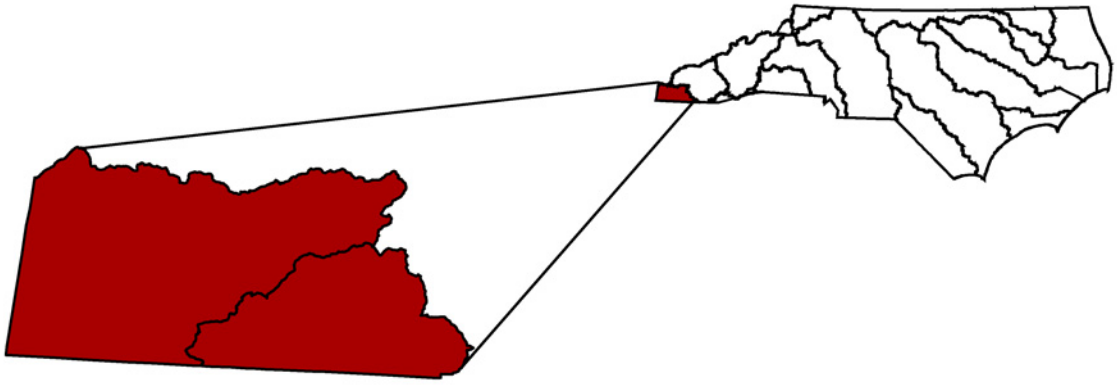
Hiwassee River Basinwide Water Quality Plan

March 2007



North Carolina Department of
Environment and Natural Resources

Division of Water Quality
Basinwide Planning Unit

HIWASSEE RIVER BASIN
WATER QUALITY PLAN

March 2007

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This document was approved and endorsed by the NC Environmental Management Commission on March 8, 2007 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 third five-year update to the Hiwassee River Basinwide Water Quality Plan approved by the NC Environmental Management Commission in May 1997.

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Executive Summary

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. The North Carolina Division of Water Quality (DWQ) prepares Basinwide water quality plans for each of the 17 major river basins in the state. Each basinwide plan is revised at five-year intervals. While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholders throughout the state.

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.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.
- Assure equitable distribution of waste assimilative capacity.
- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.
- Regulate point and nonpoint sources of pollution where other approaches are not successful.

This document is the third five-year update of the *Hiwassee River Basinwide Water Quality Plan*. The first basinwide plan for the Hiwassee River Basin was completed in 1997 and the second in 2002. The format of this plan was revised in response to comments received during the first and second planning cycles. DWQ replaced much of the general information in the first two plans with more detailed information specific to the Hiwassee River basin. For this plan, a greater emphasis was placed on identifying water quality concerns on the watershed level in order to facilitate protection and restoration efforts.

DWQ considered comments from the Western North Carolina Basinwide Planning Conference held in the region and subsequent discussions with local resource agency staff and citizens during draft plan development. This input will help guide continuing water quality management activities throughout the river basin over the next five years.

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. Water from the Tennessee River flows to the Gulf of Mexico via the Ohio and Mississippi Rivers (Figure *iii,* page *xii*). 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 *iv*).

Information presented in this basinwide water quality plan is based on data collected from September 1999 to August 2004. Maps of each subbasin are included in each of the subbasin chapters. Each subbasin has its own characteristics and water quality concerns. These are discussed in Chapters 1 and 2.

DWQ identifies the stressors of water quality impact as specifically as possible depending on the amount of information available in a watershed. Most often, the source of the stressor is based on the predominant land use in a watershed. In the Hiwassee River basin, new development/construction activities, agriculture, impervious surfaces, pasture and stormwater outfalls were all identified as possible stressors. However, unknown stressors impact many streams. Water quality decline can often be attributed to a combination of many stressors that lead to habitat and water quality degradation. In some way, every person, industry, landowner, and municipality in the basin impacts water quality. Therefore, every resident of the basin must play a role in management strategies designed to protect and restore the streams, lakes, and rivers of the basin.

Subbasin 04-05-01

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. Two major tributaries, Big Tuni Creek and Fires Creek, originate in the high mountains of northern Clay County. Land use in this area is mostly forest and the terrain is rugged. Conversely, Tusquitee and Brasstown Creeks flow through the broad valleys of southern Clay County where topography is gentle and more favorable for agriculture and residential land uses. Hayesville is the only municipality.

Most of the land within this subbasin is forested (69 percent), but cropland and pasture are also common (14 percent). Nearly fifteen percent of the area is surface water, reflecting the 3,629 acres of Lake Chatuge. 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 26.4 percent over the years 2000-2020.

There is one large NPDES discharger in this subbasin (Clay County WWTP, NC0026697) whose permitted discharge is 0.3 MGD. Since the last basinwide assessment in 1999, this facility has had an upgrade in treatment and is no longer required to perform toxicity testing. There is also a facility in Georgia (Town of Young Harris Water Pollution Control Plant, 0.24 MGD) that discharges to Brasstown Creek about six miles upstream of the North Carolina state line in Towns County.

Subbasin 04-05-02

The North Carolina portion of this subbasin lies entirely within Cherokee County. Steeper relief, more precipitation, and greater forest cover characterize the north and eastern portions of the watershed. This area includes the catchments of Apalachia Lake, Hanging Dog, Owl, Beaverdam, and Shuler Creeks, as well as the headwaters of the Valley River including Junaluska, Welch Mill, and Hyatt Creeks. The Nantahala National Forest generally dominates land use in this section but residential development is increasing along ridges and in proximity to the Town of Andrews.

The southern and central portions of the watershed are characterized by broad valleys with lower elevations, less relief, less precipitation, and less forest cover. The Hiwassee River, Nottely River, Peachtree, Martins, Persimmon, and South Shoal creeks, along with Hiwassee Lake and the lower half of the Valley River are major water bodies in this area. Agricultural lands in the broad Hiwassee River valley remain common; however conversion to residential development is on the rise. In addition, a new bypass is currently under construction in Murphy and residential and commercial development in the Peachtree and Martins Creek watershed is rapidly increasing as a result. Despite these changes, land use in Subbasin 04-05-02 remains largely forested. The vast majority of the Nottely River watershed lies in Georgia and includes the City of Blairsville.

From 1990 to 2000, the population in Murphy remained fairly constant. However, Andrews saw a 37 percent decrease in population over the same period. Cherokee County as a whole grew approximately 17 percent from 1990 to 2000 and is expected to grow another 20 percent by 2020.

There are two major NPDES dischargers in this subbasin and both are required to perform whole effluent toxicity testing. The Andrews WWTP (NC0020800, 1.5 MGD) discharges to the Valley River and has had three failing tests since 2001. The Murphy WWTP (NC0020940, 0.925 MGD) has had no failing tests since January of 2001 and discharges to the Hiwassee River.

Impaired streams in this subbasin include Martins Creek, Persimmon Creek, and the Valley River.

Use Support Summary

Use support assessments based on surface water classifications form the foundation of this basinwide plan. Surface waters are classified according to their best-intended use. Determining how well a waterbody supports its use (*use support* rating) is an important method of interpreting water quality data and assessing water quality.

Biological, chemical, and physical monitoring data collected between September 1999 and August 2004 were used to assign use support ratings in the Hiwassee River basin. A total of 23.6 miles (13 percent) of monitored streams are Impaired in the Hiwassee River basin (Table *i*). The impairments are associated with nonpoint source pollution and habitat degradation. Table *ii* presents a summary of the Impaired waters and the associated stressors. Current status and recommendations for restoration of water quality for each Impaired water is discussed in the subbasin chapters (Chapters 1 & 2). Maps showing the current use support rating are also presented in each subbasin chapter.

Table *i* Summary of Use Support Ratings by Category and Subbasin in the Hiwassee River Basin

Subbasin 04-05-01			Subbasin 04-05-02		
Use Support Rating	**Aquatic Life**	**Recreation**	**Use Support Rating**	**Aquatic Life**	**Recreation**
Monitored Waters					
Supporting	34.9 mi	0	Supporting	133.0 mi	11.9 mi
Impaired*	0	0	Impaired*	23.6 mi (13%)	0
Not Rated	8.4 mi	0	Not Rated	27.7 mi	0
Total	**43.3 mi**	**0**	**Total**	**184.3 mi**	**0**
Unmonitored Waters					
Not Rated	2.5 mi	2.6 mi	Not Rated	2.4 mi	0
No Data	271.5 mi	314.7 mi	No Data	464.7 mi	639.5 mi
Total	**274 mi**	**317.3 mi**	**Total**	**467.1 mi**	**639.5 mi**
Totals					
All Waters	**317.3 mi**	**317.3 mi**	**All Waters****	**651.4 mi**	**639.5 mi**

* The noted percent Impaired is the percent of monitored miles/acres only.
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Use support methodology has changed significantly since the 2002 revision of the *Hiwassee River Basinwide Water Quality Plan*. In the previous plan, surface waters were rated fully supporting (FS), partially supporting (PS), not supporting (NS) and not rated (NR). FS was used to identify waters that were meeting their designated use. Impaired waters were rated PS and NS, depending on the degree of degradation. NR was used to identify waters with no data or those that had inconclusive data.

The *2002 Integrated Water Quality Monitoring and Assessment Report Guidance* issued by the Environmental Protection Agency (EPA) requests that states no longer subdivide the Impaired category. In agreement with this guidance, North Carolina no longer subdivides the Impaired category and rates waters as Supporting (S), Impaired (I), Not Rated (NR), or No Data (ND). These ratings refer to whether the classified uses of the water (such as water supply, aquatic life, primary/secondary recreation) are being met. Detailed information on use support methodology is provided in Appendix VIII.

Table *ii* Summary of Impaired Waters in the Hiwassee River Basin

Stream/ River Name	Assessment Unit Number (AU#)	Subbasin	Class	Miles	Category	Water Quality Stressor/Source
Martins Creek	1-49	04-05-02	C	8.8	Aquatic Life	Habitat degradation
Persimmon Creek	1-63	04-05-02	C	7.1	Aquatic Life	Habitat degradation
Valley River	1-52c	04-05-02	C Tr	7.7	Aquatic Life	Turbidity and Habitat Degradation

Use support methods were developed to assess ecosystem health and human health risk through the development of use support ratings for five categories: aquatic life, fish consumption, recreation, shellfish harvesting, and water supply. These categories are tied to the uses associated with the primary classifications applied to North Carolina rivers, streams, and lakes. 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*. This document is available on-line at http://h2o.enr.state.nc.us/csu/.

Challenges Related to Achieving Water Quality Protection

Several streams in the Hiwassee River basin appear on the 303(d) list of impaired waters and as urbanization continues the risk of impairment increases. Balancing economic growth and water quality protection will be a tremendous challenge. Point source impacts on surface waters can be measured and addressed through the basinwide planning process, however they do not represent the greatest threat to water quality in the basin.

> ***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.

The cumulative effects of nonpoint source pollution are the primary threat to water quality and aquatic habitat in the Hiwassee River basin. Nonpoint source pollution issues can be identified through the basinwide plan, but actions to address these impacts must be taken at the local level. Such actions should include:

- Develop and enforce local erosion control ordinances
- Conduct comprehensive land use planning that assesses and reduces the impact of development on natural resources
- Require stormwater best management practices for existing and new commercial and residential development
- Develop and enforce riparian buffer ordinances

This basinwide plan presents many water quality initiatives and accomplishments that are underway within the basin. These actions provide a foundation on which future initiatives can be built. Individual homeowners can participate in resource protection by doing the following on their own properties.

- To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns.
- Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose.
- Instead of disposing of yard waste, use the materials to start a compost pile.
- Learn to use Integrated Pest Management (IPM) in the garden and on the lawn to reduce dependence on harmful pesticides.
- Pick up after pets.
- Use, store, and dispose of chemicals properly.
- Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed.
- Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that recycle water.
- Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.
- Support local government watershed planning efforts and ordinance development.

Impacts from Steep Slope Disturbance

Dramatic elevation changes and steep slopes define mountain topography. Building sites perched along mountainsides provide access to unparalleled vistas and are a major incentive for development. However, construction on steep slopes presents a variety of risks to the environment and human safety.

Poorly controlled erosion and sediment from steep slope disturbance negatively impact water quality, hydrology, aquatic habitat, and can threaten human safety and welfare. Soil types, geology, weather patterns, natural slope, surrounding uses, historic uses, and other factors all contribute to unstable slopes. Improper grading practices disrupt natural stormwater runoff patterns and result in poor drainage, high runoff velocities, and increased peak flows during storm events. There is an inherent element of instability in all slopes and those who choose to undertake grading and/or construction activities should be responsible for adequate site assessment, planning, designing, and construction of reasonably safe and stable artificial slopes.

Local communities also have a role in reducing impacts from steep slope development. These impacts can also be addressed through the implementation of city and/or county land use and sediment and erosion control plans. Land use plans are a non-regulatory approach to protect water quality, natural resources and sensitive areas. In the planning process, a community gathers data and public input to guide future development by establishing long-range goals for the local community over a ten- to twenty-year period. They can also help control the rate of development, growth patterns and conserve open space throughout the community. Land use plans examine the relationship between land uses and other areas of interest including quality-of-life, transportation, recreation, infrastructure and natural resource protection (Jolley, 2003).

Hiwassee River Basin Statistics (North Carolina Portion)

Total Area: 644 sq. miles
Freshwater Stream Miles: 968.7 mi
No. of Counties: 2
No. of Municipalities: 3
No. of Subbasins: 2
Population (2000): 33,073*
Pop. Density (2000): 49 persons/sq. mile*

Water Quality Statistics

Aquatic Life
Percent Monitored Streams: 34.9%
Percent Supporting: 25.8%
Percent Impaired: 3.6%

Recreation
Percent Monitored Streams: 1.2%
Percent Supporting: 1.2%
Percent Impaired: 0%

* Estimated based on % of county land area that is partially or entirely within the basin, not the entire county population.

Population Growth and Changes in Land Use

The Hiwassee River basin encompasses all or portions of two counties and three municipalities. In 2000, the overall population in the basin (based on the percent of the county land area in the basin) was 33,073. The most populated areas are located in and around the towns of Andrews, Hayesville and Murphy.

Once one of the most remote and sparsely populated regions of the state, western North Carolina is now penetrated by modern interstates and highways that provide speedy access to the deepest folds of the rugged terrain. This improved access coupled with an abundance of recreational opportunities, cultural activities, and countless other amenities sets the stage for rapid population increases. With this growth comes increased pressure on the natural environment. Every person living in or visiting a watershed contributes to impacts on water quality. If water pollution is to be eliminated, each

individual should be aware of these contributions and take actions to reduce them.

Between 1990 and 2000, county populations increased by nearly 6,000 people. The fastest growing county was Clay (18.5 percent increase). County populations are expected to grow by another 9,500 people (22.3 percent) by 2020. This would result in a total population of over 42,000 people in the two counties partially or entirely contained within the Hiwassee River basin. Population growth trends and the accompanying impacts to water quality are discussed in Chapters 4 and 5.

Population growth results in dramatic impacts on the natural landscape. The most obvious impact is the expansion of urban and suburban areas. New stores, roads, and subdivisions are products of growing populations. What is not so obvious is the astonishing rate at which rural landscapes are converted to developed land. Between 1982 and 1997, the United States population increased by 15 percent. Over the same period, developed land increased by 34 percent – more than double the rate of population growth (NRI, 2001; U.S. Census Bureau, 2000). Locally, the trend can be even more pronounced. For example, the urban area of Charleston, SC expanded 250 percent between 1973 and 1994 while its population grew by 40 percent (Allen and Lu, 2000). Based on the current land cover information provided by the National Resources Inventory (USDA-NRCS, 2001), there was a 78.6 percent decrease (6,600 acres) in cultivated cropland in the Hiwassee River basin from 1982 to 1997. Uncultivated cropland decreased by 17.4 percent (400 acres), and pastureland followed with a 21.7 percent decrease (4,800 acres). Urban and built-up areas increased by nearly 100.8 percent (12,200 acres). Much of this land cover change is accounted for in the area around Andrews. Land use cover tables and statistics are included in Appendix III.

Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams and groundwater. The impacts on rivers, lakes, and streams can be significant and permanent if stormwater runoff is not controlled. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000).

Impacts from Stormwater Runoff

Stormwater runoff is rainfall or snowmelt that runs off the ground or impervious surfaces (e.g., buildings, roads, parking lots, etc.) instead of absorbing into the soil. In some cases, stormwater runoff drains directly into streams, rivers, lakes, and oceans. In other cases, particularly in urbanized areas, stormwater drains into streets and manmade drainage systems consisting of inlets and underground pipes, commonly referred to as a storm sewer system. Stormwater runoff is a primary carrier of nonpoint source pollution in both urbanized and rural areas. The impact of stormwater runoff is particularly severe in developing areas where recently graded lands are highly susceptible to erosion. Water quality impacts are also evident in urbanized areas where stormwater runoff is increased by impervious surfaces and is rapidly channeled through ditches or curb and gutter systems into nearby streams. For more information on stormwater as it relates to growth and development, refer to Chapter 5.

There are several different stormwater programs administered by DWQ. One or more of these programs may affect communities in the Hiwassee River basin. The goal of DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the

source(s) of pollution. For more information on statewide stormwater programs, refer to Chapter 6.

Septic Systems and Straight Pipes

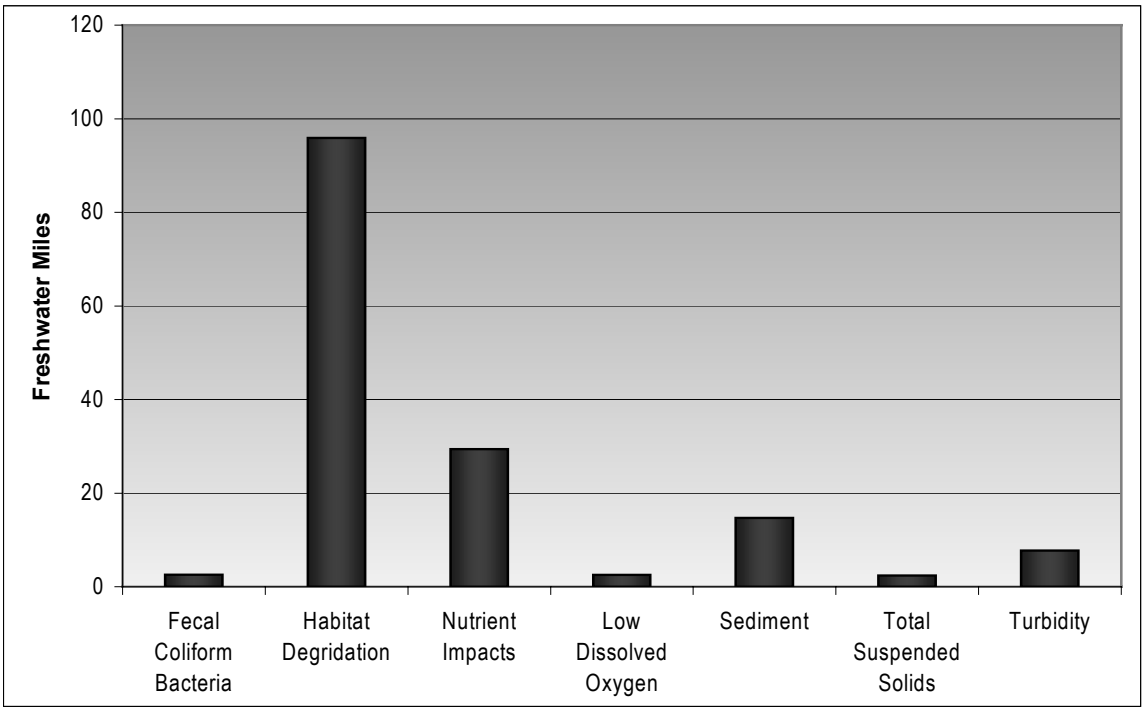
In the Hiwassee River basin, wastewater from many households is not treated at a wastewater treatment plant (WWTP). Instead, it is treated on-site through the use of permitted septic systems. However, wastewater from some homes illegally discharges directly into streams through what is known as a "straight pipe". In some cases, wastewater can also enter streams through failing septic systems. In highly susceptible areas, wastewater from failing septic systems or straight pipes can contaminate a drinking water supply or recreational waters with nutrients, disease pathogens (such as fecal coliform bacteria), and endocrine disturbing chemicals. More information on DWQ wastewater programs can be found in Chapter 6.

Water Quality Stressors

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Whenever possible, water quality stressors are identified for Impaired waters as well as waters with notable impacts (Figure *i* & *ii*).

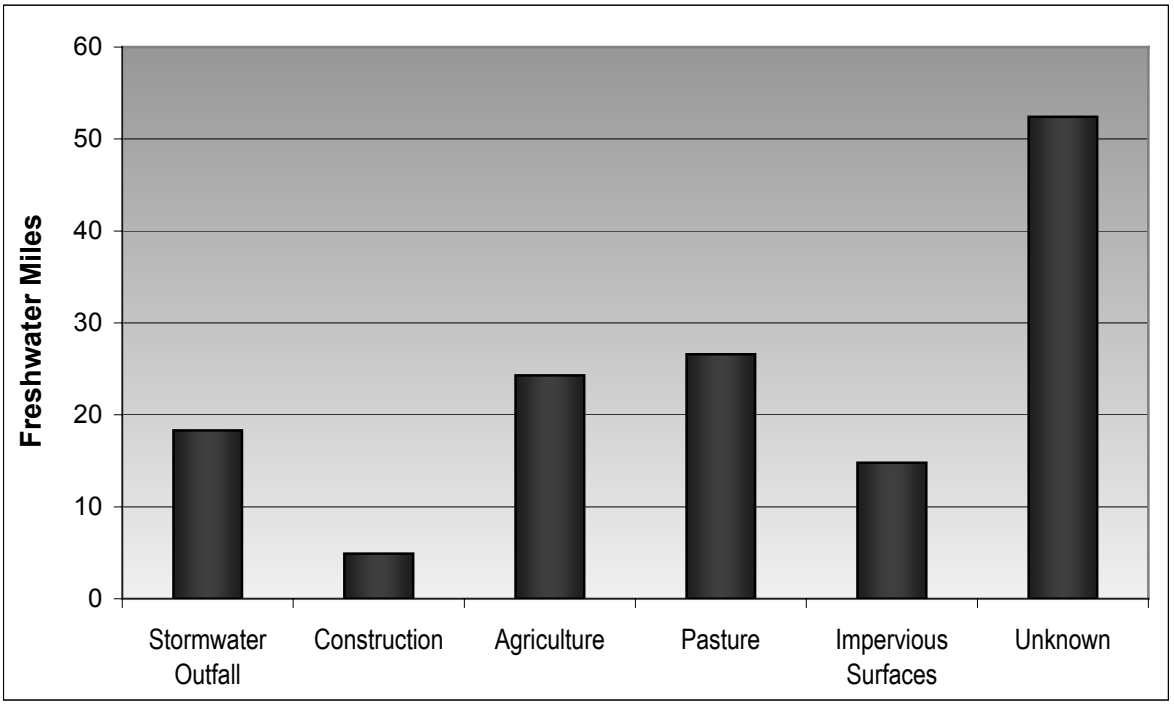
One of the most commonly noted water quality stressors in the Hiwassee River Basin is instream habitat degradation. Instream habitat degradation is identified where there is a notable reduction in habitat diversity or a negative change in habitat. Sedimentation, streambank erosion, channelization, lack of riparian vegetation, loss of pools or riffles, loss of woody habitat, and streambed scour are all associated with habitat degradation. These stressors are typically a result of increased flow of stormwater runoff from land-disturbing activities and streambank erosion due to a lack of adequate riparian vegetation. Streams with noted habitat degradation are discussed in the subbasin chapters (Chapters 1-2).

Figure *i* Stressors Identified for Streams in the Hiwassee River Basin



Other chemical and biological factors can also impact water quality. These include excess algal growth, low dissolved oxygen, nitrogen and phosphorus levels, pH, and fecal coliform bacteria. Chapter 4 provides definitions and recommendations for reducing impacts associated with physical, chemical, and biological factors.

Figure *ii* Sources of Stressors Identified in the Hiwassee River Basin



Local Involvement

Local organizations and agencies are able to combine professional expertise and local knowledge not present at the state and federal level. This allows groups to holistically understand the challenges and opportunities of local water quality concerns. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests and encourages others to become involved and invested in these projects. Working in cooperation across jurisdictional boundaries and agency lines opens the door to additional funding opportunities and eases the difficulty of generating matching or leveraged funds. This could potentially allow local entities to do more work and be involved in more activities because funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success. Chapter 11 examines the importance of local, state, and federal initiatives.

The collaboration of local efforts is key to water quality improvements. The demonstrated cooperation between the members of the Hiwassee River Watershed Coalition is an excellent example in the Hiwassee River Basin. DWQ encourages local governments to continue their support for the Coalition and encourages concerned citizens to get involved in the Coalition's activities. Several of the Coalition's projects are discussed in the subbasin chapters (Chapters 1 & 2).

Water Quality Standards and Classifications

Throughout the Hiwassee River basin, water quality is generally good. However, significant problems and some impairments exist. Chapter 3 discusses water quality standards and classifications and includes maps showing the designated Water Supply (WS) watersheds, High Quality Waters (HQW), and Outstanding Resource Waters (ORW).

In the Hiwassee River basin, several municipalities and smaller outlying communities are being pressured to expand. This often involves construction and/or development in areas of pristine waters along several tributaries of Hiwassee and Valley Rivers. HQW and ORW are supplemental classifications to the primary freshwater classification placed on a waterbody. Special management strategies are often associated with the supplemental HQW and ORW classification and are intended to prevent degradation of water quality below present levels from point and nonpoint sources of pollution. A brief summary of these strategies and the administrative code under which the strategies are found are included in Chapters 1 & 2.

Agriculture and Water Quality

Excess nutrient loading, pesticide and/or herbicide contamination, bacterial contamination, and sedimentation are often associated with agricultural activities, and all can impact water quality. Chapter 7 provides information related to agricultural activities in the Hiwassee River basin and also identifies funding opportunities for best management practices (BMP). During this assessment period, the North Carolina Agricultural Cost Share Program (NCACSP) funded BMP projects totaling more than $800,000 (Table *iii*).

Table *iii* NCACSP Summary for Hiwassee River Basin

NCACSP Summary for Hiwassee River Basin				
	Subbasin 04-05-01		Subbasin 04-05-02	
Purpose of BMP	Total Implemented	Cost	Total Implemented	Cost
Erosion Reduction/Nutrient Loss Reduction in Fields	3 acres	$7,611	17.6 acres 145 linear ft.	$3,654 $268
Sediment/Nutrient Delivery Reduction from Fields	0.2 acres 2,570 linear ft.	$5,123 $62,118	0.3 acres 100 linear ft.	$489 $1,015
Stream Protection from Animals	277.2 units 62,550 linear ft.	$301,178 $69,234	621.1 units 51,559 linear ft	$194,107 $59,864
Proper Animal Waste Management	1 unit	$15,000		
Agricultural Chemical Pollution Prevention				
Total Costs		$460,264		$259,397

Benefits*	Subbasin 04-04-01	Subbasin 04-04-02
Total Soil Saved (tons)	961.38	823.00
Total Nitrogen (N) Saved (lb.)	148.00	443.50
Total Phosphorus (P) Saved (lb.)	21.25	31.00
Total Waste-N Saved (lb.)		
Total Waste-P Saved (lb.)		

* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the NCDENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus, and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

In several streams throughout the basin, DWQ noted evidence and observed several areas where livestock had direct, easy access to the streams. Fencing, or livestock exclusion, prevents livestock from entering a stream and provides an area of vegetative cover, which can secure streambanks, lower stream velocities, trap suspended sediments, and decrease downgradient erosion. Livestock exclusion is also effective in reducing nutrient, bacteria, and sediment loads in a stream (Line and Jennings, 2002).

Forestry and Water Quality

Approximately 50 percent of forestland in the Hiwassee River basin is publicly owned, and primarily consists of the Nantahala National Forest. Most of the remaining balance of forestland is privately owned by individuals. This ownership estimate comes from the most recent data published by the USDA-Forest Service *Forest Statistics for North Carolina, 2002.* (Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004). No streams were noted or identified by stressors associated with forestry activities. Where forest harvesting is identified as a source of water quality impact, DWQ will notify the Division of Forest Resources to investigate for potential violations and the enforcement of management strategies. Chapter 8 presents more information related to the impacts of forestry on water quality.

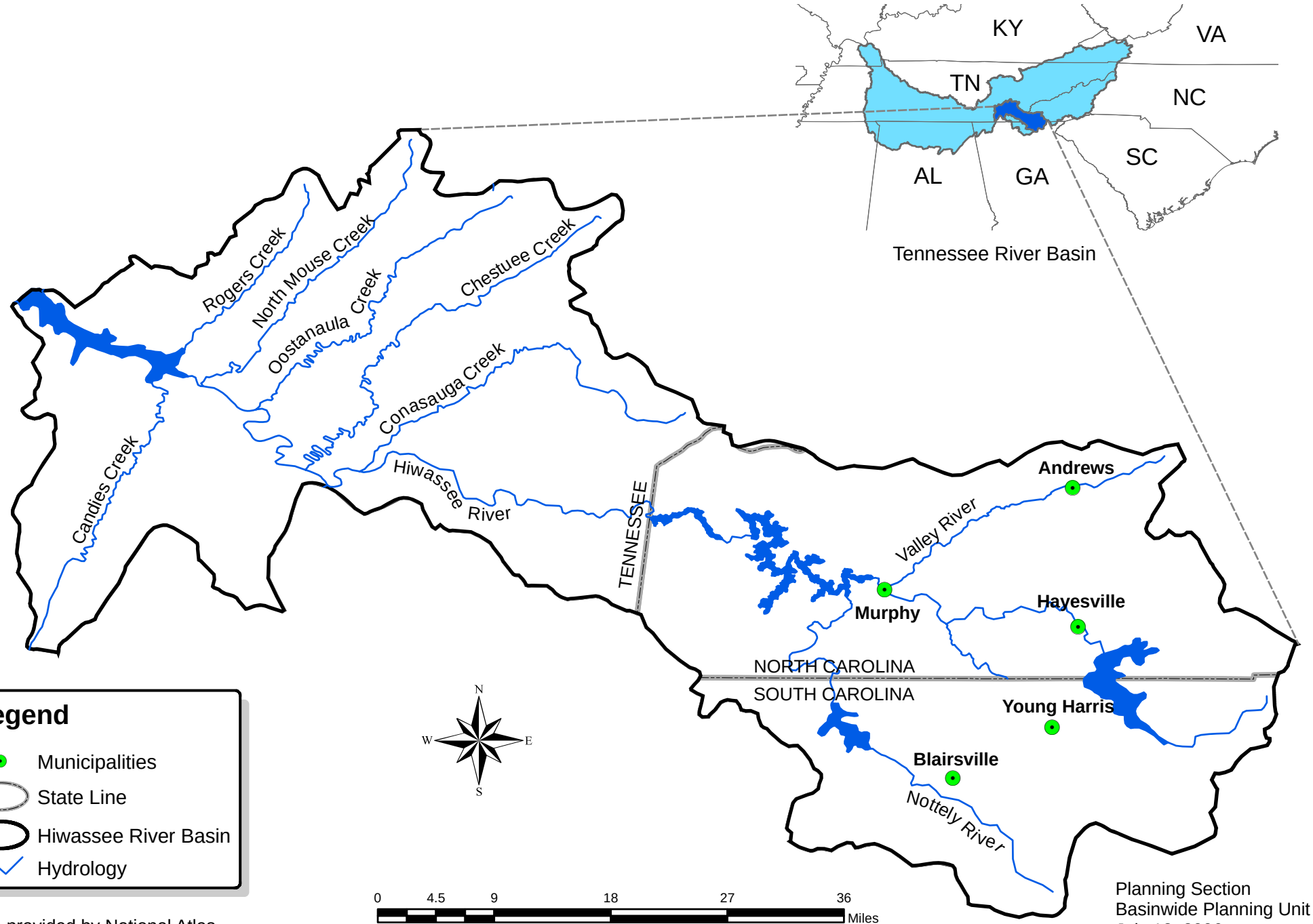
Water Resources

Chapter 9 presents information related to minimum streamflow requirements, interbasin transfers, and the impact to water quality during drought conditions. The chapter also includes the federal cataloging units, or hydrologic units, as they relate to the state subbasin boundaries.

Natural Resources

North Carolina's portion of the Hiwassee River basin is located entirely within the Blue Ridge physiographic province. The basin is home to a wide diversity of plants and animals with over 70 species considered endangered, threatened, special concern, or significantly rare by the NC Natural Heritage Program (NHP). Chapter 10 presents information related to the ecological significance of the basin and identifies endangered and threatened species, significant natural areas and aquatic habitats, and public lands that are locally significant.

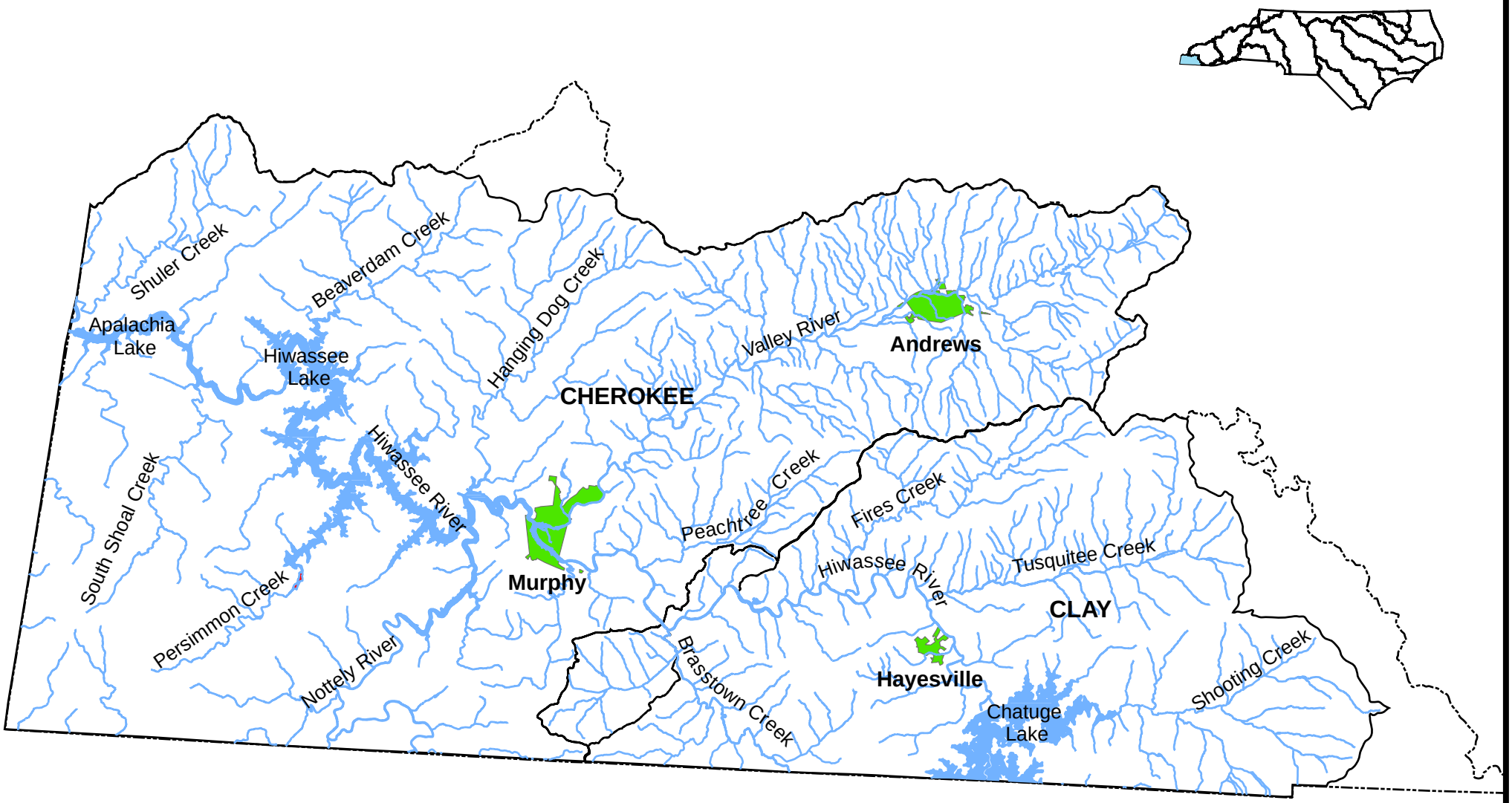
Figure iii General Map of the Entire Hiwassee River Basin



*Data provided by National Atlas

Planning Section
Basinwide Planning Unit
July 18, 2006

Figure iv General Map of the Hiwassee River Basin in North Carolina



Planning Section
Basinwide Planning Unit
May 23, 2006

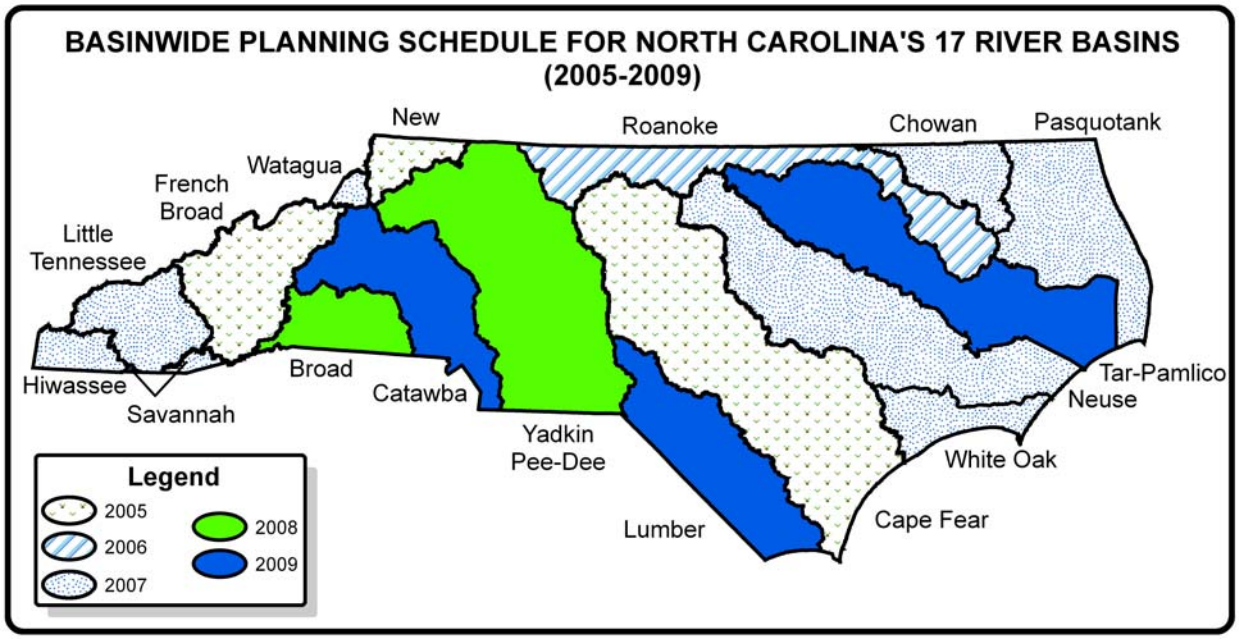
Introduction

What is Basinwide Water Quality Planning?

Basinwide water quality planning is a watershed-based approach to restoring and protecting the quality of North Carolina's surface waters. The NC Division of Water Quality (DWQ) prepares Basinwide water quality plans for each of the 17 major river basins in the state (Figure 1 and Table 1). Preparation of a basinwide water quality plan is a five-year process, which is broken down into three phases (Table 2).

While these plans are prepared by DWQ, their implementation and the protection of water quality entail the coordinated efforts of many agencies, local governments and stakeholder groups throughout the state. The first cycle of plans was completed in 1998. Each plan is updated at five-year intervals.

Figure 1 Basinwide Planning Schedule (2005to 2009)



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 yet allow for reasonable economic growth.

DWQ accomplishes these goals through the following objectives:

- Collaborate with other agencies to develop appropriate management strategies. This includes providing agencies information related to financial and funding opportunities.

- Assure equitable distribution of waste assimilative capacity.
- Evaluate cumulative effects of pollution.
- Improve public awareness and involvement.
- Regulate point and nonpoint sources of pollution where other approaches are not successful.

Benefits of Basinwide Water Quality Planning

Basinwide planning and management benefits water quality by:

- Focusing resources on one river basin at a time.
- Using sound ecological planning and fostering comprehensive NPDES permitting by working on a watershed scale.
- Ensuring better consistency and equitability by clearly defining the program's long-term goals and approaches regarding permits and water quality improvement strategies.
- Fostering public participation to increase involvement and awareness about water quality.
- Integrating and coordinating programs and agencies to improve implementation of point and nonpoint source pollution reduction strategies.

How You Can Get Involved

To assure that basinwide plans are accurately written and effectively implemented, it is important for citizens and local stakeholders to participate in all phases of the planning process. You may contact the basinwide planner responsible for your basin anytime during the plan's development. Upon request, the basin planner can also present water quality information and basin concerns to local stakeholder groups.

To make the plan more inclusive, DWQ is coordinating with the local Soil and Water Conservation Districts (SWCD), council of governments, NC Cooperative Extension Service, the county Natural Resources Conservation Service (NRCS), and stakeholder groups to develop language and identify water quality concerns throughout the basin. Citizens and local communities can also be involved during the planning process by contacting their county extension service or local SWCD.

During the public comment period, the draft plan is available online and by request for a period of at least 30 days. DWQ welcomes written comments and questions during this phase of the planning process and will incorporate comments and suggestions when appropriate.

Division of Water Quality Functions and Locations

For more information on the basinwide planning process, DWQ activities, or contacts, visit http://h2o.enr.state.nc.us/basinwide/ or call (919) 733-5083 and ask for the basin planner responsible for your basin of interest. You can also contact the appropriate Regional Office (Figure 2) for additional information. For general questions about the Department of Environment and Natural Resources, contact the Customer Service Center at 1-877-623-6748.

Table 1 Basinwide Planning Schedule (2004 to 2011)

Basin	DWQ Biological Data Collection	Draft Out For Public Review	Final Plan Receives EMC Approval	Begin NPDES Permit Issuance
Chowan	Summer 2005	7/2007	9/2007	11/2007
Pasquotank	Summer 2005	7/2007	9/2007	12/2007
Neuse	Summer 2005	9/2007	11/2007	1/2008
Broad	Summer 2005	1/2008	3/2008	7/2008
Yadkin-Pee Dee	Summer 2006	3/2008	5/2008	9/2008
Lumber	Summer 2006	1/2009	3/2009	7/2009
Tar-Pamlico	Summer 2007	5/2009	7/2009	9/2009
Catawba	Summer 2007	7/2009	9/2009	12/2009
French Broad	Summer 2007	3/2010	4/2010	7/2010
New	Summer 2008	8/2010	11/2010	1/2011
Cape Fear	Summer 2008	9/2010	11/2010	2/2011
Roanoke	Summer 2004	7/2006	9/2006	1/2007
White Oak	Summer 2004	3/2007	5/2007	6/2007
Savannah	Summer 2004	1/2007	3/2007	8/2007
Watauga	Summer 2004	11/2006	1/2007	9/2007
Hiwassee	Summer 2004	1/2007	3/2007	8/2007
Little Tennessee	Summer 2004	1/2007	3/2007	10/2007

Note: A basinwide plan was completed for all 17 basins during the second cycle (1998 to 2003).

Table 2 Five-Year Planning 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 Collect Information from State and Local Agencies**	• Gather and analyze data from sampling activities • Develop use support ratings • Conduct special studies and other water quality sampling activities • Work with state and local agencies to establish goals and objectives • Identify and prioritize issues for the next basin cycle • Develop preliminary pollution control strategies • Coordinate with local stakeholders and other state/local 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 for public review • Revise plan (when appropriate) to reflect public comments • 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

Some Other Reference Materials

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

- *Supplemental Guide To North Carolina's Basinwide Planning* (January 2007) 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. Visit the website at http://h2o.enr.state.nc.us/basinwide/SupplementalGuide.htm to download this document.
- *Hiwassee River Basinwide Assessment Report* (August 2004). This technical report presents physical, chemical, and biological data collected in the Hiwassee River basin. This report can be found on the DWQ Environmental Sciences Section (ESS) website at http://www.esb.enr.state.nc.us/.
- *Hiwassee River Basinwide Water Quality Management Plan* (September 1995; July 2000). These first basinwide plans for the Hiwassee River basin present water quality data, information, and recommended management strategies for the first two five-year cycles.
- *North Carolina's Basinwide Approach to Water Quality Management: Program Description* (Creager, C.S. and J.P. Baker, 1991). NC DWQ Water Quality Section. Raleigh, NC.

How to Read the Basinwide Plan

Chapters 1 - 2: Subbasin and Watershed Information

- **Summarizes information and data by subbasin, including:**
  - **Recommendations from the previous basin plan.**
  - **Achievements, current priority issues and concerns.**
  - **Impaired waters and water with notable impacts.**
  - **Goals and recommendations for the next five years by subbasin.**

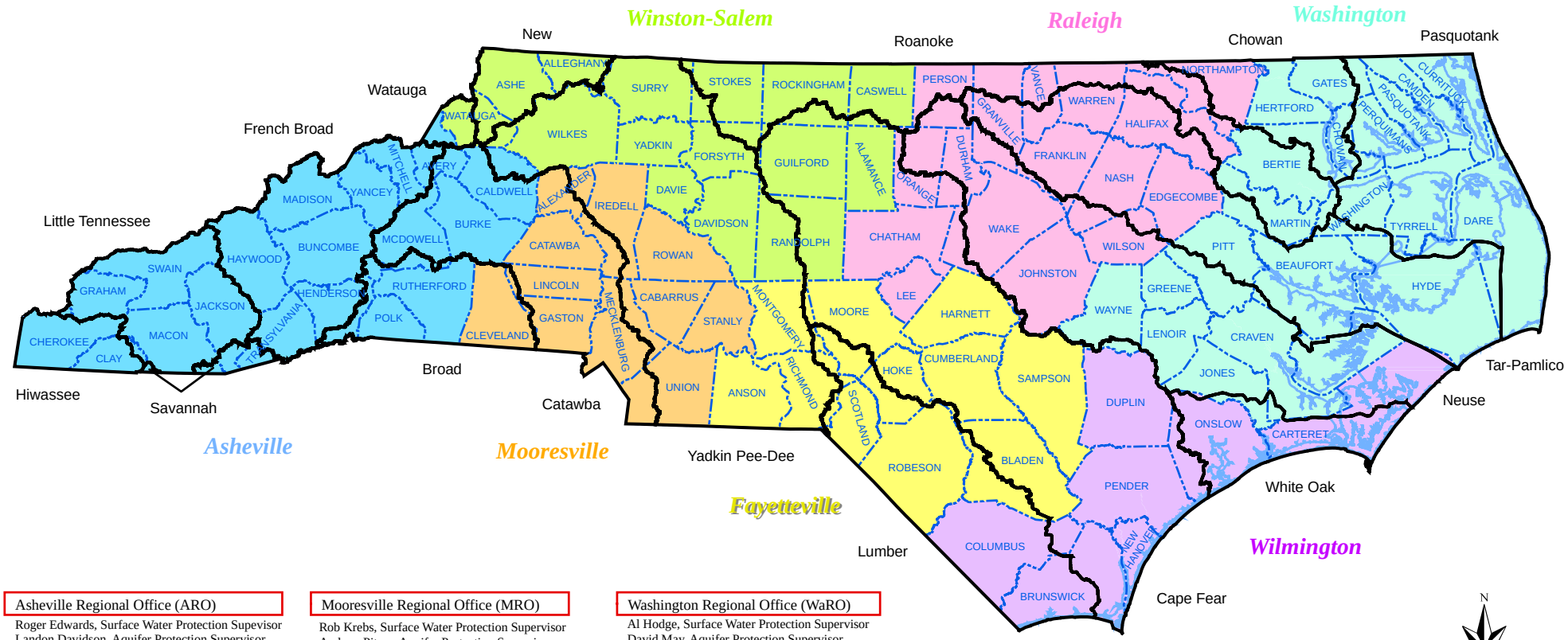
Chapter 3 – 11

- **Presents information on various topics of interest to the protection and restoration of water quality in the basin, including:**
  - **Stream classifications.**
  - **Population and land cover changes.**
  - **Water Quality stressors.**
  - **Agricultural, forestry and permitting activities in the basin.**
  - **Water and natural resources.**
  - **Local initiatives.**

Appendices

- **Population and land use changes over time and local governments in the basin.**
- **Water quality data collected by DWQ, use support methodology and 303(d) listing.**
- **NPDES dischargers and general stormwater permits.**
- **Points of contact, and a glossary of terms and acronyms.**

North Carolina Department of Environment and Natural Resources
Division of Water Quality Regional Offices



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

Mooresville Regional Office (MRO)

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Cabarrus	Mecklenburg
Catawba	Rowan
Cleveland	Stanly
Gaston	Union
Iredell	

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

Winston-Salem Regional Office (WSRO)

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Alamance	Forsyth	Watauga
Alleghany	Guilford	Wilkes
Ashe	Randolph	Yadkin
Caswell	Rockingham	
Davidson	Stokes	
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Carteret	Onslow
Columbus	Pender
Duplin	

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NCDENR

Planning Section
Basinwide Planning Unit
January 2007

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

1.1 Subbasin Overview

Subbasin 04-05-01 at a Glance

Land and Water Area

Total area:	223 mi²
Land area:	195 mi²
Water area:	28 mi²

Population (County)

2000 Est. Pop.:	8,775 people
Pop. Density:	45.0 persons/mi²

Land Cover (percent)

Forest/Wetland:	69%
Water:	14.8%
Urban:	2.5%
Cultivated Crop:	6.9%
Pasture/ Managed Herbaceous:	6.8%

Counties
Clay

Municipalities
Hayesville

Aquatic Life Monitored Streams Statistics

Total Streams:	43.3 mi
Total Supporting:	34.9 mi
Total Not Rated:	8.4 mi

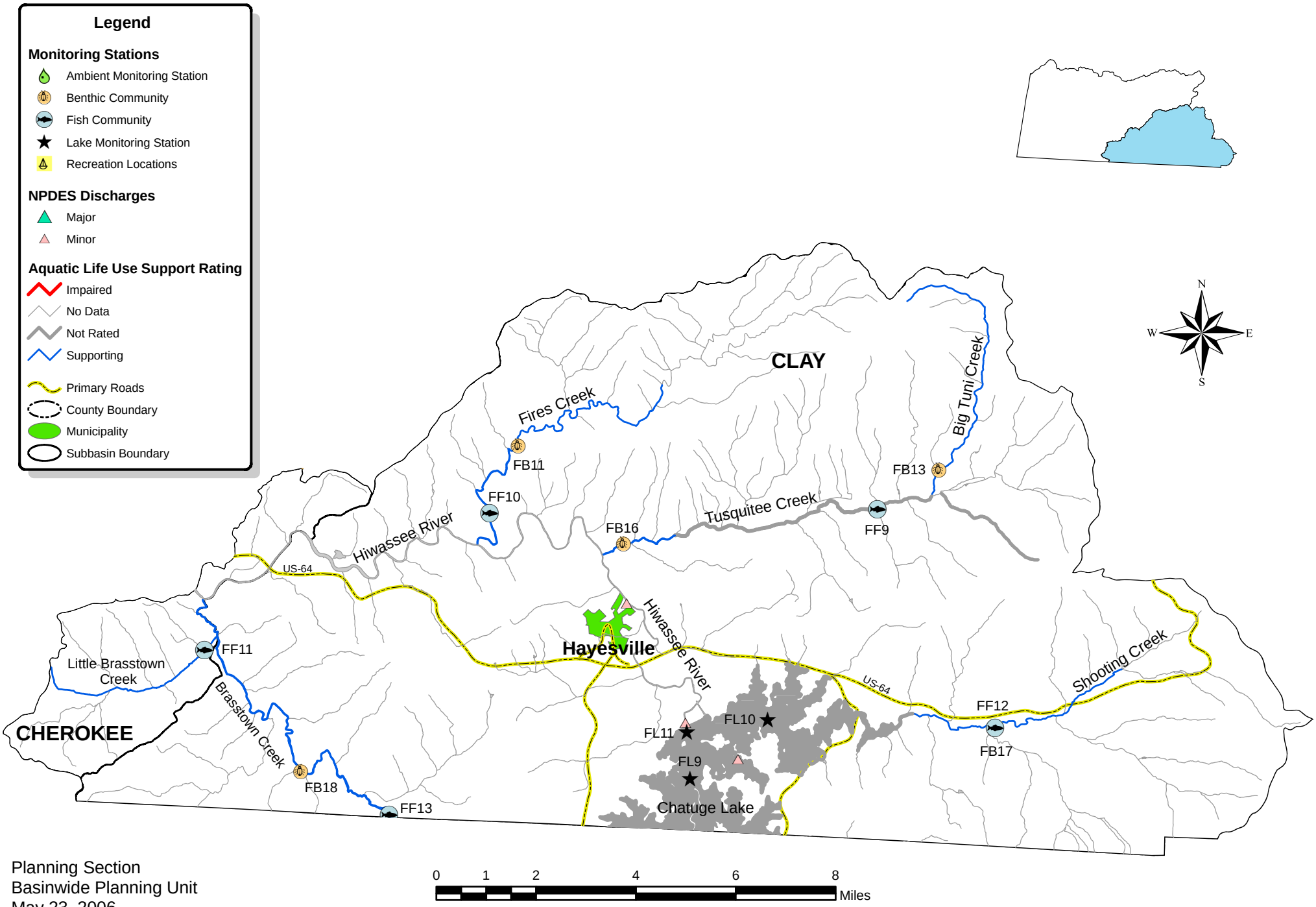
The Hiwassee River originates in the mountains of Towns County, Georgia and flows northward. Near the NC/GA state line, the river is impounded to form Lake Chatuge. Two major tributaries, Big Tuni Creek and Fires Creek, originate in the high mountains of northern Clay County. Land use in this area is mostly forest and the terrain is rugged. Conversely, Tusquitee and Brasstown Creeks flow through the broad valleys of southern Clay County where topography is gentle and more favorable for agriculture and residential land uses. Hayesville is the only municipality.

Most of the land within this subbasin is forested (69 percent), but cropland and pasture are also common (14 percent). Nearly fifteen percent of the area is surface water, reflecting the 3,629 acres of Lake Chatuge. 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 26.4 percent over between 2000 and 2020. Refer to Appendix I and III for more information about population growth and land use changes, respectively.

There is one large NPDES discharger in this subbasin (Clay County WWTP, NC0026697) whose permitted discharge is 0.3 MGD. Since the last basinwide assessment in 1999, this facility has had an upgrade in treatment and is no longer required to perform toxicity testing. There is also a facility in Georgia (Town of Young Harris Water Pollution Control Plant, 0.24 MGD) that discharges to Brasstown Creek about six miles upstream of the North Carolina state line in Towns County. Refer to Appendix V for the listing of NPDES permit holders.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 3. Table 3 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Refer to Appendix VIII for more information about use support methodology.

Figure 3 Hiwassee River Subbasin 04-05-01



Planning Section
Basinwide Planning Unit
May 23, 2006

Table 3 Hiwassee Subbasin 04-05-01

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Big Tuni Creek													
1-21-5	C Tr HQW	6.1 FW Miles		**S**					ND				
	From source to Tusquitee Creek				FB13	E	2004						
Brasstown Creek													
1-42	WS-IV	8.7 FW Miles		**S**					ND			Nutrient Impacts	
	From North Carolina-Georgia State Line to Hiwassee River				FF13	GF	2004					Habitat Degradation	Unknown
					FB18	E	2004					Habitat Degradation	Agriculture
Fires Creek													
1-27-(5.5)	WS-IV Tr ORW	8.6 FW Miles		**S**					ND				
	From Rocky Cove Branch to Hiwassee River				FF10	NR	2004						
					FB11	E	2004						
HIWASSEE RIVER (Chatuge Lake below elevation 1928)													
1-(1)	B	3,533.1 FW Acres		**NR**	FL11	ID			ND				
					FL10	ID							
					FL9	ID							
	From North Carolina-Georgia State line to Chatuge Dam												
Little Brasstown Creek													
1-42-11	WS-IV	4.2 FW Miles		**S**					ND			Habitat Degradation	Unknown
	From source to Brasstown Creek				FF11	GF	2004					Habitat Degradation	Agriculture
Shooting Creek													
1-5	C Tr	5.6 FW Miles		**S**					ND				
	From source to Chatuge Lake				FF12	GF	2004						
					FB17	E	2004						

Table 3 Hiwassee Subbasin 04-05-01

AU Number / Description	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Tusquitee Creek													
1-21-(16.5)	WS-IV Tr HQW	1.7	FW Miles	**S**					ND			Habitat Degradation	Unknown
From Buckner Branch to Hiwassee River					FB16	E	2004						
1-21-(4.5)	C Tr HQW	5.8	FW Miles	**NR**					ND				
From Big Tuni Creek to Buckner Branch					FF9	NR	2004						

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
FF - Fish Community Survey
FB - Benthic Community Survey
FA - Ambient Monitoring Site
FL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired

Use Support Ratings 2005:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	34.9	FW Miles
NR	m	5.8	FW Miles
NR	m	3,533.1	FW Acres
NR	e	2.5	FW Miles
ND		271.5	FW Miles

Recreation Rating Summary

NR	e	2.6	FW Miles
ND		312.1	FW Miles
ND		3,533.1	FW Acres

Fish Consumption Rating Summary

I	e	314.7	FW Miles
I	e	3,533.1	FW Acres

Benthic macroinvertebrates have been collected from sites in subbasin 04-05-01 since 1985. There were 5 benthic macroinvertebrate community and 5 fish community samples collected during this assessment period. Big Tuni, Fires, and Tusquitee Creeks all maintained Excellent bioclassifications between 1999 and 2004. Shooting and Brasstown Creeks improved from Good to Excellent over the same period.

Data were also collected from three stations on Lake Chatuge. There are no ambient monitoring stations in this subbasin. Refer to the *2005 Hiwassee River Basinwide Assessment Report* at http://h2o.enr.state.nc.us/esb/Basinwide/HIW2005.pdf and Appendix IV for more information on monitoring. All streams sampled in 2004 for benthic macroinvertebrates in subbasin 04-05-01 were classified using mountain criteria.

All of the fish community sites in this subbasin were sampled by DWQ for the first time in 2004. The 2004 basinwide assessment will therefore serve as a baseline for the 2009 basinwide monitoring cycle. The North Carolina Wildlife Resources Commission manages Shooting and Tusquitee Creeks as Hatchery Supported Trout Waters (HSTW). Wild, not stocked, trout were collected from Shooting, Tusquitee, and Fires Creeks.

Shooting, Big Tuni, Fires, and Tusquitee Creeks all have supplemental trout waters (Tr) classifications. Tusquitee Creek watershed is also classified as High Quality Waters (HQW) and Fires Creek watershed is classified as Outstanding Resource Waters (ORW). Brasstown and Little Brasstown Creeks are surface water supply waters and carry the WS-IV classification.

Waters in the following sections and in Table 3 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same. For example, index number 11-3-(14) might be split into two assessment units 11-3-(14)a and 11-3-(14)b.

1.2 Use Support Assessment Summary

Table 4 Summary of Use Support Ratings by Category in Subbasin 04-05-01

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	34.9 mi	0
Impaired*	0	0
Not Rated	8.4 mi	0
Total	**43.3 mi**	**0**
Unmonitored Waters		
Not Rated	2.5 mi	2.6 mi
No Data	271.5 mi	314.7 mi
Total	**274 mi**	**317.3 mi**
Totals		
All Waters**	**317.3 mi**	**317.3 mi**

* The noted percent Impaired is the percent of monitored mile/acres only.
** Total Monitored + Total Unmonitored = Total All Waters.

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification is assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to Appendices IV and VIII, respectively. Appendix IX provides definitions of the terms used throughout this basin plan.

In subbasin 04-05-01, use support was assigned for the aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS). All waters are Supporting in the water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Refer to Table 4 for a summary of use support for waters in subbasin 04-05-01.

1.3 Status and Recommendations of Previously and Newly Impaired Waters

No stream segments in this subbasin were rated as impaired in the 2002 basin plan or based on recent DWQ monitoring (1999-2004). Section 1.4 below discusses specific streams where water quality impacts have been observed.

1.4 Status and Recommendations for Waters with Noted Impacts

Based on DWQ's most recent use support methodologies, the surface waters discussed in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, water quality education on local issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Refer to Section 1.1 for more information about AU#. Nonpoint source program agency contacts are listed in Appendix VII.

1.4.1 Brasstown and Little Brasstown Creeks Including Crawford Creek [AU# 1-42, 1-42-11, and 1-42-1]

Current Status

Brasstown Creek originates in northern Georgia where it drains a portion of Towns County and the Town of Young Harris before flowing through southwestern Clay County, NC to join the Hiwassee River. Brasstown Bald is the highest point in GA and is in the headwaters of Brasstown Creek. Little Brasstown Creek is a large tributary to Brasstown creek, draining a small portion of southeastern Cherokee County. The watershed contains low density, rural residential development, pasture, hay, and row crops in addition to substantial forest cover. Brasstown Creek from the North Carolina-Georgia state line (8.7 miles) and Little Brasstown Creek from its source to Brasstown Creek (4.2 miles) are Supporting aquatic life.

DWQ has sampled the benthic community of Brasstown Creek at site FB18 three times. The sample results show a steady improvement since 1994: Fair in 1994, Good in 1999, and Excellent in 2004. DWQ also sampled the fish community at site FF13, just downstream of the GA-NC state line. This site rated Good-Fair in 2004. The fish community there indicated a shift from a cool water trout stream to a mixture of cool and warm water fish species, including 22 bluegills, one green sunfish (exotic), and one largemouth bass. There were no smallmouth bass,

few pollution intolerant species, and no trout species collected. The specific conductance at this site (40 µmhos/cm) suggested that nutrient inputs from agricultural land use and the Young Harris municipal treatment plant upstream in Georgia may be contributing to the species shift.

DWQ sampled the fish community in Little Brasstown Creek at site FF11 for the first time in 2004. The fish community received a Good-Fair rating, largely due to instream habitat problems. Biologists noted sediment accumulating in deep pools, probably originating from nonpoint sources in the watershed.

Special Studies

TVA: The Tennessee Valley Authority (TVA) sampled the fish community of Little Brasstown Creek at SR 1565 in 1995, 1997 and 1999 as part of its routine monitoring efforts. The index of biotic integrity developed by the TVA staff to summarize these data and rate this stream is different than North Carolina's methodologies (NCIBI); therefore scores and ratings assigned are not equivalent. However, these data can be used to "screen" waterbodies in further need of monitoring efforts by DWQ or in need of local restoration efforts. The rating assignment for Little Brasstown Creek improved with each of these successive assessments for undescribed reasons (1995 = Poor-Fair, 1997 = Fair, and 1999 = Good).

HRWC: The Hiwassee River Watershed Coalition (HRWC) hired a professional consultant to conduct benthic monitoring along Little Brasstown Creek in association with a watershed restoration project (discussed below). Three sites on Little Brasstown Creek, along with one reference site on Winchester Creek, were evaluated before and one year after stream restoration work was conducted. These sites were rated using methods established by NC DWQ. Winchester Creek and the sites upstream and downstream of the restoration project on Little Brasstown Creek showed no between-year differences. Winchester Creek received a Good bioclassification in both 2004 & 2005; the upstream and downstream sites rated Good-Fair. Although the site on Little Brasstown Creek within the project reach still received a Good-Fair bioclassification, there was a large improvement in habitat quality. The habitat score improved from 37 in 2004 to 70 in 2005 following restoration work. Improvements in the benthic macroinvertebrate community typically require more than one year following restoration (Lenat Consulting Services, March 2005).

The HRWC study also noted that the benthic macroinvertebrate community structure at all sites, including the reference reach, are warmer than expected for mountain streams, probably due to a lack of shading from the riparian buffer. Habitat scores in unrestored sections of Little Brasstown Creek that were monitored immediately upstream and downstream of the Carringer/Mitchell restoration project were poor, averaging 35/100 in both years (Lenat Consulting Services, March 2005).

Water Quality Initiatives

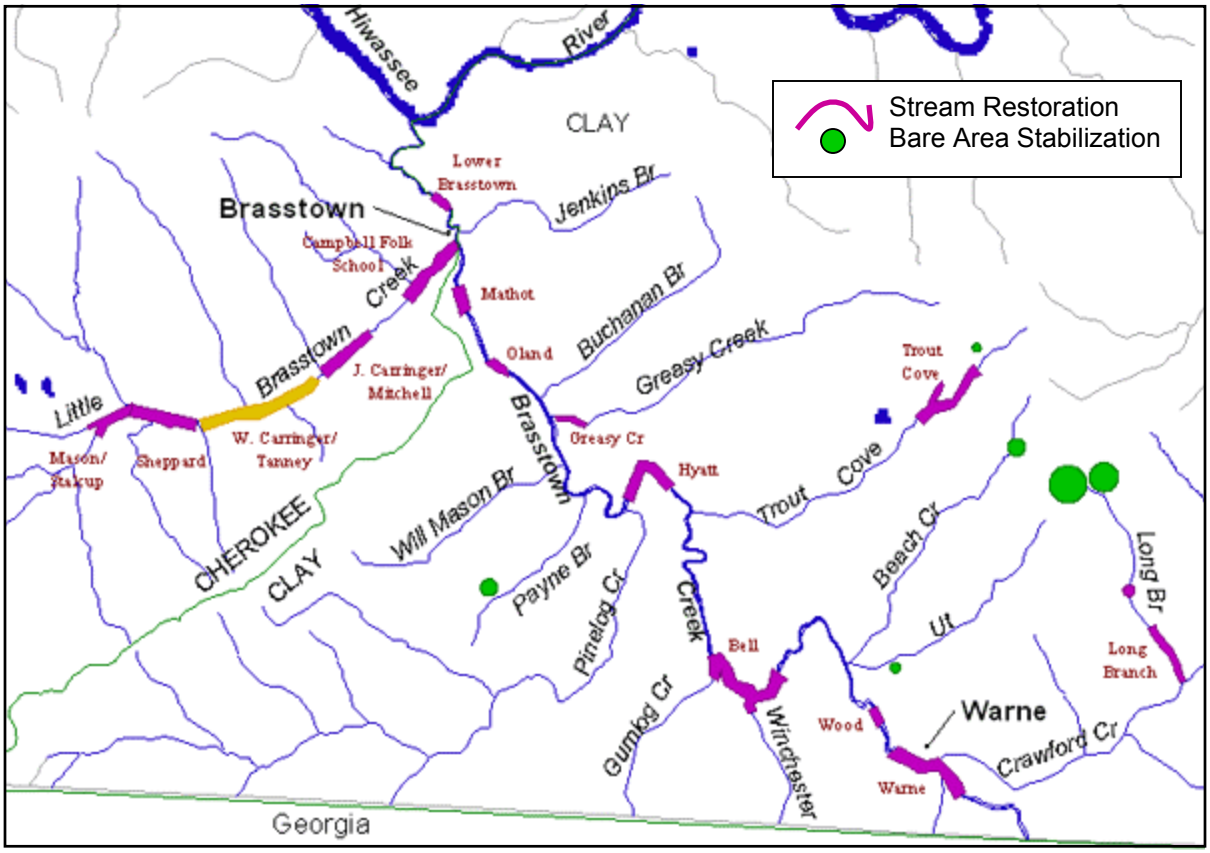
In 1999, the North Carolina Clean Water Management Trust Fund (CWMTF) awarded a $2.1 million grant to HRWC for restoration work in the North Carolina portion of the Brasstown Creek watershed. Using these funds, the Coalition was able, in partnership with the Natural Resources Conservation Service, the Clay County Soil & Water Conservation District, and 40 local landowners, to restore more than five miles (27,042 linear feet) of stream in the watershed (Figure 4). In addition, more than 50 acres of wooded riparian buffer were created and placed under a protective easement, 160 acres of critically eroding bare areas were re-vegetated, and

2,000 acres of pastureland were improved. Work under this grant was completed in December 2003.

In 2004, HRWC received an additional grant for several projects in the Little Brasstown Creek watershed that build upon work completed under the first Brasstown Creek grant. HRWC received $431,470 from CWMTF for three projects along this major tributary to Brasstown Creek. To-date, the Coalition has restored 55 percent of Little Brasstown Creek's total length (11,342 linear feet). When the current projects are completed, HRWC will have restored 70 percent (14,542 linear feet) of the stream's total length.

Additional accomplishments of the Brasstown Creek Watershed Restoration Project include $1.5 million dollars spent locally (materials and grading/clearing contractors), the purchase and rental (to cover costs only) of a no-till seed drill, and a community educated about the value of riparian buffers for controlling erosion. Specific information, including before and after pictures, about the projects shown in Figure 4 can be found at the HRWC website: www.hrwc.net. Currently, HRWC is working with an $185,000 grant from the CWMTF to monitor channel stability, vegetation survival, temperature, benthic communities, and suspended sediment at 10 restoration sites in the Brasstown Creek watershed over a 3-year period (2005-2007). As data are obtained about the success of the restoration work, HRWC will evaluate the needs within the watershed for additional water quality improvements. HRWC is also currently pursuing funding for restoration work in the Georgia portion of the watershed upstream.

Figure 4 HRWC Restoration Projects in Brasstown Creek Watershed.



2007 Recommendations

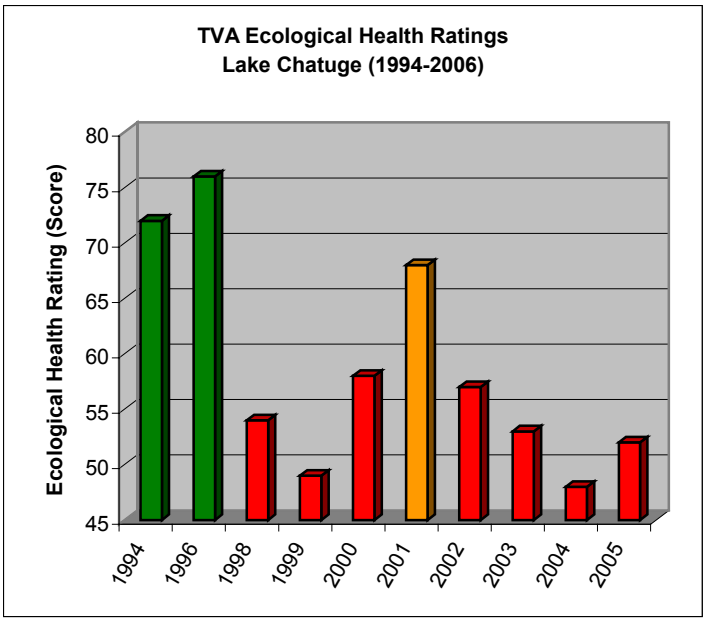
Additional efforts to prevent sedimentation and to re-establish instream habitats and riparian vegetation are needed in the Brasstown Creek watershed. HRWC has demonstrated its ability to coordinate such projects. HRWC's restoration effort in the Brasstown Creek watershed is a model program. It uses sound scientific methods and has created effective partnerships at the federal, state, and local level. DWQ strongly supports their ongoing restoration goals.

HRWC is monitoring restored reaches of the watershed using funds from the CWMTF. These funds, however, cannot be used to monitor streams without restoration projects. In order to compare water quality between the restored and unrestored streams and guide future restoration efforts, additional monitoring is need on Pinelog and Crawford Creeks. Additionally, the Clay County Soil and Water Conservation District has prioritized Crawford Creek and monitoring is needed to support their activities in the watershed – particularly suspended solids and turbidity measurements. In the next assessment cycle, DWQ will perform a special survey of fish and/or benthic communities in these creeks if resources permit.

1.4.2 Lake Chatuge [AU#1-(1)] and Hiwassee River Below Chatuge Dam [AU# 1-16.5a]

Current Status of Lake Chatuge

Lake Chatuge straddles the border of North Carolina and Georgia, and is a popular recreation area. As a result, development along the shoreline is significantly more concentrated than in the rest of the subbasin. By 2003, 42 percent of the total shoreline miles were developed. This development has resulted in the loss of critical riparian buffer and in a significant increase in the amount of impervious surfaces draining into the lake.



Lake Chatuge was monitored by DWQ in June, July, and August of 2004. Low nutrient and chlorophyll *a* concentrations were found in all months indicating low biological productivity. Water clarity was good despite frequent rainfall in summer 2004. Because of an insufficient number of samples, Lake Chatuge (7,050 acres) is not rated for aquatic life support. Bacteriological monitoring has not been conducted by DWQ and therefore Lake Chatuge is also not rated for recreation use. TVA has conducted bacteriological monitoring; the results of this sampling are discussed in the Special Studies section below.

Figure 5 TVA Ecological Health Ratings for Lake Chatuge

TVA began monitoring five ecological indicators (dissolved oxygen, chlorophyll, fish, bottom life, and sediment quality) on Lake Chatuge Reservoir in 1993. After 1994, TVA went to a two-year monitoring cycle, but resumed annual monitoring in 1999 after observing a substantial drop

in the reservoir's ecological health score in 1998. From 1998 to 2005, Lake Chatuge has rated poor every year with the exception of 2001, when it rated fair due to improved DO conditions and lower average chlorophyll concentrations (Figure 5).

Weather conditions (the timing and amount of rainfall) and the related changes in runoff have proved to be a major factor in the variation in ecological health scores for Lake Chatuge and many other reservoirs. Dissolved oxygen and chlorophyll — the indicators most responsive to changes in weather conditions — tend to rate better in reservoirs during drought conditions and worse during periods of normal to high rainfall and runoff. This is because fewer nutrients and less organic material are washed into the reservoir when rainfall and runoff are low, which tends to result in lower chlorophyll concentrations and decreased oxygen demand for decomposition of organic materials.

Comparing TVA and DWQ Lake Sampling Programs

The Tennessee Valley Authority (TVA) began a program to monitor the biological conditions of its reservoirs in 1990. The purpose of this monitoring is to provide data sufficient to reliably characterize the ecological health of the reservoirs. TVA collects data for five indicators (dissolved oxygen, chlorophyll, sediment quality, benthic macroinvertebrates, and fish communities), which are used to derive an overall reservoir ecological health rating score. Ratings are based on best-observed conditions given the environmental and operational characteristics of the dam/reservoir and professional judgment.

Of the five indicators monitored by TVA, only two (dissolved oxygen and chlorophyll *a*) are also monitored by DWQ. TVA develops a DO rating, as opposed to using the actual DO concentrations. This rating includes dissolved oxygen levels throughout the water column and requires determining the percent of the average cross-sectional length (at the location where the sampling was conducted) where the DO concentration is less than 2 mg/L. DWQ analysis only considers the surface DO concentration as a single point for comparison to the NC surface water quality standard (>4 mg/L instantaneous at the surface).

For chlorophyll-*a*, TVA recorded concentrations ranging from 16 ug/L in April to 3 ug/L in June. DWQ reported concentrations ranging from 5 ug/L in August to 1 ug/L in June. Nutrient concentrations were similar between TVA and DWQ and were considered to be low by DWQ as expected of an oligotrophic system such as Chatuge. The higher chlorophyll-a concentrations were seen in April and May. DWQ sampling focused on the time of the year when nuisance algae such as blue-greens normally become dominant (June through August). June, July and August concentrations recorded by TVA were slightly higher than DWQ's reported concentrations for the same time period (DWQ average = 2 ug/L & TVA average = 5 ug/L).

While TVA's data seem to indicate a trend toward decreasing ecological health, all surface water quality standards are being met and no designated uses are impaired. Factors that could influence the reservoir ratings developed by TVA include changes in the reservoir operations, land use changes in the watershed, and weather conditions during the sampling period. TVA's data seems to follow the general trend for many lakes in the state; increasing impacts due to non point sources as evidenced by increased chlorophyll-*a* and nutrients during high flow conditions. DWQ will continue to monitor TVA's findings and Lake Chatuge to better document changes in water quality.

Current Status of Hiwassee River Below Chatuge Dam

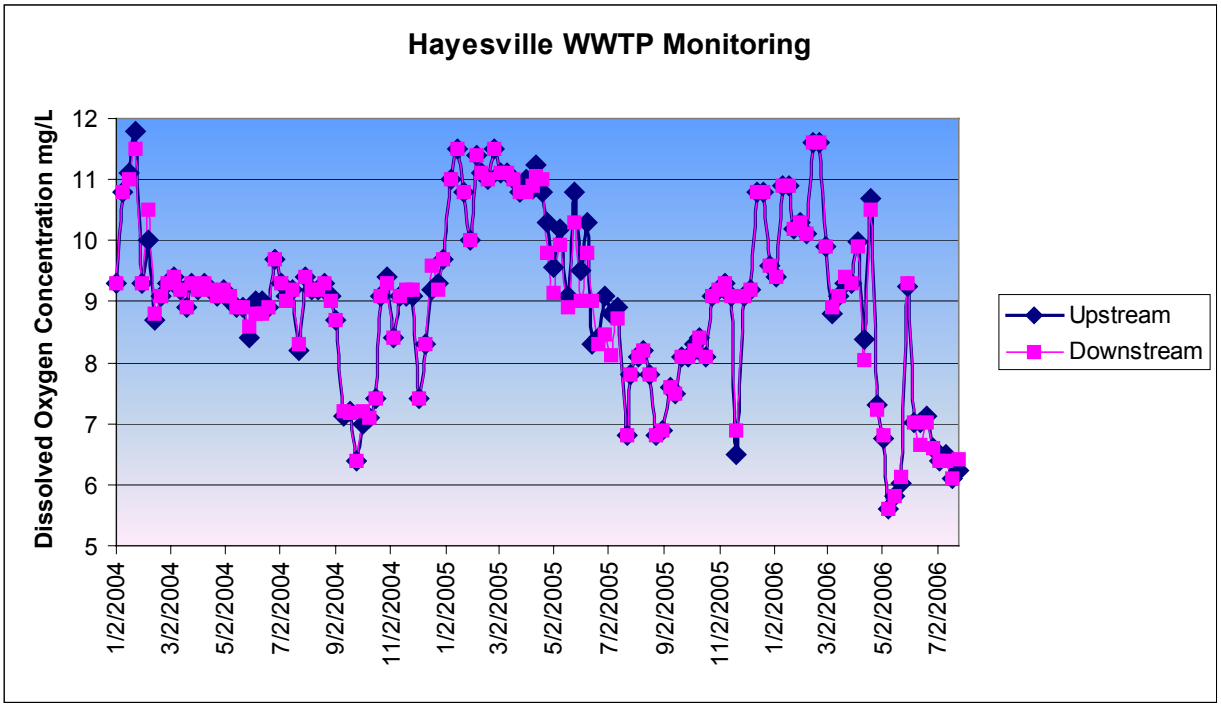
Historically, dissolved oxygen levels in the water released through Chatuge Dam were very low during the late summer months. To improve dissolved oxygen levels, TVA installed an infuser weir to improve the quality of water released from Chatuge Dam. The weir is a small dam located downstream from the powerhouse. When power is generated, water flowing from the turbine fills the pool above the weir and overflows across a deck made of wooden timbers and steel grating. The water flows through the slots in the deck, creating a series of waterfalls that introduce air into the water. The grating helps break up the falling sheets of water, entraining more air as the water falls into the downstream pool. This entrained air creates millions of bubbles in the water below the weir, producing higher dissolved oxygen levels downstream.

The Chatuge weir also maintains a minimum flow of water downstream from the dam during periods when the turbines are not operating. This is accomplished by means of special valves near the bottom of the weir that release a constant flow of water as the weir pool drains. When no hydro generation is scheduled, TVA releases water from the dam twice a day to refill the weir pool. This process helps to prevent the riverbed from drying out and provides additional habitat for fish and other aquatic life.

Below Chatuge Dam, the Clay County WWTP discharges to the Hiwassee River. This facility is required to monitor dissolved oxygen concentrations upstream and downstream of its outfall. DWQ summarized the monitoring results from January 2004 through July 2006. On average, the downstream dissolved oxygen concentration was 0.03mg/l lower than the upstream concentration. At no time was the dissolved oxygen concentration below the state water quality standard. These findings suggest the discharge has a negligible effect on dissolved oxygen concentrations in the river (Figure 6).

There were periods in which dissolved oxygen levels approached the water quality standard just upstream of the Clay County WWTP, but did not exceed it. Because these measurements were taken several miles downstream and TVA has a 4 mg/l target dissolved oxygen concentration target for its release, it is possible that the dissolved oxygen standard is actually exceeded further upstream closer to the dam release. Limited dissolved oxygen monitoring conducted by TVA below the weir does not indicate a dissolved oxygen standard violation. However, this monitoring is not continuous and is therefore not conclusive.

Figure 6 Dissolved Oxygen Concentrations Upstream and Downstream of Clay County WWTP



Special Studies

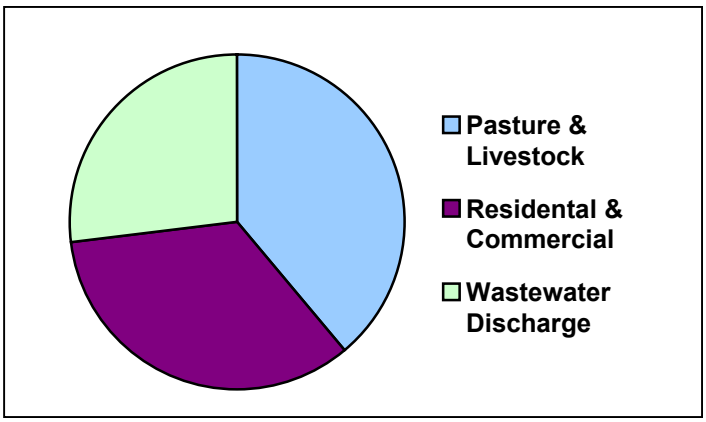
TVA: The Tennessee Valley Authority (TVA) performed fecal coliform bacteria monitoring at seven locations in Lake Chatuge in the summer of 2004 as part of a monitoring program targeting heavily used recreational areas throughout the Tennessee Valley. All geometric mean fecal coliform values found by TVA were low and well under the North Carolina water quality standard of 200/100 ml for five consecutive samples taken within a 30-day period (Rebecca Hallman, 2004; NCDENR-Division of Water Quality, August 1, 2004).

HRWC: In 2001, HRWC received an appropriation from the Georgia legislature of $216,000 to determine the causes of the Poor TVA ecological health ratings for Nottely (GA) and Chatuge Reservoirs and to develop an action plan for improving water quality conditions. Eighteen months of physical/chemical water quality data were collected by water quality professionals in 2002 (Nottely) and 2003 (Chatuge) from 11 sites in each watershed. Half of the stations were located within the reservoirs and half were sited on major tributary streams. In addition to professional monitoring, HRWC established volunteer monitoring teams to monitor additional sites on tributaries throughout the two watersheds. These teams continue to monitor 14 parameters monthly at 21 locations. The volunteer monitoring results have been published in three reports by the Environmental Quality Institute of the University of Asheville, the most recent of which is dated 2006. (Patch, 2006)

Concurrently, TVA conducted a detailed land use analysis based on low-altitude, color infrared, aerial photography for each watershed. In 2004, the physical/chemical data, land use information, flow data from gaging stations throughout the watersheds, and data from wastewater treatment plant discharges (two discharges into Lake Chatuge) were used to calibrate computer models for each watershed. Once calibrated, different scenarios were evaluated to determine how activities in the watershed affect the ecological health of Lake Chatuge and Lake Nottely.

The model results show that an excess of nutrients (primarily phosphorus) is the primary cause for concern related to Lake Chatuge's ecological health. In 2003, Lake Chatuge was receiving an estimated 9,600 pounds of phosphorus per year. There are three major sources of excess nutrients into the lake: pasture/livestock (39 percent), residential/commercial developed areas (34 percent), and treated wastewater discharges (27 percent) (Figure 7).

Figure 7 Phosphorus Loads to Chatuge Lake



The Lake Chatuge watershed contains approximately 11,000 acres of pasture and hay. Nutrients from these lands come from fertilizers (commercially-prepared and poultry waste) that are applied to the land to produce better grasses for grazing and hay for winter-feeding livestock. Often, there is not enough vegetation along streams to filter runoff from these lands, and in many cases, livestock have direct access to streams. Additionally, soil contains nutrients. When erosion of streambanks occurs, nutrients are carried directly into the lake on particles of sediment and become dissolved in the lake.

There are approximately 4,800 acres of developed areas in the Lake Chatuge watershed, primarily along highway corridors and in the City of Hiawassee, GA. Excess nutrients in stormwater runoff come from soil erosion associated with new construction, as well as from applications of fertilizer on lawns, ball fields, golf courses and landscaping. There are insufficient stormwater and erosion controls to filter runoff from these areas.

Water Quality Initiatives

HRWC, with the help of Lake Chatuge watershed stakeholders, is currently in the process of developing a Watershed Action Plan based on the results of the 4-year study described above. The Lake Chatuge Watershed Action Plan (to be published in 2007) will be a five year planning document that outlines recommendations for citizens, local governments, and other organizations/agencies working to improve water quality in the watershed that, if implemented in a timely fashion, should return the lake to Good ecological health (as routinely monitored by TVA).

2007 Recommendations

The HRWC/TVA project shows that roughly 3,750 pounds of phosphorus per year comes from 11,000 acres of agricultural land. A similar amount (3,200 pounds per year) comes from just 4,800 acres of developed land, demonstrating the large impact of developed land. Very little excess nutrients come from forested lands. If forest and agricultural lands continue to be developed without practices in place to prevent excess nutrients from flowing into the lake, the ecological health rating and water quality may decline.

DWQ supports the findings of the HRWC study and encourages efforts to implement the actions it identifies within the Lake Chatuge Watershed Action Plan to reduce sediment and nutrient

loads to the reservoir. Additionally, planning for future wastewater treatment is also needed to protect Lake Chatuge's health.

Monitoring is needed to determine if dissolved oxygen concentrations are above state standards in the Hiwassee River below Chatuge dam. The monitoring should be continuous (at least hourly) to allow daily average calculations.

1.4.3 Shooting Creek [AU#1-5]

Current Status
Shooting Creek is a major tributary to Lake Chatuge, creating one of its largest embayments when reaching the impoundment. The creek parallels US-64 for much of its length. The 1997 and 2002 sampling surveys noted that this proximity increases its susceptibility to residential and commercial development. The same remains true today, especially in the lower reach where it flows through a wide and flat valley before entering Lake Chatuge. DWQ sampled both fish (FF12) and benthic (FB17) communities during the current assessment period. Benthos have been sampled at site FB17 three times. In 1994 and 1999, the site rated Good. It improved to Excellent in 2004. In 2004, biologists observed areas of moderate bank erosion and portions of the riparian zone that had been cleared for residential purposes. Conductivity was slightly high for a mountain stream. This monitoring was conducted prior to the damaging rain events associated with hurricanes in the fall of 2002. DWQ did not assess Shooting Creek after the storms.

The fish community rated Good-Fair in 2004 due to a mixed assemblage of cool and warm water species including two catfish species (yellow and brown bullhead), and 12 yellow perch that likely migrated upstream from Lake Chatuge. This portion of Shooting Creek is classified as Trout Waters (Tr) by DWQ and is annually stocked with over 2,000 brook, rainbow, and brown trout from March to June by the Wildlife Resources Commission. Fifteen wild rainbow trout including twelve young-of-year were collected at this site, indicating that water quality is sufficient to support trout reproduction. Shooting Creek is rated Supporting from its source to Chatuge Lake (5.6 miles).

In November 2004 Clay County received $184,400 in Emergency Watershed Protection funds from the USDA Natural Resources Conservation Service (NRCS) to repair damage from hurricanes Frances and Ivan. A total of 2,000 linear feet of Eagle Fork Creek, Muskrat Creek, and Shooting Creek were restored using natural channel design techniques. The Projects were administered and supervised by the Clay County Soil and Water Conservation District and Clay County personnel. Additional accomplishments in the Shooting Creek drainage include two restoration projects funded by the North Carolina Agricultural Cost Share Program totaling 500 linear feet of restoration on Geisky and Eagle Fork Creeks.

Water Quality Initiatives
The Clay County Soil & Water Conservation District is actively seeking landowners in the Shooting Creek watershed that are in need of stream restoration work. Building on the work begun with Emergency Watershed Protection funds, the District has completed two small projects using Agricultural Cost Share monies on farms along Geisky and Eagle Fork Creeks. Depending on landowner interest, the District plans to partner with the Hiwassee River Watershed Coalition (HRWC) to submit a grant application to the NC Clean Water Management Trust Fund for more extensive restoration funding.

HRWC has four volunteer water quality monitoring stations in the Shooting Creek watershed.

2007 Recommendations
Local actions are needed to address nonpoint pollution sources in the watershed. DWQ encourages local governments to adopt and enforce local ordinances to protect existing water quality in the watershed. Refer to Chapters 5 and 6 for information on how this can be accomplished. Additionally, new development should avoid building in the floodplain and employ best management practices designed to reduce impacts to water quality.

HRWC, with the help of Lake Chatuge watershed stakeholders, is currently in the process of developing a Watershed Action Plan based on the results of the 4-year study described in Section 1.4.2. The Lake Chatuge Watershed Action Plan (to be published in 2007) will be a five year planning document that outlines recommendations for citizens, local governments, and other organizations/agencies working to improve water quality in the watershed. If implemented in a timely fashion, the lake should return to Good ecological health (as routinely monitored by TVA). The plan will include actions applicable to Shooting Creek, a major tributary to the lake. DWQ encourages citizens to volunteer their time to assist HRWC in implementing the plan and also encourages funding organizations to support plan implementation.

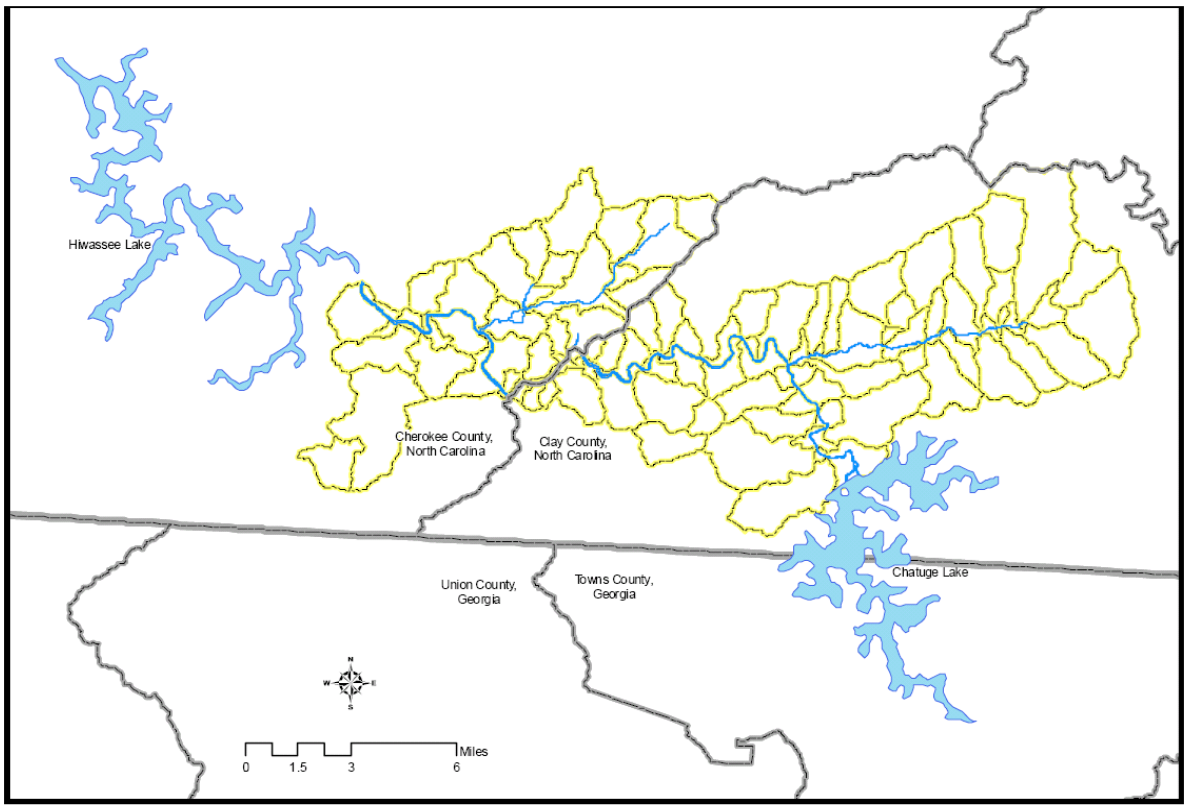
1.4.4 Tusquitee Creek [AU#1-21-(16.5)]

Current Status
Tusquitee Creek received an Excellent bioclassification in 2004 at site FB16 and the fish site at FF9 qualified as a regional reference site. Therefore, Tusquitee Creek from Big Tuni Creek to Hiwassee River (7.5 miles) is rated Supporting. Because of its excellent water quality, Tusquitee Creek is classified High Quality Water (additional discussion of the HWQ classification and rules is found in Section 1.5.6). However, biologists noted moderate bank erosion and a lack of riparian vegetation in places.

Large-scale residential developments are currently under construction in this formerly pristine watershed. Steep access roads, impervious surfaces, and lack of sediment controls are causing increased sedimentation in Tusquitee Creek. Local Soil and Water Conservation District employees have noted sediment problems after rain events on Tusquitee Creek, suggesting that runoff from residential construction may be causing sedimentation. Citizens also report a lack of awareness and enforcement of HQW rules in place to protect the watershed (See Section 1.5.6). This demonstrates a critical need for an ambient monitoring station and/or sediment monitoring station on Tusquitee Creek.

Special Studies
The North Carolina Ecosystem Enhancement Program (EEP) anticipates significant mitigation needs originating from stream disturbances related to road construction led by NCDOT. In July 2005, EEP, Hiwassee River Watershed Coalition (HRWC), and Equinox Environmental Consultation and Design started a local watershed planning process in the Hiwassee River basin. This planning effort will guide mitigation project site selection. An area that encompasses the Tusquitee Creek watershed was selected for more detailed data collection (Figure 8).

Figure 8 The Tusquitee-Peachtree-Martins Creek Watershed Study Area



A component of this local watershed planning effort is to develop detailed GIS and pollutant modeling information for both the Peachtree-Martins Creek watershed and an extended area to the east, which includes the Tusquitee watershed (Figure 8). This extended study area, the Tusquitee-Peachtree-Martins Creek study area, comprises 126 square miles in Clay and Cherokee counties. It includes the area draining to the Hiwassee River between its confluence with the Valley River upstream to Chatuge Dam. The Fires Creek watershed is excluded because it is essentially all owned and managed by the United States Forest Service. The study area includes all of six 14-digit hydrologic units (06020002-060010, -070010, -170010, -100040, -100050, and -090020) and part of two 14-digit hydrologic units (06020002-071010 and -100030). The project crosses the DWQ subbasin boundary, and is also discuss in Chapter 2 (See Section 2.3.1)

At HRWC's request, Equinox contracted with the Tennessee Valley Authority for an Integrated Pollutant Source Identification (IPSI) analysis that involves interpretation of aerial photography to assess impacts from various nonpoint sources of pollution in the watershed. The IPSI package includes a nonpoint source (NPS) inventory, desktop Geographic Information System (GIS), and pollutant loading models.

The NPS inventory is a geographic database that consists of information on watershed features such as land use/land cover, streambank erosion sites, and livestock operations that are known or suspected to be nonpoint pollution sources. The desktop GIS uses ARCGIS software, developed and supported by Environmental Systems Research Institute, Inc. (ESRI), for managing and viewing the data generated by the NPS inventory. The desktop GIS is a mapping system that allows the user to investigate relationships among various geographic features that are known or suspected to contribute NPS pollution to a selected waterbody.

The pollutant-loading model (PLM) uses Microsoft Excel software to estimate pollutant loadings based on the data generated by the NPS inventory. The pollutant loading model estimates pollutant loads to streams in the study area for total suspended solids, five-day biochemical oxygen demand, total nitrogen, and total phosphorus from the following sources: residential, commercial, industrial, transportation, cropland, pasture, orchards, forests, clear-cuts, mining, disturbed areas, livestock operations, eroding streambanks, and eroding road surfaces and road banks (TVA, 2006).

Although the Tusquitee Creek watershed wasn't ultimately included in the area chosen for EEP Local Watershed Plan Development, projects that are identified by HRWC and local agricultural agency staff within the watershed will be readily considered by EEP for mitigation efforts. Additionally, HRWC will be using the results of the IPSI for prioritization of water quality improvement projects and to serve as baseline information as the watershed continues to be developed. The chosen watershed, Peachtree-Martins, is discussed in Section 2.3.1

2007 Recommendations
Protection of existing water quality in the watershed is the highest priority. First, existing sediment and erosion control laws must be strictly enforced. Because state resources are limited, DWQ encourages local governments to develop and implement local sediment and erosion control programs. More information on creating a local program can be found in Chapter 5. Second, a plan to educate local citizens, landowners, and developers about HQW regulations is necessary.

Additionally, the gently sloped valley is attractive for residential development. Working Farm Easements on properties in the watershed could be used to protect against the negative water quality impacts associated with increased residential development. For information on the benefits of Working Farm Easements, refer to Chapter 7.

1.5 Additional Water Quality Issues within Subbasin 04-05-01

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

This section also discusses ideas, rules and practices in place to preserve and maintain the pristine waters of the Hiwassee River basin. In subbasins 04-05-01 and 04-05-02 (Chapter 2), this is particularly important since many of the waters are designated as high quality or outstanding resource waters (HQW and ORW, respectively). Special management strategies, or rules, are in place to better manage the cumulative impact of pollutant discharges, and several landowners have voluntarily participated in land conservation, stabilization, and/or restoration projects.

1.5.1 Fires Creek Development

The recent sale of timber/paper company land in the Fires Creek watershed has resulted in rapid residential development in a formerly pristine watershed. Local Soil and Water District personnel have reported sedimentation in Fires Creek after rain events. Sediment monitoring is necessary to determine the extent of development impacts on water quality in this watershed.

Additionally, erosion control enforcement is critical to protect the water quality of this Outstanding Resource watershed.

1.5.2 Hiwassee River Tributaries Between Chatuge and Mission Dams

The Hiwassee River Watershed Coalition and the Clay County Soil and Water Conservation District report significant impacts to streams entering the Hiwassee River between Chatuge and Mission Dams. These streams include Sweetwater, Blair, South Fork Blair, Town, and Hyatt Mill Creeks. These streams are impacted by agriculture, historic channel alterations, highway impacts, and increasingly, development (both residential and commercial). All of these streams are included in the Tusquitee-Martins Creek IPSI (See section 1.4.4). Habitat degradation and sediment problems are common in each of the watersheds. A special study is needed to evaluate the extent and severity of sediment problems and the biological health of these streams. Completion of such a study in the next basin cycle would complement the IPSI findings and could be used to track improvements as mitigation projects are completed and BMPs are installed.

1.5.2.1 Hyatt Mill Creek [AU# 1-16] and Blair Creek [AU# 1-17]

These small streams are tributaries to the Hiwassee River below Lake Chatuge near Hayesville. TVA sampled these streams in 1999, 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. The Clay County Soil and Water Conservation District identified these streams as problem areas and has prioritized them for BMP installations to reduce sediment impacts. Strong enforcement of current sediment and erosion control rules is also needed.

1.5.2.2 Town Creek [AU#1-19]

Habitat degradation 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 is targeted by the Clay County Soil and Water Conservation District for BMP installation to address nonpoint source pollution. Sediment monitoring is necessary to determine the extent of development impacts on water quality in this watershed. Additionally, erosion control enforcement is critical to protect the water quality in this water supply watershed.

1.5.2.3 Sweetwater Creek [AU# 1-32]

Sweetwater Creek is identified as a significant contributor of sediment to the Hiwassee River. Land use in the watershed is a mixture of residential development, agricultural activities, and forest. US-64 parallels the creek for much of its length. This watershed is targeted by the Clay County Soil and Water Conservation District for BMP installation to address nonpoint source

pollution. Monitoring is needed to determine the extent of the sedimentation problem and to support the activities led by the District.

1.5.3 Septic System Concerns

Development of rural land in areas not served by sewer systems is occurring rapidly in the upper Hiwassee River basin. Hundreds of permit applications for onsite septic systems are approved every year. Septic systems generally provide a safe and reliable method of disposing of residential wastewater when they are sited (positioned on a lot), installed, operated, and maintained properly. Rules and guidelines are in place in both Georgia and North Carolina to protect human health and the environment. Water quality is protected by locating the systems at least 50 feet away from streams and wetlands, limiting buildable lot sizes to a ¾-acre minimum, and installing drain fields in areas that contain suitable soil type and depth for adequate filtration; drinking water wells are further protected by septic system setbacks.

Septic systems typically are very efficient at removing many pollutants found in wastewater including suspended solids, metals, bacteria, phosphorus, and some viruses. However, they are not designed to handle other pollutants that they often receive such as solvents, automotive and lubricating oil, drain cleaners, and many other household chemicals. Additionally, some byproducts of organic decomposition are not treated. Nitrates are one such byproduct and are the most widespread contaminant of groundwater in the United States (Smith, et al., 2004).

One septic system generates about 30 to 40 pounds of nitrate nitrogen per year (NJDEP, 2002). Nitrates and many household chemicals are easily dissolved in water and therefore move through the soil too rapidly to be removed. Nitrates are known to cause water quality problems and can also be harmful to human health (Smith, et al., 2004).

Proper location, design, construction, operation, and maintenance of septic systems are critical to the protection of water quality in a watershed. If septic systems are located in unsuitable areas, are improperly installed, or if the systems have not been operated and/or maintained properly, they can be significant sources of pollution. Additionally if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded (Smith, et al., 2004). Nutrients and some other types of pollution are often very slow to leave a lake system. Therefore, malfunctioning septic systems can have a significant long-term impact on water quality and ecological health (PACD, 2003).

Local governments, in coordination with local health departments, should evaluate the potential for water quality problems associated with the number and density of septic systems being installed throughout their jurisdiction. Long-term county-wide planning for future wastewater treatment should be undertaken. There are water quality concerns associated with both continued permitting of septic systems for development in outlying areas and with extending sewer lines and expanding wastewater treatment plant discharges. Pros and cons of various wastewater treatment options should be weighed for different parts of the county (based on soil type, depth, proximity to existing sewer lines, etc.) and a plan developed that minimizes the risk of water quality degradation from all methods employed.

In addition, local governments, again in coordination with local health departments, should consider programs to periodically inform citizens about the proper operation of septic systems

and the need for routine maintenance and replacement. Owners of systems within 100 feet of streams or lakes should be specifically targeted and encouraged to routinely check for the warning signs of improperly functioning systems and to contact the health department immediately for assistance in getting problems corrected.

1.5.4 Sediment, Erosion, and Stormwater Concerns

Clay County Soil and Water Conservation District personnel and the Hiwassee River Watershed Coalition report a marked increase in sedimentation and turbidity in the Clay County portion of the Hiwassee River and many of its tributaries. The Clay SWCD receives continuing complaints from citizens regarding runoff issues, sediment build-up in local creeks, and pollution of wells and springs by poorly controlled stormwater. District personnel do not have the enforcement authority over these issues and must pass the complaints on to DENR Water Quality and Land Quality staff. The citizens placing the complaints and District personnel are frequently unsatisfied and frustrated by a lack of enforcement actions after complaints are placed. They have determined that, due to resource constraints, state enforcement agencies are unable to effectively monitor land-disturbing activities associated with residential development, and are failing to prevent severe impacts to the water quality in the Hiwassee River Basin.

Clay and Cherokee Counties do not have local sediment and erosion control programs. The high rate of residential development in the Hiwassee River Basin, combined with this lack of erosion control ordinances and limited enforcement at the state level, has resulted in an apparent increase in sediment loads. This is visibly evident as the Hiwassee River changes appearance from clear to muddy after storm events. Clay and Cherokee Counties are encouraged to adopt a local Sediment and Erosion Control Ordinance and local enforcement program to prevent declines in the water quality in the Hiwassee River Basin. A model ordinance can be downloaded at: http://www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html. Additionally both counties and the municipal jurisdictions within the basin should implement the voluntary Universal Stormwater Management Program (USMP) to address stormwater runoff concerns. Under the USMP, a local government will be able to meet the different post-construction requirements for many existing stormwater strategies (HWQ, Phase 2 NPDES, etc) with just a single set of requirements. More information about the program can be found at: http://h2o.enr.state.nc.us/su/usmp.htm

1.5.5 Floodplain Protection

The riverside land that gets periodically inundated by a river's floodwaters is called the floodplain. Floodplains serve important purposes. They:

- temporarily store floodwaters,
- improve water quality,
- provide important habitat for river wildlife, and
- create opportunities for recreation.

Natural floodplains help reduce the heights of floods. During periods of high water, floodplains serve as natural sponges, storing and slowly releasing floodwaters. The floodplain provides additional "storage," reducing the velocity of the river and increasing the capacity of the river channel to move floodwaters downstream.

When the river is cut off from its floodplain by levees and dikes, flood heights are often increased. The construction of levees along the Lower Missouri River, for example, has increased flood heights by as much as twelve feet. By contrast, protected floodplain wetlands along the Charles River in Massachusetts store and slowly release floodwaters -- providing as much "storage" as a medium-sized reservoir.

Natural floodplains also help improve water quality. As water courses through the floodplain, plants serve as natural filters, trapping sediments and capturing pollutants. Nitrogen and phosphorus (found in fertilizers) that wash off farm fields, suburban lawns and city streets ignite a chemical chain reaction which reduces the amount of oxygen in the water, suffocating fish and other aquatic organisms.

Many floodplain plants use nitrogen and phosphorus before they can reach the river, thereby improving water quality. Many cities have built artificial wetlands to reduce water treatment costs. Studies of heavily polluted waters flowing through Tinicum Marsh in Pennsylvania, for example, have shown significant reductions in phosphorus and nitrogen. The water treatment value of Georgia's 2,300-acre Alcovy River Swamp is more than $1 million a year. Floodplains also play an important role in the recharging of groundwater supplies (American Rivers, 2006).

Clay County is strongly encouraged to adopt and implement comprehensive floodplain protection. Doing so will help protect its aquatic resources over the long-term. Guidance on floodplain ordinance adoption is provided by the Association of State Flood Plain Managers at www.floods.org.

1.5.6 Management Strategies for Water Quality Protection

Fires Creek and Tusquitee Creek watersheds are classified as Outstanding Resource Waters and High Quality Waters, respectively. High Quality Water (HQW) and Outstanding Resource Water (ORW) are supplemental classifications to the primary freshwater classification(s) placed on a waterbody. Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody. Below is a brief summary of these strategies and the administrative code under which the strategies are found. More detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/. Definitions of the primary and supplemental classifications can be found in Chapter 3.

HQW is intended to protect waters with water quality higher than the state's water quality standards. In the Hiwassee River basin, waters classified as Water Supply I and II (WS-I and WS-II), ORW, and waters designated by the NC Wildlife Resources Commission (WRC) as native (wild) trout waters are subject to HQW rules. Streams petitioned for WS-I or WS-II or which are considered Excellent based on biological and physical/chemical parameters may qualify for the HQW supplemental designation.

New discharges and expansions of existing discharges may, in general, be permitted in waters classified as HQW provided that the effluent limits are met for dissolved oxygen (DO), ammonia/nitrogen levels (NH_3-N), and the biochemical oxygen demand (BOD_5). More stringent limitations may be necessary to ensure that the cumulative effects from more than one discharge of oxygen-consuming wastes will not cause the dissolved oxygen concentration in the receiving

water to drop more than 0.5 milligrams per liter (mg/l) below background levels. Discharges from single-family residential structures into surface waters are prohibited. When a discharge from an existing single-family home fails, a septic tank, dual or recirculation sand filters, disinfection, and step aeration should be installed (Administrative Code 15A NCAC 2B .0224) In addition to the above, development activities which require an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). Under these rules, stormwater management strategies must be implemented if development activities are within one mile of and draining to waters designated as HQW. The low-density option requires a 30-foot wide vegetative buffer between development activities and the stream. This option can be used when the built upon area is less than 12 percent of the total land area or the proposed development is for a single-family residential home on one acre or greater. Vegetated areas may be used to transport stormwater in the low-density option, but it must not lead to a discrete stormwater collection system (e.g., constructed). The high-density option is for all land disturbing activities on greater than one acre. For high-density projects, structural stormwater controls must be constructed (e.g., wet detention ponds, stormwater infiltration systems, innovative systems) and must be designed to control runoff from all surfaces affected by one inch or more of rainfall. More stringent stormwater management measures may be required on a case-by-case basis where it is determined additional measures are needed to protect and maintain existing and anticipated uses of the water (Administrative Code 15A NCAC 2H .1006).

ORWs are unique and special surface waters that have some outstanding resource value (e.g., outstanding fish habitat and fisheries, unusually high levels of water-based recreation, special ecological or scientific significance). No new discharge or expansions on existing discharges are permitted. Rules related to the development activities are similar to those for HQW, and stormwater controls for all new development activities requiring an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). In addition, site-specific stormwater management strategies may be developed to protect the resource values of these waters.

Many of the streams in this subbasin are also classified as trout (Tr) waters, and therefore, are protected for natural trout propagation and maintenance of stocked trout. There are no watershed development restrictions associated with the trout classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected trout water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

Chapter 2
Hiwassee River Subbasin 04-05-02
Including: Hiwassee Lake, Apalachia Lake, and Valley River

2.1 Subbasin Overview

The North Carolina portion of this subbasin lies entirely within Cherokee County. Steeper relief, more precipitation, and greater forest cover characterize the north and eastern portions of the watershed. This area includes the catchments of Apalachia Lake, Hanging Dog, Owl, Beaverdam, and Shuler Creeks, as well as the headwaters of the Valley River including Junaluska, Welch Mill, and Hyatt Creeks. The Nantahala National Forest generally dominates land use in this section but residential development is increasing along ridges and in proximity to the Town of Andrews.

Subbasin 04-05-02 at a Glance

Land and Water Area

Total area:	458 mi²
Land area:	431 mi²
Water area:	27 mi²

Population Statistics

2000 Est. Pop.:	24,298 people
Pop. Density:	56.3 persons/mi²

Land Cover (percent)

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

Counties
Cherokee

Municipalities
Andrews and Murphy

Aquatic Life Monitored Streams Statistics

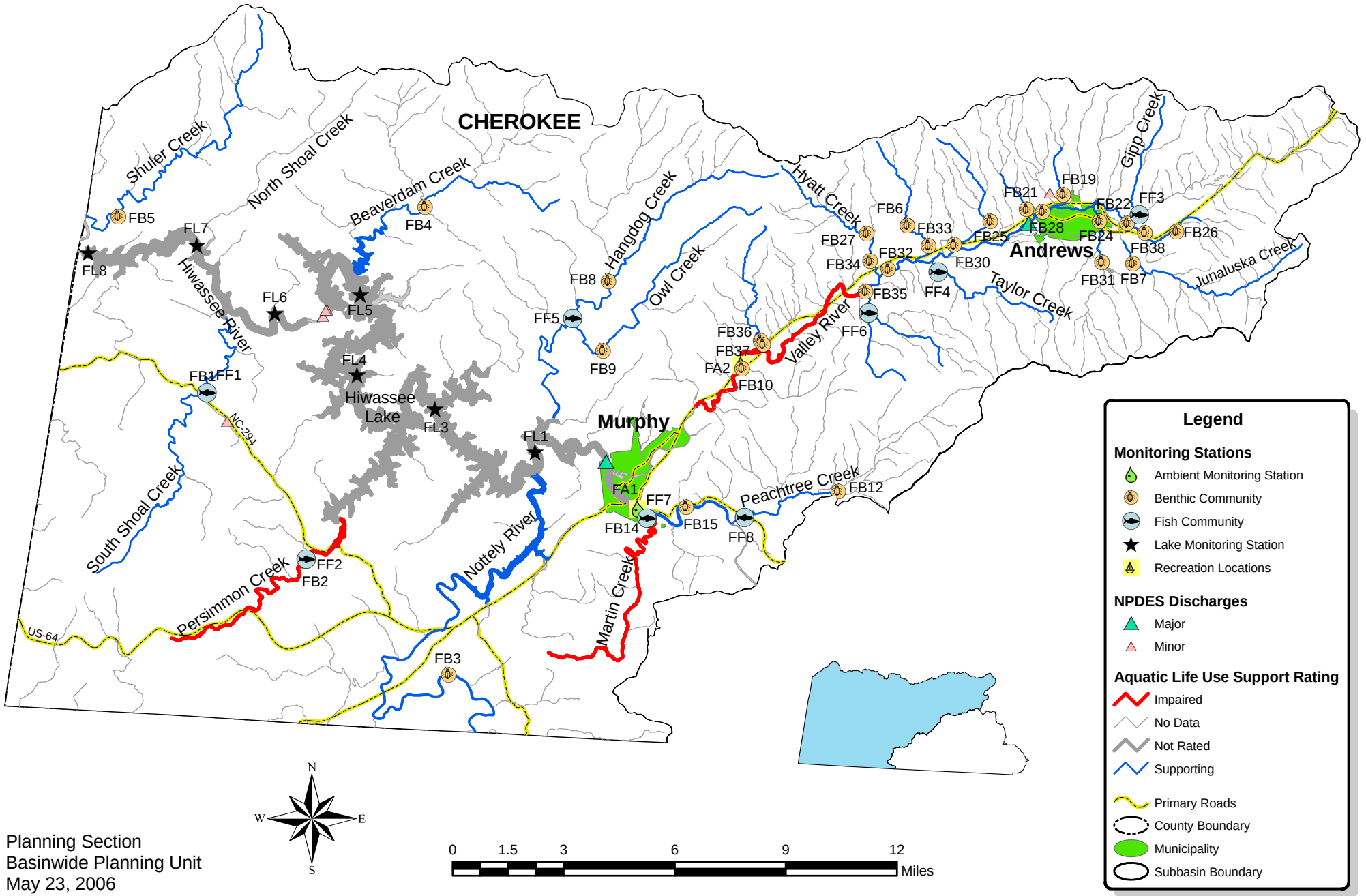
Total Streams:	184.3 mi
Total Supporting:	133.0 mi
Total Impaired:	23.6 mi
Total Not Rated:	27.7 mi

The southern and central portions of the watershed are characterized by broad valleys with lower elevations, less relief, less precipitation, and less forest cover. The Hiwassee River, Nottely River, Peachtree, Martins, Persimmon, and South Shoal creeks, along with Hiwassee Lake and the lower half of the Valley River are major waterbodies in this area. Agricultural lands in the broad Hiwassee River valley are still common, however conversion to residential development is on the rise. In addition, a new bypass is currently under construction in Murphy and residential and commercial development in the Peachtree and Martins Creek watershed is rapidly increasing as a result. Despite these changes, land use in Subbasin 04-05-02 remains largely forested. The vast majority of the Nottely River watershed lies in Georgia and includes the Town of Blairsville.

From 1990 to 2000, the population in Murphy remained fairly constant. However, Andrews saw a 37 percent decrease in population over the same period. Cherokee County as a whole grew approximately 17 percent from 1990 to 2000 and is expected to grow another 20 percent by 2020. Additional information regarding population and land use changes throughout the entire basin can be found in Appendix I and III, respectively.

There are two major NPDES dischargers in this subbasin and both are required to perform whole effluent toxicity testing. The Andrews WWTP (NC0020800, 1.5 MGD) discharges to the Valley River and has had three failing tests since 2001. The Murphy WWTP (NC0020940, 0.925 MGD) discharges to the Hiwassee River and has had no failing tests since January 2001. See Section 2.3.1 for more information. For the listing of NPDES permit holders, refer to Appendix V.

Figure 9 Hiwassee River Subbasin 04-05-02



Planning Section
Basinwide Planning Unit
May 23, 2006

Table 5 Hiwassee Subbasin 04-05-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Beaver Creek													
1-52-30-(3)	C Tr	2.0 FW Miles		S					ND			Habitat Degradation	Unknown
	From Andrews Water Supply Intake to Valley River				FB19	NI	2002						
Beaverdam Creek													
1-72	C Tr	6.7 FW Miles		S					ND				
	From source to Hiwassee Lake				FB4	E	2004						
Colvard Creek													
1-52-58	C Tr	4.3 FW Miles		S					ND			Habitat Degradation	Pasture
	From source to Valley River				FB37	NI	2002						
					FB36	NI	2002						
Gipp Creek													
1-52-23	C Tr ORW	3.6 FW Miles		S					ND				
	From source to Valley River				FB20	E	2002						
Hanging Dog Creek													
1-57	C	13.2 FW Miles		S					ND			Habitat Degradation	Unknown
	From source to Hiwassee Lake				FF5	G	2004						
					FB8	E	2004						
HIWASSEE RIVER													
1-(43.7)	WS-V	4.2 FW Miles		S	FA1	NCE			S	FA1	NCE	Habitat Degradation	
	From Town of Murphy water supply intake to a point 0.3 mile downstream of Martin Creek				FB15	E	2004						

Table 5 Hiwassee Subbasin 04-05-02

AU Number	Classification	Length/Area		Aquatic Life Assessment					Recreation Assessment				
Description				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
HIWASSEE RIVER (Apalachia Lake below elevation 1281)													
1-(75)	B	1,021.5	FW Acres	**NR**	FL6	ID			ND				
					FL8	ID							
					FL7	ID							
From River Mile 75 0.8 mile downstream from Hiwassee Dam at Hiwassee Reservation Boundary to Apalachia Dam													
HIWASSEE RIVER (Hiwassee Lake below elevation 1525)													
1-(53)	B	5,029.5	FW Acres	**NR**	FL4	ID			ND				
					FL5	ID							
					FL3	ID							
					FL1	ID							
From Laurel Creek to Hiwassee Dam													
Hyatt Creek													
1-52-43	C	4.9	FW Miles	**S**					ND			Sediment	Construction
From source to Valley River					FB34	E	2002						
					FB27	E	2002						
Junaluska Creek													
1-52-25a	C Tr	6.5	FW Miles	**S**					ND				
From source to Junaluska Road					FB7	E	2004						
Martin Creek													
1-49	C	8.8	FW Miles	**I**					ND			Habitat Degradation	Agriculture
From source to Hiwassee River					FF7	F	2004					Habitat Degradation	Stormwater Outfall
					FB14	G	2004						

Table 5 Hiwassee Subbasin 04-05-02

AU Number	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
Description			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Morris Creek												
1-52-36	C Tr	4.7 FW Miles	**S**					ND			Habitat Degradation	
From source to Valley River				FB29	NI	2002					Nutrient Impacts	Unknown
				FB25	NI	2002						
Nottely River												
1-58	C	18.7 FW Miles	**S**					ND			Habitat Degradation	
From North Carolina-Georgia State Line to Hiwassee Lake				FB3	G	2004						
Owl Creek												
1-57-6	C	8.5 FW Miles	**S**					ND				
From source to Hanging Dog Creek				FB9	E	2004						
Peachtree Creek												
1-44b	C	3.0 FW Miles	**S**					ND			Habitat Degradation	Unknown
From Pipes Branch to Hiwassee River				FF8	E	2004						
				FB12	E	2004						
Persimmon Creek (Lake Cherokee)												
1-63a	C	5.9 FW Miles	**I**					ND			Habitat Degradation	Unknown
From source to Lake Cherokee				FF2	P	2004						
				FB2	E	2004						
Shuler Creek												
1-86	C	11.9 FW Miles	**S**					ND				
From source to Hiwassee River				FB5	E	2004						

Table 5 Hiwassee Subbasin 04-05-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
South Shoal Creek													
1-77	C Tr	12.1 FW Miles	From source to Apalachia Lake	**S**	FF1	NR	2004		ND				
					FB1	E	2004						
Tatham Creek													
1-52-28	C Tr	1.8 FW Miles	From source to Valley River	**S**	FB31	NI	2002		ND			Habitat Degradation	Stormwater Outfall
					FB24	G	2002						
Taylor Creek													
1-52-39	C Tr	4.8 FW Miles	From source to Valley River	**S**	FF4	GF	2004		ND			Habitat Degradation	Pasture
					FB33	NI	2002						
Valley River													
1-52b	C Tr	9.8 FW Miles	From Gipp Creek above Andrews to Venegeance Creek near Marble	**S**	FF3	NR	2004		ND			Nutrient Impacts	
												Sediment	
					FB32	G	2002					Sediment	
					FB28	E	2002					Sediment	
					FB22	E	2002					Sediment	Pasture
1-52c	C Tr	7.7 FW Miles	From Venegeance Creek near Marble to Marble Creek above Murphy	**I**	FA2	CE	Turbidity	12.2	**S**	FA2	NCE	Turbidity	Impervious Surface
					FB10	G	2004					Turbidity	Pasture
												Turbidity	Stormwater Outfall

Table 5 Hiwassee Subbasin 04-05-02

AU Number	Classification	Length/Area	Description	Aquatic Life Assessment					Recreation Assessment			Stressors	Sources
				AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result		
Venegeance Creek													
1-52-45	C Tr	3.6 FW Miles		**S**					ND			Nutrient Impacts	Unknown
	From source to Valley River				FF6	G	2004						
					FB35	G	2002						
Webb Creek													
1-52-32	C Tr	1.6 FW Miles		**S**					ND			Habitat Degradation	Unknown
	From source to Valley River				FB21	NI	2002						
Welch Mill Creek													
1-52-40	C Tr	4.5 FW Miles		**S**					ND			Habitat Degradation	Impervious Surface
	From source to Valley River				FB6	E	2004						
					FB30	NI	2002						
					FB6	E	2002						
Worm Creek													
1-52-24	C Tr	2.6 FW Miles		**S**					ND			Nutrient Impacts	
	From source to Valley River				FB38	NI	2002					Nutrient Impacts	Unknown
					FB26	NI	2002					Nutrient Impacts	Agriculture
												Nutrient Impacts	Impervious Surface

Table 5 Hiwassee Subbasin 04-05-02

AU Number / Description	Classification	Length/Area	Aquatic Life Assessment					Recreation Assessment				
			AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources

Use Categories:
AL - Aquatic Life
REC - Recreation

Monitoring data type:
FF - Fish Community Survey
FB - Benthic Community Survey
FA - Ambient Monitoring Site
FL- Lake Monitoring

Results:
E - Excellent
G - Good
GF - Good-Fair
F - Fair
P - Poor
NI - Not Impaired

Use Support Ratings 2005:
S - Supporting, I - Impaired
NR - Not Rated
NR*- Not Rated for Recreation (screening criteria exceeded)
ND-No Data Collected to make assessment

Miles/Acres
FW- Fresh Water

m- Monitored
e- Evaluated

Results
CE-Criteria Exceeded > 10% and more than 10 samples
NCE-No Criteria Exceeded
ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	133.0	FW Miles
I	m	22.4	FW Miles
NR	m	6,051.0	FW Acres
NR	e	143.4	FW Acres
ND		464.7	FW Miles
ND		41.7	FW Acres

Recreation Rating Summary

S	m	11.9	FW Miles
ND		608.2	FW Miles
ND		6,236.1	FW Acres

Fish Consumption Rating Summary

I	e	620.1	FW Miles
I	e	6,194.4	FW Acres
		41.7	FW Acres

There are two ambient monitoring sites located in this subbasin. Ambient water chemistry values at the Hiwassee River (US 64) have been stable since 1999. At this location, three measurements (one turbidity and two copper measurements) in five years exceeded water quality standards or action levels. The second ambient site is on the Valley River (SR 1373). This location has also been stable since 1999. Seven measurements (six for turbidity and one for iron) exceeded water quality standards or action levels. The turbidity violations indicate the Valley River is Impaired.

DWQ collected 33 benthic macroinvertebrate samples in subbasin 04-05-02 between 1999 and 2004. All streams sampled for benthic macroinvertebrates in this subbasin were classified using mountain criteria. Samples were collected in both 1999 and 2004 at 13 locations. Bioclassifications were higher in 2004 at four of the 13 sites: Junaluska Creek, South Shoal Creek, and the Hiwassee River received Excellent bioclassifications (Good in 1999) and one site on the Valley River received a Good bioclassification (Good-Fair in 1999). Nine sites received Excellent bioclassifications in both years.

DWQ evaluated the fish community sites in this subbasin for the first time in 2004. Therefore, the 2004 basinwide assessment will serve as a baseline for the 2009 basinwide monitoring cycle. Fish community bioclassifications in 2004 varied from Poor (Persimmon Creek) to Excellent (Peachtree Creek). Four of the eight sites in this subbasin are classified as trout waters (Tr). The NC Wildlife Resources Commission manages the Valley River and Persimmon Creek as Hatchery Supported Trout Waters. Wild, not stocked, trout were collected from the Valley River, Peachtree, Taylor, Vengeance, Hanging Dog, and South Shoal Creeks.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 9. Table 5 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Refer to Appendix VIII for more information about use support ratings. Refer to the 2005 Hiwassee River Basinwide Assessment Report at http://h2o.enr.state.nc.us/esb/Basinwide/HIW2005.pdf and Appendix IV for more information on monitoring.

Waters in the following sections and in Table 5 are identified by an assessment unit number (AU#). This number is used to track defined segments in the water quality assessment database, list 303(d) Impaired waters, and is used to identify waters throughout the basin plan. The AU# is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU# indicates that the assessment is smaller than the DWQ index segment. No letter indicates that the AU# and the DWQ index segment are the same. For example, index number 11-3-(14) might be split into two assessment units 11-3-(14)a and 11-3-(14)b.

2.2 Use Support Assessment Summary

All surface waters in the state are assigned a classification appropriate to the best-intended use of that water. Waters are regularly assessed by DWQ to determine how well they are meeting their best-intended use. For aquatic life, an Excellent, Good, Good-Fair, Fair, or Poor bioclassification is assigned to a stream based on the biological data collected by DWQ. For more information about bioclassification and use support assessment, refer to Appendices IV and VIII, respectively. Appendix IX provides definitions of the terms used throughout this basin plan.

Table 6 Summary of Use Support Ratings by Category in Subbasin 04-05-02

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	133.0 mi	11.9 mi
Impaired*	23.6 mi (13%)	0
Not Rated	27.7 mi	0
Total	**184.3 mi**	**0**
Unmonitored Waters		
Not Rated	2.4 mi	0
No Data	464.7 mi	639.5 mi
Total	**467.1 mi**	**639.5 mi**
Totals		
All Waters**	**651.4 mi**	**639.5 mi**

* The noted percent Impaired is the percent of monitored mile/acres only.
**Total Monitored + Total Unmonitored = Total All Waters.

In subbasin 04-05-02, use support was assigned for the aquatic life, recreation, fish consumption and water supply categories. Waters are Supporting, Impaired, Not Rated, and No Data in the aquatic life and recreation categories on a monitored or evaluated basis. Waters are Impaired in the fish consumption category on an evaluated basis based on fish consumption advice issued by the Department of Health and Human Services (DHHS). All waters are Supporting in the water supply category on an evaluated basis based on reports from Division of Environmental Health (DEH) regional water treatment plant consultants. Refer to Table 6 for a summary of use support for waters in subbasin 04-05-02.

2.3 Status and Recommendations of Previously and Newly Impaired Waters

The following waters were either identified as Impaired in the previous basin plan (2002) or are newly Impaired based on recent data. If previously identified as Impaired, the water will either remain on the state's 303(d) list or will be delisted based on recent data showing water quality improvements. If the water is newly Impaired, it will likely be placed on the 2008 303(d) list. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Information regarding 303(d) listing and reporting methodology is presented in Appendix VI.

2.3.1 Martins Creek [AU# 1-49]

Current Status

Martins Creek was sampled for the first time by DWQ in 2004 at a site 400 meters upstream from Martins Creek confluence with the Hiwassee River in the southeast corner of Cherokee County (FB14). The stream received a Good bioclassification based on benthic macroinvertebrate monitoring, but had the lowest species diversity of all the Hiwassee basin samples. Its watershed is the most developed of those sampled by DWQ in the Hiwassee River basin, with many new single-family homes under construction in addition to older, established residential neighborhoods associated with the town of Murphy. Conductivity was elevated in the stream, indicating runoff from residential development and/or agricultural areas. Habitat problems at this site included high percentages of sand (10 percent) and silt (20 percent) that resulted in poorly developed riffles and pools. Although the benthic community is not yet heavily impacted, Martins Creek is clearly showing adverse effects from upstream development. Fill has recently been deposited in one streamside area upstream of Hughes Road, reportedly to construct a recreational vehicle (RV) camping park.

The upper portion of the watershed is largely forested, although some ongoing residential development was evident, including new road construction. The middle portion of the watershed, from Tobe Stalcup Road to Postell Road, is characterized by extensive agricultural activity in and along the floodplain. Much of Martins Creek and many of its tributaries appear to have been channelized in this portion of the watershed. Recent and ongoing residential construction is particularly notable in the drainage of Right Prong Martins Creek (TVA, 2006).

Fish community sampling revealed a mixed community of cool and warm water species, dominated by mottled sculpin. Despite qualifying as a regional reference site, the fish community was rated Fair because of the low number of fish collected. The uniform depth and lack of habitat diversity may be contributing to the low numbers of fish in this reach of Martins Creek, but it is not totally clear what the impacts are. Because of the Fair bioclassification at site FF-7, Martins Creek is Impaired for aquatic life from its source to Hiwassee River (8.8 miles).

Special Studies

In July 2005, the North Carolina Ecosystem Enhancement Program (EEP), Hiwassee River Watershed Coalition (HRWC), and Equinox Environmental Consultation and Design started a local watershed planning process in the Peachtree-Martins Creek watershed. http://www.hrwc.net/peachtreemartinslwp.htm. Its goals are to: (1) assess stream quality in the watershed, identifying key sources of degradation and pollution, and (2) develop a comprehensive strategy to address watershed needs. The resulting Local Watershed Plan will address both ecological and community priorities. The project is being completed in three phases:

- Phase I. Existing information on stream health, watershed land use, and threats to stream integrity is gathered into a Preliminary Findings and Recommendations Report. A plan for further study is developed based on this existing information and the input of a Local Advisory Committee.

- Phase II. Detailed assessment of the watershed is performed, including intensive monitoring of stream organisms, water chemistry, habitat, and stability and detailed mapping of watershed attributes such as land use, impervious cover, and pollution sources. Much of this mapping work will be done by the Tennessee Valley Authority, which took low altitude aerial photographs of the Peachtree-Martins Creek watershed in 2005 and developed an Integrated Pollution Source Identification (IPSI) report.

- Phase III. A plan to protect and restore the watershed is developed, naming specific strategies to address causes of stream degradation and prioritizing restoration activities and areas. With the Local Advisory Committee's oversight, this Watershed Management Plan is developed to address both ecological and community priorities.

In conjunction with this local watershed planning project, the WaDE program will be surveying the project area. The NC Wastewater Discharge Elimination (WaDE) Program is actively helping to identify and remove straight pipes (and failing septic systems) in the western portion of North Carolina. This program uses door-to-door surveys to locate straight pipes and failing septic systems, and offers deferred loans or grants to homeowners who have to eliminate the straight pipes by installing a septic system.

DWQ assessed four fish sites, 23 benthic sites, and 33 physical/chemical water quality sites within the upper Hiwassee River watershed in Cherokee County in 2006 to support development of the Peachtree-Martins Creek Local Watershed Plan. Because this assessment falls outside the data window of this basinwide plan, the data cannot be used for Use Support Ratings. However, less than optimal instream and riparian habitat characteristics were observed at each site; this was especially so for upper Martins Creek and Slow Creek in the Peachtree Creek watershed. Nonpoint source runoff contributes to elevated specific conductivities at these sites. The fish community in the upper Martins Creek watershed at SR 1576 was Not Rated due to its small size, but it is clearly impacted by physical alterations in the watershed. The Fish community at lower Martins Creek (SR 1558) was Good-Fair.

2007 Recommendations

The final Peachtree-Martins Creek Watershed Management Plan is expected in mid-2007. DWQ expects it to be the best available strategy for restoration and will work with federal, state, and local parties to implement its recommendations.

2.3.2 Persimmon Creek [AU# 1-63]

Current Status

Persimmon Creek flows northeasterly through the southwestern corner of Cherokee County into Hiwassee Lake. US-64 parallels much of the upstream reach. DWQ collected fish and benthic samples (sites FF2 & FB2) in 2004. Persimmon Creek has received Excellent bioclassifications each time it has been sampled since 1994 based on benthic macroinvertebrate data; 2004 was no exception. However, the fish community received a Poor bioclassification when sampled for the first time in 2004. Aquatic life in Persimmon Creek is Impaired from its source to Hiwassee Lake (7.1 miles) as a result of these new data.

Habitat degradation is the primary stressor in Persimmon Creek. It received the lowest habitat score of all sites evaluated in the Hiwassee River basin in 2004. Biologists noted severely eroding banks, little riparian vegetation, and high percentages of silt (10 percent) and sand (20 percent) in the substrate. These habitat problems resulted in low fish species diversity and a small fish population. Additionally, 30 percent of the fish collected were pollution tolerant.

The Cherokee County Soil and Water Conservation District conducted a stream survey to evaluate water quality impacts in the watershed. The District determined pasture, road construction, and other construction activities are contributing to sediment and erosion problems in the creek.

Water Quality Initiatives

The Cherokee County SWCD completed a stream restoration project on Persimmon Creek in 2006. The project included stream bank stabilization and instream structures. The stream survey, design and plan were conducted with the help of engineers from NRCS. A total of 1,700 linear feet of streambank was stabilized using $50,000 of NC Ag Cost Share monies; the project included cooperation from five local landowners.

2007 Recommendations

It appears that substantial stream restoration and bank stabilization is needed in Persimmon Creek. DWQ supports the restoration efforts led by the Cherokee County Soil and Water Conservation District. Additionally, DWQ encourages the District to develop a watershed plan

for moving forward in order to insure that both water quality and watershed function are restored and to prevent a "band-aid" approach to restoration. DWQ will sample this stream again to evaluate the improvements to water quality as a result of these efforts.

2.3.3 Valley River [AU# 1-52c]

2000 Recommendations
19.6 miles of the Valley River downstream of Stewart Road appeared on the 2000 303(d) list because of a Fair bioclassification. Sampling for the 2002 assessment resulted in Good-Fair bioclassifications and the segment was removed from the 2002 303(d) list. The 2002 basinwide plan recommended intensive sampling to identify aquatic life stressors in the Valley River mainstem. DWQ also committed to 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 Status
Aquatic life in the Valley River from Vengeance Creek to Marble Creek (7.7 miles) is Impaired because turbidity values exceeded the state standard in 12.2 percent of samples collected from site FA2 at Tomotla.

The Valley River originates in the Snowbird Mountains near the Cherokee/Graham County line and flows generally southwest into the Hiwassee River near Murphy. The entire 120-square mile watershed lies within Cherokee County and the county boundaries follow the watershed boundary for much of its length. The Valley River is one of the largest tributaries of the Hiwassee River and directly influences the water quality of Hiwassee Lake immediately downstream.

The Valley River watershed is predominantly forested, but the valley contains significant pastureland and row crops. A major highway, US 74/19/129, crosses the river several times as it follows the valley from Andrews to Murphy. Residential development is currently low density and generally not located directly on the banks of the river. Development is increasing, but the pace is relatively slow when compared to other parts of Cherokee and Clay counties.

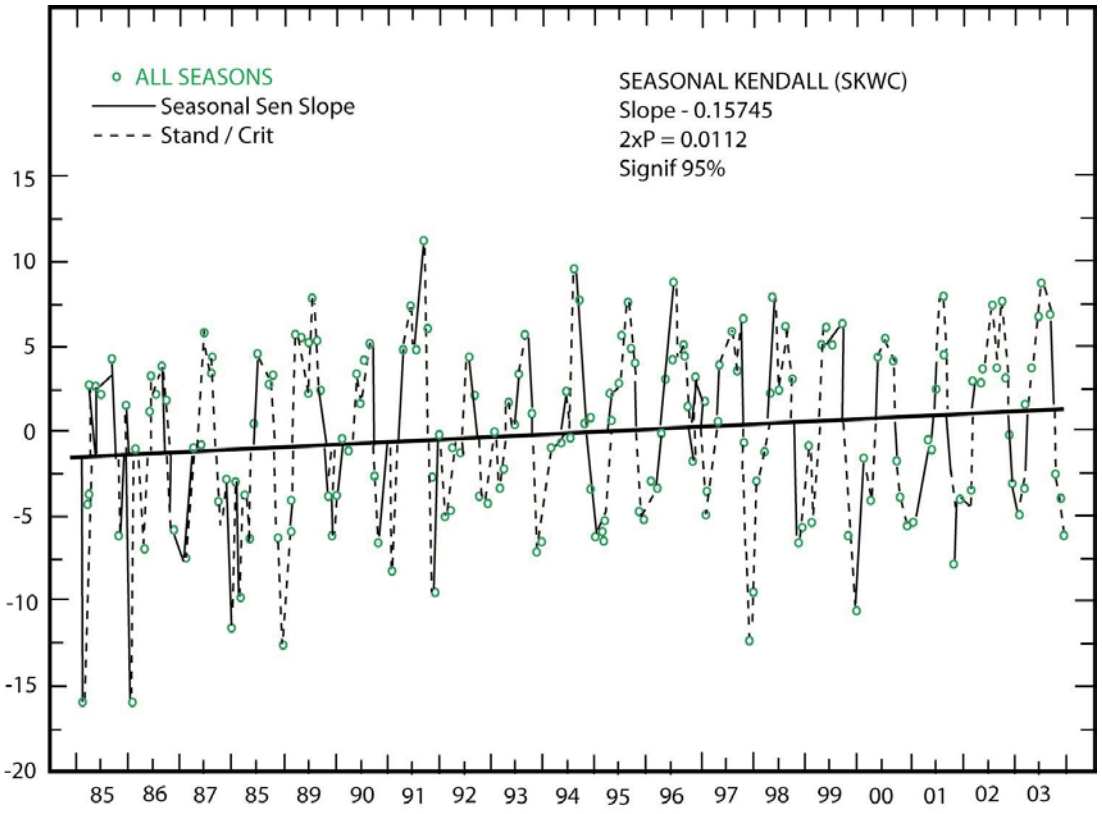
Major impacts to water quality and instream habitat include a lack of riparian vegetation, streambank erosion, livestock access, stream channel alterations, and runoff from the highway and urbanized areas. As a result, turbidity and sedimentation continue to stress the river. DWQ has conducted sampling in the vicinity of the old and new landfills on the Valley River and no impacts from these facilities were found.

Special Studies
In June 2002, benthic macroinvertebrate and fish communities were sampled at three sites on the Valley River mainstem and 23 sites on tributaries to the Valley River in support of the Hiwassee River Watershed Coalition's (HRWC) effort to prioritize streams in the watershed for future restoration work (see water quality initiatives below). DWQ staff collected benthic samples at all 26 sites, a volunteer crew led by HRWC collected fish community samples and TVA provided additional help with both fish and benthic data collection. The DWQ report determined that erosion and sedimentation are problems in most tributaries to the Valley River mainstem. Additionally, riparian vegetation has been removed from most streambanks within the valley. DWQ biologists suggest that the high gradient/high flow of headwater streams, coupled with the

rocky nature of mountain streams have kept the tributaries from becoming impaired despite poor land use practices; but note that their biological integrity will decline if land disturbing activities continue without appropriate best management practices and riparian buffer protection.

In a separate analysis, DWQ used the Water Quality / Hydrology Graphics / Analysis System (WQHYDRO) model to evaluate trends in TSS concentrations and water temperature in the Valley River at Tomotla (site FA2). The model is a multi-faceted computer program, capable of computing flow-adjusted concentration and Seasonal Kendall tests (Aroner, 2000). The analysis included data from 1985-2003 and revealed a significant upward trend in the flow-adjusted water temperature at a rate of approximately 0.15 ^{o}C/year. Over the 18-year analysis period, the average flow-adjusted water temperature increased 2.7^{o}C (4.9^{o}F) (Figure 10). Some possible causes of this temperature increase include a large-scale climatic shift or direct human induced changes such as increased impervious cover or riparian vegetation removal coupled with stream channelization. Despite some new development, impervious surfaces remain a relatively small percentage (<2 percent) of the landscape in the Valley River watershed. Therefore, the most likely causes of increasing water temperature include riparian vegetation removal and climate change. Changes due to riparian vegetation removal are relatively easy and inexpensive to correct by replanting the riparian zone with shade trees.

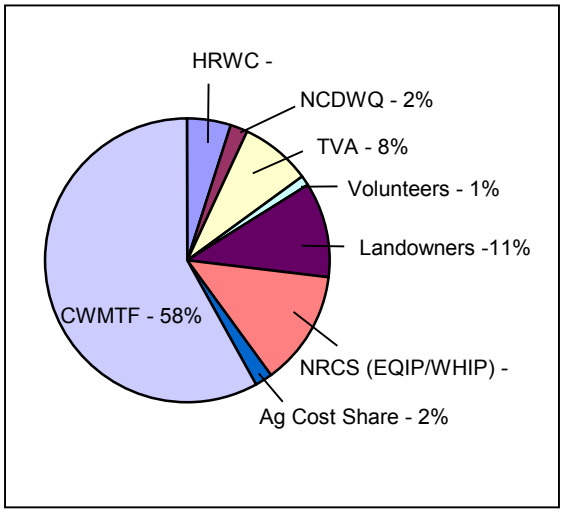
Figure 10 Flow and Seasonally Adjusted Temperature Trend in the Valley River



Water Quality Initiatives

In 2003, the Clean Water Management Trust Fund (CWMTF) provided a $400,000 grant to the HRWC to help support a restoration initiative in the Valley River watershed. Using this initial funding from CWMTF and funding from other partners in the watershed, HRWC began Phase I of a 6-year watershed restoration initiative. Work on the grant was completed in October 2004. The total project cost, including matching funds, was $679,656. Figure 11 shows the monetary contributions of project partners. In 2005, HRWC received funding from the CWMTF in the amount of $966,000 for an additional three years to continue restoration efforts in the Valley River watershed. (Figure 11)

Figure 11 Participant Contribution to Valley River Restoration Project



Phase I

Fish and benthic community data were collected at 26 sites in the watershed, including four sites on the Valley River proper, most of which were last sampled in 1993-94 by TVA. A report of these data with comparisons to historical data was published by HRWC in November 2004 and is available at: http://www.hrwc.net/valley_combined_2002data.pdf. HRWC was also able to begin restoration activities with a 5,600-linear foot project along the Valley River below Andrews (Wood Phase I) and a 960 foot project along the Town of Andrews Recreational Park (Andrews Rec Park).

Phase II

In 2003, HRWC began a more intensive effort to gain community support for continued restoration activities. Coalition staff reviewed the water quality data collected in 2002 and identified landowners along all streams with severely eroding streambanks identified during a nonpoint source pollution inventory. NRCS, local Soil & Water Conservation District staff, and HRWC staff visited all of the local landowners and sent packets by mail to those that do not live locally to explain the restoration program and gage interest in participation. Landowners were asked to complete a form to document their interest.

Of the 63 parcels identified as high to medium priority based on restoration/water quality need, 31 landowners were contacted and 22 interest forms were completed. In addition, 35 people were in attendance at a February 2004 public meeting to discuss the project. Following receipt of interest forms, five Valley River mainstem projects (18,050 linear feet) and eight tributary projects (19,000 linear feet) were identified for varying levels of restoration work. HRWC estimates that approximately five and a half years and $4.5 million will be needed to complete all of this work.

In 2004, CWMTF approved $966,000 (44 percent) of the Coalition's nearly $2.2 million grant request for Phase II of the Valley River Watershed Restoration Project. Work began on this grant in 2005, and is scheduled for completion in 2008.

2007 Recommendations
While HRWC has made significant progress towards reducing erosion and sediment inputs to the Valley River, much work remains to be done. HRWC has identified thirteen restoration projects that will address erosion and sedimentation problems in the Valley River watershed. These include approximately 18,050 feet of restoration on the Valley River mainstem and 19,000 feet on its tributaries. Projects to protect and restore riparian vegetation along the Valley River and its tributaries can slow the rate of water temperature increase and greatly reduce turbidity. The Valley River will be re-listed on the 2008 303(d) list of impaired waters because of turbidity standard violations at Site FA2. Therefore, funding agencies should prioritize funding for these projects. Aggressive funding and implementation strategies could result in a measurable reduction in total suspended solids, turbidity levels, and temperature at Site FA2.

2.4 Status and Recommendations for Waters with Noted Impacts

The surface waters discussed (alphabetically) in this section are not Impaired. However, notable water quality problems and concerns were documented for these waters during this assessment. Attention and resources should be focused on these waters to prevent additional degradation and facilitate water quality improvements. DWQ will notify local agencies of these water quality concerns and work with them to conduct further assessments and to locate sources of water quality protection funding. Additionally, education on local water quality issues and voluntary actions are useful tools to prevent water quality problems and to promote restoration efforts. The current status and recommendations for addressing these waters are presented below, and each is identified by an AU#. Nonpoint source program agency contacts are listed in Appendix VII.

2.4.1 Beaver Creek [AU# 1-52-30-(3)]

Current Status
Beaver Creek was sampled at Site FB19 as part of the 2002 Valley River Watershed Assessment. Riparian vegetation is absent from many of the banks and much of the stream has been channelized and hardened with riprap.

2007 Recommendations
Channel restoration is advised where feasible, but identifying restoration sites may be difficult due to the proximity of the road that parallels the creek for its entire length. Residential landowners along the creek can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 5 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. Copies can usually be obtained locally at the Hiwassee River Watershed Coalition office.

2.4.2 Britton Creek [AU# 1-52-29-(2)]

Current Status
TVA evaluated Britton Creek in 1993 and 2002. The stream was rated Good based on fish community data, but habitat was degraded. Habitat problems included: lack of well-developed riffle/run complexes, embedded substrate, heavy deposits of sediment, unstable banks, bank erosion, and a narrow riparian zone. Much of the bank damage, erosion, and sediment deposition are likely due to livestock access.

2007 Recommendations
The impacts from cattle access should be corrected through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 7 describes many of these programs. The Cherokee County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.4.3 Camp Creek [AU# 1-82]

Current Status
Camp Creek was not sampled by DWQ during this assessment period, but the Cherokee County Soil and Water Conservation District conducted a stream survey to evaluate water quality impacts. Cherokee SWCD noted a sediment and erosion problem in the creek and identified pasture, road construction, and residential construction activities as possible sources. Water quality stressors originating from these sources include stream channelization, livestock access, and development.

2007 Recommendations
Less than twenty percent of the agricultural land is operating with a conservation plan. Agricultural landowners are encouraged to work with Cherokee SWCD to develop and implement conservation plans for the remaining agricultural land in the watershed. The following are also needed to reduce the sediment and erosion problem: streambank stabilization/repair, establishing vegetated riparian buffers, livestock exclusion, off-stream livestock watering locations, and better erosion and sediment control enforcement for new construction.

2.4.4 Colvard Creek [AU# 1-52-58]

Current Status
Colvard Creek was sampled at sites FB36 and FB37 as part of the 2002 Valley River Watershed Assessment. Habitat was severely degraded primarily due to poor cattle management practices. At the time the stream was sampled, livestock had direct access to the stream. During periods of high water, parts of a feedlot could be submerged.

2007 Recommendations
The impacts from cattle access should be corrected through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 7 describes many of these programs. The Cherokee County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.4.5 Hanging Dog Creek [AU# 1-57]

Current Status
DWQ biologists sampled the fish (FF5) and benthic (FB8) communities in 2004. The sites received Good and Excellent bioclassifications, respectively. Large portions of the watershed lie within the Nantahala National Forest, although immediate land use near the sampling site consisted of sparse residences and pasture. Downstream, the riparian zone was narrow and provided insufficient shading.

2007 Recommendations
The riparian zone should be replanted and/or allowed to reestablish itself. Doing so will provide more shading to keep water temperature low and protect against bank erosion.

2.4.6 Hyatt Creek [AU# 1-52-43]

Current Status
Hyatt Creek is one of the larger tributary streams to the Valley River. The lower end passes through residential areas and follows SR 1379. Farther upstream some livestock (horses and cows) were noted in the riparian zone and excess sediment was noted in the stream. In 2002, DWQ sampled upstream at site FB27 and downstream at site FB34. Both sites received Excellent bioclassifications. Sediment was accumulating at site FB27, mostly due to streamside land disturbing activity conducted without the use of erosion control measures. This activity was reported to the DWQ Regional Office and the Division of Land Resources.

TVA biologists also evaluated Hyatt Creek fish populations and noted impacts. Addressing the habitat degradation discussed above would help the fish community at this site recover.

HRWC is helping to facilitate the development of an outdoor environmental education area on property adjacent to the Marble Elementary School in Cherokee County. The property, which was donated by NC Rep. Roger West, contains the original Marble Springs, Hyatt Creek (which is a designated trout stream), a wetland area, and an area of native pine forest.

2007 Recommendations
Land disturbing activities should be conducted using sediment and erosion control BMPs. Residential landowners along the creek can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 5 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. Copies can usually be obtained locally at the Hiwassee River Watershed Coalition office.

2.4.7 Junaluska Creek [AU# 1-52-25a]

Current Status
DWQ sampling at site FB7 resulted in an Excellent bioclassification. This site has improved from Good-Fair in 1994. TVA biologists sampled further downstream at Highway US-19 Business. Habitat evaluation there noted channelization, narrow riparian zones, and some sediment deposition. Citizen complaints indicate that instream mining (rock removal) is contributing to stream stability and habitat problems. HRWC has evaluated stream restoration and bank stabilization options and determined that public money should not be spent until the destabilizing activities are stopped and restoration projects will have better chance for long-term success.

2007 Recommendations
The Divisions of Land Resources and Water Quality should work together to ensure any illegal mining activities are stopped. Once these activities are under control, restoration activities should proceed.

2.4.8 Marble Creek [AU# 1-52-66-(3)]

Current Status
TVA evaluated Marble Creek as part of the 2002 Valley River Watershed Assessment. Severe habitat degradation affects the biological communities in this stream. The substrate was partially embedded, with cobble and boulders (25-50 percent) surrounded by fine sediment. The banks were moderately stable, but there were small areas of erosion. The channel of this stream was altered (channelized) in the past.

2007 Recommendations
Stream restoration and bank stabilization options should be evaluated.

2.4.9 Morris Creek [AU# 1-52-36]

Current Status
Morris Creek was sampled above (site FB25) and below (site FB29) the Andrews Airport during the 2002 Valley River Watershed Assessment. Both sites were rated Not Impaired based on the stream's small size (Refer to Appendix VIII for more information on Use Support methodology). There were several pollution intolerant species collected at the upstream site, but green algae and abundant aquatic worms indicated nutrient enrichment. The stream is channelized through the airport property and the downstream benthic community was more pollution tolerant. The streambanks are unstable due to the lack of riparian vegetation and channelization.

2007 Recommendations
Stream restoration and bank stabilization options should be evaluated.

2.4.10 Nottely River [AU# 1-58]

Current Status
DWQ sampled the Nottely River in the regulated reach below Lake Nottely. The benthic community received a Good bioclassification (site FB3), but the habitat was severely degraded. Bank erosion, substrate embeddedness, and a lack of well-developed pools and riffles were the primary habitat deficiencies. These combined to produce the worst habitat score in the Hiwassee River basin. Water released from Lake Nottely is hypolimnetic and is reflected by the lowest water temperature measured in the basin.

2007 Recommendations
DWQ supports efforts led by HRWC in Georgia to reduce nutrient loads to Lake Nottely. Nutrient reductions in the lake may lead to improved water quality in the regulated river reach. Options for bank stabilization should be evaluated and implemented if feasible. Doing so will likely reduce erosion and improve instream habitat.

2.4.11 Peachtree Creek [AU# 1-44b]

Current Status
Peachtree Creek was sampled near its confluence with the Hiwassee River (site FF8) and upstream (site FB12). Biologists noted severe bank erosion at both sites and suspect that the stream may be suffering from new erosion problems that have yet to be reflected in the biological communities. The cause of this erosion is unknown, but may be related to high stream

flows in spring 2004, coupled with poor riparian habitat. The dominant land use in this watershed is forest, but agriculture and scattered residences are also present.

Special Studies
In July 2005, the NC Ecosystem Enhancement Program (EEP) began a local watershed planning process in the Peachtree and Martins Creek watersheds. DWQ assessed four sites within the upper Hiwassee River watershed in Cherokee County in March 2006 to support development of the Peachtree-Martins Creek Local Watershed Plan. Because this assessment falls outside the data window of this basinwide plan, the data cannot be used for Use Support Ratings. However, less than optimal instream and riparian habitat characteristics were observed at each site; this was especially so for Slow Creek in the Peachtree Creek watershed and upper Martins Creek. Nonpoint source runoff contributes to elevated specific conductivities at these sites. Although the fish communities at Slow Creek and lower Martins Creek received Good-Fair bioclassifications, the community at Slow Creek was clearly more impacted. The fish community at upper Peachtree Creek, although Not Rated due to its small size seemed to be healthy, but perhaps slightly impacted by narrow riparian buffers. These data will be incorporated into Use Support Ratings during the next basinwide planning cycle.

2007 Recommendations
The final Peachtree-Martins Creek Watershed Management Plan is expected in mid-2007. DWQ expects it to be the best available strategy for restoration and will work with federal, state, and local parties to implement its recommendations.

2.4.12 Tatham Creek [AU# 1-52-28]

Current Status
Two sites (FB24 and FB31) were sampled on Tatham Creek during the 2002 Valley River Watershed Assessment. Much of the watershed is in residential land use. Instream habitat was generally good at both sites, but the riparian vegetation had been cleared for residential purposes. Periphyton growth was prolific and the creek bed was slightly embedded with silt and sand. These problems are likely due to a combination of leaky/failing septic systems, straight pipes, and runoff from lawns through the poor riparian habitat.

2007 Recommendations
There are several techniques residential landowners can use to reduce runoff from their property. These practices are generally low cost and easy to implement. Refer to Chapter 5 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. Copies can usually be obtained locally at the Hiwassee River Watershed Coalition office.

2.4.13 Taylor Creek [AU# 1-52-39]

Current Status
Benthic and fish community samples (FB33 & FF4) were collected from Taylor Creek during the assessment period. This stream flows through pastureland where cattle have access to the stream and have caused breaks in the riparian zone, bank instability, and instream sedimentation. Despite its classification as trout water, the fish population indicated a mix of cool and warm water species.

2007 Recommendations
Both instream and riparian habitats could be improved if cattle were excluded from this stream. Riparian vegetation protection and restoration will provide shade and help to maintain cool water fish species, including trout. These habitat problems could be addressed through the Valley River Watershed Restoration project led by HRWC (Refer to Section 2.3.3).

2.4.14 Vengeance Creek [AU# 1-52-45]

Current Status
While sampling the fish community at site FF6, DWQ biologists noted many upstream residences with gardens and lawns along the streambanks. Residential activities may be contributing nutrients to the stream via runoff. Vengeance Creek received a Good bioclassification.

2007 Recommendations
There are a variety of easy and low cost practices residential landowners can use to reduce pollution caused by runoff from their property. Residents should refer to Chapter 5 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf.

2.4.15 Webb Creek [AU# 1-52-32]

Current Status
Site FB21 on Webb Creek was sampled in 2002 as part of the Valley River Watershed Assessment. The stream is Supporting aquatic life with good water quality and good habitat. However, the substrate was slightly embedded with sand that likely originated from the road that parallels it.

2007 Recommendations
The habitat degradation noted in Webb Creek demonstrates the need for careful road planning and maintenance. For more information on road impacts to stream health, refer to Chapter 5.

2.4.16 Welch Mill Creek [AU# 1-52-40]

Current Status
Three samples were taken from Welch Mill Creek during the assessment period. Two samples were collected from site FB6 near the Nantahala Game Lands boundary where water quality and habitat are excellent. One benthic sample was collected near US19 (site FB30) and indicated a more pollution tolerant aquatic community. The protective riparian zone was absent and conductivity was elevated, potentially by runoff from human activities.

2007 Recommendations
This stream is not impaired. However, the habitat problems noted by DWQ should be addressed through the Valley River Watershed Restoration project led by HRWC (Refer to Section 2.3.3).

2.4.17 Worm Creek [AU# 1-52-24]

Current Status
The benthic community in Worm Creek was sampled at sites FB26 and FB38 as part of the Valley River Watershed Assessment in 2002. The habitat at the upstream site (FB26) was good, but the conductivity was elevated. This suggests runoff from residential or agricultural land use. The downstream site (FB38) was plagued by several habitat and water quality problems. The stream was full of silt and muck due to severe erosion. Heavy equipment had been used to push trees and other woody debris into the creek, disrupting flow. The site was very productive with long filamentous algae, suggesting nutrient enrichment. Conductivity was also very high for a mountain stream. Field staff determined the source of this high conductivity was Rail Cove Creek, a very small tributary to Worm Creek. Rail Cove Creek runs along SR 1503 through a number of residences. Unidentified concrete structures with pipes discharging to the creek were located at these residences.

Biologists from TVA sampled the fish community in the upstream reach of Worm Creek in 1994 and 2002. These samples indicated that elevated temperature and nutrients were a concern, but their impact had lessened between 1994 and 2002.

2007 Recommendations
The purpose of the concrete structures should be identified. If these structures are indeed impacting water quality, options for their removal or replacement should be explored. Erosion and sedimentation problems should be addressed in order to prevent further habitat degradation that may result in aquatic life impairment. These habitat problems could be addressed through the Valley River Watershed Restoration Project. See Section 2.3.3 and Chapter 11 for more information on this initiative.

2.5 Additional Water Quality Issues within Subbasin 05-07-02

The previous sections discussed water quality concerns for specific stream segments. The following section discusses issues that may threaten water quality in the subbasin that are not specific to particular streams, lakes, or reservoirs. The issues discussed may be related to waters near certain land use activities or within proximity to different pollution sources.

This section also discusses ideas, rules, and practices in place to preserve and maintain the pristine waters of the Hiwassee River basin. In subbasins 05-07-01 (Chapter 1) and 05-07-02, this is particularly important since some of the waters are designated high quality or outstanding resource waters (HQW and ORW, respectively). Special management strategies, or rules, are in place to better manage the cumulative impact of pollutant discharges, and several landowners have voluntarily participated in land conservation, stabilization, and/or restoration projects.

2.5.1 Sediment, Erosion, and Stormwater Concerns

The Hiwassee River Watershed Coalition reports a marked increase in sedimentation and turbidity in the Cherokee County portion of the Hiwassee River Basin. Their reports are substantiated by the increase in turbidity standard exceedances at DWQ ambient monitoring station on the Valley River. The Coalition receives continuing complaints from citizens regarding runoff from construction sites, sediment build-up in local creeks, and pollution of wells and springs by poorly controlled stormwater. Coalition staff does not have the

enforcement authority over these issues and must pass the complaints on to DENR Water Quality and Land Quality staff. The citizens placing the complaints and District personnel are frequently unsatisfied and frustrated by a lack of enforcement actions after complaints are placed. They have determined that, due to resource constraints, state enforcement agencies are unable to effectively monitor land-disturbing activities associated with residential development, and are failing to prevent severe impacts to the water quality in the Hiwassee River Basin.

Clay and Cherokee Counties do not have local sediment and erosion control programs. The high rate of residential development in the Hiwassee River Basin, combined with this lack of erosion control ordinances and limited enforcement at the state level, has resulted in an apparent increase in sediment loads. This is visibly evident as the Hiwassee River changes appearance from clear to muddy after storm events. Clay and Cherokee Counties are encouraged to adopt a local Sediment and Erosion Control Ordinance and local enforcement program to prevent declines in the water quality in the Hiwassee River Basin. A model ordinance can be downloaded at: http://www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html.

Additionally, both counties and the municipal jurisdictions within the basin should implement the voluntary Universal Stormwater Management Program (USMP) to address stormwater runoff concerns. Under the USMP, a local government will be able to meet the different post-construction requirements for many existing stormwater strategies (HWQ, Phase 2 NPDES, etc) with just a single set of requirements. More information about the program can be found at: http://h2o.enr.state.nc.us/su/usmp.htm. The Counties are also encouraged to adopt local sediment and erosion control programs. The Division of Land Resources operates several assistance programs that provide technical advice and cost sharing opportunities to those interested in starting a local program. More information can be found at: http://www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html

2.5.2 Septic System Concerns

Development of rural land in areas not served by sewer systems is occurring rapidly in the upper Hiwassee River basin. Hundreds of permit applications for onsite septic systems are approved every year. Septic systems generally provide a safe and reliable method of disposing of residential wastewater when they are sited (positioned on a lot), installed, operated, and maintained properly. Rules and guidelines are in place in both Georgia and North Carolina to protect human health and the environment. Water quality is protected by locating the systems at least 50 feet away from streams and wetlands, limiting buildable lot sizes to a ¾-acre minimum, and installing drain fields in areas that contain suitable soil type and depth for adequate filtration; drinking water wells are further protected by septic system setbacks.

Septic systems typically are very efficient at removing many pollutants found in wastewater including suspended solids, metals, bacteria, phosphorus, and some viruses. However, they are not designed to handle other pollutants that they often receive such as solvents, automotive and lubricating oil, drain cleaners, and many other household chemicals. Additionally, some byproducts of organic decomposition are not treated. Nitrates are one such byproduct and are the most widespread contaminant of groundwater in the United States (Smith, et al., 2004).

One septic system generates about 30 to 40 pounds of nitrate nitrogen per year (NJDEP, 2002). Nitrates and many household chemicals are easily dissolved in water and therefore move through

the soil too rapidly to be removed. Nitrates are known to cause water quality problems and can also be harmful to human health (Smith, et al., 2004).

Proper location, design, construction, operation, and maintenance of septic systems are critical to the protection of water quality in a watershed. If septic systems are located in unsuitable areas, are improperly installed, or if the systems have not been operated and/or maintained properly, they can be significant sources of pollution. Additionally if building lots and their corresponding septic systems are too densely developed, the natural ability of soils to receive and purify wastewater before it reaches groundwater or adjacent surface water can be exceeded (Smith, et al., 2004). Nutrients and some other types of pollution are often very slow to leave a lake system. Therefore, malfunctioning septic systems can have a significant long-term impact on water quality and ecological health (PACD, 2003).

Local governments, in coordination with local health departments, should evaluate the potential for water quality problems associated with the number and density of septic systems being installed throughout their jurisdiction. Long-term county-wide planning for future wastewater treatment should be undertaken. There are water quality concerns associated with both continued permitting of septic systems for development in outlying areas and with extending sewer lines and expanding wastewater treatment plant discharges. Pros and cons of various wastewater treatment options should be weighed for different parts of the county (based on soil type, depth, proximity to existing sewer lines, etc.) and a plan developed that minimizes the risk of water quality degradation from all methods employed.

In addition, local governments, again in coordination with local health departments, should consider programs to periodically inform citizens about the proper operation of septic systems and the need for routine maintenance and replacement. Owners of systems within 100 feet of streams or lakes should be specifically targeted and encouraged to routinely check for the warning signs of improperly functioning systems and to contact the health department immediately for assistance in getting problems corrected.

2.5.3 Floodplain Protection

The riverside land that gets periodically inundated by a river's floodwaters is called the floodplain. Floodplains serve important purposes. They:

- temporarily store floodwaters,
- improve water quality,
- provide important habitat for river wildlife, and
- create opportunities for recreation.

Natural floodplains help reduce the heights of floods. During periods of high water, floodplains serve as natural sponges, storing and slowly releasing floodwaters. The floodplain provides additional "storage," reducing the velocity of the river and increasing the capacity of the river channel to move floodwaters downstream.

When the river is cut off from its floodplain by levees and dikes, flood heights are often increased. The construction of levees along the Lower Missouri River, for example, has increased flood heights by as much as twelve feet. By contrast, protected floodplain wetlands along the Charles River in Massachusetts store and slowly release floodwaters -- providing as much "storage" as a medium-sized reservoir.

Natural floodplains also help improve water quality. As water courses through the floodplain, plants serve as natural filters, trapping sediments and capturing pollutants. Nitrogen and phosphorus (found in fertilizers) that wash off farm fields, suburban lawns and city streets ignite a chemical chain reaction which reduces the amount of oxygen in the water, suffocating fish and other aquatic organisms.

Many floodplain plants use nitrogen and phosphorus before they can reach the river, thereby improving water quality. Many cities have built artificial wetlands to reduce water treatment costs. Studies of heavily polluted waters flowing through Tinicum Marsh in Pennsylvania, for example, have shown significant reductions in phosphorus and nitrogen. The water treatment value of Georgia's 2,300-acre Alcovy River Swamp is more than $1 million a year. Floodplains also play an important role in the recharging of groundwater supplies (American Rivers, 2006).

Cherokee County is strongly encouraged to adopt and implement comprehensive floodplain protection. Doing so will help protect its aquatic resources over the long-term. Guidance on floodplain ordinance adoption is provided by the Association of State Flood Plain Managers at www.floods.org.

2.5.4 Management Strategies for Water Quality Protection

Gipp Creek watershed is classified as High Quality Waters. High Quality Water (HQW) and Outstanding Resource Water (ORW) are supplemental classifications to the primary freshwater classification(s) placed on a waterbody. Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody. Below is a brief summary of these strategies and the administrative code under which the strategies are found. More detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/. Definitions of the primary and supplemental classifications can be found in Chapter 3.

HQW is intended to protect waters with water quality higher than the state's water quality standards. In the Hiwassee River basin, waters classified as Water Supply I and II (WS-I and WS-II), ORW, and waters designated by the NC Wildlife Resources Commission (WRC) as native (wild) trout waters are subject to HQW rules. Streams petitioned for WS-I or WS-II or are which considered Excellent based on biological and physical/chemical parameters may qualify for the HQW supplemental designation.

New discharges and expansions of existing discharges may, in general, be permitted in waters classified as HQW provided that the effluent limits are met for dissolved oxygen (DO), ammonia/nitrogen levels (NH_3-N), and the biochemical oxygen demand (BOD_5). More stringent limitations may be necessary to ensure that the cumulative effects from more than one discharge of oxygen-consuming wastes will not cause the dissolved oxygen concentration in the receiving water to drop more than 0.5 milligrams per liter (mg/l) below background levels. Discharges from single-family residential structures into surface waters are prohibited. When a discharge from an existing single-family home fails, a septic tank, dual or recirculation sand filters, disinfection, and step aeration should be installed (Administrative Code 15A NCAC 2B .0224)

In addition to the above, development activities which require an Erosion and Sedimentation Control Plan under the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program are required to follow stormwater management rules as specified in Administrative Code 15A NCAC 2H .1000 (NCDENR-DWQ, 1995). Under these rules, stormwater management strategies must be implemented if development activities are within one mile of and draining to waters designated as HQW. The low-density option requires a 30-foot wide vegetative buffer between development activities and the stream. This option can be used when the built upon area is less than 12 percent of the total land area or the proposed development is for a single-family residential home on one acre or greater. Vegetated areas may be used to transport stormwater in the low-density option, but it must not lead to a discrete stormwater collection system (e.g., constructed). The high-density option is for all land disturbing activities on greater than one acre. For high-density projects, structural stormwater controls must be constructed (e.g., wet detention ponds, stormwater infiltration systems, innovative systems) and must be designed to control runoff from all surfaces affected by one inch or more of rainfall. More stringent stormwater management measures may be required on a case-by-case basis where it is determined additional measures are needed to protect and maintain existing and anticipated uses of the water (Administrative Code 15A NCAC 2H .1006).

Many of the streams in this subbasin are classified as trout (Tr) waters, and therefore, are protected for natural trout propagation and maintenance of stocked trout. There are no watershed development restrictions associated with the trout classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect trout streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as trout waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along trout waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected trout water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated trout streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

Chapter 3
North Carolina Water Quality Classifications and Standards

3.1 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.

3.1.1 Statewide Classifications

All surface waters in the state are assigned a *primary* classification that is appropriate to the best uses of that water. In addition to primary classifications, surface waters may be assigned a *supplemental* classification. Most supplemental classifications have been developed to provide special protection to sensitive or highly valued resource waters. Table 7 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 7 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 and SC uses.
SA	Suitable for commercial shellfish harvesting and SB and SC uses.
WS	*Water Supply (WS)*: Assigned to watersheds based on land use characteristics. The WS classifications have management strategies to protect the surface water supply. For WS-I through WS-IV, these include limits on point source discharges and local programs to control nonpoint source and stormwater runoff. A WS Critical Area (CA) has more stringent protection measures and is designated within one-half mile from a WS intake or WS reservoir. All WS classifications are suitable for Class C uses.
WS-I	Generally located in natural and undeveloped watersheds.
WS-II	Generally located in predominantly undeveloped watersheds.
WS-III	Generally located in low to moderately developed watersheds.
WS-IV	Generally located in moderately to highly developed watersheds.
WS-V	Generally upstream of and draining to Class WS-IV waters. No categorical restrictions on watershed development or treated wastewater discharges.
SUPPLEMENTAL CLASSIFICATIONS	
Class	**Best Uses**
Sw	*Swamp Waters*: Waters that have low velocities and other natural characteristics that are different from adjacent streams (i.e., lower pH, 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 that have excellent water quality, primary nursery areas and other functional nursery areas, WS-I and WS-II or SA waters.
ORW	*Outstanding Resource Waters*: Unique and special waters of exceptional state or national recreational or ecological significance which require special protection.
NSW	*Nutrient Sensitive Waters*: Waters subject to excessive plant growth and requiring limitations on nutrient inputs.

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

3.1.2 Statewide Water Quality Standards

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

High Quality Waters (Class HQW)

There are 48.80 stream miles HQW waters in the Hiwassee River Basin (Figure 12). Special HQW protection management strategies are intended to prevent degradation of water quality below present levels from both point and nonpoint sources. HQW requirements for new wastewater discharge facilities, and facilities which expand beyond their currently permitted loadings, address oxygen-consuming wastes, total suspended solids, disinfection, emergency requirements, volume, nutrients (in nutrient sensitive waters) and toxic substances.

Criteria for HQW Classification

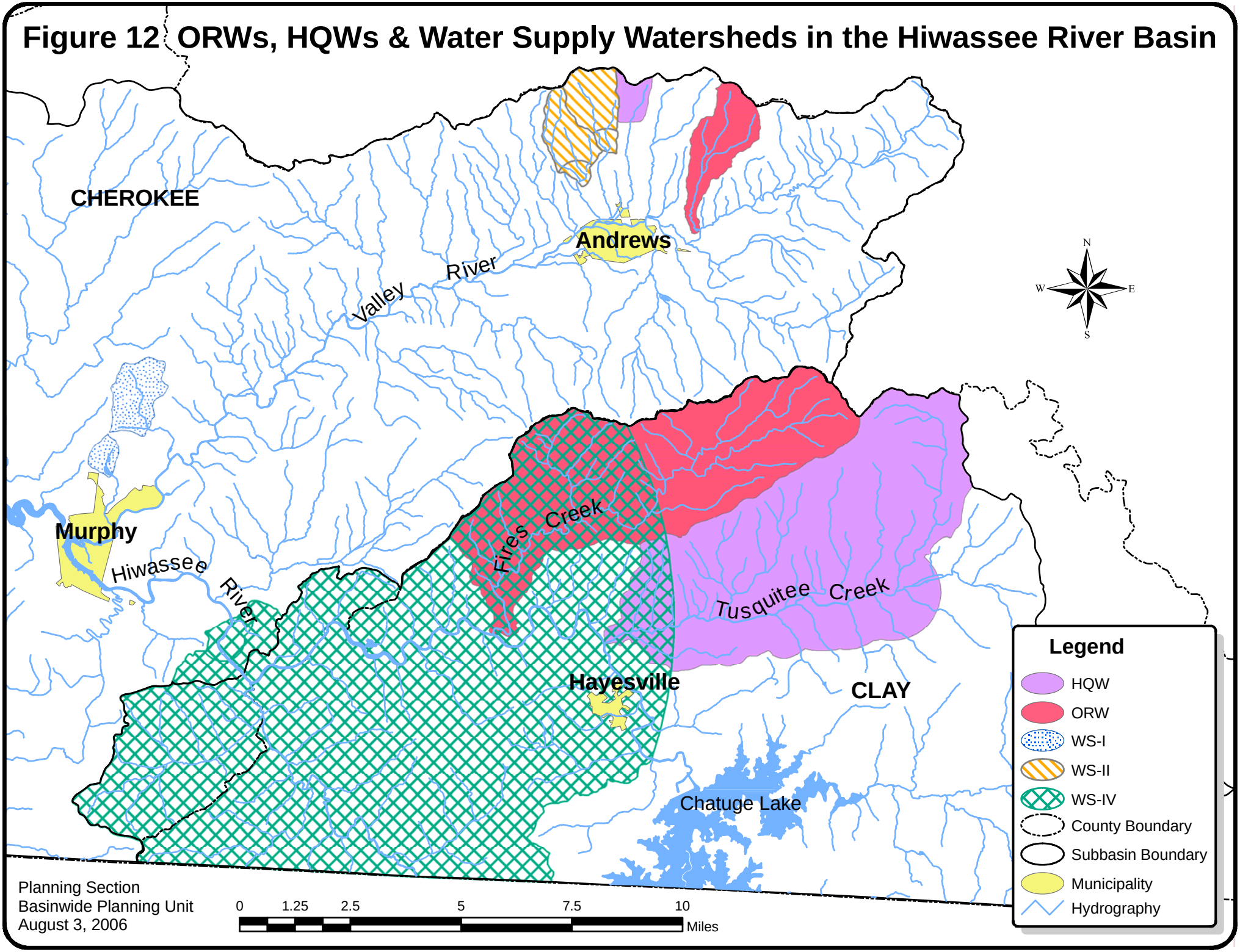
- Waters rated as Excellent based on DWQ's chemical and biological sampling.
- Streams designated as native or special native trout waters by the Wildlife Resources Commission (WRC).
- Waters designated as primary nursery areas or other functional nursery areas by the Division of Marine Fisheries.
-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

For nonpoint source pollution, development activities which require a Sedimentation and Erosion Control Plan in accordance with rules established by the NC Sedimentation Control Commission or an approved local erosion and sedimentation control program, and which drain to and are within 1 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 (DLR) requires more stringent erosion controls for land-disturbing projects within 1 mile of and draining to HQWs.

Outstanding Resource Waters (Class ORW)

There are 55.20 stream miles of ORW waters in the Hiwassee River Basin (Figure 12). These waters have excellent water quality (rated based on biological and chemical sampling as with HQWs) and an associated outstanding resource.

Figure 12 ORWs, HQWs & Water Supply Watersheds in the Hiwassee River Basin



Planning Section
Basinwide Planning Unit
August 3, 2006

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

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

The requirements for ORW waters are more stringent than those for HQWs. Special protection measures that apply to North Carolina ORWs are set forth in 15A NCAC 2B .0225. At a minimum, no new discharges or expansions are permitted, and a 30-foot vegetated buffer or stormwater controls for new developments are required. In some circumstances, the unique characteristics of the waters and resources that are to be protected require that a specialized (or customized) ORW management strategy be developed.

Primary Recreation (Class B)

There are 30.3 stream miles classified for primary recreation in the Hiwassee basin. Waters classified as Class B are protected for primary recreation, include frequent and/or organized swimming, and must meet water quality standards for fecal coliform bacteria. Sewage and all discharged wastes into Class B waters much be treated to avoid potential impacts to the existing water quality.

Trout Waters (Class Tr)

There are 354.0 stream miles classified as trout (Tr) waters in the Hiwassee River Basin. 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.

There are no watershed development restrictions associated with the Tr classification; however, the NC Division of Land Resources (DLR), under the NC Sedimentation and Pollution Control Act (SPCA), has requirements to protect Tr streams from land disturbing activities. Under G.S. 113A-57(1), "waters that have been classified as Tr waters by the Environmental Management Commission (EMC) shall have an undisturbed buffer zone 25 feet wide or of sufficient width to confine visible siltation within the twenty-five percent of the buffer zone nearest the land-disturbing activity, whichever is greater." The Sedimentation Control Commission, however, can approve land-disturbing activities along Tr waters when the duration of the disturbance is temporary and the extent of the disturbance is minimal. This rule applies to unnamed tributaries flowing to the affected Tr water stream. Further clarification on classifications of unnamed tributaries can be found under Administration Code 15A NCAC 02B .0301(i)(1). For more information regarding land-disturbing activities along designated Tr streams, see the DLR website at http://www.dlr.enr.state.nc.us/.

A state fishery management classification, Designated Public Mountain Tr Waters, is administered by the NC WRC. 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.

Water Supply Watersheds (Class WS)

There are 162.80 freshwater stream miles currently classified for water supply in the Hiwassee River Basin (Figure 12). The purpose of the Water Supply Watershed Protection Program is to

provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills and residual application sites to control the impacts of point and nonpoint sources of pollution to water supplies.

There are five water supply classifications (WS-I to WS-V) that are defined according to the land use characteristics of the watershed. The WS-I classification carries the greatest protection for water supplies. No development is allowed in these watersheds. Generally, WS-I lands are publicly owned. WS-V watersheds have the least amount of protection and do not require development restrictions. These are either former water supply sources or sources used by industry. WS-I and WS-II classifications are also HQW by definition because requirements for these levels of water supply protection are at least as stringent as those for HQWs. Those watersheds classified as WS-II through WS-IV require local governments having jurisdiction within the watersheds to adopt and implement land use ordinances for development that are at least as stringent as the state's minimum requirements. A 30-foot vegetated setback is required on perennial streams in these watersheds. The Hiwassee River Basin currently contains WS-I, WS-II, WS-IV and WS-V water supply watersheds.

3.1.3 Reclassification of Surface Waters

The classification of a surface water may be changed after a request is submitted to the Classifications and Standards Unit. DWQ reviews each request for reclassification and conducts an assessment of the surface water to determine if the reclassification is appropriate. If it is determined that a reclassification is justified, the request must proceed through the state rule-making process. To initiate a reclassification, the "Application to Request Reclassification of NC Surface Waters" must be completed and submitted to DWQ's Classifications and Standards Unit. For more information on requests for reclassification and contact information, visit http://h2o.enr.state.nc.us/csu/.

Chapter 4
Water Quality Stressors

4.1 Stressor and Source Identification

4.1.1 Introduction – Stressors

Water quality stressors are identified when impacts have been noted to biological (fish and benthic) communities or water quality standards have been violated. Stressors apply to one or more use support categories and may be identified for Impaired as well as Supporting waters with noted impacts. Identifying stressors is challenging because direct measurements of the stressor may be difficult or prohibitively expensive. DWQ staff use field observations from sample sites, special studies and data from ambient monitoring stations as well as information from other agencies and the public to identify potential water quality stressors. It is important to identify stressors and potential sources of stressors so that water quality programs can target limited resources to address water quality problems.

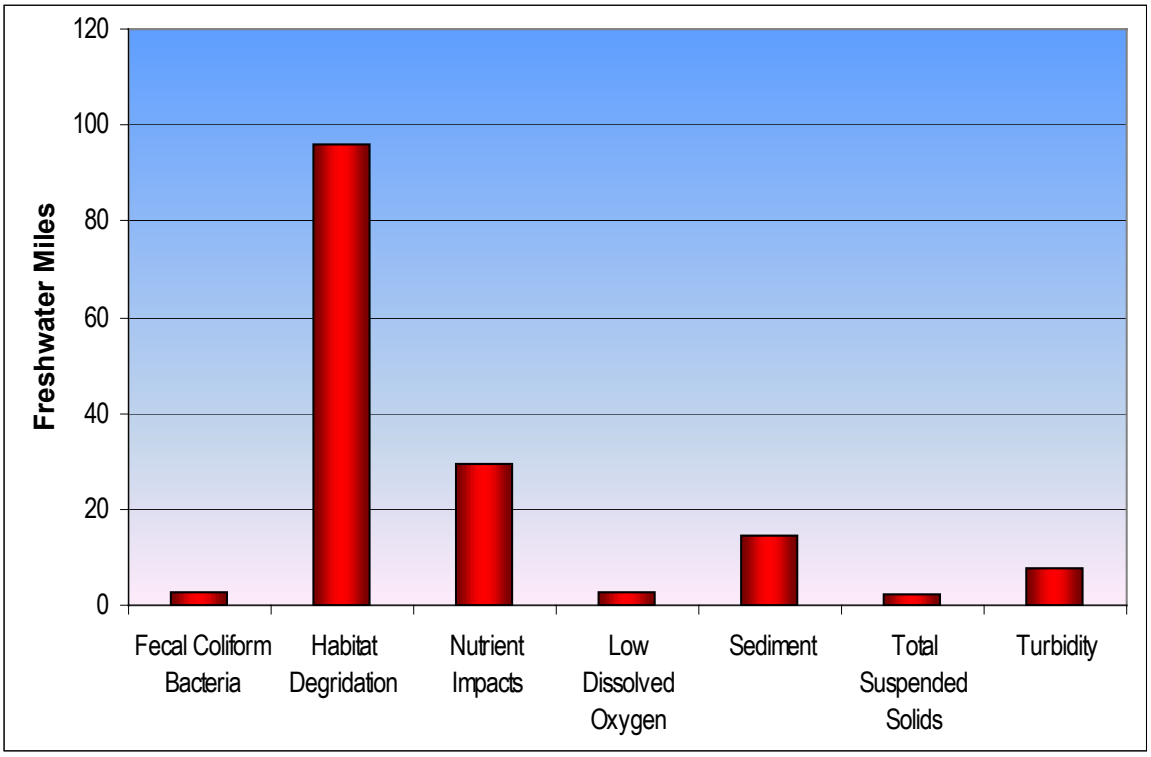
Many times impacts to biological communities are complex groupings of many different stressors that individually may not degrade water quality or aquatic habitat, but together can severely impact aquatic life. Sources of stressors are most often associated with land use in a watershed, as well as the quality and quantity of any treated wastewater that may be entering a stream. During naturally severe conditions such as droughts or floods, any individual stressor or group of stressors may have more severe impacts to aquatic life than during normal climatic conditions. The most common source of stressors is from altered watershed hydrology.

Stressors to recreational uses include pathogenic indicators such as fecal coliform bacteria, escheria coli and enterrococci. Stressors to fish consumption are mercury and any other substance that causes the issuance of a fish consumption advisory by the NC Division of Health and Human Services (NCDHHS).

4.1.2 Overview of Stressors Identified in the Hiwassee River Basin

The sources noted below are summarized for all waters and for all use support categories. Figure 13 identifies sources of stressors noted for monitored waters in the Hiwassee River Basin during the most recent assessment period. Refer to the subbasin chapters (Chapters 1 – 2) for a complete listing and discussion of sources by stream.

Figure 13 Stressors Identified for Streams with Noted Impacts in the Hiwassee River Basin



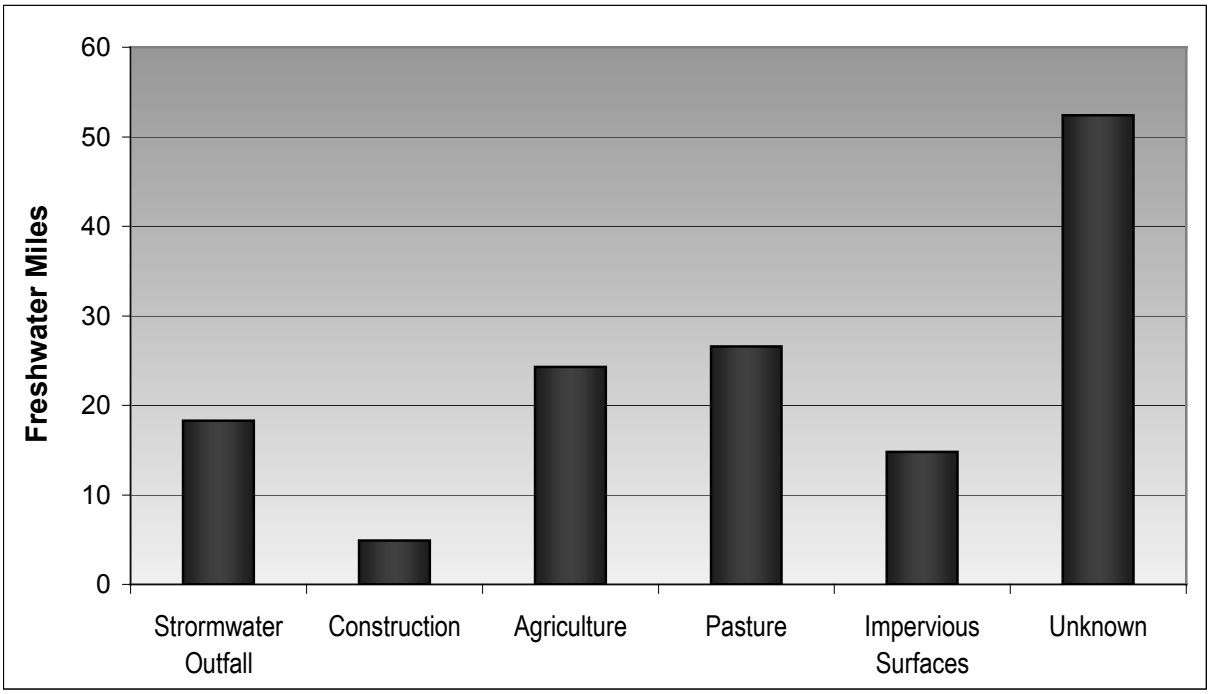
4.1.3 Introduction – Sources of Stressors

Sources of stressors most often come from a watershed where the hydrology has been altered to the point at which stressors are easily delivered to a stream during a rain event along with unusually large amounts of water. DWQ identifies the source of a stressor as specifically as possible depending on the amount of information available in a watershed. Most often the source is based on the predominant land use in a watershed. Construction, stormwater outfalls, agriculture, impervious surfaces were all sources of stressors identified in the Hiwassee River basin during the most recent assessment period. Over fifty miles of stream are stressed by unknown sources. Point source discharges are also considered a water quality stressor source.

4.1.4 Overview of Stressor Sources Identified in the Hiwassee River Basin

The sources noted below are summarized for all waters and for all use support categories. Figure 14 identifies sources of stressors noted for monitored waters in the Hiwassee River Basin during the most recent assessment period. Refer to the subbasin chapters (Chapters 1 – 2) for a complete listing and discussion of sources by stream.

Figure 14 Sources of Stressors Identified in the Hiwassee River Basin



Impervious surface as a stressor source accounted for noted impacts to 14.8 stream miles. Impervious surface cover is often associated with increased development. Refer to Chapter 5 for more information related to population growth and land cover changes and their potential impacts on water quality.

Stressor sources could not be identified for 155.2 stream miles in the Hiwassee River basin. These stream segments may be in areas where sources could not be identified during field observations, but the streams had noted impacts (i.e., habitat degradation). DWQ and the local agencies will work to identify potential sources for these stream segments during the next basinwide cycle.

4.2 Aquatic Life Stressors – Habitat Degradation

4.2.1 Introduction and Overview

Instream habitat degradation is identified as a notable reduction in habitat diversity or a negative change in habitat. This term includes sedimentation, streambank erosion, channelization, lack of riparian vegetation, loss of pools and/or riffles, loss of organic (woody and leaf) habitat, and streambed scour. These stressors to aquatic insect and fish communities can be caused by many different land use activities and less often by discharges of treated wastewater. In the Hiwassee River basin, 23.6 stream miles are Impaired where habitat degradation has been identified as the stressor. There are an additional 95.9 stream miles that are not Impaired but where habitat degradation is a noted impact to water quality. Many of the stressors discussed below are either directly caused by or are a symptom of altered watershed hydrology. Altered hydrology increases both sources of stressors and delivery of the stressors to the receiving waters. Refer to the subbasin chapters (Chapters 1 – 2) for more information on the types of habitat degradation noted in a particular stream segment.

Good instream habitat is necessary for aquatic life to survive and reproduce. Streams that typically show signs of habitat degradation are in watersheds that have a large amount of land-disturbing activities (i.e., construction, mining, timber harvest, 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 (straightening) has occurred also exhibits instream habitat degradation. Streams that receive a discharge quantity that is much greater than the natural flow in the stream often have degraded habitat as well.

Some Best Management Practices to Improve Habitat Degradation

Agriculture

- No till or conservation tillage practices
- Strip cropping and contour farming
- 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

Quantifying the amount 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 then even more resources to restore them. Although DWQ and other agencies (i.e., SWCD, NRCS, town and county governments) 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 source dischargers become less common sources of water quality impairment, nonpoint sources that pollute water and cause habitat degradation must be addressed to further improve water quality in North Carolina's streams and rivers.

4.2.2 Sedimentation

Sedimentation is a natural process that is important to the maintenance of diverse aquatic habitats. It is the process by which soil particles that washed off the landscape and stream banks are deposited within the stream. Streams naturally tend toward a state of equilibrium between erosion and deposition of sediments. As streams meander through their floodplains, the outside of the stream cuts into the bank eroding it away, while the inside of the stream deposits sediments to create sand bars further downstream. The natural process of erosion and deposition can be disrupted by human activities such as dams, dredging, agriculture, development, or logging. Construction projects or logging in the upper reaches of a watershed may worsen erosion or sediment deposition on someone else's property further downstream. If people straighten, narrow, or move stream channels without taking into consideration their natural energy, erosion and sediment deposition rates can increase, resulting in the loss of valuable agricultural land, damage to roads or structures, destruction of productive wetlands, and addition of sediments and nutrients to waterways that can degrade surface water quality and biodiversity.

Overloading of sediment in the form of sand, silt and clay particles fills pools and covers or embeds riffles that are vital aquatic insect and fish habitats. Suspended sediment can decrease primary productivity (i.e., photosynthesis) by shading sunlight from aquatic plants, thereby 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 which leads to reduced growth by some species, respiratory impairment, reduced tolerance to

diseases and toxicants, and increased physiological stress (Roell, 1999). Sediment filling rivers and streams decreases their storage volume and increases the frequency of floods (NCDENR-DLR, 1998). Suspended sediment also increases the cost of treating municipal drinking water.

Streambank erosion and land-disturbing activities are sources of sedimentation. Streambank erosion is often caused by high stormwater flows immediately following rainfall events or snowmelts. Watersheds with large amounts of impervious surface transport water to streams more rapidly and at higher volumes than in watersheds with more vegetative cover. In many urban areas, stormwater is delivered directly to the stream by a stormwater sewer system. This high volume and concentrated flow of water after rain events undercuts streambanks often causing streambanks to collapse. This leads to large amounts of sediment being deposited into the stream. Many urban streams are adversely impacted by sediment overloading from the watershed as well as from the streambanks. Minimizing impervious surface area and reducing the amount of stormwater outlets releasing stormwater directly to the stream can often prevent substantial amounts of erosion.

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. In most land-disturbing activities, sedimentation can be controlled through the use of appropriate best management practices (BMPs). BMPs that minimize the amount of acreage and length of time that the soil is exposed during land-disturbing activities can greatly reduce the amount of soil erosion. For more information on sedimentation as it relates to changes in land use, refer to Chapter 5.

Livestock grazing with unlimited access to the stream channel and banks can also cause severe streambank erosion resulting in sedimentation and 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). For more information on the livestock exclusion, refer to Chapter 7.

4.2.3 Loss of Riparian Vegetation

During the 2002 basinwide sampling, DWQ biologists reported degradation of aquatic communities at several 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, 2003). The loss of riparian vegetation and subsequent reduction of organic aquatic habitats (Section 5.2.4) is most commonly associated with land clearing for development, agriculture, pastureland, and forestry. Instream organic habitat loss has also been caused by stream channelization or debris removal activities.

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 streambank 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 streambanks with grass or rock severely impact the habitat that aquatic insects and fish need to survive.

Establishing, conserving and managing streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. Forested buffers in particular provide a variety of benefits including filtering runoff and taking up nutrients, moderating water temperature, preventing erosion and loss of land, providing flood control and helping to moderate streamflow, and providing food and habitat for both aquatic and terrestrial wildlife (NCDENR-DWQ, 2004). To obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

4.2.4 Loss of Instream Organic Microhabitats

Organic microhabitat (i.e., leafpacks, sticks and large wood) and edge habitat (i.e., root banks and undercut banks) play very important roles in a stream ecosystem. Organic matter in the form of leaves, sticks and other materials serve as the base of the food web for small streams. Additionally, these microhabitats serve as special niches for different species of aquatic insects, providing food and/or habitat. For example, many stoneflies are found almost exclusively in leafpacks and on small sticks. Some beetle species prefer edge habitat, such as undercut banks. If these microhabitat types are not present, there is no place for these specialized macroinvertebrates to live and feed. The absence of these microhabitats in some streams in the Hiwassee River basin is directly related to the absence of riparian vegetation. Organic microhabitats are critical to headwater streams, the health of which is linked to the health of the entire downstream watershed. For more information related to headwater streams, refer to Chapter 5.

4.2.5 Channelization

Channelization refers to the physical alteration of naturally occurring stream and riverbeds. Typical modifications are described in the text box. Although increased flooding, streambank erosion and channel instability often occur in downstream areas after channelization has occurred, flood control, reduced erosion, increased usable land area, greater navigability and more efficient drainage are frequently cited as the objectives of channelization projects (McGarvey, 1996). Direct or immediate biological effects of channelization include injury and mortality of aquatic insects, fish, shellfish/mussels and other wildlife populations, as well as habitat loss. Indirect biological effects include changes in the aquatic insect, 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 in parts of the Hiwassee River basin and continues to occur in some watersheds, especially in small headwater streams.

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.

4.2.6 Small Dams, Impoundments, and Water Features

The consensus among river ecologists is that dams are the single greatest cause of the decline of river ecosystems (World Commission on Dams, 2000). This report was focused on large dams, but by design, all dams, including small impoundments, alter the natural flow regime, and with it virtually every aspect of a river ecosystem, including water quality, sediment transport and deposition, fish migrations and reproduction, and riparian and floodplain habitat and the organisms that rely on this habitat (Raphals, 2001). Dams also require ongoing maintenance. For example, reservoirs in sediment-laden streams lose storage capacity as silt accumulates in the reservoir.

Dams cause significant adverse impacts to the ecology of rivers and streams by blocking migration of fish to upriver spawning habitat; warming water temperatures in impoundments well above downstream conditions and accumulating sediment, which degrades water quality and often buries high quality fisheries habitat.

The damming and/or diverting of streams can lead to the loss of habitat resulting from the inundation of wetlands, riparian areas, and farmland in upstream areas of the impounded waterway, or erosion of these resources in downstream areas. As dams trap sediment and other pollutants, changes in water quality especially in tailwaters and downstream areas occur. They include: reduced sediment transport, decreased dissolved oxygen, altered temperature regimes, and increased levels of some pollutants, such as hydrogen sulfide, nutrients, and manganese.

Once streams are impounded, water demand dictates the artificial regulation and control of streamflow. The new flow rates and volume often do not reproduce natural conditions preceding the impoundment. Releases of impounded water with decreased levels of dissolved oxygen, high turbidity, or altered temperature can reduce downstream populations of fish and other organisms. Not only can reservoir water temperatures and oxygen content differ significantly from expected seasonal temperatures in the formerly free-flowing stream or river, but critical minimum flows needed for riparian areas are often not maintained as well. (EPA, 1995).

These effects are seen in both large and small impoundments. In 2003, the Tennessee Department of Environment and Conservation, Division of Water Pollution Control was awarded a grant to perform a probabilistic monitoring study of 75 streams below small impoundments. Many of these are similar to those found in western North Carolina. The study measured effects

of the impoundments on aquatic life, nutrients, dissolved oxygen, pH, iron, manganese, habitat, flow and periphyton density in the downstream stream reaches.

Macroinvertebrate communities were adversely affected in most of the streams sampled. Of the 75 sites below impoundments, only four passed biological criteria guidelines or were comparable to unimpounded streams in both seasons sampled. A shift in the type of dominant organisms toward more tolerant taxa was also observed.

Lack of adequate flow was one of the biggest problems downstream of impoundments. Approximately one third of the perennial streams that were randomly selected for reconnaissance were dry. Of those with flow during the summer reconnaissance, one fourth had dry channels by the fall sampling period. Thirty-nine percent of the dams with year-round discharge provided insufficient flow to supply adequate habitat for aquatic life during at least one season.

Disruption of habitat was a major concern below most of the impoundments. Sediment deposition was the most significant habitat problem in impounded streams with 80% failing to meet regional expectations. High levels of sediment deposition are symptoms of an unstable and continually changing environment that becomes unsuitable for many aquatic organisms. Other frequently documented habitat problems included embedded substrate, instability of banks, loss of stream sinuosity and disruption of bank vegetation.

The most frequently encountered chemical water quality problems below impoundments were elevated iron, manganese and nutrients as well as low dissolved oxygen concentrations. Elevated manganese was the number one problem. Ammonia was the most frequently elevated nutrient.

Dissolved oxygen in lakes and streams is critical to support fish and aquatic life. Low levels of dissolved oxygen may be caused by decay of organic material, respiration of algae, inflow of substantial amounts of ground water, or reduced stream flow. Dissolved oxygen was below criteria in at least one season at 21 of the impounded test sites. Many sites that passed dissolved oxygen criteria during daylight hours did not maintain saturation comparable to reference levels. Streams with dissolved oxygen saturation below this level may not be providing adequate oxygen to support benthic communities appropriate for the ecoregion.

Water temperature is an important component of the aquatic environment. Almost all facets of life history and distribution of aquatic macroinvertebrates are influenced by temperature. Eight of the impounded streams violated the temperature criterion at the time of sampling. Most of the test sites fell outside the temperature ranges found in regional reference streams.

Approximately half of the impounded test sites had elevated suspended solids (TSS) compared to regional reference streams. Total suspended solids (TSS) can include a wide variety of material, such as silt, nutrients and decaying organic matter. High TSS can block light from reaching submerged vegetation. Particles can clog gills, reduce growth rates, decrease resistance to disease and prevent egg and larval development of benthic fauna. Suspended particles absorb heat from sunlight, which can result in higher water temperatures. Pollutants such as bacteria, nutrients, pesticides and metals may attach to sediment particles and be transported to the water where they are released or carried further downstream. (Arnwine, 2006)

These results clearly demonstrate the negative impact small dams and impoundments can have on stream habitat and water quality. DWQ strongly encourages developers and homeowners to

carefully consider these impacts before choosing to install a water feature. In many cases, the harm caused will outweigh the benefits. Additionally, many existing small dams and impoundments may have outlived their usefulness. These old dams negatively influence biological communities and may have become maintenance problems. Removal options should be explored for these dams.

4.2.7 Recommendations for Reducing Habitat Degradation

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

(1) Evaluate, in consultation with the Attorney General's Office, whether statutory authority is adequate to mandate temporary ground cover over a percentage of the uncovered area at a construction site within a specific time after the initial disturbance of the area. If it is found that statutory authority does not exist, then the EMC and SCC should prepare resolutions for the General Assembly supporting new legislation to this effect.

(2) Prepare resolutions supporting new legislation to increase the maximum penalty allowed in the Sedimentation Pollution Control Act from $5,000 to $25,000 for the initial response to a noncompliant site.

(3) Jointly support a review of the existing Erosion and Sediment Control Planning and Design Manual by the NC Division of Land Resources (DLR). This review should include, but not be limited to, a redesign of the minimum specifications for sedimentation basins.

(4) Evaluate, in consultation with the Attorney General's Office, whether the statutory authority is adequate for effective use of the "Stop Work Order" tool and, if found not to be adequate, to prepare resolutions for the General Assembly supporting new legislation that will enable staff to more effectively use the "Stop Work Order" tool.

(5) Support increased research into and experimentation with the use of polyacrylamides (PAMs) and other innovative soil stabilization and turbidity reduction techniques.

(6) Jointly support and encourage the awarding of significant monetary penalties for all activities found to be in violation of their Stormwater Construction General Permit, their Erosion and Sediment Control Plan, or the turbidity standard.

(7) Hold those individuals who cause serious degradation of the environment through excessive turbidity and sedimentation ultimately responsible for restoration of the area.

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

basin. Additionally, more public education is needed basinwide to educate landowners about the value of riparian vegetation along small tributaries and the impacts of sedimentation to aquatic life.

Funding is available through numerous federal and state programs for landowners to restore and/or protect riparian buffer zones along fields or pastures, develop alternative watering sources for livestock, and fence animals out of streams (refer to Chapters 7 and 11). EPA's *Catalog of Federal Funding Sources for Watershed Protection* (Document 841-B-99-003) outlines some of these and other programs aimed at protecting water quality. A copy may be obtained by calling the National Center for Environmental Publications and Information at (800) 490-9198 or by visiting the website at http://www.epa.gov/OWOW/watershed/wacademy/fund.html. Local contacts for various state and local agencies are listed in Appendix VII.

4.3 Aquatic Life Stressors – Water Quality Standards

4.3.1 Introduction and Overview

In addition to the habitat stressors discussed in the previous section, the stressors discussed below are identified by water quality standards. These are usually direct measures of water quality parameters from ambient water quality monitoring stations. The water quality standards are designed to protect aquatic life. As with habitat degradation, altered watershed hydrology greatly increases the sources of these stressors as well as delivery of the stressors to the receiving waters. The following are water quality standards that were identified for waters with noted impacts. Refer to the subbasin chapters (Chapter 1 – 2) for more information on the affected waters.

4.3.2 pH

The pH water quality standard for Class C waters is between 6.0 and 9.0. In the Hiwassee River basin during the most recent assessment period, pH was not identified as a potential stressor.

4.3.3 Toxic Impacts

Toxic impacts are noted as a stressor during biological monitoring. Waters are not impaired due to toxic impacts, but toxic impacts can be noted as a potential stressor on the system. In the Hiwassee River basin during the most recent assessment period, toxic impact was not identified as a potential stressor.

4.3.4 Fish Consumption Advisories and Advice Related to Mercury

The presence and accumulation of mercury in North Carolina's aquatic environment are similar to contamination observed throughout the country. Mercury has a complex life in the environment, moving from the atmosphere to soil, to surface water, and eventually, to biological organisms. Mercury circulates in the environment as a result of natural and human (anthropogenic) activities. A dominant pathway for mercury in the environment is through the atmosphere. Mercury emitted from industrial and municipal stacks into the ambient air can circulate around the globe. At any point, mercury may then be deposited onto land and water. Once in the water, mercury can accumulate in fish tissue and humans. Mercury is also

commonly found in wastewater; however, mercury in wastewater is typically not at levels that could be solely responsible for elevated fish levels.

Fish is part of a healthy diet and an excellent source of protein and other essential nutrients. However, nearly all fish and shellfish contain trace levels of mercury. The risks from mercury in fish depend on the amount of fish eaten and the levels of mercury in the fish. In March 2003, the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA) issued a joint consumer advisory for mercury in fish and shellfish. The advice is for women who might become pregnant, women who are pregnant, nursing mothers, and young children. Aside from being issued jointly by two federal agencies, this advisory is important because it emphasizes positive benefits of eating fish and gives examples of commonly eaten fish that are low in mercury. In the past, the FDA issued an advisory on consumption of commercially caught fish, while the EPA issued advice on recreationally caught fish.

By following these three recommendations for selecting and eating fish, women and young children will receive the benefits of eating fish and shellfish and be confident that they have reduced their exposure to the harmful effects of mercury. These recommendations are:

- **Do not eat shark, swordfish, king mackerel, or tilefish**. They contain high levels of mercury.

- Eat up to 12 ounces (two average meals) a week of a variety of fish and shellfish that are lower in mercury. Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Another commonly eaten fish, albacore ("white") tuna, has more mercury than canned light tuna. So, when choosing your two meals of fish, you may eat up to 6 ounces (one average meal) of albacore per week.

- Check local advisories about the safety of fish caught by family and friends in your local lakes, rivers, and coastal areas. If no advice is available, eat up to 6 ounces (one average meal) per week of fish you catch from local waters. Don't consume any other fish during that week.

For more detailed information, visit EPA's website at http://www.epa.gov/waterscience/fish/ or visit the FDA at http://www.cfsan.fda.gov/seafood1.html. The FDA's food information toll-free phone number is 1-888-SAFEFOOD.

The NC Department of Health and Human Services (NCDHHS) also issues fish consumption advisories and advice for those fish species and areas at risk for contaminants. NCDHHS notifies people to either limit consumption or avoid eating certain kinds of fish. While most freshwater fish in North Carolina contain very low levels of mercury and are safe to eat, several species have been found to have higher levels. More information regarding use support assessment methodology related to fish consumption advisories and advice can be found in Appendix VIII.

Due to high levels of mercury in seventeen saltwater and five freshwater fish species, the NCDHHS offers the following health advice (updated March 31, 2006).

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

- **Do not eat** the following ocean fish: almaco jack, banded rudderfish, canned white tuna (albacore tuna), cobia, crevalle jack, greater amberjack, south Atlantic grouper (gag, scamp, red, and snowy), king mackerel, ladyfish, little tunny, marlin, orange roughy, shark, Spanish mackerel, swordfish, tilefish, or tuna (fresh or frozen).
- **Do not eat** the following freshwater fish: bowfin (blackfish), catfish (caught wild), chain pickerel (jack fish), or warmouth caught in North Carolina waters south and east of Interstate 85.
- **Do not eat** largemouth bass caught in North Carolina waters (statewide).
- Eat up to two meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

All other people:

- Eat no more than one meal (6 ounces) per week of ocean and/or freshwater fish listed above. These fish are often high in mercury.
- Eat up to four meals per week of other fish. A meal is 6 ounces of cooked fish for adults or 2 ounces of cooked fish for children under 15.

For more information and detailed listing of site-specific advisories, visit the NCDHHS website at http://www.schs.state.nc.us/epi/fish/current.html or call (919) 733-3816.

4.4 Recreation Stressor – Fecal Coliform Bacteria

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

No waters in the Hiwassee River basin are Impaired for fecal coliform bacteria. Current methodology requires additional bacteriological sampling for streams with a geometric mean greater than 200 colonies/100ml or when concentrations exceed 400 colonies/100ml in more than 20 percent of the samples. These additional assessments are prioritized such that, as monitoring resources become available, the highest priority is given to those streams where the likelihood of full-body contact recreation is the greatest.

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

Sources of Fecal Coliform in Surface Waters

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

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

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

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

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

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

Chapter 5
Population Growth, Land Cover Changes, and Water Quality in Western North Carolina

Once one of the most remote and sparsely populated regions of the state, western North Carolina is now penetrated by modern interstates and highways that provide speedy access to the deepest folds of the rugged terrain. This improved access coupled with an abundance of recreational opportunities, cultural activities, and countless other amenities sets the stage for rapid population increases. With this growth comes increased pressure on the natural environment. Every person living in or visiting a watershed contributes to impacts on water quality. If water pollution is to be eliminated, each individual should be aware of these contributions and take actions to reduce them. The following section describes the most common impacts of human activity and offers suggestions to lessen those impacts.

5.1 Impacts of Population Growth and Land Cover Changes

5.1.1 Rapid Urbanization

Population growth results in dramatic impacts on the natural landscape. The most obvious impact is the expansion of urban and suburban areas. New stores, roads, and subdivisions are products of growing populations. What is not so obvious is the astonishing rate at which rural landscapes are converted to developed land. Between 1982 and 1997, the United States population increased by 15 percent. Over the same period, developed land increased by 34 percent – more than double the rate of population growth (NRI, 2001; U.S. Census Bureau, 2000). Locally, the trend can be even more pronounced. For example, the urban area of Charleston, SC expanded 250 percent between 1973 and 1994 while its population grew by 40 percent (Allen and Lu, 2000).

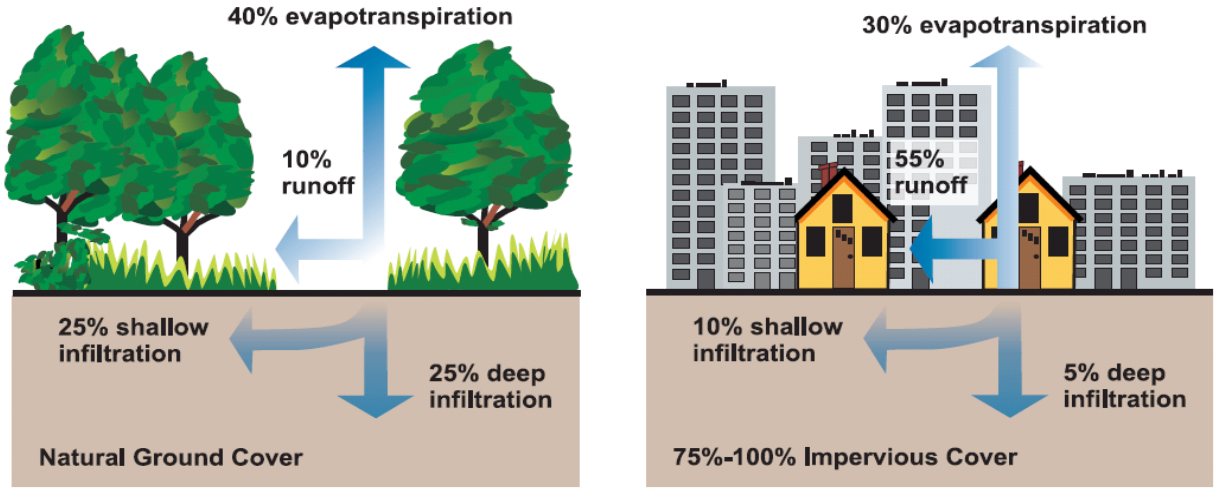
County populations in the Hiwassee River basin are expected to grow by over 20 percent between 2000 and 2020 (See Appendix I). If development patterns follow the trends described above, there could be a 40 percent increase in developed land in the Hiwassee River basin by 2020. Such an increase in developed land poses a significant threat to water quality and stream health because it will be accompanied by a similar increase in impervious surfaces.

Impervious surfaces are materials that prevent infiltration of water into the soil and include roads, rooftops, and parking lots (Figure 15). Impervious surfaces alter the natural hydrology, prevent the infiltration of water into the ground, and concentrate the flow of stormwater over the landscape. In undeveloped watersheds, stormwater filters down through the soil, replenishing groundwater quantity with water of good quality.

Vegetation stabilizes the soil, slows the flow of stormwater over land, and filters out some pollutants, by both slowing the flow of the water and trapping some pollutants in the root system. As the imperviousness of a watershed increases, the greater volume of stormwater increases the possibility of flooding and reduces the potential for pollutants to settle out, meaning that more pollution is delivered to drinking water streams and aquifers. Too much paving and hardening of a watershed can reduce infiltration and groundwater levels which in turn can decrease the availability of aquifers, streams and rivers for drinking water supplies (Kauffman and Brant,

2000). It is well established that stream degradation begins to occur when 10 percent or more of a watershed is covered with impervious surfaces (Schueler, 1995).

Figure 15 Impervious Cover and Surface Runoff (EPA, 2003)



Relationship between impervious cover and surface runoff. Impervious cover in a watershed results in increased surface ruunoff. As little as 10 percent impervious cover in a watershed can result in stream degradation.

5.1.2 Population Growth and Urbanization Impacts on Aquatic Resources

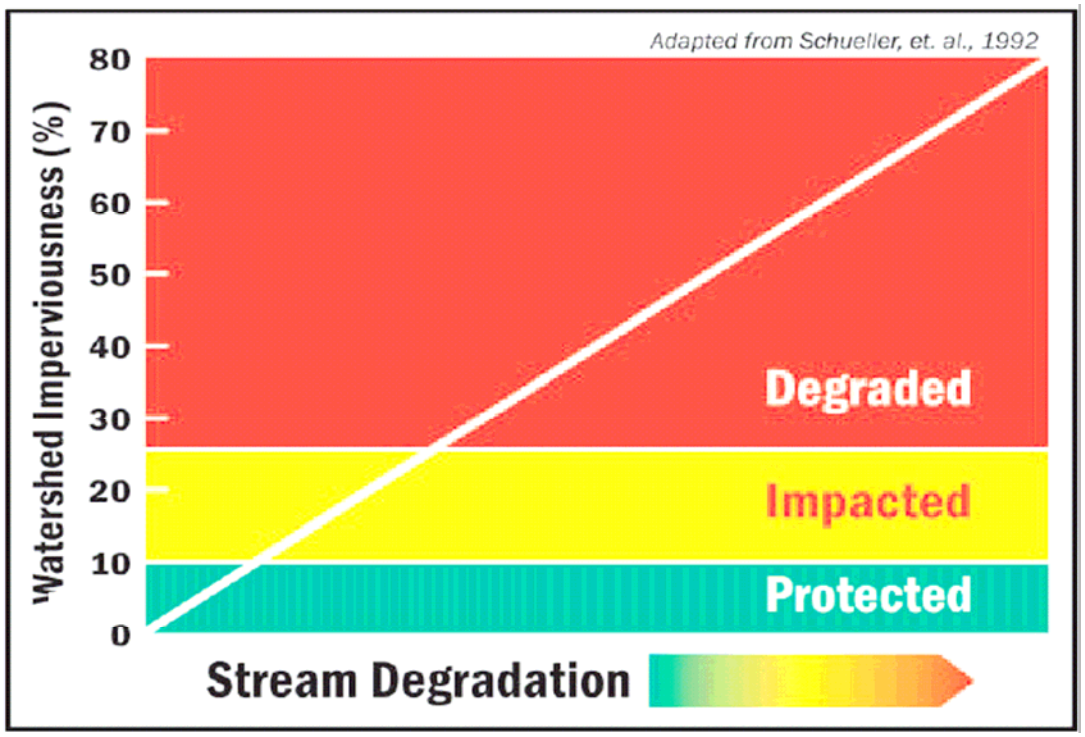
Urbanization poses one of the greatest threats to aquatic resources. The small towns and communities in western North Carolina are usually not considered urban centers, but even small concentrations of urbanizing areas have significant impacts on local waterways. For example, a one-acre parking lot produces 16 times more runoff than a one-acre meadow (Schueler and Holland, 2000). A wide variety of studies over the past decade converge on a central point: when more than 10 percent of the acreage in a watershed is covered in roads, parking lots, rooftops, and other impervious surfaces, the rivers and streams within the watershed become seriously degraded. Brown trout populations have been shown to decline sharply at 10 to 15 percent imperviousness. If urbanized area covers more than 25 percent of a watershed, these studies point to an irreversible decline in ecosystem health (Beach, 2002 and Galli, 1991).

Greater numbers of homes, stores, and businesses require greater quantities of water. Growing populations not only require more water, but they also lead to the discharge and runoff of greater quantities of waste and pollutants into the state's streams, rivers, lakes and groundwater. Thus, just as demand and use increases, some of the potential water supply is lost (Orr and Stuart, 2000).

As development in surrounding metropolitan areas consumes neighboring forests and fields, the impacts on rivers, lakes, and streams can be significant and permanent if stormwater runoff is not controlled (Orr and Stuart, 2000). As watershed vegetation is replaced with impervious surfaces, the ability of the landscape to absorb and diffuse the effects of natural rainfall is diminished. Urbanization results in increased surface runoff and correspondingly earlier and higher peak streamflows after rainfall. Flooding frequency also increases. These effects are compounded when small streams are channelized (straightened) or piped, and storm sewer systems are installed to increase transport of stormwater 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). See Figure 16.

Figure 16 Impervious Cover and Stream Degradation



5.2 Key Elements of a Comprehensive Watershed Protection Strategy

Extensive research on the impacts of development and alarming population growth projections make it clear that comprehensive land use planning is necessary to protect aquatic resources. In order for land use planning to effectively protect watersheds in the long-term, tools and strategies must be applied at several scales. Effective implementation will require commitment ranging from the individual citizen to the state government. A comprehensive watershed protection plan should act on the following elements:

Basin Scale (Implemented by Town, County, and State Governments)

1. Characterize the watersheds within a basin as developed or undeveloped, identifying the watersheds that are currently less than 10 percent impervious and those that are more than ten percent impervious.
2. Focus new construction projects to the already developed watersheds first. Then assign any construction that cannot be accommodated in developed watersheds to a limited number of undeveloped watersheds. The watersheds to be developed should be determined by their ecological importance and by other regional growth considerations, such as the value of terrestrial ecosystems, the economic development potential as determined by proximity to roads and rail lines, and the disposition of landowners in the area toward land preservation and development.
3. Adopt policies that maintain impervious surfaces in undeveloped watersheds at less than ten percent. These can include private conservation easements, purchase of development

rights, infrastructure planning, urban service boundaries, rural zoning (20-200 acres per unit, depending on the area), and urban growth boundaries.
4. Ensure that local governments develop land use plans to provide adequate land for future development within developed or developing watersheds.

Neighborhood Scale (Implemented by Town and County Governments)

1. Allow residential densities that support transit, reduce vehicle trips per household and minimize land consumption. The minimum density for new development should be seven to ten net units per acre.
2. Require block densities that support walking and reduce the length of vehicle trips. Cities that support walking and transit often have more than 100 blocks per square mile.
3. Connect the street network by requiring subdivision road systems to link to adjacent subdivisions.
4. Integrate houses with stores, civic buildings, neighborhood recreational facilities, and other daily or weekly destinations.
5. Incorporate pedestrian and bike facilities (greenways) into new development and ensure these systems provide for inter-neighborhood travel.
6. Encourage and require other design features and public facilities that accommodate and support walking by creating neighborhoods with a pleasing scale and appearance. (e.g., short front-yard setbacks, neighborhood parks, alleys, and architectural and material quality)

Site Scale (Implemented by Individual Property Owners, Developers, and Town and County Governments)

1. Require application of the most effective structural stormwater practices, especially focusing on hot spots such as high-volume streets, gas stations, and parking lots.
2. Establish buffers and setbacks that are appropriate for the area to be developed – more extensive in undeveloped watersheds than in developed watersheds. In developed watersheds, buffers and setbacks should be reconciled to other urban design needs such as density and a connected street network.
3. Educate homeowners about their responsibility in watershed management, such as buffer and yard maintenance, proper disposal of oil and other toxic materials, and the impacts of excessive automobile use (Beach, 2002).

5.3 Focus Areas for Managing the Impacts of Population Growth

The elements of watershed protection listed in Section 5.2 above are intended to guide land use planning and population density decision-making. This section discusses specific concepts necessary to reduce the impacts of population growth.

5.3.1 Control Stormwater Runoff and Pollution

Introduction to Stormwater

Stormwater runoff is rainfall or snowmelt that runs off the ground and impervious surfaces (e.g., buildings, roads, parking lots, etc.). Because urbanization usually involves creation of new impervious surfaces, stormwater can quickly become a major concern in growing communities.

The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands traps rainwater and snowmelt and allows them to filter slowly into the ground. In contrast, impervious

(nonporous) surfaces like roads, parking lots, and rooftops prevent rain and snowmelt from infiltrating, or soaking, into the ground. Most of the rainfall and snowmelt remains above the surface, where it runs off rapidly in unnaturally large amounts.

Common Pollutants in Stormwater

Storm sewer systems concentrate runoff into smooth, straight conduits. This runoff gathers speed and power as it travels through the pipes. When this runoff leaves the storm drains and empties into a stream, its excessive volume and power blast out streambanks, damaging streamside vegetation and destroying aquatic habitat. These increased storm flows carry sediment loads from construction sites and other denuded surfaces and eroded streambanks. They often carry higher water temperatures from streets, rooftops, and parking lots, which are harmful to the health and reproduction of aquatic life. The steep slopes and large elevation changes in western North Carolina intensify this effect as water rushes downhill.

Storm sewers should not be confused with sanitary sewers, which transport human and industrial wastewaters to a treatment plant before discharging into surface waters. There is no pre-treatment of stormwater in North Carolina.

Uncontrolled stormwater runoff has many impacts on both humans and the environment. Cumulative effects include flooding, undercut and eroding streambanks, widened stream channels, threats to public health and safety, impaired recreational use, and increased costs for drinking and wastewater treatment. For more information on stormwater runoff, visit the DWQ Stormwater Permitting Unit at http://h2o.enr.state.nc.us/su/stormwater.html or the NC Stormwater information page at http://www.ncstormwater.org/. Additional fact sheets and information can also be found at http://www.stormwatercenter.net/intro_factsheets.htm and www.bae.ncsu.edu/stormwater/index.html.

Common Pollutants in Stormwater

- Sediment
- Oil, grease, and toxic chemicals from motor vehicles
- Pesticides and nutrients from lawns and gardens
- Viruses, bacteria, and nutrients from pet waste and failing septic systems
- Road salts
- Heavy metals from roof shingles, motor vehicles, and other sources
- Thermal pollution from dark impervious surfaces such as streets and rooftops

Controlling Stormwater Runoff and Pollution

Many daily activities have the potential to cause stormwater pollution. Any situation where activities can contribute more pollutants to stormwater runoff is an area that should be considered for efforts to minimize stormwater impacts. A major component in reducing stormwater impacts involves planning up front in the design process. New construction designs should include plans to prevent or minimize the amount of runoff leaving the site. Wide streets, large cul-de-sacs, long driveways, and sidewalks lining both sides of the street are all features of urbanizing areas that create excess impervious cover and consume natural areas. In many instances, the presence of intact riparian buffers and/or wetlands in urban areas can reduce the impacts of urban development. Establishment and protection of buffers should be considered where feasible, and the amount of impervious cover should be limited as much as possible.

"Good housekeeping" to reduce the volume of stormwater leaving a site and reducing the amount of pollutants used in our own backyards can also minimize the impact of stormwater runoff. DWQ has published a pamphlet entitled *Improving Water Quality in Your Own Backyard:*

Stormwater Management Starts at Home. The pamphlet provides information on how homeowners and businesses can reduce the amount of runoff leaving their property and how to reduce the amount and types of pollutants in that runoff. This document is available on-line at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf or by calling (919) 733-5083 ext. 558.

Preserving the natural streamside vegetation (riparian buffer) is one of the most economical and efficient BMPs. In particular, forested buffers 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, 2004). For more information or to obtain a free copy of DWQ's *Buffers for Clean Water* brochure, call (919) 733-5083, ext. 558.

5.3.2 Protect Headwater Streams

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 (Figure 17). 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. These streams account for approximately 80 percent of the stream network and provide many valuable services for quality and quantity of water delivered downstream (Meyer et al., 2003). However, degradation of headwater streams can (and does) impact the larger stream or river.

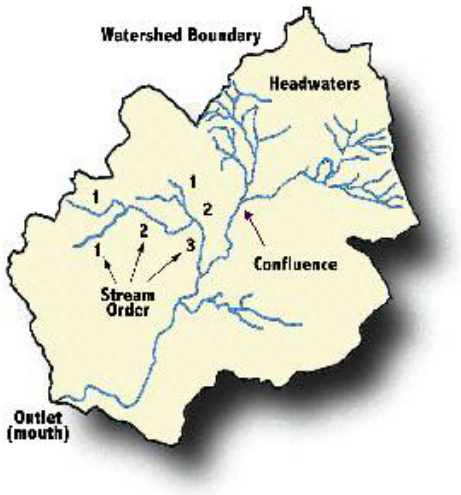


Figure 17 Diagram of Headwater Streams within a Watershed Boundary

There are three types of headwater streams: 1) perennial (flow year-round); 2) intermittent (flow during wet seasons); and 3) ephemeral (flow only after precipitation events). All types of headwater streams provide benefits to larger streams and rivers. Headwater streams control flooding, recharges groundwater, maintain water quality, reduce downstream sedimentation, recycle nutrients, and create habitat for plants and animals (Meyer et al., 2003).

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, as occurs during land use changes, it can have repercussions in many parts of both the terrestrial and aquatic food web.

Headwater streams 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. In addition to macroinvertebrates, these streams support diverse populations of plants and animals that face similar problems if streams are disturbed. Headwater streams are able to provide these important ecosystem services due to their unique locations, distinctive flow patterns, and small drainage areas.

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 and watershed management, refer to EPA's Watershed Academy website at http://www.epa.gov/OWOW/watershed/wacademy/acad2000/watershedmgt/principle1.html.

5.3.3 Reduce Impacts from Steep Slope Disturbance

Dramatic elevation changes and steep slopes define mountain topography. Building sites perched along mountainsides provide access to unparalleled vistas and are a major incentive for development. However, construction on steep slopes presents a variety of risks to the environment and human safety.

Poorly controlled erosion and sediment from steep slope disturbance negatively impacts water quality, hydrology, aquatic habitat, and can threaten human safety and welfare. Soil types, geology, weather patterns, natural slope, surrounding uses, historic uses, and other factors all contribute to unstable slopes. Steep slope disturbance usually involves some form of grading. Grading is the mechanical excavation and filling of natural slopes to produce a level working surface. Improper grading practices disrupt natural stormwater runoff patterns and result in poor drainage, high runoff velocities, and increased peak flows during storm events. There is an inherent element of instability in all slopes and those who choose to undertake grading and/or construction activities should be responsible for adequate site assessment, planning, designing, and construction of reasonably safe and stable artificial slopes.

In cases where construction activities occur on steep slopes, slope stabilization should be mandated through a Site Grading Plan and/or Site Fingerprinting. Site Grading Plans identify areas intended for grading and address impacts to existing drainage patterns. They identify practices to stabilize, maintain and protect slopes from runoff and include a schedule for grading disturbance as well as methods for disposal of borrow and fill materials. Site Fingerprinting is a low-impact development (LID) best management practice (BMP) that minimizes land disturbances. Fingerprinting involves clearing and grading only those onsite areas necessary for access and construction activities. Extensive clearing and grading accelerates sediment and pollutant transport off-site. Fingerprinting and maintenance of vegetated buffers during grading operations provide sediment control that reduces runoff and off-site sedimentation (Yaggi and Wegner, 2002).

Local communities also have a role in reducing impacts from steep slope development. These impacts can also be addressed through the implementation of city and/or county land use and sediment and erosion control plans. Land use plans are a non-regulatory approach to protect water quality, natural resources and sensitive areas. In the planning process, a community gathers data and public input to guide future development by establishing long-range goals for the local community over a ten- to twenty-year period. They can also help control the rate of development, growth patterns and conserve open space throughout the community. Land use plans examine the relationship between land uses and other areas of interest including quality-of-life, transportation, recreation, infrastructure and natural resource protection (Jolley, 2003).

Sediment and Erosion Control Plans are a regulatory approach to reducing the impacts of development and ensure that land disturbing activities do not result in water quality degradation, soil erosion, flooding, or harm to human health (i.e., landslides). The Division of Land Resources (DLR) Land Quality Section (LQS) has the primary responsibility for assuring that erosion is minimized and sedimentation is reduced during construction activities. Under the Sedimentation Pollution Control Act, cities and counties are given the option to adopt local ordinances that meet or exceed the minimum requirements established by the State. Local programs must be reviewed and approved by the NC Sedimentation Control Commission. Once approved, local staff performs plan reviews and enforces compliance. If for some reason the local program is not being enforced, the NC Sedimentation Control Commission can assume administrative control of the local program until the local government assures the State that it can administer and enforce sediment and erosion control rules. The Sedimentation and Pollution Control Act as well as an example of a local ordinance can be found on the DLR website (http://www.dlr.enr.state.nc.us/pages/sedimentation.html).

The requirements outlined in the Sedimentation Pollution Control Act were designed to be implementable statewide and may not fully capture the needs of mountain communities. For example, only projects disturbing more than 1-acre of land are required to produce a sediment and erosion control plan. Many small construction projects fall below this threshold. In steep mountainous terrain, even these small disturbances can produce an astounding volume of sediment runoff. DWQ strongly encourages local governments to adopt Sediment and Erosion Control ordinances that exceed the State's minimum requirements.

5.3.4 Implement Effective Education Programs

North Carolina's natural resources are under stress and could be lost in the absence of a widespread awareness of their existence, their significance and their value. Government officials, business leaders and private citizens must better understand the complexity of the natural ecosystems that support our quality of life and make this state an appealing place to live, work and visit.

These natural resources are not isolated from each other or from the people; each element is part of the ecosystem, interrelated and interconnected. When one part of the system is affected, other parts feel the impact. Sound development decisions require an understanding of these interconnections as well as of the life-support roles played by natural resources.

The cause and effect relationship between human behavior and the environment and the economics of that relationship must be well understood by decision makers - including individuals, business, industry, government, and elected officials - to instill a conservation ethic and a sense of stewardship into the choices facing the state. Such stewardship of land, water, air and biological resources is required to continue to enjoy the existing quality of life and to ensure future improvements.

Environmental policy is often viewed as regulatory in nature. The coercive powers of the state are limited, and no regulatory initiative that presses these limits can long survive. Environmental quality ultimately depends upon the understanding and support of individual and corporate citizens who come to embrace standards and practices that discourage pollution while they prize high quality air, water and soil. This relationship between knowledge of the environment and support for its protection form a basis of public policy development. While the need for education to improve our understanding of ecology and environment is accepted as important, the practice of environment education may take many forms. DWQ encourages implementation of educational programs tailored to specific audiences that invoke the following principles:

1. **Respect and care for the community of life.**
   All things are connected. When something affects one part of the environment, other parts feel the impact. The more we understand and respect our own community, the better we will understand this interconnectedness and our responsibilities to the global community of life.

2. **Improve the quality of human life.**
   The aim of development is to improve the overall quality of human life. Development must enable all people to realize their potential and lead lives of dignity and fulfillment. This kind of development requires a healthy and robust supporting ecosystem.

3. **Conserve North Carolina's vitality and diversity.**
   Renewable natural resources are the base of all economies. Soil, water, air, timber, medicines, plants, fish, wildlife and domesticated species -- all come from natural systems and can be maintained through conservation.
   Life support systems are the ecological processes that shape climate, cleanse air and water, regulate water flow, recycle essential elements, create and regenerate soil and keep our environment fit for life. We must prevent pollution and degradation of these ecosystems as well as the natural plant and wildlife habitats they provide.

Biological diversity includes the total array of species, genetic varieties, habitats and ecosystems on Earth. It contributes to our quality of life, including a healthy economy. It is a foundation of the Earth's biosphere, buffering us from the inevitable changes in the environment.

4. **Change personal understanding and practice.**
   Society must promote values that build and support its ability to continuously improve the quality of living for its citizens. This requires maintaining the quality and integrity of our natural environment. Knowledge, awareness and decision-making skills must be taught through formal and non-formal education to promote problem solving and constructive action to nurture the life-giving qualities of our ecosystem.

5. **Enable communities to care for their own environment.**
   Living within the limits set by the environment depends on the beliefs and commitment of individuals, but it is through communities that people share concerns and promote practices that can nourish rather than cripple their natural life-support systems.

Provide a state and local knowledge base for integrating development and conservation.
Economic policy can be an effective instrument for sustaining ecosystems and natural resources. Every economy depends on the environment as a source of life support and raw materials. The knowledge base for each city, county and the state must be strengthened, and information on environmental matters made more accessible. The State's adult and student populations must understand certain ecological and civics concepts, and North Carolina's place within those concepts.

5.4 The Role of Local Governments

5.4.1 Reduce Impacts from Existing Urbanization

Below is a summary of management actions recommended for local authorities, followed by discussions on large watershed management issues. These actions are necessary to address current sources of impairment and to prevent future degradation in all streams. The intent of these recommendations is to describe the types of actions necessary to improve stream conditions, not to specify particular administrative or institutional mechanisms for implementing remedial practices. Those types of decisions must be made at the local level.

Because of uncertainties regarding how individual remedial actions cumulatively impact stream conditions and in how aquatic organisms will respond to improvements, the intensity of management effort necessary to bring about a particular degree of biological improvement cannot be established in advance. The types of actions needed to improve biological conditions can be identified, but the mix of activities that will be necessary – and the extent of improvement that will be attainable – will only become apparent over time as an adaptive management approach is implemented. Management actions are suggested below to address individual problems, but many of these actions are interrelated (NCDENR-DWQ, 2003).

Actions one through five are important to restoring and sustaining aquatic communities in watersheds, with the first three recommendations being the most important.

(1) **Feasible and cost-effective stormwater retrofit projects should be implemented throughout the watershed to mitigate the hydrologic effects of development** (e.g., increased stormwater volumes and increased frequency and duration of erosive and scouring flows). This should be viewed as a long-term process. Although there are many uncertainties, costs in the range of $1 million per square mile can probably be anticipated.

   (a) Over the short term, currently feasible retrofit projects should be identified and implemented.
   (b) In the long term, additional retrofit opportunities should be implemented in conjunction with infrastructure improvements and redevelopment of existing developed areas.
   (c) Grant funds for these retrofit projects may be available from EPA initiatives, such as EPA Section 319 funds, or the North Carolina Clean Water Management Trust Fund.

(2) **A watershed scale strategy to address toxic inputs should be developed and implemented, including a variety of source reduction and stormwater treatment methods.** As an initial framework for planning toxicity reduction efforts, the following general approach is proposed:

   (a) Implementation of available BMP opportunities for control of stormwater volume and velocities. As recommended above to improve aquatic habitat potential, these BMPs will also remove toxics from stormwater.
   (b) Development of a stormwater and dry weather sampling strategy in order to facilitate the targeting of pollutant removal and source reduction practices.
   (c) Implementation of stormwater treatment BMPs, aimed primarily at pollutant removal, at appropriate locations.
   (d) Development and implementation of a broad set of source reduction activities focused on: reducing non-storm inputs of toxics; reducing pollutants available for runoff during storms; and managing water to reduce storm runoff.

(3) **Stream channel restoration activities should be implemented in target areas, in conjunction with stormwater retrofit BMPs, in order to improve aquatic habitat.** Before beginning stream channel restoration, a geomorphologic survey should be conducted to determine the best areas for stream channel restoration. Additionally, it would be advantageous to implement retrofit BMPs before embarking on stream channel restoration, as restoration is best designed for flows driven by reduced stormwater runoff. Costs of approximately $200 per foot of channel should be anticipated (Haupt, et al., 2002 and Weinkam, 2001). Grant funds for these retrofit projects may be available from federal sources, such as EPA Section 319 funds, or state sources including North Carolina Clean Water Management Trust Fund.

(4) Actions recommended above (e.g., stormwater quantity and quality retrofit BMPs) are likely to reduce nutrient/organic loading, and to some extent, its impacts. Activities recommended to address this loading include the identification and elimination of illicit discharges; education of homeowners, commercial applicators, and others regarding proper fertilizer use; street sweeping; catch basin clean-out practices; and the installation of additional BMPs targeting biological oxygen demand (BOD) and nutrient removal at appropriate sites.

(5) Prevention of further channel erosion and habitat degradation will require effective post-construction stormwater management for all new development in the study area.

(6) Effective enforcement of sediment and erosion control regulations will be essential to the prevention of additional sediment inputs from construction activities. Development of improved erosion and sediment control practices may also be beneficial.

(7) Watershed education programs should be implemented and continued by local governments with the goal of reducing current stream damage and preventing future degradation. At a minimum, the program should include elements to address the following issues:

   (a) Redirecting downspouts to pervious areas rather than routing these flows to driveways or gutters;
   (b) Protecting existing woody riparian areas on all streams;
   (c) Replanting native riparian vegetation on stream channels where such vegetation is absent; and
   (d) Reducing and properly managing pesticide and fertilizer use.

5.4.2 Reduce Impacts of Future Urbanization

Proactive planning efforts at the local level are needed to assure that urbanization is done in a manner that maintains water quality. These planning efforts will need to find a balance between water quality protection, natural resource management, and economic growth. Managing population growth requires planning for the needs of increased population, 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. Public education is also needed in the Hiwassee River basin so that citizens can learn and understand the value of urban planning and stormwater management.

Streams in areas adjacent to high growth areas of the basin are at a high risk of loosing healthy aquatic communities. These biological communities are important to maintaining the ecological integrity in the Hiwassee River basin. Unimpacted streams are important sources of benthic macroinvertebrates and fish for reestablishment of biological communities in nearby streams that are recovering from past impacts or are being restored.

Planning Recommendations for New Development

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

To prevent further impairment to aquatic life in streams in urbanizing watersheds local governments should:

(1) Identify waters that are threatened by construction activities.
(2) Protect existing riparian habitat along streams.
(3) Implement stormwater BMPs during and after construction.
(4) Develop land use plans that minimize disturbance in sensitive areas of watersheds.

(5) Minimize impervious surfaces including roads and parking lots.
(6) Develop public outreach programs to educate citizens about stormwater runoff.
(7) Enact a Stormwater Control Ordinance. EPA offers a model ordinance at: http://www.epa.gov/nps/ordinance/stormwater.htm

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, the Center for Watershed Protection website at www.cwp.org, and the Low Impact Development Center website at www.lowimpactdevelopment.org. For an example of local community planning effort to reduce stormwater runoff, visit http://www.charmeck.org/Home.htm. For more information on stormwater programs across the state, refer to Chapter 6.

5.5 The Role of Homeowners and Landowners

5.5.1 Ten Simple Steps to Reduce Runoff and Pollution from Individual Homes

1. To decrease polluted runoff from paved surfaces, households can develop alternatives to areas traditionally covered by impervious surfaces. Porous pavement materials are available for driveways and sidewalks, and native vegetation and mulch can replace high maintenance grass lawns.
2. Homeowners can use fertilizers sparingly and sweep driveways, sidewalks, and roads instead of using a hose.
3. Instead of disposing of yard waste, use the materials to start a compost pile.
4. Learn to use Integrated Pest Management (IPM) in the garden and on the lawn to reduce dependence on harmful pesticides.
5. Pick up after pets.
6. Use, store, and dispose of chemicals properly.
7. Drivers should check their cars for leaks and recycle their motor oil and antifreeze when these fluids are changed.
8. Drivers can also avoid impacts from car wash runoff (e.g., detergents, grime, etc.) by using car wash facilities that do not generate runoff.
9. Households served by septic systems should have them professionally inspected and pumped every 3 to 5 years. They should also practice water conservation measures to extend the life of their septic systems.
10. Support local government watershed planning efforts and ordinance development.

Chapter 6
Stormwater and Wastewater Programs

6.1 Federal and State Stormwater Programs

The goal of the DWQ stormwater discharge permitting regulations and programs is to prevent pollution from entering the waters of the state via stormwater runoff. These programs try to accomplish this goal by controlling the source(s) of pollutants. These programs include NPDES Phase I and II regulations, HQW/ORW stormwater requirements, and requirements associated with the Water Supply Watershed Program. Currently, there are no individual stormwater permits listed for the Hiwassee River basin and Phase I regulations are not applicable; however, there are a few local governments and/or counties that are affected by other water quality protection programs. Those affected are listed in Table 8.

6.1.1 NPDES Phase I

Phase I of the EPA stormwater program started with Amendments to the Clean Water Act (CWA) in 1990. Phase I required NPDES permit coverage to address stormwater runoff from medium and large stormwater sewer systems serving populations of 100,000 or more people. There are no NPDES Phase I stormwater permits issued in the Hiwassee River basin.

Phase I also had requirements for ten categories of industrial sources to be covered under stormwater permits. 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. Construction sites disturbing greater than five acres are also required to obtain an NPDES stormwater permit under Phase I of the EPA stormwater program. Excluding construction stormwater general permits, there were no general stormwater permits or individual stormwater permits issued in this basin under Phase I.

6.1.2 NPDES Phase II

The Phase II stormwater program is an extension of the Phase I program that expands permit coverage to include smaller municipalities below 100,000 populations. The local governments permitted under Phase II are required to develop and implement a comprehensive stormwater management program that includes six minimum measures.

1. Public education and outreach on stormwater impacts;
2. public involvement/participation;
3. illicit discharge detection and elimination;
4. construction site stormwater runoff control;
5. post-construction stormwater management for new development and redevelopment; and
6. pollution prevention/good housekeeping for municipal operations.

Construction sites greater than one acre will also be required to obtain an NPDES stormwater permit under Phase II of the EPA stormwater program in addition to erosion and sedimentation control approvals.

Those municipalities and counties required to obtain a NPDES stormwater permit under the Phase II rules are identified using 1990 US Census Designated Urban Areas and the results of the 2000 US Census. Based on federal census data, EPA identified 123 cities, including, and 33 counties in North Carolina that would be required to obtain permits for stormwater management.

The EPA delegated Phase II implementation to each state and then in 1999 the Division of Water Quality and the Environmental Management Commission (EMC) initiated a rulemaking process.

Stormwater Management Rule Update:

In 2002, the EMC adopted temporary stormwater rules and by 2003 had adopted permanent rules that were to become effective August 1, 2004. In early 2004, the Rules Review Commission (RRC) objected to the rules for failure to comply with the Administrative Procedures Act and lack of statutory authority. The EMC challenged the decision of the RRC in court (EMC v. RRC 04 CVS 3157). A Wake County Superior Court ruled in the EMC's favor and the RRC subsequently approved the EMC's rules. However, while the case was pending the legislature enacted a separate set of requirements in 2004 that were designed to replace the EMC rules.

These rules include NPDES stormwater rules covering owners and operators of storm sewer systems and State stormwater rules covering activities in urbanizing areas. The EMC amended the rules at their November 10, 2005 meeting to address objections raised by the RRC at their October 2005 meeting. The inconsistency between the legislative requirements and the EMC rules necessitated consideration of Senate Bill 1566 in the 2006 short session. The legislature approved Session Law 2006-246, Senate Bill 1566 in 2006.

Senate bill 1566 provides that development projects in Phase II municipalities and counties that cumulatively disturb one acre or more of land must comply with the post-construction stormwater standards set out in the bill. The bill sets out criteria whereby unincorporated areas of counties will be subject to Phase II requirements. Under these criteria 25 counties are fully covered, while 8 counties have portions that are subject to the stormwater requirements. The bill also provides a designation and petition process by which additional local governments and other entities may be required to obtain a stormwater management permit.

The bill sets out stormwater controls that are based on a project's level of density and its proximity to Shellfish Resource Waters. Shellfish Resource Waters are waters classified by the EMC as Class SA waters (shellfish growing waters) that contain an average concentration of 500 parts per million of natural chloride ion (saltwater).

The Water Quality Committee (WQC) met in November 2006 and directed DWQ Staff to return at the January 2007 WQC meeting with proposed amendments to the State Stormwater Rules. These rules will extend the coastal post-construction stormwater controls in Session Law 2006-246 to all 20 Coastal Counties (Table 8).

Low Density Projects

Development projects that are located within one-half mile of and draining to Shellfish Resource Waters are considered low density if they contain no more than 12 percent built-upon area. A project that is not located within one-half mile of Shellfish Resource Waters is a low density project if it contains no more than 24 percent built-upon area or no more than two dwelling units per acre. Low density projects must use vegetated conveyances to the maximum extent practicable to transport stormwater runoff from the project.

High Density Projects

Projects that are located within one-half mile of and draining to Shellfish Resource Waters are considered high density if they contain more than 12 percent built-upon area. A project that is not located within one-half mile of Shellfish Resource Waters is a high density project if it contains more than 24 percent built-upon area or more than two dwelling units per acre. High density projects must use structural stormwater management systems that will control and treat runoff from the first one inch of rain unless the project is in a coastal county, in which case the project must use structural stormwater management systems that will control and treat runoff from the first one and one-half inches of rain. In addition, projects that are located within one-half mile and draining to Shellfish Resource Waters must control and treat the difference in the stormwater runoff from the pre-development and post-development conditions for the one-year twenty-four hour storm as well as meet certain design standards.

Implementation

The bill provides an implementation schedule that requires regulated entities to apply for an NPDES stormwater management permit within 18 months of being notified that it is a regulated entity subject to the requirements of this act. A regulated entity must implement its post-construction program no later than 24 months from the date the permit is issued and fully implement its permitted program within five years of permit issuance. City of Jacksonville and Onslow County have both submitted applications for Phase II.

The bill authorizes the EMC to adopt Phase II stormwater management rules. If the EMC does adopt rules, the rules must be substantially identical to the provisions of this act and will be automatically subject to review by the General Assembly and not subject to review by the RRC. The bill became effective retroactively to July 1, 2006.

Table 8 Major Post-Construction Stormwater Controls in SL 2006-246

	Shellfish Resource Waters* (SA Waters w/ > 500 ppm chlorides)	**SA Designated Waters – Not Shellfish Resource Waters***	**Coastal County – Not SA Designated Waters**	**Non – Coastal County**
Low Density Threshold	12%	24%	24%	24%
Storm Design for High Density	Difference in pre and post-development for 1-yr, 24-hour storm**	Runoff from first 1.5 inches of rain	Runoff from first 1.5 inches of rain	Runoff from first 1 inch of rain
Setback	30 feet	30 feet	30 feet	30 feet
Other Controls	No new points of s/w discharge No increase in rate, volume, or capacity in existing conveyances Infiltration up to 1-yr, 24-hr storm Diffuse flow in excess of 1-yr, 24-hr storm	No new points of s/w discharge No increase in rate, volume, or capacity in existing conveyances Infiltration up to 1-yr, 24-hr storm Diffuse flow in excess of 1-yr, 24-hr storm		

*These controls apply within ½ mile and draining to these waters.

**Amount of Runoff that would need to be controlled in inches for the difference in pre- and post-development conditions for the 1-year, 24-hour storm.

For additional information on stormwater programs please go to http://h2o.enr.state.nc.us/su/

2007 Recommendations

Even though none of the municipalities were identified as federally designated urban areas, DWQ recommends that the local governments and county officials develop stormwater management programs that go beyond the six minimum measures listed for Phase II rules. Implementation of stormwater programs should help reduce future impacts to streams in the basin. Local governments, to the extent possible, should identify sites for preservation or restoration. DWQ and other NCDENR agencies will continue to provide information on funding sources and technical assistance to support local government and county stormwater programs.

6.1.3 State Stormwater Programs – Sensitive Waters

The State Stormwater Management Program was established in the late 1980s under the authority of the North Carolina Environmental Management Commission (EMC) and North Carolina General Statute 143-214.7. This program, codified in 15A NCAC 2H .1000, affects development activities that require either an Erosion and Sediment Control Plan (for disturbances of one or more acres) or a CAMA major permit within one of the 20 coastal counties and/or development draining to Outstanding Resource Waters (ORW) or High Quality Waters (HQW). The State Stormwater Management Program requires developments to protect these sensitive waters by maintaining a low density of impervious surfaces, maintaining vegetative buffers, and transporting runoff through vegetative conveyances. Low density development thresholds vary from 12-30 percent built-upon area (impervious surface) depending on the classification of the receiving stream. If low density design criteria cannot be met, then high density development requires the installation of structural best management practices (BMPs) to collect and treat stormwater runoff from the project. High density BMPs must control the runoff from the 1 or 1.5-inch storm event (depending on the receiving stream classification) and remove 85 percent of the total suspended solids.

Table 9 shows the counties in the Hiwassee River basin where permits may be required under the state stormwater management program under ORW stormwater rules. All development requiring an Erosion and Sediment Control Plan (for disturbances of one or more acres) must obtain a stormwater permit.

2007 Recommendations

DWQ will continue implementing the state stormwater program with the other NCDENR agencies and local governments. Local governments should develop local land use plans that minimize impervious surfaces in sensitive areas. Communities should integrate state stormwater program requirements, to the extent possible, with other stormwater programs in order to be more efficient and gain the most water quality benefits for protection of public health and aquatic life.

Table 9 Communities in the Hiwassee River Subject to Stormwater and/or Water Supply Watershed Stormwater Requirements

Local Government	NPDES		State Stormwater Program	Water Supply Watershed Stormwater Requirements
	Phase I	Phase II*		
Municipalities				
Andrews				
Hayesville				**X**
Murphy				
Counties				
Cherokee			**X**	**X**
Clay			**X**	**X**

6.1.4 Water Supply Watershed Stormwater Rules

The purpose of the Water Supply Watershed Protection Program is to provide a proactive drinking water supply protection program for communities. Local governments administer the program based on state minimum requirements. There are restrictions on wastewater discharges, development, landfills, and residual application sites to control the impacts of point and nonpoint sources of pollution. The program attempts to minimize the impacts of stormwater runoff by utilizing low-density development or stormwater treatment in high-density areas.

2007 Recommendations

DWQ recommends implementation of local water supply watershed protection ordinances to ensure safe and economical treatment of drinking water. Communities should also integrate water supply watershed protection ordinances with other stormwater programs, to the extent possible, in order to be more efficient and gain the most water quality benefits for both drinking water and aquatic life.

6.2 Federal and State Wastewater Programs

6.2.1 NPDES Wastewater Discharge Permit Summary

The primary pollutants associated with point source discharges are:

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

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

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

Types of Wastewater Discharges

Major Facilities: Wastewater treatment plants with flows ≥1 MGD (million gallons per day); and some industrial facilities (depending on flow and potential impacts to public health and water quality).

Minor Facilities: Facilities not defined as Major.

100% Domestic Waste: Facilities that only treat domestic-type waste (from toilets, sinks, washers).

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

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

Currently, there are 9 permitted wastewater discharges in the Hiwassee River basin. Table 10 provides summary information (by type and subbasin) about the discharges. The types of dischargers listed in the table are described in the inset box. Facilities are mapped in each subbasin chapter, and a complete listing of permitted facilities is included in Appendix V.

The majority of NPDES permitted wastewater flow into the waters of the Hiwassee River basin is from three municipal wastewater treatment plants (WWTP). Two nonmunicipal discharge permits are held by the Tennessee Valley Authority for the Chatuge and Hiwassee Hydro Plants. Facilities, large or small, where recent data show problems with a discharge are discussed in each subbasin chapter (Chapters 1-2).

Table 10 Summary of NPDES Dischargers and Permitted Flows for the Hiwassee River Basin

	Hiwassee River Subbasins		
Facility Categories	**04-05-01**	**04-05-02**	**TOTAL**
Total Facilities	3	6	9
Total Permitted Flow (MGD)	0.31	3.0	3.31
Facilities Grouped by Size			
Major Discharges	0	2	2
Permitted Flow (MGD)	0.00	2.90	2.90
Minor Discharges	3	4	7
Permitted Flow (MGD)	0.31	0.09	0.40
Facilities Grouped by Type			
100% Domestic Waste	1	2	3
Permitted Flow (MGD)	0.013	0.090	0.103
Municipal Facilities	1	3	4
Permitted Flow (MGD)	0.30	2.90	3.20
Nonmunicipal Facilities	1	1	2
Permitted Flow (MGD)	0.00	0.00	0.00

6.2.2 Septic Systems and Straight Piping

In the Hiwassee River basin, wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Instead, it is treated on-site through the use of permitted septic systems. Wastewater from some of these homes illegally discharges directly to streams through what is known as a "straight pipe". In other cases, wastewater from failing septic systems makes its way to streams or contaminates groundwater. Straight piping and failing septic systems are illegal discharges of wastewater into waters of the State.

With on-site septic systems, the septic tank unit treats some wastes, and the drainfield associated with the septic tank provides further treatment and filtration of the pollutants and pathogens found in wastewater. A septic system that is operating properly does not discharge untreated wastewater to streams and lakes or to the ground's surface where it can run into nearby surface waters. Septic systems are a safe and effective long-term 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 ensure they function properly over the life of the system. Information about the proper installation and maintenance of septic tanks can be obtained by calling the environmental health sections of the local county health departments. See Appendix VII for contact information.

The discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Pollutants from illegally discharged household wastewater contain chemical nutrients, disease pathogens and endocrine disrupting chemicals. Although DWQ ambient monitoring of the waters in the Hiwassee River basin show a relatively small percentage of fecal coliform bacteria samples exceeding state standards for primary recreation, smaller streams may contain a higher concentration of bacteria and other pollutants. The economies of the counties in this basin are highly dependent upon lake recreation, especially for tourists and seasonal residents.

In order to protect human health and maintain water quality, straight pipes must be eliminated and failing septic systems should be repaired. The NC Wastewater Discharge Elimination (WaDE) Program is actively helping to identify and remove straight pipes (and failing septic systems) in the western portion of North Carolina. This program uses door-to-door surveys to locate straight pipes and failing septic systems, and offers deferred loans or grants to homeowners who have to eliminate the straight pipes by installing a septic system.

2007 Recommendations

The WaDE Program in collaboration with the Local Health Departments should request additional funding from the CWMTF (Chapter 11) and Section 319 Program (Chapter 11) to expand the straight pipe elimination program in 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 Section (OSWW), NC Division of Environmental Health, toll free at 1-866-223-5718 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 has developed 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. 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.

Chapter 7
Agriculture and Water Quality

7.1 Animal Operations

In 1992, the Environmental Management Commission (EMC) 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.

Key Animal Operation Legislation (1995-2003)

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

1996 Senate Bill 1217 required all facilities (above threshold populations) to obtain coverage under a general permit, beginning in January 1997, for all new and expanding facilities. DWQ was directed to conduct annual inspections of all animal waste management facilities. Poultry facilities with 30,000+ birds and a liquid waste management system were required to hire a certified operator by January 1997 and facilities with dry litter animal waste management systems were required to develop an animal waste management plan by January 1998. The plan must address three specific items: 1) periodic testing of soils where waste is applied; 2) development of waste utilization plans; and 3) completion and maintenance of records on-site for three years. Additionally, anyone wishing to construct a new, or expand an existing, swine farm must notify all adjoining property owners.

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

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

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

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

2001 House Bill 1216 extended (again) the moratorium on new construction or expansion of swine farms.

Table 11 summarizes (by subbasin) the number of registered livestock operations, total number of animals, number of facilities, and total steady state live weight (SSLW). These numbers reflect only operations required by law to be registered, and therefore, do not represent the total number of animals in each subbasin. No violations or problems have been reported for any of the registered animal operations in the Hiwassee River basin.

Table 11 Registered Animal Operations in the Hiwassee River Basin (March 2006)

Subbasin	Cattle			Poultry			Swine		
	No. of Facilities	No. of Animals	Total Steady State Live Weight*	No. of Facilities	No. of Animals	Total Steady State Live Weight*	No. of Facilities	No. of Animals	Total Steady State Live Weight*
04-05-01	14	1,317	1,382,400	0	0	0	0	0	0
04-05-02	6	835	977,000	1	1,050,000	4,200,000	1	60	85,020
Totals	**20**	**2,152**	**2,359,400**	**1**	**1,050,000**	**4,200,000**	**1**	**60**	**85,020**

* Steady State Live Weight (SSLW) is in pounds, after a conversion factor has been applied to the number of swine, cattle or poultry on a farm. Conversion factors come from the US Department of Agriculture, Natural Resource Conservation Service (NRCS) guidelines. Since the amount of waste produced varies by hog size, this is the best way to compare the sizes of the farms.

7.2 Impacted Streams in Agricultural Areas

In the Hiwassee River basin, the majority of agricultural land is pasture. There is also some row cropping. Impacts to streams from agricultural activities can include excessive nutrient loading, pesticide and herbicide contamination, bacterial contamination, and sedimentation.

Based on the most recent information from the USDA Natural Resources Conservation Service (NRCS) National Resources Inventory (NRI), most of the agricultural land use in the Hiwassee River basin has decreased from the year 1982 to 1997. Cultivated and uncultivated cropland decreased by 78.6 percent (6,600 acres) and 17.4 percent (400 acres), respectively. Pasture use increased by 21.7 percent (4,800 acres). This same data also shows that urban and built-up areas increased by 100.8 percent (12,200 acres) (USDA-NRCS, 2001). Refer to Appendix III for more information related to land use changes in the Hiwassee River basin.

2007 Recommendations

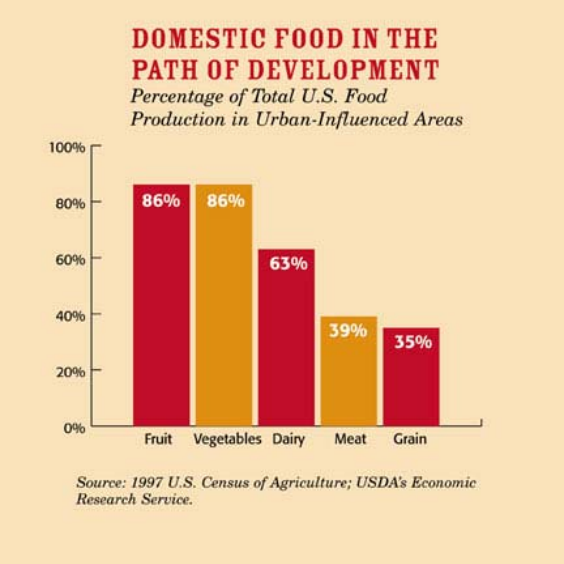
DWQ will identify streams where agricultural land use may be impacting water quality and aquatic habitat. Local Soil and Water Conservation District (SWCD) and NRCS staff should investigate these streams to assess agricultural impacts and recommend best management practices (BMPs) to reduce the impacts. DWQ recommends that funding and technical support for agricultural BMPs continue and increase. Refer to Appendix VII for agricultural nonpoint source agency contact information.

7.3 Working Land Conservation Benefits

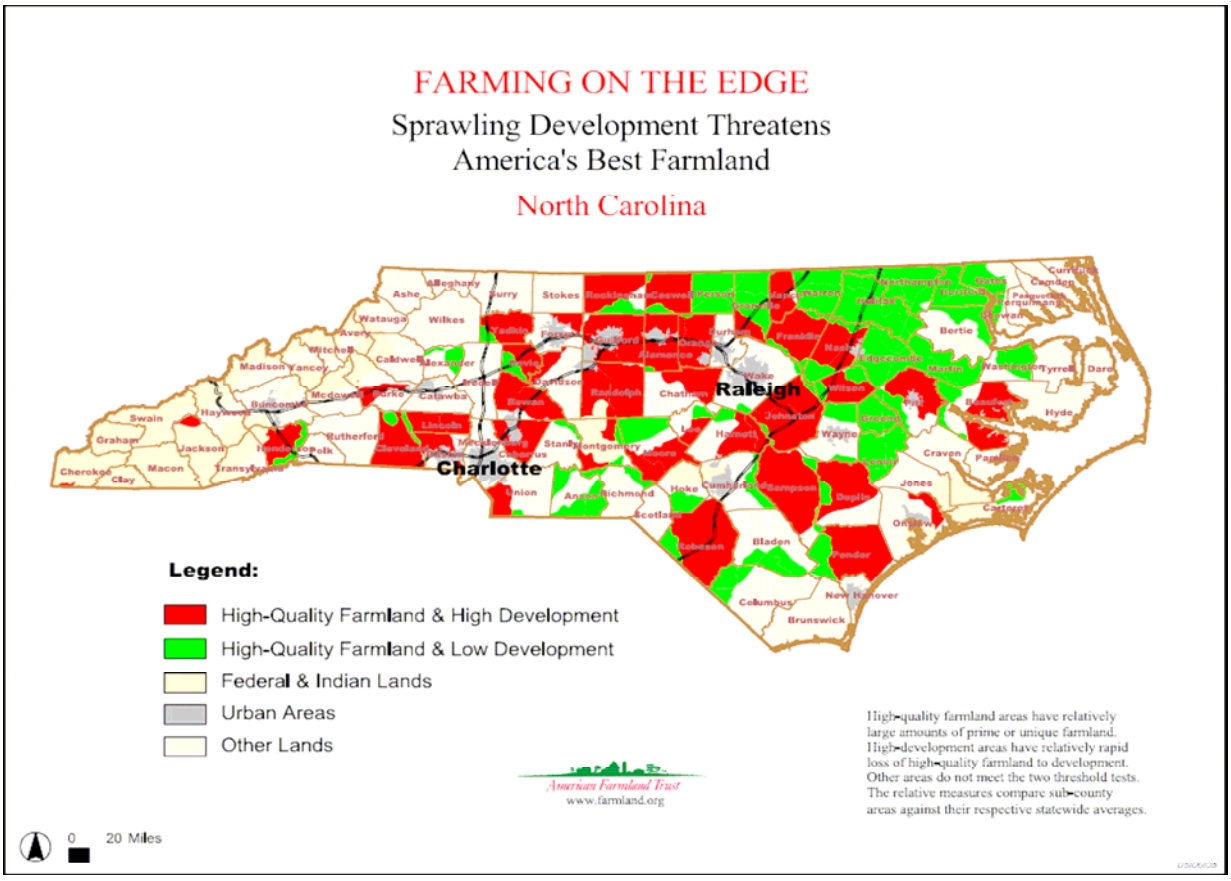
Working Lands are those used for agriculture, forestry or other natural resource industries. Well-managed working lands provide important non-market goods and services. For example, farms, ranches, and forestlands provide food and cover for wildlife, help control flooding, protect

wetlands and watersheds, and maintain air quality. They can absorb and filter wastewater, runoff, and provide groundwater recharge.

Rapid urbanization is forcing the conversion of working land to developed land at an astonishing rate in North Carolina. From1992-1997, over 170,000 acres of agricultural land was converted to developed land. That was the 12th highest rate in the nation. The figures for Prime Farmland, the best land for growing crops, are even more disturbing. North Carolina is losing prime farmland at the fourth fastest rate in the nation (USDA, 2001). The 1997 U.S. Census of Agriculture shows that a large percentage of cropland is in urban-influenced areas, making them prime targets for development. It is well established that developed land negatively impacts water quality (See Section 5.1). Therefore, preserving North Carolina's working lands should be a priority.



The value of specific working lands can be calculated for any watershed by performing a Cost of Community Services (COCS) study. COCS studies are a case study approach used to determine a community's public service costs versus revenues based on current land use. Their particular niche is to evaluate the overall contribution of agricultural and other open lands on equal ground



with residential, commercial and industrial development.

As of January 2002, 83 COCS studies conducted in 19 states found that tax and other revenues collected from farm, ranch and forest landowners more than covered the public service costs these lands incur. COCS studies show that on average, residential development generates significant tax revenue but requires costly public services that typically are subsidized by revenues from commercial and industrial land uses. The special contribution of COCS studies is that they show that farm, ranch, and forestlands are important commercial land uses that help balance community budgets. Working lands are not just vacant land waiting to be developed (Freedgood and others, 2002).

A recent analysis of the fiscal impact of different land uses in Macon County, NC demonstrates the cost-saving benefits to the county of maintaining farmland and open space. Using county budget data and tax data from fiscal year 2000, the study indicates that typical residential and commercial properties cost the county budget by demanding more in tax-supported services than they contribute in property tax revenues. Such services include schools, roads, water and sewer lines, fire and police protection, and social and administrative services. On the other hand, the typical farmland/open-space parcel contributed more property tax to the county budget than it demanded in expenditures for county services. Analyzing a scenario of a 30-acre parcel of farmland/open-space, the study estimated that the county budget would gain $290 if the land remained as farmland, but would lose a net $532 if converted to ten 3-acre lots with houses on them (Jones and Kask, 2001).

The opportunities for private landowners to protect working lands are growing. North Carolina cities and counties have now begun to use the new set of farmland protection tools authorized by the General Assembly in 2005 through Session Law 2005-390. Along with an expanded definition of agriculture and a revamped Agricultural Development and Farmland Preservation Trust Fund, this legislation authorized a new category for localities to promote the stability of their agricultural sectors. Counties and municipalities now have the authority to create an Enhanced Voluntary Agricultural District (EVAD) option, which offers an increased set of incentives for landowners to restrict development over a ten-year period. Polk County in the mountains and Wentworth in the Piedmont are amongst the first jurisdictions in the state to utilize this new tool, with the recent adoption of local EVAD ordinances. Landowners interested in working land protection should contact their local land trust; NRCS field representative, or Soil and Water Conservation District. The Farmland Information Center is also an excellent online resource: http://www.farmlandinfo.org/. Local government officials interested in the value of working land conservation should visit the Land Trust Alliance's Economic Benefits of Open Space Protection web page at: http://www.lta.org/resources/economic_benefits.htm.

7.4 Agricultural Best Management Practices and Funding Opportunities

7.4.1 USDA – NRCS Environmental Quality Improvement Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides assistance to farmers and ranchers who face threats to soil, water, air, and related natural resources on their land. Through EQIP, the Natural Resources Conservation Service (NRCS) provides assistance to agricultural producers in a manner that will promote agricultural production and environmental quality as compatible goals, optimize environmental benefits, and help farmers and ranchers meet Federal, State, Tribal, and local environmental requirements.

The 2002 Farm Bill reauthorized national EQIP funding at $6.16 billion over the six-year period of FY 2002 through FY 2007. Program priorities are as follows:

- Reduction of nonpoint source pollution including nutrients, sediment, pesticides, and excess salinity in impaired watersheds consistent with TMDLs where available; reduction of groundwater contamination; reduction of point source pollution including contamination from confined animal feeding operations
- Conservation of ground and surface water resources
- Reduction of emissions including particulate matter, nitrogen oxides (NOx), volatile organic compounds, and ozone precursors and depleters that contribute to air quality impairment violations of National Ambient Air Quality Standards
- Reduction in soil erosion and sedimentation from unacceptable levels on agricultural land
- Promotion of at-risk species habitat conservation.

EQIP offers contracts with a minimum term that ends one year after the implementation of the last scheduled practices and a maximum term of ten years. These contracts provide incentive payments and cost-shares to implement conservation practices. Persons who are engaged in livestock or agricultural production on eligible land may participate in the EQIP program. EQIP activities are carried out according to an environmental quality incentives program plan of operations developed in conjunction with the producer that identifies the appropriate conservation practice or practices to address the resource concerns. The practices are subject to NRCS technical standards adapted for local conditions. The local conservation district approves the plan.

North Carolina EQIP Funding 2000-2005

2000:	$1.1 Million
2001:	$3.5 Million
2002:	$7.1 Million
2003:	$10.0 Million
2004:	$13.2 Million
2005:	$14.3 Million

EQIP may cost-share up to 75 percent of the costs of certain conservation practices. Incentive payments may be provided for up to three years to encourage producers to carry out management practices they may not otherwise use without the incentive. However, limited resource producers and beginning farmers and ranchers may be eligible for cost-shares up to 90 percent. Farmers and ranchers may elect to use a certified third-party provider for technical assistance. An individual or entity may not receive, directly or indirectly, cost-share or incentive payments that, in the aggregate, exceed $450,000 for all EQIP contracts entered during the term of the Farm Bill.

NRCS district contacts for the Hiwassee River basin are provided in Appendix VII, and EQIP signup information can be found on NRCS website at http://www.nc.nrcs.usda.gov/programs/EQIP/index.html.

7.4.2 NC Agriculture Cost Share Program

The NC Agricultural Cost Share Program (NCACSP) was established in 1984 to help reduce agricultural nonpoint runoff into the state's waters. The program helps owners and renters of established agricultural operations improve their on-farm management by using best

management practices. 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 NCACSP is implemented by the Division of Soil and Water (DSWC), which divides the approved BMPs into five main purposes or categories.

- *Erosion Reduction/Nutrient Loss Reduction in Fields*
  Erosion/nutrient management measures include planned systems for reducing soil erosion and nutrient runoff from cropland into streams to improve water quality. Practices include: critical area planting, cropland conversion, water diversion, long-term no-till, pastureland conversion, sod-based rotation, stripcropping, terraces, and Christmas tree conservation cover.

- *Sediment/Nutrient Delivery Reduction from Fields*
  Sediment/nutrient management measures include planned systems that prevent sediment and nutrient runoff from fields into streams. Practices include: field borders, filter strips, grassed waterways, nutrient management strategies, riparian buffers, water control structures, streambank stabilization, and road repair/stabilization.

- *Stream Protection from Animals*
  Stream protection management measures are planned systems for protecting streams and streambanks. Such measures eliminate livestock access to streams by providing an alternate watering source away from the stream itself. Other benefits include reduced soil erosion, sedimentation, pathogen contamination, and pollution from dissolved, particulate, and sediment-attached substances. Practices include: heavy use area protection, livestock exclusion (i.e., fencing), spring development, stream crossings, trough or watering tanks, wells, and livestock feeding areas.

- *Proper Animal Waste Management*
  A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled livestock lounging area, dry manure stacks, heavy use area protection, insect and odor control, stormwater management, waste storage ponds/lagoons, compost, and waste application system.

- *Agricultural Chemical (agrichemical) Pollution Prevention*
  Agrichemical pollution prevention measures involve a planned system to prevent chemical runoff to streams for water quality improvement. Practices include: agrichemical handling facilities and fertigation/chemigation back flow prevention systems.

The NCACSP 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 BMP is completed, inspected and certified to be installed according to NCACSP standards. The annual statewide budget for BMP cost sharing is approximately $6.9 million. Table 12 summaries the cost and total BMPs implemented (i.e., acres, units, and linear feet) throughout the Hiwassee River basin.

County Soil and Water Conservation District (SWCD) contacts for the Hiwassee River basin are included in Appendix VII. BMP definitions and DSWC contact information can be found online at www.enr.state.nc.us/DSWC/pages/agcostshareprogram.html.

Table 12 Summary of NCACSP projects in the Hiwassee River Basin (1998 to 2003)

Purpose of BMP	Subbasin 04-05-01		Subbasin 04-05-02	
	Total Implemented	Cost	Total Implemented	Cost
Erosion Reduction/Nutrient Loss Reduction in Fields	3 acres	$7,611	17.6 acres 145 linear ft.	$3,654 $268
Sediment/Nutrient Delivery Reduction from Fields	0.2 acres 2,570 linear ft.	$5,123 $62,118	0.3 acres 100 linear ft.	$489 $1,015
Stream Protection from Animals	277.2 units 62,550 linear ft.	$301,178 $69,234	621.1 units 51,559 linear ft	$194,107 $59,864
Proper Animal Waste Management	1 unit	$15,000		
Agricultural Chemical Pollution Prevention				
Total Costs		$460,264		$259,397

Benefits*	Subbasin 04-04-01	Subbasin 04-04-02
Total Soil Saved (tons)	961.38	823.00
Total Nitrogen (N) Saved (lb.)	148.00	443.50
Total Phosphorus (P) Saved (lb.)	21.25	31.00
Total Waste-N Saved (lb.)		
Total Waste-P Saved (lb.)		

* The North Carolina Agricultural Nutrient Assessment Tool (NCANAT) contains two field-scale assessment tools: the Nitrogen Loss Estimation Worksheet (NLEW) and the Phosphorus Loss Assessment Tool (PLAT). NCANAT is a product of the cooperative effort between the NC State University, NC Department of Agriculture & Consumer Services, USDA-NRCS and the NCDENR. The tool consists of a function that allows comparisons to be made before and after BMPs are installed. Gains and losses of nitrogen, phosphorus, and sediment due to BMP implementation can be computed. The DSWC has adopted this program to calculate these losses for the NCACSP reporting requirements.

Chapter 8
Forestry in the Hiwassee River Basin

8.1 Forestland Ownership and Resources

Approximately 50 percent of forestland in the Hiwassee River basin is publicly owned, and primarily consists of the Nantahala National Forest. Most of the remaining balance of forestland is privately owned by individuals. This ownership estimate comes from the most recent data published by the USDA-Forest Service *Forest Statistics for North Carolina, 2002.* (Brown, Mark J. Southern Research Station Resource Bulletin SRS-88. January 2004).

8.1.1 Forest Management

At least 1,300 acres of land were established or regenerated with forest trees across the basin from September 1, 1999 through August 31, 2004. During this same time period the Division of Forest Resources (DFR) provided nearly 300 individual forest plans for landowners that encompassed 13,500 acres in the basin. For more information on forest management, visit the website at www.dfr.state.nc.us.

8.2 Forestry Water Quality Regulations in North Carolina

8.2.1 Forest Practice Guidelines (FPG) for Water Quality

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (G.S. Ch.113A Art.4 referred to as "SPCA"). However, forestry operations may be exempted from the permit and plan requirements of the SPCA, if the operations meet the compliance standards outlined in the *Forest Practices Guidelines Related to Water Quality* (15A NCAC 1I .0101 - .0209, referred to as "FPGs") and General Statutes regarding stream obstruction (G.S.77-13 & G.S.77-14).

The North Carolina Division of Forest Resources (DFR) is delegated the authority to monitor and evaluate forestry operations for compliance with these aforementioned laws and/or rules. In addition, the DFR works to resolve identified FPG compliance questions brought to its attention through citizen complaints. Violations of the FPG performance standards that cannot be resolved by the DFR are referred to the appropriate State agency for enforcement action.

During the period September 1, 1999 through August 31, 2004 the Division of Forest Resources conducted 213 FPG inspections of forestry-related activities in the Hiwassee basin; 90 percent of the sites inspected were in compliance.

8.2.2 Other Forestry Related Water Quality Regulations

In addition to the State regulations noted above, DFR monitors the implementation of the following Federal rules relating to water quality and forestry operations:

- The Section 404 silviculture exemption under the Clean Water Act
- The federally-mandated 15 Best Management Practices (BMPs) related to road construction in wetlands

- The federally-mandated BMPs for mechanical site preparation activities for the establishment of pine plantations in wetlands of the southeastern U.S.

8.2.3 Water Quality Foresters

While the DFR currently has a Water Quality Forester located in ten of the DFRs thirteen Districts across the State, there are none assigned within the Hiwassee basin. However, the forester staff based in the DFRs Sylva District Office and Asheville Regional Office address water quality issues related to forestry as time permits, while also handling wildfire suppression and forest management duties. Contact information for each district and/or county can be found on DFRs website at www.dfr.state.nc.us and in Appendix VII.

8.2.4 Forestry Best Management Practices (BMPs)

Implementing Forestry Best Management Practices is strongly encouraged by the Division of Forest Resources in order to efficiently and effectively protect the water resources of North Carolina. During this reporting period, the DFR recorded over 300 instances across 13,000 acres in which BMPs were either noted in use or had been recommended. The Forestry Best Management Practices Manual describes recommended techniques that should be used to help comply with the State's forestry laws and help protect water quality. This manual is currently undergoing its first revision since adoption in 1989. This revision, led by the DENR-appointed Technical Advisory Committee (TAC) has undertaken four years of effort.

To further assess BMPs, the DFR conducted a detailed, statewide BMP Implementation Survey from March 2000 through March 2003 to evaluate Forestry BMPs on *active* harvest operations. This survey evaluated 12 harvest sites in the Hiwassee basin, with a resulting BMP implementation rate of 66 percent, which falls in the lower quartile of implementation across the state. The problems most often cited in this survey relate to stream crossings, skid trails, and site rehabilitation. This survey, and additional surveys to be conducted, will serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP implementation and training.

8.2.5 Bridgemats

DFR has been providing bridgemats on loan out to loggers for establishing temporary stream crossings during harvest activities. Temporary bridges are usually the best solution for stream crossings, instead of culverts or hard-surfaced 'ford' crossings. Wooden timber bridgemats have been available for use in the basin for nearly seven years, and are available upon request from the Sylva District Office. In 2005, six new 25-foot wooden bridgemats were assigned to the Sylva District; these mats were acquired with USEPA 319-Grant funds, allowing DFR to continue this successful program. More information about using bridgemats, and the above noted BMP survey, is available on the 'Water Quality' section of the DFR's Web site http://www.dfr.state.nc.us./.

8.2.6 Protection from Wildfires

The "Firewise Communities" program is a national, multi-agency effort designed to reach homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of wildfires, before a fire starts. The Firewise

Communities program offers a series of practical steps that individuals and communities can take to minimize wildfire risks. The Firewise approach emphasizes community responsibility for planning in the design of a safe community as well as effective emergency response, and individual responsibility for safer home construction and design, landscaping, and maintenance. In North Carolina, the most susceptible areas for wildfires in which homes and woodlands co-exist are in the mountains and areas of the coast.

Some examples of Firewise practices include:

- Maintaining a 'defensible perimeter' around homes and structures by controlling vegetation growth
- Removing so-called 'ladder fuels' from around structures, that may allow a small fire on the ground to move upwards, and into the structure
- Constructing access roads and driveways in a way that will allow access by fire trucks and other heavy emergency response vehicles.

More information is available on the North Carolina Firewise Web site http://www.ncfirewise.org/ and the national Web site www.firewise.org.

8.2.7 Forestry Accomplishments

Since the previous basinwide plan was produced, the DFR accomplished the following tasks in an ongoing effort to improve compliance with forest regulations and, in turn, minimize nonpoint source (NPS) pollution from forestry activities:

- Replaced worn-out wood timber bridgemats in the Sylva District with new mats available for use throughout the basin.
- Established a Forestry NPS Unit that develops and oversees projects throughout the state that involves protection, restoration and education on forestry NPS issues.
- Revised and produced 10,000 copies of a pocket field guide outlining the requirements of the FPGs and suggested BMPs to implement.
- Created and published 15,000 copies of a new brochure "Call Before You Cut" for landowners promoting pre-harvest planning to insure water quality issues are addressed prior to undertaking timber harvesting.
- Continued to assist with workshops in cooperation with the N.C. Forestry Association's "ProLogger" logger training program.
- DFR continues its efforts to protect water quality through various protection, restoration, and education projects. This includes research projects, on-site demonstrations, and integration of NPS topics through the DFR's network of Educational State Forests and State Forests. Progress reports and summaries are posted in the 'Water Quality' section of the DFR's Web site http://www.dfr.state.nc.us./ as they are completed.

Chapter 9
Water Resources

9.1 River Basin Hydrologic Units

Under the federal system, the Hiwassee River basin is made up of hydrologic areas referred to as cataloging units (USGS 8-digit hydrologic units). Cataloging units are further divided into smaller watershed units (14-digit hydrologic units or local watersheds) that are used for smaller scale planning like that done by NCEEP (Chapter 11). There are 22 local watershed units in the basin, all of which are listed in Table 13.

Table 13 Hydrologic Subdivisions in the Hiwassee River Basin

Watershed Name and Major Tributaries	DWQ Subbasin 6-Digit Codes	USGS 8-Digit Hydrologic Units	USGS 14-Digit Hydrologic Units Local Watersheds*
Hiwassee River	04-05-01 and 04-05-02	06020002	050010, 050020, 060010, 070010, 071010,
Chatuge Lake	04-05-01		090010, 100050, 090020, 100010, 100020,
Hiwassee Lake, Apalachia Lake	04-05-02		100030, 100040, 110010, 170010, 170020,
Valley River, Nottely River	04-05-02		170030, 180010, 180020, 180030, 210010
Ocoee Drainage	04-05-02	06020003	030010, 100010

- Numbers from the 8-digit and 14-digit column make the full 14-digit HU.

9.2 Minimum Streamflow

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. One of the purposes of the Dam Safety Law is to ensure maintenance of minimum streamflows below dams. The Division of Water Resources (DWR), in conjunction with the Wildlife Resources Commission (WRC), recommends conditions related to release of flows to satisfy minimum instream flow requirements. The Division of Land Resources (DLR) issues the permits.

Under the authority of the Federal Power Act, the Federal Energy Regulatory Commission (FERC) licenses all non-federal dams located on the navigable waters in the United States that produce hydropower for the purposes of interstate commerce. The license may include requirements for flows from the project for designated in-stream or off-stream uses.

Under the authority of Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers issues permits for the discharge of fill material into navigable waters. The permit may include requirements for flows for designated in-stream or off-stream uses. A 404 permit will not only apply to dams under state and federal regulatory authorities mentioned above, but will also cover structures that are not under their authority, such as weirs, diversions, and small dams. Table 14 presents minimum streamflow projects in the Hiwassee River basin.

Table 14 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	189	83
Mission Dam	Clay County near the Clay/Cherokee county line	Hiwassee River	292	280
Hiwassee Dam	Cherokee County NW of Murphy below Beaverdam Cr.	Hiwassee River	968	
Apalachia Dam	Near the NC/TN state line	Hiwassee River	1,018	
Nottely dam	In Georgia near the NC/GA state line	Nottely River	215	50

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. Also, persons wishing to transfer more than the minimum transfer quantity allowed by the Interbasin Transfer (IBT) law (usually 2 MGD) 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, and included as part G.S. 143-215.22G of the law. 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 must outweigh the potential impacts. Factors used to determine whether a certificate should be issued include:

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

A provision of the interbasin transfer law requires that an environmental assessment or environmental impact statement be prepared in accordance with the State Environmental Policy Act as support documentation for a transfer petition. Currently, there are no certified or known potential interbasin transfers in the Hiwassee River basin. For more information on interbasin transfers, visit the website at http://www.ncwater.org/or call DWR at (919) 733-4064.

9.4 Water Quality Issues Related to Drought

Water quality problems associated with rainfall events usually involve degradation of aquatic habitats because the high flows may carry increased loadings of substances like metals, oils, herbicides, pesticides, sand, clay, organic material, bacteria and nutrients. These substances can be toxic to aquatic life (fish and insects) or may result in oxygen depletion or sedimentation. During drought conditions, these pollutants become more concentrated in streams due to reduced flow. Summer months are generally the most critical months for water quality. Dissolved oxygen is naturally lower due to higher temperatures, algae grow more due to longer periods of sunlight, and streamflows are reduced. In a long-term drought, these problems can be greatly exacerbated and the potential for water quality problems to become catastrophic is increased. This section discusses water quality problems that can be expected during low flow conditions.

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

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

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

9.5 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.

The table below shows the water use and the service population for water systems that use water from the Hiwassee River Basin and submit a Local Water Supply Plan to the Division of Water Resources. Except where noted, the data is from the systems' 2002 LWSP.

Population and Water Use for LWSP systems using water from the Hiwassee River Basin					
County	System	Average Daily Demand (mgd)		Population Served	
		2002	2020	2002	2020
Cherokee	Murphy	0.916	1.272	3880	4685
Cherokee	Andrews	0.6	0.761	3541	4533
Cherokee	Marble CWS	0.127	0.18	1300	1660
Clay	Clay Co WSD	0.137	0.171	950	995
	Totals	**1.78**	**2.384**	**9671**	**11873**

9.5.1 Registered Water Withdrawals

Large water users are required to register their withdrawals with the Division of Water Resources. General Statute 143-215.22H requires non-agricultural users that withdraw 100,000 gallons per day or more and agricultural users that withdraw 1,000,000 gallons per day or more to report their withdrawals. Details of this program can be found on the Division's website at: www.ncwater.org. The table below lists the registered water withdrawers in the Hiwassee River Basin.

Registered Water Withdrawals in the Hiwassee River Basin (1999 Data)

County	Registered Facility	Source of Withdrawal	Average for Days Used (mgd)
Cherokee	Carolina Water Service	Ground Water	0.027
Cherokee	Craig's Trout Farm, Inc.	Owl Creek	0.864
Cherokee	Harrison Const. Div. of APAC TN - Cherokee Quarry	Unnamed Stream	0.000
Clay	Harrison Const. Div. of APAC TN - Hayesville Quarry	Unnamed Stream	0.005

9.6 Source Water Assessment of Public Water Supplies

9.6.1 Introduction

The Federal Safe Drinking Water Act (SDWA) Amendments of 1996 emphasize pollution prevention as an important strategy for the protection of ground and surface water resources. This new focus promotes the prevention of drinking water contamination as a cost-effective means to provide reliable, long-term and safe drinking water sources for public water supply (PWS) systems. In order to determine the susceptibility of public water supply sources to contamination, the amendments also required that all states establish a Source Water Assessment Program (SWAP). Specifically, Section 1453 of the SDWA Amendments require that states develop and implement a SWAP to:

- Delineate source water assessment areas;
- Inventory potential contaminants in these areas; and
- Determine the susceptibility of each public water supply to contamination.

In North Carolina, the agency responsible for the SWAP is the Public Water Supply (PWS) Section of the DENR Division of Environmental Health (DEH). The PWS Section received approval from the EPA for their SWAP Plan in November 1999. The SWAP Plan, entitled *North Carolina's Source Water Assessment Program Plan*, fully describes the methods and procedures used to delineate and assess the susceptibility of more than 9,000 wells and

approximately 207 surface water intakes. To review the SWAP Plan, visit the PWS website at http://www.deh.enr.state.nc.us/pws/index.htm.

9.6.2 Delineation of Source Water Assessment Areas

The SWAP Plan builds upon existing protection programs for ground and surface water resources. These include the state's Wellhead Protection Program and the Water Supply Watershed Protection Program.

Wellhead Protection (WHP) Program
North Carolinians withdraw more than 88 million gallons of groundwater per day from more than 9,000 water supply wells across the state. In 1986, Congress passed Amendments to the SDWA requiring states to develop wellhead protection programs that reduce the threat to the quality of groundwater used for drinking water by identifying and managing recharge areas to specific wells or wellfields.

Defining a wellhead protection area (WHPA) is one of the most critical components of wellhead protection. A WHPA is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield." The SWAP uses the methods described in the state's approved WHP Program to delineate source water assessment areas for all public water supply wells. More information related to North Carolina's WHP Program can be found at http://www.deh.enr.state.nc.us/pws/swap.

Water Supply Watershed Protection (WSWP) Program
DWQ is responsible for managing the standards and classifications of all water supply watersheds. In 1992, the WSWP Rules were adopted by the EMC and require all local governments that have land use jurisdiction within water supply watersheds adopt and implement water supply watershed protection ordinances, maps and management plans. SWAP uses the established water supply watershed boundaries and methods established by the WSWP program as a basis to delineate source water assessment areas for all public water surface water intakes. Additional information regarding the WSWP Program can be found at http://h2o.enr.state.nc.us/wswp/index.html.

9.6.3 Susceptibility Determination – North Carolina's Overall Approach

The SWAP Plan contains a detailed description of the methods used to assess the susceptibility of each PWS intake in North Carolina. The following is a brief summary of the susceptibility determination approach.

Overall Susceptibility Rating
The overall susceptibility determination rates the potential for a drinking water source to become contaminated. The overall susceptibility rating for each PWS intake is based on two key components: a contaminant rating and an inherent vulnerability rating. For a PWS to be determined "susceptible", a potential contaminant source must be present and the existing conditions of the PWS intake location must be such that a water supply could become contaminated. The determination of susceptibility for each PWS intake is based on combining the results of the inherent vulnerability rating and the contaminant rating for each intake. Once combined, a PWS is given a susceptibility rating of higher, moderate or lower (H, M or L).

Inherent Vulnerability Rating
Inherent vulnerability refers to the physical characteristics and existing conditions of the watershed or aquifer. The inherent vulnerability rating of groundwater intakes is determined based on an evaluation of aquifer characteristics, unsaturated zone characteristics and well integrity and construction characteristics. The inherent vulnerability rating of surface water intakes is determined based on an evaluation of the watershed classification (WSWP Rules), intake location, raw water quality data (i.e., turbidity and total coliform) and watershed characteristics (i.e., average annual precipitation, land slope, land use, land cover, groundwater contribution).

Contaminant Rating
The contaminant rating is based on an evaluation of the density of potential contaminant sources (PCSs), their relative risk potential to cause contamination, and their proximity to the water supply intake within the delineated assessment area.

Inventory of Potential Contaminant Sources (PCSs)
In order to inventory PCSs, the SWAP conducted a review of relevant, available sources of existing data at federal, state and local levels. The SWAP selected sixteen statewide databases that were attainable and contained usable geographic information related to PCSs.

9.6.4 Source Water Protection

The PWS Section believes that the information from the source water assessments will become the basis for future initiatives and priorities for public drinking water source water protection (SWP) activities. The PWS Section encourages all PWS system owners to implement efforts to manage identified sources of contamination and to reduce or eliminate the potential threat to drinking water supplies through locally implemented programs

To encourage and support local SWP, the state offers PWS system owners assistance with local SWP as well as materials such as:

- Fact sheets outlining sources of funding and other resources for local SWP efforts.
- Success stories describing local SWP efforts in North Carolina.
- Guidance about how to incorporate SWAP and SWP information in Consumer Confidence Reports (CCRs).

Information related to SWP can be found at http://www.deh.enr.state.nc.us/pws/swap.

9.6.5 Public Water Supply Susceptibility Determinations in the Hiwassee River Basin

In April 2004, the PWS Section completed source water assessments for all drinking water sources and generated reports for the PWS systems using these sources. A second round of assessments were completed in April 2005. The results of the assessments can be viewed in two different ways, either through the interactive ArcIMS mapping tool or compiled in a written report for each PWS system. To access the ArcIMS mapping tool, simply click on the "NC SWAP Info" icon on the PWS web page (http://www.deh.enr.state.nc.us/pws/swap). To view a report, select the PWS System of interest by clicking on the "SWAP Reports" icon.

In the Hiwassee River Basin, 70 public water supply sources were identified. Three are surface water sources, and 67 are groundwater sources. All 67 groundwater sources have a Moderate susceptibility rating. Table 15 identifies the three surface water sources and the overall susceptibility rating. It is important to note that a susceptibility rating of Higher does not imply poor water quality. Susceptibility is an indication of a water supply's potential to become contaminated by the identified PCSs within the assessment area.

Table 15 SWAP Results for Surface Water Sources in the Hiwassee River Basin

PWS ID Number	Inherent Vulnerability Rating	Contaminant Rating	Overall Susceptibility Rating	Name of Surface Water Source	PWS Name
0120010	H	L	M	Hiwassee River	Town of Murphy
0120020	M	L	M	Beaver Creek	Town of Andrews
0120020	M	L	M	Dan Holland Creek	Town of Andrews

Chapter 10
Natural Resources

10.1 Ecological Significance of the Hiwassee River Basin

North Carolina's portion of the Hiwassee River basin is located entirely within the Blue Ridge physiographic province. The basin is home to a wide diversity of plants and animals with over 70 species considered endangered, threatened, special concern, or significantly rare by the NC Natural Heritage Program (NHP).

10.2 Rare Aquatic and Wetland-Dwelling Animal Species

Table 16 lists rare aquatic and wetlands-dwelling animals within the Hiwassee River basin. For more information on these and rare plant species, visit the NC Natural Heritage Program (NHP) website at www.ncnhp.org.

Considerable work is in progress regarding the life history of **sicklefin redhorse**, including movement and spawning habitat studies, which will soon lead to a formal species description. The Hiwassee basin contains six species of redhorse, an amazing diversity of these bottom-dwelling fish. The knotty elimia has changed names since the last basinwide plan to **Christy's elimia**, but is still a rare snail, endemic to the Hiwassee basin. There are also three endemic crayfish in the Hiwassee basin. **Littlewing pearlymussel** (*Pegias fabula*) was removed from the rare animal list since the last iteration of the basinwide plan because it is presumed to be extirpated from the basin. It is given a 'historical' status within NHP.

There are several rare freshwater mussels in the Hiwassee River basin. In general, freshwater mussels are declining throughout the Southeast, which is the area of greatest freshwater mussel diversity in the world. Mussels have a unique life cycle that depends on the availability of a proper fish host. Female mussels are fertilized and produce larval mussels, called glochidia, which are often packaged as a 'lure' to attract fish. The fish 'consumes' the lure and glochidia attach to its fins and gills. The glochidia remain attached to the fish for a maturation period, then drop into the substrate to begin growth to adulthood. The continued survival of freshwater mussels depends on water quality but also on the availability of appropriate habitat and host fish.

10.3 Significant Natural Heritage Areas in the Hiwassee River Basin

The NC NHP compiles a list of Significant Natural Heritage Areas as required by the Nature Preserves Act. The list is based on the program's inventory of natural diversity in the state. The terrestrial and aquatic natural heritage areas included on this list are the best representatives of the natural diversity of the state, and therefore, have priority for protection. Inclusion on the list does not imply that any protection or public access to the site exists. The identification of a significant natural heritage area conveys no protection; these lands are the responsibility of the landowner.

The Hiwassee River basin contains fourteen significant natural heritage areas (Figure 18) and six of those are aquatic habitats. The aquatic significant natural heritage areas include: Fires Creek, Hanging Dog Creek, Lower Hiwassee River, Tusquitee Creek/Big Tuni Creek, Upper Hiwassee

River, and Valley River. Additionally, the watersheds of Fires Creek and Gipp Creek are significant areas due to the inextricable link between water quality and the surrounding land quality. Maintaining good water quality in all of the above habitats is imperative to support the diversity of aquatic species contained within them.

The 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 that contain an unusual mixture of piedmont and coastal plain species not typically found in the mountains of the Blue Ridge. The Hiwassee Church Bluffs (sometimes called the Hiwassee River Bluffs) are rocky cliffs along the Hiwassee River that are not only scenic, but may represent migration corridors for plant species.

The Eller Seep, which is owned and managed by the Nature Conservancy, is a small yet very important Southern Appalachian bog. It is home to green pitcher plant (*Sarracenia oreophila*), a state and federally endangered carnivorous plant, and rough rush (*Juncus caesariensis*), a state endangered and federal species of concern plant.

Table 16 List of Rare Animals Associated with Aquatic and Wetland Habitats in the Hiwassee River Basin (May 2006)

Major Taxon	Scientific Name	Common Name	State Status	Federal Status
crustacean	*Cambarus parrishi*	Hiwassee headwaters crayfish	SC	FSC
invertebrate	*Matrioptila jeanae*	A caddisfly	SR	
invertebrate	*Micrasema burksi*	A caddisfly	SR	
invertebrate	*Rhyacophila mainensis*	A caddisfly	SR	
mollusk	*Elimia christyi*	Christy's elimia	E	FSC
mollusk	*Elliptio dilatata*	Spike	SC	
mollusk	*Fusconaia subrotunda*	Long-solid	SR	
mollusk	*Lampsilis fasciola*	Wavy-rayed lampmussel	SC	
mollusk	*Pleurobema oviforme*	Tennessee clubshell	E	FSC
mollusk	*Villosa iris*	Rainbow	SC	
mollusk	*Villosa trabalis*	Cumberland bean	SR	FE
mollusk	*Villosa vanuxemensis*	Mountain creekshell	T	
amphibian	*Ambystoma talpoideum*	Mole salamander	SC	
amphibian	*Cryptobranchus alleganiensis*	Hellbender	SC	FSC
amphibian	*Pseudacris brachyphona*	Mountain chorus frog	SC	
amphibian	*Desmognathus aeneus*	Seepage salamander	SR	FSC
amphibian	*Eurycea junaluska*	Junaluska salamander	T	FSC
fish	*Moxostoma sp. 2*	Sicklefin redhorse	SR	
fish	*Percina squamata*	Olive darter	SC	FSC
fish	*Sander canadensis*	Sauger	SR	
reptile	*Glyptemys muhlenbergii*	Bog turtle	T	FT (S/A)
reptile	*Sternotherus minor*	Loggerhead musk turtle	SC	

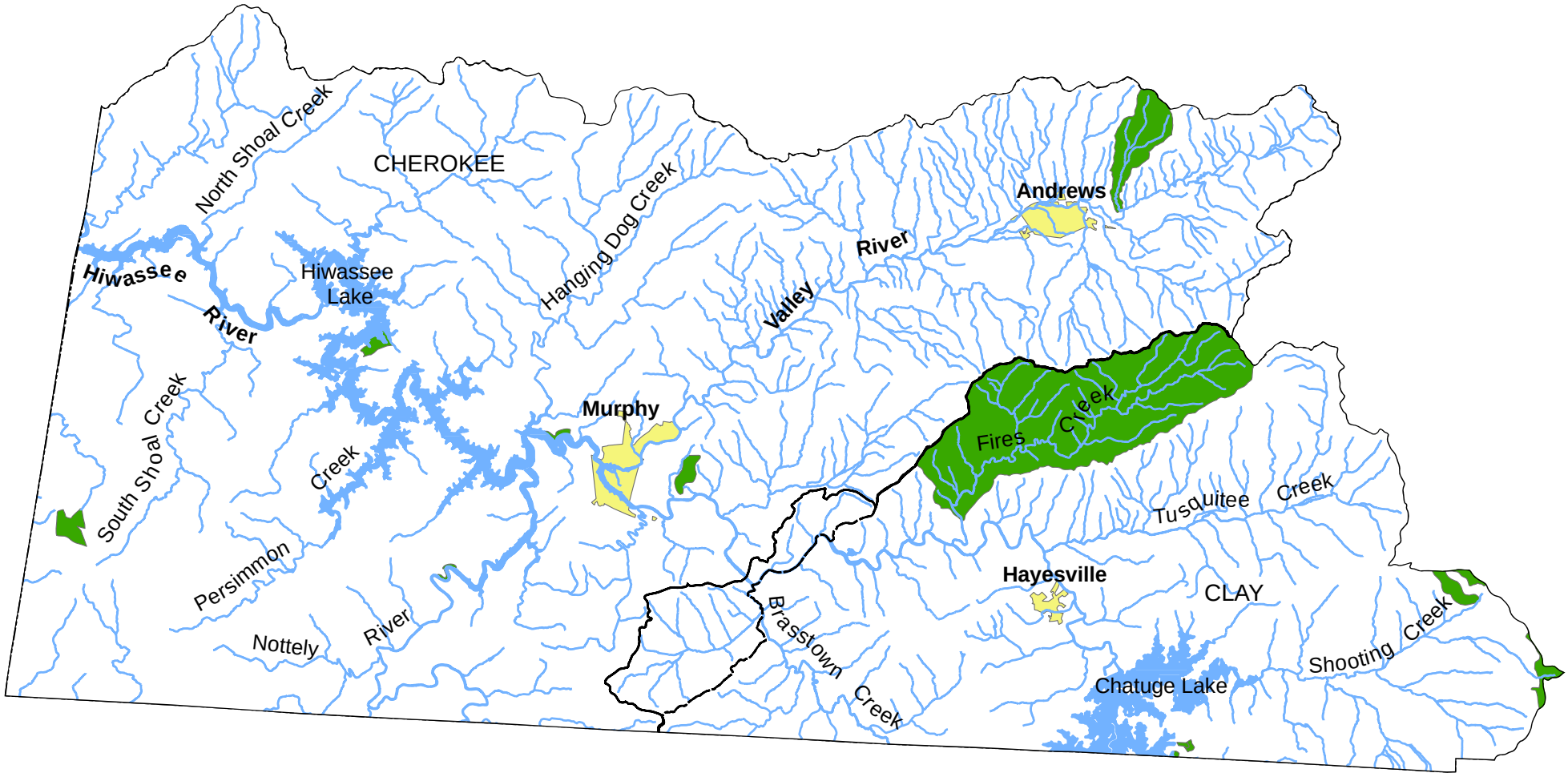
Rare Species Listing Criteria

E = Endangered (those species in danger of becoming extinct)
T = Threatened (considered likely to become endangered within the foreseeable future)
SR = Significantly Rare (those whose numbers are small and whose populations need monitoring)
SC = Species of Special Concern
FSC = Federal Species of Concern (those under consideration for listing under the Federal Endangered Species Act)
T(S/A) = Threatened due to similarity of appearance
EX = Extirpated

10.4 Public Lands

There are over 150,000 acres of land in the Hiwassee basin contained in the Nantahala National Forest and managed by the U.S. Forest Service (USFS). There are no state parks and no significant state land holdings in the basin. Forest Service land ownership is often fragmented and it is rare than any natural area falls under single ownership. The Fires Creek watershed is one of the exceptions and other than some private property near the mouth; the USDA Forest Service is the sole owner. Here, and in other significant natural areas that occur on U.S. Forest Service property, the USFS has been asked to manage in such a way to protect the natural features that make this area unique.

Figure 18 Significant Natural Heritage Areas in the Hiwassee River Basin



Planning Section
Basinwide Planning Unit
August 4, 2006

Chapter 11
Water Quality Initiatives

11.1 The Importance of Local Initiatives

As the Basinwide Planning Program completes its third cycle of plan development, there are many efforts being undertaken at the local level to improve water quality. Information about local efforts particular to a watershed or subbasin is included in Chapters 1-2. DWQ encourages local agencies and organizations to learn about and become active in their watersheds.

In an effort to provide water quality information and gain public input, DWQ partnered with local watershed associations, the National Resource Conservation Service, and Soil and Water Conservation Districts to host the Western North Carolina Basinwide Water Quality Conference in 2005. The purpose of the conference was to educate people about water quality concerns specific to the mountain region and show how participation in the Basinwide Planning process can benefit local initiatives.

An important benefit of local initiatives is that local people make decisions that affect change in their own communities. There are a variety of limitations local initiatives can overcome including: state government budgets, staff resources, lack of regulations for nonpoint sources, the rulemaking process, and many others.

These local organizations and agencies are able to combine professional expertise in a watershed. This allows groups to holistically understand the challenges and opportunities of different water quality efforts. Involving a wide array of people in water quality projects also brings together a range of knowledge and interests, and encourages others to become involved and invested in these projects. By working in coordination across jurisdictions and agency lines, more funding opportunities are available, and it is easier to generate necessary matching or leveraging funds. This will potentially allow local entities to do more work and be involved in more activities because their funding sources are diversified. The most important aspect of these local endeavors is that the more localized the project, the better the chances for success.

The collaboration of these local efforts is key to water quality improvements. There are good examples of local agencies and groups using these cooperative strategies throughout the state. A few of the local organizations are highlighted in Table 17. Specific projects are described in the subbasin chapters (Chapters 1 – 2). Nonpoint source program descriptions and contact, Soil and Water Conservation District (SWCD), NC Cooperative Extension Service and USDA Natural Resources Conservation Service (NRCS) contact information can be found in Appendix VII.

DWQ applauds the foresight and proactive response to potential water quality problems by the organizations mentioned above. Federal and State government agencies are interested in assisting local governments and citizen groups in developing their water quality management programs. The distribution of several grantors is discussed below.

Table 17 Local Water Quality Initiatives

Cherokee County Soil and Water Conservation District
225 Valley River Avenue, Suite J
Murphy NC 28906-2924

Soil and Water Conservation Districts are organized to plan and carry out a conservation program that the local people need and want. District affairs are managed by individuals and groups involved in a coordinated conservation program, including resources from local, state and federal agencies. This way, governmental assistance in conservation practices remains under local control. It was felt that local people, rather than the Federal Government, could better manage their own resources through a Soil and Water Conservation District.

Tel: 828-837-6417
Fax: 828-837-2727

Clay County Soil and Water Conservation District
PO Box 57
Hayesville NC 28904

Soil and Water Conservation Districts are organized to plan and carry out a conservation program that the local people need and want. District affairs are managed by individuals and groups involved in a coordinated conservation program, including resources from local, state and federal agencies. This way, governmental assistance in conservation practices remains under local control. It was felt that local people, rather than the Federal Government, could better manage their own resources through a Soil and Water Conservation District.

Tel: 828-389-9695
Fax: 828-389-0262

Hiwassee River Watershed Coalition
87 Upper Peachtree Road
Murphy, NC 28906
The Hiwassee River Watershed Coalition, Inc. strives to facilitate water quality improvements throughout the upper Hiwassee River watershed, across political boundaries, while honoring local initiatives.

The Coalition began in the early 1990s as local concern for sedimentation in the Brasstown Creek watershed. Because the watershed is divided almost equally between two states, the founders realized the need for a separate entity beyond the federal, state and local programs already in existence. The Coalition was formally organized in 1995 as a nonprofit organization that encompasses portions of two states, three Soil & Water Conservation Districts, four counties, and six municipalities.

The Soil and Water Conservation Districts and County Commissions are the original members of the Coalition and still appoint the Board of Directors today. However, the Coalition membership now includes nearly 300 individual, family and business members as well.

Office Email Address:	Phone/Fax:	Toll Free:
hrwcoalition@brmemc.net	(828) 837-5414	(877) 863-7388

Accomplishments/Projects:

- Brasstown Creek Restoration Project
- Valley River Restoration Project
- Peachtree-Martins Watershed Planning
- Extensive outreach and education

11.2 Federal Initiatives

11.2.1 Clean Water Act – Section 319 Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects. Through annual base funding, there is approximately $1 million available for demonstration and education projects across the state. An additional $2 million is available annually through incremental funds for restoration projects. All projects must provide nonfederal matching funds of at least 40 percent of the project's total costs. 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 (NPS). Information on the North Carolina Section 319 Grant Program application process is available online at http://h2o.enr.state.nc.us/nps/application_process.htm. Descriptions of projects and general Section 319 Program information are available at http://h2o.enr.state.nc.us/nps/Section_319_Grant_Program.htm.

Between 1999 and 2004, there was one project in the Hiwassee River basin funded through the Section 319 Program. The project aimed to demonstrate low impact development principles at the Clay-Towns Industrial Park site and contributed data to TVA's "Guide to Design Principles for Sustainable Industrial Development".

11.3 State Initiatives

11.3.1 North Carolina Ecosystem Enhancement Program (NCEEP)

The North Carolina Ecosystem Enhancement Program (NCEEP) is responsible for providing ecologically effective compensatory mitigation in advance of permitted impacts associated with road projects and other development activities. The fundamental mission of the program is to restore, enhance and protect key watershed functions in the 17 river basins across the state. This is accomplished through the implementation of wetlands, streams and riparian buffer projects within selected local watersheds. The vital watershed functions that NCEEP seeks to restore and protect include water quality, floodwater conveyance and storage, fisheries and wildlife habitat.

The NCEEP is not a grant program but can implement its restoration projects cooperatively with other state or federal programs such as the Section 319 Program. Combining NCEEP-funded restoration or preservation projects with 319 or other local watershed initiatives (e.g., those funded through the Clean Water Management Trust Fund or local/regional Land Trusts) increases the potential to improve the water quality, hydrologic and habitat functions within selected watersheds.

The selection of optimal sites for NCEEP mitigation projects is founded on a basinwide and local watershed planning approach, which results, respectively, in the development of *River Basin Restoration Priorities* and *Local Watershed Plans*.

In developing *River Basin Restoration Priorities (RBRP)* (formerly called *Watershed Restoration Plans*), the NCEEP identifies local watersheds (14-digit hydrologic units) with the greatest need and opportunity for restoration, enhancement or preservation projects. These high-priority watersheds are called "targeted local watersheds" (*TLW*s). Targeted local watersheds are

identified, in part, using information compiled by DWQ's programmatic activities (e.g., *Basinwide Assessment Reports*). Local factors considered in the selection of *TLW*s include: water quality impairment, habitat degradation, the presence of critical habitat or significant natural heritage areas, the presence of water supply watersheds or other high-quality waters, the status of riparian buffers, estimates of impervious cover, existing or planned transportation projects, and the opportunity for local government partnerships. Recommendations from local resource agency professionals and the presence of existing or planned watershed projects are given significant weight in the selection of *TLW*s. In essence, targeted local watersheds represent those areas within a river basin where NCEEP resources can be focused for maximum benefit to local watershed functions.

The *RBRP* for the Hiwassee River Basin can be found on the NCEEP website at http://www.nceep.net/services/restplans/watershedplans.html. A revised *RBRP* with updated selections for *Targeted Local Watersheds* will be posted to this website by summer 2006.

The NCEEP also develops *Local Watershed Plans (LWP*s), usually within targeted local watersheds identified in the *RBRPs*. Through the local watershed planning process, NCEEP conducts watershed characterization and field assessment tasks to identify critical stressors in local watersheds. The NCEEP planners and their consultants coordinate with local resource professionals and local governments to identify optimal watershed projects and management strategies to address the major functional stressors identified. The *LWP*s prioritize restoration/enhancement projects, preservation sites, and best management practices (BMP) projects that will provide water quality improvement, habitat protection and other environmental benefits to the local watershed.

In the Hiwassee River Basin, NCEEP launched the Peachtree-Martins Creek Local Watershed Plan in 2005. In cooperation with the Hiwassee River Watershed Coalition, NCEEP is developing a watershed management plan for this 39 mi^2 area in three phases: initial watershed characterization, intensive field and GIS watershed assessment, and development of management strategies to address local and ecological priorities. As part of this process, the Tennessee Valley Authority has developed an Integrated Pollutant Source Identification (IPSI) for the Peachtree-Martins Creek area, which includes a GIS database of stream and land attributes and a non-point source pollutant loading model. The Peachtree-Martins Creek Local Watershed Plan should be complete in summer 2007 and updated information is available through the *LWP* factsheet at http://www.nceep.net/services/lwps/localplans.htm and on the Hiwassee River Watershed Coalition's website at http://www.hrwc.net/peachtreemartinslwp.htm.

NCEEP Projects in the Hiwassee River Basin

In the Hiwassee River Basin, NCEEP has one constructed stream restoration project—Trout Cove Branch, an approximately 3,900 ft project. However, NCEEP is actively pursuing projects and expects to implement both stream and wetland projects, focusing on the Peachtree-Martins Creek *LWP* area.

For additional information about NCEEP's Project Implementation efforts, go to: http://www.nceep.net/services/implementation/project_implementation.htm. For additional information about NCEEP in general, including its various program activities and products, visit http://www.nceep.net/.

11.3.2 Clean Water Management Trust Fund

The 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, -- projects have been funded for a total of $3,851,000 (Table 18). For more information on the CWMTF or these grants, call (252) 830-3222 or visit the website at www.cwmtf.net.

Table 18 Projects in the Hiwassee River Basin Funded by the Clean Water Management Trust Fund

Project Number	Application Name	Proposed Project Description	Amount Funded
1998B-404	Hiwassee River Watershed Coalition, Inc. - Restoration & NPS/ Brasstown Creek	Restore streambanks on 10,000 ft of mainstem and 10,000 ft of tribs. Reestablish 10,000 ft of buffer, restore 100 acres of bare areas within 300 ft of streams, and restore 1,000 acres of pastureland. ID future wetland restoration & stormwater sites.	$2,100,000
2001A-401	Hiwassee River Watershed Coalition, Inc - Stream Restoration Valley River	Collect ecological data on the Valley River to establish baseline conditions, conduct nonpoint source survey, stabilize 3,300 LF of streambanks and buffers, and treat 125 acres to reduce erosion. CWMTF funds to by used only for the first year of work.	$400,000
2004A-802	Hiwassee River Watershed Coalition, Inc - Planning/ Brasstown Creek Restoration Monitoring	Monitor 10 existing stream restoration projects for two years in the Brasstown Creek watershed. Will include measurements for channel stability, habitat and biological monitoring, plant survival, flow and suspended sediment, and photo documentation.	$185,000
2004B-401	Hiwassee River Watershed Coalition, Inc. - Rest/ Town Branch Restoration	Restore 970 linear feet of Town Branch, a tributary of the Valley River, using natural channel design. Project is part of a larger restoration effort in the Valley River watershed.	$61,000
2004B-402	Hiwassee River Watershed Coalition, Inc. - Rest/ Valley River Tributaries	Design, permit and construct a stream restoration, enhancement and stabilization project on 3 sites (12,700 LF of stream) in the Valley River watershed. This project continues an existing effort to restore streams in the Valley River watershed.	$966,000
2005A-002	Cherokee County - Acq/ Valley River and Town Creek Greenways	Protect through fee simple purchase 31.79 acres along the Valley River and Town Creek. CWMTF funds to purchase the 10.4 riparian acres. Tract would become part of a greenway system and would protect a Regionally Significant Aquatic Habitat.	$139,000
		Total Funded	**$3,851,000**

Notes:
(1) The entire Hiwassee River basin is within CWMTF's Mountain Region
(2) A regional straight pipe and septic system discharge elimination program was funded in an area that includes the Hiwassee River basin.

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Appendix I

Population and Growth Trends in the Hiwassee River Basin

Population and Growth Trends

Below are three different ways of presenting population data for the Hiwassee River basin. The data presented by basin allow for 2000 population data to be presented by subbasin. Population data presented by county allow for analysis of projected growth trends in the basin based on information from the Office of State Planning (April-May, 2001). Data presented by municipality summarizes information on past growth of large urban areas in the basin. While the three different sets of information cannot be directly compared, general conclusions are apparent by looking at the information. Counties with the highest expected growth are associated with the largest municipal areas and the most densely populated subbasins in the basin.

Basin Population and Population Density

Information on population density at a watershed scale is useful in determining what streams are likely to have the most impacts as a result of population growth. This information is also useful in identifying stream segments that have good opportunities for preservation or restoration. This information is presented to estimate population and population density by each subbasin and for the entire basin. It is assumed that county populations are distributed evenly throughout each county; therefore, subbasins that are within counties with large urban areas may overestimate the actual population in that portion of the basin. The overall population of the basin based on 2000 Census data is 31,271, with approximately 49 persons/square mile. (See the map of hydrologic units and population density.) The overall population and persons/square mile is estimated based on the percent of the county land area that is partially or entirely within the basin.

County Population and Growth Trends

The following table and map show the projected population for 2020 and the change in growth between 1990 and 2020 for counties that are partially or entirely contained within the basin. Since river basin boundaries do not coincide with county boundaries, these numbers are not directly applicable to the Hiwassee River basin. This information is intended to present an estimate of expected population growth in counties that have some land area in the Hiwassee River 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://demog.state.nc.us.

County	Percent of County in Basin ♦	County Population 1990	County Population 2000	Estimated % Growth 1990-2000	Estimated Population 2020	Estimated % Growth 2000-2020
Cherokee	98%	20,170	24,298	17%	30,660	20.8%
Clay	85%	7,155	8,775	18.5%	11,916	26.4%
Subtotals		**27,325**	**33,073**	**17.4%**	**42,576**	**22.3%**

♦ Source: North Carolina Center for Geographic Information and Analysis (CGIA), 1997.

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

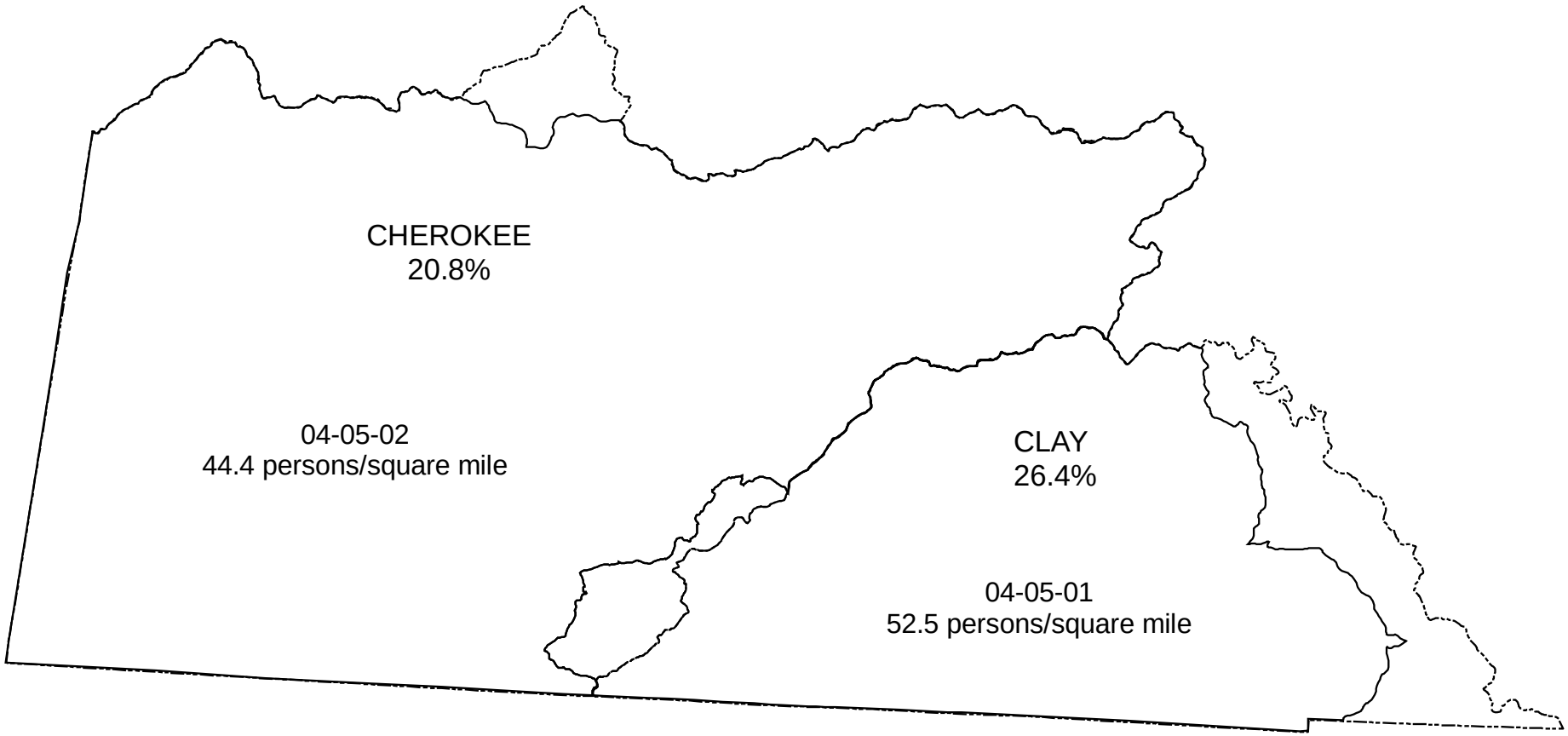
Municipal Population and Growth Trends

The table below presents population data from Office of State Planning for municipalities located partially or entirely in the basin. These data represent three municipalities in the basin.

Municipality	County	April 1980	April 1990	April 2000	Percent Change (1980-1990)	Percent 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%

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

Projected Population Growth (2000-2020) by County and Population Density by Subbasin for the Hiwassee River Basin



Planning Section
Basinwide Planning Unit
August 11, 2006

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Appendix II

Local Governments and Planning Jurisdictions in the Hiwassee River Basin

Local Governments and Planning Jurisdictions in the Basin

The Hiwassee River basin encompasses most or all of these two counties and three municipalities. The following table provides a listing of these local governments, along with the regional planning jurisdiction (Council of Governments).

County	Region	Municipalities
Cherokee	A	Murphy and Andrews
Clay	A	Hayes

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

Region	Name	Location
A	Southwestern Commission Council of Government	Bryson City

Appendix III

Land Cover
in the
Hiwassee River Basin

Land Cover

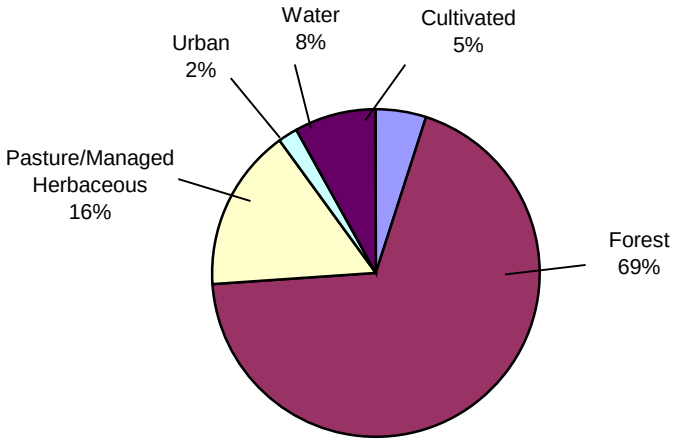
Land cover can be an important way to evaluate the effects of land use changes on water quality. Unfortunately, the tools and database to do this on a watershed scale are not available. The information below describes two different ways of presenting land cover in the Hiwassee River basin.

The state's Center for Geographic Information and Analysis (CGIA) land cover information is useful in providing a snapshot of land cover in the basin from 1993 to 1995. This information is also available in a GIS format so it can be manipulated to present amounts of the different land covers by subbasin or at the watershed scale. The Natural Resources Inventory (NRI) land cover information is presented only at a larger scale (8-digit hydrologic unit), but the collection methods allow for between year comparisons. The two datasets cannot be compared to evaluate land cover data. This information is presented to provide a picture of the different land covers and some idea of change in land cover over time. In the future, it is hoped that land cover information like the GIS formatted dataset will be developed to make more meaningful assessments of the effects of land use changes on water quality. This dataset would also be useful in providing reliable and small-scale information on land cover changes that can be used in water quality monitoring, modeling and restoration efforts.

CGIA Land Cover

The North Carolina Corporate Geographic Database contains land cover information for the Hiwassee River basin based on satellite imagery from 1993-1995. 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 the following table. The chart provides an illustration of the relative amount of land area that falls into each major cover type for the Hiwassee River basin.

Land Cover Type	Land Cover Description
Urban	Greater than 50 percent coverage by synthetic land cover (built-upon area) and municipal areas.
Cultivated Cropland	Areas that are covered by crops that are cultivated in a distinguishable pattern.
Pasture/Managed Herbaceous	Areas used for the production of grass and other forage crops and 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 forested areas (i.e., needleleaf evergreens, deciduous hardwoods).
Water	Areas of open surface water, areas of exposed rock and areas of sand or silt adjacent to tidal waters and lakes.



NRI Land Cover Trends

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

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

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

The following table summarizes acreage and percentage of land cover from the 1997 NRI for the major watersheds within the basin, as defined by the USGS 8-digit hydrologic units, and compares the land cover to 1982 land cover. Definitions of the different land cover types are also presented.

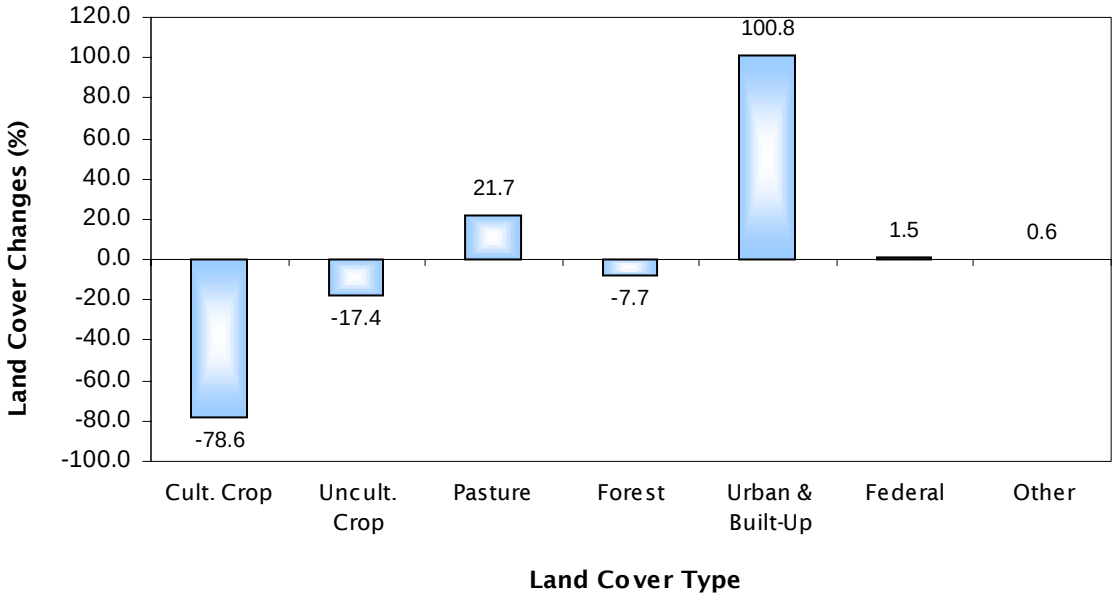
LAND COVER	MAJOR WATERSHED AREAS*								
	Hiwassee River Watershed		Ocoee Watershed		1997 TOTALS		1982 TOTALS		
	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	Acres (1000s)	% of TOTAL	% Change Since 1982
Cult. Crop	1.8	0.4	0.0	0.0	1.8	0.4	8.4	2.0	-78.6
Uncult. Crop	1.9	0.5	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		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.

Type	Description
Cultivated Cropland	Harvestable crops including row crops, small-grain and hay crops, nursery and orchard crops, and other specialty crops.
Uncultivated Cropland	Summer fallow or other cropland not planted.
Pastureland	Includes land that has a vegetative cover of grasses, legumes and/or forbs, regardless of whether or not it is being grazed by livestock.
Forestland	At least 10 percent stocked (a canopy cover of leaves and branches of 25 percent or greater) by single-stemmed trees of any size, which will be at least 4 meters at maturity, and land bearing evidence of natural regeneration of tree cover. The minimum area for classification of forestland is 1 acre, and the area must be at least 1,000 feet wide.
Urban and Built-up Areas	Includes airports, playgrounds with permanent structures, cemeteries, public administration sites, commercial sites, railroad yards, construction sites, residences, golf courses, sanitary landfills, industrial sites, sewage treatment plants, institutional sites, water control structure spillways and parking lots. Includes highways, railroads and other transportation facilities if surrounded by other urban and built-up areas. Tracts of less than 10 acres that are completely surrounded by urban and built-up lands.
Other	*Rural Transportation*: Consists of all highways, roads, railroads and associated rights-of-way outside urban and built-up areas, private roads to farmsteads, logging roads and other private roads (but not field lanes). *Small Water Areas*: Waterbodies less than 40 acres; streams less than 0.5 mile wide. *Census Water*: Large waterbodies consisting of lakes and estuaries greater than 40 acres and rivers greater than 0.5 mile in width. *Minor Land*: Lands that do not fall into one of the other categories.

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

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 decreases 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). Most land cover change is accounted for in the areas surrounding the local municipalities in the Hiwassee River basin. Below is a graph that presents changes in land cover between 1982 and 1997.



Source: USDA-NRCS, NRI, updated June 2001

Appendix IV

DWQ Water Quality Monitoring Programs in the Hiwassee River Basin

DWQ Water Quality Monitoring Programs in the Hiwassee River Basin

Staff in the Environmental Sciences Section (ESS) 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 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
- Fish Assessments
- Aquatic Toxicity Monitoring
- Lake Assessment
- Ambient Monitoring System

Benthic Macroinvertebrate Monitoring

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

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

Overview of Benthic Macroinvertebrate Data

Based on benthic macroinvertebrate data, water quality in the Hiwassee River basin is Excellent to Good. Since 1999, 34 benthic macroinvertebrate basinwide samples have been collected with one (3%) receiving a Good-Fair bioclassification, nine (26%) resulting in Good bioclassifications, and 24 (71%) receiving Excellent bioclassifications. Comparisons of benthos data from 1999 to 2004 between repeat sites show that one site (Valley River at SR 1555) improved from Good-Fair to Good, while five sites (Shooting Creek at SR 1370, Brasstown Creek SR 1104, Hiwassee River at US 64, Junaluska Creek at SR 1505, South Shoal Creek at SR 1314) improved from Good to Excellent. All remaining sites were Excellent in both 1999 and 2004 while the Nottely River maintained a Good bioclassification from 1999 to 2004. Overall, water quality in this basin has improved since 1999.

Several rare invertebrate taxa were collected in the Hiwassee River basin in 2004 including the mayflies Serratella spiculosa (Persimmon Creek, Beaverdam Creek, Big Tuni Creek, Junaluska Creek), Rhithrogena fuscifrons (Big Tuni Creek, Welch Mill Creek), Nixe (Fires Creek), the caddisflies Molanna tryphena (Hiwassee River), Molanna blenda (Fires Creek), Micrasema

rickeri (Welch Mill Creek), Agarodes (Brasstown Creek) and the stoneflies Beloneuria (Welch Mill Creek) and Agnetina (Fires Creek). The collection of Molanna tryphena at the Hiwassee River represents a significant range extension for this species as it has only previously been collected in the coastal plain and sandhills ecoregions of North Carolina. Two particularly noteworthy benthos sites (Shuler Creek SR 1323, and Tusquittee Creek at SR 1300) set the highest total taxa and EPT taxa diversities ever recorded in the Hiwassee River basin. For detailed information regarding the samples collected during this assessment period, refer to the tables at the end of this appendix.

Assessing Benthic Macroinvertebrate Communities in Small Streams

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

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

DWQ will use this monitoring information to identify potential impacts to these waters even though a use support rating is not assigned. DWQ will continue to develop criteria to assess water quality in small streams.

Fish Assessments

In 2004, 13 sites were sampled in the Hiwassee River basin in mid June. No previous fish community assessments have been performed by DWQ in any of these mountain streams. The most commonly collected species in 2004 was the mottled sculpin, which was collected at all 13 sites and comprised almost 50 percent of all individuals collected in this watershed. The second most abundant species was the central stoneroller, collected at 12 of 13 sites, making up roughly eight percent of all individuals collected in the basin.

Nine of the 13 stream sites were evaluated using the North Carolina Index of Biotic Integrity (NCIBI) (Appendices F2 – F5). Four of the sites were not rated with the NCIBI because “Trout stream” specific criteria and metrics have not yet been developed for the mountain ecoregions of North Carolina. Furthermore, criteria should be considered “tentative” for the Hiwassee River basin because no previous fish community data exists for this basin. More reference site data is needed to verify that the present metrics being used are appropriate for the Hiwassee River basin.

The NCIBI ratings for the nine ratable streams ranged from Poor to Excellent with scores that varied from 20 to 58. Although Martin Creek qualified as a regional reference site based on its abiotic characteristics, its rating was Fair. This inconsistency warrants further monitoring efforts including a site further upstream from the mouth of the Hiwassee River with slightly higher gradient and more riffles.

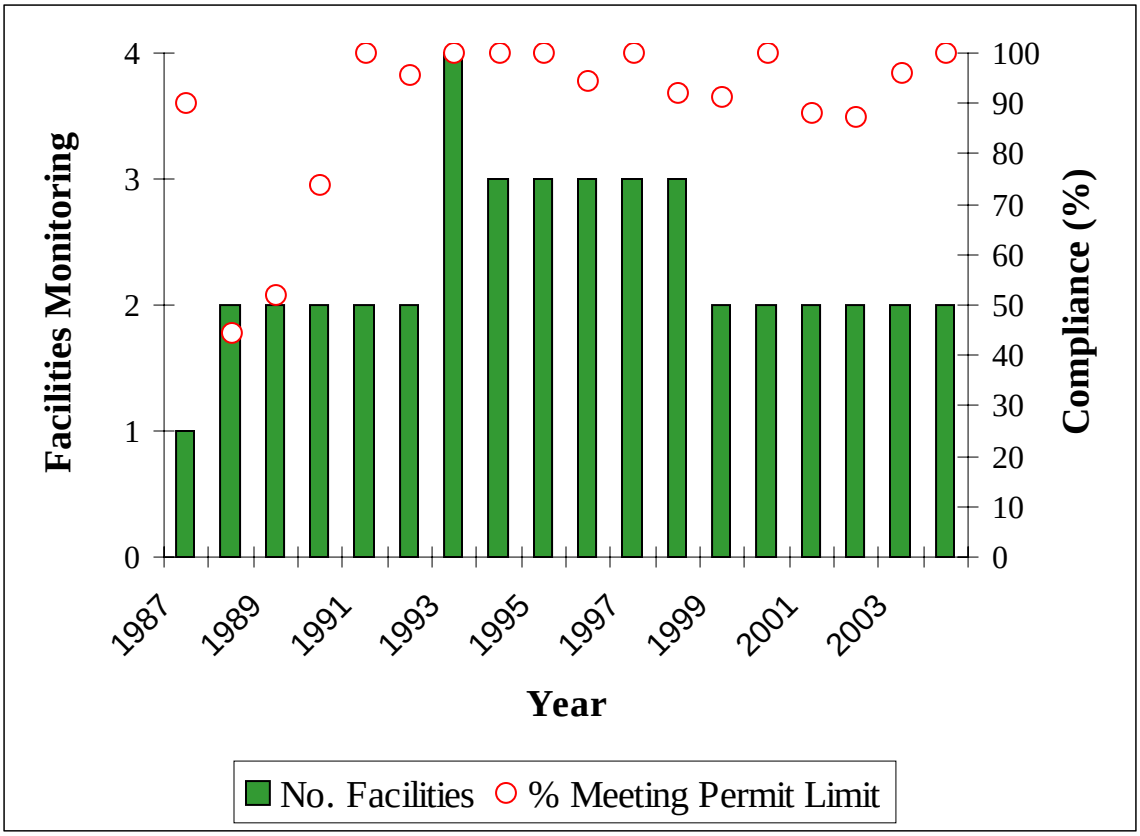
For detailed information regarding the samples collected during this assessment period, refer to the tables at the end of this Appendix.

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 (WET) by their NPDES permit or by administrative letter. Other facilities may also be tested by DWQ's Aquatic Toxicology Unit (ATU). Per Section 106 of the Clean Water Act, the ATU is required to test at least 10 percent of the major discharging facilities over the course of the federal fiscal year (FFY). However, it is ATU's target to test 20 percent of the major dischargers in the FFY. This means that each major facility would get evaluated over the course of their five-year permit. There are no requirements or targets for minor dischargers.

The ATU maintains a compliance summary for all facilities required to perform tests and provides monthly updates 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.

Two facility permits in the Hiwassee River basin currently require whole effluent toxicity (WET) monitoring. Both facility permits have a WET limit.Across the state, the number of facilities required to perform WET has increased steadily since 1987, the first year that WET limits were written into permits in North Carolina. Consequently, compliance rates have also risen. Since 1996, the compliance rate has stabilized at approximately 90 percent. The following graph summaries WET monitoring compliance in the Hiwassee River basin from 1987 to 2002. Facilities with toxicity problems during the most recent two-year review period are discussed in subbasin chapters.



Lakes Assessment Program

Three lakes were sampled in the Hiwassee River Basin during 2004 –Chatuge, Hiwassee and Appalachia Lakes. These three water bodies are all oligotrophic with good water clarity. All of these lakes were sampled three times during the summer (June, July and August). Lakes with noted water quality impacts are discussed in the appropriate subbasin chapter.

Ambient Monitoring System

The Ambient Monitoring System (AMS) is a network of stream, lake and estuarine stations strategically located for the collections of physical and chemical water quality data. North Carolina has more than 378 water chemistry monitoring stations statewide, including 2 stations in the Hiwassee River basin. Between 23 and 32 parameters are collected monthly at each station. The locations of these stations are listed in the following table and shown on individual subbasin maps. Notable ambient water quality parameters are discussed in the subbasin chapters. Refer to *2005 Hiwassee Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/bar.html for more detailed analysis of ambient water quality monitoring data.

Locations of Ambient Monitoring Stations in the Roanoke River Basin by Subbasin

Subbasin/ Station ID	Location	Class	Lat.	Long.	County	Map ID
01	**Hiwassee River (upper)**					
	No Stations					
02	**Hiwassee River (lower) and Valley River**					
F2500000	Hiwassee River beside US 64 above Murphy	WS-V	35.0788	-84.0254	Cherokee	A1
F4000000	Valley River at US 74/19/129 at Tomotla	C Tr	35.1373	-83.9796	Cherokee	A2

Benthic Macroinvertebrate Data Collected in the Hiwassee River Basin, 1999 – 2004
(Current basinwide sampling sites are in **bold** print.)

Waterbody	Location	County	Index No.	Date	ST	EPT	BI	EPT BI	Bioclass
01									
Shooting Cr	SR 1340	Clay	1-5	8/04	-----	39	-----	2.6	Excellent
				8/99	-----	30	-----	2.5	Good
Big Tuni Cr	SR 1311	Clay	1-21-5	8/04	-----	48	-----	1.5	Excellent
				8/99	-----	45	-----	1.6	Excellent
Tusquitee Cr	SR 1300	Clay	1-21-(16.5)	8/04	119	51	4.0	2.7	Excellent
				8/99	84	39	3.4	2.7	Excellent
Fires Cr	SR 1334	Clay	1-27-(5.5)	8/04	118	53	3.7	2.6	Excellent
				8/99	77	44	2.9	2.4	Excellent
Brasstown Cr	SR 1104	Clay	1-42	8/04	108	53	4.8	3.7	Excellent
				8/99	77	44	4.6	3.8	Good
Webb Cr	SR 1428	Cherokee	1-42-1-1	8/99	58	37	3.2	2.8	Good
	Off SR 1384	Cherokee	1-42-1-1	6/02	63	45	2.4	2.0	Not Impaired
02									
Hiwassee R	US 64	Cherokee	1-(43.7)	8/04	100	46	4.4	3.5	Excellent
				8/99	73	36	4.4	3.5	Good
Peachtree Cr	SR 1537	Cherokee	1-44	8/04	-----	49	-----	2.5	Excellent
				8/99	-----	38	-----	2.9	Excellent
Martin Cr	SR 1558	Cherokee	1-49	8/04	-----	30	-----	3.1	Good
Valley R	SR 1554	Cherokee	1-52	8/04	101	36	5.0	3.9	Good
		Cherokee		8/99	80	33	5.0	4.1	Good-Fair
Valley R	Main Street, Andrews	Cherokee	1-52	6/02	94	52	4.6	3.6	Excellent
Valley R	Stewart Rd.	Cherokee	1-52	6/02	99	51	4.0	3.2	Excellent
Valley R	Off SR 1515	Cherokee	1-52	6/02	92	40	5.0	4.2	Good
Valley R	Off SR 1515	Cherokee	1-52	8/99	63	28	5.2	4.4	Good-Fair
Valley R	Main Street, Andrews	Cherokee	1-52	8/99	-----	24	-----	4.7	Good-Fair
Gipp Cr	SR 1409	Cherokee	1-52-23	6/02	76	44	2.7	2.2	Excellent
Worm Cr	SR 1393A	Cherokee	1-52-24	6/02	62	35	3.6	3.0	Not Impaired
	SR 1502	Cherokee	1-52-24	6/02	53	31	2.5	1.8	Not Impaired
Junaluska Cr	SR 1505	Cherokee	1-52-25	8/04	-----	41	-----	2.2	Excellent
				8/99	-----	31	-----	3.2	Good
Tatham Cr	US 19 Business	Cherokee	1-52-28	6/02	85	40	4.0	3.3	Excellent
Collet Cr	SR 1507	Cherokee	1-52-28-2	6/02	63	36	3.2	2.6	Not Impaired
Beaver Cr	SR 1388	Cherokee	1-52-30-(1)	6/02	49	29	2.8	2.4	Not Impaired
Taylor Cr	SR 1515	Cherokee	1-52-39	6/02	96	41	4.3	3.0	Not Impaired
Colvard Cr	SR 1426	Cherokee	1-52-39-1-1	6/02	60	41	2.8	2.0	Not Imapired
Colvard Cr	US 19/74	Cherokee	1-52-39-1-1	6/02	62	35	3.0	2.1	Not Impaired
Welch Mill Cr	SR 1381	Cherokee	1-52-40	8/04	-----	44	-----	1.9	Excellent
				6/02	-----	43	-----	1.8	Excellent
Welch Mill Cr	SR 1428	Cherokee	1-52-40	6/02	60	34	3.4	2.8	Not Impaired
Hyatt Cr	SR 1428	Cherokee	1-52-43	6/02	80	45	2.9	2.1	Excellent
Hyatt Cr	SR 1379	Cherokee	1-52-43	6/02	-----	49	-----	2.0	Excellent
Vengeance Cr	Off NC 141	Cherokee	1-52-45	6/02	92	50	4.1	3.3	Good
Hanging Dog Cr	SR 1331	Cherokee	1-57	8/04	-----	41	-----	2.4	Excellent
				8/99	-----	40	-----	2.5	Excellent
Owl Cr	SR 1331	Cherokee	1-57-6	8/04	-----	44	-----	2.5	Excellent
Nottely R	SR 1596	Cherokee	1-58	8/04	-----	32	-----	2.6	Good
				8/99	-----	33	-----	3.5	Good
Persimmon Cr	SR 1127	Cherokee	1-63	8/04	-----	40	-----	3.0	Excellent
				8/99	-----	40	-----	3.6	Excellent
Beaverdam Cr	SR 1326	Cherokee	1-72	8/04	-----	50	-----	2.5	Excellent
				8/99	-----	38	-----	2.7	Excellent
South Shoal Cr	SR 1314	Cherokee	1-77	8/04	-----	38	-----	2.3	Excellent
				8/99	-----	33	-----	3.5	Good
Shuler Cr	SR 1323	Cherokee	1-86	8/04	-----	54	-----	2.7	Excellent
				8/99	-----	40	-----	2.7	Excellent
Morris Cr	SR 1383	Cherokee	1-86-6	6/02	56	34	3.1	2.5	Not Impaired
Morris Cr	US 19/74	Cherokee	1-86-6	6/02	74	36	4.2	3.6	Not Impaired

Fish Community Structure Data Collected in the Hiwassee Basin, 1993 – 2003
(Current basinwide sampling sites are in **bold** print.)

Subbasin/Waterbody	Location	County	Index No.	Date	NCIBI Score	NCIBI Rating
040501						
Shooting Cr	SR 1340	Clay	1-5	06/14/04	40	Good-Fair
Tusquittee Cr	SR 1330	Clay	1-21-(0.5)	06/15/04	---	Not Rated
Fires Cr	SR 1300	Clay	1-27-(5.5)	06/15/04	---	Not Rated
Brasstown Cr	SR 1111	Clay	1-42	06/14/04	46	Good-Fair
Little Brasstown Cr	SR 1565	Cherokee	1-42-11	06/17/04	44	Good-Fair
040502						
Peachtree Cr	US 64	Cherokee	1-44	06/15/04	58	Excellent
Martin Cr	SR 1558	Cherokee	1-49	06/17/04	38	Fair
Valley R	SR 1409	Cherokee	1-52	06/18/04	---	Not Rated
Taylor Cr	SR 1515	Cherokee	1-52-39	06/18/04	44	Good-Fair
Vengeance Cr	NC 141 / SR 1520	Cherokee	1-52-45	06/17/04	56	Good
Hanging Dog Cr	off SR 1342	Cherokee	1-57	06/16/04	56	Good
Persimmon Cr	SR 1127	Cherokee	1-63	06/16/04	20	Poor
S Shoal Cr	SR 1314	Cherokee	1-77	06/16/04	---	Not Rated

Appendix V

NPDES Discharges
and
Stormwater Permits

Permit	Owner	Facility	County	Region	Type	Class	Flow	Subbasin	Receiving Stream
NC0021148	USDA US Forest Service	Jackrabbit Mountain Recreation Area	Clay	Asheville	100% Domestic < 1MGD	Minor	13000	40501	HIWASSEE RIVER (Chatuge Lake below elevation 1928)
NC0026697	Clay County Water and Sewer District	Hayesville WWTP	Clay	Asheville	Municipal, < 1MGD	Minor	300000	40501	HIWASSEE RIVER (Mission Reservoir)
NC0027332	Tennessee Valley Authority	Chatuge Hydro Plant	Clay	Asheville	Industrial Process & Commercial	Minor	not limited	40501	HIWASSEE RIVER
NC0020800	Town of Andrews	Andrews WWTP	Cherokee	Asheville	Municipal, Large	Major	1500000	40502	Valley River
NC0020940	Town of Murphy	Murphy WWTP	Cherokee	Asheville	Municipal, < 1MGD	Major	1400000	40502	HIWASSEE RIVER
NC0023001	Carolina Water Service Inc Of NC	Bear Paw WWTP	Cherokee	Asheville	100% Domestic < 1MGD	Minor	80000	40502	HIWASSEE RIVER (Apalachia Lake below elevation 1281)
NC0027359	Tennessee Valley Authority	Hiwassee Hydro Plant	Cherokee	Asheville	Industrial Process & Commercial	Minor	not limited	40502	HIWASSEE RIVER (Apalachia Lake below elevation 1281)
NC0035386	Cherokee County Schools	Hiwassee Dam School	Cherokee	Asheville	100% Domestic < 1MGD	Minor	8800	40502	Thompson Branch
NC0069892	Town of Andrews	Andrews WTP	Cherokee	Asheville	Water Treatment Plant	Minor	not limited	40502	Dan Holland Creek

COC Number	Facility Name	Receiving Stream	Subbasin	County
NCG020244	Hayesville Quarry	Beech Flats Branch	# 04-05-01	Clay
NCG020606	Mission Quarry	HIWASSEE RIVER (Chatuge Lake below elevation 1928)	# 04-05-01	Clay
NCG080730	Hayesville Bin	South Fork Blair Creek	# 04-05-01	Clay
NCG140249	Southern Concrete Mat-Hayesvil	Hyatt Mill Creek	# 04-05-01	Clay
NCG020503	Cherokee County Quarry	Hothouse Creek	# 04-05-02	Cherokee
NCG030026	Team Industries-Andrews, Inc.	Valley River	# 04-05-02	Cherokee
NCG030530	MGM Brakes	HIWASSEE RIVER (Hiwassee Lake below elevation 1525)	# 04-05-02	Cherokee
NCG080564	NC Nat Gd- Murphy	Valley River	# 04-05-02	Cherokee
NCG080732	Murphy Bin	HIWASSEE RIVER	# 04-05-02	Cherokee
NCG080754	Andrews Bin	Valley River	# 04-05-02	Cherokee
NCG120071	Cherokee County Municipal Solid Waste Landfill	Valley River	# 04-05-02	Cherokee
NCG160152	Cherokee County Asphalt Plant	Persimmon Creek (Lake Cherokee)	# 04-05-02	Cherokee
NCG170268	Coats American - Cherokee Plant	Hyatt Creek	# 04-05-02	Cherokee
NCG200427 (pending)	Cherokee County Recycling Facility	Valley River	# 04-05-02	Cherokee
NCG210294	DBA Mundy's Lumber & Veneer Co	Valley River	# 04-05-02	Cherokee

Appendix VI

303(d) Listing
and
Reporting Methodology

Integrated 305(b) and 303(d) Report Summary

The *North Carolina Water Quality Assessment and Impaired Waters List* is an integrated report that includes both the 305(b) and 303(d) reports of previous years. The *305(b) Report* is compiled biennially to update the assessment of water quality in North Carolina and to meet the Section 305(b) reporting requirement of the Clean Water Act. The 305(b) reports present how well waters support designated uses (e.g., swimming, aquatic life support, water supply), as well as likely causes (e.g., sediment, nutrients) and potential sources of impairment. The term "Use Support" refers to the process mandated by 305(b). The *303(d) List* is a comprehensive public accounting of all Impaired waterbodies that is derived from the 305(b) Report/Use Support. An Impaired waterbody is one that does not meet water quality uses, such as water supply, fishing or propagation of aquatic life. Best professional judgement along with numeric and narrative standards criteria and anti-degradation requirements defined in 40 CFR 131 is considered when evaluating the ability of a waterbody to serve its uses.

Section 303(d) of the federal Clean Water Act (CWA) which Congress enacted in 1972 required States, Territories and authorized Tribes to identify and establish a priority ranking for waterbodies for which technology-based effluent limitations required by Section 301 are not stringent enough to attain and maintain applicable water quality standards, establish total maximum daily loads (TMDLs) for the pollutants causing impairment in those waterbodies, and submit, from time to time, the list of Impaired waterbodies and TMDLs to the US Environmental Protection Agency (EPA). Current federal rules require states to submit 303(d) lists biennially, by April 1st of every even numbered year. EPA is required to approve or disapprove the state-developed 303(d) list within 30 days. For each water quality limited segment Impaired by a pollutant and identified in the 303(d) list, a Total Maximum Daily Load (TMDL) must be developed. TMDLs are not required for waters Impaired by pollution. Here, pollution is defined by the EPA as, “man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of the water,” and is related to water control structures (i.e., dams).

The Integrated Report includes descriptions of monitoring programs, the use support methodology, and the Impaired waters list. New guidance from EPA places all waterbody assessment units into one unique assessment category (EPA, 2001b). Although EPA specifies five unique assessment categories, North Carolina elects to use seven categories. Each category is described in detail below:

Category 1: Attaining the water quality standard and no use is threatened. This category consists of those waterbody assessment units where all applicable use support categories are rated " Supporting". Data and information are available to support a determination that the water quality standards are attained and no use is threatened. Future monitoring data will be used to determine if the water quality standard continues to be attained.

Category 2: Attaining some of the designated uses; no use is threatened; and insufficient or no data and information are available to determine if the remaining uses are attained or threatened. This category consists of those waterbody assessment units where at least one of the applicable use support categories are rated " Supporting" and the other use support categories are rated "Not Rated" or “No Data”. Also included in this category are waters where at least one of the applicable use support categories, except Fish Consumption, are rated "Supporting"; the remaining applicable use support

categories, except Fish Consumption, are rated "Not Rated"; and the Fish Consumption category is rated "Impaired-Evaluated". Data and information are available to support a determination that some, but not all, uses are attained. Attainment status of the remaining uses is unknown because there are insufficient or no data or information. Future monitoring data will be used to determine if the uses previously found to be in attainment remain in attainment, and to determine the attainment status of those uses for which data and information were previously insufficient to make a determination.

Category 3: Insufficient or no data and information to determine if any designated use is attained. This category consists of those waterbody assessment units where all applicable use support categories, except Fish Consumption, are rated "Not Rated", and the Fish Consumption category is rated "Impaired-Evaluated". Measured data or information to support an attainment determination for any use are not available. Supplementary data and information, or future monitoring, will be required to assess the attainment status.

Category 4: Impaired or threatened for one or more designated uses but does not require the development of a TMDL. This category contains three distinct sub-categories:

> **Category 4a: TMDL has been completed**. This category consists of those waterbody assessment units for which EPA has approved or established a TMDL and water quality standards have not yet been achieved. Monitoring data will be considered before moving an assessment unit from Category 4a to Categories 1 or 2.
>
> **Category 4b: Other pollution control requirements are reasonably expected to result in the attainment of the water quality standard in the near future**. This category consists of those waterbody assessment units for which TMDLs will not be attempted because other required regulatory controls (e.g., NPDES permit limits, Stormwater Program rules, etc.) are expected to attain water quality standards within a reasonable amount of time. Future monitoring will be used to verify that the water quality standard is attained as expected.
>
> **Category 4c: Impairment is not caused by a pollutant**. This category consists of assessment units that are Impaired by pollution, not by a pollutant. EPA defines pollution as "The man-made or man-induced alteration of the chemical, physical, biological and radiological integrity of the water." EPA staff have verbally stated that this category is intended to be used for impairments related to water control structures (i.e., dams). Future monitoring will be used to confirm that there continues to be an absence of pollutant-caused impairment and to support water quality management actions necessary to address the cause(s) of the impairment.

Category 5: Impaired for one or more designated uses by a pollutant(s) and requires a TMDL. This category consists of those waterbody assessment units that are Impaired by a pollutant and the proper technical conditions exist to develop TMDLs. As defined by the EPA, the term pollutant means "dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological

materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt and industrial, municipal, and agricultural waste discharged into the water." When more than one pollutant is associated with the impairment of a single waterbody assessment unit in this category, the assessment unit will remain in Category 5 until TMDLs for all listed pollutants have been completed and approved by the EPA.

Category 6: Impaired based on biological data. This category consists of waterbody assessment units historically referred to as "Biologically Impaired" waterbodies; these assessment units have no identified cause(s) of impairment although aquatic life impacts have been documented. The waterbody assessment unit will remain in Category 6 until TMDLs have been completed and approved by the EPA.

Category 7: Impaired, but the proper technical conditions do not yet exist to develop a TMDL. As described in the Federal Register, "proper technical conditions" refer to the availability of the analytical methods, modeling techniques and data base necessary to develop a technically defensible TMDL. These elements will vary in their level of sophistication depending on the nature of the pollutant and characteristics of the segment in question" (43 FR 60662, December 28, 1978). These are assessment units that would otherwise be in Category 5 of the integrated list. As previously noted, EPA has recognized that in some specific situations the data, analyses or models are not available to establish a TMDL. North Carolina seeks EPA technical guidance in developing technically defensible TMDLs for these waters. Open water and ocean hydrology fecal coliform Impaired shellfishing waters are included in this category.

For this integrated list, Categories 1 and 2 are considered fully supporting any assessed uses. This portion of the integrated list is extensive (thousands of segments); thus, a printed copy is not provided. A table of waters on Categories 1 through 3 is available for downloading on the DWQ website (http://h2o.enr.state.nc.us/tmdl/General_303d.htm). **Categories 5, 6 and 7 constitute the 2004 North Carolina 303(d) List for the State of North Carolina**.

Delisting Waters

In general, waters will move from Categories 5, 6 or 7 when data show that uses are fully supported or when a TMDL has been approved by EPA. In some cases, mistakes have been discovered in the original listing decision and the mistakes are being corrected. Waters appearing on the previously approved Impaired waters list will be moved to Categories 1, 2, 3 or 4 under the following circumstances:

- An updated 305(b) use support rating of Supporting, as described in the basinwide management plans.
- Applicable water quality standards are being met (i.e., no longer Impaired for a given pollutant) as described in either basinwide management plans or in technical memoranda.

- The basis for putting the water on the list is determined to be invalid (i.e., was mistakenly identified as Impaired in accordance with 40 CFR 130.7(b)(6)(iv) and/or National Clarifying Guidance for State and Territory 1998 Section 303(d) Listing Decisions. Robert Wayland, III, Director. Office of Wetlands, Oceans and Watersheds. Aug 27, 1997).
- A water quality variance has been issued for a specific standard (e.g., chloride).
- Removal of fish consumption advisories or modification of fish eating advice.
- Typographic listing mistakes (i.e., the wrong water was identified).
- EPA has approved a TMDL.

Scheduling TMDLs

Category 5 waters, those for which a TMDL is needed, are at many different stages on the path to an approved TMDL. Some require additional data collection to adequately define the problem in TMDL terms. Some require more outreach to increase stakeholder involvement. Others need to have a technical strategy budgeted, funded and scheduled. Some are ready for EPA submittal.

North Carolina has prioritized TMDL development for waters Impaired due to bacteria or turbidity. The approach of prioritizing TMDL development based on pollutant has been successfully used in other states. Limited resources are used more effectively with a focus on a particular pollutant. Waters Impaired by other pollutants (i.e., not bacteria) are not excluded from the schedule. However, the majority of waters prioritized for the next few years are associated with bacterial contamination. Compliance with TMDL development schedules provided in the Integrated Report depends upon DWQ and EPA resources.

North Carolina uses biological data to place the majority of waterbody assessment units on the 303(d) list. Additional consideration and data collection are necessary if the establishment of a TMDL for waters on Category 6 is to be expected. It is important to understand that the identification of waters in Category 6 does not mean that they are low priority waters. The assessment of these waters is a high priority for the State of North Carolina. However, it may take significant resources and time to determine the environmental stressors and potentially a cause of impairment. Assigning waters to Category 6 is a declaration of the need for more data and time to adequately define the problems and whether pollution, pollutants or a combination affects waters.

According to EPA guidance (EPA 2004), prioritization of waterbody assessment units for TMDLs need not be reflected in a “high, medium or low” manner. Instead, prioritization can be reflected in the TMDL development schedule. Generally, North Carolina attempts to develop TMDLs within 10 years of the original pollutant listing. Other information for each assessment unit is also utilized to determine the priority in the TMDL development schedule. This information includes the following:

- Year listed. Assessment units that have been on the 303(d) list for the longest period of time will receive priority for TMDL development and/or stressor studies.
- Reason for listing. (Applicable to Category 5 AUs only) AUs with an impairment due to a standard violation will be prioritized based on which standard was violated. Standard violations due to bacteria or turbidity currently receive priority for TMDL development.

- Classification. AUs classified for primary recreation (Class B), water supply (Class WS-I through WS-V), trout (Tr), high quality waters (HQW), and outstanding resource waters (ORW) will continue to receive a higher priority for TMDL development and/or stressor studies.
- Basinwide Planning Schedule. (Applicable to Category 6 AUs only). The basinwide schedule is utilized to establish priority for stressor studies.

Revising TMDLs

Current federal regulations do not specify when TMDLs should be revised. However, there are several circumstances under which it would seem prudent to revisit existing TMDLs. The TMDL analysis of targets and allocations is based upon the existing water quality standards, hydrology, water quality data (chemical and biological), and existing, active NPDES wastewater discharges. Conditions related to any of these factors could be used to justify a TMDL revision. Specific conditions that the Division will consider prior to revising an existing, approved TMDL include the following:

- A TMDL has been fully implemented and the water quality standards continue to be violated. If a TMDL has been implemented and water quality data indicate no improvement or a decline in overall water quality, the basis for the TMDL reduction or the allocation may need to be revised;
- A change of a water quality standard (e.g., fecal coliform to Echerichia coli). The Division will prioritize review of existing TMDLs and data to determine if a revision to TMDLs will be required;
- The addition or removal of hydraulic structures to a waterbody (e.g., dams). Substantial changes to waterbody hydrology and hydraulics have the potential to change many aspects of target setting, including the water quality standard upon which the TMDL was developed, the water quality data, and the water quality modeling;
- Incorrect assumptions were used to derive the TMDL allocations. This would include errors in calculations and omission of a permitted discharge.

Should a TMDL be revised due to needed changes in TMDL targets, the entire TMDL would be revised. This includes the TMDL target, source assessment, and load and wasteload allocations. However, the Division may elect to revise only specific portions of the TMDL. For example, changes may be justifiable to the load and wasteload allocation portions of a TMDL due to incorrect calculations or inequities. In these cases, revisions to the TMDL allocations would not necessarily include a revision of TMDL targets.

Appendix VII

Hiwassee River Basin Nonpoint Source Program Description and Contacts

Agriculture

USDA Natural Resources Conservation Service:

Part of the U.S. Department of Agriculture (USDA), 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. www.nc.nrcs.usda.gov/

County	Contact Person	Phone	Address
Area 1 Conservationist		828-456-6341	589 Raccoon Road, Suite 246, Waynesville NC 28786
Cherokee		828-837-6417 ext. 3	225 Valley River Ave., Suite J, Murphy, NC 28906
Clay		828-837-6417 ext. 3	225 Valley River Ave., Suite J, Murphy, NC 28906

Soil and Water Conservation Districts:

Boards and staff under the administration of the NC Soil and Water Conservation Commission (SWCC). Districts are responsible for: administering the *Agricultural Cost Share Program for Nonpoint Source Pollution Control* at the county level; identifying areas needing soil and/or water conservation treatment; allocating cost share resources; signing cost share contracts with landowners; providing technical assistance for the planning and implementation of BMPs; and encouraging the use of appropriate BMPs to protect water quality.

Clay County SWCD		828-837-6417	225 Valley River Ave., Suite J, Murphy, NC 28906
Cherokee County SWCD		828-837-6417	225 Valley River Ave., Suite J, Murphy, NC 28906

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, provides administrative and technical assistance related to soil science and engineering. Distributes Wetlands Inventory maps for a small fee. www.enr.state.nc.us/DSWC/

Central Office		919-733-2302	512 N Salisbury Street, Raleigh NC 27604
Asheville Region *		828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778

NCDA&CS Regional Agronomists:

The NC Department of Agriculture & Consumer Services (NCDA&CS) technical specialists: certify waste management plans for animal operations; provide certification training for swine waste applicators; track, monitor, and account for use of nutrients on agricultural lands; operate the state *Pesticide Disposal Program*, and enforce the state pesticide handling and application laws with farmers. www.ncagr.com/

Central Office		919-733-2655	4300 Reedy Creek Road, Raleigh NC 27607
Region 13		828-456-3943	

Education

NC Cooperative Extension Service:

Provides practical, research-based information and programs to help individuals, families, farms, businesses and communities. www.ces.ncsu.edu

Cherokee		828-837-2917	39 Peachtree Street, Suite 103, Murphy, NC 28906
Clay		828-389-6305	55 Riverside Circle, Community Serv Bldg - Room 108, Hayesville, NC 28904

Forestry

DENR 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. www.dfr.state.nc.us

District Office (DFR District 9)	Service Forester	828-586-4007	443 Hwy. 116, Sylva, NC 28779-8513
Region III Mountains	Regional Forester or Asst. Regional Forester	828-251-6509	14 Gaston Mountain Road, Asheville NC 28806-9101
Raleigh Central Office (Statewide)	Forest Hydrologist, NPS Unit	919-733-2162 ext. 206	1616 Mail Service Center, Raleigh NC 27699-1616
Griffiths Forestry Center (Statewide)	Water Quality & Wetlands Forester	919-553-6178 ext. 230	2411 Old U.S. Hwy 70 West, Clayton NC 27250

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. www.dlr.enr.state.nc.us

Central Office		919-733-4574	512 North Salisbury Street, Raleigh NC 27626
Asheville Region *		828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778

Local Erosion and Sedimentation Control Ordinances:

Several local governments in the basin have qualified to administer their own erosion and sedimentation control ordinances. For a listing of the most recently approved local programs visit www.dlr.enr.state.nc.us/pages/sedimentlocalprograms.html

There are no Local Ordinances for the Hiwassee River Basin.

General Water Quality			
DENR DWQ Planning Section: Coordinate the numerous nonpoint source programs carried out by many agencies; coordinate the Neuse and Tar-Pamlico 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. http://h2o.enr.state.nc.us/pb/index.html			
Planning Section Chief		919-733-5083 x 570	1617 Mail Service Center, Raleigh NC 27699
NPS Planning		919-733-5083 x 356	1617 Mail Service Center, Raleigh NC 27699
Modeling/TMDL		919-733-5083 x 505	1617 Mail Service Center, Raleigh NC 27699
Classifications and Standards		919-733-5083 x 579	1617 Mail Service Center, Raleigh NC 27699
Basinwide Planning		919-733-5083 x 354	1617 Mail Service Center, Raleigh NC 27699
Groundwater Planning		919-733-5083 x 522	1617 Mail Service Center, Raleigh NC 27699
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. http://www.enr.state.nc.us/html/regionaloffices.html			
Asheville Region *		828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778
NC 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. www.ncwildlife.org			
Central Office	Wildlife Management	919-707-0050	1722 Mail Service Center, Raleigh NC 27699
U.S. 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. www.usace.army.mil			
Asheville Field Office		828-271-7980	151 Patton Ave, Room 208, Asheville NC 28801

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. http://wastenot.enr.state.nc.us		
Central Office	919-508-8409	401 Oberlin Road, Suite 150, Raleigh NC 27605
Asheville Region *	828-296-4500	2090 U.S. Highway 70, Swannanoa NC 28778
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; and technical assistance to local health departments, other state agencies, and industry on soil suitability and other site considerations for on-site wastewater systems. www.deh.enr.state.nc.us		
Central Office	919-715-3274	2728 Capital Boulevard, Raleigh NC 27604
Asheville Region *	828-397-5152	2090 U.S. Highway 70, Swannanoa NC 28778
Cherokee	828-835-3853	180 Hilton Street, Murphy, NC 28906
Clay	828-389-8326	PO Box 55, Hayesville, NC 28904

* **DENR Asheville Regional Office covers the following counties:** Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, Macon, Madison, McDowell, Mitchell, Polk, Rutherford, Swain, Transylvania and Yancey

Appendix VIII

Use Support Methodology
and
Use Support Ratings

Introduction to Use Support

All surface waters of the state are assigned a classification appropriate to the best-intended uses of that water. Waters are assessed to determine how well they are meeting the classified or best-intended uses. The assessment results in a use support rating for the use categories that apply to that water.

Use Support Categories

Beginning in 2000 with the *Roanoke River Basinwide Water Quality Plan*, DWQ assesses ecosystem health and human health risk through the use of five use support categories: aquatic life, recreation, fish consumption, water supply, and shellfish harvesting. These categories are tied to the uses associated with the primary classifications applied to NC rivers and streams. Waters are Supporting if data and information used to assign a use support rating meet the criteria for that use category. If these criteria are not met, then the waters are Impaired. Waters with inconclusive data and information are Not Rated. Waters where no data or information are available to make an assessment are No Data. The table below specifies which use support categories apply to which primary classifications.

A single water may have more than one use support rating corresponding to one or more of the use support categories, as shown in the following table. For many waters, a use support category will not be applicable (N/A) to the 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* (15A NCAC 2b .0100 and .0200). Information can also be found within each basin plan and at http://h2o.enr.state.nc.us/csu/.

Use Support Categories

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

Assessment Period

Data and information are used to assess water quality and assign use support ratings using a five-year data window that ends on August 31 of the year of basinwide biological sampling. For example, if biological data are collected in a basin in 2004, then the five-year data window for

use support assessments would be September 1, 1999 to August 31, 2004. There are occasionally some exceptions to this data window, especially when follow up monitoring is needed to make decisions on samples collected in the last year of the assessment period.

Data and information for assessing water quality and assigning use support ratings for lakes uses a data window of October 1 to September 30. Any data collected by DWQ during the five-year data window that ends on September 30 of the year of biological sampling will be used to develop a Weight-of-Evidence approach to lakes assessment. Refer to page 16 of this appendix for more information.

Assessment Units

DWQ identifies waters by index numbers and assessment unit numbers (AU). The AU is used to track defined stream segments or waterbodies in the water quality assessment database, for the 303(d) Impaired waters list, and in the various tables in basin plans and other water quality documents. The AU is a subset of the DWQ index number (classification identification number). A letter attached to the end of the AU indicates that the AU is smaller than the DWQ index segment. No letter indicates that the AU and the DWQ index segment are the same.

Interpretation of Data and Information

It is important to understand the associated limitations and degree of uncertainty when interpreting use support ratings. Although these use support methods are based on data analysis and other information, some best professional judgment is applied during these assessments. Use support ratings are intended to provide an assessment of water quality using a five-year data window, to describe how well surface waters support their classified uses, and to document the potential stressors contributing to water quality degradation and the sources of these contributions.

Use support methods continue to improve over time, and the information and technology used to make use support determinations also continue to become more accurate and comprehensive. These improvements sometimes make it difficult to make generalizations comparing water quality between basin plans. However, technology and methods improvements result in more scientifically sound use support assessments.

Assessment Methodology

Introduction

Many types of data and information are used to determine use support ratings and to identify stressors and sources of water quality degradation. All existing data pertaining to a stream segment for each applicable use support category are entered into a use support database. Assessments and data entries may include use support ratings for each of the five use support categories, basis of assessment, stressors and potential sources, biological, chemical/physical (ambient monitoring), and lakes assessment data, fish consumption advisories from the NC Department of Health and Human Services, swimming advisories and shellfish sanitation growing area classifications from the NC Division of Environmental Health, and available land

cover and land use information. The following describes the data and methodologies used to conduct use support assessments. These methods will continue to be refined as additional information and technology become available.

Basis of Assessment

Assessments are made on an overall basis of either monitored (M) or evaluated (E), depending on the level of information available. A monitored rating is based on the most recent five-year data window and site-specific data and is therefore treated with more confidence than an evaluated rating. Evaluated ratings are used when there are no site-specific data.

Rating Basis	Use Support Category	Assessment Applicability*
S/M	AL	Biological community data or ambient water quality parameters do not exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
S/M	REC	Ambient fecal coliform bacteria levels do not exceed criteria in AU or AU with DEH sites is posted with advisories for 61 days or less during assessment period.
S/M	SH	AU is a DEH Approved shellfish growing area.
I/M	AL	Biological community data or ambient water quality parameters exceed criteria in AU during assessment period. Biological and ambient data are independently applied.
I/M	REC	Ambient fecal coliform bacteria levels exceeds criteria in AU or AU with DEH sites is posted with advisories for more than 61 days during assessment period.
I/M	FC	Fish tissue data collected in AU during assessment period and basin is under mercury advice or site-specific advisory.
I/M	SH	AU is a DEH Conditionally-Approved, Prohibited or Restricted shellfish growing area.
NR/M	AL	Biological community is Not Rated or inconclusive, or ambient water quality parameters are inconclusive or there are less than 10 samples in AU during assessment period. Biological and ambient data are independently applied.
NR/M	REC	Ambient fecal bacteria parameter exceeds annual screening criteria, but does not exceed assessment criteria of five samples in 30 days in AU during assessment period.
NR/M	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice; fish tissue data available.
S/E	AL	AU is a tributary to a S/M AU and land use is similar between AUs.
S/E	WS	AU is classified as WS, and DEH report notes no significant closures at time of assessment.
I/E	FC	AU is in basin under a mercury advice or drains to areas within a mercury advice and has no fish tissue data.
NR/E	AL	AU is tributary to I/M AU, or AU is in watershed with intensive and changing land use, or other information suggests negative water quality impacts to AU. Discharger in AU has noncompliance permit violations or has failed three or more WET tests during the last two years of the assessment period.
NR/E	REC	Discharger has noncompliance permit violations of fecal bacteria parameter during last two years of assessment period.
NR/E	FC	AU does not have site-specific advisory and is not under a mercury advice or drains to areas within a mercury advice, or has no fish tissue data.
ND	AL, REC, SH	No data available in AU during assessment period.

Note: S/M = Supporting/Monitored I/M = Impaired/Monitored NR/M = Not Rated/Monitored
S/E = Supporting/Evaluated I/E = Impaired/Evaluated NR/E = Not Rated/Evaluated
ND = No Data
AL = Aquatic Life REC = Recreation FC = Fish Consumption
SH = Shellfish Harvesting WS = Water Supply
AU = Assessment Unit WET = Whole Effluent Toxicity
DEH = Division of Environmental Health
* = for lakes assessments, see page 16

Supporting ratings are extrapolated up tributaries from monitored streams when there are no problematic dischargers with permit violations or changes in land use/cover. Supporting ratings may also be applied to unmonitored tributaries where there is little land disturbance (e.g., national forests and wildlife refuges, wilderness areas or state natural areas). Problem stressors or sources are not generally applied to unmonitored tributaries. Impaired ratings are not extrapolated to unmonitored tributaries.

Stressors

Biological and ambient samplings are useful tools to assess water quality. However, biological sampling does not typically identify the causes of impairment, and ambient sampling does not always link water quality standards to a biological response. Linking the causes of impairment and the biological response are a complex process (USEPA, 2000) that begins with an evaluation of physical, chemical or biological entities that can induce an adverse biological response. These entities are referred to as stressors. A stressor may have a measurable impact to aquatic health. Not all streams will have a primary stressor or cause of impairment. A single stressor may not be sufficient to cause impairment, but the accumulation of several stressors may result in impairment. In either case, impairment is likely to continue if the stressor or the various cumulative stressors are not addressed. Use support assessments evaluate the available information related to potential stressors impacting water quality.

A stressor identification process may be initiated after a stream appears on the 303(d) list in order to address streams that are Impaired based on biological data. Intensive studies are required to summarize and evaluate potential stressors to determine if there is evidence that a particular stressor plays a substantial role in causing the biological impacts. Intensive studies consider lines of evidence that include benthic macroinvertebrate and fish community data, habitat and riparian area assessment, chemistry and toxicity data, and information on watershed history, current watershed activities and land uses, and pollutant sources. These studies result in decisions regarding the probable stressors contributing to or causing impairment. The intensity of a stressor study may be limited due to a lack of resources. In these cases, it may still be appropriate to include stressors in use support assessments, but to also note where additional information is needed in order to evaluate other stressors.

Where an ambient parameter is identified as a potential concern, the parameter is noted in the DWQ database and use support summary table. Where habitat degradation is identified as a stressor, DWQ and others attempt to identify the type of habitat degradation (e.g., sedimentation, loss of woody habitat, loss of pools or 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.

Aquatic Life Category

The aquatic life category is an ecosystem approach to assessing the biological integrity of all surface waters of the state. The biological community data and ambient water quality data are used in making assessments in this category. These represent the most important monitoring data for making water quality assessments in the aquatic life category. Evaluation information such as compliance and whole effluent toxicity information from NPDES dischargers, land cover, and other more anecdotal information are also used to identify potential problems and to refine assessments based on the monitoring data. The following is a description of each monitoring data type and the criteria used in assigning use support ratings. Criteria used to evaluate the other information and assign use support ratings are also described. Refer to page 14 for lakes and reservoir assessment methods as applied in the aquatic life category.

Biological Data

Benthic macroinvertebrate (aquatic insects) community and fish community samples are the best way to assess the biological integrity of most waterbodies. Unfortunately, these community measures cannot be applied to every stream size and are further limited by geographic region. These community measures are designed to detect current water quality and water quality changes that may be occurring in the watershed. However, they are only directly applied to the assessment unit where the sample was collected.

Where recent data for both benthic macroinvertebrates and fish communities are available, both are assessed for use support ratings. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit.

Benthic Macroinvertebrate Criteria

Criteria have been developed to assign bioclassifications 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 sample. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored.

If a Fair macroinvertebrate bioclassification is obtained under conditions (such as drought or flood conditions, recent spills, etc.) that may not represent normal conditions or is borderline Fair (almost Good-Fair), a second sample should be taken within 12-24 months to validate the Fair bioclassification. Such sites will be Not Rated until the second sample is obtained.

Use support ratings are assigned to assessment units using benthic macroinvertebrate bioclassifications as follows.

Waterbody Sample Type or Criteria	Benthic Bioclassification	Use Support Rating
Mountain, piedmont, coastal A[3]	Excellent	Supporting
Mountain, piedmont, coastal A[3]	Good	Supporting
Swamp[1]	Natural	Supporting
Mountain, piedmont, coastal A	Good-Fair	Supporting
Smaller than criteria but Good-Fair[2]	Not Impaired	Supporting
Swamp[1]	Moderate Stress	Supporting
Mountain, piedmont, coastal A[3]	Fair	Impaired
Swamp[1]	Severe Stress	Impaired
Mountain, piedmont, coastal A[3]	Poor	Impaired
Criteria not appropriate to assign bioclassification	Not Rated	Not Rated

1 Swamp streams for benthos sampling are defined as streams in the coastal plain that have no visible flow for a part of the year, but do have flow during the February to early March benthic index period.

2 This designation may be used for flowing waters that are too small to be assigned a bioclassification (less than three square miles drainage area), but have a Good-Fair or higher bioclassification using the standard qualitative and EPT criteria.

3 Coastal A streams are those located in the coastal plain that have flow year round and are wadeable.

Fish Community Criteria

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. Because these data represent water quality conditions with a high degree of confidence, use support ratings using these data are considered monitored. Use support ratings are assigned to assessment units using the NCIBI bioclassifications as follows:

NCIBI	Use Support Rating
Excellent	Supporting
Good	Supporting
Good-Fair	Supporting
Fair	Impaired
Poor	Impaired

The NCIBI was recently revised (NCDENR, 2001), and the bioclassifications and criteria have also been recalibrated against regional reference site data (NCDENR, 2000a, 2000b and 2001a). NCIBI criteria are applicable only to wadeable streams in the following river basins: Broad, Catawba, Savannah, Yadkin-Pee Dee, Cape Fear, Neuse, Roanoke, Tar-Pamlico, French Broad, Hiwassee, Little Tennessee, New and Watauga. Additionally, the NCIBI criteria are only applicable to streams in the piedmont portion of the Cape Fear, Neuse, Roanoke and Tar-Pamlico River basins. The definition of "piedmont" for these four river basins is based upon a map of North Carolina watersheds (Fels, 1997). Specifically:

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

NCIBI criteria have not been developed for:

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

Ambient Water Quality Monitoring Criteria

Chemical/physical water quality data are collected through the DWQ Ambient Monitoring Program statewide and NPDES discharger coalitions in some basins. All samples collected (usually monthly) during the five-year assessment period are used to assign a use support rating. Ambient water quality data are not direct measures of biological integrity, but the chemical/physical parameters collected can provide an indication of conditions that may be impacting aquatic life. Because these data represent water quality conditions with a high degree of confidence, use support ratings assigned using these data are considered monitored. Where both ambient data and biological data are available, each data type is assessed independently.

The parameters used to assess water quality in the aquatic life category include dissolved oxygen, pH, chlorophyll *a* and turbidity. Criteria for assigning use support ratings to assessment units with ambient water quality data of a minimum of ten samples are as follows:

Ratings Criteria	Rating
Numerical standard exceeded in ≤10% of samples	Supporting
Numerical standard exceeded in >10% of samples	Impaired
Less than 10 samples collected	Not Rated
DO and pH standard exceeded in swamp streams	Not Rated

Some standards are written with more specific criteria than others and these specific criteria are used to assess use support. For example, the DO standard for Class C waters is a daily average of 5 mg/l and an instantaneous value of 4 mg/l. Because DWQ does not collect daily DO levels

at the ambient stations, the instantaneous value is used for assessment criteria. In areas with continous monitoring, the daily average of 5 mg/l will also be assessed. In addition, pH has a standard of not less than 6 and not greater than 9; each level is assessed. To assess the fecal coliform bacteria standard, five samples must be collected within a 30 day period (see Recreation Category for more information).

Multiple Monitoring Sites

There are assessment units with more than one type of monitoring data. When the data from multiple biological data types are gathered, each data type is assessed independently. Biological monitoring is typically assessed independent of ambient monitoring data and either may be used to assign a use support rating for an assessment unit. Monitoring data are always used over the evaluation information; however, evaluation information can be used to lengthen or shorten monitored assessment units and to assign use support ratings on an evaluated basis to non-monitored assessment units.

NPDES Wastewater Whole Effluent Toxicity (WET) Information

Whole Effluent Toxicity (WET) tests are required for all major NPDES discharge permit holders, as well as those minor NPDES dischargers with complex effluent (defined as not being of 100 percent domestic waste). WET tests are evaluated to determine if the discharge could be having negative water quality impacts. If a stream with a WET test facility has not been sampled for instream chronic toxicity, biological community data or has no ambient water quality data, and that facility has failed three or more WET tests in the last two years of the assessment period, the assessment unit is Not Rated. Because this information is not a direct measure of water quality and the confidence is not as high as for monitoring data, this use support rating is considered evaluated rather than monitored. Problems associated with WET test failures are addressed through NPDES permits.

NPDES Discharger Daily Monitoring Report (DMR) Information

NPDES effluent data monthly averages of water quality parameters are screened for the last two years of the assessment period. If facilities exceed the effluent limits by 20 percent for two or more months during two consecutive quarters, or have chronic exceedances of permit limits for four or more months during two consecutive quarters, then the assessment unit is Not Rated if no biological or ambient monitoring data are available. Because discharger effluent data is not a direct measure of water quality and data confidence is not as high as for stream monitoring data, the assessment units are considered evaluated rather than monitored. If biological or ambient data are available, that data will be used to develop a use support rating for appropriate stream segments.

Fish Consumption Category

The fish consumption category is a human health approach to assess whether humans can safely consume fish from a waterbody. This category is applied to all waters of the state. The use support rating is assigned using fish consumption advisories or advice as issued by the NC Department of Health and Human Services (DHHS). The fish consumption category is different from other categories in that assessments are based on the existence of a DHHS fish

consumption advice or advisory at the time of use support assessment. The advice and advisories are based on DHHS epidemiological studies and on DWQ fish tissue data, so a fish tissue monitoring site will constitute a monitored assessment unit (AU) and all other AUs will be evaluated. DWQ fish tissue data are used to inform DHHS of potential fish tissue toxicity. DHHS is responsible for proclaiming a fish tissue advisory for any waterbody. Fish tissue monitoring data are not used directly for assigning a use support rating in this category.

If a limited site-specific fish consumption advisory or a no consumption advisory is posted at the time of assessment, the water is Impaired. If there are no site-specific advisories posted or the stream is not in a basin where mercury advice is applied, then the assessment unit will be Not Rated in this category.

The DHHS has developed regional fish consumption advice (all waters south and east of I-85) for certain fish species shown to have elevated levels of mercury in their tissue. DWQ applies the DHHS fish consumption advice for mercury on a basinwide scale rather than an AU scale in recognition that fish move up and downstream regardless of the presence of I-85. All AUs draining below or intersecting I-85 are Impaired in the fish consumption category. AUs with monitoring data are considered Impaired/Monitored, and AUs with no monitoring data are considered Impaired/Evaluated. When a DHHS site-specific advisory is in place for a parameter other than mercury, the assessment is based on that advisory and the mercury advice will take a lower ranking in the assessment. Therefore, when a site-specific advisory is in place in a basin with a mercury advice and the AU has fish tissue monitoring data, the AU will be considered Impaired/Monitored for the specific parameter, rather than Impaired/Evaluated for mercury.

Basins under the mercury advice are the Cape Fear, Chowan, Lumber, Neuse, Pasquotank, Roanoke, White Oak and Yadkin-Pee Dee. All waters in these basins are Impaired in the fish consumption category, even when there is a site-specific advisory. All waters are also considered Monitored or Evaluated, dependent upon the availability of monitoring data.

Only a small portion of the Catawba River basin is intersected by I-85 (lower Mecklenberg, Union and Gaston counties). Due to the presence of dams that impede fish travel throughout the Catawba River basin, only those waters draining to and entering the mainstem Catawba below I-85 and are not impeded by dams are considered Impaired/Evaluated.

Basins not under the mercury advice are the Broad, French Broad, Hiwassee, Little Tennessee, New, Savannah and Watauga. All waters in these basins are Not Rated in the fish consumption category if there is no site-specific advisory; waters are Impaired if there is a site-specific advisory. All waters are also considered Monitored or Evaluated, dependent upon the availability of monitoring data.

Recreation Category

This human health related category evaluates waters for the support of primary recreation activities such as swimming, water-skiing, skin diving, and similar uses usually involving human body contact with water where such activities take place in an organized manner or on a frequent basis. Waters of the state designated for these uses are classified as Class B, SB and SA. This category also evaluates other waters used for secondary recreation activities such as wading, boating, and other uses not involving human body contact with water, and activities involving

human body contact with water where such activities take place on an infrequent, unorganized or incidental basis. Waters of the state designated for these uses are classified as Class C, SC and WS.

The use support ratings applied to this category are currently based on the North Carolina fecal coliform bacteria water quality standard where ambient monitoring data are available or on the duration of local or state health agencies posted swimming advisories. Use support ratings for the recreation category may be based on other bacteriological indicators and standards in the future.

DWQ conducts monthly ambient water quality monitoring that includes fecal coliform bacteria testing. The Division of Environmental Health (DEH) tests coastal recreation waters (beaches) for bacteria levels to assess the relative safety of these waters for swimming. If an area has elevated bacteria levels, health officials will advise that people not swim in the area by posting a swimming advisory and by notifying the local media and county health department.

The North Carolina fecal coliform bacteria standard for freshwater is: 1) not to exceed the geometric mean of 200 colonies per 100 ml of at least five samples over a 30-day period; and 2) not to exceed 400 colonies per 100 ml in more than 20 percent of the samples during the same period. The AU being assessed for the five-year data window is Supporting in the recreation category if neither number (1) nor (2) of the standard are exceeded. The AU being assessed is Impaired in the recreation category if either number (1) or (2) is exceeded. Waters without sufficient fecal coliform bacteria data (five samples within 30 days) are Not Rated, and waters with no data are noted as having No Data.

Assessing the water quality standard requires significant sampling efforts beyond the monthly ambient monitoring sampling and must include at least five samples over a 30-day period. Decades of monitoring have demonstrated that bacteria concentrations may fluctuate widely in surface waters over a period of time. Thus, multiple samples over a 30-day period are needed to evaluate waters against the North Carolina water quality standard for recreational use support. Waters classified as Class SA, SB and B are targeted for this intensive sampling effort due to the greater potential for human body contact.

Waters with beach monitoring sites will be Impaired if the area is posted with an advisory for greater than 61 days of the assessment period. Waters with beach monitoring sites with advisories posted less than 61 days will be Supporting. Other information can be used to Not Rate unmonitored waters.

DWQ Ambient Monitoring Fecal Coliform Bacteria Screening Criteria

As with other information sources, all available information and data are evaluated for the recreation category using the assessment period. However, DWQ conducts an annual screening of DWQ ambient fecal coliform bacteria data to assess the need for additional monitoring or immediate action by local or state health agencies to protect public health.

Each March, DWQ staff will review bacteria data collections from ambient monitoring stations statewide for the previous sampling year. Locations with annual geometric means greater than 200 colonies per 100 ml, or when more than 20 percent of the samples are greater than 400

colonies per 100 ml, are identified for potential follow-up monitoring conducted five times within 30 days as specified by the state fecal coliform bacteria standard. If bacteria concentrations exceed either portion of the state standard, the data are sent to DEH and the local county health director to determine the need for posting swimming advisories. DWQ regional offices will also be notified.

Due to limited resources and the higher risk to human health, primary recreation waters (Class B, SB and SA) will be given monitoring priority for an additional five times within 30 days sampling. Follow-up water quality sampling for Class C waters will be performed as resources permit. Any waters on the 303(d) list of Impaired waters for fecal coliform will receive a low priority for additional monitoring because these waters will be further assessed for TMDL development.

DWQ attempts to determine if there are any swimming areas monitored by state, county or local health departments or by DEH. Each January, DEH, county or local health departments are asked to list those waters which were posted with swimming advisories in the previous year.

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 assign use support ratings for shellfish waters.

Division of Environmental Health (DEH) Shellfish Sanitation Surveys

DEH is required to classify all shellfish growing areas as to their suitability for shellfish harvesting. Estuarine waters are delineated according to DEH shellfish management areas (e.g., Outer Banks, Area H-5) which include Class SA, SB and SC waters. DEH samples growing areas regularly and reevaluates the areas by conducting shellfish sanitation shoreline 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 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. These areas tend to be open more frequently than closed.

Conditionally Approved-Closed (CAC)	Sanitary Survey indicates an area can meet approved area criteria for a reasonable period of time, and the pollutant event is known and predictable and can be managed by a plan. These areas tend to be closed more frequently than open.
Restricted (RES)	Sanitary Survey indicates limited degree of pollution, and the area is not contaminated to the extent that consumption of shellfish could be hazardous after controlled depuration or relaying.
Prohibited (PRO)	No Sanitary Survey; point source discharges; marinas; data do not meet criteria for Approved, Conditionally Approved or Restricted Classification.

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

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 DWQ Class SA (shellfish harvesting) waters. 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. This will result in a difference of acreage between DEH areas classified as CAC, PRO and RES, and DWQ waters rated as Impaired. 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 rated as Impaired.

The DEH "Closed" polygon coverage includes CAC, RES and PRO classifications, and it is not currently possible to separate out the PRO from the RES areas. Therefore, these areas are a combined polygon coverage, and DWQ rates these waters as Impaired.

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 information 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 frequency of closures. In the interim, DWQ has been identifying the frequency of closures in Class SA waters using an interim methodology (see below) based on existing databases and GIS shapefiles. There will be changes in reported acreages in future assessments using the permanent methods and tools that result from this project.

Past Interim Frequency of Closure-Based Assessment Methodology

The interim method was 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.

Percent of Time Closed within Basin Data Window	DEH Growing Area Classification	DWQ Use Support Rating
N/A	Approved*	Supporting
Closed ≤10% of data window	Portion of CAO closed ≤10% of data window	Supporting
Closed >10% of the data window	Portion of CAO closed >10% of data window	Impaired
N/A	CAC and PRO/RES**	Impaired

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

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

For CAO areas, DWQ worked with DEH to determine the number of days and acreages that CAO Class SA waters were closed to shellfish harvesting during the assessment period. For each growing area with CAO Class SA waters, DEH and DWQ defined subareas within the CAO area that were opened and closed at the same time. The number of days these CAO areas were closed was determined using DEH proclamation summary sheets and the original proclamations.

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

Current Assessment Methodology

Use support assessment is now conducted such that only the DEH classification will be used to assign a use support rating. By definition, CAO areas are areas that DEH has determined do not, or likely do not, meet water quality standards and these areas will be rated Impaired, along with CAC and PRO/RES areas. Only APP areas will be rated Supporting.

Growing areas that have been reclassified by DEH during the assessment period from a lower classification to APP will be rated Supporting. Areas that are reclassified from APP to any other classification during the assessment period will be rated Impaired.

Over the next few years, DWQ, DEH, Division of Coastal Management (DCM) and Division of Marine Fisheries (DMF) will be engaged in developing a database with 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. 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 large or named storms.

Water Supply Use Support

This human health related use support category is used to assess all Class WS waters for the ability of water suppliers to provide potable drinking water. Water quality standards established for drinking water apply to water delivered to consumers after it has been treated to remove potential contaminants that may pose risks to human health. Ambient standards established by states under the Clean Water Act are not intended to ensure that water is drinkable without

treatment. Modern water treatment technologies are required to purify raw water to meet drinking water standards as established by the North Carolina Division of Environmental Health.

Water supply use support is assessed by DWQ using information from the seven DEH regional water treatment plant consultant staff. Each January, the DEH staff consultants are asked to 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, and the reason for the closure or switch.

The spreadsheets are reviewed by DWQ staff 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. Using these criteria, North Carolina's surface water supplies are currently rated Supporting on an Evaluated basis. Specific criteria for rating waters Impaired are to be determined on a case-by-case basis.

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 90 days for data to be submitted. Data from sources outside DWQ are screened for data quality and quantity. If data are of sufficient quality and quantity, they may be incorporated into use support assessments. A minimum of ten samples for more than a one-year period is needed to be considered for use support assessments.

The way the solicited data are used depends on the degree of quality assurance and quality control of the collection and analysis of the data as detailed in the 303(d) report and shown in the table below. Level 1 data can be use with the same confidence as DWQ data to determine use support ratings. Level 2 or Level 3 data may be used to help identify causes of pollution and stressors. 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

Lakes and Reservoir Use Assessment

Like streams, lakes are classified for a variety of uses. All lakes monitored as part of North Carolina's Ambient Lakes Monitoring Program carry the Class C (aquatic life) classification, and most are classified Class B and SB (recreation) and WS-I through WS-V (water supply). The surface water quality numeric standard specifically associated with recreation is fecal coliform. For water supplies, there are 29 numeric standards based on consumption of water and fish. Narrative standards for Class B and Class WS waters include aesthetics such as no odors and no untreated wastes. There are other numeric standards that also apply to lakes for the protection of aquatic life and human health. These standards also apply to all other waters of the state and are listed under the Class C rules. One of the major problems associated with lakes and reservoirs is increasing eutrophication related to nutrient inputs. Several water quality parameters help to describe the level of eutrophication.

For nutrient enrichment, one of the main causes of impacts to lakes and reservoirs, a more holistic or weight of evidence approach is necessary since nutrient impacts are not always reflected by the parameters sampled. For instance, some lakes have taste and odor problems associated with particular algal species, yet these lakes do not have chlorophyll *a* concentrations above 40 µg/l frequently enough to impair them based on the standard. In addition, each reservoir possesses unique traits (watershed area, volume, depth, retention time, etc.) that dramatically influence its water quality, but that cannot be evaluated through standards comparisons. In such waterbodies, aquatic life may be Impaired even though a particular indicator is below the standard. Where exceedances of surface water quality standards are not sufficient to evaluate a lake or reservoir, the weight of evidence approach can take into consideration indicators and parameters not in the standards to allow a more sound and robust determination of water quality.

The weight of evidence approach uses the following sources of information to determine the eutrophication (nutrient enrichment) level as a means of assessing lake use support in the aquatic life category:

- Quantitative water quality parameters - dissolved oxygen, chlorophyll *a*, pH, etc.
- Algal bloom reports
- Fish kill reports
- Hydrologic and hydraulic characteristics – watershed size, lake volume, retention time, volume loss, etc.
- Third party reports – citizens, water treatment plant operators, state agencies, etc.
    - Taste and odor
    - Sheens
    - Odd colors
    - Other aesthetic and safety considerations

In implementing the weight of evidence approach for eutrophication, more consideration is given to parameters that have water quality standards (see table). Each parameter is assessed for percent exceedance of the state standard. Parameters with sufficient (ten or more observations), quality-assured observations are compared to surface water quality standards. When standards

are exceeded in more than 10 percent of the assessment period, portions or all of the waterbody are rated Impaired.

However, in many cases, the standards based approach is incapable of characterizing the overall health of a reservoir. The eutrophication-related parameters and water quality indicators without numeric standards are reviewed based on interpretation of the narrative standards in 15A NCAC 2B .0211(2) and (3).

A modification to lake use assessment is the evaluation and rating of a lake or reservoir by assessment units (AUs). Each lake or reservoir may have one or more AU based on the classification segments (DWQ index numbers). Each sampling date is considered one sample. Multiple sampling locations within one AU are considered one sample. A minimum of ten samples is needed to assess use support for any AU. Each AU with documented problems (sufficient data, ambient data above standards, and supporting public data) will be rated as Impaired while the other portions are rated as Supporting or Not Rated. The following table lists the information considered during a lake/reservoir use assessment, as well as the criteria used to evaluate that information.

References

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Lake/Reservoir Weight of Evidence Use Assessment for Aquatic Life Category	
Assessment Type	**Criteria**
EUTROPHICATION	
Water Quality Standards (a minimum of 10 samples is required for use support assessment)	
Chl *a*	Above standard in >10% of samples.
DO	Below or above standard in >10% of samples.
pH	Below or above standard in >10% of samples.
Turbidity	Above standard in >10% of samples.
% Total Dissolved Gases	Above standard in >10% of samples.
Temperature	Minor and infrequent excursions of temperature standards due to anthropogenic activity. No impairment of species evident.
Metals (excluding copper, iron and zinc)	Above standard in >10% of samples.
Other Data	
% Saturation DO	>10% of samples above >120%
Algae	Blooms during 2 or more sampling events in 1 year with historic blooms.
Fish	Kills related to eutrophication.
Chemically/ Biologically Treated	For algal or macrophyte control - either chemicals or biologically by fish, etc.
Aesthetics Complaints	Documented sheens, discoloration, etc. - written complaint and follow-up by a state agency.
Trophic Status Index (TSI)	Increase of 2 trophic levels from one 5-year period to next.
Historic DWQ Data	Conclusions from other reports and previous use support assessments.
AGPT	Algal Growth Potential Test ≥5 mg/L
Macrophytes	Limiting access to public ramps, docks, swimming areas; reducing access by fish and other aquatic life to habitat; clogging intakes.
Taste and Odor	Public complaints; Potential based on algal spp.
Sediments	Clogging intakes - dredging program necessary.

Appendix IX

Glossary

Glossary

7Q10	The annual minimum 7-day consecutive low flow, which on average will be exceeded in 9 out of 10 years.
ACOE	United States Army Corps of Engineers.
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 over enrichment 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).
conductivity	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.
DEH	Department of Environmental Health

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.
DHHS	Department of Health and Human Services.
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.
EEP	Ecosystem Enhancement Program (EEP)
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.
FDA	Unites States Food and Drug Administration.
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 water body that is not meeting the designated use criteria.
impervious	Incapable of being penetrated by water; non-porous.
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.
NOV	Notices of Violation. An NOV serve to alert the permittee of permit infractions and request that whatever caused the violation be corrected immediately. Many times these will not include a fine. Depending upon the severity of the violation, the permittee may receive a Notice of Violation and Assessment of a Civil Penalty, which will include a fine.
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.
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.
PCBs	Polychlorinated Biphenyls. PCBs are man-made chemicals that persist in the environment. There are a number of adverse health effect associated with exposure to PCBs.
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.
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).
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.
SWCD	Soil and Water Conservation District
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.
USGS	United States Geological Survey
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.
WTP	Water Treatment Plant
WWTP	Wastewater treatment plant.