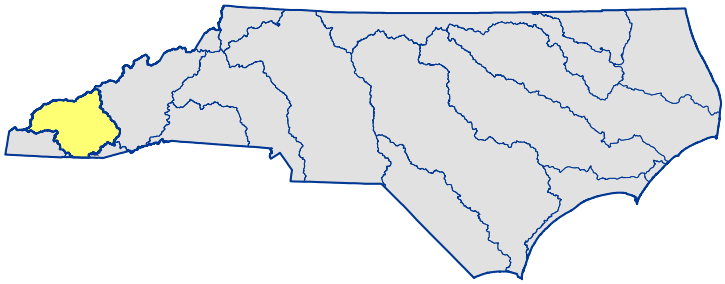
Little Tennessee River Basinwide Water Quality Plan



Summary

Introduction

This 2012 document is the fourth five-year update of the Little Tennessee River Basinwide Water Quality Plan. Previous basinwide plans for the Little Tennessee River Basin were completed in 1997, 2002, and 2007 and are available from the DWQ Basinwide Planning website. This basin plan was written to provide guidance for watershed stakeholders, municipal planners, natural resource regulators, and other environmental professionals with identifying and addressing water quality stressors, sources, and emerging issues. This document can be used in conjunction with the Supplemental Guide to Basinwide Planning which provides general information about water quality issues and DWQ programs.

National Pollution Discharge Elimination System (NPDES) permits were issued in 2012 for a five year period. Basinwide biological and lake sampling last occurred in the Little Tennessee River Basin in 2009 and will be conducted again in 2014.

The Little Tennessee River Basin spans over 1,797 square miles and is divided into three subbasins, Figure 1-1. The Division of Water Quality grouped these subbasins to conform to the federal system of river basin management. Previously, DWQ had its own set of subbasins and numbering system (formerly 040401, 040402, 040403, 040404), but is now using the federal cataloging unit known as hydrologic unit codes (HUCs), Figure 1-2. This report is organized by chapters at the 8-digit hydrologic unit or subbasin level.

The Little Tennessee River is one of three North Carolina river basins that flow westward into the Tennessee Region and eventually drain into the Mississippi River, Figure 1-3.

This plan includes three chapters covering water quality information for each of the subbasins:

- Chapter 1: Upper Little Tennessee River Subbasin HUC 06010202
- Chapter 2: Tuckasegee River Subbasin HUC 06010203
- Chapter 3: Lower Little Tennessee River Subbasin HUC 06010204

Basin at a Glance

Land Area square miles....1,797
Stream Miles.....2,501
Lake/Reservoir acres.....14,171

Counties:

Cherokee, Clay, Graham, Jackson, Macon, Swain,

Municipalities:

Bryson City, Dillsboro, Forest Hills, Franklin, Highlands, Robbinsville, Sylva, Santeetlah, Webster

Population:

2000.....81,917
2010.....94,566

2006 Land Cover:

Developed.....5%
Forested.....91%
Agriculture.....4%

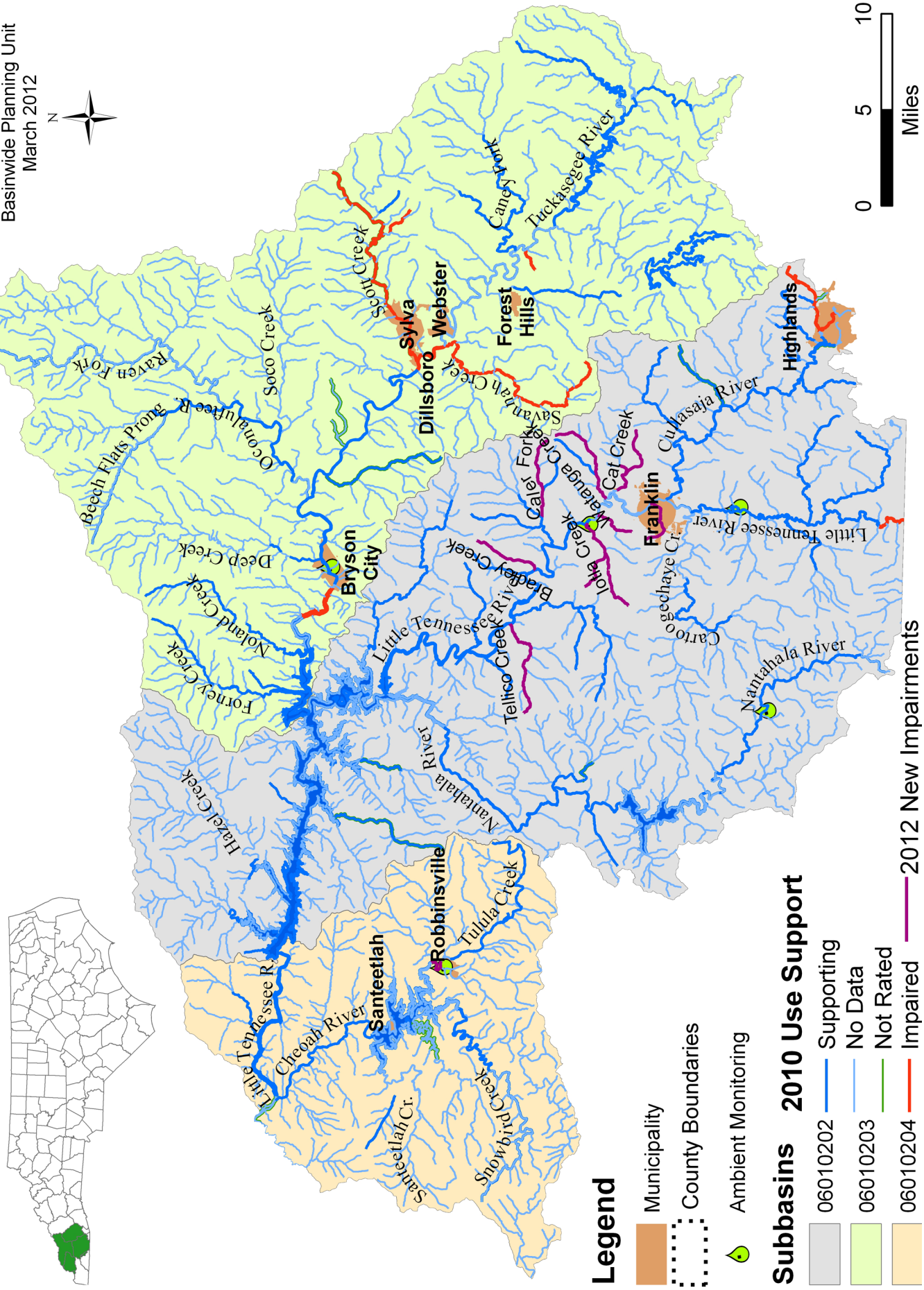
EPA Level IV Ecoregions:

Broad Basins, High Mtns., Southern Crystalline Ridges & Mtns., & Southern Metasedimentary Mtns.

Permited Facilities:

NPDES
Wastewater Discharge.....58
Wastewater Nondischarge...13
Stormwater.....38
Aquaculture Operations.....4

Figure 1-1: Little Tennessee River Basin Map

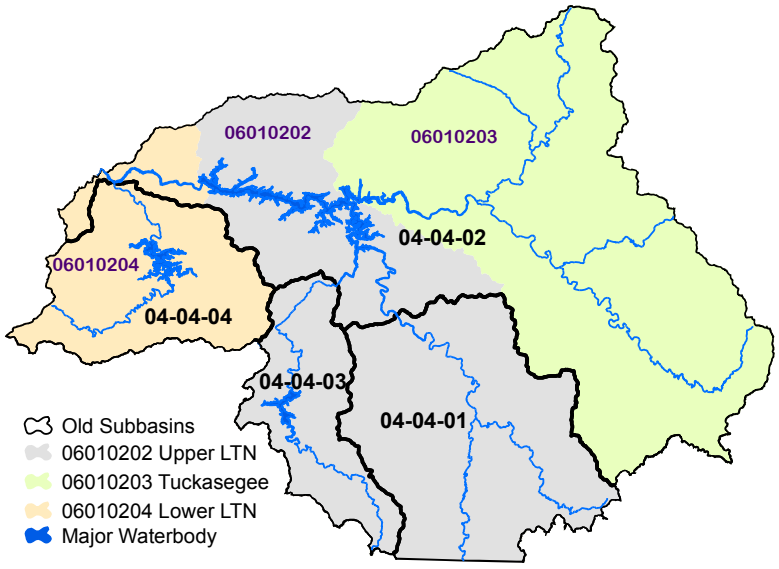


Overview

The Little Tennessee River basin is located within the Blue Ridge Province of the Appalachian Mountains of western North Carolina. It encompasses ~1,800 mi^2 in Swain, Macon, Clay, Graham, Cherokee, and Jackson counties. Much of the land within the basin is federally owned (49%) and in the U.S. Forest Service's Nantahala National Forest (Joyce Kilmer/Slick Rock Wilderness Area) or the Great Smoky Mountains National Park. The basin also includes the Cherokee Indian Reservation.

The Little Tennessee River is one of three major tributaries of Fontana Lake. The other two are the Nantahala River and the Tuckasegee River. The Cheoah River, the fourth major tributary of the Little Tennessee River in North Carolina, has its confluence with the river below Fontana Lake.

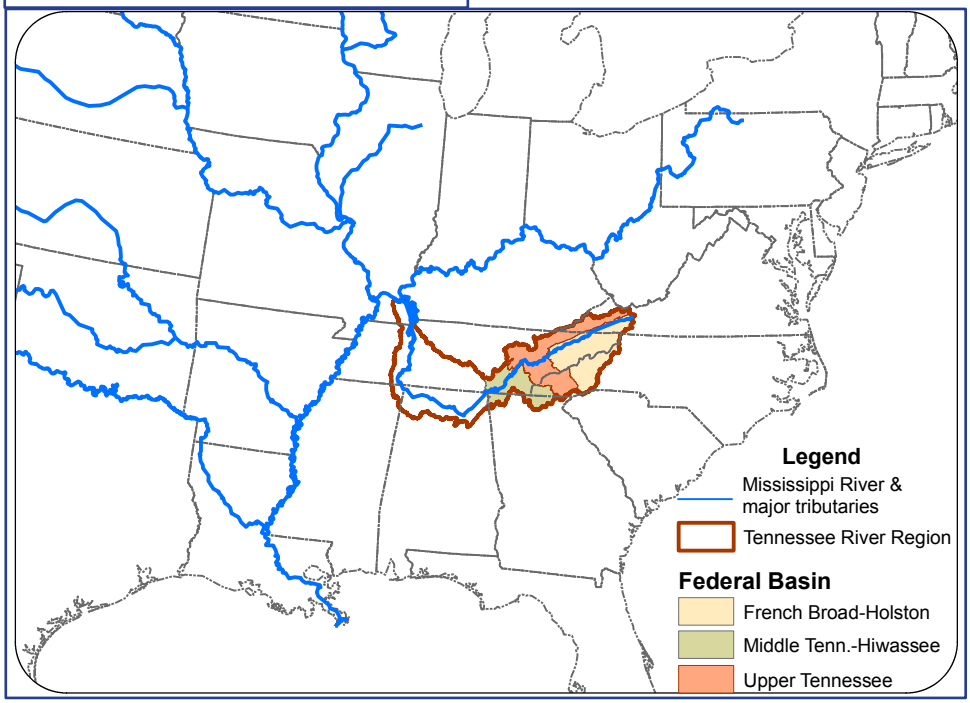
Figure 1-2: Old DWQ Subbasin- HUC Subbasin Conversion Map



The North Carolina section of the Little Tennessee River is typical of many other mountain rivers. The gradient is relatively steep in most reaches of the river and the substrate is dominated by riffle habitats. Most tributaries are high gradient streams capable of supporting trout populations in the upper reaches. The Basin has one of the most outstanding and diverse aquatic communities within the entire state. It is home to a variety of rare species, including crayfish, mussels, fish, aquatic insects, and amphibians. The stretch of Little Tennessee River between Franklin and Fontana Lake (25 miles) has a faunal diversity that rivals any in the state and perhaps in the nation. Forested land continues to comprise a large majority of this basin, owing to its relatively pristine condition.

Although habitat fragmentation due to dam construction has occurred throughout this system in North Carolina and Tennessee, it continues to support an incredibly rich and diverse ecosystem. Mountain home development on steep slopes is an increasing environmental concern and the lower reaches of many tributary catchments are farmed or developed resulting in the increased potential for nonpoint source problems.

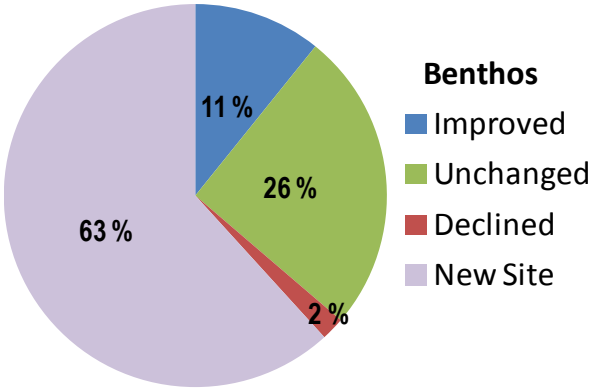
Figure 1-3: Tennessee River Region



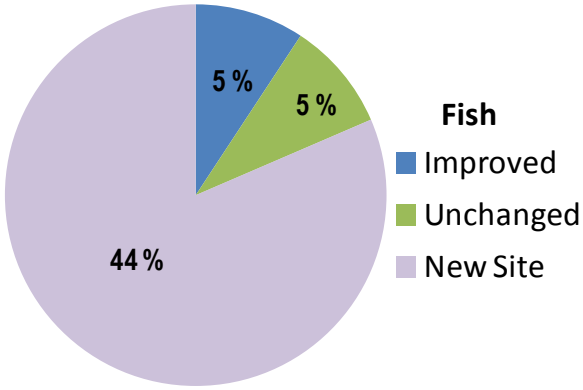
Water Quality Summary

There are five ambient water quality monitoring stations within the Basin, of which turbidity and low pH are the only parameters that have had incidences of exceeding surface water standards. Special Studies and data collected by other groups have documented incidences of high turbidity levels, high nutrient levels and high fecal coliform bacteria levels. Biological samples were taken at 39 macroinvertebrate and 12 fish community basinwide sites with an additional 63 macroinvertebrate and 42 fish samples taken because of special study requests. A majority of the macroinvertebrate sites have Excellent Bioclassification ratings and most of the fish community sites resulted in a Not Rated status due to absence of criteria for rating high gradient mountain trout waters.

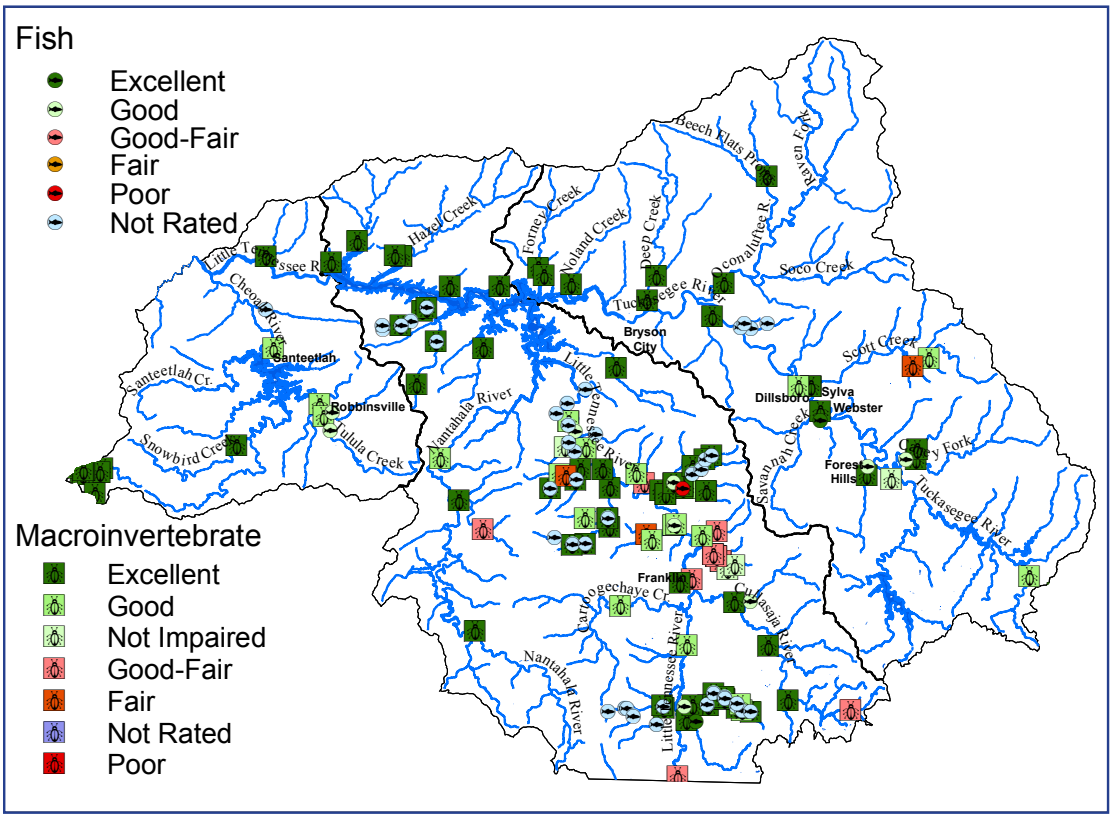
Change in Benthic Macroinvertebrate Site Ratings



Change in Fish Community Site Ratings



Biological Sample Sites and Ratings between 2005-2011



Improved Waters

The Cullasaja River (Ravenel Lake) AU# 2-21-(0.5)a is no longer Impaired for biological integrity as the benthic macroinvertebrate sample resulted in a Good-Fair Bioclassification rating in 2010. This is an improvement over the Fair rating it received in the previous four samples.

Impaired Waters

Water quality data within a 5- year data sampling period is assessed every two years and reported to EPA to meet requirements under Section 303(d) of the Clean Water Act of 1972. Impaired waterbodies exceed a surface water quality standard for that waterbody's designated use; these waterbodies are listed on the 303(d) list. The following list in Table 1-1 includes waterbodies in which a parameter exceeded the standard and enough samples were collected to meet criteria assessment.

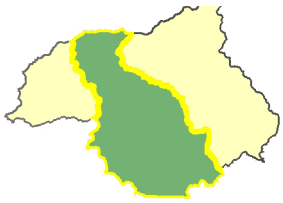
Table 1-1: Impaired Waters

Waterbody	Classification	Assessment Unit #	Length	Parameter	Impaired Year
Caler Fork Creek	C	2-29-4	4.6 mi.	EBIF	2012
Cat Creek	C	2-23-4a 2-23-4b 2-23-4b	2.5 mi 0.5 mi. 0.5 mi.	FCB EBIB FCB	2012 2010 2012
Cheoah River	C;Tr	2-190-(3.5)	1.4 mi.	Turbidity	2012
Crawford Branch	C	2-22	2.7 mi.	FCB EBIB	2012
Cullasaja River (Ravenel Lake)	WS-III;Tr	2-21-(0.5)b	0.7 mi.	EBIB	1998
Bradley Creek	C;Tr	2-33	3.7 mi.	FCB	2012
Iotla Branch	C	2-27-1	2.4 mi.	FCB	2012
Iotla Creek	C	2-27	5.5 mi.	FCB	2012
Little Tennessee R.	C	2-(1)a	2.1 mi.	EBIF	2002
Mill Creek	WS-III;Tr	2-21-3	1.3 mi.	EBIB	1998
Rabbitt Creek	C;Tr	2-23b	2.1 mi.	EBIB FCB	2010 2012
Rocky Branch	C	2-26	2.3 mi.	FCB	2012
Savannah Creek	C;Tr	2-79-36	13.4 mi.	FCB	2008
Scott Creek	C;Tr	2-79-39	15.3 mi.	FCB	2008
Sugarloaf Creek	C	2-79-39-5-1	1.8 mi.	EBIB	2010
Tellico Creek	C;Tr	2-40b	1.0 mi.	EBIB	2012
Tuckasegee River Arm of Fontana Lake	C	2-(78)a	170.6 ac.	FCB	2008
Tuckasegee River	C	2-79-(38)	0.7 mi.	FCB	2008
Tuckasegee River	C;Tr	2-79-(35.5)a 2-79-(35.5)b	1.4 mi. 0.5 mi.	FCB	2008
UT Tuckasegee	C	2-79-(24)ut4	1.3 mi.	Low pH	2010
Watauga Creek	C;Tr	2-24	5.4 mi.	FCB	2012

EBIF= Ecological Biological Integrity Fish Community
EBIB= Ecological Biological Integrity Benthos (Macroinvertebrates) Community
FCB= Fecal Coliform Bacteria

Subbasin Water Quality Summaries

Upper Little Tennessee River Subbasin HUC 06010202

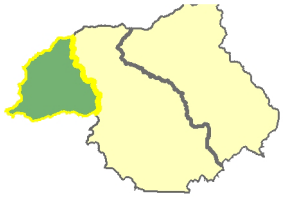


Water quality issues of concern in this subbasin include impacts from developments on steep slopes, agricultural runoff, trout farm waste, stream bank erosion, limited riparian buffers, failing culverts and individual onsite wastewater failures. Waterbodies currently on the 2010 303(d) list of Impaired waters include: a two mile reach of the Little Tennessee River, Cullasaja River, Mill Creek, Cat Creek, Rabbit Creek and Iotla Branch. Also a new fish advisory was issued in 2008 for Lake Fontana due to the potential mercury content in walleye. In 2011, The **Little Tennessee Watershed Association** completed their State of the Streams report. This document is an excellent resource, covering land use changes, natural history, local biomonitoring program results and restoration initiatives.

Chapter 2: Tuckasegee River Subbasin HUC 06010203

This subbasin contains some of the most pristine high quality waters in the state and supports numerous trout streams. Water quality issues of concern in this subbasin include impacts from developments on steep slopes, agricultural runoff, stream bank erosion, limited riparian buffers and individual onsite wastewater failures. Waterbodies currently on the 2010 303(d) list of Impaired waters include: a 1.3 mile unnamed tributary to the Tuckasegee River, Scott Creek, Sugarloaf Creek, Savannah Creek and 170 acres of the Tuckasegee River Arm of Fontana Lake.

Chapter 3: Lower Little Tennessee River Subbasin HUC 06010204



This subbasin contains high quality waters and supports numerous trout streams. Water quality issues of concern in this subbasin include agricultural runoff, stream bank erosion, and individual onsite wastewater failures. There are currently no waterbodies on the 2010 303(d) list of Impaired waters, however a new fish advisory was issued in 2008 for Lake Santeetlah due to the potential mercury content in walleye. Water quality improvements were made in West Buffalo Creek with the removal of four trout farms that were contributing nutrients to Santeetlah Lake, in the Cheoah River with the improved management of water releases from Santeetlah Dam to support aquatic habitat, and in the Tellico River watershed by the restoration of forest and stream conditions impacted from off-highway vehicle recreation.

Local Initiatives & Needs

One of the major assets this basin has to protect and preserve water quality are the local groups that are actively participating in stream restoration, protection, monitoring, education, research and land acquisition. Their specific activities are incorporated within the descriptions of water quality issues within the subbasin chapters of this Basin Plan. DWQ supports and encourages these local groups to continue to identify problems and solutions and to implement activities to improve and protect water quality.

Sediment Control

In 1995, a group of Little Tennessee River Basin stakeholders, particularly non-profit organizations and public agencies, was convened as the Little Tennessee Non-Point Source Team (LTNPST) by the NC Division of Water Quality. The participants in the LTNPST continue to meet on a regular basis to exchange information and ideas and, at times, pursue collaborative opportunities. Various participants facilitated the meetings and in 2007, NC Natural Heritage Program assumed a leadership role in convening meetings. In 2008, a Conservation Action Plan for the Upper Little Tennessee River Basin was assembled with assistance

from World Wildlife Fund, and with direction provided by LTNPST. In 2009, the stakeholders changed the name of this informal group to “Partners for the Little Tennessee”.

The PLT has identified the need for a system of erosion and sediment control (E&SC) trainings within the western North Carolina region as a priority, as some counties require contractors to have annual E&SC training while other counties do not. Research about mountainous terrain E&SC best management practices specific to western NC has been identified as a need. In November 2009, key PLT participants (Land Trust for the Little Tennessee, Watershed Association of the Tuckasegee River, Little Tennessee Watershed Association, Jackson-Macon Conservation Alliance, Southwestern Resource Conservation and Development Service, NC Natural Heritage Program) invited the Hiwassee River Watershed Coalition and Haywood Waterways Association to a discussion about E&SC training for the seven westernmost counties [Haywood, Jackson, Macon, Swain, Graham, Clay, Cherokee]. This steering committee has been meeting since that time, working on the Regional Erosion and Sediment Control Initiative for Western North Carolina. The steering committee continues to pursue grant funding and promote this effort which could have a significant impact on the sedimentation problem in mountain region stream systems. In addition to the benefit of reduced sedimentation, the initiative will benefit local economies and small businesses by helping contractors create and retain jobs.

Franklin to Fontana Local Watershed Plan

Between 2008 and 2011, the North Carolina Ecosystem Enhancement Program led a watershed study and planning effort in the Little Tennessee River watershed between Lake Emory and Lake Fontana. This effort included an assessment of the health of the Little Tennessee River and its tributaries, identification of the major stressors that impact stream quality, development of a plan that names specific recommendations to restore and protect watershed resources, and the production of an atlas of on-the-ground projects that can provide the greatest benefit to the watershed. The data collected during this assessment greatly enhanced DWQ’s existing dataset and provides valuable knowledge on site specific restoration needs. Implementation of identified restoration and protection projects is encouraged.

Impervious Surfaces

Impervious surfaces alter the natural hydrology by preventing infiltration of water into the soil. Impervious surfaces include roads, rooftops, and parking lots; all are characteristics of conventional growth and development. 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. Bank scour from these frequent high flow events tends to enlarge streams and increase suspended sediment. These effects are compounded when small streams are channelized or piped, and storm sewer systems are installed to increase transport of stormwater downstream.

Progressive planning is needed to protect our water resources to prevent exceeding a watershed’s impervious surface threshold. 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 (HQW, Phase 2 NPDES, etc) with just a single set of requirements.

Trout Farms

Macroinvertebrate and chemical sampling data collected in streams used by and adjacent to trout farms indicated negative impacts to water quality standards. In an effort to improve and protect water quality, while supporting the trout farm industry in the region, a collaborative approach has been undertaken which includes trout farmers, NC Department of Agriculture and Consumer Services, NC Cooperative Extension and DWQ. The outcome of the collaborative work should lead to a better understanding of farm operations, best management practices (BMPs), water resource/quality protection and regulatory needs for all parties. The NCG530000 permit is anticipated to be renewed in July 2012. Any necessary permit modifications to fully protect surface waters used by trout farm operations will be considered and discussed by DWQ and stakeholders during the renewal period. Possibilities may include individual permits for certain farms, farm-specific BMP plan requirements and system modifications.

The economic impact of trout farms in the rural counties within which they are located is considered important. The past six years have seen a decrease of ten percent of the total number of trout farms in the state. Various reasons account for the changes, including an aging farmer population, land valuation increases and, considered most significant, an increase in water temperatures. Options are being considered to maintain current production levels in light of the water temperature change.

Bacteria

Whether a stream is classified for primary recreation (B) or not, the nature of mountain streams lead to a heavy recreation use. High levels of fecal coliform bacteria have been detected in several streams due to the increase in monitoring during a special study. The bacteria normally would have gone undetected because DWQ's limited monitoring resources primarily focus on Class B waters. The detected instream high bacteria counts reinforce the need to reduce non-point source pollution, focus on limiting livestock access to streams, implement agriculture BMPs, promote domestic pet waste pick-up, control urban stormwater and repair failing septic systems.

WaDE

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. Special study requests led to an increase in number of streams sampled for bacteria and have led to several new stream impairments. As of 2012, there are 58 stream miles and 171 lake acres Impaired because of high fecal coliform bacteria levels. The economies of the counties in this basin are highly dependent upon river recreation, especially for tourists and seasonal residents. Reducing bacterial contamination is crucial for supporting a tourist economy. In order to protect human health and maintain water quality, straight pipes must be eliminated and failing septic systems should be repaired.

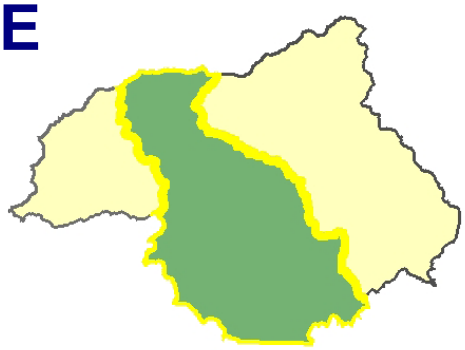
Recent budgetary changes caused the dissolution of an important program that provided significant water quality as well as human health and quality of life benefits. The Wastewater Discharge Elimination (WaDE) Program formed to identify and correct straight-piped wastewater discharges and failing septic systems, lost funding for all activities. The work that had been accomplished by the program assisted in the reduction of fecal coliform levels in several watersheds across the region. The Division of Water Quality in the Asheville region receives regular phone calls from health department personnel, county personnel and other agencies seeking assistance to help families in need of septic system repairs. Funds need to be reallocated to reestablish the WaDE program or allocated to County Health Departments to assist in detecting and eliminating straight pipes and septic failures.

DWQ Asheville Regional Office Outreach

The Asheville Regional Office (ARO) has recently embarked upon a long-term, outreach initiative designed to establish partnership and understanding across the wide variety of industries and organizations within its management area. To accomplish its mission and obtain its goals, the DWQ understands that partnership-building, continuous education efforts and leveraging of resources are required. In that direction, the ARO has launched several efforts with more to come:

- Western North Carolina is home to a large set of active environmental organizations (EOs) involved in numerous initiatives, many involving water quality. Those organizations, located across the nineteen counties of the Asheville Regional Office, house many resources, including experienced staff, community members and local knowledge. The DWQ employs experienced staff as well, with regulatory and technical expertise. Clearly, leveraging the resources of EOs and the DWQ would benefit all parties in the common mission of protecting water quality. In late 2011, DWQ staff launched an effort in pursuit of such partnering. EOs from across the western region along with DWQ personnel will convene several summits during 2012 to develop a better understanding of the work being done across the region and how to mutually benefit from building partnerships.

Upper Little Tennessee River Subbasin



HUC 06010202

Includes: Nantahala River, Cullasaja River, Little Tennessee River & Fontana Lake

Watershed at a Glance

Counties:
Clay, Graham, Macon, & Swain

Municipalities:
Franklin, Highlands

EPA Level IV Ecoregions:
Broad Basins, High Mtns., Southern Metasedimentary Mtns, Southern Crystalline Ridges & Mtns.

Population:
2000: 33,168
2010: 37,924

Area 789 mi²

2006 Land Cover:
Open Water.....2%
Developed.....5%
Forested.....87%
Scrub.....1%
Agriculture.....5%

Permitted Facilities:
NPDES
Wastewater Discharge.....27
Wastewater Nondischarge.....4
Stormwater.....19
Trout Farms.....3

Figure 1-1: NLCD 2006 Land Cover

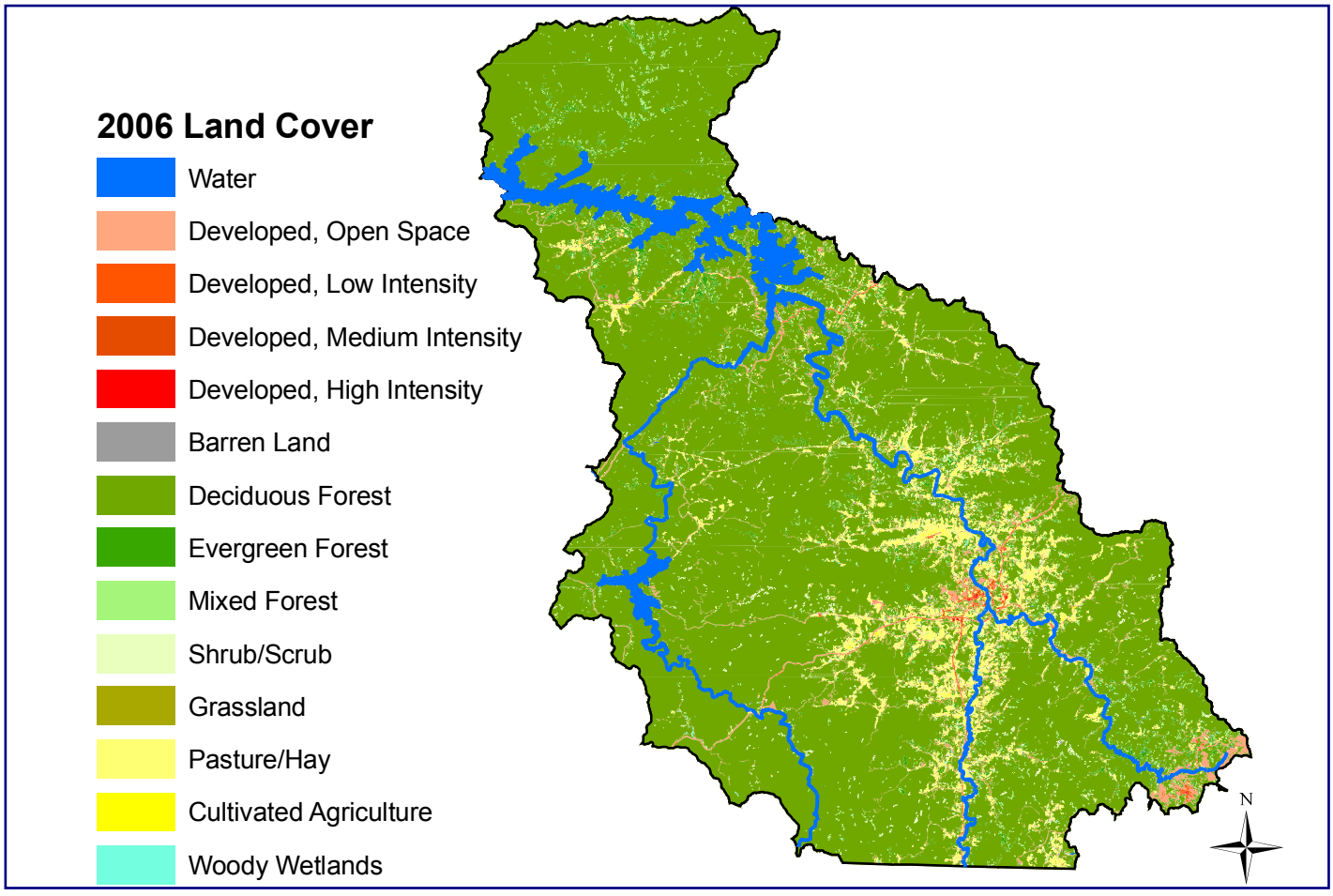
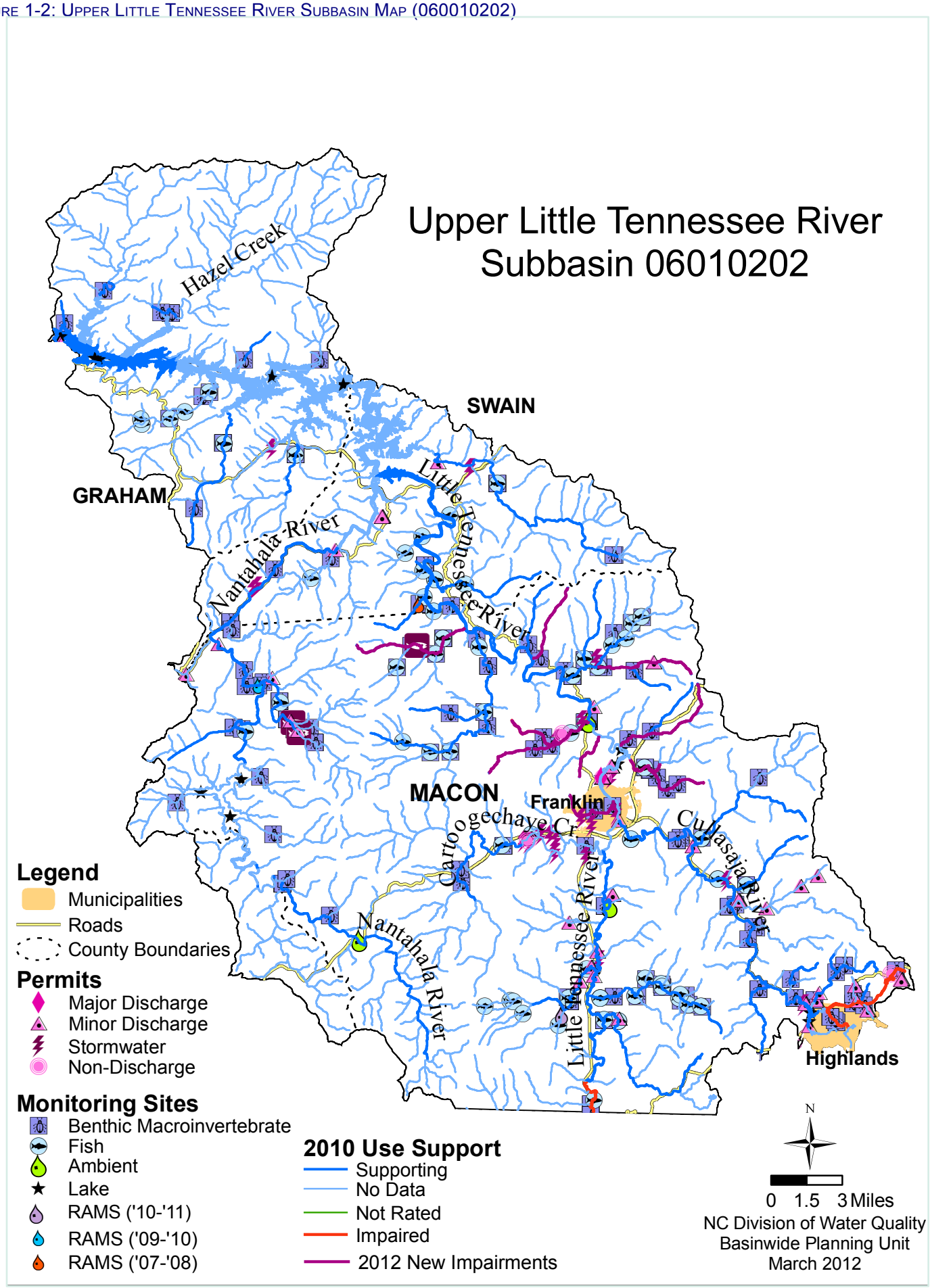


Figure 1-2: Upper Little Tennessee River Subbasin Map (060010202)

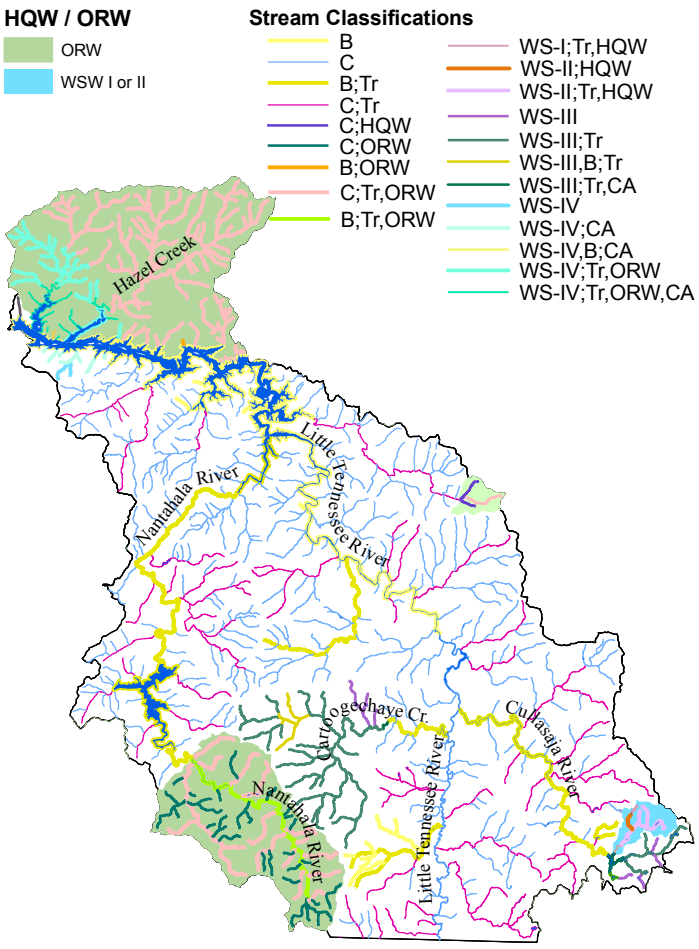


Water Quality Overview

The Upper Little Tennessee River Subbasin, hydrologic unit 06010202, was represented in previous Basin Plans as Subbasins 04-04-01, 04-04-02, 04-04-03, and 04-04-04. This subbasin covers 789 sq. miles and is 87% forested; containing portions of Nantahala National Forest and Great Smoky Mountains National Park (Figure 1-1). There are approximately 9,761 reservoir acres and ~1,083 classified stream miles, not including the numerous unnamed tributaries. The Nantahala River is a major tributary to the Little Tennessee River and drains into Fontana Lake. A map of the subbasin showing Impaired streams, monitoring and permit locations is shown in Figure 1-2.

This subbasin contains some of the most pristine high quality waters in the state and supports numerous trout streams (Figure 1-3). Water quality issues of concern in this subbasin include impacts from developments on steep slopes, agricultural runoff, trout farm waste, stream bank erosion, limited riparian cover, failing culverts and individual onsite wastewater failures. Waterbodies currently on the 2010 303(d) list of Impaired waters include: a 2 mile reach of the Little Tennessee River, Cullasaja River, Mill Creek, Cat Creek, Rabbit Creek and Iotla Branch. A new fish advisory was issued in 2008 for Lake Fontana due to the potential mercury content in walleye.

Figure 1-3: Stream Classifications

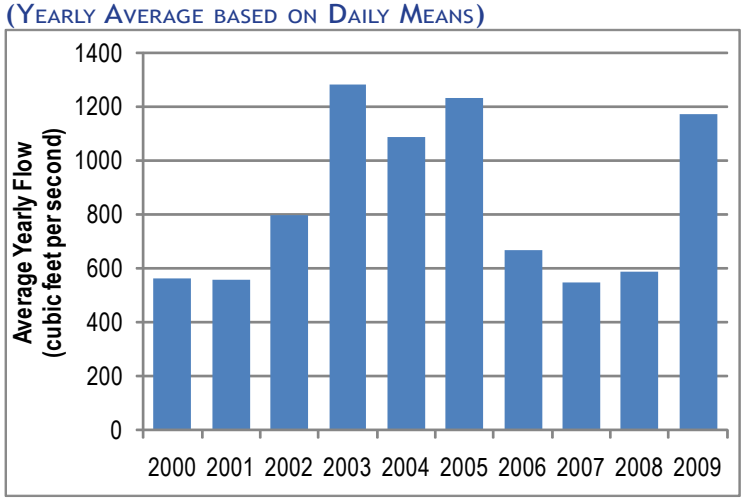


In 2011, The Little Tennessee Watershed Association completed their State of the Streams report. This document is an excellent resource, covering land use changes, natural history, local biomonitoring program results and restoration initiatives.

Stream Flow

Stream flow is monitored at US Geological Survey gaging stations. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). There are six gaging stations in this subbasin. Figure 1-4 provides an example of average stream flow over a 10 year period and gives an idea of which years received heavier precipitation. The flow rate in a stream can impact the measurement of physical and chemical parameters. In particular, droughts can have major effects on parameters such as dissolved oxygen, turbidity, pH, and others by reducing stream flow. For more information about instream flow see Division of Water Resources website: http://www.ncwater.org/Permits_and_Registration/Instream_Flow/ or for USGS daily discharge data: http://coweeta.uga.edu/dbpublic/hydrologic_data.asp.

Figure 1-4: Stream flow at USGS 03503000 Little Tennessee River at Needmore (Yearly Average based on Daily Means)

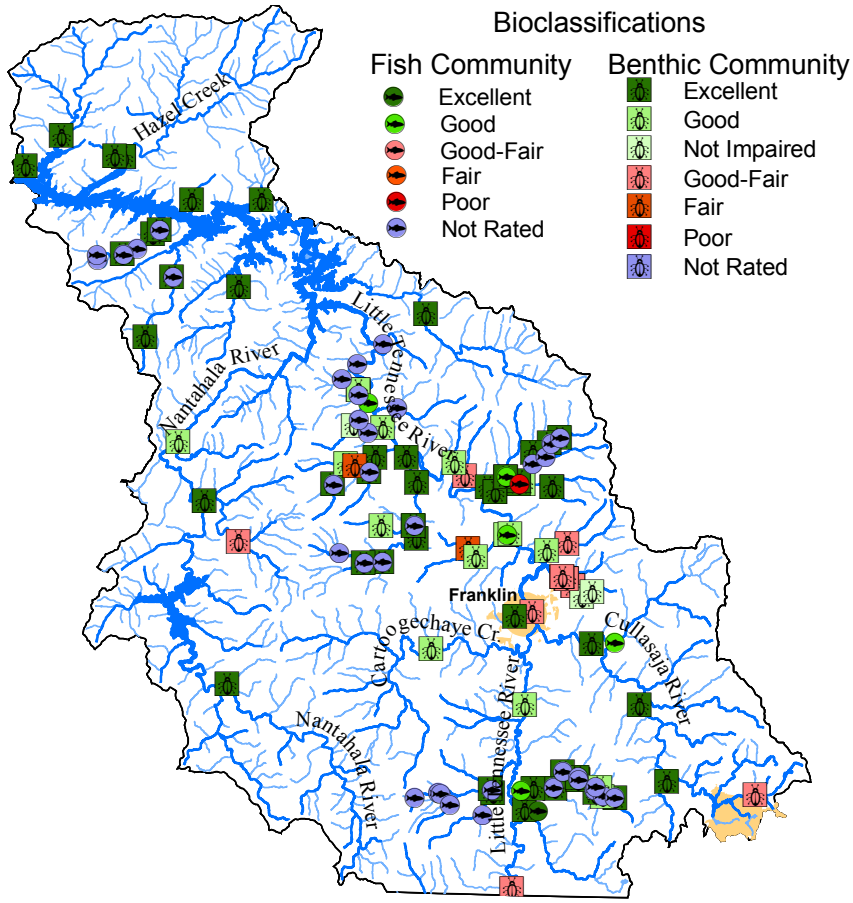


Biological Monitoring

Biocriteria have been developed using the diversity, abundance, and pollution sensitivity of the organisms that inhabit flowing waterbodies in NC. One of five bioclassifications are typically assigned to each water body sampled: Excellent, Good, Good-Fair, Fair and Poor. Not Impaired and Not Rated designations are reserved for samples that were not eligible to be assigned one of the five typical bioclassification categories. Typically, a "Not Impaired" rating is equivalent to a Good-Fair or better bioclassification and a "Not Rated" designation is equivalent to a Fair or worse bioclassification. The reasons for not being able to assign one of these five typical bioclassifications may be a lack of appropriate bio-criteria or atypical sampling conditions (e.g., drought). These bioclassifications are used to assess the various impacts of both point source discharges and nonpoint source runoff. The resulting information is used to document both spatial and temporal changes in water quality, and to complement water chemistry analyses, ambient toxicity data, and habitat evaluations. In addition to assessing the effects of water pollution, biological information is also used to define High Quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with management actions.

Biological samples were collected during the spring and summer months of 2004 and 2009-10 by the DWQ-Environmental Sciences Section as part of the five-year basinwide sampling cycle. Twenty-one benthic macroinvertebrate sites and six fish community sites were evaluated in 2009-10, representing 24 distinct localities. Each basinwide biological station monitored during the current cycle is shown in Figure 1-5 and color coded based on its current rating. The majority of benthic macroinvertebrate samples taken in this watershed received an Excellent rating, while most fish community sites resulted in a Not Rated status, due to the absence of criteria for rating high gradient mountain trout waters. For more information about biological data in this watershed, see the 2010 Little Tennessee River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 1-B.

Figure 1-5: Biological Sites Current Ratings



Benthos

Among the benthic macroinvertebrate sample sites, six sites improved, while the remainder retained the same bioclassification in 2009-2010 as observed in 2004 (Figure 1-6). There were an additional 51 benthic samples taken to support special studies.

Fish

Among the six fish community sites, two improved from 2004 while the remaining sites maintained the same bioclassification in 2009 from that observed in 2004 (Figure 1-7). There were an additional 38 fish community samples taken to support special studies.

Figure 1-6: Benthic Macroinvertebrate Sample Status

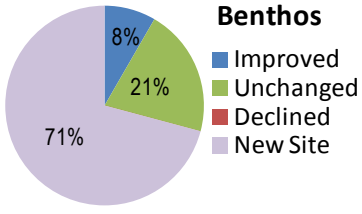
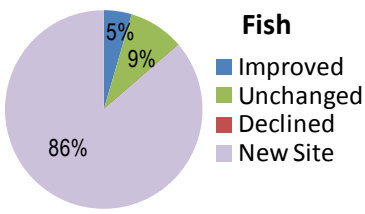


Figure 1-7: Fish Community Sample Status



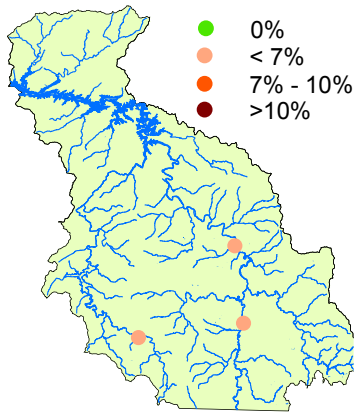
In addition, over 20 years of fish community data collected by Dr. Bill McLarney of the Little Tennessee Watershed Association (LTWA) was assessed for Brush, Cowee, Crawford Branch, Cullasaja, Ellijay, Skeenah and Watauga Creeks. A discussion of IBI scores, fish abundance, diversity, and land cover comparisons are detailed in the report **Fishing for Answers: An Analysis of Biomonitoring Trends in Seven Different Watersheds within the Little Tennessee River Basin**. The LTWA biomonitoring data is available on Coweeta Long Term Ecological Research website: **http://coweeta.uga.edu/ltwa/**.

Long Term Ambient Monitoring

The DWQ's Ambient Monitoring System (AMS) is a network of stream stations strategically located for the collection of physical and chemical water quality data. There are three AMS stations: G2000000, G0035000, and G3500000 in this subbasin; data has been collected from these sites since 1968, 1981 and 1973 respectively.

To assist with an EEP Special Study, DWQ assessed the relationships between the concentrations of pollutants detected at AMS station G2000000 with mean daily flow measurements obtained by the USGS's gaging station near Needmore, NC. Water quality data, representing 106 parameters, were available for the period between July 1968 and December 2007, but only 25 parameters were analyzed. Pair-wise comparisons providing correlation coefficients of concentrations for all 25 parameters with mean daily discharge were calculated. Alkalinity (field), conductivity (field), pH (laboratory) manganese, pH (field), total alkalinity, and water temperatures had significant negative correlations ($p<0.05$) with flow. Dissolved oxygen, nitrite/nitrate, total aluminum, total iron, total nonfilterable residue, total residue and turbidity (laboratory) had significant positive correlations ($p<0.05$) with flow; the remaining 11 parameters had no significant correlations with flow. Details of this assessment are available on pages 96-114 of **EEP's Phase II WAT report.**

Figure 1-8: Percentage of Samples Below the pH 6 Standard between 2004-2008

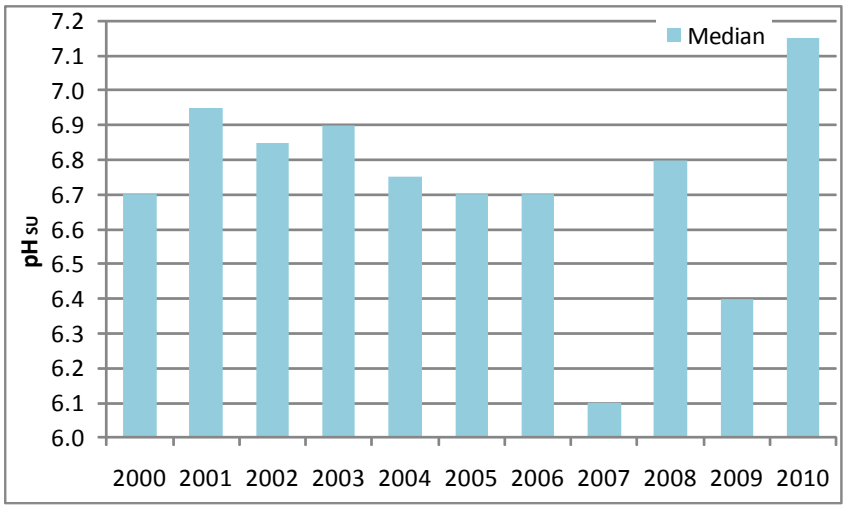


The following discussion of ambient monitoring parameters includes concentration value graphs for AMS station G2000000 over a 11 year period (2000-2010). Each major parameter is discussed, even if no current impairment exists. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the **Little Tennessee River Basin Ambient Monitoring Report**.

pH

As seen in Figure 1-8, which represents the data window for the 2010 **303(d)** list, each ambient site had at least one sample that fell below the pH standard of 6su, but no stations exceeded the standard in 10% or more of the samples. Over 11 years there were four incidences of pH dropping below the minimal standard of 6su at ambient station G2000000 (Figure 1-9). Two of which occurred during the fall of 2007; 2007 also had the fewest samples (6) taken.

Figure 1-9: Summarized pH data at AMS G2000000 site between 2000-2010.



Dissolved Oxygen

As seen in Figure 1-10, which represents the data window for the 2010 303(d) list, each ambient station did not have any exceedances of their DO standards. Over the past 11 years, (Figure 1-11) no samples were collected with dissolved oxygen levels below the 4mg/l instantaneous standard for Class C waters or below 6mg/l standard for trout waters at ambient station G2000000.

Figure 1-10: Percentage of Samples Exceeding the DO Standard between 2004-2008

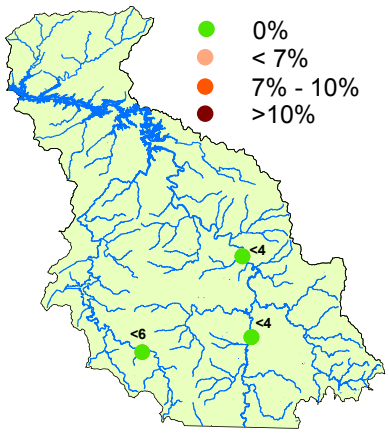
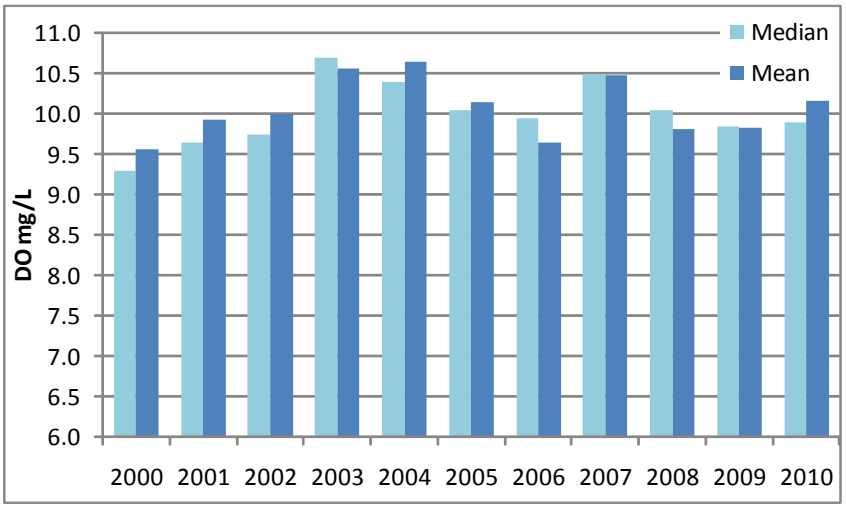


Figure 1-11: Summarized DO data at AMS G2000000 site between 2000-2010.



Fecal Coliform Bacteria

Fecal coliform bacteria occurs in water as a result of the overflow of domestic sewage and from other nonpoint sources of human and animal waste, including pets, wildlife and farm animals. The fecal coliform bacteria standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether a stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

As seen in Figure 1-12, which represents the data window for the 2010 303(d) list, two ambient stations exceeded the 400 colonies/100ml in greater than 10% of the samples. There were eleven incidences of high bacteria counts as indicated by several peaks in mean values over the eleven compared years, shown in Figure 1-13. In 2008, a 5-in-30 was collected at AMS G2000000; data results did not exceed the standard. However, an additional eight streams were sampled as part of a special study all indicating fecal coliform bacteria levels that exceed state standards.

Figure 1-12: Percentage of Samples Exceeding the Fecal Coliform Bacteria >400 colonies/100ml between 2004-2008

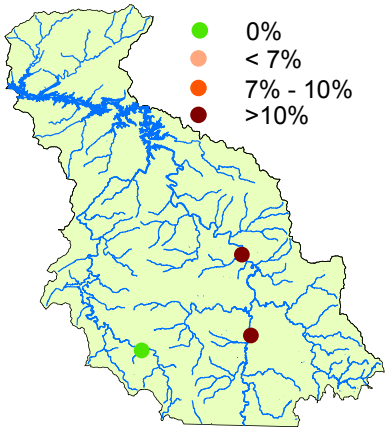
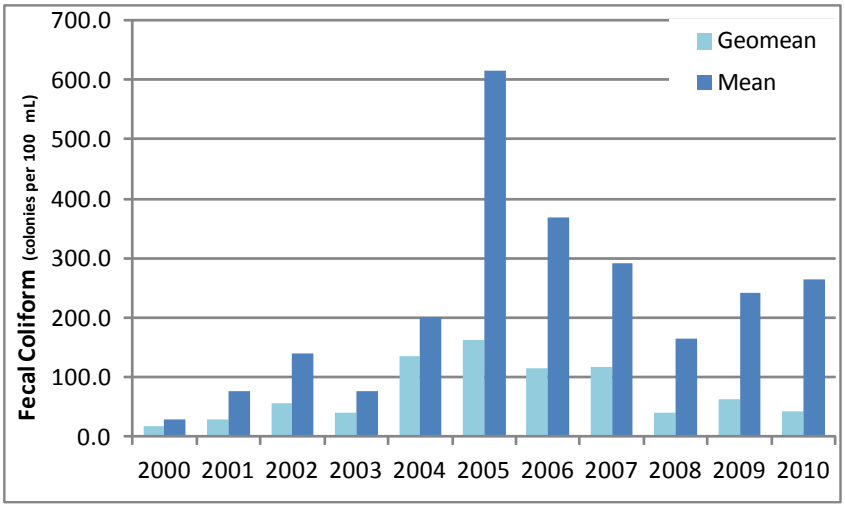


Figure 1-13: Summarized Fecal Coliform Bacteria data at AMS G2000000 site between 2000-2010.



Turbidity

As seen in Figure 1-14, which represents the data window for the 2010 303(d) list, two ambient sites had at least one sample that was >50NTUs, but no stations exceeded the standard in 10% or more of the samples. Over the past 11 years (Figure 1-15), six samples at AMS G2000000 exceeded the standard of >50 NTUs for Class C waters.

Figure 1-14: Percentage of Samples Exceeding Turbidity Standard between 2004-2008

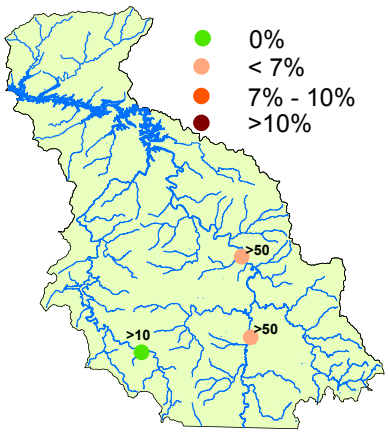
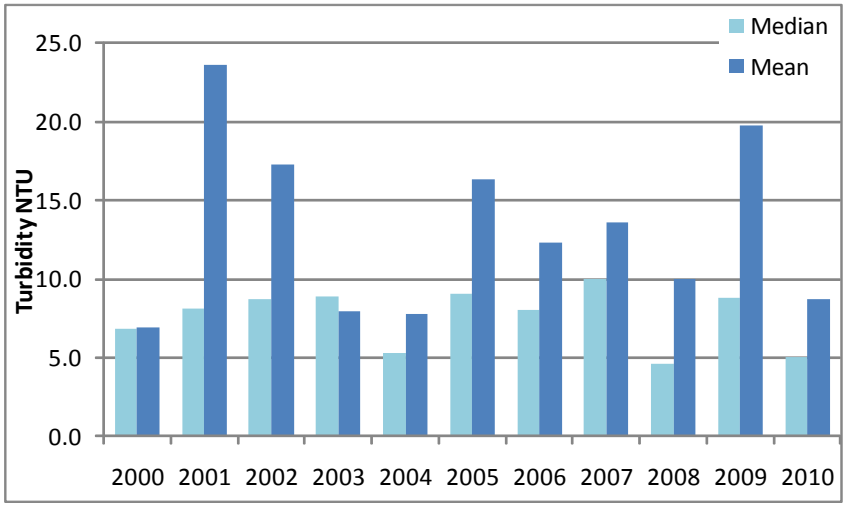


Figure 1-15: Summarized Turbidity data at AMS G2000000 site between 2000-2010.



Supplemental Ambient Monitoring

Coweeta Hydrologic Laboratory collected water quality data at 12 locations within the Upper Little Tennessee subbasin. Data collected includes:

1) Weekly stream grabs analyzed for DOC, TN, NH4-N, Cl, NO3-N, O-PO4, SO4, K, Na, Ca, Mg, and TP from ~January 2010 to September 2011, plus six storm events,

2) Hourly conductivity, dissolved oxygen, temperature, and turbidity measurements from ~January 2010 to September 2011 from Hach Hydrolabs, and

3) Stream TSS and TOS from 6 storm events from January 2010 to September 2011; samples were collected by ISCO water samplers and includes stage data from pressure transducer which were later converted to discharge data.

Original Sample Sites		Smaller Stream sites
1) Little Tenn. at Needmore USGS gage	7) Ball Creek	Falls Branch
2) Little Tenn. at Prentiss USGS gage	8) Watauga Creek	Mica City Creek
3) Cartoogechaye Creek at USGS gage	9) Jones Creek	Hugh White Creek
4) South Skeenah Creek	10) Crawford Branch	Willis Cove Creek
5) Caler Fork	11) Ray Branch	Ammons Branch
6) Cowee Creek	12) Bates Branch	

Coweeta staff plan to continue monitoring the 3 large stream sites (Little T at Needmore, Little T and Prentiss, and Little T and Cartoogechaye) until mid 2013 for all the above metrics. In addition, monitoring has begun in smaller streams to attempt to link land use directly to water quality with a focus on three land use types: forested, traditional valley development, and mountain development.

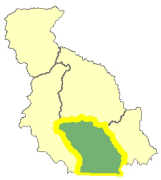
Other measurements include physical measurements of the stream bed, including coarse woody debris, width, depth, etc. and biological measurements such as salamander, fish, and macroinvertebrate surveys. These data will be made available when published.

Protection and Restoration Opportunities

The following section provides more detail about specific streams where special studies have occurred or stressor sources information is available. Within this document, biological sample site IDs ending in an "F" denote fish community and a "B" denote macroinvertebrate community. Specific stream information regarding basinwide biological samples sites are available in Appendix 1B. Use support information on all monitored streams can be found in Appendix 1A. Detailed maps of each of the watersheds are found in Appendix 1C or by clicking on the following small maps.

To assist in identifying potential water quality issues citizens, watershed groups and resource agencies can gather and report information through our Impaired and Impacted Stream/ Watershed survey found here: http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey.

Headwaters Little Tennessee River Watershed (HUC 0601020201)



This watershed encompasses 127,057 acres and has an estimated 2010 population of 13,377 people.

The Little Tennessee River [AU# 2-(1)a] (C) from North Carolina-Georgia State line to the confluence of Mulberry Creek has been Impaired since 2002, because of a Fair bioclassification at site GF17, which was last sampled in 2004 and rated again as Fair. However, the benthic population improved from Fair in 2000 to Good-Fair in 2010 at site GB50. The Little Tennessee River watershed above sites GF17 and GB50 is approximately 56 square miles, mostly in Georgia. Water quality may have improved and is reflected in the improvement of macroinvertebrate communities at site GB50 when the Fruit of the Loom plant in Rabun Gap, GA, which accounted for over 95% of the total permitted industrial discharges to the entire watershed, stopped discharging in 2006. There are four NPDES permitted facilities within the river's watershed in Georgia. WWTPs' effluent, agriculture, road construction, small industries, urbanization, residential development, and failing septic systems remain a concern. Beginning downstream of the NC/ GA state line, Little Tennessee River is Designated Critical Habitat for the Appalachia Elktoe mussel, further raising the importance of clean water in the river.

Improving water quality in this reach will require corrective action by both nonpoint and point sources of pollution. Local action is needed to address nonpoint source pollution through installation of BMPs and riparian zone protection/restoration. Protective measures should be written into the NPDES permit for any new operation at the old Rabun Mills (Fruit of the Loom) plant. The fish community site needs to be sampled to assess biological changes due to the recent changes in industrial effluent contributions.

The Little Tennessee River [AU# 2-(1)b] (C) gains volume rapidly as it flows into North Carolina, becoming a major river. Land use in the watershed south of Franklin is a mix of light commercial, agriculture, scattered residences and broken tracts of forest. DWQ sampled the benthic community at GB10 resulting in a Good bioclassification and found that water quality has improved at this location since the 1985, 1987, and 1999 samples. Past habitat problems include very poor riparian vegetation, lack of pools, and infrequent riffles. Data collected at ambient monitoring station G0035000 showed incidences of low pH and high turbidity levels but not enough to cause Impairment. Laurel Hills Homeowners Association WWTP discharges into the Little Tennessee River and has incidences where their effluent exceeded limits with high BOD levels and low pH levels.

Middle Creek [AU# 2-8] (C;Tr) drains southern Macon County and a small portion of northern Rabun County, GA. The creek's benthic (GB49) and fish (GF19) communities were sampled in 2009 resulting in Excellent ratings. There is one single family residence domestic wastewater discharge (NCG550392) into the Creek.

Tessentee Creek [AU# 2-9] (C;Tr) is an 8 mile trout creek draining southern Macon County. Land use in the Tessentee Creek catchment is mostly forested, but includes lesser areas of cropland, pasture, Fraser Fir Christmas farms and second homes. There are no NPDES permitted discharges in the catchment. DWQ sampled the basinwide benthic site, GB46 in 2009 resulting in an Excellent rating and fish community site, GF28 resulting in a Good rating.

Tributaries to Tessentee Creek (listed in the table below) were also sampled in 2009 as part of a Use Attainability Study to determine suitability for supplemental classification as trout waters (Tr). The request was expanded to have Tessentee Creek and its tributaries sampled for benthic macroinvertebrates to determine whether they were suitable as High Quality Waters and Outstanding Resource Waters as well. Later in 2009, DWQ collected trout from seven of the eight tributaries, with multiple age classes of rainbow trout collected from six of the sites sampled. The presence of multiple age classes of trout provides evidence of natural trout reproduction and survival within the Tessentee Creek watershed. Based on 2009 and 2011 benthic macroinvertebrates samples collected from the Tessentee Creek watershed, seven sites received an Excellent bioclassification and therefore qualify for consideration for the High Quality Waters classification. Moreover, two Federal and State Species of Special Concern were found in Tessentee Creek (Hellbender, *Cryptobranchus alleganiensis* and Smoky Dace, *Clinostomus sp. cf. funduloides*) as well as in four tributaries. The combination of Excellent bioclassifications within this catchment plus the presence of resource values (Hellbender and Smoky Dace) further qualifies the catchment for classification to Outstanding Resource Waters.

Name	Assessment Unit #	Sample Site ID	Bioclassification Rating
Cadon Branch	2-9-1	GB193	Excellent
Nichols Branch	2-9-2	GB192	Good
Whiterock Branch	2-9-3	GB191	Good
Possum Branch	2-9-4	GB190	Excellent
Stillhouse Branch	2-9-5	GB189	Excellent
Wheatfield Branch	2-9-6	GB188	Excellent
Buckeye Creek	2-9-7	GB187	Excellent
Evans Branch	2-9-8	GB186	Excellent

On the contrary, Tessentee Creek received a Poor rating as part of LTWA's **Stream Visual Assessment Protocol** (SVAP) biomonitoring efforts.

Coweeta Creek [AU# 2-10] (B;Tr) was sampled again in 2009 at site GB45. This site has rated Excellent since sampling commenced in 1994. The majority of the watershed is undisturbed forest, in part, associated with Coweeta Creek Hydrological Laboratory. A protected, forested watershed combined with a minimally disturbed riparian zone and instream habitat have resulted in a temporally stable, diverse, and pollution intolerant macroinvertebrate benthic community. There is one single family residence domestic wastewater discharge (NCG550364) and one minor WWTP from Willowbrook Park (NC0070394) discharging into the creek.

Skeenah Creek [AU# 2-13] (C,Tr) is not monitored by DWQ, but it is monitored by the LTWA. Skeenah Creek's **Water Health Report Card** notes its fish community IBI score as being Fair and using LTWA's **Stream Visual Assessment Protocol** the stream also rated Fair. The LTWA notes the stream is impacted from limited riparian cover, past agricultural activities and more recently road building and developments. They have also noted the disappearance of the endemic Smoky Dace with the decline in the biotic integrity of the stream. The Smoky Dace is classified as both a Federal and State Species of Special Concern.

Cartoogechaye Creek [AU# 2-19-(1), AU# 2-19-(10.3) & AU# 2-19-(10.5)] (WS-III;Tr, WS-III;Tr,CA, & B;Tr) is an 11 mile tributary to the Little Tennessee River that enters the river near the backwaters of Lake Emory. The creek's watershed drains west-central Macon County and is characterized by steep mountainous terrain in its headwaters reaching an elevation of 5324' at Wayah Bald. The headwaters are mostly within the Nantahala National Forest and habitat and stream conditions remain mostly unimpacted. The stream and tributaries in the lower elevations are surrounded by alluvial valleys and land use consists of cattle pasture

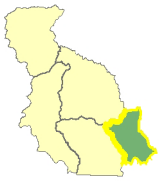
and some large-lot residential areas. Before Cartoogechaye Creek enters the Little Tennessee River, it goes through an area within the town limits of Franklin with more dense residential and some light industrial/ commercial property. The creek provides drinking water to the Town of Franklin.

DWQ sampled Cartoogechaye Creek for possible bacterial contamination in September 2011, completing five samples within 30 days resulting in a geometric mean of 273 colonies/100 ml which exceeds the standard. This creek qualifies to be listed on the 303(d) list in 2014. The sampling site is located at the Town of Franklin WTP, which is just upstream of the town limits and the more commercial zone. Surveys in the watershed indicate that livestock farming without the use of BMPs (e.g.,cattle exclusion fencing), may be the main cause of elevated fecal coliform levels. There may be some contribution from failing septic systems, but surveys by the WaDE program indicated this was not a major problem. Action to address this issue should include working with the local Soil and Water Conservation District to provide cost-share funding for the implementation of BMP's where livestock have access to the creek.

Biological data collected by DWQ indicated the benthic community at site GB40 rated Good in 2009 and 2004, but was Excellent in 1999. The habitat was good, indicating the decline is likely due to a change in water quality. Site GB41, in the headwaters, rated Excellent in 2004 and the fish community at site GF6 rated Good.

The Little Tennessee Watershed Association (LTWA) completed the Cartoogechaye Creek Municipal Watershed Assessment in 2008. They monitored fish communities in the Cartoogechaye watershed at 14 locations. Their monitoring results indicate a high incidence of the parasitic infection called blackspot. Blackspot is often associated with organic enrichment, but can be found in healthy streams. LTWA reports blackspot was in decline in 2006, but a resurgence was seen in 2009. Further monitoring will determine if the trend will continue. LTWA also evaluated several tributaries to Cartoogechaye Creek. Blaine Branch and Mill Creek (not to be confused with Mill Creek in Highlands) suffer from channelization, bank erosion, development, and riparian zone disturbance. Allison and Jones Creek continues to suffer from cattle access and Allison Creek is under increased pressure from development.

Cullasaja River Watershed (HUC 0601020202)



The upper Cullasaja River Watershed is located in southeastern Macon County and contains most of the Town of Highlands and surrounding lands with an estimated 2010 population of 5,604. The 59,263 acre watershed lies on the Highlands Plateau, a high elevation area noted for exceptionally high rainfall (80 - over 100 inches per year). The watershed was historically logged and many of the streams dammed and/ or channelized. Estimates provided by the Upper Cullasaja Watershed Association (UCWA) indicate land use in the watershed was approximately 50 percent residential-commercial-industrial (high level of impervious cover), and 50 percent forested as of 2004.

Within this watershed, the Cullasaja River [AU# 2-21-(0.5)a & 2-21-(0.5)b] (WS-III;Tr) from its source to Macon Co. SR-1545 (4.4 miles) and Mill Creek [AU# 2-21-3] (WS-III;Tr) from its source to Mirror Lake (1.3 miles) are listed as Impaired on North Carolina's 303(d) list. The watershed is developed in golf courses, residences, and an urban center. The upper Cullasaja River and its tributaries are impounded numerous times in three golf course communities, while Mill Creek drains half of the town of Highlands. The 2010 benthic sample collected at site GB48 rated Good-Fair which is an improvement over the Fair rating it received in the previous four samples and therefore the upper segment [AU# 2-21-(0.5)a] of the River is now Supporting. A lower pH (5.4) level was measured in 2010; the 2010 observations were substantially lower than the 2000 (6.7), 2001 (6.7) and 2004 (6.8) measurements and suggests a reduction in non-point pollution inputs which tend to have neutral to high pH characteristics. Many sites in this basin with minimal non-point pollution have very low pH values.

The Wildcats Cliffs County Club WWTP (NC0075612) facility which discharges into the Cullasaja River has had several permit violations since 2007. As this facility ages an evaluation should be conducted to determine if rehabilitation or replacement of the facility would be the better course of action.

In 2002, DWQ completed an assessment of the biological impairment for the **Upper Cullasaja River Watershed**. A wide range of data was collected to evaluate potential causes and sources of impairment. Data collection activities included: benthic macroinvertebrate sampling; assessment of stream habitat, morphology, and riparian zone condition; water quality sampling to evaluate stream chemistry and toxicity; analysis of stream bed sediment for chemistry and toxicity; and characterization of watershed land use, conditions and pollution sources. A total of 17 benthic samples were collected, ranging from Fair on the Cullasaja River (site GB48) to Excellent in Big Creek (site GB51). The study determined that sedimentation is a significant problem in many of the impoundments, but the primary causes of biological impairment in the Cullasaja River are dam related issues including the prevention of fish and benthic macroinvertebrate colonization and migration, lower water levels, increased temperature, and shifts in food availability. The lack of organic microhabitat (sticks and leaf packs), pesticides, elevated cadmium, and low dissolved oxygen levels also contribute to impairment. Several other streams were also evaluated during the study. Big Creek [AU# 2-21-5-1-(0.5)], Houston Branch [AU# 2-21-5-1-3-(2)], and Ammons Branch [AU# 2-21-2] watersheds are mostly forested with minimal disturbance and considered Supporting for aquatic life. Saltrock Branch [AU# 2-21-1] (WS-III), however, is heavily impacted by a golf community and would benefit greatly from habitat restoration efforts. Because of its small size, it is Not Rated for aquatic life. Skyline Lodge & Village WWTP which discharges into Big Creek had exceeded its effluent BOD limit in 2010.

DWQ's Lakes Assessment Unit evaluated Lake Sequoyah [AU# 2-21-(3.5)b] in summer 2009. The lake, is classified as WS-III and Trout Waters (Tr). Out of 15 samples taken at three locations within the lake in 2009, five samples exceeded the 10 NTU turbidity standard. Lake Sequoyah is Not Rated because of an insufficient number of samples (10 samples in one location over a 5 year period is needed to assess for Use Support). The lake was also considered to be eutrophic during May conditions and algal growth is limited by phosphorous. More information is available from DWQ's **Lake & Reservoir Assessment Report**.

The Upper Cullasaja Watershed Association (UCWA) has noted Lake Sequoyah, along with most impoundments in the watershed, has shown significant impacts from sediment deposition. Much of this sedimentation occurred prior to the enacting of local sediment and erosion control measures but continues as development on steep slopes progresses. Reducing current sediment loads and removing existing sediment deposits are high priorities for many local watershed residents. In 2004, Hurricane Ivan aggravated flooding and erosion problems in the watershed leaving large sediment deposits near critical drinking water intakes. The Town of Highlands, Upper Cullasaja Watershed Association, and the Mirror Lake Improvement Association are working together to secure funds to remove built-up sediment in the lakes and pave eroding gravel roads.

Water Quality Initiatives

The Upper Cullasaja Watershed Association (UCWA) and the Town of Highlands have taken significant steps towards addressing water quality issues. Since its inception, UCWA's primary focus has evolved from rainfall measurement and erosion control to understanding and implementing effective stormwater management in the watershed. UCWA received a Regional Geographic Initiative grant from the U.S. Environmental Protection Agency to determine stakeholder concerns and issues within the watershed and define possible solutions. In 2004, UCWA compiled their findings in the **Upper Cullasaja River Watershed Strategy and Action Plan**. The action plan divides the watershed into four subbasins including: Upper Cullasaja River, Mill Creek, Monger Creek, and Big Creek. General recommendations are given for the entire watershed and specific tasks are outlined for each watershed. With help from UNC's Highlands Biological Station, an addendum was published "**Water Quality Monitoring of the Upper Cullasaja Watershed, Highland, NC**" to the 2004 Action Plan that included a detailed assessment of the Cullasaja River, Mill Creek, Monger Creek, and Big Creek and an assessment of stream restoration opportunities in those watersheds.

The following needs were identified by DWQ and UCWA after completing watershed assessments:
• Evaluate and implement the following at each of the impoundments in the upper Cullasaja River watershed; minimum and/or bypass flows, sediment transport devices, and fish passages. Doing so will allow passage of aquatic organisms and help address sediment build up, elevated temperatures, and low dissolved oxygen levels. If the problems associated with dams are not addressed, then the recovery potential for the Cullasaja River is limited and other strategies listed below will have limited effect.
• Complete restoration projects at all sites identified in the Upper Cullasaja Watershed Strategy and Action Plan. Successful completion will improve habitat conditions and stormwater management in the watershed.
• Pesticide and nutrient management programs should be evaluated and improved to further decrease the use of these materials and their potential to enter lakes and streams. Homeowners and landscapers should also be educated about the responsible use of pesticides, fertilizers, and hydroseed mix.
• Woody vegetation should be planted along cleared streams, and large woody debris and rock clusters should be placed in the stream channel where wooded buffers are not planted. This action will stabilize eroding streambanks, provide shade, and produce leaf packs and other organic instream habitat.

In addition, the LTWA with the assistance of students at the UNC's Highlands Biological Station and UCWA are completing a nine element watershed restoration plan for the Upper Cullasaja River. This process is funded through DWQ's NPS 319 grant program and will outline additional restoration implementation activities.

The Cullasaja River [AU# 2-21-(5.5)] (B;Tr) from dam at Lake Sequoyah to Little Tennessee River (10.6 mi) is noted as having improved water quality conditions with 2010 Excellent ratings at benthic sites GB79 and GB39. The Cullasaja School's WWTP facility has had several permit violations since 2007, including exceeding BOD and flow levels.

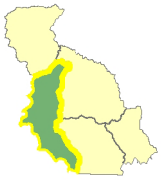
Turtle Pond Creek [AU# 2-21-8] (C;Tr) is a 4 mile creek that has consistently rated Excellent for its benthic community since sampling commenced in 1999 at site GB47.

Peeks Creek [AU# 2-21-16] (C,Tr) is not monitored by DWQ, but is monitored annually by LTWA since 2004. In the fall of 2004, a **landslide** moved debris down this drainage over 2 miles to the Cullasaja River. Since then, natural stream restoration has occurred and fish populations have returned giving it a Good IBI fish score in 2010. Monitoring details are discussed in Peeks Creek **Health Report Card**.

Walnut Creek [AU# 2-21-17] (C;Tr) a 4.5 mile tributary to the middle reaches of the Cullasaja River and is adjacent to the Ellijay Creek watershed. It is a high gradient Southern Appalachian-type trout stream with plunge pools and riffles. DWQ sampled the fish and benthic communities in 2004 (sites GF30 and GB43). The benthic site was sampled in response to complaints of dead fish, soapy water, and development. There are no NPDES discharges in the watershed, but conductivity was elevated for a mountain stream. The results from the benthic sample suggest instream habitat appears to be declining. Increased residential development along the stream banks and agricultural activities in the watershed are affecting the riparian and in-stream habitats by increasing the sediment load. The stream is significantly embedded with sand at site GB43. The fish site technically qualified as a regional reference site based on land use calculations and despite noted sediment problems. The fish community was typical of many un-impacted trout streams (low species diversity, a reproducing population of naturalized rainbow trout, and mottled sculpin being the numerically dominant species). This stream was not resampled in 2009.

Ellijay Creek's [AU# 2-21-23] (C;Tr) 7.2 miles drains the east-northeast region of Macon County. The creek was sampled at site GF14, in 2004 and 2009 resulting in Good bioclassifications and it is currently supporting its supplemental classification as a trout waters (Tr). Although in 2009, fish species present indicate upstream nonpoint nutrient runoff. Riparian zones were noted as narrow with a fairly open canopy, pasture or roads are adjacent to the creek. As part of LTWA's **Stream Visual Assessment Protocol** (SVAP) biomonitoring efforts Ellijah Creek was assessed and received Fair rating.

Nantahala River Watershed (HUC 0601020203)



This watershed encompasses 112,202 acres and has an estimated 2010 population of 2,070 people. The majority of the watershed falls within the Nantahala National Forest.

Moore Creek [AU# 2-57-17] (C;Tr,ORW) was sampled in 2008 by DWQ. The purpose was to evaluate the possible effects on Moore Creek and downstream reaches of the Nantahala River as the result of a sediment release from two in-line ponds located on Moore Creek. Four sites were sampled, upstream of the Moore Creek ponds, downstream of the ponds and on the Nantahala upstream of Moore Creek confluence and downstream of the confluence. Moore Creek-upstream benthic macroinvertebrate collection resulted in a Not Impaired bioclassification and would have received an Excellent rating using mountain EPT criteria had this stream's watershed exceeded three-square miles. Moore Creek-downstream is located approximately 0.25 miles downstream of the two in-line ponds from which the sediment was released and is about 0.5 miles below the upstream sample reach. This sample resulted in a Not Rated bioclassification and would have received a Fair rating using mountain EPT criteria had this stream's watershed exceeded three-square miles. Habitat quality between these two locations were essentially the same and further supports the conclusion that the large discrepancy between the downstream and upstream benthic macroinvertebrate communities is related to the sediment release and not a result of habitat differences. The invertebrate sample collected on the Nantahala River upstream and downstream of the Moore Creek confluence resulted in an Excellent ratings, although the downstream location had noted sediment accumulation.

Nantahala River [AU# 2-57-(0.5)] (B;Tr,ORW) straddles the Macon County-Clay County line and is upstream of Nantahala Lake. It's waters are derived from small mountain streams that reside within Nantahala National Forest, and thus has colder water than many other rivers of similar size. The river has consistently rated Excellent for its benthic community since sampling commenced in 1984 at site GB42. At ambient site G3500000 several incidences of low pH were recorded.

Nantahala Lake [AU# 2-57-(22.5)a] (B;Tr) is an impoundment of the Nantahala River. Duke Power Company owns this reservoir, which was impounded in 1942 for hydroelectric power. The lake is 76 meters deep at the dam at maximum pool. Nantahala Lake was monitored five times from May through September 2009 by DWQ field staff. No water quality issues were detected. Nantahala Lake demonstrates it is oligotrophic and has exhibited these trophic conditions since DWQ began monitoring in 1981. Nantahala Mountain Village WWTP discharges into Nantahala Lake and has had several permit violations for exceeding ammonia permit limits.

Below Nantahala Lake the Nantahala River [AU# 2-57-(22.5)b] (B;Tr) is highly regulated with daily releases that greatly influence water chemistry, water depth and velocities. The benthic site at GB8 rated Good in 2009. A Random Ambient Monitoring System site (G3700000) also collected data along this reach of the river between Jan. 2009 - Dec. 2010. Station G3700000 was located on Nantahala R. off of SR 1310 near Beechertown. Data collected included normal field parameters along with metals, volatile organics, semi-volatiles, and pesticides. No water quality problems were detected, although there was one sample with low pH and one sample with high dissolved copper content. The Nantahala Outdoor Center wastewater facility has had permit violations for exceeding fecal coliform bacteria and TSS levels.

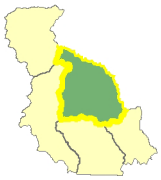
Whiteoak Creek [AU# 2-57-45a, 2-57-45b, & 2-57-45c] (C;Tr) is a 3.6 mile creek with its headwaters in Nantahala National Forest. The creek rated Good-Fair in 2009 at site GB36, the same rating it received in 2004. Since first being sampled in 1988, this waterbody has rated Fair twice and Good-Fair four times. This segment is located downstream of a trout farm, which appears to be adversely affecting the benthic community. Previous DWQ investigations (B-881209, B-900220, B-900720, B-050218) clearly documented the effects of untreated wastewater in this creek. Abnormally large and thick mats of aquatic plants have

been a historic issue in Whiteoak Creek from 1998 to present.

Otter Creek [AU# 2-57-45-10] (C;Tr) is a 3.8 mile tributary to Whiteoak Creek. In October 2011, a special study request was made to assess macroinvertebrate communities upstream and downstream of trout farms. Data results on Otter Creek showed similar EPT richness values between the upstream and downstream sites. However, the increase in EPTBI value is significant and indicative of degradation downstream. (BAU Memorandum 120201).

Water in Dicks Creek [AU# 2-57-42] (C;Tr) was historically impounded at Dicks Creek Pond and diverted into Duke Energy's Nantahala Hydroelectric Project. As part of the 1999 agreement between Duke Energy, NCDENR, USDA, and USFWS, this diversion ceased and flows in Dicks Creek were allowed to pass through Dicks Creek dam, into the Nantahala River. In 2003, Duke Energy agreed to restore additional flow in Dicks Creek as part of its mitigation for impacts caused by the Nantahala Hydroelectric Project. DWQ sampled the benthic community in Dicks Creek at site GB9 to determine the condition of the stream prior to the introduction of new, stable flows. This site received a Good-Fair bioclassification in 2004. Additional sampling is needed to evaluate the stream response to restored flows.

Alarka Creek-Little Tennessee River Watershed (HUC 0601020204)



This watershed encompasses 130,309 acres and has an estimated 2010 population of 15,445 people. The Town of Franklin's WWTP is the only NPDES permit with limit violations since 2007; the facility was in violation for exceeding its BOD and TSS limits. The facility is in the process of upgrading portions of its treatment works and has been compliant with its whole effluent toxicity testing.

Crawford Branch [AU# 2-22] (C) was sampled for macroinvertebrates in two locations in May 2010, in support of the EEP's local watershed planning (LWP) effort. The upstream site received a Good bioclassification based on small stream criteria and the downstream site received a Fair rating. Both Crawford Branch sites have poor habitat and riparian zones are narrow and the substrate is filled with sand and silt. The stream is straight from channelization and lacks adequate pool habitat. The benthic macroinvertebrate community clearly declines in Crawford Branch as it flows through the town of Franklin. Five fecal coliform bacteria samples were also taken as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 2600 and a geometric mean of 1308 cfu/100ml. The source of fecal coliform bacteria was not detected during stream walks of Crawford Branch as described in the special study report, but elevated fecal values typically occurred at the same locations as elevated NOx, possibly indicating a common source of both. Water samples were also collected to test for the presence of urban pollutants (aluminum, silver, arsenic, cadmium, chromium, copper, iron, mercury, nickel, lead, selenium, and zinc). Only aluminum, iron and zinc were detected at low levels and the results indicate further sampling is not warranted.

The Lake Emory [AU# 2-(1)c] (C) segment of the Little Tennessee River is a run-of-river impoundment created in the 1920's by construction of Porter Bend Dam at Franklin. DWQ considered it shallow and eutrophic based on samples collected in 1988. In 1994, DWQ Lake Assessment Unit ceased sampling this reservoir because sediment accumulation prevented boat access. Sediment deposition had become so pronounced that vegetation had become established on sediment bars and the upstream areas resembled a braided stream rather than a lake. DWQ determined Lake Emory was no longer functioning as a reservoir and Tennessee Valley Authority gave it an ecological health rating of Very Poor. The USGS conducted an analysis of sediment loads to Lake Emory from 2000-2001. The study compared sediment loads from the Cullasaja River, Cartoogechaye Creek, and the mainstem Little Tennessee River. This study noted that riparian agricultural activities and increasing urbanization in the upper portion of the watershed in the towns of Highlands and Franklin have increased the river's sediment load. The study also notes the dam has trapped many of those sediments, protecting the downstream habitat in the Needmore area. However, during the FERC dam relicensing process Duke Energy reported that Lake Emory has limited sediment retention capacity and the incoming sediment is being passed through the impoundment and

flowing downstream into the reach of the Little Tennessee River known for its ecological significance (Duke Energy 2003). In 2010, DWQ issued a Section 401 Water Quality Certification for the FERC relicensing of the Franklin Hydroelectric Project (# 2603). A condition of the permit includes a Long-Term Sediment Management Plan that will protect existing aquatic life uses in downstream waters.

Downstream of Lake Emory, water quality and habitat improves significantly. This downstream section of river is noted as one of the healthiest major rivers in the Blue Ridge region and supports a nearly complete biological community, including sensitive and protected species such as the spotfin chub, sicklefin redhorse, olive darter, slippershell mussel and Appalachian Elktoe mussels. The limited capacity of Lake Emory to trap sediment and the possible organic and metal contaminants attached to sediments both trapped within the Lake's sediment and those sediments moving through the impoundment is a concern to protecting downstream conditions. Investigations by USGS and Western Carolina University (as reported in EEP's Watershed Plan) indicate metals (Cd, Cu, Ni, Zn, Pb) and organic pollutants are present in legacy sediments in Lake Emory and the Little Tennessee River. These contaminants may negatively impact aquatic biota, especially those associated with bottom substrates, such as mussels.

The heavy sediment in Lake Emory and increasing loads in the downstream reach demonstrates the need for strong sediment and erosion control, wetland restoration, and streambank stabilization throughout the entire watershed. Macon County has adopted a Soil Erosion & Sedimentation Control Ordinance that should help reduce erosion problems originating from certain new land disturbing activities.

Additional research indicates that since 2005, there has been a >90% decline in the abundance of Appalachian elktoe and slippershell (Alasmidonta viridis) mussels in the Little Tennessee River between Franklin Dam and the backwaters of Fontana Reservoir. This reach of the Little Tennessee River formerly supported the strongest populations of both species, but slippershell has now dropped below detection at multiple monitoring sites and Appalachian elktoe has become rare. Research into causes of this decline are on-going by NC State University and US Geological Survey. No single, definitie casual factor has been identified to date, but increased sedimentation, as well as elevated levels of manganese, and an explosion of a recently established population of the exotic Asian clam (Corbicula flumminea), have been observed and may be contributing factors. (Personal communication, S. Fraley, NCWRC).

Rabbitt Creek [AU# 2-23b] (C;Tr) watershed lies northeast of Franklin and drains the Holly Springs community. DWQ evaluated the fish community at site GF22 in 2004, when it received a Good-Fair bioclassification. The creek's benthic community was sampled by DWQ in 2008 and 2009 as part of an EEP special study. Samples collected resulted in Poor, Good-Fair and Good ratings. During these sampling efforts, the Biologists noted sedimentation especially in pools, beaver activity, and channelization. Five fecal coliform bacteria samples were also taken in Rabbitt Creek as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 1300 and a geometric mean of 510 cfu/100ml. The Creek is Impaired.

Cat Creek [AU# 2-23-4a & 2-23-4b] (C) suffers from severe habitat degradation due to land clearing activities, channelization, livestock access, unpaved roads and several small impoundments. In 2000, a half-mile reach of Cat Creek was re-channelized and the riparian zone was cleared. This action resulted in a significant increase in streambank erosion and sediment delivery to Rabbitt Creek. Cat Creek was sampled four times by DWQ, in 2008, as part of an EEP special study resulting in an Impaired status for the lower 0.5 miles [AU# 2-23-4b]. Five fecal coliform bacteria samples were also taken as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 1000 and a geometric mean of 443 cfu/100ml.

Both Rabbitt and Cat creeks show instream habitat degradation caused by toxic and sediment impacts. Identified sediment sources include, livestock access to streams, stream bank erosion, unpaved roads. Toxicity impacts to the benthic community were attributed to the large tomato farm at the confluence of Cat and Rabbit Creeks. The tomato farm went into production in 2008 and a sample comparison from pre & post growing season noted a decline in macroinvertebrate taxa collected (Special Study see page 60 for Memorandum addendum 20090429). The samples in the upper reaches of Cat Creek resulted in Not Impaired ratings, a sample taken just above the tomato farm resulted in a Good-Fair rating and the sample below the tomato farm received a Poor rating. The tomato farm has since converted to growing blackberries and thus sampling the macroinvertebrate communities in both Rabbitt and Cat creeks is suggested, preferably in the fall after the growing season.

The Ecosystem Enhancement Program's restoration project on Cat Creek included the restoration of ~9,000 ft of stream channel and riparian area and 8 acres of riparian wetland through old and current cattle pasture and an old golf course.

The LTWA has been sampling the fish community in Rabbit Creek for many years and the IBI score has fluctuated from Very Poor in the 1990's to Fair & Poor in recent years. Recovery from disturbance during golf course construction and removal of cattle access may be responsible for some improvement, but subsequent declines could also be associated with the large tomato farm and pesticide use and a bridge replacement project. The negative changes also appear to be related to increasing sedimentation originating from poor land use practices. As part of LTWA's **Stream Visual Assessment Protocol** (SVAP) biomonitoring efforts Rabbit Creek was assessed and received Fair rating and received a Poor IBI score reported on LTWA's **Health Report Card**. DWQ supports LTWA's efforts to include Franklin High School students in restoration and protection activities in this subwatershed.

Coon Creek [AU# 2-24-3] (C) was sampled in 2008, at site GB160, and received a Good rating as part of an **EEP special study**. The creek was noted as having severe bank erosion and sediment within the channel.

Watauga Creek [AU# 2-24] (C;Tr) was sampled for macroinvertebrates in 2008, at site GB161, and received a Good rating as part of an **EEP special study**. Five fecal coliform bacteria samples were also taken as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 1100 and a geometric mean of 417 cfu/100ml. The creek was noted as being impacted from animal agriculture. As part of LTWA's **Stream Visual Assessment Protocol** (SVAP) biomonitoring efforts Watauga Creek was assessed in two locations and both received Fair ratings. In 2009, the LTWA completed a restoration project to help improve fish passage on Watauga Creek; activities included removal of an abandoned dam and a damaged culvert which was replaced with a free-spanning bridge and streambank restoration.

Rocky Branch [2-26] (C) was sampled as part of the EEP special study to assess fecal coliform bacteria contamination. Five samples taken between July 20- August 18, 2009 detected bacteria levels that exceed state standards with a maximum coliform count of 780 and a geometric mean of 370 cfu/100ml.

Iotla Creek [AU# 2-27] (C) watershed contains large amounts of agriculture and the Macon County Regional Airport. Impacts from these land use practices are evident in both DWQ and LTWA sample results. DWQ sampled this stream in two locations in 2004 and 2009. The fish and benthic communities were evaluated downstream of the airport at sites GB33 and GF15 and both rated Good. The stream was also sampled at as part of an **EEP special study** with the upper site receiving a Good-Fair rating and the lower site a Good rating. Biologists noted sediment problems and nutrient enrichment. Samples collected by LTWA confirm the instream habitat in Iotla Creek is some of the poorest in the basin and much of the lower reach has been channelized. Five fecal coliform bacteria samples were also taken as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 1600 and a geometric mean of 917 cfu/100ml. Three small tributaries were found to have high fecal levels and need to be investigated further to try and determine the source of the elevated fecal coliform bacteria

Iotla Branch [AU# 2-27-1] (C) was sampled at site GB152 as part of an EEP special study, in 2008, and received a Good-Fair rating. The creek was noted as having poor overall habitat with channels and pools filled in with sediment. In 2007, water samples showed elevated levels of fecal coliform bacteria. A 5-in-30 days study was completed in 2008 to assess if the stream was meeting water quality standards; the samples did not indicate standard violations. However, in 2009 the stream was resampled as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 2300 and a geometric mean of 1306 cfu/100ml. The tributaries with primarily agricultural land uses should be further investigated as sources of fecal coliform bacteria.

Cowee Creek [AU# 2-29] (C;Tr) drains the northeast corner of Macon County, an area with historical ruby mining operations and scattered residential and pasture areas. DWQ sampled the fish community at site GF8 in 2004 and the benthic community at site GB31 in 2007 and 2009. The fish community was rated Good and the benthic community rated Excellent both years, improving steadily from Good-Fair in 1994. The benthic community was also sampled upstream at site GB156 and rated Excellent in 2008 as part of the EEP special study. Biologists noted turbid water and slight sedimentation.

LTWA collected fish samples on Cowee Creek and three of its larger tributaries: Caler Fork, Matlock Creek, and Beasley Creek. Their results compare well with the DWQ samples and indicate the fish community in the downstream reach is in good health, but also note an increase in stream temperature and disappearance of trout. Significant sedimentation impacts are noted in and above Caler Fork from failing roads in the Wildflower development. LTWA measured the single largest drop in stream health at their site on Caler Fork. They report turbidity problems on this stream even during dry spells. Caler Fork received a Fair IBI fish rating; details of their monitoring results are described on their Health Report Card. LTWA noted Matlock Creek is also deteriorating, perhaps due to an increase in organic loading from development. Beasley is in good condition and supports a healthy population of rainbow trout.

DWQ sampled Caler Fork [AU# 2-29-4] (C) in Sept. 2010 and it received at Poor fish community rating at site GF62 leading to its Impaired status on the 2012 303(d) list. The Creek was also sampled as part of the EEP special study, in 2008, at site GB154 resulting in a Good rating. Samples were also take in Matlock Creek [AU# 2-29-5] (C) at GB155 resulting in a Good-Fair rating and Dalton Creek [AU# 2-29-4-2] (C) at site GB172 resulting in a Not Impaired rating, Dalton Creek was sampled again in May 2010, using the small stream criteria received an Excellent bioclassification.

Bradley Creek [AU# 2-33] (C;Tr) was sampled in 2008 at site GB148 and received a Good rating as part of an EEP special study. The creek was noted as having rocks coated with an abundance of aufwuchs and poor riparian and edge habitat. Five fecal coliform bacteria samples were also taken as part of the EEP special study between July 20- August 18, 2009 which detected bacteria levels that exceed state standards with a maximum coliform count of 770 and a geometric mean of 314 cfu/100ml. Bradley Creek was also monitored by the LTWA's biomonitoring program and received a Fair IBI fish rating; details of their monitoring results are described on their Health Report Card. In early 2011, the LTWA completed a restoration project to improve fish passage and reduce sedimentation caused by streambank scour; activities included removal of two damaged culverts which were replaced with a free-spanning bridge and streambank restoration.

Lakey Creek [AU# 2-34] (C;Tr) was sampled for macroinvertebrates in 2008 at site GB149 and received a Good rating as part of an EEP special study. The stream was noted as having poor riparian cover.

Burningtown Creek [AU# 2-38] (B;Tr) is the largest tributary to the Little Tennessee River downstream of Franklin. Compared with much of the county, its watershed is largely undeveloped excepting light residential and agricultural activities. The stream provides habitat for several sensitive species including the spotfin chub, hellbender salamander, smoky dace, and the sicklefin redhorse. DWQ sampled the fish community at GF3 in 2004 and benthic communities at sites GB30 in 2009, GB34 in 2007 and GB147 in 2008 as part of an EEP special study, all resulted in Excellent Ratings.

LTWA monitors Burningtown Creek and two of its tributaries, Younce Creek and Left Prong Burningtown Creek. Their data shows a healthy fish population in Burningtown Creek and the Left Prong. They report impacts from cattle near the mouth of Burningtown Creek. LTWA notes Younce Creek is degraded, but

by unknown causes. However, Younce Creek [AU# 2-38-8] (C) was also sampled by DWQ with the latest samples resulting in Excellent ratings at both sites, GB150 and GB151.

Tellico Creek's [AU# 2-40a, 2-40b & 2-40c] (C;Tr) fish community was sampled in 2004 resulting in a Good rating and the benthic community, at site GB28, in 2009 resulting in an Excellent rating. The creek was sampled several miles upstream from GB28 in 2010, in response to concerns regarding the Tellico Trout Farm located along the creek. The upstream sample location rated Good and downstream of the farm rated Fair. Based on the Fair rating a one mile segment [AU# 2-40b] of the Creek is now Impaired. **Tellico Trout Farm** claims to be the largest commercial hatchery in the eastern United States. At the trout farm, Tellico Creek drains 6.6 square miles of largely forested land, much of it in Nantahala National Forest. In 2008, ambient data was collected downstream of the trout farm showing, increased nutrient levels, a decrease in dissolved oxygen and pH, and specific conductance, water temperature, turbidity, and total suspended solids increased compared to the upstream sample. Also, in August 2008, DWQ staff observed that the trout farm was diverting the entire flow of Tellico Creek through the trout runs; similar stream conditions were observed recently in August 2010 (details of the ambient water quality data collected in 2008 & 2009 are found on page 57 of **EEP's Phase II report**). It also appears that the trout farm is influencing the stream's substrate and growth of aquatic moss in Tellico Creek. The substrate below the trout farm discharge is noticeably filled in with silt and fine sediments and there is abundant growth of aquatic moss on the rocks and in the leafpacks. These conditions were not seen upstream of the farm. Based on the benthic macroinvertebrate sampling results, the Tellico Trout farm is a significant contributor of pollution to Tellico Creek. DWQ's Asheville Regional Office is monitoring water quality conditions and may require permit changes or enhancements.

In July 2010, fish community sample collected by the LTWA in Tellico Creek downstream of the trout farm reported a very low catch rate and small fish of all species scarce or lacking. The community was characterized by extremely low numbers of sculpins, a high number of fish associated with sediment, a high proportion of omnivores and herbivores, a relatively high proportion of specialized insectivores, and a high darter/sculpin ratio. The LTWA concluded that the biotic integrity is declining in Tellico Creek (although no species have been eliminated) and that the decline is probably related to nutrient enrichment (McLarney, 2010).As part of LTWA's **Stream Visual Assessment Protocol** (SVAP) biomonitoring efforts Tellico Creek was assessed and received a Good rating, but received a Fair IBI score reported on LTWA's **Health Report Card**.

Rattlesnake Creek [AU# 2-44] (C) was sampled in 2007 as part of the **EEP special study** and rated as Not Impaired. The creek flows along a forested corridor and is one of the healthiest tributaries to the Little Tennessee River and it was noted as having some of the best habitat amongst all those sampled for the special study (although habitat conditions are limited due to bedrock substrate). Ambient data was also collected as part of the Random Ambient Monitoring System (RAMS) sample between Jan. 2007 - Dec. 2008. Station G3080000 was located on Rattlesnake Creek at Big Dog Road near Lauada. Data collected included normal field parameters along with metals, volatile organics, semi-volatiles, and pesticides; no water quality problems were detected.

Brush Creek's [AU# 2-46] (C) fish community was sampled in 2009 at site GF2, resulting in a Good rating. Good habitat and riparian conditions were present, but upstream nonpoint sediment runoff sources should be investigated.

Alarka Creek [AU#s 2-69-(0.4), 2-69-(0.5), & 2-69-(2.5)] (C;Tr; HQW) a medium-size tributary to the Little Tennessee River Arm of Fontana Reservoir. The creek's watershed (25 mi^2) drains southern Swain County. The headwaters are classified as High Quality Waters, but land uses in the lower portion of the catchment are residential and pasture. The benthic community sample at site GB17 indicates the water quality is Excellent. However, the fish community at site GF1 reflects significant habitat problems, receiving only a Good-Fair bioclassification. Also, an exceptionally large number of fish were collected, indicating the stream may be nutrient enriched. Likely sources for excess nutrients include nonpoint source runoff from lawns and/or failing septic systems. In many locations, the riparian zone was narrow or nonexistent and manicured lawns reached to the stream bank. The Swain County Soil and Water Conservation District identified concentrated livestock, row cropping, Christmas tree farming, and new development projects as possible pollution sources in the watershed. Swain SWCD is focusing efforts on this watershed.

Little Tennessee River [AU# 2-(26.5)a & 2-(26.5)b] (B) was sampled near Iotla Creek (GB35) in 2009 with noted water quality improvements resulting in a Good benthic rating. Downstream the river runs along 13 miles of Needmore Game Lands (4,525 acres) in which the river has seen an increase in recreational use and fishing. The river was sampled at site GB24, in 2007, resulting in an Excellent rating.

Fontana Lake Watershed (HUC 0601020205)

This watershed encompasses 107,019 acres and has an estimated 2010 population of 1,425 people.

Panther Creek [AU# 2-115] (C;Tr) in northeastern Graham County, is a high gradient tributary to the Panther Creek Arm of Fontana Reservoir. Habitat and water quality are good, the benthic community has rated from Excellent at site GB16 in 2009.

Stecoah Creek [AU# 2-130] (C;Tr) in northeastern Graham County, is a small tributary to Fontana Reservoir. The recent NC 28 widening project occurred in the middle part of its watershed. This stream is located in a more densely developed residential drainage than other streams in the subbasin. Some channelization has occurred, and a significant amount of substrate (large rocks) has been removed from the streambed for retaining walls around adjacent livestock areas or stream bank protection. Areas along the bank near the residential and agricultural areas are actively eroding. Riparian vegetation consists of mostly grasses and a few trees. The benthic community sampled in 2009 at site GB14 rated Excellent and the fish community at site GF26 was Not Rated but noted higher conductivity levels and siltation.

Hazel Creek [AU# 2-146-(0.5)] (C;Tr,ORW) was sampled in 2009 resulting in an Excellent benthic bioclassification.

Tuskeegee Creek [2-136] (C) is a tributary to the Little Tennessee River (Fontana Lake) and drains northern Graham county. The catchment is primarily forested with rural residential development and pastures and fallow fields along the state secondary roads. There are no NPDES permitted dischargers to the creek or to any of its tributaries. In 2007 a request to evaluate the Tuskeegee Creek watershed for the supplemental Tr waters classification was made. DWQ sampled two sites on the mainstem reach of Tuskeegee Creek in 2007 to determine if a wild, reproducing population of trout exists. The creek's tributaries were not sampled for trout because of their small size, lack of sufficient flow, or inaccessibility via public roads. A reproducing population of rainbow trout was found at one of the two sampling sites, but the habitat conditions during the sampling of this site were found to be less than optimal. Therefore, the Tuskeegee Creek watershed was re-sampled for trout and sampled for benthic macroinvertebrates in 2011 to provide additional data for consideration of the Tr, HQW, or ORW classifications for the watershed.

Trout Reclassification Request	
Tuckeegee Tributaries	Assessment Unit #
S.Fork Tuckeegee Creek	2-136-1
N.Fork Tuckeegee Creek	2-136-2
Cindy (Sandy) Branch	2-136-3
Apple Tree Branch	2-136-4
Chestnut Log Branch	2-136-5
Maple Branch	2-136-6
Garland (Flat) Branch	2-136-7
Bailey Branch	2-136-8

Fontana Lake is located along the southern boundary of the Great Smoky Mountain National Park. It provides power and flood control on the Little Tennessee River. Fontana Lake is owned by the federal government and operated by the Tennessee Valley Authority. Construction on the dam was begun in 1942 and was completed in 1944. At a height of over 480 feet, the Fontana dam is the highest dam east of the Mississippi River. The upstream 5,568 acres [AU# 2-(66)] of the lake is classified for primary swimming (B) and the downstream 1,697 acres [AU# 2-(140.5)] is classified WS-IV B CA.

Fontana Lake was sampled monthly from May through September 2009 by DWQ. Dissolved oxygen and water temperature readings in 2009 were similar to readings measured by DWQ staff on previous sampling trips. The thermocline near the dam generally occurred at a depth of 15 meters from the lake surface. Since 1981, the trophic state of this lake has been consistently oligotrophic.

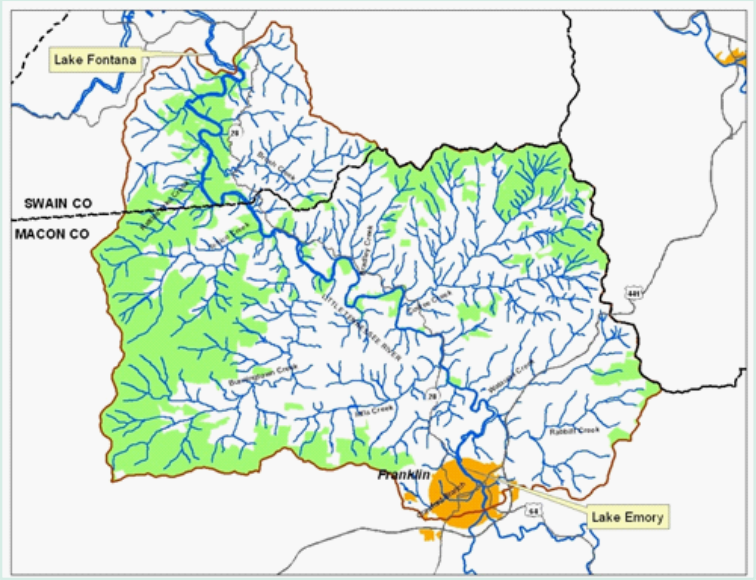
In September 2008, a lake fish consumption advisory was announced for Fontana Lake based on high levels of mercury found in walleye fish. Fontana Lake is also under a statewide consumption advisory for largemouth bass due to mercury contamination.

The Tennessee Valley Authority (TVA) began a monitoring program for its reservoirs in 1990 as a means of collecting data to assess the integrity or "health" of the aquatic ecosystems of these reservoirs. The TVA monitored Fontana Reservoir in 2010. Data results from this monitoring determined that the Ecological Health Rating was Fair. This reservoir has received this rating since 1995. The bottom life, one of the parameters used in the TVA's monitoring program, has consistently rated Poor and this may be the reason for the overall Fair rating. (www.tva.com/environment/ecohealth/fontana.htm)

Franklin to Fontana Local Watershed Plan

A Summary of a Comprehensive Watershed Planning Effort

Between 2008 and 2011, the North Carolina Ecosystem Enhancement Program led a watershed study and planning effort in the Franklin to Fontana watershed. The Franklin to Fontana watershed is a 154 square mile area that encompasses the Little Tennessee River watershed between Lake Emory and Lake Fontana. It lies within north Macon County and a small portion of south Swain County, and it includes much of the Town of Franklin.



The Franklin to Fontana watershed was chosen for study due to the interest of both local and regional stakeholders in its natural resources and cultural landscape. This area is of great ecological significance, and it includes a 23-mile free-flowing stretch of the Little Tennessee River that hosts a highly diverse aquatic community, including a number of rare, threatened or endangered fish and mussels. The area includes many tributaries to the Little Tennessee River, including Cowee, Burningtown, Iotla, Watauga, Cat, Rabbit, Brush, and Tellico Creeks. This primarily rural watershed is a mix of pasture, forest, and residential land, but there is notable development pressure on existing agricultural and forested land.

The objectives of this effort were to assess the health of the Little Tennessee River and its tributaries, identify the major stressors that impact stream quality, develop a plan that names specific recommendations to restore and protect watershed resources, and produce an atlas of on-the-ground projects that can provide the greatest benefit to the watershed.

A Team Effort

A Local Advisory Committee (LAC) comprised of representatives of local governments, conservation organizations, and resource agencies, was formed to oversee the project. The LAC established watershed study and planning objectives, carried out field studies, provided data, and developed management recommendations for the watershed plan.

Findings

An assessment of stream and upland conditions revealed that a large portion of the watershed is highly functioning, or healthy, including much of the Cowee subwatershed and the Burningtown, Tellico, Brush, Sawmill, and Needmore subwatersheds. These subwatersheds have a high amount of public and privately-owned forest and are generally associated with healthy fish and aquatic macroinvertebrate communities.

Franklin to Fontana Planning Timeline

June 2008: Plan started, Local Advisory Committee established
January 2009: Preliminary Findings & Recommendations Report completed, intensive watershed assessment tasks begin
January 2010: Watershed plan recommendation development begins
October 2010: Watershed Assessment Report completed
January 2011: Project Atlas completed
July 2011: Watershed Management Plan completed

The most highly impacted subwatersheds are those of Iotla Creek, Watauga Creek, Cat and Rabbit Creeks, and the Franklin area, including Crawford Branch. Aquatic macroinvertebrate communities were severely impacted by toxic impacts associated with a large tomato farm along Cat and Rabbit Creeks. Stream habitat is severely degraded in the Cat and Rabbit Creek and Iotla Creek subwatersheds; poor habitat was linked to a lack of woody riparian buffers, extensive stream straightening, livestock access to streams, and unpaved roads. In Franklin, Crawford Branch fish and aquatic macroinvertebrate communities are highly degraded, impacted by urban stormwater, water quality problems, and poor habitat. Tellico Creek biological communities were found to be impacted by waste inputs from a trout farm in its upper reaches.

Fecal coliform bacteria and nutrient levels were high in numerous subwatersheds; high fecal bacteria levels were often associated with livestock access to streams in rural subwatersheds, and high fecal bacteria levels in urban Crawford Branch are still under investigation. Assessment of mussel populations in the Little Tennessee River demonstrated continued decline in the federally endangered Appalachian Elktoe and other mussel species populations. High levels of metals were found in Lake Emory sediments, but copper levels in downstream Little Tennessee sediments were low.

The primary stressors to streams in the Franklin to Fontana watershed include the following:

1. Lack of woody streamside vegetation
2. Channel modification/straightening
3. Excess sediment inputs
4. Excess nutrient inputs
5. Bacterial contamination
6. Stormwater runoff
7. Tomato pesticides
8. Barriers to fish passage

Recommendations Developed:

The recommendations developed for the Franklin to Fontana Watershed Management Plan represent what were identified to be the most effective solutions to address the primary watershed stressors and to protect healthy streams across the Franklin to Fontana area. These thirty-six recommendations are summarized and grouped into four categories: Conservation Projects, Policy and Institutional Measures, Educational Activities, and Research and Assessment Activities.

Good fish habitat in Matlock Creek

Conservation projects include specific on-the-ground projects and general recommendations for landowners who would like to improve water quality and habitat of streams on their land. One key general recommendation for landowners is to maintain and plant a streamside buffer of native trees and shrubs, which can greatly improve stream habitat and stream bank stability, filter pollutants, and provide cooler water needed by mountain fishes like trout. Specific stream and wetland restoration projects and agricultural best management practices (BMPs) were proposed for the most highly impacted

rural subwatersheds. Stream-side reforestation projects were proposed along the Little Tennessee River. Forty retrofit stormwater BMPs were suggested for specific sites in Franklin. In order to conserve the natural and cultural heritage of the Franklin to Fontana watershed, both forestland and farmland preservation projects were proposed across the study area.

A number of policy and institutional measures related to state and local government programs are needed to address both existing and future threats to stream health. Two new ordinances would be particularly effective at protecting resources, including a county steep slope ordinance and a stormwater management ordinance. Existing sedimentation and erosion control programs and ordinances can be modified to increase their efficacy in streamside vegetation protection and provide consistent training and rules across Western North Carolina.

Education is a key element in achieving many of the strategies named above and is fundamental to increasing public awareness of the value of streams and rivers. A local environmental education program is essential to encourage environmental stewardship, and a number of specific elements of that program are spelled out in the Plan.

Continued research and assessment are needed to better understand watershed stressors, protect and restore aquatic resources, and to target conservation activities. In particular, continued investment into understanding the ecology of mussels in general and the cause of the Appalachian Elktoe decline in the Little Tennessee River in particular are important to mussel and aquatic habitat conservation both in the Little Tennessee River and in Western North Carolina at large. The Little Tennessee Watershed Association's highly successful stream biomonitoring program not only provides an on-going picture of stream and river health, but it also serves to educate area citizens through volunteer opportunities; this program is essential to community-based conservation of watershed resources.

The Franklin to Fontana watershed is an ecologically and culturally rich area. Everything that we do can impact stream and river health both in the Franklin to Fontana watershed and in downstream waters; the Franklin to Fontana Watershed Management Plan identifies a number of ways to live and work and play in the watershed that will conserve and improve the health of the Little Tennessee River and its tributaries.

For more information on the Franklin to Fontana watershed planning effort, including the full Watershed Management Plan, see: **http://portal.ncdenr.org/web/eep/rbrps/little-tennessee.**

Notable Waters

Table 1-1 lists waterbodies identified as needing additional protection and potential restoration actions. The third and fourth columns of this table list potential stressors and sources that may be impacting a stream based on in-field observations, monitoring data, historical evidence, permit or other violations, and other staff and public input. In many cases, additional study is needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Stream Name	AU#	Class.	Stressor	Source	Status	Actions Needed
Cartoogechaye Creek	2-19-(1) 2-19-(10.3) 2-19-(10.5)	WS-III;Tr WS-III;Tr,CAB;Tr	nutrients, fecal coliform bacteria	development, agriculture	S	P, BMPs
Little Tennessee R.	2-(1)b	C	low pH, habitat degradation	WWTP, Non-point sources	S, IP	P
Blaine Branch	2-19-13	C	habitat degradation	channelization, bank erosion, development, riparian zone disturbance	NR	R
Mill Creek	2-19-9	WS-III	habitat degradation	channelization, bank erosion, development, riparian zone disturbance	NR	R
Mill Creek	2-21-3	WS-III;Tr	habitat degradation	impoundments, low water levels, temperature, sediment, pesticides, flow modification, stormflow scour, development	I	R
Cullasaja River	2-21-(0.5)b	WS-III;Tr	habitat degradation	impoundments, low water levels, temperature, sediment, pesticides	I	R
Saltrock Branch	2-21-1	WS-III	habitat degradation	golf course	NR	R
Walnut Creek	2-21-17	C;Tr	habitat degradation, sediment, elevated conductivity	development, agriculture	S, IM	SS, BMPs
Alarka Creek	2-69-(2.5)	C;Tr	habitat degradation, nutrients	non-point source runoff, failing septic systems, limited riparian cover, agriculture	S	R, BMPs
Bradley Creek	2-33	C; Tr	fecal coliform bacteria, nutrients, habitat degradation	limited riparian cover, unfenced livestock	I	R, BMPS
Caler Fork	2-29-4	C	sediment	development on steep slopes	I	BMPs
Cat Creek	2-23-4a 2-23-4b	C	sediment, toxicity, habitat degradation, fecal coliform bacteria	channelization, land clearing, livestock, impoundments, lack of riparian cover, pesticides	I	R, BMPs
Crawford Branch	2-22	C	sediment, habitat degradation, channelization, fecal coliform bacteria	development, agriculture	I	R, BMPs
Iotla Creek Iotla Branch	2-27 2-27-1	C	sediment, nutrients, fecal coliform bacteria	channelization, agriculture	I I	R, BMPs
Moore Creek	2-57-17	C;Tr,ORW	sedimentation	impoundments	NR	P, R

Stream Name	AU#	Class.	Stressor	Source	Status	Actions Needed
Rabbitt Creek	2-23	C; Tr	sediment, toxicity, habitat degradation, fecal coliform bacteria	development, agriculture, beavers, channelization, pesticides	I	R, BMPs
Rocky Branch	2-26	C	fecal coliform bacteria		I	
Tellico Creek	2-40	C;Tr	sediment, nutrients,	trout farm, flow alterations	I	Ag BMPs, NMC
Whiteoak Creek	2-57-45a	C;Tr	nutrients	trout farm	NR	BMPs, NMC
Watauga Creek	2-24	C, Tr	fecal coliform bacteria	agriculture	I	R, BMPS
Younce Creek	2-38-8	C	habitat degradation		S	SS
Tuskeegee Cr + 8 tributaries	2-136	C	-	-	S	P, SS
AU # = Assessment Unit # or stream segment/reach						
Class. = Classification (e.g., C, S, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)						
Stressor = chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use.(e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.)						
Status = I=Impaired, IM= Impacted, S=Supporting, IP= Improving,						
Actions Needed = R= restoration, P= protection, SC= stormwater controls, SS= stressor study, E= education, LO= local ordinance, BMPs, SSP= species protection plan, F= forestry BMPs, Ag= Agriculture BMPs, NMC= nutrient mgmt controls.						

NPDES Permits

NPDES Permits Discharging to Upper Little Tennessee River Subbasin			
Permit #	**Permit Type**	**Outfall location**	**Facility Name**
NPDES Permits Discharging to Little Tennessee River			
NCG551116	Wastewater	Little Tennessee R.	single family residence
NCG550866	Wastewater	Little Tennessee R	single family residence
NC0060844	WWTP	Little Tennessee R	Laurel Hills HOA
NCG070136	Stormwater	Little Tennessee R	Cemex Construction
NCG520024	Stormwater	Little Tennessee R	Mountain Sand
NPDES Permits within Cullasaja Subwatershed			
NC0051381	WWTP	Saltrock Br	Highlands Falls Country Club
NC0021407	WTTP	Cullasaja R	Town of Highlands
NC0075612	WWTP	Cullasaja R	Wildcat Cliffs Country Club
NC0067326	WWTP	Cullasaja R	Macon County Schools
NC0059552	WWTP	Cullasaja R	Highlands Falls Community
NCG550658	Wastewater	Cullasaja R	Highlands-Cashiers Animal Clinic
NC0036692	WWTP	Big Cr	Skyline Lodge & Village
NC0032778	WTP	Big Cr	Town of Highlands
NCG110104	Stormwater	ditch to Cullasaja. R	Highlands WWTP
NCG550389	Wastewater	Little Buck Cr	single family residence

NPDES Permits Discharging to Upper Little Tennessee River Subbasin			
Permit #	**Permit Type**	**Outfall location**	**Facility Name**
NCG550170	Wastewater	Buck Cr	single family residence
NCG550162	Wastewater	Buck Cr	single family residence
NCG550444	Wastewater	Buck Cr	single family residence
NPDES Permits within Nantahala watershed			
NCG530062	Wastewater	Whiteoak Cr.	Whiteoak Trout Farm
NCG530072	Wastewater	Whiteoak Cr.	Coldspring Trout Farm
NC0067318	WWTP	Partridge Cr.	Macon County Schools
NCG500136	Wastewater	Nantahala R./Lake	Duke Nantahala Hydroelectric
NCG530121	Wastewater	Rowlin Cr.	Nantahala Trout Farm
NCG160030	Stormwater	Nantahala R./Lake	Nantahala Asphalt Plant
NCG020065	Stormwater	Nantahala R./Lake	Nantahala Talc & Limestone
NC0057193	WWTP	Nantahala R./Lake	Nantahala Outdoor Center
NC0037737	WWTP	Nantahala R./Lake	Nantahala Village
WQ0003441 WQ0003442	Wastewater recycling	Non-discharge	Nantahala River Gem Mine
NPDES Permits within the alarka Creek- Little Tenn. Watershed			
NCG080728	Stormwater	Crawford Br.	Rolling Frito-Lay
NCG210393	Stormwater	Ditch to Little Tenn. R	Zickgraf Hardwood Flooring
NCG120083	Stormwater	Ditch to Little Tenn. R	Macon County Landfill
NC0021547	WWTP	Little Tenn. R.	Town of Franklin
NCG550300 NCG550299	Wastewater	Little Tenn. R.	single family residence
WQ0022711	Irrigation	Non-discharge	Macon County
WQ0034616	Irrigation	Non-discharge	North Macon K-4 School
NCG150005	Stormwater	Iotla Cr.	Macon County Airport
NCG020262	Stormwater	UT to Iotla Cr.	Rose Creek Mine
NCG520016	Wastewater	Mason Br.	Old Cardinal Gem Mine- sand dredging
WQ0006560	Recycling	Non-discharge	Mason Mountain Mine
NCG520017	Wastewater	Caler Fork Cr.	Maceffie Gems & Land- sand dredging
NCG020146	Stormwater	Cowee Cr.	Sheffield Mine
NCG140400	Stormwater	Alarka Cr.	Smoky Mtn. Ready Mix
NCG551010	Wastewater	Alarka Cr.	single family residence
NPDES Permits within the Panther Creek Subwatershed			
NCG210055	Stormwater	Wolf Cr.	Dehart Lumber Co.

References & Useful Websites

Coweeta Long Term Ecological Research

http://coweeta.uga.edu/

USGS Hydrologic Data- http://coweeta.uga.edu/dbpublic/hydrologic_data.asp

Duke Energy

Franklin Hydroelectric Project- http://www.duke-energy.com/pdfs/Franklin_Vol_IIId.pdf

Land Trust for the Little Tennessee /Little Tennessee Water Association

http://www.ltlt.org/ or http://www.ltwa.org/

State of the Streams- http://www.ltwa.org/sites/all/files/images/2011SOSsmall.pdf

Cartoogehcaye Report- http://www.ltwa.org/sites/all/files/images/Cartoogechaye_report_final_web_version.pdf

LTWA Biomonitoring Trends- http://coweeta.uga.edu/publications/10415.pdf

LTWA Biomonitoring Program- http://coweeta.uga.edu/ltwa/

SVAP- http://coweeta.uga.edu/publications/10519.pdf

Skeenah Health Report- http://www.ltwa.org/sites/all/files/images/Skeenah_ck_mini.pdf

Peeks Cr.Health Report- http://www.ltwa.org/sites/all/files/images/Peeks_ck_mini.pdf

Rabbitt Cr. Health Report- http://www.ltwa.org/sites/all/files/images/Rabbit_ck_mini.pdf

Caler Fk. Health Report- http://www.ltwa.org/sites/all/files/images/Caler_Fork_mini.pdf

Bradley Cr. Health Report- http://www.ltwa.org/sites/all/files/images/Bradley_ck_mini.pdf

Tellico Cr. Health Report- http://www.ltwa.org/sites/all/files/images/Tellico_ck_mini.pdf

NC Ecosystem Enhancement Program

http://portal.ncdenr.org/web/eep/rbrps/little-tennessee

Phase I- http://www.nceep.net/services/lwps/Little_Tennessee/New/5_Supporting%20Documents%20I-II_F2F_Jan09.pdf

Phase II- http://portal.ncdenr.org/c/document_library/get_file?p_l_id=1169848&folderId=2806346&name=DLFE-41508.pdf

Phase III-http://www.nceep.net/services/lwps/Little_Tennessee/New/F2F_WMP_Final_21July2011.pdf

NC Division of Water Quality

Biological Assessment- http://portal.ncdenr.org/c/document_library/get_file?uuid=de0dbb2d-3417-44c4-9736-1710d2e18d43&groupId=38364

Ambient Report- http://portal.ncdenr.org/c/document_library/get_file?uuid=ac3b7afe-e2f1-4d1e-93df-c2ba9d897888&groupId=38364

Lakes & Reservoir Assessment- http://portal.ncdenr.org/c/document_library/get_file?uuid=0b586b2a-6851-4783-a4e1-a7f58b2549f4&groupId=38364

303(d) List- http://portal.ncdenr.org/web/wq/ps/mtu/assessment

Impaired & Impacted Survey- http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey

Cullasaja River- http://portal.ncdenr.org/c/document_library/get_file?uuid=c75eb8e2-0354-4490-88ab-771d9b7871d0&groupId=38364

NC Department Health and Human Services

Fish Advisory- http://epi.publichealth.nc.gov/fish/current.html

NC Division of Water Resources

Flow- http://www.ncwater.org/Permits_and_Registration/Instream_Flow/

Upper Cullasaja Watershed Association

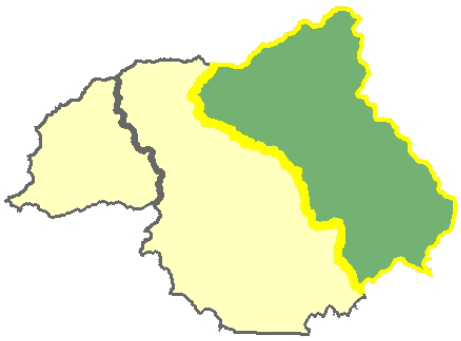
http://portal.ncdenr.org/c/document_library/get_file?uuid=bda0b403-848d-4951-b7fe-d8f365505a71&groupId=38364

http://coweeta.uga.edu/publications/10518.pdf

Tennessee Valley Authority

Monitoring- http://www.tva.com/environment/ecohealth/fontana.htm

Tuckasegee River Subbasin



HUC 06010203

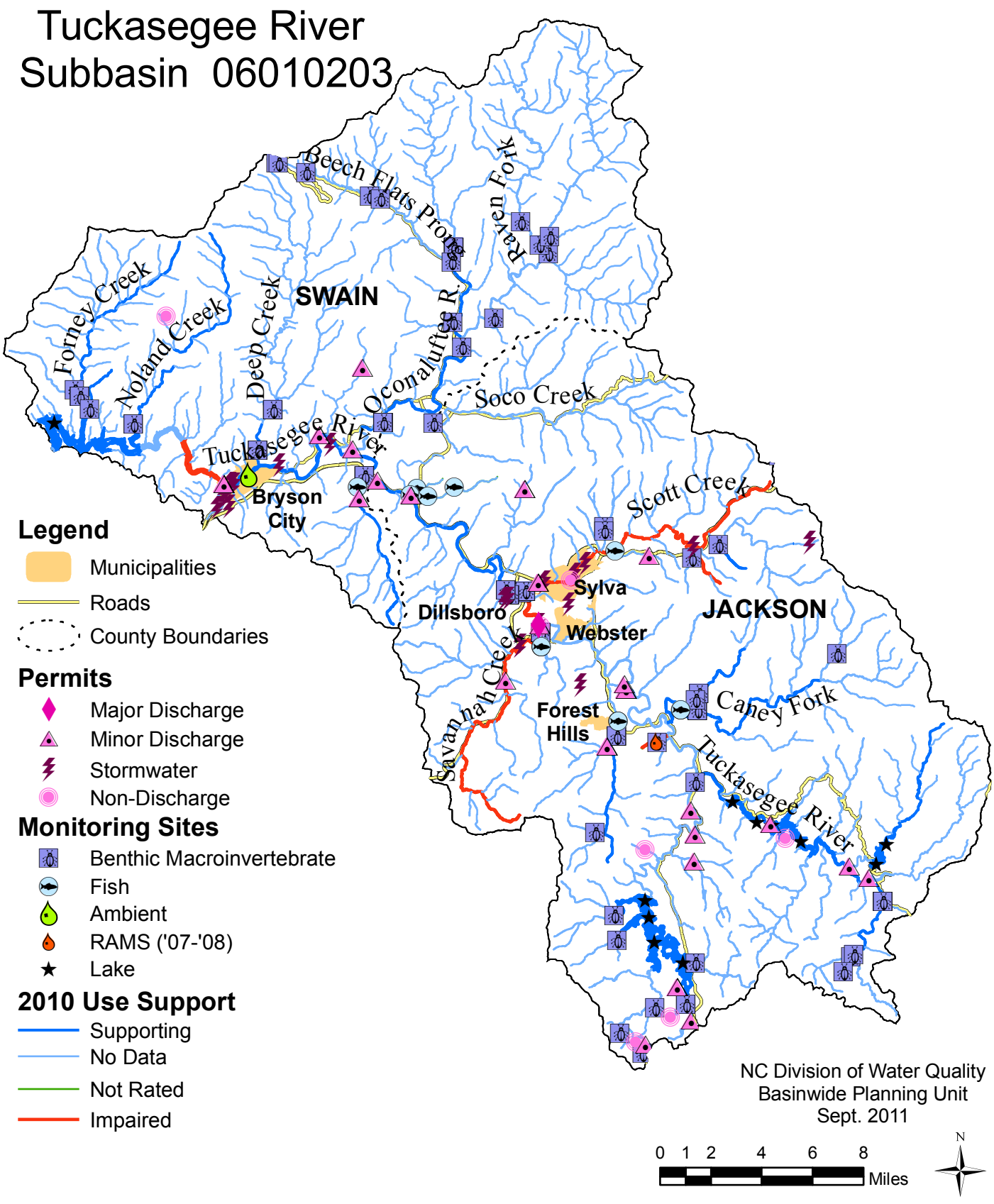
Includes: Tuckasegee River, Caney Fork, Scott Creek, Savannah Creek & Oconaluftee River

Watershed at a Glance

Counties:	Population:	2006 Land Cover:	Permitted Facilities:
Jackson, Swain	2000: 41,737	Open Water.....1%	NPDES
Municipalities:	2010: 49,162	Developed.....5%	Wastewater Discharge.....22
Bryson City, Dillsboro, Forest Hills, Sylva, Webster		Forested.....89%	Wastewater Nondischarge....8
EPA Level IV Ecoregions:	**Area** 734 mi²	Scrub.....1%	Stormwater.....16
High Mtns., Southern Metasedimentary Mtns, Southern Crystalline Ridges & Mtns		Agriculture..... .....4%	Animal Operations.....0

Figure 1-1: NLCD 2006 Land Cover

Figure 1-2: Tuckasegee River Subbasin Map (06010203)



Water Quality Overview

The Tuckasegee River Subbasin, hydrologic unit 06010203, was represented in previous Basin Plans as Subbasin 04-04-02. This subbasin covers 734 sq. miles and is 89% forested; containing portions of Nantahala National Forest and Great Smoky Mountains National Park (Figure 1-1). There are approximately 3,429 reservoir acres and ~998 classified stream miles, not including the numerous unnamed tributaries. The Tuckasegee River drains into Fontana Lake just downstream of Bryson City.

This subbasin contains some of the most pristine high quality waters in the state and supports numerous trout streams (Figure 1-3). Water quality issues of concern in this subbasin include impacts from developments on steep slopes, agricultural runoff, stream bank erosion, limited riparian cover and individual onsite wastewater failures. Waterbodies currently on the 2010 303(d) list of Impaired waters include: a 1.3 mile unnamed tributary to the Tuckasegee River, Scott Creek, Sugarloaf Creek, Savannah Creek and 170 acres of the Tuckasegee River Arm of Fontana Lake. A map of the subbasin showing Impaired streams, monitoring and permit locations is shown in Figure 1-2.

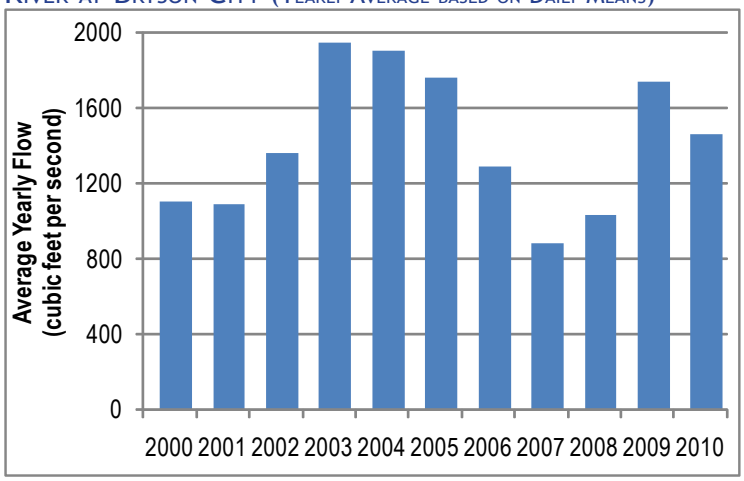
Figure 1-3: Stream Classifications

For more information regarding stream classifications see: http://portal.ncdenr.org/web/wq/ps/csu/

Stream flow

Stream flow is monitored at US Geological Survey gaging stations. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). There are four gaging stations in this subbasin. Figure 1-4 provides an example of average stream flow over a 11 year period and gives an idea of which years received heavier precipitation. For more information about instream flow see DWR website: http://www.ncwater.org/About_DWR/Water_Projects_Section/Instream_Flow/welcome.html.

Figure 1-4: Stream flow at USGS 03513000 Tuckasegee River at Bryson City (Yearly Average based on Daily Means)



The flow rate in a stream can impact the measurement of physical and chemical parameters. In particular, droughts can have major affects on parameters such as dissolved oxygen, turbidity, pH, and others by reducing stream flow. Most recently this subbasin was in drought conditions in 2007 and 2008 (see page 17 AMS Report). Drought effect on discharge in the Tuckasegee River was somewhat reduced by the almost daily releases of water

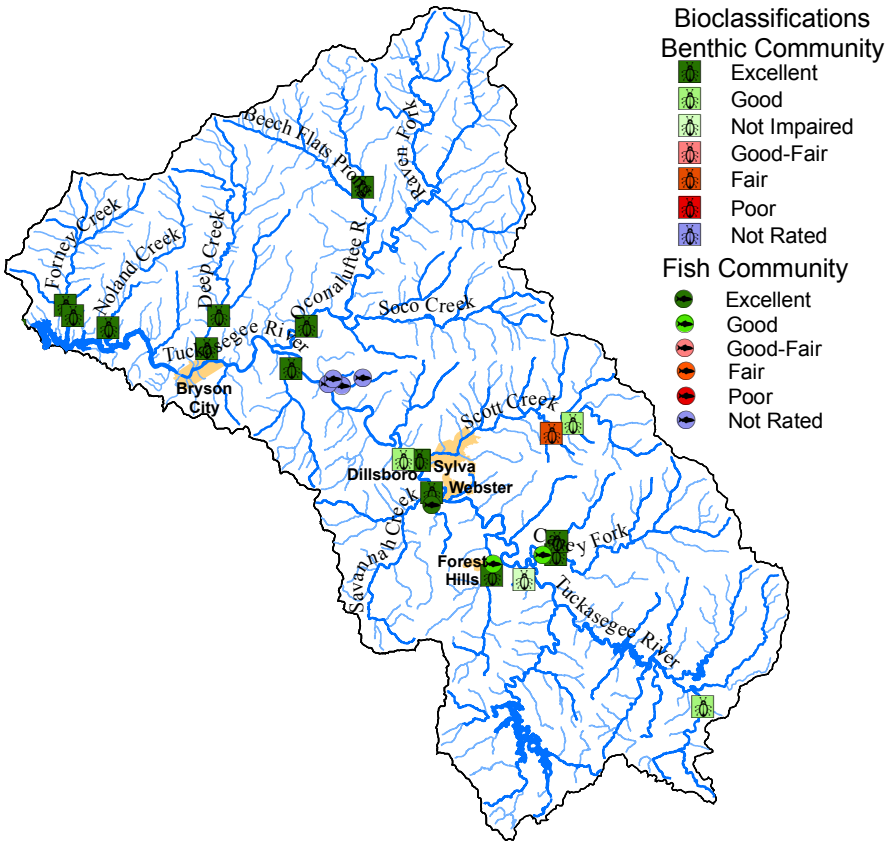
from the Duke Energy hydroelectric facility at the lower end of the West Fork of the Tuckasegee River. The Oconaluftee River, with no dam control, the drought effect was more pronounced. Annual average streamflow for 2007 was the lowest in since data collection in ~1946. Low precipitation over the 2007-08 winter accentuated the drought with recovery not starting until the storms in November 2008.

Biological Monitoring

Biocriteria have been developed using the diversity, abundance, and pollution sensitivity of the organisms that inhabit flowing waterbodies in NC. One of five bioclassifications are typically assigned to each water body sampled: Excellent, Good, Good-Fair, Fair and Poor. Not Impaired and Not Rated designations are reserved for samples that were not eligible to be assigned one of the five typical bioclassification categories. Typically, a "Not Impaired" rating is equivalent to a Good-Fair or better bioclassification and a "Not Rated" designation is equivalent to a Fair or worse bioclassification. The reasons for not being able to assign one of these five typical bioclassifications may be a lack of appropriate bio-criteria or atypical sampling conditions (e.g., drought). These bioclassifications are used to assess the various impacts of both point source discharges and nonpoint source runoff. The resulting information is used to document both spatial and temporal changes in water quality, and to complement water chemistry analyses, ambient toxicity data, and habitat evaluations. In addition to assessing the effects of water pollution, biological information is also used to define High Quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with management actions. The results of biological investigations have been an integral part in North Carolina's basinwide monitoring program.

Biological samples were collected during the spring and summer months of 2004 and 2009-10 by the DWQ-Environmental Sciences Section as part of the five-year basinwide sampling cycle. Fourteen benthic macroinvertebrate sites and three fish community sites were evaluated in 2009-10, representing seventeen distinct localities. Each basinwide biological station monitored during the current cycle is shown in Figure 1-5 and color coded based on its current rating. The majority of benthic macroinvertebrate samples taken in this watershed received an Excellent rating. Several fish community sites resulted in a Not Rated status, due to the absence of criteria for rating high gradient mountain trout waters, while others rated Good. There were an additional 8 samples taken at new locations.

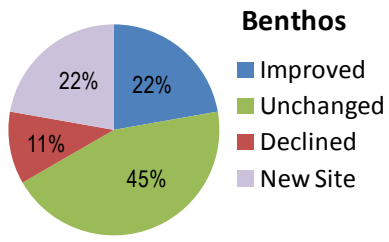
Figure 1-5: Biological Sites Current Ratings



Benthos

Among the benthic macroinvertebrate sample sites, four sites improved, two declined and eight retained the same bioclassification in 2009-2010 as observed in 2004. There were an additional four benthic samples taken to support special studies. Figure 1-6 shows the distribution of these samples.

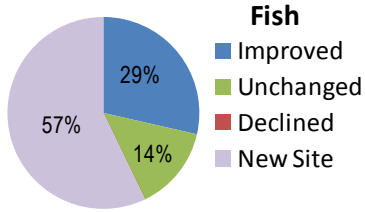
Figure 1-6: Benthic Macroinvertebrate Sample Status



Fish

Among the three fish community sites, two improved from 2004 while the one remaining site maintained the same bioclassification in 2009 from that observed in 2004. There were an additional four fish community samples taken to support special studies. Figure 1-7 shows the distribution of these samples.

Figure 1-7: Fish Community Sample Status



For more information about biological data in this watershed, see the 2010 Little Tennessee River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 1-B.

Long Term Ambient Monitoring

The DWQ's Ambient Monitoring System (AMS) is a network of stream stations strategically located for the collection of physical and chemical water quality data. There is one AMS station (G8600000) in this subbasin; data has been collected from this site since 1973. The following discussion of ambient monitoring parameters includes concentration value graphs for AMS station G8600000 over a 11 year period (2000-2010). Each major parameter is discussed, even if no current impairment exists. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the Little Tennessee River Basin Ambient Monitoring System Report.

pH

As seen in Figure 1-8, which represents the data window for the 2010 303(d) list, ambient site G8600000 had at least one sample that fell below the pH standard of 6su, but it did not exceed the standard in 10% or more of the samples. Over 11 years (Figure 1-9), there were four incidences of pH dropping below the minimal standard of 6 su at AMS G8600000.

At a Random Ambient Monitoring System site (G4210000) on an unnamed tributary to Tuckasegee River at State Road 1172 near East Laport, samples taken recorded low pH levels resulting in Impairment.

Figure 1-8: Percentage of Samples Exceeding the pH <6 Standard between 2004-2008

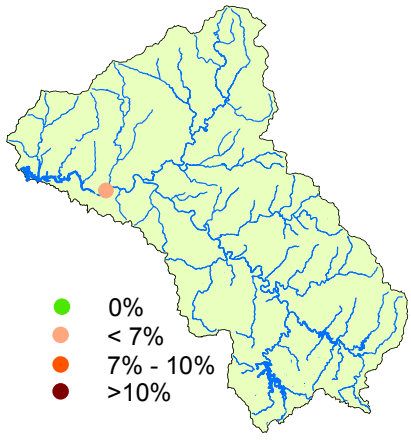
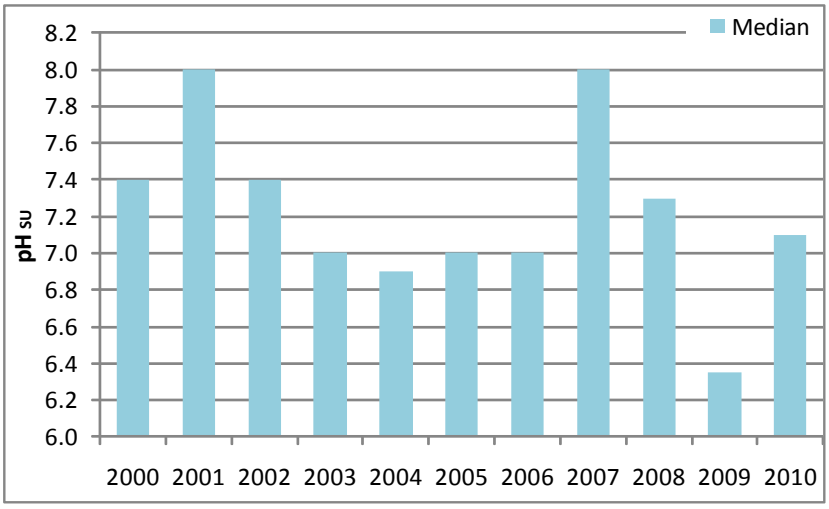


Figure 1-9: Summarized pH data at AMS G8600000 site between 2000-2010



Dissolved Oxygen

As seen in Figure 1-10, which represents the data window for the 2010 303(d) list, ambient station G8600000 did not have any exceedances of DO standards. Over the past 11 years (Figure 1-11), no samples were collected with dissolved oxygen levels below the 4mg/l instantaneous standard for Class C waters.

Figure 1-10: Percentage of Samples Exceeding the DO <4 Standard between 2004-2008

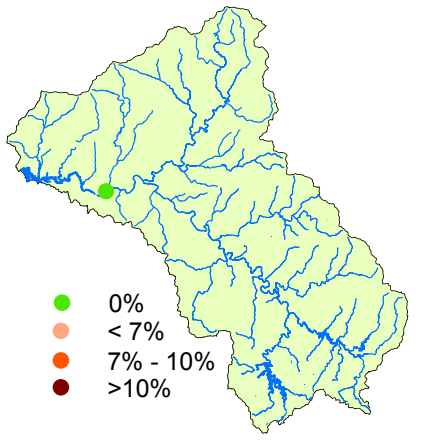
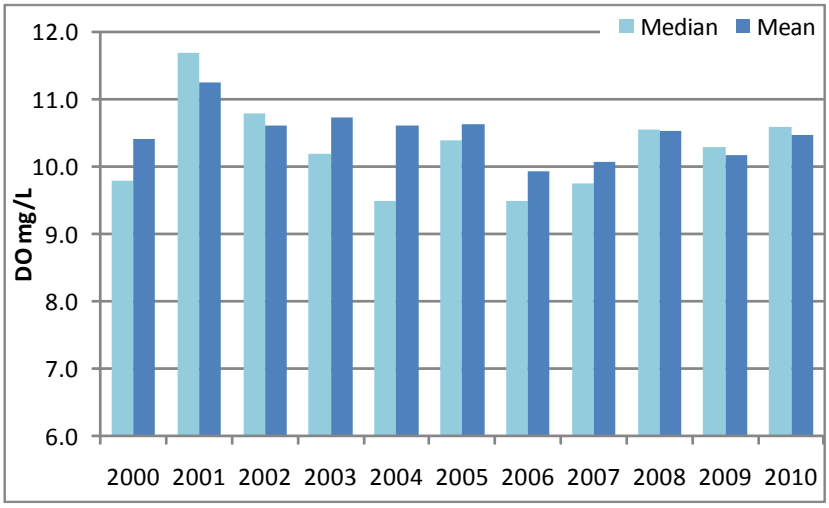


Figure 1-11: Summarized DO data at AMS G8600000 site between 2000-2010.



Fecal Coliform Bacteria

Fecal coliform bacteria occurs in water as a result of the overflow of domestic sewage and from other nonpoint sources of human and animal waste, including pets, wildlife and farm animals. The fecal coliform bacteria standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are used to indicate whether a stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) are prioritized for 5-in-30 studies.

As seen in Figure 1-12, which represents the data window for the 2010 303(d) list, ambient station G8600000 exceeded the 400 colonies/100ml in at least one sample. There were eight incidences of high bacteria counts as indicated by several peaks in mean values over the eleven compared years, shown in Figure 1-13 . There are three waterbodies Impaired because of elevated fecal coliform bacteria detected in 5-in-30 data collected in August 2005: Savannah Creek, Scott Creek and Tuckasegee River.

Figure 1-12: Percentage of Samples Exceeding the Fecal Coliform Bacteria >400 Standard between 2004-2008

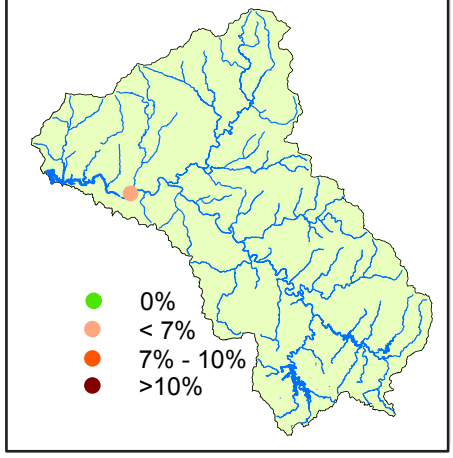
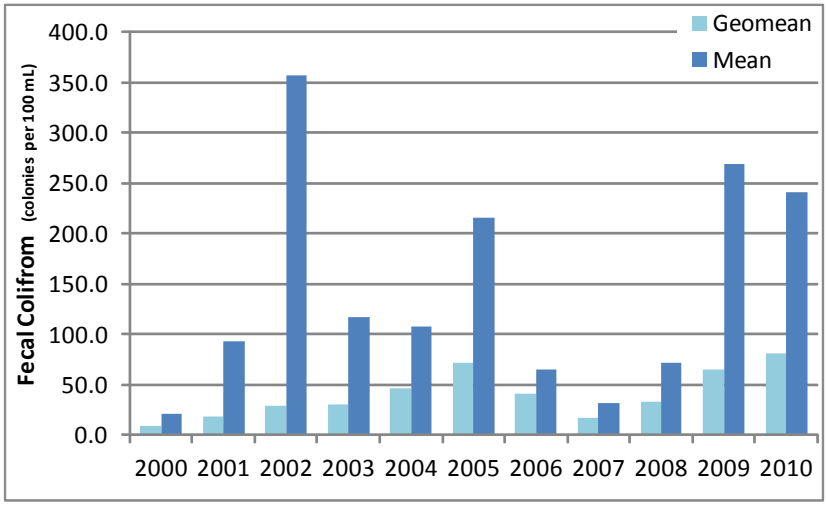


Figure 1-13: Summarized Fecal Coliform Bacteria data at AMS G8600000 site between 2000-2010.



Turbidity

As seen in Figure 1-14, which represents the data window for the 2010 303(d) list, ambient site G8600000 did not have any samples that exceeded 50NTUs. Over the past 11 years (Figure 1-15), only one sample at exceeded the standard of >50 NTUs for Class C waters.

Figure 1-14: Percentage of Samples Exceeding the >50 Turbidity Standard between 2004-2008

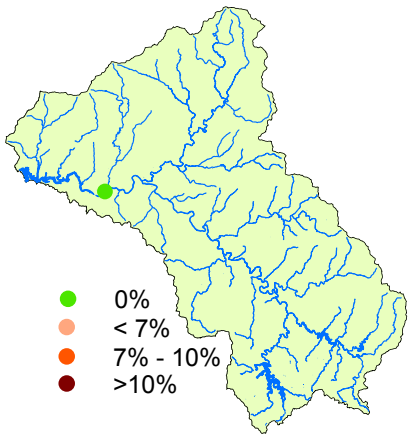
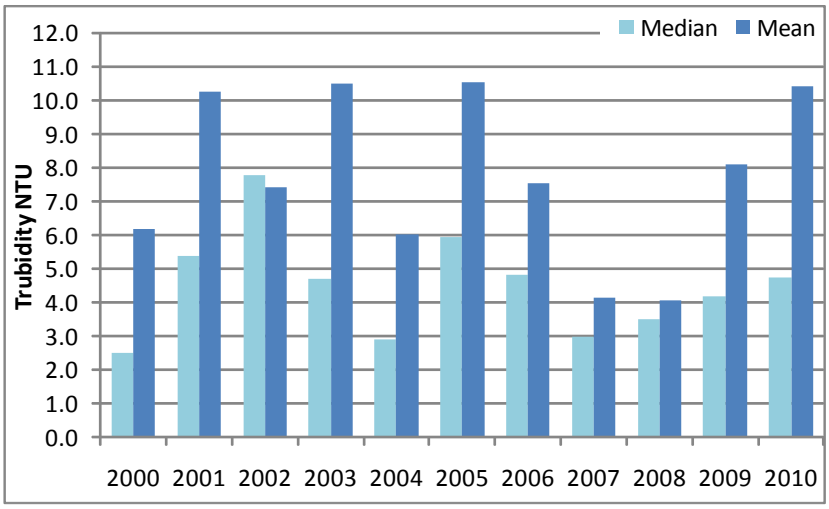


Figure 1-15: Summarized Turbidity data at AMS G8600000 site between 2000-2010.

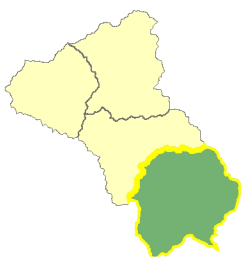


Protection and Restoration Opportunities

The following section provides more detail about specific streams where special studies have occurred or stressor sources information is available. Within this document, biological sample site IDs ending in an "F" denote fish community and a "B" denote macroinvertebrate community. Specific stream information regarding basinwide biological samples sites are available in Appendix 1B. Use support information on all monitored streams can be found in Appendix 1A. Detailed maps of each of the watersheds are found in Appendix 1C or by clicking on the following small maps.

To assist in identifying potential water quality issues citizens, watershed groups and resource agencies can gather and report information through our Impaired and Impacted Stream/ Watershed survey found here: http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey.

Upper Tuckasegee River Watershed (HUC 0601020301)



This watershed encompasses 152,466 acres and has an estimated 2010 population of 15,325 people. A majority of the watershed is within a WS-III area.

West Fork Tuckasegee River/ Thorpe Lake [2-79-23-(1)] (WS-III,B;HQW) also known as Glenville Lake, is a man-made impoundment on the Tuckasegee River located in Jackson County. The lake is used for recreational fishing, swimming, and boating. Owned by Duke Energy, the reservoir also has been used for hydroelectric power generation since its construction in 1941. Thorpe Lake was monitored by DWQ in 2009, which determined the Lake is still oligotrophic as it has been since it was first monitored in 1988. Trillium

Links & Village WWTP discharges into Hurricane Creek which a tributary to Thorpe Lake. The facility has had several permits violations over the past five years, including exceedances for BOD, TSS, ammonia and low DO.

Wolf Creek (Wolf Creek Lake) [2-79-9-(1)] (WS-III,B;Tr,HQW) Wolf Creek Reservoir is a small hydroelectric reservoir built by Nantahala Power and Light Company in 1955 on the Tuckasegee River and is currently owned by Duke Energy. Wolf Creek Reservoir has a forested watershed. The shoreline of the lake has a relatively low density of private homes, however evidence of land clearing and new home construction was observed in 2009. Monitoring by DWQ field staff of Wolf Creek Lake was conducted monthly from May through September, 2009. Data collected indicated that the lake's trophic state to be oligotrophic. This trophic state has not changed since monitoring by DWQ began in 1988.

Tuckasegee River [AU# 2-79-(0.5)] (WS-III,B;Tr,ORW) was sampled at site GB38 in 2009 resulting in an Good benthos bioclassification.

Tuckasegee River/ Bear Creek Lake [2-79-(5.5)b & 2-79-(5.5)c] (WS-III,B;Tr) is a hydroelectric impoundment of the Tuckasegee River. Most of the 194 mi^2 upland drainage area is forested with steep slopes and clean, fast-moving streams. Bear Creek Lake was built in 1953 and is currently owned by Duke Energy. DWQ field staff monitored Bear Creek Lake five times from May through September in 2009. This reservoir has remained oligotrophic since it was first monitored by DWQ in 1994. In past evaluations of Bear Creek Reservoir, it was observed that the shoreline was predominantly forested with a relatively undisturbed drainage area that helped to maintain the reservoir's low nutrient concentration and very clear water. It was noted in 2009 that residential development has significantly increased along the shoreline and in the watershed of this reservoir.

Tuckasegee River/ Cedar Cliff Lake [2-79-(5.5)c] (WS-III,B;Tr) is a picturesque mountain lake on the Tuckasegee River. The lake is owned by Duke Energy and was built in 1952. Water quality in the lake supports swimming, boating, and trout fishing. The name of the lake was probably derived from a sheer rock cliff, which faces it from the north. This lake was sampled in 2009 by DWQ, which determined the Lake is still oligorophic as it has been since it was first monitored in 1988.

Unnamed tributary to Tuckasegee River [2-79-(24)ut4] was sampled for macroinvertebrate communities in 2007 resulting in a Not Impaired status. A Random Ambient Monitoring System site (G4210000) also collected data along this tributary between Jan. 2007 - Dec. 2008. Data collected included normal field parameters along with metals, volatile organics, semi-volatiles, and pesticides. Over 18% of the samples had low pH, but no other water quality problems were detected. This creek is now Impaired for Aquatic Life because of the low pH levels.

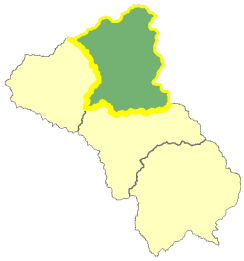
Caney Fork [AU# 2-79-28-(2.5)] (WS-III;Tr) drains a small portion of east-central Jackson County, a mostly forested landscape, and ultimately feeds into the Tuckasegee River. Caney Fork, for most of it's length, is paralleled by roadway and is lined by agricultural fields and residences. The stream is lacking significant riparian vegetation and is often denuded on both sides streambanks. However, most of the watershed is forested thereby protecting the Excellent water quality that has persisted in Caney Fork over the last two decades. The stream was sampled at sites GB27 and GF4 resulting in an Excellent benthos and Good fish community bioclassifications.

Moses Creek [2-79-28-8] (WS-III;Tr) is a tributary of Caney Fork. This stream has a catchment that is largely forested with only the lower segment paralleling a rural residential road. It was noted that riparian loss was occurring due to residential lawns, some upstream agriculture, and the nearby road. The Creek was sampled at site GB26 in 2010 resulting in an Excellent benthos rating.

Cullowhee Creek [AU# 2-79-31a & b] (C;Tr) flows north through Jackson County in the southwestern portion of North Carolina. The majority of the headwaters are forested and of good water quality. The lower portion of the watershed includes Western Carolina University, light commercial, and residential development.

The stream through this section was historically moved and channelized resulting in poor habitat and flood protection. In 2009, DWQ sampled Cullowhee Creek at two locations upstream of the university. The benthic community at site GB29 rated Excellent, and the fish community at GF13 received a Good bioclassification. The biologists noted high levels of sand, silt and macrophytes. Although Cullowhee Creek rated as Excellent in 2009, habitat degradation is an issue and may negatively affect the fauna in the future.

Oconaluftee River Watershed (HUC 0601020302)

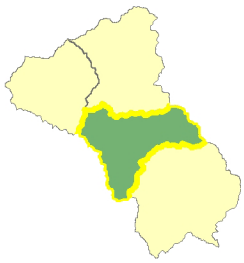


This watershed encompasses 120,226 acres and has an estimated 2010 population of 8,833 people.

Bradley Fork {AU# 2-79-55-12-(11)] (B;Tr,HQW) a tributary to the Oconaluftee River, is located within Great Smoky Mountain National Park and as such has a completely undeveloped and forested watershed. This stream has high recreational usage among the public as it lies next to a campground just inside the park border The creek was sampled in 2009 at site GB1 resulting in an Excellent benthos bioclassification.

Oconaluftee River [AU# 2-79-55-(16.5)] (C;Tr) is a large tributary to the Tuckasegee River draining the eastern portion of Great Smoky Mountain National Park. The lower segment of this river is tracked on both sides by roads and receives large amounts of urban runoff from Cherokee. High development pressures have introduced sediments into the river and removed large amounts of riparian vegetation. The River was sampled in 2009, at site GB11, resulting in an Excellent benthos bioclassification, however the Excellent rating is likely supported from the unimpacted tributaries as conditions in the Oconaluftee River itself are deteriorating.

Middle Tuckasegee River Watershed (HUC 0601020303)



This watershed encompasses 104,486 acres and has an estimated 2010 population of 19,373 people.

Savannah Creek [AU# 2-79-36] (C;Tr) watershed drains the west-central portion of Jackson County. Savannah Creek itself flows alongside US 441 and NC 116 for much of its length before joining the Tuckasegee River near Webster. Traditionally, land use in the watershed was agricultural with light residential and commercial activity along the transportation corridors. Residential development is increasing substantially and elevating sediment and erosion concerns. DWQ does not have an ambient monitoring station but DWQ did sample fecal coliform bacteria concentrations in Savannah Creek as part of a Class B (Recreation) use-attainability study for the Tuckasegee River initiated in 2003. The samples exceeded state standards and indicate Savannah Creek, from its source to the Tuckasegee River (13.4 miles), is Impaired in the recreation category. The sources of fecal coliform contamination are unknown, but may include failing septic systems and/or agricultural runoff. DWQ also sampled the fish and benthic communities at sites GF23 and GB23, both resulting in Excellent ratings. However, these data do not reflect the habitat threats posed by development in the watershed. Many stream reaches have been channelized and riparian vegetation removed.

The Watershed Association for the Tuckasegee River (WATR) is currently writing a watershed plan and coordinates sampling in the Savannah Creek Watershed. Data collected at Savannah Creek and its largest tributary, Greens Creek, from July 2003 through September 2010 show turbidity levels that exceed the 10 NTU standard for trout habitat waters.

	Savannah Ck.	Greens Ck.
N	89	87
Exceeding 10 NTUs	~37%	~33%
Mean	19.4	9.7
Median	7.7	7.5
Maximum	450	80

Measurements exceeded turbidity standards 37% of the time for Savannah Creek and 33% for Greens Creek [AU# 2-79-36-11]. These results were obtained despite the regional drought conditions. Monthly sampling also detected high flow and high turbidity conditions during the summers of 2007 and 2008.

WATR notes that DWQ's sample site at NC116 is not representative of stream conditions. The monitoring site at bridge on NC116 has a relatively large gradient as compared to stream reaches up and downstream. The station occupies a small water gap in a local ridge and it has a rocky substrate. These factors combine to yield a short zone that does not accumulate deposited sediments and is favorable habitat for macroinvertebrates WATR recommends that if it is necessary to acknowledge this biologically productive stream segment, then Savannah Creek should be divided into three assessment reaches. Moving upstream from the confluence, the first reach is a section of stream that is characterized by low gradient. It passes through a wide floodplain with agriculture, and stream banks are unstable and eroding. The second assessment reach starts with the high gradient segment at Bridge along NC116. In the upstream direction it forms a large curve in an isolated patch of flood plain, again dedicated to agriculture. This reach extends into a larger water gap paralleled by Rt 116. The high gradient section in the water gap, a place frequented by anglers, marks the upper end of this section. The third assessment reach starts at the mid point in the water gap and extends upstream for the remaining length of Savannah Creek.

Since the temporary moratorium on construction in 2008 and the downturn in home building in 2009, the relative effect of construction on erosion and turbidity has decreased significantly. Enforcement, and especially clarity and enforcement of temporary and final vegetative cover, remains critically important to improving water quality in the Savannah Creek watershed. Developing agriculture buffers and public education on maintaining fallow land, road ways and road ditches are recommended. Fecal coliform contamination sources in the Savannah Creek watershed should be identified and corrected. Additionally, sediment and erosion control problems should be addressed to prevent further habitat degradation.

Water Quality Initiatives

WATR is working diligently to inform the public on the critical role of stream side buffers in maintaining a healthy aquatic ecology and good water quality. Partnering with the Town of Dillsboro WATR volunteers and staff have build the Stream Buffer Demonstration Trails at Monteith Farmstead Park. These short nature trails with educational signs are specifically aimed at informing the landowners, and stream-side landowners in particular, about the necessity of riparian buffers to healthy mountain streams. This work has been supported by **Resourceful Communities Program**. WATR also has conducted youth environmental education events funded by the Cherokee Preservation Foundation, the USDA Natural Resources Conservation Service, and by WATR members and contributors.

Scott Creek [AU# 2-79-39] (C;Tr) is a large, swift tributary to the Tuckasegee River. Draining northeastern Jackson County, US 19/23 and Old US 19/23 parallel the creek is for most of its length. The stream passes through many residential areas before entering the urban environment in Sylva and Dillsboro. DWQ sampled fecal coliform bacteria concentrations in Scotts Creek as part of a Class B Recreation use-attainability study for the Tuckasegee River initiated in 2003. The samples exceeded state standards and indicate Scotts Creek, from its source to the Tuckasegee River (15.3 miles), is Impaired in the recreation category.

Rafting on Scott Creek

The sources of fecal coliform contamination are unknown, but may include failing septic systems, leaking sewer systems and/or nonpoint source runoff. In 2009, DWQ evaluated the benthic macroinvertebrate community at site GB167 resulting in an Excellent bioclassification. This is an noted improvement compared to the 2004 conditions, however the Creek still has turbidity and habitat issues. The stream channel is highly modified and the bank is armored by riprap.

The Morningstar of Jackson WWTP facility discharges into Blanton Branch (AU# 2-79-39-10) which is a tributary to Scott Creek. In 2010 the facility exceeded fecal coliform bacteria levels.

A small pond dam failure in the Balsam Mountain Preserve development occurred on June 7, 2007. The resultant sediment and debris slide entered Sugarloaf Creek [AU# 2-79-39-5-1] (C) and finally the lower segments of Scott Creek. A special benthos study was completed in 2007 to assess the impacts from the dam failure. A total of three streams were sampled in this study. Two of the streams sampled (Sugarloaf Creek and Scott Creek) were directly affected by the sediment. The third stream, Licklog Branch [2-79-39-3-6] (C), was sampled as a comparative reference site to Sugarloaf Creek and was similar in both landuse and drainage area. Results of the study indicate that the dam failure did affect the macroinvertebrate community in Sugarloaf Creek as it had a “Fair” bioclassification while the reference site was “Good”. The downstream reaches of Scott Creek received an “Excellent” bioclassification.

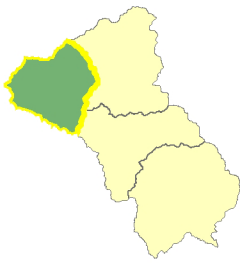
Tuckasegee River [2-79-(35.5)a & 2-79-(35.5)b & 2-79-(38)] (C;Tr) receives effluent from the municipalities of Sylva, Webster, and Dillsboro and drains almost the entirety of Jackson County. The River is Impaired for recreational uses due to exceedances of the fecal coliform bacteria levels. The Jackson County WWTP has had numerous permit violations within the five years, including exceedances in fecal coliform bacteria, BOD, TSS levels and low pH.

Downstream [AU# 2-79-(40.5)] the in the Tuckasegee River a biological sample was taken in 2009 at site GB19 resulting in an Good benthos bioclassification. The most significant event for aquatic biology in the Tuckasegee River watershed was the removal of the low-head dam at Dillsboro in early winter of 2009. Prior to dam removal, Duke Energy pumped out and removed much of the impounded sediment. Dam removal allows fish species to migrate upstream, with the potential for host species for the endangered Appalachian Elktoe Mussel to also migrate upstream. As part of the dam removal, the river bank along the former impoundment has been restored with stone armoring at the toe of the slope affected by water level changes caused by daily discharge related to hydroelectric generation.

Camp Creek [AU# 2-79-49] (C) watershed, including the Beck Branch [AU# 2-79-49-1] (C) watershed, encompasses approximately 4.5 square miles in northwestern Jackson County. The creek is a tributary to the Tuckasegee River. Visible landuses in the watershed include forest, rural residential, infrastructure (secondary roads and US 441), commercial, active pastures, horse pastures, and fallow fields. There is one NPDES permitted discharger to Camp Creek (NC0074250) with no recent permit violations. DWQ received a request to reclassify Camp Creek to trout waters in 2004. In 2005, the fish community was sampled at several sites in the Camp Creek watershed to determine if determine if there were wild, reproducing populations of trout in Camp Creek and Beck Branch. The survey did indicate significant habitat problems in the watershed. The primary habitat problems were unstable, eroding stream banks, and narrow or non-existent riparian vegetation. In this Camp Creek reclassification/use attainability study, it was determined after sampling 4 locations that only the upper 2.3 square mile watershed of the creek met the trout waters regulation criteria. Suitable instream habitats were present at the lower two sites on Camp Creek for trout, but the lack of wide forested riparian zones and nonpoint source runoff may prevent their occupation of those reaches of the creek on a year-round basis. Stream restoration activities would benefit the likelihood of trout recolonizing, inhabiting on a year-round basis, and reproducing in the middle and lower reaches of the creek. (memorandum 20050605).

Conley Creek (Connelly Creek) [2-79-52] (C;Tr) is a small tributary to the Tuckasegee River and drains a small portion of southeastern Swain County. Only the lower portion of the watershed is developed, consisting mostly of residences and a golf course, while majority of the upper watershed is forest. The stream follows a road for much of its length which has reduced or removed the riparian on one side for much of the segment. However, overall habitat was good and the stream banks were stable with little erosion. The Creek was sampled in 2009 resulting in an Excellent benthos bioclassification.

Lower Tuckasegee River Watershed (HUC 0601020304)



This watershed encompasses 92,429 acres and has an estimated 2010 population of 5,630 people. A majority of the watershed (the northern portion) falls within the Great Smoky Mtn National Park.

Deep Creek [2-79-63-(16) & 2-79-63-(21)] (B;Tr) flows through a primarily forested area and has high recreational use draining into the Tuckasegee River. The lower 1.8 miles of the creek are not within the Great Smoky Mtns National Park and the land use turns to agriculture. Sedimentation was noted in this reach of the Creek but not enough to prevent the sample site GB7 from receiving an Excellent benthos bioclassification. The Creek has maintained an Excellent rating for the last 20 years.

However, Deep Creek experienced effluent overflow from a sewer spill in 2010 that was captured on video. The video can be viewed through this youtube link: http://www.youtube.com/user/RogerWATR

Noland Creek [2-90] (C;Tr) lies within the south central portion Great Smoky Mountain National Park and drains into Fontana Lake. It is an undeveloped and forested watershed. The habitat of Noland Creek is exceptional and consists of a series of cascades, riffles, and pools; site GB6 rated Excellent in 2009.

Forney Creek [2-97] (C;Tr,ORW) lies within and drains the south-central portion of Great Smoky Mtns into Fontana Lake. It is an entirely undeveloped and forested watershed. The habitat of this stream is as expected for a stream in a natural setting and consists of a series of riffles, cascades, and pools with excellent riparian zones. The Creek rated Excellent in 2009 at site GB4.

Tuckasegee River [2-(78)a] (C) downstream of Bryson City from Lemmons Creek to Peachtree Creek is Impaired for Recreational uses due to exceedances of fecal coliform bacteria levels. Just upstream is AMS station G8600000 which also detected high levels of fecal coliform bacteria and had several incidences of low pH. Bryson City's WWTP discharges into the Tuckasegee River and over the last five years has had several incidences of permit violations, including fecal coliform bacteria and TSS.

Notable Waters

Table 1-1 lists waterbodies identified as needing additional protection and potential restoration actions. The fourth and fifth columns of this table list potential stressors and sources that may be impacting a stream based on in-field observations, monitoring data, historical evidence, permit or other violations, and other staff and public input. In many cases, additional study is needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Table 1-1: Notable Waters

Stream Name	AU#	Class.	Stressor	Source	Status	Actions Needed
Cullowhee Creek	2-79-31a 2-79-31b	C;Tr	sediment, nutrients	development	S	S&E, P
Oconoaluftee R	2-79-55-(16.5)	C;Tr	sediment	development	S	S&E, P
Savannah Creek	2-79-36	C;Tr	fecal coliform bacteria, sediment	development, agriculture, failing septic systems	I	S&E, BMPs
Scott Creek	2-79-39	C;Tr	fecal coliform bacteria, sediment	non-point source runoff, failing septic systems, impoundments	I	R, BMPs
Tuckasegee R	2-79-(35.5)a 2-79-(35.5)b 2-79-(38) [2-(78)a	C; Tr C; Tr C C	fecal coliform bacteria	WWTP, non-point source runoff	I	BMPs
AU # = Assessment Unit # or stream segment/reach						
Class. = Classification (e.g., C, S, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)						
Stressor = chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use.(e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.)						
Status = I=Impaired, IM= Impacted, S=Supporting, IP= Improving,						
Actions Needed = R= restoration, P= protection, SC= stormwater controls, SS= stressor study, E= education, LO= local ordinance, BMPs, SSP= species protection plan, F= forestry BMPs, Ag= Agriculture BMPs, NMC= nutrient mgnt controls, S&E= sediment and erosion controls						

Table 1-2: NPDES Permits within the Tuckasegee River Subbasin

NPDES Permits within the Tuckasegee River Subbasin			
Permit #	**Permit Type**	**Outfall location**	**Facility Name**
NPDES Permits within the Upper Tuckasegee River Watershed			
NC0075736	WWTP	Grassy Swamp Cr	Whiteside Estates Inc
WQ0017530	Non-discharge	irrigation	Highlands Cove
WQ0028693	Non-discharge	reuse	Mountaintop Golf & Lake Club
NC0066958	WWTP	Hurricane Cr	Blue Ridge School
NC0059200	WWTP	Hurricane Cr	Trillium Links & Village LLC
NC0038687	WWTP	Trout Cr	Singing Waters Camping Resort
WQ0031427	Non-discharge	irrigation	Legasus of North Carolina LLC
NCG500127	Wastewater	W Fork Tuckasegee R	Thorpe Hydroelectric Station
NCG500126	Wastewater	W Fork Tuckasegee R	Tuckasegee Hydroelectric Station
NCG500125	Wastewater	W Fork Tuckasegee R	Cedar Cliff Hydroelectric Station
NCG500124	Wastewater	W Fork Tuckasegee R	Bear Creek Hydroelectric Plant

NPDES Permits within the Tuckasegee River Subbasin			
Permit #	**Permit Type**	**Outfall location**	**Facility Name**
NCG500123	Wastewater	Tennessee Cr	Tennessee Cr Hydroelectric Station
WQ0029233	Non-discharge	reuse	Bear Lake Reserve
NCG550374	Wastewater	Tilley Cr	Cullowhee Valley Baptist Church
NCG510066	groundwater remediation	Tuckasegee R	Lewis Oil Company
NC0074624	WTP	Tuckasegee R	Western Carolina University
NCG150027	Stormwater	Ditch to Tuck. R	Jackson County Airport
NPDES Permits within the Oconaluftee Watershed			
NCG500129	Wastewater	Oconaluftee R	Bryson Hydroelectric Station
NPDES Permits within the Middle Tuckasegee River Watershed			
NCG210134	Stormwater	Scott Cr	T&S Hardwoods Inc
NCG100168	Stormwater	Scott Cr	Dr Automotive
NCG050383	Stormwater	Scott Cr	Stonewall Packaging, LLC
NCG140158	Stormwater	Scott Cr	Southern Concrete Materials Inc
NCS000295	Stormwater	Scott Cr	Jackson Paper Manufacturing Co.
NC0020214	WWTP	Scott Cr	Sylva WWTP
NC0032808	WWTP	Blanton Br	Morningstar of Jackson
NCG080191	Stormwater	Yellow Bird Br	United Parcel Service Inc
WQ0005207	Non-discharge	Wastewater Recycling	Jackson Paper Manufacturing Co.
NCG551046	Wastewater	Savannah Cr	single family residence
NCG080730 NCG080731	Stormwater	South Fork Blair Cr	Rolling Frito-Lay
WQ0005763	Non-discharge	Biosolids	Tuckasegee Water & Sewer Authority
NC0000264	WWTP	Tuckasegee R	Jackson Co Industrial Park
NC0039578	WWTP	Tuckasegee R	Jackson County WWTP
NCG110111	Stormwater	Tuckasegee R	Tuckasegee Water & Sewer Authority
NCG160031	Stormwater	Tuckasegee R	Dillsboro Asphalt Plant
NCG020247	Stormwater	Tuckasegee R	Dillsboro Quarry
NCG550375	Wastewater	W Fork Dicks Cr	single family residence
NC0074250	WWTP	Camp Creek	Gateway Chevron
NC0084441	WWTP	Connelly Cr	Smoky Mountain Country Club
NPDES Permits within Lower Tuckasegee River Watershed			
NCG530095	Wastewater	Cooper Cr	Cooper Creek Trout Farm
NC0061620	WWTP	Tuckasegee R	Hide Away Campground
NC0026557	WWTP	Tuckasegee R	Town of Bryson City
NCG210098 NCG210095	Stormwater	Tuckasegee R	Powell Industries
WQ0005557	Non-discharge	Wastewater Recycling	Mini Apolis Grand Prix Corp
NCG050249	Stormwater	Cochran Br	Consolidated Metco Inc
NCG140395	Stormwater	Cochran Br	Southern Concrete Materials Inc
NCG210392	Stormwater	ditch to Cochran Br	Zickgraf Hardwood Flooring LLC
NCG160199	Stormwater	ditch to Cochran Br	Hmc Paving & Construction Co Inc

References & Useful Websites

NC Division of Water Quality

Biological Assessment- http://portal.ncdenr.org/c/document_library/get_file?uuid=de0dbb2d-3417-44c4-9736-1710d2e18d43&groupId=38364

Ambient Report- http://portal.ncdenr.org/c/document_library/get_file?uuid=ac3b7afe-e2f1-4d1e-93df-c2ba9d897888&groupId=38364

Lakes & Reservoir Assessment- http://portal.ncdenr.org/c/document_library/get_file?uuid=0b586b2a-6851-4783-a4e1-a7f58b2549f4&groupId=38364

303(d) List- http://portal.ncdenr.org/web/wq/ps/mtu/assessment

Impaired & Impacted Survey- http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey

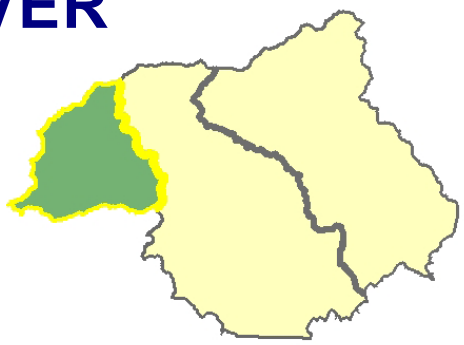
NC Division of Water Resources

Flow- http://www.ncwater.org/Permits_and_Registration/Instream_Flow/

Watershed Association for the Tuckasegee River (WATR)

http://watrnc.wordpress.com/

Lower Tennessee River Subbasin



HUC 06010204

Includes: Tulula Creek, Snowbird Creek, Santeetlah Creek & Cheoah River

Watershed at a Glance

Counties:
Cherokee, Graham, Swain

Municipalities:
Robbinsville, Santeetlah

EPA Level IV Ecoregions:
High Mtns., Southern Metasedimentary Mtns.

Population:
2000: 7,012
2010: 7,480

Area 274 mi²

2006 Land Cover:
Open Water.....2%
Developed.....3%
Forested.....93%
Agriculture.....2%

Permitted Facilities:
NPDES
Wastewater Discharge.....9
Wastewater Nondischarge....1
Stormwater.....3
Trout Farms.....1

Figure 1-1: NLCD 2006 Land Cover

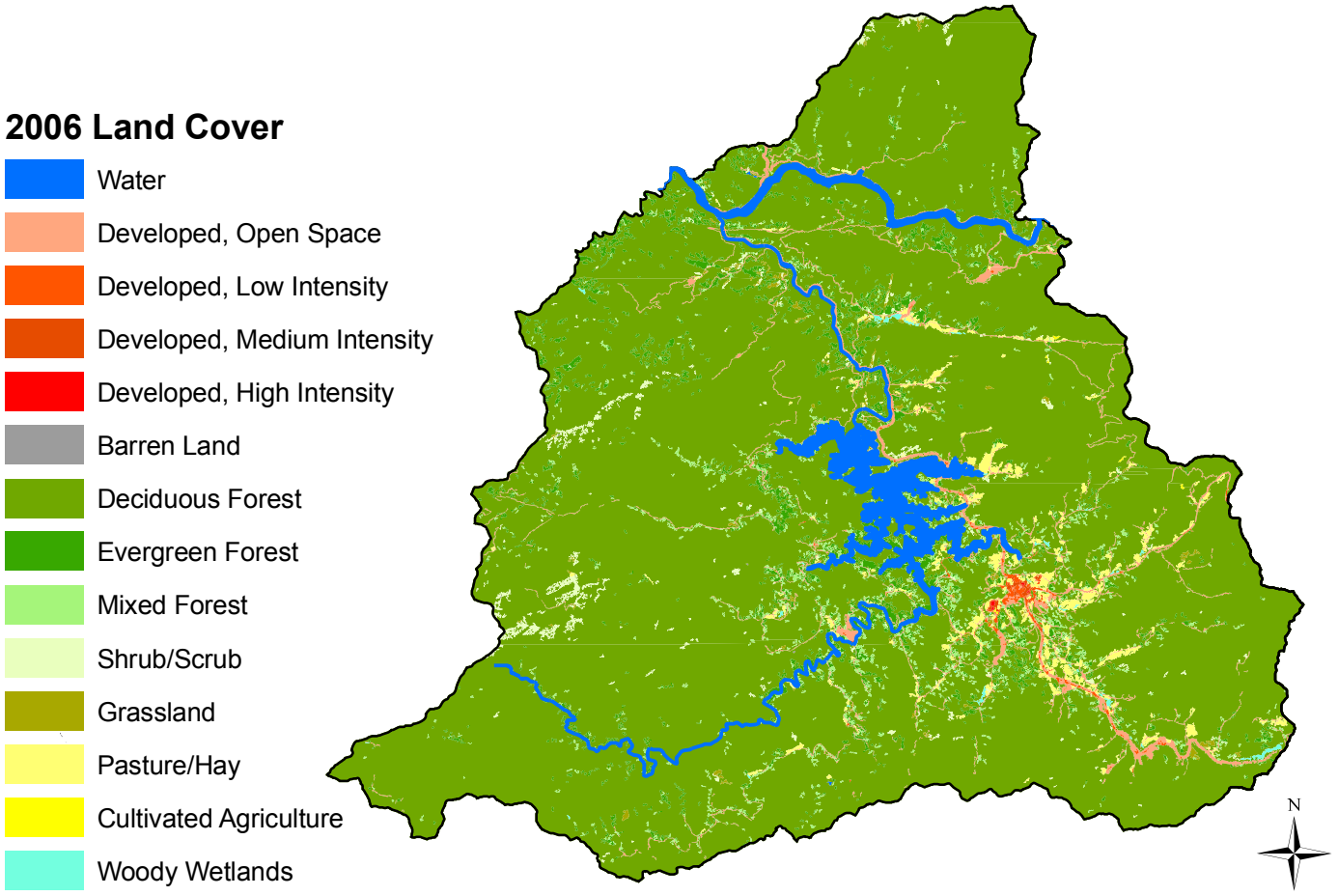
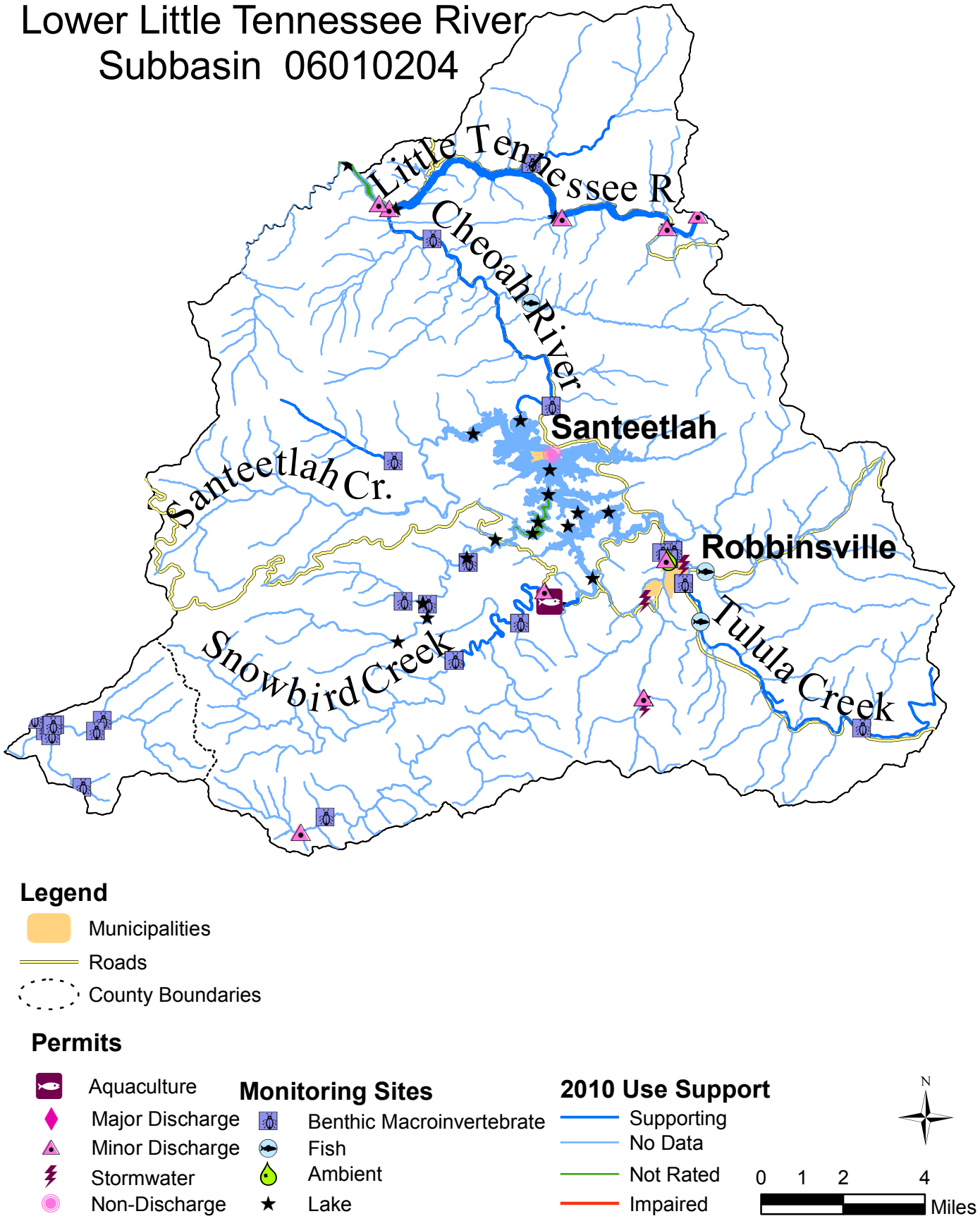


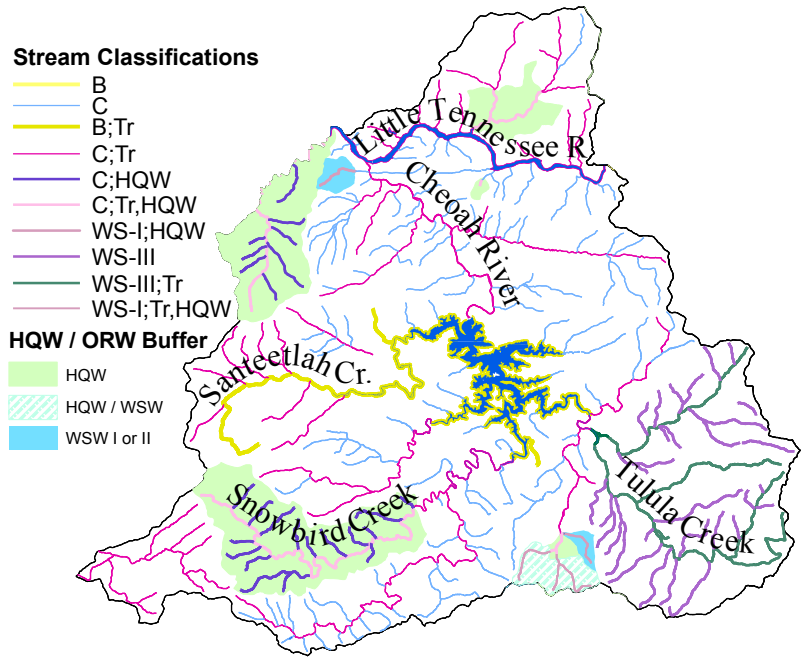
Figure 1-2: Lower Tennessee River Subbasin Map (HUC 06010204)



Water Quality Overview

The Lower Little Tennessee River Subbasin, hydrologic unit 06010204, was represented in previous Basin Plans as Subbasin 04-04-04. This subbasin covers 274 sq. miles and is 93% forested; containing portions of Nantahala National Forest and Joyce Kilmer Wilderness Area. (Figure 1-1). There are approximately 980 reservoir acres and ~420 classified stream miles, not including the numerous unnamed tributaries. Several tributaries flow into Santeetlah Lake, an impoundment on the Cheoah River. The Cheoah River drains into the Little Tennessee River (Cheoah Lake) just before the Tennessee / North Carolina border. A map of the subbasin showing Impaired streams, monitoring and permit locations is shown in Figure 1-2.

Figure 1-3: Stream Classifications

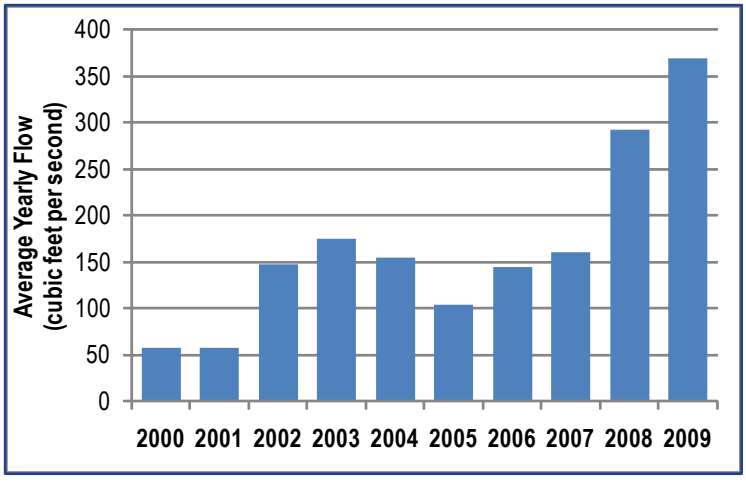


This subbasin contains high quality waters and supports numerous trout streams (Figure 1-3). Water quality issues of concern in this subbasin include agricultural runoff, stream bank erosion, and individual onsite wastewater failures. There are no waterbodies on the 2010 303(d) list of Impaired waters, although the 2012 303(d) will include a portion of the Cheoah River because of high turbidity levels. A fish advisory was issued in 2008 for Lake Santeetlah due to the potential mercury content in walleye. Water quality improvements were made in West Buffalo Creek with the removal of four trout farms that were contributing nutrients to Santeetlah Lake, in the Cheoah River with the improved management of water releases from Santeetlah Dam to support aquatic habitat, and in the Tellico River watershed resulting from the restoration of forest and stream conditions impacted from off-highway vehicle recreation.

Stream flow

Stream flow is monitored at US Geological Survey gaging stations. Flow, often abbreviated as "Q", is measured in terms of volume of water per unit of time, usually cubic feet per second (cfs). There is one gaging station in this subbasin. Figure 1-4 provides an example of average stream flow over a 10 year period and gives an idea of which years received heavier precipitation. The flow rate in a stream can impact the measurement of physical and chemical parameters. For more information about instream flow see DWR website: http://www.ncwater.org/About_DWR/Water_Projects_Section/Instream_Flow/welcome.html.

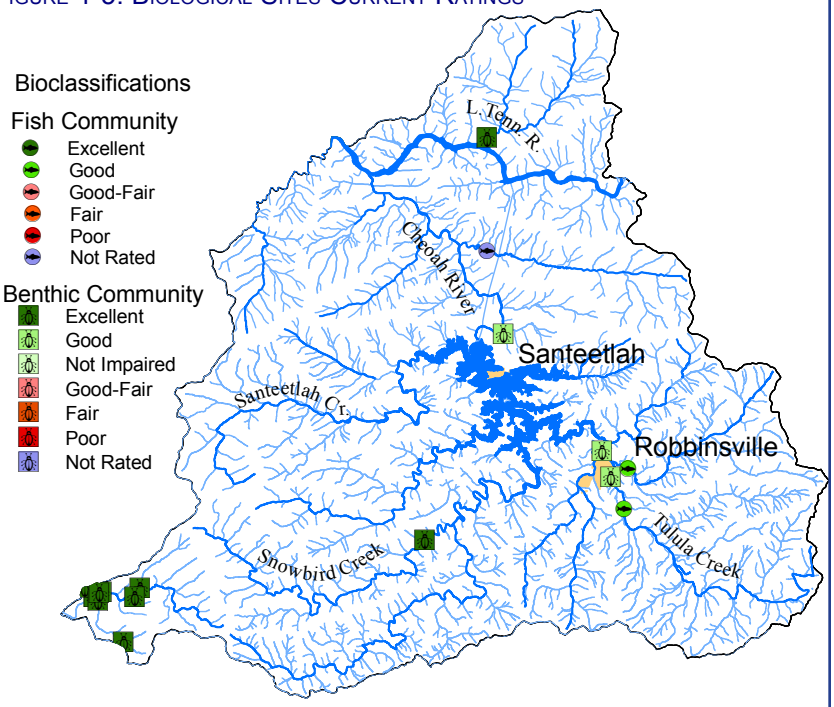
Figure 1-4: Stream flow at USGS 0351706800 Cheoah River near Tapoco
(Yearly Average based on Daily Means)



Stream flow conditions were assessed between 2005-2009 and detected drought conditions in 2006, 2007 and 2008 (see page 16 AMS Report). In particular, droughts can have major effects on parameters such as dissolved oxygen, turbidity, pH, and others by reducing stream flow.

Biological Monitoring

Figure 1-5: Biological Sites Current Ratings



Biocriteria have been developed using the diversity, abundance, and pollution sensitivity of the organisms that inhabit flowing waterbodies in NC. One of five bioclassifications are typically assigned to each water body sampled: Excellent, Good, Good-Fair, Fair and Poor. Not Impaired and Not Rated designations are reserved for samples that were not eligible to be assigned one of the five typical bioclassification categories. Typically, a "Not Impaired" rating is equivalent to a Good-Fair or better bioclassification and a "Not Rated" designation is equivalent to a Fair or worse bioclassification. The reasons for not being able to assign one of these five typical bioclassifications may be a lack of appropriate bio-criteria or atypical sampling conditions (e.g., drought). These bioclassifications are used to assess the various impacts of both point source discharges and nonpoint source runoff. The resulting information is used to document both spatial and temporal changes in water quality, and to complement water chemistry analyses, ambient toxicity data, and habitat evaluations. In addition to assessing the effects of water pollution, biological information is also used to define High Quality or Outstanding Resource Waters, support enforcement of stream standards, and measure improvements associated with management actions. Biological samples were collected during the spring and summer months of 2004 and 2009-10 by the DWQ-Environmental Sciences Section as part of the five-year basinwide sampling cycle. Four benthic macroinvertebrate sites and three fish community sites were evaluated in 2009-10. Each basinwide biological station monitored during the current cycle is shown in Figure 1-5 and color coded based on its current rating. As seen on the map, the majority of benthic macroinvertebrate samples taken in this watershed received an Excellent or Good ratings. Two fish community sites rated Good and one resulted in a Not Rated status, due to the absence of criteria for rating high gradient mountain trout waters. There were 10 samples taken at new locations.

Figure 1-6: Benthic Macroinvertebrate Sample Status

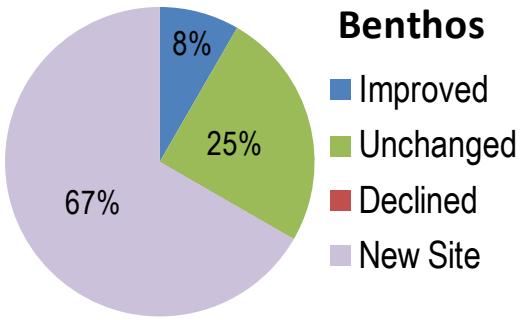
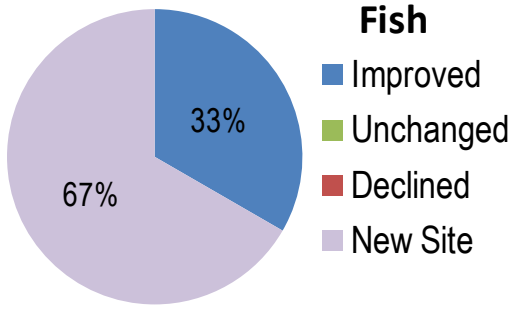


Figure 1-7: Fish Community Sample Status



Benthos

Among the benthic macroinvertebrate sample sites, one site improved, and three retained the same bioclassification in 2009-2010 as observed in 2004 (Figure 1-6). There were an additional eight benthic samples taken to support special studies.

Fish Among the three fish community sites, one improved from 2004 while the other two represent new sample locations (Figure 1-7).

For more information about biological data in this watershed, see the 2010 Little Tennessee River Basinwide Assessment Report. Detailed data sheets for each sampling site can be found in Appendix 1-B.

Long Term Ambient Monitoring

The DWQ's Ambient Monitoring System (AMS) is a network of stream stations strategically located for the collection of physical and chemical water quality data. There is one AMS station (G9550000) in this subbasin; data has been collected from this site since 1973. The following discussion of ambient monitoring parameters includes concentration value graphs for AMS station G9550000 over a 11 year period (2000-2010). Each major parameter is discussed, even if no current impairment exists. The graphs are not intended to provide statistically significant trend information, but rather an idea of how changes in land use or climate conditions can affect parameter readings over the long term. The difference between median and mean results indicate the presence of outliers in the data set. Box and whisker plots of individual ambient stations were completed by parameter for data between 2005 and 2009 by DWQ's Environmental Sciences Section (ESS) and can be found in the Little Tennessee River Basin Ambient Monitoring Report.

pH

As seen in Figure 1-8, which represents the data window for the 2010 303(d) list, ambient site G9550000 had at least one sample that fell below the pH standard of 6su. Over these 11 years (Figure 1-9) there were three incidences of pH dropping below the minimal standard of 6 su in the samples collected by DWQ. Figure 1-9 shows are decline in pH values with a jump in 2010.

Figure 1-8: Percentage of Samples Exceeding the pH <6 Standard between 2004-2008

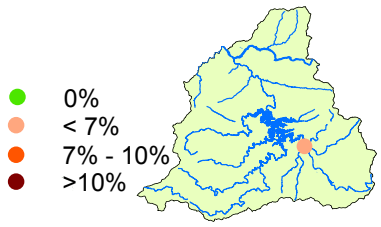
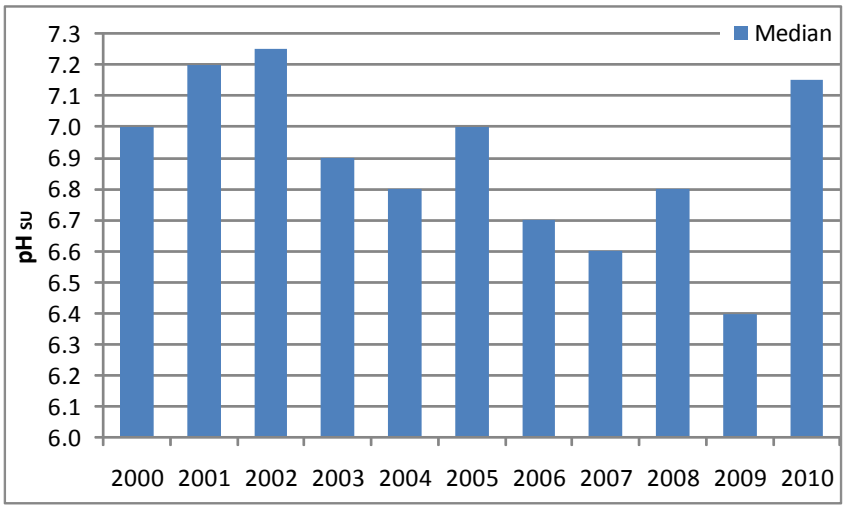


Figure 1-9: Summarized pH data at AMS G9550000 site between 2000-2010.



Dissolved Oxygen

Over the past 11 years (Figure 1-10), no samples were collected with dissolved oxygen levels below 6mg/l standard for trout waters. As seen in Figure 1-11, which represents the data window for the 2010 303(d) list, AMS station G9550000 did not have any exceedances of its DO standards.

Figure 1-11: Percentage of Samples Exceeding the DO <6 Standard between 2004-2008

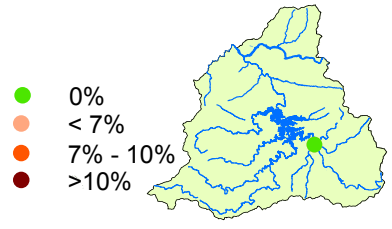
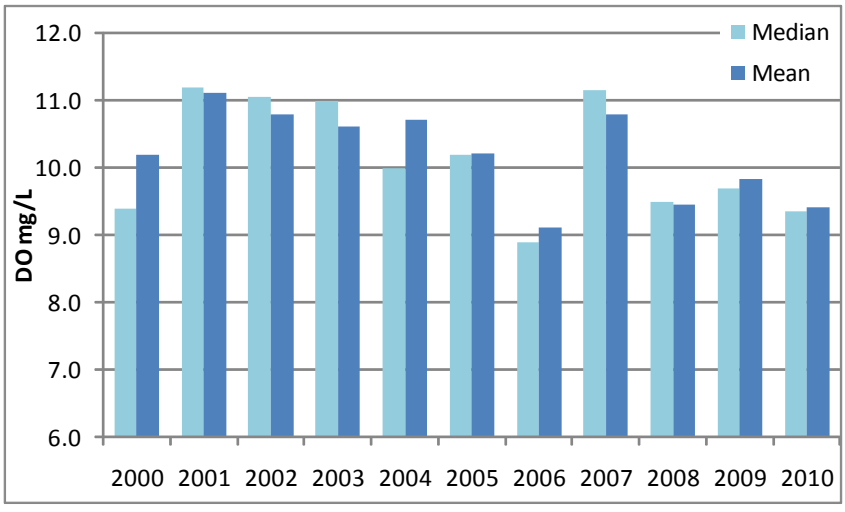


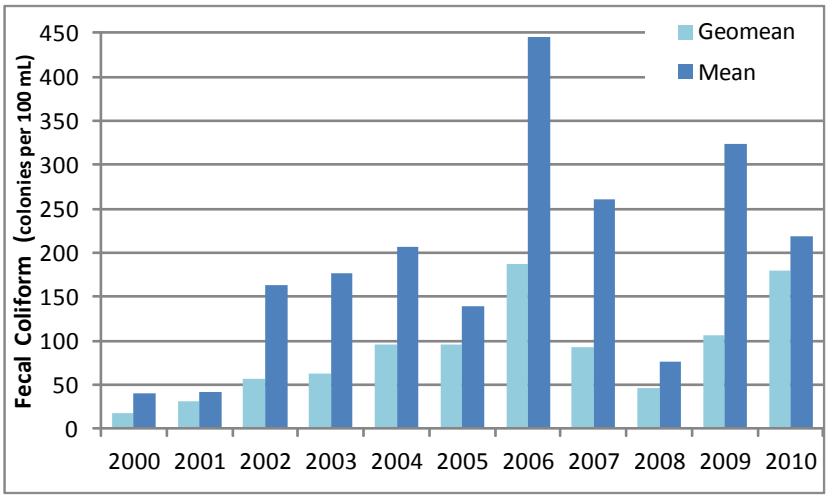
Figure 1-10: Summarized DO data at AMS G9550000 site between 2000-2010.



Fecal Coliform Bacteria

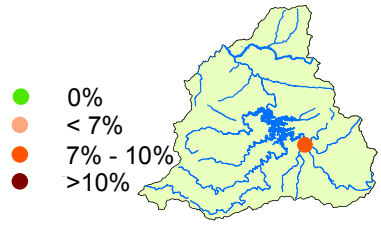
Fecal coliform bacteria occurs in water as a result of the overflow of domestic sewage and from other nonpoint sources of human and animal waste, including pets, wildlife and farm animals. The fecal coliform bacteria standard for freshwater streams is not to exceed the geometric mean of 200 colonies/100 ml or 400 colonies/100 ml in 20% of the samples where five samples have been taken in a span of 30 days (5-in-30). Only results from a 5-in-30 study are to be used to indicate whether a stream is Impaired or Supporting. Waters with a use classification of B (primary recreational waters) receive priority for 5-in-30 studies. Other waters are studied as resources permit.

Figure 1-12: Summarized Fecal Coliform Bacteria data at AMS G9550000 site between 2000-2010.



There were several incidences of high bacteria counts as indicated by several peaks in mean values, shown in Figure 1-12. Over 11 years there were 10 samples with bacteria colony counts over 400/100ml. As seen in Figure 1-13, which represents the data window for the 2010 303(d) list, ambient station G9550000 did have samples that recorded high bacteria levels.

Figure 1-13: Percentage of Samples Exceeding the Fecal Coliform Bacteria >400 Standard between 2004-2008



Turbidity

Over 11 years (Figure 1-14) there were seven samples with that exceeded the 10 NTU standard for water classified for trout protection. As seen in Figure 1-15, which represents the data window for the 2010 303(d) list, ambient site G9550000 had at least one sample that was >10NTUs, but did not exceed the standard in 10% or more of the samples.

Figure 1-15: Percentage of Samples Exceeding the >10 Turbidity Standard between 2004-2008

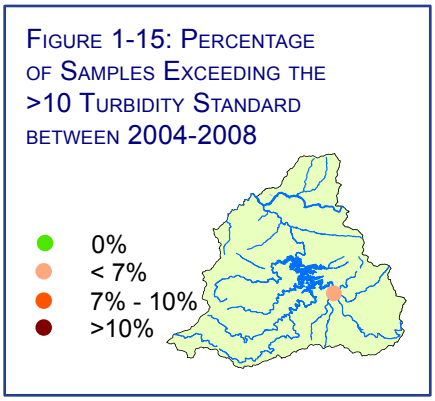
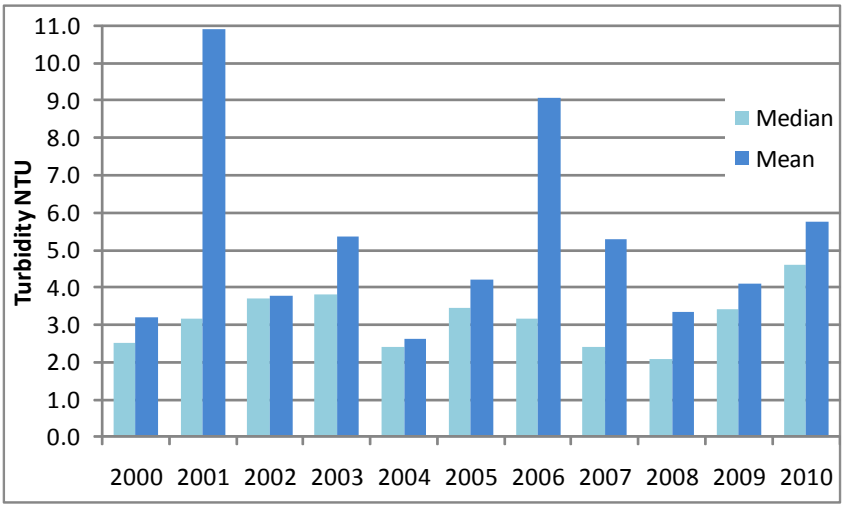


Figure 1-14: Summarized Turbidity data at AMS G9550000 site between 2000-2010.

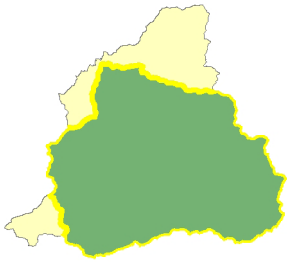


Protection and Restoration Opportunities

The following section provides more detail about specific streams where special studies have occurred or stressor sources information is available. Within this document, biological sample site IDs ending in an "F" denote fish community and a "B" denote macroinvertebrate community. Specific stream information regarding basinwide biological samples sites are available in Appendix 1B. Use support information on all monitored streams can be found in Appendix 1A. Detailed maps of each of the watersheds are found in Appendix 1C or by clicking on the following small maps.

To assist in identifying potential water quality issues citizens, watershed groups and resource agencies can gather and report information through our Impaired and Impacted Stream/ Watershed survey found here: http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey.

Cheoah River Watershed (HUC 0601020401)



This watershed encompasses 137,710 acres and has an estimated 2010 population of 7,332 people. There are six subwatersheds that drain into Santeetlah Lake, which then flows into Cheoah River and eventually the Little Tennessee River.

NPDES Permits within the Cheoah River Watershed

Permit #	Permit Type	Outfall location	Facility Name
NC0083071	WTP	Rock Cr	Town of Robbinsville WTP
NC0025879	WWTP	Long Cr	Town of Robbinsville
NCG180053	Stormwater	Long Cr	Stanley Furniture Comp.
NCG200437	Stormwater	Atoah Cr	Graham Co. Recycling Facility
NC0079090	Wastewater	Snowbird Cr	Coldwater Farms, Inc.
NCG530076	Wastewater	Little Snowbird Cr	Hemac Inc- Fish Farm
NCG140260	Stormwater	Chedah R	Southern Concrete Materials
WQ0031396	Non-discharge	reuse	Santeetlah Lakeside

Tulula Creek [AU# 2-190-2-(0.5)] (WS-III; Tr) subwatershed drains ~18,300 acres within the southeastern corner of Graham County. The whole watershed is classified as a WS-III and the headwaters drain Nantahala National Forest. For much of its length, US 129 and a railroad parallel the creek as it courses down the valley before flowing through the urban areas in and around Robbinsville. Land use in the headwater portions are generally forested, but the mainstem valley is mostly agriculture and residential. Tulula Creek was sampled in 2009 and received a Good benthos (GB22) and fish (GF29) ratings. Biologists noted bluegreen algal mats with the possibility of upstream straight-piping or nonpoint-source erosion contributions of nutrients, but also noting the stream supports its supplemental designation as trout waters.

Sweetwater Creek [AU# 2-190-3-(0.5)] (WS-III; Tr) drains ~9,000 acres. The entire subwatershed is classified as WS-III with headwater portions in Nantahala National Forest and much of the rest of the drainage is used for hay production. Sweetwater Creek was sampled (GF36) by DWQ fish biologists for the first time in 2009 resulting in a Good Bioclassification rating. Water quality conditions support its supplemental designation as trout waters. The Graham County Soil and Water Conservation District is aware of streambank stability problems and has assisted landowners along the creek with planning and installing BMPs. The District plans to continue to devote conservation resources to this watershed but will require landowner participation.

Snowbird Creek [AU#s 2-190-9-(0.5) & 2-190-9-(15.5)] (C;Tr) subwatershed is ~29,950 acres. Snowbird and Little Snowbird Creeks are supplementally classified as trout waters, with the upper portion of Snowbird Creek, within the boundary of Nantahala National Forest, also being classified as HQW. The 2009 benthos sample (GB25) in Snowbird Creek resulted in an Excellent Bioclassification. There is one permitted (NC0079090) trout farm with a discharge into Snowbird Creek.

West Buffalo Creek [AU# 2-190-12a] (C;Tr) drains ~10,625 acres. The creek is classified as trout waters and as it flows into Santeetlah Lake it becomes classified for primary recreation also. The last benthic samples taken in this subwatershed were during the 1990's and all resulted in Excellent Bioclassifications.

West Buffalo Creek Arm of Santeetlah Lake [AU# 2-190-12b] (B;Tr) is Not Rated due to inconclusive temperature and DO data. However, it was on the 303(d) list (289 acres) of impaired waters due to nutrient enrichment (chlorophyll *a*) based on special studies conducted by the DWQ in 1993 and 1999. Nutrient concentrations were especially high immediately downstream of trout farms on West Buffalo Creek. The Clean Water Management Trust Fund awarded $1.25 million dollars to support the buyout of the four trout farms on the West Buffalo Creek arm responsible for the largest contributions of nutrients to the creek. The four farms were fully decommissioned by the end of March 2004.

During the spring, summer, and fall of 2005, the Division of Water Quality conducted a special study of West Buffalo Creek and the West Buffalo Creek arm of Santeetlah Lake. This study was conducted to document changes or improvements to the water quality of Buffalo Creek following the de-population and dismantling of the trout farms. The study examined both physical, chemical and biological water quality parameters on West Buffalo Creek and Santeetlah Lake to determine the degree of nutrient reduction obtained from the trout farm removal. Results from that study indicate that the nutrient reduction strategy was effective. Nutrient loading into the West Buffalo Creek arm of the lake was reduced up to 92 percent and algal blooms were diminished.

Santeetlah Creek [AU# 2-190-19] (B;Tr) drains ~20,900 acres, all of which is in Nantahala National Forest. Three Significant Natural Heritage Areas are also located in this subwatershed including: Stratton Meadows, Santeetlah Bluffs and Joyce Kilmer Wilderness Area.

Santeetlah Lake subwatershed drains ~22,450 acres. Within the subwatershed, Long Creek [AU# 2-190-4-(5)] drains from tributaries classified as WS-I, Tr, HQW and flows into the Cheoah River. Downstream of Robbinsville, DWQ, in 2009, collected a benthos sample in the Cheoah River [AU# 2-190-(3.5)] (C;Tr) at site GB133 resulting in a Good Bioclassification. Turbidity data collected at AMS G9550000 through 2010 show exceedances in turbidity levels causing the Cheoah River from the Town of Robbinsville's proposed water supply intake to Mountain Creek [AU# 2-190-(3.5)] to be Impaired on the 2012 303(d) list.

The Robbinsville WWTP (NC0025879) discharges into Long Creek and is old and outdated, has limited capacity and for years has failed to meet compliance criteria. Robbinsville proposed a relocation of the existing WWTP to a larger 12-acre site on the Cheoah River, approximately 0.2 mile downstream of the present location on Long Creek. DWQ conducted a water quality study of the Cheoah River Arm of Santeetlah Lake to assess current water quality conditions near the site of the proposed relocation and expansion of the Robbinsville WWTP and outfall. DWQ field staff sampled sites located upstream and downstream of the current Robbinsville WWTP outfall on Long Creek, upstream of the confluence of Long Creek and the Cheoah River, at the vicinity of the proposed new outfall on the Cheoah River and upstream of US Hwy 129 on the Cheoah River. Study results indicated that the current discharge does affect nutrient concentrations in Long Creek, but its effect appears to be negligible downstream in the Cheoah River and in the lake (Memorandum 20100105). In 2011, the Town of Robbinsville received ~$4.6 million grant to build a new WWTP facility that will relocate the discharge from Long Creek into the Cheoah River.

Santeetlah Lake [AU# 2-190-(5)] (B;Tr) is owned by the Aluminum Company of America (ALCOA) and is used to generate hydroelectric power as well as for recreational purposes. Santeetlah Lake is classified for the protection of primary recreation and propagation of trout (B; Tr). Santeetlah Lake is a deep lake with a maximum depth of 213 feet and a mean depth of 56 feet with an average retention time of 161 days. Santeetlah Lake continues to demonstrate low biological productivity (oligotrophic).

In September 2008, a fish consumption advisory was announced for Santeetlah Lake due to high levels of mercury found in walleye fish. Santeetlah Lake is also under the statewide consumption advisory for largemouth bass – also associated with elevated levels of mercury found in this fish.

In August, 2008, the Asheville Regional Office reported an algal bloom in the Cheoah River arm of Santeetlah Lake downstream of the US Hwy 129 bridge. An analysis of a phytoplankton sample from the bloom indicated that the dominant algae were filamentous blue greens *Anabaena plantonica*, *Anabaena spirodes* and/or *Anabaena circinalis*. Filamentous blue-green algae form significant blooms that discolor the water and produce taste and odor problems in drinking water. In 2009, no surface blooms of *Anabaena* sp. were observed in the Cheoah River by DWQ staff.

Santeetlah Dam is located on the Cheoah River [AU# 2-190-(22)a] (C;Tr) in Graham County. The Santeetlah Development was completed in 1928, and consists of a dam, pipeline/tunnel, and powerhouse. Santeetlah Dam creates Santeetlah Reservoir, which has a normal full pool area of approximately 2,881 acres and a drainage area of 176 square miles. The normal full pool elevation of Santeetlah Reservoir is 1,940.9 feet (USGS).

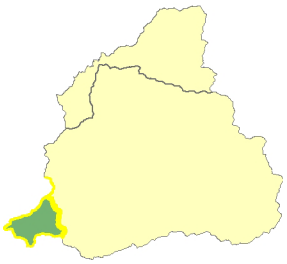
The Santeetlah powerhouse is located on the left bank of the Little Tennessee River (Cheoah Reservoir) about five miles upstream of Cheoah Dam. Water is withdrawn from Santeetlah Reservoir through an intake in the Santeetlah Dam and is passed through a 5-mile tunnel and pipeline to the powerhouse located on the Little Tennessee River.

The Santeetlah Development is operated as a storage impoundment in accordance with an annual operating curve, which establishes target seasonal reservoir levels. The current operating curve was adopted in 2004 as part of the Tapoco Project Relicensing Settlement Agreement. Under the current operating guide, Santeetlah Reservoir is operated to maintain high recreational elevations during the summer months, followed by fall drawdown to allow for collection of rainfall and runoff during the late fall, winter, and early spring. The current operating curve was developed to also provide protection and enhancement for a variety of other resources and uses, including aquatic species and habitat, water quality, reservoir wetlands, archaeological sites, and scenic appearance throughout the year. During the period April 1 to November 1, the maximum drawdown at Santeetlah Reservoir is 4-5 feet. The reservoir is filled during the month of March at such a rate that by April 1 the maximum drawdown is 5 feet. During the period December 1 to March 1, the maximum drawdown is 10 feet. During the month of November, the reservoir is drawn down at such a rate that by December 1 the maximum drawdown is 10 feet. Prior to the Relicensing Settlement Agreement, there were no regular flow releases from Santeetlah Dam into the Cheoah River. Water from Santeetlah Reservoir was diverted to the powerhouse located on the Little Tennessee River upstream of Cheoah Dam. The drainage area for the Cheoah River below Santeetlah Dam was made up of leakage from the dam, tributary inflow and occasional spills from the dam. The lack of flow severely impacted the benthic community (GB15) in this reach and resulted in Impairment in the aquatic life category from Santeetlah Dam to Rock Creek (3.4 miles). Beginning September 1, 2005 as part of the Relicensing Settlement Agreement, Tapoco began releasing minimum flows designed to enhance and protect the biologic community in the Cheoah River below the dam. The benthic community at site GB15 was resampled in 2008 resulting in a Good Bioclassification and the river is no longer Impaired.

As an additional enhancement, Tapoco established a fund intended to improve resource management in the river. The fund provides monetary support to the North Carolina Wildlife Resources Commission, North Carolina Department of Environment and Natural Resources, US Forest Service, Eastern Band of Cherokee Indians, and U. S. Fish and Wildlife Service. These agencies may use the fund to monitor biology and habitat in the river, add large woody debris (habitat), manage gravel and vegetation (bank stabilization), and other natural resource stewardship activities including threatened and endangered species recovery efforts, exotic species control, and environmental outreach and education directly related to segments of the Cheoah River and Little Tennessee River affected by dam operation. The complete consensus agreement can be found in the Tapoco (FERC #2169), Final License Application filed with FERC. These and other associated documents can be obtained at: http://www.ferc.gov.

Yellow Creek [AU# 2-190-29] (C;Tr) was sampled for the first time in 2009 at site GF37 and was given a Not Rated status. No reproducing populations of trout were detected in this trout classified stream, however there was no evidence of water quality impairments.

Tellico River Watershed (HUC 0601020403)



This watershed encompasses 20,771 acres and has an estimated 2010 population of 12 people. Land use in this general area is composed of large tracts of relatively undisturbed forest associated with the Nantahala National Forest. Streams here are high gradient with heterogeneous rocky substrates and well-developed riffle-pool sequences.

The US Forest Service (USFS) manages a large Off-Highway Vehicle (OHV) recreation area located within the upper Tellico River watershed in northern Cherokee County. According to the USFS, the use of the OHV area has resulted in water quality issues to nearby waterbodies. In an effort to determine possible impacts from the OHV system DWQ sampled 12 streams for benthic macroinvertebrates in 2009. The data generated from these collections suggest adverse impacts to many of the streams in the OHV despite the Excellent bioclassification ratings. The smallest of the streams sampled for this study showed the most noteworthy impacts to the benthic communities relative to reference sites. Adverse sediment-mediated effects on the benthos communities in Jenks Branch, and the two lower reaches of Tipton Creek were noted. The specifics of this study are available in requesting BAU memorandum 20090817, from DWQ.

Tellico River [AU# 2-195] (C;Tr) samples at sites GB181, GB183 & GB182 resulted in Excellent benthos bioclassifications

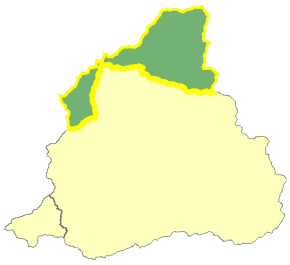
Peckerwood Creek [AU# 2-195-4] (C;Tr) sample at site GB180 resulted in an Excellent benthos bioclassification

Tipton Creek [AU# 2-195-5] (C;Tr) samples at sites GB177, GB178 & GB179 resulted in Excellent benthos bioclassifications

Jenks Branch [AU# 2-195-5-2] (C;Tr) sample at site GB185 resulted in an Excellent benthos bioclassification

In October 2009, the USFS closed the Upper Tellico OHV trail system due to sediment loading to the Tellico River and its tributaries. Many of the trails were located adjacent to streams, on steep slopes and were highly eroding. The USFS was violating its own standards of preventing visible sediment from reaching perennial and intermittent stream channels and state water quality turbidity standards of 10 NTUs. Field surveys sited 1,889 sources of visible sediment along the 34 miles of trails, which was negatively impacting brook trout habitat. In 2010, the USFS Tusquitee Ranger District obliterated ~26 miles of degraded trails and completed restoration activities to allow natural forest regeneration to occur. DWQ surveyed the area in 2011 and noted that water quality issues have been resolved and stream banks are stable.

Upper Tellico Lake Watershed (HUC 0601020404)



This watershed encompasses 65,629 acres and has an estimated 2010 population of 72 people.

NPDES Permits within the Upper Tellico Lake Watershed

Permit #	Permit Type	Outfall location	Facility Name
NC0027341	Wastewater	Little Tenn. R	TVA Fontana Hydro Plant
NCG500050	Wastewater	Little Tenn. R	Alcoa Santeelah Powerhouse
NCG500049	Wastewater	Little Tenn. R	Alcoa Cheoah Powerhouse
NC0023086	WWTP	Little Tenn. R	Fontana Village Resort
NC0023281	WWTP	Little Tenn. R	Tapoco Lodge Inc.

Little Tennessee River (Cheoah Lake/Calderwood Lake) [AU# 2-(167)a] (C;Tr) is a narrow, deep impoundment of the Little Tennessee River on the North Carolina/Tennessee border. Inflow to this Lake is dominated by the hypolimnetic discharge from Fontana Lake, located directly upstream. The upstream portion of the Lake flows swiftly in response to this discharge and temperatures in the Lake are generally low. The Lake was monitored by DWQ field staff monthly from June through August 2009. Surface water temperatures were cool in this Lake, ranging from 7.8 C to 21.1 C. Surface dissolved oxygen ranged from 8.4 mg/L to 9.9 mg/L and were elevated to the low water temperatures which allowed more oxygen to dissolve into the water. Surface pH values ranged from 6.6 s.u to 7.5 s.u. Secchi depths, which ranged from 1.8 meters on an overcast day following a rain event to 7.6 meters, indicated that the water clarity was very good. Lake Cheoah continues to have very low biological productivity (oligotrophic) since 1988.

Twentymile Creek [AU# 2-178-(4)] (C;Tr,HQW) was sampled in 2010 at site GB2 resulting in an Excellent benthos bioclassification. Twenty Mile Creek lies within and drains North Carolina's western portion of Great Smoky Mountain National Park (GSMNP) and ultimately joins the Little Tennessee River (Cheoah Lake) downstream of Fontana Dam. It has an undeveloped (hiking trails aside) and forested catchment. The habitat of this picturesque stream is as expected for a stream in a natural setting and consists of a series of cascades, riffles, and plunge pools. Typical of undisturbed mountain streams, the specific conductance was very low.

Notable Waters

Table 1-1 lists waterbodies identified as needing additional protection and potential restoration actions. The fourth and fifth columns of this table list potential stressors and sources that may be impacting a stream based on in-field observations, monitoring data, historical evidence, permit or other violations, and other staff and public input. In many cases, additional study is needed to determine exact source(s) of the impact. The last column includes a list of recommended actions.

Stream Name	AU#	Class.	Stressor	Source	Status	Actions Needed
Little Tenn. River (Cheoah Lake)	2-(167)b	C;Tr	turbidity	unknown	IM	P, BMPs
Tulula Creek	2-190-2-(0.5)	WS-III; Tr	nutrients	non-point source runoff, straight pipes	S	P, BMPs
West Buffalo Creek Arm of Santeetlah Lake	2-190-12b	B;Tr	temperature, DO, nutrients	trout farms	IP	P
AU # = Assessment Unit # or stream segment/reach						
Class. = Classification (e.g., C, S, B, WS-I, WS-II, WS-III, WS-IV, WS-V, Tr, HQW, ORW, SW, UWL)						
Stressor = chemical parameters or physical conditions that at certain levels prevent waterbodies from meeting the standards for their designated use.(e.g., low/high DO, nutrients, toxicity, habitat degradation, etc.)						
Status = I=Impaired, IM= Impacted, S=Supporting, IP= Improving,						
Actions Needed = R= restoration, P= protection, SC= stormwater controls, SS= stressor study, E= education, LO= local ordinance, BMPs, SSP= species protection plan, F= forestry BMPs, Ag= Agriculture BMPs, NMC= nutrient mgnt controls, S&E= sediment and erosion controls						

References & Useful Websites

Federal Energy Regulatory Commission (FERC)
http://www.ferc.gov/industries/hydropower.asp

NC Department Health and Human Services
Fish Advisory- http://epi.publichealth.nc.gov/fish/current.html

NC Division of Water Quality
Biological Assessment- http://portal.ncdenr.org/c/document_library/get_file?uuid=de0dbb2d-3417-44c4-9736-1710d2e18d43&groupId=38364
Ambient Report- http://portal.ncdenr.org/c/document_library/get_file?uuid=ac3b7afe-e2f1-4d1e-93df-c2ba9d897888&groupId=38364
Lakes & Reservoir Assessment- http://portal.ncdenr.org/c/document_library/get_file?uuid=0b586b2a-6851-4783-a4e1-a7f58b2549f4&groupId=38364
303(d) List- http://portal.ncdenr.org/web/wq/ps/mtu/assessment
Impaired & Impacted Survey- http://portal.ncdenr.org/web/wq/ps/bpu/about/impactedstreamssurvey

NC Division of Water Resources
Flow- http://www.ncwater.org/Permits_and_Registration/Instream_Flow/

Local Conservation Initiatives

Chapter Topics

- SWCD
- EEP
- 319 Grants
- WaDE

Soil and Water Conservation District Operations

The soil and water conservation districts in North Carolina are comprised of a five-member Board of Supervisors for each county in the state staffed by resource professionals in the district, usually with federal, state, and local funds. This group establishes local resource priorities. This structure allows the local district to call upon federal, state, local, non-profit, non-government, and other natural resource groups for technical, financial, planning, and implementation support to restore, enhance, and/or maintain the natural resource base at the local level.

The North Carolina Agricultural 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, administered by the NC Division of Soil and Water Conservation (now within the NC Department of Agriculture and Consumer Services) and managed by the local districts, helps owners and renters of established agricultural operations improve their on-farm management by using best management practices (BMPs). These BMPs include vegetative, structural or management systems that can improve the efficiency of farming operations while reducing the potential for surface and groundwater pollution. The NCACSP is implemented by the Division of Soil and Water (DSWC), which divide the approved BMPs into five main purposes or categories:

• 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.

• 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. 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.

• 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.

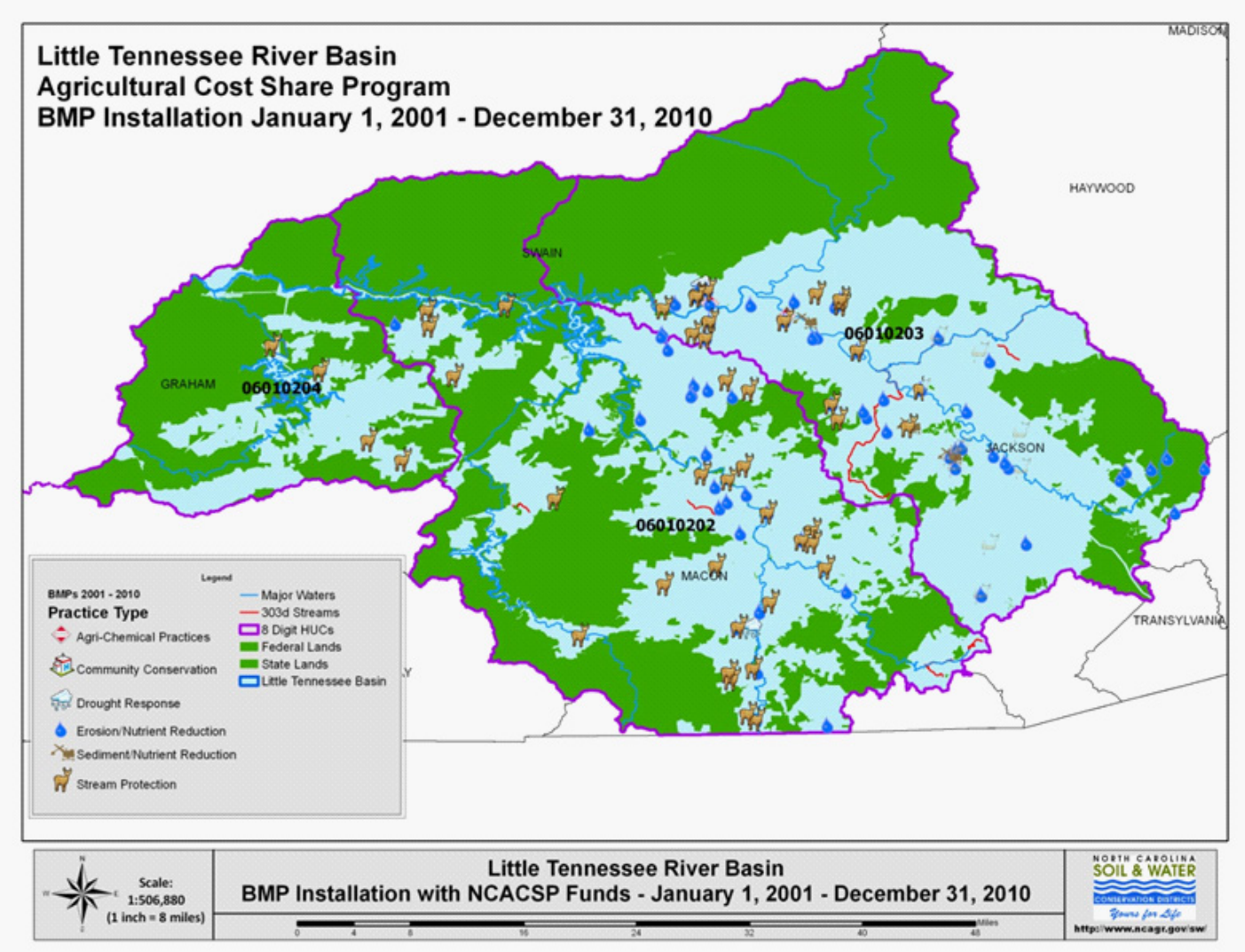
• Proper Animal Waste Management - A waste management system is a planned system in which all necessary components are installed for managed liquid and solid waste to prevent or minimize degradation of soil and water resources. Practices include: animal waste lagoon closures, constructed wetlands, controlled 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.

A full listing of all the BMPs and the categories they are grouped in is available at the following link (under Section V: Best Management Practice Guidelines): http://www.ncagr.gov/sw/acspprogrammanual.html

The practices mentioned above (please note, this is a partial list) have calculated water quality benefits associated with the implementation of the BMP. The benefits calculated include: affected acres, nitrogen reductions, phosphorus reductions, tons of soil saved, and the proper management of nitrogen and phosphorus resulting from animal waste. Within the Hiwassee Basin from 2001, 598 individual BMPs were installed that affected over 6,400 acres. The majority of these practices are categorized as “Stream Protection” measures. Stream Protection practices accounted for nearly 48% of the affected area. Nitrogen and phosphorus reductions were achieved primarily by Erosion/Nutrient Reduction practices. however, over 83% of the soil savings was achieved through Streamside Protection practices.

BMPs installed by the NC Agricultural Cost Share Program for the period January 1, 2001 through December 31, 2010 are shown in the map below:



Aquaculture

There are 4 permitted trout farms in the Little Tennessee River Basin, including the largest commercial trout hatchery in the eastern United States. This number excludes farms not meeting permit coverage requirements related to annual fish production and feed usage. Cold-water fish farms are required to obtain an NPDES general fish farm permit if they harvest over 20,000 pounds of fish per year, feed more than 5,000 pounds per month, and discharge more than 30 days per year. (See NPDES General Permit NCG530000 for more information.) Macroinvertebrate and chemical sampling data collected in streams utilized by farms indicate negative impacts to water quality standards. Additional data need to be collected and analyzed.

In an effort to support the industry in the region and improve and protect water quality, a collaborative approach has been undertaken which includes trout farmers, NC Department of Agriculture and Consumer Services, NC Cooperative Extension and DWQ. The collaborative work outcomes should be a better understanding of farm operations, BPMs, water resource/quality protection and regulatory needs for all parties. The NCG530000 permit will be renewed in July 2012. Any necessary permit modifications to fully protect surface waters utilized by trout farm operations will be considered and discussed by DWQ and stakeholders during the renewal period.

During this process, DWQ encourages trout farms to contact their local extension service and/or research institutions to use management measures such as those recommended/developed by DWQ in Collaborative Assessment for Watershed and Streams (CAWS) Project (funded by an EPA 104(b)(3) grant):
- Use hand feeding as much as possible to reduce the amount of food that enters the raceways and stream;
- Use high quality feed, which results in less manure production;
- Clean raceways regularly and land apply the manure as fertilizer; and
- Consider reducing the amount of fish being raised if the assimilative capacity has been exceeded.

NC Ecosystem Enhancement Program (EEP)

EEP uses watershed planning at two scales (basinwide and local) to identify the best locations to implement stream, wetland and riparian buffer restoration/enhancement and preservation projects. The EEP planning process considers where compensatory mitigation (under provisions of the Clean Water Act) is needed, and how mitigation efforts might contribute to the improvement of water quality, habitat and other vital watershed functions in the state. Watershed planning requires GIS data analysis, stakeholder involvement, water quality monitoring, habitat assessment and consideration of local land uses and ordinances. It is a multi-dimensional process which considers science, policy and partnership.

For more information on EEP's mission, processes and products, please visit http://portal.ncdenr.org/web/eep/home.

River Basin Restoration Priorities

EEP River Basin Restoration Priorities (RBRPs) are focused on the identification of Targeted Local Watersheds (TLWs) within the 8-digit Cataloging Units (subbasins) that comprise individual river basins. TLWs represent priority areas (14-digit Hydrologic Units or HUs) for the implementation of stream and wetland mitigation projects. GIS screening factors considered in the selection of TLWs include: documented water quality impairment and habitat degradation, the presence of critical habitat or significant natural heritage areas, the presence of water supply watersheds or other high-quality waters, the condition of riparian buffers, estimates of impervious cover, existing or planned transportation projects, and the opportunity for local partnerships. Recommendations from local resource agency professionals and the presence of existing watershed projects are given significant weight in the selection of TLWs. RBRP

documents (and TLW selections) for each of the 17 river basins in North Carolina are updated periodically to account for changing watershed conditions, increasing development pressures and local stakeholder priorities.

The most recent update to the Little Tennessee River Basin TLWs occurred in 2008. Nineteen 14-digit HUs (of 63 total in the basin) have been selected as TLWs by EEP in the Little Tennessee River basin:

Upper Little Tennessee Subbasin (06010202):

- Upper Little Tennessee River/ Middle Creek (06010202020010);
- Coweeta/ Tessentee Creek (06010202020020);
- Cartoogechaye Creek (06010202020030)
- Upper Cullasaja River (06010202030010)
- Lower Cullasaja River (06010202030020)
- Rabbitt/Watauga Creek (06010202040010)
- Iotla/Crawford/upper Burningtown Creek (06010202040020)
- Cowee Creek (06010202040030)
- Tellico/Lower Burningtown Creek (06010202040040)
- Brush/Rattlesnake Creek (06010202060010)

Tuckaseegee River Subbasin (06010203):

- Caney Fork (06010203010060)
- Cullowhee Creek (06010203010070)
- Lower Scott Creek (06010203020010)
- Upper Scott Creek (06010203020020)
- Savannah Creek: 06010203020030
- Soco Creek: 06010203030080

Lower Little Tennessee Subbasin (06010204):

- Tulula Creek (06010204010010),
- Sweetwater Creek (06010204010020)
- Long/Atoah Creek (06010204010030)

The 2008 Little Tennessee RBRP, including maps and a summary table of Targeted Local Watersheds, can be found at http://portal.ncdenr.org/web/eep/rbrps/little-tennessee.

Local Watershed Planning

EEP Local Watershed Planning (LWP) initiatives are conducted in specific priority areas (typically a cluster of two or three Targeted Local Watersheds) where EEP and the local community have identified a need to address critical watershed issues. The LWP process typically takes place over a two-year period, covers a planning area around 50 to 150 square miles, and includes three distinct phases: I - existing data review and preliminary watershed characterization (largely GIS-based); II – detailed watershed assessment (including water quality & biological monitoring and field assessment of potential mitigation sites); and III – development of a final Project Atlas and Watershed Management Plan. EEP collaborates with local stakeholders and resource professionals throughout the process to identify projects and management strategies to restore enhance and protect local watershed resources.

There is one LWP in the basin, Franklin to Fontana. This plan is summarized in the Upper Little Tennessee Subbasin section.

EEP Projects

In the Upper Little Tennessee River Subbasin, there is one restoration project in the Franklin to Fontana Local Watershed planning area. The Cat Creek project restored almost 9,000 ft of stream channel and riparian area and 8 acres of riparian wetland through old and current cattle pasture and an old golf course. In addition, EEP contributed funds to protect the 4,500 acre Needmore Tract, which includes riparian wetland, field, and forest along the Little Tennessee River and numerous high quality tributaries.

There is one EEP restoration project in the Tuckaseegee River Subbasin. The Junes Branch project will be constructed in 2012 and will restore the stream channel and riparian area on a 3,000 ft reach on the outskirts of Sylva.

There are three EEP restoration projects that have been constructed in the Lower Little Tennessee River Subbasin. The East Buffalo Creek project restores about 3,000 ft of stream channel and riparian area and preserves almost 9,000 ft of additional headwater forested stream channel. The Snowbird Tributaries project restores only about 600 ft of stream channel and riparian area but preserves 7,500 ft of additional forested stream channel along tributaries to lower Snowbird Creek. The Tulula Bog project is a large project in a Significant Natural Heritage Area, and it restored almost 9,000 ft of stream channel, preserved about 5,000 additional stream feet, restored 81 acres of riparian wetland, and protected 141 additional wetland acres.

Section 319 Grant Program

Section 319 of the Clean Water Act provides grant money for nonpoint source demonstration and restoration projects. In 2009/2010, approximately $450,000 was available annually through base funding for demonstration and education projects across the state. An additional $2 million was available annually through incremental funding for restoration projects on impaired waters statewide. All projects must provide non-federal 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. Information on the North Carolina Section 319 Grant Program application process is available online as well as descriptions of projects and general Section 319 Program information.

The Little Tennessee Watershed Association was granted an award in 2010 for watershed restoration planning in the Upper Cullasaja Watershed. The project involves review of past data and collection of new baseline data to be analyzed and combined into an approved nine element watershed restoration plan.

WaDE

In the Little Tennessee River basin, wastewater from many households is not treated at wastewater treatment plants associated with NPDES discharge permits. Instead, it is treated onsite 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.

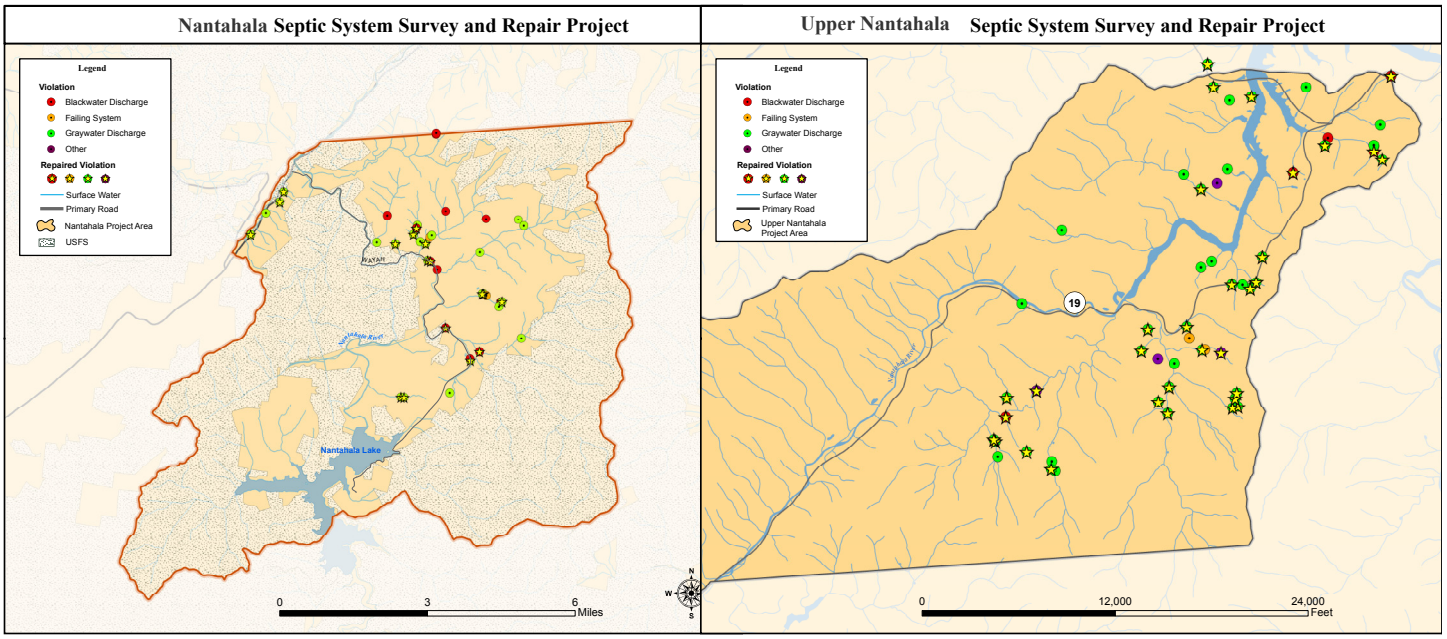
The discharge of untreated or partially treated sewage can be extremely harmful to humans and the aquatic environment. Pollutants from illegally discharged household wastewater contain chemical nutrients, disease pathogens and endocrine disrupting chemicals. Special study requests in the Little Tennessee River Basin led to an increase in number of streams sampled for bacteria and have led to several new stream impairments. As of 2012, there are 58 stream miles (11 streams) and 171 acres of Fontana Lake Impaired because of high fecal coliform bacteria levels. The economies of the counties in this basin are highly dependent upon river recreation, especially for tourists and seasonal residents. Reducing bacterial contamination is crucial for supporting a tourist economy. 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 was actively helping to identify and remove straight pipes (and failing septic systems) in the western portion of North Carolina. This program used door-to-door surveys to locate straight pipes and failing septic systems, and offered deferred loans or grants to homeowners who had to eliminate the straight pipes by installing a septic system. This program was cut from the State budget and is no longer in operation.

As of 2009, WaDE surveys in the Little Tennessee Basin resulted in 215 wastewater violations.

County	Project Area	Septic Survey Completed	Violations	Repairs
Macon	Nanatahala	447	44	18
Swain	Upper Nantahala	266	53	32
Swain	Alarka	104	28	6
Graham	Tulula	435	90	55

The following maps show areas surveyed by the WaDE program.



Forestry

Forestry in the Little Tennessee River Basin: 2012 Update

Forestland Ownership*

Approximately 56% of the forestland in the basin is privately-owned, with the remainder being publically-owned land, primarily the Nantahala National Forest and Great Smoky Mountains National Park.

* The ownership estimates come 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).

Forest Water Quality Regulations

Forestry operations in North Carolina are subject to regulation under the Sedimentation Pollution Control Act of 1973 (Article 4-GS113A, referred to as "SPCA"). However, forestry operations may be exempted from specific requirements of the SPCA if the operations meet the compliance performance standards outlined in the Forest Practices Guidelines Related to Water Quality (15A NCAC 1I .0100 - .0209, referred to as "FPGs") and General Statutes regarding stream and ditch obstructions (GS 77-13 and GS 77-14).

The FPG performance standard rule-codes and topics include:
.0201 Streamside Management Zone (SMZ)
.0202 Prohibition of Debris Entering Streams and Waterbodies
.0203 Access Road and Skid Trail Stream Crossings
.0204 Access Road Entrances
.0205 Prohibition of Waste Entering Streams, Waterbodies, and Groundwater
.0206 Pesticide Application
.0207 Fertilizer Application
.0208 Stream Temperature
.0209 Rehabilitation of Project Site

The NC Forest Service (NCFS) monitors forestry operations for compliance with these aforementioned laws and/or rules. In addition, the NCFS 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 NCFS are referred to the appropriate State agency for enforcement action. During the period September 1, 2005 through August 31, 2010 there were 137 sites in the basin inspected for FPG compliance with 85% of the sites in compliance upon the initial site inspection.

Other Water Quality Regulations

In addition to the multiple State regulations noted above, NCFS 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 for activities in wetlands;
- 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.Other Water Quality Regulations

Forestry Best Management Practices

Implementing forestry Best Management Practices (BMPs) is strongly encouraged to efficiently and effectively protect the water resources of North Carolina. In 2006, the first ever revision to the North Carolina forestry BMP manual was completed. This comprehensive update to the forestry BMP manual is the

result of nearly four years of effort by the NCFS and a forestry Technical Advisory Committee consisting of multiple sector stakeholders, supported by two technical peer-reviews. The forestry BMP manual describes measures that may be implemented to help comply with the forestry regulations while protecting water quality. Copies of the forestry BMP manual can be obtained at a County or District office, or online: http://www.ncforestservice.gov/water_quality/bmp_manual.htm.

From 2006 to 2008, the NCFS conducted its second cycle of BMP implementation site assessment surveys to evaluate the use of forestry BMPs, and qualitatively assess the strengths and weaknesses of BMPs in regards to protecting water quality. Statewide, the BMP surveys were completed on 212 active logging sites and the average BMP implementation rate observed during this survey was 85 percent.

- In the Little Tennessee basin we surveyed 6 sites, evaluated 275 individual BMPs, and observed a BMP implementation rate of 72 percent.

A copy of the survey report (PDF, 5MB) is available from the website http://www.ncforestservice.gov/publications/WQ0210.pdf. These periodic, recurring BMP surveys serve as a basis for focused efforts in the forestry community to address water quality concerns through better and more effective BMP development, implementation and training.

Protecting Stream Crossings with Bridgemats

The NCFS provides bridgemats on loan to loggers for establishing temporary stream crossings during harvest activities in an effort to educate loggers about the benefits of installing crossings in this manner. Temporary bridges can be a very effective solution for stream crossings, since the equipment and logs stay completely clear of the water channel. Bridgemats are available for use in this river basin, and have been for several years. Periodic status reports, a list of bridgemat suppliers, and additional information are available at http://www.ncforestservice.gov/water_quality/bridgemats.htm.

Forest Harvesting, Regeneration & Planning

During this last planning period an estimated 649 acres of land were established or regenerated with forest trees across the basin. During this same time period, approximately 607 acres had a final harvest conducted and 3,393 acres had an intermediate harvest conducted. In addition, 593 individual forestry-related management plans were produced for landowners, encompassing more than 31,400 acres of forestland.

Christmas Tree Production

The Christmas tree industry is predominant across many counties in the North Carolina mountains. It should be noted that the N.C. Forest Service does not oversee regulations or land-clearing activities associated with Christmas tree production. These activities are not considered forestry (“silviculture”) activities, but are instead deemed to be an agricultural or horticultural activity. Personnel with the County Soil & Water Conservation District or USDA-Natural Resources Conservation Service (NRCS) can provide BMP assistance. Additional information about Christmas trees is available from the N.C. Cooperative Extension Service: http://www.ces.ncsu.edu/fletcher/programs/xmas/ctnotes/index.html

North Carolina Forest Service (NCFS) Contacts for the Little Tennessee River Basin:

Office Location	Contact Person	Phone
Sylva District (District-9)	Assistant District Forester	(828) 586-4007
Western region (Region-3)	Asst. Regional Forester	(828) 665-8688
State Central Office, Raleigh	Nonpoint Source Branch - Forest Hydrologist	(919) 857-4856
Griffiths Forestry Center, Clayton	Water Quality & Wetlands Staff Forester	(919) 553-6178 Ext. 230

Appendix 1A

Use Support Ratings for All Monitored Waterbodies

IR & 303(d) list Category Codes

IR Category	Integrated Reporting Categories for individual Assessment Unit/Use Support Category/ Parameter Assessments. A single Assessement Unit (AU) can have multiple assessments depending on data available and classified uses.
1	Supporting the assessed use no criteria exceeded (NCE) for a parameter of interest (POI) in a Use Support Category (USC).
1nc	DWQ have made field determination that parameter in exceedance is due to natural conditions.
1b	Parameter is supporting uses in the AU and there is a management strategy in place to address exceedances of the parameter.
1r	Parameter is supporting uses in the AU and there was restoration activity to address past standards violations of this parameter.
1t	Parameter is supporting uses in the AU and there is an approved TMDL for the parameter.
2	All monitored uses are supporting or not rated and there are no impaired assessments in the AU
3a	Parameter assessment is Not Rated due to insufficient or inconclusive data.
3b	Parameter assessment is Not Rated due to insufficient or inconclusive data and there is a management strategy in place to address exceedances of the parameter.
3n2	Not Rated for Chlorophyll a. Exceeds the evaluation level but there are less than 10 samples.
3c	No Data available for assessment
3t	No Data available for assessment –AU is in a watershed with an approved TMDL
4b	Parameter assessment is impaired and there is a management strategy in place to address exceedances of the parameter.
4c	Parameter assessment is impaired and there is a dam upstream or downstream that is causing exceedances of the parameter.
4cr	Impaired for loss of Recreation use and there is no data for TMDL (swimming advisories posted)
4cs	Impaired loss of Shellfish Harvesting us, no data for TMDL (non-approved area)
4ct	Impaired for the assessed USC/POI and the AU is in a watershed that is part of TMDL study area for the POI.
4t	Parameter assessment is impaired and there is an approved TMDL for theparameter.
4s	Ecological/biological integrity is Impaired and there is separate category 5assessment for another aquatic life parameter.
5	Parameter assessment is impaired and a TMDL development is required for the parameter.
5r	Assessed as impaired watershed is in restoration effort status

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Headwaters Little Tennessee River Watershed 0601020201**

Little Tennessee River Basin — Little Tennessee River Subbasin 06010202

Little Tennessee River Basin — **Headwaters Little Tennessee River Watershed 0601020201**

⊙ 2-19-(1)	**Cartoogechaye Creek**	From source to a point 0.5 mile downstream of Lenior Branch	**7.7 FW Miles**		WS-III;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙ 2-10	**Coweeta Creek**	From source to Little Tennessee River	**4.6 FW Miles**		B;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙ 2-(1)a	**LITTLE TENNESSEE RIVER**	From North Carolina-Georgia State line to the confluence of Mulberry Creek	**2.1 FW Miles**		C
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
5	**Ecological/biological Integrity FishCom**	Fair Bioclassification	Aquatic Life	2004	2002
⊙ 2-(1)b	**LITTLE TENNESSEE RIVER**	From the confluence of Mulberry Creek to the confluence of Cartoogechaye Creek	**15.9 FW Miles**		C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
⊙ 2-8	**Middle Creek**	From source to Little Tennessee River	**8.8 FW Miles**		C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
⊙ 2-9	**Tessentee Creek**	From source to Little Tennessee River	**8.1 FW Miles**		C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

Little Tennessee River Basin — **Cullasaja River Watershed 0601020202**

⊙ 2-21-2	**Ammons Branch**	From source to Cullasaja River	**0.8 FW Miles**		WS-III
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2001	
⊙ 2-21-5-1-(0.5)	**Big Creek (Randall Lake)**	From source to a point 0.7 mile upstream of mouth	**3.4 FW Miles**		WS-II;Tr,HQW
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2001	
⊙ 2-21-5-1-(4)	**Big Creek Arm of Lake Sequoyah**	From a point 0.7 mile upstream of mouth to Lake Sequoyah, Cullasaja River	**0.6 FW Miles**		WS-II;Tr,HQW,CA
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2000	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Cullasaja River Watershed** — **0601020202**

2-21-(5.5)	**Cullasaja River**	From dam at Lake Sequoyah to Little Tennessee River	**10.6**	**FW Miles**	B;Tr

1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	

2-21-(3.5)b	**Cullasaja River (Lake Sequoyah)**	From backwaters of Lake Sequoyah to dam at Lake Sequoyah	**42.1**	**FW Acres**	WS-III;Tr,CA

3a	**Low Dissolved Oxygen**	Potential Standards Violation	Aquatic Life	2008	
3a	**Low pH**	Potential Standards Violation	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

2-21-(0.5)a	**Cullasaja River(Ravenel Lake)**	Source to 0.6 miles downstream of US64 (head of Mirror lake)	**3.7**	**FW Miles**	WS-III;Tr

5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2004	1998

2-21-(0.5)b	**Cullasaja River(Ravenel Lake)**	From 0.6 miles downstream of US64 (head of Mirror lake) to Mirror lake	**0.7**	**FW Miles**	WS-III;Tr

5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2004	1998

2-21-23	**Ellijay Creek**	From source to Cullasaja River	**7.2**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

2-21-5-1-3-(2)	**Houston Branch**	From Dam at Highlands Reservoir to Big Creek	**0.9**	**FW Miles**	WS-II;HQW

1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2000	

2-21-3	**Mill Creek**	From source to Mirror Lake, Cullasaja River	**1.3**	**FW Miles**	WS-III;Tr

5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	1991	1998

2-21-1	**Saltrock Branch**	From source to Cullasaja River	**0.8**	**FW Miles**	WS-III

3a	**Ecological/biological Integrity Benthos**	Not Rated Bioclassification	Aquatic Life	2001	

2-21-6-(1)	**Skitty Creek (Cliffside Lake)**	From source to Dam at Cliffside Lake	**1.9**	**FW Miles**	B;Tr

1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2000	

2-21-8	**Turtle Pond Creek**	From source to Cullasaja River	**4.0**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	

2-21-17	**Walnut Creek**	From source to Cullasaja River	**4.5**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004	

Little Tennessee River Basin — **Nantahala River Watershed** — **0601020203**

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Nantahala River Watershed** — **0601020203**

2-57-42	**Dicks Creek**	From source to Nantahala River	**3.3**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004

2-57-(0.5)	**Nantahala River**	From source to Roaring Fork	**3.5**	**FW Miles**	B;Tr,ORW

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008

2-57-(22.5)b	**Nantahala River**	From Nanthahala Lake Dam to Nantahala River Arm of Fontana Lake, Little Tennessee R.	**18.2**	**FW Miles**	B;Tr

1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004

2-57-45b	**Whiteoak Creek**	From SR 1397 to SR 1423	**1.0**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004
3a	**Legacy Nutrient Listing no Water Quality S**	Data Inconclusive	Aquatic Life	1998

2-57-45c	**Whiteoak Creek**	From SR 1423 to Nantahala River	**3.6**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004

Little Tennessee River Basin — **Alarka Creek-Little Tennessee River Watershed** — **0601020204**

2-69-(2.5)	**Alarka Creek**	From Upper Long Creek to Fontana Lake, Little Tennessee R.	**13.1**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004

2-33	**Bradley Creek**	From source to Little Tennessee River	**3.7**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2008

2-46	**Brush Creek**	From source to Little Tennessee River	**6.3**	**FW Miles**	C

1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004

2-38	**Burningtown Creek**	From source to Little Tennessee River	**11.7**	**FW Miles**	B;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2008
1	**Ecological/biological Integrity FishCom**	Excellent Bioclassification	Aquatic Life	2004

2-29-4	**Caler Fork Creek**	From source to Cowee Creek	**4.6**	**FW Miles**	C

1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2008

2-23-4a	**Cat Creek**	From source GB171 off Preserve Drive	**2.5**	**FW Miles**	C

1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2008

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Alarka Creek-Little Tennessee River Watershed** — **0601020204**

2-23-4b	**Cat Creek**	From GB171 off Preserve Drive to Rabbit Creek	**0.5**	**FW Miles**	C
5	**Ecological/biological Integrity Benthos**	Poor Bioclassification	Aquatic Life	2008	2010
2-24-3	**Coon Creek**	From source to Watauga Creek	**3.1**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2008	
2-29	**Cowee Creek**	From source to Little Tennessee River	**4.0**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2008	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	
2-29-4-2	**Dalton Creek**	From source to Caler Fork Creek	**2.2**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2008	
2-27-1	**Iotla Branch**	From source to Iotla Creek	**2.4**	**FW Miles**	C
5	**Ecological/biological Integrity Benthos**	Fair Bioclassification	Aquatic Life	2008	2010
2-27	**Iotla Creek**	From source to Little Tennessee River	**5.5**	**FW Miles**	C
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2008	
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
2-34	**Lakey Creek**	From source to Little Tennessee River	**3.4**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2008	
2-(26.5)a	**LITTLE TENNESSEE RIVER (Including the backwaters of Fontana Lake at normal pool elevation 1708 fee**	From to a point 0.4 mile upstream of N.C. Hwy. 28 (located 0.42 mile upstream of mouth of Iotla Creek) to subbasin 01/02 border	**10.0**	**FW Miles**	B
1	**Ecological/biological Integrity Benthos**	Good-Fair Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
2-(26.5)b	**LITTLE TENNESSEE RIVER (Including the backwaters of Fontana Lake at normal pool elevation 1708 fee**	From Subbasin 01/02 boundary to Nantahala River Arm of Fontana Lake	**11.9**	**FW Miles**	B
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2007	

NC 2010 Integrated Report

All 13,123 Waters in NC are in Category 5-303(d) List for Mercury due to statewide fish consumption advice for several fish species

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Alarka Creek-Little Tennessee River Watershed 0601020204**

2-29-5	Matlock Creek	From source to Cowee Creek	4.3 FW Miles	C	
1	Ecological/biological Integrity Benthos	Good-Fair Bioclassification	Aquatic Life	2008	
2-23b	Rabbitt Creek	From Elmore Branch to Little Tennessee River	2.1 FW Miles	C;Tr	
5	Ecological/biological Integrity Benthos	Poor Bioclassification	Aquatic Life	2008	2010
1	Ecological/biological Integrity FishCom	Good-Fair Bioclassification	Aquatic Life	2004	
2-44	Rattlesnake Creek	From source to Little Tennessee River	3.1 FW Miles	C	
1	Ecological/biological Integrity Benthos	Not Impaired Bioclassification	Aquatic Life	2007	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	
2-40	Tellico Creek	From source to Little Tennessee River	5.9 FW Miles	C;Tr	
1	Ecological/biological Integrity Benthos	Excellent Bioclassification	Aquatic Life	2004	
1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	
2-24	Watauga Creek	From source to Little Tennessee River	5.4 FW Miles	C;Tr	
1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2008	
2-38-8	Younce Creek	From source to Burningtown Creek	3.7 FW Miles	C	
1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2008	

Little Tennessee River Basin — **Fontana Lake Watershed 0601020205**

2-159-(6)	Eagle Creek	From Pinnacle Creek to Eagle Creek Arm of Fontana Lake, Little Tennessee River	1.7 FW Miles	WS-IV;Tr,ORW,C	
1	Ecological/biological Integrity Benthos	Excellent Bioclassification	Aquatic Life	2005	
2-146-(19)	Hazel Creek	From a point 0.7 mile upstream of mouth to Hazel Creek Arm of Fontana Lake, Little Tennessee River	0.9 FW Miles	WS-IV;Tr,ORW,CA	
1	Ecological/biological Integrity Benthos	Excellent Bioclassification	Aquatic Life	2005	
2-(140.5)	LITTLE TENNESSEE RIVER (Fontana Lake below elev. 1708)	From the upstream side of Shoal Branch to Fontana Dam	1,696.7 FW Acres	WS-IV,B;CA	
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008	
1	Water Quality Standards Water Supply	No Criteria Exceeded	Water Supply	2008	
2-115	Panther Creek	From source to Fontana Lake, Little Tennessee River	2.4 FW Miles	C;Tr	
1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2004	
3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2004	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Fontana Lake Watershed 0601020205**

2-166	**Payne Branch**	From source to Fontana Lake, Little Tennessee River	**1.0 FW Miles**	WS-IV;Tr,CA	
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2005	
2-132	**Pilkey Creek**	From source to Fontana Lake, Little Tennessee River	**1.8 FW Miles**	C;Tr,ORW	
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2005	
2-147-(0.7)	**Shehan Branch (Possum Hollow Creek)**	From Bearpen Branch to Hazel Creek Arm of Fontana Lake, Little Tennessee River	**0.6 FW Miles**	WS-IV;Tr,ORW,CA	
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2005	
2-130	**Stecoah Creek**	From source to Fontana Lake, Little Tennessee River	**7.4 FW Miles**	C;Tr	
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2007	
3a	**Ecological/biological Integrity FishCom**	Not Rated Bioclassification	Aquatic Life	2004	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Upper Tuckasegee River Watershed** — **0601020301**

Little Tennessee River Basin — Tuckasegee River Subbasin — 06010203

Little Tennessee River Basin — **Upper Tuckasegee River Watershed** — **0601020301**

⊙ **2-79-28-(2.5)**	**Caney Fork**	From Mull Creek to Tuckaseegee River	**1.3**	**FW Miles**	WS-III;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good Bioclassification	Aquatic Life	2004	

⊙ **2-79-31a**	**Cullowhee Creek**	From source to first crossing of NC 107 near Cullowhee	**8.7**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	

⊙ **2-79-28-8**	**Moses Creek**	From source to Caney Fork	**4.1**	**FW Miles**	WS-III;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	

⊙ **2-79-(5.5)b**	**Tuckaseegee River (Bear Creek Lake)**	From Tennessee Creek to West Fork Tuckaseegee River	**443.8**	**FW Acres**	WS-III,B;Tr

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **2-79-(5.5)c**	**Tuckaseegee River (Cedar Cliff Lake)**	From Tennessee Creek to West Fork Tuckaseegee River	**131.4**	**FW Acres**	WS-III,B;Tr

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **2-79-(0.5)**	**Tuckasegee River (East Fork Lake)**	From source to Tennessee Creek	**4.4**	**FW Miles**	WS-III,B;Tr,ORW

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	

⊙ **2-79-(24)ut4**	**UT TUCKASEGEE R**	Source to TUCKASEGEE R	**1.3**	**FW Miles**	

1	**Ecological/biological Integrity Benthos**	Not Impaired Bioclassification	Aquatic Life	2007	
5	**Low pH**	Standard Violation	Aquatic Life	2008	2010

⊙ **2-79-23-(1)**	**West Fork Tuckasegee River (Thorpe Lake below elevation 3492 MSL)**	From source in Thorpe Lake Backwater at Elevation 3492 MSL to Thorpe Dam	**1,388.5**	**FW Acres**	WS-III,B;HQW

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

⊙ **2-79-9-(1)**	**Wolf Creek (Wolf Creek Lake)**	From source to Wolf Creek Dam	**5.3**	**FW Miles**	WS-III,B;Tr,HQW

1	**Water Quality Standards Water Supply**	No Criteria Exceeded	Water Supply	2008	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Oconaluftee River Watershed** — **0601020302**

Little Tennessee River Basin — **Oconaluftee River Watershed** — **0601020302**

2-79-55-(11) **Oconaluftee River** — From Bradley Fork to Raven Fork — **4.9 FW Miles** — C;Tr,HQW

1	Ecological/biological Integrity Benthos	Excellent Bioclassification	Aquatic Life	2004	

2-79-55-(16.5) **Oconaluftee River** — From Raven Fork to Cherokee Indian Reservation boundary (approximately 0.4 miles downstream of Goose Creek) — **8.3 FW Miles** — C;Tr

1	Ecological/biological Integrity Benthos	Excellent Bioclassification	Aquatic Life	2004	

Little Tennessee River Basin — **Middle Tuckasegee River Watershed** — **0601020303**

2-79-49-1 **Beck Branch** — From source to Camp Creek — **1.2 FW Miles** — C

3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2005	

2-79-49 **Camp Creek** — From source to Tuckasegee River — **4.4 FW Miles** — C

3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2005	

2-79-52 **Conley Creek (Connelly Creek)** — From source to Tuckasegee River — **7.4 FW Miles** — C;Tr

1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2004	
3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2004	

2-79-39-3-6 **Licklog Creek** — From source to Dark Ridge Creek — **1.7 FW Miles** — C

1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2007	

2-79-36 **Savannah Creek** — From source to Tuckasegee River — **13.4 FW Miles** — C;Tr

1	Ecological/biological Integrity Benthos	Good Bioclassification	Aquatic Life	2004	
1	Ecological/biological Integrity FishCom	Good Bioclassification	Aquatic Life	2004	
5	Fecal Coliform (recreation)	Standard Violation	Recreation	2005	2008

2-79-39 **Scott Creek** — From source to Tuckasegee River — **15.3 FW Miles** — C;Tr

1	Ecological/biological Integrity Benthos	Excellent Bioclassification	Aquatic Life	2007	
3a	Ecological/biological Integrity FishCom	Not Rated Bioclassification	Aquatic Life	2004	
5	Fecal Coliform (recreation)	Standard Violation	Recreation	2005	2008

2-79-39-5-1 **Sugarloaf Creek** — From source to Soapstone Creek — **1.8 FW Miles** — C

5	Ecological/biological Integrity Benthos	Fair Bioclassification	Aquatic Life	2007	2010

2-79-(35.5)a **Tuckasegee River** — From Savannah Creek to UT 0.3 miles upstream of Yellow Bird Creek — **1.4 FW Miles** — C;Tr

5	Fecal Coliform (recreation)	Standard Violation	Recreation	2005	2008

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Middle Tuckasegee River Watershed 0601020303**

2-79-(35.5)b	**Tuckasegee River**	From UT 0.3 miles upstream of yellow Bird Creek to Dillsboro Dam	**0.5**	**FW Miles**	C;Tr

5	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2005	2008

2-79-(38)	**Tuckasegee River**	From Dillsboro Dam to Mack Town Branch	**0.7**	**FW Miles**	C

5	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2005	2008

Little Tennessee River Basin — **Lower Tuckasegee River Watershed 0601020304**

2-79-63-(16)	**Deep Creek**	From Indian Creek to Juney Whank Branch	**0.8**	**FW Miles**	WS-II,B;Tr,H

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004

2-79-63-(21)	**Deep Creek**	From Town of Bryson City water supply intake (located just below Great Smoky Mountains National Park Boundary) to Tuckasegee River	**1.8**	**FW Miles**	B;Tr

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004

2-97	**Forney Creek**	From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River	**9.5**	**FW Miles**	C;Tr,ORW

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004

2-96	**Gray Wolf Creek**	From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River	**2.2**	**FW Miles**	B;ORW

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2005

2-90	**Noland Creek**	From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River	**10.8**	**FW Miles**	C;Tr

1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004

2-79-(40.5)	**Tuckasegee River**	From Mack Town Branch to Cochran Branch	**17.7**	**FW Miles**	B

1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008

2-(78)a	**Tuckasegee River Arm of Fontana Lake, Little Tennessee River, below elevation 1708 MSL**	From Lemmons Creek to Peachtree Creek	**170.6**	**FW Acres**	C

5	**Fecal Coliform (recreation)**	Standard Violation	Recreation	2005	2008

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
2-(89)	Tuckasegee River Arm of Fontana Lake, Little Tennessee River, below elevation 1708 MSL	That portion of Tuckasegee River Arm of Fontana Lake below the upstream side of the mouth of Noland Creek	1,019.0	FW Acres	B

Little Tennessee River Basin — **Lower Tuckasegee River Watershed** — **0601020304**

	Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year
1	Water Quality Standards Aquatic Life	No Criteria Exceeded	Aquatic Life	2008		

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Cheoah River Watershed** **0601020401**

Little Tennessee River Basin — Lower Little Tennessee River Subbasin — 06010204

Little Tennessee River Basin — **Cheoah River Watershed** **0601020401**

2-190-(22)a	**Cheoah River**	From Santeetlah Dam to Rock Creek	**3.4**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2008	
2-190-(22)b	**Cheoah River**	From Rock Creek to Calderwood Lake, Little Tennessee River	**5.9**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
2-190-(3.5)	**Cheoah River**	From the Town of Robbinsville's proposed water supply intake, to Mountain Creek	**1.4**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Fecal Coliform (recreation)**	No Criteria Exceeded	Recreation	2008	
3a	**High Water Temperature**	Potential Standards Violation	Aquatic Life	2008	
1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008	
2-190-19-7	**Little Santeetlah Creek**	From source to Santeetlah Creek	**3.3**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
2-190-9-(15.5)	**Snowbird Creek**	From Polecat Branch to Santeetlah Lake, Cheoah River	**5.6**	**FW Miles**	C;Tr
1	**Ecological/biological Integrity Benthos**	Excellent Bioclassification	Aquatic Life	2004	
2-190-2-(0.5)	**Tulula Creek**	From source to a point 0.5 mile upstream of mouth	**12.8**	**FW Miles**	WS-III;Tr
1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004	
1	**Ecological/biological Integrity FishCom**	Good-Fair Bioclassification	Aquatic Life	2004	
2-190-12b	**West Buffalo Creek Arm of Santeetlah Lake**	From SR 1148 to Santeetlah Lake, Cheoah River	**280.0**	**FW Acres**	B;Tr
3a	**High Water Temperature**	Data Inconclusive	Aquatic Life	2008	
3a	**Low Dissolved Oxygen**	Data Inconclusive	Aquatic Life	2008	

Little Tennessee River Basin — **Upper Tellico Lake Watershed** **0601020404**

2-(167)b	**LITTLE TENNESSEE RIVER (Calderwood Lake)**	From Fontana Dam to North Carolina-Tennessee State Line Calderwood Lake Portion	**107.5**	**FW Acres**	C;Tr
3a	**Turbidity**	Potential Standards Violation	Aquatic Life	2008	

AU_Number	AU_Name	AU_Description	LengthArea	AU_Units	Classification
Category	Parameter	Reason for Rating	Use Category	Collection Year	303(d)year

Little Tennessee River Basin — **Upper Tellico Lake Watershed** — **0601020404**

2-(167)a	**LITTLE TENNESSEE RIVER (Cheoah Lake)**	From Fontana Dam to North Carolina-Tennessee State Line Cheoah Lake Portion	**592.9**	**FW Acres**	C;Tr

1	**Water Quality Standards Aquatic Life**	No Criteria Exceeded	Aquatic Life	2008

2-178-(4)	**Twentymile Creek**	From Proctor Branch to Lake Cheoah, Little Tennessee River	**3.0**	**FW Miles**	C;Tr,HQW

1	**Ecological/biological Integrity Benthos**	Good Bioclassification	Aquatic Life	2004

Appendix 1B

Biological Assessment
Macroinvertebrate and Fish Site Sample Results

The full report is available on the DWQ Environmental Sciences Section website:
http://portal.ncdenr.org/web/wq/ess/reports

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	**OFF SR 1629**	**GB50**	**08/04/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.000000	-83.381667	2-(1)a	Broad Basins

Stream Classification			Stream Width (m)	Stream Depth (m)
C			25	0.6

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	0	25	0	50 (Fallow Fields)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None		

Water Quality Parameters

Temperature (°C)	21.4
Dissolved Oxygen (mg/L)	7.3
Specific Conductance (µS/cm)	27
pH (s.u.)	5.9

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	3
Bank Vegetation (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	58

Site Photograph

Substrate Sand, gravel, cobble, silt with a trace of boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11014	72	24	5.72	4.61	Good-Fair
09/11/00	8303	67	15	6.35	4.08	Fair

Taxonomic Analysis

Numerous intolerant EPT taxa were collected in 2010 that were not present in 2000 and include the mayflies *Paraleptophlebia spp*., *Neoephemera purprea*, the stonefly *Leuctra spp*., and the caddisflies *Polycentropus spp*., *Lype diversa*, and *Neophylax consimilis*. In addition, many pollution tolerant chironomids which were abundant in 2000 were completely absent in 2010 and include *Cricotopus bicinctus*, *C. fugax*, *C. infuscatus*. These data suggest more favorable water quality conditions in 2010 relative to 2000.

Data Analysis

This sampling location is below Commissioner Creek. The large improvement in the benthic macroinvertebrate metrics at this location since the 2000 collection strongly suggests improved water quality at this location.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	SR 1113	GB24	08/05/10	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010202	35.326389	-83.523611	2-(26.5)b	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	375	1800	50	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	90	---	---	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Franklin WWTP	NC0021547	1.65

Water Quality Parameters

Temperature (°C)	27.9
Dissolved Oxygen (mg/L)	7.4
Specific Conductance (µS/cm)	35
pH (s.u.)	6.5

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	4
Riffle Habitat (16)	14
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	80

Site Photograph

Substrate: mostly cobble (50), boulder (20), and bedrock (20); some silt (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/10	11090	89	39	4.19	3.36	Good
08/05/04	9461	95	42	4.04	3.03	Good
08/09/99	7957	75	31	4.59	3.44	Good
07/13/94	6587	82	39	4.46	3.81	Good

Taxonomic Analysis

The decrease in EPT richness (15 taxa) occurred as a result of a net loss of baetid mayflies including the intolerant Baetis pluto and Acentrella turbida as well as the rare Iswaeon davidi. However, the rarely collected Heterocloeon petersi has occurred at this site over the past 11 years. As expected in a large, productive river, flat-headed mayflies were abundant and were represented by 6 taxa and included the first basinwide site record of Epeorus vitreus. Caddisflies were rich with 22 taxa, the most this site has seen during basinwide sampling. Hydropsychids dominated and, along with other net-spinning caddisflies, were very abundant. First basinwide records for this site included Leucotrichia pictipes, a species typical of warm water, open-canopied rivers, Ceraclea ancylus, and two species of Pycnopsyche. Stonefly richness was half of that found in 2004 (2 vs. 4 taxa) and consisted entirely of riffle dwelling perlid stoneflies. Perlids are long-lived (2 years) as larvae so their presence over the last 16 years suggests overall stable habitat and water conditions.

Data Analysis

This most downstream site on the Little Tennessee River occurs in southeastern Swain county well below Franklin. The river at this point has two channels. The east channel was sampled in 2004 and the west channel sampled in 2010. These channels are very different as the east channel is primarily bedrock and the west has a good mix of substrates. Overall habitat in the west channel was good, particularly root mats and riffles, although pools were somewhat lacking. The specific conductance was low for a river downstream of a WWTP and the pH was also low for a large productive river. The BI was slightly elevated over the 2004 value (but remained lower than even earlier samples) and the EPT richness decreased, albeit only slightly. Water quality in the Little Tennessee at this site remains Good although it tends to fluctuate slightly, possibly contingent on the flow regime.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	**SR 1651**	**GB10**	**08/04/10**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.122222	-83.377778	2-(1)b	Broad Basins

Stream Classification			Stream Width (m)	Stream Depth (m)
C			40	0.7

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	30	10	50	10	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None		

Water Quality Parameters

Temperature (°C)	24.1
Dissolved Oxygen (mg/L)	8.8
Specific Conductance (µS/cm)	27
pH (s.u.)	6.9

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	9
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	7
Bank Erosion (7)	3
Bank Vegetation (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	45

Site Photograph

Substrate: Sand, silt, gravel, cobble, trace of boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11015	93	35	5.03	4.12	Good
07/22/04	9435	93	37	5.30	3.62	Good
10/20/99	7993	62	29	4.16	3.27	Good-Fair
08/05/87	4196	64	20	5.59	4.73	Good-Fair
08/06/85	3536	52	18	5.48	4.66	Fair

Taxonomic Analysis

There were numerous pollution intolerant taxa present in the 2004 and 2010 samples that have not been present from the previous three samples. These taxa include the mayflies *Baetisca carolina* , *Drunella allegheniensis* , *Epeorus vitreus* , *Leucrocuta spp* . and the caddisflies *Brachycentrus spinae* , *Hydroptila spp* ., *Rhyacophila fuscula* , and *Neophylax consimilis* . The presence of these taxa suggest improved water quality at this site relative to the 1985-1999 monitoring period.

Data Analysis

Since the 1985 Fair bioclassification and the 1987 and 1999 Good-Fair ratings, invertebrate collections at this site in 2004 and 2010 have resulted in two consecutive Good bioclassifications. Since 2004, the EPT diversity has been stable and much higher than EPT data obtained in the previous three collections. The 2004 and 2010 data suggest improved water quality at this location relative to the 1985, 1987, and 1999 samples.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
L TENNESSEE R	**NC 28**	**GB35**	**08/05/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.235000	-83.395833	2-(26.5)a	Broad Basins

Stream Classification			Stream Width (m)	Stream Depth (m)
B			25	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	25	50	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	22.5
Dissolved Oxygen (mg/L)	6.1
Specific Conductance (µS/cm)	35
pH (s.u.)	6.4

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	10
Bottom Substrate (15)	3
Pool Variety (10)	6
Riffle Habitat (16)	10
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	1
Right Riparian Score (5)	5
Total Habitat Score (100)	58

Site Photograph

Substrate: bedrock, boulders, sand, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/09	10791	85	37	4.66	3.55	Good
07/22/04	9448	71	32	5.07	4.13	Good-Fair
08/24/99	7978	86	32	5.27	3.65	Good-Fair
07/26/94	6621	57	27	4.88	4.07	Good-Fair
08/06/87	4197	75	28	5.37	4.29	Good-Fair

Taxonomic Analysis

Several EPT taxa were present for the first time in 2009 and included the mayflies *Iswaeon anoka* , *Plauditus dubius GR* , and the caddisfly *Brachycentrus spinae* . The addition of these intolerant taxa coupled with the simultaneous reduction of several pollution tolerant taxa (such as the chironomids *Ablabesmyia mallochi* , *Cricotopus bicinctus* , and *Cryptochironomus fulvus)* resulted in a the lowered BI (and EPTBI) in 2009. These trends may indicate improving water quality in this watershed.

Data Analysis

The EPTS, BI, and EPTBI have all been improving since 1987 . The 2009 sample resulted in the highest EPTs, the lowest BI and the lowest EPTBI observed at this location and also resulted in an improved bioclassification of Good. THe first non Good-Fair rating at this site. The improving invertebrate metrics indicate gradually improving water quality and is supported by the specific conductance data which has also been improving (128 µS/cm in 1999, 37 µS/cm in 2004, and 35 µS/cm in 2009). The 2005 assessment of this site noted that the drastic decline in conductivity from 2005 relative to 1999 may have been related to a reduction in local gem mining activities.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MIDDLE CR	**SR 1635**	**GB49**	**08/03/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.052222	-83.374444	2-8	Broad Basins

Stream Classification		Elevation	Stream Width (m)	Stream Depth (m)
C; Tr		1930	7	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	0	50	0	25 (residential)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	24.9
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	25
pH (s.u.)	6.7

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	11
Pool Variety (10)	8
Riffle Habitat (16)	14
Bank Erosion (7)	5
Bank Vegetation (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	68

Site Photograph

Substrate rubble, boulder, sand, silt and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11013		38		2.77	Excellent
07/22/04	9427		43		2.37	Excellent
08/24/99	7979		25		3.94	Good-Fair

Taxonomic Analysis

The 1999 sample produced the lowest EPT taxa richness ever recorded at this location. Since the 1999 collection, several new records of intolerant taxa were present in both 2004 and 2010 and include the mayflies *Baetis tricaudatus* , *Serratella serrata* , *Paraleptophlebia spp* , the stonefly *Perlesta spp* and the caddisflies *Ceratopsyche bronta* , *Nectopsyche exquisita* , *Lype diversa* , *Rhyacophila fuscula* , and *Neophylax consimilis* .

Data Analysis

The new records of intolerant invertebrates collected in 2004 and 2010 suggest that water quality improved after the 1999 Good-Fair collection. The relatively stable EPTS and EPTBI from 2004 and 2010 suggest that the water quality is also generally stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TESSENTEE CR	**SR 1684**	**GB46**	**07/30/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.066944	-83.368056	2-9	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
	14.4		7	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	25	50	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	18.3
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	21
pH (s.u.)	6.1
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	73

Site Photograph

Substrate Boulder, bedrock, cobble, gravel and sand with a trace of silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10788		52		2.70	Excellent
07/22/04	9430		47		2.36	Excellent

Taxonomic Analysis

There are numerous intolerant taxa that have been present at this location since monitoring commenced in 2004 and included the mayflies *Drunella allegheniensis* , *Serratella serratoides* , *Epeorus vitreus* , the caddisflies *Micrasema wataga* , *Glossosoma spp* , *Dolophilodes spp* , *Nyctiophylax celta* and the long-lived stoneflies *Acroneuria abnormis* and *Paragnetina immarginata* .

Data Analysis

The consistent Excellent bioclassifications and persistent intolerant benthic macroinvertebrate community (and long lived stoneflies) suggests stable and favorable water quality in this catchment. This conclusion is further supported by the specific conductance data which has been low and quite similar through time at 18 µS/cm in 2004 and 21.3 µS/cm in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COWEETA CR	**SR 1114**	**GB45**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.062778	-83.400556	2-10	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr	12.1	2100	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	19.1
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	16
pH (s.u.)	5.9
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	14
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	92

Site Photograph

Substrate mostly cobble and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10787	---	41	---	2.73	Excellent
07/22/04	9429	---	45	---	2.62	Excellent
08/21/99	7948	---	39	---	2.88	Excellent
07/27/94	6622	---	39	---	2.75	Excellent

Taxonomic Analysis

A stable, diverse, and pollution intolerant EPT fauna resides in Coweeta Creek. Abundant intolerant taxa collected in 2009 that characterize this site include the mayflies *Epeorus vitreus, Paraleptophlebia* spp, the stoneflies *Tallaperla* spp, *Perlesta* spp, and the caddisflies *Ceratopsyche bronta, C. sparna* , *Lepidostoma* spp and *Dolophilodes* spp.

Data Analysis

Coweeta Creek has been sampled here on four occasions with each sample producing an Excellent bioclassification. The majority of the watershed is undisturbed forest, in part, associated with Coweta Creek Hydrological Laboratory. A protected, forested watershed combined with a minimally disturbed riparian zone and instream habitat have resulted in a temporally stable, diverse, and pollution intolerant macrobenthic community.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CARTOOGECHAYE CR	SR 1146	GB40	07/28/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.156389	-83.455556	2-19-(1)	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III;Tr	57.0	2110	17	0.0

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	75	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	33
pH (s.u.)	6.0

Water Clarity: clear/turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	14
Bottom Substrate (15)	12
Pool Variety (10)	8
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	2
Light Penetration (10)	5
Left Riparian Score (5)	4
Right Riparian Score (5)	0
Total Habitat Score (100)	68

Site Photograph

Substrate: boulder, cobble, gravle, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10784		30		3.24	Good
07/21/04	9446		31		3.03	Good
08/24/99	7977		41		2.81	Excellent
07/27/94	6623		30		2.91	Good

Taxonomic Analysis

With the exception of the 1999 sample, the invertebrate composition at this location is remarkably unifrom. In fact, 23 common EPT species have been collected at this site in at least three of the four total collection events and include the pollution intolerant mayfles *Drunella allegheniensis* , *Serratella serrata* , *Epeorus vitreus* , the stoneflies *Acroneuria abnormis* , *Leuctra spp* ., and the caddsiflies *Brachycentrus appalachia* , *Dolophilodes spp* , and *Neophylax consimilis* .

Data Analysis

With the exception of the Excellent rating from 1999, the water quality at this site has been very stable. Indeed, the specific conductance has also been very uniform through time with a measurement of 33 µS/cm in 1999, 31 µS/cm in 2004, and 33 µS/cm in 2009. The biological uniformity is further demonstrated in that 40% of all the taxa ever collected at this location have been collected in at least three of the four total collections.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLASAJA R	**US 64**	**GB48**	**08/03/10**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.068889	-83.188889	2-21-(0.5)a	Southern Crystalline Ridges and Mountains

Stream Classification			Stream Width (m)	Stream Depth (m)
WS-III; Tr			5	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	45	0	0	30	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	22.4
Dissolved Oxygen (mg/L)	6.2
Specific Conductance (µS/cm)	46
pH (s.u.)	5.4

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	6
Pool Variety (10)	10
Riffle Habitat (16)	7
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	69

Site Photograph

Substrate sand, silt, gravel, and cobble with a trace of bedrock and boulder

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11010	91	29	5.15	3.83	Good-Fair
07/21/04	9433	58	14	5.67	4.73	Fair
07/25/01	8537	41	10	6.67	6.04	Fair
08/28/00	8280	65	18	6.25	5.27	Fair
06/23/99	7869	47	14	5.63	4.88	Fair

Taxonomic Analysis

The EPT diversity at this site has more than doubled since the the most recent sample in 2004 and represents the highest EPT diversity ever observed here. EPT taxa collected here for the first time included the mayfly *Centroptilum spp* ., the intolerant and long-lived perlid stoneflies *Acroneuria abnormis* , *Paragnetina immarginata* , and the caddisflies *Micrasema wataga* , *Glossosoma spp* ., *Hydroptila spp* ., *Oxyethira spp* ., *Triaenodes marginatus* , *Neophylax consimilis* , and *N. mitchelli* . The addition of these taxa, and particularly of the long-lived perlid stoneflies, indicates that water quality at this location has improved relative to previous years.

Data Analysis

All four previous samples resulted in Fair bioclassifications. This site improved substantially from earlier samples with every benthic macroinvertebrate metric showing improvement. Of interest is the pH. The 2010 observations were substantially lower than the 2000 (6.7), 2001 (6.7) and 2004 (6.8) measurements and suggests a reduction in non-point pollution inputs which tend to have neutral to high pH characteristics. Indeed, many sites in this basin with minimal non-point pollution have very low pH values. Examples of this can be seen at Snowbird Creek (SR 1120) and Tellico Creek (SR 1367) with 2010 pH measurements of 5.6 and 4.9 respectively.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLASAJA R	**SR 1678**	**GB79**	**08/03/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.125278	-83.285278	2-21-(5.5)	Southern Crystalline Ridges and Mountains

Stream Classification			Stream Width (m)	Stream Depth (m)
B; Tr			12	0.5

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	0	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	24.2
Dissolved Oxygen (mg/L)	6.8
Specific Conductance (µS/cm)	29
pH (s.u.)	6.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	3
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	81

Site Photograph

Substrate boulder, cobble, gravel, with a trace of sand and bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11012	103	51	3.26	2.35	Excellent
06/22/99	7862	90	50	3.36	2.29	Excellent
10/15/96	7214	86	45	3.31	2.36	Excellent
07/26/94	6602	85	42	3.60	2.73	Excellent
10/15/91	5749	95	48	3.67	2.90	Excellent

Taxonomic Analysis

There are numerous pollution intolernat taxa that have been present at this location at each of the five collections and include the mayflies *Epeorus vitreus* , *Maccaffertium ithaca* , *M. pudicum* , *Neoephemera purprea* , the stoneflies, *Tallaperla spp* ., *Acroneuria abnormis* , *Paragnetina immarginata* , *Pteronarcys spp* ., and the caddisflies *Ceratopsyche morosa* , and *C. sparna* . In addition, several taxa were collected for the first time at this location in 2010 and included the intolerant mayflies *Heterocloeon curiosum* , *Procloeon spp* ., *Drunella allegheniensis* and the caddisfly *Triaenodes perna* . The new intolerant taxa collected in 2010 further support the trend of improving community metrics observed at this station since monitoring commenced in 1991.

Data Analysis

The consistent Excellent bioclassifications, high species diversity and low biotic indices are all indicative of a pollution intolerant invertebrate community typical of a largely undisturbed watershed. These conclusions are further supported by the low specific conductance values observed (20 µS/cm in 1999, 29 µS/cm in 2010). Overall, the benthic invertebrate community metrics (S, EPT, BI and EPTBI) have generally been improving since the first sample in 1991.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLASAJA R	**SR 1668**	**GB39**	**08/03/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.164444	-83.325833	2-21-(5.5)	Broad Basins

Stream Classification		Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr		2100	20	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	25	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	N/A	N/AB; Tr

Water Quality Parameters

Temperature (°C)	24.6
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	33
pH (s.u.)	7.1

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	12
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	14
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	2
Left Riparian Score (5)	4
Right Riparian Score (5)	1
Total Habitat Score (100)	63

Site Photograph

Substrate Sand, silt, gravel, cobble and bedrock.

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/03/10	11011	116	50	4.30	3.08	Excellent
08/05/04	9462	86	42	4.27	3.42	Good
08/10/99	7961	99	51	3.74	3.09	Excellent

Data Analysis

The 1999 and 2010 samples were structurally quite similar. The slight decline in bioclassificaton seen in 2004 was largely due to the lack of certain taxa collected in 1999 and 2010. These taxa included the mayflies *Leucrocuta spp* , *Stenacron pallidum* , and the caddisflies *Micrasema bennetti* , *Hydropsyche venularis* , *Ceraclea ancylus* , *Neureclipsis spp* , *Nyctiophylax spp* and *Polycentropus spp* . With the ossible exception of *Hydropsyche venularis* and *Micrasema bennetti* , these taxa are generally restricted to slow pools along the stream margin. Their presence in 1999 and 2010 and absence in 2004 suggests that this habitat type was poorly developed or absent during the 2004 sample. Therefore, the slight decreased in bioclassification seen in 2004 was likely not related to a water quality change but may have been the result of reduced habitat availability, possibly related to low flow conditions. This assertion is supported by the water quality data as specific conductance was 22 µS/cm in 2004 and 33 µS/cm in 2010.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TURTLE POND CR	**SR 1620**	**GB47**	**08/20/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.075278	-83.260278	2-21-8	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	5.5	3320	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.8
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	13
pH (s.u.)	5.7
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	84

Site Photograph

Substrate mix of cobble, sand, boulder, and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/20/09	10827	---	46	---	2.24	Excellent
07/23/04	9428	---	49	---	2.10	Excellent
06/22/99	7866	---	42	---	1.90	Excellent

Taxonomic Analysis

Several taxa were collected for the first time at the site in 2009. Most notable was *Micrasema sprulesi* , for which the BAU has fewer than 25 records. Other taxa collected for the first time included the stonefly *Sweltsa spp and the caddisflies Goera calcarata, Mystacides spp, Molanna blenda,* and *Rhyacophila minor.*

Data Analysis

Turtle Pond Creek is approximately three miles northwest of Highlands and about 0.5 stream-miles above the confluence with Cullasaja River. Though the site has a significant amount of sand, a diverse benthic community was supported. All benthic macroinvertebrate metrics have been stable at this location since monitoring commenced in 1999 and all bioclassifications have been Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
IOTLA CR	**SR 1372**	**GB33**	**08/04/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.234444	-83.398333	2-27	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
	10.0		5	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	25	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	21.2
Dissolved Oxygen (mg/L)	7.5
Specific Conductance (µS/cm)	49
pH (s.u.)	6.6

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	0
Riffle Habitat (16)	10
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	0
Total Habitat Score (100)	58

Site Photograph

Substrate boulder, silt, sand, and cobble

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/09	10790	83	32	4.63	3.92	Good
05/24/07	10188		31		3.62	Good
07/22/04	9449	73	32	4.66	3.86	Good
08/10/99	7960		35		3.50	Good
07/27/94	6624		21		4.28	Good-Fair

Taxonomic Analysis

Several intolerant taxa absent from the 1994 Good-Fair sample but present at each of the four subsequent Good collections included the mayflies *Telagonopsis deficiens* , *Heptagenia marginalis* , the stonefly *Perlesta spp* , and the caddisfly *Triaenodes ignitus* .

Data Analysis

With the exception of the 1994 Good-Fair sample, Iotla Creek at this location has rated Good on four separate occasions. There has been very little shift among the invertebrate community since the 1994 sample and suggests very stable and generaly favorable water quality in this catchment. This conclusion is further supported by the stable conductivity at each observation (49 µS/cm in 2009, 39 µS/cm in 2007 , 40 µS/cm in 2004, and 42 µS/cm in 1999).

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
COWEE CR	**NC 28**	**GB31**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.262500	-83.409444	2-29	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	26.0	1980	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	50	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	19.2
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	26
pH (s.u.)	5.9

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	5
Light Penetration (10)	6
Left Riparian Score (5)	0
Right Riparian Score (5)	4
Total Habitat Score (100)	70

Site Photograph

Substrate Boulder, cobble, gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10786		40		2.94	Excellent
05/23/07	10187		43		2.81	Excellent
07/22/04	9451		38		2.82	Excellent
08/10/99	7962		35		2.37	Good
07/26/94	6620		24		3.31	Good-Fair

Taxonomic Analysis

Several pollution intolerant taxa absent from the 1994 Good-Fair sample have been present in the subsequent samples and include the mayflies *Serratella serrata* , *Heptagenia marginalis* , *Leucrocuta spp* ., *Paraleptophlebia spp* ., the stonefly *Leuctra spp* ., and the caddisflies *Brachycentrus nigrosoma* , *Lepidostoma spp* ., and *Oecetis persimilis* .

Data Analysis

This site improved to Good in 1999 and then improved to Excellent in 2004 and has remained Excellent in both of the subsequent collections. The only small difference in the community noted at this location since 2004 was the very slight increase in the EPTBI. However, the data suggest no significant change in the water quality since 2004.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BURNINGTOWN CR	**SR 1371**	**GB30**	**08/04/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.266389	-83.473056	2-38	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr	24.8	1950	10	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	25	25	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	20.5
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	20
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	77

Site Photograph

Substrate mix of bolder, rubble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/09	10789	---	37	---	3.41	Excellent
08/03/04	9477	---	43	---	3.12	Excellent
08/10/99	7959	---	39	---	3.06	Excellent
07/26/94	6619	---	30	---	2.89	Good

Taxonomic Analysis

Few differences existed with the common and abundant EPT taxa between the 2004 and 2009 samples. Although some changes in the benthic community in 2009 included the absence of the caddisfly *Micrasema watauga (* abundant in 2004 and common in 1999) and the stonefly *Pteronarcys* spp (common in 2004 and 1999, and abundant in 1994) but absent in 2009. The rest of the differences between 2004 and 2009 at Burningtown Creek involved the absence/presence of rare taxa. Despite the few differences the EPT community here appears diverse and generally pollution intolerant.

Data Analysis

Burningtown Creek rated Excellent in 2009, the same rating it received in 2004 and 1999. Though EPT diversity remains high here, the Biotic Index has steadily increased since first being sampled in 1994 suggesting that the benthic community is becoming slightly more pollution tolerant over time.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TELLICO CR	**SR 1367**	**GB28**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.281944	-83.507500	2-40	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
	12.0		6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	50	50	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	17.7
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	23
pH (s.u.)	5.6

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	3
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	81

Site Photograph

Substrate Boulder, cobble, gravel, sand and a trace of silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10785	93	40	3.07	2.35	Excellent
08/03/04	9476	93	44	3.29	2.33	Excellent
08/09/99	7958	108	54	3.30	2.24	Excellent
07/14/94	6586	84	43	3.24	2.37	Excellent

Taxonomic Analysis

Although several intolerant taxa were present in 2009 and included the mayflies *Drunella conestee* , *Epeorus vitreus and* the stoneflies *Tallaperla spp* , *Acroneuria abnormis* , *Paragnetina immarginata* , there were several edge-dwelling caddisflies that were absent or reduced in abundance in 2009 relative to previous collections. These taxa included *Brachycentrus spinae* , *Goera spp* and *Pycnopsyche spp* . The absence or reduction in these taxa may be related to a reduction in their favored habitat due to drought induced low flows. However, changes in water chemistry cannot be ruled out.

Data Analysis

Although there is a large trout farm approximately 1.8 miles upstream, there appears to be little impact to the benthic macroinvertebrate community as this site continues to rate Excellent and harbors many intolerant taxa. It is possible that dilution effects of several tributaries located between this location and the trout farm is having a positive influence on the invertebrate community. However, the EPTs in 2009 was the lowest on record and corresponded to a small increase in the specific conductance (23 µS/cm in 2009) which was elevated relative to the 1999 (16 µS/cm) and 2004 (17 µS/cm) observations. A reduction in flow in 2009 relative to earlier samples may support the elevated conductivity data due to a weakening in tributary dilution effects. Further, a reduction in flow also supports the lack of the edge-dwelling caddisfly taxa. Additional monitoring at this location is strongly recommended.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NANTAHALA R	**FSR 437**	**GB42**	**07/21/04**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	3	06010202	35.126944	-83.619167	2-57-(0.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr, ORW	52	3065	22	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	10	0	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.9
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	17
pH (s.u.)	6.3
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	15
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	88

Site Photograph

Substrate mostly boulder, cobble and gravel with some sand and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/10	11016	108	56	3.01	1.93	Excellent
07/21/04	9445	92	49	2.90	1.60	Excellent
08/24/99	7976	100	49	3.11	2.02	Excellent
07/26/94	6627	77	48	2.40	1.95	Excellent
07/10/91	5655	94	54	2.34	1.48	Excellent

Taxonomic Analysis

Sampling in 2010 yielded the highest EPT richness yet in this upper reach of the Nantahala River. The EPT community at this site included some previously uncollected taxa including the rare mayfly *Litobrancha recurvata* as well as the mayflies *Procloeon* spp and *Epeorus subpallidus*. The stonefly community was very similar to that seen in previous samplings. Caddisflies previously uncollected included the silt-loving *Phylocentropus*, the uncommon long-horned *Triaenodes taenius* and the stone casemaker *Psilotreta frontalis.* Non-EPT benthos was rich, particularly in chironomids, but not abundant.

Data Analysis

The Nantahala River at FSR 437 straddles the Macon County-Clay County line and is upstream of Nantahala Lake. It's waters are derived from small mountain streams that reside within Nantahala National Forest, and thus has colder water than many other rivers of similar size. While both total and EPT richness increased, the respective biotic indices also increased over previous values although not dramatically. However, habitat and physico-chimical parameters were very supportive of a diverse macroinvertebrate fauna which was the productive and intolerant community one would expect from a stream supplementally classified as ORW. This site retains an Excellent bioclassification.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NANTAHALA R	**OFF US 19-74 BE QUEENS CR**	**GB8**	**08/04/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	3	06010202	35.286111	-83.667500	2-57-(22.5)b	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B;Tr	142.0	1960	20	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	66	33	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	12.8
Dissolved Oxygen (mg/L)	9.6
Specific Conductance (µS/cm)	25
pH (s.u.)	6.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	5
Left Riparian Score (5)	5
Right Riparian Score (5)	2
Total Habitat Score (100)	85

Site Photograph

Substrate mostly rubble with some boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/04/09	10782	93	37	3.90	2.42	Good
07/20/04	9438	83	35	4.19	2.26	Good
08/23/99	7953	---	35	---	2.25	Good
07/26/94	6617	71	36	3.64	2.15	Good
11/15/93	6419	65	32	4.07	2.15	Good

Taxonomic Analysis

A diverse EPT community resides in this section of the Nantahala River although there is little difference among the taxa found in 2009 from previous collections. Among the dominant taxa that appear year after year include the mayflies *Serratella deficiens, Maccafffertium modestum, M. ithaca,* the stoneflies *Leuctra* spp and *Isoperla holochlora,* and the caddisflies *Micrasema watauga* and *Glossosoma* spp. Although more taxa were found in 2009 than any of the previous six collections, very few taxa new to this location were collected.

Data Analysis

This segment of the Nantahala River rated Good in 2009, the same rating it has received since 1993. It was first sampled in 1984, rating Good-Fair, followed by the same rating two years later. This portion of the Nantahala River is highly regulated with daily releases that greatly influence water chemistry, water depth and velocities. Though some edge taxa are limited here, overall, the macroinvertebrate community has adjusted to this artificial hydrologic regime and is currently stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
ALARKA CR	**SR 1185**	**GB17**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010202	35.378611	-83.472222	2-69-(2.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	25.0	1952	9	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	80	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.6
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	28
pH (s.u.)	6.8

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	78

Site Photograph

Substrate: Cobble, boulder, and gravel with some bedrock, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10769	110	53	3.59	2.66	Excellent
08/02/04	9453	101	46	3.88	2.67	Excellent
08/09/99	7956	86	51	3.62	3.03	Excellent
07/11/94	6580	91	48	3.70	2.99	Excellent

Taxonomic Analysis

Sampling resulted in the highest total taxa richness and EPT levels yet seen in this stream since it was added as a basinwide site. Approximately half of the EPT collected were mayflies (26 taxa) of which at least one third were abundant. Two intolerant mayflies (Ephemeroptera) not collected since 1994, *Baetisca spp* and *Brachycercus spp,* were collected in 2009. Stoneflies (Plecoptera) were rich and abundant as a group while the caddisflies were dominated by *Brachycentrus spinae* and hydropsychids. Additionally, five intolerant caddisflies were collected for the first time here and included*Ceraclea spp, Mystacides spp, Rhyacophila carolina,* and *Neophylax mitchelli.*

Data Analysis

While the watershed is primarily forested, the main stem of Alarka Creek is followed closely by a road resulting in mostly residential development along the stream channel. It was noted that since the last sampling event, native rock was removed from the channel downstream of the site (see photo above) by landowners adjacent to the stream to armor the immediate banks and to construct a gabion. This removed a significant amount of local habitat but did not affect the bioclassification. Sampling in 2009 resulted in the lowest biotic index ever measured in this stream. In fact, Alarka Creek has never rated lower than Excellent and maintains this rating in 2009 indicating that the water quality is very stable.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
WHITEOAK CR	**SR 1397**	**GB36**	**07/28/09**	**Good-Fair**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	3	06010202	35.221944	-83.615278	2-57-45b	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	7.1	3300	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	0	0	100	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	18.2
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	28
pH (s.u.)	5.1

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	3
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	71

Site Photograph

Substrate mix of boulders, rubble, gravel and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10783	57	21	4.84	1.73	Good-Fair
07/21/04	9443	63	26	4.53	2.34	Good-Fair
08/09/90	5426	60	20	5.83	2.20	Fair
05/15/90	5278	79	35	4.06	1.96	Good-Fair
01/23/90	5159	83	39	3.91	2.26	Good-Fair

Taxonomic Analysis

Only three EPT, all caddisflies, were abundant at this site on Whiteoak Creek in 2009 and included *Glossosom* spp, *Ceratopsyche sparna, and Lepidostoma* spp. Low EPT taxa richness combined with high numbers of pollution tolerant taxa such as oligocheates, leeches, chironomids, and other dipterans reflect an organically enriched aquatic environment. Large numbers of the filter feeding black fly, Simulium sp, were collected in summer 2009 and 2004, an increase from 1990 suggesting that additional organic particulates are entering Whiteoak Creek. This is the only site in the Little Tennessee Basin where the dipeteran Limnophora spp was collected in 2009. This taxa resides in the aquatic mosses that dominate the benthos in this enriched aquatic environment.

Data Analysis

Whiteoak Creek rated Good-Fair in 2009, the same rating it received in 2004. Since first being sampled in 1988, this waterbody has rated Fair twice and Good-Fair four times. This segment is located downstream of a trout farm, which appears to be adversely affecting the benthic community. Previous BAU investigations (B-, 881209, B-900220, B-900720, B-050218) clearly documented the effects of untreated wastewater here. Abnormally large and thick mats of aquatic plants have been a historic issue in Whiteoak Creek from 1998 to present. These mats consisted mostly of *Hylotheca mucosa* with some *Vaucheria* spp intermixed. *Hyloceca mucosa* is a widespread green alga usually occurring in acidic, oligotrophic aquatic environs. The degraded condition of this waterbody persists 1.5 miles downstream to Whiteoak Dam.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
PANTHER CR	**SR 1233**	**GB16**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Graham	2	06010202	35.390833	-83.624444	2-115	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	9.2	1739	8	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	70	20	---	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

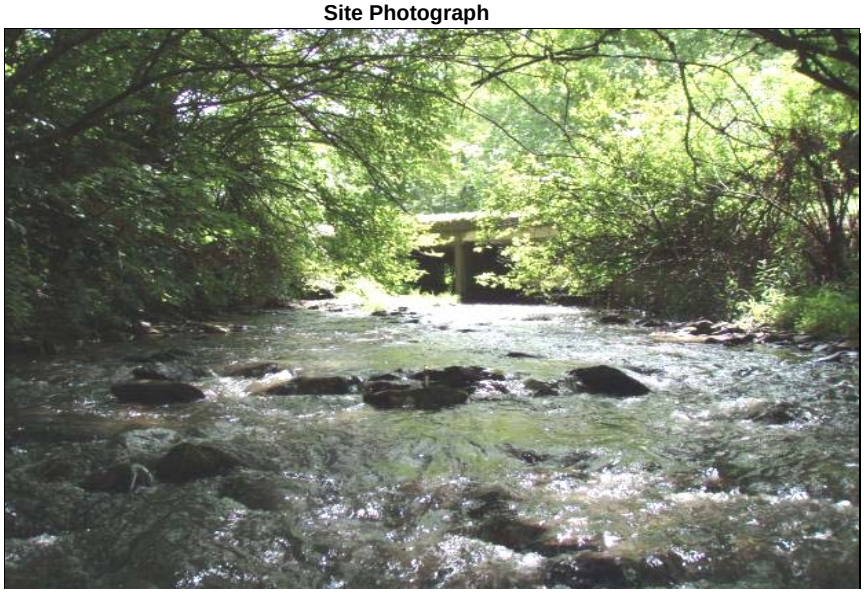
Water Quality Parameters

Temperature (°C)	17.9
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	24
pH (s.u.)	6.6
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	86

Site Photograph



Substrate Cobble, gravel, and boulder with some bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10701	---	45	---	2.13	Excellent
08/04/04	9457	---	35	---	2.07	Good
08/10/99	7963	---	39	---	2.15	Excellent
07/13/94	6585	---	37	---	1.93	Excellent

Taxonomic Analysis

The EPT richness in Panther Creek increased by more than 25% over 2004 levels to reach the highest richness yet measured in this waterbody. Although increases were seen in all three insect orders, it was primarily driven by increases in caddisfly taxa. Many taxa were new records for this stream and included the mayflies *Diphetor hageni* and *Epeorus dispar*, the stonefly *Beloneuria spp* and the caddisflies *Mystacides spp* and *Triaenodes perna/helo*.

Data Analysis

This site on Panther Creek is about 0.25 miles upstream of Fontana Lake. The high gradient stream follows a road and is impacted mostly by residential development and runoff, although the watershed is only lightly developed. In-stream habitat and physico-chemical parameters were good and no sediment problems or riparian issues (except for a road corridor) were noted. Previous observations of high periphyton biomass were not seen during 2009 sampling. The only non Excellent bioclassification observed at this site was in 2004 and that assessment was short of Excellent by just one EPT taxon. Overall, the water quality at this location has been quite stable through time.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
STECOAH CR	**SR 1237**	**GB14**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Graham	2	06010202	35.395556	-83.679167	2-130	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	8.9	1801	5	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	20	60	20	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.6
Dissolved Oxygen (mg/L)	8.3
Specific Conductance (µS/cm)	54
pH (s.u.)	6.8

Water Clarity	turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	15
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	79

Site Photograph

Substrate Cobble and gravel with some boulder and gravel

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10700	---	41	---	3.18	Excellent
08/04/04	9458	---	30	---	2.94	Good
08/11/99	7964	---	39	---	2.94	Excellent
07/13/94	6584	---	29	---	3.51	Good

Taxonomic Analysis

EPT richness increased by more than 33% from that measured in 2004 and was the highest observed here since sampling commenced. In addition, the stonefly community was the richest ever measured in Stecoah Creek with eight taxa collected while only five were collected in 2004.

Data Analysis

Stecoah Creek is a tributary to Fontana Lake and drains the northeastern portion of Graham County. Almost the entire stream corridor is developed for both residential and agricultural use leaving the forested landscape mostly around small tributaries to Stecoah Creek. At the time of sampling, flows were high and water was turbid making sampling difficult. Although benthic substrate was good, riparian vegetation was narrow or absent and some erosional areas were noted. Stecoah Creek has cycled between Good and Excellent since 1994 suggesting that water quality in this stream, though relatively stable, may be adversely affected by non-point source runoff during high flow years and positively affected during times of drought when non point pollution inputs are lower. This was likely the case in 2009.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
HAZEL CR	**NR MOUTH**	**GB3**	**07/28/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010202	35.473611	-83.722778	2-146-(19)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-IV; Tr, ORW, CA	44.8	1720	22	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	---	---	10 (gravel road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	12
pH (s.u.)	6.4

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	90

Site Photograph

Substrate Cobble and boulder with gravel and sand, some silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10696	118	61	3.17	2.13	Excellent
08/03/05	9682	108	60	3.00	2.14	Excellent
08/03/04	9456	96	46	3.29	2.17	Excellent
08/11/99	7967	106	56	2.89	1.87	Excellent
07/12/94	6583	95	47	2.81	1.85	Excellent

Taxonomic Analysis

A very high total of 61 EPT were recorded in Hazel creek in 2009, similar to the 2005 EPT richness. The benthic community composition was very similar to previous years and was composed of many pollution sensitive taxa. While most of these taxa were previously collected, a few were collected for the first time in Hazel Creek including only the second NC record of the flatheaded mayfly *Epeorus subpallidus* and the third NC record of the baetid *Acentrella barbarae* which was described from Great Smoky Mountain National Park in 2006. Other newly collected taxa included the caddisflies *Phylocentropus spp* , *Molanna spp* , and *Oligostomis pardalis* .

Data Analysis

Hazel Creek drains a southeastern portion of Great Smoky Mountain National Park into Fontana Lake. Hazel Creek is paralleled by a gravel road for much of its length but otherwise has a completely forested watershed. While the sampling site is near the historic town of Proctor which was flooded to create Fontana Lake in 1944, very little evidence of the urbanization of Hazel Creek remains. Habitat was excellent and flows were normal creating a succession of riffles and pools for macroinvertebrate colonization. Historically high total taxa, EPT richness and EPT abundance (332) values were obtained in 2009. Although the biotic index did increase slightly in 2009, this was largely due to the collection of 11 beetle taxa (most of which are pollution tolerant species). Overall, the benthic macroinvertebrate metrics have remained remarkably stable at this location and is the result of the entirely protected and forested nature of the watershed.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
MIDDLE CR	**SR 1635**	**04/30/09**	**GF19**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.05194444	-83.36361111	2-8	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	12.2	2115	7	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	85	15	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.4
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	23
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	16
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	7
Erosion (7)	4
Bank Vegetation (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	**65**

Site Photograph

Substrate Cobble, gravel, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/30/09	2009-24	19	58	Excellent
05/17/04	2004-44	16	56	Good

Most Abundant Species 2009 Mottled Sculpin (36%)

Exotic Species 2009 Yellowfin Shiner, Mountain Redbelly Dace, Brown Trout, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Whitetail Shiner, Mountain Redbelly Dace, Western Blacknose Dace, Brown Trout, Greenfin Darter
Losses -- Rainbow Trout, Largemouth Bass. All species gained or lost were represented by 1-3 individuals/species; Rainbow Trout represented only by young-of-year and excluded from the sample.

Data Analysis

Watershed -- drains southern Macon County and a small portion of northern Rabun County, GA; tributary to the Little Tennessee River; site is ~ 1.1 miles above the creek's confluence with the river; no municipalities within the watershed. **Habitats** -- primarily runs, plunge pools, snags, narrow riparian zone along the right bank in residential use. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. in 2004 and 2009. **2009** -- the collection of one individual of Greenfin Darter improved the rating from Good to Excellent; except for the darter metric, all other metric scores were comparable to reference site values (i.e., score = 5). **2004 & 2009** -- 21 species are known from the site, including 11 species of cyprinids, 5 exotic species, 4 intolerant species, 2 species of darters, and the Smoky Dace (Special Concern); dominant species has been the Mottled Sculpin (38% and 36%); no reproducing trout populations found at this lowermost site.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TESSENTEE CR	**SR 1636**	**04/30/09**	**GF28**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.06527778	-83.37777778	2-9	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	14.8	2040	7	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	60	15	0	25 (feedlot & cattle pasture)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.5
Dissolved Oxygen (mg/L)	9.4
Specific Conductance (µS/cm)	18
pH (s.u.)	6.1

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	10
Riffle Habitat (16)	10
Left Bank Stability (7)	2
Erosion (7)	4
Bank Vegetation (7)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	**70**

Site Photograph

Substrate Cobble, gravel, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/30/09	2009-25	19	52	Good
05/18/04	2004-46	16	52	Good
05/03/95	95-38	16	56	Good

Most Abundant Species 2009 Mottled Sculpin (40%)

Exotic Species 2009 Snail Bullhead, Green Sunfish, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Fatlips Minnow, Creek Chub, Snail Bullhead, Green Sunfish, **Losses** -- Golden Redhorse. All species gained or lost were represented by 1individual/species, except for Creek Chub (n = 13) and Golden Redhorse (n = 10).

Data Analysis

Watershed -- drains southern Macon County; no municipalities within the watershed; tributary to the Little Tennessee River; site is ~ 0.6 miles above the creeks' confluence with the river. **Habitats** -- riffles, runs, silty shorelines, side snags, deep chutes; narrow riparian zone along the right shoreline in residential land use; unstable banks. **Water Quality** -- low specific conductance in 2004 and 2009. **2009** -- more fish collected than at any other site in 2009; 2.6 times more fish collected in 2009 than in 2004 (1,476 *vs.* 578), especially in the numbers of Mottled Sculpin (40%), Central Stoneroller (18%), River Chub (11%), Tennessee Shiner (7%), and Yellowfin Shiner (7%); Hatchery Supported Trout Waters, no trout collected except young-of-year Brown Trout. **1995-2009** -- 23 species known from the site, including 9 species of cyprinids, 6 exotic species, 4 intolerant species, 2 species of darters, and the Smoky Dace (Special Concern); dominant species has been the Mottled Sculpin (20, 39, and 40%); no reproducing trout populations found at this lowermost site; no substantial changes in this community among the three monitoring periods.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
ELLIJAY CR	**SR 1524**	**04/30/09**	**GF14**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.16611111	-83.3075	2-21-23	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	20	2070	8	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	45	15	40	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.2
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	31
pH (s.u.)	6.9

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	9
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	4
Light Penetration (10)	5
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	**77**

Site Photograph

Substrate Cobble, bedrock, boulder, gravel, silt, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/30/09	2009-26	19	50	Good
05/20/04	2004-51	20	56	Good

Most Abundant Species 2009 Central Stoneroller (31%), Mottled Sculpin (29%)

Exotic Species 2009 Rainbow Trout, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Fatlips Minnow and Gilt Darter. **Losses** -- Green Sunfish, Greenfin Darter, Tuckasegee Darter. All species gained or lost were represented by 1 or 2 individuals/species.

Data Analysis

Watershed -- drains the east-northeast region of Macon County; tributary to the Cullasaja River; site is ~ 0.6 mile above the creek's confluence with the river. **Habitats** -- swift flow; riffles, runs, plunge pools, side snags, narrow riparian zones (road and pasture) contributing to a fairly open canopy. **2009** -- almost twice as many fish collected in 2009 than in 2004 (1,132 *vs.* 590), especially the numbers of Central Stoneroller and Mottled Sculpin, but only one individual of one darter species; increase in the abundance of Central Stoneroller and River Chub are indicative of upstream nonpoint nutrient runoff and enrichment. **2004 & 2009** -- 22 species known from the site, including 10 species of cyprinids, 5 intolerant species, 3 species of darters, but all darter species represented only by one individual per species, and the Smoky Dace (Special Concern); Mottled Sculpin is the dominant species (44% and 29%); stream is supporting its supplemental designation as trout waters (Tr). Possible upstream nonpoint nutrient runoff and decline in the NCIBI score warrant continued monitoring in 2014.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
IOTLA CR	**off SR 1378**	**05/01/09**	**GF15**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
MACON	1	06010202	35.23444444	-83.39805556	2-27	Broad Basins

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	10	1995	5	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	40	40	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	15.3
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	41
pH (s.u.)	5.7

Water Clarity	Slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	17
Bottom Substrate (15)	6
Pool Variety (10)	8
Riffle Habitat (16)	10
Erosion (7)	4
Bank Vegetation (7)	5
Light Penetration (10)	8
Left Riparian Score (5)	4
Right Riparian Score (5)	2
Total Habitat Score (100)	**69**

Site Photograph

Substrate Cobble, boulder, sand, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
05/01/09	2009-27	22	48	Good
05/19/04	2004-48	18	44	Good-Fair

Most Abundant Species 2009 River Chub (26%)

Exotic Species 2009 Yellowfin Shiner, Brown Trout, Redbreast Sunfish, Green Sunfish

Species Change Since Last Cycle

Gains -- Spotfin Chub, Telescope Shiner, Fatlips Minnow, Creek Chub, Black Redhorse, Brown Trout, Tuckasegee Darter. **Losses** -- Mountain Brook Lamprey, White Sucker, Bluegill. All species gained or loss were represented by 1-34individuals/species, except for Telescope Shiner (n = 16).

Data Analysis

Watershed -- drains north-central Macon County, including the area around the Macon County airport; tributary to the Little Tennessee River; site is ~ 0.2 miles above the creek's confluence with the river. **Habitats** -- heterogeneous habitats (riffles, runs, sandy bottom pools, and snags, undercuts, boulder crevices, rip/rap); lower one-third of the reach had a higher gradient and better habitats than did the upper two-thirds of the reach. **Water Quality** -- in 2004 and 2009 pH less than the water quality standard of 6.0 s.u and conductivity elevated for a mountain stream. **2009** -- one specimen of the Federally Endangered Spotfin Chub was collected; site's proximity to the river may increase the diversity metrics and rate the community higher (Good) than what it should be (Good-Fair) more fish, total species, species of darters and cyprinids collected in 2009 than in 2004; abundance of River Chub and Central Stoneroller are indicative of upstream nonpoint nutrient runoff and enrichment. **2004 & 2009** -- 25 species known from the site, including 10 species of cyprinids and 4 species of darters; dominant species is the River Chub (23% and 26%).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
BRUSH CR	**off SR 1129**	**04/29/09**	**GF2**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010202	35.31777778	-83.51555556	2-46	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C	7.5	1830	6	0.3	Yes

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.7
Dissolved Oxygen (mg/L)	9.9
Specific Conductance (µS/cm)	29
pH (s.u.)	6.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	8
Riffle Habitat (16)	14
Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	**87**

Site Photograph

Substrate Cobble, boulder, silt, gravel, sand

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/09	2009-23	15	52	Good
05/19/04	2004-50	16	50	Good

Most Abundant Species 2009 Whitetail Shiner (18%), Warpaint Shiner (18%)

Exotic Species 2009 Rainbow Trout

Species Change Since Last Cycle

Gains -- Spotfin Chub, Telescope Shiner, Black Redhorse, Rainbow Trout. **Losses** -- Smoky Dace, Western Blacknose Dace, Redbreast Sunfish, Green Sunfish, Smallmouth Bass. All species gained or lost were represented by 1-4 individuals/species, except for Spotfin Chub (n = 38) and Telescope Shiner (n = 12).

Data Analysis

Watershed -- drains southern Swain County; tributary to the Little Tennessee River; site is ~ 0.2 miles above the creek's confluence with the river and within the state-owned Needmore Tract; no municipalities within the watershed. **Habitats** -- riffles, runs, plunge pools; wide riparian zones providing excellent canopy over the stream; silt-covered rocks contributing to the very turbid conditions when walking in the stream. **2009** -- total species richness and diversities of cyprinids and darters were slightly lower than expected, all other metric scores were comparable to reference site values (i.e., score = 5); 38 specimens of the Federally Endangered Spotfin Chub were collected. **2004 & 2009** -- 20 species known from the site, including 9 species of cyprinids, 6 intolerant species, and 2 species of darters; seasonal migrants from the river include Whitetail Shiner, Telescope Shiner, and Spotfin Chub; dominant species in 2004 were Mottled Sculpin (25%) and Warpaint Shiner (16%). Upstream nonpoint sediment runoff sources should be investigated.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
STECOAH CR	**SR 1237**	**04/28/09**	**GF26**	**Not Rated**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	2	06010202	35.39527778	-83.67805556	2-130	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	9	1810	5	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	45	30	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

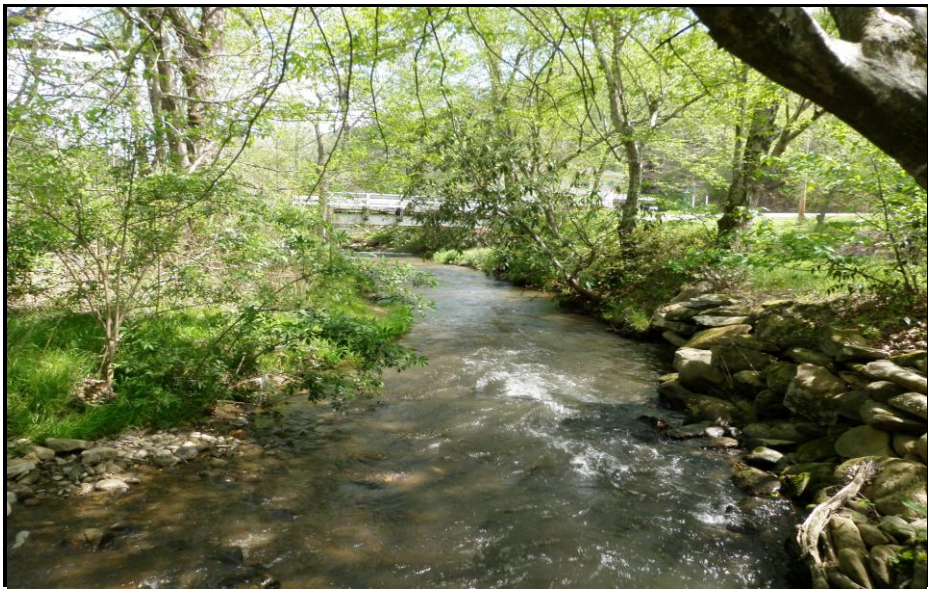
Temperature (°C)	15.4
Dissolved Oxygen (mg/L)	10.0
Specific Conductance (µS/cm)	39
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	10
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	2
Bank Vegetation (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	3
Right Riparian Score (5)	1
Total Habitat Score (100)	**79**

Site Photograph



Substrate Cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/09	2009-19	12	---	Not Rated
06/03/04	2004-68	10	---	Not Rated

Most Abundant Species 2009 River Chub (33%)

Exotic Species 2009 Rainbow Trout, Green Sunfish

Species Change Since Last Cycle **Gains** -- Green Sunfish (n = 8), Smallmouth Bass (n = 1). **Losses** -- none.

Data Analysis

Watershed -- drains northeastern Graham County; tributary to Fontana Reservoir; site is ~ 1.5 miles above its mouth; no municipalities within the watershed. **Habitats** -- extensive riffles, chutes, plunge pools; degraded riparian zones and unstable banks; livestock with access to stream above the reach; more upstream development (i.e., campground and mobile homes) than in 2004. **Water Quality** -- conductivity elevated for a mountain stream in 2004 and 2009; pH less than the water quality standard of 6.0 s.u. in 2009. **2009** -- community is dominated by omnivores+herbivores (Central Stoneroller and River Chub); Mottled Sculpin, an indicator of cold-cool water, constituted only 3% of the fish; darters absent; Hatchery Supported Trout Waters, three stocked Brown Trout collected (236-313 mm TL). **2004 & 2009** -- 12 species known from the site, but no darters; site appeared to be degraded by straight-piping or nonpoint-source runoff which may be contributing nutrients to this stream; dominant species are River Chub (36% and 33%) and Central Stoneroller (14% and 19%). Stream is supporting its supplemental designation as trout waters (Tr), but the dominance by River Chub and Central Stoneroller, the silt on the substrate, and the widening of NC 28 in the Stecoah Valley warrants continued monitoring of this site in 2014.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TUCKASEGEE R	**SR 1140**	**GB38**	**08/17/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.200110	-82.991800	2-79-(0.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III,B;Tr,ORW	11	3260	14	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	90	0	0	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	20.2
Dissolved Oxygen (mg/L)	7.1
Specific Conductance (µS/cm)	10
pH (s.u.)	5.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	8
Riffle Habitat (16)	6
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	2
Right Riparian Score (5)	5
Total Habitat Score (100)	79

Site Photograph

Substrate mostly boulder, cobble, sand; some gravel and silt also present

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/17/09	10818	---	35	---	2.42	Good
08/02/04	9473	---	36	---	1.83	Excellent
07/19/99	7906	---	46	---	1.86	Excellent
09/01/94	6696	---	39	---	2.26	Excellent
09/13/89	5077	101	47	3.50	1.79	Excellent

Taxonomic Analysis

Excluding the more intensive Full-Scale sample obtained in 1989, the number of Ephemeroptera collected in 2009 was generally within the range for the other EPT samples. However, both Plecoptera and Trichoptera were reduced in 2009, by 2-3 and 3-4 taxa respectively. The most conspicuous absence from the sample collected in 2009 is *Arctopsyche irrorata* --this stressor-sensitive species was common in each of the four prior samples. Another sensitive species, *Malirekus hastatus* , was also uncollected for the first time in 2009.

Data Analysis

This uppermost benthic basinwide site on the river is within five miles of the headwaters and about 15 miles west of Brevard. The site was sampled using Full-Scale methods in 1989, then with EPT methods during each of the following sampling events. If a single additional taxon had been collected at the site in 2009 the classification would have remained at Excellent and therefore, despite the Good bioclassification in 2009, it is evident that water quality in this catchment has remained stable since sampling commenced in 1989.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TUCKASEGEE R	**SR 1378**	**GB19**	**07/30/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.368889	-83.263333	2-79-(40.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B	347.0	1952	50	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	---	90	---	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Jackson County WWTP (Tuckasegee Water and Sewer Authority)	NC0039578	3.5

Water Quality Parameters

Temperature (°C)	17.5
Dissolved Oxygen (mg/L)	9.2
Specific Conductance (µS/cm)	27
pH (s.u.)	6.0

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	15
Bottom Substrate (15)	11
Pool Variety (10)	4
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	3
Light Penetration (10)	2
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	63

Site Photograph

Substrate: Cobble and boulder with some bedrock, gravel, sand, and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10770	75	43	4.29	3.52	Good
08/04/04	9484	84	44	4.27	3.44	Excellent
07/21/99	7932	75	40	4.34	3.73	Good
07/14/94	6591	100	47	4.38	3.32	Excellent
08/10/90	5366	86	43	4.10	3.20	Good

Taxonomic Analysis

A small reduction in both total and EPT richness occurred in 2009. Conspicuously absent in 2009, after being present since 1984, were the mayflies *Maccaffertium modestum* and *Neoephemera purpurea* . Only 13 Trichoptera were collected in 2009 as compared to 21 in 2004 although most missing taxa were rare in previous samples. The paucity of midge taxa was largely responsible for the reduction in the total taxa richness.

Data Analysis

This large river site receives effluent from the municipalities of Sylva, Webster, and Dillsboro and drains almost the entirety of Jackson County. A difficult site to sample in any year, this site was assessed during higher flows and was not completely wadeable. Habitat was typical for a large river and, except for the lack of sufficient riparian vegetation, had no significant deficiencies. Since the inception of sampling in 1984, the Tuckasegee River has improved from Good-Fair (1984) to the current rating of Good. Had sampling produced one more EPT, this site would have rated Excellent in 2009. This suggests that the water quality is not declining despite the slight drop to Good in 2009. This conclusion is further supported by the very stable biotic index and EPTBI measured here since 1990.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CANEY FK	**SR 1740**	**GB27**	**08/02/04**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.305000	-83.126111	2-79-28-(2.5)	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; Tr	40	2200	14	0.3

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	40	20	30	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	25.2
Dissolved Oxygen (mg/L)	7.2
Specific Conductance (µS/cm)	26
pH (s.u.)	7.5
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	7
Riffle Habitat (16)	14
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	82

Site Photograph

Substrate good mix of cobble (40),gravel (30), boulder (20), and sand (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11088	107	52	3.13	2.20	Excellent
08/02/04	9474	107	54	3.39	2.33	Excellent
07/20/99	7912	97	53	3.26	2.50	Excellent
07/15/94	6593	93	56	3.01	2.38	Excellent

Taxonomic Analysis

The benthic community in Caney Fork has remained very speciose over the past 20 years. While EPT richness slowly decreases, total richness is trending up, due primarily to an increase in odonate and dipteran richness. These two groups contributed to the increase in the biotic index seen in the last 10 years (relative to the EPT BI), although this is partially offset by fewer Chironmidae larvae in 2010. The EPT fauna has consistently remained, over 4 basinwide cycles, both similar and productive (most likely due to the open canopy). Mayflies were dominated by baetids and included Caney Fork's first record of *Iswaeon anoka* as well as the flat-headed mayfly *Epeorus vitreus* . Intolerant species of hydropsychid net spinners, such as *Ceratopsyche morosa* , dominated, in terms of abundance, the caddisfly community suggesting slight enrichment. Finally, the stoneflies remained amazingly stable with the same 6 taxa recorded over the last 15 years.

Data Analysis

Caney Fork, along with its tributary Moses Creek, drains a small portion of east-central Jackson County, a mostly forested landscape, and ultimately feeds into the Tuckasegee River. Caney Fork, for most of it's length, is paralleled by roadway and is lined by agricultural fields and residences. It is therefore lacking any significant riparian vegetation and is often denuded on both sides of the stream. However, most of the watershed is forested thereby protecting the Excellent water quality that has persisted in Caney Fork over the last two decades. Other than loss of riparian vegetation (complete loss in some areas), no glaring problems were noted with either physico-chemical parameters or in-stream habitat. Small amounts of silt were recorded but appear to have a minimal effect on the benthos despite the occurrence of some substrate embeddedness.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
MOSES CR	**SR 1739**	**GB26**	**08/02/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.314722	-83.125556	2-79-28-8	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-III; Tr	8	2280	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	70	20	---	10	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.5
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	26
pH (s.u.)	5.6

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	5
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	3
Total Habitat Score (100)	81

Site Photograph

Substrate mostly cobble (50) and boulder (25), with some gravel (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/02/10	11089	---	42	---	1.64	Excellent
08/02/04	9475	---	46	---	1.38	Excellent
07/20/99	7913	---	37	---	1.57	Excellent

Taxonomic Analysis

The decrease in EPT richness seen in Moses Creek in 2010 from the previous 2004 high was due to the net loss of 4 mayflies taxa largly represented in part by spiny crawlers (*Drunella cornutella*) and flat-headed mayflies (*Leucrocuta* spp, *Rhithrogena* spp, and *Stenacron pallidum*). Both stonefly and caddisfly richness remained stable (8 and 18 taxa, respectively). While the stonefly community was similar to the previous 2 samplings (with the addition of *Amphinemura* spp but the loss of *Isoperla holochlora*), a slight shift was seen in the caddisfly community. Filterers, particularly net-spinners such as hydropsychids, became more dominant in both richness (with the addition of *Ceratopsyche alhedra* and *C. morosa*) as well as abundance. Furthermore, brachcentrid caddisflies were much less common with 2 species, *Brachycentrus nigrosoma* and *Micrasema wataga*, disappearing altogether.

Data Analysis

Moses Creek is a tributary of Caney Fork which, in turn, drains into the Tuckasegee River. This stream has a catchment that is largely forested with only the lower segment paralleling a rural residential road. Moses Creek is one of the few streams in the LTN that saw a loss of EPT taxa from the previous sampling cycle, although this loss was relatively small. These losses were primarily seen among very intolerant taxa thus affecting the EPT BI which, while low, is the highest yet seen for this stream. While very little silt was seen, it was noted that riparian loss was occurring due to residential lawns, some upstream agriculture, and the nearby road. However, habitat was good overall and the specific conductance, while not exceedingly low like that of an undisturbed stream, was not problematic. Water quality in Moses Creek remains solidly Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CULLOWHEE CR	SR 1001	GB29	07/30/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.288333	-83.181667	2-79-31a	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	18.9	2123	5	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	10	60	---	30 (park)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.8
Dissolved Oxygen (mg/L)	8.2
Specific Conductance (µS/cm)	32
pH (s.u.)	6.9

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	14
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	9
Bank Erosion (7)	7
Bank Vegetation (7)	4
Light Penetration (10)	7
Left Riparian Score (5)	1
Right Riparian Score (5)	3
Total Habitat Score (100)	61

Site Photograph

Substrate: Cobble and sand with some gravel and boulder, silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10773	---	52	---	3.07	Excellent
08/04/04	9481	---	47	---	2.61	Excellent
07/20/99	7914	---	43	---	2.91	Excellent
08/31/94	6681	---	32	---	2.44	Good

Taxonomic Analysis

EPT richness values have steadily increased in Cullowhee Creek to the current levels of 52 taxa since the inception of sampling in 1994. However, the EPT biotic index has also increased leading to the conclusion that as more taxa are collected, a higher proportion of the total taxa are more tolerant to urban stressors. This is seen in both the presence of facultative taxa like the mayfly *Procloeon* as well as the absence or rarity of previously occurring intolerant taxa like the mayfly *Serratella carolina* and the caddisfly *Rhyacophila fuscula*. Some taxa recorded for the first time at Cullowhee Creek included the mayflies *Stenacron pallidum* and *Rhithrogena fuscifrons* and the caddisflies *Micrasema bennetti* and *Oligostomis pardalis*. Plecoptera were both taxa rich (8) and abundant. The rare mayfly, *Epeorus subpallidus,* was collected for only the 5th time in the state.

Data Analysis

Cullowhee Creek drains a small portion of western Jackson County and eventually drains into the Tuckasegee River. The sampling site lies above Cullowhee and Western Carolina University amid light urban development reflected by the lack of significant riparian vegetation and the high degree of embedded substrate in the stream. High levels of sand (25%) and silt (10%) have removed the interstitial spaces needed for some taxa to persist. High productivity was noted as evidenced by the presence of copious amounts of the macrophyte *Podostemum ceratophylum* (riverweed), which is known to increase macroinvertebrate abundance (high in this stream at 264) and provide substrate for epiphytic algae and rufugia for invertebrates. Although Cullowhee Creek was rated as Excellent in 2009, habitat degradation is a serious issue and may negatively affect the fauna in the future if watershed development continues unabated.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SAVANNAH CR	**SR 1367**	**GB23**	**07/30/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.345833	-83.237500	2-79-36	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	40.7	2004	12	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	60	30	---	10 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	19.0
Dissolved Oxygen (mg/L)	8.6
Specific Conductance (µS/cm)	33
pH (s.u.)	6.1

Water Clarity	slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	16
Bottom Substrate (15)	7
Pool Variety (10)	5
Riffle Habitat (16)	14
Bank Erosion (7)	5
Bank Vegetation (7)	4
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	4
Total Habitat Score (100)	70

Site Photograph

Substrate	Cobble and sand with some bedrock and gravel, extremely silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10772	83	45	3.59	3.06	Excellent
08/04/04	9482	91	40	4.15	3.11	Good
07/21/99	7930	53	32	3.72	3.36	Good
07/26/94	6603	77	40	3.78	3.06	Excellent

Taxonomic Analysis

An increase in both mayfly and caddisfly taxa from 2004 levels brought the EPT richness to the highest level seen here. Many species absent in 2004 were collected in 2009 including many sensitive taxa like the mayflies *Brachycercus spp* , *Heterocloeon curiosum* , and *Serratella serrata* as well as the caddisflies *Brachycentrus spinae* and *Setodes spp* . Other sensitive species were collected for the first time such as the burrowing mayfly *Ephemera spp* (indicative of silt pools), and the caddisflies, *Nyctiophylax spp* , *Lype diversa* , and *Fattigia pele* . Fewer beetle and odonate taxa were collected in than in previous samplings which helped to reduce the biotic index.

Data Analysis

Savannah Creek, a tributary to the Tuckasegee River, drains a moderately developed landscape. Many segments of the stream are channelized and have had much of the riparian vegetation reduced or completely removed. The lower segment of the stream follows a road and has had most of the woody vegetation removed, consequently limiting habitat and resources for colonizing macroinvertebrates. Sedimentation was evident in the stream as embeddedness of bottom substrate was severe and large pools of silt and bank erosion were present. Slightly turbid water, normal in streams with development in the catchment, was also noted. Despite the habitat and watershed challenges, Savannah Creek rated Excellent for the first time in 10 years as evidenced by increased EPT richness and a significantly lower overall biotic index. This improvement was likely the result of reduced non point inputs of pollution due to drought effects.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SCOTT CR	**UPS SR 1556**	**GB167**	**07/30/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Jackson	2	06010203	35.368889	-83.249444	2-79-39	Southern Crystalline Ridges and Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	58.9	1968	9	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	---	90	---	10

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Sylva WWTP (Tuckaseigee Water and Sewer Authority)	NC0020214	0.5

Water Quality Parameters

Temperature (°C)	18.6
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	39
pH (s.u.)	6.1

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	18
Bottom Substrate (15)	6
Pool Variety (10)	4
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	4
Light Penetration (10)	9
Left Riparian Score (5)	1
Right Riparian Score (5)	1
Total Habitat Score (100)	64

Site Photograph

Substrate: Gravel and cobble with some boulder and sand, silty

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/30/09	10771	98	46	4.12	3.34	Excellent
08/09/07	10309	---	37	---	3.23	Excellent
08/04/04	9483	74	35	4.07	3.23	Good
07/21/99	7931	70	36	4.07	3.09	Good
07/14/94	6592	68	28	5.19	3.65	Good-Fair

Taxonomic Analysis

A significant increase in both total taxa and EPT richness has occurred since the last basinwide assessment in 2004. An almost 33% increase in EPT can be accounted for by additional mayflies and caddisflies occurring since 2004. In particular, the number of baetid mayfly species has more than doubled since monitoring began in 1994. Flat-headed mayflies were also abundant as a group with *Rhithrogena exilis* re-occurring for the first time in 15 years. Stonefly richness has remained relatively stable over time, varying between five and eight taxa (seven in 2009). In contrast, the caddisfly community was comprised of 16 taxa, almost double what was collected in 1994. Hydropsychids were the dominant caddisfly group and was represented by four species. Also, both beetle and midge richness increased in 2009, in part responsible for the increased total taxa richness and biotic index.

Data Analysis

Lying in northeastern Jackson County, many of Scotts Creek's tributaries drain unimpacted mountain slopes. However, the lower portion of this watershed is largely urbanized and passes through both downtown Sylva and Dillsboro before draining into the Tuckasegee River. Additionally, the stream is followed closely by major roads for much of it's length. The sampling site is on a reach that is channelized and stabilized with concrete riprap (see photo) and is next to the Great Smoky Mountain Railroad parking lot. The habitat score reflects the embeddedness and lack of riparian vegetation. Downstream of the Sylva WWTP, the specific conductance was low, although water levels were higher than normal due to recent rains. While the total taxa and EPT

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CONNELLY CR	SR 1177	GB13	07/29/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.430556	-83.365278	2-79-52	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	13.4	1869	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	50	50	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Smoky Mountain Country Club	NC0084441	0.12

Water Quality Parameters

Temperature (°C)	20.1
Dissolved Oxygen (mg/L)	7.9
Specific Conductance (µS/cm)	26
pH (s.u.)	6.7

Water Clarity: slightly turbid

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	18
Bottom Substrate (15)	14
Pool Variety (10)	5
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	5
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	1
Total Habitat Score (100)	84

Site Photograph

Substrate: Mostly cobble mixed with gravel and boulder, some bedrock

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10713	---	44	---	2.46	Excellent
08/03/04	9480	---	34	---	2.82	Good
07/21/99	7933	---	44	---	3.06	Excellent
07/14/94	6589	94	42	3.57	3.00	Excellent

Taxonomic Analysis

An EPT richness of 44 taxa collected in 2009 is the same as that obtained in 1999 but was significantly higher than that observed in 2004. This increase was driven in part by an additional 7 mayfly taxa (22) over 2004 levels (15) and is the same number of mayfly taxa that were collected in 1999. Coupled with this increase in richness is the decrease in the EPT biotic index to the lowest value recorded for this stream since sampling began in 1994. The absence of some tolerant baetid mayflies such as *Baetis flavistriga* and the addition of intolerant ephemerellid mayfly taxa, including *Drunella allegheniensis* , *Serratella carolina,* and *Serratella serratoides,* is responsible for the low EPT biotic index. Moreover, all but one taxa of the 7 Plecoptera taxa collected were abundant. The caddisfly community observed was similar to previous years with the first record of *Hydatophylax argus* at this site occurring in 2009.

Data Analysis

Connelly Creek is a small tributary to the Tuckasegee river and drains a small portion of southeastern Swain County. Only the lower portion of the watershed is developed, consisting mostly of residences and a golf course, leaving the vast majority of the upper watershed n forest. The stream follows a road for much of its length which has reduced or removed the riparian on one side for much of the segment. However, overall habitat was good and the stream banks were stable with little erosion. EPT richness levels rebounded to 1999 levels thereby increasing its bioclassification to Excellent after rating Good in 2004. Although this site was Good in 2004, that sample was only two EPT taxa short of receiving an Excellent bioclassification thus indicating temporally stable water quality in this catchment.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
BRADLEY FK	**US 441**	**GB1**	**07/29/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.563333	-83.309722	2-79-55-12-(11)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr, HQW	19.6	2254	12	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.8
Dissolved Oxygen (mg/L)	6.1
Specific Conductance (µS/cm)	15
pH (s.u.)	6.0

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	15
Pool Variety (10)	8
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	95

Site Photograph

Substrate a mix of boulder, cobble, and gravel with some bedrock and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/29/09	10694	86	48	2.50	1.70	Excellent
08/03/04	9479	79	47	2.61	2.02	Excellent
07/22/99	7935	67	39	2.58	1.75	Excellent
10/12/95	6981	69	42	1.95	1.40	Excellent
09/01/94	6682	---	31	---	1.27	Good

Taxonomic Analysis

The highest EPT richness and total taxa richness (ST) ever measured in this stream occurred in 2009. Increases in Plecoptera and Trichoptera over previous samples were partly responsible for these increases and almost all taxa observed were intolerant or facultative species. One mayfly observed *Epeorus subpallidus* , has never before been identified from this stream and is in fact only the 4th record of this species in NC. Of the EPT collected during this sampling event, the mayfly *Leptophlebia spp* , the uncommon stonefly *Agnetina capitata* , and the caddisflies *Ceraclea flava* and *Fatiggia pele* were also not collected prior to 2009.

Data Analysis

Bradley Fork, a tributary to the Oconaluftee River, is located within Great Smoky Mountain National Park and as such has a completely undeveloped and forested watershed. This stream has high recreational usage among the public as it lies next to a campground just inside the park border. The 2009 sample produced a very low biotic index of 2.50, which is the lowest biotic index recorded for a basinwide sample at this site since sampling began in 1994. In addition, richness values for both total taxa and EPT have increased in the last ten years. These metrics indicate a stream with very high water quality and is consistent with an all forested and protected watershed. Bradley Fork received an Excellent bioclassification for the third straight basinwide cycle and the fourth straight sampling event.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
OCONALUFTEE R	**SR 1359**	**GB11**	**07/27/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.461389	-83.353611	2-79-55-(16.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	284.0	1842	45	0.4

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	30	50	---	20 (road)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	23.2
Dissolved Oxygen (mg/L)	6.0
Specific Conductance (µS/cm)	21
pH (s.u.)	8.2
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	6
Riffle Habitat (16)	12
Bank Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	4
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	73

Site Photograph

Substrate Cobble and gravel with some boulder and sand, silty at times

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/27/09	10695	98	47	4.07	3.11	Excellent
08/05/04	9485	106	51	3.95	2.97	Excellent
07/22/99	7934	104	53	3.93	3.20	Excellent
07/14/94	6590	86	46	4.05	2.99	Excellent
07/26/89	5029	88	47	4.13	3.22	Excellent

Taxonomic Analysis

A varied EPT community resides in this river although over the last ten years the fauna has become less rich. The reduction in EPT is exhibited in the loss of some baetid mayfly taxa such as *Acentrella* and *Plauditus* and in the loss of the hydropsychid caddisfly taxa *Diplectrona modesta* and *Hydropsyche morosa* although, overall, hydropsychids were the dominant group in the river. Both the stonefly community composition and richness were maintained from prior years with the exception of the loss of *Agnetina,* which was not found for the first time in 15 years of sampling. Taxa collected in 2009 that have never before been collected from this site included the mayfly *Heterocloeon anoka* and the caddisflies *Micrasema bennetti* and *Glossossoma nigrior* .

Data Analysis

The Oconaluftee River, a large tributary to the Tuckasegee River, drains the eastern portion of Great Smoky Mountain National Park. The lower segment of this river is tracked on both sides by roads (including US 19) and receives large amounts of urban runoff from Cherokee. High development pressures have introduced sediments into the river and removed large amounts of riparian vegetation. *Podostemum ceratophylum* was extremely abundant and retained sand and silt which were subsequently released during sampling resulting in large plumes of turbid water. Substrates were also partially embedded although not completely so. Despite a lower EPT richness relative to prior samplings, EPT abundance (282) was the highest ever recorded

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	**W DEEP CR RD**	**GB5**	**08/06/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010203	35.466111	-83.431111	2-79-63-(16)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
WS-II, B; Tr, HQW	40	1815	14	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	80	---	---	---	20

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	19.5
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	14
pH (s.u.)	4.8
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	5
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	91

Site Photograph

Substrate mix of cobble (35), boulder (30), and gravel (25); some sand (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/10	11093	---	45	---	2.33	Excellent
08/02/04	9410	---	43	---	1.79	Excellent
08/09/99	7954	---	47	---	2.09	Excellent
07/11/94	6579	---	41	---	1.93	Excellent

Taxonomic Analysis

The second highest EPT richness ever measured in this stream occurred in 2010. Increases in Ephemeroptera over previous samples were partly responsible and almost all taxa observed were intolerant or facultative species. One mayfly collected, *Acentrella barbarae,* originally described from GSMNP, has been recorded only seven times in NC, almost all of the records from park streams. EPT collected from this stream for the first time included the baetid mayfly *Pseudocloeon propinquum* , the uncommon stone *Agnetina capitata* , and *Triaenodes ignitus,* the only long-horned caddisfly found (other leptocerid taxa previously collected in Deep creek were absent in 2010).

Data Analysis

This site on Deep Creek, a tributary to the Little Tennessee River, is located at a campground within Great Smoky Mountain National Park and as such has a mostly forested watershed. This beautiful stream has high recreational usage among the public and is popular as a tubing spot. The very low EPT BI of 2.33, which is the highest yet recorded for a basinwide sample at this site, is indicative of a very intolerant EPT community. Also, EPT richness is second only to that recorded in 1999. Habitat was very good although the lack of large pools is characterized by the presence of one continuous riffle. These metrics indicate a stream with very high water quality. Deep Creek has maintained an Excellent rating for the last 20 years.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
DEEP CR	**SR 1340**	**GB7**	**08/06/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010203	35.442500	-83.440278	2-79-63-(21)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
B; Tr	43	1750	13	0.4

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	---	70	30	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	20.1
Dissolved Oxygen (mg/L)	7.7
Specific Conductance (µS/cm)	15
pH (s.u.)	5.5

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	16
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	83

Site Photograph

Substrate mix of cobble (30), boulder (20), gravel (20), sand (20); silty (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/06/10	11094	---	49	---	2.26	Excellent
08/02/04	9452	---	38	---	1.73	Excellent
08/09/99	7955	---	45	---	2.36	Excellent
07/11/94	6578	---	50	---	2.11	Excellent

Taxonomic Analysis

Gains seen in EPT richness between the 2004 and 2010 basinwide samplings were driven by increases in both mayflies (+7) and caddisflies (+4) while stoneflies remained stable. The increase in mayflies was driven by an surge in baetid richness and included the first Deep Creek record of *Heterocloeon* spp. and *Acentrella nadineae* . The appearance of the mayflies *Baetisca* spp and *Ephemera* spp in 2010 and the absence of both *Epeorus vitreus* and *Rhithrogena exilis* , after 15 years of abundance, may be attributable to additional sediment inputs into the stream. Stoneflies were dominated by perlids and the rare *Agnetina capitata* was collected. The caddisfly community was notable for the absence of *Brachycentrus spinae* which had been abundant in the three previous basinwide samples and the addition of *Hydatophylax argus* (1st Deep Cr. record) and *Oligostomis pardalis* (1st Deep Cr. record), two caddisflies that prefer slower, less turbulent waters.

Data Analysis

The SR 1340 sampling site on Deep Creek is approximately 3 miles below the site in GSMNP and drains the east-central portion of the park. EPT levels in 2010 rebounded from a twenty year low to the second highest richness recorded. Additionally, the EPT BI, while not the lowest recorded at this site, indicates a very intolerant EPT community resides here. As evidenced by the specific conductance measured, little impact can be seen from the 3 miles of commercial, agricultural, and residential properties between this reach and the upstream park reach. While less available habitat is present for colonization and more silt occurs in-stream than the park reach (most likely due to the agriculture), the additional sediment input and habitat deficiencies are not severe enough to affect the EPT fauna dramatically. Deep Creek at SR 1340 maintains it's excellent water quality for 2010. It is recommended that this site be dropped from Basinwide rotation as further upstream development seems unlikely.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
NOLAND CR	**NR MOUTH**	**GB6**	**07/28/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010203	35.454167	-83.527778	2-90	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr	20	1780	6	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	---	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	21.2
Dissolved Oxygen (mg/L)	8.1
Specific Conductance (µS/cm)	12
pH (s.u.)	4.7

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	14
Pool Variety (10)	9
Riffle Habitat (16)	15
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	96

Site Photograph

Substrate	mix of cobble (35), boulder (30), and gravel (25), some sand (10)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/10	11092	45	45	1.31	1.31	Excellent
08/03/04	9454	35	35	1.57	1.57	Good
08/11/99	7966	40	40	1.63	1.63	Excellent

Taxonomic Analysis

Sampling in 2010 resulted in the highest yet recorded EPT richness in Noland Creek. An dramatic increase was seen in in caddisfly richness (+9) over that which was collected in 2004. Also, the EPT BI decreased for the second straight cycle time due in part to the presence of some very intolerant species of caddisflies that were not previously collected, including the uncommon *Rhyacophila acutiloba and Neophylax mitchelli.* The highest richness of Plecoptera was observed in 2010 with eight taxa collected with the majority of taxa abundant. New taxa occuring in 2010 included the rarely collected mayflies *Epeorus subpallidus* and *Acentrella barbarae,* which was described from GSMNP in 2006. The caddisfly *Molanna* spp was also previously unrecorded from Noland Creek.

Data Analysis

Noland Creek lies within the southcentral portion Great Smoky Mountain National Park and drains into Fontana Lake. It is an undeveloped and forested watershed. The habitat of Noland Creek is exceptional and consists of a series of cascades, riffles, and pools. The 2010 EPT BI is the lowest recorded in the entire LTN basin during the current basinwide cycle, even among other GSMNP sites. The EPT richness for 2010 is also the highest yet seen at this site. These metrics, coupled with the low specific conductance, indicate the very stable and intolerant benthic community one would expect from a stream with little to no anthropogenic disturbance. The low pH is partially attributable to the Anakeesta soils that are interspersed throughout the park. Noland Creek rates Excellent for the second time in 11 years.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
FORNEY CR	NR MOUTH	GB4	07/28/09	Excellent

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
Swain	2	06010203	35.468611	-83.566111	2-97	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; Tr, ORW	28.0	1788	10	0.5

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	10
pH (s.u.)	6.2

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	10
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	95

Site Photograph

Substrate Boulder and cobble with some bedrock and gravel, very little silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10697	81	52	2.47	1.64	Excellent
08/03/04	9455	78	44	2.62	1.80	Excellent
08/11/99	7965	81	46	2.59	1.58	Excellent
07/12/94	6581	79	46	2.43	1.49	Excellent

Taxonomic Analysis

Sampling in 2009 resulted in the highest yet recorded EPT richness in Forney Creek. An increase was seen in each EPT order over that which was collected in 2004. In addition, the EPTBI decreased to pre 2004 levels due in part to three species of the intolerant mayfly *Drunella* and four species of the intolerant caddisfly *Rhyacophila* . The highest richness of Plecoptera was observed in 2009 with 10 taxa collected with the majority of taxa either common or abundant, including the rarely collected stonefly *Agnetina capitata.* New taxa occurring in 2009 included only the 3rd NC record of the mayfly *Epeorus subpallidus* and the 4th NC record of mayfly *Acentrella barbarae,* which was described from Great Smoky Mountain National Park (GSMNP) in 2006. The caddisflies *Hetroplectron americanum* , *Phylocentropus spp* , and *Ceraclea flava* were also previously unrecorded from Forney Creek. Only 14 Chironomidae taxa were collected in 2009.

Data Analysis

Forney Creek lies within and drains the south-central portion of GSMNP into Fontana Lake. It is an entirely undeveloped and forested watershed. The habitat of this stream is as expected for a stream in a natural setting and consists of a series of riffles, cascades, and pools with excellent riparian zones. The biotic index and EPTBI has remained low with little variation and total taxa richness has likewise varied little over the last 15 years. These metrics, coupled with a high EPT richness, indicate the very stable benthic community one would expect for a stream whose catchment is completely encompassed within the GSMNP.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CANEY FK	SR 1738	04/27/09	GF4	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.30472222	-83.13777778	2-79-28-(2.5)	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III,Tr	50.2	2170	14	0.6	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	80	0	20	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	18.8
Dissolved Oxygen (mg/L)	8.5
Specific Conductance (µS/cm)	19
pH (s.u.)	5.9

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	6
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	3
Light Penetration (10)	4
Left Riparian Score (5)	3
Right Riparian Score (5)	2
Total Habitat Score (100)	**78**

Site Photograph

Substrate Cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/09	2009-17	15	52	Good
06/01/04	2004-62	16	56	Good

Most Abundant Species 2009 Mottled Sculpin (53%)

Exotic Species 2009 None

Species Change Since Last Cycle

Losses -- Tuckasegee Darter, Black Redhorse, Rainbow Trout. **Gains** -- Mirror Shiner, Western Blacknose Dace. All species gained or lost were represented by 1-4 individuals/species; Rainbow Trout represented only by young-of-year and excluded from the sample.

Data Analysis

Watershed -- located in east-central Jackson County where it drains the Great Balsam Mountains; tributary to the Tuckasegee River; no municipalities within the watershed. **Habitat** -- lower one-third of the reach has hay field and a road along its right and left shorelines, respectively, but is protected further upstream by a narrow forested buffer; narrow riparian zones provide minimal shading; instream habitats consist of riffles, runs, and chutes with good side pools. **Water Quality** -- pH in 2004 and 2009 slightly less than the water quality standard of 6.0 s.u.; specific conductance in 2004 and 2009 was 21 and 19 µS/cm, respectively. **2009** -- slightly lower total species and darter diversities than expected; all other metric scores were comparable to reference site values (i.e., score = 5). **2004 & 2009** -- 18 species known from the site, including 9 species of cyprinids, 4 intolerant species, but only 3 species of darters, and the Smoky Dace (Special Concern); dominant species is the Mottled Sculpin (37% and 53%); no tolerant species have ever been collected at the site; no evidence of reproducing populations of trout at this lowermost site; no appreciable change in the fish community, instream and riparian habitats, or water quality between assessment periods.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
CULLOWHEE CR	**SR 1545**	**04/27/09**	**GF13**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.29666667	-83.18111111	2-79-31a	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	19.5	2110	10	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	75	0	0	25 (school yard)

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	12.1
Dissolved Oxygen (mg/L)	8.9
Specific Conductance (µS/cm)	30
pH (s.u.)	6.2

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	11
Pool Variety (10)	10
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	5
Light Penetration (10)	5
Left Riparian Score (5)	3
Right Riparian Score (5)	5
Total Habitat Score (100)	**85**

Site Photograph

Substrate Cobble, gravel, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/27/09	2009-16	17	50	Good
06/02/04	2004-63	16	46	Good-Fair

Most Abundant Species 2009 Mottled Sculpin (60%)

Exotic Species 2009 Brown Trout, Rainbow Trout

Species Change Since Last Cycle **Losses** -- none. **Gains** -- Tuckasegee Darter, 1 individual.

Data Analysis

Watershed -- drains southwestern Jackson County; tributary to the Tuckasegee River; no municipalities in the upstream watershed. **Water Quality** -- specific conductance in 2004 and 2009 was 33 and 30 µS/cm, respectively. **Habitat** -- higher quality riffles than in 2004; increased left bank stability and quality of the riparian zone has improved since 2004 by becoming more stable and densely vegetated; fairly open canopy; debris dams trapping much of the finer sediments in the upper one-third of the reach; instream habitats of riffles, runs, and deep snag pools. **2009** -- ~ 1.7 times more fish collected in 2009 than in 2004 (648 *vs.* 391), primarily Mottled Sculpin (387 *vs.* 190); very slight increase in darter diversity and a lower percentage of tolerant fish were the reasons for the slight increase in the NCIBI score and rating; Hatchery Supported Trout waters, one stocked Brook Trout collected (360 mm TL), all other Brown Trout and Rainbow Trout were wild; slightly lower cyprinid and darter diversities and percentage of omnivores+herbivores than expected; all other metric scores were comparable to reference site values (i.e., score = 5). **2004 & 2009** -- 17 species known from the site, including 7 species of cyprinids, but only 2 species of darters; dominant species is the cold-cool water indicator Mottled Sculpin (49% and 60%); stream is supporting its supplemental designation as trout waters (Tr). No appreciable change in fish community or water quality between assessment periods.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SAVANNAH CR	**NC 116**	**04/28/09**	**GF23**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
JACKSON	2	06010203	35.3375	-83.23694444	2-79-36	Southern Crystaline Ridges & Mtns.

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	36.5	2025	11	0.6	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	50	25	25	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	12.1
Dissolved Oxygen (mg/L)	10.2
Specific Conductance (µS/cm)	29
pH (s.u.)	5.4

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	3
Instream Habitat (20)	18
Bottom Substrate (15)	12
Pool Variety (10)	6
Riffle Habitat (16)	15
Erosion (7)	4
Bank Vegetation (7)	3
Light Penetration (10)	4
Left Riparian Score (5)	1
Right Riparian Score (5)	2
Total Habitat Score (100)	**68**

Site Photograph

Substrate Cobble, boulder, rip/rap

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/09	2009-18	18	58	Excellent
06/02/04	2004-64	15	50	Good

Most Abundant Species 2009 Mottled Sculpin (36%)

Exotic Species 2009 Brown Trout, Rainbow Trout

Species Change Since Last Cycle

Losses -- none. **Gains** -- White Sucker, Brown Trout, Smallmouth Bass. All species gained were represented by 1 or 2 individuals/species.

Data Analysis

Watershed -- drains northwestern Jackson County, paralleling much of NC 116 and US 23/441 all the way to the creek's headwaters; no municipalities within the watershed; tributary to the Tuckasegee River. **Habitat** -- same as in 2004; minimal canopy; the riparian zones were in pasture, and an attempt had been made to stabilize portions of the banks with rip/rap and concrete slabs; swift & deep riffles, chutes, runs, and plunges. **Water Quality** -- pH in 2009 was less than the water quality standard of 6.0 s.u.; specific conductance in 2004 and 2009 was 28/29 µS/cm. **2009** -- although the creek is not Hatchery Supported Trout Waters in its lower reaches, one stocked Brown Trout (275 mm TL) was collected; all other Brown Trout and Rainbow Trout were wild; increased diversity and a slightly more balanced trophic structure in 2009 accounted for its Excellent rating. **2004 & 2009** -- 18 species known from the site, including 8 species of cyprinids and 4 intolerant species, but only 2 species of darters; dominant species is the Mottled Sculpin (39% and 36%); only one tolerant fish (White Sucker) has ever been collected at the site; no evidence of reproducing populations of trout at this lowermost site.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TWENTY MILE CR	**NC 28**	**GB2**	**08/05/10**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
SWAIN	2	06010204	35.466944	-83.877500	2-178-(4)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C; TR, HQW	15	1300	9	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	100	---	---	---	---

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	22.5
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	13
pH (s.u.)	5.3

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	20
Bottom Substrate (15)	14
Pool Variety (10)	9
Riffle Habitat (16)	15
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	96

Site Photograph

Substrate mostly cobble (35), boulder (25) and gravel (25)

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
08/05/10	11091	---	41	---	2.06	Excellent
08/04/04	9459	---	29	---	1.82	Good

Taxonomic Analysis

A total increase of 12 EPT was recorded in 2010 over 2004 sampling results. All three orders saw an increase in richness but the caddisflies increased the most (E - 4, P - 2, T - 6). Additions to the caddisflies were 4 net-spinning species and included the relatively uncommon *Ceratopsyche macleodi.* Additional caddisfly taxa recorded included *Ceraclea ancylus* , *Rhyacophila atrata* , and *Goera* spp. Baetid mayflies help contribute to the increase seen in mayfly richness in 2010 and included only the fifth NC record of *Acentrella barbarae* , a mayfly originally described from GSMNP. An increase in the number of flat-headed mayflies was also see with both *Heptagenia marginalis* and *Leucrocuta* spp being collected. The stonefly fauna remained stable from 2009 and included *Perlesta* spp, a stonefly that typically emerges near the end of July.

Data Analysis

Twenty Mile Creek lies within and drains North Carolina's western portion of Great Smoky Mountain National Park (GSMNP) and ultimately joins the Little Tennessee River (Cheoah Reservoir) downstream of Fontana Dam. It has an undeveloped (hiking trails aside) and forested catchment. The habitat of this picturesque stream is as expected for a stream in a natural setting and consists of a series of cascades, riffles, and plunge pools. 2010 marks only the second sampling of this stream. Typical of undisturbed mountain streams, the specific conductance was very low. Also, while the EPT biotic index was higher than in 2004, it still indicates a very intolerant EPT community. Species richness was much higher than in 2004 and may be partially attributed to the presence of woody debris and microhabitat which was mostly absent in 2004. With such a high gradient it is likely that rain events would transport woody debris and further lead to increased scour which would reduce benthic populations. Twenty Mile Creek garnered its first Excellent rating.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
CHEOAH R	OFF SR 1138 UPS MOUNTAIN CR	GB133	07/27/09	Good

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.331944	-83.807778	2-190-(3.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	55.0	1960	12	0.3

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	80	0	0	20

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
Town of Robbinsville WWTP	NC0025879	0.63

Water Quality Parameters

Temperature (°C)	20.8
Dissolved Oxygen (mg/L)	7.0
Specific Conductance (µS/cm)	40
pH (s.u.)	6.3
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	12
Bank Erosion (7)	6
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	4
Right Riparian Score (5)	4
Total Habitat Score (100)	77

Site Photograph

Substrate mixture of bedrock, boulder, rubble, gravel and silt

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/27/09	10779	93	40	4.18	3.17	Good
07/19/04	9437	84	38	3.96	3.15	Good
08/12/99	7969	89	48	3.43	2.77	Excellent

Taxonomic Analysis

Both EPT and overall taxa lists from 1999, 2004 and 2009 were very consistent. Most of the abundant taxa found in 2009 were abundant in previous samples (e.g. the mayflies *Baetis flavistriga* , *B. intercalaris* and *Epeorus vitreus* ; the stoneflies *Lecutra* spp and *Paragnetina immarginata; a* nd the caddisflies *Glossosoma spp* , *Ceratopsyche sparna, Cheumatopsyche spp* and *Dolophilodes spp*).

Data Analysis

This section of the Cheoah River rated Good in 2009, the same rating as in 2004. This site is located in one of only two free-flowing sections of the Cheoah River. There is little evidence that the WWTP is significantly suppressing benthic macroinvertebrates in this reach as a sample upstream of the WWTP did not differ from a downstream sample in 1994. Moreover, approximately half a mile upstream of the 2009 sampling location are two historical sites spanning five samples. These data originate in 1983 and suggest water quality in this reach (both upstream and downstream of the WWTP) is Good and occasionally Excellent.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
TULULA CR	**SR 1275**	**GB22**	**07/28/09**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.320556	-83.802500	2-190-2-(0.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation	Stream Width (m)	Stream Depth (m)
WS-III; Tr	28.6	2000	9	0.2

	Forested/Wetland	Urban	Agriculture	Road	Other (describe)
Visible Landuse (%)	25	50	25	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none		

Water Quality Parameters

Temperature (°C)	18.5
Dissolved Oxygen (mg/L)	7.8
Specific Conductance (µS/cm)	40
pH (s.u.)	6.2

Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	4
Instream Habitat (20)	19
Bottom Substrate (15)	8
Pool Variety (10)	4
Riffle Habitat (16)	16
Bank Erosion (7)	5
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	2
Right Riparian Score (5)	2
Total Habitat Score (100)	73

Site Photograph

Substrate Boulder, cobble, gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10780	88	39	3.77	2.70	Good
07/19/04	9436	60	31	3.23	2.73	Good
08/12/99	7968	85	40	3.57	2.69	Excellent
07/25/94	6615	78	34	3.81	3.01	Good

Taxonomic Analysis

With the exception of the 1999 Excellent bioclassification, the overall trend in the invertebrate data suggest Good water quality in this catchment. Indeed, there are numerous intolerant taxa that have been present from each of the four collections and include the mayflies *Epeorus vitreus* , *Leucrocuta spp* , *Paraleptophlebia spp* , the caddisflies *Brachycentrus spinae* , *Lepidostoma spp* , *Rhyacophila fuscula* , as well as the long-lived stoneflies *Acroneuria abnormis* and *Paragnetina immarginata* .

Data Analysis

In general, the benthic macroinvertebrate data suggest stable and Good to Excellent water quality in this catchment since the initial 1994 collection although the 2009 sample was borderline Excellent and produced the second highest EPTs recorded. Indeed had just one more EPT taxa been collected this site would have received an Excellent bioclassification in 2009.

BENTHIC MACROINVERTEBRATE SAMPLE

Waterbody	Location	Station ID	Date	Bioclassification
SNOWBIRD CR	**SR 1120**	**GB25**	**07/28/09**	**Excellent**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.289167	-83.900278	2-190-9-(15.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Stream Depth (m)
C;Tr	16.9	2220	7	0.2

	Forested/Wetland	Urban	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
none	---	---

Water Quality Parameters

Temperature (°C)	17.6
Dissolved Oxygen (mg/L)	6.9
Specific Conductance (µS/cm)	10
pH (s.u.)	4.9
Water Clarity	clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	13
Pool Variety (10)	9
Riffle Habitat (16)	16
Bank Erosion (7)	7
Bank Vegetation (7)	7
Light Penetration (10)	10
Left Riparian Score (5)	5
Right Riparian Score (5)	5
Total Habitat Score (100)	96

Site Photograph

Substrate mostly boulder and rubble with some gravel and sand

Sample Date	Sample ID	ST	EPT	BI	EPT BI	Bioclassification
07/28/09	10781	---	52	---	2.13	Excellent
07/20/04	9442	---	48	---	2.06	Excellent
08/12/99	7970	---	52	---	2.57	Excellent
06/20/90	5320	---	49	---	1.80	Excellent

Taxonomic Analysis

A diverse and pollution intolerant EPT community continues to populate Snowbird Creek. Overall there has been little change in the benthic community composition from the first sample collected here, in 1990. However, two noticeable differences in this years sample were the absences of the caddisfly *Ceratopsyche sparna* (abundant in 1990, 1999 and 2004) and the mayfly *Maccaffertium ithaca* (abundant in 1990, common in 1999, 2004). Nevertheless, Snowbird Creek contains several highly pollution sensitive taxa such as the caddisflies *Apatania* spp, *Ceratopsyche alhedra* and the mayflies *Ephmerella crenula* and *Drunella allegheniensis* .

Data Analysis

Snowbird Creek rated Excellent in 2009, the same rating it received in each of its three prior samples. The very consistent Excellent bioclassifications are indicative of the minimally disturbed forested watershed present here.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
TULULA CR	**SR 1260**	**04/29/09**	**GF29**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.30722222	-83.79444444	2-190-2-(0.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III,Tr	27.4	2035	11	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	80	10	10	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	14.5
Dissolved Oxygen (mg/L)	10.1
Specific Conductance (µS/cm)	25
pH (s.u.)	5.6

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	13
Pool Variety (10)	8
Riffle Habitat (16)	16
Erosion (7)	4
Bank Vegetation (7)	6
Light Penetration (10)	7
Left Riparian Score (5)	5
Right Riparian Score (5)	3
Total Habitat Score (100)	**85**

Site Photograph

Substrate Cobble, boulder, bedrock

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/09	2009-22	15	48	Good
06/04/04	2004-69	14	46	Good-Fair

Most Abundant Species 2009 Central Stoneroller (36%)

Exotic Species 2009 Rainbow Trout, Redbreast Sunfish

Species Change Since Last Cycle

Gains -- Black Redhorse, Redbreast Sunfish, Bluegill. **Losses** -- Creek Chub, Tangerine Darter. All species gained or lost were represented by 1 or 2 individuals/species.

Data Analysis

Watershed -- drains the southeastern corner of Graham County; US 129 and a railroad parallel the creek throughout its length. **Habitats** -- slick rocks, plunge pools in mid-channel, bluegreen algal mats covering many of the rocks; most of the habitats were of high quality, except at the upper reach along the right shoreline where there was no canopy and the riparian zone was a manicured residential lawn. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. in 2004 and 2009. **2009** -- total species richness was slightly lower than expected, especially among darters (n= 2) and minnows (n=6); very slight decline in the percentage of omnivores+herbivores from 51% to 49%) resulted in the very slight increase in NCIBI score and rating; Hatchery Supported Trout Waters, four stocked Brook Trout collected (200-291 mm TL); Rainbow Trout were all wild (n=28). **2004 & 2009** -- the presence of bluegreen algal mats and the percentages of omnivores+herbivores (i.e., Central Stoneroller and River Chub) which were much greater than expected continued to indicate possible upstream straight-piping or nonpoint-source erosion contributions of nutrients; 17 species known from the site including 7 species of minnows and 3 species of darters; dominant species have been Central Stoneroller (31% and 36%) and Mottled Sculpin (24% and 26%); stream is supporting its supplemental designation as trout waters (Tr).

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
SWEETWATER CR	**SR 1214**	**04/29/09**	**GF36**	**Good**

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.324966	-83.79335	2-190-3-(0.5)	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
WS-III;Tr	13.6	1995	7	0.5	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	40	10	50	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	13.4
Dissolved Oxygen (mg/L)	10.0
Specific Conductance (µS/cm)	32
pH (s.u.)	5.8

Water Clarity	Clear

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	19
Bottom Substrate (15)	10
Pool Variety (10)	8
Riffle Habitat (16)	16
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	9
Left Riparian Score (5)	5
Right Riparian Score (5)	4
Total Habitat Score (100)	**89**

Site Photograph

Substrate Bedrock shelves, cobble, boulder

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/29/09	2009-21	13	52	Good

Most Abundant Species 2009 Mottled Sculpin (34%)

Exotic Species 2009 Rainbow Trout

Species Change Since Last Cycle **N/A**

Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains east-central Graham County; NC 143 parallels much of the creek; no municipalities within the watershed; tributary to the Cheoah River. **Habitats** -- ledges and plunge pools, riffles, runs, poor quality riparian zones in terms of invasive plants and trash from the highway; swift flow and slippery rocks. **Water Quality** -- pH less than the water quality standard of 6.0 s.u. **2009** -- total species richness was slightly lower than expected, especially among darters (n=2) and minnows (n=7); other abundant species included River Chub (20%) and Central Stoneroller (16%); very low percentage of tolerant fish (1%); intolerant species included Rainbow Trout, Rock Bass, and Greenfin Darter; stream is supporting its supplemental designation as trout waters (Tr); and water quality is generally Good.

FISH COMMUNITY SAMPLE

Waterbody	Location	Date	Station ID	Bioclassification
YELLOW CR	SR 1242	04/28/09	GF37	Not Rated

County	Subbasin	8 digit HUC	Latitude	Longitude	AU Number	Level IV Ecoregion
GRAHAM	4	06010204	35.417284	-83.874636	2-190-29	Southern Metasedimentary Mountains

Stream Classification	Drainage Area (mi2)	Elevation (ft)	Stream Width (m)	Average Depth (m)	Reference Site
C;Tr	12.7	1830	6	0.4	No

	Forested/Wetland	Rural Residential	Agriculture	Other (describe)
Visible Landuse (%)	100	0	0	0

Upstream NPDES Dischargers (>1MGD or <1MGD and within 1 mile)	NPDES Number	Volume (MGD)
None	---	---

Water Quality Parameters

Temperature (°C)	16.2
Dissolved Oxygen (mg/L)	9.1
Specific Conductance (µS/cm)	19
pH (s.u.)	5.6

Water Clarity	Clear, tannin stained

Habitat Assessment Scores (max)

Channel Modification (5)	5
Instream Habitat (20)	18
Bottom Substrate (15)	8
Pool Variety (10)	6
Riffle Habitat (16)	10
Erosion (7)	7
Bank Vegetation (7)	6
Light Penetration (10)	10
Left Riparian Score (5)	4
Right Riparian Score (5)	5
Total Habitat Score (100)	**79**

Site Photograph

Substrate Sand, cobble, gravel, bedrock, silt

Sample Date	Sample ID	Species Total	NCIBI	Bioclassification
04/28/09	2009-20	6	---	Not Rated

Most Abundant Species 2009 Creek Chub (46%)

Exotic Species 2009 Rainbow Trout, Brown Trout

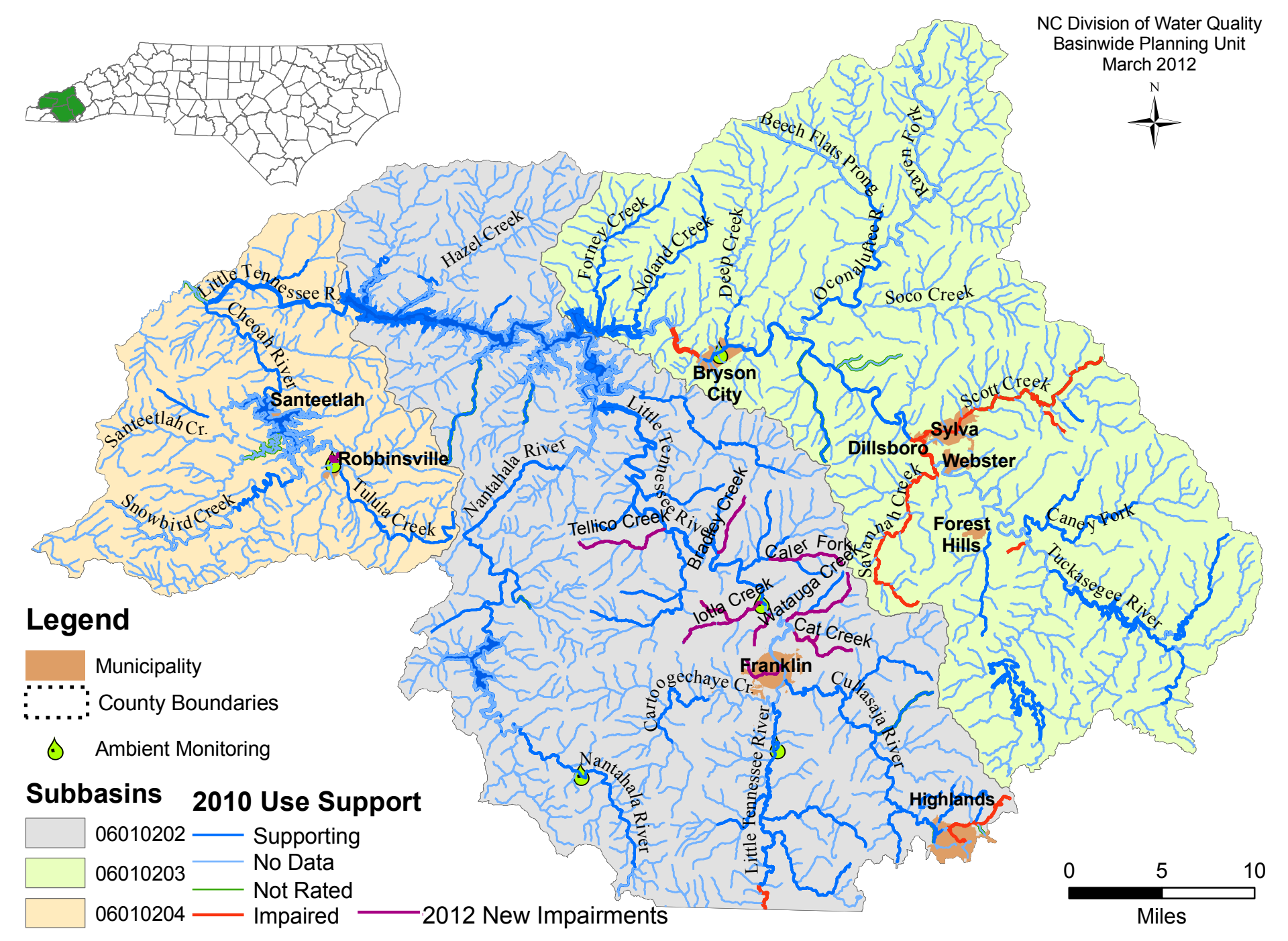
Species Change Since Last Cycle **N/A**

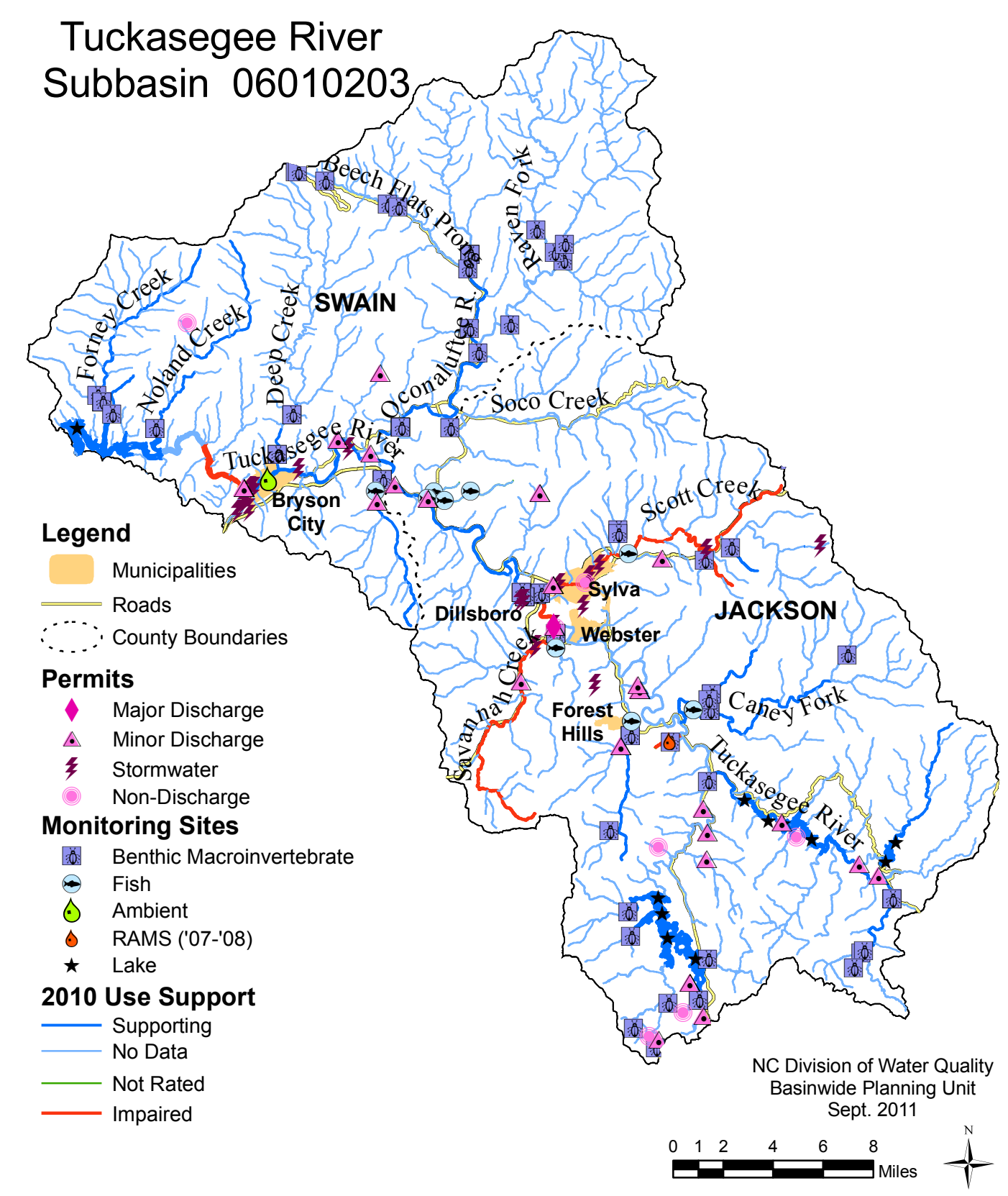
Data Analysis

This is the first fish community sample collected at this site. **Watershed** -- drains northern Graham County; no municipalities within the watershed; tributary to the by-passed reach of the Cheoah River between its confluence with Calderwood Lake and Lake Santeetlah. **Habitats** -- Sand Hills-like with tannin stained water, a substrate primarily of sand, wide forested riparian zones of American Holly and Mountain Laurel, and *Fissidens* common on coarse woody debris; side pools, runs, and riffles; gradient changes dramatically ~ 0.5 miles below the site with steeper gradients and waterfalls. **Water Quality** -- low conductivity; pH less than the water quality standard of 6.0 s.u. **2009** -- naturally depauperate (species diversity and abundance) community; fewest fish collected than at any other site in 2009 (n=186); Mottled Sculpin and darters absent; Hatchery Supported Trout Waters; no reproducing populations of trout were found, but no evidence of water quality impairment.

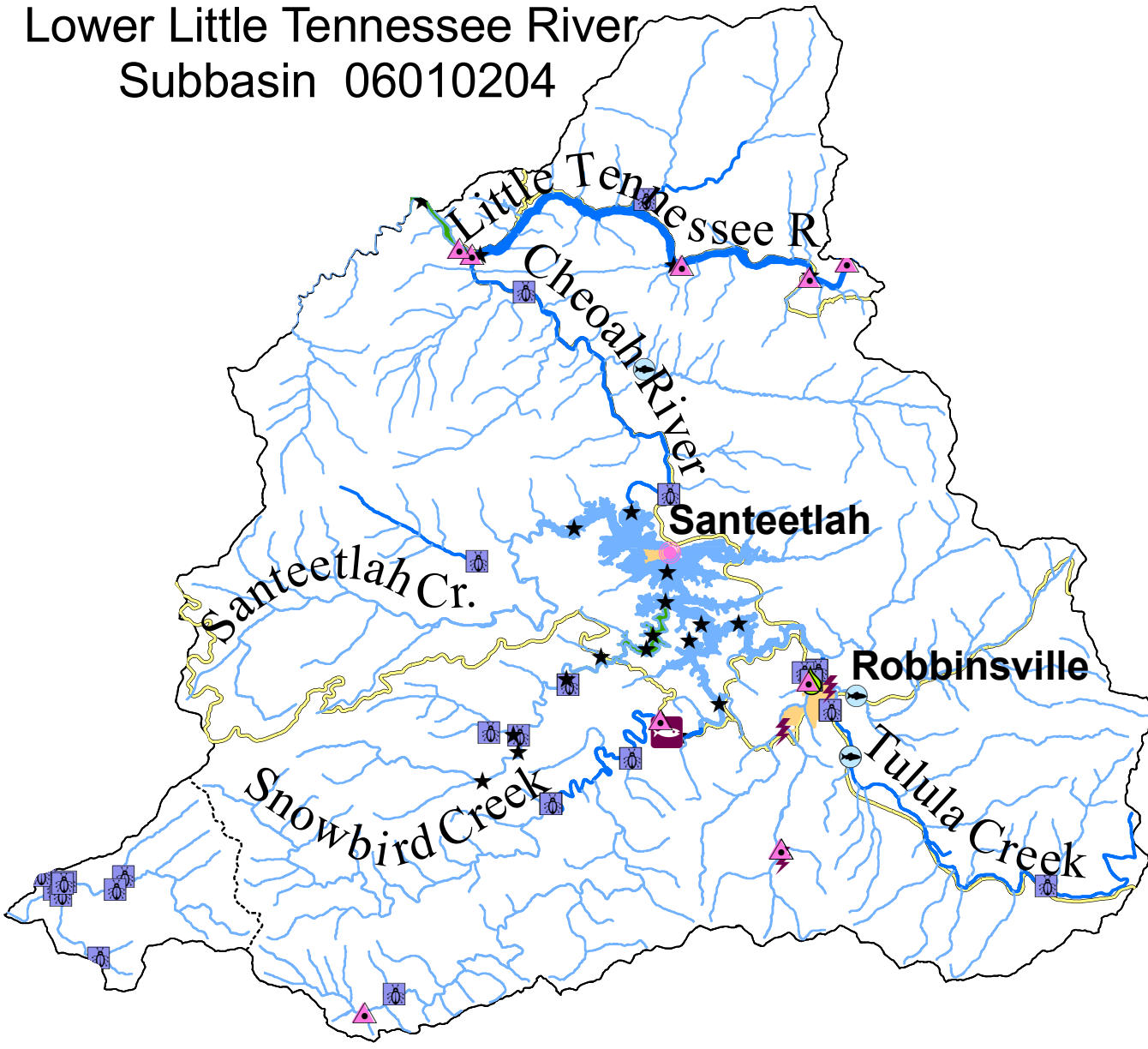
Appendix 1C

Maps


NC Division of Water Quality
Basinwide Planning Unit
March 2012
N
Little Tennessee R.
Cheoah River
Hazel Creek
Forney Creek
Noland Creek
Deep Creek
Beech Flats Prong
Raven Fork
Oconaluftee R.
Soco Creek
Santeetlah
Santeetlah Cr.
Robbinsville
Snowbird Creek
Tulula Creek
Nantahala River
Little Tennessee River
Bryson City
Scott Creek
Sylva
Dillsboro
Webster
Forest Hills
Savannah Creek
Caney Fork
Tuckasegee River
Tellico Creek
Bradley Creek
Caler Fork
Watauga Creek
Iotla Creek
Cat Creek
Franklin
Cartoogechaye Cr.
Cullasaja River
Nantahala River
Little Tennessee River
Highlands
Legend
Municipality
County Boundaries
Ambient Monitoring
Subbasins
06010202
06010203
06010204
2010 Use Support
Supporting
No Data
Not Rated
Impaired
2012 New Impairments
0
5
10
Miles


Tuckasegee River
Subbasin 06010203
Beech Flats Prong
Raven Fork
Forney Creek
Noland Creek
Deep Creek
SWAIN
Oconaluftee R.
Soco Creek
Tuckasegee River
Bryson City
Scott Creek
Sylva
Dillsboro
Webster
JACKSON
Savannah Creek
Forest Hills
Caney Fork
Tuckasegee River
Legend
Municipalities
Roads
County Boundaries
Permits
Major Discharge
Minor Discharge
Stormwater
Non-Discharge
Monitoring Sites
Benthic Macroinvertebrate
Fish
Ambient
RAMS ('07-'08)
Lake
2010 Use Support
Supporting
No Data
Not Rated
Impaired
NC Division of Water Quality
Basinwide Planning Unit
Sept. 2011
0 1 2 4 6 8
Miles
N

Lower Little Tennessee River Subbasin 06010204



Legend

- Municipalities
- Roads
- County Boundaries

Permits

- Aquaculture
- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake

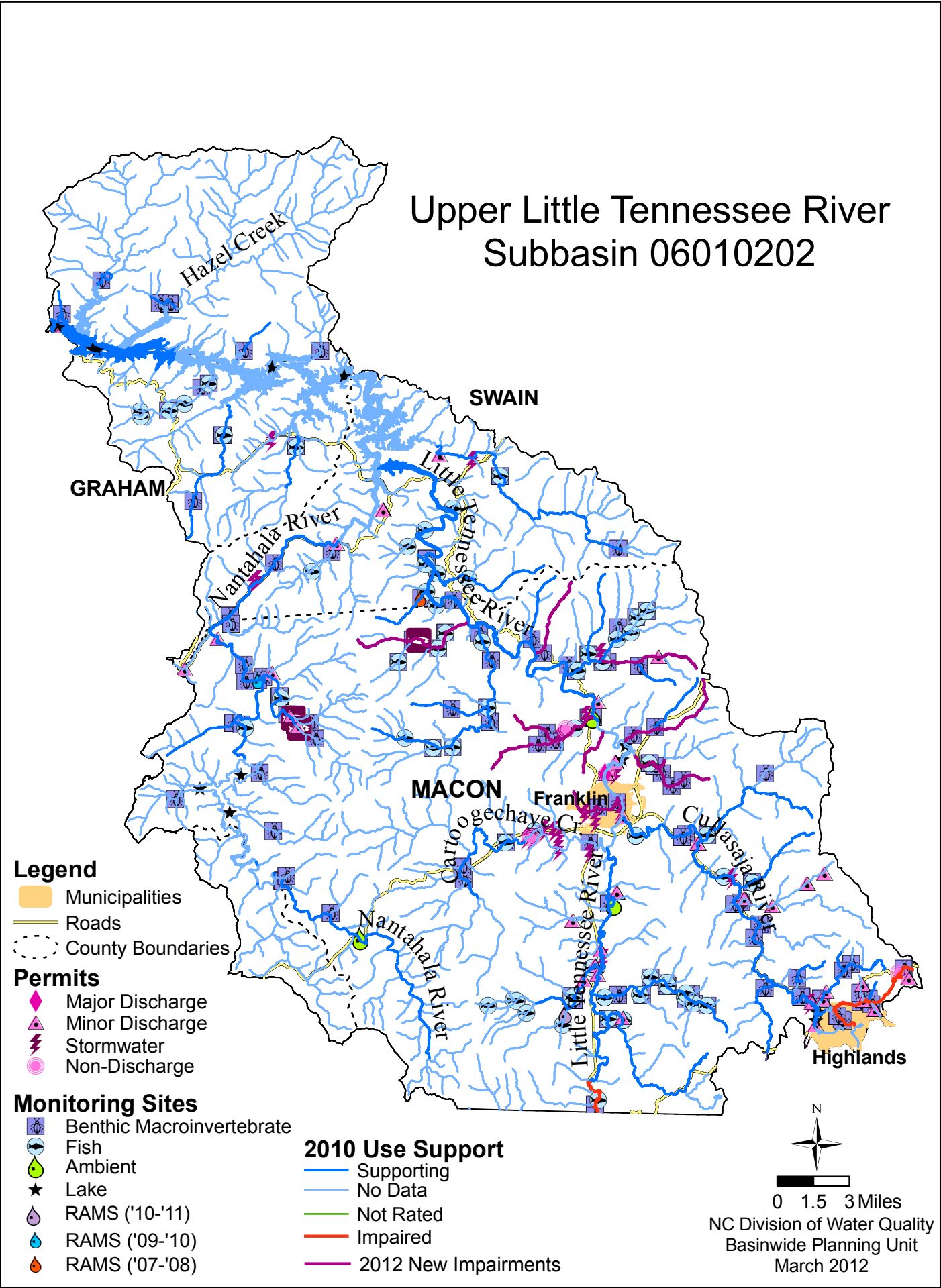
2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

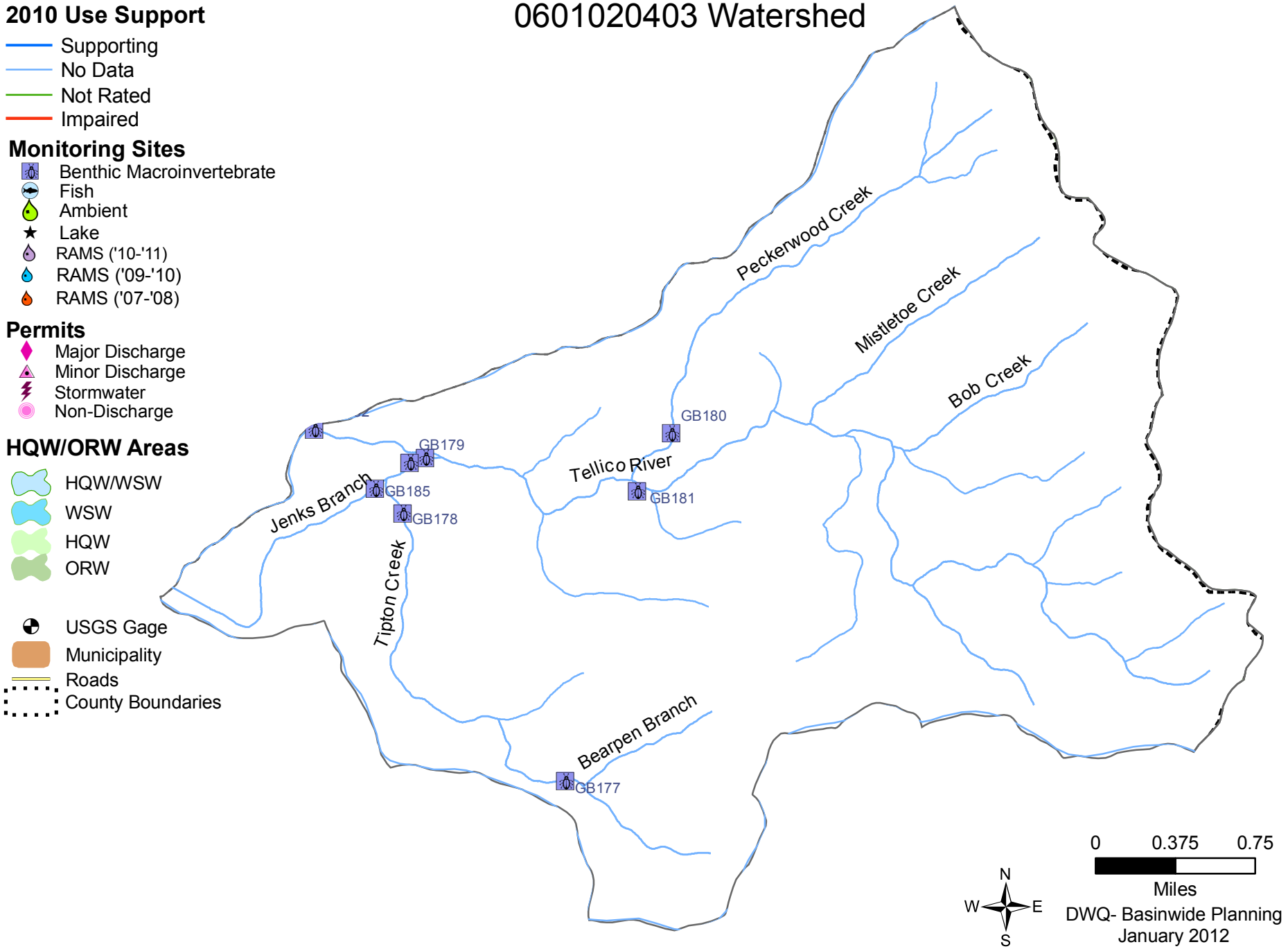
N

0 1 2 4

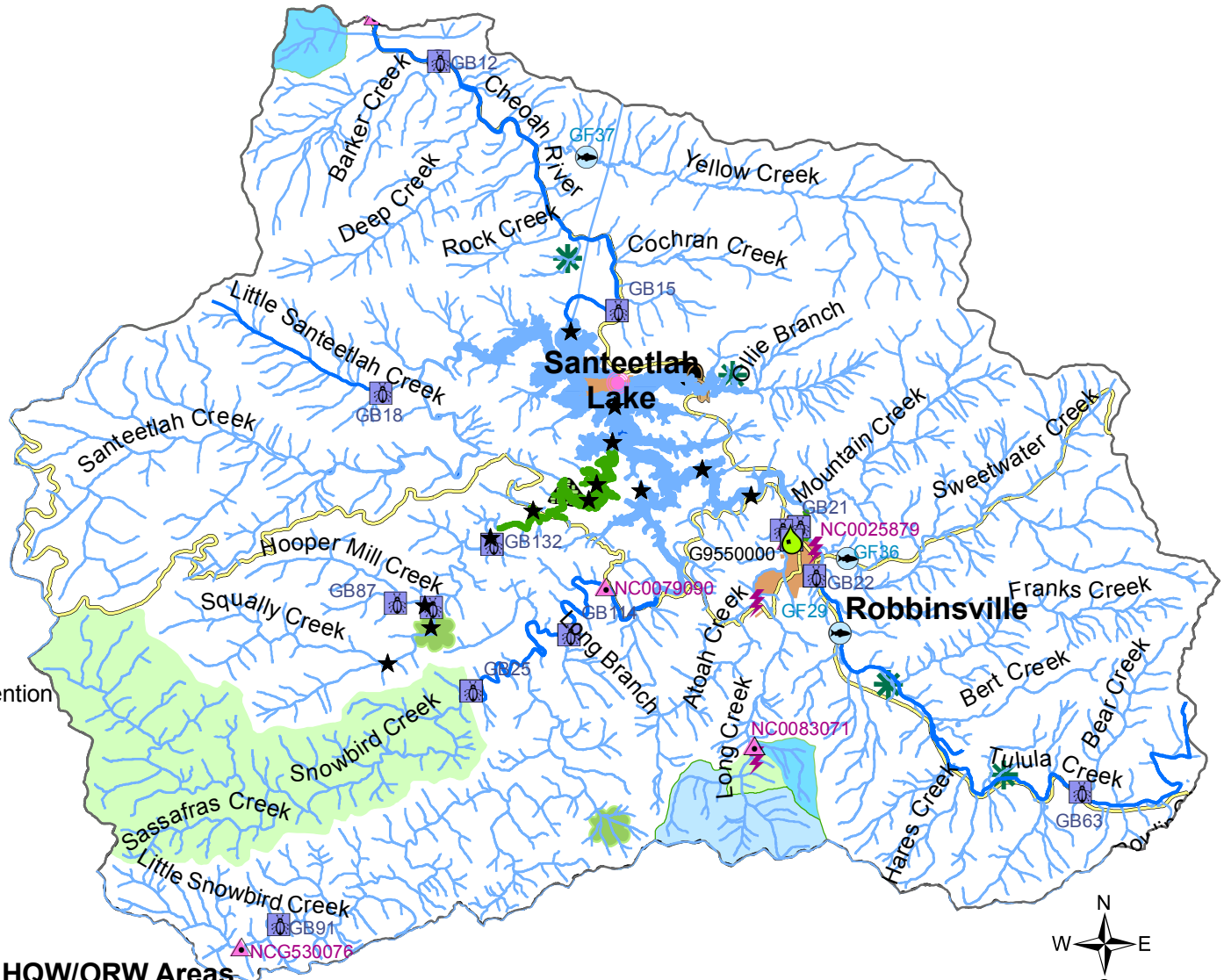
Miles


Upper Little Tennessee River
Subbasin 06010202
Hazel Creek
SWAIN
GRAHAM
Nantahala River
Little Tennessee River
MACON
Franklin
Cartoogechaye Cr
Cullasaja River
Nantahala River
Little Tennessee River
Highlands
Legend
Municipalities
Roads
County Boundaries
Permits
Major Discharge
Minor Discharge
Stormwater
Non-Discharge
Monitoring Sites
Benthic Macroinvertebrate
Fish
Ambient
Lake
RAMS ('10-'11)
RAMS ('09-'10)
RAMS ('07-'08)
2010 Use Support
Supporting
No Data
Not Rated
Impaired
2012 New Impairments
N
0 1.5 3 Miles
NC Division of Water Quality
Basinwide Planning Unit
March 2012

0601020403 Watershed



0601020401 Watershed



2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

Permits

- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

- USGS Gage
- Municipality
- Roads
- County Boundaries

Ag-Cost Share BMPs

- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

CWMTF Projects

- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

HQW/ORW Areas

- HQW/WSW
- WSW
- HQW
- ORW

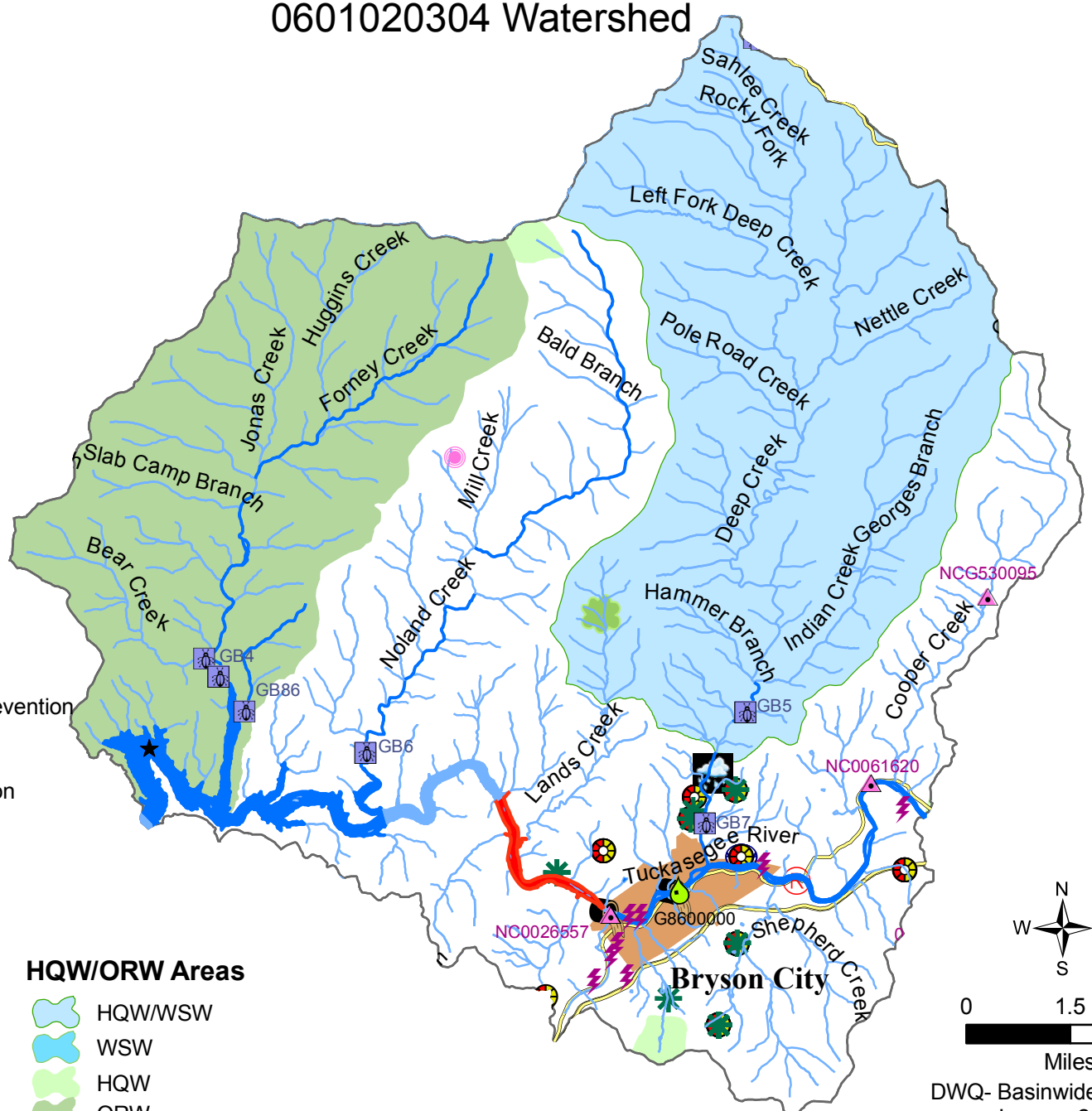
N
W E
S

0 2 4

Miles

DWQ- Basinwide Planning
January 2012

0601020304 Watershed



2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

Permits

- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

- USGS Gage
- Municipality
- Roads
- County Boundaries

Ag-Cost Share BMPs

- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

CWMTF Projects

- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

HQW/ORW Areas

- HQW/WSW
- WSW
- HQW
- ORW

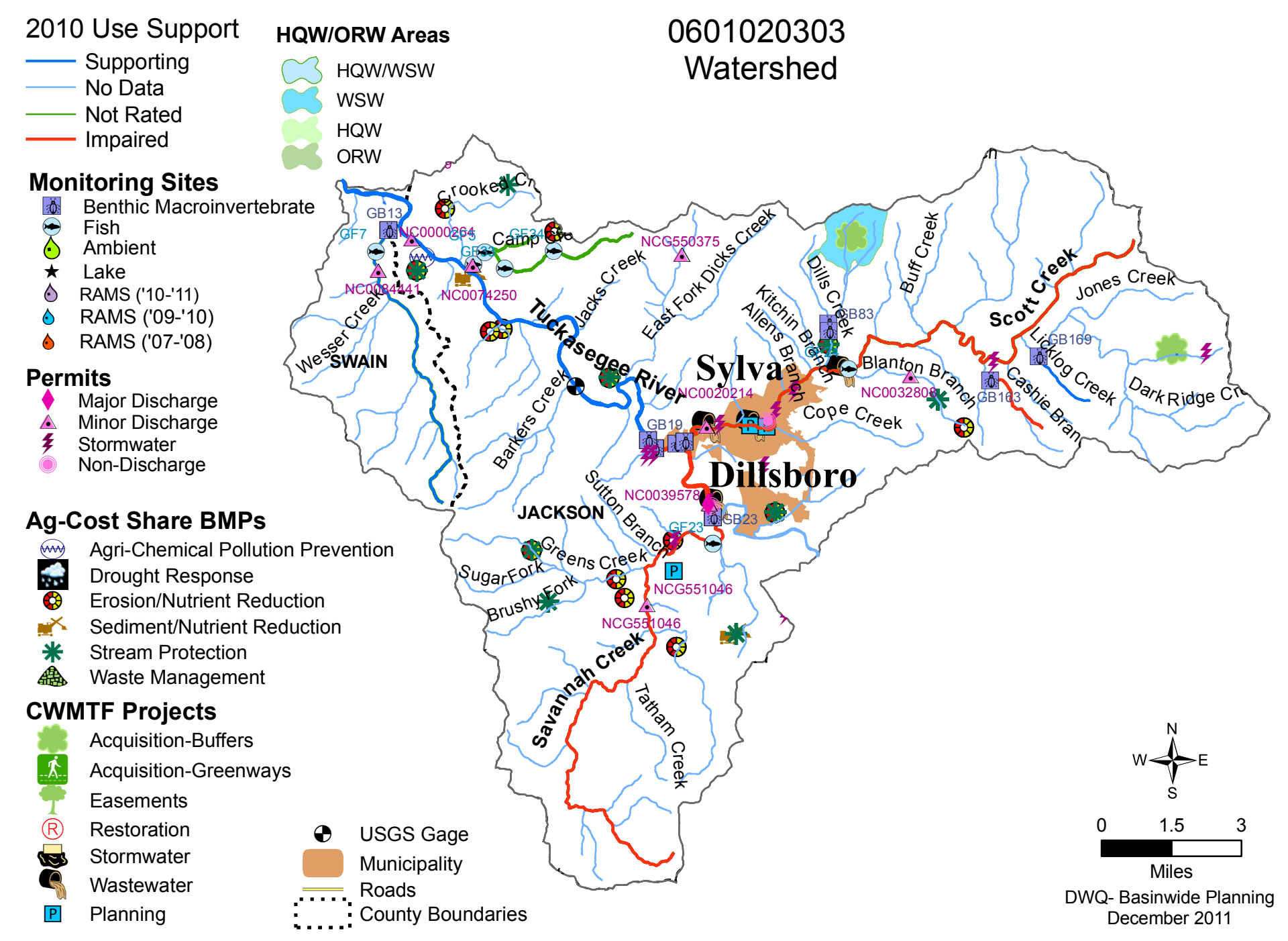
N
W E
S

0 1.5 3

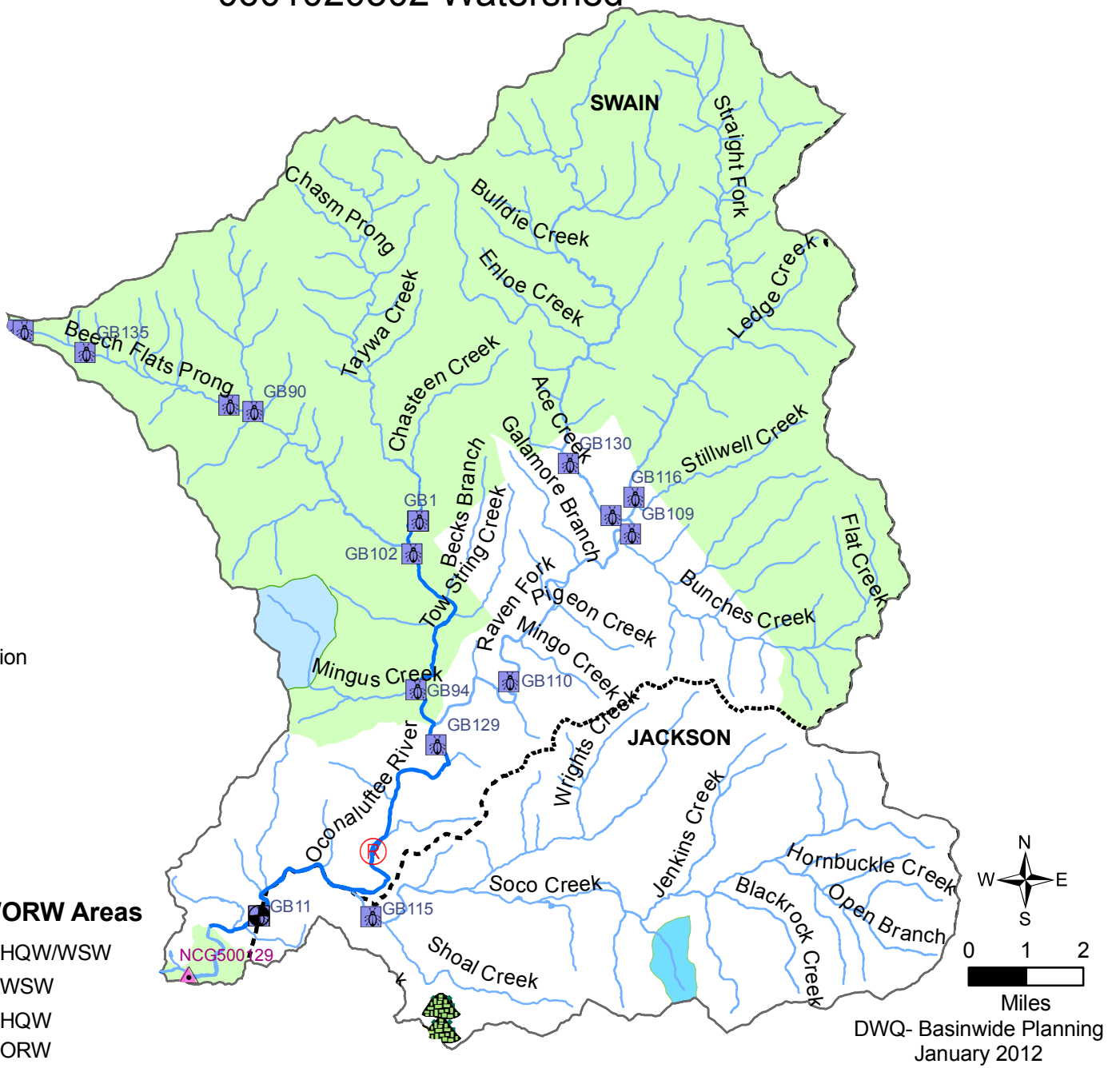
Miles

DWQ- Basinwide Planning
January 2012

0601020303 Watershed



0601020302 Watershed



2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

Permits

- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

- USGS Gage
- Municipality
- Roads
- County Boundaries

Ag-Cost Share BMPs

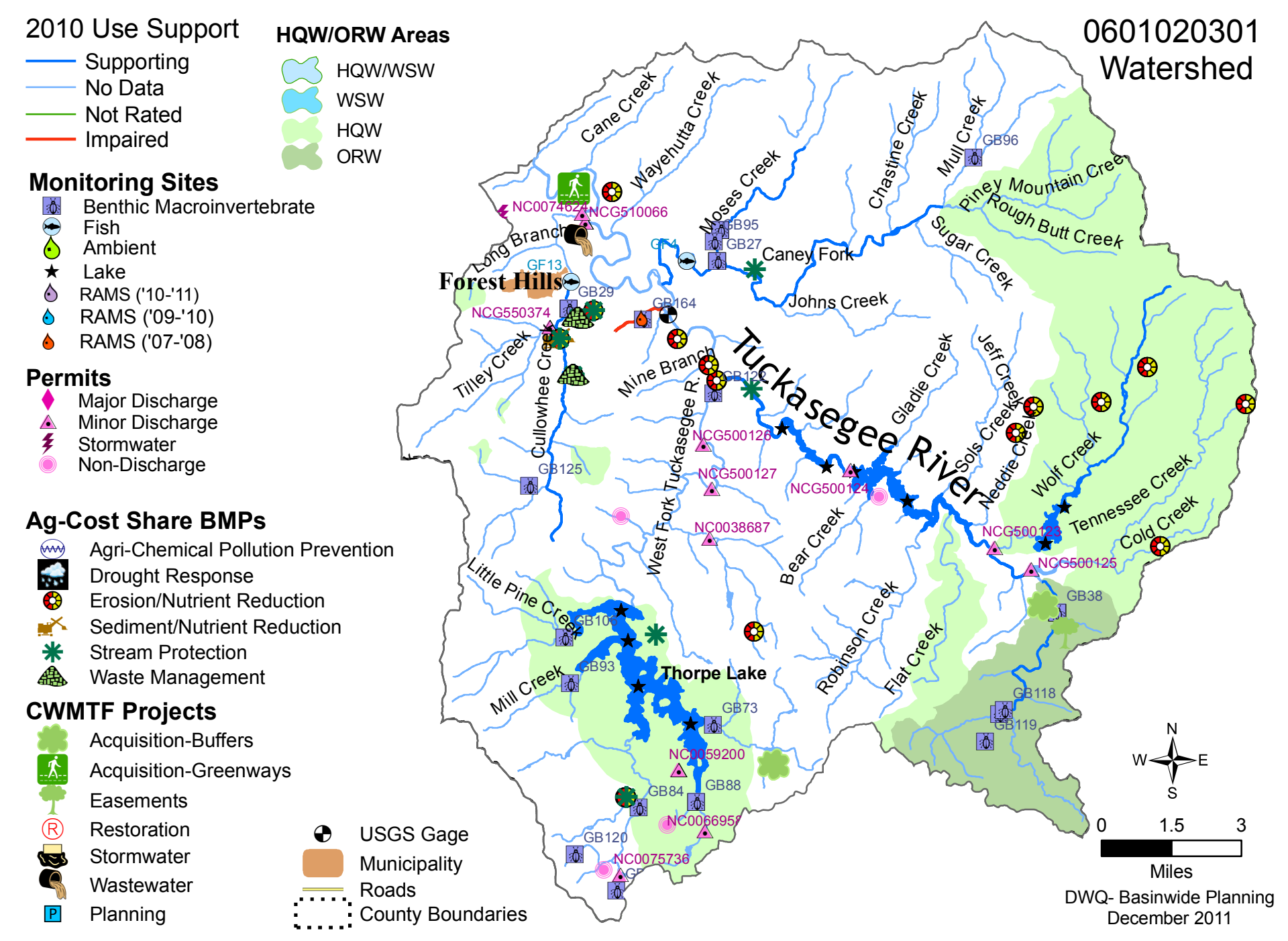
- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

CWMTF Projects

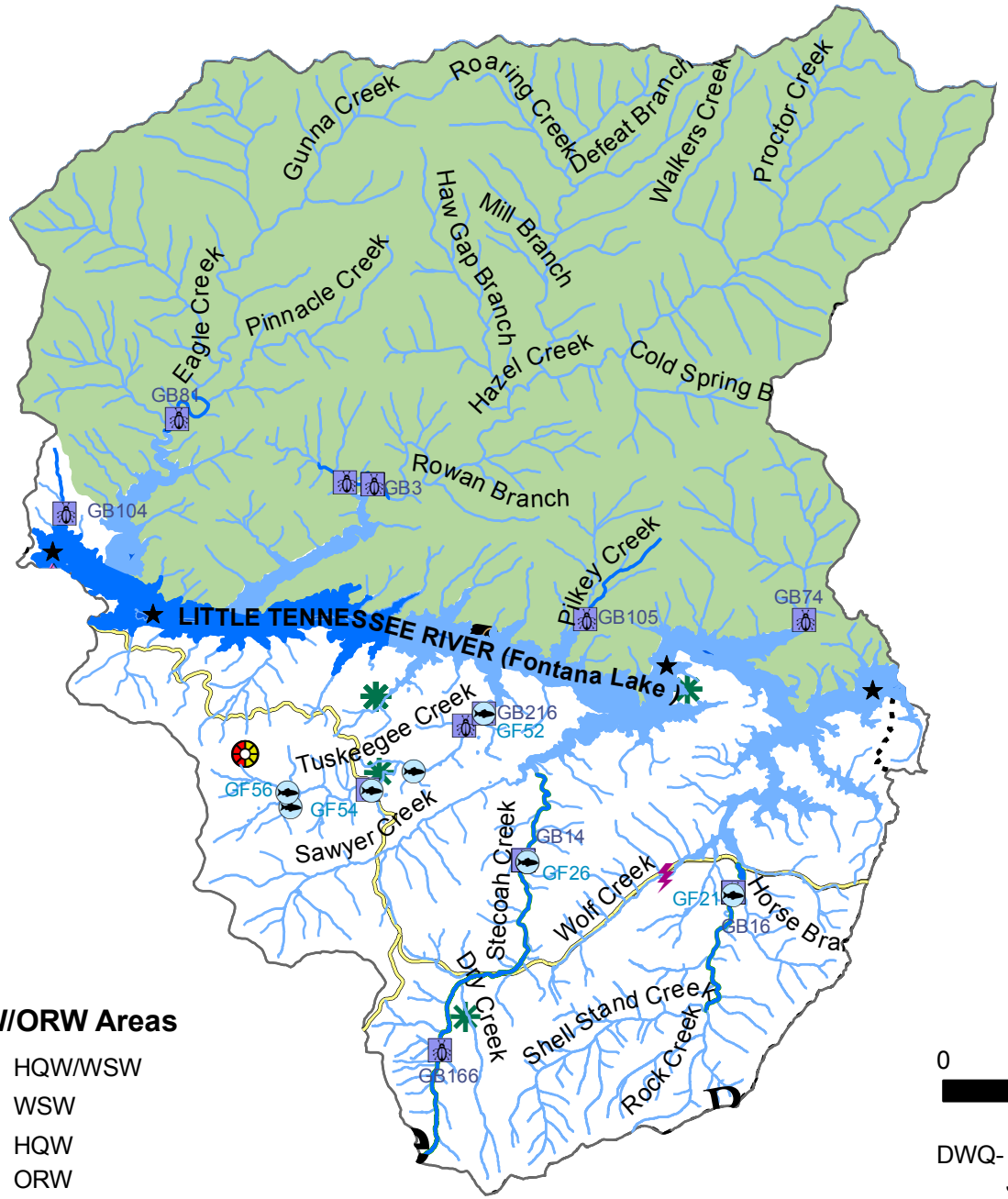
- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

HQW/ORW Areas

- HQW/WSW
- WSW
- HQW
- ORW


2010 Use Support
Supporting
No Data
Not Rated
Impaired
HQW/ORW Areas
HQW/WSW
WSW
HQW
ORW
Monitoring Sites
Benthic Macroinvertebrate
Fish
Ambient
Lake
RAMS ('10-'11)
RAMS ('09-'10)
RAMS ('07-'08)
Permits
Major Discharge
Minor Discharge
Stormwater
Non-Discharge
Ag-Cost Share BMPs
Agri-Chemical Pollution Prevention
Drought Response
Erosion/Nutrient Reduction
Sediment/Nutrient Reduction
Stream Protection
Waste Management
CWMTF Projects
Acquisition-Buffers
Acquisition-Greenways
Easements
Restoration
Stormwater
Wastewater
Planning
USGS Gage
Municipality
Roads
County Boundaries
0601020301
Watershed
Tuckasegee River
Forest Hills
Thorpe Lake
Cane Creek
Wayehutta Creek
Moses Creek
Chastine Creek
Mull Creek
Piney Mountain Creek
Rough Butt Creek
Sugar Creek
Caney Fork
Johns Creek
Long Branch
Tilley Creek
Cullowhee Creek
Mine Branch
West Fork Tuckasegee R.
Gladie Creek
Jeff Creek
Sols Creek
Neddie Creek
Wolf Creek
Tennessee Creek
Cold Creek
Bear Creek
Little Pine Creek
Mill Creek
Robinson Creek
Flat Creek
NC0074624
NCG510066
GF13
GB29
NCG550374
GB164
GB95
GB27
GB96
GB125
NCG500126
NCG500127
NCG500124
NC0038687
NCG500123
NCG500125
GB38
GB100
GB93
GB73
NC0059200
GB84
GB88
NC0066959
GB120
NC0075736
GB118
GB119
N
W
E
S
0
1.5
3
Miles
DWQ- Basinwide Planning
December 2011

0601020205 Watershed



2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

Permits

- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

- USGS Gage
- Municipality
- Roads
- County Boundaries

Ag-Cost Share BMPs

- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

CWMTF Projects

- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

HQW/ORW Areas

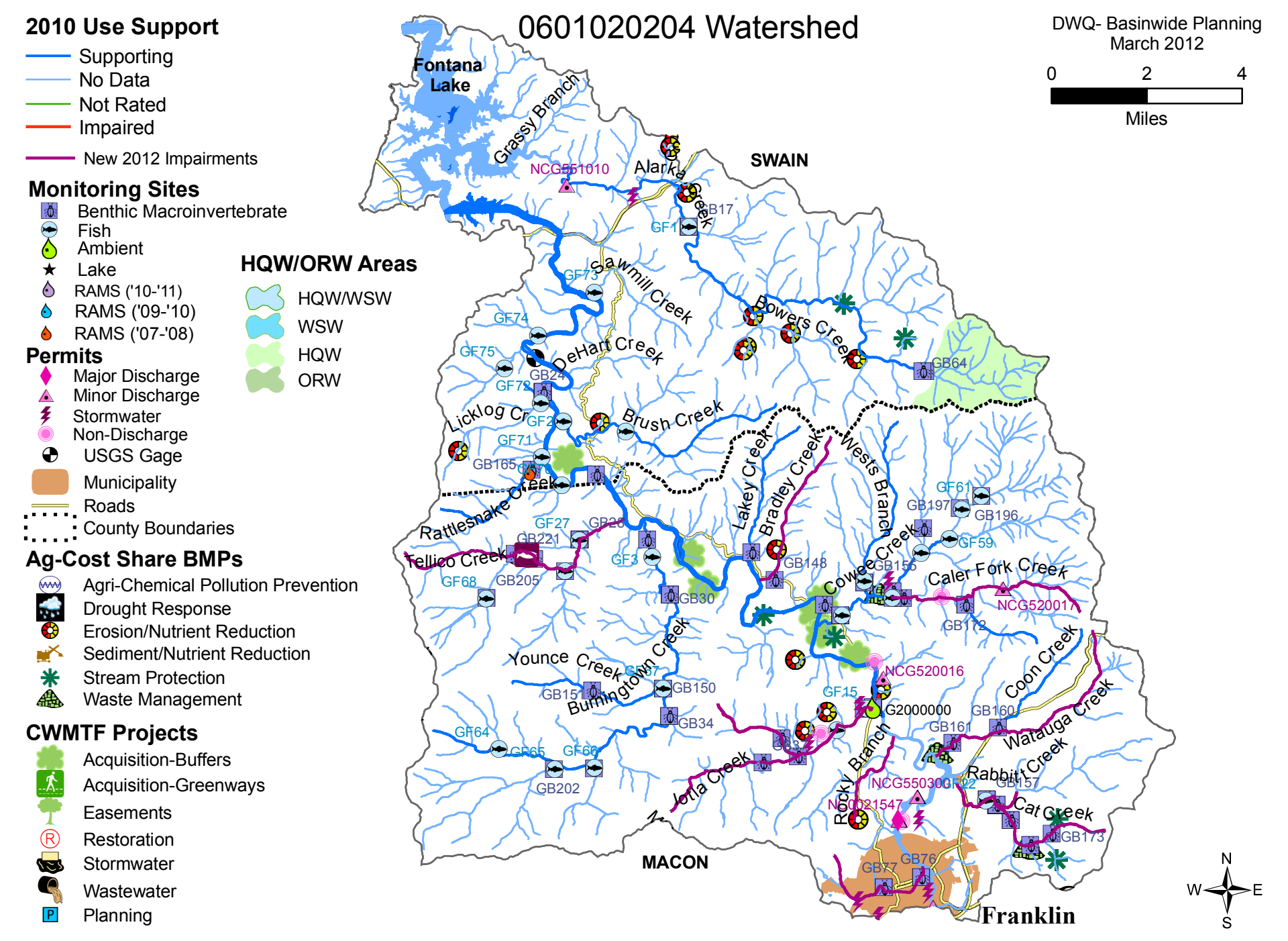
- HQW/WSW
- WSW
- HQW
- ORW

N
W E
S

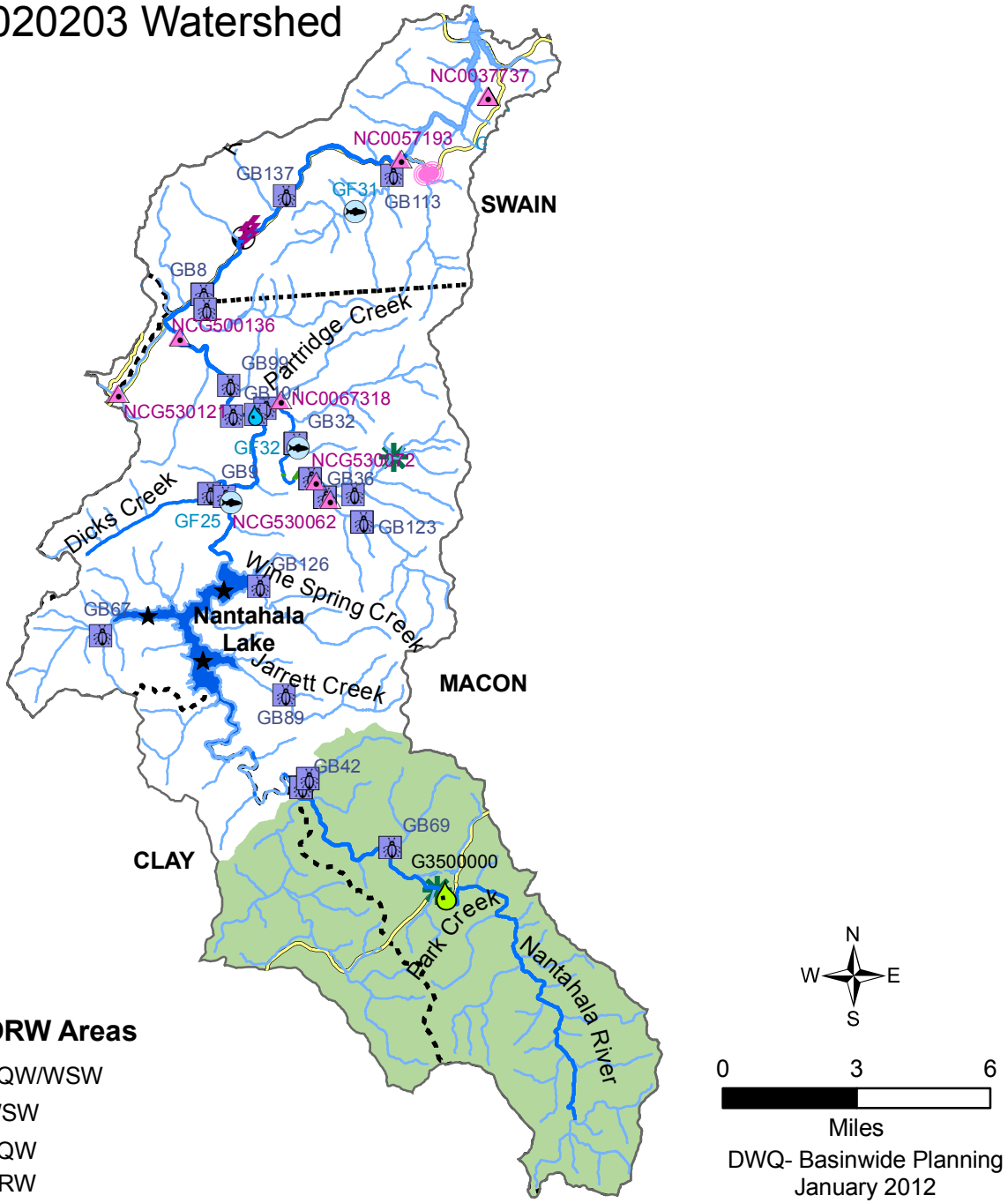
0 2 4

Miles

DWQ- Basinwide Planning
January 2012


0601020204 Watershed
DWQ- Basinwide Planning
March 2012
0
2
4
Miles
2010 Use Support
Supporting
No Data
Not Rated
Impaired
New 2012 Impairments
Monitoring Sites
Benthic Macroinvertebrate
Fish
Ambient
Lake
RAMS ('10-'11)
RAMS ('09-'10)
RAMS ('07-'08)
Permits
Major Discharge
Minor Discharge
Stormwater
Non-Discharge
USGS Gage
Municipality
Roads
County Boundaries
Ag-Cost Share BMPs
Agri-Chemical Pollution Prevention
Drought Response
Erosion/Nutrient Reduction
Sediment/Nutrient Reduction
Stream Protection
Waste Management
CWMTF Projects
Acquisition-Buffers
Acquisition-Greenways
Easements
Restoration
Stormwater
Wastewater
Planning
HQW/ORW Areas
HQW/WSW
WSW
HQW
ORW
Fontana Lake
Grassy Branch
SWAIN
MACON
Franklin
Alarka Creek
Sawmill Creek
DeHart Creek
Licklog Cr
Brush Creek
Bowers Creek
Lakey Creek
Bradley Creek
Wests Branch
Rattlesnake Creek
Fellico Creek
Cowee Creek
Caler Fork Creek
Younce Creek
Burningtown Creek
Coon Creek
Watauga Creek
Rabbit Creek
Cat Creek
Rocky Branch
Iotla Creek
NCG551010
NCG520017
NCG520016
NC0021547
G2000000
GB17
GF1
GF73
GF74
GF75
GB24
GF78
GF2
GF71
GB165
GF27
GB26
GB221
GF3
GF68
GB205
GB30
GB148
GB155
GF61
GB197
GB196
GF59
GB64
GB172
GB37
GB151
GB150
GB34
GF15
GB160
GB161
GB157
GB173
GF64
GF65
GF66
GB202
GB77
GB76

0601020203 Watershed



2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

Permits

- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

- USGS Gage
- Municipality
- Roads
- County Boundaries

Ag-Cost Share BMPs

- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

CWMTF Projects

- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

HQW/ORW Areas

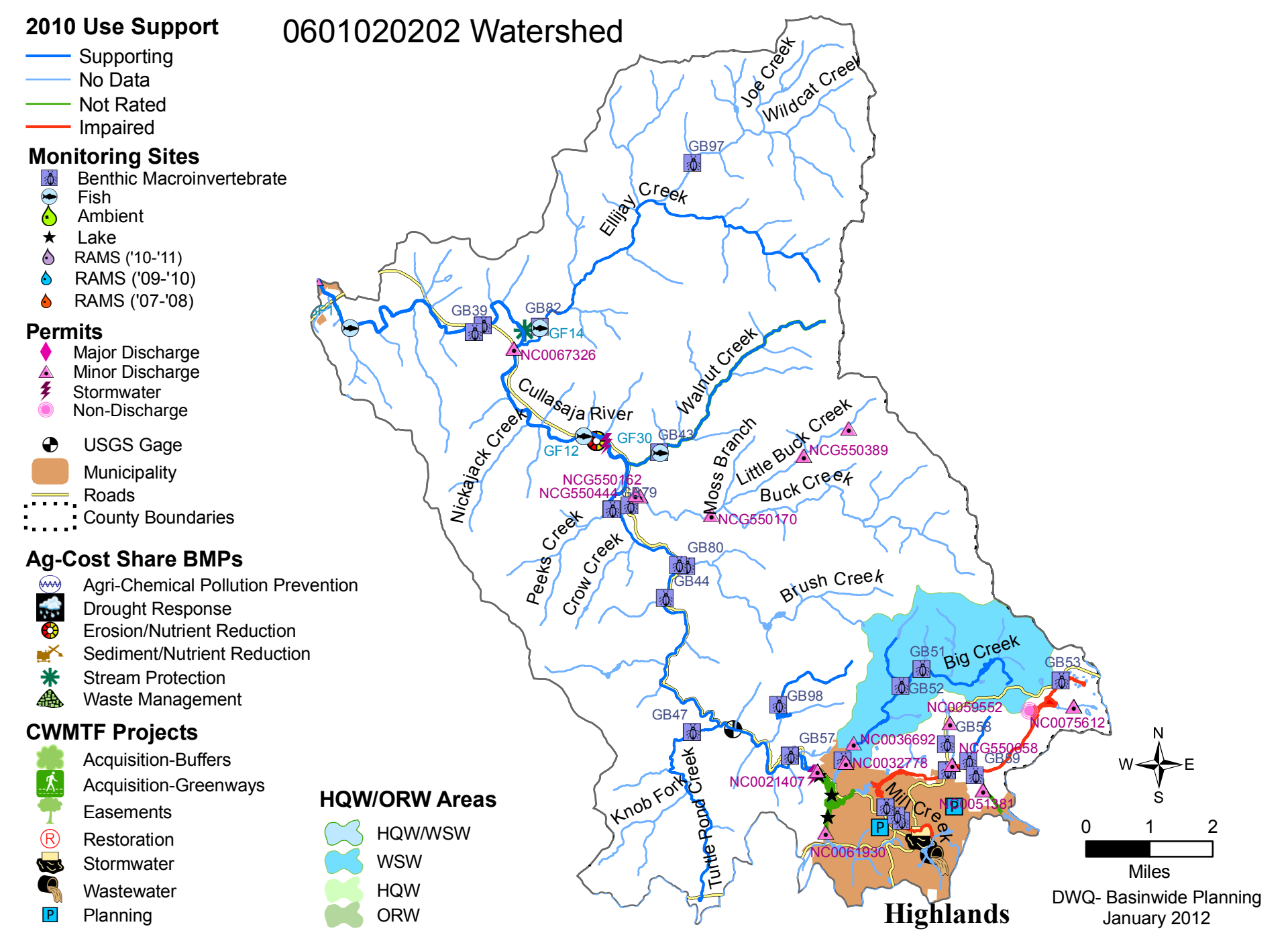
- HQW/WSW
- WSW
- HQW
- ORW

N
W E
S

0 3 6

Miles

DWQ- Basinwide Planning
January 2012


0601020202 Watershed
2010 Use Support
Supporting
No Data
Not Rated
Impaired
Monitoring Sites
Benthic Macroinvertebrate
Fish
Ambient
Lake
RAMS ('10-'11)
RAMS ('09-'10)
RAMS ('07-'08)
Permits
Major Discharge
Minor Discharge
Stormwater
Non-Discharge
USGS Gage
Municipality
Roads
County Boundaries
Ag-Cost Share BMPs
Agri-Chemical Pollution Prevention
Drought Response
Erosion/Nutrient Reduction
Sediment/Nutrient Reduction
Stream Protection
Waste Management
CWMTF Projects
Acquisition-Buffers
Acquisition-Greenways
Easements
Restoration
Stormwater
Wastewater
Planning
HQW/ORW Areas
HQW/WSW
WSW
HQW
ORW
Joe Creek
Wildcat Creek
Ellijay Creek
Cullasaja River
Walnut Creek
Nickajack Creek
Moss Branch
Little Buck Creek
Buck Creek
Peeks Creek
Crow Creek
Brush Creek
Big Creek
Knob Fork
Turtle Pond Creek
Mill Creek
GB97
GB39
GB82
GF14
NC0067326
GF12
GF30
GB43
NCG550162
NCG550444
NCG550389
NCG550170
GB80
GB44
GB51
GB53
GB52
GB98
GB47
GB57
GB58
GB59
NC0059552
NC0075612
NC0036692
NCG550358
NC0032778
NC0021407
NC0051181
NC0061930
Highlands
N
W
E
S
0
1
2
Miles
DWQ- Basinwide Planning
January 2012

0601020201 Watershed

DWQ- Basinwide Planning
January 2012

0 1.5 3
Miles

N
W E
S

2010 Use Support
- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites
- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

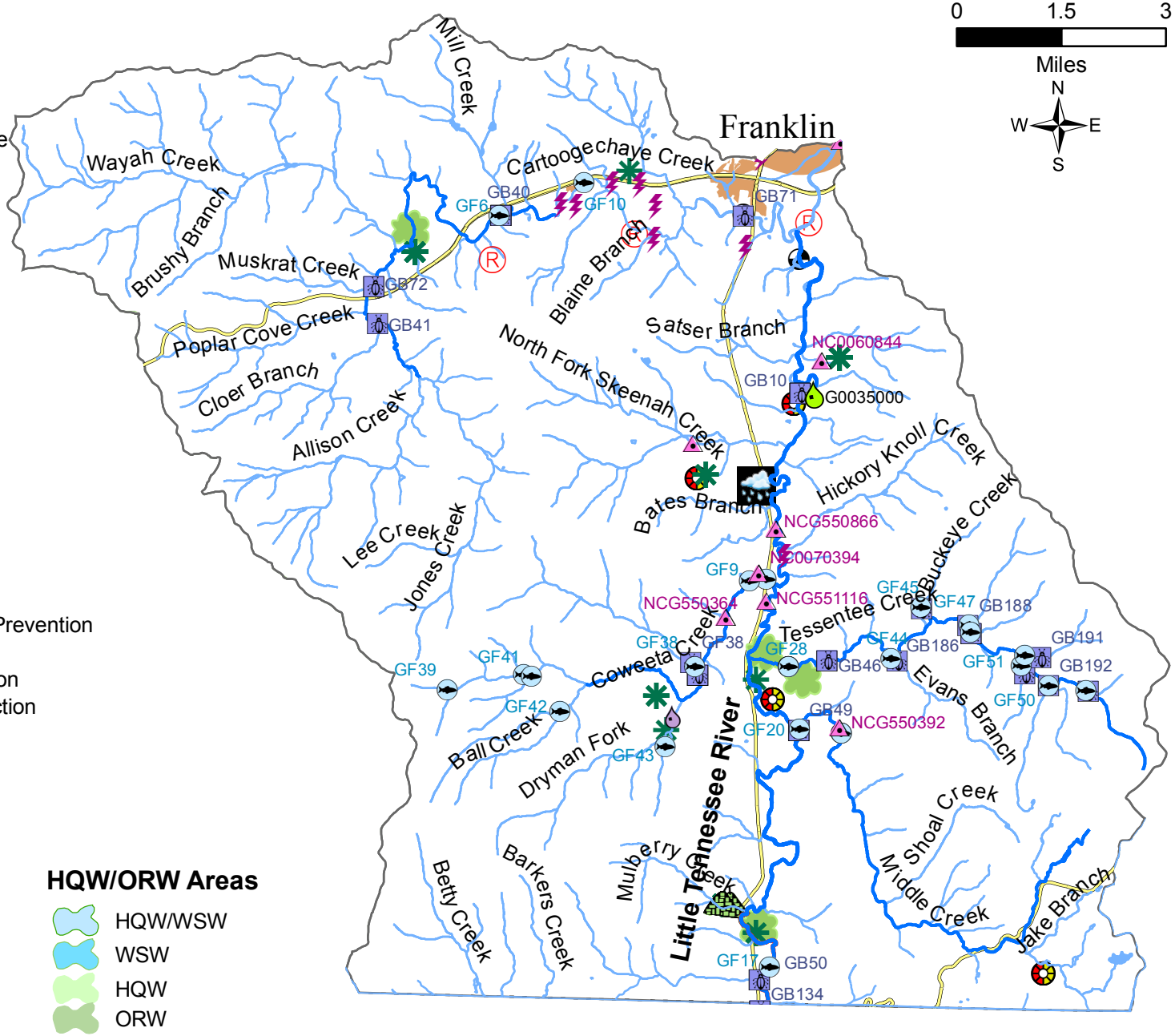
Permits
- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

- USGS Gage
- Municipality
- Roads
- County Boundaries

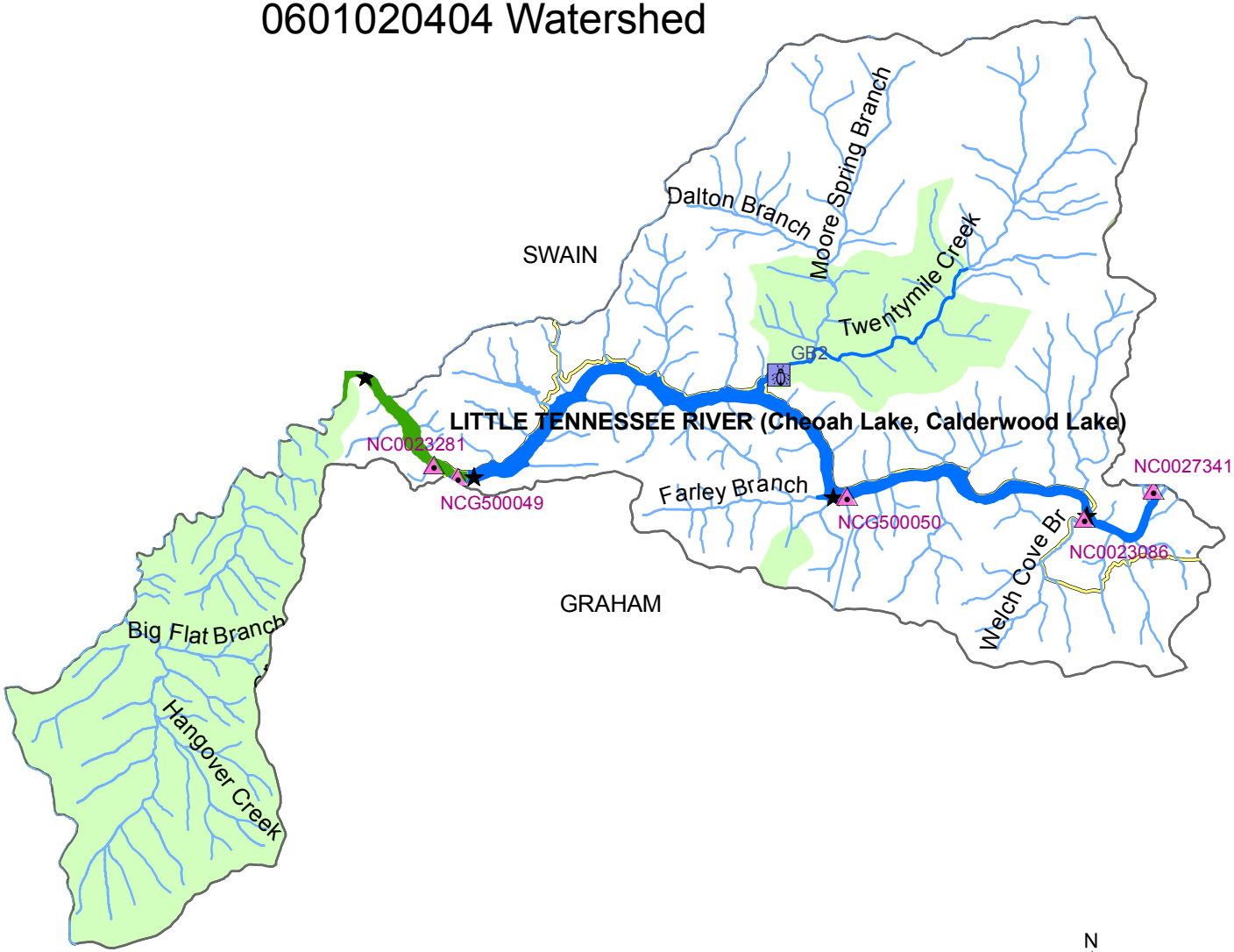
Ag-Cost Share BMPs
- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

CWMTF Projects
- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

HQW/ORW Areas
- HQW/WSW
- WSW
- HQW
- ORW



0601020404 Watershed



2010 Use Support

- Supporting
- No Data
- Not Rated
- Impaired

Monitoring Sites

- Benthic Macroinvertebrate
- Fish
- Ambient
- Lake
- RAMS ('10-'11)
- RAMS ('09-'10)
- RAMS ('07-'08)

Permits

- Major Discharge
- Minor Discharge
- Stormwater
- Non-Discharge

HQW/ORW Areas

- HQW/WSW
- WSW
- HQW
- ORW

- USGS Gage
- Municipality
- Roads
- County Boundaries

CWMTF Projects

- Acquisition-Buffers
- Acquisition-Greenways
- Easements
- Restoration
- Stormwater
- Wastewater
- Planning

Ag-Cost Share BMPs

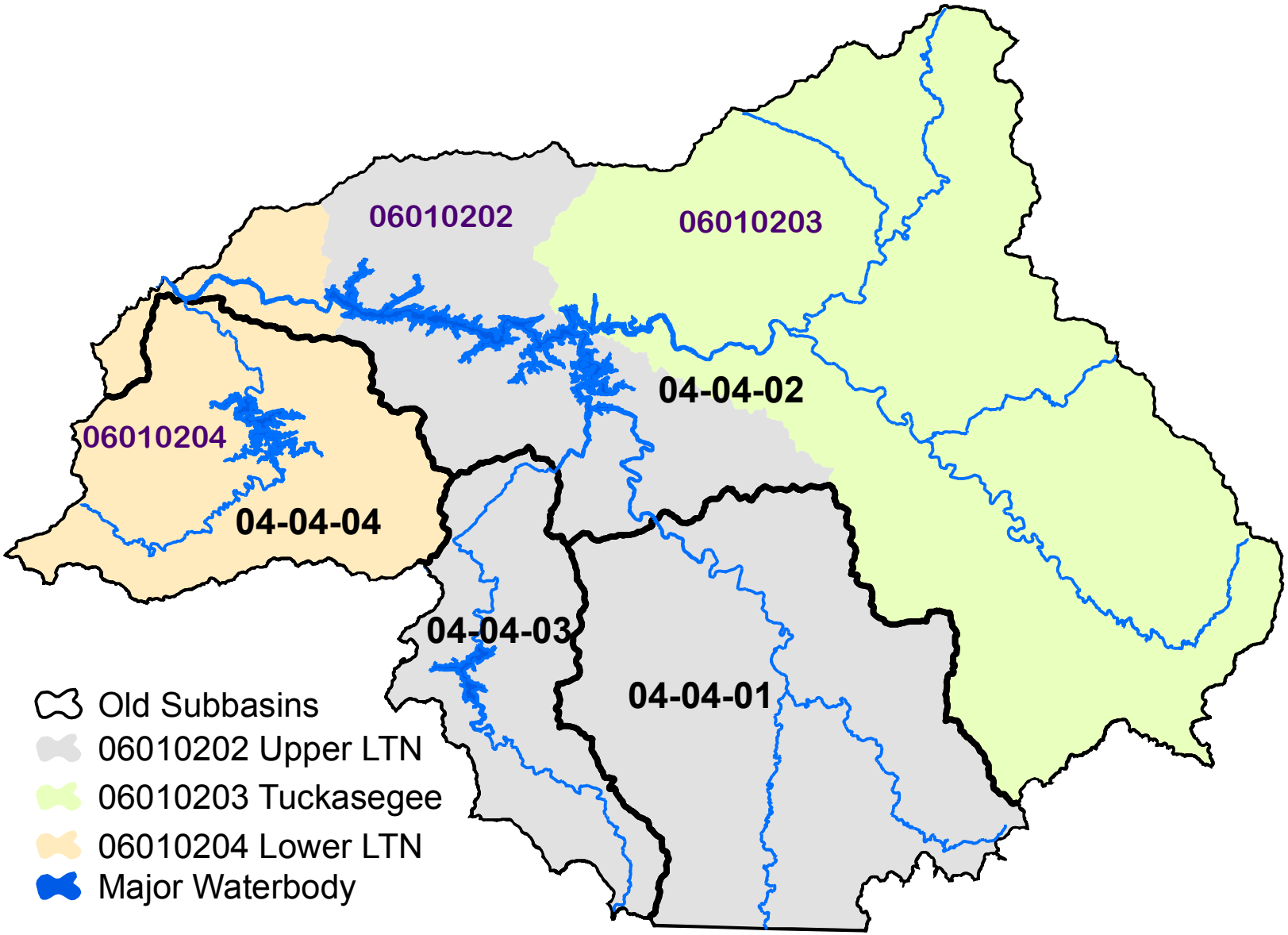
- Agri-Chemical Pollution Prevention
- Drought Response
- Erosion/Nutrient Reduction
- Sediment/Nutrient Reduction
- Stream Protection
- Waste Management

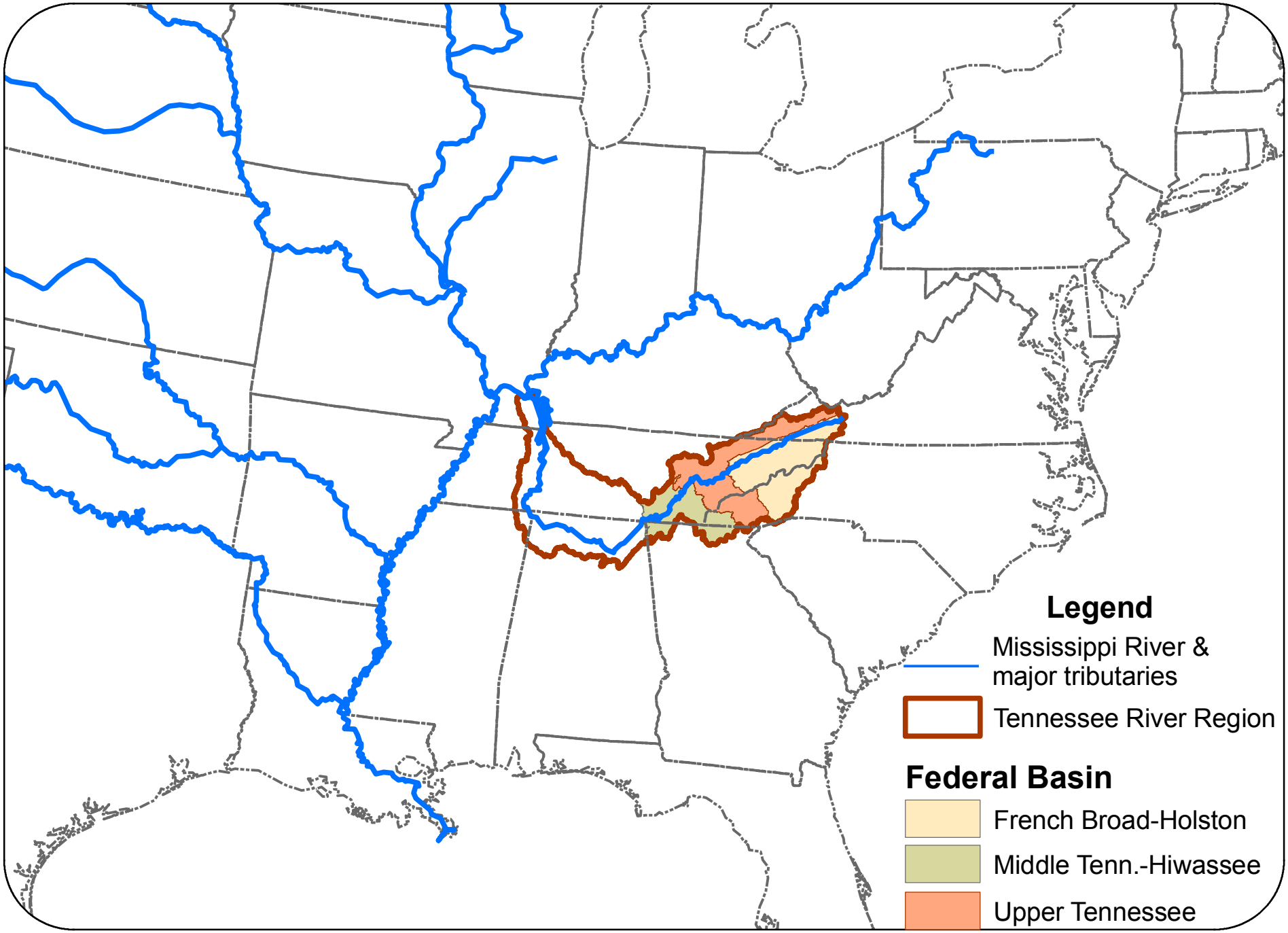
N
W E
S

0 1 2

Miles

DWQ- Basinwide Planning
January 2012


06010202
06010203
06010204
04-04-02
04-04-04
04-04-03
04-04-01
Old Subbasins
06010202 Upper LTN
06010203 Tuckasegee
06010204 Lower LTN
Major Waterbody


Legend
Mississippi River & major tributaries
Tennessee River Region
Federal Basin
French Broad-Holston
Middle Tenn.-Hiwassee
Upper Tennessee

Appendix 1D

Ambient Monitoring Station Data Summary Sheets

The full report is available on the DWQ Environmental Sciences Section website:
http://portal.ncdenr.org/web/wq/ess/reports

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: LITTLE TENNESSEE RIV AT SR 1651 NR PRENTISS
Station #: G0035000 **Hydrologic Unit Code:** 06010202
Latitude: 35.12215 **Longitude:** -83.37432 **Stream class:** C
Agency: NCAMBNT **NC stream index:** 2-(1)

Time period: 01/17/2006 to 12/15/2010

	#	#		Results not meeting EL			Percentiles						
	results	ND	EL	#	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	47	0	<4	0	0		7.6	7.8	8.4	9.8	10.8	11.7	12.9
	47	0	<5	0	0		7.6	7.8	8.4	9.8	10.8	11.7	12.9
pH (SU)	51	0	<6	4	7.8		5.4	6	6.3	6.6	6.7	6.9	7.2
	51	0	>9	0	0		5.4	6	6.3	6.6	6.7	6.9	7.2
Spec. conductance (umhos/cm at 25°C)	50	0	N/A				15	21	22	26	29	72	116
Water Temperature (°C)	52	0	>29	0	0		0.1	6.3	9	13.7	20	22.8	24
Other													
Hardness (mg/L)	4	0	N/A				6	6	6	7	10	11	11
TSS (mg/L)	20	4	N/A				2.5	3.3	6.2	8.9	15	22.3	41
Turbidity (NTU)	53	0	>50	1	1.9		1.3	2.5	3.8	6.8	12	30.4	120
Nutrients (mg/L)													
NH3 as N	7	7	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2 + NO3 as N	7	0	N/A				0.1	0.1	0.1	0.12	0.13	0.19	0.19
TKN as N	7	7	N/A				0.2	0.2	0.2	0.2	0.2	0.2	0.2
Total Phosphorus	7	1	N/A				0.02	0.02	0.02	0.02	0.03	0.04	0.04
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				170	170	215	500	695	770	770
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	6	0	>1000	0	0		260	260	268	500	675	690	690
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	5	>50	0	0		10	10	10	10	11	13	13

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
53	104.6	9	17	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: LITTLE TENNESSEE RIV AT NC 28 AT IOTLA
Station #: G2000000 **Hydrologic Unit Code:** 06010202
Latitude: 35.23490 **Longitude:** -83.39579 **Stream class:** B
Agency: NCAMBNT **NC stream index:** 2-(26.5)

Time period: 01/17/2006 to 12/15/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	47	0	<4	0	0		7.2	7.6	8.5	9.9	11.2	12.1	12.9
	47	0	<5	0	0		7.2	7.6	8.5	9.9	11.2	12.1	12.9
pH (SU)	52	0	<6	3	5.8		5	6	6.3	6.6	7	7.2	7.5
	52	0	>9	0	0		5	6	6.3	6.6	7	7.2	7.5
Spec. conductance (umhos/cm at 25°C)	49	0	N/A				24	26	28	34	38	45	49
Water Temperature (°C)	52	0	>29	0	0		0.9	6.1	9.4	14.6	21.2	24.8	26.4
Other													
Hardness (mg/L)	4	0	N/A				8	8	8	11	14	14	14
TSS (mg/L)	19	6	N/A				4	4.8	6.2	7.3	12	27	37
Turbidity (NTU)	53	0	>50	3	5.7		1.9	3.1	4.1	7.1	13.5	29.6	100
Nutrients (mg/L)													
NH3 as N	53	38	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.05
NO2 + NO3 as N	53	0	N/A				0.03	0.09	0.12	0.15	0.18	0.21	0.26
TKN as N	51	36	N/A				0.2	0.2	0.2	0.2	0.2	0.26	0.49
Total Phosphorus	53	6	N/A				0.02	0.02	0.02	0.03	0.05	0.08	0.16
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				210	210	240	360	430	460	460
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	6	0	>1000	0	0		320	320	388	495	622	690	690
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	3	>50	0	0		10	10	10	11	14	15	15

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
53	63.2	7	13.2	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: NANTAHALA RIV AT US 64 NR RAINBOW SPRINGS
Station #: G3500000 **Hydrologic Unit Code:** 06010202
Latitude: 35.09422 **Longitude:** -83.55992 **Stream class:** B Tr ORW
Agency: NCAMBNT **NC stream index:** 2-57-(0.5)

Time period: 01/17/2006 to 12/15/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	47	0	<6	0	0		7.7	8.2	8.7	10	10.9	11.5	12.9
pH (SU)	51	0	<6	5	9.8		5.4	5.8	6.2	6.5	6.6	7	7.2
	51	0	>9	0	0		5.4	5.8	6.2	6.5	6.6	7	7.2
Spec. conductance (umhos/cm at 25°C)	49	0	N/A				11	11	12	14	15	16	17
Water Temperature (°C)	52	0	>29	0	0		0	4.4	7	11.5	16.1	18.8	20.1
Other													
Hardness (mg/L)	4	0	N/A				4	4	4	5	6	6	6
TSS (mg/L)	21	17	N/A				2.5	2.5	2.8	6.2	6.2	16	19
Turbidity (NTU)	53	15	>10	1	1.9		1	1	1	1.4	2.6	5.9	11
Nutrients (mg/L)													
NH3 as N	53	50	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.13
NO2 + NO3 as N	53	13	N/A				0.02	0.02	0.02	0.03	0.04	0.07	0.5
TKN as N	51	46	N/A				0.2	0.2	0.2	0.2	0.2	0.25	0.42
Total Phosphorus	53	38	N/A				0.02	0.02	0.02	0.02	0.02	0.03	0.1
Metals (ug/L)													
Aluminum, total (Al)	6	2	N/A				50	50	50	58	97	120	120
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>0.4	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	6	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	6	1	>1000	0	0		50	50	59	76	152	160	160
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	4	>50	0	0		10	10	10	10	17	33	33

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
53	9.4	2	3.8	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: TUCKASEGEE RIV AT SR 1364 AT BRYSON CITY
Station #: G8600000 **Hydrologic Unit Code:** 06010203
Latitude: 35.42835 **Longitude:** -83.44595 **Stream class:** B
Agency: NCAMBNT **NC stream index:** 2-79-(40.5)

Time period: 01/17/2006 to 11/17/2010

	#	#		Results not meeting EL			Percentiles						
	results	**ND**	**EL**	**#**	**%**	**%Conf**	**Min**	**10th**	**25th**	**50th**	**75th**	**90th**	**Max**
Field													
D.O. (mg/L)	42	0	<4	0	0		7.3	8.2	9	10.4	11.4	12.4	13.8
	42	0	<5	0	0		7.3	8.2	9	10.4	11.4	12.4	13.8
pH (SU)	48	0	<6	4	8.3		5.6	6.2	6.4	7	7.9	8.5	9.1
	48	0	>9	1	2.1		5.6	6.2	6.4	7	7.9	8.5	9.1
Spec. conductance (umhos/cm at 25°C)	48	0	N/A				10	21	22	25	30	32	74
Water Temperature (°C)	48	0	>29	0	0		3.2	6.8	9.8	14.6	21.3	23.6	27.1
Other													
Hardness (mg/L)	5	0	N/A				6	6	7	9	11	12	12
TSS (mg/L)	21	10	N/A				3.5	5	6.2	7.8	18	40.4	71
Turbidity (NTU)	50	0	>50	0	0		1.1	1.8	3	4.2	7.2	13.9	40
Nutrients (mg/L)													
NH3 as N	47	44	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.02
NO2 + NO3 as N	47	0	N/A				0.05	0.09	0.11	0.15	0.18	0.22	0.33
TKN as N	45	37	N/A				0.2	0.2	0.2	0.2	0.2	0.26	0.35
Total Phosphorus	47	3	N/A				0.02	0.02	0.02	0.03	0.05	0.08	0.15
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				140	140	162	275	1322	2500	2500
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>2	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	5	>7	0	0		2	2	2	2	2	2	2
Iron, total (Fe)	6	0	>1000	2	33.3		180	180	240	410	1650	3300	3300
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	2	>50	0	0		10	10	10	13	19	22	22

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
50	44.2	3	6	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence

Ambient Monitoring System Station
NCDENR, Division of Water Quality
Basinwide Assessment

Location: CHEOAH RIV AT SR 1138 AT ROBBINSVILLE
Station #: G9550000 **Hydrologic Unit Code:** 06010204
Latitude: 35.32910 **Longitude:** -83.80976 **Stream class:** C Tr
Agency: NCAMBNT **NC stream index:** 2-190-(3.5)

Time period: 01/17/2006 to 11/17/2010

	#	#		Results not meeting EL			Percentiles						
	results	ND	EL	#	%	%Conf	Min	10th	25th	50th	75th	90th	Max
Field													
D.O. (mg/L)	41	0	<6	0	0		7.1	7.9	8.4	9.5	10.6	12.1	12.7
pH (SU)	44	0	<6	2	4.5		5.7	6.1	6.4	6.7	6.9	7.1	7.4
	44	0	>9	0	0		5.7	6.1	6.4	6.7	6.9	7.1	7.4
Spec. conductance (umhos/cm at 25°C)	45	0	N/A				14	27	30	34	41	43	47
Water Temperature (°C)	45	0	>29	0	0		5	6.9	11.2	15	19.4	22.9	24.7
Other													
Hardness (mg/L)	4	0	N/A				9	9	9	12	14	14	14
TSS (mg/L)	19	10	N/A				2.5	2.5	6.2	6.2	13	32	97
Turbidity (NTU)	47	1	>10	5	10.6	67.1	1	1.2	1.9	3.2	4.6	12	60
Nutrients (mg/L)													
NH3 as N	45	42	N/A				0.02	0.02	0.02	0.02	0.02	0.02	0.03
NO2 + NO3 as N	45	0	N/A				0.02	0.08	0.12	0.14	0.18	0.24	0.32
TKN as N	44	39	N/A				0.2	0.2	0.2	0.2	0.2	0.22	0.3
Total Phosphorus	45	16	N/A				0.02	0.02	0.02	0.02	0.03	0.05	0.12
Metals (ug/L)													
Aluminum, total (Al)	6	0	N/A				73	73	74	135	1182	2900	2900
Arsenic, total (As)	6	6	>10	0	0		5	5	5	5	5	5	5
Cadmium, total (Cd)	6	6	>0.4	0	0		1	1	1	2	2	2	2
Chromium, total (Cr)	6	6	>50	0	0		10	10	10	25	25	25	25
Copper, total (Cu)	6	5	>7	0	0		2	2	2	2	3	5	5
Iron, total (Fe)	6	0	>1000	1	16.7		130	130	182	265	1408	3500	3500
Lead, total (Pb)	6	6	>25	0	0		10	10	10	10	10	10	10
Mercury, total (Hg)	4	4	>0.012	0	0		0.2	0.2	0.2	0.2	0.2	0.2	0.2
Nickel, total (Ni)	6	6	>88	0	0		10	10	10	10	10	10	10
Zinc, total (Zn)	6	2	>50	0	0		10	10	10	11	16	28	28

Fecal Coliform Screening(#/100mL)

# results:	Geomean	# > 400:	% > 400:	%Conf:
47	103.5	7	14.9	

Key:
result: number of observations
ND: number of observations reported to be below detection level (non-detect)
EL: Evaluation Level; applicable numeric or narrative water quality standard or action level
Results not meeting EL: number and percentages of observations not meeting evaluation level
%Conf : States the percent statistical confidence that the actual percentage of exceedances is at least 10% (20% for Fecal Coliform)
Stations with less than 10 results for a given parameter were not evaluated for statistical confidence