YADKIN-PEE DEE RIVER BASINWIDE WATER QUALITY PLAN

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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. The NC Division of Water Quality (DWQ) prepares basinwide water quality plans for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholders in the state. The first basinwide plan for the Yadkin-Pee Dee River basin was completed in 1998.

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

DWQ considered information received during five public workshops held in the basin. Discussions with local resource agency staff and citizens during draft plan development were also essential. This input, along with that received during the upcoming public meetings and comment period, will help guide continuing DWQ activities in the basin.

Goals of the Basinwide Planning Approach

The goals of DWQ's Basinwide Planning 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.

Yadkin-Pee Dee River Basin Overview

From its headwaters in northwestern North Carolina and southern Virginia, the Yadkin River flows southeast across North Carolina's densely populated midsection. The Yadkin River is impounded several times before merging with the Uwharrie River to become the Pee Dee, creating two of the largest lakes in a chain of six. Ultimately the Pee Dee River empties into the Atlantic Ocean at Winyah Bay near Georgetown and Myrtle Beach, South Carolina.

In the North Carolina portion of the Yadkin-Pee Dee River basin (roughly 50 percent of the entire watershed), 5,862 miles of freshwater streams drain 7,221 square miles of terrain. There are nearly 23,000 acres of lakes. The basin includes portions of 21 counties and 93 municipalities. Most of the basin's estimated 1.5 million people are located along the I-40 and I-85 corridors and in the areas surrounding Winston-Salem, Salisbury and Charlotte. The basin population is projected to increase 36 percent to nearly two million people by 2020.

Approximately 50 percent of the basin is forested, and more than 95 percent is in private ownership. Nearly 30 percent is used for agriculture and about 13 percent is developed. Comparisons between land use in 1982 and 1997 show significant decreases in the amount of cultivated cropland and forested land in the basin. A substantial increase in the urban/built-up land use category occurred over the 15-year period. In addition, nearly 43 percent of the increase in developed area occurred within a five-year period between 1992 and 1997.

Originating in the Blue Ridge Mountains, and draining portions of North Carolina's Piedmont, Sandhills and Coastal Plain, it is no surprise that the Yadkin-Pee Dee River basin contains a wide variety of habitat types, as well as many rare plants and animals. The large river serves as a corridor for plants and animals migrating from the mountains to the Coastal Plain, and vice-versa. The basin contains 38 aquatic species that are endangered, threatened, of special concern or significantly rare by the NC Natural Heritage Program.

Assessment of Water Quality in the Yadkin-Pee Dee River Basin

Surface waters are classified according to their best intended uses. Determining how well a waterbody supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality. Surface waters are currently rated as *Supporting* or *Impaired*. These ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and recreation) are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater) are rated Supporting if data used to determine use support meet certain criteria. However, if these criteria are not met, then the waters would be rated as Impaired. Waters with inconclusive data are listed as Not Rated. Waters lacking data are listed as No Data.

DWQ assesses ecosystem health and human health risk through the development of use support ratings for six categories: aquatic life and secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the six use support categories. For many waters, a use support category will not be applicable (N/A) to the use classification of that water (e.g., water supply is only applied to Class WS waters). This method of determining use support differs from that done prior to 2000; there is no longer an *overall* use support rating for a water.

Aquatic Life/Secondary Recreation

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (5,862.2) and lake acres (22,987.6) in the North Carolina portion of the Yadkin-Pee Dee River basin.

Approximately 37 percent of stream miles (2,181.8) and 91 percent of lake acres (21,020.1) were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle (Table 1). Impaired waters account for 17 percent of monitored stream miles and 56 percent of monitored lake acres.

Table 1 Aquatic Life/Secondary Recreation Use Support Summary (2001)

Aquatic Life/Secondary Recreation Use Support Ratings	**Monitored and Evaluated Waters***			**Monitored Waters Only****	
	Miles or Acres	**%**		**Miles or Acres**	**%**
Supporting	**2,659.4 mi 4,119.8 ac**	**45.4% 17.9%**		**1,655.3 mi 2,696.5 ac**	**75.9% 12.8%**
Impaired	**379.2 mi 11,694.4 ac**	**6.5% 50.9%**		**379.2 mi 11,694.4 ac**	**17.4% 55.6%**
Not Rated	**147.3 mi 6,629.2 ac**	**2.5% 28.8%**		**147.3 mi 6,629.2 ac**	**6.7% 31.5%**
No Data	**2,676.3 mi 544.2 ac**	**45.6% 2.4%**			
TOTAL	**5,862.2 mi 22,987.6 ac**			**2,181.8 mi 21,020.1 ac**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Fish Consumption

Like the Aquatic Life/Secondary Recreation use support category, fish consumption is also applied to all waters in the state. Fish consumption use support ratings are based on fish consumption guidelines issued by the NC Department of Health and Human Services. If a fish consumption advisory is posted at the time of the use support assessment, the water is rated Impaired.

Due to high levels of mercury in three freshwater and four saltwater fish species, the NC Division of Public Health has issued broad health advice for consumption of these fish caught south and east of Interstate 85. Therefore, High Rock Lake, Tuckertown Reservoir, Badin Lake, Falls Reservoir, Lake Tillery and Blewett Falls Lake are all Impaired in the fish consumption use support category. In addition, a specific fish consumption advisory is posted for largemouth bass from Ledbetter Lake due to elevated mercury concentrations.

Fish tissue was monitored in only 0.1 percent of stream miles (6.3) and 0.3 percent of lake acres (67.0) during this basinwide planning cycle. A basinwide summary of current fish consumption ratings is presented in Table 2.

Table 2 Fish Consumption Use Support Summary (2001)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles or Acres	%		Miles or Acres	%
Supporting	**3,224.2 mi** **1,651.9 ac**	**55.0%** **7.2%**		**0.0 mi** **0.0 ac**	**0.0%** **0.0%**
Impaired	**2,638.0 mi** **21,335.7 ac**	**45.0%** **95.8%**		**6.3 mi** **67.0 ac**	**100.0%** **100.0%**
TOTAL	**5,862.2 mi** **22,987.6 ac**			**6.3 mi** **67.0 ac**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Primary Recreation

There are 218 stream miles and 15,314 lake acres currently classified for primary recreation (Class B) in the Yadkin-Pee Dee River basin. Primary recreation use support ratings are based on swimming advisories issued by the NC Department of Health and Human Services. Currently, there is one swimming advisory posted for a portion of Elk Creek in subbasin 03-07-01.

Approximately 28 percent of stream miles (61.5) and 97 percent of lake acres (14,886.4) were monitored for the protection of primary recreation by DWQ over the past five years (Table 3). Impaired waters account for 14.5 percent of monitored stream miles.

Table 3 Primary Recreation Use Support Summary (2001)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles or Acres	%		Miles or Acres	%
Supporting	**85.9 mi** **14,886.4 ac**	**39.4%** **97.2%**		**52.4 mi** **14,886.4 ac**	**85.2%** **100.0%**
Impaired	**9.1 mi** **0.0 ac**	**4.2%** **0.0%**		**9.1 mi** **0.0 ac**	**14.5%** **0.0%**
No Data	**122.9 mi** **427.3 ac**	**56.4%** **2.8%**			
TOTAL	**217.9 mi** **15,313.7 ac**			**61.5 mi** **14,886.4 ac**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Water Supply

There are 1,655.6 stream miles and 21,549.0 lake acres currently classified for water supply (Class WS-I through WS-V) in the Yadkin-Pee Dee River basin. All were evaluated within the past five years; all are fully supporting.

Recommended Management Strategies for Restoring Impaired Waters

The long-range mission of basinwide planning is to provide a means of addressing the complex problem of planning for increased development and economic growth while maintaining, protecting and enhancing water quality and intended uses of the Yadkin-Pee Dee River basin's surface waters. Within this basinwide plan, DWQ presents management strategies and recommendations for those waters considered to be impaired or that exhibit some notable water quality problem.

Table 4 presents monitored Impaired waters in the Yadkin-Pee Dee River basin, summaries of the recommended management strategies, and location of further information in the basinwide plan.

Table 4 Monitored Impaired Waters within the Yadkin-Pee Dee River Basin (2001)

Subbasin	Impaired Water*	Category of Impairment	Potential Sources	Recommended Management Strategies	Chapter in Section B
03-07-01	Elk Creek[1, 2]	Primary Recreation	NP	DWQ will monitor again in 2003. Local initiatives are needed to address nonpoint source pollution in the watershed.	1 (pg 118)
03-07-03	Lovills Creek[2]	Aquatic Life/ Sec. Recreation	P, NP	DWQ will monitor following removal of discharge. Local initiatives are needed to address nonpoint source pollution in the watershed.	3 (pg 138)
03-07-03	Faulkner Creek[1]	Aquatic Life/ Sec. Recreation	NP	DWQ will develop a sediment TMDL and work with local agencies to reduce habitat degradation.	3 (pg 138)
03-07-03	Heatherly Creek[1]	Aquatic Life/ Sec. Recreation	NP	DWQ plans to conduct further investigation into the causes and sources of biological impairment during this basinwide planning cycle.	3 (pg 138)
03-07-04	Muddy Creek[1]	Aquatic Life/ Sec. Recreation	NP	Local initiatives are needed to address nonpoint source pollution in the watershed. Many local governments in the watershed are required to obtain stormwater permits under Phase II.	4 (pg 146)
03-07-04	Salem Creek[1, 2]	Aquatic Life/ Sec. Recreation	NP	DWQ will develop a fecal coliform TMDL and work with local agencies to reduce bacteriological contamination. Kernersville and Forsyth County will likely join Winston-Salem in the Phase II stormwater program.	4 (pg 146)
03-07-04	Grants Creek[1, 2]	Aquatic Life/ Sec. Recreation	P, NP	DWQ will work with local stakeholders to implement the EPA-approved TMDL for fecal coliform. Rowan County and Salisbury are required to obtain Phase II stormwater permits.	4 (pg 146)
03-07-04	Town Creek[2]	Aquatic Life/ Sec. Recreation	NP	DWQ plans to conduct further investigation into the causes and sources of biological impairment during this basinwide planning cycle. Rowan County and Salisbury are required to obtain Phase II stormwater permits.	4 (pg 146)
03-07-04	High Rock Lake	Aquatic Life/ Sec. Recreation	P, NP	Both point and nonpoint management strategies are discussed in more detail in the Executive Summary, beginning on page xxvii below.	4 (pg 146)
03-07-06	South Yadkin River[2]	Aquatic Life/ Sec. Recreation	P, NP	DWQ will work with the discharger to regain compliance. Local initiatives are needed to address nonpoint source pollution in the watershed.	6 (pg 167)
03-07-06	Fourth Creek[1]	Aquatic Life/ Sec. Recreation	NP	DWQ will work with local stakeholders to implement the EPA-approved TMDL for fecal coliform. Local initiatives are needed to address nonpoint source pollution in the watershed.	6 (pg 167)
03-07-06	Third Creek[1]	Aquatic Life/ Sec. Recreation	P, NP	DWQ will work with the discharger to regain compliance. DWQ will also investigate the source of color and develop an appropriate color reduction strategy during this basinwide planning cycle. Local initiatives are needed to address nonpoint source pollution in the watershed.	6 (pg 167)

Subbasin	Impaired Water*	Category of Impairment	Potential Sources	Recommended Management Strategies	Chapter in Section B
03-07-06	Second Creek[1, 2]	Aquatic Life/ Sec. Recreation		DWQ will work with the dischargers to regain compliance. Local initiatives are needed to address nonpoint source pollution in the watershed.	6 (pg 167)
03-07-07	Lake Thom-A-Lex[1]	Aquatic Life/ Sec. Recreation	NP	Local initiatives are needed to address nonpoint source pollution, including development of a nutrient reduction strategy.	7 (pg 180)
03-07-07	Abbotts Creek	Aquatic Life/ Sec. Recreation	P, NP	Implement High Rock Lake management strategy (see further discussion on page xxvii below).	7 (pg 180)
03-07-07	Rich Fork	Aquatic Life/ Sec. Recreation	P, NP	Implement High Rock Lake management strategy (see further discussion on page xxvii below). DWQ will work with the discharger to regain compliance. Additional modeling of assimilative capacity for oxygen-consuming wastes is needed. DWQ will develop a fecal coliform TMDL and work with local agencies to reduce bacteriological contamination. Many local governments in the watershed are required to obtain stormwater permits under Phase II. Local initiatives are needed to address nonpoint source pollution in the watershed.	7 (pg 180)
03-07-07	Hamby Creek[1]	Aquatic Life/ Sec. Recreation	P, NP	DWQ will develop a fecal coliform TMDL and work with local agencies to reduce bacteriological contamination. DWQ will work with the discharger to regain compliance. DWQ also plans to conduct further investigation into the causes and sources of biological impairment during this basinwide planning cycle. Local initiatives are needed to address nonpoint source pollution in the watershed. Many local governments in the watershed are required to obtain stormwater permits under Phase II.	7 (pg 180)
03-07-07	North Hamby Creek	Aquatic Life/ Sec. Recreation	NP	Further investigation is needed into the causes and sources of impairment before specific management strategies can be developed.	7 (pg 180)
03-07-07	Swearing Creek[1]	Aquatic Life/ Sec. Recreation	NP	Local initiatives are needed to address nonpoint source pollution in the watershed.	7 (pg 180)
03-07-08	Yadkin River	Aquatic Life/ Sec. Recreation	NP	DWQ will work with Yadkin Division of APGI during the FERC relicensing process to improve dissolved oxygen concentrations below High Rock dam.	8 (pg 191)
03-07-08	Lick Creek	Aquatic Life/ Sec. Recreation	P, NP	DWQ will continue to monitor Lick Creek to evaluate improvements following facility upgrade. Local initiatives are needed to address nonpoint source pollution in the watershed.	8 (pg 191)
03-07-08	Little Mountain Creek[2]	Aquatic Life/ Sec. Recreation	P, NP	DWQ plans to conduct further investigation into the causes and sources of biological impairment during this basinwide planning cycle.	8 (pg 191)
03-07-09	Uwharrie River	Aquatic Life/ Sec. Recreation	P, NP	Further investigation is needed into the causes and sources of impairment before specific management strategies can be developed.	9 (pg 199)

Subbasin	Impaired Water*	Category of Impairment	Potential Sources	Recommended Management Strategies	Chapter in Section B
03-07-09	Back Creek Lake[1]	Aquatic Life/ Sec. Recreation	NP	Local initiatives are needed to address nonpoint source pollution, including development of a nutrient reduction strategy.	9 (pg 199)
03-07-10	Pee Dee River	Aquatic Life/ Sec. Recreation	P, NP	DWQ will work with CP&L-Progress Energy during the FERC relicensing process to improve dissolved oxygen concentrations below Tillery dam. DWQ will work with the discharger to regain compliance. Permit limits for new and expanding discharges are also outlined in the plan.	10 (pg 206)
03-07-11 03-07-12	Rocky River[2]	Aquatic Life/ Sec. Recreation	P, NP	DWQ will work with local stakeholders to implement a TMDL for fecal coliform. Additional modeling of assimilative capacity for oxygen-consuming wastes is needed. Local initiatives are needed to address nonpoint source pollution, particularly from stormwater runoff.	11, 12 (pgs 213, 224)
03-07-11	Dye Branch[1, 2]	Aquatic Life/ Sec. Recreation	P, NP	Local initiatives are needed to address nonpoint source pollution in the watershed, particularly from stormwater runoff.	11 (pg 213)
03-07-11	Coddle Creek[1, 2]	Aquatic Life/ Sec. Recreation	NP	DWQ plans to conduct further investigation into the causes and sources of biological impairment during this basinwide planning cycle. Many local governments in the watershed are required to obtain stormwater permits under Phase II. Local initiatives are needed to address nonpoint source pollution in the watershed, particularly from stormwater runoff.	11 (pg 213)
03-07-12	Goose Creek[2]	Aquatic Life/ Sec. Recreation	P, NP	DWQ, in coordination with other natural resource agencies, will develop a site-specific management strategy for the watershed which provides for the maintenance and recovery of water quality conditions necessary to sustain the Carolina heelsplitter. DWQ will develop a fecal coliform TMDL and work with local agencies to reduce bacteriological contamination. Many local governments in the watershed are required to obtain stormwater permits under Phase II. Local initiatives are needed to address nonpoint source pollution in the watershed.	12 (pg 224)
03-07-12	Duck Creek[1]	Aquatic Life/ Sec. Recreation	NP	Will be included in the development of a site-specific management strategy for the Goose Creek watershed which provides for the maintenance and recovery of water quality conditions necessary to sustain the Carolina heelsplitter, as well as the fecal coliform TMDL. Local initiatives are needed to address nonpoint source pollution in the watershed.	12 (pg 224)
03-07-12	North Fork Crooked Cr[2]	Aquatic Life/ Sec. Recreation	P, NP	Further investigation is needed into the causes and sources of impairment before specific management strategies can be developed. Local initiatives are needed to address nonpoint source pollution in the watershed.	12 (pg 224)

Subbasin	Impaired Water*	Category of Impairment	Potential Sources	Recommended Management Strategies	Chapter in Section B
03-07-14	Richardson Creek[1]	Aquatic Life/ Sec. Recreation	NP	DWQ will work with DWR to address flow issues below the Lake Lee dam. Local actions are needed to reduce nutrients from all sources.	14 (pg 243)
03-07-14	Lanes Creek	Aquatic Life/ Sec. Recreation	NP	Further investigation is needed into the causes and sources of impairment before specific management strategies can be developed. Local initiatives are needed to address nonpoint source pollution in the watershed.	14 (pg 243)
03-07-16	Ledbetter Lake	Fish Consumption	NP	Work for regional solutions to mercury deposition through the Mercury Task Force and Water Quality Section Workgroup. Continue to monitor fish tissue contamination.	16 (pg 256)
03-07-16	Pee Dee River	Aquatic Life/ Sec. Recreation	NP	DWQ will work with CP&L-Progress Energy during the FERC relicensing process to improve dissolved oxygen concentrations below Blewett Falls dam.	16 (pg 256)

* These waters are currently, or will be placed, on the 303(d) list, and a TMDL and/or management strategy will be developed to address causes and sources of impairment. Refer to Appendix IV for further information regarding 303(d) listing methodology.

[1] Only limited progress towards developing and implementing nonpoint source pollution strategies for these Impaired waters can be expected without additional resources.

[2] This Impaired water lies within a NC Wetlands Restoration Program Targeted Local Watershed. Refer to page 278 of Section C for details.

Key

P = Point Sources
NP = Nonpoint Sources
TMDL = Total Maximum Daily Load (Refer to the Glossary in Appendix VII for further information.)
FERC = Federal Energy Regulatory Commission

High Rock Lake Management Strategy

Located on the mainstem of the Yadkin River in Rowan and Davidson counties, High Rock Lake is the largest and most upstream of the Yadkin-Pee Dee chain lakes. Completed in 1929, the reservoir was constructed to provide hydroelectric power and is owned and operated by Yadkin Division of Alcoa Power Generating, Inc., a wholly owned subsidiary of Alcoa, Inc. (Yadkin Division of APGI). The 3,850-square mile watershed lies within seven subbasins (03-07-01 through 03-07-07). Water quality concerns for High Rock Lake date back the mid-1970s, and the need for nutrient reduction strategies to address problems due to accelerated eutrophication has been apparent since the mid-1990s.

Increased monitoring of High Rock Lake over the most recent assessment period has allowed DWQ to determine that the lake is Impaired. The decision is based on high levels of nutrients, combined with chlorophyll *a*, turbidity and percent dissolved oxygen saturation in excess of state standards. Low dissolved oxygen and high turbidity in the Abbotts Creek and Crane Creek Arms are also contributing to aquatic life impairment.

The current NPDES permits for the High Point Westside WWTP, Thomasville WWTP and Lexington WWTP outline mass-based summer and winter discharge limits for total phosphorus, which will be required beginning in 2004. No new NPDES permitted discharges will be permitted into the Abbotts, Swearing, Grants and Crane Creek arms of High Rock Lake. No increase in loading will be permitted for existing NPDES discharges into these same arms. Other existing discharges (in addition to the three major discharges mentioned above) will receive notification that discharge limits for total phosphorus may be required in the future.

Due to adverse dissolved oxygen concentrations in High Rock Lake, further investigation is warranted. Development of both a nutrient response model and a watershed loading model will assist in assessing water quality in High Rock Lake. DWQ staff will begin reviewing existing monitoring locations, frequency and parameters in preparation for designing a TMDL field study for High Rock Lake and the upper Yadkin River basin. DWQ will focus on developing and conducting the field study during this basinwide planning cycle. The field study will likely require 18 months to complete. The Yadkin-Pee Dee River Basin Association (details on page 296) has expressed interest in modeling the High Rock Lake watershed. DWQ will continue to work with the association to understand and manage this complex watershed.

DWQ will continue to place priority on developing TMDLs for streams in the High Rock Lake watershed. TMDLs for fecal coliform in the Fourth Creek and Grants Creek watersheds have been approved by the USEPA, and in the case of Fourth Creek, plans to implement the TMDL are being developed. Fecal coliform TMDLs are underway in the Salem Creek and Rich Fork watersheds as well. Srategies used to reduce fecal coliform concentrations in these watersheds will also help reduce nutrient and sediment loading to the upper portion of the basin, and ultimately High Rock Lake.

In addition, DWQ will work more closely with other agencies that set priorities for nonpoint source pollution reduction in the Yadkin-Pee Dee River basin, such as the NC Wetlands Restoration Program, NC Division of Soil and Water Conservation and USDA Natural

Resources Conservation Service, to get funding for best management practices targeted towards the High Rock Lake watershed.

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. 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 2,830 miles and 388,000 acres of Impaired waters on the draft 2002 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.

Strategies for Addressing Notable Water Quality Impacts in Unimpaired Waters

Often during DWQ's use support assessment, water quality concerns are documented for waters that are Supporting designated uses. While these waters are not considered Impaired, they are discussed so that attention and resources can be focused on these waters over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. These discussions are found in Part 5.5 of each subbasin chapter in Section B.

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. DWQ plans to notify local agencies and others of water quality concerns for both impaired and unimpaired waters in the Yadkin-Pee Dee River basin and work with them to conduct further monitoring and to locate sources of water quality protection funding for these unimpaired waters. 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 NC Wetlands Restoration Program, and the federally funded Environmental Quality Incentives Program.

With increased development occurring, there will be significant challenges ahead in balancing economic growth with the protection of water quality in this mountainous basin. 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

Section A: 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 (DWQ) for each of the 17 major river basins in the state, as shown in Figure A-1 and Table A-1. Preparation of an individual basinwide water quality plan is a five-year process, which is broken down into three 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 entail the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first cycle of plans was completed in 1998, but each plan is updated at five-year intervals.

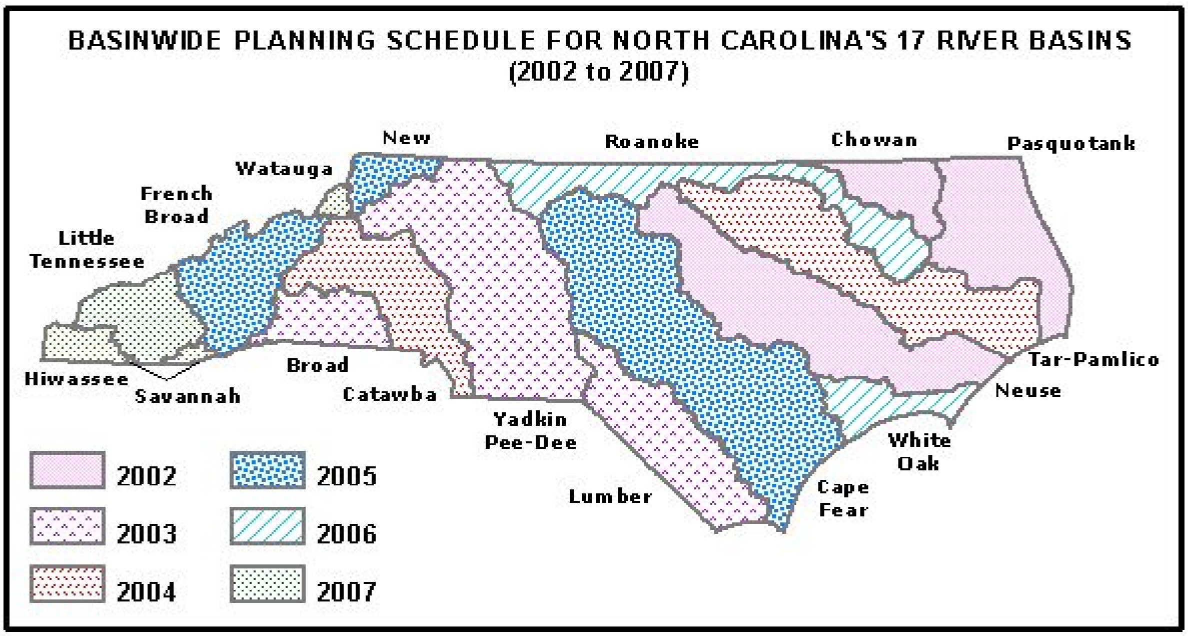


Figure A-1 Basinwide Planning Schedule (2002 to 2007)

1.2 Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

- identify water quality problems and restore full use to Impaired waters;
- identify and protect high value resource waters;
- protect unimpaired waters 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 Basinwide Planning Schedule (2000 to 2007)

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
Chowan	Summer 2000	3/2001	5/2002	7/2002	11/2002
Pasquotank	Summer 2000	3/2001	5/2002	7/2002	12/2002
Neuse	Summer 2000	6/2001	5/2002	7/2002	1/2003
Broad	Summer 2000	11/2001	11/2002	2/2003	7/2003
Yadkin-Pee Dee	**Summer 2001**	**4/2002**	**1/2003**	**3/2003**	**9/2003**
Lumber	Summer 2001	12/2002	9/2003	12/2003	7/2004
Tar-Pamlico	Summer 2002	3/2003	12/2003	3/2004	9/2004
Catawba	Summer 2002	6/2003	3/2004	6/2004	12/2004
French Broad	Summer 2002	11/2003	11/2004	2/2005	9/2005
New	Summer 2003	4/2004	5/2005	9/2005	3/2006
Cape Fear	Summer 2003	5/2004	4/2005	8/2005	4/2006
Roanoke	Summer 2004	4/2005	4/2006	8/2006	2/2007
White Oak	Summer 2004	10/2005	7/2006	9/2006	7/2007
Savannah	Summer 2004	10/2005	12/2006	2/2007	8/2007
Watauga	Summer 2004	10/2005	12/2006	2/2007	9/2007
Hiwassee	Summer 2004	10/2005	12/2006	2/2007	8/2007
Little Tennessee	Summer 2004	3/2006	12/2006	2/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the first cycle (1993 to 1998).

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

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

1.3 Major Components of the Basinwide Plan

The second cycle 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 equitability*. 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 three opportunities for the public to participate in the planning 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 basin planner for your river basin.

1.6 Other References

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

- *Yadkin-Pee Dee River Basinwide Assessment Report*. June 2002. This technical report presents physical, chemical and biological data collected in the basin. 317 pages.
- *Yadkin-Pee Dee River Basinwide Water Quality Management Plan*. May 1998. This first basinwide plan for the Yadkin-Pee Dee River basin presents water quality data, information and recommended management strategies for the first five-year cycle. 396 pages.
- *A Citizen's Guide to Water Quality Management in North Carolina*. August 2000. This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. 156 pages.
- *NC Basinwide Wetlands and Riparian Restoration Plan for the Yadkin-Pee Dee River Basin*. August 1998. NC Wetlands Restoration Program. 75 pages.
- *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 Division of Water Quality Basinwide Planning website at http://h2o.enr.state.nc.us/. Click on Water Quality Section and then, under Programs, click on Basinwide Planning Program.
- NC Division of Water Quality Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/.

Anyone interested in receiving these documents can contact the
DWQ Planning Branch at (919) 733-5083 or by internet:
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. Additional information can be found on the Division of Water Quality website at http://h2o.enr.state.nc.us/.

WATER QUALITY SECTION
(Chief)

Point Source Branch
(Phone 919-733-5083, ext. 520)

- NPDES Permits
- Stormwater and General Permits
- Point Source Compliance/Enforcement
- Pretreatment

Environmental Sciences Branch
(Phone 919-733-9960)

- Biological Monitoring
- Special Chemical Monitoring
- Fish Tissue, Fish Community Studies
- Effluent Toxicity Testing
- Lake Assessments
- Ambient Monitoring

Non-Discharge Branch
(Phone 919-733-5083, ext. 556 or 574)

- Non-Discharge Permitting (spray irrigation, sludge applications, animal waste recycling)
- Wetlands/401 Certifications
- Non-Discharge Compliance/Enforcement
- Operator Certification Training

Planning Branch
(Phone 919-733-5083, ext. 558)

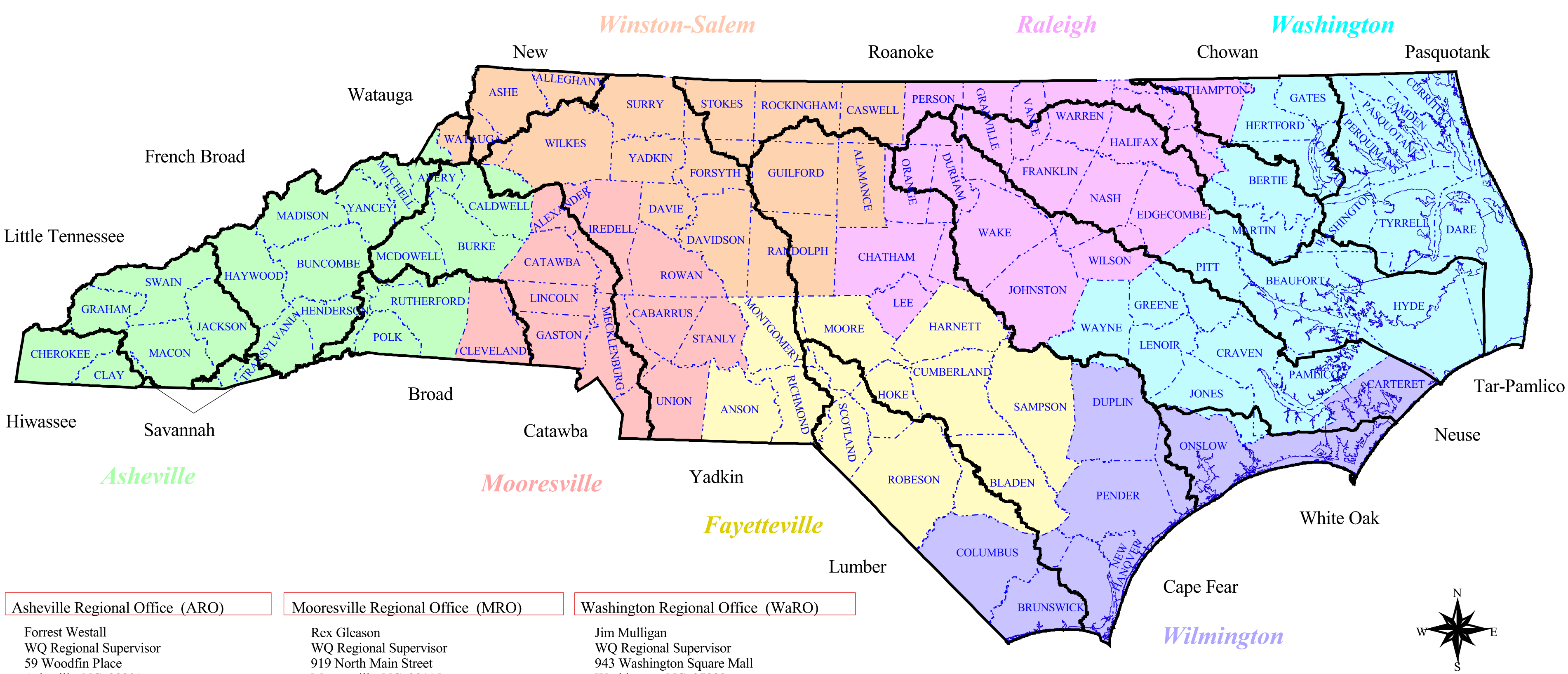
- Water Quality Standards/Classifications
- Nonpoint Source Program Planning
- Basinwide Planning, Use Support
- Modeling/TMDL Development
- Local Government Assistance

Regional Offices: Asheville, Raleigh, Fayetteville, Wilmington, Mooresville, Washington, Winston-Salem
(See Regional Office map for phone nos.)

- Wetland Reviews, Ambient Monitoring Program
- Permit Reviews, Facility Inspections
- Pretreatment Program Support
- Response to Emergencies/Complaints
- Provides Information to Public

Figure A-2 Water Quality Section Organization Structure

Figure A-3 North Carolina Department of Environment and Natural Resources Division of Water Quality Regional Offices



Asheville Regional Office (ARO)

Forrest Westall
WQ Regional Supervisor
59 Woodfin Place
Asheville, NC 28801
COURIER 12-59-01
Phone: (828) 251-6208
Fax: (828) 251-6452

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

Mooresville Regional Office (MRO)

Rex Gleason
WQ Regional Supervisor
919 North Main Street
Mooresville, NC 28115
COURIER 09-08-06
Phone: (704) 663-1699
Fax: (704) 663-6040

Alexander	Lincoln
Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

Washington Regional Office (WaRO)

Jim Mulligan
WQ Regional Supervisor
943 Washington Square Mall
Washington, NC 27889
COURIER 16-04-01
Phone: (252) 946-6481
Fax: (252) 946-9215

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

Winston-Salem Regional Office (WSRO)

Larry Coble
WQ Regional Supervisor
585 Waughtown Street
Winston-Salem, NC 27107
COURIER 13-15-01
Phone: (336) 771-4600
Fax: (336) 771-4630

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

Central Office

DENR
DIVISION OF WATER QUALITY
WATER QUALITY SECTION
1617 MAIL SERVICE CENTER
RALEIGH NC 27699-1617
COURIER 52-01-00
Phone: (919) 733-5083
Fax: (919) 733-9919

Fayetteville Regional Office (FRO)

Paul Rawls
WQ Regional Supervisor
225 Green Street
Suite 714 / Systel Building
Fayetteville, NC 28301-5043
COURIER 14-56-25
Phone: (910) 486-1541
Fax: (910) 486-0707

Anson	Moore
Bladen	Richmond
Cumberland	Robeson
Harnett	Sampson
Hoke	Scotland
Montgomery	

Raleigh Regional Office (RRO)

Ken Schuster
WQ Regional Supervisor
3800 Barrett Drive
Raleigh, NC 27609
INTEROFFICE
Phone: (919) 571-4700
Fax: (919) 571-4718

Chatham	Johnston	Vance
Durham	Lee	Wake
Edgecombe	Nash	Warren
Franklin	Northampton	Wilson
Granville	Orange	
Halifax	Person	

Wilmington Regional Office (WiRO)

Rick Shiver
WQ Regional Supervisor
127 Cardinal Drive Extension
Wilmington, NC 28405-2845
COURIER 04-16-33
Phone: (910) 395-3900
Fax: (910) 350-2004

Brunswick	New Hanover
Carteret	Onslow
Columbus	Pender
Duplin	

NCDENR

Planning Branch
Planning & Assessment Unit
September 1, 1999

Section A: Chapter 2
Yadkin-Pee Dee River Basin Overview

2.1 General Overview

From its headwaters in northwestern North Carolina and southern Virginia, the Yadkin River flows southeast across North Carolina's densely populated midsection. Three of the state's five interstate highways cross the upper half of the basin, carrying people and goods between some of the state's major municipalities including Winston-Salem, Statesville, Lexington, Salisbury, Kannapolis and Concord. The Yadkin River is impounded several times before merging with the Uwharrie River to become the Pee Dee, creating two of the largest lakes in a chain of six. Ultimately the Pee Dee River empties into the Atlantic Ocean at Winyah Bay near Georgetown and Myrtle Beach, South Carolina. Figure A-4 presents the entire Yadkin-Pee Dee River basin, including the Yadkin-Pee Dee and Lumber River basins in North Carolina and the Pee Dee River basin in South Carolina.

Yadkin-Pee Dee River Basin Statistics (NC Portion)

Total Area: 7,221 sq. miles
Stream Miles: 5,862
Lake Acres: 22,988
No. of Counties: 21
No. of Municipalities: 93
No. of Subbasins: 17
Population (2000): 1,463,535*
Estimated Pop. (2020): 1,990,838*
% Increase (2000-2020): 36%
Pop. Density (1990): 163 persons/sq. mi.

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

The North Carolina portion of the basin (Figure A-5) includes portions of 21 counties and 93 municipalities. Most of the basin's estimated 1.5 million people are located along the I-40 and I-85 corridors and in the areas surrounding Winston-Salem, Salisbury and Charlotte. The basin population is projected to increase 36 percent to nearly two million people by 2020.

Approximately 50 percent of land in the basin is forested, and more than 95 percent is in private ownership. Nearly 30 percent is used for agriculture, including cultivated and uncultivated cropland (15.6 percent) and pastureland (14.1 percent). About 13 percent of the land is developed. Comparisons between land use in 1982 and 1997 show significant decreases in the amount of cultivated cropland and forested land in the basin. There were notable increases in the amount of uncultivated cropland and pastureland. However, a substantial increase in the urban/built-up land use category occurred over the 15-year period. In addition, nearly 43 percent of the increase in developed area occurred within a five-year period between 1992 and 1997.

Originating in the Blue Ridge Mountains, and draining portions of North Carolina's Piedmont, Sandhills and Coastal Plain, it is no surprise that the Yadkin-Pee Dee River basin contains a wide variety of habitat types, as well as many rare plants and animals. The large river serves as a corridor for plants and animals migrating from the mountains to the Coastal Plain, and vice-versa. The basin contains 38 aquatic species that are endangered, threatened, of special concern or significantly rare by the NC Natural Heritage Program.

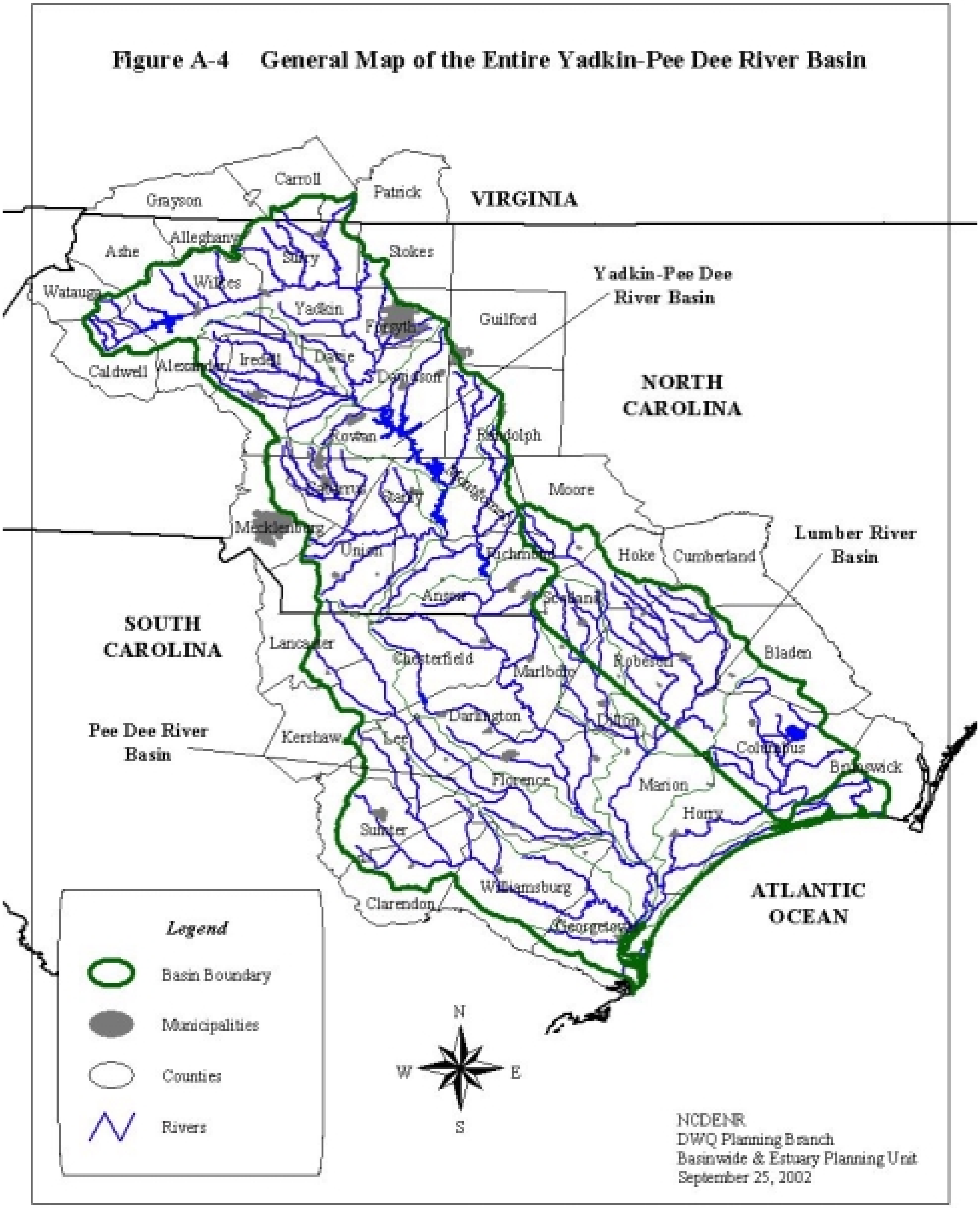
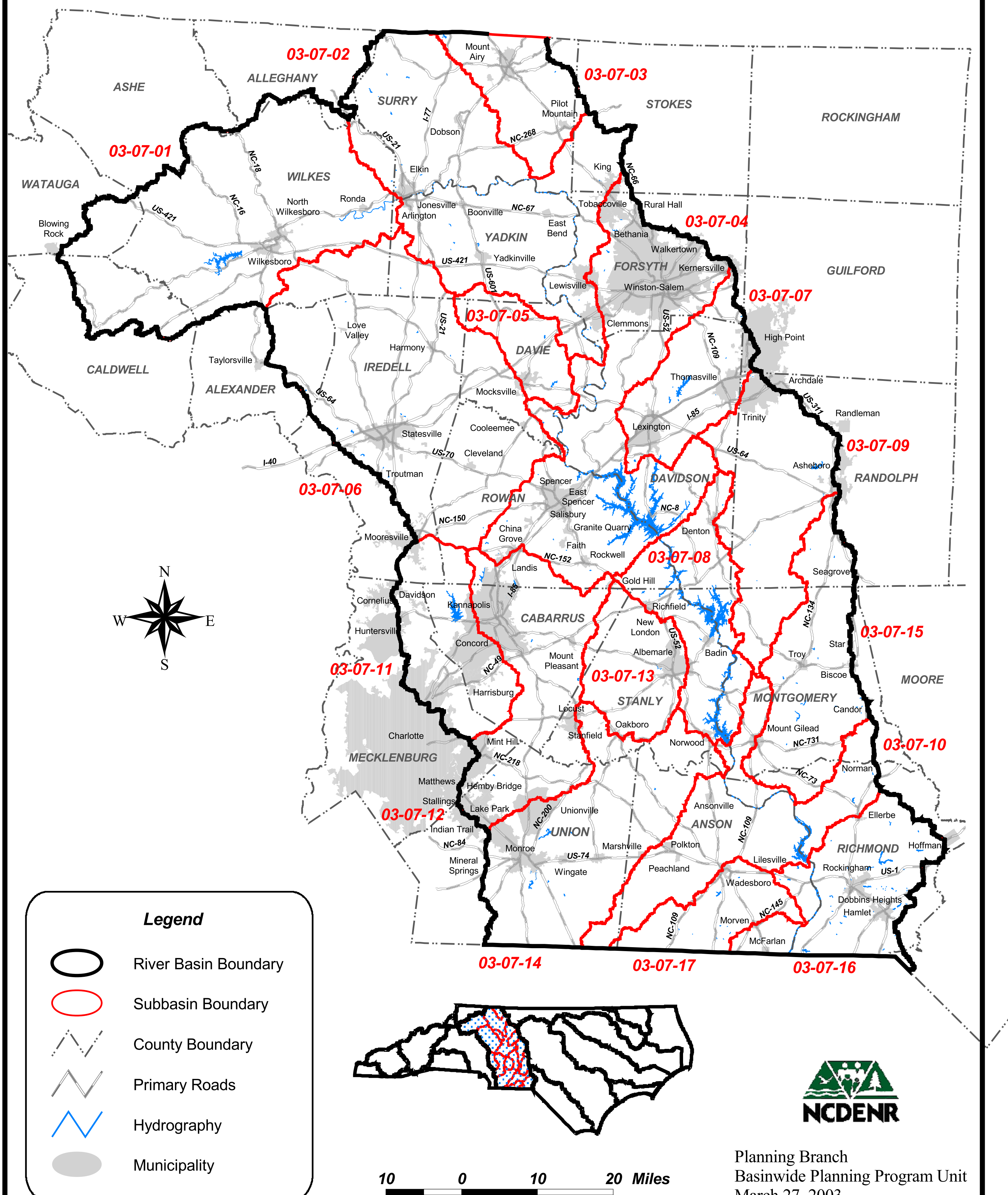


Figure A-4 General Map of the Entire Yadkin-Pee Dee River Basin

Figure A-5 General Map of the Yadkin-Pee Dee River Basin in North Carolina



Legend

- River Basin Boundary
- Subbasin Boundary
- County Boundary
- Primary Roads
- Hydrography
- Municipality

NCDENR

Planning Branch
Basinwide Planning Program Unit
March 27, 2003

2.2 Local Governments and Planning Jurisdictions in the Basin

The North Carolina portion of the Yadkin-Pee Dee River basin encompasses all or portions of 93 municipalities and 21 counties. Table A-3 provides a listing of these local governments, along with the appropriate regional planning jurisdiction (Council of Governments). Twenty-five municipalities are located in more than one major river basin.

Table A-3 Local Governments and Planning Units within the Yadkin-Pee Dee River Basin

County	Region	Municipalities
Alexander	E	Taylorsville ♦
Alleghany	D	None
Anson	H	Ansonville, Lilesville, McFarlan, Morven, Peachland, Polkton, Wadesboro
Cabarrus	F	Concord, Harrisburg, Kannapolis *, Locust *, Mount Pleasant
Caldwell	E	Blowing Rock * ♦
Davidson	G	Denton, High Point * ♦, Lexington, Thomasville *
Davie	I	Bermuda Run, Cooleemee, Mocksville
Forsyth	I	Bethania, Clemmons, High Point * ♦, Kernersville * ♦, King *, Lewisville, Rural Hall ♦, Tobaccoville *, Walkertown ♦, Winston-Salem
Guilford	G	Archdale * ♦, High Point * ♦, Kernersville * ♦
Iredell	F	Davidson * ♦, Harmony, Love Valley, Mooresville ♦, Statesville, Troutman ♦
Mecklenburg	F	Charlotte ♦, Cornelius ♦, Davidson * ♦, Huntersville ♦, Matthews ♦, Mint Hill ♦
Montgomery	H	Biscoe ♦, Candor ♦, Mount Gilead, Star ♦, Troy
Randolph	G	Archdale * ♦, Asheboro ♦, High Point * ♦, Randleman ♦, Seagrove ♦, Thomasville *, Trinity
Richmond	H	Dobbins Heights, Ellerbe, Hamlet, Hoffman ♦, Norman ♦, Rockingham
Rowan	F	China Grove, Cleveland, East Spencer, Faith, Granite Quarry, Kannapolis *, Landis, Rockwell, Salisbury, Spencer
Stanly	F	Albemarle, Badin, Locust *, New London, Norwood, Oakboro, Richfield, Stanfield
Stokes	I	King *, Tobaccoville *
Surry	I	Dobson, Elkin *, Mount Airy, Pilot Mountain
Union	F	Hemby Bridge, Indian Trail ♦, Lake Park, Marshville, Monroe, Stallings ♦, Unionville, Wingate
Watauga	D	Blowing Rock * ♦
Wilkes	D	Elkin *, North Wilkesboro, Ronda, Wilkesboro
Yadkin	I	Arlington, Boonville, East Bend, Jonesville, Yadkinville

* Located in more than one county.

♦ Located in more than one major river basin.

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2 percent) is located in that basin, unless a municipality is located in that county. (Note: Guilford County is only included because of the municipalities, Archdale, High Point and Kernersville.)

Region	Name	Location
D	Region D Council of Governments	Boone
E	Western Piedmont Council of Governments	Hickory
F	Centralina Council of Governments	Charlotte
G	Piedmont Triad Council of Governments	Greensboro
H	Pee Dee Council of Governments	Rockingham
I	Northwest Piedmont Council of Governments	Winston-Salem

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey and the Natural Resources Conservation Service, use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under the federal system, the Yadkin-Pee Dee River basin is made up of seven hydrologic areas referred to as hydrologic units. These include the Upper Yadkin River, South Yadkin River, Lower Yadkin River, Upper Pee Dee River, Rocky River, Lower Pee Dee River and Lynches River. Each hydrologic unit is defined by an 8-digit number (USDA, November 1995). DWQ has a two-tiered system in which the state is subdivided into river basins with each basin further subdivided into subbasins. Table A-4 compares the two systems. The Yadkin-Pee Dee River basin in North Carolina is subdivided by DWQ into 17 subbasins. Maps of each subbasin are included in Section B.

Table A-4 Hydrologic Subdivisions in the Yadkin-Pee Dee River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ Subbasin 6-digit Codes
Upper Yadkin River	03040101	
Stoney Fork, Reddies Creek and Roaring River		03-07-01
Mitchell River, Fisher River and South Deep Creek		03-07-02
Ararat River		03-07-03
Muddy Creek and South Fork Muddy Creek		03-07-04
Dutchman Creek		03-07-05
South Yadkin River	03040102	
Hunting Creek, Fourth Creek, Third Creek and Second Creek		03-07-06
Lower Yadkin River	03040103	
High Rock Lake and Grants Creek		03-07-04
Abbotts Creek, Rich Fork and Hamby Creek		03-07-07
Lower Yadkin River		03-07-08
Uwharrie River and Caraway Creek		03-07-09
Upper Pee Dee River	03040104	
Badin Lake and Lake Tillery		03-07-08
Blewett Falls Lake, Brown Creek and Mountain Creek		03-07-10
Little River		03-07-15
Rocky River	03040105	
Coddle Creek		03-07-11
Dutch Buffalo Creek and Irish Buffalo Creek		03-07-12
Big Bear Creek and Long Creek		03-07-13
Richardson Creek		03-07-14
Lower Pee Dee River	03040201	
Hitchcock Creek		03-07-16
Jones Creek		03-07-17
Lynches River	03040202	
Lanes Creek		03-07-14

In the North Carolina portion of the Yadkin-Pee Dee River basin (roughly 50 percent of the entire watershed), 5,862 miles of freshwater streams drain 7,221 square miles of terrain. The uppermost portion of the basin (western part of Wilkes and Caldwell counties in subbasin 03-07-01) lies in the Blue Ridge Physiographic Region. The Blue Ridge region is a mountainous area of steep ridges, inter-mountain basins and valleys that intersect at all angles. A larger number of streams drain smaller areas of land in this region compared with the Piedmont and Coastal Plain regions of the state.

The vast majority of the Yadkin-Pee Dee River basin in North Carolina lies in the Piedmont Physiographic Region; and likewise, a large portion of North Carolina's Piedmont region is within the Yadkin-Pee Dee River basin boundary. This region is characterized by rolling hills and geologic formations consisting of crystalline or sedimentary rocks. Because of the moderate topography, more streams drain a smaller amount of land, creating moderate drainage density.

Part of the southeastern corner of the basin (Richmond and Montgomery counties in subbasins 03-07-10, 03-07-15 and 03-07-16) lies in the Inner Coastal Plain Physiographic Region. The geology of this area consists of alternating layers of sand, silt, clay and limestone. In this portion of the basin, the land is relatively flat. The slope dips downward at a rate of only a few feet per mile. A smaller number of streams drain a large area of land in the Coastal Plain region.

In addition to low drainage density, the lower portion of the basin also has the lowest potential for sustaining base flow in streams. The low flow frequency, measured by a 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded 9 out of 10 years) flow calculation, is zero for all but the largest drainages. This very low flow over the warmest months of the year limits streams' ability to maintain high dissolved oxygen levels (increased temperature depletes dissolved oxygen while decreased velocity inhibits reaeration). The capacity for assimilating oxygen-consuming wastes is also limited under these conditions. DWQ limits discharges containing oxygen-consuming wastes into these low base flow streams (refer to page 103 for further information).

Hydrologic Features

Six major reservoirs help make up the mainstem of the Yadkin-Pee Dee River in North Carolina. They are known as the Yadkin Chain Lakes: High Rock Lake, Tuckertown Reservoir, Badin Lake (Narrows), Falls Reservoir, Lake Tillery and Blewett Falls Lake. Yadkin Division of APGI manages the first four of these reservoirs, while Carolina Power and Light (CP&L) manages the lower two. All six dams contain hydroelectric power generation capabilities. There is also a small reservoir in the upper part of the Yadkin River that is managed by the US Army Corps of Engineers: Kerr Scott Reservoir. The way in which all of these reservoirs are managed influences the quality of water in the Yadkin and Pee Dee Rivers.

In addition to these major mainstem reservoirs, there are an abundance of smaller reservoirs on tributaries to the Yadkin-Pee Dee throughout the basin. The majority of these lakes were constructed to store water for drinking water supply. Some statistics for lakes that are monitored by DWQ are provided in Table A-5.

Table A-5 Statistics for Major Lakes in the Yadkin-Pee Dee River Basin

Subbasin/ Lake	County	Classification*	Surface Area (ac)	Mean Depth (ft)	Volume (x 10^6 m^3)	Watershed (mi^2)
03-07-01						
Kerr Scott Reservoir	Wilkes	WS-IV B Tr	1,450	39	189	348
03-07-04						
Winston Lake	Forsyth	C	25	8	0.03	7
Salem Lake	Forsyth	WS-III	360	18	0.8	26
High Rock Lake	Rowan/Davidson	WS-IV B	15,180	16	314	3,929
Lake Wright	Rowan	WS-II HQW	29	10	0.3	2
Lake Corriher	Rowan	WS-IV	17	8	0.2	2
03-07-07						
Lake Thom-A-Lex	Davidson	WS-III	650	26	7.8	39
03-07-08						
Tuckertown Reservoir	Rowan/Davidson	WS-IV B	2,550	99	289	4,210
Badin Lake	Stanly/Montgomery	WS-IV B	5,350	46	344	4,116
Lake Tillery	Stanly/Montgomery	WS-IV B	5,261	23.6	165.6	4,834
03-07-09						
McCrary Lake	Randolph	WS-II HQW	15	10	0.9	1
Lake Bunch	Randolph	WS-II HQW	30	10	0.04	2
Back Creek Lake	Randolph	WS-II HQW	250	13	5	16
Lake Reese	Randolph	WS-III	600	16	0.9	100
03-07-10						
Blewett Falls Lake	Anson/Richmond	WS-IV B	2,570	10.8	38.1	6,784
03-07-12						
Kannapolis Lake	Rowan	WS-III	289	16	5.2	11
Lake Fisher	Cabarrus	WS-IV	277	15	0.01	78
Lake Concord	Cabarrus	WS-IV	131	12	1.3	4
03-07-14						
Lake Monroe	Union	WS-IV	140	18	1.8	9
Lake Lee	Union	WS-IV	125	5	9.5	51
Lake Twitty (Stewart)	Union	WS-III	82	18	7.6	36
03-07-16						
Roberdel Lake	Richmond	WS-III	99	10	10	140
Rockingham City Lake	Richmond	WS-III	27	2	0.02	20
Hamlet City Lake	Richmond	C	100	3	0.04	10
Water Lake	Richmond	WS-II HQW	47	10	0.06	20
03-07-17						
Wadesboro City Pond	Anson	WS-II HQW	100	8	0.1	9

* An index for DWQ freshwater classifications can be found on page 54 of this section (Table A-20).

2.4 Land Cover

Land cover information in this section is from the most recent National Resources Inventory (NRI), as developed by the Natural Resources Conservation Service (USDA, updated June 2001). The NRI is a statistically based longitudinal survey that has been designed and implemented to assess conditions and trends of soil, water and related resources on the Nation's nonfederal rural lands. The NRI provides results that are nationally and temporally consistent for four points in time -- 1982, 1987, 1992 and 1997.

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

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

Table A-6 summarizes acreage and percentage of land cover from the 1997 NRI for the North Carolina portion of the basin and for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the coverages to 1982 land cover provided for a comparison of change over 15 years.

Table A-6 Land Cover in the Yadkin-Pee Dee River Basin by Major Watersheds - 1982 vs. 1997 (Source: USDA-NRCS, NRI, updated June 2001)

	MAJOR WATERSHED AREAS																		
	Upper Yadkin River		South Yadkin River		Lower Yadkin River		Upper Pee Dee River		Rocky River		Lower Pee Dee River		Lynches River		1997 TOTALS		1982 1TOTALS		% change since 1982
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	
Cult. Crop	173.0	11.4	86.3	15.4	70.5	9.3	38.5	7.2	166.2	19.4	34.6	11.7	4.2	18.2	573.3	12.6	903.9	19.7	-36.6
Uncult. Crop	62.4	4.1	34.7	6.2	9.7	1.3	1.8	0.3	21.3	2.5	7.0	2.4	0.0	0.0	136.9	3.0	91.3	2.0	49.9
Pasture	214.6	14.2	115.9	20.6	107.8	14.3	30.5	5.7	151.1	17.7	18.9	6.4	2.4	10.4	641.2	14.1	552.6	12.0	16.0
Forest	797.3	52.7	238.2	42.4	354.2	46.8	380.2	71.0	292.9	34.2	194.7	66.0	13.0	56.3	2270.5	50.0	2378.7	51.7	-4.5
Urban & Built-Up	167.4	11.1	57.3	10.2	121.9	16.1	31.2	5.8	173.9	20.3	26.7	9.1	2.4	10.4	580.8	12.8	354.3	7.7	63.9
Federal	10.9	0.7	0.0	0.0	35.8	4.7	21.7	4.1	0.0	0.0	0.0	0.0	0.0	0.0	68.4	1.5	67.4	1.5	1.5
Other	86.5	5.7	29.8	5.3	56.5	7.5	31.6	5.9	50.4	5.9	13.1	4.4	1.1	4.8	269.0	5.9	250.6	5.4	7.3
Totals	1512.1	100.0	562.2	100.0	756.4	100.0	535.5	100.0	855.8	100.0	295.0	100.0	23.1	100.0	4540.1	100.0	4598.8	100.0	
% of Total Basin		32.9		12.2		16.4		11.6		18.6		6.4		0.5		98.7			
SUBBASINS	03-07-01 03-07-02 03-07-03 03-07-04 03-07-05		03-07-06		03-07-04 03-07-07 03-07-08 03-07-09		03-07-08 03-07-10 03-07-15		03-07-11 03-07-12 03-07-13 03-07-14		03-07-16 03-07-17		03-07-14						
8-Digit Hydraulic Units	03040101		03040102		03040103		03040104		03040105		03040201		03040202						

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

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI, updated June 2001.

Fifty percent of land in the basin is forested, and more than 95 percent is in private ownership. Nearly 30 percent is used for agriculture, including cultivated and uncultivated cropland (15.6 percent) and pastureland (14.1 percent). Approximately 13 percent of the land is developed. A description of land cover types, including the "Other" category, to which 6 percent of land in the basin is assigned, can be found in Table A-7.

Table A-7 Description of Land Cover Types
(Source: USDA-NRCS, NRI, updated June 2001)

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; 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). *Small Water Areas*: Waterbodies less than 40 acres in size and streams less than one-half mile wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width. *Minor Land*: Lands not in one of the other categories.

Figure A-6 presents changes in land cover between 1982 and 1997. Comparisons show significant decreases in the amount of cultivated cropland (-330,600 acres) and forested land (-108,200 acres) in the basin. There were notable increases in the amount of uncultivated cropland (+45,600 acres) and pastureland (+88,600 acres). However, a substantial increase (+226,500 acres) in the urban/built-up land use category occurred over the 15-year period. In addition, nearly 43 percent (+96,600 acres) of this increase in developed area occurred within a five-year period between 1992 and 1997.

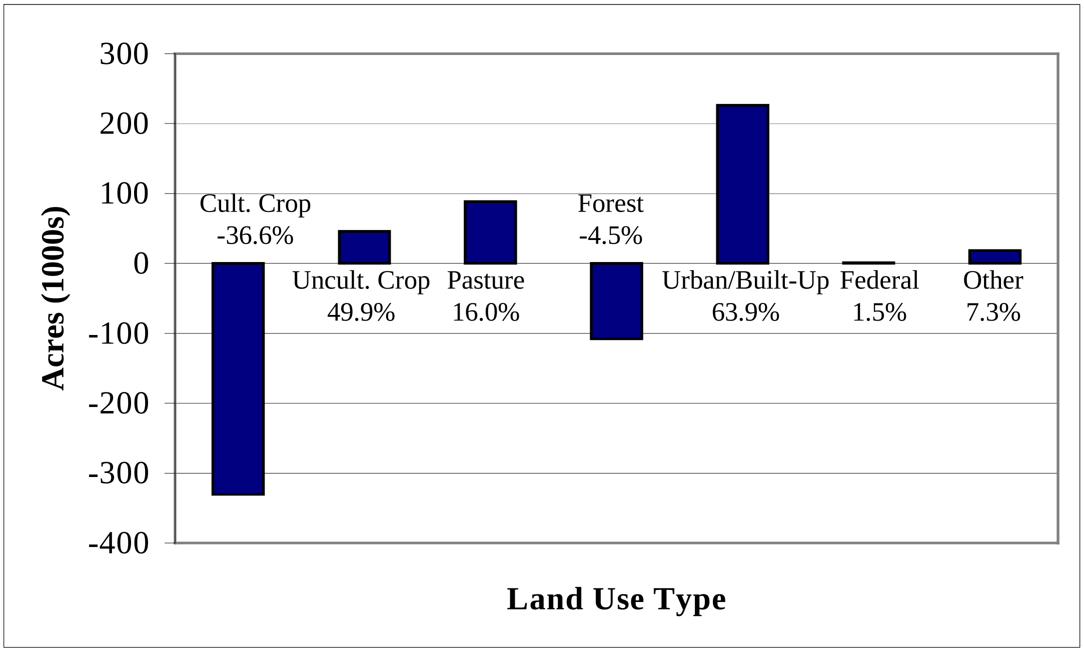


Figure A-6 Land Cover Changes from 1982 to 1997 for the Yadkin-Pee Dee River Basin (Source: USDA-NRCS, NRI, updated June 2001)

Land cover information for the Yadkin-Pee Dee River basin, based on satellite imagery collected from the North Carolina Corporate Geographic Database, is also available. The state's Center for Geographic Information and Analysis (CGIA) developed statewide land cover information based on this 1993-1995 satellite imagery. These land cover data are divided into 24 categories. For the purposes of this report, those categories have been condensed into five broader categories as described in Table A-8. An important distinction between this land cover dataset and that of the NRI is that there is no actual groundtruthing of the satellite-generated data.

Table A-8 Description of Major CGIA 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.

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not currently possible to establish trends in land cover changes by comparing this data set to previously attained land cover data. However, it is anticipated that comparisons will be possible with future satellite data since a strong consensus-based effort was made to develop the classification system that was used with the 1993-1995 data.

Figure A-7 provides an illustration of the relative amount of land area that falls into each major cover type for the Yadkin-Pee Dee River basin. Section B of this plan provides land cover data specific to each subbasin.

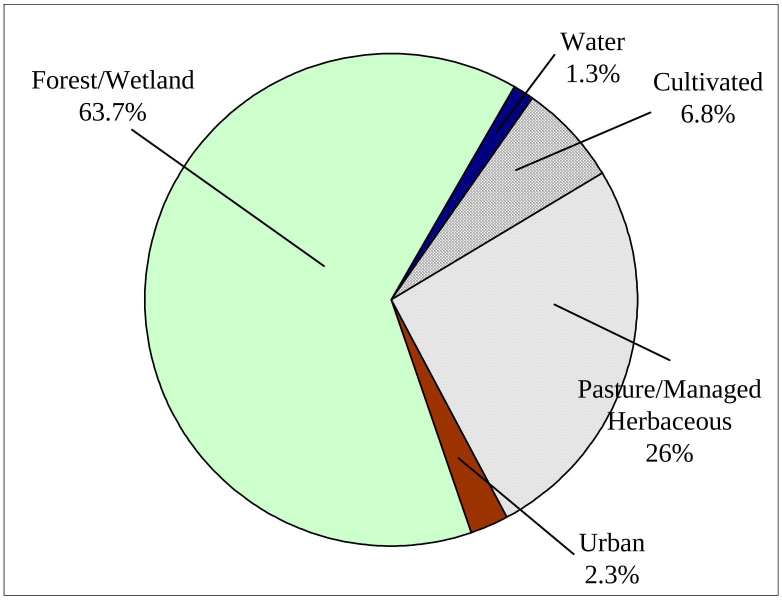


Figure A-7 Percentages within Major CGIA Land Cover Categories in the Yadkin-Pee Dee River Basin

2.5 Population and Growth Trends

Population

Following the 1990 census, North Carolina population data were compared with subbasin boundaries in an attempt to better estimate actual river basin population. Based on this comparison, the Yadkin-Pee Dee River basin had an estimated population of 1,193,353. Table A-9 presents census data, by subbasin, for 1970, 1980 and 1990 census data. It also includes population densities (persons/square mile) based on *land area* (excludes open water) for each subbasin. Approximately 63 percent of the basin's population is located in the upper portion of the basin draining into High Rock Lake, which comprises only 50 percent of total land area of the basin. The Rocky River watershed (subbasins 03-07-11 through 03-07-14) contains the majority of the population in the lower portion of the basin.

Table A-9 Yadkin-Pee Dee River Subbasin Population, Densities (1970, 1980, 1990) and Land Area Summaries

	POPULATION [1] (Number of Persons)			**POPULATION DENSITY [2] (Persons/Square Mile)**			**LAND AND WATER AREAS [3]**			
							Total Land and Water Area		**Water Area**	**Land Area**
SUBBASIN	**1970**	**1980**	**1990**	**1970**	**1980**	**1990**	**(Acres)**	**(Sq. Miles)**	**(Sq. Miles)**	**(Sq. Miles)**
03-07-01	51,090	60,347	62,655	62	73	76	530,783	830	3	827
03-07-02	63,657	81,690	90,781	78	100	111	526,384	822	4	818
03-07-03	31,796	36,036	36,299	161	182	183	126,786	198	0	198
03-07-04	263,246	286,610	325,945	372	405	461	467,120	730	23	707
03-07-05	8,455	10,705	11,800	65	82	91	83,485	130	0	130
03-07-06	78,567	88,267	94,594	87	97	104	580,680	907	1	906
03-07-07	88,845	95,844	101,019	376	406	428	151,885	237	1	236
03-07-08	15,392	19,942	18,811	56	72	68	188,280	294	17	277
03-07-09	29,482	32,081	41,702	77	83	108	248,198	388	3	385
03-07-10	15,015	17,510	15,397	38	44	38	260,499	407	7	400
03-07-11	67,277	64,388	78,047	243	232	282	177,233	277	0	277
03-07-12	107,947	107,706	125,021	249	248	288	278,219	435	1	434
03-07-13	31,261	35,025	37,644	101	113	121	199,743	312	1	311
03-07-14	38,419	43,235	50,084	92	103	120	268,433	420	2	418
03-07-15	16,445	18,307	20,432	47	52	58	224,554	351	1	350
03-07-16	36,295	42,025	41,561	111	129	127	212,141	331	4	327
03-07-17	36,295	42,025	41,561	111	129	127	212,141	331	4	327
TOTALS	979,484	1,081,743	1,193,353	134	148	163	4,736,564	7,400	72	7,328

[1] Population estimated based on US Census data and percentage of census block that falls within the subbasin.
[2] Population density based on land area only. Large wetlands are not included in area used to calculate density.
[3] Information generated by the NC Center for Geographic Information Analysis.

In using these data, it should be noted that 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 is made on the percentage of the population that is located in the subbasin. This was 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 to 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. This analysis to determine river basin population has not yet been conducted for the recently released 2000 census data.

Figure A-8 presents population density information by county for 1998. Population density exceeds 400 persons per square mile in the Muddy Creek (03-04-04) and Abbotts Creek (03-07-07) subbasins, which include Forsyth, Guilford and Davidson counties. Population densities in the upper Rocky River watershed exceed 250 persons per square mile. These subbasins (03-07-11 and 03-07-12) include Mecklenburg and Cabarrus counties. Population in the basin is concentrated along interstate corridors, particularly I-85 between Winston-Salem and Charlotte.

Growth Trends

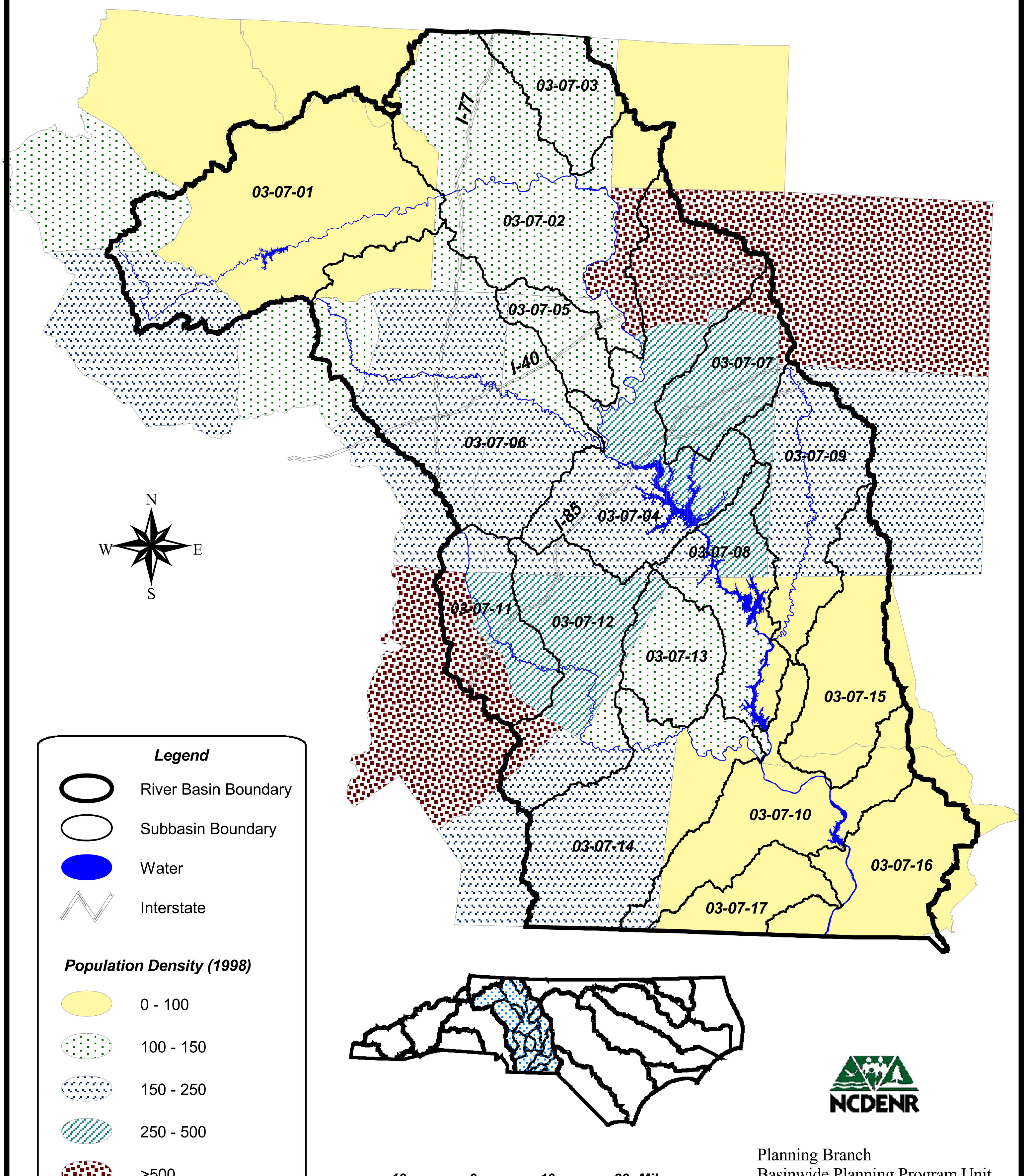
With the exception of the lower southeastern corner of the basin, population in all subbasins increased steadily between 1970 and 1990. Total population of the basin in North Carolina increased almost 20 percent over the 20-year period. Figure A-9 presents projected population growth by county between 2000 and 2020. For the majority of the Yadkin-Pee Dee River basin, population will increase more than 20 percent over the 20-year period. Projected increases are highest for subbasins surrounding High Rock Lake and the Rocky River watershed.

Table A-10 contains data from the most recent US Census (2000) and the projected change in population between 2000 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not usually coincide with county boundaries, these numbers are not directly applicable to the Yadkin-Pee Dee River basin. Even though 100 percent of eight counties are contained within the basin, only 9 percent of Alleghany County and 15 percent of Stokes are encompassed. They are instead presented as an estimate of possible countywide population changes.

The largest increases are projected for Union (70 percent), Mecklenburg (57 percent), Cabarrus (53 percent) and Iredell (49 percent). Projected population increases for Davie and Randolph counties are 37 percent; however, less than half of Randolph County is located within this basin. Eleven other counties located wholly or partially within the basin will likely increase 20-30 percent over the 20-year period.

Table A-11 presents population data for municipalities with populations greater than 2,000 persons, located wholly or partly within the basin. This information was obtained from the Office of State Planning (April and May 2001).

Figure A-8 1998 Population Density by County for the Yadkin-Pee Dee River Basin in North Carolina



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Basinwide Planning Program Unit
March 21, 2003

Figure A-9 Projected Population Growth (2000-2020) by County for the Yadkin-Pee Dee River Basin in North Carolina

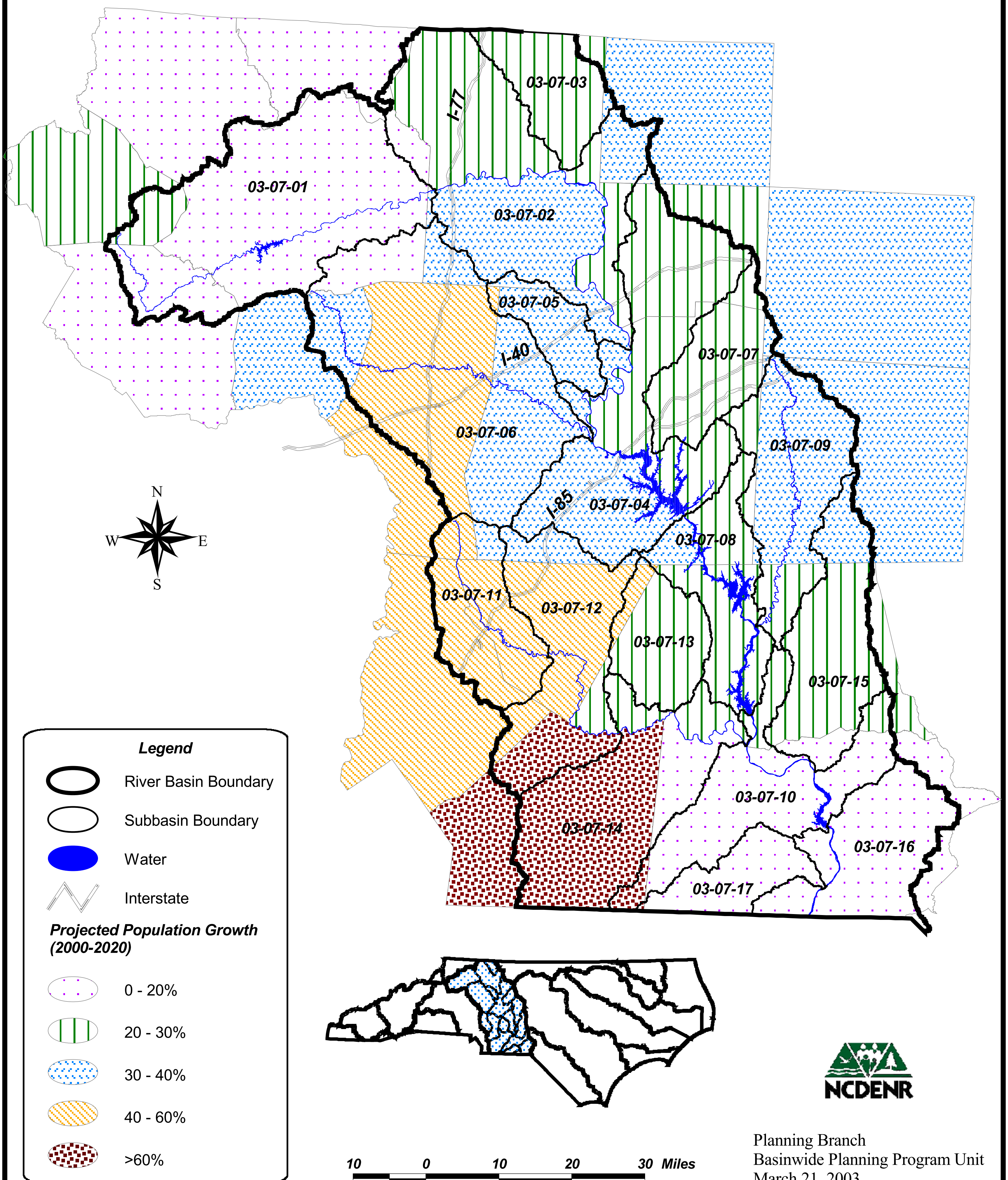

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Table A-10 Past and Projected Population (1990, 2000, 2020) and Population Change by County

County	% of County in Basin *	1990	2000	Estimated Population 2020	Population Change 1990-2000	Estimated Pop Change 2000-2020
Alexander	32%	27,544	33,603	45,168	6,059	11,565
Alleghany	9%	9,590	10,677	12,140	1,087	1,463
Anson	100%	23,474	25,275	27,653	1,801	2,378
Cabarrus	100%	98,935	131,063	200,092	32,128	69,029
Caldwell	25%	70,709	77,415	86,577	6,706	9,162
Davidson	100%	126,688	147,246	184,449	20,558	37,203
Davie	100%	27,859	34,835	47,614	6,976	12,779
Forsyth	76%	265,855	306,067	385,079	40,212	79,012
Iredell	78%	93,205	122,660	182,758	29,455	60,098
Mecklenburg	26%	511,211	695,454	1,089,258	184,243	393,804
Montgomery	88%	23,359	26,822	33,247	3,463	6,425
Randolph	44%	106,546	130,454	178,852	23,908	48,398
Richmond	81%	44,511	46,564	49,825	2,053	3,261
Rowan	100%	110,605	130,340	171,889	19,735	41,549
Stanly	100%	51,765	58,100	70,547	6,335	12,447
Stokes	15%	37,224	44,711	58,515	7,487	13,804
Surry	97%	61,704	71,219	88,596	9,515	17,377
Union	75%	84,210	123,677	210,738	39,467	87,061
Watauga	17%	36,952	42,695	51,567	5,743	8,872
Wilkes	100%	59,393	65,632	75,098	6,239	9,466
Yadkin	100%	30,488	36,348	48,041	5,860	11,693

* Source: North Carolina Center for Geographic Information and Analysis.

Note: The numbers reported reflect county population; however, the county may not be entirely contained within the basin. The intent is to demonstrate growth for counties located wholly or partially within the basin.

Table A-11 Population (1980, 1990, 2000) and Population Change for Municipalities Greater Than 2,000 Located Wholly or Partly in the Yadkin-Pee Dee River Basin

Municipality	County	Apr-80	Apr-90	Apr-2000	Percent Change (1980-90)	Percent Change (1990-2000)
Albemarle	Stanly	15,110	14,940	15,680	-1.1	5.0
Archdale •	Guilford, Randolph	5,326	6,975	9,014	31.0	29.2
Asheboro •	Randolph	15,252	16,362	21,672	7.3	32.5
Charlotte •	Mecklenburg	315,474	395,934	540,828	25.5	36.6
China Grove	Rowan	2,081	2,732	3,616	31.3	32.4
Clemmons	Forsyth	4,842	6,020	13,827	24.3	129.7
Concord	Cabarrus	16,942	27,347	55,977	61.4	104.7
Cornelius •	Mecklenburg	1,460	2,581	11,969	76.8	363.7
Davidson •	Iredell, Mecklenburg	3,241	4,046	7,139	24.8	76.4
East Spencer	Rowan	2,150	2,055	1,755	-4.4	-14.6
Elkin	Surry, Wilkes	2,858	3,790	4,109	32.6	8.4
Granite Quarry	Rowan	1,294	1,646	2,175	27.2	32.1
Hamlet	Richmond	4,720	6,324	6,018	34.0	-4.8
Harrisburg	Cabarrus	1,433	1,625	4,493	13.4	176.5
High Point •	Davidson, Forsyth, Guilford, Randolph	63,479	69,428	85,839	9.4	23.6
Huntersville •	Mecklenburg	1,294	3,023	24,960	133.6	725.7
Indian Trail •	Union	811	1,942	11,905	139.5	513.0
Kannapolis	Cabarrus, Rowan	30,303	29,709	36,910	-2.0	24.2
Kernersville •	Forsyth, Guilford	5,875	10,899	17,126	85.5	57.1
King	Forsyth, Stokes	3,811	4,059	5,952	6.5	46.6
Lake Park	Union	…..	4	2,093	…..	52,225.0
Landis	Rowan	2,092	2,333	2,996	11.5	28.4
Lewisville	Forsyth	4,854	6,433	8,826	32.5	37.2
Lexington	Davidson	15,711	16,581	19,953	5.5	20.3
Locust	Cabarrus, Stanly	1,590	1,940	2,416	22.0	24.5
Marshville	Union	2,011	2,160	2,360	7.4	9.3
Matthews •	Mecklenburg	1,648	13,651	22,127	728.3	62.1
Mint Hill •	Mecklenburg	7,915	11,615	14,922	46.7	28.5
Mocksville	Davie	2,637	3,399	4,178	28.9	22.9
Monroe	Union	12,639	16,385	26,228	29.6	60.1
Mooresville •	Iredell	8,575	9,317	18,823	8.7	102.0
Mount Airy	Surry	6,862	7,156	8,484	4.3	18.6
North Wilkesboro	Wilkes	3,275	3,384	4,116	3.3	21.6
Norwood	Stanly	1,818	1,617	2,216	-11.1	37.0
Randleman •	Randolph	2,156	2,612	3,557	21.2	36.2
Rockingham	Richmond	8,300	9,399	9,672	13.2	2.9

Rural Hall •	Forsyth	1,336	1,652	2,464	23.7	49.2
Salisbury	Rowan	22,677	23,626	26,462	4.2	12.0
Spencer	Rowan	2,938	3,195	3,355	8.7	5.0
Stallings •	Union	1,826	2,152	3,189	17.9	48.2
Statesville	Iredell	18,622	17,567	23,320	-5.7	32.7
Thomasville	Davidson, Randolph	14,144	15,915	19,788	12.5	24.3
Tobaccoville	Forsyth, Stokes	646	914	2,209	41.5	141.7
Trinity	Randolph	…..	6,470	6,690	…..	3.4
Troy	Montgomery	2,702	3,387	3,430	25.4	1.3
Unionville	Union	…..	3,039	4,797	…..	57.8
Wadesboro	Anson	4,206	3,862	3,552	-8.2	-8.0
Walkertown •	Forsyth	1,321	1,200	4,009	-9.2	234.1
Wilkesboro	Wilkes	2,335	2,964	3,159	26.9	6.6
Wingate	Union	2,615	2,821	2,406	7.9	-14.7
Winston-Salem	Forsyth	131,885	143,485	185,776	8.8	29.5
Yadkinville	Yadkin	2,216	2,525	2,818	13.9	11.6

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

For more information on past, current and projected population estimates, contact the Office of State Planning at (919) 733-4131 or visit their website at http://www.ospl.state.nc.us/demog/.

2.6 Natural Resources

Originating in the Blue Ridge Mountains, and draining portions of North Carolina's Piedmont, Sandhills and Coastal Plain, it is no surprise that the Yadkin-Pee Dee River basin contains a wide variety of habitat types, as well as many rare plants and animals. The Yadkin-Pee Dee River serves as a corridor for plants and animals migrating from the mountains to the Coastal Plain, and vice-versa. From an aquatic perspective, the NC Wildlife Resources Program recognizes the Pee Dee River as one of 13 Significant Aquatic Biodiversity Areas in North Carolina (Alderman, 1997).

2.6.1 Public Lands in the Yadkin-Pee Dee River Basin

Although public lands make up less than 5 percent of the Yadkin-Pee Dee River basin in North Carolina, many unique areas are protected. Figure A-10 presents these areas along with significant aquatic habitats, which are discussed in Part 2.6.3 below. Federally-owned lands include much of the 50,000-acre Uwharrie National Forest in Montgomery and Randolph counties and a small part of the Pisgah National Forest in Alexander County. The Blue Ridge Parkway winds in and out along the northwestern edge of the basin in Watauga and Wilkes counties and includes the 4200-acre Doughton Recreation Area. Cumberland Knob, where ground was first broken in the construction of the Parkway in 1935, also lies within the basin. Other federal lands include the Pee Dee National Wildlife Refuge in Anson County, McKinney Lake Fish Hatchery and the US Army Corps of Engineers' Kerr Scott Reservoir.

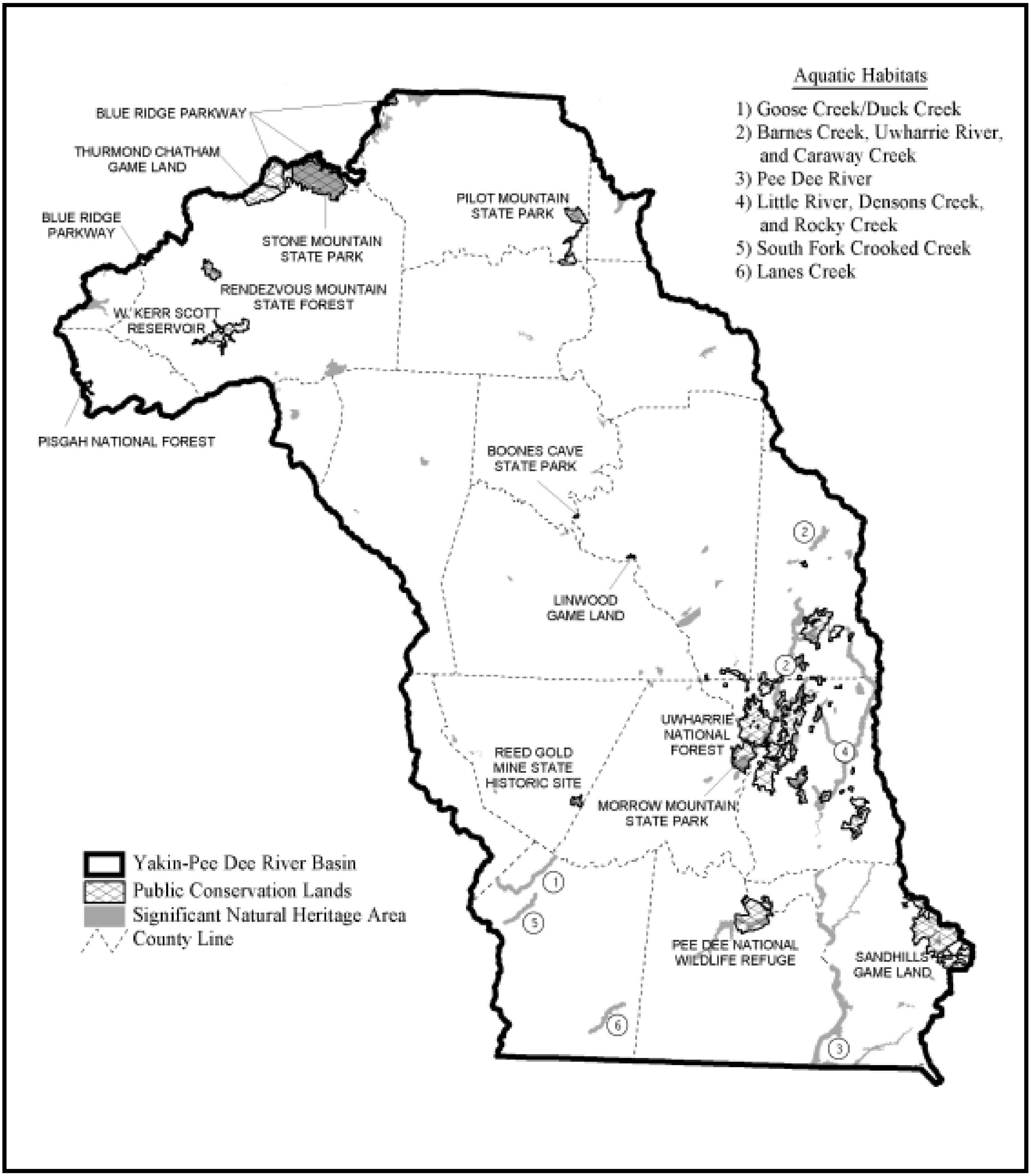


Figure A-10 Public Lands and Significant Natural Heritage Areas of the Yadkin-Pee Dee River Basin

The NC Division of Parks and Recreation manages three state parks in the basin: Stone Mountain State Park, Pilot Mountain State Park and Morrow Mountain State Park. Bullhead Mountain State Natural Area straddles the basin divide between the Yadkin-Pee Dee River and the New River basins in Alleghany County, and a small piece of Hanging Rock State Park is located across the Yadkin-Pee Dee/Roanoke River basin divide. The Wildlife Resources Commission also manages Linwood, Sandhills and Thurmond Chatham Game Lands. Other state-managed lands in the Yadkin-Pee Dee River basin include the NC Zoological Park, the Reed Gold Mine State Historic Site, Rendezvous Mountain State Forest, and the Department of Agriculture's Piedmont Research Station.

Most of these lands are considered to be in conservation ownership, meaning that the intended purpose is for conservation of the resources found within. Therefore, many significant natural heritage areas (discussed in Part 2.6.2 below) are located on public land. Local governments also manage important natural areas, such as Davie County's Boones Cave Park. Private, nonprofit organizations such as LandTrust for Central North Carolina and Piedmont Land Conservancy (refer to Section C for a complete listing of conservation organizations) are also managing land in conservation ownership. Although these lands are not shown in the figure, these organizations have achieved significant protection, particularly of riparian areas, in the Yadkin-Pee Dee River basin.

2.6.2 Significant Natural Heritage Areas within the Yadkin-Pee Dee River Basin

The North Carolina Natural Heritage Program identifies areas that have outstanding conservation value, either because they contain rare or endangered species, or because an area provides an excellent, intact example of an ecological community which naturally occurs in the state. The Yadkin-Pee Dee River basin contains more than 250 individual significant natural heritage areas (aquatic and terrestrial). It is beyond the scope of this report to discuss even a large fraction of these areas; however, some of the more impressive ones are mentioned.

Stone Mountain Escarpment Complex

An area of rugged land along the Blue Ridge escarpment encompasses several significant natural heritage areas, together forming a large forested wildland complex along the border of Alleghany and Wilkes counties. The area spans the elevational range from the base to the top of the escarpment and includes good examples of typical communities and excellent examples of rare communities such as Low Elevation Granitic Dome and Low and High Elevation Rocky Summit. A number of rare plant species are present, including Keever's bristle moss. Public land within this cluster includes Stone Mountain State Park, Doughton Park and Thurmond Chatham Game Land.

Brushy Mountains

The Brushy Mountains, located in the northeast corner of Alexander County and adjacent to Wilkes County, contain a cluster of Low Elevation Granitic Domes. Included in this cluster are the Nationally Significant Little Mountain, Nationally Significant Joe/Little Joe Mountains and Rocky Face Mountain. The state endangered Keever's bristle-moss and other rare plants occur here and represent the majority of this plant's global population.

Sauratown Mountains
The Sauratown Mountains are a cluster of monadnocks composed largely of quartzite in west central Stokes County and eastern Surry County. Standing conspicuously above the surrounding piedmont landscape, these mountains contain a mixture of montane and piedmont biota. Two state parks, Hanging Rock State Park and Pilot Mountain State Park, protect a few important areas; however, much is not currently in conservation ownership.

Beaverdam Creek/Grassy Fork Creek
Bearverdam Creek is a small slate-bottomed stream in the upper Yadkin River watershed located in the central Piedmont of North Carolina. The gravel bars and banks of this stream support the largest known population of the endangered heart-leaf plantain in North Carolina. More than 1,500 plants have been found in clumped populations in sites of ideal habitat for this aquatic plant. This particular site is of National Significance, but is not associated with a cluster of identified significant natural heritage areas.

Montgomery County
Roughly between the Uwharrie River and Badin Lake in northwestern Montgomery County lies the Badin Mafic cluster of natural areas – a rugged landscape along the east side of the Badin Lake, one of the most mountainous parts of the Uwharrie Mountains. Much of the area is underlain by mafic volcanic rocks, and the largest contiguous piece of Uwharrie National Forest lies in this area. A large number of natural areas have been identified, many containing high quality and rare natural communities associated with the unusual terrain and geology. Plants of particular note are the Yadkin River goldenrod, present in one of only two occurrences globally; and the ravine sedge, which in North Carolina, is only found here. Two of the significant natural heritage areas found in the area of national significance: the Yadkin River Scour Banks Natural Area, and the Badin Upland Depression Swamps and Xeric Woodland Natural Area. Montgomery County also contains several significant aquatic habitats discussed in Part 2.6.3 below.

Pee Dee River Riparian Area
Important natural heritage areas are located along the entire western boundary of Richmond County, from (and including) the Pee Dee National Wildlife Refuge down to the South Carolina border, as well as on adjacent lands in Anson County. Part of the area includes a large power generating reservoir, Blewett Falls Lake, but the rest of the river is free-flowing. This area contains some of the best remaining examples of riverine environments along the Pee Dee River in North Carolina, including floodplain and bottomland forests, extensive beaver ponds, a wild rice marsh and a unique oxbow lake. Adjacent slopes and ledges support a variety of forested and semi-forested communities. Historically, the Pee Dee River has been an important corridor for the movement of plants and animals in both directions, and today is a dynamic meeting ground for coastal plain and piedmont/mountain species.

As was mentioned previously, there are many upland, riparian and wetland Significant Natural Heritage Areas which are not discussed within the scope of this report. Please contact the NC Natural Heritage Program by calling (919) 715-8697 to obtain information about these natural areas. You may also visit the website at http://www.ils.unc.edu/parkproject/nhp/.

2.6.3 Significant Aquatic Habitats within the Yadkin-Pee Dee River Basin

Six watersheds in the North Carolina portion of the Yadkin-Pee Dee River basin contain Significant Aquatic Habitats (Figure A-10). In addition, there are three unique (and rare) types of wetlands found within the basin. Status of rare species mentioned here is contained in Table A-12 (page 31).

<u>Goose Creek/Duck Creek Watershed</u>
The Goose Creek watershed, including Duck Creek, is a Nationally Significant Aquatic Habitat located in Union County. Six rare mollusks are found in portions of the two streams: Carolina heelsplitter (federally endangered), creeper, notched rainbow, eastern creekshell, Carolina creekshell and Atlantic pigtoe. This watershed is one of only four sites globally in which the imperiled Carolina heelsplitter is still found.

<u>Uwharrie River Watershed</u>
The streams and rivers of the Uwharrie National Forest and vicinity (Montgomery County and southwestern Randolph County) host large numbers of rare mollusks, as well as the Carolina darter. Whether these streams were originally more diverse than other streams in the basin is open to speculation, but it is likely that species have survived in these waters due to the relatively undeveloped watershed upstream and the protection offered by the National Forest. They may be the last strongholds for some species as the Piedmont becomes even more heavily impacted by humans.

There are three identified Significant Aquatic Habitats in this watershed. The State Significant Barnes Creek Aquatic Habitat flows southwestward through the Uwharrie Mountains and ends at the Uwharrie River. Five rare mollusks inhabit this stretch of Barnes Creek: brook floater, creeper, notched rainbow, eastern creekshell and Carolina creekshell. Also, in this region is the State Significant Uwharrie River Aquatic Habitat. The Uwharrie River flows south-southwest into the Pee Dee River, passing through the heart of the Uwharrie Mountains. The lower portion contains several rare mussels, including Roanoke slabshell, Atlantic pigtoe, eastern lampmussel, notched rainbow and eastern creekshell. Another notable aquatic site is the State Significant Caraway Creek Aquatic Habitat. This stream contains a cluster of six rare mollusk species, including Atlantic pigtoe, brook floater and Carolina creekshell.

<u>Pee Dee River in North Carolina</u>
The State Significant Pee Dee River Aquatic Habitat extends from the Blewett Falls Dam to the South Carolina state line. This short stretch of river is host to several rare fishes, including the shortnose sturgeon (federally endangered) and the robust redhorse.

<u>Little River Watershed</u>
A number of aquatic habitats are associated with the Little River of Montgomery and Randolph counties. The State Significant Little River Aquatic Habitat flows southward through central Montgomery County and empties into the Pee Dee River. This stretch of the Little River has a very diverse array of rare mollusks including the triangle floater, Atlantic pigtoe, Savannah lilliput, notched rainbow, eastern creekshell and Carolina creekshell. With headwaters in the Uwharrie National Forest, the State Significant Densons Creek Aquatic Habitat flows into the Little River. Located within Montgomery County, this creek is home to five rare mollusks,

including Savannah lilliput and Carolina creekshell. Also, found here is the Regionally Significant Little River/Rocky Creek Aquatic Habitat. Downstream of the confluence of Densons Creek and Little River, this site harbors four rare mussels, including Carolina creekshell and the Carolina darter. This area also contains the most extensive remnants of Piedmont Longleaf Pine Forest left globally.

South Fork Crooked Creek

South Fork Crooked Creek Aquatic Habitat is a state significant site in Union County harboring an assemblage of three rare mussel species, with Carolina creekshell (federal species of concern, state endangered) and Savannah lilliput being highly significant.

Lanes Creek

Lanes Creek is a tributary of the Rocky River in the lower part of the basin. The Regionally Significant aquatic habitats of this site host several rare species, including one rare mayfly, the Carolina darter and the Carolina creekshell.

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. Wetlands provide a variety of benefits to society and are very important in watershed planning because of the functions they perform. Wetlands provide retention of floodwaters 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.

A number of wetland (palustrine) natural communities are found in the Yadkin-Pee Dee River basin, but three are especially notable. The Hillside Seepage Bog is an extremely rare natural community, considered globally imperiled. Nearly all of the places where this bog is found are in the Yadkin-Pee Dee River basin. Some are clustered in northern Iredell County, and others are clustered in Montgomery County. In general, these are very small sites (some are less than an acre) on gentle slopes where groundwater seepage wets the land surface. Species typical of both montane bogs and Coastal Plain savannas may be found here, such as pitcher plants and "savanna" orchids. None of the Iredell County sites are in conservation ownership, and only a few of the Montgomery sites are protected through ownership by US Forest Service or The Nature Conservancy.

The Upland Pool and Upland Depression Swamp Forest natural communities are sites that hold water for all or part of the year. These are sites removed from riverine areas, generally over gabbro or other mafic rocks that have poor drainage, and thus, pond water. Upland Pools are extremely rare, and two of the few known examples are contained within the Uwharrie National Forest. These sites generally have few, if any, trees and feature shrubs and herbs as dominant vegetation. On the other hand, Upland Depression Swamp Forest features a forested canopy of wetland trees over pools. These communities are scattered throughout the Yadkin-Pee Dee River basin, particularly on Iredell soil types.

2.6.4 Rare Aquatic and Wetland-Dwelling Animal Species

Table A-12 presents rare aquatic and wetland-dwelling species found in the Yadkin-Pee Dee River basin.

Table A-12 Rare Aquatic and Wetland-Dwelling Species (as of November 2002)

Major Taxon	Common Name	Scientific Name	State Status	Federal Status
Fish	Shortnose Sturgeon	*Acipenser brevirostrum*	E	E
Fish	Highfin Carpsucker	*Carpiodes velifer*	SC	-
Fish	Santee Chub - Piedmont population	*Cyprinella zanema pop 1*	SR	-
Fish	Carolina Darter - central Piedmont population	*Etheostoma collis pop 1*	SC	FSC
Fish	Robust Redhorse	*Moxostoma robustum*	SC	FSC
Fish	Carolina Redhorse	*Moxostoma sp 2*	SR	FSC
Fish	Sandhills Chub	*Semotilus lumbee*	SC	-
Insect	a mayfly	*Choroterpes basalis*	SR	-
Insect	a caddisfly	*Dibusa angata*	SR	-
Insect	Cahaba Sand-Filtering Mayfly	*Homoeoneuria cahabensis*	SR	-
Insect	a mayfly	*Macdunnoa brunnea*	SR	-
Insect	a caddisfly	*Micrasema sprulesi*	SR	-
Insect	White Sand-River Mayfly	*Pseudiron centralis*	SR	-
Insect	a rhyacophilan caddisfly	*Rhyacophila vibox*	SR	-
Insect	a triaenode caddisfly	*Triaenodes marginata*	SR	-
Insect	a mayfly	*Tricorythodes robacki*	SR	-
mollusk	Triangle Floater	*Alasmidonta undulata*	T	-
mollusk	Brook Floater	*Alasmidonta varicosa*	E*	FSC
mollusk	Roanoke Slabshell	*Elliptio roanokensis*	T	-
mollusk	Atlantic Pigtoe	*Fusconaia masoni*	E*	FSC
mollusk	Yellow Lampmussel	*Lampsilis cariosa*	E*	FSC
mollusk	Carolina Fatmucket	*Lampsilis radiata conspicua*	T*	-
mollusk	Eastern Lampmussel	*Lampsilis radiata radiata*	T*	-
mollusk	Carolina Heelsplitter	*Lasmigona decorata*	E	E
mollusk	Creeper	*Strophitus undulatus*	T	-
mollusk	Savannah Lilliput	*Toxolasma pullus*	E*	FSC
mollusk	a valvatid snail	*Valvata cf sincera*	SR	-
mollusk	Notched Rainbow	*Villosa constricta*	SC*	-

mollusk	Eastern Creekshell	*Villosa delumbis*	SR	-
mollusk	Carolina Creekshell	*Villosa vaughaniana*	E*	FSC
Aq Plant	Giant Peatmoss	*Sphagnum torreyanum*	SR	-
Aq Plant	Water Purslane	*Didiplis diandra*	SR	-
Aq Plant	Southern Water Grass	*Luziola fluitans*	SR	-
Aq Plant	Heart-Leaf Plantain	*Plantago cordata*	E	-
Aq Plant	Conferva Pondweed	*Potamogeton confervoides*	SR	FSC
Aq Plant	Canby's Bulrush	*Schoenoplectus etuberculatus*	SR	-
Aq Plant	Swaying Bulrush	*Schoenoplectus subterminalis*	SR	-

* New ranking in effect July 1, 2002.

Rare Species Listing Criteria

E = Endangered (those species in danger of becoming extinct)
T = Threatened (considered likely to become endangered within the foreseeable future)
SR = Significantly Rare (rare in North Carolina, but not yet officially listed as threatened or endangered)
SC = Special Concern (have limited numbers in North Carolina and vulnerable populations in need of monitoring)
FSC = Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)

Management Strategies for Federally Threatened and Endangered Species

Because the Carolina heelsplitter is a federally-listed endangered mussel species and the Shortnose sturgeon is a federally-listed threatened fish species, certain waters within the Yadkin-Pee Dee River basin are subject to a new rule (Administrative Code: 15A NCAC 02B .0110) requiring the development of site-specific management strategies by DWQ. The intent of these strategies is to provide for maintenance and recovery of the water quality conditions required to sustain these species.

Considerable information on these species, as well as the waters in which they are found, is needed for the development of appropriate management strategies as required by the rule. DWQ currently has neither the resources nor the expertise to gather this information alone. Therefore, it is necessary for the US Fish and Wildlife Service, the NC Wildlife Resources Commission, the NC Natural Heritage Program and other interested parties to collaborate on a process that will ensure successful development and implementation of appropriate management strategies to protect these species. DWQ held an initial meeting in July 2002 between the agencies to discuss the rule and its applications to the Yadkin-Pee Dee River basin. As long as agencies continue to work together, management strategies will be developed for the Goose Creek watershed and the Pee Dee River below Blewett Falls Lake during the current basinwide planning cycle.

2.6.5 Yadkin-Pee Dee River Basin Fisheries

The fish communities of the Yadkin-Pee Dee River and tributaries vary considerably throughout the basin. Adequate conditions to support wild populations of brook, brown and rainbow trout are found in the coldwaters of many of the tributaries to the upper Yadkin River which originate along the Blue Ridge escarpment in Alleghany, Caldwell, Surry, Watauga and Wilkes counties. Many of these tributaries also contain considerable coolwater habitat in the lower reaches. These include Elk Creek, Reddies River, Roaring River, Mitchell River, Fisher River and Ararat River. Primary sportfishes in these streams include smallmouth and spotted bass, redbreast sunfish and rock bass. Downstream of the confluence with the Ararat River, tributaries contain primarily warmwater habitat, with stream bottoms containing more sand and less exposed bedrock. Some tributaries in the lower portion of the basin are similar to the sandy-bottomed, blackwater streams typical of the coastal plain of North Carolina. Limited fisheries for largemouth and spotted bass, catfishes, redbreast sunfish and bluegill are found in these streams.

River Fisheries

Sportfishes in the Yadkin River upstream of W. Kerr Scott Reservoir include smallmouth bass, redbreast sunfish and bullhead catfishes. Between W. Kerr Scott Reservoir and the headwaters of High Rock Lake, the river is wide and shallow, with depths averaging less than three feet. Smallmouth, spotted and largemouth bass, redbreast sunfish, bullhead catfishes, channel catfish and flathead catfish are popular with anglers in this section of the Yadkin.

The Pee Dee River below Blewett Falls Dam flows for 16 miles before entering South Carolina. Although streamflow is regulated by releases from Blewett Falls Dam, there are no other dams between this section and Georgetown, South Carolina where the Pee Dee enters the Atlantic Ocean. The habitat in this section contains large boulders, bedrock shelves and sandbars as the river transitions from the Piedmont to the Coastal Plain physiographic regions. Fisheries for American shad, striped mullet and striped bass occur each spring during the spawning runs of these species. Anglers in this section of the river also capture resident species such as flathead catfish, blue catfish, smallmouth buffalo and sunfish.

Lake Fisheries

W. Kerr Scott Reservoir in Wilkesboro is the first major impoundment on the Yadkin River. The reservoir is operated by the US Army Corps of Engineers and is primarily used for flood control. The fish community is dominated by warmwater/coolwater sportfish species, including largemouth bass, spotted bass, sunfish, black and white crappie, and striped bass hybrids.

Idols Dam, formerly used to generate hydropower, is located west of Clemmons and is owned by the City of Winston-Salem. Although the powerhouse is no longer operational, the Winston-Salem Utility Commission intends to maintain the dam to protect their water intake just upstream of the dam. A considerable white and striped bass fishery exists below the dam in the spring when the fish migrate from downstream reservoirs to spawn.

The "Chain Lakes" of the Yadkin-Pee Dee River (High Rock Lake, Tuckertown, Badin Lake, Falls Reservoir, Lake Tillery and Blewett Falls) support fisheries for largemouth bass, sunfish, black and white crappie, several catfish species and, with the exception of Falls Reservoir, striped bass. In addition to being important natural resources, these reservoir fisheries also help make the basin a popular place for recreation, significantly boosting the local economy.

2.6.6 Forestry in the Yadkin-Pee Dee River Basin

Forest Resources

The overwhelming majority of timberland in the basin, nearly 90 percent, is owned by nonindustrial private landowners. Approximately, 5 percent of the timberland is owned by forest products companies, with the remaining 5 percent under public ownership. Most of the timberland in public ownership consists of the Uwharrie National Forest. These ownership data come from the most recent study by the USDA Forest Service, conducted in 1990 (North Carolina's Forests, 1990, *Southeastern Forest Experiment Station Resource Bulletin SE-142*).

For the period July 1998 through June 2002, nearly 59,000 acres of private land in the Yadkin-Pee Dee River basin were planted in trees, with nearly 80 percent of these acres utilizing cost shared funding through various state or federal programs. From the most recent data available at year-end 2002, 69 different businesses in the basin are considered as "Primary Processors" of forestry-related raw material, which represents nearly one-quarter of the total number of primary processors (285) located in North Carolina. A primary processor may include a sawmill, veneer mill, chip mill or paper mill.

In Wilkes County, the Division of Forest Resources ("DFR", also known as the NC Forest Service) manages approximately 3,000 acres of land at the Rendezvous Mountain Educational State Forest. The forest is managed as an outdoor classroom for school groups and the general public, as well as for sustainable forestry while protecting the headwaters of Purlear Creek, a tributary of North Prong Lewis Fork. In addition, the forest is located within the view-shed of the Blue Ridge Parkway.

Long-term goals of the DFR include the creation of additional Educational State Forests within the Yadkin-Pee Dee River basin, with the highest priority focused on serving the rapidly expanding area around Winston-Salem, Thomasville and Lexington. The southern area of the basin is also targeted for the establishment of an Educational State Forest.

In Davidson, Montgomery and Randolph counties, the US Forest Service manages over 50,000 acres in the Uwharrie National Forest, which provides water quality protection for Basin Lake and Lake Tillary.

More information is available on the North Carolina Division of Forest Resources website at http://www.dfr.state.nc.us or the US Forest Service webstie at http://www.fs.fed.us.

Forestry Regulation in North Carolina

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Chapter 113A, Article 4 referred to as "SPCA"). However, forestry operations may be exempted from the permit requirements in the SPCA, if the operations meet compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0101-.0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S. 77-13 and G.S. 77-14). Detailed information is available on the Water Quality Section of the DFR's website at http://www.dfr.state.nc.us.

DFR is delegated the authority, by the Division of Land Resources, to monitor and evaluate forestry operations for compliance with these laws. In addition, DFR works to resolve identified FPG compliance questions. Violations of the FPG performance standards that cannot be resolved by DFR are referred to the Division of Land Resources for enforcement action.

During the calendar years of 1998 through 2002, DFR conducted 2,674 FPG inspections of forestry and/or timber harvesting activities in the Yadkin-Pee Dee River basin; 92 percent of the sites inspected were in compliance.

The western portion of the Yadkin-Pee Dee River basin falls within the coverage area for two of the DFR Water Quality Foresters. The Water Quality Foresters conduct FPG inspections, develop preharvest plans, and provide training opportunities for landowners, loggers and the public regarding water quality issues related to forestry. Service Foresters and/or County Rangers handle water quality issues in the remainder of the basin, along with their other forest management and fire control responsibilities. Contact information for each district and/or county can be found on the DFR's website at http://www.dfr.state.nc.us.

Forestry Best Management Practices

The implementation of Forestry Best Management Practices ("BMPs") is encouraged by DFR to protect water resources. The *Forestry Best Management Practices Manual* describes recommended techniques that may be used to comply with the state's forestry laws and help protect water quality. The BMP Manual is being revised; publication of the new edition of the BMP Manual is expected in 2003-2004. The new version of the manual will be printed in a pocket-sized version and a full-sized desktop version. The smaller sized, condensed version will allow for greater distribution and on-site use by loggers and equipment operators.

Among the BMP's promoted for timber harvesting is the use of bridgemats for establishing temporary stream crossings. At this time in the Yadkin-Pee Dee River basin, DFR provides bridgemats for short-term loan to loggers for use in those counties located along the western portion of the basin. Purchase of additional bridgemats, scheduled in 2003, will provide bridgemats for use in all of DFR's districts in the Yadkin-Pee Dee River basin. DFR's Bridgemat Loan and Education Program is an educational and protection project which promotes the benefits of using portable bridges for stream crossings, in lieu of using other techniques such as culverts or hard-surface crossings, which both have a greater potential to result in sedimentation. All bridgemat purchases for DFR's program are funded by grant awards from the US EPA's Nonpoint Source Pollution Management Program.

2.7 Permitted Wastewater and Stormwater Discharge Facilities

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

The primary pollutants associated with point source discharges are:

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

2.7.1 Wastewater Discharges in the Yadkin-Pee Dee River Basin

Type of Wastewater Discharge

Major Facilities: Municipal wastewater treatment plants with flows $\geq$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: Public facilities that serve a municipality. Can treat waste from homes and industries.

Nonmunicipal: Non-public facilities that provide treatment for domestic, industrial or commercial wastewater. This category includes wastewater from industrial processes such as textiles, mining, seafood processing, and power generation, and other facilities such as schools, subdivisions, nursing homes, groundwater remediation projects, water treatment plants and non-process industrial wastewater.

There are 240 permitted discharges in the Yadkin-Pee Dee River basin. Table A-13 provides summary information (numbers of facilities and permitted flows) regarding the discharges by types and subbasin. Subbasin maps in Section B depict the locations of NPDES permitted discharges. Detailed information, including a key to discharge location numbers, is provided in Appendix I.

The majority of NPDES permitted discharges in the Yadkin-Pee Dee River basin are from wastewater treatment plants serving communities and schools. Many of them are small facilities with less than one million gallons of flow per day. However, there are several larger discharges in the basin as well. Facilities, large or small, where recent data show problems with a discharge are listed and discussed in each subbasin chapter in Section B.

Table A-13 Summary of NPDES Dischargers and Permitted Flows

Facility Categories	Subbasin																	
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	TOTAL
Total Facilities	28	31	11	40	2	29	14	10	5	4	24	17	8	8	2	7	0	240
Total Permitted Flow (MGD)	9.1	10.4	8.7	65.8	0.7	15.0	15.9	0.9	0.1	1.2	13.2	25.5	16.6	11.7	1.4	11.7	0.0	207.9
Major Discharges	3	3	3	5	0	6	3	1	0	0	3	1	1	3	0	4	0	36
Total Permitted Flow (MGD)	7.9	8.3	8.6	62.8	0.0	13.5	15.7	0.0	0.0	0.0	11.2	24.0	16.0	10.9	0.0	11.7	0.0	190.6
Minor Discharges	25	28	8	35	2	23	11	9	5	4	21	16	7	5	2	3	0	204
Total Permitted Flow (MGD)	1.2	2.1	0.1	3.0	0.7	1.5	0.2	0.9	0.1	1.1	1.9	1.5	0.6	0.8	1.4	0.0	0.0	17.1
100% Domestic Waste	18	17	6	22	1	13	10	1	3	0	19	9	1	2	0	0	0	122
Total Permitted Flow (MGD)	0.2	0.4	0.1	0.5	0.01	0.2	0.2	0.01	0.04	0.0	2.0	1.3	0.003	0.01	0.0	0.0	0.0	4.9
Municipal Facilities	3	7	2	4	1	7	3	2	0	3	2	4	2	3	2	3	0	48
Total Permitted Flow (MGD)	6.9	5.5	8.5	59.3	0.7	10.3	15.7	0.8	0.0	1.2	11.2	24.2	16.5	11.7	1.4	10.5	0.0	184.4
Nonmunicipal Facilities	25	24	9	36	1	22	11	8	5	1	22	13	6	5	0	4	0	192
Total Permitted Flow (MGD)	2.2	5.0	0.2	6.6	0.01	4.7	0.2	0.01	0.1	0.0	2.0	1.4	0.7	0.01	0.0	1.2	0.0	24.3

2.7.2 Stormwater Discharges in the Yadkin-Pee Dee River Basin

EPA Stormwater Rules

Phase I – December 1990

- Requires a NPDES permit for municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for ten categories of industry.
- Requires a NPDES stormwater permit for construction sites that are five acres or more.

Phase II – December 1999

- Requires a NPDES permit for some municipal storm sewer systems serving populations under 100,000, located in urbanized areas.
- Provides a "no stormwater exposure" exemption to industrial facilities covered under Phase I.
- Requires a NPDES stormwater permit for construction sites that are one acre or more.

Amendments were made to the Clean Water Act in 1990 and most recently in 1999 pertaining to permit requirements for stormwater discharges associated with industrial activities and municipal separate storm sewer systems (MS4s). DWQ administers these regulations in North Carolina through the state's NPDES stormwater program. The goal of the DWQ stormwater discharge permitting regulations is to prevent pollution via stormwater runoff by controlling the source(s) of pollutants.

The municipal permitting requirements are designed to lead into the formation of comprehensive stormwater management programs for municipal areas. Winston-Salem and Charlotte were required to obtain a NPDES permit for stormwater sewer systems under the Phase I rules.

Table A-14 presents 10 counties and 33 municipalities in the basin which are within US Census-Designated Urban Areas. A listed governmental entity is required to obtain a NPDES stormwater permit under the Phase II rules if it operates a small MS4 within the US Census-Designated Urbanized Area boundary. Local governments which were designated under the 1990 census have an application deadline of March 2003; governments designated under the 2000 census have an application deadline of May 2004. Entities such as military bases, large hospitals, prison complexes, universities, sewer districts and highway departments that operate a small MS4 within an urbanized area are also subject to the permitting regulations.

NPDES Stormwater Sewer System Permit Requirements under Phase II

Six Minimum Measures

- Public education and outreach on stormwater impacts
- Public involvement / participation
- Illicit discharge detection and elimination
- Construction site stormwater runoff control
- Post-construction stormwater management for new development and redevelopment
- Pollution prevention / good housekeeping for municipal operations

At least five additional municipalities (Lexington, Statesville, Mooresville, Asheboro and Albemarle) within the basin will be considered for inclusion under the Phase II rules during the next basinwide planning cycle because of a population greater than 10,000 and/or a population density greater than 1,000 persons per square mile. DWQ is currently developing state designation criteria that will be used to determine whether other local governments should be required to obtain a NPDES permit. In addition, DWQ can be petitioned to include a particular local government if there are significant water quality concerns associated with that community. Detailed maps of the Urbanized Area boundaries along with more detailed information about the Phase II program are available on the DWQ Stormwater and General Permits Unit website at http://h2o.enr.state.nc.us/su/NPDES_Phase_II_Stormwater_Program.htm.

Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Stormwater permits are granted in the form of general permits (which cover a wide variety of more common activities) or individual permits. Excluding construction stormwater general permits, there are 639 general stormwater permits and 27 individual permits active within the Yadkin-Pee Dee River basin. Facilities with individual NPDES stormwater permits are presented in Appendix I.

In addition to the NPDES Phase I and II stormwater programs, the state stormwater management rules (15A NCAC 2H .1000) currently regulate development activities in 20 coastal counties and on lands statewide that drain to Outstanding Resource Waters (ORW) and/or High Quality Waters (HQW). Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area on a project and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of structural best management practices to control and treat stormwater runoff from the site. Surface waters in the Yadkin-Pee Dee River basin, where development activities are regulated under these special rules, are presented on Figures A-12 and A-13 (page 58).

Table A-14 Communities in the Yadkin-Pee Dee River Basin with Stormwater Requirements

Census-Designated Urban Area	Automatically Designated Local Governments*	Phase I	Phase II 1990 Census	Phase II 2000 Census
Winston-Salem	Winston-Salem	X	X	
	Bermuda Run			X
	Bethania			X
	Clemmons		X	
	Davidson			X
	Kernersville			X
	King			X
	Lewisville			X
	Rural Hall		X	
	Tobaccoville			X
	Walkertown		X	
	Davie County			X
	Forsyth County		X	
	Stokes County			X
High Point	High Point		X	
	Archdale		X	
	Thomasville		X	
	Trinity			X
	Davidson County		X	
	Guilford County		X	
	Randolph County		X	
Concord	Concord		X	
	China Grove		X	
	Harrisburg			X
	Kannapolis		X	
	Landis		X	
	Salisbury			X
	Cabarrus County		X	
	Rowan County		X	
Charlotte	Charlotte	X	X	
	Cornelius			X
	Davidson		X	
	Harrisburg		X	
	Hemby Bridge			X
	Huntersville			X
	Indian Trail		X	
	Lake Park			X
	Matthews		X	
	Mint Hill		X	
	Monroe			X
	Stallings		X	
	Mecklenburg County		X	
	Union County		X	

* More local governments will likely be included once designation criteria are completed by the state.

2.8 Animal Operations

In 1992, the Environmental Management Commission adopted a rule modification (15A NCAC 2H.0217) establishing procedures for managing and reusing animal wastes from intensive livestock operations. The rule applies to new, expanding or existing feedlots with animal waste management systems designed to serve animal populations of at least the following size: 100 head of cattle, 75 horses, 250 swine, 1,000 sheep or 30,000 birds (chickens and turkeys) with a liquid waste system. Within the past five years there have been several additional pieces of legislation enacted that affect animal operations in North Carolina (see text box).

Key Animal Operation Legislation (1995-2000)

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. NCDENR 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 NCDENR to develop an inventory of inactive lagoons. The Bill 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.

2000 – Attorney General Easley reached a landmark agreement with Smithfield Foods, Inc. to phase out hog lagoons and implement new technologies that will substantially reduce pollutants from hog farms. The agreement commits Smithfield to phase out all anaerobic lagoon systems on 276 company-owned farms. Legislation will be required to phase out the remaining systems statewide within a 5-year period (State of Environment Report 2000).

Table A-15 summarizes, by subbasin, the number of registered livestock operations, total number of animals, and total steady state live weight as of February 2002. 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 US Department of Agriculture (USDA), 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. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin.

There are 128 registered animal operations in the Yadkin-Pee Dee River basin. Approximately 67 percent are cattle operations, 26 percent are swine, and 7 percent are poultry. Subbasin 03-07-06 contains the largest number of registered animal operations with 40 cattle operations and one swine operation. Subbasin 03-07-14 also contains a large number of registered operations with four cattle, five poultry and five swine operations. Overall the majority of registered animal operations are found in the upper portion of the basin (above High Rock Lake). Registered animal operations where recent data show problems are discussed in the appropriate subbasin chapter in Section B.

Information on animal capacity by subbasin (Table A-16) was provided by the USDA. Despite a 28 percent decrease in dairy production between 1994 and 1998, more than 40 percent of the state's total capacity for dairy production is found in the Yadkin-Pee Dee River basin. The basin also contains 35 percent of the state capacity for poultry. Overall, swine and poultry production in the basin increased over the past five years by 47 and 13 percent, respectively.

Table A-15 Registered Animal Operations in the Yadkin-Pee Dee River Basin (February 2002)

Subbasin	Cattle			Poultry			Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight	No. of Facilities	No. of Animals	Total Steady State Live Weight
03-07-01	6	2,185	2,594,000	0	0	0	0	0	0
03-07-02	10	2,665	3,731,000	0	0	0	3	21,330	2,302,350
03-07-03	2	425	595,000	0	0	0	1	1,600	212,400
03-07-04	6	1,526	2,136,400	0	0	0	2	6,250	958,900
03-07-05	2	625	875,000	0	0	0	1	2,250	318,825
03-07-06	40	33,202	15,590,800	0	0	0	1	2,120	285,620
03-07-07	2	570	798,000	0	0	0	0	0	0
03-07-08	1	215	301,000	0	0	0	0	0	0
03-07-09	4	950	1,330,000	1	52,000	208,000	2	2,687	362,745
03-07-10	0	0	0	0	0	0	6	35,922	3,529,660
03-07-11	3	560	784,000	0	0	0	0	0	0
03-07-12	5	1,250	1,750,000	0	0	0	2	6,100	1,014,500
03-07-13	1	275	385,000	3	320,000	1,168,000	1	3,790	373,650
03-07-14	4	858	1,201,200	5	389,000	1,443,000	5	32,752	4,199,460
03-07-15	0	0	0	0	0	0	3	18,604	1,336,620
03-07-16	0	0	0	0	0	0	1	325	43,875
03-07-17	0	0	0	0	0	0	5	20,653	1,542,514
Totals	**86**	**45,306**	**32,071,400**	**9**	**761,000**	**2,819,000**	**33**	**154,383**	**16,481,119**

Table A-16 Estimated Populations of Swine, Dairy and Poultry in the Yadkin-Pee Dee River Basin (1998 and 1994)

Subbasin	Total Swine Capacity		Swine Change	Total Dairy Capacity		Dairy Change	Poultry Capacity		Poultry Change
	1998	1994	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
03-07-01	537	768	-30	806	1,243	-35	18,398,350	16,876,946	9
03-07-02	13,585	6,245	118	4,523	6,703	-33	6,781,475	5,198,900	30
03-07-03	835	873	-4	1,153	1,153	0	323,900	325,250	0
03-07-04	2,373	4,553	-48	3,574	4,150	-14	31,410	25,810	22
03-07-05	2,269	2,522	-10	1,355	2,506	-46	325,150	210,900	54
03-07-06	3,607	6,908	-48	20,815	28,394	-27	7,263,805	6,579,030	10
03-07-07	771	719	7	963	1,203	-20	85,600	85,100	1
03-07-08	740	2,655	-72	260	1,942	-87	1,536,200	1,022,700	50
03-07-09	2,445	3,392	-28	1,384	2,469	-44	1,559,115	1,140,557	37
03-07-10	23,384	13,029	79	138	138	0	4,269,000	4,208,680	1
03-07-11	332	677	-51	3,173	1,642	93	210,794	220,594	-4
03-07-12	7,260	15,513	-53	515	1,336	-61	6,085,444	5,210,044	17
03-07-13	17,437	3,710	370	1,025	1,747	-41	3,674,750	3,260,295	13
03-07-14	31,811	23,483	35	969	1,161	-17	16,050,832	13,961,182	15
03-07-15	21,097	14,985	41	0	360	-100	3,789,753	3,435,300	10
03-07-16	12,902	4,694	175	0	2	-100	3,406,420	3,352,036	2
03-07-17	15,432	2,199	602	150	249	-40	1,123,800	918,800	22
TOTALS	156,817	106,925	47	40,803	56,398	-28	74,915,798	66,032,124	13
% of State Total	2%	2%		41%	42%		35%	36%	

2.9 Water Quantity Issues

In 1995, the USGS estimated that total water use in the Yadkin-Pee Dee River basin was 306 million gallons per day, with almost 80 percent supplied from surface water sources.

2.9.1 Local Water Supply Planning

The North Carolina General Assembly mandated a local and state water supply planning process in 1989 to assure that communities have an adequate supply of potable 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.

In 1997, 70 public water systems used water from the basin providing 149 million gallons of water per day to 803,281 people in the basin. Water demand from these public systems is projected to increase 36 percent by 2020. In 1997, 17 systems (24 percent) reported that available supply was not adequate to meet estimated demand through 2020, and 21 systems (30 percent) report that by 2020 demand levels will exceed 80 percent of available supply.

Not everyone gets water from public water supply systems. Many households and some commercial and industrial operations supply their own water from both surface water and groundwater sources in the basin. The US Geological Survey estimates that self-supplied users, excluding power-generating facilities, account for 50 percent of the total water used in the Yadkin-Pee Dee River basin. Water used for industrial and livestock purposes comprises the majority of self-supplied water use in the basin (Figure A-11).

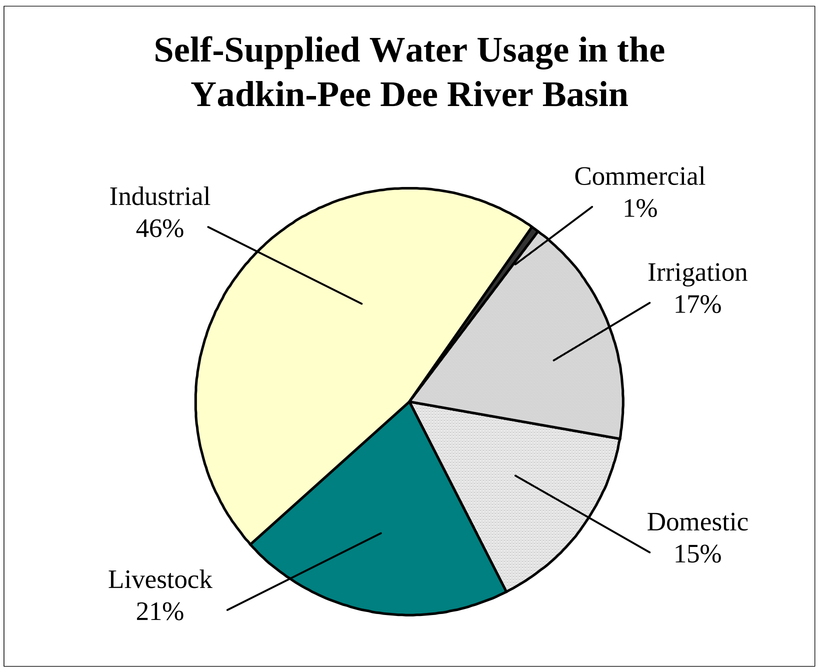


Figure A-11 Estimated Self-Supplied Water Use in the Yadkin-Pee Dee River Basin (NCDENR-DWR, January 2001)

The State Water Supply Plan is a compilation of over 500 LWSPs developed by local government water systems in North Carolina. More detailed information is available in the plan about water supply and water usage in the Yadkin-Pee Dee River basin. This plan is available online at the Division of Water Resources website at http://www.dwr.ehnr.state.nc.us or by calling (919) 733-4064.

2.9.2 Water Withdrawals

Prior to 1999, North Carolina required water users to register their water withdrawals with the Division of Water Resources (DWR) only if the amount was 1,000,000 gallons or more of surface water or groundwater per day. In 1999, the registration threshold for all water users except agriculture was lowered to 100,000 gallons per day. Table A-17 presents registered withdrawals.

Table A-17 Registered Water Withdrawals in the Yadkin-Pee Dee River Basin (1997)

County	1999 Average (MGD)	1999 Maximum (MGD)	Source of Withdrawal*	Facility
Anson	0.4	3.4	Island Creek	Hedrich Industries, Inc.
Anson	5.0	5.0	*Bonsal-owned ponds*	W.R. Bonsal Co., Mining Division – Lilesville Mine
Anson	0.0	0.0	Pee Dee River	Martin Marietta Materials, Inc.
Anson	1.3	2.2	Pee Dee River	US Pipeline for Progree Energy – pipeline testing
Cabarrus	0.07	0.07	*Gold Hill Quarry*	Vulcan Construction Materials, L.P.
Davidson	0.13	0.6	Lake on course	Sapona Country Club
Davidson	0.01	0.01	*Thomasville Quarry*	Martin Marietta Materials, Inc.
Davie	0.03	0.04	*Smith Grove Quarry*	Vulcan Construction Materials, L.P.
Forsyth	0.01	0.01	*East Forsyth Quarry*	Vulcan Construction Materials, L.P.
Forsyth	0.04	0.09	*North Quarry*	Vulcan Construction Materials, L.P.
Forsyth	0.01	0.01	*Salem Quarry*	Martin Marietta Materials, Inc.
Iredell	0.0	0.0	Big Kennedy Creek Hunting Creek	Ha-Ho Dairy Farm
Iredell	0.01	0.03	*Statesville Quarry*	Martin Marietta Materials, Inc.
Richmond	0.04	0.07	*Rockingham Quarry*	Vulcan Construction Materials, L.P.
Rowan	255.0	407.5	High Rock Lake	Duke Energy Corporation – Buck Steam Station
Rowan	1.1	1.3	Second Creek	Arteva Specialties SARL d/b/a KOSA – Salisbury
Rowan	1.8	2.9	Yadkin River	Color-Tex, NC Finishing Corp.
Rowan	0.0	0.0	*Woodleaf Quarry*	Martin Marietta Materials, Inc.
Surry	1.7	3.0	Big Elkin Creek	Chatham, Inc.
Surry	0.03	0.03	Yadkin River Elkin Quarry	Vulcan Construction Materials, L.P.
Wilkes	0.06	0.06	*115 Quarry*	Vulcan Construction Materials, L.P.
Wilkes	0.6	0.6	Yadkin River	Frontier Energy, LLC – pipeline testing
Wilkes	1.4	1.8	Yadkin River	Abt Co. at LP Company
Yadkin	0.0	0.0	*Yadkin Quarry*	Martin Marietta Materials, Inc.

* Quarries often contain connections to groundwater, but do not frequently contain direct surface water connections.

There are 24 registered water withdrawals in the North Carolina portion of the Yadkin-Pee Dee River basin. Twelve of these (50 percent) are surface water withdrawals from streams or lakes with a direct surface water connection. Excluding public water systems or power generating facilities (because the water is returned almost immediately), there is a cumulative permitted capacity to withdraw 15.2 million gallons of surface water per day.

Consumption of water from the Yadkin-Pee Dee River basin through direct withdrawals, along with interbasin transfers (discussed in the following section), has the potential to affect the salinity of the lower Pee Dee River near Myrtle Beach, SC. Consideration of the cumulative effects of saltwater intrusion on the lower Pee Dee River should be considered when additional water withdrawals are proposed.

2.9.3 Interbasin Transfers

In addition to water withdrawals (discussed above), water users in North Carolina are also required to register surface water transfers with the Division of Water Resources (DWR) if the amount is 100,000 gallons per day or more. In addition, persons wishing to transfer two million gallons per day (MGD) or more, or increase an existing transfer by 25 percent or more, must first obtain a certificate from the Environmental Management Commission (G.S. 143-215.22I). The river basin boundaries that apply to these requirements are designated on a map entitled *Major River Basins and Sub-Basins in North Carolina*, on file in the Office of the Secretary of State. These boundaries differ slightly from the 17 major river basins delineated by DWQ.

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

- the necessity, reasonableness and beneficial effects of the transfer;
- the detrimental effects on the source and receiving basins, including effects on water supply needs, wastewater assimilation, water quality, fish and wildlife habitat, hydroelectric power generation, navigation and recreation;
- the cumulative effect of existing transfers or water uses in the source basin;
- reasonable alternatives to the proposed transfer; and
- any other facts and circumstances necessary to evaluate the transfer request.

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition.

Table A-18 lists interbasin transfers for the Yadkin-Pee Dee River basin. The DWR map of major river basins, which is used for determining interbasin transfers, considers the South Yadkin River, Rocky River and Uwharrie River (several subbasins under the DWQ system) as major river basins in and of themselves. Therefore, 13 (43 percent) of the transfers listed in the table are between these major tributaries and the Yadkin-Pee Dee River and are still within the hydrologic boundaries of the Yadkin-Pee Dee River basin.

Table A-18 Interbasin Transfers in the Yadkin-Pee Dee River Basin (1997)

Supplying System	Receiving System	Source Subbasin	Receiving Subbasin	Estimated Transfers (MGD)
Anson County	Anson County	Yadkin	Rocky	0.6
Anson County	Marshville	Yadkin	Rocky	0.3
Anson County	Union County	Yadkin	Rocky	0.8
Asheboro	Asheboro	Uwharrie	Deep	4.6
Davidson Water	Davidson Water	Yadkin	Uwharrie	1.1
Davidson Water	Davidson Water	Yadkin	Deep	0.4
Davidson Water	Archdale	Yadkin	Deep	0.2
Winston-Salem	Winston-Salem	Yadkin	Roanoke	0.4
High Point	High Point	Deep	Yadkin	4.4
Montgomery County	Montgomery County	Yadkin	Deep, Lumber, Uwharrie	1.7 (total)
Montgomery County	Star	Yadkin	Deep	Unknown
Salisbury	Salisbury	Yadkin	South Yadkin	0.3
Salisbury	Rowan County	Yadkin	South Yadkin	0.1
Albemarle	Albemarle	Yadkin	Rocky	5.8
Albemarle	Stanly County	Yadkin	Rocky	0.8
Albemarle	Pfeiffer – North Stanly	Yadkin	Rocky	0.1
Norwood	Norwood	Yadkin	Rocky	0.4
Alexander County WC	Taylorsville	South Yadkin	Catawba	0.4
Statesville	West Iredell WC	South Yadkin	Catawba	Unknown
Asheboro	Asheboro	Uwharrie	Deep	4.6
Kannapolis	Kannapolis	Yadkin	Rocky	4.5
Union County	Union County	Catawba	Rocky	3.6
Union County	Monroe	Catawba	Rocky	2
Mooresville	Mooresville	Catawba	Rocky	Unknown
Mooresville	Mooresville	Catawba	South Yadkin	Unknown
Charlotte-Mecklenburg	Charlotte-Mecklenburg	Catawba	Rocky	16.1*
Mocksville	Mocksville	South Yadkin	Yadkin	0.6
Burlington Industries	Mooresville	Catawba	Rocky	0.4

* In March 2002, a Certificate was approved increasing this transfer to 33.0 MGD.

There are 10 transfers out of the Yadkin-Pee Dee River basin which are estimated to be more than 12 MGD. These transfers are primarily into the Deep River which is in the Cape Fear River basin. There are seven transfers into the Yadkin-Pee Dee River basin, primarily from the Catawba River basin. These transfers are estimated at more than 26 MGD. Through interbasin transfer, there is currently a net gain of approximately 14 MGD into the Yadkin-Pee Dee River basin as the boundary is defined by DWQ. Although this gain in volume could be considered a benefit, sometimes there are environmental impacts, such as the introduction of harmful non-native species and the transfer of excess pollution, associated with interbasin transfers.

In August 2001, the Charlotte-Mecklenburg Utilities District (CMUD) petitioned the Environmental Management Commission for an increase in its interbasin transfer from the Catawba River basin to the Yadkin-Pee Dee River basin (Rocky River). CMUD requested an increase from the existing 16.1 MGD to 33 MGD. The need for the increase is due to increasing demand for water supply in eastern Mecklenburg County and an increase in existing discharges at the Mallard Creek WWTP and the Rocky River Regional WWTP in the Yadkin-Pee Dee River basin. The increase to 33 MGD will allow CMUD to meet projected water supply demands through the year 2030 in eastern Mecklenburg County. This interbasin transfer does not include transfers associated with water or wastewater service provided to the Town of Mint Hill in Mecklenburg County. The certificate was approved by the EMC at its regular meeting on March 14, 2002.

Several interbasin transfer requests involving the Yadkin-Pee Dee River basin are being considered by the state. One is for a regional water reclamation facility (Three-County). Plans for this facility include a request by Charlotte-Mecklenburg Utilities for a 12 MGD increase in the transfer from the Catawba River basin to the Yadkin-Pee Dee River basin (Rocky River). This would bring the total transfer amount to 45 MGD. Plans also include a request by Union County to increase its existing transfer of 5 MGD to 30 MGD. This transfer is also from the Catawba River basin into the Rocky River in the Yadkin-Pee Dee. A draft Environmental Impact Statement is currently being considered by DWQ and DWR regarding the Three-County Regional Water Reclamation Facility project. Union County has additional transfer issues from the Catawba River basin to the Yadkin-Pee Dee River basin (Rocky River) which are not associated with the Three-County Regional Water Reclamation Facility. However, additional transfer amounts have not been determined at this time.

Development of alternative water supplies for Concord and Kannapolis will involve interbasin transfers between the Catawba and Yadkin-Pee Dee River basins (Rocky River). There is potential in this exchange for Concord to need two transfer certificates and Kannapolis to need one. However, the alternatives are still being evaluated.

2.9.4 Minimum Streamflow

One of the purposes of the NC Dam Safety Law is to ensure maintenance of minimum streamflows below dams. 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. The Division of Water Resources, 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 summarizes minimum flow requirements below dams in the Yadkin-Pee Dee River basin.

Table A-19 Minimum Streamflow Requirements in the Yadkin-Pee Dee River Basin

Name	Location	Waterbody	Drainage Area (sq. mi.)	Min. Release (cfs)
Dams associated with Power Production				
W. Kerr Scott		Yadkin River	367	125-400[1]
Idols	Near Clemmons	Yadkin River	1,945	554[2]
Yadkin Division of APGI FERC Project No. 2197				
High Rock	Near Denton	Yadkin River	3,973	See Footnote[3]
Tuckertown	Near Richfield	Yadkin River	4,080	Run-of River[4]
Narrows (Badin)	Near Badin	Yadkin River	4,180	See Footnote[3]
Falls	Near Badin	Yadkin River	4,190	Run-of River[4]
Progress Energy-CP&L FERC Project No. 2206				
Tillery		Yadkin River	4,638	40[5]
Blewett Falls		Yadkin River	6,821	150
Cooleemee	Near Cooleemee	South Yadkin River		124[6]
Ledbetter				6.5-9.5[7]
Other Impoundments				
Big Warrior Creek		Big Warrior Creek		0.8
Stewarts Creek	Near Mount Airy	Stewarts Creek		19
Lake Howell		Coddle Creek		6

1 Minimum flow ranges from 125 cfs when reservoir pool level is 1000.0-1003.99 feet to 400 cfs when pool level is at or above 1029 feet.
2 The hydropower facility burned in 1998. See text for further details on minimum flow release, etc.
3 Minimum discharge requirements for the Yadkin Project are measured at the Narrows Powerhouse and vary based on time of year. March 6-May 14: 1,500 CFS; May 15-July 1: 1,610 CFS; July 2-September 15: 1,400 CFS; September 16-March 5: 0 CFS, or streamflow into High Rock Reservoir as requested by Progress Energy – CP&L, FERC Project No. 2206. High Rock Reservoir is the primary storage reservoir for the Yadkin Project. Narrows Reservoir also offers some storage. A drawdown schedule calling first on High Rock Reservoir then Narrows Reservoir is followed during abnormally dry and drought periods. The minimum discharges and drawdown schedule are subject to modification during extended periods of drought.
4 The development usually operates in a run-of-river mode (i.e., inflow equals outflow).
5 Leakage from the dam has been measured by the USGS at 112 cfs.
6 This flow is required in the bypass reach below the dam. Project should operate in a run-of-river mode such that inflow to the dam equals outflow from the powerhouse.
7 Minimum flow requirements are 6.5 cfs when reservoir pool level is more than five feet below the crest and 9.5 cfs when reservoir pool level is less than five feet below the crest.

The Steeles Mill (FERC Project No. 8282) hydropower facility, located near Cordova, is no longer in operation. The request to surrender the federal exemption to operate was granted in 2001. The dam has been mentioned as a candidate for removal by resource agencies.

Instream Flow Studies

The Town of Yadkinville plans to expand water supply withdrawals from South Deep Creek to a capacity of 5.5 MGD and develop off-stream storage to draw from during periods of low flow. The intake is downstream of Highway 601. An instream flow study established a flow target of 15 cfs below the intake. An agreement between DWR and the town establishes a withdrawal limit of 1.7 cfs when streamflow is less than or equal to the 7Q10 (8.4 cfs). The town can withdraw up to the 5.5 MGD capacity when streamflow exceeds 8.4 cfs.

Also in the South Deep Creek watershed, the Yadkin County Soil and Water Conservation District and the Yadkin County Board of Commissioners are sponsoring a proposal for an impoundment upstream of Cranberry Creek. The dam will be subject to the NC Dam Safety Law and will be required to provide a minimum flow of 4.0 cfs (equal to the 7Q10 flow). All permits have been secured and design is underway. Land rights acquisition is in progress with a completion target of September 2002.

The City of Winston-Salem is constructing a new water intake and low-head weir in the Yadkin River to meet future water supply demands. The city will construct riffle habitat downstream of the weir to mitigate the loss of aquatic habitat. A canoe-access primitive camp will also be provided. The city will also coordinate their withdrawals with the US Army Corps of Engineers so as to maintain the river flow target of 554 cfs below Idols dam. The Idols hydropower facility, located near Clemmons, burned in 1998. The City of Winston-Salem and Forsyth County Utility Commission are expected to purchase the dam from the project licensee.

The Town of Pilot Mountain plans to expand water supply withdrawals from Toms Creek to a capacity of 2.25 MGD and develop off-stream storage to draw from during periods of low flow. An agreement between DWR and the town establishes a withdrawal limit of 1.6 MGD when streamflow is less than or equal to the 7Q10 (7.6 cfs). The town can withdraw up to the 2.25 MGD capacity when streamflow exceeds 7.6 cfs.

The City of Statesville proposed to increase their water supply withdrawal from the South Yadkin River. Currently, flow at 23.3 cfs is required downstream of the intake when withdrawals exceed 9 MGD. However, the city also has approval to withdraw 15 MGD of water from Lookout Shoals Reservoir on the Catawba River. When the Lookout Shoals connection is complete, 23.3 cfs will be required continually in the South Yadkin River below the intake.

Hydroelectric Project Relicensing

The license issued by the Federal Energy Regulatory Commission (FERC) to Alcoa Power Generating, Inc. for the operation of the Yadkin Hydroelectric Project (No. 2197) and the license issued to Progress Energy-Carolina Power and Light Company for the operation of the Yadkin-Pee Dee Hydroelectric Project (No. 2206) expire in 2008. The relicensing process is currently in the early stages. Extensive studies related to instream flow and water quality will be completed and the results used to make management decisions regarding these six reservoirs (listed in Table A-19).

2.10 Physical Impacts to Wetlands and Streams

DWQ and the Division of Land Resources regulate construction activities near streams and wetlands. These regulatory programs ensure that construction projects cause minimal damage to these resources and that unavoidable impacts are addressed through mitigation projects. DWQ has issued approvals for wetland filling activities since the mid-1980s; however, in 1989, the Environmental Management Commission directed DWQ to begin reviewing wetland fill and stream alteration activities using a review sequence of (1) avoidance, (2) minimization and (3) mitigation of wetland impacts. Rules finalized in 1996 required that wetland values, such as whether or not the wetland is providing significant uses or whether the filling activity would remove or degrade those uses, be considered. The rules also specify wetland and stream mitigation ratios and type and location of projects to make the mitigation process more predictable and manageable for the regulated community. DWQ's emphasis continues to be on water quality and the essential role that wetlands play in maintaining water quality. The issuance of a 401 Water Quality Certification by DWQ is required before the US Army Corps of Engineers can issue a Section 404 Permit authorizing the fill or alteration of wetlands and/or streams in North Carolina.

Permitted Impacts and Mitigation

Despite efforts to protect and restore wetland and stream functions on the part of DWQ and many other agencies and organizations in North Carolina, there is still an annual net loss of wetlands and streams statewide. DWQ tracks wetland and stream impacts that are authorized through the issuance of a 401 Water Quality Certification. In addition to the permitted wetland and stream impacts that are tracked by DWQ, an unknown amount of permanent wetland and stream losses also occurs. Projects that affect less than one-third of an acre of wetland or less than 150 linear feet of stream are not required to receive written confirmation from DWQ, and therefore, might not be reported. The magnitude of unauthorized impacts to wetlands and streams is not known.

Table A-20 presents permitted wetland and stream impacts by subbasin for the Yadkin-Pee Dee River basin from the DWQ Wetlands/401 Unit database. Miles and acres of required stream and wetland mitigation are also presented. A total of 196 acres of wetland impacts were permitted in the basin between 1997 and 2001. During that period, 276 acres of wetland mitigation were required to compensate for these impacts. About 40 percent of the permitted wetland impacts resulted from road improvement and maintenance projects, including the Rockingham Bypass. The majority of the remaining impacts were permitted for utility projects, construction of farm ponds and subdivision development.

Permitted stream impacts in the basin during the five-year period totaled 88,585 linear feet with 63,003 linear feet of stream restoration required to mitigate for permitted losses during that period. More than 50 percent of these permitted impacts resulted from road improvement and maintenance projects, including the I-85 and US 421 widening projects and the Northern Beltway around Winston-Salem. The remaining impacts are attributed to sewer and utility improvements resulting from new subdivision development.

Table A-20 Permitted Wetland and Stream Impacts and Required Mitigation in the Yadkin-Pee Dee River Basin (1997-2001)

Subbasin	**Permitted Wetland Impacts** (acres)	**Wetland Mitigation** (acres)	**Permitted Stream Impacts** (feet)	**Stream Mitigation** (acres)
03-07-01	2.1	0.0	2,464	385
03-07-02	16.1	23.1	11,373	10,218
03-07-03	0.2	0.0	270	0
03-07-04	14.2	17.4	44,714	39,958
03-07-05	64.8	0.0	90	0
03-07-06	0.9	1.2	3,115	300
03-07-07	2.4	0.0	2,992	1,332
03-07-08	1.3	0.0	3,421	125
03-07-09	0.2	0.0	2,682	3,100
03-07-10	1.5	0.0	1,059	242
03-07-11	18.4	8.5	10,400	4,428
03-07-12	6.7	0.0	4,215	2,167
03-07-13	0.3	0.0	1,095	748
03-07-14	3.2	0.0	142	0
03-07-15	3.5	1.5	165	0
03-07-16	60.0	224.4	318	0
03-07-17	0.0	0.0	70	0
Total	**195.8**	**276.1**	**88,585**	**63,003**

Section A: Chapter 3
Summary of Water Quality Information for the Yadkin-Pee Dee 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 can be grouped 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

- Construction activities
- Roads, parking lots and roof tops
- Agriculture
- Failing septic systems and straight pipes
- Timber harvesting
- Hydrologic modifications

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 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.

Cumulative Effects

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

3.2 Description of Surface Water Classifications and Standards

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

Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table A-21 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina* (NCDENR-DWQ, 2000b). Information, including a database of North Carolina's stream classifications, is also available on DWQ's website at http://h2o.enr.state.nc.us/csu/.

Table A-21 Primary and Supplemental Surface Water Classifications

PRIMARY FRESHWATER AND SALTWATER CLASSIFICATIONS*	
Class	**Best Uses**
C and SC	Aquatic life propagation/protection and secondary recreation.
B and SB	Primary recreation and Class C 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.
Tr	*Trout Waters*: Provides protection to freshwaters for natural trout propagation and survival of stocked trout.
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.

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

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.

Trout Waters

Different water quality standards for some parameters, such as dissolved oxygen, temperature and turbidity, have been developed to protect freshwaters for natural trout propagation and survival of stocked trout. These water quality standards result in more restrictive limits for wastewater discharges to trout waters (Tr). There are no watershed development restrictions associated with the Tr classification. However, the NC Division of Land Resources does require a 25-foot vegetated buffer between Tr waters and graded construction sites.

A state fishery management classification, Designated Public Mountain Trout Waters, is administered by the NC Wildlife Resources Commission. It provides for public access to streams for fishing and regulates fishing activities (seasons, size limits, creel limits, and bait and lure restrictions). Although many of these waters are also classified Tr by DWQ, this is not the same classification.

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.

Criteria for HQW Classification

- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native or special native trout waters by the Wildlife Resources Commission.
- Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
- Waters classified by DWQ as WS-I, WS-II or SA.

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 an approved local erosion and sedimentation control program, and which drain to and are within one mile of HQWs, are required to control runoff from the development using either a low density or high density option. The low density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high density option requires structural stormwater controls. In addition, the Division of Land Resources requires more stringent erosion 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 including one or more of the following:

- an 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;
- within a state or national park or forest; or
- a 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 a 30-foot vegetated buffer or stormwater controls for 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.

Water Supply Watersheds

The purpose of the Water Supply Watershed Protection Program is to provide an opportunity for communities to work with the state to strengthen protection of their water supplies. There are five water supply classifications (WS-I to WS-V) that are defined according to the amount and types of permitted point source discharges, as well as requirements to control nonpoint sources of pollution (Table A-20). Watersheds draining to waters classified WS carry some restrictions on point source discharges and on many land use activities including urban development, agriculture, forestry and highway sediment control. Minimum requirements for WS-I to WS-IV include a 30-foot undisturbed vegetated setback. The WS-I and WS-II classifications are HQW by definition because requirements for these levels of water supply protection are at least as stringent as for HQWs.

Classifications and Standards in the Yadkin-Pee Dee River Basin

There are four watersheds in the Yadkin-Pee Dee River basin that contain Outstanding Resource Waters. In subbasin 03-07-01, the Elk Creek watershed and several streams in the Roaring River watershed are classified ORW. The Mitchell River watershed, in subbasin 03-07-02, is also ORW and is used for primary recreation (Class B). Waters classified ORW in subbasin 03-07-09 are Barnes Creek and its tributaries in the Uwharrie National Forest.

A portion of the Little River, along with the entire Densons Creek watershed in subbasin 03-07-15, is classified High Quality Waters. Bridgers Creek and a portion of Rocky Creek are also HQW. There are many other watersheds in the Yadkin-Pee Dee River basin that contain HQW protection because they are drinking water supplies classified either WS-I or WS-II. In the upper portion of the basin, these include most of the Reddies River watershed and Little Cub Creek in subbasin 03-07-01; the Fisher River watershed and the Elkin Creek watershed in subbasin 03-07-02; the Toms Creek watershed in subbasin 03-07-03; and the headwaters of the South Yadkin River in subbasin 03-07-06.

In the lower portion of the basin, water supply watersheds with HQW protection include Back Creek draining to and including Back Creek Lake, as well as an unnamed tributary to Cedar Fork Creek draining to and including Lake Bunch in subbasin 03-07-09; the Coddle Creek watershed from its source to the City of Concord water supply intake in subbasin 03-07-11; the headwaters of Dutch Buffalo Creek in subbasin 03-07-12; the headwaters of Marks Creek including Water Lake in subbasin 03-07-16; and the headwaters of North Fork Jones Creek draining to Wadesboro City Pond in subbasin 03-07-17.

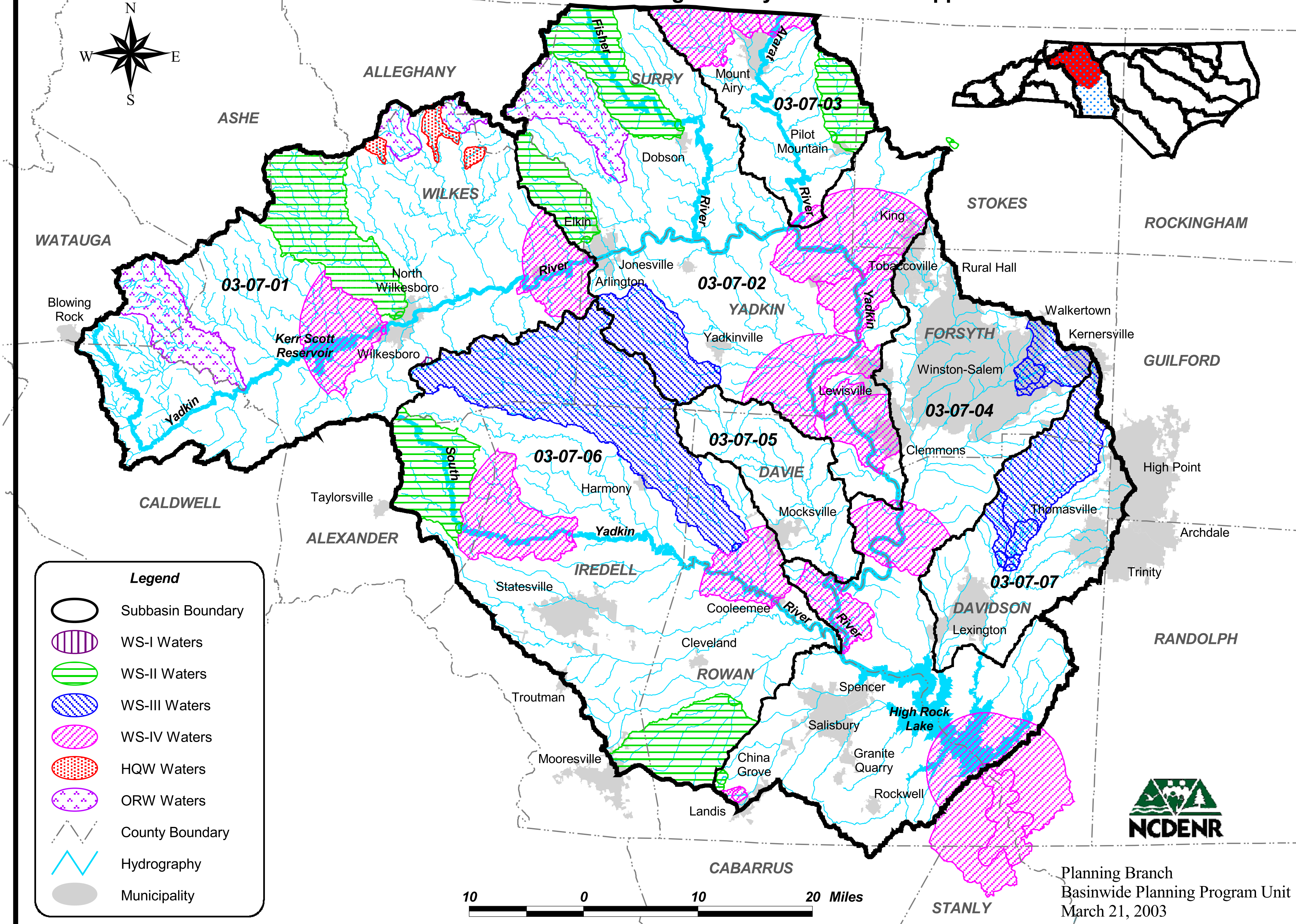
Portions of the Yadkin-Pee Dee River basin that contain these special classifications are shown on Figures A-12 and A-13.

Pending and Recent Reclassifications in the Yadkin-Pee Dee River Basin

In February 2002, the Citizens Against River Pollution requested that a portion of the Uwharrie River be reclassified to B and/or ORW. DWQ is currently completing studies needed to determine whether the proposed waters meet requirements for either or both of these more protective classifications.

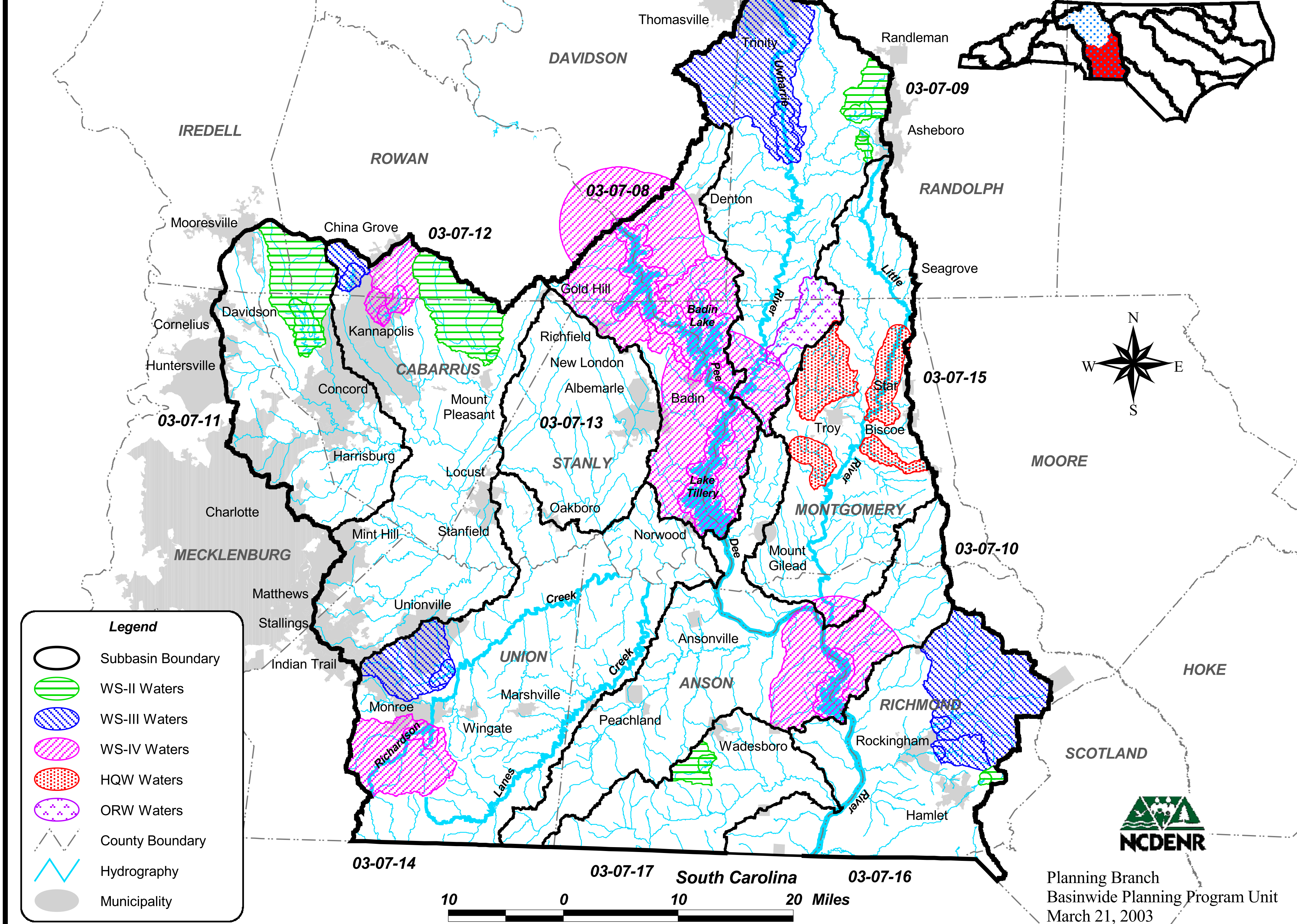
All or part of Hunting Creek, Rocky Creek, Little Hunting Creek, North Little Hunting Creek, and a larger segment of the upper South Yadkin River would likely qualify for either HQW or ORW, but a proposal for reclassification has not yet been received. Biological surveys indicate that the West Fork Little River might also be eligible for reclassification to HQW. Data also indicate that South Fork Jones Creek qualifies for this more protective classification. Citizens, organizations or local governments can recommend waters for reclassification at any time, and DWQ will consider them for these protective classifications.

Figure A-12 Water Supply Watersheds, Outstanding Resource Waters and High Quality Waters in the Upper Yadkin-Pee Dee River Basin



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Figure A-13 Water Supply Watersheds, Outstanding Resource Waters and High Quality Waters in the Lower Yadkin-Pee Dee River Basin



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March 21, 2003

3.3 DWQ Water Quality Monitoring Programs in the Yadkin-Pee Dee River Basin

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

Monitoring programs for the Yadkin-Pee Dee River Basin include:

- benthic macroinvertebrates (Part 3.3.1)
- fish assessments (Part 3.3.2)
- aquatic toxicity monitoring (Part 3.3.3)
- lakes assessment (Part 3.3.4)
- ambient monitoring (Part 3.3.5)
- basin association monitoring (Part 3.3.6)

3.3.1 Benthic Macroinvertebrate Monitoring

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

Criteria have been developed to assign a bioclassification to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies), commonly referred to as EPTs; and a Biotic Index value, which gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina. Bioclassifications fall into five categories ranging from Poor to Excellent.

Extensive evaluation of swamp streams across eastern North Carolina suggests that current coastal plain criteria are not appropriate for assessing the condition of water quality in these special systems. Swamp streams are characterized by slower flow, lower dissolved oxygen, lower pH, and sometimes very complex braided channels and dark-colored water. DWQ is working to refine biological criteria that may be used in the future to assign bioclassifications to these streams. Refer to page 113 of Section A, Chapter 4 for more detailed information.

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

Appendix II lists all the benthic macroinvertebrate collections in the Yadkin-Pee Dee River basin between 1983 and 2001, giving site location, collection date, taxa richness, biotic index values and bioclassifications. Benthic macroinvertebrates have been collected at more than 300 sites in the Yadkin-Pee Dee River basin since 1983. Table A-22 lists the most recent bioclassifications (by subbasin) for all benthos sites in the Yadkin-Pee Dee River basin. Benthos sampling may slightly overestimate the proportion of Fair and Poor sites, as DWQ special studies often have the greatest sampling intensity (number of sites/stream) in areas where it is believed that water quality problems exist.

Table A-22 Summary of Bioclassifications for All Benthic Macroinvertebrate Sites (using the most recent score for each site) in the Yadkin-Pee Dee River Basin

Subbasin	Excellent	Good	Good-Fair	Fair	Poor	Total
03-07-01	12	21	7	0	0	40
03-07-02	7	18	21	2	0	48
03-07-03	0	3	10	4	0	17
03-07-04	0	2	16	9	5	32
03-07-05	0	1	3	3	0	7
03-07-06	11	7	8	4	0	30
03-07-07	0	1	8	12	3	24
03-07-08	0	0	3	2	0	5
03-07-09	6	2	8	0	0	16
03-07-10	0	2	2	1	0	5
03-07-11	0	0	6	5	1	12
03-07-12	0	2	8	10	3	23
03-07-13	0	3	3	6	2	14
03-07-14	0	3	3	6	2	14
03-07-15	9	5	5	1	0	20
03-07-16	2	2	5	2	0	11
03-07-17	0	0	5	1	0	6
Total (#)	**47**	**72**	**121**	**68**	**16**	**324**
Total (%)	**15%**	**22%**	**37%**	**21%**	**5%**	**100%**

Samples over the past five-year planning cycle were almost all collected under severe to extreme drought conditions. Below average precipitation and streamflow tends to concentrate the effects of point sources of pollution while, in many cases, minimizing the effects of nonpoint source pollution. These conditions must be considered when evaluating water quality data. A summary of how drought affects aquatic life and water quality is found on page 102 of this section.

During basinwide surveys in 2001 (not including special study sites), benthic macroinvertebrate communities were sampled at 112 sites. Bioclassifications were not assigned at five sites due to low flow conditions or lack of criteria to properly assess the community. Figure A-14 presents the following bioclassifications: Excellent – 16 (15%), Good – 26 (24%), Good-Fair – 36 (34%), Fair – 26 (24%), Poor – 3 (3%). Excellent benthic macroinvertebrate communities were only found in six of 17 subbasins. The largest number of sites receiving Excellent or Good bioclassifications were located in the upper Yadkin River (subbasins 03-07-01 and 03-07-02) and upper South Yadkin River (subbasin 03-07-06) watersheds. With a few exceptions, Poor and Fair bioclassifications were concentrated in subbasins with large amounts of developed area.

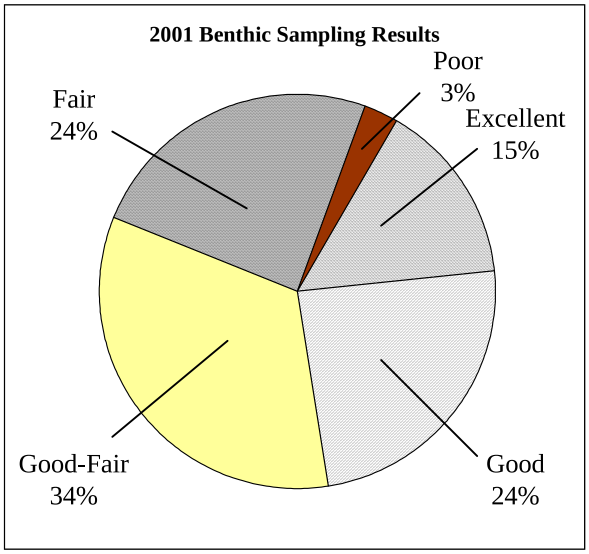


Figure A-14 Bioclassifications for 107 Yadkin-Pee Dee River Basin Benthic Macroinvertebrate Sites Sampled by DWQ in 2001

Figure A-15 presents long-term trends (>5 years of data) in water quality that were evaluated at 108 sites in the Yadkin-Pee Dee River basin. The largest number of sites (87) showed no change in water quality, other than flow-related shifts in community structure. Improving water quality was observed at 11 sites. A decline in water quality was documented at 10 sites which are presented in Table A-23; aquatic life in Grants, Second and Swearing Creeks are now Impaired. The subbasin chapters in Section B discuss all streams in Table A-23 in more detail.

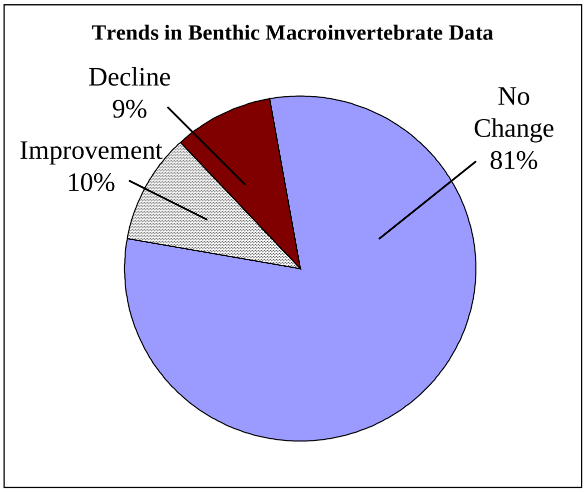


Figure A-15 Summary of Trends over Time in Benthic Macroinvertebrate Data

Table A-23 Benthic Macroinvertebrate Sites Exhibiting a Decline in Bioclassification

Subbasin	Stream	Location	County
03-07-01	Upper Yadkin River	NC 268	Caldwell
03-07-01	Roaring River	SR 1990	Wilkes
03-07-02	Little Fisher River		Surry
03-07-03	Stewarts Creek	NC 89	Surry
03-07-04	Upper Reynolds Creek	Above WWTP	Forsyth
03-07-04	Grants Creek		Rowan
03-07-05	Dutchman Creek		Davie
03-07-06	South Yadkin River	SR 1561	Iredell
03-07-06	Second Creek		Rowan
03-07-07	Swearing Creek	NC 47	Davidson

3.3.2 Fish Assessments

The condition of the fish community is one of the most meaningful indicators of ecological integrity to the public. Fish occupy the upper levels of the aquatic food web and are both directly and indirectly affected by chemical and physical changes in the environment. Water quality conditions that significantly affect lower levels of the food web (such as benthic macroinvertebrates) will affect the abundance, species composition and condition of the fish population. Three types of fish assessments are conducted by DWQ: fish community, fish tissue and information about fish kills.

Scores are assigned to fish community samples using the North Carolina Index of Biotic Integrity (NCIBI). The NCIBI uses a cumulative assessment of 12 parameters or metrics. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Appendix II contains more information regarding the NCIBI.

During the late 1990s, application of the NCIBI has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the DWQ Standard Operating Procedures (NCDEHNR, 1997). DWQ has no Index of Biotic Integrity calculated for fish populations in lakes, and the NCIBI is not used for high elevation trout streams due to their naturally limited fish diversity.

<u>Overview of Fish Community Data</u>

Appendix II lists all of the fish community collections in the Yadkin-Pee Dee River basin between 1990 and 1999, giving site location, collection date and NCIBI rating. Fish community samples have been collected at 86 sites in the Yadkin-Pee Dee River basin since 1990. Table A-24 lists the most recent ratings since 1990, by subbasin, for all fish community sites.

Table A-24 Summary of NCIBI Categories for All Freshwater Fish Community Sites (using the most recent rating for each site) in the Yadkin-Pee Dee River Basin

Subbasin	Excellent	Good	Good-Fair	Fair	Poor	Total
03-07-01	9	7	0	0	0	16
03-07-02	2	4	1	0	0	7
03-07-03	2	0	0	0	0	2
03-07-04	0	0	2	3	1	6
03-07-05	0	1	1	0	0	2
03-07-06	1	1	3	1	2	8
03-07-07	0	0	1	0	1	2
03-07-08	0	1	2	0	0	3
03-07-09	1	1	1	0	0	3
03-07-10	2	3	2	0	0	7
03-07-11	1	1	0	0	1	3
03-07-12	0	3	3	1	0	7
03-07-13	0	1	0	0	0	1
03-07-14	1	1	1	2	0	5
03-07-15	4	5	0	1	0	10
03-07-16	0	1	0	0	0	1
03-07-17	1	1	0	0	1	3
Total (#)	**24**	**31**	**17**	**8**	**6**	**86**
Total (%)	**28%**	**36%**	**20%**	**9%**	**7%**	**100%**

During basinwide surveys in 2001 (not including special study sites), fish communities were sampled at 56 sites. Bioclassifications were not assigned at three sites due to lack of criteria to properly assess the community. Figure A-16 presents the following bioclassifications: Excellent – 15 (28%), Good – 17 (31%), Good-Fair – 13 (25%), Fair – 4 (8%), Poor – 4 (8%).

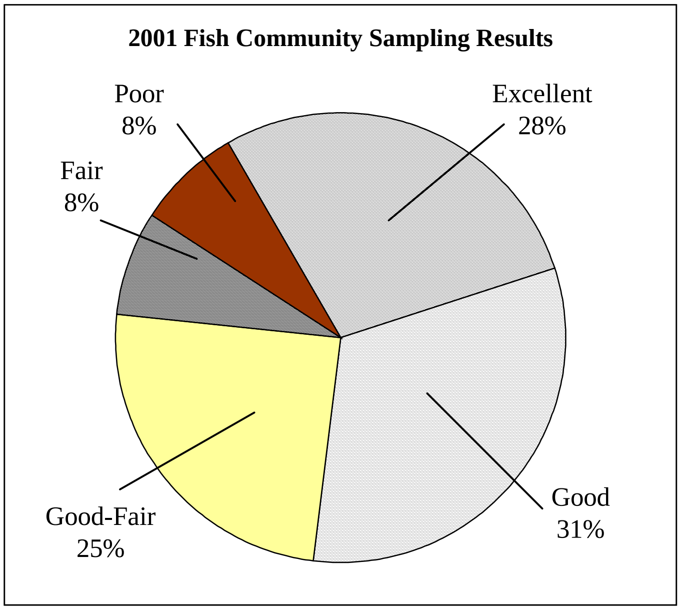


Figure A-16 Bioclassifications for 53 Yadkin-Pee Dee River Basin Fish Community Sites Sampled by DWQ in 2001

Figure A-17 presents long-term trends (5 years of data) in water quality that were evaluated at 35 sites in the Yadkin-Pee Dee River basin. The largest number of sites (17) showed no significant change in water quality. Improving water quality was observed at 13 sites. A decline in water quality was documented at five sites which are presented in Table A-25; aquatic life in Third Creek is now Impaired. The subbasin chapters in Section B discuss all streams in Table A-25 in more detail.

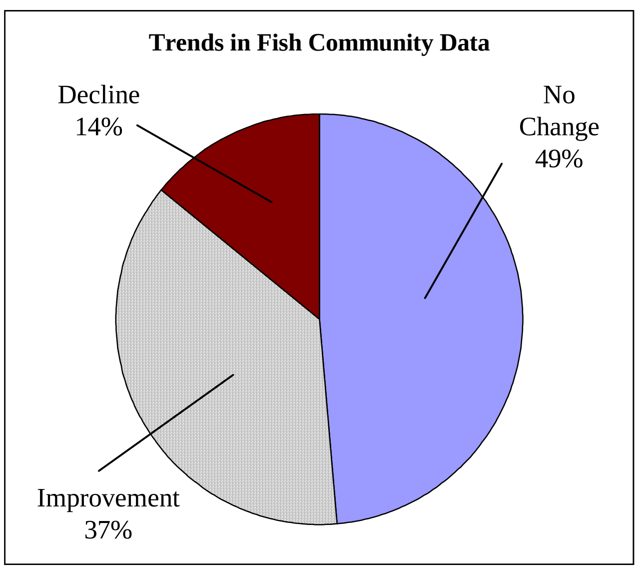


Figure A-17 Summary of Trends over Time in Fish Community Data at 35 Sites

Table A-25 Fish Community Sites Exhibiting a Decline in Bioclassification

Subbasin	Stream	Location	County
03-07-06	Third Creek	SR 1970	Rowan
03-07-08	Mountain Creek	SR 1720	Stanly
03-07-09	Betty McGees Creek	SR 1107	Randolph
03-07-12	Cold Water Creek	NC 73	Cabarrus
03-07-15	West Fork Little River	SR 1311	Montgomery

Overview of Fish Tissue Sampling

Since 1997, fish tissue surveys have been conducted by DWQ at two stations within the basin. Fish samples were collected from the Pee Dee River at US 74 during 1999 and from the Pee Dee River immediately below Blewett Falls Dam during 2000. All metal contaminants, including mercury, were undetectable or at levels below current US Environmental Protection Agency, US Food and Drug Administration, and North Carolina fish consumption criteria.

Significant mercury levels were discovered in fish from Ledbetter Lake in 1993. A fish consumption advisory for largemouth bass due to mercury contamination remains in effect for this lake. Refer to Chapter 16 of Section B (beginning on page 256) for more information.

Yadkin-Pee Dee River Basin Fish Kills

DWQ field investigators reported 19 fish kill events between 1997 and 2001; five of the kills were in small, private lakes or ponds. Kill activity and fish mortality were the highest in 1997 (11 kills affecting 5,250 fish) in the Yadkin-Pee Dee River basin, but levels even in that year are relatively low when compared with other large river basins in North Carolina. Six events (32 percent) were caused by spills. Two spills were related to failing wastewater infrastructure and three were related to failure of agricultural equipment or lagoons. Algae blooms and low dissolved oxygen related to excess nutrients and high temperatures were cited as the cause of five fish kills (26 percent). The cause of 42 percent of kills in the basin over the five-year period is unknown. Fish most often affected were sunfishes, suckers, catfishes and largemouth bass.

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. Figure A-18 presents this summary for the Yadkin-Pee Dee River basin. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge.

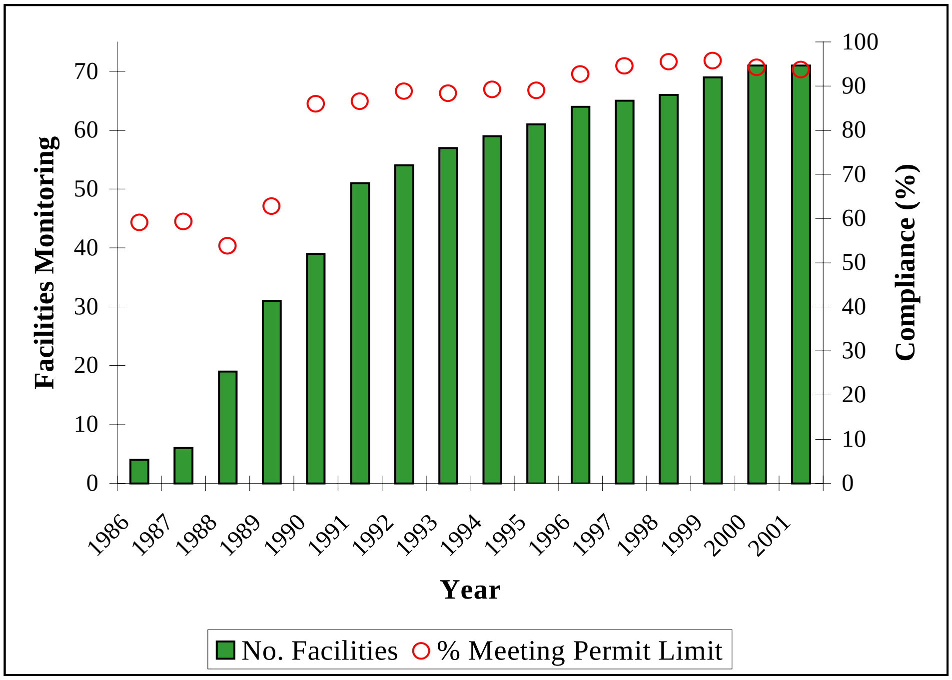


Figure A-18 Summary of Compliance with Aquatic Toxicity Tests in the Yadkin-Pee Dee River Basin

Currently, 80 facilities in the Yadkin-Pee Dee River basin have NPDES permits which require whole effluent toxicity (WET) monitoring. Of these, 77 permits have a WET limit; the other three facility permits have episodic discharges and their permits specify monitoring but with no limit. In addition, six of the facilities with a WET limit were either temporarily inactive or so new that they had not yet provided data as of 2001; therefore, only 71 facilities are represented in Figure A-18.

The number of facilities required to monitor whole effluent toxicity has increased steadily since 1987, the first year that whole effluent toxicity limits were written into permits in North Carolina. The compliance rate has risen as well. Since 1990, the compliance rate has stabilized at approximately 95 percent. Facilities with toxicity problems during the most recent two-year review period are discussed in the subbasin chapters in Section B. A complete listing of facilities that are required to monitor WET is presented in the *Basinwide Assessment Report – Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002).

3.3.4 Lakes Assessment Program

Twenty-six lakes in the basin were monitored as part of the Lakes Assessment Program between 1999 and 2001. Each lake was sampled one to three times during the summer months. There were a variety of water quality concerns documented during this time period. Appendix II contains surface physical data and photic zone chemistry data (1994-2001) for each lake.

Sixteen lakes in the basin exhibited symptoms of excessive nutrient loading, including elevated dissolved oxygen and pH values, documented algae blooms, and green or brownish-green colored water. Most nutrient inputs appeared to be from nonpoint sources (i.e., storm runoff from agricultural lands and urban areas). Elevated nutrient inputs increase the likelihood of blooms of nuisance blue-green algae that, in turn, reduce the aesthetic appearance of the lake, cause taste and odor problems in drinking water, and diminish the appeal of recreational activities such as swimming.

Sediment loading is also a problem in this river basin. Excess sediment reduces the storage capacities of lakes over time, introduces nutrients, and reduces aesthetic appeal by giving the water a muddy appearance. Soils of the Yadkin-Pee Dee River basin are highly erodible. The most notable example of this problem can be seen in the upper end of High Rock Lake. Winston Lake and Lake Concord also show signs of accelerated sedimentation.

Elevated levels of manganese, iron and zinc were occasionally observed in a few lakes throughout the basin. All of these metals are naturally occurring in piedmont soils and do not represent significant threats to the use of these lakes. Eight lakes had copper concentrations above the state water quality standard (7 µg/l). Five of these lakes (Wright, Corriher, Twitty, Water and Wadesboro City Pond) had been treated for algal blooms using copper sulfate prior to, or during, the summer sampling events. Only one sample at the other three lakes (High Rock, Thom-A-Lex and Kannapolis) exceeded the standard. These results are not considered to represent significant threats to the uses of these lakes.

High Rock Lake, Lake Thom-A-Lex and Back Creek Lake are all impaired due to supersaturated dissolved oxygen (DO) conditions. Excessive DO saturation is defined in North Carolina's water quality standards as greater than 110 percent. There are two concerns related to percent DO saturation: 1) the potential for "gas bubble disease" in aquatic life; and 2) excessive algal photosynthesis. Fish exposed to water with an excessive concentration of dissolved oxygen are killed when the dissolved gases in their circulatory system come out of solution to form bubbles that block the flow of blood through the capillary vessels. In shallow water systems, excessive saturation is even more deadly due to the restricted movement of the fish. Even when gas bubble disease does not occur, intermittent exposure of fish to highly saturated waters can be stressful, possibly depressing the fish's immune system and contributing to increased susceptibility of other diseases. Other aquatic life may also be impacted. Daphnia die within a few days at exposures of 115 percent saturation. Stoneflies have increased mortality at 130 percent saturation (EPA, 1986).

In terms of algal blooms, percent saturation in combination with other eutrophication-related parameters (chloropyll *a*, pH, DO) can be an early warning sign of blooms. For instance, most blue-green algae are low in chlorophyll *a* and may reach bloom proportions long before exceeding the chloropyll *a* standard. However, as they reach bloom levels, they photosynthesize - increasing the dissolved oxygen in the water and raising the percent saturation. Percent DO saturation for High Rock Lake ranged from 148 to 157 percent between 1999 and 2001. Subbasin chapters in Section B contain further discussion of the water quality condition of each of these impaired lakes.

Concerns that warrant additional follow-up were documented for three lakes:

- Nuisance levels of aquatic macrophytes continue to be observed in Rockingham City Lake.
- Hamlet City Lake was drained during the monitoring period for the last basinwide planning cycle. It has since been refilled, and sampling in 2000 indicates that the lake is still experiencing problems due to aquatic macrophytes and possibly increased sedimentation.
- Badin Lake experienced fish kills and poor water quality conditions in 2000 and 2001. Fish kills primarily involved striped bass, bream and catfish. Some of these fish had small sores and appeared to be emaciated. [DWQ conducted a special study of Badin Lake in 2002. Chapter 8 of Section B (page 191) contains details.]

Due to quality assurance issues with laboratory analyses for chlorophyll *a* from 1996 through February 2001, only a few of the lakes have 2001 NCTSI scores. No NCTSI scores were calculated for 1996-2000. Lakes for which one or more uses are Impaired are listed in Table A-36 on page 87 and are discussed in the appropriate subbasin chapter in Section B.

3.3.5 Ambient Monitoring System

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 46 stations in the Yadkin-Pee Dee River basin. These locations are listed in Appendix II and shown on the individual subbasin maps in Section B. Each is sampled monthly for 27 parameters.

<u>Dissolved Oxygen</u>

During this assessment period (9/1996-8/2001), dissolved oxygen fell below 5.0 mg/l in more than 10 percent of samples at eight stations. Two stations are on streams that exhibit characteristics of swamp streams (Marks Creek and Brown Creek), which include naturally lower dissolved oxygen, and are located in the small Coastal Plain portion of the basin. Rich Fork and Abbotts Creek are Impaired, primarily due to problems with point source discharges, and are discussed in more detail in Section B, Chapter 7. The four remaining stations are on the Yadkin-Pee Dee River mainstem; three are directly below hydroelectric facilities. Figure A-19 presents dissolved oxygen concentrations for all stations along the Yadkin-Pee Dee River mainstem over the assessment period. Table A-26 summarizes dissolved oxygen data for the four mainstem stations at which more than 10 percent of samples contained concentrations less than 5.0 mg/l. During the last part of the monitoring period (1999-2001), the Yadkin-Pee Dee River basin was experiencing a severe drought. Refer to page 102 for details about the relationship between drought and water quality.

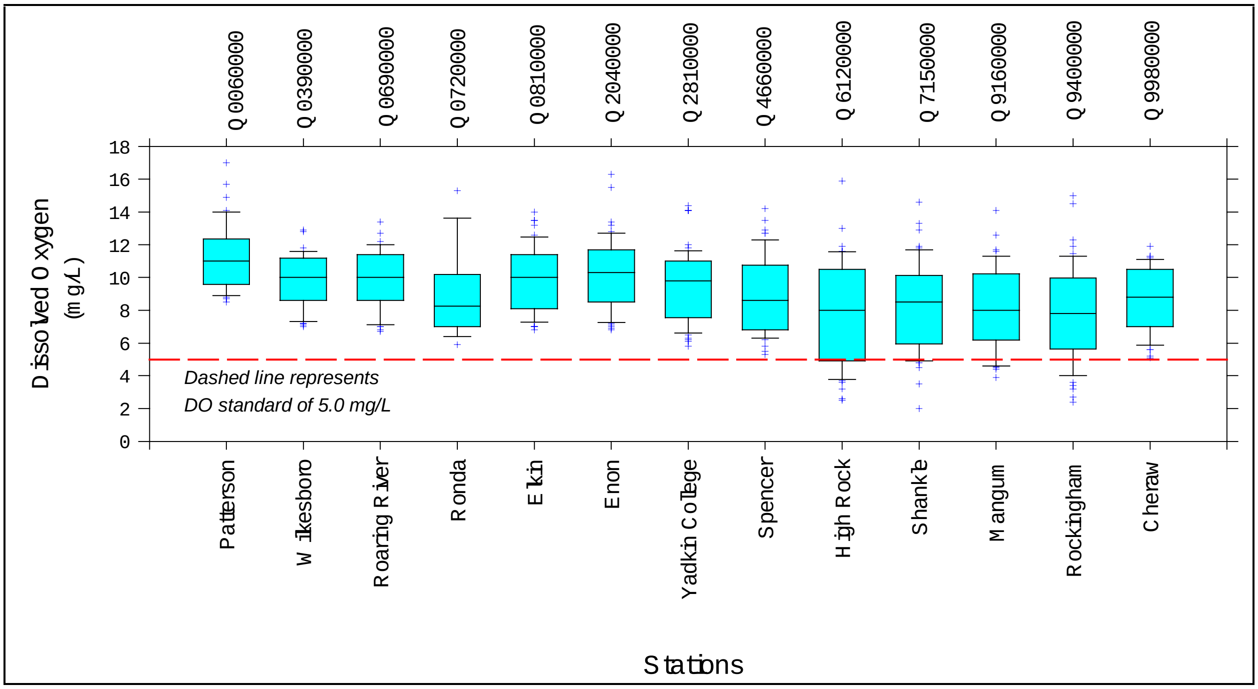


Figure A-19 Summary of Dissolved Oxygen Concentrations for the Mainstem Yadkin-Pee Dee River (9/1996-8/2001)

Table A-26 Summary of Dissolved Oxygen Data for Four Yadkin-Pee Dee River Mainstem Ambient Monitoring Stations (9/1996-8/2001)

Station	Location	No. of samples used in %	% of samples <4.0 mg/l	% of samples <5.0 mg/l
Q6120000	Yakin River below High Rock dam	48	10.4	25.0
Q7150000	Pee Dee River below Lake Tillery dam	57	3.5	10.5
Q9160000	Pee Dee River at NC 109	53	1.9	11.3
Q9400000	Pee Dee River below Blewett Falls	55	9.1	18.2

No trend in dissolved oxygen concentrations (increasing or decreasing) at these stations can be discerned over the last 20 years. However, the Pee Dee River below Blewett Falls (Q9400000) has recently begun to show an increasing frequency of measurements less than 5.0 mg/l. These data warrant further observation as additional data are collected.

Although data from the Uwharrie River at NC 109 (Station Q6810000) showed no long-term trends in dissolved oxygen, it is within this assessment period that the only measurements less than 5.0 mg/l were observed. Four of the 55 samples (7.3 percent) collected during this assessment period contained dissolved oxygen in concentrations less than 5.0 mg/l. During the previous assessment period (1992-1996), the minimum concentration observed at this station was 6.9 mg/l. The Uwharrie River is discussed in more detail in Section B, Chapter 10.

Seventeen stations showed abnormally elevated (greater than 15.0 mg/l) concentrations of dissolved oxygen over the assessment period.

Turbidity

More than 10 percent of samples exceeded turbidity water quality standards at 11 stations in the Yadkin-Pee Dee River basin within this assessment period (9/1996-8/2001). Table A-27 summarizes turbidity data for these stations over the assessment period. Stations situated in the arms of reservoirs had the greatest proportion of samples exceeding the turbidity standard. The only station in classified Trout waters is the Yadkin River at NC 268; turbidity there exceeded the standard of 10 NTU in 23 percent of the samples. The frequency of which the standard was exceeded also increased at this station during the assessment period.

Table A-27 Summary of Turbidity Data for Ambient Monitoring Stations at which 10 Percent of Samples Exceeded the Water Quality Standard (9/1996-8/2001)

Station	Subbasin	Location	Classification	No. of Samples Used in %	% > than the Turbidity Standard
Q0060000	03-07-01	Yadkin River at NC 268	Tr	44	22.7
Q1950000	03-07-03	Ararat River at SR 2080	WS-IV	56	12.5
Q2040000	03-07-02	Yadkin River at SR 1605	WS-IV	58	10.3
Q3460000	03-07-06	South Yadkin River	WS-IV	55	10.9
Q4600000	03-07-04	Grants Creek near mouth	C	56	10.7
Q4660000	03-07-04	Yadkin River at NC 150	WS-V	55	10.9
Q5360000	03-07-04	Town Creek Arm of High Rock Lake	WS-V	55	27.3
Q5970000	03-07-04	Abbotts Creek Arm of High Rock Lake at NC 47	WS-V & B	56	26.8
Q5999000	03-07-04	Abbotts Creek Arm of High Rock Lake at SR 2295	WS-V & B	45	26.7
Q7330000	03-07-11	Rocky River at SR 2420	C	56	10.7
Q8090000	03-07-12	Irish Buffalo Creek	C	57	10.5

* Turbidity standard = 10 NTU for trout waters; 25 NTU for reservoirs; and 50 NTU for all other stations.

Turbidity data collected since 1980 were examined for long-term patterns. Decreases in the long-term data were noted for a few stations, and an increase was noted for the Yadkin River at NC 268 (Station Q0060000).

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 and are therefore found in their wastes. Coliform bacteria are relatively easy to identify and are usually present in larger numbers than more dangerous pathogens, even though they respond to the environment and to treatment in much the same way. Sources of fecal coliform bacteria, as well as other more dangerous pathogens, include runoff from pastures, feedlots, poultry operations and lagoons that do not employ appropriate best management practices. Other sources include straight pipes, leaking and failing septic systems, and noncompliant WWTPs. Wildlife and pet waste also contribute to elevated concentrations of pathogens.

Five streams that are classified by DWQ for primary recreation (Class B) contain ambient monitoring stations. Elk Creek is the only one that had a geometric mean greater than 200 colonies per 100 ml over the assessment period. Table A-28 presents all stations with geometric means greater than 200 colonies/100ml. Stations where 20 percent or more of samples contained concentrations greater than 400 colonies/100ml are also presented. These waters are discussed in more detail in the subbasin chapters in Section B.

Table A-28 Ambient Monitoring Stations with Fecal Coliform Geometric Means Greater than 200 Colonies/100ml or with 20 Percent of Samples Greater than 400 Colonies/100ml in the Yadkin-Pee Dee River Basin

Station	Location	Classification	No. of Samples Used in Mean	Geometric Mean	% >400 col/100ml
Q0690000	Yadkin River at SR 2327	WS-V	42	117	23.8
Q0220000	Elk Creek at NC 268	B ORW	11	220	--
Q2510000	Salem Creek at Elledge WWTP	C	56	773	71.4
Q2600000	Muddy Creek at SR 2995	C	55	488	49.1
Q4660000	Yadkin River at NC 150	WS-V	58	104	20.7
Q3460000	South Yadkin River at SR 1159	WS-IV	54	398	44.4
Q3484000	Hunting Creek at SR 2115	WS-III	56	234	33.9
Q3435000	Fourth Creek at SR 2308	C	56	504	51.8
Q3934500	Third Creek at SR 1970	WS-IV	57	375	56.1
Q4120000	Second Creek at US 70	WS-IV	57	309	33.3
Q4600000	Grants Creek near mouth	C	57	291	36.8
Q5930000	Abbotts Creek at SR 1243	C	50	149	22.0
Q5780000	Rich Fork at SR 1800	C	52	254	32.7
Q7330000	Rocky River at SR 2420	C	57	249	33.3
Q8090000	Irish Buffalo Creek at SR 1132	C	56	234	26.8
Q8210000	Rocky River at US 601	C	55	234	21.8
Q8360000	Goose Creek at SR 1524	C	57	241	26.3

Nutrients

The term nutrients in this document refers to the two major plant nutrients: nitrogen and phosphorus. Three different forms of nitrogen are monitored by DWQ under the ambient monitoring program. They are NH_3 or ammonia, NO2+NO3 or nitrite/nitrate nitrogen, and TKN or total nitrogen. Eleven stations exhibited elevated concentrations of both phosphorus and nitrogen over the most recent assessment period (9/1996-8/2001). Generally, concentrations were higher in the Yadkin River above High Rock Lake than in the mainstem river at all stations downstream. Stations with elevated nutrients were clustered in the upper Rocky River and the Abbotts Creek watersheds. However, Richardson Creek contained the highest concentrations of phosphorus and nitrite/nitrate nitrogen of any station in the basin.

Few statistically significant long-term patterns were evident when all available nutrient data were examined. The Roaring River (Q0600000) and the Yadkin River near Elkin (Q0810000) showed increasing concentrations for nitrite/nitrate nitrogen, but most values were still less than 0.75 mg/l. Many stations depicted a dramatic decrease in concentration for nutrients during the 1970s and 1980s. Jones Creek (Q9777000) showed a significant decrease in nitrite/nitrate nitrogen beginning in late 1992.

Metals

Arsenic, cadmium, chromium, nickel, lead and mercury were detectable (i.e., greater than the reporting level) in less than one percent of sample results over the most recent assessment period. Nickel and lead were detectable at several stations, but no station showed more than 10 percent of samples greater than the appropriate action level. Nickel concentrations, from waters classified as drinking water supplies, exceeded the action level of 25 µg/l only once at one station (Station Q2810000; 34 µg/l).

Metals that typically had a sufficient number of detectable values were aluminum, copper, iron, manganese and zinc. Aluminum and iron are elements commonly observed to exceed their action levels; but these elements are found naturally in the clay-based soils of the piedmont, and aquatic life seem to be generally adapted to the observed levels (verified by biological sampling or toxicity testing). For copper, 35 stations had more than 10 percent of samples greater than the action level (7.0 µg/l). However, there were only three streams where the median concentrations exceeded 7.0 µg/l: Ararat River, Long Creek and Hamby Creek. Zinc was observed to exceed its action level (50 µg/l) at many stations. However, laboratory or sampling-related contamination may have produced higher than expected values of zinc between April 1995 and March 1999. Median values for all stations were less than 50 µg/l except for the station on Muddy Creek (Q2600000) where a median of 61 µg/l was reported.

Manganese samples are now required to be collected from all waters with water supply classifications (WS-I through WS-V). However, not all stations with this classification have a sufficient number of samples to provide any confidence in a statistical summary. Only Abbotts Creek at NC 47 exceeded the action level of 200 µg/l.

3.3.6 Yadkin-Pee Dee River Basin Association Monitoring Program

The Yadkin-Pee Dee River Basin Association (YPDRBA) formed in 1998 is comprised of 36 members representing local governments, industries and others that own and operate facilities requiring NPDES permits for discharging wastewater. A Memorandum of Agreement with DWQ allows the basin association to conduct all instream sampling (using an independent contractor) and perform all required analyses (using a state-certified lab) such that each facility that participates does not have to conduct individual sampling in order to meet the NPDES permit monitoring requirements. Under this agreement, monitoring sites and parameters sampled are strategically located and established such that instream monitoring basinwide is more efficient and effective.

Approximately 70 sites (listed in Appendix II) have been sampled on a monthly basis since June 1998. Since June 1998, monthly measurements (at minimum, some stations are sampled more frequently) of temperature, pH, dissolved oxygen, conductivity, turbidity and fecal coliform bacteria have been collected at each site. A few stations were also sampled for selected nutrients and metals.

Because the YPDRBA only began water quality monitoring in June 1998, the data represent only a portion of the DWQ assessment period (9/1996-8/2001). Overall streamflow has decreased since 1998 due to drought conditions, and these low flows often present a very different water quality scenario. In addition, some YPDRBA stations are located downstream of wastewater treatment plants in dissolved oxygen sag zones. Therefore, some caution should be used in making comparisons between data collected by the DWQ ambient monitoring program and the YPDRBA monitoring program during this basinwide planning cycle.

Dissolved Oxygen

Dissolved oxygen fell below 5.0 mg/l in more than 10 percent of samples at 10 YPDRBA stations between June 1998 and August 2001. Three stations duplicate DWQ ambient monitoring stations. During this monitoring period (1999-2001), the Yadkin-Pee Dee River basin was experiencing a severe drought. Refer to page 102 for details about the relationship between drought and water quality. Table A-29 summarizes dissolved oxygen data for stations where dissolved oxygen levels are of concern to DWQ. These streams are discussed in more detail in the appropriate subbasin chapter in Section B.

Table A-29 Summary of Dissolved Oxygen Data for Stations of Concern Collected by the Yadkin-Pee Dee River Basin Association (6/1998-8/2001)

Station	**Subbasin**	**Location**	**No. of Samples used in %**	**% of Samples <4.0 mg/l**	**% of Samples <5.0 mg/l**
Q3105000*	03-07-05	Dutchman Creek at US 64	53	3.8	9.4
Q3555000*	03-07-06	Bear Creek at SR 1116	53	1.9	5.7
Q5785000*	03-07-07	Rich Fork Creek at SR 1787	93	2.2	20.4
Q5790000*	03-07-07	Rich Fork Creek at SR 2123	94	2.1	14.9
Q5940000	03-07-07	Abbotts Creek at I-85	93	5.4	9.7
Q5980000*	03-07-04	Abbotts Creek at NC 47 (duplicates DWQ ambient site)	92	1.1	6.5
Q6180000*	03-07-08	UT to Lick Creek near Denton	50	30.0	42.0
Q6705000	03-07-10	Uwharrie River at NC 49	52	1.9	15.4
Q8340000*	03-07-12	UT to Clear Creek at SR 3104	85	7.1	17.6
Q8342000*	03-07-12	Clear Creek at US 601	93	1.9	7.5
Q8360000*	03-07-12	Goose Creek at SR 1524 (duplicates DWQ ambient site)	93	3.2	8.6
Q8386000*	03-07-12	N Fork Crooked Creek at SR 1520	85	5.9	17.6
Q8386200*	03-07-12	N Fork Crooked Creek at SR 1514	93	1.1	10.8
Q8800000	03-07-14	Richardson Creek at SR 1751	93	1.1	15.1
Q8820000*	03-07-14	Richardson Creek at SR 1006	93	1.1	8.6
Q9021300	03-07-14	Lanes Creek at SR 1005	53	43.4	54.7
Q9400000	03-07-16	Pee Dee River below Blewett Falls (duplicates DWQ ambient site)	61	4.9	16.4

* These monitoring stations are directly downstream of wastewater treatment plant discharges. Several of them are within the dissolved oxygen sag zone.

Turbidity

More than 10 percent of samples exceeded turbidity water quality standards at 13 YPDRBA monitoring stations within this assessment period (6/1998-8/2001). Table A-30 summarizes turbidity data for these stations. Turbidity at four mainstem Yadkin River monitoring locations exceeded the water quality standard in 13-21 percent of samples collected. Water from both the South Yadkin River (mostly to agricultural land use) and the upper end of North Fork Crooked Creek (mostly developed/urban land use) exceeded turbidity standards in approximately 24 percent of samples. Six sites are located in the upper Rocky River watershed.

Table A-30 Summary of Turbidity Data for YPDRBA Monitoring Stations of Concern

Station	Subbasin	Location	Classification	No. of Samples Used in %	% > than the Turbidity Standard
Q1350000	03-07-02	Yadkin River at SR 1003	WS-IV	38	15.8
Q2180000	03-07-02	Yadkin River at US 158	WS-IV	38	13.2
Q2810000	03-07-04	Yadkin River at US 64 (duplicates DWQ ambient site)	WS-IV CA	38	21.1
Q4660000	03-07-04	Yadkin River at US 150 (duplicates DWQ ambient site)	WS-V	38	18.4
Q3105000	03-07-05	Dutchman Creek at US 64	C	38	13.2
Q3735000	03-07-06	Fourth Creek at SR 2308 (duplicates DWQ ambient site)	C	38	13.2
Q3970000	03-07-06	S Yadkin River at US 601	C	38	23.7
Q7600000	30-07-11	Rocky River at SR 1304	C	38	13.2
Q8385000	03-07-12	Rocky River at SR 1606	C	38	13.2
Q8386000	03-07-12	N Fork Crooked Cr at SR 1520	C	33	24.2
Q8386200	03-07-12	N Fork Crooked Cr at SR 1514	C	38	13.2
Q8388000	03-07-12	Crooked Creek at NC 218	C	38	15.8
Q8388900	03-07-12	Crooked Creek at ST 1601	C	38	21.1

* Turbidity standard = 10 NTU for trout waters; 25 NTU for reservoirs; and 50 NTU for all other stations.

Fecal Coliform

Table A-31 presents all YPDRBA stations with geometric means greater than 200 colonies/100ml between 1998 and 2001. Stations where 20 percent or more of samples contained concentrations greater than 400 colonies/100ml are also presented. No monitoring of waters classified by DWQ for primary recreation (Class B) is currently conducted by the association.

Table A-31 YPDRBA Monitoring Stations with Fecal Coliform Geometric Means Greater than 200 Colonies/100ml or with 20 Percent of Samples Greater than 400 Colonies/100ml in the Yadkin-Pee Dee River Basin

Station	Location	No. of Samples Used in Mean	Geometric Mean	% >400 col/100ml
Q0450000	Yadkin River at US Bus 421	38	323	44.7
Q1710000	Ararat River	38	180	34.2
Q1725000	Ararat River	38	185	23.7
Q1935000	Ararat River	38	166	31.6
Q2090000	N Deep Creek at SR 1605	38	423	47.4
Q2120000	N Deep Creek	36	297	30.6

Q2135000	S Deep Creek	38	268	21.1
Q2291000	Muddy Creek at I-40	38	265	21.1
Q2479455	Salem Creek	38	307	42.1
Q2540000	Salem Creek	38	327	39.5
Q2570000	Salem Creek at 2991	38	368	39.5
Q2720000	Muddy Creek	38	255	23.7
Q2810000	Yadkin River at US 64	38	118	23.7
Q3105000	Dutchman Creek at US 64	38	572	55.3
Q3555000	Bear Creek	38	382	39.5
Q3720000	Fourth Creek at SR 2316	38	543	63.2
Q3735000	Fourth Creek	38	306	44.7
Q3900000	Third Creek	38	314	50.0
Q3932000	Third Creek at 2359	38	294	28.9
Q3970000	South Yadkin River	38	225	21.1
Q4030000	Second Creek	38	359	47.4
Q41650000	Second Creek	38	194	21.1
Q4540000	Grants Creek at 3rd St. Ext.	38	282	34.2
Q4600000	Grants Creek	37	231	21.6
Q5135000	Swearing Creek	38	295	31.6
Q5750000	Rich Fork	38	330	44.7
Q5785000	Rich Fork	38	236	21.1
Q5790000	Rich Fork	38	169	21.1
Q6180000	UT Lick Creek	37	291	29.7
Q7210000	Clarks Creek	37	136	21.6
Q7330000	Rocky River at SR 2420	38	433	44.7
Q7450000	Rocky River at NC 29	38	243	23.7
Q7600000	Rocky River at 1304	38	300	21.1
Q8200000	Coldwater Creek at SR 1132	38	290	28.9
Q8340000	UT Clear Creek at SR 3104	36	325	52.8
Q8342000	Clear Creek at US 601	38	464	50.0
Q8355000	Rocky River at SR 1606	38	124	21.1
Q8359000	Goose Creek at SR 4228	38	988	84.2
Q8360000	Goose Creek	38	412	42.1
Q8386000	N Fork Crooked Cr at SR 1520	33	349	42.4
Q8386200	N Fork Crooked Cr at SR 1514	38	318	28.9
Q8388000	Crooked Creek	38	210	28.9
Q8388900	Crooked Creek at SR 1601	38	290	34.2
Q8800000	Richardson Creek	38	105	21.1
Q9400000	Toms Branch	36	285	30.6

3.4 Other Water Quality Research

North Carolina actively solicits "existing and readily available" data and information for each basin as part of the basinwide planning process. Data meeting DWQ quality assurance objectives are used in making use support determinations. Data and information indicating possible water quality problems are investigated further. Both quantitative and qualitative information are accepted during the solicitation period. High levels of confidence must be present in order for outside quantitative information to carry the same weight as information collected from within DWQ. This is particularly the case when considering waters for the 303(d) list. Methodology for soliciting and evaluating outside data is presented in North Carolina's *Draft Water Quality Assessment and Impaired Waters List* (NCDENR-DWQ, June 2002).

DWQ data solicitation includes the following:

- Information, letters and photographs regarding the uses of surface waters for boating, drinking water, swimming, aesthetics and fishing.
- Raw data submitted electronically and accompanied by documentation of quality assurance methods used to collect and analyze the samples. Maps showing sampling locations must also be included.
- Summary reports and memos, including distribution statistics and accompanied by documentation of quality assurance methods used to collect and analyze the data.

Contact information must accompany all data and information submitted.

In addition to the Yadkin-Pee Dee River Basin Association monitoring program data that are discussed in the previous section, five sets of data and information were submitted during the most recent data solicitation period. John Cardarelli submitted an electronic database of volunteer monitoring data for Salem and Dunegan Creeks. Electronic data from instream monitoring of Rich Fork were submitted by the City of High Point. The Forsyth County Department of Environmental Affairs submitted electronic data from University of North Carolina at Asheville studies as well as a summary report on many streams in the Muddy Creek watershed. Information about current and future land-disturbing activities in the South Yadkin River watershed was submitted by Keep Iredell Clean, and the Mecklenburg County Department of Environmental Protection also submitted electronic data.

The next data solicitation period for the Yadkin-Pee Dee River is planned for fall 2005.

3.5 Use Support Summary

3.5.1 Introduction to Use Support

Surface waters are classified according to their best intended uses. Determining how well a waterbody supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality.

Surface waters are currently rated as *Supporting* or *Impaired*. These ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and recreation) are being met. For example, waters classified for aquatic life protection and secondary recreation (Class C for freshwater) are rated Supporting if data used to determine use support meet certain criteria. However, if these criteria were not met, then the waters would be rated as Impaired. Waters with inconclusive data are listed as Not Rated. Waters lacking data are listed as No Data.

In previous use support assessments, surface waters were rated fully supporting (FS), partially supporting (PS) and not supporting (NS). FS was used to identify waters that were meeting their designated uses. Impaired waters were rated PS and NS, depending on their degree of degradation. NR was used to identify waters lacking data, or having inconclusive data. In response to a request presented in the EPA's *2002 Integrated Water Quality Monitoring and Assessment Report Guidance*, North Carolina no longer subdivides the Impaired category.

Historically, the Supporting use support rating was also subdivided into fully supporting (FS) and fully supporting but threatened (ST). ST was used to identify waters that were fully supporting but had some notable water quality concerns and could represent constant, degrading or improving water quality 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 demonstrate 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 the EPA and North Carolina definitions of ST and the resulting confusion that arose from this difference, North Carolina no longer subdivides the Supporting category. However, these waters and the specific water quality concerns are identified in the Section B subbasin chapters so that data, management and the need to address the identified concerns are presented.

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the development of use support ratings for six categories: aquatic life and secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the six use support categories. For many waters, a use support category will not be applicable (N/A) to the use classification of that water (e.g., water supply is only applied to Class WS waters). This method of determining use support differs from that done prior to 2000; there is no longer an *overall* use support rating for a water. For more detailed information regarding use support methodology, refer to Appendix III.

3.5.2 Comparison of Use Support Ratings to Streams on the Section 303(d) List

Section 303(d) of the Clean Water Act requires states to identify waters not meeting standards. EPA must then provide review and approval of the listed waters. A list of waters not meeting standards is submitted to EPA biennially. Waters placed on this list, termed the 303(d) list, require the establishment of total maximum daily loads (TMDLs) intended to guide the restoration of water quality. See Appendix IV for a description of 303(d) listing methodology.

Waters are placed on North Carolina's 303(d) list primarily due to an Impaired use support rating. These use support ratings are based on biological and chemical data and, for some categories, human health advisories. When the state water quality standard 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 bioclassifications or water quality standards.

The 303(d) list and accompanying data are updated as the basinwide plans are revised and as TMDL investigations are performed. 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 standards are being met.

3.5.3 Use Support Ratings for the Yadkin-Pee Dee River Basin

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (5,862.2) and lake acres (22,987.6) in the North Carolina portion of the Yadkin-Pee Dee River basin. Table A-32 presents use support ratings by subbasin for both monitored and evaluated waters in the aquatic life/secondary recreation category.

Approximately 37 percent of stream miles (2,181.8) and 91 percent of lake acres (21,020.1) were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle (Table A-33). Impaired waters account for 17 percent of monitored stream miles and 56 percent of monitored lake acres. Refer to page 87 for details regarding Impaired waters in all use support categories.

Table A-32 Aquatic Life/Secondary Recreation Use Support Ratings for Monitored and Evaluated Waters Listed by Subbasin (1997-2001)

Subbasin	Units	Supporting	Impaired	Not Rated	No Data	Total
03-07-01	Miles Acres	653.1 1,043.4	0.0 0.0	0.0 0.0	213.2 0.0	**866.3** **1,043.4**
03-07-02	Miles Acres	380.3 8.4	0.0 0.0	0.0 0.0	335.6 126.5	**715.9** **134.9**
03-07-03	Miles Acres	124.8 0.0	11.7 0.0	0.0 0.0	36.3 14.1	**172.8** **14.1**
03-07-04	Miles Acres	69.3 275.3	48.2 10,449.7	3.3 71.0	317.2 341.3	**438.0** **11,137.3**
03-07-05	Miles Acres	48.2 41.6	0.0 0.0	6.3 0.0	78.6 0.0	**133.1** **41.6**
03-07-06	Miles Acres	320.4 7.7	67.1 0.0	34.7 0.0	262.1 0.0	**684.3** **7.7**
03-07-07	Miles Acres	52.8 52.5	65.9 889.9	7.1 0.0	77.5 0.0	**203.3** **942.4**
03-07-08	Miles Acres	59.2 2,498.8	13.5 0.0	0.0 2,550.0	82.3 0.0	**155.0** **5,048.8**
03-07-09	Miles Acres	108.1 69.6	27.3 354.8	0.6 45.0	138.8 0.0	**274.8** **469.4**
03-07-10	Miles Acres	99.4 0.0	15.3 0.0	28.5 2,570.0	184.0 13.6	**327.2** **2,583.6**
03-07-11	Miles Acres	41.5 5.1	53.0 0.0	0.0 0.0	124.4 16.6	**218.9** **21.7**
03-07-12	Miles Acres	94.8 0.0	33.6 0.0	1.3 697.0	187.4 25.1	**317.1** **722.1**
03-07-13	Miles Acres	76.0 0.0	0.0 0.0	11.9 0.0	50.5 0.0	**138.4** **0.0**
03-07-14	Miles Acres	162.7 0.0	37.3 0.0	2.5 347.0	289.0 0.0	**491.5** **347.0**
03-07-15	Miles Acres	237.1 18.5	0.0 0.0	19.8 0.0	131.2 0.0	**388.1** **18.5**
03-07-16	Miles Acres	69.4 98.9	6.3 0.0	30.7 273.0	110.7 0.0	**217.1** **371.9**
03-07-17	Miles Acres	62.3 0.0	0.0 0.0	0.6 76.2	57.5 7.0	**120.4** **83.2**
TOTAL	**Miles** **Acres**	**2,659.4** **4,119.8**	**379.2** **11,694.4**	**147.3** **6,629.2**	**2,676.3** **544.2**	**5,862.2** **22,987.6**
Percent	Miles	45.4%	6.5%	2.5%	45.6%	100%
Percent	Acres	17.9%	50.9%	28.8%	2.4%	100%

Table A-33 Aquatic Life/Secondary Recreation Use Support Summary Information for Waters in the Yadkin-Pee Dee River Basin (2001)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles or Acres	%		Miles or Acres	%
Supporting	**2,659.4 mi 4,119.8 ac**	**45.4% 17.9 %**		**1,655.3 mi 2,696.5 ac**	**75.9% 12.8%**
Impaired	**379.2 mi 11,694.4 ac**	**6.5% 50.9 %**		**379.2 mi 11,694.4 ac**	**17.4% 55.6%**
Not Rated	**147.3 mi 6,629.2 ac**	**2.5% 28.8 %**		**147.3 mi 6,629.2 ac**	**6.7% 31.5%**
No Data	**2,676.3 mi 544.2 ac**	**45.6% 2.4 %**			
TOTAL	**5,862.2 mi 22,987.6 ac**			**2,181.8 mi 21,020.1 ac**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Fish Consumption

Like the aquatic life/secondary recreation use support category, fish consumption is also applied to all waters in the state. Fish consumption use support ratings are based on fish consumption guidelines issued by the NC Department of Health and Human Services. Therefore, if a fish consumption advisory is posted at the time of the use support assessment, the water is rated Impaired. For details about how use support determinations are made, refer to Appendix III.

Due to high levels of mercury in three freshwater and four saltwater fish species, the NC Division of Public Health has issued broad health advice for consumption of these fish caught south and east of Interstate 85. In addition, a specific fish consumption advisory is posted for largemouth bass from Ledbetter Lake due to elevated mercury concentrations. For details about these advisories, refer to the discussion beginning on page 104. Table A-34 presents use support ratings by subbasin for all waters in the fish consumption use support category.

Fish tissue was monitored in only 0.1 percent of stream miles (6.3) and 0.3 percent of lake acres (67.0) during this basinwide planning cycle. A basinwide summary of current fish consumption ratings is presented in Table A-35. Fish tissue samples were collected from the Pee Dee River at US 74 during 1999 and from the Pee Dee River immediately below Blewett Falls Dam during 2000. All metal contaminants, including mercury, were undetectable or at levels below current US Environmental Protection Agency, US Food and Drug Administration, and North Carolina fish consumption criteria. However, significant mercury levels were discovered in fish from Ledbetter Lake in 1993.

Table A-34 Fish Consumption Use Support Ratings for Monitored and Evaluated Waters Listed by Subbasin (1997-2001)

Subbasin	Units	Supporting	Impaired	Total
03-07-01	Miles Acres	866.3 1,043.4	0.0 0.0	**866.3** **1,043.4**
03-07-02	Miles Acres	715.9 134.9	0.0 0.0	**715.9** **134.9**
03-07-03	Miles Acres	172.8 14.1	0.0 0.0	**172.8** **14.1**
03-07-04	Miles Acres	352.7 301.8	85.3 10,835.5	**438.0** **11,137.3**
03-07-05	Miles Acres	133.1 41.6	0.0 0.0	**133.1** **41.6**
03-07-06	Miles Acres	684.3 7.7	0.0 0.0	**684.3** **7.7**
03-07-07	Miles Acres	146.6 86.7	56.7 855.7	**203.3** **942.4**
03-07-08	Miles Acres	0.0 0.0	155.0 5,048.8	**155.0** **5,048.8**
03-07-09	Miles Acres	0.0 0.0	274.8 469.4	**274.8** **469.4**
03-07-10	Miles Acres	0.0 0.0	327.2 2,583.6	**327.2** **2,583.6**
03-07-11	Miles Acres	152.5 21.7	66.4 0.0	**218.9** **21.7**
03-07-12	Miles Acres	0.0 0.0	317.1 722.1	**317.1** **722.1**
03-07-13	Miles Acres	0.0 0.0	138.4 0.0	**138.4** **0.0**
03-07-14	Miles Acres	0.0 0.0	491.5 347.0	**491.5** **347.0**
03-07-15	Miles Acres	0.0 0.0	388.1 18.5	**388.1** **18.5**
03-07-16	Miles Acres	0.0 0.0	217.1 371.9	**217.1** **371.9**
03-07-17	Miles Acres	0.0 0.0	120.4 83.2	**120.4** **83.2**
TOTAL	Miles Acres	**3,224.2** **1,651.9**	**2,638.0** **21,335.7**	**5,862.2** **22,987.6**
Percent	Miles	55.0%	45.0%	100%
Percent	Acres	7.2%	92.8%	100%

Table A-35 Fish Consumption Use Support Summary Information for Waters in the Yadkin-Pee Dee River Basin (2001)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles or Acres	%		Miles or Acres	%
Supporting	**3,224.2 mi** **1,651.9 ac**	**55.0%** **7.2%**		**0.0 mi** **0.0 ac**	**0.0%** **0.0%**
Impaired	**2,638.0 mi** **21,335.7 ac**	**45.0%** **95.8%**		**6.3 mi** **67.0 ac**	**100.0%** **100.0%**
TOTAL	**5,862.2 mi** **22,987.6 ac**			**6.3 mi** **67.0 ac**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Primary Recreation

There are 218 stream miles and 15,314 lake acres currently classified for primary recreation in the Yadkin-Pee Dee River basin. Primary recreation use support ratings are based on swimming advisories issued by the NC Department of Health and Human Services. Currently, there is one swimming advisory posted for a portion of Elk Creek in subbasin 03-07-01. This stream is discussed in detail in Chapter 1 of Section B. Table A-36 presents use support ratings by subbasin for all waters in the primary recreation category.

Approximately 28 percent of stream miles (61.5) and 97 percent of lake acres (14,886.4) were monitored for the protection of primary recreation by DWQ over the past five years (Table A-37). Impaired waters account for 14.5 percent of monitored stream miles.

Table A-36 Primary Recreation Use Support Ratings for Monitored and Evaluated Waters Listed by Subbasin in Miles (1997-2001)

Subbasin	Units	Supporting	Impaired	No Data	Total
03-07-01	Miles Acres	19.9 948.7	9.1 0.0	49.9 0.0	**78.9** **948.7**
03-07-02	Miles Acres	30.0 0.0	0.0 0.0	22.8 17.6	**52.8** **17.6**
03-07-03	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-04	Miles Acres	0.0 4,880.9	0.0 0.0	3.0 359.5	**3.0** **5,240.4**
03-07-05	Miles Acres	0.0 0.0	0.0 0.0	18.9 41.6	**18.9** **41.6**
03-07-06	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-07	Miles Acres	11.0 855.7	0.0 0.0	0.0 0.0	**11.0** **855.7**
03-07-08	Miles Acres	5.0 5,048.8	0.0 0.0	9.0 0.0	**14.0** **5,048.8**
03-07-09	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-10	Miles Acres	20.0 3,152.3	0.0 0.0	8.4 8.6	**28.4** **3,160.9**
03-07-11	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-12	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-13	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-14	Miles Acres	0.0 0.0	0.0 0.0	6.4 0.0	**6.4** **0.0**
03-07-15	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
03-07-16	Miles Acres	0.0 0.0	0.0 0.0	4.5 0.0	**4.5** **0.0**
03-07-17	Miles Acres	0.0 0.0	0.0 0.0	0.0 0.0	**0.0** **0.0**
TOTAL	Miles Acres	**85.9** **14,886.4**	**9.1** **0.0**	**122.9** **427.3**	**217.9** **15,313.7**
Percent	Miles	39.4%	4.2%	56.4%	100%
Percent	Acres	97.2%	0.0%	2.8%	100%

Table A-37 Primary Recreation Use Support Summary Information for Waters in the Yadkin-Pee Dee River Basin (2001)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored and Evaluated Waters*		Monitored Waters Only**	
	Miles or Acres	**%**	**Miles or Acres**	**%**
Supporting	**85.9 mi 14,886.4 ac**	**39.4% 97.2%**	**52.4 mi 14,886.4 ac**	**85.2% 100.0%**
Impaired	**9.1 mi 0.0 ac**	**4.2% 0.0%**	**9.1 mi 0.0 ac**	**14.5% 0.0%**
No Data	**122.9 mi 427.3 ac**	**56.4% 2.8%**		
TOTAL	**217.9 mi 15,313.7 ac**		**61.5 mi 14,886.4 ac**	

* = Percent based on total of all streams, both monitored and evaluated. ** = Percent based on total of all monitored streams.

Water Supply

There are 1,655.6 stream miles and 21,549.0 lake acres currently classified for water supply in the Yadkin-Pee Dee River basin. All were evaluated within the past five years; all are fully supporting. A basinwide summary of current water supply use support ratings is presented in Table A-38.

Table A-38 Water Supply Use Support Summary Information for Waters in the Yadkin-Pee Dee River Basin (2001)

Water Supply Use Support Ratings	Evaluated Waters	
	Miles	**%**
Supporting	**1,655.6 mi 21,549.0 ac**	**100% 100%**
Impaired	**0.0 mi 0.0 ac**	**0% 0%**
Not Rated	**0.0 mi 0.0 ac**	**0% 0%**
TOTAL	**1,655.6 mi 21,549.0 ac**	

Impaired Waters

Table A-39 presents Impaired waters (in all categories), listed by subbasin, in the Yadkin-Pee Dee River basin. Ratings for each applicable use support category are shown, even though only one use may be Impaired. Descriptions of Impaired segments, as well as potential causes and sources, are outlined in Appendix III. Maps showing current use support ratings are presented in the appropriate subbasin chapter in Section B, along with a discussion of management strategies.

Table A-39 Monitored Impaired Waters within the Yadkin-Pee Dee River Basin (as of 2000)[1]

Impaired Water[1]	Subbasin	Chapter in Section B	Classification[2]	Use Support Categories/Rating– Impaired Miles (or Acres): Aquatic Life/ Secondary Recreation	Fish Consumption	Primary Recreation	Water Supply	Potential Sources
Elk Creek	03-07-01	1	B ORW	S	S	I – 9.1 mi	*N/A*	NP
Lovills Creek	03-07-03	3	WS-IV, C	I – 4.2 mi	S	*N/A*	S	NP, P
Faulkner Creek	03-07-03	3	C	I – 6.1 mi	S	*N/A*	*N/A*	NP
Heatherly Creek	03-07-03	3	C	I – 4.2 mi	S	*N/A*	*N/A*	P, NP
Muddy Creek	03-07-04	4	C	I – 15.2 mi	S	*N/A*	*N/A*	NP
Salem Creek	03-07-04	4	C	I – 12.0 mi	S	*N/A*	*N/A*	NP, P
Grants Creek	03-07-04	4	C	I – 1.2 mi	S	*N/A*	*N/A*	P, NP
Town Creek	03-07-04	4	C	I – 15.4 mi	S	*N/A*	*N/A*	NP, P
High Rock Lake	03-07-04	4	WS-V, WS-IV B	I – 15,750.0 ac	I*	S	S	NP, P
South Yadkin River	03-07-06	6	C	I – 5.3 mi	S	*N/A*	*N/A*	NP, P
Fourth Creek	03-07-06	6	C	I – 29.3 mi	S	*N/A*	*N/A*	NP, P
Third Creek	03-07-06	6	C	I – 22.1 mi	S	*N/A*	*N/A*	NP, P
Second Creek	03-07-06	6	C	I – 10.4 mi	S	*N/A*	*N/A*	NP, P
Lake Thom-A-Lex	03-07-07	7	WS-III	I – 650.0 ac	S	*N/A*	S	NP
Abbotts Creek	03-07-07	7	C	I – 8.0 mi	I*	*N/A*	*N/A*	NP, P
Rich Fork	03-07-07	7	C	I – 20.1 mi	I*	*N/A*	*N/A*	P
Hamby Creek	03-07-07	7	C	I – 11.1 mi	I*	*N/A*	*N/A*	P
North Hamby Creek	03-07-07	7	C	I – 5.8 mi	I*	*N/A*	*N/A*	NP
Swearing Creek	03-07-07	7	C	I – 14.3 mi	S	*N/A*	*N/A*	NP
Yadkin River	03-07-08	8	WS-IV B	I – 0.8 mi	I*	S	S	Dam
Lick Creek	03-07-08	8	C, WS-IV	I – 7.7 mi	I*	*N/A*	S	NP
Little Mountain Creek	03-07-08	8	C, WS-IV	I – 5.7 mi	I*	*N/A*	S	P

				Use Support Categories/Rating– Impaired Miles (or Acres)				
Impaired Water[1]	**Subbasin**	**Chapter in Section B**	**Classification**[2]	**Aquatic Life/ Secondary Recreation**	**Fish Consumption**	**Primary Recreation**	**Water Supply**	**Potential Sources**
Uwharrie River	03-07-09	9	C	I – 26.7 mi	I*	*N/A*	*N/A*	Dam
Back Creek Lake	03-07-09	9	WS-II	I – 250.0 ac	I*	*N/A*	S	NP
Pee Dee River	03-07-10	10	WS-V B	I – 15.3 mi	I*	S	S	Dam, P
Rocky River	03-07-11 03-07-12	11, 12	C	I – 42.6 mi	I*	*N/A*	*N/A*	P, NP
Dye Branch	03-07-11	11	C	I – 4.4 mi	I*	*N/A*	*N/A*	NP, P
Coddle Creek	03-07-11	11	C	I – 14.5 mi	I*	*N/A*	*N/A*	NP
Goose Creek	03-07-12	12	C	I – 13.1 mi	I*	*N/A*	*N/A*	P, NP
Duck Creek	03-07-12	12	C	I – 9.7 mi	I*	*N/A*	*N/A*	NP
North Fork Crooked Cr	03-07-12	12	C	I – 12.0 mi	I*	*N/A*	*N/A*	NP, P
Richardson Creek	03-07-14	14	C	I – 9.9 mi	I*	*N/A*	*N/A*	NP, P
Lanes Creek	03-07-14	14	C	I – 36.8 mi	I*	*N/A*	*N/A*	NP
Ledbetter Lake	03-07-16	16	WS-III	ND	I	*N/A*	S	NP
Pee Dee River	03-07-16	16	C	I – 6.3 mi	I[3]	*N/A*	*N/A*	Dam

* These waters are Impaired because of broad, mercury-related fish consumption health advice for three freshwater fish species. However, the waters are not monitored for the fish consumption category during this basinwide cycle. Refer to page 104 for further information.

S	Supporting	ND	No Data	P	Point Sources
I	Impaired	N/A	Not Applicable	NP	Nonpoint Sources

Notes

1 These waters are currently, or will be placed, on the 303(d) list, and a TMDL and/or management strategy will be developed to address causes and sources of impairment. Refer to Appendix IV for further information regarding 303(d) listing methodology.

2 An index for DWQ freshwater classifications can be found on page 54 of this section (Table A-20).

3 Analysis of fish tissue samples, collected by DWQ in 1999 and 2000 from the Pee Dee River at two locations, revealed one largemouth bass with elevated levels of mercury. No other species or sample contained elevated levels of any metals tested. Refer to Appendix II for details of fish tissue assessment in the Yadkin-Pee Dee River basin.

Section A: Chapter 4
Water Quality Issues Related to Multiple Watersheds in the Yadkin-Pee Dee River Basin

4.1 Overview

This chapter discusses water quality issues that relate to multiple watersheds within the basin. Habitat degradation, including sedimentation, which results from a variety of activities in the watershed, is the most prevalent water quality problem in the Yadkin-Pee Dee River basin. Other issues related to water quality include fish tissue contamination, population growth and urbanization. There are also a wide variety of concerns related to water quantity and flow management.

4.2 Habitat Degradation

Instream habitat degradation is identified in the use support summary (Appendix III) 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 exhibits 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. Although DWQ and other agencies are starting to address this issue, local efforts are needed 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 need to be addressed to further improve water quality in North Carolina's streams and rivers.

4.2.1 Sedimentation

Introduction

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 timber harvesting 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 (NCDENR-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 aquatic insects that fish feed upon and buries fish habitat that is vital to reproduction. Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998).

Suspended sediment can decrease primary productivity (photosynthesis) by shading sunlight from aquatic plants, affecting the overall productivity of a stream system. Suspended sediment also has several effects on various fish species including avoidance and redistribution, reduced feeding efficiency, and therefore, reduced growth by some species, respiratory impairment, reduced tolerance to diseases and toxicants, and increased physiological stress (Roell, June 1999). Suspended sediment also increases the cost of treating municipal drinking water.

During 1999 basinwide monitoring, DWQ aquatic biologists reported streambank erosion and sedimentation throughout the Yadkin-Pee Dee River basin that was moderate to severe. 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 (NCDENR-DWQ, June 2002).

Some Best Management Practices

Agriculture

- Using no till or conservation tillage practices
- Fencing livestock out of streams and rivers
- Leaving natural buffer areas around small streams and rivers

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
- Replanting vegetation on disturbed areas
- Leaving natural buffer areas around small streams and rivers

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. 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 to protect water quality. Where programs are not effective, as evidenced by a violation of instream water quality standards, and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this entails 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 page 37). An erosion and sediment control plan must also be developed and approved 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.

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Chapter 113A, Article 4 referred to as "SPCA"). However, forestry operations may be exempted from the permit requirements in the SPCA, if the operations meet compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0101-.0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S. 77-13 and G.S. 77-14). Detailed information is available on the Water Quality Section of the DFR's website at http://www.dfr.state.nc.us.

For agricultural activities which are not subject to the SPCA, sediment controls are carried out on a voluntary basis through programs administered by several different agencies (see Appendix VI for further information).

Stronger Rules for Sediment Control

The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. 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 (NCDENR-DLR, July-September 1999):

- 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 (NCDENR-DLR, July-September 1999):

- 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 de-watering 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.

For information on North Carolina's Erosion and Sedimentation Control Program or to report erosion and sedimentation problems, visit the new website at http://www.dlr.enr.state.nc.us/ or you may call the NC Division of Land Resources, Land Quality Section at (919) 733-4574.

Recent Review of Sediment Control Research

The two most popular sediment control devices are silt fences and sediment basins. In 2001, DWQ staff conducted a review of peer-reviewed research publications and consulted with experts at NC State University (NCSU) to investigate the effectiveness of current sediment and erosion control practices. In addition, engineering calculations have been conducted to obtain theoretical effectiveness of sediment basins and silt fences. Research conducted in North Carolina showed that construction sites in North Carolina produce 10-188 tons per acre per year of sediment. Such wide variation might be attributed to the significant spatial and temporal differences in rainfall intensity and duration, soil characteristics, slope, and the type of soil cover. DLR currently uses the assumption that (on average) construction sites produce 84 tons/acre-year. For comparison, erosion in undisturbed natural systems is only 0.1-0.2 tons/acre-year.

Currently, sediment basins are designed to have 1,800 cubic feet of storage space for each acre of disturbed land. Based on the reference review and consultation, DWQ has concluded that these basins have numerous deficiencies, including:

1. Insufficient volume. [Pennsylvania requires 5,000 cubic feet; Maryland and Virginia require 3,600 cubic feet.]
2. Inadequate cleaning frequency. [In many cases, effectiveness of the basins is significantly reduced because they are only cleaned once a year.]
3. Short-circuiting. [In many cases, inlet and outlet in basins are constructed in very close proximity, which results in a shorter than predicted retention time.]
4. Water is not being removed from the surface where concentration of the sediment is the lowest.
5. Basins are designed with consideration of only cleared land. [In many cases, basins are treating runoff from the entire drainage area, which is significantly larger than that of cleared land.]

A sedimentation basin that is ideally designed and constructed is only able to capture 55 percent of all sediment in runoff. As a result, each acre of cleared land will deliver 38 tons of sediment to the waterways each year. After six months of operation, the effectiveness of the sediment basin will be reduced to 33 percent and the loss of sediment will approach 56 tons/acre-year.

Silt fences are even less effective. A typical silt fence can capture only 22 percent of all particles in runoff. Very often, they are improperly installed and receive inadequate maintenance that results in further reduction in their effectiveness.

New research indicates that use of new technologies such as installation of baffles in the sediment basins, application of flocculents, and use of skimmers can significantly increase efficiency of sedimentation basins. Experiments conducted at NCSU demonstrated that the current turbidity standard of 50 NTU (for waters not classified Tr) can be achieved in runoff if these devices are used. However, the most important factor in reducing sedimentation is timely cover of cleared land with mulches or use of the flocculent solutions to prevent erosion. It has been conclusively proven that use of ground cover (temporary or permanent) dramatically reduces erosion rates.

Instream Mining Operations

The composition of the streambed and banks is an important facet of stream character, influencing channel form and hydraulics, erosion rates, sediment supply and other parameters. Channel bed and bank materials determine the extent of sediment transport and provide the means of dissipating energy in a stream or river. For a stream to be stable it must be able to consistently transport its sediment load, both in size and type, associated with local deposition and scour. Channel instability occurs when the scouring process leads to degradation (deepening or lowering channel elevation) or excess sediment results in aggradation (filling or raising channel elevation) (Rosgen, 1996).

In addition to physical stream changes, sedimentation and increased turbidity also can accrue from mining activities, wash water discharge, and storm runoff from active or abandoned mining sites. Other effects may include higher stream temperatures and reduced dissolved oxygen, lowering of the water table, and decreased wet periods in riparian wetlands. Expansion of a mine site or mining at a new site is often preceded by riparian forest clearing, which can affect instream habitat and contribute to bank instability (Meador and Layher, November 1998).

Two Types of Instream Mining Permits

Sand Dipping – Removes sand from the river bottom through the use of a dragline (a crane with a bucket) that sits on the riverbank. There is potential for large amounts of vegetation to be removed from the riverbank with this type of mining operation.

Sand Dredging – Hydraulically removes sand from the river bottom through the use of a floating dredge and a suction pump.

Processing typically includes screening and grading sand in wash water (usually stream water), and discharging the wash water into settling pits before releasing it back into the stream (Meador and Layher, November 1998).

The Division of Land Resources' (DLR) Mining Program "provide(s) for the mining of mineral resources while ensuring the usefulness, productivity and scenic value of all lands and waters" in North Carolina. DLR issues permits for two types of instream mining which are described in the text box: sand dipping and sand dredging. Typically, instream mining permits for sand dipping operations are issued for five years, and sand dredging operations are permitted for ten years. As of May 2002, there are approximately 17 permitted sand dredging operations and 12 permitted sand dipping operations in the Yadkin-Pee Dee River basin (NCDENR-DLR, January 16, 2003).

4.2.2 Loss of Riparian Vegetation

During 1999 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Yadkin-Pee Dee River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas as well as in urban areas (NCDENR-DWQ, June 2002).

Removing trees, shrubs and other vegetation to plant grass or place rock (also known as riprap) 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. Some fish require cooler water temperatures as well as the higher levels of dissolved oxygen cooler water provides. 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.

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 entrenchment 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 (EPA, 1999).

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, February 2002). To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

4.2.3 Loss of Instream Organic Microhabitats

Organic microhabitat (leafpacks, sticks and large wood) and edge habitat (root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of benthic macroinvertebrates, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Yadkin-Pee Dee River basin is directly related to the absence of riparian vegetation (refer to Part 4.2.2 above). Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed.

4.2.4 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Typical modifications are described in the text box. Although increased flooding, bank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996).

Direct or immediate biological effects of channelization include injury and mortality of benthic macroinvertebrates, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in benthic macroinvertebrate, fish and wildlife community structures, favoring species that are more tolerant of or better adapted to the altered habitat (McGarvey, 1996).

> ***Typical Channel Modifications***
>
> - Removal of any obstructions, natural or artificial, that inhibit a stream's capacity to convey water (clearing and snagging).
> - Widening, deepening or straightening of the channel to maximize conveyance of water.
> - Lining the bed or banks with rock or other resistant materials.

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

Channelization of streams within the continental United States is extensive and promises to become even more so as urban development continues. Overall estimates of lost or altered riparian habitats within US streams are as high as 70 percent. Unfortunately, the dynamic nature of stream ecosystems makes it difficult (if not impossible) to quantitatively predict the effects of channelization (McGarvey, 1996). Channelization has occurred historically throughout the Yadkin-Pee Dee River basin and continues to occur in some watersheds, especially in small headwater streams.

4.2.5 Recommendations for Reducing Habitat Degradation

In March 2002, Environmental Management Commission (EMC) sent a letter to the Sedimentation Control Commission (SCC) expressing seven recommendations for improving erosion and sedimentation control, based on a comprehensive performance review of the turbidity standard conducted in 2001 by DWQ staff (refer to page 91 for a summary). Specifically the recommendations are that the EMC and SCC:

1. Evaluate, in consultation with the Attorney General's Office, whether statutory authority is adequate to mandate temporary ground cover over a percentage of the uncovered area at a construction site within a specific time after the initial disturbance of the area. If it is found that statutory authority does not exist, then the EMC and SCC should prepare resolutions for the General Assembly supporting new legislation to this effect.
2. Prepare resolutions supporting new legislation to increase the maximum penalty allowed in the Sedimentation Pollution Control Act from $5,000 to $25,000 for the initial response to a noncompliant site.
3. Jointly support a review of the existing Erosion and Sediment Control Planning and Design Manual by DLR. This review should include, but not be limited to, a redesign of the minimum specifications for sedimentation basins.

4. Evaluate, in consultation with the Attorney General's Office, whether the statutory authority is adequate for effective use of the "Stop Work Order" tool and, if found not to be adequate, to prepare resolutions for the General Assembly supporting new legislation that will enable staff to more effectively use the "Stop Work Order" tool.
5. Support increased research into and experimentation with the use of polyacrylamides (PAMs) and other innovative soil stabilization and turbidity reduction techniques.
6. Jointly support and encourage the awarding of significant monetary penalties for all activities found to be in violation of their Stormwater Construction General Permit, their Erosion and Sediment Control Plan, or the turbidity standard.
7. Hold those individuals who cause serious degradation of the environment through excessive turbidity and sedimentation ultimately responsible for restoration of the area.

DWQ will continue to work cooperatively with DLR and local programs that administer sediment control 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 Yadkin-Pee Dee River basin.

Additionally, more public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life. Funding is available through numerous federal and state programs for landowners to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Section C). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of 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 or by visiting the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix VI.

4.3 Fecal Coliform

Fecal coliform bacteria live in the digestive tract of warm-blooded animals (humans as well as other mammals) and are excreted in their waste. Fecal coliform bacteria do not actually pose a danger to people or animals. However, where fecal coliform are present, disease-causing bacteria may also be present and water that is polluted by human or animal waste can harbor other pathogens that may threaten human health.

The presence of disease-causing bacteria tends to affect humans more than aquatic creatures. High levels of fecal coliform bacteria can indicate high levels of sewage or animal wastes which could make water unsafe for human contact (swimming) or the harvesting and consumption of shellfish. Fecal coliform bacteria and other potential pathogens associated with waste from warm-blooded animals are not harmful to fish and aquatic insects. However, high levels of fecal coliform bacteria may indicate contamination that increases the risk of contact with harmful pathogens in surface waters.

Pathogens associated with fecal coliform bacteria can cause diarrhea, dysentery, cholera and typhoid fever in humans. Some pathogens can also cause infection in open wounds.

Under favorable conditions, fecal coliform bacteria can survive in bottom sediments for an extended period (Howell et al., 1996; Sherer et al., 1992; Schillinger and Gannon, 1985). Therefore, concentrations of bacteria measured in the water column can reflect both recent inputs as well as the resuspension of older inputs.

> ***Sources of Fecal Coliform in Surface Waters***
>
> - Urban stormwater
> - Wild animals and domestic pets
> - Improperly designed or managed animal waste facilities
> - Livestock with direct access to streams
> - Improperly treated discharges of domestic wastewater, including leaking or failing septic systems and straight pipes

Reducing fecal coliform bacteria in wastewater requires a disinfection process, which typically involves the use of chlorine and other disinfectants. Although these materials may kill the fecal coliform bacteria and other pathogenic disease-causing bacteria, they also kill bacteria essential to the proper balance of the aquatic environment, and thereby, endanger the survival of species dependent on those bacteria.

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation and shellfish harvesting (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform standard for freshwater is 200 colonies/100ml based on the geometric mean of at least five consecutive samples taken during a 30-day period and not to exceed 400 colonies/100ml in more than 20 percent of the samples during the same period. The 200 colonies/100ml standard is intended to ensure that waters are safe enough for water contact through recreation.

The standard for Class SA waters (waters used for shellfishing) is a median or geometric mean fecal coliform Most Probable Number (MPN) not greater than 14 MPN/100ml. In addition, not more than 10 percent of the samples can be in excess of 43 MPN/100ml. Many areas closed to shellfish harvesting have median levels below 14 MPN/100ml, but fail to meet the second criteria due to periodic contamination that occurs after moderate to heavy rainfall events.

The North Carolina Division of Environmental Health (DEH) has subdivided all of the state's coastal waters into shellfish growing areas in which a sanitary survey is conducted every three years. Beginning in the summer of 1997, DEH began assessing fecal coliform levels in coastal recreation waters. These assessments provide a gauge of water quality along the North Carolina coast over the short and long-term.

If a certain area along the coast is found to have potential water quality problems related to stormwater pipes or high levels of indicator bacteria, health officials will post signs recommending that people not swim there or harvest shellfish from the area. The location will be listed on the DEH website at (http://www.deh.enr.state.nc.us/shellfish/), and local media and county health departments will be notified.

The state does not encourage swimming in surface waters since a number of factors which are beyond the control of any state regulatory agency contribute to elevated levels of disease-causing bacteria. To assure that waters are safe for swimming indicates a need to test waters for pathogenic bacteria. Although fecal coliform standards have been used to indicate the microbiological quality of surface waters for swimming and shellfish harvesting for more than 50 years, the value of this indicator is often questioned. Evidence collected during the past several decades suggests that the coliform group may not adequately indicate the presence of pathogenic viruses or parasites in water.

The detection and identification of specific pathogenic bacteria, viruses and parasites such as *Giardia*, *Cryptosporidium* and *Shigella* are expensive, and results are generally difficult to reproduce quantitatively. Also, to ensure the water is safe for swimming would require a whole suite of tests for many organisms, as the presence/absence of one organism would not document the presence/absence of another. This type of testing program is not possible due to resource constraints.

4.4 Urban Runoff

Urbanization often has greater hydrologic effects than any other land use, as native watershed vegetation is replaced with impervious surfaces in the form of paved roads, buildings, parking lots, and residential homes and yards. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

In and around municipalities in the Yadkin-Pee Dee River basin, 1999 DWQ biological assessments revealed that streams are being impacted by urban stormwater runoff. Most of the impacts are in terms of habitat degradation (see Part 4.2 of this section), but runoff from developed and developing areas can also carry toxic pollutants to a stream (NCDENR-DWQ, June 2002).

As populations expand, so do developed areas. Some local governments in the Yadkin-Pee Dee River basin have prioritized water quality planning; however, proactive planning efforts at the local level are needed across the entire basin in order to assure that development is done in a manner that minimizes impacts to water quality. A lack of good environmental planning was identified by participants at the public workshops as a threat to water quality in the Yadkin-Pee Dee River basin.

The presence of intact riparian buffers and/or wetlands in urban areas can lessen these impacts and restoration of these watershed features should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, long driveways and sidewalks lining both sides of the street are all features of urban development that create excess impervious cover and consume natural areas.

Recommendations for Reducing Urban Runoff

Proactive planning efforts at the local level are needed to assure that development is done in a manner that minimizes impacts to water quality. These planning efforts must find a balance among 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.

Planning Recommendations for New Development

- Minimize number and width of residential streets.
- Minimize size of parking areas (angled parking and narrower slots).
- Place sidewalks on only one side of residential streets.
- Vegetate road right-of-ways, parking lot islands and highway dividers to increase infiltration.
- Plant and protect natural buffer zones along streams and tributaries.
- Minimize floodplain development.
- Protect and restore wetland / bog areas.

Public education is needed in the Yadkin-Pee Dee River basin in order for citizens to understand the value of urban planning and stormwater management. Action should be taken by county governments and municipalities to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection.

4.5 On-Site Wastewater Treatment

In the Yadkin-Pee Dee River basin, there are other types of wastewater treatment besides WWTPs with NPDES permits. Wastewater from many homes and commercial businesses, such as campgrounds and convenience stores, is treated by septic systems. Septic systems can be a safe and effective method for treating wastewater if they are sized, sited and maintained properly. However, if the tank or drainfield are improperly placed, constructed or maintained, nearby wells and surface waters may become contaminated causing potential risks to human health. Section .1961(a) of the Laws and Rules for Sewage Treatment and Disposal Systems requires that the person owning or controlling the property upon which a septic system is sited be responsible for that system's operation and maintenance. Many homeowners are unaware of this legal responsibility, as well as the steps that must be taken to assure proper operation. Often owners do not realize they have an on-site wastewater treatment system until they experience problems. At this point, serious damage may have already occurred.

4.5.1 Reasons for Septic System Failure

Septic systems fail for a variety of reasons. Most of the time the failure is related to improper operation (use) and maintenance. Owners are often unaware of the necessity of pumping their tanks on a regular basis. Tanks need to be pumped every three to eight years depending on the size of the tank, the daily flow of waste and the amount of solids in the waste. It is important that owners prevent unnecessary solids such as grease, food, cigarette butts, sanitary products, disposable diapers and kitty litter from entering the septic tank system. Neglecting to do so will cause pipes to clog, tanks to fill up quickly, and can lead to premature drainfield failure.

Hydraulic overload is a significant cause of system failure. This may result from excessive water use or leaking plumbing fixtures in the home. It can also result from increasing the wasteload that a particular system was designed to handle. Failure to use low flow toilets, showerheads or other water-saving devices will contribute to overload. Leaking tanks, groundwater, stormwater, gutters and poor landscaping also hydraulically overloads systems. Drainfields must have time to rest between doses of effluent, or the life of the drainfield may be shortened significantly.

Chemicals, pesticides, paint products, cleaners, etc. dumped into a tank can kill the bacteria in a system. Bacteria in the septic tank and the drainfield are an essential part of a properly functioning system. Bacteria in the tank help reduce solids; bacteria in the drainfield treat the effluent before it reaches ground or surface waters.

Proper maintenance of the drainfield is also necessary to prevent system failure. Suitable vegetative covers must be maintained to prevent erosion and divert stormwater from the field. Appropriate vegetation helps disperse water and removes nutrients from the wastewater. Poor landscaping over the septic system can contribute thousands of additional gallons. Trees and shrubs must be located far enough away so their roots do not interfere with the systems pipes. Lastly, owners must assure drainfields remain free from vehicle traffic, impervious surfaces, construction or other activities that can compress the soil and damage trenches, pipes and, ultimately, effluent dispersion.

Improper maintenance is not the sole cause of system malfunction and failure. Septic tank systems that are installed incorrectly or are defective from the outset will fail. North Carolina does not require the certification of installers. Without suitable training, installers may be unaware of the fact that trenches should not be dug during rainy periods or care must be taken to avoid compacting the drainfield. They may not have the expertise necessary to recognize defects in the system components such as precast concrete tanks or poor gravel quality. Any one of these situations can lead to system failure and unnecessary owner expense.

Finally, problems have arisen when maintenance is required on underground utilities. Workers installing various underground utilities have damaged drainfields, as well as system components. Little or no effort is made by these underground utility contractors to locate the system and report the damage once it occurs.

More information about the installation and maintenance of septic tanks can be obtained from the NCDENR, Division of Environmental Health, On-Site Wastewater Section website at http://www.deh.enr.state.nc.us/oww/ or by contacting your county's Cooperative Extension Service Center. See Appendix VI for contact information for Cooperative Extension Service Centers in the Broad River basin.

4.5.2 Straight Piping

Sometimes pollutants associated with on-site wastewater disposal are also discharged directly to surface waters through straight pipes. Straight pipes are direct pipe connections between the septic system and surface waters, thus, bypassing the drainfield. In some cases, straight pipes pipe wastewater directly from the home or business into a stream, bypassing any type of treatment. Not only is straight piping illegal, the discharge of untreated sewage can be extremely harmful to humans and the aquatic environment. In all cases, straight pipes should be eliminated.

The Wastewater Discharge Elimination (WaDE) Program, within the Division of Environmental Health, is helping to identify and remove straight pipes in western North Carolina. This program uses door to door surveys to locate straight pipes and failing septic systems and then offers low interest loans or grants to homeowners who wish to eliminate the straight pipe by installing a septic system. The program also offers low interest loans and grants to repair malfunctioning septic systems. However, no such program is in place in the Yadkin-Pee Dee River basin. County health departments should request funding from the Clean Water Management Trust Fund and Section 319 Program to develop a straight pipe elimination program for the Yadkin-Pee Dee River basin. More information about the Clean Water Management Trust Fund can be found on page 275, and information about the Section 319 Program can be found on page 273.

4.5.3 Recommendations

On-site wastewater treatment systems should be located at least 100 feet from your well and allow access for maintenance and repair. Know the location, age, size and condition of your system. Although the maintenance schedule may vary according to the size of tank and number of uses, solids from a septic tank should be pumped every three to five years. Additives for septic systems to "clean, repair or rejuvenate, etc." have limited benefit and do not replace proper maintenance.

Keep the soil over the drainfield covered with grass or plants to prevent erosion. Avoid planting trees or deep-rooted shrubs—roots can clog systems. Do not drive on or compact the soil above drainfields. Flush only toilet paper and human wastes in toilets. Fix leaky pipes and dripping faucets and avoid excessive water use; it will overload the system.

Do not use toilet cleaners that hang in toilet tank. Keep bleach, solvents or other harmful chemicals out of drains and toilets. All of these products can destroy beneficial bacteria that help cleanse the sewage. They can also contaminate groundwater. Keep grease and oil (and their residues) out of the drain, and do not use or limit the use of a garbage disposal in your sink.

For more specific maintenance information, see *Improving Septic Systems*, published by North Carolina Home*A*Syst online at http://ces.soil.ncsu.edu/soilscience/publications/farmassist/homeassist/Septic/ or the *Septic System Owner's Guide* from the North Carolina Cooperative Extension at http://ces.soil.ncsu.edu/soilscience/publications/Soilfacts/AG-439-22/. You may also call (919) 513-3152 to request a copy (Publication No. AG-439-13).

For information on maintenance, innovative systems and current rules, see the NCDENR-Division of Environmental Health, On-Site Wastewater Section website at http://www/deh.enr.state.nc.us/owow/ or call (919) 733-2895. You may also call 1-800-9SEWAGE for technical assistance, to order a copy of the On-Site Wastewater Management Guidance Manual, or to report straight pipes and septic system failures.

4.6 Water Quality Concerns Associated with Drought Conditions

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) and may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow.

Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to warmer water temperatures, algae are more abundant due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, such as the one the basin is currently experiencing, these problems can be greatly enhanced and the potential for water quality problems to become catastrophic is increased.

The frequency of acute impacts due to nonpoint source pollution (runoff) is minimized during drought conditions. However, when rain events do occur, pollutants that have been collecting on the land surface are quickly delivered to streams. When streamflows are well below normal, this polluted runoff becomes a larger percentage of the water flowing in the stream. Point sources may also impact water quality during drought conditions, even when permit limits are being met. Facilities that discharge wastewater have permit limits that are based on the historic low flow conditions. During the record low flows currently being experienced in parts of North Carolina, these wastewater discharges make up a larger percentage of the water flowing in streams than normal and might contribute to lowered dissolved oxygen concentrations and increased levels of other pollutants.

The record low flows observed in many streams are putting a strain on the state’s water resources and aquatic habitats. As streamflows decrease, there is less habitat available for aquatic insects and fish, particularly around lake shorelines. There is also less water available for irrigation and for water supplies. The dry conditions and increased removal of water for these uses further increases strain on the resource. With less habitat, naturally lower dissolved oxygen levels and higher water temperatures, the potential for large kills of fish and aquatic insects is very high. These conditions may stress the fish to the point where they become more susceptible to disease and where stresses that normally would not harm them result in mortality.

Large, slow-moving waters found in reservoirs, behind dams and in estuarine areas naturally stratify in summer months. This stratification results in oxygen depletion (hypoxia) in the lower water column. During drought conditions, stratification results in hypoxia higher in the water column that lasts for longer periods of time. In addition to reducing the amount of habitat available to fish and aquatic insects, this extensive stratification creates a situation that could result in fish kills once rain or other events mixes the unoxygenated waters into the entire water column.

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

4.7 Low Dissolved Oxygen Concentrations

Maintaining an adequate amount of dissolved oxygen (DO) is critical to the survival of aquatic life and to the general health of surface waters. A number of factors influence DO concentrations including water temperature, depth and turbulence. Additionally, in the Yadkin-Pee Dee River basin, flow management from several impoundments also influences DO. The dissolved oxygen water quality standard for Class C waters is "not less than a daily average of 5.0 mg/l with a minimum instantaneous value of not less than 4.0 mg/l". Swamp waters (Class C Sw) "may have lower values if caused by natural conditions" (NCDENR-DWQ, 2000a).

Oxygen-consuming wastes such as decomposing organic matter and some chemicals can reduce dissolved oxygen levels in surface water through biological activity and chemical reactions. NPDES permits for wastewater discharges set limits on certain parameters in order to control the effects that oxygen depletion can have in receiving waters. This section discusses discharges of oxygen-consuming wastes in the Yadkin-Pee Dee River basin and studies that have been, or are currently being, conducted to better understand dissolved oxygen in the Yadkin-Pee Dee River mainstem.

For more information about oxygen-consuming wastes and what DWQ does to limit water quality impacts from these wastes, refer to *A Citizen's Guide to Water Quality Management in North Carolina*. This document is available online at http://h2o.enr.state.nc.us/basinwide/ or by calling (919) 733-5083.

Discharges to Zero Flow Streams

Because of the nature of the coastal plain region of the state, some streams, primarily in the southeastern portion of the Yadkin-Pee Dee River basin, have a low potential for sustaining base flow. This low flow frequency, measured by a 7Q10 (annual minimum 7-day consecutive low flow, which on average, will be exceeded 9 out of 10 years) flow calculation, is zero for all but the largest watersheds. This very low flow over the hottest several months of the year limits streams' ability to maintain high dissolved oxygen levels (temperature increases depleting dissolved oxygen while velocity decreases so there is little reaeration). The capacity for streams to assimilate oxygen-consuming wastes is also limited under these conditions. DWQ 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 Yadkin-Pee Dee River 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.

4.8 Fish Consumption Advice and Advisories

In April 2002, the NC Department of Health and Human Services (NCDHHS) developed new guidelines to advise people as to what fish are safe to eat. DWQ considers uses of waters with a consumption advisory for one or more species of fish to be impaired. Elevated methylmercury levels have been found in shark, swordfish, king mackerel, tilefish, largemouth bass, bowfin (or blackfish) and chain pickerel (or jack), and these fish species fall under the NCDHHS guidelines.

4.8.1 Mercury-Related Fish Consumption Information

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water and into biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway of mercury in the environment is through the atmosphere. Mercury that has been emitted from industrial and municipal stacks into the ambient air can circulate across the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also commonly found in wastewater. However, mercury in wastewater is typically not at levels that could be solely responsible for elevated levels in fish.

The NC Department of Health and Human Services issues fish consumption advisories for those fish species which have median and/or average methylmercury levels at 0.4 mg/kg or greater. These fish include shark, swordfish, king mackerel, tilefish as well as largemouth bass, bowfin (or blackfish) and chain pickerel (or jack) south and east of Interstate 85. In addition, a specific advisory is posted for consumption of largemouth bass from Ledbetter Lake due to elevated mercury concentrations. As a result of this guidance, DWQ considers many waters in the Yadkin-Pee Dee River basin to be Impaired for the fish consumption use support category. Refer to Appendix III for more information regarding use support ratings and assessment methodology.

DWQ has sampled fish tissue from a variety of species at two locations in the Yadkin-Pee Dee River basin. Mercury levels in one largemouth bass from the Pee Dee River exceeded the North Carolina action level for mercury in fish.

Fish Consumption Advice

Fish is an excellent source of protein and other nutrients. However, several varieties of freshwater fish may contain high levels of mercury, which may pose a risk to human health. These guidelines will help you make healthy food choices. A "meal" is defined as six ounces of cooked fish for adults and children 15 years or older and two ounces of cooked fish for younger children.

Women of childbearing age (15-44 years), pregnant or nursing women, and children under 15:

- Do not eat shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish likely contain high concentrations of mercury.
- Eat up to two meals per week of other fish.

Men, other women, and children 15 years and older:

- Eat no more than one meal per week of shark, swordfish, tilefish or king mackerel; or blackfish (bowfin), largemouth bass or jack fish (chain pickerel) caught in North Carolina waters south and east of Interstate 85. These fish likely contain high concentrations of mercury.
- Eat up to four meals per week of other fish.

For more information regarding fish consumption, visit the NC Department of Health and Human Services website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

4.8.2 2002 Recommendations

DWQ will work closely with the Department of Health and Human Service's Division of Public Health to monitor fish tissue in the Yadkin-Pee Dee River basin to assess the need to lift these advisories when there is no longer a risk to human health from consumption of fish. DWQ also strives to understand the interaction of mercury in the aquatic environment through an internal mercury workgroup, improved ambient water chemistry sampling techniques, and through participation in a regional mercury study. Each is described in further detail below.

DWQ Mercury Workgroup

DWQ is committed to characterizing methylmercury exposure levels and determining if NPDES sources need to be controlled. DWQ formed an internal Mercury Workgroup to improve communication from all programs which directly affect mercury issues (i.e., Pretreatment, Environmental Sciences, Basinwide Planning, etc.). The workgroup meets as needed to share information and determine next steps in addressing mercury issues associated with the aquatic environment.

Improved Ambient Sampling Techniques

DWQ aims to stay abreast of new technology and sampling techniques to ensure that water quality data are accurate, precise and of highest value. In 2000, DWQ started training water quality sampling staff on the new EPA Method 1631 technique. Current monitoring using a higher detection limit (EPA Method 245.1) has consistently yielded non-detected values, and DWQ aims to use the 1631 method to allow detection levels three orders of magnitude lower than EPA Method 245.1.

Regional Mercury Study

In an effort to better manage state waters that may have methylmercury issues, DWQ initiated a study through EPA 104(b)(3) funds. The study aims to provide information that may be used in water quality standard and TMDL development. The study goals include:

- determining levels of ambient mercury in the surface water system;
- estimating site-specific total mercury: methylmercury translators to evaluate water quality criteria;
- develop site-specific water to fish bioaccumulation factors; and
- determine levels of mercury in treatment plant effluent.

DWQ aims to complete this study in 2003, and results will be available to the public. For more information, contact the DWQ Planning Branch Modeling/TMDL Supervisor at (919) 733-5083.

DWQ will continue to host an internal workgroup to stay abreast of current mercury issues. The public has voiced concerns that DWQ should be working on the ecological components and consequences of mercury bioavailability to biota in these areas and the biogeochemical cycling and production of methylmercury from associated wetlands along these streams. Though the workgroup does not have a mandate to conduct research into mercury, the workgroup will better communicate its purpose and accomplishments to the public through periodic updates on the DWQ website.

DWQ will also provide interested members of the public with an overview of the new ambient monitoring sampling technique to gather feedback and insights on how DWQ can best accomplish its data collecting goals.

DWQ will continue to monitor concentrations of various contaminants in fish tissue across the state and will work to identify and reduce wastewater contributions of mercury to surface waters.

The Division of Air Quality (DAQ) evaluates mercury levels in rainwater on a regular basis through the EPA Mercury Deposition Network. EPA continues to focus on nationwide mercury reductions from stack emissions and through pollution prevention efforts. Pollution prevention efforts are being investigated on a state and federal level to reduce mercury emissions.

4.9 Management Strategy and Recommendations for the High Rock Lake Watershed

Located on the mainstem of the Yadkin River in Rowan and Davidson counties, High Rock Lake is the largest and most upstream of the Yadkin-Pee Dee chain lakes. Completed in 1929, the reservoir was constructed to provide hydroelectric power and is owned and operated by Yadkin Division of APGI. The 3,850-square mile watershed lies within seven subbasins (03-07-01 through 03-07-07). Figure C-4 on page 279 presents a map of the entire High Rock Lake watershed. Water quality concerns for High Rock Lake date back to the mid-1970s, and the need for nutrient reduction strategies to address problems due to accelerated eutrophication has been apparent since the mid-1990s.

4.9.1 Watershed Overview

The High Rock Lake watershed had an estimated population of 723,100 in 1990. Winston-Salem is the largest urban area; however, significant amounts of population are also located in Thomasville, Lexington and Salisbury along I-85, and in Statesville. Portions of 11 counties and 34 municipalities are located in the watershed. Although more than 60 percent of the High Rock Lake watershed is forested, 30 percent is described as pasture or managed herbaceous land and nearly three percent is urban (Figure A-20).

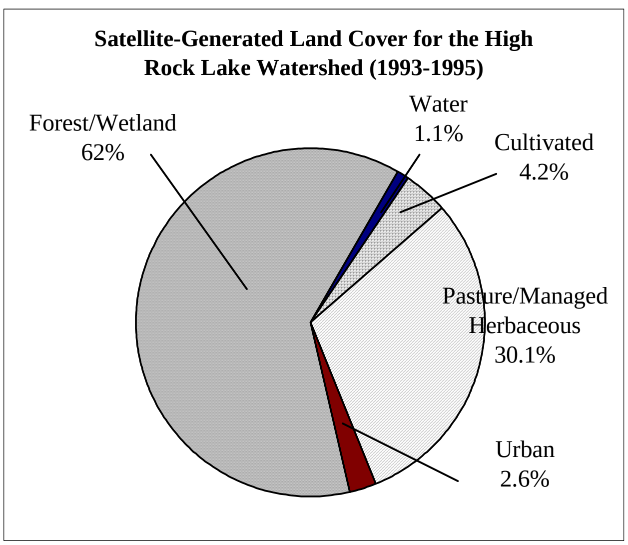


Figure A-20 Percentages within Major CGIA Land Cover Categories in the High Rock Lake Watershed (Subbasins 03-07-01 through 03-07-07) (1993-1995)

Although numerous tributaries enter the lake, the Yadkin and South Yadkin Rivers account for more than 90 percent of the total inflow. Average daily flows in the Yadkin River mainstem above the lake normally exceed 3,000 cubic feet per second. Detention time is relatively short, with estimates ranging from about 15 to 30 days (EPA, 1975; Weiss et al., 1981; NCDENR-DWQ, 1997a). These estimates exclude periods of extended low flow, such as those experienced in the basin in recent years.

The waters of the lake are classified WS-V upstream of a line connecting the downstream sides of Crane Creek and Swearing Creek. Below this line, the lake is classified as WS-IV & B, except for the upper half of the Abbotts Creek arm (above SR 2294), which is classified as WS-V & B. Additionally, the area within 0.6 miles of the dam is classified as CA due to the presence of the water supply intake for the Town of Denton a short distance below the dam. No drinking water is withdrawn directly from the reservoir, although Salisbury's water supply intake is located at the confluence of the Yadkin and South Yadkin Rivers, just upstream of the headwaters of the reservoir. In addition, Color/Tex Finishing and Duke Power's Buck Steam Station withdraw process and cooling water from the upper portion of the lake.

The watershed contains 76 registered animal operations; 68 of them (89 percent) are cattle facilities. A large percentage of the state's total capacity for dairy production (both registered and unregistered facilities) is found within the High Rock Lake watershed, mostly in Iredell County. However, dairy production in the watershed fell 27 percent between 1994 and 1998 and continues to decline. Poultry production increased 13 percent over the same four-year period.

There are 155 individual NPDES permitted dischargers in the watershed, 23 of which are major facilities that have a permitted flow of one million gallons per day (MGD) or more. Of the 126 MGD discharge capacity in the watershed, about 93 percent, or 117 MGD, is from the major facilities presented in Table A-40. Eight facilities discharge directly to the lake or to streams in the immediate proximity. The City of Salisbury WWTP and ColorTex Finishing discharge to the Yadkin River at the head of High Rock Lake. Additionally, Duke Power's Buck Steam Station discharges cooling water into the upper portion of the reservoir. Lexington's discharge to Abbotts Creek and Salisbury's Sowers Ferry Road WWTP (minor) on Grants Creek are in close proximity to the lake. Other minor discharges in close proximity are the Hilltop Living Center, Norfolk Southern Corp. and PPG Industries, Inc.

4.9.2 Summary of Historical Monitoring and Modeling Studies

Studies by DWQ (NRCD-DEM, 1974, 1975) and the EPA (EPA, 1975) in the mid-1970s documented eutrophic conditions in High Rock Lake for the first time. The EPA-sponsored research, conducted as part of the National Eutrophication Survey, indicated that High Rock Lake was the most eutrophic of the 16 North Carolina lakes studied in 1973. In 1981, a study by the University of North Carolina at Chapel Hill (Weiss et al., 1981) documented high nutrient loading to the lake as well as high levels of chlorophyll and in-lake nutrients. An intensive investigation of the lake by DWQ in 1989 and 1990 (NCDEHNR-DEM, 1993) provided additional data to allow a detailed evaluation of the reservoir and to support water quality modeling. On-going monitoring (e.g., NRCD-DEM, 1988, 1989; NCDEHNR-DEM, 1992a; NCDENR-DWQ, 1997b, June 2002) indicates that the lake continues to exhibit eutrophic conditions.

Table A-40 Major NPDES Permitted Dischargers in the High Rock Lake Watershed (2001)

NPDES Permit No.	Company/Facility Name	County	Type of Discharge	Receiving Stream	MGD	Subbasin
NC0005266	Louisiana Pacific ABT Co. Mill	Wilkes	Industrial Process	Yadkin River	1.0	03-07-01
NC0020761	Town of North Wilkesboro WWTP	Wilkes	Municipal	Yadkin River	2.0	03-07-01
NC0021717	Town of Wilkesboro WWTP	Wilkes	Municipal	Yadkin River	4.9	03-07-01
NC0005312	West Point Stevens	Surry	Industrial Process	Yadkin River	4.0	03-07-02
NC0020338	Town of Yadkinville WWTP	Yadkin	Municipal	North Deep Creek	2.5	03-07-02
NC0020567	Town of Elkin WWTP	Surry	Municipal	Yadkin River	1.8	03-07-02
NC0021121	City of Mount Airy WWTP	Surry	Municipal	Ararat River	7.0	03-07-03
NC0026646	Town of Pilot Mountain WWTP	Surry	Municipal	Ararat River	1.5	03-07-03
NC0037834	City of Winston-Salem Archie Elledge WWTP	Forsyth	Municipal	Salem Creek[1]	30.0	03-07-04
NC0050342	City of Winston-Salem Muddy Creek WWTP	Forsyth	Municipal	Yadkin River	21.0	03-07-04
NC0005487	Color/Tex Finishing Corporation	Rowan	Industrial Process	High Rock Lake[1]	4.25	03-07-04
NC0023884	City of Salisbury Grants Creek WWTP	Rowan	Municipal	High Rock Lake[1]	7.5	03-07-04
NC0004774	Duke Energy Corp. Buck Steam Station	Rowan	Industrial Process	High Rock Lake[1]	No Limit	03-07-04
NC0004286	Fieldcrest Cannon	Rowan	Industrial Process	Grants Creek[1]		03-07-04
NC0004944	Arteva Specialties KOSA	Rowan	Industrial Process	Second Creek	2.3	03-07-06
NC0005126	Tyson Foods Inc. Harmony Plant	Iredell	Industrial Process	Hunting Creek	1.7	03-07-06
NC0024872	Davie County Cooleemee WWTP	Davie	Municipal	South Yadkin River[1]	1.5	03-07-06
NC0020591	City of Statesville Third Creek WWTP	Iredell	Municipal	Third Creek[1]	4.0	03-07-06
NC0031836	City of Statesville Fourth Creek WWTP	Iredell	Municipal	Fourth Creek[1]	4.0	03-07-06
NC0024112	City of Thomasville Hamby Creek WWTP	Davidson	Municipal	Hamby Creek[1]	4.0	03-07-07
NC0024228	City of High Point Westside WWTP	Davidson	Municipal	Rich Fork[1]	6.2	03-07-07
NC0055789	City of Lexington WWTP	Davidson	Municipal	Abbotts Creek[1]	5.5	03-07-07

[1] A portion of this waterbody is currently rated Impaired.

The nutrient response model BATHTUB was applied to High Rock Lake in the mid-1990s. BATHTUB was developed by the US Army Corps of Engineers (Walker, 1986, 1985a, 1985b) to simulate eutrophication in spatially segmented reservoirs. BATHTUB is a steady state empirical lake model which predicts average in-lake nutrient and algal levels based upon phosphorus and nitrogen loading, turbidity and detention time.

The objectives of DWQ's modeling effort were: 1) to estimate nutrient loading to High Rock Lake; 2) to assess the assimilative capacity of the reservoir for phosphorus and nitrogen; and 3) to develop a predictive tool that could be used to evaluate the potential impacts of alternative management strategies on nutrient and algal levels in the lake.

The modeling effort focused on growing season (May-September) loading and algal response and yielded extensive information regarding nutrient loads to the lake. However, attempts to develop an adequately calibrated nutrient response model were less successful. While the model adequately predicts phosphorus levels in key areas of the lake, such as the mainstem and the Abbotts Creek Arm, chlorophyll *a* levels are predicted very poorly throughout the lake. Potential reasons for this are discussed in the modeling report (NCDENR-DWQ, 1997a).

4.9.3 Management Strategy and Recommendations from the 1998 Basin Plan

Phosphorus is the limiting nutrient in most freshwater systems. Nitrogen generally becomes limiting in freshwaters only under extremely eutrophic conditions (Welch, 1992). Under nitrogen limiting conditions, N-fixation by blue-green algae may encourage the dominance of blue-green algae over other algal groups and stimulate the growth of noxious blooms. For this reason, where lakes have elevated levels of both nitrogen and phosphorus, reductions in phosphorus rather than nitrogen have generally been recommended (Welch, 1992; Thomann and Mueller, 1987). While both nitrogen and phosphorus are routinely present in High Rock Lake in concentrations high enough to support algal blooms, management strategies focus on reducing phosphorus concentrations in order to limit algal growth. The main body of High Rock Lake was rated Support Threatened at the time of the 1998 basin plan. Therefore, priority was placed on tributary watersheds that were rated Impaired.

<u>*Abbotts Creek Arm*</u>

The 1998 basin plan recommended that each of the three major dischargers in the Abbotts Creek watershed (High Point, Thomasville and Lexington) receive summer mass Total Phosphorus limits based upon current permitted flow capacity and a Total Phosphorus concentration of 0.5 mg/l. The limits would go in effect for the permit cycle that begins in 2004. In order to reduce phosphorus loading in the shorter term, facilities were required to conduct an operation and maintenance assessment in order to identify methods of optimizing phosphorus removal with existing facilities. The plan also recommended that existing minor facilities be required to monitor total phosphorus and nitrogen concentrations and that no additional phosphorus loading would be permitted (individual NPDES permits for discharges containing phosphorus).

<u>*Other Arms*</u>

The only major NPDES discharges into the Grants Creek and Crane Creek arms were the two WWTPs operated by the City of Salisbury. The 1998 basin plan discusses Salisbury's plans to build a new outfall on the Yadkin River mainstem and the elimination of the two discharges into

Town and Grants Creeks when the new outfall became operational. The management strategy states that these facilities would not receive nutrient limits as long as the City of Salisbury was proceeding in good faith with construction of the new outfall. Other recommendations were for the Town of Spencer to connect to a regional WWTP. Spencer was required to conduct an engineering assessment to identify ways of optimizing phosphorus removal with current facilities.

Main Body of Lake

The 1998 basin plan also strongly recommends that the local governments (Davidson and Rowan County health departments) work with the Division of Environmental Health to identify failing on-site systems and to develop or strengthen outreach and education efforts regarding the operation and maintenance of these systems. Additionally, lake shore property owners were encouraged to establish and maintain adequate riparian buffers. The plan also expresses support for the efforts of Yadkin Division of APGI to maintain vegetated areas around High Rock Lake as recommended in its Shoreline Management Plan. DWQ planned to investigate the feasibility of developing a nutrient reduction strategy for the watershed and consider reclassifying the lake as Nutrient Sensitive Waters.

4.9.4 Current Status

Eight stations on High Rock Lake were monitored by DWQ in 1999, 2000 and 2001. Surface dissolved oxygen concentrations were elevated at most of the sampling sites, and the associated percent dissolved oxygen saturation ranged from 148 to 157 percent; the water quality standard is 110 percent. Surface pH values were also elevated, suggesting increased algal productivity.

Decreased transparency due to suspended sediments in the water column is also common in High Rock Lake. Turbidity concentrations in the Abbotts Creek and Crane Creek arms, as well as the main body of the lake, were greater than water quality standards in more than 10 percent of samples collected. In addition, transported sediment has reduced the depth of the upper end of the lake such that at low flow periods, the uppermost sampling site can no longer be reached by boat. In addition to reducing the clarity of the lake water, these sediments also contribute nutrients.

High Rock Lake was determined to be eutrophic again in 2001. Blue-green algae species, commonly found in eutrophic waters and often associated with taste and odor problems in drinking water, dominated samples collected in July and August 1999. As has been observed in previous years, total phosphorus and total organic nitrogen concentrations were high. These nutrients continued to support increased algae productivity as evidenced by chlorophyll *a* values greater than the state water quality standard of 40 ug/l.

Increased monitoring of High Rock Lake over the most recent assessment period has allowed DWQ to determine that the lake is Impaired. The decision is based on high levels of nutrients, combined with chlorophyll *a*, turbidity and percent dissolved oxygen saturation in excess of state standards. Low dissolved oxygen and high turbidity in the Abbotts Creek and Town Creek Arms are also contributing to aquatic life impairment.

Phosphorus limits, as outlined in the 1998 management strategy summary above, were placed in the most recent NPDES permits issued to the Lexington, Thomasville and High Point WWTPs in the Abbotts Creek watershed to become effective at the time of renewal in 2004. As a result of this strategy, summer point source loads of total phosphorus to the Abbotts Creek arm are projected to decline to one fifth of 1994-96 levels. Ambient phosphorus levels are projected to decline by 30 to 40 percent in the upper portion of the Abbotts Creek arm and by 20 to 25 percent in the middle portion of the arm. It is anticipated that this will lessen the incidence and severity of nuisance conditions in the lake, but these actions may not completely resolve eutrophication issues in the Abbotts Creek arm.

The Town of Spencer connected to the City of Salisbury WWTP, eliminating one discharge to Grants Creek. The City of Salisbury constructed a new WWTP which discharges to the Yadkin River in the upper reaches of High Rock Lake, eliminating one discharge to Grants Creek and one discharge to Town Creek. In addition, steps have already been taken to prioritize the High Rock Lake watershed for nonpoint source pollution reduction measures.

4.9.5 2002 Recommendations and Management Strategies

The current NPDES permits for the High Point Westside WWTP, Thomasville WWTP and Lexington WWTP outline mass-based summer and winter discharge limits for total phosphorus, which will be required beginning in 2004. No new NPDES permitted discharges will be permitted into the Abbotts, Swearing, Grants and Crane Creek arms of High Rock Lake. No increase in loading will be permitted for existing NPDES discharges into these same arms. Other existing discharges (in addition to the three major discharges mentioned above) will receive notification that discharge limits for total phosphorus may be required in the future.

A percent DO saturation TMDL for High Rock Lake will require the development of both a nutrient response model and a watershed loading model. DWQ staff will begin review of existing monitoring locations, frequency and parameters in preparation for designing a TMDL field study for High Rock Lake and the upper Yadkin River basin. DWQ will focus on developing and conducting the field study during this basinwide planning cycle. The field study will likely require 18 months to complete. The Yadkin-Pee Dee River Basin Association (details on page 296) has expressed interest in modeling the High Rock Lake watershed. DWQ will continue to work with the association to understand and manage this complex watershed.

DWQ will continue to place priority on developing TMDLs for streams in the High Rock Lake watershed. TMDLs for fecal coliform in the Fourth Creek and Grants Creek watersheds have been approved by the USEPA; and in the case of Fourth Creek, plans to implement the TMDL are being developed. Fecal coliform TMDLs are underway in the Salem Creek and Rich Fork watersheds as well. Strategies used to reduce fecal coliform concentrations in these watersheds will also help reduce nutrient and sediment loading to the upper portion of the basin, and ultimately High Rock Lake.

In addition, DWQ will work more closely with other agencies that set priorities for nonpoint source pollution reduction in the Yadkin-Pee Dee River basin, such as the NC Wetlands Restoration Program, NC Division of Soil and Water Conservation, and USDA Natural

Resources Conservation Service, to get funding for best management practices targeted towards the High Rock Lake watershed.

4.10 Davidson County Schools

In 1990, DWQ issued a Special Order of Consent (SOC) to provide relaxation of the NPDES permit limits of 14 WWTPs in subbasins 03-07-04 and 03-07-07 owned and operated by the Davidson County School District. Currently, DWQ and the school system are negotiating an amendment to extend the SOC to 2006 for nine schools: Central Davidson Jr/Sr (NC0041599), Leadford High (NC004208), Northwest Elementary (NC0042072), Midway Elementary (NC0042145), Pilot Elementary (NC0042129), Silver Valley (NC0041602), Southwood Elementary (NC0042749), Tyro Middle (NC0042056), and West Davidson High (NC0031950).

The goal of the SOC is for the nine remaining schools to tie into the City of Lexington, Tyro, Pilot or Handy Sanitary Districts' collection system which would eliminate the problem discharges. Since 1999, the school system has paid $2,000 in penalties and costs for discharge violations at two schools.

4.11 FERC Relicensing of Hydropower Projects

The licenses issued by the Federal Energy Regulatory Commission (FERC) to Yadkin Division of APGI for the operation of the High Rock, Tuckertown, Narrows and Falls dams, and to Carolina Power and Light for the operation of the Tillery and Blewett Falls dams will expire in 2008. The relicensing process is just beginning and will include an assessment of how current and future project operations may affect environmental resources in the Yadkin-Pee Dee River basin. The next *Yadkin-Pee Dee River Basinwide Water Quality Plan* will summarize relevant data collected during this process.

Recommendations
DWQ will continue to follow these studies and provide assistance and input as is appropriate. Any results that become available over the next five-year basinwide planning cycle will be discussed in the revised *Yadkin-Pee Dee River Basinwide Water Quality Plan* (2007).

4.12 Biological Community Assessment Issues

DWQ strives to properly evaluate the health of biological communities throughout the state. Swamp stream systems, small streams, nonwadeable waters and coldwater fisheries have presented unique challenges. This section discusses some of these challenges. This section also discusses the accumulation of contaminants in fish tissues and how waters with consumption advisories are assessed by DWQ.

4.12.1 Draft Criteria for Assessing Benthic Macroinvertebrates in Swamp Streams

Extensive evaluation, conducted by DWQ, of swamp streams across eastern North Carolina suggests that different criteria must be used to assess the condition of water quality in these systems. Swamp streams are characterized by slower flow, lower dissolved oxygen and lower pH. Sometimes they also have very complex braided channels and dark-colored water. Since 1995, benthos swamp sampling methods have been used at over 100 sites in the coastal plain of North Carolina, including more than 20 reference sites. In 1999, 16 sites on swamp streams in the Yadkin-Pee Dee River basin were sampled by DWQ. Preliminary investigations indicate that there are at least four unique swamp ecoregions in the NC coastal plain. The lowest "natural" diversity has been found in low-gradient streams (especially in the outer coastal plain east of the Suffolk Scarp) and in areas with poorly drained soils.

DWQ has developed draft biological criteria that may be used in the future to assign bioclassifications to these streams (as is currently done for other streams and rivers across the state). However, validation of the swamp criteria will require collecting data for several years from swamp stream reference sites. The criteria will remain in draft form until DWQ is better able to evaluate such things as: year-to-year variation at reference swamp sites, effects of flow interruption, variation among reference swamp sites, and the effect of small changes in pH on the benthos community. Other factors, such as whether the habitat evaluation can be improved and the role fisheries data should play in the evaluation, must also be resolved. While it may be difficult to assign use support ratings to these swamp streams, these data can be used to evaluate changes in a particular stream between dates or to evaluate effects of different land uses on water quality within a relatively uniform ecoregion.

DWQ is also developing criteria for use in determining whether a stream should receive the supplemental classification of Sw. Once completed the criteria will be applied to at least three streams in the southeastern portion of the Yadkin-Pee Dee River basin: Brown Creek, Marks Creek and Lanes Creek. Section A, Chapter 3 (page 54) contains details about North Carolina's surface water classification system.

4.12.2 Assessing Benthic Macroinvertebrate Communities in Small Streams

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

Presently, a designation of Not Impaired may be used for flowing waters that are too small to be assigned a bioclassification (less than 4 meters in width), but meet the criteria for a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria. This designation will translate into a use support rating of Supporting. However, DWQ will use the monitoring information from small streams to identify potential impacts to small streams even in cases when a use support rating cannot be assigned.

4.13 Use Restoration Waters (URW) Approach

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 concept will apply to all watersheds that are Impaired. The program will catalyze voluntary efforts of 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 waters. 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.

With more than 400 Impaired waters on 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, DWQ can catalyze large-scale restoration of Impaired waters. 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 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.

4.14 Priority Issues for the Next Five Years

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 Yadkin-Pee Dee 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.

4.14.1 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are identified in Section A, Chapter 3 as those not meeting their designated uses based on DWQ assessments of monitoring data. These waters are summarized by subbasin in Table A-38 and indicated on the subbasin maps in Section B. 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 are 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.
DWQ plans to further evaluate the Impaired waters in the Yadkin-Pee Dee River basin in conjunction with other NPS agencies and develop management strategies for a portion of these Impaired waters for the next Yadkin-Pee Dee River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see below).

4.14.2 Addressing Waters on the State's Section 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 Yadkin-Pee Dee 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 2,830.4 miles and approximately 388,000 acres of Impaired waters on the draft 2002 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.

Section B

Water Quality Data
and
Information by Subbasin

Section B: Chapter 1
Yadkin-Pee Dee River Subbasin 03-07-01
Includes the Upper Yadkin River and Kerr Scott Reservoir

1.1 Water Quality Overview

Subbasin 03-07-01 at a Glance

Land and Water

Total area:	830 mi^2
Stream miles:	866.3
Lake acres:	1,043.4

Population Statistics

1990 Est. Pop.:	62,655 people
Pop. Density:	76 persons / mi^2

Land Cover (%)

Forest / Wetland:	81.1
Surface Water:	0.5
Urban:	0.6
Cultivated Crop:	1.1
Pasture / Managed Herbaceous:	16.8

The Yadkin River begins in the mountains of Watauga and Caldwell counties before turning eastward and flowing into Wilkes County. This subbasin contains the upper portion of the Yadkin River which flows through Wilkesboro and North Wilkesboro, past Ronda and into Elkin. Major tributaries include Elk Creek, Lewis Fork, Reddies River and Roaring River. Kerr Scott Reservoir is also included.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-1. Table B-1 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-2. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Most of the land in this portion of the basin is forested (81 percent), but a significant portion is also in use as cultivated cropland and pasture (18 percent). The estimated subbasin population, based on the 1990 census, is 62,655 and population density is low. Population in the area is expected to increase by 14 percent between 2000 and 2020. There are 28 NPDES permitted discharges and six registered animal operations in the subbasin. The number of small poultry operations increased 9 percent between 1994 and 1998, and this subbasin alone currently contains 11 percent of the state's capacity for poultry production. Facilities with compliance or toxicity problems are discussed in following sections.

There is a significant amount of public land in this subbasin, especially when compared with other parts of the Yadkin-Pee Dee River basin. Stone Mountain State Park encompasses the headwaters of the East Prong Roaring River. The federally-owned Doughton Recreation Area and Blue Ridge Parkway skirt the northeastern portion of the subbasin along the Wilkes County line. The 1,000-acre Cumberland Knob Recreation Area in Alleghany County also lies within the subbasin and was where ground was first broken in the construction of the Parkway in 1935.

Water quality is generally excellent throughout the subbasin. Most streams are classified as Trout Waters and support healthy coldwater and coolwater fisheries. The Elk Creek watershed and several streams in the Roaring River watershed are classified Outstanding Resource Waters. Most of the Reddies River watershed is classified WS-II and Little Cub Creek is WS-I, which offer at least the same protection as the High Quality Waters classification.

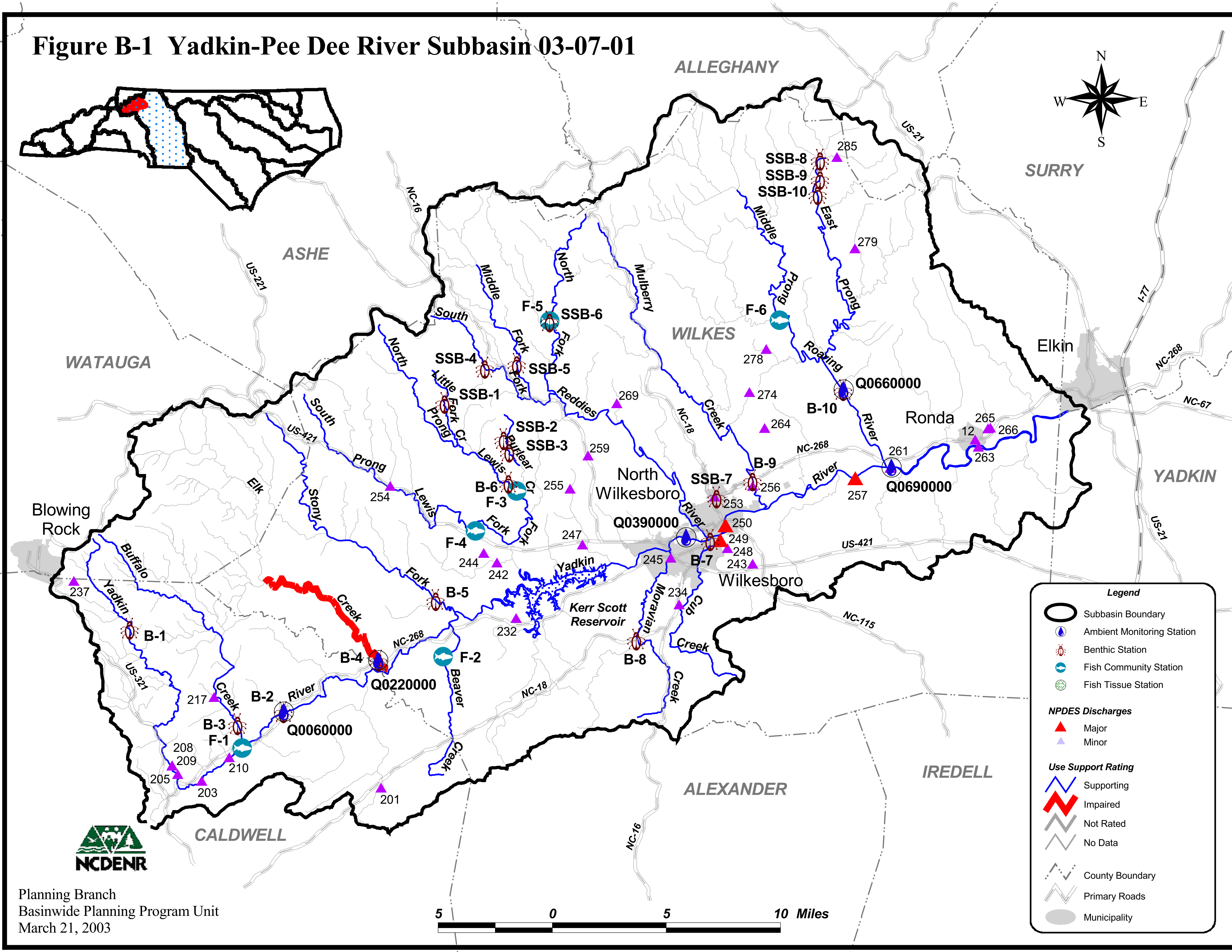


Figure B-1 Yadkin-Pee Dee River Subbasin 03-07-01

Table B-1 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-01

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Yadkin River[1]	Caldwell	SR 1372	Good
B-3	Buffalo Creek[1]	Caldwell	SR 1504	Excellent
B-2	Yadkin River	Caldwell	NC 268	Good-Fair
B-4	Elk Creek[1]	Wilkes	SR 1175	Good
B-5	Stoney Fork Creek[1]	Wilkes	SR 1135	Excellent
B-6	N Prong Lewis Fork[1]	Wilkes	SR 1304	Good
SSB-1	Little Fork	Wilkes	Headwaters	Not Impaired
SSB-3	Purlear Creek	Wilkes	Above Falls	Not Impaired
B-7	Yadkin River	Wilkes	NC 18/268	Good-Fair
B-8	Moravian Creek[1]	Wilkes	NC 18	Good-Fair
SSB-4	S Fork Reddies River	Wilkes	SR 1355	Good
SSB-5	Middle Fk Reddies R	Wilkes	SR 1559	Excellent
SSB-6	N Fork Reddies River	Wilkes	SR 1567	Good
B-9	Mulberry Creek[1]	Wilkes	NC 268	Excellent
SSB-7	UT Mulberry Creek[1]	Wilkes	Flint Hill Rd	Not Rated
B-10	Roaring River[1]	Wilkes	SR 1990	Good
SSB-9	E Prong Roaring River[1]	Wilkes	SR 1739	Good
SSB-10	E Prong Roaring River	Wilkes	Off SR 1739	Good
Fish Community Monitoring				
F-1	Yadkin River	Caldwell	NC 268	Good
	Buffalo Creek	Caldwell	SR 1594	Excellent
	Laurel Creek	Watauga	SR 1508	Excellent
F-2	Beaver Creek	Wilkes	SR 1131	Good
F-3	N Prong Lewis Fork	Wilkes	SR 1304	Excellent
F-4	S Prong Lewis Fork	Wilkes	SR 1154	Good
	Middle Fk Reddies R	Wilkes	SR 1562	Excellent
	N Fork Reddies River	Wilkes	SR 1501	Good
F-5	N Fork Reddies River	Wilkes	SR 1567	Excellent
	Cub Creek	Wilkes	SR 1001	Good
F-6	Middle Pr Roaring R	Wilkes	SR 1002	Excellent
	E Prong Roaring R	Wilkes	#1 SR 1739	Good

	E Prong Roaring R	Wilkes	#2 SR 1739	Excellent
	E Prong Roaring R	Wilkes	#3 SR 1739	Excellent
Ambient Monitoring				
Q0060000	Yadkin River	Caldwell	NC 268	Turbidity
Q0220000	Elk Creek	Wilkes	NC 268	Fecal coliform
Q0390000	Yadkin River	Wilkes	At Wilkesboro	None
Q0660000	Roaring River	Wilkes	SR 1990	None
Q0690000	Yadkin River	Wilkes	SR 2327	Turbidity Fecal coliform
Q0720000	Yadkin River	Wilkes	SR 2303	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q0360000	Reddies River	Wilkes	SR 1517	None
Q0450000	Yadkin River	Wilkes	US 421 Bus	Fecal coliform
Q0720000	Yadkin River[3]	Wilkes	SR 2303	None
Lakes Assessment				
--	Kerr Scott Reservoir	Wilkes	3 stations	Dissolved oxygen

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).
[3] This site duplicates a DWQ ambient monitoring station.

For more detailed information on sampling and assessment of streams and lakes in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-2 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-01

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	653.1 1,043.4	0.0 0.0	0.0 0.0	213.2 0.0	866.3 1,043.4
Fish Consumption	miles acres	866.3 1,043.4	0.0 0.0	0.0 0.0	0.0 0.0	866.3 1,043.4
Primary Recreation	miles acres	19.9 948.7	**9.1** 0.0	0.0 0.0	49.9 0.0	78.9 948.7
Water Supply	miles acres	185.1 973.7	0.0 0.0	0.0 0.0	0.0 0.0	185.1 973.7

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

1.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan did not identify any Impaired waters in this subbasin.

1.3 Status and Recommendations for Newly Impaired Waters

A portion of Elk Creek, from the mouth of Dugger Creek to the Yadkin River, is Impaired for the primary recreation use based on a recent swimming advisory posted by the NC Department of Health and Human Services. This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

1.3.1 **Elk Creek** (9.1 miles from Dugger Creek to Yadkin River)

Current Status

The DWQ ambient monitoring station near the mouth of Elk Creek revealed elevated levels of fecal coliform in 2001. Because Elk Creek is classified for primary recreation (Class B), sampling on five days within 30 days was initiated during June 2002 to evaluate the water quality standard. The June sampling produced a geometric mean of 408 colonies per 100 ml of solution (col/100ml); the water quality standard for fecal coliform is currently 200 col/100ml. Additional monitoring results in July indicated a geometric mean of 455 col/100ml. Upstream samples indicated sporadic high levels of fecal coliform as well. A short survey of a portion of the stream conducted by a DWQ staff member revealed cattle and horses with direct access to the stream in several locations. There are no permitted discharges. The Wilkes County Health Department has posted a swimming advisory for Elk Creek and the stream is Impaired for the primary recreation use.

2002 Recommendations

The Elk Creek watershed (03040101 010050) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. [Refer to page 278 in Section C for details.] Nonpoint source pollution programs that work with farmers to implement best management practices, such as fencing livestock out of streams and providing alternative watering sources, should also prioritize the Elk Creek watershed. DWQ will monitor Elk Creek again in the summer of 2003.

1.4 Section 303(d) Listed Waters

In subbasin 03-07-01, an unnamed tributary to Mulberry Creek (discussed below) is currently the only water presented on the state's draft 2002 303(d) list. If a swimming advisory remains persistently posted, Elk Creek will likely be added to the list in the future. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

1.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

1.5.1 Yadkin River (from the Big Bend north of Lenoir to Mulberry Creek)

Two sites on the upper Yadkin River above Kerr Scott Reservoir were monitored by DWQ over the previous basinwide cycle. The uppermost site received a Good benthic macroinvertebrate bioclassification. Habitat was good and few impacts are present. At NC 268 between Buffalo Creek and Elk Creek, DWQ anticipated that the benthic macroinvertebrate bioclassification would remain the same or improve (similar to the upstream site) due to reduced nonpoint source pollution as a result of the extended drought. However, the benthic macroinvertebrate community declined from Good in 1996 to Good-Fair in 2001. If the impacts were related to flow or weather, the pattern should be visible in other similarly-sized streams within the subbasin. This was not the case as demonstrated by improvement or maintenance of bioclassifications in Buffalo, Elk Creek, Stoney Fork, Moravian and Mulberry Creeks, and North Prong Lewis Fork. Nutrient enrichment was indicated, and 23 percent of samples exceeded the turbidity standard.

Further downstream at Wilkesboro, the river also received a Good-Fair bioclassification. Instream and riparian habitat were in worse condition in this developed area with notable sedimentation, little riparian vegetation and lots of filamentous algae. Nutrient enrichment was indicated, and the geometric mean of fecal coliform samples collected between 1998 and 2001 (323 colonies/100ml) indicates that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from two sites as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. The Yadkin River is not currently classified for primary recreation (Class B) within this subbasin.

With the exception of the developed area of Wilkesboro and North Wilkesboro below Kerr Scott Reservoir, the watershed is primarily in agriculture. NC 268 follows this portion of the Yadkin River closely, crossing every 1-2 stream miles. There are four small NPDES discharges above the sampling site; however, all are in compliance and have been over the previous assessment period. There is one registered dairy operation; however, it is no longer in operation. Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made.

1.5.2 Moravian Creek

Moravian Creek flows north from the Alexander/Wilkes County line into the Yadkin River at Wilkesboro. The headwaters are mostly forested in the Brushy Mountains; however, roads follow many of the streams and the mainstem closely. The West Prong is more agricultural. DWQ sampled the stream at NC 18 in both 1996 and 2001 and found some water quality impacts. Instream habitat is poor with evidence of historic channelization. Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made.

1.5.3 Cub Creek

The Cub Creek watershed is adjacent to the Moravian Creek watershed, although land use is more built-up in the lower reaches. Degraded instream and riparian habitat were noted during fish community sampling in 2001. No historical DWQ data exist for this stream. There is a large poultry processing facility and a dairy product manufacturing facility in the watershed.

1.5.4 Lewis Fork Watershed

Although the North and South Prongs of Lewis Fork and several major tributaries received Good bioclassifications during the assessment period, impacts to smaller streams from agricultural activities are evident. Although exceptional water quality was observed in the headwaters of Purlear Creek in June of 2001, severe water quality impacts were observed at a site lower in the watershed during a special study in June 2002. Large quantities of organic matter were deposited in areas of slower flow as well as riffle areas, and indicators of organic enrichment were very abundant. The community observed was similar to that which would be expected below a poorly operating WWTP; however, there are no NPDES permitted discharges in this primarily agricultural watershed. Naked Creek also contained abundant indicators of organic loading and low dissolved oxygen (NCDENR-DWQ, October 18, 2002).

An increase in turbidity has been observed in the South Prong Lewis Fork that is attributed to the widening/construction of US 421. A trophic shift is also being observed in the fish community that indicates nutrient enrichment.

The Lewis Fork watershed and the North and South Prong Lewis Fork watersheds (03040101 010080-010100) comprise three of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the Wetlands Restoration Program as areas with the greatest need and opportunity for stream and wetland restoration efforts. These watersheds will be given higher priority than nontargeted watersheds for the implementation of NCWRP restoration projects. [Refer to page 278 in Section C for details.] Nonpoint source pollution programs that work with farmers to implement best management practices, such as fencing livestock out of streams and providing alternative watering sources, should also prioritize the Lewis Fork watershed.

1.5.5 UT Mulberry Creek (Long Creek)

This stream was originally assessed in 1990 to determine impacts of toxicity problems with the Gardner Mirror WWTP discharge. The benthic macroinvertebrate community was assigned a Good-Fair bioclassification above the discharge and a Poor bioclassification below the discharge, and the stream was placed on the 303(d) list of Impaired waters. Gardner Mirror is now closed and there is no longer a discharge from the facility. DWQ resampled the stream in 2001 to evaluate improvement in the watershed. Due to reduced flows in this stream, it was too small to assign a bioclassification. Even though improvement was observed (from 3 EPT species in 1990 to 13 in 2001), water quality in this stream is still heavily impacted. There is still one discharge above the sampling site from Carolina Mirror, and development from North Wilkesboro also impacts the watershed.

1.5.6 Warrior Creek

Big Warrior and Little Warrior Creeks were two of 13 stream sites near Wilkesboro sampled by the DWQ Biological Assessment Unit during a special study in June 2002. Moderate to severe habitat degradation was observed along both streams, and indicators of organic enrichment were present in Big Warrior Creek (NCDENR-DWQ, October 18, 2002).

The Warrior Creek watershed (03040101 010110), is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

1.5.7 Tucker Hole Creek

Tucker Hole Creek was one of 13 stream sites near Wilkesboro sampled by the DWQ Biological Assessment Unit during a special study in June 2002. Tucker Hole drains portions of the Town of Wilkesboro, making it the most urban of the sites monitored. Data indicate that only Purlear Creek (discussed in Part 1.5.4 above) had more severe water quality and/or habitat degradation problems. Although severe habitat degradation was observed at Tucker Hole Creek, it is likely that toxicity problems and organic loading are having a larger impact on the aquatic community (NCDENR-DWQ, October 18, 2002).

The Tucker Hole Creek watershed (03040101 020010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

1.5.8 East Prong Roaring River

Three sites were sampled by DWQ on the East Prong Roaring River in 1998. Severe bank erosion and moderate sedimentation were observed at the lowest site, although all three benthic macroinvertebrate communities received a Good bioclassification. There have been problems with waste lagoon overflows at some small dairy operations in the watershed and gray water discharges are also a concern.

In October 2000, the NCWRP completed a 10,622-foot stream restoration project in Stone Mountain State Park on the East Prong Roaring River. The goals of this project were to reduce streambank erosion, improve instream and riparian habitat, restore floodplain functions, and educate visitors about natural stream design techniques. Prior to becoming part of a park, the East Prong Roaring River was relocated several times to accommodate gravel mining operations and improve conditions for agriculture. To address these problems, the NCWRP constructed 6,000 feet of new channel and stabilized the channel with rock grade control structures and root wads. The rock structures enhanced fish and aquatic habitat throughout the length of the project. Post-construction monitoring indicates that the project is stable.

The East Prong Roaring River watershed (03040101 060030) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. [Refer to page 278 in Section C for details.] Nonpoint source pollution programs that work with farmers to implement best management practices, such as fencing livestock out of streams and providing alternative watering sources, should also prioritize the East Prong Roaring River watershed.

1.6 Additional Water Quality Issues within Subbasin 03-07-01

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

1.6.1 NPDES Discharges

Six of the 28 NPDES discharges had 1-2 minor permit violations over the two-year review period (September 1999 - August 2001). No facility is in significant noncompliance at this time. Five facilities are required to monitor effluent toxicity; all were in compliance over the period of review.

1.6.2 NCWRP Projects and Local Watershed Planning Initiative

The NC Wetlands Restoration Program (NCWRP) has four stream restoration projects in this subbasin. Three of these projects, Purlear Creek, Warrior Creek and Bugaboo Creek, are located in agricultural areas currently used as pasture for cattle. These streams lack riparian vegetation to protect and stabilize the streambanks that are severely eroding. In addition, cattle have direct access to the streams at these sites further exacerbating the erosion problems. One of the project goals is to fence the cattle out of the streams at these sites to reduce erosion and bacterial pollution. In addition, the projects will restore riparian vegetation, stabilize streambanks and enhance aquatic habitat.

Currently, the NCWRP Local Watershed Planning initiative for the upper Yadkin-Pee Dee region is focused on in five tributary watersheds to the W. Kerr Scott Reservoir and the Yadkin River above the Town of Wilkesboro's Water Filtration Plant. The water treatment plant struggles with problems tied to turbidity, algae and high concentrations of total coliform bacteria. Animal agriculture, including poultry and beef cattle, and its associated land application of waste are a potential nonpoint source of nutrients and metals to the reservoir and tributary streams. In addition, many streambanks in the study area lack riparian vegetation and are severely eroding. The NCWRP is working with the Wilkes Soil and Water Conservation District and other local stakeholders to reduce nutrient, sediment and bacteriological pollution to the reservoir and the Yadkin River to ensure long-term protection of these resources for public water supply, recreation and aquatic life. As part of the planning effort, the NCWRP, in cooperation with DWQ, has initiated a comprehensive biological and chemical water quality monitoring program in the planning area. The NCWRP has also hired a technical consultant to conduct a detailed watershed assessment that will assess watershed conditions, estimate pollutant loads and identify, and prioritize restoration opportunities. The technical assessment will be completed in summer 2003 with the restoration plan completed in the fall of 2003.

Section B: Chapter 2

Yadkin-Pee Dee River Subbasin 03-07-02

Includes Mitchell River, Fisher River and Deep Creek Watersheds

2.1 Water Quality Overview

Subbasin 03-07-02 at a Glance

Land and Water

Total area:	822 mi^2
Stream miles:	715.9
Lake acres	134.9

Population Statistics

1990 Est. Pop.:	90,781 people
Pop. Density:	111 persons/mi^2

Land Cover (%)

Forest/Wetland:	59.4
Surface Water:	0.7
Urban:	1.2
Cultivated Crop:	6.5
Pasture/ Managed Herbaceous:	32.2

This large subbasin contains the Yadkin River from Elkin to the confluence with Muddy Creek below Winston-Salem. Major tributaries include the Mitchell River and Fisher River in the northern portion of the subbasin, the Little Yadkin River in the eastern portion, and Deep Creek and Forbush Creek in the southern portion. The Ararat River (discussed in subbasin 03-07-03) also flows into this portion of the Yadkin River.

Local governments found within the subbasin are Elkin and Dobson in Surry County, Jonesville, Arlington, Boonville, East Bend and Yadkinville in Yadkin County, portions of Lewisville and Clemmons in Forsyth County, and King in Stokes County. Most of Pilot Mountain State Park is located in this subbasin in the Grassy Creek watershed and along the Yadkin River.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-2. Table B-3 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-4. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Approximately 60 percent of the land in this portion of the basin is forested, but a significant amount is also in use as cultivated cropland and pasture (38 percent). Estimated subbasin population is more than 100,000. Population is expected to increase substantially (24 to 32 percent) between 2000 and 2020 for all four counties that partially comprise the subbasin. There are 31 NPDES permitted discharges and 13 registered animal operations. Facilities with compliance or toxicity problems are discussed in following sections.

Water quality is generally good throughout the subbasin. No streams are considered Impaired, but most have some notable water quality impacts. Most streams in the Mitchell and Fisher River watersheds are classified Trout Waters. The Mitchell River watershed is also Outstanding Resource Waters and used for primary recreation. The Fisher River watershed is High Quality Waters (HQW) and used for drinking water supply. The Elkin Creek watershed is also WS-II and HQW.

Figure B-2 Yadkin-Pee Dee River Subbasin 03-07-02

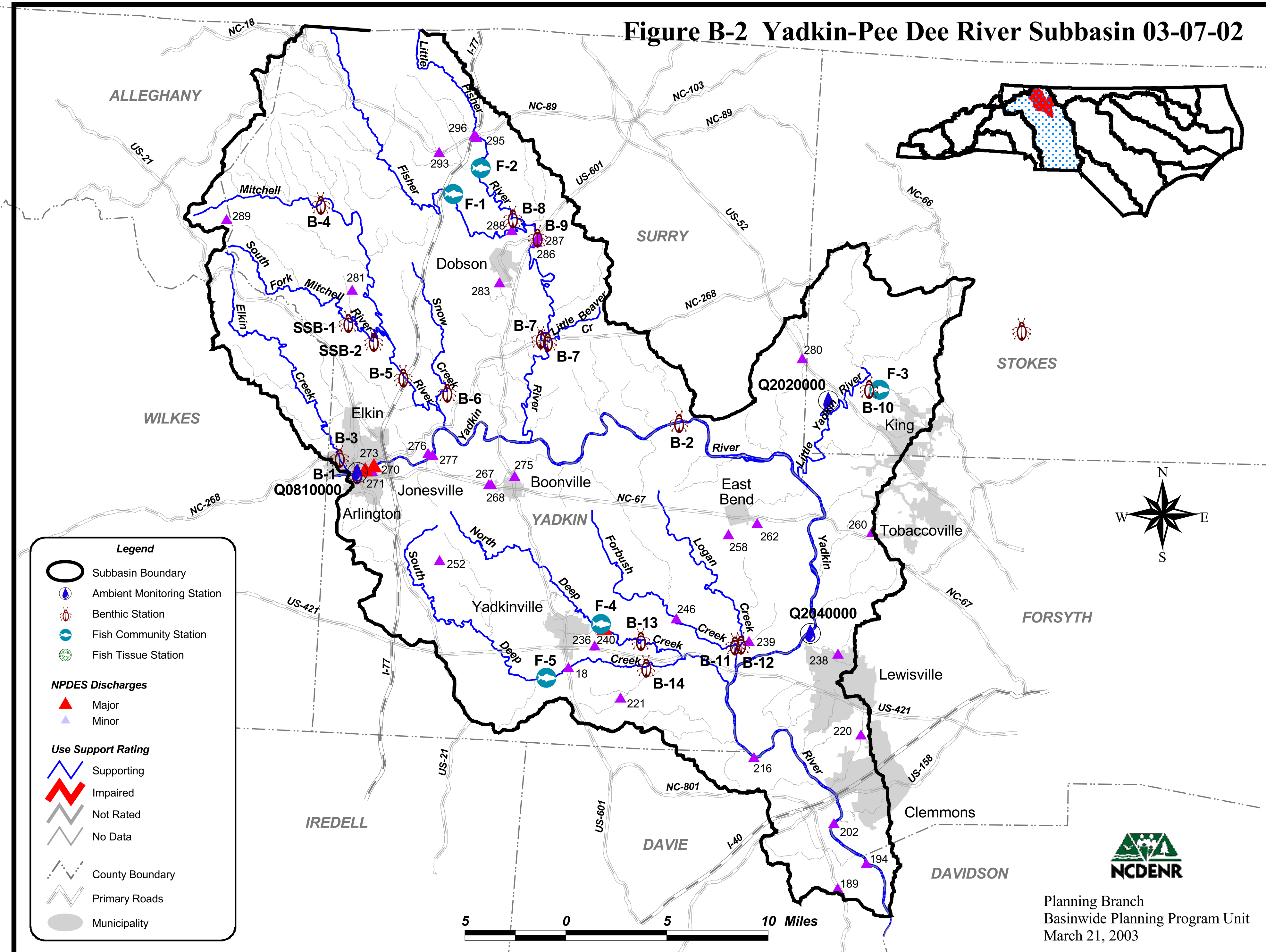


Table B-3 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-02

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Yadkin River[1]	Yadkin	US 21	Good
B-2	Yadkin River	Surry	SR 1003	Good
B-3	Elkin Creek[1]	Surry	NC 268	Good-Fair
B-4	Mitchell River[1]	Surry	SR 1330	Good
B-5	Mitchell River	Surry	SR 1001	Excellent
SSB-1	South Fork Mitchell R[1]	Surry	#1 SR 1316	Good-Fair
SSB-2	South Fork Mitchell R	Surry	#2 SR 1316	Good-Fair
	South Fork Mitchell R	Surry	SR 1301	Good
B-6	Snow Creek[1]	Surry	SR 1121	Good-Fair
B-9	Fisher River[1]	Surry	US 601	Good
B-7	Fisher River	Surry	NC 268	Good
B-8	Little Fisher River[1]	Surry	SR 1350	Good-Fair
	Little Beaver Creek[1]	Surry	NC 268	Not Impaired
B-10	Little Yadkin River[1]	Stokes	SR 1236	Good-Fair
B-11	Forbush Creek[1]	Yadkin	SR 1570	Good-Fair
B-12	Logan Creek[1]	Yadkin	SR 1571	Good
B-13	North Deep Creek[1]	Yadkin	SR 1510	Good-Fair
B-14	South Deep Creek[1]	Yadkin	SR 1733	Good-Fair
Fish Community Monitoring				
	Mitchell River[1]	Surry	SR 1330	Good
F-1	Fisher River	Surry	SR 1341	Excellent
F-2	Little Fisher River[1]	Surry	SR 1331	Good
F-3	Little Yadkin River[1]	Stokes	SR 1236	Excellent
F-4	North Deep Creek	Yadkin	SR 1605	Good-Fair
F-5	South Deep Creek	Yadkin	SR 1152	Good
Ambient Monitoring				
Q0810000	Yadkin River	Surry/Yadkin	Bus US 21	None
Q2020000	Little Yadkin River	Stokes	US 52	Turbidity
Q2040000	Yadkin River	Yadkin/Forsyth	SR 1605	Turbidity

Yadkin-Pee Dee River Basin Association Monitoring				
Q1065000	Mitchell River	Surry	SR 1001	None
Q1215000	Fisher River	Surry	NC 268	None
Q1350000	Yadkin River	Surry	SR 1003	Turbidity
Q2090000	North Deep Creek	Yadkin	SR 1605	Fecal coliform
Q2120000	North Deep Creek	Yadkin	SR 1510	None
Q2135000	South Deep Creek	Yadkin	SR 1733	None
Q2180000	Yadkin River	Davie/Forsyth	US 158	Turbidity

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-4 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-02

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	380.3 8.4	0.0 0.0	0.0 0.0	335.6 126.5	715.9 134.9
Fish Consumption	miles acres	715.9 134.9	0.0 0.0	0.0 0.0	0.0 0.0	715.9 134.9
Primary Recreation	miles acres	30.0 0.0	0.0 0.0	0.0 0.0	22.8 17.6	52.8 17.6
Water Supply	miles acres	301.5 81.7	0.0 0.0	0.0 0.0	0.0 0.0	301.5 81.7

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

2.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan did not identify any Impaired waters in this subbasin.

2.3 Status and Recommendations for Newly Impaired Waters

In subbasin 03-07-02, no stream segments are Impaired based on recent DWQ monitoring (1998-2001); however, some impacts to water quality were observed. Refer to Part 2.5 below for further discussion of potential water quality problems.

2.4 Section 303(d) Listed Waters

No waters in this subbasin are listed on the state's draft 2002 303(d) list. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

2.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

2.5.1 Elkin Creek

Elkin Creek is in Wilkes County and flows southeast into the Yadkin River at Elkin. The watershed is primarily agricultural; however, the low end is developed and road coverage is moderate throughout. Although the bioclassification did not change, four fewer benthic macroinvertebrate taxa were collected in 2001 when compared with 1996. Habitat degradation in the form of sedimentation and minimal riparian vegetation was noted. Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made.

2.5.2 South Fork Mitchell River

The South Fork Mitchell River flows southeast in Surry County from the Wilkes County line into the Mitchell River. The watershed is very similar to that of Elkin Creek (discussed above) except that the lower portion is mostly forested. The stream was sampled in three locations by DWQ in 1998. The uppermost two stations received Good-Fair bioclassifications; the lowest site received Good. The stream is rated Supporting.

South Fork Mitchell River Riparian Corridor Assessment

In 2001, the Surry Soil and Water Conservation District identified a need for a watershed assessment to prioritize future stream restoration projects. With an existing grant from Clean Water Management Trust Fund, staff were able to conduct an assessment of the South Fork Mitchell River riparian corrider. The assessment was conducted in 2002 to assess the morphological, riparian and aquatic habitat conditions of selected streams within the South Fork Mitchell River watershed and to determine potential restoration and preservation sites. Data were collected along 20 miles of stream within the South Fork Mitchell River watershed and provide specific information regarding the condition of the watershed and potential methods to improve water quality.

A significant portion of the streams within the South Fork Mitchell River watershed is incised and degraded primarily due to cattle access. For assessment purposes, the watershed was separated into five different management units: four subwatersheds and a section of the main stem of the South Fork Mitchell River. A total of 103 stream reaches, each approximately 1,000 feet in length, were assessed during the investigation. Based on the findings of this assessment, White Rock Creek is the most degraded stream in the South Fork Mitchell River watershed. The primary causes of degradation are channel modifications, both recent and historical, and agricultural land use practices. The North Prong subwatershed is primarily impacted by exotic vegetation. Brushy Fork is impacted to some degree by exotic vegetation and agricultural land use. Wood Branch was in the best condition of all the streams investigated during survey (Halley and Elmore, 2002).

Based on the best available data at the time of the investigation, it is estimated that approximately 13,000 tons of sediment are lost annually from the streambanks within the assessment area of the South Fork Mitchell River watershed. Bank height ratios exceeded 1.0 along 69 percent of the reaches surveyed, while 42 percent had bank height ratios exceeding 1.5. The length of exotic vegetation was recorded along the streambanks and totaled 8.8 miles (Halley and Elmore, 2002).

Section C contains more information about Surry County Soil and Water Conservation District programs and the South Fork Mitchell River Riparian Corridor Assessment beginning on page 301. The Piedmont Land Conservancy's Mitchell River Watershed Protection Plan also discusses the South Fork Mitchell River watershed. The Piedmont Land Conservancy is discussed beginning on page 295 of Section C.

2.5.3 Snow Creek

Snow Creek flows south into the Mitchell River near its confluence with the Yadkin River. The watershed is mostly forested with light road coverage; however, I-77 cuts across the headwaters. DWQ anticipated that the benthic macroinvertebrate bioclassification would remain the same or improve in Snow Creek due to reduced nonpoint source pollution as a result of the extended drought. However, the benthic macroinvertebrate community declined from Good in 1996 to Good-Fair in 2001. If the impacts were related to flow or weather, the pattern should be visible in other similarly-sized streams within the subbasin. Of the 18 sites sampled, only the Little Fisher River and Snow Creek declined in bioclassification between 1996 and 2001. A decrease in bioclassification was observed between 1996 (Good) and 2001 (Good-Fair). Sedimentation and effects of scouring were observed, but instream habitat overall was fairly good. Topographical maps for this watershed are outdated, and it is possible that the area is seeing an increase in development that is impacting the watershed. There is one registered animal operation and no permitted discharges. Further investigation into the causes and sources of water quality impacts is needed before recommendations to improve water quality can be made.

2.5.4 Little Fisher River

Although there is a significant amount of forested land in the Little Fisher River watershed, there is also a large amount of land being used for agriculture, especially along tributaries. I-77 also crosses this watershed, and there is an increasing amount of developed area near its intersection with NC 89. Tributaries that seem to be the most impacted are Beaverdam, Ring and Wood Creeks. DWQ anticipated that the benthic macroinvertebrate bioclassification would remain the same or improve on the Little Fisher River due to reduced nonpoint source pollution as a result of the extended drought. However, the benthic macroinvertebrate community declined from Good in 1996 to Good-Fair in 2001. If the impacts were related to flow or weather, the pattern should be visible in other similarly-sized streams within the subbasin. Of the 18 sites sampled, only the Little Fisher River and Snow Creek declined in bioclassification between 1996 and 2001. There are no permitted discharges and only one registered animal operation in the watershed. Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made.

The Little Fisher River watershed (03040101 090020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the Wetlands Restoration Program as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

2.5.5 Little Yadkin River

The Little Yadkin River flows southeast mostly in Stokes County into the Yadkin River just below its confluence with the Ararat River. This watershed is mostly in agricultural land use; however, development on Danbury and Crooked Run Creeks is moderate. Benthic macroinvertebrates have received Good-Fair or Good bioclassifications over 14 samples at three locations since 1987. However, the population of King increased by 47 percent between 1990 and 2000. Population is expected to continue increasing in these Winston-Salem suburbs. Local programs that focus on nonpoint source pollution reduction will be essential to protecting and improving water quality. King is required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to Section A, page 37 for details.

2.5.6 Yadkin River (from Fisher River to Muddy Creek)

Elevated turbidity measurements were documented over the five-year assessment period at three monitoring stations on the Yadkin River within this subbasin. Although the river is not considered Impaired, impacts are evident. The watershed above this reach of river is large and many different land uses disturb sediment, creating turbidity associated with rainfall events. However, the majority of this assessment period has been under drought conditions and, with a corresponding reduction in nonpoint source pollution, the anticipated outcome would be a reduction in turbidity. No declining trend was detectable. There are four permitted sand dipping and 12 permitted sand dredging operations in this reach of the Yadkin River.

2.5.7 North Deep Creek

The North Deep Creek watershed contains two municipalities, Boonville and Yadkinville. Land use is primarily agricultural, with the exception of these two developed areas and the US 601 corridor between them. Above the Yadkinville WWTP the stream is impacted by habitat degradation, primarily sedimentation, elevated turbidity and high concentrations of fecal coliform (a pathogen indicator). There are four registered animal operations in this portion of the watershed and several smaller operations on first order tributaries. This upper site (SR 1605) was one of only four other sites in the basin where no darters were collected.

Downstream (SR 1510) the stream is in better condition in terms of habitat. Turbidity is still elevated at this location and conductivity is high due to the WWTP upstream. Further investigation into the causes and sources of water quality impacts, particularly in the upper half of the watershed, is needed before recommendations to improve water quality can be made.

The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 from North Deep Creek (423 and 197 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. North Deep Creek is not currently classified for primary recreation (Class B).

2.5.8 South Deep Creek

Notable water quality impacts are currently limited to the lower portion (below Yadkinville) of the South Deep Creek watershed. US 421 cuts across this portion of the watershed and has recently been widened, possibly impacting the stream. US 21 and US 601 also cross through the watershed and an increase in development is likely. Moderate habitat degradation was observed by DWQ staff, primarily in the form of streambank erosion. Turbidity was also elevated.

The geometric mean of fecal coliform samples collected near Yadkinville between 1998 and 2001 from South Deep Creek (268 colonies/100ml) indicates that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. South Deep Creek is not currently classified for primary recreation (Class B). Local actions are needed to reduce sedimentation, turbidity and fecal coliform and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed.

In the upper portion of the watershed, the Town of Yadkinville plans to expand water supply withdrawals from South Deep Creek to a capacity of 5.5 MGD and develop off-stream storage to draw from during periods of low flow. An instream flow study established a flow target of 15 cfs below the intake. An agreement between the NC Division of Water Resources and the town establishes a withdrawal limit of 1.7 cfs when streamflow is less than or equal to the 7Q10 (8.4 cfs). The town can withdraw up to the 5.5 MGD capacity when streamflow exceeds 8.4 cfs.

Also in the South Deep Creek watershed, the Yadkin County Soil and Water Conservation District and the Yadkin County Board of Commissioners are sponsoring a proposal for an impoundment upstream of Cranberry Creek. The dam will be subject to the NC Dam Safety Law and will be required to provide a minimum flow of 4.0 cfs (equal to the 7Q10 flow). All permits have been secured and design is underway. The Town of Yadkinville received a Clean Water Management Trust Fund grant in 1997 to acquire a riparian buffer around the reservoir.

2.6 Additional Water Quality Issues within Subbasin 03-07-02

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

2.6.1 NPDES Discharges

Fifteen of the 31 NPDES discharges had a few permit violations over the two-year review period (September 1999 - August 2001). Two facilities are in significant noncompliance. The Davie County Shady Grove Elementary which discharges into Carter Creek at the southeastern tip of the subbasin is significantly noncompliant for ammonia and BOD. The Yadkin County Starmont High School is noncompliant for ammonia. Five facilities are required to monitor effluent toxicity. The Town of Boonville WWTP experienced problems meeting its whole effluent toxicity limit from the beginning of 1995 through the end of 1999. Many of the failures were associated with high residual chlorine levels in the effluent. The facility has only had one failure since November 1999. This improvement in effluent toxicity is likely due to better management of chlorine levels during the disinfection process that began in mid-1999. The facility has since implemented ultraviolet light disinfection, effectively eliminating problems associated with residual chlorine.

2.6.2 Projected Population Growth

From 2000 to 2020, the estimated population growth for Yadkin County is 32 percent, Stokes County – 31 percent, Forsyth County – 26 percent, and Surry County – 24 percent. Growth management within the next five years will be imperative, especially in and around urbanizing areas, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

Section B: Chapter 3
Yadkin-Pee Dee River Subbasin 03-07-03
Ararat River Watershed

3.1 Water Quality Overview

Subbasin 03-07-03 at a Glance

Land and Water

Total area:	198 mi^2
Stream miles:	172.8
Lake acres:	14.1

Population Statistics

1990 Est. Pop.:	36,299 people
Pop. Density:	183 persons/mi^2

Land Cover (%)

Forest/Wetland:	59.1
Surface Water:	0.2
Urban:	3.0
Cultivated Crop:	4.9
Pasture/ Managed Herbaceous:	32.7

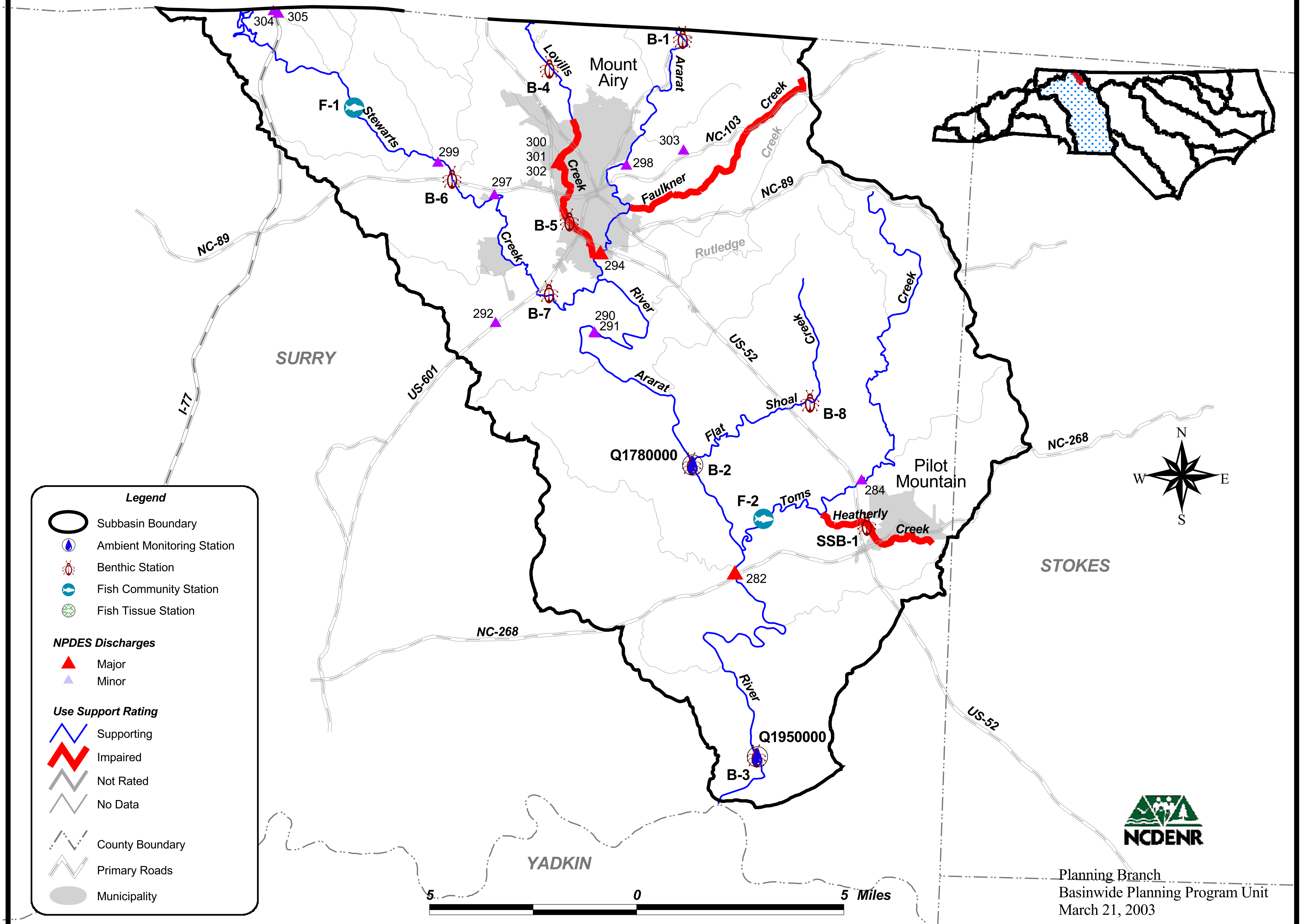
The Ararat River and many of its tributaries originate in Virginia. The river enters North Carolina just north of the Town of Mount Airy and flows south near the Town of Pilot Mountain into the Yadkin River. Almost all of this subbasin lies within Surry County.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-3. Table B-5 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-6. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Nearly 40 percent of the land is in agriculture while only 3 percent is characterized as urban. Mountains dot the landscape, and part of Pilot Mountain State Park is contained within the subbasin. The population is more than 36,000 with a moderate density of 183 persons per square mile. Population is expected to increase in the area by 24 percent between 2000 and 2020.

Water quality is generally Good-Fair throughout the subbasin. Many streams exhibit water quality impacts and portions of several are Impaired. There are currently no Outstanding Resource Waters and Toms Creek is the only watershed containing High Quality Waters protection (WS-II). Toms Creek and the upper reaches of Stewarts Creek are also the only streams that received Excellent bioclassifications during the most recent sampling period. There are 11 NPDES permitted discharges and three animal operations in the subbasin. Facilities with compliance or toxicity problems are discussed in following sections.

Figure B-3 Yadkin-Pee Dee River Subbasin 03-07-03



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-5 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-03

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Ararat River[1]	Surry	NC 104	Good-Fair
B-2	Ararat River	Surry	SR 2019	Good-Fair
B-3	Ararat River	Surry	SR 2080	Good
B-4	Lovills Creek[1]	Surry	SR 1700	Good-Fair
B-5	Lovills Creek	Surry	SR 1371	Fair
B-6	Stewarts Creek[1]	Surry	NC 89	Good-Fair
B-7	Stewarts Creek	Surry	SR 2258	Good
	Faulkner Creek	Surry	SR 1742	Not Impaired
	Faulkner Creek	Surry	SR 1756	Not Rated
B-8	Flat Shoals Creek[1]	Surry	SR 1827	Good-Fair
	Heatherly Creek	Surry	NC 268	Good-Fair
SSB-1	Heatherly Creek	Surry	US 52	Fair
Fish Community Monitoring				
F-1	Stewarts Creek[1]	Surry	SR 1622	Excellent
F-2	Toms Creek	Surry	SR 2024	Excellent
Ambient Monitoring				
Q1780000	Ararat River	Surry	SR 2019	None
Q1950000	Ararat River	Surry	SR 2080	Turbidity
Yadkin-Pee Dee River Basin Association Monitoring				
Q1500000	Ararat River	Surry	Above WWTP	None
Q1710000	Ararat River	Surry	Below WWTP	Fecal coliform
Q1725000	Ararat River	Surry	SR 2119	Fecal coliform
Q1935000	Ararat River	Surry	SR 2044	Turbidity Fecal coliform

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-6 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-03

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	124.8 0.0	**11.7** 0.0	0.0 0.0	36.3 14.1	172.8 14.1
Fish Consumption	miles acres	172.8 14.1	0.0 0.0	0.0 0.0	0.0 0.0	172.8 14.1
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	62.4 7.7	0.0 0.0	0.0 0.0	0.0 0.0	62.4 7.7

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

3.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified portions of the Ararat River, Lovills Creek and Heatherly Creek as Impaired. The waters are discussed in further detail below.

3.2.1 Ararat River (10.3 miles from the Mount Airy WWTP to SR 2026 downstream)

1998 Recommendations

Fair and Poor benthic macroinvertebrate bioclassifications were assigned at several stations downstream of Mount Airy and the Mount Airy WWTP through the late 1980s and 1990s. DWQ required the Town of Mount Airy to do instream monitoring, in addition to effluent monitoring, to try to determine the impacts associated with the discharge. Recommendations were for DWQ to review the data, which suggested water quality problems related to oxygen-consuming wastes, and work with the Town of Mount Airy to improve the quality of its discharge. Recommendations were also made for reduction of nonpoint sources of pollution in the watershed.

Current Status

The benthic macroinvertebrate community improved to Good-Fair and Good at two stations downstream of Mount Airy and the Mount Airy WWTP in 2001. In addition, four YPDRBA monitoring sites and two ambient monitoring sites showed few signs of low dissolved oxygen problems. This improvement is likely due to the reduction in discharge (4.5 MGD to 3.0 MGD) and reduction in toxicity, due to fewer industrial inputs, from the WWTP. Further improvement may be a result of reduced nonpoint source pollution due to the extended drought. Some habitat degradation was noted, primarily sedimentation of pools and lack of instream woody habitat and leafpacks. Turbidity is slightly elevated at the lower end of the watershed.

Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples collected from each of three stations between 1998 and 2001 (34%, 24% and 32%, respectively). Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest.

2002 Recommendations
Although this stream is no longer considered Impaired, impacts from nonpoint source pollution are evident. Local actions are needed to reduce sedimentation, turbidity and fecal coliform contamination and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed.

Water Quality Improvement Initiatives
The upper and middle Ararat River watersheds (03040101 110010 & 110020) are two of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the Wetlands Restoration Program as areas with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

3.2.2 Lovills Creek (4.2 miles from the Mount Airy water supply dam to the Ararat River)

1998 Recommendations
The benthic macroinvertebrate community of Lovills Creek as it flows through the Town of Mount Airy has been assigned a Fair bioclassification since 1986. The 1998 basin plan states that further investigation into the causes and sources of impairment is needed before recommendations to improve water quality can be made.

Current Status
Lovills Creek continues to receive Fair bioclassifications in the reach that flows through Mount Airy. This portion of the watershed is almost completely developed and most certainly is affected by nonpoint source pollution. However, Proctor Silex, which discharges above the monitoring site, failed 38 percent of chronic toxicity tests between September 1997 and October 2000. These sporadic toxicity problems could be a large contributor to impairment as well. Proctor Silex closed in 2001 and no longer discharges to Lovills Creek. The NPDES permit for this facility will likely be rescinded.

2002 Recommendations
DWQ will continue to monitor Lovills Creek to evaluate any improvement following the closure of Proctor Silex. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, and to restore habitat in the lower portion of the watershed. In many locations, the stream may need extensive restoration work in order to fully support aquatic life.

Water Quality Improvement Initiatives
The Lovills Creek watershed (03040101 100020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

3.2.3 **Heatherly Creek** (3.4 miles from source to Toms Creek)

1998 Recommendations
Benthic macroinvertebrate communities in Heatherly Creek were assigned Fair and Poor bioclassfications upstream and downstream (respectively) of the Pilot Mountain WWTP discharge. The Pilot Mountain WWTP had toxicity and low dissolved oxygen problems. In 1996, this discharge was relocated to the Ararat River, and the 1998 basin plan recommended that DWQ continue to monitor the stream to evaluate any improvement following the removal of the discharge.

Current Status
In 2001, DWQ sampled benthic macroinvertebrates upstream and downstream of the old Pilot Mountain discharge. Upstream Heatherly Creek is not Impaired; however, habitat degradation is apparent and improvement at this location could be related to reduced nonpoint source pollution as a result of the extended drought. Downstream the creek is still Impaired; however, improvement in the benthic community was also observed at this location. The future I-74 corridor (US 52) and NC 268 bisect the watershed in two directions. Development and its corresponding nonpoint source pollution impacts are increasing. The Impaired segment of Heatherly Creek has been reduced from 4.2 miles to 1.4 miles from NC 268 to Toms Creek.

2002 Recommendations
DWQ plans to conduct further investigation into the causes and sources of the biological impairment of Heatherly Creek during this basinwide planning cycle. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff.

3.3 Status and Recommendations for Newly Impaired Waters

Faulkner Creek is rated Impaired based on recent DWQ monitoring (1996-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

3.3.1 **Faulkner Creek** (6.1 miles from source to the Ararat River)

Current Status
Faulkner Creek was sampled by DWQ in two locations in 2002 because it was historically placed on the 303(d) list of Impaired waters based on visual observations of water quality problems. Sediment was listed as the cause of impairment, and agriculture and urban runoff were listed as

the potential sources. Results indicate that the stream is Impaired from McBride Road (SR 1742) to the Ararat River. Habitat degradation was apparent throughout the watershed, but is more of an impact lower in the watershed. Sedimentation and a lack of riparian vegetation were identified as causes of impairment, along with an unknown source of toxicity. Indicators of nutrient enrichment were also observed at the downstream location.

2002 Recommendations

A portion of Faulkner Creek will remain on the 303(d) list, and DWQ will work towards the development of a TMDL for sediment. As resources allow, DWQ will also further investigate the source of toxicity in the watershed. This area is increasingly impacted by residential and commercial development as the Town of Mount Airy grows along highway corridors. Local actions are needed to reduce sedimentation and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed.

3.4 Section 303(d) Listed Waters

Currently, portions of four waters in this subbasin are listed on the state's draft 2002 303(d) list: Ararat River, Lovills Creek, Heatherly Creek and Faulkner Creek. A sediment TMDL for Faulkner Creek will likely be developed by DWQ and/or the EPA during this basinwide planning cycle. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

3.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

3.5.1 Stewarts Creek

The 1998 basin plan noted compliance problems at the Virginia I-77 rest area near the state line in the Stewarts Creek watershed, but these problems seem to have been resolved based on recent compliance reports. Additionally, the fish community in the uppermost portion of the watershed received an Excellent bioclassification in 1996 and 2001. Further downstream, however, water quality impacts are evident. The Surry County Gentry Elementary School discharge was significantly noncompliant for ammonia over the assessment period. In addition, residential and commercial development is increasing between two currently disconnected pieces of the Town of

Mount Airy, as well as along highway corridors in general throughout the watershed. DWQ will work with Surry County to regain compliance at the elementary school. Local actions are needed to reduce sedimentation and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed.

The Stewarts Creek watershed (03040101 100010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

3.5.2 Rutledge Creek

Rutledge Creek has not been sampled by DWQ; however, concerns for this watershed are increasing due to development pressure along NC 89 and US 52 and the increase in number of small animal operations throughout the watershed. This stream flows parallel to and contains similar land use as Faulkner Creek, which is Impaired. As resources allow, DWQ will sample Rutledge Creek over this basinwide planning cycle.

3.6 Additional Water Quality Issues within Subbasin 03-07-03

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

3.6.1 NPDES Discharges

Four facilities had significant compliance or toxicity problems over the most recent review period. The Surry County Gentry Middle School was in significant noncompliance for ammonia. Violations at Pilot Mountain WWTP were for total suspended solids and cyanide. Proctor Silex and the Surry County Flat Rock Elementary School had toxicity problems. The problems at Proctor Silex are believed to be contributing to the impairment of Lovills Creek; however, the facility closed in 2001 and the WWTP no longer discharges. The other facilities, though likely impacting the streams into which they discharge, are not resulting in impairment. DWQ will work to ensure compliance at all facilities over this basinwide planning cycle.

Section B: Chapter 4
Yadkin-Pee Dee River Subbasin 03-07-04
Includes Muddy Creek, Grants Creek and High Rock Lake

4.1 Water Quality Overview

Subbasin 03-07-04 at a Glance

Land and Water

Total area:	730 mi^2
Stream miles:	438.0
Lake acres:	11,137.3

Population Statistics

1990 Est. Pop.:	325,945 people
Pop. Density:	461 persons/mi^2

Land Cover (%)

Forest/Wetland:	55.9
Surface Water:	3.6
Urban:	6.0
Cultivated Crop:	2.8
Pasture/ Managed Herbaceous:	31.7

This subbasin is located entirely within the piedmont portion of the state. Muddy Creek is the largest tributary of the Yadkin River within this subbasin and its watershed drains the Winston-Salem area. Grants Creek, in the southwestern part of the subbasin, flows through Salisbury, Spencer and East Spencer. Dutchman Creek (subbasin 03-07-05) and the South Yadkin River (subbasin 03-07-06) enter the Yadkin River above High Rock Lake in this subbasin. Abbotts Creek (discussed in subbasin 03-07-07) is a tributary to High Rock Lake. The subbasin contains all or part of more than 15 different municipalities and five counties. The Yadkin River and High Rock Lake serve as the county boundary between Davie and Davidson and Rowan and Davidson counties.

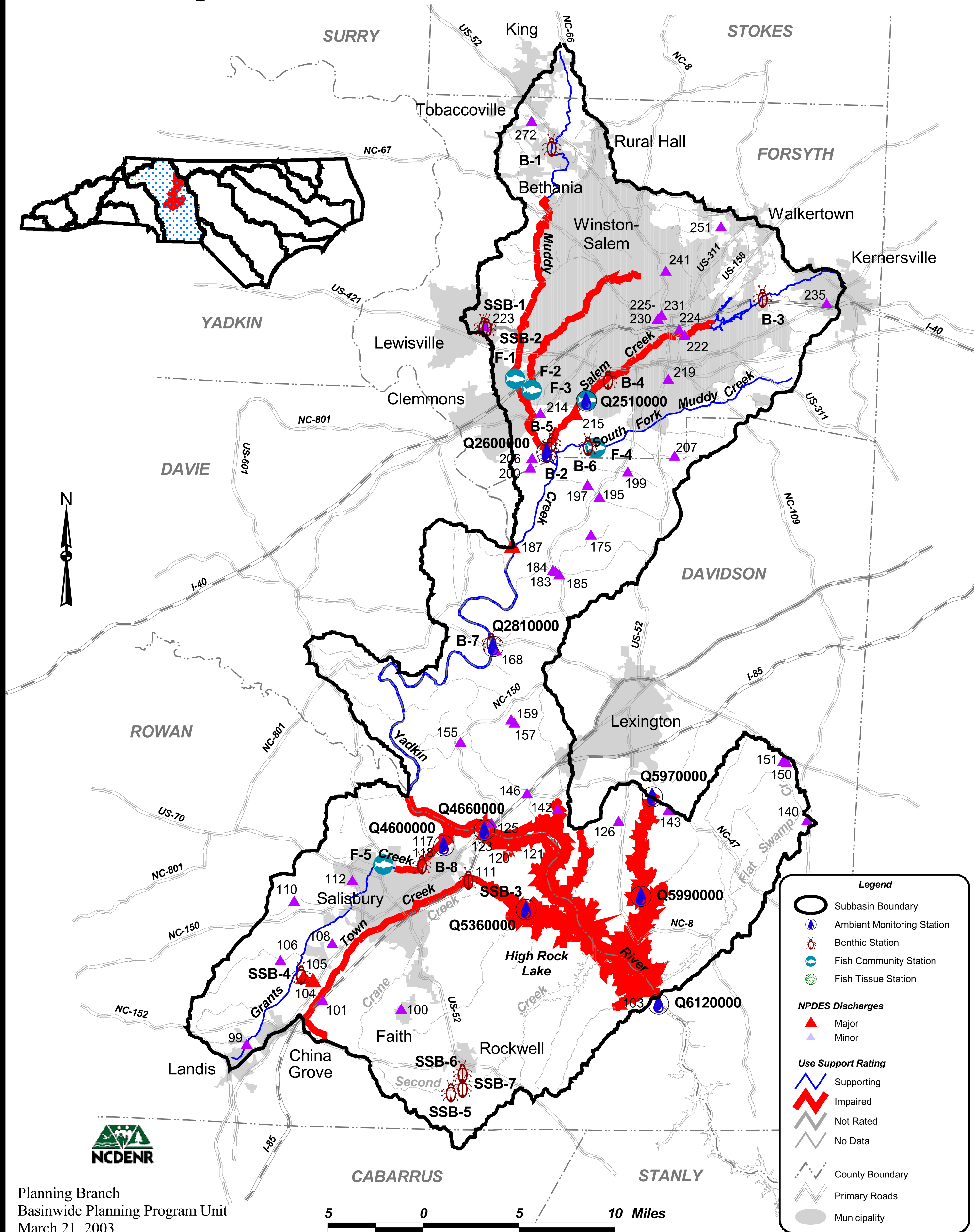
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-4. Table B-7 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-8. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

This subbasin is one of only a few in which more than 5 percent of land is described as urban. The northern portion of the subbasin includes Winston-Salem, Rural Hall, Tobaccoville and parts of King, Lewisville, Clemmons and Kernersville and is almost completely developed. Approximately 56 percent of the land is forested and nearly 35 percent is in agriculture. More than 3 percent is surface water reflecting a large portion of the 15,750-acre High Rock Lake.

This subbasin contains more than one quarter (27 percent) of the total basin population, and the population density in 1990 was the highest of any other subbasin. Population is expected to increase 32 percent in Rowan, 26 percent in Forsyth and 25 percent in Davidson counties between 2000 and 2020. The subbasin contains 40 NPDES permitted discharges and eight registered animal operations. Facilities with compliance or toxicity problems are discussed in following sections.

The majority of waters within this subbasin exhibit some level of impacts to water quality. Many streams are Impaired by a combination of nonpoint and point source pollution. There are no High Quality Waters or Outstanding Resource Waters within the subbasin.

Figure B-4 Yadkin-Pee Dee River Subbasin 03-07-04



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-7 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-04

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Muddy Creek[1]	Forsyth	SR 1898	Good-Fair
B-2	Muddy Creek	Forsyth	SR 2995	Good-Fair
SSB-1	Reynolds Creek[1]	Forsyth	Above Sequioa WWTP	Not Rated
SSB-2	Reynolds Creek	Forsyth	Below Sequioa WWTP	Not Rated
B-3	Salem Creek[1]	Forsyth	SR 2657	Not Rated
B-4	Salem Creek	Forsyth	SR 2902	Fair
B-5	Salem Creek	Forsyth	SR 2991	Fair
B-6	South Fork Muddy Cr[1]	Forsyth	SR 2902	Good-Fair
B-7	Yadkin River[1]	Davidson	SR 1447	Good
B-8	Grants Creek[1]	Rowan	SR 1914	Fair
SSB-4	UT Grants Creek[1]	Rowan	SR 1500	Not Impaired
SSB-3	Town Creek[1]	Rowan	I-85	Fair
Fish Community Monitoring				
F-1	Muddy Creek	Forsyth	SR 1891	Fair
F-2	Silas Creek	Forsyth	SR 1137	Fair
F-2	Silas Creek (2002)	Forsyth	SR 1137	Good-Fair
F-3	Salem Creek	Forsyth	SR 1120	Poor
F-4	South Fork Muddy Cr	Forsyth	SR 2902	Good-Fair
F-5	Grants Creek	Rowan	SR 2202	Good-Fair
Ambient Monitoring				
Q2510000	Salem Creek	Forsyth	At Elledge WWTP	Fecal coliform
Q2600000	Muddy Creek	Forsyth	SR 2995	Nutrients, Fecal coliform
Q2810000	Yadkin River	Davie/ Davidson	US 64	Turbidity
Q4600000	Grants Creek	Rowan	Near mouth	Turbidity, Nutrients, Fecal coliform
Q4660000	Yadkin River	Rowan/ Davidson	NC 150	Turbidity Fecal coliform
Q5970000	Abbotts Creek Arm of High Rock Lake	Davidson	NC 47	Turbidity, Iron, Dissolved oxygen
Q5990000	Abbotts Creek Arm of High Rock Lake	Davidson	SR 2295	Turbidity, Dissolved oxygen

Q5360000	Town Creek Arm of High Rock Lake	Rowan	SR 2168	Turbidity, Iron, Dissolved oxygen
Yadkin-Pee Dee River Basin Association Monitoring				
Q2291000	Muddy Creek	Forsyth	I-40	Fecal coliform
Q2479455	Salem Creek	Forsyth	SR 2740	None
Q2540000	Salem Creek	Forsyth	SR 1120	None
Q2570000	Salem Creek	Forsyth	SR 2991	Fecal coliform
Q2720000	Muddy Creek	Forsyth	SR 1485	Turbidity
Q2810000	Yadkin River[3]	Davie/ Davidson	US 64	Turbidity
Q4540000	Grants Creek	Rowan	3[RD] St. Extension	Fecal coliform, Turbidity
Q4600000	Grants Creek[3]	Rowan	Near mouth	None
Q4660000	Yadkin River[3]	Rowan/ Davidson	NC 150	Turbidity
Q5240000	Town Creek	Rowan	I-85	None
Q5980000	Abbotts Creek Arm of High Rock Lake[3]	Davidson	NC 47	None
Lakes Assessment				
--	Winston Lake	Forsyth	1 station	None
--	Salem Lake	Forsyth	3 stations	None
--	High Rock Lake	Rowan/ Davidson	8 stations	% DO saturation, Turbidity, Nutrients, Chlorophyll *a*, pH
--	Lake Wright	Rowan	1 station	None
--	Lake Corriher	Rowan	1 station	None

1 Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
2 Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).
3 This site duplicates a DWQ ambient monitoring station.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-8 Use Support Ratings Summary (2002) for Monitored and Evaluated[2] Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-04

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	69.3 275.3	**48.2** **10,449.7**	3.3 71.0	317.2 341.3	438.0 11,137.3
Fish Consumption[2]	miles acres	352.7 301.8	**85.3** **10,835.5**	0.0 0.0	0.0 0.0	438.0 11,137.3
Primary Recreation	miles acres	0.0 4,880.9	0.0 0.0	0.0 0.0	3.0 359.5	3.0 5,240.4
Water Supply	miles acres	76.9 11,084.5	0.0 0.0	0.0 0.0	0.0 0.0	76.9 11,084.5

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

4.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified portions of Reynolds Creek, Salem Creek and Grants Creek as Impaired. These waters are discussed in further detail below.

4.2.1 **Reynolds Creek** (3.3 miles from source to Muddy Creek)

1998 Recommendations

Biological surveys conducted in 1994 revealed that Reynolds Creek was Impaired downstream of the Sequoia WWTP. This facility was a package WWTP serving a residential community. DWQ recommended that an engineering alternatives analysis be conducted to determine the feasibility of eliminating this discharge and connecting to the Winston-Salem/Forsyth County collection system. Recommendations were also made for reducing nonpoint source pollution.

Current Status

Benthic macroinvertebrate communities in Reynolds Creek were sampled again at two locations in 2000. Due to reduced flow, the stream was too small for bioclassifications to be assigned. Upstream of the discharge, DWQ biologists found that there had been a slight decline over the six-year period, which is likely due to increased development in Lewisville. Downstream, significant problems still existed that were attributed primarily to the WWTP. Areas of sludge deposition were observed that were contributing to water quality problems. The Sequoia WWTP discharge was removed in July 2001.

2002 Recommendations

Although Reynolds Creek is currently Not Rated due to its small size, significant water quality problems still exist. DWQ will continue to monitor this stream to evaluate any improvement following the removal of the Sequioa WWTP discharge. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, and to restore habitat in the lower portion of the watershed. It is likely that Forsyth County and Lewisville will be required by DWQ to obtain an NPDES permit for municipal stormwater systems under the federal Phase II stormwater rules.

4.2.2 **Salem Creek** (12.0 miles from dam at Salem Lake to Muddy Creek)

1998 Recommendations

Recommendations for the Salem Creek watershed include support for the City of Winston-Salem's stormwater program and call for further action by the city and Forsyth County to help maintain and improve water quality in the face of continuing development. DWQ planned to reevaluate the computer model used to determine the wasteload allocation for the Archie Elledge WWTP and adjust the NPDES permit accordingly, based on the outcome.

Current Status

The Salem Creek watershed continues to develop, particularly in the headwaters near Kernersville, but also on the lower end. Some habitat degradation was observed above Salem Lake, but the majority of water quality problems exist below the confluence with Brushy Fork. Biological surveys were conducted by DWQ at three sites below Salem Lake, and water chemistry samples were also collected at three sites. Although a small percentage of samples downstream of the Archie Elledge WWTP contained dissolved oxygen concentrations less than 5.0 mg/l, the WWTP does not seem to be adversely impacting the stream. Benthic macroinvertebrate communities were very similar above and below the WWTP. Significant habitat degradation was observed throughout the lower watershed, including severe bank erosion, a lack of riparian vegetation, and sedimentation leading to a very uniform sand/silt substate (i.e., lack of pool and riffle habitat). Additionally, the fish community site, which received a Poor bioclassification, is located upstream of the WWTP discharge. Salem Creek, from the dam at Salem Lake to the confluence with Muddy Creek, remains Impaired.

The geometric means of fecal coliform samples collected from three stations between 1998 and 2001 and one station between 1996 and 2001 from Salem Creek (307, 327, 368 and 773 colonies/100ml) indicate that the stream may not be suitable for primary recreation. In addition, fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site. Salem Creek is not currently classified for primary recreation (Class B). However, the stream was historically placed on the 303(d) list for fecal coliform and a TMDL is being developed by DWQ.

2002 Recommendations

Further investigation into the causes and sources of biological impacts to Salem Creek is needed before specific recommendations to improve water quality can be made. Local actions are needed to reduce sedimentation, turbidity and fecal coliform contamination and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed. DWQ will develop a TMDL for fecal coliform and work with local agencies to implement it over the next five-year basinwide planning cycle. Many of the BMPs employed to reduce fecal coliform contamination will likely help reduce habitat degradation in the watershed also. In addition, Forsyth County and Kernersville are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

Water Quality Improvement Projects
The Salem Creek watershed, including Peters Creek and Brushy Fork (03040101 170060), is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.2.3 Grants Creek (1.2 miles from SR 1910 to Yadkin River)

1998 Recommendations
The 1998 basin plan discussed water quality impacts from the Salisbury Grants Creek WWTP and Spencer Sowers Ferry Road WWTP discharges and Salisbury's plans to relocate the Grants Creek WWTP discharge to the Yadkin River. Recommendations were for DWQ to monitor the stream following the removal of this discharge and for local action to reduce nonpoint source pollution.

Current Status
Biological data were collected from two sites, and water chemistry data were collected from three sites along Grants Creek over the previous basinwide planning cycle. Although the uppermost site (above the WWTP discharges) received a Good-Fair bioclassification, biological surveys indicated severe habitat degradation as well as nutrient enrichment. Further downstream, Grants Creek is impaired by a combination of historical point source problems and current nonpoint source problems.

At two water chemistry sites (above and below the WWTPs), turbidity concentrations were in excess of state standards in more than 10 percent of samples. The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 and one station between 1996 and 2001 from Grants Creek (282, 231 and 291 colonies/100ml) indicate that the stream may not be suitable for primary recreation. In addition, fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site. Grants Creek is not currently classified for primary recreation (Class B). However, the stream was historically placed on the 303(d) list for fecal coliform and a TMDL has already been developed by DWQ.

The City of Salisbury relocated the Grants Creek WWTP discharge to the Yadkin River in 1998. The City of Spencer's Sowers Ferry Road WWTP continued to have significant and chronic problems with BOD as well as chronic problems with dissolved oxygen and total suspended solids over the most recent assessment period (1998-2001). However, in November 2000, the City of Salisbury purchased the Sowers Ferry Road WWTP. Salisbury worked throughout 2001 and 2002 to divert all flows into the Grants Creek WWTP and the Sowers Ferry Road WWTP discharge was eliminated by the end of 2002.

2002 Recommendations

Although Grants Creek above the City of Salisbury is not Impaired, impacts are evident. Further investigation into the causes and sources of biological impacts in the lower portion of Grants Creek is needed before specific recommendations to improve water quality can be made. DWQ expects to see some improvement below the old Sowers Ferry Road WWTP during the next basinwide planning cycle due to Salisbury's elimination of this discharge. However, local actions will continue to be needed throughout the watershed to reduce sedimentation and turbidity and to promote the production of instream habitat by restoring riparian vegetation.

DWQ's fecal coliform TMDL for Grants Creek was approved by the EPA in 2002. The study revealed that the sources of fecal coliform in the Grants Creek watershed are urban sources in the Landis, China Grove and Salisbury areas, livestock grazing and manure application on agricultural lands and pasturelands, and wildlife in the forested areas of the watershed. The Coliform Routing and Allocation Program was utilized to simulate instream fecal concentrations and to allocate the fecal coliform loads to the various sources. In order for water quality standards for fecal coliform to be met in Grants Creek, a nonpoint source load reduction of 33-60 percent under dry weather conditions and 85-97 under wet weather conditions must be met. The model estimates that WWTP discharges contribute an insignificant percentage of the fecal coliform loading in the watershed. In addition, both major discharges have now been removed from Grants Creek. Therefore, the reduction allocation focuses on the fecal coliform loading from urban sources in the Landis, China Grove and Salisbury areas and livestock grazing and manure application on agricultural lands.

These calculations are the first step in reducing fecal coliform concentrations in the watershed. Many of the BMPs employed to implement the TMDL will likely help reduce habitat degradation in the watershed as well. In addition, Landis, China Grove and Salisbury are required to obtain an NPDES permit for municipal stormwater systems under the federal Phase II stormwater rules. Refer to Section A, page 37 for details.

Water Quality Improvement Projects

The Grants Creek watershed (03040103 010010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.3 Status and Recommendations for Newly Impaired Waters

Town Creek, a portion of Muddy Creek and High Rock Lake are rated Impaired based on recent DWQ monitoring (1996-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

4.3.1 **Muddy Creek** (15.2 miles from Mill Creek #3 to SR 2995)

Current Status

The headwaters of Muddy Creek flow from Stokes County, and the stream is currently the western boundary of the City of Winston-Salem. The watershed continues to develop, particularly in the headwaters near King, Tobaccoville and Rural Hall, but also on the lower end where Clemmons and Winston-Salem meet. Some habitat degradation was observed above the confluence with Mill Creek, but the majority of water quality problems exist below this point. On the low end, the stream exhibits some recovery below the confluence with South Fork Muddy Creek; however, impacts are evident in this portion of stream as well. The middle portion of Muddy Creek is Impaired based primarily on fish community data collected in 1996 and 2001. Benthic macroinvertebrate communities in this middle reach of stream have also received bioclassifications that indicate impairment, although these communities were not sampled at this location over the most recent assessment period.

Water chemistry is collected at three locations along Muddy Creek. Elevated nutrients, turbidity and fecal coliform were observed over the five-year period (1996-2001). The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 and one station between 1996 and 2001 from Muddy Creek (265, 255 and 488 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Muddy Creek is not currently classified for primary recreation (Class B).

The impairment of Muddy Creek is primarily attributed to nonpoint source pollution from stormwater runoff from construction sites and developed areas. The input of heavily developed and/or Impaired tributaries also contributes: Mill, Silas, Reynolds and Salem Creeks.

2002 Recommendations

Further investigation into the actual causes and sources of biological impacts to Muddy Creek is needed before specific recommendations to improve water quality can be made; however, the potential for water quality improvement for this stream is still strong. Local actions are needed to reduce sedimentation, turbidity and fecal coliform contamination and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed. In addition, Forsyth County as well as King, Tobbacoville, Rural Hall, Lewisville and Clemmons are required by DWQ to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to Section A, page 37 for details. Section A, Chapter 4 contains more recommendations for reducing habitat degradation from stormwater runoff.

Water Quality Improvement Projects

Although Muddy Creek is not one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts, several of its tributary watersheds have been selected. The Mill Creek, Silas Creek and South Fork Muddy Creek watersheds have been targeted. These watersheds will be given higher priority than nontargeted watersheds for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.3.2 **Town Creek** (15.4 miles from source to Crane Creek)

Current Status
Town Creek begins just east of Kannapolis and flows through Salisbury and East Spencer before reaching High Rock Lake. The City of Salisbury historically had a discharge from a WWTP on Town Creek. Significant improvement has been observed since the discharge was removed in 1990. However, both fish and benthic communities are Impaired in Town Creek. Habitat degradation was noted along with a few occurrences of low dissolved oxygen and elevated turbidity. The lower half of the watershed is heavily developed, and stormwater runoff is likely a major contributor to the impairment. There is one minor discharge in the headwaters which continues to be compliant with its NPDES permit.

2002 Recommendations
DWQ plans to conduct further investigation into the causes and sources of the biological impairment of Town Creek during this basinwide planning cycle. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding. In addition, Rowan County and Salisbury are required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to Section A, page 37 for details.

Water Quality Improvement Projects
The Town Creek watershed (03040103 010020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.3.3 **High Rock Lake** (15,750 acres)

1998 Recommendations
High Rock Lake was not rated Impaired during the assessment period leading up to the 1998 Yadkin-Pee Dee River basin plan. However, the lake was rated support threatened and is extensively discussed in the plan, indicating impacts to water quality that could lead to impairment. The plan focuses on problems with excessive algal growths related to high nutrient levels in the arms of the lake. Although nutrients were also high in the main body of the lake, designated uses seemed to be supported. Recommendations are for DWQ to investigate the feasibility of developing a nutrient strategy for the watershed and consider reclassifying the lake as Nutrient Sensitive Waters. DWQ also planned to require phosphorus limits for major discharges into the arms and urged all major dischargers in the watershed to identify ways to optimize phosphorus removal using existing capabilities.

Current Status
Eight stations on High Rock Lake were monitored by DWQ in 1999, 2000 and 2001. This increased monitoring of High Rock Lake over the most recent assessment period has allowed DWQ to determine that the lake is Impaired. The decision is based on high levels of nutrients, combined with chlorophyll *a*, turbidity and percent dissolved oxygen saturation in excess of state standards. Low dissolved oxygen and high turbidity in the Abbotts Creek and Town Creek Arms are also contributing to aquatic life impairment. An extensive discussion of water quality data collected from High Rock Lake is found in Section A, Chapter 4 beginning on page 107.

2002 Recommendations
The High Rock Lake watershed (map on page 279) comprises slightly more than half of the Yadkin-Pee Dee River basin. Recommendations for improving water quality in the lake are detailed in *Section A, Chapter 4: Recommendations for Water Quality Issues Related to Multiple Subbasins in the Yadkin-Pee Dee River Basin*. The High Rock Lake part of the discussion begins on page 107.

4.4 Section 303(d) Listed Waters

Currently, portions of six waters in this subbasin are listed on the state's draft 2002 303(d) list for biological impairment: Reynolds Creek, Salem Creek, Grants Creek, Town Creek and two small unnamed tributaries. Grants Creek and a portion of Salem Creek are also listed for fecal coliform and turbidity. A fecal coliform TMDL for Grants Creek has been developed by DWQ, and one for Salem Creek will likely be developed during this basinwide planning cycle. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

4.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

4.5.1 Mill Creek
Silas Creek

Mill and Silas Creeks parallel Salem Creek in the Muddy Creek watershed. These streams are likely being impacted by stormwater runoff from the City of Winston-Salem. Mill Creek has not been sampled by DWQ, but the lower two-thirds of the watershed contain moderate road coverage indicating large amounts of developed area, similar to the watershed of Silas Creek. The fish community of Silas Creek was sampled by DWQ for the first time in 2001. Severe habitat degradation was observed and the data indicated impairment. However, the stream was resampled in 2002 and received a Good-Fair bioclassification. This score is likely due to the reduction in nonpoint source pollution that accompanies an extended drought. Refer to Section A, Chapter 4 for recommendations and management strategies for reducing impacts of runoff from developed areas.

The Mill Creek and Silas Creek watersheds (03040101 170020 and 170040) are two of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the Wetlands Restoration Program as areas with the greatest need and opportunity for stream and wetland restoration efforts. These watersheds will be given higher priority than nontargeted watersheds for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.5.2 Salem Lake
Kerners Mill Creek

Although the most severe water quality problems in the Salem Creek watershed occur downstream of Salem Lake, habitat degradation has been observed in Kerners Mill Creek above the lake. In addition, this water supply lake exhibits signs of nutrient enrichment and a diverse assemblage of algae. The Lowery Creek arm exhibits slightly lower dissolved oxygen compared with the other two stations on Salem Lake. Local actions are needed to reduce the effects of nonpoint source pollution in the Salem Lake watershed, particularly from stormwater runoff from construction sites and developed areas. Kernersville is required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

The Salem Creek watershed (03040101 170060) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.5.3 South Fork Muddy Creek

South Fork Muddy Creek borders the City of Winston-Salem on the southeastern side. The watershed contains a mix of residential and agricultural land uses. Most of the new development is occurring in the Fiddlers Creek watershed. Substantial habitat degradation was observed during biological surveys of South Fork Muddy Creek below the confluence of Fiddlers Creek. The Good-Fair bioclassification could be due to the reduction in nonpoint source pollution that accompanies an extended drought. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff from construction sites and developed areas in Fiddlers Creek, but also from agricultural activities in other parts of the watershed.

The South Fork Muddy Creek watershed (03040101 170070) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program

(NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

4.5.4 North Potts Creek
South Potts Creek

North and South Potts Creeks flow south in Davidson County near Lexington into the upper reaches of High Rock Lake. The South Potts Creek watershed (larger of the two) is mostly in agriculture, with the exception of the I-85 corridor and a large rail yard on the lower end. Some historic channelization is evident, and residential development is increasing along US 29/70 between Lexington and Spencer. One NPDES permitted discharge (Davidson County Churchland Elementary) is in significant noncompliance for ammonia in the headwaters.

There is already more developed area in the North Potts Creek watershed and major channelization has occurred. Two NPDES permitted discharges (Davidson County Tyro Junior High and West Davidson High) are in significant noncompliance for BOD, ammonia and chlorine. DWQ sampled North Potts Creek in 1988, but there is no recent data for either stream.

DWQ will attempt to conduct a special study of these streams during the next basinwide planning cycle to determine: 1) the level of impacts associated with these land uses and discharges; and 2) the contribution of this watershed to the impairment of High Rock Lake. In addition, local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff.

4.6 Additional Water Quality Issues with Subbasin 03-07-04

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

4.6.1 NPDES Discharges

Twenty-two of the 40 NPDES discharges had a few permit violations over the two-year review period (September 1999 - August 2001). Nine facilities are in significant noncompliance; six are Davidson County schools. Almost every school in Davidson County is in significant noncompliance for at least one parameter. Because the facilities are scattered throughout several subbasins, these problems and the plans to correct them are discussed on page 113 of Section A, Chapter 4. Color/Tex Finishing had significant problems meeting COD, pH and total suspended solids limits in 2000. The Sowers Ferry Road WWTP (originally owned by Spencer, then bought by Salisbury) was in significant noncompliance over the entire period of review for problems meeting BOD, dissolved oxygen and total suspended solids limits. This discharge was eliminated in 2002. The Hilltop Living Center had problems meeting BOD limits over the two-year review period.

Fifteen facilities are required to monitor effluent toxicity; three have had significant compliance problems over the previous basinwide planning cycle. The Lucent Technologies groundwater remediation facility failed four consecutive chronic toxicity tests during the period from March to June of 1999. Facility staff replaced the system's carbon filter media and optimized application of treatment chemicals to address the problem. No failures have occurred since June 1999. Noncompliances in 1999 and 2000 at the City of Salisbury's Sowers Road WWTP seemed to be associated with operational problems at the WWTP. There were no WET test failures between September 2000 and 2002 when the discharge was eliminated. The Scarlett Acres Mobile Home Park WWTP has produced sporadic failures since it began operation in 1990. Its most recent noncompliances in 2001 have been attributed to poor operation and numerous power outages.

4.6.2 Projected Population Growth

The population of Rowan County is projected to increase 32 percent, Davidson County – 25 percent, and Forsyth County – 26 percent between 2000 and 2020. Much of this development is likely to occur along highway corridors (I-40, I-85, US 64 and US 29/70) and in smaller suburban municipalities like King, Kernersville, Lewisville and Clemmons. Figure B-5 presents population increases between 1990 and 2000 for selected municipalities this subbasin.

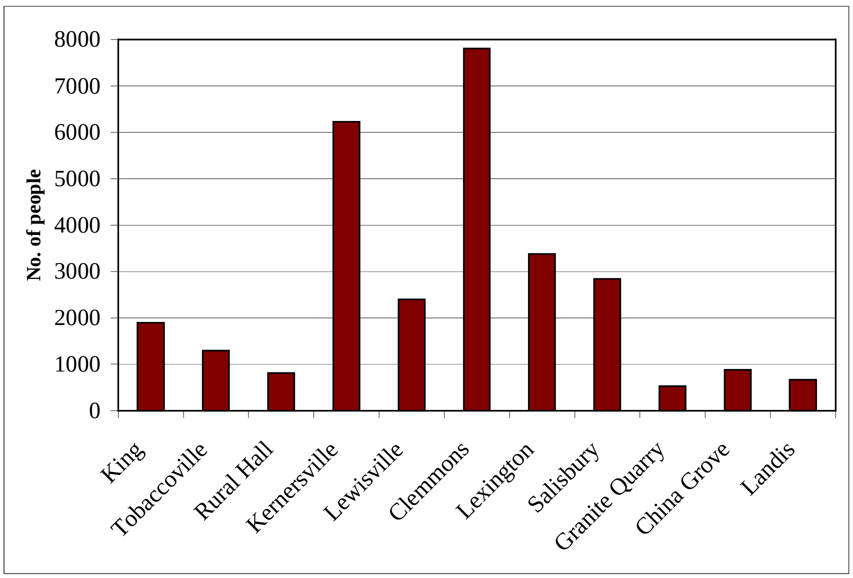


Figure B-5 Population Increases for Selected Subbasin 03-07-04 Municipalities (1990-2000)

Growth management within the next five years will be imperative in order to improve or maintain water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about minimizing impacts to water quality from development.

4.6.3 The South Yadkin/Yadkin River Corridor Conservation Plan

The LandTrust for Central NC (LTCNC) received $7,500 from the Conservation Trust for North Carolina and the Clean Water Management Trust Fund to develop a report evaluating the conservation needs and opportunities along 24 miles of the lower South Yadkin River and a 26-mile section of the Yadkin River above High Rock Lake. This corridor incidentally included a portion of lower Grants Creek as well.

The South Yadkin/Yadkin River Corridor Conservation Plan was completed in December 2001. The highest priorities for conservation identified by the plan are land between Fourth Creek and the South Yadkin River, above and including the confluence of the two streams; and land between the South Yadkin River and the Yadkin River, above and including the confluence of the two rivers. There are large tracts of land (owned by Duke Power-Progress Energy) along the Yadkin River which are in close proximity to lands that are already by LTCNC. There are also large amounts of riparian land (owned by ALCOA) along both the South Yadkin and Yadkin Rivers. These Duke Power and ALCOA lands also received high priority for protection (Merrill, December 2001).

The conservation plan has been integrated into the daily efforts of LTCNC while pursuing conservation opportunities in the Yadkin-Pee Dee River basin. Page 294 of Section C contains more information about The LandTrust for Central NC. You may also visit the website for details about the many lands which LTCNC helped place in conservation ownership at http://www.landtrustcnc.org/aboutlandtrust.html.

Section B: Chapter 5
Yadkin-Pee Dee River Subbasin 03-07-05
Dutchman Creek Watershed

5.1 Water Quality Overview

Subbasin 03-07-05 at a Glance

Land and Water

Total area:	130 mi^2
Stream miles:	133.1
Lake acres:	41.6

Population Statistics

1990 Est. Pop.:	11,800 people
Pop. Density:	91 persons/mi^2

Land Cover (%)

Forest/Wetland:	56.8
Surface Water:	0.6
Urban:	1.9
Cultivated Crop:	5.5
Pasture/ Managed Herbaceous:	35.1

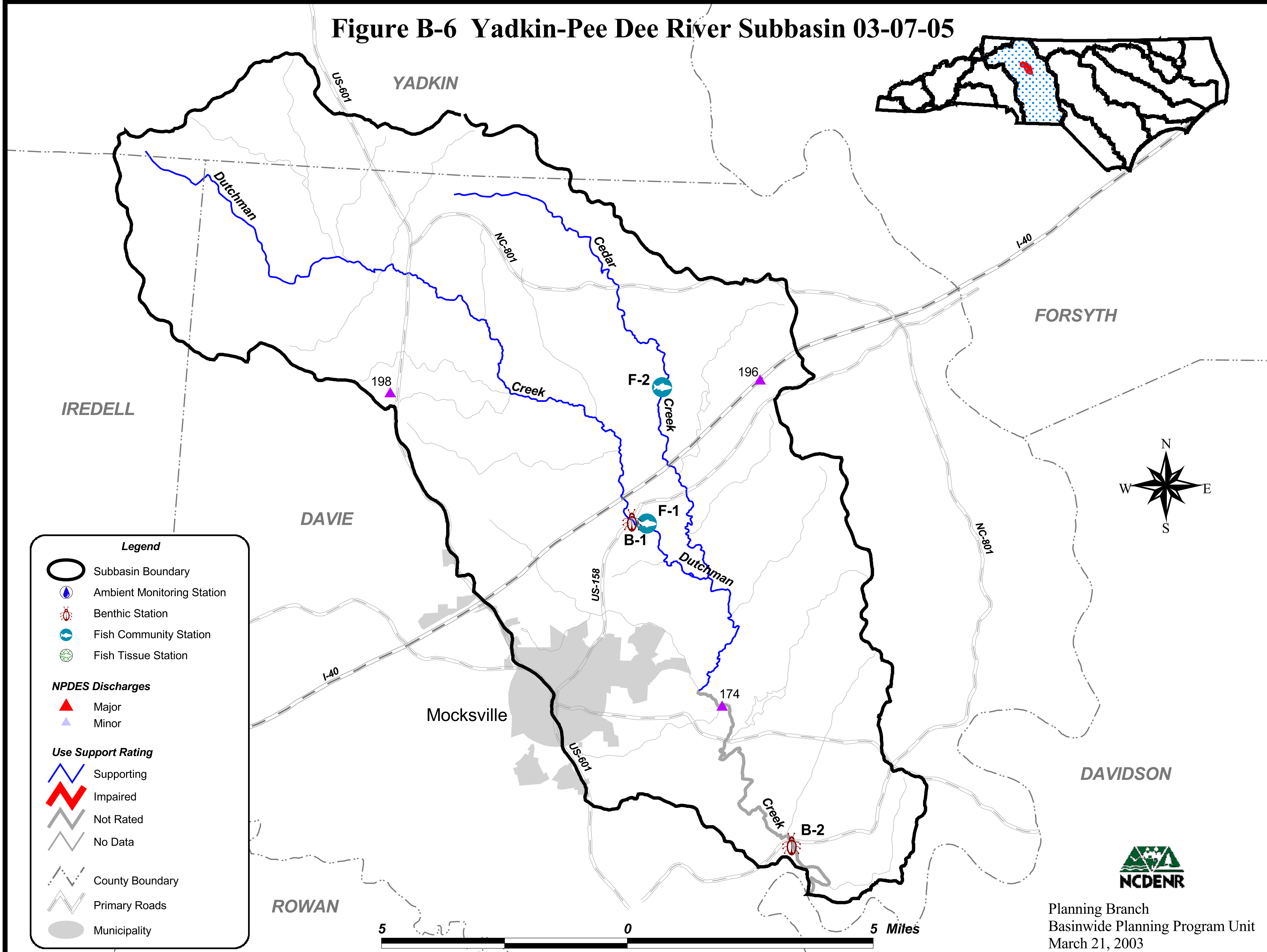
At only 130 square miles, subbasin 03-07-05 is the smallest of the 17 Yadkin-Pee Dee River subbasins. The subbasin contains the Dutchman Creek watershed and lies almost completely within Davie County. Major tributaries to Dutchman Creek include Cedar and Elisha Creeks. Mocksville is the only municipality.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-6. Table B-9 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-10. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Land within this subbasin is mostly low rolling hills, characteristic of the piedmont. Land use is dominated by forest (57 percent) and pasture (35 percent), although residential development is increasing. The population of Davie County is projected to increase 37 percent between 2000 and 2020.

Water quality is generally Good-Fair throughout the subbasin, although many streams are small and have not been monitored by DWQ. There are no streams classified as High Quality Waters or Outstanding Resource Waters, but many streams, including the upper portion of Dutchman Creek are classified for primary recreation (Class B). There are also some waters classified for drinking water supply (WS-IV). There are only two NPDES permitted discharges and three registered animal operations in this subbasin.

Figure B-6 Yadkin-Pee Dee River Subbasin 03-07-05



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-9 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-05

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Dutchman Creek[1]	Davie	US 158	Good-Fair
B-2	Dutchman Creek[1]	Davie	NC 801	Not Rated
Fish Community Monitoring				
F-1	Dutchman Creek[1]	Davie	US 158	Good-Fair
F-2	Cedar Creek[1]	Davie	SR 1437	Good
Yadkin-Pee Dee River Basin Association Monitoring				
Q3105000	Dutchman Creek	Davie	US 64	Turbidity, Dissolved oxygen, Fecal coliform

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-10 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-05

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	48.2 41.6	0.0 0.0	6.3 0.0	78.6 0.0	133.1 41.6
Fish Consumption	miles acres	133.1 41.6	0.0 0.0	0.0 0.0	0.0 0.0	133.1 41.6
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	18.9 41.6	18.9 41.6
Water Supply	miles acres	10.7 0.0	0.0 0.0	0.0 0.0	0.0 0.0	10.7 0.0

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

5.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan did not identify any Impaired waters in this subbasin.

5.3 Status and Recommendations for Newly Impaired Waters

No stream segments were rated as Impaired based on recent DWQ monitoring (1998-2001); however, as mentioned previously, some impacts to water quality were observed. Refer to Part 5.5 below, as well as Section A, Chapter 4 for further discussion of potential water quality problems in this portion of the basin.

5.4 Section 303(d) Listed Waters

No waters in this subbasin are listed on the state's draft 2002 303(d) list. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

5.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

5.5.1 Dutchman Creek

The 1998 basin plan notes some sedimentation in Dutchman Creek, but the stream was rated fully supporting. In 2001, Dutchman Creek was sampled in two locations for benthic macroinvertebrates and one location each for fish community and water chemistry. Habitat degradation, including sedimentation, was noted at both US 158 and NC 801, and some signs of nutrient enrichment were also observed. At the water chemistry site (US 64), turbidity was often elevated and dissolved oxygen was occasionally low. No flow was present when DWQ attempted to resample the stream in 2002. Impacts indicating possible impairment are evident in the lower portion of the watershed; however, DWQ is unable to separate the effects of water quality problems from the effects of the extended drought, and the stream is currently not rated.

The geometric mean of fecal coliform samples collected between 1998 and 2001 from Dutchman Creek (572 colonies/100ml) indicates that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Dutchman Creek is not currently classified for primary recreation (Class B).

The Mocksville Dutchman's Creek WWTP is currently in significant noncompliance for dissolved oxygen which explains the low dissolved oxygen values observed at US 64. However, all other impacts to Dutchman Creek are likely due to nonpoint source pollution in the watershed. Davie County is required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Page 37 of Section A, Chaper 2 for details. Section A, Chapter 4 contains recommendations and management strategies for reducing habitat degradation.

5.5.2 Elisha Creek
Leonard Creek

Elisha and Leonard Creeks flow east into Dutchman Creek near Mocksville. These streams have not been monitored by DWQ, but are likely being impacted by stormwater runoff from developed areas. Much of the increasing residential and commercial development taking place along US 64 and near the I-40/US 64 interchange is within these watersheds. Care needs to be taken during development in order to protect the water quality of these streams and Dutchman Creek. Refer to Section A, Chapter 4 for recommendations and management strategies for reducing impacts of runoff from developed areas.

5.5.3 Cedar Creek

Cedar Creek was rated support threatened in the 1998 basin plan due to observations of possible nutrient enrichment. The recommendation was that additional water quality data be collected, particularly if a NPDES discharge permit was requested. There are currently no permitted discharges in the Cedar Creek watershed. Although the fish community received a Good bioclassification in 2001, habitat degradation, higher conductivity and lower dissolved oxygen than expected were noted at the time of sampling. This watershed is very similar to that of upper Dutchman Creek, and the majority of these impacts are likely related to agricultural activities in the watershed. Refer to Section A, Chapter 4 for recommendations and management strategies for reducing habitat degradation.

5.6 Additional Water Quality Issues within Subbasin 03-07-05

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

5.6.1 Projected Population Growth

The population of Davie County is projected to increase 37 percent from 34,835 people in 2000 to 47,614 in 2020. Much of this development is likely to occur along highway corridors near Mocksville (I-40, US 64 and US 158). Growth management within the next five years will be imperative in order to improve or maintain water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about minimizing impacts to water quality from development.

Section B: Chapter 6

Yadkin-Pee Dee River Subbasin 03-07-06

South Yadkin River Watershed including Hunting Creek, Fourth Creek, Third Creek and Second Creek

6.1 Water Quality Overview

Subbasin 03-07-06 at a Glance

Land and Water

Total area:	907 mi^2
Stream miles:	684.3
Lake acres:	7.7

Population Statistics

1990 Est. Pop.:	94,594 people
Pop. Density:	104 persons/mi^2

Land Cover (%)

Forest/Wetland:	54.0
Surface Water:	0.3
Urban:	1.5
Cultivated Crop:	6.2
Pasture/ Managed Herbaceous:	38.0

The South Yadkin River watershed makes up this large subbasin in primarily Iredell and Rowan counties. The South Yadkin River is one of three major tributaries to the Yadkin River in North Carolina. Streams within the subbasin include Hunting Creek, Rocky Creek, and Second, Third and Fourth Creeks. Statesville is the largest municipality, although portions of Mocksville and Mooresville are also included.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-7. Table B-11 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-12. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

About 54 percent of the land is forested. Approximately 6 percent is cultivated and nearly 40 percent is in pasture. The subbasin contains more than 100,000 people, and the population of Iredell County is expected to increase by 49 percent between 2000 and 2020. Projected increases for Davie and Rowan counties are 37 and 32 percent, respectively. There are 29 NPDES permitted discharges and 50 registered animal operations in the subbasin. Despite a significant decrease between 1994 and 1998, this subbasin alone contains approximately 20 percent of state's capacity for dairy production. Facilities with compliance or toxicity problems are discussed in following sections.

Water quality cannot be generalized across this subbasin. The northern portion contains many streams with Excellent bioclassifications and several other streams where there are a few problem areas. In the lower portion, more water quality impacts are evident, but there are still streams that received Good bioclassifications. The headwaters of the South Yadkin River are classified WS-II and receive the same level of protection offered by the HQW classification. Although several other streams likely qualify, there are no other waters classified HQW or ORW in the subbasin. All or part of Hunting Creek, Rocky Creek, Little Hunting Creek, North Little Hunting Creek, and a larger segment of the upper South Yadkin River likely qualify for either HQW or ORW. Refer to page 54 of Section A for details on stream classifications.

Figure B-7 Yadkin-Pee Dee River Subbasin 03-07-06

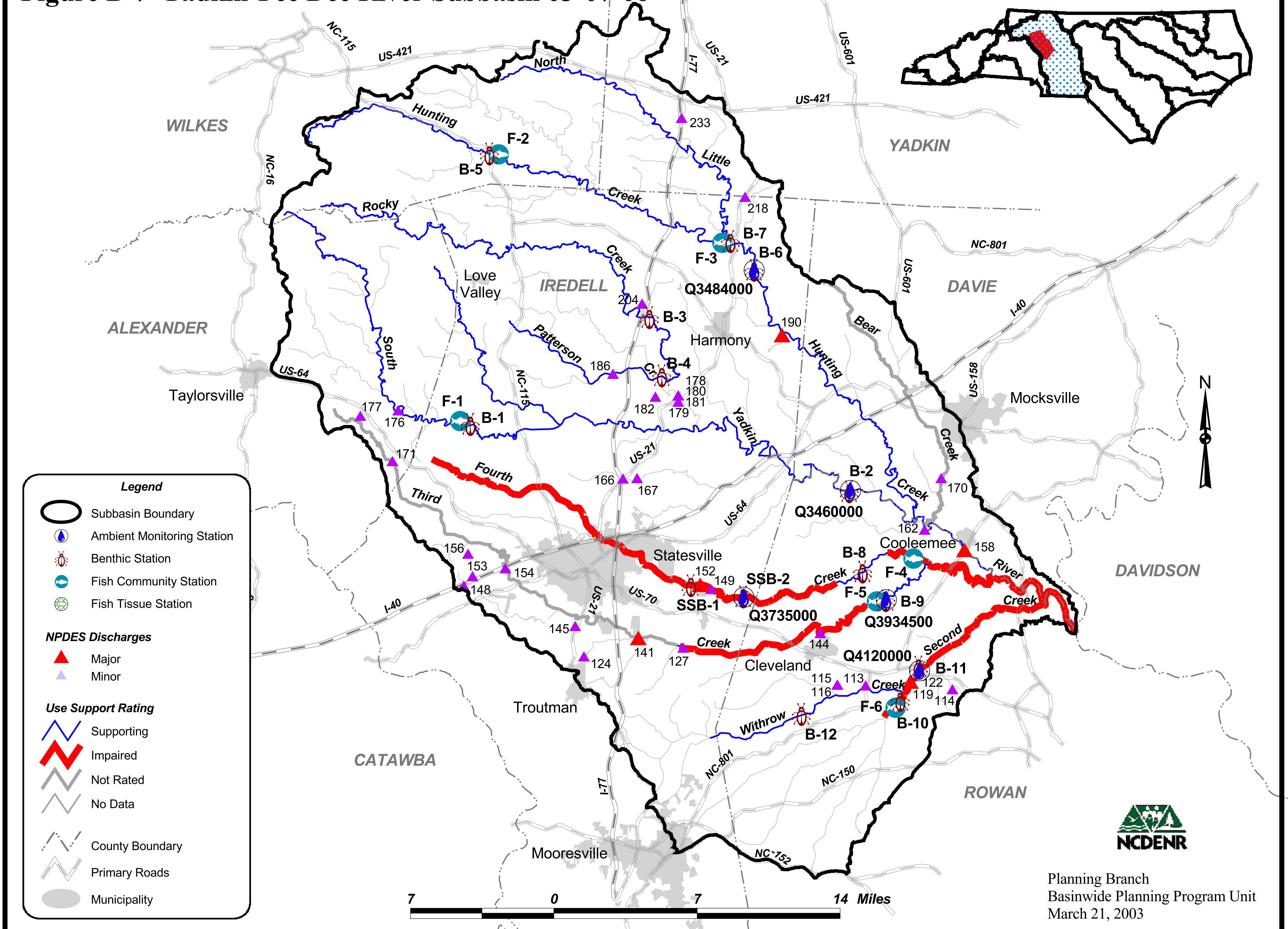


Table B-11 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-06

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	South Yadkin River[1]	Iredell	SR 1561	Good
B-2	South Yadkin River	Davie/Rowan	SR 1159	Excellent
B-3	Rocky Creek[1]	Iredell	SR 1884	Excellent
B-4	Patterson Creek[1]	Iredell	SR 1890	Good
B-5	Hunting Creek[1]	Wilkes	NC 115	Excellent
B-6	Hunting Creek	Iredell	SR 2115	Excellent
B-7	N Little Hunting Cr[1]	Iredell	SR 1829	Excellent
SSB-1	Fourth Creek[1]	Iredell	SR 2316	Fair
SSB-2	Fourth Creek	Iredell	SR 2308	Fair
B-8	Fourth Creek	Iredell	SR 1003	Good
B-9	Third Creek[1]	Rowan	SR 1970	Good
B-10	Second Creek[1]	Rowan	SR 1526	Fair
B-11	Second Creek	Rowan	US 70	Fair
B-12	Withrow Creek[1]	Rowan	SR 1547	Good-Fair
Fish Community Monitoring				
F-1	South Yadkin River[1]	Iredell	SR 1561	Good-Fair
F-2	Hunting Creek[1]	Wilkes	NC 115	Excellent
F-3	N Little Hunting Cr[1]	Iredell	SR 1829	Good
F-4	Fourth Creek[1]	Rowan	SR 1985	Poor
F-5	Third Creek[1]	Rowan	SR 1970	Poor
F-6	Second Creek[1]	Rowan	SR 1526	Good-Fair
Ambient Monitoring				
Q3460000	South Yadkin River	Davie/Rowan	SR 1159	Turbidity, Fecal coliform
Q3484000	Hunting Creek	Iredell	SR 2115	Fecal coliform
Q3735000	Fourth Creek	Iredell	SR 2308	Turbidity, Fecal coliform, Nutrients
Q3934500	Third Creek	Rowan	SR 1970	Fecal coliform, Nutrients
Q4120000	Second Creek	Rowan	US 70	Fecal coliform

Yadkin-Pee Dee River Basin Association Monitoring				
Q3555000	Bear Creek	Davie	SR 1116	Dissolved oxygen
Q3720000	Fourth Creek	Iredell	SR 2316	Fecal coliform
Q3735000	Fourth Creek[3]	Iredell	SR 2308	Turbidity
Q3900000	Third Creek	Iredell	SR 2342	None
Q3932000	Third Creek	Iredell	SR 2359	Fecal coliform
Q3970000	South Yadkin River	Davie/Rowan	US 601	Turbidity
Q4030000	Second Creek	Rowan	SR 1526	None
Q4165000	Second Creek	Rowan	US 601	Turbidity

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).
[3] This site duplicates a DWQ ambient monitoring station.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-12 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-06

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	320.4 7.7	**67.1** 0.0	34.7 0.0	262.1 0.0	684.3 7.7
Fish Consumption	miles acres	684.3 7.7	0.0 0.0	0.0 0.0	0.0 0.0	684.3 7.7
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	353.3 7.7	0.0 0.0	0.0 0.0	0.0 0.0	353.3 7.7

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

6.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. Fourth Creek was the only stream rated Impaired at the time of the 1998 Yadkin-Pee Dee River basin plan. It is discussed below.

6.2.1 **Fourth Creek** (29.3 miles from source to SR 1972 and from SR 1985 to South Yadkin River)

1998 Recommendations

Problems with low dissolved oxygen, high fecal coliform concentrations and elevated levels of nutrients downstream of Statesville were discussed in the 1998 basin plan. Recommendations are for further identification of causes and sources of pollution, along with reduction of nutrients. DWQ also planned to consider reallocation of oxygen-consuming wastes based on an updated 7Q10 flow estimate if instream dissolved oxygen standards continued to be violated.

Status of Progress

Biological surveys were conducted at four sites along Fourth Creek over the last five-year planning period. In addition, water chemistry data were collected from two sites. With the exception of a small portion of the stream in the lower half of the watershed, all of Fourth Creek is currently rated as Impaired. Much of the watershed contains significant habitat degradation. Elevated turbidity and nutrients were also observed below Statesville; however, both permitted discharges are in compliance with permit limits. There is no indication of a dissolved oxygen problem in Fourth Creek.

The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 and one station between 1996 and 2001 from Fourth Creek (543, 306 and 504 colonies/100ml, respectively) indicate that the stream may not be suitable for primary recreation. In addition, fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site. Fourth Creek is not currently classified for primary recreation (Class B). However, the stream was historically placed on the 303(d) list for fecal coliform and a TMDL has already been developed by DWQ.

2002 Recommendations

DWQ's fecal coliform TMDL for Fourth Creek was approved by the EPA in 2001. The study revealed that the sources of fecal coliform in the Fourth Creek watershed include urban sources in the Statesville area, livestock grazing and manure application on agricultural lands, the Fourth Creek WWTP, and wildlife in the forested areas of the watershed. The Coliform Routing and Allocation Program was utilized to simulate instream fecal concentrations and to allocate the fecal coliform loads to the various sources. In order for water quality standards for fecal coliform to be met in Fourth Creek, a nonpoint source load reduction of 40-60 percent under dry weather conditions and 84-98 percent under wet weather conditions must be met. The model estimates that the Fourth Creek WWTP contributes less than one percent of the total fecal coliform loading in the watershed. Therefore, the majority of the reduction allocation focuses on fecal coliform loading from urban sources in the Statesville area and livestock grazing and manure application on agricultural lands.

These calculations are the first step in reducing fecal coliform concentrations in the watershed. Many of the BMPs employed to implement the TMDL will likely help reduce habitat degradation, turbidity and nutrient concentrations in the watershed as well. The Fourth Creek TMDL can be viewed on the DWQ Modeling and TMDL Unit website under "Approved" TMDLs at http://h2o.enr.state.nc.us/tmdl/General_TMDLs.htm. DWQ plans to conduct further investigation into the causes and sources of the biological impairment of Fourth Creek during this basinwide planning cycle, beginning in 2003.

DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding. In addition, Rowan County is required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Statesville will likely be required by DWQ to obtain a stormwater permit. Refer to page 37 of Section A, Chapter 2 for details.

Water Quality Improvement Initiatives

The DWQ Nonpoint Source Pollution Program is working with Carolina Land and Lakes, Resource Conservation and Development, Inc., and the Iredell Soil and Water Conservation District to implement management strategies outlined in the Fourth Creek fecal coliform TMDL. The main goal of the Fourth Creek TMDL Implementation Project will be to reduce the fecal coliform load to the creek from agricultural sources by excluding grazing cattle from the stream.

Results of modeling during DWQ's TMDL study suggest that in order to attain water quality standards, fecal coliform loading from grazing has to be reduced by 40-50 percent during dry weather conditions and by 95-98 percent during wet weather conditions. Such substantial reductions can be achieved by completely eliminating free access that cattle have to the stream and providing alternative watering sources. The project will include construction of the fences along the streambanks, reestablishing vegetation in the buffer zone to reduce erosion, construction of the stream crossing and installation of the water wells and waterers with associated infrastructure. For more information about the Carolina Land and Lakes RC&D, refer to page 296 of Section C.

Fourth Creek and the lower South Yadkin River watersheds (03040102 030020 & 030040) are two of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the NC Wetlands Restoration Program (NCWRP) as areas with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

6.3 Status and Recommendations for Newly Impaired Waters

A portion of South Yadkin River, Third Creek and Second Creek are rated Impaired based on recent DWQ monitoring (1996-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

6.3.1 South Yadkin River (5.3 miles from Fourth Creek to the Yadkin River)

Current Status

Even though only a small portion of the South Yadkin River is Impaired, impacts are evident throughout the watershed. There is light to moderate habitat degradation in the upper portions of the watershed, but overall the biological communities upstream of Cooleemee are in good condition. No biological surveys have been conducted by DWQ downstream of Cooleemee, but water chemistry data indicate turbidity problems. More than 24 percent of samples collected at

US 601 were in excess of state water quality standards. Turbidity was only slightly elevated at a site above Hunting Creek (8 percent of samples exceeded water quality standards). The Davie County WWTP near Cooleemee was in significant noncompliance for chronic problems with total suspended solids over the assessment period; concentrations ranged from 50 to 400 mg/l.

In addition, the geometric means of fecal coliform samples collected from one station between 1996 and 2001 and a second station between 1998 and 2001 from the South Yadkin River (398 and 225 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. The South Yadkin River is not currently classified for primary recreation (Class B).

2002 Recommendations

DWQ will work with the Davie County WWTP to regain compliance; however, local actions are also needed to reduce turbidity in runoff associated with all kinds of land uses. Section A, Chapter 4 contains additional recommendations for reducing the impacts of nonpoint source pollution. Further investigation into the causes and sources of these water quality impacts is needed before more specific recommendations to improve water quality can be made.

Water Quality Improvement Initiatives

The lowest 24 miles of the South Yadkin River corridor was included in a conservation plan developed in 2001 by The LandTrust for Central North Carolina. The highest priorities for conservation identified by the plan are land between Fourth Creek and the South Yadkin River, above and including the confluence of the two streams; and land between the South Yadkin River and the Yadkin River, above and including the confluence of the two rivers (Merrill, December 2001). Page 179 of this chapter discusses the conservation plan in greater depth. Page 294 of Section C contains more information about The LandTrust for Central NC.

The South Yadkin River watershed is one of three priority areas in the Yadkin-Pee Dee River basin under the USDA Environmental Quality Incentives Program (EQIP). EQIP provides technical, educational and financial assistance to farmers and ranchers to address soil, water and related natural resource concerns on their lands. Refer to page 274 in Section C for details.

The lower South Yadkin River watersheds (03040102 020070 and 030040) comprise two of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the Wetlands Restoration Program as an area with the greatest need and opportunity for stream and wetland restoration efforts. These watersheds will be given higher priority than nontargeted watersheds for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

6.3.2 **Third Creek** (22.1 miles from SR 2359 to SR 1970)

1998 Recommendations
Third Creek was rated support threatened in the 1998 basin plan, primarily due to high concentrations of fecal coliform. Recommendations were for reduction in nonpoint source pollution.

Status of Progress
The middle section of Third Creek near Cleveland is currently Impaired based on a Poor fish community bioclassification in 2001 and a Fair bioclassification in 1996. Severe habitat degradation was observed and the water was plum-colored at the time of sampling. Conductivity and nutrients were elevated over the five-year assessment period. The Town of Cleveland WWTP was in significant noncompliance for pH in 2000.

The geometric means of fecal coliform samples collected from one station between 1996 and 2001 and two stations between 1998 and 2001 from Third Creek (375, 314 and 294 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Third Creek is not currently classified for primary recreation (Class B).

2002 Recommendations
DWQ will work with the Town of Cleveland WWTP to reduce impacts to Third Creek from its discharge. DWQ will also investigate the source of color in Third Creek and develop a strategy for color reduction over the next basinwide planning cycle. Local actions are needed to reduce sedimentation, turbidity and fecal coliform contamination and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed. Section A, Chapter 4 contains general recommendations for reducing habitat degradation from a variety of sources.

Water Quality Improvement Initiatives
The middle and lower portions of the Third Creek watershed (03040102 040030 & 040040) are two of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the Wetlands Restoration Program as areas with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

6.3.3 **Second Creek** (10.4 miles from source to South Yadkin River)

1998 Recommendations
Second Creek was discussed in the 1998 basin plan as being support threatened. There were some concerns about low dissolved oxygen, and recommendations focused on better estimations of assimilative capacity in the event that a new or expanding WWTP requested a permit.

Status of Progress

Moderate to severe habitat degradation was observed along Second Creek during biological surveys of both fish communties and benthic macroinvertebrates in 2001 and 2002. There were no indications of problems with dissolved oxygen conentrations in the stream. Three facilities in the watershed were in significant noncompliance over the review period: RDH Tire and Retread (total suspended solids); Rowan County Second Creek WWTP (pH); and Aquasource (ammonia). However, impairment also occurred above all permitted discharges.

The geometric means of fecal coliform samples collected from one station between 1996 and 2001 and a second station between 1998 and 2001 from Second Creek (309 and 359 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Second Creek is not currently classified for primary recreation (Class B).

2002 Recommendations

DWQ will work with these facilities to regain and maintain compliance with NPDES permits. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from agricultural activities, and to restore habitat in the watershed. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

Water Quality Improvement Initiatives

The Second Creek watershed (03040102 050020 and 050030) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

6.4 Section 303(d) Listed Waters

Currently, portions of Fourth Creek are on the state's draft 2002 303(d) list for fecal coliform, turbidity and biological impairment. A total maximum daily load (TMDL) study, which DWQ completed in 2001, has been approved by the EPA for use in reducing fecal coliform concentations in the Fourth Creek watershed. It is likely that portions of the South Yadkin River, Third Creek and Second Creek, discussed above, will be added to the 303(d) list in the future. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

6.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

6.5.1 Bear Creek

Bear Creek flows south near Mocksville into the South Yadkin River above Cooleemee. The headwaters are primarily in agriculture with some channelization present. The mid-section contains moderate road coverage and an increasing level of development around Mocksville along US 64. The last biological survey was done in 1994 and a Good-Fair bioclassification was assigned. These data are too old to base a current use support rating on. Yadkin-Pee Dee River Basin Association data show 6 percent of samples between 1998 and 2001 contained dissolved oxygen below 5.0 mg/l and 2 percent of samples contained concentrations less than 4.0 mg/l.

The geometric mean of fecal coliform samples collected between 1998 and 2001 from Bear Creek (382 colonies/100ml) indicates that the stream may not be suitable for primary recreation. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Bear Creek is not currently classified for primary recreation (Class B).

The Town of Mocksville was in significant noncompliance for cyanide in 2001, and there were also a few violations of the total suspended solids permit limit. Due to the potential impacts and the lack of adequate data to assess these impacts, the stream is currently not rated. DWQ plans to collect benthic macroinvertebrate samples in order to better assess the aquatic life use of the stream. In the meantime, DWQ will work with the Town of Mocksville WWTP to ensure compliance with the NPDES permit. Local actions are needed to reduce the effects of nonpoint source pollution, both from agriculture activities and from developed areas. Section A, Chapter 4 contains general recommendations for reducing nonpoint source pollution from a variety of sources.

6.5.2 Olin Creek

Olin Creek is a tributary to Patterson Creek in the Rocky Creek watershed. The stream flows southeast from near Love Valley and the headwaters are mostly forested. However, there is extensive channelization in the lower portion of the watershed. I-77 also crosses the stream. DWQ does not have recent data on which to base an assessment; however, fish community data collected in 1996 indicated impairment. There are eight registered animal operations in the watershed; all are dairy. DWQ plans to resample this stream over the next basinwide planning period. However, local actions are needed to reduce the effects of nonpoint source pollution. Section A, Chapter 4 contains general recommendations for reducing nonpoint source pollution from a variety of sources.

6.6 Additional Water Quality Issues with Subbasin 03-07-06

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

6.6.1 NPDES Discharges

Twenty of the 29 NPDES discharges had a few permit violations over the two-year review period. Table B-13 presents summary information for nine facilities which were in significant noncompliance.

Table B-13 NPDES Discharges with Significant Discharge Violations in Subbasin 03-07-06 (9/1999-8/2001)

Facility	Receiving Stream	Problem Parameter	Dates
Gulistan Carpet – Turnersburg Plant	Rocky Creek	pH	1999
NC DOT I-77 Rest Area – Iredell Co	Camel Branch	Ammonia	2001
Aquasource, Inc. – Pine Valley	Setman Branch	Ammonia	2000
Town of Cleveland	Third Creek	pH	2000
RDH Tire and Retread	Beaverdam Creek	Total suspended solids	2000
Rowan Co – Second Creek WWTP	Second Creek	pH	2001
Davie Co – Cooleemee WWTP	South Yadkin River	Total suspended solids	Two-year review period
Town of Mocksville	Bear Creek	Cyanide	2001
NC DOT I-77 Rest Area – Yadkin Co	Rocky Branch	Total suspended solids	2001

Eleven facilities are required to monitor effluent toxicity. Two have had recent problems meeting whole effluent toxicity permit limits: Town of Mocksville WWTP and the NCDOT I-77 rest area in Yadkin County. Recent noncompliances at the NC Department of Transportation's I-77 rest area in Yadkin County have been attributed to excessive chlorination. Facility staff members are investigating installation of a flow-paced chlorination system.

Noncompliances beginning in August 2001 at the Town of Mocksville's Bear Creek WWTP were associated with high levels of nickel and zinc that have been attributed to a particular industrial user. The levels of zinc detected in the effluent coupled with whole effluent toxicity failures have made the facility subject to DWQ's Action Level Implementation Strategy. The facility is required to either accept a permit limit for zinc or conduct investigations that definitively rule out zinc as the cause of toxicity. The investigations must be completed by the end of September 2002.

Although Statesville's Fourth Creek WWTP and Tyson Foods-Harmony Division had historical toxicity problems, both facilities passed all tests in 2000 and 2001.

6.6.2 High Fecal Coliform Concentrations

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 and are therefore found in their wastes. Coliform bacteria are relatively easy to identify and are usually present in larger numbers than more dangerous pathogens, even though they respond to the environment and to treatment in much the same way. Sources of fecal coliform bacteria, as well as other more dangerous pathogens, include runoff from pastures, feedlots, poultry operations and lagoons that do not employ appropriate best management practices. Other sources include straight pipes, leaking and failing septic systems, and noncompliant WWTPs. Wildlife and pet waste also contribute to elevated concentrations of pathogens.

The water quality standard for fecal coliform bacteria is based on a geometric mean of 200 colonies/100ml of five samples collected within 30 days, or 20 percent of samples having a concentration greater than 400 colonies/100ml. High levels of fecal coliform bacteria are widespread through this subbasin. Samples were collected from 13 locations on seven streams, and the geometric means for each over the five-year assessment period was greater than 200 colonies/100ml. These data indicate that many streams in this subbasin may not be suitable for primary recreation. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Currently, no waters in this subbasin are classified for primary recreation (Class B).

6.6.3 Projected Population Growth

Iredell County has the fourth largest projected population increase (49 percent between 2000 and 2020) of the 21 counties that comprise the Yadkin-Pee Dee River basin. Population is also expected to increase by 32 percent for Rowan County over the same 20-year period. Growth management within the next five years will be imperative, especially in and around urbanizing areas, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

6.6.4 The South Yadkin/Yadkin River Corridor Conservation Plan

The LandTrust for Central NC (LTCNC) received $7,500 from the Conservation Trust for North Carolina and the Clean Water Management Trust Fund to develop a report evaluating the conservation needs and opportunities along 24 miles of the lower South Yadkin River and a 26-mile section of the Yadkin River above High Rock Lake. This corridor incidentally included the lowermost portions of Fourth and Second Creeks as well.

The South Yadkin/Yadkin River Corridor Conservation Plan was completed in December 2001. The highest priorities for conservation identified by the plan are land between Fourth Creek and the South Yadkin River, above and including the confluence of the two streams; and land between the South Yadkin River and the Yadkin River, above and including the confluence of the two rivers. There are large tracts of land (owned by Duke Power-Progress Energy) along the Yadkin River which are in close proximity to lands that are already by LTCNC. There are also large amounts of riparian land (owned by ALCOA) along both the South Yadkin and Yadkin Rivers. These Duke Power and ALCOA lands also received high priority for protection (Merrill, December 2001).

The conservation plan has been integrated into the daily efforts of LTCNC while pursuing conservation opportunities in the Yadkin-Pee Dee River basin. Page 294 of Section C contains more information about The LandTrust for Central NC. You may also visit the website for details about the many lands which LTCNC helped place in conservation ownership at http://www.landtrustcnc.org/aboutlandtrust.html.

Section B: Chapter 7
Yadkin-Pee Dee River Subbasin 03-07-07
Abbotts Creek Watershed including Lake Thom-A-Lex, Rich Fork and Hamby Creek

7.1 Water Quality Overview

Subbasin 03-07-07 at a Glance

Land and Water

Total area:	237 mi^2
Stream miles:	203.3
Lake acres:	942.4

Population Statistics

1990 Est. Pop.:	101,019 people
Pop. Density:	428 persons/mi^2

Land Cover (%)

Forest/Wetland:	56.5
Surface Water:	0.8
Urban:	7.8
Cultivated Crop:	3.0
Pasture/ Managed Herbaceous:	31.8

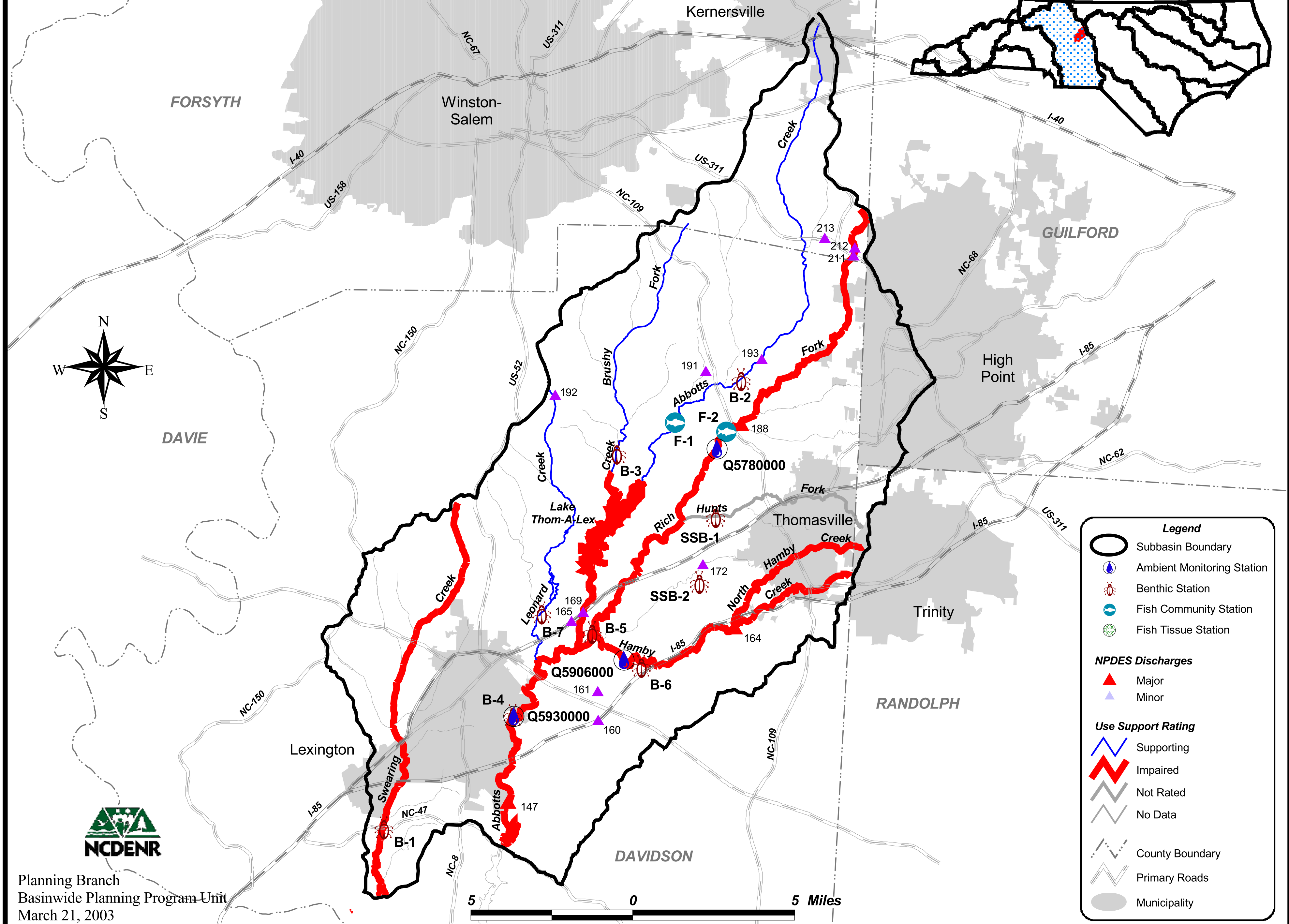
Abbotts Creek begins in Kernersville and flows generally south through Davidson County into High Rock Lake. The watershed is positioned between Winston-Salem and High Point and includes Thomasville and Lexington within its boundaries. Major tributaries include Rich Fork, Brushy Fork and Leonard Creek.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-8. Table B-14 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-15. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Nearly 60 percent of the subbasin is forested and 32 percent is characterized as pasture/managed herbaceous. However, this subbasin is one of the most urbanized areas in the basin (nearly 8 percent developed). The population is estimated at more than 100,000 and population density is high. In addition, the population of Davidson County is projected to increase 25 percent between 2000 and 2020 and similar projections have been made for surrounding counties. There are 14 NPDES discharges and two registered animal operations within the subbasin. Facilities with compliance or toxicity problems are discussed in following sections.

The majority of waters within this subbasin exhibit some level of impacts to water quality. Many streams are Impaired by a combination of nonpoint and point source pollution. There are no High Quality Waters or Outstanding Resource Waters.

Figure B-8 Yadkin-Pee Dee River Subbasin 03-07-07



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-14 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-07

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-2	Abbotts Creek[1]	Davidson	SR 1755	Good-Fair
B-3	Brushy Fork[1]	Davidson	SR 1810	Good
B-4	Abbotts Creek	Davidson	SR 1243	Fair
B-5	Rich Fork[1]	Davidson	SR 2005	Fair
SSB-1	Hunts Fork[1]	Davidson	SR 1787	Not Rated
	Hamby Creek[1]	Davidson	SR 2025	Poor
B-6	Hamby Creek	Davidson	SR 2017	Fair
SSB-2	North Hamby Creek[1]	Davidson	SR 2031	Poor
B-7	Leonard Creek[1]	Davidson	Leonard Cr Farm	Good-Fair
B-1	Swearing Creek[1]	Davidson	NC 47	Fair
Fish Community Monitoring				
F-1	Abbotts Creek[1]	Davidson	SR 1800	Good-Fair
F-2	Rich Fork[1]	Davidson	NC 109	Poor
Ambient Monitoring				
Q5930000	Abbotts Creek	Davidson	SR 1243	Nutrients Fecal coliform
Q5780000	Rich Fork	Davidson	SR 1800	Nutrients, Fecal coliform, Dissolved oxygen
Q5906000	Hamby Creek	Davidson	SR 2790	Nutrients, Copper
Yadkin-Pee Dee River Basin Association Monitoring				
Q5940000	Abbotts Creek	Davidson	I-85	Dissolved oxygen, Turbidity
Q5750000	Rich Fork	Davidson	SR 1755	None
Q5785000	Rich Fork	Davidson	SR 1787	Dissolved oxygen
Q5790000	Rich Fork	Davidson	SR 2123	Dissolved oxygen, Turbidity
Q5135000	Swearing Creek	Davidson	SR 1272	None
Lakes Assessment				
--	Lake Thom-A-Lex	Davidson	2 stations	% DO saturation

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.

[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-15 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-07

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	52.8 52.5	**65.9** **889.9**	7.1 0.0	77.5 0.0	203.3 942.4
Fish Consumption[2]	miles acres	146.6 86.7	**56.7** **855.7**	0.0 0.0	0.0 0.0	203.3 942.4
Primary Recreation	miles acres	11.0 855.7	0.0 0.0	0.0 0.0	0.0 0.0	11.0 855.7
Water Supply	miles acres	79.9 942.3	0.0 0.0	0.0 0.0	0.0 0.0	79.9 942.3

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

7.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified two Impaired waters in this subbasin: Brushy Fork and Hamby Creek. These waters are discussed below.

7.2.1 **Brushy Fork** (9.8 miles from source to Lake Thom-A-Lex)

1998 Recommendations

Brushy Fork was rated Impaired based on a Fair benthic macroinvertebrate sample collected in 1996. Recommendations for improving water quality were for reduction of nonpoint source pollution, primarily sedimentation.

Status of Progress

The benthic macroinvertebrate in Brushy Fork was resampled in 2001 and received a Good bioclassification. The score was on the border of the Good-Fair category and would likely receive the lesser bioclassification in a higher flow year. There is quite a bit of development in the headwaters of the Brushy Fork watershed and there is a substantial amount of agriculture also. There are no permitted NPDES discharges nor registered animal operations. The stream is currently rated Supporting in the aquatic life/secondary recreation category.

2002 Recommendations

Although Brushy Fork is currently Supporting designated uses, instream habitat degradation was observed. Considering the fluctuation in bioclassifications, nonpoint source pollution likely impacts the stream heavily at times. Local actions are still needed to reduce the effects of nonpoint source pollution. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

7.2.2 **Hamby Creek** (12.5 miles from source to Rich Fork)

1998 Recommendations

Hamby Creek was Impaired in 1998 due to problems with oxygen-consuming wastes and habitat degradation, primarily sedimentation. Recommendations were for no new discharges of oxygen-consuming wastes. In addition, the Thomasville WWTP would be required to pursue reuse options before additional loading of oxygen-consuming waste would be permitted. Hamby Creek was also considered a major contributor to impairment of the Abbotts Creek Arm of High Rock Lake for nutrients and low dissolved oxygen. For this reason, recommendations included reductions in phosphorus loading for the Thomasville WWTP.

Status of Progress

Benthic macroinvertabrate communities in the low end of the watershed were assigned a Fair bioclassification. Habitat was in relatively good shape compared with other biological survey sites in this subbasin. Water chemistry data revealed high nutrient concentrations and conductivity, but no problems with dissolved oxgyen. Data also indicate that high copper concentrations may be causing toxicity problems in the stream.

Over the most recent review period, Thomasville was in significant noncompliance for BOD, ammonia and cyanide. The current NPDES permit for the Thomasville WWTP outlines mass-based summer and winter discharge limits for total phosphorus which will be required beginning in 2004 as part of a point source nutrient reduction strategy for High Rock Lake. This strategy is outlined in Section A, Chapter 4, beginning on page 107.

Fecal coliform concentrations are slightly elevated, but are not at levels high enough to cause concern. However, this stream was historically placed on the 303(d) list for fecal coliform. Because Hamby Creek is a tributary to Rich Fork and fecal coliform concentrations are still high in other parts of the watershed, Hamby Creek is included along with Rich Fork in the schedule for fecal coliform TMDL development.

2002 Recommendations

DWQ will continue to monitor Hamby Creek as strategies to reduce nutrient concentrations in High Rock Lake watershed are implemented. DWQ will also continue to work with Thomasville WWTP to regain and maintain compliance with its NPDES permit. In addition, DWQ will develop a TMDL for fecal coliform and work with local agencies to implement it over the next five-year basinwide planning cycle.

DWQ plans to conduct further investigation into the causes and sources of the biological impairment of Hamby Creek during this basinwide planning cycle. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding. In addition, Davidson County as well as High Point, Trinity and Thomasville are required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

7.3 Status and Recommendations for Newly Impaired Waters

Rich Fork, North Hamby Creek, Swearing Creek, Lake Thom-A-Lex and a portion of Abbotts Creek are Impaired based on recent DWQ monitoring (1998-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

7.3.1 **Rich Fork** (20.7 miles from source to Abbotts Creek)

1998 Recommendations

Rich Fork was not rated in 1998, but problems associated with low dissolved oxygen were discussed in the basin plan. The plan stated that predictions from the model used to determine NPDES permit limits overestimated the ability of the stream to handle oxygen-consuming wastes. The plan recommended that no additional loading of oxygen-consuming wastes be permitted into Rich Fork.

Status of Progress

Biological surveys were conducted at two locations along Rich Fork in 2001 and water chemistry measurements were collected at four sites over the five-year assessment period. The biological community in Rich Fork is currently Impaired. Although the riparian vegetation was good at both biological monitoring locations, instream habitat was severely degraded. The stream bottom was almost completely filled with sediment and indicators of organic enrichment and toxicity were present.

Water chemistry samples revealed significant problems with low dissolved oxygen concentrations. Turbidity is only slightly elevated, but nutrient concentrations are high. In addition, the geometric means of fecal coliform samples collected from one station between 1996 and 2001 and two stations between 1998 and 2001 in Rich Fork (254, 330 and 236 colonies/100ml) indicate that the stream may not be suitable for primary recreation. In addition, fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site. Rich Fork is not currently classified for primary recreation (Class B). However, the stream was historically placed on the 303(d) list for fecal coliform and a TMDL is currently being developed by DWQ.

Over the most recent review period (2000-2001), High Point-Westside WWTP was in significant noncompliance for BOD and fecal coliform. Currently, the NPDES permit for the High Point-Westside WWTP contains a 2.0 mg/l discharge limit for total phosphorus. The permit also outlines mass-based summer and winter discharge limits for total phosphorus which will be required beginning in 2004 as part of a point source nutrient reduction strategy for High Rock Lake. This strategy is outlined in Section A, Chapter 4, beginning on page 107.

2002 Recommendations
DWQ will continue to monitor Rich Fork as strategies to reduce nutrient concentrations in High Rock Lake are implemented (refer to the discussion beginning on page 107 of Section A for details). DWQ will also continue to work with High Point-Westside WWTP to regain and maintain compliance with its NPDES permit. If dissolved oxygen problems downstream do not improve when the facility regains compliance, more modeling will likely be needed in order to further reduce sources of oxygen-consuming wastes. DWQ is currently developing a TMDL for fecal coliform in the Rich Fork watershed and will work with local agencies to implement it over the next five-year basinwide planning cycle.

Although problems with point sources have been identified in Rich Fork, there are habitat degradation issues as well. Development in the headwaters of Rich Fork west of High Point continues to increase, and control of stormwater from construction sites and these new developed areas is imperative. Davidson County, Randolph County and the City of High Point are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

7.3.2 North Hamby Creek (5.8 miles from source to Hamby Creek)

Current Status
North Hamby Creek is the largest tributary to Hamby Creek in the Rich Fork watershed and is almost completely developed. Benthic macroinvertebrates received a Poor bioclassification in 2001 and the stream is rated Impaired. Data from 1987 and 1985 also indicated Poor conditions. Despite the developed watershed, instream habitat was available; however, there was little riparian vegetation. The water had a reddish tinge. There are no permitted point source discharges in the watershed.

2002 Recommendations
Biologists report that flow and habitat are not likely to be limiting the benthic macroinvertebrate community of North Hamby Creek. Therefore, further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made. Thomasville is required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

7.3.3 Swearing Creek (14.3 miles from source to High Rock Lake)

Current Status
The Swearing Creek watershed is primarily in agricultural land uses, but there is some development near Lexington. The stream has received Good-Fair or Fair bioclassifications over six collections at five locations since the 1980s. In 1996, the stream received a Good-Fair score. However, in 2001 the bioclassification declined to Fair. A decline in habitat over the five-year period was also observed. Because of the historical fluctuation in bioclassification, the stream was resampled in 2002. The benthic community again received a Fair bioclassification. Swearing Creek is currently rated Impaired. Severe habitat degradation was noted including sedimentation and bank erosion. Dissolved oxygen was slightly depressed, and turbidity was slightly elevated in water chemistry samples. There are no permitted point source discharges in the watershed.

The geometric mean of fecal coliform samples collected between 1998 and 2001 from Swearing Creek (295 colonies/100ml) indicates that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in nearly 32 percent of samples from this site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Swearing Creek is not currently classified for primary recreation (Class B).

2002 Recommendations
Local actions are needed to reduce sedimentation, turbidity and fecal coliform contamination and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed. Section A, Chapter 4 contains recommendations for reducing habitat degradation. Further investigation into the causes and sources of these water quality impacts is needed before more specific recommendations to improve water quality can be made.

Water Quality Improvement Initiatives
The Swearing Creek watershed (03040103 020020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the Wetlands Restoration Program as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

7.3.4 Lake Thom-A-Lex (650 acres)

Current Status
Lake Thom-A-Lex is currently Impaired due to violations of the percent dissolved oxygen saturation water quality standard. In addition, nutrient concentrations are high, and algae blooms which contribute to taste and odor problems in drinking water are common. Lake Thom-A-Lex is a drinking water supply source for the cities of Lexington and Thomasville. There are three minor NPDES permitted discharges and several small animal operations in the watershed upstream.

2002 Recommendations
A strategy for nutrient reduction, that includes best management practices for agricultural activities, is needed for the Abbotts Creek watershed upstream of Lake Thom-A-Lex. Additionally, the amount of developed area is rapidly increasing. Davidson and Forsyth counties are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details. Controlling erosion from construction sites and implementing best management practices to control stormwater are two important strategies for reducing nutrient input to the lake.

7.3.5 **Abbotts Creek** (8.0 miles from dam at Lake Thom-A-Lex to High Rock Lake)

<u>*1998 Recommendations*</u>
Abbotts Creek was support threatened in 1998 due to problems with low dissolved oxygen. Recommendations were for no new discharges of oxygen-consuming wastes. In addition, the Lexington WWTP would be required to pursue reuse options before additional loading of oxygen-consuming waste would be permitted. Abbotts Creek was also considered a major contributor of nutrients and low dissolved oxygen in the Abbotts Creek Arm of High Rock Lake. For this reason, recommendations included reductions in phosphorus loading for the Lexington WWTP.

<u>*Status of Progress*</u>
Abbotts Creek below Lake Thom-A-Lex and the Abbotts Creek Arm of High Rock Lake are rated Impaired based on Fair benthic macroinvertebrate bioclassifications at one location and water chemistry data collected from four locations. Habitat was in relatively good condition when compared with other sampling locations throughout the subbasin; however, development is beginning to encroach on the stream from Lexington. Conductivity, turbidity and nutrient concentrations were elevated and dissolved oxygen concentrations were low over the five-year assessment period.

The current NPDES permit for the Lexington WWTP outlines mass-based summer and winter discharge limits for total phosphorus which will be required beginning in 2004 as part of a point source nutrient reduction strategy for High Rock Lake. This strategy is outlined in Section A, Chapter 4, beginning on page 107. Over the most recent review period, the Lexington WWTP was in compliance with permit limits.

<u>*2002 Recommendations*</u>
DWQ will continue to monitor Abbotts Creek as strategies to reduce nutrient concentrations in High Rock Lake are implemented. However, further investigation into the causes and sources of these water quality impacts, including an assessment of what level of impact is caused by the inflow of the severely Impaired Rich Fork watershed, is needed before more specific recommendations to improve water quality can be made. Davidson County is required by DWQ to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. It is likely that Lexington will be required to obtain a stormwater permit during the next basinwide planning cycle. Refer to page 37 of Section A, Chapter 2 for details.

7.4 Section 303(d) Listed Waters

Currently, portions of four waters in this subbasin are on the state's draft 2002 303(d) list for biological impairment: Brushy Creek, Hamby Creek, North Hamby Creek and Hunts Fork. Hamby Creek and Rich Fork are listed for fecal coliform and TMDLs are currently being developed by DWQ. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

7.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

7.5.1 Hunts Fork

Hunts Fork flows generally west from Thomasville and into Rich Fork about halfway down the watershed. I-85 bisects the watershed and the upper portion is almost completely developed. Biological surveys have revealed Fair or Poor bioclassifications over four samples at three locations since the 1980s. In 2001, DWQ sampled benthic macroinvertebrates in the lower portion of the watershed. Due to reduced flows, the stream was too small to assign a bioclassification; however, some signs of improvement were noted, possibly due to reduced nonpoint source pollution related to the extended drought. Habitat is still poor. Although this stream was not rated Impaired and discussed in the 1998 basin plan, it was historically listed on the 303(d) list and will likely remain listed despite its not rated status.

Local actions are needed to reduce habitat degradation and the effects of stormwater runoff from developed areas. Davidson County and Thomasville are required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details. Section A, Chaper 4 contains recommendations for reducing habitat degradation and the effects of urban runoff.

7.6 Additional Water Quality Issues within Subbasin 03-07-07

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

7.6.1 NPDES Discharges

Eleven of the 14 NPDES discharges had a few permit violations over the two-year review period (September 1999 - August 2001). Seven facilities are in significant noncompliance; five are Davidson County schools. Almost every school in Davidson County is in significant noncompliance for at least one parameter. Because the facilities are scattered throughout several subbasins, these problems and the plans to correct them are discussed in Section A, on page 113. The City of Thomasville WWTP had significant problems meeting BOD, ammonia and cyanide permit limits throughout the two-year review period. The City of High Point Westside WWTP was in significant noncompliance for BOD and fecal coliform.

Five facilities are required to monitor effluent toxicity; one had significant compliance problems over the previous basinwide planning cycle. The Centerclair Nursing Home WWTP failed to comply with its toxicity testing limit from the inception of its permit limit in July 1999 through June 2000. According to the plant's operator, dechlorination was installed in October 1999 which mitigated some of the toxicity problems. However, a change in detergent used at the facility's on-site laundry operation in the summer of 2000 seemed to have significantly reduced toxicity in the effluent. The facility has only failed one toxicity test since July 2000.

7.6.2 Projected Population Growth

From 2000 to 2020, the estimated population increase for Davidson County is 25 percent. Population is also expected to increase by 37 percent for Randolph County over the same 20-year period. Growth management within the next five years will be imperative, especially in and around urbanizing areas and along highway corridors, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

Section B: Chapter 8

Yadkin-Pee Dee River Subbasin 03-07-08

Includes Yadkin River below High Rock Dam, Lick Creek, Badin Lake, Mountain Creek and Lake Tillery

8.1 Water Quality Overview

Subbasin 03-07-08 at a Glance

Land and Water

Total area:	294 mi^2
Stream miles:	155.0
Lake acres:	5,048.8

Population Statistics

1990 Est. Pop.:	18,811 people
Pop. Density:	68 persons/mi^2

Land Cover (%)

Forest/Wetland:	67.9
Surface Water:	8.0
Urban:	0.8
Cultivated Crop:	2.5
Pasture/ Managed Herbaceous:	20.9

This long, relatively narrow subbasin is made up almost entirely of reservoirs in the Yadkin-Pee Dee River below High Rock dam. Tuckertown, Narrows (Badin), Falls and Tillery dams are all contained within its boundaries. Major tributaries that are discussed here include Lick Creek and Mountain Creek. The confluence with the Uwharrie River (subbasin 03-07-09) between Falls and Tillery marks the beginning of the Pee Dee River. Municipalities within the subbasin include Denton, Richfield, Badin and Norwood.

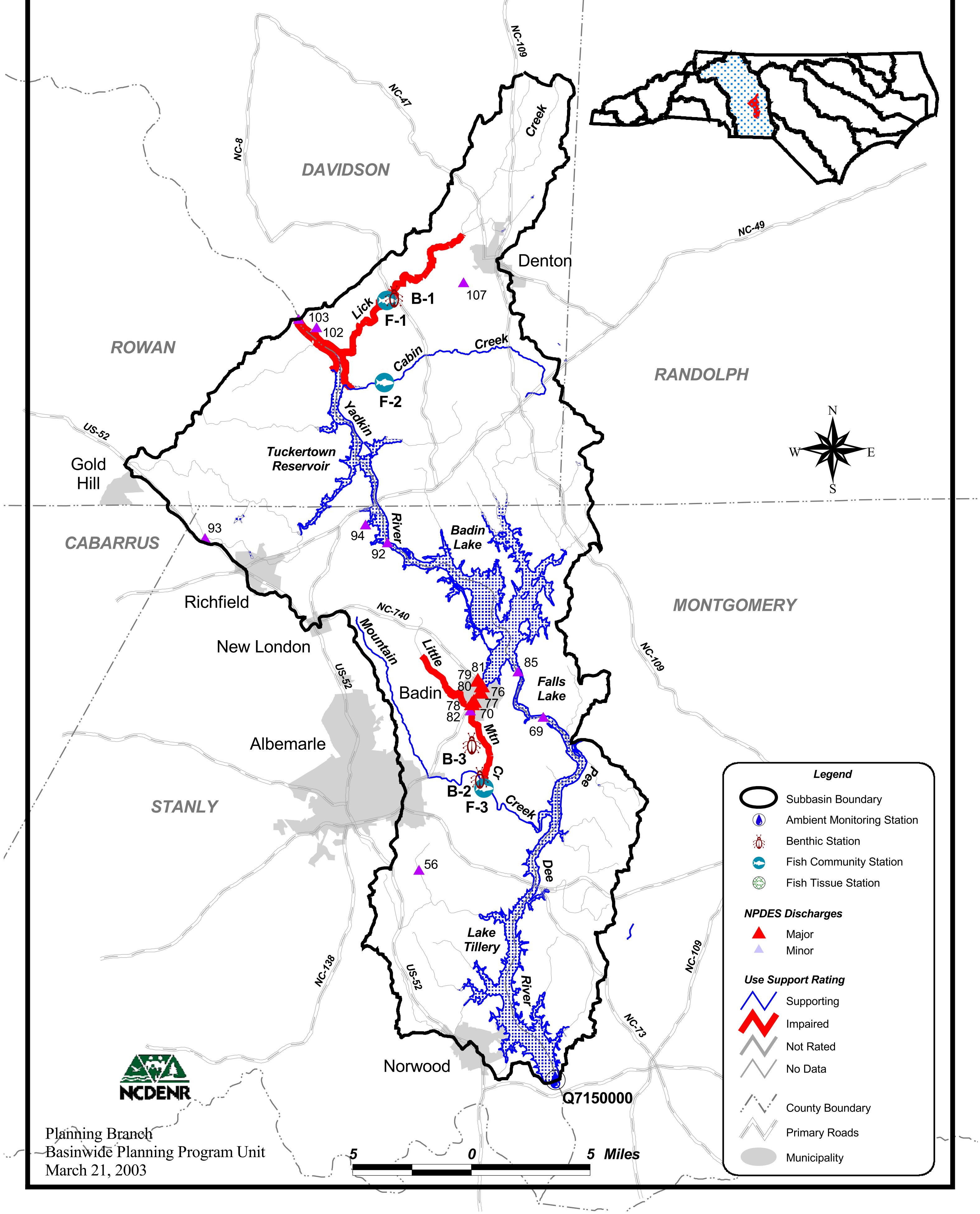
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-9. Table B-16 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-17. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

There is a significant amount of public land in this subbasin, especially when compared with other parts of the Yadkin-Pee Dee River basin. Morrow Mountain State Park is nestled in a large bend of the river between Falls and Tillery. In addition, there are large tracts of the Uwharrie National Forest along the southeastern shoreline of Badin Lake and south beyond where the Uwharrie River enters the Yadkin-Pee Dee.

Public land likely contributes significantly to the 68 percent forested area. A very small portion of the subbasin is characterized as urban and 8 percent is surface water, reflecting two large reservoirs and the riverine environment. The estimated population of the basin and the density are low, although projected population increases range from 21 percent in Stanly County to 25 percent in Davidson County between 2000 and 2020.

There are ten NPDES permitted discharges and one registered animal operation (swine). Although a few discharge violations were reported during this assessment period, most were minor and no facility is currently in significant noncompliance. The capacity for poultry production in this subbasin increased by 50 percent between 1994 and 1998.

Figure B-9 Yadkin-Pee Dee River Subbasin 03-07-08



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-16 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-08

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Lick Creek[1]	Davidson	NC 8	Fair
B-2	Mountain Creek[1]	Stanly	SR 1720	Good-Fair
B-3	Little Mountain Creek[1]	Stanly	SR 1720	Fair
Fish Community Monitoring				
F-1	Lick Creek[1]	Davidson	NC 8	Good-Fair
F-2	Cabin Creek[1]	Davidson	SR 2536	Good
F-3	Mountain Creek[1]	Stanly	SR 1720	Good-Fair
Ambient Monitoring				
Q6120000	Yadkin River	Rowan/ Davidson	SR 1002	Dissolved oxygen
Yadkin-Pee Dee River Basin Association Monitoring				
Q6360000	Yadkin River	Rowan/ Davidson	NC 8/49	None
Q6180000	UT Lick Creek	Davidson	SR 2505	Dissolved oxygen
Q6960000	Mountain Creek Arm of Lake Tillery	Stanly	SR 1730	None
Q6950000	Little Mountain Creek	Stanly	SR 1798	None
Q7030000	Pee Dee River	Stanly/ Montgomery	NC 24/27/73	None
Lakes Assessment				
--	Tuckertown Reservoir	Rowan/ Davidson	2 stations	None
--	Badin Lake (Narrows)	Mostly Montgomery	4 stations	Nutrients
--	Lake Tillery	Stanly/ Montgomery	4 stations	None

1 Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.

2 Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

Water quality in this subbasin is generally good. However, there are a few problem areas and areas where impacts have been observed. There are no waters classified as High Quality Waters or Outstanding Resource Waters.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-17 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-08

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	59.2 2,498.8	**13.5** **0.0**	0.0 2,550.0	82.3 0.0	155.0 5,048.8
Fish Consumption[2]	miles acres	0.0 0.0	**155.0** **5,048.8**	0.0 0.0	0.0 0.0	155.0 5,048.8
Primary Recreation	miles acres	5.0 5,048.8	0.0 0.0	0.0 0.0	9.0 0.0	14.0 5,048.8
Water Supply	miles acres	122.4 5,048.8	0.0 0.0	0.0 0.0	0.0 0.0	122.4 5,048.8

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

8.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified two Impaired waters in this subbasin. Lick Creek and Little Mountain Creek are discussed below.

8.2.1 **Lick Creek** (14.6 miles from source to a point 1.0 mile upstream of SR 2501)

1998 Recommendations

Streamflow in the Lick Creek watershed is naturally very low in the summer months and smaller tributaries often stop flowing completely. Problems with low dissolved oxygen were thought to be contributing to biological impairment in 1998. The Town of Denton was pursuing a relocation of its WWTP discharge from an unnamed tributary of Lick Creek into Lick Creek downstream. The basin plan recommends that any new discharges, including the Town of Denton's proposed outfall, should receive advanced tertiary limits for oxygen-consuming wastes. Local efforts to reduce nonpoint source pollution in the watershed are also recommended.

Status of Progress

Benthic macroinvertebrate communities in Lick Creek continued to indicate impairment in 2001. The stream had relatively good habitat; however, conductivity was high and dissolved oxygen was slightly low. Approximately 42 percent of samples collected from the unnamed tributary to Lick Creek contained dissolved oxygen concentrations less than 5.0 mg/l; 30 percent were below

4.0 mg/l between June 1998 and August 2001. The Town of Denton WWTP discharge was relocated from the unnamed tributary to Lick Creek mainstem in 2000.

2002 Recommendations

DWQ will continue to monitor Lick Creek and the unnamed tributary to Lick Creek to evaluate improvements following the upgrade of the Denton WWTP. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from agricultural activities in the watershed.

8.2.2 **Little Mountain Creek** (7.0 miles from source to Mountain Creek)

1998 Recommendations

Streamflow in the Little Mountain Creek watershed is naturally very low in the summer months and smaller tributaries often stop flowing completely. Problems with low dissolved oxygen were thought to be contributing to biological impairment in 1998. Low instream dissolved oxygen concentrations had been reported by the Greater Badin WWTP. There were also historical concerns with toxicity in Alcoa stormwater and cooling water discharges to an unnamed tributary of Little Mountain Creek. The 1998 basin plan recommended that any new or expanding discharges to the Little Mountain Creek watershed receive advanced tertiary limits for oxygen-consuming wastes. Local efforts to reduce nonpoint source pollution in the watershed were also recommended.

Status of Progress

Benthic macroinvertebrate surveys in Little Mountain Creek continued to indicate impairment in 2001. The stream had relatively good habitat; however, conductivity was high and dissolved oxygen was slightly low. The Alcoa aluminum production facility closed in 2002 and no longer discharges to the Little Mountain Creek watershed.

2002 Recommendations

DWQ plans to conduct further investigation into the causes and sources of the biological impairment of Little Mountain Creek during this basinwide planning cycle. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

Water Quality Improvement Initiatives

The Mountain Creek watershed, including Little Mountain Creek, (03040104 010010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

8.3 Status and Recommendations for Newly Impaired Waters

A portion of the Yadkin River is Impaired based on recent DWQ monitoring (1998-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

8.3.1 Yadkin River (0.8 miles from the dam at High Rock Lake to Cabin Creek)

1998 Recommendations

This portion of the Yadkin River was not rated in 1998. The basin plan discusses concerns with low summer dissolved oxygen (DO) levels. Recommendations were for DWQ to further evaluate the situation and coordinate efforts with the Division of Water Resources during the hydropower project relicensing process.

Current Status

Approximately 25 percent of samples collected between September 1996 and August 2001 contained DO concentrations that were less than 5.0 mg/l; 10.4 percent were less than 4.0 mg/l. Percent DO saturation is also of concern in this reach of the Yadkin River, as concentrations ranged from 2.5 mg/l to 15.9 mg/l. These problems likely result from deep water (hypolimnetic) releases through the hydropower facility at High Rock Lake.

Alcoa held an informational meeting with DWQ and DWR staff in 2002 to discuss the process and projected timeline (2002-2006) for upcoming relicensing of the Yadkin Division of APGI hydropower project. This project includes High Rock, Tuckertown, Badin (Narrows) and Falls dams and reservoirs. Alcoa has already done one large water quality study of the project area that also documents the problem with dissolved oxygen at this location.

2002 Recommendations

DWQ will work with Yadkin Division of APGI to improve water quality below High Rock dam during the hydropower relicensing process. In addition to the license application, Alcoa must also obtain a 401 Water Quality Certification for the project. DWQ will ensure, through the 401 Water Quality Certification review, that project operations will not result in violations of water quality standards.

8.4 Section 303(d) Listed Waters

Currently, portions of three waters in this subbasin are on the state's draft 2002 303(d) list for biological impairment: Lick Creek, UT to Lick Creek, and Little Mountain Creek. A portion of the Yadkin River below High Rock Lake will likely be added to the list for low dissolved oxygen in the future. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

8.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

8.5.1 Mountain Creek

Concerns about low dissolved oxygen in the Mountain Creek Arm of Lake Tillery are discussed in the 1998 Yadkin-Pee Dee River basin plan. The stream was not rated and recommendations were to further investigate the problem.

Mountain Creek is currently rated Supporting. Benthic macroinvertebrate and fish communities received Good-Fair bioclassifications in 2001. Although in 1996 the communities received Good bioclassifications, no real decline was detected and the drop in score was attributed to low flows as a result of the extended drought. Water chemistry samples collected from the Mountain Creek Arm of Lake Tillery over the most recent assessment period show only a few samples (<5 percent) that are slightly below the water quality standard.

Lake Tillery is part of a Carolina Power and Light (CP&L) hydropower project that will also be undergoing relicensing between 2002 and 2006. DWQ will work with CP&L to better evaluate water quality in the Mountain Creek Arm of Lake Tillery during the hydropower relicensing process. In addition to the license application, CP&L must also obtain a 401 Water Quality Certification for the project. DWQ will ensure, through the 401 Water Quality Certification review, that project operations will not result in violations of water quality standards.

Water Quality Improvement Initiatives
The Mountain Creek watershed, including Little Mountain Creek, (03040104 010010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

8.5.2 Badin Lake

Badin Lake has been monitored 13 times by DWQ since 1981. Nutrient enrichment, particularly in the arms, has been an ongoing concern. Potential sources of nutrient loading to Badin Lake include development in the immediate watershed and inflow of nutrient-rich water from High Rock Lake upstream. The Fayetteville Regional Office of DWQ received public complaints regarding fish kills and poor water quality conditions in Badin Lake in 2000 and 2001. Fish kills have involved striped bass, sunfish and catfish.

In May and June 2001, a nuisance blue-green algae, which forms thick fibrous mats and is generally an indicator of nutrient-rich water, was observed at a lakes monitoring station on the lower end of the lake. These algae are already a problem in South Carolina waters and appear to be expanding their range in North Carolina, taking advantage of lower water levels and high nutrient concentrations.

The Intensive Survey Unit and Fayetteville Regional Office of DWQ conducted an intensive water quality survey of Badin Lake in 2002 to better document water quality conditions. Data indicate that the productivity of Badin Lake was similar in 2002 to previous years. The fish kills of 2000 and 2001 appear to have been the culmination of stress due to an inadequate food supply (threadfin shad), along with elevated water temperatures and dissolved oxygen concentrations. Elevated nutrient and supersaturated dissolved oxygen concentrations were again observed in 2002; however, no fish kills were observed or reported. Percent DO saturation ranged from 118.5 to 138.5 in the Yadkin River arm of the lake (NCDENR-DWQ, November 8, 2002). These concentrations indicate impairment.

Badin Lake is part of the Yadkin Division of APGI Hydropower project that also includes High Rock and Tuckertown dams/reservoirs upstream and Falls dam downstream. As part of the initial relicensing process, Alcoa prepared and implemented a Shoreline Management Plan to protect shoreline habitat and water quality around the reservoir. Badin Lake was also included in the initial water quality study which was completed by Alcoa in 2002.

DWQ will work with Yadkin Division of APGI to improve water quality in Badin Lake during the hydropower relicensing process. In to the license application, Alcoa must also obtain a 401 Water Quality Certification for the project. DWQ will ensure, through the 401 Water Quality Certification review, that project operations will not result in violations of water quality standards. A nutrient reduction strategy for the immediate watershed is needed in order to protect the aquatic life communities of Badin Lake from becoming impaired.

8.6 Additional Water Quality Issues within Subbasin 03-07-08

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

8.6.1 Projected Population Growth

From 2000 to 2020, the estimated population increase for Davidson County is 25 percent, Montgomery – 24 percent, and Stanly – 21 percent. Growth management within the next five years will be imperative, especially around Badin Lake and along highway corridors, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

Section B: Chapter 9
Yadkin-Pee Dee River Subbasin 03-07-09
Uwharrie River Watershed including Lake Reese

9.1 Water Quality Overview

Subbasin 03-07-09 at a Glance

Land and Water

Total area:	388 mi^2
Stream miles:	274.8
Lake acres:	469.4

Population Statistics

1990 Est. Pop.:	41,702 people
Pop. Density:	108 persons / mi^2

Land Cover (%)

Forest / Wetland:	75.9
Surface Water:	0.7
Urban:	1.1
Cultivated Crop:	1.5
Pasture / Managed Herbaceous:	20.8

This subbasin is comprised entirely of the Uwharrie River watershed. The Uwharrie River begins below High Point in the northwestern portion of Randolph County. It flows south through the newly-formed Town of Trinity and continues for several miles on the same southern path through Lake Reese and the Uwharrie National Forest in Montgomery County before entering the Yadkin-Pee Dee River just below Falls dam. Major tributaries include the Little Uwharrie River, Caraway Creek and Back Creek.

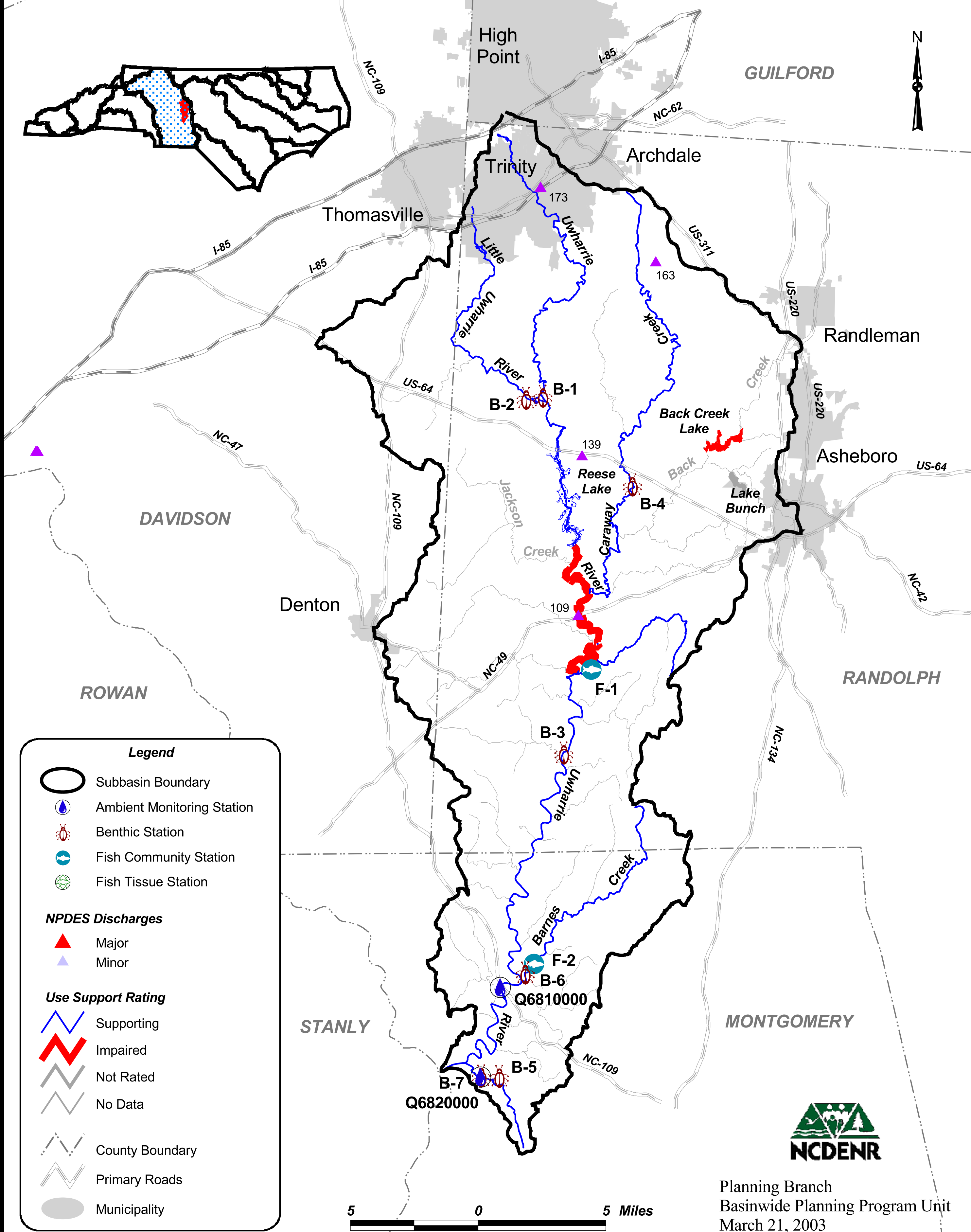
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-10. Table B-18 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-19. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Most of the land is forested (76 percent), but a significant amount is also used for agriculture (22 percent). Only a very small portion is characterized as urban. The population of the subbasin is estimated to be more than 50,000 people, although the density is still rather low compared with the statewide average. Projected population increases for Randolph and Montgomery counties are 37 and 24 percent, respectively, between 2000 and 2020.

There are only five NPDES permitted discharges and seven registered animal operations in this subbasin. The capacity for dairy and swine production decreased significantly, while poultry production capacity increased 37 percent between 1994 and 1998. Facilities with compliance or toxicity problems are discussed in following sections.

A large portion of the Uwharrie National Forest is found within this subbasin. The streams that drain this area host a large numbers of rare mollusks, as well as the Carolina darter. Barnes Creek and its tributaries in the National Forest are classified Outstanding Resource Waters. Currently, other streams throughout the watershed, including the Uwharrie River mainstem, are being evaluated to determine their suitability for this highest level of protection. Back Creek, draining to and including Back Creek Lake, as well as an unnamed tributary to Cedar Fork Creek draining to and including Lake Bunch, are classified WS-II. This classification provides an equivalent level of protection as that of HQW.

Figure B-10 Yadkin-Pee Dee River Subbasin 03-07-09



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-18 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-09

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Uwharrie River[1]	Randolph	SR 1406	Good-Fair
B-2	Little Uwharrie River[1]	Randolph	SR 1405	Good-Fair
B-3	Uwharrie River	Randolph	SR 1143	Good
B-4	Caraway Creek[1]	Randolph	SR 1331	Good-Fair
B-5	Uwharrie River	Montgomery	NC 109	Excellent
B-6	Barnes Creek[1]	Montgomery	SR 1303	Excellent
B-7	Dutchmans Creek[1]	Montgomery	SR 1150	Excellent
Fish Community Monitoring				
	Uwharrie River[1]	Randolph	SR 1406	Excellent
F-1	Betty McGees Creek[1]	Randolph	SR 1107	Good
F-2	Barnes Creek[1]	Montgomery	SR 1303	Excellent
Ambient Monitoring				
Q6810000	Uwharrie River	Montgomery	NC 109	None
Q6820000	Dutchmans Creek	Montgomery	SR 1150	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q6705000	Uwharrie River	Randolph	NC 49	Dissolved oxygen
Lakes Assessment				
--	McCrary Lake	Randolph	1 station	None
--	Lake Bunch	Randolph	1 station	Nutrients
--	Back Creek Lake	Randolph	3 stations	% DO saturation, pH, Nutrients
--	Lake Reese	Randolph	3 stations	Nutrients

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-19 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-09

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	108.1 69.6	**27.3** **354.8**	0.6 45.0	138.8 0.0	274.8 469.4
Fish Consumption[2]	miles acres	0.0 0.0	**274.8** **469.4**	0.0 0.0	0.0 0.0	274.8 469.4
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	99.1 342.9	0.0 0.0	0.0 0.0	0.0 0.0	99.1 342.9

1 Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

2 These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

9.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan did not identify any Impaired waters in this subbasin.

9.3 Status and Recommendations for Newly Impaired Waters

Back Creek Lake and a portion of the Uwharrie River are Impaired based on recent DWQ monitoring (1998-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

9.3.1 Back Creek Lake (250 acres)

Current Status

Back Creek Lake is currently Impaired due to violations of the percent dissolved oxygen water quality standard. Nutrient concentrations are high, and algae blooms which contribute to taste and odor problems in drinking water are common. Back Creek Lake is a drinking water supply source for the City of Asheboro. There are no NPDES permitted discharges to the watershed; however, many animal operations do exist. Cattle with direct access to Back Creek Lake have been observed by DWQ staff.

2002 Recommendations

A strategy for nutrient reduction, that includes best management practices for agricultural activities, is needed for the Back Creek Lake watershed. Despite the fact that these waters are classified WS-II, the amount of developed area is rapidly increasing. DWQ will work with the City of Asheboro to ensure that its local water supply watershed ordinance is being properly implemented in the headwaters of Back Creek. Randolph County is required to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Asheboro will likely be required to obtain a stormwater permit during the next basinwide planning cycle. Refer to page 37 of Section A, Chapter 2 for details. Section A, Chapter 4 contains recommendations for reducing habitat degradation and the effects of urban runoff. Controlling erosion from construction sites and implementing best management practices to control stormwater are two important strategies for reducing nutrient inputs to the lake.

Water Quality Improvement Initiatives

The Back Creek watershed (03040103 050050) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the Wetlands Restoration Program as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

9.3.2 **Uwharrie River** (26.7 miles from dam at Lake Reese to Betty McGees Creek)

Current Status

Water quality monitoring at NC 49 below Lake Reese revealed dissolved oxygen concentrations below 5.0 mg/l in 15 percent of samples collected. Two percent of samples contained concentrations less than 4.0 mg/l. Releases from the dam at Lake Reese upstream could contribute to problems with dissolved oxygen at this location.

2002 Recommendations

Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring.

9.4 Section 303(d) Listed Waters

No waters in this subbasin are on the state's draft 2002 303(d) list. Back Creek Lake and the portion of the Uwharrie River discussed above will likely be added to the list in the future. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

9.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

9.5.1 Caraway Creek

Caraway Creek was support threatened in 1998, and the basin plan discusses problems with the discharge from Countryside Mobile Home Park WWTP. The recommendation was for the facility to evaluate alternatives to discharging at this location. If no alternatives were feasible, DWQ planned to apply advanced tertiary limits for oxygen-consuming wastes under the zero flow policy. During the most recent cycle of NPDES permit renewals, Countryside MHP received the recommended advanced tertiary limits. The facility is in significant noncompliance for BOD, ammonia and total suspended solids.

The Caraway Creek watershed contains several animal operations, and many small headwater tributaries are dammed for farm ponds. Although the stream continued to receive a Good-Fair bioclassification, moderate habitat degradation was observed. Dissolved oxygen was low when compared with other sites across the subbasin.

DWQ will continue to work with Countryside MHP to protect Caraway Creek from further degradation associated with this discharge. However, further investigation into the causes and sources of water quality impacts throughout the watershed is needed before specific recommendations to improve water quality can be made. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from agricultural activities, and to restore habitat throughout the watershed. Refer to Section A, Chapter 4 for details about reducing habitat degradation.

9.5.2 Lake Reese
Upper Uwharrie River Watershed

The dam at Lake Reese almost divides the Uwharrie River watershed in half. The headwaters of the Uwharrie River are heavily developed, and the urban and agricultural land use in the upper portion of the watershed stands in significant contrast to the vastly forested and undeveloped lower portion. Habitat degradation was noted at a benthic macroinvertebrate site above Lake Reese, and the community indicated occasional impacts from low dissolved oxygen. In the lake itself, nutrients are elevated and chlorophyll *a* concentrations are considered moderate. During sampling in 2001, the water had a yellow cast due to algae production. An increase in productivity has been observed between 1989 (mesotrophic) and 2001 (eutrophic) which corresponds roughly to the increase in developed areas upstream.

Local actions are needed to reduce the effects of nonpoint source pollution in the Lake Reese watershed. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding. In addition, Randolph County, as well as High Point, Archdale and Trinity, are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details. Section A, Chapter 4 contains recommendations for reducing habitat degradation and the effects of urban runoff.

The upper Uwharrie River watershed (03040103 050010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

9.5.3 Little Uwharrie River

The headwaters of the Little Uwharrie River are in Davidson and Randolph counties. The river flows generally southeast into the Uwharrie River just above its confluence with Lake Reese. This watershed is mostly in agricultural land use; however, development on tributaries draining Trinity is moderate. Increased development in the watershed along NC 109 and US 64 is likely in the future. Benthic macroinvertebrates have received Good-Fair bioclassifications in both 1996 and 2001; however, habitat degradation, primarily in the form of sedimentation, was observed. Local programs that focus on nonpoint source pollution reduction will be essential to protecting and improving water quality. Davidson and Randolph counties, as well as Trinity, are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

9.6 Additional Water Quality Issues within Subbasin 03-07-09

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

9.6.1 Projected Population Growth

From 2000 to 2020, the estimated population increase for Randolph County is 37 percent and much of this growth is likely to occur in and around Asheboro. Population is also expected to increase by 24 percent for Montgomery County over the same 20-year period. Growth management within the next five years will be imperative, especially in and around urbanizing areas and along highway corridors, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

Section B: Chapter 10
Yadkin-Pee Dee River Subbasin 03-07-10
Includes the Pee Dee River below Lake Tillery Dam, Brown Creek, Clarks Creek and Blewett Falls Lake

10.1 Water Quality Overview

Subbasin 03-07-10 at a Glance

Land and Water

Total area:	407 mi^2
Stream miles:	327.2
Lake acres:	2,583.6

Population Statistics

1990 Est. Pop.:	15,397 people
Pop. Density:	38 persons/mi^2

Land Cover (%)

Forest/Wetland:	78.7
Surface Water:	1.7
Urban:	0.4
Cultivated Crop:	11.9
Pasture/ Managed Herbaceous:	7.3

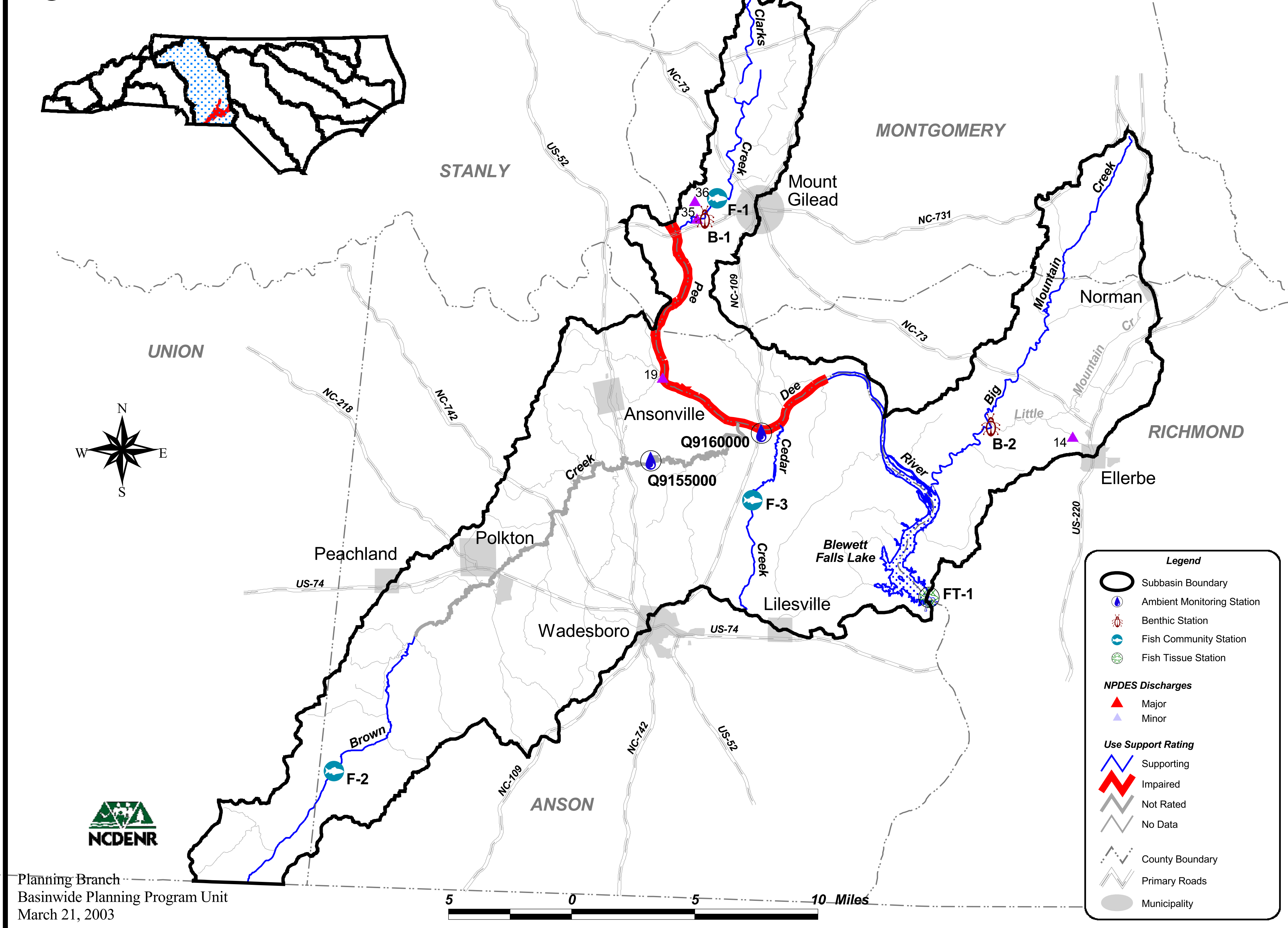
This subbasin contains a portion of the Pee Dee River between Lake Tillery dam and Blewett Falls dam, including Blewett Falls Lake. Major tributaries, which are discussed here, include Clarks Creek, Big Mountain Creek and Brown Creek. The Rocky River (subbasins 03-07-11 through 03-07-14) and the Little River (subbasin 03-07-15) enter the Pee Dee River between Tillery and Blewett Falls. Municipalities within this subbasin are portions of Mount Gilead, Ansonville, Lilesville, Wadesboro and Polkton.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-11. Table B-20 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-21. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

The Pee Dee National Wildlife Refuge is located primarily in the Brown Creek watershed in this subbasin. However, despite the relatively small amount of public land, this subbasin is nearly 80 percent forested. A significant amount of land is cultivated (12 percent) and nearly 2 percent is surface water, reflecting the 2,500-acre Blewett Falls Lake. The estimated population and density of the subbasin are low, and projected population increases for Anson County are less than 10 percent over the next 20 years.

There are only four NPDES permitted discharges and six registered animal operations. The six farms which are large enough to be registered are swine operations. Swine production from all farms (small and large) increased by 79 percent between 1994 and 1998. This capacity is a negligible percent of the state's total capacity for swine production, but indicates a shift in the agricultural community of this area. This subbasin represents more than 5 percent of the state's total capacity for poultry production. There were no significant changes in the poultry production capacity (1994-1998). The Town of Ansonville WWTP is the only facility in significant noncompliance of the most recent review period; it is discussed in following sections.

Figure B-11 Yadkin-Pee Dee River Subbasin 03-07-10



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-20 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-10

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Clarks Creek[1]	Montgomery	SR 1110	Good-Fair
B-2	Mountain Creek[1]	Richmond	SR 1150	Good
Fish Community Monitoring				
F-1	Clarks Creek	Montgomery	SR 1188	Excellent
F-2	Brown Creek[1]	Anson	SR 1230	Good
F-3	Cedar Creek[1]	Anson	SR 1709	Good-Fair
	Big Mountain Creek	Richmond	SR 1319	Good-Fair/Good/ Excellent
	Big Mountain Creek	Richmond	NC 73	Good
	Big Mountain Creek	Richmond	SR 1005	Excellent
Ambient Monitoring				
Q7150000	Pee Dee River	Stanly/ Montgomery	NC 731	Dissolved oxygen
Q9155000	Brown Creek	Anson	SR 1627	None
Q9160000	Pee Dee River	Anson/ Richmond	NC 109	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q7210000	Clarks Creek	Montgomery	SR 1187	Turbidity Fecal coliform
Lakes Assessment				
--	Blewett Falls	Anson/ Richmond	1 station	None

1 Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
2 Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-21 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-10

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	99.4 0.0	**15.3** **0.0**	28.5 2,570.0	184.0 13.6	327.2 2,583.6
Fish Consumption[2]	miles acres	0.0 0.0	**327.2** **2,583.6**	0.0 0.0	0.0 0.0	327.2 2,583.6
Primary Recreation	miles acres	20.0 3,152.3	0.0 0.0	8.4 8.6	0.0 0.0	28.4 3,160.9
Water Supply	miles acres	68.2 2,169.9	0.0 0.0	0.0 0.0	0.0 0.0	68.2 2,169.9

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.
[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

10.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified two Impaired waters in this subbasin: Pee Dee River below Lake Tillery and Brown Creek.

10.2.1 **Brown Creek** (28.5 miles from NC 74 to the Pee Dee River)

1998 Recommendations
The 1998 basin plan noted low dissolved oxygen concentrations in this lowest portion of the Brown Creek watershed at the ambient monitoring station. The ambient monitoring station is very close to the Pee Dee National Wildlife Refuge. The recommendation was that no new discharges of oxygen-consuming wastes be permitted in the watershed.

Status of Progress
The fish community in the upper portion of the Brown Creek watershed received a Good bioclassification in 2001 and 1996. The community is very diverse, but some habitat degradation was noted. This portion of stream, from the NC/SC state line to Lick Creek above Polkton, is rated Supporting. Near Polkton, the character of Brown Creek seems to change. The stream slows down and becomes very curvy with oxbow cutoffs and braids in some areas. Currently, there are no more DWQ monitoring stations until the ambient station at SR 1627 near the refuge. At this station, the stream exhibits characteristics of a natural swamp stream, low dissolved oxygen, low pH and slightly elevated nutrient concentrations. There are no permitted NPDES discharges and three registered animal operations in the watershed. Brown Creek from Lick Creek to the Pee Dee River is currently not rated.

2002 Recommendations

A special study is needed to determine whether any portion of Brown Creek stream should receive the supplemental classification of Sw. DWQ is currently working to refine criteria for making this determination. Once these criteria are approved, Brown Creek will be a high priority for assessment. Swamp waters are discussed in more detail on page 113. Additionally, there is some development along US 74 between Peachland, Polkton and Wadesboro, and along US 52 between Wadesboro and Ansonville. Local actions are needed to reduce the effects of nonpoint source pollution from these developing areas, as well as on agricultural lands throughout the watershed.

Water Quality Improvement Initiatives

The US Fish and Wildlife Service, Carolina Power and Light Company, and the NC Wildlife Resources Commission are cost sharing to conduct an aquatic resource inventory in the Brown Creek watershed and in portions of the Pee Dee River between Tillery and Blewett Falls dams and the lower Little River, with priority on the Pee Dee National Wildlife Refuge. The inventory is planned for 2003 and 2004 and will include documentation of diversity, range, distribution and relative abundance of a variety of invertebrate (primarily mussel) and fish species. More information about the Pee Dee National Wildlife Refuge begins on page 274 of Section C.

10.2.2 Pee Dee River (15.3 miles from Lake Tillery dam to Turkey Top Creek)

1998 Recommendations

The 1998 basin plan discusses problems with low dissolved oxygen (DO) levels below the Lake Tillery dam. One recommendation was for DWQ to coordinate efforts to improve water quality with the Division of Water Resources during the hydropower project relicensing process. NPDES permit limits for new or expanding discharges were also outlined.

Current Status

Approximately 11 percent of samples collected between September 1996 and August 2001 contained DO concentrations that were less than 5.0 mg/l; 4 percent were less than 4.0 mg/l. These problems likely result from deep water (hypolimnetic) releases through the hydropower facility at Lake Tillery. Lake Tillery is part of a Carolina Power and Light (CP&L) hydropower project that will be undergoing relicensing between 2002 and 2006.

Further downstream at NC 109, just below the confluence with Brown Creek, DO levels were still depressed. Low DO waters flowing in from Brown Creek likely influence this monitoring station; however, the Town of Ansonville WWTP was also in significant noncompliance for BOD, chloride, fecal coliform and total suspended solids over the most recent review period.

2002 Recommendations

DWQ will work with CP&L to better evaluate water quality in the Pee Dee River below Lake Tillery during the hydropower relicensing process. In addition to the license application, CP&L must also obtain a 401 Water Quality Certification for the project. DWQ will ensure, through the 401 Water Quality Certification review that project operations will not result in violations of water quality standards. DWQ will also continue to work with the Town of Ansonville to regain and maintain compliance with its NPDES permit. DWQ should continue to require NPDES permit limits no less stringent than 15.0 mg/l BOD_5, 4.0 mg/l NH_3-N and 5.0 mg/l DO for new and expanding discharges into this portion of the Pee Dee River.

10.3 Status and Recommendations for Newly Impaired Waters

No stream segments were rated as Impaired based on recent DWQ monitoring (1998-2001); however, as mentioned previously, some impacts to water quality were observed. Refer to Part 10.5 below, as well as Section A, Chapter 4 for further discussion of potential water quality problems in this portion of the basin.

10.4 Section 303(d) Listed Waters

Currently, portions of two waters in this subbasin are listed on the state's draft 2002 303(d) list. Brown Creek is listed for biological impairment and low dissolved oxygen. Portions of the Pee Dee River are listed for dissolved oxygen and pH. If Brown Creek were to be reclassified with the supplemental classification of Sw attached, it could likely be removed from the 303(d) list in the future. Appendix IV contains more information on the state's 303(d) list and listing requirements.

10.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

10.5.1 Clarks Creek

Clarks Creek flows generally south near Mount Gilead into the Pee Dee River just below Lake Tillery dam. The Town of Mount Gilead historically had inflow and infiltration problems associated with the old facility and discharge into Clarks Creek. In 2000, Mount Gilead completed work on the WWTP that included ultraviolet disinfection (rather than chlorination) and relocated the discharge to the Pee Dee River. The new NPDES permit contains limits consistent with the strategy recommended in the 1998 basin plan and summarized here in Part 10.2.2 above.

In 2001, Clarks Creek is rated Supporting based on biological surveys of fish and benthic macroinvertebrates. The most upstream site at SR 1188 qualified to be a new reference site for fish community sampling. Downstream of the old WWTP discharge, water chemistry samples show few problems with low dissolved oxygen. Turbidity was slightly elevated after rain events, which indicates some impacts from nonpoint source pollution in the watershed.

Fecal coliform concentrations were greater than 400 colonies/100ml in nearly 22 percent of samples collected between 1998 and 2001 from Clarks Creek. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Clarks Creek is not currently classified for primary recreation (Class B).

10.5.2 Little Mountain Creek

Little Mountain Creek begins near the Town of Norman. Most of the watershed is in agriculture, and many small headwater tributaries are dammed for farm ponds. Most of the habitat degradation observed at the benthic macroinvertebrate sampling site on Mountain Creek is likely a result of nonpoint source pollution from the Little Mountain Creek watershed.

As resources allow, DWQ will sample Little Mountain Creek over the next basinwide planning cycle. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from agricultural activities, and to restore habitat throughout the watershed.

Section B: Chapter 11
Yadkin-Pee Dee River Subbasin 03-07-11
Includes a portion of the Rocky River and Coddle Creek

11.1 Water Quality Overview

Subbasin 03-07-11 at a Glance

Land and Water

Total area:	277 mi^2
Stream miles:	218.9
Lake acres:	21.7

Population Statistics

1990 Est. Pop.:	78,047 people
Pop. Density:	282 persons / mi^2

Land Cover (%)

Forest / Wetland:	60.9
Surface Water:	0.5
Urban:	6.1
Cultivated Crop:	3.0
Pasture / Managed Herbaceous:	29.4

This subbasin is comprised of the upper Rocky River watershed in primarily Mecklenburg and Cabarrus counties. Major tributaries include Coddle Creek, Clarke Creek, Mallard Creek and Reedy Creek. Portions of Mooresville, Cornelius, Huntersville, Kannapolis, Concord, Harrisburg and Charlotte are found within the subbasin.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-12. Table B-22 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-23. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

This subbasin is rapidly urbanizing, and land cover and population information become outdated quickly. Land cover information compiled between 1993 and 1995 describe more than 60 percent of the land as forested, nearly 30 percent as pasture or managed herbaceous land, and more than 6 percent as urban. The population in 1990 was estimated to be just over 78,000 people. Estimates of subbasin population have not yet been made for the 2000 census data; however, it is likely that population increased substantially over the ten-year period. Population is projected to increase 57 percent in Mecklenburg County and 53 percent in Cabarrus County between 2000 and 2020. There are 24 NPDES permitted discharges and three registered animal operations within this subbasin. Facilities with compliance or toxicity problems are discussed in following sections.

Water quality varies substantially across this subbasin, although most waters contain some water quality impacts. Coddle Creek, from its source in Iredell County to the City of Concord water supply intake, and its tributaries in the upper watershed are classified High Quality Waters.

Figure B-12 Yadkin-Pee Dee River Subbasin 03-07-11

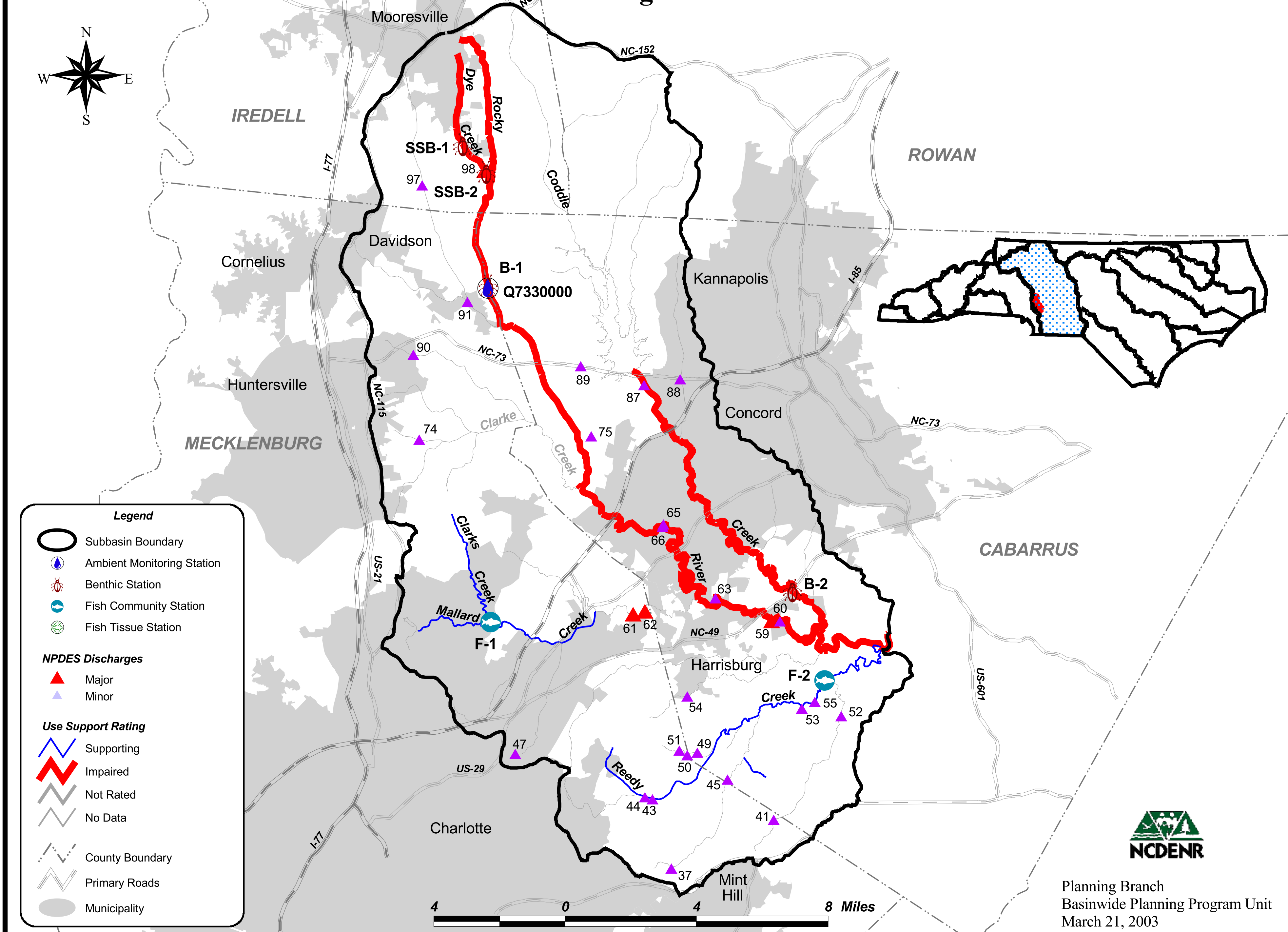


Table B-22 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-11

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Rocky River[1]	Mecklenburg	SR 1608	Fair
SSB-1	Dye Branch[1]	Iredell	SR 1147	Not Rated
SSB-2	Dye Branch	Iredell	SR 1142	Poor
B-2	Coddle Creek[1]	Cabarrus	NC 49	Fair
Fish Community Monitoring				
	Rocky River[1]	Cabarrus	SR 1608	Poor
F-1	Mallard Creek[1]	Mecklenburg	SR 2467	Excellent
F-2	Reedy Creek[1]	Cabarrus	SR 1136	Good-Fair
Ambient Monitoring				
Q7330000	Rocky River	Mecklenburg	SR 2420	Turbidity, Fecal coliform
Yadkin-Pee Dee River Basin Association Monitoring				
Q7330000	Rocky River[3]	Mecklenburg	SR 2420	Fecal coliform
Q7450000	Rocky River	Cabarrus	NC 29	Fecal coliform
Q7600000	Rocky River	Cabarrus	SR 1304	Turbidity, Fecal coliform
Q7780000	Rocky River	Cabarrus	SR 1132	None

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).
[3] This site duplicates a DWQ ambient monitoring station.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-23 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-11

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	41.5 5.1	**53.0** **0.0**	0.0 0.0	124.4 16.6	218.9 21.7
Fish Consumption[2]	miles acres	152.5 21.7	**66.4** **0.0**	0.0 0.0	0.0 0.0	218.9 21.7
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	29.4 7.8	0.0 0.0	0.0 0.0	0.0 0.0	29.4 7.8

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

11.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified two Impaired waters in this subbasin. The upper Rocky River and Coddle Creek are discussed below.

11.2.1 Rocky River (9.2 miles from source to SR 2420)

1998 Recommendations

The 1998 basin plan discusses impacts to the upper Rocky River from toxicity failures at the Mooresville WWTP discharge and oxygen-consuming wastes from several other major discharges. A dissolved oxygen model was developed for the river and the plan discusses the results of model predictions. Recommendations for Mallard Creek and the Rocky River above Mallard Creek were for any new or expanding NPDES permitted discharges to receive Best Available Technology limits for BOD and ammonia. Below Mallard Creek, the model will be used to evaluate specific scenarios, but discharges to this section could likely receive less stringent limits than those upstream. There is also a recommendation for DWQ to review the dissolved oxygen limit for the Mooresville WWTP, should the facility be expanded. Local efforts to reduce nonpoint source pollution, particularly from developing areas, were also recommended.

Status of Progress

No new discharges or expansions of existing discharges were requested over the previous five-year cycle. One large industrial facility in the watershed which contributed waste to the Mooresville WWTP closed, nearly eliminating toxicity problems with that discharge. The Mooresville WWTP had only a few minor compliance problems between 1998 and 2001, most of which were resolved quickly. However, there is a significant amount of developed area in the headwaters of the Rocky River and the Dye Branch watershed.

DWQ collected benthic macroinvertebrate, fish community and water chemistry samples from the upper Rocky River at SR 2420 between 1998 and 2001. The stream again received Fair and Poor bioclassifications. Habitat is poor with excessive amounts of sedimentation and bank erosion.

The geometric mean of fecal coliform samples collected from the Rocky River at SR 2420 (433 colonies/100ml) indicates that the stream may not be suitable for primary recreation. In addition, fecal coliform concentrations were greater than 400 colonies/100ml in more than 33 percent of samples from this site. The Rocky River is not currently classified for primary recreation (Class B). However, the stream was historically placed on the 303(d) list for fecal coliform and a TMDL has already been developed by DWQ.

2002 Recommendations

DWQ's fecal coliform TMDL for the upper Rocky River was approved by the EPA in 2002. Sources of fecal coliform in the upper Rocky River watershed include urban sources in the Mooresville area, livestock grazing and manure application on agricultural lands, residual waste application from the Mooresville WWTP, the Mooresville WWTP discharge, and wildlife. The Coliform Routing and Allocation Program was utilized to simulate instream fecal concentrations and to allocate the fecal coliform loads to the various sources. In order for water quality standards for fecal coliform to be met in the upper Rocky River, a nonpoint source load reduction of 20-33 percent under dry weather conditions and 80-91 percent under wet weather conditions must be met. The model estimates that the Mooresville WWTP typically contributes a small portion of the fecal coliform load to the watershed. However, a significant portion of the fecal coliform load is due to runoff from the Mooresville area.

These calculations are the first step in reducing fecal coliform concentrations in the upper Rocky River watershed. Many of the BMPs employed to implement the TMDL will likely help reduce habitat degradation in the watershed as well. Nonpoint source pollution is the primary source of impairment in this uppermost portion of the Rocky River. Mooresville will likely be required by DWQ to obtain a NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details. Local actions are needed to reduce sedimentation, turbidity and fecal coliform contamination and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed.

Water Quality Improvement Initiatives

The Rocky River watershed is one of three priority areas in the Yadkin-Pee Dee River basin under the USDA Environmental Quality Incentives Program (EQIP). EQIP provides technical, educational and financial assistance to farmers and ranchers to address soil, water and related natural resource concerns on their lands. Refer to page 274 in Section C for details.

The upper Rocky River watershed (03040105 010010) is currently the focus of a Local Watershed Planning Initiative by the NC Wetlands Restoration Program (NCWRP) in partnership with local governments and resource agencies. In addition, it is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by NCWRP as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.2.2 **Dye Branch** (4.4 miles from source to Rocky River)

1998 Recommendations

The 1998 basin plan discusses impacts to the upper Rocky River from toxicity failures at the Mooresville WWTP discharge and oxygen-consuming wastes from several other major discharges. There is also a recommendation for DWQ to review the dissolved oxygen limit for the Mooresville WWTP, should the facility be expanded. Local efforts to reduce nonpoint source pollution were also recommended.

Status of Progress

One large industrial facility in the watershed which contributed waste to the Mooresville WWTP closed, nearly eliminating toxicity problems with that discharge. The Mooresville WWTP had only a few minor compliance problems between 1998 and 2001, most of which were resolved quickly. However, there is a significant amount of developed area in the headwaters of the Rocky River and the Dye Branch watershed.

DWQ sampled two sites on Dye Branch, above and below the WWTP in 2001; the stream continues to be rated Impaired, based on these data. Above the WWTP, little instream habitat was observed. Heavy sedimentation was noted. Although the stream at this location could not be assigned a bioclassification due to reduced flow as a result of the extended drought, serious impacts are evident. Downstream, more instream habitat is present, but the stream again received a Poor bioclassification. A strong chlorine odor was noted by biologists.

2002 Recommendations

Further investigation into the causes and sources of these water quality impacts is needed before specific recommendations to improve water quality can be made. However, nonpoint source pollution, primarily from stormwater runoff in and around Mooresville, is likely a significant factor. Mooresville will likely be required by DWQ to obtain an NPDES permit for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

Water Quality Improvement Initiatives

The upper Rocky River watershed, including Dye Branch, (03040105 010010) is currently the focus of a Local Watershed Planning Initiative by the NC Wetlands Restoration Program (NCWRP) in partnership with local governments and resource agencies. In addition, it is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by NCWRP as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.2.3 **Coddle Creek** (13.7 miles from just above NC 73 to Rocky River)

1998 Recommendations

The 1998 basin plan discusses implementation of a recent minimum instream flow requirement for Lake Howell upstream of this Impaired segment. The Town of Concord was encouraged to take actions to reduce impacts of stormwater runoff in the immediate watershed, and general recommendations for reducing nonpoint source pollution were also given.

Status of Progress

DWQ again sampled Coddle Creek just upstream of its confluence with the Rocky River in 2001. The benthic macroinvertebrate community again received a Fair bioclassification. Little instream habitat was available and sedimentation was noted.

2002 Recommendations

DWQ plans to conduct further investigation into the causes and sources of the biological impairment of Coddle Creek during this basinwide planning cycle. However, nonpoint source pollution, largely from stormwater runoff in and around Concord and Kannapolis, is likely a significant factor. Cabarrus and Mecklenburg counties, as well as Concord and Kannapolis, are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

Water Quality Improvement Initiatives

The Coddle Creek watershed (03040105 020010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.3 Status and Recommendations for Newly Impaired Waters

A larger portion of the Rocky River within this subbasin was rated Impaired based on recent DWQ monitoring (1998-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

11.3.1 **Rocky River** (24.9 miles from SR 2420 to confluence with Reedy Creek)

Current Status

DWQ did not conduct any biological surveys in this segment of the Rocky River over the most recent assessment period. However, turbidity exceeded water quality standards in 13 percent of samples at two stations. In addition, benthic macroinvertebrate sites upstream and downstream of this segment received Fair bioclassifications in 2001. Coddle Creek is Impaired and flows into this segment of river, and the Charlotte-Mecklenburg Utilities District (CMUD) WWTP in the lower part of Mallard Creek also affects the Rocky River in this location. The CMUD Mallard Creek WWTP was in significant noncompliance for total suspended solids and fecal coliform bacteria over the most recent review period.

2002 Recommendations
DWQ will continue to work with all NPDES discharges in this reach of river to maintain compliance. In addition, new or expanding major NPDES permitted discharges above Mallard Creek will receive Best Available Technology limits for BOD (5 mg/l) and ammonia (1 mg/l); minor discharges will receive 5 mg/l for BOD and 2 mg/l for ammonia. Below Mallard Creek, DWQ's dissolved oxygen model will be used to evaluate specific scenarios, but discharges to this section could receive less stringent limits than those upstream.

The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 from this portion of the Rocky River (243 and 300 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. No portion of the Rocky River is currently classified for primary recreation (Class B).

Further investigation into the causes and sources of these impacts is needed before specific recommendations to improve water quality can be made. However, nonpoint source pollution, largely from stormwater runoff in and around municipalities, is likely a significant factor. Cabarrus and Mecklenburg counties, as well as Davidson, Kannapolis, Concord and Harrisburg, are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. [The City of Charlotte currently holds an NPDES permit for municipal stormwater systems under the Phase I stormwater rules, but modifications will be made to include additional elements of the Phase II permits.] Refer to page 37 of Section A, Chapter 2 for details.

Water Quality Improvement Initiatives
The Rocky River watershed is one of three priority areas in the Yadkin-Pee Dee River basin under the USDA Environmental Quality Incentives Program (EQIP). EQIP provides technical, educational and financial assistance to farmers and ranchers to address soil, water and related natural resource concerns on their lands. Refer to page 274 in Section C for details.

The Rocky River watershed (03040105 010030) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.4 Section 303(d) Listed Waters

Currently, portions of four waters in this subbasin are listed on the state's draft 2002 303(d) list. The upper Rocky River is listed for fecal coliform, turbidity and biological impairment. Coddle Creek, Dye Branch and Clarke Creek are listed for biological impairment. In the future, the portion of the Rocky River that appears on the list for turbidity will likely increase due to more recent data indicating impairment. The Rocky River, Coddle Creek and Dye Branch are discussed above; Clarke Creek is discussed below. Appendix IV contains more information on the state's 303(d) list and listing requirements.

11.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

11.5.1 Clarke Creek

DWQ has never sampled Clarke Creek; however, it was historically placed on the 303(d) list based on observations of heavy sedimentation. Portions of the City of Huntersville lie in the headwaters of the Clarke Creek watershed. Between 1990 and 2000, the population of Huntersville increased from 3,023 people to 24,960 people and population growth in the area will likely continue over the next 10 to 20 years. As resources allow, DWQ will sample Clarke Creek over the next basinwide planning cycle.

The Clarke Creek watershed (03040105 010020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.5.2 Mallard Creek

The fish community in the headwaters of Mallard Creek received an Excellent bioclassification in 2001. However, further downstream, the Charlotte-Mecklenburg Utilities District, Mallard Creek WWTP was in significant noncompliance for total suspended solids and fecal coliform over the most recent review period. This watershed is rapidly developing between the cities of Charlotte and Concord, and the lower portion of the stream is currently not rated. As resources allow, DWQ will sample Mallard Creek below the WWTP discharge over the next basinwide planning cycle. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff. The City of Concord, as well as Mecklenburg and Cabarrus counties, are required to obtain NPDES permits for municipal stormwater systems under the Phase II stormwater rules. Refer to page 37 of Section A, Chapter 2 for details.

The Mallard Creek watershed (03040105 010040) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.5.3 Reedy Creek
McKee Creek

The Reedy Creek watershed contains a few developed areas, but is mostly forested. However, there are nine small NPDES permitted discharges from private wastewater treatment plants. DWQ sampled this stream for the first time in 2001 and it received a Good-Fair bioclassification. Severe bank erosion and large volumes of sand were noted by biologists. There was no riffle habitat at the sampling location. It appears that the wastewater treatment plants throughout the watershed are not cumulatively impacting water quality in Reedy Creek. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from new development, and to restore riparian habitat throughout the watershed.

DWQ has completed a fecal coliform TMDL for McKee Creek, a tributary to Reedy Creek, and Clear Creek, the only tributary to McKee. In addition to two NPDES discharge facilities, the study revealed that sources of fecal coliform in the McKee and Clear Creek watersheds include urban sources from Mecklenburg County, livestock grazing and manure application on agricultural lands, on-site wastewater (i.e., septic systems), and wildlife. A mass balance approach, combined with Load-Duration curves, was used to calculate the allowable fecal coliform load to each creek. In order for the water quality target to be met, nonpoint sources of pollution in the watershed must be reduced by 29 percent.

These calculations are the first step in reducing fecal coliform concentrations in the watershed. Many of the BMPs employed to implement the TMDL will likely help reduce habitat degradation in the watershed as well. In addition, Mecklenburg County is required to obtain a NPDES permit for municipal stormwater systems under the federal Phase II stormwater rules. Refer to page 37 of Section A for details.

The Reedy Creek watershed (03040105 010050) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

11.6 Additional Water Quality Issues within Subbasin 03-07-11

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

11.6.1 Projected Population Growth

From 2000 to 2020, the estimated population increase for Mecklenburg County is 57 percent and for Cabarrus County is 53 percent. Growth management within the next five years will be imperative, especially in and around urbanizing areas and along highway corridors, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

11.6.2 NCWRP Local Watershed Planning Initiative

At present, the NC Wetlands Restoration (NCWRP) Program Local Watershed Planning project for the lower Yadkin-Pee Dee region is focused on the upper Rocky River and Clarke Creek watersheds in subbasin 03-07-11. Watershed protection issues within these two local watersheds include: aquatic habitat degradation due to sedimentation and stormwater flows; fecal coliform contamination; stream impacts from roadway construction and new development; and protection of high quality wetland and riparian buffer parcels. A group of local and regional resource agency professionals (primarily from Cabarrus, Iredell and Mecklenburg counties) forms the core of the local stakeholder team working with NCWRP and its consultants on this effort. The group expects to have a Local Watershed Plan drafted up for the two watersheds, including specific recommendations and strategies for watershed protection and improvement, by the summer of 2003. Refer to page 278 in Section C for details about the NCWRP.

Beginning in early 2003, four additional local watersheds (Coddle Creek, Mallard Creek, Reedy Creek, and a segment of the Rocky River) are being added to the NCWRP Local Watershed Planning project in the lower Yadkin-Pee Dee region. Together with the upper Rocky River and Clarke Creek watersheds, these local watersheds extend to the full boundaries of subbasin 03-07-11, which forms the entire drainage system of the upper Rocky River. The watershed assessments and local watershed plan development should be completed by the fall of 2004.

Section B: Chapter 12

Yadkin-Pee Dee River Subbasin 03-07-12

Includes a portion of the Rocky River, Dutch Buffalo, Irish Buffalo, Goose and Crooked Creeks

12.1 Water Quality Overview

Subbasin 03-07-12 at a Glance

Land and Water

Total area:	435 mi^2
Stream miles:	317.1
Lake acres:	722.1

Population Statistics

1990 Est. Pop.:	125,021 people
Pop. Density:	288 persons / mi^2

Land Cover (%)

Forest / Wetland:	53.6
Surface Water:	0.6
Urban:	5.0
Cultivated Crop:	8.8
Pasture / Managed Herbaceous:	32.0

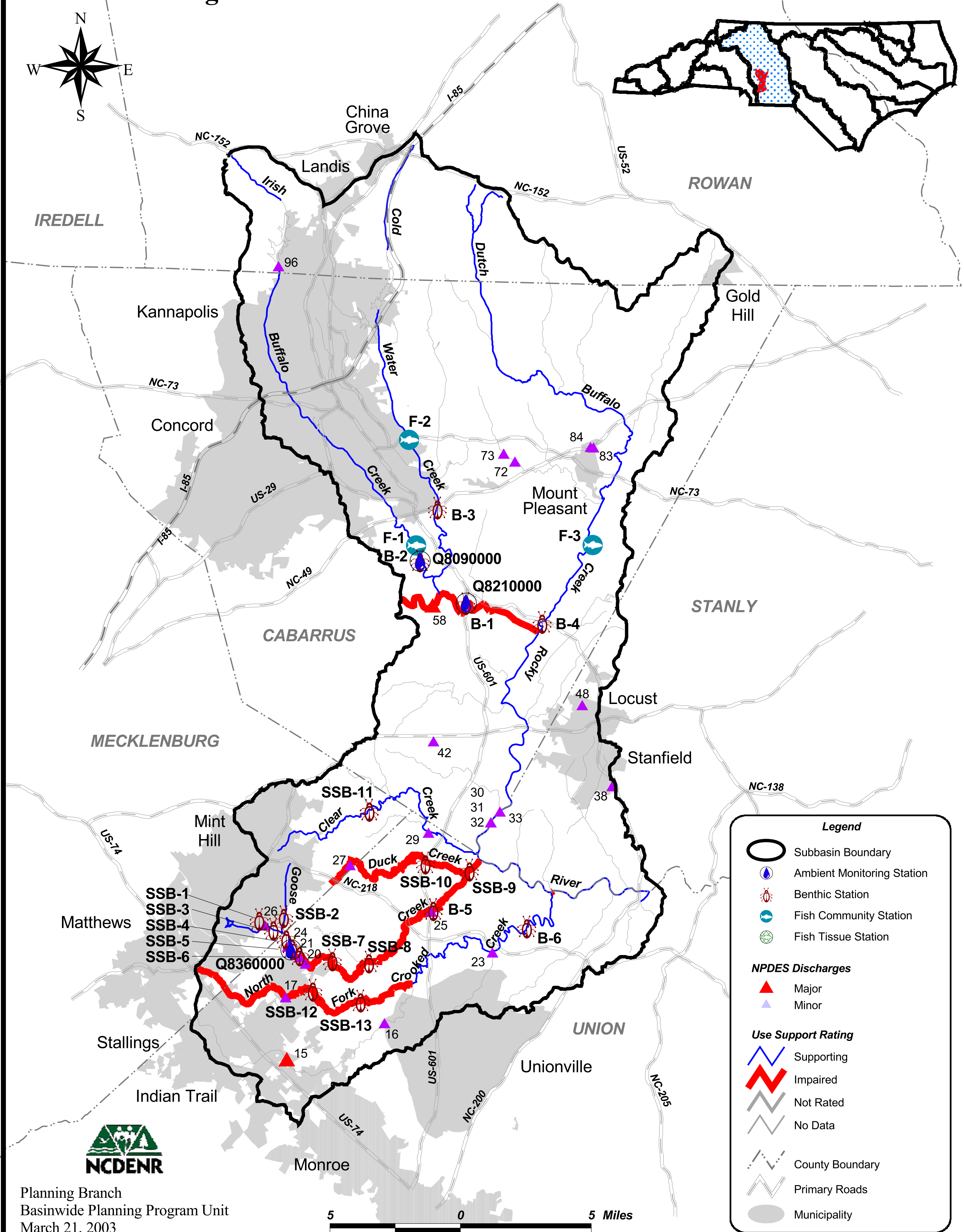
The middle section of the Rocky River flows east, then south, then east again dividing this subbasin almost in half. Tributaries in the upper half include Irish Buffalo and Dutch Buffalo Creeks flowing generally south. Smaller tributaries in the lower half include Clear, Goose and Crooked Creeks flowing generally northeast. The majority of the subbasin lies within Cabarrus County, but portions of Mecklenburg, Union and Stanly counties are also encompassed. Municipalities include Kannapolis, Concord, Locust, Mint Hill, Indian Trail, Lake Park and Unionville.

A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-13. Table B-24 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-25. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

This subbasin is rapidly urbanizing, and land cover and population information become outdated quickly. Land cover information compiled between 1993 and 1995 describes approximately 50 percent of the land as forested, more than 40 percent in agricultural uses, and approximately 5 percent as urban. The population in 1990 was estimated to be just over 125,000 people. Estimates of subbasin population have not yet been made for the 2000 census data; however, it is likely that population increased substantially over the ten-year period. Population is projected to increase 57 percent in Mecklenburg County, 53 percent in Cabarrus County, and 70 percent in Union County between 2000 and 2020. There are 17 NPDES permitted discharges and seven registered animal operations within this subbasin. Facilities with compliance or toxicity problems are discussed in following sections.

Water quality varies substantially across this subbasin, although most waters contain some water quality impacts. The headwaters of Dutch Buffalo Creek are classified WS-II and High Quality Waters.

Figure B-13 Yadkin-Pee Dee River Subbasin 03-07-12



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-24 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-12

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Rocky River[1]	Cabarrus	US 601	Fair
B-2	Irish Buffalo Creek[1]	Cabarrus	SR 1132	Good-Fair
B-3	Coldwater Creek[1]	Cabarrus	NC 49	Good-Fair
B-4	Dutch Buffalo Creek[1]	Cabarrus	NC 200	Good-Fair
SSB-11	Clear Creek	Mecklenburg	SR 3181	Good-Fair
SSB-3	Goose Creek	Mecklenburg	SR 1004	Good-Fair
SSB-4	Goose Creek	Union	Glamorgan Rd.	Good
SSB-5	Goose Creek	Union	SR 1524	Good-Fair
SSB-6	Goose Creek	Union	Below Fairfield	Fair
SSB-7	Goose Creek	Union	SR 1525	Poor
SSB-8	Goose Creek	Union	SR 1533	Fair
B-5	Goose Creek[1]	Union	US 601	Poor
SSB-9	Goose Creek	Union	SR 1547	Fair
SSB-1	Stevens Creek	Mecklenburg	Maple Hollow Rd.	Good
SSB-2	UT Stevens Creek	Mecklenburg	Thompson Rd.	Not Impaired
SSB-10	Duck Creek	Union	US 601	Fair
B-6	Crooked Creek[1]	Union	SR 1547	Good-Fair
SSB-12	N. Fork Crooked Cr[1]	Union	SR 1520	Fair
SSB-13	N. Fork Crooked Cr	Union	SR 1514	Fair
Fish Community Monitoring				
F-1	Irish Buffalo Creek[1]	Cabarrus	SR 1132	Good
F-2	Coldwater Creek[1]	Cabarrus	NC 73	Good-Fair
F-3	Dutch Buffalo Creek[1]	Cabarrus	SR 2622	Good
Ambient Monitoring				
Q8090000	Irish Buffalo Creek	Cabarrus	SR 1132	Turbidity, Fecal coliform
Q8210000	Rocky River	Cabarrus	US 601	Fecal coliform
Q8360000	Goose Creek	Union	SR 1524	Fecal coliform
Yadkin-Pee Dee River Basin Association Monitoring				
Q8200000	Coldwater Creek	Cabarrus	SR 1132	Fecal coliform
Q8210000	Rocky River[3]	Cabarrus	US 601	None
Q8340000	UT Clear Creek	Mecklenburg	SR 3104	Dissolved oxygen, Fecal coliform

Q8342000	Clear Creek	Union	US 601	Dissolved oxygen, Fecal coliform
Q8355000	Rocky River	Cabarrus	SR 1114	None
Q8359000	Goose Creek	Union	SR 4228	Fecal coliform
Q8360000	Goose Creek[3]	Union	SR 1524	Dissolved oxygen, Fecal coliform
Q8385000	Rocky River	Union	SR 1606	Turbidity
Q8386000	N. Fork Crooked Cr	Union	SR 1520	Dissolved oxygen, Turbidity, Fecal coliform
Q8386200	N. Fork Crooked Cr	Union	SR 1514	Dissolved oxygen, Turbidity, Fecal coliform
Q8388000	Crooked Creek	Union	NC 218	Turbidity
Q8388900	Crooked Creek	Union	SR 1601	Turbidity, Fecal coliform
Lakes Assessment				
--	Kannapolis Lake	Rowan	2 sites	None
--	Lake Fisher	Rowan/Cabarrus	3 sites	None
--	Lake Concord	Cabarrus	3 sites	Turbidity

1 Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
2 Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).
3 This site duplicates a DWQ ambient monitoring station.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-25 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-12

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	94.8 0.0	**33.6** **0.0**	1.3 697.0	187.4 25.1	317.1 722.1
Fish Consumption[2]	miles acres	0.0 0.0	**317.1** **722.1**	0.0 0.0	0.0 0.0	317.1 722.1
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	38.6 234.8	0.0 0.0	0.0 0.0	0.0 0.0	38.6 234.8

1 Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.
2 These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

12.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified four Impaired streams in this subbasin. Goose Creek, Crooked Creek, and the North and South Forks of Crooked Creek are discussed below.

12.2.1 **Goose Creek** (17.0 miles from source to Rocky River)

1998 Recommendations

Growth pressures, problems with wastewater discharges and infrastructure, and impacts from agricultural activities are discussed in the 1998 basin for the Goose Creek watershed. Recommendations are for DWQ to conducting modeling to evaluate the assimilative capacity of Goose Creek. DWQ planned to pursue enforcement action with some NPDES permit holders for past violations of discharge permits, and chlorine limits are recommended for existing discharges. In addition, the plan recommends local actions to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, and to restore riparian habitat throughout the watershed.

Status of Progress

In 1998, the benthic macroinvertebrate community was sampled by DWQ at 11 sites in the watershed: 1 site on Duck Creek; 2 sites on Stevens Creek; and 8 sites on Goose Creek including the regular basinwide monitoring site at US Highway 601. Five sites (63 percent) received Fair or Poor bioclassifications, indicating impairment. Three sites (37 percent) received Good-Fair or Good bioclassifications, indicating the community is not Impaired. Stevens Creek received one Good bioclassification near the mouth and the other site was too small to assign a bioclassification to, but it was found to be not Impaired. Duck Creek received a Fair bioclassification near US Highway 601 in the lower portion of the watershed, indicating impairment.

In 2001, only the US Highway 601 site was sampled by DWQ. This site is at the lower end of the watershed, but above the confluence with Duck Creek. The site contained fairly good instream habitat and riparian vegetation overall, but the streambanks were extremely unstable in places and there were few deep pools. The benthic macroinvertebrate community received a Poor bioclassification, as it had in 1998 and 1996. The specific conductance was high and there were many indicators of organic enrichment. No fish community samples were conducted.

The Goose Creek watershed contains one ambient monitoring station at SR 1524 near Mint Hill (fairly high up in the watershed). A summary of water chemistry monitoring over a five-year period ending in 2001 revealed that all nutrient levels are elevated. Phosphorus, in particular, exceeded the evaluation level (0.05 mg/l) 93 percent of the time, reaching a maximum of 3.70 mg/l. Dissolved oxygen data commonly showed supersaturated conditions, indicating algae blooms.

There are six permitted wastewater discharges in the watershed: Oxford Glen WWTP on Stevens Creek; Ashe Plantation WWTP on Duck Creek; and Fairview Elementary WWTP, Fairfield Plantation WWTP, Country Woods WWTP and Hunley Creek WWTP on Goose Creek. Each of these facilities received chlorine limits (which became effective by October of 2002) during the last cycle of NPDES permit renewals, as is recommended by the 1998 basin plan. However, owner/operators of the Oxford Glen and Ashe Plantation WWTPs decided to install ultraviolet disinfection systems. Compliance reports from the most recent review period (2000-2001) show problems with excess flow at the Fairfield Plantation and Country Woods WWTPs. No other NPDES permit violations were observed in the Goose Creek watershed.

The Hunley Creek WWTP is a member of the Yadkin-Pee Dee River Basin Association, and water chemistry samples are collected through the monitoring program at two locations on Goose Creek (upstream and downstream of the facility). Dissolved oxygen was less than 5.0 mg/l in 8.6 percent of downstream samples compared with only 1.1 percent of upstream samples. Fecal coliform concentrations were reduced by half from 988 colonies/100ml upstream to 412 colonies/100ml downstream. (The evaluation level is 200 colonies/100ml.)

The geometric means of fecal coliform samples collected from one station between 1996 and 2001 and two stations between 1998 and 2001 from Goose Creek (241, 988 and 412 colonies/100ml) indicate that the stream may not be suitable for primary recreation. In addition, fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site. Goose Creek is not currently classified for primary recreation (Class B). However, the stream was historically placed on the 303(d) list for fecal coliform and a TMDL has already been developed by DWQ. Goose Creek was historically placed on the 303(d) list for fecal coliform and DWQ is currently working with Mecklenburg County to develop a TMDL.

Stevens Creek and Goose Creek from its source to SR 1524 just inside Union County are currently Supporting aquatic life and secondary recreation, although impacts were evident in 1998, particularly in the headwaters of Goose Creek. Duck Creek and Goose Creek from SR 1524 to the confluence with the Rocky River are Impaired. Currently, problems with point sources are limited to inflow and infiltration problems at the Fairfield Plantation and County Woods WWTPs. Nonpoint source pollution problems are associated with stormwater runoff from construction sites and developed areas, as well as agricultural activities.

2002 Recommendations

DWQ, in coordination with other natural resource agencies, will develop a site-specific management strategy for the Goose Creek watershed which provides for the maintenance and recovery of water quality conditions necessary to sustain the Carolina heelsplitter. The strategy will likely contain recommendations for point and nonpoint sources of pollution (refer to page 32 for details).

Mecklenburg and Union counties, as well as Mint Hill, Indian Trail and Lake Park, are required to obtain a NPDES permit for municipal stormwater systems under the Phase II stormwater rules (refer to page 37 of Section A, Chapter 2 for details). The City of Charlotte received a NPDES permit under the federal Phase I stormwater rules. DWQ applauds Charlotte-Mecklenburg's Surface Water Improvement and Management Program (page 299 contains details) and recommends that all local governments in the Goose Creek watershed implement programs to reduce the impacts of stormwater runoff, including local riparian buffer ordinances.

Although much work is currently being conducted in the Goose Creek watershed by DWQ, other natural resource agencies and local governments, local actions by citizens are still needed to reduce nonpoint source pollution. Many parts of the Goose Creek watershed could benefit greatly from riparian area restoration and protection. Section A, Chapter 4 outlines general best management practices for protecting and improving water quality. In addition, an organized group of dedicated citizens can be one of the most effective tools for affecting watershed protection and preservation of quality of life in communities.

Water Quality Improvement Initiatives

In 1999, the NC Wildlife Resources Commission initiated a project in the Stevens Creek watershed (tributary to Goose Creek in the headwaters of Mecklenburg County) to reduce the peak flows and pollutant load carried by stormwater from residential areas, improve streambanks through stabilization and buffering, conduct community education about use of household and lawn chemicals, increase community involvement in the protection and restoration of Stevens Creek, and implement livestock exclusion to prevent direct access to the creek or its tributaries. This project was funded in part through the Clean Water Act – Section 319 Program (page 273).

The Goose Creek Watershed Advisory Committee was convened in December 2000 to make recommendations to local governments, state agencies and other appropriate organizations that would protect and improve water quality and wildlife habitat in the Goose Creek watershed. The committee is comprised of stakeholders representing diverse interests in the watershed. Refer to page 290 in Section C for details about the committee and its sources of funding. Appendix V contains a summary of the recommendations.

The Goose Creek watershed (03040105 030020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

12.2.2 Crooked Creek (13.1 miles from source to Rocky River)

1998 Recommendations

The 1998 basin plan suggests that Crooked Creek is Impaired primarily by low dissolved oxygen problems and nonpoint source pollution in the upstream watersheds of the North and South Forks. The plan recommends that DWQ collect additional data and assess assimilative capacity for oxygen-consuming wastes before any additional discharges are permitted into the watershed.

Status of Progress

In 2001, sampling of the benthic macroinvertebrate community resulted in a Good-Fair bioclassification below the Union County Grassy Branch WWTP in the lower third of the watershed. Water chemistry data revealed elevated turbidity concentrations at two locations. DWQ biologists noted good habitat in Crooked Creek; however, indicators of organic enrichment were numerous. Crooked Creek is currently rated Supporting; however, the increase in bioclassification (from Fair in 1996) could be partly due to reduced nonpoint source pollution impacts as a result of the extended drought.

The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 from Crooked Creek (290 and 210 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Crooked Creek is not currently classified for primary recreation (Class B).

2002 Recommendations

Local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, as further development occurs in the Crooked Creek watershed.

Water Quality Improvement Initiatives

The Crooked Creek watershed (03040105 040010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

12.2.3 North Fork Crooked Creek (9.2 miles from source to Crooked Creek)

1998 Recommendations

Streamflow in the upper Crooked Creek watershed is naturally very low in the summer months and smaller tributaries often stop flowing completely. Problems with low dissolved oxygen were thought to be contributing to impairment in 1998. The 1998 basin plan recommends that DWQ collect additional data and assess assimilative capacity for oxygen-consuming wastes before any additional discharges are permitted into North Fork Crooked Creek.

Status of Progress

Benthic macroinvertebrates and water chemistry were sampled at two locations on North Fork Crooked Creek over the most recent basinwide planning cycle. Bioclassifications were Fair, and elevated turbidity and fecal coliform concentrations were recorded at both sites. In addition, low dissolved oxygen concentrations were observed. Aquatic life and secondary recreation continues to be Impaired in North Fork Crooked Creek.

The geometric means of fecal coliform samples collected from two stations between 1998 and 2001 from North Fork Crooked Creek (349 and 318 colonies/100ml) indicate that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. North Fork Crooked Creek is not currently classified for primary recreation (Class B).

2002 Recommendations

Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made. However, local actions to reduce the effects of nonpoint source pollution, particularly from stormwater runoff as further development occurs in the Crooked Creek watershed, will be an imperative part of improving water quality.

12.2.4 **South Fork Crooked Creek** (13.7 miles from source to Crooked Creek)

1998 Recommendations

Streamflow in the upper Crooked Creek watershed is naturally very low in the summer months and smaller tributaries often stop flowing completely. Problems with low dissolved oxygen associated with the Union County WWTP discharge were thought to be contributing to impairment at the time of the 1998 basin plan. In 1996, Union County relocated its WWTP discharge to Crooked Creek downstream and some improvement in the stream was expected in the future as a result. DWQ recommended that no discharge containing an additional loading of oxygen-consuming waste be permitted into South Fork Crooked Creek.

Status of Progress

Due to reduced flows during an extended drought, DWQ did not resample South Fork Crooked Creek during the most recent basinwide planning cycle and the stream is currently not rated.

2002 Recommendations

As resources and stream condition allow, DWQ will sample South Fork Crooked Creek to evaluate any improvement following the relocation of the Union County WWTP discharge during the next basinwide planning cycle.

12.3 Status and Recommendations for Newly Impaired Waters

A portion of the Rocky River within this subbasin was rated Impaired based on recent DWQ monitoring (1998-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

12.3.1 **Rocky River** (8.5 miles from Reedy Creek to Dutch Buffalo Creek)

Current Status

Benthic macroinvertebrates received a Fair bioclassification at a location one mile below the Water and Sewer Authority of Cabarrus County (formerly Rocky River Regional) WWTP in 2001 and 2002. Previously, this segment of river received Good-Fair bioclassifications. This decline during an extended drought indicates point source problems. However, this portion of the Rocky River was included in a field-calibrated QUAL2E modeling analysis which was conducted by DWQ in the mid-1990s, and the WWTP has maintained compliance with its NPDES permit.

Low flows in the Rocky River watershed are difficult to assess. USGS 7Q10 estimates for various reaches of the river were made at different times using varying methodologies and, at the time of modeling for the Rocky River Regional WWTP permit, did not provide a clear picture of low flow conditions.

The geometric mean of fecal coliform samples collected between 1996 and 2001 from this portion of the Rocky River (234 colonies/100ml) indicates that the stream may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in nearly 22 percent of samples from this site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. The Rocky River is not currently classified for primary recreation (Class B).

2002 Recommendations

Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made.

Water Quality Improvement Initiatives

The Rocky River watershed is one of three priority areas in the Yadkin-Pee Dee River basin under the USDA Environmental Quality Incentives Program (EQIP). EQIP provides technical, educational and financial assistance to farmers and ranchers to address soil, water and related natural resource concerns on their lands. Refer to page 274 in Section C for details.

12.4 Section 303(d) Listed Waters

Currently, portions of four waters in this subbasin are listed on the state's draft 2002 303(d) list. Goose Creek is listed for fecal coliform and biological impairment. Crooked Creek and North and South Forks Crooked Creek are listed for biological impairment. In the future, another segment of the Rocky River will likely be added to the list for biological impairment. Appendix IV contains more information on the state's 303(d) list and listing requirements.

12.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

12.5.1 Irish Buffalo Creek
Coldwater Creek

Irish Buffalo Creek drains Kannapolis and Concord in northeastern Cabarrus County, and much of the watershed is developed. Water chemistry samples revealed elevated phosphorus and turbidity levels. Benthic macroinvertebrates received a Good-Fair bioclassification in 2001. However, the fish community remains diverse despite these water quality impacts.

Coldwater Creek makes up a large portion of the Irish Buffalo Creek watershed. With the exception of the Lake Concord watershed which is rapidly developing, there is very little urban area in the Coldwater Creek watershed. However, a decline in bioclassification was observed at NC 73 between 1996 (Good) and 2001 (Good-Fair). At the most downstream station, instream habitat was lacking and the site also received a Good-Fair bioclassification.

The geometric means of fecal coliform samples collected from Irish Buffalo Creek between 1996 and 2001 (234 colonies/100ml) and Coldwater Creek between 1998 and 2001 (290 colonies/100ml) indicate that these streams may not be suitable for primary recreation. Fecal coliform concentrations were greater than 400 colonies/100ml in more than 20 percent of samples from each site as well. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 col/100ml in more than 20 percent of samples. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Neither Irish Buffalo nor Coldwater Creeks are currently classified for primary recreation (Class B).

Local actions to reduce the effects of nonpoint source pollution, particularly from stormwater runoff as further development occurs in the Irish Buffalo Creek watershed, will be an imperative part of protecting water quality. The Irish Buffalo Creek watershed (03040105 020040) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

12.5.2 Dutch Buffalo Creek

The Dutch Buffalo Creek watershed in northeastern Cabarrus County is primarily agricultural, and many small headwater tributaries are dammed for farm ponds. Although the stream continued to receive a Good-Fair bioclassification, severe bank erosion and a lack of riparian vegetation was observed. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from agricultural activities, and to restore habitat throughout the watershed. Refer to Section A, Chapter 4 for details about reducing habitat degradation.

The Dutch Buffalo Creek watershed (03040105 020060) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

12.6 Additional Water Quality Issues within Subbasin 03-07-12

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

12.6.1 Projected Population Growth

From 2000 to 2020, the estimated population increase for Mecklenburg County is 57 percent and for Cabarrus County is 53 percent. Growth management within the next five years will be imperative, especially in and around urbanizing areas and along highway corridors, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

12.6.2 High Fecal Coliform Concentrations

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 and are therefore found in their wastes. Coliform bacteria are relatively easy to identify and are usually present in larger numbers than more dangerous pathogens, even though they respond to the environment and to treatment in much the same way. Sources of fecal coliform bacteria, as well as other more dangerous pathogens, include runoff from pastures, feedlots, poultry operations and lagoons that do not employ appropriate best management practices. Other sources include straight pipes, leaking and failing septic systems, and noncompliant WWTPs. Wildlife and pet waste also contribute to elevated concentrations of pathogens.

The water quality standard for fecal coliform bacteria is based on a geometric mean of 200 colonies/100ml of five samples collected within 30 days, or 20 percent of samples having a concentration greater than 400 colonies/100ml. High levels of fecal coliform bacteria are widespread through this subbasin. Samples were collected from 13 locations on seven streams, and the geometric means for 10 locations (77 percent) were greater than 200 colonies/100ml over the five-year assessment period. These data indicate that many streams in this subbasin may not be suitable for primary recreation. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml. However, these additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is greatest. Currently, no waters in this subbasin are classified for primary recreation (Class B).

Section B: Chapter 13
Yadkin-Pee Dee River Subbasin 03-07-13
Includes the Long and Big Bear Creek Watersheds

13.1 Water Quality Overview

Subbasin 03-07-13 at a Glance

Land and Water

Total area:	312 mi^2
Stream miles:	138.4

Population Statistics

1990 Est. Pop.:	37,644 people
Pop. Density:	121 persons/mi^2

Land Cover (%)

Forest/Wetland:	43.7
Surface Water:	0.3
Urban:	1.7
Cultivated Crop:	13.4
Pasture/ Managed Herbaceous:	40.9

Long Creek flows generally south through Stanly County and into the lower section of the Rocky River. Tributaries include Big Bear and Little Long Creeks. The headwaters of the watershed begin at Gold Hill, and the majority of Albemarle and Oakboro are encompassed in the subbasin boundary. Water quality in this subbasin is generally good in larger streams, although many of the smaller streams have not been monitored recently.

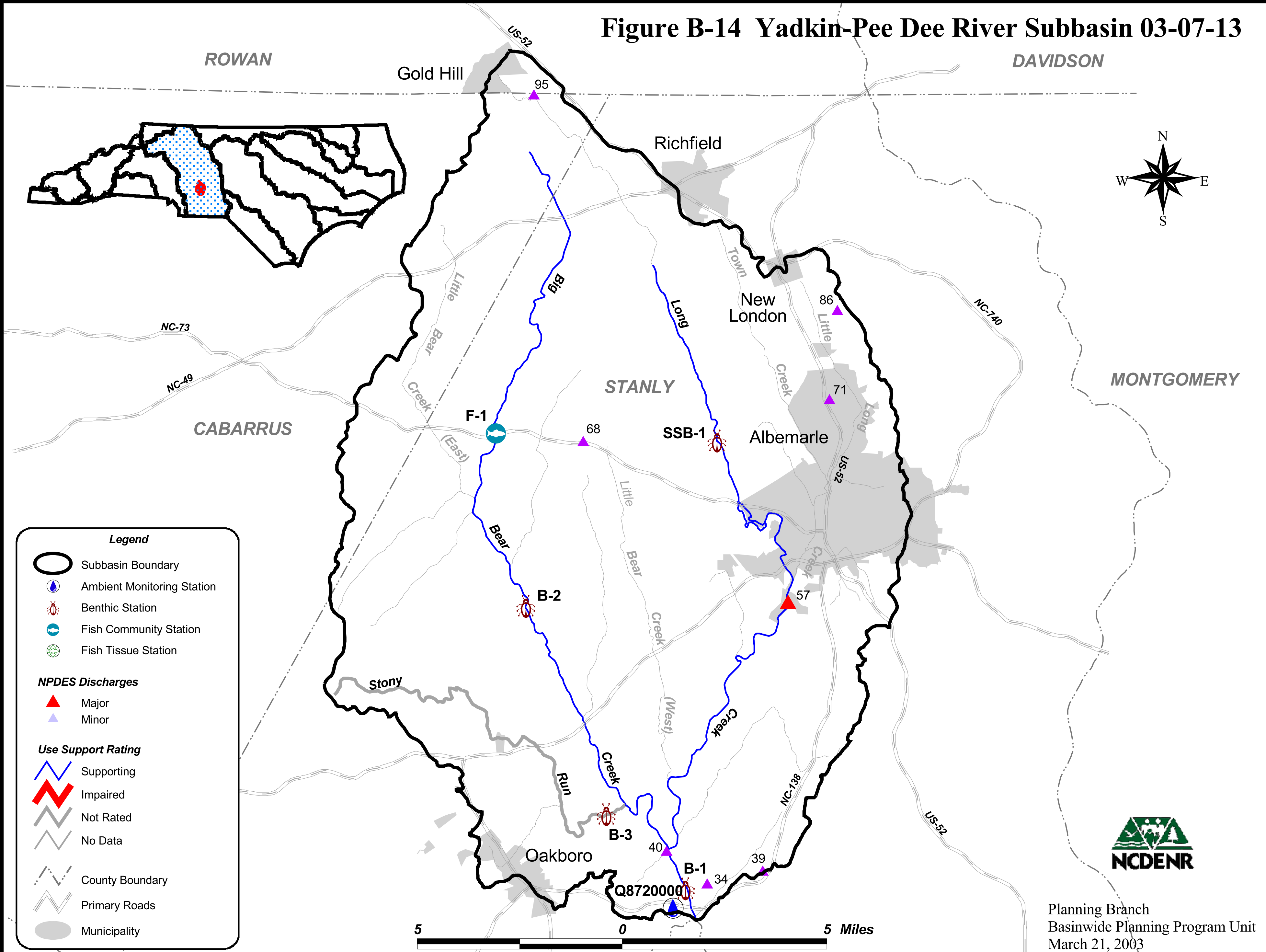
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-14. Table B-26 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-27. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

A large portion of this subbasin is in agricultural land uses. More than 40 percent of the land is described as pasture or managed herbaceous land and 13 percent is cultivated. Less than half of the area is forested (44 percent) and approximately 2 percent is developed.

Population is moderately dense, likely reflecting the Albemarle area and the US 52 Highway corridor. The population of Stanly County is expected to increase 21 percent between 2000 and 2020. Much of this growth is likely to occur to the east of this subbasin near Badin Lake (subbasin 03-07-08). There are eight NPDES permitted discharges and five registered animal operations in the subbasin. Facilities with compliance or toxicity problems are discussed in following sections.

The Reed Gold Mine State Historic Site is found within this subbasin. Reed Gold Mine is the site of the first documented gold find in the United States (1803). During its peak years, gold mining was second only to farming in the number of North Carolinians it employed. The estimated value of gold recovered reached over a million dollars a year. North Carolina led the nation in gold production until 1848, when it was eclipsed by the great rush to California (NCDCR brochure).

Figure B-14 Yadkin-Pee Dee River Subbasin 03-07-13



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-26 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-13

Site	Stream	County	Road	Bioclassification or Noted Parameter
Benthic Macroinvertebrate Community Monitoring				
SSB-1	Long Creek[1]	Stanly	SR 1401	Good-Fair
B-1	Long Creek	Stanly	SR 1917	Good-Fair
B-2	Big Bear Creek	Stanly	SR 1225	Good
B-3	Stony Run Creek[1]	Stanly	SR 1970	Not Rated
Fish Community Monitoring				
F-1	Big Bear Creek	Stanly	NC 73	Good
Ambient Monitoring				
Q8720000	Long Creek	Stanly	SR 1954	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q8715000	Long Creek	Stanly	SR 1968	None
Q8720000	Long Creek	Stanly	SR 1917	None

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-27 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-13

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	76.0 0.0	0.0 0.0	11.9 0.0	50.5 0.0	138.4 0.0
Fish Consumption[2]	miles acres	0.0 0.0	**138.4** **0.0**	0.0 0.0	0.0 0.0	138.4 0.0
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

13.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified one Impaired water in this subbasin. Long Lake is discussed below.

13.2.1 **Long Lake** (74.0 acres)

1998 Recommendations
At the time of the 1998 basin plan, Long Lake (Albemarle City Pond) was drained and was not supporting designated uses. The City of Albemarle planned to restore the lake by dredging of sediment, development of an in-lake biofilter, and implementation of agricultural BMPs in the watershed. The city was actively searching for funding; approximately 45 percent had been secured.

Status of Progress
Dredging work was not complete at the time of the most recent lakes assessment work in the Yadkin-Pee Dee River basin. As of November 2002, the lake has been refilled but construction on an adjacent public park is not yet complete. The lake should be reopened to the public in the summer of 2003. DWQ plans to sample Long Lake again in 2005 or 2006.

13.3 Status and Recommendations for Newly Impaired Waters

No waters are Impaired based on recent DWQ monitoring (1998-2001); however, some impacts to water quality were observed. Refer to Part 13.5 below for further discussion of potential water quality problems.

13.4 Section 303(d) Listed Waters

Long Lake (discussed above) and Little Long Creek (discussed below) are currently listed on the state's draft 2002 303(d) list. Appendix IV contains more information on the 303(d) list and listing requirements.

13.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

13.5.1 Long Creek

In 1998, Long Creek was rated Support Threatened. The basin plan discusses problems with low dissolved oxygen above and below the Albemarle WWTP discharge. Recommendations were for the City of Albemarle to optimize its WWTP treatment processes in order to minimize impacts to Long Creek. The plan also recommends that DWQ consider reducing summer BOD limits from 10 mg/l to 5 mg/l during the next permit cycle.

Two water chemistry stations were sampled by the Yadkin-Pee Dee River Basin Association between 1998 and 2001. These limited data indicate few water quality problems. Dissolved oxygen concentrations were good. It is possible that the historical dissolved oxygen problems higher in the watershed were related to the draining and rehabilitation of Long Lake (refer to Part 13.2.1 above). In 2000, the primary discharge from the Oakboro WWTP (downstream of the Albemarle WWTP) was relocated from Long Creek into the Rocky River.

Benthic macroinvertebrates were sampled at two locations on Long Creek in 2001: above the City of Albemarle and Long Lake, and below the confluence of Big Bear Creek near the mouth. Instream and riparian habitat was in good condition at both sites; however, conductivity was elevated and both sites received only Good-Fair bioclassifications. An ambient monitoring station near the mouth of Long Creek revealed wide swings in conductivity, elevated pH and elevated concentrations of nutrients.

The Long Creek watershed is largely agricultural with the exception of Little Long Creek which drains the City of Albemarle. There are also three crushed stone mining operations in the headwaters of Long Creek. The Albemarle WWTP reported two violations of the BOD discharge limit, one violation of the fecal coliform limit, and two violations of the total suspended solids discharge limit between September 1999 and August 2001. These violations do not constitute significant noncompliance, and the facility is currently operating well below its permitted capacity. Data and information indicate that impacts to Long Creek are primarily due to nonpoint source pollution. DWQ will continue to monitor Long Creek over the next basinwide planning cycle. However, local actions are needed to reduce the effects of nonpoint source pollution in the watershed, particularly from mining operations, agricultural activities and runoff from developed areas.

The Long Creek watershed (03040105 060030) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

13.5.2 Little Long Creek

The Little Long Creek watershed, including Town Creek, drains the City of Albemarle in eastern Stanly County. Little Long Creek has never been sampled by DWQ; however, it was historically placed on the 303(d) list based on observations of problems related to urban runoff. As resources allow, DWQ will sample Little Long Creek over the next basinwide planning cycle. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, and to restore habitat in the lower portion of the watershed.

The Little Long Creek watershed (03040105 060040) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

The City of Albemarle will likely be required by DWQ to obtain a NPDES permit for municipal stormwater systems under the Phase II stormwater rules during the next basinwide planning cycle. Refer to page 37 of Section A, Chapter 2 for details.

Section B: Chapter 14

Yadkin-Pee Dee River Subbasin 03-07-14

Includes a portion of the Rocky River and the Richardson and Lanes Creek Watersheds

14.1 Water Quality Overview

Subbasin 03-07-14 at a Glance

Land and Water

Total area:	420 mi^2
Stream miles:	491.5
Lake acres:	347.0

Population Statistics

1990 Est. Pop.:	50,084 people
Pop. Density:	120 persons/mi^2

Land Cover (%)

Forest/Wetland:	42.0
Surface Water:	0.5
Urban:	1.1
Cultivated Crop:	27.0
Pasture/ Managed Herbaceous:	29.4

The Rocky River cuts across the northeast corner of this subbasin from the confluence of Long Creek (subbasin 03-07-13) to the Pee Dee River. Richardson and Lanes Creeks flow in a northeasterly direction into this lowest segment of the Rocky River. Lanes Creek actually begins in South Carolina. Most of the subbasin lies in Union County, but portions of Anson and Stanly counties are also encompassed. Major municipalities include Unionville and Monroe.

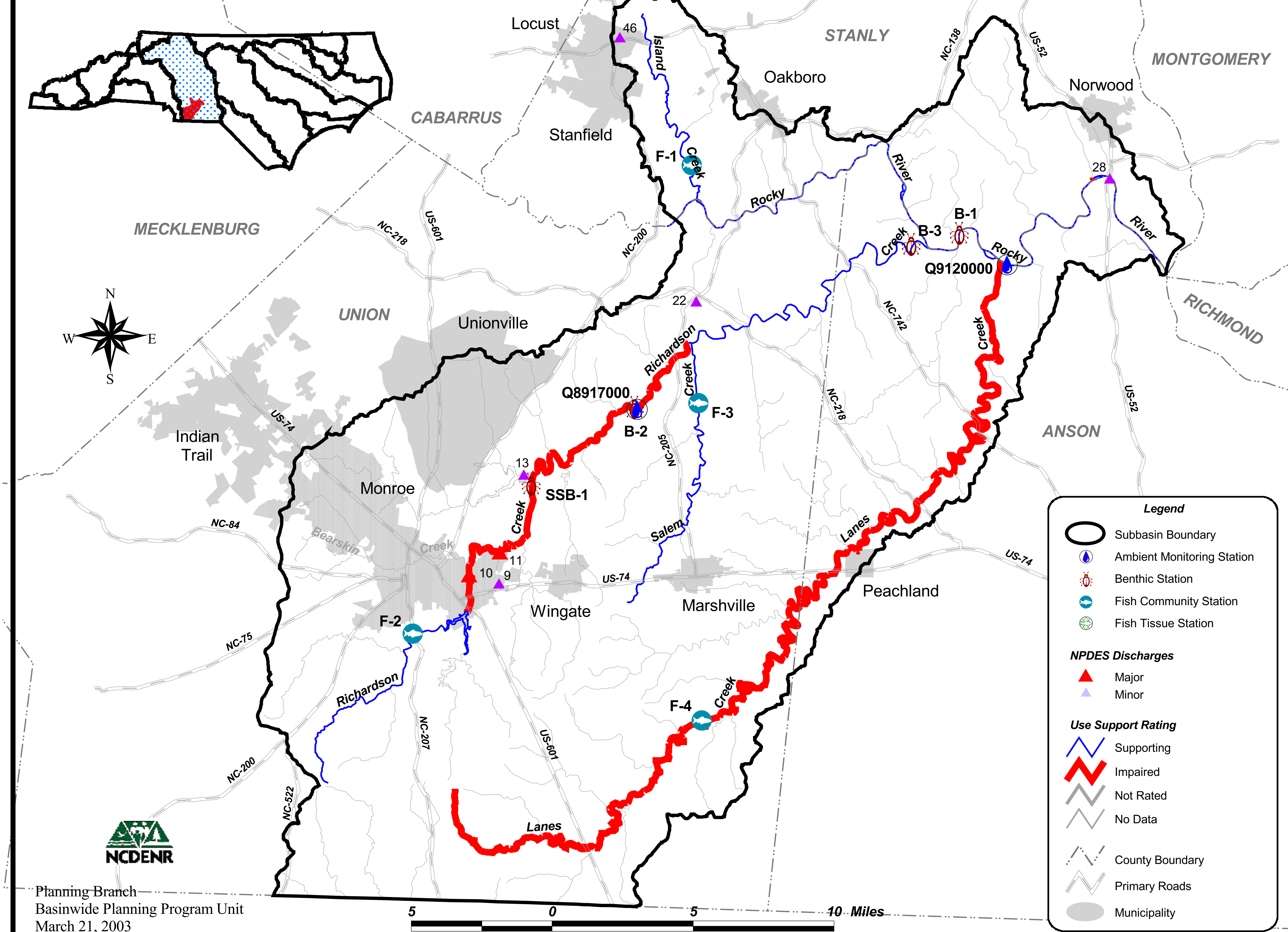
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-15. Table B-28 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-29. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

The population of the subbasin in 1990 was estimated to be just over 50,000 people. Estimates of subbasin population have not yet been made for the 2000 census data; however, it is likely that population increases substantially over the ten-year period. Population is expected to increase 70 percent in Union County between 2000 and 2020.

Land cover information compiled between 1993 and 1995 describes nearly 60 percent of the land with agricultural land uses (almost evenly divided between pasture and cultivated cropland). Only a small portion of the land was described as urban. As the Charlotte area continues to grow, this subbasin will likely become more urbanized, particularly along the US 601 Highway corridor. There are eight NPDES permitted discharges and 14 registered animal operations in this subbasin. The number of poultry operations increased 15 percent between 1994 and 1998. Swine production also increased over the four-year period. Facilities with compliance or toxicity problems are discussed in following sections.

Water quality cannot be generalized across this subbasin. In the lower portion of the subbasin, water quality is good, but several streams exhibit a wide range of impacts and impairment in the upper portion. There are no High Quality or Outstanding Resource Waters in this subbasin.

Figure B-15 Yadkin-Pee Dee River Subbasin 03-07-14



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-28 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-14

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Rocky River[1]	Stanly/Anson	SR 1943	Good
SSB-1	Richardson Creek[1]	Union	SR 1006	Fair
B-2	Richardson Creek	Union	SR 1649	Fair
B-3	Richardson Creek	Anson	SR 1600	Good
Fish Community Monitoring				
F-1	Island Creek	Stanly	SR 1118	Excellent
F-2	Richardson Creek	Union	NC 207	Good-Fair
F-3	Salem Creek[1,3]	Union	SR 1006	Good
F-4	Lanes Creek[1]	Union	SR 1929	Fair
Ambient Monitoring				
Q8917000	Richardson Creek	Union	SR 1649	Nutrients
Q9120000	Rocky River	Stanly/Anson	SR 1935	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q8800000	Richardson Creek	Union	SR 1751	Dissolved oxygen
Q8820000	Richardson Creek	Union	SR 1006	None
Q8850000	Richardson Creek	Union	SR 1630	None
Q9021300	Lanes Creek	Union	SR 1005	Dissolved oxygen
Lakes Assessment				
--	Lake Monroe	Union	2 sites	Nutrients
--	Lake Lee	Union	3 sites	Nutrients
--	Lake Twitty	Union	3 sites	Nutrients

1 Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.

2 Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

3 USGS topographical maps and the DWQ *Classifications and Water Quality Standards Assigned to the Yadkin-Pee Dee River Basin* still label this stream as Negro Head Creek. This publication will use the locally-used name "Salem Creek" to refer to this stream (index number 13-17-36-15).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-29 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-14

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	162.7 0.0	**37.3** **0.0**	2.5 347.0	289.0 0.0	491.5 347.0
Fish Consumption[2]	miles acres	0.0 0.0	**491.5** **347.0**	0.0 0.0	0.0 0.0	491.5 347.0
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	6.4 0.0	6.4 0.0
Water Supply	miles acres	149.6 335.8	0.0 0.0	0.0 0.0	0.0 0.0	149.6 335.8

1 Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

2 These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

14.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. Portions of two streams were Impaired at the time of the 1998 Yadkin-Pee Dee River basin plan. Richardson Creek and Lanes Creek are discussed below.

14.2.1 Richardson Creek (12.5 miles from dam at Lake Lee to SR 1649)

1998 Recommendations

The 1998 basin plan discusses naturally low dissolved oxygen, excess nutrients and sedimentation in Richardson Creek. Recommendations are that no new discharges of oxygen-consuming wastes be permitted above the Monroe WWTP discharge. The plan also states that further investigation into the causes and sources of water quality impacts is needed before more specific recommendations to improve water quality can be made.

Status of Progress

Richardson Creek was sampled at six locations over the most recent basinwide planning period. Biological samples were collected at four sites and water chemistry samples were collected at four sites. Richardson Creek above Lake Lee received a Good-Fair bioclassification, two samples downstream of the Monroe WWTP and Lake Twitty, respectively, received Fair bioclassifications, and the most downstream location near the mouth of the stream received a Good bioclassification. Good instream and riparian habitat were observed at all four biological monitoring stations; however, algae were prolific. Although the stream remains Impaired below the Monroe WWTP, the benthic macroinvertebrate community is steadily improving. Between 1990 and 2001, the EPT abundance increased from 16 to 46, suggesting real change in water quality.

Water chemistry samples revealed low dissolved oxygen concentrations at SR 1751 upstream of the Monroe WWTP discharge and slightly depressed concentrations at SR 1006 downstream of the WWTP discharge. Water chemistry data also show extremely high nutrient levels, nitrate/nitrite nitrogen and total phosphorus.

The headwaters of Richardson Creek are a mix of agricultural and urban land uses. The portions of watershed draining into Lake Monroe and Lake Lee are primarily in agricultural land use and many small tributaries are dammed for farm ponds. The watershed draining into Richardson Creek immediately below Lake Lee and into Lake Twitty is primarily urban, and stormwater from Monroe, Wingate and Unionville likely impacts the stream. Channelization is extensive throughout the urban portions of the watershed. Nutrient concentrations are high in all three lakes, although DWQ does not currently have sufficient data to assign use support ratings for aquatic life at this time. None of the three dams currently has a minimum instream flow requirement (refer to Section A, Chapter 2 for details).

The City of Monroe worked extensively in recent years to upgrade its WWTP. Two violations of the flow limitation in the winter of 2000 were reported over the most recent review period; otherwise, the Monroe WWTP has maintained full compliance with its NPDES permit.

2002 Recommendations

DWQ will work with the Division of Water Resources in order to determine whether a minimum instream flow requirement is feasible and/or necessary for the Lake Lee dam. Local actions are needed to reduce nutrients from all sources (agriculture, wastewater infrastructure and stormwater runoff) in the Richardson Creek watershed above SR 1649 and Salem Creek.

Water Quality Improvement Initiatives

The City of Monroe initiated a project in 1997 to demonstrate the effectiveness of extended detention constructed wetlands as an alternative to simple detention ponds. This project was funded in part through the Clean Water Act – Section 319 Program (page 273).

14.2.2 **Lanes Creek** (36.8 miles from SR 1929 to Rocky River)

1998 Recommendations

The 1998 basin plan discusses low flow and suggests that Lanes Creek has little capacity to assimilate wastewater. Recommendations are for extensive data collection in the event that a NPDES discharge permit is proposed. The plan also recommends more widespread implementation of BMPs to control nonpoint source pollution in the watershed.

Status of Progress

No discharges have been permitted into Lanes Creek. A fish community sample collected in 2001 in the upper section of stream received a Fair bioclassification, and both fish and benthic macroinvertebrate communities have received Fair or Poor bioclassifications in the past at several locations along the stream. The stream continues to be rated Impaired.

2002 Recommendations

Further investigation into the causes and sources of these water quality impacts is needed before specific recommendations to improve water quality can be made. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from agricultural activities, throughout the watershed.

Water Quality Improvement Initiatives
The upper Lanes Creek watersheds (03040105 081010, 081020, and 081030) are three of 55 watersheds in the Yadkin-Pee Dee River basin that have been identified by the Wetlands Restoration Program as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

14.3 Status and Recommendations for Newly Impaired Waters

No additional waters are Impaired based on recent DWQ monitoring (1998-2001); however, some impacts to water quality were observed. Refer to Part 14.5 below for further discussion of potential water quality problems.

14.4 Section 303(d) Listed Waters

Portions of Richardson Creek and Lanes Creek (discussed above) are currently listed on the state's draft 2002 303(d) list. Appendix IV contains more information on the 303(d) list and listing requirements.

14.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

14.5.1 Bearskin Creek

Bearskin Creek flows east through Monroe into Richardson Creek above the Monroe WWTP discharge. The watershed is almost completely developed with a small amount of agricultural land in the headwaters. DWQ has not sampled Bearskin Creek; however, impacts from stormwater runoff in this watershed likely contribute to impairment of Richardson Creek downstream. Richardson Creek is discussed in more detail on page 246. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff in Monroe.

14.5.2 Stewarts Creek

The headwaters of Stewarts Creek flow from Monroe and Unionville into Lake Twitty. The watersheds of several streams, including Chinkapin Creek and Stumplick Branch, are almost completely developed with a large amount of channelization. Other land in the watershed is agricultural, primarily cultivated cropland. DWQ has not sampled Stewarts Creek; however, impacts from stormwater runoff in this watershed likely contribute to impairment of Richardson Creek downstream. Richardson Creek is discussed in more detail on page 246. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff in Monroe and Unionville, and to restore habitat to tributary streams.

The Stewarts Creek watershed (03040105 070050) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

Section B: Chapter 15

Yadkin-Pee Dee River Subbasin 03-07-15

Little River Watershed including Densons Creek and Cheek Creek

15.1 Water Quality Overview

Subbasin 03-07-15 at a Glance

Land and Water

Total area:	351 mi^2
Stream miles:	388.1
Lake acres:	18.5

Population Statistics

1990 Est. Pop.:	20,432 people
Pop. Density:	58 persons / mi^2

Land Cover (%)

Forest / Wetland:	85.1
Surface Water:	0.4
Urban:	0.9
Cultivated Crop:	3.3
Pasture / Managed Herbaceous:	10.4

The Little River subbasin lies adjacent and parallel to that of the Uwharrie River (03-07-09), and the two rivers are somewhat similar in nature. The Little River's headwaters are in Randolph County, and it flows generally south through Montgomery County and into the Pee Dee River just above Blewett Falls Lake. Major tributaries include the West Fork Little River, Densons Creek, Rocky Creek, Cheek Creek and Hamer Creek. Municipalities include Troy and portions of Star, Bisoce and Mount Gilead.

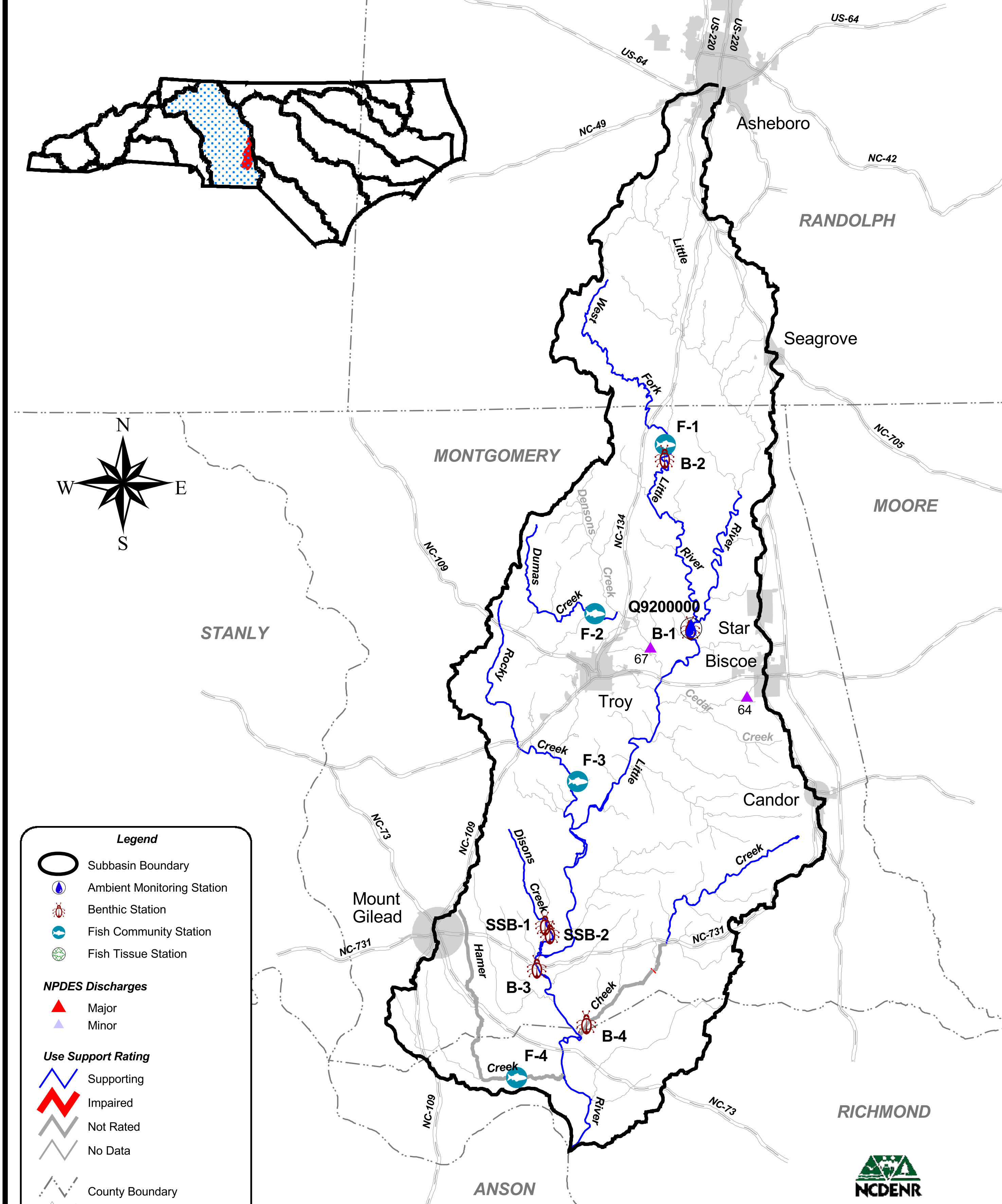
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-16. Table B-30 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-31. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

A large portion of the subbasin lies within the Uwharrie National Forest, and this public land is reflected in the large percentage of forested area (85 percent). Approximately 14 percent of the subbasin is characterized by agricultural land uses and a very small percentage is urban. The estimated population and density of this subbasin is currently low; however, projected population increases are 37 percent for Randolph County and 24 percent for Montgomery County between 2000 and 2020.

Currently, there are only two NPDES permitted discharges and three registered animal operations. Swine production from all farms (small and large) increased by 41 percent between 1994 and 1998. The capacity of this subbasin is a negligible percent of the state's total capacity for swine production, but these data indicate a shift in the agricultural community of this area. Poultry production capacity increased 10 percent over the same period. The Town of Biscoe WWTP is the only facility in significant noncompliance of the most recent review period; it is discussed in following sections.

Water quality is generally excellent. A portion of the Little River, along with the entire Densons Creek watershed, is classified High Quality Waters (HQW). Bridgers Creek and a portion of Rocky Creek are also HQW. Biological surveys indicate that the West Fork Little River might also be eligible for reclassification to HQW.

Figure B-16 Yadkin-Pee Dee River Subbasin 03-07-15



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-30 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1997-2002) for Yadkin-Pee Dee River Subbasin 03-07-15

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-2	Little River[1]	Montgomery	SR 1340	Excellent
B-2	West Fork Little River[1]	Montgomery	SR 1311	Excellent
B-3	Little River[1]	Montgomery	NC 731	Good
SSB-1	Disons Creek	Montgomery	Above SR 1543	Good
SSB-2	Disons Creek	Montgomery	SR 1546	Good
B-4	Cheek Creek[1]	Montgomery	SR 1541	Not Rated
Fish Community Monitoring				
	Little River	Randolph	SR 1127	Good
	Little River	Randolph	NC 134	Good
	Little River	Randolph	SR 1135	Good
F-1	West Fork Little River[1]	Montgomery	SR 1311	Good
F-2	Dumas Creek	Montgomery	SR 1310	Excellent
F-3	Rocky Creek	Montgomery	SR 1549	Excellent
	Cheek Creek[1]	Montgomery	SR 1563	Excellent
F-4	Hamer Creek	Richmond	SR 1159	Not Rated
Ambient Monitoring				
Q9200000	Little River	Montgomery	SR 1340	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q9320000	Little River	Richmond	SR 1148	Turbidity
Q9340000	Toms Branch	Richmond	SR 1310	None

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-31 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-15

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	237.1 18.5	0.0 0.0	19.8 0.0	131.2 0.0	388.1 18.5
Fish Consumption[2]	miles acres	0.0 0.0	**388.1** **18.5**	0.0 0.0	0.0 0.0	0.0 0.0
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	7.5 0.0	0.0 0.0	0.0 0.0	0.0 0.0	7.5 0.0

1 Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

2 These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

15.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan did not identify any Impaired waters in this subbasin.

15.3 Status and Recommendations for Newly Impaired Waters

No stream segments were rated as Impaired based on recent DWQ monitoring (1998-2001); however, as mentioned previously, some impacts to water quality were observed. Refer to Part 15.5 below, as well as Section A, Chapter 4 for further discussion of potential water quality problems in this portion of the basin.

15.4 Section 303(d) Listed Waters

No waters in this subbasin are listed on the state's draft 2002 303(d) list. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

15.5 Other Issues and Recommendations

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented during the process. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

15.5.1 Densons Creek

The headwaters of Densons Creek are within the Uwharrie National Forest and overall the majority of the watershed is forested. However, there is increasing commercial and residential development along highway corridors in and out of Troy. DWQ has not monitored this stream since 1992 when the lower half of the watershed received a Good-Fair bioclassification.

Considering the increase in development, there is the potential for increasing impacts to this watershed from nonpoint source pollution. However, the Town of Troy has received multiple Clean Water Management Trust Fund grants (see page 275 for details) to acquire riparian buffers along Densons Creek, develop a greenway system, and improve WWTP facilities. Some of the potential impacts may be mitigated through these efforts. As resources allow, DWQ will sample Densons Creek over the next basinwide planning cycle.

15.5.2 Cedar Creek

Cedar Creek flows generally west from the Town of Biscoe into the Little River. The Biscoe WWTP discharges into the headwaters (Hickory Branch) of this stream. The WWTP was in significant noncompliance for BOD throughout 2000 and also experienced some problems meeting the dissolved oxygen permit limit in 2001. DWQ staff from the Fayetteville Regional Office worked with the treatment plant operator in 2001 to resolve problems associated with the discharge. As resources allow, DWQ will sample Cedar Creek over the next basinwide planning cycle. The Biscoe WWTP could receive permit limits consistent with DWQ's zero flow policy in the future. Refer to page 103 of Section A for details.

15.5.3 Cheek Creek

The headwaters of Cheek Creek are also within the Uwharrie National Forest, and fish community sampling revealed an Excellent community in the upper half of the watershed. However, habitat degradation was observed at a benthic macroinvertebrate sampling site in the lower part of the watershed in 2001, including bank erosion, sedimentation and a narrow, broken riparian zone. There has also been substantial channelization of the stream historically. No flow was present when DWQ attempted to resample the stream in 2002. Impacts indicating possible impairment are evident in the lower portion of the watershed; however, DWQ is unable to separate the effects of water quality problems from the effects of the extended drought, and the stream is currently not rated. Land use in the impacted area is primarily agricultural. There are no NPDES permitted discharges or developed areas.

Further investigation into the causes and sources of these water quality impacts is needed before recommendations to improve water quality can be made. However, local actions are needed now to reduce sedimentation and bank erosion and to promote the production of instream habitat by restoring riparian vegetation throughout the watershed. DWQ will notify local agencies of water quality concerns regarding these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding.

The Cheek Creek watershed (03040104 050010) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the Wetlands Restoration Program as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

15.5.4 Hamer Creek

Hamer Creek was monitored for the first time by DWQ in 2001. In a situation similar to that of Cheek Creek, the initial fish community monitoring indicated impairment. When DWQ returned in 2002, there was no flow in the stream. The habitat of Hamer Creek did not appear very degraded and the stream is currently not rated. Pending higher flow conditions, DWQ will sample Hamer Creek again over the next basinwide planning cycle.

15.6 Additional Water Quality Issues within Subbasin 03-07-15

The previous parts discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within the subbasin. Information found in this section may be related to concerns about things that threaten water quality or about plans and actions to improve water quality.

15.6.1 Projected Population Growth

From 2000 to 2020, the estimated population increase for Randolph County is 37 percent and much of this growth is likely to occur in the headwaters of the Little River around Asheboro. Population is also expected to increase by 24 percent for Montgomery County over the same 20-year period. Growth management within the next five years will be imperative, especially in and around urbanizing areas and along highway corridors, in order to protect or improve water quality in this subbasin. Growth management can be defined as the application of strategies and practices that help achieve sustainable development in harmony with the conservation of environmental qualities and features of an area. On a local level, growth management often involves planning and development review requirements that are designed to maintain or improve water quality. Refer to Section A, Chapter 4 for more information about urbanization and development and recommendations to minimize impacts to water quality.

Section B: Chapter 16
Yadkin-Pee Dee River Subbasin 03-07-16
Includes the Pee Dee River below Blewett Falls Dam, Ledbetter Lake, Hitchcock Creek and Marks Creek

16.1 Water Quality Overview

Subbasin 03-07-16 at a Glance

Land and Water

Total area:	331 mi^2
Stream miles:	217.1
Lake acres:	371.9

Population Statistics

1990 Est. Pop.:	41,561 people
Pop. Density:	127 persons/mi^2

Land Cover (%)

Forest/Wetland:	82.2
Surface Water:	2.2
Urban:	1.5
Cultivated Crop:	8.0
Pasture/ Managed Herbaceous:	6.1

South Carolina forms the southern border of this subbasin, and it contains the last segment of the Pee Dee River mainstem from the dam at Blewett Falls to the state line. Major tributaries which are discussed here include Hitchcock Creek and Marks Creek. McKinney and Ledbetter Lakes are also included. The subbasin is contained almost entirely within Richmond County; the largest municipalities are Rockingham and Hamlet.

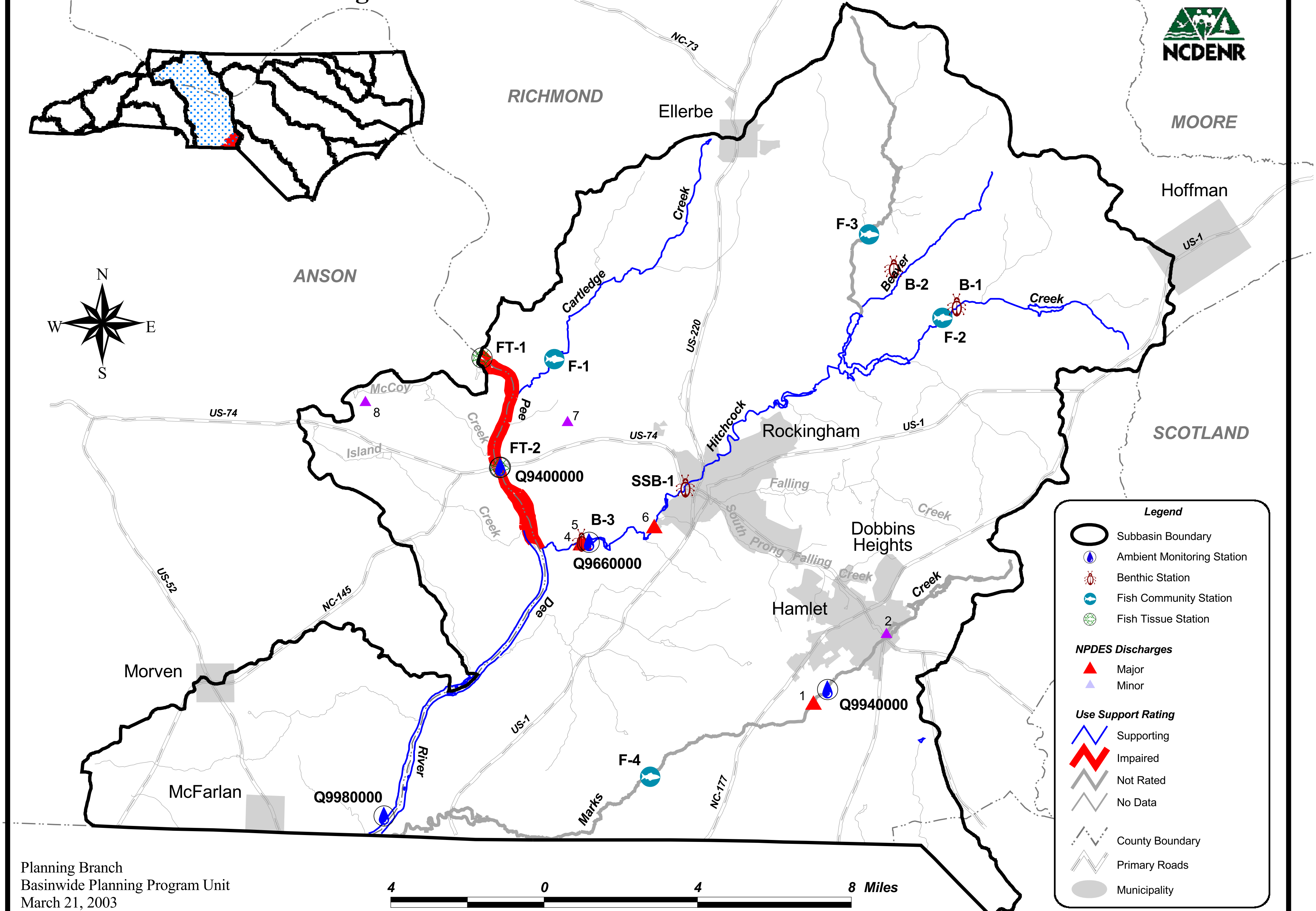
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-17. Table B-32 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-33. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

More than 80 percent of the subbasin is forested and 2 percent is surface water, reflecting the large, wide nature of the Pee Dee River. Cultivated cropland and pasture comprise about 14 percent of the land use. Population of the basin is estimated at more than 40,000 and the population density is higher than in surrounding subbasins. The population of Richmond County is expected to increase by 7 percent between 2000 and 2020.

There are seven NPDES permitted discharges and one registered animal operation in this subbasin. Two facilities were in significant noncompliance over the most recent review period: Anson County Regional WWTP and Hamlet WWTP. Swine production capacity from all farms (small and large) increased by 175 percent between 1994 and 1998. This capacity is a negligible percent of the state's total capacity for swine production, but it indicates a significant shift in the agricultural community.

Water quality is generally Good-Fair across this subbasin. Although only a few waters are Impaired, most have some notable water quality impacts. The headwaters of Marks Creek, including Water Lake, are the only waters classified as High Quality Waters.

Figure B-17 Yadkin-Pee Dee River Subbasin 03-07-16



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-32 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-16

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Hitchcock Creek[1]	Richmond	SR 1486	Good
B-2	Beaverdam Creek[1]	Richmond	SR 1486	Not Impaired
SSB-1	Hitchcock Creek	Richmond	US 74	Good
B-3	Hitchcock Creek	Richmond	SR 1109	Good-Fair
Fish Community Monitoring				
F-1	Cartledge Creek	Richmond	SR 1142	Good
F-2	Hitchcock Creek	Richmond	SR 1486	Not Rated
F-3	Rocky Fork Creek	Richmond	SR 1424	Not Rated
F-4	Marks Creek	Richmond	SR 1104	Not Rated
Fish Tissue Monitoring				
FT-1	Pee Dee River	Richmond/ Anson	Blewett Falls Dam	Mercury in one fish
FT-2	Pee Dee River	Richmond/ Anson	US 74	None
Ambient Monitoring				
Q9400000	Pee Dee River	Richmond/ Anson	US 74	Dissolved oxygen
Q9660000	Hitchcock Creek	Richmond	SR 1109	pH
Q9940000	Marks Creek	Richmond	SR 1812	None
Q9980000	Pee Dee River	South Carolina	SC Hwy 9	None
Yadkin-Pee Dee River Basin Association Monitoring				
Q9400000	Pee Dee River[3]	Richmond/ Anson	US 74	Dissolved oxygen
Lakes Assessment				
--	Roberdel Lake	Richmond	2 stations	None
--	Rockingham City Lake	Richmond	1 station	Dissolved oxygen
--	Water Lake	Richmond	2 stations	% DO saturation
--	Hamlet City Lake	Richmond	2 stations	Dissolved oxygen

1 Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
2 Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).
3 This site duplicates a DWQ ambient monitoring station.

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-33 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-16

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	69.4 98.9	**6.3** **0.0**	30.7 273.0	110.7 0.0	217.1 371.9
Fish Consumption[2]	miles acres	0.0 0.0	**217.1** **371.9**	0.0 0.0	0.0 0.0	217.1 371.9
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	4.5 0.0	4.5 0.0
Water Supply	miles acres	67.9 231.7	0.0 0.0	0.0 0.0	0.0 0.0	67.9 231.7

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.

[2] With the exception of Ledbetter Lake (100 acres), these waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

16.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified four Impaired waters in this subbasin. Cartledge Creek, Hitchcock Creek, Rockingham City Lake and Hamlet City Lake are discussed below.

16.2.1 **Cartledge Creek** (10.5 miles from source to Pee Dee River)

1998 Recommendations

Cartledge Creek was Impaired based on a Fair bioclassification in 1996. Sedimentation and bank erosion were observed at the time of the biological survey. The 1998 basin plan stated that further investigation was needed into the causes and sources of impacts, and general recommendations for reducing nonpoint source pollution were given.

Status of Progress

Cartledge Creek flows generally southwest from Ellerbe into the Pee Dee River. The watershed is mostly forested with some agricultural land use and very little developed area. The fish community received a Good bioclassification in 2001. It is likely that streamflow in the Cartledge Creek watershed is naturally very low in the summer months (which is when benthic macroinvertebrate communities are typically sampled) and smaller tributaries often stop flowing completely. Cartledge Creek is no longer considered Impaired.

2002 Recommendations
Currently, there are no NPDES permitted discharges in the Cartledge Creek watershed. Any new NPDES permit applications should be carefully scrutinized in light of DWQ's zero flow policy.

16.2.2 **Hitchcock Creek** (10.0 miles from dam at Roberdel Lake to Pee Dee River)

1998 Recommendations
The 1998 basin plan recommended no new discharges of oxygen-consuming wastes be permitted in Hitchcock Creek below the existing Rockingham WWTP discharge due to model predictions that assimilative capacity in the stream is extremely limited. The stream also contained habitat impacts from nonpoint source pollution, including sedimentation, as well as high concentrations of fecal coliform bacteria. Steeles Mill Pond also contained high concentrations of fecal coliform bacteria. General recommendations for reducing nonpoint source pollution were also included.

Status of Progress
Biological surveys of Hitchcock Creek were conducted at three locations in 2001. The most upstream location was below McKinney Lake and Bones Fork Creek and received a Good bioclassification. Habitat was relatively good at this location; however, impacts from flow fluctuation were obvious. Another location below Ledbetter and Roberdel Lakes, but above the old Rockingham WWTP discharge, also received Good bioclassification. Below the City of Rockingham and the Burlington Industries discharge, the stream received a Good-Fair bioclassification. At this most downstream location, heavy sedimentation and bank erosion were observed.

More than 14 percent of water chemistry samples were below the water quality standard for pH, and a few were below the standard for dissolved oxygen as well. The geometric mean of fecal coliform concentrations for 2001 and for the five-year assessment period was well below 200 colonies/100ml. In 2000, the Rockingham WWTP relocated its discharge to the Pee Dee River. In addition, Burlington Industries has reduced production, and therefore, reduced stress on the WWTP. Hitchcock Creek is current Supporting designated uses.

2002 Recommendations
The majority of water quality impacts in the Hitchcock Creek watershed are currently from nonpoint source pollution. Samples in 2001 were following an extended drought, which tends to lessen the effects of nonpoint source pollution. Local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, and to restore habitat in the lower portion of the watershed.

Water Quality Improvement Initiatives
The Hitchcock Creek watershed (03040201 010020) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

16.2.3 Rockingham City Lake (Old City Pond) (27 acres)

1998 Recommendations
Sedimentation and heavy growths of aquatic plants were discussed in the 1998 basin plan as problems for Rockingham City Lake. General recommendations for reducing nonpoint source pollution in the watershed were given.

Status of Progress
Old City Pond is positioned directly above Hinson Lake in the Falling Creek watershed near Rockingham. It is a secondary drinking water supply for the City of Rockingham. Only one station was sampled on this small lake in 2001, and the lake is currently not rated due to the extremely small data set. Thick stands of aquatic vegetation were present at the time of sampling and, as is not uncommon, dissolved oxygen levels were depressed. Nutrient concentrations ranged from low to moderate.

2002 Recommendations
The City of Rockingham plans to expand the treatment plant on Roberdel Lake in the future and eliminate Old City Pond as a drinking water supply source. DWQ will likely discontinue monitoring of this lake in the future due to its small size. Local actions are needed to minimize or prevent the spread of the aquatic weeds to Hinson Lake downstream. Aquatic weeds can lead to impairment of primary and secondary recreation uses.

16.2.4 Hamlet City Lake (100 acres)

1998 Recommendations
Sedimentation and heavy growths of aquatic plants were discussed in the 1998 basin plan as problems for Hamlet City Lake. The plan discusses a proposed project by the US Army Corps of Engineers (USCOE) to remove sediment from Hamlet City Lake. General recommendations for reducing nonpoint source pollution in the watershed were also given.

Status of Progress
In 1998, the USCOE completed the dredging project on Hamlet City Lake and it was refilled. Sampling in 2000 by DWQ indicated that aquatic vegetation was again becoming a problem, and dissolved oxygen levels were depressed. Nutrient concentrations ranged from low to moderate. The lake is currently not rated due to a very small data set on which to base an assessment. Hamlet City Lake is currently not classified for primary recreation or drinking water supply.

16.3 Status and Recommendations for Newly Impaired Waters

Ledbetter Lake and a portion of the Pee Dee River are Impaired based on recent DWQ monitoring (1998-2001). This section outlines the potential causes and sources of impairment and provides recommendations for improving water quality.

16.3.1 **Ledbetter Lake** (100 acres)

Current Status
Fish consumption is Impaired in Ledbetter Lake based on elevated mercury levels in largemouth bass. A fish consumption advisory is currently in effect for the lake: "Largemouth bass in Ledbetter Lake contain higher than normal levels of mercury. Consumption of largemouth bass should be limited to no more than two meals per person per month. Women of childbearing age and children should eat no largemouth bass taken from this area until further notice."

2002 Recommendations
Given the global scale of mercury cycling, it may be difficult for DWQ to recognize significant reductions of mercury in fish over the short-term. The NC Department of Environment and Natural Resources (NCDENR) has established a Mercury Task Force that includes staff from DWQ, Division of Air Quality, Hazardous Waste, Pollution Prevention and Wildlife Resources. In addition, DWQ has established an internal Water Quality Section Work Group to stay abreast of mercury issues. Section A, page 104 provides more details about mercury in the environment.

16.3.2 **Pee Dee River** (6.3 miles from the dam at Blewett Falls to Hitchcock Creek)

1998 Recommendations
The 1998 basin plan discusses problems with low dissolved oxygen (DO) levels below the Blewett Falls dam. The recommendation was for DWQ to coordinate efforts to improve water quality with the Division of Water Resources during the hydropower project relicensing process.

Current Status
More than 18 percent of samples collected from the Pee Dee River at US 74 contained concentrations of dissolved oxygen that were less than 5.0 mg/l; nearly 10 percent were less than 4.0 mg/l.

2002 Recommendations
DWQ will work with CP&L to better evaluate water quality in the Pee Dee River below Blewett Falls during the hydropower relicensing process. In addition to the license application, CP&L must also obtain a 401 Water Quality Certification for the project. DWQ will ensure, through the 401 Water Quality Certification review, that project operations will not result in violations of water quality standards. DWQ should require NPDES permit limits no less stringent than 15.0 mg/l BOD_5, 4.0 mg/l NH_3-N, and 5.0 mg/l DO for new and expanding discharges into this portion of the Pee Dee River.

16.4 Section 303(d) Listed Waters

Currently, portions of eight waters in this subbasin are listed on the state's draft 2002 303(d) list. Cartledge Creek and Hitchcock Creek (discussed above) will likely be removed from the 303(d) list in the future. The Pee Dee River, Ledbetter Lake, Rockingham City Lake and Hamlet City Lake were also discussed above. Marks Creek is discussed below. Appendix IV contains more information on the state's 303(d) list and listing requirements.

16.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

16.5.1 Marks Creek

The 1998 basin plan describes Marks Creek as "slow moving" with "swamp-like" characteristics. The plan recommends that no additional loading of oxygen-consuming wastes be permitted and that an expansion of the Hamlet WWTP not be permitted without a field-calibrated model for dissolved oxygen. Dissolved oxygen fell below 5.0 mg/l in 26 percent of ambient monitoring samples over the last basinwide planning cycle (1997-2001); concentrations were below 4.0 mg/l in 20 percent of samples. Data also reveal low pH in a significant percent of samples. These data, as well as fish community data collected in 2001, are consistent with eastern Coastal Plain streams which carry the supplemental classification of Sw.

A special study is needed to determine whether Marks Creek stream should receive the supplemental classification of Sw. DWQ is currently working to refine criteria for making this determination. Once these criteria are approved, Marks Creek will be a high priority for assessment. Swamp waters are discussed in more detail on page 113. Marks Creek is currently Not Rated; however, runoff from developed areas in the upper portion of the watershed is a water quality concern.

The Marks Creek watershed (03040201 010060) is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

16.5.2 Falling Creek
South Prong Falling Creek

The upper half of Falling Creek flows through agricultural lands in eastern Richmond County. The stream is impounded twice near Rockingham. The first dam is at the Old City Pond which still serves as a drinking water supply. The lake is discussed in more detail in Part 16.2.3 above. The second dam is for Hinson Lake, directly below the Old City Pond. The lower portion of

Falling Creek (below Hinson Lake) drains a heavily developed portion of Rockingham and is likely impacted by stormwater runoff.

South Prong Falling Creek begins in Hamlet and flows generally northwest into Falling Creek in Rockingham. Highway 74 flows the stream for much of its length, and much of this corridor between the two towns is developed. DWQ has not sampled the Falling Creek watershed, and the lowest sample on Hitchcock Creek is above the confluence of the two streams. As resources allow, DWQ will sample Falling Creek over the next basinwide planning cycle. However, local actions are needed to reduce the effects of nonpoint source pollution, particularly from stormwater runoff, throughout the watershed.

Section B: Chapter 17
Yadkin-Pee Dee River Subbasin 03-07-17
Includes the Jones Creek Watershed

17.1 Water Quality Overview

Subbasin 03-07-17 at a Glance

Total Water Miles and Acres

Stream miles:	120.4
Lake acres:	83.2

Land Cover (%)

Forest/Wetland:	79.2
Surface Water:	0.6
Urban:	0.9
Cultivated Crop:	8.4
Pasture/ Managed Herbaceous:	10.8

This subbasin primarily consists of the Jones and Deadfall Creek watersheds near the state's border with South Carolina. Jones Creek flows generally east into the Pee Dee River in subbasin 03-07-16. Deadfall Creek flows south into South Carolina. The area is almost completely within Anson County. Portions of Wadesboro, Lilesville and Morven are the only municipalities.

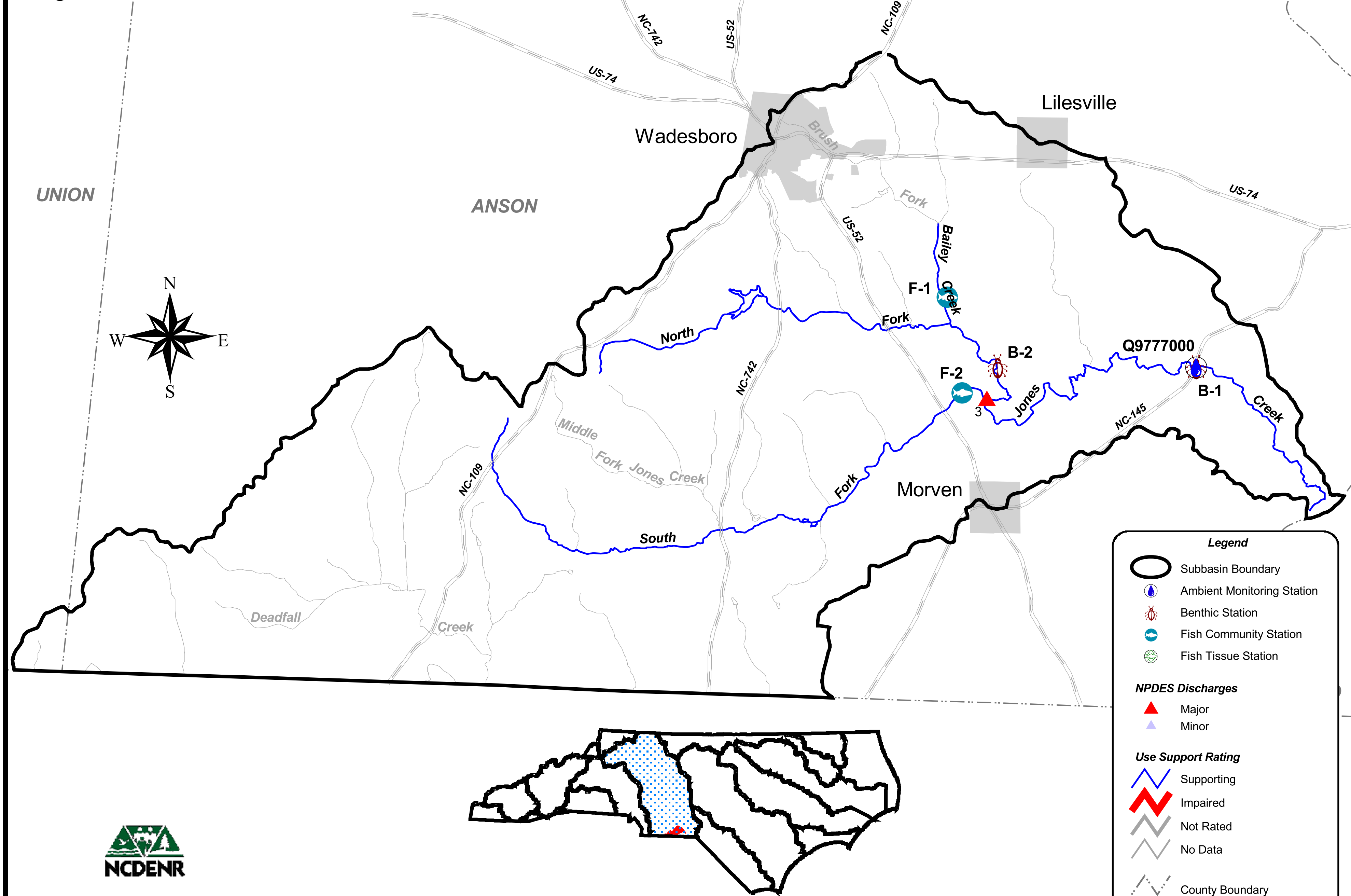
A map including the locations of NPDES discharges and water quality monitoring stations is presented in Figure B-18. Table B-34 contains a summary of monitoring data types, locations and results. Use support ratings for waters in this subbasin are summarized in Table B-35. Appendix I provides a key to discharge identification numbers. Refer to Appendix III for a complete listing of monitored waters and more information about use support ratings.

Nearly 80 percent of the land is forested and there are almost equal portions of pasture and cultivated cropland. Less than 1 percent of the land is described as urban. The area is still rural in nature and projected population growth between 2000 and 2020 is less than 10 percent.

There are no NPDES permitted discharges and five registered animal operations in the subbasin; all of which are swine. Swine production increased dramatically in the mid-to-late 1990s and poultry production increased modestly as well.

Water quality in this subbasin is generally good. There are some areas where impacts have been observed. The headwaters of North Fork Jones Creek draining to Wadesboro City Pond are the only waters currently classified as High Quality Waters. However, data indicate that South Fork Jones Creek qualifies for this more protective classification.

Figure B-18 Yadkin-Pee Dee River Subbasin 03-07-17



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table B-34 DWQ Monitoring Locations, Bioclassifications and Notable Chemical Parameters (1998-2002) for Yadkin-Pee Dee River Subbasin 03-07-17

Site	Stream	County	Road	Bioclassification or Noted Parameter[2]
Benthic Macroinvertebrate Community Monitoring				
B-1	Jones Creek[1]	Anson	NC 145	Good-Fair
B-2	North Fork Jones Cr[1]	Anson	SR 1121	Good-Fair
Fish Community Monitoring				
F-1	Bailey Creek[1]	Anson	SR 1811	Good
F-2	South Fork Jones Cr	Anson	SR 1821	Excellent
Ambient Monitoring				
Q9777000	Jones Creek	Anson	NC 145	None
Lakes Assessment				
--	Wadesboro City Pond	Anson	2 stations	None

[1] Historical data of this type are available for this waterbody; refer to Appendix II. Sites may vary.
[2] Parameters are noted if in excess of state standards in more than 10 percent of samples collected within the assessment period (9/1996-8/2001).

For more detailed information on sampling and assessment of streams in this subbasin, refer to the *Basinwide Assessment Report - Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-35 Use Support Ratings Summary (2002) for Monitored and Evaluated Freshwater Streams (miles) and Lakes (acres) in Yadkin-Pee Dee River Subbasin 03-07-17

Use Support Category	Units	Supporting	Impaired	Not Rated	No Data	Total[1]
Aquatic Life/Secondary Recreation	miles acres	62.3 0.0	0.0 0.0	0.6 76.2	57.5 7.0	120.4 83.2
Fish Consumption[2]	miles acres	0.0 0.0	**120.4** **83.2**	0.0 0.0	0.0 0.0	120.4 83.2
Primary Recreation	miles acres	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0	0.0 0.0
Water Supply	miles acres	3.4 76.2	0.0 0.0	0.0 0.0	0.0 0.0	3.4 76.2

[1] Total stream miles/acres assigned to each use support category in this subbasin. Column is not additive because some stream miles are assigned to more than one category.
[2] These waters are impaired based on fish consumption advice issued for three species of freshwater fish due to mercury contamination. Refer to page 104 of Section A for details.

17.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1998 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1998 Yadkin-Pee Dee River basin plan identified two Impaired waters in this subbasin. Portions of North and South Forks Jones Creek are discussed below.

17.2.1 North Fork Jones Creek (8.4 miles from Wadesboro City Pond to Jones Creek)

1998 Recommendations

The 1998 basin plan discusses low flow and suggests that North Fork Jones Creek has little capacity to assimilate wastewater. Recommendations are for extensive data collection in the event that a NPDES discharge permit is proposed. The plan also recommends more widespread implementation of BMPs to control nonpoint source pollution in the watershed.

Status of Progress

Benthic macroinvertebrates were sampled in 2001 near the confluence with Jones Creek and received a Good-Fair bioclassification. The improvement in benthic macroinvertebrate bioclassification between 1996 and 2001 is likely due to reduced nonpoint source pollution as a result of the extended drought. There are no NPDES permitted discharges into North Fork Jones Creek.

Water Quality Improvement Initiatives

The North Fork Jones Creek watershed, including Bailey Creek (03040201 020020), is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

17.2.2 South Fork Jones Creek (0.8 miles from SR 1821 to Jones Creek)

1998 Recommendations

The 1998 basin plan discusses low flow and suggests that South Fork Jones Creek has little capacity to assimilate wastewater. Recommendations are for extensive data collection in the event that a NPDES discharge permit is proposed. The plan also recommends more widespread implementation of BMPs to control nonpoint source pollution in the watershed.

Status of Progress

In 1995, the Anson County WWTP discharge was relocated to the Pee Dee River. The fish community of South Fork Jones Creek received an Excellent bioclassification in 2001. The stream is currently Supporting designated uses.

17.3 Status and Recommendations for Newly Impaired Waters

No waters in subbasin 03-07-17 are Impaired based on recent DWQ monitoring (1998-2001); however, some impacts to water quality were observed. Refer to Part 17.5 below for further discussion of potential water quality problems.

17.4 Section 303(d) Listed Waters

Portions of North Fork and South Fork Jones Creek (discussed above) are currently listed on the state's draft 2002 303(d) list. Appendix IV contains more information on the 303(d) list and listing requirements.

17.5 Status and Recommendations for Waters with Notable Impacts

Based on DWQ's most recent use support assessment, the surface waters discussed below are not Impaired. However, notable water quality impacts were documented. While these waters are not considered Impaired, attention and resources should be focused on them over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found in Appendix III.

Although no action is required for these streams, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source agency contacts are listed in Appendix VI.

17.5.1 Brush Fork

Brush Fork is a major tributary to Bailey Creek in the North Fork Jones Creek watershed. Although the fish community of Bailey Creek near the confluence with North Fork Jones Creek received a Good bioclassification in 2001, habitat degradation and some nutrient enrichment were observed. These impacts are likely being passed down from Brush Fork higher in the watershed. The headwaters of Brush Fork are almost completely developed in the Town of Wadesboro, and more land is being developed along highway corridors: NC 109, US 52 and US 74. In addition to impacts from stormwater in the watershed, there are likely impacts from historical wastewater collection system failures. However, Wadesboro recently completed a large collection system rehabilitation project that will reduce these impacts in the future.

The North Fork Jones Creek watershed, including Brush Fork and Bailey Creek (03040201 020020), is one of 55 watersheds in the Yadkin-Pee Dee River basin that has been identified by the NC Wetlands Restoration Program (NCWRP) as an area with the greatest need and opportunity for stream and wetland restoration efforts. This watershed will be given higher priority than a nontargeted watershed for the implementation of NCWRP restoration projects. Refer to page 278 in Section C for details.

Section C

Current and Future
Water Quality Initiatives

Section C: Chapter 1
Current Water Quality Initiatives

1.1 Workshop Summaries

In April 2002, five workshops were conducted by DWQ in the Yadkin-Pee Dee River basin at Elkin, Winston-Salem, Uwharrie, Salisbury and Fairview. There were 149 people in attendance representing a variety of interests. Figure C-1 presents an estimate of the percent of total attendance which represented various groups/interests, based on information recorded on attendance sheets. Figure C-2 presents the total attendance for each workshop by category.

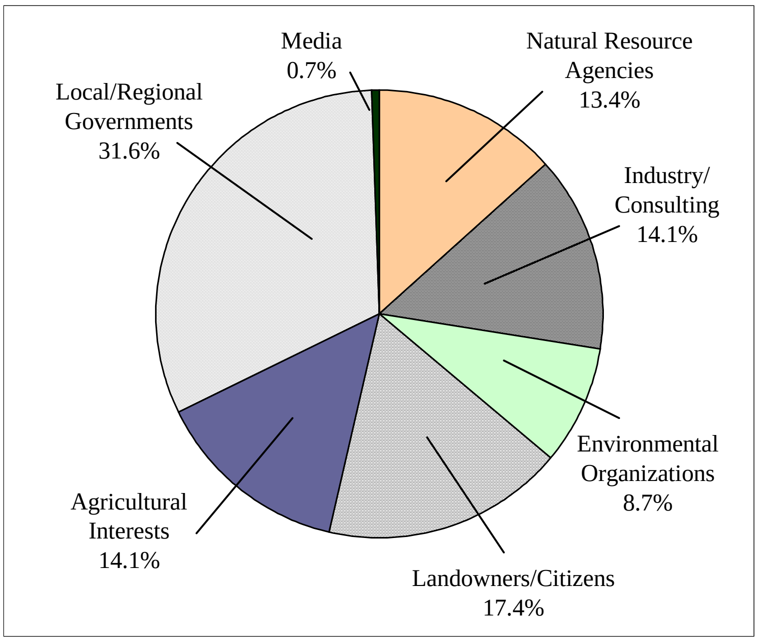


Figure C-1 Percent of Total Attendance by Various Interests at Five DWQ Water Quality Workshops in the Yadkin-Pee Dee River Basin (2001)

DWQ staff gave presentations about general water quality in the Yadkin-Pee Dee River basin, basinwide planning and the Wetlands Restoration Program. Participants at each workshop also gave brief presentations about local water quality initiatives. Workshop attendees were asked to discuss the following questions in small groups:

1. What are the main threats to water quality in the Yadkin-Pee Dee River basin?
2. Where are the problem areas or waters?
3. What recommendations do you have for addressing these problems/waters?
4. What local agencies or organizations should be involved in addressing the problems?

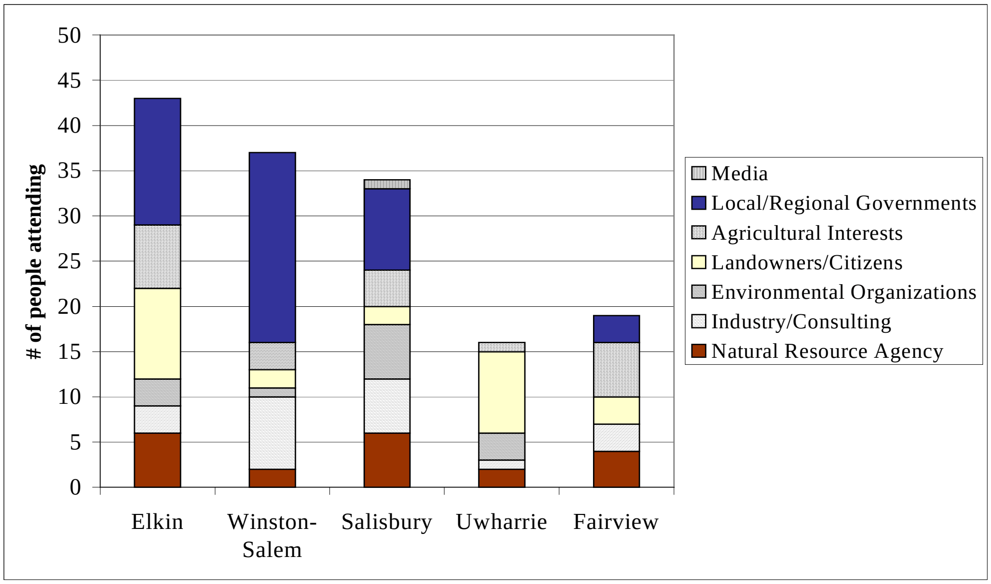


Figure C-2 Total Attendance at Each Yadkin-Pee Dee River Basin Water Quality Workshop by Various Interests (2001)

Good discussion was generated at each workshop, and all of the information was considered and, in many cases, incorporated into this draft plan. Participants expressed concerns about both point and nonpoint sources of pollution throughout the basin. Municipal WWTPs were the most frequently sited point sources. The most frequently sited nonpoint sources were aging collection and septic systems, runoff from developed areas, excess nutrients and excess sediment. Water quality concerns expressed at all five workshops are summarized below. Appendix V contains a detailed summary of the information gathered from workshop participants.

Important Water Quality Issues Basinwide

- Wastewater treatment (collection system failures, problem discharges, failing septic systems).
- Increasing development (increasing impervious surfaces) and runoff from developed areas.
- Excess nutrients (residential lawns, golf courses, agricultural runoff, failing septic and collection systems, and problem discharges).
- Sedimentation and streambank erosion.
- Physical stream/hydrology alterations (channelization, removal of riparian vegetation, development in floodplain areas).
- Water quantity issues (water withdrawals, effects of drought, consumptive use).

Recommendations for Improving Water Quality

- Better management of stormwater from developed areas.
- More enforcement of sediment/erosion control laws and ordinances.
- Widespread implementation of voluntary best management practices; positive encouragement for voluntary participation in agricultural programs.
- Local planning for development including zoning in areas of high projected population growth.

1.2 Federal Initiatives

1.2.1 Clean Water Act – Section 319 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 Section 319 Grant Program, including application deadlines and requests for proposals, are available online at http://h2o.enr.state.nc.us/nps/319.htm.

Currently, there are six projects in the Yadkin-Pee Dee River basin that have been funded (federal Section 319 money must be matched with nonfederal dollars) through the Section 319 base program between 1990 and 2001. Table C-1 summarizes these projects and provides a page reference to more detailed information in Section C.

Table C-1 Clean Water Act Section 319 Projects in the Yadkin-Pee Dee River Basin

Page in Section C	Section 319 Funding	Lead Organization	Project Area	Description
302	$125,000 (FY 1996)	City of Monroe	Richardson Creek watershed in Union County	Extended Detention Wetland Demonstration
296	$37,000 (FY 1999)	Environmental Impact (RC&D), Inc.	Anson, Moore, Montgomery and Richmond counties, focusing on sites along the US-220 corridor between Star and Rockingham	Sandhills Water Quality Longleaf Pine Ecosystem/ Waste Management
291	$43,000 (FY 1999)	NC Wildlife Resources Commission	Stevens Creek watershed (tributary to Goose Creek) in southeastern Mecklenburg County	Stevens Creek Model Watershed
	$200,000 (FY 2001)	NC Cooperative Extension Service (NCSU)	This effort will be focused in the upper Yadkin River watershed (03040101); however, the knowledge gained will be applicable to much of the Southern Appalachian mountain range.	Restoration of Mountain Wetlands and Upper Yadkin Training Center
287	$419,000 (FY 2001)	NC Division of Soil and Water Conservation	Waters throughout the Yadkin-Pee Dee and Cape Fear River basins which are listed on the 2000 303(d) list with agriculture as a potential source of impairment.	Agricultural Sediment Initiative for the Cape Fear and Yadkin-Pee Dee River basins
	$30,000 (FY 2002)	NC Division of Forest Resources	Rendezvous Mountain Educational State Forest in Jones, Purlear and/or Coal Creeks in Wilkes County	Forestry BMP Demonstration
	$25,000	NC Division of Forest Resources	Low water stream crossing	BMP
	$16,000	NC Division of Forest Resources	Stream Restoration	Restoration
296	$120,000 (FY 2003)	Carolina Land and Lakes RC&D, Inc.	Fourth Creek watershed in Iredell and Rowan counties	Fourth Creek TMDL Implementation

1.2.2 USDA – NRCS Environmental Quality Improvement Program (EQIP)

The Environmental Quality Incentives Program provides technical, educational and financial assistance to eligible farmers and ranchers to address soil, water and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers and ranchers in complying with federal and state environmental laws and encourages environmental enhancement. The purposes of the program are achieved through the implementation of a conservation plan which includes structural, vegetative and land management practices on eligible land. Five to ten-year contracts are made with eligible producers. Cost share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management and grazing land management.

Fifty percent of the funding available for this program will be targeted at natural resource concerns relating to livestock production. The program is carried out primarily in priority areas that may be watersheds, regions or multistate areas, and for significant statewide natural resource concerns that are outside of geographic priority areas. Three priority areas in the Yadkin-Pee Dee River basin have been selected for a 2002 EQIP allocation: W. Kerr Scott Reservoir ($243,416), South Yadkin River ($35,000), and Rocky River ($317,565).

NRCS district contacts for the Yadkin-Pee Dee River basin are included on the nonpoint source contact sheet found in Appendix VI or visit the website http://www.nc.nrcs.usda.gov/Programs/eqip.htm for more information.

1.2.3 US Fish and Wildlife Service - Pee Dee National Wildlife Refuge

The US Fish and Wildlife Service (FWS) is the only agency of the US Government whose primary responsibility is fish, wildlife and plant conservation. The service helps protect a healthy environment for people, fish and wildlife and helps Americans conserve and enjoy the outdoors and our living treasures. The service's major responsibilities are for migratory birds, endangered species, certain marine mammals, and freshwater and anadromous fish.

Pee Dee National Wildlife Refuge was established in 1963 and is next to the once-famous "Lockhart Gaddy Wild Goose Refuge". A once avid Canada goose hunter, Mr. Lockardt Gaddy, established a refuge for the birds on his land that grew from two released live decoys to more than 10,000. Bird watchers from all over the United States and several foreign countries visited Gaddy's Refuge to feed and observe the geese. Following the deaths of Mr. and Mrs. Gaddy, the refuge was closed to the public in the early 1970s. In the 1960s, the numbers of both geese and ducks began to decline in south central North Carolina. Fortunately, lands next to the Pee Dee River and Brown Creek offered excellent potential for waterfowl habitat development. With local and state support, the Pee Dee National Refuge was established in October 1963 with the purpose of providing sanctuary and wintering habitat for migratory birds.

Forest cover comprises approximately 6,100 acres of the refuge, including 2,900 acres of hardwood and 3,200 acres of pine and pine-hardwood forests. The upland pine habitat is managed to support the endangered red-cockaded woodpecker, and the mixed pine-hardwood stands are managed to maintain a diversity of species. The bottomland hardwoods are critical areas for neotropical migratory songbirds. The bottomland hardwoods along Brown Creek on the refuge are the largest contiguous tract of their kind in the North Carolina Piedmont and are designated as a State Natural Heritage Area. The refuge also contains approximately 1,500 acres of agricultural and open land managed for waterfowl, including 13 draw down field impoundments that are seasonally flooded to attract thousands of ducks and geese. The diversity of habitats and management programs enables the refuge to support a broad spectrum of wildlife species, including more than 168 birds, 49 amphibians and reptiles, 28 mammals and 20 fish species.

Aquatic Resource Inventory of Brown Creek
The US Fish and Wildlife Service and Carolina Power and Light Company are cost sharing to conduct an aquatic resource inventory in the Brown Creek watershed and in portions of the Pee Dee River between Tillery and Blewett Falls dams and the lower Little River, with priority on the Pee Dee National Wildlife Refuge. The inventory is planned for 2003 and 2004 and will include documentation of diversity, range, distribution and relative abundance of a variety of invertebrate (primarily mussel) and fish species.

Comprehensive Conservation Planning
The US Fish and Wildlife Service is developing a management plan for the Pee Dee River National Wildlife Refuge. This Comprehensive Conservation Plan is required by the National Wildlife Refuge System Improvement Act of 1997. The plan considers both land uses and management practices on the refuge. Public input from those who use or are affected by the refuge is currently being solicited and that input will be used to develop alternatives to current land uses and management practices. The plans will focus on the management of habitat to support the wildlife species for which the refuge was established. They will also address public use, law enforcement, land protection, maintenance and staffing. The plan will project refuge activities for 15 years.

For additional information about this unit of the National Wildlife Refuge System, visit the website at http://peedee.fws.gov/. You may also contact refuge staff by calling (704) 694-4424 or by email peedee@fws.gov.

1.3 State Initiatives

1.3.1 Clean Water Management Trust Fund

North Carolina's Clean Water Management Trust Fund (CWMTF) was established by the General Assembly in 1996 (Article 13A; Chapter 113 of the North Carolina General Statutes). At the end of each fiscal year, 6.5 percent of the unreserved credit balance in North Carolina's General Fund (or a minimum of $30 million) goes into the CWMTF. Revenues from the CWMTF are then allocated in the form of grants to local governments, state agencies and conservation nonprofit organizations to help finance projects that specifically address water pollution problems. The 18-member, independent, CWMTF Board of Trustees has full responsibility over the allocation of moneys from the fund.

The CWMTF funds projects that: 1) enhance or restore degraded waters; 2) protect unpolluted waters; and/or 3) contribute toward a network of riparian buffers and greenways for environmental, educational and recreational benefits. In the Yadkin-Pee Dee River basin, 30 projects have been funded for a total of nearly 30 million dollars ($29,488,600). Figure C-3 presents total basin funding amounts by year and category. Table C-2 lists the individual grants.

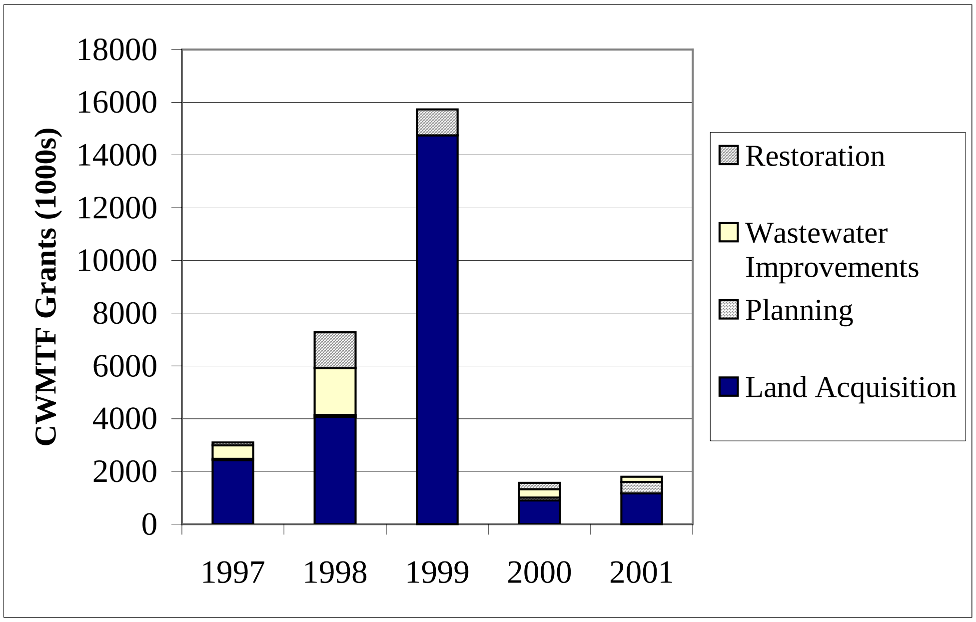


Figure C-3 Clean Water Management Trust Fund Grants Monies Approved (1997-2001) by Category in the Yadkin-Pee Dee River Basin

Several statewide and regional grants which are partially applicable to the Yadkin-Pee Dee River basin have also been funded by the CWMTF, including grants to the Conservation Trust for NC to develop riparian corridor protection plans, the Division of Soil and Water Conservation for the Agriculture Sediment Initiative, and the Center for Geographic Information Analysis for mapping and geographic information management.

For more information about the CWMTF, grant applications or details about a specific grant, call (919) 733-6375 or visit the website at www.cwmtf.net.

Table C-2 Projects in the Yadkin-Pee Dee River Basin Funded by the Clean Water Management Trust Fund (1997-2001)

Fiscal Year	Stream or Watershed	Project	Project Lead	Amount Funded
1997	South Yadkin River	Buffer acquisition	Land Trust for Central NC	$500,000
1997	South Deep Creek Reservoir	Buffer acquisition	Town of Yadkinville	$980,000
1997	Clarke Creek wetlands and rookery	Buffer acquisition	Land Trust for Central NC	$75,000
1997		Planning	Yadkin-Pee Dee River Basin Assoc.	$50,000
1997	Clarks Creek Hamer Creek	Wastewater system improvements	Town of Mount Gilead	$498,000
1997	Salem Creek	Pilot View RC&D	Restoration	$125,000
1997	Mitchell River	Buffer acquisition	Piedmont Land Conservancy	$880,000
1998	Mitchell River	Restoration	Piedmont Land Conservancy	$1,069,000
1998	Free Nancy Branch	Restoration	Pilot View RC&D	$298,000
1998	Goose Creek	Buffer acquisition and planning	NC Wildlife Resources Commission	$1,800,000
1998	Uwharrie River Little River	Coordinate public programs	Land Trust for Central NC	$75,000
1998	Brush Creek	Wastewater system improvements	Town of Wadesboro	$1,760,000
1998	Grants Creek	Buffer acquisition	Yadkin-Pee Dee River Basin Assoc.	$2,273,000
1999	Salem Creek	Restoration	City of Winston-Salem Pilot View RC&D	$985,800
1999	Barnett Branch	Buffer acquisition	NC Wildlife Resources Commission	$563,500
1999	Ramah Creek	Buffer acquisition	Catawba Lands Conservancy	$611,000
1999	Densons Creek Hughs Creek	Buffer acquisition	Town of Troy	$300,000
2000		Buffer acquisition	Archaeological Conservancy	$19,100
2000	South Yadkin River	Planning for buffer acquisition	Land Trust for Central NC	$75,000
2000	South Yadkin River	Buffer acquisition	Pilot View RC&D	$167,000
2000	Yadkin River in Yadkin County	Coordinate public programs	Pilot View RC&D Yadkin SWCD	$24,000
2000	Rocky River	Wastewater system improvements	Town of Stanfield	$300,000
2000	Mitchell River	Livestock exclusion BMPs	Surry SWCD	$250,000
2000	Densons Creek	Buffer acquisition and ultraviolet disinfection	Town of Troy	$708,700
2000	Yadkin River	Planning	Yadkin River Greenway Council	$25,000
2001	South Fork Mitchell R	Planning	Surry SWCD	$434,000
2001	Mulberry Creek	Wastewater system improvements	Town of North Wilkesboro	$200,000
2001	Badin Lake	Buffer acquisition	Environmental Impact (RC&D), Inc.	$708,000
2001	Lake Don T. Howell	Buffer acquisition	Cabarrus County Water and Sewer Authority	$361000
2001		Conservation easements	Blue Ridge Rural Land Trust	$103,000

1.3.2 NC Wetlands Restoration Program

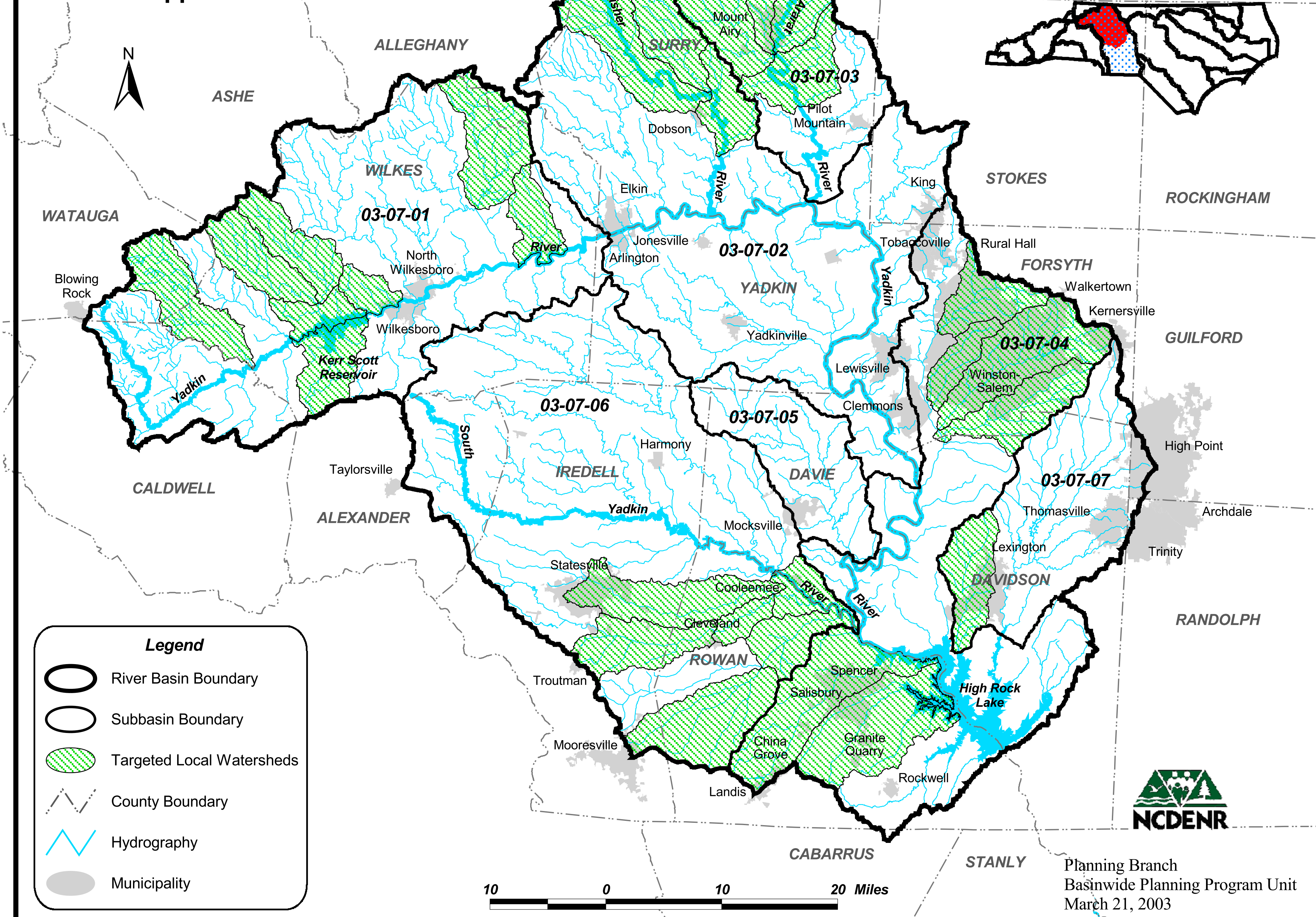
The North Carolina Wetlands Restoration Program (NCWRP) is a nonregulatory program responsible for implementing wetland and stream restoration projects throughout the state. The program's mission is to improve watershed functions including water quality protection, floodwater retention, fisheries and wildlife habitat, and recreational opportunities in North Carolina's 17 river basins. To accomplish this mission, the NCWRP works closely with DWQ and other resource agencies to identify specific 14-digit hydrologic units in each river basin that exhibit both the need and opportunity for wetland, stream and riparian buffer restoration. These watersheds are called Targeted Local Watersheds and receive priority for NCWRP planning and restoration project funds.

Prior to July 2002, the NCWRP developed Watershed Restoration Plans (formerly called Basinwide Wetlands and Riparian Restoration Plans) for each river basin in the state (NCWRP, 1998). Beginning with the Neuse River basin in 2002, the NCWRP began incorporating its Targeted Local Watershed selections and restoration project information into the DWQ basinwide plans. This programmatic change allows the NCWRP to focus more planning effort at the local level where stream and wetland restoration efforts can have the greatest measurable impact.

Targeted Local Watersheds

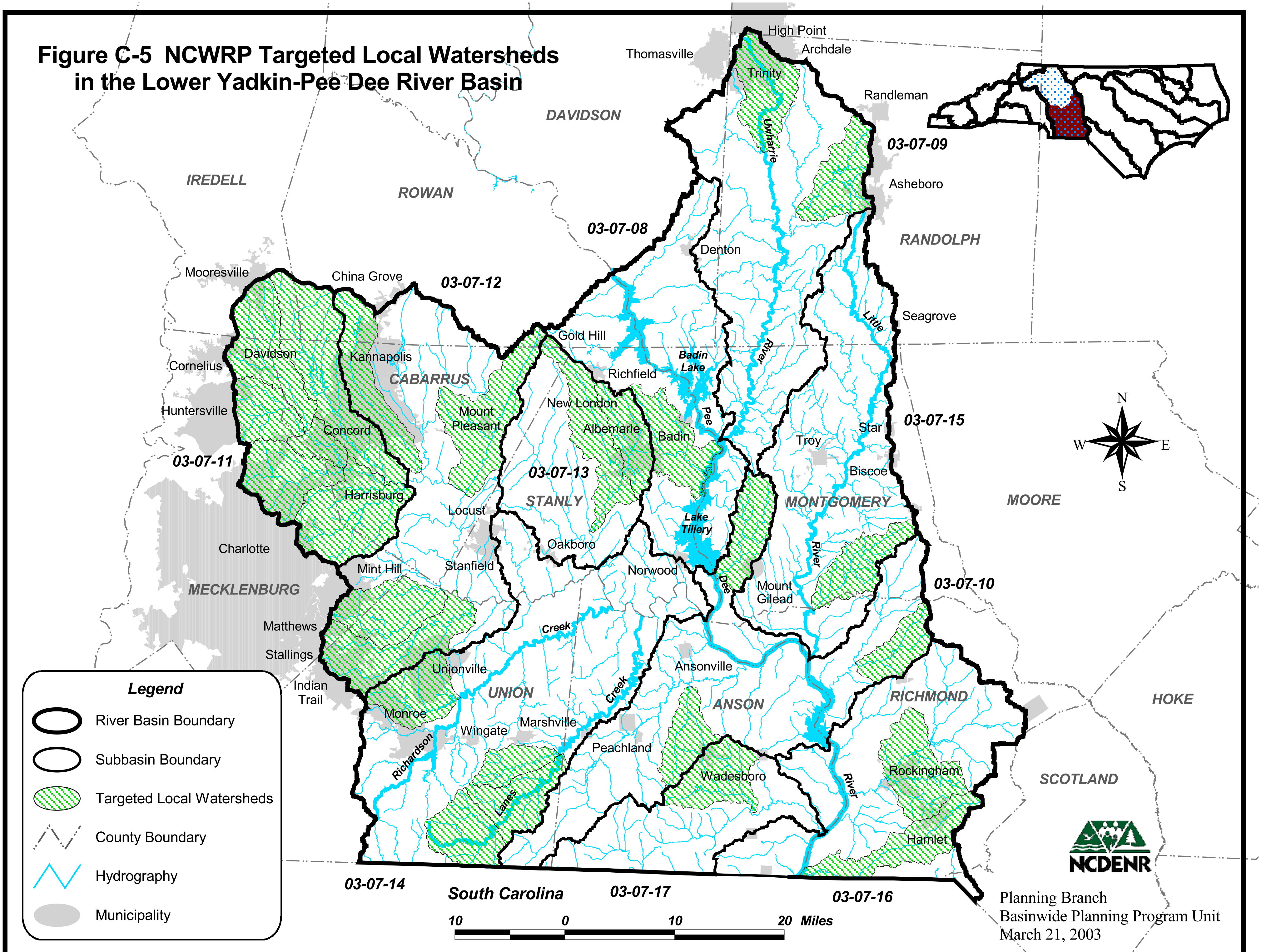
The NCWRP evaluates a variety of data and information on water quality and habitat conditions in each river basin to select Targeted Local Watersheds. However, public comment and the professional judgment of local resource agency staff play a critical role in targeting local watersheds. Figures C-4 and C-5 depict targeted local watersheds within the upper and lower Yadkin-Pee Dee River basin. A summary of the Targeted Local Watersheds selected for the Yadkin-Pee Dee River basin, including the pertinent factors used for selecting those watersheds, is delineated in Table C-3. A description of the factors NCWRP considers in watershed selections follows.

Figure C-4 NCWRP Targeted Local Watersheds in the Upper Yadkin-Pee Dee River Basin



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Figure C-5 NCWRP Targeted Local Watersheds in the Lower Yadkin-Pee Dee River Basin



Planning Branch
Basinwide Planning Program Unit
March 21, 2003

Table C-3 NCWRP Detailed Summary of Targeted Local Watersheds in the Yadkin-Pee Dee River Basin

DWQ Subbasin	Local Watershed (Name and HU Code)	County Municipality	Land Area (sq mi.)	Land Cover C = Cleared D = Developed F = Forested			Impaired Waters?[1]	Public Water Supply[2]	HQW or ORW[3]	Aquatic NHP Element[4]	Existing or Proposed Restoration Projects
				C	D	F					
03-07-01	Elk Creek 03040101010050	Wilkes	50.6	5%	-	95%	Yes	no	yes	no	
	South Prong Lewis Fork 03040101010080	Wilkes	36.3	7%	-	92%	No, but degraded habitat	yes	no	yes	Watershed Plan
	North Prong Lewis Fork 03040101010090	Wilkes	35.1	15%	-	85%	No, but degraded habitat	yes	no	no	Watershed Plan, BMPs Stream/Wetland Restoration
	Lewis Fork 03040101010100	Wilkes	17.7	22%	-	73%	No, but degraded habitat	yes	no	no	Watershed Plan
	Warrior Creek 03040101010110	Wilkes	34.2	15%	-	80%	No, but degraded habitat	yes	no	no	Watershed Plan, BMPs Stream Restoration
	Tucker Hole 03040101020010	Wilkes Wilkesboro	14.0	44%	5%	51%	No, but degraded habitat	yes	no	no	Watershed Plan
	East Prong Roaring River 03040101060030	Wilkes	56.3	19%	-	81%	No, but degraded habitat	no	yes	no	Stream Restoration
	Bugaboo Creek 03040101070010	Wilkes Rhonda	24.6	42%	2%	56%	No, but degraded habitat	yes	no	no	Stream Restoration BMPs
03-07-02	Little Fisher River 03040101090020	Surry	36.5	39%	2%	59%	No, but impacts evident	no	no	no	
	Upper Fisher River 03040101090010	Surry Dobson	60.1	27%	1%	72%	No, but impacts evident	yes	no	yes	
	Middle Fisher River 03040101090030	Surry Dobson	28.1	43%	2%	55%	No, but impacts evident	no	no	no	Stream Restoration
03-07-03	Upper Ararat River 03040101110010	Surry Mt. Airy	22	37%	5%	58%	Yes	yes	no	no	Ag Sediment Initiative
	Middle Ararat 03040101110020	Surry	39	37%	2%	61%	No, but degraded habitat	no	no	no	Ag Sediment Initiative
	Stewarts Creek 03040101100010	Surry Mount Airy	42.0	44%	3%	53%	No	yes	no	no	
	Lovills Creek 03040101100020	Surry Mount Airy	11.0	32%	20%	48%	Yes	yes	no	no	
03-07-04	Mill Creek 03040101170020	Forsyth Winston-Salem	32.7	21%	22%	56%	No, imminent threats noted	no	no	no	
	Silas Creek 03040101170040	Forsyth Winston-Salem	19.5	18%	17%	65%	No, but impacts evident	no	no	no	Stream Restoration
	Salem Creek 03040101170060	Forsyth Winston-Salem	70.1	26%	25%	48%	Yes	yes	no	no	Stream Restoration
	South Fork Muddy Creek 03040101170070	Forsyth Winston-Salem	45.2	39%	5%	55%	No, but impacts evident	no	no	no	

DWQ Subbasin	Local Watershed (Name and HU Code)	County Municipality	Land Area *(sq mi.)*	Land Cover *C = Cleared D = Developed F = Forested*			Impaired Waters?[1]	Public Water Supply[2]	HQW or ORW[3]	Aquatic NHP Element[4]	Existing or Proposed Restoration Projects
				C	D	F					
03-07-04 cont'd	Grants Creek 03040103010010	Rowan Salisbury	83.5	38%	5%	56%	Yes	no	no	no	Buffer Acquisition; Fecal coliform TMDL
	Town Creek 03040103010020	Rowan Salisbury	79.2	33%	4%	62%	Yes	yes	no	no	
03-07-06	Fourth Creek 03040102030020	Rowan/Iredell Statesville	56	42%	7%	51%	Yes	no	no	no	Fecal coliform TMDL
	Middle Third Creek 03040102040030	Rowan/Iredell	41	46%	2%	52%	Yes	no	no	no	
	Lower Third Creek 03040102040040	Rowan/Iredell	12	36%	1%	61%	Yes	no	no	no	
	Lower South Yadkin River 03040102020070	Davie Cooleemee	11.8	34%	1%	64%	No, but impacts evident	no	no	no	Buffer Acquisition
	Lower South Yadkin 03040102030040	Rowan	9.2	38%	-	62%	Yes	no	no	no	Buffer Acquisition
	Upper North Second Creek 03040102050020	Rowan	65.0	58%	1%	41%	Yes	yes	yes	no	
	Lower North Second Creek 03040102050030	Rowan	28.8	36%	1%	62%	Yes	no	no	no	Buffer Acquisition
03-07-07	Swearing Creek 03040103020020	Davidson Lexington	70	39%	10%	51%	Yes	no	no	no	
03-07-08	Mountain & Little Mountain Creeks 03040104010010	Stanly Albemarle	36.7	31%	1%	67	No	yes	no	yes	
03-07-09	Upper Uwharrie River 03040103050010	Randolph Archdale, High Point	41.2	28%	3%	68%	No, but impacts evident	yes	no	yes	
	Back Creek 03040103050050	Randolph Asheboro	37.9	18%	4%	78%	Yes	yes	no	no	
03-07-10	Clarks Creek 03040104020020	Montgomery Mount Gilead	33.3	15%	1%	84%	No, but impacts evident	no	no	yes	
	Goulds Fork 03040104061040	Anson Wadesboro	25.1	9%	1%	89%	No Data	no	no	yes	
	Little Mountain Creek 03040104080020	Richmond Ellerbe, Norman	24.0	30%	1%	69%	No Data	yes	no	no	
03-07-11	Upper Rocky River & Dye Creek 03040105010010	Cabarrus, Iredell, Mecklenburg Mooresville, Davidson	48.5	32%	3%	65%	Yes	no	no	yes	Local Watershed Planning; Fecal coliform TMDL
	Clarke & Ramah Creeks 03040105010020	Cabarrus, Mecklenburg Huntersville, Charlotte	28.2	30%	3%	66%	No, but imminent threats	no	no	yes	Local Watershed Planning
	Rocky River 03040105010030	Cabarrus, Mecklenburg Concord	12.8	26%	17%	57%	Yes	no	no	yes	Possible inclusion in Local Watershed Planning

DWQ Subbasin	Local Watershed (Name and HU Code)	County Municipality	Land Area (sq mi.)	Land Cover C = Cleared D = Developed F = Forested			Impaired Waters?[1]	Public Water Supply[2]	HQW or ORW[3]	Aquatic NHP Element[4]	Existing or Proposed Restoration Projects
				C	D	F					
03-07-11 cont'd	Mallard Creek 03040105010040	Cabarrus, Mecklenburg Charlotte	41.5	22%	15%	63%	No, but imminent threats	no	no	yes	Possible UNCC Stream Restoration; Possible LWP
	Reedy Creek 03040105010050	Cabarrus, Mecklenburg	64.7	29%	4%	67%	No, but impacts evident	no	no	yes	Possible inclusion in LWP
	Coddle Creek 03040105020010	Cabarrus, Iredell, Rowan Concord	81.3	43%	4%	52%	Yes	yes	no	yes	Possible Stream Restoration opportunities; Possible LWP
03-07-12	Irish Buffalo Creek 03040105020040	Rowan, Iredell Kannapolis, Concord	46.2	30%	18%	51%	No, but impacts evident	yes	no	no	Buffer Acquisition
	Dutch Buffalo Creek 03040105020060	Rowan, Iredell suburban Concord	61.4	44%	1%	55%	No, but impacts evident	yes	no	yes	
	Goose Creek 03040105030020	Meckl., Union Charlotte, Mint Hill	42.3	44%	3%	53%	Yes	no	no	yes	WRC Buffers, LWP
	Crooked Creek 03040105040010	Mecklenburg, Union Matthews, Monroe	52.9	56%	9%	35%	Yes	no	no	yes	
03-07-13	Long Creek 03040105060030	Cabarrus, Stanly Albemarle	45.2	54%	1%	44%	No, but impacts evident	no	no	yes	
	Little Long Creek 03040105060040	Stanly Albemarle	29.0	38%	9%	53%	No, but imminent threats	no	no	no	
03-07-14	Upper Lanes Creek (3 HUs) 03040105081010-81030	Union	84.1	64%	--	36%	Yes	no	no	yes	
	Stewarts Creek 03040105070050	Union Monroe	35.3	66%	5%	28%	Yes	yes	no	no	
03-07-15	Cheek Creek 03040104050010	Montgomery	32.6	11%	--	89%	No, but impacts evident	no	no	yes	
03-07-16	Hitchcock Creek 030402010 10020	Richmond Rockingham	46	12%	4%	82%	No	yes	no	yes	
	Marks Creek 03040201010060	Richmond Hamlet	41.2	13%	4%	80%	Not Rated; Impaired in '98	yes	no	yes	Possible Preservation opp.
03-07-17	North Fork Jones & Bailey Creeks 03040201020020	Anson Wadesboro	35.8	15%	3%	81%	No, but imminent threats	yes	no	no	

[1] Stream segments (or entire streams) that do not support their designated uses and are therefore considered Impaired based on declining biological ratings [e.g., due to degraded aquatic habitat] and/or failure to meet NC DWQ water quality standards.

[2] Public Water Supply (WS) = waters used as water supply sources for drinking, culinary or food processing purposes.

[3] ORW = outstanding resource waters. HQW = high quality waters.

[4] Aquatic Natural Heritage elements are special species, habitats or community types identified by the NC Natural Heritage Program and that occur, or spend some portion of their life cycle, in wetlands, streams, riparian areas or estuarine waters.

Water Quality Problems
The NCWRP targets watersheds with existing and potential water quality problems resulting from nonpoint source pollution. To make this determination, the NCWRP evaluates DWQ use support ratings, the 303(d) List and DWQ basinwide assessment reports. NCWRP also uses land cover data to evaluate riparian buffer condition. The NCWRP believes that riparian buffers provide many water quality benefits, and streams that lack a well-vegetated riparian buffer are at greater risk for water quality degradation.

Cumulative Wetland and Stream Impacts
The cumulative impact of many wetland and stream impacts due to farming, development and road building can have a detrimental effect on water quality. The NCWRP is responsible for addressing these cumulative impacts and uses data from the 401 Wetlands Program database to locate those watersheds facing the greatest water quality threats due to unmitigated wetland and stream impacts.

Resource Values
The NCWRP recognizes that resource values beyond water quality should be considered in evaluating the restoration need and opportunity of a watershed. The resource values that the NCWRP considers in targeting local watersheds include public water supply, shellfish areas, outstanding or high quality resource waters, aquatic natural heritage elements and regulated trout waters.

Watershed Approach
The NCWRP watershed approach advocates concentrating multiple water quality projects in one small watershed to yield a greater cumulative impact on water quality. The NCWRP wants to tie wetland and stream restoration projects with other efforts such as agricultural best management practices, stormwater control and riparian buffer preservation to restore watersheds, not just streams and wetlands. For this reason, the NCWRP targets areas with existing watershed planning or protection initiatives already underway.

Partnership Opportunities
To assess the potential for partnership opportunities at the local watershed scale, the NCWRP reviews existing or planned Clean Water Management Trust Fund and Section 319 projects and also considers if a municipality is located in the watershed. Municipal governments often own good sites for water quality improvement projects, but lack the technical expertise and the resources to implement the projects. For these reasons, the NCWRP views municipalities as good potential partners for restoration projects. In addition, many cities are subject to Phase I or Phase II Stormwater Regulations and gather monitoring information that is useful in designing and measuring the long-term benefits of restoration efforts.

Land Cover
Water quality studies suggest that heavily forested watersheds regulate stormwater runoff reducing the likelihood for sever streambank erosion, nutrient runoff and sediment pollution. For this reason, the NCWRP uses the percentage of cleared land in a watershed as an indicator of restoration need and opportunity.

Local Watershed Planning

In 2000, the NCWRP initiated a Local Watershed Planning program to conduct detailed restoration planning in a limited number of Targeted Local Watersheds across the state. These locally-based plans include a comprehensive watershed assessment to identify causes and sources of nonpoint source pollution impairment. The plans also identify and prioritize wetlands areas, stream reaches and riparian buffer areas, and best management practices that will provide significant water quality improvement and other environmental benefits to local watershed. The NCWRP will coordinate with local community groups, local governments and others to develop and implement these plans. There are currently two local watershed planning efforts underway in the Yadkin River basin and they are described below.

Upper Yadkin Local Watershed Plan

The NCWRP initiated this planning effort in November 2001 to address water quality problems in five tributary watersheds to the W. Kerr Scott Reservoir and Yadkin River above the Town of Wilkesboro's Water Filtration Plant. The study area is located in Wilkes County in subbasin 03-07-01. The treatment plant struggles with filtration problems tied to turbidity, algae and high concentrations of total coliform bacteria. Animal agriculture, including poultry and beef cattle, and its associated land application of waste are a potential nonpoint source of nutrients and metals to the reservoir and tributary streams. In addition, many streambanks in the study area lack riparian vegetation and are severely eroding. The NCWRP is working with the Wilkes Soil and Water Conservation District and other local stakeholders to reduce nutrient, sediment and bacteriological pollution to the reservoir and the Yadkin River to ensure long-term protection of these resources for public water supply, recreation and aquatic life. As part of the planning effort, the NCWRP, in cooperation with DWQ, has initiated a comprehensive biological and chemical water quality monitoring program in the planning area. The NCWRP has also hired a technical consultant to conduct a detailed watershed assessment that will assess watershed conditions, estimate pollutant loads and identify, and prioritize restoration opportunities. The technical assessment will be completed in summer 2003 with the restoration plan completed in the fall of 2003.

Lower Yadkin-Pee Dee Local Watershed Plan

At present, the NCWRP's Local Watershed Planning project for the lower Yadkin-Pee Dee region is focused on the upper Rocky River and Clarke Creek watersheds in subbasin 03-07-11. Watershed protection issues within these two local watersheds include: aquatic habitat degradation due to sedimentation and stormwater flows; fecal coliform contamination; stream impacts from roadway construction and new development; and protection of high quality wetland and riparian buffer parcels. A group of local and regional resource agency professionals (primarily from Cabarrus, Iredell and Mecklenburg counties) forms the core of the local stakeholder team working with NCWRP and its consultants on this effort. The group expects to have a Local Watershed Plan drafted up for the two watersheds, including specific recommendations and strategies for watershed protection and improvement, by the summer of 2003.

Beginning in early 2003, four additional local watersheds (Coddle Creek, Mallard Creek, Reedy Creek, and a segment of the Rocky River) are being added to the NCWRP Local Watershed Planning project in the lower Yadkin-Pee Dee region. Together with the upper Rocky River and

Clarke Creek watersheds, these local watersheds constitute the complete area of DWQ subbasin 03-07-11, which forms the entire drainage system of the upper Rocky River. The watershed assessments and local watershed plan development should be completed by the fall of 2004.

Riparian and Wetland Restoration Projects

The NCWRP currently has eight restoration projects completed or underway in the Yadkin-Pee Dee River basin accounting for more than 49,500 feet of stream and 87 acres of buffer restoration. A summary of NCWRP restoration projects in the Yadkin-Pee Dee River basin is presented in Table C-4.

Table C-4 NCWRP Stream, Wetland and Buffer Restoration Projects in the Yadkin-Pee Dee River Basin

Subbasin	Name	County	Scope	Project Size[1]	Status	Partners
03-07-01	Stone Mountain: East Prong Roaring River	Wilkes	Stream restoration	S=10,600 ln. ft B=19.5 acres	Completed 10/2000; Post-construction monitoring	NC Parks and Recreation, NC State University
03-07-01	Little Bugaboo Creek	Wilkes	Stream restoration; cattle exclusion	S=5,500 ln. ft B=9.2 acres	Design complete; construction fall 2002	Wilkes SWCD
03-07-01	Warrior Creek	Wilkes	Stream restoration, cattle exclusion	S=8,500 ln. ft B=6.8 acres	Design underway; construction fall 2002	Wilkes SWCD
03-07-01	Purlear Creek	Wilkes	Stream and wetland restoration; cattle exclusion	S=17,000 ln. ft W=4 acres B=31 acres	Design underway; construction fall 2002	Wilkes SWCD
03-07-03	Beaver Creek	Surry	Stream restoration	S=4,000 ln. ft B=9.2 acres	Design complete; construction fall 2002	Surry SWCD
03-07-04	Brushy Fork	Forsyth	Stream restoration	S=5,000 ln. ft B=6.9 acres	Design underway; construction fall 2002	City of Winston-Salem
03-07-04	Silas Creek	Forsyth	Stream restoration	S=4,500 ln. ft B=5 acres	Design underway; construction fall 2002	City of Winston-Salem
03-07-11	Cato Farm	Mecklenburg	Stream restoration	S=2,400+ ln. ft B=5 acres	Design underway; construction fall 2002	Mecklenburg County; Cabarrus Co. NRCS

[1] S = stream; W = wetlands; B = buffer.

All NCWRP projects are permanently protected by conservation easements and are designed to improve water quality, floodwater retention, habitat or recreational opportunities. NCWRP implements restoration projects in urban and rural areas and on public and private land. Stream restoration projects generally restore dimension (channel width and depth, floodplain access), pattern (meanders) and profile (riffles and pools) to channelized or severely incised streams. Wetland restoration projects restore wet soil conditions and wetland vegetation to areas with wetland soils that have been drained, cleared or otherwise altered to accommodate agriculture or other activities. For a more detailed description of each individual project, visit the NCWRP's website at http://h2o.enr.state.nc.us/wrp/project/projects.htm.

Although the NCWRP is not a grant program, it is always seeking sites that are suitable and feasible for restoration projects. Visit the NCWRP website at http://h2o.enr.state.nc.us/wrp/ to view the criteria NCWRP uses to select restoration projects that provide ecological benefits in a cost-effective manner. If your project meets the site criteria, you can download a site proposal form for an on-site consultation by NCWRP staff.

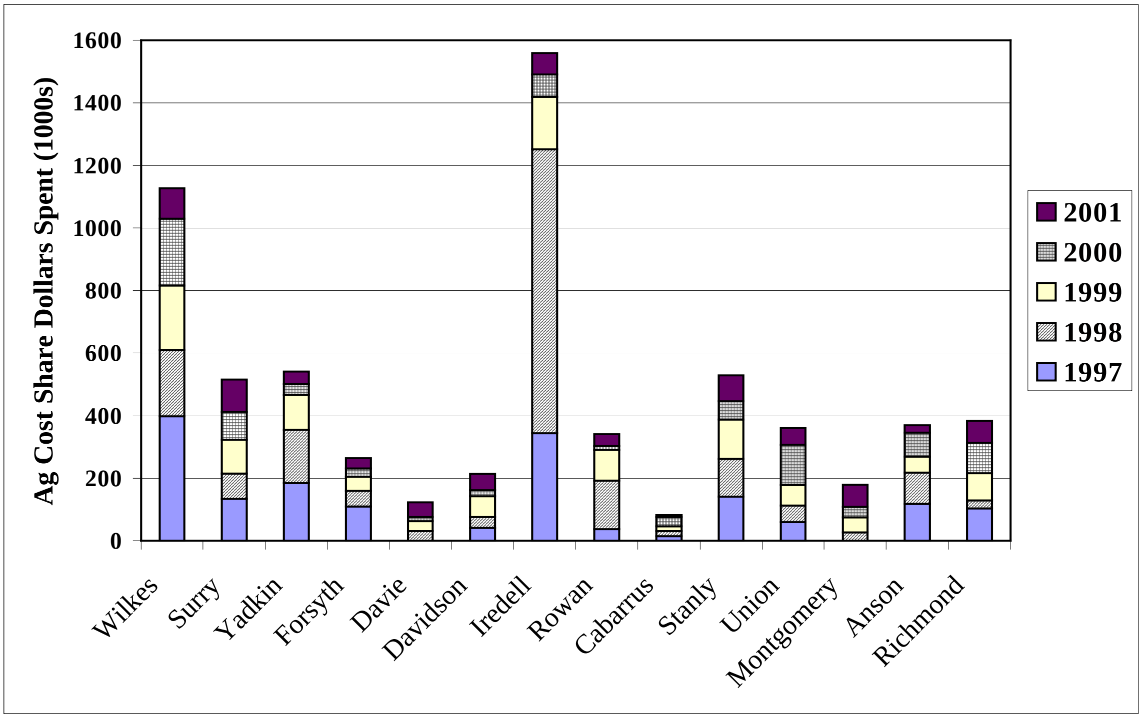
For more information about the NCWRP in the upper portion of the basin, contact Kristin Cozza at (919) 716-1922 or kristin.cozza@ncmail.net; or in the lower portion of the basin, contact Hal Bryson at (919) 715-7452 or hal.bryson@ncmail.net.

1.3.3 NC Agriculture Cost Share Program

The North Carolina Agriculture Cost Share Program was established in 1984 to help reduce the sources of agricultural nonpoint source pollution to the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using Best Management Practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface water and groundwater pollution. The Agriculture Cost Share Program is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned control measures and technical specifications are completed. The annual statewide budget for BMP cost sharing is approximately 6.9 million.

Approximately $6.6 million was expended in the Yadkin-Pee Dee River basin between 1997 and 2001 on a wide variety of nonpoint source pollution reduction projects. Figure C-6 presents Agriculture Cost Share Program dollars (in thousands) spent over the five-year period for counties of which more than 50 percent is located within the Yadkin-Pee Dee River basin.

Soil and Water Conservation District contacts for the Yadkin-Pee Dee River basin are included in Appendix VI or visit the website at http://www.enr.state.nc.us/DSWC/files/acs.htm for more information.



Note: 1997 data were not available for Montgomery County.

Figure C-6 Agriculture Cost Share Program Dollars Expended (1997-2001) for Selected Counties in the Yadkin-Pee Dee River Basin
(Source: NC Division of Soil and Water Conservation)

Agricultural Sediment Initiative

In 2000, the NC Association of Soil and Water Conservation Districts and the NC Soil and Water Conservation Commission initiated an effort to assess stream channels and watersheds of streams on the state's 2000 303(d) list due to sediment where agriculture was included as a potential source. The primary objective of the Agricultural Sediment Initiative is to evaluate 303(d) listed waters in order to assess the severity of sedimention associated with agricultural activities within the watershed and to develop local strategies for addressing sedimentation both in stream and in the watershed. The initiative involved 47 impaired stream segments in 34 counties and 11 river basins.

In 2001, the Soil and Water Conservation Commission allocated $1 million of Agriculture Cost Share Funds to 17 soil and water conservation districts to implement agricultural BMPs in selected watersheds of impaired streams. This funding was complemented by funds from the Clean Water Management Trust Fund ($1 million for agricultural BMPs in the Haw River and Ararat River Watersheds in Alamance and Surry counties) and the EPA 319 Program ($367,900 for agricultural BMPs in six soil and water conservation districts).

Table C-5 summarizes the results of Agricultural Sediment Surveys for 21 watersheds in ten counties in the Yadkin-Pee Dee River basin. District staff requested approximately $24.7 million for restoration and protection work in seven watersheds.

Table C-5 Summary of Agricultural Sediment Initiative Surveys

Stream	County	Problems Identified	Funds Requested by District
Fourth Creek	Iredell	• Streambank erosion • Development causing increased stormwater runoff	$9,600,000
Dye Creek	Iredell	• Streambank erosion • Development causing increased stormwater runoff	$6,600,000
Grants Creek	Rowan	Assessment not yet completed	
Town Creek (from SR 1526 to Crane Creek)	Rowan	Assessment not yet completed	
Brushy Fork	Davidson	• Sand dredging/pumping operations • Concrete block plant-direct discharge to stream • Livestock access to stream • Runoff from cropland • Development/construction • Stream channelization	$3,400,000
Hamby Creek (from source to Rich Fork)	Davidson	• Land-disturbing activities • Construction sites • Some streambank erosion	$10,000
Ararat River	Surry	• Streambank erosion • Land-disturbing activities • Urban development • Road construction	$3,300,000
Faulkner Creek (from source to Ararat River)	Surry	• Lack of riparian buffers • Urban development (encroachment into the floodplain) • Pasturing close/into the creek and tributaries	$1,700,000
Salem Creek (Middle Fork) (from Winston-Salem Water Supply Dam)	Forsyth	• Streambank erosion • Urban development • Road construction	• BMP Cost share • Training • Urban Specialist
Richardson Creek	Union	Assessment not yet completed	
Lanes Creek (from SR 1929 to Marshville)	Union	No problems noted by district personnel	None
Richardson Creek	Anson	Streambank erosion	None
Brown Creek (from NC 74 to Pee Dee River)	Anson	• Prison construction directly above impaired segment • Timber harvesting	None
South Fork Jones Creek (from Anson SR 1821 to Jones Cr)	Anson	No apparent sedimentation problems noted by district staff	None
North Fork Jones Creek	Anson	New residential development	None
McKee Creek	Cabarrus	• Construction on I-485 • Residential development • Erosion from overgrazed horse pasture	None
Clear Creek	Cabarrus	• Residential development • Erosion from overgrazed horse pasture • Construction on NC 24/27	None
McKee Creek	Mecklenburg	• Rapid urban development • Construction of I-485	None
Clear Creek	Mecklenburg	• Rapid urban development • Construction of I-485	None
Rocky River (from source to SR 2420)	Mecklenburg	• Rapid urban development • Construction of I-485	None
Hitchcock Creek	Richmond	Streambank erosion	$89,000

For further information about the Agriculture Sediment Initiative, contact David Williams by calling (919) 715-6103 or by email david.b.williams@ncmail.net.

1.3.4 Watershed Education for Communities and Officials

The Watershed Education for Communities and Officials (WECO) Program is dedicated to facilitating watershed planning at the local level in North Carolina. A program of the North Carolina Cooperative Extension Service at NC State University, WECO brings watershed stakeholders together to find collaborative solutions to water quality problems in their watershed. Current watershed projects have stakeholders seeking ways to restore streams and wetlands, protect an endangered mussel's habitat, and reopen closed shellfish beds for shellfishing.

The overall goal of the program is to improve water quality through education of citizens and government officials who live and work in the watershed. This involves three primary objectives:

- Delivery of technical information and educational material on water quality.
- Empowerment of local citizens by facilitating collaborative, policymaking partnerships at the watershed level between communities, local officials and state agencies.
- Facilitation of local stakeholder development of policy recommendations for the entire watershed to improve water quality.

Program guidelines for WECO projects:

- The project must be locally-empowered and stakeholder-based.
- The project must develop methods for sustainable, collaborative, community-based solutions.
- The project should partner with other state and local agencies to foster watershed-based solutions.
- The project must develop methods for the synthesis, integration and application of multidisciplinary scientific and technical information to support policymaking.
- The project should examine sustainability of policy alternatives by estimating economic costs and benefits.

In the spring of 2000, the North Carolina Wildlife Resources Commission contracted with WECO to conduct a stakeholder effort in the Goose Creek watershed in the Yadkin-Pee Dee River basin. Goose Creek is home to one of the only remaining populations of the Carolina Heelsplitter mussel (*Lasigona decorata*). This species is federally-listed as endangered.
The purpose of the Goose Creek Watershed Advisory Committee was to make recommendations to local governments, state agencies and other appropriate organizations that will protect and improve water quality and wildlife habitat in the Goose Creek watershed. The committee began meeting and investigating water quality problems in Goose Creek in December 2000. Initial meetings explored the art of collaborative problem solving and defined the current status of water quality in Goose Creek.

The committee initially identified five priority goals for the Goose Creek Watershed. At meetings held early in the process, each goal was assigned a priority score by the committee and were ranked as follows:

1. Protect creek from runoff and urbanization.
2. Maintain and improve integrity of the stream.
3. Achieve a rating of "fully supporting" for Goose Creek.
4. Protect open space.
5. Preserve farmland.

WECO developed a "toolkit" document that highlights options for improving water resources in the Goose Creek watershed. The committee used this document to identify options that address the highest priority, which was to protect the creek from runoff and urbanization. The committee's recommendations are detailed in the *Goose Creek Watershed Management Plan* which was finalized in September 2002. Goose Creek is discussed in detail on page 228 of Section B. The committee's recommendations are summarized in Appendix V.

For more information about WECO or to obtain a copy of the Goose Creek Watershed Management Plan, visit the website at http://www.ces.ncsu.edu/depts/agecon/WECO/goosecreek.html. You may also contact Christy Perrin by calling (919) 515-4542 or by email Christy_Perrin@ncsu.edu.

1.3.5 NC Wildlife Resources Commission

The NC Wildlife Resources Commission (NCWRC) Division of Inland Fisheries manages the state's freshwater fisheries through fisheries research, fisheries management, hatchery operation and habitat conservation.

Stevens Creek is a tributary to Goose Creek, an impaired stream in Mecklenburg and Union Counties that harbors a federally endangered aquatic species, the Carolina Heelsplitter, as well as other rare mussels. The Stevens Creek watershed is being developed in residential use as part of Charlotte metropolitan area growth. The development increases stormwater flows and pollutant loading. The NC Wildlife Resources Commission developed a project to reduce peak stormwater and pollutant flows into Stevens Creek, restore degraded streambank, educate the community, and help them take ownership of further restoration and protection efforts for the stream. To reduce peak flows and pollutants, willing residential property owners would be sought at lots adjacent to the stream where bioretention or other stormwater facilities could be retrofitted. Also, a pasture operation in the watershed would be contacted in an effort to fence its cattle out of the stream.

Beginning in September 1999, the project conducted baseline biological, chemical and physical monitoring of Stevens Creek, selected a neighborhood for retrofits, made initial homeowner contacts, and found a willing participant. Finding significant homeowner resistance in the neighborhood, the contractor limited initial installation to one retrofit site, which was installed by June 2000. The contractor has since conducted community meetings and grade school presentations and published articles in the local Mint Hill newsletter. The contractor requested an extension of the project until September 2003 to allow replacement staff to carry out the remaining project activities. This project is funded in part through the Section 319 program (see page 273 for details).

A related NC Wildlife Resources Commission project funded by the Clean Water Management Trust Fund (page 275) characterized stormwater systems in place throughout the entire Goose Creek watershed and evaluated stormwater retrofit and land conservation opportunities to restore and protect water quality.

In addition to these projects which are specific to the Yadkin-Pee Dee River basin, the NCWRC Habitat Conservation Program strives to protect and enhance wildlife and fisheries resources by: 1) assessing impacts and providing recommendations to avoid or minimize those impacts through permit and environmental document review; 2) providing technical guidance regarding habitat conservation to governmental and private agencies and to individuals; 3) restoring degraded streams by correcting problems in riparian corridors that have resulted in poor water quality, sedimentation, unstable stream banks, loss of aquatic habitat and diminished fish communities; and 4) encouraging adequate mitigation for losses of fish, wildlife, their habitats, and uses thereof resulting from land and water developments.

For more information, contact the Division of Inland Fisheries by calling (919) 733-3633 ext. 281 or visit the NC Wildlife Resources Commission website at http://www.state.nc.us/Wildlife/.

1.3.6 NC Construction Grants and Loans Program

The NC Construction Grants and Loans Section provides grants and loans to local government agencies for the construction, upgrade and expansion of wastewater collection and treatment systems. As a financial resource, the section administers two major programs that assist local governments, the federally funded Clean Water State Revolving Fund (SRF) Program and the NC Clean Water Revolving Loan and Grant Program. These programs can provide both low interest loan and grant funds for wastewater treatment projects.

As a technical resource, the Construction Grants and Loans Section, in conjunction with the Environmental Protection Agency, has initiated the Municipal Compliance Initiatives Program. It is a free technical assistance program to identify wastewater treatment facilities that are declining but not yet out of compliance. A team of engineers, operations experts and managers from the section work with local officials to analyze the facility's design and operation.

For more information, visit the website at http://www.nccgl.net/. You may also call (919) 715-6212 or email Bobby.Blowe@ncmail.net.

1.3.7 South Carolina Department of Health and Environmental Control

In 1991, the South Carolina Department of Health and Environmental Control (SCDHEC) Bureau implemented the Watershed Water Quality Management Strategy in order to more efficiently protect and improve the quality of South Carolina's surface water resources. This management strategy recognizes the interdependence of water quality and all the activities that occur in the associated drainage basin. Under the watershed management approach, monitoring, assessment, problem identification and prioritization, water quality modeling, planning, permitting and other SCDHEC initiatives are coordinated by basin. A watershed water quality assessment document is produced for each basin on a five-year rotating schedule. The first Watershed Water Quality Assessment for the Pee Dee River basin was published in May 2000 and will be updated on a five-year rotational basis.

To obtain a copy of the Watershed Water Quality Assessment or for further information about water quality in the Pee Dee River basin in South Carolina, contact Colt Bowles at (803) 898-4142 or by email bowlescb@columb32.dhec.state.sc.us or visit the website at http://www.scdhec.net/water.

1.3.8 Rendezvous Mountain Educational State Forest

Rendezvous Mountain Educational State Forest in Wilkes County, managed by the NC Division of Forest Resources, encompasses over 3,000 acres of headwaters in the Purlear Creek subwatershed, which is a portion of the North Prong Lewis Fork watershed. Stream restoration funding has tentatively been encumbered for performing trial tests of new "sand wand" technology on a section of first-order stream on the forest property. This type of technology is useful in clearing out sediment from the stream channel that was deposited by historically poor logging practices, thought to have occurred nearly 60 or more years ago. The stream restoration project is scheduled to occur during the summer of 2003. Funding for this technology demonstration is provided by a grant award from the USEPA's Nonpoint Source Pollution Management Program.

1.3.9 Cabarrus Soil and Water Conservation District/Cabarrus County Watershed Improvement Commission

A three-member Watershed Improvement Commission, appointed by the Board of Commissioners, is charged with oversight of water quality and water quantity initiatives. Cabarrus Soil and Water Conservation District provides staff assistance to this watershed commission. Monthly commission meetings provide forums for coordinating water quality management efforts by local planners, water and sewer system managers, emergency management officials, and erosion control and stormwater program staff.

This commission installed and maintains water supply watershed boundary signs around the county's three drinking water reservoirs. One hundred signs are posted with the message "Water Supply Area, Yadkin River Basin, Spill Response 911". These signs are in Cabarrus, Iredell and Rowan counties along roads at boundaries for water supply reservoirs on Coddle Creek, Black Run/Dutch Buffalo Creek, and Chambers Branch/Patterson Branch/Cold Water Creek.

A planning group that was guided by the 1998 basinwide plan selected Clarke Creek as one of two streams in the lower Yadkin-Pee DeeRiver basin for focused efforts to protect and restore water quality. Cabarrus Soil and Water Conservation District and Cabarrus County Watershed Improvement Commission convened a steering committee that obtained a Clean Water Management Trust Fund grant to identify water quality problems in the watershed. The Clarke Creek steering committee merged into the Upper Rocky River Watershed planning effort initiated by the state Wetland Restoration Program in 2002. The Conservation District and Watershed Commission has continued to provide leadership for the Upper Rocky River Watershed planning group.

Agricultural sediment surveys have been conducted in the watersheds of two streams on the state's 303d list - Clear Creek and McKee Creek. The conservation district is assisting the state with development of fecal coliform TMDL's for these two creeks, including hosting public hearings on development of the TMDL's.

Adoption of a countywide erosion and sedimentation control ordinance was initiated by the Conservation District and Watershed Commission. The commission holds public hearings on appeals of fines levied for violations of this ordinance and provides oversight of the county's River Stream Overlay Zone stream buffer requirements. This buffer is a vegetated zone extending between 50 and 120 feet from the top of the bank on all perennial streams.

The conservation district contracted with Wildlife Resource Commission (WRC) aquatic biologists to survey selected streams as part of the natural heritage inventory conducted for the state Natural Heritage Program. Riparian corridors were collectively identified as locally important natural areas. The WRC is following up on this survey by introducing freshwater mussels into streams with suitable habitat and water quality where no mussels are present.

The conservation district maintains a database of over 70 local streams and is coordinating efforts to place stream identification signs at road crossings. The district also coordinates stream adoption in the county through the state Stream Watch Program. These groups are also being encouraged to participate in the annual North Carolina Big Sweep waterway cleanup day, the Oceans Conservancy's Storm Drain Sentries Program, and the annual Great American Secchi Dip-In water quality monitoring program. The Conservation District and Watershed Commission has coordinated Big Sweep in Cabarrus County since 1992.

Conservation education efforts in Cabarrus County that benefit water quality also include essay, poster and public speaking contests; Enviroscape; Envirothon; Project WET; and Soil and Water Stewardship Week. The conservation district staff includes a state-certified environmental educator.

1.4 Regional Initiatives

1.4.1 The LandTrust for Central North Carolina

The LandTrust for Central North Carolina is a nonprofit corporation with a volunteer Board of Directors from throughout a ten-county region (Anson, Cabarrus, Davidson, Davie, Iredell, Montgomery, Randolph, Richmond, Rowan and Stanly). Since 1995, The LandTrust has made a major impact in the Yadkin-Pee Dee River basin, protecting thousands of acres including natural areas, rivers and streams, wildlife habitats, farmland and historic sites. Conservation easements have been acquired on the nearly 2000-acre Cooleemee Plantation (a national historic landmark), miles of river front on the Yadkin, Pee Dee and Rocky Rivers, important lands adjacent to Morrow Mountain State Park and the Uwharrie National Forest, High Rock Lake Preserve, and the Clarke Creek Rookery, just to name a few. The LandTrust also:

- Educates landowners, public officials, opinion leaders and others on the need to preserve lands and natural areas.
- Serves as resource center and clearinghouse for conservation efforts in the region.

- Encourages regional planning and ensures that conservation of natural and cultural resources are included.
- Acts as a hub when organizations and public agencies collaborate on a preservation project.
- Lends its grant-writing expertise to obtain funds for conservation efforts.
- Spearheads efforts by adjoining landowners to create wildlife protection areas or to engage in other cooperative efforts.
- Works closely with other land trusts in the state to coordinate efforts, share best practices and promote conservation.

<u>South Yadkin River/Yadkin River Corridor Conservation Plan</u>

The LandTrust for Central NC (LTCNC) received a grant from the Conservation Trust for North Carolina and the Clean Water Management Trust Fund to develop a report evaluating the conservation needs and opportunities along the lower South Yadkin River and a section of the Yadkin River above High Rock Lake. The plan is complete and has been integrated into the daily efforts of LTCNC while pursuing conservation opportunities in the Yadkin-Pee Dee River basin.

For additional information about The LandTrust for Central North Carolina, call (704) 647-0302 or email Executive Director, Jason Wasler, jason@landtrustcnc.org. You may also visit the website at http://www.landtrustcnc.org/.

1.4.2 Piedmont Land Conservancy

The Piedmont Land Conservancy (PLC) is a nonprofit organization dedicated to preserving natural and scenic lands, farms and open spaces in the piedmont of North Carolina to enrich the quality of life for our communities and for future generations. The PLC represents nine North Carolina counties: Alamance, Caswell, Forsyth, Guilford, Randolph, Rockingham, Stokes, Surry and Yadkin. PLC strives toward the following goals:

- To acquire and manage natural areas in piedmont North Carolina.
- To protect endangered or significant native species of flora and fauna and to preserve areas with significant topographical features.
- To maintain the ecological integrity of the region, including its air and water quality and biological diversity.
- To fulfill the human need for scenic land and open space to provide opportunities for learning from and enjoying the natural world.
- To enhance and buffer our communities.

PLC is not affiliated with any other organization and is supported entirely by members and friends in the piedmont and has more than 600 members. It is the only local land trust serving the Piedmont Triad region of North Carolina. PLC builds partnerships with public agencies, private organizations, landowners and individuals to save the best of our natural heritage. Since incorporation, the PLC has protected more than 3,800 acres of land.

Mitchell River Watershed Protection Project

Awarded a $1.9 million grant from the Clean Water Management Trust Fund, PLC is working with public and private agencies, private organizations and landowners to secure permanent protection along the Mitchell River, a headwater tributary of the Yadkin River and the region's only Outstanding Resource Waters. The grant monies are being used for a variety of projects within the Mitchell River watershed including conducting a riparian corridor inventory and developing a watershed protection plan. The purpose of the plan is to target critical areas for protection and restoration efforts.

For additional information about the Piedmont Land Conservancy, call (336) 691-0088 or email info@piedmontland.org. You may also visit the website at http://www.piedmontland.org/.

1.4.3 Yadkin-Pee Dee River Basin Association

The Yadkin-Pee Dee River Basin Association was formed in 1997 to protect and improve water quality in the North Carolina portion of the basin and to represent the interests of NPDES permitted dischargers (WWTPs). Over a five-year period, the association has accomplished the following:

- Successfully developed and implemented a comprehensive water quality monitoring program.
- Obtained significant funding from the Clean Water Management Trust Fund to assist with the restoration of impaired waters in the basin.
- Represented its members in discussions with DWQ, including effectively making the case against any nutrient management strategy that unfairly singles out point sources.
- Served as a clearinghouse and forum for the dissemination of information to and among its members.
- Developed relationships with other organizations and stakeholders in the basin.

Future initiatives include finding ways to increase communication between stakeholders across the basin, working with DWQ and others to develop and implement plans for the restoration of impaired waters, assist association members in identifying and addressing NPDES permit compliance problems, and continuing to stregthen and improve the monitoring program.

For more information about the Yadkin-Pee Dee River Basin Association, contact David Saunders by calling (336) 737-8418 or by email davids@cityofws.org.

1.4.4 Resource Conservation and Development (RC&D)

The mission of RC&D is to build public and private partnerships, create financial leverage, and increase the capacity of communities to meet their locally identified resource conservation and development needs. This is achieved by engaging the interests of the public and private sectors to balance the conservation and development of human and natural resources; and creating efficient community and natural resource management by bringing together cooperative action for a common benefit.

RC&D provides technical assistance with project planning, design and engineering. RC&D staff provides project planning assistance; however, RC&D coordinates assistance with NRCS, Soil and Water Conservation Districts, other agencies, private organizations and professionals to provide on the ground support. RC&D provides financial assistance for project implementation, grant writing and counseling assistance with public, private and corporate grant programs. The RC&D Council can sponsor project grants and administer project grant funds if needed.

Carolina Land and Lakes

Carolina Land and Lakes RC&D, Inc. was incorporated in 2001 as a local nonprofit, 501(c)(3) tax-exempt organization which serves Alexander, Burke, Caldwell, Catawba and Iredell counties in North Carolina.

The DWQ Nonpoint Source Pollution Program is working with Carolina Land and Lakes RC&D, Inc. and the Iredell Soil and Water Conservation District to implement management strategies outlined in the Fourth Creek fecal coliform TMDL. The main goal of the Fourth Creek TMDL Implementation Project will be to reduce the fecal coliform load to Fourth Creek from agricultural sources by excluding grazing cattle from the stream.

Results of modeling during DWQ's TMDL study suggest that in order to attain water quality standards, fecal coliform loading from grazing has to be reduced by 40-50 percent during dry weather conditions and by 95-98 percent during wet weather conditions. Such substantial reductions can be achieved by completely eliminating free access that cattle have to the stream and providing alternative watering sources. The project will include construction of the fences along the streambanks, reestablishing vegetation in the buffer zone to reduce erosion, construction of the stream crossing and installation of the water wells and waterers with associated infrastructure.

The Carolina Land and Lakes RC&D office is located in Conover, NC. For more information, call Wendell Kirkham, Council Chair, at (828) 464-5559.

Environmental Impact

Environmental Impact RC&D, Inc. was incorporated in 1988 as a local nonprofit, 501(c)(3) tax exempt organization which serves Anson, Montgomery, Moore and Richmond counties in North Carolina. The mission and purpose of Environmental Impact (RC&D), Inc. is to promote environmental quality and conservation while working to ensure sustained economic development, thereby, improving the economic opportunities of the people within the Environmental Impact RC&D project area. The mission is achieved by bringing local people and organizations together to identify natural resource problems and opportunities and seek solutions to those problems without sacrificing economic growth or environmental quality.

Counties in the lower Yadkin-Pee Dee River basin are some of the largest poultry producing counties in the state. Environmental Impact RC&D recognized that a surplus of nutrients in waste generated by these operations relative to crop needs in the area has generated concerns over improper storage and disposal, and over phosphorus and metal build-up in receiving soils. At the same time, a burgeoning industry in pine straw raised the need for nutrient additions to harvested systems. Environmental Impact developed a demonstration program to evaluate the feasibility of applying poultry waste to longleaf pine communities to evaluate the potential for addressing both of these issues.

The RC&D established 59 small plots of ¼ to ½ acre on nine farms in Montgomery, Moore and Richmond counties in January 2000. Poultry litter was applied at three different rates for nitrogen – 40, 80 and 120 lb. N/ac/yr. Monitoring of nutrient levels for two to three years was to include shallow groundwater collected in piezometers in addition to soil and foliage sampling. Tree growth and straw production were also followed. This project was funded in part through the Section 319 program (see page 273 for details). The contractor had not provided an analysis of the data as of November 2002.

Other projects affecting the Yadkin-Pee Dee River basin include Geographical Information Systems (GIS) work on a utility information system for the Town of Star, located in Montgomery County, and an on-farm composting demonstration project.

The Environmental Impact RC&D office is located in Aberdeen, NC. For more information, visit the website at http://www.environmentalimpact-rcd.com/. You may also contact R. Lynn McCaskill by calling (910) 944-4787 or by email eircd@utinet.net.

Pilot View

The Pilot View Resource Conservation and Development, Inc. is a 501(c)(3) nonprofit organization supported nationally by USDA through the Natural Resources Conservation Service, and locally by the Boards of County Commissioners and the County Soil and Water Conservation Districts in Davie, Forsyth, Stokes, Surry and Yadkin counties. Organized in 1991, Pilot View RC&D, Inc. celebrated its ten-year anniversary during this basinwide planning cycle.

The Pilot View RC&D office is located in Winston-Salem, NC. For more information, visit the website at http://www.rcdnet.org/PILOTVIEWINC/. You may also contact Charles Anderson at (336) 750-0522 or by email pvica@triad.rr.com.

1.4.5 Yadkin River Basin Commission

For decades, the Yadkin River Valley remained essentially unchanged. However, throughout the 1980s, the river increasingly became the object of economic interests. It is now a magnet for new development and an increasingly important regional source of sand, bringing new treatment demands for drinking water and waste disposal. These issues are complicated by various municipal and county boundaries along the river. Residents in one county are often unaware of river-related plans in adjacent counties until they are affected by them. In 1991, county commissioners from Davie, Forsyth and Yadkin counties chartered the Yadkin River Commission which strives to overcome these problems by taking a cooperative, regional approach to issues affecting the Yadkin River Valley.

Currently, county commissioners from Davie, Forsyth, Surry and Yadkin counties appoint citizens with a variety of public and private river interests to serve on a seven-member board.

The board meets quarterly on the third Thursday of the month and special meetings are scheduled as needed.

In addition to an educational newsletter series, members began producing their second documentary video in 2001. The commission anticipates that the video will be ready for distribution in 2003. The video discusses:

- how the Yadkin River serves as a significant source of drinking water for many counties;
- harmful effects of sedimentation and erosion; and
- how local residents can use some simple techniques to protect the river.

For further information about Yadkin River Commission projects, visit the website at http://www.co.forsyth.nc.us/ccpb/YRC_page.htm. You may also contact Chris Murphy at the Winston-Salem/Forysth City-County Planning Department by calling (336) 727-2087 or by email chrism@cityofws.org.

1.5 Local Government Initiatives

1.5.1 Charlotte-Mecklenburg

The key component in Charlotte's and Mecklenburg County's efforts to restore the quality and usability of its surface water resources is the Surface Water Improvement and Management (SWIM) Program which was established by the Mecklenburg County Department of Environmental Protection (MCDEP) in November 1995. The objective of this program is to produce measurably cleaner surface waters in Mecklenburg County and restore the usability of streams. The program utilizes a basin planning approach and focuses on:

- increasing public awareness of surface water quality conditions and current stream usability;
- engaging the public's direct involvement in efforts to restore streams;
- promoting intergovernmental cooperation and coordination to address the wide ranging and complex planning and development issues necessary to resolve the many problems associated with the use and protection of our surface waters;
- measuring water quality conditions and identifying specific pollution problems;
- identifying stakeholders and obtaining their direct input;
- participating in the development of basin plans designed to restore water quality and usability; and
- implementing activities identified in the basin plans.

Water Quality Index
To assess water quality in Mecklenburg County streams, MCDEP is using a general water quality index which includes nine water quality parameters: Biochemical Oxygen Demand, Dissolved Oxygen, Fecal Coliform Bacteria, pH, Temperature, Total Nitrate, Total Phosphorus, Total Solids and Turbidity. These parameters were selected through the combined judgment of a panel of water quality experts residing throughout the country. The lake water quality index includes the following nine parameters: Chlorophyll *a*, Dissolved Oxygen, pH, Secchi Disk

Depth, Specific Conductivity, Temperature, Total Alkalinity, Total Nitrate and Total Phosphorus.

MCDEP is collecting water samples from 40 stream sites and 17 lake sites each month. These water samples are analyzed by MCDEP's laboratory. The data generated from these sampling activities are used to produce the water quality index monthly throughout the year. These index values are used by MCDEP to compare stream and lake water quality conditions over space and time as well as to establish trends in water quality and to evaluate pollution prevention programs.

The Water Quality Index represents water quality on a scale of 0 to 100 with 0-25 representing Poor water quality; 26-50 Fair water quality; 51-70 Average water quality; 71-90 Good water quality; and 91-100 Excellent water quality. Both Excellent and Good water quality lakes and streams support a high diversity of aquatic life and are suitable for all forms of recreation.

Average water quality lakes and streams exhibit signs of stress including reduced diversity of aquatic organisms, increased nutrients and increased algae growth. Fair water quality lakes and streams support a low diversity of aquatic life and are experiencing water quality problems from point and nonpoint sources of pollution. Poor water quality lakes and streams may support only a limited number of organisms that are very tolerant to pollution and have abundant water quality problems. Poor water quality is not suitable for recreational activities involving frequent human body contact (i.e., swimming, wading, skiing, etc.).

Stream Buffer Ordinances

The purpose of the SWIM stream buffer network in Charlotte and Mecklenburg County is to ensure that the stream and adjacent lands will fulfill natural functions. Local ordinances for the protection of riparian buffer areas of varying widths, based on watershed drainage area, are currently being implemented throughout Mecklenburg County. The ordinances can be viewed on the following website at http://www.co.mecklenburg.nc.us/coenv/Water/swim_title_page.htm.

For more information about SWIM programs or stream buffer ordinances in Charlotte-Mecklenburg, contact Water Quality Program Manager, Rusty Rozzelle, at (704) 336-5500 or by email rozzers@co.mecklenburg.nc.us. You may also visit the Department of Environmental Protection website at http://www.co.mecklenburg.nc.us/coenv/Inside.htm.

1.5.2 Forsyth County Environmental Affairs Department

The Environmental Affairs Department's (EAD) Water Quality Program is designed to protect and evaluate the surface water quality of the county by addressing water quality problems relayed to us by citizens and by operating a stream monitoring program. Since 1988, Forsyth County has developed a countywide water quality monitoring program that serves as an informational database from which the impact of urban growth and other activities can be assessed. Beginning in 1996, EAD contracted with the Environmental Quality Institute (EQI) at the University of North Carolina-Asheville to perform the laboratory analysis and provide an annual summary for samples collected by the department at 12 sites throughout the county. Streams are monitored eight times annually with the aim of obtaining equal samples from base flow (no rain in more than 72 hours) and storm flow (attempting to sample within the first two hours of a storm event with greater than 0.1 inch of rainfall) conditions. All samples are analyzed for 16 parameters using EPA approved methods, as well as for a number of volatile organic compounds.

The EAD also has a Memorandum of Understanding with the NC Department of Environment and Natural Resources (DENR) to act as first contact agents for investigations involving nonemergency citizen complaints. Many stream and lake related pollution problems are caused accidentally, naturally or unwittingly. In many cases, the problems can be resolved promptly during EAD's initial on-site visit. When enforcement actions are required, EAD turns its evidence over to the proper agency for their further investigation and enforcement action. EAD's Water Quality Division is focused on local water quality issues and the resolution of stream quality problems. We are dedicated to improving the quality of our streams, rivers, lakes, and downstream reservoirs and estuaries. Forsyth County's watershed system impacts communities downstream in three separate river basins: the Yadkin/Pee-Dee River basin, the Roanoke River basin and the Cape Fear River basin. Approximately 76 percent of Forsyth County is in the Yadkin/Pee-Dee River basin.

1.5.3 Surry County Soil and Water Conservation District

Soil and Water Conservation Districts are organized to plan and carry out a conservation program that local people need and want. District affairs are managed by individuals and groups involved in a coordinated conservation program, involving resources from local, state and federal agencies. In this way, governmental assistance in conservation practices remains under local control. The Surry Soil and Water Conservation District works throughout Surry County to prevent soil loss and protect watersheds.

South Fork Mitchell River Riparian Corridor Assessment

In 2001, the Surry County Soil and Water Conservation District received $434,000 from the Clean Water Management Trust Fund for an assessment of the South Fork Mitchell River riparian corridor. The assessment was conducted in 2002 to assess the morphological, riparian and aquatic habitat conditions of selected streams within the South Fork Mitchell River watershed and to determine potential restoration and preservation sites. Data were collected along 20 miles of stream within the South Fork Mitchell River watershed and provide specific information regarding the condition of the watershed and potential methods to improve water quality. These stream-specific data and information are summarized on page 132 of Section B.

Stream restoration, exotic vegetation removal, planting and agricultural best management practices are all specific recommend management actions aimed at improving water quality. Stream restoration is recommended for 37 sites within the study area. It is estimated, based on a preliminary cost analysis, that the total cost to complete all of the recommended actions presented in this report is approximately six million dollars. A preliminary analysis indicates that stream restoration accounts for 78 percent of the total cost to complete all of the recommended actions presented in this report.

The data provided in the report, along with the Mitchell River Watershed Protection Plan which was developed by the Piedmont Land Conservancy (discussed on page 295) in 2001, provide the necessary information to implement a long-term restoration initiative to improve water quality in the South Fork Mitchell River watershed. A comprehensive field assessment methodology such as the Riparian Corridor Assessment provided the necessary data to plan restoration actions over a large study area. Progress documented through measurable milestones and a timeframe for reaching them is essential to the success of future projects in the watershed. Flexible policies, understandings between agencies and landowners, and formal agreements between all stakeholders are key tools of watershed management. Developing an interface with the public through demonstration projects and regular open forum meetings will increase the likelihood of community support for water quality improvement projects within the South Fork Mitchell River watershed.

For more information about the Surry County Soil and Water Conservation District's watershed programs, contact Julie Elmore by calling (336) 386-8751, Ext. 3 or by email julia_elmore@hotmail.com.

1.5.4 City of Monroe

The City of Monroe in Union County created a constructed wetland demonstration project to evaluate its effectiveness as an alternative to wet detention ponds under the state's water supply watershed regulations. The 0.3-acre wetland treats the runoff from a 30-acre drainage area in the Lake Twitty water supply watershed. At the time of construction, the watershed was predominantly rural in nature; however, rapid urbanization of the Highway 74 corridor from Charlotte was underway, and high density development was planned for portions of the watershed. The constructed wetland was to be monitored and compared to wet detention pond performance.

Wetland construction was completed in November 1997, and monitoring was conducted from July 1998 through June 1999. Automated, flow-weighted sampling was performed at inlet and outlet, yielding storm-related pollutant removal efficiencies. Final monitoring results were not provided by the contractor; however, the initial six months of data were reported. For the June-December period, the wetland system showed lower removal efficiencies for Total Suspended Solids and several metals compared to values compiled nationwide for wet ponds. The wetland produced comparable removal efficiencies to wet ponds for nutrients. The contractor estimated that the wetland system required half the area of a wet detention pond for treatment of the same contributing area. This project was funded in part through the Section 319 program (see page 273 for details).

1.6 Citizen Efforts

1.6.1 Mitchell River Watershed Coalition

The Mitchell River Watershed Coalition was organized in September of 1997. It is made up of 18 local, state and federal agencies and organizations, and includes a number of landowners on its steering committee. The group came together as a result of a local initiative to have the Mitchell River reclassified as Outstanding Resource Waters in the late 1980s. However, there is continuing concern for the health of the river and its watershed and a desire to see water quality improvements in the South Fork Mitchell River.

The coalition has been successful in working with local landowners and gaining financial and technical support for education and the implementation of a variety of BMPs. Education outreach includes a number of brochures, handouts and newsletters aimed at helping landowners protect and improve water quality. The *Stream Notes* series on sediment, streambank erosion and riparian buffers has been a very useful tool. Workshops conducted by the coalition range from landowner tours of local demonstration sites to teaching sessions on conservation easements for attorneys, appraisers and realtors. The coalition also sponsored the first NC Stream Restoration Conference in 1998.

Currently, the coalition's primary focus is BMP implementation and land protection. The Surry Soil and Water Conservation District (page 301) has ten stream restoration projects completed or underway for a total of over 15,000 feet of restored stream. A number of livestock BMP systems have been installed or are under contract to be installed. Before and after fecal coliform monitoring is being done to document their effectiveness. Piedmont Land Conservancy (295) has a total of 3,052 acres of land in the watershed protected by conservation easement with work on several additional farms underway at this time. This work will continue with the recent commitment of grant funds for stream restoration and land protection efforts in the watershed.

For more information about the Mitchell River Watershed Coalition, contact J. Richard Everhart by email richard.everhart@nc.usda.gov or by calling (336) 386-8751, Ext. 3.

1.6.2 Yadkin-Pee Dee Lakes Project

In 1991, sprawling development had begun to encroach from the surrounding cities along Interstate 85 and Interstate 40 into the rural counties of the Yadkin-Pee Dee River basin. Historically divided by the river, residents of Rowan, Davidson, Randolph, Stanly, Montgomery, Anson and Richmond counties united to begin a strategic plan for balanced growth. This plan called for preservation of a shared quality of life defined by the river, the forests, and the open landscape and development of the region's economy through eco-tourism, outdoor recreation, heritage tourism and small business development.

In 1994, The Yadkin-Pee Dee Lakes Project was formally incorporated as a private, nonprofit organization to implement the plan. Since then, the project has been actively involved in working with public and private interests in finding ways for the region to grow its economy while preserving its natural and cultural assets. The purpose of The Yadkin-Pee Dee Lakes Project is to serve as a clearinghouse for information on sustainable economic development, support regional projects, garner public support for and understanding of long-term, regional planning, and to coordinate local, county and regional efforts. Its mission is to promote and support efforts to balance economic development and environmental management in the Uwharrie Lakes Region.

For more information about the Yadkin-Pee Dee Lakes Project, visit the website at http://www.lakesproject.org/ or call (704) 422-3215. You may also email Office and Project Manager, Michele Ackerman, mackerman@vnet.net.

Section C: 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 wastewater 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) are 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 Yadkin-Pee Dee 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. 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.
- *Increased urban planning in municipalities with less than 25,000 people and in many counties is needed*. Increasing population in many areas throughout the Yadkin-Pee Dee River basin will demand more water and generate more wastewater. In addition, conversion of land from forests and farms will increase impervious surfaces producing higher than natural streamflows and cause erosion. Streams in these areas will likely remain (or become) impaired unless this growth is planned for and managed properly.
- *More education is needed about water quality issues in general*. Education for developers, realtors, local public officials and other citizens about all types of habitat degradation and BMPs for controlling the quantity and quality of stormwater.

DWQ would like to work more closely with the Conservation Districts in each county of the Yadkin-Pee Dee River basin to identify nonpoint sources of pollution, develop land use and land cover data, and to develop water quality management strategies for Impaired watersheds within the Yadkin-Pee Dee River basin.

2.2 DWQ Compliance and Enforcement Policy Revisions

NCDENR 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.

NCDENR 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 NCDENR's efforts to enforce environmental laws and ultimately improve compliance. This effort got underway in July 1999 with two focus group meetings. If you would like to see the Scope of Work for the enforcement assessment, see NCDENR's web page at http://www.enr.state.nc.us/novs/scope.htm/.

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Appendix I

NPDES Dischargers
and
Individual Stormwater Permits
in the
Yadkin-Pee Dee River Basin

NPDES Discharges in the Yadkin-Pee Dee River Basin (as of February 18, 2002)

Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0005266	ABTCo Mill (Louisiana Pacific Corp)	Wilkes	Winston-Salem	Industrial Process & Commercial	Major	1.000	03-07-01	Yadkin River	257
NC0006254	Omni Supply - River Road Site	Caldwell	Asheville	Industrial Process & Commercial	Minor	0.450	03-07-01	Yadkin River	208, 209
NC0006696	Carolina Mirror Co LLC	Wilkes	Winston-Salem	Industrial Process & Commercial	Minor	0.500	03-07-01	Mulberry Creek	253
NC0020761	Thurman St WWTP (Town of N Wilkesboro)	Wilkes	Winston-Salem	Municipal , Large	Major	2.000	03-07-01	Yadkin River	250
NC0021717	Cub Creek WWTP (Town of Wilkesboro)	Wilkes	Winston-Salem	Municipal , Large	Major	4.900	03-07-01	Yadkin River	249
NC0033138	Millers Creek Elem School (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.012	03-07-01	Reddies River	259
NC0035793	Career Ed Center WWTP (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.009	03-07-01	Little Cub Creek	248
NC0038709	Roaring River Elem School (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.005	03-07-01	Yadkin River	261
NC0046388	E Wilkes High School WWTP (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.009	03-07-01	Hughes Branch	265, 266
NC0046418	Mountain View Elem School (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-01	Mulberry Creek	274
NC0046426	Traphill Elem School WWTP (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.004	03-07-01	Little Sandy Creek	279
NC0051047	C.C. Wright Elem School (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.008	03-07-01	Little Cub Creek	243
NC0055590	Wilkesboro Town- WTP	Wilkes	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-01	West Prong Moravian Creek	245
NC0066877	Mulberry WWTP (Town of N Wilkesboro)	Wilkes	Winston-Salem	Municipal , Small	Minor	0.030	03-07-01	Mulberry Creek	256
NC0068543	Wilkes Assisted Living	Wilkes	Winston-Salem	Industrial Process & Commercial	Minor	0.013	03-07-01	Naked Creek	242
NC0075078	Wilkes County Airport	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.008	03-07-01	Rock Creek	264
NC0075299	Morningstar Publ/Dodge House	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.025	03-07-01	Fish Dam Creek	247
NC0075515	Boomer Ferguson Elem (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.003	03-07-01	Warrior Creek	232
NC0076066	North Wilkes H.S. WWTP (Wilkes Co)	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.011	03-07-01	Wolf Branch	278
NC0078140	Northwest Textile Incorporated	Wilkes	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-01	Yadkin River	263
NC0080748	Ronda Plant (US Fiber Inc)	Wilkes	Winston-Salem	Industrial Process & Commercial	Minor	0.015	03-07-01	Yadkin River	12
NC0083291	Reddies River Water Works	Wilkes	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-01	Reddies River	269
NC0035947	Skill Craft Enterprises	Caldwell	Asheville	100% Domestic, Small	Minor	0.021	03-07-01	Yadkin River	203
NC0041181	Caldwell Co - Happy Valley Elem School	Caldwell	Asheville	100% Domestic, Small	Minor	0.008	03-07-01	Yadkin River	205
NC0041190	Caldwell Co - Kings Creek Elem School	Caldwell	Asheville	100% Domestic, Small	Minor	0.006	03-07-01	Kings Creek	201
NC0043125	Patterson School	Caldwell	Asheville	100% Domestic, Small	Minor	0.025	03-07-01	Yadkin River	210
NC0055611	Blackberry Sewer System	Caldwell	Asheville	100% Domestic, Small	Minor	0.003	03-07-01	Yadkin River	237
NC0035939	Camp Carolwood Incorporated	Caldwell	Asheville	100% Domestic, Small	Minor	0.005	03-07-01	Cove Branch	217
NC0041955	Surry Co - Foothills High School	Surry	Winston-Salem	100% Domestic, Small	Minor	0.004	03-07-02	Beaverdam Creek	293
NC0006548	Wayne Farms LLC/Dobson	Surry	Winston-Salem	Industrial Process & Commercial	Minor	0.600	03-07-02	Fisher River	286

NPDES Discharges in the Yadkin-Pee Dee River Basin (as of February 18, 2002)

Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0021326	Dobson Town- WWTP	Surry	Winston-Salem	Municipal , Small	Minor	0.350	03-07-02	Cody Creek	283
NC0029599	Yadkin Co - Courtney Elem School WWTP	Yadkin	Winston-Salem	100% Domestic, Small	Minor	0.005	03-07-02	Harmon Creek	221
NC0029602	Yadkin Co - Forbush Elem School WWTP	Yadkin	Winston-Salem	100% Domestic, Small	Minor	0.006	03-07-02	Mill Branch	239
NC0029611	Yadkin Co - E Bend Elem School WWTP	Yadkin	Winston-Salem	100% Domestic, Small	Minor	0.007	03-07-02	Logan Creek	258
NC0031160	NC DENR Pilot Mountain State Park	Surry	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-02	Grassy Creek	280
NC0033154	Davie Co - Shady Grove Elem WWTP	Davie	Winston-Salem	100% Domestic, Small	Minor	0.012	03-07-02	Carter Creek	189
NC0038997	Roaring Gap Club Incorporated	Alleghany	Winston-Salem	100% Domestic, Small	Minor	0.013	03-07-02	Mitchell River	289
NC0041866	Surry Co - Mountain Park Elem School	Surry	Winston-Salem	100% Domestic, Small	Minor	0.004	03-07-02	Flat Branch	281
NC0044211	Brintles Truck Stop	Surry	Winston-Salem	100% Domestic, Small	Minor	0.032	03-07-02	Little Fisher River	296
NC0058815	Hope Valley Incorporated	Surry	Winston-Salem	100% Domestic, Small	Minor	0.004	03-07-02	Fisher River	288
NC0060691	Candle Corporation Of America-WWTP	Surry	Winston-Salem	Industrial Process & Commercial	Minor	0.010	03-07-02	Yadkin River	276
NC0061808	Yoco, Inc. - Neighbors Fuel Center #12	Surry	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-02	Little Fisher River	295
NC0063720	AquaSource, Inc. - Forest Ridge WWTP	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.033	03-07-02	Blanket Creek	220
NC0064726	East Bend Industrial Park WWTP	Yadkin	Winston-Salem	Municipal , Small	Minor	0.010	03-07-02	Yadkin River	262
NC0070459	Yadkin Co - Starmount H.S. WWTP	Yadkin	Winston-Salem	100% Domestic, Small	Minor	0.011	03-07-02	South Deep Creek	252
NC0071773	Yadkin Co - Forbush H.S. WWTP	Yadkin	Winston-Salem	100% Domestic, Small	Minor	0.015	03-07-02	Forbush Creek	246
NC0073822	NC DOT Surry County Office	Surry	Winston-Salem	Groundwater Remediation	Minor	0.002	03-07-02	Fisher River	287
NC0079260	Yadkinville WTP	Yadkin	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-02	South Deep Creek	18
NC0083925	Heater Utilities, Inc. - Salem Glen SD WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.140	03-07-02	Yadkin River	194
NC0084409	Heater Utilities, Inc. - Wellesley Place WWTP	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.060	03-07-02	Mill Creek	298
NC0005312	CMI Industries / Chatham Division	Surry	Winston-Salem	Industrial Process & Commercial	Major	4.000	03-07-02	Yadkin River	271
NC0020338	Yadkinville WWTP	Yadkin	Winston-Salem	Municipal , Large	Major	2.500	03-07-02	North Deep Creek	240
NC0020567	Elkin WWTP	Surry	Winston-Salem	Municipal , Large	Major	1.800	03-07-02	Yadkin River	273
NC0034827	Forsyth Co - Old Richmond Elem School	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.006	03-07-02	Fries Creek	260
NC0021580	Jonesville Town / WWTP	Yadkin	Winston-Salem	Municipal , Small	Minor	0.400	03-07-02	Sandyberry Creek	270
NC0020931	Boonville Town - WWTP	Yadkin	Winston-Salem	Municipal , Small	Minor	0.200	03-07-02	Tanyard Creek	275
NC0055158	Bermuda Center Sanitary District WWTP	Davie	Winston-Salem	Municipal , Small	Minor	0.193	03-07-02	Yadkin River	202
NC0084212	Davie Co - Sparks Road WTP	Davie	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-02	Yadkin River	216
NC0086762	Winston-Salem City - Northwest WTP	Forsyth	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-02	Yadkin River	--

NPDES Discharges in the Yadkin-Pee Dee River Basin (as of February 18, 2002)

Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0021121	Mount Airy City - WWTP	Surry	Winston-Salem	Municipal , Large	Major	7.0	03-07-03	Ararat River	294
NC0026646	Pilot Mountain WWTP	Surry	Winston-Salem	Municipal , Large	Major	1.5	03-07-03	Ararat River	282
NC0027944	Bassett Furniture Industries	Surry	Winston-Salem	Industrial Process & Commercial	Minor	0.018	03-07-03	Ararat River	290, 291
NC0038822	Central Care Incorporated	Surry	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-03	Stewarts Creek	292
NC0041904	Surry Co - Flat Rock Elementary School	Surry	Winston-Salem	100% Domestic, Small	Minor	0.005	03-07-03	Champ Creek	303
NC0041939	Surry Co - Gentry Middle School	Surry	Winston-Salem	100% Domestic, Small	Minor	0.015	03-07-03	Stewarts Creek	297
NC0041947	Surry Co - North Surry High School	Surry	Winston-Salem	100% Domestic, Small	Minor	0.021	03-07-03	Stewarts Creek	299
NC0068365	Pilot Mountain WTP	Surry	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-03	Toms Creek	284
NC0005703	Hamilton Beach / Proctor-Silex - Mount Airy	Surry	Winston-Salem	Industrial Process & Commercial	Major	0.085	03-07-03	Lovills Creek	300, 301, 302
NC0029190	NC DOT Surry County Rest Area	Surry	Winston-Salem	100% Domestic, Small	Minor	0.030	03-07-03	Naked Run	304
NC0039420	Virginia DOT/I 77 Rest Area	Surry	Winston-Salem	100% Domestic, Small	Minor	0.020	03-07-03	Naked Run	305
NC0023884	City of Salisbury - Grants Creek WWTP	Rowan	Mooresville	Municipal , Large	Major	12.5	03-07-04	Yadkin River	118
NC0023604	Thomasville Furniture Co - SFD/64 Lumber	Davidson	Winston-Salem	Industrial Process & Commercial	Minor	0.013	03-07-04	Flat Swamp Creek	150, 151
NC0027502	Landis Town- WTP	Rowan	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-04	Grants Creek	99
NC0029246	Norfolk Southern Corporation - Linwood Yard	Davidson	Winston-Salem	Industrial Process & Commercial	Minor	0.317	03-07-04	North & South Potts Creek Second Creek Arm of High Rock Lake	128-138 (10 locations)
NC0029947	Davidson Co - Churchland Elem WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.004	03-07-04	South Potts Creek	155
NC0031950	Davidson Co - West Davidson H.S. WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.007	03-07-04	North Potts Creek	157
NC0040045	Bills Truck Stop Incorporated	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.006	03-07-04	South Potts Creek	146
NC0041599	Davidson Co - Central Mid/Senior H.S. WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.014	03-07-04	Abbotts Creek Arm of High Rock Lake	143
NC0041602	Davidson Co - Silver Valley Elem WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.004	03-07-04	Flat Swamp Creek	140
NC0042056	Davidson Co - Tyro Junior H.S. WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.005	03-07-04	North Potts Creek	159
NC0042072	Davidson Co - Northwest Elem WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-04	Huffmans Creek	175
NC0051489	Three R's Mobile Home Park	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.012	03-07-04	Leak Creek	207
NC0057223	Head Mobile Home Park	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.002	03-07-04	Little Creek	214
NC0059218	Captain Stevens Seafood Rest	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.003	03-07-04	Reedy Creek	185
NC0059536	Hilltop Living Center	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.003	03-07-04	Yadkin River	125
NC0061204	Scarlett Acres Mobile Home Park	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.020	03-07-04	Mill Creek	251
NC0065587	Heater Utilities, Inc. - Frye Bridge WWTP	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.027	03-07-04	Muddy Creek	200
NC0070033	Quail Run Mobile Home Park	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.017	03-07-04	Miller Creek	199

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Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0070637	Kurz Transfer Products	Davidson	Winston-Salem	Industrial Process & Commercial	Minor	0.002	03-07-04	Reedy Creek	183
NC0083941	Heater Utilities, Inc. - Spring Creek WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.080	03-07-04	Fryes Creek	197
NC0084425	Davidson Water Incorporated- WTP	Davidson	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-04	Yadkin River	168
NC0085871	Flakt Products Incorporated	Forsyth	Winston-Salem	Groundwater Remediation	Minor	0.086	03-07-04	Brushy Fork	224
NC0086011	Winston-Salem City - Neilson WTP	Forsyth	Winston-Salem	Water Plants & Conditioning	Minor	0.500	03-07-04	Muddy Creek	206
NC0004286	Fieldcrest Cannon Inc - Plant 16	Rowan	Mooresville	Industrial Process & Commercial	Major	0.050	03-07-04	Grants Creek	104, 105
NC0004626	PPG Industries Fiber Glass - Lexington facility	Davidson	Winston-Salem	Industrial Process & Commercial	Minor	0.600	03-07-04	North Potts Creek	142
~~NC0005487~~	~~Color Tex Finishing Corporation~~	~~Rowan~~	~~Mooresville~~	~~Industrial Process & Commercial~~	~~Major~~	~~4.250~~	~~03-07-04~~	~~Yadkin River~~	~~123~~
~~NC0025593~~	~~Salisbury City - Sowers Ferry Road WWTP~~	~~Rowan~~	~~Mooresville~~	~~Municipal , Small~~	~~Minor~~	~~0.750~~	~~03-07-04~~	~~Grants Creek~~	~~117~~
NC0034703	Rowan-Salisbury Sch - Knollwood Elem WWTP	Rowan	Mooresville	100% Domestic, Small	Minor	0.011	03-07-04	Little Creek	106
NC0035921	Rowan-Salisbury Sch - Faith Elem WWTP	Rowan	Mooresville	100% Domestic, Small	Minor	0.008	03-07-04	Crane Creek	100
NC0037184	Oak Haven Mobile Home Park	Rowan	Mooresville	100% Domestic, Small	Minor	0.006	03-07-04	Grants Creek	108
NC0037834	Winston-Salem City - Archie Elledge WWTP	Forsyth	Winston-Salem	Municipal , Large	Major	30.0	03-07-04	Salem Creek	215
NC0049905	Inman Asphalt- Salisbury	Rowan	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-04	Grants Creek	112
NC0050342	Winston-Salem City - Muddy Creek WWTP	Forsyth	Winston-Salem	Municipal , Large	Major	21.0	03-07-04	Yadkin River	187
NC0055093	R J Reynolds Tobacco Co - Tobaccoville Facility	Forsyth	Winston-Salem	Industrial Process & Commercial	Minor	not limited	03-07-04	Barkers Creek	272
NC0061034	Rowan Assoc & Mercantile Center	Rowan	Mooresville	100% Domestic, Small	Minor	0.006	03-07-04	Town Creek	101
NC0079821	Winston-Salem City - R.A. Thomas WTP	Forsyth	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-04	Salem Creek	222
NC0080853	Lucent Technologies, Inc. - Salem Business Park Remediation Site	Forsyth	Winston-Salem	Groundwater Remediation	Minor	0.301	03-07-04	Salem Creek	219
NC0086321	Hartman Investments, Inc. - Meadow Lily WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.080	03-07-04	Fryes Creek	195
NC0042439	Westside Swim & Racquet Club	Rowan	Mooresville	100% Domestic, Small	Minor	0.003	03-07-04	Draft Branch	110
NC0057509	Carolina Water Service, Inc. of NC - Sequoia WWTP	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.135	03-07-04	Reynolds Creek	223
NC0021491	Mocksville Town - Dutchman's Creek WWTP	Davie	Winston-Salem	Municipal , Small	Minor	0.680	03-07-05	Dutchman Creek	174
NC0033162	Davie Co - William R. Davie Elem WWTP	Davie	Winston-Salem	100% Domestic, Small	Minor	0.007	03-07-05	Greasy Creek	198
NC0024872	Davie Co - Cooleemee WWTP	Davie	Winston-Salem	Municipal , Large	Major	1.500	03-07-06	South Yadkin River	158
NC0004898	Gulistan Carpet - Turnersburg Plant WWTP	Iredell	Mooresville	Industrial Process & Commercial	Minor	0.010	03-07-06	Little Rocky Creek	178-181 (4 locations)
NC0004944	Arteva Specialties- Kosa	Rowan	Mooresville	Industrial Process & Commercial	Major	2.305	03-07-06	Second Creek	119

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Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0005126	Tyson Foods Inc - Harmony Plant	Iredell	Mooresville	Industrial Process & Commercial	Minor	0.5	03-07-06	Hunting Creek	190
NC0028941	AquaSource, Inc. - Pine Valley WWTP	Rowan	Mooresville	100% Domestic, Small	Minor	0.025	03-07-06	Setman Branch	114
NC0045471	Barium Springs School For Children	Iredell	Mooresville	100% Domestic, Small	Minor	0.030	03-07-06	Duck Creek	124
NC0076333	Statesville Auto Auction WWTP	Iredell	Mooresville	Industrial Process & Commercial	Minor	0.012	03-07-06	Fifth Creek	166
NC0077615	Homer's Truck Stop	Iredell	Mooresville	100% Domestic, Small	Minor	0.025	03-07-06	Third Creek	154
NC0082821	Southern States Coop - Statesville	Iredell	Mooresville	Groundwater Remediation	Minor	0.144	03-07-06	Fourth Creek	149
NC0085120	Lowes Co Inc - Iredell Distribution Center WWTP	Iredell	Mooresville	100% Domestic, Small	Minor	0.016	03-07-06	Little Rocky Creek	182
NC0068632	Craftmaster Furniture Corporation	Alexander	Mooresville	100% Domestic, Small	Minor	0.015	03-07-06	Third Creek	177
NC0079898	Needmore Road Landfill (HNA Holdings Inc)	Rowan	Mooresville	Groundwater Remediation	Minor	0.288	03-07-06	South Yadkin River	162
NC0084042	Energy United Water Corp - R.L. Tatum WTP	Alexander	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-06	South Yadkin River	176
NC0087033	Harmony Town - WWTP	Iredell	Mooresville	Municipal , Small	Minor	0.250	03-07-06	Dutchman Creek	--
NC0004774	Buck Steam Station (Duke Power)	Rowan	Mooresville	Industrial Process & Commercial	Major	not limited	03-07-06	Yadkin River	120, 121
NC0020591	Statesville City - Third Creek WWTP	Iredell	Mooresville	Municipal , Large	Major	4.000	03-07-06	Third Creek	141
NC0023191	Seven Cedars Mobile Home Park WWTP	Iredell	Mooresville	100% Domestic, Small	Minor	0.010	03-07-06	Third Creek	127
NC0028606	NC DOT I-77 Rest Area Iredell County	Iredell	Mooresville	100% Domestic, Small	Minor	0.018	03-07-06	Camel Branch	204
NC0028614	NC DOT I-77 Rest Area Yadkin County	Yadkin	Winston-Salem	100% Domestic, Small	Minor	0.018	03-07-06	Rocky Branch	233
~~NC0029742~~	~~NC DOC Iredell Correctional Center WWTP~~	~~Iredell~~	~~Mooresville~~	~~100% Domestic, Small~~	~~Minor~~	~~0.024~~	~~03-07-06~~	~~Fifth Creek~~	~~167~~
NC0031836	Statesville City - Fourth Creek WWTP	Iredell	Mooresville	Municipal , Large	Major	4.000	03-07-06	Fourth Creek	152
NC0034959	Rowan-Salisbury Sch - West Rowan H.S.	Rowan	Mooresville	100% Domestic, Small	Minor	0.010	03-07-06	Withrow Creek	113
NC0037371	Iredell-Statesville Sch - North Iredell H.S.	Iredell	Mooresville	100% Domestic, Small	Minor	0.013	03-07-06	Patterson Creek	186
NC0045012	Hill Haven Residential Care	Iredell	Mooresville	100% Domestic, Small	Minor	0.018	03-07-06	Third Creek	145
NC0049867	Cleveland Town - WWTP	Rowan	Mooresville	Municipal , Small	Minor	0.270	03-07-06	Third Creek	144
NC0050903	Mocksville Town - Bear Creek WWTP	Davie	Winston-Salem	Municipal , Small	Minor	0.250	03-07-06	Bear Creek	170
NC0072664	Shurtape Tech Inc - Stony Point	Alexander	Mooresville	100% Domestic, Small	Minor	0.010	03-07-06	Third Creek	171
NC0075523	RDH Tire & Retread	Rowan	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-06	Beaverdam Creek	115, 116
NC0078361	Rowan Co - Second Creek WWTP	Rowan	Mooresville	Municipal , Small	Minor	0.030	03-07-06	Second Creek	122
NC0024112	Thomasville City - Hamby Creek WWTP	Davidson	Winston-Salem	Municipal , Large	Major	4.000	03-07-07	Hamby Creek	164
NC0024228	High Point City - Westside WWTP	Davidson	Winston-Salem	Municipal , Large	Major	6.200	03-07-07	Rich Fork	188
NC0028037	Lexington City - WTP #1 & 2	Davidson	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-07	Abbotts Creek	169

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Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0034452	Willow Creek Builders Incorporated	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.080	03-07-07	Abbotts Creek	193
NC0036561	United Church Retirement Home	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-07	Pounder Fork	160
NC0041629	Davidson Co - Extended Day Sch WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.007	03-07-07	Hamby Creek	161
NC0042081	Davidson Co - Ledford High School WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-07	Reedy Run	191
NC0042129	Davidson Co - Pilot Elem Sch WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-07	Jimmys Creek	172
NC0042145	Davidson Co - Midway Elem Sch WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.008	03-07-07	Leonard Creek	192
NC0046035	High Point Care Center	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-07	Rich Fork	211
NC0051713	Lakeview Mobile Home Park	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.015	03-07-07	Cuddybum Creek	213
NC0055212	Auman's Mobile Home Park WWTP	Forsyth	Winston-Salem	100% Domestic, Small	Minor	0.016	03-07-07	Rich Fork	212
NC0055786	Lexington Regional WWTP	Davidson	Winston-Salem	Municipal , Large	Major	5.500	03-07-07	Abbotts Creek	147
NC0042749	Davidson Co - Southwood Elem WWTP	Davidson	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-07	Swearing Creek	126
NC0004308	Aluminum Company Of America	Stanly	Mooresville	Industrial Process & Commercial	Major	not limited	03-07-08	Yadkin River & UT Little Mountain Creek	76-82 (7 locations)
NC0074756	Badin WWTP (Greater Badin WSD)	Stanly	Mooresville	Municipal , Small	Minor	0.550	03-07-08	Little Mountain Creek	70
NC0075701	Albemarle City - Tuckertown WTP	Stanly	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-08	Yadkin River (Tuckertown Reservoir)	94
NC0076775	Yadkin, Inc. - Falls Powerhouse	Stanly	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-08	Yadkin River	69
NC0081931	Yadkin, Inc. - High Rock Powerhouse	Rowan	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-08	Yadkin River	--
NC0081949	Yadkin, Inc. - Tuckertown Powerhouse	Stanly	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-08	Yadkin River	92
NC0081957	Yadkin, Inc. - Narrows Powerhouse	Stanly	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-08	Yadkin River	85
NC0082949	Denton WTP	Davidson	Winston-Salem	Water Plants & Conditioning	Minor	not limited	03-07-08	Yadkin River	102
NC0041718	Colony Ridge Apartments	Stanly	Mooresville	100% Domestic, Small	Minor	0.005	03-07-08	Curl Tail Creek	--
NC0026689	Denton WWTP	Davidson	Winston-Salem	Municipal , Small	Minor	0.300	03-07-08	Lick Creek	107
NC0040908	Randolph Co - Tabernacle Elem School	Randolph	Winston-Salem	100% Domestic, Small	Minor	0.010	03-07-09	Caraway Creek	139
NC0056201	Countryside LLC / Countryside MH	Randolph	Winston-Salem	100% Domestic, Small	Minor	0.015	03-07-09	Caraway Creek	163
NC0086029	Trinity American Corp - Glenola Remediation	Randolph	Winston-Salem	Groundwater Remediation	Minor	0.072	03-07-09	Caraway Creek	--
NC0084786	Furniture Illustrators Incorporated	Randolph	Winston-Salem	Industrial Process & Commercial	Minor	0.001	03-07-09	Uwharrie River	173
NC0076287	Randolph Co - Farmer Elem School	Randolph	Winston-Salem	100% Domestic, Small	Minor	0.012	03-07-09	Uwharrie River	109
NC0081825	Ansonville Town - WWTP	Anson	Fayetteville	Municipal , Small	Minor	0.120	03-07-10	Pee Dee River	19
NC0021784	Ellerbe Town - WWTP	Richmond	Fayetteville	Municipal , Small	Minor	0.180	03-07-10	Toms Branch	14
NC0080322	Montgomery Co - WTP	Montgomery	Fayetteville	Water Plants & Conditioning	Minor	not limited	03-07-10	Clarks Creek	36

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Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0021105	Mount Gilead Town - WWTP	Montgomery	Fayetteville	Municipal , Small	Minor	0.850	03-07-10	Pee Dee River	35
NC0061786	Poplar Trails Subdivision	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.006	03-07-11	Rocky River	75
NC0030210	CMUD - Mallard Creek WWTP	Mecklenburg	Mooresville	Municipal , Large	Major	6.000	03-07-11	Mallard Creek	61, 62
NC0006351	Chemical Specialties Incorporated	Cabarrus	Mooresville	Industrial Process & Commercial	Major	0.025	03-07-11	Rocky River	59
NC0025259	Carolina Water Service, Inc. of NC - Lamplighter Subdivision WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.070	03-07-11	McKee Creek	37
NC0034711	Cedar Park Estates LLC	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.030	03-07-11	Reedy Creek	55
NC0035033	Carolina Water Service, Inc. of NC - Cabarrus Woods WWTP	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.450	03-07-11	Reedy Creek	49
NC0041092	Cabarrus Co - W.R. Odell Elem School	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.013	03-07-11	Rocky River	89
NC0047091	Silver Maple Mobile Estates	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.040	03-07-11	Rocky River	66
NC0049441	Burlwood Mobile Home Park	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.030	03-07-11	Reedy Creek	53
NC0051632	Carolina Water Service, Inc. of NC - Huntwick WWTP	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.035	03-07-11	Fuda Creek	54
NC0063762	Carolina Village Mobile Home Park	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.090	03-07-11	Rocky River	65
NC0063932	White Forest WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.017	03-07-11	Reedy Creek	44
NC0064734	Bradfield Farms WWTP	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.460	03-07-11	McKee Creek	45
NC0065773	Heater Utilities, Inc. - Willow Creek WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.150	03-07-11	Reedy Creek	51
NC0067644	Rocky River Run Subdivison	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.020	03-07-11	Caldwell Creek	41
NC0067920	River Run Country Club, Inc.	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.300	03-07-11	West Branch Rocky River	91
NC0070289	Ridgewood Farms Subdivision	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.050	03-07-11	Caldwell Creek	52
NC0073539	AquaSource, Inc. - Willowbrook WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.048	03-07-11	Ramah Creek	90
NC0077364	Carolina Water Service, Inc. of NC - Cabarrus Woods WTP	Cabarrus	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-11	Crozier Branch	50
NC0079774	Davidson Downes Subdivision	Iredell	Mooresville	100% Domestic, Small	Minor	0.060	03-07-11	West Branch Rocky River	97
NC0083119	Concord City - Coddle Creek WTP	Cabarrus	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-11	Coddle Creek	87
NC0046728	Mooresville Town - WWTP	Iredell	Mooresville	Municipal , Large	Major	5.200	03-07-11	Dye Creek (Branch)	98
NC0071781	AquaSource, Inc. - McCarron Subdivision WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.050	03-07-11	Reedy Creek	43
NC0064751	River Hills Estates	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.029	03-07-11	Rocky River	60
NC0085812	Union Co - Grassy Branch WWTP	Union	Mooresville	Municipal , Small	Minor	0.050	03-07-12	Crooked Creek	23

NPDES Discharges in the Yadkin-Pee Dee River Basin (as of February 18, 2002)

Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0006220	Kannapolis City - WTP	Rowan	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-12	Irish Buffalo Creek	96
NC0030538	Union Co - Farview Elementary School	Union	Mooresville	100% Domestic, Small	Minor	0.004	03-07-12	Goose Creek	25
NC0034762	Goose Creek Utility Company - Fairfield Plantation WWTP	Union	Mooresville	100% Domestic, Small	Minor	0.070	03-07-12	Goose Creek	21
NC0035041	Carolina Water Service, Inc. of NC - Hemby Acres WWTP	Union	Mooresville	100% Domestic, Small	Minor	0.300	03-07-12	North Fork Crooked Creek	17
NC0041068	Cabarrus Co - Bethel Elem School	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.008	03-07-12	Muddy Creek	42
NC0044717	Mount Pleasant Town - WTP	Cabarrus	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-12	Dutch Buffalo Creek	83, 84
NC0063584	Heater Utilities, Inc. - Oxford Glen WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.075	03-07-12	Stevens Creek	26
NC0065684	Heater Utilities, Inc. - Country Wood WWTP	Union	Mooresville	100% Domestic, Small	Minor	0.670	03-07-12	Goose Creek	20
NC0065749	Heater Utilities, Inc. - Ashe Plantation WWTP	Mecklenburg	Mooresville	100% Domestic, Small	Minor	0.100	03-07-12	Duck Creek	27
NC0069523	Union Co - Tallwood Estates WWTP	Union	Mooresville	Municipal , Small	Minor	0.050	03-07-12	Clear Creek	29
NC0072508	Union Co - Hunley Creek WWTP	Union	Mooresville	100% Domestic, Small	Minor	0.023	03-07-12	Goose Creek	24
NC0077704	Cabarrus Co - Mount Pleasant High School	Cabarrus	Mooresville	100% Domestic, Small	Minor	0.012	03-07-12	Adams Creek	72
NC0081621	Cabarrus Co - Muddy Creek WWTP	Cabarrus	Mooresville	Municipal , Small	Minor	0.075	03-07-12	Rocky River	33
NC0083763	Dixie Yarns Inc/Gw Remediation	Stanly	Mooresville	Groundwater Remediation	Minor	0.072	03-07-12	Rock Hole Branch	38
NC0086169	Corning Inc. - Fiber Optic Facility	Cabarrus	Mooresville	Industrial Process & Commercial	Minor	0.027	03-07-12	Muddy Creek	30, 31, 32
NC0036269	Cabarrus Co - Rocky River WWTP	Cabarrus	Mooresville	Municipal , Large	Major	24.000	03-07-12	Rocky River	58
NC0086487	J E Morgan Knitting Mills	Stanly	Mooresville	Groundwater Remediation	Minor	0.030	03-07-13	Poplin Branch	86
NC0028169	Solite Corporation	Stanly	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-13	Long Branch	34
NC0029432	Stanly Co - Aquadale Elementary School	Stanly	Mooresville	100% Domestic, Small	Minor	0.003	03-07-13	Long Branch	39
NC0043532	Oakboro Town - WWTP	Stanly	Mooresville	Municipal , Small	Minor	0.500	03-07-13	Long Creek	40
NC0044024	Albemarle City - Highway 52 WTP	Stanly	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-13	Little Long Creek	71
NC0080586	Carolina Stalite Company	Rowan	Mooresville	Industrial Process & Commercial	Minor	not limited	03-07-13	Long Creek	95
NC0085758	South Central Oil Co - Crossroads Grocery Remediation Site	Stanly	Mooresville	Groundwater Remediation	Minor	0.033	03-07-13	Little Creek	68
NC0024244	Albemarle City - Long Creek WWTP	Stanly	Mooresville	Municipal , Large	Major	16.000	03-07-13	Long Creek	57
NC0045993	Teledyne Allvac-Monroe Plant	Union	Mooresville	Industrial Process & Commercial	Major	not limited	03-07-14	Richardson Creek	10
NC0024333	Monroe City - WWTP	Union	Mooresville	Municipal , Large	Major	9.000	03-07-14	Richardson Creek	11
NC0030597	Union Co - New Salem Elem School	Union	Mooresville	100% Domestic, Small	Minor	0.003	03-07-14	Richardson Creek	22
NC0069841	Union Co - Crooked Creek WWTP #2	Union	Mooresville	Municipal , Large	Major	1.900	03-07-14	East Fork Stewarts Creek	15

NPDES Discharges in the Yadkin-Pee Dee River Basin (as of February 18, 2002)

Permit	Facility	County	Region	Type	Class	MGD	Subbasin	Receiving Stream	Map No.
NC0080381	Monroe City - John Glenn WTP	Union	Mooresville	Water Plants & Conditioning	Minor	not limited	03-07-14	Stewarts Creek	13
NC0084344	R.P. Scherer Corp - Chelsea Laboratories	Union	Mooresville	Groundwater Remediation	Minor	not limited	03-07-14	Rays Fork	9
NC0021628	Norwood WWTP	Stanly	Mooresville	Municipal , Small	Minor	0.750	03-07-14	Rocky River	28
NC0029424	Stanly Co - Locust Elementary School	Stanly	Mooresville	100% Domestic, Small	Minor	0.010	03-07-14	Island Creek	46
NC0021504	Biscoe Town - WWTP	Montgomery	Fayetteville	Municipal , Small	Minor	0.600	03-07-15	Hickory Branch	64
NC0028916	Troy Town - WWTP	Montgomery	Fayetteville	Municipal , Small	Minor	0.840	03-07-15	Densons Creek	67
NC0020427	Rockingham City - WWTP	Richmond	Fayetteville	Municipal , Large	Major	6.000	03-07-16	Pee Dee River	6
NC0037982	Hamlet City - WTP	Richmond	Fayetteville	Water Plants & Conditioning	Minor	not limited	03-07-16	Marks Creek	2
NC0041408	Anson Co Regional WWTP	Anson	Fayetteville	Municipal , Large	Major	3.500	03-07-16	Pee Dee River	3
NC0043320	Burlington Industries - Richmond	Richmond	Fayetteville	Industrial Process & Commercial	Major	1.200	03-07-16	Hitchcock Creek	4, 5
NC0047562	Hamlet City - WWTP	Richmond	Fayetteville	Municipal , Large	Major	1.000	03-07-16	Marks Creek	1
NC0074390	Anson Co - WTP	Anson	Fayetteville	Water Plants & Conditioning	Minor	not limited	03-07-16	McCoy Creek	8
NC0081281	Richmond Co - WTP	Richmond	Fayetteville	Water Plants & Conditioning	Minor	not limited	03-07-16	Pee Dee River	7

NPDES Individual Stormwater Dischargers in the Yadkin-Pee Dee River Basin (as of February 28, 2002)

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000004	Albemarle Wood Preserving Plant, Inc.	Town Creek	03-07-13	Stanly
NCS000018	J. C. Steele & Sons, Inc.	UT Fourth Creek	03-07-06	Iredell
NCS000057	Chemical Specialties, Inc.	Rocky River	03-07-11	Cabarrus
NCS000130	Perdue Farms, Inc.	UT Falling Creek	03-07-16	Richmond
NCS000133	Jowat Corporation	UT of Uwharrie River	03-07-09	Randolph
NCS000158	Southern Die Casting & Engineering	UT Kennedy Mill Creek	03-07-07	Guilford
NCS000181	Holcomb Creosote Company	Deep Creek	03-07-02	Yadkin
NCS000183	Radiator Specialty Company	South Fork Crooked Creek & UT Price Mill Creek	03-07-12	Union
NCS000192	Sun Chemical Corp. - Fairchild Road	Brushy Fork Creek	03-07-07	Forsyth
NCS000193	Sun Chemical Corp. - Regent Drive	UT Salem Creek	03-07-04	Forsyth
NCS000218	Universal Forest Products	Town Creek	03-07-04	Rowan
NCS000233	Trinity Manufacturing Co., Inc.	Falling Creek	03-07-16	Richmond
NCS000235	Southern Resin, Inc.	UT Hamby Creek	03-07-07	Davidson
NCS000255	Citation Corp. - Foundry Service Co.	UT Lick Creek	03-07-08	Montgomery
NCS000259	National Starch & Chemical Co. - Rowan	UT Grants Creek	03-07-04	Rowan
NCS000267	American Inks & Coatings Corp.	UT Salem Creek	03-07-04	Forsyth
NCS000291	McRae Woodtreating, Inc.	Big Branch	03-07-08	Montgomery
NCS000310	Duracell-Global Bus Management Group	UT Abbott's Creek	03-07-07	Davidson
NCS000324	Consolidated Metco, Inc.	UT Stewarts Creek	03-07-14	Union
NCS000328	Carolina Woodworks	UT Third Creek	03-07-06	Iredell
NCS000330	Teledyne Allvac - Monroe Plant	Richardson Creek	03-07-14	Union
NCS000333	Chatham Manufacturing	Yadkin River	03-07-02	Surry
NCS000337	Novachem Corporation	UT Kennedy Mill Creek	03-07-07	Guilford
NCS000346	Insteel Wire Products	UT Loville Creek	03-07-03	Surry
NCS000354	Tolaram Polymers, Inc. - Randolph	UT Back Creek	03-07-09	Randolph
NCS000365	Callaway Chemical Co.	UT Irish buffalo creek	03-07-12	Cabarrus
NCS000368	Powerlab, Inc.	UT Salem Creek	03-07-04	Forsyth

Appendix II

Water Quality Data
Collected by DWQ

- **Benthic Macroinvertebrate Assessment**
- **Fish Community Assessment**
- **Fish Tissue Assessment**
- **Listing of Physical/Chemical Monitoring Stations**
- **Lakes Assessment**

More detailed information on sampling and assessment of waters in the Yadkin-Pee Dee River basin is contained within the *Basinwide Assessment Report – Yadkin-Pee Dee River Basin* (NCDENR-DWQ, June 2002), available from the DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Benthic Macroinvertebrate Sampling Methodology and Bioclassification Criteria

Benthic macroinvertebrates can be collected using two sampling procedures. DWQ's standard qualitative sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1-2 specimens), Common (3-9 specimens) or Abundant (≥10 specimens).

Several data analysis summaries (metrics) can be produced from standard qualitative samples to detect water quality problems. These metrics are based on the idea that unimpaired streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

EPT taxa richness (EPT S) is used with DWQ criteria to assign water quality ratings (bioclassifications). "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect groups that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Water quality ratings are also based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI). Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions.

Water quality ratings assigned with the biotic index numbers are combined with EPT taxa richness ratings to produce a final bioclassification, using criteria for mountain/piedmont/coastal plain streams. EPT abundance (EPT N) and total taxa richness calculations also are used to help examine between-site differences in water quality. If the EPT taxa richness rating and the biotic index differ by one bioclassification, the EPT abundance value is used to determine the final site rating.

Benthic macroinvertebrates can also be collected using the DWQ's EPT sampling procedure. Four composite samples are taken at each site instead of the 10 taken for the qualitative sample: 1 kick, 1 sweep, 1 leafpack and visual collections. Only intolerant EPT groups are collected and identified, and only EPT criteria are used to assign a bioclassification.

The expected EPT taxa richness values are lower in small high quality mountain streams, <4 meters in width or with a drainage area <3.5 square miles. For these small mountain streams, an adjustment to the EPT taxa richness values is made prior to applying taxa richness criteria. Both EPT taxa richness and biotic index values also can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling (June-September). For samples collected in other seasons, EPT taxa richness can be adjusted. The biotic index values can also be seasonally adjusted for samples collected outside the summer season.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis.

Benthic macroinvertebrate studies in unimpacted mountain watersheds have shown naturally reduced EPT taxa richness in small streams (less than 4 meters width). However, similar studies have not been done in piedmont small streams or small streams that have disturbance in the watershed. For this reason, samples taken from sites with a width less than 4 meters are currently being described as Not Impaired for use support evaluations, if the bioclassification would be Good-Fair or better using standard EPT criteria. Because such bioclassifications are minimum bioclassifications (no stream size correction factor has yet been developed), small stream sites that would be at least Poor or Fair are listed as Not Rated to reflect the possibility that such sites might have higher bioclassifications if a size correction was used. In Table A-II-1, this Not Impaired or Not Rated terminology is applied to data that were currently used for use support determinations. The table has not been updated for all of the older data from small streams.

Flow Measurement

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. However, some between-year changes in the macroinvertebrate community may be due largely to changes in flow. High flow years magnify the potential effects of nonpoint source runoff, leading to scour, substrate instability and reduced periphyton. Low flow years may accentuate the effects of point source dischargers by providing less dilution of wastes.

For these reasons, all between-year changes in the biological communities are considered in light of flow conditions (high, low or normal) for one month prior to the sampling date. Daily flow information is obtained from the closest available USGS monitoring site and compared to the long-term mean flows. High flow is defined as a mean flow >140% of the long-term mean for that time period, usually July or August. Low flow is defined as a mean flow <60% of the long-term mean, while normal flow is 60-140% of the mean. While broad scale regional patterns are often observed, there may be large geographical variation within the state and large variation within a single summer period.

Habitat Evaluation

DWQ has developed a habitat assessment form to better evaluate the physical habitat of a stream. The habitat score has a potential range of 1-100, based on evaluation of channel modification, amount of instream habitat, type of bottom substrate, pool variety, bank stability, light penetration and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed for assigning ratings indicating Excellent, Good, Fair or Poor habitat.

Table A-II-1 Benthic Macroinvertebrate Data Collected in the Yadkin-Pee Dee River Basin, 1983-2001

Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
03-07-01									
Yadkin R	US 321	Caldwell	12-(1)	9/19/88	95	35	4.49	3.66	Good
Yadkin R	NC 268	Caldwell	12-(1)	8/30/01	69	24	5.52	4.68	Good-Fair
				7/22/96	102	41	4.55	3.75	Good
				7/10/90	87	38	4.89	3.91	Good
				8/4/87	87	37	5.23	4.39	Good
				8/6/85	76	24	6.03	4.27	Good-Fair
Yadkin R	SR 1372	Caldwell	12-(1)	7/27/01	---	34	---	3.49	Good
				9/19/88	---	26	---	3.11	Good-Fair
Dennis Cr	SR 1372	Caldwell	12-7	7/22/96	---	32	---	2.71	Good
				9/19/88	---	21	---	2.99	Good-Fair
Jackson Camp Cr	SR 1372	Caldwell	12-10	9/19/88	---	23	---	3.14	Good-Fair
Preston Cr	US 321	Caldwell	12-12	9/19/88	---	29	---	3.45	Good
Buffalo Cr	be Buffalo Cove	Caldwell	12-19	9/29/88	---	31	---	3.25	Good
Buffalo Cr	SR 1504	Caldwell	12-19	8/30/01	---	43	---	3.87	Excellent
				7/22/96	---	40	---	3.65	Excellent
				9/20/88	83	32	4.63	3.46	Good
Old Field Br	SR 1502	Caldwell	12-19-9	9/20/88	---	26	---	3.24	Good-Fair
Joes Br	SR 1574	Caldwell	12-19-11	9/20/88	---	30	---	3.47	Good
Elk Cr	SR 1508	Wilkes	12-24-(1)	12/15/87	71	38	2.90	2.31	Good
				12/14/87	101	49	3.60	2.52	Excellent
Laurel Cr	SR 1508	Wilkes	12-24-8	12/14/87	---	45	---	2.20	Excellent
Elk Cr	SR 1175	Wilkes	12-24-(10)	8/29/01	100	43	4.60	3.66	Good
				7/22/96	85	42	4.68	3.90	Good
				7/29/88	96	47	4.52	3.51	Excellent
				12/14/87	100	49	3.51	2.21	Excellent
				8/6/85	107	44	4.72	3.73	Good
Dugger Cr	SR 1162	Wilkes	12-24-11	12/14/87	---	38	---	2.56	Excellent
UT Stoney Fk Cr	SR 1505	Watauga	12-26-(1)	7/23/96	---	29	---	2.31	Good
Stoney Fk Cr	SR 1500	Watauga	12-26-(1)	7/23/96	---	31	---	2.31	Good
Stoney Fk Cr	SR 1135	Wilkes	12-26-(7)	7/26/01	---	45	---	3.64	Excellent
				7/22/96	---	38	---	3.45	Excellent
Little Fk	Headwaters	Wilkes	12-31-1-2	6/13/01	69	41	2.54	1.90	Not Impaired
N Pr Lewis Fk	SR 1304	Wilkes	12-31-1-(7.5)	7/25/01	---	35	---	3.57	Good
				7/23/96	---	33	---	3.25	Good
Purlear Cr	above falls	Wilkes	12-31-8-(1)	6/12/01	50	31	2.41	1.95	Not Impaired
Purlear Cr	Headwaters	Wilkes	12-31-8-(1)	6/12/01	59	35	2.61	2.11	Not Impaired
S Pr Lewis Fk	off US 421	Wilkes	12-31-2-(1)	7/23/96	---	32	---	2.51	Good
Yadkin R	NC 18/268	Wilkes	12-(38)	7/25/01	94	32	5.30	4.41	Good-Fair
				7/24/96	72	39	5.03	4.01	Good
				6/7/93	73	34	5.50	4.47	Good-Fair
				8/10/89	75	35	4.75	4.21	Good
				8/6/87	67	26	5.41	4.60	Good-Fair
				7/12/87	---	20	---	4.70	Good-Fair
				8/5/86	67	27	5.49	4.25	Good-Fair
				9/9/85	66	21	5.69	4.87	Good-Fair
				8/28/84	58	29	4.78	4.36	Good-Fair
Yadkin R	above ABT	Wilkes	12-(38)	6/7/93	90	40	5.12	3.98	Good
Yadkin R	be ABT	Wilkes	12-(38)	6/7/93	70	26	5.59	4.63	Good-Fair

Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Moravian Cr	NC 18	Wilkes	12-39	7/26/01	---	25	---	4.96	Good-Fair
				7/23/96	---	27	---	4.25	Good-Fair
Middle Fk Reddies R	SR 1559	Wilkes	12-40-2	7/26/01	---	42	---	3.98	Excellent
S Fk Reddies R	SR 1355	Wilkes	12-40-3	7/26/01	---	33	---	2.86	Good
N Fk Reddies R	SR 1567	Wilkes	12-40-4	7/26/01	---	34	---	3.57	Good
Mulberry Cr	NC 268	Wilkes	12-42	7/25/01	---	41	---	4.11	Excellent
				7/24/96	---	37	---	3.06	Excellent
UT Mulberry Cr	AB Gardner Mirror	Wilkes	12-42-9	9/12/90	39	17	4.65	3.40	Good-Fair
UT Mulberry Cr	Flint Hill Rd	Wilkes	12-42-9	7/25/01	50	13	5.84	4.60	Not Rated
				9/12/90	22	3	7.79	3.03	Poor
Roaring R	SR 1990	Wilkes	12-46	7/25/01	89	42	4.48	3.44	Good
				7/24/96	98	48	4.68	3.43	Excellent
				7/29/88	92	43	4.77	3.53	Good
				8/8/85	88	36	4.80	3.29	Good
				8/10/83	66	35	3.94	3.35	Good
03-07-02									
Yadkin R	US 321	Caldwell	12-(1)	9/19/88	95	35	4.49	3.66	Good
Yadkin R	NC 268	Caldwell	12-(1)	8/30/01	69	24	5.52	4.68	Good-Fair
				7/22/96	102	41	4.55	3.75	Good
				7/10/90	87	38	4.89	3.91	Good
				8/4/87	87	37	5.23	4.39	Good
				8/6/85	76	24	6.03	4.27	Good-Fair
Yadkin R	SR 1372	Caldwell	12-(1)	7/27/01	---	34	---	3.49	Good
				9/19/88	---	26	---	3.11	Good-Fair
Dennis Cr	SR 1372	Caldwell	12-7	7/22/96	---	32	---	2.71	Good
				9/19/88	---	21	---	2.99	Good-Fair
Jackson Camp Cr	SR 1372	Caldwell	12-10	9/19/88	---	23	---	3.14	Good-Fair
Preston Cr	US 321	Caldwell	12-12	9/19/88	---	29	---	3.45	Good
Buffalo Cr	be Buffalo Cove	Caldwell	12-19	9/29/88	---	31	---	3.25	Good
Buffalo Cr	SR 1504	Caldwell	12-19	8/30/01	---	43	---	3.87	Excellent
				7/22/96	---	40	---	3.65	Excellent
				9/20/88	83	32	4.63	3.46	Good
Old Field Br	SR 1502	Caldwell	12-19-9	9/20/88	---	26	---	3.24	Good-Fair
Joes Br	SR 1574	Caldwell	12-19-11	9/20/88	---	30	---	3.47	Good
Elk Cr	SR 1508	Wilkes	12-24-(1)	12/15/87	71	38	2.90	2.31	Good
				12/14/87	101	49	3.60	2.52	Excellent
Laurel Cr	SR 1508	Wilkes	12-24-8	12/14/87	---	45	---	2.20	Excellent
Elk Cr	SR 1175	Wilkes	12-24-(10)	8/29/01	100	43	4.60	3.66	Good
				7/22/96	85	42	4.68	3.90	Good
				7/29/88	96	47	4.52	3.51	Excellent
				12/14/87	100	49	3.51	2.21	Excellent
				8/6/85	107	44	4.72	3.73	Good
Dugger Cr	SR 1162	Wilkes	12-24-11	12/14/87	---	38	---	2.56	Excellent
UT Stoney Fk Cr	SR 1505	Watauga	12-26-(1)	7/23/96	---	29	---	2.31	Good
Stoney Fk Cr	SR 1500	Watauga	12-26-(1)	7/23/96	---	31	---	2.31	Good
Stoney Fk Cr	SR 1135	Wilkes	12-26-(7)	7/26/01	---	45	---	3.64	Excellent
				7/22/96	---	38	---	3.45	Excellent
Little Fk	Headwaters	Wilkes	12-31-1-2	6/13/01	69	41	2.54	1.90	Not Impaired
N Pr Lewis Fk	SR 1304	Wilkes	12-31-1-(7.5)	7/25/01	---	35	---	3.57	Good
				7/23/96	---	33	---	3.25	Good
Purlear Cr	above falls	Wilkes	12-31-8-(1)	6/12/01	50	31	2.41	1.95	Not Impaired
Purlear Cr	Headwaters	Wilkes	12-31-8-(1)	6/12/01	59	35	2.61	2.11	Not Impaired
S Pr Lewis Fk	off US 421	Wilkes	12-31-2-(1)	7/23/96	---	32	---	2.51	Good

Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Yadkin R	NC 18/268	Wilkes	12-(38)	7/25/01	94	32	5.30	4.41	Good-Fair
				7/24/96	72	39	5.03	4.01	Good
				6/7/93	73	34	5.50	4.47	Good-Fair
				8/10/89	75	35	4.75	4.21	Good
				8/6/87	67	26	5.41	4.60	Good-Fair
				7/12/87	---	20	---	4.70	Good-Fair
				8/5/86	67	27	5.49	4.25	Good-Fair
				9/9/85	66	21	5.69	4.87	Good-Fair
				8/28/84	58	29	4.78	4.36	Good-Fair
Yadkin R	above ABT	Wilkes	12-(38)	6/7/93	90	40	5.12	3.98	Good
Yadkin R	be ABT	Wilkes	12-(38)	6/7/93	70	26	5.59	4.63	Good-Fair
Moravian Cr	NC 18	Wilkes	12-39	7/26/01	---	25	---	4.96	Good-Fair
				7/23/96	---	27	---	4.25	Good-Fair
Middle Fk Reddies R	SR 1559	Wilkes	12-40-2	7/26/01	---	42	---	3.98	Excellent
S Fk Reddies R	SR 1355	Wilkes	12-40-3	7/26/01	---	33	---	2.86	Good
N Fk Reddies R	SR 1567	Wilkes	12-40-4	7/26/01	---	34	---	3.57	Good
Mulberry Cr	NC 268	Wilkes	12-42	7/25/01	---	41	---	4.11	Excellent
				7/24/96	---	37	---	3.06	Excellent
UT Mulberry Cr	AB Gardner Mirror	Wilkes	12-42-9	9/12/90	39	17	4.65	3.40	Good-Fair
UT Mulberry Cr	Flint Hill Rd	Wilkes	12-42-9	7/25/01	50	13	5.84	4.60	Not Rated
				9/12/90	22	3	7.79	3.03	Poor
Roaring R	SR 1990	Wilkes	12-46	7/25/01	89	42	4.48	3.44	Good
				7/24/96	98	48	4.68	3.43	Excellent
				7/29/88	92	43	4.77	3.53	Good
				8/8/85	88	36	4.80	3.29	Good
				8/10/83	66	35	3.94	3.35	Good
Snow Cr	SR 1121	Surry	12-62-15	8/6/01	---	24	---	3.96	Good-Fair
				7/23/96	---	31	---	3.67	Good
				7/1/87	67	27	5.11	4.33	Good-Fair
Endicott Cr	off SR 1421	Surry	12-63-5-(1)	2/6/91	95	52	3.14	2.13	Excellent
L Endicott Cr	off SR 1421	Surry	12-63-5-2	2/6/91	86	48	3.13	1.91	Excellent
Endicott Cr	SR 1338	Surry	12-63-5-(3)	2/7/91	---	12	---	4.29	Fair
Fisher R	US 601	Surry	12-63-(9)	8/8/01	---	30	---	3.19	Good
				7/23/96	---	30	---	3.67	Good
Fisher R	NC 268	Surry	12-63-(9)	8/8/01	88	39	5.14	3.90	Good
				7/22/96	84	36	5.13	4.04	Good
L Fisher R	SR 1480	Surry	12-63-10-(2)	8/7/01	---	22	4.87	4.87	Good-Fair
				7/23/96	---	29	---	4.28	Good
L Beaver Cr	NC 268	Surry	12-63-13	7/6/89	63	20	5.32	4.62	Good-Fair
L Beaver Cr	off NC 268	Surry	12-63-13	7/24/01	67	27	3.95	3.05	Not Impaired
				7/6/89	23	2	6.76	4.21	Poor
N Pr S Fk Mitchell R	off SR 1515	Surry	12-62-13-1	6/12/90	32	32	3.18	3.18	Good
L Yadkin R	SR 1236	Stokes	12-77	8/8/01	89	25	5.29	4.41	Good-Fair
				7/22/96	54	24	5.05	4.64	Good-Fair
L Yadkin R	US 52	Stokes	12-77	7/26/88	---	16	---	4.91	Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
L Yadkin R	SR 1104	Stokes	12-77	5/18/94	82	31	5.42	4.08	Good
				5/13/92	94	37	5.15	4.26	Good
				5/13/91	82	32	5.05	4.36	Good
				5/14/90	72	32	4.98	4.49	Good-Fair
				8/7/89	84	27	5.57	4.82	Good-Fair
				5/31/89	77	30	5.62	4.65	Good-Fair
				7/26/88	---	19	---	5.00	Good-Fair
				5/26/88	---	23	---	4.10	Good-Fair
				7/22/87	97	32	5.14	4.25	Good-Fair
				5/6/87	62	25	5.06	4.29	Good-Fair
L Yadkin R	SR 1604	Forsyth	12-77	5/26/88	---	28	---	3.68	Good-Fair
				5/5/87	61	26	4.75	4.21	Good-Fair
W Pr L Yadkin R	SR 1136	Stokes	12-77-1-(1)	5/14/90	69	35	4.18	3.31	Good
				5/30/89	85	35	4.94	3.62	Good
				5/25/88	---	37	---	3.60	Good
				5/6/87	83	39	4.13	3.29	Good
W Pr L Yadkin R	SR 1160	Stokes	12-77-1-(2)	5/14/91	72	27	4.70	3.84	Good-Fair
				5/25/88	---	26	---	4.22	Good-Fair
				6/6/87	70	30	4.77	3.99	Good
E Pr L Yadkin R	SR 1220	Stokes	12-77-2-(1)	5/17/94	60	25	5.38	4.10	Good-Fair
				5/12/92	72	28	5.16	3.99	Good-Fair
				5/14/91	72	28	4.79	4.19	Good
E Pr L Yadkin R	SR 1166	Stokes	12-77-2-(1)	5/13/91	60	25	5.27	4.56	Good-Fair
				5/13/90	59	27	5.34	4.97	Good-Fair
				5/30/89	68	21	5.28	4.51	Good-Fair
				5/25/88	66	25	4.81	4.06	Good-Fair
				5/6/87	57	28	4.40	3.53	Good-Fair
E Pr L Yadkin R	SR 1224	Stokes	12-77-2-(1)	5/17/94	66	30	5.28	4.54	Good-Fair
				5/13/91	81	30	5.01	4.48	Good-Fair
				5/13/90	62	26	5.27	4.35	Good-Fair
				5/31/89	84	29	5.35	4.15	Good-Fair
				5/25/88	88	29	5.41	4.31	Good-Fair
				5/6/87	60	29	4.49	4.03	Good
N UT E Pr L Yadkin R	NC 66	Stokes	12-77-2-(1)	5/17/94	72	36	3.89	2.98	Good
				5/12/92	72	35	3.66	3.02	Good
				5/14/91	70	30	4.08	3.09	Good
S UT E Pr L Yadkin R	NC 66	Stokes	12-77-2-(1)	5/17/94	60	27	4.37	3.71	Good
				5/12/92	70	27	4.70	3.82	Good-Fair
				5/14/91	64	24	4.98	3.80	Good-Fair
Crooked Run Cr	SR 1104	Stokes	12-77-4	5/25/88	---	21	---	4.80	Good-Fair
				5/6/87	60	25	4.43	3.91	Good-Fair
Yadkin R	R 1605	Forsyth	12-(71)	7/21/87	65	23	4.79	3.84	Good
Justice Reynolds Cr	off SR 1561	Yadkin	12-(71)	6/29/93	61	28	4.79	4.15	Good-Fair
				7/5/89	69	25	5.24	4.25	Good-Fair
Justice Reynolds Cr	off SR 1562	Yadkin	12-(71)	6/29/93	70	30	4.29	3.61	Good
				7/5/89	65	27	4.65	4.14	Good-Fair
Dill Cr	off SR 1563	Yadkin	12-(71)	6/29/93	71	26	5.19	4.95	Good-Fair
				7/5/89	78	25	5.37	4.61	Good-Fair
Forbush Cr	SR 1570	Yadkin	12-83-(1.5)	8/8/01	---	22	---	4.15	Good-Fair
				7/24/96	---	23	---	4.02	Good-Fair
Logan Cr	SR 1571	Yadkin	12-83-2-(0.7)	8/9/01	---	31	---	4.77	Good
				7/24/96	---	27	---	4.75	Good-Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
N Deep Cr	SR 1503	Yadkin	12-84-1-(0.5)	4/12/93	62	26	5.21	4.67	Good-Fair
N Deep Cr	NC 601	Yadkin	12-84-1-(0.5)	4/12/93	58	27	5.10	4.38	Good-Fair
N Deep Cr	SR 1510	Yadkin	12-84-1-(0.5)	8/9/01	76	26	5.44	4.55	Good-Fair
				7/25/96	57	24	5.39	4.93	Good-Fair
				4/12/93	53	25	4.90	4.41	Good-Fair
S Deep Cr	SR 1710	Yadkin	12-84-2-(5)	8/9/01	65	19	5.31	4.43	Good-Fair
				7/26/96	56	26	4.88	4.41	Good-Fair
03-07-03									
Ararat R	NC 104	Surry	12-72-(1)	7/23/01	---	25	---	4.03	Good-Fair
				7/25/96	---	26	---	3.95	Good-Fair
				9/23/86	64	18	5.31	4.82	Good-Fair
Ararat R	US 52 Bus	Surry	12-72-(4.5)	9/23/86	63	20	5.70	4.52	Good-Fair
Ararat R	US 52,	Surry	12-72-(4.5)	11/15/94	72	27	5.21	3.90	Good-Fair
	above WWTP			3/20/85	82	24	5.55	4.38	Good-Fair
Ararat R	below WWTP	Surry	12-72-(4.5)	11/15/94	47	13	5.69	4.19	Fair
				9/23/86	32	1	7.56	4.28	Poor
				3/20/85	45	11	6.87	4.39	Poor
Ararat R	SR 2119	Surry	12-72-(4.5)	3/20/85	44	10	6.63	5.11	Poor
Ararat R	SR 2026	Surry	12-72-(4.5)	7/23/01	77	28	5.57	4.61	Good-Fair
				8/28/96	69	20	5.81	4.81	Fair
				7/12/90	59	17	6.16	5.43	Fair
				7/26/88	62	16	6.35	5.68	Fair
				9/24/86	50	11	6.55	5.45	Fair
				8/4/86	65	21	6.16	4.87	Fair
				8/15/84	66	24	5.94	4.68	Fair
Ararat R	SR 2080	Surry	12-72-(4.5)	7/12/01	82	35	4.94	3.85	Good
				8/28/96	42	19	5.27	4.67	Fair
				9/23/86	60	16	5.90	4.48	Fair
Lovills Cr	SR 1700	Surry	12-72-8-(1)	7/24/01	---	26	---	4.17	Good-Fair
				7/25/96	---	22	---	4.75	Good-Fair
				2/16/86	60	25	4.47	3.69	Good-Fair
Lovills Cr	SR 1371	Surry	12-72-8-(3)	7/24/01	67	14	6.38	4.70	Fair
				7/25/96	63	16	6.41	5.05	Fair
				2/19/86	39	12	5.55	4.12	Fair
Stewarts Cr	SR 1622	Surry	12-72-9-(1)	10/20/87	90	32	5.34	3.99	Good-Fair
				2/20/86	104	39	4.47	3.05	Good
Stewarts Cr	NC 89	Surry	12-72-9-(4)	7/24/01	---	18	---	4.63	Fair
				7/25/96	---	23	---	3.88	Good-Fair
Stewarts Cr	SR 2258	Surry	12-72-9-(8)	7/24/01	78	34	5.31	4.47	Good
				7/25/96	81	27	5.60	4.77	Good-Fair
Pauls Cr	SR 690		12-72-9-7	10/20/87	61	25	5.09	4.13	Good-Fair
	(Carroll, Va)								
Brushy Fk	SR 1625	Surry	12-72-9-7-1	10/20/87	---	17	---	4.30	Good-Fair
Flat Shoals Cr	SR 1827	Surry	12-72-13	7/23/01	---	20	---	3.46	Good-Fair
				8/28/96	---	27	---	3.54	Good-Fair
				1/22/87	86	37	4.40	3.52	Good
Toms Cr	NC 52	Surry	12-72-14-(3.5)	1/21/87	56	27	5.20	4.50	Good
Toms Cr	SR 1815	Surry	12-72-14-(4)	1/21/87	51	16	5.66	4.58	Fair
Heatherly Cr	above WWTP	Surry	12-72-14-5	11/15/94	48	18	6.12	4.98	Fair
				1/21/87	47	14	6.52	5.38	Fair
Heatherly Cr	NC 268	Surry	12-72-14-5	8/29/01	50	17	5.03	4.88	Good-Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Heatherly Cr	below WWTP	Surry	12-72-14-5	11/15/94	14	0	8.50	0.00	Poor
				1/21/87	25	2	8.44	7.00	Poor
Heatherly Cr	US 52	Surry	12-72-14-5	8/29/01	44	11	5.80	5.62	Not Rated
Heatherly Cr	below US 52	Surry	12-72-14-5	1/21/87	32	2	8.50	5.35	Poor
03-07-04									
Muddy Cr	SR 1620	Forsyth	12-94-(0.5)	1/14/85	90	29	5.40	4.64	Good
Muddy Cr	ab Westinghouse	Forsyth	12-94-(0.5)	1/24/89	-	22	-	4.49	Good-Fair
				10/13/88	-	18	-	5.46	Good-Fair
				1/15/85	75	22	5.73	4.99	Good-Fair
Muddy Cr	be Westinghouse	Forsyth	12-94-(0.5)	1/24/89	-	15	-	4.77	Fair
				10/13/88	-	11	-	5.81	Fair
				1/15/85	51	19	6.04	5.07	Fair
Muddy Cr	SR 1898	Forsyth	12-94-(0.5)	8/6/01	-	19	-	5.11	Good-Fair
				8/5/96	-	18	-	5.02	Good-Fair
				3/19/87	-	15	-	5.61	Fair
Muddy Cr	off SR 1632	Forsyth	12-94-(0.5)	1/15/85	71	19	6.73	5.70	Fair
Muddy Cr	SR 2995	Forsyth	12-94-(0.5)	8/7/01	50	14	6.47	5.82	Good-Fair
				8/6/96	51	18	6.37	5.56	Good-Fair
				7/31/85	53	17	6.58	5.23	Fair
				8/09/83	54	8	7.38	6.05	Fair
Barkers Cr	SR 1620	Forsyth	12-94-1	3/19/87	6	5	6.42	6.47	Poor
Barkers Cr	ab Parkers Cr	Forsyth	12-94-1	3/19/87	-	18	-	4.68	Good-Fair
Barkers Cr	SR 1898	Forsyth	12-94-1	3/19/87	-	20	-	4.73	Good-Fair
Parkers Cr	SR 1620	Forsyth	12-94-1-1	1/24/89	-	21	-	4.07	Good
				3/19/87	22	18	3.53	3.50	Good-Fair
				1/14/85	78	33	5.07	4.61	Good
Grassy Cr	SR 1669	Forsyth	12-94-7-3	10/17/84	54	11	7.12	5.77	Fair
Grassy Cr	SR 1672	Forsyth	12-94-7-3	10/17/84	65	13	6.95	5.65	Fair
Reynolds Cr	above Sequoia	Forsyth	12-94-9	10/23/00	36	11	5.84	5.32	Not Rated
				8/0/94	44	17	4.70	4.21	Good
Reynolds Cr	below Sequoia	Forsyth	12-94-9	10/23/00	36	6	7.91	7	Not Rated
				8/3/94	41	9	6.51	5.04	Fair
Salem Cr	SR 2657	Forsyth	12-94-12-(1)	8/6/01	13	13	5.07	5.07	Not Impaired
				8/5/96	-	15	-	4.97	Good-Fair
Salem Cr	NC 52	Forsyth	12-94-12-(4)	9/16/83	36	4	8.23	6.88	Poor
Salem Cr	below Bath Br	Forsyth	12-94-12-(4)	9/16/83	29	0	8.87		Poor
Salem Cr	SR 2902	Forsyth	12-94-12-(4)	8/6/01	45	9	6.85	6.31	Fair
				8/5/96	53	11	7.21	5.96	Fair
				9/27/82	31	4	7.94	7.11	Poor
Salem Cr	SR 2991	Forsyth	12-94-12-(4)	8/6/01	39	10	7.10	6.36	Fair
				8/5/96	43	8	7.16	5.85	Fair
				9/27/82	22	0	8.38		Poor
Bath Br	Stadium Dr	Forsyth	-	9/15/83	11	1	9.39	6.22	Poor
S Fk Muddy Cr	SR 2902	Forsyth	12-94-13	8/6/01	-	17	-	5.54	Good-Fair
				8/5/96	-	14	-	4.83	Good-Fair
Fryes Cr	NC 150	Davidson	12-94-15-(1)	9/28/82	53	16	5.82	5.17	Good-Fair
Yadkin R	SR 1447	Davidson	12-(97.5)	9/12/01	67	29	5.46	4.57	Good
				7/9/90	64	27	5.50	4.59	Good
				8/5/86	67	26	5.84	4.83	Good
				9/9/85	60	23	5.68	4.50	Good
				8/9/83	53	19	5.26	4.38	Good-Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Second Cr	SR 2335	Rowan	12-108-21	6/14/88	-	18	-	4.91	Good-Fair
				2/10/87	64	25	5.47	4.00	Good
				10/12/84	91	25	5.60	5.07	Good
Second Cr	SR 2337	Rowan	12-108-21	6/14/88	-	18	-	4.86	Good-Fair
				2/10/87	82	25	6.17	4.11	Good
				10/12/84	78	17	6.47	5.20	Good-Fair
Second Cr	SR 2338	Rowan	12-108-21	10/12/84	93	22	6.34	5.45	Good-Fair
UT Second Cr	SR 2235, ab WWTP	Rowan	12-108-21	6/14/88	-	18	-	5.29	Good-Fair
				2/10/87	-	17	-	4.75	Good-Fair
UT Second Cr	ocation unclear	Rowan	12-108-21	6/14/88	14	14	4.69	4.69	Good-Fair
Grants Cr	SR 1197	Rowan	12-110	7/1/83	20	3	7.57	5.67	Poor
Grants Cr	Patterson St	Rowan	12-110	7/1/83	24	1	8.52	6.22	Poor
Grants Cr	SR 1506	Rowan	12-110	7/1/83	51	10	6.42	5.34	Fair
Grants Cr	SR 1910	Rowan	12-110	8/7/01	72	13	6.57	6.26	Fair
				8/6/96	74	20	6.41	5.48	Good-Fair
				7/13/89	67	20	6.23	5.45	Good-Fair
UT Grants Cr	SR 1500	Rowan	12-110	8/28/01	34	14	5.33	4.63	Not Impaired
				9/10/90	26	0	8.33	-	Poor
Little Cr	SR 1535	Rowan	12-110-3	9/10/90	46	14	5.23	4.20	Good-Fair
N Potts Cr	ab UT	Davidson	12-112	10/20/88	-	14	-	5.26	Good-Fair
N Potts Cr	be UT	Davidson	12-112	10/20/88	-	18	-	4.54	Good-Fair
UT N Potts Cr	ab WWTP	Davidson	12-112	10/20/88	34	11	6.10	4.62	Fair
UT N Potts Cr	be WWTP	Davidson	12-112	10/20/88	26	6	6.57	4.60	Fair
Town Cr	above WWTP	Rowan	12-115-3	9/10/90	68	9	7.84	6.46	Poor
Town Cr	I-85	Rowan	12-115-3	8/7/01	50	8	6.93	6.76	Fair
				9/10/90	32	0	8.35	-	Poor
03-07-05									
Dutchmans Cr	US 158	Davie	12-102-(1)	8/7/01	72	20	6.34	5.46	Good-Fair
				7/24/96	69	24	5.63	4.80	Good
Dutchmans Cr	NC 801	Davie	12-102-(2)	8/7/01	77	17	6.54	5.20	Fair
				7/24/96	84	30	6.24	4.65	Good
Cedar Cr	NC 801	Davie	12-102-13-(1)	6/11/90	---	10	---	5.98	Fair
Cedar Cr	above quarry	Davie	12-102-13-(2)	6/13/90	63	13	6.62	6.22	Fair
Cedar Cr	I-40, be quarry	Davie	12-102-13-(2)	6/13/90	69	16	6.50	6.00	Good-Fair
Cedar Cr	US 158	Davie	12-102-13-(2)	7/24/96	---	15	---	6.00	Good-Fair
Elisha Cr	SR 1405	Davie	12-102-15	4/7/88	---	27	---	4.08	Good
03-07-06									
S Yadkin R	SR 1561	Iredell	12-108-(5.5)	9/11/01	68	21	5.80	4.92	Good-Fair
				7/24/01	77	25	5.83	5.07	Good
				8/5/96	70	30	4.97	4.25	Excellent
S Yadkin R	SR 1159	Davie	12-108-(14.5)	7/24/01	80	32	4.71	3.92	Excellent
				8/6/96	60	29	4.51	3.83	Good
				7/13/89	73	32	4.69	3.94	Excellent
				8/5/86	79	26	5.05	4.17	Good
				8/27/84	83	34	4.73	3.95	Excellent
Rocky Cr	SR 1862	Iredell	12-108-11	11/7/90	91	45	4.01	3.03	Excellent
Rocky Cr	SR 1884	Iredell	12-108-11	7/23/01	---	38	---	3.77	Excellent
				8/5/96	---	26	---	3.75	Good
Rocky Cr	SR 1890	Iredell	12-108-11	11/7/90	79	37	4.49	3.49	Excellent
Patterson Cr	SR 1892	Iredell	12-108-11-3	8/5/96	---	22	---	4.24	Good

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Patterson Cr	SR 1890	Iredell	12-108-11-3	7/23/01	---	25	---	4.06	Good
				11/7/90	77	32	5.32	4.32	Excellent
Fifth Cr	SR 2158	Iredell	12-108-13	6/21/89	---	25	---	4.82	Good
Hunting Cr	SR 2428	Wilkes	12-108-16-(0.5)	4/13/93	89	46	3.57	2.62	Excellent
Hunting Cr	NC 115	Wilkes	12-108-16-(0.5)	7/30/01	---	37	---	3.67	Excellent
				6/16/92	84	43	3.96	3.51	Excellent
Hunting Cr	SR 2423	Wilkes	12-108-16-(0.5)	6/16/92	85	42	4.23	3.45	Good
Hunting Cr	SR 2115	Iredell	12-108-16-(0.5)	7/23/01	74	31	5.06	4.19	Excellent
				8/07/96	66	30	4.66	3.29	Excellent
				7/27/88	72	27	5.36	4.08	Good
				7/30/85	79	33	4.94	3.71	Excellent
				8/10/83	78	28	5.24	4.35	Good
Hunting Cr	SR 2120	Iredell	12-108-16-(0.5)	6/12/90	82	40	4.54	4.15	Excellent
Hunting Cr	SR 2127	Iredell	12-108-16-(0.5)	6/12/90	66	34	5.24	4.66	Excellent
Hunting Cr	US 64	Davie	12-108-16-(0.5)	6/12/90	---	28	---	3.79	Excellent
N Little Hunting Cr	SR 1829	Iredell	12-108-16-6	7/23/01	---	31	---	4.08	Excellent
				8/5/96	---	28	---	3.68	Excellent
Bear Cr	US 64	Davie	12-108-18-(1)	5/25/94	74	23	5.70	4.82	Good-Fair
Bear Cr	SR 1139	Davie	12-108-18-(3)	4/7/88	77	25	5.87	5.15	Good-Fair
Bear Cr	SR 1116	Davie	12-108-18-(3)	4/7/88	93	25	6.34	4.89	Good-Fair
Fourth Cr	SR 2321	Iredell	12-108-20	9/16/87	---	16	---	5.31	Good-Fair
Fourth Cr	SR 2322	Iredell	12-108-20	9/16/87	---	16	---	5.23	Good-Fair
Fourth Cr	SR 2316	Iredell	12-108-20	9/11/01	51	13	6.13	5.11	Fair
				6/22/89	59	18	5.96	5.62	Good-Fair
Fourth Cr	SR 2308	Iredell	12-108-20	9/12/01	57	12	6.89	6.00	Fair
				6/22/89	63	17	6.99	5.81	Fair
Fourth Cr	SR 1003	Rowan	12-108-20	9/11/01	---	23	---	5.21	Good
				7/24/01	---	20	---	5.30	Good-Fair
				8/6/96	---	23	---	5.00	Good
Third Cr	SR 2318	Iredell	12-108-20-4	9/11/90	69	22	5.69	5.17	Good
				6/2189	71	23	5.71	5.37	Good
Third Cr	SR 2359	Iredell	12-108-20-4	9/11/90	72	21	5.96	5.13	Good-Fair
				6/21/89	69	17	6.09	5.24	Good-Fair
Third Cr	SR 1970	Rowan	12-108-20-4	7/24/01	52	22	5.23	4.40	Good
				8/6/96	56	23	4.93	4.36	Good
				7/9/90	62	23	5.62	4.18	Good
				7/20/87	68	26	5.69	4.10	Good
North Second Cr	SR 1526	Rowan	12-108-21	7/24/01	---	10	---	5.95	Fair
				8/6/86	---	16	---	4.75	Good-Fair
North Second Cr	US 70	Rowan	12-108-21	7/24/01	66	16	6.83	6.07	Fair
				8/7/96	54	17	6.20	5.81	Good-Fair
Withrow Cr	SR 1547	Rowan	12-108-21-3	7/25/01	---	18	---	4.77	Good-Fair
				8/7/96	---	14	---	4.64	Good-Fair
03-07-07									
Swearing Cr	SR 1147	Davidson	12-113	11/13/87	62	20	6.23	5.44	Good-Fair
Swearing Cr	SR 1104	Davidson	12-113	11/13/87	63	18	6.27	5.48	Good-Fair
				10/30/85	46	9	6.91	4.48	Fair
Swearing Cr	above WWTP	Davidson	12-113	10/30/85	72	21	6.29	4.99	Good-Fair
Swearing Cr	SR 1272	Davidson	12-113	10/30/85	42	7	7.50	5.88	Poor
Swearing Cr	NC 47	Davidson	12-113	7/25/01	---	13	---	5.75	Fair
				8/7/96	---	16	---	5.15	Good-Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Abbots Cr	SR 1755	Davidson	12-119-(1)	9/28/01	---	15	---	5.42	Good-Fair
				8/8/96	---	16	---	4.84	Good-Fair
Brushy Fk	SR 1810	Davidson	12-119-5-(1)	7/30/01	53	20	5.40	4.40	Good
				8/8/96	---	13	---	4.65	Fair
Abbotts Cr	SR 1243	Davidson	12-119-(6)	7/25/01	61	15	6.80	6.22	Fair
				8/9/96	62	17	6.54	6.15	Fair
				11/13/85	49	12	7.42	6.17	Fair
Abbotts Cr	below WWTP	Davidson	12-119-(6)	11/15/85	47	13	7.17	5.73	Fair
Abbotts Cr	I-85	Davidson	12-119-(6)	11/12/87	46	10	7.50	5.72	Fair
				8/4/86	46	10	7.5	6.48	Fair
				11/15/85	58	17	7.01	5.9	Fair
				9/24/84	55	8	7.22	5.86	Fair
Abbotts Cr	US 29/70	Davidson	12-119-(6)	11/14/85	49	12	7.28	5.79	Fair
Rich Fk	SR 1784	Davidson	12-119-7	11/13/87	60	14	6.75	5.27	Fair
				11/12/85	62	19	6.2	5.3	Good-Fair
Rich Fk	NC 109	Davidson	12-119-7	11/12/85	56	10	7.83	5.35	Fair
Rich Fk	SR 1792	Davidson	12-119-7	11/12/87	53	10	6.86	5.98	Fair
				11/14/85	34	2	8.13	6.81	Poor
				9/29/83	18	0	8.80	0	Poor
Rich Fk	SR 2123	Davidson	12-119-7	9/29/83	35	2	8.39	5.39	Poor
Rich Fk	SR 2022	Davidson	12-119-7	11/14/85	50	11	7.41	5.92	Fair
Rich Fk	SR 2005	Davidson	12-119-7	7/25/01	65	15	6.98	6.5	Fair
				11/9/87	57	13	7.03	5.81	Fair
				11/15/85	57	12	7.36	5.62	Fair
				9/29/83	34	3	7.89	6.63	Poor
Hunts Fk	SR 1792	Davidson	12-119-7-3	11/12/87	49	13	6.84	5.57	Fair
				11/13/85	69	15	6.84	5.63	Fair
Hunts Fk	above SR 1787	Davidson	12-119-7-3	8/28/01	66	9	7.21	6.46	NR
				9/29/83	40	4	8.49	2.17	Poor
Hunts Fk	SR 1787	Davidson	12-119-7-3	9/83	42	0	8.5	0	Poor
Hamby Cr	SR 2031	Davidson	12-119-7-4	11/9/87	44	3	7.92	5.73	Poor
				11/13/85	35	4	7.96	6.44	Poor
Hamby Cr	SR 2025	Davidson	12-119-7-4	8/8/96	---	6	---	6.36	Poor
Hamby Cr	SR 2005	Davidson	12-119-7-4	11/13/85	57	12	7.18	5.85	Fair
Hamby Cr	near SR 2005, above confluence	Davidson	12-119-7-4	9/29/83	34	4	7.42	6.11	Poor
Hamby Cr	SR 2017	Davidson	12-119-7-4	7/30/01	58	12	6.55	6.12	Fair
N Hamby Cr	SR 2085	Davidson	12-119-7-4-1	11/9/87	48	6	8.07	7.74	Poor
				11/13/85	41	7	7.52	6.7	Poor
N Hamby Cr	SR 2031	Davidson	12-119-7-4-1	8/28/01	41	3	7.09	7.0	Poor
Jimmy’s Cr	above quarry	Davidson	12-119-7-4-2	6/14/90	58	15	6.35	6.04	Not Rated
Jimmy’s Cr	SR 2020	Davidson	12-119-7-4-2	6/14/90	58	14	6.34	5.75	Not Rated
Leonards Cr	Leonard Creek Farm Rd	Davidson	12-119-8-(3)	7/25/01	---	17	---	5.18	Good-Fair
Leonards Cr	SR 1844	Davidson	12-119-8-(3)	8/8/96	---	18	---	5.14	Good-Fair
03-07-08									
UT Lick Cr	NC 47	Davidson	12-126-(3)	5/14/86	53	4	8.24	6.39	Poor
				5/15/85	32	2	8.46	7.31	Poor
UT Lick Cr	SR 2505	Davidson	12-126-(3)	5/14/86	56	11	7.20	4.58	Fair
				5/15/85	23	1	8.90	4.72	Poor
Lick Cr	SR 2351	Davidson	12-126-(3)	5/15/85	84	18	6.22	5.46	Good-Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Lick Cr	NC 8	Davidson	12-126-(3)	8/7/01	-	11	-	6.52	Fair
				8/6/96	-	12	-	5.54	Fair
				5/20/85	76	22	6.16	4.97	Good-Fair
Cabin Cr	NC 8	Davidson	12-127-(2)	8/06/96	20	20	-	4.59	Good-Fair
				5/16/85	88	16	6.05	5.07	Good-Fair
Mountain Cr	SR 1720	Stanly	13-5-(0.7)	8/8/01	-	18	-	5.20	Good-Fair
				8/6/96	91	25	5.65	5.09	Good
L Mountain Cr	SR 1720	Stanly	13-5-1-(2)	8/8/01	54	12	5.92	5.82	Fair
				8/7/96	-	11	-	5.91	Fair
03-07-09									
Uwharrie R	SR 1406	Randolph	13-2-(0.5)	8/9/01	-	18	-	5.34	Good-Fair
				8/8/96		22	4.97	4.97	Good-Fair
L Uwharrie R	SR 1405	Randolph	13-2-1	8/9/01	-	18	-	4.72	Good-Fair
				8/8/96	-	14	4.37	4.37	Good-Fair
Uwharrie R	SR 1143	Randolph	13-2-1-(1.5)	8/9/01	84	27	5.67	4.90	Good
				8/8/96	72	19	5.22	4.67	Good
Jackson Cr	SR 1312	Randolph	13-2-2	8/8/96	-	19	-	4.00	Good-Fair
Caraway Cr	SR 1331	Randolph	13-2-3	8/9/01	-	18	-	4.39	Good-Fair
				8/8/96	-	17	-	4.73	Good-Fair
Back Cr	SR 1318	Randolph	13-2-3-3-(1.5)	8/8/96	-	15	-	4.44	Good-Fair
L Back Cr	SR 1327	Randolph	13-2-3-3-(1.5)	2/9/89	57	21	5.10	3.63	Good-Fair
UT Back Cr	off SR 1504	Randolph	13-2-3-3-(1.5)	2/21/90	82	21	5.60	4.74	Good-Fair
UT Back Cr	SR 1512	Randolph	13-2-3-3-(1.5)	2/21/90	61	17	6.53	5.24	Good-Fair
Betty McGees Cr	SR 1107	Randolph	13-2-5	10/25/89	-	27	-	3.31	Good
Uwharrie R	NC 109	Montgomery	13-2-(17.5)	8/8/01	89	33	4.97	3.85	Excellent
				8/8/96	80	27	5.27	4.12	Good
				7/23/90	81	30	5.22	4.23	Good
				7/15/88	101	30	5.29	3.90	Good
				7/25/86	100	27	5.48	3.98	Good
Barnes Cr	SR 1307	Montgomery	13-2-18-(0.5)	3/16/88	-	30	-	3.63	Excellent
UT Barnes Cr (Poison Br)	SR 1306	Montgomery	13-2-18-1	3/17/88	-	33	-	2.84	Excellent
Barnes Cr	SR 1303	Montgomery	13-2-18-(2.5)	9/28/01	79	38	4.16	3.02	Excellent
				8/9/01	108	40	4.21	3.54	Excellent
				8/7/96	99	36	4.46	3.40	Excellent
				7/11/89	83	24	4.88	3.79	Good
				7/20/87	-	28	-	4.04	Excellent
				7/8/87	90	27	4.92	3.78	Good
				8/1/85	87	29	4.85	4.01	Excellent
				5/20/85	100	36	4.88	3.99	Excellent
				10/31/84	97	37	4.57	3.49	Excellent
Cedar Cr	SR 1150	Montgomery	13-2-23	3/17/88	90	39	4.02	3.28	Excellent
Dutchmans Cr	SR 1150	Montgomery	13-2-24	8/8/01	-	26	-	3.04	Not Rated
				8/7/96	63	29	3.76	3.05	Excellent
				7/31/85	60	24	4.05	3.22	Not Rated
				8/20/96	59	18	6.24	5.46	Good-Fair
				7/12/89	74	23	5.95	5.17	Good-Fair
				7/24/86	78	12	6.68	5.29	Fair
03-07-10									
Clarks Cr	SR 1174	Montgomery	13-16	8/7/96	-	24	-	3.91	Good
Clarks Cr	SR 1110	Montgomery	13-16	8/8/01	-	18	-	4.95	Good-Fair
				8/7/96	82	26	5.89	5.20	Good-Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Brown Cr	SR 1627	Anson	13-20	8/21/96	70	8	7.04	6.07	Fair
Lick Cr	SR 1244	Anson	13-20-5	4/3/86	88	21	6.20	5.13	Good-Fair
Savannah Cr	SR 1742	Anson	13-26	9/22/83	33	4	6.87	5.96	Not Rated
Mountain Cr	SR 1150	Richmond	13-28-1-(0.5)	8/8/01	-	25	-	3.77	Good
				8/6/96	-	30	-	3.83	Excellent
03-07-11									
Rocky R	SR 2420	Mecklenburg	13-17	8/21/01	41	8	6.73	6.32	Fair
				8/19/96	---	7	---	5.84	Fair
				3/26/85	64	13	6.41	4.92	Fair
Rocky R	SR 1142	Iredell	13-17	6/6/85	59	18	6.1	5.15	Good-Fair
Rocky R	SR 1608	Cabarrus	13-17	6/6/85	57	16	6.13	5.31	Good-Fair
Rocky R	NC 29	Cabarrus	13-17	3/26/85	70	19	6.15	5.16	Fair
Rocky R	SR 1132	Cabarrus	13-17	3/27/85	81	27	6.18	5.37	Good-Fair
Dye Br	SR 1147	Iredell	13-17-2	9/11/01	44	9	6.34	6.29	Not Rated
				9/11/90	52	13	6.33	5.70	Fair
				6/6/85	53	14	6.53	5.63	Fair
Dye Br	SR 1142	Iredell	13-17-2	9/11/01	25	2	7.75	6.25	Poor
				9/11/90	27	4	7.95	6.77	Poor
				6/6/85	30	4	8.15	5.88	Poor
Mallard Cr	SR 1300	Cabarrus	13-17-5	3/27/85	82	22	6.16	5.0	Good-Fair
Coddle Cr	SR 1612	Cabarrus	13-17-6-(0.5)	6/6/85	66	21	5.80	5.03	Good-Fair
Coddle Cr	NC 49	Cabarrus	13-17-6-(5.5)	8/21/01	67	14	6.59	5.74	Fair
				8/19/96	---	13	---	5.40	Fair
Back Cr	SR 2827	Mecklenburg	13-17-7	10/16/84	64	19	6.18	5.03	Good-Fair
Fuda Cr	SR 1158	Cabarrus	13-17-7-1	3/27/85	74	18	6.6	5.84	Fair
UT Reedy Cr	below landfill	Mecklenburg	13-17-8	10/16/84	44	11	7.09	5.69	Not Rated
03-07-12									
Rocky R	US 601	Cabarrus	13-17	8/22/01	48	15	6.55	5.79	Fair
				8/20/96	56	19	6.15	5.5	Good-Fair
				7/12/89	66	19	6.36	5.40	Good-Fair
Rocky R	NC 24/27	Cabarrus	13-17	3/28/85	86	30	6.22	4.91	Good-Fair
Irish Buffalo Cr	SR 1132	Cabarrus	13-17-9-(2)	8/21/01	56	15	6.37	5.62	Good-Fair
				8/19/96	58	15	6.01	5.36	Good-Fair
Coldwater Cr	NC 49	Cabarrus	13-17-9-4-(1.5)	8/21/01	---	15	---	5.16	Good-Fair
				8/19/96	---	14	---	5.15	Good-Fair
Dutch Buffalo Cr	SR 1006	Cabarrus	13-17-11-(4.5)	3/27/85	92	24	5.78	4.72	Good-Fair
Dutch Buffalo Cr	NC 200	Cabarrus	13-17-11-5	8/22/01	79	18	6.66	5.75	Good-Fair
				8/20/96	59	18	6.24	5.46	Good-Fair
				7/12/89	74	23	5.95	5.17	Good-Fair
				7/24/86	78	12	6.68	5.29	Fair
Clear Cr	SR 3181	Mecklenburg	13-17-17	8/22/01	57	15	5.96	5.16	Good-Fair
				5/1/98	---	19	---	4.77	Good-Fair
Goose Cr	SR 1004	Mecklenburg	13-17-18	4/21/98	80	18	5.92	5.34	Good-Fair
Goose Cr	below Fairfield Plantation	Union	13-17-18	4/22/98	---	12	---	5.43	Fair
Goose Cr	Glamorgan Rd	Union	13-17-18	4/22/98	---	22	---	4.62	Good
Goose Cr	SR 1524	Union	13-17-18	4/22/98	---	16	---	4.65	Good-Fair
Goose Cr	SR 1525	Union	13-17-18	4/21/98	35	4	6.93	6.96	Poor
Goose Cr	SR 1533	Union	13-17-18	4/21/98	---	9	---	5.5	Fair

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Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Goose Cr	US 601	Union	13-17-18	8/22/01	48	5	7.16	5.98	Poor
				7/21/98	47	10	7.37	5.87	Poor
				8/20/96	---	2	---	6.09	Poor
Goose Cr	SR 1547	Union	13-17-18	5/1/98	---	11	---	6.01	Fair
Stephens Cr	off Maple Hollow Road	Mecklenburg	13-17-18-1	4/21/98	87	26	5.29	4.09	Good
UT Stephens Cr	Thompson Rd	Mecklenburg	13-17-18-1	4/20/98	48	12	5.35	4.70	Not Impaired
Duck Cr	US 601	Union	13-17-18-3	4/21/98	65	14	6.43	5.41	Fair
Crooked Cr	SR 1547	Union	13-17-20	8/22/01	68	18	5.93	5.15	Good-Fair
				8/20/96	---	12	---	4.67	Fair
N Fk Crooked Cr	SR 1520	Union	13-17-20-1	6/27/00	57	6	7.23	6.50	Fair
				9/12/95	46	8	6.57	5.92	Fair
N Fk Crooked Cr	SR 1514	Union	13-17-20-1	6/27/00	53	7	6.98	6.79	Fair
				9/12/95	59	12	6.45	5.78	Good-Fair
N Fk Crooked Cr	SR 1004	Union	13-17-20-1	9/12/95	48	9	6.69	6.40	Fair
S Fk Crooked Cr	above SR 1515	Union	13-17-20-2	9/13/95	59	3	7.46	6.82	Poor
S Fk Crooked Cr	SR 1515	Union	13-17-20-2	9/13/95	54	5	6.89	6.83	Fair
S Fk Crooked Cr	SR 1367	Union	13-17-20-2	9/12/95	42	8	6.71	6.22	Fair
03-07-13									
Long Cr	SR 1401	Stanly	13-17-31	8/20/01	---	17	---	5.13	Good-Fair
Long Cr	above WWTP	Stanly	13-17-31	8/22/89	67	15	6.75	5.84	Fair
Long Cr	SR 1967	Stanly	13-17-31	8/22/89	56	10	6.49	6.22	Fair
Long Cr	SR 1917	Stanly	13-17-31	8/23/01	70	20	5.85	4.87	Good-Fair
				8/22/96	64	14	5.77	5.32	Good-Fair
				7/12/89	76	22	6.13	5.28	Good-Fair
				7/24/86	88	12	6.88	5.64	Fair
				9/2/83	59	15	6.63	4.92	Fair
Lower(Little) Long Br	SR 2001	Stanly	13-17-31-4	6/3/91	47	7	6.63	4.7	NR
Lower(Little) Long Br	below NC 138	Stanly	13-17-31-4	6/3/91	54	15	6.91	6.26	NR
Big Bear Cr	SR 1434	Stanly	13-17-31-5	8/22/89	---	10	---	5.39	Fair
Big Bear Cr	SR 1134	Stanly	13-17-31-5	8/22/96	---	24	---	3.83	Good
				7/24/90	88	31	5.71	4.89	Good
				7/20/87	97	28	5.90	4.92	Good
Big Bear Cr	SR 1225	Stanly	13-17-31-5	8/20/01	---	22	---	4.53	Good
Stony Run Cr	SR 1970	Stanly	13-17-31-5-5	8/20/01	---	12	---	5.55	Fair
				8/22/96	---	19	---	4.22	Good-Fair
03-07-14									
Rocky R	SR 1970	Stanly	13-17	6/3/91	---	16	---	3.43	Good-Fair
Rocky R	above Carolina Solite	Stanly	13-17	6/3/91	---	14	---	4.38	Good-Fair
Rocky R	below Carolina Solite	Stanly	13-17	6/3/91	---	16	---	4.55	Good-Fair
Rocky R	SR 1943	Stanly	13-17	8/23/01	62	24	5.07	4.24	Good
Rocky R	SR 1935	Stanly	13-17	8/21/96	68	22	5.41	4.66	Good
				7/24/90	80	28	5.45	4.29	Good
				7/14/88	80	25	5.38	4.23	Good
				7/24/86	93	22	6.24	5.06	Good-Fair
				7/31/85	76	25	5.31	4.57	Good
				3/28/85	99	27	5.29	3.96	Good
				9/24/84	79	25	5.81	4.05	Good
				8/2/83	73	23	6.05	4.61	Good-Fair

Note: Streams that were sampled during 2001 (the most recent data used for this basin plan) are presented in **bold** type.

Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Richardson Cr	SR 1751	Union	13-17-36-(5)	9/14/90	57	6	7.67	7.32	Poor
				3/13/89	62	12	7.5	5.7	Fair
Richardson Cr	SR 1006	Union	13-17-36-(5)	8/24/01	48	8	6.74	6.88	Fair
				9/14/90	55	5	7.35	6.62	Poor
				3/13/89	52	14	7.64	5.51	Fair
Richardson Cr	SR 1649	Union	13-17-36-(5)	8/23/01	46	10	6.38	6.17	Fair
				8/21/96	46	12	6.22	5.63	Fair
				7/24/90	57	10	6.95	6.12	Fair
				7/8/87	57	10	6.96	5.98	Fair
Richardson Cr	SR 1600	Anson	13-17-36-(5)	8/23/01	---	24	---	3.98	Good
				8/21/96	---	18	---	3.91	Good-Fair
				8/1/83	69	20	6.28	5.34	Good-Fair
Lanes Cr	SR 2111	Union	13-17-40-(1)	5/16/89	52	9	6.5	4.4	Fair
Lanes Cr	SR 1937	Union	13-17-40-(1)	5/16/89	59	15	6.20	5.03	Fair
				5/11/88	58	13	6.53	4.84	Fair
Lanes Cr	SR 1929	Union	13-17-40-(1)	5/17/89	72	13	6.30	5.16	Fair
Lanes Cr	SR 1901	Union	13-17-40-(12)	8/21/96	---	6	---	6.21	Poor
Lanes Cr	SR 1612	Anson	13-17-40-(12)	8/21/96	---	11	---	4.93	Fair
Wicker Br	SR 1940	Union	13-17-40-4	5/16/89	60	10	6.54	5.45	NR
				5/11/88	62	11	6.41	4.55	NR
Waxhaw Br	SR 1937	Union	13-17-40-6	5/16/89	38	8	6.06	4.6	NR
				5/11/88	56	12	6.93	5.09	NR
03-07-15									
Little R	SR 1127	Randolph	13-25-(11.5)	10/24/89	-	22	-	4.12	Good-Fair
Little R	SR 1349	Montgomery	13-25-(11.5)	10/24/89	-	36	-	3.65	Excellent
Little R	above SR 1340	Montgomery	13-25-(11.5)	11/28/95	89	36	4.36	3.26	Excellent
Little R	SR 1340	Montgomery	13-25-(11.5)	8/13/01	92	30	4.72	3.54	Excellent
				8/22/96	98	39	5.11	3.94	Excellent
				11/28/95	90	36	4.48	3.54	Excellent
				10/25/89	-	40	-	3.38	Excellent
				7/15/88	106	40	4.88	3.72	Excellent
				7/31/85	104	40	4.37	3.67	Excellent
				8/2/83	80	23	5.28	4.34	Good
Little R	below SR 1340	Montgomery	13-25-(11.5)	11/28/95	93	34	4.68	3.52	Excellent
W Fk Little R	SR 1115	Randolph	13-25-15	2/22/94	88	30	4.85	3.51	Excellent
W Fk Little R	NC 134	Montgomery	13-25-15	2/22/94	93	32	5.15	3.50	Good
W Fk Little R	SR 1311	Montgomery	13-25-15	8/13/01	37	26	4.25	4.06	Excellent
				8/22/96	-	30	-	4.04	Excellent
				2/22/94	78	28	4.79	3.51	Good
				10/24/89	-	25	-	3.60	Good
Little R	SR 1565	Montgomery	13-25-(19)	10/25/89	-	21	-	3.52	Good-Fair
Little R	NC 731	Montgomery	13-25-(19)	8/15/01	72	29	5.01	4.33	Good
				8/21/96	76	29	5.37	4.22	Good
Densons Cr	NC 134	Montgomery	13-25-20-(1)	10/24/89	-	38	-	3.84	Excellent
Densons Cr	SR 1323	Montgomery	13-25-20-(9)	7/29/92	98	31	5.52	4.45	Good
Densons Cr	SR 1324	Montgomery	13-25-20-(9)	7/29/92	75	17	5.98	5.63	Good-Fair
Bridgers Cr	SR 1519	Montgomery	13-25-24	10/25/89	-	31	-	3.99	Excellent
Rocky Cr	SR 1134	Montgomery	13-25-30-(0.3)	3/16/88	-	21	-	4.46	Good-Fair
Rocky Cr	NC 24/27	Montgomery	13-25-30-(0.3)	8/22/96	-	19	-	3.25	Good-Fair
Rocky Cr	SR 1549	Montgomery	13-25-30-(0.5)	3/16/88	104	35	4.99	3.61	Excellent

Note: Streams that were sampled during 2001 (the most recent data used for this basin plan) are presented in **bold** type.

Waterbody	Location	County	Index No.	Date	ST	EPT	NCBI	EPTBI	BioClass[1]
Disons Cr	above SR 1543	Montgomery	13-25-32	6/6/97	59	20	5.67	4.78	Good
Disons Cr	SR 1543	Montgomery	13-25-32	6/6/97	73	26	5.31	4.82	Good
Cheek Cr	SR 1541	Montgomery	13-25-36	8/15/01	62	9	6.50	6.13	Fair
				8/21/96	66	15	6.33	5.20	Good-Fair
03-07-16									
Pee Dee R	US 74	Richmond	13-(34)	7/23/90	70	21	5.99	4.77	Good-Fair
				7/14/88	68	19	6.54	5.23	Good-Fair
				9/11/85	64	21	6.11	4.94	Good-Fair
				9/24/84	68	21	5.79	4.13	Good-Fair
				8/1/83	67	17	6.79	5.42	Fair
Cartledge Cr	SR 1142	Richmond	13-35	8/19/96	-	11	-	5.57	Fair
UT Hitchcock Cr	SR 1475	Richmond	13-39-(1)	10/24/90	61	20	5.39	3.39	Good-Fair
Hitchcock Cr	SR 1486	Richmond	13-39-(1)	8/15/01	-	23	-	3.24	Good
				8/19/96	-	21	-	21	Good
Bones Fork Cr	SR 1487	Richmond	13-39-5	11/7/84	72	27	4.67	2.82	Excellent
UT Bones Fork Cr	SR 1475	Richmond	13-39-5	10/24/90	76	25	5.87	3.74	Good
Beaverdam Cr	SR 1486	Richmond	13-39-8-7	8/14/01	-	24	-	2.39	Not Impaired
				8/19/96	-	27	-	3.21	Excellent
Hitchcock Cr	US 74	Richmond	13-39-(10)	8/14/01	72	21	5.67	4.53	Good
				10/18/88	-	11	-	4.72	Fair
Hitchcock Cr	above Fox Yarns	Richmond	13-39-(10)	10/18/88	-	12	-	4.38	Fair
Hitchcock Cr	below Fox Yarns	Richmond	13-39-(10)	10/18/88	-	10	-	4.69	Fair
Hitchcock Cr	SR 1109	Richmond	13-39-(10)	8/15/01	71	21	6.01	4.61	Good-Fair
				8/20/96	40	5	7.85	6.47	Poor
Marks Cr	SR 1812	Richmond	13-45-2	8/19/96	59	15	6.26	4.86	Good-Fair
				2/21/91	63	11	7.06	5.99	Fair
Marks Cr	NC 177	Richmond	13-45-2	2/21/91	59	22	6.96	4.82	Good Fair
Marks Cr	SR 1104	Richmond	13-45-2	2/21/91	-	12	-	5.70	Fair
03-07-17									
Jones Cr	SR 1812	Anson	13-42	12/8/92	55	17	6.02	5.25	Good-Fair
Jones Cr	NC 145, near Pee Dee	Anson	13-42	8/14/01	74	18	5.95	4.49	Good-Fair
				8/20/96	63	17	5.84	4.86	Good-Fair
				7/23/90	73	16	5.93	5.04	Good Fair
				7/7/87	70	24	5.94	4.65	Good-Fair
N Fk Jones Cr	SR 1121	Anson	13-42-1-(0.5)	8/13/01	63	16	6.14	5.42	Good-Fair
				8/20/96	-	11	-	5.18	Fair
				12/8/92	51	15	5.87	4.52	Fair
Moss Br	McLaurin Rd	Anson	13-42-1-3-1	9/22/83	23	0	8.03	-	Not Rated
Moss Br	US 74	Anson	13-42-1-3-1	9/22/83	28	2	8.32	6.50	Not Rated
S Fk Jones Cr	SR 1821, above WWTP	Anson	13-42-2	8/20/96	-	15	-	4.99	Good-Fair
				12/8/92	49	14	6.11	4.91	Good-Fair
S Fk Jones Cr	SR 1821, below WWTP	Anson	13-42-2	12/8/92	41	11	6.08	5.29	Fair
Shaw Cr	SR 1421	Anson	13-42-2-4	4/3/86	70	26	5.69	4.83	Good-Fair

Note: Streams that were sampled during 2001 (the most recent data used for this basin plan) are presented in **bold** type.

Fish Community Sampling Methods and Bioclassification Criteria

At each sample site, a 600-foot section of stream was selected and measured. The fish in the delineated stretch of stream were then collected using two backpack electrofishing units and two persons netting the stunned fish. After collection, all readily identifiable fish were examined for sores, lesions, fin damage or skeletal anomalies, measured (total length to the nearest 1 mm), and then released. Those fish that were not readily identifiable were preserved and returned to the laboratory for identification, examination and total length measurement. Detailed descriptions of the sampling methods may be found at http://www.esb.enr.state.nc.us/BAU.html.

The NCIBI is a modification of the Index of Biotic Integrity initially proposed by Karr (1981) and Karr, et al. (1986). The IBI method was developed for assessing a stream's biological integrity by examining the structure and health of its fish community. The scores derived from this index are a measure of the ecological health of the waterbody and may not directly correlate to water quality. For example, a stream with excellent water quality, but with poor or fair fish habitat, would not be rated excellent with this index. However, in many instances, a stream which rated excellent on the NCIBI should be expected to have excellent water quality.

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

Currently, the focus of using and applying the NCIBI has been restricted to wadeable streams that can be sampled by a crew of four persons. The bioclassifications and criteria have also been recalibrated against regional reference site data. Criteria and ratings applicable only to wadeable streams in the mountain and piedmont regions of the Yadkin River basin are the same as those for the Broad, Catawba and Savannah River basins. The definition of the mountain and piedmont for these four river basins is based on a map of North Carolina watersheds by Fels (1997). Metrics and ratings should not be applied to nonwadeable streams and trout streams in each of these basins. These streams, along with streams draining the Sandhills ecoregion in the southeast corner of the Yadkin River basin, are currently not rated.

Karr, J.R. 1981. *Assessment of Biotic Integrity Using Fish Communities*. Fisheries 6:21-27.

____. K.D. Fausch, P.L. Angermeier, P.R. Yant and I.J. Schlosser. 1986. *Assessing Biological Integrity in Running Water: A Method and its Rationale*. Ill. Nat. Hist. Surv. Spec. Publ. 5. 28 pp.

Table A-II-2 Fish Community Structure Data Collected in the Yadkin-Pee Dee River Basin, 1990-2001

Subbasin/ Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
03-07-01						
Yadkin R	NC 268	Caldwell	12-1	06/18/01	48	Good
				05/23/96	48	Good
Buffalo Cr	SR 1594	Caldwell	12-19	06/08/99	56	Excellent
Laurel Cr	SR 1508	Watauga	12-24-8	05/05/99	52	Good
				10/01/98	54	Excellent
				05/23/96	54	Excellent
Beaver Cr	SR 1131	Wilkes	12-25	06/18/01	50	Good
				05/21/96	50	Good
North Prong Lewis Fk	SR 1304	Wilkes	12-31-1-(5.5)	06/19/01	56	Excellent
				05/21/96	48	Good
South Prong Lewis Fk	SR 1154	Wilkes	12-31-2-(7)	06/19/01	48	Good
				05/21/96	50	Good
Middle Fork Reddies R	SR 1562	Wilkes	12-40-2	05/06/99	58	Excellent
North Fork Reddies R	SR 1501	Wilkes	12-40-4	05/05/99	52	Good
				05/22/96	50	Good
North Fork Reddies R	SR 1567	Wilkes	12-40-4	06/19/01	56	Excellent
				05/05/99	58	Excellent
Cub Cr	SR 1001	Wilkes	12-41	06/18/01	50	Good
Middle Prong Roaring R	SR 1002	Wilkes	12-46-2-(6)	06/20/01	56	Excellent
				05/22/96	50	Good
Basin Cr	SR 1730	Wilkes	12-46-2-2	05/22/96	58	Excellent
East Prong Roaring R #1	SR 1739	Wilkes	12-46-4-(1)	10/21/98	52	Good
East Prong Roaring R #2	SR 1739	Wilkes	12-46-4-(5)	10/20/98	54	Excellent
East Prong Roaring R #3	SR 1739	Wilkes	12-46-4-(5)	10/20/98	58	Excellent
Garden Cr	SR 1739	Wilkes	12-46-4-6	05/22/96	54	Excellent
03-07-02						
Mitchell R	SR 1330	Surry	12-62-1	05/26/99	52	Good
				05/16/96	46	Good-Fair
Fisher R	SR 1331	Surry	12-63-(1)	06/20/01	60	Excellent
Little Fisher R	SR 1480	Surry	12-63-10-(2)	06/20/01	50	Good
				05/16/96	46	Good-Fair
Cody Cr	US 268	Surry	12-63-14	05/16/96	50	Good
Little Yadkin R	SR 1236	Stokes	12-77-(1)	06/21/01	54	Excellent
				05/17/96	54	Excellent
North Deep Cr	SR 1605	Yadkin	12-84-1	06/21/01	44	Good-Fair
				05/15/96	44	Good-Fair
South Deep Cr	SR 1152	Yadkin	12-84-2-(1)	06/22/01	52	Good
				05/15/96	48	Good
03-07-03						
Stewarts Cr	SR 1622	Surry	12-72-9-1	06/21/01	56	Excellent
				05/17/96	54	Excellent
Toms Cr	SR 2024	Surry	12-72-14-(4)	06/21/01	56	Excellent
03-07-04						
Muddy Cr	SR 1891	Forsyth	12-94-(0.5)	04/30/01	38	Fair
				05/14/96	34	Poor
Silas Cr	SR 1137	Forsyth	12-94-10	04/30/01	40	Fair
Salem Cr	off SR 1120	Forsyth	12-94-12-(4)	04/30/01	30	Poor
South Fork Muddy Cr	SR 2902	Forsyth	12-94-13	04/30/01	42	Good-Fair
Grants Cr	SR 2200	Rowan	12-110	05/02/01	42	Good-Fair
Town Cr	SR 1526	Rowan	12-115-3	04/25/96	40	Fair

Note: Streams that were sampled during 2001 (the most recent data used for this basin plan) are presented in **bold** type.

Subbasin/ Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
03-07-05						
Dutchmans Cr	US 158	Davie	12-102-(2)	05/04/01	44	Good-Fair
				05/13/96	38	Fair
Cedar Cr	SR 1437	Davie	12-102-13-(2)	05/04/01	50	Good
				05/13/96	46	Good-Fair
03-07-06						
South Yadkin R	SR 1561	Iredell	12-108-(5.5)	05/03/01	46	Good-Fair
				05/14/96	40	Fair
Olin Cr	SR 1892	Iredell	12-108-11-3-3	05/14/96	36	Fair
Hunting Cr	NC 115	Wilkes	12-108-16-(0.5)	05/03/01	58	Excellent
				05/15/96	56	Excellent
				06/16/92	52	Good
Hunting Cr	SR 2423	Wilkes	12-108-16-(0.5)	06/16/92	46	Good-Fair
North Little Hunting Cr	SR 1829	Iredell	12-108-16-6	05/03/01	50	Good
				05/14/96	44	Good-Fair
Fourth Cr	SR 1985	Rowan	12-108-20-(3.5)	05/02/01	28	Poor
				04/26/96	32	Poor
Third Cr	SR 1970	Rowan	12-108-20-4-(7)	05/02/01	34	Poor
				04/25/96	40	Fair
North Second Cr	SR 1526	Rowan	12-108-21	05/02/01	42	Good-Fair
				04/25/96	40	Fair
03-07-07						
Abbotts Cr	SR 1800	Davidson	12-119-(4.5)	05/01/01	46	Good-Fair
				04/24/96	44	Good-Fair
Rich Fork Cr	NC 109	Davidson	12-119-7	05/01/01	34	Poor
				04/25/96	34	Poor
03-07-08						
Lick Cr	NC 8	Davidson	12-126-(3)	04/19/01	44	Good-Fair
				04/23/96	44	Good-Fair
Cabin Cr	SR 2536	Davidson	12-127-(2)	05/01/01	48	Good
				04/24/96	52	Good
Mountain Cr	SR 1720	Stanly	13-5-(0.7)	04/17/01	46	Good-Fair
				04/18/96	50	Good
03-07-09						
Uwharrie R	SR 1406	Randolph	13-2-(0.5)	10/26/99	44	Good-Fair
				06/15/99	54	Excellent
				04/14/99	58	Excellent
				04/24/96	52	Good
Betty McGees Cr	SR 1107	Randolph	13-2-5	04/16/01	52	Good
				04/18/96	54	Excellent
Barnes Cr	SR 1303	Montgomery	13-2-18-(0.5)	04/16/01	54	Excellent
				10/17/97		Not rated
				04/22/96	48	Good
Dutchmans Cr	SR 1150	Montgomery	13-2-24	04/22/96		Not rated
03-07-10						
Clarks Cr	SR 1188	Montgomery	13-16	04/12/01	54	Excellent
Brown Cr	SR 1230	Anson	13-20	04/10/01	52	Good
				04/16/96	48	Good
Cedar Cr	SR 1709	Anson	13-21	04/10/01	46	Good-Fair
				06/10/96		Not rated
Mountain Cr	SR 1150	Richmond	13-28-(0.5)	04/15/96	52	Good
Big Mountain Cr	SR 1319	Richmond	13-28-1-(0.5)	10/27/99	46	Good-Fair
				06/15/99	52	Good
				04/12/99	54	Excellent
				09/22/98	56	Excellent

Note: Streams that were sampled during 2001 (the most recent data used for this basin plan) are presented in **bold** type.

Subbasin/ Waterbody	Station	County	Index No.	Date	NCIBI Score	NCIBI Rating
Big Mountain Cr	NC 73	Richmond	13-28-1-(0.5)	04/12/99	52	Good
Big Mountain Cr	SR 1005	Richmond	13-28-1-(0.5)	04/12/99	54	Excellent
03-07-11						
Rocky R	SR 1608	Cabarrus	13-17	04/14/99	32	Poor
				04/17/96	34	Poor
Mallard Cr	SR 2467	Mecklenburg	13-17-5	04/19/01	56	Excellent
				06/10/96	50	Good
Reedy Cr	SR 1136	Cabarrus	13-17-8	04/18/01	46	Good-Fair
03-07-12						
Irish Buffalo Cr	SR 1132	Cabarrus	13-17-9-(2)	04/19/01	50	Good
				04/17/96	52	Good
Coldwater Cr	NC 73	Cabarrus	13-17-9-4-(1.5)	04/18/01	44	Good-Fair
				04/17/96	52	Good
Dutch Buffalo Cr	SR 2622	Cabarrus	13-17-11-(5)	04/18/01	52	Good
				04/17/96	44	Good-Fair
North Fork Crooked Cr # 1	SR 1514	Union	13-17-20-1	10/03/95	46	Good-Fair
North Fork Crooked Cr # 2	SR 1514	Union	13-17-20-1	10/03/95	50	Good
South Fork Crooked Cr # 1	SR 1515	Union	13-17-20-2	10/03/95	42	Good-Fair
South Fork Crooked Cr # 2	SR 1515	Union	13-17-20-2	10/03/95	38	Fair
03-07-13						
Big Bear Cr	NC 73	Stanly	13-17-31-5	04/18/01	48	Good
				04/18/96	52	Good
03-07-14						
Island Cr	SR 1118	Stanly	13-17-26	04/11/01	54	Excellent
Richardson Cr	NC 207	Union	13-17-36-(3.5)	04/11/01	46	Good-Fair
Salem Cr	SR 1006	Union	13-17-36-15	04/11/01	48	Good
				06/10/96	36	Fair
Lanes Cr	SR 1929	Union	13-17-40-(1)	04/11/01	40	Fair
Lanes Cr	SR 1415	Anson	13-17-40-(12)	04/16/96	40	Fair
03-07-15						
Little R	SR 1127	Randolph	13-25-(1)	04/14/99	52	Good
Little R	NC 134	Randolph	13-25-(1)	04/13/99	52	Good
Little R	SR 1135	Randolph	13-25-(1)	04/13/99	52	Good
West Fork Little R	SR 1311	Montgomery	13-25-15	04/17/01	52	Good
				04/23/96	56	Excellent
Dumas Cr	SR 1310	Montgomery	13-25-20-8	04/16/01	54	Excellent
Bridgers Cr	SR 1519	Montgomery	13-25-24	04/22/96	52	Good
Rocky Cr	NC 24/27	Montgomery	13-25-30-(0.3)	04/23/96		Not rated
Rocky Cr	SR 1549	Montgomery	13-25-30-(0.5)	04/17/01	54	Excellent
Cheek Cr	SR 1563	Montgomery	13-25-36	10/26/99	56	Excellent
				06/15/99	56	Excellent
				04/13/99	58	Excellent
				09/21/98	58	Excellent
Cheek Cr	SR 1541	Montgomery	13-25-36	04/23/96	54	Excellent
Hamer Cr	SR 1159	Richmond	13-25-37	04/05/01	36	Fair
03-07-16						
Cartledge Cr	SR 1142	Richmond	13-35	04/06/01	50	Good
Hitchcock Cr	SR 1486	Richmond	13-39-(1)	04/05/01		Not rated
Rocky Fork Cr	SR 1424	Richmond	13-39-8	04/05/01		Not rated
Rocky Fork Cr	SR 1487	Richmond	13-39-8	08/21/90		Not rated
Beaverdam Cr	SR 1486	Richmond	13-39-8-7	04/15/96		Not rated
Marks Cr	SR 1104	Richmond	13-45-(2)	04/06/01		Not rated
03-07-17						
Jones Cr	SR 1812	Anson	13-42	04/16/96	34	Poor
Bailey Cr	SR 1811	Anson	13-42-1-3	04/06/01	52	Good
				04/15/96	52	Good
South Fork Jones Cr	SR 1821	Anson	13-42-2	04/10/01	54	Excellent

Note: Streams that were sampled during 2001 (the most recent data used for this basin plan) are presented in **bold** type.

Fish Tissue Criteria

In evaluating fish tissue analysis results, several different types of criteria are used. Human health concerns related to fish consumption are screened by comparing results with:

- Federal Food and Drug Administration (FDA) action levels
- Environmental Protection Agency (EPA) recommended screening values
- Criteria adopted by the North Carolina State Health Director

Sample results which exceed these levels are a human health concern and are evaluated by the NC Division of Occupational and Environmental Epidemiology at DWQ's request. The FDA levels were developed to protect humans from the chronic effects of toxic substances consumed in foodstuffs, and thus, employ a "safe level" approach to fish tissue consumption. Presently, the FDA has only developed metals criteria for mercury.

The EPA has recommended screening values for target analytes which are formulated from a risk assessment procedure (EPA, 1995). These are the concentrations of analytes in edible fish tissue that are of potential public health concern. DWQ compares fish tissue results with EPA screening values to evaluate the need for further intensive site-specific monitoring.

Table A-II-3 Fish Tissue Criteria

Contaminant	FDA Action Levels	US EPA Screening Values	NC Health Director
Metals			
Cadmium	--	10.0	--
Mercury	1.0	0.3	0.4
Selenium	--	50.0	5.0
Organics			
Aldrin	0.3	--	--
Chlorpyrifos	--	30	--
Total chlordane [1]	--	0.08	--
Cis-chlordane	0.3	--	--
Trans-chlordane	0.3	--	--
Total DDT [2]	--	0.3	--
Dieldrin	--	0.007	--
Dioxins (total)	--	0.7	3.0
Endosulfan (I and II)	--	60.0	--
Endrin	0.3	3.0	--
Heptachlorepoxide	--	0.01	--
Hexachlorobenzene	--	0.07	--
Lindane	--	0.08	--
Mirex	--	2.0	--
Total PCBs	--	0.01	--
PCB-1254	2.0	--	--
Toxaphene	--	0.1	--

[1] Total chlordane includes the sum of cis- and trans- isomers as well as nonachlor and oxychlordane.

[2] Total DDT includes the sum of all its isomers and metabolites (i.e., p,p DDT; o,p DDT; DDE; and DDD).

Note: All wet weight concentrations are reported in parts per million (ppm, ug/g), except for dioxin which is in parts per trillion (ppt, pg/g).

The North Carolina State Health Director has adopted a selenium limit of 5 µg/g for issuing an advisory. Although the EPA has suggested a screening value of 0.7 ppt (pg/g) for dioxins, the State of North Carolina currently uses a value of 3.0 ppt in issuing an advisory.

Table A-II-4 Wet Weight Concentrations of Mercury (Hg), Arsenic (As), Copper (Cu) and Zinc (Zn) in Fish Tissue from the Pee Dee River, July 1999 and April 2000

Station	**Species**	**Length (mm)**	**Weight (g)**	**Hg (µg/g)**	**As (µg/g)**	**Cu (µg/g)**	**Zn (µg/g)**
Pee Dee R at US 74	*Largemouth bass*	500	2286	**0.53**			
		415	1108	0.28	ND		
		403	907	0.31	ND		
		351	610	0.31	ND		
		372	644	0.29	ND		
		403	740	0.14	ND		
		366	535	0.16	ND		
	Bluegill	177	125	0.09	ND		
		162	105	0.07	ND		
	Warmouth	167	105	0.12	ND		
	Blue catfish	560	2463	0.06	ND		
		597	2846	0.07	ND		
		530	1795	0.06	ND		
	Channel catfish	442	869	0.07	ND		
		425	940	0.06	ND		
		423	708	0.10	ND		
	Flathead catfish	375	519	0.10	ND		
Pee Dee R below Blewett Falls Dam	*Largemouth bass*	361	666	0.14	0.13	0.29	4.7
		328	577	0.13	0.11	0.33	4.7
		370	740	0.23	ND	0.17	3.2
		482	2137	0.35	ND	0.20	3.7
	Channel catfish	531	1934	0.07	ND	0.29	4.9
		572	2138	0.11	ND	0.27	3.7
		461	1119	0.08	0.12	0.26	4.0
		457	1012	0.08	ND	0.21	3.7
		522	1481	0.12	ND	0.23	3.7

Cadmium, chromium, nickel and lead were non-detectable in all samples.
ND = non detect; detection level for arsenic = 1.0 µg/g.

North Carolina Department of Environment and Natural Resources. DWQ. 2001. *Standard Operating Procedure: Biological Monitoring, Stream Fish Community Assessment and Fish Tissue*. Raleigh, NC.

Locations of DWQ Ambient Monitoring and YPDRBA Stations

Table A-II-5   Ambient Monitoring System Stations within the Yadkin-Pee Dee River Basin

Station	Location	Water Classification
03-07-01		
Q0060000	Yadkin River at NC 268 at Patterson	C Tr
Q0220000	Elk Creek at NC 268 at Elkville	B ORW
Q0390000	Yadkin River at Wilkesboro	C
Q0660000	Roaring River at SR 1990 near Roaring River	B
Q0690000	Yadkin River at SR 2327 at Roaring River	WS-V
Q0720000	Yadkin River at SR 2303 at Ronda	WS-IV
03-07-02		
Q0810000	Yadkin River at US 21 Bus at Elkin	C
Q2020000	Little Yadkin River at US52 at Dalton	WS-IV
Q2040000	Yadkin River at SR 1605 at Enon	WS-IV
03-07-03		
Q1780000	Ararat River at SR 2019 at Ararat	C
Q1950000	Ararat River at SR 2080 near Siloam	WS-IV
03-07-04		
Q2510000	Salem Creek at Elledge WWTP at Winston Salem	C
Q2600000	Muddy Creek at SR 2995 near Muddy Creek	C
Q2810000	Yadkin River at US 64 at Yadkin College	WS-IV CA
Q4600000	Grants Creek Below Salisbury and Spencer WWTP	C
Q4660000	Yadkin River at NC 150 near Spencer	WS-V
Q5360000	Town Creek at SR 2168 near Duke	WS-V
Q5970000	Abbotts Creek at NC 47 near Cotton Grove	WS-V & B
Q5990000	Abbotts Creek at SR 2294 near Southmont Duracell	WS-IV & B
03-07-06		
Q3460000	S Yadkin River at SR 1159 near Mocksville	WS-IV
Q3484000	Hunting Creek at SR 2115 near Harmony	WS-III
Q3735000	Fourth Creek at SR 2308 near Elmwood	C
Q3934500	Third Creek at SR 1970 near Woodleaf	WS-IV
Q4120000	Second Creek at US 70 near Barber	WS-IV
03-07-07		
Q5780000	Rich Fork at SR 1800 near Thomasville	C
Q5906000	Hamby Creek at SR 2790 near Holly Grove	C
Q5930000	Abbotts Creek at SR 1243 at Lexington	C
03-07-08		
Q6120000	Yadkin River at SR 1002 at High Rock	WS-IV & B CA
03-07-09		
Q6810000	Uwharrie River at NC 109 near Uwharrie	WS-IV
Q6820000	Dutchman Creek at SR1150 near Uwharrie	WS-IV CA
03-07-10		
Q7150000	Pee Dee River at NC 731 near Shankle	WS-V & B
Q9155000	Brown Creek at SR 1627 near Pinkston	C
Q9160000	Pee Dee River at NC 109 near Mangum	WS-V & B
03-07-11		
Q7330000	Rocky River at SR 2420 near Davidson	C
03-07-12		
Q8090000	Irish Buffalo Creek at SR 1132 near Faggarts	C
Q8210000	Rocky River at US 601 near Concord	C
Q8360000	Goose Creek at SR 1524 near Mint Hill	C
03-07-13		
Q8720000	Long Creek at SR 1954 near Rocky River Springs	C
03-07-14		
Q8917000	Richardson Creek at SR 1649 near Fairfield	C
Q9120000	Rocky River at SR 1935 near Norwood	C
03-07-15		
Q9200000	Little River at SR 1340 near Star	C HQW
03-07-16		
Q9400000	Pee Dee River at US 74 near Rockingham	C
Q9660000	Hitchcock Creek at SR 1109 at Cordova	C
Q9940000	Marks Creek at SR 1812 near Hamlet	C
Q9980000	Pee Dee River at SC Hwy 9 at Cheraw SC	C
03-07-17		
Q9777000	Jones Creek at NC 145 near Pee Dee	C

* An index for DWQ freshwater classifications can be found in Section A, Part 3.2.

Table A-II-6 Yadkin-Pee Dee River Basin Association Monitoring Stations within the Yadkin-Pee Dee River Basin, 1998-2001

Subbasin	Station	Location
03-07-01		
	Q0360000	Reddies River at SR 1517 at N Wilkesboro
	Q0450000	Yadkin River at Business 421
	Q0720000	Yadkin River at SR 2303 near Ronda
03-07-02		
	Q1065000	Mitchell River at SR 1001
	Q1215000	Fisher River at NC 268 near Fairview
	Q1350000	Yadkin River at SR 1003 near Siloam
	Q2090000	North Deep Creek at SR 1605 near Yadkinville
	Q2120000	North Deep Creek at SR 1510 near Yadkinville
	Q2135000	South Deep Creek at SR 1710 near Yadkinville
	Q2180000	Yadkin River at NC 158
03-07-03		
	Q1500000	Ararat River at US 52 near Mt. Airy
	Q1710000	Ararat River 1 mi. below Mt. Airy's WWTP
	Q1725000	Ararat River at SR 2119 near Mt. Airy
	Q1935000	Ararat River at SR 2044 near Mt. Airy
03-07-04		
	Q2291000	Muddy Creek at Interstate 40 near Jonesville
	Q2479455	Salem Creek at SR 2740 near Winston-Salem
	Q2540000	Salem Creek at SR 1120 in Winston-Salem
	Q2570000	Salem Creek at SR 2991 near Winston-Salem
	Q2720000	Muddy Creek at SR 1485 near Winston-Salem
	Q2810000	Yadkin River at US 64 or the Davidson County water intake
	Q4540000	Grants Creek at Third St. extension near Spencer
	Q4600000	Grants Creek below Salisbury & Spencer WWTP D6
	Q4660000	Yadkin River at US 150 near Spencer
	Q5240000	Town Creek at I- 85 near Spencer
	Q5980000	Abbotts Creek at NC 47 near Cotton Grove
03-07-05		
	Q3105000	Dutchman Creek at US 64 near Mocksville
03-07-06		
	Q3555000	Bear Creek at SR 1116 near Mocksville
	Q3720000	Fourth Creek at SR 2316 near Statesville
	Q3735000	Fourth Creek at SR 2308 near Elmwood
	Q3900000	Third Creek at SR 2342 near Statesville
	Q3932000	Third Creek at SR 2359 near Statesville
	Q3970000	South Yadkin River at US 601 near Salisbury
	Q4030000	Second Creek at SR 1526 near Salisbury
	Q4165000	Second Creek at US 601 near Salisbury
03-07-07		
	Q5135000	Swearing Creek at SR 1272 near Linwood
	Q5750000	Rich Fork Creek at SR 1755 near High Point
	Q5785000	Rich Fork Creek at SR 1787 near High Point
	Q5790000	Rich Fork Creek at SR 2123 near High Point
	Q5940000	Abbotts Creek at I 85 near Lexington

Subbasin	Station	Location
03-07-08		
	Q6360000	Yadkin River at NC 8/49 near Richfield
	Q6950000	Little Mountain Creek at SR 1798 near Badin
	Q6960000	Mountain Creek arm of Lake Tillery at boat ramp off SR 1730
	Q7030000	Pee Dee River at NC 24/27 near Albemarle
03-07-09		
	Q6180000	UT to Lick Creek at SR 2505 near Denton
	Q6705000	Uwharrie River at NC 49 near Farmer
03-07-10		
	Q7210000	Clarks Creek at SR 1187 near Mount Gilead
03-07-11		
	Q7330000	Rocky River at SR 2420 near Davidson
	Q7450000	Rocky River at NC 29 near Charlotte
	Q7600000	Rocky River at SR 1304 near Charlotte
	Q7780000	Rocky River at SR 1132 near Concord
03-07-12		
	Q8200000	Coldwater Creek at SR 1132 near Concord
	Q8210000	Rocky River at US 601 near Concord
	Q8340000	UT tributary to Clear Creek at SR 3104
	Q8342000	Clear Creek at US 601 near Brief
	Q8355000	Rocky River at SR 1114 near Midland
	Q8359000	Goose Creek at SR 4228 near Mint Hill
	Q8360000	Goose Creek at SR 1524 near Mint Hill
	Q8385000	Rocky River at SR 1606 near Monroe
	Q8386000	North Fork Crooked Creek at SR 1520 near Monroe
	Q8386200	North Fork Crooked Creek at SR 1514 near Monroe
	Q8388000	Crooked Creek at NC 218 near Monroe
	Q8388900	Crooked Creek at SR 1601
03-07-13		
	Q8715000	Long Creek at SR 1968 near Oakboro
	Q8720000	Long Creek at SR 1917 near Oakboro
03-07-14		
	Q8800000	Richardson Creek at SR 1751 near Monroe
	Q8820000	Richardson Creek at SR 1006 near Monroe
	Q8850000	Richardson Creek at SR 1630 near Monroe
	Q9021300	Lanes Creek at SR 1005 near Marshville
03-07-15		
	Q9320000	Little River at SR 1148 near Ellerbe
	Q9340000	Toms Branch at SR 1310 near Ellerbe
03-07-16		
	Q9400000	Pee Dee River at US 74 near Rockingham

[1] WWTP = wastewater treatment plant; sites recommended by DWQ-BAU = Division of Water Quality-Biological Assessment Unit; NRCS = Natural Resource Conservation Service.

Lakes Assessment

Lake monitoring stations are sited to provide representative samples of lake water quality based on morphology, size and site-specific considerations. Physical field measurements (dissolved oxygen, pH, water temperature and conductivity) are made with a calibrated Hydrolab™. Readings are taken at the surface of the lake (0.15 meters) and at one-meter increments to the bottom of the lake. Secchi depths are measured at each sampling station with a weighted Secchi disk attached to a rope marked off in centimeters. Surface water samples (0.15 meters) are collected for chloride, hardness, fecal coliform bacteria and metals.

A Labline™ sampler is used to composite water samples within the photic zone (a depth equal to twice the Secchi depth). Nutrients, chlorophyll *a*, solids, turbidity and phytoplankton are collected at this depth. Nutrients and chlorophyll *a* from the photic zone are used to calculate the North Carolina Trophic State Index score. The Labline™ sampler is also used to collect a grab water samples near the bottom of the lake for nutrients. Water samples are collected and preserved in accordance with protocols specified in the Standard Operating Procedures Manual, Physical and Chemical Monitoring (NCDEHNR, February 1996 and subsequent updates).

Data results collected from selected lakes in the Yadkin-Pee Dee River basin are presented in Table A-II-7.

Table A-II-7 Surface Physical Data and Photic Zone Chemistry Data Collected from Selected Lakes in the Yadkin-Pee Dee River Basin, 1994-2001

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/l)	Water Temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/l)	TKN (mg/l)	NH_3 (mg/l)	NO_x (mg/l)	TN (mg/l)	TON (mg/l)	TIN (mg/l)	CHL *a* (µg/l)	Total Solids (mg/l)	Susp. Solids (mg/l)	Turbidity (NTU)
03-07-01 Kerr Scott Reservoir																	
08/10/2000	YAD007A	8.8	28.4	8.1	43	2.1	0.02	0.40	0.01	0.02	0.42	0.39	0.03		43	1	3.2
08/10/2000	YAD008	10.0	28.5	7.7	43	2.5	0.02	0.30	0.02	<0.01	0.31	0.28	0.03		38	3	2.6
08/10/2000	YAD008A	8.7	28.8	7.9	43	2.4	0.01	0.30	0.06	<0.01	0.31	0.24	0.07		42	1	2.2
07/19/2000	YAD007A	8.7	28.1	7.8	44	2.2	0.01	0.20	<0.01	<0.01	0.21	0.20	0.01		35	3	2.3
07/19/2000	YAD008	9.1	28.0	8.0	44	2.4	0.01	0.20	0.01	<0.01	0.21	0.19	0.02		37	4	2.1
07/19/2000	YAD008A	8.3	28.6	7.9	44	2.8	0.01	0.20	0.05	0.01	0.21	0.15	0.06		38	1	1.6
06/22/2000	YAD007A	8.7	27.0	8.3	45	1.8	0.01	0.30	<0.01	<0.01	0.31	0.30	0.01		34	4	3.3
06/22/2000	YAD008	8.6	27.5	8.2	45	2.0	<0.01	0.40	0.03	0.02	0.42	0.37	0.05		38	5	2.5
06/22/2000	YAD008A	8.3	27.9	8.2	43	2.4	0.01	0.20	<0.01	<0.01	0.21	0.20	0.01		38	2	1.6
08/12/1999	YAD007A	9.0	29.9	8.4	45	1.7	<0.01	0.30	<0.01	<0.01	0.31	0.30	0.01		58	2	3.4
08/12/1999	YAD008	8.4	29.4	8.3	45	1.6	<0.01	0.30	0.03	<0.01	0.31	0.27	0.04		43	1	2.6
08/12/1999	YAD008A	8.3	29.9	8.1	44	1.8	<0.01	0.40	0.33	<0.01	0.41	0.07	0.34		39	1	2.5
07/13/1999	YAD007A	7.5	24.9	7.8	42	1.0	0.02	0.20	0.08	0.08	0.28	0.12	0.16		58	5	8.2
07/13/1999	YAD008	7.8	24.7	6.9	41	1.2	0.02	0.20	0.01	0.06	0.26	0.19	0.07		54	5	6.0
07/13/1999	YAD008A	7.3	24.5	6.8	41	1.6	0.02	0.10	0.04	0.05	0.15	0.06	0.09		57	3	3.6
06/08/1999	YAD007A	8.5	27.5	8.0	49	1.3	0.04	0.40	<0.01	0.04	0.44	0.40	0.05		46	3	2.0
06/08/1999	YAD008	8.8	27.6	8.0	48	1.8	0.03	0.20	<0.01	0.04	0.24	0.20	0.05		41	2	3.0
06/08/1999	YAD008A	8.6	28.0	7.9	46	1.7	0.03	0.20	<0.01	0.06	0.26	0.20	0.07		34	21	3.4
08/11/1994	YAD007A	7.7	27.8	8.3	33	2.3	0.03	0.30	0.03	<0.01	0.31	0.27	0.04	3	53	4	1.8
08/11/1994	YAD008	7.6	28.5	8.1	33	2.3	0.02	0.20	0.04	0.01	0.21	0.16	0.05	6	49	3	2.0
08/11/1994	YAD008A	7.4	28.3	8.2	32	2.2	0.01	0.20	0.05	<0.01	0.21	0.15	0.06	1	55	1	1.6
Salem Lake																	
08/22/2001	YAD077A	7.4	27.4	7.4	95	0.7	0.03	0.4	<0.01	<0.01	0.40	0.39	0.01	15	72	8	7.1
08/22/2001	YAD077B	7.2	27.0	7.4	92	0.9	0.03	0.5	<0.01	<0.01	0.52	0.51	0.01	15	81	7	5.5
08/22/2001	YAD077C	8.0	27.6	7.8	95	1.3	0.02	0.5	<0.01	<0.01	0.47	0.46	0.01	14			2.4
07/16/2001	YAD077A	8.5	27.6	8.3	92	0.9	0.05	0.2	0.15	<0.01	0.23	0.07	0.16	20	97	18	15.0
07/16/2001	YAD077B	8.4	27.5	7.4	90	0.9	0.03	0.3	0.02	<0.01	0.32	0.29	0.03	19	77	6	6.9
07/16/2001	YAD077C	9.3	27.6	8.6	91	1.4	0.02	0.2	0.24	<0.01	0.25	0.00	0.25	12	75	3	2.8
08/02/2000	YAD077A	7.5	27.8	7.3	96	0.7	0.04	0.3	<0.01	<0.01	0.31	0.30	0.01		140	120	9.7
08/02/2000	YAD077B	5.5	27.7	7.2	93	0.6	0.04	0.4	0.10	0.01	0.41	0.30	0.11		68	13	8.7
08/02/2000	YAD077C	8.6	26.7	7.6	96	1.6	0.03	0.4	0.18	<0.01	0.41	0.22	0.19		60	13	2.8
07/24/2000	YAD077A	6.9	24.8	7.3	93	0.6	0.04	0.3	0.03	0.02	0.32	0.27	0.05		91	16	12.0
07/24/2000	YAD077B	8.1	20.0	6.5	100	0.7	0.07	0.6	0.17	0.08	0.68	0.43	0.25		110	32	18.0
07/24/2000	YAD077C	7.1	25.6	7.4	92	1.0	0.02	0.4	0.01	<0.01	0.41	0.39	0.02		82	5	3.5
06/12/2000	YAD077A	8.7	27.4	7.2	88	1.2	0.07	0.2	0.06	<0.01	0.21	0.14	0.07				8.9
06/12/2000	YAD077B	3.4	26.0	7.3	91	1.1	0.03	0.4	0.06	0.09	0.49	0.34	0.15		94	10	5.6
06/12/2000	YAD077C	8.4	27.0	7.2	86	1.8	0.02	0.3	0.07	<0.01	0.31	0.23	0.08		87	5	3.7
08/09/1999	YAD077A	7.3	29.8	8.1	91	0.6	0.04	0.6	<0.01	<0.01	0.61	0.60	0.01		85	16	13.0
08/09/1999	YAD077B	6.4	29.9	7.4	94	0.4	0.04	0.5	<0.01	<0.01	0.51	0.50	0.01		82	13	9.7
08/09/1999	YAD077C	8.1	29.2	7.8	88	1.5	0.01	0.5	<0.01	0.01	0.51	0.50	0.02		73	6	2.5

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/l)	Water Temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/l)	TKN (mg/l)	NH_3 (mg/l)	NO_x (mg/l)	TN (mg/l)	TON (mg/l)	TIN (mg/l)	CHL *a* (µg/l)	Total Solids (mg/l)	Susp. Solids (mg/l)	Turbidity (NTU)
07/06/1999	YAD077A	9.4	31.5	8.4	84	1.2	0.03	0.3	<0.01	0.03	0.33	0.30	0.04		65	4	6.3
07/06/1999	YAD077B	8.6	31.8	8.3	83	1.1	0.03	0.4	<0.01	<0.01	0.41	0.40	0.01		73	7	5.6
07/06/1999	YAD077C	8.3	32.0	8.2	84	1.8	0.02	0.4	<0.01	<0.01	0.41	0.40	0.01		60	4	3.6
06/23/1999	YAD077A	7.8	22.3	7.2	85	0.7	0.02	0.3	<0.01	<0.01	0.31	0.30	0.01		71	8	10.0
06/23/1999	YAD077B	7.7	22.5	7.3	85	0.9	0.02	0.3	<0.01	<0.01	0.31	0.30	0.01		77	8	8.3
06/23/1999	YAD077C	7.8	22.9	7.2	80	1.1	0.01	0.3	<0.01	<0.01	0.31	0.30	0.01		66	5	3.3
09/01/1994	YAD077A	8.2	27.0	7.7	79	0.9	0.03	0.5	0.01	0.02	0.52	0.49	0.03	14	81	6	4.5
09/01/1994	YAD077B	8.0	26.8	7.5	78	1.2	0.04	0.3	0.25	0.02	0.32	0.05	0.27	16	86	5	3.0
09/01/1994	YAD077C	7.3	26.6	7.8	78	1.1	0.03	0.4	<0.01	0.02	0.42	0.40	0.03	15	87	10	3.1
High Rock Lake																	
08/16/2001	YAD152A	8.0	29.2	7.8	122	0.4	0.14	0.6	0.02	0.44	1.06	0.60	0.46	15	110	17	14.0
08/16/2001	YAD152C	9.3	29.5	8.7	125	0.8	0.1	0.9	0.01	0.14	1.01	0.86	0.15	40	110	10	6.9
08/16/2001	YAD156A	9.6	29.2	8.8	120	0.7	0.09	0.9	<0.01	<0.01	0.90	0.89	0.01	52	94	9	6.0
08/16/2001	YAD169A	9.1	29.1	8.7	127	0.7	0.06	0.7	0.01	<0.01	0.75	0.73	0.02	39	91	11	5.0
08/16/2001	YAD169B	8.2	28.9	8.8	119	0.8	0.07	0.8	<0.01	0.03	0.78	0.75	0.04	46	97	9	4.9
08/16/2001	YAD169E	8.3	28.9	8.7	123	0.8	0.05	0.7	0.01	<0.01	0.72	0.70	0.02	34	94	9	5.2
08/16/2001	YAD169F	7.9	28.6	8.6	121	0.8	0.06	0.9	<0.01	<0.01	0.87	0.86	0.01	42	98	9	4.9
07/31/2001	YAD1391A	7.0	25.6	7.7	105	0.4	0.22	0.3	0.22	0.87	1.14	0.05	1.09	3	140	40	50.0
07/31/2001	YAD152A	6.6	26.7	7.5	98	0.3	0.2	0.5	0.32	0.83	1.33	0.18	1.15	4	120	24	50.0
07/31/2001	YAD152C	10.6	27.2	8.7	142	0.7	0.11	0.8	0.03	0.35	1.12	0.74	0.38	46	110	13	9.3
07/31/2001	YAD156A	8.1	27.1	8.1	135	0.7	0.1	0.9	0.1	0.24	1.09	0.75	0.34	38	120	12	8.2
07/31/2001	YAD169A	8.8	27.6	8.5	150	0.9	0.07	0.9	0.05	0.04	0.91	0.82	0.09	40	120	12	9.4
07/31/2001	YAD169B	7.4	28.1	8.0	129	0.9	0.09	0.6	0.04	0.21	0.77	0.52	0.25	27	120	26	13.0
07/31/2001	YAD169E	7.4	26.7	7.9	127	0.9	0.05	0.7	0.04	0.09	0.76	0.63	0.13	32	110	9	6.5
07/31/2001	YAD169F	7.0	26.7	7.8	128	1.1	0.06	0.6	0.03	0.21	0.80	0.56	0.24	22	110	25	5.6
08/01/2000	YAD152A	9.0	28.1	8.9	129	0.4	0.15	0.5	0.02	0.01	0.51	0.48	0.03		120	33	23.0
08/01/2000	YAD152C	9.5	28.2	8.9	133	0.4	0.13	0.6	0.02	0.13	0.73	0.58	0.15		100	19	14.0
08/01/2000	YAD156A	8.7	27.3	8.7	128	0.8	0.09	0.4	0.02	0.02	0.42	0.38	0.04		110	14	9.0
08/01/2000	YAD169A	7.8	27.5	8.6	132	0.6	0.07	0.5	<0.01	<0.01	0.51	0.50	0.01		110	11	8.3
08/01/2000	YAD169B	8.2	27.1	8.7	127	0.6	0.08	0.5	<0.01	<0.01	0.51	0.50	0.01		94	10	7.9
08/01/2000	YAD169E	6.8	26.2	7.8	125	0.8	0.06	0.5	0.01	0.16	0.66	0.49	0.17		90	8	5.4
08/01/2000	YAD169F	7.2	26.2	8.1	125	0.8	0.06	0.4	0.07	0.16	0.56	0.33	0.23		100	9	5.4
07/05/2000	YAD1391A	6.6	29.4	7.4	119	0.4	0.20	0.4	0.27	1.00	1.40	0.13	1.27		110	18	24.0
07/05/2000	YAD152A	11.4	28.7	8.9	115	0.6	0.12	0.7	0.01	0.44	1.14	0.69	0.45		87	12	14.0
07/05/2000	YAD152C	12.1	28.8	9.1	123	0.6	0.10	0.6	0.03	0.21	0.81	0.57	0.24		97	10	10.0
07/05/2000	YAD156A	11.8	29.0	9.1	129	0.6	0.09	0.7	0.01	0.15	0.85	0.69	0.16		93	10	8.1
07/05/2000	YAD169A	8.2	28.4	8.2	131	0.6	0.06	1.4	0.03	<0.01	1.41	1.37	0.04		110	12	8.8
07/05/2000	YAD169B	11.7	28.6	9.1	130	0.8	0.09	0.8	<0.01	0.02	0.82	0.80	0.03		110	7	7.3
07/05/2000	YAD169E	11.2	29.0	9.1	127	0.7	0.06	0.8	0.02	<0.01	0.81	0.78	0.03		84	10	6.3
07/05/2000	YAD169F	12.0	29.0	9.1	128	0.7	0.06	0.6	0.03	<0.01	0.61	0.57	0.04		100	9	9.7
06/20/2000	YAD1391A	6.2	29.3	7.6	149	0.5	0.22	0.3	0.11	1.20	1.50	0.19	1.31		120	18	18.0
06/20/2000	YAD152A	6.2	28.1	7.5	137	0.3	0.21	0.4	0.19	0.86	1.26	0.21	1.05		130	30	28.0
06/20/2000	YAD152C	6.4	27.7	7.7	133	0.6	0.11	0.7	0.15	0.51	1.21	0.55	0.66		89	12	11.0
06/20/2000	YAD156A	7.1	27.6	7.9	128	0.8	0.09	0.4	0.07	0.36	0.76	0.33	0.43		99	7	7.1

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/l)	Water Temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/l)	TKN (mg/l)	NH_3 (mg/l)	NO_x (mg/l)	TN (mg/l)	TON (mg/l)	TIN (mg/l)	CHL *a* (µg/l)	Total Solids (mg/l)	Susp. Solids (mg/l)	Turbidity (NTU)
06/20/2000	YAD169A	7.6	27.3	7.9	133	0.8	0.05	0.4	0.06	<0.01	0.41	0.34	0.07		89	7	5.5
06/20/2000	YAD169B	7.9	27.5	8.4	123	1.0	0.07	0.4	0.06	0.07	0.47	0.34	0.13		91	5	8.0
06/20/2000	YAD169E	8.5	27.4	8.5	117	1.0	0.05	0.3	0.13	<0.01	0.31	0.17	0.14		80	10	5.8
06/20/2000	YAD169F	8.6	27.6	8.7	120	1.0	0.06	0.4	0.06	0.06	0.46	0.34	0.12		94	5	6.3
08/26/1999	YAD1391A	5.7	26.8	7.1	189	0.3	0.33	0.4	0.13	1.20	1.60	0.27	1.33		190	54	49.0
08/26/1999	YAD152A	8.2	27.6	8.4	149	0.7	0.10	0.6	0.07	0.20	0.80	0.53	0.27		120	7	9.1
08/26/1999	YAD152C	8.8	27.7	8.3	143	0.7	0.10	0.6	0.13	0.21	0.81	0.47	0.34		120	8	9.2
08/26/1999	YAD156A	6.7	27.8	7.5	135	0.7	0.07	0.5	0.10	0.12	0.62	0.40	0.22		110	17	6.6
08/26/1999	YAD169A	6.2	28.4	8.0	134	0.6	0.05	0.5	0.31	0.02	0.52	0.19	0.33		100	9	6.8
08/26/1999	YAD169B	6.8	28.4	7.8	133	0.7	0.06	0.5	0.14	0.11	0.61	0.36	0.25		100	7	7.2
08/26/1999	YAD169E	5.6	28.3	7.2	126	0.9	0.04	0.4	0.06	0.17	0.57	0.34	0.23		99	6	4.8
08/26/1999	YAD169F	3.1	28.1	7.0	123	0.8	0.05	0.4	0.11	0.23	0.63	0.29	0.34		99	6	7.2
07/15/1999	YAD1391A	7.7	22.3	7.9	85	0.4	0.15	0.4	0.14	0.83	1.23	0.26	0.97		120	22	32.0
07/15/1999	YAD152A	9.5	22.1	6.3	103	0.7	0.09	0.4	0.27	0.46	0.86	0.13	0.73		100	7	12.0
07/15/1999	YAD152C	7.2	25.6	7.0	104	0.7	0.09	0.4	0.30	0.41	0.81	0.10	0.71		93	5	7.9
07/15/1999	YAD156A	7.0	25.8	7.1	110	0.8	0.06	0.4	0.30	0.26	0.66	0.10	0.56		99	4	7.6
07/15/1999	YAD169A	7.1	26.1	7.3	131	0.8	0.05	0.5	0.22	0.01	0.51	0.28	0.23		110	6	4.6
07/15/1999	YAD169B	7.3	25.9	7.0	119	0.9	0.05	0.5	0.32	0.15	0.65	0.18	0.47		100	1	5.2
07/15/1999	YAD169E	7.3	25.3	7.1	119	1.2	0.04	0.5	0.21	0.07	0.57	0.29	0.28		130	5	3.7
07/15/1999	YAD169F	5.7	25.6	7.3	116	1.0	0.05	0.4	0.29	0.11	0.51	0.11	0.40		110	<1	5.4
06/03/1999	YAD1391A	7.6	27.8	7.6	124	0.5	0.18	0.2	0.06	0.85	1.05	0.14	0.91		110	18	18.0
06/03/1999	YAD152A	10.3	27.1	8.6	109	0.6	0.09	0.4	0.03	0.34	0.74	0.37	0.37		98	9	9.2
06/03/1999	YAD152C	11.0	26.3	8.0	65	0.5	0.09	0.4	0.01	0.38	0.78	0.39	0.39		100	6	7.7
06/03/1999	YAD156A	10.5	26.7	8.5	109	0.7	0.07	0.4	0.04	0.36	0.76	0.36	0.40		88	4	8.4
06/03/1999	YAD169A	8.5	25.1	7.9	47	0.7	0.05	0.3	0.03	0.15	0.45	0.27	0.18		89	6	4.5
06/03/1999	YAD169B	9.1	24.9	8.1	107	0.9	0.04	0.3	0.01	0.35	0.65	0.29	0.36		79	7	4.7
06/03/1999	YAD169E	9.4	24.5	8.4	104	0.7	0.03	0.2	<0.01	0.27	0.47	0.20	0.28		74	3	4.1
06/03/1999	YAD169F	9.7	25.0	8.5	100	0.9	0.01	0.3	0.02	0.26	0.56	0.28	0.28		80	3	5.3
08/28/1997	YAD1391A	7.4	27.9	7.3	145	0.4	0.12	0.1	0.02	0.69	0.79	0.08	0.71	8	120	20	19.0
08/28/1997	YAD152A	11.1	28.0	8.8	123	0.5	0.04	0.3	<0.01	0.02	0.32	0.30	0.03	35	99	10	6.3
08/28/1997	YAD152C	11.0	28.1	8.8	123	0.5	0.05	0.4	0.01	0.02	0.42	0.39	0.03	49	99	11	6.8
08/28/1997	YAD156A	10.4	28.0	8.6	123	0.6	0.04	0.5	<0.01	0.03	0.53	0.50	0.04	36	99	8	5.9
08/28/1997	YAD169A	9.3	28.1	8.4	121	0.6	0.04	0.4	<0.01	0.02	0.42	0.40	0.03	31	97	9	5.5
08/28/1997	YAD169B	9.8	27.9	8.5	121	0.6	0.03	0.3	<0.01	0.02	0.32	0.30	0.03	33	97	9	5.7
08/28/1997	YAD169E	8.4	27.2	7.9	108	0.6	0.02	0.2	<0.01	0.02	0.22	0.20	0.03	18	82	8	5.6
08/28/1997	YAD169F	6.0	27.1	7.3	118	0.7	0.03	0.3	0.15	0.10	0.40	0.15	0.25	16	85	8	6.0
07/29/1997	YAD1391A	6.1	28.7	7.2	85	0.2	0.18	0.3	0.01	0.65	0.95	0.29	0.66	4	150	48	70.0
07/29/1997	YAD152A	8.0	29.5	7.5	91	0.2	0.13	0.6	<0.01	0.42	1.02	0.60	0.43	17	140	13	55.0
07/29/1997	YAD152C	9.3	30.0	8.3	99	0.4	0.11	0.4	<0.01	0.22	0.62	0.40	0.23	19	130	22	25.0
07/29/1997	YAD156A	10.8	30.5	8.8	102	0.5	0.11	0.4	<0.01	0.08	0.48	0.40	0.09	23	120	23	20.0
07/29/1997	YAD169A	8.1	30.2	8.5	114	0.6	0.06	0.4	<0.01	<0.01	0.41	0.40	0.01	14	100	6	5.4
07/29/1997	YAD169B	10.2	30.2	8.9	103	0.6	0.09	0.4	<0.01	<0.01	0.41	0.40	0.01	25	120	18	15.0
07/29/1997	YAD169E	10.9	30.9	9.0	103	0.6	0.08	0.4	<0.01	0.01	0.41	0.40	0.02	16	120	19	16.0
07/29/1997	YAD169F	11.3	31.1	9.1	106	0.6	0.07	0.4	<0.01	<0.01	0.41	0.40	0.01	22	110	12	8.7
06/25/1997	YAD1391A	6.7	28.1	7.6	94	0.2	0.15	0.3	0.04	0.84	1.14	0.26	0.88	2	100	29	50.0

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/l)	Water Temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/l)	TKN (mg/l)	NH_3 (mg/l)	NO_x (mg/l)	TN (mg/l)	TON (mg/l)	TIN (mg/l)	CHL *a* (µg/l)	Total Solids (mg/l)	Susp. Solids (mg/l)	Turbidity (NTU)
06/25/1997	YAD152A	10.5	29.7	8.7	93	0.7	0.07	0.3	<0.01	0.36	0.66	0.30	0.37	14	75	6	11.0
06/25/1997	YAD152C	10.4	29.3	8.7	95	0.7	0.07	0.3	<0.01	0.39	0.69	0.30	0.40	14	75	5	9.6
06/25/1997	YAD156A	9.2	29.0	8.5	93	0.9	0.05	0.2	0.02	0.35	0.55	0.18	0.37	10	75	4	6.3
06/25/1997	YAD169A	9.4	30.2	8.8	95	1.0	0.04	0.3	<0.01	0.17	0.47	0.30	0.18	11	71	2	4.3
06/25/1997	YAD169B	10.1	29.8	8.9	93	1.1	0.05	0.3	<0.01	0.21	0.51	0.30	0.22	10	79	2	4.3
06/25/1997	YAD169E	10.1	28.3	8.9	90	0.8	0.05	0.2	<0.01	0.17	0.37	0.20	0.18	13	77	6	4.1
06/25/1997	YAD169F	10.0	28.6	8.9	93	0.9	0.05	0.2	<0.01	0.17	0.37	0.20	0.18	12	72	5	4.3
07/20/1994	YAD1391A	7.5	29.8	7.2	113	0.4	0.30	0.5	0.04	0.60	1.10	0.46	0.64	3	130	59	22.0
07/20/1994	YAD152A	10.7	29.8	9.0	106	0.7	0.14	0.3	0.04	0.17	0.47	0.26	0.21	17	86	12	7.6
07/20/1994	YAD152C	9.6	29.8	9.1	106	0.7	0.07	0.6	<0.01	<0.01	0.61	0.60	0.01	15	77	10	5.8
07/20/1994	YAD156A	8.1	29.2	8.6	103	0.7	0.10	0.4	0.02	0.88	1.28	0.38	0.90	16	75	10	6.0
07/20/1994	YAD169A	7.9	29.9	9.1	111	0.7	0.07	0.5	0.04	<0.01	0.51	0.46	0.05	13	75	10	5.1
07/20/1994	YAD169B	8.2	29.7	9.1	107	0.8	0.07	0.5	<0.01	<0.01	0.51	0.50	0.01	21	72	9	4.5
07/20/1994	YAD169E	8.2	29.9	9.2	108	0.7	0.05	0.5	0.01	<0.01	0.51	0.49	0.02	16	69	11	4.8
07/20/1994	YAD169F	8.1	29.7	9.2	108	0.8	0.05	0.6	0.02	<0.01	0.61	0.58	0.03	15	75	9	4.2
08/24/1994	YAD122B	8.9	26.3	6.4	62	0.9	0.11	0.5	0.03	0.01	0.51	0.47	0.04	26	83	10	7.2
08/24/1994	YAD122D	9.0	26.2	7.2	62	0.8	0.09	0.6	0.02	<0.01	0.61	0.58	0.03	17	70	5	5.2
03-07-07 Lake Thom-A-Lex																	
08/22/2001	YAD160B	8.8	28.6	8.3	109	0.5	0.06	0.8	<0.01	<0.01	0.85	0.84	0.01	31	110	14	11.0
08/22/2001	YAD1611A	8.7	29.5	8.3	109	0.8	0.04	0.7	<0.01	<0.01	0.66	0.65	0.01	24	110	8	4.8
07/18/2001	YAD160B	8.5	28.5	8.3	104	0.7	0.05	0.8	0.03	<0.01	0.85	0.81	0.04	28	100	9	10.0
07/18/2001	YAD1611A	8.7	28.7	8.2	103	1.0	0.04	0.6	0.04	<0.01	0.62	0.57	0.05	28	83	5	4.0
08/02/2000	YAD160B	7.9	27.7	8.0	106	0.7	0.05	0.4	0.01	<0.01	0.41	0.39	0.02		99	10	11.0
08/02/2000	YAD1611A	8.2	26.8	7.9	101	1.0	0.04	0.3	<0.01	<0.01	0.31	0.30	0.01		92	10	6.1
07/24/2000	YAD160B	5.8	25.0	7.3	111	0.5	0.06	0.7	0.06	0.01	0.71	0.64	0.07		110	15	16.0
07/24/2000	YAD1611A	7.0	26.1	7.4	104	0.9	0.03	0.4	0.12	<0.01	0.41	0.28	0.13		90	5	4.2
06/01/2000	YAD160B	10.7	26.6	8.3	110	1.0	0.07	0.5	0.10	<0.01	0.51	0.40	0.11		130	34	29.0
06/01/2000	YAD1611A	8.5	26.1	7.9	108	1.4	0.18	0.5	0.13	<0.01	0.51	0.37	0.14		300	2	120.0
08/09/1999	YAD160B	8.0	29.2	7.8	96	0.9	0.04	0.5	<0.01	<0.01	0.51	0.50	0.01		81	4	7.2
08/09/1999	YAD1611A	8.1	29.2	8.3	85	1.1	0.02	0.5	<0.01	<0.01	0.51	0.50	0.01		82	3	3.1
07/07/1999	YAD160B	9.9	30.9	8.5	88	0.5	0.03	0.4	<0.01	<0.01	0.41	0.40	0.01		83	11	15.0
07/07/1999	YAD1611A	9.1	30.2	8.3	83	0.7	0.05	0.4	<0.01	<0.01	0.41	0.40	0.01		76	10	9.9
06/21/1999	YAD160B	6.4	21.5	7.1	95	0.4	0.06	0.5	0.12	<0.01	0.51	0.38	0.13		110	16	20.0
06/21/1999	YAD1611A	7.0	22.5	7.1	88	0.8	0.03	0.4	0.09	<0.01	0.41	0.31	0.10		90	4	7.6
07/19/1994	YAD160B	8.3	29.7	8.4	85	0.6	0.05	0.4	0.03	0.01	0.41	0.37	0.04	15	89	10	9.4
07/19/1994	YAD1611A	7.8	29.5	7.7	79	1.1	0.01	0.4	0.03	0.01	0.41	0.37	0.04	8	78	6	4.4
03-07-08 Tuckertown Reservoir																	
08/03/1999	YAD172C	7.7	30.0	8.2	116	0.5	0.09	0.5	<0.01	<0.01	0.51	0.50	0.01		75	4	6.4
08/03/1999	YAD1780A	9.5	30.5	8.9	113	0.6	0.05	0.8	0.07	<0.01	0.81	0.73	0.08		84	4	3.6
07/08/1999	YAD172C	7.4	29.0	7.8	120	0.8	0.04	0.5	0.01	0.03	0.53	0.49	0.04		81	8	4.5
07/08/1999	YAD1780A	9.2	30.0	8.1	119	1.0	0.04	0.5	<0.01	<0.01	0.51	0.50	0.01		87	6	2.5
06/03/1999	YAD172C	8.0	25.2	7.8	96	0.7	0.06	0.3	0.07	0.33	0.63	0.23	0.40		90	6	8.8
06/03/1999	YAD1780A	9.1	26.0	8.6	95	1.1	0.04	0.2	0.02	0.24	0.44	0.18	0.26		82	6	3.9
07/19/1994	YAD172C	4.7	29.1	7.8	110	0.6	0.07	0.7	0.25	0.05	0.75	0.45	0.30	21	110	9	8.1
07/19/1994	YAD1780A	8.6	29.6	8.7	107	0.7	0.05	0.5	0.03	<0.01	0.51	0.47	0.04	24	94	7	4.1

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/l)	Water Temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/l)	TKN (mg/l)	NH_3 (mg/l)	NO_x (mg/l)	TN (mg/l)	TON (mg/l)	TIN (mg/l)	CHL *a* (µg/l)	Total Solids (mg/l)	Susp. Solids (mg/l)	Turbidity (NTU)
Badin Lake																	
08/03/1999	YAD178B	8.6	30.1	8.5	108	0.9	0.02	0.4	<0.01	0.02	0.42	0.40	0.03		69	5	3.7
08/03/1999	YAD178E	7.6	30.3	7.9	98	1.6	0.01	0.4	0.01	0.02	0.42	0.39	0.03		65	1	1.6
08/03/1999	YAD178F	8.1	30.6	8.7	107	1.5	0.02	0.4	<0.01	<0.01	0.41	0.40	0.01		70	3	1.9
08/03/1999	YAD178F1	8.2	30.9	8.8	109	1.5	0.02	0.5	<0.01	0.01	0.51	0.50	0.02		74	2	2.1
07/08/1999	YAD178B	9.0	30.4	8.3	104	1.2	0.02	0.3	<0.01	0.09	0.39	0.30	0.10		77	3	2.6
07/08/1999	YAD178E	8.7	30.2	7.9	93	1.2	0.01	0.4	<0.01	0.05	0.45	0.40	0.06		76	3	1.9
07/08/1999	YAD178F	9.0	29.2	8.1	100	1.3	0.02	0.3	<0.01	0.07	0.37	0.30	0.08		110	3	1.8
07/08/1999	YAD178F1	8.7	29.2	7.9	101	1.4	0.01	0.3	<0.01	0.10	0.40	0.30	0.11		69	3	1.8
06/07/1999	YAD178B	10.3	27.4	8.9	97	1.0	0.04	0.3	0.03	0.15	0.45	0.27	0.18		81	9	3.5
06/07/1999	YAD178E	9.4	27.6	8.7	92	1.0	0.03	0.3	0.05	0.08	0.38	0.25	0.13		80	6	4.9
06/07/1999	YAD178F	10.4	26.7	9.1	96	1.0	0.03	0.3	0.04	0.10	0.40	0.26	0.14		86	6	3.8
06/07/1999	YAD178F1	8.7	26.7	8.6	94	0.8	0.03	0.3	0.04	0.17	0.47	0.26	0.21		87	18	4.8
07/28/1994	YAD178B	4.8	28.0	7.0	104	0.8	0.02	0.5	0.17	0.08	0.58	0.33	0.25	7	90	4	4.7
07/28/1994	YAD178E	6.4	28.2	7.2	94	1.4	0.01	0.3	0.07	0.07	0.37	0.23	0.14	6	72	1	2.0
07/28/1994	YAD178F	4.2	27.7	6.9	104	1.2	0.03	0.5	0.18	0.08	0.58	0.32	0.26	7	86	3	2.8
07/28/1994	YAD178F1	4.1	27.5	6.9	101	1.4	0.01	0.4	0.11	0.14	0.54	0.29	0.25	6	87	1	1.8
Lake Tillery																	
08/03/1999	YAD185A	4.8	27.6	6.8	104	1.1	0.02	0.3	0.01	0.20	0.50	0.29	0.21		81	2	2.4
08/03/1999	YAD189	6.2	28.4	7.1	102	1.5	0.01	0.3	<0.01	0.12	0.42	0.30	0.13		75	1	2.1
08/03/1999	YAD189B	8.0	29.7	8.2	97	1.4	0.01	0.3	<0.01	<0.01	0.31	0.30	0.01		82	2	3.1
08/03/1999	YAD189C	8.6	30.5	8.7	96	1.5	0.01	0.4	<0.01	<0.01	0.41	0.40	0.01		78	2	1.8
07/08/1999	YAD185A	9.5	30.9	8.4	94	1.5	<0.01	0.4	<0.01	0.10	0.50	0.40	0.11		74	3	2.6
07/08/1999	YAD189	9.2	31.0	8.7	93	1.5	0.01	0.3	<0.01	0.13	0.43	0.30	0.14		74	2	2.0
07/08/1999	YAD189B	9.2	31.4	8.6	94	1.5	<0.01	0.3	<0.01	0.14	0.44	0.30	0.15		75	2	1.8
07/08/1999	YAD189C	8.9	31.2	8.4	94	1.7	<0.01	0.4	<0.01	0.15	0.55	0.40	0.16		76	3	2.1
06/02/1999	YAD185A	9.8	25.1	7.8	93	1.5	0.02	0.2	<0.01	0.28	0.48	0.20	0.29		72	2	4.6
06/02/1999	YAD189	9.2	25.4	7.8	94	1.7	0.02	0.2	0.01	0.30	0.50	0.19	0.31		74	3	3.3
06/02/1999	YAD189B	9.5	24.9	7.6	92	1.6	0.02	0.2	<0.01	0.31	0.51	0.20	0.32		75	2	2.7
06/02/1999	YAD189C	9.1	24.5	6.9	91	2.0	0.01	0.3	<0.01	0.36	0.66	0.30	0.37		72	1	1.8
07/26/1994	YAD185A	7.0	28.3	7.4	88	1.4	0.02	0.4	0.02	0.21	0.61	0.38	0.23	7	67	2	2.0
07/26/1994	YAD189	8.1	29.6	7.9	80	1.4	0.02	0.4	0.03	0.11	0.51	0.37	0.14	3	65	3	2.4
07/26/1994	YAD189B	8.2	28.9	7.8	80	1.5	0.02	0.4	0.01	0.12	0.52	0.39	0.13	6	64	2	1.9
07/26/1994	YAD189C	8.4	29.1	7.9	80	1.5	0.02	0.3	0.01	0.12	0.42	0.29	0.13	4	70	1	2.0
Back Creek Lake																	
08/29/2001	YAD181J	8.2	28.5	7.5	97	0.8	0.06	0.7	<0.01	<0.01	0.74	0.73	0.01	27	92	7	<1
08/29/2001	YAD181K	8.2	28.5	7.6	97	1.2	0.04	0.7	<0.01	<0.01	0.69	0.68	0.01	6	84	5	<1
08/29/2001	YAD181L	9.0	28.1	7.9	98	1.2	0.04	0.7	0.02	<0.01	0.67	0.64	0.03	19	87	5	<1
07/19/2001	YAD181J	8.0	28.1	7.6	94	1.0	0.05	0.8	0.04	<0.01	0.78	0.73	0.05	27	71	7	7.2
07/19/2001	YAD181K	8.7	28.0	8.0	93	1.1	0.04	0.7	0.03	<0.01	0.73	0.69	0.04	19	77	4	3.3
07/19/2001	YAD181L	8.4	27.6	7.9	92	1.2	0.03	0.9	0.21	<0.01	0.89	0.67	0.22	14	71	12	6.4
07/07/1999	YAD181J	8.4	30.8	8.2	100	0.7	0.07	0.5	0.02	<0.01	0.51	0.48	0.03		71	12	6.4
07/07/1999	YAD181K	9.0	29.7	8.6	99	1.0	0.04	0.4	0.02	<0.01	0.41	0.38	0.03		80	9	3.8
07/07/1999	YAD181L	8.0	29.2	7.9	98	0.9	0.04	0.4	0.04	<0.01	0.41	0.36	0.05		70	8	4.5
06/03/1999	YAD181J	10.4	26.8	10.1	95	0.5	0.08	0.4	0.01	<0.01	0.41	0.39	0.02		110	11	8.1

Subbasin/ Waterbody/ Date	Station	Dissolved Oxygen (mg/l)	Water Temperature (°C)	pH (s.u.)	Conductivity (µmhos/cm)	Secchi depth (m)	TP (mg/l)	TKN (mg/l)	NH_3 (mg/l)	NO_x (mg/l)	TN (mg/l)	TON (mg/l)	TIN (mg/l)	CHL *a* (µg/l)	Total Solids (mg/l)	Susp. Solids (mg/l)	Turbidity (NTU)
06/03/1999	YAD181K	9.2	26.6	8.4	94	0.9	0.05	0.3	0.02	<0.01	0.31	0.28	0.03		100	6	5.2
06/03/1999	YAD181L	9.0	26.6	8.1	95	0.8	0.07	0.4	0.02	<0.01	0.41	0.38	0.03		120	9	6.6
08/23/1994	YAD181J	7.8	28.9	7.0	79	0.6	0.06	0.6	0.01	<0.01	0.61	0.59	0.02	6	110	8	6.6
08/23/1994	YAD181K	8.1	28.7	7.1	77	0.7	0.06	0.5	<0.01	<0.01	0.51	0.50	0.01	15	97	6	4.2
08/23/1994	YAD181L	6.7	28.1	7.1	78	0.7	0.08	0.5	0.01	<0.01	0.51	0.49	0.02	22	120	7	6.0
Lake Reese																	
08/29/2001	YAD179B	8.4	28.9	7.7	97	0.6	0.03	0.7	0.04	<0.01	0.68	0.63	0.05	20	90	7	1.1
08/29/2001	YAD179D	8.8	28.6	8.1	95	0.8	0.03	0.8	<0.01	<0.01	0.83	0.82	0.01	5	94	7	1.0
08/29/2001	YAD179F	9.3	28.1	8.3	93	0.8	0.02	0.7	0.01	<0.01	0.70	0.68	0.02	16	100	5	1.1
07/19/2001	YAD179B	7.8	29.6	7.8	99	0.8	0.05	0.6	0.11	<0.01	0.63	0.51	0.12	18	72	10	8.7
07/19/2001	YAD179D	8.9	28.9	8.4	96	1.1	0.04	0.6	0.34	<0.01	0.59	0.24	0.35	21	80	5	3.7
07/19/2001	YAD179F	8.4	28.3	8.1	96	1.2	0.02	0.6	0.03	<0.01	0.60	0.56	0.04	9	53	4	4.2
08/09/2000	YAD179B	8.6	29.5	7.9	112	1.2	0.02	0.4	0.05	0.05	0.45	0.35	0.10	29	90	5	5.5
08/09/2000	YAD179D	8.7	29.8	8.1	113	1.5	0.01	0.4	0.40	0.05	0.45	0.00	0.45	63	89	4	4.3
08/09/2000	YAD179F	8.5	30.4	8.1	110	2.3	0.01	0.4	<0.01	0.01	0.41	0.40	0.02		88	1	2.6
07/06/2000	YAD179B	8.3	28.2	7.5	110	1.1	0.02	0.5	0.03	<0.01	0.51	0.47	0.04		96	6	4.5
07/06/2000	YAD179D	8.2	28.6	8.1	118	1.4	0.02	0.3	0.08	<0.01	0.31	0.22	0.09		89	5	4.2
07/06/2000	YAD179F	8.1	28.9	8.0	116	2.0	0.01	0.4	0.13	<0.01	0.41	0.27	0.14			5	3.6
06/05/2000	YAD179B	7.4	25.4	7.7	115	1.0	0.03	0.4	0.03	<0.01	0.41	0.37	0.04		100	9	7.3
06/05/2000	YAD179D	7.8	25.4	7.6	109	1.4	0.02	0.3	0.02	<0.01	0.31	0.28	0.03		100	19	8.5
06/05/2000	YAD179F	7.5	25.8	7.6	107	1.6	0.04	0.3	0.03	<0.01	0.31	0.27	0.04		130	39	2.5
08/24/1999	YAD179B	6.0	27.9	7.1	117	0.8	0.03	0.5	0.04	<0.01	0.51	0.46	0.05		110	12	9.6
08/24/1999	YAD179D	7.6	26.6	7.4	117	1.1	0.01	0.4	0.05	0.03	0.43	0.35	0.08		95	4	4.8
08/24/1999	YAD179F	7.0	27.5	7.9	111	1.1	0.01	0.5	<0.01	0.01	0.51	0.50	0.02		100	4	3.8
07/21/1999	YAD179B	7.9	28.9	7.5	42	1.1	<0.01	0.4	0.01	0.01	0.41	0.39	0.02		95	6	4.9
07/21/1999	YAD179D	8.3	29.1	7.6	113	1.7	0.02	0.3	0.03	<0.01	0.31	0.27	0.04		93	1	3.5
07/21/1999	YAD179F	8.2	29.3	7.6	113	2.0	0.03	0.4	0.01	<0.01	0.41	0.39	0.02		89	4	2.9
06/16/1999	YAD179B	5.4	25.9	7.3	115	0.7	0.02	0.3	<0.01	<0.01	0.31	0.30	0.01		98	6	7.0
06/16/1999	YAD179D	7.3	25.8	7.3	115	0.9	0.01	0.2	<0.01	<0.01	0.21	0.20	0.01		99	2	4.5
06/16/1999	YAD179F	7.3	28.0	7.4	68	1.1	0.01	0.2	<0.01	<0.01	0.21	0.20	0.01		100	1	4.1
08/25/1994	YAD179B	8.6	26.8	7.8	87	1.1	0.04	0.4	<0.01	<0.01	0.41	0.40	0.01	3	74	6	5.6
08/25/1994	YAD179D	8.6	26.5	8.0	86	1.0	0.05	0.4	<0.01	<0.01	0.41	0.40	0.01	4	73	7	3.9
08/25/1994	YAD179F	8.2	26.2	7.9	85	1.2	0.04	0.4	<0.01	<0.01	0.41	0.40	0.01	5	67	4	3.1
03-07-10 Blewett Falls Reservoir																	
08/03/1999	YAD260B	7.6	30.1	8.4	128	1.1	0.04	0.8	<0.01	<0.01	0.81	0.80	0.01		76	6	3.4
07/08/1999	YAD260B	10.5	31.4	8.9	135	1.0	0.03	0.4	<0.01	0.08	0.48	0.40	0.09		97	4	2.6
06/02/1999	YAD260B	10.6	26.0	9.2	130	1.0	0.05	0.2	<0.01	0.17	0.37	0.20	0.18		85	5	4.9
07/26/1994	YAD260B	8.8	28.7	8.1	103	0.7	0.06	0.4	0.02	0.48	0.88	0.38	0.50	7	94	6	6.5
06/21/2000	YAD216A	8.5	28.1	8.5	139	0.8	0.02	0.4	<0.01	<0.01	0.41	0.40	0.01		100	5	9.2
08/02/1995	YAD215R	8.0	30.6	6.9	97	0.6	0.13	0.5	0.06	<0.01	0.51	0.44	0.07	<1	140	43	25.0
08/02/1995	YAD215T	9.2	30.5	8.1	90	1.0	0.06	0.4	0.02	<0.01	0.41	0.38	0.03	9	90	10	6.2
08/02/1995	YAD216A	8.9	30.5	8.1	87	0.8	0.06	0.4	0.02	<0.01	0.41	0.38	0.03	8	110	9	5.2

[1] Abbreviations are TP = total phosphorus, TKN = total Kjeldahl nitrogen, NH_3 = ammonia nitrogen, NO_x = nitrate + nitrite nitrogen, TON = total organic nitrogen, TIN = total inorganic nitrogen, and Chl *a* = chlorophyll *a*.

Appendix III

Use Support Methodology
and
Use Support Ratings

Multiple-Category Use Support Methods

DRAFT January 29, 2003

A. Introduction to Use Support

Surface waters are classified according to their best intended uses. Determining how well a waterbody supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality.

Surface waters are rated *supporting and impaired*. These ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and recreation) are being met. For example, waters classified for fish consumption, aquatic life protection and secondary recreation (Class C for freshwater or SC for saltwater) are rated Supporting if data used to determine use support meet certain criteria. However, if these criteria were not met, then the waters would be rated as Impaired. Waters with inconclusive data are listed as Not Rated. Waters lacking data are listed as No Data. More specific methods are presented in Part C of this appendix.

In previous use support assessments, surface waters were rated fully supporting (FS), partially supporting (PS), not supporting (NS) and not rated (NR). FS was used to identify waters that were meeting their designated uses. Impaired waters were rated PS and NS, depending on their degree of degradation. NR was used to identify waters lacking data or having inconclusive data. The 2002 Integrated Water Quality Monitoring and Assessment Report Guidance issued by the EPA requested that states no longer subdivide the impaired category. In agreement with this guidance, North Carolina no longer subdivides the impaired category and rates waters as Supporting, Impaired, Not Rated or No Data.

Historically, the Supporting use support rating was also subdivided into fully supporting (FS) and fully supporting but threatened (ST). ST was used to identify waters that were fully supporting but had some notable water quality concerns and could represent constant, degrading or improving water quality 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 demonstrate 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 the EPA and North Carolina definitions of ST and the resulting confusion that arose from this difference, North Carolina no longer subdivides the supporting category. However, these waters and the specific water quality concerns are identified in the Section B subbasin chapters so that data, management and the need to address the identified concerns are presented.

B. Interpretation of Data and Information

Data used in the use support assessments include biological data, chemical/physical data, lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, and swimming advisories and shellfish sanitation growing area classification from the NC Division of Environmental Health (as appropriate). Available land cover and land use information is also used, along with annual water supply reports from regional water treatment plant consultants.

Although there is a general procedure for analyzing the data and information for determining use support ratings, each waterbody is reviewed individually, and best professional judgment is applied during these determinations.

When interpreting the use support ratings, it is important to understand its associated limitations and degree of uncertainty. The assessments are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Rather, the intent of use support assessments is to gain an overall picture of water quality, to describe how well surface waters support the uses for which they were classified, and to document the potential contribution made by different pollution sources.

C. Assessment Methodology

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the development of use support ratings for six categories: aquatic life and secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the six use support categories, as shown in the table below. For many waters, a use support category will not be applicable (N/A) to the use classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*.

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

Many types of information are used to determine use support ratings and to identify causes and sources of water quality impairment. A use support data file is maintained for each of the 17 river basins. All existing data pertaining to a stream segment for each applicable use support category are entered into its record and can include, but is not limited to, use support ratings, basis of assessment, biological data, ambient monitoring data, problem parameters and potential sources. The following describes the data and methodologies used to make use support assessments for the surface water classifications (described in Section A, Chapter 3 of each basin plan) using the six use support categories. These methods will continue to be refined, as additional information becomes available.

Basis of Assessment

Assessments are made on either a monitored (M) or evaluated (E) basis depending on the level of information available. A monitored rating is based on the most recent five-year window and site-specific data and is therefore treated with more confidence than an evaluated rating.

Summary of Basis for Assigning Use Support Ratings to Surface Waters			
Use Support Status	**Overall Basis**	**Specific Basis**	**Description**
Supporting/ Impaired	Monitored	Monitored (M)	Monitored stream segments[a] with data[b] ≤5[c] years old where a bioclassification has been assigned to the sampling site and/or ambient and/or fish tissue data exist and/or DEH shellfish growing area data and/or information on posted swimming closures are available; may be applied to any use support category assessed.
Not Rated		Monitored (M)	Monitored stream segments[a] with data[b] ≤5[c] years old where a bioclassification has not been assigned to the sampling site; can only be applied to the Aquatic Life/Secondary Recreation use support category.
Supporting		Monitored/ Evaluated (ME)	Stream segment[a] is not monitored, but is assigned a use support rating based on another segment of same stream for which data[b] ≤5[c] years old are available where a bioclassification has been assigned to the sampling site and/or ambient data are available and the segment is given a Supporting rating; can only be applied to the Aquatic Life/Secondary Recreation use support category.
Supporting	Evaluated	Evaluated (E)	Applied to unmonitored streams that are direct or indirect tributaries to monitored stream segments rated Supporting in the Aquatic Life/Secondary Recreation use support category that share similar land use to the monitored stream segment; waters in the Water Supply use support category where no significant problems have been noted in the Regional Surface Water Supply Reports; waters in the Fish Consumption use support category in river basins that do not contain documented populations of bowfin.
Impaired		Evaluated (E)	Only applied to waters in the Fish Consumption use support category in river basins that contain documented bowfin populations.
Not Rated		Evaluated (E)	Unmonitored streams that receive effluent from a NPDES discharger that has been found to be in "significant noncompliance" or has failed three or more WET tests during the two-year review period; only applied to the Aquatic Life/Secondary Recreation use support category.
No Data (ND)			Insufficient or no data available to determine use support; includes unmonitored streams that are direct or indirect tributaries to stream segments rated Impaired.

a) 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).
b) Major data sources include benthic macroinvertebrate and fish community bioclassifications and chemical/physical monitoring data.
c) From the year that basin monitoring was done.

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

Problem Parameters

Where an ambient parameter is identified as a potential concern, the parameter is listed in the DWQ database and use support summary table. Where habitat degradation is identified by DWQ biologists based on site visits, it is listed and attempts are made to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools, loss of riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion). Habitat evaluation methods are being developed to better identify specific types of habitat degradation.

Potential Sources

General nonpoint sources (NPS) and point sources (PS) of pollution are identified where there is sufficient information.

Aquatic Life and Secondary Recreation Use Support

The aquatic life and secondary recreation use support category is an ecosystem approach to assess whether aquatic life (benthic macroinvertebrates and fish) can live and reproduce in the waters of the state and whether waters support secondary recreation (i.e., wading, boating and minimal human body contact with water). This category is applied to all waters of the state. Biological data, ambient monitoring data and NPDES discharger data are all considered in assessing the aquatic life and secondary recreation use support category. The following is a description of each data type and methods used to assess how well a water is meeting the criteria for protection of aquatic life and secondary recreation.

Biological Data

There are two main types of biological data: benthic marcoinvertebrate and fish community. Where recent data for both benthic macroinvertebrates and fish communities are available, both are evaluated in assessing use support. It is important to note that where both ambient monitoring data and biological data are available, biological data are given greater weight.

In special situations, where there are currently insufficient biological data available, the basinwide planner will make a request of the DWQ Environmental Sciences Branch to determine whether a biological survey is appropriate. If a biological survey is appropriate, the use support rating will be determined by the bioclassification resulting from the survey. If a biological survey is not appropriate, then the stream will be not rated.

Benthic Macroinvertebrate Bioclassifications

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera, Plecoptera* and *Trichoptera* (EPTs) and the Biotic Index (BI), which summarizes tolerance data for all taxa in each collection. The benthic macroinvertebrate bioclassifications are translated into use support ratings according to the following scheme:

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

Due to the increased emphasis placed on Fair or Poor bioclassifications and the borderline nature of some bioclassification scores, sites should be resampled within 12-24 months after a Fair rating is obtained in 1999 and beyond, if this Fair rating will result in a lower use support rating or if data are from a site never sampled before. This resampling will be done to validate the Fair bioclassification. Such sites will not be given a use support rating until the second sample is obtained. The table below shows how a final use support rating is obtained for sites that are resampled.

New Benthic Macroinvertebrate Classifications (1999 and Beyond) and Data Causing a Decline in Use Support Ratings

Pre-1999 Bioclassification	1st sample Bioclassification	Draft Use Support Rating	2nd sample Bioclassification	Final Use Support Rating
N/A	Fair	Not Rated; resample	Good-Fair, Good or Excellent	Supporting
N/A	Fair	Not Rated; resample	Fair or Poor	Impaired
N/A	Poor	Impaired	N/A	Impaired
Good-Fair, Good or Excellent	Fair	Not Rated; resample	Good-Fair, Good or Excellent	Supporting
Good-Fair, Good or Excellent	Fair	Not Rated; resample	Fair or Poor	Impaired
Good-Fair, Good or Excellent	Poor	Impaired	N/A	Impaired

N/A – Not Applicable NR = Not Rated

The use of benthic macroinvertebrate data can be limited in some waters. The accumulation of swamp stream data over nearly a decade suggests that not all swamp streams support similar fauna. The development of swamp stream criteria is complex, and one set of criteria is not appropriate for all swamp streams. Benthic macroinvertebrate data will not be used in waters characterized or classified by DWQ as swamp waters until the bioclassification criteria for these waters can be used with confidence. Benthic macroinvertebrate data are also not used to develop use support ratings for estuarine waters. Until bioclassification criteria for swamp and estuarine waters are developed, a designation of Not Rated will be used, and these waters will be listed as Not Rated for aquatic life and secondary recreation use support assessments.

Benthic macroinvertebrate data are used to provide bioclassifications for high elevation trout streams. The benthic macroinvertebrate data, while not a direct measure of the trout population, are a robust measure of stream integrity. Loss of canopy, increase in stream temperature, increased nutrients, toxicity and increased sedimentation will affect the benthic macroinvertebrate and fish communities. For these reasons, the benthic macroinvertebrate bioclassifications provide a valuable assessment of the integrity of trout waters.

A designation of Not Impaired may be used for flowing waters that are too small to be assigned a bioclassification (less than 4 meters in width), but meet the criteria for a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria. This designation will translate into a use support rating of Supporting.

Fish Community Bioclassifications

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. The NCIBI is translated into use support ratings according to the following scheme:

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

The NCIBI was recently revised by DWQ (NCDENR, 2001). Currently, the focus of using and applying the NCIBI is restricted to wadeable streams that can be sampled by a crew of four persons. Infrequently, larger wadeable streams can be sampled if there is a crew of six persons. The bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a).

NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of the "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin – all waters except for those draining the Sandhills in Moore, Lee and Harnett counties and the entire basin upstream of Lillington, NC.

- In the Neuse River basin -- the entire basin above Smithfield and Wilson, except for the south and southwest portions of Johnston County and eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

NCIBI criteria have not been developed for:

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

Due to the increased emphasis placed on Fair or Poor bioclassifications and the borderline nature of some bioclassification scores, sites should be resampled within 12-24 months after a Fair rating is obtained in 1999 and beyond, if this Fair rating will result in a lower use support rating or if data are from a site never sampled before. This resampling will be done to validate the Fair bioclassification. Such sites will not be given a use support rating until the second sample is obtained. The table below shows how a final use support rating is obtained for sites that are resampled.

New Fish Community Classifications (1999 and Beyond)
and Data Causing a Decline in Use Support Ratings

Pre-1999 Bioclassification	1st sample Bioclassification	Draft Use Support Rating	2nd sample Bioclassification	Final Use Support Rating
N/A	Fair	Not Rated; resample	Good-Fair, Good or Excellent	Supporting
N/A	Fair	Not Rated; resample	Fair or Poor	Impaired
N/A	Poor	Impaired	N/A	Impaired
Good-Fair, Good or Excellent	Fair	Not Rated; resample	Good-Fair, Good or Excellent	Supporting
Good-Fair, Good or Excellent	Fair	Not Rated; resample	Fair or Poor	Impaired
Good-Fair, Good or Excellent	Poor	Impaired	N/A	Impaired

N/A – Not Applicable NR = Not Rated

Ambient Monitoring Data

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring System. These data are downloaded from the Surface Water Information Management System for analysis. Total number of samples and percent of samples exceeding the NC water quality standards are evaluated for the development of use support ratings along with other data or alone when other data are not available. Where both ambient data and biological data are available, biological data are given greater weight.

When reviewing ambient data, a five-year window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for the ambient data would be September 1, 1995 to August 31, 2000. Selected ambient parameters are used to assess aquatic life/secondary recreation use support. These parameters include ammonia, dissolved oxygen, pH, chloride, arsenic, cadmium, chromium, nickel and lead. These parameters are measured against standards for a minimum of ten samples as follows:

Standards Violation	Rating
Criterion exceeded ≤10%	Supporting
Criterion exceeded 11-25%	Impaired

Data for copper, iron and zinc are not used according to the scheme outlined above. These metals have action level standards because they are generally not bioaccumulative and have variable toxicity to aquatic life depending on chemical form, solubility and stream characteristics. 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.

Metals data for copper and iron are screened at the 85th percentile of five years of ambient data ending on August 31 of the year of biological sampling. Sites, other than estuarine and swamp waters, with an 85th percentile of ≥20 μg/l of copper and/or ≥2000 μg/l of iron are identified and flagged for instream chronic toxicity testing by DWQ. Chronic toxicity testing in estuarine and swamp waters is not ecologically meaningful. Criteria are still being developed for zinc. If a stream does not have biological data that would deem a Supporting rating, then the stream can be rated Impaired for aquatic life if instream chronic toxicity is found. Criteria for evaluating instream chronic toxicity are three chronic pass/fail tests over three months using *Ceriodaphnia*. Two fails result in an Impaired rating.

It is important to note that some waters may exhibit characteristics outside the numerical standards due to natural conditions (e.g., many swamp waters are characterized by low pH and dissolved oxygen). These natural conditions do not constitute a violation of water quality standards.

NPDES Discharger Data

Aquatic Toxicity Data

For facilities that perform Whole Effluent Toxicity (WET) tests according to state NPDES discharge permit requirements, a review of the results of a five-year window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for the aquatic toxicity data would be September 1, 1995 to August 31, 2000. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient data, and that facility has failed three or more WET tests in the most recent two years, the stream is not rated. If failures continue, DWQ will work with the facility to correct the failures and assess stream impacts before the next basin sampling cycle begins with either a biological survey or instream chronic toxicity testing, if possible.

Discharge Effluent Data

NPDES effluent data are reviewed by analyzing monthly averages of water quality parameters over a two-year period of data ending on August 31 of the year of biological sampling in a basin. Prior to May 31, 2000, facilities were screened for criterion 40 percent in excess of state water quality standards for conventional pollutant limitations or 20 percent in excess of state water quality standards for toxic pollutants for two or more months during two consecutive quarters, or chronic violations of either conventional or toxic pollutant limitations for four or more months during two consecutive quarters.

After May 31, 2000, facilities are screened for criterion 20 percent in excess of state water quality standards for both conventional and toxic pollutants for two or more months during two consecutive quarters, or chronic violations of either conventional or toxic pollutant limitations for four or more months during two consecutive quarters. Streams with discharges that are in excess of permit limits will not be rated if no biological or ambient monitoring data are available. Therefore, streams will not be rated impaired based on effluent data alone. Appropriate DWQ staff will be given a list of these facilities for follow-up.

Fish Consumption Use Support

The fish consumption use support category is a human health approach to assess whether humans can safely consume fish from a water. This use support category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories or advice issued by the NC Department of Health and Human Services. If a limited fish consumption advisory or a no consumption advisory is posted at the time of use support assessment, the water is rated Impaired.

The current statewide limited fish consumption advice for bowfin due to elevated levels of mercury in fish tissue is an exception. It is recognized that bowfin only live and reproduce in waters of the piedmont and coastal plain. Therefore, the use support ratings will be based on the combination of the current statewide fish consumption advice for bowfin and the documented presence of bowfin in each river basin as found in *Freshwater Fisheries of North Carolina* (Menhinick, 1991). In river basins where there are documented populations of bowfin (Roanoke, Chowan, Pasquotank, White Oak, Lumber, Neuse, Tar-Pamlico, Cape Fear, Yadkin-Pee Dee and Catawba), all waters will be rated Impaired for the fish consumption category. In river basins where there are no documented populations of bowfin (Little Tennesee, Hiwassee, Savannah, Watauga, New, French Broad and Broad), the waters will be rated Supporting for the fish consumption category unless there is a site-specific advisory.

In order to separate this statewide advisory from other fish consumption advisories and to identify actual bowfin populations with high levels of mercury, only waters with fish tissue monitoring data are presented on the use support maps and in the use support summary tables of the basin plans. A review of the present methods for assessing the fish consumption use support category is being conducted, and methods may be modified in the future.

Primary Recreation Use Support

This human health related use support category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses usually involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for supporting these uses are classified as Class B, SB and SA waters. This use support category also evaluates whether waters support secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving human body contact with water where such activities take place on an infrequent, unorganized, or incidental basis. Waters of the state designated for supporting these uses are classified as Class C, SC and WS waters. The use support ratings applied to this category are based on the North Carolina water quality standard for fecal coliform bacteria where data are available or where swimming advisories are posted by local and state health agencies.

Water quality standards for fecal coliform bacteria are intended to ensure safe use of waters for recreation (refer to Administrative Code Section 15A NCAC 2B .0200). The North Carolina fecal coliform bacteria standard for freshwater is not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period and not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The 200 colonies per 100 ml standard is intended to ensure that waters are safe enough for water contact through recreation.

Beginning in the summer of 1997, the Division of Environmental Health (DEH) began testing coastal recreation waters (beaches) for fecal coliform bacteria levels to assess the relative safety of these waters for swimming. The Shellfish Sanitation Section of DEH routinely tests approximately 275 coastal sites once a week during the tourist recreational season (April to September), less often the rest of the year. These tests give researchers and the public a gauge of bacteria levels along the North Carolina coast. If an area has elevated bacteria levels, health officials will advise that people not swim there by posting a swimming advisory in the area, and by notifying the local media and county health department.

The Division of Water Quality (DWQ) does not have a comprehensive weekly monitoring program to assess inland waters for fecal coliform bacteria levels. North Carolina has more than 37,000 miles of inland waters and resources are not sufficient to perform comprehensive weekly bacteria monitoring. Rather, DWQ conducts monthly ambient water quality monitoring at approximately 375 locations across the state. These monthly samplings include fecal coliform bacteria testing of selected lakes, rivers and streams. Ambient water quality samples are routinely collected and sent to DWQ laboratories for analysis using EPA approved laboratory methods, with the exception that sample holding times are not typically within the prescribed six hour limit. These data collection and analysis restrictions may impact the quality assurance of the sample results.

Because use support decisions are made in conjunction with the development of DWQ's basinwide water quality management strategies, all available information and data are evaluated for use support ratings using a five-year assessment period. A five-year data window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for the fecal coliform data and swimming advisories would be September 1, 1995 to August 31, 2000. However, an annual screening review of all DWQ ambient fecal coliform data is conducted by DWQ to assess the need for additional monitoring or the need for immediate action by the local or state health agencies to protect public health. In most cases, management strategies to correct waters considered to be impaired due to elevated fecal coliform bacteria levels may require substantial resources and time. Therefore, impairment decisions for bacteria must be made using sound science and data.

Decades of monitoring experience have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, a five-year data window and multiple sampling efforts are used to evaluate waters against the North Carolina water quality standard for recreational use support. This level of sampling is needed before waters should be considered impaired and therefore in need of TMDL's or other management strategies. This procedure however, does not preclude any health agency from immediately posting health advisories to warn recreational users of a temporary increase in health risks related to bacterial contamination or other health related episodes.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400 colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. In addition, appropriate health agencies are notified of these locations. If an initial five times within 30 days sampling indicates a geometric mean greater than 200 colonies per100 ml, or more than 20 percent of these samples exceed 400 colonies per100 ml, then the location will continue to be sampled for bacteria persistence. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

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

Recreational use support decisions are based on a review of both DWQ and DEH monitoring data for the five-year data window. A formal solicitation for readily available and suitable fecal coliform bacteria monitoring data from other sources is conducted in accordance with EPA Section 303(d) guidance. Recreational use support assessments include an annual review of all readily available DWQ ambient monitoring data and may include additional sampling of five times within 30 days. The use support impairment status of any given water and the resulting listing of that water on the State 303(d) List will be determined using two procedures.

Monitored Class B, SB and SA waters are rated supporting for primary recreation if the geometric mean over the five-year data window is less than or equal to 200 colonies per 100 ml, and if less than 20 percent of these samples did not exceed 400 colonies per100 ml. These waters will be rated impaired if either portion of these state standards are not met, or if additional five times within 30 days sampling exceeded either portion of the state standard. Monitored Class C, SC and WS waters are rated impaired if a fecal coliform standard has been exceeded for that waterbody during the five-year data window and subsequent monitoring of five times within 30 days exceeded the 200 colonies per 100 ml geomean, or greater than 20 percent of these samples exceeded 400 colonies per 100 ml over the five-year data window. These waters are rated supporting for secondary recreation if neither portion of the state standard is exceeded. Waters without sufficient fecal coliform data or swimming advisories are not rated and waters with no data are noted as having no data.

DWQ attempts to determine if there are any inland swimming areas monitored by county or local health departments or estuarine (Class SA and SB) waters as assessed by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year. When reviewing DEH fecal coliform data and local swimming advisories, the same five-year window that ends on August 31 of the year of biological sampling is used. If a water was posted with a swimming advisory for at least two months within the five-year data window, it is further evaluated for the persistence of elevated fecal coliform bacteria levels. Those waters posted with swimming advisories for more than two months in the five-year data window are rated impaired unless county or state health agencies believe that the cause of the swimming advisory is not persistent. If DEH has no data on an estuarine water, that water will not be rated for recreational uses.

Shellfish Harvesting Use Support

The shellfish harvesting use support category is a human health approach to assess whether shellfish can be commercially harvested and is therefore applied only to Class SA waters. The following data sources are used to determine use support ratings for shellfish waters and to determine causes and sources of impairment for these waters.

Division of Environmental Health (DEH) Shellfish Sanitation Surveys

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation surveys every three years to determine if their classification is still applicable. DEH classifications may be changed after the most recent sanitary survey. Classifications are based on DEH fecal coliform bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as follows:

DEH Classification	DEH Criteria
Approved (APP)	**Fecal Coliform Standard for Systematic Random Sampling:** The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90^{th} percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test. **Fecal Coliform Standard for Adverse Pollution Conditions Sampling:** The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be open more frequently than closed.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Assigning Use Support Ratings to Shellfish Harvesting Waters (Class SA)

It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. Thus, the DWQ Class SA waters must be separated out and rated for shellfish harvesting use support. The acreage of Supporting and Impaired waters are calculated using GIS showing DWQ and DEH classifications as attribute information. However, the DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as Impaired.

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to those areas that DWQ Class SA (shellfish harvesting waters). This will result in a difference of acreage between DEH areas classified as CAC, PRO, RES and DWQ waters rated as Impaired. For example, if DEH classifies a 20-acre area CAC, but only ten acres are Class SA, only those ten acres of Class SA waters are rated as Impaired.

Sources of fecal coliform bacteria are more difficult to separate out for Class SA areas. DEH describes the potential sources in the sanitary surveys, but they do not describe specific areas affected by these sources. Therefore, in the past, DEH identified the same sources for all Class SA sections of an entire management area (e.g., urban runoff and septic systems). Until a better way to pinpoint sources is developed, this procedure will continue to be used. A point source discharge is only listed as a potential source when NPDES permit limits are exceeded.

DWQ and DEH are developing the database and expertise necessary to assess shellfish harvesting use support using a frequency of closures-based approach. This database will allow DWQ to better assess the extent and duration of closures in Class SA waters. These tools will not be available for use support determinations in Class SA waters for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. DWQ believes it is important to identify frequency of closures in these waters, so an interim methodology will be used based on existing databases and GIS shapefiles. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that result from this project. DWQ and DEH hope to have these tools fully developed for using the frequency of closure-based methods for the 2005 Cape Fear River use support assessment and basin plan.

Interim Frequency of Closure-Based Assessment Methodology

The interim method will be used for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. Shellfish harvesting use support ratings for Class SA waters using the interim methodology are summarized below.

Interim Frequency of Closure-Based Use Support Ratings

Percent of Time Closed within Basin Data Window	DEH Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	Supporting
Closed ≤10% of data window	Portion of CAO closed ≤10% of data window	Supporting
Closed >10% of the data window	Portion of CAO closed >10% of data window	Impaired
N/A	CAC and P/R**	Impaired

* Approved waters are closed only during extreme meteorological events (hurricanes).

** CAC and P/R waters are rarely opened to shellfish harvesting.

For CAO areas, DWQ will work with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during a five-year window of data that ends on August 31 of the year of biological sampling. For example, if biological data are collected in a basin in 2000, then the five-year window for data review would be September 1, 1995 to August 31, 2000. For each growing area with CAO Class SA waters, DEH and DWQ staff will define subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed will be determined using DEH proclamation summary sheets and the original proclamations.

The number of days that APP areas in the growing area were closed due to preemptive closures because of named storms are not counted. For example, all waters in growing area E-9 were preemptively closed for Hurricane Fran on September 5, 1996. APP waters were reopened September 20, 1996. Nelson Bay (CAO) was reopened September 30, 1996. This area was considered closed for ten days after the APP waters were reopened.

Proposed Permanent Frequency of Closure-Based Assessment Methodology

Over the next few years DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a fully functionally database with related georeferenced (GIS) shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. DWQ proposes to use information generated by these new tools to do frequency of closure-based shellfish harvesting use support assessments in Class SA waters, starting with the 2005 Cape Fear River basin use support assessment.

Using the new database with georeferenced areas and monitoring sites, DEH will be able to report the number of days each area was closed excluding closures related to named storms. The percent of the five-year data window that individual Class SA waters are closed will be used to make use support determinations for areas that are classified by DEH as CAO. PRO, RES and CAC areas will be rated Impaired and CAO areas will be rated Supporting or Impaired based on the methodology outlined above in the interim methods. Growing areas that have been reclassified by DEH during the data window from a lower classification to APP will be rated FS. Areas that are reclassified from APP to CAO during the data window will be rated as described above in the interim methods, taking into account the total days closed during the data window, including when the area was classified as APP.

Water Supply Use Support

This use support category is used to assess all Class WS waters and is a human health approach to assess whether a water can be used for water supply purposes. Many drinking water supplies in NC are drawn from human-made reservoirs that often have multiple uses.

Water supply use support is assessed using information from the seven regional water treatment plant (WTP) consultants. Each January, the WTP consultants submit a spreadsheet listing closures and water intake switch-overs for all water treatment plants in their region. This spreadsheet describes the length and time of the event, contact information for the WTP, and the reason for the closure or switch.

The WTP consultants' spreadsheets are reviewed to determine if any closures/switches were due to water quality concerns. Those closures/switches due to water quantity problems and reservoir turnovers are not considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. In general, North Carolina's surface water supplies are currently rated supporting. Specific criteria for rating waters impaired are yet to be determined.

Other Uses: All Waters in the State

This category of use will be assessed infrequently but could be applied to any water in the state. Examples of uses that could fall into this category are aesthetics and industrial and agricultural water supply. This category allows for the assessment of any use that is not considered for aquatic life and secondary recreation, primary recreation, fish consumption, shellfish harvesting or water supply.

D. Use of Outside Data

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 60 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and problem parameters. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

Criteria Levels for Use of Outside Data in Use Support Assessments

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

E. Lakes Assessments

One of the main causes of impacts to lakes is nutrient enrichment, or eutrophication. Several water quality variables 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. Climate, hydrology, morphology and water chemistry also play important roles in controlling the impacts of nutrients on a system. In addition, many of North Carolina's lakes are human-made reservoirs that do not mimic natural systems. Therefore, any analysis related to eutrophication must consider these variables as well.

North Carolina's lakes and reservoirs support a variety of uses including aquatic life propagation and maintenance, recreation and water supply. Prior to 2002, lake and reservoir use support was determined based mainly on extent and duration of documented algal blooms, extensive aquatic weed infestations, fish advisories and habitat degradation. Beginning in 2002, lakes and reservoirs will also be evaluated similarly to free-flowing waters where sufficient, qualityassured, surface water quality data (10 or more observations) are available for a more reliable comparison to surface water quality standards.

The first step in a lake analysis is the identification of the water quality parameters that assist in describing the level of eutrophication of a system. North Carolina has adopted surface water quality standards for all of the enrichment-related parameters except phosphorus and nitrogen. Control of phosphorus and nitrogen inputs to North Carolina water bodies has been achieved through a variety of management strategies including the use of the current eutrophication-related standards and the Nutrient Sensitive Waters supplemental classification. Working with EPA, the state is developing an action plan to achieve better nutrient management and continue moving to a more proactive approach to nutrient control.

DWQ uses many sources of information to assess the water quality and trophic status of lakes (refer to Appendix A-II for further information). These sources include:

- multiple quantitative water quality variables (e.g., dissolved oxygen, chlorophyll *a*)
- third party reports
- analysis of water quality or aesthetic complaints, and taste and odor observations
- algal bloom reports
- macrophyte observations
- fish kill reports
- frequency of noxious algal activity
- reports/observations of the NC Wildlife Resources Commission, lake associations and water treatment plant operators

Beginning in 2002, another modification to lake use assessment is the evaluation and subsequent rating of a lake or reservoir by segments. In some situations, portions of a waterbody, such as shallow coves, may have documented impairment while other areas of the same waterbody are not impaired based on ambient monitoring and outside data. In such cases, those portions with documented impairment (sufficient data, ambient data above standards, and supporting outside data) will be rated as impaired.

The management of lakes and reservoirs to support multiple uses presents an interesting challenge in that removal of sufficient nutrients to control nuisance blooms may result in decreases in fish populations or shifts in forage species needed to support a favored fishery. These considerations must be addressed in the process of developing lake management strategies, including the implementation of TMDLs.

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Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Yadkin River	From source to mouth in W. Kerr Scott Reservoir at Elevation 1030	03-07-01	35.0		S	M	Organic Enrichment Habitat degradation Turbidity	Agriculture Highway/Bridge/Road Runoff
Yadkin River (W. Kerr Scott Reservoir)	From mouth in W. Kerr Scott Reservoir at Elevation 1030 (1.4 mile downstream of Stony Fork) to a point 3.2 mile downstream of Stony Fork	03-07-01		66.7	S	ME		
Yadkin River (W. Kerr Scott Reservoir)	From a point 3.2 mile downstream of Stony Fork to W. Kerr Scott Dam	03-07-01		882.1	S	M		
Yadkin River	From W. Kerr Scott Dam to Moravian Creek	03-07-01	3.1		S	ME		
Yadkin River	From Moravian Creek to a point 1.0 mile upstream of Roaring River	03-07-01	11.5		S	M	Fecal coliform	
Yadkin River	From a point 1.0 mile upstream of Roaring River to a point 0.2 mile upstream of the mouth of Big Bugaboo Creek	03-07-01	4.2		S	M	Fecal coliform	
Yadkin River	From a point 0.2 mile upstream of Big Bugaboo Creek to a point 0.9 mile upstream of mouth of Elkin Creek (River)	03-07-01	9.7		S	M		
Yadkin River	From a point 0.9 mile upstream of the to mouth of Elkin Creek (River) to point 0.3 mile upstream of the mouth of Elkin Creek (Town of Jonesville water supply intake)	03-07-01	0.5		S	ME		
Buffalo Creek	From source to Yadkin River	03-07-01	14.9		S	M		
Elk Creek	From source to Dugger Creek	03-07-01	13.5		S	ME		
Elk Creek	From Dugger Creek to Yadkin River	03-07-01	9.1		S	M	Fecal coliform	
Beaver Creek	From source to Yadkin River	03-07-01	9.9		S	M		
Stony Fork	From source to Wilkes County SR 1168	03-07-01	10.7		S	ME		
Stony Fork	From Wilkes County SR 1168 to Yadkin River	03-07-01	5.9		S	M		
Lewis Fork	From source to W. Kerr Scott Reservoir, Yadkin River	03-07-01		91.6	S	ME		
N Prong Lewis Fork	From source to Wilkes County SR 1300	03-07-01	7.3		S	ME		

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
N Prong Lewis Fork	From Wilkes County SR 1300 to a point 1.0 mile upstream of Purlear Creek	03-07-01	4.7		S	M		
N Prong Lewis Fork	From a point 1.0 mile upstream of mouth of Purlear Creek to Lewis Fork	03-07-01	3.9		S	ME		
Little Fork	From source to North Fork Lewis Fork	03-07-01	2.2		S	M		
Purlear Creek	From source to a point 2.0 mile upstream of mouth	03-07-01	2.9		S	M		
S Prong Lewis Fork	From source to Wilkes County SR 1155	03-07-01	9.5		S	M		
S Prong Lewis Fork	From Wilkes County SR 1155 to a point 1.1 mile upstream of mouth	03-07-01	5.8		S	ME		
S Prong Lewis Fork	From a point 1.1 miles upstream of mouth to Lewis Fork	03-07-01	0.7		S	ME		
Moravian Creek	From source to Yadkin River	03-07-01	11.4		S	M	Habitat degradation	Agriculture Urban Runoff/Storm Sewers
Reddies River	From source to a point 0.4 mile downstream of Hoopers Branch	03-07-01	14.3		S	ME		
Reddies River	From North Wilkesboro Water Supply Dam to Yadkin River	03-07-01	0.9		S	M		
Reddies River	From a point 0.4 mile downstream of Hoopers Branch to North Wilkesboro Water Supply Dam	03-07-01	0.6		S	ME		
Mid Fork Reddies River	From source to Reddies River	03-07-01	7.9		S	M		
S Fork Reddies River	From source to Reddies River	03-07-01	7.5		S	M		
N Fork Reddies River	From source to Reddies River	03-07-01	11.2		S	M		
Cub Creek	From source to Yadkin River	03-07-01	10.8		S	M	Habitat degradation	Agriculture Urban Runoff/Storm Sewers
Mulberry Creek	From source to Yadkin River	03-07-01	19.7		S	M		
Roaring River	From source to Yadkin River	03-07-01	5.9		S	M		
Mid Prong Roaring River	From source to Wilkes County SR 1736	03-07-01	5.8		S	ME		

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Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Mid Prong Roaring River	From Wilkes County SR 1736 to Roaring River	03-07-01	3.1		S	M		
E Prong Roaring River	From source to Garden Creek	03-07-01	0.9		S	M		
E Prong Roaring River	From Garden Creek to Wilkes County SR 1737	03-07-01	1.7		S	M		
E Prong Roaring River	From Wilkes County SR 1737 to Roaring River	03-07-01	11.8		S	ME		
Yadkin River	From a point 0.3 mile upstream of the mouth to Elkin Creek (River) to a point 0.3 mile upstream of Ararat River	03-07-02	24.7		S	M		
Yadkin River	From a point 0.3 mile upstream of Ararat River to mouth of Carters Creek (Winston-Salem Water Supply Intake)	03-07-02	36.8		S	ME		
Yadkin River	From the mouth of Carters Creek to a point 0.7 mile upstream of Muddy Creek	03-07-02	3.1		S	M	Turbidity	
Yadkin River	From a point 0.7 mile upstream of mouth of Muddy Creek to a point 0.5 mile upstream of US Highway 64	03-07-02	9.6		S	ME	Turbidity	
Elkin Creek (River)	From source to Elkin Water Supply Intake	03-07-02	17.1		S	ME		
Elkin Creek (River)	From Elkin Water Supply Intake to Yadkin River	03-07-02	1.8		S	M	Habitat degradation	Agriculture Urban Runoff/Storm Sewers
Elkin Reservoir	Entire reservoir and connecting stream to Elkin Creek (River)	03-07-02		8.5	S	ME		
Mitchell River	From source to mouth of Christian Creek (North Fork Mitchell River)	03-07-02	8.5		S	M	Habitat degradation	Agriculture Timber Harvesting
Mitchell River	From Surry County SR 1315 to South Fork Mitchell River	03-07-02	4.3		S	ME		
Mitchell River	From South Fork Mitchell River to Yadkin River	03-07-02	6.9		S	M		
Mitchell River	From mouth of Christian Creek (North Fork Mitchell River) to Surry County SR 1315	03-07-02	7.5		S	ME		
S Fork Mitchell River	From source to Mitchell River	03-07-02	17.7		S	M	Habitat degradation	Agriculture Timber Harvesting

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Snow Creek	From source to Mitchell River	03-07-02	9.6		S	M	Habitat degradation	Agriculture
Fisher River	From NC-VA State Line To Burris Creek	03-07-02	14.0		S	ME		
Fisher River	From Burris Creek to a point 1.0 mile upstream of the Town of Dobson water supply intake	03-07-02	6.3		S	M		
Fisher River	From a point 1.0 mile upstream of Town of Dobson water supply intake to Town of Dobson water supply intake (Located 0.9 mile upstream of Surry County SR 1345)	03-07-02	1.0		S	ME		
Fisher River	From Town of Dobson water supply intake to Yadkin River	03-07-02	21.2		S	M	Habitat degradation	
Little Fisher River	From NC-VA State Line to Surry County SR 1615	03-07-02	7.3		S	ME		
Little Fisher River	From Surry County SR 1615 to Fisher River	03-07-02	8.9		S	M	Habitat degradation	
Little Beaver Creek	From source to Fisher River	03-07-02	4.4		S	M		
Little Yadkin River	From source to Yadkin River	03-07-02	12.5		S	M	Organic enrichment Habitat degradation Turbidity	Agriculture Land Development Urban Runoff/Storm Sewers
Forbush Creek	From source to a point 0.4 mile upstream of Yadkin County SR 1600	03-07-02	10.6		S	ME	Organic Enrichment	Agriculture
Forbush Creek	From a point 0.4 mile upstream of Yadkin County SR 1600 to Yadkin River	03-07-02	4.9		S	M	Organic Enrichment	Agriculture
Logan Creek	From source to a point 0.4 mile upstream of mouth of Loney Creek	03-07-02	10.6		S	ME	Habitat degradation	
North Deep Creek	From source to a point 1.0 mile downstream of Yadkin County SR 1515	03-07-02	17.3		S	M	Habitat degradation Turbidity Fecal coliform	Agriculture
North Deep Creek	From a point 1.0 mile downstream of Yadkin County SR 1515 to Deep Creek	03-07-02	2.2		S	M	Fecal coliform	
Ararat River	From NC-VA State Line to the mouth of Johnson Creek	03-07-03	2.5		S	M		

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Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Ararat River	From mouth of Johnson Creek to Town of Mount Airy proposed water supply intake (0.5 mi upstream of Champ Creek)	03-07-03	0.9		S	ME	Fecal coliform	
Ararat River	From Town of Mount Airy proposed water supply intake to a point 0.1 mile upstream of Surry County SR 2080	03-07-03	27.9		S	M	Habitat degradation Fecal coliform	
Ararat River	From a point 0.1 mile upstream of Surry County SR 2080 to Yadkin River	03-07-03	2.0		S	M	Turbidity Fecal coliform	
Flat Shoal Creek	From source to Ararat River	03-07-03	8.2		S	M		
Toms Creek	From source to a point 0.6 mile downstream of mouth of Chinquapin Creek	03-07-03	11.1		S	ME		
Toms Creek	From a point 0.6 mile downstream of mouth of Chinquapin Creek to Town of Pilot Mountain water supply intake	03-07-03	0.7		S	ME		
Toms Creek	From Town of Pilot Mountain water supply intake (Located 0.2 mile upstream of US Highway 52) to Ararat River	03-07-03	5.7		S	M		
Heatherly Creek	From source to NC 268	03-07-03	2.0		S	M	Habitat degradation	
Heatherly Creek	**From NC 268 to Toms Creek**	**03-07-03**	**1.4**		**I**	**M**	**Unknown**	**Urban Runoff/Storm Sewers Major Municipal Point Source**
Faulkner Creek	**From source to Ararat River**	**03-07-03**	**6.1**		**I**	**M**	**Unknown toxicity Sediment Habitat degradation**	**Agriculture Timber Harvesting Highway/Road/Bridge Runoff**
Lovills Creek (Lovell Creek)	From NC-VA State Line to a point 0.5 mile upstream of Town of Mount Airy Water Supply Dam	03-07-03	2.5		S	M	Habitat degradation	Sources outside state jurisdiction
Lovills Creek (Lovell Creek)	From a point 0.5 mile upstream of Town of Mount Airy Water Suppy Dam to Town of Mount Airy Water Supply Dam	03-07-03	0.5		S	ME		
Lovills Creek (Lovell Creek)	**From Town of Mount Airy Water Supply Dam to Ararat River**	**03-07-03**	**4.2**		**I**	**M**	**Unknown toxicity Habitat degradation**	**Minor Industrial Point Source Urban Runoff/Storm Sewers**

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Stewarts Creek	From NC-VA State Line to Surry County SR 1622	03-07-03	5.0		S	M		
Stewarts Creek	From Surry County SR 1622 to a point 0.7 mile downstream of mouth of Pauls Creek	03-07-03	3.3		S	M	Habitat degradation	
Stewarts Creek	From a point 0.7 mile downstream of mouth of Pauls Creek to Town of Mount Airy water supply intake	03-07-03	0.8		S	ME	Habitat degradation	
Stewarts Creek	From Town of Mount Airy water supply intake to Ararat River	03-07-03	6.8		S	M	Habitat degradation	Land Development Urban Runoff/Storm Sewers
Muddy Creek	From source to Mill Creek #3	03-07-04	10.3		S	M	Habitat degradation	Land Development
Muddy Creek	**From Mill Creek #3 to SR 2995**	**03-07-04**	**15.2**		**I**	**M**	**Habitat degradation**	**Urban Runoff/Storm Sewers Minor Non-municipal Point Source**
Muddy Creek	From SR 2995 to a point 0.8 mile upstream of mouth	03-07-04	4.8		S	M	Habitat degradation Turbidity Nutrients Fecal coliform	Urban Runoff/Storm Sewers
Muddy Creek	From a point 0.8 mile upstream of mouth to Yadkin River	03-07-04	0.7		S	ME	Habitat degradation Turbidity Nutrients Fecal coliform	Urban runoff/Storm sewers
Reynolds Creek	From source to Muddy Creek	03-07-04	3.3		NR	M	Organic enrichment Habitat degradation	Minor Non-municipal Point Source
Silas Creek	From source to Muddy Creek	03-07-04	10.1		S	M	Habitat degradation	Urban runoff/Storm sewers
Salem Creek (Salem Lake)	From source to Winston-Salem Water Supply Dam (Salem Lake)	03-07-04		275.3	S	M		Land Development Urban runoff/Storm sewers
Salem Creek	**From Winston-Salem Water Supply Dam (Salem Lake) to Muddy Creek**	**03-07-04**	**12.0**		**I**	**M**	**Habitat degradation Fecal coliform**	**Urban runoff/Storm sewers**
S Fork Muddy Cr	From source to Muddy Creek	03-07-04	14.3		S	M	Habitat degradation	Land Development Urban runoff/Storm sewers
Yadkin River	From a point 0.5 mile upstream of US Highway 64 to a point 0.3 mile downstream of US Highway 64	03-07-04	0.5		S	M	Turbidity Fecal coliform	

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Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Yadkin River	From a point 0.3 mile downstream of US Highway 64 to the mouth of Grants Creek	03-07-04	18.6		S	ME	Turbidity Fecal coliform	
Grants Creek	From source to SR 1910	03-07-04	19.7		S	M	Organic enrichment Habitat degradation Fecal coliform	
Grants Creek	**From SR 1910 to Yadkin River**	**03-07-04**	**1.2**		**I**	**M**	**Habitat degradation** **Turbidity** **Fecal coliform**	**Urban Runoff/Storm Sewers** **Minor Municipal Point Source**
Town Creek	**From source to Crane Creek**	**03-07-04**	**15.4**		**I**	**M**	**Habitat degradation**	**Urban Runoff/ Storm Sewers**
Yadkin River (High Rock Lake)	**From mouth of Grants Creek to High Rock Dam**	**03-07-04**		**10,449.7**	**I**	**M**	**% DO Saturation** **Chlorophyll a** **Nutrients** **Turbidity**	**Agricuture** **Land Development** **Urban Runoff/Storm Sewers** **Major Municipal Point Sources**
Yadkin River (Tuckertown Lake)	**From High Rock Dam to mouth of Cabin Creek**	**03-07-04**	**3.5**		**I**	**M**	**Low DO**	**Hydromodification**
Dutchman Creek	From Davie County SR 1002 to Elisha Creek	03-07-05	25.5		S	M	Habitat degradation Organic enrichment Turbidity, Low DO Fecal coliform	Agriculture Highway/Road/Bridge Runoff
Dutchman Creek	From Elisha Creek to a point 0.9 mile upstream of mouth	03-07-05	0.0		NR	M		
Cedar Creek	From source to Davie County SR 1410	03-07-05		41.6	S	ME		
Cedar Creek	From Davie County SR 1410 to Dutchman Creek	03-07-05	7.0		S	M		
South Yadkin River	From source to Alexander County SR 1456	03-07-06	17.1		S	ME	Habitat degradation	
South Yadkin River	From Alexander County SR 1456 to a point 0.6 mile downstream of Iredell County SR 1907	03-07-06	14.6		S	M	Habitat degradation	
South Yadkin River	From a point 0.6 mile downstream of Iredell County SR 1907 to a point 1.0 mile upstream of Davie County SR 1159	03-07-06	23.8		S	ME	Habitat degradation Turbidity Fecal coliform	

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Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
South Yadkin River	From a point 1.0 mile upstream of Davie County SR 1159 to NC Highway 801	03-07-06	9.5		S	M	Habitat degradation Turbidity Fecal coliform	
South Yadkin River	From a point 1.0 mile upstream of NC Highway 801 to mouth of Fourth Creek	03-07-06	5.3		S	ME	Habitat degradation Turbidity Fecal coliform	
South Yadkin River	**From mouth of Fourth Creek to Yadkin River**	**03-07-06**	**5.3**		**I**	**M**	**Turbidity** **Fecal coliform**	**Minor Municipal Point Source** **Agriculture**
Rocky Creek (Rocky River)	From source to South Yadkin River	03-07-06	42.2		S	M		
Patterson Creek	From source to Rocky Creek	03-07-06	10.6		S	M		
Hunting Creek	From source to a point 1.1 miles upstream of Davie County SR 1147	03-07-06	49.3		S	M	Habitat degradation Fecal coliform	
Hunting Creek	From a point 1.1 miles upstream of Davie County SR 1147 to South Yadkin River	03-07-06	7.8		S	ME	Habitat degradation	
North Little Hunting Creek	From source to Hunting Creek	03-07-06	23.8		S	M	Organic enrichment Habitat degradation	Agriculture
Bear Creek	From source to a point 0.2 mile downstream of US Highway 64	03-07-06	9.3		NR	ME	Low DO Fecal coliform	
Bear Creek	From a point 0.2 mile downstream of US Highway 64 to South Yadkin River	03-07-06	8.6		NR	M	Low DO Fecal coliform	
Fourth Creek	**From source to SR 1972**	**03-07-06**	**23.8**		**I**	**M**	**Habitat degradation** **Turbidity** **Nutrients** **Fecal coliform**	**Urban Runoff/Storm Sewers** **Agriculture**
Fourth Creek	From SR 1972 to SR 1985	03-07-06	6.7		S	M	Habitat degradation Turbidity Fecal coliform	Urban Runoff/Storm Sewers Agriculture
Fourth Creek	**From SR 1985 to South Yadkin River**	**03-07-06**	**5.5**		**I**	**M**	**Habitat degradation** **Turbidity** **Fecal coliform**	**Urban Runoff/Storm Sewers** **Agriculture**

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Third Creek	From source to SR 2359	03-07-06	16.8		NR	M	Habitat degradation Turbidity Fecal coliform	Agriculture Land Development
Third Creek	**From SR 2359 to SR 1970**	**03-07-06**	**22.1**		**I**	**M**	**Habitat degradation Nutrients Fecal coliform**	**Agriculture Land Development**
Third Creek	From SR 1970 to Fourth Creek	03-07-06	4.3		S	M	Habitat degradation Fecal coliform	
Second Creek (North Second Cr)	From source to South Yadkin River	03-07-06	10.4		I	M	Habitat degradation Fecal coliform	
Withrow Creek	From source to Second Creek (North Second Creek)	03-07-06	11.2		S	M	Habitat degradation	
Swearing Creek	**From source to High Rock Lake**	**03-07-07**	**14.4**		**I**	**M**	**Habitat degradation Fecal coliform**	**Urban Runoff/Storm Sewers Agriculture**
Abbotts Creek	From source to a point 0.5 mile upstream of Davidson County SR 1810	03-07-07	18.8		S	M	Fecal coliform	
Abbotts Creek (Thom-A-Lex Lake)	**From a point 0.5 mile upstream of Davidson County SR 1810 to the upstream side of culvert at US Highways 29 & 70**	**03-07-07**		**34.2**	**I**	**M**	**% DO Saturation**	**Agriculture**
Abbotts Creek	**From upstream side of culvert at US Highways 29 & 70 to Abbotts Creek Arm of High Rock Lake (At I-85 bridge)**	**03-07-07**	**8.0**		**I**	**M**	**Low DO Turbidity**	**Major Municipal Point Sources Urban Runoff/Storm Sewers**
Abbotts Creek Arm of High Rock Lake	**From source at I-85 to Davidson County SR 2294**	**03-07-07**		**855.7**	**I**	**M**	**Low DO Turbidity**	**Major Municipal Point Sources**
Brushy Fork	From source to Buck Branch	03-07-07	9.5		S	M	Habitat degradation	
Rich Fork	**From source to Abbotts Creek**	**03-07-07**	**20.6**		**I**	**M**	**Low DO Organic Enrichment Habitat degradation Unknown Toxicity Fecal coliform**	**Major Municipal Point Sources Urban Runoff/Storm Sewers**
Hunts Fork	From source to Rich Fork	03-07-07	7.1		NR	M	Habitat degradation	Urban Runoff/ Storm Sewers
Hamby Creek	**From source to Rich Fork**	**03-07-07**	**11.1**		**I**	**M**	**Copper Nutrients**	**Major Municipal Point Source**

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
North Hamby Creek	**From source to Hamby Creek**	**03-07-07**	**5.8**		**I**	**M**	**Unknown**	**Unknown**
Leonard Creek	From source to dam at City Lake	03-07-07	6.7		S	ME	Habitat degradation	Agriculture Minor Non-municipal Point Sources
Leonard Creek	From dam at City Lake to Abbotts Creek	03-07-07	2.6		S	M	Habitat degradation	Hydromodification
Yadkin River (Tuckertown and Badin Lakes)	From the mouth of Cabin Creek to Badin Dam	03-07-08			S	M		
Yadkin River (Falls Reservoir)	From Badin Dam to a point 0.5 mile upstream of Falls Dam	03-07-08		169.5	S	M		
Lick Creek	**From East Branch Lick Creek to Yadkin River**	**03-07-08**	**7.8**		**I**	**M**	**Habitat degradation Low DO**	**Agriculture**
Cabin Creek	From source to NC Highway 109	03-07-08	3.5		S	ME		Agriculture
Cabin Creek	From NC Highway 109 to a point 0.1 mile downstream of Davidson County SR 2536	03-07-08	5.8		S	M	Organic enrichment	Agriculture
Cabin Creek	From a point 0.1 mile downstream of Davidson County SR 2536 to Yadkin River	03-07-08	0.6		S	ME	Organic enrichment	Agriculture
Pee Dee River (Lake Tillery)	From mouth of Uwharrie River to Norwood Dam	03-07-08		4,845.5	S	M		
Mountain Creek	From source to Stanly County SR 1542	03-07-08	5.1		S	ME	Habitat degradation	Agriculture
Mountain Creek	From Stanly County SR 1542 to a point 0.5 mile upstream of mouth	03-07-08	7.3		S	M	Habitat degradation	Agriculture
Mountain Creek	From a point 0.5 mile upstream of mouth to Pee Dee River	03-07-08	0.5		S	M		
Little Mountain Creek	**From a point 0.5 mile upstream of Stanly County SR 1545 to Mountain Creek**	**03-07-08**	**5.7**		**I**	**M**	**Habitat degradation**	
Uwharrie River	From source to a point 0.4 mile downstream of Little Uwharrie River	03-07-09	18.3		S	M	Habitat degradation	Land Development Urban Runoff/Storm Sewers
Uwharrie River	From a point 0.4 mile downstream of Little Uwharrie River to Randolph County SR 1314 (including Lake Reese)	03-07-09		61.1	S	M	Nutrients	Agriculture

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Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Uwharrie River	**From Randolph County SR 1314 to mouth of Betty McGees Creek**	**03-07-09**		**126.5**	**I**	**M**	**Low DO**	**Hydromodification**
Uwharrie River	From mouth of Betty McGees Creek to a point 1.3 mile upstream of mouth of Barnes Creek	03-07-09	26.7		S	M		
Uwharrie River	From a point 1.3 miles upstream of the mouth of Barnes Creek to mouth of Dutchmans Creek	03-07-09	9.3		S	M		
Uwharrie River	From the mouth of Dutchmans Creek to Lake Tillery, Pee Dee River	03-07-09	0.9		S	ME		
Little Uwharrie River	From source to Uwharrie River	03-07-09		25.8	S	M	Habitat degradation	Agriculture Land Development
Back Creek Lake	**From a point 1.0 mile downstream of Randolph County SR 1504 to dam at Back Creek Lake (City of Asheboro water supply intake)**	**03-07-09**		**228.3**	**I**	**M**	**Dissolved gases Nutrients**	**Agriculture Land Development**
Lake Bunch	From a point 1.1 miles upstream of mouth to Cedar Fork Creek	03-07-09		27.7	NR	M	Nutrients	Urban Runoff/Storm Sewers
Caraway Creek	From source to Uwharrie River	03-07-09	26.4		S	M	Habitat degradation	Agriculture Minor Non-municipal Point Source
Barnes Creek	From source to a point 0.2 mile upstream of Montgomery County SR 1303	03-07-09	11.6		S	M		
Dutchmans Creek	From source to Uwharrie River	03-07-09	4.9		S	M		
Betty McGees Creek	From source to Uwharrie River	03-07-09	9.4		S	M		
Mountain Creek	From source to a point 1.1 miles upstream of mouth	03-07-10	4.6		S	M	Habitat degradation	
Big Mountain Creek	From source to Richmond County SR 1005	03-07-10	13.8		S	M		
Big Mountain Creek	From Richmond County SR 1005 to Mountain Creek	03-07-10	2.1		S	ME		
Pee Dee River	**From Norwood Dam to mouth of Turkey Top Creek**	**03-07-10**	**15.3**		**I**	**M**	**Low DO**	**Hydromodification Minor Municipal Point Source**

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Pee Dee River	From Turkey Top Creek to a point 0.8 mile downstream of mouth Savannah Creek	03-07-10	4.7		S	ME		
Pee Dee River (Blewett Falls Lake)	From a point 0.8 mile downstream of mouth of Savannah Creek to Blewett Falls Dam	03-07-10		2,170.0	S	M		
Clarks Creek	From source to Pee Dee River	03-07-10	12.6		S	M	Fecal coliform	
Brown Creek	From NC-SC State Line to mouth of Lick Creek	03-07-10	16.5		S	M	Habitat degradation	
Cedar Creek	From source to Pee Dee River	03-07-10	10.7		S	M	Habitat degradation	
Brown Creek	From mouth of Lick Creek to Pee Dee River	03-07-10	28.5		NR	M	Low DO	Natural conditions Agriculture
Rocky River	**From source to mouth of Reedy Creek**	**03-07-11**	**34.1**		**I**	**M**	**Habitat degradation Turbidity Fecal coliform**	**Urban Runoff/Storm Sewers Land Development Major and Minor Point Sources**
Dye Creek (Branch)	**From source to Rocky River**	**03-07-11**	**4.4**		**I**	**M**	**Habitat degradation Chlorine**	**Urban Runoff/Storm Sewers Minor Municipal Point Source**
Mallard Creek	From source to mouth of Stoney Creek	03-07-11	13.1		S	M	Cause Unknown	Urban Runoff/ Storm Sewers
Coddle Creek	From a point 0.2 mile upstream of NC Highway 73 to Rocky River	03-07-11	14.5		I	M	Habitat degradation	
Reedy Creek	From source to Rocky River	03-07-11	15.2		S	M	Habitat degradation	
Rocky River	**From mouth of Reedy Creek to mouth of Dutch Buffalo Creek**	**03-07-12**	**8.5**		**I**	**M**	**Organic enrichment Turbidity Fecal coliform Phosphorus**	**Urban Runoff/Storm Sewers Major Municipal Point Source**
Dutch Buffalo Creek	From source to a point 0.5 mile upstream of NC Highway 49	03-07-12	13.1		S	ME	Nutrients	Agriculture
Dutch Buffalo Creek	From a point 0.5 mile upstream of NC Highway 49 to Rocky River	03-07-12	11.3		S	M	Habitat degradation Nutrients	Agriculture
Clear Creek	From source to Rocky River	03-07-12	13.1		S	M	Habitat degradation Low DO Fecal coliform	

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Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Goose Creek	From source to SR 1524	03-07-12	3.2		S	M	Habitat degradation Nutrients	Urban Runoff/Storm Sewers
Goose Creek	**From SR 1524 to Rocky River**	**03-07-12**	**13.1**		**I**	**M**	**Organic enrichment** **Habitat degradation** **Low DO** **Fecal coliform**	**Agriculture** **Minor Non-municipal Point Sources** **Combined Sewer Overflow**
Stevens Creek	From source to Goose Creek	03-07-12	2.3		S	M	Habitat degradation	Urban Runoff/ Storm Sewers
Duck Creek	From source to Goose Creek	03-07-12	9.7		S	M		
Crooked Creek	From source to Rocky River	03-07-12	12.9		S	M	Organic enrichment Turbidty Fecal coliform	
North Fork Crooked Creek	**From source to Crooked Creek**	**03-07-12**	**12.0**		**I**	**M**	**Habitat degradation** **Low DO** **Turbidity** **Fecal coliform**	**Urban Runoff/Storm Sewers**
Irish Buffalo Creek (Kannapolis Lake)	From a point 0.5 mile upstream of Rowan County SR 1197 to Kannapolis Water Supply Dam	03-07-12		4.2	NR	M	Habitat degradation	Urban Runoff/Storm Sewers
Irish Buffalo Creek	From Kannapolis Water Supply Dam to Rocky River	03-07-12	16.7		S	M	Turbidity Phosphorus Fecal coliform	Urban Runoff/Storm Sewers
Cold Water Creek (Lake Fisher)	From a point 0.5 mile downstream of Rowan County SR 1221 to dam at Lake Fisher	03-07-12		230.6	NR	M		
Cold Water Creek	From dam at Lake Fisher to Irish Buffalo Creek	03-07-12	12.5		S	M	Habitat degradation Fecal coliform	Land Development Urban Runoff/Storm Sewers
Long Creek	From source to Rocky River	03-07-13	26.7		S	M		
Big Bear Creek	From source to Long Creek	03-07-13	19.9		S	M		
Stony Run	From source to Big Bear Creek	03-07-13	11.9		NR	M		
Rocky River	From the mouth of Island Creek to the Pee Dee River	03-07-14	29.3		S	M	Nutrients Fecal coliform	
Island Creek	From source to Rocky River	03-07-14	10.0		S	M		

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Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Richardson Creek	From source to a point 0.2 mile downstream of mouth of Beaverdam Creek	03-07-14	7.6		S	M	Habitat degradation	Agriculture
Richardson Creek (Lake Lee)	From a point 0.2 mile downstream of mouth of Beaverdam Creek to Monroe Water Supply Dam (Lake Lee)	03-07-14		106.3	NR	M		
Richardson Creek	**From Monroe Water Supply Dam (Lake Lee) to mouth of Negro Head Creek**	**03-07-14**	**9.9**		**I**	**M**	**Nutrients Low DO Fecal coliform**	**Urban Runoff/Storm Sewers Agriculture**
Negro Head Creek	From source to Richardson Creek	03-07-14	13.0		S	M		
Lanes Creek	**From source to Marshville Water Supply Dam (located 0.1 mile downstream of Beaverdam Creek)**	**03-07-14**	**27.4**		**I**	**M**	**Low DO**	**Unknown**
Richardson Creek	From mouth of Negro Head Creek to Rocky River	03-07-14	23.2		S	M		
Rocky Creek	From source to NC Highway 27	03-07-15	6.9		S	ME		
Rocky Creek	From NC Highway 27 to Little River	03-07-15	6.4		S	M		
Disons Creek	From source to Little River	03-07-15	6.9		S	M		
Cheek Creek	From source to NC 731	03-07-15	9.3		S	M		
Cheek Creek	From NC 731 to Little River	03-07-15	8.1		NR	M	Habitat degradation	
Hamer Creek	From source to Little River	03-07-15	11.7		NR	M		
Little River	From Suggs Creek to Densons Creek	03-07-15	12.9		S	M		
Little River	From Densons Creek to Hammer Creek	03-07-15	18.5		S	M	Turbidity	
West Fork Little R.	From source to Little River	03-07-15	23.7		S	M		
Dumas Creek	From source to Densons Creek	03-07-15	9.4		S	M		
Pee Dee River	**From Blewett Falls Dam to mouth of Hitchcock Creek**	**03-07-16**	**6.3**		**I**	**M**	**Low DO**	**Hydromodification**
Cartledge Creek	From source to Pee Dee River	03-07-16	10.2		S	M		
Hitchcock Creek (McKinney Lake, Ledbetter Lake)	From source to a point 0.5 mile downstream of Richmond County SR 1442	03-07-16		66.9	S	M	Habitat degradation	Hydromodification

Habitat degradation is noted as a problem parameter 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.

Aquatic Life/Secondary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Miles	Acres	Rating	Basis	Problem Parameter(s)	Potential Source(s)
Hitchcock Creek (Roberdel Lake)	From a point 0.5 mile downstream of Richmond County SR 1442 to dam at Roberdel Lake	03-07-16		48.4	NR	M		
Hitchcock Creek	From dam at Roberdel Lake to Pee Dee River	03-07-16		0.5	S	M	Habitat degradation	Urban Runoff/Storm Sewers
Rocky Fork Creek	From source to Hitchcock Creek	03-07-16	9.5		NR	M		
Beaver Dam Creek	From source to Rocky Fork Creek	03-07-16	5.2		S	M		
Marks Creek (Water Lake)	From source to a point 1.3 miles upstream of dam of lower Water Lake	03-07-16		4.6	NR	ME		
Marks Creek (Water Lake)	From a point 1.3 miles upstream of dam of lower Water Lake to dam of lower Water Lake	03-07-16		48.1	NR	M		
Marks Creek	From dam of lower Water Lake to NC-SC State Line	03-07-16		23.6	NR	M		
Pee Dee River	From mouth of Hitchcock Creek to NC-SC State Line	03-07-16	9.4		S	M		
Jones Creek	From source to Pee Dee River	03-07-17	12.5		S	M	Habitat degradation Turbidity	Agriculture
North Fork Jones Creek (City Pond)	From a point 1.0 mile downstream of Anson County SR 1122 to Wadesboro Water Supply Intake	03-07-17		76.2	NR	M		
North Fork Jones Creek	From Wadesboro Water Supply Intake to Jones Creek	03-07-17	7.4		S	M	Habitat degradation	
Bailey Creek	From source to North Fork Jones Creek	03-07-17	2.0		S	M	Habitat degradation Organic enrichment	Urban Runoff/Storm Sewers Agriculture
South Fork Jones Creek	From source to Jones Creek	03-07-17	15.0		S	M		

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Primary Recreation Use Support Summary – Yadkin-Pee Dee River Basin

Name	Description	Subbasin	Classification	Miles	Acres	Rating	Basis	Potential Source(s)
Yadkin River (W. Kerr Scott Reservoir)	From mouth in W. Kerr Scott Reservoir at Elevation 1030 (1.4 mile downstream of Stony Fork) to a point 3.2 mile downstream of Stony Fork	03-07-01	B Tr		66.7	S	ME	
Yadkin River (W. Kerr Scott Reservoir)	From a point 3.2 mile downstream of Stony Fork to W. Kerr Scott Dam	03-07-01	WS-IV&B Tr		882.1	S	ME	
Elk Creek	**From Dugger Creek to Yadkin River**	**03-07-01**	**B ORW**	**9.1**		**I**	**M**	**Agriculture**
Roaring River	From source to Yadkin River	03-07-01	B	5.9		S	M	
East Prong Roaring River	From Garden Creek to Wilkes County SR 1737	03-07-01	B Tr	1.7		S	ME	
East Prong Little Yadkin River	From source to a point 0.4 mile uptream of Surry County SR 1136	03-07-02	B	8.7		S	ME	
East Prong Little Yadkin River	From a point 0.4 mile upstream of Surry County SR 1136 to Little Yadkin River	03-07-02	WS-IV&B	0.9		S	ME	
Yadkin River (High Rock Lake)	From a line across High Rock lake from the downstream side of mouth of Crane Creek to the downstream side of mouth of Swearing Creek to a point 0.6 mile upstream of dam of High Rock Lake	03-07-04	WS-IV&B		4,870.1	S	M	
Yadkin River (High Rock Lake)	From a point 0.6 mile upstream of dam of High Rock Lake to High Rock Dam	03-07-04	WS-IV&B		10.8	S	M	
Abbotts Creek Arm of High Rock Lake	From source at I-85 to Davidson County SR 2294	03-07-07	WS-V&B		855.7	S	M	
Yadkin River	From High Rock Dam to mouth of Cabin Creek	03-07-08	WS-IV&B	3.5		S	M	
Yadkin River (Tuckertown Lake, Badin Lake)	From the mouth of Cabin Creek to Badin Dam	03-07-08	WS-IV&B			S	M	
Yadkin River (Falls Reservoir)	From Badin Dam to a point 0.5 mile upstream of Falls Dam	03-07-08	WS-IV&B		169.5	S	ME	
Yadkin River	From a point 0.5 mile upstream of Falls Dam to Uwharrie River	03-07-08	WS-IV&B		33.8	S	ME	
Pee Dee River (Lake Tillery)	From mouth of Uwharrie River to Norwood Dam	03-07-08	WS-IV&B		4,845.5	S	M	
Pee Dee River	From Norwood Dam to mouth of Turkey Top Creek	03-07-10	WS-V&B	15.3		S	M	
Pee Dee River	From Turkey Top Creek to a point 0.8 mile downstream of mouth Savannah Creek	03-07-10	WS-IV&B	4.7		S	ME	
Pee Dee River (Blewett Falls Lake)	From a point 0.8 mile downstream of mouth of Savannah Creek to Blewett Falls Dam	03-07-10	WS-IV&B		2,170.0	S	M	

Appendix IV

303(d) Listing
and
Reporting Methodology

Integrated 305(b) and 303(d) Report Summary

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports of previous years. The *305(b) Report* is compiled biennially to update the assessment of water quality in North Carolina and to meet the Section 305(b) reporting requirement of the Clean Water Act. The 305(b) reports present how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely causes (e.g., sediment, nutrients) and potential sources of impairment. The term "Use Support" refers to the process mandated by 305(b). The *303(d) List* is a comprehensive public accounting of all impaired waterbodies that is derived from the 305(b) Report/Use Support. An impaired waterbody is one that does not meet water quality uses, such as water supply, fishing or propagation of aquatic life. Best professional judgement along with numeric and narrative standards criteria and anti-degradation requirements defined in 40 CFR 131 are considered when evaluating the ability of a waterbody to serve its uses.

Section 303(d) of the federal Clean Water Act (CWA) which Congress enacted in 1972 requires States, Territories and authorized Tribes to identify and establish a priority ranking for waterbodies for which technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards, establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and submit, from time to time, the list of impaired waterbodies and TMDLs to the US Environmental Protection Agency (EPA). Current federal rules require states to submit 303(d) lists biennially, by April 1st of every even numbered year. For 2002, EPA delayed the submittal until October 1, 2002 (EPA, 2001a). EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each water quality limited segment impaired by a pollutant and identified in the 303(d) list, a Total Maximum Daily Load (TMDL) must be developed. TMDLs are not required for waters impaired by pollution.

North Carolina submitted a combined 305(b) and 303(d) Integrated Report to EPA on October 2, 2002. The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the impaired waters list. New guidance from EPA places all waterbody assessment units, or segments, into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories in order to maintain continuity with the 2000 North Carolina 303(d) list. Each category is described in detail below:

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

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

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

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

Category 4a: TMDL has been completed. This category consists of those waters for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered when evaluating Category 4a waterbodies for potential delisting.

Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future. This category consists of those waters for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards by the next regularly scheduled listing cycle. Future monitoring will be used to verify that the water quality standard is attained as expected.

Category 4c: Impairment is not caused by a pollutant. This category consists of waters that are impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA believes that in situations where the impairment is not caused by a pollutant, a TMDL is generally not the appropriate solution to the problem. Future monitoring will be used to confirm that there continues to be no pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

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

Category 6: Impaired based on biological data. This category consists of waters historically referred to as "biologically impaired" waterbodies; these waterbodies have no identified cause(s) of impairment although aquatic life impacts have been documented. Identification of the cause(s) of impairment will precede movement of these waters to Category 5 or Category 4c of the integrated list. EPA has recognized in the past that in specific situations the data are not available to develop TMDLs. Data collection and analysis will be performed in an attempt to determine the cause(s) of impairment.

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

For this integrated list, Categories 1 and 2 are considered fully supporting any assessed uses. This portion of the integrated list is extensive (thousands of segments); thus, a printed copy is not included in this document. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website (http://h2o.enr.state.nc.us/tmdl/General_303d.htm). Categories 4, 5, 6 and 7 contain those assessment units that have been determined to be impaired in North Carolina. **Therefore, Categories 4, 5, 6 and 7 constitute the 2002 North Carolina 303(d) List for the State of North Carolina**.

Prioritization of Impaired Waters

North Carolina has developed a priority ranking scheme that reflects the relative value and benefits those waterbodies provide to the state. The priority ranking system is designed to take into account the severity of the impairment, especially threats to human health and endangered species, and the designated uses of the waterbody as required by CWA 303(d)(1)(A). Since other agencies and local governments also use this ranking to direct resources and funding, the priority ranking system has intentionally not included factors to reflect the availability of DWQ resources to address either TMDL development schedules or restoration.

A priority of High, Medium or Low has been assigned to all waterbodies in Categories 4b, 5, 6 and 7 of the integrated list. A high priority is assigned to all waterbodies that are classified as water supplies. A high priority is also automatically assigned to all waterbodies harboring species listed as endangered or threatened under the federal Endangered Species Act (ESA). A medium priority has minimally been assigned to waters harboring state listed endangered and threatened species. As a way of addressing anti-degradation concerns, classified outstanding resource waters and high quality waters start at the medium priority.

Scheduling TMDLs

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

North Carolina has prioritized TMDL development for waters impaired due to bacteria. The approach of prioritizing TMDL development based on pollutant has been successfully used in other states. Limited resources are used more effectively with a focus on a particular pollutant. Waters impaired by other pollutants (i.e., not bacteria) are not excluded from the schedule. However, the majority of waters prioritized for the next few years are associated with bacterial contamination.

The movement of waters from Category 6 (Impaired based on biological data) to either Category 5 or 4c will require a large allocation of resources. North Carolina has used biological data to place the majority of waters on the 303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Category 6 is to be expected. It is important to understand that the identification of waters in Category 6 does not mean that they are low priority waters. The assessment of these waters is a high priority for the State of North Carolina. However, it may take significant resources and time to determine the cause of impairment. Assigning waters to Category 6 is a declaration of the need for more data and time to adequately define the problems and whether they are affected by pollution, pollutants or a combination. Scheduling these waters for TMDL development prior to determining the causes of impairment is misleading and counterproductive.

During this listing cycle, significant resources and a grant from the Clean Water Management Trust Fund were utilized to study multiple waters that were considered impaired based on biological data. One goal of this project was to determine the cause of impairment for these waters. Several of these studies have been completed and causes have been identified. These waters will now move from Category 6 to other locations within the integrated list.

Delisting Waters

In general, waters will move from Categories 4, 5, 6 or 7 when data show that a water is fully supporting its uses. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved impaired waters list will be moved to Categories 1, 2 or 3 under the following circumstances:

- An updated 305(b) use support rating of supporting, as described in the basinwide management plans.
- Applicable water quality standards are being met (i.e., no longer impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda.
- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or *National Clarifying*

Guidance for State and Territory 1998 Section 303(d) Listing Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).

- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (i.e., the wrong water was identified).

Appendix V

Yadkin-Pee Dee River Basin Workshop Summaries

What are the main threats to water quality in the Yadkin-Pee Dee River Basin?

Elkin Workshop

Improper use of fertilizers by homeowners
Homeowners, golf courses and municipalities
City waste treatment facilities
Large industries polluting streams
Nutrients (runoff and municipal WWTP discharges)
Industry and municipalities
Industries and cities
Sediment (3 responses)
Nonpoint sources of pollution (multiple types)
Urbanization
Channelization (2 responses)
Riparian vegetation cut down on streambanks
Exotic vegetation
Sediment pollution from streambank erosion
Streambank erosion and resulting sediment
Sedimentation from unstable streambanks
Sediment (3)
Towns and DOT
Erosion from DOT/developers/municipalities
Cities, housing development

Winston-Salem Workshop

Development
Erosion
Pesticide runoff/fertilizer
WWTP – package plants (poorly run)
Poor database to differentiate point source vs. nonpoint source (i.e., fecal coliform – livestock vs. human)
Aging infrastructure – sanitary sewers, age - harder to operate – large cities
Financial incentives for farmers to keep livestock out of stream
Exceed design capacity of infrastructure
Recreation – golf courses – runoff
Failing septic systems
Agriculture runoff
Altering stream hydrology
Channelization
Irrigation – reduction of streamflow
Development ↑ impervious surfaces
Shot gun approach – focus money prioritize on-site specific basis
Package plants
Golf courses, boats (other recreation)
Failing septic tanks
Poorly maintained collection systems
Landfills (old ones in particular) – old chemicals

Lawns (especially, commercially – maintained)
Discharges/collection systems in environmental sensitive areas
Lack of implementation/maintenance of BMPs during construction
Domestic animal waste
Wildlife waste
Illegal dumping
Too many people
Lack of implementation/maintenance of BMPs for impervious surfaces (roads)
Poorly maintained vehicles
Drought
Junkyards/tires
Litter
Agricultural runoff without proper implementation/maintenance of BMPs
Sedimentation from development
Urbanization
Lack of riparian buffers
Deforestation
Impervious surfaces
Landfills – older/not regulated
Septic tanks → lack of access to collection systems (WWTPs)
Private package plants (basinwide)
Fecal coliform
Growth management to protect resources
Wastewater lines (inflow/infiltration, leakage)

<u>Uwharrie Workshop</u>
Development
Discharges (especially from development around lakes)
Towns
Failing septic systems
Water withdrawals/interbasin transfers (pressure for more)
Policy that concentrates/regionalizes discharges – compounds problems when systems fail (need "back-up" between system and receiving water)
Lack of "big picture" understanding of water quality issues basinwide
Policy does not reflect "true sources" of problems, not just immediate sources
Collection system overflows
Consumptive use
Lack of BMPs
Better education in schools (required all the way through) and more education across board

- pay for with fine $$ (WWTP)

Poor handling flood flows by hydro projects
Development disguised as timber harvesting

<u>Salisbury Workshop</u>
Sedimentation – (throughout Yadkin)
Storm events – construction
DOT, small sites
Public education – public stormwater – pouring down drains

Impervious areas
Removal of buffer areas
Junk yard/salvage yard runoff
Package plants – SSOs – enforcement
Example of Sequoia – long time to get it fixed
Need more state funding
Nutrients
Early last year algal blooms, bad odors in WS (in Yadkin)
High grass areas – Wilkesboro – between Kerr Scott and Elkin
Aquatic weeds → moving down river
Livestock in streams
High Rock Lake water level fluctuations
Co-generations – discharge – prohibitions on withdrawal
Development (i.e., high density)
Urban – septics, impervious surfaces, stormwater BMPs
Faulty septic systems
Individual houses fertilizer application (i.e., riverside homes)
Sloped lawns to banks
Lack of buffer from lawn to water
Fighting buffer reduction rules
Water withdrawals and not putting it back into river cleaner
Development – stormwater, filling in of wetlands, sedimentation, erosion
Lack of policy for development in floodplains
Homeowners – pesticides and fertilizers, lack of sewage systems/faulty septic tanks
Small businesses – overlooked
Low water levels/drought effect on sampling?
Streambank erosion
Animal access to streams
Effects of recreational activities on lakes and rivers (jet skies, boats, ATVs)
Lack of enforcement
Faulty municipal lines

Fairview Workshop
Out of control construction – housing
Union County growth – very fast growth
Golf courses – chemical application – 3x4 times fertilizer than agricultural fields
Lawns – slope down by river – fertilizer – got to go somewhere
Fertilizer application – much greater on lawns than agriculture field
Highways shoulders – seeding, fertilizer
Stormwater management – impervious parking lots, rooftops, driveways
Forestry management practices

- cut and replace clear cut of hardwoods instead of selective (riparian buffers)
- mass conversion – hardwood → softwoods
- forestry management plans

City and industrial violations
Sewer spills – recent problem in Union County
Septic tanks – individual
Union County soils → problem with septics Anson

Streambank erosion → quickly urbanizing areas
Population projection for 2020 in Cabarrus (from 1998 plan) has been reached
Growth and development and associated sedimentation
Growth – more dischargers on Rocky River
Demand on water during drought
Minimum instream flows under low flow conditions
Lack of BMPs implemented and enforcement (urban)
Failure of erosion control not caught
Lack of stormwater regulations
Lack of education for public on how their actions impact water quality
Ammonia in tributaries (a parameter that is a problem for package treatment plants
Nutrients (including P)
Has source of ammonia been I.D.?
Impervious surfaces and runoff
How has drought affected water quality?
How has it been considered in monitoring?

Where are the problem areas or waters?
What recommendations do you have for improving them?

Elkin Workshop

Failure to follow-up on the proper implementation of BMPs.

- Fine those who break laws
- Use education and positive enforcement, not the creation of new laws.

Housing Developments

Good water quality (not impaired) seems to be in the farming and rural area. Degraded waters seem to be in urban areas – based on your presentation (such as Winston-Salem). Therefore, keeping land in agriculture and farming is important.

- Don't regulate the farmers off the land.

Runoff from urban/residential areas

Road and building construction

Ararat near Mount Airy (sediment)

- Restore buffers
- Fine those who break laws

In the Mitchell South Fork and Snow Creek – 20% of the length is eroding streambanks. These numbers are higher in the Fisher and Ararat.

South Fork Mitchell River Watershed

- Detailed assessment data (BEH1, landowner interest, photos)
- Local support (Surry County Soil and Water)

White Fork trib

Brushy Fork

Ararat River

- Buffers on all streams
- Increase fines for those that break laws

Scattered throughout – where there is a lack of riparian buffer then there are problems.

We don't have any problem areas on water problems except "LACK OF".

There are not that many problem areas in the upper basin.

Winston-Salem Workshop

Muddy Creek S. of Hwy 158

- Streambank erosion
- Evaluated for restoration
- Sewer line – stabilized bank
- Landfills – 100-year flood
- Affected flood area north of Hwy. 158

Salem Creek – downtown Winston-Salem – Erosion problem

- Water retention BMPs
- Restoration – part of stream – What value is it if not restore whole stream?

YPDRBA – monitoring, data goes to DWQ

Package plant – Sequoia – has been tied in Winston-Salem (Reynolds Creek)

Yadkin – upstream of Kerr Scott

- Herbicides and pesticides
- Alterations of tributaries
- Erosion as come across Yadkin floodplain

- potential restoration
- DWQ monitoring

Salem Creek, between RG Elledge WWTP and next one "black and bubbly dyes"

- stormwater BMPs

Rich Fork below High Point WWTP

Ebert Street tributary to Salem

- Sewer lines

Ararat River

Grants Creek – sediment

Fourth Creek – FC, nutrients

- buffers

Creek through Walkertown has package plant that malfunctions

Town Fork – water quality BMPs

Abbotts Creek – increasing development

Stormwater BMPs, wastewater treatment

Also channelized reaches, sediment

Salem Creek

- more bioassessment monitoring

Rich Fork Creek → High Point westside wastewater discharge

- take these discharges out to Yadkin River

Can DWQ address curb/gutter standards and water quality issues? How do these standards compare without road building techniques for water quality?

- Education about stormwater management and sedimentation – how to maintain BMPs – need better guidance – long-term maintenance
- DOT addressing stormwater at bridges – bioretention for filtration and treatment
- Need formalized process for ensuring that projects are inspected/maintained
- BMPs – needs to be done upfront
- Education basinwide → already happening in some areas

Uwharrie Workshop

New shcools on NC 49 (discharge)

Farmer Elementary School

- compliance with permit
- maybe look at limits (DWQ)

Major hydro projects

- better communication between dams to better handle flood flows downstream
- address during relicensing

Norwood (failing septic)

- ID locations and work with owners to correct it
- grant funding targeted to issue

Carson City (south of Mount Gilead) (on 109)

Failing septic b/c not proper conditions for on-site

- come up with alternatives

Developments on lakes designed for part-time use now with full time pressure (Badin Shores resort and Twin Harbors resort?)

- come up with alternatives for waste treatment

National Forest allowing ATVs that cause sediment problems [designated areas]; also camping along banks of Uwharrie

- design sedimentation basins and other "treatment" for designation areas
- comprehensive plan to address problems with whole forest
- ridership education when purchase ATV in order to use public lands

"Steel bridge" on Lake Tillery

<u>Salisbury Workshop</u>

Dye Branch – Chlorine toxicity
- Mooresville WWTP – toxicity sampling – ↑ TRC

South Yadkin – Impacted by suspended sediment, from 40
DOT construction – development
Grants Creek
- Small WWTP to be removed
- Salisbury has been removed

W/S, Salisbury
Stormwater impacts ↑, nutrients, metals
- Local training of contractors program - clear water contractor
- Equipment beyond compliance BMPs
- Training – certificate
- Citizen participation – storm chasers
- Local county sediment/erosion control doing better than state

Marinas
- restriction on gas filling at marinas
- above ground tanks
- buffers

Recreation – golf courses
- certification program/training
- sources of pollution away from waterways
- On-site non-discharge for wastewater constructed wetlands for treatment [Walnut Cove plant good example]
- Citizens – watershed education in schools hard o get people to come to meetings
- Land Use Planning/Zoning

Lake Tillery
High Rock Lake
Fourth Creek
- BMP $ for non-agricultural areas → for nonpoint sources

Lack of trailer park inspections
- Stop building houses along banks
- Educate local decision-makers to <u>implement</u>
- Implement buffer requirements
- Sediment and erosion controls to more stringent rules

Badin Lake – company holding sludge on property prior to use – needs regulating
Third Creek in Iredell and Rowan counties – color, needs better monitoring
Rocky River – aquatic concerns; development control
Grants Creek – development problems; needs better BMPs
- Better stormwater management
- BMPs for urban development
- Better monitoring of streams; verify 303(d) list
- Limit setbacks, density development

- Regulate landscapers/lawn contractors

Fairview Workshop

Same as in 1998 – Coddle Creek and Cabarrus County – Sedimentation and nonpoint sources

- $$ to hire erosion control for enforcement
- control growth in Cabarrus

Are BMPs required working? (State monitors 11% of construction projects)

- Partner with Soil & Water Conservation District for erosion control since they have existing knowledge
- Have local administration of state erosion control and sediment law

Septic systems? Potential problem for failures and no good means for monitoring

- needs to be a methodology

Growth will continue to pressure for wastewater discharges in Rock River
Education → need to take care of what we've got
Water as a limiting factor
Wastewater line ruptures (potential for future in Goose Creek)
Sensitive placement of sewer lines to prevent failures affecting Goose Creek
All along rivers and lakes – houses along rivers/lakes
Western portion of Union County – 2000 houses

- Erosion
- Fertilizer, lawns on new developments

Town sewage spills
Sewage treatment plants, manholes
Uneven news coverage of municipal spills vs. agricultural spills → more coverage
Example of spills in Mecklenburg (minimal coverage) vs. spill of hog lagoon – statewide coverage.

What local agencies or organizations should be involved?

Elkin Workshop

Soil and Water Conservation Districts – give them the sources to educate landowners and provide incentives for conservation.
County/city governments (Farm organizations)
Soil and Water Districts – NRCS – NC Forest Service – Town officials
Local problems need to be solved by Local Agencies ONLY !!
The local soil and water board
The local soil conservationists

Winston-Salem Workshop

Local governments
State government
BOMA – Building and Office Management Association – could be used as a clearinghouse
Triad Apartment Association
Duke Power
Winston-Salem stormwater
COG (205j)
All local municipalities
Yadkin-Pee Dee River Basin Association
Clean Sweep/Adopt-A-Stream
Voluntary agencies/nonprofits
Co-operative extension – stormwater management
Education
Local environmental groups
Soil and water districts
RC&Ds
Interfaith Partners for the Earth
Forsyth Friends of the Land
Land trusts
Cattleman's Association [every county]
Sierra Club (local)
TNC
Farm Bureau
Keep Iredell Clean
HBA
Neighbors for Better Neighbors – Winston Salem
Landscape Architects
Turf Grass
Trout Unlimited (Surry and Wilkes)
ALCOA
Economic development
PT Partnership
Yadkin-Pee Dee Lakes Project
Airport Authority

Uwharrie Workshop

National Wildlife Refuge in Anson County
Chambers of Commerce and EDC Boards
Ducks Unlimited; Wild Turkey Federation

Salisbury Workshop

Chambers of Commerce
Economic Development
Farm Bureau
Land Trust for Central NC
Keep Iredell Clean
Yad-Pee Dee Lakes Project
Ruritan/Civitan Clubs
Quail Unlimited – Ducks Unlimited
National Wild Turkey Federation
Badin Lake Environmental Group (Homeowners)
High Rock Homeowners Association
Land Stewardship Council of NC
Clean Water for NC
Housing Development Builders Association

Appendix VI

Yadkin-Pee Dee 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 water 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 is available online at 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. Most employees of the Department of Environment and Natural Resources, including the Division of Water Quality, Division of Land Resources and Division of Forest Resources, can be reached by email using the following formula: firstname.lastname@ncmail.net.

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.

	Contact Person	Phone	Address
Area 1	Carol S. Litchfield	828-456-6341, Ext. 5	589 Raccoon Road, Suite 246, Waynesville, NC 28786
Area 2	Michael E. Sugg	704-637-2400	530 West Innes Street, Salisbury, NC 28144
Alexander	James Propst	704-632-2708	255 Liledoun Road, Box 10, Taylorsville, NC 28681
Anson	Tansel M. Hudson	704-694-2593	1706 Morven Road, Wadesboro, NC 28170
Cabarrus	Matt Kinane	704-788-2107	715 Cabarrus Ave. West, Room 301, Concord, NC 28027
Caldwell	Russell W. Lyday	828-439-9727	130 Ammons Drive, Suite 3, Morganton, NC 28655
Davidson	Bruce T. Wilson	336-248-2687	301 East Center Street, Lexington, NC 27292
Davie	Frederick Y. Alexander	336-751-5011	180 South Main Street, Room 313, Mocksville, NC 27028
Forsyth	Dede DeBruhl	336-767-0720	1450 Fairchild Drive, Winston-Salem, NC 27105
Iredell	Larry L. Hendrix	704-873-6761	444 Bristol Drive, Statesville, NC 28677
Mecklenburg	Matt Kinane	704-788-2107	715 Cabarrus Ave. West, Room 216, Concord, NC 28027
Montgomery	Angela Hill	910-572-2700	227-D North Main Street, Troy, NC 27371
Randolph	B. Barton Roberson	336-629-4449	241 Sunset Ave, Room 105, Asheboro, NC 27203
Richmond	Vilma Mendez-Colombani	910-997-8244	125 Caroline Street, Suite 300 Rockingham, NC 28379
Rowan	R. Bruce Rider	704-637-1604	2727-C Old Concord Road, Salisbury, NC 28146
Stanly	Renessa Hardy-Brown	704-982-6811	26032-C Newt Road, Albemarle, NC 28001
Stokes	Reggie Lidell	336-593-8128	PO Box 98, Danbury, NC 27016
Surry	J. Richard Everhart	910-386-8751	PO Box 218, Dobson, NC 27017
Union	Phillip R. Loudermilk	704-289-3212	604 Lancaster Ave., Monroe, NC 28112
Wilkes	Ronald C. Howard	910-667-5700	207 West Main Street, Room 244, Wilkesboro, NC 28697
Yadkin	Barry J. Cook	910-679-8052	209 East Elm Street, Yadkinville, NC 27055
Pilot View RC&D	Charles Anderson	336-750-0522	2714 Henning Drive, Winston-Salem, NC 27610 pvica@triad.rr.com
Carolina Land and Lakes RC&D	Daniel McClure	828-464-5559	3305 16th Ave. SE, Suite 303, Conover, NC 28613 carolinalandandlakes@yahoo.com
Environmental Impact RC&D	John Caviness	910-944-4787	100 East Main Street, Union Station, Aberdeen, NC 28315 NC-EnvironImpact@rcdnet.net

Agriculture (cont'd)

Soil and Water Conservation Districts:

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

County	Contact Person	Phone	Address
Alexander	Larry W. Payne	828-632-4594	255 Liledoun Road, Box 10, Taylorsville, NC 28681
Anson	Carey Edwards	910-694-2710	1706 Morven Road, Wadesboro, NC 28170
Cabarrus	Myre N. Morrison	704-788-2106	715 Cabarrus Ave. West, Room 301, Concord, NC 28027
Caldwell	Boyd C. Wilson	828-758-1111	120 Hospital Ave. NE, Suite 2, Lenoir, NC 28645
Davidson	David A. Smith	336-242-2075	301 East Center Street, Lexington, NC 27292
Davie	I.H. Jones	336-751-5011	180 South Main Street, Room 313, Mocksville, NC 27028
Forsyth	Grover McPherson	336-767-0720	1450 Fairchild Drive, Room 11, Winston-Salem, NC 27105
Iredell	Wade Carrigan	704-873-6761	444 Bristol Drove, Statesville, NC 28677-2942
Mecklenburg	Owen J. Furuseth	704-336-6265	700 North Tryon Street, Charlotte, NC 28202
Montgomery	Mike Haywood	910-572-2700	227-D North Main Street, Troy, NC 27371
Randolph	Craig Frazier	336-318-6490	241 Sunset Ave., Suite 105, Asheboro, NC 27203
Richmond	Larry R. Chandler	910-997-8244	PO Box 727, Rockingham, NC 28379
Rowan	Sam E. Correll	704-637-0783	2727-C Old Concord Road, Salisbury, NC 28146
Stanly	W. Chester Lowder	704-982-6811	26032-C Newt Road, Albemarle, NC 28001
Stokes	Banner Shelton	336-593-2846	PO Box 98, Danbury, NC 27016
Surry	Ted J. Holyfield	336-386-8751	PO Box 218, Dobson, NC 27017
Union	Warren Case	704-289-3212	604 Lancaster Ave., Monroe, NC 28112
Wilkes	W. Ted Carter	336-838-3622	PO Box 194, Wilkesboro, NC 28697
Yadkin	Lenuel Chamberlain	336-679-8378	209 East Elm Street, Yadkinville, NC 27055

Division of Soil and Water Conservation:

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

Central Office[1]	David Williams	919-715-6103	512 North Salisbury Street, Raleigh, NC 27626
Area 2	Marlene Salyer	336-771-4600	585 Waughtown Street, Winston-Salem, NC 27107
Area 3	Gerald Dorsett	336-771-4600	585 Waughtown Street, Winston-Salem, NC 27107
Area 8	Ralston James	704-663-1699	919 North Main Street, Mooresville, NC 28115
Area 7	Jerry C. Raynor	910-486-1541	225 Green Street, Suite 714, Fayetteville, NC 28301

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
Regional Office	J. Ben Knox	704-278-9414	585 Lentz Road, Mount Ulla, NC 28125

[1] A map of NC Association of Soil and Water Conservation Areas is available online at http://www.enr.state.nc.us/DSWC/images/map3.jpg.

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
Alexander	Lenny Rogers	828-632-4451	255 Liledoun Road, Taylorsville, NC 28681
Anson	Richard Melton	704-694-2415	PO Box 633, Wadesboro, NC 28170
Cabarrus	Carl Pless	704-920-3310	715 Cabarrus Ave., West Concord, NC 28027
Caldwell	Allen Caldwell	828-757-1290	120 Hospital Ave. NE, Suite 1, Lenoir, NC 28645
Davidson	Robert D. Loop	336-242-2080	301 East Center Street, Lexington, NC 27292
Davie	Ronnie W. Thompson	336-751-6297	180 South Main Street, Room 313, Mocksville, NC 27028
Forsyth	Eddie Leagans	336-767-8213	1450 Fairchild Drive, Winston-Salem, NC 27105
Iredell	Kenneth E. Vaughn	704-873-0507	444 Bristol Drive, Statesville, NC 28687
Mecklenburg	Deborah Myatt	704-336-2561	700 North Tryon Street, Charlotte, NC 28202
Montgomery	Susan Hamilton	910-576-6011	203 West Main Street, Troy, NC 27371
Randolph	Lynne Qualls	910-318-6000	2222-A South Fayetteville Street, Asheboro, NC 27203
Richmond	Mary B. Bowles	910-997-8255	123 Caroline Street, Suite 100, Rockingham, NC 28380
Rowan	Amelia Watts	704-637-0571	2727-C Old Concord Road, Salisbury, NC 28146
Stanly	Patsy McNeill	704-983-3987	26032-C Newt Road, Albemarle, NC 28001
Stokes	Jeffrey Boyles	336-593-8179	PO Box 460, Danbury, NC 27016
Surry	Brenda M. Rose	336-401-8025	210 North Main Street, Dobson, NC 27017
Union	Jerry B. Simpson	704-283-3801	500 North Main Street, Room 506, Monroe, NC 28112
Wilkes	Donna Edsel	336-651-7331	110 North Street, Wilkesboro, NC 28697
Yadkin	Jack L. Loudermilk	336-679-2061	209 East Elm Street, Yadkinville, NC 27055

Forestry			

Division of Forest Resources:

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

Central Office[2]	Moreland Gueth	919-733-2162	1616 Mail Service Center, Raleigh, NC 27699-1616 Moreland.Gueth@ncmail.net
District 2	Hunter Birckhead	828-757-5611	1542 Wilkesboro Boulevard NE, Lenoir, NC 28645 hunter.birckhead@ncmail.net
District 10	Vic Owen	336-956-2111	304 Old Hargrave Road, Lexington, NC 27295 vic.owen@ncmail.net
District 12	Howard Williams	704-827-7576	1933 Mountain Island Highway, Mount Holly, NC 28120 D12opsrm@ncmail.net
District 3	Dave Andres	910-997-9220	1163 North US Highway 1, Rockingham, NC 28379 dave.andres@ncmail.net

[2] A map of NC Division of Forestry Districts is available online at http://www.dfr.state.nc.us/contacts/district.htm.

General Water Quality

DWQ Water Quality Section:

Coordinate the numerous nonpoint source programs carried out by many agencies; 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	Rich Gannon	919-733-5083 x356	1617 Mail Service Center, Raleigh, NC 27699-1617
Urban Stormwater	Bradley Bennett	919-733-5083 x525	1617 Mail Service Center, Raleigh, NC 27699-1617
Modeling	Michelle Woolfolk	919-733-5083 x505	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
Classifications/Standards	Tom Reeder	919-733-5083 x557	1617 Mail Service Center, Raleigh, NC 27699-1617

DWQ Regional Offices[3]:

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.

Asheville Region	Forrest Westall	828-251-6208	59 Woodfin Place, Asheville, NC 28801
Winston-Salem Region	Steve Mauney	336-771-4600	585 Waughtown Street, Winston-Salem, NC 27107
Mooresville Region	Rex Gleason	704-663-1699	919 North Main Street, Mooresville, NC 28115
Fayetteville Region	Paul Rawls	910-486-1541	225 Green Street, Suite 714, Fayetteville, NC 28301

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.

Habitat Conservation Section Manager	Shannon Deaton	919-733-3633	1721 Mail Service Center, Raleigh, NC 27699-1721
Technical Guidance Supervisor	David Cox	919-528-9886	1721 Mail Service Center, Raleigh, NC 27699-1721

DWQ Groundwater Section[3]:

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	1636 Mail Service Center, Raleigh, NC 27699-1636
Winston-Salem Region	Sherri Knight	336-771-4600	585 Waughtown Street, Winston-Salem, NC 27107
Mooresville Region	Matt Heller	704-663-1699	919 North Main Street, Mooresville, NC 28115
Fayetteville Region			

[3] DENR Regional Offices cover the following counties within the Yadkin-Pee Dee River basin:

Asheville – Caldwell
Winston-Salem – Watauga, Wilkes, Surry, Stokes, Yadkin, Forsyth, Davie, Davidson and Randolph
Mooresville – Alexander, Iredell, Rowan, Mecklenburg, Cabarrus, Stanly and Union
Fayetteville – Montgomery, Anson and Richmond

General Water Quality (cont'd)			
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.			
Wilmington District	W.C. Long II	910-251-4745	PO Box 1890, Wilmington, NC 28402-1890
Construction/Mining			
DENR Division of Land Resources[3]:			
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.			
Central Office	F. Mel Nevills	919-733-4574	512 North Salisbury Street, Raleigh, NC 27626
Winston-Salem Region	Matt Gantt	336-771-4600	585 Waughtown Street, Winston-Salem, NC 27107
Mooresville Region	Doug Miller	704-663-1699	919 North Main Street, Mooresville, NC 28115
Fayetteville Region		910-486-1541	225 Green Street, Suite 714, Fayetteville, NC 28301
Local Erosion and Sedimentation Control Ordinances:			
Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances for construction.			
City of Asheboro	Bobby Kivett	336-626-1521, Ext. 2202	146 North Church Street, Asheboro, NC 27203
Cabarrus County	Tony Johnson	704-920-2835, Ext. 2835	PO Box 707, Concord, NC 28026 fajohnson@co.cabarrus.nc.us
City of Charlotte	John Geer	704-336-4258	600 East Fourth Street, Charlotte, NC 28202 enjg@ci.charlotte.nc.us
Forsyth Co/Winston-Salem	Jeff Kopf	336-727-2388	100 East First Street, Suite 328, Winston-Salem, NC 27101
Mecklenburg County	Kia Whittlesey	704-336-7783	700 North Tryon Street, Charlotte, NC 28202 whittck@co.mecklenburg.nc.us
Rowan County	Greg Greene	704-638-3130	402 North Main Street, Salisbury, NC 28144 greeneg@co.rowan.nc.us
Solid Waste			
DENR Division of Waste Management[3]:			
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
Winston-Salem Region	Brent Rockett	336-771-4600	585 Waughtown Street, Winston-Salem, NC 27107
Mooresville Region	James Bealle	704-663-1699	919 North Main Street, Mooresville, NC 28115
Fayetteville Region	Mark Fry	910-486-1541	225 Green Street, Fayetteville, NC 28301

[3] DENR Regional Offices cover the following counties within the Yadkin-Pee Dee River basin:

Asheville – Caldwell
Winston-Salem – Watauga, Wilkes, Surry, Stokes, Yadkin, Forsyth, Davie, Davidson and Randolph
Mooresville – Alexander, Iredell, Rowan, Mecklenburg, Cabarrus, Stanly and Union
Fayetteville – Montgomery, Anson and Richmond

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	Michael Kelly	919-733-2870	2728 Capital Boulevard, Raleigh, NC 27604
County	**Primary Contact**	**Phone**	**Address**
Alexander	Leeanne Whisnant	828-632-9704	322 1st Ave. SW, Taylorsville, NC 28681
Anson	Jim Roosen	704-694-5188	PO Box 473, Wadesboro, NC 28170
Cabarrus	William F. Pilkington	704-920-1000	1307 South Cannon Boulevard, Kannapolis, NC 28083
Caldwell	Douglas Urland	828-757-1200	1966-B Morganton Boulevard, Lenoir, NC 28645
Davidson	Diane Crouse	336-242-2300	915 Greensboro Street, Lexington, NC 27293-0439
Davie	Joseph B. Bass, Jr.	336-751-8700	210 Hospital Street, Mocksville, NC 27028
Forsyth	Dr. Tim Monroe	336-727-2434	799 Highland Ave., Winston-Salem, NC 27101
Iredell	Raymond R. Rabe	704-878-5303	318 Turnersburg Highway, Statesville, NC 28687
Mecklenburg	Peter Safir	704-336-3100	249 Billingsley Road, Charlotte, NC 28211
Montgomery	Kathleen Devore-Jones	910-572-1393	217 South Main Street, Troy, NC 27371
Randolph	Mary M. Cooper	336-318-6217	2222 South Fayetteville Street, Asheboro, NC 27203
Richmond	Tommy Jarrell	910-997-8300	125 Caroline Street, Rockingham, NC 28380
Rowan	Leonard L. Wood	704-633-0411	1811 East Innes Street, Salisbury, NC 28146
Stanly	Jim Jones	704-982-9171	1000 North 1st Street, Suite 3, Albemarle, NC 28001
Stokes	Steve Smith	336-593-2400	1009 North Main Street, Danbury, NC 27016
Surry	David Stone	336-401-8400	118 Hamby Road, Dobson, NC 27017
Union	Lorey H. White, Jr.	704-296-4800	1224 West Roosevelt Boulevard, Monroe, NC 28110
Wilkes	Beth G. Lovette	336-651-7450	306 College Street, Wilkesboro, NC 28697
Yadkin	Gayle R. Brown	336-679-4203	217 East Willow Street, Yadkinville, NC 27055

Appendix VII

Glossary
of
Terms and Acronyms

Glossary

§	Section.
30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
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.
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
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: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.
hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.

impervious	Incapable of being penetrated by water; non-porous.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.
pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.

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

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