South Carolina
Department of Health and Environmental Control

Total Maximum Daily Load Development for
Big Wateree Creek: Station CW-072
Turbidity

February 17, 2004

Bureau of Water

D H E C

PROMOTE PROTECT PROSPER

South Carolina Department of Health
and Environmental Control

Abstract

Big Wateree Creek, in Fairfield County, SC, has been placed on South Carolina's 303(d) list of impaired waters for 2002. The creek at water quality monitoring station CW-072 (Big Wateree Creek at US-21 south of Great Falls) is impaired for violations of the turbidity standard. During the assessment period for the 2002 303(d) list (1996-2000), 29 % of samples violated the standard. The watershed of Big Wateree Creek is rural and mostly forested and agricultural. At the time the NLCD land use data was collected (early 1990's) the watershed was 77 % forest, 15 % transitional, 3.5 % pasture/hay, and 3.5 % cropland. There is one point source in the watershed, the White Oak Conference Center (SC0035980). The watershed had a population of 352 people in the 2000 census. The probable sources of turbidity in the creek are the re-suspension of sediment in the streambed and bank erosion. Cattle entering the stream seem to be a cause of the bank breakdown.

Because turbidity is not a concentration and therefore cannot be expressed as a load, total suspended solids (TSS) was used as a surrogate. The load-duration curve methodology was used to calculate the existing load and the TMDL load for Big Wateree Creek at CW-072. The existing load was estimated to be about 7300 kg-TSS /day. The TMDL load was determined to be 2156 kg-TSS /day, consisting of the Waste Load Allocation of 5.6 and the Load Allocation of 2150 kg-TSS /day. In order to reach the target load, a reduction in the existing load to the creek of 70 % will be necessary. Implementation of the Big Wateree fecal coliform bacteria TMDL should bring about the reductions necessary to improve water quality for turbidity also.

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Tables and Figures

Big Wateree Creek (HUC 03050104-020-010)

1.0 INTRODUCTION:

1.1 Background

Turbidity can be elevated in streams and other water bodies as the result of both point and nonpoint sources of pollution. Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop total maximum daily loads (TMDLs) for water bodies that are not meeting designated uses under technology-based pollution controls. The TMDL process establishes the allowable loadings of pollutants or other quantifiable parameters for a water body based on the relationship between pollution sources and in stream water quality conditions so that states can establish water quality-based controls to reduce pollution and restore and maintain the quality of water resources (USEPA 1991).

1.2 Watershed Description

The watershed of Big Wateree Creek (151 km^2; 58 mi^2) is in Fairfield County, in the lower Piedmont region of South Carolina (Figure 1). Big Wateree Creek joins with the Catawba River to form the Wateree River, at the upper end of Lake Wateree. The watershed is rural and has no cities or towns and had a population of approximately 350 in 2000. The watershed upstream of US-21, which is most of the 14-digit HUC, is included in this TMDL. References to the Big Wateree Creek watershed refer to this part of the drainage basin.

The predominant land uses (NLCD) in this watershed is forest, accounting for 77 % of the land use (Figure 2; Table 1). The next largest land use is classified as transitional (15%). Agricultural uses, cropland and pasture, account for the rest with each having about 3.5 % of the land. Developed land was under 1 %. This watershed is rather remote from population centers such as Columbia, and has a small growth potential.

An aerial infrared photograph taken in February 1999 of the watershed (Appendix D, Figure D-1) shows that the watershed was mostly forested. There are a number of pastures or other open land. Most of the riparian areas along the creek are wooded. However, in several places there are pastures along the creek.

1.3 Water Quality Standard

The impaired stream segment, Big Wateree Creek, is designated as Class Freshwater. Waters of this class are described as follows:

> "Freshwaters suitable for primary and secondary contact recreation and as a source for drinking water supply after conventional treatment in accordance with the requirements of the Department. Suitable for fishing and the survival and propagation of a balanced indigenous aquatic community of fauna and flora. Suitable also for industrial and agricultural uses." (R.61-68)

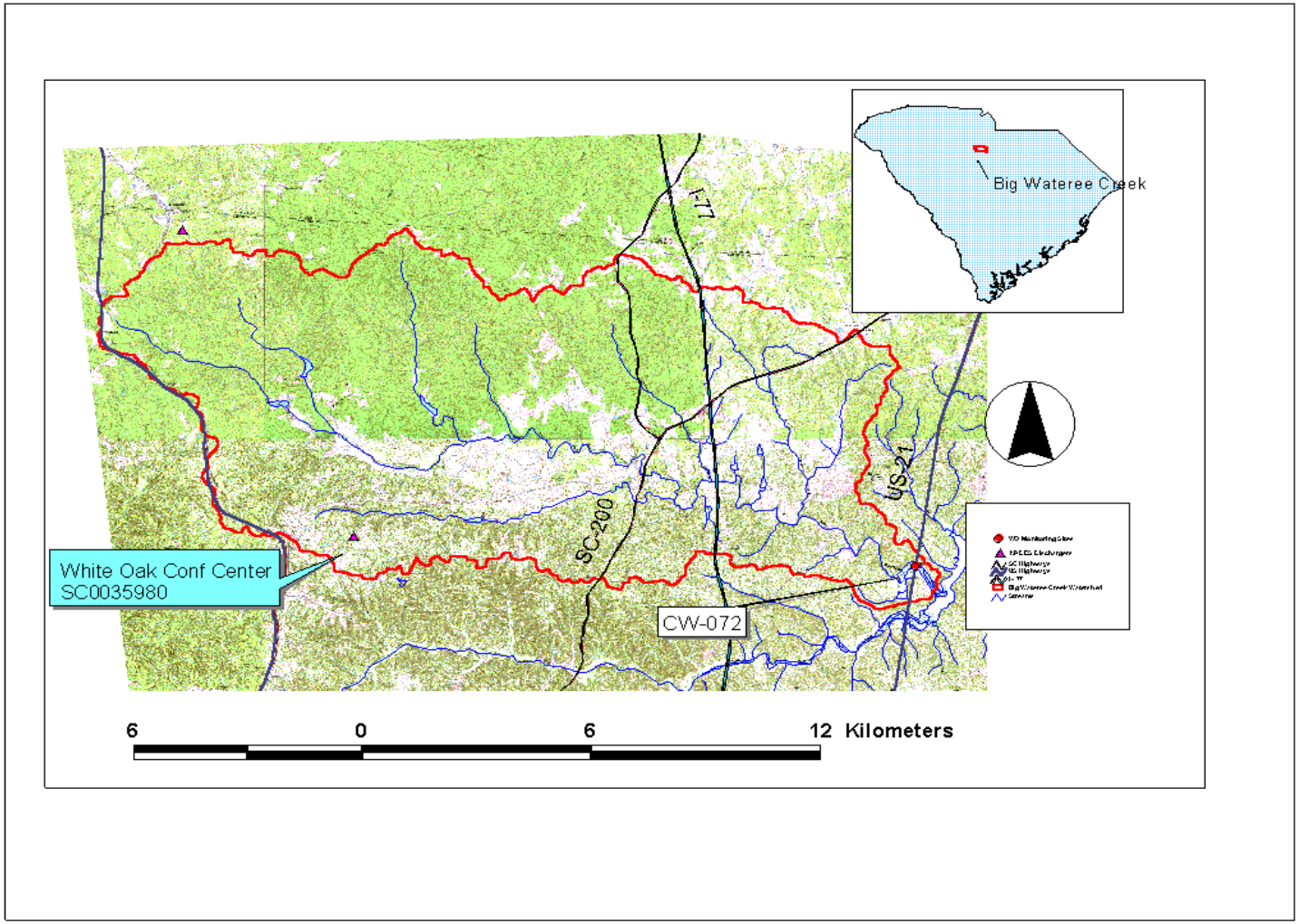

Figure 1. Map of the Big Wateree Creek watershed above CW-072.

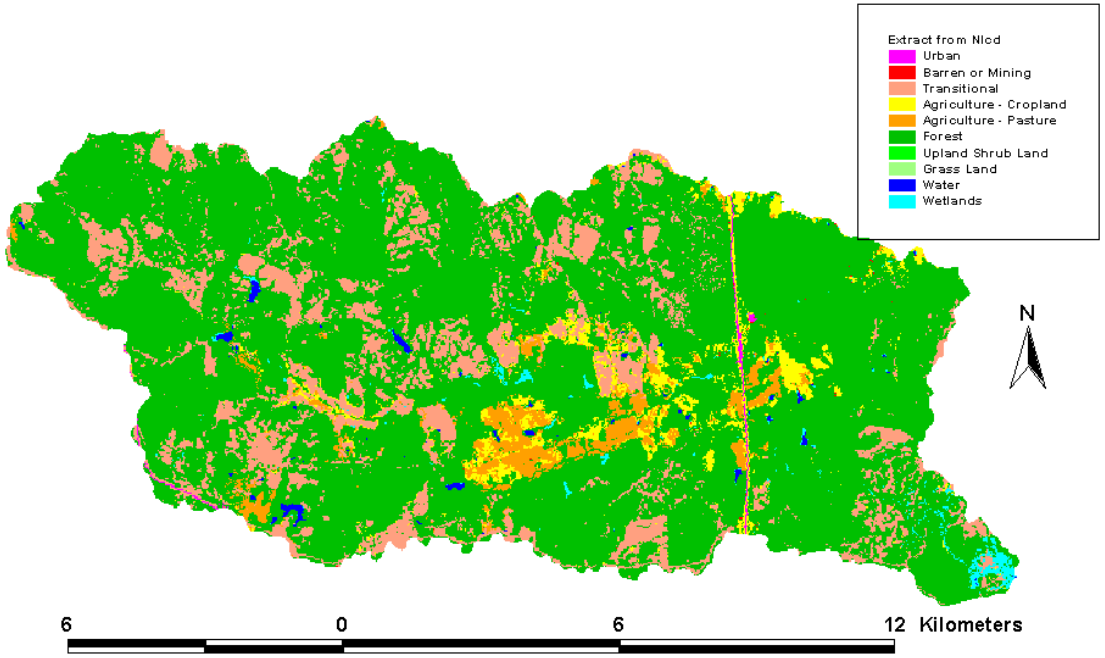

Figure 2. Map showing land uses in the Big Wateree Creek watershed.

Table 1. Land uses in the Big Wateree Creek watershed above CW-072.

Land Use Class	Land Use	Area (km^2)	Percent	Area (mi^2)
	Water	0.6	0.4%	0.2
	Residential Low Density	0.0	0.0%	0.0
	Commercial, Industrial, & Transportation	0.4	0.2%	0.1
Developed		0.4	0.2%	0.1
	Barren	0.1	0.0%	0.0
Transitional	**Transitional**	**22.6**	**14.9%**	**8.7**
	Forest Deciduous	34.6	22.9%	13.4
	Forest Evergreen	62.1	41.0%	24.0
	Forest Mixed	19.3	12.7%	7.4
Forest		**116.0**	**76.6%**	**44.8**
Pasture	Pasture	5.2	3.5%	2.0
Cropland	Cropland	5.4	3.6%	2.1
	Woody Wetlands	1.1	0.7%	0.4
	Emergent Herbaceous Wetlands	0.0	0.0%	0.0
Wetlands		1.2	0.8%	0.4
Total for Watershed		**151.5**	**100.0%**	**58.5**

South Carolina's standard for turbidity in Freshwater is:

> "Not to exceed 50 NTUs provided existing uses are maintained."(R.61-68).

2.0 WATER QUALITY ASSESSMENT

Big Wateree Creek has one water quality monitoring station. Station CW-072 is located at the US-21 bridge near the lower end of the watershed. An assessment of water quality data collected in

1996 through 2000 at station CW-072 indicated that Big Wateree Creek at this location is impaired for aquatic life uses. Waters in which no more than 25% of the samples collected over a five year period are greater than 50 NTUs are considered to comply with the South Carolina water quality standard for turbidity. Waters with more than 25 percent of samples greater than 50 NTUs are considered impaired and listed for turbidity on South Carolina's 303(d) list. During the assessment period (1996-2000), 29 % of the samples did not meet the turbidity criterion at CW-072. Stream turbidity data are provided in Appendix A.

Turbidity in Big Wateree Creek tends to increase with rainfall (Figure 3) as would be expected. Turbidity tends to increase exponentially with rainfall. A windshield survey of the creek bed at several bridges indicates that the creek has much sediment in its bed. Some portion of the turbidity during rainfall events is probably from entrainment of this sediment.

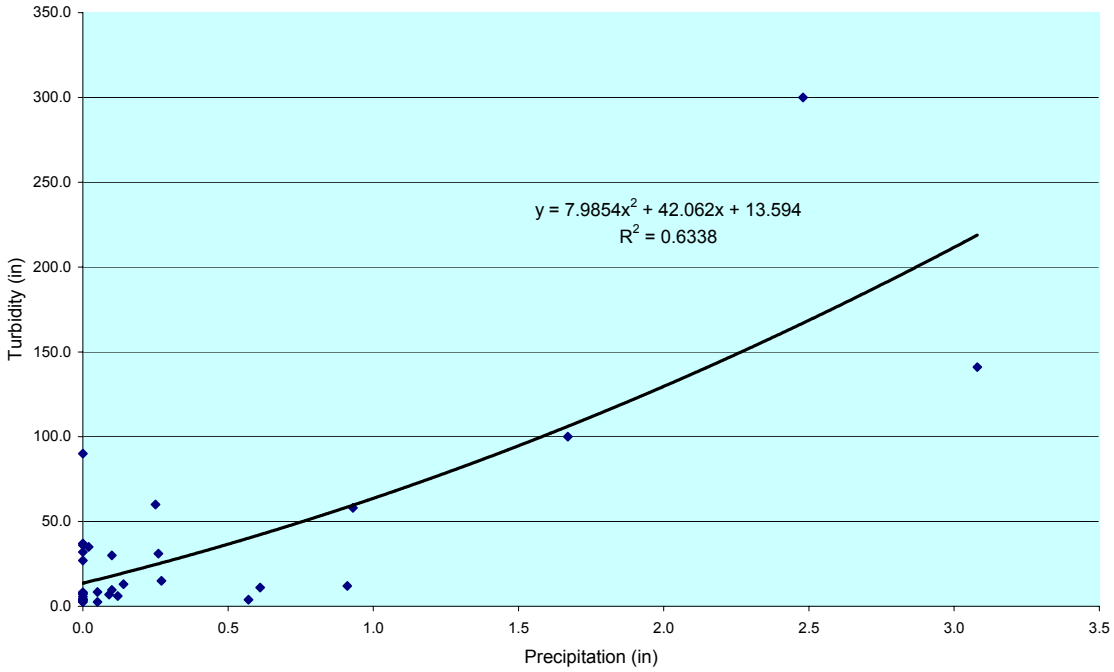

Figure 3. Comparison between precipitation and turbidity in Big Wateree Creek.

3.0 SOURCE ASSESSMENT

Turbidity is a measure of the suspended sediments, algae, and other constituents that are suspended in the water column. Turbidity is analyzed by measuring the amount of light scattered at a right angle by the sample. Turbidity is measured in NTUs. For the purposes of determining a load, total suspended solids (TSS) or fixed solids, suspended, will be used instead of turbidity. TSS

concentrations were calculated from turbidity using the relationship between turbidity and TSS determined for the Catawba River upstream of Fishing Creek Reservoir at SC-9 (CW-016).

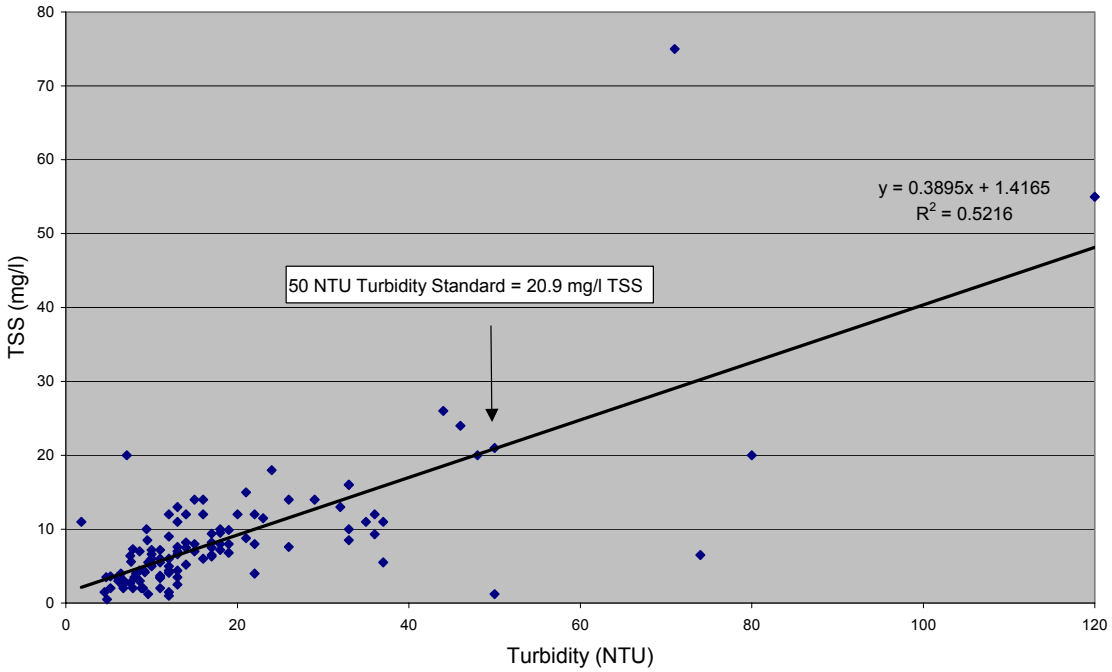

Figure 4. The relationship between turbidity and TSS in the Catawba River.

3.1 Point Sources in the Big Wateree Creek Watershed

There is one NPDES facility in this watershed, White Oak Conference Center (SC0035980), which is located on a tributary of Big Wateree Creek. This point source is far upstream of the impaired sampling station. It has a permit to discharge 0.0495 mgd (187,000 l/day) of wastewater and 30 mg/l of TSS (5.6 kg/day). This facility has consistently met its permit limits for total suspended solids (Appendix B). The average daily load of TSS from this facility since 1991 is 0.32 kg/day. Monthly wastewater (DMR) data are provided in Appendix B.

3.2 Nonpoint Sources in Big Wateree Creek Watershed

The Big Wateree watershed is rural and mainly forested and agricultural. There are no urban areas in the watershed. The major sources of turbidity in this creek appear to be stream sediments, soil and debris washed into the stream from disturbed land surfaces, and erosion of the stream bank. The sediment in the stream channel is probably a relic of past agricultural, forestry, and construction activities. One likely continuing source is the breakdown of the stream bank by cattle entering the stream to drink or crossing the stream on their way to another pasture. Cattle may also remove vegetation along the stream banks and disturb the soil near the stream.

This watershed has few people and little development. The only sources of sediment other than from cattle and forestry would seem to be in-stream: sediments and the bank erosion. Other potential sources such as tilling land for row crops do not appear to be present in Big Wateree Creek. The aerial photograph taken in 1999 of the watershed (Appendix D: Figure D-1) shows the rural nature of this watershed. The photograph also shows several pastures adjacent to the creek and what appear to be cut over areas not close to the creek.

4.0 LOAD-DURATION METHOD

A load-duration curve is a method of developing TMDLs that applies to all hydrologic conditions. The load-duration curve method uses the cumulative frequency distribution of stream flow and pollutant concentration data to estimate the existing and the TMDL loads for a water body. Development of the load-duration curve is described in this chapter.

In the ideal situation a long period of record for flow data would be available for the water body of interest. A longer period of record increases the confidence in the results of the load-duration method. Big Wateree Creek, like most small streams in South Carolina, is not gauged. Long Creek, in Gaston County, NC, is a comparable, gauged stream, with a similar sized drainage area, land uses, and is in the same ecoregion – the Piedmont. Data from the gauge (USGS 0214400) on Long Creek near Bessemer City, North Carolina for the period of record (Jan. 1, 1953 to Sept 30, 2001) was used to generate the flow-duration curve. The Long Creek watershed is smaller, 82.4 km^2 compared to 151.5 km^2 for Big Wateree Creek.

The flow for Big Wateree Creek was estimated by multiplying the daily flow rates from Long Creek by the ratio of the Big Wateree Creek drainage area to that of Long Creek (1.8394). The flows were ranked from low to high and the values that exceed certain selected percentiles determined. The load-duration curve was generated by calculating the load of TSS using the relationship between turbidity and TSS from the Catawba River, the flow rate that corresponds to the date of sampling, and a conversion factor. The load was plotted against the appropriate flow recurrence interval to generate the curve (Figure 4). The target line was created by calculating the allowable load from the flow and 20.9 mg/l of TSS, which is the concentration of TSS corresponding to the 50 NTU turbidity standard at the reference location. Sample loads above this line are violations of the standard, while loads below the line are in compliance.

The trend line was determined for loads that are above the target line. The trend line for Big Wateree Creek with the best fit was a power curve; the $r^2 = 0.7949$. The equation for the line and supporting data are provided in Appendix B. This trend line represents samples that exceeded the concentration of TSS corresponding to the water quality standard for turbidity. The existing load to Big Wateree Creek was calculated from values along this trend line between 5 % and 50 %. All of

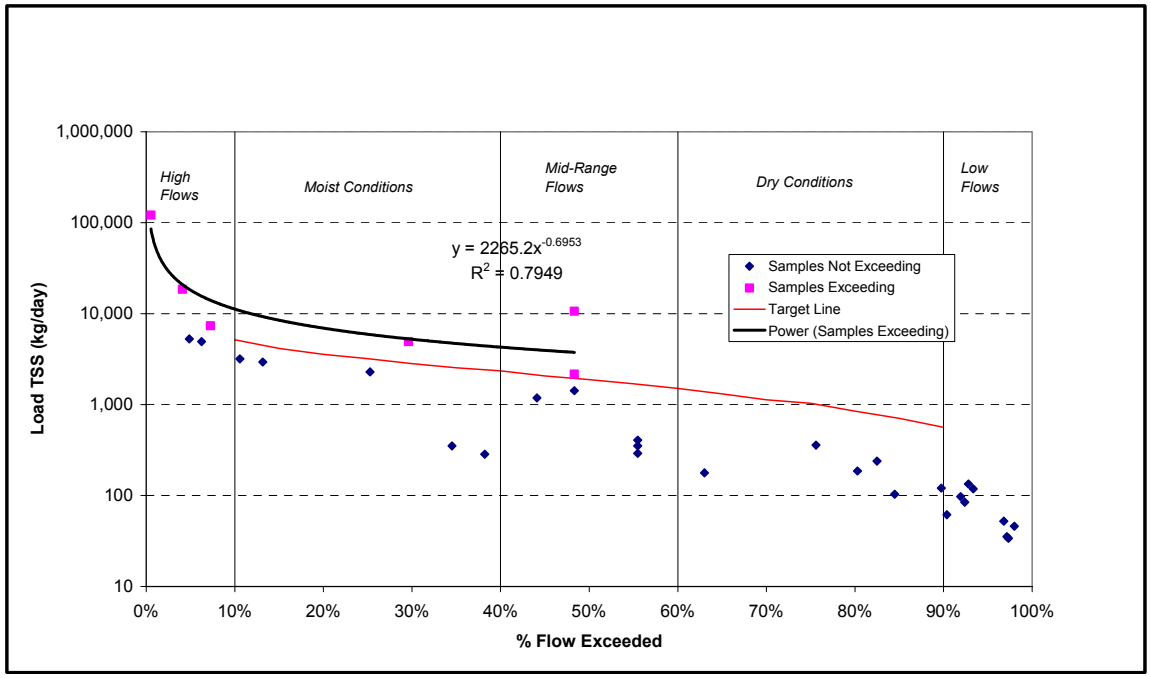

Figure 5. Load-Duration Curve for TSS in Big Wateree Creek at CW-072.

the violating loads were between the 0 % and 50 % flow recurrence intervals. The existing load is the average of loads from the 5 % to 50 % recurrence intervals at 5 % intervals, i.e. 5, 10, 15… 50.

The TMDL load is calculated from the target line in the same manner, that is the average of loads at 5 % intervals from 10 % to 90 %. The Load Allocation (LA) values are 95 % of the loads from the target line, that is the TMDL load minus the Margin of Safety. Calculations for both existing and TMDL loads are provided in Appendix B.

5.0 DEVELOPMENT OF TOTAL MAXIMUM DAILY LOAD

A total maximum daily load (TMDL) for a given pollutant and water body is comprised of the sum of individual wasteload allocations (WLAs) for point sources, and load allocations (LAs) for both nonpoint sources and natural background levels. In addition, the TMDL must include a margin of safety (MOS), either implicitly or explicitly, to account for the uncertainty in the relationship between pollutant loads and the quality of the receiving water body. Conceptually, this definition is represented by the equation:

$$\textbf{TMDL} = \textbf{3 WLAs} + \textbf{3 LAs} + \textbf{MOS}$$

The TMDL is the total amount of pollutant that can be assimilated by the receiving water body while still achieving water quality standards. In TMDL development, allowable loadings from all

pollutant sources that cumulatively amount to no more than the TMDL must be established and thereby provide the basis to establish water quality-based controls.

For most pollutants, TMDLs are expressed as a mass load (e.g., kilograms per day). Since turbidity does not represent a concentration, TSS which is concentration (mass per unit volume) and can be related to turbidity was used to calculate loads in kg/day, in accordance with 40 CFR 130.2(l).

5.1 Critical Conditions

Critical conditions for turbidity in Big Wateree Creek occur after rainfall events when flows are high. At high flow rates the sediment in the streambed can be entrained and disturbed soil from construction, agricultural, or other activities can be washed into the stream. Additionally high flows in the creek channel may erode the stream bank adding sediment to the flow.

5.2 Existing Load

The existing load was calculated from the trend line for TSS calculated from turbidity values that exceeded the water quality standard as described previously. The total existing load for CW-072 is estimated to be 7259 kg-TSS /day.

5.3 Margin of Safety

The margin of safety (MOS) may be explicit and/or implicit. The explicit margin of safety is 5 % of the 20.9 mg/l TSS concentration that is equivalent to the turbidity standard of 50 NTU. For CW-072 this is equivalent to 2150 kg-TSS /day**.** Through the use of conservative assumptions in the model, such as basing the percent reduction on high part of the trend line and calculating the point source load from permit limits, the margin of safety also has an implicit component.

5.4 Total Maximum Daily Load

The Total Maximum Daily Load (TMDL) represents the maximum load the stream may carry and meet the water quality standard for the pollutant of interest. For this TMDL the load will be expressed as kg-TSS /day.

The Waste Load Allocation (WLA) for the White Oak Conference Center is 5.6 kg-TSS /day. The WLA is an insignificant part of this TMDL. The Load Allocation (LA) was determined from the target line of load-duration curve less the MOS. The LA of 2150 kg-TSS /day accounts for most of the TMDL load.

Table 2. TMDL components for Big Wateree Creek.

Impaired Station	WLA kg-TSS /day	LA kg-TSS /day	MOS kg-TSS /day	TMDL kg-TSS /day	% Reduction
CW-072	5.6	2150	113	2267	70

The target loading value is the load to the creek that it can receive and meet the water quality standard. It is simply the TMDL minus the MOS. The target loading for Big Wateree Creek requires a reduction of 70 % from the current load of 7259 kg-TSS /day for CW-072.

6.0 IMPLEMENTATION

This TMDL will be implemented by implementation of the Big Wateree Creek Fecal Coliform Bacteria TMDL. Limiting or eliminating the access of cattle or other livestock to the creek and its tributaries should reduce the runoff of sediment into the creeks and allow the stream banks to re-stabilize. It may require years for the sediment in the streambed to be washed out into Lake Wateree.

Using existing authorities and mechanisms, these measures will be implemented in the Big Wateree Creek Watershed in order to bring about a 70 % reduction in TSS loading to Big Wateree Creek. DHEC will continue to monitor, according to the basin monitoring schedule, the effectiveness of implementation measures and evaluate stream water quality as the implementation strategy progresses.

7.0 REFERENCES AND BIBLIOGRAPHY

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APPENDIX A Turbidity and Calculated TSS Data

Turbidity and Calculated TSS for Big Wateree Creek at US-21 CW-072

TSS calculated from the regression of Turbidity on TSS for the Catawba River at SC-9 CW-016

Expression: **TSS = 0.3895 x Turb + 1.4195** **r = 0.7222**

Date	Turb (NTU)	Calculated TSS (mg/l)
18-Nov-92	**90.0**	**36**
17-Dec-92	30.0	13
15-Jan-93	**60.0**	**25**
26-Feb-93	35.0	15
12-Mar-93	32.0	14
6-Apr-93	**100.0**	**40**
26-May-93	2.6	2
10-Jun-93	3.6	3
1-Jul-93	13.0	6
5-Aug-93	3.8	3
24-Sep-93	4.1	3
9-Mar-98	**141.0**	56
15-Apr-98	36.0	15
10-Jun-98	9.6	5
16-Jul-98	6.0	4
6-Aug-98	7.0	4
14-Sep-98	7.7	4
8-Oct-98	**300.0**	118
23-Jan-01	37	16
22-Feb-01	15	7
20-Mar-01	31	13
10-Apr-01	5.6	4
14-May-01	11	6
19-Jun-01	4.1	3
31-Jul-01	6.9	4
9-Jan-02	12	6
20-Feb-02	8.3	5
25-Mar-02	7.5	4
30-Apr-02	2.4	2
28-May-02	4.1	3
25-Sep-02	3	3
24-Oct-02	8.4	5
6-Nov-02	**58**	24
9-Dec-02	27	12

APPENDIX B White Oak Conference Center DMR Data SC0035980

Date		TSS Load (lb/day)			TSS (mg/l)		Flow (mgd)			TSS Load (kg/day) *
		Monthly Average	Monthly Maximum		Monthly Average	Monthly Maximum	Monthly Average	Monthly Maximum		Monthly Average
1/31/91					19			0.0218		1.57
11/30/91				<	4			0.0055		0.08
12/31/91				<	4			0.0053		0.08
7/31/92					1.27			0.02		0.10
8/31/92					2.5			0.0112		0.11
9/30/92					3.05			0.0153		0.18
10/31/92					8.1			0.0175		0.54
11/30/92					6			0.01834		0.42
12/31/92					13.9			0.0092		0.48
1/31/93					14.75			0.0126		0.70
2/28/93					1.9			0.0126		0.09
3/31/93					2.8			0.0098		0.10
4/30/93					6.75			0.0063		0.16
5/31/93					4			0.0091		0.14
6/30/93					25.9			0.0386		3.78
7/31/93					4.6			0.0478		0.83
8/31/93					6.5			0.0123		0.30
9/30/93					9.3			0.0075		0.26
10/31/93					3			0.0038		0.04
11/30/93					4.3			0.0034		0.06
1/31/94					9			0.0106		0.36
2/28/94					3.6			0.0124		0.17
3/31/94					9.6			0.0212		0.77
4/30/94					2.8			0.0258		0.27
5/31/94					7.25			0.0259		0.71
6/30/94					4.6			0.0212		0.37
7/31/94					6			0.0186		0.42
8/31/94					5			0.0059		0.11
9/30/94					12			0.0105		0.48
10/31/94					6.3			0.0039		0.09
11/30/94					4			0.0059		0.09
12/31/94					6			0.0096		0.22
1/31/95					3		0.0177	0.0177		0.20
2/28/95					6			0.0105		0.24
3/31/95					3			0.0039		0.04
4/30/95					4			0.0114		0.17
5/31/95					2			0.0083		0.06
6/30/95					4			0.0206		0.31

* Note: TSS load calculated from concentration and flow where load in pounds not available.

Date		TSS Load (lb/day)			TSS (mg/l)		Flow (mgd)			TSS Load (kg/day) *
		Monthly Average	Monthly Maximum		Monthly Average	Monthly Maximum	Monthly Average	Monthly Maximum		Monthly Average
7/31/95					1			0.0158		0.06
8/31/95		0.13	0.13		1	1	0.0041	0.0096		0.06
9/30/95		0.10	0.18		18	32	0.0054	0.0101		0.05
10/31/95		0.09	0.09		3	3	0.0055	0.008		0.04
11/30/95		0.03	0.03		6	6	0.0045	0.0064		0.01
12/31/95		0.02	0.02		1	1	0.002	0.0031		0.01
1/31/96		0.00	0		3	3	0.0042	0.0059		0.00
2/29/96		1.10	1.1		1	1	0.0075	0.0154		0.50
3/31/96		0.02	0.02		4	4	0.0096	0.0123		0.01
4/30/96		1.40	1.4		9	9	0.0152	0.0176		0.64
5/31/96		0.04	0.04		0.7	0.7	0.0132	0.0157		0.02
6/30/96		1.00	1		7	7	0.0266	0.032		0.45
7/31/96		0.46	0.46		1	1	0.0248	0.0268		0.21
8/31/96		1.30	1.3		6	6	0.0204	0.0278		0.59
9/30/96		1.40	1.4		1.4	1.4	0.0159	0.0205		0.64
10/31/96	<	0.50	< 0.50	<	4	< 4	0.0133	0.0145	<	0.23
11/30/96		0.89	0.89		11	11	0.0157	0.0136		0.40
12/31/96		0.25	0.25	<	4	< 4	0.0092	0.0118		0.11
1/31/97	<	0.22	< .22	<	4	< 4	0.0162	0.0207	<	0.10
2/28/97		0.35	0.35		4	4	0.0179	0.0228		0.16
3/31/97	<	0.45	< 0.45	<	4	< 4	0.0127	0.0159	<	0.20
4/30/97	<	0.15	< 0.15	<	4	< 4	0.0155	0.0223	<	0.07
5/31/97	<	0.43	< 0.43	<	4	< 4	0.0158	0.0174	<	0.20
6/30/97	<	0.60	< 0.6	<	4	< 4	0.026	0.0316	<	0.27
7/31/97		5.50	5.5		18	18	0.025	0.0271		2.49
8/31/97	<	0.70	<.7	<	4	<4	0.0167	0.0228167	<	0.32
9/30/97		0.30	0.3	<	4	<4	0.0138	0.0229		0.14
10/31/97	<	0.40	< 0.40	<	4	< 4	0.0108	0.0121	<	0.18
11/30/97		0.34	0.339		4	4	0.0129	0.0167		0.15
12/31/97		2.24	2.24		18	18	0.0115	0.0176		1.02
1/31/98		1.99	1.99		8	8	0.0208	0.0238		0.90
2/28/98	<	2.52	4.85	<	9	14	0.016	0.021	<	1.14
3/31/98	<	0.94	1.44	<	8	12	0.01	0.024	<	0.43
4/30/98		0.57	0.727		4	4	0.021	0.0249		0.26
5/31/98		0.50	0.99		4	8	0.015	0.016		0.22
6/30/98	<	0.50	< 0.509	<	4	< 4	0.023	0.029	<	0.22
7/31/98	<	0.56	< 0.592	<	4	< 4	0.02	0.031	<	0.25
8/31/98	<	1.50	< 1.78	<	5	6	0.022	0.041	<	0.68
9/30/98	<	0.39	< 0.408	<	4	< 4	0.021	0.027	<	0.18
10/31/98	<	0.64	0.722	<	5	6	0.012	0.018	<	0.29
11/30/98	<	0.35	< 0.370	<	4	< 4	0.014	0.021	<	0.16

Date		TSS Load (lb/day)			TSS (mg/l)		Flow (mgd)			TSS Load (kg/day) *
		Monthly Average	Monthly Maximum		Monthly Average	Monthly Maximum	Monthly Average	Monthly Maximum		Monthly Average
12/31/98	<	0.25	< 0.256	<	4	4	0.006	0.007	<	0.11
1/31/99		0.37	0.49		5	6	0.014	0.021		0.17
2/28/99		0.64	1.017	<	4	4	0.015	0.021		0.29
3/31/99	<	0.04	< 0.45	<	4	< 4	0.014	0.016	<	0.02
4/30/99	<	0.58	0.861	<	7.6	12	0.009	0.012	<	0.26
5/31/99	<	0.67	0.997	<	6	8	0.016	0.021	<	0.31
6/30/99	<	0.40	< 0.45	<	4	< 4	0.025	0.034	<	0.18
7/31/99		4.30	4.46		14.5	15	0.024	0.026		1.95
8/31/99	<	0.83	< 0.895	<	4	< 4	0.014	0.019	<	0.38
9/30/99	<	0.40	< 0.414	<	4	< 4	0.01	0.014	<	0.18
10/31/99		1.53	1.62		9.5	11	0.013	0.014		0.69
11/30/99	<	0.32	< 0.358	<	4	< 4	0.011	0.014	<	0.15
12/31/99		0.74	0.817		5.5	6	0.014	0.017		0.33
1/31/00	<	0.51	< 0.519	<	4	< 4	0.02	0.023	<	0.23
2/29/00	<	0.77	< 0.827	<	4	< 4	0.02	0.021	<	0.35
3/31/00	<	0.34	< 0.35	<	4	< 4.0	0.018	0.02	<	0.15
4/30/00	<	0.79	< 1.05	<	4	< 4.0	0.014	0.02	<	0.36
5/31/00	<	0.48	0.56	<	4.4	4.8	0.014	0.016	<	0.22
6/30/00	<	1.04	< 1.04	<	4	< 4.0	0.028	0.036	<	0.47
7/31/00		1.21	1.25		4.3	4.7	0.026	0.021		0.55
8/31/00	<	1.50	1.2	<	4.6	5.3	0.014	0.023	<	0.68
9/30/00		0.00	0		0	0	0.018	0.018		0.00
10/31/00		0.45	0.497		4.4	4.6	0.013	0.016		0.20
11/30/00		0.00	0		0	0	0.015	0.02		0.00
12/31/00		0.00	0		0	0	0.009	0.012		0.00
1/31/01		0.30	0.374		4.8	5.6	0.012	0.012		0.13
2/28/01		0.18	0.36		2	4	0.014	0.017		0.08
3/31/01		0.18	0.36		2	4	0.02	0.026		0.08
4/30/01		0.00	0		0	0	0.017	0.026		0.00
5/31/01		0.07	0.132		1.05	2.1	0.015	0.019		0.03
6/30/01		0.00	0		0	0	0.02	0.03		0.00
7/31/01		1.91	3.82		6.5	13	0.03	0.036		0.87
8/31/01		0.42	0.834		2.05	4.1	0.02	0.024		0.19
9/30/01		0.00	0		0	0	0.018	0.023		0.00
10/31/01		0.00	0		0	0	0.016	0.017		0.00
11/30/01		0.00	0		0	0	0.016	0.023		0.00
12/31/01		0.81	1.33		9.5	13	0.0122	0.0137		0.37
1/31/02		0.89	0.8879		9	9	0.0146	0.0165		0.40
2/28/02		0.00	0		0	0	0.0163	0.0173		0.00
3/31/02		0.32	0.3202		2.4	2.4	0.0173	0.0197		0.15

* Note: TSS load calculated from concentration and flow where load in pounds not available.

Date	TSS Load (lb/day)		TSS (mg/l)		Flow (mgd)		TSS Load (kg/day) *
	Monthly Average	Monthly Maximum	Monthly Average	Monthly Maximum	Monthly Average	Monthly Maximum	Monthly Average
4/30/02	2.01	6.026	13.5	40.5	0.0194	0.0223	0.91
5/31/02	0.00	0	0	0	0.016	0.0171	0.00
6/30/02	0.00	0	0	0	0.034	0.0391	0.00
7/31/02	1.43	1.428	4.6	4.6	0.026	0.0293	0.65
8/31/02	1.25	1.25	10	10	0.0171	0.0207	0.57
9/30/02	0.94	0.9437	8.2	8.2	0.0187	0.0245	0.43
10/31/02	0.44	0.4353	3	3	0.0162	0.0198	0.20
11/30/02	0.29	0.2919	2.5	2.5	0.0151	0.0166	0.13
12/31/02	0.20	0.1999	2.2	2.2	0.0121	0.0154	0.09
1/31/03	0.00	0	0	0	0.0135	0.0159	0.00
2/28/03	0.69	0.6902	4.7	4.7	0.0119	0.0247	0.31
3/31/03	0.82	0.8195	5.2	5.2	0.0287	0.0329	0.37
4/30/03	0.90	0.9047	5.9	5.9	0.0283	0.0352	0.41
5/31/03	1.10	1.9	9	14	0.0192	0.0233	0.50
6/30/03	0.00	0	0	0			0.00
7/31/03	0.00	0	0	0			0.00
8/31/03	0.13	0.1284	2	2			0.06
9/30/03	0.00	0	0	0			0.00
10/31/03	3.30	3.3	4.5	4.5			1.50
11/30/03	4.10	4.098	5.5	5.5			1.86
12/31/03	0.88	0.8757	7.5	7.5			0.40

* Note: TSS load calculated from concentration and flow where load in pounds not available.

APPENDIX C Calculation of Existing and TMDL Loads

Date	Calculated TSS (mg/l)	Estimated Flow (cfs)	Load TSS (kg/day)
18-Nov-92	36	55.2	4926
17-Dec-92	13	99.3	3183
15-Jan-93	25	121.4	7362
26-Feb-93	15	134.3	4945
12-Mar-93	14	86.5	2938
6-Apr-93	40	187.6	18527
26-May-93	2	47.8	284
10-Jun-93	3	25.8	178
1-Jul-93	6	15.1	239
5-Aug-93	3	49.7	352
24-Sep-93	3	14	103
9-Mar-98	56	879.2	121180
15-Apr-98	15	60.7	2293
10-Jun-98	5	32.3	407
16-Jul-98	4	9.2	84
6-Aug-98	4	9.6	97
14-Sep-98	4	11.2	121
8-Oct-98	118	36.8	10648
23-Jan-01	16	36.8	1425
22-Feb-01	7	20.2	359
20-Mar-01	13	160	5281
10-Apr-01	4	33.1	291
14-May-01	6	8.5	119
19-Jun-01	3	4.6	34
31-Jul-01	4	5.2	52
9-Jan-02	6	9	134
20-Feb-02	5	16.4	187
25-Mar-02	4	33.1	351
30-Apr-02	2	10.7	62
28-May-02	3	4.8	35
25-Sep-02	3	1.3	8
24-Oct-02	5	4	46
6-Nov-02	24	36.8	2161
9-Dec-02	12	40.5	1182

TMDL Load Flow Exceedence Table		
% Exceeded	Flow (cfs)	Load (kg/day)
5%	156.35	7995
10%	101.17	5173
15%	80.93	4138
20%	69.90	3574
25%	62.54	3198
30%	55.18	2822
35%	49.66	2539
40%	45.98	2351
45%	40.47	2069
50%	36.79	1881
55%	33.11	1693
60%	29.43	1505
65%	25.75	1317
70%	22.07	1129
75%	20.23	1035
80%	16.55	846
85%	13.80	705
90%	11.04	564
95%	6.99	357

TSS Target: *	20.9	mg/l
* derived from relationship between Turbidity and TSS for the Catawba River at CW-016		
TMDL load:	2149	kg-TSS/day

% Reduction:	70%

Existing load: **7,259 kg-TSS/day**

% Q Ex-ceeded		Load (kg/day)
5%		18185.0
10%		11230.7
15%		8471.7
20%		6935.9
25%		5939.1
30%		5232.0
35%		4700.2
40%		4283.5
45%		3946.6
50%		3667.9
Mean		7259.2

Equation for trend line: $y = 2265.2 x ^ {-0.6953}$
$r^2 = 0.7949$

Note: Existing load calculations are based on Flow Exceedences between 5 % and 50% because all violations of standard occurred at Flow Exceedence percentages less than 50 %. TMDL load was calculated from 10 % to 90 % flow intervals.

APPENDIX D Aerial Color Infrared Photograph

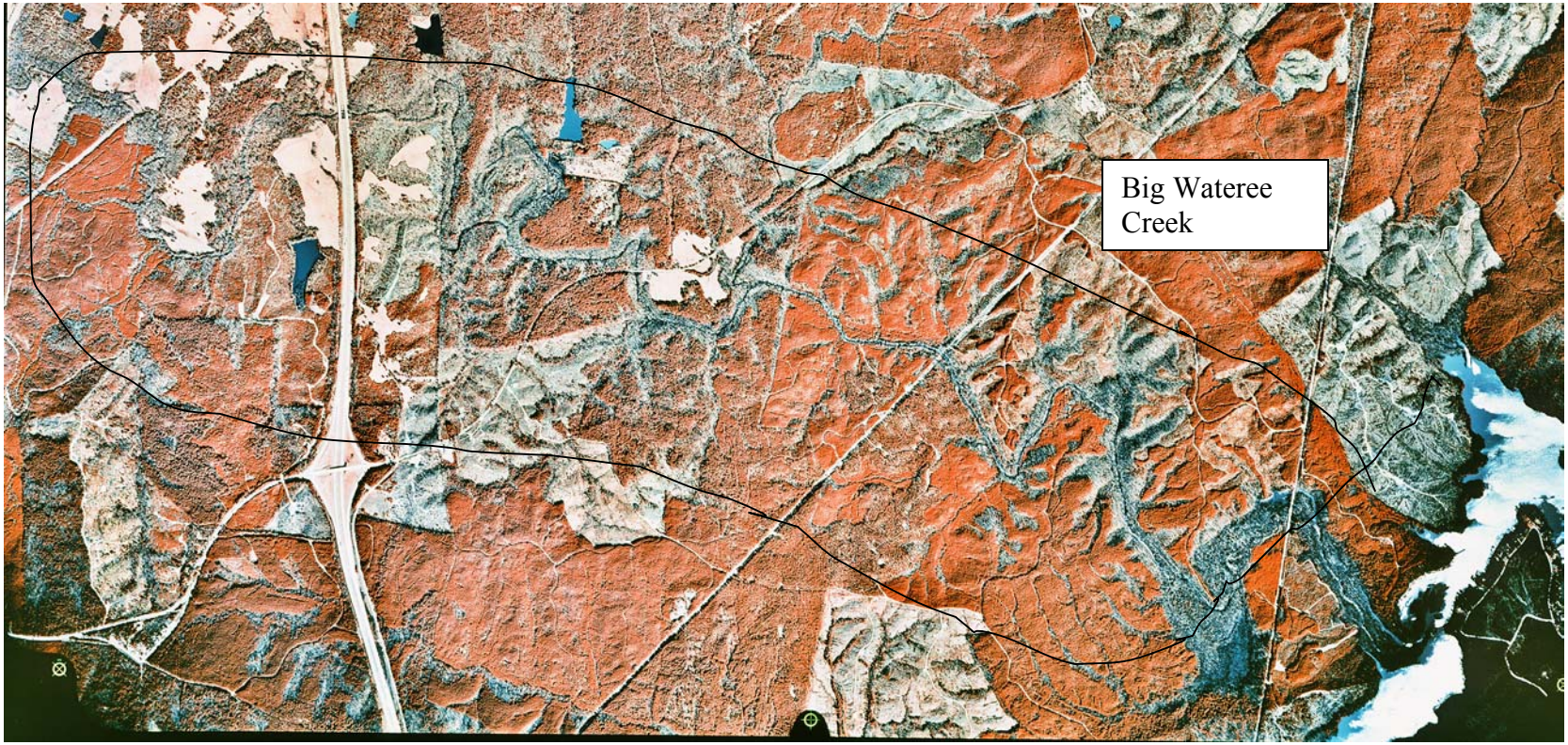

Figure D-1 Aerial photograph of the Big Wateree Creek from February 1999. Dry forest is shown in red and wetlands in green.

APPENDIX E Public Notification