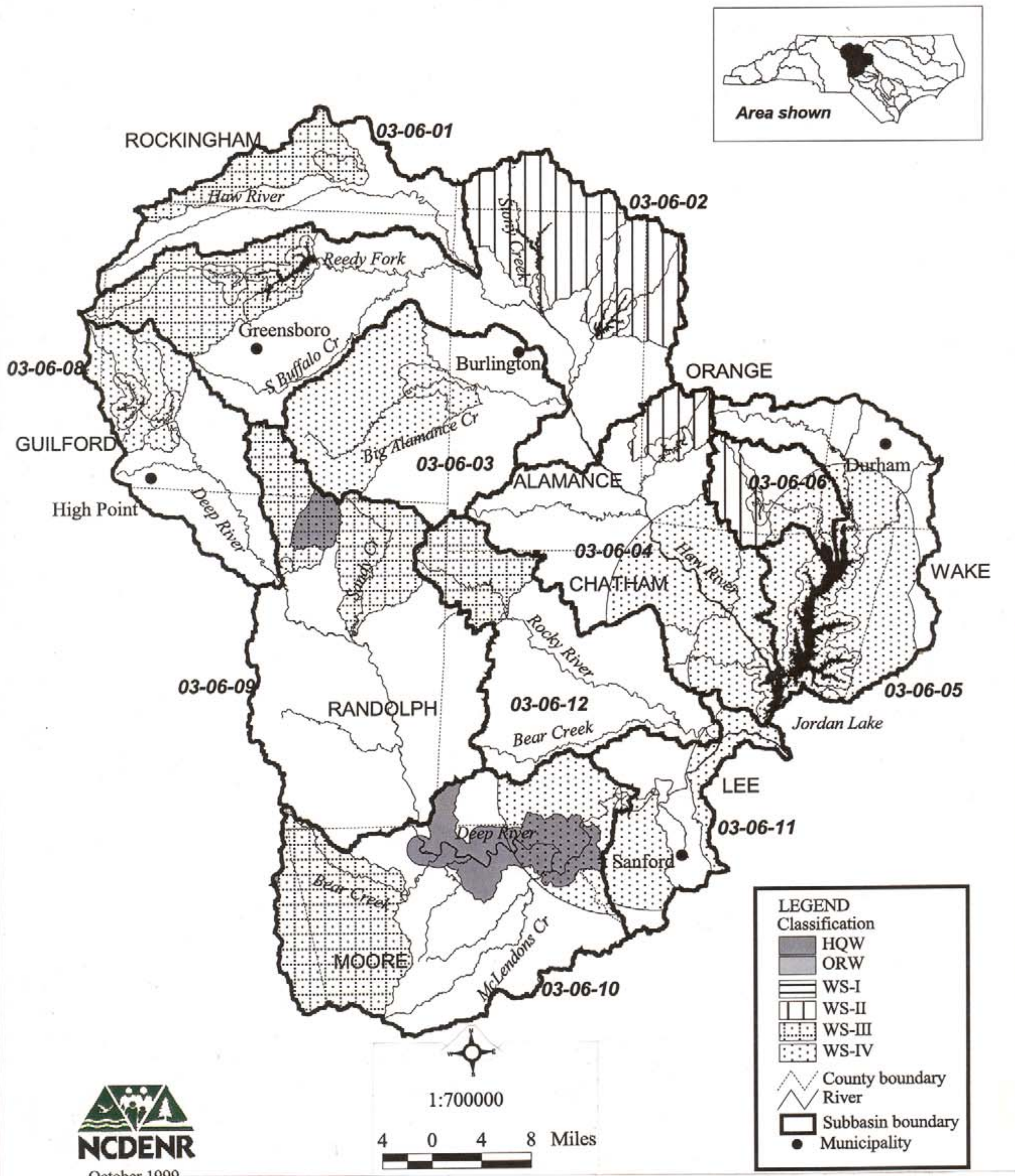



Figure A-26 Water Supply Watersheds, Outstanding Resource Waters and High Quality Waters in the Upper Cape Fear River Basin

# Water Supply Watersheds, High Quality Waters, and Outstanding Resource Waters in the Middle Cape Fear River Basin

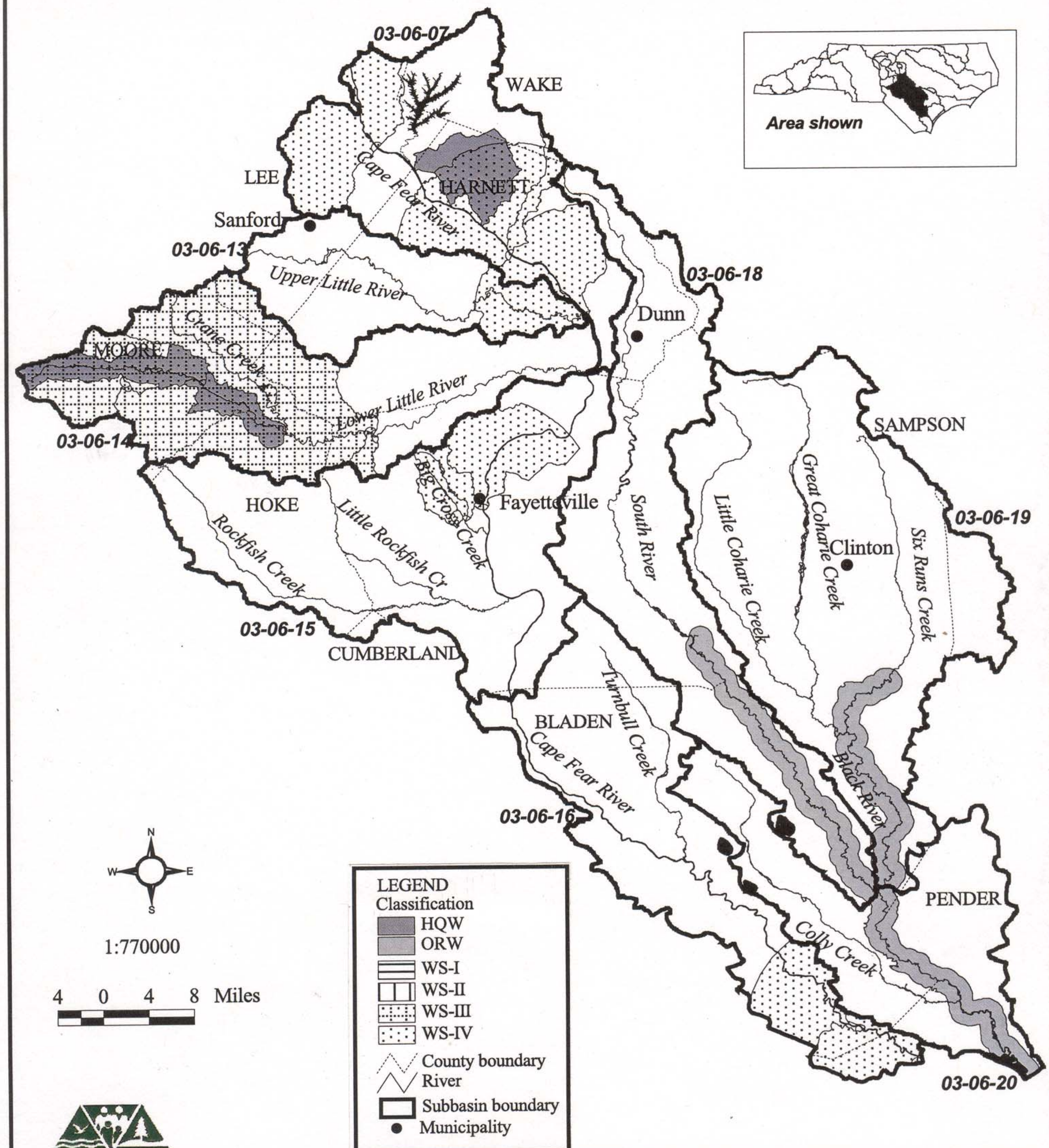



Figure A-27 Water Supply Watersheds, Outstanding Resource Waters and High Quality Waters in the Middle Cape Fear River Basin

# Water Supply Watersheds, High Quality Waters, and Outstanding Resource Waters in the Lower Cape Fear River Basin

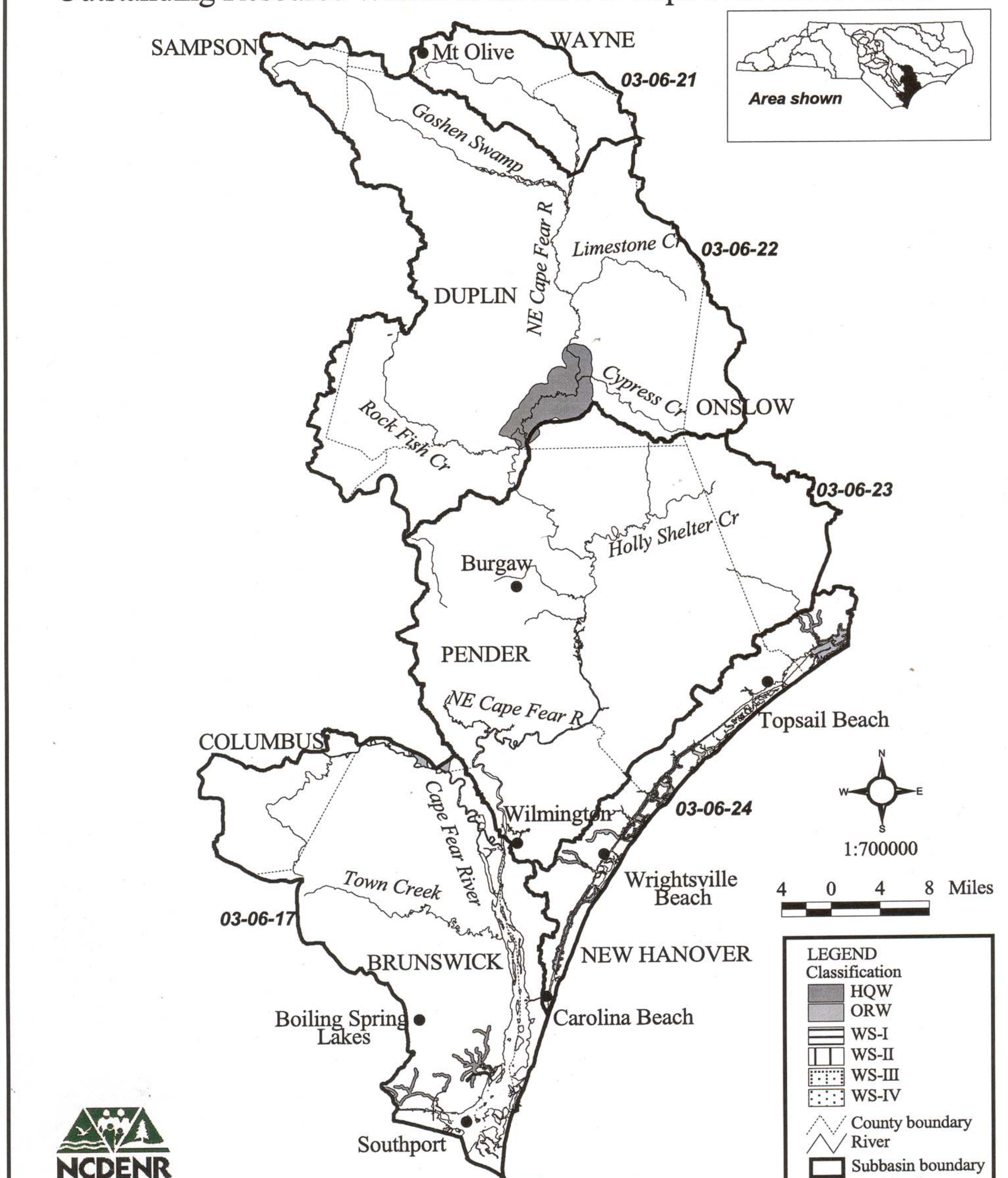



Figure A-28 Water Supply Watersheds, Outstanding Resource Waters and High Quality Waters in the Lower Cape Fear River Basin

## 3.3 DWQ Water Quality Monitoring Programs in the Cape Fear River Basin

The Environmental Sciences Branch of DWQ collects a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Cape Fear River basin for that program. A more complete discussion on biological and chemical monitoring within the basin can be found in the *Cape Fear River Basinwide Assessment Report* (DENR, June 1999).

> ***DWQ monitoring programs for the Cape Fear 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 over one year, the effects of short-term pollution (such as a spill) will generally not be overcome until the following generation appears. The benthic community also integrates the effects of a wide array of potential pollutant mixtures.

Criteria have been developed to assign a bioclassification 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.

**<u>Overview of Benthic Macroinvertebrate Data</u>**

Appendix A-II lists all the benthic macroinvertebrate collections in the Cape Fear River basin between 1983 and 1998, giving site location, collection date, taxa richness, biotic index values and bioclassifications. Benthic macroinvertebrates have been collected at over 350 freshwater sites in the Cape Fear River basin since 1983; 131 of these sites were sampled during 1998 basinwide surveys or special studies and could be assigned a rating (Table A-23). For the 1998 collections, bioclassifications were given to sites in the following breakdown: Excellent – 18 (14%), Good – 34 (26%), Good-Fair – 41 (31%), Fair - 23 (18%) and Poor – 15 (11%). The distribution of water quality ratings is very similar for both the 1998 and 1993 collections, suggesting little overall change in water quality within the Cape Fear River basin. Individual sites, however, often show distinct long-term or short-term changes in water quality (see below and Table A-24).

Table A-23 Biological Ratings for Recent Samplings in the Cape Fear River Basin

| Subbasin 03-06-01 to 03-06-24 | Excellent | Good | Good-Fair | Fair | Poor |
|---|---|---|---|---|---|
| ***Piedmont*** | | | | | |
| 01: Upper Haw/Troublesome Creek | - | - | 3 | 2 | 1 |
| 02: Greensboro/Burlington area | - | 2 | 4 | 4 | 4 |
| 03: Alamance Creek | - | 1 | 1 | - | 1 |
| 04: Lower Haw River | 1 | 2 | 5 | 1 | - |
| 05: Durham/Jordan Lake | - | - | - | 1 | - |
| 06: Chapel Hill area | 1 | 2 | 1 | 4 | 2 |
| 07: Upper Cape Fear River | - | 1 | 2 | - | 1 |
| 08: Deep River #1 | - | - | 2 | 2 | 1 |
| 09: Deep River #2 | 3 | 3 | 2 | - | 2 |
| 10: Deep River #3 | - | 4 | - | 2 | 1 |
| 11: Deep River #4 (Triassic Basin) | - | - | 2 | - | - |
| 12: Rocky River | - | 2 | 4 | - | - |
| ***Coastal*** | | | | | |
| 13: Upper Little River | 2 | 2 | 1 | - | - |
| 14: (Lower) Little River | 6 | - | 1 | - | - |
| 15: Rockfish Creek | 2 | 1 | - | 1 | - |
| 16: Middle Cape Fear River | - | 1 | 5 | - | - |
| 17: Lower Cape Fear River | 1 | 3 | 1 | 1 | - |
| 18: South River | - | 1 | 1 | 1 | - |
| 19: Clinton area | 1 | 1 | 2 | - | - |
| 20: Black River | - | 2 | - | 1 | - |
| 21: NE Cape Fear River #1 | - | - | - | - | - |
| 22: NE Cape Fear River #2 | 1 | 1 | 3 | 2 | - |
| 23: NE Cape Fear River #3 | - | 5 | - | 1 | 2 |
| 24: Coastal | - | - | 1 | - | - |
| Total (#) | 18 | 34 | 41 | 23 | 15 |
| Total (%) | 14% | 26% | 31% | 18% | 11% |

Areas of Excellent water quality in the piedmont of the Cape Fear River basin are either small streams in protected catchments or large rivers that are far enough downstream to have recovered from point source pollutants. Streams in the first category include Morgan Creek and Cane Creek (near Chapel Hill), while rivers in the second category include the Cape Fear River in Harnett County and the Deep River in Moore County. Two streams between Greensboro and High Point are also worthy of note: the headwaters of Reedy Fork and the West Fork of the Deep River. Although these streams only received a Good-Fair or Good rating, they have unusually diverse communities of intolerant stonefly taxa. Slate Belt tributaries of the Haw and Deep Rivers (Alamance, Chatham and Randolph counties) often receive a Good rating, although these streams may suffer from low flow effects during droughts.

Areas of highest water quality in the coastal area of the Cape Fear River basin are concentrated in subbasins 03-06-13 to 03-06-15: Upper Little River, Little River, Rockfish Creek and their tributaries. This area comprises most of the sandhills area within the Cape Fear River basin and contained 10 Excellent sites and three Good sites. Portions of the Black and South Rivers (subbasins 03-06-18 and 03-06-19) have high benthic diversity, although few tributary streams have the diversity observed at mainstem sites. A similar community also occurs in the middle section of the Northeast Cape Fear River near Chinquapin (subbasin 03-06-22).

The Division of Water Quality is developing criteria for swamp streams. Many swamp streams in the lower Cape Fear River basin were sampled for the first time in 1998. Areas of highest water quality ("natural" conditions) included Town Creek, Hood Creek, Shelter Swamp and Merricks Creek.

Samples taken in 1998 were often collected during a period of very low flow. This may have a variety of effects on streams, depending on both catchment size and relative contribution of point source dischargers compared to nonpoint source runoff. The smallest streams may suffer from very low flow or entirely cease flowing. This causes a lower bioclassification (sometimes evaluated as "not rated") or makes it impossible to collect samples. This was true for streams in subbasins 03-06-04 (Dry Creek); 03-06-08 (Muddy Creek/Hickory Creek); Triassic Basin sites in subbasins 03-06-05, 03-06-10 and 03-06-11; and coastal plain sites in subbasins 03-06-14, 03-06-15, 03-06-16 and 03-06-17.

Streams affected by point source runoff may have a lower bioclassification during low flow periods, due to lower dilution of the effluent (Reedy Fork, subbasin 03-06-02). More common, however, are those streams that improve due to a reduction in nonpoint source runoff during a low flow year: Haw Creek, Pokeberry Creek and Stinking Quarter Creek.

The most acute problems in the piedmont section of the Cape Fear River basin (Poor bioclassifications) are usually associated with point source discharges and/or urban runoff. Poor water quality was found for Little Troublesome Creek (Reidsville, subbasin 03-06-01); North and South Buffalo Creeks (Greensboro, subbasin 03-06-02); Northeast Creek (Durham, urban runoff, subbasin 03-06-05); Little Alamance Creek (Burlington, urban runoff, subbasin 03-06-03); Richland Creek (High Point, subbasin 03-06-08); Cotton Creek (Star, subbasin 03-06-10); Kenneth Creek (subbasin 03-06-07); Loves Creek (subbasin 03-06-12); and Burgaw Creek (subbasin 03-06-22). The segments of North and South Buffalo Creeks below Greensboro constitute one of the worst water quality problems in North Carolina.

Long-term changes in water quality were evaluated at 117 sites in the Cape Fear River basin, with the majority of sites showing no changes in water quality other than flow-related changes in bioclassification (Table A-24). The benthos sampling since 1983 may slightly overestimate the proportion of Fair and Poor sites, as DWQ special study sampling often has the greatest sampling intensity (number of sites/streams) in areas with severe water quality problems.

Table A-24 does not tabulate flow-related changes as a between-year change in water quality. For long-term changes in water quality, positive changes outnumber negative changes, usually reflecting improvements at wastewater treatment plants. Over the last five years, however, there were more negative changes. The last five years compare 117 sites, while there were only 69

Table A-24 Long-Term Changes in Bioclassification in the Cape Fear River Basin

| Subbasin 03-06-01 to 03-06-24 | # Trend Sites | 5-year trend | | | Long-term (>5 years) trend | | |
|---|---|---|---|---|---|---|---|
| | | None | + | - | None | + | - |
| ***Piedmont*** | | | | | | | |
| 01: Upper Haw/Troublesome Creek | 5 | 4 | 0 | 1 | 2 | 0 | 0 |
| 02: Greensboro/Burlington area | 11 | 9 | 1 | 1 | 5 | 1 | 1 |
| 03: Alamance Creek | 3 | 2 | 0 | 0 | 3 | 0 | 0 |
| 04: Lower Haw River | 5 | 5 | 0 | 0 | 3 | 2 | 0 |
| 05: Durham/ Jordan Lake* | 5 | 3 | 0 | 0 | 3 | 1 | 0 |
| 06: Chapel Hill area | 10 | 8 | 1 | 1 | 3 | 1 | 1 |
| 07: Upper Cape Fear River | 4 | 3 | 0 | 1 | 1 | 0 | 0 |
| 08: Deep River #1 | 6 | 5 | 0 | 1 | 3 | 3 | 0 |
| 09: Deep River #2 | 9 | 8 | 1 | 0 | 3 | 3 | 0 |
| 10: Deep River #3* | 10 | 10 | 0 | 0 | 2 | 0 | 0 |
| 11: Deep River #4 (Triassic)* | 4 | 2 | 0 | 2 | 1 | 0 | 1 |
| 12: Rocky River | 5 | 2 | 1 | 0 | 3 | 2 | 0 |
| ***Coastal*** | | | | | | | |
| 13: Upper Little River | 5 | 5 | 0 | 0 | 4 | 0 | 0 |
| 14: (Lower) Little River | 6 | 4 | 2 | 0 | 2 | 1 | 0 |
| 15: Rockfish Creek | 3 | 3 | 0 | 0 | 1 | 1 | 0 |
| 16: Middle Cape Fear River | 5 | 4 | 1 | 1 | 1 | 1 | 1 |
| 17: Lower Cape Fear River** | 3 | 2 | 1 | 0 | 0 | 0 | 0 |
| 18: South River* | 1 | 1 | 0 | 0 | 0 | 1 | 1 |
| 19: Clinton area | 4 | 2 | 0 | 2 | 1 | 0 | 2 |
| 20: Black River | 1 | 1 | 0 | 0 | 1 | 0 | 0 |
| 21: NE Cape Fear River #1* | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 22: NE Cape Fear River #2 | 6 | 3 | 0 | 3 | 0 | 1 | 1 |
| 23: NE Cape Fear River #3 | 4 | 3 | 1 | 0 | 0 | 1 | 0 |
| 24: Coastal | 2 | 2 | 0 | 0 | 0 | 0 | 0 |
| Total | 117 | 91 | 9 | 13 | 42 | 19 | 8 |

* Sampling difficulties due to inability to rate streams (Triassic Basin) or lack of flow in many streams during 1998 collections.

** Many estuarine sites are not included in this tabulation.

sites with long-term data. The latter trend reflects changes in the coastal plain area associated with a combination of desnagging (after Hurricane Fran) and possible runoff from hog farms. It is usually not possible to differentiate between the effects of these two problems (see Section A, Chapter 4, Part 4.11 for discussion of hurricane effects).

Positive changes (either over 5 years or over longer time periods) were primarily related to improvements in wastewater treatment. Collections from the Haw River (3 sites) and Deep River (6 sites) showed improvements. New Hope Creek and Morgan Creek were slightly improved. Rockfish Creek and the Northeast Cape Fear River at Castle Hayne also showed improvements. The most striking recent change in water quality was the improvement seen in the Little River below the Fort Bragg WWTP.

Two sites on the Rocky River improved due to a combination of better flow management (upstream site) and upgrades at the Siler City WWTP. The lower Cape Fear River in Bladen and Columbus counties improved in 1998, but some of this change may be due to low nonpoint source inputs in 1998 as a result of reduced rainfall.

Declines in water quality were also related to expanding urban areas. This was observed for Horsepen Creek (Greensboro) and Bolin Creek (Chapel Hill). Road construction in Greensboro caused a decline for the upper portion of South Buffalo Creek. The lower portion of the Deep River (near Sanford) has declined from Good to Good-Fair, and this change is apparently unrelated to dischargers in the Sanford area.

### 3.3.2 Fish Assessments

In 1998, 52 sites representing 19 of the 24 subbasins were sampled and evaluated using the North Carolina Index of Biotic Integrity (NCIBI). The NCIBI uses a cumulative assessment of 12 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. The NCIBI score is then used to determine the NCIBI class of the stream (Table A-25).

The NCIBI has been revised since the 1996 Cape Fear River basinwide monitoring was conducted. Recently, the focus of using and applying the Index has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the NCDWQ Standard Operating Procedures (NCDENR, 1997). The fish community integrity classes have been modified in an effort to simplify and standardize the evaluation of a stream's ecological integrity and water quality bioclassification across both fish community and benthic invertebrate assessments.

Fish sites were chosen based upon the use support ratings the streams received during the first round of basinwide monitoring in 1994. Streams that were specifically targeted in each subbasin and which had the greatest sampling priority were those rated as either Partially Supporting (25 sites) or Not Supporting (8 sites). As resources permitted, streams which were rated Fully Supporting but Threatened (8 sites) or Fully Supporting (11 sites) were then sampled. Subbasins 03-06-20, 03-06-21 and 03-06-23 were sampled for the first time in 1998.

Table A-25 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. |

**Overview of Fish Community Assessment Data**

The NCIBI classifications at the 52 sites ranged from Good (7 sites) to Poor (20 sites). The distribution of ratings were: Good (7), Good-Fair (13), Fair (12) and Poor (20) (Figure A-29). The fish community with the greatest biological integrity score was Whites Creek (Bladen County); the fish community with the lowest biological integrity score was South Buffalo Creek (Guilford County).

Of the 52 sites sampled in 1998, 17 of the sites (16 exact sites) were previously sampled in 1992-1994 (Figure A-30). In 1998, the distribution of the ratings of these 17 sites were: Good-Fair (4), Fair (3) and Poor (10). In 1992-1994, the distribution of these ratings were: Good (1), Good-Fair (3), Fair (6) and Poor (7).

Figure A-29 The North Carolina Index of Biotic Integrity for the Cape Fear River Basin (1997)

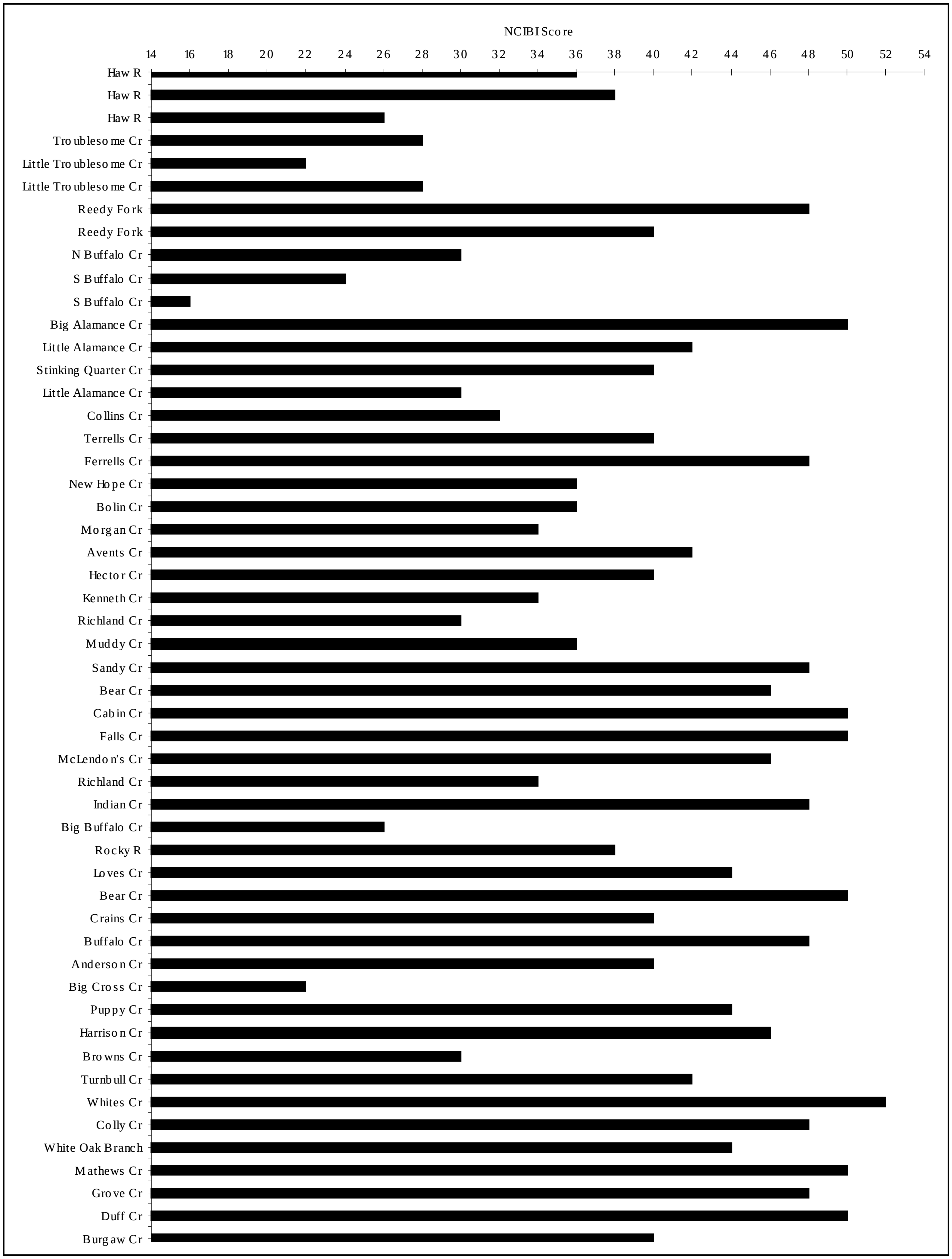
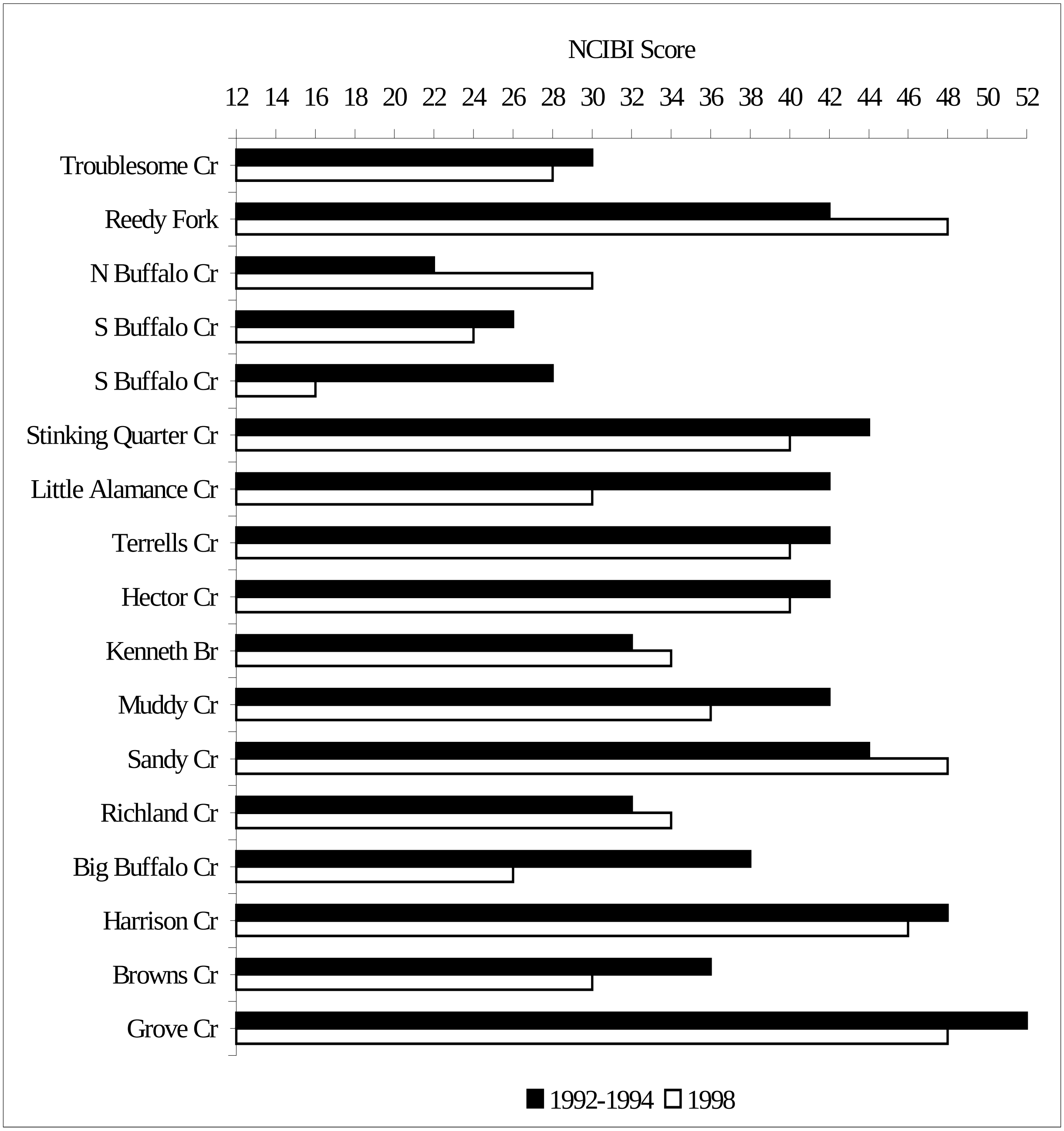


Figure A-30 The North Carolina Index of Biotic Integrity for the Cape Fear River Basin



## Overview of Fish Tissue Sampling

Fish tissue samples were collected at 23 stations within the Cape Fear River basin from 1994 to 1998. Fish tissue surveys were conducted in the basin as part of mercury assessments of fish in the eastern part of the state and during routine basinwide assessments. Most fish samples collected during the period contained metal and organic contaminants at undetectable levels or at levels below FDA and EPA criteria. Elevations in mercury were, however, measured in largemouth bass and bowfin samples from numerous stations, and in multiple species collected from the Black and South Rivers. Nearly two thirds of the total samples collected from the Black and South stations contained mercury above FDA/NC and/or EPA criteria. Mercury contamination of fish in the Cape Fear River basin was not associated with point sources and is consistent with levels measured in fish species throughout the North Carolina coastal plain.

A small number of fish samples collected from the Cape Fear River, the Deep River and the Haw River were analyzed for chlorinated pesticides and PCB arochlors during the 1998 assessment. Results showed undetectable levels of organic contaminants in fish tissue from these stations.

International Paper Company performs yearly monitoring of fish tissue for dioxins and furans along the Cape Fear River near the company mill in Reigelwood. Results from 1994 to 1998 show dioxin and furan levels in gamefish and bottom species at undetectable levels or at concentrations well below the NC limit of 3 parts per trillion (CZR Incorporated, 1998).

Carolina Power and Light (CP&L) conducts annual environmental monitoring of Lake Sutton near Wilmington. CP&L has measured levels of arsenic, copper, mercury and selenium in the liver and muscle tissue of two fish species since 1992. Results of a 1996 survey showed a significant increase in levels of copper and selenium in bluegill and largemouth bass over levels seen in prior years. Tissue burdens measured in bass and bluegill during 1996 were considered to be at levels capable of causing ecological effects (CP&L, 1996).

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Section A, Chapter 4, Part 4.8.4.

Largemouth bass, bowfin and chain pickerel in the South River and the Black River just below the South River contain higher than normal levels of mercury. Consumption of bass, bowfin and chain pickerel should be limited to no more than two meals per person per month. Women of childbearing age and children should eat no bass, bowfin or chain pickerel taken from this area until further notice. Swimming, boating and other recreational activities are not affected by this advisory.

The entire basin is posted for bowfin as part of a statewide mercury advisory on the species. Consumption of bowfin is limited to no more than 2 meals per month for the general population. Children and women of childbearing age are advised not to consume bowfin.

## Cape Fear River Basin Fish Kills

There have been 52 fish kills in the Cape Fear River basin since 1996. Low dissolved oxygen (DO) during hot dry weather, sewage and chemical spills, copper sulfate applications, hog farm spills, Hurricane Bonnie (1998) and many unknowns were listed as potential causes of fish kills. The Cape Fear River basin has accounted for nearly 33% of reported fish kills in the state over the past three years. There were 14 fish kills reported basinwide in 1999.

### 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 Cape Fear River basin from 1985 through 1998 is presented in Table A-26.

Table A-26 Summary of Compliance with Aquatic Toxicity Tests in the Cape Fear River Basin

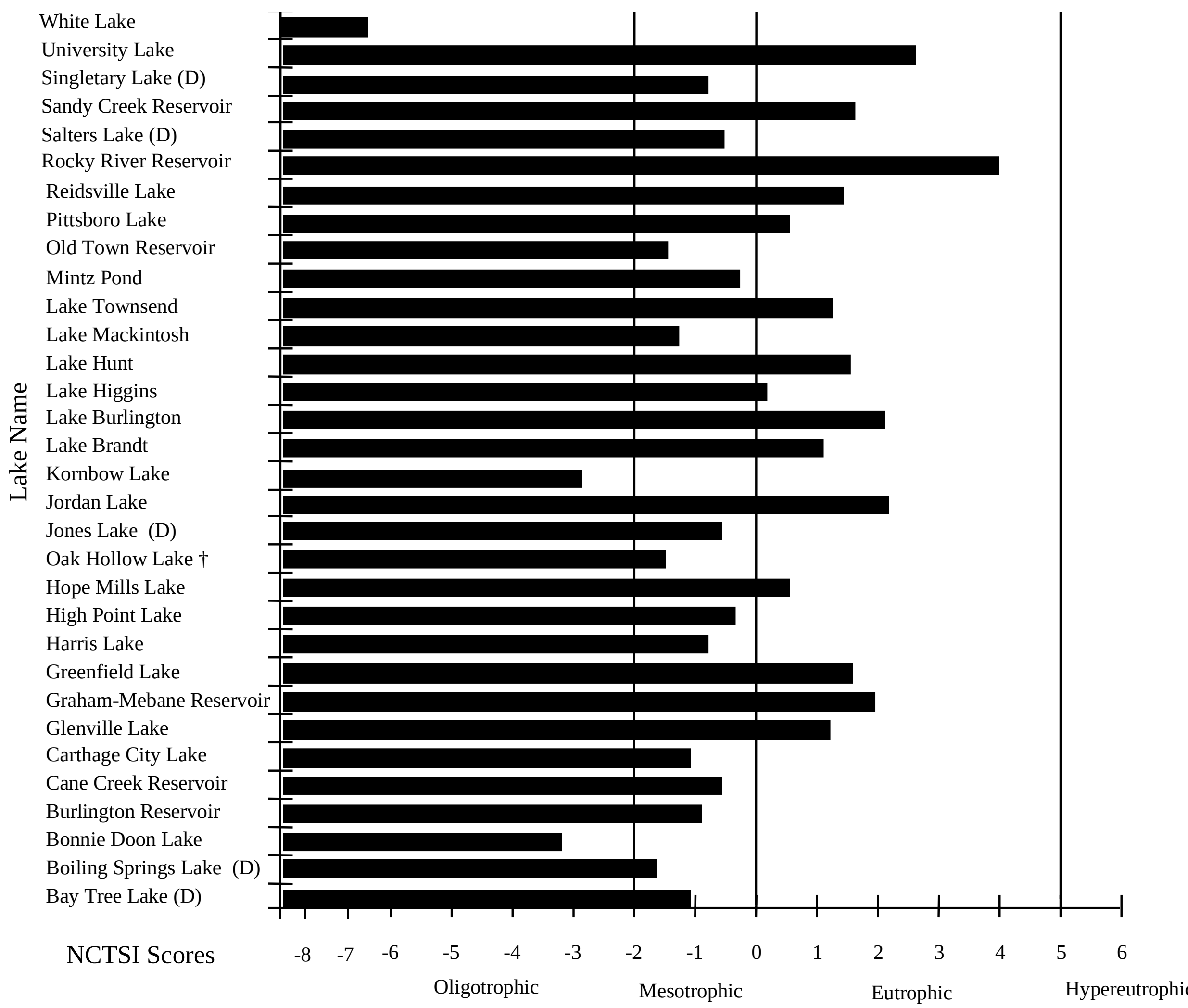
| Year | Number of Facilities | Number of Tests | % Meeting Permit Limit* |
|---|---|---|---|
| 1985 | 9 | 91 | 45.0 |
| 1986 | 15 | 145 | 49.6 |
| 1987 | 27 | 233 | 42.1 |
| 1988 | 42 | 383 | 53.0 |
| 1989 | 49 | 538 | 69.7 |
| 1990 | 57 | 625 | 71.8 |
| 1991 | 63 | 685 | 83.1 |
| 1992 | 67 | 799 | 80.2 |
| 1993 | 71 | 845 | 85.7 |
| 1994 | 79 | 908 | 83.7 |
| 1995 | 80 | 964 | 85.3 |
| 1996 | 82 | 963 | 87.5 |
| 1997 | 85 | 994 | 89.3 |
| 1998 | 87 | 1018 | 90.9 |

* 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.

### 3.3.4 Lakes Assessment Program

There were 32 lakes in the Cape Fear River basin sampled as part of the Lakes Assessment Program. Each lake is individually discussed in the appropriate subbasin section with a focus on the most recent available data. Figure A-31 shows the most recent NCTSI scores for the thirty-two sampled lakes of the Cape Fear River basin. The August NCTSI scores were not calculated for the lakes monitored by DWQ in 1998 due to unacceptable laboratory results for chlorophyll *a*.

Figure A-31 Cape Fear River Basin NCTSI Score
(All NCTSI Scores Reflect July 1998 Except for Oak Hollow Lake)




### 3.3.5 Ambient Monitoring System Program

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine sample stations strategically located for the collection of physical and chemical water quality data. North Carolina has 59 stations in the Cape Fear River basin (Table A-27). For the purpose of this report, those stations are divided into seven drainages: the Haw River, the Deep River, Cape Fear River mainstem, Cape Fear River tributaries, Black River, Northeast Cape Fear River and Coastal Areas.

## Table A-27 Locations of the Ambient Monitoring Stations

| STORET Number | Subbasin | County | Location |
|---|---|---|---|
| ***Haw River Mainstem*** | | | |
| B0040000 | 03-06-01 | Guilford | SR 2109 near Oak Ridge |
| B0050000 | 03-06-01 | Rockingham | NC Hwy 29A near Benja |
| B0210000 | 03-06-01 | Alamance | SR 1561 near Altamahaw |
| B1140000 | 03-06-02 | Alamance | NC Hwy 49N at Haw River |
| B2000000 | 03-06-02 | Alamance | SR 1005 near Saxapahaw |
| B2100000 | 03-06-04 | Chatham | US Hwy 15-501 near Bynum |
| B4050000 | 03-06-04 | Chatham | Below Jordan Dam near Moncure |
| ***Haw River Tributaries*** | | | |
| B0160000 | 03-06-01 | Rockingham | Little Troublesome Creek at SR 2600 near Reidsville |
| B0540000 | 03-06-02 | Guilford | North Buffalo Creek at SR 2832 near Greensboro |
| B0750000 | 03-06-02 | Guilford | South Buffalo Creek at SR 2821 at McLeansville |
| B0840000 | 03-06-02 | Alamance | Reedy Fork at NC Hwy 87 at Ossipee |
| B1095000 | 03-06-02 | Alamance | Jordan Creek at SR 1754 near Union Ridge |
| B1260000 | 03-06-02 | Alamance | Town Branch at SR 2109 near Graham |
| B1960000 | 03-06-02 | Alamance | Alamance Creek at SR 2116 at Swepsonville |
| B1670000 | 03-06-03 | Guilford | Little Alamance Creek at NC Highway 61 near Whitsett -- *See Footnote* |
| B2450000 | 03-06-04 | Chatham | Robeson Creek at SR 1939 near Seaforth |
| B3040000 | 03-06-05 | Durham | New Hope Creek at SR 1107 near Blands |
| B3660000 | 03-06-05 | Durham | Northeast Creek at SR 1100 near Nelson |
| B3900000 | 03-06-06 | Chatham | Morgan Creek at SR 1726 near Farrington |
| ***Deep River Mainstem*** | | | |
| B4240000 | 03-06-08 | Guilford | East Fork Deep River at SR 1541 near High Point |
| B4615000 | 03-06-08 | Randolph | SR 1921 near Randleman |
| B4800000 | 03-06-09 | Randolph | SR 2122 at Worthville |
| B5070000 | 03-06-09 | Randolph | Main Street at Ramseur |
| B5190000 | 03-06-09 | Moore | SR 1456 near High Falls |
| B5520000 | 03-06-10 | Moore | NC Hwy 22 at High Falls |
| B5575000 | 03-06-11 | Chatham | NC Hwy 42 at Carbonton |
| B5820000 | 03-06-11 | Lee | US Hwy 15-501 near Sanford |
| B6050000 | 03-06-11 | Chatham | CSX Railroad Bridge at Moncure |
| ***Deep River Tributaries*** | | | |
| B4410000 | 03-06-08 | Guilford | Richland Creek at SR 1145 near High Point |
| B4890000 | 03-06-09 | Randolph | Hasketts Creek at SR 2128 near Central Falls |
| B5480000 | 03-06-10 | Moore | Bear Creek at NC Hwy 705 at Robbins |
| B6010000 | 03-06-12 | Chatham | Rocky River at US Highway 15-501 |
| ***Cape Fear Mainstem*** | | | |
| B6160000 | 03-06-07 | Chatham | NC Hwy 42 near Corinth |
| B6370000 | 03-06-07 | Harnett | US Hwy 401 at Lillington |
| B6840000 | 03-06-13 | Harnett | NC Hwy 217 near Erwin |
| B7600000 | 03-06-15 | Cumberland | NC Hwy 24 at Fayetteville |
| B8300000 | 03-06-16 | Bladen | Huske Lock near Tar Heel |
| B8305000 | 03-06-16 | Bladen | SR 1316 near Tar Heel |
| B8340000 | 03-06-16 | Bladen | Lock And Dam #2 near Elizabethtown |
| B8350000 | 03-06-16 | Bladen | Lock #1 near Kelly |
| B8360000 | 03-06-16 | Bladen | NC Hwy 11 near Kelly |
| B8450000 | 03-06-17 | Columbus | Above Neils Eddy Landing near Acme |
| B9020000 | 03-06-17 | Brunswick | Below Hale Point Landing near Phoenix |
| B9050000 | 03-06-17 | Brunswick | Navassa |
| B9800000 | 03-06-17 | New Hanover | Channel Marker #55 at Wilmington |
| B9820000 | 03-06-17 | New Hanover | Channel Marker #50 near Wilmington |
| ***Cape Fear Tributaries*** | | | |
| B6830000 | 03-06-13 | Harnett | Upper Little River at SR 2021 near Erwin |
| B7280000 | 03-06-14 | Cumberland | Little River (Lower) at SR 1451 at Manchester |
| B7245000 | 03-06-14 | Moore | Lower Little River at SR 2023 near Lobelia |
| B7700000 | 03-06-15 | Hoke | Rockfish Creek at SR 1432 near Raeford |
| B8220000 | 03-06-15 | Cumberland | Rockfish Creek at US Highway 301 near Hope Mills |
| B8445000 | 03-06-17 | Columbus | Livingston Creek at mouth near Riegelwood |
| ***Black River Mainstem and Tributaries*** | | | |
| B8750000 | 03-06-19 | Sampson | NC Highway 411 near Tomahawk |
| B9013000 | 03-06-20 | Pender | Below Raccoon Island near Huggins |
| B8919000 | 03-06-18 | Bladen | South River at SR 1503 near Parkersburg |
| B8545000 | 03-06-19 | Sampson | Little Coharie Creek at SR 1240 near Roseboro |
| B8725000 | 03-06-19 | Sampson | Six Runs Creek at SR 1960 near Taylors Bridge |
| ***Northeast Cape Fear River Mainstem and Tributaries*** | | | |
| B9080000 | 03-06-21 | Wayne | SR 1937 near Mount Olive |
| B9290000 | 03-06-22 | Duplin | NC Highway 41 near Chinquapin |
| B9580000 | 03-06-23 | New Hanover | US Highway 117 at Castle Hayne |
| B9740000 | 03-06-17 | New Hanover | US Highway 421 at Wilmington |
| B9470000 | 03-06-22 | Duplin | Rockfish Creek at I-40 near Wallace |
| ***Coastal Area*** | | | |
| B9879000 | 03-06-24 | New Hanover | Carolina Beach Harbor near Channel Marker R6 & G7 |
| B9874000 | 03-06-24 | New Hanover | ICW @ US Hwys 74 & 76 @ Wrightsville Beach |
| B9860000 | 03-06-24 | Onslow | ICW at NC Highway 210 at Goose Bay |
| B9876000 | 03-06-24 | New Hanover | ICW at Channel Marker G151 near Everett Creek |
| B9872500 | 03-06-24 | New Hanover | ICW at Channel Marker G123 near Howe Point |
| B9872000 | 03-06-24 | Pender | ICW near Long Point |
| B9865000 | 03-06-24 | Onslow | ICW near Morris Landing |

Note: Station 15 - B1670000 was included in the previous basin assessment report. It is now part of Lake Mackintosh; therefore, this station is discussed as a lake station.

**Haw River and Tributaries**

The Haw River mainstem stations generally show an increase in pH, dissolved oxygen, conductivity and some nutrients from Oak Ridge to Haw River, after which concentrations are fairly constant or decrease. Lower levels of dissolved oxygen and high conductivity and nutrient levels show the influence of two Greensboro wastewater treatment plants discharging into North and South Buffalo Creeks.

**Deep River and Tributaries**

Field measurements for pH, dissolved oxygen and conductivity show no discernable patterns among the mainstem stations for the Deep River. However, high concentrations for some nutrients begin at Randleman and decrease downstream. Also, noteworthy are high conductivity and nutrient levels in Richland and Hasketts Creeks, below the High Point and Asheboro wastewater treatment plants.

**Cape Fear Mainstem and Tributaries**

There are no major differences for pH, dissolved oxygen and conductivity among the mainstem stations of the Cape Fear River until the river becomes influenced by salinity near Wilmington. Higher conductivity levels resulting from higher ocean salinities begin near Phoenix. Slightly lower concentrations of dissolved oxygen also begin near Phoenix. Concentrations of phosphorus increase slightly from Corinth (most upstream station) to Tar Heel (between lock and dams one and two), and then begin to decrease.

Livingston Creek shows a higher pH and conductivity and lower concentrations of dissolved oxygen. However, the Little River at Manchester, Rockfish Creek at Raeford, and Livingston Creek show elevated concentrations for some nutrients.

**Black River and Tributaries**

A decrease in median dissolved oxygen occurs between the upstream and downstream stations along the Black River. The station on the South River has the lowest pH, with a median less than 6.0.

**Northeast Cape Fear River**

Conductivity was very high at the Northeast Cape Fear station near Mount Olive, resulting from the discharge associated with a pickle manufacturer. In addition to the high conductivity were low concentrations of dissolved oxygen and high nutrients. However, time series plots show improvements in these parameters associated with improvements in the pickle companies' wastewater discharges.

High conductivities and high nutrient concentrations, particularly phosphorus, occur in Rockfish Creek below the Wallace wastewater treatment plant.

**Coastal Stations**

Dissolved oxygen concentrations and pH are relatively similar among the coastal stations. The station at Carolina Beach shows higher concentrations of total nitrogen and slightly higher concentrations of phosphorus.

**Fecal Coliform Bacteria**

Fecal coliform bacteria are widely used as an indicator of the potential presence of pathogens typically associated with the intestinal tract of warm-blooded animals. The water quality standard for fecal coliform bacteria is based on a geometric mean of 200 colonies/100ml of five samples taken within 30 days. Sites with 10 or more fecal coliform samples within the last 5 years that exceed 200 colonies/100ml are presented in Table A-28. Fecal coliform bacteria are listed as a problem parameter for use support if the geometric mean of five years of sample data is greater than 200 colonies/100ml. Fecal coliform bacteria are listed as a cause of impairment on the 303(d) list only if a geometric mean of 200 colonies/100ml has been found for five samples collected within 30 days.

There are sampling stations with high levels of fecal coliform bacteria in the Cape Fear River basin. Eleven stations reported geometric means above 200 colonies/100ml (Table A-28 in bold) for this assessment period. Most of these are in urban areas of the Haw River near Greensboro, Reidsville and Burlington, and in streams draining Chapel Hill and Durham.

Table A-28 Fecal Coliform Summary Data for the Cape Fear River Basin - 1993 to 1997

| Site | Total Samples | Geometric Mean | Samples >200/100ml | Percent >200/100ml | First Sample | Last Sample |
|---|---|---|---|---|---|---|
| **B0160000** | **52** | **262** | **30** | **57.7** | **9/27/93** | **8/27/98** |
| **B0540000** | **49** | **599** | **36** | **73.5** | **9/16/93** | **8/11/98** |
| **B0750000** | **50** | **203** | **27** | **54** | **9/16/93** | **8/11/98** |
| **B0840000** | **50** | **434** | **37** | **74** | **9/16/93** | **8/11/98** |
| **B1140000** | **48** | **286** | **25** | **52.1** | **9/23/93** | **8/24/98** |
| **B1260000** | **49** | **439** | **34** | **69.4** | **9/23/93** | **8/24/98** |
| **B1960000** | **49** | **249** | **24** | **49** | **9/23/93** | **8/24/98** |
| **B3040000** | **46** | **228** | **26** | **56.5** | **9/20/93** | **7/29/98** |
| **B3660000** | **47** | **360** | **32** | **68.1** | **9/20/93** | **7/29/98** |
| **B4240000** | **49** | **204** | **25** | **51** | **9/28/93** | **8/18/98** |
| **B4800000** | **49** | **218** | **24** | **49** | **9/28/93** | **8/20/98** |
| B0040000 | 51 | 117 | 15 | 29.4 | 9/15/93 | 8/26/98 |
| B0210000 | 50 | 153 | 17 | 34 | 9/16/93 | 8/11/98 |
| B1095000 | 34 | 167 | 13 | 38.2 | 12/7/94 | 8/11/98 |
| B1670000 | 50 | 33 | 11 | 22 | 9/23/93 | 8/24/98 |
| B2000000 | 50 | 150 | 15 | 30 | 9/23/93 | 8/24/98 |
| B3900000 | 48 | 131 | 14 | 29.2 | 9/20/93 | 7/29/98 |
| B4410000 | 54 | 104 | 17 | 31.5 | 9/22/93 | 8/18/98 |
| B4615000 | 54 | 177 | 18 | 33.3 | 9/22/93 | 8/18/98 |
| B4890000 | 49 | 141 | 18 | 36.7 | 9/28/93 | 8/20/98 |
| B5070000 | 49 | 59 | 12 | 24.5 | 9/28/93 | 8/20/98 |
| B5190000 | 47 | 103 | 15 | 31.9 | 9/1/93 | 8/25/98 |
| B5520000 | 47 | 72 | 12 | 25.5 | 9/1/93 | 8/25/98 |
| B5575000 | 48 | 69 | 10 | 20.8 | 9/16/93 | 7/29/98 |
| B6370000 | 49 | 89 | 10 | 20.4 | 9/16/93 | 8/11/98 |
| B8300000 | 47 | 86 | 14 | 29.8 | 9/23/93 | 8/17/98 |
| B8340000 | 42 | 158 | 20 | 47.6 | 9/23/93 | 8/17/98 |
| B9470000 | 48 | 116 | 15 | 31.3 | 9/13/93 | 8/4/98 |

## 3.4 Other Water Quality Research

There are many other water quality sampling programs being conducted throughout the Cape Fear River basin. Any data submitted to DWQ from other water sampling programs conducted in the Cape Fear River basin have been reviewed. Data that meet data quality and accessibility requirements were considered for use support assessments and the 303(d) list. These research efforts are also used by DWQ to adjust the location of biological and chemical monitoring sites. Some of the programs or research that developed these data are presented in Section C.

## 3.5 Use Support Summary

### 3.5.1 Introduction to Use Support

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses is an important method of interpreting water quality data and assessing water quality. Use support assessments for the Cape Fear River basin are summarized in this section and presented in the appropriate subbasin chapters in Section B.

**_Use support ratings for streams and lakes:_**

- *fully supporting (FS)*
- *partially supporting (PS)*
- *not supporting (NS)*
- *not rated (NR)*

The use support ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are fully supported (FS), partially supported (PS) or not supported (NS). 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 PS or NS, depending on the degree of exceedence. Streams rated as either partially supporting or not supporting are considered *impaired*. Impaired waters are discussed in the separate subbasin chapter in Section B.

**_Impaired waters categories:_**

- Partially Supporting
- Not Supporting

An additional use support category, fully supporting but threatened (ST), was used in previous basinwide plans. 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 to the 303(d) list rules (Appendix IV). 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. Waters that are fully supporting but have some notable water quality problems are discussed individually in the subbasin chapters (Section B).

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 III.

### 3.5.2 Revisions to Methodology Since 1992-1993 305(b) Report

Methodology for determining use support has been revised. As mentioned above, fully supporting but threatened (ST) is no longer used as a use support category. In the 1992-1993 305(b) Report, evaluated information (subjective information not based on actual monitoring) from older reports and workshops was 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 information from biological or physical/chemical monitoring (including current and older monitoring data). 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 are more than five years old.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) and it has land use similar to that of the monitored stream, 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.

### 3.5.3 Comparison of Use Support Ratings to Streams on the 303(d) List

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Cape Fear River basin that are on this list are presented in the individual subbasin chapters in Section B. The waters presented in this basinwide plan represent those that will be submitted to EPA for approval in 2000. These waters are on the state's 303(d) list based on recent monitoring data. The actual 303(d) list for the Cape Fear River basin may be somewhat different than presented in this plan, depending on EPA approval.

Section 303(d) of the federal Clean Water Act requires states develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. EPA must then provide review and approval of the listed waters. A list of waters not meeting standards is submitted to EPA biennially. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

Waters are placed on North Carolina's 303(d) list primarily due to a partially or not supporting use support rating. These use support ratings are based on biological and chemical data. When the state water quality criterion is exceeded, then this constituent is listed as the problem parameter. TMDLs must be developed for problem parameters on the 303(d) list. Other strategies may be implemented to restore water quality; however, the waterbody must remain on the 303(d) list until improvement has been realized based on either biological ratings or water quality standards.

The 303(d) list and accompanying data are updated as the basinwide plans are revised. In some cases, the new data will demonstrate water quality improvement and waters may receive a better use support rating. These waters may be removed from the 303(d) list since water quality improvement has been attained. In other cases, the new data will show a stable or decreasing trend in overall water quality resulting in the same, or lower, use support rating. Attention remains focused on these waters until water quality has improved.

In some cases, a waterbody appears on the 303(d) list, but has a fully supporting rating. There are two major reasons for this: 1) biological data show full use support, but chemical impairment continues; or 2) fish consumption advisories exist on the water. These waters will remain on the 303(d) list until the problem pollutant meets water quality standards or a TMDL is developed.

### 3.5.4 Use Support Ratings for the Cape Fear River Basin

A summary of use support ratings for the Cape Fear River basin is presented in Table A-29. Approximately 34% of freshwater streams in the basin are monitored. For further information and definition of monitored and evaluated streams, refer to Appendix III.

Table A-30 shows the total number of stream miles in each use support category for each subbasin. This table presents use support for both the monitored and evaluated streams in the basin. Table A-31 shows use support ratings for monitored lakes in the basin. Table A-32 shows use support for estuarine waters in acres. More detailed information on the monitored stream segments can be found in Appendix III. Color maps showing use support ratings for the basin are presented in Figures A-32 to A-34.

Table A-29 Use Support Summary Information for All Monitored and Evaluated Streams in the Cape Fear River Basin (1999)

| | **Monitored and Evaluated Streams** | | | **Monitored Streams Only** | |
|---|---|---|---|---|---|
| | **Miles** | **%** | | **Miles** | **%** |
| **Fully Supporting** | 4295.6 | 71 | | 1647.3 | 81 |
| **Impaired** | 403.2 | 7 | | 389.8 | 19 |
| *Partially Supporting* | *285.8* | *5* | | *276.2* | *13* |
| *Not Supporting* | *117.4* | *2* | | *113.6* | *6* |
| **Not Rated** | 1349.3 | 22 | | | |
| **Total Miles** | 6048.1 | | | 2037.1 | |

Table A-30 Cape Fear River Basin Use Support Ratings in Miles for Freshwater Streams (1999)

| Subbasin | Fully Supporting | Partially Supporting | Not Supporting | Not Rated | Total |
|---|---|---|---|---|---|
| 03-06-01 | 49.1 | 46.6 | 5.0 | 5.0 | 105.7 |
| 03-06-02 | 225.0 | 55.9 | 24.1 | 86.4 | 391.4 |
| 03-06-03 | 176.0 | 0 | 12.3 | 5.2 | 193.5 |
| 03-06-04 | 207.1 | 15.9 | 0 | 18.3 | 241.3 |
| 03-06-05 | 52.5 | 32.3 | 0 | 129.9 | 214.7 |
| 03-06-06 | 46.7 | 12.4 | 6.8 | 9.0 | 74.9 |
| 03-06-07 | 239.4 | 2.9 | 10.2 | 44.8 | 297.3 |
| 03-06-08 | 28.3 | 22.6 | 9.0 | 41.4 | 101.3 |
| 03-06-09 | 266.2 | 0 | 7.2 | 37.1 | 310.5 |
| 03-06-10 | 205.9 | 6.2 | 2.2 | 133.1 | 347.4 |
| 03-06-11 | 74.0 | 0 | 0 | 55.4 | 129.4 |
| 03-06-12 | 99.6 | 13.4 | 0.5 | 52.3 | 165.8 |
| 03-06-13 | 151.8 | 0 | 0 | 27.8 | 179.6 |
| 03-06-14 | 274.3 | 28.3 | 0 | 100.2 | 402.8 |
| 03-06-15 | 283.8 | 7.8 | 13.0 | 84.0 | 388.6 |
| 03-06-16 | 240.8 | 0 | 8.5 | 11.8 | 261.1 |
| 03-06-17 | 251.5 | 3.8 | 0 | 65.5 | 320.8 |
| 03-06-18 | 165.9 | 0 | 0 | 113.7 | 279.6 |
| 03-06-19 | 452.1 | 15.0 | 0 | 40.2 | 507.3 |
| 03-06-20 | 142.4 | 0 | 0 | 35.7 | 178.1 |
| 03-06-21 | 69.3 | 0 | 4.3 | 6.8 | 80.4 |
| 03-06-22 | 283.3 | 22.7 | 0 | 208.2 | 514.2 |
| 03-06-23 | 310.6 | 0 | 14.3 | 37.5 | 362.4 |
| 03-06-24 | 0 | 0 | 0 | 0 | 0 |
| TOTAL | 4295.6 | 285.8 | 117.4 | 1349.3 | 6048.1 |
| % | 71% | 5% | 2% | 22% | 100% |

Table A-31 Use Support Ratings for Lakes and Reservoirs in the Cape Fear River Basin

| Lake | Subbasin | County | Classification | Use Support Rating | Surface Area (Acres) | Watershed (sq. mi.) | Mean Depth (ft) | Algal Bloom Reported |
|---|---|---|---|---|---|---|---|---|
| Lake Hunt | 03-06-01 | Rockingham | WS-III B NSW | FS | 180 | 5 | 33 | no |
| Reidsville Lake | 03-06-01 | Rockingham | WS-III CA NSW | FS | 750 | 53 | 20 | no |
| Lake Higgins | 03-06-02 | Guilford | WS-III NSW CA | FS | 287 | 11 | 4 | no |
| Lake Brandt | 03-06-02 | Guilford | WS-III NSW CA | FS | 710 | 40 | 7 | yes* |
| Lake Townsend | 03-06-02 | Guilford | WS-III NSW CA | FS | 1610 | 105 | 10 | yes* |
| Burlington Reservoir | 03-06-02 | Alamance | WS-III NSW CA | FS | 750 | 28 | 12 | no |
| Lake Burlington | 03-06-02 | Alamance | WS-II NSW CA | FS | 137 | 110 | 7 | yes |
| Graham-Mebane Reservoir | 03-06-02 | Alamance | WS-II NSW CA | FS | 650 | 66 | 10 | yes* |
| Lake Mackintosh | 03-06-03 | Guilford/ Alamance | WS-IV NSW CA | FS | 1150 | 129 | 33 | yes* |
| Cane Creek Reservoir | 03-06-04 | Orange | WS-II NSW CA | FS | 500 | 32 | 8 | yes* |
| Pittsboro Lake | 03-06-04 | Chatham | WS-IV NSW | NS | 38 | 8 | 3 | no |
| B. Everett Jordan Reservoir | 03-06-05 | Chatham | WS-III IV B NSW CA | FS | 14300 | 1700 | 16 | |
| University Lake | 03-06-06 | Orange | WS-II NSW CA | FS | 205 | 29 | 5 | yes |
| Harris Lake | 03-06-07 | Chatham | WS-V | FS | 4150 | 70 | 20 | No |
| High Point Lake | 03-06-08 | Guilford | WS-IV CA | FS | 300 | 60 | 16 | yes* |
| Oak Hollow Lake | 03-06-08 | Guilford | WS-IV | FS | 720 | 55 | 23 | yes* |
| Sandy Creek Reservoir | 03-06-09 | Randolph | WS-III CA | FS | 125 | 55 | 19 | yes* |
| Carthage City Lake | 03-06-10 | Moore | WS-III CA | FS | 8 | 27 | 3 | no |
| Rocky River Reservoir | 03-06-12 | Chatham | WS-III CA | FS | 185 | 23 | 33 | no |
| Old Town Reservoir | 03-06-14 | Moore | WS-III CA | FS | 60 | 0.4 | 13 | no |
| Bonnie Doone Lake | 03-06-15 | Cumberland | WS-IV | FS | 27 | 3 | 2 | no |
| Glenville Lake | 03-06-15 | Cumberland | WS-IV CA | FS | 26 | 10 | 10 | yes* |
| Hope Mills Lake | 03-06-15 | Cumberland | B | FS | 110 | 26 | 10 | no |
| Kornbow Lake | 03-06-15 | Cumberland | WS-IV | FS | 57 | 5 | 7 | no |
| Mintz Pond | 03-06-15 | Cumberland | WS-IV | FS | 15 | 6 | 2 | yes |
| Jones Lake | 03-06-16 | Bladen | B | FS | 225 | 2 | 3 | no |
| Salters Lake | 03-06-16 | Bladen | C | FS | 450 | 27 | 7 | no |
| White Lake | 03-06-16 | Bladen | B | FS | 1050 | Unknown | 7 | no |
| Boiling Springs Lake | 03-06-17 | Brunswick | B Sw | FS | 1120 | 10 | 7 | no |
| Greenfield Lake | 03-06-17 | New Hanover | C Sw | NR | 115 | 4 | 7 | no |
| Bay Tree Lake | 03-06-18 | Bladen | C Sw | PS | 1400 | 4 | 3 | |
| Singletary Lake | 03-06-20 | Bladen | B Sw | FS | 572 | 2 | 7 | no |

* Indicates that algal blooms were confirmed by samples.

Table A-32 Use Support Ratings for Estuarine Waters in the Cape Fear River Basin (1994-1998)

| Area Name | DEH Area[1] | Total Acres | Overall Use Support (Acres) S | PS | NS | NR | Major Causes Fecal | DO | Major Sources | Possible Sources |
|---|---|---|---|---|---|---|---|---|---|---|
| Southport | B-1 | 1,325 | 0 | 1,125 | 0 | 200 | 1,125 | 0 | P, NP | Southport WWTP, marinas, urban runoff |
| Buzzard Bay | B-2 | 2,850 | 2,735 | 115 | 0 | 0 | 115 | 0 | NP | wildlife |
| The Basin | B-3 | 275 | 274 | 1 | 0 | 0 | 1 | 0 | NP | septic systems? |
| Cape Fear | B-4 B-10 | 20,000 | 13,305 | 5970 | 0 | 725 | 970 | 5,000[2] | P, NP | package WWTP, industry, Kure Beach WWTP, urban runoff |
| Myrtle Sound | B-5 | 2,300 | 2,187 | 113 | 0 | 0 | 113 | 0 | NP | marinas, urban runoff |
| Masonboro Sound | B-6 | 1,600 | 1,318 | 282 | 0 | 0 | 282 | 0 | NP | marinas, urban runoff, ag |
| Wrightsville Beach | B-7 | 2,150 | 1,975 | 175 | 0 | 0 | 175 | 0 | NP | septic systems, sewage lines, sewage pump station, marinas, urban runoff |
| Topsail Sound | B-8 | 5,700 | 5,024 | 676 | 0 | 0 | 676 | 0 | NP | septic systems, urban runoff, construction, marinas, wildlife |
| Stump Sound | B-9 | 3,000 | 2,855 | 145 | 0 | 0 | 145 | 0 | P, NP | septic systems, Holly Ridge WWTP |
| Totals | | 39,200 | 29,673 | 8,602 | 0 | 925 | 3,602 | 5,000 | | |
| % of Total Acres | | 100% | 76% | 22% | 0% | 2% | 9% | 13% | | |

**1** Denotes Division of Environmental Health Shellfish Growing Area

**2** In DEH Area B-10

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# Chapter 4 -
# Water Quality Issues Related to the Entire Cape Fear River Basin

## 4.1 Introduction

Clean water is crucial to the health, economic and ecological well-being of the state. Tourism, water supplies, recreation and a high quality of life for residents are dependent on the water resources within any given river basin. Water quality problems are varied and complex. Inevitably, water quality impairment is due to human activities within the watershed. Solving these problems and protecting the surface water quality of the basin in the face of continued growth and development will be a major challenge. Looking to the future, water quality in this basin will depend on the manner in which growth and development occur.

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

- identify and restore impaired waters in the basin;
- identify and protect high value resource waters and biological communities of special importance; and
- protect unimpaired waters while allowing for reasonable economic growth.

The 1996 Cape Fear River Basin Management Plan included several recommendations to address water quality issues in the basin. Most of these recommendations are for specific stream segments and are discussed separately in the individual subbasin chapters in Section B. There are a few recommendations that apply to areas that extend across more than one subbasin. These issues are discussed below, as well as other issues and recommendations that apply to all waters of the state.

## 4.2 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are those waters identified in Section A, Chapter 3 as partially supporting (PS) or not supporting (NS) their designated uses based on DWQ monitoring data. These waters are summarized by subbasin in Table A-30 and indicated on Figures A-32 to A-34. The impaired waters are also discussed individually in the subbasin chapters in Section B.

These waters are impaired, at least in part, due to nonpoint sources (NPS) of pollution. The tasks of identifying nonpoint sources of pollution and developing management strategies for these impaired waters is very resource intensive. Accomplishing these tasks is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments.

Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems. Due to these restraints, this plan has no NPS management strategies for many of the streams with NPS problems.

DWQ plans to further evaluate the impaired waters in the Cape Fear River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waters for the next Cape Fear River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.3 below).

## 4.3 Addressing Waters on the State's 303(d) List

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Cape Fear River basin that are on this list are presented in the individual subbasin descriptions in Section B. For information on listing requirements and approaches, refer to Appendix IV.

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

There are approximately 2,387 impaired stream miles on the 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters. This task will be accomplished through the basinwide planning process and schedule.

## 4.4 Nutrient Sensitive Waters Strategy for Jordan/Haw River Watershed

The 1996 Cape Fear River Basinwide Plan recommended that a nutrient fate and transport model be developed to better identify point and nonpoint source impacts and to evaluate the Nutrient Sensitive Waters strategy. It was determined that water in the Haw River was high in nutrients and that conditions existed for potential algal growth. Ambient monitoring data indicate high nutrient loads at both high and low flows, implicating point and nonpoint sources.

*Status of Progress*

In 1983, the Haw River and Jordan Reservoir (subbasins 03-06-01 to 03-06-06) were classified as nutrient sensitive waters (NSW). The NSW strategy mandated effluent total phosphorus (TP) of 2.0 mg/l for all discharges of 50,000 GPD or greater. Currently all subject discharges are meeting this limit. Nutrient overenrichment is a continuing potential source of impairment to the waters in this watershed. The Clean Water Responsibility Act (House Bill 515) was enacted in 1997 to further address ongoing problems associated with waters classified as NSW. The Act sets limits for nitrogen (TN) and phosphorus (TP) discharges to NSW waters. The limits apply to facilities discharging more than 0.5 MGD that were in operation or had authorization to construct prior to July 1,1997, and all facilities issued authorization to construct after that date.

Senate Bill 1366 granted extensions to compliance dates in watersheds affected by House Bill 515. The extension includes conditions that the dischargers must meet, including development of a calibrated nutrient response model. The municipalities of Greensboro, Mebane, Reidsville, Graham, Pittsboro, Burlington, and the Orange Water and Sewer Authority requested compliance extensions from the nutrient limits, primarily because of the nitrogen reduction requirements. Compliance extension requests were received by DWQ prior to the statutory deadline of January 1, 1999. South Durham, Durham RTP and Cone Mills did not apply for the extension. Triangle J and Piedmont Council of Governments are administering the project and have hired a consultant to perform the modeling tasks. Progress on the compliance extension will be reported to the Environmental Management Commission two times a year.

## 4.5 Randleman Reservoir

In November 1998, waters in the proposed Randleman Reservoir watershed were reclassified to WS-IV CA. Rules have been adopted (15A NCAC 2B .0248 through .0251) to help prevent potential water quality problems in the proposed reservoir. The rules address point source discharges by not allowing new or expanding discharges into the watershed except for High Point Eastside WWTP. This facility will have to meet phosphorus limits established to protect water quality standards. The rules also address nonpoint source pollution in the Randleman Reservoir watershed with management strategies that maintain and protect riparian areas and require urban stormwater programs to be developed by local governments having land use authority in the watershed.

Local governments are required to develop ordinances or modify existing water supply ordinances to protect riparian areas and implement stormwater management plans by January 1, 2000. All of the affected local governments have submitted their revised ordinances to meet the specifications set forth in the Randleman Lake Water Supply Watershed Nutrient Management Strategy (15A NCAC 2B .0248 through .0251) for approval by the EMC’s Water Quality Committee.

## 4.6 Modeling Efforts in the Lower Cape Fear River and Estuary

DWQ, in cooperation with the Lower Cape Fear River Program (LCFRP), (see Section C, Chapter 1, Part 1.4.1), EPA and other interested stakeholders are developing a dynamic water quality model for the Cape Fear River from Lock and Dam #1 downstream to near the mouth of the estuary. The modeling domain will also include portions of the Black and Northeast Cape Fear Rivers. The model will be used as a tool for assessing the assimilative capacity of the system and for the development of a TMDL for oxygen-consuming wastes. DWQ is working closely with stakeholders to ensure that the modeling framework ultimately chosen will not only meet the requirements for a TMDL but will also support, to the extent possible, the research needs and interests of the stakeholders.

Although a considerable amount of data has been collected by DWQ, LCFRP, USACOE and others, an extensive amount of data remains to be gathered to support the calibration and verification of the model. For example, streamflow gages on the Black and Northeast Cape Fear Rivers will need to be installed for quantifying background loadings from these two major drainages. Given the costs, complexity and substantial data collection requirements of the modeling effort, DWQ anticipates the TMDL development process to proceed over the next couple of years with the goal of having an approved TMDL in place by the next Cape Fear basin cycle. In recognition of the persistent DO water quality violations documented within the estuary, DWQ is recommending an interim NPDES permitting strategy for new and expanding discharges within subbasin 03-06-17 (see Section B, Chapter 17 for more details).

## 4.7 Growth and Development

Proactive planning efforts at the local level are needed to assure that development is done in a manner that maintains water quality. These planning efforts will need to find a balance between water quality protection, natural resource management and economic growth. Growth management requires planning for the needs of future population increases as well as developing and enforcing environmental protection measures. These actions are critical to water quality management and the quality of life for the residents of the basin.

These actions should include, but not be limited to:

- preservation of open spaces;
- provisions for controlled growth;
- development and enforcement of buffer ordinances and water supply watershed protection ordinances more stringent than state requirements;
- halt on floodplain development and protection of wetland areas;
- examination of zoning ordinances to ensure that they limit large, unnecessary parking lots; allow for vegetation and soil drainage systems; and build in green spaces in parking lots to limit and absorb runoff; and
- sustainable land use planning that considers long-term effects of development.

Phase II of the NPDES stormwater permitting program, promulgated by EPA and administered by DWQ, will help address stormwater runoff from additional municipal areas. Some local initiatives are presented in Section C.

### 4.7.1 Stormwater Management

DWQ administers a number of programs aimed at controlling urban stormwater runoff. These include: 1) programs for the control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated Water Supply (WS) watersheds; and 2) NPDES stormwater permit requirements for industrial activities and municipalities.

Throughout the Cape Fear River basin, various types of activities with point source discharges of stormwater are required to be permitted under the Phase I NPDES stormwater program. These include industrial discharges related to manufacturing, processing and materials storage areas. Construction activities with greater than five acres of disturbance are also required to obtain an NPDES permit. All of those areas requiring coverage must develop Stormwater Pollution Prevention Plans (SPPP) to minimize and control pollutants discharged from their stormwater systems. Municipal areas with populations greater than 100,000 are also required to obtain Phase I NPDES stormwater permit and develop a stormwater program. In the Cape Fear River basin, the cities of Greensboro, Durham and Fayetteville (including Cumberland County) have Phase I NPDES stormwater permits. Additional information on these stormwater programs can be found in Section C.

*Status of Progress*

On October 29, 1999, a second phase of the NPDES stormwater program was signed into law. Phase II of the NPDES stormwater program lowers the construction activity threshold to one or more acres of land disturbance and allows a permitting exemption for industrial facilities that do not have significant materials or activities exposed to stormwater. Phase II also pulls many small local governments into the NPDES stormwater program, potentially an additional 54 cities and 24 counties or more in the Cape Fear River basin. Additional information can be found in Section A, Chapter 2, Part 2.7.2.

For more information on municipal NPDES stormwater programs, contact Jeanette Powell at (919) 733-5083 ext. 537. For industrial NPDES stormwater programs, contact Bill Mills at (919) 733-5083 ext. 548.

### 4.7.2 Protecting Headwaters

Many stream miles in any river basin are small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not indicated on maps. Headwater areas are found from the mountains to the coast along all river systems and drain all of the land in a river basin. Because of the small size of headwater streams, they are often overlooked in land use activities.

Impairment of headwater streams can impact the larger stream or river. All landowners can participate in the protection of headwaters by keeping water quality issues in mind when making land use management decisions on the areas they control. This includes activities such as retaining forested stream buffers, driveway paving, lawn fertilizing, car maintenance, proper disposal of pet waste, and excluding cattle from streams.

The streams in the Cape Fear River basin are affected by the rapidly expanding urban areas of Greensboro, High Point, Fayetteville, Research Triangle Park, Burlington and Wilmington. Continued urbanization of rural areas adjacent to these municipalities has the potential to adversely affect groundwater and surface water quality and quantity. These headwater areas are important as sources of water for downstream water supplies and as potential recolonization areas for aquatic life. Local rural and urban planning initiatives should consider impacts to headwater streams when developing land around the urban areas. Efforts should be made to protect headwater streams during development. Construction projects should be required to use BMPs to reduce acute impacts.

## 4.8 Biological Monitoring Issues

### 4.8.1 Development of Draft Benthic Macroinvertebrate Swamp Criteria

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. Draft swamp stream rating criteria evaluate a stream based on benthic macroinvertebrate data collected in winter, fish community data and a habitat score. Benthos data collected outside of the winter high flow period are not used to assign ratings. At least two of the data types (benthic macroinvertebrates, fish or habitat score) must be collected to assign a rating. Each of these components is assigned a point value, and the points are averaged to assign an overall site rating. Ratings for the benthos are based entirely on the Biotic Index value. Deep (nonwadeable) coastal rivers with little or no visible current have different EPT criteria (Coastal B) that are being used on a provisional basis until more data can be gathered. Details of benthos sampling, criteria and data analysis can be found in the *Biological Monitoring SOP Manual* (NCDEHNR, 1997).

The draft swamp criteria were developed after collecting data for over four years. That data indicated that the BI values could separate differences in impact, but only during winter high flow conditions. During normal summer sampling, all sites were too similar to provide meaningful data. However, DWQ believes there is insufficient sampling of reference swamp streams to use the ratings without reservation for use support determinations. It must be stressed that the criteria are draft and will remain so 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 fisheries data should play in the evaluation. The ratings have not been used for use support and should be used for comparative purposes only.

However, much work has and will continue to be done to allow biological communities to provide meaningful information for swamp-like waters. For example: In 1992, 1993 and 1995 benthos samples were collected each year from 27 swamp streams during February or March throughout the NC coastal plain. The intent of this sampling was to develop draft swamp stream criteria, primarily using benthos data and habitat evaluations. Since 1995, benthos swamp sampling methods have been used at almost 40 sites, including 13 reference sites sampled in 1998.

Validation of the swamp criteria will require several years of data from the reference sites to determine variations due to flow conditions and changes in pH, and to see if the present draft criteria will allow differentiation between reference sites and known impacted sites.

### 4.8.2 Fish Community Assessment Draft Criteria

The NCIBI has been revised since the 1996 Cape Fear River basinwide monitoring was conducted. Recently, the focus of using and applying the Index has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the NCDWQ Standard Operating Procedures (NCDENR, 1997). The fish community integrity classes have been modified in an effort to simplify and standardize the evaluation of a stream's ecological integrity and water quality bioclassification across both fish community and benthic invertebrate assessments. The fish community assessment criteria will continue to be evaluated and adjusted to better reflect the conditions of nonwadeable coastal plain streams.

### 4.8.3 Estuarine Waters Criteria Development

Draft criteria have been developed to evaluate the level of anthropogenic impact in estuarine waters with greater than 8-10 parts per thousand salinity. Bioclassifications of Heavy, Moderate or No Impact are based on the total number of taxa, the number of taxa from intolerant groups (amphipods and caridian shrimp), and the average sensitivity of all the taxa living at a site (Estuarine Biotic Index). Higher values of each of these metrics reflect better water quality. The ranges of metric values were found to be different in the mesohaline and polyhaline salinity regimes and criteria have been developed for each. The range of values for each metric was divided into five categories and each category was given points. The points scored from each metric were summed to give a final water quality rating. The estuarine rating will not be used for use support determinations until the draft estuarine criteria are finalized.

### 4.8.4 Fish Advisories Related to Mercury Contamination

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 studies revealed mercury levels approaching or exceeding EPA and FDA criteria in largemouth bass and/or bowfin across a wide geographic area.

The presence and accumulation of mercury in North Carolina's aquatic environment is similar to contamination 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 Cape Fear 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. Waters with fish consumption advisories related to mercury remain on the North Carolina 303(d) List (see Appendix IV), and a TMDL approach is being developed.

### 4.8.5 Habitat Degradation

Instream habitat degradation is identified where there is a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (construction, mining, timber harvest and agricultural activities) or a large percentage of impervious surfaces. A watershed in which most of the riparian vegetation has been removed from streams or channelization has occurred also exhibit instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Determining the cause and quantifying amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream to a supporting rating. DWQ is working to develop a reliable habitat assessment methodology.

Although DWQ and other agencies are starting to address this issue, it requires local efforts to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation will need to be addressed to further improve water quality in North Carolina’s streams and rivers.

## 4.9 Clean Water Act of 1999 (House Bill 1160)

The General Assembly has expressed interest in protecting water quality in the Cape Fear River basin through the ratification of the Clean Water Act of 1999 (HB 1160, Part VII). This Act gives authority to the Environmental Management Commission (EMC) to adopt temporary rules to protect the Cape Fear, Catawba and Tar-Pamlico River basins. The intent of the bill is to allow for development of rules for basinwide buffers or other water quality protection measures as required in these three river basins.

DWQ will continue to maintain the schedule for developing basinwide plans. The basinwide plans are planning tools, rather than regulatory documents. The plans are intended to present current water quality information and recommend management strategies to protect or restore water quality. Temporary rule making for the Cape Fear River basin cannot begin until the Cape Fear River Basinwide Water Quality Plan has been approved by the EMC. At the time of approval, DWQ staff will alert the EMC to recommendations and comments made by the public to support rule making. The EMC will determine if rule making is warranted by current information. This is a new authority for the EMC, and they will be looking for comments and input on the need for temporary rules. There will be opportunities for stakeholder input into temporary rule making as set out by HB 1160. The bill also requires public notice and public hearings to be held after the rule-making language is developed.

There have been some efforts at the local level to protect stream water quality through buffer requirements. For example, Mecklenburg County adopted a Stream Buffer Plan that is flexible and establishes a buffer width based on the number of acres in the watershed. This buffer plan could be used as a model for counties in this basin. In addition to state mandated requirements, interested citizens have the option to petition their local government representatives to establish a buffer plan for their county.

## 4.10 Water Supply Watershed Protection

There are 32 surface water supply watersheds in the Cape Fear River basin. Local governments that have land use jurisdiction within these watersheds are responsible for the adoption, implementation and enforcement of the state's water supply watershed minimum requirements. Local governments can adopt and enforce more stringent water supply watershed protection ordinances if they choose. For example, the state's rules require the use of a 30-foot vegetated buffer (for low density development) along all waters in the water supply watershed that appear as solid blue lines on USGS 1:24,000 scale topographical maps. The state's rules allow the buffer's vegetation to consist entirely of grass rather than natural vegetation. However, a local government can require a larger and undisturbed (natural vegetation) buffer. If a local government adopts a more stringent ordinance, the state cannot require the local government to enforce anything more stringent than the state's minimum requirements. However, the state does have statutory authority to assess local governments or developers civil penalties for not administering the state's minimum requirements.

Some recent development may have received valid local approval (under vested rights) to develop under previous building requirements. Vested rights may be granted by the local government as allowed under state statutes (NCGS 153A-344.1 or NCGS 160A-385.1). This can be confusing seeing "new" development occurring in the water supply watershed that does not appear to comply with the current ordinance.

Since its inception in 1993, the DWQ's Water Supply Watershed Protection Program has focused on assuring that affected local governments are aware of their responsibility to adopt and enforce water supply watershed protection ordinances, review local ordinances to assure that they meet the state's minimum requirements, and provide technical assistance. Now that the majority of ordinances have been reviewed and approved by the state's Water Quality Committee of the Environmental Management Commission, it is DWQ's intent to refocus the program. Although technical assistance will still be a major component of the program's function, it will be DWQ's intent to direct more effort to ensuring that local governments are complying with the state's minimum requirements.

DWQ is in the process of developing an audit/enforcement component for the water supply watershed protection program. This process is expected to take about a year to set up using existing programs as models.

## 4.11 Effects of Hurricanes on Water Quality

The Cape Fear River basin is subjected to hurricanes and tropical storms on a yearly basis. In the last five years the basin has been impacted by Hurricanes Bertha and Fran (1996), Bonnie (1998), and Dennis and Floyd (1999). Fran and Floyd caused the most economic damage and water quality problems. Aquatic ecosystems and water quality can and do recover from wind damage and extensive flooding. However, human activities in hurricane prone areas can greatly increase the extent and severity of water quality problems and ecosystem impacts, as well as increase recovery time.

In September 1996, Hurricane Fran made landfall at Wilmington and traveled up the Cape Fear River into Virginia. The storm dropped several inches of rain in the basin, and flooding and wind damage ensued. It is estimated that $3.2 billion in damage was caused by Fran. The affects of Fran were not only felt by local economies, but by the various surface waters in the Cape Fear River basin.

Several million gallons of untreated human sewage were released into the river as a result of Fran. Many animal operations experienced ruptured lagoons and inundation. Large amounts of debris were generated causing flooding and adding organic matter to the river. This loading decreased dissolved oxygen (DO) levels in the Northeast Cape Fear River and the Cape Fear Estuary, causing fish kills. Hypoxic conditions were present in the Cape Fear River for several days after the hurricane.

Also of concern are the human activities that went on before and after the hurricane as part of preparation for and recovery from the problems associated with a hurricane. Emergency de-snagging was started after the storm as part of NRCS Emergency Watershed Protection (EWP). The de-snagging was mostly carried out to prevent imminent flooding around bridges and to prevent economic loss of property.

Much of the initial NRCS supervised de-snagging operations affected areas immediately upstream and downstream of road crossings. There was an effort to remove only debris that was deposited during the storm and leave in place snags that predated the event or were associated with beavers. There were difficulties assessing snag origins and ages because most of the de-snagging projects did not start until almost a year after the storm. Funding was also made available to local governments to do nonemergency de-snagging. These operations were not monitored to prevent excessive removal of debris. Several stream segments and wetland areas were completely cleared of debris and snags.

Snags are the predominant habitat for invertebrates in these systems. Removal of large proportions of snag habitat would make it difficult to assess the health of the macroinvertebrate community in these waters. During the recent sampling (1998) DWQ biologists noted that snag habitat had been removed from many segments of rivers in the lower Cape Fear River subbasins.

In September 1999, Hurricane Floyd made landfall near Wilmington only a few days after Hurricane, then Tropical Storm Dennis, made two passes through the eastern part of the state. Wind damage was not nearly as severe as that from Fran in 1996; however, flooding in eastern North Carolina was higher and more extensive than any recorded. Several towns were completely inundated, and floodwaters did not recede for several days. In some areas, because of more rainfall after Floyd, flooding continued for weeks. Animal operations lost lagoons as well as millions of animals to floodwaters. Over 40 people were killed and thousands were left homeless.

Mallin et al. (1999) studied the effects of the 1996 hurricanes on the lower Cape Fear River subbasins. This study documents dissolved oxygen (DO) problems and identifies problems associated with human activities in hurricane affected areas.

*2000 Recommendations*

NRCS should reevaluate de-snagging practices after hurricanes. Selecting sites and amounts of snag to be removed should reduce the recovery times of populations of aquatic macroinvertebrates after storms and reduce habitat degradation caused by de-snagging activities and equipment.

There has not been an environmental assessment of water quality after Floyd. Areas were flooded that have never flooded before. It is expected that, because of the record rainfall, problems after Hurricane Fran will pale in comparison to that of Floyd. All water quality information presented in this document is based on data collected prior to 1998. It is highly likely that current water quality conditions, especially in the coastal subbasins, has changed substantially; and the recovery of these waters will not be known for sometime. DWQ will continue to assess the impacts of this storm on water quality.

## 4.12 Discharges to Zero Flow Streams

Due to the preponderance of low flow streams across the state, the Division developed regulations for evaluating discharges to such waters. In 1980, a study was performed on zero flow streams (7Q10 = 0 cfs and 30Q2 = 0 cfs) to determine the effect of wastewater discharges. The study concluded that:

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

As a result of the study, regulations [15A NCAC 2B .0206 (d)] were developed that prohibit new or expanded discharges of oxygen-consuming wastes to zero flow streams. Existing facilities discharging to zero flow streams were evaluated for alternatives to discharge. Many facilities found alternatives to a surface water discharge, and some built new treatment plants to meet advanced tertiary limits for $BOD_5$ and $NH_3$-N.

This policy typically covers small discharges such as schools, mobile home parks, subdivisions and rest homes, which discharge to zero flow streams in headwater areas. Such discharges generally do not cause significant water quality problems in the mainstem of the Cape Fear or larger tributaries, but they can cause localized problems in the zero flow receiving streams.

The results of the 1980 study were extrapolated to facilities discharging to low flow streams (those with a 7Q10 = 0 but with a 30Q2 > 0) since similar adverse impacts are expected in these waters. Regulations [15A NCAC 2B .0206 (d)] were developed to set effluent limitations for new and expanding discharges to 5 mg/l $BOD_5$, 2 mg/l $NH_3$-N and 6 mg/l dissolved oxygen (DO) unless it is determined that these limitations will not protect water quality standards.

## 4.13 Sedimentation

Soil erosion, transport and redeposition are among the most essential natural processes occurring in watersheds. However, land-disturbing activities such as the construction of roads and buildings, crop production, livestock grazing and logging can accelerate erosion rates by causing more soil than usual to be detached and moved by water. If best management practices (BMPs) are not used effectively, accelerated erosion can strip the land of its topsoil, decreasing soil productivity, and causing sedimentation in streams and rivers (DENR-DLR, 1998). Sedimentation is the process by which eroded soil is deposited into waters. Sediment that accumulates on the bottom of streams and rivers smothers fish habitat vital to reproduction and impacts aquatic insects that fish feed upon. Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods. Suspended sediment increases the cost of treating municipal drinking water supplies (DENR-DLR, 1998).

***Major Causes of Sedimentation in the Cape Fear River Basin***

- Construction and land development
- Agricultural practices
- Streambank erosion
- Runoff from urban areas with high percentage of impervious surface

During 1998 basinwide monitoring, DWQ aquatic biologists reported streambank erosion and sedimentation in many subbasins in the Cape Fear River basin that was moderate to severe. Some streams are currently considered biologically impaired due to habitat degradation related in part to these impacts. Even in streams that were not listed as impaired, lower bioclassification ratings were assigned because of sedimentation; bottom substrate was embedded by silt, and/or pools were partially filled with sediment. Unstable and/or undercut (eroding) streambanks were also noted in explanation of lower ratings (DENR-DWQ, July 1999).

### 4.13.1 Land Clearing Activities

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, substantial amounts of erosion can be prevented by planning to minimize the (1) amount and (2) time the land is exposed. Land clearing activities that contribute to sedimentation in the Cape Fear River basin include: construction of homes and subdivisions as well as commercial and public buildings; plowing soil to plant crops; and road projects. DWQ's role in sediment control is to work cooperatively with those agencies that administer sediment control programs in order to maximize the effectiveness of the programs and protect water quality. Where programs are not effective, as evidenced by violation of instream water quality standards, and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this would entail requiring the landowner or responsible party to install acceptable BMPs.

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit (refer to Part 4.7.1 of this section for more information). An erosion and sediment control plan must also be developed for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

***Some Best Management Practices***

**Agriculture**

- Using no till or conservation tillage practices
- Strip cropping, contour farming and use of terraces
- Maintaining buffers along streambanks

**Construction**

- Using phased grading/seeding plans
- Limiting time of exposure
- Planting temporary ground cover
- Using sediment basins and traps

**Forestry**

- Controlling runoff from logging roads and other areas
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

For activities not subject to these rules, such as agriculture and forestry, sediment controls are carried out on a voluntary basis through programs administered by several different agencies. Forestry operations, however, must comply with nine performance standards to remain exempt from permitting requirements of the SPCA. The performance standards can be found in the document *Forest Practice Guidelines Related to Water Quality.*

### 4.13.2 Streambank Erosion and Loss of Riparian Vegetation

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as rip-rap) along the bank of a river or stream degrades water quality. Removing riparian vegetation eliminates habitat for aquatic macroinvertebrates that are food for trout and other fish. Rocks lining a bank absorb the sun's heat and warm the water even more. Trees, shrubs and other native vegetation cool the water by shading it. Straightening a stream, clearing streambank vegetation, and lining the banks with grass or rock severely impact the habitat that aquatic insects and fish need to survive (WNCT, 1999).

Livestock grazing with unlimited access to the stream channel and banks can cause severe streambank erosion resulting in degraded water quality. Although they often make up a small percentage of grazing areas by surface area, riparian zones (vegetated stream corridors) are particularly attractive to cattle that prefer the cooler environment and lush vegetation found beside rivers and streams. This concentration of livestock can result in increased sedimentation of streams due to "hoof shear", trampling of bank vegetation, and down-cutting by the destabilized stream. Despite livestock's preference for frequent water access, farm veterinarians have reported that cows are healthier when stream access is limited (USEPA, 1999).

Probably the best-known and most widely used category of BMPs is the retention of naturally vegetated buffer strips along streams. Streamside buffers serve many functions including nutrient filtering, bank stabilization, reduction of soil and land loss, moderating water temperature (which helps maintain higher levels of dissolved oxygen and hence a more suitable fish environment), and providing wildlife habitat and corridors for movement (EPA, 1999).

### 4.13.3 New Rules Regarding Sediment Control

The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. For the past several years, there were inadequate staff to achieve the mission of the agency; however, in its 1999-2001 biennial budget, the NC General Assembly provided funding for 10 new positions in the Land Quality Section of DLR.

In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program. The following rule changes were filed as temporary rules, subject to approval by the Rules Review Commission and the NC General Assembly:

- Allows state and local erosion and sediment control programs to require a preconstruction conference when one is deemed necessary.
- Reduces the number of days allowed for establishment of ground cover from 30 working days to 15 working days and from 120 calendar days to 90 calendar days. (Stabilization must now be complete in 15 working days or 90 calendar days, whichever period is shorter.)
- Provides that no person may initiate a land-disturbing activity until notifying the agency that issued the plan approval of the date the activity will begin.
- Allows assessment penalties for significant violations upon initial issuance of a Notice of Violation (NOV).

Additionally, during its 1999 session, the NC General Assembly passed House Bill 1098 to strengthen the Sediment Pollution Control Act of 1973 (SPCA). The bill made the following changes to the Act:

- Increases the maximum civil penalty for violating the SPCA from $500 to $5000 per day.
- Provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met.
- Provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules.
- Provides that any erosion control plan that involves using ditches for the purpose of dewatering or lowering the water table must be forwarded to the Director of DWQ.
- Amends the General Statutes governing licensing of general contractors to provide that the State Licensing Board for General Contractors shall test applicants' knowledge of requirements of the SPCA and rules adopted pursuant to the Act.
- Removes a cap on the percentage of administrative costs that may be recovered through plan review fees.

In August 1999, the Sedimentation Control Commission initiated rule making to increase plan review fees to $40 per acre. In addition, the Commission voted to request that Governor Hunt use his authority to put into effect at an earlier date (before August 1, 2000) the rules adopted in February. For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website: http://www.dlr.enr.state.nc.us/ or you may call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

### 4.13.4 Recommendations

DWQ will continue to work cooperatively with DLR and other agencies that administer sediment control programs in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation present in the Cape Fear River basin. Public education is needed basinwide to educate landowners about the value of riparian vegetation and the impacts of sedimentation.

Funding is available for cost sharing with local governments that set up new erosion and sedimentation control programs or conduct their own training workshops. The Sediment Control Commission will provide 40% of the cost of starting a new local erosion and sedimentation control program for up to 18 months. Two municipalities or a municipality and county can develop a program together and split the match. It is recommended that local governments draft and implement local erosion and sedimentation control programs.

Funding is also available through numerous federal and state programs for farmers to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams. EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198. Local contacts for various state and local agencies are listed in Appendix V.

## 4.14 Issues in the Development of Management Strategies for Coastal 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 harvesting 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 Coastal 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.

### *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 A-33 can be tailored to both rural and developed areas and to inland, soundside and barrier island locations. Growth management tools in Table A-34 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 A-33 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 A-34 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.

## 4.15 Coastal Habitat Protection Plans

The North Carolina General Assembly established the Coastal Habitat Protection Plan Program within the North Carolina Department of Environment and Natural Resources with passage of the Fisheries Reform Act of 1997. The Act (NCGS 143B-279.8) requires preparation of Coastal Habitat Protection Plans for critical fisheries habitats in the coastal area. The goal of the plans shall be the long-term enhancement of coastal fisheries associated with each coastal habitat. The divisions of the Department dealing with marine fisheries, water quality and coastal management were designated as the lead agencies for the program. Other agencies are to be included as necessary. The Coastal Habitat Protection Plan for the Cape Fear River basin is scheduled for completion in 2003.

# Section B

# Water Quality Data
# and
# Information by Subbasin

# Chapter 1 -
# Cape Fear River Subbasin 03-06-01
## Includes the Haw River, Little Troublesome and Troublesome Creeks

## 1.1 Water Quality Overview

***Subbasin 03-06-01 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 189 |
| Land Area: | 187 |
| Water Area: | 2 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 25,897 people |
| Pop. Density: | 138 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 58.6 |
| Water: | 2.0 |
| Urban: | 1.7 |
| Cultivated Crop: | 7.1 |
| Pasture / Managed Herbaceous: | 30.6 |

**Use Support Summary**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 49.1 mi. |
| Partially Supporting: | 46.7 mi. |
| Not Supporting: | 5.0 mi. |
| Not Rated: | 5.0 mi. |

*Lakes*:

Hunt - Fully Supporting
Reidsville - Fully Supporting

This subbasin is located in the piedmont and is the headwaters of the Haw River, including Troublesome and Little Troublesome Creeks. The City of Reidsville is the only large municipality in the subbasin. The characteristics of streams in this subbasin are strongly affected by geology and soil type. Streams in the northern and western portion (upper Haw River, upper Troublesome Creek and Little Troublesome Creek) are within the Milton Belt and tend to be very sandy. The upper reaches of the Haw River and Little Troublesome Creek are generally slow flowing and swampy with little assimilative capacity for oxygen-consuming waste. A map of the subbasin, including water quality sampling locations, is presented in Figure B-1.

Biological ratings for these sample locations are presented in Table B-1. The current sampling resulted in impaired ratings for four streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

The subbasin is primarily agricultural. There are 12 permitted discharges within the subbasin, mostly near Reidsville. Discharges from Reidsville WWTP and Glen Raven Mills are the largest.

Little Troublesome Creek, downstream of the Reidsville WWTP, rated Poor for both fish and macroinvertebrate data in 1998. Special studies of this discharge (1992 and 1994) demonstrated a reduction in organic loading in 1992; however, data indicated toxic conditions in Little Troublesome Creek during 1998. Urban nonpoint sources may also contribute to this problem, as a Fair benthos rating was assigned in 1992 and 1994 for Little Troublesome Creek above the discharge.

Cape Fear River 030601

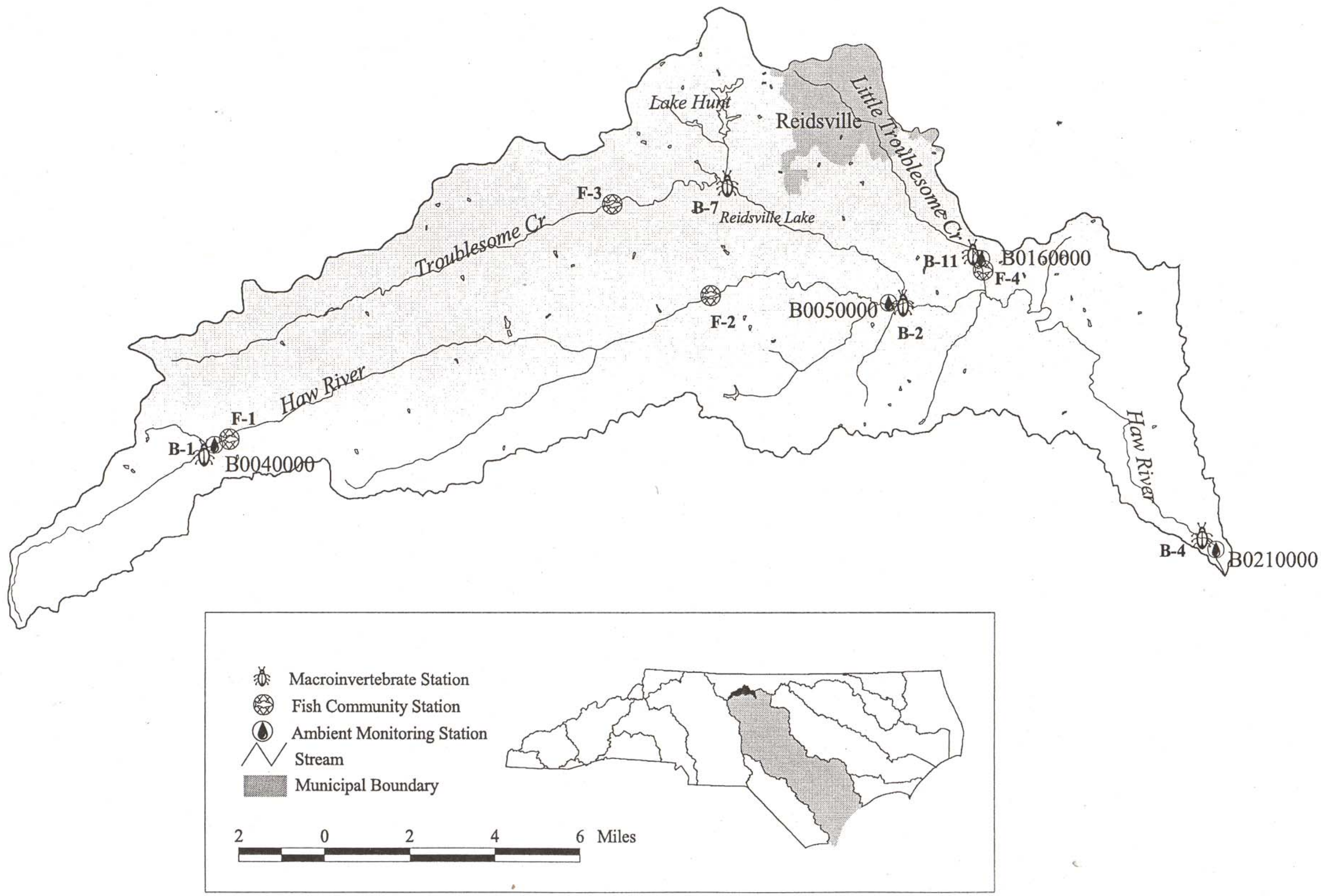


Figure B-1 Sampling Locations within Subbasin 03-06-01

Table B-1 Biological Assessment Sites in Cape Fear River Subbasin 03-06-01

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | Haw River | Guilford | SR 2109 | Fair | Fair |
| B-2 | Haw River | Rockingham | US 29 Bus | Good-Fair | Good-Fair |
| B-3 | Haw River | Rockingham | NC 150 | no sample | Good-Fair |
| B-4 | Haw River | Alamance | NC 87 | Good-Fair | Fair |
| B-7 | Troublesome Creek | Rockingham | SR 2422 | Good-Fair | Good-Fair |
| B-11 | Little Troublesome Creek | Guilford | SR 2600 | Poor | Poor |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| F-1 | Haw River | Guilford | SR 2109 | no sample | Poor |
| F-2 | Haw River | Rockingham | SR 2426 | no sample | Poor/Fair |
| F-3 | Troublesome Creek | Rockingham | SR 1001 | Poor | Poor |
| F-4 | Little Troublesome Creek | Rockingham | SR 2600 | no sample | Poor |

The Haw River at NC 87 has fluctuated between a Good-Fair benthos bioclassification (1985, 1987, 1993) and Fair (1990, 1998). While the drop from Good-Fair in 1993 to Fair in 1998 indicates a decline in water quality, part of this change may be due to the lower flow in 1998.

The Haw River Assembly has sampling sites on Little Troublesome Creek, Troublesome Creek and the Haw River (see Section C, Chapter 1, Part 1.4.6 for a description of this organization).

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 1.2 Impaired Waters

Portions of the Haw River, Candy Creek, Troublesome Creek and Little Troublesome Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of the Haw River, Troublesome Creek and Little Troublesome Creek are currently rated impaired according to recent DWQ monitoring. Current status of each stream is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 1.3 and waters with other issues, recommendations or projects are discussed in Part 1.4.

**Haw River**

*1996 Recommendations*

The 1996 Cape Fear River Basinwide Plan identified the Haw River (7.2 miles from source to SR 2109) as partially supporting (PS). This segment of the Haw River was listed as impaired from nonpoint and point sources of pollution. The 1996 plan recommended that any new or expanding discharges to this portion of the Haw River meet limits at least as stringent as 15 mg/l $BOD_5$ and 4 mg/l $NH_3$-N.

*Current Status*

No new or expanding discharges have been permitted in this section of the Haw River. The Haw River (27.8 miles from source to SR 2426) is partially supporting (PS) based on recent DWQ monitoring because of an impaired biological community. This stream is on the state's year 2000 303(d) list (not yet EPA approved). Instream habitat degradation associated with agricultural nonpoint sources may be the cause of impairment. These two stream segments are very low flowing and biological ratings may reflect the low flow condition.

*2000 Recommendations*

No new or expanding discharges should be permitted in this portion of the Haw River (because of the low flows in this stream). Continued monitoring is recommended to determine the extent of impacts from agricultural sources. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

The Haw River Assembly is establishing a management trust on 3.7 acres around the source spring of the Haw River. For more information on this project, refer to Section C, Chapter 1, Part 1.5.1.

**Candy Creek**

*Current Status*

Candy Creek (3.6 miles for source to Haw River) was partially supporting (PS) in the 1996 plan. Candy Creek is currently not rated (NR). Using new biological information, DWQ has determined that the previous rating was inappropriate because of the small size of this stream.

**Troublesome Creek**

*Current Status*

Troublesome Creek was rated partially supporting (PS) in the 1996 plan. Currently 15.6 miles of Troublesome Creek (from source to SR 2423) are partially supporting (PS) based on recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with agricultural nonpoint sources may be the cause of impairment. This stream is on the state's year 2000 303(d) list (not yet EPA approved). This portion of Troublesome Creek is very low flowing and biological ratings may reflect the low flow condition.

*2000 Recommendations*

No new or expanding discharges should be permitted in this stream (because of the low flows in these streams). Continued monitoring is recommended to determine the extent of impacts from agricultural sources. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Little Troublesome Creek**

*Current Status*

Little Troublesome Creek was identified as impaired in the 1996 plan. The 3.3-mile segment upstream of the Reidsville WWTP was partially supporting (PS) due to urban and agricultural nonpoint source pollution. The 5.0-mile stream segment upstream from the Haw River was not supporting (NS) because of point source pollution from the Reidsville WWTP.

The Reidsville WWTP outfall was relocated to the Haw River at NC 150 in November 1998, although during power outages the Little Troublesome Creek outfall is still used. Little Troublesome Creek (8.3 miles from source to the Haw River) is currently partially supporting (PS) above the Reidsville WWTP and not supporting (NS) below the WWTP because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources may be the cause of impairment. There are also indications of nutrient enrichment associated with runoff from the City of Reidsville. Fecal coliform bacteria are a noted problem parameter as well. This stream is on the state's year 2000 303(d) list (not yet EPA approved). There is currently a 100% moratorium on this facility, preventing new connections to the collection system (see Part 1.4 below).

*2000 Recommendations*

Continued monitoring is recommended to assess water quality in Little Troublesome Creek downstream of the previous discharge location. The 303(d) list approach in the lower section will be to develop a TMDL to address fecal coliform bacteria. Flow data are being collected in the lower segment as part of the TMDL development process.

Reidsville will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. The 303(d) list approach in the upper section will be to resample for biological and chemical data to attempt to determine potential problem parameters.

DWQ, with CWMTF (see Section C, Chapter 1, Part 1.3.2), will start working on a detailed study of the Little Troublesome Creek watershed to identify the sources and extent of nonpoint source impacts to this stream.

## 1.3 303(d) Listed Waters

There are three streams (64.0 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). The Haw River, Troublesome Creek and Little Troublesome Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 1.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended.

Reidsville Lake, a water supply reservoir located on Troublesome Creek, is owned by the City of Reidsville. The topography of the watershed is characterized by rolling hills, and land use is mainly agricultural (row crop and pastures) along with light residential and commercial development. A public park with boat launch area is located off of SR 2435 and is operated by the City of Reidsville Department of Parks and Recreation. In Reidsville Lake, one largemouth bass sample (of 15 fish tissue samples collected) contained mercury exceeding the EPA screening value of 0.6 ppm.

Portions of the Haw River and Troublesome Creek are downstream of partially supporting stream segments affected by agricultural nonpoint sources. DWQ encourages implementation of agricultural best management practices that reduce potential impacts to these surface waters. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams. DWQ encourages the use of voluntary measures to prevent water quality degradation.

Approximately 50% of the waters in this subbasin are impaired by nonpoint source pollution. All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Haw River at WWTP Discharge**

*Current Status*

This segment of the Haw River is currently fully supporting (FS), but is downstream of impacted waters, and may also be adversely affected by the Reidsville WWTP outfall to the Haw River at NC 150. Toxicity violations have been a continuing problem for the Reidsville WWTP. The facility has been out of compliance and on a special order of consent (SOC) for several years. The facility has been upgraded, and the discharge moved from Little Troublesome Creek to the current location. The SOC expired in 1999, and the WWTP was fined and continued to have toxicity violations. DWQ did not reissue the SOC. The facility was placed on a 100% moratorium, preventing new connections to the collection system, in August 1999. The facility has not had toxicity violations for nine months and has been from the moratorium.

*2000 Recommendations*

It is recommended that this segment of the Haw River be monitored to determine if the new discharge is degrading water quality in the Haw River. The Reidsville WWTP discharge will continue to be monitored to assure that toxicity problems do reoccur.

# Chapter 2 -

## Cape Fear River Subbasin 03-06-02

### Includes Reedy Fork and North and South Buffalo Creeks

## 2.1 Water Quality Overview

***Subbasin 03-06-02 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 562 |
| Land area: | 555 |
| Water area: | 7 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 279,034 people |
| Pop. Density: | 503 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 58.9 |
| Surface Water: | 2.5 |
| Urban: | 8.5 |
| Cultivated Crop: | 2.3 |
| Pasture / Managed Herbaceous: | 27.9 |

**Use Support Summary**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 225.0 mi. |
| Partially Supporting: | 55.9 mi. |
| Not Supporting: | 24.1 mi. |
| Not Rated: | 86.4 mi. |

*Lakes*:

Lake Higgins - Fully Supporting
Lake Brandt - Fully Supporting
Lake Townsend - Fully Supporting
Burlington Res. - Fully Supporting
Lake Burlington - Fully Supporting
Graham Mebane Res. - Fully Supporting

This subbasin is located in the piedmont and contains the cities of Greensboro, Burlington, Graham and Mebane. A map of the subbasin, including water quality sampling locations, is presented in Figure B-2.

Biological ratings for these sample locations are presented in Table B-2. The current sampling resulted in impaired ratings for six streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Although there is a large amount of agricultural land use in this subbasin, urban land use is more likely to affect stream water quality near the cities of Greensboro and Burlington.

There are 32 permitted discharges in the subbasin; the largest from Greensboro, Burlington and Cone Mills. North Buffalo Creek, South Buffalo Creek and the lower segment of Reedy Fork Creek are effluent-dominated streams, often strongly colored by wastewater discharges.

Both point source discharges and nonpoint source runoff (agriculture and urban) contribute to the Fair to Poor water quality bioclassifications found in many streams in the subbasin. North and South Buffalo Creeks, downstream of the Greensboro WWTPs, had Poor water quality based on both fish and benthos samples. Further downstream on Reedy Fork, there is slight improvement to a Fair benthos rating. The segments of North and South Buffalo Creeks below the two Greensboro discharges constitute some of the worst water quality problems in North Carolina. Conductivity continues to increase and nutrient values are high.

Cape Fear River 030602

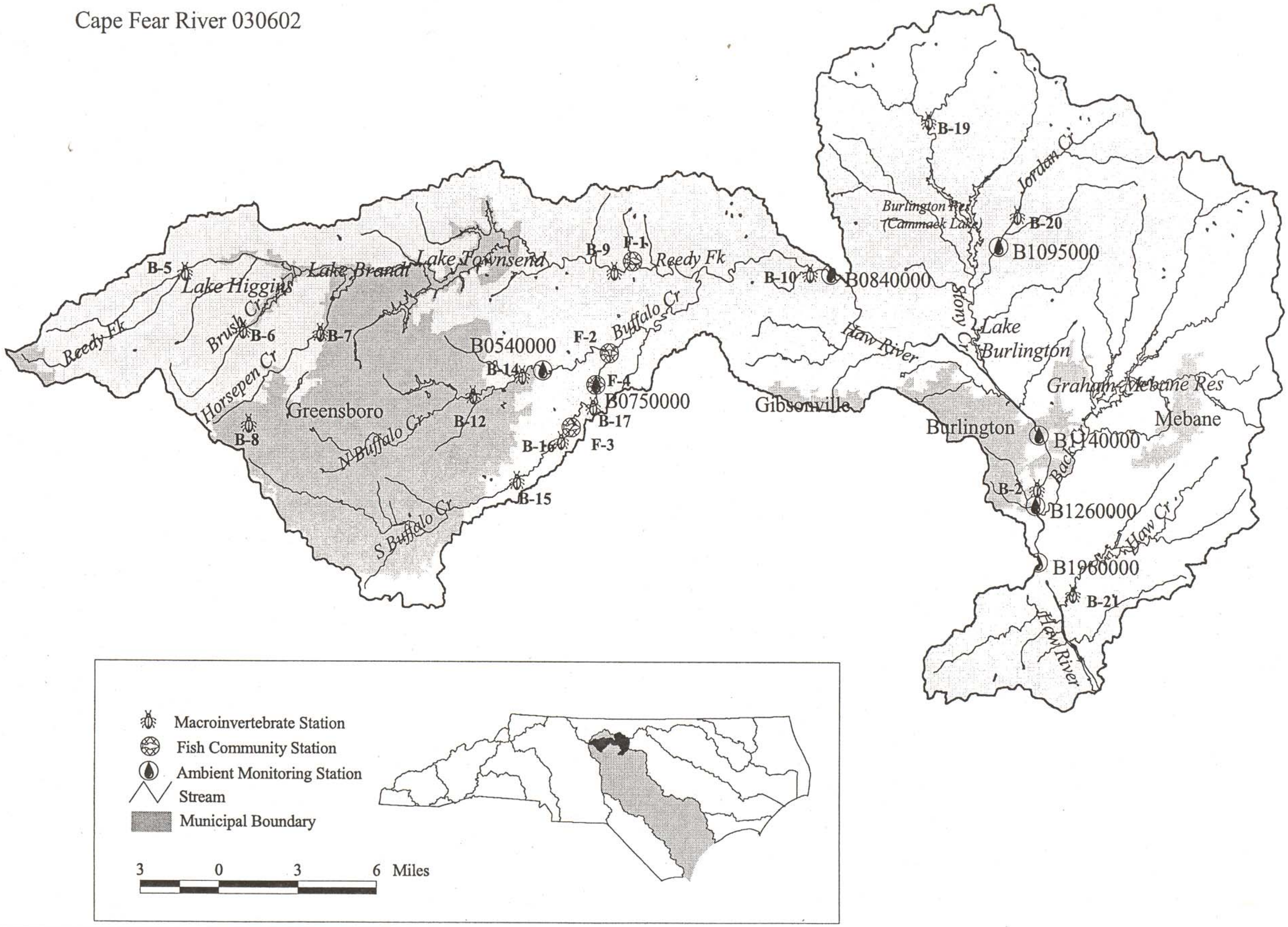


Figure B-2 Sampling Locations within Subbasin 03-06-02

Table B-2 Biological Assessment Sites in Cape Fear River Subbasin 03-06-02

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-2 | Haw River | Alamance | NC 54 | Good-Fair | Good-Fair |
| B-5 | Reedy Fork | Guilford | SR 2128 | Good-Fair | Good-Fair |
| B-6 | Brush Creek | Guilford | SR 2136 | no sample | Fair |
| B-7 | Horsepen Creek | Guilford | US 220 | Fair | Fair |
| B-9 | Reedy Fork | Guilford | SR 2728 | Good-Fair | Good-Fair |
| B-10 | Reedy Fork | Alamance | NC 87 | Good-Fair | Fair |
| B-14 | North Buffalo Creek | Guilford | SR 2832 | Poor | Poor |
| B-16 | South Buffalo Creek | Guilford | US 70 | Fair | Poor |
| B-17 | South Buffalo Creek | Guilford | SR 2821 | Poor | Poor |
| B-19 | Stony Creek | Caswell | SR 1100 | Good | Good |
| B-20 | Jordan Creek | Alamance | SR 1002 | Good-Fair | Good-Fair |
| B-21 | Haw Creek | Alamance | SR 2158 | Good-Fair | Good |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Reedy Fork | Guilford | SR 2728 | Fair | Fair/Good-Fair |
| F-2 | North Buffalo Creek | Guilford | SR 2770 | Poor | Poor |
| F-3 | South Buffalo Creek | Guilford | US 70 | Poor | Poor |
| F-4 | South Buffalo Creek | Guilford | SR 2821 | Poor | Poor |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Lake Townsend | 1998 | 17 | 1 | 0 | EPA mercury limit exceeded in 1 bass sample |
| FT-2 | Lake Burlington | 1998 | 20 | 6 | 0 | EPA mercury limit exceeded in 5 bass and 1 catfish samples |
| FT-3 | Haw River at Swepsonville | 1998 | 20 | 0 | 0 | No samples exceeded criteria |

Urban runoff also has a severe impact (Poor or Fair ratings) on the water quality of headwater streams in Greensboro and Burlington, including portions of North and South Buffalo Creeks, Horsepen Creek and Brush Creek. Areas affected by agricultural runoff, however, usually have Good or Good-Fair benthos ratings. Stream segments with the best water quality (in spite of substantial habitat degradation) include the headwaters of Reedy Fork, Stony Creek, Haw Creek and Jordan Creek.

Benthic macroinvertebrate data indicated stable water quality at most sites in the subbasin. Of the 11 sites sampled for benthic macroinvertebrates in both 1993 and 1998, eight showed no change in bioclassification. Between-year differences in flow appear to be the cause of a decline in bioclassification at one site on Reedy Fork and an improvement in bioclassification at Haw Creek. South Buffalo Creek showed a decline in water quality, probably associated with a spill at the wastewater treatment plant in the week before the sample was collected. Examination of long-term trends in water quality (>5 years) have shown improvements in bioclassification for the Haw River at NC 54, but a decline for Horsepen Creek. The improvement for the Haw River is associated with changes at wastewater treatment plants, while the decline at Horsepen Creek is associated with residential development. Recent fish tissue samples from the Haw River (Swepsonville) did not indicate any problems with either metals or pesticides.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 2.2 Impaired Waters

Portions of the Haw River, North and South Buffalo Creeks, Horsepen Creek and Town Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of the Haw River, North and South Buffalo Creeks, Horsepen Creek, Brush Creek and Reedy Fork Creek are currently rated impaired according to recent DWQ monitoring. Current status of each stream is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 2.3 and waters with other issues, recommendations or projects are discussed in Part 2.4.

### Haw River

*1996 Recommendations*

This segment of the Haw River between Altamahaw and the Saxapahaw dam was rated partially supporting (PS) in the 1996 Cape Fear River Basinwide Water Quality Plan. This segment receives a large amount of wastewater discharge. The instream wastewater concentration during low summer flow conditions is 59%. Because of expected increases of regional discharges in this subbasin, it was recommended that a fully calibrated QUAL2E model be developed to evaluate the assimilative capacity of oxygen-consuming waste in this segment of the Haw River. A reallocation of metals limits was also recommended upon permit renewal.

*Current Progress*

There has been no development of a QUAL2E model to date. The Haw River (19.2 miles from NC 87 to NC 49) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community and turbidity levels above state standard. Instream habitat degradation associated with urban and agricultural nonpoint sources may be the cause of turbidity and biological community impairment. Fecal coliform bacteria are also noted as a problem parameter. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

A TMDL and management strategy will be developed to address fecal coliform bacteria and turbidity. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters associated with the nonpoint sources. Impaired upstream waters affect water quality in the Haw River. Refer to Part 2.4 below for more general recommendations for the Buffalo/Reedy Fork Creek watershed that may help improve water quality in the Haw River.

**North Buffalo Creek**

*1996 Recommendations*

North Buffalo Creek (8.5 miles below WWTP) was not supporting (NS) in the 1996 plan. This segment receives large amounts of urban runoff from the City of Greensboro, as well as receiving point source pollution from the Greensboro North Buffalo WWTP and Cone Mills. It was recommended that no new discharges be permitted to this stream and that existing discharges conduct engineering alternatives and economic analyses to determine the feasibility of connecting to regional facilities. If alternatives were not possible then limits of 5 mg/l $BOD_5$ and 2 mg/l $NH_3$-N would be implemented. Because of inconsistent toxicity tests, it was recommended that Cone Mills connect to the Greensboro Metro (T.Z. Osborne) WWTP. It was also recommended that Greensboro North Buffalo Creek WWTP improve effluent quality.

*Current Status*

Sites monitored above and below Cone Mills received Poor macroinvertebrate ratings in 1997 and again at the below site in 1998. Cone Mills has consistently violated toxicity limits and has not been able to connect to the Greensboro Metro (T.Z. Osborne) WWTP on South Buffalo Creek. The Greensboro North Buffalo Creek WWTP has been in compliance.

North Buffalo Creek (16.8 miles from source to Buffalo Creek) is currently not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources and a low quality effluent from Cone Mills may be the causes of impairment. Below the WWTP, $NH_3$ in the effluent and high flows from the discharges may be a cause of impairment. Fecal coliform bacteria are noted as a problem parameter, and there are indications of nutrient enrichment in this stream. The City of Greensboro monitoring data also indicate fair to poor water quality in the smaller tributaries of North Buffalo Creek. North Buffalo Creek is on the state's year 2000 303(d) list (not yet EPA approved).

Cone Mills has been on a special order of consent (SOC) for several years. The facility has been fined approximately $150,000 in the past 6 years. Cone has submitted plans and applications to connect to the Greensboro Metro (T.Z. Osborne) WWTP in 2001, after the upgrades are completed. EPA issued an adminstrative order to Cone Mills in July 1998 that included $50,000 in fines. The administrative order includes provisions for toxicity testing between May 2000 and July 2001 to comply with 20% toxicity limit. The administrative order requires Cone Mills to eliminate the discharge to North Buffalo Creek or comply with all NPDES permit limits by July 2001.

*2000 Recommendations*

It is recommended that Cone Mills connect to the Greensboro Metro (T.Z. Osborne) WWTP on South Buffalo Creek as soon as possible. The North Buffalo WWTP is not increasing flow, but is currently upgrading treatment capability to increase the quality of the effluent into North Buffalo Creek. The capacity of this facility is 16 MGD.

TMDLs are being developed for portions of North Buffalo Creek as part of the 303(d) list approach. The stream will be resampled for biological and chemical data to attempt to determine potential problem parameters not addressed by the TMDLs. DWQ will work with The City of Greensboro stormwater program, where possible, to improve water quality in this creek. Refer to Part 2.4 below for more general recommendations for the Buffalo/Reedy Fork Creek watershed.

**South Buffalo Creek**

*1996 Recommendations*

South Buffalo Creek was not supporting (NS) in the 1996 plan. This segment receives large amounts of urban runoff from the City of Greensboro, as well as receiving point source pollution from the Greensboro Metro (T.Z. Osborne) WWTP. It was recommended that no new discharges be permitted to this stream and that existing discharges conduct engineering alternatives and economic analyses to determine the feasibility of connecting to regional facilities. If alternatives were not possible, then limits of 5 mg/l $BOD_5$ and 2 mg/l $NH_3$-N would be implemented. It was also recommended that Greensboro Metro (T.Z. Osborne) WWTP improve effluent quality.

*Current Status*

Greensboro Metro (T.Z. Osborne) WWTP has been in compliance and is upgrading volume and treatment to reduce $BOD_5$ to less than 5 mg/l and 1 mg/l $NH_3$-N.

South Buffalo Creek (22.1 miles from source to Buffalo Creek) is currently partially supporting (PS) according to recent DWQ monitoring above the Greensboro Metro WWTP because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources may be the cause of impairment. Below McConnel Road, South Buffalo Creek is not supporting (NS) because of an impaired biological community and $NH_3$ from the WWTP. Based on benthos monitoring, this portion has the worst water quality in the Cape Fear River basin. Instream habitat degradation associated with urban nonpoint sources and high flows from the discharge may be a cause of impairment in the lower segment. Fecal coliform bacteria are also noted as a problem parameter. South Buffalo Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The Greensboro Metro (T.Z. Osborne) WWTP is currently permitted to discharge 22 MGD to South Buffalo Creek. The facility is in the construction phase of increasing the WWTP flow to 30 MGD. TMDLs are being developed for portions of South Buffalo Creek as part of the 303(d) list approach. The stream will be resampled for biological and chemical data to attempt to determine potential problem parameters not addressed by the TMDLs. DWQ will work with the City of Greensboro stormwater program, where possible, to improve water quality in this creek. Refer to Part 2.4 below for more general recommendations for the Buffalo/Reedy Fork Creek watershed.

The City of Greensboro and CWMTF are building a 20-acre regional stormwater wetland on South Buffalo Creek to enhance sediment removal, reduce pollutant loads, and improve aquatic habitat in the 12-square mile urbanized watershed. Refer to Section C, Chapter 1, Part 1.5.1 for more information on this project.

**Horsepen Creek**

*Current Status*

Horsepen Creek and an UT to Horsepen Creek were rated partially supporting (PS) and not supporting (NS) in the 1996 plan because of impaired biological communities. Horsepen Creek (7.7 miles from source to Brandt Lake) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources may be the cause of impairment. Horsepen Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters. DWQ, with CWMTF (see Section C, Chapter 1, Part 1.3.2), will start working on a detailed study of the Horsepen Creek watershed to identify the sources and extent of nonpoint source impacts to this stream. DWQ will also work with the City of Greensboro stormwater program, where possible, to improve water quality in this creek. Refer to Part 2.4 below for more general recommendations for the Buffalo/Reedy Fork Creek watershed.

**Town Branch**

*Current Status*

Town Branch was partially supporting (PS) in the 1996 plan. Town Branch drains an urban area of Graham and was impaired because of fecal coliform bacteria from urban nonpoint sources. Because of limited sampling data, Town Branch (3.6 miles form source to Haw River) is currently not rated (NR) according recent use support information.

*2000 Recommendations*

The 303(d) list approach will be to resample the stream to obtain updated use support information.

**Brush Creek**

*Current Status*

Brush Creek (5.6 miles from source to Lake Higgins) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources may be the cause of impairment. Brush Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The City of Greensboro has a stormwater program as part of Phase I of the NPDES stormwater program. Brush Creek is downstream of developed areas in Greensboro and should benefit from the city stormwater program (see Section A, Chapter 4, Part 4.7.1 and Section C, Chapter 1, Part 1.4.4). DWQ will work with the stormwater program, where possible, to improve water quality in these creeks. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters. DWQ will work with the City of Greensboro stormwater program, where possible, to improve water quality in this creek. Refer to Part 2.4 below for more general recommendations for the Buffalo/Reedy Fork Creek watershed.

**Reedy Fork Creek**

*1996 Recommendations*

The 1996 Cape Fear River Basinwide Plan identified Reedy Fork Creek (including Buffalo Creek) as a major source of nutrients to the Haw River. This segment of Reedy Fork Creek was not impaired in the 1996 plan. It was recommended that a nutrient fate and transport model be developed to reevaluate the Nutrient Sensitive Waters (NSW) strategy for this part of the subbasin.

*Current Status*

To date, a nutrient fate and transport model has not been developed. See Section A, Chapter 4, Part 4.4 for progress on model development. Reedy Fork Creek (8.6 miles from Buffalo Creek to Haw River) is currently partially supporting (PS) according to recent DWQ monitoring due to low quality water from Buffalo Creek.

*2000 Recommendations*

The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters. Addressing water quality problems in the Greensboro area should be a step to reducing impairments on Reedy Creek Fork and points further downstream in the Haw River (see Section A, Chapter 4, Part 4.4). DWQ will work with the City of Greensboro stormwater program, where possible, to improve water quality in this creek. Refer to Part 2.4 below for more general recommendations for the Buffalo/Reedy Fork Creek watershed.

## 2.3 303(d) Listed Waters

There are 6 streams (83.6 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Segments of Brush Creek, Horsepen Creek, North and South Buffalo Creeks, Reedy Fork Creek, Town Branch and the Haw River are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 2.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Portions of Reedy Fork Creek are not impaired, but flow through a rapidly urbanizing area. Urban runoff has a high potential to degrade water quality and instream habitat. Careful planning and the City of Greensboro stormwater program should help reduce potential impacts.

Jordan Creek is in an agricultural area, and streams in this watershed are subject to erosion and sedimentation that may cause instream habitat degradation. Agricultural BMPs are encouraged to reduce potential impacts.

Graham-Mebane Reservoir serves as a water supply for the towns of Graham, Mebane, Green Level and Haw River. The watershed is mostly forested with a few houses, a public school and some farmland. High total phosphorus and chlorophyll *a* values were reported for the Quaker Creek arm of the reservoir. An algal bloom was also observed in this segment. Cattle were observed near the sample site with one or two animals in the water. Implementation of BMPs would help to reduce adverse impacts to water quality in this reservoir.

Approximately 35% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

### Upper Cape Fear River Basin Association

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

### Back Creek (Tributaries including MoAdams Creek)

*1996 Recommendations*

Back Creek was not impaired in the 1996 plan. MoAdams Creek receives wastewater from the Mebane WWTP. The instream waste concentration in Back Creek prior to the confluence with the Haw River is 80%. The 1996 plan recommended that no new discharges should be permitted in this watershed, and existing discharges should conduct an engineering alternatives and economic analysis including connection to a regional facility. If there were no alternatives, then $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l and DO = 6 mg/l would be recommended. Upon expansion from 1.2 MGD to 2.5 MGD, the Mebane WWTP would be required to meet limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 2 mg/l.

*Current Status*

MoAdams Creek is a very low flow (zero 7Q10) tributary of Back Creek. Mebane WWTP is currently permitted to discharge 2.5 MGD to MoAdams Creek at limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 2 mg/l. The facility is currently passing all self-monitoring toxicity tests. There are no other discharges to MoAdams Creek or Back Creek. Low dissolved oxygen (DO) levels have been detected in MoAdams and Back Creeks below the Mebane WWTP discharge. In November 1999, DWQ biologists surveyed MoAdams and Back Creek. Because of hurricane and drought effects on the biological communities in the streams, it was difficult to determine any effects of the Mebane WWTP discharge, although the absence of stoneflies does indicate water quality problems in the Back Creek watershed. Back Creek and MoAdams Creek are currently not rated (NR).

*2000 Recommendations*

DWQ will continue to monitor streams in this watershed to assess potential impacts from point and nonpoint sources.

### Haw Creek

*1996 Recommendations*

Haw Creek was not impaired in the 1996 plan, but because of low dissolved oxygen (DO) readings at the mouth of Haw Creek, a study was recommended to determine the persistence and source of the low DO problem.

*Current Status*

DWQ staff of the Winston-Salem Regional Office sampled this stream in September 1999 and did not conclusively find the source of low dissolved oxygen. The stream is wide and has very low flow with potential impacts from agricultural and suburban nonpoint source pollution.

*2000 Recommendations*

DWQ will continue to monitor streams in this watershed to assess potential impacts from point and nonpoint sources.

**General Recommendations for Buffalo/Reedy Fork Watershed**

Development in and around the City of Greensboro will continue to affect streams in the Buffalo Creek/Reedy Fork Creek watersheds as well as water quality in the Haw River. Increased impervious surface area will increase the potential for adverse impacts to these streams including streambank erosion and nutrient, sediment and pathogen (fecal coliform bacteria) delivery. Increased water use will require further increases in capacity for the Greensboro WWTPs. The assimilative capacity of these small streams is limited. The wasteflow into North and South Buffalo Creeks cannot increase indefinitely without having increasingly adverse effects on Reedy Creek Fork and the Haw River.

Increasing use of groundwater resources west of Greensboro may also have adverse effects on recharge of headwater streams feeding the Haw River, Reedy Fork Creek, and East and West Forks of the Deep River. Water resource planning should take into account the potential impacts on water quality to headwater streams. Increasing groundwater usage and decreasing groundwater recharge associated with impervious surface areas can degrade instream habitat quality and reduce base flow in these small streams.

The City of Greensboro has a stormwater program as part of Phase I of the NPDES stormwater program. Streams in increasingly developed areas of Greensboro should benefit from the city stormwater program (see Section A, Chapter 4, Part 4.7.1 and Section C, Chapter 1, Part 1.4.4). DWQ will work with the stormwater program, where possible, to improve water quality in these creeks.

Both WWTPs may also be subject to further total nitrogen limits as part of a Jordan Lake NSW strategy (see Section A, Chapter 4, Part 4.4). A TMDL being developed for North and South Buffalo Creeks may also influence permitted limits. The City of Greensboro has developed a stormwater program (Section C, Chapter 1, Part 1.4.4) that will start to address problems associated with nonpoint sources. In addition, the WWTPs are upgrading treatment capabilities as well as funding projects to reduce peak flows (that decrease treatment efficiency) into the WWTPs during storm events.

The water quality situation in the Greensboro area is one of the worst in the state. Because of the challenging geographic location and high population growth, it is recommended that all agencies and groups interested in development and water quality in Greensboro work together to plan growth of the city in such a way that water quality and quantity are protected. Because of the small flows in these streams, innovative strategies and technologies will need to be developed to treat the increasing amounts of wastewater and stormwater generated in these high growth watersheds. DWQ will work with the agencies and groups, where possible, to improve water quality in these creeks.

The Upper Cape Fear Riparian Buffer Protection Planning Grant is a current initiative that may help to address land use and water quality issues in this region. Refer to Section C, Part 1.5.1 for more information on this initiative.

# Chapter 3 -
## Cape Fear River Subbasin 03-06-03
### Includes Big and Little Alamance Creeks

## 3.1 Water Quality Overview

***Subbasin 03-06-03 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 262 |
| Land area: | 1 |
| Water area: | 263 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 66,593 people |
| Pop. Density: | 255 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 59.4 |
| Surface Water: | 0.2 |
| Urban: | 5.8 |
| Cultivated Crop: | 2.2 |
| Pasture/ Managed Herbaceous: | 32.4 |

**Use Support Summary**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 176.0 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 12.3 mi. |
| Not Rated: | 5.2 mi. |

*Lakes*:

Lake Mackintosh - Fully Supporting

This subbasin is located in the piedmont and contains few urban areas except along the I-40/85 corridor between Burlington and Greensboro. A map of the subbasin, including water quality sampling locations, is presented in Figure B-3.

Biological ratings for these sample locations are presented in Table B-3. The current sampling resulted in impaired ratings for one stream in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

The primary land use in this subbasin is a mixture of agriculture and forest. There are no discharges in this subbasin with a permitted flow greater than 0.05 MGD. Most water quality problems are associated with nonpoint sources.

Erosion from agricultural land may cause large sediment inputs into streams within this subbasin. The worst water quality in the subbasin was observed in Little Alamance Creek (Burlington). Urban runoff is the most likely cause of this low rating.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 3.2 Impaired Waters

There were no impaired waters in this subbasin in the 1996 Cape Fear River Basinwide Water Quality Plan. Little Alamance Creek (Burlington) is currently rated impaired according to recent DWQ monitoring. Current status and future recommendations for improving water quality in this stream are discussed below. 303(d) listed waters are summarized in Part 3.3 and waters with other issues, recommendations or projects are discussed in Part 3.4.

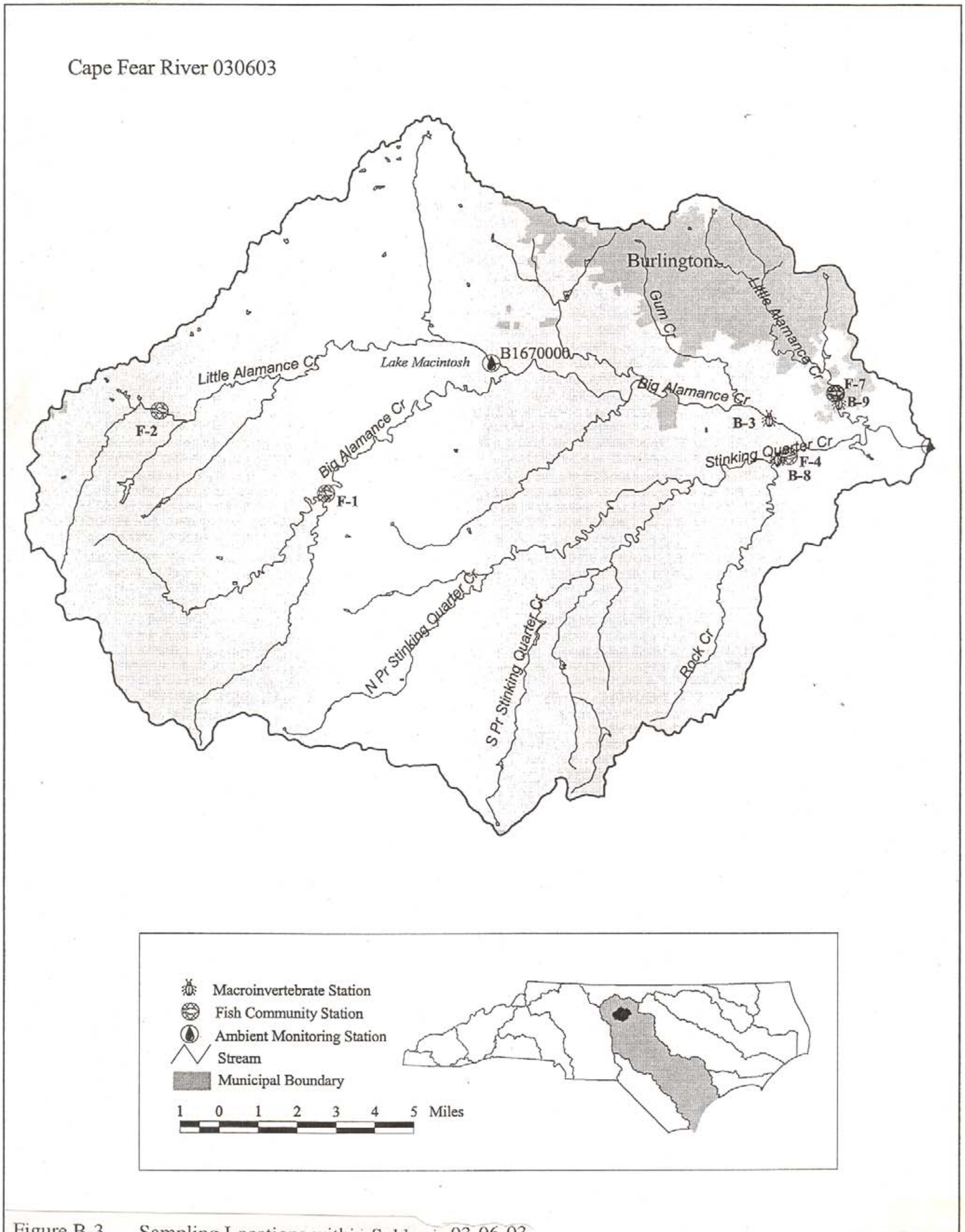


Figure B-3 Sampling Locations within Subbasin 03-06-03

Table B-3 Biological Assessment Sites in Cape Fear River Subbasin 03-06-03

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | Big Alamance Creek | Alamance | NC 49 | Good-Fair | Good-Fair |
| B-8 | Stinking Quarter Creek | Alamance | SR 1136 | Good-Fair | Good |
| B-9 | Little Alamance Creek | Alamance | SR 2309 | Not Sampled | Poor |
| | | | | | |
| ***FISH*** | | | | ***Bioclassification*** | |
| **Site #** | **Stream** | **County** | **Location** | **1993/1994** | **1998** |
| F-1 | Big Alamance Creek | Guilford | SR 3088 | no sample | Good |
| F-2 | Little Alamance Creek | Guilford | SR 3039 | no sample | Fair |
| F-4 | Stinking Quarter Creek | Alamance | SR 1136 | Good-Fair | Fair |
| F-7 | Little Alamance Creek | Alamance | SR 2309 | Fair | Poor |

**Little Alamance Creek (Burlington)** (12.3 miles from source to Big Alamance Creek)

*Current Status*

Little Alamance Creek (Burlington) (12.3 miles from source to Big Alamance Creek) is currently not supporting (NS) based on recent DWQ monitoring data because of an impaired biological community. Streambank erosion associated with stormwater surges from the City of Burlington and indications of nutrient enrichment from urban nonpoint sources are potential causes of impairment. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The City of Burlington will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. It is recommended that the City of Burlington focus stormwater program activities on Little Alamance Creek. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

## 3.3 303(d) Listed Waters

Little Alamance Creek is the only stream (12.3 stream miles) in this subbasin that is impaired and on the state's year 2000 303(d) list (not EPA approved). This stream is discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 3.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement

of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Little Alamance Creek (Guilford County) drains an agricultural area, and Big Alamance Creek also drains an agricultural area as well as urban areas near Burlington. High levels of fecal coliform bacteria have been detected in Big Alamance Creek, and both creeks show instream habitat degradation. Implementation of agricultural BMPs would reduce potential adverse impacts to these streams.

Lake Mackintosh is a water supply reservoir for the City of Burlington. The lake is also used for recreational purposes (fishing and boating only). The surrounding land is comprised of pastures and farmland with a few houses. Blue-green algal blooms were confirmed by samples in January and May 1994, June and July 1996, and June 1998. These algal blooms have been associated with continuing taste and odor problems for the City of Burlington.

Approximately 7% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

The 1996 basinwide plan recommended that the 11 small discharges (0.154 MGD) in this subbasin should explore and implement alternatives to surface discharge or connect to one of the regional WWTPs. Many of the discharges were discharging into zero flow streams. There are currently seven minor discharges in this subbasin. Regionalization of small wastewater discharges will continue to be encouraged and monitored.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

# Chapter 4 -
# Cape Fear River Subbasin 03-06-04
## Includes Cane Creek, Collins Creek and the Haw River

## 4.1 Water Quality Overview

***Subbasin 03-06-04 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 331 |
| Land area: | 327 |
| Water area: | 4 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 20,213 people |
| Pop. Density: | 62 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 73.0 |
| Surface Water: | 1.7 |
| Urban: | 0.3 |
| Cultivated Cropland: | 3.0 |
| Pasture / Managed Herbaceous: | 22.0 |

**Use Support Ratings**

*Freshwater streams*:

| | |
|---|---|
| Fully Supporting: | 207.1 mi. |
| Partially Supporting: | 15.9 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 18.3 mi. |

*Lakes*:

Cane Creek Reservoir - Fully Supporting
Pittsboro Lake - Not Supporting

This subbasin contains the lower reaches of the Haw River in Alamance, Orange and Chatham counties. This section of the Haw River is approximately 25-river miles in length and is completely within the Carolina Slate Belt. Tributary streams within this subbasin are strongly influenced by geology and characteristically have large boulder and/or rubble riffle areas. Therefore, many of the tributary streams in this subbasin are prone to extremely low flow conditions during summer months. A map of the subbasin, including water quality sampling locations, is presented in Figure B-4.

Biological ratings for these sample locations are presented in Table B-4. The current sampling resulted in impaired ratings for two streams and one lake in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Much of the land use within this subbasin is forest, although pasture, cultivated crops and urban land uses also account for significant portions of the subbasin. All three counties within this subbasin have large numbers of registered livestock and animal operations, particularly cattle and poultry operations in Chatham County.

There are 7 permitted dischargers in this subbasin. Only Pittsboro WWTP (Robeson Creek) has a permitted flow of more than 0.5 MGD.

Ambient water quality data are collected from three locations in this subbasin: two mainstem locations on the Haw River (US 15-501 near Bynum and below B. Everett Jordan dam near Moncure) and Robeson Creek at SR 1939 near Seaforth. These data have indicated good water quality with few violations in water quality criteria. Additionally, data from the two Haw River locations in this subbasin indicate an improvement in water quality compared to conditions recorded from ambient monitoring sites in the Haw River at Haw River and Saxapahaw.

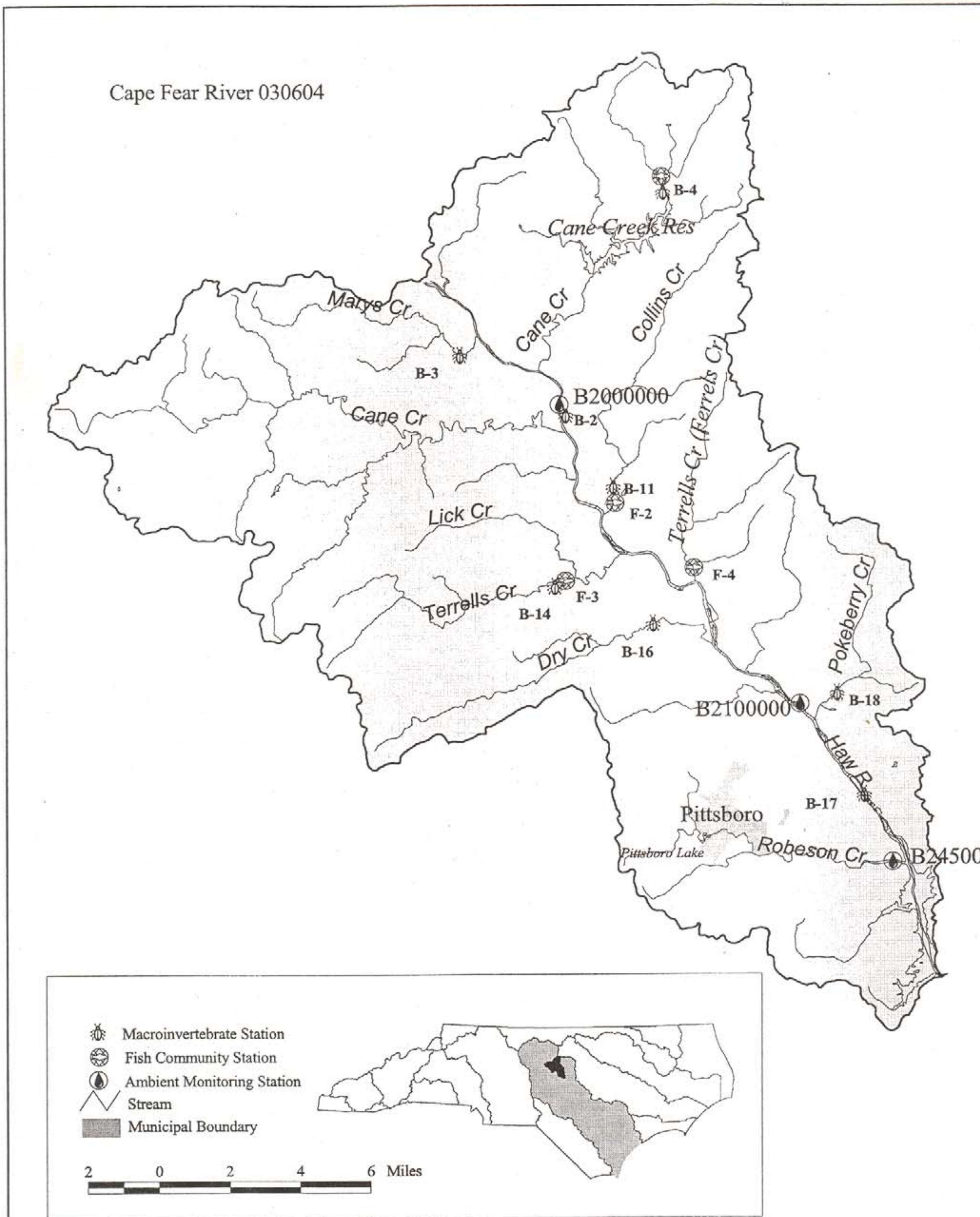


Figure B-4 Sampling Locations within Subbasin 03-06-04

Table B-4 Biological Assessment Sites in Cape Fear River Subbasin 03-06-04

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-2 | Haw River | Alamance | SR 1005 | Good-Fair (s) | Good-Fair (s) |
| B-3 | Marys Creek | Alamance | SR 2174 | Not Sampled | Fair (w) |
| B-4 | Cane Creek | Orange | SR 1114 | Good (w) | Good & Excellent (w) |
| | | | | Good-Fair (s) | Good (s) |
| B-11 | Collins Creek | Chatham | SR 1539 | no sample | Good-Fair (w) |
| B-14 | Terrells Creek | Chatham | NC 87 | Good (w) | Good-Fair (s) |
| B-16 | Dry Creek | Chatham | SR 1520 | Good (w) | Good-Fair (w) |
| B-17 | Haw River | Chatham | US 64 | Good (s) | Good (s) |
| B-18 | Pokeberry Creek | Chatham | SR 1711 | Good-Fair (w) | Good (w) |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-2 | Collins Creek | Chatham | SR 1539 | no sample | Poor |
| F-3 | Terrells Creek | Chatham | NC 87 | Fair | Fair |
| F-4 | Ferrels Creek | Chatham | SR 1525 | no sample | Good-Fair |

(w) Winter collection, (s) Summer collection

Benthic macroinvertebrate samples have been collected from two Haw River locations since 1984, including two basinwide surveys in 1993 and 1998. These data indicate that water quality conditions improve downstream near the Haw River arm of Jordan Lake (Good bioclassifications, US 64) compared to upstream reaches at Saxapahaw (Good-Fair bioclassifications, SR 1005). A benthos sample also was collected from the Saxapahaw location in November 1998 during extremely low flow conditions. Although the bioclassification did not change from summer data, taxa richness values were much lower. These data may reflect the effects of greater instream waste concentrations from upstream sources during extremely low flow conditions.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 4.2 Impaired Waters

Portions of Robeson Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Robeson Creek, Marys Creek and Pittsboro Lake are currently rated impaired according to recent DWQ monitoring. Current status of each stream is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 4.3, and waters with other issues, recommendations or projects are discussed in Part 4.4.

## Robeson Creek

*1996 Recommendations*

Robeson Creek was not supporting (NS) in the upper segment and partially supporting (PS) in the lower segment. A reconnaissance study was recommended to determine the source of low dissolved oxygen (DO) upstream of the Pittsboro WWTP discharge and to evaluate improvements to the facility. A follow-up benthic survey was also recommended.

*Current Status*

A special study to assess the effects of an oil spill into a small tributary of Robeson Creek was conducted in 1997. No aquatic life was found in the tributary, and the spill may have affected waters further downstream in the Robeson Creek watershed. Robeson Creek (6.2 miles from 0.7 miles downstream of SR 2159 to the Haw River) is currently partially supporting (PS) according to recent DWQ monitoring. There have been chlorophyll *a* violations in the lower segment and impaired biological communities in both segments. Instream habitat degradation associated with urban nonpoint sources and a discharge from the City of Pittsboro WWTP is a possible cause of impairment. A new highway bypass and other construction around Pittsboro are adding to nonpoint source problems. The City of Pittsboro has upgraded the WWTP, but has occasional violations including exceeding permitted limits for total phosphorus. A chicken processing plant has had spills from its spray line into an unnamed tributary of Robeson Creek that may contribute to nutrient problems in the lower segment.

*2000 Recommendations*

Local initiatives are needed to improve water quality in Robeson Creek. DWQ encourages development of a land use plan that protects water quality in this watershed. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters and develop a TMDL to address nutrients causing high chlorophyll *a* levels.

The Haw River Assembly was awarded funds to initiate a watershed awareness campaign in the Robeson Creek watershed including Pittsboro. The Haw River Assembly will seek cooperation from city and county agencies, the Triangle J Council of Governments, Cooperative Extension Service, and the Natural Resources Conservation Service to coordinate development of a broader restoration initiative. This funding will provide for landowner outreach and education and initiate broader opportunities for conservation and restoration.

## Marys Creek

*Current Status*

Marys Creek (9.7 miles from source to Haw River) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with agricultural nonpoint sources may be a cause of impairment. Indications of nutrient enrichment were also noted. Holding ponds have been installed at milking parlors on dairy farms in the watershed. Fencing cattle out of streams has also been implemented by some of the dairy operations on a voluntary basis. Marys Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

DWQ encourages groups interested in watershed projects to work with DWQ and other agencies to identify sources of impairment to this stream and to implement best management practices to reduce agricultural nonpoint source impacts (see nonpoint source agency contacts in Appendix V). The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Pittsboro Lake**

*Current Status*

Pittsboro Lake (38 acres, SW of Pittsboro) is currently not supporting (NS) according to recent DWQ monitoring. The lake is impacted by urban and rural nonpoint source pollution. The lake is also affected by algal blooms stimulated by excessive nutrient input from the watershed. Pittsboro Lake is a small impoundment located just outside of, and owned by, the Town of Pittsboro in Chatham County. The lake, which is a retired water supply, is actually a system of two separate ponds connected by a canal that becomes dry during periods of low precipitation. The drainage area for Pittsboro Lake is composed of forested, urban and agricultural areas. Pittsboro Lake is currently part of a town park.

When sampled by DWQ in 1993, this lake had a significant macrophyte infestation problem. Field observations in 1998 continued to identify a problem with excessive macrophyte growth in the lake. There has been no dredging or macrophyte control actions (either mechanical or chemical) to reduce the plant growth in the lake. Hurricane Fran (1996) did remove a great deal of the plant material and algae observed in the lake in 1993 by DWQ. The lake is also affected by algal blooms and nutrient loading.

*2000 Recommendations*

Local initiatives are needed to improve water quality in Pittsboro Lake. DWQ encourages development of a land use plan that protects water quality in the lake. A stormwater program with an educational component would help to reduce nutrient input into Pittsboro Lake. The 303(d) list approach will be to develop TMDL to address nutrients causing high chlorophyll *a* levels.

## 4.3 303(d) Listed Waters

There are two streams (15.9 stream miles) and one lake in the subbasin rated as impaired and on the state year 2000 303(d) list (not yet EPA approved). Robeson Creek, Marys Creek and Pittsboro Lake are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 4.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Cane Creek South, Collins Creek, Terrells Creek South, Terrells Creek North, Dry Creek and the Haw River mainstem are in agricultural watersheds and subject to streambank erosion and habitat degradation. Implementation of agricultural BMPs would reduce potential impacts to the smaller streams and reduce the potential for impacts to the mainstem.

Approximately 8% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Cane Creek Reservoir**

Algal bloom samples were collected from Cane Creek Reservoir in July and August 1998. Chlorophyll *a* above the state water quality standard was reported in June and August 1998. The North Carolina Clean Water Management Trust Fund awarded OWASA a one million-dollar grant to help acquire land and conservation easements in the Cane Creek Reservoir watershed. See Section C, Chapter 1, Part 1.5.1 for a complete description of the project.

# Chapter 5 -
## Cape Fear River Subbasin 03-06-05
### Includes New Hope Creek, Northeast Creek and Jordan Reservoir

## 5.1 Water Quality Overview

***Subbasin 03-06-05 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 269 |
| Land area: | 251 |
| Water area: | 18 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 102,058 people |
| Pop. Density: | 407 person / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 78.2 |
| Surface Water: | 8.2 |
| Urban: | 6.4 |
| Cultivated Crop: | 0.6 |
| Pasture / Managed Herbaceous: | 6.6 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 52.5 mi. |
| Partially Supporting: | 39.9 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 122.4 mi. |

*Lakes*:

B. Everett Jordon Reservoir - Fully Supporting

This subbasin includes large sections of the City of Durham and Research Triangle Park. New Hope Creek and many of its tributaries are within the geological formation of the Triassic Basin, an area that covers about 1,100 square miles. The 7Q10 values are zero for all but the largest watersheds. A large percentage of land use within this subbasin is urban and built-up. A map of the subbasin, including water quality sampling locations, is presented in Figure B-5.

Biological ratings for these sample locations are presented in Table B-5. The current sampling resulted in impaired ratings for two streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes use support data.

There are eight permitted dischargers in the subbasin. Two facilities have permitted flows of greater than 1 MGD. These facilities discharge to Northeast Creek (Durham County Triangle WWTP) and New Hope Creek (South Durham Water Reclamation Facility) and have instream waste concentrations of 100% and 99.5%, respectively, under 7Q10 flow conditions. Elevated nutrient concentrations and depressed dissolved oxygen values have been recorded at both of these locations when compared to most other Haw River tributary locations. Median fecal coliform counts are above water quality criteria at both of these locations.

Both point and nonpoint sources have impacted streams in this highly urbanized subbasin. Streams in this subbasin are typical of the Triassic Basin with 7Q10 values of zero and poor instream habitat. For these reasons, most streams in this subbasin were not sampled because of low flow conditions or were not rated using benthic macroinvertebrate criteria.

Fish tissue samples were collected from two locations on Jordan Lake during 1998: Farrington arm and near the dam. Only one largemouth bass from the Farrington arm location had a mercury concentration exceeding EPA criteria.

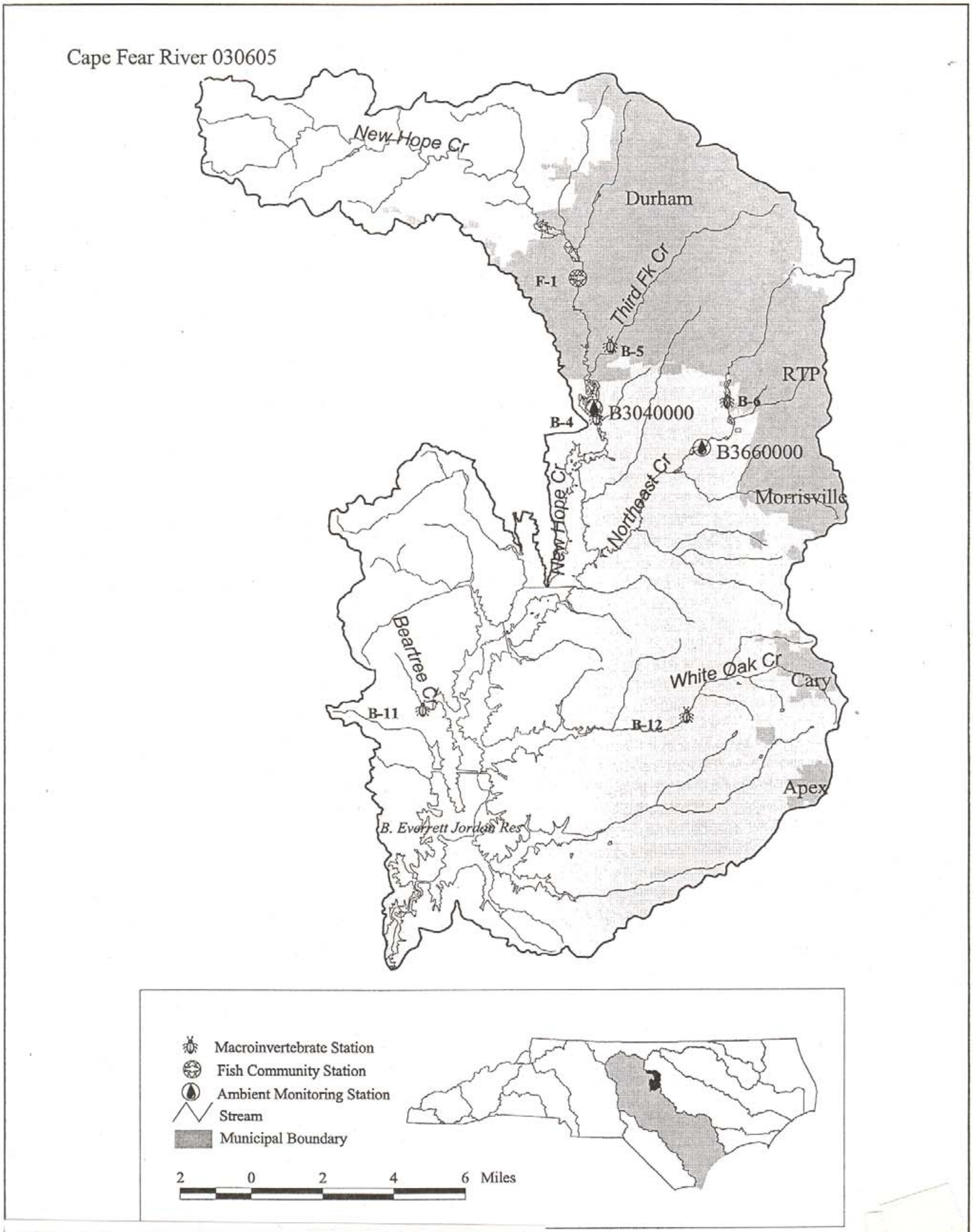


Figure B-5 Sampling Locations within Subbasin 03-06-05

Table B-5 Biological Assessment Sites in Cape Fear River Subbasin 03-06-05

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-4 | New Hope Creek | Durham | SR 1107 | Not sampled | Fair (s) |
| B-6 | Northeast Creek | Durham | SR 1102 | Not Rated (w) | Not rated (w) |
| B-11 | Beartree Creek | Chatham | SR 1716 | Not Rated (w) | Not rated (w) |
| B-12 | White Oak Creek | Chatham | SR 1603 | Not sampled | Not rated (w) |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | New Hope Creek | Durham | SR 2220 | no sample | Poor |

| ***FISH TISSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Lake Jordan near Farrington | 1998 | 24 | 1 | 0 | EPA mercury limit exceeded in 1 bass sample |
| FT-2 | Lake Jordan near Dam | 1998 | 22 | 0 | 0 | No samples exceeded criteria |

(w) Winter collection (s) Summer collection

## 5.2 Impaired Waters

Portions of New Hope Creek, Northeast Creek, Third Fork Creek and White Oak Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of New Hope Creek and Northeast Creek are currently rated impaired according to recent DWQ monitoring. Current status of each stream is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 5.3 and waters with other issues, recommendations or projects are discussed in Part 5.4.

### New Hope Creek

*1996 Recommendations*

New Hope Creek (20.7 miles from I-40 to SR 1107) was not supporting (NS) in the 1996 Cape Fear River Basinwide Water Quality Plan. The stream receives a large discharge from South Durham Water Reclamation Facility. The instream waste concentration was 99% during summer low flow conditions. The stream was subject to low dissolved oxygen (DO). The upstream segments receive wastewater from smaller discharges that reduce the instream DO prior to the WWTP. It was recommended that upon expansion from 10 to 20 MGD, the WWTP should meet advanced tertiary treatment of 5 mg/l $BOD_5$ and 1 mg/l $NH_3$-N. It was also recommended that smaller discharges into zero flow streams above the WWTP connect to regional treatment facilities.

*Current Status*

The South Durham Water Reclamation Facility has expanded to 20 MGD with permitted limits of 5 mg/l $BOD_5$ and 2 mg/l $NH_3$-N and 2 mg/l TP. The instream waste concentration is 100% during summer low flow conditions. Some of the small discharges in the area have connected to regional facilities. However, because of insufficient DWQ staffing, more regionalization of wastewater treatment has not been pursued. New Hope Creek (25 miles from Sandy Creek to SR 1107) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources and the South Durham Water Reclamation Facility discharge is a possible cause of impairment. Manganese and fecal coliform bacteria are also noted as problem parameters in the lower segment. New Hope Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

New Hope Creek is in heavily urbanized areas of Durham and should benefit from the existing city stormwater program (see Section A, Chapter 4, Part 4.7.1 and Section C, Chapter 1, Part 1.5.1). DWQ will work with the stormwater program, where possible, to improve water quality in these streams. DWQ is currently studying New Hope Creek to determine the extent and possible sources of fecal coliform bacteria contamination. DWQ also encourages further efforts to connect small discharges in this watershed to a regional facility. The South Durham Water Reclamation Facility is in compliance with current permitted limits. Permit limits may be reevaluated after modeling efforts are completed to address the NSW strategy for Jordan Reservoir/Haw River (see Section A, Chapter 4, Part 4.4).

The 800-acre New Hope Creek Riparian buffer and greenway trail system is protecting this stream from rapid commercial and residential development in this watershed. For more information on this project, refer to Section C, Chapter 1, Part 1.5.1.

The North Carolina Wetlands Restoration Program and Duke University received a grant of $582,500 to collaborate on the restoration of degraded streambanks and riparian areas of Sandy Creek, within the New Hope Creek watershed. The project will treat stormwater runoff within the 25-acre project watershed adjacent to the University Campus. Treatment methods will include the installation of twelve biofiltration areas to receive and attenuate runoff from parking and trail areas, and a structure to create an instream stormwater wetland and support the restoration of degraded streambanks. The Wetland Program at Duke University will monitor water quality at 15 sites in the project area to determine the success of the project design.

**Northeast Creek**

*1996 Recommendations*

Northeast Creek (13 miles from source to Jordan Reservoir) was partially supporting (PS) in the 1996 plan. The stream receives a large discharge from the Durham County-Triangle WWTP. The instream waste concentration was 99% during summer low flow conditions, and the stream was subject to low dissolved oxygen (DO). Because of low summer flows, it was recommended that no new discharges be allowed.

*Current Status*

No new discharges have been permitted into this stream. There was a 1.6 million-gallon sewage spill from Durham County-Triangle WWTP in 1997. Northeast Creek (14.9 miles from source to New Hope Creek arm of Jordan Reservoir, 3 segments) is currently partially supporting (PS) according to recent DWQ monitoring data because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources and the Durham County Triangle WWTP is a possible cause of impairment. Manganese, fecal coliform bacteria and low dissolved oxygen (DO) are also noted as problem parameters. Northeast Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Northeast Creek is in heavily urbanized areas of Durham and Research Triangle Park and should benefit from the existing city stormwater program (see Section A, Chapter 4, Part 4.7.1). DWQ will work with the stormwater program, where possible, to improve water quality in these streams. Durham County Triangle WWTP is in compliance with current permitted limits. Permit limits may be reevaluated after modeling efforts are completed to address the NSW strategy for Jordan Reservoir/Haw River (see Section A, Chapter 4, Part 4.4).

**Third Fork Creek**

*Current Status*

Third Fork Creek (4.5 miles from source to Jordan Reservoir) was not supporting (NS) in the 1996 plan. An impaired biological community and turbidity related to development in the watershed were the causes of impairment. New biological information has determined that the previous rating was inappropriate because of the small size of the stream. Third Fork is currently not rated.

*2000 Recommendations*

DWQ will continue to monitor the impacts of land development on streams in this watershed. The 303(d) list approach will be to resample this stream to obtain updated use support information.

**White Oak Creek**

*Current Status*

White Oak Creek (0.4 miles from NC 751 to New Hope River Arm of Jordan Reservoir) was identified as partially supporting (PS) in the 1996 basinwide plan because of an impaired biological community. White Oak Creek is currently not rated (NR). Based on new biological information, it was determined that the previous biological rating was inappropriate. This stream is not on the state's year 2000 303(d) list (not yet EPA approved).

## 5.3 303(d) Listed Waters

There are three streams (49 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). New Hope Creek, Northeast Creek and Third Fork Creek are on the list and are addressed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 5.4 Other Issues, Recommendations and Projects

Approximately 60% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Jordan Reservoir**

B. Everett Jordan Reservoir is currently supporting its designated uses. There are currently no public health advisories for swimming, fish consumption or drinking water use. Aquatic weeds are not currently a significant issue. The water treatment plant using the Jordan Reservoir as a raw water source has had (1995, 1996) some experiences with taste and odor issues as a result of noxious algal growth. However, these treatment concerns are not currently a problem according to the water plant operators. Recent DWQ evaluations of water quality, however, continue to show concerns for water quality standards. Water quality standards related to eutrophication are not consistently achieved. Continued growth in the drainage basin is likely to increase runoff and increase delivery of nutrients and sediment to the reservoir.

B. Everett Jordan Reservoir receives discharges from many large municipal facilities via the Haw River, Morgan Creek, New Hope Creek and Northeast Creek. The cumulative effect of the discharges increases the potential for water quality problems associated with excessive nutrients. Because the facilities in the Jordan watershed are increasing flow capacity in response to population growth, steps will need to be taken to prevent water quality degradation in Jordan Reservoir from both point and nonpoint sources. Refer to Section A, Chapter 4, Part 4.4 for updates on the Jordan Reservoir Nutrient Sensitive Waters Strategy.

# Chapter 6 -
## Cape Fear River Subbasin 03-06-06
### Includes Morgan Creek and Bolin Creek

## 6.1 Water Quality Overview

***Subbasin 03-06-06 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 75 |
| Land area: | 74 |
| Water area: | 1 |

**Population Statistics**

1990 Est. Pop.: 101,430 people
Pop. Density: 573 persons / $mi^2$

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 84 |
| Surface Water: | 1.4 |
| Urban: | 5.3 |
| Cultivated Crop: | 0.6 |
| Pasture / Managed Herbaceous: | 8.6 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 46.7 mi. |
| Partially Supporting: | 12.4 mi. |
| Not Supporting: | 6.8 mi. |
| Not Rated: | 9.0 mi. |

*Lakes*:

University Lake - Fully Supporting

This small subbasin contains the urban and large suburban sections of Chapel Hill in Orange County. Relative to other subbasins in the Cape Fear River basin, it contains a large proportion of urban and built-up areas. This type of land use includes residential areas, institutional sites, construction sites and golf courses. Forest and agriculture, including pasture and cultivated cropland, also make up portions of the subbasin.

Small streams in this subbasin typically stop flowing during low flow periods due to the lack of groundwater recharge. USGS has estimated that Slate Belt streams with catchment areas of 18 square miles or less will have zero 7Q10 flows during summer low flow periods (USGS, 1993). A map of the subbasin, including water quality sampling locations, is presented in Figure B-6.

Biological ratings for these sample locations are presented in Table B-6. The current sampling resulted in impaired ratings for five streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

There are 7 permitted dischargers in this subbasin. Most of these are very small, with the largest being the OWASA/Mason Farm WWTP. This facility has a permitted flow of 8.0 MGD into Morgan Creek. The facility has an instream waste concentration of 93% during 7Q10 flow conditions.

Data from Morgan Creek and the Bolin/Booker/Little Creeks watershed indicate a downstream decline in water quality. Good or Excellent water quality results are recorded from upstream sites and water quality degrades, as the streams flow through urban and suburban sections of Chapel Hill.

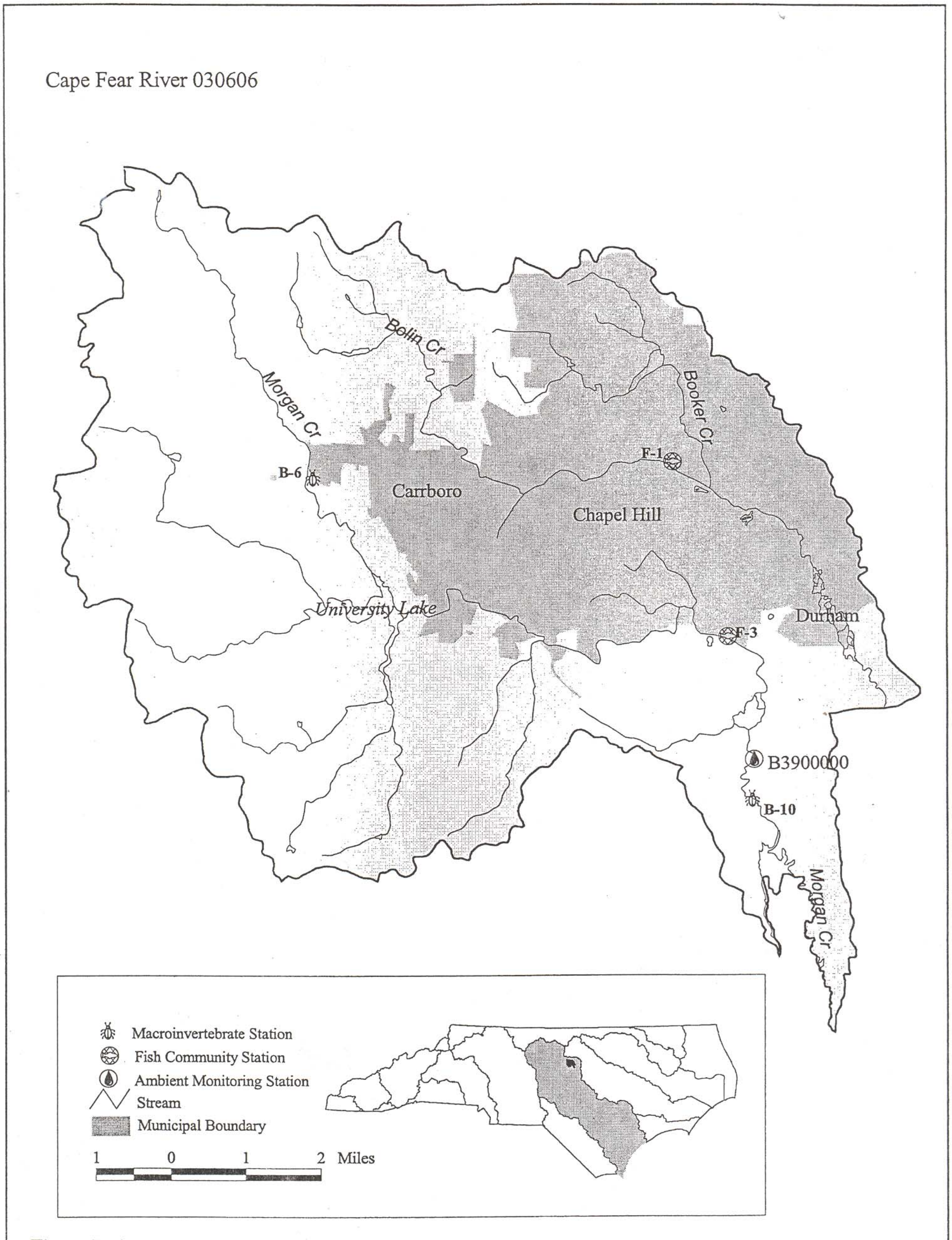


Figure B-6 Sampling Locations within Subbasin 03-06-06

Table B-6 Biological Assessment Sites in Cape Fear River Subbasin 03-06-06

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-6 | Morgan Creek | Orange | NC 54 | Excellent (w) | Excellent (w) |
| | | | | Good (s) | - |
| B-10 | Morgan Creek | Orange | SR 1726 | Fair (s) | Fair (s) |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Bolin Creek | Orange | off SR 1750 | no sample | Poor |
| F-3 | Morgan Creek | Orange | SR 1900 | no sample | Poor |

(w) Winter collection, (s) Summer collection

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 6.2 Impaired Waters

Portions of Meeting of the Waters, Morgan and Bolin Creeks were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Meeting of the Waters, Morgan, Bolin, Booker and Little Creeks are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 6.3 and waters with other issues, recommendations or projects are discussed in Part 6.4.

### Meeting of the Waters

*Current Status*

Meeting of the Waters was identified as not supporting (NS) in the 1996 basinwide plan because of an impaired biological community. Meeting of the Waters (1.4 miles from source to Morgan Creek) was resampled and is currently not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment. This stream drains heavily urbanized areas of UNC-Chapel Hill. Meeting of the Waters is on the state’s year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Meeting of the Waters is impaired from urban nonpoint sources in Chapel Hill. The City of Chapel Hill will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Morgan Creek**

*1996 Plan Recommendations*

The 1996 Cape Fear River Basinwide Plan identified two segments of the Morgan Creek (8.6 miles from SR 1919 to Jordan Reservoir) as partially supporting (PS) because of an impaired biological community. Sedimentation and fecal coliform bacteria were listed as possible causes of impairment. The 1996 plan recommended that no new discharges should be permitted in this stream.

*Current Status*

No new discharges have been permitted into this stream. The sample segments of Morgan Creek have been redefined. Approximately three miles of Morgan Creek between SR 1919 and Meeting of the Waters has improved since the last sampling period and is no longer impaired. Two segments of Morgan Creek (5.1 miles from Meeting of the Waters to Jordan Reservoir) are partially supporting (PS) and not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. These two segments are on the state's year 2000 303(d) list (not yet EPA approved). Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment. Manganese is also listed as a problem parameter for both stream segments. For more information on unimpaired segments of Morgan Creek, refer to Part 6.4 below.

*2000 Recommendations*

The City of Chapel Hill will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Bolin Creek**

*Current Status*

Bolin Creek (1 mile from NC 501 to Little Creek) was identified as partially supporting (PS) in the 1996 basinwide plan because of an impaired biological community. This same segment of Bolin Creek is partially supporting (PS) according to recent monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment. Bolin Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Bolin Creek is impaired from urban nonpoint sources in Chapel Hill. The City of Chapel Hill will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Booker Creek**

*Current Status*

Booker Creek (5.6 miles from source to Little Creek) is partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment. Booker Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Booker Creek is impaired from urban nonpoint sources in Chapel Hill. The City of Chapel Hill will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Little Creek**

*Current Status*

Little Creek (6.1 miles from source to New Hope Creek) is not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible source of impairment. The 0.7-mile segment upstream of New Hope River Arm of Jordan Reservoir is partially supporting (PS) for the same reasons. Little Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Little Creek is impaired from urban nonpoint sources in Chapel Hill. The City of Chapel Hill will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

## 6.3 303(d) Listed Waters

There are 5 streams (19.2 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Segments of Meeting of the Waters, Morgan, Bolin, Booker and Little Creeks are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 6.4 Other Issues, Recommendations and Projects

Morgan Creek upstream of Meeting of the Waters is rated as fully supporting (FS) using recent DWQ monitoring data. However, this stream may still be affected by urban runoff that has the potential to degrade water quality and instream habitat. Addressing stormwater runoff in Chapel Hill should reduce future impacts to water quality in Morgan Creek. Although no action is required for these surface waters, continued monitoring is recommended. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Approximately 40% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Chapel Hill Stream Monitoring**

The Town of Chapel Hill currently monitors 14 sites monthly in area streams. The town will also be performing watershed and stream assessments as part of the stormwater management program.

# Chapter 7 -
## Cape Fear River Subbasin 03-06-07
### Including Cape Fear River, Parkers and Neills Creeks

## 7.1 Water Quality Overview

***Subbasin 03-06-07 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 415 |
| Land area: | 403 |
| Water area: | 12 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 39,713 people |
| Pop. Density: | 99 persons/$mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 69.6 |
| Surface Water: | 2.9 |
| Urban: | 1.6 |
| Cultivated Crop: | 21.4 |
| Pasture/ Managed Herbaceous: | 4.6 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 239.4 mi. |
| Partially Supporting: | 2.9 mi. |
| Not Supporting: | 10.2 mi. |
| Not Rated: | 44.8 mi. |

*Lakes*:

Harris Lake - Fully Supporting

This subbasin contains approximately 25-river miles of the Cape Fear River from near the confluence of Lick Creek in Lee County to near Buies Creek in Harnett County. This subbasin contains many tributary streams that are completely contained within the Sand Hills, although other streams within this subbasin have piedmont or coastal plain characteristics as well. The sandy soils and high permeability rates of Sandhill soils allow for greater groundwater recharge than Slate Belt or Triassic Basin streams. Many streams within this ecoregion typically have 7Q10 flow rates greater than zero. A map of the subbasin, including water quality sampling locations, is presented in Figure B-7.

Biological ratings for these sample locations are presented in Table B-7. The current sampling resulted in impaired ratings for one stream in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

The subbasin is primarily forested, although agriculture (including pasture and cultivated cropland) accounts for a significant amount of land use. The towns of Sanford, Fuquay-Varina and Lillington are the largest urban areas in the subbasin. Parkers Creek, Avents Creek and Hector Creek in Raven Rock State Park are rated as HQW. There are 16 permitted dischargers in the subbasin. Six of these facilities have permitted flows of 0.5 MGD or greater.

Bioclassifications based on benthic macroinvertebrate data for the Cape Fear River at Lillington have been Good, with only one exception, since the first survey in 1983. This includes basinwide surveys in 1993 and 1998. Fish tissue samples also were collected from the Cape Fear River at Lillington during 1998. Twenty-six specimens were analyzed for metal contaminants. Only one bowfin had mercury exceeding the EPA screening value. The Cape Fear River near Erwin had an Excellent benthos bioclassification in 1998 and in 1993.

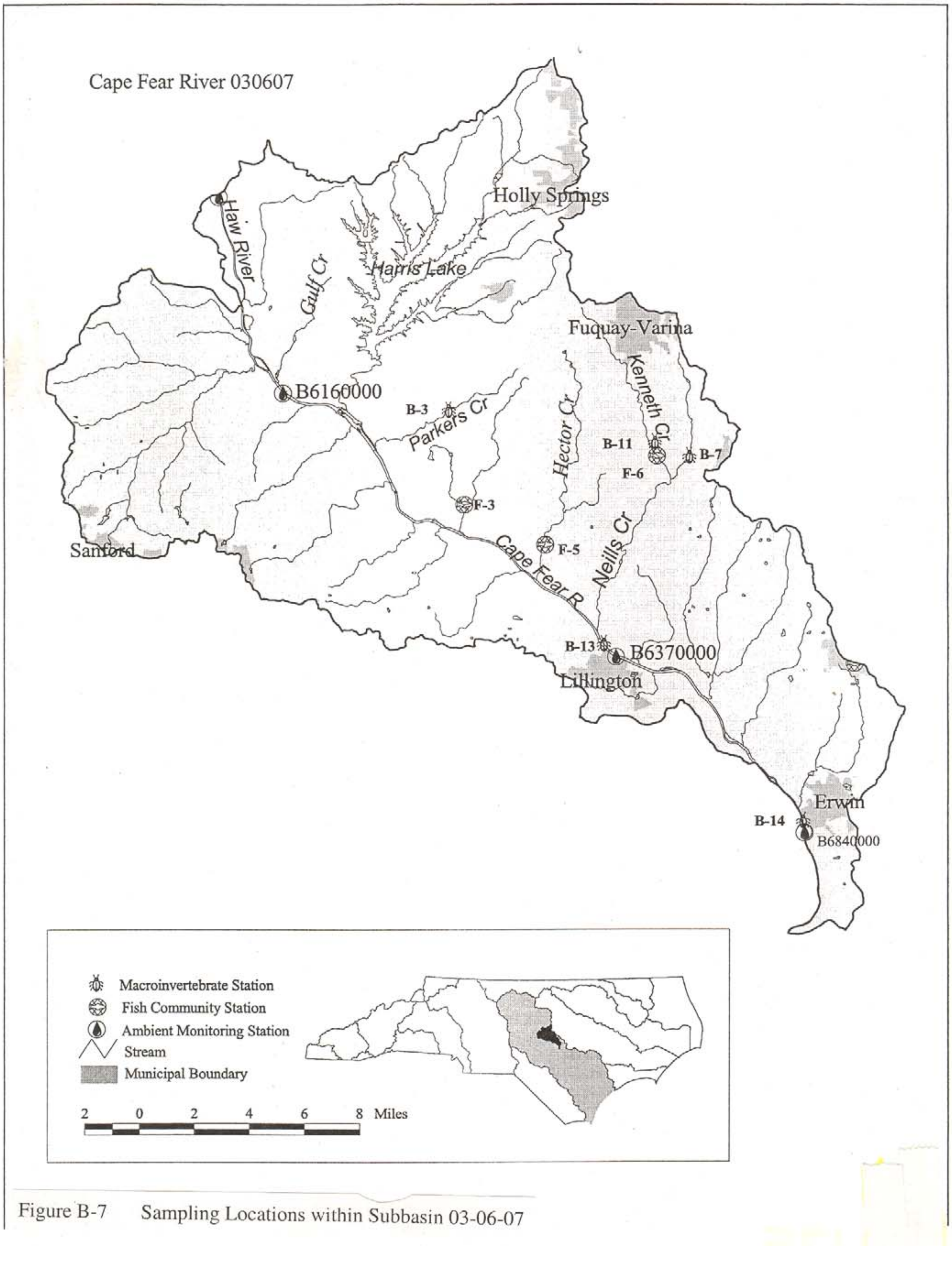


Figure B-7 Sampling Locations within Subbasin 03-06-07

Table B-7 Biological Assessment Sites in Cape Fear River Subbasin 03-06-07

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | Parkers Creek | Harnett | SR 1450 | Good (w) | Good-Fair (w) |
| | | | | Good (s) | Good-Fair (s) |
| B-7 | Neills Creek | Harnett | SR 1441 | Fair (w) | Good-Fair (w) |
| B-11 | Kenneth Creek | Harnett | SR 1441 | Poor (w) | Poor (w) |
| B-13* | Cape Fear River | Harnett | US 401 | Good (s) | Good (s) |
| B-14 | Cape Fear River | Harnett | NC 217 | Excellent | Excellent |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-5 | Hector Creek | Harnett | SR 1412 | no sample | Fair |
| F-6 | Kenneth Creek | Harnett | SR 1441 | Poor | Poor |

| ***FISH TISSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Cape Fear River at Lillington | 1998 | 22 | 1 | 0 | EPA mercury limit exceeded in 1 bowfin sample |

(w) Winter collection (s) Summer collection

A 5-year decline in water quality was found at Parkers Creek based on basinwide benthos surveys conducted in 1993 and 1998. This decline was evident during surveys conducted during both winter and summer surveys at this location. Changes in land use activities and/or nonpoint source runoff in the watershed above the collection location may have accounted for the decline in water quality. There are no permitted point source facilities in the watershed. A 5-year improvement in bioclassification is noted at Neills Creek, although only one additional EPT taxa was collected during the 1998 survey to account for the change in bioclassification. The only Poor water quality indicated by macroinvertebrates and the fish community in this subbasin was for Kenneth Creek at a location below the Fuquay-Varina WWTP.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 7.2 Impaired Waters

Portions of Kenneth Creek, Gulf Creek and Neills Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Kenneth Creek are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 7.3 and waters with other issues, recommendations or projects are discussed in Part 7.4.

**Kenneth Creek**

*1996 Recommendations*

Kenneth Creek (6.5 miles) was rated not supporting (NS) and partially supporting (PS) in the 1996 plan. The stream is a low flow stream that receives urban nonpoint source pollution and a 1.2 MGD discharge from the Fuquay-Varina WWTP. It was recommended that any new or expanding discharges to Kenneth Creek meet limits of 5 mg/l $BOD_5$ and 2 mg/l $NH_3$-N.

*Current Status*

There have been no new or expanding discharges to Kenneth Creek. Kenneth Creek (7.3 miles from source to Neills Creek) is currently not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Urban nonpoint source pollution from Fuquay-Varina and a discharge from the Fuquay-Varina WWTP are possible sources of impairment. There are also indications of nutrient enrichment in this stream. Kenneth Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Local initiatives are needed to improve water quality in Kenneth Creek. DWQ encourages development of a land use plan and stormwater program that protects water quality in this stream. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Gulf Creek**

*Current Status*

Gulf Creek (5.1 miles) was not supporting (NS) in the 1996 plan. The stream is currently partially supporting (PS) and not supporting (NS) according to 1993 DWQ monitoring data because of instream habitat degradation, possibly associated with nonpoint source runoff from a clay pit mine. The clay pit mine has BMPs in place as required in the general permit; however, there are indications that the BMPs are not protecting water quality. Gulf Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

DWQ will continue to monitor implementation of BMPs to assess their ability to protect water quality. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Neills Creek**

*Current Status*

Neills Creek (2.4 miles) was partially supporting (PS) in the 1996 plan. This stream was sampled during recent DWQ monitoring, but was not rated below the confluence with Kenneth Creek. The upper segments are currently fully supporting (FS). Neills Creek has improved in water quality, but monitoring should be continued to assess sources of instream habitat degradation.

## 7.3 303(d) Listed Waters

There are two streams (13.1 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Kenneth Creek and Gulf Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 7.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Approximately 3% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

Parkers Creek is in an agricultural area, and streams in this watershed are subject to erosion and habitat degradation. DWQ encourages implementation of agricultural best management practices (BMPs), including fencing cattle out of streams that reduce potential impacts to surface waters.

**Development in Harris Lake Watershed**

Harris Lake watershed is in an area that is experiencing rapid growth. Harris Lake will be increasingly impacted by nonpoint sources. As land in the watershed is converted from forest and agricultural land uses to residential and commercial land uses, the streams feeding Harris Lake will be subjected to higher flows during rain events and increased delivery of pollutants and nutrients. This may result in streambank erosion, habitat degradation and increased potential for algal blooms in slow-flowing sections of the streams and in Harris Lake.

Communities in western Wake County are pursuing a discharge into the Cape Fear River in this subbasin. A model approach is needed that takes into account algal activity upstream of Buckhorn dam to determine wasteload allocation in this segment of the Haw/Cape Fear River.

DWQ will be reviewing the exisiting QUAL2E model for the Cape Fear River mainstem (from Buckhorn Dam to Lock and Dam #1) to determine if improvements in the calibration can be made.

**The Middle Cape Fear River Basin Association (MCFRBA*)***

The Middle Cape Fear River Basin Association (MCFRBA) started sampling at eight stations in this subbasin (30 stations total) in July 1998. This data will be used to give a higher resolution picture of water quality conditions in the Cape Fear River mainstem as well as in Lick, Buckhorn, Avents and Buies Creeks. The data will also be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Utley Creek**

*1996 Recommendations*

Utley Creek had recommendations that were not specifically linked to an impaired stream. Because of the high instream waste concentration of Holly Springs WWTP, it was recommended that a survey be conducted below the discharge to determine water quality impacts.

*Current Status*

Utley Creek is a low flow stream (7Q10 = 0.11cfs) that currently receives a 0.5 MGD discharge from the Town of Holly Springs. Water quality data has been collected from a site just below Thomas Mill Pond (approximately 1 mile below discharge point) as well as other areas of the watershed. Calculated dissolved oxygen (DO) saturation values exceeded the state standard of 110% in 91 of 218 samples (42%) evaluated from January 1994 to May 1997. In July 1996, DWQ staff documented an algal bloom in Thomas Mill Pond and a fish kill further downstream. Dissolved oxygen (DO) levels at the fish kill site ranged from 0.2 to 0.5 mg/l. In summer 1997, DWQ staff noted a large algal bloom in a waterfowl impoundment downstream of Thomas Mill Pond. Total phosphorus (TP) and total nitrogen (TN) levels are higher below the Holly Springs WWTP discharge than in the stream above the discharge. Because of the mostly forested nature of the Utley Creek watershed and the observations noted above, it is believed that the Holly Springs WWTP is the major contributor of nutrients to this stream. In summer months, this discharge can greatly increase the potential for algal blooms and subsequent fish kills.

*2000 Recommendations*

Utley Creek is currently not rated. Water quality in Utley Creek is marginal with the current discharge and low impact land uses. Increased flow from the WWTP, as well as the expected stormwater flow, has the potential to not only increase nutrient loading but also increase sedimentation and streambank erosion. Land use planning in the watershed that considers water quality concerns is needed prior to large-scale development projects to minimize runoff effects. Because of water quality concerns in Utley Creek and the expected urbanization of the Harris Lake watershed, DWQ recommends that Holly Springs explore other means of sewage disposal including connection to existing facilities in the area.

# Chapter 8 -
## Cape Fear River Subbasin 03-06-08
### East and West Forks of the Deep River and Richland Creek

## 8.1 Water Quality Overview

***Subbasin 03-06-08 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 179 |
| Land area: | 177 |
| Water area: | 2 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 101,430 people |
| Pop. Density: | 573 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 58.4 |
| Surface Water: | 1.7 |
| Urban: | 13.0 |
| Cultivated Crop: | 1.5 |
| Pasture/ Managed Herbaceous: | 25.4 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 28.3 mi. |
| Partially Supporting: | 22.6 mi. |
| Not Supporting: | 9.0 mi. |
| Not Rated: | 41.4 mi. |

*Lakes*:

High Point Lake - Fully Supporting
Oak Hollow Lake - Fully Supporting

This subbasin is located in the piedmont and contains the City of High Point and portions of Greensboro and Randleman. A map of the subbasin, including water quality sampling locations, is presented in Figure B-8.

Biological ratings for these sample locations are presented in Table B-8. The current sampling resulted in impaired ratings for three streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Land use in the subbasin is a mixture of urban, residential and agriculture land use. Urban residential land use is increasing due to growth in both High Point (Richland Creek and Muddy Creek watersheds) and Greensboro (West Fork Deep River and Hickory Creek watersheds).

There are 21 small dischargers in this subbasin, but only two facilities with permitted flows greater than 1 MGD. High Point Eastside WWTP is permitted to discharge 16 MGD to Richland Creek, and the Randleman WWTP is permitted to discharge 1.7 MGD to the Deep River.

The High Point WWTP affects water quality in both Richland Creek and portions of the Deep River. Both of these streams, however, are also affected by urban runoff. Increased development in both High Point and Greensboro can be expected to have negative effects on the water quality of small streams in this subbasin.

Benthic macroinvertebrate data indicated stable water quality at most sites in the subbasin since 1993, although Richland Creek declined from Fair in 1993 to Poor in 1998. Low flow in Hickory Creek and Muddy Creek prevented any assessment of water quality changes at these sites during 1998. Long-term analysis of data has shown improvements at 3 sites on the Deep River associated with upgrades of wastewater treatment plants. The most substantial change occurred for the Deep River at Randleman: Poor in 1985, Fair in 1986 and 1987, Good-Fair in 1993 and 1998.

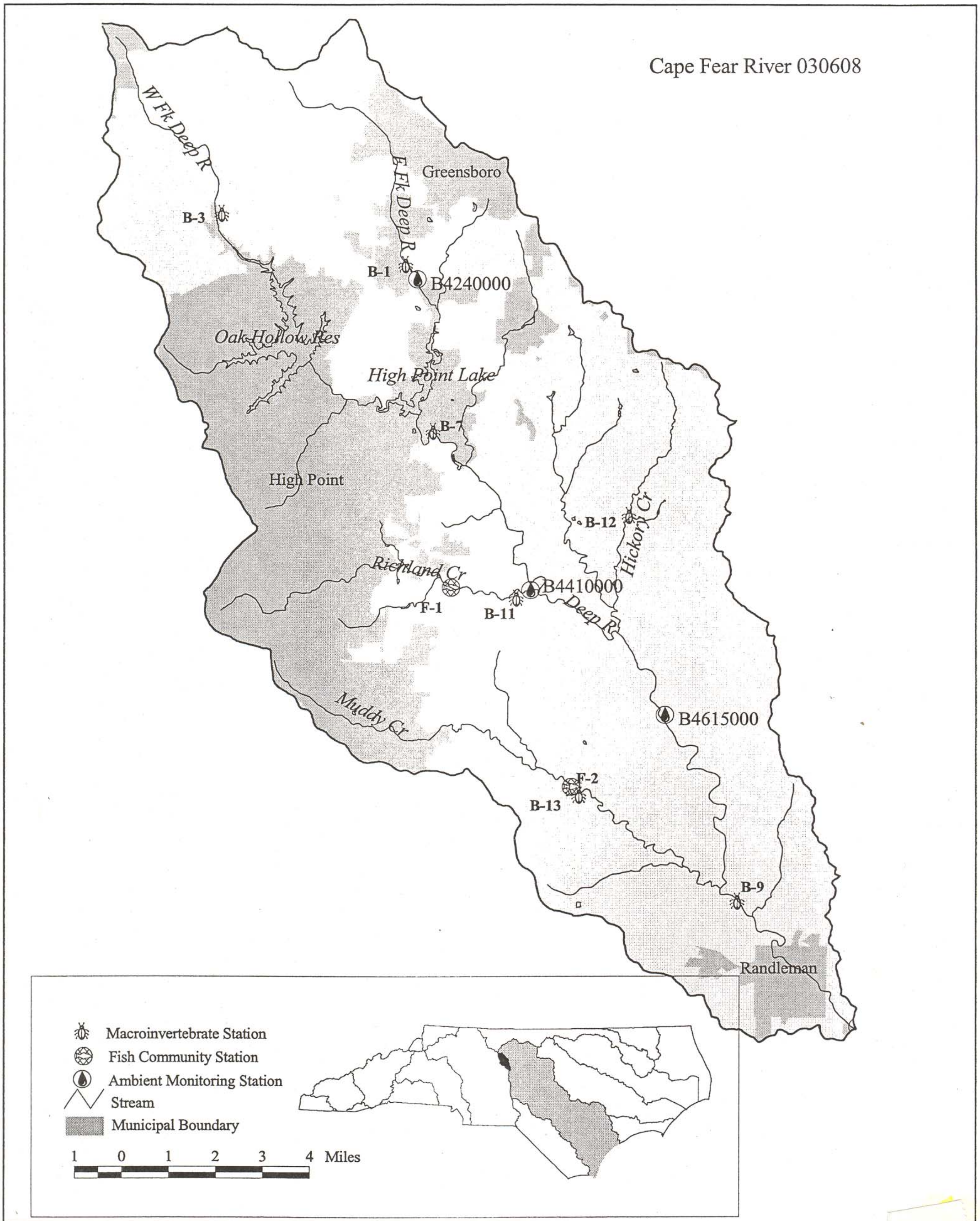


Figure B-8 Sampling Locations within Subbasin 03-06-08

Table B-8 Biological Assessment Sites in Cape Fear River Subbasin 03-06-08

| *BENTHOS* | | | | *Bioclassification* | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | East Fork Deep River | Guilford | SR 1541 | Fair | Fair |
| B-3 | West Fork Deep River | Guilford | SR 1850 | Good-Fair | Good-Fair |
| B-9 | Deep River | Randolph | US 220 Bus | Good-Fair | Good-Fair |
| B-11 | Richland Creek | Guilford | SR 1145 | Fair | Poor |
| B-12 | Hickory Creek | Guilford | SR 1131 | Fair | Not Rated |
| B-13 | Muddy Creek | Randolph | SR 1929 | Good-Fair | Not Rated |

| *FISH* | | | | *Bioclassification* | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Richland Creek | Guilford | SR 1154 | no sample | Poor |
| F-2 | Muddy Creek | Randolph | SR 1929 | Fair | Poor |

| *FISH TISSUE* | | | | *No. Samples Exceeding Criteria* | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Muddy Creek nr Glenola | 1994 | 4 | 0 | 0 | No samples exceeded criteria |
| FT-2 | Oak Hollow Lake | 1998 | 18 | 2 | 0 | EPA mercury limit exceeded in 2 bass samples |

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 8.2 Impaired Waters

Portions of Richland Creek, Deep River and Hickory Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Richland Creek, Deep River and East Fork Deep River are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 8.3 and waters with other issues, recommendations or projects are discussed in Part 8.4.

### Richland Creek

*1996 Recommendations*

Richland Creek (9.1 miles at SR 1145 near High Point) was partially supporting (PS) in the 1996 plan. The stream receives a discharge from the High Point Eastside WWTP (16 MGD) which has reported occurrences of dissolved oxygen (DO) below the daily average standard of 5.0 mg/l. This discharge has also been associated with water quality problems in downstream impoundments on the Deep River. It was recommended that High Point Eastside WWTP be issued limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 2 mg/l.

*Current Status*

High Point Eastside WWTP has passed recent toxicity tests, and DO levels below the standard have not been detected at the ambient station below the facility. Richland Creek (9.0 miles from source to Deep River) is currently not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with High Point urban nonpoint sources and High Point Eastside WWTP is a possible source of impairment. Richland Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

High Point Eastside WWTP is undergoing an upgrade. High Point will be required to develop ordinances or modify existing water supply ordinances to protect riparian areas and implement stormwater management plans. The upgrades to the WWTP should reduce the potential for algal blooms that have been observed in downstream impoundments on the Deep River. See Section A, Chapter 4, Part 4.5 for more details regarding Randleman Reservoir. Local efforts to identify and eliminate the effects of nonpoint source pollution and stormwater surges in this watershed would help to reduce the potential for impairment to the biological community. The 303(d) list approach for Richland Creek will be to resample for biological and chemical data to attempt to determine potential problem parameters. A TMDL will be developed to address high levels of fecal coliform bacteria.

The Piedmont Triad Water Authority has secured CWMTF grant money to protect 100 acres of riparian buffers along Richland and Muddy Creeks for the protection of water quality in the proposed Randleman Reservoir. For more information on this project, refer to Section C, Chapter 1, Part 1.5.2.

**Deep River**

*1996 Recommendations*

The Deep River (15.8 miles downstream of Richland Creek) was partially supporting (PS) in the 1996 plan. Because of water quality problems downstream of High Point in the Deep River, it was recommended that advanced tertiary limits be issued to new and expanding major discharges. For smaller (<1 MGD) new and expanding discharges, regionalization of wastewater treatment was encouraged. If connection to a regional WWTP was not possible, an alternatives analysis was to be completed to determine if alternatives other than surface discharge were feasible. If surface discharge was the most feasible option, then permit limits no less stringent than $BOD_5$ = 15 mg/l and $NH_3$-N = 4 mg/l were to be applied.

*Current Status*

No new or expanding discharges have been permitted in this segment of the Deep River. (Refer to discussion on the Randleman Reservoir in Section A, Chapter 4, Part 4.5.) The lower 2.3 miles of the Deep River in this subbasin are no longer impaired according to recent DWQ monitoring. Portions of the Deep River (11 miles from High Point dam to SR 1921 in Randolph County) are currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Pollution associated with urban nonpoint sources in Greensboro and High Point are possible causes of impairment. Fecal coliform bacteria are a noted problem parameter for 6.8 miles of the Deep River from SR 1113 to SR 1921. The Deep River is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The City of Greensboro has a stormwater program as part of Phase I of the NPDES stormwater program. The Deep River is downstream of developed areas in Greensboro and should benefit from the city stormwater program (see Section A, Chapter 4, Part 4.7.1). DWQ will work with the stormwater program, where possible, to improve water quality in these creeks. Refer to Section A, Chapter 4, Part 4.5 for information on ordinances related to stormwater and the proposed Randleman Reservoir.

The 303(d) list approach for the upper portions of the Deep River will be to resample for biological and chemical data to attempt to determine potential problem parameters. A TMDL will be developed to address high levels of fecal coliform bacteria in the Deep River from SR 1113 to SR 1921.

**Hickory Creek**

*Current Status*

Hickory Creek (4.5 miles from source to Deep River) was partially supporting (PS) according to DWQ monitoring data from 1993 because of an impaired biological community. Instream habitat degradation associated with agricultural nonpoint sources is a possible cause of impairment. Hickory Creek is currently not rated (NR) according to recent DWQ monitoring because of low flow conditions. The lower portion of Hickory Creek will be inundated by the Randleman dam project (See Section A, Chapter 4, Part 4.5 for more details regarding Randleman Reservoir). Hickory Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**East Fork Deep River**

*Current Status*

The East Fork Deep River (7.1 miles from source to High Point Lake) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community and violations of the state turbidity standard. Instream habitat degradation associated with urban nonpoint sources is a possible cause of biological impairment. Fecal coliform bacteria are also noted as a problem parameter. High turbidity may be from road construction activities in the watershed. The East Fork Deep River is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The City of Greensboro has a stormwater program as part of Phase I of the NPDES stormwater program. East Fork Deep River is downstream of developed areas in Greensboro and should benefit from the city stormwater program (see Section A, Chapter 4, Part 4.7.1). DWQ will work with the stormwater program, where possible, to improve water quality in these creeks. Refer to Section A, Chapter 4, Part 4.5 for information on ordinances related to stormwater and the proposed Randleman Reservoir.

The 303(d) list approach for the upper portions of the East Fork Deep River will be to resample for biological and chemical data to attempt to determine potential problem parameters. A management strategy will be developed to address high turbidity in East Fork Deep River. A TMDL will be developed to address high levels of fecal coliform bacteria.

## 8.3 303(d) Listed Waters

There are 4 stream segments (31.6 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Segments of Richland Creek, Deep River, Hickory Creek and East Fork Deep River are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 8.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Approximately 50% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

Segments of the Deep River and its headwater tributaries, downstream of impaired segments, may be affected by urban runoff that has the potential to degrade water quality and instream habitat. These waters receive runoff from the cities of High Point and Greensboro. Water quality in the Deep River could be improved by reducing urban runoff.

High Point Lake (also known as City Lake) is used for a water supply and recreation. Urban/residential areas and pasture/row crop farms dominate the watershed. The two arms of the lake are fed by the East Fork Deep River and the West Fork Deep River. There have been frequent public complaints of taste and odor problems from processed drinking water taken from this lake related to algal blooms. To reduce this problem, the water treatment plant currently treats the raw water to reduce algae-related taste and odor problems. Typical diurnal effects (dissolved oxygen and pH) related to algal activity are observed in High Point Lake and a winter bloom was observed. This winter bloom was investigated and was believed to have been caused by the use of fertilizer in the watershed as a deicer during a winter ice storm. Water clarity has decreased since 1984 and is associated with two current highway construction activities (one for I-40 and the other the Hwy 73/74 Bypass) and algal blooms. There have been no reports of stressed or dead fish in the lake and no problems with nuisance levels of aquatic macrophytes.

Oak Hollow Lake (also known as High Point Reservoir) is used for boating, fishing and swimming. The watershed is characterized by urban, residential and some agricultural land uses. Two 18-hole golf courses adjoin the lake. Conditions in Oak Hollow Lake are similar to those in High Point Lake. There have been frequent public complaints of taste and odor problems from processed drinking water taken from this lake related to algal blooms. To reduce this problem, the water treatment plant currently treats the raw water to reduce algae-related taste and odor problems, and a destratification system (forced air) is in place in the mainstem of the lake to help improve the dissolved oxygen levels in the lake. Water clarity has decreased since 1984 and is associated with increasing urban development and highway construction (the Hwy 73/74 Bypass under construction will cross over Oak Hollow Lake) and algal blooms.

### Upper Cape Fear River Basin Association

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Muddy Creek**

The lower portion of Muddy Creek will be inundated by the Randleman Reservoir. Refer to Section A, Chapter 4, Part 4.5 for information on ordinances related to stormwater and the proposed Randleman Reservoir.

Although Muddy Creek was not rated (NR) during recent sampling, there have been indications of high fecal coliform bacteria and some noted problems with aquatic habitats.

# Chapter 9 -
## Cape Fear River Subbasin 03-06-09
### Includes the Deep River, Polecat Creek and Sandy Creek

## 9.1 Water Quality Overview

***Subbasin 03-06-09 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 446 |
| Land area: | 445 |
| Water area: | 1 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 55,755 people |
| Pop. Density: | 125 persons/ $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 68.7 |
| Surface Water: | 0.6 |
| Urban: | 1.1 |
| Cultivated Crop: | 2.8 |
| Pasture/ Managed Herbaceous: | 26.9 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 266.2 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 7.2 mi. |
| Not Rated: | 37.1 mi. |

*Lakes*:

Sandy Creek Reservoir - Fully Supporting

This subbasin contains approximately 25 miles of the Deep River from Randleman to the Randolph/Moore County line. A map of the subbasin, including water quality sampling locations, is presented in Figure B-9.

Biological ratings for these sample locations are presented in Table B-9. The current sampling resulted in impaired ratings for one stream in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Much of the land use within this subbasin is forest, although pasture, cultivated crops, and urban and built-up land uses also account for significant portions of the subbasin. Randolph County has large numbers of registered livestock and animal operations, particularly cattle and poultry operations.

There are 14 permitted discharge facilities in the subbasin. Asheboro WWTP is the largest; the remaining discharges have permitted flows less than 1 MGD.

Water quality data from the Deep River ambient monitoring stations generally suggest water quality problems. For example, median conductivity concentrations are in excess of 200 µmhos/cm at each location in this subbasin. Higher median nutrient concentrations and fecal coliform levels are typically found at the Worthville location. These values decline progressively downstream, suggesting recovery at downstream locations.

Benthic macroinvertebrate data from the Deep River near Ramseur show long-term improvements in water quality (since 1985 and 1986 surveys), although no 5-year change in bioclassification was seen during basinwide surveys between 1993 and 1998. Four other Deep River locations were sampled in this subbasin as part of intensive investigations of this river. The results of these investigations have generally indicated long-term improvements in water quality. Benthic macroinvertebrate data from the most downstream location in Moore County

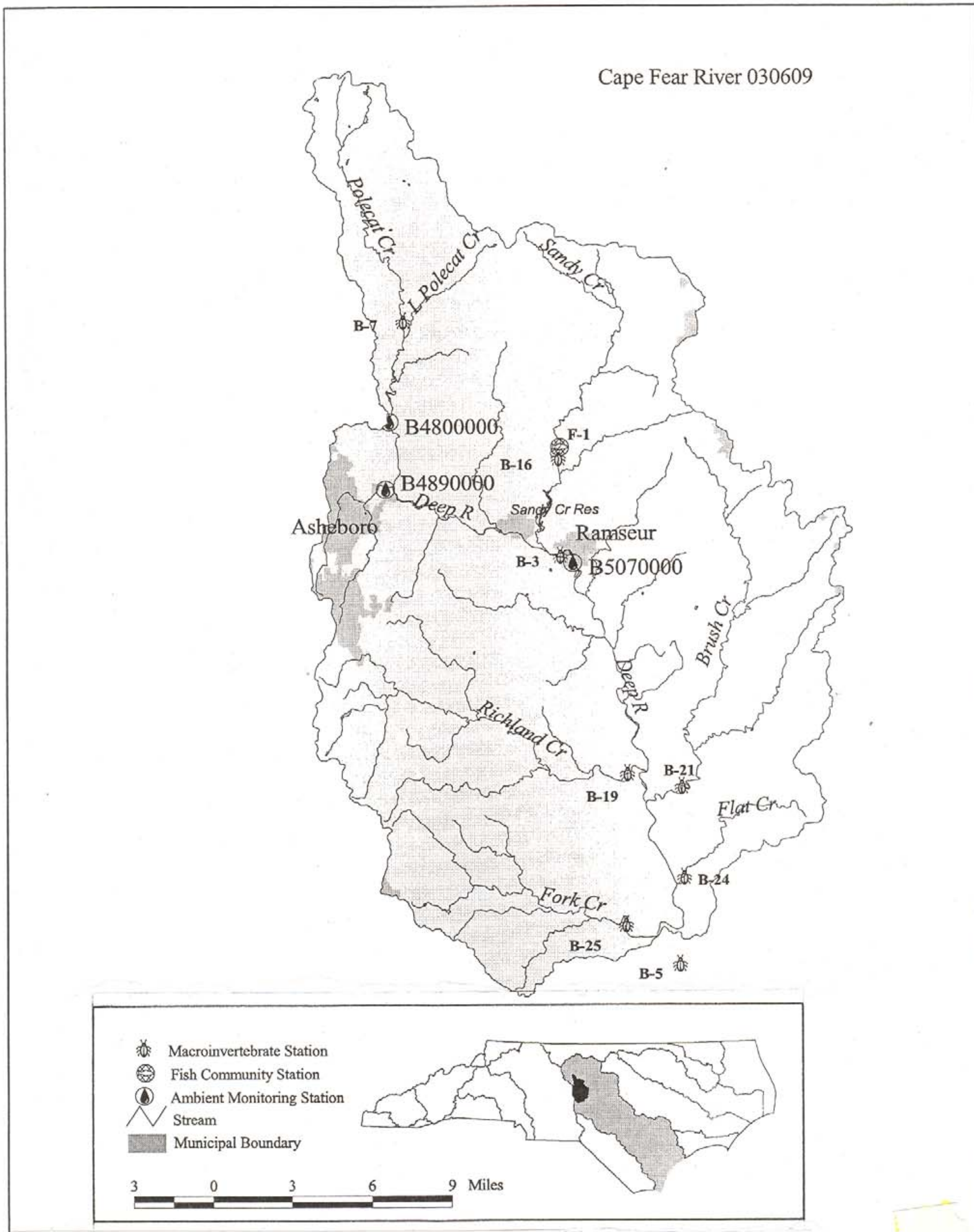


Figure B-9 Sampling Locations within Subbasin 03-06-09

Table B-9 Biological Assessment Sites in Cape Fear River Subbasin 03-06-09

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | Deep River | Randolph | SR 2615 | Good-Fair (s) | Good-Fair (s) |
| B-5 | Deep River | Moore | SR 1461 | Excellent (s) | Excellent (s) |
| B-7 | Polecat Creek | Randolph | SR 2113 | Good (w) | Good (w) |
| B-10 | L. Polecat Creek | Randolph | SR 2108 | Not Rated | Not Rated |
| B-16 | Sandy Creek | Randolph | SR 2481 | Good (w & s) | Excellent (s) |
| B-19 | Richland Creek | Randolph | SR 2873 | Good (s) | Excellent (s) |
| B-21 | Brush Creek | Randolph | NC 22 | Good (w) | Good (s) |
| B-24 | Flat Creek | Randolph | SR 2886 | Fair (w) | Good-Fair (w) |
| B-25 | Fork Creek | Randolph | SR 2873 | Good (w) | Good (w) |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Sandy Creek | Randolph | SR 2481 | Good-Fair | Good-Fair |

| ***FISH TISSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Deep River at Franklinville | 1998 | 15 | 0 | 0 | EPA mercury limit exceeded in 1 bass sample |

have consistently indicated an Excellent bioclassification, suggesting that the Deep River at this point has recovered from upstream impacts.

Benthic macroinvertebrate data from tributary streams in this subbasin found improvements at 3 of the 6 sites sampled during 1998. Two of these locations improved from Good to Excellent (Sandy and Richland Creeks).

Fish tissue samples were collected from the Deep River at Franklinville in 1998 above the WWTP. Franklinville is located above the Ramseur ambient monitoring location. Fifteen specimens were analyzed for metal contamination and, in addition, two largemouth bass were analyzed for chlorinated pesticides and PCBs. These data found that no FDA or EPA criteria were exceeded.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 9.2 Impaired Waters

Portions of Flat Creek, Hasketts Creek and an unnamed tributary to Polecat Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Hasketts Creek are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 9.3 and waters with other issues, recommendations or projects are discussed in Part 9.4.

**Flat Creek**

*Current Status*

Flat Creek (9.5 miles) was partially supporting (PS) in the 1996 plan. Flat Creek (9.5 miles) is currently fully supporting (FS) according to recent DWQ monitoring. However, this stream is in a watershed with primarily agricultural land uses and may be subject to further degradation. The land in this watershed is subject to erosion that can cause instream habitat degradation. Implementation of agricultural BMPs is encouraged to reduce potential impacts. This stream is no longer on the 303(d) list.

**Hasketts Creek**

*Current Status*

Hasketts Creek (7.2 miles source to Deep River) was partially supporting (PS) in the 1996 plan. This stream is currently not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Runoff associated with the Town of Asheboro is a possible cause of impairment. Hasketts Creek is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The Town of Asheboro will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003 (see Section A, Chapter 4, Part 4.7.1). The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**UT to Polecat Creek** (Unnamed tributary at Cone Mills Club)

UT to Polecat Creek (1.4 miles) was not supporting (NS) in the 1996 plan. The stream had very low flow during recent monitoring and could not be sampled. New biological information has determined that the previous rating was inappropriate because of the small size of the stream. This stream is no longer on the 303(d) list.

## 9.3 303(d) listed Waters

Hasketts Creek (7.2 stream miles) is on the state's year 2000 303(d) list (not yet EPA approved) and is discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 9.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Approximately 3% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

The Deep River in this subbasin is downstream of impaired segments and may be affected by urban runoff that has the potential to degrade water quality and instream habitat. Fecal coliform bacteria, turbidity and nutrients are also noted as potential problem parameters. Addressing problems upstream would benefit water quality in this segment of the Deep River.

Sandy Creek Reservoir is the water supply for the Town of Ramseur. The watershed is moderately developed, and land use is mostly characterized by forested and agricultural areas as well as urban development. There is frequently a problem with taste and odor associated with water drawn from Sandy Creek Reservoir. Algae and manganese are believed to be the source of these problems.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**General Recommendations for the Deep River Point Source Discharges**

*1996 Recommendations*

This segment of the Deep River was not identified as impaired in the 1996 plan. Because of low dissolved oxygen (DO) behind dams downstream of High Point in the Deep River, the following limits were recommended for facilities between High Point Lake and the Carbonton dam:

New and expanding discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2mg/l, TP = 1mg/l
New and expanding discharges <1 MGD: $BOD_5$ = 15 mg/l, $NH_3$-N = 4 mg/l
New and expanding discharges <1 MGD and ≥ 0.5 MGD: TP = 2mg/l

For smaller (<1 MGD) new and expanding discharges, regionalization of wastewater treatment was encouraged. If connection to a regional WWTP was not possible, an alternatives analysis was to be completed to determine if alternatives other than surface discharge were feasible.

*Current Status*

The Asheboro WWTP has expanded capacity (6 MGD to 9 MGD) and is currently in compliance. There are ongoing efforts to regionalize wastewater treatment in this subbasin. There are four small dams on the Deep River in this subbasin. The dams slow flow in the river and increase the potential for algal blooms to occur.

*2000 Recommendations*

Efforts to regionalize wastewater treatment in this subbasin should continue. Water quality behind the dams will continue to be monitored to assess impacts from upstream point and nonpoint sources. Increases in discharges of nutrients from point sources and increases in nutrients associated with development and agriculture should be carefully considered in light of past algal blooms in impoundments on the Deep River. Limits from the 1996 plan will continue to be recommended with the exception that new and expanding discharges ≥1 MGD will be given limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 1mg/l. This is now considered BAT in North Carolina for this discharge category. Recommended limits for other facilities are as follows:

New and expanding discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1mg/l, TP =1mg/l
New and expanding discharges <1 MGD: $BOD_5$ = 15 mg/l, $NH_3$-N = 4 mg/l
New and expanding discharges <1 MGD and ≥0.5 MGD: TP = 2mg/l

**Sandy Creek**

Ramseur is purchasing conservation easements on riparian corridors of Sandy Creek Reservoir to protect water quality. The town also received grant money to rehabilitate an existing sewer line. Refer to Section C, Chapter 1, Part 1.5.2 for more information on these projects.

# Chapter 10 -
## Cape Fear River Subbasin 03-06-10
### Includes the Deep River, Bear Creek and McLendons Creek

## 10.1 Water Quality Overview

***Subbasin 03-06-10 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 448 |
| Land area: | 446 |
| Water area: | 2 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 21,107 people |
| Pop. Density: | 47 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 80.0 |
| Surface Water: | 0.9 |
| Urban: | 0.4 |
| Cultivated Crop: | 0.9 |
| Pasture / Managed Herbaceous: | 17.9 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 205.6 mi. |
| Partially Supporting: | 6.2 mi. |
| Not Supporting: | 2.2 mi. |
| Not Rated: | 133.1 mi. |

*Lakes*:

Carthage City Lake - Fully Supporting

This subbasin includes the middle section of the Deep River in Moore County. The Deep River here is classified as High Quality Waters (HQW) from Grassy Creek to NC 42, where Moore, Chatham and Lee counties meet near Carbonton. Cedar Creek, Scotchman Creek and Lick Creek are also HQWs. The towns of Robbins and Carthage are in this subbasin. Most of the land is forested, but there is some agriculture. A map of the subbasin, including water quality sampling locations, is presented in Figure B-10.

Biological ratings for these sample locations are presented in Table B-10. The current sampling resulted in impaired ratings for one stream in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Good bioclassifications were found using benthos data at Cabin Creek, Mill Creek, Wet Creek, Bear Creek and Buffalo Creek in 1998. Compared to 1993 data, this indicated a slight decline in water quality for Mill Creek, an improvement for Bear Creek and Buffalo Creek and no change for Cabin Creek and Mill Creek. Very low flows occurred here during the summer of 1998, with McLendons Creek, Richland Creek and Big Governors Creek reduced to pools of water between dry streambed. These streams have low flows due to underlying geologic formations (Triassic Basin) and could not be rated. The federally endangered Cape Fear shiner was collected in Falls Creek along with 25 other species of fish, the most for any Cape Fear basin fish samples.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

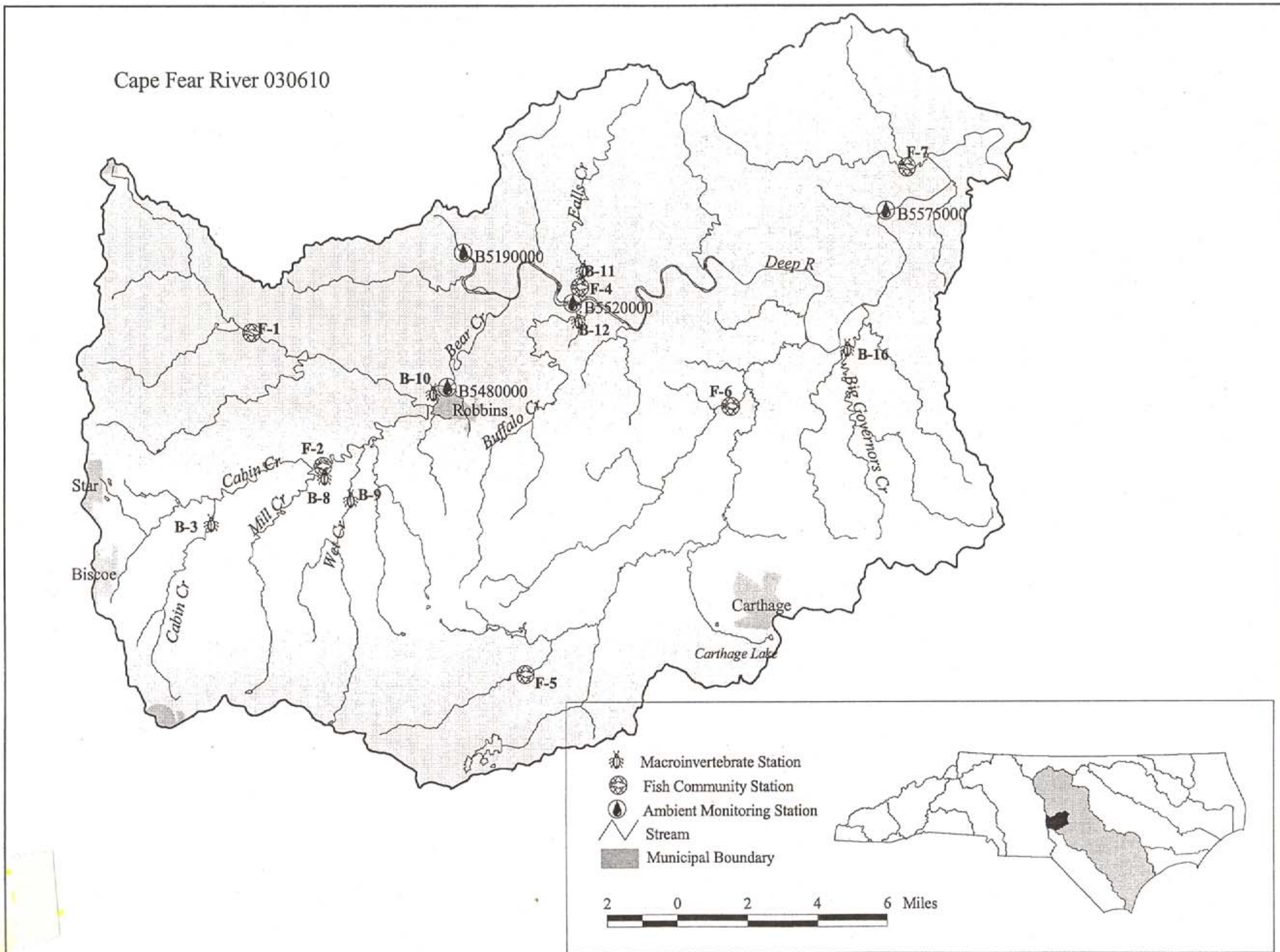


Figure B-10 Sampling Locations within Subbasin 03-06-10

Table B-10 Biological Assessment Sites in Cape Fear River Subbasin 03-06-10

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | Cabin Creek | Moore | SR 1400 | Good | Good |
| B-8 | Mill Creek | Moore | nr SR 1275 | Excellent/Good | Good/G-F |
| B-9 | Wet Creek | Moore | NC 24 | Good | Good |
| B-10 | Bear Creek | Moore | NC 705 | Good-Fair | Good |
| B-11 | Falls Creek | Moore | SR 1606 | Fair | Not Rated |
| B-12 | Buffalo Creek | Moore | NC 22 | Good-Fair | Good |
| B-16 | Big Governors Creek | Moore | SR 1625 | Poor | Not Rated |
| | | | | | |
| ***FISH*** | | | | ***Bioclassification*** | |
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-2 | Cabin Creek | Moore | SR 1275 | no sample | Good |
| F-4 | Falls Creek | Moore | SR 1606 | no sample | Good |
| F-5 | McLendons Creek | Moore | SR 1210 | no sample | Fair |
| F-6 | Richland Creek | Moore | SR 1640 | Poor | Poor |
| F-7 | Indian Creek | Chatham | SR 2306 | no sample | Good-Fair |

## 10.2 Impaired Waters

Portions of Cotton Creek, Falls Creek, McLendons Creek, Richland Creek, Indian Creek and Big Governors Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Cotton Creek are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 10.3 and waters with other issues, recommendations or projects are discussed in Part 10.4.

### Cotton Creek

*1996 Recommendations*

Cotton Creek (6.6 miles from source to Cabin Creek) was partially supporting (PS) in the 1996 plan. The creek is a very low flow (zero 7Q10 and 30Q2) stream that receives a 90% industrial wastewater flow from the Star WWTP. It was recommended that the facility meet advanced tertiary treatment limits.

*Current Status*

The 0.5 miles above the Star WWTP had no discernible flow in 1998 and could not be rated. Star WWTP has been meeting permitted limits except for toxicity. The Town of Star has signed a special order of consent (SOC) to meet toxicity limits by January 2001. From the Star WWTP to Lick Creek (2.2 stream miles), Cotton Creek is currently not supporting (NS) according to recent DWQ monitoring. The remaining 3.9 miles of Cotton Creek are currently partially supporting (PS). The stream has a biologically impaired benthic community. The Star WWTP discharge comprises 100% of the flow in this segment of Cotton Creek much of the year and is believed to be the cause of impairment. Agricultural and urban nonpoint source pollution may also be sources of impairment to Cotton Creek. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Cotton Creek is a zero flow stream. It is necessary for Star WWTP to maintain the highest quality effluent possible to reduce impacts to downstream segments of Cabin Creek and minimize adverse effects in Cotton Creek. DWQ will continue to monitor the toxicity of discharge from this facility. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Falls Creek**

*Current Status*

Falls Creek (11.6 miles from source to Deep River) was partially supporting (PS) in the 1996 plan. The stream is in a forested watershed with good instream habitat. The Fair benthos community may be indicative of very low summer flows. More fish species were collected at the site on Falls Creek than at any other site in the basin. The stream is currently not rated (NR) and not on the 303(d) list.

**McLendons Creek**

*Current Status*

McLendons Creek (20.1 miles) was partially supporting (PS) in the 1996 plan. This stream is in a watershed with a large amount of agricultural land uses that have the potential to degrade instream habitat. Streambank erosion has also been noted in this stream. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

There is currently a study on McLendons Creek to evaluate water quality benefits of agricultural BMPs. Refer to Section C, Chapter 1, Part 1.5.2 for more information on this project.

**Richland Creek**

*Current Status*

Richland Creek (12.8 miles) was partially supporting (PS) in the 1996 plan. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

**Indian Creek**

*Current Status*

Indian Creek (8.2 miles) was not supporting (NS) in the 1996 plan. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

**Big Governors Creek**

*Current Status*

Big Governors Creek (9.5 miles) was not supporting (NS) in the 1996 plan. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

**Cabin Creek**

*Current Status*

A portion of Cabin Creek (2.3 miles) was not sampled during recent DWQ monitoring, but is impaired based on data collected in 1995. This stream is impacted by low quality effluent from Star WWTP.

*2000 Recommendations*

For recommendations, see Cotton Creek in above. The 303(d) list approach for this stream will be to resample to obtain updated use support information.

## 10.3 303(d) Listed Waters

There are two streams (8.9 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Portions of Cotton Creek and Cabin Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 10.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement

of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Bear Creek is in an agricultural area, and streams in this watershed are subject to erosion and habitat degradation. Implementation of agricultural BMPs would reduce potential adverse impacts to these streams.

Approximately 2% of the waters in this subbasin are impaired by nonpoint source pollution. All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Deep River Dams**

Impounded segments of the Deep River (near Carbonton) are slower flowing and can be periodically affected by low dissolved oxygen (DO) associated with algal blooms. Nutrients from upstream sources can potentially cause algal blooms. Regionalization of small discharges, advanced treatment by larger upstream facilities, and addressing nonpoint sources of nutrients will reduce potential for algal blooms in these impoundments.

Removal of impoundments and restoration of natural flow on the Deep River would also reduce the potential for algal blooms. Further monitoring of this segment is recommended to assess the severity of low dissolved oxygen (DO) and identify sources of nutrients that increase the potential for an algal bloom in slow moving segments behind dams.

**General Recommendations for the Deep River Point Source Discharges**

*1996 Recommendations*

This segment of the Deep River was not identified as impaired in the 1996 plan. Because of low dissolved oxygen (DO) behind dams downstream of High Point in the Deep River, the following limits were recommended for facilities between High Point Lake and the Carbonton dam:

New and expanding discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2mg/l, TP = 1mg/l
New and expanding discharges <1 MGD: $BOD_5$ = 15 mg/l, $NH_3$-N = 4 mg/l
New and expanding discharges <1 MGD and ≥0.5 MGD: TP = 2mg/l

For smaller (<1 MGD) new and expanding discharges, regionalization of wastewater treatment was encouraged. If connection to a regional WWTP was not possible, an alternatives analysis was to be completed to determine if alternatives other than surface discharge were feasible.

*Current Status*

The Town of Robbins has recently completed an upgrade to the WWTP. DWQ will continue to monitor this segment of the Deep River.

*2000 Recommendations*

Efforts to regionalize wastewater treatment in this subbasin should continue. Water quality behind the dams will continue to be monitored to assess impacts from upstream point and nonpoint sources. Increases in discharges of nutrients from point sources and increases in nutrients associated with development and agriculture should be carefully considered in light of past algal blooms in impoundments on the Deep River. Limits from the 1996 plan will continue to be recommended with the exception that new and expanding discharges ≥1 MGD will be given limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 1mg/l. This is now considered BAT in North Carolina for this discharger category. Recommended limits for other facilities are as follows:

New and expanding discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1mg/l, TP =1mg/l
New and expanding discharges <1 MGD: $BOD_5$ = 15 mg/l, $NH_3$-N = 4 mg/l
New and expanding discharges <1 MGD and ≥0.5 MGD: TP = 2mg/l

# Chapter 11 -
## Cape Fear River Subbasin 03-06-11
### Includes the Deep River, Big Buffalo Creek and Cedar Creek

## 11.1 Water Quality Overview

***Subbasin 03-06-11 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 133 |
| Land area: | 132 |
| Water area: | 1 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 22,221 people |
| Pop. Density: | 111 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 83.8 |
| Surface Water: | 1.2 |
| Urban: | 3.2 |
| Cultivated Crop: | 2.2 |
| Pasture/ Managed Herbaceous: | 9.5 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 74.0 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 55.4 mi. |

This subbasin contains the lowermost reach of the Deep River prior to its confluence with the Haw River. The sedimentary geology and poor groundwater recharge capacity of these streams result in 7Q10 values of zero for all but the largest watersheds. A map of the subbasin, including water quality sampling locations, is presented in Figure B-11.

Biological ratings for these sample locations are presented in Table B-11. The current sampling resulted in impaired ratings for two streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Much of the land use within this subbasin is forest, although pasture, cultivated crops, and urban and built-up land uses also account for significant portions of the subbasin. Chatham County has high numbers of certified animal operations, primarily cattle and poultry.

There are 7 permitted discharge facilities in this subbasin, and only two facilities have permitted flow greater than 1 MGD: Sanford WWTP and Golden Poultry.

Two Deep River locations have been sampled for benthic macroinvertebrates in this subbasin. Declines in water quality were found at both locations (Good in 1993 to Good-Fair in 1998) suggesting impacts other than the Sanford WWTP. This 5-year decline in water quality was not evident at the next most upstream Deep River location in Moore County.

Tributary streams within this subbasin have physical characteristics that are typical for the geology of the Triassic Basin. These characteristics, which include zero 7Q10 values and poor instream habitat, produce streams that are difficult to rate using current DWQ classification criteria for benthic macroinvertebrates.

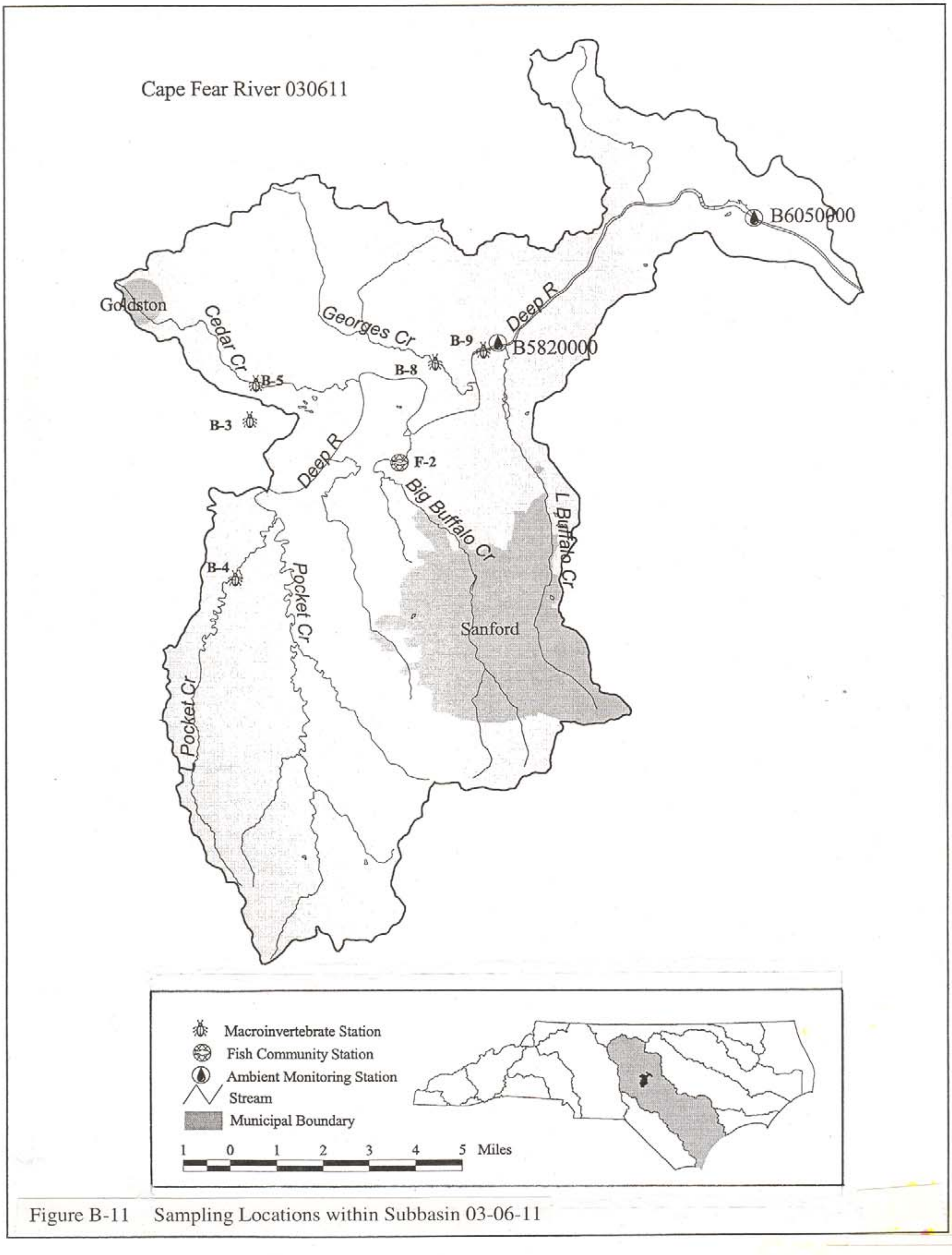


Figure B-11 Sampling Locations within Subbasin 03-06-11

Table B-11 Biological Assessment Sites in Cape Fear River Subbasin 03-06-11

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | Deep River | Lee | SR 1007 | Good (s) | Good-Fair (s) |
| B-4 | Little Pocket Creek | Lee | NC 42 | Not Rated (w) | Not Rated (w) |
| B-5 | Cedar Creek | Chatham | SR 2142 | Not Rated (w) | Not Rated (w) |
| B-8 | Georges Creek | Chatham | SR 2150 | Not sampled | Not Rated (w) |
| B-9 | Deep River | Lee | US 15/501 | Good (s) | Good-Fair (s) |
| ***FISH*** | | | | ***Bioclassification*** | |
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Cedar Creek | Chatham | SR 2145 | Fair | no sample |
| F-2 | Big Buffalo Creek | Lee | SR 1403 | Fair | Poor |

(w) Winter collection, (s) Summer collection

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 11.2 Impaired Waters

Portions of Little Pocket, Cedar, Georges and Little Buffalo Creeks were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. There are no streams currently rated as impaired according to recent DWQ monitoring. Waters with other issues, recommendations or projects are discussed in Part 11.4.

### Little Pocket Creek

*Current Status*

Little Pocket Creek (12.4 miles) was partially supporting (PS) in the 1996 plan. This stream is currently not rated (NR). New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

**Cedar Creek**

*Current Status*

Cedar Creek (7.9 miles) was partially supporting (PS) in the 1996 plan. Instream habitat degradation associated with runoff from a clay pit mine is a potential source of impairment. The clay pit mine has BMPs in place as required in the general permit; however, there are indications that the BMPs are not protecting water quality. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

**Georges Creek**

*Current Status*

Georges Creek (8.7 miles) was partially supporting (PS) in the 1996 plan. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list.

**Little Buffalo Creek**

*Current Status*

Little Buffalo Creek (9.8 miles) was not supporting (NS) in the 1996 plan. New biological information has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR) and no longer on the 303(d) list. Pollutants associated with urban runoff from the City of Sanford are a potential cause of impairment. Sanford will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. Refer to Section C, Chapter 1, Part 1.5.2 for a description of riparian buffers being established on Buffalo Creek.

## 11.3 303(d) Listed Waters

There are no stream segments in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 11.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement

of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Big Buffalo Creek (Sanford)**

New biological information from Big Buffalo Creek has determined that the previous rating was inappropriate because of the small size of the stream and the low summer flow conditions characteristic of Triassic Basin streams. This stream is currently not rated (NR). Pollutants associated with urban runoff from the City of Sanford are a potential cause of impairment. Sanford will be required to address stormwater issues as part of Phase II of the NPDES stormwater program. NPDES stormwater permit applications must be received by DWQ by March 1, 2003. Refer to Section C, Chapter 1, Part 1.5.2 for a description of riparian buffers being established on Buffalo Creek.

**Recommendations for Deep River Point Source Discharges**

*1996 Recommendations*

Because assimilative capacity had been exhausted between Carbonton dam and the Haw River, it was recommended that no new discharges should be permitted, and the expansion request by the Town of Sanford WWTP would be carefully considered in light of the possibility for increased regionalization.

*Current Status*

The Town of Sanford WWTP discharge remains at 5 MGD. There have been no new or expanding discharges in this segment of the Deep River.

*2000 Recommendations*

No new or expanding discharges should be permitted in this segment of the Deep River.

# Chapter 12 -
## Cape Fear River Subbasin 03-06-12
### Includes Rocky River, Bear Creek, Tick Creek and Loves Creek

## 12.1 Water Quality Overview

***Subbasin 03-06-12 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 244 |
| Land area: | 243 |
| Water area: | 1 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 16,015 people |
| Pop. Density: | 66 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 68.9 |
| Surface Water: | 0.6 |
| Urban: | 1.3 |
| Cultivated Crop: | 2.5 |
| Pasture / Managed Herbaceous: | 26.8 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 99.6 mi. |
| Partially Supporting: | 13.4 mi. |
| Not Supporting: | 0.5 mi. |
| Not Rated: | 52.3 mi. |

*Lakes*:

Rocky River Reservoir - Fully Supporting

This subbasin contains the entire Rocky River watershed and is located mainly in Chatham County. Siler City is the largest community in the subbasin. Streams in this region are rocky streams characterized by very low base flows during summer months. Smaller tributaries often dry up completely during prolonged low flow periods. A map of the subbasin, including water quality sampling locations, is presented in Figure B-12.

Biological ratings for these sample locations are presented in Table B-12. The current sampling resulted in impaired ratings for two streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Land use within this subbasin is primarily forest, although pasture, cultivated crops, and urban and built-up land uses also are significant. Chatham County has the largest number of cattle operations of all counties within the Cape Fear River basin and is second only to Duplin County in the number of poultry operations.

There are 4 permitted NPDES dischargers in the subbasin, and only Siler City WWTP has a permitted flow of 1 MGD or greater.

Benthic macroinvertebrate samples have been collected from three mainstem Rocky River locations in this subbasin. Data collected during recent investigations (1998 and 1997) found Good-Fair bioclassifications at the two most upstream locations. An improvement in water quality was found in the Rocky River at US 64 (Fair in 1993 to Good-Fair in 1998). Long-term improvements were found at this site and at the Rocky River at SR 2170. No change in rating (Good bioclassification) was found at the US 15/501 location, which is near the confluence with the Deep River. Several freshwater mussel species, which are proposed for state protection, have been collected from the Rocky River. A fish community sample also was collected from a headwater reach of the Rocky River above the

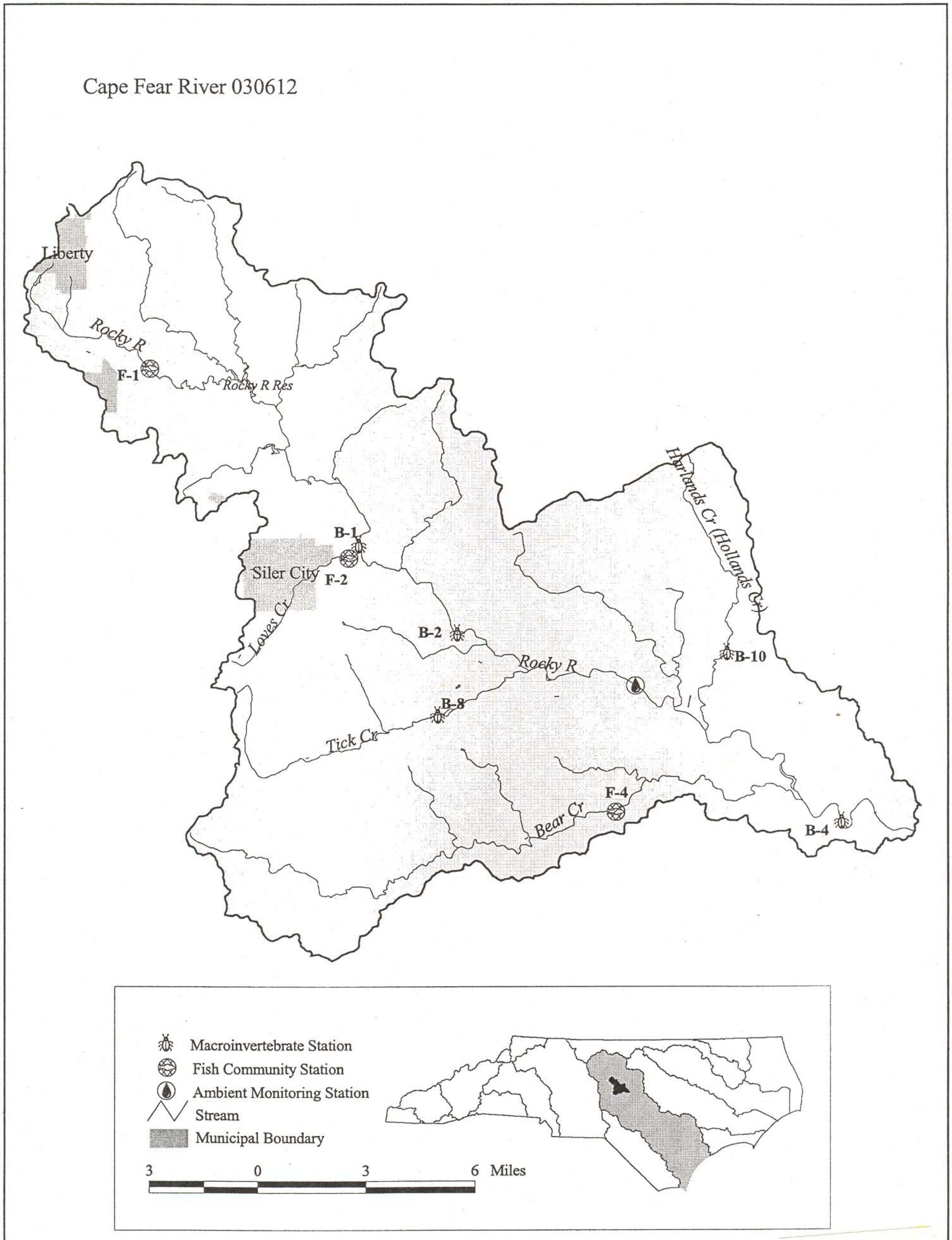


Figure B-12 Sampling Locations within Subbasin 03-06-12

Table B-12 Biological Assessment Sites in Cape Fear River Subbasin 03-06-12

| *BENTHOS* | | | | *Bioclassification* | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | Rocky River | Chatham | US 64 | Fair (s) | Good-Fair (s) |
| B-2 | Rocky River | Chatham | SR 2170 | Good-Fair (s) | Good-Fair (s) |
| B-4 | Rocky River | Chatham | US 15/501 | Good (s) | Good (s) |
| B-8 | Tick Creek | Chatham | SR 2120 | no sample | Good-Fair (s) |
| B-10 | Harlands Creek | Chatham | NC 902 | no sample | Good /Good-Fair |

| *FISH* | | | | *Bioclassification* | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Rocky River | Chatham | SR 1300 | no sample | Fair |
| F-2 | Loves Creek | Chatham | SR 2229 | no sample | Good-Fair |
| F-3 | Tick Creek | Chatham | US 421 | Good-Fair | --- |
| F-4 | Bear Creek | Chatham | SR 2187 | no sample | Good |

| *FISH TISSSUE* | | | | *No. Samples Exceeding Criteria* | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Rocky River at SR 1300 | 1998 | 9 | 0 | 0 | No samples exceeded criteria |

(w) Winter collection, (s) Summer collection

Rocky River Reservoir. A Fair score was given to this location, possibly reflecting the effects of nonpoint source runoff and enrichment.

Benthic macroinvertebrate samples were collected from two tributaries during basinwide surveys in this subbasin. Good-Fair ratings were found at two sites on Tick Creek (a winter survey at US 421 and a summer survey at SR 2120). Although a Poor bioclassification was given to the US 421 site in 1993, a 5-year trend in these data is difficult to determine. Field notes from the 1993 survey indicated that streamflow was reduced, likely affecting benthic macroinvertebrate community structure rather than water quality. An improvement in bioclassification was seen at Harlands Creek since 1990, although the difference between surveys was minimal. In addition to benthic macroinvertebrate data, fish community samples also were collected from two tributary locations in this subbasin.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 12.2 Impaired Waters

Portions of Loves Creek, Rocky River and Bear Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Loves Creek and Rocky River are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 12.3 and waters with other issues, recommendations or projects are discussed in Part 12.4.

**Loves Creek**

*1996 Recommendations*

Loves Creek (6.4 miles from source to Rocky River) was rated partially supporting (PS) above the Siler City WWTP and not supporting (NS) below the WWTP. Continued monitoring of Loves Creek was recommended to assess upgrades to the Siler City WWTP.

*Current Status*

Loves Creek was monitored in 1997, but there were no changes in bioclassifications. Loves Creek (2.8 miles from US 421 to Siler City WWTP) is partially supporting (PS), and the 0.5-mile segment below the Siler City WWTP is not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. The upper segment of Loves Creek is currently not rated (NR). Pollutants associated with Siler City urban nonpoint sources and the WWTP discharge are possible causes of impairment. There are also indications of nutrient enrichment in the lower segment. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Local initiatives are needed to address urban runoff to Loves Creek. DWQ encourages Siler City to develop a stormwater program to reduce impacts to urban streams. Siler City WWTP is currently in compliance with permitted limits (6 mg/l $BOD_5$ and 2 mg/l $NH_3$-N). The 303(d) list approach for the lower portions of Loves Creek will be to resample for biological and chemical data to attempt to determine potential problem parameters. The 303(d) list approach for the upper portion will be to resample the stream to obtain updated use support information.

**Rocky River**

*1996 Recommendations*

Rocky River (4.2 miles from dam at Siler City water supply to US 64) was partially supporting (PS) in the 1996 plan. Follow-up studies were recommended to assess implementation of minimum releases from the Siler City water supply.

*Current Status*

Recent sampling indicated a slight improvement in water quality that may be attributed to increased flow permanence in this segment. (See Section A, Table A-19 for information on minimum flow studies on the Rocky River.) Also, upgrades in treatment and increased flow from the Siler City WWTP (Loves Creek) contributed to improved water quality in downstream segments of the Rocky River. This Rocky River segment is currently fully supporting (FS).

The Rocky River (10.6 miles from source to Rocky River Reservoir) is partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with agricultural nonpoint sources is a possible cause of impairment. The Rocky River has a narrow riparian area, and cattle have access to the stream. There are also indications of nutrient enrichment in this stream. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

DWQ encourages the use of agricultural BMPs (including fencing cattle out of stream) to reduce nutrient delivery and streambank erosion. The 303(d) list approach for this portion of the Rocky River will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Bear Creek**

*Current Status*

Bear Creek (14.9 miles) was partially supporting (PS) in the 1996 plan. This stream is currently not rated (NR). Using new biological information, DWQ has determined that the previous rating was inappropriate because of the small size of the stream. This stream is no longer on the 303(d) list.

## 12.3 303(d) Listed Waters

There are two streams (17 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). The Rocky River and Loves Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 12.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Approximately 1% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

Tick Creek and Harlands Creek are in agricultural areas, and streams in these watersheds are subject to erosion and habit degradation from cattle entering streams. Implementation of agricultural BMPs would reduce potential adverse impacts to these streams.

The Rocky River receives water from agricultural watersheds as well as urban runoff and WWTP discharge water from Loves Creek. Addressing problems on Loves Creek and implementation of urban and agricultural BMPs should reduce the potential for adverse impacts in the Rocky River.

**Upper Cape Fear River Basin Association**

The Upper Cape Fear River Basin Association (UCFRBA) is starting to sample 45 sites in the upper Deep and Haw River watersheds. The data will be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Regionalization Efforts**

It was recommended that the Pittsboro and Siler City WWTPs encourage the many small single family discharges to connect to these facilities in order to reduce the number of discharges to zero flow streams in the subbasin.

The extent of regionalization of wastewater from small discharges is unknown. DWQ continues to encourage efforts to regionalize wastewater treatment, but because of insufficient staffing, more regionalization of wastewater treatment has not been pursued.

# Chapter 13 -
# Cape Fear River Subbasin 03-06-13
## Includes Upper Little River and Barbeque Creek

## 13.1 Water Quality Overview

***Subbasin 03-06-13 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 221 |
| Land area: | 219 |
| Water area: | 2 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 23,913 people |
| Pop. Density: | 109 persons/$mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 65.2 |
| Surface Water: | 2.0 |
| Urban: | 1.3 |
| Cultivated Crop: | 23.4 |
| Pasture/ Managed Herbaceous: | 8.1 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 151.8 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 27.8 mi. |

This subbasin lies within the Sand Hills and contains no urban areas (though Sanford and Lillington are just outside the subbasin), and most of the land is forested or used for agriculture. A map of the subbasin, including water quality sampling locations, is presented in Figure B-13.

Biological ratings for these sample locations are presented in Table B-13. There are no impaired streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Three sites were sampled for benthos on the Upper Little River in the headwaters, the middle section and at the ambient site near its mouth. The headwater and middle sites were barely flowing, while the downstream site had good flow. The benthos ratings indicate a progressive improvement in water quality going downstream in this agricultural watershed: Good-Fair to Good to Excellent. Only the downstream site improved, compared to 1993 when it was Good. Barbeque Creek, a slow-flowing tributary of the Upper Little River, was given a Good-Fair bioclassification in 1998; the same rating it had in 1993.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

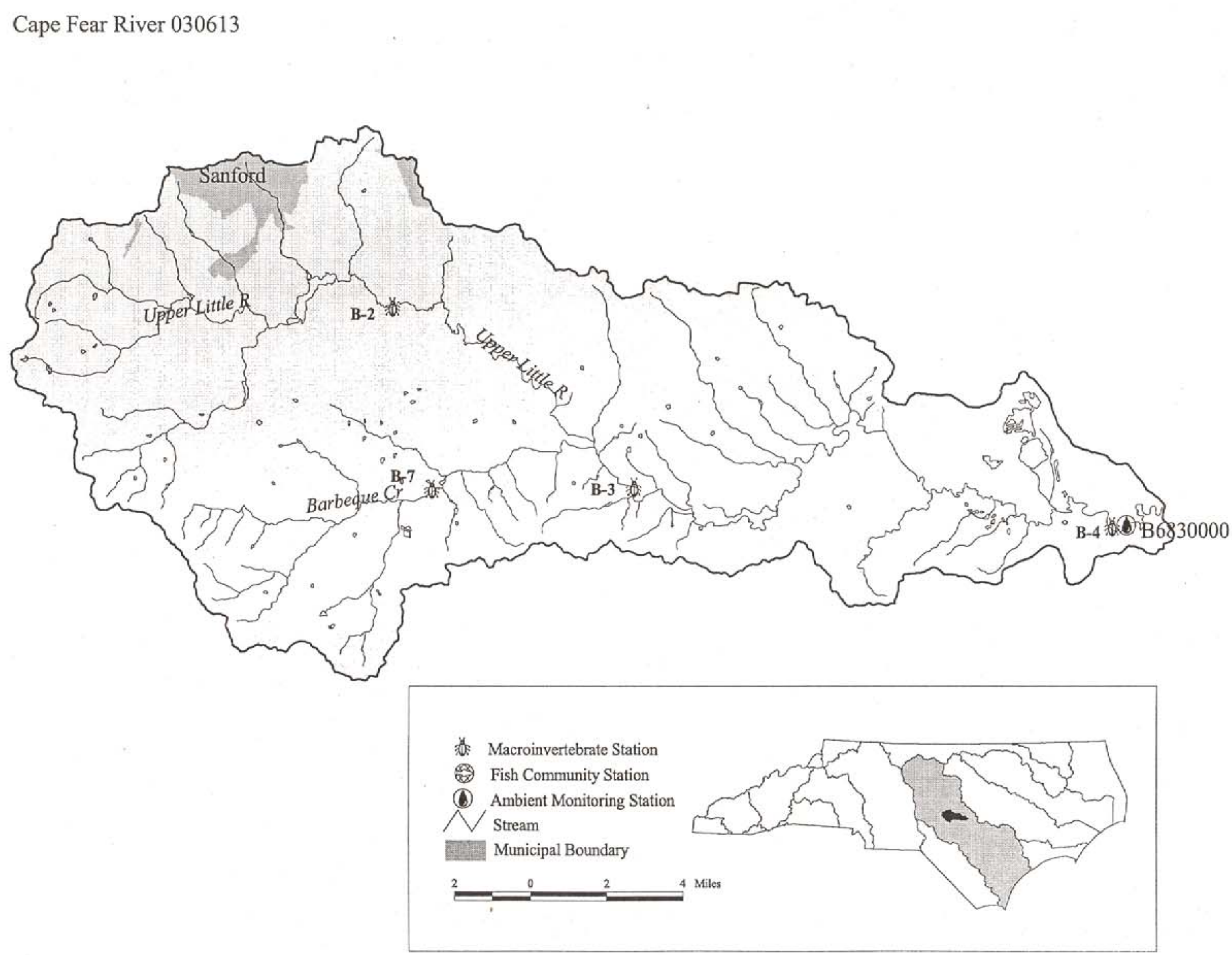


Figure B-13 Sampling Locations within Subbasin 03-06-13

Table B-13 Biological Assessment Sites in Cape Fear River Subbasin 03-06-13

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-2 | Upper Little River | Harnett | SR 1222 | Good-Fair | Good-Fair |
| B-3 | Upper Little River | Harnett | NC 27 | Good | Good |
| B-4 | Barbeque Creek | Harnett | SR 1209 | Good-Fair | Good-Fair |
| B-7 | Upper Little River | Harnett | SR 2021 | Good | Excellent |

## 13.2 Impaired Waters

All streams in this subbasin were fully supporting (FS) in the 1996 Cape Fear River Basinwide Water Quality Plan and are currently fully supporting (FS) based on recent DWQ monitoring. 303(d) listed waters are summarized in Part 13.3 and waters with other issues, recommendations or projects are discussed in Part 13.4.

## 13.3 303(d) Listed Waters

There are no streams in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 13.4 Other Issues, Recommendations and Projects

DWQ encourages the use of voluntary measures to prevent water quality degradation. Enforcement of sediment and erosion control laws will help to reduce impacts on area streams. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

### The Middle Cape Fear River Basin Association (MCFRBA)

The Middle Cape Fear River Basin Association (MCFRBA) started sampling at one station in this subbasin (30 stations total) in July 1998. This data will be used to give a higher resolution picture of water quality conditions in the Upper Little River. The data will also be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

# Chapter 14 -
## Cape Fear River Subbasin 03-06-14
### Includes Lower Little River, Nicks Creek and Juniper Creek

## 14.1 Water Quality Overview

***Subbasin 03-06-14 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 484 |
| Land area: | 478 |
| Water area: | 6 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 67,587 people |
| Pop. Density: | 141 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 78.8 |
| Surface Water: | 2.2 |
| Urban: | 2.4 |
| Cultivated Crop: | 8.2 |
| Pasture/ Managed Herbaceous: | 8.4 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 274.3 mi. |
| Partially Supporting: | 28.3 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 100.2 mi. |

*Lakes*:

Old Town Reservoir - Fully Supporting

This subbasin is located in the Sand Hills and contains the Little River watershed and the towns of Southern Pines, Pinehurst and Aberdeen. A map of the subbasin, including water quality sampling locations, is presented in Figure B-14.

Biological ratings for these sample locations are presented in Table B-14. The current sampling resulted in impaired ratings for one stream in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

The upper portion of this watershed is characterized by mostly rural areas, though Southern Pines is in the watershed of Mill Creek. The lower reaches flow through or near Fort Bragg or the urban areas of Spring Lake and Fayetteville. The Lower Little River was designated High Quality Waters (HQW) from its source to Crane Creek, based on Excellent biological (benthos) data. (Note: This has always been named the Lower Little River in biological reports, but the DWQ Schedule of Classifications refers to it as the (Lower) Little River).

The Lower Little River was sampled for benthos at three sites. The upper site is in the HQW section of the river and has rated Excellent, based on benthos data, since first sampled in 1988. The middle site near Manchester is below the Fort Bragg WWTP and has improved dramatically since 1986, when water quality was Fair. The Fort Bragg WWTP completed an upgrade in 1991, and water quality improved to Good-Fair in 1993 and then to Excellent in 1998. The most downstream site was rated Excellent in both 1993 and 1998.

Nicks Creek is a headwater tributary that improved from Good in 1993 to Excellent in 1998 based on benthos data. Jumping Run Creek in Cumberland County showed a marked improvement from a Good-Fair rating in 1993 to Excellent in 1998, based on benthos data. This

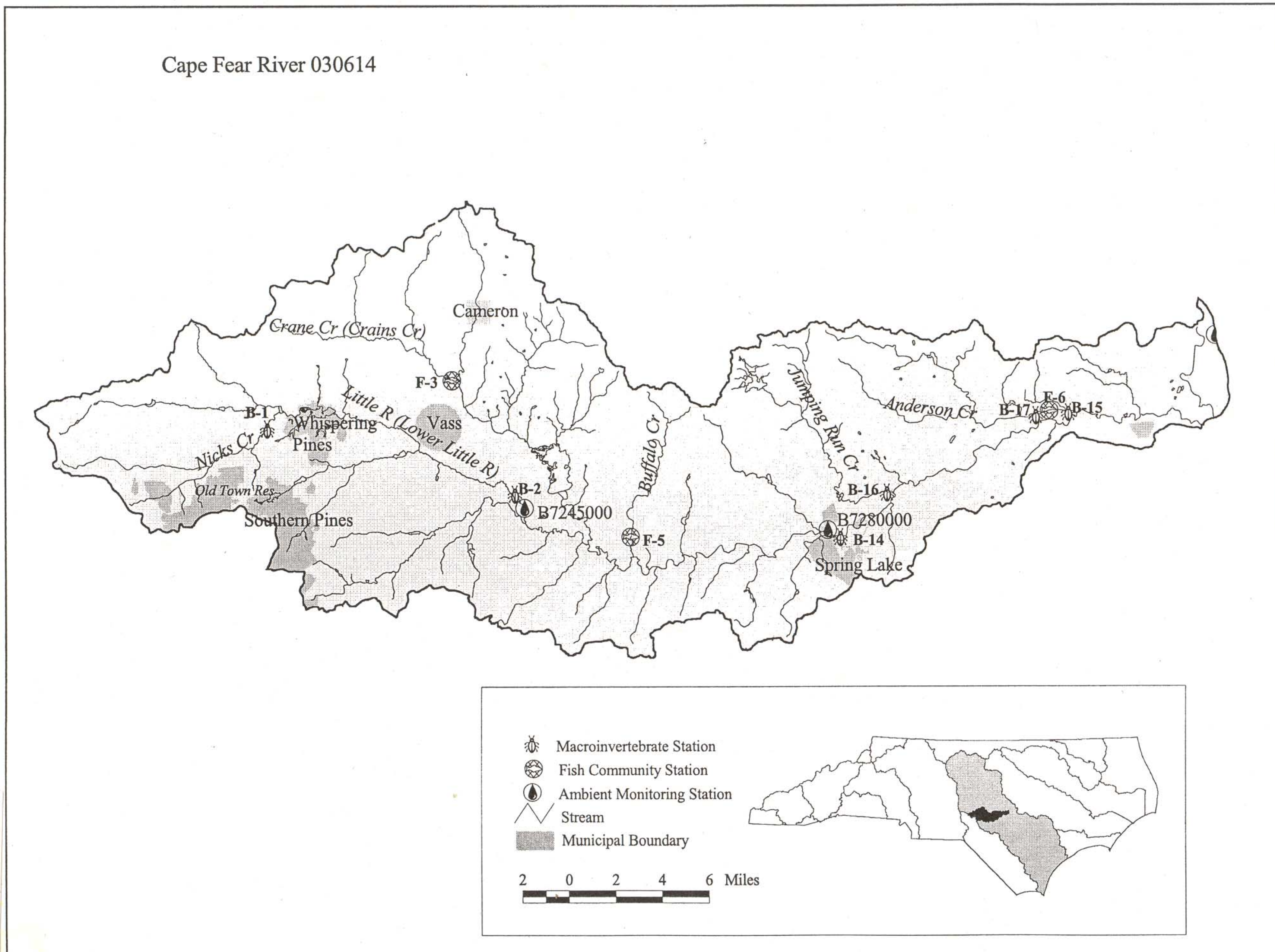


Figure B-14 Sampling Locations within Subbasin 03-06-14

Table B-14 Biological Assessment Sites in Cape Fear River Subbasin 03-06-14

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | Nicks Creek | Moore | NC 22 | Good | Excellent |
| B-2 | (Lower) Little River | Moore | SR 2023 | Excellent | Excellent |
| B-14 | (Lower) Little River | Cumberland | NC 87/24 | Good-Fair | Excellent |
| B-15 | (Lower) Little River | Cumberland | US 401 | Excellent | Excellent |
| B-16 | Jumping Run Creek | Cumberland | NC 210 | Good-Fair | Excellent |
| B-17 | Anderson Creek | Harnett | SR 2031 | Good-Fair | Good-Fair |
| ***FISH*** | | | | ***Bioclassification*** | |
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-3 | Crains Creek | Moore | US 1 | no sample | Fair |
| F-5 | Buffalo Creek | Moore | SR 1001 | no sample | Good-Fair |
| F-6 | Anderson Creek | Harnett | SR 2031 | no sample | Fair |

was despite poor instream habitat, a very developed nearby watershed, and no apparent changes in land use since 1993.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 14.2 Impaired Waters

Portions of Anderson Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Crane Creek is currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 14.3 and waters with other issues, recommendations or projects are discussed in Part 14.4.

### Anderson Creek

*Current Status*

Anderson Creek (5.5 miles from source to Little River) was partially supporting (PS) in the 1996 plan. The biological community was impaired. Recent DWQ monitoring data indicate that Anderson Creek is currently not impaired. Although Anderson Creek is not impaired, it is recommended that monitoring be continued to identify potential pollutants.

**Crane Creek**

*Current Status*

Crane Creek (28.3 miles from source to Lake Surf) is partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with agricultural nonpoint sources is a possible cause of impairment. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Local initiatives are needed to reduce land use impacts on Crane Creek. DWQ encourages implementation of agricultural best management practices that reduce potential impacts to surface waters. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

## 14.3 303(d) Listed Waters

Crane Creek is the only stream (28.3 stream miles) in the subbasin that is impaired and on the state's year 2000 303(d) list (not yet EPA approved). Crane Creek is discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 14.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**The Middle Cape Fear River Basin Association (MCFRBA)**

The Middle Cape Fear River Basin Association (MCFRBA) started sampling at one station in this subbasin (30 stations total) in July 1998. This data will be used to give a higher resolution picture of water quality conditions in the Lower Little River. The data will also be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

# Chapter 15 -
## Cape Fear River Subbasin 03-06-15
### Includes Cape Fear River, Cross Creek and Rockfish Creek

## 15.1 Water Quality Overview

***Subbasin 03-06-15 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 600 |
| Land area: | 595 |
| Water area: | 5 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 247,765 people |
| Pop. Density: | 416 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 64.2 |
| Surface Water: | 1.6 |
| Urban: | 9.9 |
| Cultivated Crop: | 14.2 |
| Pasture / Managed Herbaceous: | 10.0 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 283.8 mi. |
| Partially Supporting: | 7.8 mi. |
| Not Supporting: | 13 mi. |
| Not Rated: | 84.0 mi. |

*Lakes*:

Bonnie Doone Lake - Fully Supporting
Glenville Lake - Fully Supporting
Hope Mills Lake - Fully Supporting
Kornbow Lake - Fully Supporting
Mintz Pond - Fully Supporting

This subbasin contains the City of Fayetteville as well as the majority of the Fort Bragg Military Reservation. The Cape Fear River flows through Fayetteville in this subbasin, but most of the subbasin is made up of the Rockfish Creek and Little Rockfish Creek watersheds. A map of the subbasin, including water quality sampling locations, is presented in Figure B-15.

Biological ratings for these sample locations are presented in Table B-15. The current sampling resulted in impaired ratings for two streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

The upper Rockfish Creek site is below the Raeford WWTP, and benthos bioclassifications improved from Good-Fair in 1990 to Good in 1993 to Excellent in 1998. Upgrades in treatment at the WWTP are believed to be responsible for this improved water quality. The downstream Rockfish Creek site has been Excellent, based on benthos data since 1983, except for a slight decrease to Good in 1993. Little Rockfish Creek was also sampled above the confluence with Rockfish Creek. Even though the watershed is urban and agricultural, benthos ratings in both 1993 and 1998 were Good.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

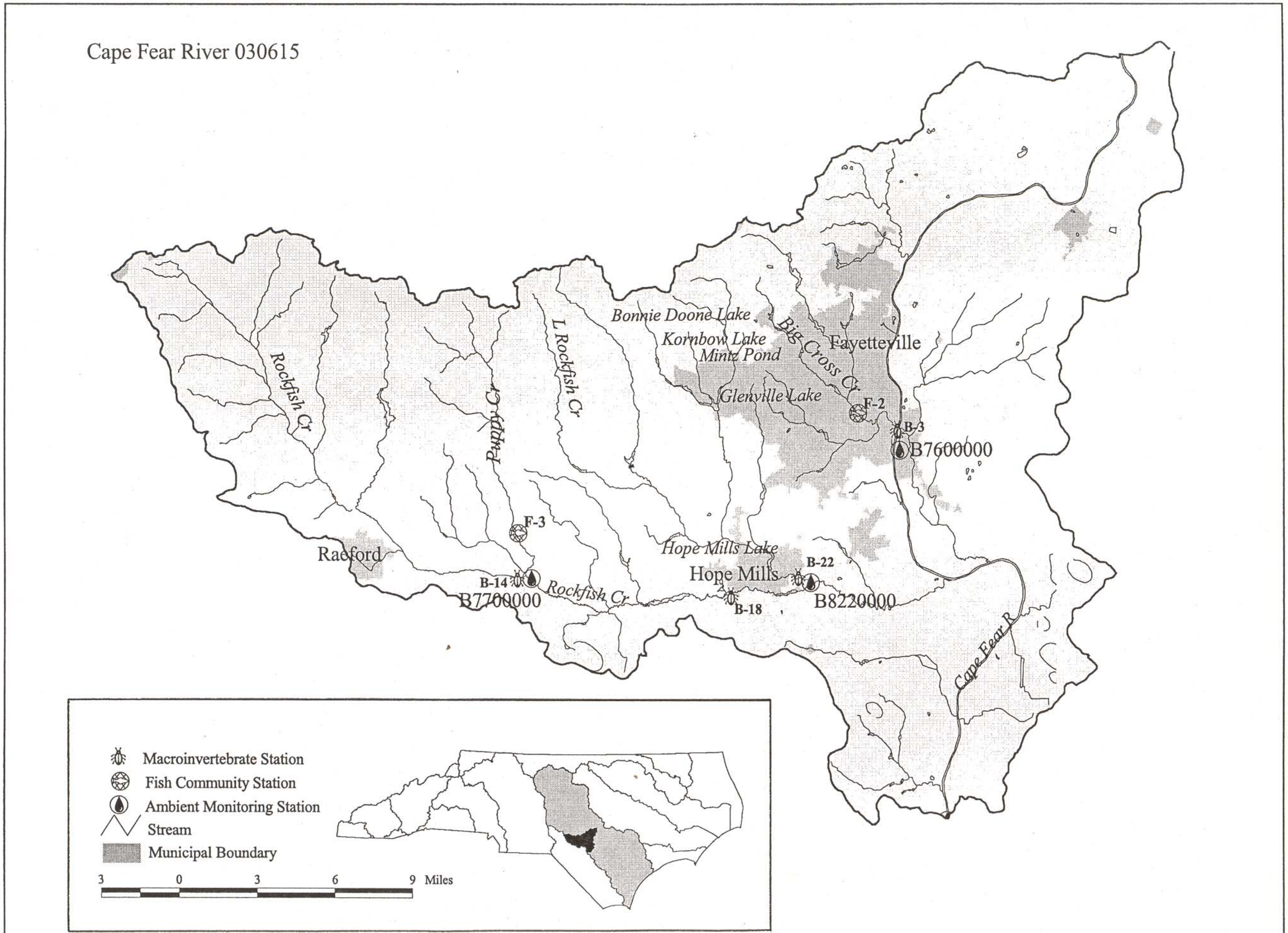


Figure B-15 Sampling Locations within Subbasin 03-06-15

Table B-15 Biological Assessment Sites in Cape Fear River Subbasin 03-06-15

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | Cape Fear River | Cumberland | Person Street | Good-Fair | Not Rated |
| B-17 | Rockfish Creek | Hoke | SR 1432 | Good | Excellent |
| B-21 | Rockfish Creek | Cumberland | NC 87 | Good | Excellent |
| B-25 | Little Rockfish Creek | Cumberland | NC 59 | Good | Good |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-2 | Big Cross Creek | Cumberland | NC 87/210/24 | no sample | Poor |
| F-3 | Puppy Creek | Hoke | SR 1406 | no sample | Good-Fair |

## 15.2 Impaired Waters

Portions of Cross Creek, Little Cross Creek, Pedler Branch and an unnamed tributary to Bones Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Cross Creek and Little Cross Creek are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 15.3 and waters with other issues, recommendations or projects are discussed in Part 15.4.

### Cross Creek

*Current Status*

Cross Creek was partially supporting (PS) in the 1996 plan. Cross Creek (13 miles from source to Cape Fear River) is not supporting according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment to this stream.

*2000 Recommendations*

The City of Fayetteville is implementing a state permitted stormwater program. Cross Creek is in heavily urbanized areas and should benefit from the city stormwater program (see Section A, Chapter 4, Part 4.7.1). DWQ will work with the stormwater program, where possible, to improve water quality in this creek. The 303(d) list approach for this stream will be to resample for biological and chemical data to attempt to determine potential problem parameters.

The Cape Fear River Botanical Garden is stabilizing the streambanks of Cross Creek where it meets the Cape Fear River main channel. For more information on this project, refer to Section C, Chapter 1, Part 1.5.3.

**Little Cross Creek**

*Current Status*

Little Cross Creek was not supporting (NS) in the 1996 plan. Little Cross Creek (7.8 miles from source to Cross Creek) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment to this stream.

*2000 Recommendations*

The City of Fayetteville is implementing a state permitted stormwater program. Little Cross Creek is in heavily urbanized areas and should benefit from the city stormwater program (see Section A, Chapter 4, Part 4.7.1). DWQ will work with the stormwater program, where possible, to improve water quality in this creek. The 303(d) list approach for this stream will be to resample for biological and chemical data to attempt to determine potential problem parameters.

The Fayetteville PWC has established buffers on 101 acres of easements around two of its water supply reservoirs. The city is also applying for funds to assess pollution hazards in the Little Cross Creek watershed. Refer to Section C, Chapter 1, Part 1.5.3 for more information on these projects.

**Pedler Branch**

*Current Status*

Pedler Branch (2.6 miles) was not supporting (NS) in the 1996 plan. This stream is currently not rated (NR), although it may be severely impacted by urban nonpoint source pollution including stormwater surges associated with impervious surfaces in the Town of Raeford. Using new biological information, DWQ has determined that the previous rating was inappropriate because of the small size of the stream. This stream is no longer on the 303(d) list.

**Unnamed Tributary to Bones Creek**

*Current Status*

UT to Bones Creek was not supporting (NS) in the 1996 plan. This stream is currently not rated (NR). New biological information has determined that the previous rating was inappropriate because of the small size of the stream. This stream is no longer on the 303(d) list.

## 15.3 303(d) Listed Waters

There are two streams (20.8 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Cross Creek and Little Cross Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 15.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

The Cape Fear River in this subbasin is downstream of many discharges and is affected by tributaries draining urban areas of the City of Fayetteville.

Puppy Creek is downstream of Fort Bragg and is potentially affected by land-disturbing activities on the military reservation. Continued monitoring of this stream is recommended to assess the extent of impacts from land-disturbing activities.

Bonnie Doone Lake is the first in a series of four lakes formed as impoundments of Little Cross Creek. Fort Bragg Military Base is located in close proximity to Bonnie Doone Lake. Firebreaks located on the base and the general soil type of the area contribute large amounts of sediment into the lake through stormwater runoff. To preserve water quality, work has been done to remove stormwater outlets which had drained into Bonnie Doone Lake.

Kornbow Lake is the second and largest in the series of four impoundments located on Little Cross Creek. The immediate shoreline of the lake is forested with residential developments beyond that buffer. Kornbow Lake is 90% infested with variable-leaf water milfoil. However, because this lake and its watershed are monitored by the North Carolina Natural Heritage Program, the city is discouraged from removing this plant. To protect Kornbow Lake, 150 acres in the headwaters have been purchased by the City of Fayetteville with money received from the Clean Water Management Trust Fund (see Section C, Chapter1, Part 1.5.3). Sanitary sewers and construction activities have been a threat to the water quality of this lake.

Mintz Pond is a small auxiliary water supply reservoir for the City of Fayetteville located in Cumberland County. The lake is the third in a series of four impoundments located on Little Cross Creek and is not open to the public. The immediate shoreline is forested and surrounded by residential and urban development. Algal blooms have occurred in the past, along with public complaints regarding odor due to these blooms. Nutrients have entered the lake from a tributary which drains a small irrigation pond. To correct this problem, the City of Fayetteville has purchased the pond and is modifying it to prevent future algal blooms. In addition to nutrients and algal blooms, pesticides and herbicides from the watershed also threaten this lake.

Glenville Lake is a small, backup water supply reservoir for the City of Fayetteville. The lake is the last in a series of four impoundments of Little Cross Creek. The immediate shoreline is forested with residential development located along the western side of the lake just beyond the forest buffer. Sedimentation has been a problem in this lake, and the lake is gradually filling in. There has also been a problem with unsupervised public access to the lake and removal of riparian buffers in a city park located in the upstream region of the lake. A stormwater management program is operated by the City of Fayetteville; however, stormwater continues to present a water quality problem for this lake.

Hope Mills Lake is a small, shallow, recreational reservoir located on Little Rockfish Creek in the Town of Hope Mills. The lake drainage area is mostly forested with some urban and agricultural uses. There have been numerous public complaints regarding odor at the dam and at the swimming beach, although there have been no reports of human health problems due to swimming in the lake. Fecal coliform bacteria may be a problem at the swimming beach and boat dock area due to waterfowl in these areas.

Approximately 7% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**The Middle Cape Fear River Basin Association (MCFRBA)**

The Middle Cape Fear River Basin Association (MCFRBA) started sampling at seven stations in this subbasin (30 stations total) in July 1998. This data will be used to give a higher resolution picture of water quality conditions in the Cape Fear River mainstem and Rockfish Creek. The data will also be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Cape Fear River from Erwin to Lock and Dam #3**

*1996 Recommendations*

A field-calibrated QUAL2E model developed during the first basinwide planning cycle indicated that assimilative capacity for oxygen-consuming wastes had been reached in the segment of the Cape Fear River from Erwin to Lock and Dam #3. It was recommended that new and expanding discharges conduct engineering alternatives and economic analyses. If no alternatives were feasible, then limits would be required as follows:

New and expanding municipal/domestic discharges <1 MGD: $BOD_5$ = 12 mg/l, $NH_3$-N = 2 mg/l
New and expanding municipal/domestic discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
New industrial discharges: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
Expanding industrial discharges: best available technology or $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

*2000 Recommendations*

Limits recommended in the 1996 plan were made to protect dissolved oxygen (DO) levels in the river. These limits will continue to be recommended with the exception that new and expanding municipal/domestic discharges ≥1 MGD will be given limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 1 mg/l. This is now considered BAT for this discharger category. Recommended limits for other facilities are as follows:

New and expanding municipal/domestic discharges <1 MGD: $BOD_5$ = 12 mg/l, $NH_3$-N = 2 mg/l
New and expanding municipal/domestic discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1 mg/l
New industrial discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1 mg/l
New industrial discharges <1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
Expanding industrial discharges: site specific best available technology or
$BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

The Middle Cape Fear River Basin Association (MCFRBA) and DWQ continue to collect data in this segment of the Cape Fear River. There are indications that algal productivity influences dissolved oxygen (DO) dynamics in this segment of the Cape Fear River.

DWQ will be reviewing the exisiting QUAL2E model for the Cape Fear River mainstem (from Buckhorn Dam to Lock and Dam #1) to determine if improvements in the calibration can be made.

# Chapter 16 -
## Cape Fear River Subbasin 03-06-16
### Includes Cape Fear River, Harrison Creek and Turnbull Creek

## 16.1 Water Quality Overview

***Subbasin 03-06-16 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 438 |
| Land area: | 430 |
| Water area: | 8 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 14,811 people |
| Pop. Density: | 34 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 78.7 |
| Surface Water: | 2.5 |
| Urban: | 0.6 |
| Cultivated Crop: | 12.7 |
| Pasture/ Managed Herbaceous: | 5.6 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 240.8 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 8.5 mi. |
| Not Rated: | 11.8 mi. |

*Lakes*:

Jones Lake - Fully Supporting
Salters Lake - Fully Supporting
White Lake - Fully Supporting

This subbasin is located in the inner coastal plain and contains the City of Elizabethtown. The Cape Fear River in this subbasin is deep and slow moving, with two locks to aid in navigation. The Bladen Lakes State Park, which includes several natural lakes, is located in this subbasin. The streams and many of the natural bay lakes within this subbasin are tannin-stained or low pH blackwaters. Land use in the subbasin is mostly forest and marsh with some agriculture. A map of the subbasin, including water quality sampling locations, is presented in Figure B-16.

Biological ratings for these sample locations are presented in Table B-16. The current sampling resulted in impaired ratings for one stream in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

There are eight permitted dischargers in this subbasin, mostly near Elizabethtown. Four of the largest dischargers, Veeder-Root, Smithfield Foods Incorporated in Tar Heel, Alamac Knit Fabrics in Elizabethtown, and Dupont of Fayetteville, discharge into the Cape Fear River.

Of the 68 fish tissue samples analyzed since 1994, seven samples exceeded the EPA mercury limit. These samples were from bass, bowfin and catfish. Only one bowfin sample exceeded the FDA/NC mercury limit.

Of the five sites sampled in both 1993 and 1995 for benthos, three improved in bioclassification and the others remained the same. Two of the three Cape Fear River sites, the Cape Fear River near Duarte and the Cape Fear River near Kelly, increased from Fair to Good-Fair. The Cape Fear River at Elizabethtown remained the same (Good-Fair), as did Ellis Creek (Good-Fair). Harrison Creek also increased from Fair to Good-Fair between 1993 and 1995. Turnbull Creek, with a Good bioclassification, had the best water quality in this subbasin.

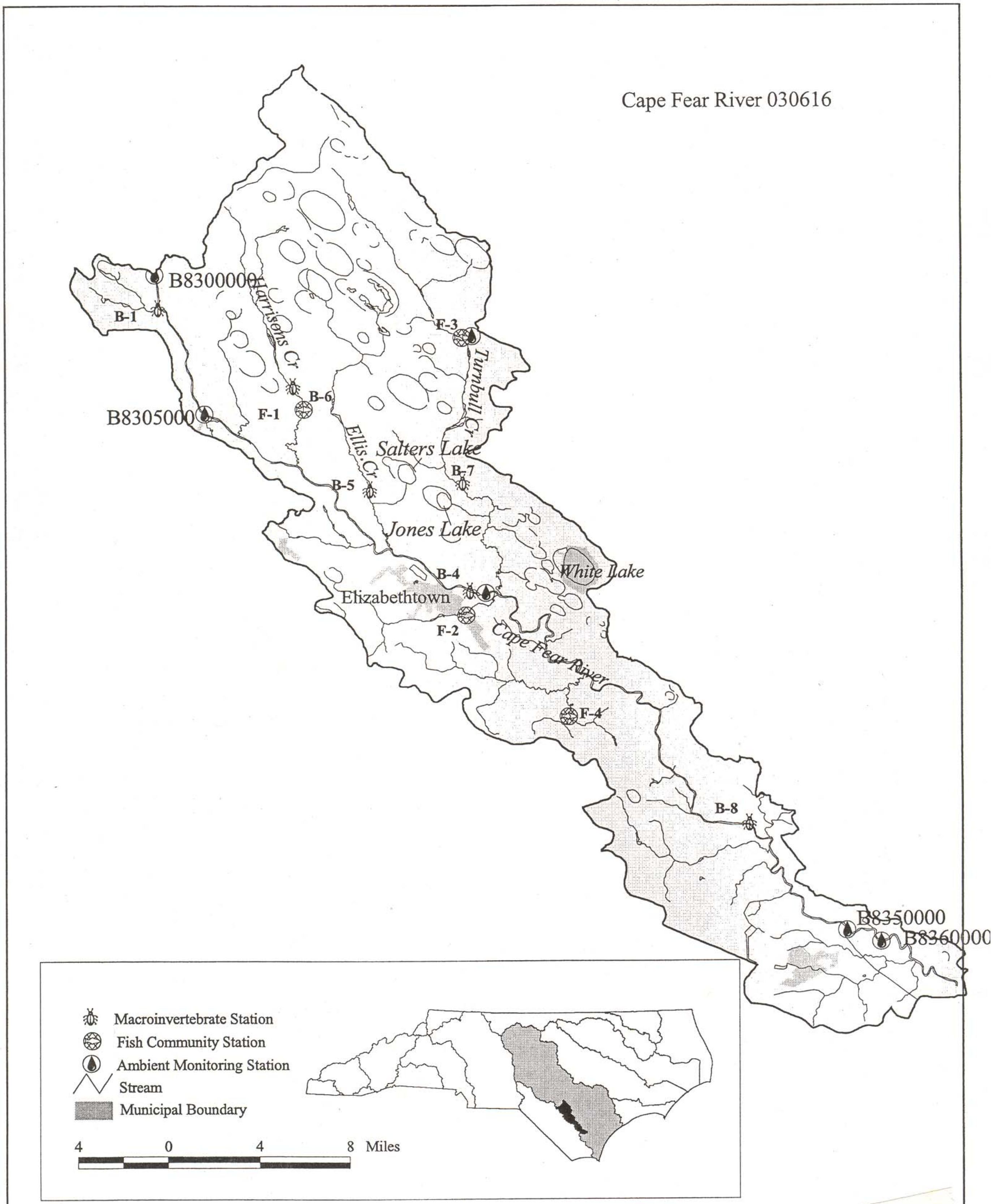


Figure B-16 Sampling Locations within Subbasin 03-06-16

Table B-16 Biological Assessment Sites in Cape Fear River Subbasin 03-06-16

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | Cape Fear River | Bladen | SR 1355 nr Duarte | Fair | Good-Fair |
| B-4 | Cape Fear River | Bladen | nr Elizabethtown | Good-Fair | Good-Fair |
| B-5 | Ellis Creek | Bladen | NC 53 | Good-Fair | Good-Fair |
| B-6 | Harrison Creek | Bladen | SR 1318 | Fair | Good-Fair |
| B-7 | Turnbull Creek | Bladen | SR 1511 | no sample | Good |
| B-8 | Cape Fear River | Bladen | SR 1730 nr Kelly | Fair | Good-Fair |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Harrison Creek | Bladen | SR 1318 | Good-Fair | Good-Fair |
| F-2 | Browns Creek | Bladen | NC 87 | Poor | Poor |
| F-3 | Turnbull Creek | Bladen | NC 242 | no sample | Fair |
| F-4 | Whites Creek | Bladen | SR 1704 | no sample | Good |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Cape Fear River at Elizabethtown | 1994 | 21 | 2 | 0 | EPA mercury limit exceeded in 1 bass/1 bowfin samples |
| | | 1995 | 8 | 3 | 0 | EPA mercury limit exceeded in 3 bowfin samples; FDA/NC mercury limit exceeded in 1 bowfin sample |
| | | 1998 | 19 | 1 | 0 | EPA mercury limit exceeded in 1 bass sample |
| FT-2 | Cape Fear at Lock and Dam 3 | 1998 | 10 | 0 | 0 | No samples exceeded criteria |
| FT-3 | Cape Fear at Lock and Dam 2 | 1998 | 10 | 01 | 0 | EPA mercury limit exceeded in 1 catfish sample |

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 16.2 Impaired Waters

Portions of Turnbull Creek and Harrisons Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Browns Creek is currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 16.3 and waters with other issues, recommendations or projects are discussed in Part 16.4.

### Turnbull Creek

*Current Status*

Turnbull Creek (27.8 miles from source to Cape Fear River) was partially supporting (PS) in the 1996 plan. Turnbull Creek is a swamp water with a naturally low pH. This stream is currently fully supporting (FS) according to recent DWQ monitoring and no longer on the state's 303(d) list. Streams in this watershed are subject to erosion and instream habitat degradation. Agricultural BMPs are encouraged to reduce potential for adverse impacts.

### Harrisons Creek

*Current Status*

Harrisons Creek (27.4 miles from source to Cape Fear River) was partially supporting (PS) in the 1996 plan. Harrisons Creek is a swamp water with a naturally low pH. This stream is currently fully supporting (FS) according to recent DWQ monitoring and no longer on the state's 303(d) list. Streams in this watershed are subject to erosion and instream habitat degradation. Agricultural BMPs are encouraged to reduce potential for adverse impacts.

### Browns Creek

*Current Status*

Browns Creek (8.5 miles from source to Cape Fear River) is not supporting (NS) according to recent DWQ monitoring because of an impaired biological community. Urban nonpoint sources and sanitary sewer overflows from the City of Elizabethtown are possible sources of impairment. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Local initiatives are needed to improve water quality in Browns Creek. DWQ encourages development of a land use plan that protects water quality in this stream.

Sanitary sewer overflows have not been a continuing problem for the City of Elizabethtown. Three overflows coincided with DWQ monitoring and may have affected the rating. Continued monitoring is recommended to determine if Browns Creek is recovering from the sewer overflows and to determine the nature of nonpoint sources. The 303(d) list approach for these two streams will be to resample for biological and chemical data to attempt to determine potential problem parameters.

## 16.3 303(d) Listed Waters

Browns Creek (8.5 stream miles) is the only impaired stream in this subbasin and is on the state's year 2000 303(d) list (not yet EPA approved). Browns Creek is discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 16.4 Other Issues, Recommendations and Projects

The following surface water segments are rated as fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Approximately 1% of the waters in this subbasin are impaired by nonpoint source pollution (mostly urban). All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**The Lower Cape Fear River Program**

The Lower Cape Fear River Program maintains five sampling stations in this subbasin that are used along with DWQ ambient data to make use support determinations in this subbasin. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**The Middle Cape Fear River Basin Association (MCFRBA)**

The Middle Cape Fear River Basin Association (MCFRBA) started sampling at seven stations in this subbasin (30 stations total) in July 1998. This data will be used to give a higher resolution picture of water quality conditions in the Cape Fear River mainstem and Rockfish Creek. The data will also be analyzed to support various studies and will be used with DWQ data to develop use support ratings for waters in the Cape Fear River basin during the upcoming basinwide cycle.

**Cape Fear River from Lock and Dam #3 to Lock and Dam #1**

A field-calibrated QUAL2E model developed during the first basinwide planning cycle indicated that assimilative capacity for oxygen-consuming wastes had been reached in the Cape Fear River from Erwin to Lock and Dam #3. It was recommended that new and expanding discharges conduct engineering alternatives and economic analyses. If no alternatives were feasible, then limits would be required as follows:

New and expanding municipal/domestic discharges <1 MGD: $BOD_5$ = 12 mg/l, $NH_3$-N = 2 mg/l
New and expanding municipal/domestic discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2mg/l
New industrial discharges: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

Expanding industrial discharges: best available technology or $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

*2000 Recommendations*

Limits recommended in the 1996 plan were made to protect dissolved oxygen (DO) levels in the river. These limits will continue to be recommended with the exception that new and expanding municipal/domestic discharges ≥1 MGD will be given limits of $BOD_5$ = 5 mg/l and $NH_3$-N = 1mg/l. This is now considered BAT for this discharger category. Recommended limits for other facilities are as follows:

New and expanding municipal/domestic discharges <1 MGD: $BOD_5$ = 12 mg/l, $NH_3$-N = 2 mg/l
New and expanding municipal/domestic discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1mg/l
New industrial discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1 mg/l
New industrial discharges <1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
Expanding industrial discharges: site specific best available technology or
$BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

The Middle Cape Fear River Basin Association (MCFRBA) and DWQ continue to collect data in this segment of the Cape Fear River. There are indications that algal productivity influences dissolved oxygen (DO) dynamics in this segment of the Cape Fear River.

DWQ will be reviewing the exisiting QUAL2E model for the Cape Fear River mainstem (from Buckhorn Dam to Lock and Dam #1) to determine if improvements in the calibration can be made.

**Suggs Mill Pond Land Acquisition**

The WRC acquired 9,000 acres of land in the Bladen Lakes Management Region. Refer to Section C, Chapter 1, Part 1.5.4 for more information on this project.

# Chapter 17 -
## Cape Fear River Subbasin 03-06-17
### Includes Town Creek, Smith Creek and the Brunswick River

## 17.1 Water Quality Overview

***Subbasin 03-06-17 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 547 |
| Land area: | 498 |
| Water area: | 49 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 56,467 people |
| Pop. Density: | 113 persons/$mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 74.7 |
| Surface Water: | 9.3 |
| Urban: | 4.1 |
| Cultivated Crop: | 7.6 |
| Pasture/ Managed Herbaceous: | 4.3 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 251.5 mi. |
| Partially Supporting: | 3.8 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 65.5 mi. |

*Estuarine Waters*:

| | |
|---|---|
| Fully Supporting: | 16,314 ac. |
| Partially Supporting: | 7,211 ac. |
| Not Supporting: | 0.0 ac. |
| Not Rated: | 925 ac. |

*Lakes*:

Greenfield Lake - Not Rated
Boiling Springs Lake - Fully Supporting

This subbasin is located in the outer Coastal Plain and in estuarine regions of the basin. The subbasin contains the City of Wilmington and the Town of Southport. Most tributaries in this subbasin are backwater and slow moving or tidal. A map of the subbasin, including water quality sampling locations, is presented in Figure B-17.

Biological ratings for these sample locations are presented in Table B-17. The current sampling resulted in impaired ratings for one stream and 7,211 acres of impaired estuarine waters in this subbasin. A summary of use support ratings for estuarine waters is presented in Table A-32. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Forest and agriculture are the primary land uses; however, Wilmington and surrounding suburban areas also contribute to nonpoint source pollution. There are 49 permitted dischargers in the subbasin; half of which discharge directly into the Cape Fear River. Ten of these are major dischargers (>1 MGD), with the largest dischargers being International Paper, Wilmington North Side WWTP and Wilmington South Side WWTP.

Benthic macroinvertebrate data indicated improved water quality at sites most affected by nonpoint sources during this low flow year. Excellent (using draft criteria) conditions were recorded from the Cape Fear River above International Paper. The Cape Fear River below the Federal Paper discharge showed no change in water quality since the last sampling. A Good-Fair rating was assigned to Livingston Creek, up from Fair in 1993. In the estuarine area, water quality has remained stable at Cape Fear River at Snows Marsh with only Moderate impacts.

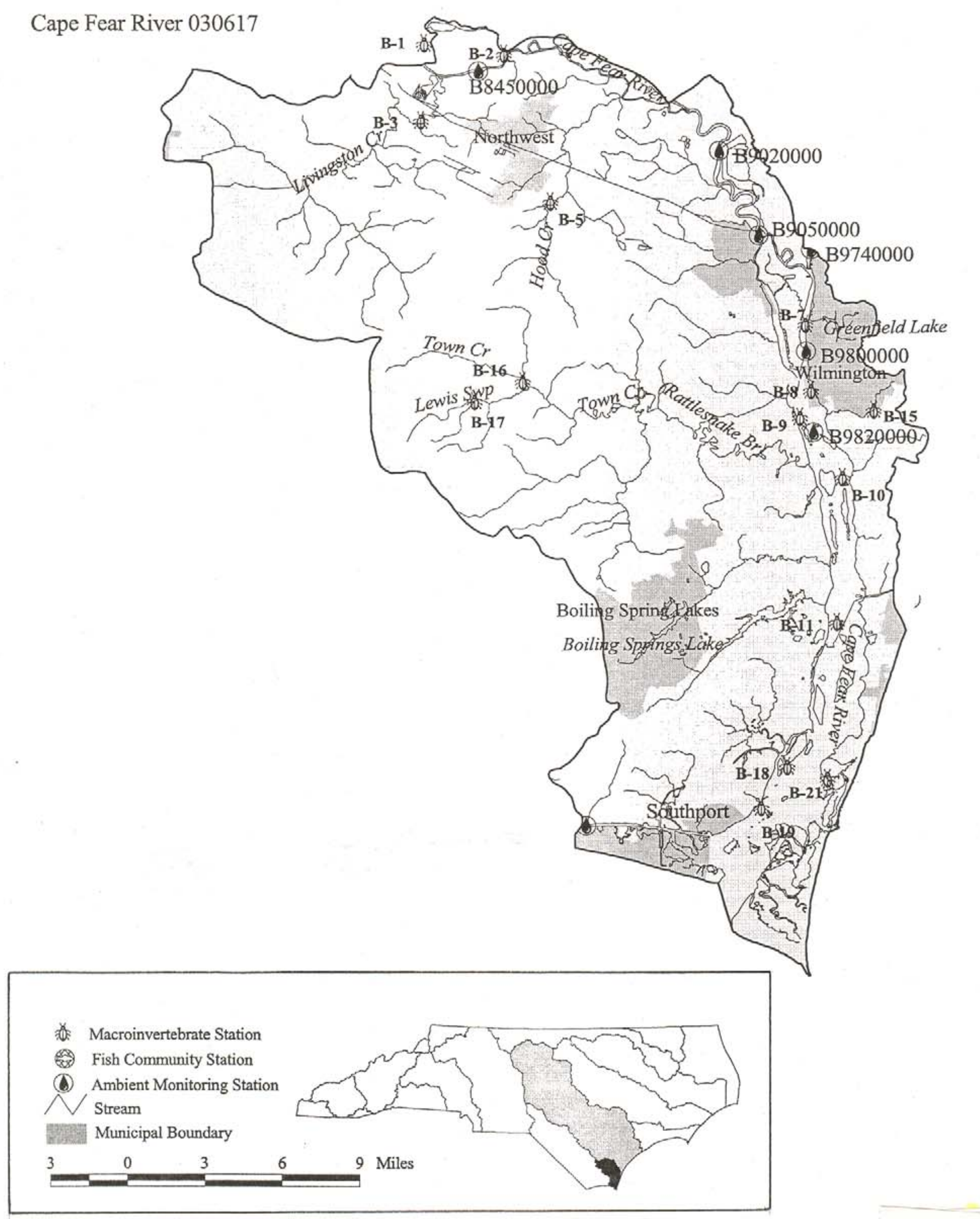


Figure B-17 Sampling Locations within Subbasin 03-06-17

Table B-17 Biological Assessment Sites in Cape Fear River Subbasin 03-06-17

| *BENTHOS* | | | | *Bioclassification* | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | Cape Fear River | Columbus | ab Federal Paper | Good-Fair | Excellent |
| B-2 | Cape Fear River | Columbus | be Federal Paper | Fair | Fair |
| B-3 | Livingston Creek | Columbus | US 74 | Fair | Good-Fair |
| B-5 | Hood Creek | Brunswick | US 74/76 | no sample | Good |
| B-9 | Barnards Creek | Brunswick | US 421 | no sample | Fair-Good |
| B-10 | Town Creek | Brunswick | ab SR 1413 | no sample | Good-Fair |
| B-11 | Lewis Swamp | Brunswick | SR 1410 | no sample | Good-Excellent |
| B-18 | Cape Fear River | Brunswick | Snows Marsh | Moderate | Moderate |

| *FISH TISSSUE* | | | | *No. Samples Exceeding Criteria* | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Cape Fear River at Riegelwood | 1998 | 23 | 8 | 0 | EPA mercury limit exceeded in 4 bowfin and 4 bass samples; FDA/NC mercury limit exceeded in 1 bass sample |
| FT-2 | Livingston Creek near Acme | 1998 | 20 | 11 | 0 | EPA mercury limit exceeded in 11 samples of bass, bowfin, pickerel; FDA/NC mercury limit exceeded in 3 samples of bass and bowfin |
| FT-3 | Cape Fear River below Riegelwood | 1994 | 15 | 3 | 0 | EPA and FDA/NC mercury limit exceeded in 3 bowfin samples |

The highest incidence of elevated mercury in fish tissue was in Livingston Creek. Over half of the fish tested, including bass, bowfin and pickerel, had levels of mercury above EPA limits. Samples from the Cape Fear River near Riegelwood found lower, but still significant levels of mercury in bass and bowfin tissues.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 17.2 Impaired Waters

Portions of Livingston Creek, the Cape Fear River and estuarine areas were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of the Cape Fear River and estuarine areas are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 17.3 and waters with other issues, recommendations or projects are discussed in Part 17.4.

**Livingston Creek**

*Current Status*

Livingston Creek (22.2 miles from source to Cape Fear River) was partially supporting (PS) in the upper segment and not supporting (NS) in the lower segment in the 1996 Cape Fear River Basinwide Plan. This stream is currently fully supporting (FS). The bioclassification improved from Fair to Good-Fair for 1993 to 1998. Livingston Creek is no longer on the 303(d) list. DWQ will continue to monitor this stream to determine the extent of impacts from both point and nonpoint sources.

**Cape Fear River (near Neils Eddy Landing, International Paper)**

*Current Status*

The Cape Fear River (near Neils Eddy Landing) was partially supporting (PS) in the 1996 plan. The Cape Fear River (3.8 miles near Neils Eddy Landing) is currently partially supporting (PS) according to recent DWQ monitoring because of an impaired biological community. The International Paper Board discharge and nonpoint source pollution are possible causes of impairment. This segment is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters. The International Paper discharge will also be monitored to determine the extent of impacts to this segment and other segments of the Cape Fear River in this subbasin. See Part 17.4 below for recommendations for the Cape Fear River mainstem that include this impaired section and the rest of the mainstem in this subbasin.

**The Cape Fear River Estuary**

*Current Status*

The Cape Fear River Estuary (5000 acres) was partially supporting (PS) in the 1996 plan because of low levels of dissolved oxygen (DO). This same area is currently partially supporting (PS) and is on the state's year 2000 303(d) list (not yet EPA approved). The cumulative impacts from WWTP discharges in the subbasin as well as nonpoint source pollution are suspected to be significant contributors to the impairment. Swamp water drainage may also be a source of low DO waters feeding into the estuary. Possible sources of nonpoint source pollution include marinas, canal systems and septic systems.

*2000 Recommendations*

See Part 17.4 below for recommendations for the Cape Fear River mainstem that include this impaired section and the rest of the mainstem in this subbasin.

**Other Estuarine Waters in Subbasin 03-06-17**

*Current Status*

There are 2,211 acres of impaired estuarine waters (Southport, Buzzard Bay, The Basin and the Cape Fear River) in the subbasin according to recent DWQ and DEH Shellfish Sanitation Section monitoring (not including 5,000 acres of Cape Fear River Estuary discussed above). These waters have been closed to shellfishing by the Division of Marine Fisheries (DMF) based on recommendations by Division of Environmental Health Shellfish Sanitation Section. DEH regulations specify closure of growing areas when fecal coliform bacteria levels exceed 14 colonies per 100 ml of water. These waters are on the state's year 2000 303(d) list (not yet EPA approved). Recommendations for improving water quality in these waters are discussed below. Refer to Table A-32 for overall use support ratings for estuarine areas and Figure A-16 for a map of DEH shellfish growing areas.

*2000 Recommendations*

In the Cape Fear 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 of various land use activities is needed to decrease fecal coliform bacteria levels in shellfish growing areas, thereby, decreasing the acreage closed to harvesting.

Refer to Section A, Chapter 4, Part 4.14 for further recommendations regarding shellfish growing areas.

## 17.3 303(d) Listed Waters

There is one stream segment (3.8 stream miles) one lake and 7,211 acres of estuarine waters in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). The Cape Fear River and impaired estuarine areas are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 17.4 Other Issues, Recommendations and Projects

Approximately 45% of the waters in this subbasin are impaired by nonpoint source pollution. All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**The Lower Cape Fear River Program**

The Lower Cape Fear River Program maintains several sampling stations in this subbasin that are used along with DWQ ambient data to make use support determinations in this subbasin.

This data is also being used to support modeling in the Cape Fear River Estuary. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**Mercury Advisories**

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Section A, Chapter 4, Part 4.8.4.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. See Section A, Chapter 4, Part 4.11 for information on Hurricane Fran in 1996.

**Greenfield Lake**

Greenfield Lake is owned by the City of Wilmington and was built before 1750. Originally a cypress swamp, the lake was impounded to provide water for milling and irrigation for the Greenfields Plantation that surrounded it. The city encompasses the lake and its watershed. Greenfield Lake is currently swampy and cypress-filled. The City of Wilmington no longer dredges the lake, but is treating the aquatic macrophytes with chemicals and grass carp. In the summer of 1998, there was a fish kill in Greenfield Lake following a rainfall event. Significant beds of submerged filamentous algae and floating mats of duckweed (*Lemna* sp.) and watermeal (*Wolffia* sp.) were observed at nuisance levels in the lake in 1998. The filamentous algae in the lake also appeared to be worse in 1998, as compared with previous years, while the clarity of the water in the lake appeared to have improved in the past few years. Greenfield Lake is currently not rated (NR) but is on the state's year 2000 303(d) list (not yet EPA approved) because of aquatic weeds and nutrient enrichment.

**Cape Fear River from Lock and Dam #1 to the lower Cape Fear River Estuary**

*1996 Recommendations*

Because of documented water quality problems related to low dissolved oxygen (DO) in the Cape Fear River below Lock and Dam #1, all new and expanding discharges will be required to complete an engineering alternatives and economic analysis. If no other alternatives are found to be feasible, then a detailed evaluation of the potential impact of the discharge will be required and recommended summer permitted limits will be as follows:

New and expanding municipal/domestic discharges <1 MGD: $BOD_5$ = 12 mg/l, $NH_3$-N = 2 mg/l
New and expanding municipal/domestic discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2mg/l
New industrial discharges: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
Expanding industrial discharges: best available technology or $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

It was also recommended that Arcadian and Wilmington Northside WWTP change from Whole Effluent Toxicity test procedure to 24-hour acute toxicity test at 90% effluent concentration. These discharges are now using this toxicity test.

*2000 Recommendations*

The impaired segments are discussed above in Part 17.2. The 303(d) list approach will be to develop a TMDL for this segment of the Cape Fear River because of low dissolved oxygen (DO) levels. A TMDL is currently under development in cooperation with the Lower Cape Fear River Program (Section C, Chapter 1, Part 1.4.5) and the interested stakeholders. Because of the nature of the river/estuary system in this portion of the Cape Fear River basin, addressing water quality issues must not be limited to problems detected in impaired segments alone. Until an EPA approved TMDL to address low DO is in place to guide wasteload allocation decisions in this portion of the Cape Fear River and Cape Fear River Estuary, recommended summer limits for oxygen consuming wastes for new and expanding discharges will be as follows:

New and expanding municipal/domestic discharges <1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
New and expanding municipal/domestic discharges ≥1 MGD: $BOD_5$ = 5 mg/l, $NH_3$-N = 1mg/l
New industrial discharges: $BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l
Expanding industrial discharges: site specific best available technology or
$BOD_5$ = 5 mg/l, $NH_3$-N = 2 mg/l

Because this segment of the Cape Fear River and Cape Fear River Estuary is impaired and on the state's year 2000 303(d) list (not yet EPA approved), issuance of permits for new and expanding discharges that would further increase the load of oxygen-consuming waste into these waters will be carefully considered on a case by case basis.

For information on model development in this segment of the Cape Fear River estuary, see Section A, Chapter 4, Part 4.6.

**Coastal Urban and Recreation BMP Demonstration Project**

This project will evaluate and implement BMPs to protect coastal waters impaired by development. For more information on this project, refer to Section C, Chapter 1, Part 1.5.4.

# Chapter 18 -
## Cape Fear River Subbasin 03-06-18
### Includes the South River and Big Creek

## 18.1 Water Quality Overview

***Subbasin 03-06-18 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 495 |
| Land area: | 493 |
| Water area: | 2 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 39,895 people |
| Pop. Density: | 81 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 56.1 |
| Surface Water: | 1.3 |
| Urban: | 1.7 |
| Cultivated Crop: | 34.4 |
| Pasture/ Managed Herbaceous: | 6.6 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 165.9 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 113.7 mi. |

*Lakes*:

Bay Tree Lake - Partially Supporting

This subbasin is located in the inner coastal plain and contains the cities of Dunn and Roseboro. Major tributaries of the Cape Fear River in this subbasin include the South River and Black River (Little Black River). The South River below Big Swamp was designated an outstanding resource water (ORW) in 1994. Land use in this subbasin is primarily agriculture in the form of animal operations (mostly hog farms). Streams in this subbasin are characterized as slow-moving blackwater swamp streams. There are 3 permitted dischargers in the subbasin, none with a design flow >0.05 MGD. A map of the subbasin, including water quality sampling locations, is presented in Figure B-18.

Biological ratings for these sample locations are presented in Table B-18. Refer to Appendix III for a complete listing of monitored waters and use support ratings. Bay Tree Lake is partially supporting. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

The benthic site on the South River near Parkersburg has consistently received a rating of either Good or Excellent since 1983. Fish tissue samples collected from the South River in 1998 contained significant mercury levels. Elevated mercury was measured in multiple species including warmouth, suckers, pickerel, perch and bass.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

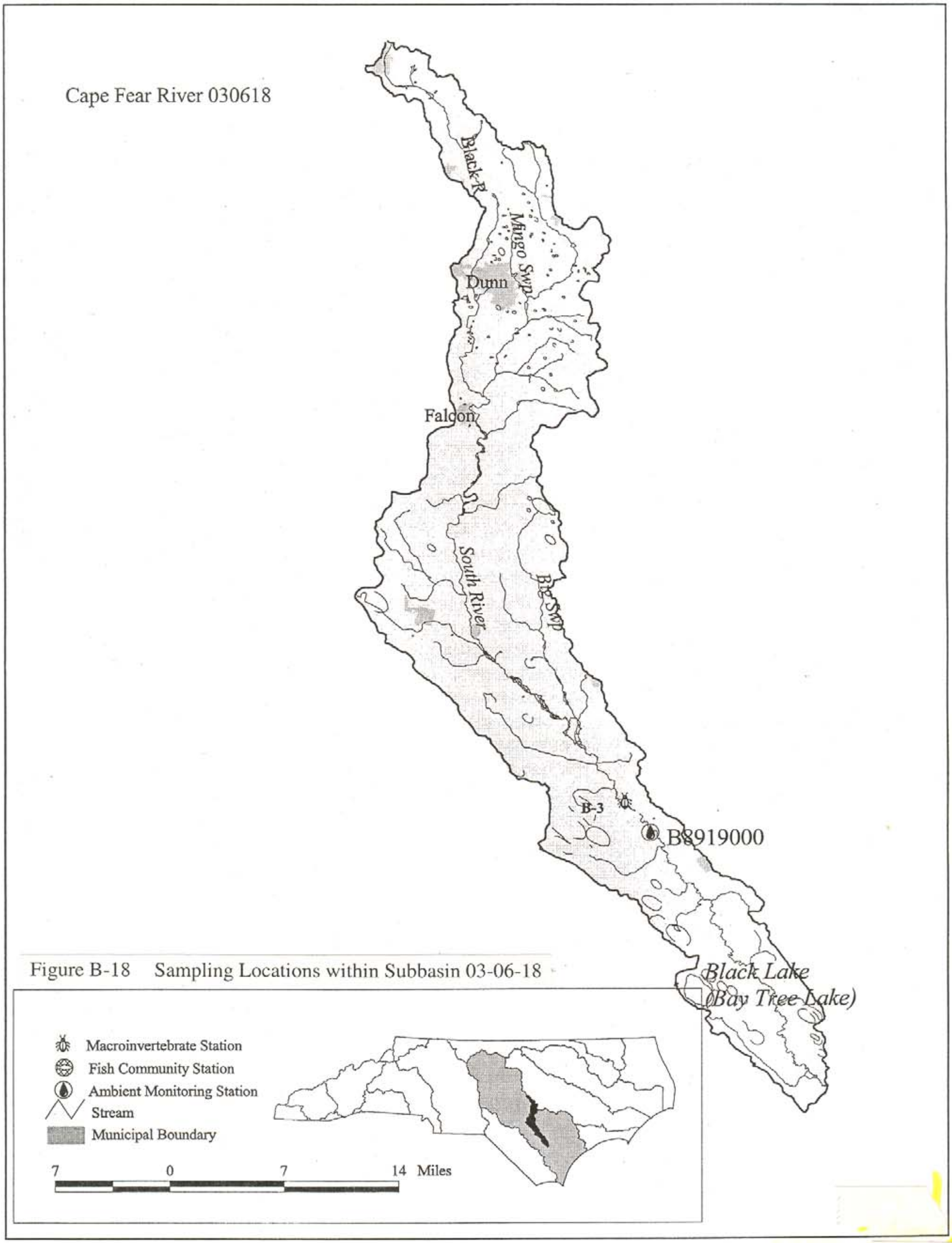


Figure B-18 Sampling Locations within Subbasin 03-06-18

Table B-18 Biological Assessment Sites in Cape Fear River Subbasin 03-06-18

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-3 | South River | Bladen | SR 1502, nr Parkersburg | Good | Good |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | South River near NC 701 | 1998 | 20 | 16 | 0 | EPA mercury limit exceeded in 16 samples of multiple species; FDA/NC mercury limit exceeded in 6 samples |

## 18.2 Impaired Waters

Portions of the South River and Black River (Little Black) were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Bay Tree Lake is currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 18.3 and waters with other issues, recommendations or projects are discussed in Part 18.4.

### South River

*Current Status*

The South River (7.2 miles from source to NC 13) was partially supporting (PS) in the 1996 plan. This river segment was not sampled by DWQ during recent monitoring because of low flow conditions. This segment of the South River is currently not rated (NR) but remains on the state's year 2000 303(d) list (not yet EPA approved). A downstream segment (SR 1502, near Parkersburg) is not impaired.

*2000 Recommendations*

The 303(d) list approach will be to resample this segment of the river to obtain updated use support information.

### Black River (Little Black)

*Current Status*

The Black River (Little Black) (from Dunn to I-95) was partially supporting (PS) in the 1996 plan. The river was not sampled by DWQ during recent monitoring because of low flow conditions. This segment of the Black River (Little Black) is currently not rated (NR) but remains on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

The 303(d) list approach will be to resample the river to obtain updated use support information. Fish tissue samples will be collected to determine if mercury contamination is a problem in this segment of the river.

**Bay Tree Lake**

*Current Status*

Bay Tree Lake (1,400 acres) was partially supporting (PS) in the 1996 plan. The lake is currently partially supporting (PS) according to recent DWQ monitoring. Bay Tree Lake (also called Black Lake) is a shallow, natural lake located in the Coastal Plain near Elizabethtown. The lake is located in Bay Tree State Park and is owned by the State of North Carolina. Typical of Carolina Bay Lakes, Bay Tree Lake receives no significant overland inflows. Bay Tree Lake has a network of drainage canals built on its northern and eastern shores. The surrounding land is primarily flat, composed of wetlands and upland forests. Bay Tree Lake is used for fishing and boating. A private residential community is located along the northern and northeastern shoreline of the lake. The lake is on the state's year 2000 303(d) list (not yet EPA approved).

Because Bay Tree Lake is dystrophic, a trophic status of the lake cannot be accurately determined through the NCTSI scores (see Appendix III). Bay Tree Lake has experienced a die-off of yellow perch (*Perca flavescens*) every summer due to long-term exposure to the naturally low pH waters of the lake. There have been no increases in aquatic macrophytes or algae in recent years, nor have there been any public complaints regarding problems related to swimming in the lake.

*2000 Recommendations*

In 1994, a "No Consumption" advisory was placed on largemouth bass and bowfin. The advisory remains in effect. These species have been found to contain elevated levels of mercury (NCDEHNR, June 1997). The 303(d) list approach will to develop a TMDL for mercury.

## 18.3 303(d) Listed Waters

There are two stream segments (102.5 stream miles) and one lake (1,400 acres) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Bay Tree Lake, the South River and the Black River (Little Black) are discussed above. Portions of the South River are not impaired; however, because of fish consumption advisories, this 70.9-mile segment is on the 303(d) list (see Part 18.4 below). For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 18.4 Other Issues, Recommendations and Projects

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**The Lower Cape Fear River Program**

The Lower Cape Fear River Program maintains three sampling stations in this subbasin that are used along with DWQ ambient data to make use support determinations in this subbasin. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**Mercury Advisories**

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Section A, Chapter 4, Part 4.8.4.

Largemouth bass, bowfin and chain pickerel in the South River and the Black River just below the South River contain higher than normal levels of mercury. Consumption of bass, bowfin and chain pickerel should be limited to no more than two meals per person per month. Women of childbearing age and children should eat no bass, bowfin or chain pickerel taken from this area until further notice. Swimming, boating and other recreational activities are not affected by this advisory.

DWQ is continuing to sample fish tissue in eastern North Carolina.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. Refer to Section A, Chapter 4, Part 4.11.

**Black and South River Riparian Protection**

The Nature Conservancy has acquired a 295-acre tract in the Black River watershed ORW to demonstrate how the riparian buffer protects the river from nonpoint source pollution. Refer to Section C, Chapter 1, Part 1.5.5 for more information on this project.

# Chapter 19 -
## Cape Fear River Subbasin 03-06-19
### Includes the Black River, Six Runs Creek and Great Coharie Creek

## 19.1 Water Quality Overview

***Subbasin 03-06-19 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 739 |
| Land area: | 737 |
| Water area: | 2 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 40,575 people |
| Pop. Density: | 55 persons/$mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 53.5 |
| Surface Water: | 0.5 |
| Urban: | 1.3 |
| Cultivated Crop: | 34.0 |
| Pasture/ Managed Herbaceous: | 10.7 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 452.1 mi. |
| Partially Supporting: | 15.0 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 40.2 mi. |

This subbasin is located in the coastal plain. The Black River and Six Runs Creek, below Quewhiffle Swamp, were designated ORW in 1994. Land adjacent to the Black River is primarily undisturbed forest. A map of the subbasin, including water quality sampling locations, is presented in Figure B-19.

Biological ratings for these sample locations are presented in Table B-19. The current sampling resulted in impaired ratings for a portion of one stream. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

This subbasin has a very high concentration of hog farms. The Town of Clinton is the largest developed area within this subbasin. There are 7 permitted dischargers in this subbasin, the largest of which is the Town of Clinton WWTP.

Analysis of monitoring data has been complicated by the de-snagging of these streams as part of the Emergency Watershed Protection Program. This program, administered by the USDA's Natural Resources Conservation Service (NRCS), provides technical and financial assistance to preserve life and property threatened by excessive erosion and flooding. Streams appeared to be totally de-snagged at sampling sites. This makes it difficult to determine whether any changes that may have occurred in the macroinvertebrate community were due to changes in water quality or lack of suitable habitat (see Section A, Chapter 4, Part 4.11).

Both Great Coharie Creek and Six Runs Creek showed decreased water quality between 1993 and 1998. All the streams in this subbasin have many hog farms in their watersheds. The Black River has maintained a rating of Excellent since 1985; however, some pollution intolerant macroinvertebrate species were not collected in 1998 that were found in earlier samplings.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

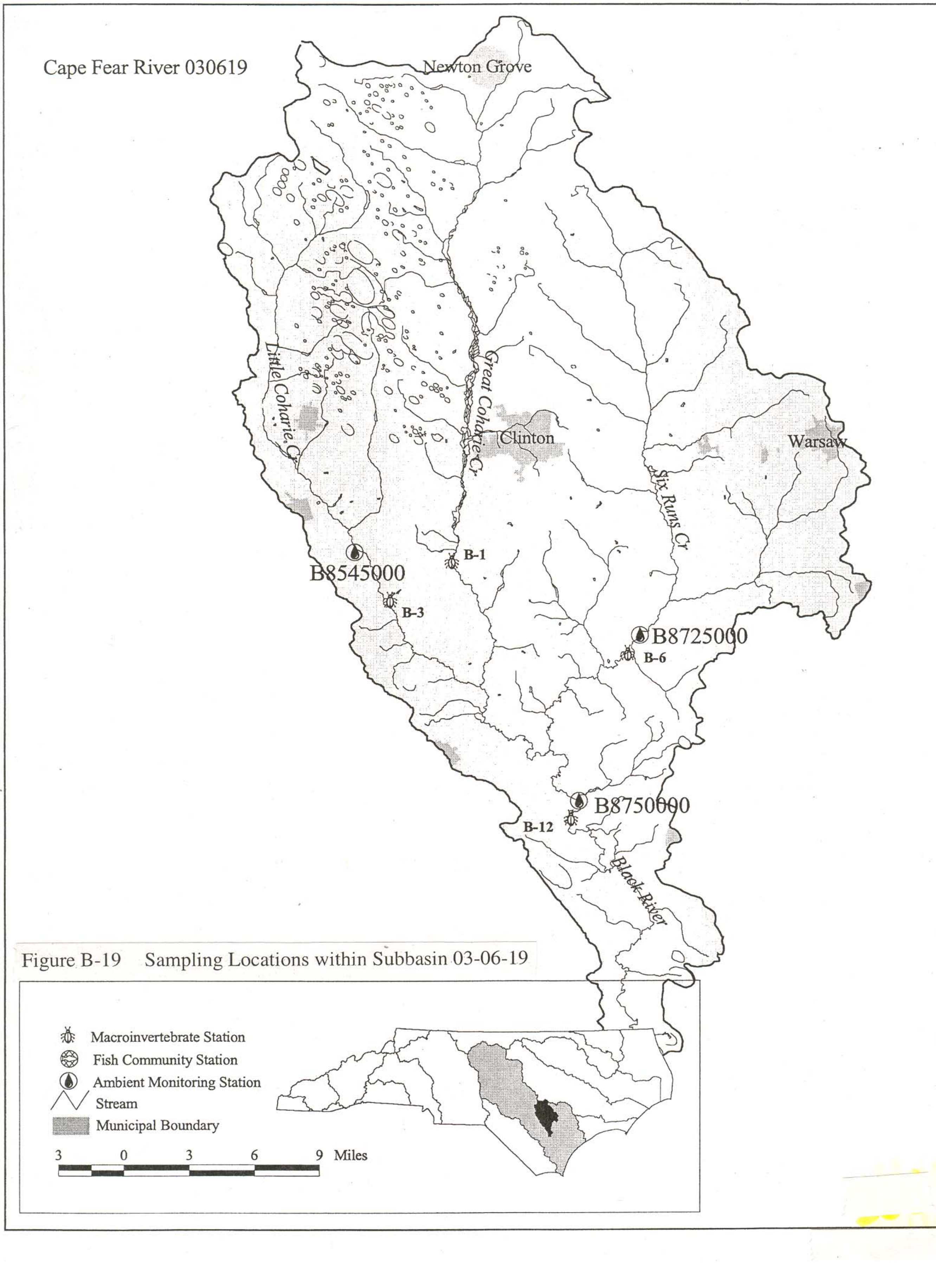


Figure B-19 Sampling Locations within Subbasin 03-06-19

Table B-19 Biological Assessment Sites in Cape Fear River Subbasin 03-06-19

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | Great Coharie Creek | Sampson | SR 1214 | Good | Good-Fair |
| B-3 | Little Coharie Creek | Sampson | SR 1214 | Good-Fair | Good-Fair |
| B-6 | Six Runs Creek | Sampson | SR 1960 | Excellent | Good |
| B-12 | Black River | Sampson | NC 411 | Excellent | Excellent |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Black River near Ivanhoe | 1995 | 7 | 3 | 0 | EPA mercury limit exceeded in 3 bowfin samples |

## 19.2 Impaired Waters

There were no impaired streams identified in the 1996 Cape Fear River Basinwide Water Quality Plan. Stewarts Creek is currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 19.3 and waters with other issues, recommendations or projects are discussed in Part 19.4.

### Stewarts Creek

*Current Status*

Stewarts Creek (15.0 miles from source to Six Runs Creek) is currently partially supporting (PS) according to DWQ monitoring in 1996 because of an impaired biological community. Nonpoint source pollution resulting from Hurricane Fran is a possible cause of the impairment. This sample was taken after the hurricane, but before de-snagging operations had started. Stewarts Creek is on the state's year 2000 303(d) list (not yet EPA approved).

The Town of Magnolia discharges into an unnamed tributary to Millers Creek, which flows into Millers Creek before entering Stewarts Creek downstream of Warsaw. The Magnolia WWTP has had problems with effluent toxicity, and UT Millers Creek has received a large amount of sludge since 1998. The problems with the WWTP are related to inflow and infiltration (I&I). The WWTP has been fined monthly since November 1999. DWQ staff are working with this facility to quickly address the collection system problems. Magnolia WWTP is replacing several thousand feet of sewer line that have caused the problems. Millers Creek and UT Millers Creek are currently not rated (NR).

*2000 Recommendations*

Because of the timing of the sampling and hurricane impacts, Stewarts Creek will continue to be monitored to assess impacts and recovery from the hurricane. The 303(d) list approach will be to resample the stream to obtain updated use support information. Monitoring of the Magnolia WWTP discharge will continue as repairs are made to the sewer system.

## 19.3 303(d) Listed Waters

Stewarts Creek is the only stream (15 stream miles) in the subbasin that is impaired and on the state's year 2000 303(d) list (not yet EPA approved). Stewarts Creek is discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 19.4 Other Issues, Recommendations and Projects

The following surface waters are fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

Portions of Great Coharie Creek, Little Coharie Creek, Six Runs Creek and Crane Creek were impacted during Hurricane Fran in 1996. These streams were also subject to massive de-snagging operations after the storm (see Section A, Chapter 4, Part 4.11). Because this region is regularly impacted by hurricanes and tropical storms, it is recommended that further monitoring be conducted to evaluate the post-hurricane recovery of macroinvertebrates. Monitoring is recommended to determine the impacts of de-snagging operations that remove important habitat in these waters.

Approximately 3% of the waters in this subbasin are impaired by nonpoint source pollution. All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

### The Lower Cape Fear River Program

The Lower Cape Fear River Program maintains three sampling stations in this subbasin that are used along with DWQ ambient data to make use support determinations in this subbasin. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**Mercury Advisories**

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Chapter 4, Part 4.8.4.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. Refer to Section A, Chapter 4, Part 4.11.

# Chapter 20 -
## Cape Fear River Subbasin 03-06-20
### Includes the Black River, Colly Creek and Moores Creek

## 20.1 Water Quality Overview

***Subbasin 03-06-20 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 343 |
| Land area: | 338 |
| Water area: | 5 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 5,231 people |
| Pop. Density: | 15 persons/$mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 77.9 |
| Surface Water: | 0.8 |
| Urban: | 0.2 |
| Cultivated Crop: | 18.0 |
| Pasture/ Managed Herbaceous: | 3.1 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 142.5 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 35.7 mi. |

*Lakes*:

Singletary Lake - Fully Supporting

This subbasin is located in the coastal plain. The subbasin contains no major urban areas, but includes the towns of White Lake, Currie and Atkinson. White Lake WWTP is the only permitted discharger in the subbasin.

The characteristics of streams in this subbasin are typical of most coastal plain areas: low geographic relief, low pH blackwaters, and a tendency for all but the largest rivers to stop flowing in summer. The Black River in this area has been classified as Outstanding Resource Waters (ORW). Agriculture is the major land use, and nonpoint source pollution is the major water quality problem, especially in the tributaries. A map of the subbasin, including water quality sampling locations, is presented in Figure B-20.

Biological ratings for these sample locations are presented in Table B-20. The current sampling resulted in no streams being rated as impaired. Refer to Appendix III for a complete listing of monitored waters and use support ratings. See Section A, Chapter 3, Table A-31 for a summary of lakes and reservoirs use support data.

Water quality in this subbasin appears to be generally good. Benthic macroinvertebrate data indicate stable water quality in the Black River for nearly a decade. Tributaries to the Black River stop flowing in the summer, so water quality assessments of tributary streams were conducted in the winter. Fair conditions were recorded at the Lyons Swamp Canal, mostly as a result of habitat degradation and heavy agricultural land use. Moore Creek had Good water quality due to its relatively undisturbed local land use and the generally lower levels of agricultural intensity in the watershed.

Fish community data were collected from Colly Creek and White Oak Branch. Fish tissue data from the Black River show elevated levels of mercury in most bowfin and bass; similar levels have been observed throughout the coastal plain.

Cape Fear River 030620

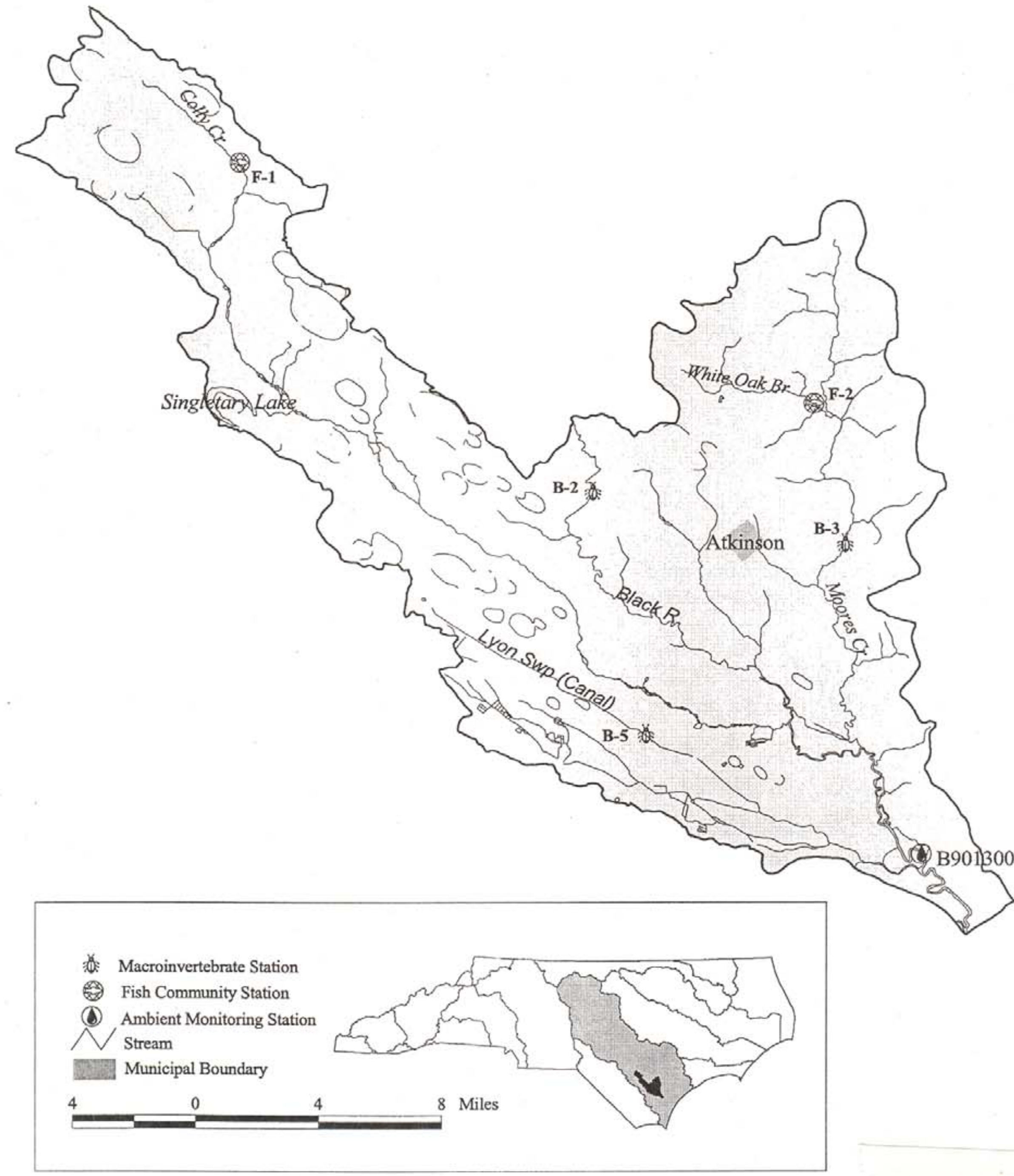


Figure B-20 Sampling Locations within Subbasin 03-06-20

Table B-52 Biological Assessment Sites in Cape Fear River Subbasin 03-06-20

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-2 | Black River | Bladen | NC 11 nr Atkinson | Good | Good |
| B- | Moores Creek | Bladen | NC 53 | no sample | Good |
| B- | Lyons Swamp Canal | Bladen | NC 11 | no sample | Fair |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993/1994** | **1998** |
| F-1 | Colly Creek | Bladen | US 701 | --- | Good-Fair |
| F-2 | White Oak Branch | Pender | SR 1206 | --- | Good-Fair |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Black River near Atkinson | 1994 | 20 | 13 | 0 | EPA mercury limit exceeded in 13 samples of bass or bowfin; FDA/NC mercury limit also exceeded in 3 bowfin |
| | Black River near Atkinson | 1998 | 36 | 26 | 0 | EPA mercury limit exceeded in 26 samples; FDA/NC mercury limit also exceeded in 12 samples |
| FT-2 | Black River at NC 210 | 1995 | 6 | 4 | 0 | EPA mercury limit exceeded in 4 bowfin samples; FDA/NC mercury limit also exceeded in 1 bowfin |

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 20.2 Impaired Waters

There were no waters identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. There are currently no waters rated as impaired according to recent DWQ monitoring. Waters with other issues, recommendations or projects are discussed in Part 20.4.

## 20.3 303(d) Listed Waters

There are no streams in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Portions of the Black River are not impaired; however, because of fish consumption advisories, this 34.5-mile segment is on the 303(d) list (see Part 20.4 below). For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 20.4 Other Issues, Recommendations and Projects

The following surface waters are fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

Portions of Colly Creek and White Oak Branch were impacted during Hurricane Fran in 1996. These streams were also subject to massive de-snagging operations after the storm (see Section A, Chapter 4, Part 4.11). Because this region is regularly impacted by hurricanes and tropical storms, it is recommended that further monitoring be conducted to evaluate the post-hurricane recovery of macroinvertebrates.

**The Lower Cape Fear River Program**

The Lower Cape Fear River Program maintains one sampling station in this subbasin that is used along with DWQ ambient data to make use support determinations in this subbasin. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**Mercury Advisories**

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Section A, Chapter 4, Part 4.8.4.

Largemouth bass, bowfin and chain pickerel in the South River and the Black River just below the South River contain higher than normal levels of mercury. Consumption of bass, bowfin and chain pickerel should be limited to no more than two meals per person per month. Women of childbearing age and children should eat no bass, bowfin or chain pickerel taken from this area until further notice. Swimming, boating and other recreational activities are not affected by this advisory.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. Refer to Section A, Chapter 4, Part 4.11.

# Chapter 21 -
# Cape Fear River Subbasin 03-06-21
## Includes the Northeast Cape Fear River and Barlow Branch

## 21.1 Water Quality Overview

***Subbasin 03-06-21 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 119 |
| Land area: | 119 |
| Water area: | 0 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 7,582 people |
| Pop. Density: | 64 persons / $mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest / Wetland: | 46.5 |
| Surface Water: | 0.2 |
| Urban: | 0.8 |
| Cultivated Crop: | 45.2 |
| Pasture / Managed Herbaceous: | 7.3 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 69.3 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 4.3 mi. |
| Not Rated: | 6.8 mi. |

This subbasin is located in the inner coastal plain and contains the headwaters of the Northeast Cape Fear River and its tributaries. Most of this subbasin is in northern Duplin County, with approximately one-third of the subbasin in southern Wayne County. Land use is primarily agriculture. The only town in this area is Mount Olive. The only significant dischargers in this subbasin are Mount Olive Pickle Company and the Town of Mount Olive. Due to lack of flow, no sites were sampled for macroinvertebrates in 1998. Fish community sampling gave Matthews Creek a Good rating. A map of the subbasin, including water quality sampling locations, is presented in Figure B-21.

Biological ratings for these sample locations are presented in Table B-21. The current sampling resulted in no impaired ratings for streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

Table B-21 Biological Assessment Site in Cape Fear River Subbasin 03-06-21

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993/1994** | **1998** |
| F-1 | Matthews Creek | Duplin | NC 111/903 | --- | Good |

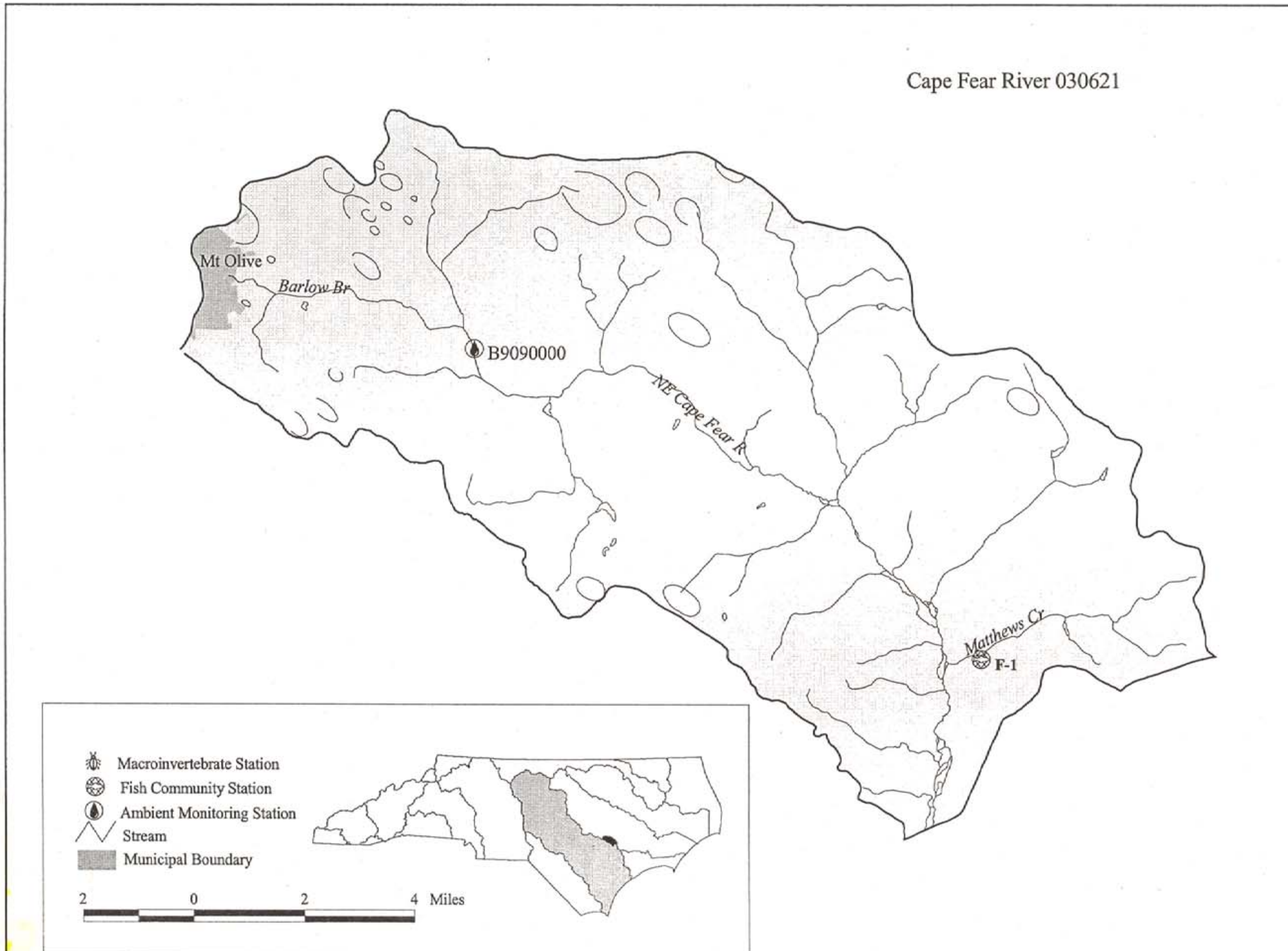


Figure B-21 Sampling Locations within Subbasin 03-06-21

## 21.2 Impaired Waters

Portions of the Northeast Cape Fear River and Barlow Branch were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of the Northeast Cape Fear River and Barlow Branch are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 21.3 and waters with other issues, recommendations or projects are discussed in Part 21.4.

**Northeast Cape Fear River and Barlow Branch**

*Current Status*

Barlow Branch (1.1 miles form source to Northeast Cape Fear River) was not supporting (NS), and Northeast Cape Fear River (4.9 miles from source to NC 403) was not supporting (NS) and partially supporting (PS) in the 1996 plan. The discharge from the Mount Olive Pickle Company was the cause of impairment. Biological monitoring data were not collected in these two streams during recent DWQ sampling because of low flow conditions. Ambient water quality data (Northeast Cape Fear River at SR 1937 approximately 2.7 miles downstream of the Mount Olive Pickle Company discharge) indicated chloride levels exceeding the water quality limit in 48% of samples taken between 1993 and July 1996. The ambient water quality station was relocated approximately 5.1 miles downstream at NC 403 in 1996. The ambient station data at NC 403 has not indicated high chloride levels. Currently the Northeast Cape Fear River (3.3 miles for source to SR 1937) and Barlow Branch (1 mile) are not supporting (NS).

The Mount Olive Pickle Company discharges chlorides above permitted levels into Barlow Branch (a zero 7Q10 stream) before it joins the Northeast Cape Fear River. The Mount Olive Pickle Company was given a variance from the state surface water quality standard for chloride (230 mg/l) in 1996. The Mount Olive Pickle Company has met the requirements of the variance to date. Over the past 11 years, the company has reduced water usage per case by 50% and salt usage by 74%.

*2000 Recommendations*

It is recommended that the Northeast Cape Fear River ambient monitoring station be relocated to SR 1937 to better evaluate the impacts of the Mount Olive Pickle Company discharge. DWQ will continue to monitor this discharge as the company continues to reduce the chloride levels reaching surface waters. For more information on the variance, refer to the EMC *Report of Proceedings on the Proposed Changes to the Surface Water Quality Standards and Classifications Rules for the Triennial Review- December 9, 1999*.

## 21.3 303(d) Listed Waters

Because the Mount Olive Pickle Company has a variance from the chloride standard and is working toward reducing the impacts of the discharge, the Northeast Cape Fear River and

Barlow Branch will not be on the state's year 2000 303(d) list (not yet EPA approved). These streams will be discussed in the narrative section of the 303(d) list.

## 21.4 Other Issues, Recommendations and Projects

The following surface waters are fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

Portions of the Northeast Cape Fear River were impacted during Hurricane Fran in 1996. These streams were also subject to massive de-snagging operations after the storm (see Section A, Chapter 4, Part 4.11). Because this region is regularly impacted by hurricanes and tropical storms, it is recommended that further monitoring be conducted to evaluate the post-hurricane recovery of macroinvertebrates. Monitoring is needed to determine the impacts of de-snagging operations that remove the most important habitat in these systems.

# Chapter 22 -
## Cape Fear River Subbasin 03-06-22
### Includes the Northeast Cape Fear River and Rockfish Creek

## 22.1 Water Quality Overview

***Subbasin 03-06-22 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 829 |
| Land area: | 828 |
| Water area: | 1 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 39,144 people |
| Pop. Density: | 47 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 58.6 |
| Surface Water: | 0.3 |
| Urban: | 1.3 |
| Cultivated Crop: | 30.3 |
| Pasture/ Managed Herbaceous: | 9.6 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 283.3 mi. |
| Partially Supporting: | 22.7 mi. |
| Not Supporting: | 0.0 mi. |
| Not Rated: | 208.2 mi. |

This subbasin contains a large portion of the Northeast Cape Fear River and its tributaries in Duplin County. Most of the watershed is agricultural, including both row crops and a dense concentration of animal operations (poultry and swine). The towns of Beulaville, Kenansville, Rose Hill and Wallace are within this subbasin. The largest discharger is Stevecoknit Fabrics. Other large dischargers include Guilford Mills, Swift-Eckrich/Butterball and the Town of Wallace. The last two facilities discharge to Rockfish Creek. A map of the subbasin, including water quality sampling locations, is presented in Figure B-22.

Biological ratings for these sample locations are presented in Table B-22. The current sampling resulted in impaired ratings for two streams in this subbasin. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Analysis of the sample data was complicated by the de-snagging of streams after Hurricane Fran as part of the Emergency Watershed Protection Program. Many streams were totally de-snagged, removing nearly all of the valuable snag habitat available for macroinvertebrate colonization. This makes it difficult to determine whether any changes that may have occurred in the macroinvertebrate community were due to changes in water quality or lack of suitable habitat (see Section A, Chapter 4, Part 4.11).

Benthos data indicated Good to Good-Fair water quality in the Northeast Cape Fear River. The section of the river between Muddy Creek and Rockfish Creek has been classified as High Quality Waters. The site at NC 41 was sampled after Hurricane Bonnie in September 1998. Sampling showed the hurricane had measurable impacts on the river. Water quality in the uppermost reach of the Northeast Cape Fear River has decreased from Excellent to Good-Fair since 1993. Most of the tributaries (Limestone Creek, Stockinghead Creek and Rockfish Creek) are rated Fair or Good-Fair, usually due to nonpoint sources of pollution.

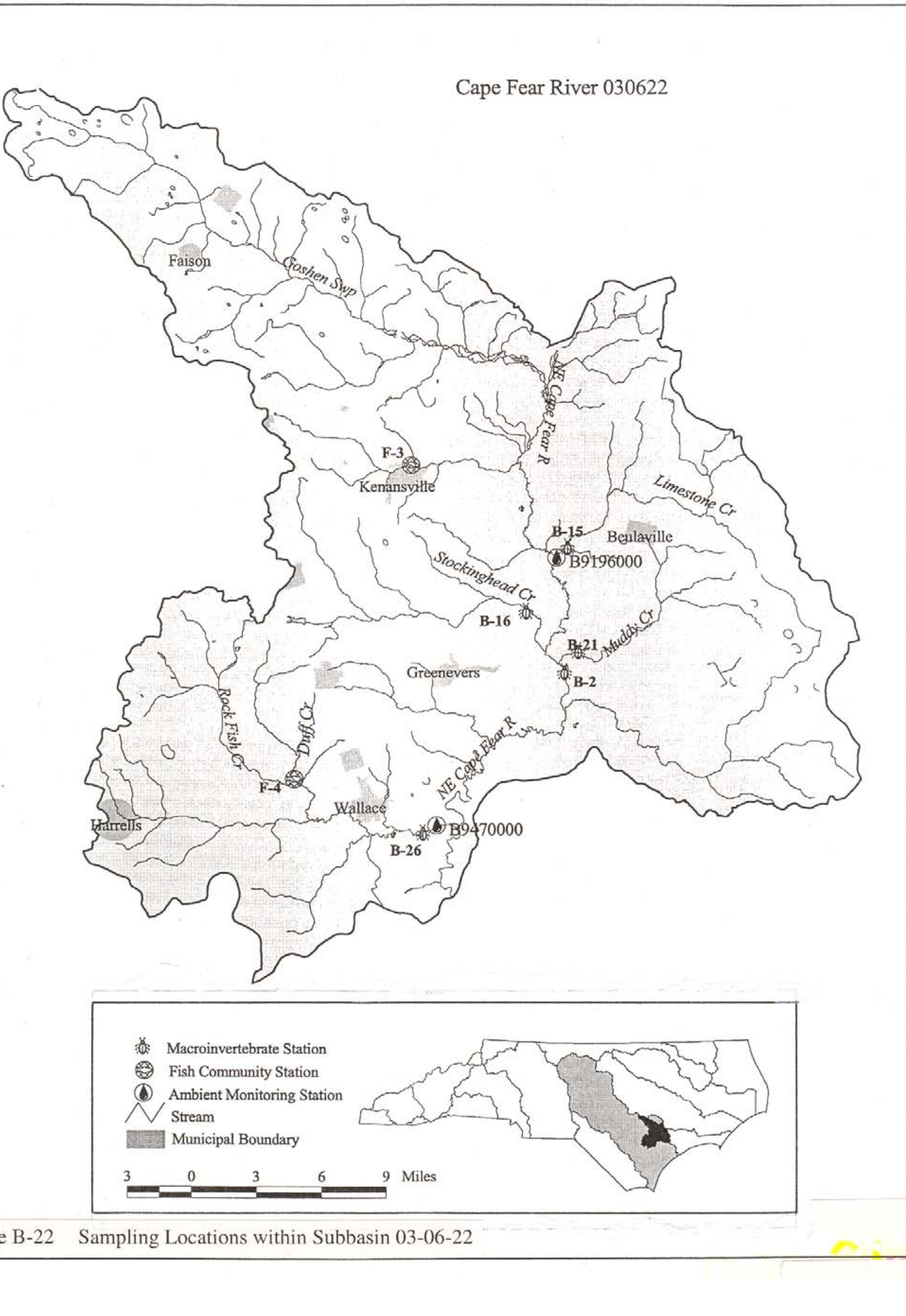


Figure B-22 Sampling Locations within Subbasin 03-06-22

Table B-22 Biological Assessment Sites in Cape Fear River Subbasin 03-06-22

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-1 | NE Cape Fear River | Duplin | NC 11/903 | Excellent | Good-Fair |
| B-2 | NE Cape Fear River | Duplin | NC 41 | Good | Good |
| B-15 | Limestone Creek | Duplin | SR 1702 | Excellent | Good-Fair |
| B-16 | Stockinghead Creek | Duplin | SR 1953 | Good-Fair | Good-Fair |
| B-21 | Muddy Creek | Duplin | NC 41 | Not Rated | Fair |
| B-25 | Rockfish Creek | Duplin | SR 1165 | Good-Fair | Fair |
| B-26 | Rockfish Creek | Duplin | I-40 | Fair | Good-Fair |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993/1994** | **1998** |
| F-3 | Grove Creek | Duplin | NC 11/903 | Good | Good-Fair |
| F-4 | Duff Creek | Duplin | SR 1170 | --- | Good |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Northeast Cape Fear River at NC 24 | 1994 | 26 | 9 | 0 | EPA mercury limit exceeded in 9 samples; FDA/NC mercury limit exceeded in 3 samples |

The fish community was evaluated at Grove Creek and Duff Creek. Fish tissue samples were collected from the Northeast Cape Fear River at NC 24. Nine of the 26 samples analyzed contained mercury at a level exceeding EPA limits. Three samples also contained mercury exceeding the FDA/NC limit.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

## 22.2 Impaired Waters

Portions of Goshen Swamp, Panther Creek, Herrings Marsh Run, Limestone Creek, Persimmon Branch and Rock Fish Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Rock Fish Creek and Muddy Creek are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 22.3 and waters with other issues, recommendations or projects are discussed in Part 22.4.

**Goshen Swamp and Panther Creek**

*Current Status*

Goshen Swamp and Panther Creek were not supporting (NS) in the 1996 plan because of a high chloride discharge from Dean Pickle and Specialty Products, which discharges into an unnamed low flow (zero 7Q10) tributary of Panther Creek before flowing into Goshen Swamp. Dean Pickle and Specialty Products was given a variance from the state surface water quality standard for chloride (230 mg/l) in 1996. The company has met the requirements of the variance to date. Goshen Swamp and Panther Creek were not sampled during recent DWQ monitoring because of low flow conditions. These two streams are currently not rated (NR). Because Dean Pickle and Specialty Products has a variance from the chloride standard and is working toward reducing the impacts of the discharge, Goshen Swamp and Panther Branch will not be on the state's year 2000 303(d) list (not yet EPA approved). For more information on the variance, refer to the EMC *Report of Proceedings on the Proposed Changes to the Surface Water Quality Standards and Classifications Rules for the Triennial Review- December 9, 1999*.

*2000 Recommendations*

DWQ will continue to monitor the discharge to further assess the extent and severity of the impacts to water quality in the receiving stream.

**Herrings Marsh Run**

*Current Status*

Herrings Marsh Run (1.8 miles) was partially supporting (PS) in the 1996 plan. This stream is currently not rated (NR). Using new biological information, DWQ has determined that the previous rating was inappropriate because of the small size of the stream. This stream is no longer on the 303(d) list.

**Limestone Creek**

*Current Status*

Limestone Creek (7.5 miles) was partially supporting (PS) in the 1996 plan. Using new biological information, DWQ has determined that the previous rating was inappropriate. This stream is currently fully supporting (FS) according to recent DWQ monitoring and is no longer on the 303(d) list.

**Persimmon Branch**

*Current Status*

Persimmon Branch (2.3 miles) was not supporting (NS) and partially supporting (PS) in the lower segment in the 1996 plan. This stream is currently not rated (NR). Using new biological information, DWQ has determined that the previous rating was inappropriate. This stream is no longer on the 303(d) list.

**Rock Fish Creek**

*Current Status*

Rock Fish Creek (7.2 miles from SR 1165 to Northeast Cape Fear River) was partially supporting (PS) in the 1996 plan. Currently, 8.7 miles (from Swift-Eckrich to Little Rockfish Creek) are partially supporting (PS) according to recent DWQ monitoring because of instream habitat degradation. The 3.8-mile segment from Little Rock Fish Creek to the Northeast Cape Fear River is currently fully supporting (FS). De-snagging operations after Hurricane Fran removed important habitat for macroinvertebrates and fish in these waters. Discharges from Swift-Eckrich may also contribute to the habitat degradation. These waters are on the state’s year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

It is recommended that monitoring of Rock Fish Creek be continued to assess recovery from hurricane impacts. For recommendations regarding de-snagging operations, see Section A, Chapter 4, Part 4.11. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

**Muddy Creek**

*Current Status*

Muddy Creek (14.0 miles from source to Northeast Cape Fear River) was not rated in 1993 because of its small size. The stream is significantly larger due to changes associated with Hurricane Fran in 1996. The stream is partially supporting (PS) according to recent DWQ monitoring due to nonpoint sources. The watershed contains many hog operations. This stream is on the state’s year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Further monitoring is recommended to determine the nature of the nonpoint source pollution. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

## 22.3 303(d) Listed Waters

There are two streams (22.7 stream miles) in the subbasin that are impaired and on the state’s year 2000 303(d) list (not yet EPA approved). Muddy Creek and Rock Fish Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 22.4 Other Issues, Recommendations and Projects

The following surface waters are fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

Portions of the Northeast Cape Fear River, Limestone Creek and Rock Fish Creek were impacted during Hurricane Fran in 1996. These streams were also subject to massive de-snagging operations after the storm (see Section A, Chapter 4, Part 4.11). Because this region is regularly impacted by hurricanes and tropical storms, it is recommended that further monitoring be conducted to evaluate the post-hurricane recovery of macroinvertebrates. Monitoring is needed to determine the impacts of de-snagging operations that remove the most important habitat in these systems.

**The Lower Cape Fear River Program**

The Lower Cape Fear River Program maintains six sampling stations in this subbasin that are used along with DWQ ambient data to make use support determinations in this subbasin. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**Mercury Advisories**

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Section A, Chapter 4, Part 4.8.4.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. Refer to Section A, Chapter 4, Part 4.11 for more information.

**Northeast Cape Fear River Riparian Buffer Protection**

The Wildlife Resource Commission was awarded funding to establish 46,000 linear feet of buffers along the Northeast Cape Fear River. Refer to Section C, Chapter 1, Part 1.5.6 for information on this project.

# Chapter 23 -
## Cape Fear River Subbasin 03-06-23
### Includes Northeast Cape Fear River and Burgaw Creek

## 23.1 Water Quality Overview

***Subbasin 03-06-23 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 795 |
| Land area: | 789 |
| Water area: | 6 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 64,540 people |
| Pop. Density: | 82 persons/mi$^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 82.5 |
| Surface Water: | 0.9 |
| Urban: | 2.1 |
| Cultivated Crop: | 11.2 |
| Pasture/ Managed Herbaceous: | 3.2 |

**Use Support Ratings**

*Freshwater Streams*:

| | |
|---|---|
| Fully Supporting: | 304.1 mi. |
| Partially Supporting: | 0.0 mi. |
| Not Supporting: | 14.3 mi. |
| Not Rated: | 37.5 mi. |

This subbasin is located in the outer Coastal Plain and contains the Town of Burgaw. The area is characterized by slow-flowing blackwater streams. Most of the streams in this subbasin stop flowing or dry up during the summer. Much of this subbasin is undeveloped and included in either the Holly Shelter Game Refuge or the Angola Bay Game Refuge. A map of the subbasin, including water quality sampling locations, is presented in Figure B-23.

Biological ratings for these sample locations are presented in Table B-23. The current sampling resulted in impaired ratings for four of the seven stream segments. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

There are six permitted dischargers in the subbasin, with the largest dischargers being Occidental Chemical, Thorn Apple Valley and Burgaw WWTP.

Ambient chemistry data show average nutrient levels in the Northeast Cape Fear River at US 117 to be lower than more upstream river sites.

Benthic macroinvertebrate data indicated stable water quality at most sites in the subbasin, except for the mainstem Northeast Cape Fear River, which has shown steady improvement from Fair water quality in 1985 to a Good rating in 1998. Fair conditions were maintained at Angola Creek, and Cypress Creek maintained its Good rating. Most other sites were not rated using macroinvertebrate data because of the swampy characteristics of these waters. Burgaw Creek below the WWTP, and Burnt Mill Creek in Wilmington were rated Poor. The fish community in Burgaw Creek below the WWTP was also impacted, receiving a Fair NCIBI rating. Mercury above EPA and /or FDA/NC limits was found in the tissue of bass and bowfin in this subbasin.

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

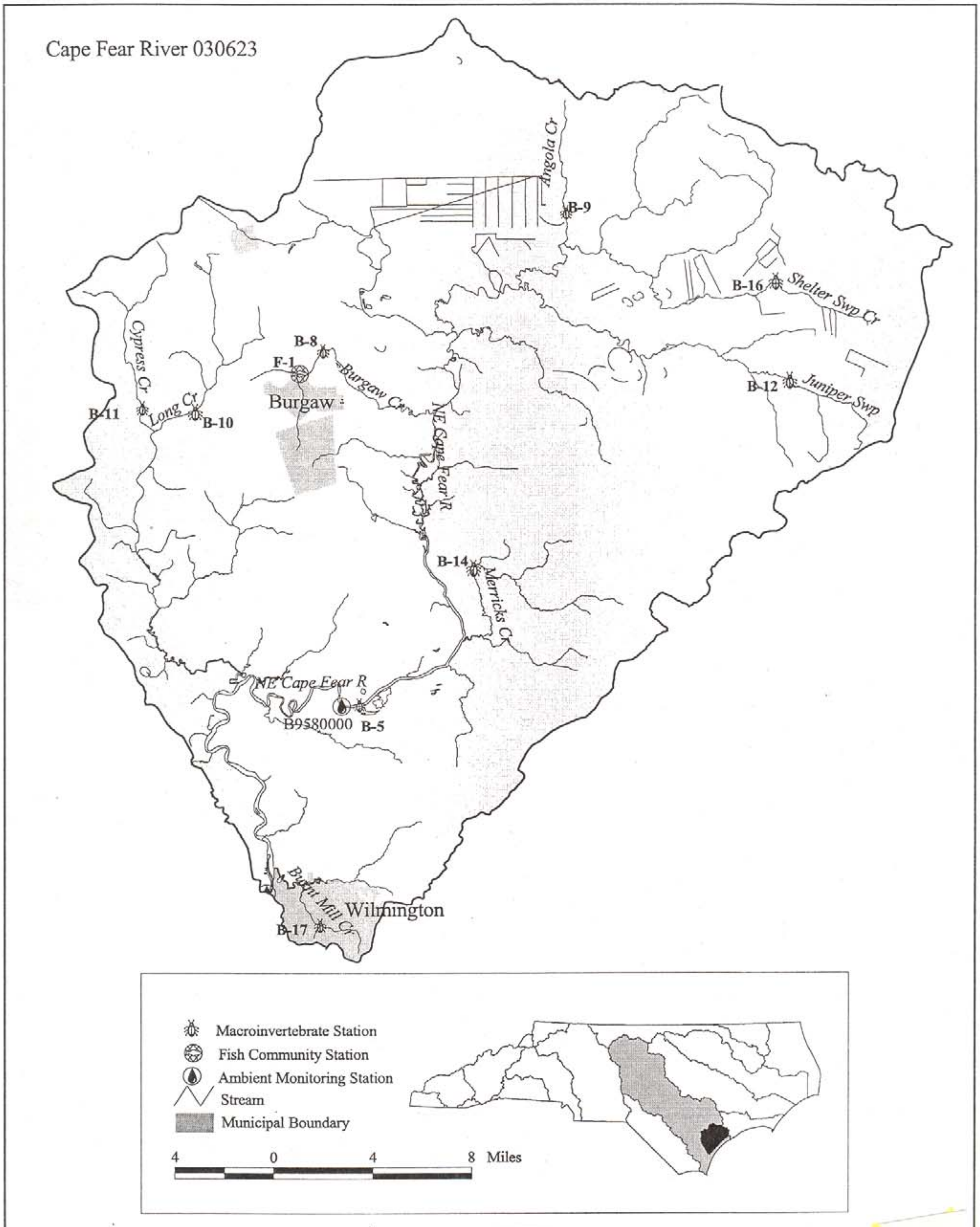


Figure B-23 Sampling Locations within Subbasin 03-06-23

Table B-23 Biological Assessment Sites in Cape Fear River Subbasin 03-06-23

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-5 | NE Cape Fear River | New Hanover | US 117 | Good-Fair | Good |
| B-8 | Burgaw Creek | Pender | I-40 | no sample | Poor |
| B-9 | Angola Creek | Pender | NC 53 | Fair | Fair |
| B-11 | Cypress Creek | Pender | NC 53 | Good | Good |
| B-12 | Juniper Swamp | Onslow | NC 50 | Good-Excellent | Good-Excellent |
| B-14 | Merricks Creek | Pender | NC 210 | Good-Excellent | Good-Excellent |
| B-16 | Shelter Swamp | Onslow | NC 50 | no sample | Good-Excellent |
| B-17 | Burnt Mill Creek | New Hanover | Metts Avenue | no sample | Poor |

| ***FISH*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1994** | **1998** |
| F-1 | Burgaw Creek | Pender | US 117 | no sample | Fair |

| ***FISH TISSSUE*** | | | | ***No. Samples Exceeding Criteria*** | | |
|---|---|---|---|---|---|---|
| **Station** | **Description** | **Year Sampled** | **Total Samples** | **Metals** | **Organics** | **Comments** |
| FT-1 | Cape Fear River at NC 53 | 1995 | 6 | 1 | 0 | EPA mercury limit exceeded in 1 bowfin sample |
| FT-2 | NE Cape Fear River at Castle Hayne | 1994 | 21 | 8 | 0 | EPA mercury limit exceeded in 8 bowfin/ bass samples |
| | | 1998 | 25 | 3 | 0 | EPA mercury limit exceeded in 3 samples; FDA/NC mercury limit exceeded in 1 sample |

## 23.2 Impaired Waters

Portions of Cypress Creek, Burnt Mill Creek and Burgaw Creek were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Burnt Mill Creek and Burgaw Creek are currently rated as impaired according to recent DWQ monitoring. Current status of each of these streams is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 23.3 and waters with other issues, recommendations or projects are discussed in Part 23.4.

### Cypress Creek

*Current Status*

Cypress Creek (8.0 miles from source to Long Creek) was partially supporting (PS) in the 1996 plan. DWQ has determined that the previous rating was inappropriate for this section. This stream segment is currently not rated (NR) and is not on the 303(d) list. A downstream sample at NC 53 shows no impairment.

**Burnt Mill Creek**

*Current Status*

Burnt Mill Creek (4.8 miles from source to Smith Creek) was not supporting (NS) in the 1996 plan and is currently not supporting (NS) because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources and channel dredging is a possible cause of impairment. This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Further monitoring is recommended to determine the nature of the nonpoint source pollution. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

The NC Wetlands Restoration Program (see Section C, Chapter 1, Part 1.3.1) will be starting a stakeholder process to develop a Local Watershed Plan for the Burnt Mill Creek watershed in June, 2000.

**Burgaw Creek**

*Current Status*

Burgaw Creek (9.5 miles from Osgood Canal to Northeast Cape Fear River) was not supporting (NS) in the 1996 plan. This stream is currently not supporting (NS) because of an impaired biological community. Instream habitat degradation associated with urban nonpoint sources is a possible cause of impairment. There are indications of excessive nutrients in this stream, and fecal coliform bacteria are also noted as a problem parameter. Failing septic systems have been noted in this watershed as well. The stream is channelized and has been adversely impacted by desnagging activities after Hurricane Fran (see Section A, Chapter 4, Part 4.11). This stream is on the state's year 2000 303(d) list (not yet EPA approved).

*2000 Recommendations*

Further monitoring is recommended to determine the nature of the nonpoint source pollution. The 303(d) list approach will be to resample for biological and chemical data to attempt to determine potential problem parameters.

## 23.3 303(d) Listed Waters

There are two streams (14.3 stream miles) in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). Burnt Mill Creek and Burgaw Creek are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 23.4 Other Issues, Recommendations and Projects

The following surface waters are fully supporting using recent DWQ monitoring data. However, these data revealed some impacts to water quality. Although no action is required for these surface waters, continued monitoring is recommended. Enforcement of sediment and erosion control laws will help to reduce impacts on these streams and lakes. DWQ encourages the use of voluntary measures to prevent water quality degradation. Education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. For information on water quality education programs, workshops and nonpoint source agency contacts, see Appendix V.

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**The Lower Cape Fear River Program**

The Lower Cape Fear River Program maintains five sampling stations in this subbasin that are used along with DWQ ambient data to make use support determinations in this subbasin. Refer to Section C, Part 1.4.5 for more information on the program and the UNCW Center for Marine Sciences.

**Mercury Advisories**

DWQ sampling in 1994 and 1998 noted mercury in fish tissue at levels greater than EPA limits and FDA/NC limits. Mercury in fish tissue is not exclusive to the Cape Fear River basin. In recent years, elevated levels of mercury in some fish species have been noted in other coastal areas. This issue is discussed further in Section A, Chapter 4, Part 4.8.4.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. Refer to Section A, Chapter 4, Part 4.11 for more information.

# Chapter 24 -
## Cape Fear River Subbasin 03-06-24
### Includes Masonboro Sound, Topsail Sound and the Intracoastal Waterway

## 24.1 Water Quality Overview

***Subbasin 03-06-24 at a Glance***

**Land and Water Area (sq. mi.)**

| | |
|---|---|
| Total area: | 162 |
| Land area: | 142 |
| Water area: | 20 |

**Population Statistics**

| | |
|---|---|
| 1990 Est. Pop.: | 49,998 people |
| Pop. Density: | 352 persons/$mi^2$ |

**Land Cover (%)**

| | |
|---|---|
| Forest/Wetland: | 63.0 |
| Surface Water: | 17.5 |
| Urban: | 8.3 |
| Cultivated Crop: | 6.7 |
| Pasture/ Managed Herbaceous: | 4.5 |

**Use Support Ratings**

| *Estuarine Waters*: | In Acres |
|---|---|
| Fully Supporting: | 13,359 ac. |
| Partially Supporting: | 1,391 ac. |
| Not Supporting: | 0.0 ac. |
| Not Rated: | 0.0 ac. |

This subbasin is located in the tidal and estuarine region of the coast and contains portions of Wilmington and the towns of Wrightsville Beach and Carolina Beach. A map of the subbasin, including water quality sampling locations, is presented in Figure B-24.

Biological ratings for these sample locations are presented in Table B-24. The current sampling resulted in impaired ratings for 1,391 acres of estuarine waters. A summary of use support ratings for estuarine waters is presented in Table A-32. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Suburban development is the major land use and nonpoint source pollution is the major water quality problem. There are 4 permitted dischargers in the subbasin, but none larger than 0.5 MGD.

Water quality appears to be high in most of the sounds and creeks in this subbasin. Masonboro Sound, Middle Sound, Topsail Sound and Stump Sound are all classified as Outstanding Resource Waters (ORW). Many creeks (Turkey, Cedar Snag, Butler, Howe and John) and channels (Howard, Long Point, Green and Nixon) also have been designated ORW. The Masonboro Island National Estuarine Research Reserve is also located in this subbasin.

The greatest water quality problem in this subbasin appears to be the rapid urbanization of this area and the increasing runoff that comes with this development. DWQ sampling suggests that water quality also appears to decline at either end of this subbasin (Snows Cut and Everett Bay), where the only flushing comes from areas of poorer water quality (Cape Fear River and New River, respectively).

For more detailed information on water quality in this subbasin, refer to *Basinwide Assessment Report – Cape Fear River Basin – June 1999*, available from DWQ Environmental Sciences Branch at (919) 733-9960.

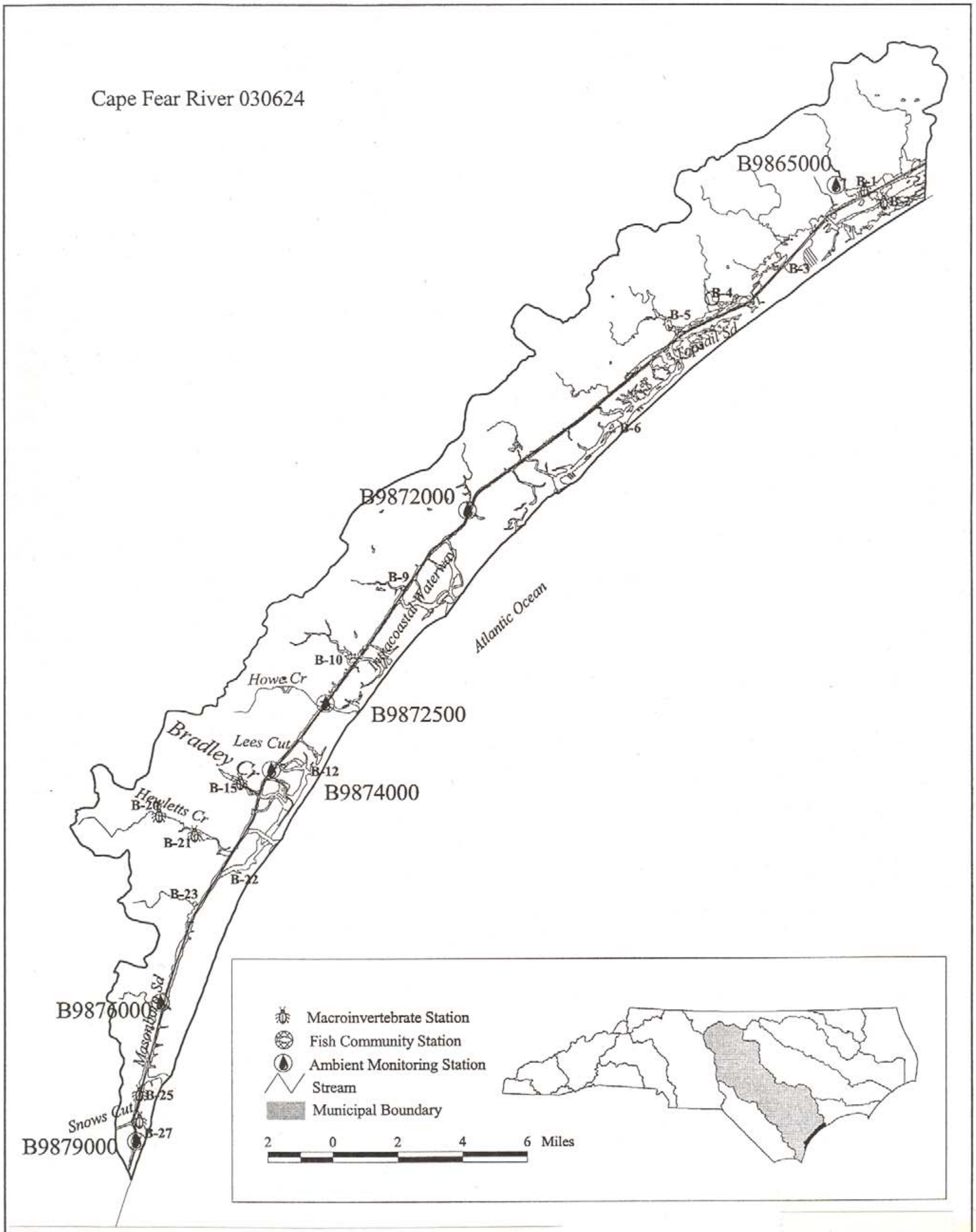


Figure B-24 Sampling Locations within Subbasin 03-06-24

Table B-24 Biological Assessment Sites in Cape Fear River Subbasin 03-06-24

| ***BENTHOS*** | | | | ***Bioclassification*** | |
|---|---|---|---|---|---|
| **Site #** | **Stream** | **County** | **Location** | **1993** | **1998** |
| B-15 | Bradley Creek | New Hanover | US 76 | Heavy | Heavy |
| B-21 | Hewletts Creek | New Hanover | at bend | Moderate | Moderate |

## 24.2 Impaired Waters

Portions of Myrtle Sound, Masonboro Sound, Wrightsville Beach, Topsail Sound and Stump Sound were identified as impaired in the 1996 Cape Fear River Basinwide Water Quality Plan. Portions of Myrtle Sound, Masonboro Sound, Wrightsville Beach, Topsail Sound and Stump Sound are currently partially supporting (PS) according to recent DWQ and DEH monitoring. Current status of each of these waters is discussed below. Prior recommendations, future recommendations and projects aimed at improving water quality for these waters are also discussed when applicable. 303(d) listed waters are summarized in Part 24.3 and waters with other issues, recommendations or projects are discussed in Part 24.4.

### Impaired Estuarine Waters

*Current Status*

Portions of Myrtle Sound, Masonboro Sound, Wrightsville Beach, Topsail Sound and Stump Sound have been closed to shellfishing by the Division of Marine Fisheries (DMF) based on recommendations by Division of Environmental Health Shellfish Sanitation Section. DEH regulations specify closure of growing areas when fecal coliform bacteria levels exceed 14 colonies per 100 ml of water. Urban runoff after rainfall events is the major source of fecal coliform bacteria contamination with several marinas, canal systems, construction, one WWTP and septic tanks as minor sources.

Based on DEH monitoring, 1,391 estuarine acres are currently partially supporting (PS). These waters are on the state’s year 2000 303(d) list (not yet EPA approved). Recommendations for improving water quality in these waters are discussed below. Refer to Table A-32 for overall use support ratings for estuarine areas and Figure A-16 for a map of DEH shellfish growing areas.

There are 14,750 acres of Class SA waters in subbasin 03-06-24. The best use of Class SA waters is for harvesting shellfish. Approximately 10% (1,391 acres) are currently impaired. Many acres have shellfish harvesting limited because of polluted runoff after rain events. Productive shellfish harvest areas are near shore and at high risk for bacterial contamination from urban runoff. There is a significant correlation between impervious surfaces in a watershed and amount of fecal coliform bacteria found in receiving waters (Mallin et al., 2000).

*2000 Recommendations*

In the Cape Fear 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 of various land use activities is needed to decrease fecal coliform bacteria levels in shellfish growing areas, thereby, decreasing the acreage closed to harvesting. Refer to Section A, Chapter 4, Part 4.14 for further recommendations regarding shellfish growing areas.

DWQ will work with DEH, DCM, DMF and local governments to better identify the extent and sources of impairment to shellfish harvesting in Class SA waters.

## 24.3 303(d) Listed Waters

There are 1,391 acres of estuarine waters in the subbasin that are impaired and on the state's year 2000 303(d) list (not yet EPA approved). The impaired estuarine areas are discussed above. For information on 303(d) listing requirements and approaches, refer to Appendix IV.

## 24.4 Other Issues, Recommendations and Projects

All the waters of the subbasin are affected by nonpoint sources. DENR, other state agencies and environmental groups have programs and initiatives underway to address water quality problems associated with nonpoint sources. DWQ will notify local agencies of water quality concerns in this subbasin and work with these various agencies to conduct further monitoring, as well as assist agency personnel with locating sources of funding for water quality protection.

**Conditionally Approved Open Shellfish Harvest Areas**

Conditionally approved open shellfish harvest areas are currently fully supporting (FS). There are concerns that the amount of time that these areas are open for shellfishing is decreasing. Increased development around these waters will likely increase the number of days that these areas are closed to shellfishing. Development must be curbed in order to maintain current open acreage of shellfishing waters. Maintenance and restoration of shellfishing waters will require the concerted efforts of local governments, environmental organizations, shellfishermen, and state and federal agencies. DWQ will work with other agencies, organizations and local governments, where possible, to improve water quality and shellfishing in coastal waters.

**1999 Hurricanes**

In September and October 1999, three hurricanes made landfall near the mouth of the Cape Fear River. Although streams throughout the basin were impacted, the streams in the lower Cape Fear River subbasins were severely impacted. The extent of water quality problems and recovery of ecosystems in this subbasin will not be known for some time. Refer to Section A, Chapter 4, Part 4.11 for more information.

### Constructed Wetlands for Landfill Leachate

This project is a non-discharge solution to leachate disposal that will greatly reduce the nitrogen load to receiving waters.  For more information on this project, refer to Section C, Chapter 1, Part 1.5.6.

### The New Hanover County Tidal Creeks Project and City of Wilmington Watersheds Project

Since 1993, the UNC-Wilmington Center for Marine Science has been conducting research on bacterial pollution, algal blooms, effect of tides on water quality parameters, nutrient limitation of phytoplankton productivity, and nutrient loading in five tidal creeks in New Hanover County. Annual reports are published on the projects' progress.  In autumn 1997, the Center began an ongoing project analyzing environmental quality of the City of Wilmington's drainage basins. Refer to Section C, Chapter 1, Part 1.4.5 for more information on these projects.

# Section C

# Current and Future Water Quality Initiatives

# Chapter 1 -
# Current Water Quality Initiatives

## 1.1 Workshop Summaries

There were three workshops held in the Cape Fear River basin in July and August 1999. The workshops were held in Greensboro, Clinton and Wilmington. The DWQ, NC Cooperative Extension Services of Guilford, Sampson and New Hanover counties, and the Cape Fear River Assembly sponsored the workshops. A total of 198 people attended the three workshops. All workshops represented a wide variety of interests in the river basin.

Each workshop had four presentations pertaining to important issues to the region of the basin where the workshop was held. Workshop participants were asked to discuss a series of questions in small groups. The questions were as follows:

1) What are the most important issues to be addressed in the next basin plan?
2) Where are the problem areas or waters in the basin?
3) What recommendations do you have for addressing these problems?
4) What local agencies or organizations should be involved in addressing these problems?

The discussion on these questions was very productive. Comments and responses were recorded during each workshop. A general summary of the workshops, providing common ideas and viewpoints, is presented below.

- urban sprawl
- comprehensive watershed management
- nonpoint source pollution
- buffers
- algal blooms and nutrients
- Randleman Reservoir
- land-use planning
- seventeen dams on the Deep River
- sedimentation
- agricultural BMPs
- focusing on economic considerations
- focus on nonpoint source pollution
- better education for general public
- growth planning
- state agency and local community coordination
- tighter controls on variances/SOCs for permittees with tighter time limits
- point source dischargers bearing brunt of enforcement
- more control on development and construction in wetlands
- stormwater runoff

Workshop participants made recommendations for addressing water quality problems. These recommendations included urban BMPs, planning, incentives for agricultural operations, local enforcement, water recycling, education, riparian buffers, increasing regulatory staff and securing funding for enforcement.

DWQ considered these comments while drafting the revised Cape Fear River Basinwide Water Quality Plan and will continue to use these comments to guide water quality activities in the Cape Fear River basin.

For a copy of the summary of the three workshops, call DWQ at (919) 733-5083, ext. 360.

## 1.2 Federal Initiatives

### 1.2.1 Section 319 – Base Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration projects. Approximately $1 million is available annually for demonstration and education projects across the state. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina 319 grant program, including application deadlines and requests for proposals, are available online at http://h2o.enr.state.nc.us/nps/bigpic.htm.

Table C-1 319 Projects in the Cape Fear River Basin

| Fund Source | Project | Contractor | Grant |
|---|---|---|---|
| 319 FY1998 | Private Well Protection Project | NC Cooperative Extension Service | $34,555 |

***Private Well Protection Project***

Many private wells in eastern North Carolina are particularly susceptible to contamination because they are shallow (typically less than 50 feet deep) and poorly constructed. Previous studies of North Carolina private water supply wells indicate that up to 10% may contain nitrate-nitrogen at levels exceeding the safe drinking water standard of 10 mg/l.

A minimum of 300 private water supply wells will be screened for nitrate contamination over a two-year period in the Cape Fear River basin. Special emphasis will be placed on sampling high-risk wells that are shallow, poorly constructed, and located near potential pollution sources. A detailed survey of well construction and location characteristics will be completed for each well. All project participants will be educated on basic well protection measures including water testing, pollution prevention, water treatment and new well construction, if needed.

### 1.2.2 Clean Water Act Section 319 (h) – Incremental Program

In 1998, the President's Clean Water Action Plan Initiative required states to compile and rate water quality conditions at the 8-digit hydrologic unit scale. This evaluation by the state resulted in the identification of 23 HUs as 'needing restoration'. The Category I rating makes these areas eligible for additional funding through the incremental 319 program. There are six hydrologic units within the Cape Fear River basin (Table C-2); three of which were rated as needing restoration in the 1998 Unified Watershed Assessment. The Haw River was identified as a high priority restoration area, particularly due to the state designation as nutrient sensitive waters and the significant urban impacts.

Table C-2 Hydrologic Units within the Cape Fear River Basin

| HU Name | HUC | UWA Rating |
|---|---|---|
| Haw | 03030002 | I-HP |
| Deep | 03030003 | I |
| Upper Cape Fear | 03030004 | II |
| Lower Cape Fear | 03030005 | I |
| Black River | 03030006 | II |
| Northeast Cape Fear River | 03030007 | II |

Funding for implementation of the Clean Water Action Plan Initiative is provided through the Section 319 Incremental Grant Program. With a separate funding source, these grant resources are to be allocated by the state for assessment and implementation in Hydrologic Units defined as "Needing Restoration" in the 1998 North Carolina Unified Watershed Assessment. This funding was first available for FY 1999, and continued funding of this program will be decided by Congress. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina 319 grant program, including application deadlines and requests for proposals, are available online at http://h2o.enr.state.nc.us/nps/bigpic.htm.

### 1.2.3 Clean Water Act – Section 205 (j) Planning Grant

Section 205 (j) of the Clean Water Act allocates a small amount of money to states for water resource planning or demonstration. Only Councils of Government are eligible to apply for this funding. Annual funding for this program is approximately $100,000. Descriptions of these projects are included in Part 1.5 below.

### 1.2.4 USDA – NRCS Environmental Quality Improvement Program (EQIP)

The EQIP program is a federal cost share program that in many states is not augmented by a state agricultural cost share program. For this reason, EQIP funds are allocated to priority areas where current available funding is identified as inadequate. Through applications, the NRCS districts are able to compete for EQIP incentive funding. A team of state agencies reviews new applications and reevaluates the performance of existing priority areas on an annual basis. Rankings are considered based upon performance; i.e., the value of contracts completed versus the amount of money allocated and environmental benefit. Initial allocations are set based upon ranking and proposal requests. The NRCS administers the local sign-up, environmental benefits ratings and contract administration.

Three areas within the Cape Fear River basin are included in the USDA – NRCS EQIP FY2000 Priority area budget. The Deep River, Northeast Cape Fear and Black River are included. Table C-3 includes descriptions of primary resource concerns, targeted practices and final FY 1999 contract allocations. NRCS district contacts are available in the NPS Contact Sheet, Appendix V.

Table C-3 Cape Fear River Basin EQIP Projects

| Priority Area | Primary Resource Concern | Targeted Practices | Lead NRCS District | Final Allocation |
|---|---|---|---|---|
| Deep River 03030003 | Soil erosion, animal waste, nutrient runoff and leaching | No-till, waste utilization, nutrient management, pest management, pasture and hay planting | Randolph County | $119,124 |
| Black River 03030006 | Animal waste, soil erosion, wildlife habitat, nutrient runoff | No-till, waste utilization, riparian buffer, nutrient management, wildlife habitat management | Sampson County | $105,945 |
| Northeast Cape Fear 03030007 | Animal waste, soil erosion, wildlife habitat, pesticide runoff | Waste utilization, no-till, wildlife habitat management, nutrient management, pest management | Duplin County | $118,214 |

## 1.3 State Initiatives

### 1.3.1 NC Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) is a nonregulatory program responsible for implementing wetland and stream restoration projects throughout the state. The focus of the program is to improve water quality, flood prevention, fisheries, wildlife habitat and recreational opportunities. The NCWRP is not a grant program. Instead, the NCWRP funds wetland, stream and streamside (riparian) area projects directly through the Wetlands Restoration Fund.

Restoration sites are targeted through the use and development of the Basinwide Wetlands and Riparian Restoration Plans. These plans were developed, in part, using information compiled in DWQ's Basinwide Water Quality Plans. The Basinwide Wetlands and Riparian Restoration Plans are updated every five years on the same schedule as DWQ's Basinwide Water Quality Plans. As new data and information become available about water quality degradation issues in the Cape Fear River River basin, priority subbasins identified in the NCWRP's plans may be modified.

The NCWRP is also working to develop comprehensive Local Watershed Restoration Plans within the identified Priority Subbasins. These more locally-based plans will identify wetland areas, contiguous reaches of stream, and contiguous strips of buffer that, once restored, will provide significant water quality and other environmental benefits to watersheds. The NCWRP will coordinate with local community groups, local governments and others to develop and implement these plans.

The NCWRP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example, the NCWRP's efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with 319 funded or proposed projects will often improve the overall water quality benefits of the project.

For more information about participating in the NCWRP, please contact Crystal Braswell at (919) 733-5208 or visit the website at http://h2o.enr.state.nc.us/, then click on Wetlands Restoration Program.

### 1.3.2 Clean Water Management Trust Fund

The Clean Water Management Trust Fund offers approximately $40 million annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and protecting state surface waters and establishing a network of riparian buffers and greenways. In the Cape Fear River basin, twenty projects have been funded. The total amount of funds allocated to this basin through the CWMTF is $21,431,700. Descriptions of the basinwide projects are included in descriptions of current initiatives by major watershed in Part 1.5 below.

For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

## 1.4 Local Initiatives

### 1.4.1 Cape Fear River Basin Associations

In complement to the DWQ's basinwide approach for planning and management of water resources, associations of NPDES dischargers are voluntarily forming in our state's river basins. The concept of these coalitions is to integrate instream sampling requirements as set forth in their NPDES permits with DWQ's basinwide management program. Monitoring sites and parameters are strategically located and established such that instream monitoring is more efficient, effective, basin-oriented, and potentially yields better quality, more usable data. A Memorandum of Agreement (MOA) specifies that one organization (usually a contract lab) conducts all the instream sampling and performs the required analyses, instead of each discharger conducting individual sampling. Three discharger associations are active in the Cape Fear River basin.

Each discharger association monitoring network is designed to complement the state's ambient sampling sites. The discharger association concept allows for a collective voice among the dischargers located in the Cape Fear River basin and fosters better communication within the association itself and with DWQ.

The Lower Cape Fear River Program (LCFRP) is comprised of 19 NPDES dischargers and began sampling in 1996. The LCFRP currently collects water quality data at 34 sites located throughout the lower portion of the basin. This association contracts with the University of North Carolina at Wilmington to collect the water quality samples and benefits from additional work that UNCW conducts, such as fisheries ecology and benthic community studies.

The Middle Cape Fear River Basin Association (MCFRBA) has 16 members and began sampling 30 stations in July 1998. Twenty-five of the stations are required in the MOA, and the other 5 stations are sampled voluntarily by the Association. The MCFRBA contracts with a commercial lab to collect the water quality samples and run the analyses.

The Upper Cape Fear River Basin Association started sampling 36 stations in 2000. DWQ will continue to work with the basin associations' water quality data in developing use support and identifying other water quality problems and solutions.

### 1.4.2 Cape Fear River Assembly

The Cape Fear River Assembly is a basinwide organization committed to achieving the highest quality of life possible for residents of the Cape Fear River basin through the proper management of the Cape Fear River, its tributaries and adjacent land uses. The Cape Fear River Assembly (CFRA) was founded 27 years ago and has several hundred members and a 34-member board of directors. The Assembly membership and the board are made up of representatives from throughout the Cape Fear River basin and with varying interests, including environmental and conservation organizations, academia, small business and industry, government (local, state and federal), and the general public. The Cape Fear River Assembly serves as the umbrella organization for the three discharger associations, including the Upper Cape Fear River Basin Association, the Middle Cape Fear River Basin Association and the Lower Cape Fear River Program.

The Assembly provides a basinwide context for resource management and a forum for discussion and issue resolution. In addition, it provides a basinwide commitment to facilitate the completion of needed scientific and economic study, to educate the public regarding the environmental and economic value of this natural resource, and to encourage the development of policy to maintain and improve the condition of the Cape Fear River and its tributaries for present and future uses and benefits. Programs and activities accomplished through the Cape Fear River Assembly include: 1) extensive, ongoing water quality monitoring (109 stations); 2) fisheries stock monitoring (lower); 3) Hurricanes Bonnie and Floyd storm event sampling; 4) clean metals sampling (mid); 5) a primary productivity study (mid); 6) a hydrologic modeling project; 7) numerous conferences; 8) a GIS/land use project; 9) Cape Fear River Basin highway signs; 10) Triangle area drinking water supply monitoring (upper); and 11) a Haw River/Jordan Lake watershed partnership (upper). For additional information, please see the Cape Fear River Assembly website www.cfra-nc.org or contact Executive Director, Don Freeman at (910) 223-4920 or by e-mail at cfra@faynet.com.

### 1.4.3 Cape Fear River Headwaters Group

The Cape Fear River Headwaters Group was formed in the fall of 1999 with the goal of determining the major water quality issues in this region and what projects the group can conduct to address these issues. The group has focused on the 303(d) impaired streams for the headwaters area of the Deep and Haw River and are currently prioritizing which 303(d) impaired streams the group can restore and develop a methodology in conjunction with DWQ to identify and correct the problems found in these streams. The group consists of the representatives from local governments, area universities, the Cape Fear River Assembly, DWQ, the Triangle J Council of Governments, and Piedmont Triad Council of Governments. The contact for this group is Carol Patrick of the Piedmont Triad Council of Governments at (336) 294-4950 or cpatrick@ptcog.org.

### 1.4.4 City of Greensboro Storm Water Services

The City of Greensboro is developing a watershed-based stormwater management program designed to be "proactive". The federal NPDES stormwater regulations mandate that municipalities take a comprehensive approach towards stormwater management issues within their jurisdiction and develop new programs that will prevent or minimize impacts to water quality from nonpoint pollution sources, such as urbanized areas. Regulatory mandates, along with local interest in developing an optimum stormwater management program, have served as initiatives for Greensboro to begin developing improved programs for both stormwater and watershed management.

The city's developing Stormwater Management Program includes the following key components:

- Implementation of a Stormwater Utility to serve as the dedicated funding mechanism for the new and improved stormwater management programs, including administration of the NPDES municipal stormwater permit.
- Development and implementation of a comprehensive GIS database of stormwater infrastructure and proactive stormwater infrastructure maintenance program.
- Development of a "Dynamic Stormwater and Watershed Management System", which includes interactive linkages between the GIS database and major hydrologic, hydraulic, water quality and stream restoration models.
- Implementation of an extensive public education and awareness program. The city has also developed partnerships with many area businesses to promote environmental and water quality protection goals through a program called the "Environmental Business Partners".
- Implementation of a watershed-based water quality monitoring program, including wet weather land use-based monitoring, ambient and wet weather stream monitoring, structural Best Management Practice (BMP) assessment monitoring, and biological/habitat assessment and monitoring. The city is also working with the United States Geological Survey to establish a citywide network of continuous monitoring rainfall and streamflow gaging stations to provide data for the watershed modeling and management program.
- Innovative restoration projects for local degraded streams including enhancement or creation of adjacent riparian wetland areas.
- Development of a comprehensive stormwater management ordinance.

For more information on the City of Greensboro Storm Water Services, contact Scott Bryant, City of Greensboro Storm Water Services, (336) 373-2988.

### 1.4.5 UNC-Wilmington – Center for Marine Science Research

The Center conducts research involving nutrients, plankton, aquatic microorganisms, and general water quality and pollution management issues in marine, estuarine and freshwater systems. Information about the program is available at: http://www.uncwil.edu/cmsr/aquaticecology.laboratory/. Descriptions of the ongoing research projects within the Lower Cape Fear River Hydrologic Unit are included below.

***Lower Cape Fear River Program***

Since 1995, the Center for Marine Science Research has regularly collected data on numerous physical, chemical and biological parameters at 35 locations throughout the Cape Fear River watershed. This data is entered into the EPA STORET system, and comprehensive reports are issued to interested parties on an annual basis. Research projects in this watershed include analysis of animal waste lagoon spills, effect of hurricanes and storms on the watershed, factors controlling phytoplankton production in the estuary and tributary rivers, effects of water chemistry on fungal breakdown of detritus, and the effects of nutrient loading on the biota and metabolism of blackwater streams. Related cooperative research projects are also conducted with the UNCW Biology Department and the UNCW Benthic Ecology Lab.

***The New Hanover County Tidal Creeks Project***

Since 1993, the Center has been conducting research on bacterial pollution, algal blooms, effect of tides on water quality parameters, nutrient limitation of phytoplankton productivity, and nutrient loading in five tidal creeks in New Hanover County, with published annual reports. A major accomplishment of this project has been publication of a set of management recommendations for environmentally sound coastal development practices. The project is funded by and works cooperatively with a citizen's group (the Northeast New Hanover Conservancy) and the New Hanover County Planning Department.

***City of Wilmington Watersheds Project***

In 1997, the Center began an ongoing project analyzing environmental quality of the City of Wilmington's drainage basins. This includes collecting baseline data on pollutants such as nutrients, fecal coliform bacteria, turbidity and other parameters; analyzing effectiveness of large stormwater detention ponds, runoff from golf courses, and effect of loadings on adjacent waterways. This project is funded by and designed in cooperation with the City of Wilmington Engineering Department and its stormwater runoff program.

### 1.4.6 Haw River Assembly

The Haw River Assembly is a nonprofit citizen organization working to restore the Haw River and protect Jordan Lake using education, citizen water monitoring and research as our tools. We share water monitoring information collected by our Haw River Watch volunteers with state biologists, and are working with state and federal agencies in the areas of land conservation, nonpoint source pollution education and dam removal. We have been instrumental in drawing attention to the impaired streams in our river basin.

## 1.5 Current Initiatives by Major Watershed

### 1.5.1 Haw River (Subbasins 03-06-01 to 03-06-06)

Table C-4 highlights projects within the Haw River watershed. A description of each project follows.

Table C-4 Haw River Watershed Projects

| | Project | Subbasin | Contractor | Funding Source | Grant |
|---|---|---|---|---|---|
| 1 | Upper Cape Fear Riparian Buffer Protection Planning Grant | 03-06-01 – 03-06-06 | Triangle J COG | CWMTF | $70,000 |
| | Upper Cape Fear Planning Initiative | 03-06-01 – 03-06-06 | Piedmont Triad and Triangle J COGs | 205(j) | $31,119 |
| 2 | New Hope Creek Corridor Riparian Buffer Acquisition | 03-06-05 – 03-06-06 | County of Durham | CWMTF | $750,000 |
| | New Hope Creek Corridor Riparian Buffer Acquisition | 03-06-05 – 03-06-06 | Triangle Land Conservancy | CWMTF | $2,250,000 |
| | New Hope Creek Corridor Riparian Buffer Acquisition | 03-06-05 – 03-06-06 | Town of Chapel Hill | CWMTF | $200,000 |
| 3 | Sandy Creek Stormwater Control Project | 03-06-05 | Duke University and NCWRP | CWMTF | $582,500 |
| 4 | South Buffalo Creek Regional Stormwater Wetland | 03-06-02 | Town of Greensboro | CWMTF | $800,000 |
| 5 | Haw River Source Land Acquisition | 03-06-01 | Haw River Assembly | CWMTF | $24,500 |
| 6 | Sedimentation Basin Design Improvements | 03-06-06 | North Carolina State University | 319 | $61,050 |
| 7 | Cane Creek Reservoir Watershed Buffer Acquisition | 03-06-04 | Orange Water and Sewer Authority | CWMTF | $1,042,500 |
| 8 | Robeson Creek Steward Education Campaign | 03-06-04 | Haw River Assembly | CWMTF | $6,000 |

***Upper Cape Fear Riparian Buffer Protection Planning Grant***

The Triangle J Council of Governments was awarded $70,000 to initiate a stakeholder program to quantify the extent and status of riparian buffers within the Jordan Reservoir watershed. The project will establish a priority listing of riparian buffer and stream restoration needs within the Haw River watershed. This initiative was augmented in 1998 with a planning grant through the Clean Water Act 205 (j) program. The three project components include: development and adoption of proposed comprehensive land use plans for portions of the upper Cape Fear River basin; development and distribution of informational materials for government officials and planners on the relationship between regional water quality and land use activities; and development of a water quality improvement strategy on one priority surface water area.

### *New Hope Creek Corridor Open Space Master Plan*

Completed in 1991, the New Hope Creek Corridor Open Space Master Plan is a large regional effort between the counties of Durham and Orange, and cities of Durham and Chapel Hill to protect a riparian corridor and trail network between the two rapidly growing areas. The Master Plan was jointly funded and adopted by the four local governments and has received additional support through the Triangle Land Conservancy, Duke University and the New Hope Audubon Society. The City and County of Durham established a bond referendum to fund the acquisition of 170 acres. In 1997, the County of Durham obtained a land acquisition grant from the CWMTF for the acquisition of an additional 330 acres identified as priorities within the county.

Because Orange County and Chapel Hill do not have bond funds, the Triangle Land Conservancy recovered funds to acquire three high priority tracts of land totaling 392 acres. In 1998, the Town of Chapel Hill also received funds from the CWMTF to acquire an additional 84 acres. The CWMTF has invested $3.2 million to acquire conservation easements on more than 800 acres, contributing to the completion of the New Hope Creek Riparian buffer and greenway trail system. Commitment of these groups to protect the New Hope Creek Corridor will help buffer the impacts of commercial and residential development along the I-40 and 15-501 corridors.

### *Sandy Creek Stormwater Control Project*

The North Carolina Wetlands Restoration Program and Duke University received a grant of $582,500 to collaborate on the restoration of degraded streambanks and riparian areas of Sandy Creek, within the New Hope Creek watershed. The project will treat stormwater runoff within the 25-acre project watershed adjacent to the University Campus. Treatment methods will include the installation of twelve biofiltration areas to receive and attenuate runoff from parking and trail areas, and a structure to create an instream stormwater wetland and support the restoration of degraded streambanks. The Wetland Program at Duke University will monitor water quality at 15 sites in the project area to determine the success of the project design.

### *City of Greensboro – South Buffalo Creek Regional Stormwater Wetland*

The Clean Water Management Trust Fund's (CWMTF) grant funds of up to $800,000, supplemented by the City of Greensboro's matching funds of up to $160,000, will be used to acquire approximately 40 acres of property located south of I-40 and east of Rehobeth Church Road in Greensboro and to construct a 20-acre riparian wetland on the property. Vegetated riparian buffers will also be provided along the banks of the South Buffalo Creek in the project reach.

The objectives of the project are to improve the water quality in the 12-square mile urbanized watershed by reducing the pollutant loads and removal of sediment. Additional objectives are to achieve improvement in aquatic and terrestrial habitats through the development of the riparian wetland and vegetative stream buffers, which will provide shade and cooling of the water in the stream.

*Haw River Source Land Acquisition*

The project acquired a 3.7-acre parcel containing the source spring of the Haw River. The Haw River Assembly will establish a management trust to protect the source and riparian buffer along the first 800 feet of the stream. This project is expected to spawn additional protection of riparian areas in the headwaters portion of the Haw River.

*Sedimentation Basin Design Improvements*

One major source of sediment is soil erosion from construction sites. Sediment basins are constructed to remove sediment from stormwater before it leaves the construction site. The project funded through the 319 program is part of a larger scale demonstration and analysis of innovative construction site sediment control basin techniques for environmentally sensitive Piedmont area streams.

Several other approaches have been tested in Orange County to increase effective sediment trapping. An improvement to sediment basin function is to use gypsum to flocculate suspended materials prior to discharge. This approach is currently being tested in Orange County under a special grant from the Sediment Control Commission. Tests conducted so far have shown that gypsum significantly reduces suspended sediment and can clarify discharge water to the state turbidity standard of 50 NTU. The use of gypsum will be demonstrated under various combinations of skimmer and level spreader configurations.

*Cane Creek Reservoir Watershed Buffer Acquisition*

The Orange Water and Sewer Authority (OWASA) received CWMTF funding to assist and augment the OWASA capital improvement funds for the acquisition of easements on 'preferred properties' within the Cane Creek watershed. The purpose of the project is to protect the long-term quality of the Cane Creek Reservoir through the protection of three hundred-foot buffers on perennial and intermittent streams, and the reservoir itself. Protection of these buffers will be accomplished through fee simple purchases and conservation agreements.

*Robeson Creek Stream Steward Education Campaign*

The Haw River Assembly was awarded funds to initiate a watershed awareness campaign in the Robeson Creek watershed including Pittsboro. The stream is listed on the 2000 303(d) list and many of the pollution sources are nonpoint source in nature. The Haw River Assembly will seek cooperation from city and county agencies, the Triangle J Council of Governments, Cooperative Extension Service, and the Natural Resources Conservation Service to coordinate development of a broader restoration initiative. This funding will provide for landowner outreach and education and initiate broader opportunities for conservation and restoration.

### 1.5.2 Deep River Watershed (Subbasins 03-06-08 to 03-06-12)

Table C-5 highlights projects within the Deep River watershed. A description of each project follows.

Table C-5 Deep River Watershed Projects

| | Project | Subbasin | Contractor | Funding Source | Grant |
|---|---|---|---|---|---|
| 1 | Deep River Campaign | 03-06-11 | Triangle Land Conservancy | CWMTF | $1,189,000 |
| 2 | McLendons Creek Watershed Project | 03-06-10 | North Carolina State University | 319 | $198,000 |
| 3 | Riparian Buffer Acquisition in Richland and Muddy Creek | 03-06-08 | Piedmont Triad Regional Water Authority | CWMTF | $615,000 |
| 4 | Buffalo Creek Riparian Protection and Greenway Project | 03-06-11 | Town of Sanford | CWMTF | $765,000 |
| 5 | Sandy Creek Riparian Buffer Acquisition | 03-06-09 | Town of Ramseur | CWMTF | $134,000 |
| 6 | Ramseur Sewer Rehabilitation Project | 03-06-09 | Town of Ramseur | CWMTF | $344,000 |

### *Deep River Campaign*

The Clean Water Management Trust Fund provided monies for the acquisition and protection of permanent riparian buffers on 4.1 miles of the Deep River and its tributaries. Three tracts will be used as keystone properties to continue riparian protection efforts along the Deep River. Coordinated efforts between the Triangle Land Conservancy and other agencies will lead to establishment and continuity of a protected riparian corridor.

### *McLendons Creek Watershed Project*

The McLendons Creek Watershed Project was a three-year effort (ended in 1999) to install and evaluate agricultural and urban BMPs targeted at reduction of phosphorus, nitrogen and sediment inputs to McLendons Creek. BMPs are land use practices such as vegetated stream buffers, fertilizer management, stormwater detention basins and others. Water quality monitoring before and after BMP implementation is used to evaluate overall effectiveness.

The education and outreach goals of the project were accomplished. As monitoring results are developed, the final report will be available online at http://www5.bae.ncsu.edu/programs/extension/wqg/ncwsheds/mlcw/.

### *Riparian Buffer Protection on Richland and Muddy Creek*

The Piedmont Triad Water Authority secured a grant from the CWMTF for acquisition of 100 acres of riparian buffer along Richland and Muddy Creeks. These streams are located within the Randleman Reservoir watershed, and protection of existing riparian buffers is important for the region's proposed drinking water supply reservoir.

### *Buffalo Creek Riparian Protection and Greenway Project*

The Town of Sanford will acquire and protect 7 miles and 250 acres of riparian buffers along the Deep River's Buffalo Creek. The CWMTF funds will acquire up to a 300-foot riparian buffer. Typical matches include acquisition of the nonriparian buffer portions of the land.

*Sandy Creek Riparian Buffer Acquisition and Ramseur Sewer Rehabilitation Project*

Ramseur has been active in establishing a local watershed protection program centered around the water supply reservoir on Sandy Creek. Sandy Creek drains into a section of the Deep River designated as High Quality Waters, just downstream of Ramseur. The town secured two grants from the Clean Water Management Trust Fund to purchase conservation easements on riparian corridors entering the Sandy Creek Reservoir. Up to 28,000 feet of easements could be purchased through this program. In 1998, the town received a grant to rehabilitate an existing sewer outfall, upgrading 7,500 feet of 8" to 12" line. The objective is to reduce infiltration and leakage from the existing system.

### 1.5.3 Upper Cape Fear River Watershed (Subbasins 03-06-07, 03-06-13 to 03-06-15)

Table C-6 highlights projects within the Upper Cape Fear River watershed. A description of each project follows.

Table C-6 Upper Cape Fear River Watershed Projects

| | Project | Subbasin | Contractor | Funding Source | Grant |
|---|---|---|---|---|---|
| 1 | Little Cross Creek Water Supply Watershed Land Acquisition | 03-06-15 | City of Fayetteville | CWMTF | $502,500 |
| | Little Cross Creek Watershed Assessment | 03-06-15 | City of Fayetteville | CWMTF | $63,200 |
| 2 | Cape Fear Botanical Garden Stream Restoration Project | 03-06-15 | Cape Fear Botanical Garden | CWMTF | $77,000 |

*Little Cross Creek Water Supply Watershed Land Acquisition*

Little Cross Creek is designated as WS-IV. Four reservoirs located in the watershed are used to supply water to the City of Fayetteville. In 1997, the city's Public Works Commission received a grant to purchase and secure property adjacent to its water supply reservoirs. A total of 101 acres were purchased as permanent easements with buffer areas defined.

In 1998, the city received funds to perform a complete pollutant source assessment of the Little Cross Creek watershed. The assessment will document watershed hazard areas and map susceptibility of pollution by nutrients, sediment and fecal coliform. Completion of this assessment will lead to implementation of a comprehensive watershed management plan.

*Cape Fear Botanical Garden*

The project will be used to stabilize the lowest portion of Cross Creek before draining into the mainstem of the Cape Fear River in Fayetteville. The Botanical Garden includes 85 acres of open space in an otherwise urban area and provides opportunity for demonstration of appropriate streambank protection and stabilization techniques in an urbanized setting.

### 1.5.4 Lower Cape Fear River (Subbasins 03-06-16, 03-07-17, 03-06-20 and 03-06-21)

Table C-7 highlights projects within the Lower Cape Fear River watershed. A description of each project follows.

Table C-7 Lower Cape Fear River Watershed Projects

| | Project | Subbasin | Contractor | Funding Source | Grant |
|---|---|---|---|---|---|
| 1 | Suggs Mill Pond Land Acquisition | 03-06-16 | Wildlife Resources Commission | CWMTF | $2,250,000 |
| | Little Singletary Lake Land Acquisition | 03-06-16 | Wildlife Resources Commission | CWMTF | $1,033,000 |
| 2 | Coastal Urban and Recreation BMP Demonstration Project | 03-06-17 – 03-06-24 | North Carolina State University | CWMTF | $145,632 |

***Little Singletary Lake/Suggs Mill Carolina Pond Land Acquisition***

The Lake Singletary/Suggs Mill Pond Complex drains to Ellis and Turnbull Creeks. In 1997, the Wildlife Resources Commission acquired more than 9,000 acres, including 6,400 acres of wetland and more than four miles of riparian buffers. A 1999 grant from the CWMTF funded the acquisition of an additional 391 acres, and one mile of riparian and wetland buffer surrounding Little Singletary Lake that were slated for development. Additional conservation activities in this area through The Nature Conservancy have resulted in the protection of the Carolina Bay Ecosystem from impending development. The land is dedicated as a nature preserve, significantly contributing to the protection of wildlife and aquatic resources in the Bladen Lakes Management Region.

***Coastal Urban and Recreation BMP Demonstration Project***

The Coastal Urban and Recreation BMP Demonstration Project Team was developed through this 319 funded project to address the issues of runoff control from developed sites. Following the pollutant source inventory and evaluation of impaired watersheds, the project team will evaluate and implement best management practices (BMPs) to protect coastal waters impaired by runoff from developed areas. Surveys of existing data and interviews with local officials and residents will be used to determine sites in four watersheds where BMPs can be installed and evaluated for nonpoint source pollution control.

The project will demonstrate BMPs to reduce pathogen, nutrient and pesticide inputs from urban and recreational development in coastal areas of the Cape Fear River basin. BMPs will include vegetation and other runoff reduction measures, nutrient and pest management to reduce pollutant sources, erosion control measures and stormwater retention.

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. A team has coordinated a Coastal Urban Workshop scheduled for the

Wilmington area in March of 2000. Coastal environmental education and demonstration projects conducted by NCSU and UNC-Wilmington have been incorporated in the education and demonstration programs.

### 1.5.5 Black River Watershed (Subbasins 03-06-18 and 03-06-19)

Table C-8 highlights projects within the Black River watershed. A description of each project follows.

Table C-8 Black River Watershed Projects

| | Project | Subbasin | Contractor | Funding Source | Grant |
|---|---|---|---|---|---|
| 1 | Little Coharie Watershed Protection Project | 03-06-19 | North Carolina Cooperative Extension Service | 319 | $27,990 |
| 2 | Black and South River Riparian Protection | 03-06-18 | The Nature Conservancy | CWMTF | $2,000,000 |
| | Black River Land Acquisition | 03-06-19 | The Nature Conservancy | 319 | $100,350 |

***Little Coharie Watershed Protection Project***

The Little Coharie Watershed Project was initiated in 1995. The intent was to accelerate the adoption and use of vegetated buffers by providing educational and technical assistance in conjunction with a cost share assistance program. Findings from surface and groundwater monitoring of vegetative buffers in Duplin County showed that these management practices are effective at reducing nutrient and sediment delivery to water resources. The project set a basis for the utilization of state cost share money for implementation of riparian buffers to protect surface waters threatened based upon BOD, nutrient and sediment inputs from nonpoint sources.

Due to the demonstrations and public attention derived from the project, many of the practices first implemented in the Little Coharie Watershed are now being implemented countywide. For instance more than 40,000 feet of field edge buffers have been planned or installed in Sampson County (Rice, 1998).

***The Nature Conservancy – Black and South River Land Acquisition and Riparian Protection***

The Nature Conservancy has been very active in the Black and South River watersheds concerning land acquisition for riparian protection. The well-established organization has met acquisition needs with both private donations and public grants. In 1995, the Nature Conservancy acquired funding through the 319 program to demonstrate the water quality benefits of a 295-acre land acquisition within the Black River watershed. The project demonstrated how preservation of a riparian buffer along an ORW river protects a river from NPS pollution. Field sampling and nutrient export models were used to predict export coefficients and potential nutrient loading based upon conversion to more intensive land uses. Without purchase, the land was subject to conversion from forest to agriculture and clearing for development. The 1998 CWMTF funded project makes available up to two million dollars for land acquisition of riparian forested areas along Outstanding Resource Waters segments of the Black and South Rivers. Three hundred-foot buffers will be established to connect presently isolated lands with continuous riparian corridors. The project will preserve at least 15 miles and 3,000 acres of riparian buffers in the project area.

### 1.5.6 Northeast Cape Fear River Watershed (Subbasins 03-06-22 to 03-06-24)

Table C-9 highlights projects within the Northeast Cape Fear River watershed. A description of each project follows.

Table C-9 Northeast Cape Fear Watershed Projects

| | Project | Subbasin | Contractor | Funding Source | Grant |
|---|---|---|---|---|---|
| 1 | Northeast Cape Fear Riparian Buffer Protection | 03-06-22 | NC Wildlife Resources Commission | CWMTF | $1,070,000 |
| 2 | New Hanover County – Constructed Wetlands for Landfill Leachate Treatment | 03-06-24 | New Hanover County – DEM | CWMTF | $785,000 |
| 3 | New Hanover County Tidal Creeks Water Quality Enhancement Project | 03-06-24 | New Hanover County | CWMTF | $6,000,000 |

***Northeast Cape Fear Riparian Buffer Protection***

The Wildlife Resources Commission was awarded funding for acquisition of riparian buffers on 1,076 acres totaling 46,000 linear feet of buffers on the Northeast Cape Fear River. These purchases tie in with existing state and private protected areas within the river basin.

***New Hanover County – Constructed Wetlands for Landfill Leachate Treatment***

The county landfill was permitted to discharge 50,000 GPD of leachate to the Northeast Cape Fear River. The project funded a non-discharge solution including constructed wetland and spray field for leachate from the New Hanover County municipal solid waste landfill. The system will drastically reduce current loading of 14,000 lbs/yr of TN, 3,500 lbs/yr of BOD, and 1,800 lbs/yr of TSS. A requirement of funding is for the county to rescind its NPDES discharge permit and replace it with a non-discharge, land application permit.

***New Hanover County Tidal Creeks Water Quality Enhancement Project***

This extensive project is coordinated through New Hanover County Planning Department. This enhancement program will tie in with an ongoing monitoring program, the Tidal Creeks Project, managed by the UNC–Wilmington Center for Marine Science. The program concentration areas include acquisition of riparian buffers and easements and implementation of best management practices. The centerpiece of the program was the acquisition and development of the Airlie Garden property. This site will act as the focal point for education, research, implementation and demonstration of estuarine water quality protection and restoration programs. The program plans to acquire and preserve riparian buffers on five tidal creeks and to implement BMPs controlling stormwater runoff from these areas.

# 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 in the state 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 this needed support and cooperation, DWQ believes that these goals are attainable through the basinwide water quality management approach.

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, use restoration waters program for nonpoint source pollution, and improving database management and use of GIS capabilities. Summaries of these initiatives are provided below.

**NPDES 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 the Division determines that there is an economically reasonable alternative to a discharge, DWQ may deny the NPDES permit.

DWQ will continue to make greater use of discharger self-monitoring data to augment the data it collects. Quality assurance, timing and consistency of data from plant to plant are issues of importance. Also, a system will need to be developed to enter the data into a computerized database for later analysis.

**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.

**Use Restoration Waters (URW) Program for Nonpoint Source Impairment**

DWQ has developed a conceptual strategy to manage watersheds with nonpoint source impairments as determined through the use support designations. In July 1998, the state Environmental Management Commission approved the Use Restoration Waters (URW) program concept which will target all NPS impaired waters in the state using a two-part approach. As envisioned, this classification will apply to all watersheds that are not supporting or partially supporting their designated uses. The program will catalyze voluntary efforts by stakeholder groups in impaired watersheds to restore those waters by providing various incentives and other support. Simultaneously, the program will develop a set of mandatory requirements for NPS pollution categories for locations where local groups choose not to take responsibility for restoring their impairments. This URW concept offers local governments an opportunity to implement site-specific projects at the local level as an incentive ("the carrot"). If the EMC is not satisfied with the progress made towards use restoration by local committees, impairment based rules will become mandatory in those watersheds ("the stick").

These mandatory requirements may not be tailored to specific watersheds but may apply more generically across the state or region. DWQ staff has developed a timeline to accomplish the following within five years from July 1998: work with stakeholder groups to develop mandatory requirements; acquire the resources needed to carry out the program; develop criteria for voluntary local programs and supporting incentive tools; and proceed through formal rule making for the mandatory requirements. The form of the URW program will be strongly influenced by the year-long stakeholder input process.

With more than 400 impaired watersheds or stream segments in the state, it is not realistic for DWQ to attempt to develop watershed specific restoration strategies for nonpoint source pollution. By involving the stakeholders in these watersheds, we believe we can catalyze large-scale restoration of impaired waters. We anticipate that one of the major implementation challenges of this new program will be educating public officials and stakeholders at the local level as to the nature and solutions to their impairments. To address this challenge, the state plans to develop a GIS-based program to help present information at a scale that is useful to local land management officials. Other incentives that the state might provide include seed grants and technical assistance, as well as retaining the authority to mandate regulations on stakeholders who are not willing to participate.

In cases where incentives and support do not result in effective watershed restoration strategies, mandatory impairment source management requirements would be implemented in the watershed. This is not the state's preferred alternative, as it would add to state monitoring and enforcement workload. However, in areas where it is necessary, DWQ plans to implement such requirements. In the management area, DWQ would be assisted by regulatory staff from the Division of Coastal Management, Division of Environmental Health, Division of Land Resources and the Division of Marine Fisheries to insure compliance.

**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, and ultimately, protecting and restoring the water quality of the Cape Fear 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 existing 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 available, 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.

## 2.2 DWQ Compliance and Enforcement Policy Revisions

DENR began implementing a new two-stage compliance and enforcement policy in 1997. Both stages of the revised policy are in effect as of July 1, 1999. The five major elements of the policy are intended to provide a comprehensive route to strengthen enforcement and heighten compliance for all dischargers and nonpoint sources of water pollution in North Carolina. The five major components of the policy are to:

1. Foster compliance through pollution prevention, technical assistance and training, reevaluate existing grant and loan funding priority criteria, and develop recognition and incentive programs.
2. Enhance enforcement through increased penalties, penalties for sewer collection systems, reduced thresholds for noncompliance, and delegation of civil penalty assessment authority to the DWQ regional office supervisors.
3. Focus on chronic and willful violators through increased use of moratoriums on expanding and additional connections, expansion of notification to the public of violators, clarification of process of determining "noncompliance", and initiation of discussion with stakeholders on possible legislative actions.
4. Assure improvement in compliance and enforcement through development of accountability measures.
5. Find and use all available resources for compliance needs with local, state and nonprofit groups.

DENR is also in the process of conducting assessment of its enforcement programs. The goal of the assessment is to identify potential areas for improvement in DENR's efforts to enforce environmental laws and ultimately improve compliance. This effort got underway in July 1999 with two focus group meetings. DENR anticipates it will make recommendations for improvements by October 1999. If you would like to see the Scope of Work for the enforcement assessment, see DENR's web page at: http://www.ehnr.state.nc.us/EHNR/novs/scope.htm/.

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# Appendix I

# NPDES Dischargers and Individual Stormwater Permits in the Cape Fear River Basin

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0003913 | Glen Raven Mills - Altamahaw Division | Alamance | Winston-Salem | Major | Non-Municipal | 2 | 55 | 14 | 16 | | 0.15 | 30601 | Haw River |
| NC0024881 | Reidsville, City - WWTP | Rockingham | Winston-Salem | Major | Municipal | 1 | 2 | 23 | 26 | 55 | 5 | 30601 | Little Troublesome Creek |
| NC0036994 | Rockingham Co School - Monroeton | Rockingham | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0042 | 30601 | UT Troublesome Creek |
| NC0045161 | Alamance Co Sch - Altamahaw-Ossi | Alamance | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.012 | 30601 | Haw River |
| NC0046019 | Episcopal Diocese Conference Center | Rockingham | Winston-Salem | Minor | Non-Municipal | 13 | | | | | 0.015 | 30601 | UT Haw River |
| NC0046043 | Oak Ridge Academy | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | 11 | | | | 0.04 | 30601 | UT Haw River |
| NC0046345 | Reidsville, City of (WTP) | Rockingham | Winston-Salem | Minor | Non-Municipal | 21 | | | | | Not limited | 30601 | Reid Lake |
| NC0046809 | Pentecostal Holiness Church | Guilford | Winston-Salem | Minor | Non-Municipal | 11 | 12 | 13 | | | 0.02 | 30601 | UT Benaja Creek |
| NC0060259 | Willow Oak LLC | Rockingham | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.0175 | 30601 | Little Troublesome Creek |
| NC0065412 | Rea Enterprises, LLC | Rockingham | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.0235 | 30601 | Little Troublesome Creek |
| NC0066010 | Rockingham Co - Williamsburg Elem | Rockingham | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.004 | 30601 | UT Haw River |
| NC0073571 | Countryside Village Retirement Center | Guilford | Winston-Salem | Minor | Non-Municipal | 7 | 11 | | | | 0.015 | 30601 | Troublesome Creek |
| NC0085791 | Gas Town, Inc - Bill's Convenience | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.0504 | 30601 | UT Beaver Creek |
| NC0000876 | Cone Mills - Greensboro | Guilford | Winston-Salem | Major | Non-Municipal | 55 | 14 | 2 | | | 1.25 | 30602 | North Buffalo Creek |
| NC0001210 | Monarch Hosiery Mills, Inc. | Alamance | Winston-Salem | Major | Non-Municipal | 55 | 2 | | | | 0.05 | 30602 | Reedy Fork Creek |
| NC0001384 | Burlington Industries - Williamsburg | Caswell | Winston-Salem | Minor | Non-Municipal | 2 | 14 | | | | 0.025 | 30602 | UT Buttermilk Creek |
| NC0003671 | Amoco Oil Company - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30602 | UT Horsepen Creek |
| NC0021211 | Graham, City - Gilbreath Street | Alamance | Winston-Salem | Major | Municipal | 1 | 55 | 57 | 59 | 40 | 3.5 | 30602 | Haw River |
| NC0021474 | Mebane, City - WWTP / Mebane | Alamance | Winston-Salem | Major | Municipal | 1 | 55 | 58 | 59 | | 2.5 | 30602 | Moadams Creek |
| NC0022446 | Rayco Utilities - Quarry Hills | Alamance | Winston-Salem | Minor | Non-Municipal | 5 | | | | | 0.05 | 30602 | Haw River |
| NC0022691 | Autumn Forest Mobile Home Park | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.082 | 30602 | UT Reedy Fork Creek |
| NC0023868 | Burlington, City - Wwwp / East Side | Alamance | Winston-Salem | Major | Municipal | 1 | 56 | 55 | 31 | 32 | 12 | 30602 | Haw River |
| NC0023876 | Burlington, City - WWTP / South Side | Alamance | Winston-Salem | Major | Municipal | 1 | 55 | 27 | 40 | 67 | 12 | 30602 | Big Alamance Creek |
| NC0024325 | Greensboro, City - North Buffalo Creek | Guilford | Winston-Salem | Major | Municipal | 1 | 26 | 55 | 57 | 56 | 16 | 30602 | North Buffalo Creek |
| NC0029351 | Arrowhead Motor Lodge | Alamance | Winston-Salem | Minor | Non-Municipal | 13 | 10 | | | | 0.007 | 30602 | UT Haw Creek |
| NC0029726 | DOC - Guilford Correctional Center | Guilford | Winston-Salem | Minor | Non-Municipal | 11 | | | | | 0.025 | 30602 | UT N.Buffalo Creek |
| NC0031607 | Alamance Co School - Western Middle | Alamance | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.015 | 30602 | Haw River |
| NC0038130 | Guilford Co Sch - Northwest JR & HS | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.031 | 30602 | UT Moores Creek |
| NC0038156 | Guilford Co Sch - Northeast Senior HS | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.032 | 30602 | UT Reedy Fork Creek |
| NC0038172 | Guilford Co Sch - Mcleansville | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0113 | 30602 | UT S.Buffalo Creek |
| NC0042528 | Saxapahaw Plant - B.E. Jordan | Alamance | Winston-Salem | Minor | Non-Municipal | 6 | 0 | 0 | 0 | | 0.015 | 30602 | Haw River |
| NC0045144 | Alamance Co Sch - West Alamance HS | Alamance | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0115 | 30602 | Haw River |
| NC0045152 | Alamance Co Sch - Jordan Elem | Alamance | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0075 | 30602 | Haw River |
| NC0045292 | Graham Mebane WTP - Graham | Alamance | Winston-Salem | Minor | Non-Municipal | 21 | | | | | Not limited | 30602 | Back Creek |
| NC0047384 | Greensboro, City - T.Z. Osborne | Guilford | Winston-Salem | Major | Municipal | 1 | 55 | 56 | 23 | 31 | 22 | 30602 | South Buffalo Creek |
| NC0055271 | Shields Mobile Home Park | Alamance | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.006 | 30602 | Travis Creek |
| NC0059625 | South Saxapahaw Home Owners | Alamance | Winston-Salem | Minor | Non-Municipal | 22 | | | | | Not limited | 30602 | UT Haw River |
| NC0066966 | Quarterstone Farm WWTP | Guilford | Winston-Salem | Minor | Non-Municipal | 5 | | | | | 0.2 | 30602 | Buffalo Creek |
| NC0071463 | Apex Oil Company | Guilford | Winston-Salem | Minor | Non-Municipal | 39 | | | | | Not limited | 30602 | UT Horsepen Creek |
| NC0077968 | Horner Investment Group | Alamance | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.04 | 30602 | Reedy Fork |
| NC0078000 | Worth Chemical Corporation | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.216 | 30602 | UT South Buffalo Creek |
| NC0081426 | Greensboro, City - N.L.Mitch / WTP | Guilford | Winston-Salem | Minor | Non-Municipal | 21 | | | | | Not limited | 30602 | North Buffalo Creek |

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0081671 | Greensboro, City - Lake Townsend | Guilford | Winston-Salem | Minor | Non-Municipal | 21 | | | | | 1.5 | 30602 | Reedy Fork Creek |
| NC0082082 | UNC - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 14 | 16 | 15 | | | Not limited | 30602 | North Buffalo Creek |
| NC0084328 | Haw River Realty, Inc. | Alamance | Winston-Salem | Minor | Non-Municipal | 82 | 66 | | | | 0.12 | 30602 | UT Haw River |
| NC0084778 | Harvin Reaction Technology | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.11 | 30602 | UT North Buffalo Creek |
| NC0085383 | Whitsett Texaco - Huffman | Alamance | Winston-Salem | Minor | Non-Municipal | 66 | | | | | Not limited | 30602 | UT Back Creek |
| NC0085821 | Amp, Inc - Greensboro Site | Guilford | Winston-Salem | Minor | Non-Municipal | 82 | | | | | 0.0576 | 30602 | UT North Buffalo Creek |
| NC0086380 | BP Oil - Station 24154 | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | | | | | Not limited | 30602 | UT Horsepen Creek |
| NC0022098 | Cedar Valley Communities, LLC | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | 3 | | | | 0.01 | 30603 | Little Alamance Creek |
| NC0022675 | Country Club MHP | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.043 | 30603 | UT Little Alamance Creek |
| NC0038164 | Guilford Co Sch - Nathaniel Greene | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0045 | 30603 | UT North Prong-Stinking Quarter C |
| NC0048241 | Staley Hosiery Mills | Alamance | Winston-Salem | Minor | Non-Municipal | 2 | 4 | | | | 0.005 | 30603 | UT Big Alamance Creek |
| NC0050024 | Forest Oaks Country Club *** | Guilford | Winston-Salem | Minor | Non-Municipal | 5 | 13 | | | | 0.01 | 30603 | UT Beaver Creek |
| NC0083828 | Burlington, City of | Alamance | Winston-Salem | Minor | Non-Municipal | 21 | | | | | Not limited | 30603 | Big Alamance Creek |
| NC0084841 | Forest Oaks Country Club | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.0288 | 30603 | UT Beaver Creek |
| NC0020354 | Pittsboro, Town - WWTP | Chatham | Raleigh | Minor | Municipal | 1 | | | | | 0.75 | 30604 | Roberson Creek |
| NC0035866 | Chatham County - Bynum WWTP | Chatham | Raleigh | Minor | Municipal | 1 | | | | | 0.025 | 30604 | Haw River |
| NC0040711 | Weyerhaeuser Company - Moncure | Chatham | Raleigh | Minor | Non-Municipal | 19 | 16 | 17 | | | Not limited | 30604 | Haw River |
| NC0042285 | Trails Property Owners Assoc. | Orange | Raleigh | Minor | Non-Municipal | 5 | | | | | 0.04 | 30604 | UT Collins Creek |
| NC0045128 | Alamance Co Sch - Sylvan Elem | Alamance | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0014 | 30604 | Cane Creek |
| NC0051331 | Chapel Hill West - Tower Apart | Chatham | Raleigh | Minor | Non-Municipal | 7 | | | | | 0.0016 | 30604 | UT Meadow Branch |
| NC0070378 | Hydraulics Ltd. *** | Chatham | Raleigh | Minor | Non-Municipal | 22 | | | | | 0.0005 | 30604 | UT Pokeberry Creek |
| NC0080896 | Pittsboro, Town - WTP | Chatham | Raleigh | Minor | Non-Municipal | 21 | | | | | Not limited | 30604 | Haw River |
| NC0026051 | Durham County - Triangle WWTP | Durham | Raleigh | Major | Municipal | 1 | 59 | 57 | 79 | 33 | 6 | 30605 | Northeast Creek |
| NC0042803 | Birchwood Mobile Home Park | Orange | Raleigh | Minor | Non-Municipal | 8 | | | | | 0.018 | 30605 | UT New Hope Creek |
| NC0043257 | Nature Trails MHP Carlylegroup | Chatham | Raleigh | Minor | Non-Municipal | 8 | 4 | | | | 0.04 | 30605 | Cub Creek |
| NC0043559 | Fearrington Utilities - Village Center | Chatham | Raleigh | Minor | Non-Municipal | 5 | | | | | 0.27 | 30605 | UT Bush Creek |
| NC0047597 | Durham, South Water Reclam. Facility | Durham | Raleigh | Major | Municipal | 1 | 56 | 27 | 57 | 55 | 20 | 30605 | New Hope Creek |
| NC0074446 | Hilltop Mobile Home Park | Orange | Raleigh | Minor | Non-Municipal | 8 | | | | | 0.012 | 30605 | Old Field Creek |
| NC0081591 | Cary, Town - WWTP / Cary & Apex | Wake | Raleigh | Minor | Non-Municipal | 21 | | | | | Not limited | 30605 | UT White Oak Creek |
| NC0084093 | Jordan Lake WTP | Chatham | Raleigh | Minor | Non-Municipal | 21 | | | | | Not limited | 30605 | New Hope River(Jordan Lake) |
| NC0085260 | Mccarthy & Associates | Durham | Raleigh | Minor | Non-Municipal | 66 | | | | | 0.0086 | 30605 | Burdens Creek |
| NC0025241 | Owasa - Mason Farm WWTP | Orange | Raleigh | Major | Municipal | 1 | 9 | 79 | | | 8 | 30606 | Morgan Creek |
| NC0025305 | UNC - Chapel Hill S.E. Power Plant | Orange | Raleigh | Minor | Non-Municipal | 68 | | | | | 0.0922 | 30606 | UT Morgan Creek |
| NC0048429 | Cedar Village Apartments | Chatham | Raleigh | Minor | Non-Municipal | 5 | 7 | | | | 0.005 | 30606 | UT Cub Creek |
| NC0051314 | North Chatham W&S / Cole Park Place | Chatham | Raleigh | Minor | Non-Municipal | 5 | | | | | 0.015 | 30606 | UT Cub Creek |
| NC0056413 | Carolina Meadows, Inc. | Chatham | Raleigh | Minor | Non-Municipal | 5 | | | | | 0.18 | 30606 | UT Morgan Creek |
| NC0082210 | Orange Water & Sewer Authority | Orange | Raleigh | Major | Non-Municipal | 22 | | | | | Not limited | 30606 | UT Morgan Creek |
| NC0084018 | Exxon Station No. 4-0779 | Orange | Raleigh | Minor | Non-Municipal | 66 | | | | | 0.008 | 30606 | Bolin Creek |
| NC0084603 | Kenan Oil Company | Orange | Raleigh | Minor | Non-Municipal | 66 | | | | | 0.0072 | 30606 | UT Chapel Creek |
| NC0000892 | Neste Resins Corporation | Chatham | Raleigh | Major | Non-Municipal | 31 | | | | | 0.1 | 30607 | Haw River |
| NC0001899 | Allied Signal-Fiber Division | Chatham | Raleigh | Major | Non-Municipal | 36 | 16 | 17 | 21 | 2 | 0.244 | 30607 | Haw River |
| NC0002861 | Sanford, City of - WTP | Lee | Raleigh | Minor | Non-Municipal | 21 | 49 | | | | Not limited | 30607 | UT Cape Fear River |

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0003433 | CP&L Cape Fear S.E. (Power Plant) | Chatham | Raleigh | Major | Non-Municipal | 68 | 14 | | | | 10 | 30607 | UT Cape Fear River |
| NC0007684 | Northeast Metropolitan Water District | Harnett | Fayetteville | Minor | Non-Municipal | 21 | | | | | Not limited | 30607 | Cape Fear River |
| NC0021636 | Lillington WWTP, Town of | Harnett | Fayetteville | Minor | Municipal | 1 | 14 | | | | 0.6 | 30607 | Cape Fear River |
| NC0023442 | Willamette Ind / Moncure Division | Chatham | Raleigh | Minor | Non-Municipal | 2 | | | | | 0.008 | 30607 | Haw River |
| NC0028118 | Fuquay-Varina, Town - Kenneth Creek | Wake | Raleigh | Major | Municipal | 1 | | | | | 1.2 | 30607 | Kenneth Creek |
| NC0030091 | Buies Creek WWTP | Harnett | Fayetteville | Minor | Municipal | 1 | 11 | | | | 0.5 | 30607 | Cape Fear River |
| NC0039586 | CP&L Shearon Harris Nuclear | Wake | Raleigh | Major | Non-Municipal | 17 | 70 | 69 | 2 | 73 | 0.05 | 30607 | Harris Reservoir |
| NC0048101 | Senters Rest Home | Harnett | Fayetteville | Minor | Non-Municipal | 11 | | | | | 0.007 | 30607 | U T Kenneth Creek |
| NC0055051 | Country Lake Estates Association | Wake | Raleigh | Minor | Non-Municipal | 5 | 8 | | | | 0.09 | 30607 | UT Buckhorn Creek |
| NC0059242 | Broadway WWTP, Town of | Lee | Raleigh | Minor | Municipal | 1 | | | | | 0.145 | 30607 | Daniels Creek |
| NC0063096 | Holly Springs, Town of - WWTP | Wake | Raleigh | Minor | Municipal | 1 | 2 | | | | 0.5 | 30607 | Utley Creek |
| NC0082597 | Angier, Town - WWTP | Harnett | Fayetteville | Minor | Non-Municipal | 1 | | | | | 0.5 | 30607 | Cape Fear River |
| NC0000795 | Exxon Co. USA - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30608 | UT East Fork Deep River |
| NC0022209 | Star Enterprise - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30608 | UT Long Branch |
| NC0024210 | High Point - East Side WWTP | Guilford | Winston-Salem | Major | Municipal | 1 | 55 | 56 | 53 | 31 | 16 | 30608 | Richland Creek |
| NC0025445 | Randleman, City - WWTP / Randleman | Randolph | Winston-Salem | Major | Municipal | 1 | 55 | 56 | | | 1.745 | 30608 | Deep River |
| NC0026247 | Louis Dreyfus Energy Corp. | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | 73 | | | Not limited | 30608 | UT E. Fork Deep River |
| NC0027758 | DOC - Sandy Ridge Corr Center #4435 | Guilford | Winston-Salem | Minor | Non-Municipal | 11 | | | | | 0.0175 | 30608 | UT West Fork Deep River |
| NC0031046 | Colonial Pipeline - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30608 | UT East Fork Deep River |
| NC0036366 | National Pipe and Plastics, Inc | Guilford | Winston-Salem | Minor | Non-Municipal | 14 | 15 | 36 | | | Not limited | 30608 | UT West Fork Deep River |
| NC0037117 | Guilford Co Sch - Sumner Elem | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.009 | 30608 | UT Hickory Creek |
| NC0038091 | Guilford Co Sch - Southern Elem | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0075 | 30608 | UT Hickory Creek |
| NC0038229 | Guilford Co Sch - South Guilford HS | Guilford | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.012 | 30608 | UT Hickory Creek |
| NC0041483 | Plaza Mobile Home Park | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.003 | 30608 | UT Hickory Creek |
| NC0042501 | Triad Terminal Company | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30608 | UT East Fork Deep River |
| NC0050792 | Rayco Utilities - Melbille Heights | Randolph | Winston-Salem | Minor | Non-Municipal | 8 | 5 | | | | 0.0315 | 30608 | Muddy Creek |
| NC0051161 | Plantation Pipe Line Company | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | | | | | Not limited | 30608 | UT East Fork Deep River |
| NC0055191 | Rayco Utilities - Penman Heights | Randolph | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.025 | 30608 | UT Muddy Creek |
| NC0055255 | Crown Mobile Home Park | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.042 | 30608 | UT Hickory Creek |
| NC0065358 | Hidden Forest Mfg Homes Comm | Randolph | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.027 | 30608 | UT Deep River |
| NC0065803 | Marathon Ashland Petroleum LLC | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30608 | UT East Fork Deep River |
| NC0069256 | Amerada Hess Corporation | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 39 | | | | Not limited | 30608 | UT East Fork Deep River |
| NC0069451 | Rimmer Mobile Home Court | Randolph | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.0204 | 30608 | Muddy Creek |
| NC0074241 | HRS Terminals, Inc. | Guilford | Winston-Salem | Minor | Non-Municipal | 37 | 38 | 39 | | | Not limited | 30608 | UT East Fork Deep River |
| NC0074578 | William Energy Ventures - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 39 | 73 | | | | Not limited | 30608 | UT Long Branch |
| NC0081256 | High Point, City - WTP | Guilford | Winston-Salem | Minor | Non-Municipal | 21 | | | | | 10 | 30608 | UT Richland Creek |
| NC0084492 | Carolina Steel Corporation | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | 82 | | | | Not limited | 30608 | UT West Fork Deep River |
| NC0085201 | Boren Brick | Guilford | Winston-Salem | Minor | Non-Municipal | 2 | 41 | | | | 0.004 | 30608 | UT Polecat Creek |
| NC0086029 | Trinity American Corporation | Randolph | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.072 | 30608 | Caraway Creek |
| NC0000639 | Sapona Manufacturing Company | Randolph | Winston-Salem | Minor | Non-Municipal | 2 | 16 | 17 | 66 | | 0.01 | 30609 | Deep River |
| NC0001171 | Hooker Furniture Corporation | Guilford | Winston-Salem | Minor | Non-Municipal | 2 | 14 | 16 | | | 0.02 | 30609 | UT Polecat Creek |
| NC0007820 | Franklinville, Town - WWTP | Randolph | Winston-Salem | Minor | Municipal | 1 | | | | | 0.03 | 30609 | Deep River |

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0023299 | Woodlake MHP - Greensboro | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.07 | 30609 | UT Polecat Creek |
| NC0026123 | Asheboro WWTP, City of | Randolph | Winston-Salem | Major | Municipal | 1 | | | | | 9 | 30609 | Hasketts Creek |
| NC0026565 | Ramseur, Town - WWTP / Roundleaf R | Randolph | Winston-Salem | Minor | Municipal | 1 | 55 | | | | 0.48 | 30609 | Deep River |
| NC0038300 | S.S. Construction & Rental, Inc | Chatham | Raleigh | Minor | Non-Municipal | 8 | | | | | 0.01 | 30609 | UT Brush Creek |
| NC0040924 | Randolph Co BOE - Seagrove Elem | Randolph | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0088 | 30609 | UT Fork Creek |
| NC0040941 | Randolph Co BOE - Grays Chapel | Randolph | Winston-Salem | Minor | Non-Municipal | 3 | 81 | | | | 0.009 | 30609 | UT Sandy Creek |
| NC0040975 | Randolph Co BOE - Coleridge Elem | Randolph | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0056 | 30609 | Deep River |
| NC0042030 | Faith Christian School | Randolph | Winston-Salem | Minor | Non-Municipal | 3 | | | | | 0.0053 | 30609 | UT Deep River |
| NC0055913 | Monroe's Mobile Home Park | Guilford | Winston-Salem | Minor | Non-Municipal | 8 | | | | | 0.03 | 30609 | Polecat Creek |
| NC0074454 | Ramseur, Town - WTP | Randolph | Winston-Salem | Minor | Non-Municipal | 21 | | | | | Not limited | 30609 | Sandy Creek |
| NC0084077 | Hancock Country Hams, Inc. | Randolph | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.1 | 30609 | UT Sandy Creek |
| NC0084816 | Thomasville Furniture Ind. | Guilford | Winston-Salem | Minor | Non-Municipal | 66 | | | | | 0.0288 | 30609 | UT Polecat Creek |
| NC0032948 | Moore Co BOE – WWTP/Highfalls Elem | Moore | Fayetteville | Minor | Non-Municipal | 3 | | | | | 0.004 | 30610 | UT Deep River |
| NC0032964 | Moore Co BOE - WWTP/N. Moore HS | Moore | Fayetteville | Minor | Non-Municipal | 3 | | | | | 0.01 | 30610 | UT Bear Creek |
| NC0039471 | Chatham Co Sch - Bennett Elem | Chatham | Raleigh | Minor | Non-Municipal | 3 | | | | | 0.005 | 30610 | UT Flat Creek |
| NC0058548 | Star, Town of - WWTP | Montgomery | Fayetteville | Minor | Municipal | 1 | 55 | | | | 0.6 | 30610 | Cotton Creek |
| NC0062855 | Robbins, Town - WWTP | Moore | Fayetteville | Major | Municipal | 1 | | | | | 1 | 30610 | Deep River |
| NC0085987 | Deep River Seafood / E.L. Smith *** | Chatham | Raleigh | Minor | Non-Municipal | 10 | | | | | 0.0085 | 30610 | UT Tysons Creek |
| NC0024147 | Sanford, City - WWTP / Big Buffalo | Lee | Raleigh | Major | Municipal | 1 | 56 | 55 | 33 | | 5 | 30611 | Deep River |
| NC0030384 | Moncure Community Health Center | Chatham | Raleigh | Minor | Non-Municipal | 9 | | | | | 0.0025 | 30611 | Deep River |
| NC0039349 | Chatham Co Sch - Waters Elem | Chatham | Raleigh | Minor | Non-Municipal | 3 | | | | | 0.009 | 30611 | UT Cedar Creek |
| NC0072575 | Golden Poultry / Gold-Kist | Lee | Raleigh | Major | Non-Municipal | 23 | | | | | 1 | 30611 | Deep River |
| NC0081493 | Bost Distributing Corp. | Lee | Raleigh | Minor | Non-Municipal | 81 | | | | | 0.003 | 30611 | Purgatory Branch |
| NC0081795 | Goldston Gulf Sanitary District | Chatham | Raleigh | Minor | Non-Municipal | 21 | | | | | 0.006 | 30611 | Deep River |
| NC0083852 | Lee County Water Treatment | Lee | Raleigh | Minor | Non-Municipal | 21 | | | | | Not limited | 30611 | UT Deep River |
| NC0026441 | Siler City WWTP, Town of | Chatham | Raleigh | Major | Municipal | 1 | | | | | 4 | 30612 | Loves Creek |
| NC0038849 | Hill Forest Rest Home | Chatham | Raleigh | Minor | Non-Municipal | 11 | | | | | 0.003 | 30612 | Bear Creek |
| NC0039331 | Chatham Co Sch - Bonlee Elem | Chatham | Raleigh | Minor | Non-Municipal | 3 | | | | | 0.007 | 30612 | UT Bear Creek |
| NC0039381 | Chatham Co BOE - Central HS | Chatham | Raleigh | Minor | Non-Municipal | 3 | | | | | 0.01 | 30612 | UT Bear Creek |
| NC0001406 | Swift Textiles (Erwin Mills) | Harnett | Fayetteville | Major | Non-Municipal | 55 | 21 | 2 | | | 2.5 | 30613 | Cape Fear River |
| NC0038831 | Carolina Trace Utilities, Inc. | Lee | Raleigh | Minor | Non-Municipal | 13 | 5 | | | | 0.325 | 30613 | Upper Little River |
| NC0043176 | Dunn, City - WWTP | Harnett | Fayetteville | Major | Municipal | 1 | 23 | | | | 3 | 30613 | Cape Fear River |
| NC0064521 | Erwin, Town - South 20th Street WWTP | Harnett | Fayetteville | Major | Municipal | 1 | | | | | 1.2 | 30613 | Cape Fear River |
| NC0078955 | Dunn, City - WTP | Harnett | Fayetteville | Minor | Non-Municipal | 21 | | | | | 2 | 30613 | Juniper Creek |
| NC0080560 | Erwin WTP, Town of | Harnett | Fayetteville | Minor | Non-Municipal | 21 | | | | | Not limited | 30613 | UT Cape Fear River |
| NC0003964 | US Army - Fort Bragg WWTP & WTP | Cumberland | Fayetteville | Major | Non-Municipal | 11 | 21 | 37 | | | 8 | 30614 | Little River |
| NC0007838 | Moore Co WASA / Vass WTP | Moore | Fayetteville | Minor | Non-Municipal | 21 | | | | | 0.02 | 30614 | UT Little River |
| NC0022489 | Little River Prop, Inc - Dilton | Cumberland | Fayetteville | Minor | Non-Municipal | 8 | | | | | 0.015 | 30614 | Little River |
| NC0030970 | Spring Lake, Town - WWTP | Cumberland | Fayetteville | Major | Municipal | 1 | | | | | 1.5 | 30614 | Lower Little River |
| NC0031470 | Cooper Ranch MHP - Hwy 210 North | Harnett | Fayetteville | Minor | Non-Municipal | 8 | | | | | 0.4 | 30614 | Jumping Run Creek |
| NC0032956 | Moore Co BOE - WWTP / Sandhills Elem | Moore | Fayetteville | Minor | Non-Municipal | 3 | | | | | 0.0045 | 30614 | UT Little River |
| NC0057525 | Crystal Lake Associates, LLC | Moore | Fayetteville | Minor | Non-Municipal | 6 | | | | | 0.012 | 30614 | Mill Creek |

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0061719 | Woodlake Water & Sewer Company, Inc. | Moore | Fayetteville | Minor | Non-Municipal | 6 | 5 | | | | 1 | 30614 | Crane Creek |
| NC0074373 | Moore Co WASA / Vass WWTP | Moore | Fayetteville | Minor | Municipal | 1 | | | | | 0.06 | 30614 | Little River |
| NC0077101 | Carolina Water Service - Whispering 4 | Moore | Fayetteville | Minor | Non-Municipal | 22 | | | | | Not limited | 30614 | UT Little River |
| NC0086100 | Cameron, Town - Well #5 | Moore | Fayetteville | Minor | Non-Municipal | 22 | | | | | Not limited | 30614 | UT Little Crane Creek |
| NC0003719 | Monsanto | Cumberland | Fayetteville | Major | Non-Municipal | 34 | 14 | 2 | 32 | 73 | 0.889 | 30615 | Cape Fear River |
| NC0023957 | PWC / Fayetteville-Cross Creek WWT | Cumberland | Fayetteville | Major | Municipal | 1 | 40 | 23 | | | 22 | 30615 | Cape Fear River |
| NC0024481 | Days Inn - Fayetteville | Cumberland | Fayetteville | Minor | Non-Municipal | 13 | | | | | 0.025 | 30615 | Bakers Swamp |
| NC0026514 | Raeford, City – WWTP / US 401 South | Hoke | Fayetteville | Major | Municipal | 1 | 23 | 55 | | | 3 | 30615 | Rockfish Creek |
| NC0050105 | PWC / Fayetteville-Rockfish Creek | Cumberland | Fayetteville | Major | Municipal | 1 | | | | | 14 | 30615 | Cape Fear River |
| NC0076783 | PWC / Fayetteville - Hoffer WTP | Cumberland | Fayetteville | Minor | Non-Municipal | 21 | | | | | Not limited | 30615 | Cape Fear River |
| NC0001121 | Veeder-Root Company | Bladen | Fayetteville | Minor | Non-Municipal | 57 | 14 | 52 | | | 5 | 30616 | Cape Fear River |
| NC0003522 | Alamac Knit Fabics, Elizabethtown | Bladen | Fayetteville | Major | Non-Municipal | 55 | 14 | 22 | | | 2.5 | 30616 | Cape Fear River |
| NC0003573 | DuPont - Fayetteville | Bladen | Fayetteville | Major | Non-Municipal | 14 | 22 | 2 | 36 | | 2 | 30616 | Cape Fear River |
| NC0023353 | White Lake WWTP, Town of | Bladen | Fayetteville | Minor | Municipal | 8 | 6 | 10 | | | 0.8 | 30616 | UT Colly Creek |
| NC0026671 | Elizabethtown, Town - WWTP | Bladen | Fayetteville | Minor | Municipal | 1 | 55 | | | | 0.7 | 30616 | Cape Fear River |
| NC0032913 | Bladen Co Sch - East Arcadia Elem | Bladen | Fayetteville | Minor | Non-Municipal | 3 | | | | | 0.006 | 30616 | Cape Fear River |
| NC0058297 | Cogentrix - Elizabethtown | Bladen | Fayetteville | Minor | Non-Municipal | 15 | 68 | | | | Not limited | 30616 | Cape Fear River |
| NC0078344 | Smithfield Foods, Inc - Tarheel | Bladen | Fayetteville | Major | Non-Municipal | 23 | 2 | | | | 3 | 30616 | Cape Fear River |
| NC0000663 | DuPont - Wilmington / Brunswick | Brunswick | Wilmington | Major | Non-Municipal | 36 | 31 | 2 | 21 | 14 | 3.5 | 30617 | Cape Fear River |
| NC0000817 | Wilmington Ind Park /Smith Creek WWTP | New Hanover | Wilmington | Minor | Non-Municipal | 2 | 40 | 73 | | | 0.1 | 30617 | Smith Creek |
| NC0001112 | Arteva Specialties - Wilmington | New Hanover | Wilmington | Major | Non-Municipal | 31 | 36 | 14 | 16 | 2 | 1.7 | 30617 | Northeast Cape Fear River |
| NC0001228 | General Electric Co - Wilm/Castle | New Hanover | Wilmington | Major | Non-Municipal | 2 | 14 | 16 | 57 | 58 | 1.875 | 30617 | Northeast Cape Fear River |
| NC0001422 | CP&L Sutton S.E. (Power Plant) | New Hanover | Wilmington | Major | Non-Municipal | 14 | 68 | 69 | 70 | | Not limited | 30617 | Cape Fear River |
| NC0002879 | Wilmington, City - Sweeney WWTP | New Hanover | Wilmington | Minor | Non-Municipal | 21 | | | | | Not limited | 30617 | Northeast Cape Fear River |
| NC0003298 | Federal Paper Board Co - Riegelwood | Columbus | Wilmington | Major | Non-Municipal | 18 | 2 | | | | 50 | 30617 | Cape Fear River |
| NC0003395 | Wright Corporation | Columbus | Wilmington | Minor | Non-Municipal | 31 | 14 | 16 | | | 0.135 | 30617 | Cape Fear River |
| NC0003727 | PCS Nitrogen Fertilizer | New Hanover | Wilmington | Minor | Non-Municipal | 32 | 15 | 16 | | | 0.28 | 30617 | Northeast Cape Fear River |
| NC0003794 | Corning, Inc – North College Road - 310 | New Hanover | Wilmington | Minor | Non-Municipal | 17 | 14 | 73 | | | Not limited | 30617 | Spring Branch |
| NC0007064 | CP&L Brunswick S.E. (Power Plant) | Brunswick | Wilmington | Major | Non-Municipal | 14 | 69 | 70 | 2 | | 0.055 | 30617 | Atlantic Ocean |
| NC0021334 | Southport, Town – WWTP / Southport | Brunswick | Wilmington | Minor | Municipal | 1 | | | | | 0.8 | 30617 | Cottage Creek |
| NC0023256 | Carolina Beach, Town - WWTP | New Hanover | Wilmington | Major | Municipal | 1 | | | | | 3 | 30617 | Cape Fear River |
| NC0023477 | Koch Sulfur Prod - Acid Plant | New Hanover | Wilmington | Minor | Non-Municipal | 14 | 16 | | | | Not limited | 30617 | Northeast Cape Fear River |
| NC0023639 | Holtrachem Manufacturing Co., LLC | Columbus | Wilmington | Minor | Non-Municipal | 14 | 16 | | | | Not limited | 30617 | Cape Fear River |
| NC0023965 | Wilmington-Northside WWTP | New Hanover | Wilmington | Major | Municipal | 1 | 27 | 56 | 40 | 59 | 8 | 30617 | Cape Fear River |
| NC0023973 | Wilmington-Southside WWTP | New Hanover | Wilmington | Major | Municipal | 1 | 27 | 59 | 40 | | 12 | 30617 | Cape Fear River |
| NC0025763 | Kure Beach WWTP, Town of | New Hanover | Wilmington | Minor | Municipal | 1 | | | | | 0.285 | 30617 | Cape Fear River |
| NC0027065 | Archer Daniels Midland Company | Brunswick | Wilmington | Major | Non-Municipal | 31 | 16 | 17 | 32 | 2 | 3.51 | 30617 | Cape Fear River |
| NC0028568 | JLM Terminals, Inc - Stw/New Han | New Hanover | Wilmington | Minor | Non-Municipal | 39 | 37 | | | | Not limited | 30617 | Cape Fear River |
| NC0029122 | US Army - Sunny Point Terminal | Brunswick | Wilmington | Minor | Non-Municipal | 11 | 2 | | | | 0.03 | 30617 | Cape Fear River |
| NC0029173 | New Hanover Co - M. Heights WWTP | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.05 | 30617 | Cape Fear River |
| NC0039527 | New Hanover Co - Walnut Hills | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.1 | 30617 | UT Northeast Cape Fear |
| NC0040061 | Brunswick Co - Beaverdam Creek WTP | Brunswick | Wilmington | Minor | Non-Municipal | 22 | 0 | 0 | | | Not limited | 30617 | Beaverdam Creek |

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0040860 | Royal Palms MHP, LLC | New Hanover | Wilmington | Minor | Non-Municipal | 8 | | | | | 0.045 | 30617 | Mott Creek |
| NC0043788 | Columbus Co Sch - Acme Delco HS | Columbus | Wilmington | Minor | Non-Municipal | 3 | | | | | 0.01 | 30617 | UT Lindscomb Branch |
| NC0043796 | Columbus Co Sch - Acme Delco Elem | Columbus | Wilmington | Minor | Non-Municipal | 3 | | | | | 0.009 | 30617 | UT Pretty Creek |
| NC0046299 | New Hanover Co - Smith Creek Estates | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.1 | 30617 | Smith Creek |
| NC0049743 | New Hanover Co - Landfill WWTP | New Hanover | Wilmington | Minor | Non-Municipal | 72 | | | | | 0.05 | 30617 | Northeast Cape Fear River |
| NC0055107 | Inlet Bay Utility - Dolphin Bay | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.08 | 30617 | Snows Cut |
| NC0057533 | Brunswick Co - Hood Creek WTP | Brunswick | Wilmington | Minor | Non-Municipal | 21 | | | | | Not limited | 30617 | Hood Creek |
| NC0057703 | Fairways Utilities / The Cape | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.26 | 30617 | Cape Fear River |
| NC0058599 | Leland, Town - Clairmont S. Center | Brunswick | Wilmington | Minor | Non-Municipal | 2 | 10 | | | | 0.1 | 30617 | Brunswick River |
| NC0058971 | New Hanover Co - Refuse To Steam | New Hanover | Wilmington | Minor | Non-Municipal | 16 | 14 | 21 | 17 | | Not limited | 30617 | UT Northeast Cape Fear River |
| NC0059234 | Takeda Chemical Products USA | New Hanover | Wilmington | Major | Non-Municipal | 33 | 66 | | | | 1 | 30617 | Cape Fear River |
| NC0059978 | Fairways Utilities, Inc. | New Hanover | Wilmington | Minor | Non-Municipal | 6 | | | | | 0.4 | 30617 | Cape Fear River |
| NC0061271 | New Hanover Co - Churchill E*** | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.025 | 30617 | Smith Creek |
| NC0064700 | Creekside Townhomes - LI | Brunswick | Wilmington | Minor | Non-Municipal | 6 | | | | | 0.027 | 30617 | Jackeys Creek |
| NC0065099 | Cogentrix - Southport | Brunswick | Wilmington | Minor | Non-Municipal | 15 | 16 | 17 | 68 | 70 | Not limited | 30617 | CP&L - Brunswick Canal |
| NC0065307 | Worsley Companies - Dixie Boy #6 | New Hanover | Wilmington | Minor | Non-Municipal | 10 | 37 | | | | 0.004 | 30617 | Northeast Cape Fear River |
| NC0065480 | Beau Rivage Plantation | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.1 | 30617 | Cape Fear River |
| NC0065676 | Leland Ind Park – WWTP / NC SR 1431 | Brunswick | Wilmington | Minor | Non-Municipal | 2 | 16 | 17 | 37 | 57 | 0.25 | 30617 | Cape Fear River |
| NC0066711 | Amerada Hess Corporation | New Hanover | Wilmington | Minor | Non-Municipal | 39 | 37 | 61 | 16 | 66 | Not limited | 30617 | Cape Fear River |
| NC0073172 | Paktank Corp - Woodbine Street Site | New Hanover | Wilmington | Minor | Non-Municipal | 73 | 16 | 39 | | | Not limited | 30617 | Cape Fear River |
| NC0073181 | Exxon Chemical Company | New Hanover | Wilmington | Minor | Non-Municipal | 39 | 37 | | | | Not limited | 30617 | Cape Fear River |
| NC0075540 | Belville, Town - WWTP | Brunswick | Wilmington | Minor | Non-Municipal | 1 | | | | | 0.4 | 30617 | Brunswick River |
| NC0076732 | Koch Petroleum Group, LP | New Hanover | Wilmington | Minor | Non-Municipal | 39 | 73 | 66 | | | 0.1 | 30617 | Cape Fear River |
| NC0077691 | S&W Ready Mix Concrete Co. *** | New Hanover | Wilmington | Minor | Non-Municipal | 2 | | | | | 0.0003 | 30617 | Northeast Cape Fear River |
| NC0081507 | Federal Paper Boardd Co - Wilmington | New Hanover | Wilmington | Minor | Non-Municipal | 66 | | | | | 0.025 | 30617 | Burnt Mill Creek |
| NC0081736 | New Hanover Co - Airport WWTP | New Hanover | Wilmington | Major | Municipal | 1 | | | | | 4 | 30617 | Cape Fear River |
| NC0082295 | Fortron Industries | New Hanover | Wilmington | Major | Non-Municipal | 31 | 73 | | | | 0.245 | 30617 | Cape Fear River |
| NC0082970 | CTI of North Carolina | New Hanover | Wilmington | Minor | Non-Municipal | 37 | 66 | | | | 0.0144 | 30617 | Cape Fear River |
| NC0083658 | AAF/Mcquay, Inc. | New Hanover | Wilmington | Minor | Non-Municipal | 66 | | | | | 0.288 | 30617 | UT Barnards Creek |
| NC0083895 | CP&L Brunswick S.E. (WWTP) | Brunswick | Wilmington | Minor | Non-Municipal | 2 | | | | | 0.036 | 30617 | Brunswick Channel - Atlantic |
| NC0085553 | Bald Head Island Development Co. | Brunswick | Wilmington | Minor | Non-Municipal | 21 | | | | | 0.006 | 30617 | Bald Head Island Marina Basin |
| NC0058793 | Golden Years Nursing Home | Cumberland | Fayetteville | Minor | Non-Municipal | 11 | | | | | 0.05 | 30618 | South River |
| NC0060747 | National Mechanical Carbon | Harnett | Fayetteville | Minor | Non-Municipal | 77 | 57 | | | | 0.026 | 30618 | Juniper Creek |
| NC0083135 | B&B Produce, Inc | Johnston | Raleigh | Minor | Non-Municipal | 24 | | | | | 0.025 | 30618 | UT Mingo Swamp |
| NC0020117 | Clinton, Town of - WWTP | Sampson | Fayetteville | Major | Non-Municipal | 1 | 23 | 55 | 58 | | 3 | 30619 | Williams Old Mill Branch |
| NC0020346 | Magnolia, Town - WWTP / Magnolia | Duplin | Wilmington | Minor | Municipal | 1 | | | | | 0.09 | 30619 | UT Millers Creek |
| NC0021903 | Warsaw, Town - WWTP | Duplin | Wilmington | Minor | Municipal | 1 | | | | | 0.61 | 30619 | Stewarts Creek |
| NC0024791 | DOT - Sampson Co. US 421 Rest Area | Sampson | Fayetteville | Minor | Non-Municipal | 13 | | | | | 0.006 | 30619 | Six Runs Creek |
| NC0025569 | Garland, Town of - WWTP | Sampson | Fayetteville | Minor | Municipal | 1 | | | | | 0.126 | 30619 | Great Coharie Creek |
| NC0026816 | Roseboro WWTP, Town of | Sampson | Fayetteville | Minor | Municipal | 1 | | | | | 0.7 | 30619 | Little Coharie Creek |
| NC0072877 | Newton Grove, Town of - WWTP | Sampson | Fayetteville | Minor | Municipal | 1 | | | | | 0.2 | 30619 | Beaverdam Swamp |
| NC0036404 | Lake Creek Corp - Bay Tree Lakes | Bladen | Fayetteville | Minor | Non-Municipal | 6 | 5 | | | | 0.02 | 30620 | Bay Tree Lake To Colly Creek |

| Permit | Facility | County | Region | Type | Ownership | D1 | D2 | D3 | D4 | D5 | Qw | Subbasin | Stream |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NC0085481 | Pender Co BOE-Penderlea Elem | Pender | Wilmington | Minor | Non-Municipal | 3 | | | | | 0.01 | 30620 | UT Crooked Run |
| NC0001074 | Mount Olive Pickle Company | Wayne | Washington | Major | Non-Municipal | 24 | 14 | | | | 0.4 | 30621 | Barlow Branch |
| NC0003051 | Mount Olive, Town - WTP #3 Way | Wayne | Washington | Minor | Non-Municipal | 22 | | | | | Not limited | 30621 | UT Northeast Cape Fear River |
| NC0020575 | Mount Olive, Town of - WWTP | Wayne | Washington | Major | Municipal | 1 | | | | | 1 | 30621 | Northeast Cape Fear River |
| NC0001970 | Dean Pickle & Specialty Products | Duplin | Wilmington | Minor | Non-Municipal | 24 | 14 | | | | 0.5 | 30622 | UT Panther Branch |
| NC0002305 | Guilford Mills, Inc / Guilford East | Duplin | Wilmington | Major | Non-Municipal | 55 | 2 | 14 | | | 1.5 | 30622 | Northeast Cape Fear River |
| NC0002763 | National Spinning Company - Warsaw | Duplin | Wilmington | Minor | Non-Municipal | 14 | 22 | 0 | | | Not limited | 30622 | UT Grove Creek |
| NC0002933 | Calypso WTP, Town of | Duplin | Wilmington | Minor | Non-Municipal | 22 | | | | | Not limited | 30622 | UT Dicks Branch |
| NC0003344 | Swift-Eckrich / Butterball | Duplin | Wilmington | Major | Non-Municipal | 23 | 14 | 16 | 2 | | 1.5 | 30622 | Rockfish Creek |
| NC0003450 | Wallace, Town - Textile WWTP | Duplin | Wilmington | Major | Municipal | 55 | 14 | 17 | | | 5 | 30622 | Little Rockfish Creek |
| NC0020702 | Wallace, Town of - WWTP | Duplin | Wilmington | Minor | Municipal | 1 | | | | | 1 | 30622 | Rockfish Creek |
| NC0026018 | Beulaville, Town of - WWTP | Duplin | Wilmington | Minor | Municipal | 1 | | | | | 0.26 | 30622 | Persimmon Branch |
| NC0036668 | Kenansville, Town of - WWTP | Duplin | Wilmington | Minor | Municipal | 1 | | | | | 0.3 | 30622 | Grove Creek |
| NC0056863 | Rose Hill, Town of - WWTP | Duplin | Wilmington | Minor | Municipal | 1 | | | | | 0.45 | 30622 | Reedy Branch |
| NC0058271 | Cogentrix - Kenansville | Duplin | Wilmington | Minor | Non-Municipal | 16 | 17 | 68 | 70 | 11 | Not limited | 30622 | UT Northeast Cape Fear River |
| NC0063711 | Albertson Water & Sewer District | Duplin | Wilmington | Minor | Non-Municipal | 22 | | | | | Not limited | 30622 | UT Great Branch |
| NC0066320 | House of Raeford - Rose Hill Plant | Duplin | Wilmington | Minor | Non-Municipal | 14 | | | | | Not limited | 30622 | UT Beaverdam Branch |
| NC0079707 | Southern Products Distribution, Inc | Duplin | Wilmington | Minor | Non-Municipal | 24 | | | | | 0.065 | 30622 | UT Panther Branch |
| NC0003875 | Occidental Chemical Corp. - Cast | New Hanover | Wilmington | Major | Non-Municipal | 32 | 2 | 61 | 17 | 22 | 1.07 | 30623 | Northeast Cape Fear River |
| NC0007757 | Thorn Apple Valley / Carolina Division | Onslow | Wilmington | Minor | Non-Municipal | 2 | 23 | | | | 0.65 | 30623 | UT Juniper Swamp |
| NC0021113 | Burgaw, Town - WWTP | Pender | Wilmington | Minor | Municipal | 1 | | | | | 0.5 | 30623 | Osgood Canal |
| NC0042251 | Pender Co BOE -Pender High School | Pender | Wilmington | Minor | Non-Municipal | 3 | | | | | 0.02 | 30623 | Long Creek |
| NC0051969 | Hermitage House Rest Home | New Hanover | Wilmington | Minor | Non-Municipal | 11 | | | | | 0.012 | 30623 | UT Prince George Creek |
| NC0062804 | New Hanover Co - Northchase WWTP | New Hanover | Wilmington | Minor | Non-Municipal | 5 | | | | | 0.2 | 30623 | Northeast Cape Fear River |
| NC0001091 | Laque Center for Corrosion Tech | New Hanover | Wilmington | Minor | Non-Municipal | 80 | | | | | Not limited | 30624 | Banks Channel |
| NC0025895 | Holly Ridge, Town of - WWTP | Onslow | Wilmington | Minor | Municipal | 1 | | | | | 0.1 | 30624 | UT Kings Creek |
| NC0032221 | Carolina Water Service - Belvedere | Pender | Wilmington | Minor | Non-Municipal | 22 | | | | | Not limited | 30624 | UT Intracoastal Waterway |
| NC0081728 | Pender Co BOE - Filter Backwash | Pender | Wilmington | Minor | Non-Municipal | 22 | | | | | Not limited | 30624 | UT Old Topsail Creek |

## *LIST OF DISCHARGE CODES*

## *INDICATING TYPES OF WASTEWATER DISCHARGED*

| | | |
|---|---|---|
| 1 | Domestic | Municipal |
| 2 | Domestic | Industrial / Commercial |
| 3 | Domestic | Schools |
| 4 | Domestic | Single Family Residence |
| 5 | Domestic | Subdivisions |
| 6 | Domestic | Condominiums |
| 7 | Domestic | Apartments |
| 8 | Domestic | Mobile Home Parks |
| 9 | Domestic | Hospitals |
| 10 | Domestic | Restaurants |
| 11 | Domestic | Institutions (colleges, academies, nursing homes, prisons, etc.) |
| 12 | Domestic | Child Care Facilities |
| 13 | Domestic | Lodging (hotels, motels, guest houses, campgrounds, rest areas, etc.) |
| 14 | Non-Contact cooling water/condensate | |
| 15 | Contact cooling water | |
| 16 | Boiler Blowdown | |
| 17 | Cooling Tower Blowdown | |
| 18 | Pulp and Paper | |
| 19 | Wood products | |
| 20 | Wood treatment | |
| 21 | Water plants (Surface water) | |
| 22 | Water plants and Water conditioning (Groundwater) | |
| 23 | Meat processing and rendering | |
| 24 | Vegetable and Fruit processing | |
| 25 | Seafood and Fish processing | |
| 26 | Tobacco processing | |
| 27 | Beverage production | |
| 28 | Agricultural animal waste | |
| 29 | Fish or Seafood farms | |
| 30 | Seafood or Fish packing | |
| 31 | Organic chemical manufacturing | |
| 32 | Inorganic chemical manufacturing | |
| 33 | Drug manufacturing | |
| 34 | Pesticide and Herbicide production | |
| 35 | Fertilizer production | |
| 36 | Plastics and Synthetics manufacturing | |
| 37 | Oil separator | |
| 38 | Oil refinery | |
| 39 | Oil terminal | |
| 40 | Laundry waste | |
| 41 | Mining and Material processing | |
| 42 | Mine dewatering | |
| 43 | Sand dredging | |
| 44 | Gem mining | |
| 45 | Swimming pool backwash | |
| 46 | Peat mining | |
| 47 | Battery manufacturing | |
| 48 | Hydroelectric turbines | |
| 49 | Paint and Ink formulation | |
| 50 | Printing and Publishing | |
| 51 | Photo Equipment and Supplies / Film Processing | |

| | |
|---|---|
| 52 | Soap and Detergent manufacturing |
| 53 | Dairy product processing |
| 54 | Cement manufacturing |
| 55 | Textiles |
| 56 | Metal plating |
| 57 | Metal finishing |
| 58 | Metal forming |
| 59 | Electrical / Electronic components |
| 60 | Railway yards |
| 61 | Car wash facilities |
| 62 | Porcelain enameling |
| 63 | Rubber processing |
| 64 | Glass manufacturing |
| 65 | Leather tanning and processing |
| 66 | Groundwater remediation |
| 67 | Non-Ferrous Metals manufacturing |
| 68 | Ash Ponds and Coal Piles |
| 69 | Metal Cleaning (Steam Electric plants) |
| 70 | Low-Volume Wastes (Steam Electric plants) |
| 71 | Brick manufacturing wastewater ponds |
| 72 | Landfill leachate |
| 73 | Stormwater |
| 74 | Aquifer depressurization |
| 75 | Phosphate rock – Clay Pond wastewater |
| 76 | Bakeries and Confectionery products |
| 77 | Marine Fisheries Research station |
| 78 | Other wastewater from Industrial and Commercial (Not otherwise listed) |
| 79 | Laboratory wastewater |
| 80 | Saltwater corrosion research |
| 81 | Food Preparation (Not classified elsewhere) |
| 82 | Contaminated soils |
| 83 | Truck washout (Concrete Plant) |
| 84 | Inorganic chemical processing |
| 85 | Organic chemical processing |
| 86 | Animal Shelters / Pounds / Hospitals |

# Appendix II

# Water Quality Data Collected by DWQ

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

# Appendix II Benthic macroinvertebrate collections in the Cape Fear River Basin, 1983-1998

**CPF 01**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Haw R, SR 2109 at Oak Ridge, Guilford | **B-1** | 16-(1) | 7/98 | -/11 | -/5.30 | Fair |
| | | | 7/93 | -/9 | -/5.67 | Fair |
| | | | 5/85 | 59/11 | 6.52/4.85 | Fair |
| Haw R, US 29 Bus, Rockingham | **B-2** | 16-(1) | 7/98 | 69/21 | 6.10/5.17 | Good-Fair |
| | | | 7/93 | 56/20 | 5.87/5.12 | Good-Fair |
| Haw R, NC 150, Alamance | **B-3** | 16-(1) | 7/98 | -/17 | -/4.90 | Good-Fair |
| Haw R, NC 87 nr Altamahaw, Alamance | **B-4** | 16-(1) | 7/98 | 57/17 | 6.69/5.98 | Fair |
| | | | 7/93 | 69/22 | 5.85/5.14 | Good-Fair |
| | | | 7/90 | 63/12 | 7.13/5.57 | Fair |
| | | | 7/87 | 65/14 | 6.41/5.93 | Good-Fair |
| | | | 5/85 | 65/23 | 6.50/4.91 | Good-Fair |
| Brooks Lake Trib, Scout Camp, Guilford | B-5 | 16-4-1-(1) | 6/90 | 53/15 | 4.30/2.39 | Not Rated |
| | | | 6/85 | 79/20 | 4.95/2.47 | Not Rated |
| Candy Cr, SR 2700, Guilford | B-6 | 16-5 | 6/90 | 59/10 | 6.61/5.72 | Not Rated |
| | | | 6/85 | 69/11 | 6.96/6.17 | Not Rated |
| Troublesome Cr, SR 2422, Rockingham | **B-7** | 16-6-(0.7) | 7/98 | -/14 | -/4.85 | Good-Fair |
| | | | 7/93 | -/18 | -/4.88 | Good-Fair |
| L Troublesome Cr, ab Reidsville WWTP, Guilford | B-8 | 16-7 | 11/94 | 59/18 | 6.48/5.58 | Fair |
| | | | 1/92 | 42/8 | 6.74/5.63 | Fair |
| | | | 12/87 | 69/18 | 6.71/5.21 | Fair |
| L Troublesome Cr, be Reidsville WWTP, Guilford | B-9 | 16-7 | 11/94 | 39/8 | 7.17/5.80 | Fair |
| | | | 1/92 | 33/7 | 6.83/5.15 | Fair |
| | | | 12/87 | 37/11 | 6.91/4.16 | Fair |
| L Troublesome Cr, SR 2598, Rockingham | B-10 | 16-7 | 5/85 | 36/3 | 7.72/5.63 | Poor |
| L Troublesome Cr, SR 2600, Rockingham | **B-11** | 16-7 | 7/98 | 42/3 | 7.60/7.02 | Poor |
| | | | 7/93 | 42/3 | 7.22/7.22 | Poor |

**CPF 02**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Haw R, NC 49 at Haw R, Alamance | B-1 | 16-(1) | 5/85 | 58/10 | 6.85/5.76 | Fair |
| | | | 8/84 | 36/12 | 6.58/5.70 | Fair |
| Haw R, NC 54 nr Graham, Alamance | **B-2** | 16-(1) | 7/98 | 73/21 | 6/01/4.69 | Good-Fair |
| | | | 7/93 | 64/19 | 6.11/5.20 | Good-Fair |
| | | | 8/89 | 58/14 | 6.15/5.55 | Good-Fair |
| | | | 8/87 | -/13 | -/5.43 | Fair |
| | | | 7/87 | 74/20 | 6.29/5.49 | Good-Fair |
| | | | 9/85 | 60/14 | 6.49/5.43 | Fair |
| | | | 5/84 | 66/16 | 6.96/5.44 | Fair |
| | | | 8/83 | 73/15 | 7.06/5.50 | Fair |
| Haw R, ab Alamance Cr, Alamance | B-3 | 16-(1) | 5/84 | 64/16 | 7.04/5.03 | Fair |
| Haw R, be Alamance Cr, Alamance | B-4 | 16-(1) | 5/84 | 68/20 | 7.12/4.61 | Fair |
| Reedy Fk, SR 2128 nr Oak Ridge, Guilford | **B-5** | 16-11-(1) | 7/98 | -/19 | -/4.06 | Good-Fair |
| | | | 7/93 | -/19 | -/4.87 | Good-Fair |
| | | | 7/88 | 69/22 | 5.55/4.44 | Good |
| | | | 4/86 | 77/24 | 5.50/4.48 | Good |
| Brush Cr, SR 2136 (Fleming Rd), Guilford | **B-6** | 16-11-4-(1) | 9/98 | 72/15 | 6.83/5.00 | Fair |
| Horsepen Cr, US 220, Guilford | **B-7** | 16-11-5-(0.5) | 7/98 | -/7 | -/6.45 | Fair |
| | | | 7/93 | -/9 | -/6.10 | Fair |
| | | | 4/86 | 82/22 | 6.48/5.13 | Good-Fair |
| UT Horsepen Cr, Friendly Rd, Guilford | B-8 | 16-11-5-1-(2) | 9/98 | 51/6 | 6.80/6.58 | Not Rated* |
| | | | 9/92 | 43/4 | 7.58/7.04 | Not Rated* |
| Reedy Fk, SR 2728, Guilford | **B-9** | 16-11-(9) | 7/98 | -/18 | -/5.63 | Good-Fair |
| | | | 7/93 | -/16 | -/5.99 | Good-Fair |
| Reedy Fk, NC 87 nr Ossippee, Alamance | **B-10** | 16-11-(9) | 7/98 | 53/11 | 7.11/6.15 | Fair |
| | | | 7/93 | 68/20 | 6.41/5.58 | Good-Fair |
| | | | 8/89 | 67/14 | 6.88/6.03 | Fair |

**CPF 02 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 7/86 | 59/10 | 6.75/6.02 | Fair |
| | | | 5/85 | 49/12 | 7.69/5.98 | Fair |
| | | | 8/83 | 52/13 | 7.65/6.69 | Fair |
| N Buffalo Cr, ab Cone Mills, Guilford | B-11 | 16-11-14-1 | 7/97 | 43/5 | 7.49/6.99 | Poor |
| N Buffalo Cr, be Cone Mills, Guilford | B-12 | 16-11-14-1 | 7/98 | -/5 | -/7.08 | Poor |
| | | | 7/97 | 50/4 | 7.81/6.49 | Poor |
| N Buffalo Cr, ab WWTP, Guilford | B-13 | 16-11-14-1 | 7/97 | 50/3 | 7.75/7.00 | Poor |
| | | | 11/88 | 37/3 | 7.79/7.42 | Poor |
| N Buffalo Cr, SR 2832 be WWTP, Guilford | **B-14** | 16-11-14-1 | 7/98 | 37/3 | 8.00/7.00 | Poor |
| | | | 7/93 | 40/4 | 8.11/6.68 | Poor |
| | | | 11/88 | 32/1 | 8.50/7.78 | Poor |
| | | | 5/85 | 28/2 | 8.66/6.05 | Poor |
| S Buffalo Cr, McConnell Rd, Guilford | B-15 | 16-11-14-2 | 7/98 | -/7 | -/6.90 | Fair |
| S Buffalo Cr, US 70 ab WWTP, Guilford | **B-16** | 16-11-14-2 | 7/98 | 46/6 | 7.68/6.48 | Poor |
| | | | 7/93 | 59/8 | 7.41/4.89 | Fair |
| | | | 8/88 | 63/9 | 7.86/4.68 | Poor |
| S Buffalo Cr, SR 2821 be WWTP, Guilford | **B-17** | 16-11-14-2 | 7/98 | 26/1 | 8.55/7.78 | Poor |
| | | | 7/93 | 50/2 | 8.23/----- | Poor |
| | | | 8/88 | 34/1 | 7.61/7.78 | Poor |
| | | | 5/85 | 36/2 | 8.47/6.88 | Poor |
| Mile Run Cr, SR 1400, Guilford | B-18 | 16-11-14-2-4 | 4/86 | 25/1 | 8.71/7.00 | Poor |
| Stony Cr, SR 1100, Caswell | **B-19** | 16-14-(1) | 7/98 | -/21 | -/5.39 | Good |
| | | | 7/93 | -/21 | -/4.68 | Good |
| | | | 2/93 | -/27 | -/4.03 | Good |
| Jordan Cr, SR 1002, Alamance | **B-20** | 16-14-6-(0.5) | 7/98 | -/16 | -/5.02 | Good-Fair |
| | | | 2/93 | -/23 | -/4.78 | Good-Fair |
| Haw Cr, SR 2158, Alamance | **B-21** | 16-20-(1) | 7/98 | -/22 | -/4.80 | Good |
| | | | 2/93 | -/19 | -/4.76 | Good-Fair |

**CPF 03**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| L Alamance Cr, SR 3056 ab Rock Cr, Guilford | B-1 | 16-19-3-(4.5) | 2/93 | 69/24 | 5.48/4.72 | Good |
| UT Rock Cr, SR 2808, Guilford | B-2 | 16-19-8-3.5-(1) | 11/88 | -/20 | -/4.52 | Not Rated* |
| Big Alamance Cr, NC 49, Alamance | **B-3** | 16-19-(4.5) | 7/98 | -/18 | -/5.54 | Good-Fair |
| | | | 7/93 | -/19 | -/5.23 | Good-Fair |
| | | | 2/93 | -/20 | -/4.27 | Good-Fair |
| Big Alamance Cr, SR 2309 nr Bellemont, Alam. | B-4 | 16-19-(4.5) | 10/89 | 95/31 | 5.87/4.47 | Good |
| | | | 8/89 | 79/22 | 6.11/5.26 | Good-Fair |
| | | | 4/89 | 79/26 | 5.77/4.41 | Good-Fair |
| | | | 2/89 | 65/22 | 5.84/4.58 | Good-Fair |
| | | | 7/86 | 80/22 | 5.84/5.05 | Good-Fair |
| UT Back Cr, off SR 1149, Alamance | B-5 | 16-19-5 | 4/95 | 70/28 | 4.84/3.95 | Excellent |
| UT Back Cr, be Triangle Paving, Alamance | B-6 | 16-19-5 | 4/95 | 54/22 | 5.49/4.76 | Good |
| Gum Cr, SR 1148, Alamance | B-7 | 16-19-7 | 4/86 | 67/14 | 7.52/5.98 | Fair |
| Stinking Quarter Cr, SR 1136, Alamance | **B-8** | 16-19-8 | 7/98 | -/23 | -/5.06 | Good |
| | | | 7/93 | -/16 | -/5.01 | Good-Fair |
| | | | 2/93 | -/25 | -/4.01 | Good-Fair |
| | | | 4/86 | 91/30 | 6.05/5.10 | Good |
| Little Alamance Cr, SR 2309, Alamance | **B-9** | 16-19-11 | 7/98 | -/6 | -/6.85 | Poor |
| | | | 7/85 | 45/8 | 7.33/6.62 | Fair |

**CPF 04**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Haw R, SR 2158 nr Saxapahaw, Alamance | B-1 | 16-(1) | 8/83 | 54/7 | 6.90/5.63 | Fair |
| Haw R, SR 1005 nr Saxapahaw, Alamance | **B-2** | 16-(1) | 11/98 | 47/15 | 5.68/4.49 | Good-Fair |
| | | | 7/98 | 65/20 | 6.17/4.76 | Good-Fair |
| | | | 7/93 | 60/18 | 5.91/5.27 | Good-Fair |
| | | | 7/90 | 71/20 | 6.11/5.01 | Good-Fair |

**CPF 04 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 8/89 | 60/18 | 6.23/5.42 | Good-Fair |
| | | | 7/88 | 71/21 | 5.90/5.15 | Good-Fair |
| | | | 7/87 | 71/21 | 6.11/5.27 | Good-Fair |
| | | | 7/87 | -/21 | -/5.05 | Good |
| | | | 7/86 | 67/19 | 6.18/5.07 | Good-Fair |
| | | | 9/85 | 64/23 | 5.63/5.20 | Good |
| | | | 5/85 | 73/24 | 6.30/5.01 | Good-Fair |
| | | | 9/84 | 61/13 | 6.53/5.17 | Fair |
| | | | 5/84 | 85/27 | 6.01/4.76 | Good |
| Marys Cr, SR 2174, Alamance | **B-3** | 16-26 | 2/98 | -/17 | -/3.88 | Fair |
| Cane Cr, SR 1114, Orange | **B-4** | 16-27-(2.5) | 7/98 | -/27 | -/4.33 | Good |
| | | | 2/98 | -/25 | -/4.20 | Good |
| | | | 2/98 | 77/37 | 4.88/3.49 | Excellent |
| | | | 7/93 | -/20 | -/4.06 | Good-Fair |
| | | | 2/93 | -/28 | -/3.57 | Good |
| | | | 4/86 | 110/33 | 5.63/4.54 | Good |
| Cane Cr, SR 1100, Orange | B-5 | 16-27-(2.5) | 11/84 | 88/27 | 5.89/4.87 | Good-Fair |
| Cane Cr, NC 54, Orange | B-6 | 16-27-(7) | 4/94 | 91/28 | 5.86/4.17 | Good-Fair |
| Cane Cr, SR 1958, Orange | B-7 | 16-27-(7) | 4/94 | 110/37 | 5.85/4.69 | Good |
| Cane Cr (west), SR 2351, Alamance | B-8 | 16-28 | 8/98 | -/10 | -/4.43 | NR |
| | | | 12/86 | -/12 | -/5.75 | Fair |
| Cane Cr (west), off SR 2351, Alamance | B-9 | 16-28 | 8/98 | 66/15 | 5.61/4.41 | Good-Fair |
| Cane Cr (west), NC 87, Alamance | B-10 | 16-28 | 2/93 | -/20 | -/4.36 | Good-Fair |
| | | | 12/86 | -/5 | -/4.86 | Poor |
| Collins Cr, SR 1539, Chatham | **B-11** | 16-30-(1.5) | 2/98 | -/19 | -/4.53 | Good-Fair |
| | | | 12/86 | 44/4 | 7.17/4.13 | Poor |
| UT Collins Cr, ab WWTP, Orange | B-12 | 16-30-(1) | 8/91 | 52/17 | 5.73/4.67 | Good-Fair |
| UT Collins Cr, be WWTP, Orange | B-13 | 16-30-(1) | 8/91 | 63/15 | 5.83/5.08 | Good-Fair |
| Terrells Cr, NC 87, Chatham | **B-14** | 16-31-(2.5) | 7/98 | -/15 | -/4.53 | Good-Fair |
| | | | 2/93 | -/30 | -/3.32 | Good |
| Terrells Cr, SR 1520, Chatham | B-15 | 16-31-(2.5) | 12/86 | -/13 | -/5.07 | Fair |
| Dry Cr, SR 1520, Chatham | **B-16** | 16-34-(0.7) | 2/98 | -/21 | -/3.98 | Good-Fair |
| | | | 2/93 | -/31 | -/4.63 | Good |
| | | | 12/86 | -/5 | -/6.02 | Poor |
| Haw R, US 64 nr Pittsboro , Chatham | **B-17** | 16-(36.7) | 7/98 | 65/25 | 5.40/4.34 | Good |
| | | | 7/93 | 63/24 | 5.19/4.42 | Good |
| | | | 7/90 | 60/24 | 5.47/4.29 | Good |
| | | | 7/88 | 81/28 | 5.97/4.70 | Good |
| | | | 7/86 | 69/24 | 5.73/4.43 | Good |
| | | | 5/85 | 84/27 | 5.74/4.32 | Good |
| | | | 9/84 | 56/20 | 5.77/4.69 | Good-Fair |
| | | | 6/83 | 48/14 | 5.50/4.43 | Good-Fair |
| | | | 6/83 | 51/19 | 5.49/4.49 | Good |
| | | | 6/83 | 61/19 | 5.63/4.53 | Good |
| Pokeberry Cr, SR 1711, Chatham | **B-18** | 16-37 | 2/98 | -/30 | -/3.93 | Good |
| | | | 2/93 | -/23 | -/4.68 | Good-Fair |
| | | | 12/86 | 94/26 | 5.91/4.24 | Good |
| | | | 10/85 | 86/21 | 6.06/4.74 | Good-Fair |
| Robeson Cr, US 15/501, Chatham | B-19 | 16-38-(3) | 3/97 | -/12 | -/5.94 | Fair |
| UT Robeson Cr, US 64, Chatham | B-20 | - | 3/97 | 24/3 | 7.62/4.03 | NR |
| Robeson Cr, ab Pittsboro WWTP, Chatham | B-21 | 16-38-(3) | 3/97 | 52/7 | 6.44/6.26 | Fair |
| | | | 9/90 | 66/7 | 7.58/7.00 | Poor |
| Robeson Cr, be Pittsboro WWTP, Chatham | B-22 | 16-38-(3) | 9/90 | 54/7 | 7.10/5.90 | Fair |
| | | | 4/86 | 82/11 | 7.26/5.89 | Fair |

**CPF 05**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| New Hope Cr, SR 1734, Orange | B-1 | 16-41-1-(0.5) | 3/93 | 94/29 | 5.03/3.85 | Good |
| New Hope Cr, SR 2220, Durham | B-2 | 16-41-1-(11.5) | 3/87 | 53/14 | 6.71/5.72 | Fair |
| New Hope Cr, I-40, Durham | B-3 | 16-41-1-(11.5) | 10/85 | 49/10 | 7.76/6.48 | Fair |
| New Hope Cr, SR 1107, Durham | **B-4** | 16-41-1-(11.5) | 7/98 | 38/10 | 6.79/5.77 | Fair |
| | | | 10/85 | 32/5 | 7.59/6.69 | Poor |
| Third Fork Cr, NC 751, Durham | **B-5** | 16-41-1-12-(2) | 2/93 | 39/8 | 7.63/6.65 | Poor |
| | | | 4/85 | 40/3 | 8.10/6.84 | Poor |
| Northeast Cr, SR 1102, Durham | **B-6** | 16-41-1-17-(0.7) | 2/98 | -/7 | -/6.57 | NR |
| | | | 2/93 | 58/9 | 6.82/6.05 | NR |
| | | | 3/87 | 29/3 | 7.72/6.51 | NR |
| Northeast Cr, SR 1100, Durham | B-7 | 16-41-1-17-(0.7) | 2/93 | 35/7 | 6.82/5.83 | Poor |
| | | | 3/87 | 27/0 | 7.97/- | Poor |
| | | | 12/86 | -/4 | -/640 | Poor |
| | | | 4/85 | 62/7 | 7.38/6.09 | Poor |
| Northeast Cr, SR 1731, Chatham | B-8 | 16-41-1-17-(0.7) | 7/93 | 46/8 | 7.10/6.31 | Fair |
| | | | 12/86 | -/8 | -/5/95 | Fair |
| Burdens Cr, SR 1945, Durham | B-9 | 16-41-1-17-1-(0.7) | 4/86 | 60/10 | 6.96/5.41 | Fair |
| Cub Cr, SR 1008, Chatham | B-10 | 16-41-2-10-(0.5) | 12/86 | -/14 | -/5.44 | Fair |
| Beartree Cr, SR 1716, Chatham | **B-11** | 16-41-5-(2) | 2/98 | -/22 | -/3.94 | NR |
| | | | 7/93 | -/10 | -/6.30 | NR |
| | | | 2/93 | -/21 | -/3.91 | NR |
| | | | 4/86 | 79/29 | 4.95/3.78 | NR |
| White Oak Cr, SR 1603, Wake | **B-12** | 16-41-6-(0.7) | 2/98 | -/10 | -/5.17 | NR |
| White Oak Cr, NC 751, Chatham | B-13 | 16-41-6-(2) | 2/93 | -/13 | -/4.82 | Fair |

**CPF 06**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Little Cr, Pinehurst Dr, Orange | B-1 | 16-41-1-15-(0.5) | 2/98 | -/5 | -/4.84 | Poor |
| | | | 2/93 | 37/7 | 7.13/4.70 | Fair |
| Bolin Cr, SR 1777, Orange | B-2 | 16-41-1-15-1-(0.5) | 3/98 | -/23 | -/4.23 | Good |
| | | | 4/93 | -/24 | -/4.46 | Good |
| Bolin Cr, Village Rd, Orange | B-3 | 16-41-1-15-1-(0.5) | 2/98 | 59/26 | 5.10/3.94 | Good |
| | | | 4/93 | -/24 | -/3.90 | Good-Fair |
| Bolin Cr, E Franklin St, Orange | B-4 | 16-41-1-15-1-(4) | 3/98 | 37/13 | 6.28/6.01 | Fair |
| | | | 2/98 | -/4 | -/6.66 | Poor |
| | | | 2/93 | 32/8 | 6.53/5.35 | Fair |
| | | | 4/86 | 89/28 | 6.08/4.35 | Good-Fair |
| Booker Cr, Piney Mt. Rd, Orange | B-5 | 16-41-1-15-2-(1) | 3/98 | -/10 | -/5.80 | Fair |
| Morgan Cr, NC 54, Orange | **B-6** | 16-41-2-(1) | 2/98 | -/31 | -/3.64 | Good |
| | | | 2/98 | 80/33 | 4.38/3.29 | Excellent |
| | | | 10/96 | 64/22 | 5.03/4.12 | Good |
| | | | 7/93 | 61/21 | 4.93/3.49 | Good |
| | | | 2/93 | 90/36 | 4.48/3.23 | Excellent |
| | | | 4/85 | 109/32 | 5.72/4.69 | Good |
| Morgan Cr, Botanical Trail, Orange | B-7 | 16-41-2-(5.5) | 3/98 | 46/20 | 6.09/5.40 | Good-Fair |
| | | | 4/93 | -/16 | -/4.94 | Fair |
| | | | 2/93 | 71/26 | 6.00/4.64 | Good-Fair |
| Morgan Cr, ab OWASA, Orange | B-8 | 16-41-2-(5.5) | 9/94 | 58/9 | 7.27/6.27 | Fair |
| | | | 9/90 | 63/8 | 7.16/6.39 | Fair |
| | | | 7/88 | 82/13 | 6.94/6.35 | Fair |
| Morgan Cr, be OWASA, Orange | B-9 | 16-41-2-(5.5) | 3/98 | 44/11 | 6.67/5.69 | Fair |
| | | | 9/94 | 47/6 | 7.61/6.12 | Poor |
| | | | 2/93 | 42/7 | 7.21/4.93 | Fair |
| | | | 9/90 | 66/8 | 7.47/5.89 | Poor |
| | | | 7/88 | 52/4 | 7.80/7.11 | Poor |
| Morgan Cr, SR 1726, Chatham | **B-10** | 16-41-2-(5.5) | 7/98 | 41/9 | 6.63/6.00 | Fair |
| | | | 7/93 | 38/7 | 6.88/6.54 | Fair |
| | | | 7/90 | 54/8 | 7.17/6.53 | Fair |
| | | | 7/87 | 35/6 | 6.82/6.30 | Fair |

**CPF 06 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 4/85 | 40/5 | 7.71/5.68 | Poor |
| | | | 8/84 | 50/10 | 7.06/5.90 | Fair |
| Pritchards Mill Cr, Damascus Rd, Orange | B-11 | 16-41-2-3-(0.5) | 4/93 | -/22 | -/4.31 | Good-Fair |
| Meeting of Waters Cr, Laurel Hill Rd, Orange | B-12 | 16-41-2-7 | 3/98 | -/3 | -/7.37 | Poor |
| | | | 4/93 | -/2 | -/7.28 | Poor |

**CPF 07**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Gulf Cr, nr SR 1924, Chatham | B-1 | 18-5-(1) | 4/93 | 34/6 | 6.68/5.39 | NR |
| UT Gulf Cr, nr SR 1924, Chatham | B-2 | 18-5-(1) | 4/93 | 19/4 | 6.63/4.50 | NR |
| Parkers Cr, SR 1450, Harnett | **B-3** | 18-9 | 7/98 | -/19 | -/5.43 | Good-Fair |
| | | | 2/98 | -/20 | -/4.21 | Good-Fair |
| | | | 8/93 | 83/25 | 5.45/4.52 | Good |
| | | | 3/93 | -/27 | -/4.04 | Good |
| Parkers Cr, off SR 1418, Harnett | B-4 | 18-9 | 11/88 | -/28 | -/3.42 | Excellent |
| Avent Cr, SR 1418, Harnett | B-5 | 18-13 | 11/88 | -/25 | -/3.93 | Excellent |
| Hector Cr, SR 1412, Harnett | B-6 | 18-15 | 11/88 | 100/29 | 5.20/3.83 | Excellent |
| Neils (Neals) Cr, SR 1441, Harnett | **B-7** | 18-16-(0.7) | 2/98 | -/19 | -/5.10 | Good-Fair |
| | | | 3/93 | -/18 | -/4.66 | Fair |
| Neils (Neals) Cr, SR 1403, Harnett | B-8 | 18-16-(0.7) | 11/88 | -/16 | -/4.25 | Good-Fair |
| Kenneth Cr, US 401, Wake | B-9 | 18-16-1-(2) | 9/98 | 67/18 | 5.97/5.14 | NR |
| Kenneth Cr, nr SR 2772, be F-V, Wake | B-10 | 18-16-1-(2) | 9/98 | 44/6 | 6.97/5.60 | NR |
| | | | 9/90 | 47/3 | 7.53/6.51 | Poor |
| Kenneth Cr, SR 1441,Harnett | **B-11** | 18-16-1-(2) | 2/98 | -/5 | -/6.22 | Poor |
| | | | 3/93 | 43/7 | 6.23/5.29 | Poor |
| UT Kenneth Cr, off SR 1447, Harnett | B-12 | 18-16-1-(2) | 8/81 | 50/16 | 4.14/2.37 | NR |
| Cape Fear R, US 401 nr Lillington, Harnett | **B-13** | 18-(16.7) | 7/98 | 75/32 | 5.99/4.84 | Good |
| | | | 8/93 | 76/28 | 5.79/4.71 | Good |
| | | | 9/90 | 107/36 | 6.10/4.73 | Good |
| | | | 7/88 | 93/30 | 5.95/4.72 | Good |
| | | | 7/86 | 89/29 | 6.09/4.82 | Good |
| | | | 8/85 | 91/29 | 6.20/5.04 | Good |
| | | | 9/84 | 94/25 | 6.01/4.98 | Good-Fair |
| | | | 7/83 | 72/30 | 5.28/4.54 | Good |
| Cape Fear R, NC 217, Harnett | **B-14** | 18-(20.7) | 7/98 | 76/34 | 5.46/4.25 | Excellent |
| | | | 8/93 | 68/30 | 5.15/4.36 | Excellent |

**CPF 08**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| E Fk Deep R, SR 1541, Guilford | **B-1** | 17-2-(0.3) | 7/98 | -/13 | -/6.01 | Fair |
| | | | 2/93 | -/12 | -/5.86 | Fair |
| UT E Fk Deep R, I-40, Guilford | B-2 | 17-2-(0.3) | 9/92 | 38/5 | 6.88/5.21 | Not Rated* |
| W Fk Deep R, SR 1850, Guilford | **B-3** | 17-3-(0.3) | 9/98 | 46/11 | 5.59/4.57 | Good-Fair |
| | | | 7/98 | -/12 | -/4.35 | Fair |
| | | | 7/93 | -/15 | -/4.66 | Good-Fair |
| | | | 2/93 | -/27 | -/4.61 | Good-Fair |
| W Fk Deep R, SR 1818, Guilford | B-4 | 17-3-(0.7) | 8/83 | 71/12 | -/----- | Fair |
| UT W Fk Deep R, ab LCP, Guilford | B-5 | 17-3-(0.3) | 10/88 | 35/8 | 5.97/5.31 | Not Rated* |
| UT W Fk Deep R, be LCP, Guilford | B-6 | 17-3-(0.3) | 10/88 | 6/0 | 8.41/---- | Not Rated* |
| Deep R, SR 1113, Guilford | B-7 | 17-(4) | 9/98 | 55/12 | 6.62/6.00 | Fair |
| | | | 8/88 | 81/8 | 7.29/6.74 | Fair |
| | | | 8/87 | 90/17 | 7.04/6.12 | Fair |
| | | | 8/86 | 87/13 | 7.06/6.28 | Fair |
| | | | 7/85 | 67/14 | 6.72/6.45 | Fair |
| | | | 8/83 | 11/0 | 8.42/---- | Poor |
| Deep R nr Randleman, SR 1921, Guilford | B-8 | 17-(4) | 7/90 | 73/12 | 7.20/6.12 | Fair |
| | | | 7/89 | 66/16 | 7.03/6.01 | Fair |
| | | | 8/88 | 78/11 | 7.28/6.43 | Fair |

**CPF 08 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 7/88 | 80/18 | 7.03/6.42 | Good-Fair |
| | | | 8/87 | 78/16 | 6.99/5.86 | Fair |
| | | | 7/87 | -/8 | -/6.57 | Fair |
| | | | 8/86 | 56/10 | 7.67/6.70 | Fair |
| | | | 8/85 | 64/11 | 7.70/6.60 | Fair |
| | | | 8/84 | 39/7 | 7.40/6.63 | Fair |
| | | | 8/83 | 56/9 | 7.86/6.47 | Poor |
| Deep R, US 220 Bus at Randleman, Randolph | **B-9** | 17-(4) | 7/98 | 77/20 | 5.98/5.10 | Good-Fair |
| | | | 7/93 | 74/20 | 6.07/5.39 | Good-Fair |
| | | | 08/88 | 63/12 | 6.64/6.22 | Fair |
| | | | 08/87 | 81/17 | 6.66/6.11 | Fair |
| | | | 08/86 | 74/10 | 7.14/6.22 | Fair |
| | | | 08/85 | 56/9 | 7.78/6.67 | Poor |
| | | | 08/83 | 60/9 | 7.22/6.46 | Fair |
| Richland Cr, ab WWTP, Guilford | B-10 | 17-7 | 08/88 | 56/10 | 7.29/5.55 | Fair |
| Richland Cr, SR 1145 be WWTP, Guilford | **B-11** | 17-7 | 07/98 | 28/5 | 7.88/6.59 | Poor |
| | | | 07/93 | 53/13 | 7.09/5.56 | Fair |
| | | | 08/88 | 62/9 | 7.61/5.78 | Poor |
| | | | 08/87 | 61/9 | 7.60/6.11 | Poor |
| | | | 08/86 | 40/2 | 8.19/6.58 | Poor |
| | | | 07/85 | 30/5 | 8.42/6.81 | Poor |
| | | | 08/83 | 47/9 | 7.53/6.75 | Fair |
| Hickory Cr, SR 1131, Guilford | **B-12** | 17-8-3 | 07/98 | -/12 | -/5.31 | Not Rated |
| | | | 02/93 | -/18 | -/3.30 | Fair |
| Muddy Cr, SR 1929, Randolph | **B-13** | 17-9 | 07/98 | -/13 | -/6.06 | Not Rated |
| | | | 02/93 | -/22 | -/4.71 | Good-Fair |

**CPF 09**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Deep R, SR 2122 at Worthville, Randolph | B-1 | 17-(4) | 8/88 | 74/10 | 7.28/6.19 | Fair |
| | | | 8/87 | 57/9 | 7.14/5.97 | Fair |
| | | | 8/86 | 66/10 | 7.92/6.41 | Fair |
| | | | 7/85 | 47/5 | 8.22/6.80 | Poor |
| | | | 8/83 | 43/3 | 8.41/7.02 | Poor |
| Deep R, SR 2226 at Cedar Falls, Randolph | B-2 | 17-(4) | 8/88 | 61/16 | 6.34/5.29 | Good-Fair |
| | | | 8/87 | 70/17 | 6.90/5.88 | Fair |
| | | | 8/86 | 61/12 | 6.89/6.23 | Fair |
| | | | 7/85 | 65/9 | 7.78/6.70 | Poor |
| | | | 8/83 | 50/5 | 7.84/6.83 | Poor |
| Deep R, SR 2615 at Ramseur, Randolph | **B-3** | 17-(4) | 7/98 | 71/20 | 5.93/4.79 | Good-Fair |
| | | | 7/93 | 67/17 | 6.22/5.14 | Good-Fair |
| | | | 7/89 | 73/18 | 6.11/5.43 | Good-Fair |
| | | | 8/87 | 78/23 | 6.27/4.96 | Good-Fair |
| | | | 8/86 | 75/21 | 6.46/5.22 | Good-Fair |
| | | | 7/85 | 74/13 | 6.92/5.95 | Fair |
| | | | 8/83 | 62/15 | 7.15/5.92 | Fair |
| Deep R, SR 2628 at Coleridge, Randolph | B-4 | 17-(4) | 8/86 | 89/26 | 6.69/5.30 | Good-Fair |
| | | | 8/85 | 104/35 | 5.77/455 | Good |
| | | | 8/83 | 71/19 | 6.93/5.78 | Good-Fair |
| Deep R, SR 1461 (1456) nr Jugtown, Moore | **B-5** | 17-(4) | 7/98 | 83/34 | 5.24/4.49 | Excellent |
| | | | 7/93 | 80/32 | 5.04/4.23 | Excellent |
| | | | 8/88 | 96/34 | 5.04/4.01 | Excellent |
| | | | 8/87 | 111/38 | 5.11/4.19 | Excellent |
| | | | 8/86 | 87/32 | 4.96/3.80 | Excellent |
| | | | 8/85 | 99/33 | 5.22/4.22 | Excellent |
| | | | 8/83 | 94/33 | 5.25/4.14 | Good |
| Polecat Cr, US 220 Bus, Guilford | B-6 | 17-11-(1) | 7/90 | 78/21 | 5.76/5.33 | Good |
| Polecat Cr, SR 2113, Randolph | **B-7** | 17-11-(1) | 2/98 | -/31 | -/4.04 | Good |
| | | | 2/93 | -/32 | -/4.31 | Good |

**CPF 09 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Polecat Cr, SR 2116, Randolph | B-8 | 17-11-(1) | 7/93 | -/9 | -/5.09 | Fair |
| | | | 8/83 | 77/22 | 6.27/5.69 | Good-Fair |
| UT Polecat Cr, nr SR 3430, Guilford | B-9 | 17-11-2-(2) | 7/90 | 33/1 | 8.87/7.42 | Poor |
| L Polecat Cr, SR 2108, Randolph | **B-10** | 17-11-3 | 2/98 | -/14 | -/4.23 | NR |
| L Polecat Cr, SR 2113, Randolph | B-11 | 17-11-3 | 2/93 | 83/32 | 4.63/3.44 | Excellent |
| | | | 8/86 | 91/20 | 5.14/4.21 | Good |
| Hasketts Cr, SR 2149, Randolph | B-12 | 17-12 | 9/98 | 33/4 | 7.03/6.41 | Poor |
| | | | 2/87 | 58/12 | 7.01/5.46 | Fair |
| Hasketts Cr, be SR 2149, Randolph | B-13 | 17-12 | 2/90 | 58/10 | 7.11/6.56 | Fair |
| | | | 8/88 | 66/12 | 7.64/6.63 | Fair |
| Hasketts Cr, SR 2128, Randolph | B-14 | 17-12 | 9/98 | 27/5 | 7.79/6.86 | Poor |
| | | | 2/90 | 42/9 | 7.43/5.48 | Poor |
| | | | 8/88 | 35/4 | 7.92/7.02 | Poor |
| | | | 8/87 | 33/3 | 7.92/5.85 | Poor |
| | | | 2/87 | 29/3 | 8.34/5.80 | Poor |
| Sandy Cr, SR 2261, Randolph | B-15 | 17-16-(1) | 5/89 | 81/19 | 6.44/4.39 | Good-Fair |
| | | | 5/88 | 69/15 | 6.10/5.24 | Good-Fair |
| Sandy Cr, SR 2481, Randolph | **B-16** | 17-16-(1) | 7/98 | -/35 | -/4.43 | Excellent |
| | | | 7/93 | -/22 | -/4.06 | Good |
| | | | 2/93 | -/27 | -/3.28 | Good |
| | | | 5/89 | 83/25 | 5.39/4/41 | Good |
| | | | 5/88 | 94/32 | 5.42/4.07 | Good |
| UT Sandy Cr, SR 2261, Randolph | B-17 | 17-16-(1) | 5/89 | 80/22 | 5.62/4.20 | Good |
| | | | 5/88 | 76/17 | 6.17/4.84 | Good-Fair |
| Mt Pleasant Cr, SR 2442, Randolph | B-18 | 17-16-3 | 5/89 | 80/22 | 4.99/4.06 | Good |
| Richland Cr, SR 2873, Randolph | **B-19** | 17-22 | 7/98 | -/29 | -/3.92 | Excellent |
| | | | 7/93 | -/26 | -/3.89 | Good |
| | | | 2/93 | -/23 | -/3.60 | Good |
| | | | 5/88 | 81/27 | 5.30/3.93 | Good |
| Brush Cr, SR 1102, Chatham | B-20 | 17-23 | 5/90 | -/26 | -/4.90 | Good |
| Brush Cr, NC 22, Randolph | **B-21** | 17-23 | 7/98 | -/26 | -/4.27 | Good |
| | | | 2/93 | -/23 | -/3.58 | Good |
| | | | 5/90 | -/28 | -/4.25 | Excellent |
| | | | 8/83 | 95/26 | 6.03/4.38 | Good |
| UT Little Brush Cr, SR 1100, Chatham | B-22 | 17-23-2 | 5/90 | -/23 | -/5.02 | Good |
| UT Little Brush Cr, SR 1005, Randolph | B-23 | 17-23-2 | 5/90 | -/17 | -/4.13 | Good-Fair |
| Flat Cr, SR 2886, Randolph | **B-24** | 17-24 | 2/98 | -/22 | -/4.72 | Good-Fair |
| | | | 2/93 | -/17 | -/5.07 | Fair |
| Fork Cr, SR 2873, Randolph | **B-25** | 17-25 | 2/98 | -/28 | -/3.75 | Good |
| | | | 2/93 | -/22 | -/3.38 | Good |

**CPF 10**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Deep R, NC 22, Moore | B-1 | 17-(25.7) | 7/89 | 69/24 | 5.58/4.83 | Good |
| Wolf Cr, SR 1403, Moore | B-2 | 17-26-4 | 7/88 | -/17 | -/5.55 | Good-Fair |
| | | | 2/84 | 91/30 | 5.36/3.76 | Good |
| Cabin Cr, SR 1400, Moore | **B-3** | 17-26-5-(1) | 3/98 | -/29 | -/4.20 | Good |
| | | | 2/93 | -/27 | -/3.62 | Good |
| | | | 9/92 | -/14 | -/4.50 | Not Rated |
| Cabin Cr, private rd off SR 1002, Moore | B-4 | 17-26-5-(1) | 9/92 | 61/11 | 6.37/3.71 | Fair |
| Cabin Cr, SR 1275, Moore | B-5 | 17-26-5-(1) | 9/92 | 91/27 | 5.50/3.73 | Good |
| Cotton Cr, SR 1372, Montgomery | B-6 | 17-26-5-3 | 9/98 | 38/4 | 6.61/5.82 | Poor |
| | | | 9/92 | 35/4 | 6.20/4.19 | Fair |
| | | | 7/88 | 15/0 | 9.3/0 | Poor |
| | | | 2/84 | 18/2 | 8.79/6.53 | Poor |
| Cotton Cr, SR 1370, Montgomery | B-7 | 17-26-5-3 | 9/98 | 49/11 | 6.07/4.39 | Fair |
| | | | 9/92 | 42/7 | 6.60/5.32 | Fair |
| | | | 2/84 | 33/10 | 7.16/4.76 | Fair |
| Mill Cr, nr SR 1275, Moore | **B-8** | 17-26-5-4 | 7/98 | -/20 | -/4.20 | Good-Fair |

**CPF 10 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 3/98 | 76/31 | 4.79/4.02 | Good |
| | | | 8/93 | 69/22 | 5.19/3.60 | Good |
| | | | 2/93 | 97/39 | 4.11/2.90 | Excellent |
| Wet Cr, NC 24, Moore | **B-9** | 17-26-5-5 | 3/98 | -/24 | -/3.26 | Good |
| | | | 2/93 | -/34 | -/3.95 | Good |
| Bear Cr, NC 705, Moore | **B-10** | 17-26-(6) | 7/98 | 82/25 | 5.70/4.42 | Good |
| | | | 8/93 | 73/22 | 6.27/4.92 | Good-Fair |
| Falls Cr, SR 1606, Moore | **B-11** | 17-27 | 2/98 | -/17 | -/4.89 | Fair |
| | | | 2/93 | -/18 | -/4.61 | Fair |
| Buffalo Cr, NC 22, Moore | **B-12** | 17-28 | 2/98 | -/27 | -/3.93 | Good |
| | | | 2/93 | -/20 | -/3.51 | Good-Fair |
| McLendons Cr, SR 1210, Moore | B-13 | 17-30 | 11/84 | 84/28 | 5.33/4.27 | Good |
| McLendons Cr, SR 1628, Moore | B-14 | 17-30 | 8/93 | 61/8 | 6.75/5.15 | Fair |
| | | | 2/93 | -/13 | -/5.59 | Fair |
| Haystack Cr, off SR 1261, Moore | B-15 | 17-30-1-2 | 3/86 | 63/21 | 4.86/2.63 | Good |
| | | | 2/84 | 65/25 | 4.20/2.31 | Good |
| Big Governors Cr, SR 1625, Moore | **B-16** | 17-32 | 2/98 | 45/11 | 6.64/5.44 | Not Rated |
| | | | 2/93 | 49/10 | 6.26/4.48 | Fair |
| Crawley Cr, nr SR 1625, Moore | B-17 | 17-32-2 | 2/98 | -/10 | -/5.47 | Not Rated |

**CPF 11**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| UT Deep R, nr SR 2140, Chatham | B-1 | 17-(33.5) | 9/87 | 64/13 | 6.50/5.28 | Good-Fair |
| Indian Cr, SR 2306, Chatham | B-2 | 17-35 | 3/93 | -/10 | -/5.18 | Poor |
| Deep R, SR 1007, Lee | **B-3** | 17-(36.5) | 7/98 | 61/23 | 5.93/4.65 | Good-Fair |
| | | | 8/93 | 74/25 | 5.78/4.90 | Good |
| | | | 9/87 | 99/32 | 5.76/4.23 | Good |
| Little Pocket Cr, NC 42, Lee | **B-4** | 11-37-4 (2) | 2/98 | -/14 | -/4.57 | NR |
| | | | 2/93 | -/16 | -/5.04 | NR |
| Cedar Cr, SR 2142, Chatham | **B-5** | 17-39 | 2/98 | -/16 | -/5.09 | NR |
| | | | 2/93 | -/13 | -/5.28 | NR |
| Big Buffalo Cr, SR 1403, Lee | B-6 | 17-40 | 8/93 | -/4 | -/6.12 | Poor |
| | | | 2/93 | -/12 | -/5.13 | Fair |
| Georges Cr, SR 2142, Chatham | B-7 | 17-41 | 2/93 | -/15 | -/4.83 | NR |
| Georges Cr, SR 2150, Chatham | **B-8** | 17-41 | 2/98 | -/4 | -/4.25 | NR |
| Deep R, US 15/501-NC 87, Lee | **B-9** | 17-(41.5) | 7/98 | 72/21 | 6.39/4.96 | Good-Fair |
| | | | 8/93 | 77/27 | 5.97/4.65 | Good |
| | | | 9/87 | 88/25 | 6.09/4.62 | Good-Fair |
| Little Buffalo Cr, SR 1420, Lee | B-10 | 17-42 | 2/93 | -/5 | -/7.09 | Poor |

**CPF 12**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Rocky R, US 64, Chatham | **B-1** | 17-43-(8) | 7/98 | 78/16 | 6.40/4.60 | Good-Fair |
| | | | 6/97 | 77/20 | 6.74/5.08 | Good-Fair |
| | | | 7/93 | 69/12 | 6.97/5.65 | Fair |
| | | | 8/89 | 57/16 | 6.70/5.80 | Fair |
| Rocky R, SR 2170, Chatham | **B-2** | 17-43-(8) | 7/98 | 69/19 | 6.24/4.97 | Good-Fair |
| | | | 6/97 | 80/19 | 6.47/5.29 | Good-Fair |
| | | | 7/93 | 66/19 | 6.54/5.38 | Good-Fair |
| | | | 8/89 | 56/11 | 6.77/6.12 | Fair |
| Rocky R, NC 902, Chatham | B-3 | 17-43-(8) | 6/97 | -/22 | -/4.76 | Good |
| | | | 8/89 | 73/24 | 5.84/4.77 | Good-Fair |
| Rocky R, US 15/501, Chatham | **B-4** | 17-43-(8) | 7/98 | 77/26 | 5.26/3.99 | Good |
| | | | 7/93 | 85/30 | 5.41/4.22 | Good |
| | | | 7/90 | 98/30 | 5.54/4.51 | Good |
| Loves Cr, nr SR 2203 ab WWTP, Chatham | B-5 | 17-43-10 | 6/97 | 55/8 | 7.25/6.61 | Fair |
| | | | 8/89 | 52/7 | 7.50/6.85 | Fair |
| Loves Cr, be WWTP nr SR 2203, Chatham | B-6 | 17-43-10 | 6/97 | 36/4 | 7.41/6.06 | Poor |

**CPF 12 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 8/89 | 27/2 | 8.41/6.62 | Poor |
| Tick Cr, US 421, Chatham | B-7 | 17-43-13 | 2/98 | -/18 | -/4.86 | Good-Fair |
| | | | 7/93 | -/5 | -/6.57 | Poor |
| | | | 8/85 | 80/19 | 6.54/5.40 | Good-Fair |
| Tick Cr, SR 2120, Chatham | **B-8** | 17-43-13 | 7/98 | -/15 | -/5.87 | Good-Fair |
| Landrum Cr, NC 902, Chatham | B-9 | 17-43-14 | 7/90 | -/19 | -/3.53 | Good-Fair |
| Harlands Cr, NC 902, Chatham | **B-10** | 17-43-15 | 7/98 | -/23 | -/4.45 | Good |
| | | | 2/98 | -/22 | -/4.68 | Good-Fair |
| | | | 7/90 | -/16 | -/3.78 | Good-Fair |
| Bear Cr, SR 2333, Chatham | B-11 | 17-43-16 | 8/91 | 73/16 | 6.78/5.56 | Fair |
| Bear Cr, SR 2189, Chatham | B-12 | 17-43-16 | 8/91 | 69/15 | 6.51/5.58 | Fair |
| Bear Cr, SR 2155, Chatham | B-13 | 17-43-16 | 7/90 | -/15 | -/4.83 | Good-Fair |

**CPF 13**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Juniper Cr, SR 1144, Lee | B-1 | 18-20-6-(1) | 11/88 | -/9 | -/4.19 | Fair |
| Upper Little R, SR 1222, Harnett | **B-2** | 18-20-(8) | 7/98 | 72/21 | 6.36/5.07 | Good-Fair |
| | | | 8/93 | 56/13 | 6.17/4.74 | Good-Fair |
| | | | 12/88 | 77/19 | 5.92/4.16 | Good-Fair |
| Upper Little R, NC 27, Harnett | **B-3** | 18-20-(8) | 7/98 | 81/27 | 5.50/3.92 | Good |
| | | | 8/93 | 81/26 | 5.51/3.85 | Good |
| Barbeque Cr, SR 1209, Harnett | **B-4** | 18-20-13 | 7/98 | -/20 | -/3.67 | Good |
| | | | 8/93 | -/14 | -/3.61 | Good-Fair |
| | | | 11/88 | -/19 | -/4.09 | Good-Fair |
| Upper Little R, nr SR 2016 ab Becker, Harnett | B-5 | 18-20-4 | 7/91 | -/23 | -/3.89 | Good |
| Upper Little R, nr SR 2016 be Becker, Harnett | B-6 | 18-20-4 | 7/91 | -/17 | -/3.00 | Good-Fair |
| Upper Little R, SR 2021 nr Erwin, Harnett | **B-7** | 18-20-4 | 7/98 | 88/35 | 5.13/3.69 | Excellent |
| | | | 8/93 | 67/25 | 5.34/3.86 | Good |
| | | | 7/91 | -/25 | -/3.44 | Excellent |
| | | | 7/88 | 83/27 | 5.25/3.79 | Excellent |

**CPF 14**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Nicks Cr, NC 22, Moore | **B-1** | 18-23-3-(3) | 7/98 | -/24 | -/3.92 | Excellent |
| | | | 8/93 | -/20 | -/3.27 | Good |
| | | | 11/88 | -/22 | -/2.99 | Good |
| (Lower )Little R, SR 2023, Moore | **B-2** | 18-23-(10.7) | 7/98 | 75/31 | 4.69/3.55 | Excellent |
| | | | 8/93 | 70/33 | 4.54/3.23 | Excellent |
| | | | 4/90 | -/35 | -/3.94 | Excellent |
| | | | 12/88 | 85/35 | 4.37/2.63 | Excellent |
| Mill Cr, SR 1853, Moore | B-3 | 18-23-11-(2) | 7/98 | 68/30 | 4.86/3.69 | Excellent |
| UT McDeeds Cr, bel HB/PS, Moore | B-4 | 18-23-11-4 | 7/93 | 15/0 | 8.46/0.00 | Not Rated |
| James Cr, nr SR 2023, Hoke | B-5 | 18-23-13 | 4/90 | -/24 | -/3.93 | Good |
| James Cr, at Little River, Moore | B-6 | 18-23-13 | 11/88 | -/22 | -/2.75 | Good |
| James Cr, nr Weymouth Springs, Moore | B-7 | 18-23-13-1 | 3/86 | 49/11 | 5.01/2.99 | Good |
| | | | 2/84 | 55/16 | 4.46/2.63 | Good |
| Horse Cr, Manchester Rd, Hoke | B-8 | 18-23-14 | 4/90 | -/18 | -/3.41 | Good-Fair |
| Flat Cr, Manchester Rd, Hoke | B-9 | 18-23-15 | 4/90 | -/21 | -/3.52 | Good |
| | | | 12/84 | 74/24 | 4.98/3.97 | Good |
| Mill Cr, Manchester Rd, Hoke | B-10 | 18-23-17-1 | 4/90 | -/13 | -/3.65 | Good-Fair |
| UT in Sicily Drop Zone, Man. Rd, Hoke | B-11 | 18-23-17 | 4/90 | -/2 | -/2.37 | Poor |
| Jumping Run Cr, Manchester Rd, Hoke | B-12 | 18-23-20 | 4/90 | -/13 | -/4.37 | Good-Fair |
| McPherson Cr, Manchester Rd, Cumber. | B-13 | 18-23-23.7 | 4/90 | -/12 | -/4.70 | Good-Fair |
| (Lower) Little R, NC 87/24 at Manchester, Cumberland | **B-14** | 18-23-(24) | 7/98 | 83/40 | 4.79/3.71 | Excellent |
| | | | 8/93 | 64/18 | 5.59/4.42 | Good-Fair |
| | | | 7/90 | 73/19 | 6.04/4.80 | Good-Fair |
| | | | 7/88 | 50/7 | 7.22/5.23 | Fair |
| | | | 6/86 | 57/8 | 6.74/3.03 | Fair |

**CPF 14 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 9/84 | 81/25 | 5.34/3.73 | Good |
| (Lower) Little R, US 401, Cumberland | **B-15** | 18-23-(24) | 7/98 | 87/38 | 4.64/3.95 | Excellent |
| | | | 8/93 | 70/26 | 5.06/3.24 | Excellent |
| Jumping Run Cr, NC 210, Cumberland | **B-16** | 18-23-29 | 7/98 | -/26 | -/4.09 | Excellent |
| | | | 8/93 | -/16 | -/3.24 | Good-Fair |
| Anderson Cr, SR 2031, Harnett | **B-17** | 18-23-32 | 7/98 | -/19 | -/3.60 | Good-Fair |
| | | | 8/93 | -/13 | -/2.97 | Good-Fair |

**CPF 15**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Cape Fear R, ab Cross Cr, Cumberland | B-1 | 18-(26) | 1/86 | 77/32 | 5.58/4.13 | Good |
| Cape Fear R, be Cross Cr WWTP, Cumber. | B-2 | 18-(26) | 1/86 | 82/24 | 6.10/4.10 | Good-Fair |
| Cape Fear R, Person Street, Cumberland | **B-3** | 18-(26) | 7/98 | 40/14 | 6.14/4.74 | Not Rated |
| | | 18-(26) | 8/93 | 48/19 | 5.38/4.05 | Good-Fair |
| Cape Fear R, be Monsanto, Cumberland | B-4 | 18-(26) | 1/86 | 78/28 | 5.78/4.46 | Good |
| Cross Cr, ab UT, Cumberland | B-5 | 18-27-(1) | 4/90 | -/7 | -/5.04 | Fair |
| Cross Cr, be UT, Cumberland | B-6 | 18-27-(1) | 4/90 | -/10 | -/5.12 | Fair |
| Cross Cr, NC 87/210, Cumberland | B-7 | 18-27-(3) | 8/93 | -/10 | -/6.01 | Fair |
| Little Cross Cr, ab lake nr Bragg Blvd, Cumb. | B-8 | 18-27-4-(1) | 9/98 | 48/12 | 5.98/4.58 | Not Rated |
| | | | 4/90 | -/2 | -/2.52 | Poor |
| UT Little Cross Cr, ab Glenville Lake, Cumb. | B-9 | 18-27-4-(1) | 9/98 | -/8 | -/2.93 | Not Rated |
| Little Cross Cr, be Glenville Lake, Cumb. | B-10 | 18-27-4-2 | 3/98 | 37/7 | 6.93/6.10 | Fair |
| Rockfish Cr, Plank Rd, Hoke | B-11 | 18-31-(1) | 4/90 | -/16 | -/3.78 | Good-Fair |
| Juniper Cr, Plank Rd, Hoke | B-12 | 18-31-10 | 4/90 | -/19 | -/3.85 | Good |
| Pedler Br, NC 20, Hoke | B-13 | 18-31-16 | 2/90 | 36/2 | 8.29/6.33 | Poor |
| Pedler Br, US 401, Hoke | B-14 | 18-31-16 | 2/90 | 16/0 | 8.46/- | Poor |
| Puppy Cr, Plank Rd, Hoke | B-15 | 18-31-19 | 4/90 | -/15 | -/4.35 | Good-Fair |
| Rockfish Cr, SR 1300 (Vass Rd), Cumberland | B-16 | 18-31-(12) | 5/94 | 66/25 | 5.10/3.94 | Good |
| Rockfish Cr, SR 1432, Hoke | **B-17** | 18-31-(23) | 7/98 | 61/26 | 5.33/3.91 | Excellent |
| | | | 5/94 | -/24 | -/3.68 | Good |
| | | | 8/93 | 61/25 | 4.81/3.48 | Good |
| | | | 6/90 | -/16 | -/4.24 | Good-Fair |
| Rockfish Cr, SR 1115, Cumberland | B-18 | 18-31-(23) | 5/94 | 76/23 | 5.40/3.80 | Good |
| | | | 6/90 | -/17 | -/4.53 | Good-Fair |
| Rockfish Cr, US 301 Bus, Cumberland | B-19 | 18-31-(23) | 7/83 | 60/25 | 5.03/4.11 | Excellent |
| Rockfish Cr, I-95 nr Hope Mills, Cumberland | B-20 | 18-31-(23) | 6/90 | -/24 | -/4.16 | Excellent |
| | | | 7/88 | 77/31 | 5.17/4.14 | Excellent |
| Rockfish Cr, NC 87, Cumberland | **B-21** | 18-31-(23) | 7/98 | 68/32 | 4.56/3.82 | Excellent |
| | | | 8/93 | 60/23 | 4.95/3.65 | Good |
| Little Rockfish Cr, Plank Rd, Hoke | B-22 | 18-31-24-(1) | 4/90 | -/12 | -/3.50 | Good-Fair |
| Bones Cr Trib, nr SR 1400, Cumberland | B-23 | 18-31-24-2 | 1/89 | 44/17 | 6.75/5.15 | Good-Fair |
| UT Bones Cr, be Sunset MHP, Cumberland | B-24 | 18-31-24-2 | 1/89 | 6/0 | 9.49/- | Poor |
| Little Rockfish Cr, NC 59, Cumberland | **B-25** | 18-31-24-(4) | 7/98 | -/22 | -/4.06 | Good |
| | | | 8/93 | -/23 | -/3.70 | Good |
| Buckhead Cr, off Glenwick Rd, Cumberland | B-26 | 18-31-24-6 | 5/97 | 39/1 | 7.68/6.22 | Not Rated |
| Little Rockfish Cr, SR 1131 be lake, Cumb. | B-27 | 18-31-24-(7) | 6/90 | -/13 | -/4.78 | Good-Fair |

**CPF 16**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Cape Fear R, SR 1355 nr Duarte, Bladen | **B-1** | 18-(26) | 8/98 | 48/16 | 6.74/5.82 | Good-Fair |
| | | | 8/93 | 50/10 | 6.37/4.69 | Fair |
| Cape Fear R, ab Carolina Foods, Bladen | B-2 | 18-(26) | 9/92 | 47/14 | 6.19/4.73 | Good-Fair |
| Cape Fear R, be Carolina Foods, SR 1316, | B-3 | 18-(26) | 9/92 | 45/11 | 6.56/4.77 | Fair |
| nr Tar Heel, Cumberland | | | 6/87 | 41/7 | 7.24/5.22 | Fair |
| Cape Fear R, be Lock 2 nr Elizabethtown, | **B-4** | 18-(26) | 8/98 | 39/14 | 6.57/5.37 | Good-Fair |
| Bladen | | | 8/93 | 53/15 | 6.74/4.91 | Good-Fair |
| Ellis Cr, NC 53, Bladen | **B-5** | 18-44 | 8/98 | -/16 | -/3.95 | Good-Fair |
| | | | 8/93 | -/16 | -/3.88 | Good-Fair |

**CPF 16 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Harrison Cr, SR 1318, Bladen | **B-6** | 18-42 | 8/98 | -/17 | -/3.39 | Good-Fair |
| | | | 8/93 | -/11 | -/3.61 | Fair |
| Turnbull Cr, SR 1511, Bladen | **B-7** | 18-46 | 8/98 | -/18 | -/3.93 | Good |
| Cape Fear R, SR 1730 at Kelly, Bladen | **B-8** | 18-(53.5) | 8/98 | 49/15 | 6.72/4.82 | Good-Fair |
| | | | 8/93 | 48/11 | 6.51/4.62 | Fair |
| | | | 8/90 | 44/12 | 7.42/4.28 | Fair |
| | | | 7/88 | 69/12 | 7.14/6.35 | Fair |
| | | | 6/86 | 51/6 | 7.25/6.83 | Fair |
| | | | 8/84 | 52/7 | 7.20/5.66 | Fair |

**CPF 17**

| Site | DEM # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Cape Fear R, ab Federal Paper, Columbus | **B-1** | 18-(59) | 7/98 | 51/13 | 6.36/5.06 | Excellent |
| | | | 8/93 | 45/8 | 6.61/4.81 | Good-Fair |
| Cape Fear R, be Federal Paper, Columbus | **B-2** | 18-(63) | 7/98 | 36/4 | 7.00/5.21 | Fair |
| | | | 8/93 | 32/5 | 7.21/5.34 | Fair |
| Livingston Cr, NC 74, Columbus | **B-3** | 18-64 | 7/98 | 83/20 | 6.30/5.31 | Good-Fair |
| | | | 8/93 | 68/9 | 7.31/5.60 | Fair |
| Livingston Cr, SR1878, Columbus | B-4 | 18-64 | 8/90 | 39/4 | 7.65/4.22 | NR |
| | | | 8/90 | 24/0 | 8.73/- | NR |
| Hood Cr, US 74/76, Brunswick | **B-5** | 18-66 | 9/98 | -/13 | -/4.75 | Good-Fair |
| | | | 7/98 | -/18 | -/4.14 | Good |
| | | | 3/98 | 69/20 | 5.86/4.70 | NR |
| Jumping Run Br, ab 17th St, New Hanover | B-6 | 18-76-1-3 | 5/95 | 43/9 | 6.25/4.08 | NR |
| | | | 9/94 | 58/4 | 7.46/7.11 | NR |
| Jumping Run Br, be 17th St, New Hanover | B-7 | 18-76-1-3 | 5/95 | 28/1 | 7.73/4.10 | NR |
| | | | 9/94 | 43/3 | 7.53/6.96 | NR |
| Brunswick R, nr mouth, Brunswick | B-8 | 18-77 | 6/93 | 11/1 | 1.44/- | NR |
| Barnards Cr, US 421, New Hanover | **B-9** | 18-80 | 2/98 | 45/5 | 7.72/6.58 | Fair-Good* |
| Town Cr, ab SR 1413, Brunswick | **B-10** | 18-81 | 9/98 | -/16 | -/4.34 | Good-Fair |
| | | | 7/98 | -/15 | -/5.02 | Good-Fair |
| | | | 3/98 | 71/24 | 5.86/4.77 | NR* |
| Lewis Swp, SR 1410, Brunswick | **B-11** | 18-81-2 | 3/98 | 63/14 | 6.36/5.05 | Good-Exc* |

**Estuarine**

| Site | Site # | Index # | Date | S/A&C S | EBI | Bioclass |
|---|---|---|---|---|---|---|
| Cape Fear R, Wilmington Main St, New Han. | B-12 | 18-72 | 7/83 | 8/0 | 2.08 | NR |
| Cape Fear R, Wilmington Docks, New Han. | **B-13** | 18-72 | 6/98 | 22/0 | 1.24 | NR |
| | | | 6/93 | 9/0 | 1.33 | NR |
| Cape Fear R, S. Side WWTP, New Hanover | **B-14** | 18-72 | 6/98 | 30/4 | 1.66 | Elevated |
| | | | 6/93 | 9/0 | 1.07 | NR |
| Cape Fear R, Mkr 56, New Hanover | **B-15** | 18-72 | 6/98 | 31/6 | 2.08 | Moderate |
| Cape Fear R, Mkr 40, New Hanover | **B-16** | 18-72 | 6/98 | 19/7 | 1.92 | Moderate |
| Cape Fear R, Mkr 35, Brunswick | **B-17** | 18-72 | 6/98 | | | |
| Cape Fear R, at Snow's Marsh, Brunswick | **B-18** | 18-(87.5) | 6/98 | 75/12 | 2.06 | Moderate |
| | | | 6/96 | 94/16 | 1.99 | Moderate |
| | | | 6/93 | 62/8 | 1.95 | Moderate |
| | | | 7/85 | 38/0 | 2.14 | NR |
| Cape Fear R, at Southport, Brunswick | **B-19** | 18-88-3.5 | 10/98 | 57/6 | 2.50 | Elevated |
| | | | 7/98 | 85/17 | 2.29 | Moderate |
| The Basin at Zeke's Island | | | | | | |
| nr Wilmington, US421, New Hanover | B-20 | 18-88-8-1 | 7/85 | 61/0 | 2.52 | NR |
| at Rocks, New Hanover | **B-21** | 18-88-8-1 | 7/98 | 42/4 | 2.09 | NR |

**CPF 18**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| South R, NC 13, Sampson | B-1 | 18-68-12(0.5) | 10/89 | -/5 | -/5.78 | Fair |
| South R, NC 242, Cumberland | B-2 | 18-68-12(0.5) | 10/89 | -/26 | -/3.91 | Excellent |
| South R, SR 1502, nr Parkersburg, Sampson/Bladen County line | **B-3** | 18-68-12(0.5) | 8/98 | 68/25 | 5.91/4.46 | Good |
| | | | 8/93 | 75/25 | 5.36/3.75 | Good |
| | | | 6/87 | 84/29 | 5.46/3.85 | Excellent |
| | | | 9/85 | 93/30 | 5.49/3.81 | Excellent |
| | | | 7/83 | 76/25 | 5.49/4.16 | Good |
| Black R, US 421, Harnett | B-4 | 18-68-12-1 | 10/89 | -/11 | -/5.47 | Fair |
| Black R, SR 1780, nr Dunn, Harnett | B-5 | 18-68-12-1 | 7/84 | 53/13 | 6.79/5.93 | Fair |
| Mingo Swamp, NC 55, Sampson/Harnett | B-6 | 18-68-12-2 | 8/94 | 18/0 | 7.78/0 | Poor |
| Mingo Swamp, US 421, Sampson/Harnett | B-7 | 18-68-12-2 | 8/94 | 50/10 | 7.28/6.33 | Fair |
| Starlins Swamp, SR 1005, Sampson | B-8 | 18-68-12-2-4-1 | 6/98 | -/6 | -/5.22 | Fair |
| Big Cr, SR 1851, Cumberland | B-9 | 18-68-12-5 | 6/98 | -/12 | 4.78/4.69 | Good-Fair |
| Big Swamp, SR 1246, Sampson | B-10 | 18-68-12-8 | 12/89 | -/14 | -/5.38 | Good-Fair |

**CPF 19**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Great Coharie Cr, SR 1214, Sampson | **B-1** | 18-68-1 | 8/98 | 39/12 | 5.88/4.06 | Good-Fair |
| | | | 8/93 | 77/26 | 5.51/4.23 | Good |
| | | | 10/89 | -/19 | -/4.53 | Good |
| | | | 9/88 | 69/20 | 5.89/4.47 | Good |
| | | | 7/83 | 62/19 | 5.53/3.66 | Good-Fair |
| Little Coharie Cr, NC 24, Sampson | B-2 | 18-68-1-17 | 8/93 | -/20 | -/4.69 | Good |
| Little Coharie Cr, SR 1214, Sampson | **B-3** | 18-68-1-17) | 8/98 | -/16 | -/4.41 | Good-Fair |
| | | | 8/93 | -/17 | -/4.08 | Good-Fair |
| | | | 10/89 | -/23 | -/3.86 | Good |
| Little Coharie Cr, SR 1207 | B-4 | 18-68-1-17 | 9/88 | -/17 | -/3.94 | Good-Fair |
| Six Runs Cr, SR 1004, Sampson | B-5 | 18-68-2 | 11/96 | -/9 | -/5.43 | Fair |
| | | | 12/89 | -/21 | -/3.78 | Good |
| Six Runs Cr, SR 1960, Sampson | **B-6** | 18-68-2 | 9/98 | -/13 | -/5.49 | Good-Fair |
| | | | 8/98 | -/23 | -/4.78 | Good |
| | | | 8/93 | -/28 | -/3.39 | Excellent |
| Six Runs Cr, SR 1130, Sampson | B-7 | 18-68-2 | 10/89 | -/26 | -/3.39 | Excellent |
| Six Runs Cr, SR 1003, Sampson | B-8 | 18-68-2 | 9/88 | -/25 | -/4.07 | Excellent |
| Tenmile Swp, SR 1740, Sampson | B-9 | 18-68-2-4 | 12/86 | 58/6 | 7.45/5.92 | Fair |
| Stewarts Cr, SR 1973, Sampson | B-10 | 18-68-2-10 | 11/96 | -/8 | -/5.20 | Fair |
| | | | 12/89 | -/17 | -/4.73 | Good-Fair |
| Crane Cr, SR 1004, Sampson | B-11 | 18-68-2-12 | 6/98 | -/14 | -/5.16 | Good-Fair |
| Black R, NC 411 nr Tomahawk, Sampson | **B-12** | 18-68 | 10/98 | 58/19 | 5.77/4.51 | Good |
| | | | 8/98 | 77/30 | 5.42/4.35 | Excellent |
| | | | 8/93 | 96/31 | 5.49/3.92 | Excellent |
| | | | 10/89 | -/31 | -/3.67 | Excellent |
| | | | 7/88 | 107/37 | 5.51/4.26 | Excellent |
| | | | 9/85 | 94/30 | 5.33/3.98 | Excellent |

**CPF 20**

| Site | Site# | Index# | Date | S/EPTS | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Black R, at Turlington's (3 Sisters Area), Pend. | B-1 | 18-68 | 9/88 | 72/22 | 5.60/4.16 | Good |
| Black R, NC 11 nr Atkinson , Bladen | **B-2** | 18-68 | 7/98 | 90/28 | 5.86/4.46 | Good |
| | | | 8/93 | 73/28 | 5.53/4.39 | Good |
| | | | 9/91 | 100/28 | 5.79/4.23 | Good |
| | | | 8/90 | 48/18 | 6.19/4.59 | Good-Fair |
| | | | 10/89 | -/28 | -/3.89 | Excellent |
| | | | 6/86 | 78/23 | 6.18/4.82 | Good |
| Moores Cr, NC 53, Pender | **B-3** | 18-68-18 | 3/98 | -/11 | -/4.96 | Good* |
| White Oak Br, SR 1209, Pender | B-4 | 18-68-18-5 | 12/87 | -/17 | -/5.02 | Good-Fair |
| Lyons Swamp Canal, NC 11, Bladen | **B-5** | 18-68-22-1-1 | 3/98 | -/5 | -/6.24 | Fair* |

**CPF 21**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| NE Cape Fear R, SR 1937, Wayne | B-1 | 18-74-(1) | 5/93 | 54/4 | 7.85/6.87 | Poor |
| | | | 6/86 | 13/0 | 8.08/- | Poor |
| NE Cape Fear R, NC 403, Duplin | B-2 | 18-74-(1) | 5/93 | 68/13 | 6.96/5.27 | Good-Fair |
| NE Cape Fear R, SR 1948, Wayne | B-3 | 18-74-(1) | 5/93 | 67/15 | 6.16/4.88 | Good-Fair |
| Barlow Br, Bell St in Faison, be Mt. Olive, Duplin | B-4 | 18-74-2 | 5/93 | 26/0 | 8.88/- | Poor |
| | | | 6/86 | 8/0 | 9.63/- | Poor |
| Polly Run Cr, SR 1501, Duplin | B-5 | 18-74-5 | 7/86 | 67/11 | 6.70/5.52 | Fair |
| Buck Marsh Br, NC 111, Duplin | B-6 | 18-74-8 | 8/93 | -/16 | -/3.84 | Good-Fair |
| Grove Cr, SR 1301, ab Kenans. WWTP, Duplin | B-7 | 18-74-21 | 5/94 | 61/13 | 6.35/4.79 | NR |
| Grove Cr, NC 11, be Kenansv. WWTP, Duplin | B-8 | 18-74-21 | 5/94 | 63/9 | 6.99/5.05 | NR |
| Little Rockfish Cr, NC 11, Duplin | B-9 | 18-74-29-6 | 5/94 | 24/0 | 8.27/- | Poor |

**CPF 22**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| NE Cape Fear R, NC 11/903, Duplin | **B-1** | 18-74-(1) | 8/98 | -/17 | -/5.49 | Good-Fair |
| | | | 8/93 | 78/23 | 5.33/3.86 | Excellent |
| | | | 7/86 | 32/8 | 5.47/4.34 | Fair |
| NE Cape Fear R, NC 41, nr Chinquapin, Duplin | **B-2** | 18-74-(25.5) | 9/98 | 40/3 | 7.00/4.48 | Poor |
| | | | 8/98 | 70/28 | 5.66/4.92 | Good |
| | | | 8/93 | 82/22 | 5.43/4.57 | Good |
| | | | 10/89 | -/26 | -/4.17 | Excellent |
| | | | 10/89 | 85/28 | 5.74/3.95 | Good |
| | | | 8/89 | -/27 | -/4.07 | Excellent |
| | | | 8/89 | 83/30 | 5.40/4.17 | Excellent |
| | | | 9/85 | 89/31 | 5.65/4.00 | Excellent |
| Goshen Swp, SR 1302, Wayne | B-3 | 18-74-19 | 5/93 | 62/8 | 6.66/5.30 | Fair |
| Goshen Swp, US 117, Duplin | B-4 | 18-74-19 | 5/93 | 51/11 | 6.68/5.44 | Fair |
| Goshen Swp, NC 403, Duplin | B-5 | 18-74-19 | 5/93 | 56/10 | 6.67/5.57 | Fair |
| Panther Br, NC 50, Duplin | B-6 | 18-74-19-3 | 12/86 | 64/11 | 6.59/5.10 | Fair |
| Panther Br, be Faison UT, Duplin | B-7 | 18-74-19-3 | 5/93 | 35/1 | 8.26/6.22 | Poor |
| | | | 12/86 | 10/0 | 8.05/0 | Poor |
| Halls Marsh Run, SR 1306, Duplin | B-8 | 18-74-19-11 | 9/96 | -/4 | -/5.51 | Poor |
| | | | 9/95 | 67/13 | 6.55/5.53 | Good-Fair |
| | | | 9/94 | 76/9 | 6.82/5.23 | Fair |
| | | | 9/93 | 68/12 | 6.55/5.27 | Good-Fair |
| | | | 9/92 | 69/9 | 6.36/4.98 | Good-Fair |
| | | | 9/91 | 54/7 | 6.55/4.88 | Fair |
| | | | 9/90 | 68/11 | 6.56/4.92 | Good-Fair |
| UT Herrings Marsh Run, SR 1508, Duplin | B-9 | 18-74-19-16 | 9/93 | -/8 | -/4.89 | Fair |
| | | | 9/92 | -/7 | -/5.22 | Fair |
| | | | 9/91 | -/2 | -/5.68 | Poor |
| Herrings Marsh Run, SR 1508, Duplin | B-10 | 18-74-19-16 | 9/93 | 0/0 | 0/0 | Poor |
| | | | 9/92 | -/8 | -/4.94 | Fair |
| | | | 9/91 | -/14 | -/4.43 | Good-Fair |
| Herrings Marsh Run, SR 1306, Duplin | B-11 | 18-74-19-16 | 9/96 | 48/4 | 7.03/6.68 | Poor |
| | | | 9/95 | 55/9 | 6.61/5.50 | Good-Fair |
| | | | 9/94 | 69/8 | 7.32/5.77 | Fair |
| | | | 9/93 | 71/15 | 7.02/5.45 | Good-Fair |
| | | | 9/92 | 72/13 | 6.58/5.13 | Good-Fair |
| | | | 9/91 | 67/11 | 6.13/4.87 | Good-Fair |
| | | | 9/90 | 74/10 | 6.79/5.44 | Fair |
| | | | 1/90 | -/13 | -/5.08 | Fair |
| UT Grove (Maple) Cr, SR 1376, Duplin | B-12 | 18-74-21 | 9/90 | 62/15 | 6.29/4.61 | Good-Fair |
| Limestone Cr, NC 111, Duplin | B-13 | 18-74-23 | 7/95 | -/3 | -/6.64 | NR |
| Limestone Cr, NC 24, Duplin | B-14 | 18-74-23 | 4/86 | 35/1 | 7.36/6.23 | Poor |
| Limestone Cr, SR 1702, Duplin | **B-15** | 18-74-23 | 8/98 | -/14 | -/4.85 | Good-Fair |
| | | | 7/95 | -/4 | -/5.48 | Poor |
| | | | 8/93 | -/26 | -/4.50 | Excellent |
| Stockinghead Cr, SR 1953, Duplin | **B-16** | 18-74-24 | 8/98 | -/12 | -/4.72 | Good-Fair |

**CPF 22 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| | | | 8/93 | -/13 | -/3.99 | Good-Fair |
| Maxwell Cr, SR 1921, Duplin | B-17 | 18-74-24-1 | 6/85 | 55/5 | 6.89/5.52 | Fair |
| UT Beaverdam Cr, SR 1916, Duplin | B-18 | 18-74-24-1-1 | 4/87 | 49/4 | 7.05/5.05 | Fair |
| Cabin Br, SR 1911, Duplin | B-19 | 18-74-24-1-1-1 | 4/87 | 37/0 | 8.16/0 | Poor |
| | | | 6/85 | 48/2 | 8.72/8.94 | Poor |
| Cabin Br, SR 1915, Duplin | B-20 | 18-74-24-1-1-1 | 4/87 | 20/0 | 9.11/0 | Poor |
| | | | 6/85 | 38/0 | 8.91/0 | Poor |
| Muddy Cr, NC 41, Duplin | **B-21** | 18-74-25 | 8/98 | -/8 | -/5.37 | Fair |
| | | | 8/93 | -/4 | -/5.59 | NR |
| Persimmon Br, ab Beulaville, Duplin | B-22 | 18-74-25-1 | 9/90 | 45/4 | 6.98/6.62 | NR |
| Persimmon Br, be Beulaville, Duplin | B-23 | 18-74-25-1 | 9/90 | 31/0 | 7.53/0 | NR |
| Rockfish Cr, NC 41, at Wallace, Duplin | B-24 | 18-74-29 | 7/88 | 79/17 | 6.47/4.84 | Good-Fair |
| Rockfish Cr, SR 1165, Duplin | **B-25** | 18-74-29 | 8/98 | 44/8 | 6.87/5.39 | Fair |
| | | | 8/93 | 81/14 | 6.31/4.79 | Good-Fair |
| Rockfish Cr, I-40, Duplin | **B-26** | 18-74-29 | 10/98 | 50/6 | 7.30/6.02 | Fair |
| | | | 8/98 | 62/16 | 6.97/5.85 | Good-Fair |
| | | | 8/93 | 64/12 | 6.83/5.26 | Fair |

**CPF 23**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| NE Cape Fear R, nr Watha, Pender | B-1 | 18-74-(29.5) | 7/83 | 44/5 | 7.30/4.84 | NR |
| NE Cape Fear R, NC 53 ab br, Pender | B-2 | 18-74-(29.5) | 5/94 | 47/10 | 7.16/5.45 | NR |
| NE Cape Fear R, NC 53 be br, Pender | B-3 | 18-74-(29.5) | 5/94 | 42/6 | 6.53/5.02 | NR |
| NE Cape Fear R, White Stocking Ramp, Pender | B-4 | 18-74-(29.5) | 5/94 | 40/9 | 6.91/5.39 | NR |
| NE Cape Fear R at Castlehayne US117, | **B-5** | 18-74-(29.5) | 7/98 | 44/9 | 6.40/5.26 | Good |
| New Hanover | | | 8/93 | 38/7 | 6.93/4.84 | Good-Fair |
| | | | 6/90 | 45/7 | 6.51/5.26 | Good-Fair |
| | | | 6/87 | 41/6 | 7.32/5.34 | Good-Fair |
| | | | 7/85 | 42/5 | 7.05/3.97 | Fair |
| Burgaw Cr, at old RR track, Pender | B-6 | 18-74-39 | 12/87 | 37/0 | 8.85/- | Poor |
| Burgaw Cr, NC 117, Pender | B-7 | 18-74-39 | 12/87 | 14/0 | 9.44/- | Poor |
| Burgaw Cr, I-40, Pender | **B-8** | 18-74-39 | 7/98 | -/5 | -/6.11 | Poor |
| | | | 3/98 | 34/5 | 7.12/6.46 | NR* |
| Angola Cr, NC 53, Pender | **B-9** | 18-74-33-3 | 7/98 | -/9 | -/6.06 | Fair |
| | | | 11/93 | 62/10 | 6.39/4.82 | Fair |
| | | | 11/93 | 56/9 | 6.33/4.70 | NR |
| | | | 8/93 | 52/11 | 6.01/4.33 | NR |
| | | | 5/93 | 68/17 | 6.23/4.93 | NR |
| | | | 2/93 | 61/18 | 6.20/5.12 | NR |
| Long Cr, NC 53, Pender | **B-10** | 18-74-55 | 3/98 | -/2 | -/7.00 | NR |
| Cypress Cr, NC 53, Pender | **B-11** | 18-74-55-2 | 3/98 | -/9 | -/5.70 | Good* |
| | | | 3/93 | -/9 | -/5.88 | Good* |
| Juniper Swp, NC 50, Onslow | **B-12** | 18-74-33-4-2 | 3/98 | 22/2 | 6.66/6.25 | Good-Exc* |
| | | | 2/97 | 19/1 | 7.00/6.23 | Good-Exc* |
| | | | 11/93 | 30/2 | 6.90/6.30 | NR |
| | | | 8/93 | 25/1 | 7.30/4.46 | NR |
| | | | 5/93 | 34/2 | 7.07/5.90 | NR |
| | | | 2/93 | 44/5 | 7.02/5.85 | Good-Exc* |
| Lillington Cr, SR 1520, Pender | B-13 | 18-74-42 | 2/97 | 33/7 | 5.98/4.75 | Fair-Good* |
| Merrick's Cr, NC 210, Pender | **B-14** | 18-74-49-2 | 3/98 | 43/10 | 6.14/5.02 | Good-Exc* |
| | | | 2/97 | 43/12 | 6.00/4.58 | Fair-Good* |
| | | | 11/93 | 53/11 | 6.61/5.50 | NR |
| | | | 11/93 | 52/11 | 6.38/5.50 | NR |
| | | | 5/93 | 51/13 | 6.14/4.42 | NR |
| | | | 2/93 | 52/16 | 6.24/5.21 | Good-Exc* |
| Sandy Run Swp, NC 50, Onslow | B-15 | 18-74-33-2 | 11/93 | 36/2 | 7.27/6.34 | NR |
| | | | 8/93 | 31/0 | 7.41/- | NR |
| | | | 6/93 | 42/5 | 6.59/4.89 | NR |
| | | | 3/93 | 39/8 | 6.40/4.86 | NR |

**CPF 23 (con't)**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| Shelter Swp, NC50, Onslow | **B-16** | 18-74-33-2-2 | 3/98 | 28/3 | 6.74/5.93 | Good-Exc* |
| Burnt Mill Cr, Metts Ave, New Hanover | **B-17** | 18-74-63-2 | 7/98 | -/4 | -/5.00 | Poor |
| | | | 3/98 | 40/5 | 7.99/6.69 | NR |

**CPF 24**
**Estuarine**

| Site | Site # | Index # | Date | S/A&C S | EBI | Bioclass |
|---|---|---|---|---|---|---|
| Everett Bay, nr point, Onslow | **B-1** | 18-87-2 | 6/98 | 42/6 | 2.36 | Heavy |
| Spicer Bay, at neck, Onslow | **B-2** | 18-87-4 | 6/98 | 54/8 | 2.24 | Heavy |
| Onslow Canal, ½way down 3rd canal, Onlsow | **B-3** | 18-87-(5.5) | 6/98 | | | |
| Beckys Cr, Onlsow | **B-4** | 18-87-8 | 6/98 | | | |
| Virginia Cr, Pender | **B-5** | 18-87-9 | 6/98 | | | |
| Topsail Sd, Marker 5, Pender | **B-6** | 18-87-10 | 6/98 | | | |
| Topsail Sd, docks nr Marker 5, Pender | B-7 | 18-87-10 | 6/93 | 46/3 | 1.95 | NR |
| Black Mud Ch, Pender | B-8 | 18-87-13 | 6/93 | 24/5 | 2.80 | NR |
| Futchs Cr, between inlets, Pender | **B-9** | 18-87-19 | 6/98 | | | |
| Pages Cr, upstr bend, New Hanover | **B-10** | 18-87-22 | 6/98 | | | |
| Howe Cr, nr bend, New Hanover | B-11 | 18-87-23 | 5/94 | 95/22 | 2.47 | None |
| | | | 2/94 | 108/17 | 2.39 | Slight |
| | | | 5/93 | 11/1 | 2.10 | NR |
| | | | 3/93 | 28/1 | 2.71 | NR |
| Lees Cut, at Exxon, New Hanover | **B-12** | 18-87-24-1 | 6/98 | | | |
| ICWW, N of US 74, New Hanover | B-13 | 18-87-24 | 6/93 | 5/1 | 1.86 | NR |
| ICWW, Bridgetender Marina, New Hanover | B-14 | 18-87-24 | 6/93 | 17/1 | 1.21 | NR |
| Bradley Cr, US 76, New Hanover | **B-15** | 18-87-24-4-(2) | 6/98 | 59/8 | 1.74 | Heavy |
| | | | 2/96 | 62/5 | 1.91 | Heavy |
| | | | 2/96 | 67/5 | 1.70 | Heavy |
| | | | 2/96 | 48/7 | 1.88 | Heavy |
| | | | 1/96 | 73/8 | 1.87 | Heavy |
| | | | 1/96 | 48/4 | 1.44 | Heavy |
| | | | 1/96 | 48/7 | 1.84 | Heavy |
| | | | 5/94 | 68/9 | 1.87 | Heavy |
| | | | 2/94 | 60/7 | 1.84 | Heavy |
| | | | 11/93 | 45/7 | 1.86 | Heavy |
| | | | 2/93 | 36/2 | 1.63 | NR |
| Bradley Cr, off fuel dock, New Hanover | B-16 | 18-87-24-4-(2) | 2/93 | 40/5 | 2.30 | NR |
| Bradley Cr, No Wake Sign, New Hanover | B-17 | 18-87-24-4-(2) | 2/93 | 35/3 | 1.85 | NR |
| Hewletts Cr, at bend ab docks, New Hanover | **B-21** | 18-87-26 | 6/98 | 80/10 | 2.16 | Moderate |
| | | | 2/96 | 97/9 | 1.95 | Moderate |
| | | | 2/96 | 90/10 | 1.97 | Moderate |
| | | | 2/96 | 86/9 | 1.88 | Elevated |
| | | | 1/96 | 91/9 | 2.15 | Moderate |
| | | | 1/96 | 77/7 | 1.99 | Elevated |
| | | | 1/96 | 89/6 | 1.66 | Elevated |
| | | | 5/94 | 105/15 | 1.95 | Moderate |
| | | | 2/94 | 91/8 | 2.20 | Moderate |
| | | | 11/93 | 93/9 | 2.22 | Moderate |
| | | | 5/93 | 42/3 | 2.20 | NR |
| | | | 2/93 | 42/2 | 2.02 | NR |
| Masonboro Ch, Masonboro Isl NERR, New H. | **B-22** | 18-87-27 | 6/98 | 123/25 | 2.55 | No Impact |
| Whiskey Cr at Marina, New Hanover | **B-23** | 18-87-28 | 6/98 | | | |
| Carolina Inlet Marina, in basin, New Hanover | B-24 | 18-87-(30.5) | 6/93 | 27/0 | 1.53 | NR |
| ICWW, Marker 156, New Hanover | **B-25** | 18-87-(30.5) | 6/98 | 67/14 | 2.16 | Moderate |
| | | | 6/93 | 21/2 | 1.94 | NR |
| ICWW spur, Marker 4, New Hanover | B-26 | 18-87-31.2 | 6/93 | 11/1 | 1.15 | NR |
| ICWW spur, Markr 5, New Hanover | **B-27** | 18-87-31.2 | 6/98 | | | |

**Freshwater**

| Site | Site # | Index # | Date | S/EPT S | BI/BIEPT | Bioclass |
|---|---|---|---|---|---|---|
| UT Hewletts Cr, ab pond, New Hanover | B-18 | 18-87-26 | 9/94 | 26/1 | 6.82/6.20 | NR |
| UT Hewletts Cr, Beasley Rd, New Hanover | B-19 | 18-87-26 | 9/94 | 37/1 | 7.23/6.20 | NR |
| Hewletts Cr, SR 1492, New Hanover | **B-20** | 18-87-26 | 7/98 | -/5 | -/6.10 | Fair |
| | | | 2/98 | 41/6 | 7.11/5.95 | NR |

* Denotes draft swamp stream rating-under revision and not to be used for use support.

Appendix II Fish community assessments in the Cape Fear River Basin, 1992-1998

| Subbasin/Stream | Road | County | Map F# | Index # | D.A. ($mi^2$) | Date | NCIBI Score | NCIBI Class[1] |
|---|---|---|---|---|---|---|---|---|
| **030301** | | | | | | | | |
| Haw R | SR 2109 | Guilford | F-1 | 16-(1) | 14.1 | 04/06/98 | 36 | P |
| Haw R | SR 2426 | Rockingham | F-2 | 16-(1) | 62.1 | 10/12/98 | 38 | F |
| | | | | | | 04/06/98 | 26 | P |
| Troublesome Cr | SR 1001 | Rockingham | F-3 | 16-6-(0.3) | 25.6 | 04/06/98 | 28 | P |
| | | | | | | 11/03/93 | 30 | P |
| L Troublesome Cr | SR 2600 | Rockingham | F-4 | 16-7 | 12.1 | 10/12/98 | 22 | P |
| | | | | | | 04/06/98 | 28 | P |
| **030602** | | | | | | | | |
| Reedy Fork | SR 2728 | Guilford | F-1 | 16-11-(9) | 125 | 10/12/98 | 48 | G-F |
| | | | | | | 04/07/98 | 40 | F |
| | | | | | | 11/03/93 | 42 | F |
| N Buffalo Cr | SR 2770 | Guilford | F-2 | 16-11-14-1 | 43.7 | 04/07/98 | 30 | P |
| | | | | | | 05/10/94 | 22 | P |
| S Buffalo Cr | US 70 | Guilford | F-3 | 16-11-14-2 | 39.5 | 04/07/98 | 24 | P |
| | | | | | | 05/10/94 | 26 | P |
| S Buffalo Cr | SR 2821 | Guilford | F-4 | 16-11-14-2 | 43.5 | 04/07/98 | 16 | P |
| | | | | | | 05/10/94 | 28 | P |
| Stony Cr | SR 1104 | Caswell | F-5 | 16-14-(1) | 12.4 | 05/19/94 | 48 | G-F |
| Jordan Cr | SR 1002 | Alamance | F-6 | 16-14-6-(0.5) | 13.8 | 11/04/93 | 46 | G-F |
| **030603** | | | | | | | | |
| Big Alamance Cr | SR 3088 | Guilford | F-1 | 16-19-(1) | 30.5 | 04/08/98 | 50 | G |
| L Alamance Cr | SR 3039 | Guilford | F-2 | 16-19-3-(0.5) | 10.1 | 04/22/98 | 42 | F |
| Big Alamance Cr | SR 2309 | Alamance | F-3 | 16-19-(4.5) | 242 | 11/14/93 | 40 | F |
| Stinking Quarter Cr | SR 1136 | Alamance | F-4 | 16-19-8 | 83 | 04/08/98 | 40 | F |
| | | | | | | 05/19/94 | 44 | G-F |
| Rock Cr | off SR 2409 | Alamance | F-5 | 16-19-8-3 | 11 | 07/30/92 | 44 | G-F |
| Rock Cr | off SR 2409 | Alamance | F-6 | 16-19-8-3 | 11 | 07/30/92 | 50 | G |
| L Alamance Cr | SR 2309 | Alamance | F-7 | 16-19-11 | 14.8 | 04/08/98 | 30 | P |
| | | | | | | 11/04/93 | 42 | F |
| **030604** | | | | | | | | |
| Cane Cr | SR 1114 | Orange | F-1 | 16-27-(2.5) | 7.5 | 03/24/94 | 44 | G-F |
| Collins Cr | SR 1539 | Chatham | F-2 | 16-30-(1.5) | 19.4 | 04/21/98 | 32 | P |
| Terrells Cr | NC 87 | Chatham | F-3 | 16-31-(2.5) | 20.9 | 04/21/98 | 40 | F |
| | | | | | | 04/19/94 | 42 | F |
| Ferrells Cr | SR 1525 | Chatham | F-4 | 16-32 | 15.7 | 04/21/98 | 48 | G-F |
| **030605** | | | | | | | | |
| New Hope Cr | SR 2220 | Durham | F-1 | 16-41-1-(11.5) | 52.2 | 05/18/98 | 36 | P |
| Third Fork Cr | NC 751 | Durham | F-2 | 16-41-1-12-(2) | 16.5 | 06/16/93 | 26 | P |
| Northeast Cr | SR 1102 | Durham | F-3 | 16-41-1-17-(0.7) | 13 | 06/16/93 | 42 | F |
| Northeast Cr | SR 1100 | Durham | F-4 | 16-41-1-17-(0.7) | 18.2 | 06/16/93 | 32 | P |

| Subbasin/Stream | Road | County | Map F# | Index # | D.A. ($mi^2$) | Date | NCIBI Score | NCIBI Class[1] |
|---|---|---|---|---|---|---|---|---|
| **030606** | | | | | | | | |
| Bolin Cr | off SR 1750 | Orange | F-1 | 16-41-1-15-1-(4) | 11.8 | 05/18/98 | 36 | P |
| Morgan Cr | NC 54 | Orange | F-2 | 16-41-2-(1) | 8.4 | 03/24/94 | 42 | F |
| Morgan Cr | SR 1900 | Orange | F-3 | 16-41-2-(5.5) | 41 | 05/18/98 | 34 | P |
| **030607** | | | | | | | | |
| Gulf Cr | off SR 1924 | Chatham | F-1 | 18-5-(1) | 3.1 | 04/22/93 | 42 | F |
| Gulf Cr | off SR 1916 | Chatham | F-2 | 18-5-(1) | 4.6 | 04/22/93 | 34 | P |
| Avents Cr | SR 1418 | Harnett | F-3 | 18-13 | 14.2 | 09/21/98 | 42 | F |
| Hector Cr | SR 1403 | Harnett | F-4 | 18-15 | 11.2 | 02/09/94 | 42 | F |
| Hector Cr | SR 1412 | Harnett | F-5 | 18-15 | 17.4 | 05/06/98 | 40 | F |
| Kenneth Cr | SR 1441 | Harnett | F-6 | 18-16-1-(2) | 15.2 | 05/06/98 | 34 | P |
| | | | | | | 02/09/94 | 32 | P |
| **030608** | | | | | | | | |
| Richland Cr | SR 1154 | Guilford | F-1 | 17-7 | 12.5 | 04/22/98 | 30 | P |
| Muddy Cr | SR 1929 | Randolph | F-2 | 17-9 | 16.8 | 04/22/98 | 36 | P |
| | | | | | | 03/22/94 | 42 | F |
| **030609** | | | | | | | | |
| Sandy Cr | SR 2481 | Randolph | F-1 | 17-16-(1) | 45.1 | 05/04/98 | 48 | G-F |
| | | | | | | 03/22/94 | 44 | G-F |
| **030610** | | | | | | | | |
| Bear Cr | SR 1405 | Moore | F-1 | 17-26-(1) | 25.2 | 09/21/98 | 46 | G-F |
| Cabin Cr | SR 1275 | Moore | F-2 | 17-26-5-(1) | 46.9 | 05/05/98 | 50 | G |
| Bear Cr | NC 705 | Moore | F-3 | 17-26-(6) | 137 | 05/20/94 | 42 | F |
| Falls Cr | SR 1606 | Moore | F-4 | 17-27 | 14.4 | 05/05/98 | 50 | G |
| McLendon's Cr | SR 1210 | Moore | F-5 | 17-30-(0.5) | 14.5 | 05/05/98 | 46 | G-F |
| Richland Cr | SR 1640 | Moore | F-6 | 17-30-5-(2) | 24.9 | 04/24/98 | 34 | P |
| | | | | | | 05/20/94 | 32 | P |
| Indian Cr | SR 2306 | Chatham | F-7 | 17-35 | 25.4 | 04/23/98 | 48 | G-F |
| **030611** | | | | | | | | |
| Cedar Cr | SR 2145 | Chatham | F-1 | 17-39 | 13 | 04/11/94 | 38 | F |
| Big Buffalo Cr | SR 1403 | Lee | F-2 | 17-40 | 19.7 | 04/24/98 | 26 | P |
| | | | | | | 04/11/94 | 38 | F |
| **030612** | | | | | | | | |
| Rocky R | SR 1300 | Chatham | F-1 | 17-43-(1) | 7.4 | 05/04/98 | 38 | F |
| Loves Cr | SR 2229 | Chatham | F-2 | 17-43-10 | 7.9 | 05/04/98 | 44 | G-F |
| Tick Cr | US 421 | Chatham | F-3 | 17-43-13 | 15.5 | 04/19/94 | 48 | G-F |
| Bear Cr | SR 2187 | Chatham | F-4 | 17-43-16 | 42.4 | 04/23/98 | 50 | G |
| **030614** | | | | | | | | |
| Nicks Cr | NC 22 | Moore | F-1 | 18-23-3-(3) | 26.8 | 05/31/96 | 40 | F |
| Lower Little R | SR 2023 | Moore | F-2 | 18-23-(10.7) | 112 | 04/20/94 | 42 | F |
| Crains Cr | US 1 | Moore | F-3 | 18-23-16 | 32.7 | 05/07/98 | 40 | F |
| Crains Cr | SR 1001 | Moore | F-4 | 18-23-16 | 94.6 | 04/20/94 | 30 | P |
| Buffalo Cr | SR 1001 | Moore | F-5 | 18-23-18 | 18.3 | 05/07/98 | 48 | G-F |
| Anderson Cr | SR 2031 | Harnett | F-6 | 18-23-32 | 34.7 | 05/06/98 | 40 | F |

| Subbasin/Stream | Road | County | Map F# | Index # | D.A. (mi²) | Date | NCIBI Score | NCIBI Class[1] |
|---|---|---|---|---|---|---|---|---|
| **030615** | | | | | | | | |
| Cross Cr | NC 87/210 | Cumberland | F-1 | 18-27-(3) | 15.4 | 05/03/94 | 30 | P |
| Big Cross Cr | NC 87/210/24 | Cumberland | F-2 | 18-27-(3) | 25.2 | 05/21/98 | 22 | P |
| Puppy Cr | SR 1406 | Hoke | F-3 | 18-31-19 | 26 | 05/21/98 | 44 | G-F |
| **030616** | | | | | | | | |
| Harrison Cr | SR 1318 | Bladen | F-1 | 18-42 | 48.3 | 05/20/98 | 46 | G-F |
| | | | | | | 05/03/94 | 48 | G-F |
| Browns Cr | NC 87 | Bladen | F-2 | 18-45 | 15 | 05/20/98 | 30 | P |
| | | | | | | 08/11/92 | 36 | P |
| Turnbull Cr | NC 242 | Bladen | F-3 | 18-46 | 36.6 | 05/20/98 | 42 | F |
| Whites Cr | SR 1704 | Bladen | F-4 | 18-50-5 | 10.3 | 05/20/98 | 52 | G |
| **030620** | | | | | | | | |
| Colly Cr | US 701 | Bladen | F-1 | 18-68-17 | 16.6 | 05/19/98 | 48 | G-F |
| White Oak Br | SR 1206 | Pender | F-2 | 18-68-18-5 | 17 | 05/19/98 | 44 | G-F |
| **030621** | | | | | | | | |
| Mathews Cr | NC 111/903 | Duplin | F-1 | 18-17-13 | 8.1 | 05/22/98 | 50 | G |
| **030622** | | | | | | | | |
| Halls Marsh Run | SR 1306 | Duplin | F-1 | 18-74-19-11 | 8.5 | 11/18/92 | 34 | P |
| Herrings Marsh Run | SR 1306 | Duplin | F-2 | 18-74-19-16 | 8.8 | 11/18/92 | 34 | P |
| Grove Cr | NC 11/903 | Duplin | F-3 | 18-74-21 | 22.6 | 05/22/98 | 48 | G-F |
| | | | | | | 06/01/94 | 52 | G |
| Duff Cr | SR 1170 | Duplin | F-4 | 18-74-29-2-(2) | 21.8 | 05/22/98 | 50 | G |
| **030623** | | | | | | | | |
| Burgaw Cr | US 117 | Pender | F-1 | 18-74-39 | 8.6 | 05/19/98 | 40 | F |

[1] The NCIBI Classifications are: G = Good, G-F = Good-Fair, F = Fair, and P = Poor.

# Appendix III

# Use Support Methodology
# and
# Use Support Ratings

# 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), *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 PS or NS, depending on the degree of exceedence.

An additional use support category, fully supporting but threatened (ST), was used in previous 305(b) reports. In the past, ST was used to identify a water that was fully supporting but had some notable water quality concerns. ST could represent constant, degrading or improving conditions. North Carolina's past 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 (EPA Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates, 1997). Given the difference between US EPA's and North Carolina's definitions of ST and the resulting confusion that arises from this difference, North Carolina no longer subdivides the fully supporting category. However, the waterbodies and the specific concerns remain identified in the basin plans so that data, management and the need to address the identified concerns is not lost.

Waters that are either partially supporting or not supporting are considered *impaired* and are rated based on specific criteria discussed more fully below. There must be a specified degree of degradation before a waterbody is considered impaired. This differs from the word impacted, which can refer to any noticeable or measurable change in water quality, good or bad. Waters which have inconclusive or no data to determine their use support were listed as not rated (NR).

## 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., habitat degradation or nutrients) and sources (e.g., agriculture, urban runoff, point sources) of waterbody degradation. Data used in the use support assessments include biological data, chemical/physical data, lakes assessment data, and shellfish sanitation surveys from the NC Division of Environmental Health (as appropriate). Although there is a general procedure for analyzing the data and determining a waterbody's use support rating, each waterbody 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 use support assessments by basin is to gain an overall picture of the water quality, to describe how well these waters support the uses for which they were classified, and to document the relative contribution made by different pollution sources.

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.

## C. Assessment Methodology – Freshwater Streams

Many types of information are 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 are entered into its record. In determining the use support rating for a stream segment, corresponding ratings are assigned to data values where appropriate. The following data and the corresponding use support ratings are used in the process.

### 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 |
| Fair | Partially Supporting |
| Poor | Not Supporting |

*Fish Community Structure*

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The 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 |
| 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 $mm^3/m^3$, 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.

## 2. 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 the ambient database, the Surface Water Information Management System, 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 |
|---|---|
| Criterion exceeded ≤10% | Fully Supporting |
| Criterion exceeded 11-25% | Partially Supporting |
| Criterion exceeded >25% | Not Supporting |

* Percentages are rounded to the nearest whole number. A minimum of ten samples is needed.

It is important to note that some waters may exhibit characteristics outside the appropriate standards due to natural conditions (e.g., many swamp waters are characterized by low pH). These natural conditions do not constitute a violation of water quality standards.

Data for copper, iron and zinc are not used according to the percent excess scheme outlined above. Because these metals are generally not bioaccumulative and have variable toxicity to aquatic life because of chemical form, solubility and stream characteristics, they have *action level* standards. In order for an action level standard to be violated, there must be a toxicological test that documents an impact on a sensitive aquatic organism. The action level standard is used to screen waters for potential problems with copper, iron and zinc. Best professional judgement is used to determine which streams have metal concentrations at potentially problematic levels. Streams with high metal concentrations are evaluated for toxicity, and they may be rated as PS or NS if toxicity tests or biomonitoring (e.g., benthic macroinvertebrate communities) indicate problematic metal levels.

Fecal coliform bacteria data are not used alone to determine a partially or not supporting rating. The geometric mean is calculated using monthly samples, and if the geometric mean is above 200 colonies per 100 ml, fecal coliform bacteria are listed as a problem parameter. Because North Carolina’s fecal coliform bacteria standard is 200 colonies per 100 ml for the geometric mean of *five samples taken in a thirty-day period*, fecal coliform bacteria are listed as a cause of impairment for the 303(d) list only when the standard is exceeded.

### 3. Source and Cause Data

In addition to the above data, existing information is documented for potential sources and causes of stream degradation. It is important to note that not all impaired waterbodies have sources and/or causes listed for them. Additionally, fully supporting waterbodies may have sources and/or causes of stream degradation as well. Staff and resources do not currently exist to collect this level of information for all waterbodies. Much of this information is obtained through the cooperation of other agencies (federal, state and local), organizations and citizens.

*Point Source Data*

*Whole Effluent Toxicity Data*: Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Streams that receive a discharge from a facility that has failed its whole effluent toxicity tests may have that facility listed as a potential source of pollution.

*Daily Monitoring Reports*: Streams which receive a discharge from a facility significantly out of compliance with permit limits may have that facility listed as a potential source of pollution.

*Nonpoint Source Data*

Nonpoint sources of pollution (i.e., agriculture, urban and construction) are identified by monitoring staff, other agencies (federal, state and local), land use reviews, and public workshops.

*Problem Parameters*

Causes of stream degradation (problem parameters), such as habitat degradation and low dissolved oxygen, are also identified for specific stream segments where possible. For streams with ambient water quality stations, those parameters which exceed the water quality standard $\geq$11 percent of the time for the review period are listed as a problem parameter. Zinc, copper and iron are listed as problem parameters if levels are high enough to impact the biological community (see *Chemical/Physical Data* section). Fecal coliform bacteria are listed as a problem parameter if the geometric mean is greater than 200 colonies per 100 ml. For segments without ambient stations, information from reports, other agencies and monitoring staff is used if it is available.

Habitat degradation is identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, streambed scour, lack of riparian vegetation, loss of pools or riffles, and loss of woody habitat.

## 4. Outside Data

DWQ actively solicits outside data and information. Data from outside DWQ, such as USGS ambient monitoring data, volunteer monitoring data, and data from academic researchers, are screened for data quality and quantity. If data are of sufficient quality and quantity, they are incorporated into use support assessments. A minimum of ten samples over a period of two years is needed to be considered for use support assessments. The way the data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data. Data of the highest quality are used in the same fashion as DWQ data to determine use support ratings. Data with lower quality assurance may be used to pinpoint causes of pollution and problem parameters. They may also be used to limit the extrapolation of use support ratings up or down a stream from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

## 5. Monitored vs. Evaluated

Assessments are made on either a monitored (M) or evaluated (E) basis depending on the level of information that was available. 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)<br><br>Monitored/Evaluated (ME) | Monitored stream segments[1] with data[2] ≤5[3] years old.<br><br>Stream segment[1] is unmonitored, but is assigned a use support rating based on another segment of same stream for which data[2] ≤5[3] years old are available. |
| Evaluated | Evaluated (E)<br><br>Evaluated/Old Data (ED) | Unmonitored streams that are direct or indirect tributaries to monitored stream segments rated FS. Must share similar land use to the monitored stream segment.<br><br>Monitored stream segments[1] with available data[2] >5[3] 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. |

1 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 number).

2 Major data sources include benthic macroinvertebrate bioclassifications, fish community structure (NCIBI), and chemical/physical monitoring data.

3 From the year that basin monitoring was done.

## 6. Assigning Use Support Ratings to Freshwater Streams

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

After reviewing the existing data, use support 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
Monitoring 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 are assessed. Streams that are direct or indirect tributaries to streams rated FS receive the same rating (with an evaluated basis) if they have no known significant impacts, based on a review of the watershed characteristics and discharge information.  Streams that are direct or indirect tributaries to streams rated PS or NS, or that have no data, are assigned a NR rating.

## D. Assessment Methodology – Lakes

The complex and dynamic ecosystem interactions that link chemical and physical water quality parameters and biological response variables must be considered when evaluating use support. In general, North Carolina assesses use support by determining if a lake's *uses*, such as water supply, fishing and recreation, are met; violations of water quality standards are not equated with use impairment unless uses are not met.  In following this approach, use support for agriculture, aquatic life propagation, maintenance of biological integrity, wildlife, recreation and water supply can be holistically evaluated.

Nutrient enrichment, or eutrophication, is one of the main causes of lake impairment.  Several water quality variables may help to describe the level of eutrophication.  These include pH, chlorophyll *a*, dissolved oxygen, phosphorus, nitrogen, turbidity, total dissolved gases, and other quantitative indicators, some of which have specific water quality standards.  It is generally agreed that excessive amounts of nitrogen and phosphorus are the principal culprits in eutrophication related use impairment.  These variables are important concerns; however, climate, hydrology and biological response factors (chlorophyll, phytoplankton, fish kills, etc.) are also essential to evaluate because they may control the frequency of episodes related to potential use impairment.  In addition, many of North Carolina's lakes are human-made reservoirs that do not mimic natural systems.

North Carolina does not determine eutrophication related use impairment with the quantitative assessment of an individual water quality variable (i.e., chlorophyll *a*).  Likewise, North Carolina does not depend on a fixed index composed of several water quality variables, which does not have the flexibility to adapt to numerous hydrological situations, to determine use impairment. The weight of evidence approach is most appropriate to determine use support in terms of nutrient enrichment in lakes.  This approach can be flexibly applied depending on the amount and quality of available information.  The approach uses the following sources of information:

- multiple quantitative water quality variables (e.g., dissolved oxygen, chlorophyll *a*)
- third party reports
- analysis of water quality complaints
- algal bloom reports
- macrophyte observations
- reports from water treatment plant operators
- reports from lake associations
- fish kill reports
- taste and odor observations
- aesthetic complaints
- frequency of noxious algal activity
- reports/observations of the NC Wildlife Resources Commission

## E. Assessment Methodology – Estuaries

Estuarine waters are delineated according to Division of Environmental Health (DEH) shellfish management areas (e.g., Outer Banks, Area H-5) for use support assessment (for map of shellfish management areas, see 1996 305(b) report). As with the freshwater assessments, many types of information are used to determine use support ratings and to determine causes and sources of use support impairment for saltwater bodies. The following data sources are used when assessing estuarine areas:

### 1. DEH Sanitary Surveys

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. Classifications are based on fecal coliform bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. 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

Chemical/physical water quality data are collected monthly through the Ambient Monitoring System. These data are downloaded from the ambient database, the Surface Water Information Management System, to a desktop computer for analysis. The total number of samples and percent exceedences of the NC state standards are used for use support ratings (see methods for freshwater streams). Parameters are evaluated based on the salt waterbody classification and corresponding water quality standards.

Fecal coliform bacteria data from DWQ ambient monitoring are considered for SB and SC waters (saltwaters not classified by DWQ for shellfishing), but are not used alone to determine a partially or not supporting rating. The geometric mean is calculated using monthly samples, and if the geometric mean is above 200 colonies per 100 ml, fecal coliform bacteria are listed as a problem parameter. Because North Carolina's fecal coliform bacteria standard for SB and SC waters is 200 colonies per 100 ml for the geometric mean of *five samples taken in a thirty-day period*, fecal coliform bacteria are listed as a cause of impairment for the 303(d) list only when the standard is exceeded.

### 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 $mm^3/m^3$, 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.

### 4. Assigning Use Support Ratings to Estuarine Waters

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[1] |
|---|---|---|
| ***Fully Supporting*** | | |
| SA | Approved or Conditionally Approved-Open | standard exceeded ≤10% of measurements |
| SB & C | Does not Apply | standard exceeded ≤10% of measurements |
| ***Partially Supporting*** | | |
| SA | Prohibited[2], Restricted or Conditionally Approved-Closed | standard exceeded 11-25% of measurements |
| SB & SC | Does not Apply | standard exceeded 11-25% of measurements |
| ***Not Supporting*** | | |
| SA | Prohibited[2] or Restricted | standard exceeded >25% of measurements |
| SB & SC | Does not Apply | standard exceeded >25% of measurements |

1 Percentages are rounded to the nearest whole number. A minimum of ten samples is needed.
2 DEH classifies some SA waters as prohibited, because DEH does not sample them due to the absence of a shellfish resource. DEH is federally required to prohibit harvesting in such areas, although actual fecal coliform bacteria concentrations are unknown. These waters are not rated (NR) for use support.

It is important to note that DEH classifies <u>all</u> actual and *potential* growing areas (which includes all saltwater and brackish water areas) for 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 has classified as SA (shellfish harvest waters). This will result in a difference of acreage between DEH areas classified as conditionally approved-closed, prohibited or restricted, and DWQ waterbodies rated as PS or NS. 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 based on DEH information. DWQ areas classified as SB and SC are rated using chemical/physical data, phytoplankton data, and algal bloom and fish kill data.

### 5. Cause and Source Data

See methods for freshwater streams.

### 6. Outside Data

See methods for freshwater streams.

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

Three 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 was 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.

The rating fully supporting but threatened (ST) is no longer used. Instead, three categories are now used, including fully supporting (FS), partially supporting (PS) and not supporting (NS). Waters that are fully supporting but have some notable water quality problems are discussed in the subbasin chapters of the basinwide plan.

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 RATINGS FOR MONITORED STREAMS IN THE HAW AND DEEP RIVER WATERSHEDS IN THE CAPE FEAR RIVER BASIN. DRAFT, 8/99.

NC DIVISION OF WATER QUALITY

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| HAW RIVER | From source to SR 2109, Guilford | 30601 | SR 2109, Guilford | S | | | F | | P | PS | PS | | sed | NP | ag |
| HAW RIVER | From SR 2109 to SR 2426, Guilford | 30601 | SR 2426, Guilford | | | | | | F/P | PS | PS | | sed | NP | ag |
| HAW RIVER | From SR 2426, Guilford, to NC 87 | 30601 | US 29A & NC 150 | S | | | G-F/G-F | | | S | S | Y | sed | NP, P | ag, urban, Reidsville WWTP |
| HAW RIVER | From NC 87 to NC 49 | 30601 | NC 87 & NC 49 | PS | | | F | | | PS | PS | | turb, fecal, sed | NP | ag, urban |
| HAW RIVER | From NC 49 to a point 0.4 mile downstream of Cane Creek (South side of Haw River) | 30601 | NC 54, nr Graham; SR 1005 nr Saxapahaw, Alamance | PS | | | G-F/G-F | | | S | S | Y | turb | NP | |
| Troublesome Creek | From source to Rockingham County SR 2423 | 30601 | SR 1001, SR 2422, Rockingham | | | | G-F | P | P | PS | PS | | sed | NP | ag |
| Troublesome Creek (Lake Reidsville) | From Rockingham County SR 2423 to dam at Lake Reidsville (City of Reidsville water supply intake) | 30601 | | lakes:S | | | | | | | S | Y | sed | NP | ag |
| Troublesome Creek | From dam at Lake Reidsville to Haw River | 30601 | | | | | | | | | S | Y | sed | NP | ag |
| Little Troublesome Creek | From source to Reidsville WWTP | 30601 | ab Reidsville WWTP | | F | | | | | PS | PS | | fecal, sed, nutrients | NP | urban |
| Little Troublesome Creek | From Reidsville WWTP to Haw River | 30601 | be WWTP; SR 2600 | S | F | | P | P | P | NS | NS | | fecal, sed, nutrients | P, NP | urban |
| Reedy Fork | From source to a point 0.4 mile downstream of Moores Creek | 30602 | SR 2128, Guilford | | | | G-F | | | S | S | Y | sed | NP | ag |
| Brush Creek | From source to L. Higgins | 30602 | SR 2136, Guilford | | | | F | | | PS | PS | | sed | NP | urban |
| Brush Creek | From upper edge of L. Higgins to a point 0.5 mile downstream of Guilford County SR 2190 | 30602 | | | | | | | | | S | | | | |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Brush Creek (Lake Higgins) | From a point 0.5 mile downstream of Guilford County SR 2190 to Lake Brandt, Reedy Fork | 30602 | | lakes:S | | | | | | | S | | | | |
| Horsepen Creek | From source to U.S. Hwy. 220 | 30602 | US 220 | | | | F | | | PS | PS | | sed | NP | urban |
| Horsepen Creek | From U.S. Hwy. 220 to Lake Brandt, Reedy Fork | 30602 | | | | | | | | | PS | | sed | NP | urban |
| Reedy Fork (Hardys Mill Pond) | From Lake Townsend Dam to Buffalo Creek | 30602 | SR 2728, Guilford | | | | G-F | F | G-F/F | S | S | Y | | NP | urban, non-urban development |
| Reedy Fork (Hardys Mill Pond) | From Buffalo Creek to Haw River | 30602 | NC 87 | PS | | | F | | | PS | PS | | fecal | NP, P | urban, non-urban, Cone Mills, Greensboro WWTP |
| North Buffalo Creek | From source to above WWTP | 30602 | ab/be Cone Mills, ab WWTP | | | P/P/P | P | | | NS | NS | | fecal, sed, nutrients | NP, P | urban, Cone Mills |
| North Buffalo Creek | From WWTP to Buffalo Creek | 30602 | SR 2832, 2770, Guilford | PS | | | P | 94:P | P | NS | NS | | fecal, sed, nutrients | NP, P | urban, Cone Mills, Greensboro WWTP |
| South Buffalo Creek | From source to McConnell Rd, Guilford | 30602 | McConnell Rd., Guilford | | | | F | | | PS | PS | | fecal, sed | NP | urban |
| South Buffalo Creek | From McConnell Rd to US 70, Guilford | 30602 | US 70 ab WWTP | | | | P | 94:P | P | PS | PS | | fecal, sed | NP | urban |
| South Buffalo Creek | From US 70 to Buffalo Creek | 30602 | SR 2821, Guilford | NS | | | P | 94:P | P | NS | NS | | fecal, sed | NP | urban, Greensboro WWTP |
| Stony Creek (Lake Burlington) | From source to Buttermilk Creek | 30602 | SR 1100 & 1104, Caswell | | | | G | 94:G-F | | S | S | | sed | NP | ag |
| Stony Creek (Stony Creek Reservoir) | From Buttermilk Creek to dam at Stony Creek Reservoir | 30602 | | lakes:S | | | | | | | S | | | | |
| Jordan Creek | From source to a point 0.7 mile upstream of mouth | 30602 | SR 1002, Alamance | | | | G-F | G-F | | S | S | Y | sed | NP | ag |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Jordan Creek | From a point 0.7 mile upstream of mouth to Stony Creek | 30602 | SR 1754, Alamance | PS | | | | | | | S | Y | sed, Mn | NP | ag |
| Stony Creek | From dam at Stony Creek Reservoir to dam at Copeland Fabrics, Inc. water supply | 30602 | | | | | | | | | S | | | | |
| Stony Creek | From dam at Copland Fabrics, Inc., water supply to Haw River | 30602 | | | | | | | | | S | | | | |
| Town Branch | From source to Haw River | 30602 | ST 2109, Alamance | PS | | | | | | | NR | Y | fecal | NP | urban |
| Back Creek | From source to a point 0.3 mile upstream of N.C. Hwy. 119 | 30602 | | | | | | | | | S | | | | |
| Back Creek (GrahamMebane Reservoir) | From a point 0.3 mile upstream of N.C. Hwy. 119 to dam at Graham-Mebane Reservoir | 30602 | | | | | | | | | S | | | | |
| Back Creek | From dam at Graham-Mebane Reservoir to Haw River | 30602 | | | | | | | | | S | | | | |
| Big Alamance Creek (Alamance Creek) | From source to a point 2.4 miles downstream of Guilford County SR 3045 | 30603 | SR 3088, Guilford | | | | | | G; 99:G F | S | S | Y | sed | NP | ag |
| Big Alamance Creek (Alamance Creek)(Lake Mackintosh) | From a point 2.4 miles downstream of Guilford County SR 3045 to dam at Lake Mackintosh | 30603 | | lakes:S | | | | | | | S | | sed | NP | |
| Little Alamance Creek (Guilford County) | From source to a point 0.3 mile downstream of Guilford County SR 3073 | 30603 | SR 3088 and 3056, Guilford | | | | | | F | S | S | Y | sed | NP | ag |
| Little Alamance Creek (Guilford County) | From a point 0.3 mile downstream of Guilford County SR 3073 to Lake Mackintosh, Big Alamance Creek | 30603 | | | | | | | | | S | Y | sed | NP | ag |
| Big Alamance Creek (Alamance Creek) | From Lake Mackintosh dam to Haw River | 30603 | NC 49, SR2309, SR 2116 Alamance | S | | | G-F | F | | S | S | Y | sed, fecal | NP, P | ag, urban |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Stinking Quarter Creek | From source to Big Alamance Creek | 30603 | SR 1136, Alamance | | | | G | 94:F | G-F | S | S | Y | sed | NP | ag |
| Little Alamance Creek (Gant Lake, Mays Lake) (Alamance County) | From source to Big Alamance Creek | 30603 | SR 2309, Alamance | | | | P | F | P | NS | NS | | nutrients | NP | urban, stormwater surges |
| Haw Creek (including the proposed reservoir below normal reservoir elevation) | From source to N. C. Hwy. 54 | 30602 | SR 2158, Alamance | | | | G | | | S | S | | sed | NP | ag, non-urban development |
| Haw Creek | From N. C. Hwy. 54 to Haw River | 30602 | | | | | | | | | S | | sed | NP | ag, non-urban development |
| Marys Creek | From source to Haw River | 30604 | SR 2174, Alamance | | | | F | | | PS | PS | | sed, nut | NP | ag |
| Cane Creek | From source to a point 0.4 mile upstream of Turkey Hill Creek | 30604 | | | | | | | | | S | | | NP | |
| Cane Creek (Cane Creek Reservoir) | From a point 0.4 mile upstream of Turkey Creek to dam at Cane Creek Reservoir (located 0.5 mile north of N.C. Hwy. 54) | 30604 | SR 1114, Orange | | | | G/G/E | 94:G-F | | S | S | | | NP | |
| Cane Creek | From dam at Cane Creek Reservoir to Haw River | 30604 | NC 54 & SR 1958, Orange | | G-F/G | | | | | S | S | | | NP | |
| Cane Creek (South side of Haw River) | From source to Haw River | 30604 | off SR 2351 & NC 87, Alamance | | | | G-F | | | S | S | Y | sed | NP | ag |
| HAW RIVER | From a point 0.4 mile downstream of Cane Creek (South side of Haw River) to a point 0.4 mile downstream of Brooks Branch | 30604 | | | | | | | | | S | Y | | NP | |
| Collins Creek | From source to a point 0.8 mile downstream of Orange County SR 1005 | 30604 | | | | | | | | | S | Y | | NP | ag |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Collins Creek | From a point 0.8 mile downstream of Orange County SR 1005 to Haw River | 30604 | SR 1539, Chatham | | | | G-F | | P | S | S | Y | nut | NP | ag |
| Terrells Creek (South Side Haw River | From source to Cattail Creek | 30604 | | | | | | | | | S | Y | | NP | |
| Terrells Creek (South Side Haw River | From Cattail Creek to Haw River | 30604 | NC 87, Chatham | | | | G-F | 94:F | F | S | S | Y | | NP | |
| Terrells Creek (Ferrels Creek) (North Side Haw River) | From source to Haw River | 30604 | | | | | G-F | | | S | S | Y | | NP | |
| Dry Creek | From source to a point 0.3 mile downstream of Chatham County SR 1506 | 30604 | | | | | | | | | S | Y | sed | NP | ag |
| Dry Creek | From a point 0.3 mile downstream of Chatham County SR 1506 to Haw River | 30604 | SR 1520, Chatham | | | | G-F | | | S | S | Y | sed | NP | ag |
| HAW RIVER | From a point 0.4 mile downstream of Brooks Branch to Pittsboro water supply intake (located 0.3 mile upstream of Pokeberry Creek) | 30604 | | | | | | | | | S | Y | | NP | |
| HAW RIVER | From Pittsboro water supply intake to a point 0.5 mile downstream of U.S. Hwy. 64 | 30604 | nr Bynum; US 64 & 1713, Chatham | S | | | G | | | S | S | | | NP | |
| Pokeberry Creek | From source to Haw River | 30604 | SR 1711, Chatham | | | | G | | | S | S | | sed | | ag |
| HAW RIVER | From a point 0.5 mile downstream of U.S. Hwy. 64 to approximately 1.0 mile below U.S. Hwy. 64 | 30604 | | | | | | | | | S | | | NP | |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| HAW RIVER (B. Everett Jordan Lake below normal pool elevation) | From approximately 1.0 mile below U.S. Hwy. 64 to dam at B. Everett Jordan Lake | 30604 | | lakes:S | | | | | | | S | | | | |
| Robeson Creek | From a point 0.7 mile downstream of Chatham County SR 2159 to a point 0.3 mile upstream of mouth | 30604 | US 15/501, ab & be WWTP, & SR 1939 Chatham | PS; lakes PS | | F/ F | | | | PS | PS | | chl a, sed | NP, P | urban, Pittsboro WWTP |
| Robeson Creek | From a point 0.3 mile upstream of mouth to B. Everett Jordan Lake, Haw River | 30604 | | | | | | | | | PS | | chl a | NP,P | urban, Pittsboro WWTP |
| New Hope River Arm of B. Everett Jordan Lake (below normal pool elevation) | From source at confluence of Morgan Creek and New Hope Creek Arms of B. Everett Jordan Lake (a east-west line across the southern tip of the formed penisula) to Chatham County SR 1008 | 30605 | | lake | | | | | | | S | | | | |
| New Hope Creek | From Sandy Creek to a point 0.3 mile upstream of Durham County SR 2220 | 30605 | | | | | | | | | PS | | sed | NP | urban |
| New Hope Creek | From a point 0.3 mile upstream of Durham County SR 2220 to a point 0.8 mile downstream of Durham County SR 1107 | 30605 | SR 2220 & SR 1107, Durham | NS | | | F | | P | PS | PS | | Mn, fecal, sed | NP | urban |
| New Hope Creek (including New Hope Creek Arm of New Hope River Arm of B. Everett Jordan Lake) | From a point 0.8 mile downstream of Durham County SR 1107 to confluence with Morgan Creek Arm of New Hope River Arm of B. Everett Jordan Lake | 30605 | | lakes | | | | | | | S | | | NP | |
| Little Creek | From source to a point 0.7 mile downstream of Durham County SR 1110 | 30606 | Pinehurst Dr., Orange | | | | P | | | NS | NS | | sed | NP | urban |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Bolin Creek (Hogan Lake) | From source to U.S. Hwy. 501 Business | 30606 | SR 1777 & Village Rd, Orange | | | | G, G | | | S | S | | | NP | urban |
| Bolin Creek | From U.S. Hwy. 501 Business to Little Creek | 30606 | E. Franklin St. & off SR 1750, Orange | | | | F/P | | P | PS | PS | | sed | NP | urban |
| Booker Creek (Eastwood Lake) | From source to dam at Eastwood Lake | 30606 | | | | | | | | | PS | | | NP | urban |
| Booker Creek | From dam at Eastwood Lake to U.S. Hwy. 15 | 30606 | Piney Mtn Rd, Orange | | | | F | | | PS | PS | | | NP | urban |
| Booker Creek | From U.S. Hwy. 15 to Little Creek | 30606 | | | | | | | | | PS | | | NP | urban |
| Little Creek | From a point 0.7 mile downstream of Durham County SR 1110 to New Hope Creek | 30606 | | | | | | | | | PS | | sed | NP | urban |
| Northeast Creek | From source to N.C. Hwy. 55 | 30605 | | | | | | | | | PS | | sed, fecal, DO, Mn | NP | urban |
| Northeast Creek | From N.C. Hwy. 55 to a point 0.5 mile downstream of Panther Creek | 30605 | SR 1100, SR 1102, & SR 1731, Durham | PS | | | | F/P | | PS | PS | | fecal, DO, Mn, sed | NP | urban, non-urban development |
| Northeast Creek | From a point 0.5 mile downstream of Panther Creek to New Hope Creek Arm of B. Everett Jordan Lake | 30605 | | | | | | | | | PS | | fecal, DO, Mn, sed | NP | urban, non-urban development |
| Morgan Creek | From source to a point 1.4 miles downstream of N.C. Hwy. 54 | 30606 | NC 54, Orange | | | | G/E | 94:F | | S | S | | sed | NP | |
| Morgan Creek (University Lake) | From a point 1.4 miles downstream of N.C. Hwy. 54 to dam at University Lake | 30606 | | | | | | | | | S | | | | |
| Morgan Creek | From dam at University Lake to Orange County SR 1919 | 30606 | | | | | | | | | S | | sed | | |
| Morgan Creek | From Orange County SR 1919 to Meeting of the Waters | 30606 | Botanical Trail, Orange | | | | G-F | | | S | S | Y | sed | NP | |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Morgan Creek | From Meeting of the Waters to Chatham County SR 1726 (Durham County SR 1109) | 30606 | ab & be OWASA & SR 1900, Orange | | F/P | | F | | P | PS | PS | | Mn, sed | NP | urban |
| Meeting of the Waters | From source to Morgan Creek | 30606 | Laurel Hill Rd, Orange | | | | P | | | NS | NS | | sed | NP | urban, University Hospital, stadium |
| Morgan Creek (including the Morgan Creek Arm of New Hope River Arm of B. Everett Jordan Lake) | From Chatham County SR 1726 (Durham County SR 1109) to New Hope Creek Arm of New Hope River Arm of B. Everett Jordan Lake | 30606 | SR 1726, Chatham | NS | | | F | | | PS | PS | | Mn, sed | NP | urban |
| New Hope River Arm of B. Everett Jordan Lake (below normal pool elevation) | From Chatham County SR 1008 to Haw River Arm of B. Everett Jordan Lake, Haw River | 30605 | | lakes | | | | | | | S | | | | |
| HAW RIVER | From dam at B. Everett Jordan Lake to Cape Fear River (junction with Deep River) | 30607 | nr Moncure, be Jordan Dam | PS | | | | | | | S | | Mn | NP | |
| DEEP RIVER (including High Point Lake at normal pool elevation) | From source in backwaters of High Point Lake to dam at High Point Lake (City of High Point water supply intake) | 30608 | | lakes: S | | | | | | | S | | | NP | |
| East Fork Deep River | From source to a point 0.4 mile downstream of Guilford County SR 1541 | 30608 | SR 1541, Guilford | PS | | | F | | | PS | PS | | sed, turb, fecal | NP | urban, industrial runoff |
| East Fork Deep River | From a point 0.4 mile downstream of Guilford County SR 1541 to High Point Lake, Deep River | 30608 | | | | | | | | | PS | | sed, turb, fecal | NP | urban, industrial runoff |
| West Fork Deep River | From source to a point 0.3 mile downstream of Guilford County SR 1850 | 30608 | SR 1850, Guilford | | | | G-F/F | | | S | S | Y | sed | NP | ag, non-urban development |

| Name of stream | Description | Subbasin | Monitoring station location | CHEM 94-98 | BENTHOS 94 | 97 | 98 | FISH 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| West Fork Deep River (Oak Hollow Reservoir) | From a point 0.3 mile downstream of Guilford County SR 1850 to dam at Oak Hollow Reservoir | 30608 | | | | | | | | | S | Y | sed | NP | ag, non-urban development |
| DEEP RIVER | From dam at High Point Lake to Guilford County SR 1334 | 30608 | | | | | | | | | PS | | | NP | urban |
| DEEP RIVER | From Guilford County SR 1334 to dam at Oakdale Cotton Mills, Inc. (Town of Jamestown water supply intake) | 30608 | | | | | | | | | PS | | | NP | urban |
| DEEP RIVER | From dam at Oakdale Cotton Mills, Inc. to SR 1113, Guilford Co. | 30608 | SR 1113, Guilford | | | | F | | | PS | PS | | | NP | urban |
| DEEP RIVER | From SR 1113 ( Guilford) to SR 1921 (Randolph) | 30608 | SR 1921, Randolph | S | | | | | | | PS | | fecal | NP | urban |
| DEEP RIVER | From SR 1921 (Randolph) to Randelman dam (located 1.6 mi ab US 220 bus) | 30608 | | | | | | | | | S | Y | fecal | NP | urban, ag |
| Richland Creek | From source to a point 0.4 mile upstream of Guilford County SR 1154 | 30608 | | | | | | | | | NS | | sed, fecal | NP | urban, stormwater surges |
| Richland Creek | From a point 0.4 mile upstream of Guilford County SR 1154 to Randleman Reservoir, Deep River | 30608 | SR 1154 & SR 1145, Guilford | S | | | P | | P | NS | NS | | sed, fecal | NP,P | urban, High Point WWTP, stormwater surges |
| DEEP RIVER | From Randelman dam (located 1.6 mi ab US 220 bus) to US 220 bus | 30608 | US 220, bus | | | | G-F | | | S | S | Y | fecal | NP | urban |
| DEEP RIVER | From US 220 bus to SR 2122 (Randolph) | 30608 | SR 2122/2128, Randolph | S | | | | | | | S | Y | fecal | NP | urban |
| DEEP RIVER | From SR 2122 (Randolph Co.) to Haskett Creek | 30609 | | | | | | | | | S | Y | fecal | NP | urban |
| DEEP RIVER | From Haskett Creek to Brush Creek | 30609 | SR 2615, Randolph | S | | | G-F | | | S | S | Y | sed, turb, nut | NP, P | urban, Franklinville WWTP |

| Name of stream | Description | Subbasin | Monitoring station location | CHEM 94-98 | BENTHOS 94 | 97 | 98 | FISH 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEEP RIVER | From Brush Creek to Grassy Creek | 30609 | SR 1456, Moore | PS | | | E | | | S | S | | sed, turb, nut | NP | |
| Polecat Creek | From source to a point 0.4 mile downstream of Randolph County SR 2116 | 30609 | US 220 Bus (Guilford), SR 2113 & 2116 (Randolph) | | | | G | | | S | S | | sed | NP | cattle, non-urban development |
| Polecat Creek | From a point 0.4 mile downstream of Randolph County SR 2116 to dam at Randleman water supply reservoir | 30609 | | | | | | | | | S | | sed | NP | cattle, non-urban development |
| Polecat Creek | From dam at Randleman's water supply to Deep River | 30609 | | | | | | | | | S | | sed | NP | cattle, non-urban development |
| Haskett Creek | From source to SR 2149 | 30609 | SR 2149, Randolph | | | | P | | | NS | NS | | | NP | urban |
| Haskett Creek | From SR 2149 to Deep River | 30609 | be SR 2149 & SR 2128, Randolph | S | | | P | | | NS | NS | | | NP | urban |
| Sandy Creek | From source to a point 0.6 mile upstream of N.C. Hwy. 22 | 30609 | SR 2261 & 2481, Randolph | | | | E | | | S | S | | | NP | |
| Sandy Creek | From a point 0.6 mile upstream of N.C. Hwy. 22 to Ramseur water supply | 30609 | | | | | | | | | S | | | NP | |
| Sandy Creek | From dam at Ramseur's water supply to Deep River | 30609 | | | | | | | | | S | | | NP | |
| Richland Creek | From source to Deep River | 30609 | SR 2873, Randolph | | | | E | | | S | S | | sed | NP | ag |
| Brush Creek | From Little Brush Creek to Deep River | 30609 | NC 22, Randolph | | | | G | | | S | S | | sed | NP | ag, cattle |
| Flat Creek | From source to Deep River | 30609 | SR 2886, Randolph | | | | G-F | | | S | S | Y | nut, sed | NP | ag, cattle |
| Fork Creek | From source to Deep River | 30609 | SR 2873, Randolph | | | | G | | | S | S | | sed | NP | ag, cattle |
| DEEP RIVER | From Grassy Creek to a point 1.0 mile upstream of Tysons Creek | 30610 | NC 22, Moore | PS | | | | | | S | S | Y | turb | NP | |
| Bear Creek | From source to a point 0.5 mile upstream of Cabin Creek | 30610 | SR 1405, Moore | | | | | G-F | | S | S | Y | | NP | |

| | | | | CHEM | BENTHOS | | | FISH | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Name of stream | Description | Subbasin | Monitoring station location | 94-98 | 94 | 97 | 98 | 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
| Cabin Creek | From source to Cotton Creek | 30610 | SR 1400, Moore | | | | G | | | S | S | | | NP | |
| Cabin Creek | From SR 1281 SR 1434 (Moore Co.) | 30610 | SR 1275, Moore | | | | G | | | S | S | | | NP | |
| Cotton Creek | From Star WWTP to Lick Creek | 30610 | SR 1372, Moore | | | | P | | | NS | NS | | | P | Star WWTP |
| Cotton Creek | From Lick Creek to Cabin Creek | 30610 | SR 1370, Montgomery | | | | F | | | PS | PS | | | P | Star WWTP |
| Mill Creek | From source to Cabin Creek | 30610 | nr SR 1275, Moore | | | | G/G-F | | | S | S | | | | |
| Wet Creek | From source to Cabin Creek | 30610 | NC 24, Moore | | | | G | | | S | S | | | | |
| Cabin Creek | From Moore County SR 1434 to Bear Creek | 30610 | | | | | | | | | S | | | NP | |
| Bear Creek | From Robbin's water supply intake to Deep River | 30610 | NC 705, Moore | S | | | G | 94:F | | S | S | Y | | NP | |
| Falls Creek | From source to Deep River | 30610 | SR 1606, Moore | | | | NR | | G | S | S | | | NP | |
| Buffalo Creek | From source to Deep River | 30610 | NC 22, Moore | | | | G | | | S | S | | | NP | |
| DEEP RIVER | From a point 1.0 mile upstream of Tysons Creek to Moore Co. SR 1621 | 30610 | | | | | | | | | S | | turb | NP | |
| DEEP RIVER | From Moore Co. SR 1621 to mouth of Big Governors Creek | 30610 | | | | | | | | | PS | | | NP | Carbonton dam, High Point WWTP |
| DEEP RIVER | From mouth of Big Governors Creek to Carbonton Dam @ NC 42 | 30610 | NC 42 | PS | | | | | | | PS | | DO | P, NP | Carbonton dam, High Point WWTP |
| DEEP RIVER | From Carbonton Dam @ NC 42 to 0.8 mi ab Lee Co. SR 1007 | 30610 | | | | | | | | | S | Y | DO | NP | Carbonton dam |

| Name of stream | Description | Subbasin | Monitoring station location | CHEM 94-98 | BENTHOS 94 | 97 | 98 | FISH 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DEEP RIVER | From a point 0.8 mile upstream of Lee County SR 1007 to Town of Gulf-Goldston water supply intake (located 0.3 mile upstream of Lee County SR 1007) | 30611 | | | | | | | | | S | Y | DO | NP | Carbonton dam |
| DEEP RIVER | From Town of Gulf-Goldston water supply intake to a point 0.6 mile upstream of the Norfolk Southern Railroad bridge crossing at Cumnock | 30611 | SR 1007, Lee | | | | G-F | | | S | S | Y | DO | NP | Carbonton dam |
| DEEP RIVER | From a point 0.6 mile upstream of Norfolk Southern Railroad bridge crossing at Cumnock to Lee County water supply intake (located just upstream of Norfolk Southern RR bridge) | 30611 | | | | | | | | | S | Y | DO | NP | Carbonton dam |
| DEEP RIVER | From Lee County water supply intake to a point 0.4 mile upstream of Rocky Branch | 30611 | US 15/501, Lee | NS | | | G-F | | | S | S | Y | DO | NP | Carbonton dam |
| Cedar Creek | From source to Deep River | 30611 | SR 2145, Chatham | | | | | 94:F | | | PS | | sed | NP | clay pit |
| Big Buffalo Creek | From source to Deep River | 30611 | SR 1403, Lee | | | | | 94:F | P | NS | NS | | | NP | urban |
| Rocky River | From source to Rocky River Reservoir | 30612 | SR 1300, Chatham | | | | | | F | PS | PS | | sed, nut | NP | cattle, ag |
| Rocky River | From Rocky River Reservoir to 0.3 mi be Lacy Creek | 30612 | | lakes: S | | | | | | | S | | | | |
| Rocky River | From a point 0.3 mile downstream of Lacys Creek to dam at lower water supply for Siler City | 30612 | | | | | | | | | S | Y | | | |

| Name of stream | Description | Subbasin | Monitoring station location | CHEM 94-98 | BENTHOS 94 | 97 | 98 | FISH 93 | 98 | Bio rating | Rating | WC | Problem parameter | Major source | Possible source* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Rocky River | From dam at lower water supply reservoir for Siler City to Deep River | 30612 | US 64, SR 2170, NC 902, US 15/501 (Chatham) | S | | | G-F/G-F/G/G | | | S | S | Y | nut | NP | |
| Loves Creek | From US 421 to Siler City WWTP | 30612 | nr SR 2203 & SR 2229 ab WWTP, Chatham | | | F | | | G-F | PS | PS | | | NP | urban |
| Loves Creek | From Siler City WWTP to Rocky River | 30612 | nr SR 2203 be WWTP, Chatham | | | P | | | | NS | NS | | nut | NP, P | urban, Siler City WWTP |
| Tick Creek | From source to Rocky River | 30612 | US 421 & SR 2120, Chatham | | | | G-F/G-F | 94:G-F | | S | S | Y | sed | NP | cattle, ag |
| Harlands Creek (Hollands Creek) | From source to Rocky River | 30612 | NC 902, Chatham | | | | G/G-F | | | S | S | Y | | NP | |
| Bear Creek | From SR 2187, Chatham, to Rocky River | 30612 | SR 2187 & 2155, Chatham | | | | | | G | S | S | Y | | NP, P | |
| DEEP RIVER | From a point 0.4 mile upstream of Rocky Branch to Cape Fear River (junction with Haw River) | | CSX RR bridge nr Moncure | S | | | | | | | S | | | NP | |

**NOTES**

"Rating" = Use Support Rating; "WC" = Water of Concern

Where rating is given, but no monitoring data are noted, data from an adjacent stream segment are used to give rating.

*"Ag" denotes agriculture, which could include row crops and animal operations. Where "cattle" is noted, cattle were observed on site at the time of sampling or the watershed hosts many cattle farms.

**ABBREVIATION KEY**

E = Excellent
G = Good
G-F = Good-fair
F = Fair
P = Poor (Benthos/fish ratings)
P = Point Source Pollution (Major source)
NP = Non-point Source Pollution
M = Monitored
ME = Monitored-evaluated
S = Fully Supporting
ST = Fully Supporting but Threatened
PS = Partially Supporting
NS = Not Supporting
NR = Not Rated

nut = high nutrient levels
turb = turbidity
fecal = fecal coliform bacteria
sed = sediment

# Appendix IV

# 303(d) Listing and Reporting Methodology

## 303(d) LISTING AND REPORTING REQUIREMENTS

### 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. This draft of the 303(d) list will be submitted to EPA for approval in the year 2000. The latest approved 303(d) list was published on May 15, 1998. 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) or partially supporting (PS) based on monitored information in the 305(b) report were considered as initial candidates for the 303(d) list. Waters that were listed on the previously approved 303(d) list were evaluated and automatically included if the use support rating was NS, PS or not rated (NR).

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) because fish advisories are not considered in the 305(b) use support process.

Guidance from EPA on developing the 1998 303(d) lists indicated 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 an identified cause of impairment 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 an identified cause of impairment are on the draft 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.

The prioritization process results in ratings of high, medium and low. Generally, waters rated with the highest priority are classified for water supply use, 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 be addressed first within their basin cycles when technically feasible. TMDLs are not possible where the pollutant(s) have yet to be identified. TMDLs cannot be attempted without flow data. Collecting physical/chemical data and accumulating flow data are milestones that must precede developing TMDLs of any priority.

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 303(d) listed waters 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 constantly reviewing its resource allocations 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 impairment without an identified pollutant; or 3) biological impairment where the criteria used to originally rate the stream as impaired has been deemed inappropriate. Many low flow streams and swamp waters were rated as biologically impaired in the past using inappropriate criteria. These waters will be resampled and rated using specialized criteria currently in development. Until the updated rating criteria is finalized, these waters will continue to be rated NR and will stay on the 303(d) list. 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.

**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.

Cause of Impairment **–** The cause of impairment as identified in the use support rating process. 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. There may be other unidentified causes contributing to the impairment. Causes included in the 303(d) list are listed below:

**Chl *a* –** chlorophyll *a*
**Cl** – chloride
**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), **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 are 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 be fully supporting (FS). The 305(b) report describes these use support ratings further. On the 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, fecal coliform, ammonia and metals. Management strategies are typically done for pH, sediment and turbidity. 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 cause of impairment 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 or invalid 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 cause of impairment. TMDLs or management strategies will be developed within 2 basin cycles of pollutant 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 cause of impairment 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 when technically feasible.
>
> **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 that are 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 cause of impairment 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.

# Appendix V

# Cape Fear River Basin Nonpoint Source Program Description and Contacts

**Statewide Nonpoint Source Management Program Description**

The North Carolina Nonpoint Source Management Program consists of a broad framework of federal, state and local resource and land management agencies. More than 2,000 individuals administer programs that are directly related to nonpoint source pollution management within the state. A range of responsibilities have been delegated to county or municipal programs including the authority to inspect and permit land clearing projects or septic system performance. In the field of agriculture, a well established network of state and federal agricultural conservationists provide technical assistance and program support to individual farmers.

Staff in the DWQ Water Quality Section's Planning Branch lead the Nonpoint Source Management Program, working with various agencies to insure that program goals are incorporated into individual agencies' management plans. The goals include:

1. Coordinate implementation of state and federal initiatives addressing watershed protection and restoration.
2. Continue to target geographic areas and waterbodies for protection based upon best available information.
3. Strengthen and improve existing nonpoint source management programs.
4. Develop new programs that control nonpoint sources of pollution not addressed by existing programs.
5. Integrate the NPS Program with other state programs and management studies (e.g., Albemarle-Pamlico National Estuary Program).
6. Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

Coordination between state agencies is achieved through reports in the *North Carolina Nonpoint Source Management Program Update*. Reports are intended to keep the program document current and develop a comprehensive assessment identifying the needs of each agency to meet the state nonpoint source program goals. Annual reports are developed to describe individual program priorities, accomplishments, significant challenges, issues yet to be addressed, and resource needs. A copy of the latest Annual Report (FY1998) is available online: http://h2o.enr.state.nc.us/nps/nps_mp.htm.

The nature of nonpoint source pollution is such that involvement at the local level is imperative. Basinwide Water Quality Plans identify watersheds that are impaired by nonpoint sources of pollution. Identification, status reports and recommendations are intended to provide the best available information to local groups and agencies interested in improving water quality. The plans also make available information regarding federal, state and local water quality initiatives aimed at reducing or preventing nonpoint source pollution.

The following table is a comprehensive guide to contacts within the state's Nonpoint Source Management Program. For more information, contact Alan Clark at (919) 733-5083 ext. 570.

**Agriculture**

**USDA Natural Resources Conservation Service:**

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

| | | | |
|---|---|---|---|
| Area 2 Conservationist | | 704-637-2400 | 600 West Innes Street, Salisbury, NC 28144 |
| Area 3 Conservationist | | 919-734-0961 | Federal Building, Room 108, 134 North John Street, Goldsboro, NC 27530-3676 |
| **County** | **District Conservationist** | **Phone** | **Address** |
| Alamance | Gary Cox | 336-228-1753 x3 | Environmental Center, 209 North Graham Hopedale Road, Burlington, NC 27215 |
| Bladen | Samuel G. Warren | 910-862-3179 x3 | Agriculture Service Center, Room 122, Ice Plant Road, Elizabethtown, NC 28337-9409 |
| Brunswick | Joshua W. Spencer | 910-253-2830 | Brunswick County Government Center, Highway 17, PO Box 26, Bolivia, NC 28422-0026 |
| Caswell | Warren H. Mincey, Jr. | 910-694-4581 | Agriculture Building, Main Street, PO Box 96, Yanceyville, NC 27379 |
| Chatham | Michael Sturdivant | 919-542-2244 | Chatham County Agriculture Building, 45 South Street, PO Box 309, Pittsboro, NC 27312 |
| Columbus | Donna G. Register | 910-642-2348 | 45 Government Complex Road, PO Box 545, Whiteville, NC 28472-0545 |
| Cumberland | John M. Ray, Jr. | 910-484-8939 | Charlie Rose Agri-Expo Center, Suite 229, 121 East Mountain Drive, Fayetteville, NC 28306-3422 |
| Duplin | Harold D. Jones | 910-296-2120 | Duplin County Soil Conservation Building, 302 North Main Street, PO Box 219, Kenansville, NC 28349-0219 |
| Durham | | 919-560-0558 | County Agriculture Building, 721 Foster Street, Durham, NC 27701 |
| Forsyth | Dierdre Debruhl "DeDe" | 336-767-0720 | Forsyth Agriculture Building, 1450 Fairchild Drive, Winston-Salem, NC 27105 |
| Guilford | John W. Andrews | 336-333-5401 x3 | County Agriculture Center, 3309 Burlington Road, Greensboro, NC 27405 |
| Harnett | Parks V. Blake | 910-893-7584 | County Office Building, 102 East Front Street, PO Box 267, Lillington, NC 27546 |
| Hoke | John Ray, Jr.* DC based in Fayetteville FO | 910-875-8685 | Federal Building, Room 202, 122 West Elmwood Avenue, Raeford, NC 28376 |
| Johnston | Kenneth C. York | 919-934-7156 x3 | County Agriculture Building, 806 North Street, Smithfield, NC 27577 |
| Lee | Lauren A. Massey | 919-776-2633 | County Agriculture Building, Room 6, 225 Steele Street, Sanford, NC 27330 |
| Montgomery | | 910-572-2700 | 2270 North Main Street, Troy, NC 27371 |
| Moore | Angela V. Hill | 910-947-5183 | County Agriculture Center, 707 Pinehurst Avenue, PO Box 908, Carthage, NC 28327 |
| New Hanover | Marilyn M. Stowell DC based in Burgaw FO | 910-762-6072 | New Hanover SWCD, 414 Chestnut Street, Room 305, Wilmington, NC 28401 |

| Agriculture (con't) | | | |
|---|---|---|---|
| Onslow | Harry S. Tyson | 910-455-4472 x3 | Donald A. Halsey Agriculture Building, 604 College Street, Jacksonville, NC 28540 |
| Orange | E. Brent Bogue | 919-644-1079 x3 | County Planning/Agriculture Center, 306D Revere Road, PO Box 8181, Hillsboro, NC 27278 |
| Pender | Marilyn M. Stowell | 910-259-4305 | Agriculture Building, 801 South Walker Street, PO Box 248, Burgaw, NC 28425-0248 |
| Randolph | B. Barton Roberson | 336-629-4449 | Federal Building, Room 105, 241 Sunset Avenue, Asheboro, NC 27203 |
| Robeson | Edward V. Holland | 910-739-5478 | 440 Caton Road, Lumberton, NC 28358 |
| Rockingham | John I. Timmons | 910-342-8225 | County Government Center, 371 NC Highway 65, PO Box 201, Wentworth, NC 27375-0201 |
| Sampson | C. Wilson Spencer | 910-592-7963 x3 | New Agriculture Building, 84 County Complex Road, Clinton, NC 28328 |
| Wake | Stephen C. Woodruff | 919-250-1070 | Agriculture Services Building, Suite D, 4001 Carya Drive, Raleigh, NC 27610 |
| Wayne | Patricia S. Gabriel | 919-731-1532 | Wayne Center, Room 104, 208 West Chestnut Street, Goldsboro, NC 27530 |

**Soil & Water Conservation Districts:**

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

| County | Board Chairman | Phone | Address |
|---|---|---|---|
| Alamance | Roy Stanley, Jr. | 336-226-0477 | PO Box 3185, Burlington, NC 27215-0185 |
| Bladen | Ronald Allen | 910-862-3179 | 122 Agriculture Services Center, Elizabethtown, NC 28337 |
| Brunswick | Bryan Smith | 910-253-4448 | 10 Referendum Drive, PO Box 26, Bolivia NC 28422 |
| Caswell | James R. Blackwell | 336-694-4581 | Agriculture Building, PO Box 96, Yanceyville, NC 27379 |
| Chatham | John W. Etchison | 919-542-8240 | PO Box 309, Pittsboro, NC 27312 |
| Columbus | Gilbert J. Anderson | 910-642-2348 | PO Box 545, Whiteville, NC 28472-0545 |
| Cumberland | Wingate Collier | 910-484-8479 | Agri-Expo Center, 121 East Mountain Drive, Suite 229, Fayetteville, NC 28306-3422 |
| Duplin | G. Rouse Ivey | 910-296-2120 | PO Box 277, 302 North Main Street, Kenansville, NC 28349-0277 |
| Durham | Ed C. Harrison | 919-560-0558 | 721 Foster Street, Durham, NC 27701-2110 |
| Forsyth | Grover McPherson | 336-767-0720 | 1450 Fairchild Drive, Room 11, Winston-Salem, NC 27105 |
| Guilford | Lewis Brandon III | 336-375-5401 | 3309 Burlington Road., Greensboro, NC 27405 |
| Harnett | Gerald Temple | 910-893-7584 | PO Box 267, Lillington, NC 27546 |
| Hoke | George Raz Autry, Jr. | 910-875-8685 | Federal Building, Room 202, 122 West Elwood Avenue, Raeford, NC 28376-2800 |
| Johnston | James W. Hughes | 919-989-5381 | County Agriculture Building, 806 North Street, Smithfield, NC 27577 |
| Lee | Michael L. Gaster | 919-776-2633 | 225 South Steele Street, Sanford, NC 27330 |
| Montgomery | Mike Haywood | 910-572-2700 | 227-D North Main Street, Troy, NC 27371 |
| Moore | Albert F. Troutman, Jr. | 910-947-5183 | PO Box 908, 707 Pinehurst Avenue, Carthage, NC 28327 |
| New Hanover | Daniel Moore | 910-762-6072 | 414 Chestnut Street, Room 305, Wilmington, NC 28401 |
| Onslow | Jerome Shaw | 910-455-4472 | Donald A. Halsey Agriculture Building, 604 College Street, Jacksonville, NC 28540 |

| Agriculture (con't) | | | |
|---|---|---|---|
| Orange | Charles W. Snipes | 919-644-1079 | PO Box 8181, Hillsborough, NC 27278 |
| Pender | Don Rawls | 910-259-4305 | PO Box 248, 801 South Walker Street, Burgaw, NC 28425 |
| Randolph | Craig Frazier | 336-318-6490 | Federal Building, Suite 105, 241 Sunset Avenue, Asheboro, NC 27203 |
| Robeson | William A. Davis | 910-739-5478 | 440 Caton Road, Lumberton, NC 28358 |
| Rockingham | Rupert O. Jones, Jr. | 336-342-8225 | PO Box 201, Wentworth, NC 27375-0201 |
| Sampson | Anna S. Sumner | 910-592-7963 | 84 County Complex Road, Clinton, NC 28328 |
| Wake | Kay A. Adcock | 919-250-1070 | 4001-D Carya Drive, Raleigh, NC 27610-2921 |
| Wayne | Russell Gurley | 919-731-1532 | Wayne Center, Room 104, 208 West Chestnut Street, Goldsboro, NC 27530-4708 |

**Division of Soil and Water Conservation:**

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

| | | | |
|---|---|---|---|
| Central Office | Carroll Pierce | 919-715-6110 | Archdale Building, 512 North Salisbury Street, Raleigh, NC 27626 |
| Fayetteville Region | Jamie Revels | 910-486-1541 | 225 Green Street, Suite 714, Fayetteville, NC 28301 |
| Raleigh Region | Margaret O'Keefe | 919-571-4700 | 1628 Mail Service Center, Raleigh, NC 27699-1628 |
| Wilmington Region | Brian Gannon | 910-395-3900 | 127 Cardinal Drive Extension, Wilmington, NC 28405-3845 |
| Winston-Salem Region | Daphne Cartner | 336-771-4600 | 585 Waughton Street, Winston-Salem, NC 27107 |

**NCDA Regional Agronomists:**

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

| | | | |
|---|---|---|---|
| Central Office | Tom Ellis | 919-733-7125 | PO Box 27647, Raleigh, NC 27611 |
| Region 4 | Tim Hall | 910-590-2801 | 104 Jaclane Drive, Clinton, NC 28502-3867 |
| Region 5 | Rick Morris | 910-866-5485 | 3184 Old NC 41, Bladenboro, NC 28320 |
| Region 7 | Kevin Johnson | 919-736-1799 | PO Box 1970, Pikeville, NC 27863 |
| Region 8 | Robin Watson | 336-570-6850 | 1709 Fairview Street, Burlington, NC 27215 |
| Region 9 | David Dycus | 919-776-9338 | 5022 Henley Road, Sanford, NC 27330 |
| Region 10 | Tim Hambrick | 336-352-5360 | 192 Davis Road, Mount Airy, NC 27030 |

| Education | | | |
|---|---|---|---|

**NC Cooperative Extension Service:**
Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities.

| County | Contact Person | Phone | Address |
|---|---|---|---|
| Alamance | Junius E. "Rett" Davis Jr. | 336-570-6740 | 209-C North Graham-Hopedale Road, Burlington, NC 27217 |
| Bladen | Dr. Martha Warner | 910-862-4591 | PO Box 209, Elizabethtown, NC 28337 |
| Brunswick | Phil Ricks | 910-253-2610 | Brunswick County Government Complex, 25 Referendum Drive, PO Box 109, Bolivia, NC 28422 |
| Caswell | Larry Whitt | 336-694-4158 | 126 Court Square, Yanceyville, NC 27379 |
| Chatham | Glenn Woolard | 919-542-8202 | 45 South Street, PO Box 279, Pittsboro, NC 27312 |
| Columbus | Jacqueline D. Roseboro | 910-640-6605 | Columbus County Center, 45 Government Complex Road, PO Box 569, Whiteville, NC 28472 |
| Cumberland | George Autry | 910-484-7156 | Charlie Rose Agri-Expo Center, 121 East Mountain Drive, PO Box 270, Fayetteville, NC 28302 |
| Duplin | Ed Emory | 910-296-2143 | PO Box 949, Kenansville, NC 28349 |
| Durham | Cheryl L. Lloyd | 919-560-0525 | Agricultural Building, 721 Foster Street, Durham, NC 27701 |
| Forsyth | Maureen Minton | 336-767-8213 | 1450 Fairchild Drive, Winston-Salem, NC 27105 |
| Guilford | Gwyn F. Riddick | 336-375-2295 | 3309 Burlington Road, Greensboro, NC 27405-7605 |
| Harnett | Jennifer S. Walker | 910-893-7530 | PO Box 1089, 102 East Front Street, Lillington, NC 27546 |
| Hoke | Betty A. Green | 919-875-2162 | 116 West Prospect Avenue, PO Box 578, Raeford, NC 28376 |
| Johnston | Kenneth R. Bateman | 919-989-5380 | Agricultural Center, 806 North Street, Smithfield, NC 27577 |
| Lee | John V. Hall | 919-775-5624 | 225 South Steele Street, Sanford, NC 27330-4294 |
| Montgomery | Roger K. Galloway | 910-576-6011 | 203 West Main Street, Troy, NC 27371 |
| Moore | Charles Hammond | 910-947-3188 | 707 Pinehurst Avenue, Carthage, NC 28327 |
| New Hanover | C. Bruce Williams | 910-452-6393 | 6206 Oleander Drive, Wilmington, NC 28403 |
| Onslow | F. Daniel Shaw | 910-455-5873 | 604 College Street, Room 8, Jacksonville, NC 28540 |
| Orange | Fletcher Barber | 919-732-8181 x2050 | 306-E Revere Road, PO Box 8181, Hillsborough, NC 27278 |
| Pender | Michael Jones | 910-259-1235 | Agricultural Building, 801 South Walker Street, Burgaw, NC 28425 |
| Randolph | Lynne Qualls | 336-318-6000 | Ira L. McDowell Center, 2222-A Fayetteville Street, Asheboro, NC 27203 |
| Robeson | Everett Davis | 910-671-3276 | 455 Caton Road, PO Box 2280, Lumberton, NC 28359 |
| Rockingham | Scott Shoulars | 336-342-8230 | Rockingham County Center, PO Box 200, Wentworth, NC 27375-0200 |
| Sampson | George P. Upton | 910-592-7161 | Sampson County Center, 369 Rowan Road, Clinton, NC 28328 |
| Wake | Brent Henry | 919-250-1100 | 4001-E Carya Drive, Raleigh, NC 27610 |
| Wayne | Howard Scott | 919-731-1520 | Wayne County Center, 208 West Chestnut Street, PO Box 68, Goldsboro, NC 27533-0068 |

| Forestry | | | |
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**Division of Forest Resources:**
Develop, protect and manage the multiple resources of North Carolina's forests through professional stewardship, enhancing the quality of our citizens while ensuring the continuity of these vital resources.

| | | | |
|---|---|---|---|
| Districts 3,4,6,8,10,11 | Rocky Tucker | 910-642-5093 | 1413 Chadbourn Highway, Whiteville, NC 28472 |
| Central Office | Bill Swartley | 919-733-2162 | 1616 Mail Service Center, Raleigh, NC 27699-1616 |

| Construction/Mining | | | |
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**DENR Division of Land Resources**:
Administers the NC Erosion and Sedimentation Control Program for construction and mining operations. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources.

| | | | |
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| Central Office | Mel Nevills | 919-733-4574 | 512 North Salisbury Street, Raleigh, NC 27626 |
| Fayetteville Region | William Vinson | 910-486-1541 | 225 Green Street, Suite 714, Fayetteville, NC 28301 |
| Raleigh Region | John Holley | 919-571-4700 | 1628 Mail Service Center, Raleigh, NC 27699-1628 |
| Wilmington Region | Dan Sams | 910-395-3900 | 127 Cardinal Drive Extension,<br>Wilmington, NC 28405-3845 |
| Winston-Salem Region | Mathew Gantt | 336-771-4600 | 585 Waughton Street, Winston-Salem, NC 27107 |

**Local Erosion and Sedimentation Control Ordinances:**
Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances.

| | | | |
|---|---|---|---|
| Town of Apex | Robert (Rocky) Ross | 919-387-3090 x101 | PO Box 250, Apex, NC 27502 |
| City of Asheboro | Wendell Holland | 336-626-1249 | PO Box 1106, Asheboro, NC 27204 |
| City of Burlington | Robert C. Patterson, Jr., P.E. | 336-222-5050 | PO Box 1358, Burlington, NC 27215 |
| Town of Chapel Hill | W. Calvin Horton<br>George Small | | 306 North Columbia Street,<br>Chapel Hill, NC 27514-3699 |
| Durham/Durham County | Glen Whisler, P.E. | 919-560-0735 | 120 East Parrish Street, Suite 100, Durham, NC 27701 |
| Forsyth County/<br>Winston-Salem | Jeff Kopf | 336-727-2388 | 100 Liberty Walk, Winston-Salem, NC 27101 |
| City of Greensboro | Michael B. Cramer | 336-373-2124 | PO Box 3136, Greensboro, NC 27402 |
| Guilford County | Earl Davis | 336-373-3803 | PO Box 3427, Greensboro, NC 27402 |
| City of High Point | Brian Sullivan/<br>Terry Kuneff | 336-883-3194 | PO Box 230, High Point, NC 27261 |
| New Hanover County | Beth Easley | 910-341-7139 | 414 Chestnut Street, Wilmington, NC 28401 |
| Orange County/<br>Chapel Hill | Warren Faircloth | 919-732-8181<br>ext. 2586 | PO Box 8181, Hillsborough, NC 27278 |
| Southern Pines?? | BB Teague, PE/<br>AH Davis Jr | 910-692-1983 | 140 Memorial Park Court, Southern Pines, NC 28387 |
| Wake County | Ken Cromartie | (919) 856-6194 | PO Box 550, Raleigh, NC 27602 |

## General Water Quality

**DWQ Water Quality Section:**

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the French Broad and Neuse River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; conduct stormwater permitting; model water quality; conduct water quality monitoring; perform wetlands permitting; conduct animal operation permitting and enforcement; and conduct water quality classifications and standards activities.

| | | | |
|---|---|---|---|
| NPS Planning | Alan Clark | 919-733-5083 x570 | 1617 Mail Service Center, Raleigh, NC 27699-1617 |
| Urban Stormwater | Bradley Bennett | 919-733-5083 x525 | 1617 Mail Service Center, Raleigh, NC 27699-1617 |
| Modelling | Ruth Swanek | 919-733-5083 x503 | 1617 Mail Service Center, Raleigh, NC 27699-1617 |
| Monitoring | Jimmie Overton | 919-733-9960 x204 | 1621 Mail Service Center, Raleigh, NC 27699-1621 |
| Wetlands | John Dorney | 919-733-1786 | 1621 Mail Service Center, Raleigh, NC 27699-1621 |
| Animal Operations | Dennis Ramsey | 919-733-5083 x528 | 1617 Mail Service Center, Raleigh, NC 27699-1617 |
| Classific'ns/Standards | Boyd DeVane | 919-733-5083 x559 | 1617 Mail Service Center, Raleigh, NC 27699-1617 |

**DWQ Regional Offices:**

Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring.

| | | | |
|---|---|---|---|
| Fayetteville Region | Paul Rawls | 910-486-1541 | 225 Green Street, Fayetteville, NC 28301 |
| Raleigh Region | Ken Schuster | 919-571-4700 | 1628 Mail Service Center, Raleigh, NC 27699-1628 |
| Wilmington Region | Rick Shiver | 910-395-3900 | 127 Cardinal Drive Extension, Wilmington, NC 28405-3845 |
| Winston-Salem Region | Larry Coble | 336-771-4600 | 585 Waughton Street, Winston-Salem, NC 27107 |

**Wildlife Resources Commission:**

To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state; and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner.

| | | | |
|---|---|---|---|
| Central Office | Frank McBride | 919-528-9886 | PO Box 118, Northside, NC 27564 |

**US Army Corps of Engineers:**

Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits.

Ask for the project manager covering your county.

| | | | |
|---|---|---|---|
| Wilmington Field Office | Ernest Jahnke | 910-251-4511 | Post Office Box 1890, Wilmington, NC 28402-1890 |
| Raleigh Field Office | Ken Jolly | 919-876-8441 x22 | 6508 Falls of the Neuse Road, Suite 120, Raleigh, NC 27615 |

**DWQ Groundwater Section:**

Groundwater classifications and standards; enforcement of groundwater quality protection standards and cleanup requirements; review of permits for wastes discharged to groundwater; issuance of well construction permits; underground injection control; administration of the underground storage tank (UST) program (including the UST Trust Funds); well head protection program development; and ambient groundwater monitoring.

| | | | |
|---|---|---|---|
| Central Office | Carl Bailey | 919-733-3221 | Mail Service Center 1636, Raleigh, NC 27699-1636 |
| Fayetteville Region | Art Barnhardt | 910-486-1541 | 225 Green Street, Fayetteville, NC 28301 |
| Raleigh Region | Jay Zimmerman | 919-571-4700 | 3800 Barrett Drive, Raleigh, NC 27609 |
| Wilmington Region | Charlie Stehman | 910-395-3900 | 127 Cardinal Drive Extension, Wilmington, NC 28405-2845 |
| Winston-Salem Region | Sherri Knight | 336-771-4600 | 585 Waughton Street, Winston-Salem, NC 27107 |

## Solid Waste

**DENR Division of Waste Management:**

Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund and the Resident Inspectors program.

| | | | |
|---|---|---|---|
| Central Office | Brad Atkinson | 919-733-0692 | 401 Oberlin Road, Suite 150, Raleigh, NC 27605 |

## On-Site Wastewater Treatment

**Division of Environmental Health and County Health Departments:**

Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust.
Services include:

- Training of and delegation of authority to local environmental health specialists concerning on-site wastewater.
- Engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface.
- Technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.

| | | | |
|---|---|---|---|
| Central Office | Steve Steinbeck | 919-715-3273 | 2728 Capital Boulevard, Raleigh, NC 27604 |
| Fayetteville Region | David McCloy | 910-692-4118 | Southern Pines |
| Raleigh Region | Fred Smith | 252-212-0304 | Rocky Mount |
| Wilmington Region | VACANT | | |
| Winston-Salem Region | Scott Greene | 336-431-6736 | Archdale, NC |

| County | Primary Contact | Phone | Address |
|---|---|---|---|
| Alamance | Tim Green | 336-513-5514 | 319 North Graham-Hopedale Road, Suite B, Burlington, NC 27217 |
| Bladen | Myra Johnson | 910-862-6900 | 300 Mercer Mill Road., PO Box 188, Elizabethtown, NC 28337 |
| Brunswick | Donald J. Yousey | 888-428-4429 | 25 Courthouse Drive, PO Box 9, Bolivia, NC 28422 |
| Caswell | Anne Scott | 336-694-4129 | County Park Road, PO Drawer H, Yanceyville, NC 27379 |
| Chatham | Wayne Sherman | 919-542-8266 | 80 East Street, PO Box 130, Pittsboro, NC 2 7312 |
| Columbus | Marian Duncan | 910-642-5700 x441 | Miller Building, PO Box 810, Whiteville, NC 28472 |
| Cumberland | Jesse F. Williams, M. D. | 910-433-3700 | 227 Fountainhead Lane, Fayetteville, NC 28301 |
| Duplin | Dr. Harriette E. Duncan | 910-296-2130 | 340 Seminary Street, PO Box 948, Kenansville, NC 28349 |
| Durham | Brian Letourneau | 919-560-7600 | 414 East Main Street, Durham, NC 27701 |
| Forsyth | Sherman Kahn, M. D. | 336-727-2434 | 799 Highland Avenue, PO Box 686, Winston-Salem, NC 27102-0686 |
| Guilford | Harold Gabel, M. D. | 336-373-3283 | 232 North Edgeworth Street, PO Box 3508, Greensboro, NC 27401 |
| Harnett | A. Wayne Raynor | 910-893-7550 | 307 Cornelius Harnett Boulevard, Lillington, NC 27546 |
| Hoke | Donald Womble | 910-875-3717 | 429 East Central Avenue, Raeford, NC 28376 |
| Johnston | L. S. Woodall, M. D. | 919-989-5200 | 517 North Bright Leaf Boulevard, Smithfield, NC 27577 |
| Lee | Mike Hanes | 919-718-4640 x5388 | 106 Hillcrest Drive, PO Box 1528, Sanford, NC 27331-1528 |
| Montgomery | | 910-572-1393 | 217 South Main Street, Troy, NC 27371 |
| Moore | Robert R. Whittmann | 910-947-3300 | 705 Pinehurst Avenue, Box 279, Carthage, NC 28327 |
| New Hanover | David E. Rice | 910-343-6591 | 2029 South 17th Street, Wilmington, NC 28401 |

| On-Site Wastewater Treatment | | | |
|---|---|---|---|
| Onslow | | 910-347-7042 | 612 College Street, Jacksonville, NC 28540 |
| Orange | Dr. Rosemary Summers | 919-732-8181 x2411 | PO Box 8181, Hillsborough, NC 27278 |
| Pender | Jack Griffith, Ph. D. | 910-259-1230 | 803 West Walker Street, PO Box 1209, Burgaw, NC 28425 |
| Randolph | Mary M. Cooper | 336-318-6217 | 2222 South Fayetteville Street, Asheboro, NC 27203 |
| Robeson | William J. Smith | 910-671-3200 | 460 Country Club Road, Lumberton, NC 28360 |
| Rockingham | Glenn Martin | 336-342-8132 | 371 NC 65, Suite 204, PO Box 204, Wentworth, NC 27375-8143 |
| Sampson | Wanda Robinson | 910-592-1131 | 360 County Complex Road, Clinton, NC 28328 |
| Wake | Ms. Lou Brewer | 919-250-4400 | 10 Sunybrook Road, PO Box 14049, Raleigh, NC 27620-4049 |
| Wayne | Robert H. Peck | 919-731-1000 | 310 North Herman Street, Box CC, Goldsboro, NC 27530 |

- **DENR Fayetteville Region Office covers the following counties:** Anson, Bladen, Cumberland, Harnett, Hoke, Montgomery, Moore, Richmond, Robeson, Sampson and Scotland.
- **DENR Raleigh Region Office covers the following counties:** Chatham, Durham, Edgecome, Franklin, Granville, Halifax, Johnston, Lee, Nash, Northampton, Orange, Person, Vance, Wake, Warren and Wilson.
- **DENR Winston-Salem Region Office covers the following counties:** Alamance, Alleghany, Ashe, Caswell, Davidson, Davie, Forsyth, Guilford, Randolph, Rockingham, Stokes, Surry, Watauga, Wilkes and Yadkin.
- **DENR Wilmington Region Office covers the following counties:** Brunswick, Columbus, Duplin, New Hanover, Onslow and Pender.

# Appendix VI

# Glossary
# of
# Terms and Acronyms

# Glossary

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| 30Q2 | The minimum average flow for a period of 30 days that has an average recurrence of one in two years. |
| 7Q10 | The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years. |
| B (Class B) | Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing. |
| basin | The watershed of a major river system. There are 17 major river basins in North Carolina. |
| benthic macroinvertebrates | Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information. |
| benthos | A term for bottom-dwelling aquatic organisms. |
| best management practices | Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time. |
| bioclassification | A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent. |
| BMPs | See *best management practices*. |
| BOD | Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged. |
| C (Class C) | Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses. |
| chlorophyll *a* | A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication. |
| coastal counties | Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington. |

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| 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). |
| conductivitiy | A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution. |
| degradation | The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress. |
| DENR | Department of Environment and Natural Resources. |
| DO | Dissolved oxygen. |
| drainage area | An alternate name for a watershed. |
| DWQ | North Carolina Division of Water Quality, an agency of DENR. |
| dystrophic | Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes. |
| 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: <u>E</u>phemeroptera (mayflies), <u>P</u>lecoptera (stoneflies) and <u>T</u>richoptera (caddisflies). |
| eutrophic | Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur. |
| eutrophication | The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems. |
| fall line | A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast. |
| FS | Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality. |

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| GIS | Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information. |
| habitat degradation | Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. |
| headwaters | Small streams that converge to form a larger stream in a watershed. |
| HQW | High Quality Waters. A supplemental surface water classification. |
| HU | Hydrologic unit. See definition below. |
| *Hydrilla* | The genus name of an aquatic plant - often considered an aquatic weed. |
| hydrologic unit | A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units. |
| hypereutrophic | Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth. |
| impaired | Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses. |
| impervious | Incapable of being penetrated by water; non-porous. |
| kg | Kilograms. To change kilograms to pounds multiply by 2.2046. |
| lbs | Pounds. To change pounds to kilograms multiply by 0.4536. |
| loading | Mass rate of addition of pollutants to a waterbody (e.g., kg/yr) |
| macroinvertebrates | Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate). |
| macrophyte | An aquatic plant large enough to be seen by the naked eye. |
| mesotrophic | Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life. |
| MGD | Million gallons per day. |

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| mg/l | Milligrams per liter (approximately 0.00013 oz/gal). |
| NCIBI | North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody. |
| $NH_3$-N | Ammonia nitrogen. |
| nonpoint source | A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands. |
| NPDES | National Pollutant Discharge Elimination System. |
| NPS | Nonpoint source. |
| NR | Not rated. A waterbody that is not rated for use support due to insufficient data. |
| NS | Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired. |
| NSW | Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed). |
| NTU | Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions. |
| oligotrophic | Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality. |
| ORW | Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ. |
| pH | A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution. |
| phytoplankton | Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries. |

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| Piedmont | One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region. |
| PS | Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired. |
| riparian zone | Vegetated corridor immediately adjacent to a stream or river. See also SMZ. |
| river basin | The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins. |
| river system | The main body of a river, its tributary streams and surface water impoundments. |
| runoff | Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies. |
| SA | Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting. |
| SB | Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact. |
| SC | Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival. |
| sedimentation | The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms). |
| silviculture | Care and cultivation of forest trees; forestry. |
| SOC | Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOCs are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance). |
| streamside management zone (SMZ) | The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms. |
| subbasin | A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These |

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| | subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*). |
| Sw | Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of “blackwater” streams. |
| TMDL | Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards. |
| TN | Total nitrogen. |
| TP | Total phosphorus. |
| tributary | A stream that flows into a larger stream, river or other waterbody. |
| trophic classification | Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic". |
| TSS | Total Suspended Solids. |
| turbidity | An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity. |
| UT | Unnamed tributary. |
| watershed | The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin. |
| WET | Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test. |
| WS | Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV. |
| WWTP | Wastewater treatment plant. |