Chapter 2
Little Tennessee River Subbasin 04-04-02
Including: The Tuckasegee River Watershed and Fontana Lake

2.1 Subbasin Overview

Subbasin 04-04-02 at a Glance

Land and Water Area
Total area: 1,021 mi²
Land area: 998 mi²
Water area: 23 mi²

Population Statistics
2000 Est. Pop.: 42,815 people
Pop. Density: 24 persons/mi²

Land Cover (percent)
Forest/Wetland: 93.5%
Surface Water: 2.3%
Urban: 0.6%
Cultivated Crop: 0.3%
Pasture/ Managed Herbaceous: 3.3%

Counties
Jackson, Swain and Graham

Municipalities
Dillsboro, Sylva, Webster, Forest Hills and Bryson City

Monitored Streams Statistics
Aquatic Life
Total Streams: 155.9 mi/10,947.9 ac
Total Supporting: 150.6 mi
Total Not Rated: 5.3 mi/10,947.9 ac

Recreation
Total Streams: 57.2 mi/170.6 ac
Total Supporting: 26.5 mi
Total Impaired: 30.7 mi/170.6 ac

This subbasin drains 1,021 square miles. The majority of the subbasin lies in Jackson and Swain counties, but small portions of Graham and Macon counties are also included.

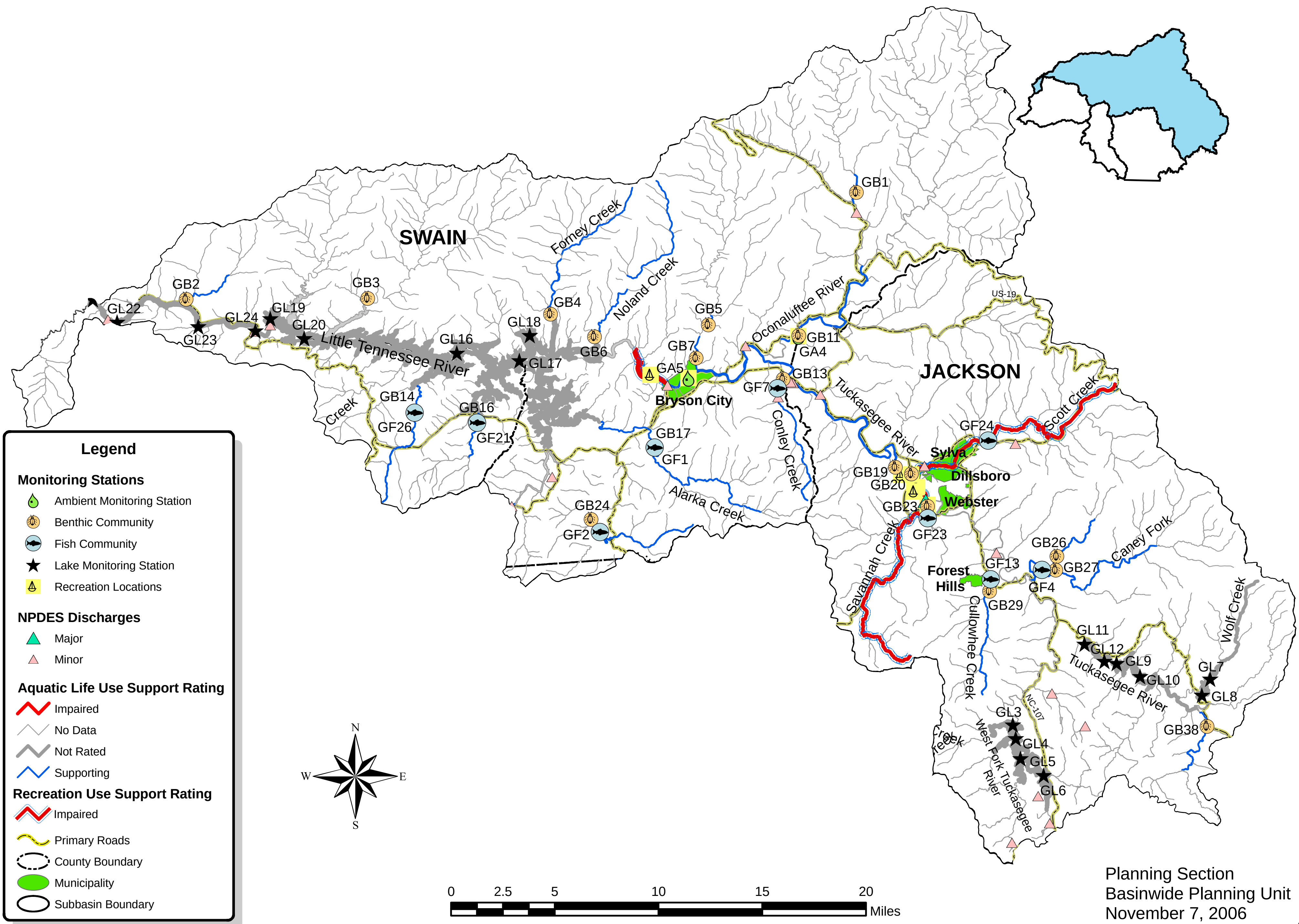
Fontana Lake is the largest impoundment in this region and the body of water to which all streams in this subbasin flow. Fontana Lake/Reservoir, operated by the Tennessee Valley Authority, is the result of damming the Little Tennessee River in the 1940's near Fontana Village on the Graham/Swain County line. Flood control and hydroelectric power generation are the primary purposes for Fontana Lake, though recreational use is growing steadily.

The principle tributaries to the Little Tennessee River are the Oconaluftee River and the Tuckasegee River. This subbasin contains over 1,390 miles of streams and rivers and 12,456 acres of lakes and ponds.

Much of the catchment to the north of the Little Tennessee River is within either the Great Smoky Mountains National Park or the Cherokee Indian Qualla Boundary. Most streams on the north side of the lake are in a roadless area and can only be reached by hiking trails or boat across Fontana Lake. Much of the remainder of this subbasin is included in the Nantahala National Forest, although this does not preclude other land uses.

The largest towns in the subbasin are Bryson City, Cherokee, Cullowhee, and Sylva. The area also contains some of the most pristine and some of the highest quality waters in the State. It also contains some of the most famous trout streams in North Carolina, including Hazel Creek, Forney Creek, Deep Creek and Noland Creek. Portions of Alarka Creek, the Tuckasegee River, Caney Fork, and most of the Oconaluftee River catchments are classified as High Quality Waters (HQW). Small streams, formally classified for water supply, have also been reclassified as HQW: Whiterock, Wolf, Clingman's, and Twentymile Creeks and Long, Jenkins, Dednan, and Moore Spring Branches. The Tuckasegee River upstream of Tanassee Creek is classified as Outstanding Resource Waters.

Figure 5 Little Tennessee Subbasin 04-04-02



Planning Section
Basinwide Planning Unit
November 7, 2006

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Alarka Creek												
2-69-(2.5)	C;Tr	13.1 FW Miles	**S**					ND			Nutrient Impacts	Unknown
From Upper Long Creek to Fontana Lake, Little Tennessee R.				GF1	GF	2004					Habitat Degradation	Agriculture
				GB17	E	2004					Habitat Degradation	Construction
Bradley Fork												
2-79-55-12-(11)	B;Tr,HQW	2.1 FW Miles	**S**					ND				
From Chasteen Creek to Oconaluftee River				GB1	E	2004						
Brush Creek												
2-46	C	6.3 FW Miles	**S**					ND				
From source to Little Tennessee River				GF2	G	2004						
Caney Fork												
2-79-28-(2.5)	WS-III;Tr	1.3 FW Miles	**S**					ND				
From Mull Creek to Tuckaseegee River				GF4	G	2004						
				GB27	E	2004						
Conley Creek (Connelly Creek)												
2-79-52	C;Tr	7.4 FW Miles	**S**					ND				
From source to Tuckasegee River				GF7	NR	2004						
				GB13	G	2004						
Cullowhee Creek												
2-79-31a	C;Tr	8.7 FW Miles	**S**					ND			Habitat Degradation	Unknown
From source to first crossing of NC 107 near Cullowhee				GF13	GF	2004						
				GB29	E	2004						

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Deep Creek												
2-79-63-(16)	WS-II,B;Tr,HQW	0.8 FW Miles	S					ND				
From Indian Creek to Juney Whank Branch				GB5	E	2004						
2-79-63-(21)	B;Tr	1.8 FW Miles	S					ND				
From Town of Bryson City water supply intake (located just below Great Smoky Mountains National Park Boundary) to Tuckasegee River				GB7	E	2004						
Forney Creek												
2-97	C;Tr	9.5 FW Miles	S					ND				
From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River				GB4	E	2004						
Hazel Creek												
2-146-(19)	WS-IV;Tr,CA	0.9 FW Miles	S					ND				
From a point 0.7 mile upstream of mouth to Hazel Creek Arm of Fontana Lake, Little Tennessee River				GB3	E	2004						
LITTLE TENNESSEE RIVER (Calderwood Lake)												
2-(167)b	C;Tr	107.5 FW Acres	NR	GL21	ID			ND				
From Fontana Dam to North Carolina-Tennessee State Line Calderwood Lake Portion												
LITTLE TENNESSEE RIVER (Cheoah Lake)												
2-(167)a	C;Tr	592.9 FW Acres	NR	GL24	ID			ND				
				GL23	ID							
				GL22	ID							
From Fontana Dam to North Carolina-Tennessee State Line Cheoah Lake Portion												

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
LITTLE TENNESSEE RIVER (Fontana Lake below elev. 1708)													
2-(140.5)	WS-IV,B;CA	1,696.7	FW Acres	**NR**	GL19	ID			ND				
					GL20	ID							
From the upstream side of Shoal Branch to Fontana Dam													
LITTLE TENNESSEE RIVER (Fontana Lake below elevation 1708 MSL)													
2-(66)	B	5,568.1	FW Acres	**NR**	GL16	ID			ND				
					GL17	ID							
From Nantahala River Arm of Fontana Lake to the upstream side of mouth of Shoal Branch													
LITTLE TENNESSEE RIVER (Including the backwaters of Fontana Lake at normal pool elevation 1708 fee													
2-(26.5)b	B	11.9	FW Miles	**S**					ND				
From Subbasin 01/02 boundary to Nantahala River Arm of Fontana Lake					GB24	G	2004						
Moses Creek													
2-79-28-8	WS-III;Tr	4.1	FW Miles	**S**					ND				
From source to Caney Fork					GB26	E	2004						
Noland Creek													
2-90	C;Tr	10.8	FW Miles	**S**					ND				
From source to Tuckasegee River Arm of Fontana Lake, Little Tennessee River					GB6	G	2004						
Oconaluftee River													
2-79-55-(16.5)	C;Tr	8.3	FW Miles	**S**	GA4	NCE			**S**	GA4	NCE		
From Raven Fork to Cherokee Indian Reservation boundary (approximately 0.4 miles downstream of Goose Creek)					GB11	E	2004						

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area	AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Panther Creek												
2-115	C;Tr	2.4 FW Miles	S					ND			Nutrient Impacts	Construction
From source to Fontana Lake, Little Tennessee River				GF21	NR	2004					Nutrient Impacts	Unknown
				GB16	G	2004					Nutrient Impacts	Agriculture
Savannah Creek												
2-79-36	C;Tr	13.4 FW Miles	S					I	GA8	CE	Fecal Coliform Bacteria	Unknown
From source to Tuckasegee River				GF23	G	2004					Turbidity	Unknown
				GB23	G	2004					Habitat Degradation	Agriculture
Scott Creek												
2-79-39	C;Tr	15.3 FW Miles	S					I	GA11	CE	Fecal Coliform Bacteria	Failing Septic Syst
From source to Tuckasegee River				GF24	NR	2004					Fecal Coliform Bacteria	MS4 NPDES
				GB20	G	2004					Fecal Coliform Bacteria	WWTP NPDES
											Turbidity	Unknown
											Habitat Degradation	Impervious Surface
											Habitat Degradation	Construction
Stecoah Creek												
2-130	C;Tr	7.4 FW Miles	S					ND			Nutrient Impacts	Unknown
From source to Fontana Lake, Little Tennessee River				GF26	NR	2004					Nutrient Impacts	Agriculture
				GB14	G	2004					Habitat Degradation	Road Construction
											Habitat Degradation	Construction
											Habitat Degradation	Construction

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Tuckaseegee River (Bear Creek Lake)													
2-79-(5.5)b	WS-III,B;Tr	443.8	FW Acres	**NR**	GL10	ID			ND				
					GL9	ID							
From Tennessee Creek to West Fork Tuckaseegee River													
Tuckaseegee River (Cedar Cliff Lake)													
2-79-(5.5)c	WS-III,B;Tr	131.4	FW Acres	**NR**	GL11	ID			ND				
					GL12	ID							
From Tennessee Creek to West Fork Tuckaseegee River													
Tuckasegee River													
2-79-(35.5)a	C;Tr	1.4	FW Miles	ND					**I**	GA9	CE	Fecal Coliform Bacteria	Unknown
From Savannah Creek to UT 0.3 miles upstream of Yellow Bird Creek													
2-79-(35.5)b	C;Tr	0.5	FW Miles	ND					**S**	GA10	NCE	Fecal Coliform Bacteria	WWTP NPDES
From UT 0.3 miles upstream of yellow Bird Creek to Dillsboro Dam													
2-79-(38)	C	0.7	FW Miles	ND					**I**	GA12	CE	Fecal Coliform Bacteria	Unknown
From Dillsboro Dam to Mack Town Branch													
2-79-(40.5)	B	17.7	FW Miles	**S**	GA5	NCE			**S**	GA5	NCE	Fecal Coliform Bacteria	WWTP NPDES
From Mack Town Branch to Cochran Branch					GB19	E	2004					Total Suspended Solids	WWTP NPDES
Tuckasegee River (East Fork Lake)													
2-79-(0.5)	WS-III,B;Tr,OR	4.4	FW Miles	**S**					ND				
From source to Tennessee Creek					GB38	E	2004						

Table 5 Little Tennessee Subbasin 04-04-02

AU Number / Description	Classification	Length/Area		AL Rating	Station	Result	Year/ Parameter	% Exc	REC Rating	Station	Result	Stressors	Sources
Tuckasegee River Arm of Fontana Lake, Little Tennessee River, below elevation 1708 MSL													
2-(78)a	C	170.6	FW Acres	ND					I	GA13	CE	Fecal Coliform Bacteria	Unknown
From Lemmons Creek to Peachtree Creek												Sediment	Unknown
2-(89)	B	1,019.0	FW Acres	**NR**	GL18	ID			ND				
That portion of Tuckasegee River Arm of Fontana Lake below the upstream side of the mouth of Noland Creek													
Twentymile Creek													
2-178-(4)	C;Tr,HQW	3.0	FW Miles	**S**					ND				
From Proctor Branch to Lake Cheoah, Little Tennessee River					GB2	G	2004						
West Fork Tuckasegee River (Thorpe Lake below elevation 3492 MSL)													
2-79-23-(1)	WS-III,B;HQW	1,388.5	FW Acres	**NR**	GL3	ID			ND				
					GL5	ID							
					GL6	ID							
					GL4	ID							
From source in Thorpe Lake Backwater at Elevation 3492 MSL to Thorpe Dam													
Wolf Creek (Wolf Creek Lake)													
2-79-9-(1)	WS-III,B;Tr,HQ	5.3	FW Miles	**NR**	GL8	ID			ND				
					GL7	ID							
From source to Wolf Creek Dam													

Table 5 Little Tennessee Subbasin 04-04-02

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

(Aquatic Life Assessment: AL Rating, Station, Result, Year/Parameter, % Exc; Recreation Assessment: REC Rating, Station, Result)

Use Categories:	Monitoring data type:	Results:	Use Support Ratings 2006:
AL - Aquatic Life	GF - Fish Community Survey	E - Excellent	S - Supporting, I - Impaired
REC - Recreation	GB - Benthic Community Survey	G - Good	NR - Not Rated
	GA - Ambient Monitoring Site	GF - Good-Fair	NR*- Not Rated for Recreation (screening criteria exceeded)
	GL- Lake Monitoring	F - Fair	ND-No Data Collected to make assessment
		P - Poor	
		NI - Not Impaired	
Miles/Acres	m- Monitored		**Results**
FW- Fresh Water	e- Evaluated		CE-Criteria Exceeded > 10% and more than 10 samples
			NCE-No Criteria Exceeded
			ID- Insufficeint Data Available

Aquatic Life Rating Summary

S	m	150.6	FW Miles
NR	m	5.3	FW Miles
NR	m	10,947.9	FW Acres
NR	e	9.5	FW Miles
ND		1,225.0	FW Miles
ND		1,508.8	FW Acres

Recreation Rating Summary

S	m	26.5	FW Miles
I	m	30.7	FW Miles
I	m	170.6	FW Acres
NR	e	9.5	FW Miles
ND		1,323.7	FW Miles
ND		12,286.1	FW Acres

Fish Consumption Rating Summary

I	e	1,377.2	FW Miles
I	e	12,456.7	FW Acres
I		13.3	FW Miles

There are 25 NPDES permitted dischargers in this subbasin, but only three have permitted flows greater than 0.5 MGD: the Tuckasegee Water & Sewer Authority (0.5 MGD to Scott Creek); the Tuckasegee Water & Sewer Authority (1.5 MGD to the Tuckasegee River), and the Town of Bryson City's WWTP (0.6 MGD to the Tuckasegee River). Only the latter two facilities are required to monitor whole effluent toxicity. See Section 2.3.1 for more information. For the listing of NPDES permit holders, refer to Appendix V.

Additional information regarding population and land use changes throughout the entire basin can be found in Appendices I and III, respectively.

The primary problem in this basin continues to be nonpoint source pollution, including inputs of sediment and (or) nutrients. Although much of this subbasin is forested, development is often located along the stream corridor. Farmland and new residential areas are typically found adjacent to streams, often with inadequate riparian buffer zones. Many of the sampled sites have roads that run parallel to the stream leading to narrow riparian zones with frequent breaks. Water quality was not a problem throughout most of this area, but there was evidence of habitat problems. These included few pools, relatively uniform riffles and runs, and an embedded substrate. These changes have been shown to have less effect on the benthic macroinvertebrates than fish fauna.

Whereas actual water quality is the most important parameter for macroinvertebrates in mountain streams, fishes are affected to a higher degree by habitat alterations (in addition to water quality), especially; the lack of riparian shading of the stream, increased nutrient loads, lack of bank stability, and silt accumulation of plunge pools and riffles. The lack of stream shading raises water temperatures, excluding sensitive cold-water fishes such as trout. An increase in nutrient loads causes a shift in species composition towards dominance by the central stoneroller and the river chub. Silt accumulation, caused by unstable banks and overland runoff limits habitats in riffles, resulting in a low number or complete lack of darters and sculpin.

A map including the locations of the NPDES facilities and water quality monitoring stations is presented in Figure 5. Table 5 contains a summary of assessment unit numbers (AU#) and lengths, streams monitored, monitoring data types, locations and results, along with use support ratings for waters in the subbasin. Refer to Appendix VIII for more information about use support ratings.

There were 20 benthic macroinvertebrate community and 9 fish community samples collected during this assessment period. Data were also collected from two ambient monitoring stations. Refer to the *2005 Little Tennessee Basinwide Assessment Report* at http://www.esb.enr.state.nc.us/Basinwide/LTN2005.pdf and Appendix IV for more information on monitoring.

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

2.2 Use Support Assessment Summary

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

Use Support Rating	Aquatic Life	Recreation
Monitored Waters		
Supporting	150.6 mi	26.5 mi
Impaired*	0.0 0.0	30.7 mi (54%) 170.6 ac (100%)
Not Rated	5.3 mi 10,947.9 ac	0.0 0.0
Total	**155.9 mi** **10,947.9 ac**	**57.2 mi** **170.6 ac**
Unmonitored Waters		
Not Rated	9.5 mi	9.5 mi
No Data	1,225.0 mi 1,508.8 ac	1,323.7 mi 12,286.1 ac
Total	**1,234.5 mi** **1,508.8 ac**	**1,333.2 mi** **12,286.1 ac**
Totals		
All Waters**	**1,390.4 mi** **12,456.7 ac**	**1,390.4 mi** **12,456.7 ac**

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

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

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

2.3 Status and Recommendations of Previously and Newly Impaired Waters

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

2.3.1 Beech Flats Prong [AU# 2-79-55-2a]

Current Status

Beech Flats Prong (2.3 miles), located in the GSMNP, is Impaired due to acidic conditions resulting from exposure of Anakeesta rock formations in the vicinity of Newfound Gap as a result of US Highway 441 construction. This conclusion is based on a Fair benthic bioclassification assigned in 1995. Anakeesta rock contains elements that, when exposed to water, produce low pH levels and high concentrations of heavy metals in adjacent streams. It is fairly common throughout the southwestern Appalachian Mountains for road cuts or landslides, mining activities or the use of fill material containing this rock to cause water quality impacts.

<u>*2007 Recommendations*</u>

No scientifically and economically defensible way to minimize the Anakeesta exposure has been found. DWQ strongly discourages all construction projects that disturb Anakeesta rock formations. DWQ does not plan to conduct further sampling on Beech Flats Prong.

2.3.2 Savannah Creek [AU# 2-79-36]

<u>*Current Status*</u>

The Savannah Creek 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 sampled fecal coliform bacteria concentrations in Savannah Creek as part of a Class B (Recreation) use-attainability study for the Tuckasegee River initiated in 2003 (See Section 2.3.4). 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. For a description of Recreation Use Support assessment methodologies, refer to Appendix VIII.

DWQ also sampled the fish and benthic communities at sites GF23 and GB23. The benthic population declined from Excellent in 1994 to Good in 2004. The fish community received a Good bioclassification. These results indicate Savannah Creek is Supporting aquatic life. 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. Streambanks have been stabilized with concrete slabs and riprap.

The Watershed Association for the Tuckasegee River (WATR) coordinates sampling in the Savannah Creek Watershed as part of a larger the Volunteer Water Information Network (Chapter 13) project. Data collected on tributaries and in the mainstem between July 2003 and June 2005 indicated turbidity and suspended solid readings were well above the regional average, despite 80 percent of these samples being collected during dry weather or after light precipitation, when erosion due to rainfall is low. This condition usually occurs when there is heavy sediment build-up in the streambed, when there is extensive streambank erosion, or in high energy, fast flowing streams in headwater areas where watersheds have been cleared of most trees. Suspended solid readings were highest in Greens Creek [AU# 2-79-36-11], suggesting it may be a major source of sediment delivered to Savannah Creek. WATR plans to sample other tributaries to Savannah Creek to assess the spatial pattern of erosion and sediment transport.

WATR also evaluated fecal coliform concentrations in the Savannah Creek watershed. Their results support DWQ's findings and suggest contamination exists both upstream of and within Greens Creek.

Water Quality Initiatives

After monitoring results noted Greens Creek was a significant contributor of both sediment and fecal coliform bacteria, WATR embarked on an effort to develop a Watershed Action Plan. In 2004, WATR requested and received technical assistance from the U.S. Environmental Protection Agency (EPA).

WATR volunteers embarked on a sampling project consisting of daily turbidity readings at 10 sites in the Greens Creek watershed and daily rainfall, throughout April 2005. The purposes of the study were (1) to determine spatial and temporal patterns in turbidity, and (2) to evaluate the turbidity values with respect to the DWQ limit of 10 NTU for trout-habitat waters. Greens Creek drains a 9.4 sq. mile watershed within the 47 sq. miles of Savannah Creek watershed. This nested watershed configuration will allow WATR and its partners to focus efforts first on Greens Creek in order to gain early success via measurable criterion. Meanwhile actions on the larger and more complex Savannah Creek Watershed can grow as funding and public awareness expand. By focusing on the Savannah Creek Watershed, WATR is dedicated to making a reduction in the pollution loading to the middle reach of the Tuckasegee River where the public recreation is concentrated.

Sites were selected above the mouth of each main tributary, and also upstream of the tributary confluence along the main stem of Greens Creek. These site pairs were used to determine the relative sediment input for each tributary. The Unnamed Tributary (Site 9) is a special case. It drains a small area that was heavily impacted by a developer who was cited and fined for violating the Jackson County sediment control ordinance about the time of this project. Therefore, the Unnamed Tributary was a known turbidity source from the onset of the project. WATR's turbidity data are summarized in Table 7.

Table 7 Summary of turbidity along Greens Creek and in its tributaries collected daily during April 2006 – Source: Watershed Association of the Tuckasegee River

Site	Site Name	Min	Median	Max	Average	Freq greater than 10 NTU
1	Greens Crk at Confluence	5.4	10.2	77.0	13.5	53%
2	Brooks Branch	13.9	23.3	154.0	28.9	100%
3	Greens Crk abv Brooks	5.7	9.9	69.2	12.7	47%
4	Brushy Fork	5.1	9.4	35.3	10.5	30%
5	Greens Crk abv Brushy Fork	5.6	8.7	53.9	10.9	37%
6	Peewee Branch	14.0	19.2	77.4	21.7	100%
7	Sugar Fork	4.0	8.0	20.4	8.5	10%
8	Greens Crk abv Sugar Fork	4.7	7.9	55.8	10.1	17%
9	Unnamed Trib	19.6	28.1	751.0	62.5	100%
10	Upper Greens Creek	3.3	5.4	13.1	5.6	3%

These data suggest that the Unnamed Tributary, Peewee, and Brooks Branch should be the focus of further assessment and, in time, the focus of restoration activities. These data, with other corroborating measurements, will help in planning restoration activities for Greens Creek watershed and, in turn, help improve conditions in Savannah Creek.

2007 Recommendations

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. A key challenge to stream restoration is gaining voluntary participation and improvements from local landowners. In mountainous terrain, stream density is significantly larger than in other parts of the state, and there are many stream-side landowners. Upslope landowners also contribute sediment through gullies and across down-slope land parcels. Consequently, public education and involvement is critical to load reductions. Sediment reduction from excavation and construction activities will depend heavily on education of excavators and contractors through Clear Water Contractor Courses and follow-up educational opportunities. Achieving load reductions will also require dilligent enforcement of the county erosion ordinance. Despite all the tools and BMPs available, innovation and extensive public communication are still needed to address the challenges of erosion in mountainous watersheds. With respect to fecal coliform loads, proposed reductions can utilize the WaDE program extensively. The Greens Creek Watershed Action Plan is scheduled for completion in 2007. It will provide site-specific strategies to reduce sediment and erosion impacts to Savannah Creek. Funding should be directed towards implementing these strategies.

2.3.3 Scotts Creek [AU# 2-79-39]

Current Status

Scott Creek 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. (See Section 2.3.4) 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. The sources of fecal coliform contamination are unknown, but may include failing septic systems and/or nonpoint source runoff. For a description of Recreation Use Support assessment methodologies, refer to Appendix VIII.

In 2004, DWQ evaluated the fish and benthic macroinvertebrate communities at sites GF24 and GB20, respectively. GB20 is downstream of the Sylva WWTP and a few other small dischargers and adjacent to the parking lot of the Great Smoky Mountains Railroad in downtown Dillsboro. The stream channel is highly modified and the bank is armored by riprap. The site received a low habitat score because of the poor riparian zone in Dillsboro, plus a relatively uniform riffle/run habitat. The stream was very turbid after storms during the sample period and water levels rose and fell quickly, reflecting the high amount of impervious surface in the watershed. The fish community upstream of US19/23 was not rated in 2004 because it had characteristics of a trout stream (low total species diversity, low diversities of darters and cyprinids, a low percentage of omnivores + herbivores, and a high percentage of insectivores) and criteria have yet to be developed for this type of fish community. Wild, young-of-year and stocked adult brown trout were collected along with wild, young-of-year, juvenile, and adult rainbow trout. Species collected at this site but not typically found in trout streams included redbreast sunfish, bluegill, and largemouth bass. Although not rated, the community appeared to be supporting its designated uses as trout (Tr) waters.

Water Quality Initiatives

The Watershed Association for the Tuckasegee River (WATR) coordinates sampling in Scotts Creek as part of a larger the Volunteer Water Information Network (Mass, 2006). WATR's VWIN annual sampling program runs from July through June. As of October 2006, WATR had collected 38 months of VWIN data at 15 sites (16 sites during the first 2 years) throughout the watershed. WATR has also collected fecal coliform data for the last 3 years, particularly during 2004, which can be compared to DWQ coliform sampling in 2005.

Table 8 Mean TSS Concentrations

Source: Watershed Association of the Tuckasegee River

	Mean TSS
	mg/L
Kirkland Crk	19.4
Greens Crk	16.2
Savannah Crk	19.1
Barkers Crk	14.3
Scotts Crk	34.7
Tuck. abv Barkers Crk	19.9
Tuck. blw Bryson City	16.9
Cullowhee Crk WCU	10.4
Tuck. abv Scotts Crk	11.4
Conley Crk	10.9

WATR's data supports DWQ's findings of elevated fecal coliform concentrations and also shows relatively higher average concentration of suspended sediment compared to other streams in Subbasin 04-04-02. See Table 8.

In 2006, WATR received funds to develop and install a public turbidity meter. The novel project will raise public awareness of turbidity concentrations by displaying real-time turbidity values on a billboard near the creek. WATR with the help of faculty from Western Carolina University will develop and install the real-time turbidity meter on Scotts Creek in Sylva. People who drive or walk by will know the turbidity level and can see the conditions in the creek at the same time. This meter coupled with public education efforts including a public survey before and after the meter is activated and articles in the local paper will help inform the citizens of Scotts Creek and beyond. The data will be electronically logged and used for assessment in future planning and restoration projects.

In the fall of 2004, WATR put together the Coliform Action Group, a group of advisors and stakeholders who work cooperatively to identify coliform sources and develop solutions to reduce contamination sources. In particular, WATR worked with the Tuckasegee Sewer and Water Authority (TWSA) to sample along Scotts Creek above and within Sylva, with the objective of defining source areas. Additionally, TWSA has made significant investments in sewer line repair and replacement. Their efforts have identified and repaired or replaced many old and leaking sewer pipes.

2007 Recommendations

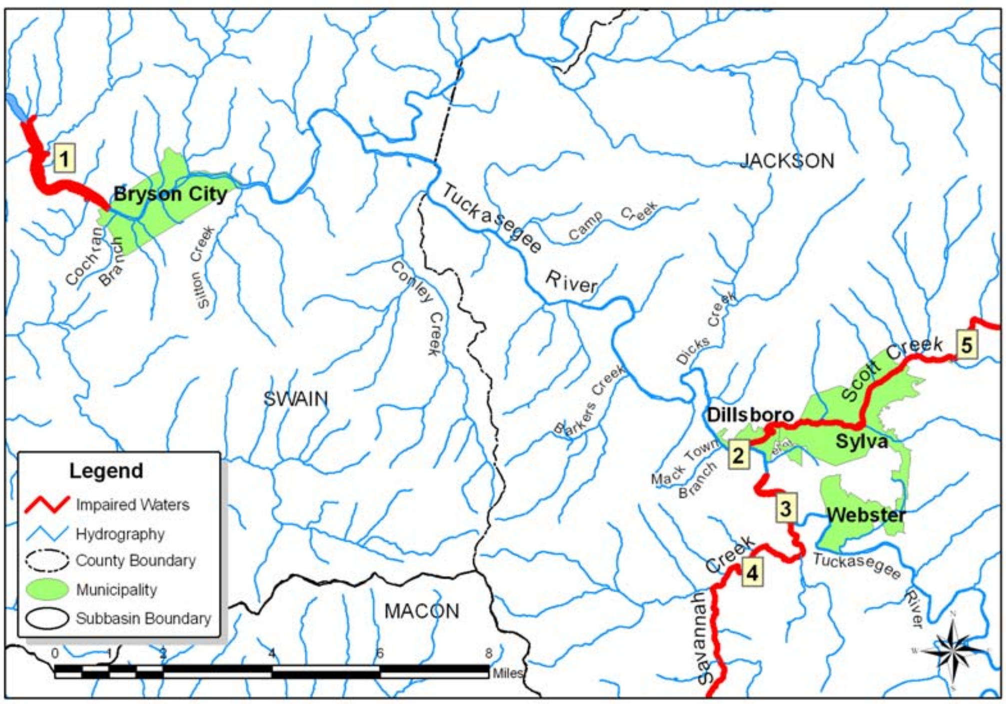
Efforts to identify and repair or replace leaking sewer lines should continue. Additional efforts to identify other sources of fecal coliform contamination are necessary. Monitoring to track fecal coliform bacteria concentrations should continue. TWSA needs support for camera inspections and other standard methods to detect fecal sources to Scotts Creek, followed by corrective actions. To address sediment and turbidity concerns, a plan to reduce erosion in the watershed should be developed. The plan should be implemented. Jackson County and the Towns of Sylva and Dillsboro should implement stormwater control measures equivalent to or stronger than Phase II stormwater requirements (See Section 8.2.2). Sediment and erosion control ordinances must be strictly enforced.

2.3.4 Tuckasegee River [AU# 2-79-(35.5)a, 2-79-(38), and 2-(78)a]

<u>*Current Status*</u>

In 2001, DWQ received a request to reclassify two Tuckasegee River reaches to Class B - Recreation. The requested reaches included the river from Savannah Creek to Mack Town Branch and Cochran Branch to the Tuckasegee River Arm of Fontana Lake. A study to determine if fecal coliform bacteria levels met Class B standards was initiated in 2003. Initial sampling revealed extremely elevated fecal coliform concentrations. The study was rescheduled for 2005 to allow time for sewer and wastewater treatment upgrades to be completed. The study was completed in 2005 and included sampling on major tributaries with suspected fecal coliform contamination. With the exception of one sample location between Leatherwood and the Dillsboro Dam, all sites evaluated in this study exceeded fecal coliform bacteria standards. Therefore, the Tuckasegee River is Impaired in the Recreation category in these reaches (See Figure 6). At the Dillsboro Dam, the watershed drainage area is approximately 347 mi^2.

Figure 6 Recreation Impairment in the Tuckasegee River-Watershed



	AU#	River Name	Segment	Mileage/Acers
1	2-(78)a	Tuckasegee	Lemmons Creek to Peachtree Creek	170.6 ac
2	2-79-(38)	Tuckasegee	Dillsboro Dam to Macktown Branch	0.7 mi
3	2-79-(35.5)a	Tuckasegee	Savannah Creek to Upper Tuckasegee Upstream of Yeallow Bird Creek	1.4 mi
4	2-79-36	Savannah	Source to Tuckasegee River	13.4 mi
5	2-79-39	Scotts Creek	Source to Tuckasegee River	15.3 mi

The Tuckasegee Water and Sewer Authority (TWSA) operates two wastewater treatment plants that discharge to the upstream reach. WWTP #1 discharges directly into the Tuckasegee River and WWTP #2 discharges to Scotts Creek. Each of these is required to monitor effluent bacteria concentrations. Concentrations at WWTP #2 were consistently low. Concentrations were elevated at WWTP #1, but did not coincide with DWQ measurements within the river. Additionally, concentrations in Savannah Creek and Scotts Creek above WWTP #2 were the highest in the study, suggesting sources other than the treatment plants are contributing to impairment. These sources are unknown, but could include failing septic systems, illicit discharges, and residential/agricultural runoff.

In December 2006, TWSA entered into a Special Order of Consent (SOC) with DWQ because of chronic difficulties meeting discharge limits for Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and Fecal Coliform in their NPDES permit. During the time in which this SOC is effective, TWSA will operate under relaxed permit limits and follow a specific schedule for improvements that will assure their compliance with the original permit limits by 2010. The schedule is as follows:

1. Completion of preliminary Engineering Report – June 1, 2006
2. Submit NPDES Renewal with flow increase – April 1, 2007
3. Submit Plans and Specs for Upgrade after issuance of Permit – May 1, 2008
4. Notice to Proceed for Construction – March 1, 2009
5. Complete Construction and submit engineering certification – August 1, 2010
6. Compliance with NPDES Permit Final Limits – December 1, 2010
7. Quarterly progress repots should be submitted to the Asheville Regional Office until the completion of the project.

TWSA will be subject to a $1000 fine for each violation of this SOC and a $5,000 fine if the final compliance deadline is not met.

The Bryson City Wastewater Treatment Facility discharges to the Tuckasegee River just upstream of the lower study reach. This facility is also required to disinfect and monitor its effluent concentration. The facility was fully compliant during the study, but fecal coliform levels remained elevated in the river, suggesting again that other sources are contributing to impairment in this reach. A dramatic spike in fecal coliform concentrations following a one-inch rainfall points towards nonpoint sources of contamination. The plant has also suffered from grease problems and has begun implementation of a grease elimination program that includes flushing lines and an education component. The Bryson City also has a grease ordinance that prohibits disposal of grease into the sewer system.

In addition to bacteria issues, sediment and turbidity are concerns in the Tuckasegee River. The entire Tuckasegee River watershed drains to Fontana Lake, carrying a tremendous load of sediment, trash, and woody debris. The swift and powerful currents slow as they enter the backwaters of the lake downstream of Bryson City, depositing their load. Several feet of sediment is deposited yearly and trash and woody debris block recreational access. These deposits are heaviest following heavy rainfall events. WATR estimates 55,000 tons of sediment were transported past Bryson City during the hurricanes of September 2004.

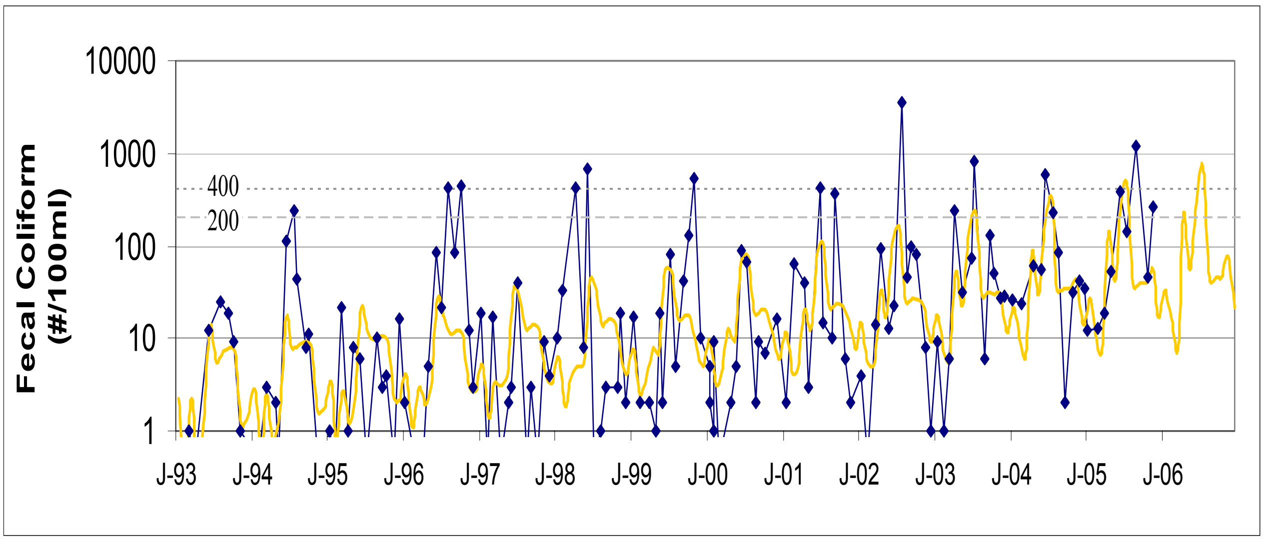
The Fontana Lake Users Association in cooperation with Swain County conducts an ongoing trash and debris cleanup program. This program collects trash and floating woody debris deposited in the Fontana headwaters after periods of heavy rain. Large floating trees are bundled and anchored to the lakebed to replace fish habitat destroyed by excess sediment deposits.

2007 Recommendations

The Watershed Association of the Tuckasegee River analyzed fecal coliform bacteria collected at site GA5 and determined a seasonal trend in concentration may mask an upward trend in bacteria concentrations. In the use-attainability study of the lower Tuckasegee River in Bryson City, fecal coliform levels above the recreation-use limit were observed at the monitoring point at the inflow of Cochran Branch, in the vicinity of the outflow of the Bryson City WWTP. It was estimated that impairment did not extend up river because of measurements made at the ambient station located in the center of Bryson City. Monthly measurements, when averaged together, were below the regulatory limit indicating acceptable conditions (no impairment). A closer look at the data suggests that this conclusion could be revisited.

The monthly data are shown in Figure 7. Looking only at the data points for the summer months (June, July, and August) it appears that most years have at least one value over the retulatory limit of 200 col/100 mL, and in the past 2 years the 3-month average value has exceeded the limit (225 and 403 col/100mL for 2004 and 2005, respectively). Because it is the summer months when recreational exposure usually occurs, a seasonal evaluation of bacteria concentrations is needed.

Figure 7 Monthly Fecal Coliform Concentrations Measured by DWQ at the Tuckasegee River - Bryson City station. The 200 and 400 unit standards appear as straight dashed and dotted lines, respectively.



DWQ will complete a trend analysis that compensates for seasonality and flow to determine if fecal coliform concentrations are rising at this site. Fecal coliform bacteria sources must be identified. Once identified, a plan to reduce or eliminate those sources should be developed and implemented.

To effectively reduce sediment deposits in Fontana Lake, erosion problems must be addressed across the entire 1,571mile² watershed. Reductions at this scale require comprehensive programs implemented by citizen groups, local governments, and service providers best suited to implement such a plan. At a minimum, property owners should implement recommendations included in Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Swain County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding. Local, State, and Federal governments should adopt and/or enforce programs that require erosion control and low-impact development techniques.

2.4 Status and Recommendations for Waters with Noted Impacts

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

2.4.1 Alarka Creek [AU# 2-69-(2.5)]

Current Status

Alarka Creek is 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.

2007 Recommendations

Where damaged or missing, a vegetated riparian zone should be reestablished. Sources of nutrient enrichment should be identified and corrected. Property owners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf.

The impacts from agricultural operations can be reduced through use of agricultural best management practices including streambank stabilization, livestock exclusion, off stream watering systems, and critical area seeding. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Swain County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.4.2 Camp Creek [AU# 2-79-49]

Current Status
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 the reclassification was appropriate. This survey was conducted outside the data window for this assessment, so the data will not be used to assign a use support rating at this time. However, 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.

2007 Recommendations
Stream bank stabilization and riparian zone restoration projects are needed in this watershed. The Swain County Soil and Water District and local NRCS staff can assist landowners with choosing appropriate BMPs and identifying funding

2.4.3 Cullowhee Creek [AU# 2-79-31a & b]

Current Status
Cullowhee Creek 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 2004, DWQ sampled Cullowhee Creek at two locations upstream of the university. The benthic community at site GB29 rated Excellent, but the fish community at GF13 only received a Good-Fair bioclassification. These results suggest water quality is good, but habitat problems are negatively affecting fish populations.

In 2004, a leaking sewer pipe was found in an unnamed tributary to Cullowhee Creek, but ownership was questionable. TWSA assumed responsibility and replaced the leaking line. This along with other sewer improvements around the Cullowhee community and an expanding university population will likely bring increased demand for housing development.

Water Quality Initiatives
In June 2005, a major stream restoration project was initiated on approximately 5,000 feet of Cullowhee Creek flowing through WCU. Discovery Land Company is funding the project as mitigation for stream impacts caused during a development project in the Cashiers area. The project will restore many of the stream's functions lost during recent decades of substantial development within the watershed. Such functions in the stream channel include improving bank stability, sediment transport, and storm flow regulation. More information on this project can be found at http://www3.wcu.edu/%7Emlord/CCRestoreWeb/CCRestorationHome.html

2007 Recommendations
DWQ should sample Cullowhee Creek downstream of the urbanized university area to track the water quality impacts resulting from development in this expanding community. Best management practices designed to control stormwater flow should be installed where possible and new development projects should incorporate low impact development (LID) techniques. Refer to Chapter 6 for information on LID.

2.4.4 Panther Creek [AU# 2-115]

Current Status

Panther Creek, in northeastern Graham County, is a high gradient tributary to the Panther Creek Arm of Fontana Reservoir. Habitat and water quality are good, but the benthic community has declined from Excellent to Good at site GB16. Both the benthic sample and a fish community sample at site GF21 indicate nutrient enrichment. New residential development and small agricultural operations are possible sources for nutrients.

2007 Recommendations

Monitoring should continue to determine if stream quality continues to decline. Residential property owners can use a variety of techniques to reduce pollution caused by runoff from their yards. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Graham County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.4.5 Stecoah Creek [AU# 2-130]

Current Status

Stecoah Creek, 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 fish community at site GF26 indicated nutrient enrichment, possibly from straight piping and/or nonpoint source runoff.

2007 Recommendations

Restoration will likely improve conditions in Stecoah Creek. Restoration options should be evaluated and if deemed feasible, a restoration plan for Stecoah Creek should be developed and executed. In the meantime, residential landowners can use a variety of techniques to reduce pollution caused by runoff from their property. Residents should refer to Chapter 6 and the document "Improving Water Quality in Your Own Backyard." This pamphlet is available free of charge through the Division of Water Quality and online at http://h2o.enr.state.nc.us/nps/documents/BackyardPDF.pdf. The impacts from agricultural operations can be reduced through use of agricultural best management practices. There are a variety of funding sources that can be used to make installation of these improvements more affordable to farm owners. Chapter 9 describes many of these programs. The Graham County Soil and Water District and local NRCS staff can assist farm owners with choosing appropriate BMPs and identifying funding.

2.5 Additional Water Quality Issues within Subbasin 04-04-02

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

This section also discusses ideas, rules, and practices in place to preserve and maintain the pristine waters of the Little Tennessee River basin. This is particularly important because many of the waters are designated high quality or outstanding resource waters (HQW and ORW, respectively). Those surface waters given an Excellent bioclassification may be eligible for reclassification to a High Quality Water (HQW) or Outstanding Resource Water (ORW). These streams are shown in Table 5. Special management strategies, or rules, are in place to better manage the cumulative impact of pollutant discharges, and several landowners have voluntarily participated in land conservation, stabilization, and/or restoration projects.

2.5.1 Fontana Lake Waste Recovery

Fontana Lake is a popular recreation site, and over many years has developed a large and permanent population of houseboats in several of its coves. In the late 1990's, local citizens became concerned that untreated sewage produced on these boats was discharging directly into the lake. High fecal coliform bacteria concentrations supported these concerns, and during winter lake level drawdowns, when houseboats rest on dry land, straight pipes connected directly to toilets were identified under many of the boats.

After confirming raw sewage was discharging into the lake, local citizens formed a partnership to eliminate the discharges and create a sewage pumping and collection program called Fontana Lake Waste Recovery (FLWR). The partnership includes houseboat owners, marina operator, the Fontana Lake Users Association, and the Partnership for the Future of Bryson City/Swain County. The program is supported by ordinances in Graham and Swain Counties that require every houseboat owner to install a permanent toilet and sewage holding tank on their boat. Marina and boat dock owners maintain pump-out stations and recovery boats to serve houseboats within their harbor. Houseboat owners pay a yearly fee to fund the pump-out system. The ordinances also specified that boats not in compliance could be removed from the lake.

The program became fully operational in 2005, and fecal coliform concentrations dropped dramatically. The success of this program is largely due to the cooperation between a variety of organizations and individuals. TVA and CWMTF provided substantial funding to build the pump stations, retrofit the houseboats, and acquire pump boats. Swain and Graham counties administer the program with marina and houseboat owner participation.

In 2006, WATR was asked to design and coordinate a monitoring program to determine the fecal coliform levels in the lake and to determine if the required wastewater holding tanks were effective.

Forty-one (41) sampling sites were identified in the vicinity of five marinas: Alarka, Greasy Branch, Crisp, Prince, and Fontana. Each site was sampled at least twice; and the sites near Alarka and Greasy were sampled a third time. The sites were chosen in order to have one site upstream of all the houseboats (in the inundated portion of the feeder tributary) and subsequent sites located roughly equidistant toward the main body of the lake. In addition, several tributaries were also sampled farther upstream where the creeks were flowing and not inundated. Data showed that Fontana Lake was very clean except for two particular sites, where measured fecal coliform exceeded the NC health standard for organized recreational use, which is 200 col/100mL. One site located on Panther Creek upstream of all actively used houseboats is downstream of a popular campground. The exceedence is judged to be caused by contamination from the tributary and not from the houseboats. In the second case, two samples exceeding the health standard were collected in the vicinity of a houseboat that was known to be out of compliance with the ordinance. Soon thereafter, the offending houseboat was moved and access was denied until it was brought into compliance.

In this study, the tributaries generally had more contamination than the water around the marinas. The average fecal coliform concentration in the tributaries was 98 col/100mL, whereas the average for samples collected near the marinas (excluding the samples collected upstream in the inundated portion of the creeks) was 12 col/100mL, statistically different at the 0.01 level. While none of the tributary samples exceeded the health standard, the sampling itself was limited; and it appears likely that some of the tributaries are capable of exceeding that limit. More assessment of the tributary fecal levels needs to be done in both Swain and Graham counties.

The study concludes that tributaries feeding Fontana Lake are the most significant source of fecal coliform contamination in the lake, and that wastewater from in-compliance houseboats no longer poses unacceptable health risks. In short, this study shows the lake to be very clean with only minor bacterial levels – well below levels of concern (McMillan and others, 2006).

DWQ applauds the initiative and creativity demonstrated during the creation of this program. It is a model for interagency, government, and citizen cooperation.

2.5.2 Management Strategies for Water Quality Protection

Municipalities and smaller outlying communities are being pressured to expand and this involves construction and/or developing in areas along tributaries of the Tuckasegee River and the river itself. HQW and ORW are supplemental classifications to the primary freshwater classification(s) placed on a waterbody (Chapter 5). Management strategies are associated with the supplemental HQW and ORW classifications and are intended to protect the current use of the waterbody.

Waters in the Little Tennessee River Basin under special management strategies are designated with a “@” or “#” symbol in the stream classifications schedule. The “@” identifies waters that are subject to the specific actions specified in 15A NCAC 2B .0224, the High Quality Waters (HQW) rule, in order to protect downstream waters designated as HQW. Point source discharges are prohibited to segments classified HQW with a “#” symbol according to the provisions of 15A NCAC 2B .0201 in order to protect the existing and anticipated usage of those waters.

A summary of the special management strategies for HQW and ORW waters can be found in Chapter 5. Detailed information can be found in the document entitled *Classifications and Water Quality Standards Applicable to Surface Waters and Wetlands of North Carolina* (NCDENR-DWQ, 2004). This document is available on-line at http://h2o.enr.state.nc.us/admin/rules/codes_statutes.htm.

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

Those streams noted as having Excellent bioclassifications in Table 5 may qualify for HQW or ORW classification. There may also be many more streams in the basin that qualify for such designation that DWQ has not monitored. DWQ relies on citizen requests to initiate the stream reclassification process (See Section 5.1.4) and encourages requests for reclassification to HQW or ORW when it is warranted. Appropriate stream classification will help to protect water quality in the long-term.

Native Southern Appalachian Brook Trout occupy many high elevation streams in the Little Tennessee River Basin. They are the only trout native to the southern Appalachian Mountains and require clear, cold streams to survive. They are very sensitive to excess sediment. Efforts to restore and expand their populations across the basin will benefit from designation as HQW or ORW. Those streams that can support Native Appalachian Brook Trout should be identified and evaluated for qualification as HQW or ORW.

2.5.3 North Shore Fontana Lake Stream Reclassification

In June 2005, the North Carolina General Assembly passed Session Law 2005-97, directing the Environmental Management Commission to initiate a rule-making process to adopt rules to reclassify the entire watershed of all creeks that drain to the north shore of Fontana Lake between and including Eagle and Forney Creeks.

In August 2005, DWQ biologists conducted a benthic community survey to evaluate the appropriateness of ORW status for the streams identified by the NC General Assembly. While it was not practicable to sample all 35 named streams, it was appropriate, given the protected and pristine nature of the watershed, to select representative streams of varying drainage areas and extrapolate the results of the assessed streams to the unassessed streams with similar drainage areas. Therefore, seven sites were sampled, with drainage areas ranging from 0.5 to 44.8 square miles.

Each site sampled received an Excellent bioclassification. Additionally, at least one rare species was collected at every site. In Eagle Creek, biologists collected an extremely rare species that has been collected only seven other times out of 5,800 benthic collections performed by DWQ. Based on these results, DWQ believes all streams identified in Session Law 2005-97 deserve

ORW classification. At the time of this writing, the request for reclassification was moving successfully through the approval process.

2.5.4 Federal Energy Regulatory Commission Hydropower Relicensing

The Federal Energy Regulatory Commission (FERC), under the authority of the Federal Power Act, issues licenses for the construction, operation, and maintenance of non-federal hydroelectric developments. Duke Energy operates several hydroelectric projects in subbasin 04-04-02 including the East Fork, West Fork, Bryson, and Dillsboro Projects. The operation of these hydropower projects has provided an affordable and dependable supply of electrical power to a growing population in western North Carolina since 1929. These projects were built and began operations 50 – 80 years ago, well before modern regulatory requirements were in place. While providing much needed power to a growing customer base, these same facilities have also resulted in reduced flows and fluctuating flows in river reaches downstream from dams and fluctuating reservoir levels. This has resulted in a variety of impacts to water related natural resources. The licenses for these projects expired in 2005 and 2006. The process to relicense these projects began in 1999.

The relicensing of these facilities will have a significant impact on the future health of these important freshwater ecosystems as well as on the lives of the people and communities who utilize and live adjacent to the resources. In late 2000, in an effort to identify issues and stakeholder interests in the projects, Duke Energy assembled the Tuckasegee Cooperative Stakeholder Team (TCST), consisting of stakeholders who represented various interests and uses of the waters and related natural resources of the Tuckasegee River Basin upstream of Bryson City. The TCST included state and federal resource agencies, local governments, adjacent landowners, resource users, water dependent businesses, conservation organizations, Duke Power and others. The TCST worked to develop a comprehensive set of recommendations for the new license that addresses resource protection, enhancement, and mitigation measures commensurate with project impacts. The documented result of this effort is called the Consensus Agreement.

The Consensus Agreement is comprehensive in scope and includes numerous provisions for resource management, protection, and enhancement opportunities including: new recreation facilities and access areas, improvements in recreation and rule curve information, changes in lake levels and rule curves, minimum flows and bypass flows, angling and boating recreation flows, resource enhancement initiatives, shoreline management, sediment management, and cultural resource protection. The complete consensus agreement can be found in the Bryson (FERC #2601), Dillsboro (FERC #2602), East Fork Tuckasegee River (FERC #2698), or West Fork Tuckasegee River (FERC #2686), Nantahala (FERC #2692) Final License Applications filed to FERC. These and other associated documents can be obtained at: http://www.ferc.gov.

2.5.5 Kirkland Creek [AU# 2-79-61-(2)] and Other Tuckasegee River Tributaries

Current Status
DWQ did not sample Kirkland Creek during this assessment cycle, but reconnaissance by WATR revealed fecal coliform contamination and elevated turbidity levels on par with Scotts Creek and Savannah Creek. Those two streams are significantly degraded and will appear on the 2008 303(d) list of impaired waters (See Sections 2.3.2-4).

In lower reach of the Tuckasegee River as it flows through Swain County, other creeks also have problems but WATR's monitoring data is more sparse. At Conleys Creek, for example, the geometric mean concentration for fecal coliform was >484 col/100mL.

With volunteer help and generous assistance from the Jackson County Public Health Department, who performed the laboratory evaluations, WATR sampled creeks in Swain County for bacteria. These results are shown in Table 9.

Table 9 WATR Monitoring: Bacteria Concentrations in Tuckasegee River Tributaries
Source: Watershed Association of the Tuckasegee River

Location	**e. coli** (MPN/100 mL)				**Fecal coliform** (col/100ml)	
	7/5/06	7/17/06	8/1/06	8/8/06	8/1/06	8/8/06
Tuck Abv Connelly	**1460**	52	**143.9**		107	
Connelly Creek	**200**	**246**	101.4		77	
Oconaluftee at Two Rivers Motel	**2430**	**158**	**235.9**		163	
Coopers Creek	**200**	NA	73.8		90	
Johnson Branch		**683**	**686.7**	**13775**	**200**	**547**
Kirkland Creek	**740**	**341**	74.9		61	
Jenkins Branch	**7060**	**6131**	**2420**	**48392**	**200**	**7375**
Toot Hollow	**740**	**481**	**2420**	**1112**	**200**	**560**
Bryson Branch	**630**	**146**	**2420**	**910**	**200**	193
Tuck Below Bryson City	**850**	52	72.3		62	
Lower Alarka Creek	**520**		122.3		81	

EPA recommends the maximum e.coli level for organized recreation is 126 MPN/100mL

2007 Recommendations
Further assessment work is necessary to identify and rank the relative health of tributaries to the Tuckasegee River. Biological community data is needed in addition to an intensive fecal coliform investigation and turbidity/suspended solids analysis. The results of those surveys should be used to secure funding for planning and to restoration of water quality. DWQ will conduct monitoring as resources allow, and encourages WATR to continue its monitoring efforts.

2.5.6 General Support for Volunteer Watershed Associations

WATR identified the following needs that must be met to assure their ongoing success and effectiveness:

- Open and regular communication with state regulators, state agency representatives, watershed experts, and city/county government workers is critical. The Little Tennessee Non Point Source Team facilitated this communication during the last basinwide cycle. The Team should continue to meet and adjust to changing watershed needs. In late 2005, the Non Point Source Team initiated a web site for the dissemination of the information to the public www.littleTbasin.org about water quality issues.

- Technical assistance is needed from EPA and NC State Extension.
- Continued collaboration with the Eastern Band of Cherokee Indians and the support of Cherokee Preservation Foundation. WATR worked with the Cherokee Office of Environment and Natural Resources to organize a regional workshop *Partners for Water Quality in the Little Tennessee River Basin* and Clear Water Contractor courses designed to train construction professionals on techniques used to avoid water quality impacts during construction. Similar activities should be pursued in the next basinwide cycle.
- Form an Oconaluftee Watershed Group on the Reservation.
- Funding from a wide variety of sources is needed. Funds to pay for operational expenses are particularly important.
- Watershed associations need training on data collection methods and Quality Assurance Project Plan (QAPP) production. This will assure volunteer data is available for official decision-making at appropriate scales.
- New citizen-based training programs, such as the Stream Monitoring Information Exchange (SMIE), should be implemented. This system is being tested in WNC, but more training is needed.
- Better communication is needed with the NC Ecosystem Enhancement Program (EEP). In late 2005, EEP issued a request for proposals for restoration projects on 15000 ft of streams in the Tuckasegee River watershed. There was no consultation with local watershed organizations prior to the request. Therefore, projects proposed by outside engineering firms may conflict with ongoing efforts by local watershed organizations. Citizen cooperation for such an endeavor is paramount.
- Flexible conservation easements are needed. In mountainous areas, streams are often property divides with two landowners owning opposite stream banks, making agreement and cooperation difficult. Flexibility and innovation in conservation easements used for stream restorations is important to protecting aquatic and riparian habitat.
- Support is needed for watershed-wide data acquisition and assessment. Although WATR has collected VWIN data on 11 tributaries to the Tuckasegee River, there are many more streams that are suspected of contributing high loads of turbidity, sediment and fecal coliform contamination. More that 80 percent of the watershed remains unmonitored by DWQ. There are few grant programs in DWQ or EPA that focus primarily on monitoring.
- Better enforcement of trout stream buffers and buffer education for landowners is critical. Currently, county inspectors poorly enforce the requirement for 25-ft natural buffers along classified trout streams. Landowners with streamside properties need both education and incentives for restoring the functionality of buffers, i.e., stream bank stabilization, sediment trapping, and stream shading for temperature control.
- Long-term support for Clear Water Contractors Courses is needed. Erosion occurring during excavation and development at building sites is a major source of turbidity and sediment to the streams. In 2006, WATR facilitated the first Clear Water Contractor courses in the watershed. The project was sponsored by the Cherokee Preservation Foundation, the Cherokee Office of Environment and Natural Resources, and the Southwestern NC Resource, Conservation, and Development Council. These courses are critical to engendering environmental stewardship within the development community. These classes should be held annually. A shorter refresher course should be developed for graduates of past courses. The program should be expanded to include Macon and Graham Counties.
- A comprehensive data review and summary is needed. There are no programs to bring together historic and current data to assess potentially unknown water quality problems, such as residual contamination from past mining and agricultural operations. In Haywood County,

pesticide use led to groundwater contamination, and WATR knows of no systematic assessment as to whether or not similar conditions exist in the Tuckasegee river watershed.

- Ecological and water quality data, such as those collected by the NC Wildlife Resources Commission and by university professors, need to be combined to get a better idea of conditions.
- Groundwater quality in the watershed should be systematically assessed.
- Effects of Christmas tree growing on water quality need to be documented for the special conditions found in mountainous terrain.
- An economic cost benefit analysis to determine the value of trout and other sport fisheries; stream and river access; clean and clear water; and undisturbed habitat to the Jackson and Swain County economies needs to be completed.
- WATR needs to assist in citizen conservation efforts upstream from the Duke Energy impoundments.

2.5.7 Septic System Concerns

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

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

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

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

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

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

2.5.8 Floodplain Protection

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

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

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

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

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

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

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

2.5.9 Special Management Strategies for Threatened and Endangered Species

Several streams in Little Tennessee River subbasin 04-04-02 are home to federally listed Threatened and Endangered Species. The Tuckasegee River hosts the Appalachian elktoe and the Spotfin Chub. Section .0100 of the Administrative Code states the following:

> Certain waters provide habitat for federally-listed aquatic animal species that are listed as threatened or endangered by the U.S. Fish and Wildlife Service or National Marine Fisheries Service under the provisions of the Endangered Species Act, 16 U.S.C. 1531-1544 and subsequent modifications. Maintenance and recovery of the water quality conditions required to sustain and recover federally-listed threatened and endangered aquatic animal species contributes to the support and maintenance of a balanced and indigenous community of aquatic organisms and thereby protects the biological integrity of the waters. The Division shall develop site-specific management strategies under the provisions of 15A NCAC 2B .0225 or 15A NCAC 2B .0227 for those waters. These plans shall be developed within the basinwide planning schedule with all plans completed at the end of each watershed's first complete five year cycle following adoption of this Rule. Nothing in this Rule shall prevent the Division from taking other actions within its authority to maintain and restore the quality of these waters.

An interagency team from the USFWS, the NC Wildlife Resources Commission and the NC Natural Heritage Program was asked to develop technical reports to support NCDWQ's development of site-specific management strategies to restore water quality in the Little Tennessee River Basin. It is intended to provide a framework for getting additional stakeholder input prior to formulating the water quality management strategy which will be completed through rule-making by NCDWQ (with the requisite public involvement and Environmental Management Commission oversight).