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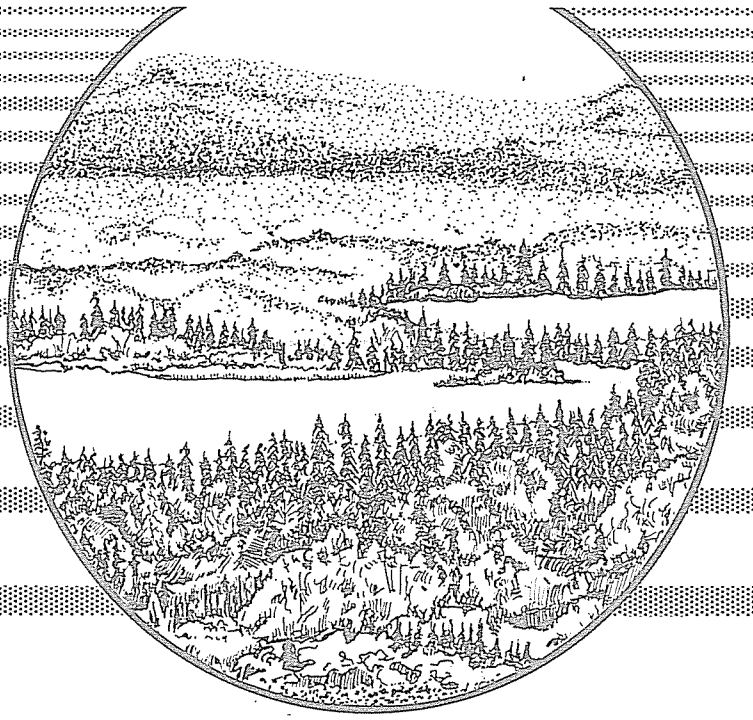
Catawba River



Basinwide Water Quality Plan

North Carolina
Department of Environment
and Natural Resources

Division of Water Quality
Water Quality Section December, 1999

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

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

April 22, 2003

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

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

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

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

Sincerely,

Darlene Kucken

Darlene Kucken
Basinwide Planning Program Coordinator

Enclosure

ADDENDUM: **Use Support Changes for the Catawba River Basin**
January 2000

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

Streams and Rivers

Table A-22 Use Support Summary Information for All Monitored and Evaluated Streams in the Catawba River Basin (1999) *(Found on p. 56 of this plan.)*

			Monitored and Evaluated Streams			Monitored Streams Only	
			Miles	%		Miles	%
Fully Supporting			2379.3	79			
Impaired			186.6	6			
	Partially Supporting		174.2	6		162.1	15
	Not Supporting		12.4	<1		7.4	1
Not Rated			439.5	15			

Table A-23 Use Support Determination for Monitored and Evaluated Freshwater Streams
(Found on p. 57 of this plan.)

Catawba Use Support Ratings in Miles for 1993-1997					
Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
030830	625.7	5.3	0	19.9	650.9
030831	558.3	35.3	0	75.6	669.2
030832	462.3	0	0	19.8	482.1
030833	147.5	9.8	0	10.1	167.4
030834	34.1	82.1	2.6	131.3	250.1
030835	391.9	19.0	0	81.2	492.1
030836	42.4	0.8	0	26.2	69.4
030837	14.5	21.9	9.8	26.8	73.0
030838	102.6	0	0	48.6	151.2
TOTAL	2375.3	174.2	12.4	443.5	3005.4
%	79	6	<1	15	100

Lakes

Maiden Lake *(p. 117)* and the Catawba Creek and Crowders Creek Arms of Lake Wylie *(p. 107)* are now considered fully supporting.

CATAWBA RIVER
BASINWIDE WATER QUALITY PLAN

December, 1999

Prepared by:

North Carolina
Division of Water Quality
Water Quality Section
1617 Mail Service Center
Raleigh, NC 27699-1617

(919) 733-5083 ext. 354

This document was approved and endorsed by the NC Environmental Management Commission on December 9, 1999 to be used as a guide by the NC Division of Water Quality in carrying out its Water Quality Program duties and responsibilities in the Catawba River basin. This plan is the first five-year update to the original Catawba River Basinwide Water Quality Management Plan approved by the NC Environmental Management Commission on February 9, 1995.

500 copies of this document were printed at a cost of $4,713.25 or $9.43 per copy.

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Executive Summary

North Carolina's Basinwide Approach to Water Quality Management

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality for each of the seventeen major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by the Division of Water Quality, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholders in the state. The first basinwide plan for the Catawba River basin was completed in 1995.

This document is the first five-year update of the Catawba River Basinwide Water Quality Plan approved. The format of this plan was revised in response to comments received by various people interested in the basin plans. Much of the general information in the original plan was replaced by more detailed information specific to the Catawba River basin. A greater emphasis has been placed on identifying causes and sources of pollution on individual streams in order to facilitate restoration efforts at the local level.

Comments from the seven pubic workshops held in the basin were seriously considered during plan development. While not all of the comments may have been addressed to the satisfaction of the commentors, this input will help guide continuing DWQ activities in the basin. In addition, a workshop questionnaire was used to obtain further input on the basinwide planning process for the Catawba River basin.

Goals of the Basinwide Approach

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

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

Catawba River Basin Overview

The Catawba River basin, along with the Broad River basin, forms the headwaters of the Santee-Cooper River system. This river system begins on the eastern slopes of the Blue Ridge Mountains in NC, flows through the NC piedmont to the NC-SC border near Charlotte, and continues to flow through SC to the Atlantic Ocean.

The basin contains the Linville River, one of only four state designated Natural and Scenic Rivers. The mainstem of the Catawba River is regulated by a series of seven hydropower

reservoirs: Lake James, Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie. Lake Wylie crosses the border of NC and SC.

About one-half of the land in the basin is forested, and about 23 percent is in urban and developed land use. Between 1982 and 1992, cultivated and uncultivated lands decreased by about 26 percent, while urban and developed areas increased by about 35 percent.

The population of the basin, based on 1990 census data, was estimated at 1,033,347 people. The overall population density of the basin was 321 persons per square mile, as compared to the statewide average of 123 persons per square mile. The percent population growth over the past ten years (1980 to 1990) was 16.5 percent, as compared to the statewide average of 12.7 percent. Population density is greatest in the Mecklenburg County are of the basin.

Assessment of Water Quality in the Catawba River Basin

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses is an important method of interpreting water quality data and assessing water quality. This determination results in a use support rating. The use support ratings refer to whether the classified uses of the water (such as water supply, aquatic life protection and swimming) are fully supported, partially supported or not supported. For instance, waters classified for fishing and water contact recreation (Class C) are rated as fully supporting if data used to determine use support (such as chemical/physical data collected at ambient sites or benthic macroinvertebrate bioclassifications) did not exceed specific criteria. However, if these criteria were exceeded, then the waters are rated as partially supporting or not supporting, depending on the degree of exceedence. Streams rated as either partially supporting or not supporting are considered *impaired.*

Overall water quality conditions in the basin are good, as reflected by use support ratings based on recent monitored and evaluated information. The greatest number of impaired stream miles is in the Mecklenburg County area (subbasin 03-08-34). The greatest number of good to excellent water quality ratings are in the headwaters of the basin (subbasins 03-08-30 and 03-08-31). A summary of current use support ratings for the Catawba River basin is presented in Table 1. For further information and definition of monitored and evaluated streams, refer to Appendix III.

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

	Monitored and Evaluated Streams*			Monitored Streams Only**	
	Miles	%		Miles	%
Supporting	2375.3	79			
Fully Supporting	1694.5	56		638.2	59
Fully Supporting but Threatened	680.8	23		265.9	25
Impaired	186.6	6			
Partially Supporting	173.6	6		162.1	15
Not Supporting	12.4	<1		7.4	1
Not Rated	444.1	15			
Total	3005.4			1073.6	

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

Recommended Management Strategies for Restoring Impaired Waters

The long-range mission of basinwide management is to provide a means of addressing the complex problem of planning for increased development and economic growth while protecting and/or restoring the quality and intended uses of the Catawba 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.

Within this basinwide plan, DWQ presents management strategies for those waters considered to be impaired. Table 2 presents impaired waters in the Catawba River basin, the sources of impairment, summaries of the recommended management strategies, and location of further information in the basinwide plan.

Water quality problems are primarily attributed to nonpoint source pollution. However, certain streams are degraded by point source pollution. Where point sources of pollution are known, the plan presents a management strategy to reduce that pollutant source.

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

DWQ plans to further evaluate the impaired waters in the Catawba River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waters for the next Catawba River Basinwide Water Quality Plan.

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. The waters in the Catawba River basin that are on this list are presented in the individual subbasin descriptions in Section B.

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. 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.

Table 2 Impaired Waters Within the Catawba River Basin (as of 1999)•

Subbasin	Chapter in Section B	Listed Water	Use Support Rating	Potential Sources	Recommended Management Strategy
03-08-30	1	Lower Mackey Creek	PS	P	DWQ is working with discharge to improve and remove the discharge. DWQ is also developing a TMDL for mercury.
03-08-30	1	Corpening Creek	PS	NP P	More information and local actions to address stormwater runoff are needed.*
03-08-31	2	Lower Creek below Zacks Fork	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Zacks Fork	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Spainhour Creek	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Greasy Creek	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Bristol Creek	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-33	3	McDowell Creek	PS	NP	DWQ will support actions of the Mecklenburg County SWIM program.*
03-08-34	4	Long Creek	PS	NP	DWQ will continue to monitor to assess sources of impairment. Local actions are needed.*
03-08-34	4	Sugar Creek	PS	NP P (upper section)	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources. DWQ is developing a fecal coliform bacteria TMDL.*
03-08-34	4	Irwin Creek	PS	NP P	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources.*
03-08-34	4	Little Sugar Creek	PS	NP P	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources. DWQ is developing a fecal coliform bacteria TMDL.*
03-08-34	4	McAlpine Creek	PS	NP P (lower section)	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources. DWQ is developing a fecal coliform bacteria TMDL.*
03-08-35	5	Clark Creek	PS	NP P	DWQ has completed a toxics review with recommendations, and a color reduction strategy is being implemented.*
03-08-35	5	Mauney Creek	PS	NP P	Stanley WWTP has made improvements; more information and local actions are needed.*
03-08-37	7	Catawba Creek	NS	NP P	Many point source reductions are being made. Local actions are needed.*
03-08-37	7	Crowders Creek	PS	NP P	Many point source reductions are being made. Local actions are needed.*

Key: NS = Not Supporting PS = Partially Supporting
NP = Nonpoint sources P = Point Sources
* = Only limited progress towards developing and implementing NPS strategies for these impaired waters can be expected without additional resources.
• = These waters are also on the 303(d) list, and a TMDL and/or management strategy will be developed to remove the water from the list.

There are approximately 470 stream segments on the 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each listed water during a 13-year time frame will require the focus of many resources. It will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters. This task will be accomplished through the basinwide planning process and schedule.

Challenges Related to Achieving Water Quality Improvements

To achieve the goal of restoring impaired waters throughout the basin, DWQ will need to work more closely with other state and federal agencies and stakeholders to identify and control pollutants. The costs of restoration will be high, but several programs exist to provide funding for restoration efforts. These programs include the Clean Water Management Trust Fund, the NC Agricultural Cost Share Program, the Wetlands Restoration Program and the federally funded Conservation Reserve Enhancement Program (approval pending). Additional funding may be available through the Unified Watershed Assessments program, under the President's recently issued Clean Water Action Plan.

With the tremendous growth occurring within this basin, there will be significant challenges ahead in balancing growth with the restoration and protection of water quality in this basin. Point source impacts to the surface waters of the basin 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 water supply watershed ordinances more stringent than state requirements; development and enforcement of buffer ordinances along tributaries, shorelines and the Catawba River; requirement of stormwater best management practices for existing and new development; development and enforcement of local erosion control 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 and successes can be built.

Section A

General Basinwide Information

Chapter 1 -
Introduction to Basinwide Water Quality Planning

1.1 What is Basinwide Water Quality Planning?

Basinwide water quality planning is a nonregulatory watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. Basinwide water quality plans are prepared by the NC Division of Water Quality for each of the seventeen major river basins in the state, as shown in Figure A-1 and Table A-1. Preparation of an individual basinwide management plan is a five-year process, which is broken down into four major phases as presented in Table A-2. While these plans are prepared by the Division of Water Quality, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first round of plans was completed in 1998. Each plan is now being updated at five-year intervals during round two.

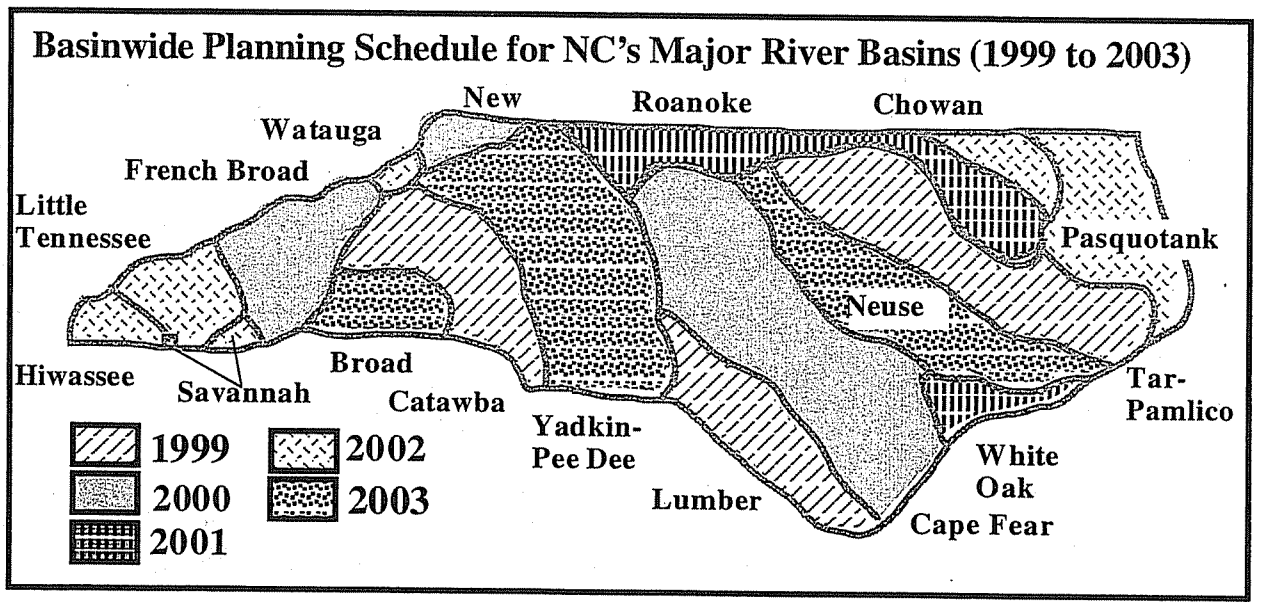


Figure A-1 Basinwide Planning Schedule (1999 to 2003)

1.2 Goals of Basinwide Water Quality Planning

The goals of basinwide management are to:

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

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

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

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

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

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

1.3 Major Components of the Basinwide Plan

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

Section A: Basinwide Information

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

Section B: Subbasin Information

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

Section C: Current and Future Initiatives

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

1.4 Features of Basinwide Water Quality Planning

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

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

1.5 Benefits of Basinwide Water Quality Planning

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

- *Improved efficiency.* The state's efforts and resources are focused on one river basin at a time.
- *Increased effectiveness.* The basinwide approach is in agreement with basic ecological principles.

- *Better consistency and equability.* By clearly defining the program's long-term goals and approaches, basinwide plans encourage *consistent* decision-making on permits and water quality improvement strategies.
- *Increased public awareness of the state's water quality protection programs.* The basinwide plans are an educational tool for increasing public awareness of water quality issues.
- *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.

1.6 How to Get Involved

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

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

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

1.7 Other References

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

- *Catawba River Basinwide Assessment Report.* August 1998. This technical report presents the physical, chemical and biological data in the Catawba River basin. 218 pages.
- *Catawba River Basinwide Water Quality Management Plan.* February 1995. This first basinwide plan for the Catawba River basin presents water quality data, information and recommended management strategies for the first five-year cycle. 197 pages.
- NC Division of Water Quality Basinwide Planning Website at http://h2o.enr.state.nc.us/. Then click on Water Quality Section and scroll down the menu to Basinwide Planning Program.
- NC Division of Water Quality Environmental Sciences Branch Website at http://esb.ehnr.state.nc.us/BAU.html.

- *A Guide to Water Quality in North Carolina.* This document will be available soon. The document will include general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description.* Creager, C.S. and J.P. Baker. 1991. DWQ Water Quality Section. Raleigh, NC.
- *NC Basinwide Wetlands and Riparian Restoration Plan for the Catawba River Basin.* DWQ NC Wetlands Restoration Program. Raleigh, NC.

Anyone interested in receiving these documents can contact the DWQ Planning Branch at (919) 733-5083.

1.8 Division of Water Quality Functions and Locations

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

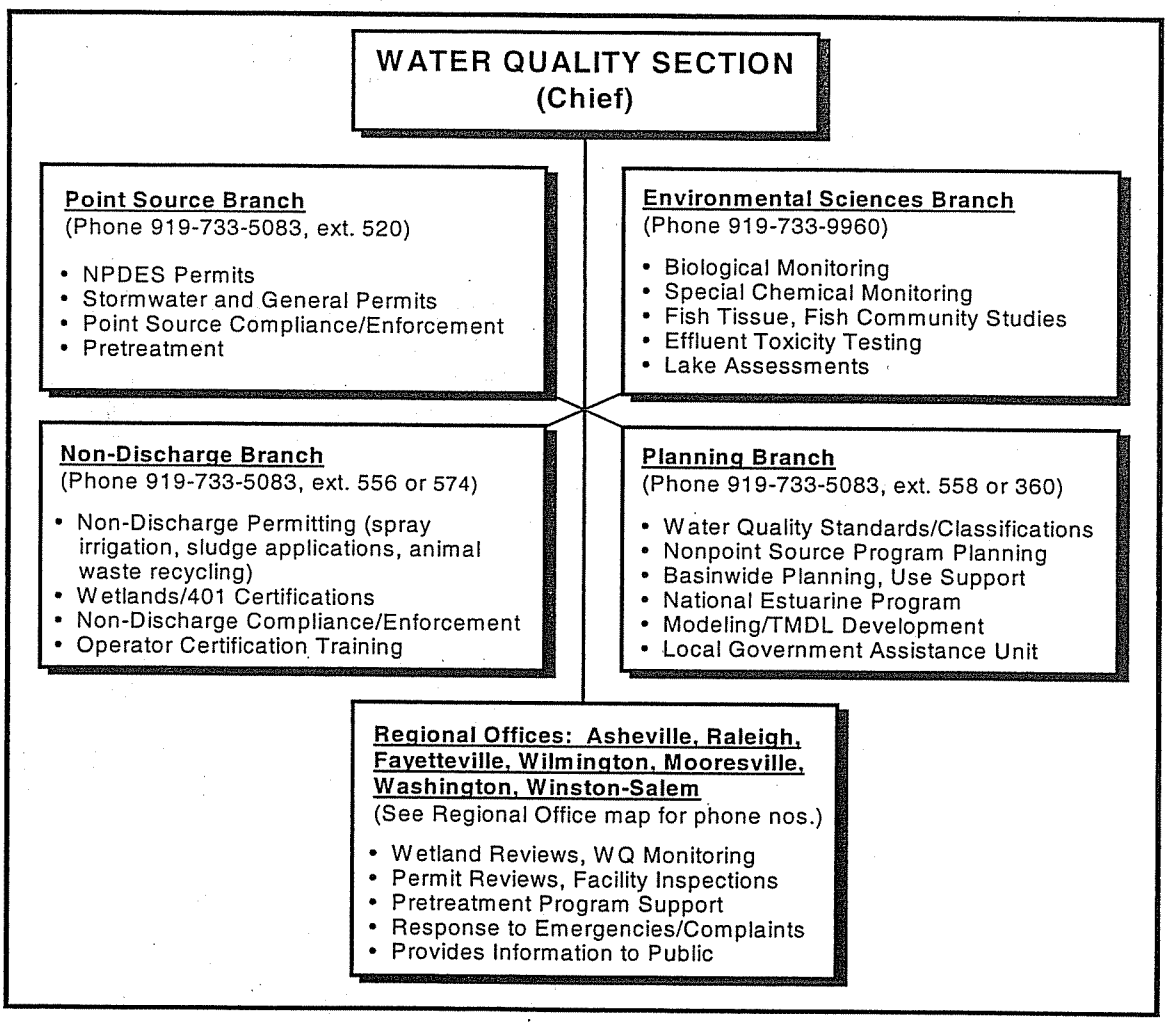
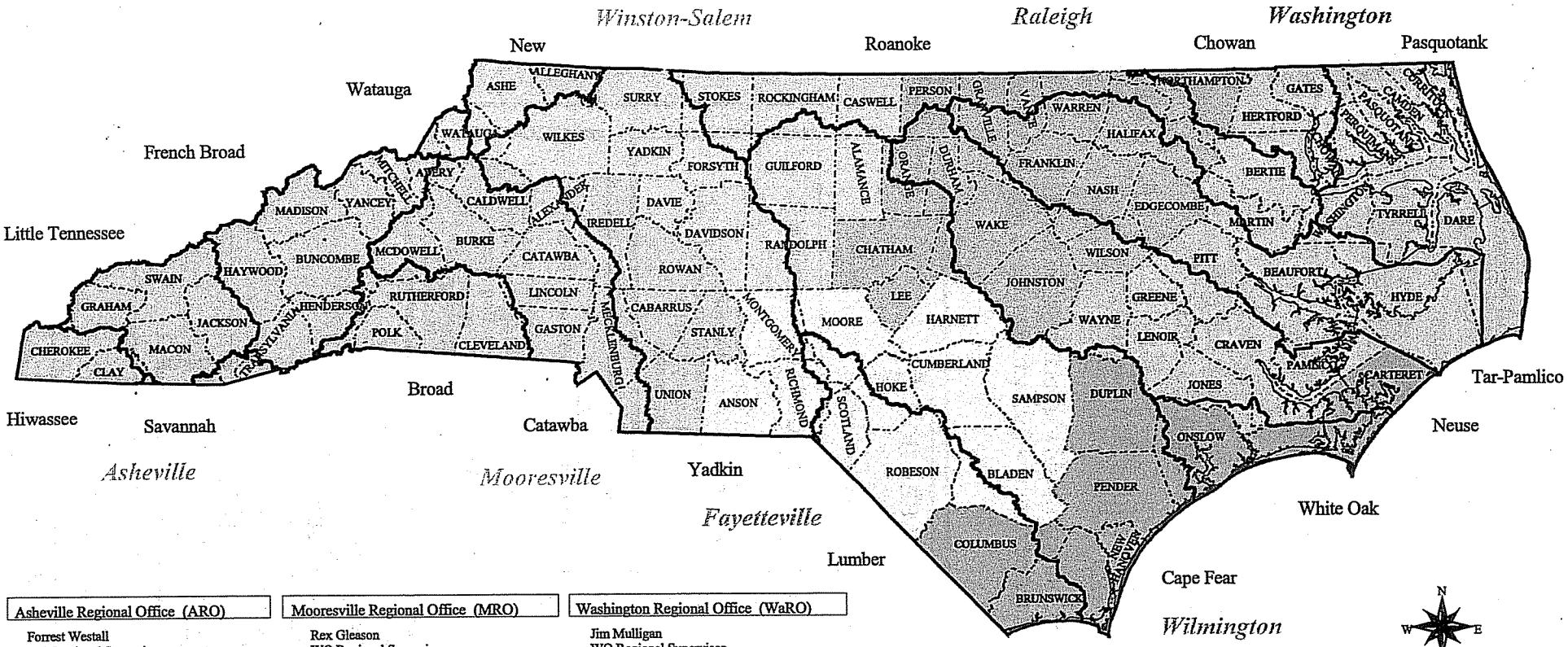


Figure A-2 Water Quality Section Organization Structure

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

Chapter 2 -
Catawba River Basin Overview

2.1 General Overview

The Catawba River basin, along with the Broad River basin, forms the headwaters of the Santee-Cooper River system which flows through South Carolina to the Atlantic Ocean (Figure A-4). The basin is the eighth largest river basin in the state and is located in the south central portion of western North Carolina (Figure A-5).

Catawba River Basin Statistics

Total Area: 3,285 sq. miles
Stream Miles: 3,005
No. of Counties: 12
No. of Subbasins: 9
Population (1990): 1,033,347*
Estimated Pop. (2015): 1,200,778*
% Increase (1990-2015): 39%
Pop. Density (1990): 321 persons/sq. mi.

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

The Catawba River begins on the eastern slopes of the Blue Ridge Mountains in Avery, Burke, Caldwell and McDowell counties and flows southeast to the North Carolina-South Carolina border near Charlotte. Many of these streams have good to excellent water quality and are classified as trout waters. The basin contains the Linville River, one of only four rivers in the state designated as a Natural and Scenic River. The Linville flows through the Pisgah National Forest Wilderness area and into Lake James.

As the basin enters the piedmont from the mountains, land use shifts from forest to agricultural and urban uses. Nonpoint runoff from agricultural operations and urban areas has caused nutrient enrichment and sedimentation in the streams, rivers and lakes of the area. Though urban areas are not numerous in the upper portions of the basin, the lower Catawba region contains many cities, including the growing metropolitan area surrounding Charlotte. In this region, urban growth has affected the water quality of the lakes, streams and rivers.

The mainstem of the Catawba River is regulated by a series of seven hydroelectric dams. The reservoirs formed by these dams are commonly referred to as the Catawba chain lakes. All are owned by Duke Energy and were created to generate electricity. The lakes begin with Lake James, located at the foot of the Blue Ridge Mountains, followed by Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie.

There are 3,005 miles of named and classified streams in the Catawba River basin in North Carolina and over 60,000 acres of impoundments. The basin is subdivided into nine subbasins represented in Figure A-5 by six digit subbasin codes (03-08-30 through 03-08-38).

The population of the basin, based on 1990 census data, was estimated at 1,033,347. The overall population density of the basin is 321 persons per square mile versus a statewide average of 127 persons per square mile. The percent population growth over the past ten years (1980 to 1990) was 16.5% versus a statewide percentage increase of 12.7%.

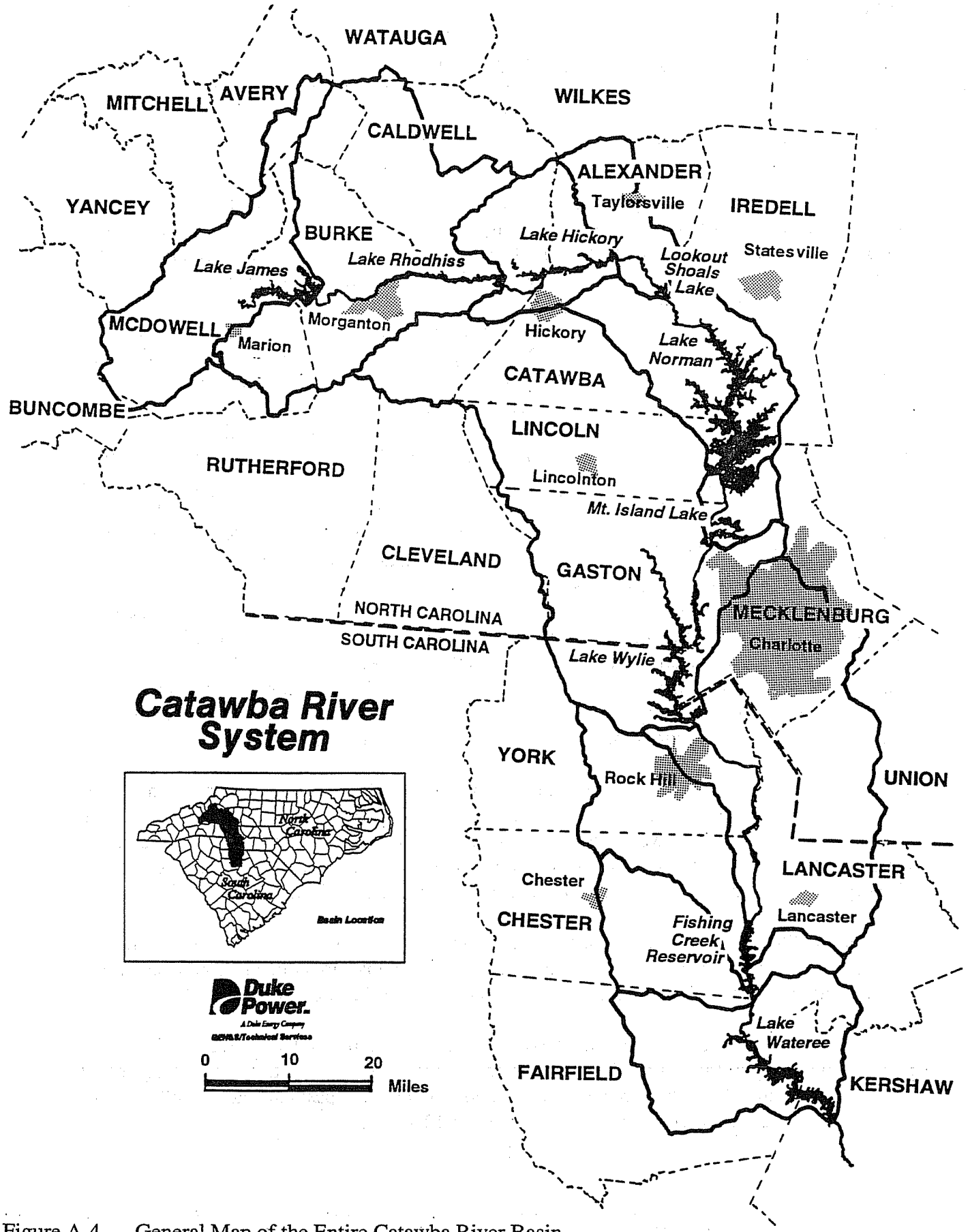


Figure A-4 General Map of the Entire Catawba River Basin

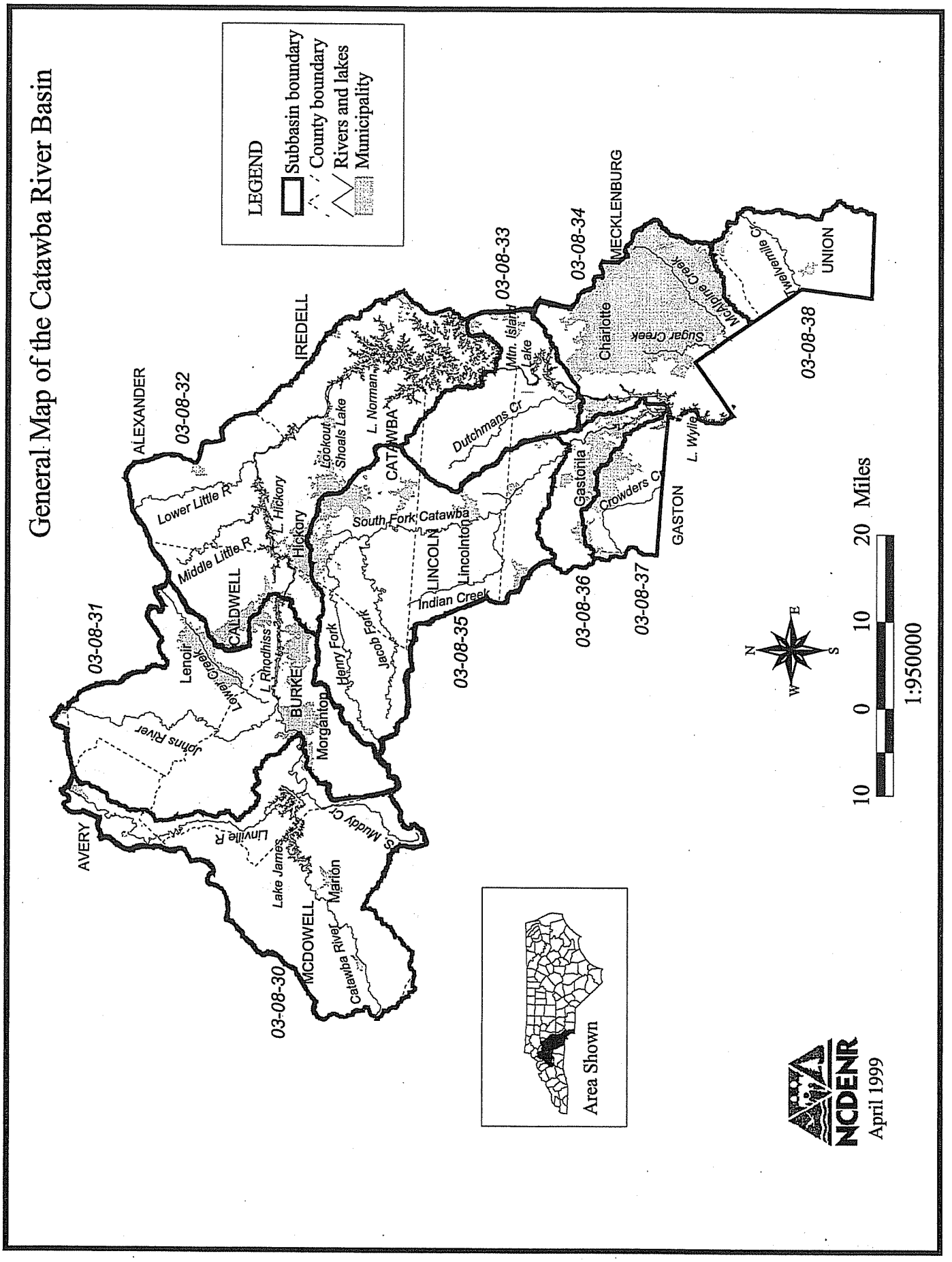


Figure A-5 General Map of the Catawba River Basin in North Carolina

2.2 Local Governments and Planning Jurisdictions in the Basin

The Catawba River basin encompasses all or portions of twelve counties and fifty-eight municipalities. Table A-3 provides a listing of these municipalities, along with an identification of the regional planning jurisdiction (Council of Governments), and an estimation of what percentage of the county area is within the river basin.

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

County	% of County in basin**	Region	Municipalities
Alexander	68	Western Piedmont Council of Governments	Taylorsville
Avery	35	Region D Council of Governments	Crossnore, Grandfather Village
Burke	100	Western Piedmont Council of Governments	Connelly Springs, Drexel, Glen Alpine, Hickory ***, Hildebran, Long View ***, Morganton, Rhodhiss ***, Rutherford College, Valdese
Caldwell	75	Western Piedmont Council of Governments	Blowing Rock ***, Cajah's Mountain, Gamewell, Granite Falls, Hickory ***, Hudson, Lenoir, Rhodhiss ***, Sawmills, Cedar Rock
Catawba	100	Western Piedmont Council of Governments	Brookford, Catawba, Claremont, Conover, Hickory ***, Long View ***, Maiden ***, Newton
Gaston	97	Centralina Council of Governments	Belmont, Bessemer City *, Cherryville, Cramerton, Dallas, Dellview, Gastonia *, High Shoals ***, Kings Mountain ***, Lowell, McAdenville, Mount Holly, Ranlo, Spencer Mountain, Stanley
Iredell	22	Centralina Council of Governments	Davidson ***, Mooresville, Troutman
Lincoln	93	Centralina Council of Governments	High Shoals ***, Lincolnton, Maiden ***
McDowell	86	Isothermal Planning and Development Commission	Marion Old Fort
Mecklenburg	74	Centralina Council of Governments	Charlotte *, Cornelius, Davidson ***, Huntersville, Matthews, Mint Hill, Pineville
Union	25	Centralina Council of Governments	Indian Trail, Marvin, Stallings, Waxhaw, Weddington
Watauga	1	Region D Council of Governments	Blowing Rock ***

Key:

* Located in more than one major river basin.
** Estimated by Center for Geographic Information and Analysis.
*** Located in more than one county.

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey and the US Natural Resources Conservation Service (NRCS), use a system of defining watersheds that is different from that used by the Division of Water Quality (DWQ) and many other state agencies in North Carolina. Under the federal system, the Catawba River basin is made up of three hydrologic areas referred to as hydrologic units. Each hydrologic unit is defined by an 8-digit number. By contrast, DWQ has a two-tiered system in which the state is subdivided into 17 river basins with each basin further subdivided into subbasins. The Catawba River basin is subdivided by DWQ into nine subbasins. Table A-4 compares the two systems. Maps of each subbasin are included in Section B of this basinwide plan.

Table A-4 Hydrologic Subdivisions in the Catawba River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ Subbasin 6-digit Codes (Fig A-2)
Upper Catawba Catawba River headwaters, Linville River, North Muddy Creek	03050101	03-08-30
Upper Catawba Warrior Fork, Johns River, Silver Creek, Lower Creek	03050101	03-08-31
Upper Catawba Little Rivers, Gunpowder Creek, Muddy Fork	03050101	03-08-32
Upper Catawba Dutchmans Creek	03050101	03-08-33
Upper Catawba and Lower Catawba Irwin Creek, McAlpine Creek, Sugar Creek	03050101 03050103	03-08-34
South Fork Catawba Henry Fork, Jacob Fork, Clark Creek	03050102	03-08-35
South Fork Catawba Long Creek	03050102	03-08-36
Upper Catawba Crowders Creek	03050101	03-08-37
Lower Catawba Twelvemile Creek, Sixmile Creek, Waxhaw Branch	03050103	03-08-38

2.4 Land Cover

Land cover information in this section is from the National Resources Inventory (NRI) of 1992 and 1982, as developed by the Natural Resources Conservation Service (USDA, 1994). The NRI is a multi-resource national inventory based on soils and other resource data collected at scientifically selected random sample sites. It is considered accurate to the 8-digit hydrologic unit scale established by the US Geological Survey.

Table A-5 summarizes acreage and percentage of land cover from the 1992 NRI for the basin as a whole and for the major watersheds within the basin as defined by the USGS 8-digit hydrologic units and compares the coverages to 1982 land cover. Refer to Part 2.3 for a comparison between state and federal hydrologic divisions. Descriptions of land cover types identified by the NRI are found in Table A-6.

Forestlands (both private and federal forests) cover approximately 45% of the basin. Agriculture (including cultivated and uncultivated cropland and pastureland) covers approximately 16% of the land area. The urban and built-up category comprises roughly 23% and exhibited the most dramatic change since 1982 (35% increase). Agriculture related land cover decreased by a total of 31% in the basin. It is likely that some of this land was converted to urban and built-up areas. These land cover changes are presented in Figure A-6.

Table A-5 Estimated Land Use Acreage for the Catawba River Basin - 1982 vs. 1992 (Source: Natural Resources Inventory, 1992)

	MAJOR WATERSHED AREAS *										
	Upper Catawba		South Fork Catawba		Lower Catawba		1992 TOTALS		1982 TOTALS		% Change
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of Total	Acres (1000s)	% of Total	since 1982
Cult. Crop	50.9	3.6	38.1	8.5	31.6	13.9	120.6	5.8	193.6	9.3	-37.7
Uncult. Crop	48.3	3.4	12.8	2.8	2.3	1.0	63.4	3.0	56.5	2.7	12.2
Pasture	82.7	5.9	56.6	12.6	13.7	6.0	153	7.4	160.5	7.7	-4.7
Federal	126.2	9.0	48.7	10.8	0	0.0	174.9	8.4	173.3	8.3	0.9
Forest	693.9	49.4	177.4	39.4	59.6	26.3	930.9	44.7	986.4	47.4	-5.6
Urban & built-up	281.3	20.0	78.7	17.5	114.1	50.3	474.1	22.8	351.0	16.9	35.1
Other	120.6	8.6	38	8.4	5.7	2.5	164.3	7.9	159.9	7.7	2.8
Totals	1403.9	100.0	450.3	100.0	227	100.0	2081.2	100.0	2081.2	100.0	
% of Total Basin		67.5		21.6		10.9		100.0			
Subbasin Numbers	030830 030831 030832 030833 030834 030837		030835 030836		030834 030838						
8-Digit Hydraulic Units	03050101		03050102		03050103						

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

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

Type	Description
Cultivated Cropland	Harvestable crops including ...row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow, aquaculture in crop rotation, or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	Rural Transportation: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas; private roads to farmsteads; logging roads; and other private roads (but not field lanes). Small Water Areas: Waterbodies less than 40 acres in size and streams less than one-half mile wide. Census Water: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than one-half mile in width. Minor Land: Lands not in one of the other categories.

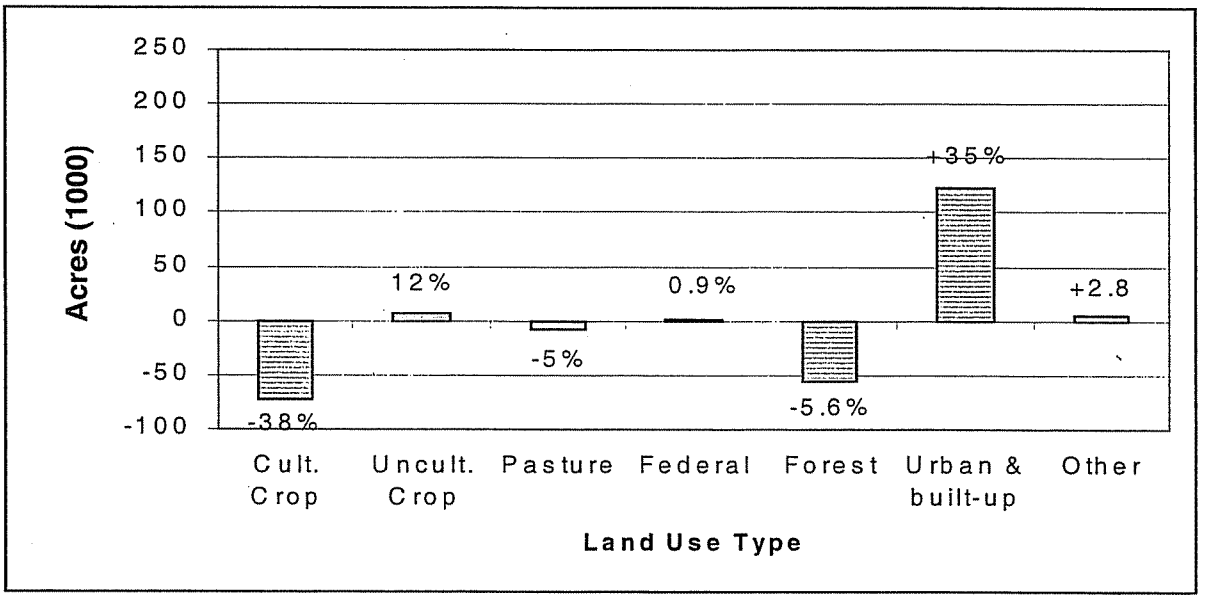


Figure A-6 Land Cover Changes from 1982 to 1992 for the Catawba River Basin (Source: USDA-NRCS 1992 NRI)

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

Unfortunately, due to differences in the system of categorizing various land cover classes, it is not 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 1996 data.

Table A-7 Description of Land Cover Categories

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

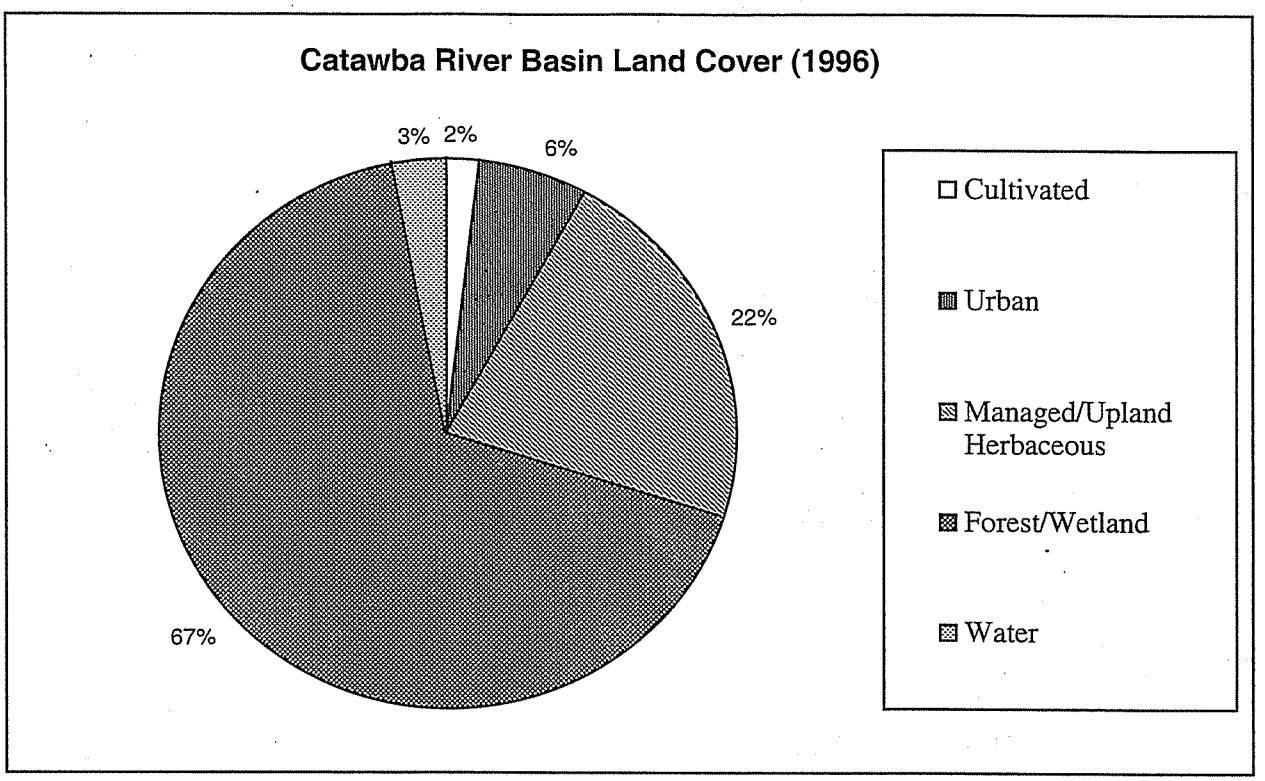


Figure A-7 Percentages within Major Land Cover Categories in the Catawba River Basin

2.5 Population and Growth Trends

Population

Based on 1990 census data, approximately 1,033,347 people live in the basin. Table A-8 presents census data for 1970, 1980 and 1990, the percent population change and population density (persons per square mile) within each subbasin. It also includes land and water area by subbasin. The subbasins containing Mecklenburg County and Gaston County have the greatest population and density.

Figure A-8 shows 1990 population densities by census block group for the Catawba River basin. The overall population density was 312 persons per square mile versus a statewide average of 123 persons per square mile. Subbasin population densities, as of 1990, are highest in the lower portion of the basin.

In using these data, it should be noted that some of the population figures are estimates because the census block group boundaries do not generally coincide with subbasin boundaries. The census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, the percentage of the population that is located in the subbasin is estimated. This is done by simply estimating the percentage of the census block

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

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

	POPULATION (Number of Persons)			POPULATION DENSITY (Persons/Square Mile)			LAND AND WATER AREAS			
							Total Land and Water Area		Water Area	Land Area
SUBBASIN	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
03-08-30	36,369	42,671	42,702	70	82	82	336,659	526	10	516
03-08-31	77,096	88,648	92,541	133	153	160	372,006	581	3	578
03-08-32	101,842	126,998	151,979	157	196	234	451,872	706	59	647
03-08-33	30,127	39,067	47,301	139	180	218	141,101	220	4	216
03-08-34	281,144	348,562	435,725	885	1,098	1,372	207,501	324	7	317
03-08-35	87,074	101,427	110,523	155	181	197	357,843	559	1	558
03-08-36	52,676	59,851	61,697	520	591	609	66,438	104	3	101
03-08-37	62,379	59,586	64,977	594	567	618	67,872	106	1	105
03-08-38	10,714	20,121	25,902	60	112	145	114,669	179	1	178
TOTALS	739,421	886,931	1,033,347	230	276	321	2,115,961	3,305	89	3,216

Growth Trends

Figure A-9 presents population growth by subbasin for the entire Catawba River basin. The percent population growth over the last ten-year census period (1980-1990) was 16.5 percent, as compared to the statewide average of 12.7 percent.

Table A-9 presents population data for municipalities, with populations greater than 2,000 persons, located wholly or partly within the basin. Table A-10 shows the projected percent change in growth between 1990 and 2015 for counties within the basin (Office of State Planning, 1996). Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Catawba River basin. They are instead presented as an estimate of possible countywide population changes. With the exception of Avery, Caldwell, Cleveland and Gaston counties, all counties within the basin are expected to experience significant growth by 2015.

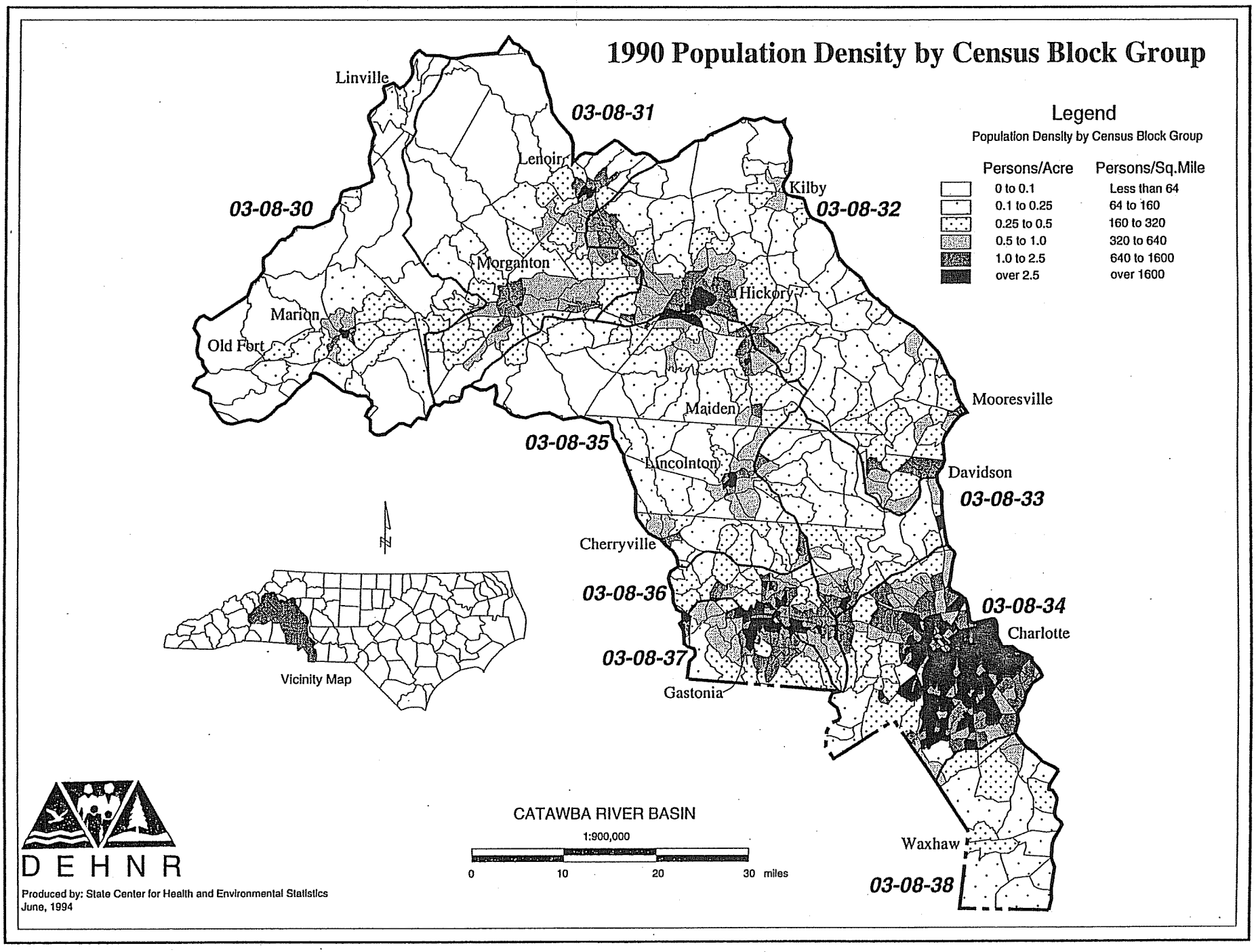


Figure A-8 1990 Population Density by Census Block Group

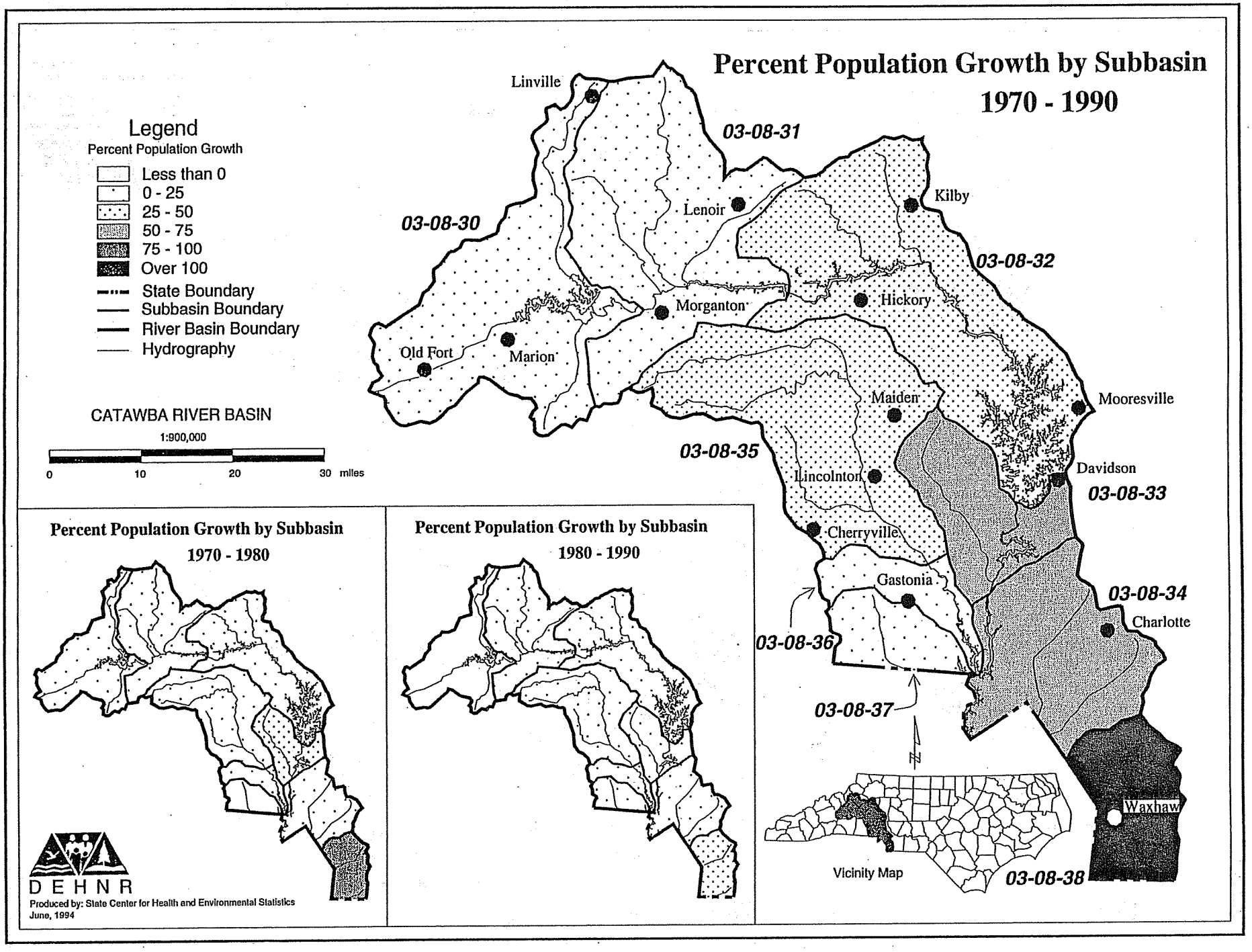


Figure A-9 Population Growth by Subbasin (1970 to 1990)

Table A-9 Population and Percent Change (1980, 1990, 1996) for Municipalities Greater Than 2,000 Located Wholly or Partly in the Catawba River Basin (Source: North Carolina Municipal Population 1996 and 1997)

Municipality	County	Apr-80	Apr-90	Jul-96	Percent Change (1980-90)	Percent Change (1990-96)
Belmont	Gaston	4,607	8,434	8,072	83.1	-4.3
Bessemer City	Gaston	4,787	4,698	4,957	-1.9	5.5
Cajah's Mountain	Caldwell	1,884	2,429	2,717	28.9	11.9
Charlotte •	Mecklenburg	315,474	395,934	469,741	25.5	18.6
Cherryville	Gaston	4,844	4,756	5,474	-1.8	15.1
Conover	Catawba	4,245	5,465	6,408	28.7	17.3
Cornelius •	Mecklenburg	1,460	2,581	8,198	76.8	217.6
Cramerton	Gaston	1,869	2,371	2,477	26.9	4.5
Dallas	Gaston	3,340	3,012	2,959	-9.8	-1.8
Davidson •	Mecklenburg	3,241	4,046	5,127	24.8	26.7
Gamewell	Caldwell	2,910	3,357	3,601	15.4	7.3
Gastonia	Gaston	47,218	54,725	61,898	15.9	13.1
Granite Falls	Caldwell	2,580	3,253	3,634	26.1	11.7
Hickory	Catawba	20,684	28,395	32,632	37.3	14.9
Hudson	Caldwell	2,888	2,819	3,158	-2.4	12.0
Huntersville •	Mecklenburg	1,294	3,023	11,777	133.6	289.6
Indian Trail	Union	811	1,942	6,399	139.5	229.5
Kings Mountain •	Cleveland	8,430	8,007	8,230	-5.0	2.8
Lenoir	Caldwell	13,748	14,192	15,797	3.2	11.3
Lincolnton	Lincoln	4,879	6,955	10,203	42.5	46.7
Long View •	Catawba	3,277	2,995	3,902	-8.6	30.3
Lowell	Gaston	2,917	2,710	2,595	-7.1	-4.2
Maiden	Catawba	2,574	2,470	3,033	-4.0	22.8
Marion	McDowell	3,684	4,765	4,972	29.3	4.3
Matthews •	Mecklenburg	1,648	13,651	18,144	728.3	32.9
Mint Hill •	Mecklenburg	7,915	11,615	15,821	46.7	36.2
Mooresville •	Iredell	8,575	9,317	13,500	8.7	44.9
Morganton	Burke	13,763	15,085	16,129	9.6	6.9
Mount Holly	Gaston	4,530	7,710	8,159	70.2	5.8
Newton	Catawba	7,624	9,077	11,731	19.1	29.2
Pineville	Mecklenburg	1,525	2,970	3,312	94.8	11.5
Ranlo	Gaston	1,774	1,650	2,113	-7.0	28.1
Sawmills	Caldwell	3,706	4,088	4,933	10.3	20.7
Stallings	Union	1,826	2,152	2,489	17.9	15.7
Stanley	Gaston	2,341	2,897	3,203	23.8	10.6
Taylorsville	Alexander	1,103	1,566	2,275	42.0	45.3
Valdese	Burke	3,364	3,914	4,167	16.3	6.5
Weddington	Union	848	3,803	5,403	348.5	42.1

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

Table A-10 Past and Projected Population and Percent Change (1990 to 2015) by County (Source: Office of State Planning 1996)

County	1990	2015	% Change
Alexander	27,544	36,992	34.3
Avery	14,867	15,335	3.1
Burke	75,740	93,827	23.9
Caldwell	70,709	78,975	11.7
Catawba	118,412	150,077	26.7
Gaston	175,093	187,398	7.0
Iredell	92,935	134,324	44.5
Lincoln	50,319	72,971	45.0
McDowell	35,681	39,374	10.4
Mecklenburg	511,481	818,704	60.1
Union	84,210	143,360	70.2
Watauga *	36,952	46,532	25.9
Subtotal	1,295,933	1,819,884	40.4

* Less than 5% of the county is in this basin

2.6 Natural Resources

2.6.1 Major Lakes

One of the most prominent hydrologic features of the Catawba River basin is the series of hydropower impoundments along the river's length that are widely referred to as the Catawba chain lakes (Figure A-10). The water quality of each impoundment is influenced by the discharge from the upstream reservoir, as well as inputs from the surrounding watershed and discharges to the lakes. The most upstream impoundment, Lake James, has the best water quality of all of the lakes in the Catawba chain.

The next three impoundments are Rhodhiss Lake, Lake Hickory and Lookout Shoals Lake. Enriched conditions found at some of these reservoirs may be caused by nutrient loading from agricultural runoff, urban stormwater and municipal dischargers. Although nutrient concentrations in these reservoirs are sufficient to support substantial algal populations, short water retention times and limited light availability generally keep algae from reaching higher levels (NC Department of Environment, Health and Natural Resources, 1992).

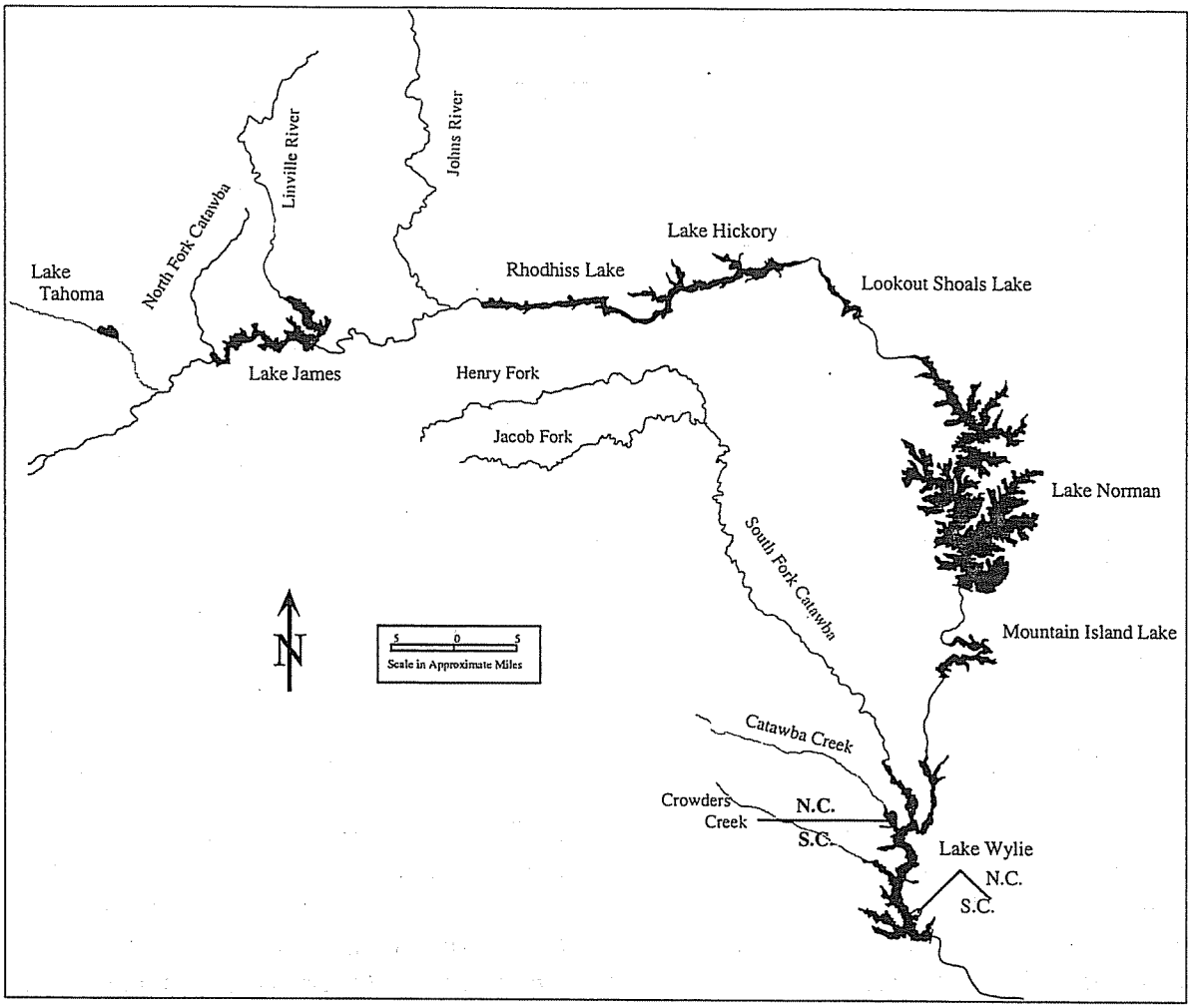


Figure A-10 Catawba River Chain Lakes

Lake Norman is located on the Catawba River below Lookout Shoals Lake and has historically exhibited good water quality. Water released from Lake Norman forms Mountain Island Lake, which is moderately productive. The final impoundment on the Catawba River in North Carolina is Lake Wylie. Lake Wylie is experiencing localized sedimentation and nutrient enrichment problems in the Crowders Creek and Catawba Creek arms of the lake.

All seven of the Catawba chain lakes are owned by Duke Power Company and were created to generate electricity. All of the chain lakes were completed between 1904 and 1928 with the exception of Lake Norman, which was completed in 1967. In addition to power generation, the lakes are popular recreational areas, and some are used for water supply purposes and for waterfront home development (Table A-11).

More detailed information on each of the lakes can be found in Section B.

Table A-11 Statistics on Major Lakes in the Catawba River Basin

Lake	Surface Area (Acres)	Mean Depth (Feet)	Shore Length (Miles)	Retention Time (Days)	Trophic Level	Watershed Area (Sq. Mi.)	Major Uses
Catawba Chain Lakes (Upstream to downstream order)							
Lake James	6,510	46	145	208	Oligotrophic	380	Hydro, Rec
Rhodhiss Lake	3,515	20	90	21	Mesotrophic	1,090	Hydro, Rec
Lake Hickory	4,100	33	105	33	Oligotrophic	1,310	Hydro, Rec, WS
Lookout Shoals	1,270	30	39	7	Oligotrophic	1,449	Hydro, Rec
Lake Norman	32,510	33	520	239	Oligotrophic	1,790	Hydro, Rec, WS
Mt. Island Lake	3,234	16	61	12	Oligotrophic	1,859	Hydro, Rec, WS
Lake Wylie	12,450	23	327	39	Eutrotrophic	3,020	Hydro, Rec
Other Major Lakes (Not on Catawba River)							
Lake Tahoma	161				Oligotrophic		Rec (was Hydro)
Little River Dam	162				Eutrotrophic	25	Rec (was Hydro)
Maiden Lake	14				Eutrotrophic	20	WS
Bessemer City	15				Mesotrophic	0.4	WS
Newton City Lake	17				Oligotrophic		WS

The five other lakes in the Catawba basin included in Table A-11 are not on the Catawba River. The Little River Dam, located on a tributary to Lake Hickory, is no longer used for hydropower purposes and has become a local fishing spot. Lake Tahoma, located on a tributary to the Catawba River upstream from Lake James, is now a recreational lake owned by Lake Tahoma, Incorporated. The last three lakes are small water supply reservoirs serving the municipalities of Maiden, Bessemer City and Newton.

2.6.2 Ecological Significance of the Catawba River Basin

Significant natural plant and animal communities in the basin are somewhat influenced by the geology of the area. In Mecklenburg County, for instance, areas of gabbro (a coarse grained mafic rock) are responsible for shaping very flat topography, which in turn supports rare community types, such as Xeric Hardpan Forests and Upland Depression Swamp Forests. Other important upland geologic features of the Catawba River basin that influence biodiversity are the low mountain areas of South Mountains and Kings/Crowders Mountain and the slopes and cliffs of Linville Gorge, Linville Caverns and Wilson Creek (NC Division of Parks and Recreation, 1998).

The Catawba River basin supports several nationally significant aquatic habitat communities, notable for their rare mollusk, fish and insect populations (see Part 2.6.5). The most biologically important aquatic habitats in the basin are in Waxhaw Creek, Wilson Creek and Upper Creek. The Linville River, which also contains several rare species, is valued as a recreational river and has been designated a State Natural and Scenic River. Ecologically significant wetlands in the basin are mostly small, isolated bogs, such as the nationally significant Pineola Bog in Avery County and several bogs in McDowell County. These bogs are often home to a variety of rare

plants and animals. Large, high quality floodplain wetland communities have not been identified in the basin.

Compared with other river basins of the state, there has not been significant detailed investigation into the biodiversity of the Catawba River basin. Of the eleven counties represented in the basin, only Mecklenburg and Iredell counties have been systematically inventoried, and Gaston is in progress. Detailed biological inventories of the remaining counties in the Catawba River basin would greatly increase knowledge of significant natural areas remaining in the region.

2.6.3 Public Lands in the Catawba River Basin

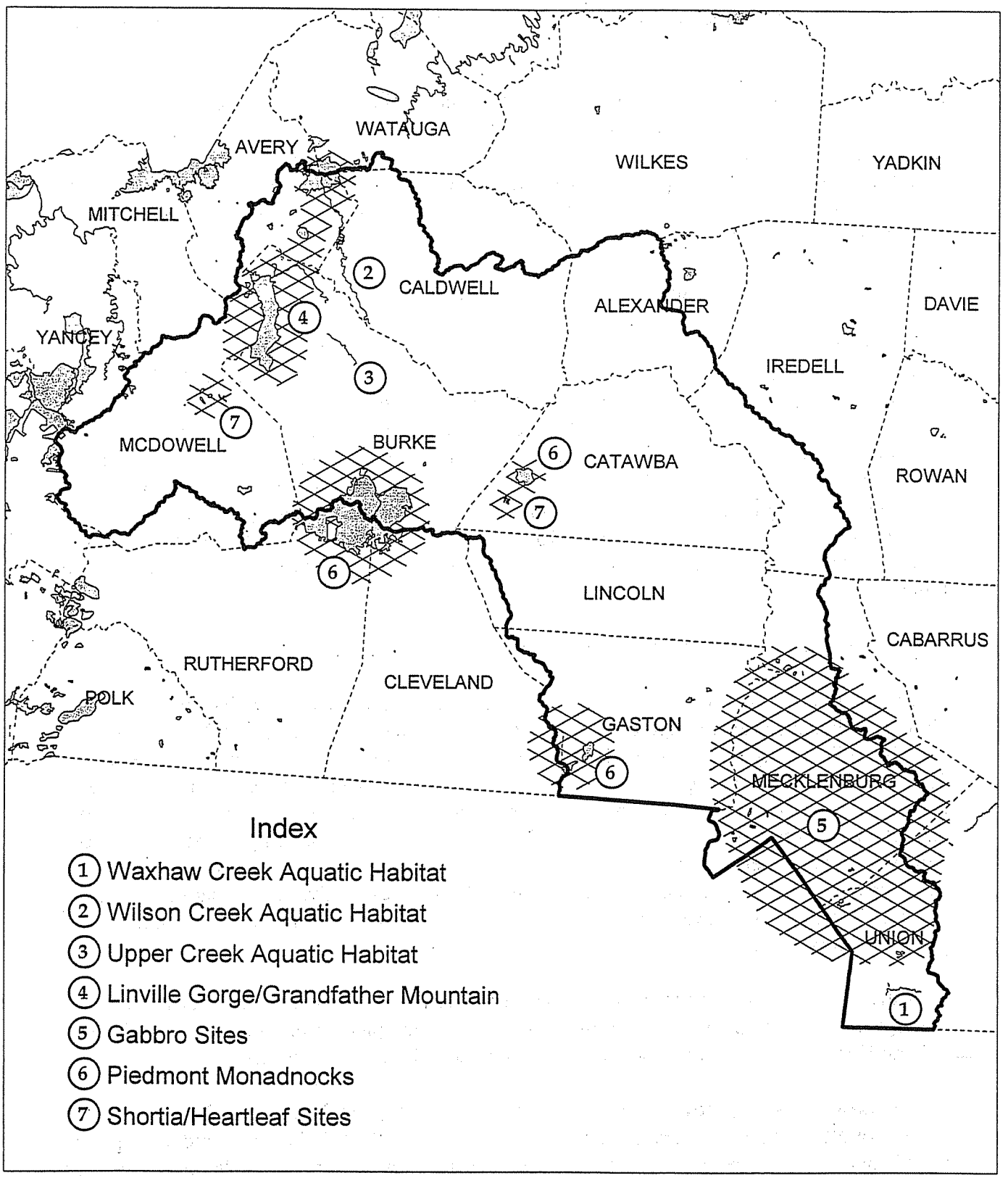
There are four state parks within the Catawba River basin: Crowders Mountain State Park, South Mountains State Park, Lake James State Park and Duke Power State Park. Over 17,700 acres of natural area are protected by these parks. Additional acreage is protected in the Broughton Hospital Watershed and the NC School for the Deaf Watershed by the NC Department of Agriculture and the NC Department of Human Resources, respectively. A large area of land in the western end of the Catawba River basin is in the Pisgah National Forest. In addition, there are several ongoing projects to protect streamside buffers and important aquatic and wetland habitats that have been funded by the NC Clean Water Management Trust Fund, including a river/riparian planning project for South Fork Creek watershed being conducted by the Catawba Lands Conservancy.

2.6.4 Significant Natural Heritage Areas

Figure A-11 is a map of the Significant Natural Heritage Areas of the Catawba River basin. The North Carolina Natural Heritage Program (NHP) of the Division of Parks and Recreation compiles a list of Significant Natural Heritage Areas as required by the Nature Preserves Act. The list is based on the program's inventory of natural diversity in the state. Natural areas are evaluated on the basis of the occurrences of rare plant and animal species, rare or high quality natural communities and geologic features. The global and statewide rarity of these elements and the quality of their occurrence at a site relative to other occurrences determine a site's significance. The sites included on this list are the best representatives of the natural diversity of the state, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access exists.

Sites that directly contribute to the maintenance of water quality in the Catawba basin are highlighted on the map and in the following text. More complete information on Significant Natural Heritage Areas may be obtained from the Natural Heritage Program.

1. **Waxhaw Creek Aquatic Habitat**. A section of Waxhaw Creek in Union County, from the vicinity of NC 200 downstream to the first tributary below SR 1117, is considered an important aquatic habitat for a rare species of freshwater mussel known as Carolina heelsplitter. Waxhaw Creek is one of only two streams in North Carolina and approximately five streams nationwide that have living populations of this federally endangered species.



Significant Natural Heritage Areas in the Catabaw River Basin

Legend
- County Line
- Significant Aquatic Habitat
- Significant Natural Area
- Natural Area Group
- Catabaw River Basin

0 10 20 30 Miles

N

NC Natural Heritage Program
Division of Parks and Recreation
January 1999

Figure A-11 Significant Natural Heritage Areas of the Catawba River Basin

2. **Wilson Creek Aquatic Habitat**. Wilson Creek is a large creek that flows southeast from the area of Grandfather Mountain to Johns River in northwestern Caldwell County. Wilson Creek is one of only two known sites that support a population of a rare dragonfly, Edmund's snaketail. Edmund's snaketail is a globally rare species, which was feared to be extinct until it was rediscovered a few years ago.

3. **Upper Creek Aquatic Habitat**. Upper Creek is a fairly large stream that flows southward toward Catawba River in northern Burke County. The upper boundary of Upper Creek Aquatic Habitat is at Timbered Branch, and the downstream boundary is at Warrior Fork, just north of Morganton. Upper Creek is a nationally significant aquatic habitat recognized for being the best of only two known locations with a population of a rare dragonfly, Edmund's snaketail. Upper Creek also supports another rare dragonfly, the pygmy snaketail. Two rare freshwater mussel species, brook floater, a state threatened species, and eastern creekshell, a significantly rare species, are also found in Upper Creek.

4. **Linville Gorge/Grandfather Mountain**. Linville Gorge, a 10,000-acre high quality natural area significant for its 2000-foot steep valley walls topped by quartzite cliffs, is one of the few primeval gorges in the Appalachians. It contains several rare plant species, as well as a few rare animal species and high quality examples of rare natural communities. Linville Gorge is within the Pisgah National Forest and has been established as a National Wilderness Area and a Registered Natural Heritage Area.

Grandfather Mountain is the highest mountain (5,964 feet) in the Blue Ridge Ranges region of the Blue Ridge Mountains. Grandfather Mountain has an astonishing diversity of both endemic and disjunct species, with nearly 60 rare plant and animal species known. Nearly 1,000 acres of Grandfather Mountain in Watauga and Avery counties are permanently dedicated as a State Nature Preserve.

5. **Gabbro sites**. Mecklenburg and Union counties contain areas of unique geology that support high quality wetland communities such as Upland Depression Swamp Forests. Several of the upland depressions have recently been protected, but most of the gabbro sites are highly threatened by development in the Charlotte area.

6. **Piedmont Monadnocks**. A cluster of monadnocks occurs on the southern edge of the Catawba River basin in Gaston, Catawba and Burke counties. Three of the most prominent monadnock clusters (remnant bodies of rock that are more resistant to erosion than the surrounding rocks) are Crowders and Kings Mountains, South Mountains and Bakers Mountain. In addition to their geologic significance, these monadnocks are significant natural areas for their biodiversity.

The South Mountains are a rugged landscape of narrow ridges, ravine-like valleys and steep slopes. The South Mountains support communities typical of the Blue Ridge but are extremely rare in the Piedmont. Over 11,000 acres of South Mountains are protected as a state park, and the recent acquisition of the adjacent Rollins Tract by the NC Wildlife Resources Commission adds another 17,000 acres to the protected area. Crowders Mountain and Kings Pinnacle are protected as the 3000-acre Crowders Mountain State Park. Approximately 300 acres of Bakers Mountain are owned by Catawba County and are under consideration for protection as a park.

7. **Shortia/Heartleaf sites.** Northern oconee bells and dwarf-flowered heartleaf are two very rare plants that live in areas of moist, sandy, acidic soils found on slopes of several streams in Catawba and McDowell counties. These species have been extirpated over most of their former ranges by the damming of streams and rivers. Other populations have been endangered through land development or excessive logging of the steep ravines in which the plants grow.

2.6.5 Rare Aquatic and Wetland-Dwelling Animal Species

The following information on rare aquatic and wetland-dwelling species (Table A-12) was obtained from the NC Natural Heritage Program, Division of Parks and Recreation (April 1998).

Table A-12 Rare and Aquatic Animals in the Catawba River Basin

Major Taxon	Common Name	Scientific Name	State Status	Federal Status
fish	Highfin carpsucker	*Carpiodes velifer*	SC	
fish	Santee chub - piedmont population	*Cyprinella zanema pop 1*	SR	
fish	Carolina darter	*Etheostoma collis*	SC	
fish	Redeye bass	*Micropterus coosae*	SR	
mollusk	Brook floater	*Alasmidonta varicosa*	T	FSC
mollusk	Carolina heelsplitter	*Lasmigona decorata*	E	E
mollusk	Seep mudalia	*Leptoxis dilatata*	T	
mollusk	Notched rainbow	*Villosa constricta*	SR	
mollusk	Eastern creekshell	*Villosa delumbis*	SR	
mollusk	Carolina creekshell	*Villosa vaughaniana*	SC	
crustacean	Bennett's mill cave water slater	*Caecidotea carolinensis*	SR	FSC
crustacean	French broad crayfish	*Cambarus reburrus*	SR	FSC
crustacean	Catawba crayfish ostracod	*Dactylocythere isabelae*	SR	FSC
dragonfly	Edmund's snaketail	*Ophiogomphus edmundo*	SR	FSC
dragonfly	Pygmy snaketail	*Ophiogomphus howei*	SR	FSC
Rare Wetland-Dwelling Animals in the Catawba River Basin				
amphibian	Bog turtle	*Clemmys muhlenbergii*	T	T(S/A)
mammal	Star-nosed mole - coastal plain population	*Condylura cristata pop 1*	SC	
mammal	Southern water shrew	*Sorex palustris punctulatus*	SC	FSC

Rare Species Listing Criteria

E = Endangered (those species in danger of becoming extinct)
T = Threatened (considered likely to become endangered within the foreseeable future)
SC = Special Concern (have limited numbers and vulnerable populations in need of monitoring)
FSC = Federal Species of Concern (formerly considered Category 2 candidates for listing)
SR= Significantly Rare (those whose numbers are small and whose populations need monitoring)

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, and
* toxic substances including chlorine, ammonia and metals.

2.7.1 Wastewater Discharges in the Catawba River Basin

There are 234 permitted wastewater discharges in the Catawba River basin. Table A-13 provides summary information (numbers of facilities and permitted flows) regarding the discharges by type and subbasin. The various types of dischargers characterized in the table are described in the inset box. A summary of all dischargers can be found in Appendix I.

Figure A-12 shows the location of major and minor permitted wastewater discharges within the basin. The number of triangles on the map depicting major discharges do not correspond exactly to the number of major facilities listed in Table A-13, since some major facilities have more than one outfall point. Each outfall point received its own triangle.

Types of Wastewater Discharges:

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

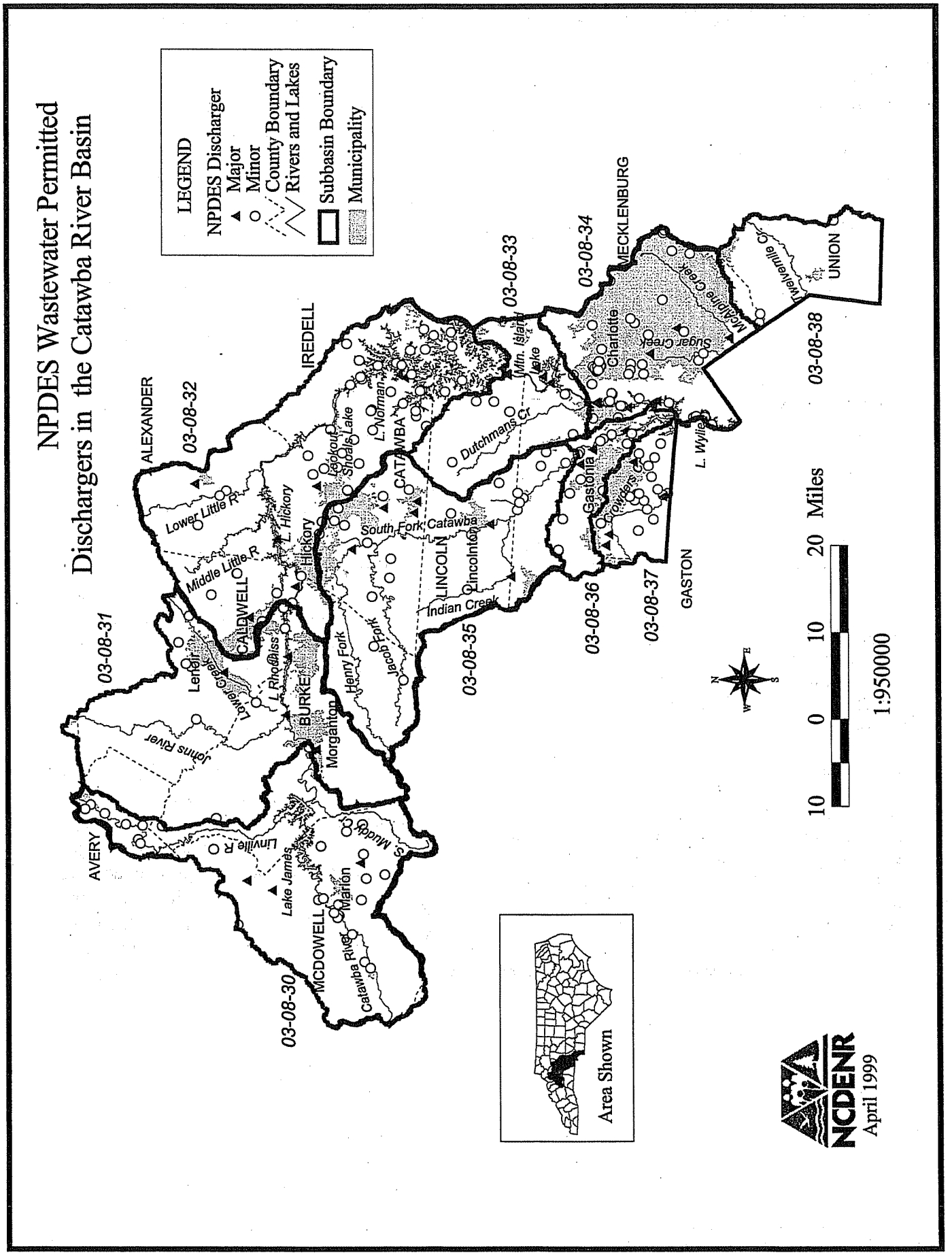


Figure A-12 Location of NPDES Permitted Discharges in the Catawba River Basin

Table A-13 Summary of NPDES Dischargers and Permitted Flows for the Catawba River Basin

	Subbasin									
Facility Categories	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**TOTAL**
Total Facilities	30	15	55	14	50	28	18	21	3	234
Total Permitted Flow (MGD)	10.24	19.69	15.28	8.00	103.20	22.12	18.90	18.46	0.26	216.15
Major Discharges	3	4	6	4	6	6	5	4	0	38
Total Permitted Flow (MGD)	6.2	19.58	10.53	7.0	101.9	21.0	15.9	17.11	0	199.22
Minor Discharges	27	11	49	10	44	22	13	17	3	196
Total Permitted Flow (MGD)	4.04	0.11	4.75	1.00	1.30	1.12	3.00	1.35	0.26	16.93
100% Domestic Waste	21	8	38	5	15	14	8	6	3	118
Total Permitted Flow (MGD)	1.08	0.10	4.91	0.80	48.54	5.88	4.22	0.07	0.26	65.86
Municipal Facilities	4	4	12	3	4	12	7	3	0	49
Total Permitted Flow (MGD)	4.12	19.58	12.72	7.75	88.0	20.83	12.13	16.5	0	181.63
Nonmunicipal Facilities	26	11	43	11	46	16	11	18	3	185
Total Permitted Flow (MGD)	6.12	0.11	2.56	0.25	15.20	1.28	6.77	1.96	0.26	34.51
Industrial Facilities	3	2	4	1	3	2	0	1	0	16
Total Permitted Flow (MGD)	0.03	0.01	0.04	0.01	0.01	0.013	0	0.14	0	0.253

2.7.2 Stormwater Discharges in the Catawba River Basin

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

The municipal permitting requirements are designed to lead to the formation of site-specific stormwater management programs for a municipal area. Municipalities covered by these regulations are called Municipal Separate Storm Sewer Systems (MS4s). Only the City of Charlotte was required to have an NPDES stormwater permit under Phase I.

Industrial activities that require permitting are defined in eleven categories in the federal regulations ranging from sawmills and landfills to phosphate manufacturing plants and hazardous waste treatment, storage or disposal facilities. Permits are granted in the form of general

stormwater permits (which covers a wide variety of activities) or individual stormwater permits. Excluding construction general permits, there are 652 general stormwater permits and 38 individual stormwater permits issued within the river basin. Individual permit holders are presented in Appendix I.

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

On October 29, 1999, Phase II of the NPDES stormwater program became law. Phase II lowers the construction activity threshold to one or more acres of land disturbance and allows a permitting exemption for industrial facilities that do not have significant materials or activities exposed to stormwater. Phase II will include smaller local governments into the NPDES stormwater program. Phase II MS4 permit applications must be submitted to DWQ by March 1, 2003.

2.8 Agriculture

Table A-14 summarizes, by subbasin, the number of registered livestock operations, total animals, total acres in operation and total steady state live weight as of April 1998. These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin. Figure A-13 shows the general location of the registered operations in the basin.

Steady State Live Weight (SSLW) is a measure in pounds, after a conversion factor is applied to the number of animals on a farm. The conversion factors vary depending on the type of animals and the operation. The SSLW is the best way to compare farm sizes.

Information on animal capacity by subbasin (Table A-15) was provided by the NC Department of Agriculture.

Key Livestock Operation Legislation

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

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

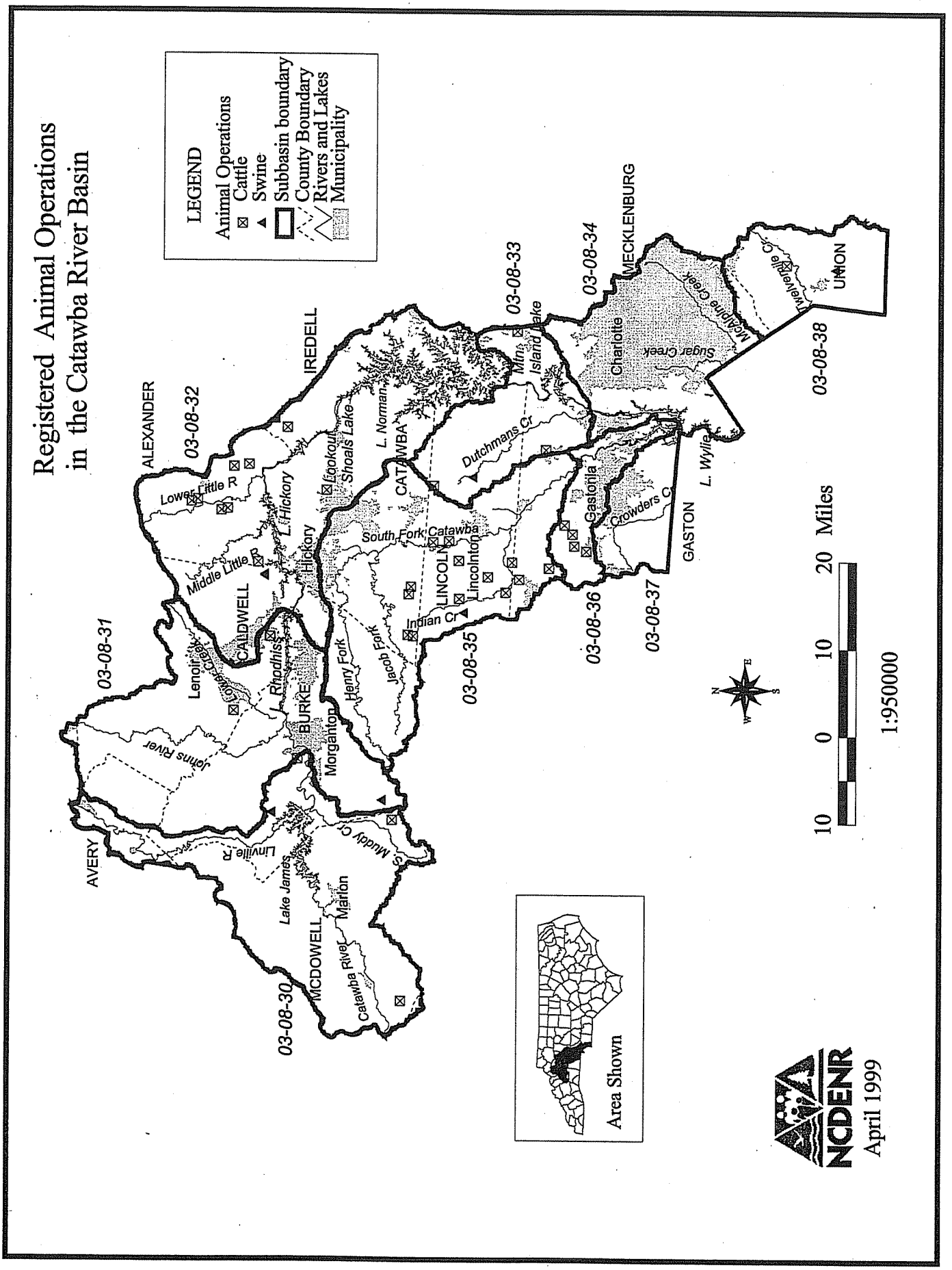


Figure A-13 Registered Animal Operations in the Catawba River Basin

Table A-14 Registered Animal Operations in the Catawba River Basin (as of 4/98)

Subbasin	Cattle Total Animals	Cattle Total Steady State Live Weight	Total Cattle Operations	Swine Total Animals	Swine Total Steady State Live Weight	Total Swine Operations	Total Animals	Total Steady State Live Weight
03-08-30	300	420,000	2	1,350	191,295	1	1,650	611,295
03-08-31	0	0	0	2,800	1,212,400	1	2,800	1,212,400
03-08-32	2,170	3,038,000	10	4,000	564,120	3	6,170	3,602,120
03-08-33	210	294,000	2	2,500	354,250	1	2,710	648,250
03-08-34	0	0	0	0	0	0	0	0
03-08-35	2,680	3,752,000	12	500	70,850	1	3,180	3,822,850
03-08-36	1,055	1,477,000	4	0	0	0	1,055	1,477,000
03-08-37	0	0	0	0	0	0	0	0
03-08-38	630	882,000	2	450	60,750	1	1,080	942,750
TOTALS	7,045	9,863,000	32	11,600	2,453,665	8	18,645	12,316,665

Table A-15 Estimated Populations of Swine (1998, 1994 and 1990), Dairy (1998 and 1994) and Poultry (1998 and 1994) in the Catawba River Basin (Source: NCDA Veterinary Division)

Subbasin	1998 Swine Total Capacity	1994 Swine Total Capacity	1990 Swine Total Capacity	Swine Change 94-98 (%)	1998 Dairy Total Capacity	1994 Dairy Total Capacity	Dairy Change 94-98 (%)	1998 Poultry Total Capacity	1994 Poultry Total Capacity	Poultry Change 94-98 (%)
03-08-30	292	391	2,938	-25	295	737	-60	550,507	431,907	27
03-08-31	3,921	3,477	3,712	13	743	747	-1	1,836,300	1,730,400	6
03-08-32	3,628	4,578	3,176	-21	4,203	5,485	-23	3,942,879	3,175,448	24
03-08-33	2,717	1,802	2,639	51	1,448	1,448	0	62,084	11,822	425
03-08-34	428	274	485	56	45	45	0	538	538	0
03-08-35	1,355	1,814	4,615	-25	4,896	6,757	-28	2,133,378	1,767,550	21
03-08-36	107	101	229	6	1,793	2,138	-16	100,352	352	28,409
03-08-37	236	236	306	0	223	223	0	276	250	10
03-08-38	1,838	1,280	2,153	44	192	237	-19	2,179,920	1,869,620	17
TOTALS	14,522	13,953	20,253	4	13,838	17,817	-22	10,806,234	8,987,887	20
% of State Total	0.1%	0.3%	0.8%		14%	13%		5%	5%	

2.9 Water Use and Minimum Streamflow

2.9.1 Local Water Supply Planning

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

meet those needs. The current LWSPs are based on 1992 data. Plans are being updated this year (1999) based on 1997 water supply and water use information.

Forty-four systems that use water from the Catawba River basin provided an average of 153 million gallons per day (MGD) to 747,348 persons in 1992. Projections of future needs show that these systems expect their service populations to increase by 55% to 1,238,702 persons by the year 2020. Average daily water use for these systems is expected to double to 317 MGD by the year 2020. This information represents systems submitting a LWSP and does not reflect the needs of the many public water systems in this basin that are not required to prepare a local plan because they are not operated by a unit of local government. The information is self-reported and has not been field verified. However, plans have been reviewed by staff engineers for consistency and reasonableness. More information is available for these and other systems across the state that submitted a Local Water Supply Plan from the Division of Water Resources website at: www.dwr.ehnr.state.nc.us/home.htm.

2.9.2 Minimum Streamflow

One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. 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, 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. DWR has been involved in many minimum streamflow studies in this basin (Table A-16).

2.9.3 Interbasin Transfers

Water users in North Carolina are required to register their water withdrawals and transfers with the Division of Water Resources (DWR) if the amount is 100,000 gallons per day or more, according to G.S. 143-215.22H. In addition, transfers of two million gallons per day or more require certification from the Environmental Management Commission, according to 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*, that was filed in the Office of the Secretary of State on April 16, 1991. Within the Catawba basin, two subbasins are delineated: the Catawba River and the South Fork Catawba River (Figure A-14).

Table A-17 lists transfers involving the Catawba basin. The transfer amounts shown are 1992 average daily amounts in million gallons per day (MGD) based on 1992 Local Water Supply Plans (see Part 2.9.1) and registered withdrawal/transfer information. Many of the transfers listed cannot be quantified due to undocumented consumptive losses (examples: septic, lawn irrigation). Note: Under a provision of Senate Bill 1299 (ratified by the General Assembly on September 23, 1998), all local water systems are now required to report existing and anticipated interbasin transfers as part of the Local Water Supply Planning process. This information will be available for future updates of this management plan and will allow an assessment of cumulative impacts.

Currently, there are no interbasin transfer certificate holders in the Catawba basin. Current transfers by Burlington Industries, Charlotte-Mecklenburg Utilities (CMU), Gastonia, Hickory and Mooresville - all estimated to be greater than 2.0 MGD - are grandfathered under provisions of the interbasin transfer law. CMUD has recently applied for a certificate to transfer additional water from the Catawba subbasin to the Rocky River subbasin. CMUD is preparing environmental documentation to support its application.

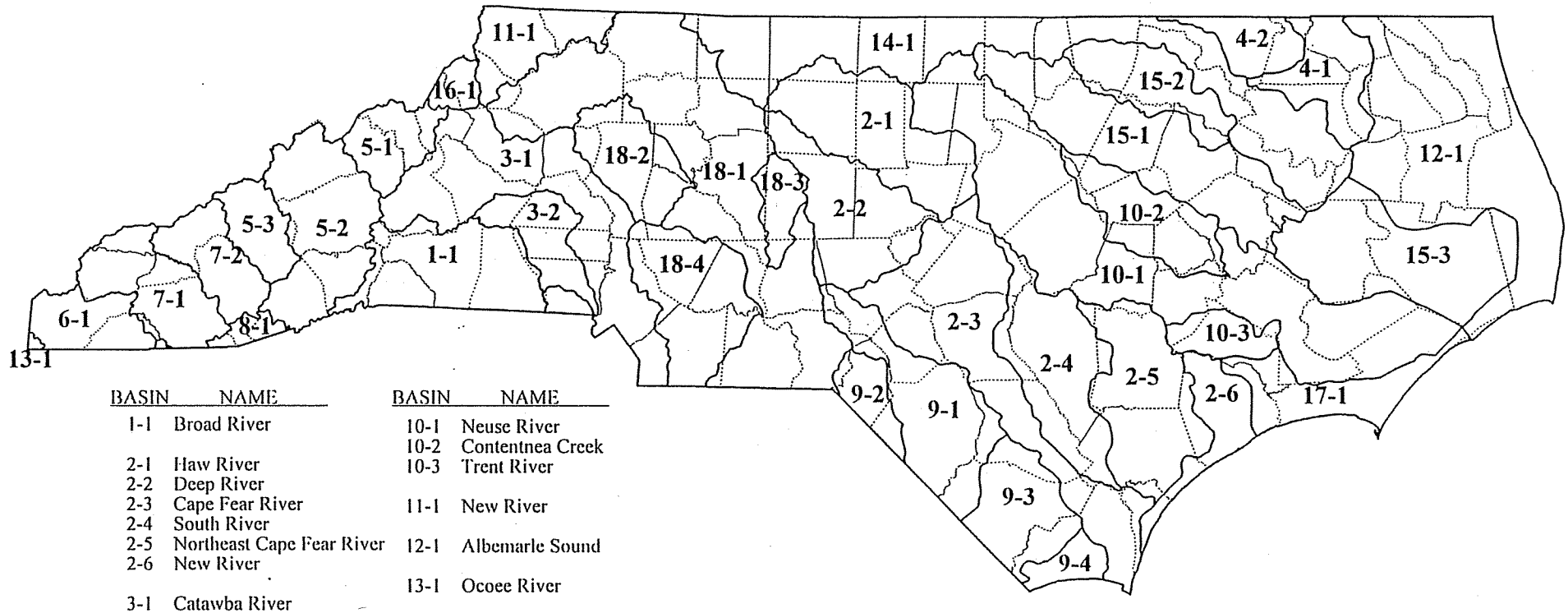
Table A-16 Minimum Streamflow Projects in the Catawba River Basin

Site	Waterbody	Drainage Area (sq. mi.)	Min. Release (cu.ft/sec)
Hydropower Dams			
+Catawba-Wateree Project (FERC#2232)	Catawba River: Lakes James, Rhodhiss, Hickory, Lookout, Norman, Mountain Island, Wylie		
McAdenville (FERC#4186)	South Fork Catawba River	632	None*
Spencer Mountain (FERC#2607)	South Fork Catawba River	622	76
Hardins (FERC#6492)	South Fork Catawba River	512	43.5
High Shoals (FERC#4827)	South Fork Catawba River	510	None*
Long Shoals (FERC#7742)	South Fork Catawba River	470	92
Brushy Mountain (Millersville) (Non-Jurisdictional)	Lower Little River	80.7	2
Lake Tahoma (FERC#4021)	Buck Creek	23.1	None*
Henry River (closed) (unlicensed)	Henry Fork	81	24.5
Non-Hydropower Dams			
Loch Dornie	Linville River	3.5	7Q10 (1.9)
Land Harbor Lake	Linville River	19	6.6
Miscellaneous			
Blue Ridge Country Club irrigation intake	Laurel Branch	1.05	7Q10(.39)
Duke Power Lincoln Combustion Turbine Station	Killian Creek	36	7Q10 (2.28)
Bessemer City Intake Weir	Long Creek	26	?

Notes:

+ The license issued for the Catawba-Wateree project by the Federal Energy Regulatory Commission will expire on August 31, 2008. Studies to determine the need for a minimum flow to protect aquatic habitat below each dam will probably begin during the span of the 1999 Catawba Basinwide Management Plan.

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



BASIN	NAME
1-1	Broad River
2-1	Haw River
2-2	Deep River
2-3	Cape Fear River
2-4	South River
2-5	Northeast Cape Fear River
2-6	New River
3-1	Catawba River
3-2	South Fork Catawba River
4-1	Chowan River
4-2	Meherrin River
5-1	Nolichucky River
5-2	French Broad River
5-3	Pigeon River
6-1	Hiwassee River
7-1	Little Tennessee River
7-2	Tuckasegee River
8-1	Savannah River
9-1	Lumber River
9-2	Big Shoe Heel Creek
9-3	Waccamaw River
9-4	Shallotte River

BASIN	NAME
10-1	Neuse River
10-2	Contentnea Creek
10-3	Trent River
11-1	New River
12-1	Albemarle Sound
13-1	Ocoee River
14-1	Roanoke River
15-1	Tar River
15-2	Fishing Creek
15-3	Pamlico River & Sound
16-1	Watauga River
17-1	White Oak River
18-1	Yadkin River
18-2	South Yadkin River
18-3	Uwharrie River
18-4	Rocky River

Miles

0 20 40 60 80 100

Legend

Basin Boundary

County Boundary

DEHNR
Division of Water Resources
919-733-4064

Figure A-14 NC Division of Water Resources Interbasin Map of Major River Basins and Subbasins

Table A-17 Interbasin Transfers in the Catawba River Basin

Source System	Receiving System	Source Subbasin	Receiving Subbasin	Estimated Transfer (MGD)[1]
Charlotte-Mecklenburg	Charlotte-Mecklenburg	Catawba	Rocky	4.8
Charlotte-Mecklenburg	Union Co.	Catawba	Rocky	0.22
Burlington Industries	Burlington Industries	Catawba	Rocky	3.75
Gastonia	Gastonia	Catawba	S. Fork Catawba	8.3
Gastonia	Cramerton	Catawba	S. Fork Catawba	0.33
Gastonia	Lowell	Catawba	S. Fork Catawba	0.48
Gastonia	McAdenville	Catawba	S. Fork Catawba	0.46
Mooresville	Mooresville	Catawba	Rocky	2.70
Valdese	Burke Co.	Catawba	S. Fork Catawba	0.66
Hickory	Hickory	Catawba	S. Fork Catawba	3.62
Hickory	Newton	Catawba	S. Fork Catawba	Emergency
Hickory	Conover	Catawba	S. Fork Catawba	1.16
Hickory	Long View	Catawba	S. Fork Catawba	0.19
Hickory	Brookford	Catawba	S. Fork Catawba	0.19
Belmont	Belmont	Catawba	S. Fork Catawba	Unknown
Belmont	Cramerton	Catawba	S. Fork Catawba	Emergency
Long View	Long View	Catawba	S. Fork Catawba	1.25
Mount Holly	Stanley	Catawba	S. Fork Catawba	Unknown
Lincoln Co.	Lincolnton	Catawba	S. Fork Catawba	0.446
Lenoir	Caldwell Co. SE	Catawba	Yadkin	0.38
Lenoir	Caldwell Co. N	Catawba	Yadkin	0.01
Mooresville	Mooresville	Catawba	S. Yadkin	Unknown
Kings Mountain	Kings Mountain	Broad	Catawba	Unknown
Anson Co.	Union Co.	Yadkin	Catawba	0.61
Alexander Co.	Taylorsville	S. Yadkin	Catawba	0.41
Alexander Co.	Alexander Co.	S. Yadkin	Catawba	Unknown
Alexander Co.	Alexander Co. Hwy. 16 S	S. Yadkin	Catawba	Unknown
Alexander Co.	West Iredell	S. Yadkin	Catawba	0.05
Statesville	Troutman	S. Yadkin	Catawba	0.09
Monroe	Union Co.	Rocky	Catawba	Unknown
Morganton	Drexel	S. Fork Catawba	Catawba	1.3
Newton	Newton	S. Fork Catawba	Catawba	Unknown
Newton	Catawba	S. Fork Catawba	Catawba	0.09
Dallas	Gastonia	S. Fork Catawba	Catawba	Emergency
Bessemer City	Gastonia	S. Fork Catawba	Catawba	Emergency
Bessemer City	Bessemer City	S. Fork Catawba	Catawba	1.07
Ranlo	Gastonia	S. Fork Catawba	Catawba	Emergency
Stanley	Stanley	S. Fork Catawba	Catawba	Unknown
Lincolnton	Lincoln Co.	S. Fork Catawba	Catawba	0.11
Cherryville	Cherryville	S. Fork Catawba	Broad	Unknown
Kings Mountain	Bessemer City	Broad	S. Fork Catawba	0.683

[1] Transfer amounts for Charlotte-Mecklenburg Utilities are 1993 average values based on its interbasin transfer application. Transfer amounts for Gastonia are 1997 average values based on recently submitted interbasin transfer documentation. All other transfer amounts are based on average daily water use reported in 1992 Local Water Supply Plans and the 1993 Water Withdrawal and Transfer Registration Database. "Unknown" refers to undocumented consumptive use. "Emergency" refers to emergency connections.

Chapter 3 -
Summary of Water Quality Information for the Catawba River Basin

3.1 General Sources of Pollution

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

Point Sources

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

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

Nonpoint Sources

- Stormwater runoff
- Land clearing activities (construction and preparing land for crops and development)
- Road construction related to timber harvesting activities
- Agricultural lands
- Rural residential development
- Septic systems
- Mining

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

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

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

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

3.2 Description of Surface Water Classifications and Standards

Program Overview

North Carolina'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. A full description of the state's primary and supplemental classifications are available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina.* Information on this subject is also available at DWQ's website: http://h2o.enr.state.nc.us/wqhome.html.

Statewide Water Quality Standards

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

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

Table A-18 Primary and Supplemental Surface Water Classifications
(Primary classifications beginning with an "S" are assigned to saltwaters)

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

High Quality Waters

Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities and facilities which expand beyond their currently permitted loadings address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

Criteria for HQW Classification

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

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. In addition, the Division of Land Resources requires more stringent sedimentation controls for land-disturbing projects within one mile and draining to HQWs.

Outstanding Resource Waters

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

The ORW rule defines outstanding resource values as:

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

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and stormwater controls for most new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

Classifications and Standards in the Catawba River Basin

The waters of the Catawba River basin have a variety of surface water quality classifications applied to them. Water Supply watersheds range from WS-II to WS-V. Water supply watersheds, Outstanding Resource Waters and High Quality Waters are presented in Figure A-15.

Classification and standards for the entire basin can be found in a separate document titled *Classifications and Water Quality Standards Assigned to the Waters of the Catawba River Basin* available by calling the Planning Branch of DWQ at (919) 733-5083. They can also be accessed through DWQ's Water Quality Section website: http://h2o.enr.state.nc.us/wqhome.html.

Pending and Recent Reclassifications in the Catawba River Basin

There is one pending reclassification in the Catawba River basin on Little Grassy Creek in Avery County. The proposed reclassification is from C Tr to C Tr ORW went to public hearings in May 1999. DWQ will continue to assess the proposed reclassification.

Recent reclassifications in the basin include Armstrong Creek in McDowell County (from WS-II Tr to C Tr HQW), Lookout Shoals Lake (from WS-V and WS-IV to WS-IV and WS-IV CA), and the Catawba River near Morganton in McDowell County (WS-IV Protected Area revision). These recent reclassifications became effective in April 1999. There were five reclassifications in 1998.

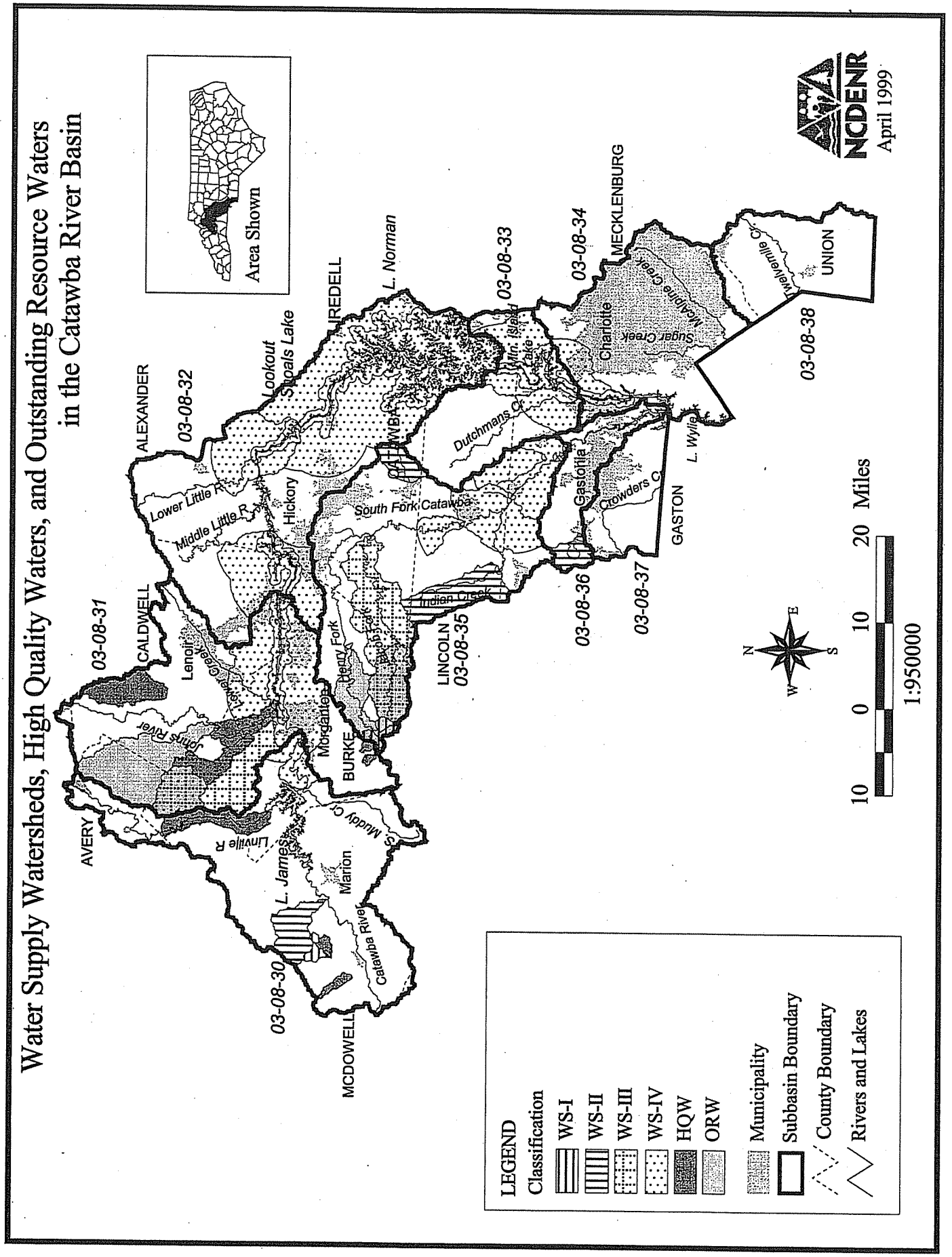


Figure A-15 Water Supply Watersheds, Outstanding Resource Waters and High Quality Waters in the Catawba River Basin

3.3 DWQ Water Quality Monitoring Programs in the Catawba River Basin

The Environmental Sciences Branch of DWQ collects a variety of biological, chemical and physical data. The following discussion contains a brief introduction to each program, followed by a summary of water quality data in the Catawba River basin for that program. A more complete discussion on biological and chemical monitoring within the basin can be found in the *Catawba River Basinwide Assessment Report* (DENR, August 1998 or at the Environmental Sciences website address: http://esb.ehnr.state.nc.us).

DWQ monitoring programs for the Catawba River Basin include:

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

3.3.1 Benthic Macroinvertebrates

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

Criteria have been developed to assign a bioclassification rating to each benthic sample based on the number of different species present in the pollution intolerant groups of Ephemeroptera (Mayflies), Plecoptera (Stoneflies) and Trichoptera (Caddisflies); or commonly referred to as EPTs. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina. The ratings fall into five categories ranging from Poor to Excellent.

Overview of Benthic Macroinvertebrate Data

Appendix A-II lists all the benthic macroinvertebrate collections in the Catawba River basin between 1983 and 1996, giving site location, collection date, taxa richness, biotic index values and bioclassifications. Benthic macroinvertebrates have been collected at 217 sites in the Catawba River basin since 1983, and 67 of these sites were sampled during the 1997 basinwide surveys. For the 1997 collections, bioclassifications were given to sites in the following breakdown: Excellent (11), Good (21), Good-Fair (18), Fair (16) and Poor (1). The distribution of water quality ratings is similar for all collections since 1983 versus 1997 ratings. However, a lower percentage of Poor sites was observed in the 1997 samples. This reflects a change in the type of surveys conducted by Division biologists, rather than any improvement in water quality. Basinwide collections in 1997 are aimed at sampling larger streams, while prior collections include many surveys of small streams affected by point source dischargers. Future collections

will attempt to assess improvements in water quality for small streams. Table A-19 lists the biological ratings for sample sites since 1983 by subbasin for the Catawba River basin.

Table A-19 Biological Ratings for Recent Samplings in the Catawba River Basin

Subbasin 03-08-30 to 03-08-38	Excellent	Good	Good-Fair	Fair	Poor
Headwaters (to Lake James) - 30	10	24	8	2	2
Johns R and L Rhodhiss Tribs - 31	19	8	8	8	0
Lower Catawba to L Norman - 32	0	5	8	1	4
Dutchmans Cr/McDowell Cr - 33	4	3	1	1	0
Charlotte area - 34	0	0	3	9	6
S Fork Catawba R - 35	10	13	8	8	4
Long Cr - 36	0	8	6	3	0
Crowders Cr/Catawba Cr - 37	0	0	5	7	7
Waxhaw area - 38	0	0	3	0	0
Total (#)	43	61	50	39	23
Total (%)	20%	28%	23%	18%	11%

High quality streams in the Catawba River basin (Good and Excellent ratings) are concentrated in two areas: northern tributaries of the Catawba River above Lake Rhodhiss in 03-08-30 and 03-08-31 and the Henry Fork/Jacob Fork catchments in 03-08-35. Macroinvertebrate sampling has found the greatest number of water quality problems in smaller effluent-dominated streams and streams draining highly urbanized catchments. Charlotte (03-08-34), Gastonia (03-08-37) and Lincolnton (03-08-35) have the greatest number of Fair and Poor ratings.

Long-term changes in water quality were evaluated at 52 sites in the Catawba River basin, with the majority of sites showing no changes in water quality (Table A-20). High flows in 1997 caused several changes over a 5-year period either due to greater scour at sites affected by nonpoint source runoff or due to dilution in effluent-dominated streams. Negative changes in water quality were usually related to nonpoint source problems. Improvements in water quality were usually associated with the elimination or improvements of wastewater treatment plants. For greater detail, go to specific subbasin chapters of this document.

Table A-20 Long-Term Changes in Water Quality Using Benthic Macroinvertebrate Samples

Subbasin 03-08-30 to 03-08-38	# Trend Sites	5-year trend			Long-term (>5 years) trend		
		None	+	-	None	+	-
Headwaters (to Lake James) - 30	21	15	0	4	3	4	1
Johns R and L Rhodhiss Tribs - 31	7	7	0	0	2	0	0
Lower Catawba to L Norman - 32	6	5	0	1	0	0	0
Dutchmans Cr/McDowell Cr - 33	3	2	0	1(1*)	1	0	0
Charlotte area - 34	4	1	2	1(1*)	0	1	0
S Fork Catawba R - 35	6	4	2(2*)	0	2	3	0
Long Cr - 36	2	2	0	0	1	1	0
Crowders Cr/Catawba Cr - 37	1	0	1(1*)	0	0	1	0
Waxhaw area - 38	0	0	0	0	2	0	0
Total	52	36	5(3*)	7(2*)	11	10	1

* Number of changes in bioclassification related to between-year differences in flow, not indicative of any long-term change in water quality.

3.3.2 Fish Assessments

In 1997, 32 sites representing all nine of the subbasins were sampled and evaluated 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. Finally, the NCIBI score is used to determine the NCIBI class, as proposed by Karr (1981), of the stream from which the sample was collected (Table A-21 and Appendix A-II).

The NCIBI has been revised since the 1995 Catawba River basinwide monitoring was conducted. Recently, the focus of using and applying the Index has been restricted to wadeable streams that can be sampled by a crew of 2-4 persons using backpack electrofishers and following the NCDWQ Standard Operating Procedures (NCDENR, 1997). In an effort to simplify and standardize the evaluation of a stream's ecological integrity and water quality bioclassification whether using a fish community or benthic invertebrate assessment, the fish community integrity classes were also modified.

Overview of Fish Community Assessment Data

The NCIBI classifications at these sites ranged from Good to Poor (Figure A-16). The fish communities with the highest biological integrity scores were Mulberry Creek and Jacob Fork (in Caldwell and Burke counties, respectively). The fish communities with the lowest biological integrity scores were McDowell Creek, Irwin Creek, Little Sugar Creek (all in Mecklenburg County), Hoyle and Indian Creek (Lincoln County), and Crowders Creek (Gaston County).

Of the 32 sites sampled in 1997, twelve of the sites were previously sampled in 1993 (Figure A-17 and Appendix A-II). The 1997 average NCIBI score was 41 with an NCIBI classification of Fair. The 1993 average NCIBI score was 36 with a NCIBI classification of Poor. It, thus, seems that between 1993 and 1997 the overall ecological health of these twelve sites improved slightly.

Fish ratings were much lower than the benthos ratings in subbasins 03-08-33, 03-08-35 and 03-08-36, suggesting that sediment is the primary stress factor for the aquatic fauna in these areas.

Table A-21 Scores, Integrity Classes and Class Attributes for Evaluating a Wadeable Stream Using the North Carolina Index of Biotic Integrity

NCIBI Scores	NCIBI Classes	Class Attributes
56 - 60	Excellent	Comparable to the best situations without human disturbance. All regionally expected species for the habitat and stream size, including the most intolerant forms are present, along with a full array of size classes and a balanced trophic structure.
50 - 54	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant species; some species are present with less than optimal abundance or size distributions; and the trophic structure shows some signs of stress.
44 - 48	Good-Fair	Signs of additional deterioration include the loss of intolerant species, fewer species and a highly skewed trophic structure.
38 - 42	Fair	Dominated by omnivores, tolerant species and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; and diseased fish often present.
< 36	Poor	Few fish present, mostly introduced or tolerant species; and disease fin damage and other anomalies are regular.

Overview of Fish Tissue Sampling

Fish tissue was sampled at 10 stations within the Catawba drainage during 1997 as part of routine basinwide assessments. All fish samples collected during 1997 contained metals at non-detectable levels or at levels below FDA and EPA criteria. A small number of fish were also analyzed for chlorinated pesticides and PCBs during the 1997 assessment. Results showed only trace amounts of the DDT metabolites DDD and DDE in fish from Mountain Island Lake and the South Fork Catawba River near Belmont. Concentrations of DDD and DDE at these stations were below EPA and FDA criteria. Only one fish sample collected from the Catawba basin during 1997 contained an organic pollutant exceeding accepted criteria. A largemouth bass sample from South Fork Catawba River contained PCBs exceeding the EPA screening value, but results were below FDA limits. Targeted organic analytes were not detected at other stations during the 1997 survey.

At present, there are no fish tissue consumption advisories posted specifically in the Catawba basin. However, the entire basin is posted for bowfin, as part of a statewide mercury advisory on the species. Consumption of bowfin is limited to no more than 2 meals per month for the general population. Children and women of childbearing age are advised not to consume bowfin.

Figure A-16 The North Carolina Index of Biotic Integrity for the Catawba River Basin (1997)

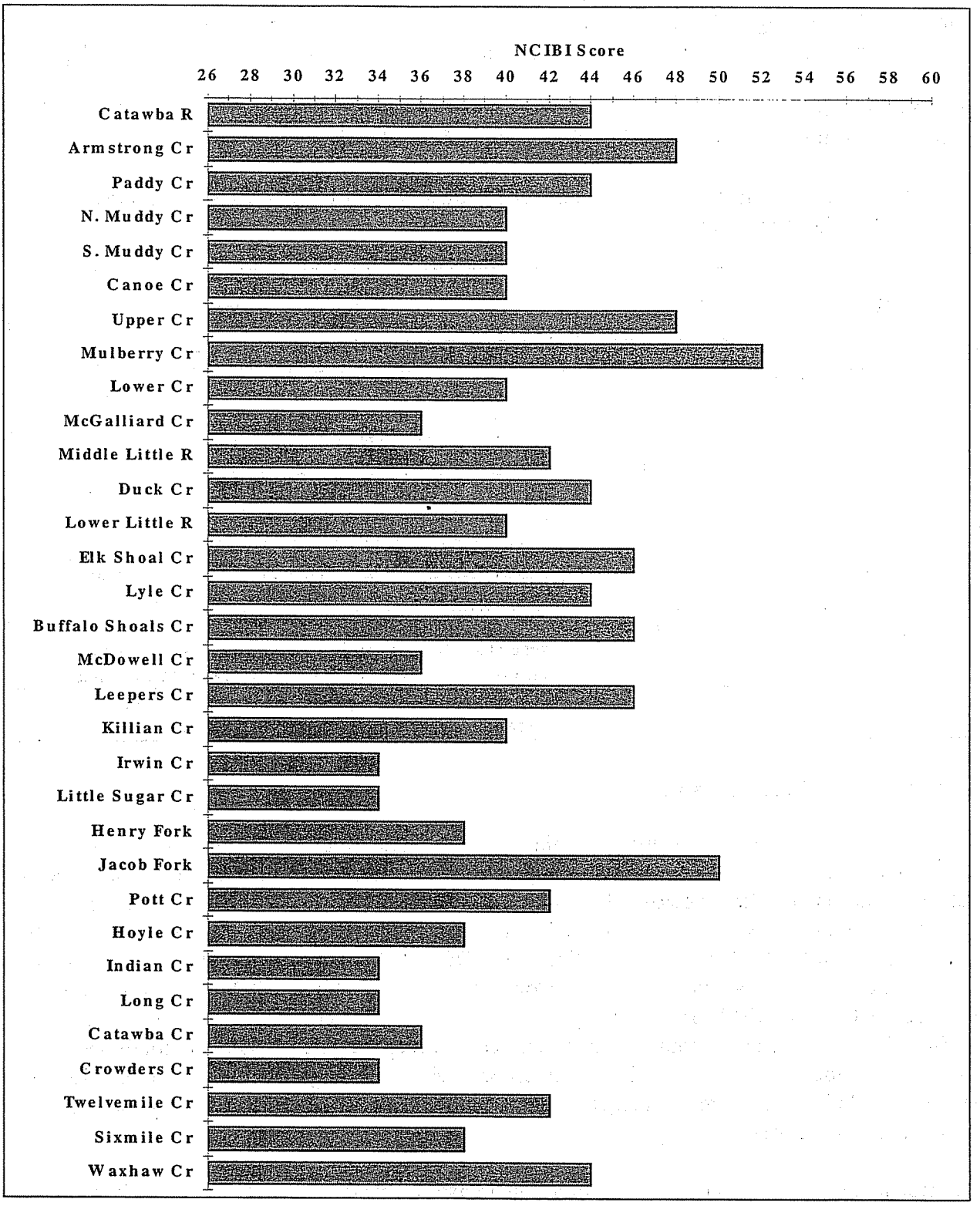
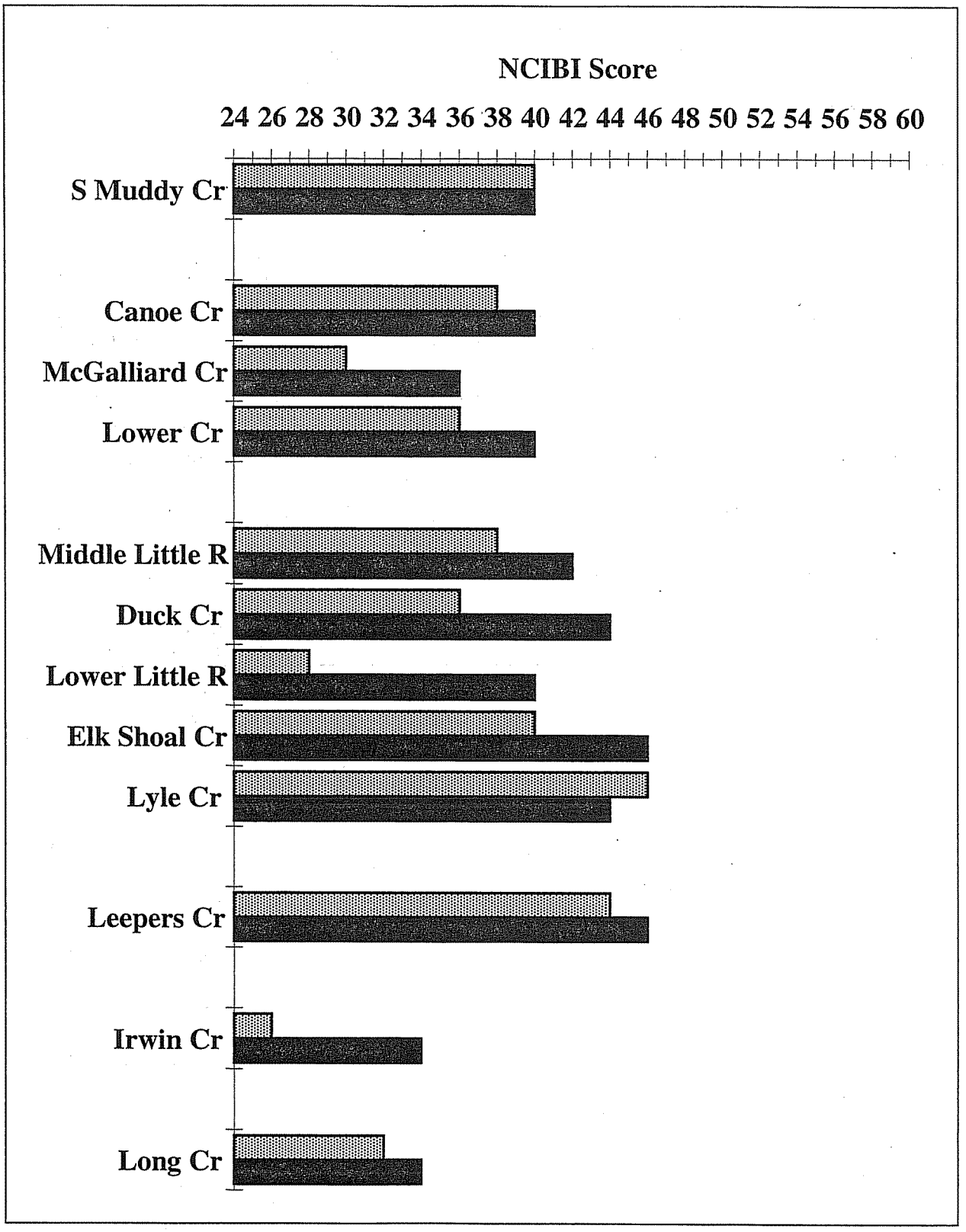


Figure A-17 The North Carolina Index of Biotic Integrity for the Catawba River Basin 1993 (shaded bars) *vs.* 1997 (solid bars)



Catawba River Basin Fish Kills

Field investigators reported 19 fish kill events in the Catawba River basin from 1987 to 1997. Mortality estimates ranged from 50 to 1500 individuals. Causes for most events during the period were cited as unknown or the result of chemical, industrial and municipal spills. The majority of fish kill activity in the basin was reported from 03-08-34 and includes the Charlotte metropolitan area.

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. Other facilities may be tested by DWQ's Aquatic Toxicology Laboratory.

The Aquatic Toxicology Unit maintains a compliance summary for all facilities required to perform tests and provides a monthly update of this information to regional offices and DWQ administration. Ambient toxicity tests can be used to evaluate stream water quality relative to other stream sites and/or a point source discharge. A summary of compliance for the Catawba River basin from 1986 through 1997 is presented in Table A-22 below.

Table A-22 Summary of Compliance with Aquatic Toxicity Tests in the Catawba River Basin

Year	Number of Facilities	Number of Tests	% Meeting Permit Limit*
1985	5	29	37.9
1986	7	62	69.3
1987	19	129	56.5
1988	32	372	43.0
1989	45	420	63.1
1990	48	519	74.6
1991	51	555	79.6
1992	52	603	83.2
1993	54	628	85.2
1994	58	631	86.2
1995	63	694	89.2
1996	64	726	92.4
1997	68	781	93.5

* This number was calculated by determining whether a facility was meeting its ultimate permit limit during the given time period, regardless of any SOCs in force.

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

3.3.4 Lakes Assessment Program

Eight lakes in the Catawba River basin were sampled as part of the Lakes Assessment Program in 1997. Of these lakes, seven were sampled by Duke Energy (Lake James, Lake Rhodhiss, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake). Monitored lakes are presented below by subbasin. Six lakes were sampled for their potential of supporting algal blooms with the Algal Growth Potential Test (AGPT).

03-08-30	03-08-31	03-08-32	03-08-33	03-08-34	03-08-35
Lake James	Lake Rhodhiss	Lake Hickory Lookout Shoals Lake Norman	Mountain Island Lake	Lake Wylie	Maiden Lake

Each lake is individually discussed in the appropriate subbasin chapter, with a focus on the most recent available data. Figure A-18 shows the most recent NCTSI scores for the eight lakes of the Catawba River basin.

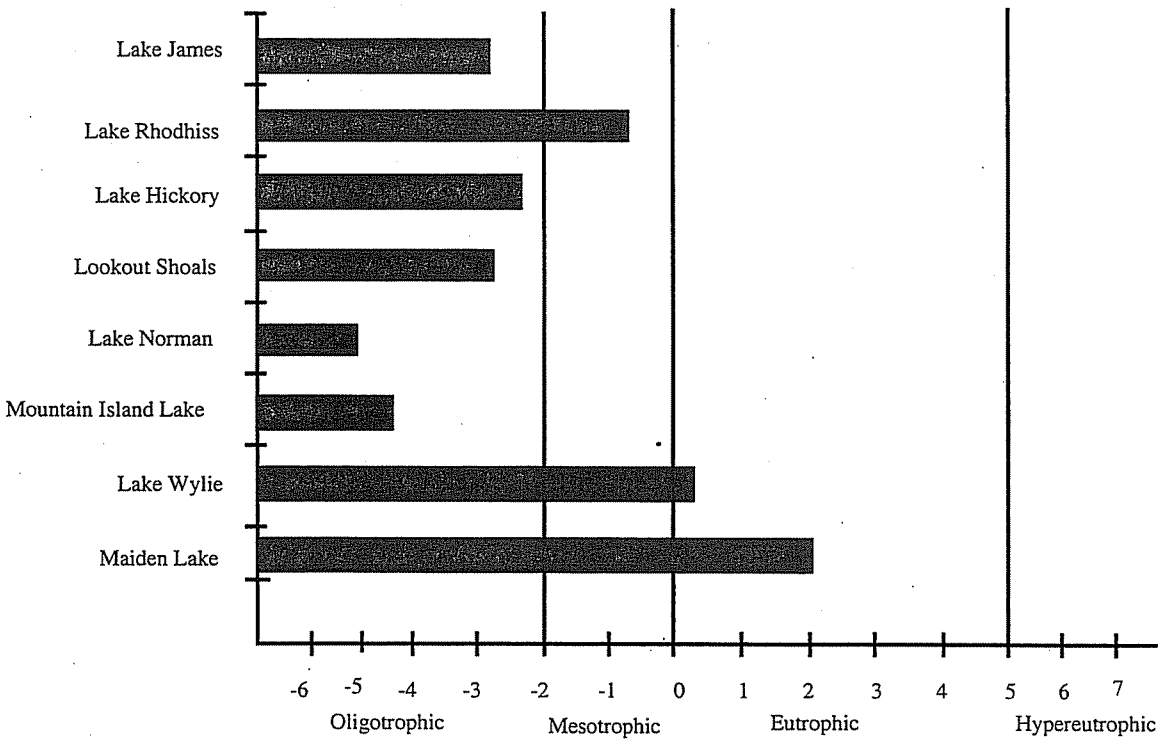


Figure A-18 NCTSI Scores for Lakes in the Catawba River Basin Sampled in 1997

3.3.5 Ambient Monitoring System Program

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine sample stations strategically located for the collection of physical and chemical water quality data. North Carolina has 37 stations in the Catawba River basin (Table A-23). For the purpose of this report those stations are divided into five drainages: the Catawba River mainstem, tributaries of the Catawba River, the South Fork Catawba River mainstem, tributaries of the South Fork

Catawba River and Lake Ambient Stations. Discussions of the more significant findings of these samplings are below.

Catawba River Mainstem

Total phosphorus was high at Greenlee, Pleasant Gardens and Belmont in comparison to the other sites. Total nitrogen concentrations gradually increase downstream with Belmont location having the highest median value. The irregular pattern of total phosphorus is possibly due to the effect of the lakes along the mainstem; however, this does not seem to be the case for total nitrogen.

Catawba River Tributaries

Dissolved oxygen concentrations in the tributary streams is relatively constant with a slight decrease in the downstream tributaries. There are some low (<5.0 mg/l) dissolved oxygen concentrations recorded from the tributaries around the Charlotte area. These are Crowders Creek, Irwin Creek, Sugar Creek, Little Sugar Creek and McAlpine Creek.
The Charlotte area tributaries have very high concentrations of total phosphorus. In particular, Little Sugar Creek, McAlpine Creek Camp Cox and Sugar Creek Fort Mill have very high levels of total phosphorus (median >1 mg/l). There are high concentrations at the downstream tributaries in general and in particular at Crowders Creek and Sugar Creek Pineville. The same general distribution of total nitrogen is seen at downstream tributaries, in particular Crowders Creek and Sugar Creek Pineville.

South Fork Catawba Mainstem

Total phosphorus concentrations are low in the upper Henry Fork and Jacob Fork; however, the lower Henry Fork Brookford has high levels of total phosphorus. The mainstem of the South Fork Catawba also has high concentrations at Startown and McAdenville. Total nitrogen concentrations show the same pattern in distribution as total phosphorus concentrations.

South Fork Catawba Tributaries

Total phosphorus and total nitrogen are slightly higher in Clark Creek than in Indian or Long Creek. Both nutrient distributions decrease in a downstream direction for the three tributaries.

Catawba Lake Stations

Regular ambient sampling was done for five lakes in the basin (Lake Rhodhiss, Lake Hickory, Lake Norman, Mountain Island Lake and Lake Wylie). Total phosphorus was higher in Lake Rhodhiss and Lake Wylie. Lake Wylie also has higher total nitrogen levels.

Table A-23 Ambient Monitoring System Stations within the Catawba River Basin

Primary No	STORETNo	Station Name	Subbasin
Catawba Mainstem			
0213649985	C0009000	Catawba River at SR 1273 at Old Fort NC	03-08-30
02137500	C0145000	Catawba River at SR 1234 near Greenlee NC	03-08-30
02137727	C0250000	Catawba River at SR 1221 near Pleasant Gardens	03-08-30
02139036	C1210000	Catawba River at SR 1147 near Glen Alpine NC Marion	03-08-30
02142808	C3900000	Catawba River at NC Hwy 27 near Thrift NC	03-08-33
02142938	C4220000	Catawba River at South Belmont	03-08-34
Catawba Tributaries			
02138133	C0550000	North Fork Catawba River at SR 1552 near Hankins NC	03-08-30
02138500	C1000000	Linville River at NC Hwy 126 near Nebo NC	03-08-30
02140304	C1370000	Wilson Creek at US Hwy 221 near Gragg NC	03-08-31
0214031250	C1385000	Wilson Creek at SR 1358 at Edgemont NC	03-08-31
02141245	C1750000	Lower Creek at SR 1501 near Morganton NC Marion	03-08-31
02142000	C2818000	Lower Little River at SR 1313 near All Healing Springs	03-08-32
0214272204	C3860000	Dutchmans Creek at SR 1918 at Mountain Island NC	03-08-33
02142900	C4040000	Long Creek at SR 2042 near Paw Creek NC	03-08-34
02145524	C7400000	Catawba Creek at SR 2302 NC-SC State Line	03-08-37
02145640	C8660000	Crowders Creek at Ridge Road near Bowling Green SC	03-08-37
02146300	C8896500	Irwin Creek at Irwin Creek WWTP near Charlotte NC	03-08-34
02146381	C9050000	Sugar Creek at NC Hwy 51 at Pineville NC	03-08-34
02146530	C9210000	Little Sugar Creek at NC Hwy 51 at Pineville NC	03-08-34
02146600	C9370000	McAlpine Creek at Sardis Road near Charlotte NC	03-08-34
0214676115	C9680000	McAlpine Creek at SC SR 2964 near Camp Cox SC	03-08-34
02146800	C9790000	Sugar Creek near Fort Mill SC	03-08-34
02146900	C9819500	Twelve Mile Creek near Waxhaw NC	03-08-38
South Fork Mainstem			
02143000	C4300000	Henry Fork at SR 1124 near Henry River NC	03-08-35
02143027	C4360000	Henry Fork River at SR 1143 near Brookford NC	03-08-35
02143040	C4370000	Jacob Fork at SR 1924 at Ramsey NC	03-08-35
02143069	C4380000	South Fork Catawba River at NC 10 near Startown NC	03-08-35
02145112	C6500000	South Fork Catawba River at NC Hwy 7 at McAdenville NC	03-08-36
02145442	C7000000	South Fork Catawba River at SR 2524 near S Belmont NC	03-08-36
South Fork Tributaries			
02143260	C4800000	Clark Creek at Grove Street at Lincolnton NC	03-08-35
02143500	C5170000	Indian Creek at SR 1252 near Laboratory NC	03-08-35
02144000	C5900000	Long Creek at SR 1456 near Bessemer City NC	03-08-36
Lake Stations			
02141461	C2030000	Lake Rhodhiss at SR 1001 near Baton NC Marion	03-08-31
02141840	C2600000	Lake Hickory at NC Hwy 127 near Hickory Clean Lakes	03-08-32
0214253319	C3420000	Lake Norman at SR 1004 near Mooresville Clean Lakes	03-08-32
0214266050	C3699000	Mountain Island Lake above Gar Creek near Croft Clean Lakes	03-08-33
02145531	C7500000	Lake Wylie at NC Hwy 49 near Oak Grove Clean Lakes	03-08-37

Fecal Coliform Bacteria

Fecal coliform bacteria are widely used as an indicator of the potential presence of pathogens typically associated with the intestinal tract of warm-blooded animals. The water quality standard for fecal coliform bacteria is based on a geometric mean of 200 colonies/100ml. Sites

with 10 or more fecal coliform samples within the last 5 years that have a geometric mean exceeding 200 colonies/100ml are in bold print in Table A-24. Fecal coliform bacteria are listed in the use support information for these waters as a problem parameter (see Section A, Part 3.5).

There are fecal coliform problems in the Catawba River basin. Fourteen stations reported geometric means above 200 colonies/100ml for this assessment period. Most of these are in the Charlotte area. There were also two stations, Long Creek (near Paw Creek) and Lower Creek (near Morganton), with a geometric mean less than 200 colonies/100ml, but the sites had elevated fecal coliform levels.

3.4 Other Water Quality Research

There are many other water quality sampling programs being conducted throughout the Catawba River basin. Any available data from this research has been reviewed and included in DWQ analysis for developing the 303(d) list and considered as use support determinations were made. These research efforts have also been used by DWQ to adjust biological and chemical sampling sites. Programs or research that developed these data are presented in Section C.

Table A-24 Fecal Coliform Summary Data for the Catawba River Basin - 1993 to 1997

Site	Total Samples	Geometric Mean	Samples >200/100ml	Percent >200/100ml	First Sample	Last Sample
Clark Creek at Grove St at Lincolnton NC	**56**	**682.36**	**48**	**85.7**	**930107**	**971106**
Long Creek at SR 1456 near Bessemer City NC	**52**	**573.98**	**42**	**80.8**	**930107**	**971113**
McAlpine Creek at Sardis Road near Charlotte NC	**55**	**557.47**	**42**	**76.4**	**930121**	**971120**
Little Sugar Creek at NC Hwy 51 at Pineville NC	**54**	**493.85**	**38**	**70.4**	**930126**	**971120**
Sugar Creek near Fort Mill SC	**55**	**482.27**	**46**	**83.6**	**930126**	**971120**
Indian Creek at SR 1252 near Laboratory NC	**55**	**478.41**	**47**	**85.5**	**930107**	**971106**
Irwin Creek at Irwin Creek WWTP near Charlotte NC	**53**	**474.97**	**41**	**77.4**	**930217**	**971113**
Henry Fork River at SR 1143 near Brookford NC	**49**	**429.36**	**30**	**61.2**	**930111**	**971029**
South Fork Catawba River at NC 10 near Startown NC	**51**	**394.95**	**32**	**62.7**	**930111**	**971124**
McAlpine Creek at SC SR 2964 near Camp Cox SC	**53**	**384.78**	**34**	**64.2**	**930126**	**971120**
Sugar Creek at NC Hwy 51 at Pineville NC	**54**	**298.49**	**33**	**61.1**	**930126**	**971120**
Crowders Creek at Ridge Road near Bowling Green SC	**51**	**260.84**	**30**	**58.8**	**930120**	**971113**
Twelve Mile Creek near Waxhaw NC	**55**	**231.11**	**26**	**47.3**	**930125**	**971120**
Dutchmans Creek at SR 1918 at Mountain Island NC	**56**	**220.45**	**28**	**50.0**	**930120**	**971106**
Long Creek at SR 2042 near Paw Creek NC	55	176.94	26	47.3	930120	971106
Lower Creek at SR 1501 near Morganton NC Marion	51	172.03	28	54.9	930127	970930
Lower Little River at SR 1313 near All Healing Springs	54	131.85	22	40.7	930111	971105
South Fork Catawba River at NC Hwy 7 at McAdenville NC	51	120.78	19	37.3	930120	971113
Henry Fork at SR 1124 near Henry River NC	51	52.6	11	21.6	930111	971029

3.5 Use Support Summary

3.5.1 Introduction to Use Support

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

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

Use support ratings for streams and lakes:

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

Impaired waters categories:

- Partially Supporting
- Not Supporting

A water is fully supporting but threatened (ST) for a particular designated use when it supports that use, but has some notable water quality problems. Although threatened waters are currently supporting their uses; they are treated as a separate category from waters fully supporting uses. Streams which had no data to determine their use support were listed as not rated (NR). For a more complete description of use support methodology, refer to Appendix III.

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

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

- If the only existing data for a stream are more than five years old.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) or fully supporting but threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored segment rated partially supporting (PS) or not supporting (NS), the stream is considered not rated (NR).

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

3.5.3 Comparison of Use Support Ratings to Streams on the 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) listed waters in the Catawba River basin.

Waters are placed on North Carolina's 303(d) list primarily due to a partially or not supporting use support rating, as determined in the 305(b) or basinwide planning process. These use support ratings are based on biological and chemical data. 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 ratings or water quality standards.

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

In some cases, a waterbody appears on the 303(d) list, but supports its uses. There are two major reasons for this: 1) biological data show full use support, but chemical impairment continues; or 2) fish consumption advisories exist on the water. These waters will remain on the 303(d) list until the problem pollutant meets water quality standards or a TMDL is developed. Thus, there are inconsistencies between the use support impaired waters and the 303(d) listed waters.

3.5.4 Use Support Ratings for the Catawba River Basin

A summary of current use support ratings for the Catawba River basin is presented in Table A-25. For further information and definition of monitored and evaluated streams, refer to Appendix A-III.

Table A-25 Use Support Summary Information for All Monitored and Evaluated Streams in the Catawba River Basin (1999)

	Monitored and Evaluated Streams*			**Monitored Streams Only****	
	Miles	**%**		**Miles**	**%**
Supporting	2375.3	79			
Fully Supporting	1694.5	56		638.2	59
Fully Supporting but Threatened	680.8	23		265.9	25
Impaired	186.0	6			
Partially Supporting	173.6	6		162.1	15
Not Supporting	12.4	<1		7.4	1
Not Rated	444.1	15			

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

Table A-26 shows the total number of stream miles and stream miles per each use support category for each subbasin. This table presents use support for both the monitored and evaluated streams in the basin. More detailed information on the monitored stream segments can be found in Appendix III. Color maps showing use support ratings for the basin are presented in Figures A-19 and A-20. Refer to Section A, Chapter 4, Table A-28 for a listing of impaired waters in the basin.

Table A-26 Use Support Determination for Monitored and Evaluated Freshwater Streams

Catawba Use Support Ratings in Miles for 1993-1997						
Subbasin	**Fully Supporting**	**Fully Supporting but Threatened**	**Partially Supporting**	**Not Supporting**	**Not Rated**	**Total**
03-08-30	408.1	213.6	5.3	0	23.9	650.9
03-08-31	463.6	94.7	35.3	0	75.6	669.2
03-08-32	341.3	121.0	0	0	19.8	482.1
03-08-33	147.5	0	9.8	0	10.1	167.4
03-08-34	28.7	5.4	81.5	2.6	131.9	250.1
03-08-35	285.6	106.3	19.0	0	81.2	492.1
03-08-36	19.7	22.7	0.8	0	26.2	69.4
03-08-37	0	14.5	21.9	9.8	26.8	73.0
03-08-38	0	102.6	0	0	48.6	151.2
TOTAL	1694.5	680.8	173.6	12.4	444.1	3005.4
%	56	23	6	<1	15	100

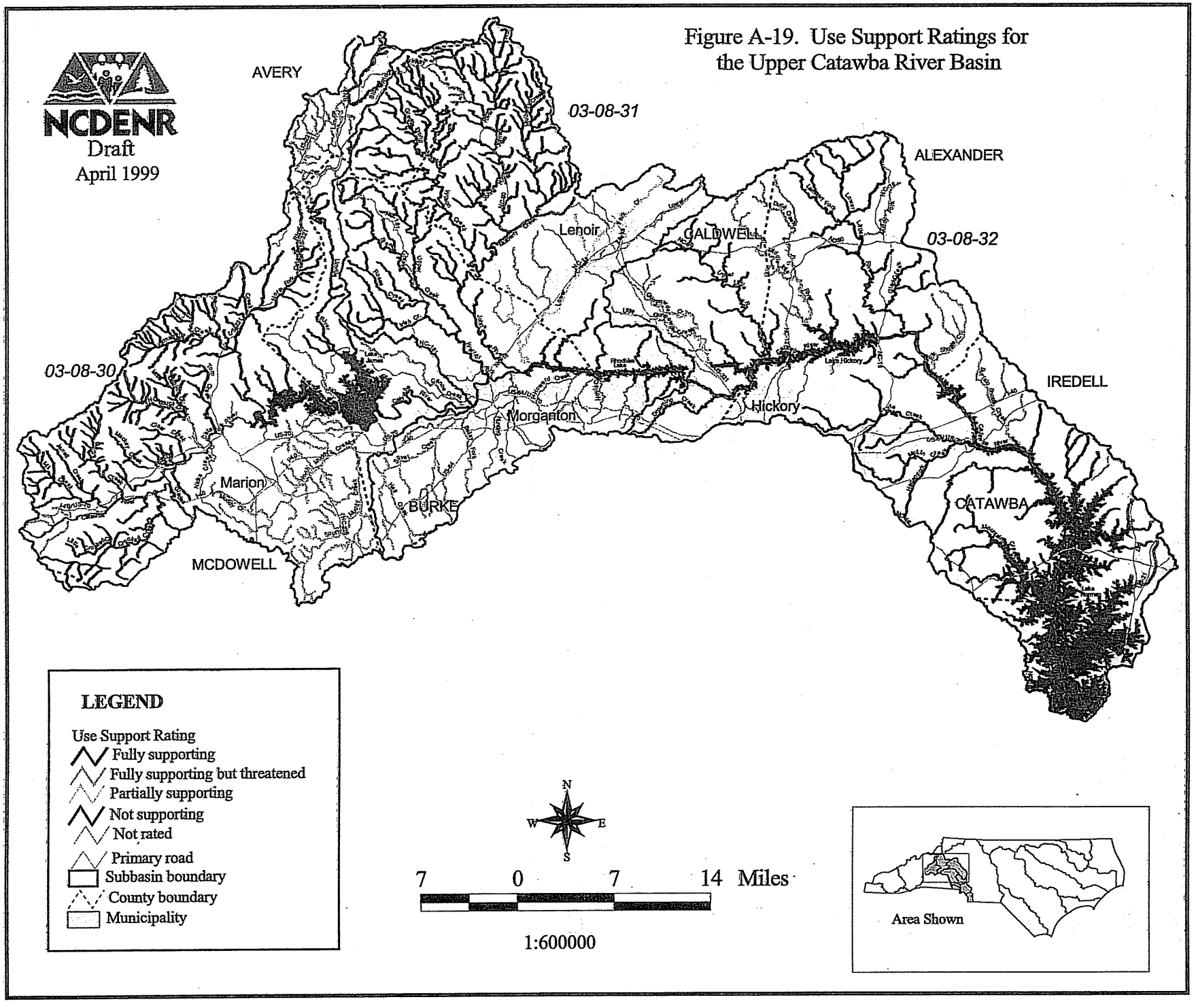
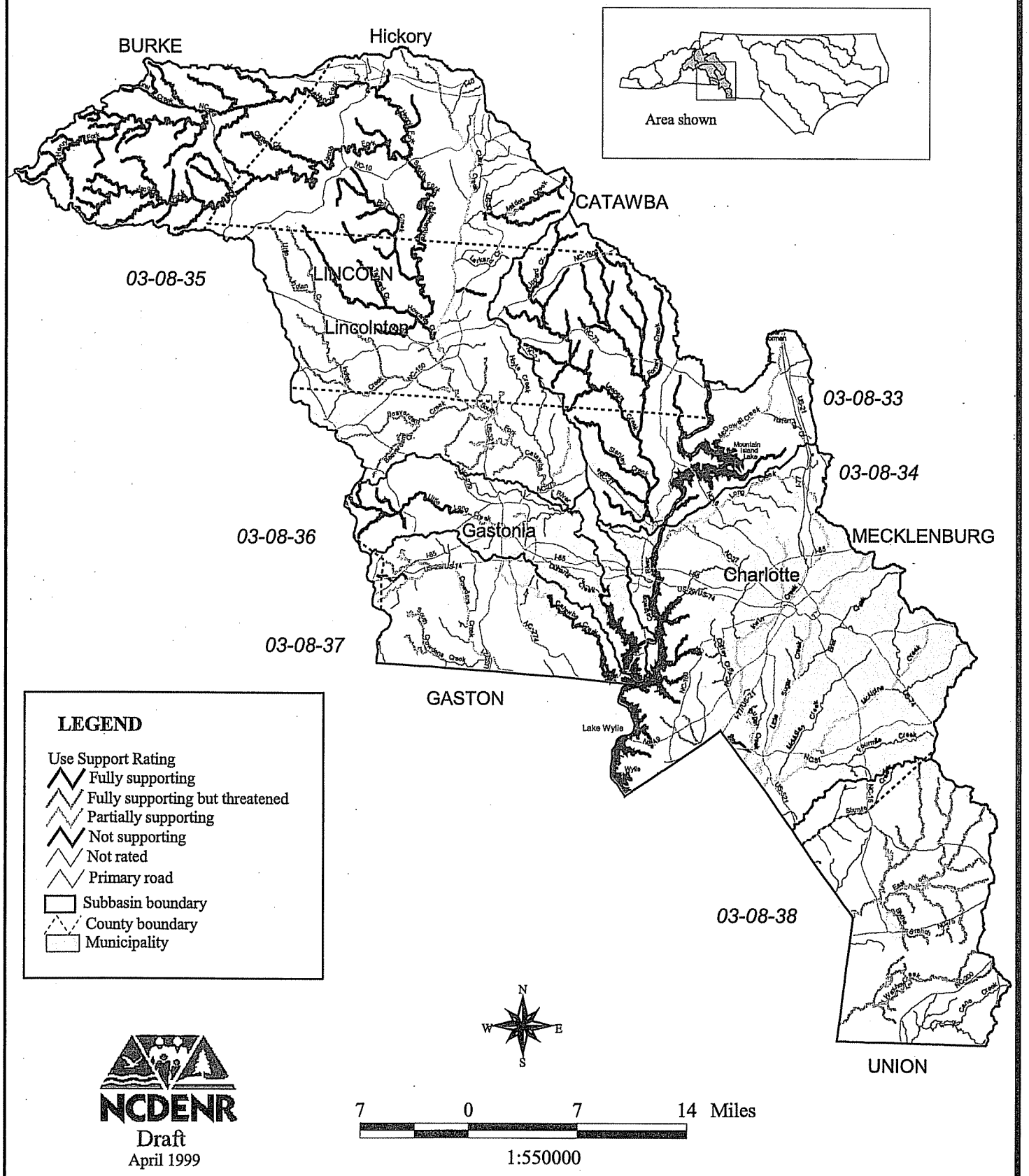


Figure A-19. Use Support Ratings for the Upper Catawba River Basin

Figure A-20. Use Support Ratings for the Lower Catawba River Basin



Chapter 4 -
Water Quality Issues Related to Multiple Watersheds in the Catawba River Basin

4.1 Prior Basinwide Plan Recommendations and Achievements for Issues Related to Multiple Watersheds

4.1.1 Introduction

The 1995 Catawba River Basinwide Water Quality Management Plan included a number of recommendations to address water quality issues in the basin. Some of these recommendations were pertinent to several watersheds or the basin as a whole, while others were specific to a particular stream or area within a subbasin. A status of the more specific recommendations is reported within the subbasin chapters in Section B. In this chapter, recommendations from the 1995 plan that relate to more than one watershed are addressed. These issues are grouped into six categories: discharges to the major lakes, nutrient management for Lake Wylie, color reduction, sedimentation control, stormwater management and the South Fork Catawba River toxics review. A summary of the 1995 recommendations is presented and followed by a description of efforts that have (or have not) been made related to the task.

4.1.2 General Recommended Strategies for New and Expanding Dischargers to Lakes

DWQ recommended that all new and expanding discharges of oxygen-consuming wastes, or those predicted to increase oxygen-consuming waste loading to the lakes (Lake James, Rhodhiss Lake, Lake Hickory, Lookout Shoals Lake, Lake Norman, Mountain Island Lake and Lake Wylie), should be required to meet a minimum of advanced treatment limits of 15 mg/l BOD_5 and 4 mg/l NH_3-N.

Status of Progress

This strategy has been implemented on all major municipalities and direct dischargers.

4.1.3 Nutrient Management for Lake Wylie

Eutrophic conditions in Lake Wylie and several of its major tributaries have been evident for several years. To address eutrophication in Lake Wylie, DWQ and the South Carolina DHEC developed a point and nonpoint nutrient control strategy for the Lake Wylie watershed. The Lake Wylie Nutrient Management Area is considered to be Lake Wylie and its tributaries including: the Catawba River and its tributaries below Mountain Island Dam and the South Fork Catawba River below its confluence with Long Creek.

1995 Recommended Point Source Nutrient Reduction Strategies

- No new discharges allowed on the lake mainstem or its tributaries, unless an evaluation of engineering alternatives (EAA) shows that it is the most environmentally sound alternative. For any new or expanding discharges that meet this requirement, it was recommended that advanced treatment technology be required.
- Any new or expanding facility with a permitted design flow of greater than or equal to 1 MGD was required to meet monthly average limits of 1.0 mg/l total phosphorus (TP) and 6.0 mg/l total nitrogen (TN), (TN applies to summer only). For new or expanding facilities with a permitted design flow of less than 1 MGD but greater than 0.05 MGD (50,000 gallons per day), a TP limit of 2.0 mg/l was recommended. No expansion was to be allowed if it increased the total nutrient load from the facility, unless an EAA shows that it is the most environmentally sound alternative.
- All industrial discharges were to be handled on a case-by-case basis. DWQ recommended that industries in the management area control TP and TN to best available technology levels.
- Existing discharges to the lake mainstem and tributaries were encouraged to remove that discharge when alternatives became available. Programs such as the Charlotte-Mecklenburg Utility (CMUDD) sewer line extension project were supported.
- Additional recommendations were made for point source discharges to the Catawba Creek and Crowders Creek watersheds to reduce nutrient enrichment. These recommendations called for more stringent permit limits for nutrients on all dischargers with permitted design flow of ≥ 0.05 MGD within the Catawba Creek watershed (0.5 mg/l TP and TN limits of 4 mg/l in summer and 8 mg/l in winter) by January 1, 2006. Interim limits of 1.0 mg/l TP and 6.0 mg/l TN become effective January 1, 2001. By January 1, 2000, all facilities with permitted design flow of ≥ 1MGD will be required to meet limits of 1.0 mg/l TP and 6.0 mg/l TN in summer within the Crowders Creek watershed.
- Incentives should be established to encourage privately-owned facilities to tie on to larger municipal WWTPs.

1995 Recommendations for Nonpoint Sources

Future study will be conducted to reevaluate the extent of the defined management area. Nonpoint sources on the South Fork Catawba River upstream of Long Creek will be further assessed to determine what effect additional control of nutrients in the upper South Fork Catawba River basin may have upon eutrophication in Lake Wylie. Results of this study will be considered during the development of the next Catawba River Basin Plan.

All tributaries to Lake Wylie should be targeted by the NC Division of Soil and Water Conservation for cost share funds for use in implementation of best management practices (BMPs). When possible, resources should be targeted toward implementation of BMPs in the Catawba Creek, Crowders Creek and the South Fork Catawba River watersheds. The South Fork Catawba River watershed should be considered the highest priority for implementation of BMPs.

Status of Progress

The Lake Wylie Management Strategy is still being implemented, and therefore, the full effects of the strategy are yet to be realized. DWQ has already required marked reductions in point

source loads and is working to gain a better understanding of nonpoint source nutrient contributions to Lake Wylie and ways to control them. Some specific actions taken since the 1995 Catawba River Basinwide Water Quality Management Plan include:

- Upon expansion or major modification, all industries are required to control nutrients on a site-specific basis. Municipal dischargers are required to meet advanced nutrient removal upon expansion or major modification (see appropriate chapter in Section B for more information).
- As identified in the 1995 basinwide plan, existing dischargers in the Catawba Creek and Crowders Creek watersheds will be required to meet more stringent permit limits.
- There have been no new permit requests for discharges to the lake mainstem or its tributaries.
- Targeting of cost share funding for BMPs has not necessarily been targeted to the South Fork Catawba River watershed as a result of the basinwide plan. However, the watershed has been rated a Category I watershed in the Unified Watershed Assessment program under the President's Clean Water Action Plan. This designation will allow some additional nonpoint source funding to be targeted to this watershed in the future.
- In direct response to nutrient reduction requirements specified in the 1995 Lake Wylie Nutrient Management Strategy, several municipalities are evaluating the potential environmental and economic benefits derived from a regional approach to wastewater treatment in the Lake Wylie watershed. Consolidation of anticipated future nutrient removal costs is one of the primary goals, as well as removing some of the individual discharges to the Lake Wylie watershed. For example, the towns of Belmont, Mt. Holly and Cramerton and Gaston County are jointly reviewing regional wastewater treatment alternatives.
- The Town of Cramerton has purchased the JPS Automotive WWTP and plans to route wastewater to this facility in the future and eliminate the town's existing discharge..

Significant reductions in pollutants have been achieved by various point sources. DWQ staff have summarized examples of the point source pollutant reduction initiatives occurring in the Lake Wylie watershed. These examples do not identify all of the efforts being made, but focus on the areas closest to Lake Wylie. In an effort to evaluate the impact of recent permit changes, NPDES staff examined a sampling of several large point source dischargers within three watersheds: Crowders Creek, Catawba Creek and South Fork Catawba River.

City of Gastonia's Wastewater Treatment Plant Improvements

The City of Gastonia has three wastewater treatment facilities that discharge into different tributaries of Lake Wylie: Catawba Creek WWTP, Long Creek WWTP and Crowders Creek WWTP. Gastonia's role as a provider of large regional systems is key in water quality improvements for Lake Wylie. Progress has been made at all three of these facilities and continues to be made. The following summarizes Gastonia's past accomplishments and proposed improvements at the three facilities.

1) Catawba Creek WWTP

Catawba Creek WWTP discharges to an arm of Lake Wylie, which is wide and slow moving and does not assimilate wastewater well. In an effort to improve water quality, Gastonia has decommissioned the Catawba Creek facility at a cost exceeding $2.25 million. This will result in

the removal of several tons of oxygen-consuming wastes and nutrients from Catawba Creek. Reductions in pollutant loading as a result of the elimination of this discharge are anticipated to be over 150 tons/year of both BOD_5 and total suspended solids, over 140 tons/year of total nitrogen, and over 20 tons/year of total phosphorus.

2) Long Creek WWTP

Gastonia will route the wastewater presently treated at the Catawba Creek WWTP to the newly renovated Long Creek WWTP. There are at least two advantages to having wastewater discharged at this plant as opposed to Catawba Creek WWTP. Long Creek WWTP provides more effective treatment for nutrient removal than the Catawba Creek WWTP, and it discharges to the South Fork Catawba River, a river more capable of assimilating wastewater than Catawba Creek. It will cost Gastonia approximately $30 million to upgrade the Long Creek WWTP to meet new effluent limits (for both nitrogen and phosphorus).

3) Crowders Creek WWTP

Crowders Creek WWTP, which discharges to the Crowders Creek arm of Lake Wylie, has also made improvements in the area of nutrient reduction. Currently, the Crowders Creek WWTP removes phosphorus and by September 30, 2001, the plant will be modified to include removal of total nitrogen. Over 60 tons/year of total nitrogen and phosphorus reductions will be removed from Crowders Creek. Improvements to the Crowders Creek WWTP, in order to meet the new effluent limits, will cost approximately $14 million.

Dischargers to Crowders Creek

1) Bessemer City WWTP

Bessemer City WWTP currently discharges to Abernethy Creek, but is scheduled to connect to Crowders Creek WWTP. Pollutant reductions resulting from this connection should result in a significant reduction of oxygen-consuming wastes and ammonia nitrogen.

2) Carolina Byproducts Resources (CBP)

This is a rendering facility that accepts inedible animal by-products and waste restaurant oils and uses them for protein and fat for the animal feed industry. Its discharge permit was renewed in 1997. A reexamination and reapplication of the effluent guidelines used to develop the permit limits led to more stringent limits and a reduction of several tons of total suspended solids, ammonia nitrogen and BOD_5. As a condition in the discharge permit, DWQ required CBP to connect to Crowders Creek WWTP. Reductions in pollutant loading as a result of the elimination of this discharge are anticipated to be over 50 tons/year of both BOD_5 and total suspended solids, over 20 tons/year of ammonia nitrogen, and over 6 tons/year of both total nitrogen and total phosphorus.

Dischargers to South Fork Catawba River

1) Pharr Yarns

Pharr Yarns discharges to the South Fork Catawba River. Upon the most recent permit renewal for Pharr Yarns, a reexamination and reapplication of the effluent guidelines used to develop the permit limits resulted in more stringent limits for BOD_5 and TSS. These new limits should result in a reduction of over 30 tons/year of both BOD_5 and total suspended solids.

2) Delta Mills

Delta Mills discharges to Clark Creek in the South Fork Catawba River watershed. Upon Delta Mills' most recent permit renewal, a reinvestigation of production numbers used with the effluent guidelines to develop the permit limits resulted in more stringent limits for both existing flow (1.0 MGD) and expanded flow (1.5 MGD). These new limits are expected to significantly reduce pollutant loads from this facility.

Various Industrial Dischargers

Several industrial discharges, including Pharr Yarns, Clariant, Crompton and Knowles, and JPS Automotive are in the process of performing site-specific studies regarding pollution prevention and the investigation of treatment technologies beyond currently constructed systems. The aim of this work is to reduce total phosphorus and total nitrogen levels to levels of best available technology that is economically achievable. This should result in additional reductions in pollutant loadings to the Lake Wylie system.

Summary of Overall Point Source Pollutant Reductions to Lake Wylie Watershed

Figure A-21 presents a summary of overall pollutant reductions to the Lake Wylie watershed as described above. This summary includes all wastewater treatment facilities in subbasins 03-08-34, 03-08-36 and 03-08-37 with permitted flows above 0.5 MGD that discharge to Lake Wylie. The eleven facilities included in this summary account for approximately 92 percent of the point source flows from wastewater treatment plants in the three subbasins. Flows from water treatment plants, mining facilities, cooling water systems and all facilities downstream of Lake Wylie were excluded from the summary.

Each pie chart in this figure represents 100 percent of permitted loading from the eleven dischargers to the reservoir prior to the adoption of the 1995 Catawba River Basinwide Water Quality Management Plan. The reductions that have been achieved since that time are due to lower permit limits or elimination of the discharge. It should be noted that these reductions represent permitted loads. Actual load reductions for the dischargers included in the summary may vary depending on effluent quality.

Figure A-21 demonstrates that there has been a lot of progress made in reducing the amount of pollutants authorized to be discharged. More reductions will be realized as additional permit limits go into effect in 2001 and 2006.

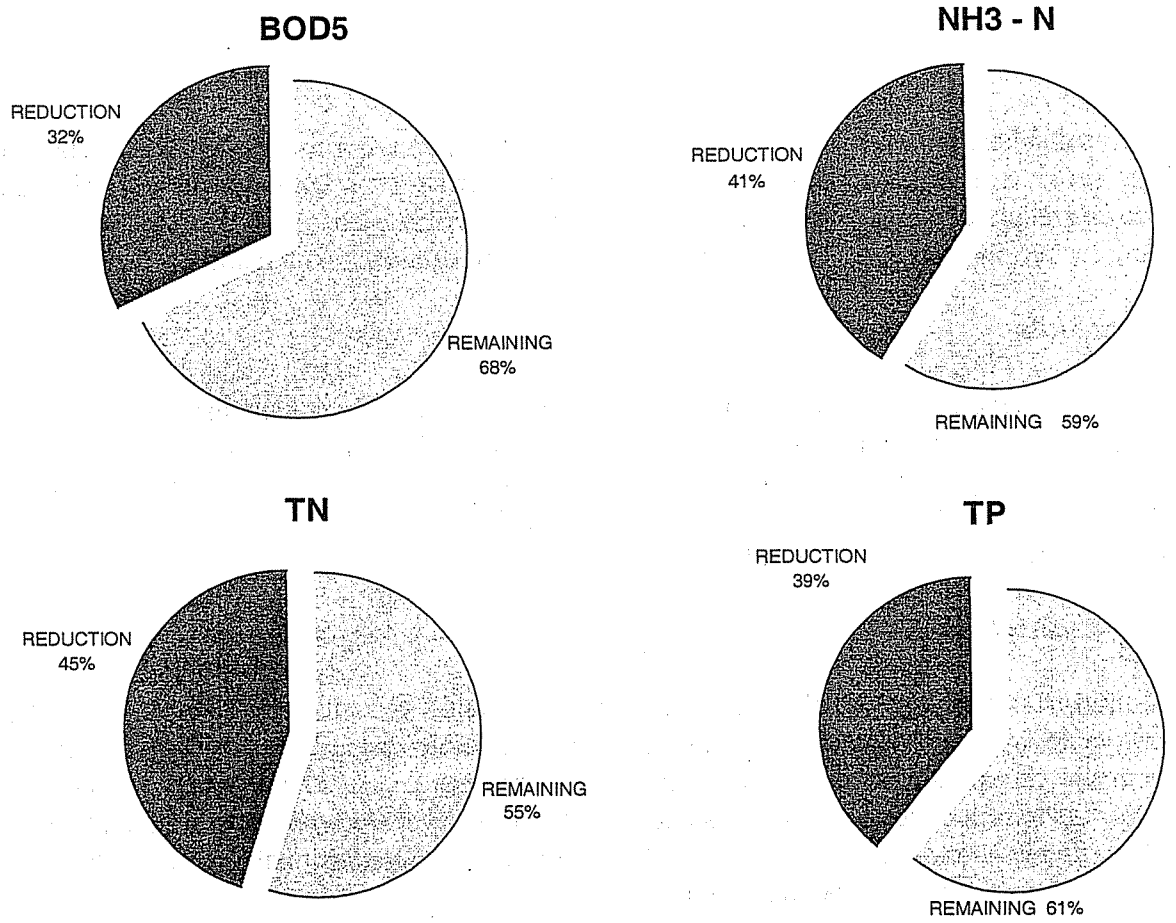


Figure A-21 Overall Permitted Pollutant Reductions to the Lake Wylie Watershed Since the 1995 Catawba River Basinwide Plan

1999 Recommendations

Nutrient loads from the South Fork Catawba River to Lake Wylie were examined to determine if there was a trend in the total load to the lake since 1992, and as a means to assess the need for additional management strategies at this time. Daily nutrient loads were assessed using the period of 1992 to 1997. In general, there was no trend in the total phosphorus load. However, a slight decreasing trend in total nitrogen load was seen at McAdenville. Thus, there is currently no evidence to suggest that additional controls are needed based on nutrient load trends. Trends should be reevaluated in the next basin cycle when proposed additional nutrient controls for the Lake Wylie watershed are in effect.

In addition to these pollutant reducing activities, the Division submitted a memorandum to John Hankinson of the US Environmental Protection Agency - Region IV supporting South Carolina's request to designate Lake Wylie as a no-discharge zone for marine toilets. The EPA has concurred with this request and the designation will be noticed in the Federal Register, then made an official regulation.

4.1.4 Color Reduction Strategy

The 1995 basinwide plan recommended a pilot study to address color in the South Fork Catawba River watershed (03-08-35 and 03-08-36). This watershed was selected for a pilot study because of the relatively high concentration of textile discharges in the watershed and public concerns and complaints regarding color. The study was to involve color monitoring and development of color control measures for several facilities in the South Fork Catawba watershed.

In addition, DWQ is committed to work with the Office of Waste Reduction to identify possible color source reduction methods. The results of the pilot study would be used to guide color management decisions throughout the Catawba River basin and to develop a color management strategy for the South Fork Catawba watershed as part of the Catawba basinwide plan update in 1999.

According to state regulations, colored effluent is allowed in "only such amounts as will not render the waters injurious to public health, secondary recreation, or to aquatic life and the wildlife or adversely affect the palatability of fish, aesthetic quality or impair the waters for any designated uses". This color standard is a narrative standard based on aesthetics. The standard for color is not a numeric standard. The advantage of a narrative standard is that it is flexible. The disadvantages are that is it subjective and difficult to enforce. The state has considered developing a numeric standard, but there are many challenges in doing so. Some of these challenges include knowing what the appropriate analytical approach is; what the appropriate numeric standard is; and if a different standard should be used for different regions in the state to reflect variations in background water color. In addition, the practical application of this regulation must take into account the various ways in which color is perceived. No narrative definition of color impairment can be specified by a simple set of criteria because color is perceived differently by individuals under varying environmental conditions.

Status of Progress

As a result of the 1995 Catawba River Basinwide Plan, DWQ developed a color study plan for the South Fork Catawba River watershed. The purpose of this study was to determine: background color for the basin and acceptable increases in color over that background; site-specific color limits, if necessary; and the effects of voluntary waste reduction on instream color. Progress on this study has been limited due to more pressing demands on DWQ staff. However, as a result of the complaints about the color of the South Fork Catawba River and its tributary Clark Creek, DWQ determined that actions to reduce color in effluent must be taken.

It should be noted, that to date, there are no data to show that the colored effluent is posing any human health threat or is the only source of impact on the aquatic life in the river. Color is usually not a toxicological problem. However, under certain conditions it can limit light penetration that may be essential for the growth and existence of instream organisms. All dischargers with color waste are required to conduct toxicity testing on the effluent to assure the discharge will not adversely impact the organisms in the receiving stream. All of the color discharge facilities conducting toxicity testing have been in compliance with permit limits.

As a first step toward making progress in reducing color in the South Fork Catawba River watershed, DENR hosted a color reduction conference in Charlotte in 1998. Over 140 people from across the state were in attendance. Most attendees represented textile mills, municipalities and consulting firms. The main purposes of the conference were to emphasize the state's interest in reducing instream color and to encourage facilities to reduce color.

1999 Recommendations

DWQ, in response to comments at the public workshops and to complaints, has brought the need to reduce color in effluent to the forefront. Progress is being made to address this need with the following actions.

DWQ still believes that the most effective and equitable means of addressing color is to rely on the narrative aesthetic standard and complaints. DWQ will concentrate on a color reduction strategy to reduce color in the South Fork Catawba River watershed to the point that complaints are infrequent. Some of the specific actions DWQ will take to address the issue of color are to:

- Identify means to reward those facilities that have taken some measures to reduce color and avoid penalizing these facilities.
- Work with the Riverkeeper and other environmental groups in the areas to obtain assistance in monitoring efforts. These local stakeholders will also be asked to conduct routine reconnaissance that might include taking pictures, documenting plumes and making visual observations. A reporting format will be developed with these groups to assure that the information obtained is standardized.
- Verify significant color dischargers in the South Fork Catawba River watershed and request a meeting with them. The meeting is intended to review the history of color and let the dischargers know that they will be required to reduce their color input unless they can demonstrate that they are not a significant source of color. The meeting is intended to also discuss plans for determining the amount of color reduction necessary to protect the aesthetic water quality standard.

Specific action items underway or to be completed between now and 2006 are:

- August 1999 - All dischargers were invited to attend a color reduction strategy meeting.
- A draft Color Action Plan was presented by DWQ. As a result of discussion during the meeting, the dischargers requested time to work together on an alternative Color Action Plan that incorporated sampling along the entire 40 miles of the South Fork Catawba River and would address issues related to color analysis and background color. This request was granted with the stipulation that the alternative plan would be complete by October 1, 1999.
- September 1999 - A draft alternative plan was presented to DWQ.
- October 1999 - The dischargers and DWQ agreed upon the final components of the alternative Color Action Plan. They include:
  - Monitoring twice monthly April - October 1999 and once a month November through October 2000.
  - Review data in October 1999 with assistance from a Citizen's Advisory Committee to determine problem areas. Sources at the problem areas would be required to conduct

color reduction studies to determine the ability and cost of achieving 25, 50, 75 and 99 percent color removal. These studies will be completed by the end of 2002.
  - The facilities would form an alliance, formally known as the South Fork Catawba River Water Quality Alliance, Inc.
  - Permits would include monitoring requirements unless there is a formal agreement signed between DWQ and the Alliance stating that the study will be completed with all facilities participating. Failure to participate will result in reopening of the permit to allow the addition of monitoring requirements.
- January-March 2000 - Finalize study plan. The Alliance will work with DWQ, other researchers and environmental interests in the South Fork Catawba River watershed to establish a comprehensive study plan.
- December 2000 - Year 1 Report due.
- June 2002 - Final report due.
- December 2002 - Color Reduction Studies completed and submitted to the Division.
- 2003-2004 - Based on the results of the monitoring and reduction studies, a final reduction goal will be established for facilities that continue to have significant color discharges. Permit limits would be developed, as needed, for the next permit cycle (2004-2007) based on the final reduction goals.

Dianne Reid, the contact person for this initiative, can be reached at (919) 733-5083 ext. 568.

4.1.5 South Fork Catawba River Watershed Toxics Review

The 1995 basinwide plan recommended that wasteload allocations for each facility discharging to the South Fork Catawba River from Lincolnton to Lowell should include a TMDL analysis for total loading at the Lowell Gage to address toxicity concerns. The South Fork Catawba River watershed is discussed in this section because the river flows through two subbasins (03-08-35 and 03-08-36). Therefore, a more complete picture of the entire river can be presented in this chapter rather than separating the river into subbasin chapters in Section B.

Status of Progress

EPA has recently changed the definition and requirements of a TMDL. TMDLs are now required for those waters listed on the state 303(d) list as required by EPA (see Appendix IV for more information). Although a TMDL is not required for the South Fork Catawba River because it is not impaired, DWQ believed that a cursory review of toxics in the South Fork watershed was warranted. To evaluate if potentially toxic chemicals may exceed water quality standards or action levels, available DWQ and USGS ambient monitoring data and NPDES and Pretreatment discharger data were assembled for the entire South Fork Catawba River watershed. These data were summarized to provide a basis for identifying areas where problems may exist. The available ambient and discharger chemical data were confined to three general classes: metals/inorganics, organics and pesticides/herbicides.

DWQ conducts instream monitoring for metals along the South Fork Catawba River watershed. USGS recently performed a pesticide/herbicide study that included the South Fork Catawba River watershed. As part of the study, USGS collected samples from Jacobs Fork, Indian Creek, and the lower South Fork Catawba River. Organic chemical data are only available from

dischargers. Instream chemical monitoring for subbasin 03-08-35 indicates that manganese standards are often exceeded in the South Fork Catawba River. In addition, copper levels are often higher than the action level, and thus, need to be assessed using instream aquatic toxicity tests to determine if the standard is exceeded. Standards or action levels are exceeded for other metals sporadically.

Additionally, in order to evaluate the cumulative effects of multiple NPDES dischargers and the background level of some metals, a model for low flow conditions was used. Modeling was performed for the main channel of the South Fork Catawba River and several major tributaries. The model analyzed for all metals and organic chemicals found in effluent. Predicted concentrations were compared to water quality standards to determine if instream exceedences may be a problem. If predicted concentrations were greater than a water quality standard or greater than two times an action level, the chemical was classified as a chemical of concern and was recommended for further study. In some cases, a chemical was listed as a chemical of concern if further information is needed to make a sound judgment. Recommendations based on the results of this analysis are presented below.

1999 Recommendations

Based on the analysis conducted by DWQ to date, specific recommendations are as follows:

- DWQ will look into conducting additional monitoring on Hoyle Creek. If monitoring shows water quality standards or designated uses are not being met, then DWQ may request that dischargers to this creek conduct additional monitoring for cadmium, copper, nickel, lead, silver and total phenols.
- DWQ will assess the need for additional monitoring stations on the middle South Fork Catawba River.
- DWQ needs to identify the sources of copper, cadmium and silver in the South Fork Catawba River watershed. If these metals are from NPDES dischargers, DWQ may need to place copper and silver limits on dischargers at next permit renewal. Efforts will be made to determine how much of the copper originates from nonpoint sources.
- Instream monitoring for other organic chemicals is needed to increase knowledge about organic chemicals in discharges.
- Given that some metals are in excess of the action level, additional ambient toxicity testing may be needed to determine whether these metals are toxic at the concentrations found instream.

4.2 Priority Issues and Recommendations for the Entire Basin During the Next Five Years

4.2.1 Introduction

Clean water is crucial to the health, economic and ecologic 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 Catawba 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.

4.2.2 Strategies for Restoring and Protecting Impaired Waters

Impaired waters are those waters identified in Section A, Chapter 3 as partially supporting (PS) or not supporting (NS) their designated uses based on DWQ monitoring data. Table A-27 presents impaired waters in the Catawba River basin, the sources of impairment, summaries of the recommended management strategies, and location of further information in the basinwide plan.

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 waterbodies is very resource intensive. Accomplishing these tasks is overwhelming, given the current limited resources of DWQ, other agencies (e.g., Division of Land Resources, Division of Soil and Water Conservation, Cooperative Extension Service, etc.) and local governments. Therefore, only limited progress towards restoring NPS impaired waters can be expected during this five-year cycle unless substantial resources are put toward solving NPS problems. Due to these restraints, this plan has no NPS management strategies for most of the streams with NPS problems.

DWQ plans to further evaluate the impaired waterbodies in the Catawba River basin in conjunction with other NPS agencies and develop management strategies for a portion of these impaired waterbodies for the next Catawba River Basinwide Water Quality Plan, in accordance with the requirements of Section 303(d) (see Part 4.2.3 below).

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

For the next several years, addressing water quality impairment in waters that are on the state's 303(d) list will be a priority. The waters in the Catawba River basin that are on the state's year 2000 (not yet EPA approved) 303(d) list are presented in the individual subbasin chapters in Section B.

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

Table A-27 Impaired Waters within the Catawba River Basin (as of 1999)•

Subbasin	Chapter in Section B	Listed Water	Use Support Rating	Potential Sources	Recommended Management Strategy
03-08-30	1	Lower Mackey Creek	PS	P	DWQ is working with discharge to improve and remove the discharge. DWQ is also developing a TMDL for mercury.
03-08-30	1	Corpening Creek	PS	NP P	More information and local actions to address stormwater runoff are needed.*
03-08-31	2	Lower Creek below Zacks Fork	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Zacks Fork	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Spainhour Creek	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Greasy Creek	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-31	2	Bristol Creek	PS	NP	DWQ supports WPCOG study recommendations. Local actions are needed.*
03-08-33	3	McDowell Creek	PS	NP	DWQ will support actions of the Mecklenburg County SWIM program.*
03-08-34	4	Long Creek	PS	NP	DWQ will continue to monitor to assess sources of impairment. Local actions are needed.*
03-08-34	4	Sugar Creek	PS	NP P (upper section)	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources. DWQ is developing a fecal coliform bacteria TMDL.*
03-08-34	4	Irwin Creek	PS	NP P	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources.*
03-08-34	4	Little Sugar Creek	PS	NP P	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources. DWQ is developing a fecal coliform bacteria TMDL.*
03-08-34	4	McAlpine Creek	PS	NP P (lower section)	South Carolina, Charlotte-Mecklenburg Utilities and DWQ are working towards a nutrient reduction plan for point sources. DWQ is developing a fecal coliform bacteria TMDL.*
03-08-35	5	Clark Creek	PS	NP P	DWQ has completed a toxics review with recommendations and a color reduction strategy is being implemented.*
03-08-35	5	Mauney Creek	PS	NP P	Stanley WWTP has made improvements; more information and local actions are needed.*
03-08-37	7	Catawba Creek	NS	NP P	Many point source reductions are being made. Local actions are needed.*
03-08-37	7	Crowders Creek	PS	NP P	Many point source reductions are being made. Local actions are needed.*

Key: NS = Not Supporting PS = Partially Supporting
NP = Nonpoint sources P = Point Sources
* = Only limited progress towards developing and implementing NPS strategies for these impaired waters can be expected without additional resources.
• = These waters are also on the 303(d) list, and a TMDL and/or management strategy will be developed to remove the water from the list.

waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

There are approximately 470 stream segments on the 303(d) list in NC. The rigorous and demanding task of developing TMDLs for each of these waters during an 8 to 13-year time frame will require the focus of much of the water quality program's resources. Therefore, it will be a priority for North Carolina's water quality programs over the next several years to develop TMDLs for 303(d) listed waters. This task will be accomplished through the basinwide planning process and schedule.

4.2.4 Growth and Development and Stormwater Management

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 urban 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).

Urban runoff also carries a wide variety of contaminants to streams including oil and grease from roads and parking lots, street litter and pollutants from the atmosphere. Generally, there are a larger number of point source discharges in urban areas. Cumulative impacts from habitat alterations, point and nonpoint source pollution can cause severe impairment to urban streams.

Status of Progress

DWQ administers a number of programs aimed at controlling urban stormwater runoff. These include: 1) programs for the control of development activities near High Quality Waters (HQW) and Outstanding Resource Waters (ORW) and activities within designated Water Supply (WS) watersheds; and 2) NPDES stormwater permit requirements for industrial activities and municipalities greater than 100,000 in population.

Throughout the Catawba basin various types of activities with point source discharges of stormwater are required to be permitted under the Phase I NPDES stormwater program. These include industrial discharges related to manufacturing, processing and materials storage areas. Construction activities with greater than five acres of disturbance are also required to obtain an NPDES permit. Most of those areas requiring coverage must develop Stormwater Pollution Prevention Plans (SPPP) to minimize and control pollutants discharged from their stormwater systems. Municipal areas with populations greater than 100,000 are also required to obtain an NPDES stormwater permit and develop a stormwater program. In the Catawba River basin, only

the City of Charlotte is required to obtain an NPDES stormwater permit. Additional information on the City of Charlotte's Storm Water Program can be found in Section C.

1999 Recommendations

In addition to the current NPDES stormwater permitting, DWQ is developing a permitting and program strategy to address the EPA proposed Phase II stormwater permitting program requirements. The Phase II program will be directed towards smaller municipalities and construction sites. Phase II could potentially bring an additional 60 cities and 24 counties statewide into the NPDES permitting process. At present, Phase II requirements will be handled with existing state staff. The proposed ruleswere published in November 1999. About 20 local and four county governments within the Catawba River basin will fall within the Phase II requirements. For more information on the state NPDES stormwater program, contact the Stormwater and General Permits Unit at (919) 733-5083.

At the Governor's request, a series of public meetings were held across the state in 1999 to kick off the "21st Century Communities Task Force". The seven-member task force conducted public meetings to look at growth issues across the state. The task force will report its findings to a special legislative commission on growth and issue a final report in January 2001.

Planning Recommendations for New Development

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

The presence of intact riparian buffers and/or wetlands in urban areas can lesson the urban impacts. Protection of buffers should be considered where feasible; however, the amount of impervious cover should be limited as much as possible. Wide streets, huge cul-de-sacs, and 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.

For more information regarding these and other recommendations, refer to the EPA's website: www.epa.gov/owow/watershed/wacademy/acad2000/protection.

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

These actions should include, but not be limited to:

- preservation of open spaces;
- provisions for controlled growth;

- development and enforcement of buffer ordinances and water supply watershed protection ordinances more stringent than state requirements;
- implementation of best management practices to reduce sediment to streams from urban development;
- stormwater runoff detention from urban developments;
- full support of the Mecklenburg County Surface Water Improvement Management (SWIM) plan;
- halt on floodplain development and protection of wetland areas;
- examination of zoning ordinances to ensure that they limit large, unnecessary parking lots, allow for vegetation and soil drainage systems, and build in green spaces in parking lots to limit and absorb runoff; and
- sustainable land use planning that considers long-term effects of development.

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

4.2.5 Water Supply Watershed Protection

There are 26 surface water supply watersheds in the Catawba River basin. Local governments that have land use jurisdiction within these watersheds are responsible for the adoption, implementation and enforcement of the state's water supply watershed minimum requirements. Local governments can adopt and enforce more stringent water supply watershed protection ordinances if they choose. For example, the state's rules require the use of a 30-foot vegetated buffer (for low density development) along all waters in the water supply watershed that appear as solid blue lines on USGS 1:24,000 scale topographical maps. The state's rules allow the buffer's vegetation to consist entirely of grass rather than natural vegetation. However, a local government can require a larger and undisturbed (natural vegetation) buffer. If a local government adopts a more stringent ordinance, the state cannot require the local government to enforce anything more stringent than the state's minimum requirements. However, the state does have statutory authority to assess local governments or developers civil penalties for not administering the state's minimum requirements.

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

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

intent to direct more effort to ensuring that local governments are complying with the state's minimum requirements.

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

4.2.6 Sedimentation Control

DWQ's role in sediment control is to work cooperatively with those agencies that administer the sediment control programs in order to maximize the effectiveness of the programs and protect water quality. Where programs are not effective, as evidenced by violation of instream water quality standards and where DWQ can identify a source, then appropriate enforcement action can be taken. Generally, this would entail requiring the landowner or responsible party to install acceptable best management practices (BMPs).

Status of Progress

Communication and cooperation continues to improve between state agencies that work to reduce erosion. The Division of Land Resources (DLR) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced. There are currently inadequate staff within DLR to achieve the mission of this agency. In February 1999, the NC Sedimentation Control Commission adopted significant changes for strengthening the Erosion and Sedimentation Control Program.

An erosion and sediment control plan must also be developed for disturbed sites of one acre or more 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.

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

New Rules Regarding Sediment Control

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

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

- A pre-construction conference may be required.
- Provisions for ground cover stabilization were reduced 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.)
- No person may initiate a land-disturbing activity until notifying the agency that issued the Plan Approval of the date the land-disturbing activity will begin.
- The Director of Division of Land Resources may now begin to assess penalties of significant violations upon initial Notice of Violation (NOV).

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

- Increases the maximum civil penalty for violating the SPCA from $500 to $5000 per day.
- Provides that a person may be assessed a civil penalty from the date a violation is detected if the deadline stated in the Notice of Violation is not met.
- Provides that approval of an erosion control plan is conditioned on compliance with federal and state water quality laws, regulations and rules.
- Provides that any erosion control plan that involves using ditches for the purpose of 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.

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

Recommendations

DWQ will continue to work cooperatively with DLR and other agencies that administer sediment control programs in order to maximize the effectiveness of the programs and to take appropriate enforcement action when necessary to protect or restore water quality. However, more voluntary implementation of BMPs is needed for activities that are not subject to these rules in order to substantially reduce the amount of widespread sedimentation in the basin.

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

Some Best Management Practices

Agriculture

- Using no till or conservation tillage practices.
- Strip cropping, contour farming and use of terraces.
- Taking land on steep terrain out of production.

Construction

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

Forestry

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

General Practices

- Avoiding disturbance of streams and the riparian zone.
- Protecting existing vegetated riparian buffers and restoring vegetation that has been cleared from the buffer areas.
- Maintaining natural stream channels to reduce susceptibility to erosion and maintain habitat.
- Maintaining predevelopment peak flows and flow velocities to the extent possible through the use of stormwater management techniques.

Construction activities can dramatically increase the sediment delivered to streams. Generally, a landowner or developer must install acceptable best management practices (BMPs) when the land is disturbed by construction or development activities. Management practices may include barriers, filters or sediment traps to reduce the amount of sediment that leaves a site. Under the Sedimentation and Pollution Control Act, local governments may take responsibility for reviewing and enforcing the Sedimentation and Erosion Control Program within their jurisdiction.

The responsibility for controlling sediment from construction activities falls on many shoulders. The parties with the greatest responsibility include: homeowners, developers/contractors, local governments and the NC Division of Land Resources. Table A-28 presents actions that will help to address sediment problems associated with construction activities. No sediment control measures are completely effective, so some level of sedimentation will occur with land-disturbing activities. Education and promotion of stewardship are keys to reducing sedimentation, along with judicious strengthening of regulations and enforcement.

Table A-28 Recommended Actions to Prevent Construction-Related Sediment Problems

Homeowners	• Know and follow state and local erosion/sedimentation ordinances. • Fit development to existing site conditions and avoid highly erodible soils. • Establish, maintain and protect streamside vegetation. • Carefully monitor the construction process. • Establish and maintain vegetation as quickly as possible. • Continue to control sediment after construction is complete. • Report any serious sediment problems on construction sites, including bare soil that has not been stabilized or malfunctioning erosion controls.
Developers and Contractors	• Know and follow state and local erosion/sedimentation ordinances. • Fit development to existing site conditions and avoid floodplains and highly erodible soils. • Minimize the extent and duration of exposure. • Protect disturbed areas from stormwater runoff. Use dikes, diversions and waterways to intercept runoff and divert it away from disturbed areas. • Convey stormwater away from steep slopes to stabilized outlets, preserving natural vegetation when possible. • Inspect and maintain control structures during construction. • Retain sediment on-site. When possible, construct sediment traps before other land-disturbing activities. • Train equipment operators to execute erosion control practices.
Local Governments, With or Without Delegated Sediment and Erosion Control Programs	• Educate citizens on the importance of erosion and sediment control before they begin construction activities, and ensure they understand their responsibilities under local or state laws. • Report any serious problems on construction sites, including bare soil that has not been stabilized or malfunctioning erosion/sediment controls. • Consider developing a sediment and erosion control program in your jurisdiction. This will allow greater control over implementation and enforcement of the program. It will also offer the opportunity to require sediment control on developments disturbing less than one acre. • Evaluate the effectiveness of current sediment control enforcement if you have your own program. • Maintain publicly-owned open space to prevent sediment loss from tracts of land near waterbodies.

References/Resources

- The following can be ordered from the NC Division of Land Resources at (919) 733-3833:
  - *NC Erosion and Sediment Control "Planning and Design Manual"* ($55 in-state)
  - *NC Erosion and Sediment Control "Inspector's Guide"* ($20 in-state)
  - *NC Erosion and Sediment Control "Field Manual"* ($20 in-state)
  - *NC Erosion and Sediment Control "Video Modules"* ($15 in-state)
  - *Erosion Patrol 3rd Grade Curriculum Supplement*
  - *Muddy Water...It's More Dangerous Than You Think Video*

You may also refer to Appendix VI for a contact name and number for the NC Division of Land Resources regional office in your area.

4.2.7 The Importance of Riparian Buffers

Probably the best-known and most widely useful category of BMPs is the retention of naturally vegetated buffers along streams. Streamside buffers serve many functions including nutrient filtering, bank stabilization, reduction of soil and land loss, moderating water temperature (which helps increase dissolved oxygen and hence fisheries), and providing wildlife habitat and corridors for movement (EPA, 1999).

> ***What is a Riparian Buffer?***
>
> The term riparian buffer is used to describe lands adjacent to streams and comprised of an area of native trees, shrubs and other vegetation.

Although streamside vegetation of any kind is desirable, forests provide the greatest amount of benefit and highest potential for meeting both water quality and habitat protection objectives. A sound scientific foundation exists to support the sediment and nutrient reduction, as well as ecological values and functions of riparian forest buffers. Riparian vegetation slows runoff and helps maintain stable streambanks and protect downstream property. Riparian vegetation also soaks up rainwater instead of allowing it to runoff, thereby helping to recharge groundwater. The use of riparian buffers as a management tool should be promoted.

> ***Riparian buffers are managed to:***
>
> - maintain the integrity of stream channels and shorelines by protecting them from erosion;
> - reduce the impact of nonpoint sources of pollution by trapping, filtering and converting sediments, nutrients and other chemicals; and
> - supply food, cover and thermal protection to fish and other wildlife.

The loss of riparian buffers can reduce water quality, wildlife and fish populations, cause property damage and loss of agricultural lands through bank erosion. The loss of riparian vegetation results in increased water temperatures and decreased oxygen levels. These factors can significantly impact aquatic life and reduce land values. There are many benefits to protecting and restoring riparian buffers. The appropriate width of the buffer should consider land use, topography and water quality goals.

Recommendations

The General Assembly expressed interest in protecting water quality in the Catawba River basin through the ratification of the Clean Water Act of 1999 (HB 1160, Part VII). This bill gives authority to the Environmental Management Commission (EMC) to adopt temporary rules to protect water quality in the Cape Fear, Catawba and Tar-Pamlico River basins. The intent of the bill is to allow for development of rules for basinwide buffers or other water quality protection measures as required in these three river basins. The temporary rule-making process can be used to put water quality protection measures into place more rapidly than the permanent rule-making process and thus provide more immediate protection for riparian buffers.

Temporary rules require public input on language development and public hearings. Temporary rules are effective until permanent rules are adopted. Public hearings are also required during the permanent rule-making process.

Temporary rule-making for the Catawba River basin could not begin until the Catawba River Basinwide Water Quality Plan was approved by the EMC in December 1999. At the time of approval, DWQ staff alerted the EMC to local resolutions and comments made by the public concerning rule making for buffers.

The EMC did instruct DWQ staff to pursue temporary rule-making for buffers for the Catawba River basin. There will be opportunities for stakeholder input into the language of the temporary rules and public hearings will be held after the rule-making language is developed.

The Clean Water Act (Part VII) requires that DWQ take several steps to obtain public input on the development of temporary rules for buffers within the Catawba River basin. The bill requires that DWQ obtain stakeholder input on the development of the temporary rule language. As a first step, DWQ met with about 30 stakeholder groups in January 2000 to obtain feedback on the pursuit of rule-making for buffers in the basin. Some of the major issues the stakeholder group identified as needing to be addressed during rule development included:

- land owner rights;
- buffer width requirements;
- applicability of the rule for lake and river shorelines versus perennial and intermittent streams;
- enforceability of the rules; and
- compatibility with existing buffer programs (i.e., Mecklenburg county SWIM Steam Buffer Program).

Additional meetings with stakeholders on the language of the rules are anticipated in the next few months.

After temporary rule language is developed and approved by the EMC, the temporary rules will be publicly noticed and public hearings will be held throughout the basin. The earliest that the EMC would be able to reasonably adopt temporary rules and meet the HB1160 requirements would be late summer 2000.

Temporary rules are effective until permanaent rules are adopted. Public hearings are also required during the permanaet rule making process. Permanent rule language will likely be considered by the EMC during 2001, with an effective date of August 2002.

There have been some efforts at the local level in the Catawba River basin to protect stream water quality through buffer requirements. For example, Mecklenburg County adopted a Stream Buffer Plan that is flexible and establishes a buffer width based on the number of acres in the watershed (see Section C, Chapter 1, Part 1.5.2). Another effort, called Voices and Choices (see Section C, Chapter 1, Part 1.8.3) has been working on proposed buffer recommendations. In addition, 26 local governments in a 5-county area of the uppper basin submitted local resolutions supporting buffers for the basin. (It should also be noted that one county government in the upper basin submitted a resolution in opposition to buffer rules). Interested citizens always have the option to petition their local government representatives to establish a buffer plan for their county.

Section B

Water Quality Data and Information by Subbasin

Chapter 1 -
Catawba River Subbasin 03-08-30
Includes Catawba River Headwaters

1.1 Water Quality Overview

Subbasin 03-08-30 at a Glance

Land and Water Area (sq. mi.)

Total area:	526
Land Area:	516
Water Area:	10

Population

1990 Est. Pop.:	42,702 people
Pop. Density:	83 persons/mi^2

Land Cover (%)

Forest/Wetland:	87%
Water:	3%
Urban:	1%
Cultivated Crop:	1%
Pasture/ Managed Herbaceous:	8%

Use Support Ratings

Freshwater Streams:

Fully Supporting:	408.1 mi.
Fully Supporting but Threatened:	217.6 mi.
Partially Supporting:	5.3 mi.
Not Supporting:	0.0 mi.
Not Rated:	19.9 mi.

Lakes:

Lake James - Fully Supporting

This subbasin contains the headwaters of the Catawba River from its source near Old Fort to the confluence with Silver Creek in Burke County. Major tributaries include Curtis Creek, Buck Creek, Crooked Creek, Muddy Creek, the North Fork Catawba River and the Linville River. This subbasin also includes the entire watershed of Lake James. Approximately one-half of the subbasin is within the Pisgah National Forest. A map of this subbasin including water quality sampling locations is presented in Figure B-1. Overall biological ratings are presented in Table B-1.

The Catawba River flows generally eastward with the largest tributaries flowing south from mountainous headwaters. These northern tributaries are typically swiftly flowing, coldwater streams capable of supporting trout populations.

There are many high quality streams in this subbasin with 74% of the sites receiving a Good or Excellent rating using benthic macroinvertebrate data. Areas of highest water quality include the headwater segment of Mill Creek, Buck Creek/Little Buck Creek, the headwater segment of the North Fork Catawba River, Armstrong Creek and tributaries, Little Grassy Creek, and the lower segment of the Linville River. HQW streams in this subbasin include Jarrett Creek, portions of Mackey Creek, portions of Armstrong Creek, and the lower part of the Linville River.

Streams with the poorest water quality include Corpening Creek (draining urban areas of Marion). Recent fish and benthic macroinvertebrate collections (March 1998) also indicated severe water quality problems in lower Mackey Creek below the discharge from Metal Industries. These streams are impaired and are discussed further below.

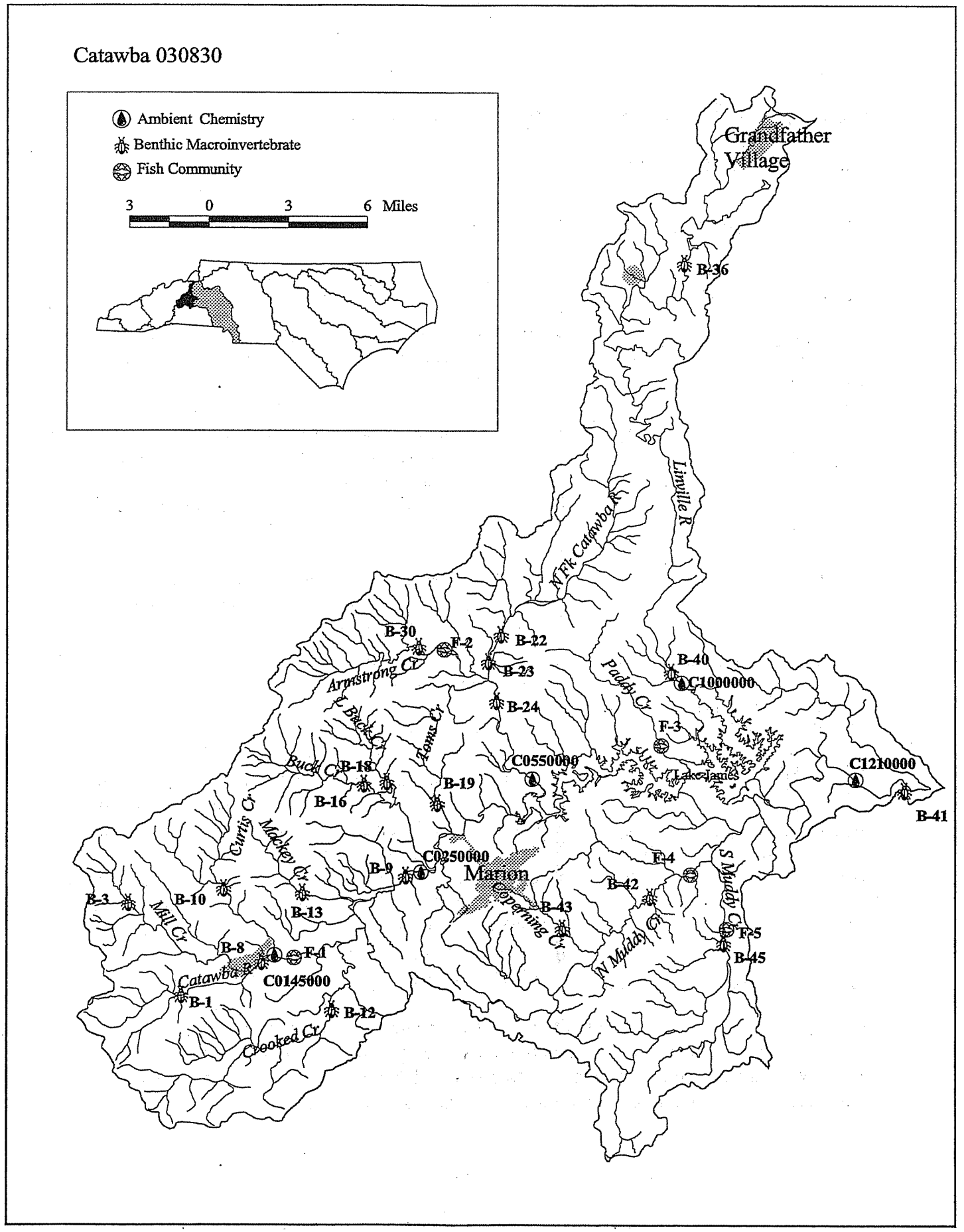


Figure B-1 Sampling Locations within Subbasin 03-08-30

Table B-1 Biological Assessment Sites in Catawba River Subbasin 03-08-30 (1997)

Site	Stream	County	Road	Rating
B-1	Catawba River	McDowell	SR 1274	Good-Fair
B-3	Mill Creek	McDowell	ab RR Bridge	Excellent*
B-8	Catawba River	McDowell	SR 1234	Good-Fair
B-9	Catawba River	McDowell	SR 1221	Good
B-10	Curtis Creek	McDowell	be Newberry Creek	Good
B-12	Crooked Creek	McDowell	SR 1135	Good
B-13	Mackey Creek	McDowell	SR 1453	Good
B-16	Buck Creek	McDowell	NC 80	Excellent
B-18	Little Buck Creek	McDowell	SR 1436	Excellent
B-19	Toms Creek	McDowell	SR 1434	Good
B-22	N Fork Catawba River	McDowell	SR 1573	Excellent
B-23	N Fork Catawba River	McDowell	SR 1560	Good
B-24	N Fork Catawba River	McDowell	be Sevier	Good
B-30	Armstrong Creek	McDowell	FS Rd	Excellent
B-36	Linville River	Avery	US 221	Good-Fair
B-40	Linville River	Burke	NC 126	Excellent
B-41	Catawba River	Burke	SR 1147	Good
B-42	North Muddy Creek	McDowell	SR 1750	Good
B-43	Corpening Creek	McDowell	SR 1819	Fair
B-45	South Muddy Creek	McDowell	SR 1764	Good-Fair
F-1	Catawba River	McDowell	SR 1110	Good-Fair
F-2	Armstrong Creek	McDowell	SR 1456	Good-Fair
F-3	Paddy Creek	Burke	NC 126	Good-Fair
F-4	North Muddy Creek	McDowell	SR 1760	Fair
F-5	South Muddy Creek	McDowell	SR 1764	Fair

Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites
* Small stream criteria

Streams with intensive agricultural or residential land use often had high turbidity and Good-Fair ratings based on either macroinvertebrate or fish collections. These include: South Muddy Creek, North Muddy Creek, Paddy Creek, lower Buck Creek, the upper Linville River and the headwaters of the Catawba River.

Trends in water quality over a period greater than 5 years could be assessed with macroinvertebrate data at nine sites in 03-08-30 (refer to Appendix II for sampling results). One

site in the headwaters of the Catawba River showed a decline in water quality (Excellent in 1983, Good-Fair in 1997), while four sites showed some improvement: Catawba River near Old Fort, Linville River near Briery Knob, Linville River near Nebo, and North Muddy Creek. Changes at the Catawba River and North Muddy Creek were associated with upgrades at wastewater treatment plants, while the upper Linville River appears to have recovered from the effects of a drawdown at an upstream golf course lake. Most of these improvements occurred prior to 1992. Fish samples indicated a long-term improvement (35 years) at North Muddy Creek.

Trends in water quality over a five-year period could be assessed at 20 sites, with the majority of these (16) showing no significant change in bioclassification. Three sites showed a decline associated with a soybean oil spill into Swannanoa Creek. A more recent sampling (1999) in Swannanoa Creek showed improvements, and the creek appears to have recovered (rated Excellent) from the soybean oil spill. A decline at Mackey Creek might be associated with nonpoint source runoff.

Benthos ratings for the Catawba River below Old Fort improved from Fair in 1985 to Excellent in 1992. Improvements in water quality were associated with the closing of the Old Fort finishing plant and improvements to effluent quality at the Old Fort WWTP. The Pleasant Gardens site has improved from Good-Fair to Good during this same time period, but this station still has elevated levels of turbidity and suspended solids, especially during times of high flow. This pattern suggests that nonpoint source runoff may be affecting this portion of the Catawba River.

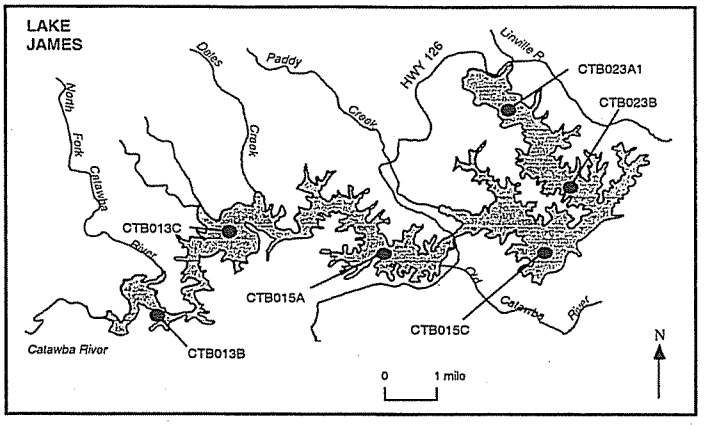
Eight facilities monitor effluent toxicity, including five dischargers with a permitted flow greater than 0.5 MGD. Consistent problems were observed only at Metal Industries (discharging to Mackey Creek), but most facilities have failed at least one test during the last five years. The Marion-Corpening Creek WWTP had more severe problems in 1997, failing five self-monitoring toxicity tests.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. A complete listing of use support ratings for this subbasin can be found in Appendix III.

Lake James Assessment

COUNTY:	Burke /McDowell	**CLASSIFICATION:**	WS-IV, WS-V B Tr
SURFACE AREA:	6510 acres (2635 hectares)	**MEAN DEPTH:**	46 feet (14 meters)
VOLUME:	$36.9 \times 10^6 m^3$	**WATERSHED:**	380 mi^2 (984 km^2)
SHORELINE:	150 Miles	**RETENTION TIME:**	228 days

Lake James is owned by Duke Energy. The Catawba River, the North Fork of the Catawba River, and the Linville River are the major tributaries of Lake James. Lake James is hydrologically divided into two units: the Catawba River section and Linville River section. These units are connected by a man-made canal located at the NC 126 bridge. The watershed is



primarily forested and is characterized by rolling hills. The waters of Lake James are used to generate electricity at the Bridgewater Hydroelectric Plant and for recreational purposes. Lake James was most recently monitored in June, July and August 1997 and was found to be oligotrophic on the days it was sampled.

Increasing development pressures within the lake's watershed, particularly along the shoreline, may pose a threat to the water quality of Lake James. An increase in the number of septic tanks within the watershed and recreational boating activities on the lake are viewed as potentially damaging to the lake's water quality (The Charlotte Observer, October 13, 1993).

For more detailed information on water quality in this subbasin, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998,* available from the DWQ Environmental Sciences Branch at (919) 733-9960.

1.2 Prior Basinwide Plan Recommendations (1995) and Achievements

1.2.1 Impaired Waters

The 1995 Catawba River Basinwide Plan identified only Corpening Creek as impaired in this subbasin.

Corpening Creek

Approximately 4.7 miles of Corpening Creek was listed as impaired due to nonpoint sources and the Marion WWTP, based on biological data collected in 1990. The 1995 plan recommended that efforts to address water quality issues in the Corpening Creek watershed should concentrate on nonpoint source pollution reduction, and several recommendations were made to address urban stormwater pollution. Corpening Creek drains a highly urban portion of Marion. The water quality problems seen in the creek are typical of urban streams.

Status of Progress

DWQ has relied on existing nonpoint source control programs and the actions of local governments to correct water quality degradation in Corpening Creek. Corpening Creek is still rated as impaired, and recommendations for improving water quality can be found in Part 1.3.

1.3 Current Priority Issues and Recommendations

1.3.1 Monitored Impaired Waters

Mackey Creek and Corpening Creek were given an impaired use support status based on the most recent DWQ data available. These creeks are also on the state's year 2000 (not yet EPA approved) 303(d) list (see Part 1.3.2 below).

Mackey Creek

Mackey Creek, from US 70 to the Catawba River (0.6 miles), is rated partially supporting due to impacts from Metal Industries discharge. Metal Industries has had consistent problems meeting its toxicity limits.

1999 Recommendation(s)

DWQ is working with this discharger while they make process improvements to assure permit limits are met in the future. DWQ has a Special Order by Consent (SOC) on Metals Industries. The facility has plans to remove the discharge entirely in the future. DWQ will also develop a TMDL for Mackey Creek (see Part 1.3.2 below).

Corpening Creek

Corpening Creek, from source to junction with North Muddy Creek (4.7 miles), is listed partially supporting due to nonpoint sources, urban impacts and the Marion WWTP. Growth around Marion is impacting the creek, and the Marion WWTP had several toxicity test failures in 1997.

1999 Recommendation(s)

There is not enough information available to determine what efforts might be needed to restore Corpening Creek. A more in-depth watershed study should be conducted to identify the land use activities and streambank problems that are causing degradation of this creek. There is currently not enough staff available at the state level to make this commitment. Local projects aimed at identifying sources of pollution and necessary actions would be very useful to DWQ and various funding agencies. It may be possible to use projects such as the Lower Creek Watershed Project (referred to in subbasin 03-08-31) as a model.

The Town of Marion was experiencing toxicity problems as a result of discharges to their system. The town successfully addressed the toxicity issue through their pretreatment program and has been in compliance.

DWQ will conduct further monitoring to better determine problem parameters on Corpening Creek (see Part 1.3.2 below).

1.3.2 303(d) Listed Waters

Two waters in this subbasin (Mackey Creek and Corpening Creek) are listed on the state's year 2000 (not yet EPA approved) 303(d) list (see Appendix IV for more information). Mackey Creek and Corpening Creek are currently impaired and are discussed above.

1.3.3 Other Recommendations

Lake James

Development in the watershed of Lake James has the potential to increase pollutant loading to the lake through both point and nonpoint sources. Due to these concerns, two water quality studies are currently underway to assess the impacts of land use changes on the lake.

The WPCOG received an EPA 205(j) grant to model the effects of land use changes on water quality in Lake James. The study includes the collection of data to characterize pollutant loading rates to the lake and modeling the response of the lake to these loadings. The Lake James response model will be completed prior to issuing the next basinwide plan and results of the study will be included in the next basinwide plan. For more information on the study, contact Mike Struve of WPCOG at (828) 322-9191.

Duke Power has initiated a modeling study of Lake James. This study will attempt to: 1) quantify the extent of point and nonpoint loading from the watershed to the lake under various land use and land cover practices; and 2) assess the impact of this loading on reservoir and tailrace water quality. The proposed modeling effort will predict nutrient cycling, dissolved oxygen and algae levels on the lake. This modeling effort will develop tools to evaluate effects of changing land use, point source dischargers and weather on water quality of the lake. Duke Power will incorporate data through 1999 into the model, and results of the study will be incorporated into the next revision of the basinwide plan.

For more information on this study, contact Bill Foris of Duke Power at (704) 875-5262.

Muddy Creek Watershed

The 98-square mile watershed of Muddy Creek is in Burke and McDowell counties. Muddy Creek is formed by the confluence of North Muddy Creek and South Muddy Creek just upstream of the confluence of Muddy Creek and the Catawba River. This watershed shows evidence of nonpoint source problems. Although waters in this watershed are not considered to be impaired, the watershed experiences significant sediment loads due to eroding streambanks and stream blockages. Duke Power has been collecting data on sediment loads in the North and South Muddy Creeks and estimate that between 14,000 – 23,000 tons per year of sediment enter the Catawba River from the Muddy Creek watershed under typical streamflow conditions. North Muddy Creek is estimated to contribute about 80% of this load. This watershed is in need of

focused restoration activities. Refer to Section C, Chapter 1 for more information on a multi-partner restoration initiative currently underway.

The City of Morganton uses the Catawba River as its primary drinking water source. Reduction in the sediment load from the Muddy Creek watershed will likely result in lower treatment costs for the city and significantly reduce the sediment loading to Lake Rhodhiss.

Chapter 2 -
Catawba River Subbasin 03-08-31
Includes Warrior Fork, Johns River and Rhodhiss Lake

2.1 Water Quality Overview

Subbasin 03-08-31 at a Glance

Land and Water Area (sq. mi.)

Total area:	581
Land area:	578
Water area:	3

Population Statistics

1990 Est. Pop.:	92,541 people
Pop. Density:	160 persons/mi^2

Land Cover (%)

Forest/Wetland:	85%
Surface Water:	1%
Urban:	3%
Cultivated Crop:	1%
Pasture/ Managed Herbaceous:	10%

Use Support Ratings:

Freshwater Streams:

Fully Supporting:	463.6 mi.
Fully Supporting but Threatened:	94.7 mi.
Partially Supporting:	35.3 mi.
Not Supporting:	0.0 mi.
Not Rated:	75.6 mi.

Lakes:

Lake Rhodhiss - Fully Supporting

This subbasin contains the cities of Morganton, Lenoir, Drexel and Granite Falls. Many headwater tributaries are designated as HQW because they are native trout waters. Portions of this catchment, including Wilson Creek, are within the Pisgah National Forest and have received ORW designation. The Johns River catchment contains some high quality areas, but also has widespread agricultural land use. Urban development and runoff from Lenoir and Morganton have impacted several tributaries to the Catawba River in the southeastern portion of the subbasin. A map of this subbasin including water quality sampling locations is presented in Figure B-2. Biological ratings of these sites are presented in Table B-2.

All of the monitored streams with headwaters in the Pisgah National Forest had Good or Excellent water quality ratings based on biological data. Even though there is recreational use in the upper sections of these creeks and development in many of the watersheds, the water quality has remained high.

As watersheds become more developed around Morganton and Lenoir, the water quality ratings were lower (Good-Fair or Fair). None of the streams showed a change in water quality since sampling in 1992.

Lower Creek was the most degraded stream sampled in the basin. Data from this site have resulted in a Fair bioclassification in all years. A special study in 1997 did not detect additional impacts to Lower Creek from the WWTP, but this may be masked by the Fair water quality above the WWTP's discharge. Throughout the watershed, Lower Creek and many of its tributaries suffer from urban development and runoff, as well as cattle access to streams.

Four facilities monitor effluent toxicity. All facilities have been compliant with their permits during the past 5 years.

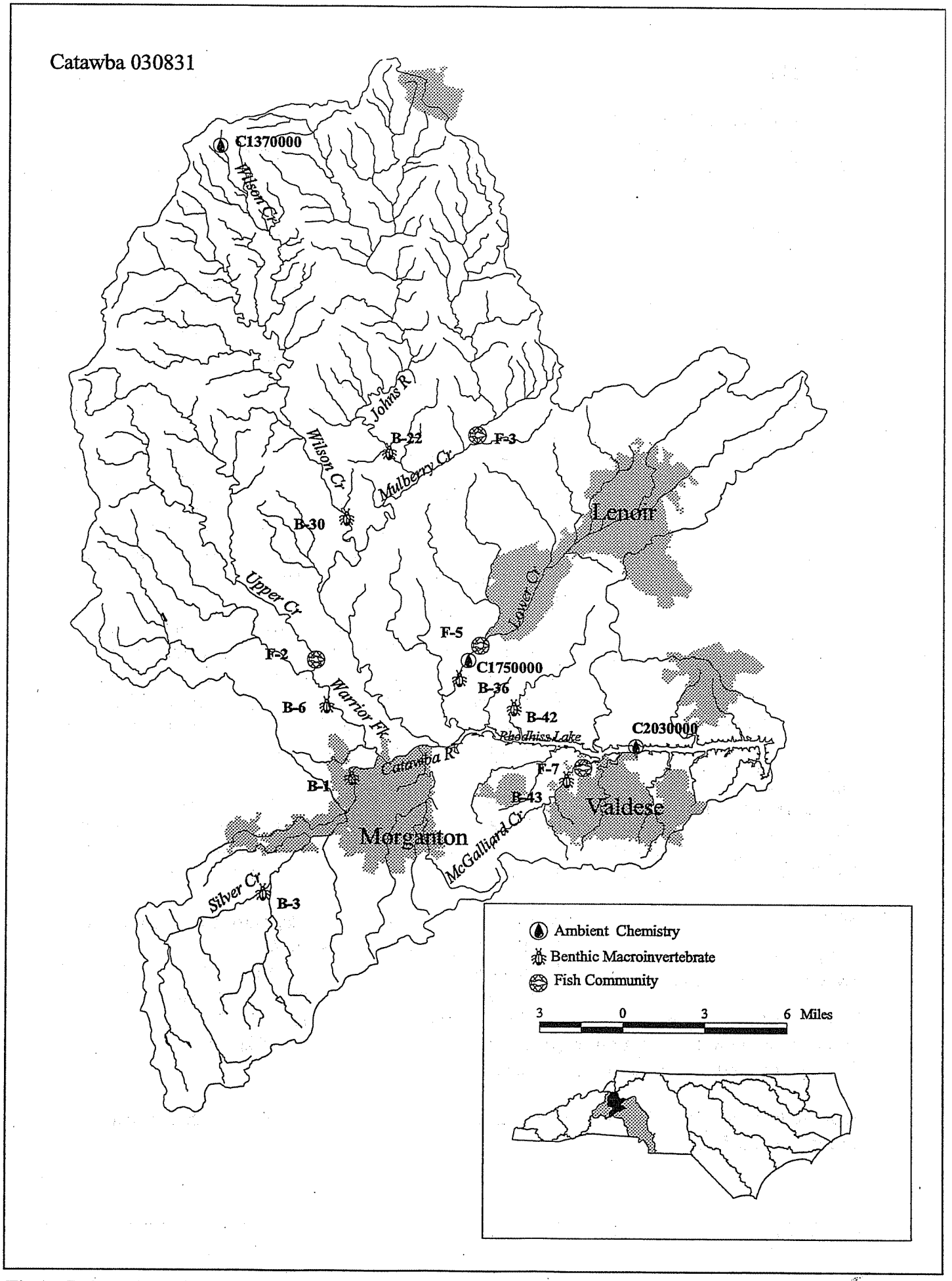


Figure B-2 Sampling Locations within Subbasin 03-08-31

Table B-2 Biological Assessment Sites in Catawba River Subbasin 03-08-31 (1997)

Site	Stream	County	Road	Rating
B-1	Catawba River	Burke	NC 181	Good-Fair
B-2	Canoe Creek	Burke	SR 1250	Good-Fair
B-3	Silver Creek	Burke	SR 1149	Good-Fair
B-6	Warrior Creek	Burke	SR 1440	Excellent
B-22	Johns River	Caldwell	SR 1356	Excellent
B-30	Wilson Creek	Caldwell	SR 1335	Excellent
B-36	Lower Creek	Caldwell	SR 1501	Fair
B-42	Smoky Creek	Burke	SR 1515	Good
B-43	McGalliard Creek	Burke	SR 1538	Good-Fair
F-1	Canoe Creek	Burke	SR 1250	Fair
F-2	Upper Creek	Burke	SR 1439	Good-Fair
F-3	Mulberry Creek	Caldwell	NC 90	Good
F-5	Lower Creek	Burke	SR 1501	Fair
F-7	McGalliard Creek	Burke	SR 1538	Poor

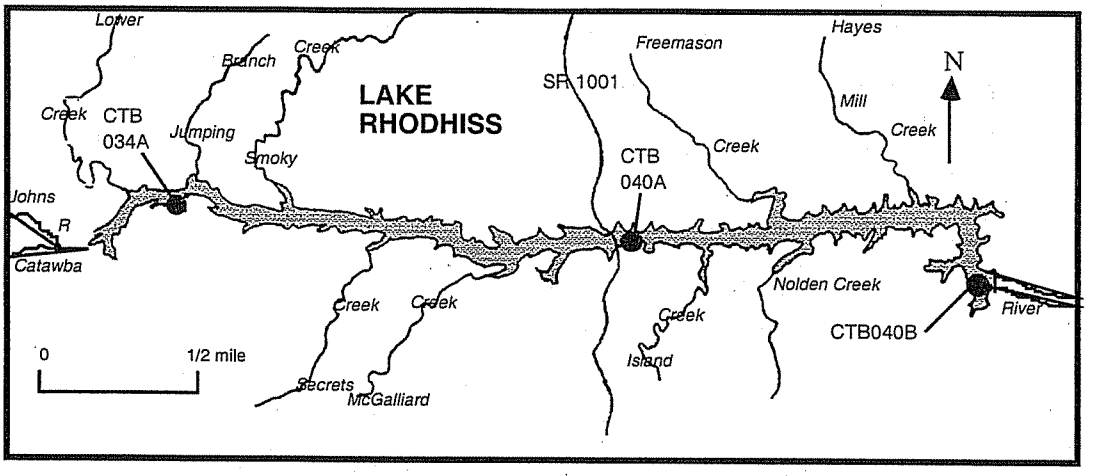
Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites

Lake Rhodhiss Assessment

COUNTY:	Caldwell/Burke	**CLASSIFICATION:**	WS-IV B CA
SURFACE AREA:	3515 acres (1423 hectares)	**MEAN DEPTH:**	20 feet (6 meters)
VOLUME:	36.7 $x10^6 m^3$	**WATERSHED:**	1090 mi^2 (2823 km^2)
SHORELINE:	90 miles	**RETENTION TIME:**	21 days

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. A complete listing of use support ratings for this subbasin can be found in Appendix III.

Lake Rhodhiss is owned by Duke Energy and is formed by the discharge of Lake James into the Catawba River and by the Johns River. The lake was filled when the construction of the Rhodhiss Hydroelectric Station was completed in 1925. Rhodhiss is a relatively small and narrow lake located between Lake James and Lake Hickory on the Catawba River. Three-fourths of the land in the watershed is forested. The waters of the lake are used for recreational purposes as well as to generate hydroelectric power.



Lake Rhodhiss was most recently sampled in June, July and August 1997 by Duke Energy. Water quality in the lake fluctuates due to the short retention time. The lake was found to be mesotrophic in June, oligotrophic in July and mesotrophic in August. While nutrient values are adequate to support nuisance algal blooms, the short retention time of this lake prevents this from occurring.

In 1995, Lake Rhodhiss was the first reservoir in the Catawba River Chain to have its bottom profile mapped using hydroacoustics. Scientists with Duke Energy compared data collected during this survey with the original topographic survey conducted in 1925 when the reservoir was constructed. This comparison revealed areas within Lake Rhodhiss which had filled in with several feet of sediment, thus reducing the storage capacity of the reservoir (Duke Energy, 1997).

The US Geological Survey conducted an investigation of Lake Rhodhiss from January 1993 through March 1994 in cooperation with the Western Piedmont Council of Governments (Giorgino and Bales, 1997). The objectives of this investigation were to describe ambient hydrologic and water quality conditions, estimates of nutrient loading and suspended solids from selected tributaries and point sources, and to simulate hydraulic circulation and water quality characteristics of Lake Rhodhiss using a hydrodynamic computer model. Based on nutrient concentrations measured during this study, Lake Rhodhiss was determined to be eutrophic. Calculations of total suspended solids, nitrogen and phosphorus loading indicated that all of the suspended solids and the majority of the nitrogen and phosphorus entering the headwaters of the reservoir originated from nonpoint sources. While less than one percent of the suspended solids load to the reservoir was from point sources, up to 27% and 22% of the total nitrogen and total phosphorus loads, respectively, were from point sources (Giorgino and Bales, 1997).

For more detailed information on water quality in subbasin 03-08-31, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

2.2 Prior Basinwide Plan Recommendations (1995) and Achievements

2.2.1 Impaired Waters

The 1995 Catawba River Basinwide Plan identified only Lower Creek as impaired in this subbasin.

Lower Creek

Approximately 6.6 miles of Lower Creek near Morganton were identified as partially supporting due to both nonpoint and point sources of pollution. The plan cited the need to target best management practice (BMP) implementation along Lower Creek.

Status of Progress

The Lower Creek sampling site is located approximately 2 miles downstream of Lenoir and the community of Gamewell and approximately 6 miles downstream of the Lenoir WWTP. Land use near the sampling station is pasture with cattle access to the creek. Data from this site have resulted in a Fair bioclassification in all years. Throughout the watershed, Lower Creek and many of its tributaries suffer from urban development and runoff. Lower Creek is still rated as impaired, and recommendations for improving water quality can be found in Part 2.3.

2.2.2 Other Recommendations

Rhodhiss Lake Studies

The Western Piedmont Council of Governments (WPCOG) and the US Geological Survey (USGS), in conjunction with DWQ, were to perform a water quality study of Rhodhiss Lake. The objectives of this study included an effort to estimate the assimilative capacity of Rhodhiss Lake for oxygen-consuming wastes. Rhodhiss Lake receives a considerable load of oxygen-consuming wastes from both point and nonpoint sources.

Status of Progress

USGS, in cooperation with WPCOG, developed a water quality model of Rhodhiss Lake (USGS Open File Report 94-509 and USGS Water Resources Investigations Report 97-4131). Data collected for this study indicated that the majority of nutrients entering the lake headwaters originated from the Lower Creek watershed. Most of the sediment and nutrients in the headwaters were from nonpoint sources. A water quality model was used to simulate water movement and water quality in the lake. The water quality parameters of concern are chlorophyll *a* and dissolved oxygen.

The water quality model provided valuable information on Rhodhiss Lake. Chlorophyll *a* levels in the lake during 1992-1993 were relatively insensitive to the phosphorus discharge from the Valdese WWTP, but were very sensitive to phosphorus levels entering the lake from upstream. However, dissolved oxygen levels in the deeper waters of the reservoir were sensitive to

increases in the phosphorus load at the Valdese WWTP. Thus, any increase in phosphorus from the facility would result in lower average dissolved oxygen levels in the lake.

1999 Recommendation(s)

DWQ is using the model to develop a management strategy to protect the water quality of Rhodhiss Lake. The USGS developed model was used to evaluate the response of chlorophyll *a* levels in the lake to a variety of nutrient reduction scenarios. Reductions of phosphorus and nitrogen were considered at the headwaters of the lake and at the Valdese Rhodhiss Lake WWTP. The model runs indicated that the mean lake-wide concentrations of chlorophyll *a* were only moderately sensitive to nutrient reductions. Peak or maximum concentrations of chlorophyll *a* were more sensitive to nutrient reductions.

DWQ, with input from local stakeholders, will develop a management strategy for controlling nutrient inputs to Rhodhiss Lake. Using the model results as a guide, point and nonpoint source controls may be required to achieve nutrient reductions. Point sources were documented to contribute approximately 22 percent of the phosphorus load and 27 percent of the nitrogen load to the headwaters of the lake (USGS 1997). The remaining nutrient loads were attributed to nonpoint sources. The point source discharges that contribute to nutrient loading include the Marion WWTP, Valdese WWTP, Morganton WWTP and Lenoir WWTP. Recommendations such as those presented by the WPCOG for the Lower Creek watershed may form the basis of nonpoint source nutrient controls throughout the subbasin. The overall nutrient management strategy will be described in the next basin plan.

2.3 Current Priority Issues and Recommendations

2.3.1 Monitored Impaired Waters

Lower Creek and its tributaries are listed as impaired waters based on the most recent sampling. These waters are also on the state's year 2000 (not yet EPA approved) 303(d) list (see Part 2.3.2 below).

Lower Creek Mainstem and Several Tributaries

The entire length of Lower Creek below the junction of Zacks Fork (approximately 12.7 miles) is rated as partially supporting, primarily due to urban runoff. The mainstem has water quality problems such as sedimentation and turbidity, as well as elevated fecal coliform bacteria levels. Several major tributaries to Lower Creek are also listed as partially supporting. These include: Zacks Fork Creek (8.2 miles), Spainhour Creek (4.3 miles), Greasy Creek (4.5 miles) and Bristol Creek (5.6 miles). These streams are listed impaired due to nonpoint sources of pollution such as agriculture and cattle access to the creeks, urban runoff and construction activities. The upper reach of Lower Creek is listed as fully supporting but threatened; a status that is not considered to be impaired; however, degradation is apparent.

DWQ conducted a watershed survey to help identify areas of pollution as a first step in identifying areas to concentrate restoration efforts. Four sites on Lower Creek and five

tributaries (Zacks Fork, Spainhour Creek, Greasy Creek, Husband Creek and Bristol Creek) were sampled in June 1997. The survey did not identify specific areas on which to concentrate restoration efforts due to the many sources of pollution, mostly nonpoint in origin. However, there may be several riparian zones that could be restored to reduce runoff and further erosion. Eight of nine sampling sites had severe streambank erosion with little protection by a riparian buffer zone, and high fecal coliform bacteria counts were prevalent.

The Western Piedmont Council of Governments (WPCOG) received a grant from DWQ in 1996 to get local involvement in improving water quality in the Lower Creek watershed (see Section C for more information). The WPCOG report prioritized subbasin areas for nonpoint source reduction and restoration projects. (Note: WPCOG denotes subbasins differently than DWQ. Maps of the areas prioritized are available from WPCOG). Three areas were given a high priority: Lower Creek below Lenoir; Spainhour Creek flowing into Lower Creek above Lenoir; and the headwaters of Lower Creek, Greasy Creek, the length of Lower Creek near Gamewell, Briston Creek and two unnamed tributaries above Lenoir. Medium priority subbasin areas include: Zacks Fork, Husband Creek and Abingdon tributaries. The report made several recommendations for corrective actions for these streams, as presented below.

1999 Recommendation(s)

DWQ supports the WPCOG study, which makes several recommendations for addressing the nonpoint sources of pollution in the Lower Creek watershed. The recommendations are grouped into two general areas: watershed protection and urban stormwater planning. The key implementers of these recommendations, and others that may be developed in the future, are the local governments and citizens of the Lower Creek watershed. Funding opportunities for implementation are available through several programs, some of which are presented in Section C.

WPCOG Study recommendations for watershed protection include:

1. Establish 50-foot buffers along streams in the Lower Creek watershed.
2. Within targeted subbasins, identify property owners interested in participating in nonpoint source demonstration projects.
3. Develop a strategy to raise awareness and educate the public about major pollution sources to Lower Creek.
4. Encourage bioengineered solutions for future projects to stabilize streambanks.
5. Establish a Lower Creek Nonpoint Source Team to assist in implementing recommendations and evaluate progress.

WPCOG Study recommendations for consideration by the local governments for urban stormwater include:

1. Adopt strategies and regulations to minimize new impervious surfaces.
2. Encourage use of curb cuts and reduce street curb and gutter systems.
3. Encourage cluster development or open space zoning near perennial streams.
4. Encourage treatment of "hot spots" including gas stations and trash storage and handling areas.

5. Label stormwater drains.
6. Participate in regional stormwater discussions.

The implementation of actions at the local level, such as those presented in these recommendations, will help restore the water quality in this watershed. Improved water quality in Lake Rhodhiss will depend on actions taken to reduce pollutant inputs from Lower Creek, since data indicate that the majority of nutrients entering the lake are from the Lower Creek watershed. DWQ will work with local interests to develop a management strategy for this watershed.

2.3.2 303(d) Listed Waters

There are seven stream segments in this subbasin listed on the year 2000 (not yet EPA approved) 303(d) list. These include three sections of Lower Creek, Zacks Fork Creek, Spainhour Creek, Greasy Creek, Bristol Creek and Harper Creek. These waters are currently impaired and are discussed above. For further information on 303(d) listing requirements and approaches, refer to Appendix IV.

Chapter 3 -
Catawba River Subbasin 03-08-32
Includes the Little Rivers, Lake Hickory, Lookout Shoals Lake and Lake Norman

3.1 Water Quality Overview

Subbasin 03-08-32 at a Glance

Land and Water Area (sq. mi.)

Total area:	706
Land area:	647
Water area:	59

Population Statistics

1990 Est. Pop.:	151,979 people
Pop. Density:	235 persons/mi^2

Land Cover (%)

Forest/Wetland:	54%
Surface Water:	9%
Urban:	3%
Cultivated Crop:	3%
Pasture/ Managed Herbaceous:	31%

Use Support Ratings:

Freshwater Streams:

Fully Supporting:	341.3 mi.
Fully Supporting but Threatened:	121.0 mi.
Partially Supporting:	0.0 mi.
Not Supporting:	0.0 mi.
Not Rated:	19.8 mi.

Lakes:

Lake Hickory - Fully Supporting
Lookout Shoals Lake - Fully Supporting
Lake Norman - Fully Supporting

This subbasin contains portions of the cities of Hickory, Conover and Newton. Highly erodable soils and moderate gradients contribute to the large amounts of sediment in the Little Rivers (Upper, Middle and Lower) and their tributaries. A map of this subbasin including water quality sampling locations is presented in Figure B-3. Biological ratings for these sample locations are presented in Table B-3.

Biological data showed a Good or Good-Fair rating for all monitored streams in this subbasin except for a section of Lower Little River, which received a Fair rating for fish sampling. Using macroinvertebrate data, water quality only changed in one stream since 1992: Middle Little River declined from Good to Good-Fair.

Fish tissue samples were collected from four stations within the subbasin: Middle Little River, Lake Hickory, Lookout Shoals Lake and Lake Norman. Metals results from all sites were below FDA and EPA criteria. The lake sites were also analyzed for chlorinated pesticides and PCBs with no organic analytes detected.

Twenty facilities in this subbasin currently monitor effluent toxicity under their NPDES permit.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. There are no impaired waters in this subbasin based on the most recent use support assessment. However, there are some streams that are impacted by nonpoint sources of pollution. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

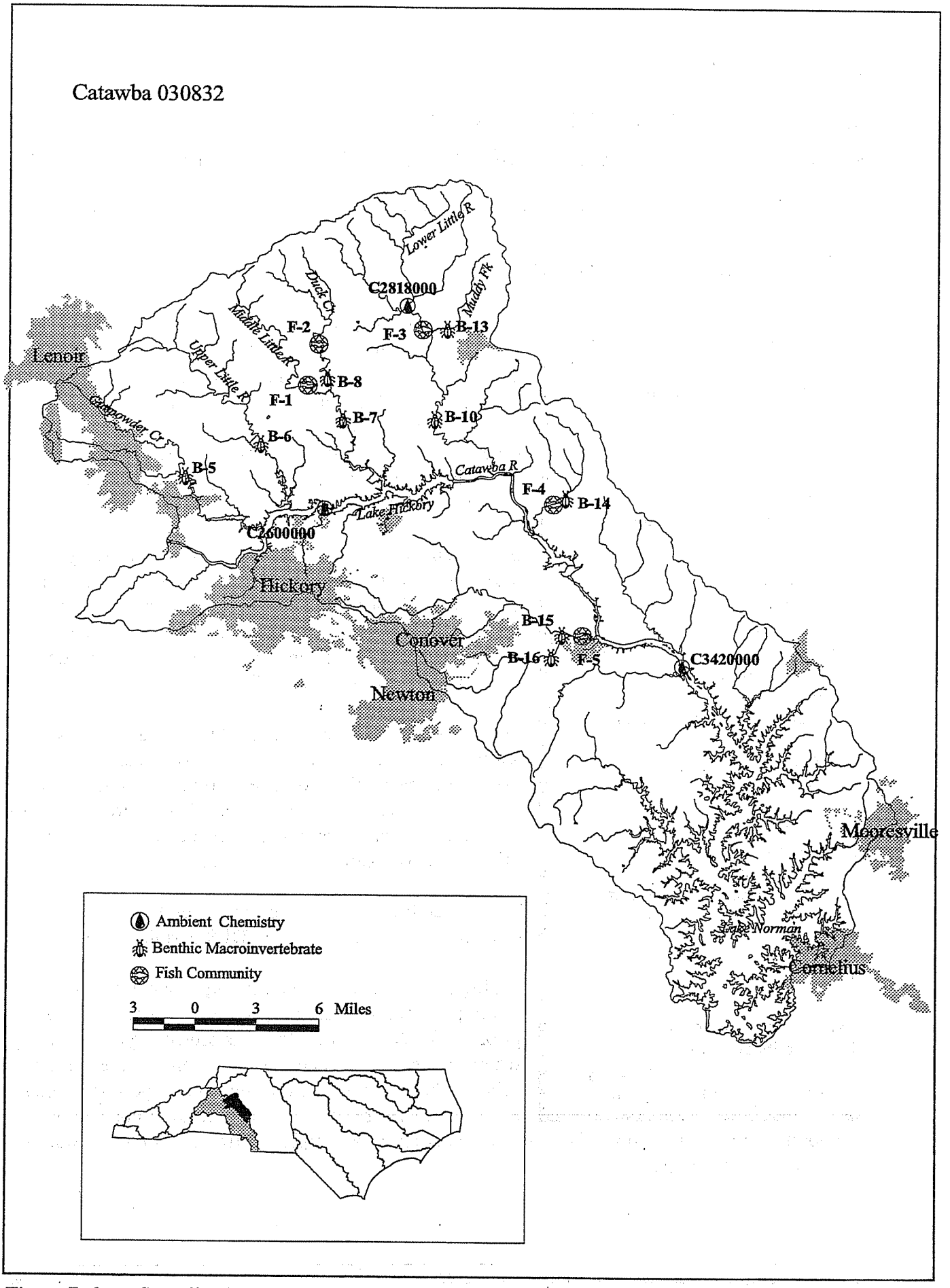


Figure B-3 Sampling Locations within Subbasin 03-08-32

Table B-3 Biological Assessment Sites in Catawba River Subbasin 03-08-32 (1997)

Site	Stream	County	Road	Rating
B-5	Gunpowder Creek	Caldwell	SR 1002	Good-Fair
B-6	Upper Little River	Caldwell	SR 1744	Good
B-7	Middle Little River	Alexander	SR 1153	Good-Fair
B-8	Duck Creek	Alexander	NC 127	Good-Fair
B-10	Lower Little River	Alexander	SR 1131	Good
B-13	Muddy Fork	Alexander	SR 1313	Good-Fair
B-14	Elk Shoal Creek	Alexander	SR 1605	Good-Fair
B-15	Lyle Creek	Catawba	NC 64/70	Good
B-16	McLin Creek	Catawba	SR 1722	Good
F-1	Middle Little River	Alexander	SR 1002	Fair
F-2	Duck Creek	Alexander	NC 90	Good-Fair
F-3	Lower Little River	Alexander	SR 1318	Fair
F-4	Elk Shoal Creek	Alexander	SR 1605	Good-Fair
F-5	Lyle Creek	Catawba	US 70	Good-Fair
F-6	Buffalo Shoals Creek	Iredell	SR 1503	Good-Fair

Key:

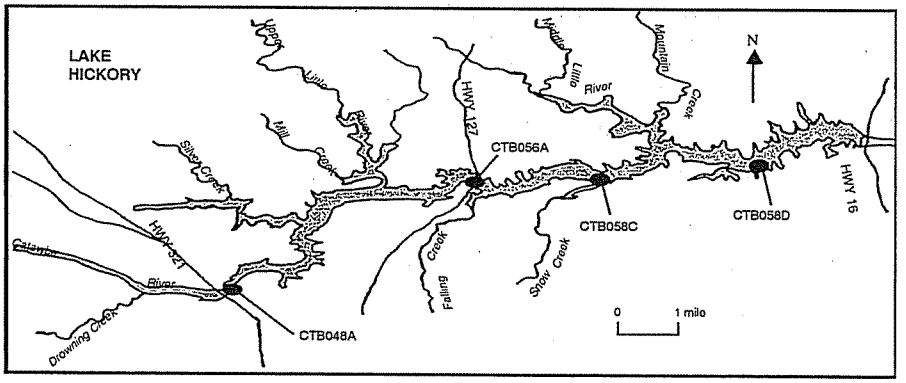
B = Benthic Macroinvertebrate Sites
F = Fish Sites

Lake Hickory Assessment

COUNTY:	Alexander/Catawba/Burke	**CLASSIFICATION:**	WS-V, WS-IV B CA
SURFACE AREA:	4100 acres (1659 hectares)	**MEAN DEPTH:**	33 feet (10 meters)
VOLUME:	17 $x10^6 m^3$	**WATERSHED:**	1310 mi^2 (3393 km^2)
SHORELINE:	105 miles	**RETENTION TIME:**	33 days

Lake Hickory is a run-of-river impoundment located between Lake Rhodhiss and Lookout Shoals Lake on the Catawba River. The lake was filled in 1928. Approximately half of the drainage area is forested and another one-third is agricultural. The major tributaries into Lake Hickory are the Catawba River, Middle Little River and Gunpowder Creek. The lake is owned by Duke Energy, and the waters of the lake are used to generate hydroelectric power and for recreational purposes. Lake Hickory is classified from the Rhodhiss Dam to the US Highway 321 bridge on the Catawba River as WS-IV B CA and from the US Highway 321 bridge to Oxford Dam as WS-V and Class B.

Lake Hickory was sampled by Duke Energy in June, July and August 1997. Lake Hickory was determined to be mesotrophic in June and July and oligotrophic in August. Lake Hickory was previously sampled by DWQ in 1981-1985 and 1992 and was found to be eutrophic.



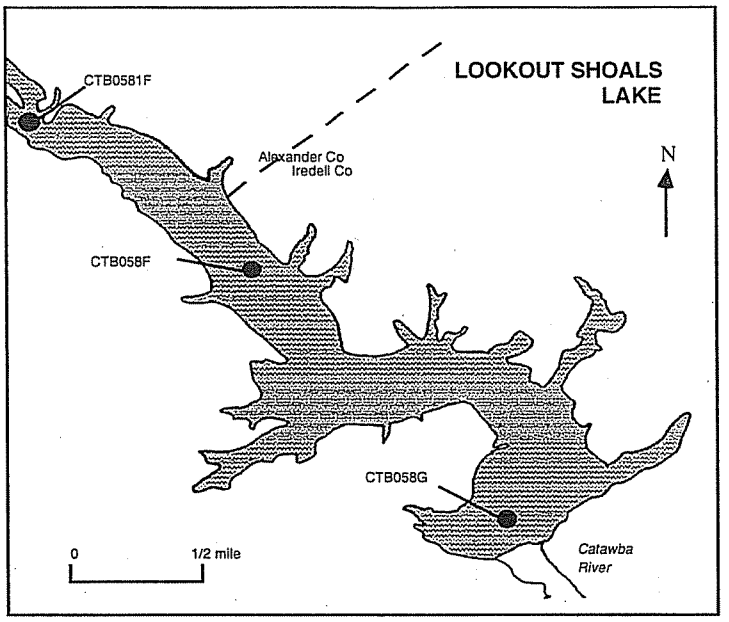
Lookout Shoals Assessment

COUNTY:	Catawba/Iredell	**CLASSIFICATION:**	WS-IV, WS-V B CA
SURFACE AREA:	1270 acres (514 hectares)	**MEAN DEPTH:**	30 feet (9 meters)
VOLUME:	$4.6 \times 10^6 m^3$	**WATERSHED:**	1450 mi^2 (3755 km^2)
SHORELINE:	39 miles	**RETENTION TIME:**	9 days

Lookout Shoals Lake is one of the smaller Catawba chain lakes. The lake is owned by Duke Energy and is located between Lake Hickory and Lake Norman on the Catawba River. Construction of the Lookout Shoals Dam was begun in 1914 and was completed in 1916, making it the first dam built on the Catawba River in North Carolina. The waters of the lake are used to generate electricity at the Lookout Shoals Hydroelectric plant and for recreational purposes. The water quality of Lookout Shoals Lake is more reflective of releases from upstream impoundments (Lake Hickory and Lake Rhodhiss) than conditions in the surrounding watershed. The lake is currently classified as WS-IV from its headwaters to Elk Shoal Creek, and WS-IV and Class B from Elk Shoal Creek to Lookout Shoals Dam.

Lookout Shoals was most recently monitored in June, July and August of 1997 by Duke Power. The reservoir was found to be oligotrophic in June, mesotrophic in July and oligotrophic in August. Lookout Shoals Lake has consistently bordered on the eutrophic/mesotrophic classification from 1981 to 1992.

The City of Statesville requested that Lookout Shoals Lake be reclassified in 1997 as a WS-IV drinking water supply. There are no water supply intakes in the lake at this time.

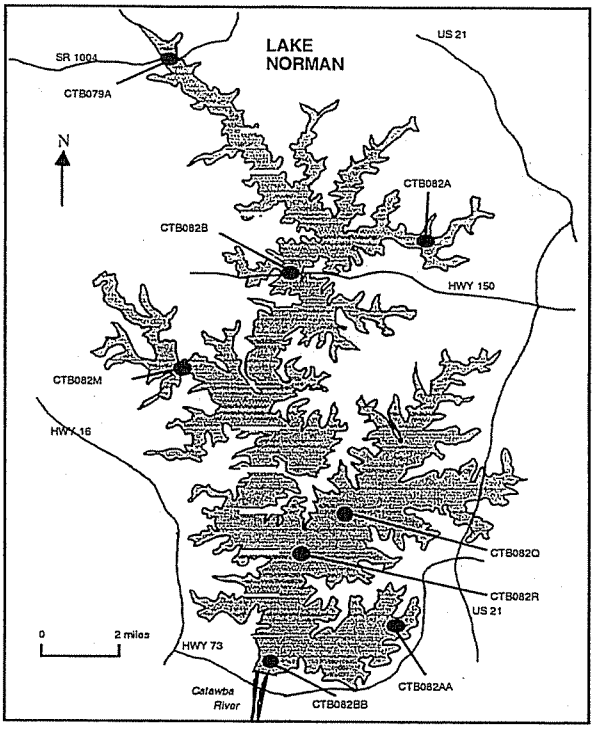


Lake Norman Assessment

COUNTY:	Lincoln/Mecklenburg	**CLASSIFICATION:**	WS-IV B CA
SURFACE AREA:	32510 acres (13157 hectares)	**MEAN DEPTH:**	33 feet (10 meters)
VOLUME:	131.5 $x10^6 m^3$	**WATERSHED:**	1790 mi^2 (4636 km^2)
SHORELINE:	520 miles	**RETENTION TIME:**	206 days

Lake Norman is North Carolina's largest man-made reservoir. Located between Lookout Shoals Lake and Mountain Island Lake, the lake extends almost 34 miles from the Cowans Ford Dam to the tailrace of Lookout Shoals Lake. Construction of the dam and the hydroelectric station were completed in 1967. Lake Norman is owned by Duke Energy, and the water from the lake is used to generate electricity. The lake is the largest of the Catawba chain lakes with the Catawba River, Lyle Creek and Buffalo Shoals Creek as its major tributaries. The topography of the drainage area is characterized by rolling hills with approximately half forested and over one-fourth agricultural. The waters of the lake are classified WS-IV CA from Lookout Shoals Dam to Lyle Creek and WS-IV B CA from Lyle Creek to Cowans Ford Dam.

Lake Norman was most recently sampled in June, July and August 1997 by Duke Energy and was found to be oligotrophic on the three days it was sampled. The lake was sampled by DWQ in 1981, 1982, 1983, 1986 and 1992. On three occasions (1982, 1986 and 1992) the lake received an oligotrophic rating.



3.2 Prior Basinwide Plan Recommendations (1995) and Achievements

3.2.1 Impaired Waters

The 1995 basinwide plan identified two waters in this subbasin as impaired. Each of these is presented and discussed below.

Big Branch

The 1995 plan identified Big Branch as partially supporting and not supporting due to a special study to assess the impacts of the Town of Troutman WWTP.

Status of Progress

The facility received toxicity limits prior to finalization of the first basinwide plan. The town has been in compliance with toxicity permit limits. Big Branch has not been resampled.

Powder Spring Branch

Powder Spring Branch was listed as impaired due to impacts from the South Iredell High School WWTP to a zero flow stream reach. It was recommended that additional monitoring should be done to determine if the stream has improved.

Status of Progress

This facility has ceased its discharge, and the NPDES permit was rescinded in 1992. This stream will not be sampled because it is a zero flow stream, and the dischargers have been removed.

3.2.2 Other Recommendations

Lake Hickory

The Western Piedmont Council of Governments (WPCOG), United States Geological Survey (USGS) and DWQ have completed a three-year water quality study of Lake Hickory. Recommendations were to include results from this study in the updated basinwide plan.

Status of Progress

The Lake Hickory system was monitored for hydrologic and water quality conditions from January 1993 - March 1994. The monitoring data was used by USGS (Bales and Giorgino, 1998 and USGS Report 98-4149) to develop a calibrated water quality model. The model is capable of simulating flow, transport and water quality conditions within the Lake Hickory reservoir. DWQ will use this model to develop management strategies for the reservoir and its watershed.

During the monitoring study, two samples from the upper portion of the lake exceeded the North Carolina water quality standard for chlorophyll *a*. Nutrients, chlorophyll *a* and dissolved oxygen levels are parameters of concern. While samples from the lake did not document fecal coliform bacteria standard violations, the state fecal coliform bacteria standard was commonly exceeded in two of Lake Hickory's monitored tributaries: Upper Little River (40 percent of the samples) and Middle Little River (60 percent of the samples).

Flow from Rhodhiss Dam accounts for most of the total suspended solids, nitrogen and phosphorus loading to the system. However, the loading from the three major tributaries is also important. In general, increased tributary flow was accompanied by increased concentrations of total suspended solids and phosphorus. Nitrogen concentrations did not vary with flow. The six permitted point sources within the watershed contributed about 10 percent of the total nitrogen and about 18 percent of the total phosphorus.

The hydraulic retention time of the lake averaged 19 days with a range of 3.8 to 65 days. During periods of thermal stratification, relatively coldwater coming from the base of Rhodhiss Dam sinks beneath the relatively warmwater on the surface of Lake Hickory. This action results in a strong subsurface "interflow" that rapidly delivers coolwater from the base of Rhodhiss Dam through the middle layers of Lake Hickory to the release at Oxford Dam. This circulation pattern magnifies the effects of nutrient loading to the surface waters of Lake Hickory. Initial runs of the calibrated model show an increased sensitivity to nutrient loading delivered mid-reservoir.

Nonpoint sources of pollution are having a greater impact on Lake Hickory water quality than point sources. Additional studies of the Lake Hickory watershed should be conducted to assess the sources of fecal coliform bacteria in Upper Little River and Middle Little River. Since the

majority of total suspended solids and nutrients are attributed to flow from Rhodhiss Lake, additional management strategies will be needed upstream of Lake Hickory.

DWQ may develop a management strategy for this watershed based on completion of modeling and the development of a management strategy for Lake Rhodhiss (see Section B, Chapter 2, Part 2.2.2 for more information).

Lyle Creek Watershed Management Strategy

This watershed includes Lyle Creek, Huffman Branch, McLin Creek, Mull Creek, Hagan Fork and all other Lyle Creek tributaries. In July 1988, a modeling study of the Lyle Creek watershed was conducted to address an expansion request for the Conover Northeast. The model was used to establish NPDES permit limits for new and expanding facilities in the Lyle Creek watershed. This approach has been used since 1988. It was recommended that this strategy continue as part of the Catawba Basinwide Plan.

Status of Progress

All new and expanding facilities receive BOD limits of 8 mg/l and NH_3 limits of 2 mg/l to hold the load of oxygen-consuming wastes constant.

3.3 Current Priority Issues and Recommendations

3.3.1 Monitored Impaired Waters

During the next five years, addressing monitored impaired waters will be a priority. This subbasin has no monitored impaired waters; however, there are a number of streams showing impacts from nonpoint source pollution. These impacts are attributable to urban runoff and agricultural land use including cattle access to streams. Local land use planning efforts and the use of best management practices (BMPs) and naturally vegetated buffer zones could help improve water quality in these impacted streams.

3.3.2 303(d) Listed Waters

There are no 303(d) listed waters in this subbasin.

Chapter 4 -
Catawba River Subbasin 03-08-33
Includes Dutchmans Creek and Mountain Island Lake

4.1 Water Quality Overview

Subbasin 03-08-33 at a Glance

Land and Water Area (sq. mi.)

Total area:	220
Land area:	216
Water area:	4

Population Statistics

1990 Est. Pop.:	47,301 people
Pop. Density:	219 persons/mi^2

Land Cover (%)

Forest/Wetland:	69%
Surface Water:	2%
Urban:	2%
Cultivated Cropland:	2%
Pasture/ Managed Herbaceous:	25%

Use Support Ratings

Freshwater Steams:

Fully Supporting:	147.5 mi.
Fully Supporting but Threatened:	0.0 mi.
Partially Supporting:	9.8 mi.
Not Supporting:	0.0 mi.
Not Rated:	10.1 mi.

Lakes:

Mountain Island Lake - Fully Supporting

Dutchmans Creek, formed by the confluence of Leepers and Killian Creeks, is the largest watershed in this subbasin and flows into the Catawba River just downstream of Mountain Island Lake. Land use is primarily agricultural with recreational and residential use near the lake. The largest discharger in this subbasin is Charlotte-Mecklenburg Utilities (CMUD), with three discharges into McDowell Creek, a tributary of Mountain Island Lake. A map of this subbasin including water quality sampling locations is presented in Figure B-4. Biological ratings for these sample sites are presented in Table B-4.

Based on benthic macroinvertebrate data since 1992, Dutchmans, Killian, Gar and Leepers Creeks were rated either Good or Excellent (although these streams often carry a heavy sediment load).

McDowell Creek received a Poor fish community rating due to the effects of severe bank erosion and lack of suitable fish habitat. Previous benthos studies here also indicated water quality problems. The discrepancy between fish and macroinvertebrate ratings of Killian and Leepers Creeks may be due to the heavy sediment load and lack of fisheries habitat typical of streams in this area.

Additional data on fish community integrity for Mecklenburg County streams were collected (using slightly different methods and metrics) by the Mecklenburg County Department of Environmental Protection (MCDEP) and Duke Energy.

Seven facilities in this subbasin currently monitor effluent toxicity in accordance with their NPDES discharge permit. Since 1995, all have consistently passed their self-monitoring tests.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. Only McDowell Creek is currently listed as impaired (partially supporting) in this subbasin. All other

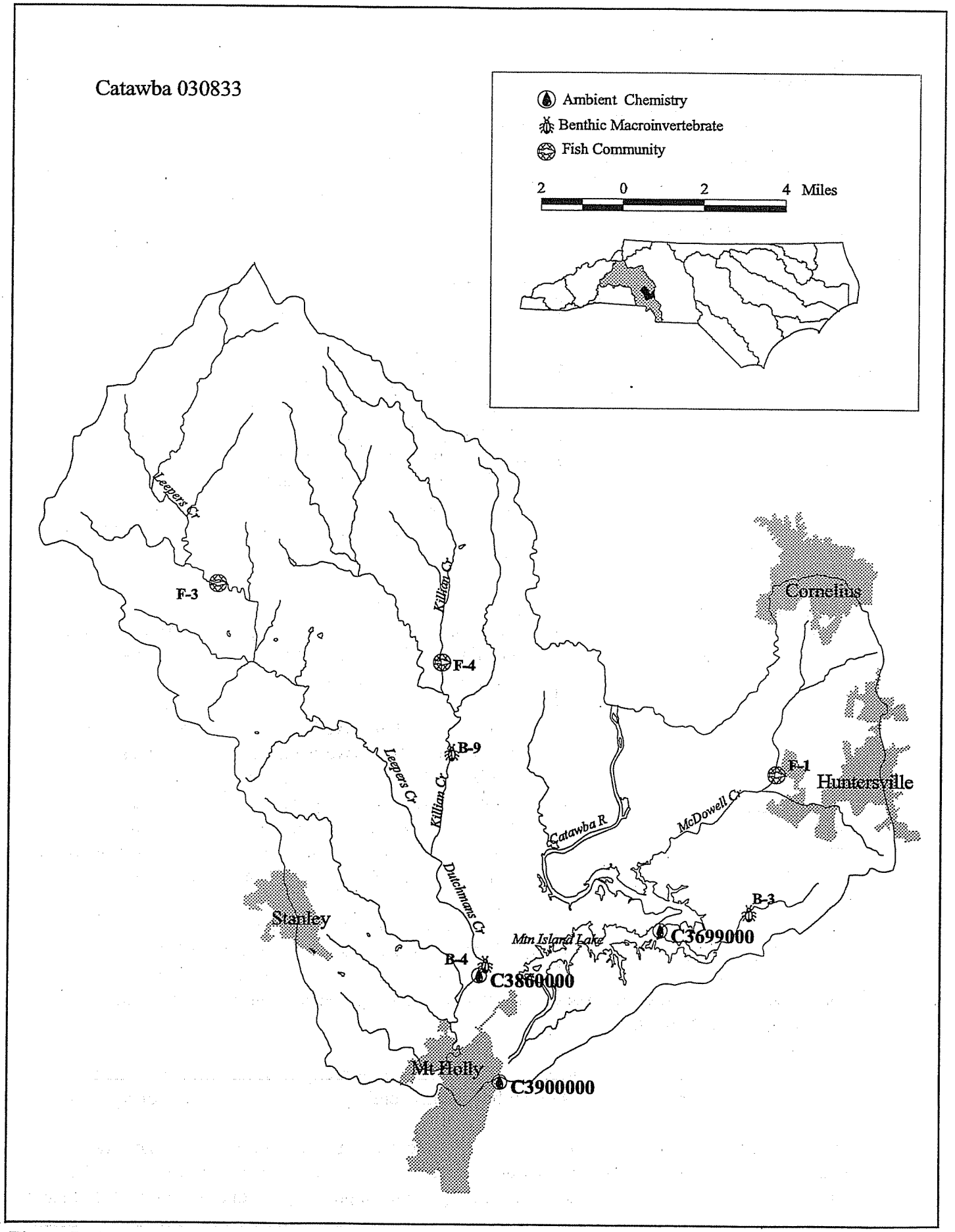


Figure B-4 Sampling Locations within Subbasin 03-08-33

sampling locations resulted in fully supporting ratings. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Table B-4 Biological Assessment Sites in Catawba River Subbasin 03-08-33 (1997)

Site	Stream	County	Road	Rating
B-3	Gar Creek	Mecklenburg	SR 2074	Good
B-4	Dutchmans Creek	Gaston	SR 1918	Excellent
B-9	Killian Creek	Lincoln	SR 1511	Good
F-1	McDowell Creek	Mecklenburg	SR 2136	Poor
F-3	Leepers Creek	Lincoln	NC 73	Good-Fair
F-4	Killian Creek	Lincoln	NC 73	Fair

Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites

Mountain Island Lake Assessment

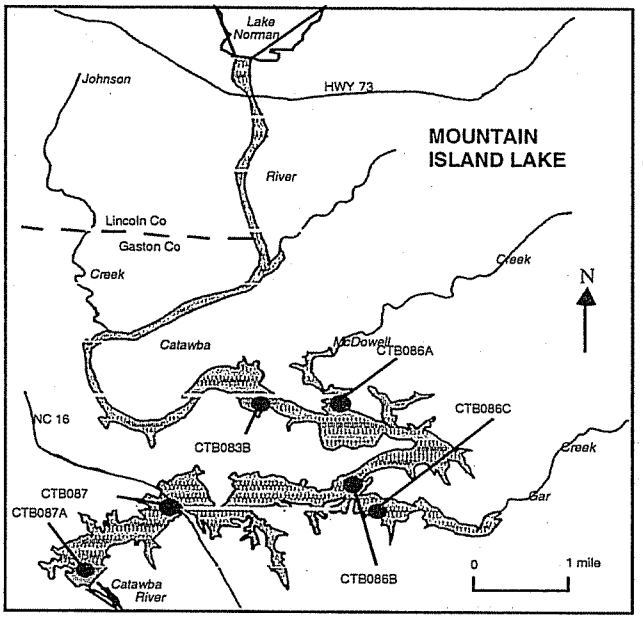
COUNTY:	Gaston/Mecklenburg	**CLASSIFICATION:**	WS-IV B CA
SURFACE AREA:	3235 acres (1309 hectares)	**MEAN DEPTH:**	16 feet (5 meters)
VOLUME:	$71.0 \times 10^6 m^3$	**WATERSHED:**	1860 mi^2 (4817 km^2)
SHORELINE:	61 miles	**RETENTION TIME:**	12 days

Mountain Island Lake is owned by Duke Energy and is formed by the drainage of Lake Norman into the Catawba River. The lake was filled when construction on the Mountain Island Hydroelectric Station was completed in 1924. Mountain Island is a relatively small and narrow lake. The drainage area is characterized by very hilly terrain of which approximately half is forested; one-fourth is agricultural; and the remainder is urban. The waters of Mountain Island Lake are used as a water supply for the City of Charlotte and by Duke Energy to generate electricity at both the Riverbend Steam Station and the Mountain Island Station located at the dam. The lake is classified as WS-IV from Cowans Ford Dam to the water intake at the River Bend Steam Station, and as WS-IV and Class B water from the water intake to the Mountain Island Dam.

Mountain Island Lake was most recently sampled in June, July and August 1997 and was determined to be oligotrophic. The lake was previously sampled by DWQ in 1981, 1982, 1986, 1992, 1995 and 1996. Mountain Island Lake was mesotrophic the first three years it was sampled, then oligotrophic in both 1992 and 1995.

In 1991 and 1992, a decrease in water quality in the McDowell Creek arm of Mountain Island Lake, downstream of the McDowell Creek WWTP, was observed by the Mecklenberg County Department of Environmental Protection (MCDEP). In response to concerns regarding the

decrease in water quality in the McDowell Creek arm of Mountain Island Lake and at the request of MCDEP, DWQ conducted a joint study with MCDEP from May 13 through October 13, 1994 to address nutrient contributions from the McDowell Creek WWTP. Results of this study are discussed further in Part 4.2.1 below.



For more detailed information on water quality in subbasin 03-08-33, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

4.2 Prior Basinwide Plan Recommendations (1995) and Achievements

4.2.1 Impaired Waters

The 1995 basinwide plan identified two waters in this subbasin as impaired. Each of these waters is discussed further below.

McDowell Creek Arm of Mountain Island Lake

At the time of the 1995 basinwide plan, Mecklenburg County and DWQ were in the midst of a study to monitor and document nutrient loading throughout the McDowell Creek watershed and the impact of nutrients on the McDowell Creek Arm of Mountain Island Lake. The study was designed to address nutrient contributions by the McDowell Creek WWTP operated by Charlotte-Mecklenburg Utilities (CMUD). Sampling stations were located above and below the WWTP discharge. Preliminary results of this study indicated that the CMUD McDowell Creek WWTP was the largest contributor of nutrients to the McDowell Creek arm of Mountain Island Lake. Finalized results of the study were to be included in this revised plan.

The basinwide plan also identified other lesser sources of nutrient contributions upstream of the facility (cattle, dairy and row crop agriculture, along with land clearing activities associated with residential and commercial development).

Status of Progress

Although high nutrient levels were found in McDowell Creek due to the discharge from the McDowell Creek WWTP, problematic algal bloom conditions were not generally found in the McDowell Creek arm of the lake. The current NPDES permit sets nutrient limits of 10 mg/l total nitrogen and 1 mg/l total phosphorus effective upon expansion above 3.5 MGD. The facility will complete expansion construction in 1999 and be subject to the nutrient limits. CMUD is currently experimenting with various biological nutrient removal modes in anticipation of the forthcoming nutrient limits. These process changes should result in significant reductions in nutrient loading. McDowell Creek is listed as impaired and recommendations are presented in Part 4.3.1 and 4.3.2.

Unnamed Tributary to Fites Creek

This stream segment was listed as impaired due to impacts from the Parkdale Mill discharge to a zero flow segment of the stream. Additional monitoring was recommended to determine if the stream has improved.

Status of Progress

This stream was not resampled because it is a zero flow stream, and the discharges have been removed.

4.2.2 Other Recommendations

Mountain Island Lake Study

DWQ and Mecklenburg County were conducting a two-year study of nutrient loading in the McDowell Creek watershed and the eutrophic response in Mountain Island Lake. Preliminary data suggested that the CMUD McDowell Creek WWTP discharge was the largest source of nutrients to this arm of the lake. This facility was to be required to implement nutrient removal upon major modification or expansion.

Status of Progress

For further discussion of this study, see Part 4.2.1, McDowell Creek Arm of Mountain Island Lake and Part 4.3.1 below.

4.3 Current Priority Issues and Recommendations

4.3.1 Monitored Impaired Waters

McDowell Creek is rated as impaired based on the most recent DWQ data available. The creek is also on the state's year 2000 (not yet EPA approved) 303(d) list (see Part 4.3.2).

McDowell Creek

The entire length of McDowell Creek (approximately 9.8 miles) is rated partially supporting due to nonpoint sources. During the 1997 sampling, it was noted that streambank erosion was extensive; there were no snags or riffles; and well-defined pools were rare and had been filled in with sediment. Because of such habitat alteration, the fish community was classified as Poor at the sampling site at SR 2136. The section of creek below the fish sampling station was also rated as impaired based on a 1990 benthos sampling and the heavily urbanized watershed of the creek.

1999 Recommendation(s)

Charlotte-Mecklenburg Utilities (CMUD) has recently completed an upgrade of the WWTP discharging into McDowell Creek. CMUD has added additional monitoring sites downstream of the discharge to assess reductions in nutrient loading to the creek. Preliminary data show a significant reduction of phosphorus as a result of this upgrade.

McDowell Creek may be suitable for local actions under the Mecklenburg County Surface Water Improvement and Management (SWIM) program (see Section C for more information) to address the nonpoint source contributions to degradation. Given the highly urbanized nature of the watershed, it will be challenging and costly to conduct enough mitigative activities in the watershed to result in measurable improvements. DWQ will work in cooperation with Mecklenburg County, where possible, to develop management strategies for stream restoration.

4.3.2 303(d) Listed Waters

The entire length of McDowell Creek is on the state's year 2000 (not yet EPA approved) 303(d) list and is discussed above. Refer to Appendix IV for more information on 303(d) listing methodology and requirements.

Chapter 5 -
Catawba River Subbasin 03-08-34
Includes Sugar Creek and its tributaries

5.1 Water Quality Overview

Subbasin 03-08-34 at a Glance

Land and Water Area (sq. mi.)

Total area:	324
Land area:	317
Water area:	7

Population Statistics

1990 Est. Pop.: 435,725 people
Pop. Density: 1,375 person/mi^2

Land Cover (%)

Forest/Wetland:	52%
Surface Water:	2%
Urban:	32%
Cultivated Crop:	0%
Pasture/ Managed Herbaceous:	13%

Use Support Ratings

Freshwater Streams:

Fully Supporting:	28.7 mi.
Fully Supporting but Threatened:	5.4 mi.
Partially Supporting:	82.1 mi.
Not Supporting:	2.6 mi.
Not Rated:	131.3 mi.

Lakes:

Lake Wylie - Fully Supporting

(Note: 300 acres of the Catawba Creek Arm and 570 acres of the Crowders Creek Arm are Fully Supporting but Threatened.)

Water quality in this heavily developed subbasin is affected by intensive urban runoff from the City of Charlotte and Mecklenburg County growth, as well as discharges from several large wastewater treatment plants. A map of this subbasin including water quality sampling locations is presented in Figure B-5. Biological ratings for these sample sites are presented in Table B-5.

There are currently over 50 permitted dischargers in this subbasin. The largest discharger is the Charlotte-Mecklenburg Utilities (CMUD), which discharges to Irwin Creek, McAlpine Creek and Little Sugar Creek. Thirty-three facilities in this subbasin currently monitor effluent toxicity under their NPDES permit. Only three of these facilities have experienced toxicity test failures in the past 5 years.

Most of the sample sites in the subbasin received a bioclassification of Poor or Fair based on benthic data since 1983. All 1997 benthos sites received a Fair rating. However, Irwin Creek and Little Sugar Creek improved from Poor to Fair between 1992 and 1997. Sugar Creek improved from Poor to Good-Fair between 1983 and 1992, but it received a Fair rating again in 1997. These are intensely urbanized streams draining the City of Charlotte.

Irwin Creek and Little Sugar Creek are rated Poor based on fish data. However, there were some improvements in the fish community in Irwin Creek between the 1993 and 1997 samplings. For example, approximately twice as many fish were collected in 1997 compared with 1993 and a greater percentage of multiple age groups was represented. This was indicative of more successful fish reproduction at the sampling point in 1997 than in 1993.

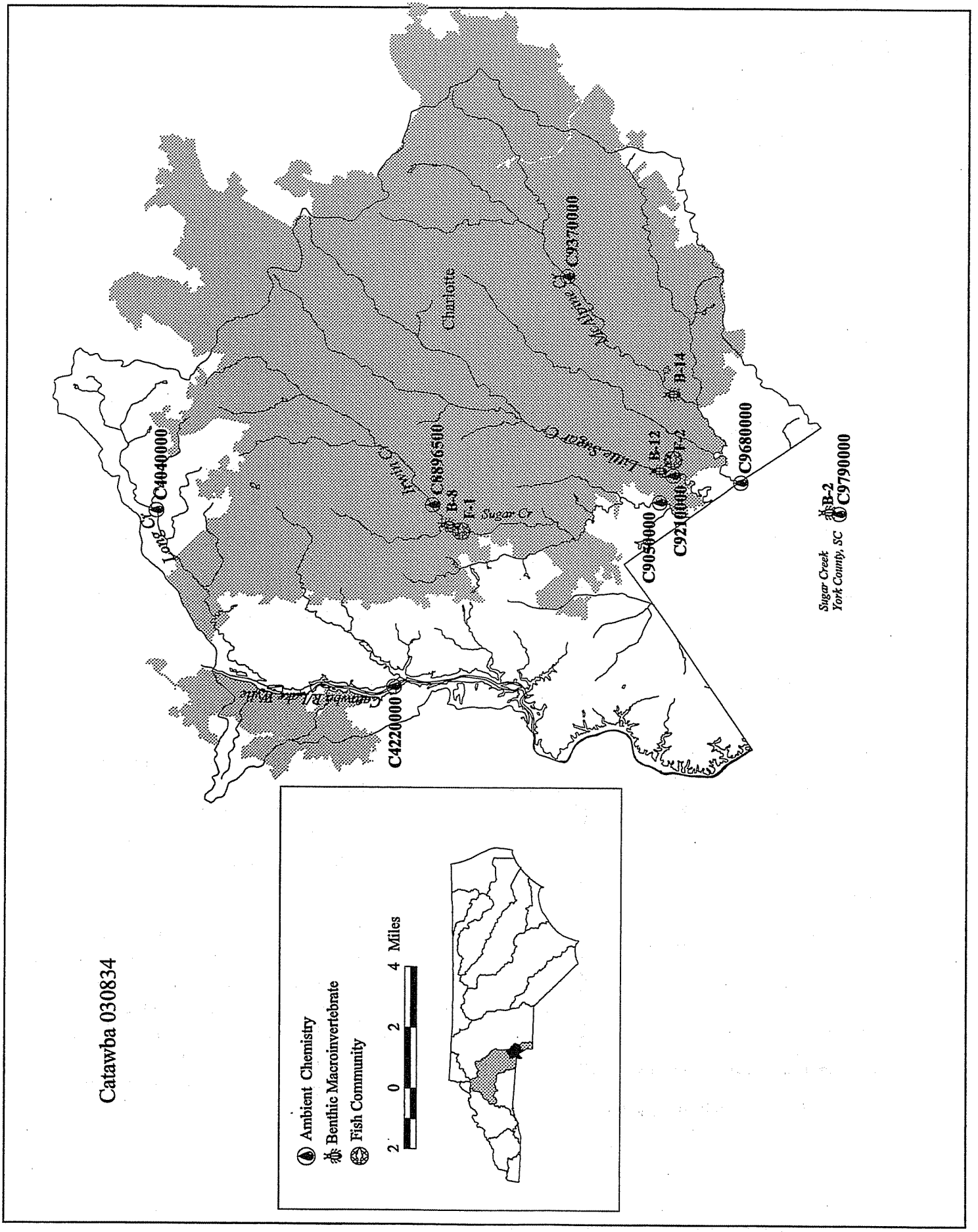


Figure B-5 Sampling Locations within Subbasin 03-08-34

Table B-5 Biological Assessment Sites in Catawba River Subbasin 03-08-34 (1997)

Site	Stream	County	Road	Rating
B-2	Sugar Creek	York, SC	SC 160	Fair
B-8	Irwin Creek	Mecklenburg	SR 1156	Fair
B-12	Little Sugar Creek	Mecklenburg	NC 51	Fair
B-14	McAlpine Creek	Mecklenburg	NC 51	Fair
F-1	Irwin Creek	Mecklenburg	SR 1156	Poor
F-2	Little Sugar Creek	Mecklenburg	NC 51	Poor

Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites

Historical data indicate that Sugar Creek has long been a severely polluted stream. Fisheries collections in the 1960s and 1970s usually recorded "no fish" in Sugar Creek. Both urban runoff and several large wastewater treatment plants contributed to these problems. This watershed is still characterized by Fair to Poor water quality.

The Mecklenburg County Department of Environmental Protection (MCDEP) has developed a stream bioassessment program to enhance the City of Charlotte's Storm Water Services' protection of streams in Charlotte and Mecklenburg County. This program uses benthic macroinvertebrate surveys to determine the overall water quality of the streams. Sampling methods are similar to DWQ, but stream classifications are slightly different.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. With the exception of the Catawba River mainstem, all monitored waters in this subbasin are impaired. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Lake Wylie Assessment

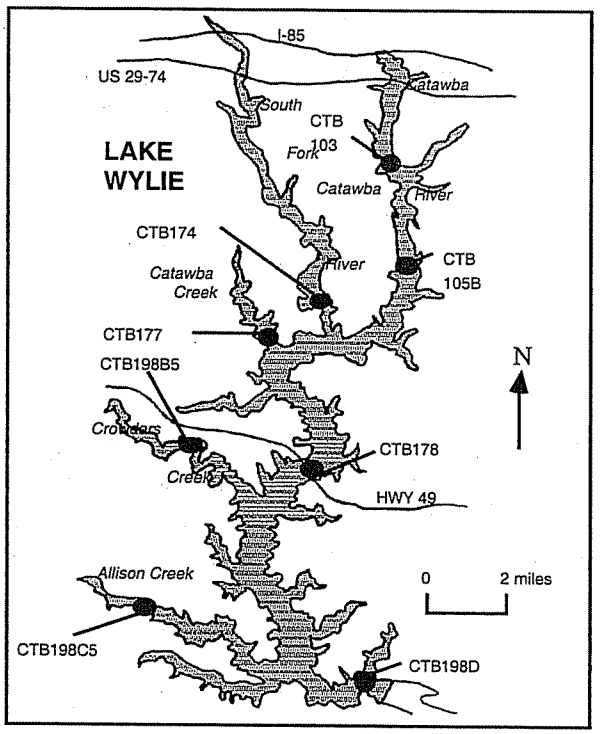
COUNTY:	Gaston/Mecklenburg	**CLASSIFICATION:**	WS-IV, WS-V B CA
SURFACE AREA:	12450 acres (5039 hectares)	**MEAN DEPTH:**	23 feet (7 meters)
VOLUME:	$35.3 \times 10^6 m^3$	**WATERSHED:**	3020 mi^2 (7822 km^2)
SHORELINE:	327 miles in NC	**RETENTION TIME:**	32 days

The Lake Wylie dam was built in 1904 and reconstructed and enlarged in 1928m making it the first lake built on the Catawba River. The lake is owned by Duke Energy and is located in Gaston and Mecklenburg counties in North Carolina and York County in South Carolina. Major tributaries include the Catawba River, the South Fork Catawba River, Crowders Creek, Catawba Creek and Allison Creek. The upstream watershed consists of forested areas along with agriculture and urban land uses. The waters of the lake are used to generate electricity and for

recreational purposes. The lake is classified WS-IV CA from Mountain Island Dam to the Interstate Highway 85 bridge at Belmont, WS-IV B CA from the Interstate 85 bridge to the upstream side of the Paw Creek arm of Lake Wylie, and WS-V B from the Paw Creek arm to the North Carolina-South Carolina state line.

Lake Wylie was most recently sampled by DWQ in June, August and September 1997. Lake Wylie was determined to be eutrophic in June, mesotrophic in August and eutrophic in September 1997. Historical data collected at Lake Wylie from 1981 to 1997 found total phosphorus, total organic nitrogen and chlorophyll *a* concentrations to be greatest in the Crowders Creek arm as compared with other sampling sites.

In response to continued public concern regarding the water quality of Lake Wylie and the proliferation of wastewater dischargers into the lake, the states of NC and SC conducted a joint water quality study of Lake Wylie in 1989 and 1990. Results of this study are presented in Section A, Chapter 4, Part 4.1.3.



For more detailed information on water quality in subbasin 03-08-34, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

5.2 Prior Basinwide Plan Recommendations (1995) and Achievements

The 1995 basinwide plan identified many streams in this subbasin as impaired. These are described below along with recommendations for addressing this impairment.

McCullough Branch, Brier Creek, Fourmile Creek, McMullen Creek and Steele Creek

These streams were previously rated impaired based on evaluated information. Use support methodology has been improved, and only monitored data are now used in use support determinations (see Section A, Chapter 3 for more information). The planned management strategy for these streams was to rely on the City of Charlotte Storm Water Program.

Current Status

These streams are located within the Sugar Creek watershed. This watershed is discussed further below. The City of Charlotte Storm Water Program is described further in Section C.

Dixon Branch, McIntyre Creek and Walker Branch

These streams were previously incorrectly rated impaired based on evaluated information. The streams should have been given a rating of fully supporting but threatened (ST). In addition, use support methodology has been improved, and only monitored data are now used in use support determinations (see Section A, Chapter 3 for more information). The planned management strategy for these streams was to rely on point source discharge removal.

Current Status

There are no longer any NPDES dischargers on these creeks.

Sugar Creek Watershed Including: *Sugar Creek, Little Sugar Creek, Irwin Creek, Stewart Creek, McAlpine Creek and Irwin Creek*

The Sugar Creek watershed receives a significant amount of wastewater from three facilities operated by Charlotte-Mecklenburg Utilities (CMUD): Irwin Creek WWTP, Sugar Creek WWTP and McAlpine Creek WWTP. In addition, the Sugar Creek watershed receives pollutant loads from several minor discharges and a highly urbanized area.

A water quality study of 32.3 stream miles in the Sugar Creek, Little Sugar Creek and McAlpine Creek watersheds was performed to calibrate a water quality model. This model was used to predict dissolved oxygen, ammonia and biochemical oxygen demand at low flow conditions.

Each major facility was given revised permit limits that were to become applicable when modifications were undertaken.

Status of Progress

As recommended, McAlpine Creek WWTP, Sugar Creek WWTP and Irwin Creek WWTP began operation of advanced tertiary treatment to meet revised permit limits. Sugar Creek, Irwin Creek, Little Sugar Creek and McAlpine Creek are all currently listed as impaired waters. Recommendations for addressing this impairment are discussed in Part 5.3.1. Stewart Creek is no longer impaired based on recent DWQ monitoring.

5.3 Current Priority Issues and Recommendations

5.3.1 Monitored Impaired Waters

This subbasin contains the highest number of impaired stream miles based on DWQ monitoring data. A large number of stream miles within this subbasin are not sampled by DWQ and are, therefore, not rated. It is likely that the number of impaired stream miles would be much higher if sampling was conducted on all streams in the subbasin. In large part, the highly urbanized nature of the subbasin is responsible for this impairment and makes it challenging and costly to retrofit the urbanization to make measurable water quality improvements. The streams that are listed impaired by DWQ are presented below. These streams are also on the state's year 2000 (not yet EPA approved) 303(d) list (see Part 5.3.2 below).

The City of Charlotte and Mecklenburg County Department of Environmental Protection conduct chemical and biological sampling on many streams within this subbasin. This data was used to support use support determinations where DWQ had a sampling station nearby.

Long Creek

Approximately 15.3 miles of Long Creek are rated impaired (partially supporting) due to turbidity and exceedences of the manganese water quality standard. Impairment is likely due to urban runoff, construction and agriculture in the watershed. This evaluation is based on chemical monitoring data since DWQ does not have biological monitoring locations on Long Creek at this time.

1999 Recommendation(s)

DWQ will conduct further monitoring on Long Creek to better determine sources of impairment. Long Creek is also on the 303(d) list for developing a management strategy (see Part 5.3.2). To assist in these efforts, an in-depth watershed assessment is needed.

Sugar Creek, Irwin Creek, Little Sugar Creek and McAlpine Creek

The entire length of each of these creeks (Sugar Creek = 13.3 mi., Irwin Creek = 11.8 mi., Little Sugar Creek = 20.7 mi., and McAlpine Creek = 20.4 mi.) is listed as impaired (partially supporting) due to wastewater discharges and urban runoff. Problem parameters include turbidity and fecal coliform bacteria as well as poor to fair biological communities. This impairment is perceived to be responsible for some portion of the impact to the water quality of Lake Wateree in South Carolina.

1999 Recommendation(s)

The waters of this subbasin are part of a larger watershed that spans both North and South Carolina. Sugar Creek is part of the Fishing Creek Reservoir watershed in South Carolina. Downstream of Fishing Creek Reservoir is Cedar Creek Reservoir and Lake Wateree. Fishing Creek and Cedar Creek Reservoirs and Lake Wateree are on the South Carolina 303(d) list. A

TMDL must be developed to address the causes and sources of impairment for these lakes. South Carolina Department of Health and Environmental Control (DHEC) is working with DWQ to develop a management plan for phosphorus reduction to SC's waters. DHEC has proposed the development of a phosphorus TMDL, as presented in Figure B-6.

The University of South Carolina is performing a nonpoint source assessment and modeling study in cooperation with SC DHEC to meet the goal of TMDL development. This study has four components: nonpoint source water quality field studies, watershed/nonpoint source modeling, nutrient response modeling, and consensus building for load allocation to Lake Wateree. This study should provide significant insight into nutrient contributions from nonpoint sources and direct management strategies to address these sources.

Using the currently available information, as described in the Interim column of Figure B-6, DHEC plans to include total phosphorus limits for South Carolina NPDES dischargers with flows greater than 50,000 gallons per day beginning in year 2000. DHEC has been placing phosphorus limits on all new and expanding dischargers, regardless of size, since 1998.

Significant discharges of phosphorus also come from the NC portion of the Fishing Creek Reservoir watershed. Early estimates indicate that approximately 40 percent of the phosphorus load comes from the Sugar Creek subbasin in NC. Thus, some phosphorus controls are needed from both NC and South Carolina sources to improve water quality in Lake Wateree.

Charlotte-Mecklenburg Utilities (CMUD) has three NPDES discharges in this subbasin that carry a significant amount of the phosphorus load through the watershed. CMUD has expressed an interest in working with DHEC and DWQ to establish goals and develop a plan of action to reduce nutrient loading. CMUD recently developed a Long-Term Monitoring Program at the McAlpine, Sugar and Irwin Creek WWTPs addressing nutrients entering the facilities, and how existing treatment processes and operating practices affect effluent nutrient concentrations. In addition, CMUD has diverted the waste activated sludge (and primary sludge) stream from the Sugar Creek WWTP to the McAlpine Creek WWTP, where different treatment processes and flow routing produce lower phosphorus levels in the plant effluent and higher treatment levels.

CMUD believes the elevated phosphorus levels from the Sugar Creek WWTP may be due to sludge storage tank digester processes. CMUD is completing construction to transfer all solids treatment from the Sugar Creek facility to the McAlpine Creek facility. The goal is to reduce concentrations of total phosphorus being discharged from the Sugar Creek WWTP to those levels documented at the other plants on McAlpine Creek and Irwin Creek.

CMUD has also initiated, in cooperation with Mecklenburg County, a monitoring plan for determining nutrient levels in the receiving streams above and below the WWTPs. CMUD has also recently begun a system of collecting nutrient information for Significant Industrial Users (SIUs) and commercial dischargers that discharge to the sanitary sewer system as a means of better understanding potential sources and influent levels.

DWQ will recommend plant optimization for these three facilities upon permit renewal. Plant optimization could significantly reduce nutrient loadings from the facilities. After completion of data gathering and modeling analysis, DWQ will assess the need for additional nutrient

reductions and permit limits for total phosphorus on dischargers in the subbasin at future permit renewal.

Additional management strategies need to be developed to address the other problem parameters for these waters: fecal coliform bacteria and turbidity. The Mecklenburg County SWIM program will be instrumental in implementing strategies to restore these waters. DWQ will support the actions of SWIM as much as possible.

DWQ is currently developing fecal coliform TMDLs for Sugar Creek, Little Sugar Creek and McAlpine Creek. Data on these waters have been collected by DWQ, the Mecklenburg County Department of Environment Protection (MCDEP) and the USGS. Data from all of these sources will be considered in developing the TMDL. The MCDEP is also providing land use data and other information to support TMDL development.

Existing data indicate that fecal coliform levels are elevated throughout these watersheds. Fecal coliform levels are especially high during storm events, but elevated concentrations during non-storm periods are common. While work to characterize sources of fecal coliform is still ongoing, it is likely that several types of sources are important. These sources include runoff from urban surfaces as well as leaking sanitary sewer lines. While several municipal wastewater plants discharge into these waters, they are not believed to be major contributors to the problem.

Each TMDL will include: 1) an assessment of current fecal coliform loadings from particular source types or source areas; 2) an estimate of the loading capacity (i.e., a determination of the fecal coliform loading each stream can sustain and still meet water quality standards); 3) an allocation of the loading capacity to specific source types or source areas; and 4) specifying the extent of reduction from various sources necessary to bring the loading down to the specified level. An implementation plan will also be developed, discussing the specific measures that will be taken to attain the loading reductions required by the TMDL.

DWQ will work closely with Mecklenburg County and the City of Charlotte during development of the TMDL and implementation plan. As much as possible, the implementation plan will function in cooperation with the Mecklenburg County Surface Water Improvement and Management (SWIM) initiative (see Section C). It is the intent of DWQ to complete a draft of the fecal coliform TMDLs in 2000. Development of the implementation plan will follow completion of the TMDL.

5.3.2 303(d) Listed Waters

Several streams within this subbasin are on the state's year 2000 (not yet EPA approved) 303(d) list. All of these waters are currently considered to be impaired and are discussed above. Refer to Appendix IV for more information on 303(d) listing requirements.

Proposed TMDL Development for Lake Wateree, SC

SC 303(d) listed reservoirs in the Catawba River Basin:
Fishing Creek Reservoir
Cedar Creek Reservoir Lake Wateree

Interim (1999-2000)		Final (2002-2003)
1-D Nutrient Response Model of Lake Wateree. Funded by WHOA. Models chlorophyll-a and DO. Discretized longitudinally, not vertically (i.e., depth averaged). (USC, 1997)	Nutrient Response Model	***Lake Wateree Nutrient Field Study.*** Additional monitoring including recommendations from 1997 modeling report. (EPA, 2000) ***Nutrient Model Refinement.*** Using new study results and WARMF Wateree model or existing Lake Wateree model. (USC, 2001?)
Point Load Estimates. Where water quality and flow data are available, estimate the total nutrient loads. (DHEC & DWQ, 1999) ***TP fate and transport.*** TP fate below Lk Wylie, mainstem Catawba. (USGS, 1999)	Watershed/ NPS Loading Model	***NPS Water Quality Field Studies.*** Storm event monitoring to verify coefficients in WARMF. Cane or Rocky Creek watershed. (USC, 1999-2001) ***Watershed/NPS Modeling.*** Nutrients in watershed below Lk Wylie modeled using WARMF. MCDEP data may be used to assist model calibration. (USC, 2002)
Interim Nutrient Management. Develop interim plan for management of nutrients until more comprehensive plan is developed. (DHEC & DWQ, 1999-2000)	Allocation and Management Strategy	***Load Allocation.*** Allocate nutrient loads to point and nonpoint sources. (USC,DHEC, DWQ, stakeholders, 2002-2003) ***TMDL Development with Implementation Plan.*** (DHEC & DWQ, 2003)

draft

Figure B-6 Proposed TMDL Development for the Watershed of Lake Wateree, South Carolina

Chapter 6 -
Catawba River Subbasin 03-08-35
Includes Henry Fork, Jacob Fork, Clark Creek, Indian Creek and South Fork Catawba River

6.1 Water Quality Overview

Subbasin 03-08-35 at a Glance

Land and Water Area (sq. mi.)

Total area:	559
Land area:	558
Water area:	1

Population Statistics

1990 Est. Pop.:	110,523 people
Pop. Density:	198 persons/mi^2

Land Cover (%)

Forest/Wetland:	57%
Surface Water:	0%
Urban:	3%
Cultivated Crop:	4%
Pasture/ Managed Herbaceous:	35%

Use Support Ratings

Freshwater Streams:

Fully Supporting:	285.6 mi.
Fully Supporting but Threatened:	106.3 mi.
Partially Supporting:	19.0 mi.
Not Supporting:	0.0 mi.
Not Rated:	81.2 mi.

Lakes:

Maiden Lake - Fully Supporting but Threatened - 23 acres

Land use in this subbasin is primarily agriculture with some urban areas. The largest dischargers in this subbasin are the municipalities of Hickory, Lincolnton and Newton. Smaller dischargers include Cherryville, Delta Mills and Stanley. Nine facilities in this subbasin currently monitor effluent toxicity under their NPDES permit. A map of this subbasin including water quality sampling locations is presented in Figure B-7. Biological ratings for these sample sites are presented in Table B-6.

The upper reaches of Henry Fork and Jacob Fork have Excellent water quality ratings and have been designated ORW areas. The lower reaches of Jacob Fork and Henry Fork generally have Good water quality. These areas receive nonpoint source runoff and effluent from point source dischargers. Streams with the worst water quality include Clark Creek (which receives effluent from domestic, industrial and textile sources) and Mauney Creek (which receives effluent from the Stanley WWTP).

Of the seven sites that have long-term data, all but Clark Creek experienced an increase in water quality or remained stable. However, the Clark Creek ambient location improved between 1983 and 1997.

A special study in 1997, requested by the Mooresville Regional Office, investigated the effects of leakage from underground storage tanks along Mauney Creek. Although the tanks had been removed, gasoline contaminated the groundwater and was reaching Mauney Creek. The Stanley WWTP, discharging only 0.2 miles above the gasoline contamination area, was found to be the most likely source of instream toxicity.

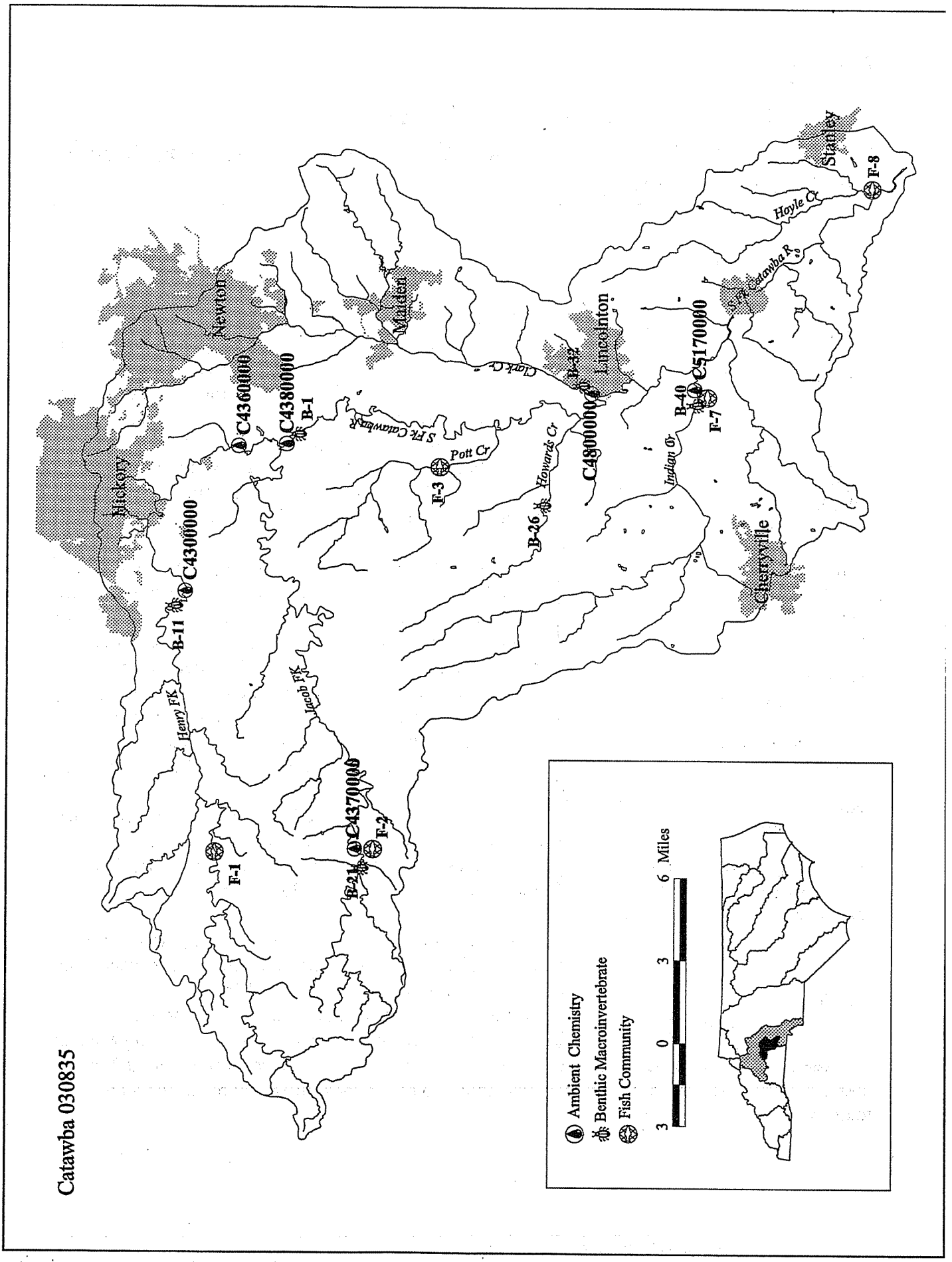


Figure B-7 Sampling Locations within Subbasin 03-08-35

Table B-6 Biological Assessment Sites in Catawba River Subbasin 03-08-35 (1997)

Site	Stream	County	Road	Rating
B-1	South Fork Catawba River	Catawba	NC 10	Good
B-11	Henry Fork	Catawba	SR 1124	Good
B-21	Jacob Fork	Burke	SR 1924	Excellent
B-26	Howards Creek	Lincoln	SR 1200	Good
B-32	Clark Creek	Lincoln	SR 1008	Good-Fair
B-40	Indian Creek	Lincoln	SR 1252	Good
B-42	Mauney Creek	Gaston	SR 1831 (ab)	Fair
B-43	Mauney Creek	Gaston	SR 1831 (bl)	Fair
F-1	Henry Fork	Burke	SR 1916	Fair
F-2	Jacob Fork	Burke	SR 1924	Good
F-3	Pott Creek	Lincoln	SR 1217	Fair
F-7	Indian Creek	Lincoln	SR 1252	Poor
F-8	Hoyle Creek	Gaston	SR 1836	Fair

Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites

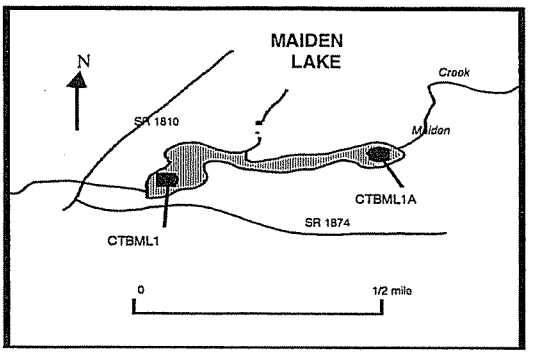
Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. There are two streams listed as impaired in this subbasin: Clark Creek (partially supporting) and Mauney Creek (partially supporting). Further discussion on these streams can be found in Part 6.3 below.

Fully supporting but threatened waters (ST) in this subbasin include most of the South Fork Catawba River and Indian Creek. The 1995 basinwide plan listed only the lower portion of the South Fork Catawba River as ST. Therefore, there are currently more stream miles on the South Fork Catawba River rated ST than the previous plan. All other sampled tributary waters are fully supporting (FS). Refer to Appendix II for a complete listing of monitored waters and use support ratings.

Maiden Lake Assessment

COUNTY:	Catawba	**CLASSIFICATION:**	WS-II CA
SURFACE AREA:	14 acres (6 hectares)	**MEAN DEPTH:**	10 feet (3 meters)
VOLUME:	$0.02 \times 10^6 m^3$	**WATERSHED:**	20 mi^2 (52 km^2)

Maiden Lake is the water supply for the Town of Maiden. Built in the mid-1960s, the reservoir is fed by Maiden Creek and several springs. An average of 1.5 to 2 million gallons of water per



day are extracted from the lake for water supply. Increased siltation has been evident since mid-1990. An investigation was conducted in March 1993 pursuant to a complaint by the Town of Maiden regarding sediment buildup in Maiden Lake. The investigation indicated that siltation originated upstream of the lake from a land clearing operation for development of a nursery, as well as from other nonpoint sources located above this nursery. The investigation indicated that the entire watershed (above and below the nursery) is degraded, although a fishery survey indicated slightly higher levels of impact downstream (NCDEHNR, 1993).

Maiden Lake was most recently monitored by DWQ in June, July and August 1997 and was determined to be hypereutrophic in June, eutrophic in July and mesotrophic in August 1997. The lake has been given a use support rating of fully supporting but threatened (ST).

For more detailed information on water quality in subbasin 03-08-35, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

6.2 Prior Basinwide Plan Recommendations (1995) and Achievements

6.2.1 Impaired Waters

The 1995 Catawba River basinwide plan identified two streams as impaired in this subbasin. These are described below along with recommendations for improving water quality.

Clark Creek

The lower sections of Clark Creek were listed in the 1995 basinwide plan as impaired (partially supporting and not supporting) due to instream violations of the fecal coliform bacteria and turbidity standards and copper action levels. Colored effluent from textile dischargers was noticeable on Clark Creek, and the plan recommended that DWQ conduct a color reduction study.

The potential for toxicity impacts from three major dischargers (Newton WWTP, Maiden WWTP and Delta Mills) was also cited as a concern. To address this concern, DWQ recommended that a toxicity Total Maximum Daily Load (TMDL) for Clark Creek be developed. DWQ also recommended that the Newton WWTP be required to meet new limits for certain metals upon permit renewal. Because copper levels above the action level have been observed,

DWQ recommended an assessment to determine if copper limits in the discharge permits were needed at next permit renewal.

Status of Progress

Limited progress has been made in developing a color reduction strategy since the 1995 basinwide plan. However, this initiative has recently been revived in response to citizen complaints and concerns expressed at public workshops. DWQ and the Division of Pollution Prevention and Environmental Assistance (DPPEA) are working to develop a color management strategy with stakeholder involvement prior to finalization of this revised basinwide plan (see Section A, Chapter 4, Part 4.1.4 for more information).

As a result of the 1995 basinwide plan concerns for toxicity, the Town of Newton was given permit limits for cadmium and lead and monitoring limits for copper and toluene. In February 1997, the facility requested a review of the cadmium and lead limits. DWQ conducted a Reasonable Potential Analysis of the data and reasoned it acceptable to drop the cadmium and lead limits from the NPDES permit. Under the *Reasonable Potential Analysis Policy*, the EPA requires that the Director of DWQ must limit a pollutant after determining that it "may be discharged at a level which will cause, or have the reasonable potential to cause ... an excursion above any State water quality standard" [40 CFR 122.44 (d)(i)]. However, monitoring for lead, cadmium, copper, zinc, nickel and toluene continue under the Pretreatment Long-Term Monitoring Plan.

DWQ has completed a draft review of toxics information for the Clark Creek watershed (NCDENR, 1999). Recommendations from this study are discussed in Part 6.3. North Carolina uses a statistical method approved by the EPA to determine the potential of a discharge to violate a water quality standard for a given parameter based on existing data. If a calculated maximum predicted effluent concentration is greater than the allowable level, then a parameter is determined to have the reasonable potential to violate the state's water quality standard, and a limit will be required in the permit. The toxics review conducted for Clark Creek did not indicate that any of the parameters in question would exceed water quality standards for Clark Creek.

Clark Creek is still an impaired water and recommendations for improving water quality in the creek are presented in Part 6.3. The creek is also on the 303(d) list, and a combination TMDL and management strategy will be developed (see Part 6.3.2 below for further discussion).

Bills Branch

Bills Branch was listed as impaired due to effluent from the North Carolina Department of Correction Catawba Correctional Center WWTP. This facility ceased discharging in 1990. Additional monitoring was recommended to determine if the stream has improved.

Status of Progress

DWQ biologists have determined that Bills Branch is a low flow stream, and therefore, too small to adequately sample. There is still one discharger to this creek: Precedent, Incorporated. In

1993, this discharger received a letter from DWQ requesting that the facility look into possible connection to a publicly-owned wastewater facility or non-discharge alternatives. A report of this investigation is to be provided by the facility at the time of requesting permit renewal. DWQ will review this information at the next permit renewal.

6.2.2 Other Recommendations

South Fork Catawba River

The South Fork Catawba River is used both as a drinking water supply and for the assimilation of wastewater. To address concerns about potential toxicity, DWQ recommended that point source wasteload allocations for each facility discharging to the South Fork Catawba River from Lincolnton to Lowell should include a TMDL analysis for total loading at the Lowell Gage. Nonpoint source strategies, implemented through the industrial NPDES stormwater program, were expected to be helpful in reducing toxic substance loading to surface waters.

Status of Progress

Current EPA requirements for 303(d) listing and the development of TMDLs have significantly changed since the 1995 basinwide plan (see Appendix IV for more details). The development of TMDLs for the South Fork Catawba River is not required because the river is not an impaired water (current status is fully supporting but threatened). Additional studies were not conducted to determine if potentially toxic chemicals are present in the South Fork Catawba River. However, a review of existing data was performed to identify those chemicals that may contribute to a toxicity problem in the South Fork Catawba River. Because the South Fork Catawba River flows through two subbasins, the South Fork Toxics Review of the South Fork Catawba River is discussed in Section A, Chapter 4, Part 4.1.5.

6.3 Current Priority Issues and Recommendations

6.3.1 Monitored Impaired Waters

There are two impaired waters in this subbasin: Clark Creek and Mauney Creek. Discussion on these creeks and recommendations for improving water quality are presented below. These creeks are also on the state's year 2000 (not yet EPA approved) 303(d) list (see Part 6.3.2 below).

Clark Creek

The entire length (10.1 mi.) of Clark Creek is impaired (partially supporting) due to urban runoff, agriculture and point sources. Fecal coliform bacteria, turbidity and copper are the listed problem parameters. As noted in Part 6.2.1, the potential for toxicity impacts has also been of concern to DWQ. To address the potential toxicity issue, DWQ conducted a toxics review for Clark Creek. Although not directly contributing to impairment of Clark Creek, the colored effluent visible in the creek is also a matter of concern to DWQ.

1999 Recommendation(s)

DWQ completed a draft review of toxics information for the Clark Creek watershed (NCDENR, 1999). Data were assembled from dischargers through the NPDES and pretreatment programs and ambient instream data on Clark Creek at Lincolnton. Data were analyzed to determine if toxic effluent resulted in violations of water quality standards in the creek. The analysis showed that current levels of cadmium, chromium, cyanide, lead, nickel and toluene in effluent are not likely to result in instream violations of standards. Further analysis of copper and manganese are required since the standards for these two metals are frequently violated, and point sources may contribute to these violations. This level of analysis is being conducted as part of a toxics review for the South Fork Catawba River. Because the South Fork Catawba River flows through more than one subbasin, this issue is discussed further in the South Fork Catawba River toxics section (see Section A, Chapter 4, Part 4.1.5 for more information).

Clark Creek is on the 303(d) list and a TMDL approach will be used to address the fecal coliform bacteria, turbidity and copper parameters (see Part 6.3.2 below). DWQ is using a Clean Water Management Trust Fund grant to further identify sources of water quality problems in this watershed.

A discussion of a color reduction strategy is presented in Section A, Chapter 4, Part 4.1.4 because the issue of colored effluent is not unique to Clark Creek, but rather is of concern to DWQ for the entire South Fork Catawba River watershed.

Mauney Creek

About 4.3 miles of Mauney Creek is listed impaired (partially supporting) due to both nonpoint and point sources (Stanley WWTP) of pollution. The Stanley WWTP conducts whole effluent toxicity tests on the discharge and has been in compliance with permit limits recently, although they had toxicity problems in 1996. Recent compliance is due to improvements made at the facility, including dechlorination. In addition, Mount Holly is taking some of the Stanley WWTP waste to reduce the sewer overflows that are problematic for Stanley. This cooperation reduces the number of sewer overflows for the Stanley system.

1999 Recommendation(s)

DWQ will continue to work with the Stanley WWTP facility to assure permit limits are met. Additional resources will be necessary to conduct a watershed survey to determine the potential actions needed to address nonpoint sources of pollution to this creek. Mauney Creek is on the 303(d) list (see Part 6.3.2).

6.3.2 303(d) Listed Waters

Both Clark Creek and Mauney Creek are on the state's year 2000 (not yet EPA approved) 303(d) list. These creeks are currently considered to be impaired and are discussed above. Refer to Appendix IV for more information on 303(d) listing requirements. Eight miles of Henry Fork, though not considered to be impaired, are on the list due to turbidity levels, and a monitoring strategy will be used to assess the sources of turbidity.

6.3.3 Other Issues and Recommendations

South Fork Catawba River Watershed

Clark Creek is contributing to the degradation of the South Fork Catawba River water quality, including fecal coliform bacteria, metals and sedimentation. Other tributaries within the watershed are cumulatively affecting the water quality of the South Fork Catawba River. Colored effluent is noted in the South Fork Catawba, but the impact of this color on the biota of the stream is not apparent.

1999 Recommendation(s)

Although the South Fork Catawba River is not an impaired river, it has been given a use support rating of fully supporting but threatened (ST) for most of its length. There is obviously a need to improve water quality in the river based on water quality standards and on comments received at public workshops. The South Fork flows through more than one subbasin and is therefore discussed in Section A, Chapter 4, Part 4.1.5 for a color reduction strategy and for a review of toxics in the river.

Maiden Lake

Maiden Lake is experiencing eutrophication and siltation resulting from land use activities within the watershed. Given that this lake is the water supply for the Town of Maiden, the town will need to develop protection measures for the resource. These measures might include a local sedimentation and erosion control program, developing and enforcing ordinances to prevent erosion, and education efforts to increase public awareness about reducing runoff.

Chapter 7 -
Catawba River Subbasin 03-08-36
Includes Long Creek and lower South Fork Catawba River

7.1 Water Quality Overview

Subbasin 03-08-36 at a Glance

Land and Water Area (sq. mi.)

Total area:	104
Land area:	101
Water area:	3

Population Statistics

1990 Est. Pop.:	61,697 people
Pop. Density:	611 persons/mi^2

Land Cover (%)

Forest/Wetland:	54%
Surface Water:	3%
Urban:	14%
Cultivated Crop:	2%
Pasture/ Managed Herbaceous:	27%

Use Support Ratings

Freshwater Streams:

Fully Supporting:	19.7 mi.
Fully Supporting but Threatened:	22.7 mi.
Partially Supporting:	0.8 mi.
Not Supporting:	0.0 mi.
Not Rated:	26.2 mi.

This small subbasin includes Gastonia and parts of Bessemer City. Major dischargers include Crompton & Knowles, Pharr Yarns, Union County, Collins and Aikman, and Gastonia. Seven facilities in this subbasin currently monitor effluent toxicity under their NPDES permit. A map of this subbasin including water quality sampling locations is presented in Figure B-8. Biological ratings for these sample sites are presented in Table B-7.

Long Creek is primarily affected by agricultural runoff and attempts are being made to control erosion in the watershed. Most of the long-term benthos sites from this subbasin are associated with the Long Creek agricultural BMP effectiveness investigation. The BMPs were installed by the Gaston County Soil and Water Conservation District and primarily target the dairy farms in the watershed. Two of the sites have improved from Good-Fair to Good.

During the 1997 basinwide sampling, one fish community site was sampled on Long Creek. Although the classification for this site was Poor for both 1997 and 1993, the 1997 results indicated an increase in the NCIBI score and a large increase in the number of species collected.

The other long-term data site is South Fork Catawba River near McAdenville. This site has improved over the years from Fair in 1985 to Good-Fair in 1987 and has remained Good-Fair since that time.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. There are no impaired waters in this subbasin.

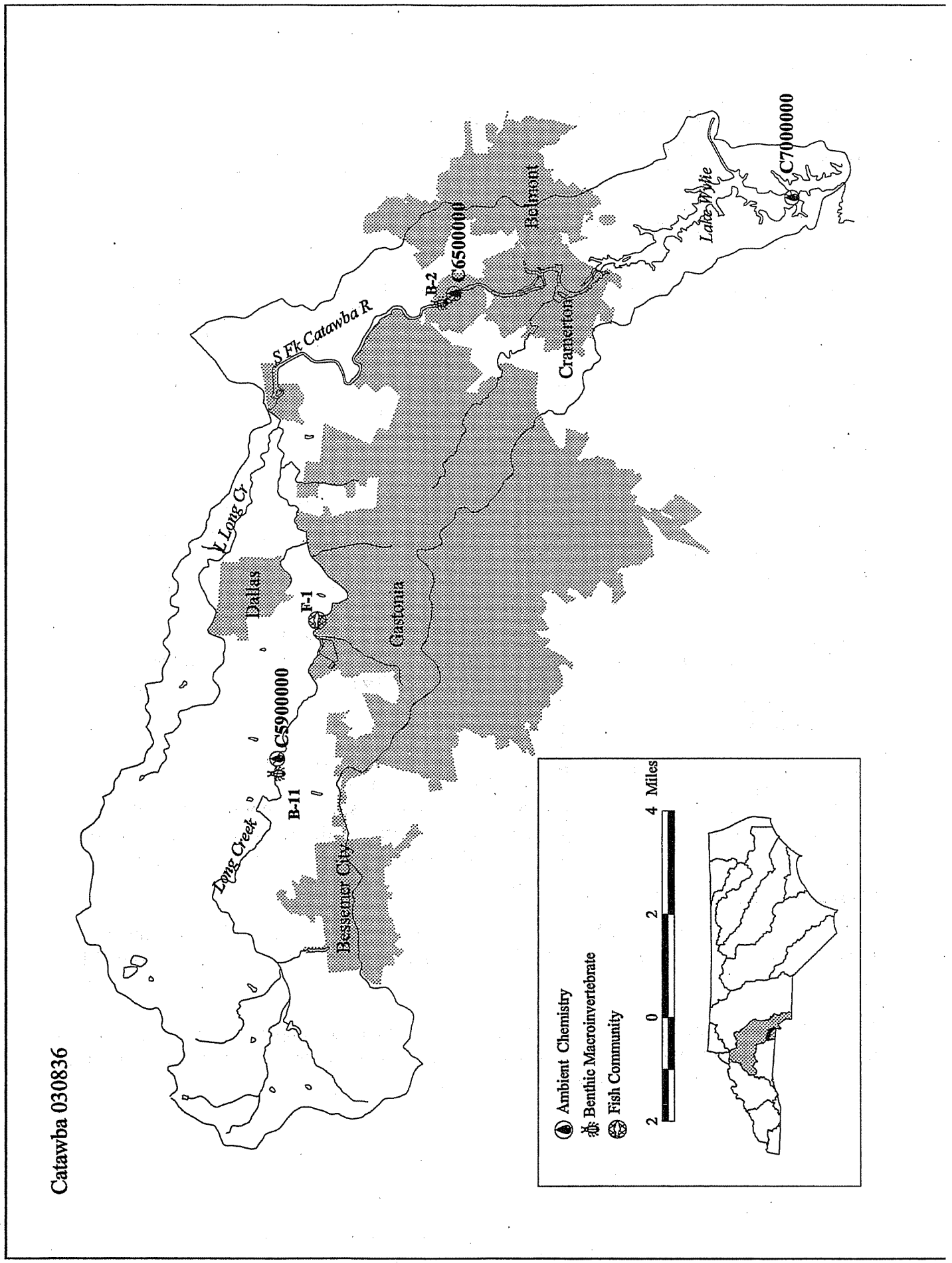


Figure B-8 Sampling Locations within Subbasin 03-08-36

Table B-7 Biological Assessment Sites in Catawba River Subbasin 03-08-36 (1997)

Site	Stream	County	Road	Rating
B-2	South Fork Catawba River	Gaston	NC 7	Good-Fair
B-11	Long Creek	Gaston	SR 1456	Good-Fair
F-1	Long Creek	Gaston	US 321	Poor

Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites

Fully supporting but threatened waters (ST) in this subbasin include the South Fork Catawba River and a short segment of Long Creek. The 1995 basin plan listed only the lower portion of the South Fork Catawba River as ST. There are currently more stream miles rated ST than the previous plan. Refer to Appendix II for a complete listing of monitored waters and use support ratings.

7.2 Prior Basinwide Plan Recommendations (1995) and Achievements

7.2.1 Impaired Waterbodies

The 1995 basinwide plan identified two streams as impaired. Each of these impaired waters are discussed below.

Long Creek

The 1995 basinwide plan identified lower Long Creek as impaired due to impacts from the Gastonia WWTP and nonpoint sources throughout the watershed. The Gastonia Long Creek WWTP was the largest point source discharge in the watershed. In 1990, the Gaston County Quality of Natural Resources Commission and the North Carolina Cooperative Extension Service, in conjunction with 13 sponsors including DWQ, initiated a water quality study of the Long Creek watershed. The objectives of the study were to identify and monitor point and nonpoint pollution sources and to collect water quality data that will allow for the development of policies and plans to protect the watershed. North Carolina Agricultural Cost Share Program funds were to be targeted for BMP implementation for animal waste management systems to address nonpoint sources of pollution.

Status of Progress

DWQ has been working with the City of Gastonia to reduce the discharge of oxygen-consuming wastes from the Long Creek WWTP. The Long Creek WWTP relocated its outfall from Long Creek to the South Fork Catawba River in 1998. This treatment upgrade means that even as permitted wasteflow is doubled, the facility will be able to reduce the total loading of oxygen-consuming wastes to the watershed. Following expansion to 16 MGD, the facility will be subject to advanced tertiary limits.

The Long Creek Watershed project in Gaston County was initiated in 1992 as an EPA 319 nonpoint source monitoring program project. The project will continue through 2001. Several agencies have cooperated on this project with the Gaston County Cooperative Extension Service playing a lead role. More details on this project can be found in Section C of this plan. Current data indicate that the installation of best management practices (BMPs) in the watershed have resulted in a decrease in bacteria and total phosphorus levels.

Many university research projects are also taking place in this watershed, in cooperation with several dairy operations. Best management practices are being installed throughout the watershed to reduce sediment transport and reduce nutrients and fecal coliform bacteria levels. For more information, refer to Section C, Chapter 1 or contact the Gaston County Cooperative Extension Service at (704) 922-0303.

Based on the most recent DWQ data, Long Creek is no longer listed as an impaired stream. While Long Creek is rated as fully supporting its uses, there are elevated fecal coliform bacteria levels in the creek. DWQ will continue to conduct monitoring in Long Creek to assess water quality improvements as a result of ongoing NPS reduction projects and improvements to the Gastonia-Long Creek WWTP.

Dallas Branch

Dallas Branch is a tributary to Long Creek and was listed as impaired in the 1995 basinwide plan due to nonpoint sources of pollution. The planned management strategy for the creek was to include the creek in the Long Creek Watershed study.

Status of Progress

Dallas Branch has not specifically been a focus of the Long Creek Watershed project, and DWQ did not include this branch in the most recent sampling. Therefore, the creek has not been given a use support rating. However, the creek is on the 303(d) list due to prior DWQ sampling (see Part 7.3.2 for more information).

7.2.2 Other Recommendations

South Fork Catawba River

A water quality study of 10 miles of the South Fork Catawba River was performed in order to calibrate a water quality model. This model was used to predict dissolved oxygen, ammonia and biochemical oxygen demand under low flow conditions.

Results of the study suggested that the assimilative capacity for oxygen-consuming wastes in the lower South Fork Catawba River is extremely limited. It was recommended that new or expanding major discharges (permitted wasteflow greater than 1.0 MGD) to the South Fork below Long Creek should receive advanced tertiary limits.

Status of Progress

The South Fork Catawba River flows through both subbasins 03-08-35 and 03-08-36 and is, therefore, discussed in Section A, Chapter 4, Part 4.1.2 and 4.1.3.

7.3 Current Priority Issues and Recommendations

7.3.1 Monitored Impaired Waters

There are no impaired waters in this subbasin based on the most recent DWQ sampling data. During the next five years, addressing monitored impaired waters will be a priority. This subbasin has no monitored impaired waters; however, the South Fork Catawba River and Long Creek show impacts from nonpoint source pollution. Local land use planning efforts and the use of best management practices (BMPs) and naturally vegetated buffer zones could help improve water quality in these streams.

7.3.2 303(d) Listed Waters

During the next five years, it will be a priority of DWQ to begin to address waters listed on the state's 303(d) list. In this subbasin, only Dallas Branch is on the 303(d) list based on prior DWQ sampling data. This stream is discussed below. Further information on the 303(d) list and listing requirements can be found in Appendix IV.

Dallas Branch

Dallas Branch was sampled by DWQ biologists in 1992 (listed as UT to Long Creek) above and below the Dallas WWTP. The intent of the sampling was to assess potential impacts on Dallas Branch due to effluent from the facility. At that time, DWQ noted water quality impacts (benthos samples rated Good-Fair above the facility and Fair below). This sampling resulted in Dallas Branch being given an impaired use support status (partially supporting). The Dallas WWTP, at that time, had chronic problems meeting effluent toxicity test limits in their NPDES permit. As of 1996, the facility opted to meet NH_3 permit requirements instead of conducting toxicity testing. Therefore, there is currently not enough information about the current toxicity of the effluent.

1999 Recommendation(s)

Given that Dallas Branch is on the 303(d) list with a planned approach to conduct monitoring and identify problem parameters in the stream, it is recommended that the Dallas WWTP be required to conduct toxicity testing during the next permit cycle to determine the impact of this effluent on the stream.

Chapter 8 -
Catawba River Subbasin 03-08-37
Includes Crowders Creek and its tributaries

8.1 Water Quality Overview

Subbasin 03-08-37 at a Glance

Land and Water Area (sq. mi.)

Total area:	106
Land area:	105
Water area:	1

Population Statistics

1990 Est. Pop.:	64,977 people
Pop. Density:	619 persons/mi^2

Land Cover (%)

Forest/Wetland:	63%
Surface Water:	1%
Urban:	15%
Cultivated Crop:	1%
Pasture/ Managed Herbaceous:	20%

Use Support Ratings

Freshwater Streams:

Fully Supporting:	0.0 mi.
Fully Supporting but Threatened:	14.5 mi.
Partially Supporting:	21.9 mi.
Not Supporting:	9.8 mi.
Not Rated:	26.8 mi.

Lakes:

Lake Wylie - Fully Supporting

(Note: 300 acres of the Catawba Creek Arm and 570 acres of the Crowders Creek Arm are Fully Supporting but Threatened.)

This small subbasin contains portions of Bessemer City and South Gastonia. The largest discharger is Gastonia with two permitted discharges; one to Catawba Creek and one to Crowders Creek. Bessemer City WWTP discharges to Abernethy Creek, a tributary to Crowders Creek, and to Crowders Creek. Crowders Creek (or its tributaries) receives a total of 13.2 MGD of effluent from dischargers, which is a likely explanation for the degraded water quality conditions. A map of this subbasin including water quality sampling locations is presented in Figure B-9. Biological ratings for these sample sites are presented in Table B-8.

Nine facilities currently monitor effluent toxicity under conditions of their NPDES permits. Six of these facilities have had a history of problems meeting their permitted limits.

The benthic site on Crowders Creek was first sampled in 1988 and was rated Poor due to problems associated with a discharge from a chicken processing plant. The most recent sampling showed a slight improvement. Fish community analysis at Crowders Creek and Catawba Creek resulted in a Poor rating for both streams. Phytoplankton surveys on the Crowders Creek and Catawba Creek arms of Lake Wylie have indicated elevated levels of nutrients and chlorophyll *a* and algal bloom conditions.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. Catawba Creek and Crowders Creek are rated as impaired. Refer to Appendix II for a complete listing of monitored waters and use support ratings.

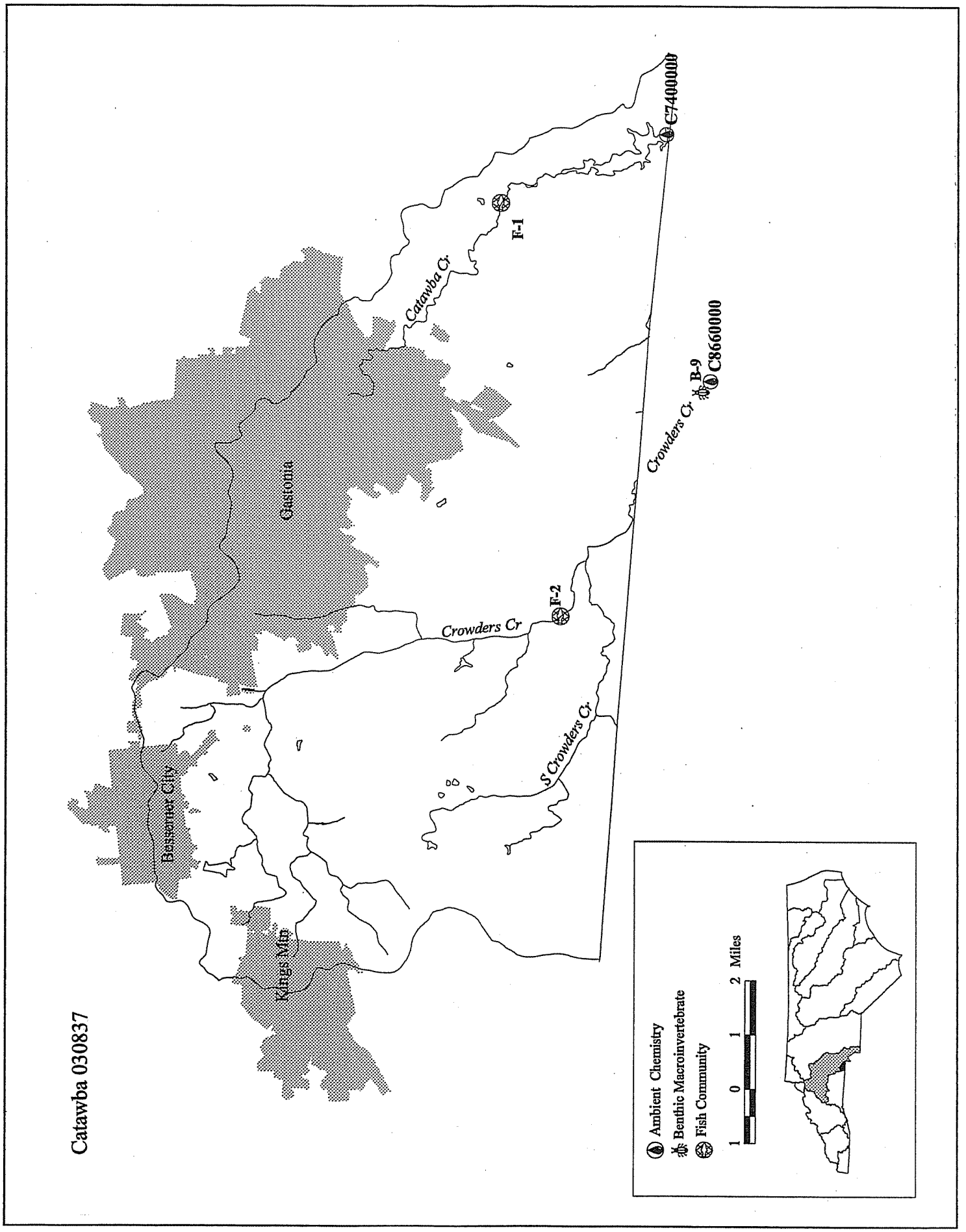


Figure B-9 Sampling Locations within Subbasin 03-08-37

Table B-8 Biological Assessment Sites in Catawba River Subbasin 03-08-37 (1997)

Site	Stream	County	Road	Rating
B-9	Crowders Creek	Gaston	SC 564	Fair
F-1	Catawba Creek	Gaston	SR 2435	Poor
F-2	Crowders Creek	Gaston	SR 1108	Poor

Key:
B = Benthic Macroinvertebrate Sites
F = Fish Sites

For more detailed information on water quality in subbasin 03-08-37, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

8.2 Prior Basinwide Plan Recommendations (1995) and Achievements

8.2.1 Impaired Waterbodies

The 1995 basinwide plan identified several streams as impaired. Each of these impaired waters are discussed below.

Catawba Creek, Crowders Creek, Unnamed Tributary to Crowders Creek, McGill Creek, Abernethy Creek and Unnamed Tributary to Abernethy Creek

A water quality study of 25 stream miles of McGill, Crowders and Abernethy Creeks in Gaston County was performed in order to calibrate a water quality model. The study was initiated due to high instream waste concentrations in Crowders Creek and observations of poor water quality downstream in the Crowders Creek Arm of Lake Wylie.

Results of the study suggested that regionalized wastewater collection by the Gastonia Crowders Creek WWTP significantly reduced loading of oxygen-consuming wastes to Crowders Creek due to advanced tertiary treatment. It was recommended that smaller facilities continue to tie on to the Gastonia WWTP.

It was also recommended that all facilities with a permitted design flow of greater than or equal to 1 MGD be required to meet limits of 1.0 mg/l total phosphorus (TP) and 6.0 mg/l total nitrogen (TN) by January 1, 2000.

Status of Progress

The Lake Wylie management strategy, presented in the 1995 basinwide plan, and progress on this recommendation are discussed in Section A, Chapter 4, Part 4.1 because the strategy affected dischargers in more than one subbasin.

Mill Creek

Mill Creek was misreported as impaired (not supporting) in the 1995 basinwide plan, and the management strategy was to remove point source discharges.

Status of Progress

The status of the creek at that time should have been reported as not rated (NR). There are currently no permitted discharges to this creek.

8.2.2 Other Recommendations

Lake Wylie Management Strategy

The Lake Wylie Management Strategy within the 1995 Catawba River Basinwide Water Quality Management Plan was based on a joint water quality investigation between the South Carolina Department of Health and Environmental Control (DHEC) and DWQ. The long-range plan was developed to address concerns regarding eutrophication.

Status of Progress

The Division has already required marked reductions in point source loads and is working to gain a better understanding of nonpoint source nutrient contributions to Lake Wylie and ways to control them. Significant reductions in pollutants are being achieved by various point sources. This strategy is discussed in more detail in Section A because the Lake Wylie watershed and management area covers more than one subbasin. Examples of the point source pollutant reduction initiatives in the Lake Wylie watershed and recommendations for the next five years are presented in Section A, Chapter 4, Part 4.1.

8.3 Current Priority Issues and Recommendations

8.3.1 Monitored Impaired Waters

There are two impaired waters in this subbasin based on the most recent DWQ sampling data. These waters and recommendations for improving water quality are discussed below and in Part 8.3.2. It is worth noting that there is significant development occurring in this subbasin which could result in decreasing water quality in the headwaters. DWQ has limited monitoring stations in this subbasin, and these monitoring efforts should be expanded in the future to better assess the effects of this development. Local land use planning should be implemented to assure water quality is protected.

Catawba Creek

Approximately 7.4 miles of Catawba Creek are impaired (not supporting) due to both point and nonpoint sources of pollution. The Gastonia WWTP has impacted the creek, along with urban

runoff. The Catawba Creek arm of Lake Wylie is not impaired; however, DWQ is concerned about the eutrophication of this arm of the lake. About 300 acres of the Catawba Creek arm are rated fully supporting but threatened (ST).

1999 Recommendation(s)

The Gastonia WWTP on Catawba Creek was decommissioned in early 1999. All waste is being sent to a state-of-the-art facility on Long Creek. The removal of this discharge and the operation of a new facility are expected to improve water quality on Catawba and Long Creeks. The Catawba Creek arm should also reflect this improvement. DWQ will further assess water quality to measure changes after the removal of this effluent. For further information, refer to the Section A, Chapter 4 discussion on the Lake Wylie nutrient management strategy.

Crowders Creek

The entire NC portion of Crowders Creek (15.8 mi.) is impaired (partially supporting) due to both point and nonpoint sources of pollution. Point sources include the Gastonia WWTP (with several discharges to this facility) and nonpoint sources include urban runoff. About 570 acres of the Crowders Creek arm are rated fully supporting but threatened (ST).

1999 Recommendation(s)

CBP Resources, a chicken processing plant, ceased its discharge to Crowders Creek in December 1998. The plant is sending its discharge to the Gastonia Crowders Creek WWTP. This facility currently removes phosphorus and is being modified to remove total nitrogen in 2001. DWQ will conduct monitoring to assess the cumulative impacts of the Gastonia area above the WWTP and improvements to water quality as a result of improvements at the Crowders Creek WWTP.

Further monitoring will be conducted in the Abernethy Creek watershed to better assess water quality impacts to Crowders Creek and possible improvements to water quality resulting from rerouting the Bessemer City WWTP effluent to the Crowders Creek facility.

The significant improvements made by the dischargers in this watershed are expected to result in measurable improvements in water quality in Crowders Creek. The Crowders Creek arm of Lake Wylie should also show improvements. For further information, refer to the Section A, Chapter 4 discussion on the Lake Wylie nutrient management strategy.

8.3.2 303(d) Listed Waters

During the next five years, it will be a priority of DWQ to begin to address waters listed on the state's year 2000 (not yet EPA approved) 303(d) list. In this subbasin, several streams are on the 303(d) list. These include: Catawba Creek, McGill Creek, an unnamed tributary to Crowders Creek and Crowders Creek. Both Catawba and Crowders Creeks are currently considered to be impaired and are discussed further above. Each of these creeks will be monitored to identify the potential parameters causing water quality problems. Further information on the 303(d) list and listing requirements can be found in Appendix IV.

Chapter 9 -
Catawba River Subbasin 03-08-38
Includes Sixmile Creek, Waxhaw Creek and Twelvemile Creek

9.1 Water Quality Overview

Subbasin 03-08-38 at a Glance

Land and Water Area (sq. mi.)

Total area:	179
Land area:	178
Water area:	1

Population Statistics

1990 Est. Pop.:	25,902 people
Pop. Density:	146 persons/mi^2

Land Cover (%)

Forest/Wetland:	61%
Surface Water:	1%
Urban:	4%
Cultivated Crop:	7%
Pasture/ Managed Herbaceous:	28%

Use Support Ratings

Freshwater Streams:

Fully Supporting:	0.0 mi.
Fully Supporting but Threatened:	102.6 mi.
Partially Supporting:	0.0 mi.
Not Supporting:	0.0 mi.
Not Rated:	48.6 mi.

The streams in this small subbasin have very low flows during summer drought periods. Agricultural nonpoint source runoff is a major source of water quality degradation in this subbasin, although low flow conditions during the summer also limit the diversity of aquatic life. No benthic macroinvertebrate samples were collected in 1997 due to low flows. According to earlier benthic data, water quality in both Twelvemile and Waxhaw Creek improved from Fair in 1983 to Good-Fair in 1990. Fish community sampling was assessed at three sites in 1997 (see Table B-9). A map of this subbasin including water quality sampling locations is presented in Figure B-10.

No problems have been reported from the three facilities that currently monitor effluent toxicity under conditions of their NPDES permit.

Biological and chemical monitoring data are used to develop use support ratings. These ratings are used to prioritize DWQ activities towards protecting and restoring waters in the basin. There are no impaired waters in this subbasin.

For more detailed information on water quality in subbasin 03-08-38, refer to the *Basinwide Assessment Report - Catawba River Basin - August 1998*, available from the DWQ Environmental Sciences Branch at (919) 733-9960.

Table B-9 Biological Assessment Sites in Catawba River Subbasin 03-08-38 (1997)

Site	Stream	County	Road	NCIBI Class
F-1	Twelvemile Creek	Union	NC 16	Fair
F-2	Sixmile Creek	Union	SR 1312	Fair
F-3	Waxhaw Creek	Union	SR 1103	Good-Fair

Key:
F = Fish Sites

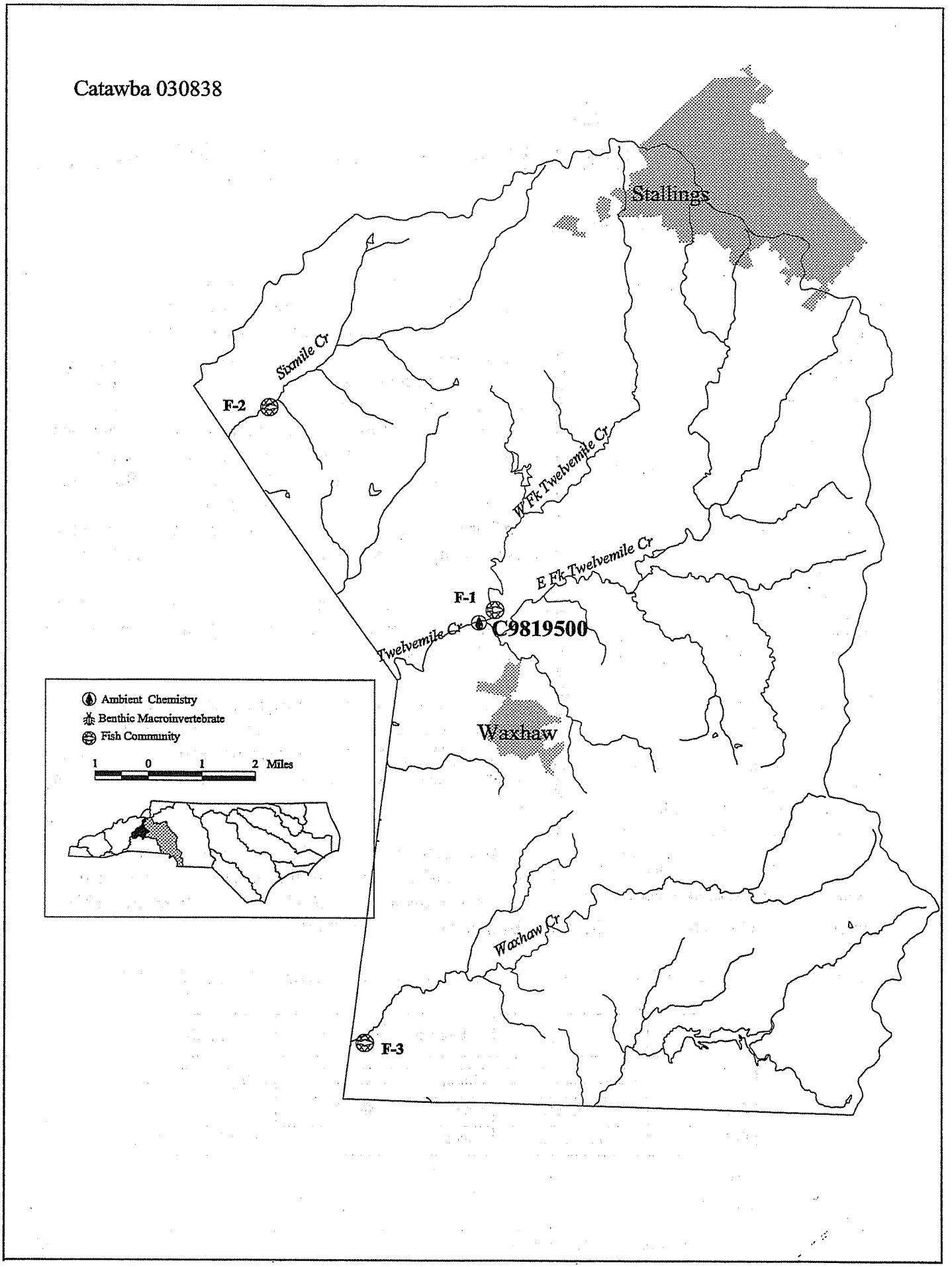


Figure B-10 Sampling Locations within Subbasin 03-08-38

9.2 Prior Basinwide Plan Recommendations (1995) and Achievements

9.2.1 Impaired Waterbodies

The 1995 basinwide plan identified Sixmile Creek as impaired. This creek is discussed below.

Sixmile Creek

Per existing DWQ regulations for zero 7Q10 flow streams, it was recommended that all new and expanding facilities would receive summer limits of 5 mg/l BOD_5, 2 mg/l NH_3 and 6 mg/l DO. Winter limits for new and expanding facilities would be 10 mg/l BOD_5, 4 mg/l NH_3 and 6 mg/l DO. It was recommended that all facilities tie on to sewer lines serving a regional facility.

Status of Progress

Of the eight facilities that were discharging to Sixmile Creek, there are currently only three remaining. DWQ will not allow any new discharges to Sixmile Creek, given that Charlotte-Mecklenburg Utilities (CMUD) has extended sewer lines to this area. Although existing dischargers will not be required to tie on to CMUD, DWQ may require these dischargers to perform an engineering alternatives analysis (EAA) in the future. DWQ biologists believe this stream is too small to appropriately use sampling methodologie and is no longer be rated. However, water quality concerns remain.

9.2.2 Other Issues

Union County Watersheds

The entire Sixmile Creek watershed in North Carolina and much of Union County has zero 7Q10 flow streams. However, much of Sixmile Creek does have a positive 30Q2 flow. Existing water quality models cannot accurately predict the effects of discharges to a zero 7Q10 flow stream, yet because of the positive 30Q2 flow, DWQ procedures have allowed for new and expanding facilities to be permitted at advanced tertiary limits. However, without a model in place there is no way to estimate at what point such a stream will be impaired by additional wastewater flow. This is a concern in watersheds such as Sixmile Creek where a significant amount of wastewater is discharged to zero 7Q10 streams. It is also a potential concern for nearby Waxhaw Creek, which provides habitat for the state and federally endangered Carolina Heelsplitter mussel.

Status of Progress and 1999 Recommendation(s)

DWQ will continue to encourage facilities in such low flow streams to tie on to regional facilities when this option is available. When tying into another larger facility is not feasible, DWQ will continue to implement the zero flow policy for new and expanding facilities to zero flow streams. In some instances, dischargers may be required to perform an engineering alternatives analysis (EAA).

9.3 Current Priority Issues and Recommendations

9.3.1 Monitored Impaired Waters

There are no impaired waters in this subbasin based on the most recent DWQ sampling data. However, it is worth noting that there is significant development occurring in this subbasin which could result in decreasing water quality in the headwaters. DWQ has limited monitoring stations in this subbasin, and these monitoring efforts should be expanded in the future to better assess the effects of this development. Local land use planning should be implemented to assure water quality is protected.

9.3.2 303(d) Listed Waters

There are no streams in this subbasin on the state's year 2000 (not yet EPA approved) 303(d) list. See Appendix IV for further information on 303(d) listing requirements.

Section C

Current and Future Water Quality Initiatives

Chapter 1 -
Current Water Quality Initiatives

1.1 Workshop Summaries

A total of seven workshops were held in the Catawba River basin between June 1998 and April 1999. Five of these workshops were held in the upper portion of the basin in cooperation with the Western Piedmont Council of Governments (WPCOG) with 178 people in attendance. Sponsors of the two workshops in the lower portion of the basin were the Gaston County Quality of Natural Resources Commission, Mecklenburg County Department of Environmental Protection, Mecklenburg County Soil and Water Conservation District, and the Gaston County Cooperative Extension Service. Approximately 125 people were in attendance at these two workshops. All workshops represented a wide variety of interests in the river basin.

Each workshop had three to four presentations pertaining to issues important to the region of the basin where the workshop was held. Workshop participants were asked to discuss a series of questions in small groups. The questions varied slightly between workshops, but were generally the following questions:

1) What are the most important issues that should be addressed in the next basinwide plan?
2) What are the main threats to water quality in the Catawba River basin?
3) Where are the problem areas or waters in the basin?
4) What recommendations do you have for addressing these problems?
5) What local agencies or organizations should be involved in addressing the problems?

The discussion on these questions was very productive. Comments and responses were recorded during each workshop. A general summary providing common ideas and viewpoints expressed by many of the participants is presented below. The most important issues to address in the basinwide plan were quite different between the upper and the lower portions of the basin and are therefore presented as separate summaries.

DWQ considered these comments while drafting the revised Catawba River Basinwide Water Quality Plan and will continue to use these comments to guide water quality activities in the Catawba River basin.

Upper Catawba River Basin Workshops

The WPCOG, with funding from the 205(j) grant program, held five public workshops. The workshops were held in Hickory, Lenoir, Newton and Morganton (2). The workshops were summarized by the WPCOG in the *Summary of Catawba River Basinwide Planning Workshops.*

The most frequently cited threats to water quality identified by workshop participants were:

- Sedimentation
- Point source dischargers
- Inadequate enforcement
- Inadequate buffers and loss of natural riparian areas
- Stormwater runoff
- Development

Eighteen different waters were identified as problem waters, with Clark Creek and the South Fork Catawba River mentioned most frequently. Recommendations by participants for addressing water quality problems within the basin varied with most solutions centered on the need for more public education, better enforcement and regulatory approaches. Participants identified city and county governments as the local entities most responsible for addressing water quality problems within the upper Catawba River basin.

For more information on these workshops, contact Mike Struve of WPCOG at (828) 322-9191.

Lower Catawba River Basin Workshops

Participants of the two workshops in the lower portion of the basin identified the following threats to water quality in the Catawba River basin most frequently (there was a wide variety of responses, with these threats the most frequently cited):

- Lack of enforcement of regulations
- Urbanization, population growth and sprawl
- Nutrient loading from point sources to the watershed of Lake Wylie
- Sedimentation from agriculture and construction/development
- Color in Clark Creek and the South Fork Catawba River watershed

In response to the many issues listed as threats to water quality in the basin, participants also listed recommendations for addressing these threats. This list was also very expansive, and many of the suggestions are beyond the authority of DWQ to implement. A few of the most frequently cited recommendations were:

- Need better enforcement of existing regulations and stiffer penalties
- Need more education and public involvement in water quality
- Adopt buffer regulations and implement best management practices for nonpoint sources of pollution
- Set higher point source discharge standards and set color limits in the South Fork Catawba River watershed
- Develop regional planning and cooperation efforts

For a copy of the summary of the two workshops in the lower portion of the basin, call DWQ at (919) 733-5083, ext. 360.

1.2 Recommendations from Other Sources

Several recommendations were presented to DWQ during the development of the revised Catawba River Basinwide Water Quality Plan. These recommendations are more broad-based than the basinwide plan and provide recommendations to address various land use activities that are typically authorized by local government ordinances. In addition, the recommendations are more focused on long-term changes that may need to be made to adequately address water quality degradation at the local level. These recommendations are summarized and generally addressed here.

Clean Water Fund of North Carolina Report

The Clean Water Fund of North Carolina compiled a report titled *The Rainbow River: Stain on the Piedmont* in March 1994. This review of the South Fork River watershed was intended to provide information about the sources of water pollution (with a spotlight on wastewater discharges) and make recommendations for improving existing problems. Several of these recommendations were considered while developing this revised plan for the Catawba River basin. The recommendations are highlighted below in italics, followed by DWQ's response and actions taken.

- *Reopen South Fork NPDES permit limits on certain pollutants* -- DWQ has conducted a South Fork Catawba River watershed toxics review with recommendations for additional monitoring and possible permit limits for specific pollutants (see Section A, Chapter 4, Part 4.1.5).
- *Dechlorination and chlorine limits should be imposed* -- DWQ requires dechlorination or alternatives to chlorination for new and expanding dischargers.
- *Phosphorus limits should be placed on major dischargers* -- The 1995 basinwide plan presented a strategy for reducing nutrient loading from discharges in the watershed (see Section A, Chapter 4, Part 4.1.3).
- *Monitoring requirements and limits on color should be imposed* -- DWQ is developing a color reduction strategy (see Section A, Chapter 4, Part 4.1.4).
- *Allowing more concentrated toxics in wastewater at new discharge points should not be allowed* -- While DWQ often allows dischargers to move the point of discharge to waters with more assimilative capacity, these new discharge points typically provide much better waste treatment than the older facility and often provide nutrient removal. Dischargers are required to conduct an environmental alternatives analysis before permit approval, and toxicity testing is often required in the discharge permit.
- *DWQ should provide a guidance document on enforcement* -- DWQ is implementing a revised enforcement policy. Guidelines on the policy can be found on the DWQ web page at http://h2o.enr.state.nc.us.
- *Local governments should require strict watershed ordinances* -- Local governments have the authority under the water supply watershed rules to develop ordinances that are more stringent than the state's rules. DWQ can provide technical support for creating these ordinances (see Section A, Chapter 4, Part 4.2.5).

Catawba Riverkeeper Platform and Marine Commission Recommendations

The Catawba River Foundation and the Catawba Riverkeeper developed a Catawba River Basinwide Water Quality Management Plan Platform consisting of nine items believed to be critical to achieving an effective basinwide plan to protect the natural resources of the region. Over 43 organizations and individuals co-sponsored the platform. The key recommendations are presented, with a general response from DWQ. In addition to this platform, the Mountain Island Lake Marine Commission and Lake Wylie Marine Commission approved and submitted similar comments for consideration during development of the revised basinwide plan. These recommendations can be found in Appendix V. A detailed response from DWQ was sent to each of the sponsors of the platform.

DWQ believes that the recommendations presented in the platform are well worth the time and effort of exploring the possibilities of implementing. However, the recommendations as presented cannot be accomplished by DWQ alone. These recommendations will require a broad range of strong public voice and support to make them a reality. Several of the recommendations are outside the authority of DWQ and will, therefore, have to be pursued, approved, implemented and enforced at the local level. In addition, a great deal of resources will be needed to make measurable progress on several of the recommendations. Obtaining these resources will require public pursuit of specific legislative actions. Given these constraints, DWQ can continue to work towards achieving some of these recommendations.

Summary of Recommendations Presented and DWQ Response

- *Buffer requirements –*

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

DWQ will continue to maintain the schedule for developing basinwide plans. The basinwide plans are planning tools, rather than regulatory documents. The plans are intended to present current water quality information and recommend management strategies to protect or restore water quality. Temporary rule making for the Catawba River basin could not begin until the Catawba River Basinwide Water Quality Plan was approved by the EMC in December 1999. At the time of approval, DWQ staff alerted the EMC to resolutions and comments made by the public to support rule making for buffers. The EMC has instructed DWQ staff to begin temporary rule making processes. There will be opportunities for stakeholder input into the temporary rules, as set out by HB 1160. The bill also requires public notice and public hearings to be held after the rule-making language is developed. The EMC will then determine if rule making is warranted by current information. For more information, refer to Section A, Chapter 4, Part 4.2.7.

- *Best management practices for construction sites, urban areas with >50,000 people and agriculture –*

Best management practices are currently required for all construction activity. An erosion control plan is required of all sites with one or more acres disturbed. The current shortage of staff within the NC Division of Land Resources (the enforcement agency for the Sediment and Pollution Control Act) makes it difficult for every construction activity to be inspected. The DLR has also delegated oversight of the erosion and sedimentation control program to a few local governments in the basin. These local programs provide the opportunity for inspections and enforcement of erosion control at the local level.

The implementation of the Phase II Stormwater Rules, as promulgated by EPA and administered by DWQ, will include smaller municipalities within the Catawba River basin. With the Phase II rules, additional urban stormwater runoff will be managed through the use of best management practices.

Several programs currently provide financial incentives for cropland agriculture for installing best management practices. These programs include the Agriculture Cost Share Program, Conservation Reserve Program, Environmental Quality Incentives Program and the Conservation Easement Program, to name a few.

- *Halt on new floodplain development, better protection of wetlands and restoration of damaged wetlands –*

Floodplain development can be controlled through local government ordinances. Wetlands are given protection through state and federal regulation. DWQ is increasing compliance overview and developing a wetland enforcement program.

- *Nutrient controls on all NPDES discharges to eutrophic lakes –*

Only Maiden Lake and Lake Wylie are currently considered to be eutrophic lakes in the North Carolina portion of the Catawba River basin. The 1995 Catawba River Basinwide Plan presented a detailed management strategy for Lake Wylie (see Section A, Chapter 4). The water quality problems in Maiden Lake are due to siltation and nonpoint sources. Additional efforts by the Town of Maiden to control nonpoint sources within their jurisdiction would benefit the water quality in this water supply.

It must be noted that both of these lakes, though somewhat eutrophic, are currently meeting their designated uses and are not considered to be impaired. DWQ does recognize that there may be a need to require additional nutrient reductions from all sources in the Lake Wylie watershed in the future. This will require local actions to address nonpoint source pollution to make water quality improvements.
Data from Lake Rhodhiss and Lake Hickory show some eutrophication is occurring. DWQ is in the process of analyzing all available data to determine what management strategies are needed for both of these lakes (see Section A, Chapter 4).

➢ *Moratorium on package treatment plant discharges to eutrophic lakes –*

Legislative authority would be required to place a moratorium on package plants that discharge to watersheds of eutrophic impoundments. DWQ recognizes that nutrient controls may be required for some of these package plants, but there is currently not enough evidence to demonstrate that these facilities are causing water quality impairment. With additional staff or with the aid of private research efforts, modeling to assess the cumulative impacts of small package plants would be useful. The Clean Water Act of 1999 contains several study requirements which may address this issue.

➢ *Color standards for the South Fork Catawba River watershed –*

DWQ has recently taken steps to address color issues for the South Fork Catawba River watershed (see Section A, Chapter 4).

➢ *Enforcement of Buffers and Sedimentation/Erosion Regulations –*

The enforcement of ordinances protecting buffer zones within water supply watersheds is an issue to be addressed by local governments having the authority to implement these rules. DWQ is pursuing an implementation and enforcement initiative to address citizen complaints concerning buffer zones (see Section A, Chapter 4).

Sediment and erosion control, if not implemented locally, is under the jurisdiction of the Division of Land Resources. This agency is severely understaffed and does not have enough resources to fully implement these regulations. The General Assembly's action this session will reduce the severity of the understaffing to manage this program.

The Division of Forest Resources (DFR), as required by the Sedimentation Pollution Control Act, requires Streamside Management Zones (SMZ) of sufficient width to prevent accelerated erosion from reaching the stream when forestry activities disturb land adjacent to an intermittent or perennial stream. The DFR actively inspects forestry operations statewide and has a Water Quality Forester in the Lenoir and Mount Holly districts.

➢ *Moratorium on all clear-cutting until buffer zones are established –*

The DFR reports that timbercutting does not in itself create sediment problems, rather these problems are created by improperly constructed/maintained roads and trails. As previously pointed out, SMZs are required on all forestry site disturbing activities which disturb land adjacent to an intermittent or perennial stream or perennial waterbody.

➢ *Enforcement –*

DWQ has repeatedly heard concerns pertaining to the lack of enforcement of existing regulations. Through education of everyone in the basin and enforcement of existing regulations, much can be achieved. As noted above, lack of staff and resources impedes the effectiveness of the DLR and DFR in enforcing current regulations. Legislative funding has been provided for

additional personnel in both of these agencies, and this should increase the effectiveness of these regulations.

Mecklenburg County Department of Environmental Protection Recommendations

The Mecklenburg County Department of Environmental Protection (MCDEP) offered several comments regarding the development of the revised Catawba River basinwide plan. Several of these comments are summarized below in italics, followed by a DWQ response.

- *The state should consider using SWIM as a possible resolution to the TMDL requirements within Mecklenburg County –*

DWQ is working closely with MCDEP, the City of Charlotte and CMUD to develop the necessary TMDLs for the Mecklenburg County area.

- *Vegetated undisturbed buffers should be used along the Catawba River and its tributaries –*

DWQ supports the idea of undisturbed buffers along perennial streams and applauds Mecklenburg County for their buffer requirements. The General Assembly has expressed interest in protecting water quality in the Catawba River basin through the ratification of the Clean Water Act of 1999 (HB 1160, Part VII). This Act gives authority to the EMC to adopt temporary rules to protect the Cape Fear, Catawba and Tar-Pamlico River basins. The intent of the bill is to allow for development of rules for basinwide buffers or other water quality protection measures as required in these three river basins.

- *Nutrient limits should be imposed on all major NPDES facilities –*

DWQ will consider applying nutrient limits on any major discharges where sound scientific data point to the need for limits.

- *Need stricter enforcement of sanitary collection systems and water supply watershed ordinances –*

DWQ has revised its enforcement policy (refer to Section C, Chapter 2) and is developing a water supply watershed enforcement policy (see Section A, Chapter 4, Part 4.2.5).

- *Stormwater management –*

EPA is currently developing Phase II of the NPDES stormwater rules. These rules, administered by DWQ, will apply to smaller municipalities and urban areas. DWQ will assess the rules promulgated by EPA before making revisions to the state stormwater program.

1.3 Federal Initiatives

1.3.1 Section 319 - National Monitoring Program

Under Section 319 of the Clean Water Act, the USEPA has developed the Section 319 National Monitoring Program (NMP) specifically to address nonpoint source pollution. Its objectives are: 1) to scientifically evaluate the effectiveness of watershed technologies designed to control nonpoint source pollution; and 2) to improve our understanding of nonpoint source pollution. To achieve these objectives, the Section 319 NMP has selected watersheds across the country to be monitored over a 6 to10-year period to evaluate how improved land management reduces water pollution. NMP projects will help communities and citizens protect their local water resources by providing information on the effectiveness techniques for solving nonpoint source problems.

Long Creek Watershed Project

In 1992, the USEPA included the Long Creek Watershed Project in the NMP. The 28,480 acre mixed agricultural and urban watershed is the primary water supply for Bessemer City. The stream channel near the water supply intake in the headwaters area has frequently required dredging due to sediment accumulation. Aquatic habitat downstream of the intake is degraded due to high levels of fecal coliform and excessive sediment and nutrient loading from agricultural and urban nonpoint sources.

Land management upstream of the water intake is reducing erosion from cropland and streambanks. Downstream of the intake, land management activities include fencing to exclude cattle from streams, animal waste management, and implementation of sediment and rainwater runoff controls. A system of dairy BMPs including: 1) livestock exclusion from perennial and ephemeral streams; 2) an alternative watering system; 3) streambank stabilization and riparian buffer establishment; 4) a waste management system; 5) heavy use and feeding area improvements; and 6) improved stream crossings were installed. Water quality monitoring of streams has been performed to quantify the effectiveness of different BMPs on nonpoint source pollution. The initial NMP grant totaled $901,486 for the nine-year project. An additional $200,000 was added to the project in 1996. Monitoring within the watershed will continue through the period of the grant, ending September 2001. Information regarding the Long Creek NMP site is available from the North Carolina Cooperative Extension Service.

1.3.2 Section 319 – Base Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration projects (Table C-1). There are five projects or programs in the Catawba Basin that have been funded through this grant source. Each project is described individually below.

Table C-1 Section 319 Projects in the Catawba River Basin

PROJECT	FEDERAL CONTRIBUTION	NON-FEDERAL MATCH	TOTAL
Long Creek Watershed Restoration	$157,500	$105,000	$262,500
Catawba River Land Acquisition – City of Morganton	$250,000	$126,667	$376,667
Water Quality and Perennial Grasses Demonstration – McDowell County	$58,500	$39,000	$97,500
South Fork Catawba River Urban and Agriculture Demonstration	$88,392	$58,928	$147,320
Area I Water Quality Engineer – annual support for technical assistance to agricultural operators in western North Carolina	$21,418	$14,279	$35,697
Total	**$575,810**	**$343,874**	**$919,684**

Long Creek Watershed Restoration – Additional Funding in NMP Watershed

The Long Creek Watershed is the site of a 9-year EPA National Monitoring Program described in Section C-1.3.1 above. This funding was used to support accelerated design and implementation of additional BMPs including streambank stabilization, livestock exclusion, urban stormwater controls, and establishment of permanent wildlife habitat.

Catawba River Land Acquisition – City of Morganton

The City of Morganton Comprehensive Long-Term Land Management Plan identifies a six-mile greenway corridor along the Catawba River. An aggressive acquisition and development program began in 1992 with identification of riparian parcels. Prioritization of properties was made based upon location, greenway values and water quality benefit. Section 319 grant funds were used to acquire the highest priority parcel.

Additional funds for acquisition were obtained through the North Carolina Clean Water Management Trust Fund grant of $550,000 (Table C-2) to purchase a 204-acre tract of land adjacent to the priority one parcel. The acquisition phase of the project is nearing completion, and Morganton is making plans to stabilize and restore the channel and develop the greenway area.

Water Quality and Perennial Grasses Demonstration – McDowell County

This ongoing demonstration intends to evaluate the species establishment, competitiveness, adaptability and forage quality of seeding perennial warm season grasses for wildlife habitat, forage and water quality protection. This project is performed through the NC Department of Agriculture and compares response of warm season grasses to different soil types.

South Fork Catawba River Urban and Agriculture Demonstration

The Gaston County Quality of Natural Resources Commission (Section C, Part 1.7.2) has supported a monitoring program in local watersheds. Data from the monitoring program will enable identification of problem areas and target specific stream reaches for action. A project based upon the findings of the Commission was submitted by the NC Cooperative Extension Service and is funded in the FY1998 Section 319 workplan. Planned project activities include streambank protection, agricultural and urban BMPs, and urban NPS education for local elected officials, agency officials, developers, students and local leaders.

Area I Water Quality Engineer – annual support for technical assistance to agricultural operators in western North Carolina

This engineering position, housed by the Natural Resources Conservation Service, provides technical support for implementation of agricultural best management practices (BMPs) related to concentrated animal feeding operations and trout farms in western NC. This technical assistance is readily available to farmers, facilitating proper management practices and water quality protection. Activity costs are shared with the Tennessee Valley Authority and local Soil and Water Conservation Districts.

1.4 State Initiatives

1.4.1 NC Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) is a nonregulatory program responsible for implementing wetland and stream restoration projects throughout the state. The focus of the program is to improve water quality, flood prevention, fisheries, wildlife habitat and recreational opportunities. The NCWRP is not a grant program. Instead, the NCWRP funds wetland, stream and streamside (riparian) area projects directly through the Wetlands Restoration Fund.

Restoration sites are targeted through the use and development of the Basinwide Wetlands and Riparian Restoration Plans. These plans were developed, in part, using information compiled in DWQ's Basinwide Water Quality Plans. The Basinwide Wetlands and Riparian Restoration Plans are updated every five years on the same schedule as DWQ's Basinwide Water Quality Plans. As new data and information become available about water quality degradation issues in the Catawba River basin, priority subbasins identified in the NCWRP's plans, may be modified.

The NCWRP is also working to develop comprehensive Local Watershed Restoration Plans within the identified Priority Subbasins. These more locally-based plans will identify wetland areas, contiguous reaches of stream, and contiguous strips of buffer that, once restored, will provide significant water quality and other environmental benefits to watersheds. The NCWRP will coordinate with local community groups, local governments and others to develop and implement these plans. The NCWRP has chosen subbasins 03-08-31, 03-08-34 and 03-08-35, and 03-08-37 as priority subbasins.

The NCWRP can perform restoration projects cooperatively with other state or federal programs or environmental groups. For example, the NCWRP's efforts can complement projects funded through the Section 319 Program. Integrating wetlands or riparian area restoration components with 319 funded or proposed projects will often improve the overall water quality benefits of the project.

The NCWRP actively seeks landowners within the Catawba River basin who have restorable wetland, riparian and stream sites. Currently the NCWRP is working to implement a stream restoration project in the Catawba at an Alexander County dairy farm. Through streamside/buffer restoration, the sedimentation and nutrient inputs contributing to water quality degradation at this site will be reduced.

For more information about participating in the NCWRP, please contact Crystal Braswell at (919) 733-5208 or visit the website at http://h2o.enr.state.nc.us/ then click on Wetlands Restoration Program.

1.4.2 Clean Water Management Trust Fund

The Clean Water Management Trust Fund offers about $40,000,000 annually in grants for projects within the broadly focused areas of restoring and protecting state surface waters and establishing a network of riparian buffers and greenways. In the Catawba River basin, sixteen projects have been funded. The total amount of funds that have been allocated to the basin is $12,506,250. These projects are presented in Table C-2.

For more information on the CWMTF or these grants, contact Dave McNaught at (919) 830-3222 or visit the website at www.cwmtf.net.

1.4.3 Nicholas School of the Environment at Duke University

In the fall of 1998, the Nicholas School of the Environment at Duke University, with the financial support of Duke Energy Corporation, conducted a public opinion survey with 872 randomly selected households in counties within the NC portion of the Catawba River basin. A total of 1085 surveys were conducted within the entire Catawba River basin (both SC and NC portions of the basin). The surveys, which consisted primarily of telephone interviews, collected a variety of information from respondents regarding their perceptions and opinions about water quality in the region, their use of the waters in the Catawba River basin and their level of support of water quality management programs.

Survey results indicated a high level of interest among local populations for the protection of water quality in the region. Respondents reported many different reasons for being interested in protection of this resource. Local interest in water quality protection stemmed from several different sets of concerns. These included the use of basin waters for recreation by the respondents and their friends and families, the quality of respondents' drinking water and the knowledge that this resource was being protected regardless of actual use.

For more information on this research, contact Randy Kramer at (919) 613-8072.

Table C-2 Projects in the Catawba River Basin Funded by the Clean Water Management Trust Fund (as of 7/99

Responsible Party	Purpose of Project	Amount Funded
Mecklenburg County Parks and Recreation	Stormwater	$209,000
NC Wildlife Resources Commission	Restoration	$156,000
Catawba Lands Conservancy	Acquisition-Buffers	$310,000
Town of Granite Falls	Wastewater	$1,228,000
Mecklenburg County Department of Environmental Protection	Stormwater	$750,000
Town of Hildebran	Wastewater	$136,000
Western Piedmont Council of Governments	Wastewater	$450,000
McDowell County	Restoration	$294,250
City of Gastonia	Acquisition-Buffers	$347,000
Town of Maiden	Acquisition-Buffers	$360,000
Centralina Council of Governments	Acquisition-Buffers	$6,560,000
Catawba Lands Conservancy	Planning	$50,000
City of Gastonia	Wastewater	$1,000,000
City of Lenoir	Acquisition-Greenways	$50,000
City of Clarement	Acquisition-Greenways	$56,000
City of Morganton	Acquisition-Greenways	$550,000

1.5 Local Initiatives

1.5.1 Western Piedmont Council of Governments (WPCOG)

Lower Creek Watershed Project

The WPCOG was awarded a grant from DENR to develop a watershed management plan for Lower Creek in 1996. During 1997-1998, the WPCOG held six public meetings to identify locally important issues and develop recommendations for improving conditions within the watershed. Fifteen subbasins were ranked for future nonpoint source controls using all available information (WPCOG, 1998). Most of the high priority subbasins are located in the upper portion of the watershed. Water quality impacts in this area are due to urbanization and development pressures. In addition, agricultural activities, land-disturbing activities and erosion are problems for the creek.

The report cited many recommendations that will be useful for local restoration efforts, along with recommendations for education efforts in the watershed and using preventative measures on new development. Refer to Section B, Chapter 2 for further information on water quality in Lower Creek and recommendations for restoration.

1.5.2 Mecklenburg County Department of Environmental Protection (MCDEP)

Surface Water Improvement and Management (SWIM) Program

The City of Charlotte and Mecklenburg County Department of Environmental Protection (MCDEP) have joined in a cooperative effort to restore the quality and usability of surface waters. The Surface Water Improvement and Management (SWIM) Program began in 1995 with enhanced water quality monitoring, regulatory enforcement and educational efforts. A numerical water quality rating system was developed and incorporated into a GIS mapping program. Water quality results and maps are presented in the biennial Mecklenburg County's State of the Environment Report. In the spring of 1996, an educational campaign was launched to increase public awareness on current water quality conditions and to obtain public input and involvement in the SWIM program. MCDEP conducts presentations to the public, provides SWIM Alert newsletters, develops plans for subbasins in the Catawba River drainage, and developed an Adopt-A-Stream program. Citizen activities include cleanup efforts, storm drain stenciling and reporting of pollution problems. SWIM efforts could result in significant changes in development activities, improved greenway acquisition efforts and the development of stream buffers.

MCDEP also adopted a Creek Use Policy in October 1996. The policy is intended to protect the surface waters of Mecklenburg County "for prolonged human contact and recreational opportunities and shall be suitable to support varied species of aquatic vegetation and aquatic life." Under this policy, MCDEP staff are directed to bring to the Mecklenburg County Board of County Commissioners "alternatives and potential costs to restore waterways and lakes to natural beauty and recreational use..." within 90 days of listing a waterway under the SWIM program. In January 1998, the Board voted to proceed with staff recommendations of a proposed SWIM Strategy.

The SWIM panel and staff developed a Phase I Implementation Strategy that was strongly supported at public meetings. SWIM Phase I was fully funded with over $800,000 for fiscal year 1998-1999. Several key components of the Phase I SWIM Strategy include:

- Enhanced enforcement of erosion and sedimentation control ordinances
- Enhanced enforcement of stream buffers required in regulated water supply watersheds
- Establish and maintain vegetative stream buffer
- Address elevated levels of fecal coliform bacteria
- Implement countywide water quality modeling
- Enhance water quality monitoring
- Improve coordination between county and city personnel
- Conduct instream inventory and assessment
- Increase public education and awareness

SWIM Stream Buffer Plan

Through the SWIM strategy, Mecklenburg County has developed a proposed stream buffer network plan to ensure that the stream and adjacent lands will fulfill their natural functions. These functions include filtering pollutants, conveying storm and groundwater, storing

floodwater, and supporting aquatic life and other life. Protection will be provided for stream sections by a variety of options currently being considered by the Storm Water Advisory Committee. Stream buffer requirements will begin at the point on a stream segment where the drainage basin is equal to or greater than 100 acres. The buffer at this point will consist of a 20-foot streamside zone and a 15-foot upland zone on each side of the stream. At 300 acres or greater, a three-zone buffer will be required to a total width of 50 feet on each side of the stream. At 640 acres or greater, the three-zone buffer width will increase to 100 feet plus 50 percent of the area of the flood fringe. A mitigation procedure is also proposed for unavoidable or requested buffer impacts, as well as a grandfathering clause and enforcement actions.

The proposed text for the SWIM Stream Buffer Ordinance has been written for Charlotte and Mecklenburg County. The six towns located in Mecklenburg County are also working on draft ordinances. Following public hearings and final adoption by the City of Charlotte, Mecklenburg County and the six towns, the buffer ordinance should be effective countywide in year 2000.

Additional Water Quality Programs and Efforts of MCDEP

- Storm Drain Stenciling Program – Several hundred storm drains have been stenciled by community groups.
- Adopt-a-Stream – Dozens of groups have adopted stream segments, resulting in thousands of pounds of trash being removed and numerous pollution problems being reported and corrected.
- Issue written notices of violation for water quality problems.
- Monitors active stormwater permits in Mecklenburg County. MCDEP identifies problem facilities and conducts site inspections at a minimum of 24 problem facilities per year. Problems at these facilities are identified and corrected.
- Works with Charlotte Storm Water Services to monitor and inspect private BMPs and to ensure that stormwater maintenance activities are adequate.
- Works with Charlotte Storm Water Services in the design and construction of pilot BMPs including compost filters, storm ceptors and enhanced sediment basins.
- GIS mapping of Surface Water Quality Index by watershed to identify problem areas.
- Quarterly ambient and stormwater monitoring at fixed stations in the major creeks draining Charlotte.

For more information on the SWIM strategy and its various components, contact Rusty Rozelle at (704) 336-5449.

1.5.3 City of Charlotte Storm Water Services

The City of Charlotte has administered a storm water quality management program (SWQMP) since January 1993. Seven years earlier (in 1986), Charlotte began local administration of a soil erosion and sedimentation control program. The SWQMP is coordinated with the countywide Surface Water Improvement and Management (SWIM) initiative (see Part 1.5.2). It is likely that the SWQMP and SWIM program will be merged into one program in the future.

The SWQMP involves measures to comply with USEPA nonpoint source pollution regulations and state water supply watershed protection regulations for Lake Wylie. The types of activities

performed by the city as part of the SWQMP include watershed management and coordination, research of Best Management Practices (BMPs), elimination of illegal water pollution activities, stormwater sampling and testing, and public education and outreach.

The city is in the process of finalizing the development of a Watershed Management System (WMS) which entails an extensive database of water quality, water quantity, land use and land feature information. The WMS will be used to enhance project design, modeling and master planning efforts. Charlotte participates in a number of local and regional water quality initiatives and committees.

Stormwater quality controls are implemented in the City of Charlotte through several different programs/policies. These programs range from state/federally mandated land development requirements for the drinking water supply watersheds and NPDES permit directed BMP Pilot Program to locally driven policies such as a Pond and Dam Restoration Policy, streamside buffers and a stormwater utility fee credit system. Improvements to design standards for new development are continually encouraged. Charlotte's SWQMP also involves evaluation of maintenance and "housekeeping" practices in coordination with the city's industrial operations (i.e., street maintenance, solid waste, etc.) and with Charlotte Storm Water Services' (CSWS) infrastructure repair and maintenance methods including channel stabilization, cleaning, culvert replacement/blow-out repair, and pond/dam management. CSWS has funded research for the development of a "regional curve" that will be used in designing stream restoration or stabilization projects. This research will benefit the Piedmont Region and the state.

Illegal water pollution activities are identified and eliminated through enforcement of the Storm Water Pollution Ordinance by follow-up to reports of illicit connections and improper disposal, industrial inspections, inspection and enforcement per the Soil Erosion and Sedimentation Control Ordinance, and long and short-term monitoring activities. Stream and stormwater monitoring activities performed on behalf of the Charlotte's SWQMP include:

- Quarterly land use monitoring (completed in 1998 and discontinued; report, expected in late 1999, will analyze pollutant loads based on land use and other factors).
- Monthly stream monitoring for chemical and physical parameters during ambient flow conditions at 25 sites.
- Benthic macroinvertebrate sampling at 44 stream sites (annually at some and 3-year rotation at others).
- Fish community analysis on a 5-year rotation at the 44 benthic sites with fish tissue analyses performed at 11 of these sites.
- Quarterly instream stormwater monitoring to measure nonpoint source pollutant loads in major streams draining Charlotte and to identify sources of these pollutants for possible corrective actions.
- Nonroutine monitoring to evaluate effectiveness of maintenance practices, identify/delineate areas of illegal water pollution activities, and monitor industrial practices.

Educational outreach efforts are coordinated through the Water Quality Coalition (WQC). The WQC consists of representatives from Charlotte-Mecklenburg Storm Water Services, Charlotte-Mecklenburg Utilities, NC Division of Forestry - Mecklenburg Office, Mecklenburg County Department of Environmental Protection, Mecklenburg County Solid Waste Management,

University of North Carolina at Charlotte, and NC Soil and Water Conservation District. The WQC organizes joint public outreach efforts aimed at improving surface water quality. Public education and outreach efforts have also been locally coordinated through the "Water U Wadin For" campaign. Additional activities aimed at involving and educating the public on stormwater pollution prevention have included:

- Public involvement programs (Storm Drain Stenciling, Adopt-a-Stream, bio-engineering projects)
- Workshops (Erosion control, Stream and Wetland Protection/Restoration, industrial operations, pesticide application, etc.)
- Educational materials (SWIM Newsletter, handouts/brochures, newspaper inserts/articles, Slime Stoppers Video)
- Special events and festivals (Big Sweep, Water Week, Used Oil Recycling Week, Spring Show, Earth Day, etc.)

For additional information regarding the City of Charlotte's SWQMP or other activities, contact Steve Jadlocki, Water Quality Program Administrator at (704) 336-4398.

1.5.4 Initiative for Mountain Island Lake

The Clean Water Management Trust Fund has provided a $6.15 million grant to Gaston County, Lincoln County, the Trust for Public Lands and the Centralina Council of Governments to purchase 1,231 acres of Crescent Resources property in Gaston and Lincoln counties. This initiative was spearheaded by the Catawba Lands Conservancy, the Community Foundation of Gaston County, Foundation for the Carolinas and the Trust for Public Land.

This tract of land resulted in the purchase of nearly six miles of Mountain Island Lake shoreline for preservation and protection. Combined with the 2,700 acres acquired by Mecklenburg County for watershed protection, about 53 percent of the lake shoreline is held in public hands. Computer modeling is being developed to determine which other Mountain Island Lake parcels should receive top priority for purchase to provide further protection in this water supply watershed.

For more information on the Initiative for Mountain Island Lake, contact Mark Harrison or Harry Hoover at (704) 364-8969.

1.5.5 Muddy Creek Watershed Restoration Initiative

The NC Wildlife Resources Commission, Duke Power, Natural Resources Conservation Service, Trout Unlimited, Clean Water Management Trust Fund, National Fish and Wildlife Foundation, Western Piedmont Council of Governments, DWQ, McDowell County Soil and Water Conservation District, Burke County Department of Community Development, City of Morganton and the Foothills Conservancy of NC are working together to reduce sediment loads in Muddy Creek. This project is expected to consist of streambank restoration sites, channel realignment, clearing blockages, bank stabilization, fencing out livestock, establishment of buffers with willing landowners, and public education and outreach.

This initiative is forming partnerships among industry, resource and conservation agencies, local governments, and landowners to pursue sedimentation and water quality improvements in the Muddy Creek watershed. The ultimate goal is to improve fish habitat and water quality in the Catawba River and demonstrate the effectiveness of BMPs.

In 1999, the project partners began to implement a stream improvement project, conduct a Muddy Creek watershed assessment to determine the feasibility and cost of significant sediment improvement, and outreach and education through a newsletter and a brochure.

1.6 Corporate Initiatives

1.6.1 Duke Power

Duke Power has an ongoing watershed management-related initiative in several respects. Duke has an environmental monitoring program that has performed water quality monitoring for over 20 years. In response to the increased demand for water resources as a result of growth, Duke has recently diversified its monitoring to include bacteriological, phytoplankton, aquatic plants and fish. Duke has also been very interested in developing partnerships with other groups interested in water quality management. Duke publishes *The Catawba Magazine* as a means of sharing information to the public about water quality issues and resource issues in the Catawba River basin.

1.7 Citizen Efforts

1.7.1 Catawba River Foundation and the Riverkeeper Program

In 1992, the county commissioners of five counties (Mecklenburg, Union, Gaston and Lincoln counties in NC and York County in SC) appointed 100 citizens to the Catawba River Corridor Study Group. The Group also had representatives from Duke Power, Jansen and Centralina Council of Governments. The Study Group made eight recommendations to the commissioners. One of these recommendations was to create a Catawba Riverkeeper Program.

In 1997, the Lake Wylie and Lake Norman Marine Commissions established the Catawba River Foundation, Incorporated to improve and protect the water quality of the Catawba River. The Foundation is a nonprofit corporation, which has been designated by the National Association of Water Keeper Alliance, Incorporated as the umbrella organization for the RIVERKEEPER® movement on the Catawba River. In January 1998, the Foundation contracted Donna Lisenby to be the Catawba Riverkeeper. The Foundation plans to establish individual Creek/Covekeepers programs on each of the eleven impoundments located in North and South Carolina. These Creek/Covekeeper programs would work in coordination with the Riverkeeper. Currently, there is an established Lake Wylie Creek/Covekeeper, and one is being formed on Lake Norman.

For more information on the Catawba Riverkeeper, contact Donna Lisenby at 1-87-Riverkeeper. For more information on the Catawba River Foundation, contact Mike McLaurin at (704) 348-2075.

1.7.2 Gaston County Quality of Natural Resources Commission (QNRC)

Established in 1988, the Gaston County QNRC is a citizen-based organization working together to improve the quality of air and water resources in the county. The mission of the QNRC is to:

- assess the state of natural resources in Gaston County;
- review environmental concerns of the residents and determine if state and federal regulations are sufficient to address them;
- study alternatives and make recommendations to the Board of County Commissioners;
- communicate with county residents and encourage active understanding of pollution problems in the county and alternatives for improving the environment; and
- coordinate and communicate with appropriate county officials and agencies.

In addition to cooperating on the Long Creek project (see Part 1.2.1 above), the QNRC has: 1) held workshops to educate the public about changes in state water pollution control policy and gathered information on the needs and interests of the residents to affect new pollution control policies; 2) worked with the City of Gastonia to improve water quality on Kaglor Branch by creating a stormwater detention basin and constructing wetlands in Rankin Park; and 3) worked with a local boy scout troop to plant hardwoods above the Bessemer City water supply intake to protect the intake from sedimentation.

For more information on the Gaston County QNRC activities, call (704) 922-0303.

1.7.3 Catawba Lands Conservancy (CLC)

The CLC is a nonprofit land trust dedicated to preserving the land, water and wildlife resources of the lower Catawba River basin in NC, including all or portions of Catawba, Gaston, Iredell, Lincoln, Mecklenburg and Union counties. CLC works in partnership with private landowners, public agencies, developers and others to place land into conservation. The CLC acquires property through donations of land or conservation easements, as well as purchases.

Many of CLC's conservation efforts are focused on working with landowners to permanently protect riparian buffers and wetlands along the Catawba River and its tributaries. The CLC has a number of these stream corridor protection efforts underway in the Catawba River basin including:

Mountain Island Lake Initiative -- The Conservancy is a lead partner in the Mountain Island Lake Initiative (see Part 1.5.4 above), an effort to acquire and permanently protect approximately 4,800 acres in the Mountain Island Lake Watershed. These lands, in addition to the 2,700 acres protected as Nature Preserves in Mecklenburg County and 1,231 acres protected in Gaston and Lincoln Counties, will protect the drinking water source for nearly 600,000 NC residents. Priorities in the watershed include the lakeshore and Johnson, Gar, Torrence and McDowell Creeks.

South Fork Catawba River -- The Conservancy is working with landowners to protect buffers along the river and its tributaries in Gaston and Lincoln counties. CLC provides outreach to landowners about the benefits of riparian buffers, as well as conservation options and benefits.

Over 600 acres along the river have already been protected. The CLC expects to protect an additional 215 acres along Long and Little Long Creeks in Gaston County, as well as 245 acres on both sides of the river in Lincoln County. A conservation plan for a portion of the South Fork River in Gaston County is being prepared with funds from the Clean Water Management Trust Fund and the Community Foundation of Gaston County.

Stanley Creek -- A private landowner has agreed to donate a conservation easement protecting approximately 60 acres along the creek. The Conservancy will also initiate outreach to other landowners in the Stanley Creek basin in an effort to protect a continuous forested riparian buffer along this tributary to Dutchmans Creek.

Waxhaw Creek -- A grant from the Clean Water Management Trust Fund, through the Conservation Trust for North Carolina, will allow the Conservancy to identify and prioritize land in the Waxhaw Creek watershed that is essential to protect the water quality of the creek. The Creek supports the only remaining population of the federally endangered Carolina Heelsplitter (*Lasmigona decorata)* mussel in the Catawba River basin.

For more information on the Conservancy and its water quality protection efforts, contact: Catawba Lands Conservancy at (704) 342-3330.

1.7.4 Lake Norman Marine Commission

The Lake Norman Marine Commission was authorized by the General Assembly in 1969. The Lake Norman Marine Commission is composed of one representative from the four counties in the Lake Norman watershed: Catawba, Iredell, Lincoln and Mecklenburg. The Commission has the authority to make regulations applicable to Lake Norman and its shoreline area concerning all matters relating to or affecting public recreation and water safety. In lieu of, or in addition to, passing regulations supplementary to state law and regulations concerning the operations of vessels on Lake Norman, the Commission may request that the Wildlife Commission pass local regulations on this subject after public notice.

In addition to these regulatory activities on Lake Norman, the Lake Norman Marine Commission has been instrumental in increasing public awareness of water quality issues on the lake. The Commission has developed a brochure for citizens on erosion control methods, buffer requirements, and illegal discharge fines and penalties. Through this brochure, the public is made aware of violation reporting procedures. The Commission also developed a reporting form that is to be faxed to the DENR regional office for reporting violations.

For more information on the Lake Norman Marine Commission, call (704) 372-2416.

1.7.5 Lake Wylie Marine Commission

The Lake Wylie Marine Commission was established as an interstate compact between North and South Carolina in 1989. The counties of Mecklenburg, Gaston and York (SC) fund the Commission equally and appoint seven Commissioners, with each county having two appointees and a third appointee that rotates among the three counties.

The Lake Wylie Marine Commission has regulatory authority provided that the regulations do not supercede federal or state law. The Marine Commission's authority extends up to1000 feet beyond the full pond level of Lake Wylie. The Marine Commission has passed two local regulations. In 1991, the Commission passed the first regulation in the Carolinas that governs the operation of personal watercraft (i.e., jet skis). In 1992, the Commission passed a regulation that governs the operation of motorboats. Currently, the Marine Commission is considering a regulation that would govern the operation of water-skiing. The Marine Commission is also involved in the establishment or recommendation for no-wake zones. In addition to passing local regulations, the Marine Commission is actively involved with other agencies from both states on various lake issues including increased lake patrols, better boating education, state legislation, environmental protection, etc.

The Marine Commission is also actively involved with various environmental organizations and individuals such as NC Department of Environment and Natural Resources, SC Department of Health and Environmental Control, Duke Power, the Catawba Riverkeeper and others. The Lake Wylie Marine Commission has been focusing its environmental resources on preventing illegal dumping into Lake Wylie and participating in the development process to ensure environmental compliance. When violations are discovered, the Marine Commission works with the counties and state to insure that prompt enforcement action is taken.

For information about the Lake Wylie Marine Commission, contact Mike McLaurin at (704) 348-2705 or visit their website at http://www.charweb.org/organizations/wylie.index.htm.

1.7.6 Mountain Island Lake Marine Commission

The Mountain Island Lake Marine Commission was established by the NC General Assembly in 1997. The counties of Mecklenburg, Gaston and Lincoln fund the Commission and appoint members to the Commission. There are seven commissioners, with Mecklenburg and Gaston counties each having three commissioners and Lincoln having one commissioner.

The Mountain Island Lake Marine Commission has regulatory authority provided that the regulations do not supercede federal or state law. This Commission is currently considering local regulations that would affect the operation of personal watercraft. The Marine Commission is also involved in the establishment or recommendations for no-wake zones. Also, the Marine Commission is helping to establish a US Coast Guard Auxiliary Flotilla on the lake. In addition to considering local regulations, the Marine Commission is actively involved with local law enforcement, the NC Wildlife Resources Commission and legislators on various lake issues.

The Marine Commission is also actively involved with various environmental organizations and individuals such as NC Department of Environment and Natural Resources, Duke Power, the Catawba Riverkeeper and others. The Mountain Island Lake Marine Commission has been focusing its environmental resources on participating in the development process to ensure environmental compliance. When violations are discovered, the Marine Commission works with the counties and state to insure that prompt enforcement action is taken.

For information about the Mountain Island Lake Marine Commission, contact Mike McLaurin at (704) 348-2705.

1.7.7 Trust for Public Land Mountain Island Lake Technical Study

The purpose of this study is to make an assessment of environmental and land use conditions in the Mountain Island Lake watershed and to identify the areas within the watershed where development may pose the greatest risk to water quality on the lake. The study was commissioned by the Trust for Public Lands and conducted by the Carolinas Lands Conservation Network, with assistance from the Centralina Council of Governments. A computer model was used to compute a calculated buffer around the lake and its tributaries, and then individual stream segments were prioritized based on a series of factors. This information is expected to be of significant benefit to the region to protect those waters to be at greatest water quality risk and to reduce nonpoint source pollution in the watershed.

1.8 Regional Activities

1.8.1 Catawba River Bi-State Task Force

The Bi-State Task Force is a forum for discussing issues among stakeholders in the Catawba River basin. The Bi-State Task Force quarterly meetings are open to the public. Meetings typically consist of experts addressing key topics and a "River Roundtable" that allows anyone in the group to share concerns. The Task Force also sponsors an annual public conference at UNCC on such issues as water allocation, ecosystem management and water quality management.

For more information on the Catawba River Task Force, contact Trille Mendenhall of Charlotte-Mecklenburg Utilities at (704) 399-2221.

1.8.2 Catawba Water Quality Consortium (CWQC)

The Consortium was formed in 1996 to enhance communication and share technical information among entities conducting water quality monitoring in the Catawba River basin. Membership in the organization represents a wide spectrum of state, federal and local agencies with interests in water quality. The consortium also acts as a sounding board for ideas related to water quality.

For more information on the Catawba Water Quality Consortium, contact David Chestnut at (803) 898-4066.

1.8.3 Voices and Choices

Several organizations partnered together to bring about an Environmental Summit for the Central Carolinas region, defined as Anson, Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly and Union counties in NC, and three SC counties of Chester, Lancaster and York. Many organizations, ranging from nonprofits, private and public sector, and environmental groups, continue to be involved in this initiative.

Prior to the Environmental Summit, a series of regional meetings were held for people to express views, concerns and choices for the future of the Central Carolina's region. The issues most

commonly raised were: 1) growth planning, sprawl and land use policies; 2) surface and groundwater protection; 3) waste management and disposal; 4) transportation alternatives and impact on air quality; and 5) preservation of open space and the aesthetic appeal of the region. The Environmental Summit was held in November 1998 with over 700 people in attendance.

A need to continue an inclusive initiative to develop regional consensus on issues affecting the environment in the Central Carolinas was also identified. Five action teams are formed to develop and implement specific plans. Specific recommendations for addressing water quality include:

- Improve land use decision-making and enforce pollution regulations with education as one component.
- Reduce the number of wastewater treatment plants through regionalization.
- Reduce nutrient loads from point sources where loads contribute to impairment of downstream waters.
- Improve wastewater collection systems to reduce the number of system leaks and overflows.
- Encourage and facilitate development of local sediment and erosion control programs.
- Fund more erosion control inspector positions at the state level.
- Continue developing color guidelines and reducing color discharges on the South Fork Catawba River.
- Implement more buffer zones around waters.

For more information on the Voices and Choices Initiative, contact the Central Carolinas Choices at (704) 376-9214.

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) is made available to the GIS system, the potential to graphically display the results of water quality data analysis will be tremendous.

Additional Research and Monitoring Needs

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

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

DWQ would like to work more closely with the Conservation Districts in each county of the Catawba 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 Catawba River basin.

2.2 DWQ Compliance and Enforcement Policy Revisions

DENR began implementing a new two-stage compliance and enforcement policy in 1997. Both stages of the revised policy are in effect as of July 1, 1999. The five major elements of the policy are intended to provide a comprehensive route to strengthen enforcement and heighten compliance for all dischargers and nonpoint sources of water pollution in North Carolina. The five major components of the policy are to:

1. Foster compliance through pollution prevention, technical assistance and training, reevaluate existing grant and loan funding priority criteria, and develop recognition and incentive programs.
2. Enhance enforcement through increased penalties, penalties for sewer collection systems, reduced thresholds for noncompliance, and delegation of civil penalty assessment authority to the DWQ regional office supervisors.
3. Focus on chronic and willful violators through increased use of moratoriums on expanding and additional connections, expansion of notification to the public of violators, clarification of process of determining "noncompliance", and initiation of discussion with stakeholders on possible legislative actions.
4. Assure improvement in compliance and enforcement through development of accountability measures.
5. Find and use all available resources for compliance needs with local, state and nonprofit groups.

DENR is also in the process of conducting assessment of its enforcement programs. The goal of the assessment is to identify potential areas for improvement in DENR's efforts to enforce environmental laws and ultimately improve compliance. This effort got underway in July 1999 with two focus group meetings. If you would like to see the Scope of Work for the enforcement assessment, see DENR's web page at http://www.ehnr.state.nc.us/EHNR/novs/scope.htm/.

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Appendix I

NPDES Dischargers and Individual Stormwater Permits in the Catawba River Basin

Permit	Facility	County	Region	Type	Ownership	Qw	Facility Operations	Comments	Subbasin	Stream
NC0006564	Baxter Healthcare Corporation	McDowell	Asheville	Major	Non-Municipal	1.2	Drug manufacturing	Process + domestic	30830	North Fork Catawba River
NC0004243	Coats American, Inc. - Marion	McDowell	Asheville	Major	Non-Municipal	2	Textile Mill	Process + domestic	30830	North Fork Catawba River
NC0031879	Marion, City - Corpening Creek	McDowell	Asheville	Major	Municipal	3	POTW	Process + domestic	30830	Corpening Creek
NC0055221	Marion WTP, City of	McDowell	Asheville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30830	Nicks Creek
NC0035157	Pinnacle Rest Home	McDowell	Asheville	Minor	Non-Municipal	0.003	Nursing Home	100% domestic	30830	UT South Muddy Creek
NC0029831	Sugar Hill Truck Stop	McDowell	Asheville	Minor	Non-Municipal	0.005	Restaurant	100% domestic	30830	UT North Muddy Creek
NC0060224	Jonas Ridge Nursing Home	Burke	Asheville	Minor	Non-Municipal	0.0075	Nursing Home	100% domestic	30830	UT Linville River
NC0067130	McDowell Co Sch - Glenwood Elem	McDowell	Asheville	Minor	Non-Municipal	0.0075	School	100% domestic	30830	Goose Creek
NC0067148	McDowell Co Sch - Nebo Elem	McDowell	Asheville	Minor	Non-Municipal	0.0075	School	100% domestic	30830	UT Shadrick Creek
NC0045543	Brigam Medical, Inc.	Avery	Asheville	Minor	Non-Municipal	0.0081	Industrial site	100% domestic	30830	Stacey Creek
NC0077801	Gibbs Motel And Restaurant	McDowell	Asheville	Minor	Non-Municipal	0.009	Restaurant	100% domestic	30830	UT Catawba River
NC0069965	Hillside Mobile Village MHP	McDowell	Asheville	Minor	Non-Municipal	0.01	Mobile Home Park	100% domestic	30830	UT Catawba River
NC0057819	Metal Industries, Inc.	McDowell	Asheville	Minor	Non-Municipal	0.01	Metal Plating Plant	Process wastewater only	30830	Mackey Creek
NC0075353	Rocky Pass Adult Care, LLC	McDowell	Asheville	Minor	Non-Municipal	0.01	Nursing Home	100% domestic	30830	North Muddy Creek
NC0030996	The Chalet Motor Lodge	McDowell	Asheville	Minor	Non-Municipal	0.01	Hotel	100% domestic	30830	UT Buchanan Creek
NC0076180	Jeld-Wen Fiber of North Carolina	McDowell	Asheville	Minor	Non-Municipal	0.012	Industrial site	Process + domestic	30830	Catawba River
NC0062413	Linville Ridge Development	Avery	Asheville	Minor	Non-Municipal	0.015	Condominiums	100% domestic	30830	UT West Fork Linville River
NC0039934	Crane Resistoflex	McDowell	Asheville	Minor	Non-Municipal	0.016	Industrial site	Process + domestic	30830	UT Catawba River
NC0040339	EHNR - Corpening Training Center	Avery	Asheville	Minor	Non-Municipal	0.018	Conference Center	100% domestic	30830	Linville River
NC0060208	Scenic Inn	McDowell	Asheville	Minor	Non-Municipal	0.019	Restaurant	100% domestic	30830	Hicks Branch
NC0079481	Elledge (R.D.) Harmony Estates	McDowell	Asheville	Minor	Non-Municipal	0.02	Subdivision	100% domestic	30830	UT North Muddy Creek
NC0040291	Park Inn International	McDowell	Asheville	Minor	Non-Municipal	0.02	Hotel	100% domestic	30830	Hicks Branch
NC0026654	Crossnore WWTP, Town of	Avery	Asheville	Minor	Municipal	0.07	POTW	100% domestic	30830	Mill Timber Creek
NC0023124	GGCC Utility, Inc.	Avery	Asheville	Minor	Non-Municipal	0.07	Subdivision	100% domestic	30830	Linville River
NC0039446	Linville Resorts	Avery	Asheville	Minor	Non-Municipal	0.1	Subdivision	100% domestic	30830	Linville River
NC0080098	Blue Ridge Country Club LTD	McDowell	Asheville	Minor	Non-Municipal	0.202	Subdivision	100% domestic	30830	North Fork Catawba River
NC0022756	Linville Land Harbor - POA	Avery	Asheville	Minor	Non-Municipal	0.225	Subdivision	100% domestic	30830	Linville River
NC0071200	Marion, Town - Catawba River WWTP	McDowell	Asheville	Minor	Municipal	0.25	POTW	100% domestic	30830	Catawba River
NC0021229	Old Fort, Town - WWTP	McDowell	Asheville	Minor	Municipal	0.8	POTW	Process + domestic	30830	Curtis Creek
NC0077623	United Merchants & Manufacturers ***	McDowell	Asheville	Minor	Non-Municipal	2.12	Groundwater remediation	Process wastewater only	30830	Catawba River
NC0005258	Sigri Great Lakes Carbon Corporation	Burke	Asheville	Major	Non-Municipal	0	Industrial site	Process wastewater only	30831	Silver Creek
NC0023981	Lenoir, City - Lower Creek WWTP	Caldwell	Asheville	Major	Municipal	4.08	POTW	Process + domestic	30831	Lower Creek
NC0041696	Valdese, Town - Lake Rhodiss WWTP	Burke	Asheville	Major	Municipal	7.5	POTW	Process + domestic	30831	Lake Rhodhiss - Catawba River
NC0026573	Morganton WWTP, City of	Burke	Asheville	Major	Municipal	8	POTW	Process + domestic	30831	Catawba River
NC0082546	Granite Falls, Town - WTP	Caldwell	Asheville	Minor	Municipal	0	Water Treatment Plant	Process wastewater only	30831	Rhodhiss Lake
NC0060194	Morganton WTP (City of)	Burke	Asheville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30831	Catawba River
NC0048755	Monte Carlo Trailer Park	Burke	Asheville	Minor	Non-Municipal	0.005	Mobile Home Park	100% domestic	30831	Lower Creek
NC0041165	Caldwell Co BOE - Saw Mills Elem	Caldwell	Asheville	Minor	Non-Municipal	0.006	School	100% domestic	30831	Freemason Creek

NC0047147	Quality Care Assisted Living	Caldwell	Asheville	Minor	Non-Municipal	0.0066	Nursing Home	100% domestic	30831	Greasy Creek
NC0040754	NC Outward Bound School	Burke	Asheville	Minor	Non-Municipal	0.0075	Conference Center	100% domestic	30831	Roses Creek
NC0043231	Cedar Rock Country Club	Caldwell	Asheville	Minor	Non-Municipal	0.009	Country Club	100% domestic	30831	UT Lower Creek
NC0047627	Sealed Air Corporation	Caldwell	Asheville	Minor	Non-Municipal	0.0095	Industrial site	Process + domestic	30831	Blair Fork Creek
NC0050075	Caldwell Co Sch - Collettsville	Caldwell	Asheville	Minor	Non-Municipal	0.01	School	100% domestic	30831	Johns River
NC0030783	Caldwell Co Sch - Baton Elem	Caldwell	Asheville	Minor	Non-Municipal	0.015	School	100% domestic	30831	Stafford Creek
NC0040274	The Bullek Corporation of NC	Caldwell	Asheville	Minor	Non-Municipal	0.05	Conference Center	100% domestic	30831	UT Zacks Fork Creek
NC0004987	Duke Power Company, Marshall S.E.	Catawba	Mooresville	Major	Non-Municipal	0	Power Plant	Complex waste stream	30832	Catawba River - Lake Norman
NC0025135	Huffman Finishing Company	Caldwell	Asheville	Major	Non-Municipal	0.25	Textile Mill	Process + domestic	30832	Catawba River
NC0034860	Schneider Mills, Inc.	Alexander	Mooresville	Major	Non-Municipal	0.78	Textile Mill	Process + domestic	30832	Muddy Fork Creek
NC0024252	Conover WWTP - Northeast	Catawba	Mooresville	Major	Municipal	1.5	POTW	100% domestic	30832	Lyle Creek
NC0023736	Lenoir, City - Gunpowder Creek WWTP	Caldwell	Asheville	Major	Municipal	2	POTW	Process + domestic	30832	Gunpowder Creek
NC0020401	Hickory Northeast WWTP	Catawba	Mooresville	Major	Municipal	6	POTW	Process + domestic	30832	Lake Hickory - Catawba River
NC0048712	Alumax Extrusions, Inc.	Catawba	Mooresville	Minor	Non-Municipal	0	Industrial site	Process wastewater only	30832	UT Lake Norman
NC0044121	Hickory WTP	Catawba	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30832	Catawba River - Lake Hickory
NC0044164	Lenoir, City - Lake Rhodhiss WTF	Caldwell	Asheville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30832	Catawba River
NC0084573	Lincoln County WTP	Lincoln	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30832	Catawba River - Lake Norman
NC0041220	Caldwell Co BOE - Oak Hill Elem	Caldwell	Asheville	Minor	Non-Municipal	0.003	School	100% domestic	30832	Mountain Run Creek
NC0041157	Caldwell Co BOE - Dudley Shoals	Caldwell	Asheville	Minor	Non-Municipal	0.004	School	100% domestic	30832	Upper Little River
NC0035211	Shuford Mills - Dudley Shoals Plant	Caldwell	Asheville	Minor	Non-Municipal	0.0054	Industrial site	100% domestic	30832	Upper Little River
NC0086304	Catawba Co Sch - East Catawba	Catawba	Mooresville	Minor	Non-Municipal	0.0065	School	100% domestic	30832	Balls Creek
NC0045438	Catawba Co Sch - Sherrills Ford	Catawba	Mooresville	Minor	Non-Municipal	0.007	School	100% domestic	30832	UT Mountain Creek
NC0064599	Lake Norman Motel/Restaurant WWTP	Catawba	Mooresville	Minor	Non-Municipal	0.0075	Hotel	100% domestic	30832	Mountain Creek - Lake Norman
NC0041122	Alexander Co BOE - Ellendale Elem	Alexander	Mooresville	Minor	Non-Municipal	0.01	School	100% domestic	30832	Beaver Branch
NC0044253	Camp Dogwood	Catawba	Mooresville	Minor	Non-Municipal	0.01	Campground	100% domestic	30832	Mountain Creek - Lake Norman
NC0062430	Duke Power State Park Swim Area	Iredell	Mooresville	Minor	Non-Municipal	0.01	Campground	100% domestic	30832	Hicks Creek
NC0062481	Mid South Water System - Mallard Hd	Iredell	Mooresville	Minor	Non-Municipal	0.01	Condominiums	100% domestic	30832	UT Reeds Creek
NC0076163	Rock Barn Properties, Inc. ***	Catawba	Mooresville	Minor	Non-Municipal	0.01	Condominiums	100% domestic	30832	Lyle Creek
NC0085545	Express Food Mart	Catawba	Mooresville	Minor	Non-Municipal	0.0115	Groundwater remediation	Process wastewater only	30832	UT Mundy Creek
NC0069345	Murrays Mill Historical Site	Catawba	Mooresville	Minor	Non-Municipal	0.0125	Park	100% domestic	30832	Balls Creek
NC0032972	C & C Mobile Home Park	Catawba	Mooresville	Minor	Non-Municipal	0.015	Mobile Home Park	100% domestic	30832	Lyle Creek
NC0034967	Carolina Glove Company	Alexander	Mooresville	Minor	Non-Municipal	0.015	Industrial site	100% domestic	30832	Lower Little River
NC0051608	Catawba Co Sch - Bandys High Sch	Catawba	Mooresville	Minor	Non-Municipal	0.015	School	100% domestic	30832	Battle Run Creek
NC0044059	Catawba Co Sch - Bunker Hill HS	Catawba	Mooresville	Minor	Non-Municipal	0.015	School	100% domestic	30832	UT Lyle Creek
NC0062448	Duke Power State Park Camp Area	Iredell	Mooresville	Minor	Non-Municipal	0.015	Campground	100% domestic	30832	Catawba River - Lake Norman
NC0075205	Mid South Water System - Alexander	Iredell	Mooresville	Minor	Non-Municipal	0.015	Subdivision	100% domestic	30832	Catawba River - Lake Norman
NC0074535	Mid South Water System - Pier 16	Iredell	Mooresville	Minor	Non-Municipal	0.0185	Restaurant	100% domestic	30832	Catawba River - Lake Norman
NC0034754	Commscope, Inc.	Catawba	Mooresville	Minor	Non-Municipal	0.02	Industrial site	Process + domestic	30832	UT Terrapin Creek
NC0067784	Mid South Water Sys - Governor Island	Lincoln	Mooresville	Minor	Non-Municipal	0.02	Subdivision	100% domestic	30832	Lake Norman
NC0050822	Pine Ridge Subdivision	Catawba	Mooresville	Minor	Non-Municipal	0.02	Subdivision	100% domestic	30832	Lyle Creek

NC0071528	Lake Norman Woods Homeownrs Asso	Catawba	Mooresville	Minor	Non-Municipal	0.025	Subdivision	100% domestic	30832	Lake Norman
NC0058742	Mid South Water Sys - Country Valley	Catawba	Mooresville	Minor	Non-Municipal	0.0265	Subdivision	100% domestic	30832	Hagan Fork Creek
NC0074772	Mid South Water Sys - Diamondhead	Iredell	Mooresville	Minor	Non-Municipal	0.033	Subdivision	100% domestic	30832	Reeds Creek Arm - Lake Norman
NC0062456	Mid South Water Sys - Riverwood	Catawba	Mooresville	Minor	Non-Municipal	0.04	Subdivision	100% domestic	30832	Lake Norman
NC0063355	Mid South Water Sys - Killians	Catawba	Mooresville	Minor	Non-Municipal	0.05	Subdivision	Process + domestic	30832	Reed Creek - Lake Norman
NC0022497	Cross Country Campground	Catawba	Mooresville	Minor	Non-Municipal	0.065	Campground	100% domestic	30832	Reed Creek
NC0056154	Mid South Water Sys - Bridgeport	Iredell	Mooresville	Minor	Non-Municipal	0.08	Subdivision	100% domestic	30832	Lake Norman
NC0080691	Mid South Water Sys - Windemere	Iredell	Mooresville	Minor	Non-Municipal	0.09	Subdivision	100% domestic	30832	Catawba River
NC0025917	Rhodhiss WWTP, Town of	Burke	Asheville	Minor	Municipal	0.096	POTW	100% domestic	30832	Catawba River - Lake Hickory
NC0032662	Claremont WWTP - North	Catawba	Mooresville	Minor	Municipal	0.1	POTW	Process + domestic	30832	Mull Creek
NC0026549	Claremont WWTP - South	Catawba	Mooresville	Minor	Municipal	0.1	POTW	Process + domestic	30832	UT McLin Creek
NC0074900	Mid South Water Sys - Knots Landing	Iredell	Mooresville	Minor	Non-Municipal	0.1	Subdivision	100% domestic	30832	McCrary Creek - Lake Norman
NC0060593	Mid South Water Sys - Spinnaker Bay	Catawba	Mooresville	Minor	Non-Municipal	0.125	Condominiums	100% domestic	30832	Mountain Creek - Lake Norman
NC0078603	Lake Norman Limited	Iredell	Mooresville	Minor	Non-Municipal	0.175	Subdivision	100% domestic	30832	Catawba River
NC0026832	Troutman, Town - WWTP	Iredell	Mooresville	Minor	Municipal	0.22	POTW	100% domestic	30832	Big Branch
NC0025542	Catawba WWTP, Town of	Catawba	Mooresville	Minor	Municipal	0.225	POTW	Process + domestic	30832	Lyle Creek
NC0081370	Claremont - McLin Creek WWTP	Catawba	Mooresville	Minor	Municipal	0.3	POTW	100% domestic	30832	McLin Creek
NC0076350	Crescent Resources, Inc.	Iredell	Mooresville	Minor	Non-Municipal	0.45	Subdivision	100% domestic	30832	Lake Norman
NC0024279	Conover WWTP - Southeast	Catawba	Mooresville	Minor	Municipal	0.6	POTW	100% domestic	30832	McLin Creek
NC0021890	Granite Falls WWTP, Town of	Caldwell	Asheville	Minor	Municipal	0.75	POTW	100% domestic	30832	Gunpowder Creek
NC0026271	Taylorsville, Town - WWTP	Alexander	Mooresville	Minor	Municipal	0.83	POTW	Process + domestic	30832	Lower Little River
NC0084565	CWS / The Harbour WTP	Iredell	Mooresville	Minor	Non-Municipal	none	Water Treatment Plant	Process wastewater only	30832	Catawba River
NC0024392	Duke Power Company - McGuire S.E.	Mecklenburg	Mooresville	Major	Non-Municipal	0	Power Plant	Complex waste stream	30833	Catawba River
NC0004961	Duke Power Company - Riverbend S.E.	Gaston	Mooresville	Major	Non-Municipal	0	Power Plant	Complex waste stream	30833	Catawba River
NC0036277	CMUD - McDowell Creek WWTP	Mecklenburg	Mooresville	Major	Municipal	3	POTW	Process + domestic	30833	McDowell Creek
NC0021156	Mount Holly, City of - WWTP	Gaston	Mooresville	Major	Municipal	4	POTW	Process + domestic	30833	Catawba River
NC0084387	CMUD - North Mecklenburg WTP	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30833	McDowell Creek
NC0023540	Belmont Textile Machinery Company	Gaston	Mooresville	Minor	Non-Municipal	0.005	Industrial site	100% domestic	30833	Fites Creek
NC0085677	Shuffletown Grocery & Service	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0086	Groundwater remediation	Process wastewater only	30833	UT Catawba River
NC0072621	Fa-Be Enterprises, Inc.	Lincoln	Mooresville	Minor	Non-Municipal	0.012	Nursing Home	100% domestic	30833	Forney Creek
NC0086185	Lincoln Co Sch - Pumpkin Center	Lincoln	Mooresville	Minor	Non-Municipal	0.012	School	100% domestic	30833	Ore Bank Branch
NC0041360	Gaston Co BOE - East Gaston HS	Gaston	Mooresville	Minor	Non-Municipal	0.025	School	100% domestic	30833	UT Taylors Creek
NC0080781	Duke Power Co - Lincoln Center Plant	Lincoln	Mooresville	Minor	Non-Municipal	0.095	Power Plant	Process wastewater only	30833	Killian Creek
NC0084689	Mount Holly, City - WTP	Gaston	Mooresville	Minor	Non-Municipal	0.1	Water Treatment Plant	Process wastewater only	30833	UT Catawba River
NC0074012	East Lincoln Co / Forney Creek WWTP	Lincoln	Mooresville	Minor	Municipal	0.75	POTW	100% domestic	30833	Forney Creek
NC0080195	Forest Hills Mobile Home Estates	Gaston	Mooresville	Minor	Non-Municipal	none	Water Treatment Plant	Process wastewater only	30833	UT Hoyle Creek
NC0004375	Clariant Corp - Mount Holly Road/Sand	Mecklenburg	Mooresville	Major	Non-Municipal	3.9	Chemical manufacturing	Process + domestic	30834	Catawba River
NC0021181	Belmont, City of - WWTP	Gaston	Mooresville	Major	Municipal	5	POTW	Process + domestic	30834	Catawba River
NC0004979	Duke Power Company - Allen S.E.	Gaston	Mooresville	Major	Non-Municipal	10	Power Plant	Complex waste stream	30834	South Fork Catawba River
NC0024945	CMUD - Irwin Creek	Mecklenburg	Mooresville	Major	Municipal	15	POTW	Process + domestic	30834	Irwin Creek

NC0024937	CMUD – WWTP / Sugar Creek	Mecklenburg	Mooresville	Major	Municipal	20	POTW	Process + domestic	30834	Little Sugar Creek
NC0024970	CMUD - McAlpine	Mecklenburg	Mooresville	Major	Municipal	48	POTW	100% domestic	30834	McAlpine Creek
NC0005771	Amerada Hess Corporation - Paw Creek	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Paw Creek
NC0083887	Charlotte Douglas International Airport	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Airport	Stormwater + washwater	30834	Ticer Creek
NC0021962	Citgo Petroleum - Paw Creek	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Gum Branch
NC0084549	CMUD - WTP / Franklin	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30834	UT Stewart Creek
NC0031038	Colonial Pipeline - Charlotte DF	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Gum Branch
NC0021971	Louis Dreyfus Energy Corporation	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Paw Creek
NC0046213	Marathon Ashland Petroleum LLC	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Long Creek
NC0046892	Motiva Enterprises - Charlotte	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Long Creek
NC0085006	Nisbet Oil Company	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Groundwater remediation	Process wastewater only	30834	UT Irvins Creek
NC0032891	Phillips Pipe Line / Charlotte	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Gum Branch
NC0085731	Shorenstein Realty Investors	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Groundwater remediation	Process wastewater only	30834	UT Irwin Creek
NC0006521	Spectrum Dyed Yarns / Piedmont	Gaston	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30834	Catawba River - Lake Wylie
NC0022187	Star Enterprise - Paw Creek Terminal	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator + stormwater	30834	UT Gum Branch
NC0004723	Valero Refining Company	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator	30834	UT Paw Creek
NC0074705	William Energy Ventures - Charlotte	Mecklenburg	Mooresville	Minor	Non-Municipal	0	Oil terminal	Oil/water separator + stormwater	30834	UT Paw Creek
NC0058084	Gough Econ, Inc.	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0012	Industrial site	100% domestic	30834	UT Catawba River
NC0057401	Hideways WWTP - Marion Smith	Mecklenburg	Mooresville	Minor	Non-Municipal	0.002	Subdivision	100% domestic	30834	Catawba River - Lake Wylie
NC0068705	Mariners Watch Homeowners Assoc.	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0025	Subdivision	100% domestic	30834	Lake Wylie
NC0056669	Industrial Fire Protection	Mecklenburg	Mooresville	Minor	Non-Municipal	0.004	Industrial site	100% domestic	30834	UT Sugar Creek
NC0028711	Mecklenburg Co Sch - Berryhill	Mecklenburg	Mooresville	Minor	Non-Municipal	0.006	School	100% domestic	30834	Lake Wylie
NC0084298	Weyerhaeuser Company - Mecklenburg	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0072	Groundwater remediation	Process wastewater only	30834	UT Paw Creek
NC0063789	Mint Hill Festival - Mid South	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0075	Subdivision	100% domestic	30834	Irvins Creek
NC0079758	National Welders Supply Co., Inc.	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0143	Industrial site	Stormwater only	30834	Taggart Creek
NC0085286	Amoco Corporation	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0144	Groundwater remediation	Process wastewater only	30834	UT McMullen Creek
NC0085391	Terrell Properties, Inc.	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0144	Groundwater remediation	Process wastewater only	30834	UT Little Hope Creek
NC0083461	Ace Chemical Corporation ***	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0216	Groundwater remediation	Process wastewater only	30834	UT Steele Creek
NC0086002	Livingstone Coating Corporation	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0216	Groundwater remediation	Process wastewater only	30834	UT Long Creek
NC0085561	PYA/Monarch, Inc. ***	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0216	Groundwater remediation	Process wastewater only	30834	UT Taggart Creek
NC0063860	Mid South Water Sys - Harbour Estates	Mecklenburg	Mooresville	Minor	Non-Municipal	0.024	Condominiums	100% domestic	30834	Catawba River
NC0059226	Performance Road WWTP / Perf. Sys	Mecklenburg	Mooresville	Minor	Non-Municipal	0.03	Office park	100% domestic	30834	UT Lake Wylie - Catawba River
NC0046531	Crown Central Petroleum Corporation	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0432	Oil terminal	Oil/water separator + stormwater + groundwater remediation	30834	UT Gum Branch
NC0085057	Unocal Corp - Orr Road Site	Mecklenburg	Mooresville	Minor	Non-Municipal	0.0432	Groundwater remediation	Process wastewater only	30834	UT Brier Creek
NC0085928	American Truetzschler, Inc.	Mecklenburg	Mooresville	Minor	Non-Municipal	0.05	Groundwater remediation	Process wastewater only	30834	UT Catawba River
NC0071242	Carolina Water Service / Riverpointe	Mecklenburg	Mooresville	Minor	Non-Municipal	0.05	Subdivision	100% domestic	30834	Catawba River
NC0029220	CMUD - McDowell Park WWTP	Mecklenburg	Mooresville	Minor	Non-Municipal	0.05	Park	100% domestic	30834	Lake Wylie
NC0004839	Exxon Company USA - Paw Creek	Mecklenburg	Mooresville	Minor	Non-Municipal	0.057	Oil terminal	Oil/water separator + groundwater remediation	30834	UT Long Creek
NC0059579	Carolina Water Service / Emerald Point	Mecklenburg	Mooresville	Minor	Non-Municipal	0.06	Condominiums	100% domestic	30834	Catawba River - Lake Wylie

NC0064602	Carolina Water Service / Farmwood	Mecklenburg	Mooresville	Minor	Non-Municipal	0.06	Subdivision	100% domestic	30834	Irvins Creek
NC0086207	Childress Klein Prop - 31st Uni	Mecklenburg	Mooresville	Minor	Non-Municipal	0.072	Groundwater remediation	Process wastewater only	30834	UT Little Sugar Creek
NC0062383	Carolina Water Service / Queens Harbor	Mecklenburg	Mooresville	Minor	Non-Municipal	0.1	Subdivision	100% domestic	30834	Catawba River - Lake Wylie
NC0084301	Celanese Acetate, LLC	Mecklenburg	Mooresville	Minor	Non-Municipal	0.1152	Groundwater remediation	Process wastewater only	30834	Little Sugar Creek
NC0029181	Carolina Water Service / Forest Ridge	Mecklenburg	Mooresville	Minor	Non-Municipal	0.15	Subdivision	100% domestic	30834	UT Irvins Creek
NC0005185	Amoco Petroleum - Paw Creek	Mecklenburg	Mooresville	Minor	Non-Municipal	0.259	Oil terminal	Oil/water separator + groundwater remediation	30834	UT Long Creek
NC0084727	R. L. Stowe Mills ***	Gaston	Mooresville	Minor	Non-Municipal	none	Groundwater remediation	Process wastewater only	30834	UT Catawba River
NC0006190	Delta Mills, Inc. (Maiden)	Catawba	Mooresville	Major	Non-Municipal	1	Textile Mill	Process wastewater only	30835	Clark Creek
NC0039594	Maiden, Town – WWTP / Maiden	Catawba	Mooresville	Major	Municipal	1	POTW	Process + domestic	30835	Clark Creek
NC0044440	Cherryville, Town - WWTP	Gaston	Mooresville	Major	Municipal	2	POTW	Process + domestic	30835	Indian Creek
NC0036196	Newton, Town / Clark Creek WWTP	Catawba	Mooresville	Major	Municipal	5	POTW	100% domestic	30835	Clark Creek
NC0040797	Hickory WWTP, City of	Catawba	Mooresville	Major	Municipal	6	POTW	Process + domestic	30835	Henry Fork River
NC0025496	Lincolnton, Town - WWTP	Lincoln	Mooresville	Major	Municipal	6	POTW	Process + domestic	30835	South Fork Catawba River
NC0082694	Dallas, Town - Stanley Hwy / Dallas	Gaston	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30835	South Fork Catawba River
NC0080837	Maiden, Town – WTP / Maiden	Catawba	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30835	Maiden Creek
NC0023761	National Fruit Product Co., Inc.	Lincoln	Mooresville	Minor	Non-Municipal	0	Fruit processing	Process wastewater only	30835	Carpenter Creek
NC0022071	Norfolk Southern Corp - Oyama ***	Catawba	Mooresville	Minor	Non-Municipal	0	Railway yard	Complex waste stream	30835	Miller Branch
NC0031119	Burke Co BOE - George Hildebran	Burke	Asheville	Minor	Non-Municipal	0.005	School	100% domestic	30835	UT Abee Creek
NC0022934	Sonoco Products Co / Long Shoals	Gaston	Mooresville	Minor	Non-Municipal	0.0053	Industrial site	Process + domestic	30835	South Fork Catawba River
NC0050920	Catawba Country Club	Catawba	Mooresville	Minor	Non-Municipal	0.0075	Country Club	100% domestic	30835	UT Henry Fork River
NC0039853	High Shoals, City - WTP	Gaston	Mooresville	Minor	Non-Municipal	0.008	Water Treatment Plant	Process wastewater only	30835	South Fork Catawba River
NC0036871	Precedent, Inc.	Catawba	Mooresville	Minor	Non-Municipal	0.008	Industrial site	100% domestic	30835	Bills Branch
NC0041246	Lincoln Co BOE - West Lincoln HS	Lincoln	Mooresville	Minor	Non-Municipal	0.01	School	100% domestic	30835	UT Indian Creek
NC0074233	Catawba Co BOE - Blackburn Middle	Catawba	Mooresville	Minor	Non-Municipal	0.0149	School	100% domestic	30835	Haas Creek
NC0072940	High Shoals, City - WWTP	Gaston	Mooresville	Minor	Municipal	0.0159	POTW	100% domestic	30835	South Fork Catawba River
NC0024155	High Shoals, City - WWTP / River St	Gaston	Mooresville	Minor	Municipal	0.018	POTW	100% domestic	30835	South Fork Catawba River
NC0029297	Catawba Co BOE - Fred T. Foard	Catawba	Mooresville	Minor	Non-Municipal	0.02	School	100% domestic	30835	Pott Creek
NC0071447	Catholic Conference Center	Catawba	Mooresville	Minor	Non-Municipal	0.02	Conference Center	100% domestic	30835	UT Camp Creek
NC0036935	Pine Mountain Property Owners	Burke	Asheville	Minor	Non-Municipal	0.0696	Restaurant	100% domestic	30835	Jacobs Fork Creek
NC0024261	Conover, Town - Southwest WWTP	Catawba	Mooresville	Minor	Municipal	0.1	POTW	100% domestic	30835	UT Cline Creek
NC0023264	Fairgrove WWTP - Conover	Catawba	Mooresville	Minor	Municipal	0.1	POTW	100% domestic	30835	Clark Creek
NC0041815	Lincoln County Hoyle Creek WWTP	Lincoln	Mooresville	Minor	Municipal	0.1	POTW	Process + domestic	30835	Hoyle Creek
NC0076643	General Electric Co - Hickory	Catawba	Mooresville	Minor	Non-Municipal	0.12	Groundwater remediation	Process wastewater only	30835	UT Cline Creek
NC0020036	Stanley, Town - Lola Street WWTP	Gaston	Mooresville	Minor	Municipal	0.5	POTW	100% domestic	30835	Mauney Creek
NC0085588	Lincolnton, City of - WTP	Lincoln	Mooresville	Minor	Municipal	none	Water Treatment Plant	Process wastewater only	30835	Catawba River
NC0005274	Crompton & Knowles Colors, Inc.	Gaston	Mooresville	Major	Non-Municipal	0.4	Chemical manufacturing	Process wastewater only	30836	South Fork Catawba River
NC0004812	Pharr Yarns Industrial WWTP	Gaston	Mooresville	Major	Non-Municipal	1	Textile Mill	Process wastewater only	30836	South Fork Catawba River
NC0085359	Union Co - Twelve Mile Creek / WWTP	Union	Mooresville	Major	Municipal	2.5	POTW	100% domestic	30836	UT Twelve Mile Creek
NC0006033	Collins and Aikman Products Company	Gaston	Mooresville	Major	Non-Municipal	4	Textile Mill	Process + domestic	30836	South Fork Catawba River

NC0020184	Gastonia, City / Long Creek WWTP	Gaston	Mooresville	Major	Municipal	8	POTW	Process + domestic	30836	Long Creek
NC0077763	Belmont Converting Company	Gaston	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30836	Catawba River
NC0005169	Fmc Corporation - Lithium D ***	Gaston	Mooresville	Minor	Non-Municipal	0	Mining/processing	Process wastewater only	30836	UT Long Creek
NC0056855	Pharr Yarns - Complex 46	Gaston	Mooresville	Minor	Non-Municipal	0	Textile Mill	Process wastewater only	30836	UT South Fork Catawba River
NC0066141	Spencer Mountain, Town of - WTP	Gaston	Mooresville	Minor	Non-Municipal	0.01	Water Treatment Plant	Process wastewater only	30836	South Fork Catawba River
NC0033421	Carolina Water Service / College Park	Gaston	Mooresville	Minor	Non-Municipal	0.022	Subdivision	100% domestic	30836	Little Long Creek
NC0020966	Spencer Mountain, Town of - WWTP	Gaston	Mooresville	Minor	Municipal	0.05	POTW	100% domestic	30836	South Fork Catawba River
NC0032760	Carolina Water Service / Kings Grant	Gaston	Mooresville	Minor	Non-Municipal	0.07	Subdivision	100% domestic	30836	UT Duharts Creek
NC0084280	Plantation Pipe Line Company	Mecklenburg	Mooresville	Minor	Non-Municipal	0.072	Groundwater remediation	Process wastewater only	30836	UT Catawba River
NC0020052	Mcadenville, Town – WWTP / Church	Gaston	Mooresville	Minor	Municipal	0.13	POTW	100% domestic	30836	South Fork Catawba River
NC0055948	Cramerton, Town of - WWTP	Gaston	Mooresville	Minor	Municipal	0.25	POTW	100% domestic	30836	South Fork Catawba River
NC0068888	Dallas, City of - WWTP	Gaston	Mooresville	Minor	Municipal	0.6	POTW	100% domestic	30836	UT Long Creek
NC0025861	Lowell, City of - WWTP	Gaston	Mooresville	Minor	Municipal	0.6	POTW	100% domestic	30836	South Fork Catawba River
NC0040070	Gastonia, City of - WTP	Gaston	Mooresville	Minor	Non-Municipal	1.2	Water Treatment Plant	Process wastewater only	30836	UT Long Creek
NC0005177	FMC Corporation - Lithium Division	Gaston	Mooresville	Major	Non-Municipal	0.615	Chemical manufacturing	Process + domestic	30837	UT Abernathy Creek
NC0020826	Bessemer City, City of - WWTP	Gaston	Mooresville	Major	Municipal	1.5	POTW	Process + domestic	30837	Abernethy Creek
NC0074268	Gastonia, City / Crowders Creek	Gaston	Mooresville	Major	Municipal	6	POTW	Process + domestic	30837	Crowders Creek
NC0020192	Gastonia,City / Catawba Creek WWTP	Gaston	Mooresville	Major	Municipal	9	POTW	Process + domestic	30837	Catawba Creek
NC0084468	Lewis Water Co / Keltic Meadows	Gaston	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30837	UT Catawba Creek
NC0072061	Mid South Water Sys / Fox Run WTP	Gaston	Mooresville	Minor	Non-Municipal	0	Water Treatment Plant	Process wastewater only	30837	UT Crowders Creek
NC0086142	Mid South Water Sys / Oakley Park	Gaston	Mooresville	Minor	Non-Municipal	0.001	Water Treatment Plant	Process wastewater only	30837	Mcgill Branch
NC0086193	Mid South Water Sys / Maplecrest	Gaston	Mooresville	Minor	Non-Municipal	0.001	Water Treatment Plant	Process wastewater only	30837	Catawba Creek
NC0083496	Jayesh Patel - Bel Air Motel	Gaston	Mooresville	Minor	Non-Municipal	0.0023	Hotel	100% domestic	30837	UT Crowders Creek
NC0060755	Carolina Water Service - Saddlewood	Gaston	Mooresville	Minor	Non-Municipal	0.009	Subdivision	100% domestic	30837	UT Crowders Creek
NC0024490	Bessemer City - Edgewood WWTP	Gaston	Mooresville	Minor	Non-Municipal	0.01	Campground	100% domestic	30837	Oates Creek
NC0069175	Ridge Community Sewer Association	Gaston	Mooresville	Minor	Non-Municipal	0.01	Subdivision	100% domestic	30837	UT Blackwood Creek
NC0074799	Pines Mobile Home Park	Gaston	Mooresville	Minor	Non-Municipal	0.011	Mobile Home Park	100% domestic	30837	UT Crowders Creek
NC0062278	Ramsey Mobile Home Subd - Ramsey	Gaston	Mooresville	Minor	Non-Municipal	0.036	Mobile Home Park	100% domestic	30837	UT Mcgill Branch
NC0081744	D. R. Hoover, Inc.	Gaston	Mooresville	Minor	Non-Municipal	0.072	Groundwater remediation	Process wastewater only	30837	UT Catawba Creek
NC0004260	CR Industries	Gaston	Mooresville	Minor	Non-Municipal	0.148	Industrial site	Complex waste stream	30837	Crowders Creek
NC0084638	Rhone - Poulenc, Inc.	Gaston	Mooresville	Minor	Non-Municipal	0.1944	Groundwater remediation	Process wastewater only	30837	UT Crowders Creek
NC0005011	CBP Resources - Gastonia Division	Gaston	Mooresville	Minor	Non-Municipal	0.257	Rendering Plant	Process + domestic	30837	Crowders Creek
NC0005231	John Deere Consumer Products	Gaston	Mooresville	Minor	Non-Municipal	0.3	Manufacturing Plant	Complex waste stream	30837	UT Crowders Creek
NC0084662	Textron, Inc / Homelite Plant	Gaston	Mooresville	Minor	Non-Municipal	0.3	Groundwater remediation	Process wastewater only	30837	UT Crowders Creek
NC0069035	Mid South Water Sys / Southgate WTP	Gaston	Mooresville	Minor	Non-Municipal	none	Water Treatment Plant	Process wastewater only	30837	UT Catawba Creek
NC0034541	Kennedy Campus / Elon Homes	Mecklenburg	Mooresville	Minor	Non-Municipal	0.01	Nursing Home	100% domestic	30838	UT Sixmile Creek
NC0028517	Union Co BOE - Parkwood Middle	Union	Mooresville	Minor	Non-Municipal	0.012	School	100% domestic	30838	UT Waxhaw Creek
NC0066559	Union Co Pwd - Six Mile Creek WWTP	Union	Mooresville	Minor	Non-Municipal	0.24	Condominiums	100% domestic	30838	Sixmile Creek

Individual Stormwater Permits in the Catawba River Basin

Permit #	Facility Name	Receiving Stream	Subbasin	County
NCS000359	Collins And Aikman - Old Fort Landfill	UT Brevard Creek	030830	McDowell
NCS000007	Synthron, Inc.	UT Hunting Creek	030831	Burke
NCS000009	Sigri Great Lakes Carbon	Silver Creek	030831	Burke
NCS000066	Couth Eastern Adhesives	UT Lower Creek	030831	Caldwell
NCS000332	Borden World Wide Resins	Little Silver Creek	030831	Burke
NCS000020	McGuire Nuclear Site	Catawba River & Lake Norman	030832	Mecklenburg
NCS000051	Arcona Leather Company	Little Gunpowder Creek	030832	Caldwell
NCS000061	Lenoir Mirror Company	Gun Powder Creek	030832	Caldwell
NCS000041	Clariant Corporation	Catawba River	030833	Gaston
NCS000021	Westinghouse Turbine Generator Plant	Lake Wylie	030834	Mecklenburg
NCS000037	Sandoz Chemical Company	Long Creek & Catawba River	030834	Mecklenburg
NCS000040	Charlotte Pipe & Foundry	Irwin Creek	030834	Mecklenburg
NCS000045	National Welders	UT Taggart Creek	030834	Mecklenburg
NCS000049	Henkel Corporation	Steele Creek	030834	Mecklenburg
NCS000079	Forshaw Chemicals, Inc.	Stewart Creek	030834	Mecklenburg
NCS000083	Celanese Acetate, LLC	Little Sugar Creek	030834	Mecklenburg
NCS000161	Freedom Textile Chemicals Company	Paw Creek	030834	Mecklenburg
NCS000176	INX International Ink Company	Sugar Creek	030834	Mecklenburg
NCS000184	Radiator Specialty Company	Irwin Creek	030834	Mecklenburg
NCS000207	Duke Power Toddville Operations Center	Paw Creek	030834	Mecklenburg
NCS000312	Heritage Environmental Service	Stewart Creek	030834	Mecklenburg
NCS000313	Continental General Tire, Inc.	Big Sugar Creek	030834	Mecklenburg
NCS000315	Asheland Chemical Company	Charlotte MSSS - Stewart Creek	030834	Mecklenburg
NCS000322	Tillett Chemical, Inc.	Sugar Creek	030834	Mecklenburg
NCS000334	Jones Chemicals, Inc.	Paw Creek	030834	Mecklenburg
NCS000339	Durable Wood Preserves, Inc.	UT McAlpine Creek	030834	Mecklenburg
NCS000343	Continental Ind Chemical, Inc. - Mecklenburg	UT Stewart Creek	030834	Mecklenburg
NCS000356	BASF Corporation	Stewart Creek	030834	Mecklenburg
NCS000357	Monarch Color Corporation	UT Stewart Creek	030834	Mecklenburg
NCS000358	Diversey Water Technologies	Charlotte MSSS - Sugar Creek	030834	Mecklenburg
NCS000361	Carolina Paper Board Corp - Mecklenburg	Stewart Creek	030834	Mecklenburg
NCS000029	Hickory Springs Manufacturing Company	Cline Creek	030835	Catawba
NCS000304	Ameristeel Corporation	UT Long Creek	030836	Mecklenburg
NCS000074	Globe Manufacturing Company	UT Kaglar Creek	030836	Gaston
NCS000002	FMC Corporation	UT Abernathy Creek	030837	Gaston
NCS000163	Colormate, Inc.	Crowder Creek Basin	030837	Gaston
NCS000311	Uniroyal Chemical Company, Inc.	Catawba Creek	030837	Gaston
NCS000321	B F Goodrich Performance	UT Crowders Creek	030837	Gaston

Appendix II

Water Quality Data Collected by DWQ

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

Benthic Macroinvertebrate Sampling and Criteria

Freshwater Wadeable Flowing Waters

Benthic macroinvertebrates can be collected using two sampling procedures. The Division of Water Quality'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 unstressed 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 also are 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 Division of Water Quality'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 outside summer, EPT taxa richness can be adjusted by subtracting out winter/spring Plecoptera or other adjustment based on resampling of summer site. The biotic index values also are seasonally adjusted for samples 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. Different criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina.

Benthos Classification Criteria by Ecoregion *

EPT taxa richness values

	10-sample Qualitative Samples			4-sample EPT Samples		
	Mountains	Piedmont	Coastal	Mountains	Piedmont	Coastal
Excellent	>41	>31	>27	>35	>27	>23
Good	32-41	24-31	21-27	28-35	21-27	18-23
Good-Fair	22-31	16-23	14-20	19-27	14-20	12-17
Fair	12-21	8-15	7-13	11-18	7-13	6-11
Poor	0-11	0-7	0-6	0-10	0-6	0-5

Biotic Index Values (Range = 0-10) for 10-sample Qualitative Samples

	Mountains	Piedmont	Coastal
Excellent	<4.05	<5.19	<5.47
Good	4.06-4.88	5.19-5.78	5.47-6.05
Good-Fair	4.89-5.74	5.79-6.48	6.06-6.72
Fair	5.75-7.00	6.49-7.48	6.73-7.73
Poor	>7.00	>7.48	>7.73

* These criteria apply to flowing water systems only.

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Site	DWQ #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba R, end of SR 1274, McDowell	B-1	11-(1)	08/97	-/24	-/2.88	Good-Fair
Catawba R, SR 1273, McDowell	B-2	11-(1)	04/85	99/49	4.28/2.95	Good
Mill Cr, at Graphite ab RR bridge, McDo.	B-3	11-7	08/97	-/31	-/1.63	Excellent
			07/92	85/49	2.49/2.05	Excellent
			02/92	-/39	-/1.65	Good
Mill Cr, SR 1400/1407, McDowell	B-4	11-7	06/94	81/43	3.26/2.17	Excellent
Mill Cr, SR 1401, McDowell	B-5	11-7	08/97	-/18	-/3.26	Fair
Swannanoa Cr, off SR 1400, McDowell	B-6	11-7-9	08/97	-/0	-	Poor
			04/97	-/18	-/1.34	Fair
			06/94	-/35	-/1.90	Excellent
Catawba R ab Curtis Cr, McDowell	B-7	11-(8)	04/85	82/39	4.44/3.07	Good-Fair
Catawba R I-40 or SR 1234 be Old Fort,	B-8	11-(8)	08/97	70/31	4.89/3.43	Good-Fair
McDowell			07/92	102/41	3.93/2.93	Excellent
			07/90	84/38	4.16/3.39	Good
			07/87	74/30	5.47/4.20	Good-Fair
			04/85	86/28	6.26/3.99	Fair
Catawba R, SR 1221 , McDowell	B-9	11-(8)	08/97	75/35	4.11/3.45	Good
			07/92	90/42	4.25/3.33	Good
			07/90	77/43	4.08/3.51	Good
			08/88	86/31	5.53/4.62	Good-Fair
			07/88	-/27	-/3.88	Good-Fair
			07/86	78/26	5.69/3.98	Good-Fair
			08/85	73/24	5.33/4.18	Good-Fair
			08/84	63/23	4.73/4.08	Good-Fair
			08/83	70/27	5.44/4.25	Good-Fair
Curtis Cr, ab WWTP off SR 1227, McD	B-10	11-10-(6)	08/97	-/34	-/2.46	Good
			02/92	-/42	-/2.10	Good
			04/85	97/44	3.76/2.41	Good
Curtis Cr be WWTP, US 70, McDowell	B-11	11-10-(14)	06/94	-/30	-/2.65	Good
			04/85	56/25	5.73/3.05	Fair
Crooked Cr, SR 1135, McDowell	B-12	11-12	08/97	69/38	3.84/3.25	Good
			07/92	-/32	-/3.02	Good
Mackey Cr, SR 1453, McDowell	B-13	11-15-(3.5)	08/97	-/29	-/2.92	Good
			02/92	-/45	-/1.98	Excellent
Mackey Cr, ab US 70, McDowell	B-14	11-15-(3.5)	10/96	68/30	4.06/3.47	Good
Mackey Cr, be US 70, McDowell	B-15	11-15-(3.5)	10/96	43/25	4.60/4.19	Good-Fair
Buck Cr, NC 80 ab L Tahoma, McDowell	B-16	11-19-(1)	08/97	-/38	-/2.58	Excellent
			06/94	75/41	3.11/2.33	Excellent
			02/92	-/42	-/2.19	Excellent
Buck Cr, US 70, McDowell	B-17	11-19-(14)	06/94	58/20	4.56/3.28	Good-Fair
L Buck Cr, SR 1436	B-18	11-19-11	08/97	-/37	-/2.44	Excellent
			02/92	-/43	-/2.00	Excellent
			07/91	60/37	2.50/2.13	Good
Toms Cr, SR 1434, McDowell	B-19	11-21-(2)	08/97	62/33	3.07/2.51	Good
			07/92	75/37	3.31/2.44	Excellent
			02/92	-/49	-/2.29	Excellent
N Fk Catawba R at Linville Caverns,	B-20	11-24-(1)	01/91	-/37	-/1.89	Good
N Fk Catawba R, US 221, McDowell	B-21	11-24-(1)	01/91	-/42	-/2.57	Good
N Fk Catawba R, SR 1573, McDowell	B-22	11-24-(1)	08/97	-/37	2.74	Excellent
			01/91	-/37	-/2.83	Good

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Site	DWQ #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
N Fk Catawba R, SR 1560, McDowell	B-23	11-24-(1)	08/97	81/39	3.71/2.92	Good
			07/92	95/41	4.03/3.13	Excellent
			01/91	-/44	-/2.60	Excellent
N Fk Catawba R, off SR 1559 be Sevier,	B-24	11-24-(1)	08/97	84/39	4.40/3.30	Good
Laurel Br, US 221, McDowell	B-25	11-24-3	01/91	-/32	-/1.37	Good
Pond Br, SR 1560, McDowell	B-26	11-24-4	01/91	-/24	-/1.54	Good
Stillhouse Br, SR 1560, McDowell	B-27	11-24-6	01/91	-/25	-/1.55	Good
Honeycutt Cr, SR 1568, McDowell	B-28	11-24-8	01/91	-/44	-/2.60	Good
Pepper Cr, US 221, McDowell	B-29	11-24-10	01/91	-/42	-/2.53	Good
Armstrong Cr, end of FS Rd, McDowell	B-30	11-24-14-(1.5)	08/92	-/36	-/2.16	Excellent
			07/92	-/38	-/2.11	Excellent
Three Mile Cr, SR 1443, McDowell	B-31	11-24-14-10	06/94	-/40	-/2.17	Excellent
Cox Cr, Off NC 226, McDowell	B-32	11-24-14-12	06/94	-/37	-/2.89	Excellent
Armstrong Cr, off NC 226, McDowell	B-33	11-24-14-(13.5)	06/94	99/48	3.31/2.49	Excellent
Linville R, off NC 105 ab Golf co, Avery	B-34	11-24-(1)	06/97	60/32	2.84/1.81	Good
Linville R, nr NC 105 nr Brier Kn, Avery	B-35	11-29-(1)	06/97	-/32	-/2.18	Good
			11/89	-/27	-/3.30	Good-Fair
Linville R, NC 221, Avery	B-36	11-29-(1)	08/97	-/27	-/3.25	Good-Fair
			06/97	-/24	-/3.24	Good-Fair
			07/92	-/30	-/3.27	Good
			11/89	-/22	-/3.98	Good-Fair
L Grassy Cr, ab Golf course, Avery	B-37	11-29-2	06/97	59/36	1.83/1.02	Excellent
W Fk Linville R, SR 1349, Avery	B-38	11-29-4	11/89	-/39	-/1.76	Good
Grandmother Cr, SR 1511, Avery	B-39	11-29-5-(2)	11/89	-/30	-/2.62	Good
Linville R, nr Nebo, NC 126, Burke	B-40	11-29-(23)	08/97	108/54	3.97/3.01	Excellent
			07/92	108/48	4.04/3.07	Excellent
			07/91	84/43	3.89/2.90	Excellent
			01/91	-/48	-/2.51	Excellent
			10/90	94/47	3.67/2.62	Excellent
			07/90	104/46	4.10/3.05	Excellent
			04/90	113/54	3.61/2.37	Excellent
			01/90	94/56	3.36/2.43	Excellent
			11/89	100/54	3.32/2.52	Excellent
			08/89	99/46	3.93/2.73	Excellent
			03/89	89/43	3.53/3.00	Good
			02/89	113/59	3.78/2.81	Excellent
			08/87	-/42	-/3.28	Excellent
			07/87	113/48	4.38/3.25	Excellent
			08/85	101/41	5.00/3.47	Good
			08/83	105/45	4.48/3.21	Good
Catawba R, Glen Alpine, SR 1147, Burke	B-41	11-(31)	08/97	66/30	4.07/3.06	Good
			08/88	79/34	4.74/3.20	Good
N Muddy Cr, SR 1750 , McDowell	B-42	11-32-1-(0.5)	08/97	63/33	4.46/3.85	Good
			07/92	80/32	4.72/4.07	Good
			04/85	85/35	5.35/3.85	Good-Fair
Corpening Cr (Youngs Fk), SR 1819	B-43	11-32-1-4	08/97	-/16	-/5.02	Fair
McDowell			09/90	55/17	5.97/5.07	Fair
			04/85	64/19	6.65/4.77	Fair
Corpening Cr (Youngs Fk), SR 1794	B-44	11-32-1-4	09/90	44/8	7.15/6.49	Poor
McDowell			04/85	58/17	6.62/4.60	Fair
S Muddy Cr, SR 1764, McDowell	B-45	11-32-2-(8.5)	08/97	-/24	-/3.67	Good-Fair
			07/92	-/27	-/3.64	Good-Fair
High Shoals Cr, SR 1798, McDowell	B-46	11-32-2-6	07/86	76/32	4.25/2.94	Good

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Site	DWQ #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba R, NC 181, Burke	B-1	11-(31)	08/97	57/23	4.48/3.02	Good-Fair
			07/92	76/30	4.93/3.89	Good
Canoe Cr, SR 1250, Burke	B-2	11-33-(2)	08/97	-/19	-/4.05	Good-Fair
			08/92	-/25	-/3.09	Good-Fair
Silver Cr, SR 1149, Burke	B-3	11-34	08/97	73/32	5.05/4.05	Good-Fair
			08/92	71/29	5.65/4.45	Good-Fair
Clear Cr, ab Hospital Reservoir, Burke	B-4	11-34-6-(1)	12/91	-/30	-/2.51	Good
Bailey Fk, SR 1102, Burke	B-5	11-34-8-(2)	08/92	-/24	-/3.46	Good-Fair
Warrior Cr, SR 1440, Burke	B-6	11-35-(1)	08/97	-/41	-/3.20	Excellent
Upper Cr, NC 181 nr Jonas Ridge, Burke	B-7	11-35-2-(1)	09/88	-/46	-/2.57	Excellent
Upper Cr, USFS Rd 128 (Raven Cliff Rd)	B-8	11-35-2-(1)	03/89	-/44	-/2.62	Good
			10/88	-/34	-/3.00	Good
			09/88	-/26	-/3.68	Good-Fair
Upper Cr, ab USFS Rd 982, Burke	B-9	11-35-2-(1)	06/94	100/51	3.46/2.45	Excellent
			06/93	94/47	3.37/2.48	Excellent
UT Upper Cr, ab Timbered Br, Burke	B-10	11-35-2-(1)	06/94	56/27	3.25/2.16	Excellent
			06/93	63/27	3.60/2.19	Excellent
Timbered Br, USFS Rd 982, Burke	B-11	11-35-2-9	06/94	79/48	2.67/2.13	Excellent
			06/93	74/38	3.01/2.10	Excellent
			09/88	-/20	-/3.15	Good-Fair
Upper Cr, be USFS Rd 982, Burke	B-12	11-35-2-(8.5)	06/94	103/57	3.29/2.42	Excellent
			06/93	108/58	3.31/2.28	Excellent
Upper Cr, ab Optimists Park, Burke	B-13	11-35-2-(10)	09/88	108/45	4.63/3.22	Excellent
Steels Cr, USFS Rd 128, Burke	B-14	11-35-2-12-(1)	05/90	-/48	-/1.79	Excellent
			09/88	-/38	-/2.94	Excellent
Gingercake Cr, USFS Rd 496, Burke	B-15	11-35-2-12-3	05/90	-/39	-/1.72	Excellent
			10/88	-/31	-/1.40	Excellent
Buck Cr, USFS Rd, ab Steels Cr, Burke	B-16	11-35-2-12-4	05/90	-/40	-/1.59	Excellent
Little Fk, USFS Rd 128, Burke	B-17	11-35-2-12-6	09/88	-/38	-/2.61	Excellent
			03/86	102/45	3.23/2.40	Excellent
Steels Cr, ab NC 181, Burke	B-18	11-35-2-12-(7)	05/90	-/49	-/2.17	Excellent
			09/88	105/43	4.69/3.39	Good
Upper Cr, SR 1407, Burke	B-19	11-35-2-(13)	10/88	-/34	-/3.55	Good
Upper Cr, SR 1439 nr Worry, Burke	B-20	11-35-2-(13)	09/88	100/42	4.90/3.69	Good
Johns R, SR 1367, Caldwell	B-21	11-38-(1)	03/89	-/45	-/2.28	Good
Johns R, SR 1356, Caldwell	B-22	11-38-(9)	08/97	-/47	-/2.50	Excellent
			08/92	-/43	-/3.12	Excellent
			03/89	-/40	-/2.54	Good
			10/84	108/48	4.16/2.92	Excellent
Anthony Cr, ab Gragg, Caldwell	B-23	11-38-10-3	03/89	-/30	2.35	Good-Fair
Anthony Cr (Gragg Pr), SR 1462, Cald.	B-24	11-38-10	03/89	-/47	2.38	Good
Johns R, SR 1438, Burke	B-25	11-38-(28)	03/89	116/63	3.93/2.75	Excellent
			08/83	89/43	4.20/3.48	Excellent
Mulberry Cr, SR 1368, Caldwell	B-26	11-38-32-(11)	03/89	-/53	-/2.62	Excellent
Mulberry Cr, SR 1310, Caldwell	B-27	11-38-32-(15)	03/89	-/43	-/2.93	Good
Wilson Cr, NC 221, Avery	B-28	11-38-34	07/90	65/32	2.99/1.75	Excellent
			08/88	81/37	3.26/1.67	Excellent
			07/86	67/36	2.62/1.56	Excellent
			08/84	38/20	2.85/1.45	Good
Wilson Cr, SR 1358, Caldwell	B-29	11-38-34	07/91	92/50	3.76/2.67	Excellent
			03/89	-/57	-/2.19	Excellent
			07/86	106/49	3.67/2.55	Excellent

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Site	DWQ #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Wilson Cr, SR 1335, Caldwell	B-30	11-38-34	08/97	-/47	-/2.68	Excellent
N Harper Cr, USFS Rd 58, Avery	B-31	11-38-34-14-2	08/86	90/43	3.54/2.24	Excellent
Lower Cr, NC 90, Caldwell	B-32	11-39-(0.5)	06/97	51/21	5.09/4.48	Good-Fair
Lower Cr, Harrisburg St, Caldwell	B-33	11-39-(0.5)	09/87	65/22	6.23/5.00	Fair
Lower Cr, SR 1313, Caldwell	B-34	11-39-(0.5)	06/97	43/17	5.11/4.40	Fair
Lower Cr, SR 1142, Caldwell	B-35	11-39-(6.5)	06/97	39/16	5.72/4.82	Fair
Lower Cr, SR 1501, Burke	B-36	11-39-(6.5)	06/97	46/18	5.44/4.87	Fair
			08/92	55/20	6.03/4.89	Fair
			07/90	62/19	6.83/5.49	Fair
			07/87	61/18	7.00/5.06	Fair
			08/84	60/20	6.64/5.20	Fair
Zacks Fk Cr, NC 18A, Caldwell	B-37	11-39-1	06/97	-/17	-/4.35	Fair
			09/87	55/19	6.22/5.55	Fair
Spainhour Cr, SR 1303, Caldwell	B-38	11-39-3	06/97	-/14	-/5.03	Fair
Greasy Cr, NC 18 Caldwell	B-39	11-39-4	06/97	-/15	-/4.31	Fair
Husband Cr, NC 18, Caldwell	B-40	11-39-7-(2)	06/97	-/19	-/4.68	Good-Fair
Bristol Cr, NC 18, Caldwell	B-41	11-39-8	06/97	-/15	-/4.51	Fair
Smoky Cr, SR 1515, Burke	B-42	11-41-(1)	08/97	-/32	-/3.33	Good
			08/92	-/30	-/3.23	Good
McGalliard Cr, SR 1538 (Church St), Bur.	B-43	11-44-(0.5)	08/97	-/21	-/4.81	Good-Fair
			08/92	66/22	5.80/4.59	Good-Fair

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Site	DWQ #	Index #	Date	S/EPT S	BI/BIEPT	Bioclass
Huffman Br, #2, be Huffman Finishing	B-1	-	10/84	13/0	9.12/-	Poor
Huffman Br, #3, Caldwell	B-2	-	10/84	19/1	9.19/-	Poor
Huffman Br, #3A (recovery), Caldwell	B-3	-	10/84	20/0	9.13/-	Poor
UT Huffman Br, Caldwell	B-4	-	10/84	54/15	-/-	Good
Gunpowder Cr, SR 1002, Caldwell	B-5	11-55-(1.5)	08/97	-/25	-/4.27	Good-Fair
Upper Little R, SR 1744, Caldwell	B-6	11-58	08/97	90/39	4.26/3.43	Good
			08/92	74/38	4.17/3.53	Good
Middle Little R, SR 1153, Alexander	B-7	11-62	08/97	-/26	-/3.94	Good-Fair
			08/92	-/32	-/4.14	Good
Duck Cr, NC 127, Alexander	B-8	11-62-2-(4)	08/97	-/26	-/3.74	Good-Fair
			08/92	-/26	-/3.38	Good-Fair
Lower Little R, SR 1313, Alexander	B-9	11-69	07/88	88/33	5.13/3.61	Good-Fair
			08/88	-/29	-/4.42	Good
			08/85	53/18	5.97/5.48	Fair
Lower Little R, SR 1131, Alexander	B-10	11-69	08/97	74/34	4.78/4.04	Good
			08/92	70/29	4.56/3.84	Good
Muddy Fk, ab Schneider Mills, Alexander	B-11	11-69-4	06/92	70/19	5.73/4.65	Good-Fair
Muddy Fk, be Schneider Mills, NC 16, Alexander	B-12	11-69-4	06/92	66/19	6.91/5.07	Fair
Muddy Fk, SR 1313, Alexander	B-13	11-69-4	08/97	22/76	6.14/5.11	Good-Fair
Elk Shoal Cr, SR 1605, Alexander	B-14	11-73-(1.5)	08/97	-/18	-/4.48	Good-Fair
			08/92	-/15	-/5.05	Good-Fair
Lyle Cr, NC 64/70, Catawba	B-15	11-76-(3.5)	09/97	51/23	4.79/4.15	Good
			08/92	63/22	5.47/4.69	Good
McLin Cr, SR 1722, Catawba	B-16	11-76-5-(0.7)	08/97	57/27	5.02/4.27	Good
Big Br (Rocky Cr), SR 1303 ab Troutman, Iredell	B-17	11-83-1-(1)	02/87	-/12	-/4.29	Good-Fair
Big Br (Rocky Cr), SR 1303, be Troutman, Iredell	B-18	11-83-1-(1)	02/87	-/0	-	Poor

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
McDowell Cr, SR 2136, Mecklenburg	B-1	11-115-1.5	09/90	55/15	6.84/6.02	Fair
McDowell Cr, SR 2128, Mecklenburg	B-2	11-115-1.5	09/90	54/17	6.57/5.50	Good-Fair
Gar Cr, SR 2074, Mecklenburg	B-3	11-116-(1)	08/97	-/21	-/4.92	Good
			06/94	64/20	5.61/4.92	Good
			08/92	86/24	5.72/4.68	Good
Dutchmans Cr, SR 1918, Gaston	B-4	11-119-(0.5)	08/97	73/33	5.07/4.23	Excellent
			06/94	66/26	5.02/4.34	Excellent
			08/92	77/33	5.72/4.82	Excellent
			07/88	83/34	5.47/4.73	Excellent
Leepers Cr, NC 150, Lincoln	B-5	11-119-1-(1)	06/84	86/30	5.14/4.32	Good
Leepers Cr, SR 1354, Lincoln	B-6	11-119-1-(1)	06/94	-/31	-/3.43	Excellent
Leepers Cr, NC 73, Lincoln	B-7	11-119-1-(1)	09/94	71/30	4.84/4.10	Excellent
Leepers Cr, SR 1820, Gaston	B-8	11-119-1-(1)	06/94	-/29	-/4.30	Excellent
Killian Cr, SR 1511, Lincoln	B-9	11-119-2-(0.5)	08/97	-/24	-/3.90	Good
			06/94	82/33	4.98/4.67	Excellent
			08/92	-/28	-/5.30	Excellent

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Long Cr, SR 2042, Mecklenburg	B-1	11-120-(2.5)	07/89	65/17	6.44/6.02	Good-Fair
Sugar Cr, SC 160, York Co., SC	B-2	11-137	08/97	57/12	6.74/4.86	Fair
			08/92	58/21	6.92/5.77	Good-Fair
			07/91	49/14	6.91/6.24	Fair
			07/90	39/7	7.30/5.88	Fair
			07/88	53/9	8.23/6.81	Poor
			07/86	40/2	8.82/8.61	Poor
			08/84	45/9	8.30/6.49	Poor
			08/83	30/3	8.55/6.45	Poor
Irwin Cr, SR 2523, Mecklenburg	B-3	11-137-1	02/90	52/17	6.24/5.22	Good-Fair
Irwin Cr, Statesville Rd, ab landfill, Meck.	B-4	11-137-1	10/84	50/13	7.58/6.41	Fair
Irwin Cr, Statesville Rd, be landfill, Meck.	B-5	11-137-1	10/84	36/11	7.80/6.16	Fair
Irwin Cr, West Blvd, Mecklenburg	B-6	11-137-1	08/92	55/8	7.89/6.90	Poor
Irwin Cr, ab WWTP, Mecklenburg	B-7	11-137-1	11/83	23/2	8.61/7.39	Poor
Irwin Cr, be WWTP, SR 1156, Meck.	B-8	11-137-1	08/97	-/7	-/6.15	Fair
			08/92	45/4	8.12/7.38	Poor
Stewart Cr, SR 2050, Mecklenburg	B-9	11-137-1-2	02/90	37/14	6.31/4.17	Fair
McCullough Br, NC 51, Mecklenburg	B-10	11-137-7	02/90	34/5	7.75/7.23	Poor
L Sugar Cr, SR 3657 (Archdale Rd), Meck	B-11	11-137-8	11/83	15/1	8.59/7.60	Poor
L Sugar Cr, NC 51, Mecklenburg	B-12	11-137-8	08/97	-/7	-/5.15	Fair
			09/92	43/3	8.09/6.66	Poor
McAlpine Cr, Sardis Rd, SR 3356,	B-13	11-137-8	03/87	45/12	6.40/5.23	Fair
Mecklenburg			11/83	61/12	6.92/5.97	Fair
McAlpine Cr, NC 51 ab WWTP, Meck.	B-14	11-137-9	08/97	57/15	6.93/4.95	Fair
			08/92	55/9	7.53/6.08	Fair
McAlpine Cr, NC 521 ab WWTP, Meck	B-15	11-137-9	03/87	33/5	7.73/5.46	Poor
McAlpine Cr, NC 521 be WWTP, Meck.	B-16	11-137-9	11/83	24/3	8.83/6.70	Poor
McAlpine Cr, Dorman Rd, SC	B-17	11-137-9	08/92	40/11	7.31/6.68	Fair
			03/87	19/2	8.16/2.91	Poor
Walker Br, NC 49, Mecklenburg	B-18	11-137-10-1	02/90	68/18	6.47/5.79	Good-Fair

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
S Fk Catawba R, NC 10, Catawba	B-1	11-129-(0.5)	08/97	60/25	5.56/4.70	Good
			08/92	75/24	6.20/5.05	Good-Fair
			07/90	56/16	6.57/5.27	Fair
			07/88	67/24	6.25/5.07	Good-Fair
			07/86	49/12	6.59/4.68	Fair
			07/84	67/26	5.28/4.15	Good-Fair
S Fk Catawba R, NC 27, Lincoln	B-2	11-129-(3.5)	09/84	77/29	5.58/4.17	Good
Henry Fk, be He Cr, SR 1918, Burke	B-3	11-129-1-(1)	04/88	106/53	3.29/2.11	Excellent
Henry Fk, SR 1922, Burke	B-4	11-129-1-(2)	04/88	116/62	3.59/2.52	Excellent
Henry Fk, NC 18, Burke	B-5	11-129-1-(2)	04/88	127/65	3.84/2.68	Excellent
UT Henry Fk, SR 1915, Burke	B-6	-	04/88	110/52	3.83/2.33	Good
He Cr, ab water intake, Burke	B-7	11-129-1-4-(1)	04/88	-/45	-/2.01	Excellent
Ivy Cr, SR 1919, Burke	B-8	11-129-1-6	04/88	-/42	-/2.36	Good
Long Br, SR 1917, Burke	B-9	11-129-1-8	04/88	-/46	-/2.87	Excellent
Rock Cr, SR 1915, Burke	B-10	11-129-1-12	04/88	-/43	-/2.84	Good
Henry Fk, SR 1124, Catawba	B-11	11-129-1-(12.5)	08/97	76/38	3.90/3.30	Good
			08/92	74/38	4.58/3.75	Good
			07/89	64/27	4.65/4.22	Good
			07/87	73/25	5.09/4.01	Good-Fair
			07/86	79/28	5.39/3.88	Good-Fair
Henry Fk, SR 1008, be WWTP, Catawba	B-12	11-129-1-(12.5)	11/83	27/5	6.87/4.20	Poor
UT Henry Fk A ab Pantasote, SR 1213, Catawba	B-13	-	06/85	29/8	6.34/4.23	Fair
UT Henry Fk A be Pantasote, SR 1213, Catawba	B-14	-	06/85	31/7	6.24/2.71	Fair
UT Henry Fk B(control), SR 1148, Burke	B-15	-	02/87	-/36	-/2.13	Excellent
UT Henry Fk C (ab Neuville), 64 Bypass, Burke	B-16	-	02/87	-/0	-/-	Poor
UT Henry Fk C, be discharge, Burke	B-17	-	02/87	-/5	-/5.96	Poor
UT Henry Fk C, recovery, I-40, Burke	B-18	-	02/87	-/17	-/3.40	Good-Fair
Jacob Fk, S Mts St Pk, Burke	B-19	11-129-2-(1)	05/90	-/42	-/2.49	Excellent
Jacob Fk, SR 1904, Burke	B-20	11-129-2-(1)	05/90	-/42	-/2.31	Excellent
Jacob Fk, SR 1924, Burke	B-21	11-129-2-(1)	08/97	99/47	4.06/3.20	Excellent
			08/92	104/48	4.48/3.32	Excellent
			10/90	102/50	3.95/2.60	Excellent
			07/90	92/45	4.77/4.01	Excellent
			05/90	-/48	-/2.56	Excellent
			01/90	86/55	3.41/2.87	Excellent
			07/87	96/35	4.96/3.76	Good
			08/85	75/32	5.14/3.99	Good-Fair
Shinny Cr, (S Mts St Pk), Burke	B-22	11-129-2-3	05/90	-/41	-/2.13	Excellent
Jacob Fk, NC 27, Catawba	B-23	11-129-2-(9.5)	11/83	79/35	**	Good
Jacob Fk, SR 1139, Catawba	B-24	11-129-2-(9.5)	11/83	69/23	**	Good-Fair
Hop Cr, SR 1131, Catawba	B-25	11-129-2-14	06/85	86/36	4.56/3.44	Good
Howards Cr, SR 1200, Lincoln	B-26	11-129-4	08/97	-/25	-/4.15	Good
			08/92	-/25	-/4.33	Good
Clark Cr, SR NC 64, Catawba	B-27	11-129-5-(0.3)	09/84	57/15	6.14/5.15	Good-Fair
Clark Cr, SR 1149, Catawba	B-28	11-129-5-(0.3)	08/92	-/16	-/5.74	Good-Fair
			09/84	60/16	6.6 5/5.81	Good-Fair
Clark Cr, SR 2014, ab Newton WWTP, Catawba	B-29	11-129-5-(0.3)	09/90	50/13	7.16/6.46	Fair
			09/84	59/15	6.79/6.17	Fair
			06/84	59/16	6.25/5.80	Good-Fair
Clark Cr, SR 2012,be Newton WWTP,	B-30	11-129-5-0.3	09/90	40/6	7.11/5.33	Fair

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba			09/84	64/19	7.11/6.26	Good-Fair
Clark Cr, SR 1274, Catawba	B-31	11-129-5-(7.5)	09/84	70/16	6.92/6.06	Fair
Clark Cr, SR 1008, Lincoln	B-32	11-129-5-(7.5)	08/97	48/16	5.72/5.16	Good-Fair
			08/92	48/10	6.67/5.63	Fair
			07/88	54/11	6.78/6.11	Fair
			08/85	48/13	7.14/6.25	Fair
			09/84	79/27	6.62/5.40	Good
			11/83	38/9	**	Fair
Cline Cr, SR 1164, Catawba	B-33	11-129-5-2	09/84	50/11	7.16/6.21	Fair
Maiden Cr, SR 1858, Catawba	B-34	11-129-5-7-2-(1)	03/93	55/22	4.85/4.02	Good
Maiden Cr, SR 1810, Catawba	B-35	11-129-5-7-2-(3)	09/93	67/26	4.93/4.26	Good
Maiden Cr, SR 2007, Catawba	B-36	11-129-5-7-2-(3)	09/84	86/18	6.55/5.76	Good-Fair
Shady Br, be Maiden, SR 2005, Catawba	B-37	11-129-5-7-3	09/84	32/1	8.86/7.37	Poor
Carpenter Cr, US 301, Lincoln	B-38	11-129-5-9	06/94	64/28	4.47/3.90	Good
			09/84	85/30	4.94/4.61	Excellent
Walker Cr, SR 1405, Lincoln	B-39	11-129-5-10	09/84	75/18	7.09/6.11	Good-Fair
Indian Cr, SR 1252, Lincoln	B-40	11-129-8-(5)	08/97	73/24	5.23/4.63	Good
			08/92	79/29	6.06/5.38	Good
			07/90	72/25	6.19/5.44	Good-Fair
			07/87	67/18	6.33/5.52	Good-Fair
			07/86	77/18	6.58/5.40	Good-Fair
			11/83	50/6	6.90/5.36	Fair
			08/83	51/12	6.39/6.00	Good-Fair
Hoyle Cr, SR 1836, Gaston	B-41	11-129-15-(4)	11/83	50/15	6.12/4.88	Good-Fair
Mauney Cr, ab SR 1831, Gaston	B-42	11-129-15-5	05/97	49/11	6.73/5.34	Fair
Mauney Cr, be SR 1831, Gaston	B-43	11-129-15-5	05/97	52/10	6.76/5.29	Fair

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
S Fk Catawba R, SR 2003, Gaston	B-1	11-129-(15.5)	08/83	49/19	6.51/5.65	Good-Fair
S Fk Catawba R, NC 7, McAdenville,	B-2	11-129-(15.5)	08/97	61/16	6.02/5.05	Good-Fair
Gaston			08/92	63/18	6.70/5.40	Good-Fair
			07/89	62/15	6.32/4.72	Good-Fair
			07/87	65/23	6.50/5.43	Good-Fair
			08/85	55/16	7.02/5.34	Fair
			11/83	7/2	7.82/5.64	Poor
Long Cr, SR 1409, Gaston	B-3	11-129-16-(2.3)	06/96	67/14	5.84/4.78	Good-Fair
Long Cr 1A, SR 1408, Gaston	B-4	11-129-16-(2.3)	04/92	81/29	5.28/4.39	Good
Long Cr 1, SR 1405, Gaston	B-5	11-129-16-(2.3)	04/93	63/24	5.53/4.55	Good
			04/94	73/26	5.47/4.43	Good
			04/95	83/31	5.21/3.80	Good
			04/92	-/22	-/5.07	Good-Fair
			04/91	89/29	5.63/4.70	Good
Long Cr 2A, NC 274, Gaston	B-6	11-129-16-(4)	04/95	75/28	4.90/3.95	Good
			04/94	73/25	5.58/4.91	Good
			04/93	63/21	5.69/4.90	Good-Fair
			04/92	79/19	5.82/5.22	Good-Fair
			04/91	90/24	6.35/4.92	Good-Fair
Long Cr, SR 1443, Gaston	B-7	11-129-16-(4)	04/95	90/37	5.09/4.35	Good
Long Cr 5A, SR 1446, Gaston	B-8	11-129-16-(4)	04/95	98/35	5.22/4.40	Good
			04/94	65/25	5.30/4.80	Good
			04/93	54/20	5.58/4.87	Good-Fair
			04/92	76/24	6.20/5.40	Good-Fair

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
			04/91	70/23	5.52/4.68	Good
Long Cr 6, SR 1448, Gaston	B-9	11-129-16-(4)	04/94	76/26	4.97/4.19	Good
			04/93	62/22	5.57/4.89	Good-Fair
			04/92	80/23	5.82/5.15	Good
		04/91	86/30	5.83/5.04	Good	
Long Cr 8A, NC 275, Gaston	B-10	11-129-16-(4)	04/95	89/31	5.51/4.54	Good
			04/94	59/21	5.45/5.0	Good
			04/93	51/21	5.55/5.07	Good-Fair
			04/92	72/20	6.36/5.47	Good-Fair
			04/91	84/21	6.26/5.17	Good-Fair
Long Cr, SR 1456, Gaston	B-11	11-129-16-(4)	08/97	62/21	5.81/4.79	Good-Fair
			07/90	67/18	6.42/5.39	Good-Fair
			07/87	71/19	6.59/5.61	Good-Fair
			08/84	62/17	6.25/5.44	Good-Fair
Long Cr, SR 2003 be WWTP, Gaston	B-12	11-129-16-(4)	07/90	54/14	7.33/6.30	Fair
			11/83	20/3	8.61/4.93	Poor
UT Long Cr 5, SR 1446, Gaston	B-13	-	04/94	-/26	-/4.89	Good-Fair
			04/91	76/25	5.46/4.39	Good
UT Long Cr 8, SR 1456, Gaston	B-14	-	04/91	55/26	4.44/4.25	Good
UT Long Cr, ab Dallas WWTP, Gaston	B-15	-	06/92	42/10	6.45/6.11	Good-Fair
UT Long Cr, be Dallas WWTP, SR 2275 Gaston	B-16	-	06/92	39/8	7.60/6.40	Fair
Kiser Br, Kiser Dairy, Gaston	B-17	-	06/96	59/8	7.09/6.13	Fair
Kaglor Br, at Park, Gaston	B-18	11-129-16-5	06/96	55/8	6.29/5.8	NR

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Catawba Cr, SR 2446 ab WWTP, Gaston	B-1	11-130	07/90	42/10	6.94/6.66	Fair
			05/85	55/16	7.09/6.13	Fair
Catawba Cr, SR 2439 be WWTP, Gaston	B-2	11-130	07/90	43/1	8.12/7.40	Poor
			05/85	38/5	8.55/6.07	Poor
Catawba Cr, SR 2435, Gaston	B-3	11-130	05/85	43/6	8.44/6.50	Poor
Crowders Cr, SR 1118, Gaston	B-4	11-135	09/89	50/14	6.02/4.73	Good-Fair
Crowders Cr, SR 1125, Gaston	B-5	11-135	09/89	55/13	7.07/6.11	Fair
Crowders Cr, SR 1131, Gaston	B-6	11-135	09/89	46/7	7.69/7.00	Fair
Crowders Cr, NC 321,Gaston	B-7	11-135	09/89	46/10	6.81/5.64	Fair
Crowders Cr, SR 2424,Gaston	B-8	11-135	09/89	51/15	6.86/5.87	Fair
Crowders Cr, SC 564 York Co., SC	B-9	11-135	08/97	67/11	6.56/5.94	Fair
			08/92	66/18	6.55/5.65	Good-Fair
			09/89	61/15	6.83/6.13	Fair
			07/88	43/4	8.30/7.50	Poor
McGill Cr, ab WWTP, Gaston	B-10	11-135-2	09/89	-/4	-/7.43	Poor
McGill Cr, be WWTP, SR 1300, Gaston	B-11	11-135-2	09/89	-/6	-/7.09	Poor
Abernethy Cr, ab UT, SR 1302, Gaston	B-12	11-135-4	03/93	56/20	5.76/4.95	Good-Fair
			09/89	-/12	-/4.93	Fair
			06/87	67/13	7.40/5.81	Fair
Abernethy Cr, be UT, SR 1302, Gaston	B-13	11-135-4	03/93	51/19	6.49/5.39	Good-Fair
			09/89	-/4	-	Poor
			06/87	43/4	7.78/7.53	Poor
Abernethy Cr, ab Bessemer WWTP,Gast.	B-14	11-135-4	09/89	-/3	-/6.90	Poor
Abernethy Cr, be WWTP, Gaston	B-15	11-135-4	09/89	-/1	-/6.57	Poor
UT Abernethy be Lithium, Gaston	B-16	-	03/93	40/5	7.77/7.52	Poor
			06/87	25/0	7.90/-	Poor

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
S Crowders Cr, SR 1103, Gaston	B-17	11-135-10-1	05/85	89/31	5.31/4.41	Good-Fair
S Crowders Cr, SR 1109, Gaston	B-18	11-135-10-1	09/89	-/16	-/5.56	Good-Fair
UT Crowders Cr, SR 2416, Gaston	B-19	-	09/89	-/11	-/6.62	Fair

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Site	Site #	Index#	Date	S/EPT S	BI/BIEPT	Bioclass
Twelvemile Cr, NC 16, Union	B-1	11-138	02/90	-/30	-/4.93	Good-Fair
			07/89	71/20	6.25/5.37	Good-Fair
			11/83	50/7	7.15/6.33	Fair
Sixmile Cr, SR 3445, Mecklenburg	B-2	11-138-3	03/87	67/22	5.26/3.58	Good-Fair
Waxhaw Cr, SR 1103, Union	B-3	11-139	08/92	-/14	-/5.53	Good-Fair
			11/83	38/6	6.82/5.39	Fair

Sampling Methodology

At each sample site, a 200-m 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 (usually sport fishes, catfishes and suckers) were examined for sores, lesions, fin damage and skeletal anomalies, measured (total length to the nearest 1 mm), and then released. The remaining fish (i.e., those fish that were not readily identifiable) were preserved in 10% formalin and returned to the laboratory for identification, examination and total length measurement. The resulting data are analyzed with the NCIBI.

NCIBI Analysis

The assessment of biological integrity using the NCIBI is provided by the cumulative assessment of 12 parameters or metrics. The values provided by the metrics are converted into scores on a 1, 3 or 5 scale. A score of 5 represents conditions which would be expected for undisturbed streams in the specific river basin or ecoregion, while a score of 1 indicates that the conditions vary greatly from those expected in undisturbed streams of the region. Each metric is designed to contribute unique information to the overall assessment. The scores for all metrics are then summed to obtain the overall NCIBI score. Finally, the NCIBI score (an even number between 12 and 60) is then used to determine the ecological integrity class, as proposed by Karr (1981), of the stream from which the sample was collected (Table 1).

Table 1 Scores, Integrity Classes and Class Attributes for Evaluating a Wadeable Stream Using the North Carolina Index of Biotic Integrity

NCIBI Scores	Karr's Integrity Classes	Class Attributes[1]
58 or 60	Excellent	Comparable to the best situations without human disturbance. All regionally expected species for the habitat and stream size, including the most intolerant forms are present, along with a full array of size classes and a balanced trophic structure.
54 or 56	Good-Excellent	
48, 50, or 52	Good	Species richness somewhat below expectation, especially due to the loss of the most intolerant species; some species are present with less than optimal abundances or size distributions; and the trophic structure shows some signs of stress.
46	Fair-Good	
40, 42, or 44	Fair	Signs of additional deterioration include the loss of intolerant species, fewer species and a highly skewed trophic structure.
36 or 38	Poor-Fair	
28, 30, 32, or 34	Poor	Dominated by omnivores, tolerant species and habitat generalists; few top carnivores; growth rates and condition factors commonly depressed; and diseased fish often present.
24 or 26	Very Poor-Poor	
12, 14, 16, 18, 20, or 22	Very Poor	Few fish present, mostly introduced or tolerant species; and disease fin damage and other anomalies are regular.
-----	No fish	Repeated sampling finds no fish.

[1] Over-lapping classes share attributes with classes greater than and less than the respective NCIBI score.

The NCIBI has been revised since the initial Catawba River basinwide monitoring was conducted in 1993 (NCDEHNR, 1994). Recently, the focus of using and applying the Index has been restricted to wadeable streams that can be sampled by a crew of 4 persons and following the NCDWQ Standard Operating Procedures (NCDEHNR, 1997). Also, changes have been made to the trophic guild classifications (Metrics 8-10), tolerance rankings (Metrics 6 and 7), the number of fish and species as a function of a stream's watershed size (Metrics 1 and 2), and the percentage of species with multiple age groups (Metric 12).

In an effort to simplify and standardize the evaluation of a stream's ecological integrity and water quality bioclassification, whether using a fish community or benthic invertebrate assessment, the fish community integrity classes were also modified (Table 2).

Table 2 Revised Scores and Classes for Evaluating the Fish Community of a Wadeable Stream Using the North Carolina Index of Biotic Integrity

NCIBI Scores	NCIBI Classes
56-60	Excellent
50-54	Good
44-48	Good-Fair
38-42	Fair
<36	Poor

These refinements in the metrics and classification scheme did cause some changes in the Catawba River basin fish community assessments previously reported in NCDEHNR (1994). For example, of the 18 wadeable stream sites monitored in 1993, the NCIBI score increased by 2 units at 1 site, and the scores decreased by 2-8 units at the other 17 sites (Table 3). This resulted in 1 site whose NCIBI classification increased, 9 sites whose classification decreased, and the remaining 8 sites whose classification did not change.

Table 3 Differences in Fish Community Evaluations Using the NCIBI as Reported in NCDEHNR (1994) and Current Evaluations

	Old		New	
Site	**NCIBI Score**	**Integrity Class**	**NCIBI Score**	**NCIBI Class**
South Muddy Creek	42	Fair	40	Fair
Canoe Creek	44	Fair	38	Fair
Lower Creek	44	Fair	36	Poor
Jumping Branch	38	Poor-Fair	40	Fair
McGalliard Creek	38	Poor-Fair	30	Poor
Middle Little River	40	Fair	38	Fair
Duck Creek	40	Fair	36	Poor
Lower Little River	32	Poor	28	Poor
Elk Shoal	44	Fair	40	Fair
Lyle Creek	52	Good	46	Good-Fair
Dutchmans Creek	46	Fair-good	40	Fair
Leepers Creek	52	Good	44	Good-Fair
Killian Creek	50	Good	42	Fair
Irwin Creek	32	Poor	26	Poor
Clark Creek	40	Fair	36	Poor
Maiden Creek	40	Fair	48	Fair
Maiden Creek	30	Poor	28	Poor
Long Creek	38	Poor-Fair	32	Poor

Appendix II Fish Community Assessments in the Catawba River Basin, 1993-1997

Stream	Road	County	Map F#	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class[1]
Subbasin 030830								
Catawba River	SR 1110	McDowell	1	11-1	14.1	05/07/97	44	G-F
Armstrong Creek	SR 1456	McDowell	2	11-24-14-(1.5)	21.3	05/07/97	48	G-F
Paddy Creek	NC 126	Burke	3	11-28-(0.5)	6.7	05/05/97	44	G-F
North Muddy Creek	SR 1760	McDowell	4	11-32-1-(0.5)	45.7	05/07/97	40	F
South Muddy Creek	SR 1764	McDowell	5	11-32-2-(8.5)	33.5	07/02/97	40	F
						06/28/93	40	F
Subbasin 030831								
Canoe Creek	SR 1250	Burke	1	11-33-(2)	12.4	05/05/97	40	F
						05/10/93	38	F
Upper Creek	SR 1439	Burke	2	11-35-2-(13)	42.4	07/01/97	48	G-F
Mulberry Creek	NC 90	Caldwell	3	11-38-32-(15)	32	05/08/97	52	G
Lower Creek	SR 1142	Caldwell	4	11-39-(6.5)	70.5	05/10/93	36	P
	SR 1501	Burke	5		89.5	10/24/97	40	F
Jumping Branch	SR 1515	Burke	6	11-40-(2)	1.5	05/10/93	40	F
McGalliard Creek	SR 1538	Burke	7	11-44-1	7.5	05/06/97	36	P
Subbasin 030832								
Middle Little River	SR 1002	Alexander	1	11-62	16.3	05/05/97	42	F
						05/11/93	38	F
Duck Creek	NC 90	Alexander	2	11-62-2-(1)	14.6	05/08/97	44	G-F
						05/11/93	36	P
Lower Little River	SR 1318	Alexander	3	11-69	44	05/09/97	40	F
						05/11/93	28	P
Elk Shoal Creek	SR 1605	Alexander	4	11-73-(1.5)	13.6	05/09/97	46	G-F
						05/11/93	40	F
Lyle Creek	US 70	Catawba	5	11-76-(3.5)	43.2	07/01/97	44	G-F
						05/11/93	46	G-F
Buffalo Shoals Creek	SR 1503	Iredell	6	11-78-(0.5)	13.8	06/04/97	46	G-F
Subbasin 030833								
McDowell Creek	SR 2136	Mecklenburg	1	11-115-(1.5)	10.2	06/12/97	36	P
Dutchmans Creek	SR 1918	Gaston	2	11-119-(0.5)	116	06/30/93	40	F
Leepers Creek	NC 73	Lincoln	3	11-119-1-(1)	28.2	05/20/97	46	G-F
						06/29/93	44	G-F
Killian Creek	NC 73	Lincoln	4	11-119-2-(0.5)	12.1	05/20/97	40	F
	SR 1511		5		46.9	06/29/93	42	F
Subbasin 030834								
Irwin Creek	SR 1156	Mecklenburg	1	11-137-1	38	06/30/97	34	P
						06/30/93	26	P
Little Sugar Creek	NC 51	Mecklenburg	2	11-137-8	49.2	06/30/97	34	P
Subbasin 030835								
Henry Fork	SR 1916	Burke	1	1-129-1-(2)	33.7	05/06/97	38	F
Jacob Fork	SR 1924	Burke	2	11-129-2-(4)	25.7	05/06/97	50	G
Pott Creek	SR 1217	Lincoln	3	11-129-3	21	05/21/97	42	F
Clark Creek	SR 1282	Lincoln	4	11-129-5-(4.5)	84.1	06/29/93	36	P
Maiden Creek	SR 1858	Catawba	5	11-129-5-7-2-(1)	3.3	03/18/93	38	F
	off SR 1892		6		6.4	03/18/93	28	P
Indian Creek	SR 1252	Lincoln	7	11-129-8-(5)	69.2	07/01/97	34	P
Hoyle Creek	SR 1836	Gaston	8	11-129-15-(6)	27.5	06/21/97	38	F

Appendix II Fish Community Assessments in the Catawba River Basin, 1993-1997 (cont'd)

Stream	Road	County	Map F#	Index #	D.A. (mi^2)	Date	NCIBI Score	NCIBI Class
Subbasin 030836								
Long Creek	US 321	Gaston	1	11-129-16-(4)	41.7	05/20/97	34	P
						06/30/93	32	P
Subbasin 030837								
Catawba Creek	SR 2435	Gaston	1	11-130	23.4	05/19/97	36	P
Crowders Creek	SR 1108	Gaston	2	11-135	40.7	05/19/97	34	P
Subbasin 030838								
Twelvemile Creek	NC 16	Union	1	11-138	76.5	06/11/97	42	F
Sixmile Creek	SR 1312	Union	2	11-138-3	20.3	06/11/97	38	F
Waxhaw	SR 1103	Union	3	11-139	35	06/11/97	44	G-F

[1] The NCIBI Classifications are: G = Good, G-F = Good-Fair, F = Fair, and P = Poor.

References

Karr, J. R. 1981. *Assessment of Biotic Integrity Using Fish Communities*. Fisheries. 6:21-27.

Appendix III

Use Support Methodology
and
Use Support Ratings

Use Support: Definitions and Methodology

A. Introduction to Use Support

Waters are classified according to their best intended uses. Determining how well a waterbody supports its designated uses (*use support* status) is another important method of interpreting water quality data and assessing water quality. Use support assessments are presented in Section A, Chapter 3 and for each subbasin in Section B.

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

Streams rated as either partially supporting or nonsupporting are considered *impaired*. A waterbody is fully supporting but threatened (ST) for a particular designated use when it fully supports that use, but has some notable water quality problems. Although threatened waters are currently supporting uses, they are treated as a separate category from waters fully supporting uses. Streams which had no data to determine their use support were listed as not rated (NR).

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

B. Interpretation of Data

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

Interpretation of the use support ratings compiled by DWQ should be done with caution. The methodology used to determine the ratings must be understood, as should the purpose for which the ratings were generated. The intent of this use support assessment was to gain an overall

picture of the water quality; how well these waters support the uses for which they were classified; and the relative contribution made by different categories of pollution within the basin. In order to comply with guidance received from EPA to identify likely sources of pollution for all impaired stream mileage, DWQ used the data mentioned above.

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

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

C. Assessment Methodology - Freshwater Bodies

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

1. Biological Data

Benthic Macroinvertebrate Bioclassification

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample based on the number of taxa present in the intolerant groups Ephemeroptera, Plecoptera and Trichoptera (EPTs) and the Biotic Index (BI) which summarizes tolerance data for all taxa in each collection. The bioclassifications are translated to use support ratings as follows:

Bioclassification	Rating
Excellent	Fully Supporting
Good	Fully Supporting
Good-Fair	Fully Supporting but Threatened
Fair	Partially Supporting
Poor	Not Supporting

Fish Community Structure

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

NCIBI	Rating
Excellent	Fully Supporting
Good	Fully Supporting
Good-Fair	Fully Supporting but Threatened
Fair	Partially Supporting
Poor	Not Supporting

Phytoplankton and Algal Bloom Data

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of alga may discolor the water or form visible mats on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5,000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentration approaching or exceeding 40 micrograms per liter (the NC state standard) constitutes a bloom. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms, associated fish kills or interference with recreation or water supply uses are all considered.

Chemical/Physical Data

Chemical/physical water quality data are collected through the Ambient Monitoring System as discussed in Section A, Chapter 3. These data are downloaded from STORET to a desktop computer for analysis. Total number of samples and percent exceedences of the NC state standards are used for use support ratings. Percent exceedences correspond to use support ratings as follows:

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

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

Lakes Program Data

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

2. Sources and Cause Data

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

a. Point Source Data

Whole Effluent Toxicity Data

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

Daily Monitoring Reports

Streams which receive a discharge from a facility significantly out of compliance with permit limits may be rated ST (unless water quality data indicated otherwise) and have that facility listed as a potential source of impairment.

b. Nonpoint Source Data

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

c. Problem Parameters

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

3. Monitored vs. Evaluated

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

- If the only existing data for a stream are more than five years old.
- If a stream is a tributary to a monitored segment of a stream rated fully supporting (FS) or fully supporting but threatened (ST), the tributary will receive the same rating on an evaluated basis. If a stream is a tributary to a monitored segment of a stream rated partially supporting (PS) or not supporting (NS), the stream is considered not rated (NR).
- Because a monitored rating is based on more recent and site-specific data, it is treated with more confidence than an evaluated rating.

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

Summary of Basis for Assigning Use Support Ratings to Freshwater Streams

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

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

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

D. Assessment Methodology - Saltwater Bodies

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

1. DEH Sanitary Surveys

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

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

2. Chemical/Physical Data

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

3. Phytoplankton and Algal Bloom Data

Prolific growths of phytoplankton, often due to high concentrations of nutrients, sometimes result in "blooms" in which one or more species of algae may discolor the water or form visible mates on top of the water. Blooms may be unsightly and deleterious to water quality, causing fish kills, anoxia, or taste and odor problems. An algal sample with a biovolume larger than 5000 mm3/m3, density greater than 10,000 units/ml, or chlorophyll *a* concentrations approaching or exceeding 40 micrograms per liter (the NC standard) constitutes a bloom. Best professional judgment is used on a case-by-case basis in evaluating how bloom data should be used to determine the use support rating of specific waters. The frequency, duration, spatial extent, severity of blooms, associated fish kills or interference with recreation or water supply uses are all considered.

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

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

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

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

E. Assigning Use Support Ratings

At the beginning of each assessment, all data are reviewed by subbasin with the monitoring staff, and data are adjusted where necessary based on best professional judgment. Discrepancies between data sources are resolved during this phase of the process. For example, a stream may be sampled for both benthos and fish community structure, and the bioclassification may differ from the NCIBI (i.e., the bioclassification may be FS while the NCIBI may be PS). To resolve

this, the final rating may defer to one of the samples (resulting in FS or PS), or it may be a compromise between both of the samples (resulting in ST).

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

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

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

After assigning ratings to streams with existing data, streams with no existing data were assessed. Streams that were direct or indirect tributaries to streams rated FS or ST received the same rating (with an evaluated basis) if they had no known significant impacts, based on a review of the watershed characteristics and discharge information. Streams that were direct or indirect tributaries to streams rated PS or NS, or that had no data, were assigned a NR rating.

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

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

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

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

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

USE SUPPORT RATINGS FOR MONITORED STREAMS IN THE CATAWBA RIVER BASIN. NC DIVISION OF WATER QUALITY

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
CATAWBA RIVER	From source to Old Fort Finishing Plant WSI	7.5	B-SR 1274; F-SR 1103; B-SR 1273, McDowell	30830	FS					G-F	G-F	sed	NP	culvert construction	ST	M
Mill Creek	From source to Swannanoa Creek	4.9	Ab RR bridge at Graphite; SR 1400/1407, McDowell	30830			E			E; 98-G					FS	M
Mill Creek	From Swannanoa Creek to Catawba River	3.3	SR 1401/1407, McDowell	30830						F; 98-G					FS	M
Swannanoa Creek	From source to Mill Creek	3.2	off SR 1400, McDowell	30830			E			F/P; 98-F; 99-E					FS	M
CATAWBA RIVER	From Dam At Old Fort Finishing Plant to SR 1234	1.8	SR 1234, McDowell	30830	FS					G-F					ST	M
CATAWBA RIVER	From SR 1234 to I40	1.3		30830											FS	ME
CATAWBA RIVER	From I40 to N Fk Catawba	13.7	SR 1221, McDowell	30830	FS					G					FS	M
Curtis Creek	From source to Catawba River	9.4	SR 1227 ab WWTP; US 70 be WWTP, McDowell	30830			G (be WWTP)			G			P	trout farms	FS	M
Crooked Creek	From source to Catawba	15.6	SR 1135, McDowell	30830						G		sed	NP	ag	FS	M
Mackey Creek	From source to Marion Water Supply	2.4		30830									NP	trout farms, ag	FS	ME
Mackey Creek	From Marion Water Supply to Laurel Fork	0.3		30830									NP	trout farms, ag	FS	ME
Mackey Creek	From Laurel Fork Creek to US 70	2.4	SR 1453; ab US 70, McDowell	30830					G	G; 98-G			NP	trout farms, ag	FS	M
Mackey Creek	From US 70 to Catawba River	0.6	be US 70, McDowell	30830						G-F; 98-F		metals discharge	P	Metal Industries	PS	M
Buck Creek	From source to Dam at Lake Tahoma	5.4	NC 80 ab Lake Tahoma, McDowell	30830			E			E		sed	NP		FS	M
Little Buck Creek	From source to Lake Tahoma, Buck Creek	3.8	SR 1436, McDowell	30830						E			NP		FS	M
Buck Creek	From Dam at Lake Tahoma to a point .6 mile upstream of Marion Water Supply	2.3		30830									NP		ST	ME
Buck Creek	From 0.6 mi upstream of Marion WSI to Marion WSI	0.6	US 70, McDowell	30830			G-F						NP		ST	M
Buck Creek	From Marion Water Supply Intake To Catawba R	0.4		30830									NP		ST	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Toms Creek (Fall Branch)	From source to Harris Creek	1.8		30830											FS	ME
Toms Creek (Morgan Lake)	From Harris Creek to Catawba River	5.5	SR 1434, McDowell	30830						G					FS	M
CATAWBA RIVER (Lake James)	From North Fork Catawba River to a point 1.0 mile upstream of Burke-McDowell Co Line	7.5		30830	lakes										FS	M
North Fork Catawba River	Laurel Branch to Armstrong Creek	9.3	US 221; SR 1573; SR 1560 McDowell	30830						E; G			NP		FS	M
North Fork Catawba River	From Armstrong Creek to Lake James,	6.6	B: SR 1559; A:SR 1552, McDowell	30830	FS					G			NP		FS	M
Armstrong Creek	From source to Hickory Bottom Creek	10.7	B:end of FS rd; F:SR 1456; B:off NC 226	30830			E			E	G				FS	M
Three Mile Creek	From source to Armstrong Creek	3.1	SR 1443, McDowell	30830			E								FS	M
Cox Creek	From source to Armstrong Creek	3.8	Off NC 226, McDowell	30830			E								FS	M
Armstrong Creek	From Hickory Bottom Cr to American Thread Company Water Sup. Dam	0.4		30830											FS	ME
Armstrong Creek	From American Thread Company Water Sup Dam to North Fk Catawba R	0.1		30830											FS	ME
CATAWBA RIVER (Lake James)	From 1.0 mile upstream of Burke-McDowell Co Line To Bridgewater Dam	4.5		30830	lakes										FS	M
Paddy Creek	From 2.5 mi above NC Hwy 126 to Hwy 126	2.5	NC Hwy 126, Burke	30830						99:G	F	nutrients	NP	cattle access, trout farms, ag	ST	M
Paddy Creek	From Hwy 126 to Catawba River	1.5		30830											ST	ME
Linville River	From source to Grandmother Creek	6.4	off NC 105 ab golf course; nr NC 105 nr Brier Knob Avery	30830						G; G		sed	NP	non-urban development	FS	M

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Linville River	From Grandmother Creek to Linville Falls	15.1	NC 221, Avery	30830						G-F/G-F			NP	non-urban development, urban	ST	M
Little Grassy Creek	From source to Linville River	1.5	ab golf course, Avery	30830						E					FS	M
Linville River	From Linville Falls to S. boundary of Daniel Boone Wildlife Mgmt Area	9.9		30830											FS	ME
Linville River	From S Boundary of Daniel Boone Wildlife Mgmt Area to Shooks Ck	6.2		30830											FS	ME
Linville River	From Shooks Ck to Lake James, Catawba River	0.7	Hwy 126 nr Nebo, Burke	30830	FS					E					FS	M
CATAWBA RIVER	From Bridgewater Dam (Linville Dam) to 1.2 miles upstream of Canoe Ck	10.8	SR 1147 nr Glen Alpine, Burke	30830	FS					G					FS	M
Muddy Creek	From source to Catawba	4.6		30830								sed	NP	ag	ST	ME
North Muddy Creek	From source to .3 miles upstream from Thompsons	14.7	SR 1760, McDowell	30830						G	F	sed, turb	NP	ag	ST	M
Coperning Creek	From source to Marion WWTP	4.2	SR 1819, McDowell	30830						F			NP		PS	M
Coperning Creek	From Marion WWTP to North Muddy Creek	0.5	SR 1794, McDowell	30830									NP,P	urban, Marion WWTP	PS	M
North Muddy Creek	From .3 mi upstream of Thompsons Fk to Muddy Ck	2.2		30830								sed, turb	NP	ag	ST	ME
South Muddy Creek	From source to .5 mile upsteam of Hoppers Ck	11.4		30830								sed, turb	NP	ag	ST	ME
South Muddy Creek	From 0.5 mile upstream o Hoppers Ck to Muddy Creek	4.8	SR 1764	30830						G-F	F	sed, turb	NP	ag	ST	M
CATAWBA RIVER	From 1.2 miles upstream of Canoe Ck to 0.7 mi upstream of Canoe Ck	0.5		30830											FS	ME
CATAWBA RIVER	From 0.7 miles upstream of Canoe Ck to 0.6 miles upstream of Warrior Fork	3.8		30830											FS	ME
Canoe Creek	From source to Burke co SR 1248	6.2		30830									NP	logging	ST	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Canoe Creek	From Burke Co SR 1248 to Catawba River	5.3	SR 1250, Burke Co,	30830						G-F	G-F	sed	NP	logging	ST	M
Silver Creek	From source to1.3 miles downstream of Clear Ck	13.7	SR 1149, Burke Co,	30831						G-F			NP	ag	ST	M
Silver Creek	From 1.3 miles downstream of Clear Ck to Catawba River	3		30831									NP	ag, urban	ST	ME
CATAWBA RIVER	From 0.6 miles upstream of Warrior Fork To Johns River	2.7		30831											FS	ME
Warrior Fork	From source to .6 mile upstream of city of Morganton water supply intake	3.6	SR 1440, Burke	30831						E					FS	M
Upper Creek	Source to Timbered Br.	9.6	NC 181; USFS 128; ab USFS 982, Burke	30831			E								FS	M
Upper Creek	From Timbered Branch to Holly Spring Br	1.1	be USFS 982, Burke	30831		E	E								FS	M
Timbered Branch	From source to Upper Creek	2.3	USFS 982, Burke	30831		E	E								FS	M
Upper Creek (Clear	From Holly Spring Branch to Dam at Clear Water Beach	3.9		30831											FS	ME
Upper Creek	From Dam at Clear Water Beach Lake to Warrior Fk	5.5	SR 1407; SR 1439, Burke	30831							G				FS	ME
Warrior Fork	From 0.6 mile upstream of City of Morganton water supply intake to City of Morganton water supply intake	0.6		30831											FS	ME
Warrior Fork	From City of Morganton water supply intake to Rhodhiss Lake, Catawba	1.1		30831											FS	ME
CATAWBA RIVER (L. Rhodhiss0	From Johns River to Rhodhiss Dam	13.7	SR 1001 nr Baton, Burke	30831	S, lakes										FS	M
Johns River	From Gragg Prong to Reids Creek	10.2		30831											FS	ME
Johns River	From Reids Creek to Wilson Cr	22.3	SR 1356, Caldwell	30831						E					FS	M
Mulberry Creek	From source to Boone Fork	7.6		30831									NP		FS	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Mulberry Creek	From Boone Branch to Dam at Mulberry	2.4	SR 1368, Caldwell	30831									NP		FS	ME
Mulberry Creek	From Dam at Mulberry Beach to Johns	5.3	NC 90, Caldwell	30831							G	sed	NP	ag	FS	M
Wilson Creek	From source to US 221	0.6	US 221, Avery	30831	PS							low pH		acid rain??	FS	M
Wilson Creek	From US 221 to Johns River	22.5	SR 1358; SR 1335, Caldwell	30831	FS					E					FS	M
Lower Creek	From source to Zack's Fork	8.8	NC 90, Caldwell	30831						G-F		sed	NP	ag, non-urban	ST	M
Lower Creek	From Zack's Fork to Caldwell Co SR 1143	4.8	SR 1303, Caldwell	30831						F			NP	urban	PS	M
Zacks Fork Creek	From source to Lower Ck	8.2	NC 18A, Caldwell	30831						F			NP	ag--cattle	PS	M
Spainhour Creek	From source to Lower Creek	4.3	SR 1303, Caldwell	30831						F			NP	urban	PS	M
Greasy Creek	From source to Lower Creek	4.5	NC 18, Caldwell	30831						F			NP		PS	M
Lower Creek	From Caldwell Co SR 1143 to 0.7 mile downstream of Bristol Cr	6.6	SR 1142 (Caldwell); SR 1501 (Burke)	30831	PS					F/F	F	sed, turb	NP,P	urban, ag, non-urban development	PS	M
Husband Creek	From source to 0.5 mi upstream of Celia Ck	7.5		30831									NP	golf course, ag, urban	ST	ME
Husband Creek	From 0.5 mi upstream of Celia Ck to Lower Creek	0.5	NC 18	30831						G-F			NP	golf course, ag, urban	ST	M
Bristol Creek	From source to Lower Creek	5.6	NC 18	30831						F		sed	NP	non-urban development	PS	M
Lower Creek	From 0.7 mil downstream of Bristol Cr to Rhodhiss Lake, Catawba	1.3		30831								sed, turb	NP, P	urban, ag, non-urban development	PS	ME
Smoky Creek	From source to .6 mi upstream of mouth	7.4	SR 1515	30831						G					FS	M
Smoky Creek	From0.6 mile upstream of mouth to Rhodhiss Lake, Catawba	0.6		30831											FS	ME
McGalliard Creek	From source to 0.6 mi upstream of mouth	4.3	SR 1538, Burke	30831						G-F	P		NP	urban	ST	M
McGalliard Creek	From 0.6 mi upstream of mouth to Rhodhiss Lake,	0.6		30831									NP	urban	ST	ME
CATAWBA RIVER (L. Hickory)	From Rhodhiss Dam to U.S. Hwy. 321	3.8		30832	lakes										FS	M

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
CATAWBA RIVER (L. Hickory)	From U.S. Highway 321 Bridge to NC Hwy 127	13.6		30832											FS	M
Gunpowder Creek	From source to 0.5 mile downstream of Caldwell Co Sr 1127	5.7		30832									NP		ST	ME
Gunpowder Creek	From 0.5 mile downstream of Caldwell Co Sr 1127 to 0.8 mi downstream of Bily Br	8.2	SR 1002, Caldwell	30832						G-F			NP	ag, urban	ST	M
Gunpowder Creek	From 0.8 mi downstream of Billy Br to Lake Hickory, Catawba R	0.8		30832									NP		ST	ME
Upper Little River	From source to Morris Ck	8.4		30832									NP		FS	ME
Upper Little River	From Morris Cr to 0.6 mile upstream of mouth	7.9	SR 1744, Caldwell	30832						G			NP		FS	M
Upper Little River	From 0.6 mile upstream of mouth to Lake Hickory,	0.6		30832									NP		FS	ME
CATAWBA RIVER (L. Hickory)	From NC Hwy 127 to Oxford Dam	7.1		30832	lakes										FS	M
Middle Little River	From source to Lake Hickory,	21.5	f:SR 1002, b:SR 1153 (Alexander)	30832						G-F	F	turb, sed	NP	ag	ST	M
Duck Creek	From source to N.C. Highway 90	7.8	NC 90, Alexander	30832							G-F	sed	NP	ag, cattle access	ST	M
Duck Creek	From N.C. Highway 90 to Middle	4.6	NC 127, Alexander	30832						G-F		sed	NP	ag	ST	M
CATAWBA RIVER (Lookout Shoals L.)	From Oxford Dam to Island Ck	3		30832											FS	ME
Lower Little River	From source to Lookout Shoals Lake	24	b/a:SR 1313, SR 1131; b:SF 1318	30832	FS					G	F	turb, sed	NP	ag	FS	M
Muddy Fork	From source to ab Schneider Mills	5.5	ab Schneider Mills	30832									NP	urban, ag	ST	ME
Muddy Fork	From ab Schneider Mills to Lower Little River	1.6	NC 16; SR 1313 (Alexander)	30832						G-F			NP	urban, ag	ST	M
CATAWBA RIVER (Lookout Shoals L.)	From Island Ck to Lookout Shoals Lake, Catawba River	3.4		30832	lakes										FS	M
CATAWBA RIVER (Lookout Shoals L.)	From Elk Shoal Creek (East Side) to 0.5 mile upstream of Lookout Shoals Dam	[illegible]		[illegible]	[illegible]											

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Elk Shoal Creek	From source to Guys Br	4.2		30832									NP	ag	ST	ME
Elk Shoal Creek	From Guys Br to Lookout Shoals Lake,	4.8		30832						G-F	G-F	turb, sed	NP	ag	ST	M
CATAWBA RIVER (Lookout Shoals L.)	From 0.5 mile upstream of Lookout Shoals Dam to Lookout Shoals Dam	0.5		30832	lakes										FS	M
CATAWBA RIVER (Lake Norman)	From Lookout Shoals Dam to Lyle Creek	3.6		30832	lakes										FS	M
CATAWBA RIVER (Lake Norman)	From Lyle Creek to Cowan's Ford Dam	28.9		30832	lakes										FS	M
Lyle Creek	From source to Bakers Ck	8.7		30832									NP		FS	ME
Lyle Creek	From Bakers Ck to US Hwys 64&70	6.4	US 64/70, Catawba	30832						G	G-F	sed	NP		FS	M
Lyle Creek	From US Hwy 64&70 to Lake Norman, Catawba	1.8		30832									NP		FS	ME
McLin Creek	From source to Catawba Co SR 1734	1.1		30832									NP		FS	ME
McLin Creek	From Catawba Co SR 1734 to 0.2 mile upstream of Catawba Co SR 1722	7.7		30832									NP		FS	ME
McLin Creek	From 0.2 mile upstream of Catawba Co SR 1722 to Lyle Ck	0.6	SR 1722, Catawba	30832						G			NP		FS	M
Buffalo Shoals Creek	From source to 0.2 mi downstream of Broad Meadow Ck	8.4		30832							G-F		NP		ST	M
Buffalo Shoals Creek	From 0.2 mile downstream of Broad Meadow Ck to Lake Norman	0.6		30832									NP		ST	ME
CATAWBA RIVER (Mountain Island L.)	From Cowan's Ford Dam to Water Intake at River Bend Steam Station	6.5		30833											FS	M
CATAWBA RIVER (Mountain Island L.)	From Water Intake at River Bend Steam Station to Mt Island Dam	8.4		30833	lakes										FS	M
McDowell Creek	From source to US Hwy 21	1.1		30833									NP		PS	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
McDowell Creek	From US Hwy 21 to SR 2136 Mecklenburg Co	5	SR 2136, Mecklenburg	30833							P		NP		PS	M
McDowell Creek	From SR 2136 Mecklenburg Co to).7 mile upstream from mouth	3	SR 2128, Mecklenburg	30833									NP		PS	ME
McDowell Creek	From 0.7 mile upstream of mouth to Mountain Island Lake, Catawba	0.7		30833									NP		PS	ME
Gar Creek	From source to 0.6 mile upstream from mouth	3.5	SR 2074, Mecklenburg	30833			G			G					FS	M
Gar Creek	From 0.6 mile upstream from mouth to Mountain Island Lake,	0.6		30833											FS	ME
Catawba River	From Mountain Island Dam to I Hwy 85 Bridge at	5.9	NC 27, Mecklenburg	30833	FS										FS	M
Dutchmans Creek	From source to 0.8 miles downstream of Taylors Ck	7.2	SR 1918, Gaston	30833	ST		E			E		fecal	NP	ag	FS	M
Leepers Creek	From source to 0.8 mile upstream of mouth	9.1	b:SR 1354, b/f:NC 73 (Lincoln), b:SR 1820 (Gaston)	30833			E/E/E				G-F		NP	ag	FS	M
Leepers Creek	From 0.8 miles upstream of mouth to Dutchmans Ck	0.8		30833									NP	ag	FS	ME
Killian Creek	From source to 1.2 miles upstream of mouth	14.7	b:SR 1511, f:NC 73 (Lincoln)	30833			E			E	F		NP	ag	FS	M
Killian Creek	From 1.2 miles upstream of mouth to Dutchmans Creek	1.2		30833									NP	ag	FS	ME
Long Creek	From source to 0.6 mile downstream of Mecklenburg Co SR 2074	5.1		30834								turb	NP	urban, construction, ag	PS	ME
Long Creek	From 0.6 mile downstream of Mecklenburg Co SR 2074 to 0.4 mile upstream of Mecklenburg Co SR 1606	8.4	SR 2042, Mecklenburg	30834	PS							turb, Mn	NP	urban, construction, ag	PS	M
Long Creek	From 0.4 mile upstream of Mecklenburg Co SR 1606 to Lake Wylie, Catawba	1.8		30834								turb, Mn	NP	urban, construction, ag	[illegible]	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Catawba River	From I-85 to bridge to the upstream side of Paw Cr Arm of Lake Wylie, Catawba	3.6		30834	lakes										FS	M
Catawba River	From the upstream side of Paw Cr Arm of Lake Wylie to NC/SC state line	14.9		30834	lakes										FS	M
Sugar Creek	From source to below WWTP, SR 1156, Meck	0.2	SR 1156, Mecklenburg	30834						F	P		P, NP	Irwin WWTP, urban	PS	M
Sugar Creek	From SR 1156 Mecklenburg, to HWY 51	11.9	NC 51, Mecklenburg	30834	PS							turb, fecal	NP	urban	PS	M
Sugar Creek	From Hwy 51 to NC/SC border	1.2	SC 160, near Ft Mill, SC	30834	PS					F		turb, fecal	NP	urban	PS	M
Irwin Creek	From source to Sugar Creek	11.8	SR 2523, West Blvd, Irwin WWTP at SR 1156 (Mecklenburg)	30834	PS							turb, fecal	P, NP	Irwin WWTP, Aramark, urban	PS	M
Little Sugar Creek	From source to Archdale Rd	11.8		30834								fecal	NP,P	L. Sugar WWTP, urban	PS	ME
Little Sugar Creek	From Arcdale Rd to NC 51	5.3	NC 51, Mecklenburg	30834	ST					F	P	fecal	NP,P	L. Sugar WWTP, urban	PS	M
Little Sugar Creek	From NC 51 to state line	3.6		30834								fecal	NP,P	L. Sugar WWTP, urban	PS	ME
McAlpine Creek	From source to SR 3356, (Sardis Rd)	8.3	Sardis Rd	30834	PS							fecal,turb	NP	urban	PS	M
McAlpine Creek	From SR 3356 to NC 51	6.3	NC 51, Mecklenburg	30834						F		fecal,turb	NP	urban	PS	M
McAlpine Creek	From NC 51 to NC 521	4.7		30834								fecal,	NP	urban	PS	ME
McAlpine Creek	From NC Hwy 521 to NC/SC stateline	1.1	b:Dorman Rd, SC; a:SC SR 2964	30834	PS							fecal, turb	NP,P	urban	PS	M
South Fork Catawba River	From source to Catwba-Lincoln County Line	8.4	NC 10, Catawba	30835	ST	92-G-F				G		fecal	NP		FS	M
Henry Fork	From source to Morganton Water Intake	3.9		30835											FS	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Henry Fork	From Morganton Water Intake to Laurel Cr.	21.9	B: SR 1918, SR 1922; F: SR 1916, Burke	30835							F				FS	M
Henry Fork	From Laurel Cr (NC 18) Burke Co to SR 1124	10.2	SR 1124, Catawba	30835						G			NP	ag	FS	M
Henry Fork	From SR 1124 to SR 1143	4.6	SR 1143, Catawba	30835	PS							fecal,turb	NP		FS	ME
Henry Fork	From SR 1143 to South Fork	8		30835								fecal,turb	NP		FS	ME
Jacob Fork	From source to Little River	7.8		30835											FS	ME
Jacob Fork	From Little River to Camp Creek, Burke Co	6.6	SR 1924, Burke	30835	FS					E	G				FS	M
Jacob Fork	From Camp Ck in Burke Co to 0.6 mi upstream of mouth	27.7		30835											FS	ME
Jacob Fork	From 0.6 mile upstream of mouth to South Fork	0.6		30835											FS	ME
South Fork Catawba River	From Catawba-Lincoln Co. Line to a pt 0.8 mi upstream of Lincoln Co. SR 1008	9.1		30835											FS	ME
South Fork Catawba River	From 0.8 mile upstream of Lincoln Co SR 1008 to Lincolnton water Supply Intake	0.7		30835											FS	ME
South Fork Catawba River	From City of Lincolnton water supply intake to Clark	1.8		30835											FS	ME
South Fork Catawba River	From Clark Creek to 0.3 mi upstream of Muddy Ck	7.2		30835									P	Clark Cr.	ST	ME
Howards Creek	From source to South Fork Catawba	13.3	SR 1200, Lincoln	30835						G		sed	NP		FS	M
Clark Creek	From SR 2012 to SR-1274, Catawba	4.4		30835									NP,P	ag, urban	PS	ME
Clark Creek	From SR-1274 to 0.9 mi ab Walker Cr.	4		30835									NP,P	ag, urban	PS	ME
Clark Creek	From 0.9 mi ab Walker Cr. to S. Fk. Catawba R.	1.7	SR 1008, Lincoln	30835	PS					G-F		fecal,turb	NP,P	urban	PS	M
Maiden Creek	From source to 0.7 mile upstream from backwaters of Maiden Reservoir	4.5	SR 1858, Catawba	30835		G									FS	M

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
Maiden Creek	From 0.7 mile upstream from backwaters of Maiden Reservoir to dam at Maiden Reservoir	0.7		30835	lakes							sed, hi P,NOx,lo secchi	NP		ST	M
Maiden Creek	From dam at Maiden Reservore located 680 feet more or less upstream from the bridge on Catawba co SR 1810 to Pinch Gut Creek	1.5	SR 1810, Catawba	30835		G									FS	M
Carpenter Creek	From source to Clark Creek/NC-301	3.1	US 301, Lincoln	30835			G								FS	M
Indian Creek	From source to 0.5 mile upstream of MIlle Creek	13.9		30835									NP	cattle	ST	ME
Indian Creek	From 0.5 mile upstream of Mill Cr to 0.4 mile upstream of mouth of Lick Fork	0.5		30835									NP	cattle, ag	ST	ME
Indian Creek	From 0.4 mile upstream of mouth of Lick Fork to 0.3 mi upstream of Lincoln Co. SR 1169	2.4		30835								fecal	NP	cattle, ag	ST	ME
Indian Creek	From 0.3 mi upstream of Lincoln Co. SR 1169 to South Fork Catawba R.	5.5	SR 1252, Lincoln	30835	ST					G	P	fecal	NP	cattle, ag	ST	M
South Fork Catawba River	Muddy Ck to Town of High Shoals water Supply Intake	0.5		30835									NP, P	Clark Cr.	ST	ME
South Fork Catawba River	water Supply Intake to 0.6 mile upstream of NC Hwy 275	8.1		30835									NP, P	Clark Cr.	ST	ME
Mauney Creek	From source to Hoyle Creek	4.3	ab and be SR 1831, Gaston	30835						F/F			NP,P	Stanley WWTP	PS	M
South Fork Catawba River	From 0.6 mile upstream of NC Hwy 275 to 0.4 mile upstream of Long Cr	2.2		30836									NP		ST	ME

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis
South Fork Catawba River	From 0.4 mile upstream of Long Cr. to Cramerton Dam & L. Wylie at Upper Armstrong Br.	10.3	a&b:NC 7; a:SR 2524, Gaston	30836	FS					G-F		sed	NP,P	Crompton&Knowles Colors	ST	M
Long Creek	From Source 0.7 mile upstream of Gaston Co SR 1408	2.7		30836											FS	ME
Limekiln Creek	From source to Long Creek	1.6	SR 1409 Gaston	30836						98:G					FS	M
Long Creek	From 0.7 mile upstream of Gaston Co SR 1408 to Mountain Cr	1.8	SR 1408, SR 1405 Gaston	30836				G					NP		FS	M
Long Creek	From Mountain Cr to SR 1456	6.4	NC 274, SR 1443, SR 1448, Gaston	30836			G	G/G/G					NP		FS	M
Long Creek	From SR 1456 to NC 275	0.7	SR 1456, Gaston	30836	ST					G-F		sed, fecal	NP	cattle	ST	M
Long Creek	Branch	4.5	NC 275, Gaston	30836				G				sed, fecal	NP	cattle	ST	ME
Catawba Creek	From SR 2446 to SR-2439, Gaston	2.9	SR 2439, Gaston	30837									NP,P	Gastonia WWTP, urban	NS	M
Catawba Creek	From SR 2439 to Lake Wylie	4.5	SR 2435, Gaston	30837						P			NP,P	cattle, urban	NS	M
Crowders Creek	From source to SR 1118	1.8	SR 1118, Gaston	30837									NP	urban	PS	ME
Crowders Creek	SR 1118 to SR 1125	1.7	SR 1125, Gaston	30837									NP	urban	PS	ME
Crowders Creek	Sr 1125 to SR1131	4.5	SR 1131, Gaston	30837									NP,P	urban, Lithium Corp	PS	ME
Crowders Creek	SR 1131 to SR 1108	4.2	SR 1108, Gaston	30837							P		NP	urban	PS	ME
Crowders Creek	SR 1108 to NC 321	1.4	NC 321, Gaston	30837								fecal	NP	urban	PS	ME
Crowders Creek	NC 321- SR 2424	1.4	SR 2424, Gaston	30837								fecal	P, NP	urban, CBR Resources	PS	ME
Crowders Creek	SR 2424 to NC/SC line	0.8	SC 564, York Co. SC	30837						F		fecal	P, NP	urban, CBR Resources	PS	M
Abernethy Creek	From source to Lithium Co. discharge	2.2	SR 1302, ab Lithium Co. discharge	30837		G-F							NP	urban	ST	M
Abernethy Creek	From Lithium Co. discharge to Crowders Ck	2.2	SR 1302, be Lithium Co. discharge	30837		G-F							NP	urban	ST	M
Waxhaw Creek	From source to NC/SC	16	SR 1103, Union	30838							G-F		NP,P	ag	ST	M

NOTES: See next page for key and comments

Stream name	Description	Miles	Sampling station location	Subbasin	CHEM 93-97	BENTHOS RATING 1993	1994	1995	1996	1997	FISH 1997	Problem parameter	Major source	Possible source*	Rating	Basis

NOTES

*"Ag" denotes agriculture, which could include row crops and animal operations. Where "cattle" is noted, cattle were observed on site at the time of sampling or the watershed hosts many cattle farms.

"Rating" = Use Support Rating

Where rating is given, but no monitoring data are noted, data from an adjacent stream segment are used to give rating.

"Non-urban development" is residential and/or commercial development outside urban areas.

ABBREVIATION KEY

E = Excellent

G = Good

G-F = Good-fair

F = Fair

P = Poor (Benthos/fish ratings)

P = Point Source Pollution (Major source)

NP = Non-point Source Pollution

M = Monitored

ME = Monitored-evaluated

FS = Fully Supporting

ST = Fully Supporting but Threatened

PS = Partially Supporting

NS = Not Supporting

Appendix IV

303(d) Listing
and
Reporting Methodology

YEAR 2000 DRAFT LIST OF 303(d) WATERS IN THE CATAWBA RIVER BASIN

What is the 303(d) List?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a list of waters not meeting water quality standards or which have impaired uses. Waters may be excluded from the list if existing control strategies for point and nonpoint source pollution will improve water quality to the point that standards or uses are being met. Listed waters must be prioritized, and a management strategy or total maximum daily load (TMDL) must subsequently be developed for all listed waters. This draft of the 303(d) list will be submitted to EPA for approval in the year 2000. The latest approved 303(d) list was published on May 15, 1998. A summary of the 303(d) process follows. More complete information can be obtained from *North Carolina's 1998 303(d) List* (DENR, 1998), which can be obtained by calling the Planning Branch of DWQ at (919) 733-5083.

303(d) List Development

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

Sources of Information

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

Listing Criteria

Waters whose use support ratings were not supporting (NS) or partially supporting (PS) based on monitored information in the 305(b) report were considered as initial candidates for the 303(d) list. Waters that were listed on the previously approved 303(d) list were evaluated and automatically included if the use support rating was NS, PS or not rated (NR).

Fish consumption advisory information was then reviewed to determine if other waters should be added to the list. Fish consumption advisories are no longer considered when determining use support since a fish advisory for mercury contamination in Bowfin was posted for the entire state in June 1997. While fish consumption advisories do indicate impairment, DWQ did not want to mask other causes and sources of impairment by having the entire state (or an entire basin) listed as impaired due to fish consumption advisories. However, DWQ believes that advisories on specific waters are cause to include the water on the 303(d) list; therefore, advisories other than

the statewide Bowfin posting were considered when developing North Carolina's 303(d) list. Waters listed due to fish consumption advisories may have overall ratings of fully supporting (FS) because fish advisories are not considered in the 305(b) use support process.

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

Assigning Priority

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

The prioritization process results in ratings of high, medium and low. Generally, waters rated with the highest priority are classified for water supply use, rated not supporting, and harbor an endangered species. Waters receiving a high priority are important natural resources for the State of North Carolina and generally serve significant human and ecological uses. High priority waters will be addressed first within their basin cycles when technically feasible. TMDLs are not possible where the pollutant(s) have yet to be identified. TMDLs cannot be attempted without flow data. Collecting physical/chemical data and accumulating flow data are milestones that must precede developing TMDLs of any priority.

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

Other priorities have also been assigned to waters. A monitor priority indicates that the waterbody is listed based on: 1) data older than 5 years; 2) biological impairment without an identified pollutant; or 3) biological impairment where the criteria used to originally rate the stream as impaired has been deemed inappropriate. Many low flow streams and swamp waters were rated as biologically impaired in the past using inappropriate criteria. These waters will be resampled and rated using specialized criteria currently in development. Until the updated rating criteria is finalized, these waters will continue to be rated NR and will stay on the 303(d) list. Further information on the monitoring approaches that have a monitor priority is provided in the next section.

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

Additional Guidance on Using the 303(d) List

The column headings in the 303(d) list refer to the following:

Class – The information in this column indicates the classification assigned to the particular waterbody. Stream classifications are based on the existing and anticipated best usage of the stream as determined through studies and information obtained at public hearings. The stream classifications are described in 15A NCAC 2B .0300.

Subbasin – The number in this column refers to the DWQ subbasin in which the waterbody is located. The NRCS 14-digit hydrologic units nest within the DWQ subbasins.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

1. Data that is greater than 5 years of age when use support assessment is done (denoted by RES in approach column).
2. Biological data collected within 5 years of use support assessment, but no cause of impairment has been identified (available chemical data show full use support denoted by PPI in approach column).
3. Freshwater biological criteria applied to swamp waters.

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

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

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

Appendix V

Other Recommendations

- **Catawba Riverkeeper Platform**
- **Mountain Island Lake Marine Commission**
- **Lake Wylie Marine Commission**
- **Mecklenburg County Department of Environmental Protection**

The Catawba River Basinwide Water Quality Management Plan Platform:

1. A minimum of a 100-foot buffer zone along the entire main stem of the Catawba River. A minimum of a 50-foot buffer zone along all tributaries of the Catawba River. Buffer zones should be composed of woody vegetation & include fines for the removal of natural vegetative buffers.

2. Mandatory use of best management practices within the basin for construction sites (including residential), urban areas (population >50,000) and agriculture.

3. A halt on new floodplain development, better protection of our remaining wetlands and the restoration of damaged or overdeveloped wetlands.

4. Mandatory nutrient control technology on all NPDES dischargers in the basin that discharge into watersheds of eutrophic impoundments.

5. A moratorium on all package treatment plants in the basin that discharge into watersheds of eutrophic impoundments.

6. Color standards for the Catawba River. Especially the South Fork of the Catawba River (nicknamed the "Rainbow River" because of dye discharges).

7. Better/more stringent enforcement of existing buffer zone and sediment/erosion control regulations in the basin.

8. A moratorium on all clear cutting in the Catawba Basin until buffer zones are established along tributaries of the Catawba River. Buffer zones in clear cut watersheds will help control sedimentation into waters of the Catawba.

9. Better enforcement, better enforcement, better enforcement!

Full Co-Sponsors of the Catawba River Platform

As of 3/4/99

NC Wildlife Federation
Dock Kornegay,
Executive Director,
NC Wildlife Federation
919/833-1923;
ncwf_dock@mindspring.com
1024 Washington Street,
PO Box 10626
Raleigh, NC 27605-0626

Catawba Waterfowl, Inc.
W. Edward Godwin, Jr.(Pres.)
Charlotte, NC

Conservation Council of NC
PO Box 12671
Raleigh, NC 27605
919-821-4455
We have posted it on our website
www.serve.com/ccnc/
John Runkle

Mecklenburg Audubon Society
Judy Walker, President
Charlotte, NC

Venture Program at UNC Charlotte
Dave Walsh, Kim Judy, Sandy Kohn,
Holly Luther, and Cathy Graham

Clean Water Fund of NC
Asheville, NC

Sierra Club
Central Peidmont Chapter
Charlotte, NC

Trout Unlimited
Rocky River Chapter
Harry Taylor

Oscar Penegar, Chairman
South Fork Catawba River
Task Force
Gaston County Quality of Natural
Resources Commission

Daniel Stowe Botanical Garden
BILL HILTON JR.
Director of Education & Research
6500 South New Hope Road
Belmont, North Carolina 28012
USA

Gaston Natural Resources
Conservation District
Board of Directors and Staff
1303 Cherryville Highway
Dallas, NC 28034
704-922-4181

Mountain Island Lake
Marine Commission
Charlotte, NC

Lake Wylie
Marine Commission
Charlotte, NC

Agricultural Resources Center
Allen Spalt, Director
PESTicide EDucation project
115 West Main Street
Carrboro, NC 27510
Ph.: 919/967-1886
FAX: 933-4465
E-mail: <aspalt@mindspring.com>
Visit ARC at:
http://sunsite.unc.edu/arc

Steve and Pat Cashion
Lake Wylie Lakekeepers

Rick Dove, Neuse Riverkeeper®
New Bern, NC

Neuse River Foundation,
Marion Smith, Ex. Dir.
New Bern, NC

Eno River Association
Wayne Cash, President
4419 Guess Road
Durham, NC 27712
919-477-4549
mailto:enofest@gte.net
http://www.geo.duke.edu/erahome.htm

Catherine and Woody Mitchell
Synergy Magazine
Charlotte, NC

CBM Environmental Services, Inc.
Catherine Ross, President
Charlotte, NC

Sierra Club
Western North Carolina Group
Asheville, NC

Dan Faris
6000 Rose Valley Dr.
Charlotte, N.C. 21210

Ron and Nancy Bryant, Charlotte, NC
Dr. John Brzorad, Charlotte, NC
John Carter, Mooresville, NC
Norah Dahlen Cornelius, NC
John Kelly, Kershaw County, SC
Dr. Dave Martin, Davidson, NC
HC Tony Martin, Mountain Island Lake, NC
Mary A. McDaniel, Charlotte, NC
Dr. Timothy Mead, UNCC, Charlotte, NC
Don Morris, Mountain Island Lake, NC
Dr. Reed Perkins, Queens College, Charlotte NC
Lisa Renstrom, Charlotte, NC
David Ward, Gaston County Commission, Gastonia, NC
Candace Warren Wilson, Charlotte, NC

Yadkin-Pee Dee Lakes Project
P.O. Box 338
Badin, NC 28009

Protect All Children's Environment
E.M.T. O'Nan
Director
2261 Buck Creek Road
Marion, NC 28752
Phone: (828) 724 4221
Fax: (828) 724 4177
Email: pace@mcdowell.main.nc.us
Web site:
http://www.main.nc.us/pace

Wateree Home Owners Association
Kershaw County, SC

Dr. Larry Barden, UNCC,
Charlotte, NC
Lawrence S. Barden, Dept. Biology, UNC-Charlotte, Charlotte, NC, 28223-0001
LSBarden@email.uncc.edu,
(704) 547-4059, FAX (704) 547-3128,
http://www.bioweb.uncc.edu/faculty/barden/index.htm

Shawn E. Smith
District Conservationist,
Natural Resource
Conservation Service
Gaston County
e-mail= shsmith@nc.usda.gov
phone=(704-922-3956)

Mecklenburg Bassmasters
Charlotte, NC

Sierra Club
South Mountains Group
Brenda Craig, Chair and
Connie Adams, Vice-Chair
Morganton, NC

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MAR 9 1999
WATER QUALITY
PLANNING BRANCH

Mountain Island Lake Marine Commission
Post Office Box 35008
Charlotte, NC 28235-5008
(704) 372-2416

March 4, 1999

Mr. Darlene Kucken
DENR - N.C. Division of Water Quality/Planning
Post Office Box 29535
Raleigh, NC 27626-0535

RE: Catawba River Basinwide Plan

Dear Darlene:

At its March 3, 1999 meeting the Mountain Island Lake Marine Commission approved the following comments to the Catawba River Basinwide Plan.

1. A minimum of 100-foot buffer zone along the entire main steam of the Catawba River. A minimum of a 50-foot zone along all tributaries of the Catawba River. Buffer zones should be comprised of woody vegetation and include fines for removal of natural vegetative buffers.
2. Mandatory use of best management practices within the basin for construction sites (including residential), urban areas with populations greater than 50,000 as determined by the N.C. Data Center, and agriculture.
3. A halt on new floodplain development, better protection of wetlands and restoration of damaged wetlands.
4. Mandatory nutrient control technology on all NPDES discharges in the basin that discharge into watersheds of eutrophic impoundments.
5. A moratorium on all package treatment plans that discharge into watersheds of eutrophic impoundments.
6. Color standards.
7. More effective enforcement of existing buffer zones, sediment and erosion control regulations including review of local programs by the State. This would be similar to the supervision that the State of North Carolina has over local government fiscal management.
8. Moratorium on all clear cutting in the Catawba Basin until such time as buffer zones are established along tributaries of the Catawba River.
9. More effective enforcement of water quality regulations.

Thank you for allowing us to comment on this issue. Please contact me at (704) 399-2282 or our Executive Director Michael McLaurin at (704) 348-2705 if you have questions or need additional information.

Sincerely,

Barbara Lockwood

Barbara Lockwood, Chair
Mountain Island Lake Marine Commission

THE LAKE WYLIE MARINE COMMISSION

POST OFFICE BOX 35008
CHARLOTTE, N.C. 28235

PHONE 372-2416
AREA CODE 704

May 7, 1999

Mr. Darlene Kucken
DENR - N.C. Division of Water Quality/Planning
Post Office Box 29535
Raleigh, NC 27626-0535

RE: Catawba River Basinwide Plan

Dear Darlene:

At its January 18, 1999 meeting, the Lake Wylie Marine Commission approved the following comments to the Catawba River Basinwide Plan.

1. A minimum of a 100-foot buffer zone along the entire main stream of the Catawba River. Currently York and Chester Counties, South Carolina are considering similar requirements. A minimum of a 50-foot zone along all tributaries of the Catawba River. The buffer zone should be comprised of woody vegetation and include fines for removal of natural vegetative buffers.
2. Mandatory use of best management practices within the basin for construction sites (including residential), urban areas with populations greater than 50,000 as determined by the N.C. Data Center, and agriculture.
3. A halt on new floodplain development, better protection of wetlands and restoration of damaged wetlands.
4. Mandatory nutrient control technology on all NPDES discharges in the basin that discharge into watershed of eutrophic impoundments.
5. A moratorium on all package treatment plans that discharge into watersheds of euthrophic impoundments.
6. Color standards
7. More effective enforcement of existing buffer zones, sediment and erosion control regulations including review of local programs by the State. This would be similar to the supervision that the State of North Carolina has over local government fiscal management.
8. Moratorium on all clear cutting in the Catawba Basin until such time as buffer zones are established along tributaries of the Catawba River.

1300 BAXTER STREET-CHARLOTTE, N.C. 28204

Thank you for allowing us to comment on this issue. Please contact me at (704) 348-2705 if you have questions or need additional information.

Sincerely,

Michael

Michael McLaurin
Executive Director

MECKLENBURG COUNTY
Department of Environmental Protection

March 1, 1999

Ms. Darlene Kucken
North Carolina Division of Water Quality
P.O. Box 29535
Raleigh, NC 27626

Subject: Catawba River Basinwide Water Quality Management Plan

Dear Ms. Kucken:

The Mecklenburg County Department of Environmental Protection (MCDEP) has reviewed and discussed the various water quality issues and concerns regarding the Catawba River Basin. Based upon our specific knowledge of the water quality within Mecklenburg County, MCDEP offers the following comments regarding the development of the 2000 Catawba River Basinwide Water Quality Management Plan:

- MCDEP, in conjunction with other local government entities in Mecklenburg County, has developed, approved, and begun implementation of Phase I of the Surface Water Improvement and Management (SWIM) Strategy. The ultimate objective of SWIM is to ensure that all surface waters in Mecklenburg County are suitable for prolonged human contact (see attached). SWIM Phase I has been fully funded with over $800,000 for FY 98-99. We would suggest that the State consider using SWIM as a possible resolution to the TMDL requirements for streams on the 303d list within Mecklenburg County. Since this plan is already in place, it would minimize work for the State and would prevent duplication of efforts.

- MCDEP strongly supports the use of vegetated undisturbed buffers to protect surface waters from pollutants. It is recommended that buffer requirements be implemented along the Catawba River and it's tributaries in an effort to help provide stream shading and reduce pollutant loads into the river. We would suggest using the SWIM buffer requirements, which were developed for Mecklenburg County, as a guideline for basinwide buffer requirements (see attached).

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- MCDEP has observed the impacts of nutrients on several streams and lake coves, and feels that actions should be taken now to prevent this same situation in other Catawba River reservoirs. We recommend that effluent nutrient limits be imposed on all major NPDES facilities in the basin, such as what has been implemented at the McDowell Creek Wastewater Treatment Plant by the Charlotte Mecklenburg Utilities.

- In the past, Mecklenburg County has experienced major flooding episodes. This flooding has resulted in significant property damage, environmental problems, and in some cases the loss of lives. MCDEP recommends that stricter floodplain development restrictions be imposed throughout the Catawba Basin as part of the buffer requirements, similar to floodplain mitigation efforts currently being implemented by Mecklenburg County Storm Water Services. Floodplains should be left in their natural state in order that they may function as flood storage and water quality buffers.

- Fecal Coliform bacteria is the primary pollutant in most Mecklenburg County streams. One of the primary sources of this pollutant is overflowing and leaking municipal sanitary sewer collection systems. MCDEP recommends the implementation of stricter requirements for maintenance of municipal sanitary sewer collection systems and increased enforcement in regards to sanitary sewer overflows.

- Over the past five (5) years, MCDEP has observed a significant lack of enforcement of drinking water supply watershed protection requirements. We recommend enhanced enforcement of these rules to include routine reviews of local programs to insure compliance with State minimum requirements.

- Storm water sampling data collected by MCDEP shows significant increases in pollutant loads in basins with a high percentage of impervious cover. We recommend the implementation of mandatory requirements for the construction of structural Best Management Practices (BMP's) in new developments. Some BMP's in Mecklenburg County have significantly reduced pollutant loads. We suggest the prohibition of any direct discharge of storm water to a water body without prior treatment by an approved BMP. Grassed swales, vegetated buffers, level spreaders or other BMP's may be approved, depending on the density and topography of the development.

- MCDEP has observed significant increases in stream pollutants such as Zinc, Lead, Copper, and Chromium during storm events. We have also observed storm water pollutants in extreme amounts at several industrial facilities in Mecklenburg County. MCDEP recommends the development and implementation of water quality standards for storm water. The development of such standards would provide the enforcement tool

needed to solve some of the non-point source problems in the basin.

Thank you for your continued efforts towards the protection of the Catawba River Basin. We appreciate this opportunity to comment on the development of the plan. Please feel free to give me a call if you have any questions or if we can be of any assistance to you.

Sincerely,

John M. Barry, Ph.D.
Director

dmc/JMB

cc: Don Willard, Rusty Rozzelle, David Caldwell- MCDEP
Wanda Towler- County Manager's Office
Barry Gullet- CMU
Dave Canaan- Mecklenburg Storm Water Services

Appendix VI

Catawba River Basin Nonpoint Source Program Description and Contacts

Appendix VI Catawba River Basin Nonpoint Source Program Descriptions and Contacts

Agriculture

USDA Natural Resources Conservation Service:

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

Area 1 Conservationist	Jacob Crandall	828-456-6341	PO Box 1109, Waynesville, NC 28786
Area 2 Conservationist	Darlene Angel	704-637-2400	600 West Innes Street, Salisbury, NC 28144
County	**Contact Person**	**Phone**	**Address**
Alexander	Daniel McClure	828-632-2708	255 Liledoun Road, Taylorsville, NC 28681
Avery	K. D. Cook	828-837-6417	225 Valley River Avenue, Murphy, NC 28906
Burke	Russell Lyday	828-439-9727	700 East Parker Road, Morganton, NC 28655
Caldwell	Russell Lyday	828-439-9727	700 East Parker Road, Morganton, NC 28655
Catawba	Richard Grant	828-464-1382	1175 South Brady Avenue, Newton, NC 28658
Gaston	Shawn Smith	704-922-3956	1303 Cherryville Hwy, Dallas, NC 28034
Iredell	Larry Hendrix	704-873-6761	201 Water Street, Statesville, NC 28677
Lincoln	Elton Barber	704-736-8501	115 Main Street, Lincolnton, NC 28092
McDowell	Russell Lyday	828-439-9727	700 East Parker Road, Morganton, NC 28655
Mecklenburg	Matthew Kinane	704-792-0400	715 Cabarrus Avenue West, Concord, NC 28027
Union	Phillip Loudermilk	704-289-3212	604 Lancaster Avenue, Monroe, NC 28112

Soil & Water Conservation Districts:

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

County	Board Chairman	Phone	Address
Alexander	Larry Payne	828-632-0638	255 Liledoun Road, Taylorsville, NC 28681
Avery	Edward Storey	828-733-2291	PO Box 190, Newland, NC 28657
Burke	Don Abernethy	828-439-9727	700 East Parker Road, Morganton, NC 28655
Caldwell	Boyd Wilson	828-758-1111	120 Hospital Avenue NE, Lenoir, NC 28645
Catawba	Charles Wike	828-465-8950	PO Box 389, Newton, NC 28658
Gaston	William Craig	704-922-4181	1303 Cherryville Hwy, Dallas, NC 28034
Iredell	Wade Carrigan	704-873-6761	201 Water Street, Statesville, NC 28677
Lincoln	Blair Goodson	704-736-8501	115 Main Street, Lincolnton, NC 28092
McDowell	C. A. Buckner	828-652-7121	15 North Garden Street, Marion, NC 28752
Mecklenburg	Owen Furuseth	704-336-2455	700 North Tryon Street, Charlotte, NC 28202
Union	Warren Case	704-289-3212	604 Lancaster Avenue, Monroe, NC 28112

Division of Soil and Water Conservation:

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

Central Office	Carroll Pierce	919-715-6110	Archdale Building, 512 N. Salisbury St. Raleigh, NC 27626
Asheville*	Jeff Young	828-251-6208	59 Woodfin Place, Asheville, NC 28801
Mooresville**	Rocky Durham	704-663-1699	919 North Main Street, Mooresville, NC 28115

NCDA Regional Agronomists:

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

Central Office	Tom Ellis	919-733-7125	PO Box 27647, Raleigh, NC 27611
Region 12	Lynn Howard	828-728-4675	604 Pine Mountain Road, Hudson, NC 28638
Region 14	Steven Dillon	828-453-0104	242 At East Acres Farm Road, Ellenboro, NC 28040

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	Lindsay Rogers	828-632-4451	255 Liledoun Road, Taylorsville, NC 28681
Avery	Michael Pitman	828-733-8270	PO Box 280, Newland, NC 28657
Burke	Reagan Ammons	828-439-4460	700 East Parker Road, Room 105, Morganton, NC 28655
Caldwell	Allen Caldwell	828-757-1290	120 Hospital Avenue NE , Lenoir, NC 28645
Catawba	Fred Miller	828-465-8240	PO Box 389, Newton, NC 28658
Gaston	Martha Burris	704-922-0301	PO Box 476, Dallas, NC 28034
Iredell	Kenneth Vaughn	704-873-0507	PO Box 311, Statesville, NC 28687
Lincoln	Kevin Starr	704-736-8452	115 West Main Street, Lincolnton, NC 28092
McDowell	Daniel Smith	828-652-7121	10 East Court Street, Marion, NC 28752
Mecklenburg	Deborah Crandall	704-336-2561	700 North Tryon Street, Charlotte, NC 28202
Union	Jerry Simpson	704-283-3801	500 North Main Street, Room 506, Monroe, NC 28112

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.

Districts 12	Howard Williams	704-827-7576	1933 Mountain Island Hwy, Mount Holly, NC 28120
Central Office	Moreland Gueth	919-733-2162	1616 Mail Service Center, Raleigh, NC 27699-1616

Construction/Mining

DENR Division of Land Resources:

Administers the NC Erosion and Sedimentation Control Program for construction and mining operations. Conducts land surveys and studies, produces maps, and protects the state's land and mineral resources.

Central Office	Mel Nevills	919-733-4574	512 North Salisbury Street, Raleigh, NC 27626
Asheville*	Richard Phillips	828-251-6208	59 Woodfin Place, Asheville, NC 28801
Mooresville**	Doug Miller	704-663-6040	919 North Main Street, Mooresville, NC 28115

Local Erosion and Sedimentation Control Ordinances:

Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances.

Avery County	Tommy Burelson	828-733-8204	PO Box 638, Newland, NC 28657
Cabarrus County	Tony Johnson	704-788-9835	PO Box 707, Concord, NC 28026
Mecklenburg County	Kia Whittlesey	704-336-7783	700 North Tryon Street, Charlotte, NC 28202

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	Alan Clark	919-733-5083 x570	1617 Mail Service Center, Raleigh, NC 27699-1617
Urban Stormwater	Bradley Bennett	919-733-5083 x525	1617 Mail Service Center, Raleigh, NC 27699-1617
Modeling	Ruth Swanek	919-733-5083 x503	1617 Mail Service Center, Raleigh, NC 27699-1617
Monitoring	Jimmie Overton	919-733-9960 x204	1621 Mail Service Center, Raleigh, NC 27699-1621
Wetlands	John Dorney	919-733-1786	1621 Mail Service Center, Raleigh, NC 27699-1621
Animal Operations	Dennis Ramsey	919-733-5083 x528	1617 Mail Service Center, Raleigh, NC 27699-1617
Classifications/Standards	Boyd DeVane	919-733-5083 x559	1617 Mail Service Center, Raleigh, NC 27699-1617

DWQ Regional Offices:

Conduct permitting and enforcement field work on point sources, stormwater, wetlands and animal operations; conduct enforcement on water quality violations of any kind; and perform ambient water quality monitoring.

Asheville Region*	Forrest Westall	828-251-6208	59 Woodfin Place, Asheville, NC 28801
Mooresville Region**	Rex Gleason	704-663-1699	919 North Main Street, Mooresville, NC 28115

Wildlife Resources Commission:

To manage, restore, develop, cultivate, conserve, protect and regulate the wildlife resources of the state; and to administer the laws enacted by the General Assembly relating to game, game and non-game freshwater fishes, and other wildlife resources in a sound, constructive, comprehensive, continuing and economical manner.

Central Office	Frank McBride	919-528-9886	PO Box 118, Northside, NC 27564
Central Office	David Cobb	919-733-7291	512 North Salisbury Street, Raleigh, NC 27604

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.

Asheville Field Office	Steve Chapin	828-271-4014	151 Patton Avenue, Room 143, Asheville, NC 28801

DWQ Groundwater Section:

Groundwater classifications and standards; enforcement of groundwater quality protection standards and cleanup requirements; review of permits for wastes discharged to groundwater; issuance of well construction permits; underground injection control; administration of the underground storage tank (UST) program (including the UST Trust Funds); well head protection program development; and ambient groundwater monitoring.

Central Office	Carl Bailey	919-733-3221	PO Box 29578, Raleigh, NC 27626-0578
Asheville*	Don Link	828-251-6208	59 Woodfin Place, Asheville, NC 28801
Mooresville**	Barbara Christian	704-663-1699	919 North Main Street, Mooresville, NC 28115

Solid Waste

DENR Division of Waste Management:

Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program -- Hazardous Waste, Solid Waste, Superfund and the Resident Inspectors Program.

Central Office	Brad Atkinson	919-733-0692	401 Oberlin Road, Suite 150, Raleigh, NC 27605
Asheville*	Jesse Wells	828-251-6208	59 Woodfin Place, Asheville, NC 28801
Mooresville**	Robert Krebs	704-663-1699	919 North Main Street, Mooresville, NC 28115

On-Site Wastewater Treatment

Division of Environmental Health and County Health Departments:

Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust.

Services include:

- Training of and delegation of authority to local environmental health specialists concerning on-site wastewater.
- Engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface.
- Technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.

Central Office	Steve Steinbeck	919-715-3273	2728 Capital Boulevard, Raleigh, NC 27604
Asheville*	James Boyer	828-251-6208	59 Woodfin Place, Asheville, NC 28801
County	**Primary Contact**	**Phone**	**Address**
Alexander	Shelley Carraway	828-632-9704	322 First Avenue SW, Taylorsville, NC 28681
Avery	Thomas Singleton	828-733-6031	PO Box 325, Newland, NC 28657
Burke	David Rust, Jr.	828-439-4400	PO Drawer 1266, Morganton, NC 28680
Caldwell	Douglas Urland	828-757-1200	1966-B Morganton Boulevard SW, Lenoir, NC 28645
Catawba	Barry Blick	828-326-5800	3070 11th Avenue SE, Hickory, NC 28602
Gaston	Bruce Parsons	704-853-5262	991 West Hudson Boulevard, Gastonia, NC 28052
Iredell	Raymond Rabe	704-878-5300	318 Turnersburg Hwy, Statesville, NC 28625
Lincoln	Margaret Dollar	704-736-8634	151 Sigmon Road, Lincolnton, NC 28092
McDowell	Joyce Sluder	828-652-6811	140 Spaulding Road, Marion, NC 28752
Mecklenburg	Peter Safer	704-336-4700	249 Billingsley Road, Charlotte, NC 28211
Union	Lorey White, Jr.	704-296-4800	1224 West Roosevelt Boulevard, Monroe, NC 28110

- **DENR Regional Offices involved**

* **Asheville Region Office covers the following counties:**

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

** **Mooresville Region Office covers the following counties:**

Alexander, Cabarrus, Catawba, Cleveland, Gaston, Iredell, Lincoln, Mecklenburg, Rowan, Stanly and Union

Appendix VII

Glossary of Terms and Acronyms

Glossary

30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The 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.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.

C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.
drainage area	An alternate name for a watershed.
DO	Dissolved oxygen.
DENR	Department of Environment and Natural Resources.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
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.
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.
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.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
MGD	Million Gallons Per Day.
NCIBI	North Carolina Index of Biotic Integrity. A measure of water quality factors affecting the fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.

NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
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.
Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.
PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.

river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins. These include the Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
ST	Fully supporting but threatened. A rating given to a waterbody that fully supports it designated uses, but has notable water quality problems.
sedimentation	The sinking and deposition of waterborne particles (e.g., sediment, algae and dead organisms).
silviculture	Care and cultivation of forest trees; forestry.
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of "blackwater" streams.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in

	the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses.
TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.
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 testing. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.

WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant.