HIWASSEE RIVER BASINWIDE WATER QUALITY PLAN

March 2002

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This document was approved and endorsed by the NC Environmental Management Commission on March 14, 2002 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 Hiwassee River basin. This plan is the first five-year update to the Hiwassee River Basinwide Water Quality Management Plan approved by the NC Environmental Management Commission in May 1997.

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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 (DWQ) 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 DWQ, 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 Hiwassee River basin was completed in 1997.

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

DWQ considered comments from one public workshop held in the basin and subsequent discussions with local resource agency staff and citizens during draft plan development. This input will help guide continuing DWQ activities in the basin.

Goals of the Basinwide Approach

The goals of DWQ's basinwide program are to:

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

Hiwassee River Basin Overview

The headwaters of the Hiwassee River basin originate in the mountains of northern Georgia and flow north through North Carolina before veering west into Tennessee to join the waters of the Tennessee River. The entire Hiwassee River watershed drains 2,700 square miles of land, much of which lies in the Chattahoochee (Georgia), Nantahala (North Carolina) and Cherokee (Tennessee) National Forests. In the North Carolina portion of the basin, the Hiwassee River and its two major tributaries, the Nottely and Valley Rivers, drain more than 400,000 acres (644 square miles) of Clay and Cherokee counties in the southwestern corner of the state. Water flow is regulated by the Tennessee Valley Authority (TVA) for flood control and the production of hydroelectric power via three impoundments: Chatuge Lake on the Georgia-North Carolina state

line near Hayesville; Hiwassee Lake near Murphy; and Apalachia Lake adjacent to the Tennessee border.

Almost 70 percent of the basin is forested, and only about three percent of land falls into the urban/built-up category. Over a 15-year period between 1982 and 1997, the amount of forest and cultivated cropland in the basin decreased significantly, while the amount of developed land more than doubled (+14,700 acres). Land used for pasture also increased over the 15-year time frame (+4,000 acres). Population of the basin, based on 2000 census data, is estimated to be 31,271. Population is expected to increase approximately 28 percent to 40,063 over the next twenty years. While the resident population may be fairly low, the basin experiences significant seasonal population fluctuations from recreation and tourist travel.

The Hiwassee River basin contains 72 plant and animal species that are endangered, threatened, of special concern, or considered significantly rare by the NC Natural Heritage Program. Twenty-five of these are aquatic, including several endemic species that rely on good water quality as well as the basin's unique ecological conditions.

Assessment of Water Quality in the Hiwassee River Basin

Surface waters are classified according to their best intended uses. Determining how well a waterbody supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality. Surface waters are rated *fully supporting* (FS), *partially supporting* (PS) or *not supporting* (NS). The ratings refer to whether the classified uses of the water (i.e., aquatic life protection, primary recreation and water supply) are being met. For example, waters classified for fish consumption, aquatic life protection and secondary recreation (Class C for freshwater) are rated FS if data used to determine use support meet certain criteria. However, if these criteria were not met, then the waters would be rated as PS or NS, depending on the degree of degradation. Waters rated PS or NS are considered to be impaired. Waters lacking data, having inconclusive data, or for which criteria have not been developed are listed as not rated (NR).

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

<u>Aquatic Life/Secondary Recreation</u>

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (967.6) and lake acres (10,847.8) in the North Carolina portion of the Hiwassee River basin. Approximately 21

percent of stream miles (204.3) and 100 percent of lake acres were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle. In this category, there are currently no impaired waters in the North Carolina portion of the Hiwassee River basin. A basinwide summary of current aquatic life/secondary recreation use support ratings is presented in Table 1.

Table 1 Aquatic Life/Secondary Recreation Use Support Summary Information for Waters in the Hiwassee River Basin (1999)

Aquatic Life/Secondary Recreation Use Support Ratings	**Monitored and Evaluated Waters***			**Monitored Waters Only****	
	Miles and Acres	**%**		**Miles and Acres**	**%**
Fully Supporting	**714.0 mi 10,847.8 ac**	**74% 100%**		**204.3 mi 10,847.8 ac**	**100% 100%**
Impaired	**0.0**	**0%**		**0.0**	
Partially Supporting	*0.0*			*0.0*	
Not Supporting	*0.0*			*0.0*	
Not Rated	**253.6 mi 0.0 ac**	**26%**		**0.0 mi 0.0 ac**	
TOTAL	**967.6 mi 10,847.8 ac**			**204.3 mi 10,847.8 ac**	

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

Fish Consumption

Like the aquatic life/secondary recreation use support category, fish consumption is also applied to all waters in the state. Fish consumption use support ratings are based on fish consumption advisories issued by the NC Department of Health and Human Services. Currently, there are no fish consumption advisories specific to the NC portion of the basin. Therefore, all waters are considered to be fully supporting the fish consumption category. No waters were monitored for fish consumption during this basinwide cycle because of the lack of any significant contaminant concerns in the Hiwassee River basin.

Primary Recreation

There are 30.3 stream miles and 10,847.8 lake acres currently classified for primary recreation (Class B) in the Hiwassee River basin. All (100 percent) were monitored by DWQ and the Tennessee Valley Authority over the past five years. Primary recreation use support ratings are based on swimming advisories issued by the NC Department of Health and Human Services (NCDHHS). Currently, there are no swimming advisories in the Hiwassee River basin and all waters classified for primary recreation are fully supporting. A basinwide summary of current use support ratings is presented in Table 2.

Table 2 Primary Recreation Use Support Summary Information for Waters in the Hiwassee River Basin (1999)

Primary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles	%		Miles	%
Fully Supporting	**30.3 mi 10,847.8 ac**	**100% 100%**		**30.3 mi 10,847.8 ac**	**100% 100%**
Impaired	**0.0 mi 0.0 ac**			**0.0 mi 0.0 ac**	
Not Rated	**0.0 mi 0.0 ac**			**0.0 mi 0.0 ac**	
TOTAL	**30.3 mi 10,847.8 ac**			**30.3 mi 10,847.8 ac**	

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

Water Supply

There are 163.3 stream miles currently classified for water supply in the Hiwassee River basin. Approximately 79 percent of stream miles (128.4) were monitored within the past five years; all are fully supporting the water supply use. A basinwide summary of current water supply use support ratings is presented in Table 3.

Table 3 Water Supply Use Support Summary Information for Waters in the Hiwassee River Basin (1999)

Water Supply Use Support Ratings	Monitored and Evaluated Streams*			Monitored Streamss Only**	
	Miles	%		Miles	%
Fully Supporting	**163.3**	**100%**		**128.4**	**100%**
Impaired	**0.0**			**0.0**	
Not Rated	**0.0**			**0.0**	
TOTAL	**163.3**			**128.4**	

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

Currently, there are no impaired waters in the North Carolina portion of the Hiwassee River basin.

Strategies for Addressing Notable Water Quality Impacts in Unimpaired Waters

Often during DWQ's use support assessment, water quality concerns are documented for waters that are fully supporting designated uses. While these waters are not considered impaired, attention and resources should be focused on these waters over the next basinwide planning cycle to prevent additional degradation or to facilitate water quality improvement. Waters with notable water quality concerns in the Hiwassee River basin include Town Creek, Shooting Creek, Little Brasstown Creek, Valley River and Nottely River.

The most pressing water quality concern for these streams and throughout the Hiwassee River basin is habitat degradation. Habitat degradation includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour. It is attributed to nonpoint source pollution. The primary sources of nonpoint source pollution in the Hiwassee River basin are runoff from construction sites, pasturelands, roads and developed areas. The task of quantifying nonpoint sources of pollution and developing management strategies for these waters is resource intensive. DWQ plans to notify local agencies and others of water quality concerns for these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding for these unimpaired waters.

Water Quality Improvement Initiatives in the Hiwassee River Basin

There are several initiatives in the Hiwassee River basin dedicated to improving and protecting water quality. The Hiawassee River Watershed Coalition is a nonprofit, grassroots organization made up of citizens from both Georgia and North Carolina, with a mission to improve water quality in the upper Hiwassee River basin. The Coalition received a grant for $2.1 million from the Clean Water Management Trust Fund in 1998 for restoration work in the Brasstown Creek watershed. The benthic macroinvertebrate bioclassification for Brasstown Creek improved from Fair in 1994 to Good in 1999. The Coalition is now turning its focus toward the Valley River watershed.

In 1998, the Hiwassee River Basin Nonpoint Source Team (made up primarily of local natural resource agency staff) chose projects in the Town Creek and Little Brasstown Creek watersheds to implement nonpoint source pollution demonstration projects using Section 319 funds. The Clay County school system has been a particularly committed participant in the Hiwassee River Basin Nonpoint Source Team.

Additionally, there is a federally initiated interagency team of natural resource professionals in the Hiwassee River basin. The Hiwassee Interagency Team is made up primarily of federal and state agency staff from North Carolina, Tennessee and Georgia. The team meets quarterly to discuss water quality concerns and improvement projects in the entire Hiwassee River basin. DWQ participates on this team and has found that it allows a good mechanism for coordination of monitoring and sharing of information.

Because local natural resource agency staff participate with each of these groups, there is opportunity for them to guide citizens toward real water quality improvement in the Hiwassee River basin. The work that these groups do then enhances daily agency program activities (such as work accomplished through the Ag Cost Share program or the Environmental Quality Incentives Program). DWQ is just one (often small) partner working to reduce nonpoint source pollution and improve water quality in this basin.

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 (DWQ) 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 water quality plan is a five-year process, which is broken down into three major phases as presented in Table A-2. While these plans are prepared by the Division of Water Quality, their implementation and the protection of water quality entails the coordinated efforts of many agencies, local governments and stakeholder groups in the state. The first cycle of plans was completed in 1998, but each plan is updated at five-year intervals.

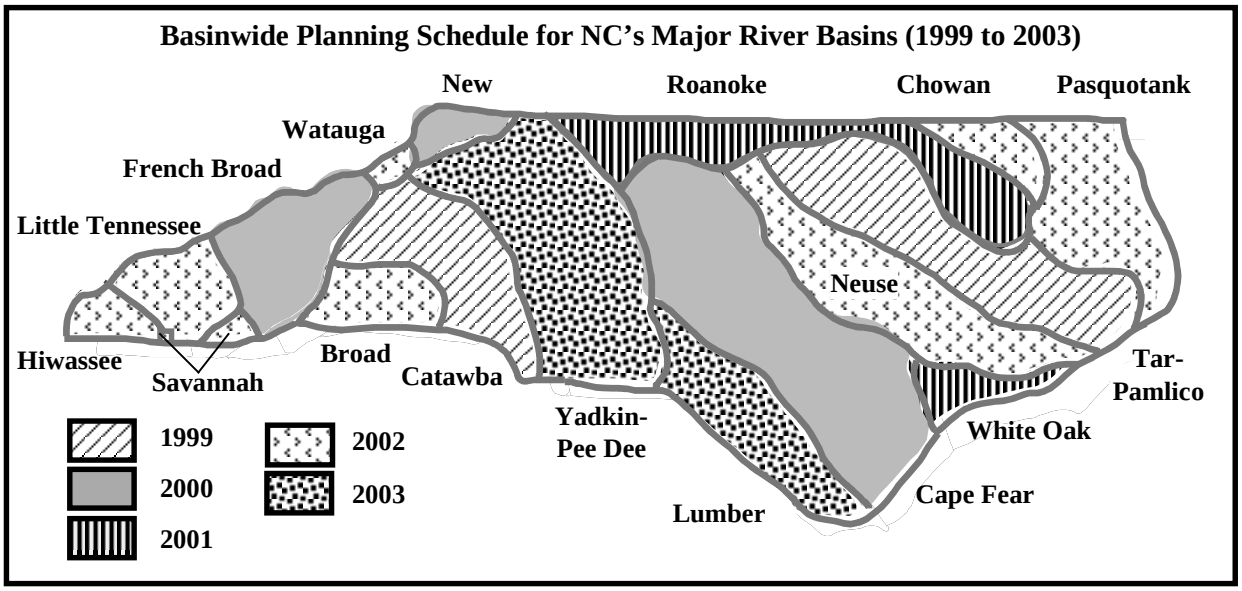

Figure A-1 Basinwide Planning Schedule (1999 to 2003)

1.2 Goals of Basinwide Water Quality Planning

The goals of basinwide planning are to:

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

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

Basin	DWQ Biological Data Collection	River Basin Public Workshops	Public Mtgs. and Draft Out For Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Neuse	Summer 2000	6/2001	5/2002	7/2002	1/2003
Lumber	Summer 2001	12/2002	9/2003	12/2003	7/2004
Tar-Pamlico	Summer 97	6/1998	4/1999	7/1999	1/2000
Catawba	Summer 97	2/1999	10/1999	12/1999	3/2000
French Broad	Summer 97	5/1999	2/2000	5/2000	8/2000
New	Summer 98	6/1999	4/2000	7/2000	11/2000
Cape Fear	Summer 98	7/1999	4/2000	7/2000	12/2000
Roanoke	Summer 99	4/2000	2/2001	7/2001	1/2002
White Oak	Summer 99	10/2000	7/2001	9/2001	6/2002
Savannah	Summer 99	10/2000	12/2001	3/2002	8/2002
Watauga	Summer 99	10/2000	12/2001	2/2002	9/2002
Little Tennessee	Summer 99	3/2001	12/2001	4/2002	10/2002
Hiwassee	**Summer 99**	**10/2000**	**12/2001**	**3/2002**	**8/2002**
Chowan	Summer 2000	3/2001	3/2002	7/2002	11/2002
Pasquotank	Summer 2000	3/2001	3/2002	7/2002	12/2002
Broad	Summer 2000	11/2001	9/2002	12/2002	7/2003
Yadkin Pee-Dee	Summer 2001	4/2002	12/2002	3/2003	9/2003

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

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

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

1.3 Major Components of the Basinwide Plan

The second 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 was not 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 by federal, state and local agencies and corporate, citizen and academic efforts.
- Describes DWQ goals and initiatives beyond the five-year planning cycle for the basin.

1.4 Benefits of Basinwide Water Quality Planning

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

- *Improved efficiency.* The state's efforts and resources are focused on one river basin at a time.
- *Increased effectiveness.* The basinwide approach is in agreement with basic ecological principles.
- *Better consistency and equitability.* By clearly defining the program's long-term goals and approaches, basinwide plans encourage *consistent* decision-making on permits and water quality improvement strategies.
- *Increased public participation in the state's water quality protection programs*. The basinwide plans are an educational tool for increasing public involvement and awareness of water quality issues.
- *Increased integration of point and nonpoint source pollution assessment and controls*. Once waste loadings from both point and nonpoint sources are established, management strategies can be developed to ensure compliance with water quality standards.

1.5 How to Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and other local stakeholders to participate in the planning process. DWQ offers three opportunities for the public to participate in the 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 planner for the river basin of interest.

1.6 Other References

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

- *Hiwassee River Basinwide Assessment Report*. April 2000. This technical report presents the physical, chemical and biological data in the Hiwassee River basin. 45 pp.
- *Hiwassee River Basinwide Water Quality Management Plan*. May 1997. This first basinwide plan for the Hiwassee River basin presents water quality data, information and recommended management strategies for the first five-year cycle. 250 pp.
- *A Citizen's Guide to Water Quality Management in North Carolina*. August 2000. This document includes general information about water quality issues and programs to address these issues. It is intended to be an informational document on water quality. 156 pages.
- *NC Basinwide Wetlands and Riparian Restoration Plan for the Hiwassee River Basin*. August 1998. DWQ NC Wetlands Restoration Program. Raleigh, NC.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description*. Creager, C.S. and J.P. Baker. 1991. DWQ Water Quality Section. Raleigh, NC.
- NC Division of Water Quality Basinwide Planning website at http://h2o.enr.state.nc.us/. Click on Water Quality Section and then, under Programs, click on Basinwide Planning Program.
- NC Division of Water Quality Environmental Sciences Branch website at http://www.esb.enr.state.nc.us/.

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

1.7 Division of Water Quality Functions and Locations

The major activities coordinated by DWQ through basinwide planning are listed in Figure A-2. Information on the location, address and phone numbers for each branch and regional office are also shown in Figure A-2 and Figure A-3. Additional information can be found on the Division of Water Quality website at http://h2o.enr.state.nc.us/.

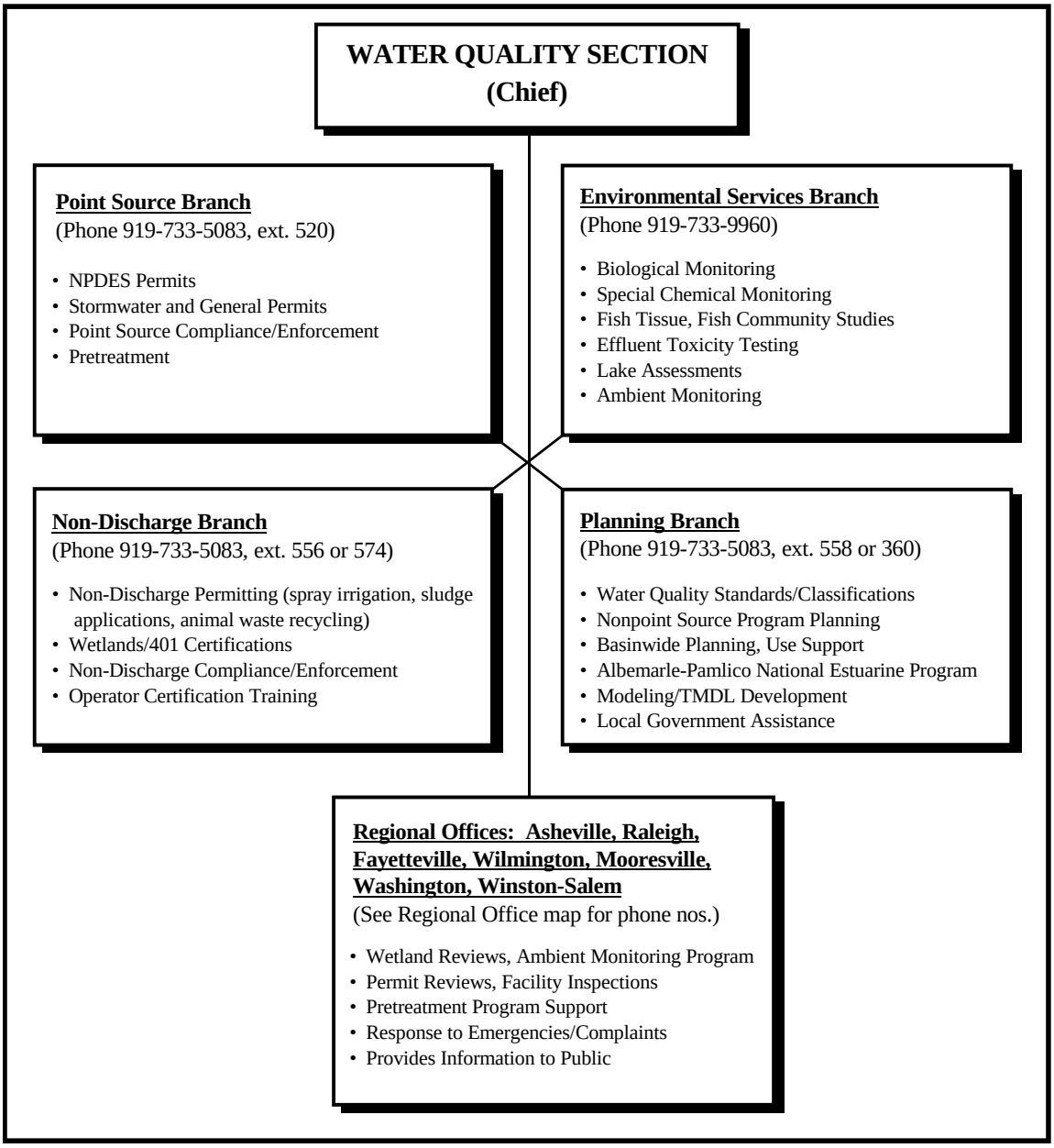

Figure A-2 Water Quality Section Organization Structure

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Figure A-3 Division of Water Quality Regional Offices

Chapter 2 -
Basin Overview

2.1 General Overview

The headwaters of the Hiwassee River basin originate in the mountains of northern Georgia and flow north through North Carolina before veering west into Tennessee to join the waters of the Tennessee River. Water from the Tennessee River flows to the Gulf of Mexico via the Ohio and Mississippi Rivers (Figure A-4). The entire Hiwassee River watershed drains 2,700 square miles of land, much of which lies in the Chattahoochee (Georgia), Nantahala (North Carolina) and Cherokee (Tennessee) National Forests. In the North Carolina portion of the basin, the Hiwassee River and its two major tributaries, the Nottely and Valley Rivers, drain more than 400,000 acres (644 square miles) of Clay and Cherokee counties in the southwestern corner of the state (Figure A-5).

Hiwassee River Basin Statistics

Total Area: 644 mi^2
Stream Miles: 967.6
No. of Counties: 2
No. of Municipalities: 3
No. of Subbasins: 2
Population (2000): 31,271*
Estimated Pop. (2020): 40,063*
% Increase (2000-2020): 28.1%
Pop. Density (1990): 43 persons/sq. mi.

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

The Hiwassee River's name is derived from "Ayuhwasi", a Cherokee word that signifies a savanna or meadow. This name also referred to at least two important Cherokee settlements, one in Tennessee and the other at the confluence of Peachtree Creek and the Hiwassee River near Murphy (Ellison, November 1999). Water flow is regulated by the Tennessee Valley Authority (TVA) for flood control and the production of hydroelectric power via three impoundments: Chatuge Lake on the Georgia-North Carolina state line near Hayesville; Hiwassee Lake near Murphy; and Apalachia Lake adjacent to the Tennessee border.

Population of the basin, based on 2000 census data, is estimated to be 31,271. Population is expected to increase approximately 28 percent to 40,063 over the next twenty years. While the resident population may be fairly low, the basin experiences significant seasonal population fluctuations from recreation and tourist travel. There are two counties and three municipalities located wholly or partly within the basin in North Carolina.

Almost 70 percent of the basin is forested, and only about three percent of land falls into the urban/built-up category. Over a 15-year period between 1982 and 1997, the amount of forest and cultivated cropland in the basin decreased significantly, while the amount of developed land more than doubled (+14,700 acres). Land used for pasture also increased over the 15-year time frame (+4,000 acres).

The Hiwassee River basin contains 72 plant and animal species that are endangered, threatened, of special concern, or considered significantly rare by the NC Natural Heritage Program. Twenty-five of these are aquatic, including several endemic species that rely on good water quality as well as the basin's unique ecological conditions.

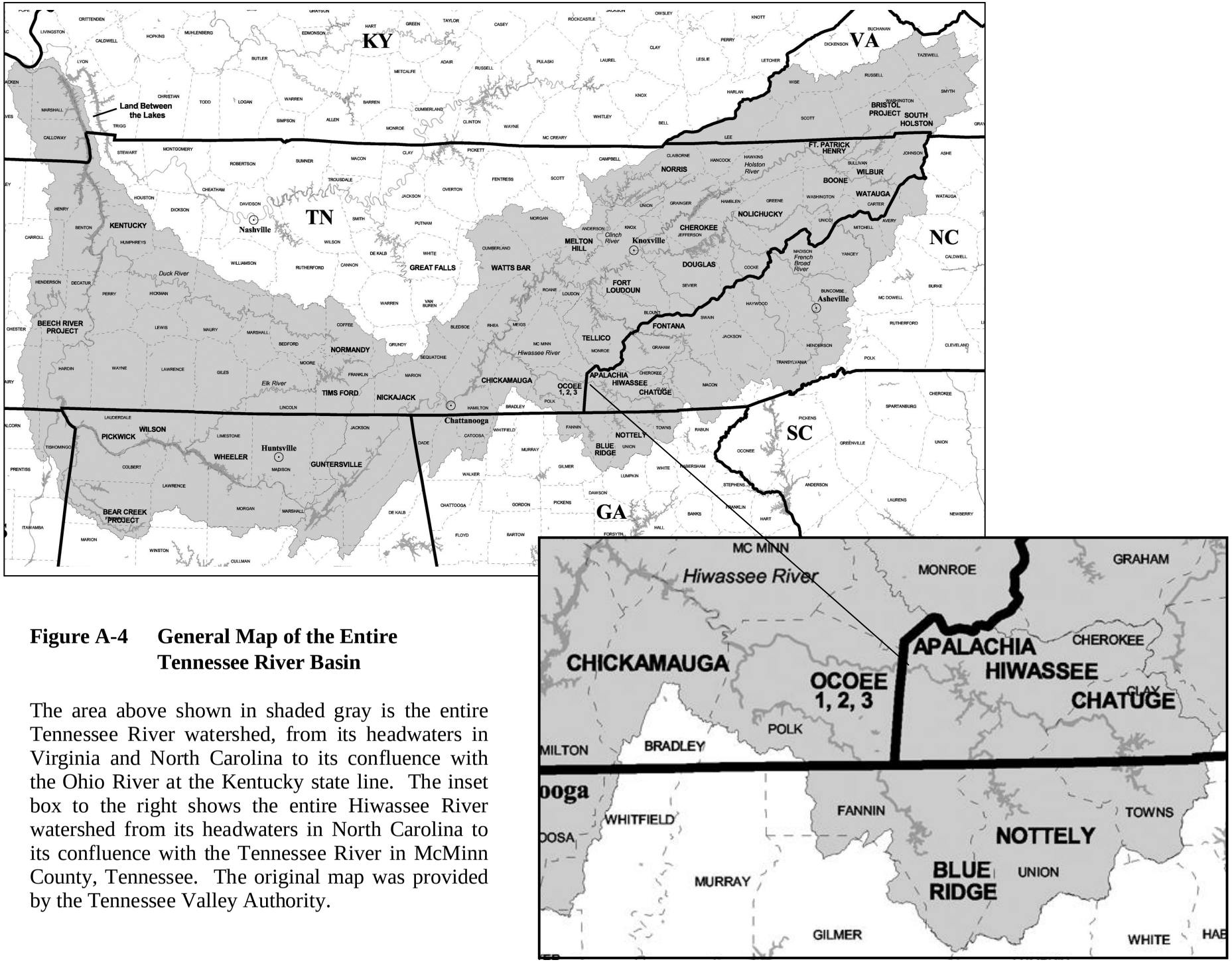
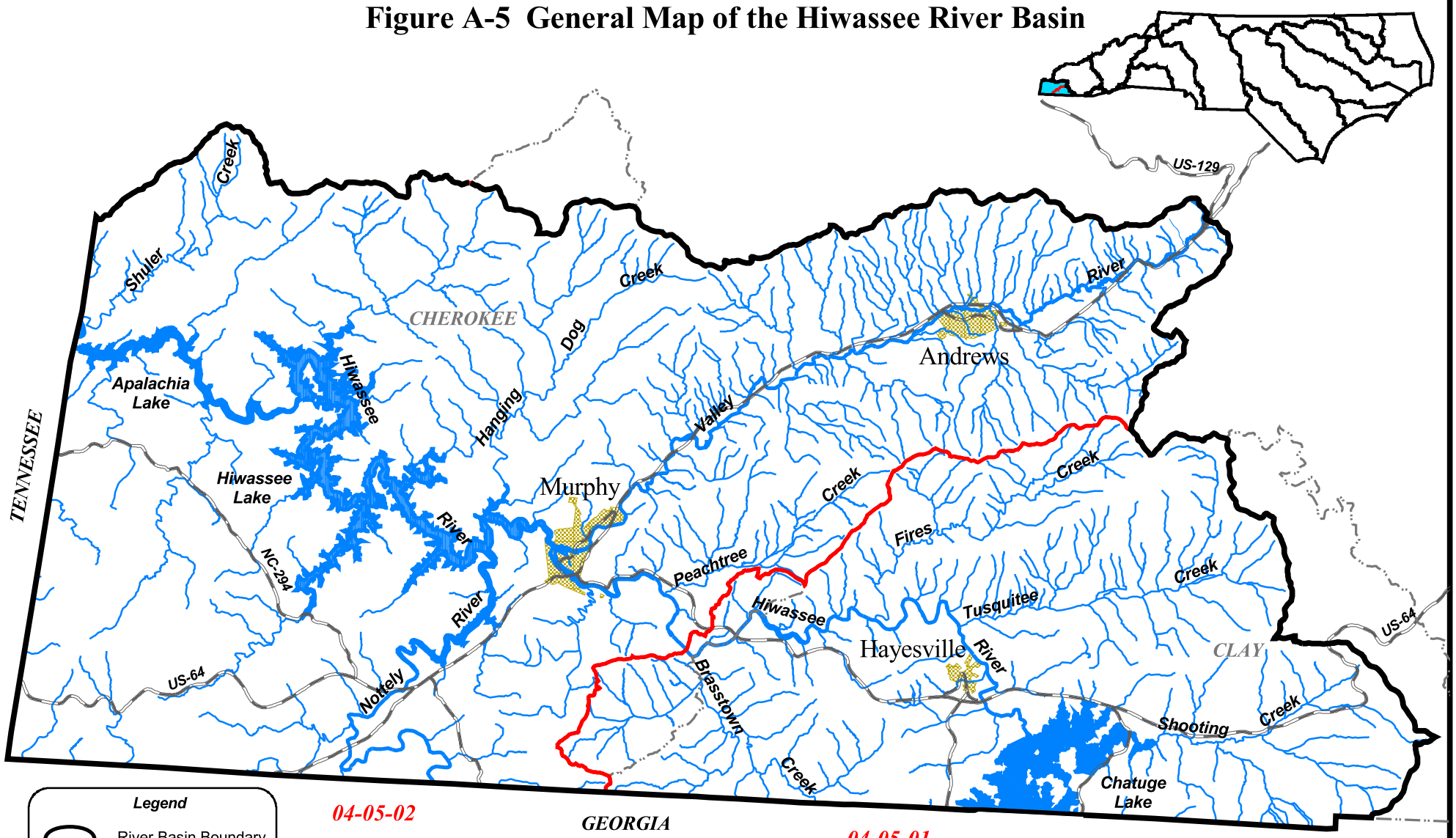


Figure A-4 General Map of the Entire Tennessee River Basin

The area above shown in shaded gray is the entire Tennessee River watershed, from its headwaters in Virginia and North Carolina to its confluence with the Ohio River at the Kentucky state line. The inset box to the right shows the entire Hiwassee River watershed from its headwaters in North Carolina to its confluence with the Tennessee River in McMinn County, Tennessee. The original map was provided by the Tennessee Valley Authority.

Figure A-5 General Map of the Hiwassee River Basin



NCDENR

Planning Branch
Basinwide & Estuary Planning Unit
October 23, 2001

2.2 Local Governments and Planning Jurisdictions in the Basin

The basin encompasses all or part of the following two counties and three municipalities (Table A-3). Both counties are included within the Southwestern Commission Council of Governments (Region A) located in Bryson City (http://www.regiona.org/).

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

County	Municipalities
Cherokee	Murphy and Andrews
Clay	Hayesville

Note: Counties adjacent to and sharing a border with a river basin are not included as part of that basin if only a trace amount of the county (<2%) is located in that basin, unless a municipality is located in that county.

2.3 Surface Water Hydrology

Most federal government agencies, including the US Geological Survey and the 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 Hiwassee River basin is made up of two hydrologic areas referred to as hydrologic units. DWQ has a two-tiered system in which the state is divided into 17 major river basins with each basin further subdivided into subbasins. Table A-4 compares the two systems. The Hiwassee River basin is subdivided by DWQ into two subbasins (shown on Figure A-5). Maps of each subbasin are included in Section B of this plan.

Table A-4 Hydrologic Subdivisions in the Hiwassee River Basin

Watershed Name and Major Tributaries	USGS 8-digit Hydrologic Units	DWQ 6-digit Subbasin Codes
Hiwassee River	06020002	04-05-01 and 04-05-02
Chatuge Lake		04-05-01
Hiwassee Lake, Apalachia Lake		04-05-02
Valley River, Nottely River		04-05-02
Ocoee Drainage	06020003	04-05-02

In this basin, 967.6 miles of freshwater streams drain 644 square miles in portions of Clay and Cherokee counties. The basin is located entirely within the Blue Ridge physiographic province. The NC Blue Ridge Province is a mountainous area of steep ridges, inter-mountain basins and valleys that intersect at all angles. A larger number of streams drain smaller areas of land in this region compared with the piedmont and coastal plain portions of the state.

Hydrologic Features

Water flow in the Hiwassee River basin is regulated by the Tennessee Valley Authority (TVA) for flood control and the production of hydroelectric power via three man-made reservoirs: Chatuge Lake on the Georgia-North Carolina state line near Hayesville; Hiwassee Lake northwest of Murphy; and Apalachia Lake adjacent to the Tennessee border. Hiwassee Lake is one of 16 lakes selected by DWQ throughout the state as representative of minimally impacted lakes. Apalachia Lake, located immediately downstream of Hiwassee Lake, is a run-of-the-river reservoir located almost entirely within the Nantahala National Forest. Table A-5 outlines surface area, average depth and watershed area for each of these reservoirs.

Table A-5 Statistics for Major Lakes (Entire Size Calculations) in the Hiwassee River Basin

Subbasin/ Lake	County	Classification	Surface Area (ac)	Mean Depth (ft)	Watershed (mi^2)	Retention Time (days)
04-05-01						
Chatuge Lake	Clay	B	6,950	36	187	260
04-05-02						
Hiwassee Lake	Cherokee	B, C	6,275	154	968	116
Apalachia Lake	Cherokee	B, C	1,100	59	1,006	12

Despite its location near an area of the state that receives the highest amount of annual rainfall, the Hiwassee River basin has only two significant waterfalls. These are the Leatherwood Falls (Fires Creek Wildlife Management Area of the Nantahala National Forest) in Clay County and the falls on the Tellico River (Nantahala National Forest) in Cherokee County. Although the mountain slopes are steep, the river valleys are broad. Therefore, by the time the flow of these streams is large enough to create waterfalls, they begin to fan out into the valley below. This pattern of topography, in addition to more resistant rock types, explains the low abundance of waterfalls (Adams, 1994).

2.4 Land Cover

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

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

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

Table A-6 summarizes acreage and percentage of land cover from the 1997 NRI for the North Carolina portion of the basin, as defined by the USGS 8-digit hydrologic units. Data from 1982 are also provided for a comparison of change over 15 years. During this period, the amount of forest (-12,900 acres) and cultivated cropland (-6,500 acres) in the basin decreased significantly, while the amount of developed land more than doubled (+14,700 acres). Land used for pasture also increased over the 15-year time frame (+4,800 acres). Figure A-6 presents these land cover changes. Descriptions of land cover types identified by the NRI are found in Table A-7.

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

	MAJOR WATERSHED AREAS *								
	Hiwassee River Watershed		Ocoee Watershed		1997 TOTALS		1982 TOTALS		% change
LAND COVER	Acres (1000s)	%	Acres (1000s)	%	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	since 1982
Cult. Crop	1.8	0.4	0.0	0.0	1.8	0.4	8.4	2.0	-78.6
Uncult. Crop	1.9	0.5	0.0	0.0	1.9	0.5	2.3	0.6	-17.4
Pasture	25.7	6.3	1.2	15.6	26.9	6.5	22.1	5.3	21.7
Forest	147.7	36.3	5.9	76.6	153.6	37.1	166.5	40.2	-7.7
Urban & Built-Up	23.9	5.9	0.4	5.2	24.3	5.9	12.1	2.9	100.8
Federal	188.3	46.3	0.0	0.0	188.3	45.5	185.5	44.8	1.5
Other	17.3	4.3	0.2	2.6	17.5	4.2	17.4	4.2	0.6
Totals	406.6	100.0	7.7	100.0	414.3	100.0	414.3	100.0	
% of Total Basin		98.1		1.9		100.0			
SUBBASINS	04-05-01 04-05-02		04-05-02						
8-Digit Hydraulic Units	06020002		06020003						

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

Source: USDA, Soil Conservation Service - 1982 and 1997 NRI

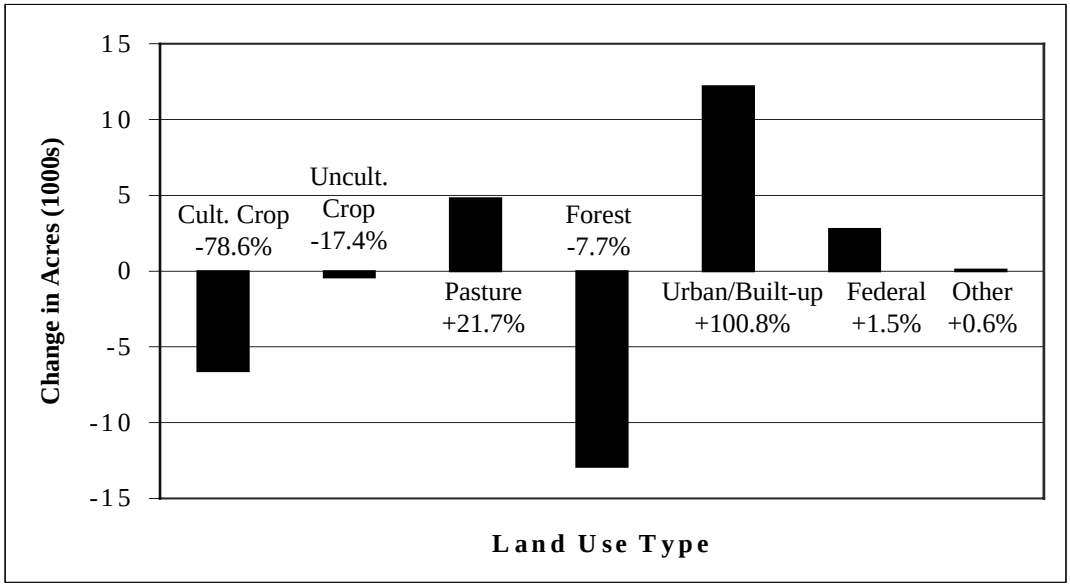


Figure A-6 Land Cover Changes from 1982 to 1997 for the Hiwassee River Basin (Source: USDA-NRCS, NRI, updated June 2001)

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

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

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

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

Table A-8 Description of Major CGIA Land Cover Categories

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

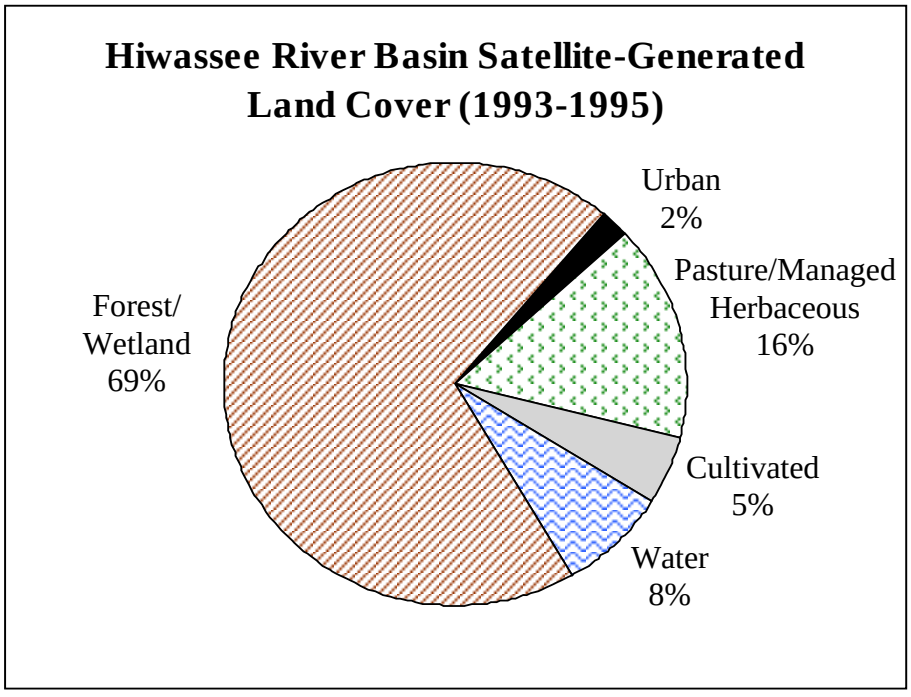


Figure A-7 Percentages within Major CGIA Land Cover Categories in the Hiwassee River Basin

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 1993-1995 data.

2.5 Population and Growth Trends

Population

Following the 1990 census, North Carolina population data were compared with subbasin boundaries in an attempt to better estimate actual river basin population. Based on this comparison, the Hiwassee River basin had an estimated population of 26,723. Table A-9 presents census data, by subbasin, for 1970, 1980 and 1990 census data.

In using these data, it should be noted that the census data are collected within boundaries such as counties and municipalities. By contrast, the subbasin lines are drawn along natural drainage divides separating watersheds. Therefore, where a census block group straddles a subbasin line, an estimate is made on the percentage of the population that is located in the subbasin. This was done by simply determining the percentage of the census block group area located in the subbasin and then taking that same percentage of the total census block group population and assigning it to the subbasin. Use of this method necessitates assuming that population density is evenly distributed throughout a census block group, which is not always the case. However, the level of error associated with this method is not expected to be significant for the purposes of this document. It is also important to note that the census block groups change every ten years, so comparisons between years must be considered approximate. This analysis to determine river basin population has not yet been conducted for the recently released 2000 census data.

Table A-9 also includes population densities (persons/square mile) based on the *land area* (excludes open water) for each subbasin. Most of the basin's population is located in subbasin 04-05-02 in and around the Murphy and Andrews areas.

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

	POPULATION [1] (Number of Persons)			POPULATION DENSITY [2] (Persons/Square Mile)			LAND AND WATER AREAS [3]			
							Total Land and Water Area		Water Area	Land Area
SUBBASIN	1970	1980	1990	1970	1980	1990	(Acres)	(Sq. Miles)	(Sq. Miles)	(Sq. Miles)
04-05-01	5,236	6,839	7,445	27	35	38	128,717	201	6	195
04-05-02	15,694	18,102	19,278	36	42	45	282,981	442	11	431
TOTALS	20,930	24,941	26,723	33	40	43	411,698	643	17	626

[1] Population estimated based on US census data and percentage of census block that falls within the subbasin.

[2] Population density based on land area only. Large wetlands (swamps) not included in area used to calculate density.

[3] Information generated by the NC Center for Geographic Information Analysis.

Growth Trends

Table A-10 presents population data for municipalities, located wholly or partially within the basin. The population of Andrews decreased significantly between 1990 and 2000 (-949 persons) to a population less than that recorded in 1980. Murphy's population decreased only slightly (-7 persons), while the population of Hayesville grew 6.5 percent (+18 persons). This information was obtained from the Office of State Planning (April and May 2001).

Table A-10 Population and Percent Change for Municipalities Located Wholly or Partly in the Basin

Municipality	County	Apr-80	Apr-90	Apr-2000	% Change (1980-1990)	% Change (1990-2000)
Andrews	Cherokee	1,621	2,551	1,602	57.4	-37.2
Hayesville	Clay	376	279	297	-25.8	6.5
Murphy	Cherokee	2,070	1,575	1,568	-23.9	-0.4

Table A-11 shows the projected population and percent change in growth between 2000 and 2020 for counties that are wholly or partly contained within the basin. Since river basin boundaries do not usually coincide with county boundaries, these numbers are not directly applicable to the Hiwassee River basin. Even though 98 percent of Cherokee County is contained within the basin, only 85 percent of Clay County is encompassed.

Table A-11 Past and Projected Population (1990, 2000, 2020) and Population Change by County

County	% of County in Basin*	1990	2000	1990-2000 Pop Change	Estimated Population 2020	Estimated Pop Change 2000-2020
Cherokee	98	20,170	24,298	4,128	31,053	6,755
Clay	85	7,155	8,775	1,620	11,331	2,556

* Source: North Carolina Center for Geographic Information and Analysis

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

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

2.6 Natural Resources

The Hiwassee River basin contains 72 plant and animal species that are endangered, threatened, of special concern, or considered significantly rare by the NC Natural Heritage Program. Twenty-five of these are aquatic, including several endemic species (found no other place in the world). Biologists note that the Hiwassee system is unique because, though technically located

in the Blue Ridge Province, it hosts some plants and animals that are usually associated with the Piedmont.

2.6.1 Rare Aquatic and Wetland-Dwelling Species

Table A-12 presents rare aquatic and wetland-dwelling species. This information was obtained from the NC Natural Heritage Program, Division of Parks and Recreation.

Table A-12 Rare Aquatic and Wetland-Dwelling Species (as of November 2000)

Major Taxon	Common Name	Scientific Name	State Status	Federal Status
fish	Sicklefin redhorse	*Moxostoma sp 1*	SR	FSC
fish	Olive darter	*Percina squamata*	SC	FSC
fish	Tangerine darter	*Percina aurantiaca*	WL	
fish	Sauger	*Stizostedion canadense*	SR	
invertebrate	Caddisfly (no common name)	*Helicopsyche paralimnella*	SR	FSC
invertebrate	Caddisfly (no common name)	*Matrioptila jeanae*	SR	
invertebrate	Caddisfly (no common name)	*Psilotreta frontalis*	SR	
invertebrate	Caddisfly (no common name)	*Psilotreta labida*	SR	
invertebrate	Caddisfly (no common name)	*Rhyacophila melita*	SR	
invertebrate	Caddisfly (no common name)	*Micrasema burksi*	SR	
invertebrate	Mayfly (no common name)	*Timpanoga lita*	SR	
invertebrate	Mayfly (no common name)	*Leptohyphes robacki*	SR	
invertebrate	Stonefly (no common name)	*Diploperla morgani*	SR	
invertebrate	Brown drake mayfly	*Litobrancha recurvata*	SR	
mussel	Littlewing pearlymussel	*Pegias fabula*	E	E
mussel	Tennessee heelsplitter	*Lasmigona holstonia*	E	FSC
mussel	Spike	*Elliptio dilatata*	SC	
mussel	Mountain creekshell	*Villosa vanuxemensis*	T	
mussel	Rainbow	*Villosa iris*	SC	
mussel	Tennessee clubshell	*Pleurobema oviforme*	SR	FSC
mussel	Wavy-rayed lampmussel	*Lampsilis fasciola*	SC	
crustacean	Hiwassee crayfish	*Cambarus hiawasseensis*	WL	
crustacean	Hiwassee headwaters crayfish	*Cambarus parrishi*	SR	FSC
snail	Knotty elimia	*Goniobasis interrupta*	E	
salamander	Hellbender	*Cryptobranchus alleganiensis*	SC	FSC
turtle	Bog turtle	*Clemmys muhlenbergii*	T	
turtle	Loggerhead musk turtle	*Sternotherus minor*	SC	
plant	Lichen (no common name)	*Hydrothyria venosa*	C	

Rare Species Listing Criteria

E =	Endangered (those species in danger of becoming extinct)
T =	Threatened (considered likely to become endangered within the foreseeable future)
C =	Candidate (very rare in North Carolina and likely to merit listing as endangered or threatened)
WL =	Watch List (declining populations, threats to populations, or inadequate information to assess its rarity in NC)
SR =	Significantly Rare (rare in North Carolina, but not yet officially listed as threatened or endangered)
SC =	Special Concern (have limited numbers in North Carolina and vulnerable populations in need of monitoring)
FSC =	Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)

The status of two aquatic species that were listed as significantly rare in the 1997 Basinwide Plan, the Hiwassee crayfish and the Tangerine darter, has been changed. Both species are now on the Watch List, and although the Watch List status is defined as a "species believed to be of conservation concern in the state because of scarcity, declining populations, threats to populations, or inadequacy of information to assess its rarity", the status is an increment above the previous designation of Significantly Rare. The Hiwassee crayfish, the Knotty Elimia and the Hiwassee headwaters crayfish are all endemic to the Hiwassee River basin, meaning they are found no other place in the world.

Freshwater Mussels

The number of mussels with rare state status in the Hiwassee River basin increased over the last five years from three to seven. Here, as in other river basins, freshwater mussels are one of the most threatened groups of species. A number of factors contribute to the decline of mussel populations. Mussels feed by filtering detritus, diatoms, phytoplankton and zooplankton out of the water. Sediment in the stream significantly affects mussels' ability to feed, and their sensitivity to other forms of pollution and habitat degradation also impact populations. Also, many mussels have an interesting aspect in their life history which involves parasitizing fish for larval development. Mussels have developed a clever method of attaching their larvae to the gills or fins of a specific fish species. The host fish provide a source of food and shelter while the mussels are in their most vulnerable stage of life. After the larvae have developed, they drop from the fish and metamorphose into juveniles. The survival of mussel populations is directly linked to the health and presence of certain fish species.

The Littlewing pearlymussel (state and federally Endangered), a small, chalky-white mussel, prefers to live in transition zones between riffles and pools in small to medium streams with low turbidity. The Tennessee heelsplitter (state Endangered and a federal Species Of Concern) generally prefers small streams. The Spike (state Special Concern) is found in a range of habitats, from small streams to large rivers and in substrates from sand to gravel and cobble.

The long-term survival of these Hiwassee mussel populations is questionable. The Littlewing pearlymussel has not been observed in the Hiwassee River basin for many years. The Tennessee heelsplitter was last observed in the Hiwassee River basin in 1991, but there are few previous records of the species. Although populations of Spikes are still found in the basin, they are susceptible to pollution, especially from sedimentation, which has a major impact on their populations.

Management Strategies for Federally Threatened and Endangered Species

Because the Littlewing pearlymussel is federally endangered, the watershed in which it was observed could be subject to a new rule (Administrative Code: 15A NCAC 02B .0110) requiring the development of a site-specific management strategy. The intent of the strategy would be to provide for maintenance and recovery of the water quality conditions required to sustain the species. As was mentioned previously, a number of factors can contribute to the decline of mussel populations. Therefore, the development of such a management strategy would be difficult. Implementation of the strategy could be even more complex. If it is determined that a management strategy should be developed for the watershed(s) in which the Littlewing pearlymussel is found, it would be accomplished during the next basinwide planning cycle for the Hiwassee River basin (2003-2007).

2.6.2 Significant Natural Heritage Areas in the Hiwassee River Basin

In addition to tracking the status of individual species, the North Carolina Natural Heritage Program identifies areas that have outstanding conservation value, either because they contain rare or endangered species, or because they provide an excellent, intact example of an ecological community which naturally occurs in the state. The Hiwassee River basin contains a number of unique natural areas, including several important aquatic and riparian areas, presented on Figure A-8 and discussed below.

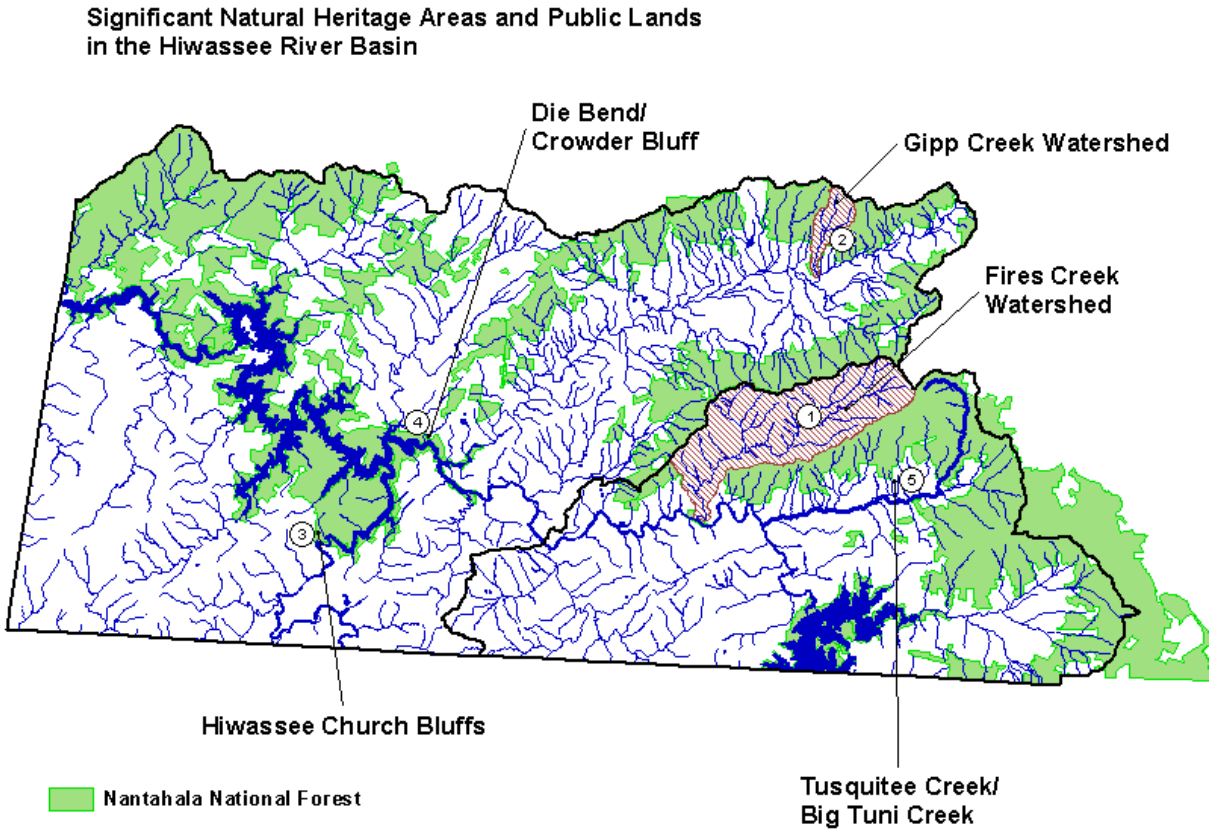


Figure A-8 Natural Heritage Areas and Public Lands in the Hiwassee River Basin

Fires Creek Watershed

The maturing forest of the Fires Creek watershed (Figure A-8) is considered significant because it is less fragmented than many remaining forest areas. The watershed is classified Outstanding Resource Waters, indicating excellent water quality as well as its unique ecological and protected status. Groups of semi-aquatic animals such as amphibians (frogs, toads, salamanders) require the overall damp nature of a forest throughout their life cycle, in addition to access to water for at least one stage of their lives. The Hiwassee River basin is home to a large number of amphibians, including one frog and five salamander species that are considered significantly rare or are of special concern.

Gipp Creek

The Gipp Creek watershed is a high quality aquatic community set in a rich cove forest. The stable slopes and abundant and mature vegetation of the understory provide a magnificent display of seasonal wildflowers, in addition to having a positive effect on water quality.

Hiwassee Church Bluffs

The Hiwassee Church Bluffs are rocky cliffs along the Hiwassee River that are not only scenic, but may represent migration corridors for plant species. This is one explanation for the occurrence of the terrestrial species prostrate eryngo (*Eryngium prostratum*) in the mountains, since it is generally distributed in the piedmont and coastal plain.

Die Bend/Crowder Bluff

The NC Natural Heritage Program has identified Die Bend/Crowder Bluff as a unique area because of the piedmont/mountain alluvial forest and floodplain pools found here. These areas contain an unusual mixture of piedmont and coastal plain species not typically found in the mountains of the Blue Ridge.

Tusquitee-Big Tuni Creek

Close to the Fires Creek watershed is the Tusquitee-Big Tuni Creek natural heritage area. Within the waters of Fires, Tusquitee and Big Tuni Creeks lives an outstanding assemblage of rare aquatic insects, including 10 species considered Significantly Rare in North Carolina (refer to Table A-11). Hellbenders are also found here.

Mountain Bogs

Less than 500 acres of mountain bogs exist within North Carolina, while the entire Appalachian Highlands (which includes the Appalachian Plateau, Ridge and Valley, and Blue Ridge provinces of Alabama, Georgia, Tennessee, North Carolina, Virginia and West Virginia) contain less than 6,175 acres (Moorhead and Rossell, 1998). Mountain bogs in North Carolina are generally small, isolated and rare wetlands largely concentrated in two areas: a band between Henderson and Clay counties in the southern mountains; and in Avery, Watuaga, Ashe and Alleghany counties in the northern mountains (Early, 1989).

North Carolina's mountain bogs host 77 species of rare, threatened or endangered plants such as the bunched arrowhead, swamp pink and Gray's lily. In addition to harboring important plant species, the state's mountain bogs also host five species of rare, threatened or endangered animals (Murdock, 1994), most notably the bog turtle (*Clemmys muhlenbergii*). Of the estimated 500 acres of mountain bogs in North Carolina, less than half support bog turtles (Herman, 1994).

Little research has investigated the hydrology of these bogs, but they may be found in four principle positions on the landscape: 1) headwater regions of mountain streams; 2) slopes intercepting the water table and subject to constant groundwater seepage; 3) stream valleys no longer subject to flooding; and 4) isolated systems over resistant rock strata (Walbridge, 1991; Weakley and Schafale, 1994). Although these wetlands are groundwater fed, technically called "fens" in classifications based on water source, they are locally known as bogs and have been called that in most publications within the state. The groundwater in fens tends to be acidic and nutrient poor, because of the rock and soil types it flows through. Groundwater in these areas of the Savannah River basin is less rich than is typical of most northern fens; therefore, the vegetation is more "bog-like" (Pohlman, September 2001).

Historically ditched and drained for farms, ponds and pastures, mountain bogs today are also imperiled by development activities. Active management of some mountain bogs has focused on protecting or enhancing habitat for bog turtles or rare plants (Moorhead and Rossell, 1998). Since many bogs are privately owned and not actively managed or protected (Weakley and Moorhead, 1991), educating landowners on the value and significance of mountain bogs is an important first step in their protection.

2.6.3 Public Lands in the Hiwassee River Basin

While there are no state parks in the Hiwassee River basin, the Nantahala National Forest (Tusquitee Ranger District) encompasses 134,730 acres, representing 32 percent of total land area in the basin (Figure A-8). Much of the public land is not connected; therefore, it is rare that an entire watershed falls within public ownership. The Fires Creek watershed is an exception where, other than a small amount of private property near the mouth, the US Forest Service (USFS) owns the entire watershed. Here, as well as in other significant natural areas that occur on National Forest land, the USFS has been asked to manage the land so as to protect the natural features that make this area unique.

2.7 Permitted Wastewater and Stormwater Discharge Facilities

Discharges that enter surface waters through a pipe, ditch or other well-defined point 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

The primary pollutants associated with point source discharges are:

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

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.

2.7.1 Wastewater Discharges in the Hiwassee River Basin

There are 11 permitted discharges in the Hiwassee River basin. Table A-13 provides summary information (by type and subbasin) about the discharges. Various types of dischargers listed in the table are described in the inset box. A list of all facilities can be found in Appendix I.

Type of Wastewater Discharge

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: Public facilities that serve a municipality. Can treat waste from homes and industries.

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

More than half of the NPDES permitted discharges in the Hiwassee River basin are from wastewater treatment plants serving communities and schools. Most of them are small facilities with less than one million gallons of flow per day. However, there are a few larger discharges as well. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter in Section B.

Figure A-9 shows the location of major and minor permitted wastewater discharges within the basin. The number of sites on the map depicting major discharges may differ from the number of major facilities listed in Table A-13. Since some major facilities have more than one outfall point, each outfall received a symbol on the map.

Table A-13 Summary of NPDES Dischargers and Permitted Flows for the Hiwassee River Basin (as of February 2001)

	Subbasin		
Facility Categories	**04-05-01**	**04-05-02**	**TOTAL**
Total Facilities	3	8	11
Total Permitted Flow (MGD)	0.1	2.5	2.6
Major Discharges	0	2	2
Total Permitted Flow (MGD)	0.0	2.4	2.4
Minor Discharges	3	6	9
Total Permitted Flow (MGD)	0.1	0.1	0.2
100% Domestic Waste	2	4	6
Total Permitted Flow (MGD)	0.1	0.1	0.2
Municipal Facilities	1	2	3
Total Permitted Flow (MGD)	0.1	2.4	2.5
Non-municipal Facilities	2	6	8
Total Permitted Flow (MGD)	0.02	0.1	0.12

2.7.2 Stormwater Discharges in the Hiwassee River Basin

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

The municipal permitting requirements are designed to lead into the formation of comprehensive stormwater management programs for municipal areas. No municipalities in the Hiwassee River basin were required to obtain a NPDES permit for stormwater sewer systems under the Phase I

EPA Stormwater Rules

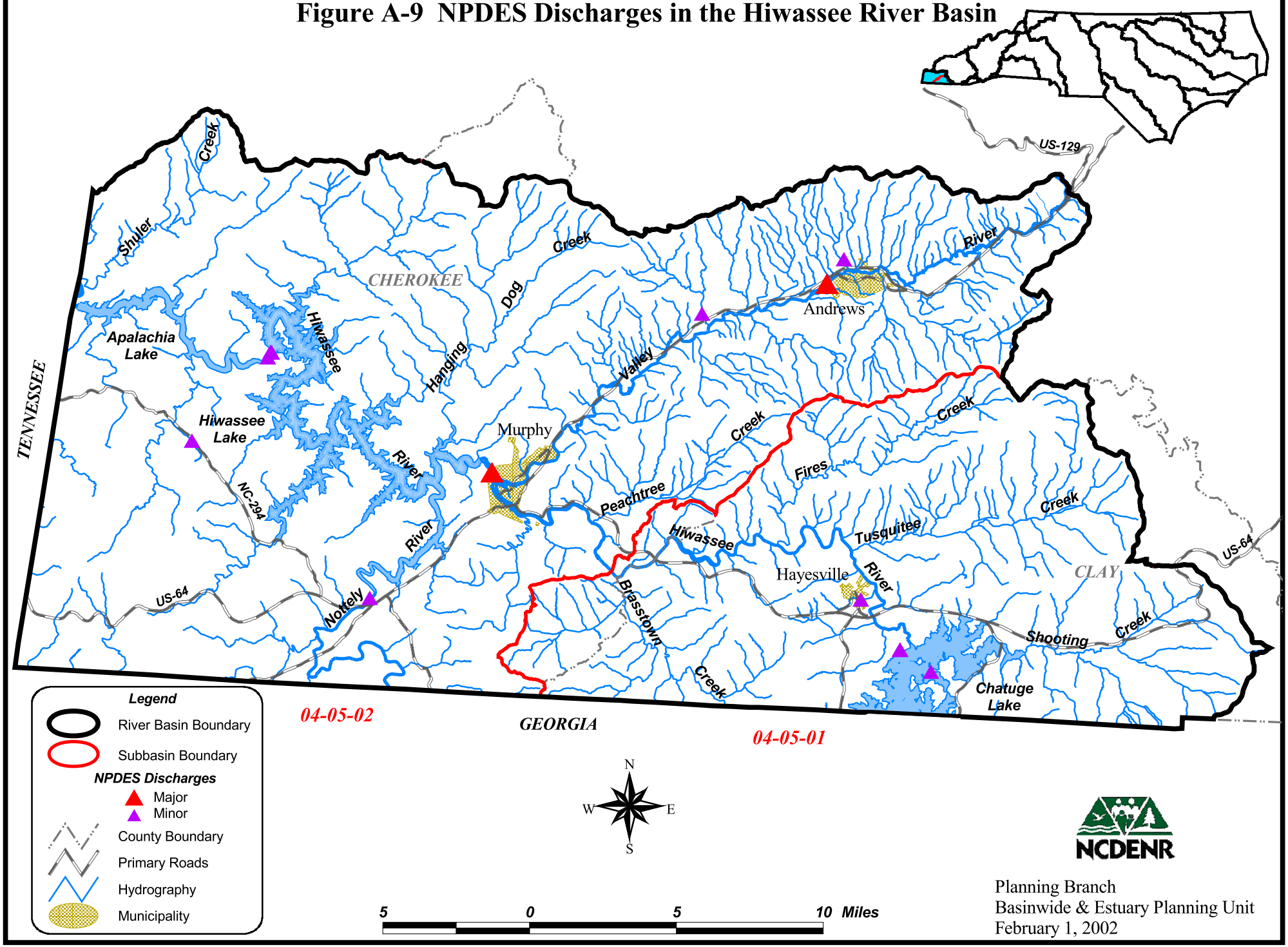
Phase I – December 1990

- Requires a NPDES permit for municipal separate storm sewer systems (MS4s) serving populations of 100,000 or more.
- Requires a NPDES stormwater permit for ten categories of industry.
- Requires a NPDES stormwater permit for construction sites that are 5 acres or more.

Phase II – December 1999

- Requires a NPDES permit for some municipal storm sewer systems serving populations under 100,000, located in urbanized areas.
- Provides a "no stormwater exposure" exemption to industrial facilities covered under Phase I.
- Requires a NPDES stormwater permit for construction sites that are larger than 1 acre.

Figure A-9 NPDES Discharges in the Hiwassee River Basin



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rules (population >100,000). Additionally, no municipalities in the basin are automatically required (US Census designated Urban Areas) to obtain a NPDES stormwater permit under the Phase II rules. DWQ is currently developing criteria that will be used to determine what local governments should be required to obtain a NPDES stormwater permit.

Industrial activities which require permitting are defined in categories ranging from sawmills and landfills to manufacturing plants and hazardous waste treatment, storage or disposal facilities. Stormwater permits are granted in the form of general permits (which cover a wide variety of more common activities) or individual permits. Excluding construction stormwater general permits, there are 18 general stormwater permits active within the Hiwassee River basin. Currently, there are no individual stormwater permits held in the basin.

The primary concern with runoff from industrial facilities is the contamination of stormwater from contact with exposed materials. 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 identified as having significant potential to impact water quality may also be required to conduct analytical monitoring to characterize pollutants in stormwater discharges.

The state stormwater management rules (15A NCAC 2H .1000) regulate development activities in 20 coastal counties and on lands statewide that drain to Outstanding Resource Waters (ORW) and/or High Quality Waters (HQW). Under this program, development is permitted as either low density or high density. Low density limits the impervious, or built upon, area on a project and allows natural infiltration and attenuation of stormwater runoff. High density requires installation and maintenance of structural best management practices to control and treat stormwater runoff from the site. Surface waters in the Hiwassee River basin where development activities are regulated under these special rules are presented on Figure A-11 (page 35).

2.8 Animal Operations

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

There are only two registered animal operations in the Hiwassee River basin, containing a total of 320 cattle (448,000 pounds Steady State Live Weight). There are no registered poultry and swine operations. Information on animal capacity by subbasin (Table A-14) was provided by the USDA for operations (registered and unregistered) in the Hiwassee River basin. A small percentage of the state's total capacity for dairy is found in the Hiwassee River basin. Overall, swine and dairy production in the Hiwassee River basin decreased from 1994 to 1998 while poultry production increased by four percent.

Table A-14 Estimated Populations of Swine, Dairy and Poultry in the Hiwassee River Basin (1998 and 1994)

Subbasin	Total Swine Capacity		Swine Change	Total Dairy Capacity		Dairy Change	Poultry Capacity		Poultry Change
	1998	1994	94-98 (%)	1998	1994	94-98 (%)	1998	1994	94-98 (%)
04-05-01	460	516	-11	403	546	-26	130,100	86,105	51
04-05-02	81	214	-62	625	736	-15	1,057,300	1,056,739	0
TOTALS	541	730	-26	1,028	1,282	-20	1,187,400	1,142,844	4
% of State Total	<1%	<1%		1%	1%		<1%	<1%	

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 in 1989 to assure that communities have an adequate supply of potable water for future needs. Under this statute, all units of local government that provide, or plan to provide, public water supply service are required to prepare a Local Water Supply Plan (LWSP) and to update that plan at least every five years. The information presented in a LWSP is an assessment of a water system's present and future water needs and its ability to meet those needs.

Surface water is used to meet 85 percent of overall water needs in the North Carolina portion of the Hiwassee River basin. In 1997, four public water systems used water from the basin, providing 1.8 million gallons per day to 9,070 people. Water demand from these public systems is projected to increase 40 percent by 2020. Two systems reported that by 2020 demand levels will exceed 80 percent of available supply.

Not everyone gets water from public water supply systems. Many households and farms supply their own water from both surface and groundwater sources in the basin. The US Geological Survey estimates that self-supplied users, excluding power-generating facilities, account for 86 percent of the total water used in the Hiwassee River basin. Water used for livestock and irrigation purposes comprises the majority of self-supplied water use in the basin (Figure A-10).

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

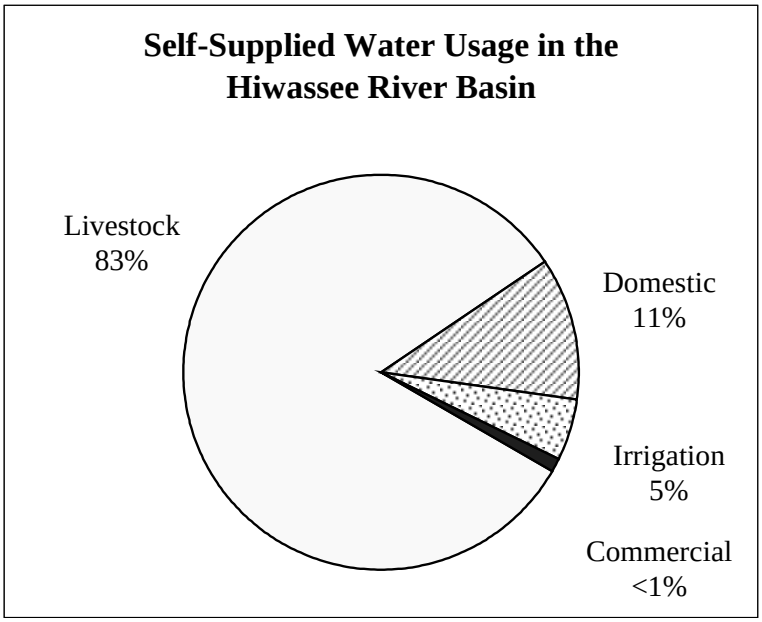


Figure A-10 Estimated Self-Supplied Water Use in the Hiwassee River Basin (Source: NCDENR-DWR, January 2001)

2.9.2 Water Withdrawals

Prior to 1999, North Carolina required water users to register their water withdrawals with the Division of Water Resources (DWR) only if the amount was 1,000,000 gallons or more of surface or groundwater per day. In 1999, the registration threshold for all water users except agriculture was lowered to 100,000 gallons per day. Table A-15 presents registered withdrawals.

Table A-15 Registered Water Withdrawals in the Hiwassee River Basin

County	1999 Average (MGD)	1999 Maximum (MGD)	Source of Withdrawal	Facility
Cherokee	0.027	0.076	Groundwater	Carolina Water Service – Bear Paw
Cherokee	0.864	0.864	Owl Creek	Craig's Trout Farm Inc.
Clay	0.005	0.010	Unnamed Stream	Harrison Construction – Hayesville Quarry
Cherokee	0	0	Unnamed Stream	Harrison Construction – Cherokee County Quarry

There are four registered water withdrawals in the North Carolina portion of the Hiwassee River basin. Three of these (75 percent) are surface water withdrawals. Excluding public water systems or power generating facilities, there is a cumulative permitted capacity to withdraw 874,000 gallons of surface water per day.

2.9.3 Interbasin Transfers

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

In determining whether a certificate should be issued, the state must determine that the overall benefits of a transfer outweigh the potential impacts. A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as supporting documentation for a transfer petition. Currently, there are no certified or known potential interbasin transfers in the Hiwassee River basin.

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 of Water Resources, in conjunction with the Wildlife Resources Commission, recommends conditions relating to the release of flows to satisfy minimum instream flow requirements. The permits are issued by the Division of Land Resources. Table A-16 summarizes minimum flow requirements in the Hiwassee River basin.

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

Name	Location	Waterbody	Drainage Area (sq. mi.)	Min. Release (cu.ft/sec)
Hydroelectric Dams:				
Chatuge Dam	Near the NC/GA state line near Hayesville, NC	Hiwassee River	187	83
Mission	Clay County near the Clay/Cherokee county line	Hiwassee River		280[1]
Hiwassee Dam	Cherokee county NW of Murphy below Beaverdam Cr.	Hiwassee River	968	
Apalachia Dam	Near the NC/TN state line	Hiwassee River	1,006	
Nottely Dam	In Georgia near the NC/GA state line	Nottely River		50

[1] If inflow is less than the specified minimum release, the release must be equal to the inflow. In other words, the project must operate in a run-of-river mode (i.e., instantaneous inflow equals instantaneous outflow) until the inflow becomes greater than the specified minimum release.

Hydroelectric Project Relicensing

As presented in Table A-16, there are five hydroelectric dams that affect streamflow and, to some extent, water quality in the Hiwassee River basin. The license issued by the Federal Energy Regulatory Commission (FERC) to the Nantahala Power and Light Division of Duke Energy for the operation of the Mission Project expires in 2005. During relicensing, Duke Energy will examine project operations and equipment technology to prevent deviations from the run-of-river mode during low flow events and project maintenance activities. Several other studies have also been proposed. For further information, visit the website at http://www.nantahalapower.com/relicensing/actionlist.html/.

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

3.1 General Sources of Pollution

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

Point Sources

Piped discharges from:

- Municipal wastewater treatment plants
- Industrial facilities
- Small package treatment plants
- Large urban and industrial stormwater systems

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

Nonpoint Sources

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

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

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

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

Cumulative Effects

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

3.2 Description of Surface Water Classifications and Standards

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

Surface Water Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table A-17 briefly describes the best uses of each classification. A full description is available in the document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*. Information on this subject is also available at DWQ's website: http://h2o.enr.state.nc.us/wqhome.html.

Table A-17 Primary and Supplemental Surface Water Classifications

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

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

Statewide Water Quality Standards

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

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

Trout Waters

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

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

High Quality Waters

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

Criteria for HQW Classification

- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native 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.
- 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. The low density option requires a 30-foot vegetated buffer between development activities and the stream; whereas, the high density option requires structural stormwater controls. In addition, the Division of Land Resources requires more stringent erosion controls for land-disturbing projects within one mile and draining to HQWs.

Outstanding Resource Waters

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

The ORW rule defines outstanding resource values as including one or more of the following:

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

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot buffer or 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.

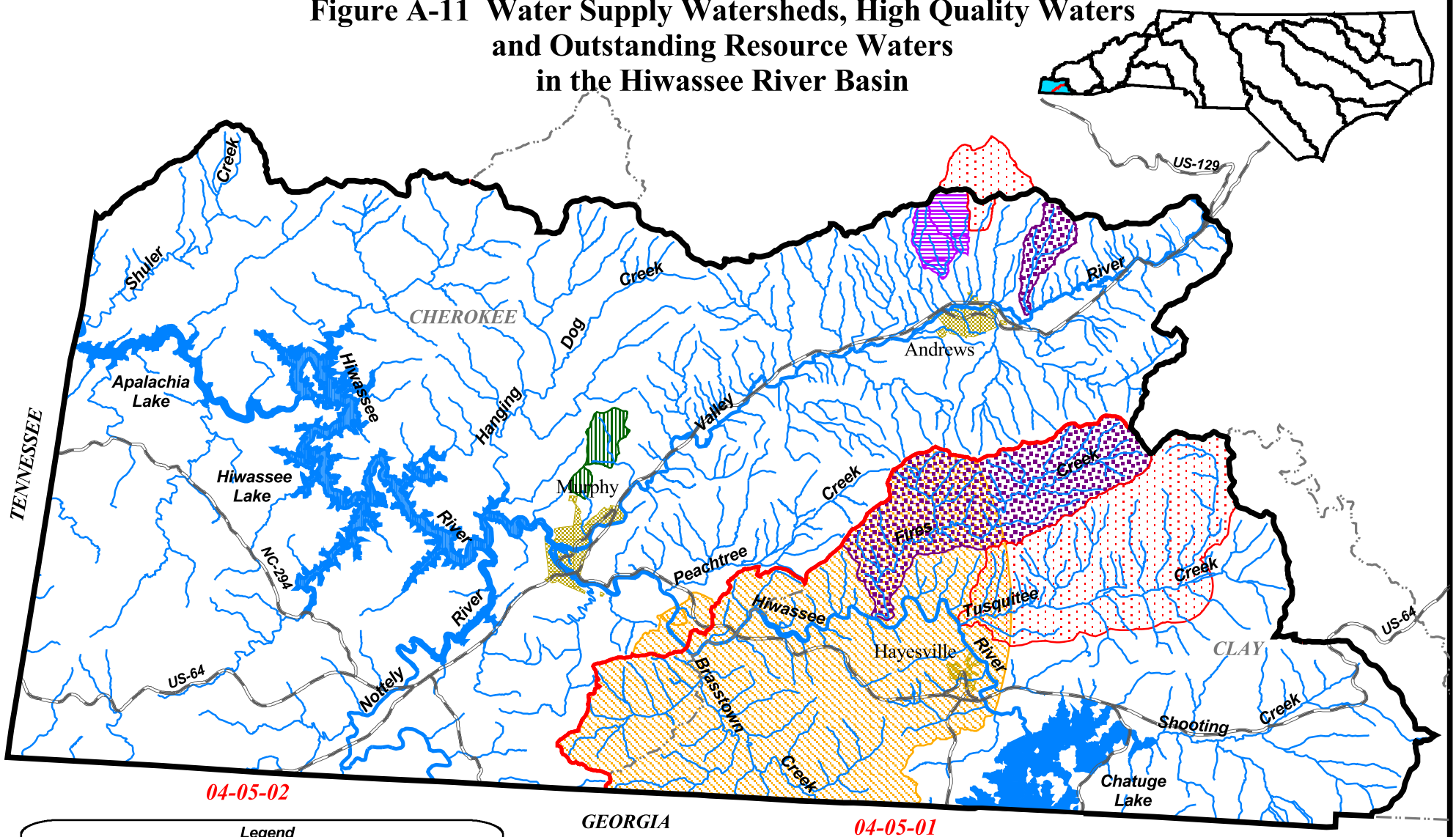
Water Supply Watersheds

The purpose of the Water Supply Watershed Protection Program is to provide an opportunity for communities to work with the state to strengthen protection of their water supplies. There are five water supply classifications (WS-I to WS-V) that are defined according to the amount and types of permitted point source discharges, as well as requirements to control nonpoint sources of pollution (Table A-17). Watersheds draining to waters classified WS carry some restrictions on point source discharges and on many land use activities including urban development, agriculture, forestry and highway sediment control. Minimum requirements for WS-I to WS-IV include a 30-foot undisturbed vegetated buffer. The WS-I and WS-II classifications are HQW by definition because requirements for these levels of water supply protection are at least as stringent as for HQWs.

Classifications and Standards in the Hiwassee River Basin

The waters of the Hiwassee River basin have a variety of surface water quality classifications applied to them. Many streams throughout the basin are classified Trout Waters (Tr). In subbasin 04-05-01, a large portion of the Tusquitee Creek watershed is currently designated High Quality Waters, and the entire Fires Creek watershed is Outstanding Resource Waters. In subbasin 04-05-02, the Gipp Creek watershed is classified ORW. Portions of the Hiwassee River basin that contain these special classifications are shown on Figure A-11.

Figure A-11 Water Supply Watersheds, High Quality Waters and Outstanding Resource Waters in the Hiwassee River Basin



Legend

River Basin Boundary		*Water Supply Watershed*	
Subbasin Boundary		HWQ	
County Boundary		ORW	
Primary Roads		WS-I	
Hydrography		WS-II	
Municipality		WS-IV	

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October 23, 2001

Water supply watersheds are also presented on Figure A-11. Marble Creek and its tributary Brittian Creek, as well as a portion of Brittian Branch in the Valley River watershed, are classified WS-I (most protective). Also in the Valley River drainage, a large portion of the Beaver Creek watershed, including Dan Holland Creek, is classified WS-II.

Pending and Recent Reclassifications in the Hiwassee River Basin

Figure A-11 shows a large area including parts of the Hiwassee River and the Brasstown Creek watershed classified as WS-IV. This is the primary water supply for the Town of Murphy. The NC Department of Transporation (DOT) intends to start construction of a bridge within the existing Critical Area (CA) of the Town of Murphy's water intake in June 2003. [The Critical Area designation is for watershed areas within a half-mile and draining to the water supply intake.] In order to alleviate Division of Environmental Health (DEH) Public Water Supply (PWS) Section and town concerns that construction of the bridge might contaminate the water supply, a new water intake must be constructed. Before the DEH PWS Section will allow water to be withdrawn at the new location, the CA for the new intake must be established. Therefore, some waters within the water supply watershed currently classified WS-IV are proposed for reclassification to WS-IV CA.

3.3 DWQ Water Quality Monitoring Programs in the Hiwassee River Basin

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

DWQ monitoring programs for the Hiwassee 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), commonly referred to as EPTs; and a Biotic Index value, which gives an indication of overall community pollution tolerance. Different benthic macroinvertebrate criteria have been developed for different ecoregions (mountains, piedmont and coastal plain) within North Carolina. Bioclassifications fall into five categories ranging from Poor to Excellent.

Overview of Benthic Macroinvertebrate Data

Appendix II lists all of the benthic macroinvertebrate collections in the Hiwassee River basin between 1983 and 1999, giving site location, collection date, taxa richness, biotic index values and bioclassifications. Ninety-one benthic macroinvertebrate samples have been collected from 39 sites since 1983 in the Hiwassee River basin. Approximately 80 percent of these received Excellent or Good bioclassifications. Table A-18 lists the most recent bioclassifications since 1983 (by subbasin) for all benthos sites in the Hiwassee River basin.

Table A-18 Summary of Most Recent Benthic Macroinvertebrate Bioclassifications for All Freshwater Benthos Sites in the Hiwassee River Basin

Subbasin	Excellent	Good	Good-Fair	Fair	Poor	Total
04-05-01	13	7	0	0	0	20
04-05-02	5	6	6	2	0	19
Total (#)	**18**	**13**	**6**	**2**	**0**	**39**
Total (%)	**46%**	**33%**	**16%**	**5%**	**0%**	**100%**

Fifteen sites were sampled during routine 1999 basinwide surveys. For the 1999 collection, Figure A-12 presents the following bioclassifications: Excellent – 8 (53%), Good – 6 (40%), Good-Fair – 1 (7%). Water quality has improved slightly in the Hiwassee River basin since 1994, when only 80 percent of sites received Excellent or Good bioclassifications and one site received a Fair.

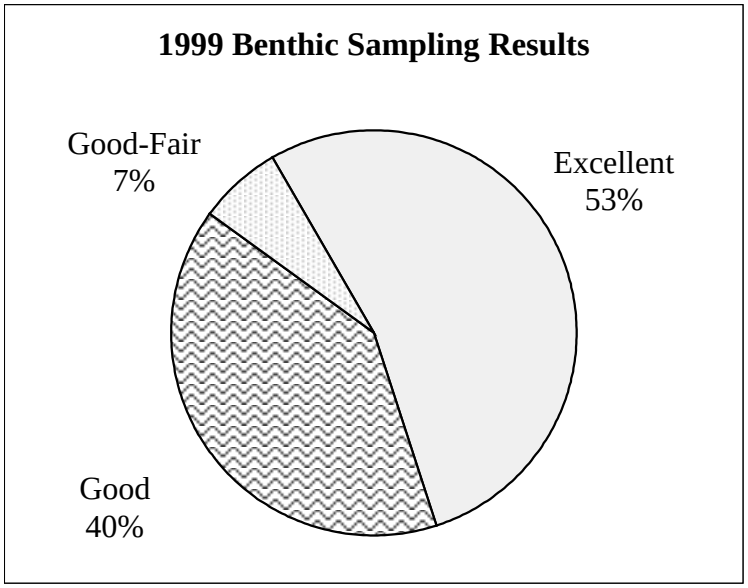

Figure A-12 Bioclassifications for 15 Hiwassee River Basin Benthic Macroinvertebrate Sites Sampled by DWQ in 1999

3.3.2 Fish Assessments

Sixty-eight fish species have been collected from the Hiwassee River basin in North Carolina. Special status has been granted to four of these species by the US Department of the Interior, the NC Wildlife Resources Commission, or the NC Natural Heritage Program under the North Carolina State Endangered Species Act (G.S. 113-311 to 113-337) (NCWRC, May 1998).

The North Carolina Index of Biotic Integrity is one of the tools DWQ uses to summarize all classes of factors such as water and habitat quality, flow regime and energy sources which influence the freshwater fish communities of wadeable streams throughout the state. No stream fish community basinwide monitoring was conducted during 1999 in the Hiwassee River basin because of recent revisions and a reexamination of the criteria and metrics.

DWQ has only systematically tracked reported fish kill events across the state since 1996. The only fish kills reported in the Hiwassee River basin occurred during the summer of 1998 when several small kills (less than 25 fish per kill) were observed in Chatuge Lake. During this dry and hot period, dissolved oxygen levels were low in the reservoir. A larger kill of approximately 200 fish (of which most were yellow perch, 10-25 cm in length) was observed during this period in the Hiwassee River below the dam. The kill was attributed to low dissolved oxygen levels in the water passing through the turbines.

No fish tissue contaminant monitoring was conducted between 1994 and 1999 by DWQ because of the lack of any significant contaminant concerns in the Hiwassee River basin. Currently, there are no fish consumption advisories specific to the North Carolina portion of the basin.

3.3.3 Aquatic Toxicity Monitoring

Acute and/or chronic toxicity tests are used to determine toxicity of discharges to sensitive aquatic species (usually fathead minnows or the water flea, *Ceriodaphnia dubia*). Results of these tests have been shown by several researchers to be predictive of discharge effects on receiving stream populations. Many facilities are required to monitor whole effluent toxicity by their NPDES permit or by administrative letter. Other facilities may be tested by DWQ's Aquatic Toxicology Laboratory.

The Aquatic Toxicology Unit maintains a compliance summary (Figure A-13) 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.

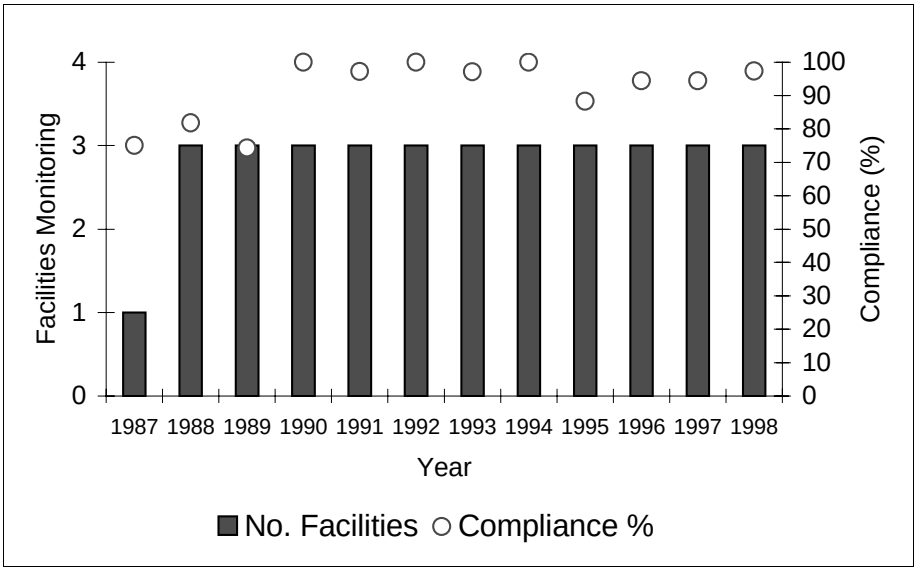

Figure A-13 Summary of Compliance with Aquatic Toxicity Tests in the Hiwassee River Basin (1999)

Three facilities in the Hiwassee River basin have NPDES permits which require whole effluent toxicity (WET) testing. Since 1993, all facilities operated within a compliance rate of 90-95 percent. Facilities with toxicity problems during the most recent two-year review period are discussed in the subbasin chapters in Section B.

3.3.4 Lake Assessment

Three lakes in the Hiwassee River basin were sampled as part of the Lakes Assessment Program in the summer of 1999. These data are used to determine the trophic state of each lake, a relative measure of nutrient enrichment and biological productivity. All three lakes (Chatuge, Hiwassee and Apalachia) exhibited low biological productivity, as is expected in the mountain region. NC Trophic State Index scores are presented in Figure A-14. All three lakes are oligotrophic.

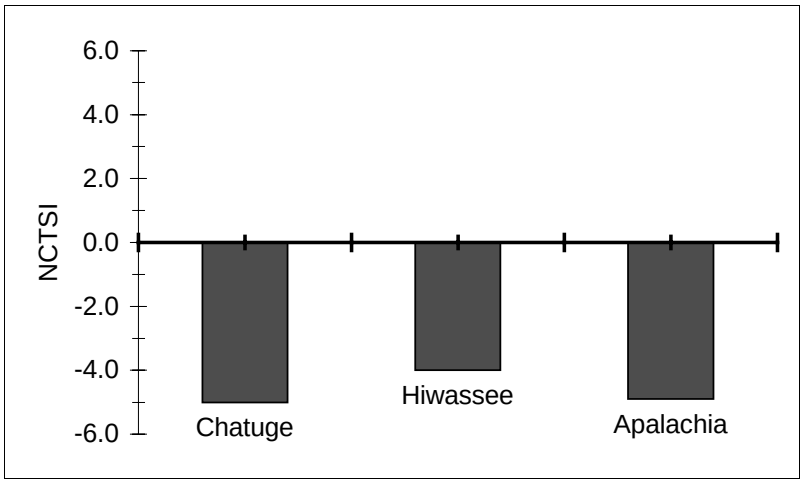

Figure A-14 North Carolina Trophic State Index Scores for Lakes in the Hiwassee River Basin

3.3.5 Ambient Monitoring System Program

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collection of physical and chemical water quality data. North Carolina has 450 monitoring stations statewide, including two stations in the Hiwassee River basin presented in Table A-19 and shown on individual subbasin maps in Section B. These stations are sampled monthly for 27 parameters.

Table A-19 Ambient Monitoring System Stations within the Hiwassee River Basin

Station Code	Station Name	Subbasin	County	Classification
F2500000	Hiwassee River above Murphy NC	04-05-02	Cherokee	WS-V
F4000000	Valley River at SR 1373 at Tomotla NC	04-05-02	Cherokee	C Tr

Water quality, based on ambient monitoring station data, at both locations is good. Fecal coliform bacteria (a pathogen indicator) concentrations at both stations have decreased significantly over time (Table A-20).

Table A-20 Summary of Fecal Coliform Bacteria Collections from the Hiwassee River Basin Ambient Monitoring Stations (1973-1999)

Site	Collection Range (Date)	No. of Samples	Geometric Mean	No. of Samples >200 col/100ml	% of Samples >200 col/100 ml
Hiwassee River	6/27/73 - 6/15/89	77	160.4	29	37.7%
	9/6/89 - 8/29/94	15	5.9	1	6.7%
	9/28/94- 8/26/99	**49**	**3.4**	**3**	**6.1%**
Valley River	11/19/73 - 8/24/89	133	367.0	93	69.9%
	9/6/89 - 8/29/94	18	24.0	3	16.7%
	9/28/94 - 8/26/99	**49**	**19.2**	**6**	**12.2%**

Note: Rows in bold represent the current basinwide assessment period.

3.4 Other Water Quality Research

North Carolina actively solicits "existing and readily available" data and information for each basin as part of the basinwide planning process. Data meeting DWQ quality assurance objectives are used in making use support determinations. Data and information indicating possible water quality problems are investigated further. Both quantitative and qualitative information are accepted during the solicitation period. High levels of confidence must be present in order for outside quantitative information to carry the same weight as information collected within DWQ. This is particularly the case when considering waters for the 303(d) list. Methodology for soliciting and evaluating outside data is presented in *North Carolina's 2000 § 303(d) List* (NCDENR-DWQ, May 2001).

DWQ data solicitation includes the following:

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

Contact information must accompany all data and information submitted.

During March 1999, Tennessee Valley Authority (TVA) biologists collected information on fish, benthic macroinvertebrates and habitat characteristics at fifteen sites on streams in the North Carolina portion of the Hiwassee River basin. This currently unpublished data are presented in Table A-21.

The benthic data are limited to the number of EPT families with a maximum of about 25 families/site. TVA's EPT rating is not equivalent to DWQ's benthic bioclassification. TVA's IBI score is not equivalent to DWQ's fish community IBI score. TVA uses IBI information as a

ecological watershed screening tool, whereas the focus of DWQ work is on use assessment. The TVA habitat assessment score has a maximum value of 52. These data are not currently used by North Carolina to assign use support ratings.

Table A-21 Biological and Habitat Data Collected by the Tennessee Valley Authority from the Hiwassee River Basin, March 1999

Stream	Location	Subbasin	County	# EPT Families	TVA EPT Rating*	# Fish Species	Total # Fish	TVA IBI	Habitat Score
Hyatt Mill Cr	SR 1140	04-05-01	Clay	22	Good	8	501	42	26
Blair Cr	SR 1140	04-05-01	Clay	19	Good	10	114	32	25
Town Cr	SR 1140	04-05-01	Clay	4	Poor	3	79	24	21
Qually Cr	SR 1306	04-05-01	Clay	20	Good	7	307	46	36
Tusquitee Cr	SR 1300	04-05-01	Clay	19	Good	10	737	36	42
Fires Cr	SR 1300	04-05-01	Clay	21	Good	9	287	34	49
Brasstown Cr	SR 1564	04-05-01	Cherokee	21	Excellent	18	713	52	37
L Brasstown	SR 1565	04-05-01	Cherokee	16	Good	17	239	50	21
Valley River	SR 1515 & US 19/129	04-05-02	Cherokee	15	Good	24	1282	52	34
Valley River	SR 1370 & US 19/129	04-05-02	Cherokee	15	Good	31	1019	58	28
Rapier Mill Cr	Off 1124	04-05-02	Cherokee	20	Excellent	10	449	40	41
Nottely River	Off 1124	04-05-02	Cherokee	18	Good	11	---	34	--
Hanging Dog	SR 1349	04-05-02	Cherokee	16	Good	13	194	42	48
Beaverdam Cr	SR 1326	04-05-02	Cherokee	21	Excellent	13	631	42	42
South Shoal Cr	Near mouth	04-05-02	Cherokee	21	Excellent	3	116	28	42

* TVA EPT ratings are not equivalent to DWQ bioclassifications.

TVA also monitors the ecological health of its reservoirs annually. The TVA reservoir rating system is based on the assignment of a numerical score which is then used to define each of five reservoir indicators (algae, dissolved oxygen, fish, benthic macroinvertebrates and sediment) as Poor, Fair or Good.

The overall ecological condition of Chatuge Reservoir rated poor based on 1999 TVA monitoring results. Dissolved oxygen and benthic macroinvertebrates received low scores at both the forebay and Shooting Creek sites within the lake. No insects were collected at three of the ten samples in the forebay (30 percent) and five of ten in the Shooting Creek arm (50 percent) of Lake Chatuge. Sediment quality also received a low score at the Shooting Creek site due to high levels of copper, chromium and nickel. Chatuge also received a poor rating in 1998 (TVA-Chatuge, March 2000).

The poor ratings in 1998 and 1999 for Lake Chatuge are in stark contrast to previously good ratings in 1996, 1994 and 1993. TVA speculates that the very hot, dry weather which occurred in late summer was likely a contributing factor in both years (TVA-Chatuge, March 2000).

Hiwassee Reservoir rated good and Apalachia Reservoir rated fair in 1999. These ratings are consistent with ratings in previous years. The fair rating for Apalachia Lake is primarily related to the fish assemblage (TVA-Apalachia, March 2000).

Nottely Reservoir, located on the Nottely River just upstream of the NC/GA state line, rated Poor in 1999. The only indicator that received a high score was sediment. Data indicate increasing nutrient enrichment. Dissolved oxygen was low in as much as 50 percent of the water column from mid-August to mid-September. Benthic macroinvertebrate scores were also low. Problems with low dissolved oxygen have been observed in Nottely Reservoir every year since monitoring began in 1991 (TVA-Nottely, March 2000)

3.5 Use Support Summary

3.5.1 Introduction to Use Support

Surface waters are classified according to their best intended uses. Determining how well a waterbody supports its uses (*use support* status) is an important method of interpreting water quality data and assessing water quality. Surface waters are rated *fully supporting* (FS), *partially supporting* (PS) or *not supporting* (NS). The ratings refer to whether the classified uses of the water (i.e., aquatic life protection, primary recreation and water supply) are being met.

For example, waters classified for fish consumption, aquatic life protection and secondary recreation (Class C for freshwater or SC for saltwater) are rated FS if data used to determine use support meet certain criteria. However, if these criteria were not met, then the waters would be rated as PS or NS, depending on the degree of degradation. Waters rated PS or NS are considered to be impaired. Waters lacking data, having inconclusive data, or for which criteria have not yet been developed are listed as not rated (NR). More specific methods are presented in Appendix III.

Use support ratings for surface waters:

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

Impaired waters categories:

- Partially Supporting
- Not Supporting

Historically, the non-impaired category was subdivided into fully supporting and fully supporting but threatened (ST). ST was used to identify waters that were fully supporting but had some notable water quality concerns and could represent constant, degrading or improving conditions. North Carolina's past use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that demonstrate declining water quality (EPA Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates, 1997). Given the difference between the EPA and North Carolina definitions of ST and the resulting confusion that arises from this difference, North Carolina no longer subdivides the non-impaired category. However, these waters and the specific water quality concerns remain identified in the basin plans so that data, management and the need to address the identified concerns are not lost.

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

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

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

Waters are placed on North Carolina's 303(d) list primarily due to a partially or not supporting use support rating. 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 bioclassifications or water quality standards.

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

3.5.3 Use Support Ratings for the Hiwassee River Basin

<u>Aquatic Life/Secondary Recreation</u>

The aquatic life/secondary recreation use support category is applied to all waters in North Carolina. Therefore, this category is applied to the total number of stream miles (967.6) and lake acres (10,847.8) in the North Carolina portion of the Hiwassee River basin. Table A-22 presents use support ratings by subbasin for both monitored and evaluated streams in the aquatic life/secondary recreation category. Refer to Appendix III for a description of monitored and evaluated waters.

Table A-22 Aquatic Life/Secondary Recreation Use Support Ratings for Monitored and Evaluated Waters Listed by Subbasin (1995-1999)

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
04-05-01	216.1 mi 3,629.0 ac	0.0 mi 0.0 ac	0.0 mi 0.0 ac	97.7 mi 0.0 ac	313.8 mi 3,629 ac
04-05-02	497.9 mi 7,218.8 ac	0.0 mi 0.0 ac	0.0 mi 0.0 ac	155.9 mi 0.0 ac	653.8 mi 7,218.8 ac
TOTAL	**714.0 mi 10,847.8 ac**	**0.0 mi 0.0 ac**	**0.0 mi 0.0 ac**	**253.6 mi 0.0 ac**	**967.6 mi 10,847.8 ac**
Percent Miles	74%	0%	0%	26%	100%
Percent Acres	100%	0%	0%	0%	100%

Approximately 21 percent of stream miles (204.3) and 100 percent of lake acres were monitored for the protection of aquatic life and secondary recreation by DWQ during this basinwide planning cycle. In this category, there are currently no impaired waters in the North Carolina portion of the Hiwassee River basin. A basinwide summary of current aquatic life/secondary recreation use support ratings is presented in Table A-23.

Table A-23 Aquatic Life/Secondary Recreation Use Support Summary Information for Waters in the Hiwassee River Basin (1999)

Aquatic Life/Secondary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles and Acres	%		Miles and Acres	%
Fully Supporting	**714.0 mi 10,847.8 ac**	**74% 100%**		**204.3 mi 10,847.8 ac**	**100% 100%**
Impaired	**0.0 mi**	**0%**		**0.0 mi**	
Partially Supporting	*0.0*			*0.0*	
Not Supporting	*0.0*			*0.0*	
Not Rated	**253.6 mi**	**26%**		**0.0**	
TOTAL	**967.6 mi 10,847.8 ac**			**204.3 mi 10,847.8 ac**	

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

Fish Consumption

Like the aquatic life/secondary recreation use support category, fish consumption is also applied to all waters in the state. Fish consumption use support ratings are based on fish consumption advisories issued by the NC Department of Health and Human Services. Currently, there are no fish consumption advisories specific to the NC portion of the basin. Therefore, all waters are considered to be fully supporting the fish consumption category. No waters were monitored for

the fish consumption category during this basinwide cycle because of the lack of any significant contaminant concerns in the Hiwassee River basin.

Primary Recreation

There are 30.3 stream miles and 10,847.8 lake acres currently classified for primary recreation (Class B) in the Hiwassee River basin. All (100 percent) were monitored by DWQ and the Tennessee Valley Authority over the past five years. Primary recreation use support ratings are based on swimming advisories issued by the NC Department of Health and Human Services (NCDHHS). Currently, there are no swimming advisories in the Hiwassee River basin and all waters classified for primary recreation are fully supporting. Table A-24 presents use support ratings by subbasin for both monitored and evaluated waters in the primary recreation category. A basinwide summary of current use support ratings is presented in Table A-25.

Table A-24 Primary Recreation Use Support Ratings for Monitored and Evaluated Waters Listed by Subbasin (1995-1999)

Subbasin	Fully Supporting	Partially Supporting	Not Supporting	Not Rated	Total
04-05-01	2.6 mi 3,629.0 ac	0.0 mi 0.0 ac	0.0 mi 0.0 ac	0.0 mi 0.0 ac	2.6 mi 3,629.0 ac
04-05-02	27.7 mi 7,218.8 ac	0.0 mi 0.0 ac	0.0 mi 0.0 ac	0.0 mi 0.0 ac	27.7 mi 7,218.8 ac
TOTAL	**30.3 mi 10,847.8 ac**	**0.0 mi 0.0 ac**	**0.0 mi 0.0 ac**	**19.9 mi 1,366 ac**	**24.5 mi 1,366 ac**
Percent Miles	100%	0%	0%	0%	100%
Percent Acres	100%	0%	0%	0%	100%

Table A-25 Primary Recreation Use Support Summary Information for Waters in the Hiwassee River Basin (1999)

Primary Recreation Use Support Ratings	Monitored and Evaluated Waters*			Monitored Waters Only**	
	Miles	%		Miles	%
Fully Supporting	**30.3 mi 10,847.8 ac**	**100% 100%**		**30.3 mi 10,847.8 ac**	**100% 100%**
Impaired	**0.0 mi 0.0 ac**			**0.0 mi 0.0 ac**	
Not Rated	**0.0 mi 0.0 ac**			**0.0 mi 0.0 ac**	
TOTAL	**30.3 mi 10,847.8 ac**			**30.3 mi 10,847.8 ac**	

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

Water Supply

There are 163.3 stream miles currently classified for water supply in the Hiwassee River basin. Approximately 79 percent of stream miles (128.4) were monitored within the past five years; all are fully supporting the water supply use. A basinwide summary of current water supply use support ratings is presented in Table A-26.

Table A-26 Water Supply Use Support Summary Information for Waters in the Hiwassee River Basin (1999)

Water Supply Use Support Ratings	Monitored and Evaluated Streams*			Monitored Streamss Only**	
	Miles	%		Miles	%
Fully Supporting	**163.3**	**100%**		**128.4**	**100%**
Impaired	**0.0**			**0.0**	
Not Rated	**0.0**			**0.0**	
TOTAL	**163.3**			**128.4**	

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

Use Support Summary

There are currently no impaired waters in the North Carolina portion of the Hiwassee River basin. A color map showing use support ratings for monitored waters in the basin is presented in Figure A- 15.

Figure A-15 Use Support Ratings for Monitored Waters in the Hiwassee River Basin

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Chapter 4 -
Water Quality Issues Related to the Entire Hiwassee River Basin

4.1 Overview

The 1997 *Hiwassee River Basinwide Water Quality Management Plan* included several recommendations to address water quality issues in the basin. Most of these recommendations were for specific stream segments and are discussed in the subbasin chapters in Section B. This chapter discusses water quality issues that relate to multiple watersheds within the basin. Habitat degradation, including sedimentation (resulting from land clearing activities, loss of riparian vegetation, rural roads, and livestock grazing on streambanks) is the main water quality issue in the basin. Runoff from developed areas, straight pipes and failing septic systems, as well as mining activities are also water quality concerns affecting the Hiwassee River basin in NC.

4.2 Habitat Degradation

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

Determining the cause and quantifying the amounts of habitat degradation is very difficult in most cases. To assess instream habitat degradation in most streams would require extensive technical and monetary resources and perhaps even more resources to restore the stream. Although DWQ and other agencies are starting to address this issue, local efforts are needed to prevent further instream habitat degradation and to restore streams that have been impaired by activities that cause habitat degradation. As point sources become less of a source of water quality impairment, nonpoint sources that pollute water and cause habitat degradation need to be addressed to further improve water quality in North Carolina's streams and rivers.

4.2.1 Sedimentation

Introduction

Soil erosion, transport and redeposition are among the most essential natural processes occurring in watersheds. However, land-disturbing activities such as the construction of roads and

buildings, crop production, livestock grazing and timber harvesting can accelerate erosion rates by causing more soil than usual to be detached and moved by water. If best management practices (BMPs) are not used effectively, accelerated erosion can strip the land of its topsoil, decreasing soil productivity and causing sedimentation in streams and rivers (NCDENR-DLR, 1998).

Sedimentation is the process by which eroded soil is deposited into waters. Sediment that accumulates on the bottom of streams and rivers smothers aquatic insects that fish feed upon and buries fish habitat that is vital to reproduction. Sediment filling lakes and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998).

Major Causes of Sedimentation in the Hiwassee River Basin

- Land clearing activities (construction and preparing land for planting and crops)
- Streambank erosion
- Runoff from unpaved rural roads and eroding road grades

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

During 1999 basinwide monitoring, DWQ aquatic biologists reported streambank erosion and sedimentation throughout the Hiwassee River basin that was moderate to severe. Lower bioclassification ratings were assigned because of sedimentation; bottom substrate was embedded by silt and/or pools were partially filled with sediment. Unstable and/or undercut (eroding) streambanks were also noted in explanation of lower ratings (NCDENR-DWQ, April 2000).

Land Clearing Activities

Erosion and sedimentation can be controlled during most land-disturbing activities by using appropriate BMPs. In fact, substantial amounts of erosion can be prevented by planning to minimize the (1) amount and (2) time the land is exposed. Land clearing activities that contribute to sedimentation in the Hiwassee River basin include: construction of homes and subdivisions as well as commercial and public buildings; plowing of soil to plant crops; site preparation and harvest on timberlands; and road projects.

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

As a result of new stormwater rules enacted by EPA in 1999, construction or land development activities that disturb one acre or more are required to obtain a NPDES stormwater permit (refer to page 24). An erosion and sediment control plan must also be developed for these sites under the state's Sedimentation Pollution Control Act (SPCA) administered by the NC Division of Land Resources. Site disturbances of less than one acre are required to use BMPs, but a plan is not required.

Forestry activities in North Carolina are subject to regulation under the SPCA. However, a forestry operation in the Hiwassee River basin may be exempt from the permitting requirements if compliance with performance standards outlined in *Forest Practice Guidelines Related to Water Quality* (15NCAC 1I .201-.209) and General Statutes regarding stream obstruction (77-13 and 77-14) are maintained. Extensive information regarding these performance standards and rules as they apply to forestry operations can be found on the NC Division of Forest Resources website at http://www.dfr.state.nc.us/managing/water_qual.htm.

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

Some Best Management Practices

Agriculture

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

Construction

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

Forestry

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

Unpaved Roads and Eroding Road Grades

As is typical of settlement in mountainous areas, many roads in the Hiwassee River basin follow streams. The roads are often constructed on the streambank with very little (if any) vegetated buffer to filter sediment and other pollutants from surface runoff. Many of the steep road grades are actively eroding because of a lack of stabilization. Road grades of 12 percent or less are desirable. Unpaved roads with grades in excess of 12 percent erode easily and are difficult to maintain (WNCT, 1999). Additionally, when road maintenance activities are conducted, there is often inadequate space for structural BMPs to be installed to control erosion from the land-disturbing activity.

Roads built to accommodate vehicles and equipment used for forestry activities in the Hiwassee River basin also contribute to sediment runoff. These roads are generally unpaved and accelerate erosion unless they are maintained with stable drainage structures and foundations. In the mountainous areas of North Carolina, ordinary forest roads are known to lose as much as 200 tons of soil per acre of roadway during the first year following disturbance (NRCD-DFR, September 1989).

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

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

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

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

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

4.2.2 Loss of Riparian Vegetation

During 1999 basinwide sampling, DWQ biologists reported degradation of aquatic communities at numerous sites throughout the Hiwassee River basin in association with narrow or nonexistent zones of native riparian vegetation. Riparian vegetation loss was common in rural and residential areas, as well as in urban areas (NCDENR-DWQ, April 2000).

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

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

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

4.2.3 Channelization

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

Typical Channel Modifications

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

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

Restoration or recovery of channelized streams may occur through processes, both naturally and artificially induced. In general, streams that have not been excessively stressed by the channelization process can be expected to return to their original forms. However, streams that

have been extensively altered may establish a new, artificial equilibrium (especially when the channelized streambed has been hardened). In such cases, the stream may enter a vicious cycle of erosion and continuous entrenchment. Once the benefits of a channelization project become outweighed by the costs, both in money and environmental integrity, channel restoration efforts are likely to be taken (McGarvey, 1996).

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

4.2.4 Recommendations for Reducing Habitat Degradation

DWQ will continue to work cooperatively with DLR and local governments 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. 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 percent of the cost of starting a new local erosion and sedimentation control program for up to 18 months. Citizens should immediately report erosion and sedimentation problems to DLR or DWQ. Appendix VI lists contact information for these offices.

It is recommended that the NC Department of Transportation, as well as developers and county highway departments, take special care when constructing and maintaining (including mowing) roads along streams in the Savannah River basin. Vegetation along streams should remain as undisturbed as possible when conducting these activities. Additionally, public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

Funding is available through numerous federal and state programs for stream restoration and/or restoration and protection of riparian buffer zones. Descriptions of these funding sources in the can be found in Section C. Additionally, s document entitled *A Guide for North Carolina Landowners: Financial Incentives and Technical Assistance Programs Which Apply to Wetlands, Streams and Streamside (Riparian Areas)* summarizes these programs and can be found on the Wetlands Restoration Program website at http://h2o.enr.state.nc.us/wrp/pdf/landowng.pdf.

4.3 Urban Runoff

Runoff from built-upon (developed) areas carries a wide variety of contaminants to streams including sediment, oil and grease from roads and parking lots, street litter, and pollutants from the atmosphere. The volume and speed of runoff are greatly increased in these areas as well, causing erosion of streambanks, temperature and salinity alterations, and scouring of the streambed. Generally, there are also a larger number of point source discharges in these areas.

Cumulative impacts from habitat and floodplain alterations as well as point and nonpoint source pollution can cause severe impairment to streams.

Projected population growth over the next ten years (1998-2008) for the Hiwassee River basin shows a 10 percent increase for Cherokee and Clay counties. As populations expand, so do developed areas. Proactive planning efforts at the local level are needed to assure that development is done in a manner that minimizes impacts to water quality. A lack of good environmental planning was identified by participants at the public workshops as a threat to water quality in the Hiwassee River basin. Additionally, there are many things that individuals can do to reduce the quantity and improve the quality of stormwater runoff.

4.3.1 Rural Development

More than three-quarters of the land in western North Carolina has a slope in excess of 30 percent. Building site preparation and access are complicated by shallow bedrock, high erosion rates, soils that are subject to sliding, and lack of adequate sites for septic systems. Additionally, road grades of 12 percent or less are desirable. Unpaved roads with grades in excess of 12 percent erode easily and are difficult to maintain (WNCT, 1999). This terrain presents a challenge for environmentally sensitive development. Development could occur in the relatively flat stream and river valleys, placing pressure on floodplains and riparian zones, and displacing agricultural land uses. Alternatively, it could occur on the steep slopes accelerating erosion during construction. In addition, chronic problems with failing septic systems and eroding road grades are more likely.

4.3.2 Urbanization

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 driveways. Urbanization results in increased surface runoff and correspondingly earlier and higher peak flows after storms. Flooding frequency is also increased. These effects are compounded when small streams are channelized (straightened) or piped, and storm sewer systems are installed to increase transport of drainage waters downstream. Bank scour from these frequent high flow events tends to enlarge streams and increase suspended sediment. Scouring also destroys the variety of habitat in streams leading to degradation of benthic macroinvertebrate populations and loss of fisheries (EPA, 1999).

In and around developed areas in the Hiwassee River basin, 1999 DWQ biological assessments revealed that streams, particularly the Valley River, are being impacted by urban stormwater runoff. Most of the impacts are in terms of habitat degradation (see page 49), but runoff from developed and developing areas can also carry toxic pollutants to a stream (NCDENR-DWQ, April 2000).

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

4.3.3 Stormwater Regulations

DWQ administers several programs aimed at controlling stormwater runoff in the Hiwassee River basin. They are: 1) programs for the control of development activities within designated water supply (WS) watersheds; 2) NPDES stormwater permit requirements for construction or land development activities on one acre of land or more; and 3) NPDES stormwater requirements for certain industrial activities. For more detailed information on current and proposed stormwater rules, refer to page 24.

4.3.4 Recommendations

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

Planning Recommendations for Hiwassee Development

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

Action should be taken at the local level to plan for new development in urban and rural areas. For more detailed information regarding recommendations for new development found in the text box, refer to EPA's website at www.epa.gov/owow/watershed/wacademy/acad2000/protection. Additional public education is also needed in the Hiwassee River basin in order for citizens to understand the value of urban planning and stormwater management. DWQ is developing a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. To obtain a free copy, call (919) 733-5083, ext. 558.

4.4 Mining Activities in Streams

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

Mining of sand and gravel typically occurs in two major forms: instream mining and land mining, which include floodplain excavations that often involve a connecting outlet to a stream. In addition to physical stream changes, sedimentation and increased turbidity can accrue from both types of mining activities, wash water discharge, and storm runoff from active or abandoned mining sites. Other effects may include higher stream temperatures and reduced dissolved oxygen, lowering of the water table, and decreased wetted periods in riparian wetlands. Expansion of a mine site or mining at a new site is often preceded by riparian forest clearing, which can affect instream habitat and contribute to bank instability (Meador and Layher, 1998), though an undisturbed buffer is required at permitted mine sites.

Mining activities are regulated by the Division of Land Resources' (DLR) because of the potential impacts to land and water resources. Currently, there are no permitted instream mining operations in the Hiwassee River basin. However, extensive removal of streambed material (primarily cobble) has been observed in the Hiwassee River basin, specifically from the Valley River and its tributaries.

Two Types of Instream Mining Permits

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

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

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

DLR issues permits for two types of instream mining which are described in the text box: sand dipping and sand dredging. DLR does not currently issue permits for instream *rock removal* activities. Floodplain gravel mines have been permitted in the past, but they must be located at least 200 feet landward from the top edge of the riverbank and along a straight section of river. Additionally, a permit is required for mines disturbing an area larger than one acre, including the mine excavation and any associated land disturbance, such as haul roads, processing facilities and stockpiles (Davis, May 31, 2001).

Recommendations

DWQ will work with DLR to evaluate and reduce the aquatic life impacts from mining activities in the Hiwassee River basin. In addition, DWQ will notify local agencies of water quality concerns regarding these activities and work with them to conduct further monitoring and to locate sources of water quality protection funding. If a citizen has concerns about observed instream activities, especially if they do not fit the description of permitted activities discussed above, the activity should be reported to Mr. Richard Phillips, Land Quality Regional Engineer, at the Asheville Regional Office by calling (828) 251-6208.

4.5 Straight Pipes and Failing Septic Systems

In the Hiwassee River basin, waste from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Waste from some homes discharges directly to

streams through what is known as a "straight pipe". These are illegal discharges of wastewater into waters of the State of North Carolina. Septic systems receive and treat wastewater from other homes and businesses. In this system, the septic tank unit treats some wastes, but the soil drainfield associated with the septic tank provides further absorption and treatment of the pollutants found in wastewater. A septic system that is operating properly does not directly discharge to streams and lakes or to the ground's surface where it can run untreated into nearby surface waters. Septic systems are a safe and effective method for treating wastewater if they are sited, sized and maintained properly. If the tank or drainfield are improperly located or constructed or the systems are not maintained, nearby wells and surface waters may become contaminated, causing potential risks to human health. Septic tanks must be properly installed and maintained to insure they function properly over the life of the system (Thoren, 2000). Information about the proper installation and maintenance of septic tanks can be obtained by calling the local Soil and Water Conservation District office (Appendix VI contains contact information).

The discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Nutrients in wastewater nourish algae that (1) deplete oxygen in streams and lakes and (2) produce high levels of toxins, both of which can cause death of fish and other aquatic animals. Wastewater may also contain disease-causing bacteria and viruses that are harmful to humans as well as animals. Although DWQ ambient monitoring of the Hiwassee and Valley Rivers show a relatively small percentage of fecal coliform bacteria samples exceeding state standards for primary recreation (page 40), smaller streams may contain a higher concentration of bacteria and other pollutants. Clay and Cherokee counties' economies are highly dependent upon lake recreation, especially for tourists and seasonal residents. Concerns were expressed at the public workshop for the Hiwassee River basin about the possibility of failing septic systems and straight pipes, as well as the number of septic systems that are currently being permitted each year.

In order to protect human health and maintain water quality, straight pipes must be eliminated and failing septic systems must be repaired. The Wastewater Discharge Elimination (WaDE) program is actively helping to identify and remove straight pipes (and failing septic systems) in the western portion of the North Carolina. This program uses door to door surveys to locate straight pipes, and then, offers low interest loans or grants to homeowners who wish to eliminate the straight pipe by installing a septic system. The program also offers low interest loans and grants to repair old, malfunctioning septic systems. Some local health departments (Jackson County, for example) are also obtaining grant money to conduct similar surveys. No such program is currently in place in the Hiwassee River basin.

Recommendations

The Cherokee and Clay County Health Departments should request funding from the Clean Water Management Trust Fund (page 82) and Section 319 Program (page 79) to develop a straight pipe elimination program for the Hiwassee River basin. Additional monitoring of fecal coliform throughout tributary watersheds where straight pipes and failing septic systems are a potential problem should be conducted in order to narrow the focus of the surveys. For more information on the WaDE program, contact the DENR On-Site Wastewater Division at 1-800-973-9243 or visit their website at http://www.deh.enr.state.nc.us/oww/Wade/wade.htm.

Additionally, precautions should be taken by local septic system permitting authorities to ensure that new systems are sited and constructed properly and that an adequate repair area is also available. Educational information should also be provided to new septic system owners regarding the maintenance of these systems over time. DWQ is developing a booklet that discusses actions individuals can take to reduce stormwater runoff and improve stormwater quality entitled *Improving Water Quality In Your Own Backyard*. The publication includes a discussion about septic system maintenance and offers other sources of information. To obtain a free copy, call (919) 733-5083, ext. 558. The following website also offers good information in three easy to follow steps:
http://www.wsg.washington.edu/outreach/mas/water_quality/septicsense/septicmain.html

4.6 Protecting Headwaters

Many streams in a given river basin are only small trickles of water that emerge from the ground. A larger stream is formed at the confluence of these trickles. This constant merging eventually forms a large stream or river. Most monitoring of fresh surface waters evaluates these larger streams. The many miles of small trickles, collectively known as headwaters, are not directly monitored and in many instances are not even indicated on maps. However, degradation of headwater streams can (and does) impact the larger stream or river.

In smaller headwater streams, fish communities are not well developed and benthic macroinvertebrates dominate aquatic life. Benthic macroinvertebrates are often thought of as "fish food" and, in mid-sized streams and rivers, they are critical to a healthy fish community. However, these insects, both in larval and adult stages, are also food for small mammals, such as river otter and raccoons, birds and amphibians (Erman, 1996). Benthic macroinvertebrates in headwater streams also perform the important function of breaking down coarse organic matter, such as leaves and twigs, and releasing fine organic matter. In larger rivers, where coarse organic matter is not as abundant, this fine organic matter is a primary food source for benthic macroinvertebrates and other organisms in the system (CALFED, 1999). When the benthic macroinvertebrate community is changed or extinguished in an area, even temporarily, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwaters also provide a source of insects for repopulating downstream waters where benthic macroinvertebrate communities have been eliminated due to human alterations and pollution. Adult insects have short life spans and generally live in the riparian areas surrounding the streams from which they emerge (Erman, 1996). Because there is little upstream or stream-to-stream migration of benthic macroinvertebrates, once headwater populations are eliminated, there is little hope for restoring a functioning aquatic community.

Recommendations

Because of the small size of headwater streams, they are often overlooked during land use activities that impact water quality. All landowners can participate in the protection of headwaters by keeping small tributaries in mind when making land use management decisions on the areas they control. This includes activities such as retaining vegetated stream buffers, minimizing stream channel alterations, and excluding cattle from streams. Local rural and urban planning initiatives should also consider impacts to headwater streams when land is being developed.

For a more detailed description of watershed hydrology, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

4.6 Priority Issues for the Next Five Years

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

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

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

Section 303(d) of the federal Clean Water Act requires states to develop a 303(d) list of waters not meeting water quality standards or which have impaired uses. States are also required to develop Total Maximum Daily Loads (TMDLs) or management strategies for 303(d) listed waters to address impairment. In the last few years, the TMDL program has received a great deal of attention as the result of a number of lawsuits filed across the country against EPA. These

lawsuits argue that TMDLs have not adequately been developed for specific impaired waters. As a result of these lawsuits, EPA issued a guidance memorandum in August 1997 that called for states to develop schedules for developing TMDLs for all waters on the 303(d) list. The schedules for TMDL development, according to this EPA memo, are to span 8-13 years.

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

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 Hiwassee River basin that are on this list are presented in the individual subbasin descriptions in Section B. For information on listing requirements and approaches, refer to Appendix IV.

4.6.2 Strategies for Addressing Notable Water Quality Concerns in Unimpaired Waters

Often during DWQ's use support assessment, water quality concerns are documented for waters that are fully supporting designated uses. While these waters are not considered impaired, attention and resources should be focused on these waters over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. Waters with notable water quality concerns are discussed individually in the subbasin chapter in Section B.

Water quality problems in the Hiwassee River basin are varied and complex. Inevitably, many of the water quality impacts noted are associated with 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. Although no action is required for these unimpaired waters, voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns for these waters and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts.

Section B

Water Quality Data
and
Information by Subbasin

Chapter 1 -
Hiwassee River Subbasin 04-05-01
Includes Chatuge Lake, Shooting Creek and Brasstown Creek

1.1 Water Quality Overview

Subbasin 04-05-01 at a Glance

Land and Water

Land area:	195 mi^2
Stream miles:	313.8
Lake acres:	3,629

Population Statistics

1990 Est. pop.:	7,445 people
Pop. density:	38 persons / mi^2

Land Cover (%)

Forest / Wetland:	69.0
Surface Water:	14.8
Urban:	2.5
Cultivated Crop:	6.9
Pasture / Managed Herbaceous:	6.8

The Hiwassee River originates in the mountains of Towns County, Georgia and flows northward. Near the NC/GA state line, the river is impounded to form Lake Chatuge. Larger tributaries to the Hiwassee River in this subbasin include Shooting Creek, Tusquitee Creek, Fires Creek and Brasstown Creek (which also originates in Georgia). Hayesville is the only municipality. A map of this subbasin including water quality sampling locations is presented as Figure B-1.

Bioclassifications for these sample locations are presented in Table B-1. Use support ratings for each applicable category in this subbasin are summarized in Tables B-2 and B-3. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

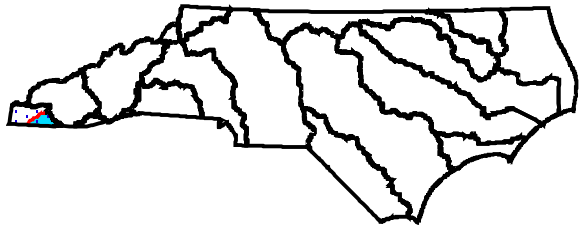
Generally, water quality in this subbasin is good. Two large watersheds are fairly undisturbed, undeveloped and protected mountain areas; almost all of Fires Creek and the headwaters of Tusquitee Creek, including Big Tuni Creek, are part of the Nantahala National Forest. The Fires Creek watershed is classified ORW, and most of the Tusquitee Creek watershed is HQW.

Most of the land within this subbasin is forested (70 percent), but cropland and pasture are also common (13 percent). Nearly fifteen percent of the area is surface water reflecting, in part, the 3,629 acres of Lake Chatuge. The subbasin population, based on the 1990 census, is 7,445. However, the population of Clay County, based on 2000 census data, is 8,775 and the majority of the county lies within this subbasin boundary. The population of Clay County is expected to increase 16 percent over the next twenty years (2000-2020).

There are three permitted dischargers in the subbasin. The Hayesville WWTP (operated by Clay County) had chronic problems meeting permitted limits for suspended solids over the most recent review period and historically experienced problems meeting limits for BOD, fecal coliform and flow. Clay County constructed a new WWTP in 1999 to replace the old Hayesville WWTP. The new plant has more capacity and discharges directly to the Hiwassee River.

Lake Chatuge is monitored by both DWQ and the Tennessee Valley Authority (TVA). The North Carolina portion of the lake is classified for the protection of aquatic life and secondary recreation, as well as primary recreation. It is currently fully supporting these designated uses.

Figure B-1 Hiwassee River Subbasin 04-05-01



Legend

- Subbasin Boundary
- Ambient Monitoring Station
- Benthic Station
- USGS Gaging Station
- County Boundary
- Primary Roads
- Hydrography
- Municipality

N W E S

2 0 2 4 6 Miles

NCDENR

Planning Branch
Basinwide & Estuary Planning Unit
October 23, 2001

Table B-1 DWQ Monitoring Locations and Benthic Macroinvertebrate Bioclassifications (1999) for Hiwassee River Subbasin 04-05-01

Site	Stream	County	Location	Bioclassification
Benthic Macroinvertebrates				
B-3	Shooting Creek	Clay	SR 1340	Good
B-8	Big Tuni Creek	Clay	SR 1311	Excellent
B-10	Tusquitee Creek	Clay	SR 1300	Excellent
B-16	Fires Creek	Clay	SR 1330	Excellent
B-20	Brasstown Creek	Clay	SR 1104	Good

Historical data are available for all of the benthic macroinvertebrate sample sites; refer to Appendix II.

Benthic macroinvertebrates have been collected from twenty sites in this subbasin since 1985. Two of the sites sampled in 1999, Fires Creek and Big Tuni Creek, have long-term data. Both streams continue to receive Excellent bioclassifications. Brasstown Creek showed an improvement in water quality between 1994 (Fair) and 1999 (Good). Shooting Creek also received a Good bioclassification in 1999. The few water quality problems encountered in this subbasin are related to nonpoint source runoff. Water quality in Brasstown Creek and Shooting Creek is discussed further in the following sections.

Some small fish kills were observed in Chatuge Lake in the summer of 1998 when dissolved oxygen (DO) concentrations were low in the reservoir. A larger kill (approximately 200 fish) was also observed during this hot dry period in the Hiwassee River below the dam. This kill was attributed to low DO as well. Chatuge Lake was sampled by DWQ in 1998 and 1999 and was found to be oligotrophic. Refer to Part 1.5.4 for further discussion of the Hiwassee River below Lake Chatuge.

For more detailed information on sampling and assessment of streams and lakes in this subbasin, refer to the *Basinwide Assessment Report - Hiwassee River Basin* (NCDENR-DWQ, April 2000), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-2 Use Support Ratings Summary (2000) for Monitored Lakes (acres) in Hiwassee River Subbasin 04-05-01

Use Support Category	FS	PS	NS	Total[1]
Aquatic Life/ Secondary Recreation	3,629.0	0.0	0.0	3,629.0
Fish Consumption	0.0	0.0	0.0	0.0
Primary Recreation	3,629.0	0.0	0.0	3,629.0
Water Supply	0.0	0.0	0.0	0.0

Table B-3 Use Support Ratings Summary (2000) for Monitored and Evaluated Freshwater Streams (miles) in Hiwassee River Subbasin 04-05-01

Use Support Category	FS	PS	NS	NR	Total[1]
Aquatic Life/ Secondary Recreation	216.1	0.0	0.0	97.7	313.8
Fish Consumption	313.8	0.0	0.0	0.0	313.8
Primary Recreation	2.6	0.0	0.0	0.0	2.6
Water Supply	30.0	0.0	0.0	0.0	30.0

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

1.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1997 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects directed towards improving water quality for each water. The 1997 Hiwassee River Basinwide Plan identified one impaired water in this subbasin: Brasstown Creek. This stream is no longer impaired and is discussed in further detail below.

1.2.1 Brasstown Creek (8.5 miles from the NC/GA state line to Hiwassee River)

1997 Recommendations

Brasstown Creek received a Fair bioclassification in 1994 and was rated partially supporting. Water quality appeared to be most degraded by nonpoint sources throughout the watershed, including runoff from the Town of Young Harris, GA, agricultural lands and NC 66 which follows the stream for most of its length. Elevated fecal coliform concentrations were attributed to problems with the Young Harris Water Pollution Control Plant upstream in Georgia. The 1997 basin plan recommended that DWQ work more closely with Georgia's Environmental Protection Division (EPD) to address problems with permitted discharges in the Georgia portion of the watershed.

Status of Progress

DWQ most recently sampled Brasstown Creek in 1999. Although instream habitat was still sparse and there was significant sedimentation, the benthic macroinvertebrate community showed a marked improvement (Good bioclassification). EPT taxa richness and abundance (indices of certain pollution intolerant indicator species) more than doubled over the five-year period. In 1994, flow in the stream was substantially higher, making this fairly difficult sampling site even more so. This may explain some of the difference between the bioclassifications; however, the majority of the water quality improvement in Brasstown Creek is likely due to efforts of local agencies and citizens (outlined below), funded in large part by the Clean Water Management Trust Fund. Brasstown Creek is no longer considered impaired.

In terms of point sources, DWQ has been working to establish a better relationship with Georgia EPD. Brasstown Creek, from Little Bald Cove to the GA/NC state line, is on the Georgia 303(d) list. The "action to alleviate" water quality problems in the stream in Georgia is for EPD to "address nonpoint sources through a watershed protection strategy". In 1993, Georgia began a River Basin Management Planning approach. River Basin Watershed Protection Plans have been developed for five of Georgia's fourteen river basins (http://www.state.ga.us/dnr/environ/ scroll down and click on water quality under "Georgia's Environment"). However, the draft "Tennessee River Basin Management Plan" that would cover streams flowing into NC will not be available until mid-2004.

DWQ is also working with GA EPD Water Protection Branch to establish a system whereby NC would be notified in the event of a spill or other event affecting waters flowing into the state from GA. GA currently has a similar arrangement with other surrounding states.

Current Water Quality Projects

The Hiwassee River Watershed Coalition is a nonprofit, grassroots organization made up of citizens from both Georgia and North Carolina, with a mission to improve water quality, in the upper Hiwassee River watershed. The coalition received $2.1 million from the Clean Water Management Trust Fund in 1999 for restoration work in the Brasstown Creek watershed.

In 1998, the Hiwassee River Nonpoint Source Team chose Little Brasstown Creek as one of two watersheds to implement nonpoint source pollution demonstration projects using Section 319 funds. Section C contains more information on these and other water quality improvement initiatives in the Hiwassee River basin.

1.3 Status and Recommendations for Newly Impaired Waters

No stream segments in this subbasin are rated as impaired based on recent DWQ monitoring (1994-1999). However, impacts to many streams from narrow riparian buffer zones, sedimentation and moderate to severe bank erosion were documented. Part 1.5 below discusses specific streams where these impacts were observed.

1.4 303(d) Listed Waters

Brasstown Creek (discussed above) is the only water listed on the state's year 2000 303(d) list. During this basinwide cycle, DWQ data documented water quality improvement that may allow this stream to be removed from the 303(d) list in 2002. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

1.5 Other Water Quality Concerns and Recommendations

The surface waters discussed in this section are fully supporting designated uses based on DWQ's use support assessment and are not considered to be impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not considered impaired, attention and resources should be focused on these waters over the next basinwide planning cycle to prevent additional degradation or

facilitate water quality improvement. A discussion of how impairment is determined can be found on page 43.

Water quality problems in the Hiwassee River basin are varied and complex. Inevitably, many of the water quality impacts noted are associated with 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. Voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns for the waters discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VI.

1.5.1 Shooting Creek

Sedimentation in Shooting Creek was noted in the 1997 basin plan. Although the stream received a Good bioclassification in 1999, pools filled with sand and silt and bank erosion were noted by DWQ biologists. This watershed continues to experience increasing pressure for residential development due to its close proximity to US Highway 64 and Chatuge Lake. The Shooting Creek arm of the lake is almost completely full of sediment. When the reservoir is drawn down during winter months, the flow in Shooting Creek carries sediment further into the main body of the lake. More information about and recommendations for reducing sedimentation and other forms of habitat degradation is presented beginning on page 49.

1.5.2 Town Creek

Although the Town Creek watershed is fairly small (less than two square miles), many different land uses have the potential to impact water quality. Because the stream is too small for DWQ to assign a bioclassification, the stream is not rated; however, Tennessee Valley Authority (TVA) data indicate water quality impacts in 1999 (refer to page 41). The 1997 basin plan discussed impacts to Town Creek from the Hayesville WWTP. In 1999, Clay County constructed a new facility to replace the old Hayesville WWTP, and the discharge was moved from Town Creek to the Hiwassee River. The new WWTP contains additional capacity for connecting homes and businesses with failing septic systems while allowing for future growth in Clay County. Clay County WWTP is required, through its NPDES permit, to monitor dissolved oxygen levels in the Hiwassee River above and below the discharge as well as actual discharge water.

In addition to the point source problems discussed above, habitat degradation also impacts water quality in Town Creek. The watershed is approximately 25 percent forested, 25 percent pasture, and about 50 percent urban area (Town of Hayesville). Habitat degradation is primarily a result of streambank erosion, loss of riparian vegetation, gully erosion from improperly routed stormwater runoff, and eroding road grades and roadside ditches. Impacts from beef cattle, questionable performance of septic systems, spills from municipal wastewater collection systems, and sediment from development activities are also likely contributing to water quality degradation (Southwestern RC&D, 1998). This watershed was targeted by the Hiwassee River Basin Nonpoint Source Team for nonpoint source pollution demonstration projects. Refer to

page 79 for further information regarding this locally managed water quality improvement initiative.

1.5.3 Hiwassee River (below Chatuge Dam)

The 1997 Hiwassee River basin plan discussed historical problems with low dissolved oxygen (DO) in the Hiwassee River below Chatuge Dam. TVA is not required to provide a minimum flow below this dam and a now discontinued USGS flow gage showed wide fluctuations in flow historically. The plan also reported that, in 1992, TVA constructed a reaeration weir in the Hiwassee River downstream of the dam to improve DO concentrations; however, it was designed to provide a minimum DO of 5.0 mg/l. DWQ recommended that Clay County monitor instream DO concentrations after the WWTP discharge was moved to the Hiwassee River.

Although DWQ did not monitor this portion of the Hiwassee River over the past five years, a fairly large fish kill (approximately 200 fish) was reported in the summer of 1998 in the Hiwassee River below Chatuge dam. This fish kill, as well as some smaller fish kills that were observed in Chatuge Lake, were attributed to low DO concentrations within the reservoir. [Page 41 discusses TVA data collected from Lake Chatuge in 1998 and 1999.]

In 1999, Clay County constructed a new facility to replace the old Hayesville WWTP and the discharge was moved from Town Creek to the Hiwassee River. Clay County WWTP is required, through its NPDES permit, to monitor dissolved oxygen levels in the Hiwassee River above and below the discharge as well as actual discharge water. DWQ will summarize these data for the next Hiwassee River basinwide water quality plan.

1.5.4 Hyatt Mill Creek
Blair Creek

Hyatt Mill Creek and Blair Creek were both brought up as problem areas by participants at the Hiwassee River Basin Water Quality Workshop in October 2000 (see Appendix V). These small streams are tributaries to the Hiwassee River below Lake Chatuge near Hayesville. The recommendations were for better sediment BMPs and better enforcement of current rules related to construction. TVA sampled these streams in 1999 (see page 41), and the biological community of each appears to be in good shape. Habitat scores, however, were fairly low. Nonpoint source pollution, including sedimentation, produces habitat degradation. Habitat degradation can eventually lead to impairment of aquatic life in streams. BMPs should be installed and maintained in these two watersheds to prevent further habitat degradation. Restoration activities may also be needed. Further information regarding habitat degradation is presented beginning on page 49.

Chapter 2 -
Hiwassee River Subbasin 04-05-02
Includes Hiwassee and Apalachia Lakes and Valley River

2.1 Water Quality Overview

Subbasin 04-05-02 at a Glance

Land and Water

Land area:	431 mi^2
Stream miles:	653.9
Lake acres:	1,974

Population Statistics

1990 Est. pop.:	19,278 people
Pop. density:	45 persons / mi^2

Land Cover (%)

Forest / Wetland:	69.4
Surface Water:	6.4
Urban:	2.0
Cultivated Crop:	4.4
Pasture / Managed Herbaceous:	17.8

This subbasin lies entirely within Cherokee County. Here the Hiwassee River is impounded to form Hiwassee Lake and Apalachia Lake before it leaves North Carolina, flowing west into Tennessee. The Valley River is the largest tributary in this subbasin. It flows in a southwesterly direction from Topton through Andrews, Marble and Tomatla to converge with the Hiwassee River near Murphy. Other tributaries include Nottely River, Hanging Dog Creek and Shuler Creek. A map of this subbasin including water quality sampling locations is presented as Figure B-2.

Bioclassifications for these sample locations are presented in Table B-4. Use support ratings for each applicable category in this subbasin are summarized in Tables B-5 and B-6. Refer to Appendix III for a complete listing of monitored waters and use support ratings.

Generally, water quality in this subbasin is good. The headwaters of many tributaries to the Valley River, as well as much of the land surrounding Hiwassee Lake is part of the Nantahala National Forest. Almost all of the Shuler Creek watershed is federal land also. Gipp Creek, a tributary to the Valley River, and its watershed is classified ORW.

Most of the land within this subbasin is forested (70 percent); however, pasture represents almost 18 percent of the land cover. While only two percent of the land falls into the urban category, almost all of it lies within the Valley River watershed, including Andrews and Murphy along US 19/129.

There are eight permitted dischargers in this subbasin, the largest of which are the Andrews and Murphy WWTPs. No significant compliance or toxicity problems were noted during the most recent review period. Part 2.5.2 contains further discussion about NPDES discharges in this subbasin.

Hiwassee and Apalachia Lakes are monitored by both DWQ and the Tennessee Valley Authority (TVA). The lakes are classified for the protection of aquatic life and secondary recreation as well as primary recreation. Both lakes are oligotrophic and currently fully supporting all designated uses.

Figure B-2 Hiwassee River Subbasin 04-05-02

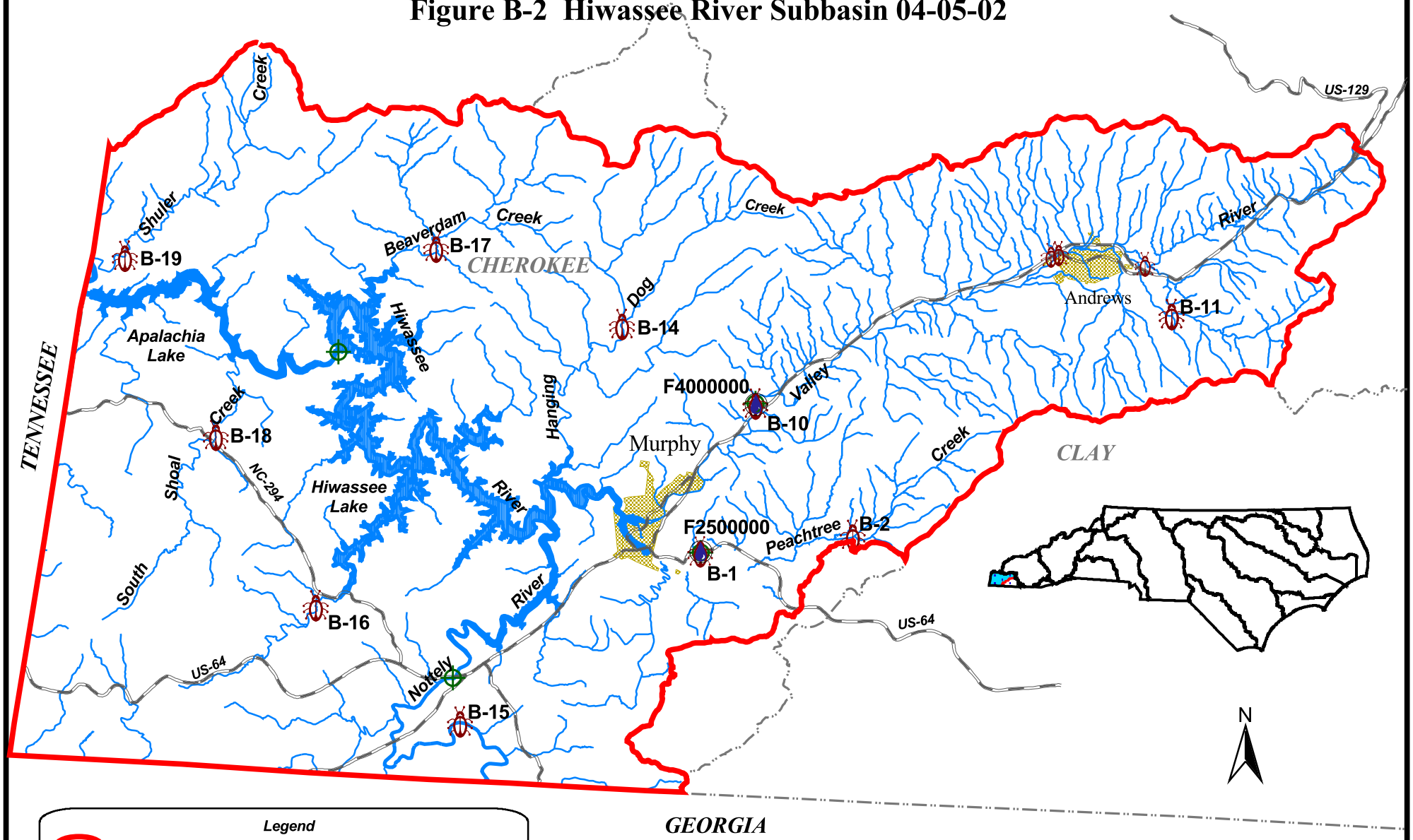


Table B-4 DWQ Monitoring Locations and Benthic Macroinvertebrate Bioclassifications (1999) for the Hiwassee River Subbasin 04-05-02

Site(s)	Stream	County	Location	Bioclassification
Benthic Macroinvertebrates				
B-1	Hiwassee River	Cherokee	US 64	Good
B-2	Peachtree Creek	Cherokee	SR 1537	Excellent
B-10	Valley River	Cherokee	SR 1555	Good-Fair
B-11	Junaluska Creek	Cherokee	SR 1505	Good
B-14	Hanging Dog Creek	Cherokee	SR 1331	Excellent
B-15	Nottely River	Cherokee	SR 1596	Good
B-16	Persimmon Creek	Cherokee	SR 1127	Excellent
B-17	Beaverdam Creek	Cherokee	SR 1326	Excellent
B-18	South Shoal Creek	Cherokee	SR 1314	Good
B-19	Shuler Creek	Cherokee	SR 1323	Excellent
Ambient Monitoring				
F2500000	Hiwassee River	Cherokee	Above Murphy	N/A
F4000000	Valley River	Cherokee	SR 1373 (Tomotla)	N/A

Historical data are available for all of the benthic macroinvertebrate sample sites; refer to Appendix II.

Benthic macroinvertebrates have been collected from nineteen sites in this subbasin since 1983. Two of the sites sampled in 1999, Valley River near Tomotla and the Hiwassee River at Murphy, have long-term data. Water quality has not fluctuated much through time at either site, the Hiwassee River maintaining a Good bioclassification and the Valley River a Good-Fair. Half of the streams sampled received an Excellent bioclassification. Nottely River declined from Excellent in 1994 to Good in 1999, while Shuler Creek improved from Good in 1994 to Excellent in 1999.

Two sites on the Valley River and one site on Webb Creek were also sampled in 1999 as part of a special study of streams on the state's 303(d) List. Webb Creek received a Good bioclassification and both Valley River sites received a Good-Fair.

Water chemistry samples are collected monthly from the Hiwassee River and the Valley River. These data have indicated good water quality. Fecal coliform bacteria (a pathogen indicator) concentrations at both stations have decreased significantly over time; however, concentrations in 12 percent of samples at the Valley River station were greater than 200 colonies per 100 ml.

For more detailed information on sampling and assessment of streams and lakes in this subbasin, refer to the *Basinwide Assessment Report - Hiwassee River Basin* (NCDENR-DWQ, April 2000), available from DWQ Environmental Sciences Branch at http://www.esb.enr.state.nc.us/bar.html or by calling (919) 733-9960.

Table B-5 Use Support Ratings Summary (2000) for Monitored Lakes (acres) in Hiwassee River Subbasin 04-05-02

Use Support Category	FS	PS	NS	Total[1]
Aquatic Life/ Secondary Recreation	7,218.8	0.0	0.0	7,218.8
Fish Consumption	0.0	0.0	0.0	0.0
Primary Recreation	7,218.8	0.0	0.0	7,218.8
Water Supply	0.0	0.0	0.0	0.0

Table B-6 Use Support Ratings Summary (2000) for Monitored and Evaluated Freshwater Streams (miles) in Hiwassee River Subbasin 04-05-02

Use Support Category	FS	PS	NS	NR	Total[1]
Aquatic Life/ Secondary Recreation	497.9	0.0	0.0	155.9	653.8
Fish Consumption	653.8	0.0	0.0	0.0	653.8
Primary Recreation	27.7	0.0	0.0	0.0	27.7
Water Supply	7.6	0.0	0.0	0.0	7.6

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

2.2 Status and Recommendations for Previously Impaired Waters

This section reviews use support and recommendations detailed in the 1997 basinwide plan, reports status of progress, gives recommendations for the next five-year cycle, and outlines current projects aimed at improving water quality for each water. The 1997 Hiwassee River Basinwide Plan identified two impaired waters in this subbasin: Valley River and Webb Creek. These streams are no longer impaired and are discussed in further detail below.

2.2.1 Valley River (19.6 miles from Rhodo to just above the landfill near Andrews)

1997 Recommendations

This portion of the Valley River near Andrews was rated partially supporting in 1994, based on Fair benthic macroinvertebrate bioclassifications from three sites in the 19.6-mile reach. The Andrews WWTP was having problems passing toxicity tests; however, nonpoint source pollution was also identified as contributing to the decline in water quality. The 1997 basin plan recommended that more investigation was needed to identify specific sources.

Status of Progress

DWQ worked extensively with local resource agencies, through the Hiwassee Interagency Team, to better understand land uses and water quality impacts in the Valley River watershed. The

Valley River begins near the Cherokee/Graham county line in predominately forested and low density residential conditions. The major highway (US 74/19/129) crosses back and forth over it as it follows the river down the valley. Land along the lower portion of tributaries is in agriculture, primarily pastureland. There are impacts from rock mining, stream alterations, wetland draining and road runoff.

By the time the Valley River gets to Andrews, it is receiving a large amount of road runoff from the highway (which is four lanes at Andrews), in addition to urban runoff from the town. Riparian vegetation is thin, and there is a large amount of streambank erosion. Instream habitat is mediocre. Benthic macroinvertebrate bioclassifications seem to fluctuate based on flow. Flows were above average in 1994, increasing the amount of nonpoint source runoff into the river, and bioclassifications were Fair. Flows in 1999 were below average and bioclassifications were Good-Fair.

It appears there is some recovery in the lower third of the watershed. The tributaries in this section are primarily forested, and there is not as much agriculture or developed areas. Ambient water chemistry shows few water quality concerns and benthic macroinvertebrate bioclassifications are Good-Fair, regardless of flow conditions.

In summary, the Valley River received Good-Fair bioclassifications at three sites in 1999. Therefore, it is no longer considered impaired. However, impacts to water quality from nonpoint sources of pollution in the watershed are still evident and need to be addressed. The Andrews WWTP had no significant compliance or toxicity problems during this basinwide cycle.

2002 Recommendations

DWQ should conduct more intensive sampling of the watershed, particularly on the tributaries, to try to better determine causes and sources of impacts to aquatic life in the mainstem Valley River. DWQ should also work with the Hiawassee River Watershed Coalition and local natural resource agency staff to prioritize protection and restoration efforts in the watershed based on the results of biological monitoring.

Current Water Quality Projects

The Hiawassee River Watershed Coalition is a nonprofit, grassroots organization made up of citizens from both Georgia and North Carolina, with a mission to improve water quality, in the upper Hiwassee River watershed. The coalition recently received a CWMTF grant for stream restoration projects in the Valley River watershed. Work is slated to begin in 2002. Further details and contact information for the coalition are presented on page 86.

2.2.2 Webb Creek (1.6 miles from source to Valley River)

1997 Recommendations

Webb Creek is listed on NC's 2000 303(d) List based on sedimentation impacts that were historically observed. DWQ planned to sample the stream in 1999.

Status of Progress

DWQ sampled Webb Creek in 1999 and the stream received a Good bioclassification. The watershed is primarily forested with a small amount of residential use. Little streambank erosion

and good instream habitat were observed (MacPherson, August 2001). This stream is currently fully supporting all designated uses.

2.3 Status and Recommendations for Newly Impaired Waters

No stream segments in this subbasin are rated as impaired based on recent DWQ monitoring (1994-1999). However, impacts to many streams from narrow riparian buffer zones, sedimentation and moderate to severe bank erosion were documented. Part 1.5 below discusses specific streams where these impacts were observed.

2.4 303(d) Listed Waters

Valley River and Webb Creek (discussed above) are the only waters listed on the state's year 2000 303(d) list. During this basinwide cycle, DWQ data documented water quality improvement that may allow these streams to be removed from the 303(d) list in 2002. Refer to Appendix IV for more information on the state's 303(d) list and listing requirements.

2.5 Other Water Quality Impacts and Recommendations

The surface waters discussed in this section are fully supporting designated uses based on DWQ's use support assessment and are not considered to be impaired. However, notable water quality problems and concerns have been documented for some waters based on this assessment. While these waters are not considered impaired, attention and resources should be focused on these waters over the next basinwide planning cycle to prevent additional degradation or facilitate water quality improvement. A discussion of how impairment is determined can be found on page 43.

Water quality problems in the Hiwassee River basin are varied and complex. Inevitably, many of the water quality impacts noted are associated with 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. Voluntary implementation of BMPs is encouraged and continued monitoring is recommended. DWQ will notify local agencies and others of water quality concerns for the waters discussed below and work with them to conduct further monitoring and to locate sources of water quality protection funding. Additionally, education on local water quality issues is always a useful tool to prevent water quality problems and to promote restoration efforts. Nonpoint source program agency contacts are listed in Appendix VI.

2.5.1 Nottely River

Although the bioclassification score for the Nottely River varied only slightly between 1999 and 1994, impacts were observed. Two groups of insects that indicate low dissolved oxygen conditions were abundant, and the water temperature was several degrees lower than at other sites sampled on the same day. Habitat degradation as a result of flow fluctuation was also noted by DWQ biologists. These impacts are all likely results of flow management and water quality from the Nottely Reservoir located upstream in Georgia.

The overall ecological condition of Nottely Reservoir rated poor based on 1999, 1997 and 1995 Tennessee Valley Authority (TVA) monitoring results. In 1999, the only indicator that received a high score was sediment. Data indicate increasing nutrient enrichment. Dissolved oxygen was low in as much as 50 percent of the water column from mid-August to mid-September. Benthic macroinvertebrate scores were also low. Problems with low dissolved oxygen have been observed in Nottely Lake every year since monitoring began in 1991 (TVA-Nottely, 1999).

Current Water Quality Projects
The Hiwassee River Watershed Coalition is a nonprofit, grassroots organization made up of citizens from both Georgia and North Carolina, with a mission to improve water quality, in the upper Hiwassee River watershed. The coalition recently received a two-year grant from the Georgia legislature to determine causes of environmental degradation in Nottely and Chatuge Reservoirs. Further details and contact information about the coalition are presented on page 86.

2.6 Additional Issues of Concern within this Subbasin

The previous part discussed water quality concerns for specific stream segments. This section discusses water quality issues related to multiple watersheds within subbasin 04-05-02. Problems with Murphy's WWTP and collection system were water quality impacts identified in the 1997 basin plan.

2.6.1 NPDES Discharges

The 1997 Hiwassee River Basin Plan reported that the Town of Murphy had substantial inflow and infiltration (I&I) problems that resulted in occasional raw wastewater discharges to the Hiwassee River. The town was under a flow moratorium for additional sewer hookups. Murphy was working with an engineering consulting firm to alleviate the I&I problems and was planning to pursue expanding the wastewater treatment plant.

The majority of the Town of Murphy's I&I problems have been resolved and the town is no longer under a sewer moratorium. A modified permit was issued in May 2000 which incorporated discharge limits for 1.4 MGD, in addition to the existing flow (0.925 MGD). In March 2001, the Construction Grants and Loans Section issued an Authorization to Construct for expansion to accommodate the additional capacity.

As was mentioned previously, no significant compliance or toxicity problems were noted during the most recent review period for this or any other permitted facility in this subbasin.

Section C

Current and Future Water Quality Initiatives

Chapter 1 -
Current Water Quality Initiatives

1.1 Workshop Summaries

One workshop was held in the Hiwassee River basin in Murphy on October 17, 2000. There were 18 people in attendance representing a variety of interests. Figure C-1 gives an estimation of groups/interests represented based on information recorded by participants on attendance sheets.

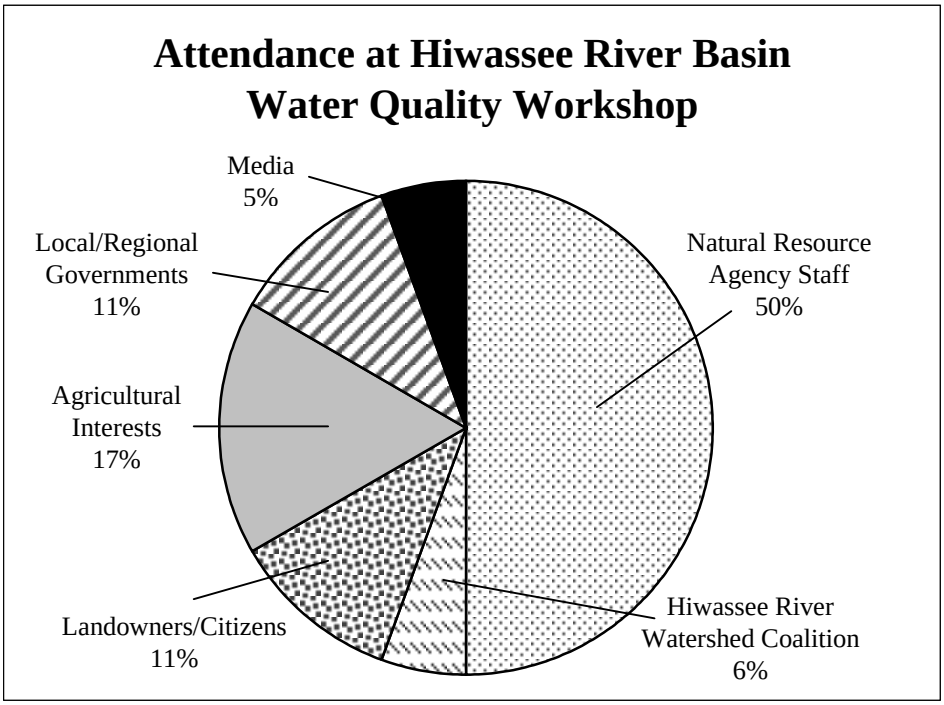


Figure C-1 Percent of Total Attendance by Various Interests at DWQ Water Quality Workshops in the Hiwassee River Basin (2000)

DWQ staff gave presentations about general water quality in the Hiwassee River basin, basinwide planning and the Wetlands Restoration Program. Participants at each workshop also gave brief presentations about local water quality initiatives. Workshop attendees were asked to discuss the following questions:

1. What are the main threats to water quality in the Hiwassee River basin?
2. Where are the problem areas or waters?
3. What recommendations do you have for addressing these problems/waters?
4. What local agencies or organizations should be involved in addressing the problems?

A detailed outline of discussion of these questions is provided in Appendix V.

Important Issues Basinwide

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

- Sedimentation (variety of sources)
- Nonpoint source pollution (agriculture, silviculture and urban runoff)
- Development
- Septic tanks and construction in floodplains
- Lack of public education regarding impacts to water quality and regulations

1.2 Federal Initiatives

1.2.1 Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration projects. Approximately $1 million is available annually for demonstration and education projects across the state. Project proposals are reviewed and selected by the North Carolina Nonpoint Source Workgroup, made up of state and federal agencies involved in regulation or research associated with nonpoint source pollution. Information on the North Carolina 319 grant program, including application deadlines and requests for proposals, is available online at http://h2o.enr.state.nc.us/nps/bigpic.htm.

The Hiwassee River Watershed Coalition and the Hiwassee River Nonpoint Source Team were partially funded (federal Section 319 money must be matched with nonfederal dollars) through the Section 319 base program between 1990 and 2000. The Southwestern Resource Conservation and Development Council, Inc. (RC&D), in cooperation with multiple partners that include the Hiwassee River Watershed Coalition, the Natural Resources Conservation Service (NRCS), and the Clay and Cherokee Soil and Water Conservation Districts, was granted $100,000 for demonstration projects to reduce nonpoint source pollution in the Town Creek and Little Brasstown Creek watersheds in 1998. A primary objective of this grant request was to involve many local individuals and agencies to promote effective and permanent conservation solutions for all riparian areas in the Hiwassee River basin.

NPS Demonstration Projects – Town Creek and Little Brasstown Creek Watersheds

The overall objective of this project is to demonstrate the whole watershed approach for implementing Best Management Practices (BMPs) aimed at minimizing several types of erosion to reduce sedimentation. The following BMPs were proposed for the Town Creek watershed:

- Streambank stabilization
  - ⇒ Stabilize at least 600 feet of streambank at a Clay County park and the Neal Cabe farm
  - ⇒ Exclude livestock on three private farms
- Control of urban runoff
  - ⇒ Install drop structure and pipe at Clay County park
  - ⇒ Repair gully behind school bus garage and control runoff from parking area and driveway on Clay County schools property

- ⇒ Repair gullies and possible construction of infiltration basin along main road on private property
- ⇒ Restore wetlands for educational opportunities behind Clay County school

- Stabilization of critical eroding upland areas on a total of seven acres involving Clay County and NC Department of Transportation property

The following BMPs were proposed for the Little Brasstown Creek watershed:

- Installation of grazing land demonstration project
- Streambank stabilization
  - ⇒ Identify and restore the most eroded streambanks (at least 1,000 feet watershed-wide)
  - ⇒ Determine innovative approaches for stabilization including bioengineering alternatives
- Upland erosion reduction from existing land uses
- Wildlife habitat and food source enhancement
- Education for local residents about streambank protection
- Coordination with the NC Department of Transportation to stabilize eroding road grades and roadside ditches throughout the watershed.

As of December 2000, approximately 75 percent of the work outlined above had been implemented. Most of the remaining work is in the Little Brasstown Creek watershed.

1.2.2 USDA – NRCS Environmental Quality Incentives Program (EQIP)

Authorized in the 1996 farm bill, the Environmental Quality Incentives Program (EQIP) provides technical assistance, cost share payments, incentive payments and education to producers to address a broad range of soil, water, air, wildlife and related natural resource concerns. This voluntary program provides assistance to farmers in complying with federal and state environmental laws and encourages environmental enhancement. Local workgroups, convened by individual Soil and Water Conservation Districts, identify the specific resource concerns to be addressed, set priority area goals, select cost share practices, establish ranking criteria for evaluating applications, and set their own schedule for approving applications.

In 2001, North Carolina had $3,689,400 available for cost sharing on installation of best management practices and educational assistance to producers. At least half of this funding is targeted to improving livestock operations. NRCS district contacts for the Hiwassee River basin are included on the Nonpoint Source contact sheet found in Appendix VI or visit the website at http://www.nc.nrcs.usda.gov/Programs/eqip.htm.

1.2.3 Tennessee Valley Authority

The quality of the water in the Tennessee River system affects not only the people who live in the valley, but also business and industry and the entire ecosystem's plant and animal life. In managing the watershed, the Tennessee Valley Authority (TVA) uses an integrated method that balances water quality with the other demands on the system.

Reservoir Ratings

TVA rates the condition of each reservoir based on five ecological indicators: algae, dissolved oxygen, fish, benthic macroinvertebrates and sediment.

Fish Populations

TVA and state agencies issue sport fishing ratings of the region's reservoirs, indicating the availability of important sport species. TVA's annual Catch Depletion Survey monitors the size and health of bass populations in 19 reservoirs.

Clean Water

TVA works with other agencies, communities and industries to improve water quality. Through its Clean Water Initiative, which began in 1992, TVA builds partnerships with community residents, businesses and government agencies to promote watershed protection. TVA's Watershed Teams are responsible for carrying out the program. They focus on improving water and shoreline conditions so that people and aquatic life can benefit from having clean water.

Among other accomplishments, these community coalitions have:

- Instituted agricultural and urban management practices that reduce water pollution.
- Treated eroded land and stabilized streambanks.
- Planted vegetation and installed structures intended to improve aquatic habitat.
- Collected waste and litter from streambanks and shores.

TVA's Clean Water Initiative served as a model for the development of the national Clean Water Action Plan announced by the Clinton-Gore administration in 1998. TVA was actively involved in developing the plan, which is designed to protect public health and restore the nation's waterways by helping communities form partnerships to address water quality problems.

Clean Marinas and Clean Boating

TVA's Tennessee Valley Clean Marina Initiative certifies marinas that are in compliance with pollution control standards. TVA is also an active participant in the national Clean Boating Campaign, helping educate boating enthusiasts and marina operators in practices that reduce pollution and erosion on the waterways.

Aiding Aquatic Life during Hydropower Production

Two conditions arising from hydropower production are harmful to fish and other forms of aquatic life: low levels of dissolved oxygen in the area just below a dam (called tailwater), and dry streambeds that sometimes result when hydro-generation is off.

In 1991, TVA undertook a $50 million tailwater improvements program to tackle these problems. It committed to providing minimum flows through all its dams, and it devised various

aeration methods to increase oxygen in the water. Studies show that the program has improved conditions for aquatic life in more than 300 miles of river and has resulted in a dramatic increase in tailwater fishing, which aids local economies.

For further information about TVA water quality programs in the Hiwassee River basin, contact Watershed Team member Rebecca Hayden by calling (423) 751-4266 or by email rlhayden@tva.gov. You may also visit the website at http://www.tva.gov/environment/water/.

1.3 State Initiatives

1.3.1 Clean Water Management Trust Fund

The Clean Water Management Trust Fund (CWMTF) offers approximately $40 million 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 Hiwassee River basin, one project has been funded for a total of $2.1 million. Refer to page 86 for details about this grant.

For more information on the CWMTF, contact Beth McGee by calling (919) 363-8257 or by email beth.mcgee@ncmail.net. You may also visit the website at http://www.cwmtf.net/.

1.3.2 NC Wetlands Restoration Program

The North Carolina Wetlands Restoration Program (NCWRP) is a nonregulatory program responsible for implementing wetland and stream restoration projects throughout the state. The major goal of the NCWRP is to restore or improve the vital functions provided by wetlands, streams and riparian buffer zones within the context of local watershed management and overall aquatic ecosystem health. These vital functions include water quality protection, erosion control, flood prevention, fisheries and wildlife habitat, and recreational opportunities. The NCWRP is not a grant program. Instead, it funds wetland, stream and riparian zone projects directly through the Wetlands Restoration Fund.

Restoration sites are targeted through the development and use of Watershed Restoration Plans (formerly called "Basinwide Wetland and Riparian Restoration Plans"). These plans are developed, in part, using information compiled in DWQ's Basinwide Water Quality Plans and Basinwide Assessment Reports. The NCWRP Plans evaluate resource data and existing water quality initiatives within local watersheds in order to select "Targeted Local Watersheds". Targeted Local Watersheds are areas with the greatest need and opportunity for stream and wetlands restoration efforts and where NCWRP resources can be most efficiently focused for maximum restoration benefit. The NCWRP Watershed Restoration Plans are updated every five years, generally on the same timeline as DWQ's Basinwide Water Quality Plans.

Table C-1 lists the NCWRP's draft targeted Local Watersheds in the Hiwassee River basin. Other agencies, individuals and private groups are encouraged to target their search for restoration projects within these local watersheds.

Table C-1 Wetlands Restoration Program Targeted Local Watersheds (2001)

Subbasin	Targeted Local Watershed Name(s)	Targeted Local Watershed Number(s)*
04-05-01	Shooting Creek	50020
04-05-01	Brasstown Creek	90010
04-05-02	Valley River1	00010
04-05-02	Valley River2	00020
04-05-02	Valley River3	00030

* The numbers listed are the last five digits of the 14-digit Hydrologic Unit (HU) for each Local Watershed. The first nine digits for each watershed are 060200020.

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 Nonpoint Source Program. Integrating wetlands and riparian restoration components with 319 funded and/or Clean Water Management Trust Fund projects will often optimize the overall water quality benefits within a given watershed.

The NCWRP actively seeks landowners [both public and private] within the Hiwassee River basin who have potentially restorable stream, wetland or riparian buffer sites. For more information about participating in the NCWRP, please contact Crystal Braswell at (919) 733-5208 or visit the website at http://h2o.enr.state.nc.us/, then click on Wetlands Restoration Program.

1.3.3 Wildlife Resources Commission – Habitat Conservation Program

The Wildlife Resources Commission (WRC) Division of Inland Fisheries manages the state's freshwater fisheries through fisheries research, fisheries management, hatchery operation and habitat conservation.

During the past biennium (July 1994 - June 1996), habitat conservation biologists reviewed 4,000 proposed projects statewide and evaluated the potential environmental threats associated with each project. WRC recommended project design modifications to minimize adverse environmental impacts and also recommended mitigation to compensate for unavoidable impacts. Evaluations of the program's effectiveness in influencing permit conditions were completed in both 1994 and 1995. WRC was able to influence permit conditions 70 percent of the time in 1994. In 1995, the success rate increased to 80 percent.

In the mountain region, frequent and severe flooding has resulted in damage to many streams from debris blockages and erosion. WRC reviewed numerous proposals for work in streams sponsored by the Natural Resources Conservation Service (NRCS) as part of their Emergency Watershed Protection Program (EWP). EWP provides assistance to landowners to relieve imminent hazards to life and property from floods and other natural disasters. These activities have the potential to degrade aquatic habitat, especially in trout streams, besides being short-term solutions to large problems in a watershed. As a result, the NRCS has joined staff of the Wildlife Resources Commission and other state and federal agencies to examine more environmentally

sound methods of stream restoration. Interagency flood response teams are being developed to respond rapidly to landowner needs while taking into account natural tendencies of streams and protection of aquatic habitat.

During the biennium, biologists also reviewed 366 highway improvement projects and in many cases recommended design modifications or alignment shifts to minimize impacts to wildlife and fishery habitats. Linear roadway projects often have multiple stream crossings and can affect many different habitat types.

WRC works closely with the NC Department of Transportation (NCDOT) to develop mitigation strategies to offset this loss of wildlife and fisheries habitat. WRC identifies areas that should be preserved and helps restore habitat on previously disturbed areas. In the mountain region, one large highway project can result in as much as 10,000 feet of high quality streams, either trout streams or tributaries to trout streams, to be placed in culverts. As mitigation for this loss of high quality fishery habitat, the NCDOT has agreed to set up a restoration fund to be administered by WRC for restoration of approximately 25,000 linear feet of degraded streams. Ultimately, the restoration will involve bank stabilization, fencing livestock out of the stream, revegetating streambanks, installing fish habitat enhancing devices, and purchasing conservation easements to protect the areas that have been restored.

For more information, contact the Division of Inland Fisheries by calling (919) 733-3633 ext. 281 or visit the Wildlife Resources Commission website at http://www.state.nc.us/Wildlife/.

1.3.4 NC Agricultural Cost Share Program

The North Carolina Agriculture Cost Share Program was established in 1984 to help reduce the sources of agricultural nonpoint source pollution to the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using Best Management Practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The Agriculture Cost Share Program is a voluntary program that reimburses farmers up to 75 percent of the cost of installing an approved BMP. The cost share funds are paid to the farmer once the planned control measures and technical specifications are completed. The annual statewide budget for BMP cost sharing is approximately $6.9 million.

Approximately $685,400 were expended in the Hiwassee River basin from 1995 through 1999 on a wide variety of nonpoint source pollution reduction projects. Figure C-2 presents Agriculture Cost Share Program dollars spent over the five-year period for each county in the North Carolina portion of the basin.

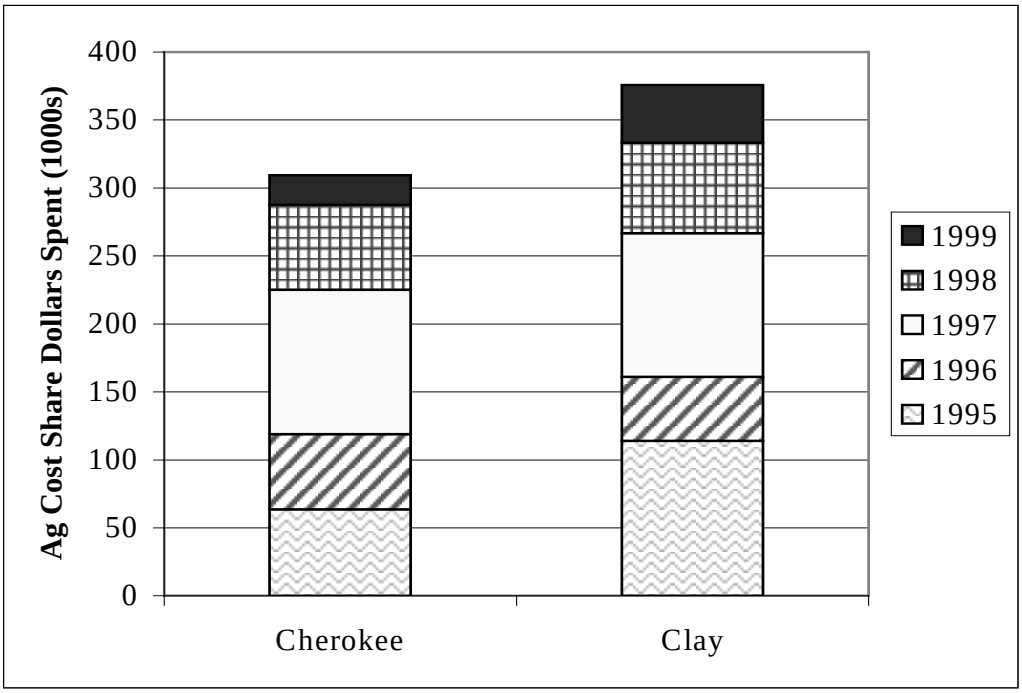


Figure C-2 Agriculture Cost Share Program Dollars Expended (1995-1999) in Counties in the Hiwassee River Basin (Source: NC Division of Soil and Water Conservation)

Soil and Water Conservation District contacts for the Hiwassee River basin are included in Appendix VI or visit the website at http://www.enr.state.nc.us/DSWC/files/acs.htm for more information.

1.4 Regional Initiatives

1.4.1 Hiwassee Interagency Team

The Hiwassee Interagency Team was initiated in the late 1990s as a project of the Southeastern Natural Resources Leadership Group (SENRLG) as a way to increase communication between federal agency staff working in the Hiwassee River basin. The Hiwassee Interagency Team today is made up of federal and state natural resource agency staff from North Carolina, Tennessee and Georgia, as well as a representative from the Hiawassee River Watershed Coalition. The team meets quarterly to discuss water quality concerns and improvement projects in the entire Hiwassee River basin. Individual projects are also identified through the team with participating agencies sharing the cost of implementation. DWQ participates on this team and has found that it allows a good mechanism for coordination of monitoring and sharing of information.

1.4.2 The Nature Conservancy

The Nature Conservancy works with members, contributors and partners to acquire endangered land. Some of this land, around 71,000 acres, is owned or managed by the NC Chapter. Other sites are acquired on behalf of state and federal conservation agencies to be placed in public ownership.

The North Carolina Chapter works in conjunction with the NC Natural Heritage Program (a Division of the State Parks system) to identify and inventory unique natural areas and habitats. The chapter establishes protection priorities based on information gathered by the Heritage Program. In the Hiwassee River basin, The Nature Conservancy is working to protect several important areas.

For further information about The Nature Conservancy projects in the mountain region of North Carolina, contact Mountains District Coordinator, Beth Bockoven, by calling (828) 749-1700 or email bbockoven@tnc.org.

1.5 Local Initiatives

1.5.1 Hiawassee River Watershed Coalition

The Hiwassee River Watershed Coalition is a nonprofit, grassroots organization made up of citizens from both Georgia and North Carolina. The coalition's mission is to facilitate and coordinate water quality efforts throughout the Hiwassee River watershed, across political boundaries, while still honoring local initiatives. Recognizing that growth and development are increasing, the coalition promotes and encourages good development practices to maintain water quality for the future.

In 1999, the coalition was awarded a three-year, $2.1 million grant from the Clean Water Management Trust Fund (CWMTF) for stream restoration projects in the Brasstown Creek watershed. The coalition and its partners achieved more than 90 percent of the goals set forth in the grant proposal within the first two years of work. In 2001, the Georgia legislature awarded the coalition a two-year grant to determine causes of environmental degradation in Chatuge and Nottely Reservoirs. The coalition partnered with the Tennessee Valley Authority (page 80) to begin work on this grant in the fall of 2001. Most recently, the coalition received a second CWMTF grant for stream restoration projects in the Valley River watershed. Work is slated to begin in 2002.

The coalition also coordinates an Adopt-A-Stream Program in the basin and provides environmental education information and outreach activities in the area. Additionally, the coalition participates with both the Hiwassee River Nonpoint Source Team (page 79) and the Hiwassee Interagency Team (page 85). For more information about the Hiawassee River Watershed Coalition, contact Executive Director, Lucy Gratton, or Field Director, Robert Wallus, by calling (706) 896-8091.

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-application of 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 as a means of providing the 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. The program will catalyze voluntary efforts by stakeholder groups in impaired watersheds to restore those waters by providing various incentives and other support. For locations where local groups choose not to take responsibility for restoring their impairments, the program will consider the option of developing a set of mandatory requirements for NPS pollution categories.

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. 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, DWQ may be able to catalyze large-scale restoration of impaired waters. DWQ anticipates 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 Divisions of Environmental Health and Land Resources and 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 significant.

Additional Research and Monitoring Needs

Some additional research needs that would be useful for assessing, protecting and restoring the water quality of the Hiwassee River basin were identified while this plan was being updated. The following list is not inclusive. Rather, it is meant to stimulate ideas for obtaining more information to better address water quality problems in the basin. It may be desirable for grant applicants to focus proposals on the following issues:

- *More resources are needed to address nonpoint sources of pollution*. Identifying nonpoint sources of pollution and developing management strategies for impaired waters, given the current limited resources available, is an overwhelming task. Therefore, only limited progress towards restoring NPS impaired waters can be expected unless substantial resources are put towards solving NPS problems.
- *Urban planning is needed (specifically in the Andrews and Murphy areas along Hwy. 74)*. Increasing population in these areas will demand more water and generate more wastewater. In addition, conversion of land from forests and farms will increase impervious surfaces, producing higher than natural streamflows and causing erosion. Streams in these areas will likely remain (or become) impaired unless this growth is planned for and managed properly.
- *More education is needed about water quality issues in general*. Education for developers, realtors and other citizens about erosion control and BMPs for reducing sedimentation is needed throughout the basin. Many construction contractors attended the "Clear Water Contractor" workshops held in 2000 to educate heavy equipment operators regarding erosion control. However, more general education of this nature is needed.
- *Study of existing and new septic system impacts*. Approximately 500 septic tank permits were issued in Cherokee County in 2000. Identification of failing septic systems is needed throughout the basin, along with identification of general areas that contain marginal or unsuitable soils for this type of waste treatment. More resources are needed to monitor watershed areas that contain a large number of septic systems so that problems can be corrected as they arise.

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 as well as 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 an 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. To review the Scope of Work for the enforcement assessment, see DENR's web page at http://www.enr.state.nc.us/novs/scope.htm/.

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Appendix I

NPDES Dischargers in the Hiwassee River Basin

NPDES Dischargers in the Hiwassee River Basin

Permit	Facility	County	Region	Type	D1	D2	D3	D4	MGD	Subbasin	Receiving Stream
NC0026697	Clay Co Water & Sewer	Clay	Asheville	Minor Municipal	1				0.3	04-05-01	Hiwassee River
NC0027332	TVA - Chatuge Hydro Plant	Clay	Asheville	Minor Non-Municipal	48				not limited	04-05-01	Hiawassee River
NC0021148	USDA - Jackrabbit Mountain Rec. Area	Clay	Asheville	Minor Non-Municipal	13				0.013	04-05-01	Chatuge Lake (Hiwassee River)
NC0069892	Andrews, Town - WTP	Cherokee	Asheville	Minor Non-Municipal	21				not limited	04-05-02	UT Dan Holland Creek
NC0020800	Andrews, Town - WWTP	Cherokee	Asheville	Major Municipal	1	40	57	19	1.5	04-05-02	Valley River
NC0035386	Cherokee Co School - Hiwassee Dam	Cherokee	Asheville	Minor Non-Municipal	3				0.0088	04-05-02	Thompson Branch
NC0023001	CWS - Bear Paw	Cherokee	Asheville	Minor Non-Municipal	13	6			0.08	04-05-02	Hiwassee River (Apalachia Lake)
NC0079031	Industrial Opportunities, Inc.	Cherokee	Asheville	Minor Non-Municipal	2				0.003	04-05-02	Hyatt Creek
NC0020940	Murphy (Town) - WWTP	Cherokee	Asheville	Major Municipal	1	57			0.925	04-05-02	Hiwassee River (Hiwassee Lake)
NC0027359	TVA - Hiwassee Hydro Plant	Cherokee	Asheville	Minor Non-Municipal	48				not limited	04-05-02	Hiwassee River

NPDES Discharge Codes (D1-D5) Indicating Types of Wastewater Discharged

1	Domestic	Municipal
2	Domestic	Industrial/Commercial
3	Domestic	Schools
4	Domestic	
6	Domestic	
10	Domestic	Restaurants
13	Domestic	Lodging (hotels, motels, campgrounds, rest areas)
19	Wood products	
21	Water plants	Surface water
40	Laundry waste	
48	Hydroelectric turbines	
57	Metal finishing	

Appendix II

Biological Water Quality Data Collected by DWQ

- **Benthic Macroinvertebrate Collections**
- **Lakes Assessment**

Benthic Macroinvertebrate Sampling Methodology and Bioclassification Criteria

Benthic macroinvertebrates can be collected using two sampling procedures. DWQ's standard qualitative sampling procedure includes 10 composite samples: two kick-net samples, three bank sweeps, two rock or log washes, one sand sample, one leafpack sample, and visual collections from large rocks and logs. The purpose of these collections is to inventory the aquatic fauna and produce an indication of relative abundance for each taxon. Organisms are classified as Rare (1-2 specimens), Common (3-9 specimens) or Abundant (≥10 specimens).

Several data analysis summaries (metrics) can be produced from standard qualitative samples to detect water quality problems. These metrics are based on the idea that unimpaired streams and rivers have many invertebrate taxa and are dominated by intolerant species. Conversely, polluted streams have fewer numbers of invertebrate taxa and are dominated by tolerant species. The diversity of the invertebrate fauna is evaluated using taxa richness counts; the tolerance of the stream community is evaluated using a biotic index.

EPT taxa richness (EPT S) is used with DWQ criteria to assign water quality ratings (bioclassifications). "EPT" is an abbreviation for Ephemeroptera + Plecoptera + Trichoptera, insect groups that are generally intolerant of many kinds of pollution. Higher EPT taxa richness values usually indicate better water quality. Water quality ratings are also based on the relative tolerance of the macroinvertebrate community as summarized by the North Carolina Biotic Index (NCBI). Both tolerance values for individual species and the final biotic index values have a range of 0-10, with higher numbers indicating more tolerant species or more polluted conditions.

Water quality ratings assigned with the biotic index numbers are combined with EPT taxa richness ratings to produce a final bioclassification, using criteria for mountain/piedmont/coastal plain streams. EPT abundance (EPT N) and total taxa richness calculations also are used to help examine between-site differences in water quality. If the EPT taxa richness rating and the biotic index differ by one bioclassification, the EPT abundance value is used to determine the final site rating.

Benthic macroinvertebrates can also be collected using the DWQ's EPT sampling procedure. Four composite samples are taken at each site instead of the 10 taken for the qualitative sample: 1 kick, 1 sweep, 1 leafpack and visual collections. Only intolerant EPT groups are collected and identified, and only EPT criteria are used to assign a bioclassification.

The expected EPT taxa richness values are lower in small high quality mountain streams, <4 meters in width or with a drainage area <3.5 square miles. For these small mountain streams, an adjustment to the EPT taxa richness values is made prior to applying taxa richness criteria. Both EPT taxa richness and biotic index values also can be affected by seasonal changes. DWQ criteria for assigning bioclassification are based on summer sampling (June-September). For samples collected in other seasons, EPT taxa richness can be adjusted. The biotic index values can also be seasonally adjusted for samples collected outside the summer season.

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to each benthic sample. These bioclassifications primarily reflect the influence of chemical pollutants. The major physical pollutant, sediment, is not assessed as well by a taxa richness analysis.

Flow Measurement

Changes in the benthic macroinvertebrate community are often used to help assess between-year changes in water quality. However, some between-year changes in the macroinvertebrate community may be due largely to changes in flow. High flow years magnify the potential effects of nonpoint source runoff, leading to scour, substrate instability and reduced periphyton. Low flow years may accentuate the effects of point source dischargers by providing less dilution of wastes.

For these reasons, all between-year changes in the biological communities are considered in light of flow conditions (high, low or normal) for one month prior to the sampling date. Daily flow information is obtained from the closest available USGS monitoring site and compared to the long-term mean flows. High flow is defined as a mean flow >140% of the long-term mean for that time period, usually July or August. Low flow is defined as a mean flow <60% of the long-term mean, while normal flow is 60-140% of the mean. While broad scale regional patterns are often observed, there may be large geographical variation within the state and large variation within a single summer period.

Habitat Evaluation

DWQ has developed a habitat assessment form to better evaluate the physical habitat of a stream. The habitat score has a potential range of 1-100, based on evaluation of channel modification, amount of instream habitat, type of bottom substrate, pool variety, bank stability, light penetration and riparian zone width. Higher numbers suggest better habitat quality, but no criteria have been developed for assigning ratings indicating Excellent, Good, Fair or Poor habitat.

Table A-II-1 Benthic Macroinvertebrate Data Collected in the Hiwassee River Basin, 1983 - 1999 (Current basinwide monitoring sites are bolded.)

Subbasin/ Stream	Location	County	Map No. [1]	Index No.	Date	S/ EPT S	NCBI EPT BI	Bio Class [1]
04-05-01								
Shooting Cr (above chicken farm)	SR 1349	Clay	B-1	1-5	08/94	68/37	2.97/2.22	G
Shooting Cr (below confluence of UT)	SR 1168	Clay	B-2	1-5	08/94	59/28	3.24/2.73	G
Shooting Cr	**SR 1340**	**Clay**	**B-3**	**1-5**	**08/99**	**-/30**	**-/2.57**	**G**
					07/94	-/32	-/2.36	G
Tusquitee Cr (above trout farm)	Off SR 1307	Clay	B-4	1-21-(0.5)	03/89	-/35	-/2.14	G
Tusquitee Cr (above Big Tuni Cr)	SR 1307	Clay	B-5	1-21-(0.5)	03/89	-/49	-/2.49	E
Tusquitee Cr	SR 1330	Clay	B-6	1-21-(4.5)	07/94	69/33	3.79/2.82	G
					03/89	-/45	-/2.25	E
					04/87	95/53	3.24/2.47	E
					05/87	101/51	3.23/2.33	E
Big Tuni Cr (headwaters)	USFS Rd 440	Clay	B-7	1-21-5	03/89	-/46	-/1.46	E[2]
					06/88	-/41	-/1.24	E
					04/88	-/39	-/1.37	E
					05/87	90/46	2.19/1.34	E
					04/87	77/38	2.06/1.44	E
Big Tuni Cr	**SR 1311**	**Clay**	**B-8**	**1-21-5**	**08/99**	**-/45**	**-/1.63**	**E**
					07/94	63/37	2.11/1.57	E
					03/89	83/45	2.89/2.10	E
Johnson Mill Cr	SR 1307	Clay	B-9	1-21-13	03/89	-/42	-/1.71	E
Tusquitee Cr	**SR 1300**	**Clay**	**B-10**	**1-21-(16.5)**	**08/99**	**82/39**	**3.56/2.81**	**E**
					03/89	90/47	3.12/2.37	E
Greasy Cr	SR 1318	Clay	B-11	1-21-20-(2)	03/89	-/38	-/2.38	G[3]
Albone Cr	SR 1300	Clay	B-12	1-24	05/87	79/37	2.96/1.80	E[3]
					04/87	77/38	3.15/2.10	E[3]
Fires Cr (headwaters)	USFS Rd C	Clay	B-13	1-27-(0.5)	06/88	-/35	-/1.15	E[3]
					04/88	-/39	-/1.19	E[3]
Coldspring Br	USFS Rd	Clay	B14	1-27-4-3	06/88	-/39	-/1.90	E
					04/88	-/37	-/1.33	E
Fires Cr (at Bristol Camp)	Off SR 1344	Clay	B-15	1-27-(5.5)	07/94	80/43	2.73/1.77	E
					06/88	102/47	3.06/1.75	E
					04/88	103/54	2.70/1.72	E
					05/87	95/52	2.95/1.97	E
Fires Cr (at picnic area)		**Clay**	**B-16**	**1-27-(5.5)**	**08/99**	**77/44**	**2.98/2.48**	**E**
					08/94	81/36	3.58/2.39	G
					07/94	-/35	-/1.78	G
					08/88	107/54	3.54/2.61	E
					04/88	-/48	-/1.47	E
					05/87	113/58	2.89/2.03	E
					04/87	101/54	2.68/1.97	E
					08/85	111/50	4.03/2.37	E
Fires Cr	SR 1300	Clay	B-17	1-27-(5.5)	05/87	-/41	-/2.14	E
					04/87	-/43	-/2.27	E
L Fires Cr (near mouth)	USFS Rd	Clay	B-18	1-27-7	12/91	-/34	-/1.75	E
					06/88	-/38	-/1.46	E
					04/88	-/37	-/1.43	E
Leatherwood Br	USFS Rd	Clay	B-19	1-27-12	06/88	-/30	-/2.25	E[2]
					04/88	-/34	-/1.78	E[2]
					05/87	60/30	2.81/1.80	E[2]
					04/87	58/34	2.12/1.44	E[2]
Brasstown Cr	**SR 1104**	**Clay**	**B-20**	**1-42**	**08/99**	**77/44**	**4.63/3.88**	**G**
					07/94	-/18	-/4.41	F

Subbasin/ Stream	Location	County	Map No.[1]	Index No.	Date	S/ EPT S	NCBI EPT BI	Bio Class[1]
04-05-02								
Hiwassee R (near Murphy)	**US 64**	**Cherokee**	**B-1**	**1-(43.7)**	**08/99**	**73/36**	**4.42/3.53**	**G**
					08/90	79/38	4.43/3.40	G
					08/87	78/35	4.77/3.47	G
					07/86	65/32	4.97/3.98	G-F
					08/85	56/25	4.49/3.77	G
					08/84	67/29	4.60/3.56	G
					08/83	62/23	4.77/3.62	G-F
Peachtree Cr	**SR 1537**	**Cherokee**	**B-2**	**1-44**	**08/99**	**-/38**	**-/2.91**	**E**
					07/94	-/37	-/2.42	E
Valley R (near Rhodo)	Off US 19	Cherokee	B-3	1-52	08/94	-/23	-/2.84	G-F
Valley R (above Andrews)	SR 1389	Cherokee	B-4	1-52	08/94	-/15	-/3.30	F
Valley R (above WWTP)	Bus. US 19	Cherokee	B-5	1-52	08/99	-/24	-/4.75	G-F
					08/94	40/6	5.97/2.47	F
Valley R (above Andrews WWTP)		Cherokee	B-6	1-52	08/85	76/33	5.34/3.97	G-F
Valley R (below Andrews WWTP)		Cherokee	B-7	1-52	08/85	75/30	5.72/3.86	G-F
Valley R (above landfill)	Off US 19	Cherokee	B-8	1-52	08/94	57/13	5.51/4.00	F
Valley R (below landfill)	Off SR 1315	Cherokee	B-9	1-52	08/99	63/28	5.26/4.49	G-F
Valley R (near Tomotla)	**SR 1554**	**Cherokee**	**B-10**	**1-52**	**08/99**	**80/33**	**5.15/4.27**	**G-F**
					07/94	77/29	5.05/4.37	G-F
					08/90	87/33	4.75/3.88	G
					08/88	91/33	5.02/4.29	G-F
					07/86	71/28	5.60/4.04	G-F
					08/84	70/26	5.05/4.16	G-F
Junaluska Cr	**SR 1505**	**Cherokee**	**B-11**	**1-52-25**	**08/99**	**-/31**	**-/3.22**	**G**
					07/94	-/25	-/2.11	G-F
					08/94	-/22	-/2.50	G-F
Britton Cr (near SR 1339)	Off USFS Rd	Cherokee	B-12	1-52-29-(1)	12/91	-/35	-/1.54	E
Webb Cr	SR 1428,	Cherokee	B-13	1-52-32	08/99	58/37	3.21/2.80	G
Hanging Dog Cr	**SR 1331**	**Cherokee**	**B-14**	**1-57**	**08/99**	**-/40**	**-/2.62**	**E**
					07/94	-/46	-/2.49	E
Nottely R	**SR 1596**	**Cherokee**	**B-15**	**1-58**	**08/99**	**-/33**	**-/3.54**	**G**
					07/94	-/36	-/2.83	E
Persimmon Cr	**SR 1127**	**Cherokee**	**B-16**	**1-63**	**08/99**	**-/40**	**-/3.65**	**E**
					07/94	-/42	-/2.97	E
Beaverdam Cr	**SR 1326**	**Cherokee**	**B-17**	**1-72**	**08/99**	**-/38**	**-/2.76**	**E**
					08/94	-/39	-/2.45	E
South Shoal Cr	**SR 1314**	**Cherokee**	**B-18**	**1-77**	**0/899**	**-/33**	**-/2.55**	**G**
					08/94	-/30	-/2.40	G
Shuler Cr	**SR 1323**	**Cherokee**	**B-19**	**1-86**	**08/99**	**-/40**	**-/2.78**	**E**
					08/94	-/35	-/2.42	G

[1] E = Excellent, G = Good, G-F = Good-Fair, and F = Fair.

[2] Small stream criteria.

Lakes Assessment

Numerical indices are often used to evaluate the trophic state of lakes. An index was developed specifically for North Carolina lakes as part of the state's original Clean Lakes Classification Survey (NCDNRCD, 1982). The North Carolina Trophic State Index (NCTSI) is based on total phosphorus (TP in mg/l), total organic nitrogen (TON in mg/l), Secchi depth (SD in inches), and chlorophyll *a* (CHL in µg/L). Lakewide means for these parameters are used to produce a NCTSI score for each lake, using the equations:

TON_{Score} = ((Log (TON) + 0.45)/0.24)*0.90

TP_{Score} = ((Log (TP) + 1.55)/0.35)*0.92

SD_{Score} = ((Log (SD) – 1.73)/0.35)*-0.82

CHL_{Score} = ((Log (CHL) – 1.00)/0.48)*0.83

NCTSI = $TON_{Score} + TP_{Score} + SD_{Score} + CHL_{Score}$

In general, NCTSI scores relate to trophic classifications (Table L1). When scores border between classes, best professional judgment is used to assign an appropriate classification. NCTSI scores may be skewed by highly colored water typical of dystrophic lakes. Some variation in the trophic state of a lake between years is not unusual because of the potential variability of data collections which usually involve sampling a limited number of times during the growing season.

Table L1 Lakes Classification Criteria

NCTSI Score	Trophic Classification
< -2.0	Oligotrophic
-2.0 – 0.0	Mesotrophic
0.0 – 5.0	Eutrophic
> 5.0	Hypereutrophic

Lakes are classified for their "best usage" and are subject to the state's water quality standards. Primary classifications are C (suited for aquatic life propagation /protection and secondary recreation such as wading), B (primary recreation, such as swimming, and all Class C uses), and WS-I through WS-V (water supply source ranging from highest watershed protection level I to lowest watershed protection V, and all Class C uses).

Lakes with a CA designation represent water supplies with watersheds that are considered Critical Areas (i.e., an area within 0.5 mile and draining to water supplies from the normal pool elevation of reservoirs, or within 0.5 mile and draining to a river intake).

Supplemental classifications may include HQW (High Quality Waters which are rated excellent based on biological and physical/chemical characteristics) and ORW (Outstanding Resource Waters which are unique and special waters of exceptional state or national recreational or ecological value). A complete listing of these water classifications and standards can be found in Title 15 North Carolina Administrative Code, Chapter 2B, Section .0100 and .0200.

Appendix III

Use Support Methodology
and
Use Support Ratings

Multiple-Category Use Support Methods

DRAFT December 11, 2001

A. Introduction to Use Support

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

Surface waters are rated *fully supporting* (FS), *partially supporting* (PS) or *not supporting* (NS). The ratings refer to whether the classified uses of the water (i.e., aquatic life protection, primary recreation and water supply) are being met. For example, waters classified for fishing, aquatic life protection and secondary recreation (Class C for freshwater or SC for saltwater) are rated FS if data used to determine use support meet certain criteria. However, if these criteria were not met, then the waters would be rated as PS or NS, depending on the degree of degradation. Waters rated PS or NS are considered to be impaired. Waters lacking data, or having inconclusive data, are listed as not rated (NR). More specific methods are presented in Part C of this appendix.

Historically, the non-impaired category was subdivided into fully supporting and fully supporting but threatened (ST). ST was used to identify waters that were fully supporting but had some notable water quality concerns and could represent constant, degrading or improving conditions. North Carolina's past use of ST was very different from that of the US Environmental Protection Agency (EPA), which uses it to identify waters that demonstrate declining water quality (EPA Guidelines for Preparation of the Comprehensive State Water Quality Assessments [305(b) Reports] and Electronic Updates, 1997). Given the difference between the EPA and North Carolina definitions of ST and the resulting confusion that arises from this difference, North Carolina no longer subdivides the non-impaired category. However, these waters and the specific water quality concerns remain identified in the basin plans so that data, management and the need to address the identified concerns are not lost.

B. Interpretation of Data and Information

Data used in the use support assessments include biological data, chemical/physical data, lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, and swimming advisories and shellfish sanitation growing area classification from the NC Division of Environmental Health (as appropriate). Available land cover and land use information is also used, along with annual water supply reports from regional water treatment plant consultants.

Although there is a general procedure for analyzing the data and information for determining use support ratings, each waterbody is reviewed individually, and best professional judgment is applied during these determinations. Assessments are made on either a monitored (M) or evaluated (E) basis depending on the level of information available. Refer to Part E for more information on the basis of assessments.

When interpreting the use support ratings, it is important to understand its associated limitations and degree of uncertainty. The assessments are not intended to provide precise conclusions about pollutant budgets for specific watersheds. Rather, the intent of use support assessments is to gain an overall picture of water quality, to describe how well surface waters support the uses for which they were classified, and to document the potential contribution made by different pollution sources.

C. Assessment Methodology

Use Support Categories and Uses

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the development of use support ratings for six categories: aquatic life and secondary recreation, fish consumption, shellfish harvesting, primary recreation, water supply and "other" uses. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. A single water could have more than one use support rating corresponding to one or more of the six use support categories, as shown in the table below. For many waters, a use support category will not be applicable (N/A) to the use classification of that water (e.g., shellfish harvesting is only applied to Class SA waters). A full description of the classifications is available in the DWQ document titled: *Classifications and Water Quality Standards Applicable to Surface Waters of North Carolina*.

	Use Support Categories					
Primary Classification	**Ecosystem Approach**	**Human Health Approach**				
	Aquatic Life/Secondary Recreation	**Fish Consumption**	**Primary Recreation**	**Water Supply**	**Shellfish Harvesting**	**Other**
C	X	X	N/A	N/A	N/A	X
SC	X	X	N/A	N/A	N/A	X
B	X	X	X	N/A	N/A	X
SB	X	X	X	N/A	N/A	X
SA	X	X	X	N/A	X	X
WS I – WS IV	X	X	N/A	X	N/A	X

Many types of information are used to determine use support ratings and to identify causes and sources of use support impairment. A use support data file is maintained for each of the 17 river basins. All existing data pertaining to a stream segment for each applicable use support category are entered into its record and can include, but is not limited to, use support ratings, basis of assessment, biological data, ambient monitoring data, problem parameters and potential sources. The following describes the data and methodologies used to make use support assessments for the surface water classifications (described in Section A, Chapter 3 of each basin plan) using the six use support categories. These methods will continue to be refined, as additional information becomes available.

Basis of Assessment

FS ratings are extrapolated up tributaries from monitored streams when no problematic dischargers or change in land use/cover are identified. The FS rating may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem parameters or sources (except general NPS) are not applied to unmonitored tributaries. PS or NS ratings are not extrapolated to unmonitored tributaries. Refer to Part E for more information.

Problem Parameters

Where an ambient parameter is identified as a potential concern, the parameter is listed in the DWQ database and use support summary table. Where habitat degradation is identified by DWQ biologists based on site visits, it is listed and attempts are made to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools, loss of riffles, channelization, lack of riparian vegetation, streambed scour and bank erosion). Habitat evaluation methods are being developed to better identify specific types of habitat degradation.

Potential Sources

General nonpoint sources (NPS) and point sources (PS) of pollution are identified where there is sufficient information.

Aquatic Life and Secondary Recreation Use Support

The aquatic life and secondary recreation use support category is an ecosystem approach to assess whether aquatic life (benthic macroinvertebrates and fish) can live and reproduce in the waters of the state and whether waters support secondary recreation (i.e., wading, boating and minimal human body contact with water). This category is applied to all waters of the state. Biological data, ambient monitoring data and NPDES discharger data are all considered in assessing the aquatic life and secondary recreation use support category. The following is a description of each data type and methods used to assess how well a water is meeting the criteria for aquatic life protection and secondary recreation.

Biological Data

There are two main types of biological data: benthic marcoinvertebrate and fish community. Where recent data for both benthic macroinvertebrates and fish communities are available, both are evaluated in assessing use support. It is important to note that where both ambient monitoring data and biological data are available, biological data are given greater weight.

In special situations, where there are currently insufficient biological data available, the basinwide planner will make a request of the DWQ Environmental Sciences Branch to determine whether a biological survey is appropriate. If a biological survey is appropriate, the use support rating will be determined by the bioclassification resulting from the survey. If a biological survey is not appropriate, then the stream will be not rated.

Benthic Macroinvertebrate Bioclassifications

Criteria have been developed to assign bioclassifications ranging from Poor to Excellent to most benthic macroinvertebrate samples based on the number of taxa present in the pollution intolerant aquatic insect groups of *Ephemeroptera, Plecoptera* and *Trichoptera* (EPTs) and the Biotic Index (BI), which summarizes tolerance data for all taxa in each collection. The benthic macroinvertebrate bioclassifications are translated into use support ratings according to the following scheme:

Bioclassification	Use Support Rating
Excellent	Fully Supporting (FS)
Good	Fully Supporting (FS)
Good-Fair	Fully Supporting (FS)
Fair	Partially Supporting (PS)
Poor	Not Supporting (NS)

Due to the increased emphasis placed on Fair or Poor bioclassifications and the borderline nature of some bioclassification scores, sites should be resampled within 12-24 months after a Fair rating is obtained in 1999 and beyond, if this Fair rating will result in a lower use support rating or if data are from a site never sampled before. This resampling will be done to validate the Fair bioclassification. Such sites will not be given a use support rating until the second sample is obtained. The table below shows how a final use support rating is obtained for sites that are resampled.

New Benthic Macroinvertebrate Classifications (1999 and Beyond) and Data Causing a Decline in Use Support Ratings

Pre-1999 Bioclassification	1st sample Bioclassification	Draft Use Support Rating	2nd sample Bioclassification	Final Use Support Rating
N/A	Fair	NR; resample	Good-Fair, Good or Excellent	FS
N/A	Fair	NR; resample	Fair	PS
N/A	Fair	NR; resample	Poor	NS
N/A	Poor	NS	N/A	NS
Good-Fair, Good or Excellent	Fair	NR; resample	Good-Fair, Good or Excellent	FS
Good-Fair, Good or Excellent	Fair	NR; resample	Fair	PS
Good-Fair, Good or Excellent	Fair	NR; resample	Poor	NS
Good-Fair, Good or Excellent	Poor	NS	N/A	NS

N/A – Not Applicable NR = Not Rated

The use of benthic macroinvertebrate data can be limited in some waters. The accumulation of swamp stream data over nearly a decade suggests that not all swamp streams support similar fauna. The development of swamp stream criteria is complex, and one set of criteria is not

appropriate for all swamp streams. Benthic macroinvertebrate data will not be used in waters characterized or classified by DWQ as swamp waters until the bioclassification criteria for these waters can be used with confidence. Benthic macroinvertebrate data are also not used to develop use support ratings for estuarine waters. Until bioclassification criteria for swamp and estuarine waters are developed, a designation of Not Rated (NR) will be used, and these waters will be listed as NR for aquatic life and secondary recreation use support assessments.

Benthic macroinvertebrate data are used to provide bioclassifications for high elevation trout streams. The benthic macroinvertebrate data, while not a direct measure of the trout population, are a robust measure of stream integrity. Loss of canopy, increase in stream temperature, increased nutrients, toxicity and increased sedimentation will affect the benthic macroinvertebrate and fish communities. For these reasons, the benthic macroinvertebrate bioclassifications provide a valuable assessment of the integrity of trout waters.

A designation of Not Impaired (NI) may be used for flowing waters that are too small to be assigned a bioclassification (less than 4 meters in width), but meet the criteria for a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria. This designation will translate into a use support rating of FS.

Fish Community Bioclassification

The North Carolina Index of Biotic Integrity (NCIBI) is a method for assessing a stream's biological integrity by examining the structure and health of its fish community. The NCIBI incorporates information about species richness and composition, indicator species, trophic function, abundance and condition, and reproductive function. The NCIBI is translated into use support ratings according to the following scheme:

NCIBI	Use Support Rating
Excellent	Fully Supporting (FS)
Good	Fully Supporting (FS)
Good-Fair	Fully Supporting (FS)
Fair	Partially Supporting (PS)
Poor	Not Supporting (NS)

The NCIBI was recently revised by DWQ (NCDENR, 2001b). Currently, the focus of using and applying the NCIBI is restricted to wadeable streams that can be sampled by a crew of four persons. Infrequently, larger wadeable streams can be sampled if there is a crew of six persons. The bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a).

NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamilco, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of the "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

- In the Cape Fear River basin – all waters except for those draining the Sandhills in Moore, Lee and Harnett counties and the entire basin upstream of Lillington, NC.
- In the Neuse River basin -- the entire basin above Smithfield and Wilson, NC, except for the south and southwest portions of Johnston County and the eastern two-thirds of Wilson County.
- In the Roanoke River basin -- the entire basin in North Carolina upstream of Roanoke Rapids, NC and a small area between Roanoke Rapids and Halifax, NC.
- In the Tar-Pamlico River basin -- the entire basin above Rocky Mount, NC, except for the lower southeastern one-half of Halifax County and the extreme eastern portion of Nash County.

NCIBI criteria have not been developed for:

- Streams in the Broad, Catawba, Yadkin-Pee Dee, Savannah, French Broad, Hiwassee, Little Tennessee, New and Watauga River basins which are characterized as wadeable first to third order streams with small watersheds, naturally low fish species diversity, coldwater temperatures, and high gradient plunge-pool flows. Such streams are typically thought of as "Southern Appalachian Trout Streams".
- Wadeable streams in the Sandhills ecoregion of the Cape Fear, Lumber and Yadkin-Pee Dee River basins.
- Wadeable streams and swamps in the coastal plain region of the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, Tar-Pamlico and White Oak River basins.
- All non-wadeable and large streams and rivers throughout the state.

Due to the increased emphasis placed on Fair or Poor bioclassifications and the borderline nature of some bioclassification scores, sites should be resampled within 12-24 months after a Fair rating is obtained in 1999 and beyond, if this Fair rating will result in a lower use support rating or if data are from a site never sampled before. This resampling will be done to validate the Fair bioclassification. Such sites will not be given a use support rating until the second sample is obtained. The table below shows how a final use support rating is obtained for sites that are resampled.

New Fish Community Classifications (1999 and Beyond) and Data Causing a Decline in Use Support Ratings				
Pre-1999 Bioclassification	**1st sample Bioclassification**	**Draft Use Support Rating**	**2nd sample Bioclassification**	**Final Use Support Rating**
N/A	Fair	NR; resample	Good-Fair, Good or Excellent	FS
N/A	Fair	NR; resample	Fair	PS
N/A	Fair	NR; resample	Poor	NS
N/A	Poor	NS	N/A	NS
Good-Fair, Good or Excellent	Fair	NR; resample	Good-Fair, Good or Excellent	FS
Good-Fair, Good or Excellent	Fair	NR; resample	Fair	PS
Good-Fair, Good or Excellent	Fair	NR; resample	Poor	NS
Good-Fair, Good or Excellent	Poor	NS	N/A	NS

N/A – Not Applicable NR = Not Rated

Ambient Monitoring Data

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring System. These data are downloaded from the ambient database, the Surface Water Information Management System, for analysis. Total number of samples and percent of samples exceeding the NC water quality standards are evaluated for the development of use support ratings along with other data or alone when other data are not available. Where both ambient data and biological data are available, biological data are given greater weight.

When reviewing ambient data, a five-year window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for the ambient data would be September 1, 1995 to August 31, 2000. Selected ambient parameters are used to assess aquatic life/secondary recreation use support. These parameters include ammonia, dissolved oxygen, pH, chloride, arsenic, cadmium, chromium, nickel and lead. These parameters are measured against standards for a minimum of ten samples as follows:

Standards Violation	Rating
Criterion exceeded ≤10%	Fully Supporting (FS)
Criterion exceeded 11-25%	Partially Supporting (PS)
Criterion exceeded >25%	Not Supporting (NS)

Data for copper, iron and zinc are not used according to the scheme outlined above. These metals have action level standards because they are generally not bioaccumulative and have variable toxicity to aquatic life depending on chemical form, solubility and stream characteristics. In order for an action level standard to be violated, there must be a toxicological

test that documents an impact on a sensitive aquatic organism. The action level standard is used to screen waters for potential problems with copper, iron and zinc.

Metals data for copper and iron are screened at the 85th percentile of five years of ambient data ending on August 31 of the year of biological sampling. Sites, other than estuarine and swamp waters, with an 85th percentile of ≥20 µg/l of copper and/or ≥2000 µg/l of iron are identified and flagged for instream chronic toxicity testing by DWQ. Chronic toxicity testing in estuarine and swamp waters is not ecologically meaningful. Criteria are still being developed for zinc. If a stream does not have biological data that would deem a FS rating, then the stream can be rated PS or NS for aquatic life if instream chronic toxicity is found. Criteria for evaluating instream chronic toxicity are three chronic pass/fail tests over three months using *Ceriodaphnia*. Three fails result in a NS rating, and two fails result in a PS rating.

It is important to note that some waters may exhibit characteristics outside the numerical standards due to natural conditions (e.g., many swamp waters are characterized by low pH and dissolved oxygen). These natural conditions do not constitute a violation of water quality standards.

NPDES Discharger Data

Aquatic Toxicity Data

For facilities that perform Whole Effluent Toxicity (WET) tests according to state NPDES discharge permit requirements, a review of the results of a five-year window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for aquatic toxicity data would be September 1, 1995 to August 31, 2000. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data, or has no ambient data, and that facility has failed three or more WET tests in the most recent two years, the stream is not rated. If failures continue, DWQ will work with the facility to correct the failures and assess stream impacts before the next basin sampling cycle begins with either a biological survey or instream chronic toxicity testing, if possible.

Discharge Effluent Data

NPDES effluent data are reviewed by analyzing monthly averages of water quality parameters over a two-year period of data ending on August 31 of the year of biological sampling. Prior to May 31, 2000, facilities were screened for criterion 40 percent in excess of state water quality standards for conventional pollutant limitations or 20 percent in excess of state water quality standards for toxic pollutants for two or more months during two consecutive quarters, or chronic violations of either conventional or toxic pollutant limitations for four or more months during two consecutive quarters.

After May 31, 2000, facilities are screened for criterion 20 percent in excess of state water quality standards for both conventional and toxic pollutants for two or more months during two consecutive quarters, or chronic violations of either conventional or toxic pollutant limitations for four or more months during two consecutive quarters. Streams with discharges that are in excess of permit limits will not be rated if no biological or ambient monitoring data are available.

Therefore, streams will not be rated PS or NS based on effluent data alone. Appropriate DWQ staff will be given a list of these facilities for follow-up.

Fish Consumption Use Support

The fish consumption use support category is a human health approach to assess whether humans can safely consume fish from a water. This use support category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories issued by the NC Department of Health and Human Services.

If a limited fish consumption advisory is posted at the time of use support assessment, the water is rated PS. If a no consumption advisory is posted at the time of use support assessment, the water is rated NS.

The current statewide limited fish consumption advisory for bowfin due to elevated levels of mercury in fish tissue is an exception. It is recognized that bowfin only live and reproduce in waters of the piedmont and coastal plain. Therefore, the use support ratings will be based on the combination of the current statewide fish consumption advisory for bowfin and the documented presence of bowfin in each river basin as found in *Freshwater Fisheries of North Carolina* (Menhinick, 1991). In river basins where there are documented populations of bowfin (Roanoke, Chowan, Pasquotank, White Oak, Lumber, Neuse, Tar-Pamlico, Cape Fear, Yadkin and Catawba), all waters will be rated PS for the fish consumption category. In river basins where there are no documented populations of bowfin (Little Tennesee, Hiwassee, Savannah, Watauga, New, French Broad and Broad), the waters will be rated FS for the fish consumption category unless there is a site-specific advisory.

In order to separate this from other fish consumption advisories and to identify actual bowfin populations with high levels of mercury, only waters with fish tissue monitoring data are presented on the use support maps and in the use support summary tables of the basin plans. A review of the present methods for assessing the fish consumption use support category is being conducted, and methods may be modified in the future.

Primary Recreation Use Support

In addition to the use support categories applicable to Class C and SC waters, the primary recreation use support category will be assessed for all Class B, Class SA and Class SB waters where data are available. This use support category is a human health approach to assess whether waters support primary recreation activities such as swimming, water-skiing, skin diving, and similar uses involving human body contact in an organized or frequent basis. The use support rating is based on swimming advisories issued by local health departments and by the NC Division of Environmental Health (DEH) beach monitoring program.

Freshwaters

Each January, the geometric mean for ambient stations in Class B waters for the previous sampling year is obtained, and a screen is conducted for waters with geometric means greater than 200 colonies per 100 ml. If the geometric mean is greater than 200 colonies per 100 ml during the previous year, fecal coliform bacteria are noted as a problem parameter, and a request

is made of the DWQ regional office to sample this water 5 times within 30 days in June during non-runoff events, if possible. If this data, as required to assess the NC standard, indicate a geometric mean greater than 200 colonies per 100 ml, then the data are sent to DEH for consideration of posting swimming advisories. The DWQ regional office should continue to sample the stream 5 times within 30 days during the months of July and August and send the data to DEH.

When reviewing fecal coliform data and swimming advisories, a five-year window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for the fecal coliform data and swimming advisories would be September 1, 1995 to August 31, 2000. Monitored Class B waters are rated FS if the geometric mean over the five-year window is less than or equal to 200 colonies per 100 ml. If a water was posted with an advisory for at least two months within the five-year window, it is rated as PS unless DEH staff believes that the cause of elevated fecal bacteria is not persistent. Those waters posted as "Do Not Swim" for more than two months in the five-year window are rated NS. Class B waters without fecal coliform data or swimming advisories are not rated.

DWQ attempts to determine if there are any inland swimming areas monitored by county or local health departments. County or local health departments are asked to list those waters with swimming advisories posted for at least two months in the previous five years (ending on August 31 of the year of biological sampling).

Estuarine waters

Each January, the geometric mean for ambient stations in Class SB and SA waters for the previous sampling year is obtained, and a screen is conducted for waters with geometric means greater than 200 colonies per 100 ml. If the geometric mean is greater than 200 colonies per 100 ml during the previous year, fecal coliform bacteria are noted as a problem parameter, and a request is made of the DWQ regional office to sample this water 5 times within 30 days in June during non-runoff events, if possible. If this data, as required to assess the NC standard, indicate a geometric mean greater than 200 colonies per 100 ml, then the data are sent to DEH for consideration of posting swimming advisories. The DWQ regional office should continue to sample the stream 5 times within 30 days during the months of July and August and send the data to DEH.

DEH fecal coliform data are used to assess estuarine (SA and SB) waters. Each January, DEH submits a letter to DWQ stating which coastal waters were posted with an advisory reporting an increased risk from swimming during the prior year. When reviewing DEH fecal coliform data and swimming advisories, a five-year window that ends on August 31 of the year of biological sampling is used. For example, if biological data are collected in a basin in 2000, then the five-year window for the DEH fecal coliform data and swimming advisories would be September 1, 1995 to August 31, 2000. If a water was posted with an advisory for at least two months within the five-year window, it is rated as PS unless DEH staff believes that the cause of elevated fecal bacteria is not persistent. Those waters posted as "Do Not Swim" for more than two months in the five-year window are rated NS. If DEH has no data on a water, that water will not be rated.

Shellfish Harvesting Use Support

The shellfish harvesting use support category is a human health approach to assess whether shellfish can be commercially harvested and is therefore applied only to Class SA waters. The following data sources are used to determine use support ratings for shellfish waters and to determine causes and sources of impairment for these waters.

Department of Environmental Health (DEH) Shellfish Sanitation Surveys

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation surveys every three years to determine if their classification is still applicable. DEH classifications may be changed after the most recent sanitary survey. Classifications are based on DEH fecal coliform bacteria sampling, locations of pollution sources, and the availability of the shellfish resource. Growing waters are classified as follows:

DEH Classification	DEH Criteria
Approved (APP)	**Fecal Coliform Standard for Systematic Random Sampling:** The median fecal coliform Most Probable Number (MPN) or the geometric mean MPN of the water shall not exceed 14 per 100 milliliters (ml), and the estimated 90th percentile shall not exceed an MPN of 43 MPN per 100 ml for a 5-tube decimal dilution test. **Fecal Coliform Standard for Adverse Pollution Conditions Sampling:** The median fecal coliform or geometric mean MPN of the water shall not exceed 14 per 100 ml, and not more than 10 percent of the samples shall exceed 43 MPN per 100 ml for a 5-tube decimal dilution test.
Conditionally Approved-Open (CAO)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data does not meet criteria for Approved, Conditionally Approved or Restricted Classification.

Assigning Use Support Ratings to Shellfish Harvesting Waters (Class SA)

It is important to note that DEH classifies all actual and potential growing areas (which includes all saltwater and brackish water areas) for their suitability for shellfish harvesting. Thus, the DWQ Class SA waters must be separated out and rated for shellfish harvesting use support. The acreage of FS, PS and NS waters are calculated using GIS showing DWQ and DEH classifications as attribute information. However, the DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from

the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as NS.

DWQ use support ratings may be assigned to separate segments within DEH management areas. In assessing use support, the DEH classifications and management strategies are only applicable to those areas that DWQ Class SA (shellfish harvesting waters). This will result in a difference of acreage between DEH areas classified as CAC, PRO, RES and DWQ waters rated as PS or NS. For example, if DEH classifies a 20-acre area CAC, but only 10 acres are Class SA, only those 10 acres of Class SA waters are assessed and rated PS.

Sources of fecal coliform bacteria are more difficult to separate out for Class SA areas. DEH describes the potential sources in the sanitary surveys, but they do not describe specific areas affected by these sources. Therefore, in the past, DEH identified the same sources for all Class SA sections of an entire management area (e.g., urban runoff and septic systems). Until a better way to pinpoint sources is developed, this procedure will continue to be used. A point source discharge is only listed as a potential source when NPDES permit limits are exceeded.

DWQ and DEH are developing the database and expertise necessary to assess shellfish harvesting use support using a frequency of closures-based approach. This database will allow DWQ to better assess the extent and duration of closures in Class SA waters. These tools will not be available for use support determinations in Class SA waters for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. DWQ believes it is important to identify frequency of closures in these waters, so an interim methodology will be used based on existing databases and GIS shapefiles. There will likely be changes in reported acreages in future assessments using the permanent methods and tools that result from this project. DWQ and DEH hope to have these tools fully developed for using the frequency of closure-based methods for the 2005 Cape Fear River use support assessment and basin plan.

Interim Frequency of Closure-Based Assessment Methodology

The interim method will be used for the 2001 White Oak, 2002 Neuse and 2003 Lumber River basin use support assessments. Shellfish harvesting use support ratings for Class SA waters using the interim methodology are summarized below.

Interim Frequency of Closure-Based Use Support Ratings

Percent of Time Closed within Basin Data Window	DEH Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	FS
Closed ≤10% of data window	Portion of CAO closed ≤10%	FS
Closed >10% to ≤25% of data window	Portion of CAO closed >10% to ≤25% of data window	PS
Closed >25% of data window	Portion of CAO closed >25% of data window	NS
N/A	CAC and P/R**	NS

* Approved waters are closed only during extreme meteorological events (hurricanes).

** CAC and P/R waters are rarely opened to shellfish harvesting.

For CAO areas, DWQ will work with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during a five-year window of data that ends on August 31 of the year of biological sampling. For example, if biological data are collected in a basin in 2000, then the five-year window for closure data would be September 1, 1995 to August 31, 2000. For each growing area with CAO Class SA waters, DEH and DWQ staff will define subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed will be determined using DEH proclamation summary sheets and the original proclamations.

The number of days that APP areas in the growing area were closed due to pre-emptive closures because of named storms is not counted. For example, all waters in growing area E-9 were pre-emptively closed for Hurricane Fran on September 5, 1996. APP waters were reopened September 20, 1996. Nelson Bay (CAO) was reopened September 30, 1996. This area was considered closed for 10 days after the APP waters were reopened.

Proposed Permanent Frequency of Closure-Based Assessment Methodology

Over the next few years DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a fully functionally database with related georeferenced (GIS) shellfish harvesting areas. The new database and GIS tools will be valuable for the above agencies to continue to work together to better serve the public. DWQ proposes to use information generated by these new tools to do frequency of closure-based shellfish harvesting use support assessments in Class SA waters, starting with the 2005 Cape Fear River basin use support assessment.

Using the new database with georeferenced areas and monitoring sites, DEH will be able to report the number of days each area was closed excluding closures related to named storms. The percent of the five-year data window that individual Class SA waters are closed will be used to make use support determinations for areas that are classified by DEH as CAO. PRO, RES and CAC areas will be rated NS and CAO areas will be rated FS, PS or NS based on the methodology outlined above in the interim methods. Growing areas that have been reclassified by DEH during the data window from a lower classification to APP will be rated Supporting. Areas that are reclassified from APP to CAO during the data window will be rated as described above in the interim methods, taking into account the total days closed during the data window, including when the area was classified as APP.

Water Supply Use Support

This use support category is used to assess all Class WS waters and is a human health approach to assess whether a water can be used for water supply purposes. Many drinking water supplies in NC are drawn from human-made reservoirs that often have multiple uses.

Water supply use support is assessed using information from the seven regional water treatment plant (WTP) consultants. Each January, the WTP consultants submit a spreadsheet listing closures and water intake switch-overs for all water treatment plants in their region. This spreadsheet describes the length and time of the event, contact information for the WTP, and the reason for the closure or switch.

The WTP consultants' spreadsheets are reviewed to determine if any closures/switches were due to water quality concerns. Those closures/switches due to water quantity problems and reservoir turnovers are not considered for use support. The frequency and duration of closures/switches due to water quality concerns are considered when assessing use support. In general, North Carolina's surface water supplies are currently rated FS. Specific criteria for rating waters PS and NS are yet to be determined.

Other Uses: All Waters in the State

This category of use will be assessed infrequently but could be applied to any water in the state. Examples of uses that could fall into this category are aesthetics and industrial and agricultural water supply. This category allows for the assessment of any use that is not considered for aquatic life and secondary recreation, primary recreation, fish consumption, shellfish harvesting or water supply.

D. Use of Outside Data

DWQ actively solicits outside data and information in the year before biological sampling in a particular basin. The solicitation allows approximately 60 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the draft 2000 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and problem parameters. They may also be used to limit the extrapolation of use support ratings up or down a stream segment from a DWQ monitoring location. Where outside data indicate a potential problem, DWQ evaluates the existing DWQ biological and ambient monitoring site locations for adjustment as appropriate.

Criteria Levels for Use of Outside Data in Use Support Assessments

Criteria	Level 1	Level 2	Level 3
Monitoring frequency of at least 10 samples for more than a one-year period	Yes	Yes/No	No
Monitoring locations appropriately sited and mapped	Yes	Yes	No
State certified laboratory used for analysis according to 15A NCAC 2B .0103	Yes	Yes/No	No
Quality assurance plan available describing sample collection and handling	Yes, rigorous scrutiny	Yes/No	No

E. Monitored vs. Evaluated

Assessments are made on either a monitored (M) or evaluated (E) basis depending on the level of information available. Because a monitored rating is based on the most recent five-year window and site-specific data, it is treated with more confidence than an evaluated rating.

FS ratings are extrapolated up tributaries to monitored streams where there are no dischargers with permit violations or changes in land use/cover. Problem parameters or sources (except general NPS) are not applied to unmonitored tributaries. PS or NS are not applied to unmonitored tributaries. Refer to the following summary for the basis 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[a] with data[b] ≤5[c] years old.
	Monitored/Evaluated (ME)	Stream segment[a] is unmonitored, but is assigned a use support rating based on another segment of same stream for which data[b] ≤5[c] years old are available.
Evaluated	Evaluated (E)	Unmonitored streams that are direct or indirect tributaries to monitored stream segments rated FS. Must share similar land use to the monitored stream segment.
Not Rated	Not Rated (NR)	Insufficient or no data available to determine use support. Includes unmonitored streams that are direct or indirect tributaries to stream segments rated PS or NS.

a) A stream segment is a stream, or a portion thereof, listed in the Classifications and Water Quality Standards for a river basin. Each segment is assigned a unique identification number (index number).
b) Major data sources include benthic macroinvertebrate and fish community bioclassifications and chemical/physical monitoring data.
c) From the year that basin monitoring was done.

F. Nutrient Enrichment Issues

One of the main causes of impacts to lakes is nutrient enrichment, or eutrophication. Several water quality variables help to describe the level of eutrophication. These include pH, chlorophyll *a*, dissolved oxygen, phosphorus, nitrogen, turbidity, total dissolved gases and other quantitative indicators, some of which have specific water quality standards. It is generally agreed that excessive amounts of nitrogen and phosphorus are the principal culprits in eutrophication related use impairment. These variables are important concerns; however, climate, hydrology and biological response factors (chlorophyll, phytoplankton, fish kills, etc.) are also essential to evaluate because they may control the frequency of episodes related to potential use impairment. In addition, many of North Carolina's lakes are human-made reservoirs that do not mimic natural systems.

Violations of water quality standards in lakes or estuaries are not equated with use impairment unless uses are not met. DWQ does not determine eutrophication related use impairment with the quantitative assessment of an individual water quality variable (i.e., chlorophyll *a*).

Likewise, DWQ does not depend on a fixed index composed of several water quality variables, which does not have the flexibility to adapt to numerous hydrological situations, to determine use impairment. Instead, the weight of evidence approach is used to determine use support in lakes. This approach can be flexibly applied depending on the amount and quality of available information. The approach uses the following sources of information:

- multiple quantitative water quality variables (e.g., dissolved oxygen, chlorophyll *a*)
- third party reports
- analysis of water quality or aesthetic complaints, and taste and odor observations
- algal bloom reports
- macrophyte observations
- fish kill reports
- frequency of noxious algal activity
- reports/observations of the NC Wildlife Resources Commission, lake associations and water treatment plant operators

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Aquatic Life/Secondary Recreation Use Support Summary – Hiwassee River Basin

Name	Description	Subbasin	Miles	Rating	Basis	Problem Parameter	Potential Source(s)
HIWASSEE RIVER (Chatuge Lake)	From North Carolina-Georgia State line to Chatuge Dam	04-05-01	2.6	FS	M		
Shooting Creek	From source to Chatuge Lake	04-05-01	5.6	FS	M	Habitat degradation	Agriculture, Land Development Highway/Road/Bridge Runoff
HIWASSEE RIVER	From Hyatt Mill Creek to Tusquitee Creek	04-05-01	2.2	FS	ME	Habitat degradation	Urban Runoff/Storm Sewers, Agriculture
Tusquitee Creek	From source to Big Tuni Creek	04-05-01	4.1	FS	ME		
Tusquitee Creek	From Big Tuni Creek to Buckner Branch	04-05-01	5.8	FS	ME		
Big Tuni Creek	From source to Tusquitee Creek	04-05-01	6.1	FS	M		
Tusquitee Creek	From Buckner Branch to Hiwassee River	04-05-01	1.7	FS	M		
Fires Creek	From source to Rocky Cove Branch	04-05-01	5.7	FS	ME		
Fires Creek	From Rocky Cove Branch to Hiwassee River	04-05-01	8.6	FS	M		
HIWASSEE RIVER (Mission Reservoir)	From Tusquitee Creek to Calhoun Creek below Mission Reservoir	04-05-01	4.7	FS	ME		
HIWASSEE RIVER	From Calhoun Creek below Mission Reservoir to a point 0.6 mile upstream of McComb Branch	04-05-01	1.5	FS	ME	Habitat degradation	Hydromodification, Agriculture
Brasstown Creek	From North Carolina-Georgia State Line to Hiwassee River	04-05-01	8.7	FS	M	Habitat degradation	Sources Outside State Jurisdiction or Borders, Agriculture, Highway/Road/Bridge Runoff
HIWASSEE RIVER	From a point 0.6 mile upstream of McComb Branch to Town of Murphy water supply intake (located 0.1 mile downstream of McComb Branch)	04-05-02	0.6	FS	ME		
HIWASSEE RIVER	From Town of Murphy water supply intake to a point 0.3 mile downstream of Martin Creek	04-05-02	4.2	FS	M	Habitat degradation	Hydromodification, Agriculture
Peachtree Creek	From source to Hiwassee River	04-05-02	5.3	FS	M		

Aquatic Life/Secondary Recreation Use Support Summary Table – Hiwassee River Basin

Name	Description	Subbasin	Miles	Rating	Basis	Problem Parameter	Potential Source(s)
HIWASSEE RIVER (Hiwassee Lake below elevation 1525)	From a point 0.3 mile downstream of Martin Creek to Laurel Creek	04-05-02	2.4	FS	M		
Valley River	From source to Gipp Creek above Andrews	04-05-02	8.2	FS	ME	Habitat degradation	Highway/Road/Bridge Runoff, Agriculture
Valley River	From Gipp Creek above Andrews to Venegeance Creek near Marble	04-05-02	9.8	FS	M	Habitat degradation, Fecal coliform	Highway/Road/Bridge Runoff, Urban Runoff/Storm Sewers Agriculture
Valley River	From Venegeance Creek near Marble to Marble Creek above Murphy	04-05-02	7.7	FS	M	Habitat degradation, Fecal coliform	Highway/Road/Bridge Runoff, Agriculture
Valley River	From Marble Creek above Murphy to the Hiwassee River	04-05-02	3.2	FS	ME	Habitat degradation, Fecal coliform	Highway/Road/Bridge Runoff, Urban Runoff/Storm Sewers Agriculture
Junaluska Creek	From source to Valley River	04-05-02	6.5	FS	M		
Webb Creek	From source to Valley River	04-05-02	1.6	FS	M		
HIWASSEE RIVER (Hiwassee Lake below elevation 1525)	From Laurel Creek to Hiwassee Dam	04-05-02	18.8	FS	M		
Hanging Dog Creek	From source to Hiwassee Lake	04-05-02	13.3	FS	M		
Nottely River	From North Carolina-Georgia State Line to Hiwassee Lake	04-05-02	18.7	FS	M	Low DO, Thermal modifications	Hydromodification
Persimmon Creek (Lake Cherokee)	From source to Hiwassee Lake	04-05-02	7.1	FS	M		
Beaverdam Creek	From source to Hiwassee Lake	04-05-02	6.7	FS	M		
HIWASSEE RIVER (Apalachia Lake below elevation 1281)	From River Mile 75, 0.8 mile downstream from Hiwassee Dam at Hiwassee Reservation Boundary to Apalachia Dam	04-05-02	8.9	FS	M		
South Shoal Creek	From source to Apalachia Lake	04-05-02	12.1	FS	M		
Shuler Creek	From source to Hiwassee River	04-05-02	11.9	FS	M		

Primary Recreation Use Support Summary – Hiwassee River Basin

Name	Description	Subbasin	Classification	Miles	Primary Recreation Rating	Basis
HIWASSEE RIVER (Chatuge Lake)	From North Carolina-Georgia State line to Chatuge Dam	04-05-01	B	2.6	FS	M
HIWASSEE RIVER (Hiwassee Lake)	From Laurel Creek to Hiwassee Dam	04-05-02	B	18.8	FS	M
HIWASSEE RIVER (Apalachia Lake)	From River Mile 75, 0.8 mile downstream from Hiwassee Dam at Hiwassee Reservation Boundary to Apalachia Dam	04-05-02	B	8.9	FS	M

Water Supply Use Support Summary – Hiwassee River Basin

Name	Description	Subbasin	Classification	Miles	Water Supply Rating	Basis
HIWASSEE RIVER	From Hyatt Mill Creek to Tusquitee Creek	04-05-01	WS-IV	2.2	FS	M
Tusquitee Creek	From Buckner Branch to Hiwassee River	04-05-01	WS-IV Tr HQW	1.7	FS	M
Fires Creek	From Rocky Cove Branch to Hiwassee River	04-05-01	WS-IV Tr ORW	8.6	FS	M
HIWASSEE RIVER (Mission Reservoir)	From Tusquitee Creek to a point 0.6 mile upstream of McComb Branch	04-05-01	WS-IV	6.2	FS	M
Brasstown Creek	From North Carolina-Georgia State Line to Hiwassee River	04-05-01	WS-IV	8.7	FS	M
HIWASSEE RIVER	From a point 0.6 mile upstream of McComb Branch to a point 0.3 mi downstream Martin Cr	04-05-02	WS-IV CA & WS-V	4.8	FS	M
Dan Holland Creek	From source to a point 0.5 mile downstream of Sunk Branch	04-05-02	WS-II Tr	1.9	FS	ME
Dan Holland Creek	From a point 0.5 mile downstream of Sunk Branch to dam at Andrews Water Supply Reservoir	04-05-02	WS-II Tr CA	0.6	FS	M
Brittian Branch (Fain Mountain Reservoir)	From source to dam at Fain Mountain Reservoir	04-05-02	WS-I	0.3	FS	M

Appendix IV

303(d) Listing
and
Reporting Methodology

303(d) LISTING AND REPORTING REQUIREMENTS

What is the 303(d) List?

Section 303(d) of the Clean Water Act (CWA) requires states to develop a comprehensive public accounting of all impaired waters. North Carolina's list of impaired waters must be submitted to EPA by April 1 of every even year (40 CFR 130.7). The list includes waters impaired by pollutants, such as nitrogen, phosphorus and fecal coliform bacteria, and by pollution, such as hydromodification and habitat degradation. The source of impairment might be from point sources, nonpoint sources or atmospheric deposition. Some sources of impairment exist across state lines. North Carolina lists impaired waters regardless of whether the pollutant or source of pollution is known and whether the pollutant/pollution source(s) can be legally controlled or acted upon by the State of North Carolina. More complete information can be obtained from *North Carolina's Draft 2000 303(d) List* (http://h2o.enr.state.nc.us/mtu/), which can be obtained by calling the Planning Branch of DWQ at (919) 733-5083.

303(d) List Development

Generally, there are three 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; and 3) prioritizing listed waters for TMDL development. The following subsections describe each of these steps in more detail.

Sources of Information

North Carolina considers all practical existing and readily available data and information in preparing the 303(d) list. Sources solicited for "existing and readily available data and information" include, but are not limited to the following:

- The previous 303(d) list.
- Basinwide Water Quality Plans and Assessment Reports.
- 305(b) reports.
- 319 nonpoint source pollution assessments.
- Waters where specific fish or shellfish consumption bans and/or advisories are currently in effect.
- Waters for which effluent toxicity test results indicate possible or actual excursions of state water quality standards.
- Waters identified by the state as impaired in its most recent Clean Lakes Assessment.
- Drinking water source water assessments under the Safe Drinking Water Act.
- Trend analyses and predictive models used for determining numeric and narrative water quality standard compliance.
- Data, information and water quality problems reported from local, state or federal agencies, Tribal governments, members of the public and academic institutions.

Listing Criteria

Waters whose use support ratings were not supporting (NS) or partially supporting (PS) based on monitored information in the 305(b) report are considered as initial candidates for the 303(d) list. Waters that were listed on the previously approved 303(d) list are evaluated and automatically included if the use support rating was NS, PS or not rated (NR).

Guidance from EPA on developing the 1998 303(d) lists indicates that impaired waters without an identifiable problem parameter should not be included on the 303(d) list. However, DWQ feels that waters listed in the 305(b) report as impaired for biological reasons, where problem parameters have not been identified, should remain on the 303(d) list. The Clean Water Act states that chemical, physical and biological characteristics of waters shall be restored. The absence of an identified cause of impairment does not mean that the water should not receive attention. Instead, DWQ should resample or initiate more intensive studies to determine why the water is impaired. Thus, biologically impaired waters without an identified cause of impairment are on the draft 2000 303(d) list.

Assigning Priority

North Carolina has developed a TMDL priority ranking scheme that reflects the relative value and benefits that a water provides to the state. The priority ranking system is designed to take into account the severity of the impairment, especially when threats to human health, endangered species or the designated uses of the water are present.

A priority of High, Medium or Low has been assigned to all waters on Parts 1, 4, 5 and 6 of the list (the following section describes these parts in more detail). A high priority is assigned to all waters that are classified as water supplies. A high priority is also automatically assigned to all waters harboring species listed as endangered or threatened under the federal Endangered Species Act (ESA). A medium priority has minimally been assigned to waters harboring state listed endangered and threatened species. As a way of addressing anti-degradation concerns, classified Outstanding Resource Waters and High Quality Waters start at the medium priority. The remaining waters on the list are prioritized according to severity of the impairment.

New Format of the List

North Carolina has begun to make the structural changes prescribed in EPA's July 13, 2000 final TMDL rule. The *Draft 2000 §303(d) List* reflects many of these changes. EPA's final rule will likely eventually require 303(d) lists to be divided into four sections. North Carolina's 2000 list has been divided into six parts and reflects comments made on the proposed rules by North Carolina and other states. This six-part format meets the requirements of existing rules, and future lists will meet requirements of revised federal rules (when implemented). A summary of each part of the list is provided below. A more detailed discussion is found in the preface to the actual list document.

Part 1 - Waters impaired by a *pollutant* as defined by EPA.

"The term pollutant means dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." TMDLs will be submitted for all water/pollutant combinations listed in Part 1.

Part 2 - Waters impaired by *pollution*, not by a *pollutant*.

EPA defines *pollution* as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water" in the CWA section 502(19). EPA believes that in situations where the impairment is not caused by a *pollutant*, a TMDL is generally not the appropriate solution to the problem. In keeping with the principle that the 303(d) list is an

accounting of all impaired waters; however, these types of waters will remain on Part 2 of the list until water quality uses and standards are attained by some other means.

Part 3 - Waters for which EPA has approved or established a TMDL and water quality standards have not yet been attained.
Monitoring data will be considered when evaluating Part 3 waters for potential delisting. Waters will be moved to Part 1 of the list if updated information and data demonstrate that the approved TMDL is inadequate.

Part 4 - Waters for which TMDLs are not required.
Other required regulatory controls (e.g., NPDES permit limits, Phase I Federal Stormwater Permits, etc.) are expected to attain water quality standards by the next regularly scheduled listing cycle.

Part 5 - Biologically impaired waters with no identified cause of impairment.
Roughly half of the waters on North Carolina's 303(d) list appear on Part 5. Identification of the cause(s) of impairment will precede movement of these waters to Parts 1 and 2 of the list. EPA recognized that in specific situations the data are not available to establish a TMDL, and that these specific waters might be better placed on a separate part of the 2000 303(d) list (64 FR, 46025). Data collection and analysis will be performed in an attempt to determine a cause of impairment. North Carolina's proposed plan for managing biologically impaired waters can be found in the preface to Part 5 of the list.

Part 6 – The *proper technical conditions* do not yet exist to develop a TMDL.
"*Proper technical conditions* refers to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662). These are waters that would otherwise be on Part 1 of the list. In the proposed TMDL regulations, EPA again recognized that in some specific situations the data, analyses or models are not available to establish a TMDL, and that these specific waters might be better off on a separate part of the 2000 303(d) list (64 FR, 46025). North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. DWQ has included fecal impaired shellfish waters on this part of the list. North Carolina's approach to managing shellfish waters impaired because of fecal coliform violations is outlined in the preface to Part 6 of the list.

Scheduling TMDLs

North Carolina will submit TMDLs for each water within 13 years of its first listing, starting with the EPA-approved 1998 303(d) list. TMDLs for waters first listed in 1998 or earlier will be developed by 2011. As a general rule, TMDLs will be addressed according to highest priority in accordance with the rotating basinwide planning approach. Due to the wide range of complexities encountered in TMDL development, TMDLs will not necessarily be submitted to EPA in order of priority.

TMDLs on Part 1 of the 303(d) list are at many different stages on the path to an approved TMDL. Some require additional data collection to adequately define the problem in TMDL terms. Some require more outreach to increase stakeholder involvement and "buy-in". Others

need to have a technical strategy budgeted and scheduled. Some are almost ready for submittal to EPA for approval. As the current regulations require, North Carolina has listed waters targeted for TMDL development within the next two years.

North Carolina has used "biological impairment" to place the majority of waters on the 303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Part 5 is to be expected. It is important to understand that the identification of waters on Part 5 of the list does not mean that they are low priority waters. The problem parameter identification (PPI) approach is a high priority for the State of North Carolina. However, it should be noted that it may take significant resources and time to determine the cause of impairment. The PPI approach is also a declaration of need for more data and more time to adequately define the problems and whether they are affected by *pollution, pollutants* or a combination.

North Carolina believes it to be both practical and honest to schedule TMDL development for only those waters where we have some information about the cause of impairment. Scheduling TMDLs for waters that may not be impaired by a *pollutant* is misleading and counterproductive.

Delisting Waters

North Carolina relies heavily on the existing 305(b) reporting methodology to complete the 303(d) process. In general, waters will be removed from the 303(d) list when data show that a water is fully supporting its uses. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved 303(d) list will be removed from the 303(d) lists under the following circumstances:

- An updated 305(b) use support rating of fully supporting.
- Applicable water quality standards are being met (i.e., no longer impaired for a given *pollutant*).
- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or *National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions*. Robert Wayland III, Director. Office of Wetlands, Oceans, and Watersheds. Aug 27, 1997.)
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories.
- Typographic listing mistakes (i.e., the wrong water was identified).

Appendix V

Hiwassee River Basin
Summary of Public Comment

Public Comment Summary	DWQ Comments	Location in Plan
Development, especially at higher elevations. Also improperly constructed access roads associated with the new development.	The plan provides details about erosion/sedimentation laws and enforcement, as well as requirements, recommendations and contact information for agencies, developers and local programs. Recommendations for proper road grade and drainage control structures are also provided.	Section A, Part 4.2 Section A, Part 4.3 Appendix VI
Old septic systems that might be failing, new ones that might be improperly installed or in marginal areas/soils, and vast number of systems being installed.	Elevated fecal coliform concentrations (an indicator of pathogens typical in wastewater) have been observed in some part of the basin. Discussion and recommendations to address these concerns are provided.	Section A, Part 4.5 Section A, Part 3.3.5
Increased flow from more impervious surfaces.	No local governments are currently required to obtain a permit for stormwater in the basin, however general recommendations are provided and local planning for development is encouraged.	Section A, Part 4.3
Lack of general education about water quality issues.	DWQ workshops are intended to provide some level of general education about water quality issues. In addition, a document called *A Citizen's Guide to Water Quality Management in North Carolina* is available from DWQ. The Planning Branch is also developing a guide targeted towards homeowners and aimed at reducing quantity and improving the quality of stormwater. Unfortunately, DWQ does not currently have resources to do more face-to-face education than what is currently being done through the Basinwide Planning Program.	Section A, Part 1.6 Section A, Chapter 4
Water quality contamination from an old landfill near Andrews in the Valley River watershed.	DWQ has conducted biological monitoring upstream and downstream of this landfill in the past and staff do not suspect a problem with pollution of the Valley River from this source.	Appendix II – Tables Section B, Part 2.2.1
Streambank erosion.	In addition, to previous comments regarding sedimentation and development, the plan discusses several initiatives designed to identify and correct problems with streambank erosion	Section A, Part 4.2 Section C
Shooting Creek watershed (primarily streambank erosion/loss of riparian vegetation).	The plan discusses Shooting Creek as a water where impacts have been observed. DWQ will attempt to sample the watershed more intensively during the next round of biological sampling.	Section B, Part 1.5.1

Public Comment Summary	DWQ Comments	Location in Plan
Sedimentation and development in the Blair Creek and Hyatt Mill Creek watersheds.	DWQ did not sample either of these streams in 1999, however data were collected by TVA. The plan discusses Blair and Hyatt Mill Creeks as streams where impacts have been observed.	Section B, Part 1.5.4 Section A, Part 3.4
Mining in Valley River and its tributaries.	DWQ is working with DLR to address reported impacts associated with unpermitted instream mining activities.	Section A, Part 4.4
More sampling of Valley River tributaries is needed.	DWQ is working with the Hiawassee River Watershed Coalition to sample additional tributaries within the Valley River watershed prior to the next cycle of basinwide sampling. Also, the Coalition recently received a CWMTF grant for the Valley River.	Section B, Part 2.2.1 Section C, Part 1.5.1
Absentee landowners often make BMP implementation and education difficult.	DWQ will support local agencies in trying to reach out to absentee landowners.	
Nottely River watershed	The plan discusses Nottely River as a water where impacts from flow fluctuation and low dissolved oxygen have been observed.	Section B, Part 2.5.1 Section A, Part 3.4
Hiwassee River below Mission dam in terms of the operation of the dam.	DWQ is involved with relicensing efforts in the Hiwassee River basin and will work to obtain the least possible water impact upon relicensing of the Mission project.	Section A, Part 2.9.2
Low dissolved oxygen, sedimentation and nutrients in Lake Chatuge and tributary embayments.	DWQ and TVA monitored Lake Chatuge over the past five years and will continue to do so. In addition, DWQ supports the Hiawassee River Watershed Coalition's more in-depth study of the watershed.	Section A, Part 3.3.4 Section A, Part 3.4 Section B, Part 1.5.3 Section C, Part 1.5.1
Need for more enforcement of current regulations as they relate to sediment control.	Comments with regard to state or local sediment/erosion control programs have been passed on to the appropriate governing program. DWQ is working to provide these programs with better information about how turbidity standards can be met.	Section A, Part 4.2.1 Section C, Part 1.5.1 Appendix VI
Need for more presence from the US Corp of Engineers to handle permits and enforcement.	Comment will be passed on US Corp of Engineers staff in Asheville.	

Appendix VI

Hiwassee River Basin Nonpoint Source Program Description and Contacts

Statewide Nonpoint Source Management Program Description

The North Carolina Nonpoint Source Management Program consists of a broad framework of federal, state and local resource and land management agencies. More than 2,000 individuals administer programs that are directly related to nonpoint source pollution management within the state. A range of responsibilities have been delegated to county or municipal programs including the authority to inspect and permit land clearing projects or septic system performance. In the field of agriculture, a well established network of state and federal agricultural conservationists provide technical assistance and program support to individual farmers.

Staff in the DWQ Water Quality Section's Planning Branch lead the Nonpoint Source Management Program, working with various agencies to insure that program goals are incorporated into individual agencies' management plans. The goals include:

1. Coordinate implementation of state and federal initiatives addressing watershed protection and restoration.
2. Continue to target geographic areas and waterbodies for protection based upon best available information.
3. Strengthen and improve existing nonpoint source management programs.
4. Develop new programs that control nonpoint sources of pollution not addressed by existing programs.
5. Integrate the NPS Program with other state programs and management studies (e.g., Albemarle-Pamlico National Estuary Program).
6. Monitor the effectiveness of BMPs and management strategies, both for surface and groundwater quality.

Coordination between state agencies is achieved through reports in the *North Carolina Nonpoint Source Management Program Update*. Reports are intended to keep the program document current and develop a comprehensive assessment identifying the needs of each agency to meet the state nonpoint source program goals. Annual reports are developed to describe individual program priorities, accomplishments, significant challenges, issues yet to be addressed, and resource needs. A copy of the latest Annual Report (FY1998) is available online at http://h2o.enr.state.nc.us/nps/nps_mp.htm.

The nature of nonpoint source pollution is such that involvement at the local level is imperative. Basinwide water quality plans identify watersheds that are impaired by nonpoint sources of pollution. Identification, status reports and recommendations are intended to provide the best available information to local groups and agencies interested in improving water quality. The plans also make available information regarding federal, state and local water quality initiatives aimed at reducing or preventing nonpoint source pollution.

The following table is a comprehensive guide to contacts within the state's Nonpoint Source Management Program. For more information, contact Alan Clark at (919) 733-5083 ext. 570. Most employees of the Department of Environment & Natural Resources, including Division of Water Quality, Division of Land Resources, and the Division of Forest Resources, can be reached by email using the following formula: firstname.lastname@ncmail.net.

Agriculture

USDA Natural Resources Conservation Service:

Part of the US Department of Agriculture, formerly the Soil Conservation Service. Technical specialists certify waste management plans for animal operations; provide certification training for swine waste applicators; work with landowners on private lands to conserve natural resources, helping farmers and ranchers develop conservation systems unique to their land and needs; administer several federal agricultural cost share and incentive programs; provide assistance to rural and urban communities to reduce erosion, conserve and protect water, and solve other resource problems; conduct soil surveys; offer planning assistance for local landowners to install best management practices; and offer farmers technical assistance on wetlands identification.

Area 1 Conservationists	Alan Walker Perry Wilkerson	828-456-6341 Ext. 5	589 Raccoon Road, Suite 246, Waynesville, NC 28786 awalker.nc.usda.gov or pwilkerson@nc.usda.gov

County	District Conservationist	Phone	Address
Cherokee/Clay	K.D. Cook	828-837-6417	225 Valley River Rd., Ste. J, Murphy, NC
Southwestern RC&D (includes Jackson, Macon and Clay counties)	Timothy Garrett	828-452-2519	P. O. Box 1230, Waynesville, NC 28786 swrcd@dnet.net

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. For detail information, please visit the web site of the Division of Soil and Water Conservation at http://www.enr.state.nc.us/DSWC/files/do.htm.

County	Board Chairman	Phone	Address
Cherokee	Mike Hawk	828-321-1353	347 Beaver Creek Rd., Andrews, NC 28901
Clay	James Clay Logan	828-389-8081	6025 Fires Creek Rd., Hayesville, NC 28904

*** Division of Soil and Water Conservation:**

State agency that administers the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* (ACSP). Allocates ACSP funds to the Soil and Water Conservation Districts; and provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee.

Central Office	David B. Williams	919-715-6103	Archdale Building, 512 North Salisbury Street, Raleigh, NC 27626
Area 1, Asheville	Davis Ferguson	828-251-6208	59 Woodfin Place, Asheville, NC 28801

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.

District 9 Ranger	Gerald McCall	828-586-4007	443 Hwy. 116, Sylva, NC 28779
Central Office	Moreland Gueth	919-733-2162	1616 Mail Service Center, Raleigh, NC 27699-1616

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
Cherokee	Doug Clement	828-837-2210	39 Peachtree St., Ste. 103, Murphy, NC 28906 Doug_Clement@ncsu.edu
Clay	Silas Brown	828-389-6305	Community Service Bldg., PO Box 156, Hayesville, NC 28904

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	1612 Mail Service Center, Raleigh, NC 27699-1621
Asheville Region	Richard Phillips	828-251-6208	59 Woodfin Place, Asheville, NC 28801-2482

Local Erosion and Sedimentation Control Ordinances:

No local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances for construction.

Solid Waste

*** DENR Division of Waste Management:**

Management of solid waste in a way that protects public health and the environment. The Division includes three sections and one program – Hazardous Waste, Solid Waste, Superfund and the Resident Inspectors Program.

Central Office	Brad Atkinson	919-733-0692	401 Oberlin Road, Suite 150, Raleigh, NC 27605

On-Site Wastewater Treatment

Division of Environmental Health and County Health Departments:

Safeguard life, promote human health, and protect the environment through the practice of modern environmental health science, the use of technology, rules, public education, and above all, dedication to the public trust. Services include:

- Training of and delegation of authority to local environmental health specialists concerning on-site wastewater.
- Engineering review of plans and specifications for wastewater systems 3,000 gallons or larger and industrial process wastewater systems designed to discharge below the ground surface.
- Technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems.

Central Office	Steve Steinbeck	919-570-6746	2728 Capital Boulevard, Raleigh, NC 27604
Asheville Region		828-251-6788	

County	Primary Contact	Phone	Address
Cherokee	Elaine Russell	828-837-7486	228 Hilton St., Murphy, NC 28906 chkeechd@grove.net
Clay	Janice Patterson	828-389-8052	Riverside Circle, PO Box 55, Hayesville, NC 28904 healthdept@clayconc.com

General Water Quality

*** DWQ Water Quality Section:**

Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the French Broad and Neuse River Nutrient Sensitive Waters Strategies; administer the Section 319 grants program statewide; conduct stormwater permitting; model water quality; conduct water quality monitoring; perform wetlands permitting; conduct animal operation permitting and enforcement; and conduct water quality classifications and standards activities.

NPS Planning	Alan Clark	919-733-5083 x570	1617 Mail Service Center, Raleigh, NC 27699-1617
Urban Stormwater	Bradley Bennett	919-733-5083 x525	1617 Mail Service Center, Raleigh, NC 27699-1617
Modeling	Michelle Woolfolk	919-733-5083 x515	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
Classifications/Standards	Jeff Manning	919-733-5083 x579	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

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
Local Office	Owen Anderson	828-452-2546	20830 Great Smoky Mountains Expressway, Waynesville, NC 28786

US Army Corps of Engineers:

Responsible for: investigating, developing and maintaining the nation's water and related environmental resources; constructing and operating projects for navigation, flood control, major drainage, shore and beach restoration and protection; hydropower development; water supply; water quality control, fish and wildlife conservation and enhancement, and outdoor recreation; responding to emergency relief activities directed by other federal agencies; and administering laws for the protection and preservation of navigable waters, emergency flood control and shore protection. Responsible for wetlands and 404 Federal Permits.

Ask for the project manager covering your county.

Asheville Field Office	Robert Johnson	828-271-7980, ext. 3	151 Patton Avenue, Room 208, 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	1636 Mail Service Center, Raleigh, NC 27699-1636
Asheville Region	Landon Davidson	828-251-6208	59 Woodfin Place, Asheville, North Carolina 28801

* Most employees of the Department of Environment & Natural Resources, including Division of Water Quality, Division of Land Resources and Division of Forest Resources, can be reached by email using the following formula: firstname.lastname@ncmail.net.

Appendix VII

Glossary
of
Terms and Acronyms

Glossary

§	Section.
30Q2	The minimum average flow for a period of 30 days that has an average recurrence of one in two years.
7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
B (Class B)	Class B Water Quality Classification. This classification denotes freshwaters protected for primary recreation and other uses suitable for Class C. Primary recreational activities include frequent and/or organized swimming and other human contact such as skin diving and water skiing.
basin	The watershed of a major river system. There are 17 major river basins in North Carolina.
benthic macroinvertebrates	Aquatic organisms, visible to the naked eye (macro) and lacking a backbone (invertebrate), that live in or on the bottom of rivers and streams (benthic). Examples include, but are not limited to, aquatic insect larvae, mollusks and various types of worms. Some of these organisms, especially aquatic insect larvae, are used to assess water quality. See EPT index and bioclassification for more information.
benthos	A term for bottom-dwelling aquatic organisms.
best management practices	Techniques that are determined to be currently effective, practical means of preventing or reducing pollutants from point and nonpoint sources, in order to protect water quality. BMPs include, but are not limited to: structural and nonstructural controls, operation and maintenance procedures, and other practices. Often, BMPs are applied as system of practices and not just one at a time.
bioclassification	A rating of water quality based on the outcome of benthic macroinvertebrate sampling of a stream. There are five levels: Poor, Fair, Good-Fair, Good and Excellent.
BMPs	See *best management practices*.
BOD	Biochemical Oxygen Demand. A measure of the amount of oxygen consumed by the decomposition of biological matter or chemical reactions in the water column. Most NPDES discharge permits include a limit on the amount of BOD that may be discharged.
C (Class C)	Class C Water Quality Classification. This classification denotes freshwaters protected for secondary recreation, fishing, wildlife, fish and aquatic life propagation and survival, and others uses.
channelization	The physical alteration of streams and rivers by widening, deepening or straightening of the channel, large-scale removal of natural obstructions, and/or lining the bed or banks with rock or other resistant materials.
chlorophyll *a*	A chemical constituent in plants that gives them their green color. High levels of chlorophyll *a* in a waterbody, most often in a pond, lake or estuary, usually indicate a large amount of algae resulting from nutrient overenrichment or eutrophication.
coastal counties	Twenty counties in eastern NC subject to requirements of the Coastal Area Management Act (CAMA). They include: Beaufort, Bertie, Brunswick, Camden, Carteret, Chowan, Craven, Currituck, Dare, Gates, Hertford, Hyde, New Hanover, Onslow, Pamlico, Pasquotank, Pender, Perquimans, Tyrrell and Washington.
Coastal Plain	One of three major physiographic regions in North Carolina. Encompasses the eastern two-fifths of state east of the *fall line* (approximated by Interstate I-95).
conductivitiy	A measure of the ability of water to conduct an electrical current. It is dependent on the concentration of dissolved ions such as sodium, chloride, nitrates, phosphates and metals in solution.
degradation	The lowering of the physical, chemical or biological quality of a waterbody caused by pollution or other sources of stress.

DENR	Department of Environment and Natural Resources.
DO	Dissolved oxygen.
drainage area	An alternate name for a watershed.
DWQ	North Carolina Division of Water Quality, an agency of DENR.
dystrophic	Naturally acidic (low pH), "black-water" lakes which are rich in organic matter. Dystrophic lakes usually have low productivity because most fish and aquatic plants are stressed by low pH water. In North Carolina, dystrophic lakes are scattered throughout the Coastal Plain and Sandhills regions and are often located in marshy areas or overlying peat deposits. NCTSI scores are not appropriate for evaluating dystrophic lakes.
effluent	The treated liquid discharged from a wastewater treatment plant.
EMC	Environmental Management Commission.
EPA	United States Environmental Protection Agency.
EPT Index	This index is used to judge water quality based on the abundance and variety of three orders of pollution sensitive aquatic insect larvae: Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies).
eutrophic	Elevated biological productivity related to an abundance of available nutrients. Eutrophic lakes may be so productive that the potential for water quality problems such as algal blooms, nuisance aquatic plant growth and fish kills may occur.
eutrophication	The process of physical, chemical or biological changes in a lake associated with nutrient, organic matter and silt enrichment of a waterbody. The corresponding excessive algal growth can deplete dissolved oxygen and threaten certain forms of aquatic life, cause unsightly scums on the water surface and result in taste and odor problems.
fall line	A geologic landscape feature that defines the line between the piedmont and coastal plain regions. It is most evident as the last set of small rapids or rock outcroppings that occur on rivers flowing from the piedmont to the coast.
FS	Fully supporting. A rating given to a waterbody that fully supports its designated uses and generally has good or excellent water quality.
GIS	Geographic Information System. An organized collection of computer hardware, software, geographic data and personnel designed to efficiently capture, store, update, manipulate, analyze and display all forms of geographically referenced information.
habitat degradation	Identified where there is a notable reduction in habitat diversity or change in habitat quality. This term includes sedimentation, bank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour.
headwaters	Small streams that converge to form a larger stream in a watershed.
HQW	High Quality Waters. A supplemental surface water classification.
HU	Hydrologic unit. See definition below.
Hydrilla	The genus name of an aquatic plant - often considered an aquatic weed.
hydrologic unit	A watershed area defined by a national uniform hydrologic unit system that is sponsored by the Water Resources Council. This system divides the country into 21 regions, 222 subregions, 352 accounting units and 2,149 cataloging units. A hierarchical code consisting of two digits for each of the above four levels combined to form an eight-digit hydrologic unit (cataloging unit). An eight-digit hydrologic unit generally covers an average of 975 square miles. There are 54 eight-digit hydrologic (or cataloging) units in North Carolina. These units have been further subdivided into eleven and fourteen-digit units.
hypereutrophic	Extremely elevated biological productivity related to excessive nutrient availability. Hypereutrophic lakes exhibit frequent algal blooms, episodes of low dissolved oxygen or periods when no oxygen is present in the water, fish kills and excessive aquatic plant growth.
impaired	Term that applies to a waterbody that has a use support rating of partially supporting (PS) or not supporting (NS) its uses.

impervious	Incapable of being penetrated by water; non-porous.
kg	Kilograms. To change kilograms to pounds multiply by 2.2046.
lbs	Pounds. To change pounds to kilograms multiply by 0.4536.
loading	Mass rate of addition of pollutants to a waterbody (e.g., kg/yr)
macroinvertebrates	Animals large enough to be seen by the naked eye (macro) and lacking backbones (invertebrate).
macrophyte	An aquatic plant large enough to be seen by the naked eye.
mesotrophic	Moderate biological productivity related to intermediate concentrations of available nutrients. Mesotrophic lakes show little, if any, signs of water quality degradation while supporting a good diversity of aquatic life.
MGD	Million gallons per day.
mg/l	Milligrams per liter (approximately 0.00013 oz/gal).
NCIBI	North Carolina Index of Biotic Integrity. A measure of the community health of a population of fish in a given waterbody.
NH_3-N	Ammonia nitrogen.
nonpoint source	A source of water pollution generally associated with rainfall runoff or snowmelt. The quality and rate of runoff of NPS pollution is strongly dependent on the type of land cover and land use from which the rainfall runoff flows. For example, rainfall runoff from forested lands will generally contain much less pollution and runoff more slowly than runoff from urban lands.
NPDES	National Pollutant Discharge Elimination System.
NPS	Nonpoint source.
NR	Not rated. A waterbody that is not rated for use support due to insufficient data.
NS	Not supporting. A rating given to a waterbody that does not support its designated uses and has poor water quality and severe water quality problems. Both PS and NS are called impaired.
NSW	Nutrient Sensitive Waters. A supplemental surface water classification intended for waters needing additional nutrient management due to their being subject to excessive growth of microscopic or macroscopic vegetation. Waters classified as NSW include the Neuse, Tar-Pamlico and Chowan River basins; the New River watershed in the White Oak basin; and the watershed of B. Everett Jordan Reservoir (including the entire Haw River watershed).
NTU	Nephelometric Turbidity Units. The units used to quantify turbidity using a turbidimeter. This method is based on a comparison of the intensity of light scattered by the sample under defined conditions with the intensity of the light scattered by a standard reference suspension under the same conditions.
oligotrophic	Low biological productivity related to very low concentrations of available nutrients. Oligotrophic lakes in North Carolina are generally found in the mountain region or in undisturbed (natural) watersheds and have very good water quality.
ORW	Outstanding Resource Waters. A supplemental surface water classification intended to protect unique and special resource waters having excellent water quality and being of exceptional state or national ecological or recreational significance. No new or expanded wastewater treatment plants are allowed, and there are associated stormwater runoff controls enforced by DWQ.
pH	A measure of the concentration of free hydrogen ions on a scale ranging from 0 to 14. Values below 7 and approaching 0 indicate increasing acidity, whereas values above 7 and approaching 14 indicate a more basic solution.
phytoplankton	Aquatic microscopic plant life, such as algae, that are common in ponds, lakes, rivers and estuaries.

Piedmont	One of three major physiographic regions in the state. Encompasses most of central North Carolina from the Coastal Plain region (near I-95) to the eastern slope of the Blue Ridge Mountains region.
PS	Partially supporting. A rating given to a waterbody that only partially supports its designated uses and has fair water quality and severe water quality problems. Both PS and NS are called impaired.
riparian zone	Vegetated corridor immediately adjacent to a stream or river. See also SMZ.
river basin	The watershed of a major river system. North Carolina is divided into 17 major river basins: Broad, Cape Fear, Catawba, Chowan, French Broad, Hiwassee, Little Tennessee, Lumber, Neuse, New, Pasquotank, Roanoke, Savannah, Tar-Pamlico, Watauga, White Oak and Yadkin River basins.
river system	The main body of a river, its tributary streams and surface water impoundments.
runoff	Rainfall that does not evaporate or infiltrate the ground, but instead flows across land and into waterbodies.
SA	Class SA Water Classification. This classification denotes saltwaters that have sufficient water quality to support commercial shellfish harvesting.
SB	Class SB Water Classification. This classification denotes saltwaters with sufficient water quality for frequent and/or organized swimming or other human contact.
SC	Class SC Water Classification. This classification denotes saltwaters with sufficient water quality to support secondary recreation and aquatic life propagation and survival.
sedimentation	The sinking and deposition of waterborne particles (e.g., eroded soil, algae and dead organisms).
silviculture	Care and cultivation of forest trees; forestry.
SOC	Special Order by Consent. An agreement between the Environmental Management Commission and a permitted discharger found responsible for causing or contributing to surface water pollution. The SOC stipulates actions to be taken to alleviate the pollution within a defined time. The SOC typically includes relaxation of permit limits for particular parameters, while the facility completes the prescribed actions. SOCs are only issued to facilities where the cause of pollution is not operational in nature (i.e., physical changes to the wastewater treatment plant are necessary to achieve compliance).
streamside management zone (SMZ)	The area left along streams to protect streams from sediment and other pollutants, protect streambeds, and provide shade and woody debris for aquatic organisms.
subbasin	A designated subunit or subwatershed area of a major river basin. Subbasins typically encompass the watersheds of significant streams or lakes within a river basin. Every river basin is subdivided into subbasins ranging from one subbasin in the Watauga River basin to 24 subbasins in the Cape Fear River basin. There are 133 subbasins statewide. These subbasins are not a part of the national uniform hydrologic unit system that is sponsored by the Water Resources Council (see *hydrologic unit*).
Sw	Swamp Waters. A supplemental surface water classification denoting waters that have naturally occurring low pH, low dissolved oxygen and low velocities. These waters are common in the Coastal Plain and are often naturally discolored giving rise to their nickname of “blackwater” streams.
TMDL	Total maximum daily load. The amount of a given pollutant that a waterbody can assimilate and maintain its uses and water quality standards.
TN	Total nitrogen.
TP	Total phosphorus.
tributary	A stream that flows into a larger stream, river or other waterbody.

trophic classification	Trophic classification is a relative description of a lake's biological productivity, which is the ability of the lake to support algal growth, fish populations and aquatic plants. The productivity of a lake is determined by a number of chemical and physical characteristics, including the availability of essential plant nutrients (nitrogen and phosphorus), algal growth and the depth of light penetration. Lakes are classified according to productivity: unproductive lakes are termed "oligotrophic"; moderately productive lakes are termed "mesotrophic"; and very productive lakes are termed "eutrophic".
TSS	Total Suspended Solids.
turbidity	An expression of the optical property that causes light to be scattered and absorbed rather than transmitted in straight lines through a sample. All particles in the water that may scatter or absorb light are measured during this procedure. Suspended sediment, aquatic organisms and organic particles such as pieces of leaves contribute to instream turbidity.
UT	Unnamed tributary.
watershed	The region, or land area, draining into a body of water (such as a creek, stream, river, pond, lake, bay or sound). A watershed may vary in size from several acres for a small stream or pond to thousands of square miles for a major river system. The watershed of a major river system is referred to as a basin or river basin.
WET	Whole effluent toxicity. The aggregate toxic effect of a wastewater measured directly by an aquatic toxicity test.
WS	Class WS Water Supply Water Classification. This classification denotes freshwaters used as sources of water supply. There are five WS categories. These range from WS-I, which provides the highest level of protection, to WS-V, which provides no categorical restrictions on watershed development or wastewater discharges like WS-I through WS-IV.
WWTP	Wastewater treatment plant.