Total Maximum Daily Load

Evaluation

for

Fifteen Stream Segments

in the

Oconee River Basin

For Sediment

(Biota Impacted)

Submitted to:

The U.S. Environmental Protection Agency
Region 4
Atlanta, Georgia

Submitted by:
The Georgia Department of Natural Resources
Environmental Protection Division
Atlanta, Georgia

January 2002

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EXECUTIVE SUMMARY

The State of Georgia assesses its water bodies for compliance with water quality standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories, supporting, partially supporting, or not supporting their designated uses 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* every two years.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. 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 fifteen (15) stream segments located in the Oconee River Basin as water quality limited (i.e. 303(d) listed as Biota Impacted) due to sedimentation. The water use classification of all of the impacted streams is Fishing. The general water quality criteria not being met states:

> 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..

The Biota Impacted designation indicates that studies have shown a modification of the biological community, more specifically, fish. In 1990, 1998, and 1999, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations. WRD used the Index of Biotic Integrity (IBI) and modified Index of Well-Being (IWB) to identify affected fish populations. The IBI and IWB values were used to classify the population as Excellent, Good, Fair, Poor, or Very Poor. Stream segments with fish populations rated as Poor or Very Poor were included in the partially supporting list. As a result, fifteen stream segments in the Oconee River Basin were added to the State's 303(d) list and scheduled for a TMDL evaluation. Ten stream segments, assessed and rated as Excellent, Good, and/or Fair, were considered as supporting uses.

The general cause of low IBI scores is the lack of fish habitat due to stream sedimentation. 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 303(d) listed watersheds utilized the Universal Soil Loss Equation (USLE). The USLE predicts the average annual soil loss caused by erosion. The USLE method considered the characteristics of the watershed including land use, soil type, ground slope, and road surface. National Pollutant Discharge Elimination System (NPDES) permitted discharges were also considered. Modeling assumptions were considered conservative and provide the necessary implicit margin of safety for the TMDL.

The USLE was applied to both the 303(d) listed watersheds and those not biologically impacted to determine the both the existing sediment loading rates and the sediment load reductions needed to support beneficial use (i.e. unimpacted conditions). The average sediment load in those watersheds on the 303(d) list is 0.77 tons/acre/yr, ranging from 0.03 to 4.84 tons/acre/yr. The average sediment load of the watersheds not on the 303(d) list is 0.62 tons/acre/yr, ranging from 0.03 to 1.56 tons/acre/yr. These values represent sediment load contributions from all land uses within unimpaired watersheds. Note that the average annual sediment loads for both watershed groups are generally within the same range.

Table 1 shows that approximately 73.0 percent of the average sediment load in the Oconee River Basin results from row crops having an average sediment load of 5.40 tons/acre/yr. Approximately 5.0 percent of the total sediment load is from pastureland with an average load on 0.19 tons/acre/yr. In the Oconee River Basin, mining activities contribute approximately 12.8 percent of the total sediment load with an average load of 15.58 tons/acre/yr. Roads contribute approximately 6.5 percent of the total sediment load, forests make up about 0.8 percent of the total load with an average load of 0.23 tons/acre/year, and urban land contributes approximately 0.8 percent of the total sediment load with an average load of 0.32 tons/acre/yr. Estimates of the sediment contribution from construction are not available, but could represent a relatively high sediment load per acre.

Table 1. Summary of Current Conditions in the Oconee River Basin

Land Use	Average Percent Land Use	Average Percent Sediment Load	Average Sediment Load (tons/acre/yr)
Open Water	0.0%	0.0%	0.00
Urban	1.5%	0.8%	0.32
Bare Rock, Sand and Clay	0.1%	0.0%	0.00
Quarries, Strip Mines, Gravel Pits	0.5%	12.8%	15.58
Transitional Land	2.8%	0.2%	0.05
Forest	69.0%	0.8%	0.01
Pasture/Hay	15.4%	5.0%	0.19
Row Crops	8.1%	73.0%	5.40
Grasses, Wetland	2.2%	0.8%	0.23
Roads		6.5%	

These data indicate that row crops are the major source of sediment to our rivers and streams. However, over the last century there has been a dramatic 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, streams will repair themselves over time.

This TMDL determines the sediment loads that can enter the impaired Oconee River Basin streams without causing sediment impairment to the streams. This is based on the hypothesis that if an impaired watershed has an annual average sediment loading rate similar to a biologically unimpaired watershed, then the receiving stream will remain stable and not be biologically impaired due to sediment. The average annual sediment load in the Oconee River Basin watersheds not on the 303(d) list is 0.62 tons/acre/yr. The annual average sediment loads for each of the impaired watersheds are summarized in the table below with any required sediment load reductions.

Total Annual Sediment Loads and the Required Sediment Reduction

Name	Current Load (tons/yr)	WLA (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	% Reduction
Alligator Creek	724	0	724	724	0.0%
Black Creek	256	0	256	256	0.0%
Carr Creek	3,522	20	428	448	87.3%
Carter's Mill Creek	2,323	0	2,323	2,323	0.0%
Crooked Creek	1,893	0	1,494	1,494	21.1%
Limestone Creek	6,951	761	2,109	2,870	58.7%
Little Commissioner Creek	21,789	1,274	16,266	17,540	19.5%
Little Fishing Creek	1,255	0	1,255	1,255	0.0%
Porter Creek	13,453	0	11,942	11,942	11.2%
Rooty Creek	4,734	10	3,371	3,381	28.6%
Sandy Creek	356	0	356	356	0.0%
Sandy Hill Creek	3,244	0	2,736	2,736	15.7%
Sandy Run Creek	110	0	110	110	0.0%
Tobler Creek	192	0	192	192	0.0%
Zoie Brown Creek	484	0	484	484	0.0%

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

- Compliance with the requirements of the NPDES permit program
- Implementation of GFC Best Management Practices for forestry
- Adoption of NRCS Conservation Practices
- Adherence to the Mined Land Use Plan prepared as part of the Surface Mining Permit Application
- Adoption of proper unpaved road maintenance practices
- Implementation of Erosion and Sedimentation Control Plans for land disturbing activities
- Evaluation of the effects of increased flow due to urban runoff on stream bank erosion

though 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 standards criteria established for their designated uses as required by the Federal Clean Water Act (CWA). Assessed water bodies are placed into three categories, supporting, partially supporting, or not supporting their designated uses 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 addresses the assessment process, and are published in *Water Quality in Georgia* every two years.

Some of the 305(b) partially and not supporting water bodies are also assigned to Georgia's 303(d) list, also named after that section of the CWA. Water bodies on the 303(d) list are required to have a Total Maximum Daily Load (TMDL) evaluation for the water quality constituent(s) in violation of the water quality standard. 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.

In 1990, 1998, and 1999, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish populations at a number of monitoring sites in the Oconee River Basin. WRD used the Index of Biotic Integrity (IBI) and modified Index of Well-Being (IWB) to identify affected fish populations. The IBI and IWB values were used to classify the populations as Excellent, Good, Fair, Poor, or Very Poor. Stream segments with fish populations rated as Poor or Very Poor were listed as Biota Impacted. The Biota Impacted designation indicates that studies have shown a significant modification of the biological community. Fourteen stream segments (see Table 2) were rated as Poor or Very Poor, placed on the 303(d) list as partially supporting their designated water use, and scheduled for TMDL evaluation. One additional stream, Carr Creek, was placed on the 303(d) list based on EPD investigations. Ten stream segments were rated as Excellent, Good, or Fair and assessed as supporting their designated water use.

1.2 Watershed Description

The fifteen impaired watersheds are located in the Oconee River Basin in middle Georgia, in Baldwin, Clarke, Hancock, Jones, Putnam, Twiggs, Washington, and Wilkinson Counties (see Figure 1). The ten unimpaired watersheds are located in Baldwin, Barrow, Greene, Hancock, Jasper, Jones, Morgan, Newton, Oconee, Putnam, and Walton Counties.

The land use characteristics of the Oconee River Basin watersheds were determined using data from Georgia's Multiple Resolution Land Coverage (MRLC). This coverage is based on Landsat Thematic Mapper digital images developed in 1995. The classification is based on a modified Anderson level one and two system. Table 3 lists the land use distribution of the 25 watersheds WRD monitored in 1998 and 1999. The watersheds are grouped by those that are not on the 303(d) list, and those that are on the 303(d) list. Table 4 lists the land use percentages for all the Oconee River Basin watersheds monitored. The data show that the watersheds are predominately forested with approximately 73.7 percent (ranging from 29.4 to 96.4 percent) in forest use. Agriculture is the next predominate land use with approximately 8.2 percent cropland (ranging from 0 – 29.6 percent) and approximately 8.1 percent pasture land (ranging from 0 to 41.4 percent).

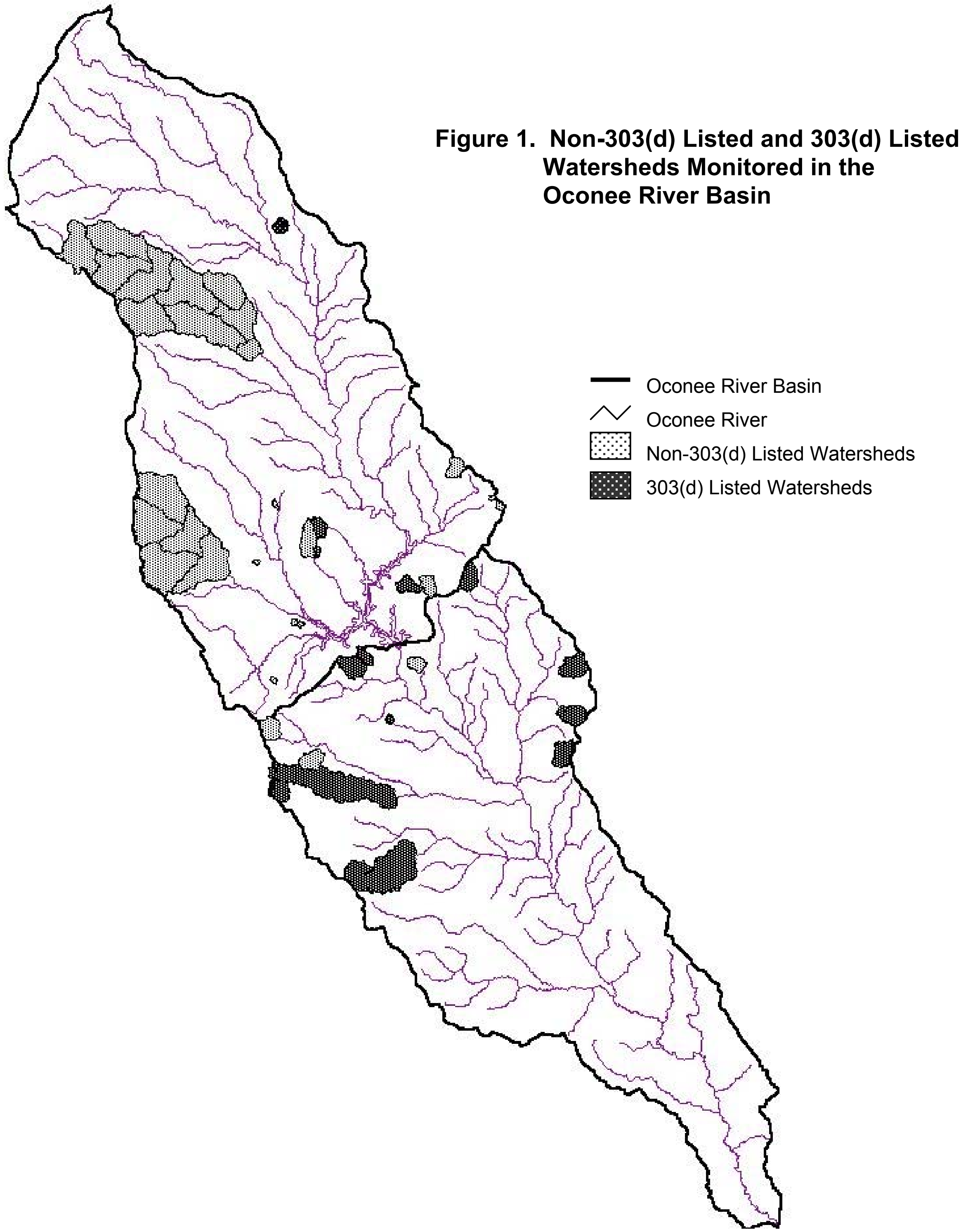

Figure 1. Non-303(d) Listed and 303(d) Listed Watersheds Monitored in the Oconee River Basin

Table 2. 303(d) Listed Stream Segments located in the Oconee River Basin

STREAM	STATUS	LOCATION	MILES
Alligator Creek	Partially Supporting	Tributary to Ugly Creek - Twiggs County	6
Black Creek	Partially Supporting	Baldwin County	2
Carr Creek	Partially Supporting	Headwaters to North Oconee River - Clarke County	2
Carter's Mill Creek	Partially Supporting	Washington County	6
Crooked Creek	Partially Supporting	Putnam County	9
Limestone Creek	Partially Supporting	Washington County	8
Little Commissioner Creek	Partially Supporting	GA Hwy 18 to Commissioner Creek - Wilkinson County	9
Little Fishing Creek	Partially Supporting	Baldwin County	5
Porter Creek	Partially Supporting	Wilkinson County	12
Rooty Creek	Not Supporting	RD S926, Eatonton to Little Creek - Putnam County	9
Sandy Creek	Partially Supporting	Jones County	6
Sandy Hill Creek	Partially Supporting	Washington County	9
Sandy Run Creek	Partially Supporting	Hancock County	5
Tobler Creek	Partially Supporting	Baldwin County	8
Zoie Brown Creek	Partially Supporting	Tributary to Buffalo Creek -Hancock County	3

Source: GAEPD, 1998-1999. *Water Quality in Georgia, 1998-1999,* Georgia Department of Natural Resource, Environmental Protection Division.

The soil characteristics of the Oconee River Basin watersheds were determined using data from the State Soil Geographic (STATSGO) coverage. This coverage provides major soil type classifications. Table 5 lists the soil type distribution of the monitored watersheds.

1.3 Water Quality Standard

The water use classification for the impaired watersheds in the Oconee River Basin is Fishing. The criterion violated is listed as Biota Impacted, which indicates studies have shown a significant impact on fish. The potential cause(s) listed include urban runoff, nonpoint sources, unknown sources, and industrial facilities. The narrative standard is to prevent objectionable conditions which 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.

Table 3. Land Use Distribution

	Area (acres)															
Name	**Open Water**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial/ Industrial Transportation**	**Bare Rock Sand and Clay**	**Quarries Strip Mines Gravel Pits**	**Transitional**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Pasture/Hay**	**Row Crops**	**Other Grasses (Urban Recreational)**	**Woody Wetland**	**Emergent Herbaceous Wetlands**	**Total**
Apalachee River	889.5	1028.8	157.9	823.5	66.3	2.2	1955.4	52050.6	26140.5	22200.2	35902.6	13783.3	958.5	3974.1	61.2	159994.5
Beaverdam Creek Trib						0.2	19.8	304.0	228.6	58.3	0.9			0.2		612.0
Black Springs Branch	4.4	14.9		2.4	2.0		128.5	902.0	728.1	297.6	19.3	99.9	3.6	5.8		2208.5
Cedar Creek	0.2	16.7		11.1	0.7	60.5	27.6	278.0	248.0	142.1	59.2	52.7	1.3	1.3		899.3
Copeland Creek	6.4	2.7			0.4		34.7	923.4	1273.2	334.2	262.4	85.2	10.9	1.8	0.2	2935.5
Crooked Creek	21.1			0.2	4.7		172.1	1278.3	938.3	430.3	282.9	775.5		17.3	0.4	3921.1
Log Dam Creek	0.9				0.9		144.8	1475.3	586.9	302.2	22.2	56.7		1.8		2591.7
Milsap Creek	51.1	253.1	30.2	54.0	4.4		134.1	799.0	963.2	469.2	376.7	851.7	13.3	27.4	0.4	4028.1
Murder Creek	459.9	606.7	42.7	143.9	28.9	0.2	1667.5	27289.8	21062.3	11530.1	12485.0	6714.8	261.7	753.2	23.6	83070.2
Rooty Ck U/S WPCP	53.2	274.0	15.1	63.2	5.1	72.5	123.0	572.0	1104.8	381.6	1690.1	457.2	41.1	14.0	2.9	4869.8
Alligator Creek	1.1	20.5	10.0	0.7	0.7	2.0	346.9	3678.7	944.0	847.5	10.2	59.8		4.7		5926.8
Black Creek	2.7	2.9		0.9	0.4		28.7	217.0	117.6	42.0	5.3	169.2	0.2	1.6		588.7
Carr Creek	2.0	121.0	25.4	101.9	5.3	151.9	0.2	79.8	63.4	46.5	21.3	28.0	74.1	2.2		723.0
Carter's Mill Creek	35.4	0.2			6.4		379.8	1115.3	2072.2	488.4	202.4	726.1		371.4	1.3	5398.9
Crooked Creek	19.3				2.7		60.3	314.0	450.8	194.1	991.2	371.2		5.6	1.1	2410.2
Limestone Creek	95.8	165.5	44.5	308.7	28.2	485.5	320.5	1016.3	1076.1	352.9	77.8	445.4	72.5	134.1	4.7	4628.5
Little Commissioner Ck	167.0	332.7	80.1	187.7	47.4	567.3	2640.0	11446.3	6587.1	3436.3	396.3	2140.0	43.1	212.4	6.2	28289.8
Little Fishing Creek				0.7	2.9		119.6	1781.5	2262.6	442.6	107.4	205.5	0.2	3.1		4926.1
Porter Creek	68.7	9.8		2.4	23.4	358.7	396.7	9236.6	4604.3	3798.1	30.9	636.2	1.8	87.2	6.7	19261.6
Rooty Ck D/S WPCP	54.5	286.0	15.1	63.2	5.1	72.5	137.4	680.1	1321.0	456.3	1734.4	561.5	48.9	14.7	2.9	5453.6
Sandy Creek	6.7	25.8		5.1	7.1		488.4	1615.4	796.4	292.2	31.1	4.0		17.8		3290.0
Sandy Hill Creek	8.9	1.8			2.7		255.7	1118.8	1051.9	310.0	590.7	608.0		464.1	0.2	4412.8
Sandy Run Creek							254.0	1504.2	1226.7	195.7				4.4		3185.0
Tobler Creek	3.3				0.7		41.8	532.4	1117.5	187.9	31.1	37.1		2.9		1954.8
Zoie Brown Creek	7.3					1.6	94.7	1740.8	1399.5	375.2	56.3	138.5		8.0	0.2	3821.9

Table 4. Land Use Percentages

	Percent Total Land Use														
Name	**Open Water**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial/ industrial Transportation**	**Bare Rock Sand and Clay**	**Quarries Strip Mines Gravel Pits**	**Transitional**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Pasture/Hay**	**Row Crops**	**Other Grasses (Urban Recreational)**	**Woody Wetland**	**Emergent Herbaceous Wetlands**
Apalachee River	0.56%	0.64%	0.10%	0.51%	0.04%	0.00%	1.22%	32.53%	16.34%	13.88%	22.44%	8.61%	0.60%	2.48%	0.04%
Beaverdam Creek Trib						0.04%	3.23%	49.67%	37.35%	9.52%	0.15%			0.04%	
Black Springs Branch	0.20%	0.67%		0.11%	0.09%		5.82%	40.84%	32.97%	13.47%	0.88%	4.52%	0.16%	0.26%	
Cedar Creek	0.02%	1.85%		1.24%	0.07%	6.73%	3.07%	30.91%	27.57%	15.80%	6.58%	5.86%	0.15%	0.15%	
Copeland Creek	0.22%	0.09%			0.02%		1.18%	31.45%	43.37%	11.39%	8.94%	2.90%	0.37%	0.06%	0.01%
Crooked Creek	0.54%			0.01%	0.12%		4.39%	32.60%	23.93%	10.97%	7.21%	19.78%		0.44%	0.01%
Log Dam Creek	0.03%				0.03%		5.59%	56.92%	22.64%	11.66%	0.86%	2.19%		0.07%	
Milsap Creek	1.27%	6.28%	0.75%	1.34%	0.11%		3.33%	19.84%	23.91%	11.65%	9.35%	21.15%	0.33%	0.68%	0.01%
Murder Creek	0.55%	0.73%	0.05%	0.17%	0.03%	0.00%	2.01%	32.85%	25.35%	13.88%	15.03%	8.08%	0.32%	0.91%	0.03%
Rooty Ck U/S WPCP	1.09%	5.63%	0.31%	1.30%	0.11%	1.49%	2.53%	11.75%	22.69%	7.84%	34.71%	9.39%	0.84%	0.29%	0.06%
Alligator Creek	0.02%	0.35%	0.17%	0.01%	0.01%	0.03%	5.85%	62.07%	15.93%	14.30%	0.17%	1.01%		0.08%	
Black Creek	0.45%	0.49%		0.15%	0.08%		4.87%	36.87%	19.98%	7.14%	0.91%	28.75%	0.04%	0.26%	
Carr Creek	0.28%	16.73%	3.51%	14.09%	0.74%	21.01%	0.03%	11.04%	8.77%	6.43%	2.95%	3.88%	10.24%	0.31%	
Carter's Mill Creek	0.65%	0.00%			0.12%		7.04%	20.66%	38.38%	9.05%	3.75%	13.45%		6.88%	0.02%
Crooked Creek	0.80%				0.11%		2.50%	13.03%	18.70%	8.05%	41.12%	15.40%		0.23%	0.05%
Limestone Creek	2.07%	3.57%	0.96%	6.67%	0.61%	10.49%	6.92%	21.96%	23.25%	7.63%	1.68%	9.62%	1.57%	2.90%	0.10%
Little Commissioner Ck	0.59%	1.18%	0.28%	0.66%	0.17%	2.01%	9.33%	40.46%	23.28%	12.15%	1.40%	7.56%	0.15%	0.75%	0.02%
Little Fishing Creek				0.01%	0.06%		2.43%	36.17%	45.93%	8.98%	2.18%	4.17%	0.00%	0.06%	
Porter Creek	0.36%	0.05%		0.01%	0.12%	1.86%	2.06%	47.95%	23.90%	19.72%	0.16%	3.30%	0.01%	0.45%	0.03%
Rooty Ck D/S WPCP	1.00%	5.24%	0.28%	1.16%	0.09%	1.33%	2.52%	12.47%	24.22%	8.37%	31.80%	10.30%	0.90%	0.27%	0.05%
Sandy Creek	0.20%	0.78%		0.16%	0.22%		14.84%	49.10%	24.21%	8.88%	0.95%	0.12%		0.54%	
Sandy Hill Creek	0.20%	0.04%			0.06%		5.80%	25.35%	23.84%	7.03%	13.39%	13.78%		10.52%	0.01%
Sandy Run Creek							7.97%	47.23%	38.51%	6.14%				0.14%	
Tobler Creek	0.17%				0.03%		2.14%	27.24%	57.17%	9.61%	1.59%	1.90%		0.15%	
Zoie Brown Creek	0.19%					0.04%	2.48%	45.55%	36.62%	9.82%	1.47%	3.63%		0.21%	0.01%

Table 5. Soil Type Distribution

NAME	Drainage Area upstream from the monitoring point	Soil Types (acres)											
		GA056	GA051	GA046	GA041	GA040	GA039	GA038	GA032	GA031	GA030	GA026	GA025
K-Factor	(sq mile)	0.15	0.12	0.16	0.17	0.14	0.13	0.15	0.43	0.24	0.27	0.25	0.27
Apalachee River	251.94											66785	94448
Beaverdam Creek Trib	1.00								142.33			366.9	134.5
Black Springs Branch	3.58				333.8					177.7		1322.1	459.9
Cedar Creek	1.48										64.937	575.5	308.7
Copeland Creek	4.69								242.4		292.44	1614.3	853.1
Crooked Creek	6.21					1835.8	2138.3						
Log Dam Creek	4.19				752.3	1317.4		295.6				314.0	1.1
Milsap Creek	6.42				242.0						384.73	515.7	2964.2
Murder Creek	130.50											43189	40330
Rooty Creek U/S WPCP	7.84										66.494	521.9	4429.1
Alligator Creek	9.43	3499.3		1787.5			749.45						
Black Creek	0.96				87.0	187.5	337.8						
Carr Creek	1.52											156.0	567.0
Carter's Mill Creek	8.66	2015.7		3528.2									
Crooked Creek	3.89					1835.8	2138.3				132.54	603.6	1755.3
Limestone Creek	7.49	989.4		3800.1									
Little Commissioner Creek	44.55		2219.4		2484.5	10730	10162	2911.9					
Little Fishing Creek	7.82				821.3					768.79	307.34	2546.1	559.5
Porter Creek	30.34	7734.4	1192.9	2658.2	4792.2		700.3	2340					
Rooty Creek D/S WPCP	8.77										477.91	584.4	4550.7
Sandy Creek	5.19				453.5	1786.7	1083.5						
Sandy Hill Creek	7.17	1568.1	38.0	2542.8				438.6					
Sandy Run Creek	5.15				415.2					1650.8	411.42		796.8
Tobler Creek	3.12										172.57	1284.3	543.3
Zoie Brown Creek	6.15								753.2		5.3373	1166.9	2011

2.0 WATER QUALITY ASSESSMENT

2.1 Fish Sampling

In 1990, the Department of Natural Resources (DNR) Wildlife Resources Division (WRD) conducted studies of fish communities in the Piedmont ecoregion. Biological monitoring is a method used to evaluate the health of a biological system in order to assess degradation from various sources. It is based on direct observations of aquatic communities. The results of these studies were the basis for the original listing of Biota Impacted stream segments on Georgia's 1996 303(d) list. In 1998 and 1999, WRD re-evaluated the stream segments in the Piedmont ecoregion. Eight of the segments (Alligator Creek, Black Creek, Carter Mill Creek, Limestone Creek, Little Commissioner Creek, Porter Creek, Sandy Creek and Sandy Hill Creek) are in the Southeastern Plains ecoregion. Biological monitoring protocols have not been developed for this area, so these segments have not been scored. Carr Creek was placed on the 303(d) list based on EPD investigations.

The work performed by the WRD looked at patterns of fish communities within the various ecoregions. An ecoregion is a region of relative homogeneity in ecological systems or in relationships between organisms and their environment. Seven major ecoregions have been identified in Georgia based upon the soil types, potential natural vegetation, land surface form, and predominant land uses. These include the Blue Ridge Mountains, Ridge and Valley, Southwestern Appalachians, Piedmont, Middle Atlantic Coastal Plain, Southeastern Plains, and Southern Coastal Plain.

Reference sites within the Piedmont ecoregion were established. These sites represented the least impacted sites that exist given the prevalent land use within the ecoregion. Fifteen sites were sampled within the Oconee River Basin (see Tables 6, 7, and 8). These sites had to be accessible, wadeable, and representative of the stream under investigation. The length of the fish sampling site was thirty-five times the mean stream width up to 500 meters. This sampling length was found to be long enough to include the major habitat types present. Electrofishing and seining techniques were used for sampling the fish population (GAWRD, 2000).

Two indices of fish community health were used to assess the biotic integrity of the aquatic systems: the modified Index of Well-Being (IWB) and the Index of Biotic Integrity (IBI). The IWB and IBI scores were classified as Excellent, Good, Fair, Poor, or Very Poor. Segments with fish populations rated as Poor or Very Poor were listed as Biota Impacted.

The modified IWB measures the health of the aquatic community based on the density and diversity or structural attributes of the fish community. The IWB is calculated based on four parameters: the relative density of fish, the relative biomass of fish, the Shannon-Wiener Index of Diversity based on number, and the Shannon-Wiener Index of Diversity based on biomass.

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, which assess three facets of the fish population: species richness and composition, trophic composition and dynamics, and fish abundance and condition. Each metric is scored by comparing its value to the value 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 regional drainage basins, e.g. the Atlantic Slope Drainage Basin, which includes the Ocmulgee, Oconee, Ogeechee, and Savannah River 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 metric (GAWRD, 2000).

To supplement the findings of the fish community data, habitat assessments were performed at each sampling site. Habitat scores evaluate the physical surroundings of a stream as they affect and influence the quality of the water resource and its resident aquatic community. These data may also help clarify the results of the biotic indices. The habitat assessment used was developed by personnel with the Water Protection Branch (WPB) of the Georgia Environmental Protection Division and is a modification of the EPA Rapid Bioassessment Protocol III (GAWPB, 2000). It incorporates different assessment parameters for riffle/run prevalent streams. The 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 (in-stream cover, epifaunal substrate, embeddedness, and riffle frequency). Level two describes the channel morphology (channel alteration, sediment deposition and channel flow status). Level three describes the riparian zone surrounding the stream, which indirectly affects the type of habitat and food resources available in the stream (bank vegetation, bank stability, and riparian zone width). The total habitat scores obtained for each sampling station are compared to a site-specific control or regional reference site. The ratio between the station of interest and the reference site provides a percent comparability that can be used to classify the stream.

Table 6 summaries WRD's study scores. The IBI, IWB, and Habitat Assessment scores are listed and the watersheds are grouped by those that were not 303(d) listed and those that were. In addition, the table includes the drainage areas upstream of the monitoring points, the county in which the monitoring points are located, and the pollutant source (nonpoint source NPS, or point source PS) or stream type (reference REF). Table 7 provides the detailed habitat assessment scores.

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 riffles, 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 8 provides a summary of these field measurements.

2.2 Macroinvertebrate Sampling

In February 1999, the Department of Natural Resources (DNR) Environmental Protection Division (EPD) collected water quality samples at a number of locations monitored by WRD including all the 303(d) listed waters. Samples were analyzed to provide data to assess for the presence or absence of chemical pollution. The following analyses were conducted on each sample: dissolved oxygen (DO), temperature, conductivity, pH, turbidity, 5-day biochemical oxygen demand (BOD_5), nitrate-nitrite, ammonia, total phosphorus, total alkalinity, total suspended solids (TSS), total organic carbon (TOC), metals, semi-volatile organics, pesticides, and PCBs. The results are summarized in Table 9. The watersheds are grouped by those that were not 303(d) listed and those that were, including those located in the Southeastern Plains ecoregion.

EPD also conducted macroinvertebrate sampling at several of the locations to provide additional information and/or insights to water quality conditions. Macroinvertebrate sampling was conducted using a modified version of EPA's Rapid Bioassessment Protocol III. Macroinvertebrate data results were evaluated using seven metrics as a measure of diversity,

Table 6. 1998-1999 WRD's Fish Community Study Scores

Name	Drainage Area upstream from the monitoring point (sq mile)	County	Source/Type	IBI Score	IBI Category	IWB Score	IWB Category	Habitat Total
Apalachee River	251.94	Morgan/Oconee	REF	56	Excellent	10.5	Excellent	131
Beaverdam Creek Trib.	1.00	Hancock	NPS	40	Fair	6.1	Fair	97.1
Black Springs Branch	3.58	Baldwin	NPS	40	Fair	6.7	Fair	92.7
Cedar Creek	1.48	Jasper	NPS	34	Fair	6.2	Fair	81.1
Copeland Creek	4.69	Hancock	REF	42	Fair	7.6	Good	128
Copeland Creek	6.21	Hancock	REF	54	Excellent	8.5	Excellent	116.9
Log Dam Creek	4.19	Hancock	NPS	38	Fair	6	Fair	108.7
Milsap Creek	6.42	Jones	NPS	48	Good	8	Good	75
Murder Creek	130.50	Jasper	REF	48	Good	8	Fair	56.1
Rooty Creek U/S WPCP	7.84	Putnam	PS	34	Fair	7.5	Good	52
Crooked Creek	3.89	Putnam	NPS	16	Very Poor			68.4
Little Fishing Creek	7.82	Baldwin	NPS	22	Very Poor	4.9	Poor	60.4
Rooty Creek D/S WPCP	8.77	Putnam	PS	30	Poor	5.8	Fair	54.9
Sandy Run Creek	5.15	Hancock	NPS	26	Poor	5.5	Poor	113.5
Tobler Creek	3.12	Baldwin	NPS	32	Poor	6.4	Fair	61.4
Zoie Brown Creek	6.15	Hancock	NPS	22	Very Poor	5.8	Fair	75.9

Table 7. 1998-1999 WRD's Habitat Assessment Scores

Name	Instream Cover	Epifaunal Substrate	Embeddedness	Channel Alteration	Sediment Depostion	Riffle Frequency	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Total
Apalachee River	15.9	8.6	13	17.8	9.2	19.5	7.5	5	6.5	6.3	7.5	6	8.2	131
Beaverdam Creek Trib.	4.7	6.3	9.4	16.7	7.3	8	8.1	4.5	4.1	5.9	5.5	8.3	8.3	97.1
Black Springs Branch	9.5	9.5	4.7	14.2	3.9	10.3	8.8	3.9	4.4	3.3	3.6	8.3	8.3	92.7
Cedar Creek	5	9.6	2.5	15.9	3	6.5	8.5	3.6	3.6	3.6	3.7	7.3	8.3	81.1
Copeland Creek	10.3	15	16.7	10.7	12	15	12.7	6.3	5.7	5.3	5	9	4.3	128
Copeland Creek	9.2	9	11.8	16.3	10.2	18.6	11.3	3.9	3.3	4.8	3.9	8.9	5.7	116.9
Log Dam Creek	10.3	10.7	8.7	14	9.2	18	8.7	5.4	6	5.2	4.6	5.6	2.3	108.7
Milsap Creek	11	5.3	5	6	6	4.7	9.3	3.3	2.7	2	1.7	9	9	75
Murder Creek	6.7	2	1.2	15.3	4.7	0	6.1	2.6	2	1.9	1.5	8.7	3.4	56.1
Rooty Creek U/S WPCP	5.3	6	2.7	4.7	4.3	2.7	8.3	4.3	5	2.7	2.7	1.3	2	52
Crooked Creek	4	0.8	0.7	14.2	1.3	0	11.5	5.9	5.6	5.3	5.2	4.9	9	68.4
Little Fishing Creek	2.8	7.3	3.2	3.7	3.2	11.5	7.1	5.6	5.8	4.6	4.3	0.7	0.6	60.4
Rooty Creek D/S WPCP	5	8.3	4.3	3.7	2.3	6	7.7	4.3	5	3	3.3	1	1	54.9
Sandy Run Creek	6.2	10.5	10.6	16	9.4	18	9.6	3.8	3.8	4	4.2	8.7	8.7	113.5
Tobler Creek	6.8	0.8	2.8	13.7	3.2	0	9.2	3	4.2	3.2	3.9	8.3	2.3	61.4
Zoie Brown Creek	8.7	0.4	2.1	14.7	5.5	0	13.1	5	5.2	4.2	4.5	6.4	6.1	75.9

Table 8. 1998-1999 WRD's Field Measurements

Name	Number of Pools	Deepest Pool (m)	Number of Riffles	Average Stream Depth (m)	Average Stream Width (m)	Dissolved Oxygen (mg/L)	Water Temperature (deg C)	pH	Conductivity (uS)	Turbidity (NTU)	Total Hardness (mg/L)	Alkalinity (mg/L)
Apalachee River	5	1.5	3	0.43	24.5	7.72	18.1	7.3	78.5	7.9	16	30
Beaverdam Creek Trib.	0	0	1	0.09	1.8	10.78	9.9	7.18	48.7	5.08	24	30
Black Springs Branch	0	0	4	0.11	3.8	9.2	15	7.26	45.5	4.78	13	25
Cedar Creek	2	0.78	2	0.13	2.8	8.3	16.2	7.33	147.7	30	57	162
Copeland Creek	6	0.71	6	0.13	3.9	8.33	20.3	7.55	95.1	5.69	-	-
Copeland Creek	2	0.72	8	0.17	5	8.01	20.2	6.39	78.4	14.5	31	40
Log Dam Creek	1	0.6	4	0.14	3.9	10.17	14.5	6.98	37.8	11.8	13	25
Milsap Creek	10	0.92	1	0.2	38	8.55	18.2	7.17	146	7.13	-	-
Murder Creek	9	1.11	0	0.24	8.5	7.43	19.2	7.28	81	6.8	31	40
Rooty Creek U/S WPCP	2	0.4	3	9.7	2.9	6.79	22.9	7.17	162.4	7.06	-	-
Crooked Creek	0	0	1	0.1	4	6.24	14.1	7.2	123.5	12.4	45	117
Little Fishing Creek	0	0	2	5.4	4.9	8.98	12.8	7.05	73.9	3.86	30	45
Rooty Creek D/S WPCP	2	0.35	2	6.5	4.5	7.25	23.8	7.13	284.7	7.88	-	-
Sandy Run Creek	2	0.58	5	0.1	3.2	8.76	18.3	7.25	112.8	5.21	55	65
Tobler Creek	1	0.7	0	0.1	2.7	8.45	14.8	7.03	75.8	8.97	35	45
Zoie Brown Creek	1	0.98	0	0.4	4.2	7.41	13.5	6.95	73.8	23.3	35	55

Table 9. 1999 EPD's Field Measurements and Water Chemistry

Name	Depth (m)	Width (m)	DO (mg/L)	Water Temperature (deg C)	pH	Conductivity (umohs/cm)	Turbidity (NTU)	TSS (mg/L)	Chemical Violations
Beaverdam Creek Trib.	0.13	2.07	11.91	6.92	7.14	56	5	1	none
Black Springs Branch	0.25	5.19	11.4	7.69	7.2	48	5	1	none
Cedar Creek	0.27	2.49	8.46	15.2	6.92	51	36	5	none
Log Dam Creek	0.21	2.78	10.84	8.79	6.97	36	6	3	none
Milsap Creek	0.26	5.34	10.15	9.03	7.11	105	11	4	none
Rooty Creek U/S of Eatonton WPCP	0.13	3.61	6.76	22.9	7.17	162	no chemistry		
Crooked Creek	0.14	2.50	9.4	8.57	9.4	150	11	8	none
Little Fishing Creek	0.10	2.55	10.48	10.83	7.26	77	7	3	none
Rooty Creek D/S Eatonton WPCP	0.13	3.61	10.29	8.7	7.73	140	17	11	none
Sandy Run Creek	0.15	4.29	8.99	10.77	7.02	69	5	1	none
Tobler Creek	0.11	1.54	10.68	8.05	7	67	10	2	none
Zoie Brown Creek	0.50	4.13	10.18	7.57	6.97	65	10	5	none
Alligator Creek (ugly Creek Trib)	0.31	4.70	7.83	15.18	7.03	78	23	27	none
Black Creek	0.18	1.10	5.64	10.92	5.62	23	29	73	none
Carter Mill Creek	0.54	4.71	7.88	13.45	6.87	35	10	9	none
Crooked Creek	0.21	3.91	9.5	10.05	6.91	38	-	-	none
Limestone Creek d/s Thiele discharge	0.43	5.50	6.76	17	6.79	723	44	59	none
Limestone Creek u/s Thiele discharge	-	-	8.48	23.94	4.84	1682	no chemistry		
Little Commissioner Creek	3.00	7.50	7.23	15.83	6.49	235	21	37	none
Porter Creek	0.54	19.08	7.62	14.94	6.81	68	8	23	none
Sandy Creek	0.30	3.64	8.07	10.27	6.56	26	6	2	none
Sandy Hill Creek	0.44	5.05	8.22	14.27	6.8	60	15	14	none

community composition (e.g., prevalence of tolerant or intolerant organisms), and environmental stress from a variety of possible sources. These data and metric calculation results were compared to those from five reference streams located in the Piedmont ecoregion (GAWPB, 2000). In conjunction with macroinvertebrate sampling, habitat assessments were performed. The habitat assessments were conducted using the same procedures described in the previous section.

Since WRD and EPD were conducting field sampling simultaneously, not all WRD impaired sites were monitored by EPD. Table 10 summaries EPD's macroinvertebrate study scores and includes the IBI, IBW, Benthic and Habitat Assessment scores. The watersheds are grouped by those that were not 303(d) listed and those that were. Table 11 provides EPD's detailed habitat assessment scores. Habitat scores are subjective measurements that can vary between evaluators, as well as temporally and spatially. In general, each habitat assessment score is the average of three independent values that are determined on the same day. WRD performed their habitat assessments from April through September. EPD performed their assessment from mid-August through early October. The correlation between WRD and EPD habitat scores is 29.0 percent. It should be noted that in 1999, WRD modified how it scored channel alteration based on comparative field scoring methods conducted between WRD and EPD.

Field personnel also performed a pebble count at those sampling locations where macroinvertebrate samples were collected. Pebble counts were conducted to document streambed particle-size distribution. The modified Wolman Pebble Count procedure was used, where 100 random particle samples are measured. A zig-zag collection technique was used that allows a longitudinal stream reach, incorporating pools and riffles, to be collected along a continuum instead of individual cross-sections (GAWPB, 2000). The results of the Pebble Count are given in Table 12.

Visual observations of the stream and watershed were also made by EPD personnel. The type of land use and the extent of land-disturbing activities and other pertinent features of the watershed were systematically observed from all available road accesses and were recorded. This information was used to determine the possible sources of eroded soils and other possible contaminants.

Table 10. 1999 EPD's Macroinvertebrate Community Study Scores

Name	County	IBI Score	IBI Category	IWB Score	IWB Category	Benthic Score	Rank	Habitat Total
Rooty Creek U/S of Eatonton WPCP	Putnam	34	Fair	7.5	Good			135.5
Crooked Creek	Putnam	16	Very Poor			36	Poor	92.2
Little Fishing Creek	Baldwin	22	Very Poor	4.9	Poor	81	Good/Fair	66.8
Rooty Creek D/S Eatonton WPCP	Putnam	30	Poor	5.8	Fair			64.8
Tobler Creek	Baldwin	32	Poor	6.4	Fair	0	Very Poor	84.8

Table 11. 1999 EPD's Habitat Assessment Scores

Name	Instream Cover	Epifaunal Substrate	Embeddedness	Channel Alteration	Sediment Depostion	Riffle Frequency	Channel Flow Status	Bank Vegetation (Left)	Bank Vegetation (Right)	Bank Stability (Left)	Bank Stability (Right)	Riparian Zone (Left)	Riparian Zone (Right)	Habitat Assessment Score
Rooty Creek U/S of Eatonton WPCP	14.8	13.6	15.0	17.0	14.0	14.0	11.8	7.2	6.4	7.2	5.3	7.4	1.8	135.5
Crooked Creek	11.6	6.3	5.7	16.7	5.7	4.7	7.7	5.7	6.0	5.3	5.7	2.7	8.7	92.2
Little Fishing Creek	5.5	4.8	3.0	15.3	2.3	1.3	8.3	7.8	7.5	6.0	4.8	0.3	0.3	66.8
Rooty Creek D/S Eatonton WPCP	11.0	2.4	3.2	12.2	4.6	5.6	8.2	4.2	3.8	4.2	3.8	0.8	0.8	64.8
Tobler Creek	7.0	7.0	6.0	16.5	5.5	11.3	7.5	3.5	2.8	3.0	2.5	9.3	3.0	84.8

Table 12. Pebble Counts

Name	Silt/Clay/Sand <4 mm	Fine Gravel I 4-6 mm	Fine Gravel 6-8 mm	Medium Gravel 8-10 mm	Coarse to Very Coarse >10 mm	Small Cobble 64 - 127 mm	Large Cobble 128-255 mm	Small Boulder 256-511 mm	Medium Boulder 512-1023 mm	Large Boulder 1024-2047 mm	Very Large Boulder	Bedrock	Total
Rooty Creek U/S of Eatonton WPCP	33	4	3	4	22	7						27	100
Crooked Creek	75	2	3	13	7								100
Little Fishing Creek	56	16	9	8	11								100
Rooty Creek D/S Eatonton WPCP	rapid field survey conducted before pebble count was adopted in revised SOP												
Tobler Creek	63	1		1	14	1	1	4	2		13		100

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 (GAEPD, 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. The general sources of sediment are point and nonpoint sources. National Pollutant Discharge Elimination System (NPDES) permittees discharging treated wastewater are the primary point sources of sediment as total suspended solids (TSS) and/or turbidity.

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. Nonpoint sources of sediment included in the source assessment analysis are:

- Silviculture,
- Agriculture,
- Grazing areas,
- Mining sites,
- Roads, and
- Urban Development

For nonpoint sources involving silviculture, the Georgia Forestry Commission (GFC) was consulted for information and parameters regarding silviculture activities. The Natural Resources Conservation Service (NRCS) was consulted for information and parameters regarding agricultural activities.

3.1 Point Source Assessment

For purposes of this TMDL, facilities permitted under the National Pollutant Discharge Elimination System (NPDES) will be considered point sources. Discharges from municipal and industrial facilities may contribute sediment to receiving waters as TSS and/or turbidity. There are twenty-one permitted NPDES discharges identified in the Oconee River Basin watersheds upstream from the listed segments (see Table 13).

Table 13 provides the permitted flow, TSS concentrations, and/or turbidity levels for the NPDES permits located in the impaired Oconee River Basin watersheds. The calculated TSS load is also given. A relationship between TSS and turbidity was used, developed from the EPD field measurements, to calculate TSS loads for those facilities that only report turbidity data. The average levels discharged over the last nine years are given. These data were determined from analysis of the available Discharge Monitoring Reports (DMR).

Table 13 also includes the current permitted discharges from surface mine locations. These locations are constantly changing. These discharges consist of accumulated surface water, pit-pumpout water, groundwater, and stormwater runoff associated with mining activities authorized under approved Mined Land Use Plans. These discharges have no numeric limit but shall not violate the Water Quality Standards in the receiving streams and there shall not discharge floating solids or visible foam in other than trace amounts.

Table 13. NPDES Permit Limits For Facilities in the Impaired Watersheds of the Oconee River Basin

FACILITY	NPDES PERMIT NO	FACILITY TYPE	RECEIVING WATER	FLOW (MGD)		TURBIDITY (NTU)		TSS (mg/L)	
				Daily Average	Monthly Max	Daily/ Monthly Average	Monthly/ Weekly Max	Daily Average	Monthly Max
Martin Marietta Aggregates	GA0002330	Industrial	Slash Creek	NA				55	110
				1.12	78.00			27.44	78
Hanson Aggregates South East	GA0046132		Unnamed stream to North	NA				55	110
			Oconee River (Carr Creek)	0.24	0.5			21.57	90
Thiele Kaolin - outfall 001	GA0002453	Industrial	Limestone Creek	NA		50.0	100.0		
				4.95	54.45	24.3	80.6		
Thiele Kaolin - outfall 002			Limestone Creek	NA		50.0	100.0		
				5.80	28.12	16.9	97.8		
Lapp Insulator Division	GA0003123	Industrial	Limestone Creek no. 2	NA		50.0	100.0		
				0.03	0.00	30.4	99.0		
Englehard Corporation - outfall 004	GA0003131	Industrial	Little Commissioner Creek	NA		50.0	100.0		
				0.0010	0.01	9.1	28.0		
Englehard Corporation - outfall 005			Little Commissioner Creek	NA		50.0	100.0		
				0.2436	23.0	15.0	53.0		
Englehard Corporation - outfall 001	GA0003271	Industrial	Little Commissioner Creek	NA		50.0	100.0		
				9.41	64.00	20.8	78.0		
Englehard Corporation - outfall 002			Gordon Branch	NA		50.0	100.0		
			(Little Commissioner trib)	0.06	0.06	19.3	97.0		
Kentucky - Tennessee Clay Co	GA0003387	Industrial	Limestone Creek tributary	NA		50.0	100.0		
				0.10	0.30	27.8	600.0		
Imerys Pigment Inc.	GA0046329	Industrial	Unnamed tributary to	NA		50.0	100.0		
			Limestone Creek	0.56	0.70	19.23	42.00		
Eatonton East WPCP	GA0032271	Municipal	Rooty Creek tributary	0.28				30	45
				0.36	0.95			5.52	17
Gordon WPCP	GA0020397	Municipal	Little Commissioner Creek	0.75				30	45
				0.23	0.87			17.45	68

permit limits
actual data from monthly DMR

Table 13. NPDES Permit Limits For Facilities in the Impaired Watersheds of the Oconee River Basin

FACILITY	NPDES PERMIT NO	FACILITY TYPE	RECEIVING WATER	PERMIT REQUIREMENTS
Englehard Corporation - outfall no. M37 Englehard Corporation - outfall no. M1 Englehard Corporation - outfall no. M47 Englehard Corporation - outfall no. M48	GA0046621	Industrial – Mining Site	Little Commissioner Creek Porter Creek Porter Creek Porter Creek	Shall not violate the Water Quality in the receiving streams Shall not discharge floating solids or visible foam in other than trace amounts.
Dry Branch Kaolin Company (Imery's) - outfall no. M32 Dry Branch Kaolin Company (Imery's) - outfall no. M33	GA0030848	Industrial – Mining Site	Porter Creek Porter Creek	Shall not violate the Water Quality in the receiving streams Shall not discharge floating solids or visible foam in other than trace amounts.
Unimin Corporation – Outfall n0. 002 Sims Mine Unimin Corporation – Outfall n0. 003 Shepard Mine	GA0037251	Industrial – Mining Site	Porter Creek Porter Creek	Shall not violate the Water Quality in the receiving streams Shall not discharge floating solids or visible foam in other than trace amounts.

Thiele Kaolin Company also reports metals in its DMRs as a requirement of its NPDES permit. The DMR data indicate that discharges from Outfall 001 into Limestone Creek exceeded the permitted levels of copper and zinc. During most of 1993, three months in 1994, one month in 1995, and two months in 1999, the copper limit of 0.0122 mg/L was exceeded. The zinc limit of 0.114 mg/L was exceeded for four months in 1994, and two months in both 1995 and 1999. These metal exceedances may have affected the fish community in this listed stream segment.

The ammonia concentrations discharged from the two municipal facilities, Gordon and Eatonton, were also reviewed. Effluent ammonia concentrations were developed for these facilities according to the 1999 Ambient Water Quality Criteria for Ammonia (USEPA, 1999a). The ammonia limit in the Gordon WPCP NPDES permit was found to be protective of the stream. The Eatonton WPCP, which discharges into Rooty Creek, has an ammonia permit limit of 17.4 mg/L. The ammonia level calculated using the 1999 Ambient Water Quality Criteria for Ammonia was 3.61 mg/L. This facility exceeded the 1999 ammonia criteria several times between March 1994 and February 1995, but has not exceeded this level since 1994. The ammonia concentrations in this discharge may have affected the fish communities in the listed stream.

Soil erosion from construction sites is also a major source of sediment in Georgia's streams. Georgia requires construction sites over five acres to have a General Storm Water NPDES permit. Since construction sites are regulated by NPDES permits, they will be considered as point sources.

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 several 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 affect the ability of the stream to assimilate pollutants. It can change the diversity of fish populations and other biological communities. It can also cause increased flooding. In addition, harmful pollutants attached to the sediment can 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 (GAEPD, 1999).

The majority of soil erosion from forested land occurs during timber harvesting and the period immediately following, 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. Table 14 lists the percent timberland and percent harvested per year by county.

Table 14. Percent Timberland and Percent Harvested per Year by County

County	Total Area (1000 acres)	Timberland (1000 acres)	Percent Timberland	Growing Stock Volume (million ft^3) [a]	Annual Volume Removal (million ft^3)	Annual percent Removal
Baldwin	165.4	118.9	71.89%	147.7	9.2	6.23%
Barrow	103.8	45.3	43.64%	73.5	4.1	5.58%
Clarke	77.3	34.9	45.15%	76.5	0.9	1.18%
Greene	248.6	197.7	79.53%	297.1	26.2	8.82%
Gwinnett	277.0	104.4	37.69%	227.6	13.3	5.84%
Hancock	302.9	274.8	90.72%	340.6	24.7	7.25%
Jasper	237.1	190.7	80.43%	304.3	9.4	3.09%
Jones	252.0	210.7	83.61%	309.8	17.0	5.49%
Morgan	223.8	138.6	61.93%	184.4	14.8	8.03%
Newton	176.9	98.7	55.79%	240.5	7.7	3.20%
Oconee	118.9	62.0	52.14%	103.0	4.4	4.27%
Putnam	220.5	174.5	79.14%	240.3	10.5	4.37%
Twiggs	230.6	188.5	81.74%	214.8	20.3	9.45%
Walton	210.7	114.7	54.44%	250.4	2.7	1.08%
Washington	435.5	315.4	72.42%	415.8	19.6	4.71%
Wilkinson	285.8	254.4	89.01%	328.6	13.5	4.11%

[a] Estimate - does not include trees less than 5" DBH.
Source: Thomas, Michael T., 1997. Forest Statistics for Georgia

3.2.2 Agriculture

Agriculture can be a significant contributor of nonpoint pollutants to rivers and streams. Sediment and nutrients are the major pollutants of concern and cropland is one of the major sources of soil loss due to sheet and rill erosion. Over the last century there has been a dramatic decrease in the amount of land farmed in Georgia. In 1950, there were 208,000 farms encompassing 26 million acres in Georgia (U.S. Department of Agriculture, National Agricultural Statistics Service website). In 2000, there were approximately 11.1 million acres of farmland in Georgia, with the number of farms estimated to be 50,000 and the average farm size being approximately 222 acres. This represents a 57 percent reduction in farmland.

With the reduction in farmland, there has also been a decrease in the amount of soil erosion. 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 in 1997 (Source: 1997 NRI, USDA NRCS). This suggest that the source of sediment in many of the impaired streams in the Oconee 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 pasture land can leave areas of ground with little or no vegetative cover. During a rainfall runoff event, the 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 had 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 all 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 pass 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 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. Table 15 lists the active, inactive, and exploratory mines located in the watersheds monitored in the Oconee River Basin.

3.2.5 Roads

Erosion from unpaved roadways can be a significant source of sediment to our rivers and streams. It 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 and/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 road bed into the roadway drainage ditches. Some of these particles settle out satisfactorily, but usually they settle out poorly, causing diminished ditch carrying capacity resulting in roadway flooding and, subsequently, more roadway erosion (Choctawhatchee, et. al, 2000).

Table 15. Mines Located in the Oconee River Basin Watersheds

Name	Company	Type	County	Current Status	Material Mined
Branch Prospect		Unknown	Oconee	Exp Prospect	Mica
H B Marble Prospect		Unknown	Walton	Exp Prospect	Manganese
Thomas Prospect		Unknown	Oconee	Exp Prospect	Mica
Unnamed Prospect		Unknown	Walton	Raw Prospect	Mica
Kaolin Mines		Surface Mine	Wilkinson	Past Producer	Clay Kaolin (China Clay)
Kaolin Mines		Surface Mine	Wilkinson	Past Producer	Clay Kaolin (China Clay)
Anglo-American Mill	Anglo American Clays Corp.	Processing	Washington	Producer	Clay
Athens Quarry	Gainesville Stone Co. Inc.	Surface Mine	Clarke	Producer	Stone Granite Cb
Evans Clay Co Mine	Evans Clay Company	Surface Mine	Wilkinson	Producer	Clay
Ga Kaolin Mine 70		Surface Mine	Wilkinson	Producer	Clay Kaolin (China Clay)
Ga Kaolin Mine 71	Ga Kaolin Co.	Surface Mine	Twiggs	Producer	Clay Kaolin (China Clay)
Griffin Mill	Freeport Kaolin Company	Processing	Wilkinson	Producer	Clay Kaolin (China Clay)
Hardie Mine	Hardie Clay Co	Surface Mine	Wilkinson	Producer	Clay Fire Clay
Huber Wilkinson County Mine	J M Huber Corp	Surface Mine	Wilkinson	Producer	Clay Kaolin (China Clay)
Jefferson Mine	Nord Kaolin Co	Surface Mine	Twiggs	Producer	Clay Kaolin (China Clay)
Main Processing Plant	Thiele Kaolin Company	Processing	Washington	Producer	Clay
Sandersville Operations	Cyprus Industrial Minerals	Surface Mine	Washington	Producer	Clay
Wall Mine	Cyprus Industrial Minerals	Surface Mine	Wilkinson	Producer	Clay Kaolin (China Clay)
Watkins Mine	Anglo-American Clays Corp.	Surface Mine	Wilkinson	Producer	Clay Kaolin (China Clay)
Watkins Pit	Anglo-American Clays Corp.	Surface Mine	Wilkinson	Producer	Clay Kaolin (China Clay)
Weston & Brooker Ruby Quarry	Martin Marietta Aggregates	Surface Mine	Jones	Producer	Stone Granite Cb

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

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. From 1982 through 1989, the area classified as commercial forest within the Oconee River Basin decreased by approximately 1053 acres or 0.0045 percent (GAEPD, 1998). 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 streamflow 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 both 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 standard. 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 EPD from using a dynamic watershed runoff model, which requires a great deal of data for model development and calibration. Instead, EPD determined the annual sediment loads delivered to the 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 30 years ago. It is the most widely accepted and most 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 the 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 Best Management Practices (BMPs).

4.2 Universal Soil Loss Equation

For each of the watersheds monitored in the Oconee 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
LS = topographic factor
  L = slope length
  S = slope
C = cropping factor
P = conservation practice factor

4.2.1 Rainfall Erosivity Index

The R factor or rainfall erosivity index describes the kinetic energy generated by the frequency and intensity of the rainfall. It 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. It varies geographically and ranges from 250 to 300 within the Oconee 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. It is a function of the soil type, which is provided by the STATSGO data. Table 5 provides a breakdown of the soil type within each modeled watershed and the corresponding K factor. STATSGO soil data has a resolution of 1:250,000 and is available for all of Georgia. A higher-resolution (1:25,000) soil data, SSURGO, is available for fourteen Georgia counties. For consistency, it was decided that STATSGO data would be used for the first round or phase of sediment TMDLs because of its availability for all of Georgia. During the second phase of sediment TMDLS, if SSURGO data is available for all of Georgia, it may be used.

4.2.3 Topographic Factor

The LS factor or topographic factor represents the effect of slope length and slope steepness on erosion. Steeper slopes produce higher overland flow velocities. Longer slopes accumulate more runoff from larger areas and also result in higher overflow velocities. The slope length and slope is based on the grid size and ground slope provided by the USGS 30 by 30 meter Digital Elevation Model (DEM) grids downloaded from the State GIS clearinghouse.

4.2.4 Cropping factor

The C factor or cropping factor represents the effect plants, soil cover, soil biomass, and soil disturbing activities have on erosion. It is the most complicated of the USLE factors. It incorporates effects of tillage, crop type, cropping history, and crop yield. Cropping factors for forested, agricultural, and urban lands were provided by the Georgia Forestry Commission (GFC), Natural Resources Conservation Service (NRCS), and U.S. Environmental Protection Agency (EPA), respectively.

Forested land includes both mature trees and those being harvested. The forest C factor for each watershed was calculated based on the percent of forest harvested in each county (see Table 13). If a watershed is in multiple counties, the percent forest harvested is determined by area-weighting the forested area within each county.

C factors for cropland and pasture land for each county were developed by NRCS under the National Resource Inventory Program and are listed in Table 16. These values were developed based on the 1995 MRLC data. Low-level aerial photography was performed and the photographs are interpreted to identify land features. If data were not available for a given county, the C factor was calculated by averaging the C factors from all the surrounding counties. The crop and pasture land C factors for watersheds in multiple counties were determined by area-weighting the agricultural land use within each county.

Table 16. Cropland and Pasture C factors by County

County	C factor	
	Cropland	Pasture
Baldwin	0.116	0.007
Barrow	0.090	0.008
Clarke	0.182	0.005
Greene	0.241	0.005
Gwinnett	0.283	0.018
Hancock	0.090	0.008
Jasper	0.143	0.003
Jones	0.349	0.012
Morgan	0.502	0.004
Newton	0.286	0.005
Oconee	0.242	0.008
Putnam	0.240	0.012
Twiggs	0.421	0.003
Walton	0.192	0.003
Washington	0.315	0.004
Wilkinson	0.306	0.010

Source:, USDA-NCRS, 1997. National Resources Inventory; USDA-NCRS Athens, Georgia

C factors for the road networks were determined based on the road surface and are given in Table 17. Road information, including road surface, was provided by the Georgia Department of Transportation (DOT). Data gaps were filled based on adjacent road surfaces and road types (i.e., state, county, private).

Table 17. Road C factors

Road Surface	Type	C factor
Rigid and High Flexible Road	1	0.13
Bituminous Surfaced Road	2	0.25
Gravel or Stone Road	3	0.65
Soil-Surfaced Road	4	0.75
Primitive or Unimproved Road	5	0.75

C factors for other land uses including urban, mining, transitional, grass, and wetlands are listed in Table 18. These values were provided by the U.S. Environmental Protection Agency (EPA) and are used in all watersheds.

Table 18. Various Land Use C factors

Land Use	C factor
Water	0
Low Intensity Residential	0.02
High Intensity Residential	0.005
High Intensity Commercial, Industrial, Transportation	0.003
Bare rock, sand, clay	0
Quarries, strip mines, gravel pits	0.75
Transitional	0.002
Other Grasses	0.003
Woody Wetlands	0.011
Emergent Herbaceous Wetlands	0.003

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 Best Management Practices (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

EPA 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.

An extension of WCS is the Sediment Tool, which incorporates the USLE. The Sediment Tool can be used to perform the following tasks:

- Estimate the extent and distribution of potential soil erosion within a watershed.
- Estimate the potential sediment delivery to the receiving water body.
- Evaluate the effects of land use, BMPs, and road networks on erosion and sediment delivery.

The watersheds of interest were delineated based on the RF3 stream coverage and elevation data. If there was no RF3 segment within the delineated watershed, the WCS Sediment Tool could not be used (i.e. Whitten Creek trib and Lake Sinclair trib).

A stream grid for each delineated watershed was created based on elevation data. The stream grid corresponded to a stream network with twenty-five 30 by 30 meter headwater cells (5.5 acres). The stream grid network has flow and can accumulate flow.

For each 30 by 30 meter grid cell within the watershed, the WCS Sediment Tool calculates the potential erosion using the USLE based on the specific cell characteristics. The model then calculates the potential sediment delivery to the stream grid network. Sediment delivery can be calculated using one of the four available sediment delivery equations:

- Distance-based equation

  $Md = M * (1-0.97 * D/L)$

  where Md = mass moved (tons/acre/yr)
  M = sediment mass eroded (ton)
  D = least cost distance from a cell to the nearest stream grid (ft)
  L = maximum distance the sediment may travel (ft)

- Distance Slope-based equation

  $DR = \exp(-0.4233 * L * Sf) \quad Sf = \exp(-16.1 * r/L + 0.057)) - 0.6$

  where DR = sediment delivery ration
  L = distance to the stream (m)
  r = relief to the stream (m)

- Area-based equation

  $DR = 0.417762 * A^{(-0.134958)} - 1.27097, \quad DR <= 1.0$

  where DR = sediment delivery ratio
  A = area (sq miles)

- WEPP-based regression equation

  $Z = 0.9004 - 0.1341 * X^2 + X^3 - 0.0399 * Y + 0.0144 * Y^2 + 0.00308 * Y^3$

  where Z = percent of source sediment passing to the next grid cell
  X = cumulative distance downslope
  Y = percent slope in the grid cell

Based on work previously performed by EPA on the Chattooga River Watershed, it was determined that the distance slope-based equation provided the best prediction of the sediment delivery (USEPA, 2001b).

The WCS Sediment Tool estimates the total soil erosion and sediment delivered to the stream from each grid cell due to land use cover and from the grids representing roads.

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 waterbody without exceeding the applicable water quality standard; in this case the narrative water quality standard for aquatic life. TMDLs establish allowable pollutant loadings that are less than or equal to the TMDL, and thereby provide the basis to establish water quality based controls. For some pollutants, TMDLs are expressed on a mass loading basis.

This TMDL determines the range of sediment load that can enter the impaired Oconee River Basin watersheds without causing additional impairment to the stream. This is based on the hypothesis that if an impaired watershed has an annual average sediment loading rate similar to a biologically unimpaired watershed, then the receiving stream will remain stable and not be biologically impaired due to sediment. The average sediment load in the watersheds not on the 303(d) list is 0.62 tons/acre/yr, ranging from 0.03 to 1.56 tons/acre/yr.

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 standards 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 allocations are provided to the point sources. There are twenty-one permitted facilities in the Oconee River Basin watersheds. Eight of these facilities are surface mines, which are constantly changing locations for year to year. Discharges from these sites consist of accumulated surface water, pit-pumpout water, groundwater, and stormwater runoff associated with mining activities authorized under approved Mined Land Use Plans. These discharges are covered under NPDES permits, but have no numeric limits. However, these discharges shall not violate the Water Quality Standards in the receiving streams and shall not discharge floating solids or visible foam in other than trace amounts. The waste load allocation from these sites is included in the load allocation for the mining land use discussed in the following section. The daily maximum and annual allocated TSS loads for the other thirteen facilities are given in Table 19.

The WLA loads were calculated based on the design flow and average monthly permitted TSS concentration for the municipal facilities, or the average measured flow and average daily permitted TSS concentration or turbidity level for the industrial facilities. For those facilities that are only permitted for turbidity, the relationship between TSS and turbidity developed from EPD field measurements was used to calculate the TSS loads.

Table 19. Waste Load Allocations

FACILITY	NPDES PERMIT NO	RECEIVING WATER	COUNTY	TSS LOAD Daily Max (lbs/day)	TSS LOAD Annual (ton/yr)
Martin Marietta Aggregates	GA0002330	Slash Creek (Little Commissioner Ck trib)	Jones	1745	160
Hanson Aggregates South East	GA0046132	Unnamed stream to North Oconee (Carr Ck)	Clarke	110	20
Thiele Kaolin - outfall no. 001	GA0002453	Limestone Creek	Washington	3500	320
Thiele Kaolin – outfall no. 002	GA0002453	Limestone Creek	Washington	4100	375
Lapp Insulator Division	GA0003123	Limestone Creek no. 2	Washington	24	2.2
Englehard Corporation - outfall no. 001	GA0003271	Little Commissioner Creek	Wilkinson	7500	685
Englehard Corporation - outfall no. 002	GA0003271	Gordon Branch (Little Commissioner Ck trib)	Wilkinson	42.5	3.9
Englehard Corporation - outfall no. 004	GA0003131	Little Commissioner Creek	Wilkinson	1060	97
Englehard Corporation - outfall no. 005	GA0003131	Little Commissioner Creek	Wilkinson	3325	300
Kentucky - Tennessee Clay Co	GA0003387	Limestone Creek tributary	Washington	300	28
Imerys Pigment Inc.	GA0046329	Unnamed trib to Limestone Ck	Washington	200	36
Eatonton East WPCP	GA0032271	Rooty Creek tributary	Putnam	85	10
Gordon WPCP	GA0020397	Little Commissioner Creek	Wilkinson	230	28

Average annual load assumes discharge every day at average daily flow

The sediment load allocation from future construction sites within the watershed will have to meet the requirements outlined in the Georgia General Storm Water NPDES Permit for Construction Activities. This permit 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 I through VII of the Georgia Storm Water Permit. The conditions of the permit were established to assure that the storm water runoff from these sites does not cause or contribute sediment to the stream. Georgia's General Storm Water Permit 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.

5.2 Load Allocations

The USLE was used to determine the relative sediment contributions from each significant land use. The USLE was applied to those watersheds that are biologically impaired and those that are not, to determine the current sediment loading rates to the streams. The sediment load allocation for each stream by land use, including roads, is reported in Table 20 . The watersheds are grouped by: those that are not on the 303(d) list and those that are on the 303(d) list. For comparison purposes, the total sediment load in tons per acre per year is also given. The average sediment load in the watersheds that are biota impacted is 0.77 tons/acre/yr, ranging from 0.03 to 4.84 tons/acre/yr. The average sediment load in the watersheds not on the 303(d) list is 0.62 tons/acre/yr, ranging from 0.03 to 1.56 tons/acre/yr. Table 21 gives each source's percent contribution to the total sediment load.

Understanding the potential sediment sources and the changes in land use that have occurred over the last century, provides insight into the streams current water quality issues. The average annual sediment load per unit area for the unimpaired and impaired watersheds are generally within the same range. Over the last century there has been a dramatic decrease in the amount of land farmed in Georgia. Since 1950, there has been a 57 percent reduction in

Table 20. Sediment Load Allocations

	Sediment Load (tons/yr)																	
Name	**Open Water**	**Low Intensity Residential**	**High Intensity Residential**	**High Intensity Commercial/ Industrial Transportation**	**Bare Rock Sand and Clay**	**Quarries Strip Mines Gravel Pits**	**Transitional**	**Deciduous Forest**	**Evergreen Forest**	**Mixed Forest**	**Pasture/Hay**	**Row Crops**	**Other Grasses (Urban Recreational)**	**Woody Wetland**	**Emergent Herbaceous Wetlands**	**Road**	**Total**	**load (tons/acre/yr)**
Apalachee River	0.0	521.7	14.3	56.7	0.0	6.6	121.7	400.1	181.6	159.3	8246.4	75958.8	47.8	1054.6	4.5	6960.8	93734.9	**0.59**
Beaverdam Creek Trib						8.0	1.5	2.7	1.9	0.5	0.0			0.1		2.6	17.3	**0.03**
Black Springs Branch	0.0	7.0		0.1	0.0		9.3	10.6	7.4	3.2	2.4	348.0	0.2	2.5		40.6	431.1	**0.20**
Cedar Creek	0.0	9.6		1.2	0.0	711.8	1.3	2.6	1.5	1.0	5.1	222.8	0.0	0.7		74.0	1031.8	**1.15**
Copeland Creek	0.0	1.1			0.0		2.5	6.2	6.8	2.0	33.1	292.2	0.4	0.4	0.0	62.6	407.2	**0.14**
Crooked Creek	0.0			0.0	0.0		5.2	5.1	3.2	1.5	57.1	4494.9		3.4	0.0	166.8	4737.2	**1.21**
Log Dam Creek	0.0				0.0		4.5	11.6	3.1	1.6	1.5	64.4		0.6		22.7	110.0	**0.04**
Milsap Creek	0.0	106.5	3.0	3.5	0.0		5.5	4.4	5.0	2.6	87.3	5871.0	0.8	7.5	0.0	174.9	6271.9	**1.56**
Murder Creek	0.0	425.8	5.4	11.5	0.0	1.3	112.5	237.3	146.8	88.5	1028.0	38810.0	17.4	254.5	3.0	4029.9	45171.9	**0.54**
Rooty Ck U/S WPCP	0.0	147.6	1.4	4.1	0.0	802.7	4.9	3.2	5.7	2.1	397.9	2163.3	2.1	4.0	0.2	128.7	3667.8	**0.75**
Alligator Creek	0.0	9.7	1.0	0.0	0.0	53.2	13.5	33.9	7.0	6.8	0.4	571.6		0.5		26.3	723.9	**0.12**
Black Creek	0.0	1.2		0.1	0.0		0.7	0.8	0.4	0.2	0.9	240.9	0.0	0.2		10.2	255.6	**0.43**
Carr Creek	0.0	64.3	2.0	5.8	0.0	3315.7	0.0	0.2	0.2	0.1	1.7	77.9	3.9	0.4		30.2	3502.4	**4.84**
Carter's Mill Creek	0.0	0.1			0.0		8.4	5.9	8.7	2.0	5.0	2020.6		113.7	0.0	158.0	2322.6	**0.43**
Crooked Creek	0.0				0.0		2.0	1.5	1.8	0.9	219.1	1628.5		1.3	0.1	38.2	1893.2	**0.79**
Limestone Creek	0.0	39.2	1.7	9.2	0.0	4154.6	7.7	5.9	4.5	1.6	3.3	1795.6	2.1	42.1	0.7	121.5	6189.8	**1.34**
Little Commissioner Ck	0.0	64.0	3.5	3.4	0.0	10763.4	113.9	61.7	25.9	13.9	49.0	8482.7	1.1	20.4	0.3	911.8	20514.9	**0.73**
Little Fishing Creek				0.0	0.0		6.4	20.9	18.9	4.0	74.1	1067.0	0.0	1.2		62.5	1255.0	**0.25**
Porter Creek	0.0	2.5		0.1	0.0	7024.1	19.7	66.6	27.7	24.3	1.9	5943.5	0.1	8.7	0.5	333.1	13452.7	**0.70**
Rooty Ck D/S WPCP	0.0	159.7	1.4	4.1	0.0	802.7	5.6	4.0	7.1	2.6	413.5	3180.4	2.9	4.3	0.2	135.1	4723.8	**0.87**
Sandy Creek	0.0	13.6		0.3	0.0		23.3	10.6	4.6	1.5	7.0	29.9		2.4		263.0	356.3	**0.11**
Sandy Hill Creek	0.0	1.3			0.0		11.1	6.5	5.7	1.8	19.6	3012.2		153.4	0.0	32.7	3244.4	**0.74**
Sandy Run Creek							14.3	10.9	9.9	1.4				0.7		72.8	110.0	**0.03**
Tobler Creek	0.0				0.0		2.9	4.9	9.9	1.6	13.5	119.7		1.0		38.7	192.1	**0.10**
Zoie Brown Creek	0.0					15.7	3.9	11.6	7.3	2.1	9.1	261.0		2.0	0.0	171.3	484.0	**0.13**

Table 21. Sediment Load Percentages

	Percent Total Sediment Load															
Name	Open Water	Low Intensity Residential	High Intensity Residential	High Intensity Commercial/ Industrial Transportation	Bare Rock Sand and Clay	Quarries Strip Mines Gravel Pits	Transitional	Deciduous Forest	Evergreen Forest	Mixed Forest	Pasture/Hay	Row Crops	Other Grasses (Urban Recreational)	Woody Wetland	Emergent Herbaceous Wetlands	Road
Apalachee River	0.00%	0.56%	0.02%	0.06%	0.00%	0.01%	0.13%	0.43%	0.19%	0.17%	8.80%	81.04%	0.05%	1.13%	0.00%	7.43%
Beaverdam Creek Trib						46.20%	8.83%	15.59%	10.76%	2.87%	0.23%			0.52%		15.00%
Black Springs Branch	0.00%	1.62%		0.02%	0.00%		2.15%	2.46%	1.72%	0.73%	0.56%	80.71%	0.04%	0.57%		9.41%
Cedar Creek	0.00%	0.93%		0.11%	0.00%	68.99%	0.13%	0.25%	0.14%	0.10%	0.50%	21.59%	0.00%	0.07%		7.17%
Copeland Creek	0.00%	0.27%			0.00%		0.61%	1.52%	1.67%	0.48%	8.12%	71.75%	0.10%	0.09%	0.00%	15.38%
Crooked Creek	0.00%			0.00%	0.00%		0.11%	0.11%	0.07%	0.03%	1.21%	94.88%		0.07%	0.00%	3.52%
Log Dam Creek	0.00%				0.00%		4.05%	10.51%	2.85%	1.48%	1.38%	58.57%		0.53%		20.64%
Milsap Creek	0.00%	1.70%	0.05%	0.06%	0.00%		0.09%	0.07%	0.08%	0.04%	1.39%	93.61%	0.01%	0.12%	0.00%	2.79%
Murder Creek	0.00%	0.94%	0.01%	0.03%	0.00%	0.00%	0.25%	0.53%	0.32%	0.20%	2.28%	85.92%	0.04%	0.56%	0.01%	8.92%
Rooty Ck U/S WPCP	0.00%	4.02%	0.04%	0.11%	0.00%	21.89%	0.13%	0.09%	0.15%	0.06%	10.85%	58.98%	0.06%	0.11%	0.01%	3.51%
Alligator Creek	0.00%	1.35%	0.13%	0.00%	0.00%	7.34%	1.87%	4.68%	0.97%	0.94%	0.05%	78.97%		0.07%		3.63%
Black Creek	0.00%	0.48%		0.02%	0.00%		0.29%	0.31%	0.17%	0.07%	0.34%	94.24%	0.01%	0.09%		3.99%
Carr Creek	0.00%	1.83%	0.06%	0.17%	0.00%	94.67%	0.00%	0.01%	0.00%	0.00%	0.05%	2.22%	0.11%	0.01%		0.86%
Carter's Mill Creek	0.00%	0.01%			0.00%		0.36%	0.26%	0.37%	0.09%	0.22%	87.00%		4.90%	0.00%	6.80%
Crooked Creek	0.00%				0.00%		0.10%	0.08%	0.10%	0.05%	11.57%	86.02%		0.07%	0.00%	2.02%
Limestone Creek	0.00%	0.63%	0.03%	0.15%	0.00%	67.12%	0.12%	0.10%	0.07%	0.03%	0.05%	29.01%	0.03%	0.68%	0.01%	1.96%
Little Commissioner Ck	0.00%	0.31%	0.02%	0.02%	0.00%	52.47%	0.56%	0.30%	0.13%	0.07%	0.24%	41.35%	0.01%	0.10%	0.00%	4.44%
Little Fishing Creek				0.00%	0.00%		0.51%	1.66%	1.51%	0.32%	5.91%	85.02%	0.00%	0.10%		4.98%
Porter Creek	0.00%	0.02%		0.00%	0.00%	52.21%	0.15%	0.50%	0.21%	0.18%	0.01%	44.18%	0.00%	0.06%	0.00%	2.48%
Rooty Ck D/S WPCP	0.00%	3.38%	0.03%	0.09%	0.00%	16.99%	0.12%	0.08%	0.15%	0.05%	8.75%	67.33%	0.06%	0.09%	0.00%	2.86%
Sandy Creek	0.00%	3.82%		0.08%	0.00%		6.55%	2.97%	1.29%	0.42%	1.97%	8.40%		0.68%		73.81%
Sandy Hill Creek	0.00%	0.04%			0.00%		0.34%	0.20%	0.18%	0.05%	0.61%	92.84%		4.73%	0.00%	1.01%
Sandy Run Creek							13.01%	9.87%	9.03%	1.28%				0.63%		66.19%
Tobler Creek	0.00%				0.00%		1.49%	2.53%	5.17%	0.84%	7.00%	62.32%		0.52%		20.12%
Zoie Brown Creek	0.00%					3.25%	0.80%	2.40%	1.50%	0.43%	1.88%	53.92%		0.42%	0.00%	35.40%

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, streams will repair themselves over time.

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 is usually evened out by the response of the biological community to habitat alteration, which is a long-term process. Therefore, the average annual sediment load was determined.

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 and the use of the average sediment loading rates for the numeric targets.

5.5 Total Sediment Load

The total maximum daily load of sediment was determined by adding the WLA and the LA. The MOS, as described above, was implicitly included in the TMDL analysis and does not factor directly in the TMDL equation as shown above. The annual average sediment loads for each of the impaired watersheds are summarized in the Table 22 with any required sediment load reduction. A Summary Memorandum for each watershed is provided in Appendix A.

The USLE method used indicates that the largest sediment loads come from areas with close proximity to the stream grid, especial dirt roads and croplands. The model does not account for any BMPs that are currently being used to control erosion from these areas., and thus may over estimate some sediment loads.

The sediment load calculated for Carr Creek (4.84 ton tons/acre/yr) is high. This is due to the high C factor used for quarries, strip mines and gravel pits, and thus the large contribution of sediment (94.67 percent) from this land use. The Athens Quarry, owned by Hanson Aggregates, mines stone granite within this watershed. The sediment load from stone and gravel mines is typically low. It is believed the C factor used in the USLE for stone quarries was too high and thus, the sediment load was over estimated.

Table 22. Total Annual Sediment Loads and the Required Sediment Reduction

Name	Current Load (tons/yr)	WLA (tons/yr)	LA (tons/yr)	Total Load (tons/yr)	% Reduction
Alligator Creek	724	0	724	724	0.0%
Black Creek	256	0	256	256	0.0%
Carr Creek	3,522	20	428	448	87.3%
Carter's Mill Creek	2,323	0	2323	2,323	0.0%
Crooked Creek	1,893	0	1494	1,494	21.1%
Limestone Creek	6,951	761	2,109	2,870	58.7%
Little Commissioner Creek	21,789	1,274	16266	17,540	19.5%
Little Fishing Creek	1,255	0	1,255	1,255	0.0%
Porter Creek	13,453	0	11,942	11,942	11.2%
Rooty Creek	4,734	10	3,371	3,381	28.6%
Sandy Creek	356	0	356	356	0.0%
Sandy Hill Creek	3,244	0	2,736	2,736	15.7%
Sandy Run Creek	110	0	110	110	0.0%
Tobler Creek	192	0	192	192	0.0%
Zoie Brown Creek	484	0	484	484	0.0%

6.0 RECOMMENDATIONS

6.1 Monitoring

Monitoring is conducted at a number of locations across the State each year. GAEPD has 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. The Oconee River Basin along with the Ocmulgee and Altamaha River Basins were the basins of focused monitoring in 1999 and will again receive focused monitoring in 2004. One goal of the focused basin monitoring is to continue to monitor 303(d) listed waters. Therefore, additional monitoring of these streams will be initiated as appropriate during the next monitoring cycle to determine if there has been improvement in the biological communities.

6.2 Sediment Management Practices

Based on the findings of the source assessment, it was determined that most of the sediment found in the Oconee 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 impaired 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, changes in habitat and aquatic communities are usually slow to respond, which is why monitoring will continue according to the five-year monitoring cycle. Thus, this TMDL recommends that the compliance with NPDES permits and implementation of Best Management Practices (BMPs) be monitored. The anticipated effects of compliance with NPDES and implementation of BMPs will contribute to the improvement of stream habitats and water quality, and thus be an indirect measurement of the TMDL.

Management practices recommended to maintain the average annual sediment loads at current levels include:

- Compliance with NPDES permit limits and requirements
- Implementation of GFC Best Management Practices for forestry
- Adoption of NRCS Conservation Practices
- Adherence to the Mined Land Use Plan prepared as part of the Surface Mining Permit Application
- Adoption of proper unpaved road maintenance practices
- Implementation of Erosion and Sedimentation Control Plans for land disturbing activities
- Mitigation and prevention of stream bank erosion due to increased streamflow and velocities caused by urban runoff

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 municipal, industrial and storm water permits, monitoring and compliance with limitations, and appropriate enforcement actions for violations.

In accordance with GAEPD 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 mass loading of sediment (TSS) above those in the current NPDES permits, in order to maintain the current sediment loads in the impaired streams. 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 either sedimentation ponds or detention basins prior to being discharged to the stream and are regulated by NPDES permits. For mining facilities located within the impaired watersheds, it is recommended that monitoring frequencies be increased in order to better characterize the total annual sediment loads coming from these facilities.

Georgia EPD has developed a General Storm Water NPDES Permit for Construction Activities. The current permit is required for all construction sites disturbing five or more acres. In 2003, this permit will cover all construction sites disturbing one or more acres. All sites required to have this 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 I through VII of the Georgia Storm Water Permit. 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.

It is recommended that construction sites within impaired watersheds located within 100 feet of the impaired stream, or its tributaries, use DIRT II techniques to model and manage storm water runoff from these sites. In addition, all construction sites will monitor their storm water runoff as required by the General Storm Water NPDES Permit for Construction Activities.

6.2.2 Nonpoint Source Land Use Approaches

The Georgia EPD is responsible for administering and enforcing laws to protect the waters of the State. EPD is the lead agency for implementing the State's Nonpoint Source Management Program. Regulatory responsibilities include establishing water quality standards 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 best management practices that address nonpoint source pollution. In addition, public education efforts are being targeted to individual stakeholders to provide information regarding the use of best management practices 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, 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 to assess the extent of water pollution caused by forestry practices, and develop recommendations to reduce or eliminate 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 incorporated the 1989 Wetland BMP manual developed by the Georgia Forestry Association. The current BMP manual, *Georgia's Best Management Practices for Forestry,* was developed and became effective January 1, 1999 (GAEPD, 1999).

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 coordinator and the twelve district coordinators conduct the educational programs across the state. The district coordinators 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.

To determine if educational efforts have been successful and if the BMPs are effective at minimizing erosion and sedimentation, the GFC conducted BMP compliance surveys in 1991 and 1992. In 1998, another BMP survey was conducted using a newly developed and more rigorous protocol recommended by a Southern Group of State Foresters (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 survey results show that of the number of acres evaluated, the number in BMP compliance for the most part was very good. In 1991, approximately 86 percent of the acres evaluated were in compliance. In 1992, the figure increased to 92 percent compliance and in 1998, compliance rose to 98 percent.

The GFC also investigates and mediates complaints or concerns involving forestry operations on behalf of the 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 can not get satisfactory compliance, the case is turned over to Georgia 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 farmers. 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, Georgia 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 Protection Water Quality in Georgia,* for the agricultural community (GSWCC, 1994).

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 and Job Sheets on their website (www.ga.nrcs.usda.gov/ga/gapas/FOTG/Section _4/). Some of these BMPs may be used for farming operations to reduce soil erosion. It is recommended that the agricultural communities with crop land close to impaired streams, and pasture land 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 the 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 included 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 Georgia Environmental Protection Division 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 by the USDA Natural Resources Conservation Service 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 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 in 1997 (USDA NRCS, 1998).

NRCS also provides a web-based database application (Performance and Results Measurement System, PRMS) 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://sugarberry.itc.nrcs.usda.gov/Netdynamics/deeds/index.html.

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 GAEPD supports the PRMS website.

6.2.2.3 Mine Sites

Surface mining and mineral processing present two threats to surface waters. The first threat is the wastewater from mining and mineral processing operations. These discharges are considered point sources, and therefore, are 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 Georgia EPD. These permits are administered by the Land Protection Branch. The surface mining permit application must include a Mined Land Use Plan, reclamation strategies, and surety bond requirements to guarantee proper management and reclamation of surface mined areas. The Mined 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 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 impaired 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 Georgia Mining Association 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 Best Management Practices 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. The following guidance for the maintenance and service of unpaved roadways, drainage ditches, and culverts can be used to minimize roadway erosion. One publication that may include some additional guidance is *Recommended Practices Manual, A Guideline for Maintenance and Service of Unpaved Roads* (Choctawhatchee, et. al, 2000).

Disturbances to unpaved roadway surfaces and ditches, and poor road surface drainage, results 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 streamflows 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 streamflows 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 effect 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 adapted erosion and sedimentation ordinances and have been given authority to issue and enforce permits for land-disturbing activities. Approximately 32 counties and 240 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 Georgia 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 Best Management Practices. The *Field Manual for Erosion and Sediment Control in Georgia* developed by the State Soil and Water Conservation Commission may be used as a guide to develop erosion and sedimentation control plans (GSWCC, 1997).

Local governments, with oversight by the Georgia EPD, and the Soil and Water Conservation Districts, are primarily responsible for implementing the Erosion and Sedimentation Act. Reports of suspected violations are made to the agency that issued the permit. In cases with local issuing authority, if the violation continues, the compliant is referred to the appropriate Soil and Water Conservation District. If the situation remains unresolved, the compliant is then referred to Georgia 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 revised January 2001 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 streamflow rates may increase significantly from pre-construction rates. These changes in the streamflow 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* (GAEPD, 1997).

6.3 Reasonable Assurance

Permitted discharges will be regulated through the NPDES permitting process described in this report. 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 this time the availability of the TMDL was public noticed, 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

EPD has coordinated with EPA to prepare this Initial TMDL Implementation Plan for this TMDL. EPD has also established a plan and schedule for development of a more comprehensive implementation plan after this TMDL is established. EPD and EPA have executed a Memorandum of Understanding that documents the schedule for developing the more comprehensive plans. This Initial TMDL Implementation Plan includes a list of best management practices and provides for an initial implementation demonstration project to address one of the major sources of pollutants identified in this TMDL while State and/or local agencies work with local stakeholders to develop a revised TMDL implementation plan. It also includes a process whereby EPD and/or Regional Development Centers (RDCs) or other EPD contractors (hereinafter, "EPD Contractors") will develop expanded plans (hereinafter, "Revised TMDL Implementation Plans").

This Initial TMDL Implementation Plan, written by EPD and for which EPD and/or the EPD Contractor are responsible, contains the following elements.

1. EPA has identified a number of management strategies for the control of nonpoint sources of pollutants, representing some best management practices. The "Management Measure Selector Table shown below identifies these management strategies by source category and pollutant. Nonpoint sources are the primary cause of excessive pollutant loading in most cases. Any wasteload allocations in this TMDL will be implemented in the form of water-quality based effluent limitations in NPDES permits issued under CWA Section 402. See 40 C.F.R. § 122.44(d)(1)(vii)(B). NPDES permit discharges are a secondary source of excessive pollutant loading, where they are a factor, in most cases.

2. EPD and the EPD Contractor will select and implement one or more best management practice (BMP) demonstration projects for each River Basin. The purpose of the demonstration projects will be to evaluate by River Basin and pollutant parameter the site-specific effectiveness of one or more of the BMPs chosen. EPD intends that the BMP demonstration project be completed before the Revised TMDL Implementation Plan is issued. The BMP demonstration project will address the major category of contribution of the pollutant(s) of concern for the respective River Basin as identified in the TMDLs of the watersheds in the River Basin. The demonstration project need not be of a large scale, and may consist of one or more measures from the Table or equivalent BMP measures proposed by the EPD Contractor and approved by EPD. Other such measures may include those found in EPA's "Best Management Practices Handbook", the "NRCS National Handbook of Conservation Practices, or any similar reference, or measures that the volunteers, etc., devise that EPD approves. If for any reason the EPD Contractor does not complete the BMP demonstration project, EPD will take responsibility for doing so.

3. As part of the Initial TMDL Implementation Plan the EPD brochure entitled "Watershed Wisdom -- Georgia's TMDL Program" will be distributed by EPD to the EPD Contractor for use with_appropriate stakeholders for this TMDL, and a copy of the video of that same title will be provided to the EPD Contractor for its use in making presentations to appropriate stakeholders, on TMDL Implementation plan development.

4. If for any reason an EPD Contractor does not complete one or more elements of a Revised TMDL Implementation Plan, EPD will be responsible for getting that (those) element(s) completed, either directly or through another contractor.

5. The deadline for development of a Revised TMDL Implementation Plan, is the end of August, 2003.

6. The EPD Contractor helping to develop the Revised TMDL Implementation Plan, in coordination with EPD, will work on the following tasks involved in converting the Initial TMDL Implementation Plan to a Revised TMDL Implementation Plan:
   A. Generally characterize the watershed;
   B. Identify stakeholders;
   C. Verify the present problem to the extent feasible and appropriate, (e.g., local monitoring);
   D. Identify probable sources of pollutant(s);
   E. For the purpose of assisting in the implementation of the load allocations of this TMDL, identify potential regulatory or voluntary actions to control pollutant(s) from the relevant nonpoint sources;
   F. Determine measurable milestones of progress;
   G. Develop monitoring plan, taking into account available resources, to measure effectiveness; and
   H. Complete and submit to EPD the Revised TMDL Implementation Plan.

7. The public will be provided an opportunity to participate in the development of the Revised TMDL Implementation Plan and to comment on it before it is finalized.

8. The Revised TMDL Implementation Plan will supersede this Initial TMDL Implementation Plan when the Revised TMDL Implementation Plan is approved by EPD.

Management Measure Selector Table

Land Use	Management Measures	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Agriculture	1. Sediment & Erosion Control	_	_		_	_				
	2. Confined Animal Facilities	_	_							
	3. Nutrient Management	_	_							
	4. Pesticide Management		_							
	5. Livestock Grazing	_	_		_	_				
	6. Irrigation		_		_	_				
Forestry	1. Preharvest Planning				_	_				
	2. Streamside Management Areas	_	_		_	_				
	3. Road Construction &Reconstruction		_		_	_				
	4. Road Management		_		_	_				
	5. Timber Harvesting		_		_	_				
	6. Site Preparation & Forest Regeneration		_		_	_				
	7. Fire Management	_	_	_	_	_				
	8. Revegetation of Disturbed Areas	_	_	_	_	_				
	9. Forest Chemical Management		_			_				
	10. Wetlands Forest Management	_	_	_		_		_		

Land Use	**Management Measures**	Fecal Coliform	Dissolved Oxygen	pH	Sediment	Temperature	*Toxicity*	*Mercury*	Metals (copper, lead, zinc, cadmium)	PCBs, toxaphene
Urban	1. New Development	–	–		–	–			–	
	2. Watershed Protection & Site Development	–	–		–	–		–	–	
	3. Construction Site Erosion and Sediment Control		–		–	–				
	4. Construction Site Chemical Control		–							
	5. Existing Developments	–	–		–	–			–	
	6. Residential and Commercial Pollution Prevention	–	–							
Onsite Wastewater	1. New Onsite Wastewater Disposal Systems	–	–							
	2. Operating Existing Onsite Wastewater Disposal Systems	–	–							
Roads, Highways and Bridges	1. Siting New Roads, Highways & Bridges	–	–		–	–			–	
	2. Construction Projects for Roads, Highways and Bridges		–		–	–				
	3. Construction Site Chemical Control for Roads, Highways and Bridges		–							
	4. Operation and Maintenance-Roads, Highways and Bridges	–	–			–			–	

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APPENDIX A

Annual Average Sediment Load Summary Memorandum

SUMMARY MEMORANDUM
Annual Average Sediment Load
Alligator Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Twiggs**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Alligator Creek**
Location:	**Tributary to Ugly Creek**
Stream Length:	**6 miles**
Watershed Area:	**9.43 square miles**
Tributary to:	**Big Sandy Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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) :	**724 tons/yr**
Land Use	**698 tons/yr**
Road	**26 tons yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**724 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Black Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Clarke

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070102

Waterbody Name: Black Creek
Location: Baldwin County
Stream Length: 2 miles
Watershed Area: 0.96 square miles
Tributary to: Oconee River

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:

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): 256 tons/yr
Land Use 246 tons/yr
Road 10 tons yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 256 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Carr Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Clarke

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070101

Waterbody Name: Carr Creek
Location: Headwaters to North Oconee River, Athens
Stream Length: 2 miles
Watershed Area: 1.52 square miles
Tributary to: North Oconee River

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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): 20 tons/yr
Hanson Aggregates 20 tons/yr
Future Construction Sites Meet requirements of General Storm Water Permit

Load Allocation (LA): 428 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 448 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Carter's Mill Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Washington**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Carter's Mill Creek**
Location:	**Washington County**
Stream Length:	**6 miles**
Watershed Area:	**8.66 square miles**
Tributary to:	**Keg Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):	**2,323 tons/yr**	
Land Use		**2,165 tons/yr**
Road		**158 tons/yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**2,323 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Crooked Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Putnam

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070101

Waterbody Name: Crooked Creek
Location: Putnam County
Stream Length: 9 miles
Watershed Area: 3.89 square miles
Tributary to: Lake Sinclair/Oconee River

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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): 1,494

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 1,494 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Limestone Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Washington**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Limestone Creek**
Location:	**Washington County**
Stream Length:	**8 miles**
Watershed Area:	**7.49 square miles**
Tributary to:	**Buffalo Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):	**761.2 tons/yr**
Thiele Kaolin Outfall 001	**320 tons/yr**
Thiele Kaolin Outfall 002	**375 tons/yr**
Imerys Pigment Inc.	**36 tons/yr**
Lapp Insulator Division	**2.2 tons/yr**
KY -TN Clay Co	**28 tons/yr**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**2,108.8 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**2,870 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Little Commissioner Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Jones/Wilkinson**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Little Commissioner Creek**
Location:	**GA Hwy 18 to Commissioner Creek**
Stream Length:	**9 miles**
Watershed Area:	**44.55 square miles**
Tributary to:	**Commissioner Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:

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):	**1,274 tons/yr**
Englehard Outfall 001	**685 tons/yr**
Englehard Outfall 002	**4 tons/yr**
Englehard Outfall 004	**97 tons/yr**
Englehard Outfall 005	**300 tons/yr**
Martin Marietta Aggregates	**160 tons/yr**
Gordon WPCP	**28 tons/yr**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**16,266 tons /yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**17,540 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Little Fishing Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Baldwin**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Little Fishing Creek**
Location:	**Baldwin County**
Stream Length:	**5 miles**
Watershed Area:	**7.82 square miles**
Tributary to:	**Fishing Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:

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):	**1,255 tons/yr**	
Land Use		**1,192 tons/yr**
Road		**63 tons/yr**

Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**1,255 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Porter Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Twiggs/Wilkinson**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070102**
Waterbody Name:	**Porter Creek**
Location:	**Wilkinson County**
Stream Length:	**12 miles**
Watershed Area:	**30.34 square miles**
Tributary to:	**Big Sandy Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:
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):	**11,942 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**11,942 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Rooty Creek

1. 303(d) Listed Waterbody Information

State:	**Georgia**
County:	**Putnam**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Rooty Creek**
Location:	**Rd S962, Eatonton to Little Creek**
Stream Length:	**9 miles**
Watershed Area:	**8.77 square miles**
Tributary to:	**Lake Sinclair/Oconee River**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (not supporting designated use)**

Applicable Water Quality Standard:
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):	**10 tons/yr**
Eatonton East WPCP	**10 tons/yr**
Future Construction Sites	**Meet requirements of General Storm Water Permit**
Load Allocation (LA):	**3,371 tons/yr**
Margin of Safety (MOS):	**implicit**
Annual Average Sediment Load:	**3,381 tons/yr**

SUMMARY MEMORANDUM
Annual Average Sediment Load
Sandy Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Jones

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070102

Waterbody Name: Sandy Creek
Location: Jones County
Stream Length: 6 miles
Watershed Area: 5.19 square miles
Tributary to: Lake Sinclair/Oconee River

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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): 356 tons/yr
- Land Use: 93 tons/yr
- Road: 263 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 356 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Sandy Hill Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Washington

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070102

Waterbody Name: Sandy Hill Creek
Location: Washington County
Stream Length: 9 miles
Watershed Area: 7.17 square miles
Tributary to: Buffalo Creek

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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): 2,736 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 2,736 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Sandy Run Creek

1. **303(d) Listed Waterbody Information**

State:	**Georgia**
County:	**Hancock**
Major River Basin:	**Oconee**
8-Digit Hydrologic Unit Code(s):	**03070101**
Waterbody Name:	**Sandy Run Creek**
Location:	**Hancock County**
Stream Length:	**5 miles**
Watershed Area:	**5.15 square miles**
Tributary to:	**Town Creek**
Constituent(s) of Concern:	**Sediment**
Designated Use:	**Fishing (partially supporting designated use)**

Applicable Water Quality Standard:

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):	**110 tons/yr**	
Land Use		**37 tons/yr**
Road		**73 tons/yr**
Margin of Safety (MOS):	**implicit**	
Annual Average Sediment Load:	**110 tons/yr**	

SUMMARY MEMORANDUM
Annual Average Sediment Load
Tobler Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Baldwin

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070102

Waterbody Name: Tobler Creek
Location: Baldwin County
Stream Length: 8 miles
Watershed Area: 3.12 square miles
Tributary to: Fishing Creek

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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): 192 tons/yr
Land Use 153 tons/yr
Road 39 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 192 tons/yr

SUMMARY MEMORANDUM
Annual Average Sediment Load
Zoie Brown Creek

1. 303(d) Listed Waterbody Information

State: Georgia
County: Hancock

Major River Basin: Oconee
8-Digit Hydrologic Unit Code(s): 03070102

Waterbody Name: Zoie Brown Creek
Location: Tributary to Buffalo Creek
Stream Length: 3 miles
Watershed Area: 6.15 square miles
Tributary to: Buffalo Creek

Constituent(s) of Concern: Sediment

Designated Use: Fishing (partially supporting designated use)

Applicable Water Quality Standard:
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): 484 tons/yr
Land Use — 313 tons/yr
Road — 171 tons/yr

Margin of Safety (MOS): implicit

Annual Average Sediment Load: 484 tons/yr