Total Maximum Daily Load

Evaluation

for

Thirty Six Stream Segments

in the

Tennessee River Basin

for

Sediment

28 Fish Community Impacted
7 Macroinvertebrate Community Impacted
1 Fish & Macroinvertebrate Community Impacted

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The U.S. Environmental Protection Agency
Region 4
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Submitted by:
The Georgia Department of Natural Resources
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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list, as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* (GA EPD, 2012-2013).

Some of the 305(b) not supporting water bodies are also assigned to Georgia's 303(d) list, named after that section of the CWA. Water bodies on the 303(d) list are denoted by a Category of 5, and are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality criteria. The TMDL process establishes the allowable pollutant loadings or other quantifiable parameters for a water body based on the relationship between pollutant sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

The State of Georgia has identified thirty six (36) stream segments located in the Tennessee River Basin as Biota Impacted. The Biota Impacted designation indicates that studies have shown a degradation of the biological populations in the stream, either in the fish community or benthic macroinvertebrate community. The water use classification of the impacted streams is Fishing. The general and specific water quality criteria for Fishing and Drinking Water streams are stated in Georgia's *Rules and Regulations for Water Quality Control*, Chapter 391-3-6-.03, Sections (5) and (6).

Starting in 1998 and continuing periodically through 2013, the Georgia Department of Natural Resources (GADNR) Wildlife Resources Division (GA WRD) has conducted studies of fish populations in rivers and streams across the State. GA WRD used the Index of Biotic Integrity (IBI) to classify fish populations as Excellent, Good, Fair, Poor, or Very Poor. For this TMDL evaluation, twenty nine (29) stream segments in the Tennessee River Basin have fish populations rated as Poor or Very Poor. For these stream segments, the criterion violated is listed as Bio F, denoting Biota Impacted (Fish Community). These stream segments are included on the list of streams not supporting their designated use, and placed in Category 5. These streams are listed as water quality limited due to sedimentation. Seventeen (17) stream segments in the Tennessee River Basin were rated as Excellent or Good and assessed as supporting their designated use. These Excellent and Good rated supporting stream segments were used to set the sediment yield target for the not supporting streams.

Starting in 2000 and continuing periodically through 2012, GADNR Environmental Protection Division (GA EPD) and their contractors have conducted studies of benthic macroinvertebrate communities in wadeable rivers and streams throughout the State. GA EPD used a Multi-Metric Index (MMI) to classify benthic macroinvertebrates populations as Very Good, Good, Fair, Poor, or Very Poor. For this TMDL evaluation, eight (8) stream segments in the Tennessee River Basin have benthic macroinvertebrate populations rated as Poor or Very Poor. For these stream segments, the criterion violated is listed as Bio M, denoting Biota Impacted (Macroinvertebrate Community). These stream segments are included on the list of streams not supporting their designated use, and placed in Category 5. Again, these streams are listed as water quality limited due to sedimentation. Fourteen (14) stream segments throughout comparable Level IV ecoregions in the northern part of Georgia were rated as Very Good or Good and assessed as supporting their designated use. These Very Good and Good rated supporting stream segments were used to set the sediment yield target for the not supporting streams.

The most common cause of low IBI (fish) and MMI (benthic macroinvertebrates) scores is the lack of in-stream habitat due to stream sedimentation. However, high levels of heavy metals, ammonia, chlorine, elevated temperatures, low dissolved oxygen levels, and extreme pH levels are possible sources of toxicity, and can adversely affect the aquatic communities. These parameters are typically due to point source discharges and are regulated through National Pollutant Discharge Elimination System (NPDES) permits. They are not the focus of this TMDL evaluation. To determine the relationship between the in-stream water quality and the source loadings, each watershed was modeled. The analysis performed to develop sediment TMDLs for the not supporting stream segments and their watersheds utilized the Universal Soil Loss Equation (USLE). The USLE predicts the total annual soil loss caused by sheet and rill erosion. The USLE method considered the characteristics of the watershed including land use, soil type, ground slope, and rainfall intensity. NPDES permitted discharges were also considered in the final sediment load reduction calculations. Modeling assumptions were considered to be conservative and provide the necessary implicit margin of safety for the TMDL.

This TMDL evaluation determined the sediment loads that can enter the not supporting Tennessee River Basin streams without causing sediment impairment to the streams. This is based on the hypothesis that if a not supporting watershed has a total annual sediment loading rate similar to a biologically unimpaired watershed, then the receiving stream will remain stable and will not be biologically impaired due to sediment. For fish populations, Georgia's 305(b)/303(d) Listing Assessment Methodology defines a stream as supporting its designated use when a biological assessment results in an IBI narrative rating of Excellent, Good, or Fair. Similarly, a stream is supporting its designated use when macroinvertebrate biological assessment results in a MMI narrative ranking of Very Good or Good. MMI rankings of Fair are placed in Category 3, assessment pending.

The USLE was applied to the supporting watersheds, as well as the not supporting 303(d) listed watersheds in the same ecoregion or subecoregion, to determine both the existing sediment yields and the sediment load reductions needed to support the beneficial uses (i.e., least impacted conditions). Fish community health rankings are analyzed and compared at an ecoregion level in this TMDL. Macroinvertebrate community health rankings are analyzed and compared at a subecoregion level in this TMDL. Table 1 provides the average, minimum, and maximum modeled sediment yield for the ecoregions in which impaired fish communities have been monitored and observed. Table 2 provides the average, minimum, and maximum modeled sediment yield for the subecoregions in which impaired macroinvertebrate communities have been monitored and observed.

Table 1. Modeled Sediment Yield Summary for Fish Bioassessment Streams

Modeled Sediment Yield (Tons/Acre/Yr) - Fish Streams						
Ecoregion	Supporting			Not Supporting		
	Average	Minimum	Maximum	Average	Minimum	Maximum
Blue Ridge - 66	0.41	0.34	0.65	0.38	0.12	0.64

Table 2. Modeled Sediment Yield Summary for Macroinvertebrate Bioassessment Streams

Modeled Sediment Yield (Tons/Acre/Yr) - Macroinvertebrate Streams						
Subecoregion	Supporting			Not Supporting		
	Average	Minimum	Maximum	Average	Minimum	Maximum
66d	0.40	0.39	0.40	0.40	-	-
66j	0.33	0.23	0.50	0.41	0.27	0.60
67f&i	0.78	0.64	0.92	0.17	-	-
67g	0.62	0.49	0.76	0.25	-	-
68c&d	0.53	0.30	0.74	1.08	-	-

Subecoregions 66d, 67f&I, 67g, and 68c&d each had 1 segment not supporting its designated use

Currently, agricultural lands may be the major source of sediment to the State's rivers and streams. However, over the last century there has been a significant decrease in the amount of land farmed in Georgia. Since 1950, there has been a 57 percent reduction in farmland. With the reduction in farmland, there has also been a decrease in the amount of soil erosion. This suggests that the sedimentation observed in the impaired stream segments may be legacy sediment resulting from past land use practices. It is believed that if sediment loads are maintained at acceptable levels, the streams will repair themselves over time.

In the case of both fish and macroinvertebrate watersheds evaluated in this TMDL, the average sediment yield of supporting watersheds was utilized to formulate the total allowable load for the not supporting watersheds. The total allowable sediment loads for the not supporting fish and macroinvertebrate watersheds are summarized in Table 3 along with any required sediment load reductions.

Table 3. Total Allowable Sediment Loads and the Required Sediment Load Reductions

Name	WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Current Total Load (tons/yr)	Total Allowable Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	% Reduction
Anderson Creek			636.6	636.6	636.6	299.1	0.0%
Arkaqua Creek			3,090.3	3,300.4	3,090.3	1,452.0	6.4%
Bitter Creek			1,004.9	1,004.9	1,004.9	472.2	0.0%
Brasstown Creek			1,517.6	1,655.4	1,517.6	713.1	8.3%
Charlie Creek			536.4	536.4	536.4	252.0	0.0%
Cooper Creek (WRD ID 865)			3,216.9	3,216.9	3,216.9	1,511.5	0.0%
Cooper Creek (WRD ID 991)			939.2	957.6	939.2	441.3	1.9%
Coosa Creek			5,289.5	5,289.5	5,289.5	2,485.3	0.0%
Dooley Creek			1,591.0	1,591.0	1,591.0	747.5	0.0%

Name	WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Current Total Load (tons/yr)	Total Allowable Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	% Reduction
East Fork Coosa Creek			953.1	953.1	953.1	447.8	0.0%
Fodder Creek			2,435.9	2,809.5	2,435.9	1,144.5	13.3%
Fortenberry Creek			834.6	834.6	834.6	392.1	0.0%
Helton Creek			781.9	856.3	781.9	367.4	8.7%
Hightower Creek			4,534.8	5,311.2	4,534.8	2,130.7	14.6%
Ivylog Creek			2,494.2	2,494.2	2,494.2	1,171.9	0.0%
Jones Creek			967.3	967.3	967.3	454.5	0.0%
Keener Creek			491.2	491.2	491.2	230.8	0.0%
Little Youngcane Creek			1,071.6	1,071.6	1,071.6	503.5	0.0%
Owenby Creek			511.4	511.4	511.4	240.3	0.0%
Owl Creek			1,041.4	1,064.8	1,041.4	489.3	2.2%
Right Prong Butternut Creek			377.1	377.1	377.1	177.2	0.0%
South Fork Rapier Mill Creek			959.6	959.6	959.6	450.9	0.0%
Stink Creek			998.9	998.9	998.9	469.3	0.0%
Swallow Creek			1,514.0	1,597.4	1,514.0	711.4	5.2%
Town Creek			4,704.2	4,752.0	4,704.2	2,210.3	1.0%
Tumbling Creek			381.5	381.5	381.5	179.3	0.0%
Wilscot Creek			1,121.6	1,121.6	1,121.6	527.0	0.0%
Winchester Creek			654.0	1,010.0	654.0	307.3	35.2%
Youngcane Creek			5,447.8	5,447.8	5,447.8	2,559.7	0.0%
Big Spring Branch (aka Higdon Creek)			1,613.7	3,294.1	1,613.7	780.1	51.0%
Black Branch		44.3	1,010.6	1,054.9	1,054.9	78.7	0.0%
Hemptown Creek			2,143.8	2,294.3	2,143.8	1,007.3	6.6%
Sugar Creek (EPD ID 66j-9)			2,905.0	5,277.6	2,905.0	1,364.9	45.0%
Sugar Creek (EPD ID 67g-1)			1,170.6	2,161.8	1,170.6	87.3	45.8%
Tributary to Tiger Creek			720.7	852.7	720.7	53.8	15.5%
West Fork Wolf Creek			873.2	876.3	873.2	410.3	0.4%

Definitions:
Current Total Load - Sum of modeled sediment load and approved waste load allocations (WLA)
WLA - waste load allocation for discrete point sources
WLAsw - waste load allocation associated with storm water discharges from a municipal separate storm sewer system (MS4)
LA - portion of the total allowable load attributed to nonpoint sources and natural background sources of sediment
Total Allowable Load - allowable sediment load calculated using the target sediment yield and the stream's watershed area
Maximum Allowable Daily Load - total allowable load (annual) converted to a daily figure based on the bankfull sediment transport relationship
% Reduction - percent reduction applied to current load in order to meet total allowable load

Management practices that may be used to help maintain and/or reduce the total allowable sediment loads at current levels include:

- Compliance with NPDES(wastewater and/or MS4) permit limits and requirements;
- Implementation of *Georgia's Best Management Practices for Forestry* (GFC, 2009);
- Implementation of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013) and Adoption of National Resource Conservation Service (NRCS) Conservation Practices for agriculture;
- Adherence to the Surface Mining Land Use Plan prepared as part of the Surface Mining Permit Application;
- Implementation of the *Georgia Better Back Roads Field Manual* (GA RCDC, 2009) and adoption of additional practices for proper unpaved road maintenance;
- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2014)
- Implementation of the *Georgia Stormwater Management Manual* (ARC, 2001) to facilitate prevention and mitigation of stream bank erosion due to increased stream flow and velocities caused by urban runoff through structural storm water BMP installation.

Although the measurement of sediment delivered to a stream is difficult to determine, by monitoring the implementation of these practices, their anticipated effects will contribute to improving stream habitats and water quality, and thus be an indirect measurement of the TMDLs.

1.0 INTRODUCTION

1.1 Background

The State of Georgia assesses its water bodies for compliance with water quality criteria established for their designated uses as required by the Federal Clean Water Act (CWA).Assessed water bodies are placed into one of three categories, supporting designated use, not supporting designated use, or assessment pending, depending on water quality assessment results. These water bodies are found on Georgia's 305(b) list, as required by that section of the CWA that defines the assessment process, and are published in *Water Quality in Georgia* (GA EPD, 2012-2013).

A subset of the water bodies that do not meet designated uses on the 305(b) list are also assigned to Georgia's 303(d) list, named after that section of the CWA. Although the 305(b) and 303(d) lists are two distinct requirements under the CWA, Georgia reports both lists in one combined format called the Integrated 305(b)/303(d) List, which is found in Appendix A of *Water Quality in Georgia* (GA EPD, 2012-2013).Water bodies included in the 303(d) list are denoted by Category 5, and are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality criteria. The TMDL process establishes the allowable loading of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in-stream water quality conditions. This allows water quality-based controls to be developed to reduce pollution and restore and maintain water quality.

1.2 Fish Community Sampling

During the years 2004 through 2009, the Georgia Department of Natural Resources (GA DNR) Wildlife Resources Division (GA WRD) conducted studies of fish community populations in several streams in the Tennessee River Basin. From the data collected, two indices of fish community health were established and used to assess the biotic integrity of the aquatic systems: the Index of Biotic Integrity (IBI) and the modified Index of Well-Being (IWB).The IBI and IWB numerical scores were developed by analyzing field data collected at each sampling site according to ecoregion-specific scoring criteria developed by WRD. These numerical scores were further classified into the integrity classes of Excellent, Good, Fair, Poor, or Very Poor. According to the 2012 305(b)/303(d) Listing Assessment Methodology in Appendix A of *Water Quality in Georgia,* fish sampling sites and their corresponding stream segments with fish population IBI rated as Poor or Very Poor do not support their designated uses. Fish sampling sites that score in the lower end of the Fair IBI range are also determined not to be supporting their use designation if the corresponding site IWB score is either Poor or Very Poor. Starting in the 2014 listing cycle, the IWB is no longer used in assessment and listing decisions. This has resulted in streams receiving an IBI rating of Fair being placed in the supporting designated use list. The fish sampling sites and corresponding stream segments that do not support their designated use are then included in the Integrated 305(b)/303(d) List with the criterion violated noted as Biota Impacted - Fish Community and the segments are placed in Category 5 until a TMDL is completed.

In the Tennessee River Basin, twenty nine (29) stream segments in the Blue Ridge ecoregion were rated as Poor or Very Poor, and were placed on the 303(d) list as not supporting their designated use, and scheduled for a TMDL evaluation. Seventeen (17) stream segments in the Blue Ridge ecoregion were rated as Excellent or Good, and assessed as supporting their designated use. A supporting stream segments rated Excellent and Good, were used to set the sediment yield target from which the total allowable sediment load for the not supporting stream segments was calculated.

Table 4. Stream Segments on the 2014 303(d) List as Biota Impacted - Fish Community

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Anderson Creek	Headwaters to Coosa Creek	R060200020516	3	Fishing
Arkaqua Creek	Pine Ridge Road to Nottely River	R060200020505	4	Fishing
Bitter Creek	Headwaters to Brasstown Creek	R060200020303	3	Fishing
Brasstown Creek	Little Bald Cove to Yewell Branch	R060200020307	4	Fishing
Charlie Creek	Stillhouse Creek to Blue Ridge Lake	R060200030125	2	Fishing
Cooper Creek (WRD ID 865)	Logan Creek to Bryant Creek	R060200030123	5	Fishing
Cooper Creek (WRD ID 991)	Lake Winfield Scott to Logan Creek	R060200030122	2	Fishing
Coosa Creek	Anderson Creek to Nottely Lake	R060200020515	1	Fishing
Dooley Creek	Tributary to Nottely River	R060200020603	6	Fishing
East Fork Coosa Creek	Headwaters to Coosa Creek	R060200020518	6	Fishing
Fodder Creek	Tributary to Chatuge Lake	R060200020104	3	Fishing
Fortenberry Creek	Headwaters to the Nottely River	R060200020519	3	Fishing
Helton Creek	Headwaters to the Nottely River	R060200020520	4	Fishing
Hightower Creek	Little Hightower Creek to Scataway Creek (formerly Shoal Branch to Swallow Creek)	R060200020115	2	Fishing
Ivylog Creek	Tributary to Lake Nottely	R060200020508	7	Fishing
Jones Creek	Headwaters to Youngcane Creek	R060200020521	4	Fishing
Keener Creek	Headwaters to the Little Tennessee River	R060102020103	3	Fishing
Little Youngcane Creek	Mason Branch to Youngcane Creek	R060200020522	2	Fishing
Owenby Creek	Headwaters to Stateline	R060200020606	5	Fishing
Owl Creek	Headwaters to the Hiwassee River	R060200020117	4	Fishing
Right Prong Butternut Creek	Headwaters to Butternut Creek	R060200020523	3	Fishing
South Fork Rapier Mill Creek	Stateline to Stateline	R060200020605	2	Fishing
Stink Creek	Headwaters to the Nottely River (formerly Union County)	R060200020524	5	Fishing
Swallow Creek	Headwaters to Hightower Creek	R060200020113	4	Fishing
Town Creek	Townsend Branch to the Nottely River	R060200020510	3	Fishing
Tumbling Creek	Headwaters to State Line	R060200030211	5	Fishing
Wilscot Creek	Headwaters to Crawford Creek	R060200030119	4	Fishing

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Winchester Creek	Headwaters to State Line	R060200020305	4	Fishing
Youngcane Creek	Little Youngcane Creek to Nottely Lake	R060200020512	4	Fishing

1.3 Benthic Macroinvertebrate Community Monitoring

During the years 2000 through 2003, the Department of Environmental Science at Columbus State University (CSU) conducted field studies of benthic macroinvertebrate community populations in several streams in the Tennessee River Basin as part of a multi-phase project to establish multi-metric indices and a numerical scoring system. Using the data collected multi-metric indices were produced and the biotic integrity of the streams were evaluated. The macroinvertebrate multi-metric index numerical scores are calculated by analyzing macroinvertebrate assemblage data collected at each sampling site according to ecoregion-specific scoring criteria developed by CSU. For each stream, the index numerical scores were ranked, described, and rated. A stream received a ranking between 1 and 5, which corresponded with a narrative description of Very Good, Good, Fair, Poor, and Very Poor. The stream's "health" rating combines the two top categories of Very Good and Good for an "A" rating, Fair for a "B" rating, and Poor and Very Poor for a "C" rating. According to the Integrated 305(b)/303(d) Listing Assessment Methodology in Appendix A of *Water Quality in Georgia,* macroinvertebrate sampling sites and their corresponding stream segments with narrative description of "Poor" or "Very Poor" do not support their designated uses. The macroinvertebrate sampling sites and corresponding stream segments that do not support their designated use are included in the Integrated 305(b)/303(d) List with the criterion violated noted as Biota Impacted - Macroinvertebrate Community and the segments are placed in Category 5 until a TMDL is completed.

In the Tennessee River Basin, four (4) stream segments in the Blue Ridge subecoregions 66d and 66j, three (3) stream segments in the Ridge and Valley subecoregions 67f&I and 67g, and one (1) stream in the Southwestern Appalachians subecoregion 68c&d were rated as Poor or Very Poor, placed on the 303(d) list as not supporting their designated use, and scheduled for a TMDL evaluation. Six (6) stream segments in the Blue Ridge subecoregions 66d and 66j, five (5) stream segments in the Ridge and Valley subecoregions 67f&I and 67g, and three (3) stream in the Southwestern Appalachians subecoregion 68c&d were rated as Excellent or Good and assessed as supporting their designated use. These supporting stream segments were used to set the sediment yield target from which the total allowable sediment load for the not supporting stream segments was calculated.

Table 5. Stream Segments on the 2014 303(d) List as Biota Impacted - Macroinvertebrate Community

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Big Spring Branch (aka Higdon Creek)	Harris Creek to Stateline (Formerly Higdon Creek to Stateline)	R060300010201	1	Fishing
Black Branch	Van Cleve St., Ft. Ogelthorpe to Spring Creek	R060200010925	3	Fishing

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Hemptown Creek	Mitchell Branch to Young Stone Creek	R060200030203	10	Fishing
Ivylog Creek	Tributary to Lake Nottely	R060200020508	7	Fishing
Sugar Creek	State Line to Tiger Creek	R060200010716	5	Fishing
Sugar Creek	Upstream Toccoa River	R060200030206	2	Fishing
Tributary to Tiger Creek	Headwaters to Tiger Creek	R060200010719	3	Fishing
West Fork Wolf Creek	Headwaters to Wolf Creek (formerly Headwaters to the Nottely River)	R060200020525	4	Fishing

1.4 Water Quality Criteria

The general and specific criteria for Fishing, Drinking Water, and Recreational waters are stated in Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Sections (5) and (6). As previously mentioned, the designated uses for these streams are Fishing. The criterion violated is Biota Impacted and is a violation of Georgia's narrative criteria, 391-3-6-.03, Section 5(e). Studies indicate a significant impact on fish communities, and/or macroinvertebrate communities. The potential causes listed include nonpoint/unknown sources (NP), urban runoff/urban effects (UR), municipal facility wastewater discharge, and residual from an industrial source (I2).

1.5 Watershed Description

The twenty nine (29) not supporting fish community stream segments and their associated watersheds that are located in the Tennessee River Basin are within the boundaries of Fannin, Rabun, Towns, and Union Counties. The seventeen (17) targeted supporting stream segments and their associated watersheds are also located in Fannin, Rabun, Towns, and Union Counties.

The eight (8) not supporting macroinvertebrate community stream segments and their associated watersheds that are located in Tennessee River Basin are within the boundaries of Catoosa, Dade, Fannin, Union, and Walker Counties. The fourteen (14) targeted supporting stream segments and their associated watersheds are distributed throughout northern Georgia in subecoregions that correspond to the not supporting macroinvertebrate stream segments.

Figure 1 shows a state-level view of the fourteen river basins in Georgia, with the Tennessee River Basin highlighted in yellow. Figure 2 shows a detailed view of the Tennessee River Basin, its five USGS 8-digit subbasins, major streams and waterbodies, and counties. Figure 3 shows a detail view of the fish community not supporting stream segments and their associated watersheds in the Little Tennessee River subbasin. Figure 4 shows a detail view of the fish community not supporting stream segments and their associated watersheds in the Hiwassee River subbasin. Figure 5 shows a detail view of the fish community not supporting stream segments and their associated watersheds in the Toccoa River subbasin. Figure 6 shows a detail view of the macroinvertebrate community not supporting stream segments and their associated watersheds in the Chickamauga Creek subbasin. Figure 7 shows a detail view of the macroinvertebrate community not supporting stream segments and their associated watersheds in the Toccoa and Hiwassee River subbasins.

1.5.1 Ecoregions and Subecoregions

In Georgia, the criteria and metrics used to evaluate the health of both fish communities and benthic macroinvertebrates communities has been developed for geographically specific regions due to the diverse terrestrial landscape and aquatic habitats found throughout the state. GADNR, in collaboration with other state and federal agencies, have worked to establish a general-purpose, geographical framework that categorizes the State into logical divisions of similar geology, physiography, soils, vegetation, land use, and water quality.

This collaborative group of agencies, led by the United States Environmental Protection Agency (USEPA), established and further refined a nationwide framework of ecological regions for the research, assessment, management, and monitoring of ecosystems and ecosystem components. These ecological regions, or ecoregions, denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. The current level III ecoregions were refined from the dataset created in 1987 by James Omernik at the USEPA National Health and Environmental Effects Research Laboratory. Level IV ecoregions, or subecoregions, are a further subdivision of the level III ecoregions that display details at a high resolution (Griffith et al. 2001).The six level III ecoregions established in Georgia are listed in Table 6. When fish community health is being studied and evaluated, ecoregions are used as a means to divide the State into geographic areas with similar characteristics. The six level III ecoregions in Georgia are divided into 27 level IV ecoregions, also known as subecoregions. These subecoregions are currently used as the means to divide the state into geographic areas for study and evaluation when the health of benthic macroinvertebrate communities is of concern.

Table 6. Ecoregions in Georgia

Ecoregion Name	Ecoregion ID	Ecoregion Description
Piedmont	**45**	The Piedmont ecoregion comprises a transitional area between the mostly mountainous ecoregions of the Appalachians to the northwest and the relatively flat coastal plain to the southeast. It is a complex mosaic of Precambrian and Paleozoic metamorphic and igneous rocks with moderately dissected irregular plains and some hills. The soils tend to be finer-textured than in coastal plain regions. Once largely cultivated, much of this region has reverted to pine and hardwood woodlands, and, more recently, spreading urban- and suburbanization.
Southeastern Plains	**65**	These irregular plains with broad interstream areas have a mosaic of cropland, pasture, woodland, and forest. Natural vegetation is mostly oak-hickory-pine and Southern mixed forest and soils consist of Cretaceous or Tertiary-age sands, silts, and clays. Elevations and relief are greater than in the Southern Coastal Plain (75), but generally less than in much of the Piedmont. Streams in this area are relatively low-gradient and sandy-bottomed.
Blue Ridge	**66**	The Blue Ridge varies from narrow ridges to hilly plateaus to more massive mountainous areas with high peaks. The mostly forested slopes, high-gradient, cool, clear streams, and rugged terrain occur on a mix of igneous, metamorphic, and sedimentary geology. The southern Blue Ridge is one of the richest centers of biodiversity in the eastern U.S.
Ridge and Valley	**67**	This is a relatively low-lying region between the Blue Ridge (66) to the east and the Southwestern Appalachians (68) on the west. As a result of extreme folding and faulting events, the roughly parallel ridges and valleys come in a variety of widths, heights, and geologic materials. Springs and caves are relatively numerous. Land cover is mixed and present-day forests cover about 50% of the region. Forested ridges, and valleys with pasture and cropland, are typical. Its diverse habitats contain many unique species of terrestrial and aquatic flora and fauna.
Southwestern Appalachians	**68**	These low mountains contain a mosaic of forest and woodland with some cropland and pasture. The mixed mesophytic forest is restricted mostly to the deeper ravines and escarpment slopes, and the summit or tableland forests are dominated by mixed oaks with shortleaf pine.

Ecoregion Name	Ecoregion ID	Ecoregion Description
Southern Coastal Plain	**75**	This is a heterogeneous region containing barrier islands, coastal lagoons, marshes, and swampy lowlands along the Gulf and Atlantic coasts. This ecoregion is generally lower in elevation with less relief and wetter soils than ecoregion 65. Once covered by a variety of forest communities that included trees of longleaf pine, slash pine, pond pine, beech, sweetgum, southern magnolia, white oak, and laurel oak, land cover in the region is now mostly slash and loblolly pine with oak-gum-cypress forest in some low lying areas, citrus groves, pasture for beef cattle, and urban.

1.5.2 Land Use

The land use characteristics of the Tennessee River Basin watersheds were determined using data from the 2008 Georgia Land Use Trends (GLUT). This raster land use trend product was developed by the University of Georgia – Natural Resources Spatial Analysis Laboratory (NARSAL) and follows land use trends for years 1974, 1985, 1991, 1998, 2001, 2005, and 2008.The raster data sets were developed from Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+), with a resolution of 30 meters.

The distribution of land uses and their percentages is given in Table 7 for both the segments and their associated watersheds not supporting their designated uses and segments and their watersheds supporting designated uses. This table is divided into sections by use support and ecoregion.

1.5.3 Soils

The soil characteristics of the Tennessee River Basin watersheds were determined using data from the Soil Survey Geographic (SSURGO) database. SSURGO soil data represents a higher spatial resolution and degree of detail when compared to the State Soil Geographic (STATSGO) Database used in previous sediment TMDLs drafted by GA EPD. Currently, SSURGO soil data represents the most detailed level of soil geographic data available from the NRCS within the United States Department of Agriculture (USDA). This database provides detailed soil map units characterized by hydrologic soil group; percentages of clay, silt, sand, and organic matter; soil erodibility factor (K-factor); and soil hydraulic conductivity (K_{sat}). Table 8 provides a summary of the hydrologic soil groups in each not supporting and supporting watershed that was evaluated. The detailed soil data for each individual soil map unit is not included in this document due to the sheer volume of tabular data. The complete soils data is available upon request from GA EPD

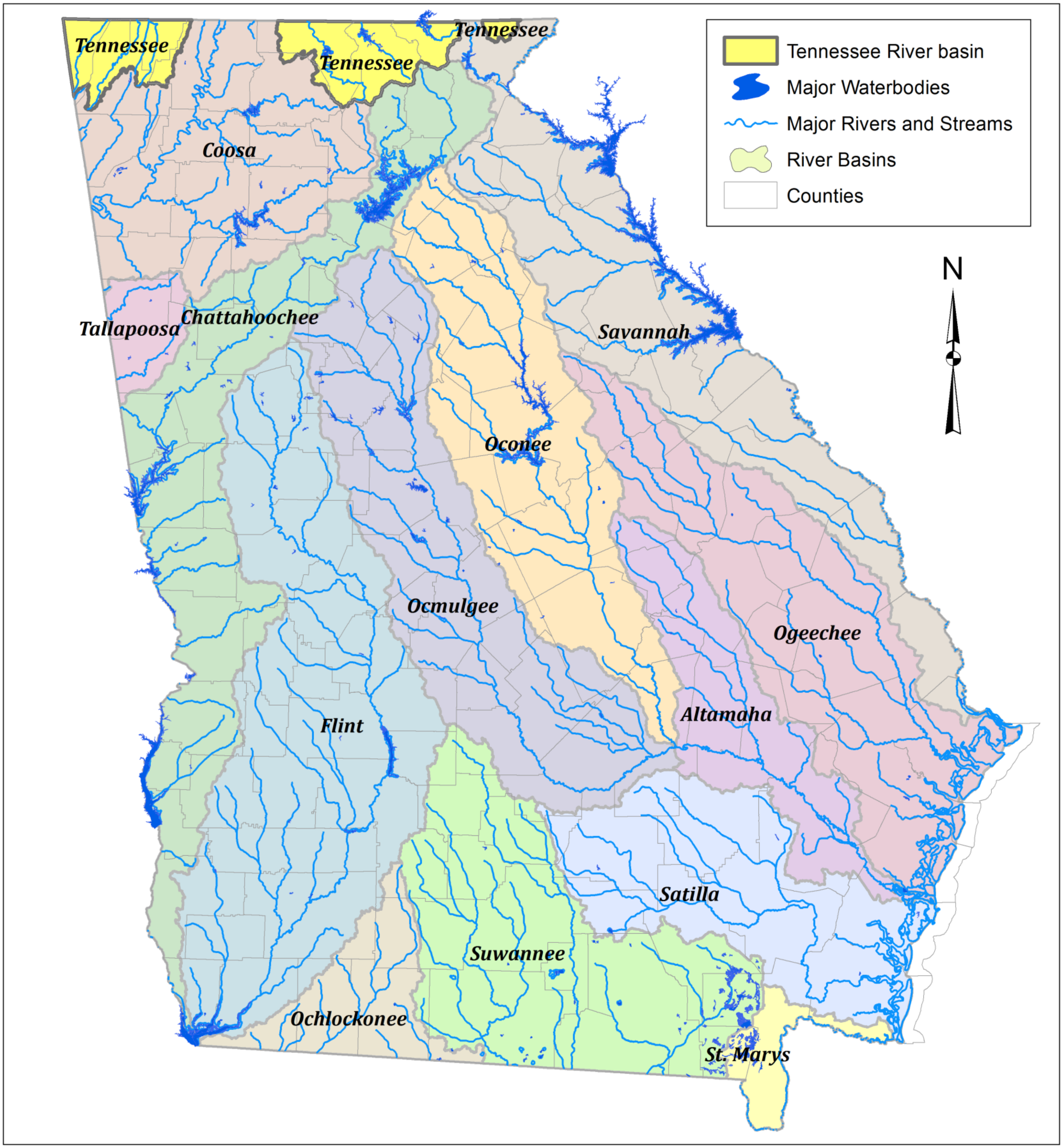

Figure 1. Tennessee River Basin and the River Basins of Georgia

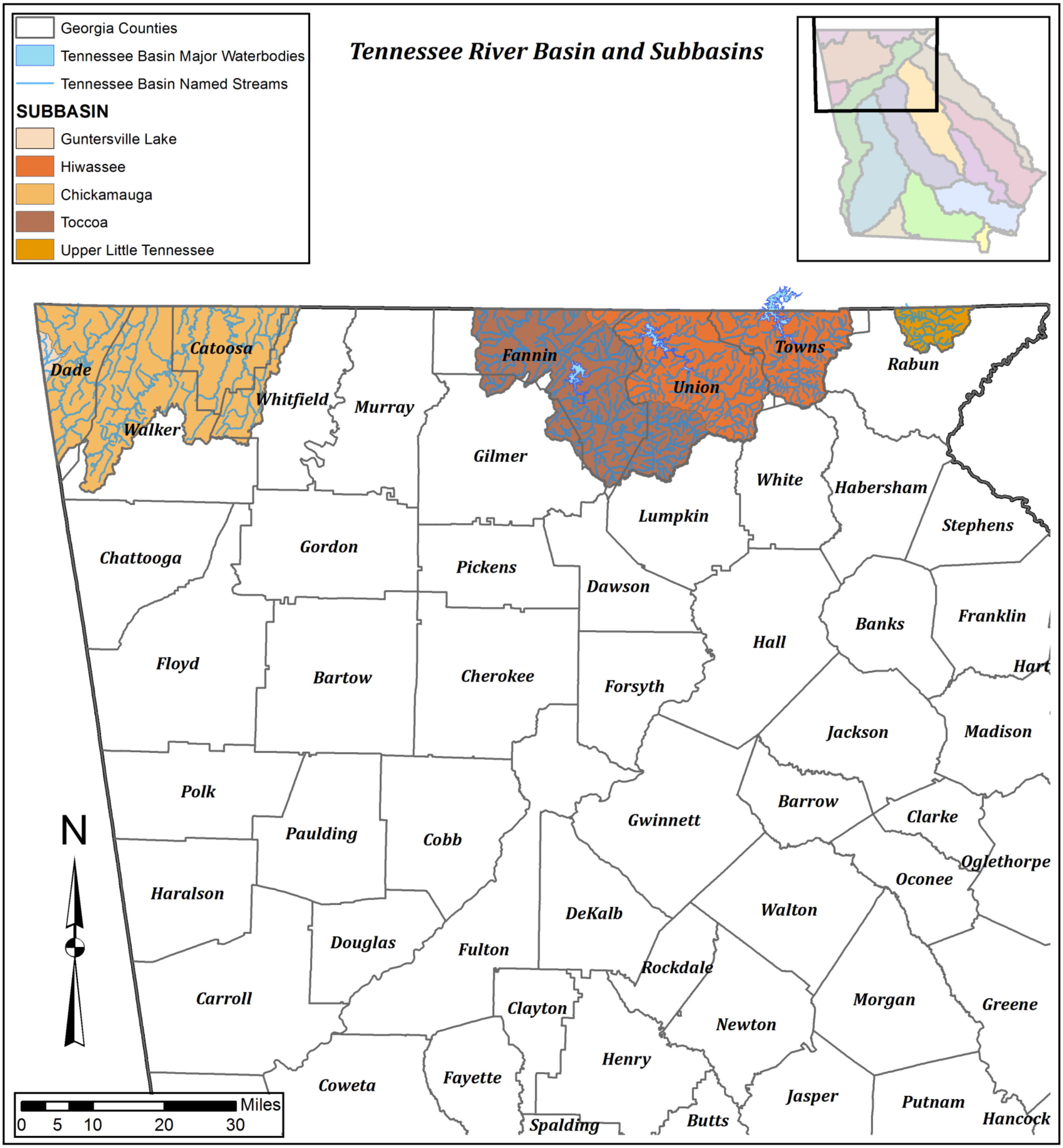

Figure 2. Tennessee River Basins and Subbasins

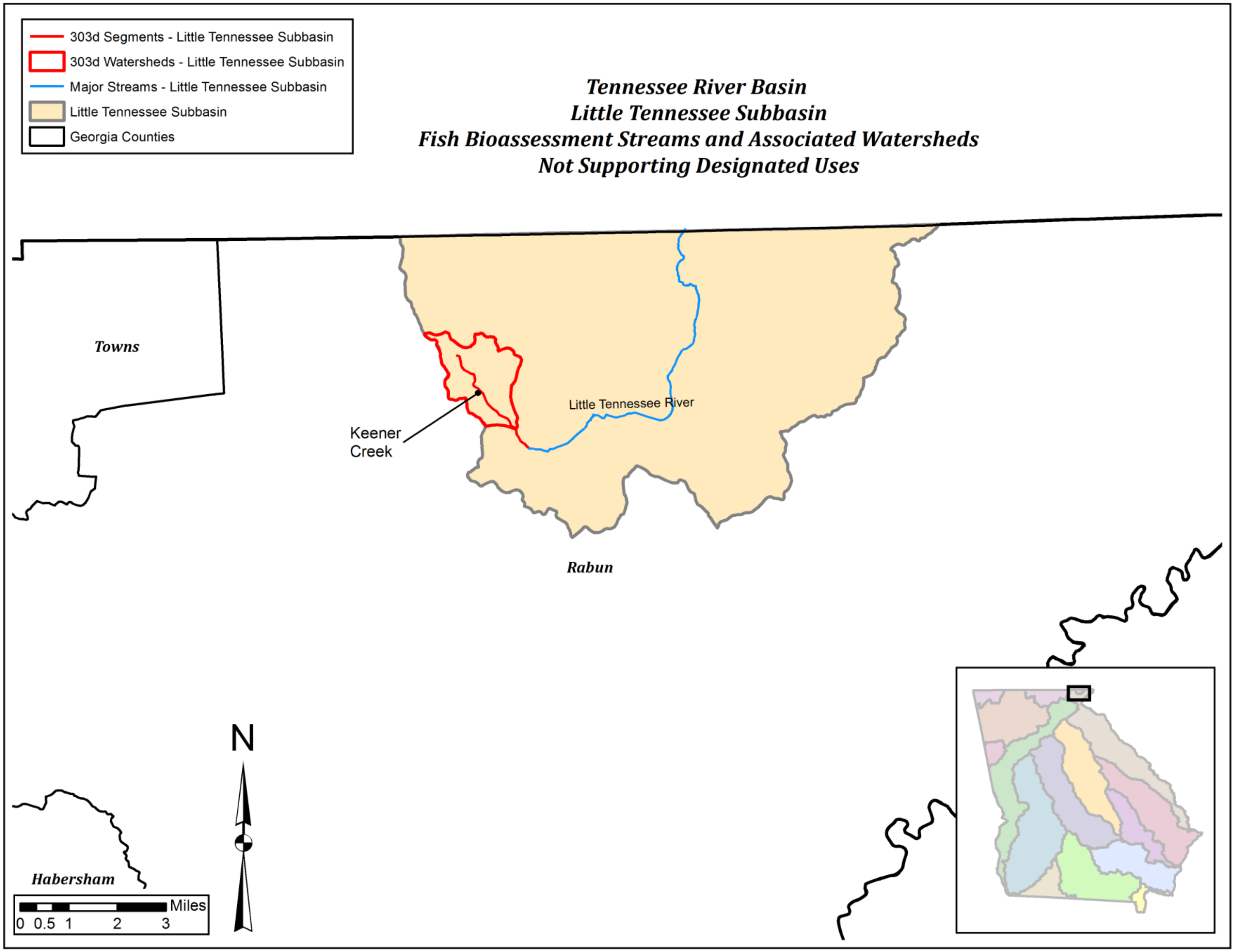

Figure 3. Fish Community Not Supporting Stream Segments and their Associated Watersheds - Little Tennessee subbasin

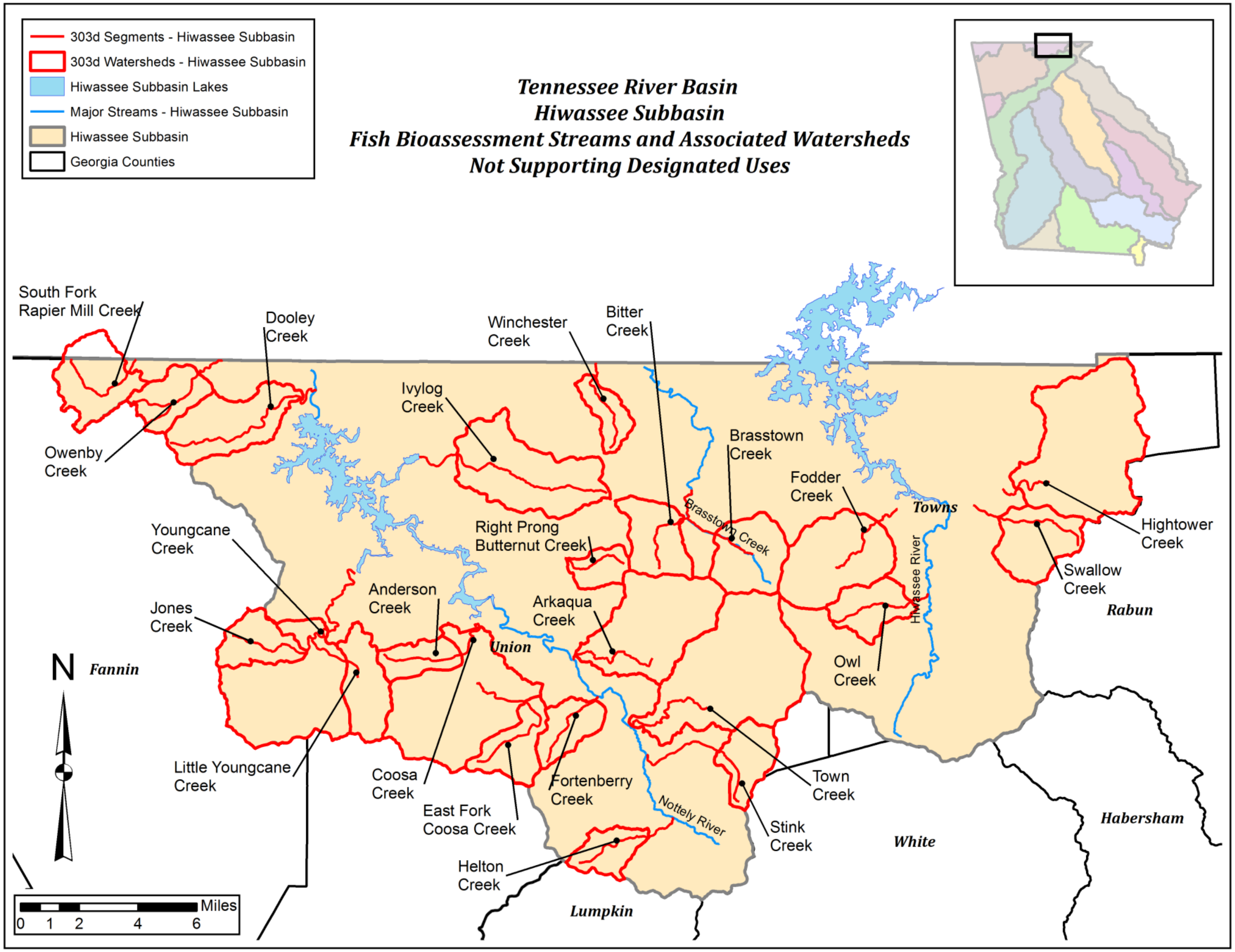

Figure 4. Fish Community Not Supporting Stream Segments and their Associated Watersheds - Hiwassee subbasin

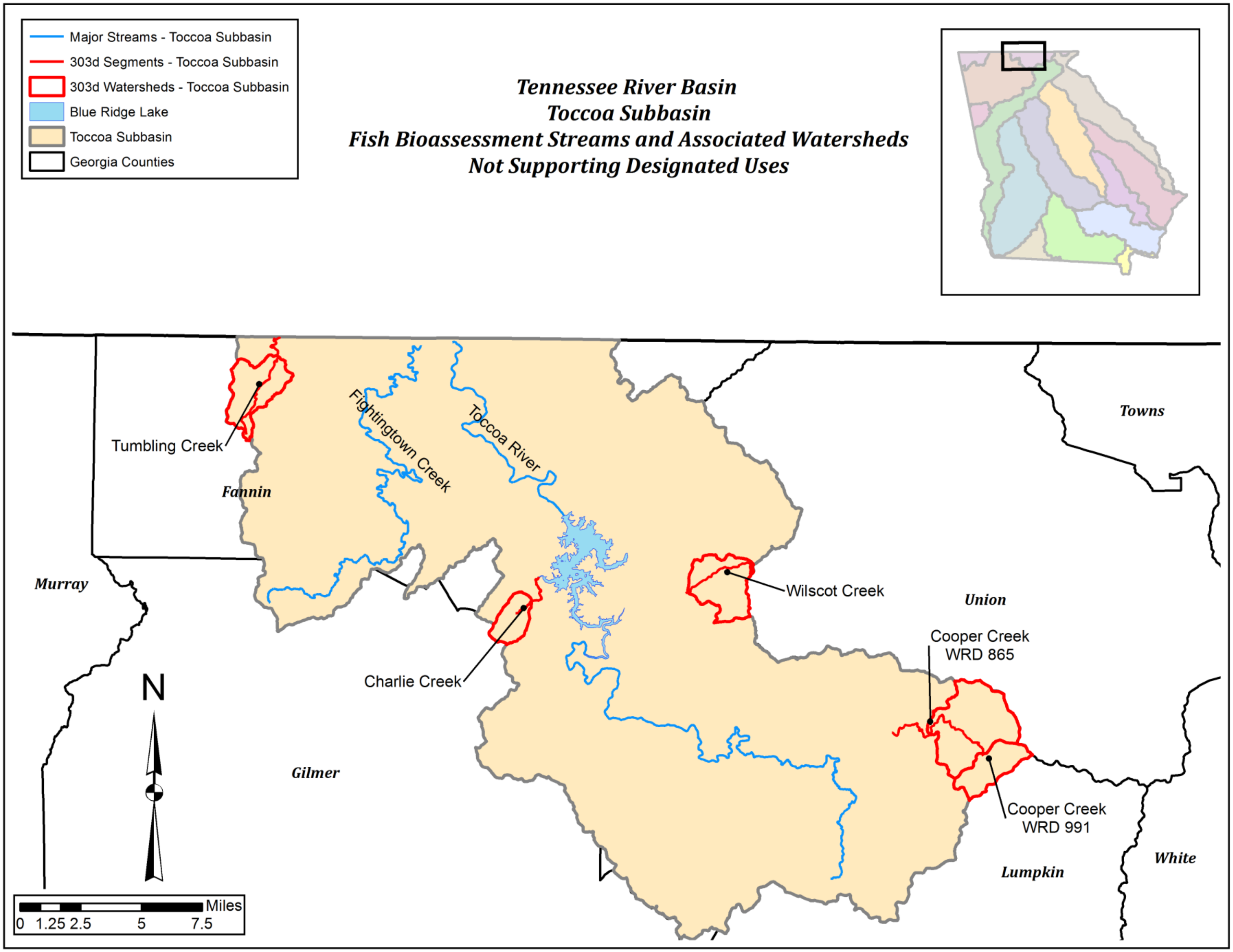

Figure 5. Fish Community Not Supporting Stream Segments and their Associated Watersheds - Toccoa subbasin

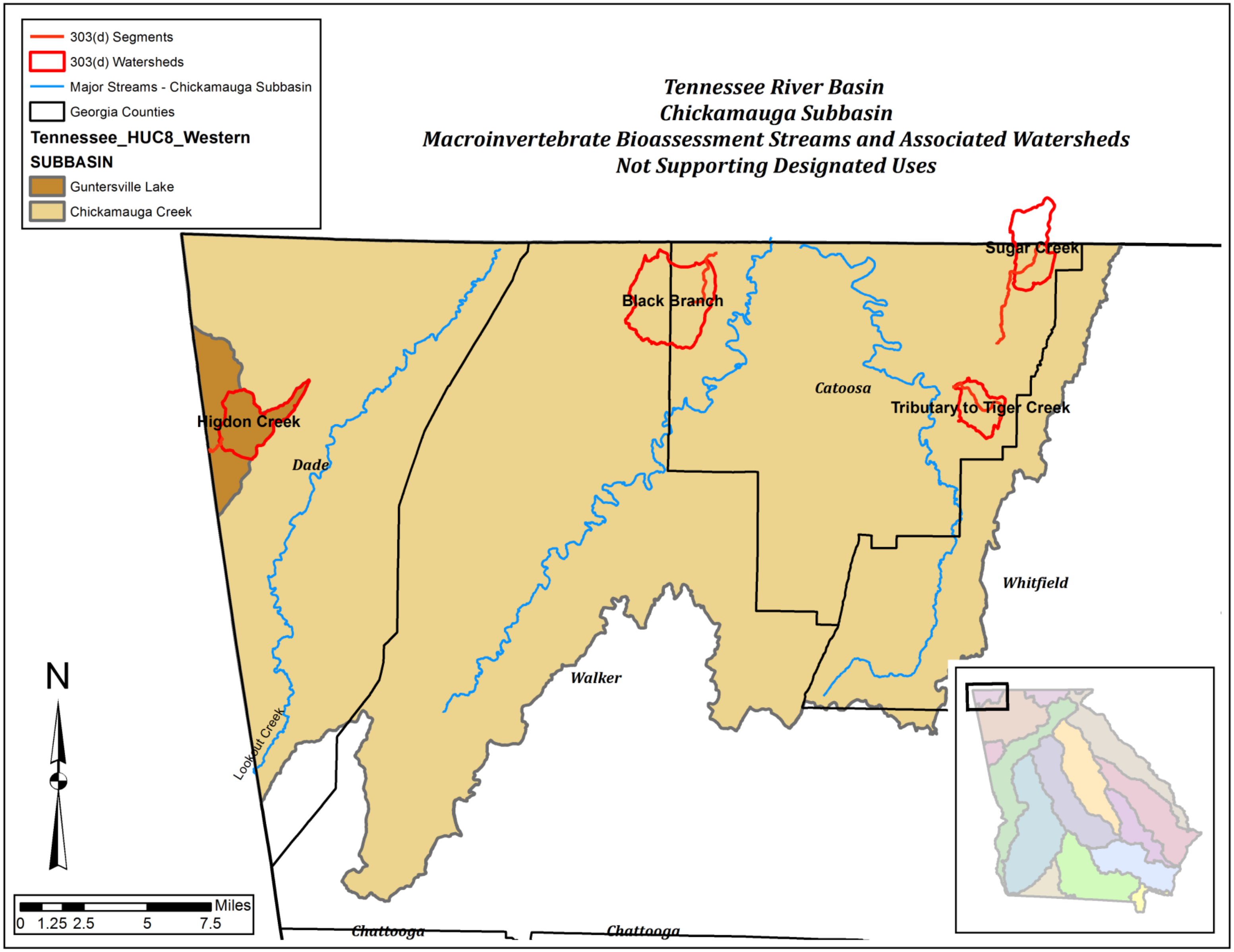

Figure 6. Macroinvertebrate Community Not Supporting Stream Segments and their Associated Watersheds - Chickamauga subbasin

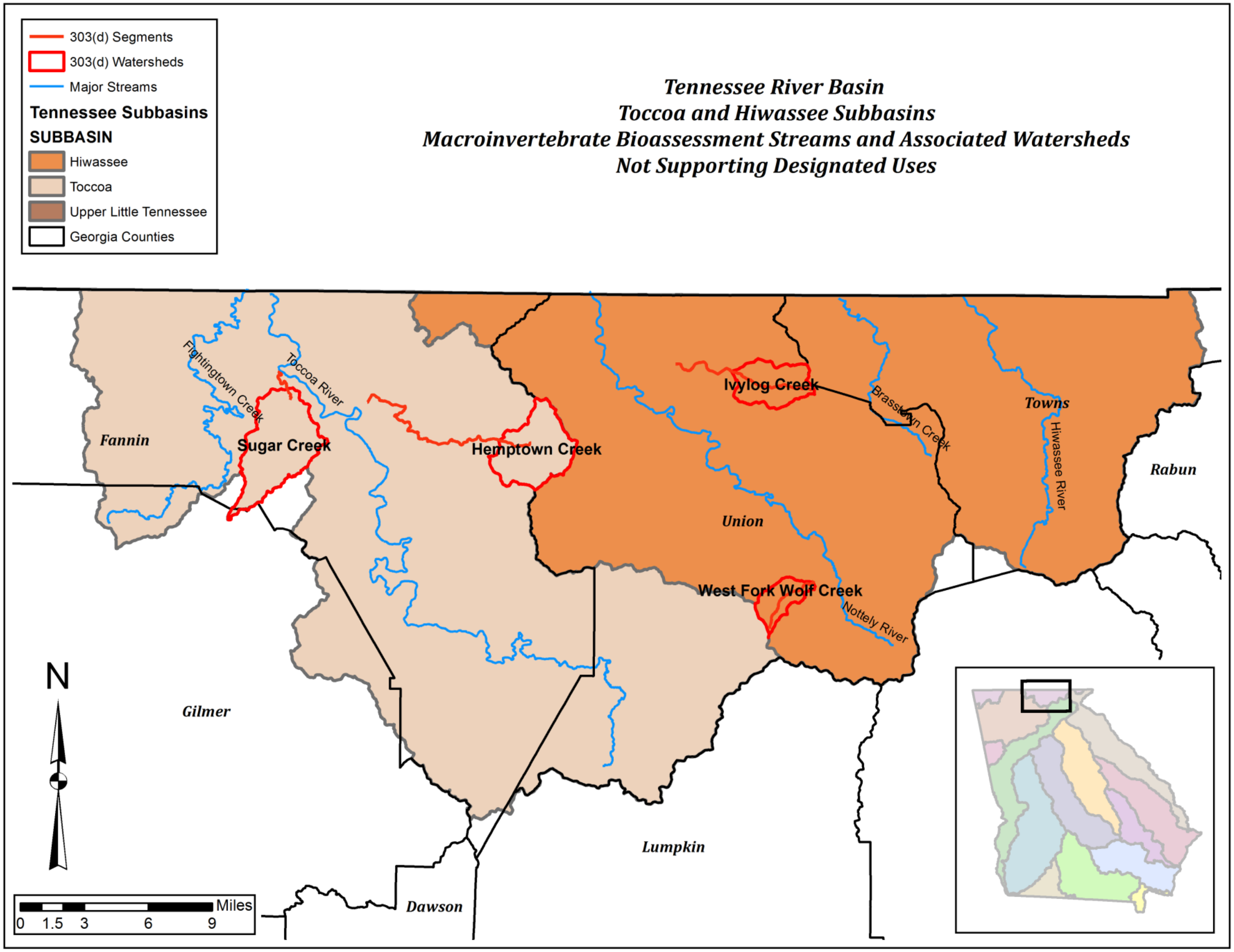

Figure 7. Macroinvertebrate Community Not Supporting Stream Segments and their Associated Watersheds - Hiwassee and Toccoa subbasins

Table 7. Land Use Distribution and Percentages

Name	Area (acres)																		
	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
Blue Ridge Ecoregion - Not Support																			
Anderson Creek	1.3	0.0	0.0	259.5	30.2	5.6	0.4	3.6	0.7	0.0	0.0	806.6	205.7	4.0	501.7	0.0	0.7	0.0	1,820.1
WRD 875	0.07%	0.00%	0.00%	14.26%	1.66%	0.31%	0.02%	0.20%	0.04%	0.00%	0.00%	44.32%	11.30%	0.22%	27.57%	0.00%	0.04%	0.00%	100.00%
Aarkaqua Creek (merged)	4.0	0.0	0.0	476.6	41.6	7.8	0.0	46.3	2.7	0.0	3.3	4,807.7	685.2	124.8	1,251.2	1.1	3.3	0.0	7,455.5
WRD 697-819	0.05%	0.00%	0.00%	6.39%	0.56%	0.10%	0.00%	0.62%	0.04%	0.00%	0.04%	64.49%	9.19%	1.67%	16.78%	0.01%	0.04%	0.00%	100.00%
Bitter Creek	0.9	0.0	0.0	210.4	17.1	1.6	0.0	6.0	0.0	0.0	0.0	2,492.1	297.8	20.2	52.9	0.0	7.8	0.0	3,106.8
WRD 997	0.03%	0.00%	0.00%	6.77%	0.55%	0.05%	0.00%	0.19%	0.00%	0.00%	0.00%	80.21%	9.58%	0.65%	1.70%	0.00%	0.25%	0.00%	100.00%
Brasstown Creek	2.0	0.0	0.0	47.4	2.2	0.2	0.0	2.0	0.2	0.0	0.0	2,909.8	499.9	169.7	26.2	0.0	0.0	0.0	3,659.7
WRD 996	0.05%	0.00%	0.00%	1.29%	0.06%	0.01%	0.00%	0.05%	0.01%	0.00%	0.00%	79.51%	13.66%	4.64%	0.72%	0.00%	0.00%	0.00%	100.00%
Charlie Creek	3.6	0.0	0.0	55.6	2.4	0.0	0.0	2.4	0.7	0.0	0.0	1,050.8	319.4	20.2	58.5	0.0	0.7	0.0	1,514.3
WRD 1175	0.23%	0.00%	0.00%	3.67%	0.16%	0.00%	0.00%	0.16%	0.04%	0.00%	0.00%	69.39%	21.09%	1.34%	3.86%	0.00%	0.04%	0.00%	100.00%
Cooper Creek	14.2	0.0	0.0	90.1	5.1	0.0	0.0	0.9	0.0	0.0	0.0	2,018.4	33.4	6.2	91.6	0.0	4.9	0.0	2,264.9
WRD 991	0.63%	0.00%	0.00%	3.98%	0.23%	0.00%	0.00%	0.04%	0.00%	0.00%	0.00%	89.12%	1.47%	0.27%	4.05%	0.00%	0.22%	0.00%	100.00%
Cooper Creek (merged)	14.7	0.0	0.0	178.8	4.9	0.0	0.0	0.9	0.0	0.0	0.0	7,356.1	313.4	79.4	94.1	0.0	23.1	0.0	8,065.3
WRD 865-991	0.18%	0.00%	0.00%	2.22%	0.06%	0.00%	0.00%	0.01%	0.00%	0.00%	0.00%	91.21%	3.89%	0.98%	1.17%	0.00%	0.29%	0.00%	100.00%
Coosa Creek	4.0	0.0	0.0	1,020.6	144.3	50.0	16.2	36.7	2.7	0.0	3.3	9,132.8	1,554.1	175.2	1,672.8	1.1	6.4	0.4	13,820.9
TVA 2596-1	0.03%	0.00%	0.00%	7.38%	1.04%	0.36%	0.12%	0.27%	0.02%	0.00%	0.02%	66.08%	11.24%	1.27%	12.10%	0.01%	0.05%	0.00%	100.00%

Name	Area (acres)																		
	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
Dooley Creek	0.4	0.0	0.0	374.7	14.9	1.8	0.4	44.5	0.0	0.0	0.0	3,359.9	545.8	8.7	279.3	0.4	13.8	0.0	4,644.7
WRD 877	0.01%	0.00%	0.00%	8.07%	0.32%	0.04%	0.01%	0.96%	0.00%	0.00%	0.00%	72.34%	11.75%	0.19%	6.01%	0.01%	0.30%	0.00%	100.00%
East Fork Coosa Creek	0.0	0.0	0.0	42.5	1.1	0.0	0.0	1.6	0.0	0.0	0.0	2,335.1	230.4	56.3	11.6	0.0	1.3	0.0	2,679.8
WRD 696	0.00%	0.00%	0.00%	1.59%	0.04%	0.00%	0.00%	0.06%	0.00%	0.00%	0.00%	87.14%	8.60%	2.10%	0.43%	0.00%	0.05%	0.00%	100.00%
Fodder Creek	1.1	0.0	0.0	291.6	17.3	4.7	0.0	8.2	0.0	0.0	0.0	4,900.0	380.1	40.3	234.6	0.0	0.0	0.0	5,877.9
WRD 715	0.02%	0.00%	0.00%	4.96%	0.30%	0.08%	0.00%	0.14%	0.00%	0.00%	0.00%	83.36%	6.47%	0.68%	3.99%	0.00%	0.00%	0.00%	100.00%
Fortenberry Creek	0.0	0.0	0.0	121.9	5.6	0.0	0.0	9.6	0.2	0.0	0.0	1,519.6	400.1	16.0	63.8	0.0	2.0	0.0	2,138.8
WRD 998	0.00%	0.00%	0.00%	5.70%	0.26%	0.00%	0.00%	0.45%	0.01%	0.00%	0.00%	71.05%	18.71%	0.75%	2.98%	0.00%	0.09%	0.00%	100.00%
Helton Creek	0.0	0.0	0.0	76.1	2.0	0.0	0.0	0.0	0.0	0.0	2.2	1,551.4	231.5	24.0	0.0	0.0	0.0	0.0	1,887.2
WRD 695	0.00%	0.00%	0.00%	4.03%	0.11%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12%	82.21%	12.27%	1.27%	0.00%	0.00%	0.00%	0.00%	100.00%
Hemptown Creek	7.1	0.0	0.0	363.8	104.3	12.0	0.9	25.4	0.0	3.1	0.0	4,599.6	566.7	9.3	779.0	0.0	1.1	0.0	6,472.3
EPD 66j-25	0.11%	0.00%	0.00%	5.62%	1.61%	0.19%	0.01%	0.39%	0.00%	0.05%	0.00%	71.06%	8.76%	0.14%	12.04%	0.00%	0.02%	0.00%	100.00%
Ivylog Creek	0.0	0.0	0.0	51.8	0.7	0.0	0.0	2.9	0.0	0.0	0.0	3,595.4	234.8	19.6	153.0	0.0	0.0	0.0	4,058.2
EPD 66j-17	0.00%	0.00%	0.00%	1.28%	0.02%	0.00%	0.00%	0.07%	0.00%	0.00%	0.00%	88.60%	5.79%	0.48%	3.77%	0.00%	0.00%	0.00%	100.00%
Ivylog Creek (merged)	0.7	0.0	0.0	278.4	14.9	0.9	0.0	44.5	0.0	0.0	0.0	5,382.4	579.6	25.1	607.6	0.0	1.8	0.0	6,935.8
WRD 700-820	0.01%	0.00%	0.00%	4.01%	0.21%	0.01%	0.00%	0.64%	0.00%	0.00%	0.00%	77.60%	8.36%	0.36%	8.76%	0.00%	0.03%	0.00%	100.00%
Jones Creek	0.0	0.0	0.0	199.9	14.5	1.3	0.0	20.7	0.0	0.0	0.0	1,829.6	89.8	5.8	268.2	0.0	0.0	0.4	2,430.3
WRD 1001	0.00%	0.00%	0.00%	8.23%	0.59%	0.05%	0.00%	0.85%	0.00%	0.00%	0.00%	75.28%	3.70%	0.24%	11.04%	0.00%	0.00%	0.02%	100.00%

	Area (acres)																		
Name	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
Keener Creek	0.4	0.0	0.0	4.9	0.4	0.0	0.0	0.0	0.0	0.0	0.0	1,326.8	86.3	23.6	4.4	0.0	0.0	0.0	1,446.9
WRD 706	0.03%	0.00%	0.00%	0.34%	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	91.70%	5.96%	1.63%	0.31%	0.00%	0.00%	0.00%	100.00%
Little Youngcane Creek	1.3	0.0	0.0	194.8	10.2	4.7	0.4	8.2	0.7	0.0	0.9	1,985.3	165.7	23.8	658.1	1.1	0.4	0.0	3,055.7
WRD 817	0.04%	0.00%	0.00%	6.38%	0.33%	0.15%	0.01%	0.27%	0.02%	0.00%	0.03%	64.97%	5.42%	0.78%	21.54%	0.04%	0.01%	0.00%	100.00%
Owenby Creek	8.9	0.0	0.0	101.2	6.2	0.7	0.0	40.7	0.0	0.0	0.0	1,600.8	566.9	16.2	63.2	0.0	0.0	0.0	2,404.7
WRD 802	0.37%	0.00%	0.00%	4.21%	0.26%	0.03%	0.00%	1.69%	0.00%	0.00%	0.00%	66.57%	23.57%	0.68%	2.63%	0.00%	0.00%	0.00%	100.00%
Owl Creek	1.1	0.0	0.0	85.0	3.8	0.0	0.0	0.0	0.0	0.0	0.0	2,339.6	24.5	1.8	59.8	0.0	0.0	0.0	2,515.5
WRD 795	0.04%	0.00%	0.00%	3.38%	0.15%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	93.01%	0.97%	0.07%	2.38%	0.00%	0.00%	0.00%	100.00%
Right Prong Butternut Creek	0.0	0.0	0.0	44.7	2.9	0.0	0.0	0.0	0.0	0.0	0.0	1,196.9	142.3	12.9	22.2	0.0	0.0	0.0	1,422.0
WRD 796	0.00%	0.00%	0.00%	3.14%	0.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	84.17%	10.01%	0.91%	1.56%	0.00%	0.00%	0.00%	100.00%
South Fork Rapier Mill Creek	1.8	0.0	0.0	221.1	14.5	1.6	0.0	30.7	0.2	0.0	0.0	2,759.7	518.8	49.4	253.3	0.0	12.0	0.0	3,863.0
WRD 711	0.05%	0.00%	0.00%	5.72%	0.37%	0.04%	0.00%	0.79%	0.01%	0.00%	0.00%	71.44%	13.43%	1.28%	6.56%	0.00%	0.31%	0.00%	100.00%
Stink Creek	0.0	0.0	0.0	15.6	3.1	0.0	0.0	0.0	0.0	0.0	0.0	2,076.5	178.8	151.0	22.2	0.0	6.9	0.0	2,454.1
WRD 821	0.00%	0.00%	0.00%	0.63%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	84.61%	7.29%	6.15%	0.91%	0.00%	0.28%	0.00%	100.00%
Sugar Creek	12.7	0.0	0.0	682.7	125.0	64.3	8.9	157.5	0.7	0.0	0.0	4,812.2	1,396.9	38.7	1,462.9	0.0	2.9	6.2	8,771.4
EPD 66j-9	0.14%	0.00%	0.00%	7.78%	1.42%	0.73%	0.10%	1.80%	0.01%	0.00%	0.00%	54.86%	15.93%	0.44%	16.68%	0.00%	0.03%	0.07%	100.00%
Swallow Creek	0.0	0.0	0.0	47.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,571.4	14.9	0.4	15.6	0.0	0.0	0.0	3,650.2
WRD 698	0.00%	0.00%	0.00%	1.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	97.84%	0.41%	0.01%	0.43%	0.00%	0.00%	0.00%	100.00%

Name	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
	Area (acres)																		
Town Creek	0.0	0.0	0.0	429.9	24.2	3.8	0.7	24.7	0.4	0.0	24.2	8,302.6	1,381.7	377.4	777.7	0.2	1.6	0.0	11,349.2
TVA 11511-1	0.00%	0.00%	0.00%	3.79%	0.21%	0.03%	0.01%	0.22%	0.00%	0.00%	0.21%	73.16%	12.17%	3.33%	6.85%	0.00%	0.01%	0.00%	100.00%
Tumbling Creek	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2,472.1	643.8	18.7	0.0	0.0	0.0	0.0	3,162.4
WRD 739	0.00%	0.00%	0.00%	0.88%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	78.17%	20.36%	0.59%	0.00%	0.00%	0.00%	0.00%	100.00%
Wilscot Creek	0.4	0.0	0.0	62.7	0.4	0.0	0.0	5.3	0.0	0.0	0.0	2,842.6	252.6	12.7	266.2	0.0	2.0	0.0	3,445.1
WRD 1003	0.01%	0.00%	0.00%	1.82%	0.01%	0.00%	0.00%	0.15%	0.00%	0.00%	0.00%	82.51%	7.33%	0.37%	7.73%	0.00%	0.06%	0.00%	100.00%
Winchester Creek	0.0	0.0	0.0	27.4	0.4	0.0	0.0	17.1	0.0	0.0	0.9	1,190.0	127.9	21.3	187.5	0.0	5.3	0.0	1,577.9
WRD 789	0.00%	0.00%	0.00%	1.73%	0.03%	0.00%	0.00%	1.09%	0.00%	0.00%	0.06%	75.42%	8.10%	1.35%	11.88%	0.00%	0.34%	0.00%	100.00%
Youngcane Creek (merged)	1.3	0.0	0.0	856.7	77.8	20.0	4.9	88.7	1.3	0.0	0.9	9,538.3	680.5	76.7	2,216.4	3.6	0.4	0.4	13,568.0
WRD 817-1000-1001	0.01%	0.00%	0.00%	6.31%	0.57%	0.15%	0.04%	0.65%	0.01%	0.00%	0.01%	70.30%	5.02%	0.57%	16.34%	0.03%	0.00%	0.00%	100.00%
Ridge and Valley - Not Support																			
Black Branch	0.0	0.0	0.0	1,459.8	1,678.4	458.8	219.7	9.1	0.0	0.0	0.0	1,188.5	534.0	314.0	218.8	19.3	2.2	0.0	6,102.7
EPD 67fi-1	0.00%	0.00%	0.00%	23.92%	27.50%	7.52%	3.60%	0.15%	0.00%	0.00%	0.00%	19.47%	8.75%	5.15%	3.59%	0.32%	0.04%	0.00%	100.00%
Sugar Creek	4.0	0.0	0.0	150.3	54.0	6.4	1.3	16.7	2.2	0.0	0.0	871.6	271.1	139.9	1,100.4	0.0	2.0	0.4	2,620.5
EPD 67g-1	0.15%	0.00%	0.00%	5.74%	2.06%	0.25%	0.05%	0.64%	0.08%	0.00%	0.00%	33.26%	10.35%	5.34%	41.99%	0.00%	0.08%	0.02%	100.00%
Tributary to Tiger Creek	0.0	17.1	0.0	107.6	67.4	23.8	1.6	31.1	0.0	0.0	0.0	892.2	314.0	96.3	183.9	16.0	0.0	0.0	1,751.1
EPD 67g-2	0.00%	0.98%	0.00%	6.15%	3.85%	1.36%	0.09%	1.78%	0.00%	0.00%	0.00%	50.95%	17.93%	5.50%	10.50%	0.91%	0.00%	0.00%	100.00%

Name	Area (acres)																		
	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
Southwestern Appalachians - Not Support																			
Big Spring Branch-Higdon Creek	18.0	0.0	0.0	255.1	142.3	21.3	3.1	3.1	2.4	0.0	0.0	1,552.1	129.4	54.9	629.2	252.0	0.0	0.0	3,063.0
EPD 68cd-3	0.59%	0.00%	0.00%	8.33%	4.65%	0.70%	0.10%	0.10%	0.08%	0.00%	0.00%	50.67%	4.23%	1.79%	20.54%	8.23%	0.00%	0.00%	100.00%
Blue Ridge Ecoregion - Support																			
Betty Creek	11.1	0.0	0.0	235.5	8.2	1.3	0.4	4.9	0.2	0.0	0.0	9,026.1	228.0	62.5	218.8	24.2	18.2	0.0	9,839.6
WRD 856	0.11%	0.00%	0.00%	2.39%	0.08%	0.01%	0.00%	0.05%	0.00%	0.00%	0.00%	91.73%	2.32%	0.64%	2.22%	0.25%	0.19%	0.00%	100.00%
Brasstown Creek (merged)	5.3	0.0	0.0	540.6	77.2	27.6	3.8	34.7	0.7	0.0	0.7	7,897.2	1,289.4	223.1	705.2	0.0	12.2	0.0	10,817.7
WRD 778-996-997	0.05%	0.00%	0.00%	5.00%	0.71%	0.25%	0.03%	0.32%	0.01%	0.00%	0.01%	73.00%	11.92%	2.06%	6.52%	0.00%	0.11%	0.00%	100.00%
Brasstown Creek (merged)	13.6	0.0	0.0	1,440.9	234.4	65.2	5.1	175.9	1.6	0.0	4.0	14,903.7	2,504.2	336.7	2,377.6	0.0	12.2	0.7	22,075.7
WRD 778-878-996-997	0.06%	0.00%	0.00%	6.53%	1.06%	0.30%	0.02%	0.80%	0.01%	0.00%	0.02%	67.51%	11.34%	1.53%	10.77%	0.00%	0.06%	0.00%	100.00%
Bryan Creek	0.4	0.0	0.0	91.0	2.2	0.0	0.0	6.0	0.0	0.0	0.0	1,947.3	149.4	4.2	124.8	0.0	0.0	0.0	2,325.4
EPD 66j-211	0.02%	0.00%	0.00%	3.91%	0.10%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	83.74%	6.43%	0.18%	5.37%	0.00%	0.00%	0.00%	100.00%
Cooper Creek (merged)	14.7	0.0	0.0	262.4	5.1	0.0	0.0	2.0	0.0	0.0	26.0	12,415.4	1,303.9	249.1	94.5	0.0	23.1	0.0	14,396.2
WRD 796-865-991	0.10%	0.00%	0.00%	1.82%	0.04%	0.00%	0.00%	0.01%	0.00%	0.00%	0.18%	86.24%	9.06%	1.73%	0.66%	0.00%	0.16%	0.00%	100.00%
Cooper Creek (merged)	14.7	0.0	0.0	517.3	5.6	0.0	0.0	5.3	0.0	0.0	29.4	21,075.0	2,776.8	495.0	231.5	0.0	23.1	0.0	25,173.7
WRD 796-770-865-991	0.06%	0.00%	0.00%	2.05%	0.02%	0.00%	0.00%	0.02%	0.00%	0.00%	0.12%	83.72%	11.03%	1.97%	0.92%	0.00%	0.09%	0.00%	100.00%
Bryan Creek	0.4	0.0	0.0	91.0	2.2	0.0	0.0	6.0	0.0	0.0	0.0	1,947.3	149.4	4.2	124.8	0.0	0.0	0.0	2,325.4
EPD 66j-211	0.02%	0.00%	0.00%	3.91%	0.10%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	83.74%	6.43%	0.18%	5.37%	0.00%	0.00%	0.00%	100.00%

	Area (acres)																		
Name	**Open Water**	**Utility Swaths**	**Golf Courses**	**Developed, Open Space**	**Developed, Low Intensity**	**Developed, Medium Intensity**	**Developed, High Intensity**	**Transitional, Clearcut, Sparse**	**Beaches, Dunes, Mud**	**Quarries, Strip Mines**	**Rock Outcrop**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Pasture, Hay**	**Row Crops**	**Forested Wetlands**	**Non-Forested Wetlands (Freshwater)**	**Total**
Fightingtown Creek	0.7	0.0	0.0	196.2	8.0	1.3	0.0	15.3	0.0	0.0	0.0	6,739.9	837.8	62.7	386.5	0.0	0.0	0.0	8,248.4
WRD 761	0.01%	0.00%	0.00%	2.38%	0.10%	0.02%	0.00%	0.19%	0.00%	0.00%	0.00%	81.71%	10.16%	0.76%	4.69%	0.00%	0.00%	0.00%	100.00%
Fightingtown Creek	0.0	0.0	0.0	160.3	6.0	1.1	0.0	11.1	0.0	0.0	0.4	7,590.3	571.3	24.2	54.7	0.0	6.0	0.0	8,425.6
WRD 862	0.00%	0.00%	0.00%	1.90%	0.07%	0.01%	0.00%	0.13%	0.00%	0.00%	0.01%	90.09%	6.78%	0.29%	0.65%	0.00%	0.07%	0.00%	100.00%
Hemptown Creek (merged)	13.1	0.0	0.0	970.1	198.6	28.2	1.8	97.6	0.7	3.1	0.0	11,406.1	1,553.9	32.2	2,043.8	0.0	5.6	0.0	16,354.9
WRD 738-1002	0.08%	0.00%	0.00%	5.93%	1.21%	0.17%	0.01%	0.60%	0.00%	0.02%	0.00%	69.74%	9.50%	0.20%	12.50%	0.00%	0.03%	0.00%	100.00%
Hothouse Creek	3.1	0.0	0.0	605.1	63.6	5.6	0.0	95.2	0.0	0.0	0.0	9,719.1	1,584.1	303.3	1,005.2	0.0	12.5	0.0	13,396.8
WRD 763	0.02%	0.00%	0.00%	4.52%	0.47%	0.04%	0.00%	0.71%	0.00%	0.00%	0.00%	72.55%	11.82%	2.26%	7.50%	0.00%	0.09%	0.00%	100.00%
Little Tennessee River (merged)	49.1	0.0	0.0	2,295.6	423.4	195.0	55.2	14.7	1.3	116.1	12.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3,163.1
WRD 705-706-856-857-883	1.55%	0.00%	0.00%	72.57%	13.39%	6.17%	1.74%	0.46%	0.04%	3.67%	0.40%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	100.00%
McClure Creek	0.0	0.0	0.0	58.5	1.8	0.2	0.0	7.6	0.2	0.0	0.0	2,623.4	221.5	3.1	125.2	0.0	0.4	0.0	3,041.9
WRD 1177	0.00%	0.00%	0.00%	1.92%	0.06%	0.01%	0.00%	0.25%	0.01%	0.00%	0.00%	86.24%	7.28%	0.10%	4.12%	0.00%	0.01%	0.00%	100.00%
Nottley River (merged)	0.0	0.0	0.0	398.1	17.8	2.7	0.0	10.5	0.2	0.0	18.5	9,257.2	1,263.0	316.0	182.4	0.0	8.2	0.0	11,474.4
WRD 695-867-999	0.00%	0.00%	0.00%	3.47%	0.16%	0.02%	0.00%	0.09%	0.00%	0.00%	0.16%	80.68%	11.01%	2.75%	1.59%	0.00%	0.07%	0.00%	100.00%
South Fork Rapier Mill Creek	1.8	0.0	0.0	222.2	14.5	1.6	0.0	32.2	0.2	0.0	0.0	2,803.7	526.2	50.9	268.4	0.0	12.0	0.0	3,933.7
EPD 66j-28	0.05%	0.00%	0.00%	5.65%	0.37%	0.04%	0.00%	0.82%	0.01%	0.00%	0.00%	71.27%	13.38%	1.29%	6.82%	0.00%	0.31%	0.00%	100.00%
Suches Creek	0.0	0.0	0.0	158.6	2.0	0.0	0.0	3.8	0.0	0.0	0.0	3,951.5	209.7	38.7	89.4	0.0	0.0	0.0	4,453.7
WRD 835	0.00%	0.00%	0.00%	3.56%	0.04%	0.00%	0.00%	0.08%	0.00%	0.00%	0.00%	88.72%	4.71%	0.87%	2.01%	0.00%	0.00%	0.00%	100.00%
Toccoa River (merged)	26.5	0.0	0.0	374.1	20.2	2.2	0.2	0.0	0.0	0.0	0.0	10,240.1	531.3	117.0	297.1	0.0	60.9	2.0	11,671.7

Name	Area (acres)																		
	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
WRD 754-990	0.23%	0.00%	0.00%	3.20%	0.17%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	87.73%	4.55%	1.00%	2.55%	0.00%	0.52%	0.02%	100.00%
Toccoa River (merged)	26.5	0.0	0.0	630.9	24.0	2.2	0.2	15.1	0.0	0.0	0.0	17,008.5	1,182.2	239.1	605.6	0.0	60.9	2.0	19,797.3
WRD 754-835-864-990	0.13%	0.00%	0.00%	3.19%	0.12%	0.01%	0.00%	0.08%	0.00%	0.00%	0.00%	85.91%	5.97%	1.21%	3.06%	0.00%	0.31%	0.01%	100.00%
Town Creek (merged)	0.0	0.0	0.0	81.4	2.7	1.1	0.7	1.3	0.0	0.0	23.1	5,739.1	826.6	323.4	25.4	0.0	0.0	0.0	7,024.8
WRD 866-992	0.00%	0.00%	0.00%	1.16%	0.04%	0.02%	0.01%	0.02%	0.00%	0.00%	0.33%	81.70%	11.77%	4.60%	0.36%	0.00%	0.00%	0.00%	100.00%
Town Creek (merged)	0.0	0.0	0.0	369.4	23.6	5.3	0.4	22.5	0.4	0.0	24.2	7,800.3	1,277.9	369.4	620.7	0.0	1.6	0.0	10,515.7
WRD 713-866-992	0.00%	0.00%	0.00%	3.51%	0.22%	0.05%	0.00%	0.21%	0.00%	0.00%	0.23%	74.18%	12.15%	3.51%	5.90%	0.00%	0.01%	0.00%	100.00%
Ridge and Valley - Support																			
Cane Creek	4.4	90.3	0.0	330.7	99.0	15.8	3.8	211.1	1.1	0.0	0.0	3,871.7	1,040.6	389.0	1,289.9	267.8	20.0	1.1	7,636.1
EPD 67fi-16	0.06%	1.18%	0.00%	4.33%	1.30%	0.21%	0.05%	2.76%	0.01%	0.00%	0.00%	50.70%	13.63%	5.09%	16.89%	3.51%	0.26%	0.01%	100.00%
Clarks Creek	52.0	45.8	0.0	325.8	79.8	1.8	0.0	137.2	0.4	0.0	0.0	3,534.7	2,060.0	383.9	429.2	102.1	37.1	0.0	7,190.0
EPD 67fi-25	0.72%	0.64%	0.00%	4.53%	1.11%	0.02%	0.00%	1.91%	0.01%	0.00%	0.00%	49.16%	28.65%	5.34%	5.97%	1.42%	0.52%	0.00%	100.00%
Little Armuchee Creek	0.4	0.0	0.0	118.3	19.3	7.8	0.4	16.7	0.0	0.0	0.0	2,422.1	735.2	149.4	694.3	0.0	1.3	0.0	4,165.4
EPD 67g-11	0.01%	0.00%	0.00%	2.84%	0.46%	0.19%	0.01%	0.40%	0.00%	0.00%	0.00%	58.15%	17.65%	3.59%	16.67%	0.00%	0.03%	0.00%	100.00%
Moss Creek	0.0	0.0	0.0	142.3	22.2	1.1	0.0	27.8	0.0	0.0	0.0	2,417.0	853.8	208.6	619.6	129.7	14.2	0.0	4,436.3
EPD 67g-13	0.00%	0.00%	0.00%	3.21%	0.50%	0.03%	0.00%	0.63%	0.00%	0.00%	0.00%	54.48%	19.25%	4.70%	13.97%	2.92%	0.32%	0.00%	100.00%
Tributary to Armuchee Creek	8.0	43.6	0.0	143.7	60.9	10.2	1.8	151.0	0.7	0.0	0.0	1,733.3	811.1	160.3	352.5	97.0	9.6	0.0	3,583.7
EPD 67g-15	0.22%	1.22%	0.00%	4.01%	1.70%	0.29%	0.05%	4.21%	0.02%	0.00%	0.00%	48.37%	22.63%	4.47%	9.84%	2.71%	0.27%	0.00%	100.00%

Name	Open Water	Utility Swaths	Golf Courses	Developed, Open Space	Developed, Low Intensity	Developed, Medium Intensity	Developed, High Intensity	Transitional, Clearcut, Sparse	Beaches, Dunes, Mud	Quarries, Strip Mines	Rock Outcrop	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture, Hay	Row Crops	Forested Wetlands	Non-Forested Wetlands (Freshwater)	Total
	Area (acres)																		
Southwestern Appalachians - Support																			
Bear Creek	13.3	49.4	0.0	248.9	48.9	8.2	0.2	1.8	0.2	0.0	0.0	3,609.0	258.4	124.3	457.5	148.6	0.0	0.0	4,968.7
EPD 68cd-5	0.27%	0.99%	0.00%	5.01%	0.98%	0.17%	0.00%	0.04%	0.00%	0.00%	0.00%	72.63%	5.20%	2.50%	9.21%	2.99%	0.00%	0.00%	100.00%
Daniels Creek	16.2	24.5	0.0	199.3	36.9	2.4	0.0	1.8	0.0	0.0	0.0	2,397.6	197.3	130.8	383.9	173.7	0.0	0.0	3,564.3
EPD 68cd-6	0.46%	0.69%	0.00%	5.59%	1.04%	0.07%	0.00%	0.05%	0.00%	0.00%	0.00%	67.27%	5.53%	3.67%	10.77%	4.87%	0.00%	0.00%	100.00%
Rock Creek	14.7	61.6	0.0	590.9	154.1	12.7	0.2	17.3	0.2	0.0	1.1	9,088.8	697.0	444.3	402.5	99.9	9.3	0.0	11,594.7
EPD 68cd-4	0.13%	0.53%	0.00%	5.10%	1.33%	0.11%	0.00%	0.15%	0.00%	0.00%	0.01%	78.39%	6.01%	3.83%	3.47%	0.86%	0.08%	0.00%	100.00%

Table 8. Soil Type Distribution

Stream Segment	Station ID	A				B				C				D				Other	
		Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%	Min K Factor	Max K Factor	Area (Acres)	%
Blue Ridge - Not Support																			
Anderson Creek	875					1490.7	81.9	0.16	0.27	250.4	13.8	0.19	0.28	70.9	3.9	0.31	0.31		
Arkaqua Creek	697, 819					6848.1	91.9	0.11	0.27	511.1	6.9	0.19	0.28	45.3	0.6	0.31	0.31	40.3	0.5
Bitter Creek	997					2978.3	95.9	0.11	0.26	116.5	3.8	0.19	0.25	6.9	0.2	0.31	0.31		
Brasstown Creek	996					3621.6	98.9	0.11	0.26	12.9	0.4	0.19	0.27					23.9	0.7
Charlie Creek	1175					1462.0	96.7	0.11	0.26	47.0	3.1	0.08	0.19						
Cooper Creek	991					2172.8	95.9	0.11	0.26	43.7	1.9	0.19	0.28	4.1	0.2	0.31	0.31	26.0	1.1
Cooper Creek	865					7957.5	98.7	0.11	0.26	56.1	0.7	0.19	0.28	4.1	0.1	0.31	0.31	26.0	0.3
Coosa Creek	2596-1					12737.1	92.1	0.06	0.27	953.5	6.9	0.19	0.28	117.5	0.8	0.31	0.31		
Dooley Creek	877					4169.2	89.8	0.06	0.27	452.0	9.7	0.19	0.28	20.2	0.4	0.31	0.31		
East Fork Coosa Creek	696					2644.6	98.7	0.11	0.27	34.6	1.3	0.19	0.19						
Fodder Creek	715					5790.4	98.5	0.11	0.26	37.1	0.6	0.05	0.27	47.6	0.8	0.31	0.31	0.2	0.0
Fortenberry Creek	998					2016.3	94.3	0.06	0.27	117.6	5.5	0.19	0.28	3.6	0.2	0.31	0.31		
Helton Creek	695					1871.9	99.2	0.11	0.26									15.2	0.8
Hemptown Creek						6112.8	94.4	0.06	0.27	333.4	5.2	0.19	0.28	14.8	0.2	0.31	0.31		
Hightower Creek	872					10729.9	98.1	0.13	0.29	49.8	0.5	0.05	0.27	19.2	0.2	0.31	0.31	125.8	1.2
Ivylog Creek						3854.0	94.9	0.11	0.26	205.8	5.1	0.19	0.28						
Ivylog Creek	820, 700					6425.6	92.7	0.11	0.27	479.4	6.9	0.19	0.28	25.7	0.4	0.31	0.31		
Jones Creek	1001					2211.4	91.0	0.11	0.27	217.8	9.0	0.19	0.28						
Keener Creek	706					1131.3	78.2	0.13	0.26	257.8	17.8	0.05	0.07					57.5	4.0

Little Youngcane Creek	817					2752.5	90.2	0.06	0.27	239.0	7.8	0.19	0.28	59.4	1.9	0.31	0.31		
Owenby Creek	802					2248.1	93.4	0.06	0.26	156.3	6.5	0.25	0.25						
Owl Creek	795					2510.5	99.9	0.13	0.26									3.6	0.1
Right Prong Butternut Creek	796					1394.3	98.1	0.11	0.26	27.6	1.9	0.25	0.28						
South Fork Rapier Mill Creek	711	6.76266	0.1752	0.11	0.11	3577.1	92.6	0.06	0.27	258.7	6.7	0.19	0.28					13.3	0.3
Stink Creek	821					2418.0	98.5	0.11	0.26	23.8	1.0	0.19	0.19					13.1	0.5
Sugar Creek						8040.2	91.7	0.06	0.27	710.1	8.1	0.08	0.28	7.0	0.1	0.31	0.31		
Swallow Creek	698					3581.6	98.1	0.13	0.26	70.1	1.9	0.05	0.05						
Town Creek	11511-1					10849.0	95.6	0.11	0.27	322.3	2.8	0.19	0.28	50.8	0.4	0.31	0.31	123.5	1.1
Tumbling Creek	739					1286.9	40.7	0.11	0.21									1875.2	59.3
West Fork Wolf Creek						2196.4	99.9	0.11	0.26										
Wilscot Creek	1003					3319.0	96.3	0.11	0.27	126.4	3.7	0.19	0.28						
Winchester Creek	789					1464.4	92.8	0.13	0.26	54.3	3.4	0.27	0.27	59.5	3.8	0.31	0.31		
Youngcane Creek	876					12392.4	91.3	0.06	0.27	1048.1	7.7	0.19	0.28	120.5	0.9	0.31	0.31		
Ridge and Valley - Not Support																			
Black Branch		53.1	0.9	0.06	0.06	3344.4	54.8	0.09	0.28	359.4	5.9	0.16	0.32	2285.5	37.4	0.08	0.29	62.6	1.0
Sugar Creek						1057.1	37.1	0.16	0.35	1526.1	53.6	0.14	0.43	247.5	8.7	0.29	0.30		
Trib To Tiger Creek						1035.0	59.1	0.16	0.32	707.3	40.4	0.14	0.30	4.9	0.3	0.29	0.29	0.3	0.0
Southwestern Appalachians - Not Support																			
Big Spring Branch-Higdon Creek						3012.9	98.4	0.21	0.27									29.6	1.0
Blue Ridge -Support																			
Betty Creek	856	1525.55	15.503	0.04	0.18	6784.0	68.9	0.03	0.26	479.1	4.9	0.05	0.27	658.5	6.7	0.05	0.06	384.8	3.9

Brasstown Creek	878	20.5285	0.0927	0.07	0.07	20722.6	93.6	0.03	0.29	628.6	2.8	0.05	0.28	687.3	3.1	0.31	0.31	60.1	0.3
Brasstown Creek	778					10066.9	93.1	0.11	0.29	394.3	3.6	0.05	0.28	288.4	2.7	0.31	0.31	55.6	0.5
Bryan Creek						2161.9	93.0	0.11	0.27	162.0	7.0	0.19	0.28						
Chattahoochee River						11182.8	85.7	0.11	0.28	1865.7	14.3	0.08	0.27					0.5	0.0
Coleman River		322.1	9.6	0.06	0.18	2828.0	83.9	0.03	0.24	159.3	4.7	0.05	0.07	2.7	0.1	0.05	0.06	57.3	1.7
Cooper Creek	770					24939.4	99.1	0.06	0.27	184.5	0.7	0.19	0.28	4.1	0.0	0.31	0.31	26.0	0.1
Cooper Creek	769					14273.7	99.2	0.06	0.26	72.0	0.5	0.19	0.28	4.1	0.0	0.31	0.31	26.0	0.2
East Gumlog Creek						4564.2	94.1	0.06	0.27	256.5	5.3	0.25	0.28	28.2	0.6	0.31	0.31		
Fightingtown Creek	761					7987.8	96.9	0.11	0.27	253.3	3.1	0.19	0.28						
Fightingtown Creek	862					7871.0	93.4	0.11	0.28	551.3	6.5	0.08	0.26						
Hemptown Creek	738					15172.4	92.8	0.06	0.27	1085.8	6.6	0.19	0.28	78.0	0.5	0.31	0.31		
Hothouse Creek	763	259.283	1.9357	0.09	0.30	12327.9	92.0	0.03	0.27	614.4	4.6	0.19	0.28	2.4	0.0	0.31	0.31	186.7	1.4
Little Tennessee River	883	2049.28	5.8292	0.04	0.18	27324.6	77.7	0.03	0.29	3265.5	9.3	0.05	0.27	1085.9	3.1	0.05	0.31	3793.3	10.8
McClure Creek	1177					2960.7	97.4	0.11	0.27	70.1	2.3	0.19	0.28						
Nottley River	867					11275.6	98.3	0.11	0.27	99.7	0.9	0.19	0.25	21.0	0.2	0.31	0.31	72.4	0.6
South Fork Rapier Mill Creek		6.8	0.2	0.11	0.11	3636.3	92.5	0.06	0.27	270.1	6.9	0.19	0.28					13.3	0.3
Suches Creek	835					4254.3	95.5	0.11	0.26	193.1	4.3	0.19	0.25	5.1	0.1	0.31	0.31		
Tallulah River		4598.6	22.3	0.06	0.18	15361.3	74.3	0.03	0.26	399.2	1.9	0.05	0.07	2.7	0.0	0.05	0.06	258.8	1.3
Toccoa River	864					19295.4	97.5	0.11	0.26	411.3	2.1	0.19	0.28	49.3	0.2	0.31	0.31	3.0	0.0
Toccoa River	754					11455.9	98.1	0.11	0.26	146.1	1.3	0.19	0.28	38.1	0.3	0.31	0.31	3.0	0.0
Town Creek	713					10112.8	96.2	0.11	0.27	250.7	2.4	0.19	0.28	30.3	0.3	0.31	0.31	122.0	1.2
Town Creek	866					6882.1	98.0	0.11	0.27	29.9	0.4	0.19	0.25					109.0	1.6
Ridge and Valley - Support																			
Cane Creek		267.3	3.5	0.06	0.06	4605.6	60.3	0.09	0.32	182.2	2.4	0.22	0.24	2095.7	27.4	0.05	0.28	480.5	6.3

Clarks Creek						5180.1	72.1	0.13	0.33	1303.4	18.1	0.10	0.33	653.5	9.1	0.07	0.29		
Little Armuchee Creek						2148.4	50.5	0.13	0.37	1078.8	25.4	0.10	0.33	1021.4	24.0	0.07	0.31	2.4	0.1
Moss Creek						2241.7	50.5	0.13	0.37	1044.3	23.5	0.10	0.33	1148.7	25.9	0.07	0.29		
Trib To Armuchee Creek						1286.9	35.9	0.13	0.32	1828.7	51.0	0.10	0.33	450.1	12.6	0.07	0.31		
Southwestern Appalachians - Support																			
Bear Creek		60.3	1.2	0.05	0.05	4788.4	96.3	0.21	0.27									95.4	1.9
Daniels Creek						3484.5	97.8	0.21	0.27									37.1	1.0
Rock Creek		423.9	3.7	0.05	0.05	10057.9	86.7	0.21	0.43									1091.1	9.4

2.0 WATER QUALITY ASSESSMENT

2.1 Fish Community Sampling

The GA WRD conducted studies of fish community populations at a number of monitoring sites in the Tennessee River Basin. Biological monitoring of fish communities is a method used to evaluate the health of a biological system to assess degradation from various sources, both point and non-point.GA WRD's biological monitoring of fish communities is based on direct observations of the aquatic communities within a stream. The results of these studies were the basis for the listings of Biota Impacted - Fish Community stream segments on Georgia's 303(d) list.

The work performed by the GA WRD consisted of looking at patterns of fish communities within the various ecoregions in Georgia. From this, GA WRD has established reference sampling sites within each ecoregion. These sites represent the least impacted sites that exist given the prevalent land use within the ecoregion.

Of all the sites GA WRD sampled in the Tennessee River Basin, forty six (46) sites were used in this TMDL evaluation. Tables 9, 10, and 11 list the data collected during the field investigations and subsequent laboratory analysis. All sites had to be accessible, wadeable, and representative of the stream under investigation. The length of each fish sampling site was thirty-five times the mean stream width, up to a maximum length of 500 meters. This sampling length has been found to be long enough to include the major habitat types present. Electrofishing and seining techniques were used for sampling the fish population (GA WRD, 2005a).

From data collected during the GA WRD fish community studies, two indices of fish community health were developed and used to assess the biotic integrity of the aquatic systems: the Index of Biotic Integrity (IBI) and the modified Index of Well-Being (IWB).The IBI and IWB numerical scores were developed by analyzing field data collected at each sampling site according to ecoregion-specific scoring criteria developed by GA WRD. These numerical scores were further classified into the integrity classes of Excellent, Good, Fair, Poor, or Very Poor.

The IBI assesses the biotic integrity of aquatic communities based on the functional and compositional attributes of the fish community. The IBI consists of twelve measurements or metrics that assess three facets of the fish population: 1) species richness and composition, 2) trophic composition and dynamics, and 3) fish abundance and condition. For each sampling site, each metric is calculated by comparing the site value of a particular scoring criterion to that of the regional reference site. Factors that affect the structure and function of a fish community include stream location and size. Thus, the metrics were developed for ecoregional drainage basins. To account for the fact that streams with larger drainage basins normally have greater species richness, Maximum Species Richness plots were developed for the species richness metrics.

The modified IWB measures the health of the aquatic community based on the abundance and diversity of the fish community. The IWB is calculated based on four parameters: 1) the relative density of fish, 2) the relative biomass of fish, 3) the Shannon-Wiener Index of Diversity based on number, and 4) the Shannon-Wiener Index of Diversity based on biomass (GA WRD, 2005b).As of April 2013, the modified IWB is no longer be calculated or used for listing assessment decisions. This has resulted in streams receiving an IBI rating of Fair being placed in the supporting designated use list.

Table 9 summarizes GA WRD's fish community study scores. The IBI, IWB, and Habitat Assessment scores are listed for each study watershed, and are grouped according to supporting or not supporting status. In addition, the table includes the drainage areas upstream of the monitoring points and the county in which the monitoring points are located.

To supplement the findings of the fish community data, visual habitat assessments were performed at each sampling site. Habitat scores evaluate the in-stream habitat, morphology, and riparian characteristics of a stream as they affect and influence the quality of the water resource and its resident aquatic community. These scores may help clarify the results of the biotic indices. The visual habitat assessment was developed by personnel within the Watershed Protection Branch (WPB) of the Georgia Environmental Protection Division (GA EPD) and is a modification of the USEPA Rapid Bioassessment Protocol (GAWPB, 2000).It incorporates different assessment parameters for riffle/run prevalent streams and glide/pool prevalent streams. In Georgia, streams in the Blue Ridge, Piedmont, Ridge and Valley, and Southwestern Appalachian ecoregions are considered riffle/run prevalent streams, while streams in the Southeastern Plains and Southern Coastal Plain ecoregions are considered glide/pool prevalent streams.

The visual habitat assessment evaluates the stream's physical parameters and is broken into three levels. Level one describes in-stream characteristics that directly affect biological communities (bottom substrate / available cover, pool substrate characterization, and pool variability). Level two describes the channel morphology (channel sinuosity, channel alteration, sediment deposition, and channel flow status). Level three describes the riparian zone surrounding the stream that indirectly affects the type of habitat and food resources available in the stream (bank vegetative protection, bank stability, and riparian vegetation zone width). Table 10 provides detailed habitat assessment scores for both supporting and not supporting streams.

During the fish community studies, physical characteristics of the stream were measured at the monitoring sites. These characteristics included the number of pools, depth of the deepest pool, number of bends, average stream depth, and average stream width. In addition, stream water quality measurements were taken at the time of the fish sampling. The parameters measured included water temperature, dissolved oxygen, conductivity, pH, turbidity, total hardness, and alkalinity. Table 11 provides a summary of these field measurements.

2.2 Macroinvertebrate Community Sampling

With the goal of monitoring and assessing the biological integrity of wadeable streams, GA EPD has undertaken a multi-phase project to establish macroinvertebrate stream assessment methodology and develop numerical scoring criteria for wadeable streams throughout the State. The results of the field studies completed as a part of this project were the basis for the listings of Biota Impacted - Macroinvertebrate Community stream segments on Georgia's 303(d) list.

GA EPD contracted with CSU to identify and sample streams from across the gradient of human disturbance in each of Georgia's level IV ecoregions, or subecoregions. Using data and information gathered as a part of this wide ranging sampling effort, CSU developed and validated an assortment of discrete metric indices that would take into account the ecological differences of Georgia's subecoregions. Using these indices, a standardized numerical scoring system was developed that can then be translated into a 5-step descriptive classification system that ranks a stream's health as Very Good, Good, Fair, Poor or Very Poor.

The first task in this project was to identify the best attainable reference, or least impacted, conditions representative of each subecoregion. In order to assess the least impacted condition in each subecoregion, a process was established to identify candidate reference streams that were both wadeable and perennial in nature. Strahler stream order was used as the initial filtering criteria. Fourth-order streams were initially selected as they generally are found in even the smallest of subecoregions, and generally flow year-round, except in extreme drought. To increase the number of candidate streams, large second- and third-order streams with a total catchment length of over 8 kilometers (km) and small fifth-order streams with catchment length of less than 8 km were included, as they have roughly the same catchment areas as the fourth-order streams. Using geographic information system (GIS) software, land use data for the catchments areas were analyzed to quantify the level of human impact on each catchment area. For each catchment, the total land use areas and percentages, stream riparian buffer land use areas and percentages, number and density of stream/road crossings, and number and density of impoundments were analyzed. Candidate sampling sites were ranked, scored, and classified as reference (least impacted) or impaired (more heavily impacted). A separate list of candidate reference sites was also compiled from local regulatory agencies with expertise in aquatic biological integrity based on staff best professional judgment (BPJ) and institutional knowledge of least impacted streams in areas throughout the State. The list of agency candidate sites were evaluated using a similar GIS data analysis (Gore et al. 2010).

The next task involved sampling the potential reference sites. A representative sample of each stream's benthic macroinvertebrate community was collected and analyzed, each stream's water chemistry and physical properties was sampled and assessed, and available in-stream biological habitat at each candidate reference site was evaluated. Samples collected during the field investigations provided raw data for statistical analysis that subsequently yielded a set of possible metrics. These metrics were used to quantify different attributes of the biological community, and served as the method by which to compare streams with one another, and to the established reference condition. Sampling potential reference sites allowed for field validation of the GIS selection process, and helped to further refine which streams and corresponding sampling sites were included in the final reference stream determination to set the reference condition in each subecoregion.

Following the field evaluation of the reference sites, the impaired streams identified through the GIS selection process were sampled for biological, chemical, physical conditions. The raw field data and subsequent analysis from the impaired sites was used, in combination with that of the reference sites, to identify trends and provide a statistical basis for the development of multi-metric indices (MMI) that could discriminate between reference and impaired streams. The choice of final metrics ultimately used was based, in part, on their relationship to ecoregional characteristics and response to stressors (Barbour *et al*. 1999). Metrics were selected from the following categories of biological information: richness, composition, tolerance/intolerance, and habit/trophic measures. Each category was represented when possible. Metrics were grouped into candidate indices for each subecoregion. A numerical scoring system and a 5-step descriptive classification system for evaluating the health of streams throughout Georgia were then created based on these multi-metric indices.

Following the initial establishment of the subecoregion specific MMI and numerical/descriptive scoring systems in 2007, GA EPD embarked on a further refinement of these evaluation criteria by collecting additional data at both least impacted and impaired sampling sites throughout the

State. The numerical scoring system has been withdrawn until these additional data and subsequent analyses can be incorporated into each subecoregions' evaluation criteria.

The streams presented in this document as not supporting their designated use are a subset of the original streams sampled by CSU during the development of the original MMI and numerical scoring system. Despite the current withdrawal of the numerical scoring criteria for streams, it has been determined that these streams are classified as not supporting their designated use due to their degraded physical and biological condition, as documented during the initial CSU study.

The stream sampling phase of the project took place from 2000 through 2003, with all field work occurring between September and February, the designated "index period". Within each stream, over a hundred meter sample reach, macroinvertebrate samples were collected, and a visual habitat assessment was completed using the modified USEPA Rapid Bioassessment Protocol described in Section 2.1. Water quality samples and in-situ water quality data were collected at the downstream end of the sampling reach. Macroinvertebrates were collected by the means of a D-frame net, mesh size of 595-600 microns, using the twenty-jab method, as described in *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia* (GA EPD,2007).Samples were collected in all available stream habitats including: fast and slow riffles, undercut banks, leaf material, snags, and sandy bottoms. Macroinvertebrate sampling started at the zero meter mark and continued upstream to reduce habitat disturbance.

From each macroinvertebrate sample, a 200-organism subsample was randomly selected and the macroinvertebrates were identified to the lowest possible taxonomic level.

Table 12 summarizes CSU's macroinvertebrate community study scores. The subecoregion index score, and total habitat assessment scores are listed for each study watershed, and are grouped according to supporting or not supporting status. In addition, the table includes the drainage areas upstream of the monitoring points and the county in which the monitoring points are located. Table 13 provides the individual habitat scores.

Table 9. WRD's Fish Community Study Scores

Stream Name	GAWRD Fish Site ID	Drainage Area upstream from the monitoring point (sq mile)	County	Date	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total (Maximum: 200)
Blue Ridge Ecoregion – Not Support									
Anderson Creek	875	2.8	Union	10/05/2005	20	Very Poor	6.10	Poor	92.7
Arkaqua Creek	697	11.6	Union	05/19/2004	30	Poor	7.23	Fair	86.5
Arkaqua Creek	819	5.1	Union	06/22/2005	22	Very Poor	6.66	Fair	96.5
Bitter Creek	997	4.8	Union	10/05/2006	26	Poor	6.34	Poor	99.5
Brasstown Creek	996	5.7	Towns	10/05/2006	26	Poor	5.07	Very Poor	119.3
Charlie Creek	1175	2.4	Fannin	07/29/2009	26	Poor	5.01	Very Poor	136.5
Cooper Creek	865	12.6	Union	09/13/2005	32	Poor	7.15	Fair	133.1
Cooper Creek	991	3.5	Union	09/28/2006	16	Very Poor	3.93	Very Poor	142.5
Dooley Creek	877	7.2	Union	10/05/2005	32	Poor	6.74	Fair	122.1
East Fork Coosa	696	4.2	Union	05/19/2004	24	Very Poor	5.32	Very Poor	134.0
Fodder Creek	715	9.2	Towns	06/10/2004	28	Poor	7.45	Fair	115.8
Fortenberry Creek	998	3.3	Union	10/05/2006	26	Poor	5.84	Poor	106.8
Helton Creek	695	2.9	Union	05/19/2004	18	Very Poor	5.37	Very Poor	136.5
Hightower Creek	872	17.1	Towns	09/22/2005	34	Fair	7.82	Poor	117.1
Ivylog Creek	700	10.8	Union	05/20/2004	26	Poor	6.35	Poor	122.7
Ivylog Creek	820	6.3	Union	06/23/2005	28	Poor	6.52	Poor	128.0
Jones Creek	1001	3.8	Union	10/10/2006	30	Poor	6.38	Poor	109.3
Keener Creek	706	2.3	Rabun	05/27/2004	22	Very Poor	5.75	Poor	136.0
Little Youngcane Creek	817	4.8	Union	06/22/2005	28	Poor	7.44	Fair	86.9
Owenby Creek	802	3.8	Fannin	05/26/2005	30	Poor	6.79	Fair	118.4
Owl Creek	795	3.9	Towns	05/19/2005	26	Poor	6.58	Fair	133.4

Right Prong Butternut	796	2.2	Union	05/19/2005	30	Poor	5.59	Poor	112.8
South Fork Rapier Mill Creek	711	6.0	Fannin	06/03/2004	32	Poor	6.44	Poor	66.7
Stink Creek	821	3.8	Union	06/23/2005	26	Poor	5.69	Poor	134.3
Swallow Creek	698	5.7	Towns	05/20/2004	18	Very Poor	5.49	Very Poor	148.0
Town Creek	713	16.4	Union	06/10/2004	46	Good	7.93	Poor	119.1
Tumbling Creek	739	4.9	Fannin	07/14/2004	30	Poor	5.88	Poor	170.3
Wilscot Creek	1003	5.4	Fannin	10/10/2006	28	Poor	6.21	Poor	124.3
Winchester Creek	789	2.5	Towns	05/12/2005	28	Poor	6.21	Poor	108.7
Youngcane Creek	876	21.2	Union	10/05/2005	34	Fair	7.20	Very Poor	112.2
Blue Ridge Ecoregion - Support									
Betty Creek	856	15.4	Rabun	08/25/2005	46	Good	8.14	Fair	128.5
Brasstown Creek	778	16.9	Towns	10/05/2004	50	Good	8.67	Fair	112.3
Brasstown Creek	878	34.6	Towns	10/06/2005	46	Good	8.80	Fair	132.8
Cooper Creek	769	22.5	Union	08/26/2004	46	Good	7.65	Poor	157.6
Cooper Creek	770	39.2	Fannin	08/26/2004	44	Good	7.73	Poor	121.7
Fightingtown Creek	761	12.9	Fannin	08/18/2004	44	Good	8.55	Excellent	119.1
Fightingtown Creek	862	13.1	Fannin	09/07/2005	54	Excellent	8.75	Excellent	120.7
Fightingtown Creek	862	13.1	Fannin	09/11/2008	48	Good	7.79	Good	109.5
Hemptown Creek	738	25.5	Fannin	07/14/2004	50	Good	9.08	Good	115.1
Hothouse Creek	763	20.9	Fannin	08/18/2004	44	Good	8.16	Fair	104.8
Little Tennessee River	883	54.9	Rabun	10/19/2005	44	Good	8.46	Fair	85.7
McClure Creek	1177	4.7	Fannin	08/26/2009	50	Good	8.18	Good	93.7
Nottley River	867	17.8	Union	09/14/2005	46	Good	7.77	Poor	130.7
Suches Creek	835	7.0	Union	07/20/2005	48	Good	7.76	Good	141.4
Toccoa River	754	18.2	Union	08/10/2004	52	Excellent	9.40	Excellent	124.3
Toccoa River	864	30.9	Union	09/13/2005	48	Good	8.47	Fair	115.8
Town Creek	713	16.4	Union	06/10/2004	46	Good	7.93	Poor	119.1
Town Creek	866	11.0	Union	09/14/2005	44	Good	7.84	Good	142.3

Table 10. WRD's Habitat Assessment Scores - High Gradient Streams

Stream Name	GAWRD Fish Site ID	Date	Instream Cover/ Epifaunal Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Total
Blue Ridge Ecoregion – Not Support																
Anderson Creek	875	10/05/2005	9.3	9.5	4.7	16.0	14.7	2.7	12.3	1.8	3.5	2.7	4.2	2.0	9.3	92.7
Arkaqua Creek	697	05/19/2004	10.0	10.0	8.0	17.4	12.8	4.2	9.8	3.4	3.6	3.5	3.5	0.0	0.3	86.5
Arkaqua Creek	819	06/22/2005	10.3	11.3	8.3	12.0	12.0	8.5	14.3	3.3	1.3	5.3	4.3	2.3	3.0	96.5
Bitter Creek	997	10/05/2006	9.0	11.0	11.7	15.0	13.3	7.3	11.7	5.2	2.7	5.7	1.7	4.0	1.3	99.5
Brasstown Creek	996	10/05/2006	14.0	13.3	13.1	17.0	15.5	10.0	12.3	3.8	4.2	5.3	4.7	3.3	2.7	119.3
Charlie Creek	1175	07/29/2009	12.3	10.3	11.3	20.0	15.7	9.8	12.3	7.3	7.3	7.3	7.0	6.7	9.0	136.5
Cooper Creek	865	09/13/2005	18.3	15.6	13.3	18.0	14.4	9.7	14.3	2.1	3.8	2.6	4.2	9.2	7.7	133.1
Cooper Creek	991	09/28/2006	13.7	18.0	12.0	16.0	16.7	17.0	13.3	3.3	3.3	7.5	7.3	8.7	5.7	142.5
Dooley Creek	877	10/05/2005	14.1	12.4	10.7	18.0	17.4	9.4	13.0	3.3	3.1	3.1	2.8	7.0	7.8	122.1
East Fork Coosa	696	05/19/2004	14.5	12.7	12.5	17.8	17.0	9.8	11.7	6.7	6.2	6.3	6.2	7.7	5.0	134.0
Fodder Creek	715	06/10/2004	14.5	15.0	8.8	18.0	15.7	7.8	15.0	4.3	3.8	4.8	4.2	2.3	1.5	115.8
Fortenberry Creek	998	10/05/2006	11.3	10.0	11.0	14.0	13.7	10.0	11.3	4.7	4.7	4.5	4.0	3.8	3.8	106.8
Helton Creek	695	05/19/2004	14.4	12.0	13.3	19.3	15.9	10.0	12.4	4.7	6.1	5.8	6.9	6.0	9.7	136.5
Hightower Creek	872	09/22/2005	13.4	13.6	15.1	16.0	14.8	11.6	15.7	2.7	2.6	3.3	3.4	1.8	3.2	117.1
Ivylog Creek	700	05/20/2004	14.9	12.0	7.7	19.0	16.4	7.7	12.1	5.4	5.5	5.7	5.9	7.6	2.9	122.7
Ivylog Creek	820	06/23/2005	15.9	14.1	12.5	19.0	18.3	8.4	15.7	2.0	2.0	2.8	2.5	8.9	5.8	128.0
Jones Creek	1001	10/10/2006	13.7	12.3	11.7	15.0	16.3	8.5	12.7	3.5	2.7	3.5	2.8	4.7	2.0	109.3
Keener Creek	706	05/27/2004	18.0	11.3	16.0	16.0	15.0	9.3	14.0	8.3	6.7	8.0	7.7	3.3	2.3	136.0
Little Youngcane Creek	817	06/22/2005	5.3	7.7	5.5	16.5	12.8	2.9	17.0	4.1	3.1	3.8	3.5	2.3	2.3	86.9
Owenby Creek	802	05/26/2005	13.4	9.2	12.7	12.0	17.3	9.4	11.7	3.1	3.8	4.6	4.7	8.6	8.0	118.4
Owl Creek	795	05/19/2005	13.2	12.0	14.3	17.5	16.8	12.8	16.2	6.2	5.6	6.6	6.3	3.9	2.1	133.4

Stream Name	GAWRD Fish Site ID	Date	Instream Cover/ Epifaunal Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Total
Right Prong Butternut	796	05/19/2005	11.0	11.0	10.3	13.0	13.3	7.7	16.3	4.2	5.2	5.3	5.7	6.5	3.3	112.8
South Fork Rapier Mill Creek	711	06/03/2004	10.7	6.5	2.3	0.0	16.7	1.0	13.5	3.3	3.0	4.9	3.9	0.5	0.5	66.7
Stink Creek	821	06/23/2005	17.9	14.0	14.9	18.0	18.7	13.2	15.3	1.6	2.8	3.7	5.8	6.8	1.7	134.3
Swallow Creek	698	05/20/2004	18.0	16.3	18.3	20.0	16.5	17.7	15.0	5.0	5.2	5.0	5.2	1.7	4.2	148.0
Town Creek	713	06/10/2004	15.8	16.0	10.6	19.0	16.0	10.2	13.2	4.0	4.3	4.3	4.2	1.1	0.4	119.1
Tumbling Creek	739	07/14/2004	18.3	17.3	15.5	19.0	18.0	15.3	16.3	7.2	7.0	8.7	8.7	9.2	9.8	170.3
Wilscot Creek	1003	10/10/2006	14.0	10.0	14.3	13.0	16.5	13.8	14.3	6.7	6.7	6.0	6.0	1.5	1.5	124.3
Winchester Creek	789	05/12/2005	11.7	12.5	9.7	15.0	14.7	8.0	15.7	4.7	5.7	3.3	5.2	1.5	1.2	108.7
Youngcane Creek	876	10/05/2005	11.8	12.9	11.7	19.0	14.2	5.1	15.4	3.1	2.3	3.7	2.9	5.6	4.5	112.2
Blue Ridge Ecoregion – Support																
Betty Creek	856	08/25/2005	17.8	18.2	13.9	17.0	11.2	12.0	17.3	3.2	3.0	5.2	4.8	3.2	1.5	128.5
Brasstown Creek	778	10/05/2004	13.8	16.9	12.3	16.0	12.1	10.9	13.4	2.4	3.3	3.7	4.8	0.5	2.2	112.3
Brasstown Creek	878	10/06/2005	15.3	16.0	16.2	16.5	17.6	6.3	16.7	4.1	4.9	4.5	5.5	5.2	3.9	132.8
Cooper Creek	769	08/26/2004	17.1	14.5	13.9	20.0	17.3	14.0	15.2	5.5	6.4	7.5	8.3	8.5	9.5	157.6
Cooper Creek	770	08/26/2004	13.8	14.0	11.5	15.0	16.0	13.0	14.9	5.0	4.7	5.1	4.5	2.9	1.3	121.7
Fightingtown Creek	761	08/18/2004	15.3	15.0	7.0	19.0	14.6	8.4	11.9	5.3	3.0	6.3	3.0	1.7	8.7	119.1
Fightingtown Creek	862	09/07/2005	12.0	14.8	11.9	17.0	13.0	8.5	16.3	4.7	4.0	6.5	7.2	3.5	1.1	120.7
Fightingtown Creek	862	09/11/2008	13.0	11.7	9.5	19.0	9.0	10.2	12.3	5.3	5.3	5.3	4.7	2.2	2.0	109.5
Hemptown Creek	738	07/14/2004	16.6	16.3	6.3	14.5	15.0	6.7	15.8	4.2	6.0	7.0	6.4	0.0	0.3	115.1
Hothouse Creek	763	08/18/2004	13.0	13.5	8.3	15.0	16.1	8.3	12.0	3.3	2.3	4.1	2.9	4.1	1.8	104.8
Little Tennessee River	883	10/19/2005	13.0	16.2	6.4	0.0	9.9	3.4	16.7	2.7	3.4	3.6	4.6	2.2	3.5	85.7
McClure Creek	1177	08/26/2009	11.7	10.3	4.7	16.0	11.3	4.0	10.0	6.7	7.0	4.0	4.0	2.0	2.0	93.7

Stream Name	GAWRD Fish Site ID	Date	Instream Cover/ Epifaunal Substrate	Velocity Depth Combinations	Embeddedness	Riffle Frequency	Channel Alteration	Sediment Deposition	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Total
Nottley River	867	09/14/2005	16.3	16.9	14.9	16.0	14.9	11.9	15.3	4.7	3.2	4.9	3.1	5.8	2.7	130.7
Suches Creek	835	07/20/2005	16.0	14.3	14.4	18.0	17.3	13.7	18.7	6.0	6.2	6.2	7.0	1.8	1.8	141.4
Toccoa River	754	08/10/2004	16.8	17.5	10.8	19.0	13.3	11.2	15.3	3.8	3.6	5.2	6.0	0.7	1.1	124.3
Toccoa River	864	09/13/2005	13.9	15.2	10.2	14.0	14.9	8.6	16.3	3.8	3.6	5.6	4.7	2.3	2.5	115.8
Town Creek	713	06/10/2004	15.8	16.0	10.6	19.0	16.0	10.2	13.2	4.0	4.3	4.3	4.2	1.1	0.4	119.1
Town Creek	866	09/14/2005	16.9	17.3	15.4	17.0	18.9	13.7	17.0	2.3	3.2	6.0	4.3	3.7	6.6	142.3

Table 11. WRD's Field Measurements

Stream Name	GAWRD Fish Site ID	Date	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Blue Ridge Ecoregion – Not Support														
Anderson Creek	875	10/05/2005	4.7	0.25	5	0.85	3	16.7	6.85	34.2	6.5	3.8	10	20
Arkaqua Creek	697	05/19/2004	6.8	0.26	5	0.55	7	19.8	7.91	34.5	7	7.39	13	20
Arkaqua Creek	819	06/22/2005	3.4	0.21	2	0.70	3	20.6	7.67	33.4	7	6.9	10	15
Bitter Creek	997	10/05/2006	3.4	0.18	3	---	4	16.3	8.93	35.5	7	1.7	13	30
Brasstown Creek	996	10/05/2006	4.3	0.16	4	0.70	6	16.4	9.76	15.6	7	0.5	5	10
Charlie Creek	1175	07/29/2009	3.7	0.16	1	0.51	10	20.9	8.51	25	6.58	---	7	15
Cooper Creek	865	09/13/2005	10.7	0.34	11	1.10	6	17.2	9.07	13.9	6.5	1.4	7	15
Cooper Creek	991	09/28/2006	5.3	0.14	3	0.95	6	17	9.05	23.9	7	2.1	10	20
Dooley Creek	877	10/05/2005	5.8	0.22	6	0.73	6	18.1	7.96	19.1	7	5.5	10	10
East Fork Coosa	696	05/19/2004	5.0	0.18	4	1.03	7	16.1	8.48	12.4	6.5	2.75	4	10
Fodder Creek	715	06/10/2004	6.7	0.24	10	1.70	7	19.4	7.51	20.4	6.5	8.74	7	15
Fortenberry Creek	998	10/05/2006	3.4	0.13	0	---	5	17.6	8.76	20.3	7	11.7	8	5
Helton Creek	695	05/19/2004	6.0	0.20	9	0.60	13	15.1	8.04	13.5	6.5	1.55	4	10
Hightower Creek	872	09/22/2005	9.0	0.40	4	1.10	4	17.5	7.71	17	7	2.6	8	10
Ivylog Creek	700	05/20/2004	7.4	0.30	12	0.65	8	19.1	8.21	20.7	7	5.95	5	15
Ivylog Creek	820	06/23/2005	5.9	0.25	12	0.70	11	15.8	9.01	16.3	6.5	5.7	5	15
Jones Creek	1001	10/10/2006	3.3	0.20	2	0.85	6	16.3	8.05	19.2	7	8.7	7	10
Keener Creek	706	05/27/2004	3.6	0.17	1	0.50	5	17.6	8.35	11.2	6.5	3.06	4	10
Little Youngcane Creek	817	06/22/2005	4.9	0.25	2	0.70	4	18	8.38	26.7	6.5	11.9	6	15

Stream Name	GAWRD Fish Site ID	Date	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Owenby Creek	802	05/26/2005	4.4	0.17	2	0.65	2	13.6	9.18	18.4	7	16.3	12	15
Owl Creek	795	05/19/2005	3.9	0.25	1	1.15	7	---	---	---	6.5	3.58	8	10
Right Prong Butternut	796	05/19/2005	2.7	0.14	1	0.51	4	17.8	8.96	23.6	7	6.2	7	15
South Fork Rapier Mill Creek	711	06/03/2004	4.9	0.49	14	1.33	0	19	8.27	24.5	7	7.8	10	15
Stink Creek	821	06/23/2005	5.4	0.32	7	0.70	7	16.3	8.33	14	6.5	1.7	5	10
Swallow Creek	698	05/20/2004	5.5	0.26	5	0.73	1	13.8	8.98	8.8	6.5	2.97	3	10
Town Creek	713	06/10/2004	8.2	0.30	13	0.75	12	17.5	8.35	22.8	6.5	2.77	9	10
Tumbling Creek	739	07/14/2004	5.5	0.21	3	1.17	10	19	7.24	12.5	7	3.9	6	15
Wilscot Creek	1003	10/10/2006	2.7	0.18	0	---	3	18.9	7.15	21.9	7	8.8	6	20
Winchester Creek	789	05/12/2005	2.7	0.21	1	0.70	3	18	9.13	15	7	3.54	6	15
Youngcane Creek	876	10/05/2005	10.8	0.41	12	0.85	7	16.5	8.08	20.6	7	5.6	9	15
Blue Ridge Ecoregion – Support														
Betty Creek	856	08/25/2005	10.1	0.50	5	1.55	6	17.8	8.44	13.8	6.5	4.8	5	5
Brasstown Creek	778	10/05/2004	7.7	0.36	13	1.74	5	13.8	9.35	30.4	7	1.5	12	20
Brasstown Creek	878	10/06/2005	12.8	0.46	22	1.30	5	18.8	7.75	38.1	7	9.8	9	15
Cooper Creek	769	08/26/2004	13.3	0.34	25	0.86	1	17.6	9.19	14.8	7	4.7	6	10
Cooper Creek	770	08/26/2004	11.7	0.42	7	0.95	5	19.7	8.8	15.1	7	7.3	4	10
Fightingtown Creek	761	08/18/2004	9.7	0.32	25	1.30	11	16.9	8.94	14	7	7	15	10
Fightingtown Creek	862	09/07/2005	9.7	0.34	5	0.90	6	17.1	9.51	11.0	6.5	2.6	3	5
Fightingtown Creek	862	09/11/2008	8.7	0.24	5	0.66	8	18.6	9.78	12	7.17	1.96	4	10
Hemptown Creek	738	07/14/2004	6.3	0.36	7	0.90	5	20.5	8.13	30.3	7	9.8	14	25

Stream Name	GAWRD Fish Site ID	Date	Average Stream Width (m)	Average Stream Depth (m)	Number of Pools	Deepest Pool (m)	Number Riffles	Water Temp (deg C)	Dissolved Oxygen (mg/L)	Conductivity (uS)	pH (SU)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Hothouse Creek	763	08/18/2004	8.1	0.34	7	0.90	5	21	8.36	23.6	7	13.3	9	15
Little Tennessee River	883	10/19/2005	14.1	0.61	9	1.25	1	13.8	7.51	242.2	7	4.1	15	25
McClure Creek	1177	08/26/2009	5.0	0.24	4	0.70	5	19.64	9.16	17	7.15	13.8	5	15
Nottley River	867	09/14/2005	12.1	0.35	8	1.50	4	17.8	7.86	15	7	1.3	4	10
Suches Creek	835	07/20/2005	6.4	0.36	7	1.20	7	16.6	---	16.5	7	6.1	6	15
Toccoa River	754	08/10/2004	10.2	0.36	13	1.33	8	16.6	8.88	15.9	7	2.7	6	10
Toccoa River	864	09/13/2005	11.8	0.44	5	1.20	3	15.6	8.75	15	7	2	6	10
Town Creek	713	06/10/2004	8.2	0.30	13	0.75	12	17.5	8.35	22.8	6.5	2.77	9	10
Town Creek	866	09/14/2005	8.7	0.36	10	1.30	6	15.9	7.9	15.1	7	1.6	5	10

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Table 12. EPD's Macroinvertebrate Community Study Scores

Sub-ecoregion	Stream Name	Area (Acres)	County	Sampling Date	Sub-ecoregion Index Score	Subecorgion Narrative Description
66d	Chattahoochee River	11,315.7	White	10/8/2000	75	Good
	Coleman River	3,230.7	Rabun	10/27/2001	77	Good
	Tallulah River	20,569.4	Rabun	10/21/2000	89	Very Good
	West Fork Wolf Creek	2,198.0	Union	10/27/2001	57	Poor
66j	Bryan Creek	2,327.7	Fannin	12/2/2000	82	Good
	Hemptown Creek	6,440.8	Fannin	10/27/2001	31	Very Poor
	Ivylog Creek	4,055.4	Union	10/27/2001	49	Poor
	South Fork Rapier Mill Creek	3,868.2	Fannin	11/17/2001	87	Very Good
	Sugar Creek	8,694.2	Fannin	10/28/2001	47	Poor
67f&I	Alpine Creek	3,690.4	Chattooga	1/10/2002	19	Very Poor
	Black Branch	5,983.7	Catoosa	10/5/2001	20	Very Poor
	Cane Creek	7,706.5	Walker	2/18/2001	85	Very Good
	Clarks Creek	1,672.2	Chattooga	2/4/2001	76	Good
	Jones Branch	4,238.4	Bartow	2/8/2002	27	Poor
67g	Armuchee Creek Tributary	3,758.7	Floyd	2/10/2001	71	Good
	Little Armuchee Creek	4,094.6	Chattooga	2/10/2001	76	Good
	Moss Creek	4,140.7	Chattooga	2/4/2001	81	Very Good
	Polecat Creek	4,933.6	Murray	12/2/2001	37	Poor
	Sugar Creek	2,195.6	Catoosa	10/6/2001	23	Very Poor
	Tributary to Tiger Creek	1,390.2	Catoosa	9/14/2002	36	Poor
68c&d	Bear Creek	5,026.2	Dade	2/24/2001	83	Very Good
	Big Spring Branch	2,930.7	Dade	10/5/2001	32	Poor
	Daniel Creek	3,444.2	Dade	3/6/2001	83	Very Good
	East Fork Little River	7,838.4	Chattooga	10/7/2001	30	Very Poor
	Rock Creek	11,565.8	Walker	2/24/2001	77	Good

Table 13. EPD's Habitat Assessment Scores – High Gradient Streams

Subecoregion	Stream Name	Sample Date	Epifaunal Substrate/Available Cover	Embeddedness	Velocity/Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles (or bends)	Bank Stability (Left Bank)	Bank Stability (Right Bank)	Vegetative Protection (Left Bank)	Vegetative Protection (Right Bank)	Riparian Vegetative Zone Width (Left Bank)	Riparian Vegetative Zone Width (Right Bank)	Habitat Score	Subecorgion Narrative Description
66d	Chattahoochee River	10/8/2000	17	16	18	15	14	18	17	9	9	8	9	9	10	169	Good
66d	Coleman River	10/27/2001	14	18	19	18	18	19	19	9	9	9	9	10	10	181	Good
66d	Tallulah River	10/21/2000	16	15	17	13	15	17	18	9	8	10	7	10	7	162	Very Good
66d	West Fork Wolf Creek	10/27/2001	18	18	12	16	17	16	17	9	9	9	9	10	9	169	Poor
66j	Bryan Creek	12/2/2000	18	16	17	18	16	15	17	9	8	9	4	9	4	160	Good
66j	Gumlog Creek	12/2/2000	17	15	15	16	17	18	18	8	8	9	9	8	8	166	Good
66j	Hemptown Creek	10/27/2001	14	14	15	9	17	16	13	8	8	8	7	10	9	148	Very Poor
66j	Ivylog Creek	10/27/2001	17	16	13	12	12	13	14	4	5	4	5	6	5	126	Poor
66j	South Fork Rapier Mill Ck	11/17/2001	10	4	15	5	16	20	16	4	3	5	3	9	1	111	Very Good
66j	Sugar Creek	10/28/2001	10	7	14	8	18	16	16	3	4	2	2	9	3	112	Poor
67f&I	Alpine Creek	1/10/2002	19	16	15	8	9	15	11	5	4	3	3	2	2	112	Very Poor
67f&I	Cane Creek	2/18/2001	18	16	15	14	18	18	18	8	8	9	9	10	9	170	Very Good
67f&I	Clarks Creek	2/4/2001	13	13	9	10	14	13	13	6	6	6	6	5	4	118	Good
67f&I	Jones Branch	2/8/2002	14	13	14	8	15	16	17	5	5	4	5	7	5	128	Poor
67g	Armuchee Creek Trib	2/10/2001	13	12	18	14	14	18	16	7	8	8	8	9	8	153	Good
67g	Little Armuchee Creek	2/10/2001	12	16	17	11	17	16	18	10	4	6	6	3	7	143	Good

Subecoregion	Stream Name	Sample Date	Epifaunal Substrate/Available Cover	Embeddedness	Velocity/Depth Regime	Sediment Deposition	Channel Flow Status	Channel Alteration	Frequency of Riffles (or bends)	Bank Stability (Left Bank)	Bank Stability (Right Bank)	Vegetative Protection (Left Bank)	Vegetative Protection (Right Bank)	Riparian Vegetative Zone Width (Left Bank)	Riparian Vegetative Zone Width (Right Bank)	Habitat Score	Subecorgion Narrative Description
67g	Moss Creek	2/4/2001	15	13	16	12	16	15	16	8	5	8	4	8	3	139	Good
67g	Polecat Creek	12/2/2001	15	16	16	6	16	19	9	2	2	2	1	3	9	116	Poor
67g	Sugar Creek	10/6/2001	14	18	15	13	10	15	13	9	8	10	7	9	6	147	Very Poor
68c&d	Bear Creek	2/24/2001	18	18	19	15	19	19	17	8	9	10	9	10	9	180	Very Good
68c&d	Daniel Creek	3/6/2001	19	18	18	19	19	18	17	10	10	9	9	10	9	185	Very Good
68c&d	East Fork Little River	10/7/2001	15	18	14	19	13	20	16	9	9	9	10	9	10	171	Very Poor
68c&d	Rock Creek	2/24/2001	17	18	15	19	18	17	19	9	10	9	10	8	10	179	Good

3.0 SOURCE ASSESSMENT

A healthy aquatic ecosystem requires a healthy habitat. The major disturbance to stream habitats is erosion and sedimentation. As sediment is carried into the stream, it changes the stream bottom and smothers sensitive organisms. Turbidity associated with sediment loads may also impair recreational and drinking water uses (GA EPD, 1998).

A source assessment characterizes the known and suspected sources of sediment in the watershed for use in a water quality model and the development of the TMDL. Sources are broadly classified as either point or nonpoint sources. A point source is defined as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Nonpoint sources are diffuse, and generally, but not always, involve accumulation of pollutants on land surfaces that wash off as a result of storm events.

3.1 Point Source Assessment

Title IV of the Clean Water Act establishes the National Pollutant Discharge Elimination System (NPDES) permit program. There are two basic kinds of NPDES permits: 1) municipal and industrial wastewater treatment facilities, and 2) regulated stormwater discharges.

3.1.1 Wastewater Treatment Facilities

In general, municipal and industrial wastewater treatment facilities have NPDES permits with effluent limits. These permit limits are either based on federal and state effluent guidelines (technology-based limits) or on water quality standards (water quality-based limits).

The United States Environmental Protection Agency (USEPA) has developed technology-based guidelines, which establish a minimum standard of pollution control for municipal and industrial discharges without regard for the quality of the receiving waters. These are based on Best Practical Control Technology Currently Available (BPT), Best Conventional Control Technology (BCT), and Best Available Technology Economically Achievable (BAT). The level of control required by each facility depends on the type of discharge and the pollutant.

The USEPA and the states have also developed numeric and narrative water quality standards. Typically, these standards are based on the results of aquatic toxicity tests and/or human health criteria and include a margin of safety. Water quality-based effluent limits are set to protect the receiving stream. These limits are based on water quality standards that have been established for a stream based on its intended use and the prescribed biological and chemical conditions that must be met to sustain that use.

For purposes of this TMDL, NPDES permitted wastewater treatment facilities will be considered point sources. Discharges from municipal, industrial, private and federal NPDES permitted facilities are the primary point sources of sediment as total suspended solids (TSS) and/or turbidity. There are no permitted NPDES discharges identified in the not supporting Tennessee River Basin watersheds upstream from the listed segments.

3.1.2 Regulated Storm Water Discharges

Certain sources of storm water runoff are covered under the NPDES Permit Program. It is considered a diffuse source of pollution. Unlike other NPDES permits that establish end-of-pipe pollutant limits, storm water NPDES permits establish controls that are intended to reduce the quantity of pollutants that storm water picks up and carries into storm sewer systems during rainfall events. Currently, regulated storm water discharges include those associated with industrial activities, construction sites one acre or greater, large and medium municipal separate storm sewer systems (MS4s), and small MS4s serving urbanized areas.

3.1.2.1 Industrial General Storm Water NPDES Permit

Storm water discharges associated with industrial activities are currently covered under Georgia's General Industrial Storm Water NPDES Permit (GAR050000).This permit requires visual monitoring of storm water discharges, site inspections, implementation of Best Management Practices (BMPs), preparation of a Storm Water Pollution Prevention Plan (SWPPP), and annual reporting. Table 14 provides a list of those facilities in the Tennessee River Basin that have submitted a Notice of Intent to be covered under Georgia's Industrial General Storm Water NPDES Permit, that also discharge into streams that are impaired for biota. At this time, it is unknown whether these facilities are contributing sediment to the watershed.

Table 14. Facilities Covered Under Georgia's General Industrial Storm Water NPDES Permit in the Tennessee River Basin that Discharge to Not Supporting Streams

Stream Segment	Facility	Permit #
Black Branch	Victory Sign Industries LTD	NOI 10480
	Washington Road Surface Mine	NOI 12649

Source: Nonpoint Source Program, GA DNR, 2014

3.1.2.2 MS4 NPDES Permits

The collection, conveyance, and discharge of diffuse storm water to local water bodies by a public entity is regulated in Georgia by the NPDES MS4 permits. These MS4 permits have been issued under two phases. Phase I MS4 permits cover medium and large cities, and counties with populations over 100,000. Each individual Phase I MS4 permit requires the prohibition of non-storm water discharges (i.e., illicit discharges) into the storm sewer systems and controls to reduce the discharge of pollutants to the maximum extent practicable, including the use of management practices, control techniques and systems, as well as design and engineering methods (Federal Register, 1990). A site-specific Storm Water Management Plan (SWMP) outlining appropriate controls is required by and referenced in the permit. A program to monitor and control pollutants in storm water discharges from industrial facilities, construction sites, and highly visible pollutant sources that exist within the MS4 area must be implemented under the permit. Additionally, monitoring of not supporting streams, public education and involvement, post-construction storm water controls, low impact development, and annual reporting requirements must all be addressed by the permittee on an ongoing basis.

Small MS4s serving urbanized areas are required to obtain a storm water permit under the Phase II storm water regulations. An urbanized area is defined as an area with a residential population of at least 50,000 people and an overall population density of at least 1,000 people per square mile. Thirty (30) counties, fifty-six (56) communities, seven (7) Department of Defense facilities, and the Georgia Department of Transportation (GDOT) are permitted under the Phase II regulations in Georgia. All municipal Phase II permitees are authorized to discharge under Storm Water General Permit GAG610000. Department of Defense facilities are authorized to discharge under Storm Water General Permit GAG480000. GDOT owned or operated facilities are authorized to discharge under Storm Water General Permit GAG410000. Under these general permits, each permittee must design and implement a SWMP that incorporates BMPs that focus on public education and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction storm water management, and pollution prevention in municipal operations. Table 15 lists the permitted MS4s that discharge into stream segments not supporting their designated use.

Table 15. Permitted MS4s in the Tennessee River Basin

Stream Segment	MS4 Permittees	MS4 Phase
Bio M Streams		
Big Spring Branch-Higdon Creek	Dade County	2
Black Branch	City of Fort Oglethorpe City of Rossville Catoosa County Walker County	2 2 2 2
Sugar Creek EPD 67g-1	Catoosa County	2
Tributary to Tiger Creek	Catoosa County	2

Source: Nonpoint Source Program, GA DNR, 2014

Table 16 provides the total area of each not supporting watershed and the percentage of urbanized area in the permitted MS4 area contained within the watershed. The land use types that are considered urbanized include 1) developed open space, 2) developed low intensity, 3) developed medium intensity, 4) developed high intensity, 5) utility swaths, and 6) golf courses.

Table 16. Percentage of Watersheds Located in MS4 Areas or Urban Areas

Stream Segment	Total Area (sq. mi.)	% In MS4 Urbanized Area	Contributing MS4 Permittees
Bio M Listed Segments			
Black Branch	9.5	6.0	City of Fort Oglethorpe, City of Rossville, Catoosa County, Walker County

Soil erosion from construction sites has historically been a major source of sediment in Georgia's streams. Georgia requires construction sites over one acre to have a General Storm Water NPDES permit. General permits have been created to cover construction projects that fall into three distinct categories; standalone construction projects (General Permit No. GAR100001), infrastructure construction projects (General Permit No. GAR100002), and construction that occurs under a common plan of development where the primary permittee chooses to use secondary permittees for land disturbance activities (General Permit No. GAR100003). Since construction sites are regulated by NPDES permits, they are considered as point sources. It is unknown if there are any construction sites in the not supporting watersheds of the Tennessee River Basin.

3.2 Nonpoint Source Assessment

Eroded soils from forests, cropland, mining sites, and other land can be transported to Georgia streams through runoff. Excessive sediment that reaches the water bodies can cause a variety of changes to the stream. It can make the streams shallower and wider, affecting the stream's temperature, dissolved oxygen, flow rate, and velocity. It can cause increased flooding. It can affect the ability of the stream to assimilate pollutants. Excessive sediment can change the diversity of fish populations and other biological communities. In addition, harmful pollutants can attach to the sediment and be transported to rivers and streams.

3.2.1 Silviculture

Georgia has 23.6 million acres of commercial forests. This represents approximately 64 percent of all of Georgia's land use. Approximately 68 percent of the commercial forests are privately owned, 25 percent are owned by industry, and 7 percent are publicly held (GA EPD, 1999).

The majority of soil erosion from forested land occurs during timber harvesting and the period immediately following, and during reforestation. Once the forest is re-established, very little soil erosion occurs. Timber harvesting includes the layout of access roads, log decks, and skid trails; the construction and stabilization of these areas; and the cutting of trees. Both hardwoods and pines are harvested throughout Georgia. A minimum harvest is usually ten acres and the percent of forest that is harvested each year varies from county to county. The Georgia Forestry Commission (GFC) was consulted for information and parameters regarding silviculture activities. Table 17 lists the percent timberland and percent harvested per year for counties that contain modeled watersheds.

Table 17. Timberland, Growing Stock and Annual Removal

County	Forest Area (1000 acres)	Timberland (1000 acres)	Growing Stock Volume (million ft^3) [a]	Annual Volume Removal (million ft^3)
Catoosa	52	43	60	
Dade	80	80	168	0.3
Fannin	204	169	336	0.2
Gilmer	249	237	567	4.4
Rabun	225	202	499	1.1
Towns	69	52	93	1.4
Union	166	126	245	0.1
Walker	165	165	262	1.3

Estimate - does not include trees less than 5" diameter at breast height (DBH).
Source: Forest Inventory EVALIDator web-application, USDA-FS, Northern Research Station

3.2.2 Agriculture

Agriculture can be a significant contributor of nonpoint pollutants to rivers and streams including sediment and nutrients. Cropland is one of the major sources of soil loss due to sheet and rill erosion. The NRCS was consulted for information and parameters regarding agricultural activities. Over the last century there has been a significant decrease in the amount of land farmed in Georgia. In 1950, there were approximately 198,000 farms encompassing 25.7 million acres in Georgia (U.S. Bureau of the Census, 1954).In 1982, there were approximately 12.3 million acres of farmland in Georgia, with the number of farms estimated to be 50,000 and the average farm size being approximately 248 acres. This represents a 52 percent reduction in farmland acreage. The number and acreage of farms has continued to decrease as time has gone on. In 2012, it was reported that approximately 42,000 farms covering9.6 million acres existed in Georgia, which represents a 63 percent reduction from 1950 (USDA-NASS, 2012).

With the reduction in farmland, there has also been a decrease in the amount of soil erosion from agricultural lands. The National Resources Inventory found the total wind and water erosion on cropland and Conservation Reserve Program land in Georgia declined 38 percent, from 3.1 billion tons per year in 1982 to 1.9 billion tons per year in 1997 (USDA-NRCS, 1997).This suggests that the source of sediment in many of the not supporting streams in the Tennessee River Basin may be the result of past land use practices. Thus, it is believed that if sediment loads are maintained at acceptable levels, streams will repair themselves over time.

3.2.3 Grazing Areas

Farm animals grazing on pastureland can leave areas of ground with little or no vegetative cover. During a rainfall runoff event, soil in the pastures is eroded and transported to nearby streams, typically by gully erosion. The amount of soil loss from gully erosion is generally less than that caused by sheet and rill erosion. Work in small grazed catchments in New Mexico found that gully erosion contributed only 1.4 percent of the total sediment load as compared to sheet and rill erosion. Other research has found that gully erosion typically contributes less than 30 percent of the total sediment load; however, contributions have ranged from 0 to 89 percent (USEPA, 2001b).

Beef cattle spend most of their time grazing in pastures, while dairy cattle and hogs are confined periodically. Hog farms confine the animals or allow them to graze in small pastures or pens. On dairy farms, the cows are confined for a limited period each day, during which time they are fed and milked.

In addition, cattle and other unconfined animals often have direct access to streams that flow through pastures. As these animals walk down to the stream, they often damage stream banks. Stream bank vegetation is destroyed and the banks often collapse, resulting in increased sedimentation to the waterway.

3.2.4 Mining Sites

Minerals, rocks, and ores are found in natural deposits on or in the earth. Kaolin, clays, granite, marble, sand, gravel, and other mineral products are the materials primarily mined in Georgia. Surface mining involves the activities and processes used to remove minerals, ores, or other solid material. Tunnels, shafts, and dimension stone quarries are not considered to be surface mines. Surface mining encompasses a variety of activities ranging from sand dredging to open pit clay mining to hard rock aggregate quarrying.

Removal of vegetation, displacement of soils, and other significant land disturbing activities are typically associated with surface mining. These operations can result in accelerated erosion and sedimentation of surface waters.

3.2.5 Roads

Erosion from unpaved roadways can be a significant source of sediment to rivers and streams. Road erosion occurs when soil particles are loosened and carried away from the roadway, ditch or road bank by water, wind or traffic. The actual road construction (including erosive road-fill soil types, shape and size of coarse surface aggregate, poor subsurface or surface drainage, poor road bed construction, roadway shape, and inadequate runoff discharge outlets or “turn-outs” from the roadway) may aggravate roadway erosion. In addition, external factors such as roadway shading and light exposure, traffic patterns, and road maintenance may also affect roadway erosion.

Exposed soils, high runoff velocities and volumes, and poor road compaction all increase the potential for erosion. Loose soil particles are often carried from the roadbed into roadway drainage ditches. Some of these particles settle out satisfactorily, but usually they settle out poorly, causing diminished ditch carrying capacity that results in roadway flooding and, subsequently, more roadway erosion (Choctawhatchee, et. al, 2000).

3.2.6 Urban Development

Soil erosion from land disturbing activities is a major source of sediment in Georgia’s streams. Land-disturbing activities are defined as any activity that may result in soil erosion and the movement of sediments into State waters or on lands of the State. Examples of land disturbing activities include clearing, grading, excavating, or filling of land. The following activities are unconditionally exempt from the provisions of the Erosion and Sedimentation Act: surface mining, granite quarrying, minor land-disturbing activities such as home gardens and landscaping, agricultural and silvicultural operations, and any project carried out under the technical supervision of the NRCS.

Conversion of forest to urban land use is often associated with water quality degradation. Since the early 80’s the area classified as commercial forest within the Tennessee River Basin has significantly decreased. It should be noted that forest undergoing conversion to another land use is not considered silviculture, but rather a land disturbing activity.

Storm water runoff from developed urban areas can also have an impact on the transport of sediment to and within streams. Urbanization increases imperviousness, resulting in an increase in the volume of runoff entering the streams. In addition, the stream flow rates may increase significantly from pre-construction rates, causing stream bank erosion and stream bottom down cutting.

4.0 MODELING APPROACH

Establishing the relationship between the in-stream water quality and the source loadings is an important component of TMDL development. It provides for the identification of sources and their relative contribution, as well as the examination of potential water quality changes resulting from varying management options to meet the water quality criteria. This relationship can be developed using a variety of techniques ranging from simple methods based on scientific principles to more complex numerical computer modeling techniques.

In this section, the numerical modeling techniques developed to simulate sediment fate and transport in the watershed are discussed. The limited amount of sediment loading data and in-stream sediment information prevents GA EPD from using a dynamic watershed runoff model, which requires a great deal of data for model development and calibration. Instead, GA EPD determined the annual sediment loads delivered to a stream from the surrounding watershed. This TMDL does not address in-stream sedimentation processes, such as bank erosion and stream bottom down cutting, since computer models that simulate these processes are not available at this time.

4.1 Model Selection

The Agricultural Research Station (ARS) developed the Universal Soil Loss Equation (USLE) over 40 years ago. It is the most widely accepted and used soil loss equation. It was designed as a method to predict average annual soil loss caused by sheet and rill erosion. The USLE can estimate long-term soil loss, and can assist in choosing proper cropping, management, and conservation practices. However, it cannot be used to determine erosion for a specific year or specific storm. Because of its wide acceptance by the forestry, agricultural, and academic communities, the USLE was selected as the tool for estimating long-term annual soil erosion, assessing the impacts of various land uses, and evaluating the benefits of various BMPs.

4.2 Universal Soil Loss Equation

For each of the watersheds monitored in the Tennessee River Basin, the existing annual sediment load was estimated using the USLE. The USLE predicts the average annual soil loss caused by sheet and rill erosion. Soil loss from sheet and rill erosion is mainly due to detachment of soil particles during rainfall events. It is the major source of soil loss from crop production and animal grazing areas, logging areas, mine sites, unpaved roads, and construction sites. The equation used for estimating average annual soil erosion is:

$$A = RKLSCP$$

Where:

A = average annual soil loss, in tons / acre
R = rainfall erosivity index
K = soil erodibility factor
L = slope length factor
S = slope steepness factor
C = cover management factor
P = conservation practice factor

4.2.1 Rainfall Erosivity Index

The R factor, or rainfall erosivity index, is a measure of the cumulative erosive force of individual precipitation events. When other factors are constant, soil losses from storm rainfall are directly proportional to the product of the total kinetic energy of the storm (E) times its maximum 30-minute intensity (I_{30}); this is termed the single-storm erosion index (EI_{30}). The mean annual R-factor represents the sum of EI_{30} values for all storms in a year, averaged over all years of record (Daly and Taylor, 2002). Daily rain-gauge data for the period 1971-2000 were used to compute R-factor values for the conterminous United States. The R-factor values are specified by a raster dataset with a spatial resolution of 2.5 minutes (about 4 km cell size), which was produced by the Spatial Climate Analysis Service at Oregon State University. R factor varies geographically and ranges from 270 to 424 within the Tennessee River Basin

4.2.2 Soil Erodibility Factor

The K-factor, or soil erodibility factor, represents the susceptibility of soil to be eroded. This factor quantifies the cohesive or bonding character of the soil and ability of the soil to resist detachment and transport during a rainfall event. The factor reflects the fact that different soils erode at different rates when the other factors that affect erosion (e.g., infiltration rate, permeability, total water capacity, dispersion, rain splash, and abrasion) are the same. Texture is the principal factor affecting erodibility, but structure, organic matter, and permeability also contribute (Goldman et al. 1986).

The soil erodibility factor is a raster dataset generated for each modeled watershed from the SSURGO database. The erodibility of the soil horizons and components of each soil map unit are proportioned and summed to compute the overall K-factor for each soil map unit. Soil map units are the basic geographic unit utilized in the SSURGO database. Table 6 provides a summary of hydrologic soil groups in each supporting and not supporting watershed that was modeled and the corresponding range of K-factors.

4.2.3 Slope Length and Steepness Factors

L is the slope length factor, representing the effect of slope length on erosion. It is the ratio of soil loss from the field slope length to that from a unit plot length on the same soil type and gradient. In practice, slope length is the distance from the origin of overland flow along its flow path to the location of either concentrated flow or deposition. Longer slopes generally accumulate more runoff from larger areas and also result in higher overflow velocities. The slope length factor is computed with the equation:

$$L = (x_i^{m+1} - x_{i-1}^{m+1})/[\lambda_u^m(x_i - x_{i-1})]$$

Where:

x_i = distance to the lower end of the segment

x_{i-1} = distance to the upper end of the segment

λ_u = length of the unit plot (72.6 ft)

$m = \frac{\beta}{1+\beta}$ = slope length exponent

$$\beta = \left[\frac{k_r}{k_i}\right] * \left[\frac{c_r}{c_i}\right] * \left[\frac{\exp(-0.05\ G_c)}{\exp(-0.025\ G_c)}\right] * \left[\frac{\left(\frac{\sin\theta}{0.0896}\right)}{\left[3\left(\frac{\sin\theta}{0.896}\right)^{0.8} + 0.56\right]}\right]$$

$\left[\frac{k_r}{k_i}\right]$ = the ratio of rill erodibility to interrill erodibility, assumed to be 1

$\left[\frac{c_r}{c_i}\right]$ = the ratio for below ground effects for rill and interrill erosion, assumed to be 1

$\left[\frac{\exp(-0.05\ G_c)}{\exp(-0.025\ G_c)}\right]$ = ratio of the ground cover effect on rill and interrill erosion, assumed to be 1

θ = slope angle of the segment

S is the slope steepness factor, representing the effect of slope steepness on erosion. Steeper slopes generally produce higher overland flow velocities. Soil loss increases more rapidly with slope steepness than it does with slope length. The slope steepness factor is computed with the equation:

$$S = 10.8 \sin\theta + 0.03 \quad \text{for slopes} < 9\%$$
$$S = 16.8 \sin\theta - 0.50 \quad \text{for slopes} \geq 9\%$$

Both the L and S factor equations depend on the slope angle (θ) of the given watershed. Slope angle is calculated using digital elevation model (DEM) data obtained from the United States Geological Survey (USGS) National Elevation Dataset (NED).

4.2.4 Cropping Factor

The C-factor, or cover management factor, is a dimensionless number, ranging between 0 and 1, that represents the degree of protection from erosion provided by crops, vegetation, and other soil cover. For this application of USLE, the C-factor has been utilized to convey the inherent erosion potential of the different land covers in each modeled watershed.

For agricultural lands, the C-factor incorporates the effects of tillage, crop type, cropping history, and crop yield on both soil erosivity and erodibility. ARS has continually refined C-factor values for specific crop and pasture types throughout the years. These values are easily obtained and well distributed. A review of available literature yielded generalized C-factor values for all land cover types and is given in Table 18.

Table 18. C-Factor for Land Cover types in Georgia

Land Cover Type	C-factor
Open Water/Beaches/Dunes/Mud	0
Utilities Swaths / Golf Courses	0.011
Developed	0.003
Clearcut/Sparse	0.2
Quarries/Strip Mines	0.2
Rock Outcrops	0
Forested	0.001
Pasture	0.011
Row Crops	0.2
Wetland	0.011

Source: Soil & Water Assessment Tool Documentation, 2012

4.2.5 Conservation Practice Factor

The P factor or conservation practice factor represents the effects of conservation practices on erosion. The conservation practices include BMPs such as contour farming, strip cropping and terraces. In all cases, it was assumed that no BMPs were used and the P factor for all land uses was 1.0.

4.3 WCS Sediment Tool

USEPA and Tetra Tech developed the ArcView-based Watershed Characterization System (WCS) to provide tools for characterizing various watersheds. WCS was used to display and analyze geographic information system (GIS) data, including land use, soil type, ground slope, road networks, point source discharges, and watershed characteristics. The Sediment Tool extension, which utilized the USLE, was used to estimate the potential sediment delivery to a defined water body of concern. This original version of WCS was used for modeling of sediment TMDLs issued by GA EPD through 2012.

GA EPD has updated and modernized the code and originally developed by USEPA and Tetra Tech. The original WCS program and code was evaluated to determine what functionality and features should be incorporated into the updated system.

The utilization of a GIS-based platform was considered a high priority so large amounts of high resolution geospatial data could be efficiently analyzed for water quality limited streams. The Natural Resources Spatial Analysis Lab (NARSAL), within the College of Agricultural and Environmental Sciences, at the University of Georgia was contracted to update the GIS-based platform that would allow for similar analyses of the original WCS and its Sediment Tool.

The GIS software platform chosen was ArcGIS. The GA EPD Watershed Characterization System (GAWCS) was developed to run in ArcMap 10.X and utilize widely available and regularly updated state-wide geospatial datasets. Within the ArcGIS toolbox, two source code scripts, written in the open-source Python coding language, generate required datasets based on DEM data, and evaluate a selected watershed utilizing a sediment budget model based on the Revised Universal Soil Loss Equation, Version 2 (RUSLE2).The sediment budget model provides the estimated annual average soil loss due to sheet and rill erosion. A tabular summary of land cover, soil, stream, and demographic attributes of the selected watershed is provided to fully characterize a watershed, aid in water quality evaluation, and identify potential sources of impairment.

The DEM Process script utilizes the highest resolution DEM dataset available to generate three raster datasets that are subsequently used in the sediment budget calculation process. First, a state-wide slope angle raster data file is generated by calculating the slope angle from the raw DEM raster data. Following the generation of the slope angle raster, the DEM raster is hydrologically corrected such that modeled streamflow always flows along accurate stream paths to the edge of the DEM dataset. In this process, the streams from the USGS National Hydrography Dataset (NHD) NHD Flowline Feature Class are rasterized, snapped, and “burned” into the DEM. The “burn” process is essentially subtracting the stream pixels from the DEM, thus making an artificial gully and forcing the subsequently calculated flow accumulation and flow direction to follow the NHD streams. The DEM raster is then filled to remove any sinks. Finally, a state-wide flow direction raster and flow accumulation raster are generated, based on the edited DEM raster file. As higher resolution DEM datasets become available, the DEM processing script can be used to generate state-wide slope angle, flow direction, and flow accumulation raster datasets with a higher degree of accuracy.

The Watershed Characterization script evaluates a user-defined watershed that can either be based on a manual watershed delineation provided by the user or the script can delineate a watershed based on a user-selected pour point. Once the watershed is delineated, a variety of statistics describing land cover, population, and soil makeup are calculated and exported in tabular form.

Following the tabulation of watershed statistics, the Watershed Characterization script initiates the sediment erosion calculation process. A 30-meter by 30-meter grid is superimposed over the watershed to form the basic framework from which the sediment erosion estimate is calculated. This grid size represents the spatial resolution of the most land cover datasets, including the National Land Cover Dataset (NLCD) produced by USGS, and the Georgia Land Use Trends (GLUT) dataset produced by NARSAL. For each grid cell within the watershed, the Watershed Characterization script extracts or calculates the individual USLE factors based on the geospatial data provided through the ArcMap interface. Based on the specific cell characteristics and individual factors, the potential erosion for each grid cell is calculated using the USLE.

After the annual soil loss is computed for each grid cell in the watershed, areas of deposition and erosion are identified. Only areas of erosion are assumed to contribute to the total sediment yield of the watershed. Curvature of the watershed is computed along with a 3x3 focal mean slope. Areas of deposition are defined where slope is concave and less than ½ the mean slope. All other areas are defined as eroding. To compute the total sediment yield (tons/acre/year), a weighted flow accumulation is computed excluding the areas of deposition. The calculated sediment yields (tons/acre/year) are recalculated based on the actual watershed size to get an absolute sediment yield (tons/year).

5.0 TOTAL MAXIMUM DAILY LOAD

A Total Maximum Daily Load (TMDL) is the amount of a pollutant that can be assimilated by the receiving water body without exceeding the applicable water quality criteria; in this case, the narrative water quality criteria for aquatic life. This TMDL determines the range of sediment loads that can enter the Tennessee River Basin watersheds not supporting their designated use without causing additional impairment to the stream. This range is based on the hypothesis that if a not supporting watershed has an annual average sediment loading rate similar to a watershed supporting its biology, then the receiving stream will remain stable and not be biologically impaired due to sediment. In the Tennessee River Basin, the average sediment yield in the watersheds supporting fish communities in the Blue Ridge ecoregion is 0.41 tons/acre/yr. The average sediment yield in the watershed supporting macroinvertebrate communities in subecoregions 66d, 66j, 67f&l, 67g, and 68c&d are 0.40, 0.33, 0.78, 0.41, and 0.53 tons/acre/yr, respectively. This TMDL establish allowable pollutant loadings, and thereby provide the basis to establish water quality based controls. For some pollutants, TMDLs are expressed on a mass loading basis.

A TMDL is the sum of the individual waste load allocations (WLA) for point sources and load allocations (LA) for nonpoint sources and natural background (40 CFR 130.2).The sum of these components may not result in an exceedance of water quality criteria for a water body. To protect against exceedances, the TMDL must also include a margin of safety (MOS), either implicitly or explicitly, that accounts for the uncertainty in the relationship between pollutant loads and the water quality response of the receiving water body. Conceptually, a TMDL can be expressed as follows:

$$\text{TMDL} = \Sigma\text{WLAs} + \Sigma\text{LAs} + \text{MOS}$$

The following sections describe the various TMDL components.

5.1 Waste Load Allocations

The waste load allocation (WLA) is the portion of the receiving water's loading capacity that is allocated to existing or future point sources including industrial facilities, municipal treatment plants, and private and institutional development (PID) facilities. WLAs are provided to the point sources from municipal and industrial wastewater treatment systems with NPDES effluent limits. There are no permitted facilities in the Tennessee River Basin watersheds that discharge into a stream segment or upstream of a stream segment not supporting its designated use.

The maximum allocated sediment load for these facilities is dependent on the discharge flow. Table 20 provides the WLAs for these facilities. The WLA given is a concentration or a range of daily average and daily maximum TSS limits for these facilities; however, a load can be calculated based on the permitted (where available) or design flows, and the permitted TSS concentrations.

The WLA, as a load, can be represented by the following equation:

$$WLA = C_{permitted} * Q$$

Where:

WLA = Wasteload Allocation sediment load
$C_{permitted}$ = permitted concentration, in TSS (mg / L)
Q = permitted flow (where available) or design discharge flow

It is recognized that effluent from biological treatment systems that have TSS limits of 20 mg/L or less are not expected to contribute to stream sedimentation. If there is available assimilative capacity, a new facility may be allowed, or for an existing facility may be able to expand. Any discharge into a stream without any assimilative capacity will be evaluated on a case-by-case basis and increases will be allowed, dependent on engineering and biological integrity study results.

State and federal rules define storm water discharges covered by NPDES permits as point sources. However, storm water discharges are from diffuse sources and there are multiple storm water outfalls. Storm water sources (point and nonpoint) are different than traditional NPDES permitted sources in four respects:1) they do not produce a continuous (pollutant loading) discharge; 2) their pollutant loading depends on the intensity, duration, and frequency of rainfall events, over which the permittee has no control; 3) the activities contributing to the pollutant loading may include various allowable activities of others, and control of these activities is not solely within the discretion of the permittee; and 4) they do not have wastewater treatment plants that control specific pollutants to meet numerical limits.

The intent of storm water NPDES permits is not to treat the water after collection, but to reduce the exposure of storm water to pollutants by implementing various controls. It would be infeasible and prohibitively expensive to control pollutant discharges from each storm water outfall. Therefore, storm water NPDES permits require the establishment of controls or BMPs to reduce the pollutants entering the environment.

The waste load allocations from storm water discharges associated with MS4s (WLAsw) are estimated based on the percentage of urban area in each watershed covered by the MS4 storm water permit. At this time, the portion of each watershed that goes directly to a permitted storm sewer and that which goes through non-permitted point sources, or is sheet flow or agricultural runoff, has not been clearly defined. Thus, it is assumed that approximately 70 percent of storm water runoff from the regulated urban area is collected by the municipal separate storm sewer systems.

The storm water discharges associated with industrial facilities that are not covered under individual NPDES permits are regulated by a Georgia NPDES General Permit No. GAR050000 for Storm Water Discharges Associated with Industrial Activities. The general permit requires that storm water discharges into an stream segment not supporting its designated use or within one linear mile upstream of and within the same watershed as any portion of an impaired stream segment identified as “not supporting” its designated use(s), must satisfy the requirements given in Appendix C of the permit if the impaired stream segment has been listed for criteria violated, “Bio F” (Impaired Fish Community) and/or “Bio M” (Impaired Macroinvertebrate Community) within Category 4a, 4b or 5 and the potential cause is either “NP”(nonpoint source) or “UR” (urban runoff).Table 11 lists the industrial facilities that are covered under Georgia NPDES General Permit for Storm Water Discharges Associated with Industrial in the Tennessee River Basin, which discharge into not supporting streams.

Georgia requires construction sites over one acre to have a General Storm Water NPDES permit. General permits have been created to cover construction projects that fall into three distinct categories; standalone construction projects (General Permit No. GAR100001), infrastructure construction projects (General Permit No. GAR100002), and construction that occurs under a common plan of development where the primary permittee chooses to use secondary permittees for land disturbance activities (General Permit No. GAR100003).These permits authorizes the discharge of storm water associated with construction activity to the waters of the State in accordance with the limitations, monitoring requirements, and other conditions set forth in Parts III through V of each permit. The conditions of each permit were established to assure that the storm water runoff from these sites does not cause or contribute sediment to the stream. Each Georgia NPDES General Permit for Storm Water Associated with Construction Activities can be considered a water quality-based permit in that the numeric limits in the permit, if met, will not cause a water quality problem. The sediment load allocation from future construction sites within the watershed have to meet requirements outlined in the Georgia NPDES General Permit for Storm Water Associated with Construction Activities.

5.2 Load Allocations

The USLE was applied to those watersheds that are biologically impaired and those considered least impacted to determine the current sediment loading rates to the streams. The current annual sediment load in tons/year for each watershed is reported in Table 19.

Table 19. Annual Sediment Yield

Stream Segment	Watershed Area (acres)	Total Sediment (ton/yr)	Road Sediment (tons/yr)	Total Sediment Yield (tons/acre/yr)
Blue Ridge - Not Support				
Anderson Creek	1819.4	636.6	78.9	0.3499
Arkaqua Creek	7455.6	3300.4	288.1	0.4427
Bitter Creek	3104.6	1004.9	95.2	0.3237
Brasstown Creek	3661.3	1655.4	61.5	0.4521
Charlie Creek	1513.0	536.4	67.0	0.3545
Cooper Creek (WRD ID 865)	8065.4	3216.9	202.7	0.3989
Cooper Creek (WRD ID 991)	2266.0	957.6	83.5	0.4226
Coosa Creek	13820.9	5289.5	495.7	0.3827
Dooley Creek	4641.6	1591.0	144.0	0.3428
East Fork Coosa Creek	2676.7	953.1	49.8	0.3561
Fodder Creek	5876.8	2809.5	229.7	0.4781
Fortenberry Creek	2139.4	834.6	62.2	0.3901
Helton Creek	1886.4	856.3	79.3	0.4539
Hemptown Creek	6472.8	2294.3	237.2	0.3545
Hightower Creek	10940.5	5311.2	381.7	0.4855
Ivylog Creek (WRD ID 700)	6935.8	2494.2	147.2	0.3596
Ivylog Creek (EPD ID 66j-17)	4058.9	1077.5	39.1	0.2655
Jones Creek	2429.9	967.3	100.9	0.3981

Stream Segment	Watershed Area (acres)	Total Sediment (ton/yr)	Road Sediment (tons/yr)	Total Sediment Yield (tons/acre/yr)
Keener Creek	1448.2	491.2	11.8	0.3391
Little Youngcane Creek	3054.4	1071.6	87.6	0.3509
Owenby Creek	2406.8	511.4	47.8	0.2125
Owl Creek	2512.4	1064.8	76.1	0.4238
Right Prong Butternut Creek	1422.4	377.1	17.7	0.2651
South Fork Rapier Mill Creek	3860.1	959.6	114.6	0.2486
Stink Creek	2453.2	998.9	20.3	0.4072
Sugar Creek	8771.2	5277.6	545.1	0.6017
Swallow Creek	3652.6	1597.5	30.7	0.4373
Town Creek	11349.2	4752.0	244.8	0.4187
Tumbling Creek	3164.0	381.5	16.4	0.1206
West Fork Wolf Creek	2199.5	876.3	66.9	0.3984
Wilscot Creek	3447.8	1121.6	71.9	0.3253
Winchester Creek	1577.9	1010.0	41.4	0.6401
Youngcane Creek	13568.1	5447.8	378.8	0.4015
Blue Ridge - Support				
Betty Creek	9840.1	4332.1	223.6	0.4403
Brasstown Creek (WRD ID 778)	10814.2	4734.7	353.0	0.4378
Brasstown Creek (WRD ID 878)	22139.4	13257.0	939.9	0.5988
Bryan Creek	2324.0	538.6	47.0	0.2318
Chattahoochee River	13051.7	5205.6	145.3	0.3988
Coleman River	3369.7	1316.2	20.9	0.3906
Cooper Creek (WRD ID 769)	14400.5	5265.8	291.7	0.3657
Cooper Creek (WRD ID 770)	25177.1	8879.9	527.1	0.3527
Fightingtown Creek (WRD ID 761)	8243.7	3170.2	174.5	0.3846
Fightingtown Creek (WRD ID 862)	8424.5	2864.4	108.6	0.3400
Gumlog Creek	4851.1	2438.9	155.0	0.5027
Hemptown Creek	16355.6	5815.2	517.3	0.3555
Hothouse Creek	13395.5	4758.0	498.7	0.3552
Little Tennessee River	35156.8	23019.1	2389.0	0.6548
McClure Creek	3042.4	1073.0	82.6	0.3527
Nottley River	11476.5	4984.6	366.5	0.4343
South Fork Rapier Mill Creek	3929.5	1018.0	120.0	0.2591
Suches Creek	4455.2	1686.0	113.5	0.3784
Tallulah River	20662.9	8297.1	247.2	0.4015
Toccoa River (WRD ID 754)	11675.3	4519.4	271.1	0.3871
Toccoa River (WRD ID 864)	19796.2	7917.9	466.5	0.4000
Town Creek (WRD ID 713)	10515.9	4443.3	218.2	0.4225
Town Creek (WRD ID 866)	7020.6	2710.8	62.2	0.3861
Ridge & Valley - Not Support				
Black Branch	6100.7	1054.9	270.4	0.1729
Sugar Creek	2847.1	2161.8	48.3	0.7593
Tributary to Tiger Creek	1752.9	852.7	57.4	0.4865

Stream Segment	Watershed Area (acres)	Total Sediment (ton/yr)	Road Sediment (tons/yr)	Total Sediment Yield (tons/acre/yr)
Ridge & Valley - Support				
Cane Creek	7637.3	7020.8	102.5	0.9193
Clarks Creek	7188.0	4572.5	165.8	0.6361
Armuchee Creek Tributary	3584.3	1880.3	83.1	0.5246
Little Armuchee Creek	4256.9	1284.7	46.7	0.3018
Moss Creek	4438.3	1807.0	60.8	0.4071
Southwestern Appalachians - Not Support				
Big Spring Branch (aka Higdon Creek)	3058.6	3294.1	329.5	1.0770
Southwestern Appalachians - Support				
Bear Creek	4969.9	2725.7	117.2	0.5484
Daniel Creek	3562.5	2631.4	163.2	0.7386
Rock Creek	11595.2	3428.8	233.3	0.2957

The watersheds are grouped by those that are biologically impaired (not supporting designated uses and on the 303(d) list, and by those that are biologically least impacted (supporting designated uses). For comparison purposes, the annual average sediment load per acre, or sediment yield, was calculated for each watershed and is also given in Table 21. For streams that were sampled for fish community integrity, the average sediment yield of the Tennessee River Basin watersheds located in the Blue Ridge ecoregion not supporting their designated uses is 0.38 tons/acre/yr, while the average sediment yield of the supporting watersheds located within the Blue Ridge ecoregion 0.41 tons/acre/yr, respectively. For streams that were sampled for benthic macroinvertebrate community integrity, the average sediment yield of the Tennessee River Basin watersheds located in subecoregions 66d, 66j, 67f&l, 67g, and 68c&d not supporting their designated uses are 0.40, 0.41, 0.17, 0.62, and 1.08 tons/acre/yr, respectively, while the average sediment yield of the supporting watersheds located within the subecoregions 66d, 66j, 67f&l, 67g, and 68c&d are 0.40, 0.33, 0.78, 0.41, and 0.53 tons/acre/yr, respectively.

Fish community assessment scores are based on a specific set of metrics for each ecoregion. A target sediment yield was established in each ecoregion by averaging the sediment yield of all watersheds where the associated stream integrity class was either “Good” or “Excellent”. The sediment yield per acre for each watershed was then compared with the average target sediment yield for the corresponding ecoregion. In cases where the not supporting yields exceeded the average target yield, the Total Allowable Load was calculated as a tons/year load based on the average target yield multiplied by the total acres for the not supporting watershed. Where the yields were less than the target yield, the Total Allowable Load was given as the current annual sediment load in tons/year.

Benthic macroinvertebrate community assessment scores are based on a specific set of metrics for each subecoregion. A target sediment yield was established in each subecoregion by averaging the sediment yield of all watersheds where the associated stream integrity class was either “Good” or “Very Good”. The sediment yield per acre for each not supporting watershed was then compared with the average target sediment yield for the corresponding ecoregion. In cases where the not supporting yields exceeded the average target yield, the Total Allowable Load was calculated as a tons/year load based on the average target yield multiplied by the total acres for the not supporting watershed. Where the yields were less than the target yield, the Total Allowable Load was given as the current annual sediment load in tons/year.

Once the Total Allowable Load for each not supporting watershed is calculated, the nonpoint source loads (LA) for each watershed is calculated by subtracting the WLA and WLAsw from the Total Allowable Load. It is recognized that there may be additional assimilative capacity in the cases where there is no required reduction in the sediment load and future dischargers (WLA) may be allowed. In the watersheds that have exceeded the total allowable load, new dischargers (WLA) may be allowed if there is sufficient reduction in the.

5.3 Seasonal Variation

Sediment is expected to fluctuate according to the amount and distribution of rainfall. Since rainfall is greatest in the spring and winter seasons, it is expected that sediment loadings would be highest during these seasons. However, these seasonal fluctuations and other short-term variability in loadings due to episodic events are usually evened out by the response of the biological community to habitat alteration, which is a long-term process. Therefore, the annual sediment load was determined to be appropriate for the TMDL.

5.4 Margin of Safety

The MOS is a required component of TMDL development. There are two basic methods for incorporating the MOS: 1) implicitly incorporate the MOS using conservative model assumptions to develop allocations; or 2) explicitly specify a portion of the TMDL as the MOS and use the remainder for allocations. For this TMDL, the MOS was implicitly incorporated in the use of conservative modeling assumptions, including the selection of average USLE factors, the use of the average sediment loading rates for the numeric targets, and the assumption that no BMPs were used.

5.5 Total Sediment Load

The total allowable load was determined by adding the WLA (WLA + WLAsw) and the LA. The MOS, as described above, was implicitly included in the TMDL analysis and does not factor directly into the TMDL equation.

The USLE method used calculates a total annual sediment load, as opposed to a daily load. The R factor from the USLE (the rainfall erosivity index) is statistically calculated from the annual summation of rainfall energy in every storm, which correlates to the raindrop size, times its maximum 30-minute intensity. Table 20 provides the rainfall statistics from six meteorological stations located throughout Georgia, and shows the variability of rainfall frequency and amount.

Table 20. Georgia Meteorological Rainfall Statistics

Station	Normal Monthly Precipitation (in.) / Avg. Days of Precipitation (0.1 in. or more)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Athens, GA	4.6/11	4.4/9	5.5/11	4.0/8	4.4/9	3.9/9	4.9/11	3.7/9	3.4/8	3.3/7	3.7/8	4.1/10
Atlanta, GA	4.8/11	4.8/10	5.8/11	4.3/9	4.3/9	3.6/10	5.0/12	3.7/10	3.4/8	3.1/6	3.9/8	4.3/10
Augusta, GA	4.1/10	4.3/9	4.7/10	3.3/8	3.8/9	4.1/9	4.2/11	4.5/10	3.0/7	2.8/6	2.5/7	3.4/9
Columbus, GA	4.6/10	4.9/10	5.8/10	4.3/8	4.2/8	4.1/9	5.5/13	3.7/10	3.2/8	2.2/5	3.6/8	5.0/10

Macon, GA	4.6/11	4.7/10	4.8/10	3.5/7	3.6/9	3.6/10	4.3/13	3.6/11	2.8/8	2.2/6	2.7/7	4.3/9
Savannah, GA	3.6/9	3.2/9	3.8/9	3.0/7	4.1/9	5.7/10	6.4/14	7.5/13	4.5/10	2.4/6	2.2/6	3.0/8

The allowable annual sediment load expressed in terms of tons per year is intended to prevent the cumulative impacts of excessive run-off related sediment in the watershed. The maximum daily allowable sediment load is a subcomponent of the allowable annual load. It is based upon the critical flow event that represents the maximum sediment load capacity for the stream. Research conducted by the ARS National Sedimentation Laboratory and USEPA Region 4 has determined that the bankfull flow is the critical flow that has the maximum daily sediment carrying capacity, and therefore has the maximum daily sediment loading capacity. Bankfull flow can be estimated using the one-day flow event that occurs once every one and a half years, 1Q1.5, determined by the Log Pearson recurrence interval statistical analysis.

The National Sedimentation Laboratory has correlated, by ecoregion, a relationship between the annual average sediment yield and the bankfull flow sediment yield for stable or unimpaired streams. Table 21 provides the mean bankfull flow (Q1.5) sediment yield expressed as tons per day per square kilometer for each ecoregion compared to the mean annual average sediment yield discharged into a stable unimpaired stream. The coefficient is the ratio of the maximum daily yield to the total annual yield. These relationships were used to transform total allowable sediment loads to daily maximum sediment loads (USDA-ARS, 2006).

Table 21. Suspended-Sediment Transport Rates Comparing Bankfull Flow Yield to Mean Annual Yield

Ecoregion	Yield at Q1.5 (T/d/km2)	Mean Annual yield (T/yr/km2)	Annual to Daily Max Coefficient
Blue Ridge - 66	9.82	20.9	0.4699
Ridge and Valley - 67	1.44	19.3	0.0746
Southwestern Appalachians - 68	17.5	36.2	0.4834

The total allowable sediment loads and daily maximum sediment loads for the not supporting watersheds are summarized in Table 22, along with any required sediment load reductions. The WLAs (WLA + WLAsw) provided in Table 22 are for accounting purposes. A Summary Memorandum for each watershed is provided in Appendix

Table 22. Total Allowable Sediment Loads and the Required Sediment Load Reductions

Name	WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Current Total Load (tons/yr)	Total Allowable Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	% Reduction
Anderson Creek			636.6	636.6	636.6	299.1	0.0%
Arkaqua Creek			3,090.3	3,300.4	3,090.3	1,452.0	6.4%
Bitter Creek			1,004.9	1,004.9	1,004.9	472.2	0.0%
Brasstown Creek			1,517.6	1,655.4	1,517.6	713.1	8.3%
Charlie Creek			536.4	536.4	536.4	252.0	0.0%
Cooper Creek (WRD ID 865)			3,216.9	3,216.9	3,216.9	1,511.5	0.0%
Cooper Creek (WRD ID 991)			939.2	957.6	939.2	441.3	1.9%
Coosa Creek			5,289.5	5,289.5	5,289.5	2,485.3	0.0%
Dooley Creek			1,591.0	1,591.0	1,591.0	747.5	0.0%
East Fork Coosa Creek			953.1	953.1	953.1	447.8	0.0%
Fodder Creek			2,435.9	2,809.5	2,435.9	1,144.5	13.3%
Fortenberry Creek			834.6	834.6	834.6	392.1	0.0%
Helton Creek			781.9	856.3	781.9	367.4	8.7%
Hightower Creek			4,534.8	5,311.2	4,534.8	2,130.7	14.6%
Ivylog Creek			2,494.2	2,494.2	2,494.2	1,171.9	0.0%
Jones Creek			967.3	967.3	967.3	454.5	0.0%
Keener Creek			491.2	491.2	491.2	230.8	0.0%
Little Youngcane Creek			1,071.6	1,071.6	1,071.6	503.5	0.0%
Owenby Creek			511.4	511.4	511.4	240.3	0.0%
Owl Creek			1,041.4	1,064.8	1,041.4	489.3	2.2%
Right Prong Butternut Creek			377.1	377.1	377.1	177.2	0.0%
South Fork Rapier Mill Creek			959.6	959.6	959.6	450.9	0.0%
Stink Creek			998.9	998.9	998.9	469.3	0.0%
Swallow Creek			1,514.0	1,597.4	1,514.0	711.4	5.2%
Town Creek			4,704.2	4,752.0	4,704.2	2,210.3	1.0%
Tumbling Creek			381.5	381.5	381.5	179.3	0.0%
Wilscot Creek			1,121.6	1,121.6	1,121.6	527.0	0.0%
Winchester Creek			654.0	1,010.0	654.0	307.3	35.2%
Youngcane Creek			5,447.8	5,447.8	5,447.8	2,559.7	0.0%
Big Spring Branch (aka Higdon Creek)			1,613.7	3,294.1	1,613.7	780.1	51.0%
Black Branch		44.3	1,010.6	1,054.9	1,054.9	78.7	0.0%
Hemptown Creek			2,143.8	2,294.3	2,143.8	1,007.3	6.6%
Sugar Creek (EPD ID 66j-9)			2,905.0	5,277.6	2,905.0	1,364.9	45.0%
Sugar Creek			1,170.6	2,161.8	1,170.6	87.3	45.8%

Name	WLA (tons/yr)	WLAsw (tons/yr)	LA (tons/yr)	Current Total Load (tons/yr)	Total Allowable Load (tons/yr)	Maximum Allowable Daily Load (tons/day)	% Reduction
(EPD ID 67g-1)							
Tributary to Tiger Creek			720.7	852.7	720.7	53.8	15.5%
West Fork Wolf Creek			873.2	876.3	873.2	410.3	0.4%

Definitions:
Current Total Load - Sum of modeled sediment load and approved waste load allocations (WLA)
WLA - waste load allocation for discrete point sources
WLAsw - waste load allocation associated with storm water discharges from a municipal separate storm sewer system (MS4)
LA - portion of the total allowable load attributed to nonpoint sources and natural background sources of sediment
Total Allowable Load - allowable sediment load calculated using the target sediment yield and the stream's watershed area
Maximum Allowable Daily Load - total allowable load (annual) converted to a daily figure based on the bankfull sediment transport relationship
% Reduction - percent reduction applied to current load in order to meet total allowable load

6.0 RECOMMENDATIONS

6.1 Monitoring

GA EPD had previously adopted a basin approach to water quality management; an approach that divides Georgia's major river basins into five groups. This approach provides for additional sampling work to be focused on one of the five basin groups each year and offers a five-year planning and assessment cycle.GA EPD is in the process of reevaluating the effectiveness of the basin monitoring approach and comparing it to a more thorough statewide annual monitoring program. Currently, all river basins within the state are receiving some water quality monitoring each year. The locations include both previously assessed and unassessed waters.

6.2 Sediment Management Practices

It has been determined that most of the sediment found in the Tennessee River Basin streams is due to past land use practices and is referred to as "legacy" sediment. Therefore, it is recommended that there be no net increase in sediment delivered to the not supporting stream segments, so that these streams will recover over time.

The measurement of sediment delivered to a stream is difficult, if not impossible, to determine. Therefore, setting a numeric TMDL may be ineffective given the difficulty in measuring it. In addition, habitat and aquatic communities can be slow to respond to changes in sediment loading, which is why monitoring will continue according to the five-year monitoring cycle. Thus, this TMDL recommends that compliance with NPDES permits and implementation of Best Management Practices (BMPs) be monitored. The anticipated effects of compliance with NPDES permits and implementation of BMPs will be the improvement of stream habitats and water quality, and thus be an indirect measurement of the TMDL.

Management practices recommended to maintain the total allowable sediment loads at current levels include:

- Compliance with NPDES(wastewater and/or MS4) permit limits and requirements;
- Implementation of *Georgia's Best Management Practices for Forestry* (GFC, 2009);
- Implementation of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013) and Adoption of NRCS Conservation Practices for agriculture;
- Adherence to the Surface Mining Land Use Plan prepared as part of the Surface Mining Permit Application;
- Implementation of the *Georgia Better Back Roads Field Manual* (GA RCDC, 2009) and adoption of additional practices for proper unpaved road maintenance;
- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2014)
- Implementation of the *Georgia Stormwater Management Manual* (ARC, 2001) to facilitate prevention and mitigation of stream bank erosion due to increased stream flow and velocities caused by urban runoff through structural storm water BMP installation.

6.2.1 Point Source Approaches

Point sources are defined as discharges of treated wastewater or storm water into rivers and streams at discrete locations. Treated wastewater tends to be discharged at relatively stable rates; whereas, storm water is discharged at irregular, intermittent rates, depending on precipitation and runoff. The NPDES permit program provides a basis for developing municipal, industrial, and storm water permits; monitoring and compliance with limitations; and appropriate enforcement actions for violations.

In accordance with GA EPD rules and regulations, all NPDES dischargers in the watershed are required to meet their current NPDES permit limits. It is recommended that there be no authorized increase in the concentration of TSS above that identified in the TMDL. However, if there is available assimilative capacity, new discharges may be allowed based on engineering evaluations and current stream biological integrity studies.

The removal of mined material involves water pumped from the mine pit, and mineral processing involves the disposal of process waters. These waters are treated through sedimentation ponds or detention basins prior to being discharged to the stream and are regulated by NPDES permits. It is recommended that the peak flow from mining sites be maintained at pre-development levels in order to control bank erosion and instabilities in the receiving stream. In addition, monitoring frequencies should be such that the total annual sediment loads coming from mining facilities can be characterized.

GA EPD has developed a Georgia NPDES General Permit for Storm Water Associated with Construction Activities. Coverage under a General Permit is required for all construction sites disturbing one or more acres. General permits have been created to cover construction projects that fall into three distinct categories; standalone construction projects (General Permit No. GAR100001), infrastructure construction projects (General Permit No. GAR100002), and construction that occurs under a common plan of development where the primary permittee chooses to use secondary permittees for land disturbance activities (General Permit No. GAR100003).Regardless of the type of construction project, all sites required to have a coverage permit are authorized to discharge storm water associated with construction activity to the waters of the State in accordance with the limitations, monitoring requirements, and other conditions set forth in Parts III through V of each NPDES General Permit for Storm Water Associated with Construction Activities. The permit requires all sites to have an Erosion and Sedimentation Control Plan; to implement, inspect and maintain BMPs; and to monitor storm water for turbidity. Georgia's General Storm Water Permit can be considered a water quality-based permit, in that the numeric limits in the permit, if met and enforced, will not cause a water quality problem.

The General Storm Water NPDES Permit for Construction Activity also requires that storm water discharges into a stream segment not supporting its designated use or a stream segment within one linear mile upstream of and within the same watershed as, any portion of an stream segment not supporting its designated use, must address any site-specific condition or requirement in a TMDL implementation plan and must include at least four additional BMPs from a list provided in Part III. C. of the Permit. This condition only applies to streams with impairments for "Bio F" (fish community) and /or "Bio M" (macroinvertebrate community), and with the listed potential cause of either "NP" (nonpoint source) or "UR" (urban runoff).

6.2.2 Nonpoint Source Land Use Approaches

GA EPD is the lead agency for implementing the State's Nonpoint Source Management Program, as described in Georgia's *Statewide Nonpoint Source Management Plan* (GA EPD, 2014).The *Statewide Nonpoint Source Management Plan* combines regulatory and nonregulatory approaches, in cooperation with other State and Federal agencies, local and regional governments, State colleges and universities, businesses and industries, nonprofit organizations, and individual citizens. The 2014 document represents a revision of the *Statewide Nonpoint Source Management Plan* last updated in 2000. This revision provides an update to reflect new priorities and practices of nonpoint source pollution control in Georgia. It represents Georgia's plan for making progress toward meeting the ultimate goal of the Clean Water Act of achievement of water quality standards for fishable and swimmable waters. Regulatory responsibilities include establishing water quality criteria and use classifications, assessing and reporting water quality conditions, issuing point source permits, issuing water withdrawal and ground water permits, and regulating land-disturbing activities. Georgia is working with local governments, agricultural, and forestry agencies such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission to foster the implementation of BMPs that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of BMPs to protect water quality. The following sections describe in more detail the specific measures to reduce nonpoint sources of sediment by land use type.

6.2.2.1 Forested Land

In 1978, GA EPD designated the Georgia Forestry Commission (GFC) to be the lead agency in managing and implementing the silvicultural portion of Georgia's Nonpoint Source Management Program. The GFC is responsible for coordinating water quality issues with regard to forested land in Georgia. The GFC is basically responsible for:

- Developing Best Management Practices (BMPs) for the forestry industry,
- Educating the forestry community on BMPs, and
- Conducting site inspections for compliance with the established BMPs.

The GFC formed a Forestry Nonpoint Source Pollution Technical Task Force (FNSPTTF) to assess the extent of water pollution caused by forestry practices, and to develop recommendations for reducing or eliminating erosion and sedimentation. After a three-year field study, the task force developed a set of BMPs that address all aspects of silviculture, including forest road construction, timber harvesting, site preparation, and forest regeneration. The task force recommended the BMPs be implemented through a voluntary program, exempt from permitting under the Georgia Erosion and Sedimentation Control Act, emphasizing educational and training programs instead. In 1997, the original BMP document was revised to incorporate the 1989 Wetland BMP manual developed by the Georgia Forestry Association. This comprehensive BMP manual, *Georgia's Best Management Practices for Forestry* was released in January 1999.Additional guidance has been developed by the FNSPTTF since 1999. The current version of Georgia's forestry BMP manual, *Georgia's Best Management Practices for Forestry,* was developed and released in May 2009 (GFC, 2009).

It is the responsibility of the GFC to educate and inform the forest community (landowners, procurement and land management foresters, consulting foresters, loggers, site prep and tree planting contractors) on the importance of BMPs. The GFC statewide program coordinator and the four regional specialists conduct educational programs across the State. The regional specialists receive specialized training in erosion and sediment control, forest road layout and construction, stream habitat assessment, rapid bioassessment (macroinvertebrate) monitoring, wetland delineation, and fluvial geomorphology. The GFC has developed training videos, slide programs, tabletop exhibits, and BMP billboards that are displayed at wood yards across the State. For the benefit of private landowners selling timber, the GFC has developed a Sample Forest Products Sale Agreement, which includes fill in the blank spaces for specific BMP incorporation. Since December 1995, the GFC has been cooperating with the University of Georgia School of Forest Resources, the Georgia Forestry Association, and American Forest and Paper Association (AFPA) member companies in the ongoing education of loggers and timber buyers through the Sustainable Forestry Initiative (SFI) Master Timber Harvester program. This includes an intensive training session on the BMPs conducted by the GFC. Since publication of the first BMP manual in 1981, the GFC has given 2,672 BMP talks to over 86,500 persons and participated in 492 field demonstrations of BMPs (through June 2013). The education process is ongoing, with workshops routinely provided for foresters, timber buyers and loggers through the Sustainable Forestry Initiative® (SFI®) Program in Georgia.

To determine if educational efforts have been successful and if the BMPs are effective at minimizing erosion and sedimentation, the GFC conducted BMP Implementation and Compliance Surveys in 1991, 1992, 1998, 2002, 2004, 2007, 2009, 2011, and 2013.In 1997, the Southern Group of State Foresters (SGSF) Task Force completed a newly developed and more rigorous survey protocol document titled *Silviculture Best Management Practices Implementation Monitoring – A Framework for State Forestry Agencies*. In 2002, this document was revised and re-published. Starting with the 1998 BMP implementation survey and every one thereafter, surveys were conducted using this protocol recommended by the SGSF Task Force. The GFC sampled about 10 percent of the forestry operations that occur annually. The number of samples taken in each county was based on the volume of wood harvested as reported in the State’s latest Product Drain Report. Sites were randomly selected to reflect various forest types (non-industrial private forest, forest industry, and publicly owned lands).The statewide average BMP implementation has ranged from 65 percent in 1991 to the current rate of 90 percent. In 1991, approximately 86 percent of the acres evaluated were in compliance. This total acreage percentage increased to 92 percent compliance in 1992, 98 percent compliance in 1998, and over 99 percent compliance in 2013.

The GFC also investigates and mediates complaints or concerns involving forestry operations on behalf of the GA EPD and the Army Corps of Engineers (COE) when stream water quality and wetlands are involved, respectively. Complaints from citizens are common, particularly in counties growing in population where landowners are living close to commercial forestry operations. After notifying the forest owner, the GFC District Coordinator conducts a field inspection to determine if BMPs were followed, if the potential for water quality problems exists, and who is the responsible party. If the complaint is valid, GFC will work with the responsible party until the problem is corrected. However, the GFC has no regulatory authority. In situations where the GFC cannot get satisfactory compliance, the case is turned over to GA EPD or COE for enforcement actions under the Georgia Water Quality Control Act or Section 404 of the Federal Clean Water Act.

It is recommended that the GFC continue to encourage BMP implementation, educational training programs, and site compliance surveys. The numbers of individuals trained and site compliance inspections should be recorded each year. In addition, the number of complaints received, the actions taken, and enforcement actions written should be recorded.

6.2.2.2 Agricultural Land

There are a number of agricultural organizations that work to support Georgia's more than 40,000 farms. The following three organizations have primary responsibility for working with farmers to promote soil and water conservation:

- The University of Georgia - Cooperative Extension Service
- Georgia Soil and Water Conservation Commission
- Natural Resources Conservation Service

The University Of Georgia (UGA) has faculty, County Cooperative Extension Agents, and technical specialists who provide services in several key areas relating to agricultural impacts on water quality. These include classroom instruction, basic and applied research, consulting assistance, and information on nonpoint source water quality impacts.

The Georgia Soil and Water Conservation Commission (GSWCC) was created in 1937 by a Georgia Legislative Act. In 1977, GA EPD designated the GSWCC as the lead agency for agricultural Nonpoint Source Management in the State. The GSWCC develops nonpoint source management programs and conducts educational activities to promote conservation and protection of land and water devoted to agricultural uses. In September 1994, the GSWCC developed a BMP manual, *Agricultural Best Management Practices for Protecting Water Quality in Georgia,* for the agricultural community (GSWCC, 1994).To incorporate advances in BMP technology and include estimates of BMP effectiveness and cost, the GSWCC compiled and published a new BMP document in 2007 titled, *Best Management Practices for Georgia Agriculture*. In 2013, GSWCC published the 2nd edition of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013), which included an expanded section on nutrient management planning.

The Natural Resources Conservation Service (NRCS) cooperates with Federal, State, and local governments to provide financial and technical assistance to farmers. NRCS develops standards and specifications for BMPs that are to be used to improve, protect, or maintain our State's natural resources. Practice standards establish the minimum level of acceptable quality for planning, designing, installing, operating, and maintaining BMPs. Practice specifications describe the technical details and workmanship required to install a BMP and the quality and extent of materials to be used in a BMP.

The NRCS provides Conservation Practice Standards, found in the electronic Field Office Technical Guide (FOTG); on their website (http://www.nrcs.usda.gov/technical/efotg/).Some of these BMPs may be used for farming operations to reduce soil erosion. It is recommended that the agricultural communities with cropland close to not supporting streams, and pastureland where grazing animals have access to the stream, investigate the various BMPs available to them in order to reduce soil erosion and bank collapse.

The 1996 Farm Bill and PL83-566 Small Watershed Program provided new financial assistance programs to address high priority environmental protection goals. Some programs that specifically address erosion and sedimentation are:

- The Environmental Quality Incentives Program
- Conservation Reserve Program
- Small Watershed Program

The Environmental Quality Incentives Program (EQIP) is a USDA cost-share program available to farmers to address natural resource problems. EQIP offers financial, educational and technical assistance funding for installing BMPs that reduce soil erosion, improve water quality, or enhance wildlife habitats.

The Conservation Reserve Program (CRP) was originally designed to provide incentive and offer assistance to farmers to convert highly erodible and other environmentally sensitive land normally devoted to crop production, to land with other long-term resource-conserving cover. CRP has been expanded to place eligible acreage into filter strips, riparian buffers, grassed waterways, or contour grass strips. Each of these practices helps to reduce erosion and sedimentation and improve water quality.

The Small Watershed Program provides financial and technical assistance funding for the installation of BMPs in watersheds less than 250,000 acres. This program is used to augment ongoing conservation programs where serious natural resource degradation has or is occurring. Agricultural water management, which includes projects that reduce soil erosion and sedimentation and improve water quality, is one of the eligible purposes of this program. NRCS is authorized by Public Law 83-566 to conduct river basin surveys and investigations. The NRCS River Basin Planning Program is designed to collect data on natural resource conditions within river basins of focus. NRCS is providing technical assistance to the GSWCC and the GA EPD with the Georgia River Basin Planning Program. Planning activities associated with this program will describe conditions of the agricultural natural resource base once every five years.

Every five years, the NRCS conducts the National Resources Inventory (NRI).The NRI is a statistically based sample of land use and natural resource conditions and trends, and it covers non-federal land in the United States. The NRI found that the total wind and water erosion on cropland and Conservation Reserve Program land in Georgia declined from 3.1 billion tons per year in 1982 to 1.9 billion tons per year in 1997, a reduction of 38 percent (USDA-NRCS, 1997).

NRCS also provides a web-based database application (Performance Results System, PRS) so conservation partners and the public can gain fast and easy access to the accomplishments and the progress made toward strategies and performance goals. The web site is http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/econ/

It is recommended that the GSWCC and the NRCS continue to encourage BMP implementation, education efforts, and river basin surveys with regard to River Basin Planning. The five year National Resources Inventory should be continued and GA EPD supports the PRS website.

6.2.2.3 Mine Sites

Surface mining and mineral processing present two threats to surface waters. The first threat is the wastewater produced from mining and mineral processing operations. These discharges are considered point sources, and are therefore regulated by NPDES permits and were discussed in Section 6.2.1 above. The second threat involves mine reclamation activities. Reclamation occurs throughout the mining operation. From the first cut to the last, overburden is moved twice. With each movement of the soil and rock debris, the overburden must be managed to prevent soil and mineral erosion. Until the mine is re-vegetated, and hence reclaimed, BMPs must be implemented to prevent nonpoint source pollution.

The Georgia Surface Mining Act of 1968 provides for the issuance of mining permits at the discretion of the Director of GA EPD. These permits are administered by the Land Protection Branch of GA EPD. The surface mining permit application must include a Surface Mining Land Use Plan, reclamation strategies, and surety bond requirements to guarantee proper management and reclamation of surface mined areas. The Surface Mining Land Use Plan specifies activities prior to, during, and following mining to dispose of refuse and control erosion and sedimentation. The reclamation strategy includes the use of operational BMPs and procedures. The BMPs used are drawn from the *Manual for Erosion and Sedimentation Control in Georgia*, *Georgia's Best Management Practices for Forestry*, and from other states. Thus, the issuance of a surface mining permit in effect addresses BMPs to control nonpoint source pollutants. The regional GA EPD offices monitor and inspect surface mining sites to assess permit compliance.

It is recommended that special attention be given to those facilities located in not supporting watersheds. The implementation and maintenance of BMPs used to control erosion should be reviewed during the site inspections.

The Georgia Mining Association (GMA) is an informal trade association of the mining industry. It serves more than 200 members, 47 mining companies and over 150 associate companies. The association monitors legislative developments and coordinates industry response. It educates miners about laws and regulations that affect them and provides a forum for the exchange of ideas. Through its newsletters, seminars, workshops, and annual conventions, the GMA serves as a source for mining industry information. It has several committees, including the Environmental Committee, that meet three to four times a year. The mining industry is conducting informal discussions on the potential of developing industry-wide standards for BMPs to prevent and reduce nonpoint source pollution. If these standards are adopted, the mining industry would likely conduct demonstration projects to gauge the effectiveness of the BMPs.

6.2.2.4 Roads

Unpaved roads can be a major contributor of sediment to our waterways if not properly managed. Under the Georgia Better Back Roads Program, the Georgia Resource Conservation and Development Council (GARC&D) led a partnership of natural resource agencies and County Administrators that developed the *Georgia Better Back Roads Field Manual* in 2009.In addition to publishing Georgia's first unpaved road improvement field manual with the goal of improving water quality through the identification of cost-effective techniques/materials for stabilizing road surfaces and ditches, the Georgia Better Back Roads Program has worked to establish statewide demonstration sites, and provides statewide training opportunities for public works officials responsible for maintaining unpaved roads. USEPA has also distributed *Recommended Practices Manual, A Guideline for Maintenance and Service of Unpaved Roads* (Choctawhatchee, et. al, 2000) as guidance for the maintenance and service of unpaved roadways, drainage ditches, and culverts to be used to minimize roadway erosion.

Disturbances to unpaved roadway surfaces and ditches, and poor road surface drainage, result in deterioration of the road surface. This leads to increased roadway erosion and, thus, stream sedimentation. Unpaved roads are typically maintained by blading and/or scraping of the roads to remove loose material. Proper, timely, and selective surface maintenance can prevent and minimize erosion of unpaved roadways. This in turn lengthens the life of the road and reduces maintenance costs. Roadway blading that occurs during periods when there is enough moisture content allows for immediate re-compaction. In addition, roadwork performed near streams or stream-crossings during “dry” months of the year can reduce the amount of sediment that enters a stream.

Roadside ditches convey storm water runoff to an outlet. A good drainage ditch is shaped and lined with appropriate vegetative or structural material. A well-vegetated ditch slows, controls and filters the storm water runoff, providing an opportunity for sediments to be removed from the runoff before it enters surface waters. Energy dissipating structures to reduce velocity, dissipate turbulence or flatten flow grades in ditches are often necessary. Efficient disposal of runoff from the road helps preserve the roadbed and banks. Properly installed “turn-outs” or intermittent discharge points help to maintain a stable velocity and proper flow capacity within the ditch by timely outleting water from them. This in turns alleviates roadway flooding, erosion, and maintenance problems. Properly placed “turn-outs” distribute roadway runoff and sediments over a larger vegetative filtering area, helping to reduce road side ditch maintenance to remove accumulated sediment.

Culverts are conduits used to convey water from one side of a road to another. Installation, modification, and/or improvements of culverts when stream flows and expected rainfall is low can reduce the amount of sediment that enters a stream. If the entire installation process, from beginning to end, can be completed before the next rainfall event, stream sedimentation can be minimized. Diverting all existing or potential stream flows while the culvert is being installed can also help reduce or avoid sedimentation below the installation. The culvert design can have a significant impact on the biological community if the size and species of fish passing through it are not considered. Changes in water velocities and the creation of vertical barriers affect the biological communities.

6.2.2.5 Urban Development

The Erosion and Sedimentation Act, established in 1975, provides the mechanism for controlling erosion and sedimentation from land-disturbing activities. This Act establishes a permitting process for land-disturbing activities. Many local governments and counties have adopted erosion and sedimentation ordinances and have been given authority to issue and enforce permits for land-disturbing activities. Approximately 113 counties and 227 municipalities in Georgia have been certified as the local issuing authority. In areas where local governments have not been certified as an issuing authority, the GA EPD is responsible for permitting, inspecting, and enforcing the Erosion and Sedimentation Act.

To receive a land-disturbing permit, an applicant must submit an erosion and sedimentation control plan that incorporates specific conservation and engineering BMPs. The *Manual for Erosion and Sediment Control in Georgia*, developed by the Georgia Soil and Water Conservation Commission, may be used as a guide to develop erosion and sedimentation control plans (GSWCC, 2014)

Local governments, with oversight by the GA EPD, and the Soil and Water Conservation Districts, are primarily responsible for implementing the Georgia Erosion and Sedimentation Act, O.C.G.A. §12-7-1 (amended in 2003).Reports of suspected violations are made to the agency that issued the permit. In cases with local issuing authority, if the violation continues, the complaint is referred to the appropriate Soil and Water Conservation District. If the situation remains unresolved, the complaint is then referred to GA EPD for enforcement action. Enforcement may include administrative orders, injunctions, and civil penalties. It is recommended that the local and State governments continue to work to implement the provisions of the Georgia Erosion and Sedimentation Act across Georgia.

Storm water runoff from developed urban areas (post-construction) can also have an impact on the transport of sediment to and within streams. Urbanization increases imperviousness, resulting in an increase in the volume of runoff that enters the streams. In addition, the stream flow rates may increase significantly from pre-construction rates. These changes in the stream flow can result in stream bank erosion and stream bottom down cutting. It is recommended that local governments review and consider implementation of practices presented in the *Land Development Provisions to Protect Georgia Water Quality* (GA EPD, 1997).The development of the *Georgia Stormwater Management Manual* (the "Blue Book") (ARC, 2001), was facilitated by the Atlanta Regional Commission for use as a multi-volume document designed to provide guidance on storm water management policy, technical design standards and pollution prevention. A *Coastal Stormwater Supplement* to the Blue Book was also developed for use in the coastal region of Georgia. Georgia's Coastal Regional Commission developed *Green Growth Guidelines* (GADNR, 2005), which outlines the environmental, social, and economic benefits from use of low impact development (LID) strategies when compared to today's conventional development approach. Up-to-date versions of these documents may be found online.

6.3 Reasonable Assurance

Permitted discharges will be regulated through the NPDES permitting process described in this report. An allocation to a point source discharger does not automatically result in a permit limit or monitoring requirement. Through its NPDES permitting process, GA EPD will determine whether a new or existing discharger has a reasonable potential of discharging sediment levels equal to or greater than the total allocated load. The results of this reasonable potential analysis will determine the specific requirements in an individual facility's NPDES permit. As part of its analysis, the GA EPD will use its USEPA approved 2003 NPDES Reasonable Potential Procedures to determine whether monitoring requirements or effluent limitations are necessary.

Georgia is working with local governments, agricultural and forestry agencies, such as the Natural Resources Conservation Service, the Georgia Soil and Water Conservation Commission, and the Georgia Forestry Commission, to foster the implementation of best management practices to address nonpoint sources. In addition, public education efforts will be targeted to individual stakeholders to provide information regarding the use of best management practices to protect water quality.

6.4 Public Participation

A thirty-day public notice was provided for this TMDL. During that time, the TMDL was available on the GA EPD website, a copy of the TMDL was provided as requested, and the public was invited to provide comments on the TMDL.

7.0 INITIAL TMDL IMPLEMENTATION PLAN

This plan identifies applicable State-wide programs and activities that may be employed to manage point and nonpoint sources of sediment loads for thirty six segments in the Tennessee River Basin. Local watershed planning and management initiatives will be fostered, supported or developed through a variety of mechanisms. Implementation may be addressed by Watershed-Based Plans or other assessments funded by Section 319 (h) grants, the local development of watershed protection plans, or "Targeted Outreach" initiated by EPD. These initiatives will supplement or possibly replace this initial implementation plan.

7.1 Not Supporting Segments

This initial plan is applicable to the following water bodies that were added to Georgia's 303(d) list of not supporting waters in *Water Quality in Georgia* (GA EPD, 2012-2013) available on the EPD website (www.epd.georgia.gov):

Stream Segments on the Draft 2014 303(d) List as Biota Impacted - Fish Community

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Anderson Creek	Headwaters to Coosa Creek	R060200020516	3	Fishing
Arkaqua Creek	Pine Ridge Road to Nottely River	R060200020505	4	Fishing
Bitter Creek	Headwaters to Brasstown Creek	R060200020303	3	Fishing
Brasstown Creek	Little Bald Cove to Yewell Branch	R060200020307	4	Fishing
Charlie Creek	Stillhouse Creek to Blue Ridge Lake	R060200030125	2	Fishing
Cooper Creek (WRD ID 865)	Logan Creek to Bryant Creek	R060200030123	5	Fishing
Cooper Creek (WRD ID 991)	Lake Winfield Scott to Logan Creek	R060200030122	2	Fishing
Coosa Creek	Anderson Creek to Nottely Lake	R060200020515	1	Fishing
Dooley Creek	Tributary to Nottely River	R060200020603	6	Fishing
East Fork Coosa Creek	Headwaters to Coosa Creek	R060200020518	6	Fishing
Fodder Creek	Tributary to Chatuge Lake	R060200020104	3	Fishing
Fortenberry Creek	Headwaters to the Nottely River	R060200020519	3	Fishing
Helton Creek	Headwaters to the Nottely River	R060200020520	4	Fishing
Hightower Creek	Little Hightower Creek to Scataway Creek (formerly Shoal Branch to Swallow Creek)	R060200020115	2	Fishing
Ivylog Creek	Tributary to Lake Nottely	R060200020508	7	Fishing
Jones Creek	Headwaters to Youngcane Creek	R060200020521	4	Fishing
Keener Creek	Headwaters to the Little Tennessee River	R060102020103	3	Fishing
Little Youngcane Creek	Mason Branch to Youngcane Creek	R060200020522	2	Fishing

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Owenby Creek	Headwaters to Stateline	R060200020606	5	Fishing
Owl Creek	Headwaters to the Hiwassee River	R060200020117	4	Fishing
Right Prong Butternut Creek	Headwaters to Butternut Creek	R060200020523	3	Fishing
South Fork Rapier Mill Creek	Stateline to Stateline	R060200020605	2	Fishing
Stink Creek	Headwaters to the Nottely River (formerly Union County)	R060200020524	5	Fishing
Swallow Creek	Headwaters to Hightower Creek	R060200020113	4	Fishing
Town Creek	Townsend Branch to the Nottely River	R060200020510	3	Fishing
Tumbling Creek	Headwaters to State Line	R060200030211	5	Fishing
Wilscot Creek	Headwaters to Crawford Creek	R060200030119	4	Fishing
Winchester Creek	Headwaters to State Line	R060200020305	4	Fishing
Youngcane Creek	Little Youngcane Creek to Nottely Lake	R060200020512	4	Fishing

Stream Segments on the Draft 2014 303(d) List as Biota Impacted - Macroinvertebrate Community

Name	Location	Reach ID	Stream Segment (Miles)	Designated Use
Big Spring Branch (aka Higdon Creek)	Harris Creek to Stateline (Formerly Higdon Creek to Stateline)	R060300010201	1	Fishing
Black Branch	Van Cleve St., Ft. Ogelthorpe to Spring Creek	R060200010925	3	Fishing
Hemptown Creek	Mitchell Branch to Young Stone Creek	R060200030203	10	Fishing
Ivylog Creek	Tributary to Lake Nottely	R060200020508	7	Fishing
Sugar Creek	State Line to Tiger Creek	R060200010716	5	Fishing
Sugar Creek	Upstream Toccoa River	R060200030206	2	Fishing
Tributary to Tiger Creek	Headwaters to Tiger Creek	R060200010719	3	Fishing
West Fork Wolf Creek	Headwaters to Wolf Creek (formerly Headwaters to the Nottely River)	R060200020525	4	Fishing

The GA EPD developed TMDLs in 2015 for sediment in the Tennessee River Basin due to a “biota/habitat-impacted” designation on Georgia’s Draft 2014 Section 303(d) list. These streams have shown a degradation of the biological community, which is generally caused by habitat loss due to stream sedimentation. The purpose of the narrative sediment criteria is to prevent objectionable conditions that interfere with legitimate water uses as stated in Georgia’s Rules and Regulations for Water Quality Control Chapter 391-3-6-.03(5)(c):

> “All waters shall be free from material related to municipal, industrial, or other discharges which produce turbidity, color, odor

or other objectionable conditions which interfere with legitimate water uses."

7.2 Potential Sources

A healthy aquatic ecosystem requires a healthy habitat. The major disturbance to stream habitats is erosion and sedimentation. As sediment is carried into the stream, it settles to the stream bottom and smothers sensitive organisms. Turbidity associated with sediment loads may also impair recreational and drinking water uses (GA EPD, 1998).

A source assessment characterizes the known and suspected sediment sources in the watershed. The general sediment sources are point and nonpoint. NPDES permittees discharging treated wastewater are the primary point sources of sediment as TSS. It is recognized that effluent from biological treatment systems that have TSS limits of 20 mg/L or less are not expected to contribute to stream sedimentation. Nonpoint sources of sediment are diffuse sources that cannot be identified as entering the water body at a single location. These sources generally involve land use activities that contribute sediment to streams during a rainfall runoff event.

Prior to the implementation of this plan, a detailed assessment of the potential sources should be carried out. This will better determine what best management practices are needed and where they should be installed. A watershed assessment will also help when requesting funding assistance for the implementation of this plan. EPD is available to provide assistance in completing a watershed survey of the potential sources of impairment.

Through water quality modeling, it has been determined that the sediment loading found in 16 of the 36 segments needs to be reduced. This sediment may be due to land disturbing activities including, but not limited to land development, agriculture, impervious surfaces, commercial forestry, and others. It is believed that, if sediment loads are not reduced, these streams will continue to degrade over time. Remedies exist for addressing excess sediment, from both point and non-point sources, in streams. They will be discussed in this plan.

Based on modeling, some segments have been found to need 0% reductions in sediments loads. This occurs if the estimated sediment yield (tons/acre/year) for these not supporting segments is below the average sediment yield for the least impacted stream segments within the Tennessee River Basin. It is likely that the impairment in these segments is due to past land use practices and is referred to as "legacy" sediment. It is believed that these streams will repair themselves over time if sediment loads are maintained at current levels.

7.3 Management Practices and Activities

Compliance with NPDES permits, the Erosion and Sedimentation Control Act, and local ordinances related to land disturbing activities will contribute to controlling sediment delivery from regulated activities and may help to achieve the reductions necessary to meet the TMDL. Using federal, state, and local laws, enforcement actions are available as a remedy for excess sediment coming from regulated sources. These may include land clearing for non-agricultural use, construction, wastewater discharges, and excessive sediment run-off from other land disturbing activities. The local issuing authority typically enforces these laws. However, the enforcement may be deferred to EPD if the local city or county government is not the issuing authority or further and action is needed.

Sediment produced from non-point sources such as the erosion of stream banks, paved surfaces, roofs, and others are not regulated. Therefore, these are not subject to most enforcement actions. Best Management Practices (BMPs) may be used to help reduce average annual sediment loads and achieve water quality criteria, and improve the over aquatic health of the system. The table below lists examples of BMPs that address excess sediment. This is not a complete list and additional management measures may be proposed that will be considered as implementing non-point source controls consistent with this plan.

Examples of BMPs for Use in Controlling Sediment from Non-Point Sources

Name of BMP	Type (Ag., Forestry, Urban, Other.)
Filter Strips	Agriculture
Reduced Tillage System	Agriculture
Exclusion	Agriculture
Timber Bridges	Forestry
Revegetation	Forestry
Sediment Basin	Urban
Porous Pavement	Urban
Wet Detention Pond	Urban
Organic Filter	Urban
Streambank Protection and Restoration	Ag, Forestry, Urban, Other
Stream Buffers	Ag, Forestry, Urban, Other
Additional Ordinances	Ag, Forestry, Urban, Other

Management practices that may be used to help maintain average annual sediment loads at current levels include:

- Compliance with NPDES(wastewater and/or MS4) permit limits and requirements;
- Implementation of *Georgia's Best Management Practices for Forestry* (GFC, 2009);
- Implementation of *Best Management Practices for Georgia Agriculture* (GSWCC, 2013) and Adoption of NRCS Conservation Practices for agriculture;
- Adherence to the Surface Mining Land Use Plan prepared as part of the Surface Mining Permit Application;
- Implementation of the *Georgia Better Back Roads Field Manual* (GA RCDC, 2009) and adoption of additional practices for proper unpaved road maintenance;
- Implementation of individual Erosion and Sedimentation Control Plans for land disturbing activities; and application of the *Manual for Erosion and Sediment Control in Georgia* (GSWCC, 2014)
- Implementation of the *Georgia Stormwater Management Manual* (ARC, 2001) to facilitate prevention and mitigation of stream bank erosion due to increased stream flow and velocities caused by urban runoff through structural storm water BMP installation.
- Adherence to DNR River Corridor Protection guidelines;
- Promulgation and enforcement of local natural resource protection ordinances such as: land development, storm water management, water protection, protection of environmentally sensitive areas, and others.

Public education efforts target individual stakeholders to provide information regarding the use of BMPs to protect water quality. GA EPD will continue efforts to increase awareness and educate the public about the impact of human activities on water quality.

The GA EPD Grants Unit should be consulted when selecting appropriate management practices for addressing the TMDL, particularly when determining the best practices for specific watersheds.

7.4 Monitoring

Monitoring of sediment through the measurement of total settable solids or TSS may be carried out through GA EPD's Adopt-A-Stream program. Additional opportunities for monitoring aquatic habitat through macro-invertebrate assessments may be available in the future. If it is determined through stakeholder involvement that either of these types of monitoring should take place, GA EPD will work with the entity that assumes responsibility for monitoring activities by providing the necessary training and taking the needed steps to establish a well-organized monitoring program.

7.5 Future Action

This Initial TMDL Implementation Plan includes a general approach to pollutant source identification as well as management practices to address pollutants. In the future, GA EPD will continue to determine and assess the appropriate point and non-point source management measures needed to achieve the TMDLs and also to protect and restore water quality in not supporting water bodies.

For point sources, any wasteload allocations for wastewater treatment plant facilities will be implemented in the form of water-quality based effluent limitations in NPDES permits. Any wasteload allocations for regulated storm water will be implemented in the form of best management practices in the NPDES permits. Contributions of sediment from regulated communities may also be managed using permit requirements such as watershed assessments, watershed protection plans, and long term monitoring. These measures will be directed through current point source management programs.

GA EPD will work to support watershed restoration, improvement and protection projects that address non-point source pollution. This is a process whereby GA EPD and/or Regional Commissions or other agencies or local governments, under a contract with GA EPD, will develop a watershed management plan intended to address water quality at the small watershed level (HUC 10 or smaller).These plans will be developed as resources and willing partners become available. The development of these plans may be funded via several grant sources including but not limited to Clean Water Act Section 319(h), Section 604(b), and/or Section 106 grant funds. These plans are intended for implementation upon completion.

Any watershed management plan that specifically address water bodies contained within this TMDL will supersede the Initial TMDL Implementation Plan for that water body, once GA EPD accepts and/or approves the plan. Watershed management plans intended to address this TMDL and other water quality concerns, written by GA EPD and for which GA EPD and/or the GA EPD Contractor are responsible, will contain at a minimum the USEPA's 9-Key Elements of Watershed Planning :

1) An identification of the sources or groups of similar sources contributing to nonpoint source pollution to be controlled to implement load allocations or achieve water quality criteria. Sources should be identified at the subcategory level (with estimates of the extent to which they are present in the watershed (e.g., X numbers of cattle feedlots needing upgrading, Y acres of row crops needing improved sediment control, or Z linear miles of eroded streambank needing remediation);

2) An estimate of the load reductions expected for the management measures;

3) A description of the NPS management measures that will need to be implemented to achieve the load reductions established in the TMDL or to achieve water quality criteria;

4) An estimate of the sources of funding needed, and/or authorities that will be relied upon, to implement the plan;

5) An information/education component that will be used to enhance public understanding of and participation in implementing the plan;

6) A schedule for implementing the management measures that is reasonably expeditious;

7) A description of interim, measurable milestones (e.g., amount of load reductions, improvement in biological or habitat parameters) for determining whether management measures or other control actions are being implemented;

8) A set of criteria that can be used to determine whether substantial progress is being made towards attaining water quality criteria and, if not, the criteria for determining whether the plan needs to be revised; and;

9) A monitoring component to evaluate the effectiveness of the implementation efforts, measured against the criteria established under item (8).

The public will be provided an opportunity to participate in the development of watershed management plans that address water bodies not supporting their designated uses that are listed in this TMDL and to comment on them before they are finalized.

GA EPD will continue to offer technical and financial assistance (when and where available) to complete watershed management plans that address the water bodies not supporting their designated uses listed in this and other TMDL documents. Assistance may include but will not be limited to:

- Assessments of pollutant sources within watersheds;
- Determinations of appropriate management practices to address impairments;
- Identification of potential stakeholders and other partners;
- Developing a plan for outreach to the general public and other groups;
- Assessing the resources needed to implement the plan upon completion; and
- Other needs determined by the lead organization responsible for plan development.

GA EPD will also make this same assistance available, if needed, to proactively address water quality concerns. This assistance may be in the way of financial, technical, or other aid and may be requested and provided outside of the TMDL process or schedule.

7.6 References

ARC, 2001. *Georgia Stormwater Management Manual*, Atlanta Regional Commission, August 2001.

Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards, Revised October 2, 2013.

GA EPD, 2015.Draft Total Maximum Daily Load Evaluation the Tennessee River Basin for Sediment (Biota Impacted),August 2015.

GFC, 2009, *Georgia's Best Management Practices for Forestry*, Georgia Forestry Commission, Macon, Georgia, May 2009.

GA RCDC, 2009. *Georgia Better Back Roads Field Manual*, Georgia Resource Conservation and Development Council, May 2009

GSWCC, 2013. *Best Management Practices for Georgia Agriculture, Second Edition*, Georgia Soil and Water Conservation Commission, Athens, Georgia, 2013

GSWCC, 2014. *Manual for Erosion and Sediment Control in Georgia, Sixth Edition,* Georgia Soil and Water Conservation Commission, Athens, Georgia, 2014.

National Management Measures to Control Nonpoint Source Pollution from Agriculture, USEPA, July 2003

National Management Measures to Control Nonpoint Source Pollution from Forestry, USEPA, April 2005

National Management Measures to Control Nonpoint Source Pollution from Urban Areas, USEPA, November 2005

National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution, USEPA, July 2005

REFERENCES

ARC, 2001. *Georgia Stormwater Management Manual*, Atlanta Regional Commission, August 2001.

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. *Rapid Bioassessment Protocols for Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates and Fish, Second Edition*. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water; Washington, D.C.

Choctawhatchee, Pea and Yellow Rivers Watershed Management Authority, 2000. *Recommended Practices Manual, A Guideline for Maintenance and Service of Unpaved Roads*, February 2000.

Coastal Georgia RDC, 2005. *Green Growth Guidelines: A Low Impact Development Strategy for Coastal Georgia*, Coastal Georgia Regional Development Center, 2005.

Daly, C. and Taylor, G. H.: Development of New Spatial Grids of R-factor and 10-yr EI_{30} for the Conterminous United States, Internal USEPA Report, NERL-LV. Spatial Climate Analysis Service, Oregon State University, Corvallis, Oregon, 2002.

GA EPD, 1997*. Land Development Provisions to Protect Georgia Water Quality*, Georgia Department of Natural Resources, Environmental Protection Division, October 1997.

GA EPD, 2007. *Macroinvertebrate Biological Assessment of Wadeable Streams in Georgia, Standard Operating Procedures*, Georgia Department of Natural Resources, Environmental Protection Division, Water Protection Branch, March 2007

GA EPD, 2014. *Georgia Nonpoint Source Management Plan FFY 2014 Update*, Georgia Department of Natural Resources, Environmental Protection Division, Water Protection Branch, September 2014.

GA EPD, 2012-2013. *Water Quality in Georgia,* Draft, 2012-2013, Georgia Department of Natural Resources, Environmental Protection Division.

GA EPD, *Rules and Regulations for Surface Mining, 391-3-3,* Georgia Department of Natural Resources, Environmental Protection Division.

Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03, Water Use Classifications and Water Quality Standards, Revised October 2, 2013.

GA EPD, *Rules for Erosion and Sedimentation Control, Chapter 391-3-7,* Georgia Department of Natural Resources, Environmental Protection Division, Revised January 2005.

GFC, 2009, *Georgia's Best Management Practices for Forestry*, Georgia Forestry Commission, Macon, Georgia, May 2009

Goldman, S.J., K. Jackson, and T.A. Bursztynsky. *Erosion and Sediment Control Handbook*. McGraw-Hill, New York, NY. 1986

Gore, J.A., Hughes, D.L., Brossett, M.P., and Olson, J.R., *Rapid Bioassessment of Stream Health*, CRC Press, 2010

Griffith, G.E., Omernik, J.M., Comstock, J.A., Lawrence, S.,Martin, G., Goddard, A., Hulcher, V.J., and Foster, T., *Ecoregions of Alabama and Georgia* (color poster with map, descriptive text, summary tables, and photographs), U.S. Geological Survey, 2001.

GA RCDC, 2009. *Georgia Better Back Roads Field Manual*, Georgia Resource Conservation and Development Council, May 2009

GSWCC, 1994. A*gricultural Best Management Practices for Protecting Water Quality in Georgia*, Georgia Soil and Water Conservation Commission, Athens, Georgia, September 1994.

GSWCC, 2013. *Best Management Practices for Georgia Agriculture, Second Edition*, Georgia Soil and Water Conservation Commission, Athens, Georgia, 2013

GSWCC, 2014. *Manual for Erosion and Sediment Control in Georgia, Sixth Edition,* Georgia Soil and Water Conservation Commission, Athens, Georgia, 2014.

GA WRD, 2005a. *Part I: Standard Operating Procedures for Conducting Biomonitoring on Fish Communities in Wadeable Streams in Georgia*, Georgia Department of Natural Resources, Wildlife Resources Division, Fisheries Management Section, Revised June 1, 2005.

GA WRD, 2005b. *Part III: Scoring Criteria for the Index of Biotic Integrity and the Index of Well-Being to Monitor Fish Communities in Wadeable Streams in the Apalachicola and Atlantic Slope drainage basins of the Southeastern Plains Ecoregion of Georgia,* Georgia Department of Natural Resources, Wildlife Resources Division, Fisheries Management Section, Revised June 1, 2005.

GAWPB, 2000. *Draft Standard Operating Procedures Freshwater Macroinvertebrate Biological Assessment*, Georgia Department of Natural Resources, Water Protection Branch, 2000.

U.S. Bureau of the Census, 1954. *U. S. Census of Agriculture:* 1954. Vol. I, Counties and State Economic Areas, Part 17. U.S. Bureau of the Census. U.S. Government Printing Office, Washington, D. C., 1956.

USDA-ARS, 2006. *Suspended-Sediment Transport Rates for Level III Ecoregions of EPA Region 4: The Southeast*, U.S. Department of Agriculture, Agricultural Research Service, National Sedimentation Laboratory, Watershed Physical Processes Research Unit, Technical Report 55, December 2006

USDA-FS, 1998. *Forest Statistics for Georgia, 1997*. U.S. Department of Agriculture, Forest Service, Southern Research Station, December 1998.

USDA-NASS, 2012, *Census of Agriculture : 2012.* Vol. 1, Geographic Area Series, Part 10, U.S. Department of Agriculture, National Agricultural Statistics Service, May 2014

USDA-NRCS, 1997. *National Resources Inventory*, U.S. Department of Agriculture, Natural Resource Conservation Service, Athens, Georgia.

USEPA, 1991. *Guidance for Water Quality –based Decisions: The TMDL Process.*U.S. Environmental Protection Agency, Office of Water, Washington, D.C.EPA-440 / 4-91-001, April 1991.

USEPA, 1998. *Better Assessment Science Integrating Point and Nonpoint Sources (BASIN*S), *Version 2.0 User's Manual,* U.S. Environmental Protection Agency, Office of Water, Washington D.C.

USEPA, 1999a*. 1999 Update of Ambient Water Quality Criteria*, U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA-822-R-99-014, December 1999.

USEPA, 1999b. *Protocol for Developing Sediment TMDLs*, First Edition, U.S. Environmental Protection Agency, Office of Water, Washington, D.C.

USEPA,2000. *Watershed Characterization System - User's Manual*, U.S. Environmental Protection Agency, Region IV, Atlanta, Georgia, 2000.

USEPA,2001a. Watershed Characterization System (WCS) Data, Georgia, U.S. Tetra Tech, Environmental Protection Agency, Region IV, Atlanta, Georgia, Jan. 31, 2001.

USEPA, 2001b. *Total Maximum Daily Load (TMDL) Development for Sediment in the Chattooga River Watershed*, April 2001.

APPENDIX A

Total Allowable Sediment Load
Summary Memorandum

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Anderson Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Anderson Creek**
Location:	**Headwaters to Coosa Creek**
Stream Length:	**3 miles**
Watershed Area:	**2.84 square miles**
Reach ID:	**R060200020516**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**636.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**636.6 tons/yr**
Maximum Allowable Daily Load:	**299.1 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Arkaqua Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Arkaqua Creek**
Location:	**Pine Ridge Road to Nottely River**
Stream Length:	**4 miles**
Watershed Area:	**11.65 square miles**
Reach ID:	**R060200020505**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**3,090.3 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**3,090.3 tons/yr**
Maximum Allowable Daily Load:	**1,452.0 tons/day**
% Reduction:	**6.4%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Bitter Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Bitter Creek**
Location:	**Headwaters to Brasstown Creek**
Stream Length:	**3 miles**
Watershed Area:	**4.85 square miles**
Reach ID:	**R060200020303**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,004.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1 004.9 tons/yr**
Maximum Allowable Daily Load:	**472.2 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Brasstown Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union/ Towns**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Brasstown Creek**
Location:	**Little Bald Cove to Yewell Branch**
Stream Length:	**4 miles**
Watershed Area:	**5.72 square miles**
Reach ID:	**R060200020307**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1517.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,517.6 tons/yr**
Maximum Allowable Daily Load:	**713.1 tons/day**
% Reduction:	**8.3%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Charlie Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Charlie Creek**
Location:	**Stillhouse Creek to Blue Ridge Lake**
Stream Length:	**2 miles**
Watershed Area:	**2.36 square miles**
Reach ID:	**R060200030125**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**536.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**536.4 tons/yr**
Maximum Allowable Daily Load:	**252.0 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Cooper Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Cooper Creek**
Location:	**Logan Creek to Bryant Creek**
Stream Length:	**5 miles**
Watershed Area:	**12.6 square miles**
Reach ID:	**R060200030123**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**3,216.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**3,216.9 tons/yr**
Maximum Allowable Daily Load:	**1,511.5 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Cooper Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Cooper Creek**
Location:	**Lake Winfield Scott to Logan Creek**
Stream Length:	**2 miles**
Watershed Area:	**3.54 square miles**
Reach ID:	**R060200030122**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**939.2 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**939.2 tons/yr**
Maximum Allowable Daily Load:	**441.3 tons/day**
% Reduction:	**1.9%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Coosa Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Coosa Creek**
Location:	**Anderson Creek to Nottely Lake**
Stream Length:	**1 miles**
Watershed Area:	**21.6 square miles**
Reach ID:	**R060200020515**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**5,289.5 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**5,289.5 tons/yr**
Maximum Allowable Daily Load:	**2,485.3 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Dooley Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Dooley Creek**
Location:	**Tributary to Nottely River**
Stream Length:	**6 miles**
Watershed Area:	**7.25 square miles**
Reach ID:	**R060200020603**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,591.0 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,591.0 tons/yr**
Maximum Allowable Daily Load:	**747.5 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
East Fork Coosa Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**East Fork Coosa Creek**
Location:	**Headwaters to Coosa Creek**
Stream Length:	**6 miles**
Watershed Area:	**4.18 square miles**
Reach ID:	**R060200020518**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**953.1 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**953.1 tons/yr**
Maximum Allowable Daily Load:	**447.8 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Fodder Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Towns**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Fodder Creek**
Location:	**Tributary to Chatuge Lake**
Stream Length:	**3 miles**
Watershed Area:	**9.18 square miles**
Reach ID:	**R060200020104**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**2,435.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2,435.9 tons/yr**
Maximum Allowable Daily Load:	**1,144.5 tons/day**
% Reduction:	**13.3%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Fortenberry Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Fortenberry Creek**
Location:	**Headwaters to the Nottely River**
Stream Length:	**3 miles**
Watershed Area:	**3.34 square miles**
Reach ID:	**R060200020519**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**834.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**834.6 tons/yr**
Maximum Allowable Daily Load:	**392.1 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Helton Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Helton Creek**
Location:	**Headwaters to the Nottely River**
Stream Length:	**4 miles**
Watershed Area:	**2.95 square miles**
Reach ID:	**R060200020520**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**781.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**781.9 tons/yr**
Maximum Allowable Daily Load:	**367.4 tons/day**
% Reduction:	**8.7%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Hightower Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Towns**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Hightower Creek**
Location:	**Little Hightower Creek to Scataway Creek (formerly Shoal Branch to Swallow Creek)**
Stream Length:	**2 miles**
Watershed Area:	**17.09 square miles**
Reach ID:	**R060200020115**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**4,534.8 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**4,534.8 tons/yr**
Maximum Allowable Daily Load:	**2,130.7 tons/day**
% Reduction:	**14.6%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Ivylog Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Ivylog Creek**
Location:	**Tributary to Lake Nottely**
Stream Length:	**7 miles**
Watershed Area:	**10.84 square miles**
Reach ID:	**R060200020508**
Ecoregion:	**Blue Ridge**
Violations:	**Bio F, Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**2,494.2 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2,494.2 tons/yr**
Maximum Allowable Daily Load:	**1,171.9 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Jones Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Jones Creek**
Location:	**Headwaters to Youngcane Creek**
Stream Length:	**4 miles**
Watershed Area:	**3.8 square miles**
Reach ID:	**R060200020521**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**967.3 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**967.3 tons/yr**
Maximum Allowable Daily Load:	**454.5 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Keener Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Rabun**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6010202**
Waterbody Name:	**Keener Creek**
Location:	**Headwaters to the Little Tennessee River**
Stream Length:	**3 miles**
Watershed Area:	**2.26 square miles**
Reach ID:	**R060102020103**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**491.2 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**491.2 tons/yr**
Maximum Allowable Daily Load:	**230.8 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Little Youngcane Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Little Youngcane Creek**
Location:	**Mason Branch to Youngcane Creek**
Stream Length:	**2 miles**
Watershed Area:	**4.77 square miles**
Reach ID:	**R060200020522**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,071.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,071.6 tons/yr**
Maximum Allowable Daily Load:	**503.5 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Owenby Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Owenby Creek**
Location:	**Headwaters to Stateline**
Stream Length:	**5 miles**
Watershed Area:	**3.76 square miles**
Reach ID:	**R060200020606**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**511.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**511.4 tons/yr**
Maximum Allowable Daily Load:	**240.3 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Owl Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Towns**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Owl Creek**
Location:	**Headwaters to the Hiwassee River**
Stream Length:	**4 miles**
Watershed Area:	**3.93 square miles**
Reach ID:	**R060200020117**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,041.4 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,041.4 tons/yr**
Maximum Allowable Daily Load:	**489.3 tons/day**
% Reduction:	**2.2%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Right Prong Butternut Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Right Prong Butternut Creek**
Location:	**Headwaters to Butternut Creek**
Stream Length:	**3 miles**
Watershed Area:	**2.22 square miles**
Reach ID:	**R060200020523**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**377.1 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**377.1 tons/yr**
Maximum Allowable Daily Load:	**177.2 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
South Fork Rapier Mill Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**South Fork Rapier Mill Creek**
Location:	**Stateline to Stateline**
Stream Length:	**2 miles**
Watershed Area:	**6.03 square miles**
Reach ID:	**R060200020605**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**959.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**959.6 tons/yr**
Maximum Allowable Daily Load:	**450.9 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Stink Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Stink Creek**
Location:	**Headwaters to the Nottely River (formerly Union County)**
Stream Length:	**5 miles**
Watershed Area:	**3.83 square miles**
Reach ID:	**R060200020524**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**998.9 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**998.9 tons/yr**
Maximum Allowable Daily Load:	**469.3 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Swallow Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Towns**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Swallow Creek**
Location:	**Headwaters to Hightower Creek**
Stream Length:	**4 miles**
Watershed Area:	**5.71 square miles**
Reach ID:	**R060200020113**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,514.0 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,514.0 tons/yr**
Maximum Allowable Daily Load:	**711.4 tons/day**
% Reduction:	**5.2%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Town Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Town Creek**
Location:	**Townsend Branch to the Nottely River**
Stream Length:	**3 miles**
Watershed Area:	**17.73 square miles**
Reach ID:	**R060200020510**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**4,704.2 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**4,704.2 tons/yr**
Maximum Allowable Daily Load:	**2,210.3 tons/day**
% Reduction:	**1.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Tumbling Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Tumbling Creek**
Location:	**Headwaters to State Line**
Stream Length:	**5 miles**
Watershed Area:	**4.94 square miles**
Reach ID:	**R060200030211**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**381.5 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**381.5 tons/yr**
Maximum Allowable Daily Load:	**179.3 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Wilscot Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Wilscot Creek**
Location:	**Headwaters to Crawford Creek**
Stream Length:	**4 miles**
Watershed Area:	**5.39 square miles**
Reach ID:	**R060200030119**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,121.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,121.6 tons/yr**
Maximum Allowable Daily Load:	**527.0 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Winchester Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Towns**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Winchester Creek**
Location:	**Headwaters to State Line**
Stream Length:	**4 miles**
Watershed Area:	**2.47 square miles**
Reach ID:	**R060200020305**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**654.0 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**654.0 tons/yr**
Maximum Allowable Daily Load:	**307.3 tons/day**
% Reduction:	**35.2%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Youngcane Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**Youngcane Creek**
Location:	**Little Youngcane Creek to Nottely Lake**
Stream Length:	**4 miles**
Watershed Area:	**21.2 square miles**
Reach ID:	**R060200020512**
Ecoregion:	**Blue Ridge**
Violation:	**Bio F**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**5,447.8 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**5,447.8 tons/yr**
Maximum Allowable Daily Load:	**2,559.7 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Big Spring Branch (aka Higdon Creek)

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Dade**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6030001**
Waterbody Name:	**Big Spring Branch (aka Higdon Creek)**
Location:	**Harris Creek to Stateline (Formerly Higdon Creek to Stateline)**
Stream Length:	**1 miles**
Watershed Area:	**4.78 square miles**
Reach ID:	**R060300010201**
Ecoregion:	**Southwestern Appalachians**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,613.7 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,613.7 tons/yr**
Maximum Allowable Daily Load:	**780.1 tons/day**
% Reduction:	**51.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Black Branch

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Catoosa**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020001**
Waterbody Name:	**Black Branch**
Location:	**Van Cleve St., Ft. Ogelthorpe to Spring Creek**
Stream Length:	**3 miles**
Watershed Area:	**9.53 square miles**
Reach ID:	**R060200010925**
Ecoregion:	**Ridge and Valley**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Storm Water (WLAsw):	**44.3 tons/year**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,010.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,054.9 tons/yr**
Maximum Allowable Daily Load:	**78.7 tons/day**
% Reduction:	**0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Hemptown Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Hemptown Creek**
Location:	**Mitchell Branch to Young Stone Creek**
Stream Length:	**10 miles**
Watershed Area:	**10.11 square miles**
Reach ID:	**R060200030203**
Ecoregion:	**Blue Ridge**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**2,143.8 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2,143.8 tons/yr**
Maximum Allowable Daily Load:	**1,007.3 tons/day**
% Reduction:	**6.6%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Sugar Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Catoosa**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020001**
Waterbody Name:	**Sugar Creek**
Location:	**State Line to Tiger Creek**
Stream Length:	**5 miles**
Watershed Area:	**4.45 square miles**
Reach ID:	**R060200010716**
Ecoregion:	**Ridge and Valley**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**2,905.0 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**2,905.0 tons/yr**
Maximum Allowable Daily Load:	**1,364.9 tons/day**
% Reduction:	**45.0%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Sugar Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Fannin**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020003**
Waterbody Name:	**Sugar Creek**
Location:	**Upstream Toccoa River**
Stream Length:	**2 miles**
Watershed Area:	**13.71 square miles**
Reach ID:	**R060200030206**
Ecoregion:	**Blue Ridge**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):	
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**1,170.6 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**1,170.6 tons/yr**
Maximum Allowable Daily Load:	**87.3 tons/day**
% Reduction:	**45.8%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
Tributary to Tiger Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Catoosa**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020001**
Waterbody Name:	**Tributary to Tiger Creek**
Location:	**Headwaters to Tiger Creek**
Stream Length:	**3 miles**
Watershed Area:	**2.74 square miles**
Reach ID:	**R060200010719**
Ecoregion:	**Ridge and Valley**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3.Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**720.7 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**720.7 tons/yr**
Maximum Allowable Daily Load:	**53.8 tons/day**
% Reduction:	**15.5%**

SUMMARY MEMORANDUM
Total Allowable Sediment Load
West Fork Wolf Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Union**
Major River Basin:	**Tennessee**
8-Digit Hydrologic Unit Code(s):	**6020002**
Waterbody Name:	**West Fork Wolf Creek**
Location:	**Headwaters to Wolf Creek (formerly Headwaters to the Nottely River)**
Stream Length:	**4 miles**
Watershed Area:	**3.44 square miles**
Reach ID:	**R060200020525**
Ecoregion:	**Blue Ridge**
Violation:	**Bio M**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Criteria:

All waters shall be free from material related to municipal, industrial or other discharges which produce turbidity, color, odor or other objectionable conditions which interfere with legitimate water uses.

2. TMDL Development

Analysis/Modeling:	**Universal Soil Loss Equation was used to determine the average annual sediment load**

3. Allocation Watershed/Stream Reach

Wasteload Allocations (WLA):

Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA) :	**873.2 tons/yr**
Margin of Safety (MOS):	**implicit**
Total Allowable Sediment Load:	**873.2 tons/yr**
Maximum Allowable Daily Load:	**410.3 tons/day**
% Reduction:	**0.4%**