WATER QUALITY DEMONSTRATION STUDY

CHOCCOLOCCO CREEK
ANNISTON, ALABAMA
1984 AND 1989

SPECIAL SERVICES SECTION
FIELD OPERATIONS DIVISION
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

WATER QUALITY DEMONSTRATION STUDY
CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
1984 AND 1989

INTRODUCTION

The City of Anniston, Alabama utilizes Choccolocco Creek as a receiving stream for the treated effluent from its municipal waste-water treatment facility. During the period from April 1988 to October 1989, the City of Anniston underwent construction to upgrade the old disposal plant. Staff members of the Field Operations Division of the Alabama Department of Environmental Management (ADEM), at the request of the Municipal Branch of the Water Division of ADEM, conducted a water quality demonstration study to assess the effects of the new treatment facility on Choccolocco Creek.

EPA CONSTRUCTION GRANTS PROGRAM

Since 1972, approximately $534 million in EPA grant funds have been expended for the construction of new, upgraded, and/or expanded wastewater collection and treatment works in Alabama. One recent recipient of grant funding from this program was Anniston in Calhoun County.

The Water Works and Sewer Board of the City of Anniston received an EPA Step 3 grant in June of 1986 for the construction of an upgrade/expansion of its Choccolocco WWTP from 7.2 million gallons per day (mgd) of secondary treatment capacity to 10.50 mgd of treatment capacity. Also included in this EPA grant were the replacement of the Snow Creek interceptor and sewer rehabilitation to eliminate bypasses and hydraulic overloading of the treatment and transport system. While improvements to the Snow Creek interceptor are to begin in early 1990, improvements to the Choccolocco Creek treatment facility began May 30, 1986, and were completed September 20, 1988. The total cost of the plant upgrade was $13,221,560; EPA grant participation amounted to $4,593,381 while the City provided the balance of the funding for the plant work. The improvements to the Snow Creek interceptor will be funded by EPA grant of approximately $440,000 and $2.02 million from the State Revolving Fund (SRF) loan program.

The project engineer for both projects is Paul B. Krebs and Associates of Birmingham, Alabama. The construction of the plant improvements was accomplished in two phases. Phase 1 dealt with the liquid train while Phase 2 involved the treatment of sludge. The construction contractor for both Phases was Brasfield and Gorrie, Inc. of Birmingham, Alabama.

The Choccolocco Creek facility currently serves a sewered population of approximately 40,000 with an ultimate service area population projected to be approximately 65,000. The facility discharges its treated wastewater to Choccolocco Creek which is classified as Fish and Wildlife.

The upgrade of the Choccolocco treatment plant included extensive rehabilitation, replacement and augmentation of treatment units related to raw wastewater pumping, preliminary treatment (bar screens, grit removal units, comminutors), primary and final clarification, activated sludge aeration, effluent chlorination/ dechlorination and aeration, and sludge treatment with a centrifuge for dewatering. Although almost every part of the plant received attention in the upgrade/expansion, the most significant additions consisted of primary and secondary clarifiers, aeration tanks, sludge digestion and centrifuge dewatering facilities and the construction of methane gas storage sphere. Interestingly, the methane gas derived from the anaerobic digesters provide fuel for the blower engines which aerate the activated sludge treatment units.

The seasonal NPDES permit limits for the upgraded Anniston Choccolocco treatment facility are as follows:

	June-Nov	Dec-May
Flow (mgd)	10.50	10.50
BOD_5 (mg/L)	15	30
TSS (mg/L)	30	30
NH_3-N (mg/L)	2	15
D.O. (mg/L)	6	

Dechlorination Required.

Prior to the upgrade of this facility, the following performance data was reported by the Discharge Monitoring Reports (DMR) submitted by the City for the span from July 1985 through June 1986:

Flow (mgd)	7.015
BOD_5 (mg/L)	28.3
TSS (mg/L)	30.8
NH_3-N (mg/L)	8.17
D.O. (mg/L)	4.7

After the Phase 1 and 2 upgrades were completed, the following performance data was submitted on the DMR's for the span from October 1988 through September 1989:

	June-Nov	Dec-May
Flow (mgd)	9.13	9.96
BOD_5 (mg/L)	3.8	6.5
TSS (mg/L)	5.0	9.3
NH_3-N (mg/L)	0.51	1.2
D.O. (mg/L)	7.6	8.9

As the above DMR data indicates, a higher level of treatment is being attained at a higher hydraulic loading after the completion of the plant improvements.

FIELD OPERATIONS

During July and August 1984, staff members of the Field Operations Division collected data to establish conditions and provide a comparative base of information on Choccolocco Creek. This sampling was accomplished prior to construction and implementation of the new treatment plant. During May to August 1989, data were collected to demonstrate the improvement, if any, of water quality in the receiving stream attributable to the new plant.

SAMPLING LOCATIONS AND METHODOLOGY

Three sampling locations were selected and utilized for data collection during the water quality demonstration study. The station names and locations were as follows:

STATION	LOCATION:
CC-1	Choccolocco Creek approximately 2&1/4 miles upstream of treatment plant at County Road crossing. T16S,R8E,S27, SW1/4,NE1/4,NW1/4.
CC-2	Choccolocco Creek approximately 1/8 mile downstream of treatment plant at County Road crossing. T16S,R8E,S29, SW1/4,SW1/4,SW1/4.
CC-3	Choccolocco Creek approximately 2&1/4 miles downstream of treatment plant at State Highway 21 crossing. T17S,R7E,S1, NE1/4,NE1/4,NE1/4.

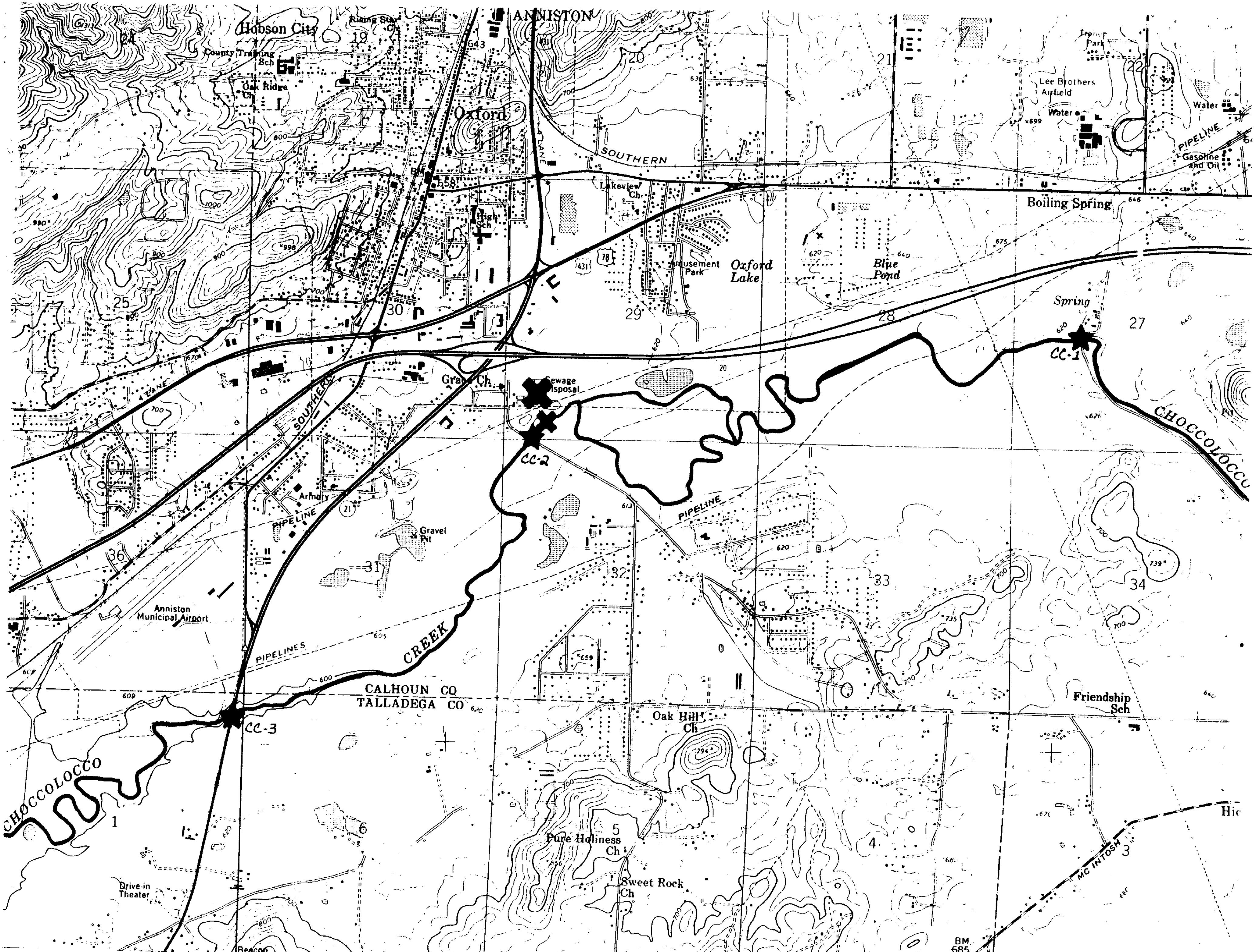
The following parameters were collected at each sampling location:

1). Date
2). Time
3). Air Temperature
4). Water Temperature
5). Conductivity
6). pH
7). Dissolved Oxygen (D.O.)
8). Biochemical Oxygen Demand (BOD_5)
9). Total Suspended Solids (TSS)
10). Nitrate (NO_3-N)
11). Ammonia (NH_3-N)
12). Total Kjeldahl Nitrogen (TKN)
13). Total Organic Nitrogen (TON)
14). Phosphate (PO_4-P)
15). Stream Flow
16). Fecal Coliform
17). Aquatic Macroinvertebrates

All sampling, sample handling techniques, and field parameter analyses utilized in the acquisition of data for this water quality demonstration study were as described in the Field Operations <u>Standard Operating Procedures and Quality Control Assurance Manual</u> (Field Operations Division, ADEM, December 1986), as amended. Chain-of-custody was maintained by locking the samples in a Departmental vehicle when not in sight of a Field Operations employee. The samples requiring laboratory analysis were transported to the ADEM Environmental Laboratory in Montgomery, Alabama. Analysis methodology were as specified in the Federal Register, 40 CFR Part 136, October 1984, as amended. Analysis of the samples yielded the data which are reported in Tables 1 and 2.

BIOLOGICAL METHODOLOGY

Aquatic macroinvertebrates, defined as organisms which are retained on a U.S. Standard No. 30 sieve (0.595 mm openings) (Weber, 1973), were collected by a staff biologist utilizing


ANNISTON
Hobson City
County Training Sch
Oak Ridge Ch
Oxford
High Sch
SOUTHERN
Lakeview Ch
Boiling Spring
Lee Brothers Airfield
Water
PIPELINE
Gasoline and Oil
Amusement Park
Oxford Lake
Blue Pond
Spring
CC-1
CHOCCOLOCCO
Grace Ch
Sewage Disposal
CC-2
Armory
Gravel Pit
PIPELINE
Anniston Municipal Airport
PIPELINES
CREEK
CALHOUN CO
TALLADEGA CO
CC-3
Oak Hill Ch
Friendship Sch
Pure Holiness Ch
Sweet Rock Ch
Drive-in Theater
Beacon
MC INTOSH
BM 685

Hester-Dendy multiple plate artificial substrate samplers. A total of three samplers were deployed at each sampling location. Each sampler was placed in such a manner as to be suspended at a depth of 12 to 18 inches in the water column. The samplers were deployed for a period of approximately six weeks. At the end of the sampling period, the samplers were collected in wide-mouth jars, returned to the laboratory, cleaned over a No. 30 sieve, and the materials retained on the sieve preserved in 90% ethanol. The macroinvertebrate organisms were then sorted and identified to the lowest possible taxonomic level. The purpose of this sampling method is to provide a quantitative representation of the aquatic macroinvertebrate community at each station.

The macroinvertebrate data were analyzed using the following methods:

1). Relative Abundance- total number of organisms and total number of taxa were enumerated and compared station to station.

2). EPT Index- total number of distinct taxa within the orders Ephemeroptera, Plecoptera, and Trichoptera. This number, generally, increases with increasing water quality and summarizes taxa richness within the insect orders which are considered to be pollution sensitive (Plafkin, 1989).

3). Percent Contribution of Dominant Taxa- an indication of community balance at the lowest positive taxonomic level. A community dominated by relatively few taxa would indicate environmental stress (Plafkin, 1989).
Percent= # of Most Abundant Taxa/ Total # of Organisms
As environmental stress increases, percentage increases.

4). Sorenson's Community Similarity- measures the degree of similarity in taxonomic composition between two stations in terms of presence or absence. Station of interest is compared to a reference station.
SCS= # of taxa common to both samples/ total # of taxa in both samples.
As value approaches 1.0, samples are considered more similar.

5). Dominants in Common- provides a measure of replacement or substitution, between the reference community and the downstream station, utilizing the dominant five taxa. Four or more dominant taxa in common indicates no impairment (Plafkin, 1989).

6). Indicator Assemblage Index- integrates the relative abundances of the EPT taxonomic groups and the relative abundances of chironomids and annelids (CA) upstream and downstream to evaluate impairment (Plafkin, 1989).
IAI=0.5* [(%EPT @ test station / %EPT @ control station) +(%CA @ control station / %CA @ test station)]
As IAI approaches 1.0, value indicates good community balance.

7). Shannon-Weaver Species Diversity Index ($\bar{d}$)- a general representation of taxa richness and water quality. Values between 3 and 4 generally indicate unimpaired waters, whereas, in impacted waters, values are less than 1 (Weber, 1973).

$$\bar{d} = [(C/N)* ((N \log_{10} N)-(n_i \log_{10} n_i))]$$

C= 3.32928 (a constant)
N= total # of individuals

n_i= total # of individuals in the i^{th} species

8). Equitability (e)= s´/s -compares the number of taxa in a sample (s) with the number of taxa expected (s´) from a community that conforms to the MacArthur´s Broken Stick Model. Equitability has been found to be very sensitive to even slight levels of degradation due to oxygen demanding wastes. Generally, values greater than 0.5 indicate little stress, whereas, values less than 0.5 indicate that the communities are impacted (Weber, 1973).

9). Indicator organism analysis, using the Hilsenhoff Biotic Index (Plafkin,1989), and Weber´s Tolerance Classification system (Weber,1973), was used to evaluate the composition and environmental requirements of the taxa. The Hilsenhoff Biotic Index is a whole number tolerance value ranging from 0 (least tolerant) to 10 (most tolerant). Weber´s Tolerance Classification system rates an organism as T (tolerant, F (facultative), I (intolerant) or combinations of these based on the number of literary descriptions of the referenced organism.

DISCUSSION AND RESULTS

A. PHYSICAL

Choccolocco Creek is a fourth order stream. Along the length of the study, it is a typical lotic-depositional stream with varying bottom structure. At all stations, the bottom consists of primarily sand, clay, and heavy siltation is evident.Choccolocco Creek has a high flow which is typically greater than fifty cubic feet per second (Table 1). There is significant riparian vegetation and habitat suitable for macroinvertebrate colonization. Logan-Martin Lake on the Coosa River receives the flow from Choccolocco Creek.

B. CHEMICAL

The Water Use Classification for Choccolocco Creek from the Coosa River to its source is Fish and Wildlife (F&W), which designates the waters are suitable for fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and whole-body water contact sports or as a source of water supply for drinking or food processing purposes.

As seen in Table 1 and Figure 1, data collected prior to the upgrade of the treatment plant indicated that the waters below the discharge point, with the exception of CC-2, were consistently in violation of the dissolved oxygen standard for the F&W classification (5.0 mg/L). The dissolved oxygen values at station CC-2 ranged, during the summer of 1984, from a low of 5.5 mg/L to a high of 6.5 mg/L, and averaging 6.0 mg/L. At station CC-3, the dissolved oxygen values ranged from a low of 2.6 mg/L to a high of 5.7 mg/L, and averaging 4.2 mg/L. Dissolved oxygen values at CC-1, the reference station, ranged from a low of 5.9 mg/L to a high of 8.5 mg/L, and averaged 7.0 mg/L. A sag in the amount of dissolved oxygen can be observed in the D.O. values at stations CC-2 and CC-3.

As seen in Table 2 and Figure 1, data collected after the construction of the new treatment plant show a marked improvement. The dissolved oxygen values were frequently above the 5.0 mg/L F&W

standard, during the summer of 1989. Station CC-2 had D.O. values averaging 7.7 mg/L and ranging from a low of 6.8 mg/L to a high of 8.5 mg/L. D.O. values at CC-3 had an average of 7.2 mg/L and ranged between a low of 6.4 mg/L and a high of 8.2 mg/L.

In addition to improved dissolved oxygen content, other improvements were evident. At all downstream stations, biochemical oxygen demand was significantly reduced, as was the amount of suspended solids below the discharge point. Ammonia, and phosphates also experienced a dramatic decrease. Nitrates increased slightly at CC-2 and CC-3 over the previous years data. The pH values increased from the 6.4 standard unit to 7.3 standard unit range to the 7.2 standard unit to 7.9. standard unit range. It should be noted, that, due to high precipitation events, stream flows during the 'after' portion of this study were increased. This makes a determination of improved stream conditions difficult due to the potential for greater dilution than what would normally be expected during low flow conditions.

C. BIOLOGICAL

Station CC-1, upstream of the WWTP effluent, was sampled for aquatic macroinvertebrates after upgrade to use as a reference database (Table 3, Figure 2). During the 1989 macroinvertebrate sampling, a total of 157 organisms were collected representing 21 taxa. Of the taxa present, four were classified as tolerant organisms, fourteen were moderately tolerant, three were intolerant, and one was undetermined. The EPT Index showed a value of 11, indicating the presence of pollution sensitive organisms. Most notable of these are Serratella, Allocapnia, and Taeniopteryx, all pollution intolerant organisms. The dominant taxa, Stenonema, made up 40% of the total population. Species diversity and equitability values indicated no impairment evident in the stream. The number of organisms per square meter was calculated as being 785.

At station CC-2, immediately downstream of the WWTP, the 1989 after upgrade data indicated that there was some impairment of the aquatic macroinvertebrate community (Table 3, Figure 2). A total of 73 organisms were collected representing 14 taxa. Of the taxa present, seven were classified as tolerant organisms, six were moderately tolerant, and one was intolerant. Members of Diptera, a pollution tolerant group, made up 67% of the total population with the Thienemannimyia group, a moderately intolerant group with an estimated Biotic Index of 6, comprising 60% of the collection. The EPT Index value was 1 indicating the presence of Polycentropus, a moderately tolerant Trichopteran. Species Diversity and equitability values, indicated slight impairment to the aquatic community. Equitability, however, is erratic when dealing with samples of less than 100 organisms. As compared to CC-1, Sorenson's Community Similarity indicated that the two stations were very dissimilar . There was one dominant organism common to both stations, Cricotopus, a moderately tolerant Dipteran. The Indicator Assemblage Index indicated that CC-2 was very poorly balanced, as compared to CC-1. The number of organisms per square meter was calculated as 365.

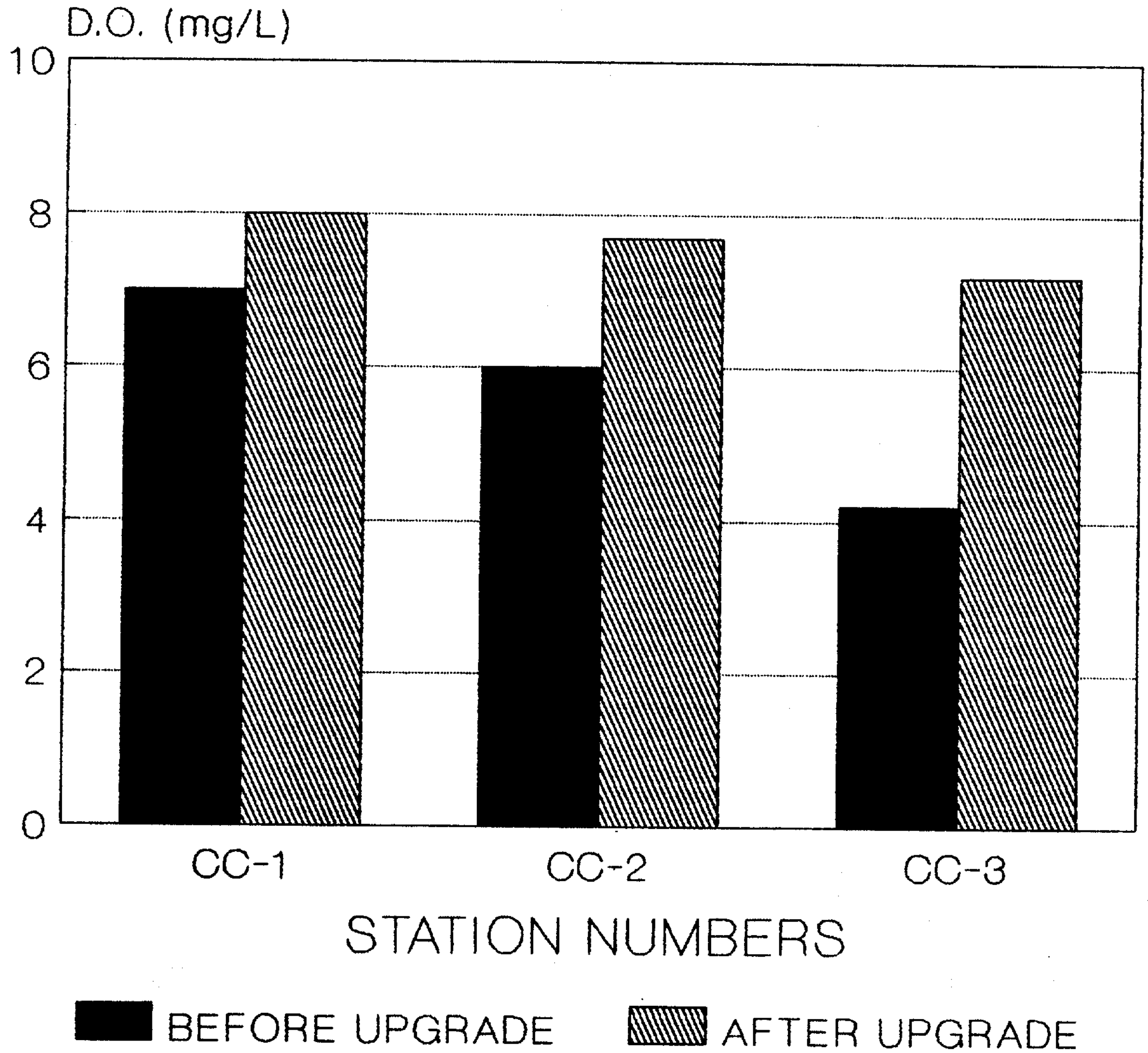
At CC-3 in 1989, the macroinvertebrate data indicated that there was still serious impairment to the stream (Table 3, Figure 2). A total of 116 organisms representing 9 taxa were found to be present during sampling. Of the taxa present, four were classified as tolerant organisms, three were moderately tolerant, and two were intolerant. Members of the group Oligochaeta, a pollution tolerant group, comprised 84% of the collection and were the dominant taxa. The EPT Index value of 1, again, indicated the presence of *Polycentropus*, a moderately tolerant Trichopteran. There were approximately 1160 organisms per square meter. Species diversity and equitability values indicated a moderate impact on the aquatic community. As compared to CC-1, Sorenson's Community Similarity indicated that CC-3 was very much dissimilar. One dominant organism was found to be common to both stations, *Cricotopus*. The Indicator Assemblage Index showed that CC-3 was still very poorly balanced.

The aquatic macroinvertebrate data collected from Choccolocco Creek during 1989 clearly demonstrate the adverse impacts of the Anniston WWTP after upgrade. Choccolocco Creek is in very poor condition, biologically, even two and one-quarter miles downstream. The 1989 data documents biological impairment at all downstream locations.

CONCLUSIONS

Physical, chemical, and DMR data collected before and after the construction of the new Hanceville wastewater treatment plant indicate that Choccolocco Creek has experienced an improvement in overall water quality. However, biological data indicates that Choccolocco Creek is still in very poor condition below the effluent of the Anniston WWTP. Choccolocco Creek appears to be meeting its Water Use Classification of Fish and Wildlife,if chemical data alone is considered. Further work may be required to document a substantial improvement to water quality in Choccolocco Creek.

FIGURE 1
CHOCCOLOCCO CREEK
DISSOLVED OXYGEN DATA



THE ABOVE NUMBERS REPRESENT AVERAGES OF D.O. VALUES COLLECTED DURING THE SAMPLING PERIOD.

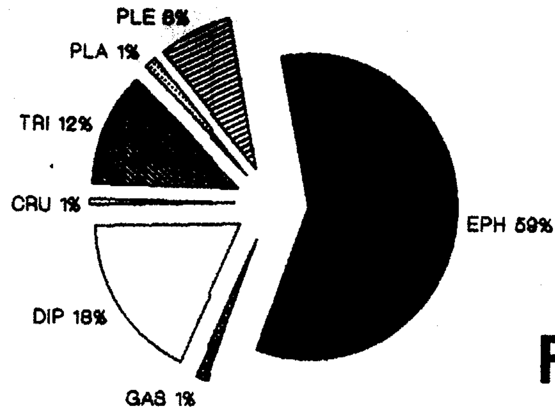
TABLE 1
WATER QUALITY DEMONSTRATION STUDY
CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
DATA COLLECTED PRIOR TO UPGRADE OF WWTP

DATE	LOCATION	TIME	AIR TEMP	WATER TEMP	D.O.	pH	BOD_5	TSS	NO_3-N	NH_3-N	TKN	TON	PO_4-P	FLOW
07/11/84	CC-1	13:20	33	28	8.5		2	14	0.12	0.2	0.4	0.2	0.82	
07/12/84		08:00	27	26	5.9	6.7	4.1	121	0.24	<0.2	<0.2	0	6.8	
08/15/84		10:40	30	26	6.9	6.5	0.8	20	0.2	<0.2	<0.4		0.1	
08/16/84		09:25	26	25	6.7		1.1	19	0.5	<0.2	<0.4		0.3	
AVERAGE			29.0	26.3	7.0	6.6	2.0	43.5	0.3	----	----	0.1	2.0	----
07/11/84	CC-2	18:28	34	28	5.8		13		0.12	0.2	0.2	0	6.4	
07/12/84		08:05	27	26	5.5	6.9	8	62	0.16	0.4	0.5	0.1	6.8	127
08/15/84		11:25	30.5	26.5	6.5	6.4	2.4	29	0.1	0.3	<0.4		1.9	
08/16/84		09:10	26.5	25	6.3		14	22	0.3	0.2	<0.4		20	
AVERAGE			29.5	26.4	6.0	6.7	9.4	37.7	0.2	0.3	----	0.1	8.8	127.0
07/11/84	CC-3	14:30	33	28	2.6		3	15	0.18	0.6	0.7	0.1	3.5	
07/12/84		08:25	27	26	2.8	6.8	4.5	118	0.2	0.4	<0.2		1.88	
08/15/84		11:40	32.5	26	5.7	6.4	1.6	36	0.1	0.4	<0.4		1.7	
08/16/84		08:55	26.5	25	5.7		0.5	22	0.4	0.2	<0.4		1.6	----
AVERAGE			29.8	26.3	4.2	6.6	2.4	47.8	0.2	0.4	----	0.1	2.2	0.0
			(C)	(C)	(mg/L)	(SU)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)

TABLE 2
WATER QUALITY DEMONSTRATION STUDY
CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
DATA COLLECTED AFTER UPGRADE OF WWTP

DATE	LOCATION	TIME	AIR TEMP	WATER TEMP	D.O.	pH	COND	BOD_5	TSS	NO_3-N	NH_3-N	TKN	TON	PO_4-P	FLOW	BACTERIA
05/02/89	CC-1	10:25			7.9											
05/12/89		11:00	16.7	16.1	8.9	7.6	70	0.5	14	0.2	0.2	<0.4	0.2	<0.02		19
07/13/89		12:30	27.8	23.9	7.2	7.9	100	0.1	25	0.24	<0.2	1.02	0.82	0.15		
08/17/89		14:54	29	24	8.1	7.4	130	0.5	11	0.13	<0.2	<0.4	<0.2	<0.02		
AVERAGE			24.5	21.3	8.0	7.6	100	0.4	17	0.2	0.1	----	0.3	----	----	19.0
05/02/89	CC-2	09:55			7.5										13.54	
05/12/89		10:40	21.1	16.7	8.5	7.4	280	0.4	21	0.52	0.4	0.4	0	0.16	13.54	21.8
07/13/89		12:15	28.9	23.9	6.8	7.5	160	0.7	30	0.49	<0.2	<0.4	<0.2	0.2	21.24	
08/17/89		14:06	28	24	7.9	7.3	360	0.5	14	0.68	<0.2	<0.4	<0.2	0.27	14.33	
AVERAGE			26.0	21.5	7.7	7.4	267	0.5	22	0.6	0.1	0.1	0.0	0.2	15.66	21.8
05/12/89	CC-3	10:25	16.1	16.7	8.2	7.4	280	1	35	0.4	0.4	0.4	0	0.16		220
07/13/89		11:55	27.8	24.4	6.4	7.3	170	2	29	0.45	<0.2	0.61	0.41	0.23		
08/17/89		13:14	27	23	7.1	7.2	340	0.8	19	0.62	<0.2	<0.4	<0.2	0.26		
AVERAGE			23.6	21.4	7.2	7.3	263	1.3	28	0.5	0.1	----	0.1	0.2	----	220.0
			(C)	(C)	(mg/L)	(SU)	(uhmo)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(cfs)	(org/ 100 mL)

STATION CC-1



STATION CC-2

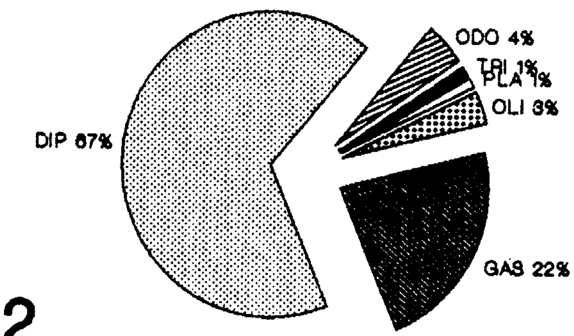
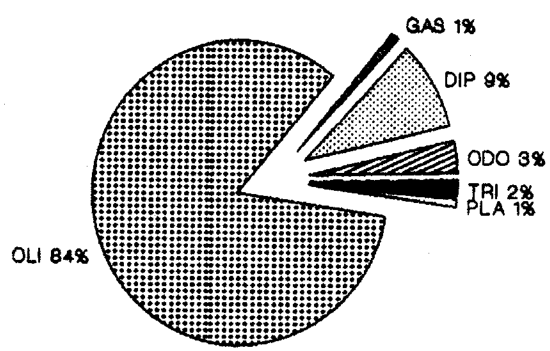


FIGURE 2

% TOTAL POPULATION OF TAXA PRESENT

CHOCCOLOCCO CREEK - AFTER UPGRADE

STATION CC-3



LEGEND

TRI - Trichoptera
ODO - Odonata
COL - Coleoptera
DIP - Diptera
HIR - Hirudinea
MOL - Mollusca
CRU - Crustacea
OLI - Oligochaeta
EPH - Ephemeroptera
MEG - Megaloptera
PLA - Planaria
HEM - Hemiptera
NEM - Nematoda
ACA - Acari
PLE - Plecoptera
LEP - Lepidoptera

TABLE 3

*

CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TOLERANCE CLASS.	HILSENHOFF BIOTIC INDEX	Data Collected After Upgrade of WWTP FY-1989 CC-1	CC-2	CC-3
INSECTA					
EPHEMEROPTERA					
Baetidae		4			
Baetis	I		0	0	0
Baetodes	?		0	0	0
Callibaetis	F		0	0	0
Cloeon	?		0	0	0
Caenidae		7			
Caenis	?		0	0	0
Ephemerellidae		1			
Attenella	?		0	0	0
Ephemerella	?		0	0	0
Serratella	?		20	0	0
Heptageniidae		4			
Heptagenia	?		0	0	0
Stenacron	?		7	0	0
Stenonema	F,I		63	0	0
Leptophlebiidae		2			
Choroterpes	?		0	0	0
Leptophlebia	?		0	0	0
Paraleptophlebia	?		0	0	0
Tricorythidae		4			
Tricorythodes	F,I		2	0	0
PLECOPTERA					
Capniidae		1			
Allocapnia	F		1	0	0
Taeniopterygidae		2			
Taeniopteryx	I		12	0	0
TRICHOPTERA					
Hydropsychidae					
Ceratopsyche	?	6	1	0	0
Cheumatopsyche	F	5	10	0	0
Hydropsyche	F,I	7	3	0	0
Hydroptilidae		4			
Hydroptila	I		0	0	0
Neotrichia	?		0	0	0
Orthotrichia	?		0	0	0
Oxyethira	I		0	0	0
Philopotamidae					
Chimarra	I	4	0	0	0
Polycenropodidae					
Cyrnellus	F	8	0	0	0
Polycentropus	?	6	3	1	2

TABLE 3
*
CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TOLERANCE CLASS.	HILSENHOFF BIOTIC INDEX	Data Collected After Upgrade of WWTP FY-1989		
			CC-1	CC-2	CC-3
Psychomyiidae		?			
Lype	?		2	0	0
ODONATA					
Aeshnidae		3			
Anax	I		0	0	0
Aeshna	?		0	0	0
Basiaeschna	?		0	0	0
Boyeria	?		0	0	0
Agrionidae		?			
Agrion	?		0	0	0
Calopterygidae		5			
Calopteryx	?		0	0	0
Hetaerina	I		0	0	0
Coenagrionidae		9			
Argia	F,I		0	2	4
Amphiagrion	?		0	1	0
Chromagrion	?		0	0	0
Enallagma	F,I		0	0	0
Ischnura	T,F		0	0	0
Cordulidae					
Epicordulia	?		0	0	0
Neurocordulia	F		0	0	0
Lestidae		9			
Lestes	?		0	0	0
Libellulidae		9			
Libellula	F		0	0	0
Macrodiplax	?		0	1	0
Pachydiplax	?		0	0	0
Perithemis	?		0	0	0
Sympetrum	?		0	0	0
Macromiidae		3			
Didymops	?		0	0	0
Macromia	F,I		0	0	0
DIPTERA					
Ceratopogonidae					
Bezzia	T	6	1	0	0
Palpomyia	F	6	0	0	0
Chironomidae			1	2	
Ablabesmyia	T,F,I	8	0	0	0
Chironomus	T,F	10	0	4	0
Cricotopus	F,I	7	21	9	7
Cryptochironomus	T	8	0	0	0
Dicrotendipes	T,F,I	8	1	0	0

TABLE 3
*
CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TOLERANCE CLASS.	HILSENHOFF BIOTIC INDEX	Data Collected After Upgrade of WWTP FY-1989		
			CC-1	CC-2	CC-3
Glyptotendipes	T	10	0	0	0
Goeldichironomus	?	?	0	0	0
Kiefferulus	T	10	0	0	0
Labrundinia	I	7	0	0	0
Larsia	F	6	0	0	0
Microtendipes	I	6	1	0	0
Nanocladius	I	3	0	0	1
Nilothauma	?	2	0	0	0
Orthocladius	F,I	6	0	0	0
Psectrocladius	F	8	0	0	0
Phaenopsectra	I	?	0	0	1
Polypedilum	F,I	6	1	2	0
Procladius	T,F	9	0	0	0
Rheotanytarsus	F	6	1	0	0
Stenochironomus	I	5	0	0	0
Tanytarsus	F,I	6	1	1	0
Thienemannimyia Group	?	6	0	44	2
Tribelos	T	10	0	0	0
Zavrelia	?	?	0	0	0
Culicidae					
Aedes	?	?	0	0	0
Simuliidae					
Prosimulium	I	6	0	0	0
Tipuliidae					
Antocha	?	3	0	1	0
NEUROPTERA	?	?	0	0	0
MEGALOPTERA					
Corydalidae					
Corydalus	F,I	6	0	0	0
Nigronia	?	0	0	0	0
Sialidae					
Sialis	F,I	4	0	0	0
HEMIPTERA		?			
Gerridae					
Trepobates	?		0	0	0
Hebridae					
Hebrus	?		0	0	0
COLEOPTERA					
Elmidae					
Ancyronyx	I	6	0	0	0
Dubiraphia	F	6	0	0	0

TABLE 3
*
CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TOLERANCE CLASS.	HILSENHOFF BIOTIC INDEX	Data Collected After Upgrade of WWTP FY-1989		
			CC-1	CC-2	CC-3
Macronychus	I	4	0	0	0
Stenelmis	T,F,I	5	0	0	0
Haliplidae		?			
Peltodytes	?		0	0	0
Hydrophilidae		?			
Ametor	?		0	0	0
Berosus	T		0	0	0
Tropisternus	T,I		0	0	0
Noteridae		?			
Hydrocanthus	?		0	0	0
Psephenidae					
Ectopria	?	5	0	0	0
LEPIDOPTERA					
Noctuidae		?			
Lithacodia	?		0	0	0
MALACOSTRACA					
AMPHIPODA		?			
Talitridae					
Hyalella	T,F		0	0	0
DECAPODA		?			
Astacidae	?		0	0	0
Cambaridae	?		0	0	0
ISOPODA		?			
Asellidae					
Asellus	T,F,I		0	0	0
Lirceus	F		1	0	0
GASTROPODA		?			
LIMNOPHILIA					
Ancylidae					
Ferrissia	T,F		2	0	0
Laevapex	?		0	1	0
Hydrobiidae					
Amnicola	I		0	0	0
Physidae					
Physella	T		0	0	1
Planorbidae					
Helisoma	T		0	0	0
Planorbula	?		0	0	0
Pleuroceridae					
Elimia	?		0	0	0
Pleurocera	F		0	0	0

TABLE 3

*

CHOCCOLOCCO CREEK AT ANNISTON, ALABAMA
MACROINVERTEBRATE DATA

MACROINVERTEBRATE	TOLERANCE CLASS.	HILSENHOFF BIOTIC INDEX	Data Collected After Upgrade of WWTP FY-1989 CC-1	CC-2	CC-3
BIVALVIA		?			
Fresh Water Mussel					
Corbiculidae			0	0	0
Corbicula	I		0	0	0
ANNELIDA		?			
OLIGOCHAETA	T,F		0	3	97
HIRUDINEA					
Erpobdellidae	T,F		0	0	0
Glossiphoniidae					
Helobdella	T		0	0	0
PLANARIA	F	?	2	1	1
NEMATODA	F	?	0	0	0
ACARI	?	?	0	0	0
Total # Organisms			157	73	116
Total # Taxa			21	14	9
#H-D Plates / Sample			2	2	1
# Organisms/ Meter Squared			785	365	1160
EPT Index			11	1	1
% Contribution of Dominant Taxa			40.	60.3	83.6
Species Diversity ($\bar{d}$)			3	2.25	1.07
Equitability (e)			0.5	0.46	0.28
Sorenson's Community Similarity (as compared to reference station CC-1)			---	0.17	0.11
# of Dominant Organisms in Common (as compared to reference station CC-1)			---	1	1
Indicator Assemblage Index (as compared to reference station CC-1)			---	0.11	0.1

BIBLIOGRAPHY

Hilsenhoff, William L., 'An Improved Biotic Index of Organic Stream Pollution', The Great Lakes Entomologist. Vol. 20, No. 1, 1987.

Plafkin, James L., Rapid Bioassessment Protocols for Use in Streams and Rivers: Benthic Macroinvertebrates and Fish. EPA/444/4-89-001, (USEPA, Washington D.C., May 1989).

Weber, Cornelius I., Biological Field and Laboratory Methods for Measuring the Quality of Surface Waters and Effluents. EPA-670/4-73-001, (USEPA, Cincinnati, July 1973).