WATER QUALITY DEMONSTRATION STUDY

MOORE CREEK
HALEYVILLE, ALABAMA
1989 AND 1990

SPECIAL STUDIES SECTION
FIELD OPERATIONS DIVISION
ALABAMA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

WATER QUALITY DEMONSTRATION STUDY
MOORE CREEK AT HALEYVILLE, ALABAMA
1989 AND 1990

INTRODUCTION

The City of Haleyville in Marion county, Alabama utilizes Moore Creek as a receiving stream for the treated effluent from its municipal wastewater treatment facility. During the period of May 1989 to September 1990 the old disposal plant for the City of Haleyville was under construction to upgrade its´ treatment facility. Staff members of the Special Studies Section 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 Moore Creek.

EPA CONSTRUCTION GRANTS PROGRAM

Since 1972, approximately $545 million dollars in EPA grant funds have been expended toward construction of municipal wastewater treatment works in Alabama.

In December 1977, the City of Haleyville was awarded an EPA grant for Facility Planning to determine the most cost-effective alternative of enlarging their two wastewater treatment plants to serve the projected population and wastewater flows, and to upgrade their treatment plants so that water quality standards would be maintained in the receiving streams. At that time, the City of Haleyville had a 0.44 million gallon per day (mgd) trickling filter wastewater treatment plant (WWTP) discharging to Flat Creek and a 0.3 mgd extended aeration WWTP discharging to Moore Creek. Neither plant had the capacity to serve the projected growth or meet water quality standards without modifications and upgrading. The 201 Facility Plan indicated that a 0.8 mgd WWTP was needed to serve Haleyville and that it was more cost-effective to upgrade the South Haleyville WWTP and discharge to Moore Creek. The Schreiber counter-current aeration system was selected as the most cost-effective method of treatment to achieve tertiary treatment limitations.

In September 1988, the City of Haleyville received a $681,206 EPA Step III construction grant to upgrade the WWTP. Almon and Associates was selected as the project engineer and the construction contract was awarded in December 1988 for $1,247,759 to B.H. Craig Construction Co. A new force main was constructed from the North Haleyville WWTP to the South plant. The treatment process consists of a bar screen with grit and grease removal, an aeration basin with integral clarifier, sludge thickener, sludge drying beds, and chlorination/dechlorination facilities. Construction began in March 1989 and was completed in March 1990.

The Schreiber counter-current aeration system is an extended aeration process. The treatment system is unique in that the air diffusers move on a rotating bridge rather than having to maintain liquid scouring velocities. This process takes advantage of reductions in air requirements for mixing in low conditions while providing high oxygen transfer capabilities.

The South Haleyville WWTP discharges treated wastewater to Moore

Creek. Seasonal NPDES permits for the WWTP are as follows:

	May-Nov	Dec-Apr
BOD_5	20 mg/L	20 mg/L
TSS	30 mg/L	30 mg/L
NH_3-N	3 mg/L	10 mg/L
D.O.	6 mg/L	6 mg/L

Average monthly performance by the treatment facility for the period from May 1990 through January 1991 is as follows:

Flow	0.745 mgd
BOD_5	10.1 mg/L
TSS	9.6 mg/L
NH_3-N	1.5 mg/L
D.O.	6.6 mg/L

FIELD OPERATIONS

During May through September, 1989, staff members of the Special Studies Section collected data to establish conditions, and provide a comparative base of information on Moore Creek. This sampling was accomplished prior to construction and implementation of the new plant. During May through September, 1990, data were collected to demonstrate the improvement, if any, of water quality in the receiving stream attributable to the new plant.

SAMPLING LOCATIONS AND METHODOLOGIES

Physical, chemical, and biological water quality data were collected at the following locations:

MR-1 - (Control) Moore Creek approximately 75 feet upstream of treatment plant. Lat 034° 12´ 53.7" Lon 087° 38´ 35.5" T10S, R11W, S1, NE1/4, SW1/4, SW1/4.

MR-2 - Moore Creek approximately 0.4 miles downstream of treatment plant just above confluence with small unnamed tributary. Lat 034° 12´ 37.1" Lon 087° 38´56.4" T10S, R11W, S1, SW1/4, NW1/4, SE1/4.

MR-3 - Moore Creek approximately 0.8 miles downstream of treatment plant. Lat 034° 12´41.8" Lon 087° 39´16.3" T10S, R11W, S2, SE1/4, NE1/4, NE1/4.

MR-4 - Moore Creek approximately 2.0 miles downstream of treatment plant at Marion County Road 81 bridge crossing. Lat 034° 12´ 37.1"Lon 087° 40´06.6" T10S, R11W, S2, SE1/4, NE1/4, SE1/4.

All physical data, chemical and biological sample collection and handling, and field parameter analyses for this water quality demonstration study were in accordance with the ADEM Field Operations Division <u>Standard Operating Procedures and Quality Assurance Manual</u>, Volumes 1 and 2, as amended. Chain-of-Custody was maintained by locking the samples in a Departmental vehicle when not in the sight of Field Operations personnel. The samples requiring laboratory analysis were transported to the ADEM Environmental Laboratory in Montgomery, Alabama. Analysis methodologies 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.

DISCUSSION AND RESULTS

A. Physical

Moore Creek at MR-1 is a first order stream in a predominantly forested area. At the time of the study, the tree canopy completely shaded the streambed. The average stream width was approximately 5 feet and the estimated stream depth was 0.1 to 0.3 feet. Stream flow was estimated at < 0.1 cubic feet per second (cfs). There was little evidence of local watershed erosion or nonpoint source (NPS) pollution, other than slight sand and silt deposition. There were no odors, surface oils or turbidity observed. The Habitat Assessment (Table 4) classified the habitat quality as "good" with a score of 75. This station was lacking several of the more productive habitats necessary for maintaining a high quality biological community. The stream bottom was dominated by bedrock (95%). Few undercut banks with exposed root masses, and rocks with sheltered surfaces, both usually productive habitats, were uncommon. There was very little organic matter that could be used as a food source for organisms inhabiting the area.

Moore Creek at MR-2, also a first order stream in a predominantly forested area, had an average stream width of approximately 4 feet and an estimated stream depth of approximately 0.5 to 1 foot with a closed canopy. Flow at this station consisted primarily of the effluent discharge from the WWTP (Figure 1). Using the 0.5 foot Parshall flume,flow was calculated to average 0.40 cfs prior to upgrade and 0.99 cfs after upgrade. There was evidence of NPS pollution having occured during rain events from the raw slope leading down to the WWTP effluent pipe. Slight deposits of sludge were present on the substrate as were hydrogen sulfide odors. The water odors were normal without surface oils. Though no turbidity was noted, the water had a distinct red color. The bottom was composed primarily of bedrock, gravel, and sand, with lesser amounts of cobble, silt and boulder. The Habitat Assessment Matrix (Table 4) also classified the habitat quality as "good" with a score of 89. This station was also susceptable to scouring of the bedrock and gravel, especially with the introduction of sand from NPS pollution.

At station MR-3, Moore Creek is a second order stream formed by its convergence with a first order, unnamed tributary. The surrounding land is predominantly forested providing a shaded canopy for the creek. During the study period the estimated stream width was approximately 9 feet with a depth ranging from 0.5 feet in the faster moving riffle areas to 2.5 feet in pools. The possibility of NPS pollution existed at this station from the raw slope at the STP, especially during a heavy rain event. The sediment odor was of hydrogen sulfide and the undersides of stones not deeply embedded were black, indicating that anaerobic conditions were evident at or near the surface of the substrate. The water odors were normal and there were no surface oils. The water color was described as "dark red". The bottom substrate consisted mostly of sand and gravel (80%) with the remaining composed of cobble, boulder, silt and sludge. The Habitat Assessment Matrix assigned a "Good" habitat quality (Table 4) with a value of 87. This station was also found to be susceptable to the scouring effects of sand during high flow events.

Moore Creek is a third order stream at station MR-4, created by the confluence of Moore Creek and an unnamed, second order stream. The average flow over the sampling period prior to upgrade was 6.23 cfs. After upgrading the WWTP the flow averaged 5.28 cfs. The predominant surrounding land use continued to be forests with a partly shading canopy cover over the creek. The stream width was estimated to be 23 feet with an average stream depth estimated at 0.2 to 0.7 feet in the riffle-run areas and 1.5 to 2.0 feet in the pools. There was some evidence of possible local watershed erosion but no potential sources were identified. All the substrate characteristics were considered normal. Some slight sand deposits were noted. The substrate was composed of 75% gravel and sand, with the remaining comprised of cobble, boulder, and silt. Rooted aquatic macrophytes were present. The water odor and color were normal with no surface oils, turbidity or color present. The Habitat Assessment Matrix assigned a habitat quality of "excellent" (Table 4) with a value of 109; indicating adequate habitat was present to sustain a healthy macroinvertebrate population. Scouring was considered to be less of a problem here than at the other stations.

B. Chemical

Moore Creek has a Water Use Classification of Fish and Wildlife. This assigns the best usage of the waters for fishing, propagation of fish, aquatic life, and wildlife, and any other usage except for swimming and water-contact sports or as a source of water supply for drinking or food processing purposes. As seen in Table 1, Table 2 and Figures 2 through 5, the average dissolved oxygen (D.O.) values for each station consistently met the 5 milligram per liter (mg/l) standard for Fish and Wildlife. It should be noted, however, that at station MR-3 prior to upgrade, there were 3 occasions where D.O. concentrations fell below the 5 mg/l standard. After the upgrade all measured D.O. concentrations were in compliance with the dissolved oxygen standard. Average Total Suspended Solids (TSS) and 5-day Biochemical Oxygen Demand (BOD_5) generally decreased for all stations after the upgrade. Flow data indicates that the average flow at MR-2 increased from greater than four times the flow at MR-1, to greater than 10 times the flow at MR-1 after the upgrade. The average flow at MR-4 decreased after the upgrade from 16 times that of the average flow of MR-2, to five times the average flow of MR-2.

Chloride determinations were made during the post-upgrade sampling period. Concentrations of up to 100 times background were found at station MR-2 with decreasing values as one progresses downstream. These elevated values may be due to textile plant effluent being routed through the wastewater treatment facility.

The nutrient concentrations, as seen in Table 1, Table 2 and Figures 2 through 5, are generally higher after the upgrade. The upstream station, MR-1, showed higher average Nitrates (NO_3), Kjeldahl (TKN) and Organic Nitrogen (TON), after, as compared to before, the upgrade. The latter two averages were greatly influenced by one data point. The average NO_3 concentration of the first station downstream of the discharge increased after the upgrade, while all other chemical parameters showed improvement over the pre-upgrade situation. Average NO_3 and Ammonia (NH_3) concentrations were higher at MR-3 after the upgrade. MR-4 had higher concentrations of NO_3, NH_3, TKN, TON, and Phosphate (PO_4) after upgrade. It should also be noted that on several individual sampling trips several nutrient values increased, instead of decreasing, as one progressed down stream from MR-2 to MR-3 and/or MR-3 to MR-4. This occurred both prior to, and after, upgrade of the wastewater treatment facility. Potential impacts from two small tributaries to Moore Creek between MR-2 and MR-3, and the three small tributaries between MR-3 and MR-4, may be responsible. The tributaries between MR-2 and MR-3 drain residential areas with one crossing under a major highway. Agricultural operations occur in the vicinity of the tributaries entering between MR-3 and MR-4. These tributaries may be contributing to the nutrient loading of these stream segments.

C. Biological

An assessment of Moore Creek water quality would be incomplete with out considering impacts to its biological community. The aquatic macroinvertebrate community was surveyed using the RBP-Multihabitat sampling method to substantiate the physical and chemical data and to provide a view of pollution response over time.

Biological metrics were used to analyze the raw benthic data. Table 4 provides simplified interpretations of these metrics and should be referred to in the following discussion.

The macroinvertebrate community, as illustrated in Tables 3A through 4 and Figures 6 through 9, showed a definite adverse impact from the pre-upgrade discharge. This impact was reflected in the dramatic change seen in the Biotic Index, which increased from 3.14 at station MR-1 to 9.60 at MR-2, indicating a shift from intolerant organisms, to organisms very tolerant of organic pollution. A partial recovery in the quality of the organisms present was noted as one progresses downstream. The EPT Index (Ephemeroptera, Plecoptera, and Trichoptera) also showed a definite adverse impact. The Index drops from an EPT of 8 at MR-1, to 0 at MR-2 indicating a complete loss of these generally pollution intolerant organisms. As with the Biotic Index, a recovery is noted as one progresses downstream. The post-upgrade community, as seen in Figure 6 and 7, showed major improvement of the Biotic Index at all stations and an improvement at MR-2 of all biometric indices. As seen in Table 3A and 3B, the percent composition of the dominant taxon (% Dom. Taxa) at station MR-2 did not change after the upgrade. This is considered an improvement when taking into account the greater intolerance to organic pollution of the post-upgrade dominant organism (See Table 4). Figures 8 and 9 compare pre- to post-upgrade communities in terms of their balance of indicator-type organisms (IAI), their similarity, in functional feeding group structure (QSI-FFG), and taxa present (Comm. Loss Index and Sorenson's CSI). Figures 10 and 11 illustrate the pre- and post-upgrade functional feeding group structure for all stations. It can be noted that there is an improvement in the balance of the functional feeding groups at MR-2 after the upgrade of the WWTP. Table 5 summarizes the relative changes in the pre- and post-upgrade biological indices. Data indicated a definite improvement in the community after upgrade at MR-2, some improvement at MR-3, and little or no change at MR-4. The less dramatic changes at MR-3 and MR-4 may be due in part to the influence of the tributaries as described earlier.

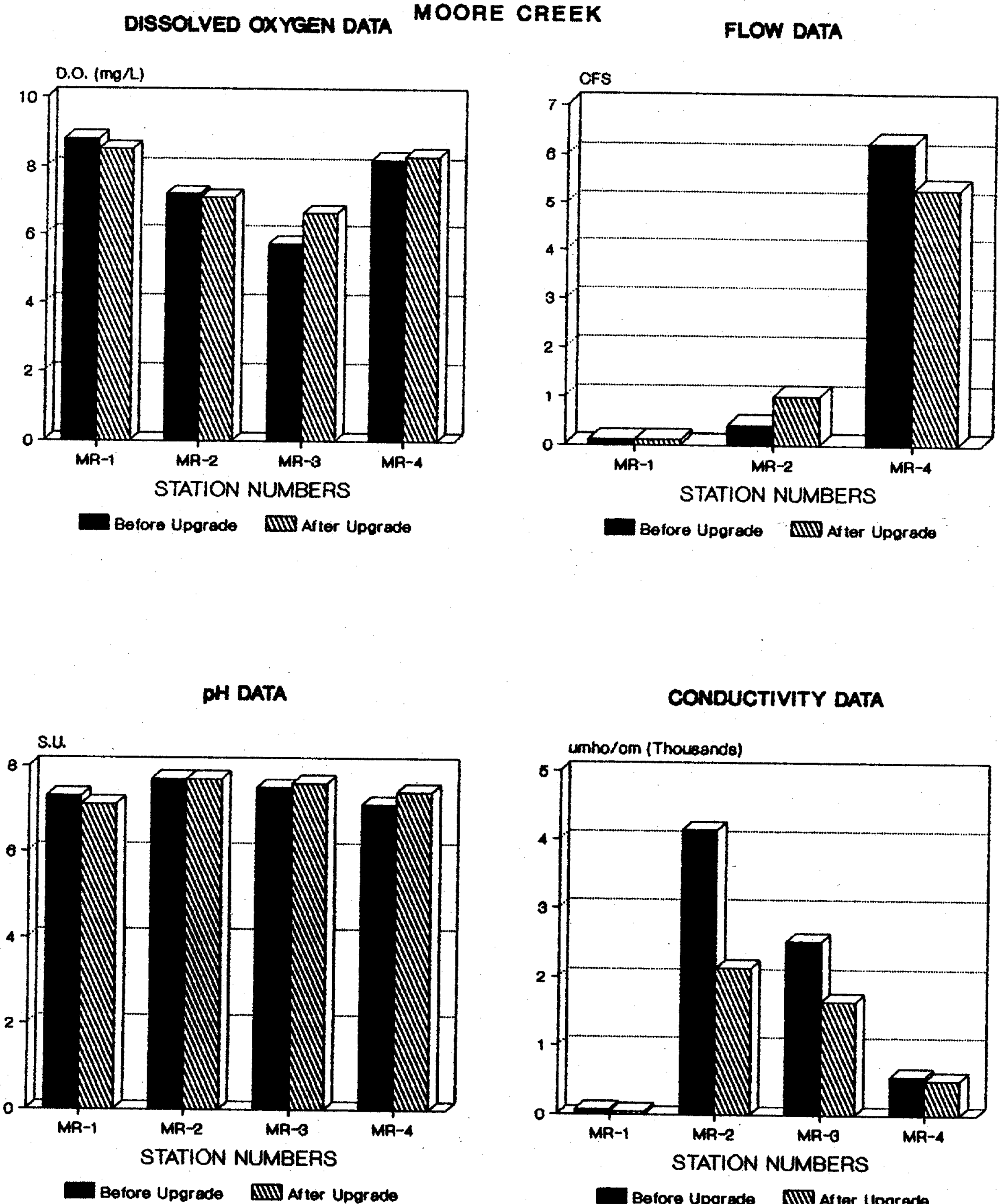
Adequate habitat quantity and quality are also important factors when considering the macroinvertebrate community. As noted in Section A, MR-1 is lacking several of the more productive habitats. MR-2 and MR-3 have experienced some habitat degradation due to sludge and sand deposits from the effluent discharge and NPS pollution, but were considered to have adequate habitat. MR-4 was found to have excellent habitat with very little degradation of quality. When habitat is considered, the apparent severity of the effluent's impact on the biota is increased. MR-4 with "excellent" habitat has attained, after effluent upgrade, the community quality of MR-1 with only "good" habitat.

CONCLUSIONS

Physical, chemical, and biological data indicate that the upgrade of the wastewater treatment facility discharging to Moore Creek has improved the overall water quality of the portions of Moore Creek directly downstream of the discharge. Improvement is less noticeable as one progresses further downstream. Lack of improvement further downstream may be attributable to factors other than the effects of the wastewater treatment facility discharge. However, at the time of this study the entire study reach was meeting its Fish and Wildlife Water Use Classification.

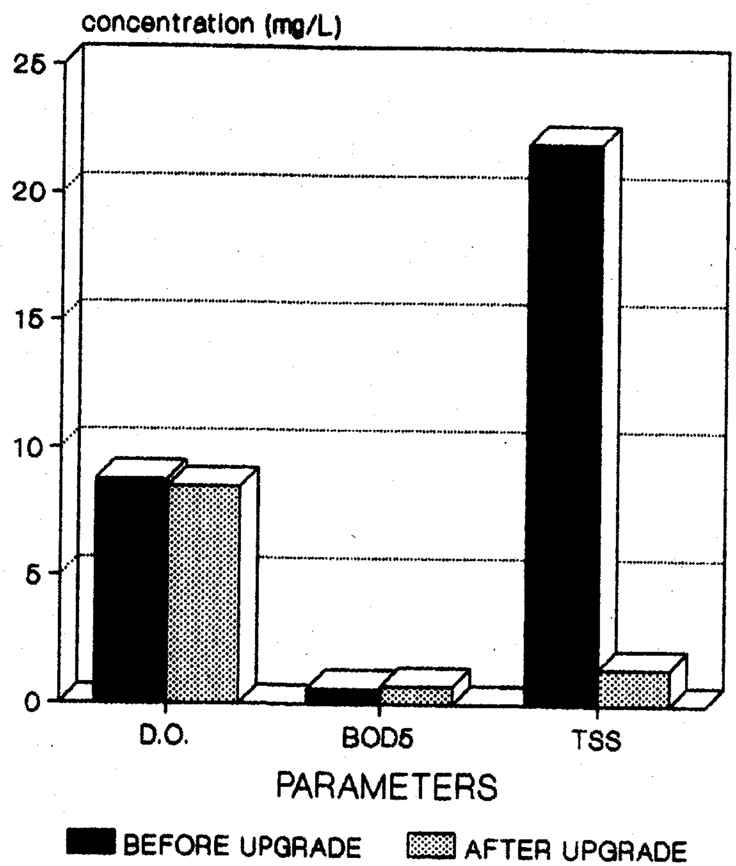
FIGURE 1

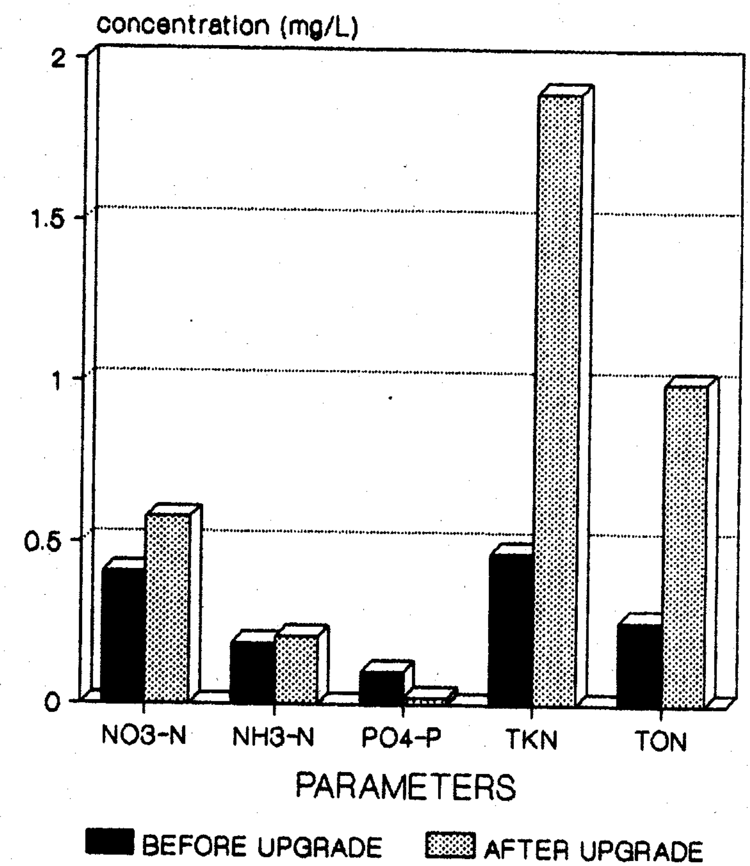
MOORE CREEK



THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS

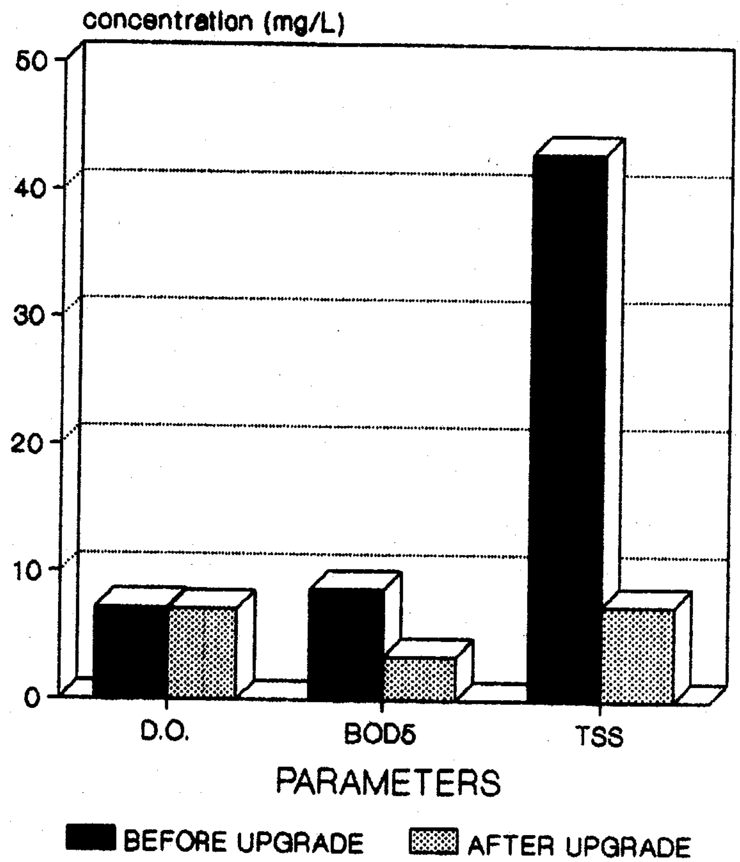
FIGURE 2
MOORE CREEK (MR-1)
CHEMICAL ANALYSIS DATA

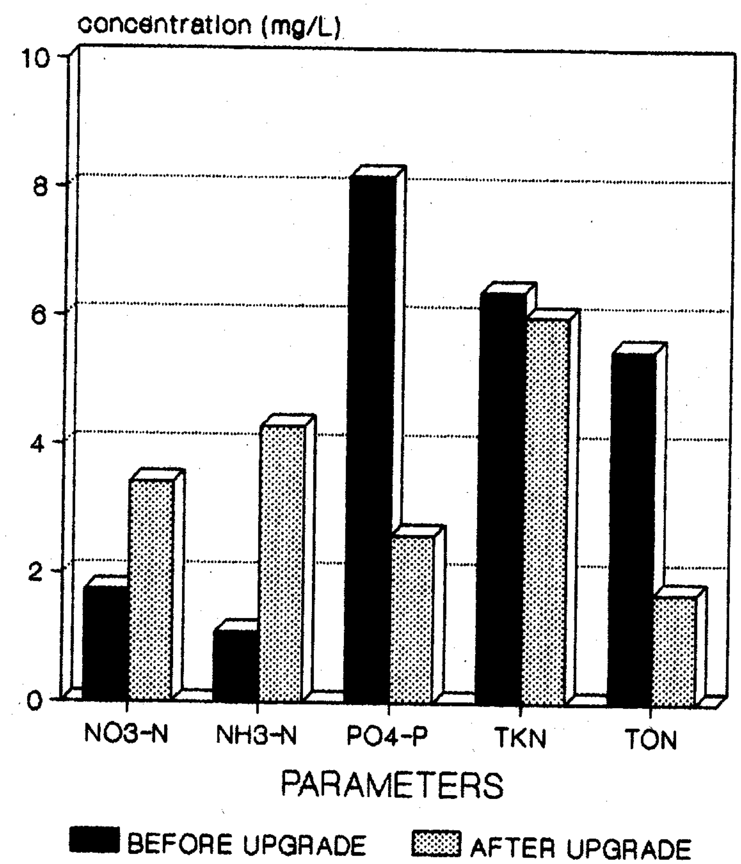




THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS

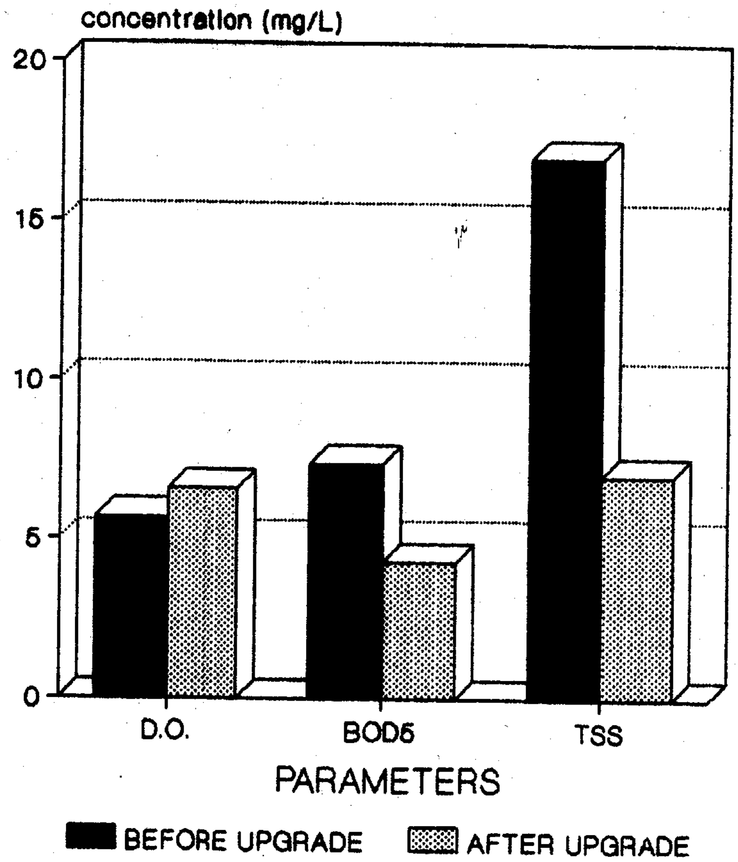
FIGURE 3
MOORE CREEK (MR-2)
CHEMICAL ANALYSIS DATA

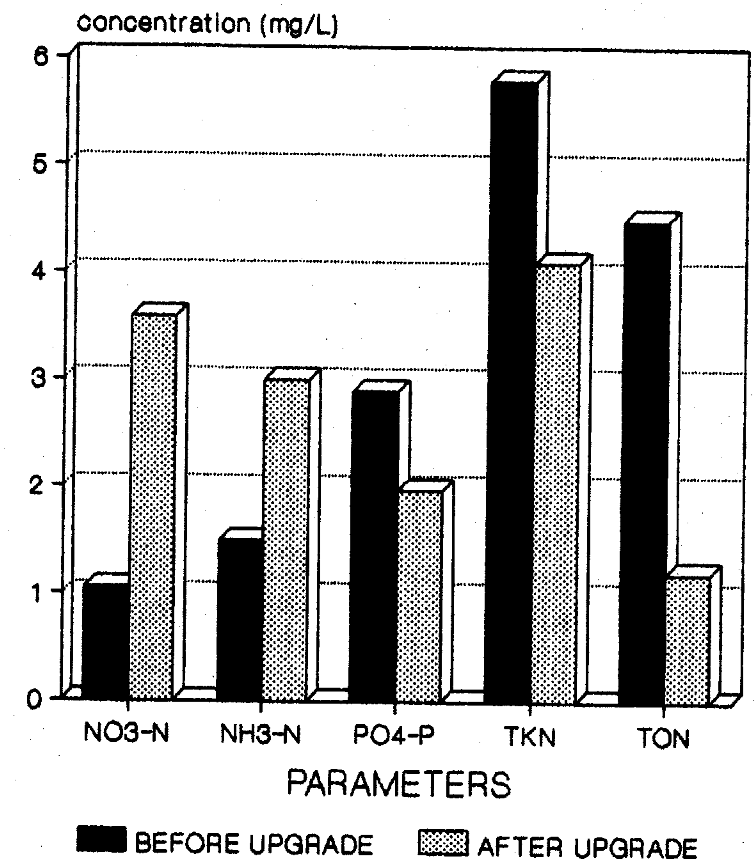




THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS

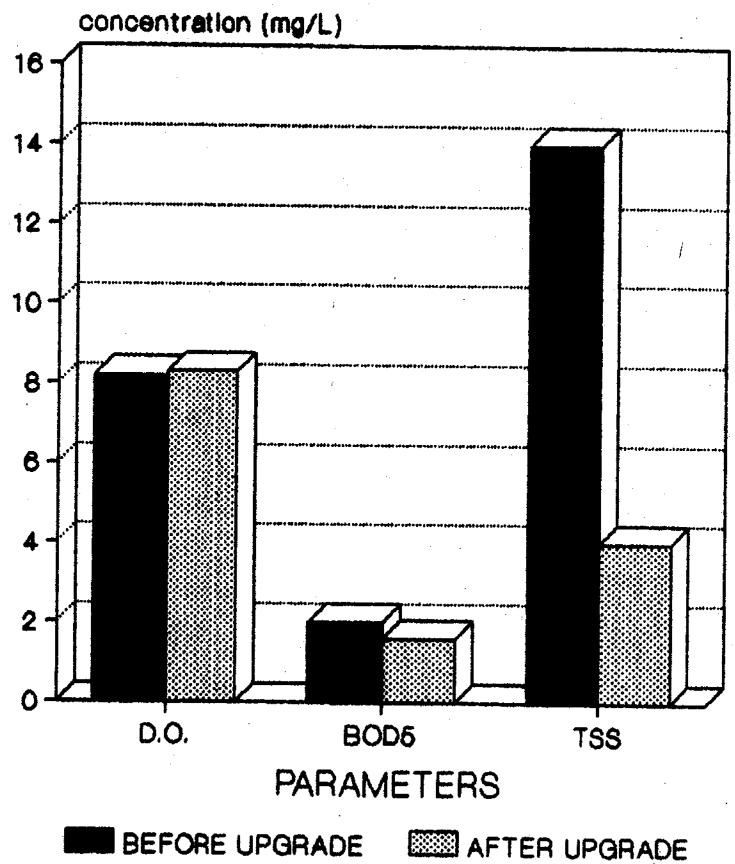
FIGURE 4
MOORE CREEK (MR-3)
CHEMICAL ANALYSIS DATA

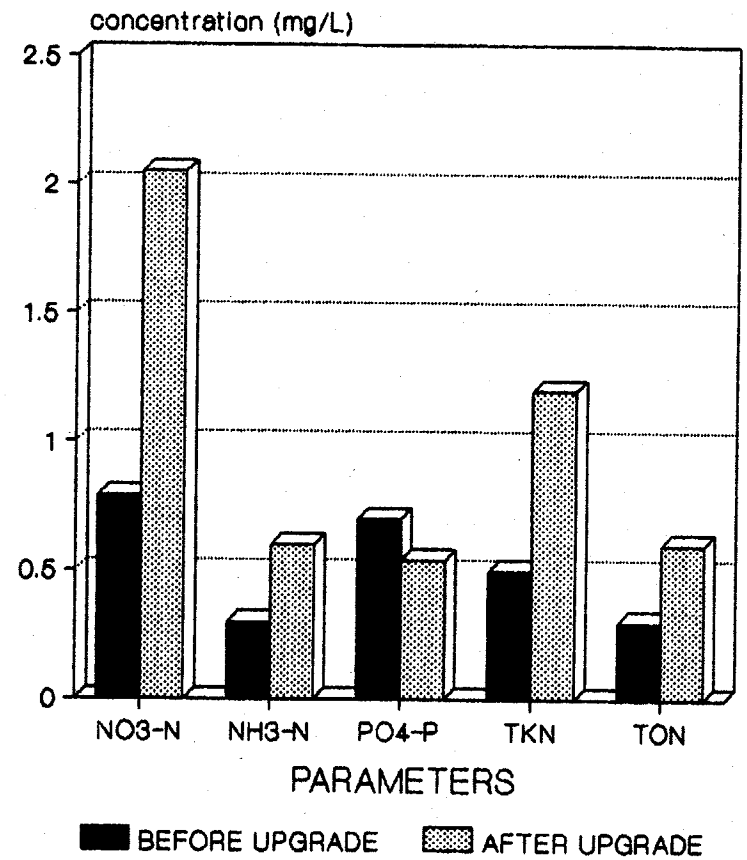




THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS

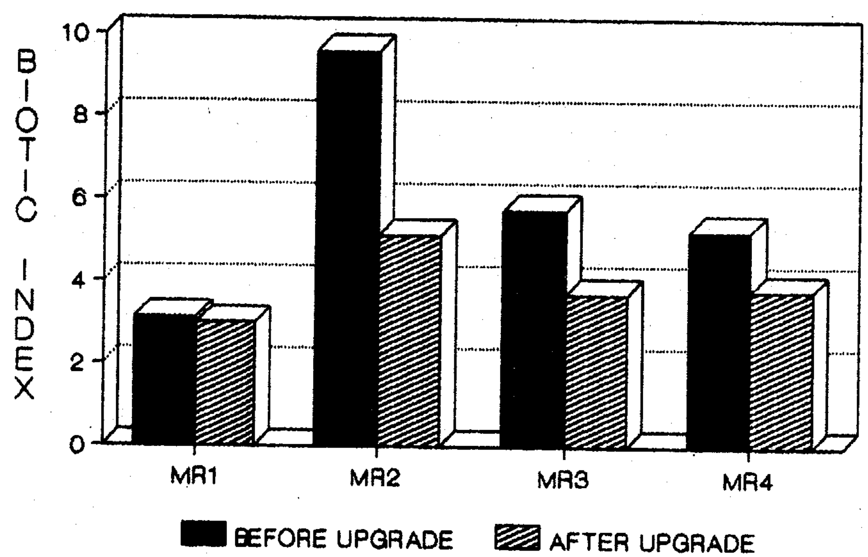
FIGURE 5
MOORE CREEK (MR-4)
CHEMICAL ANALYSIS DATA

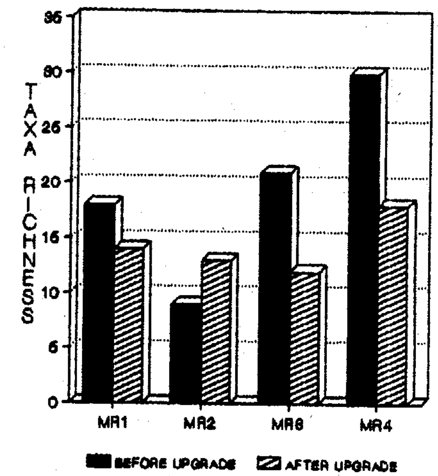




THE ABOVE NUMBERS ARE AVERAGES REPRESENTING MULTIPLE SAMPLING EVENTS

FIGURE 6
MOORE CREEK
BIOMETRIC INDICES





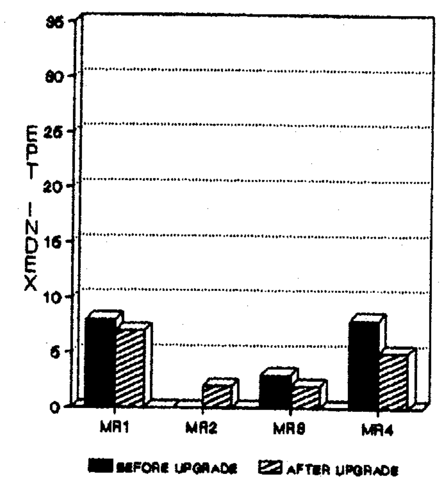
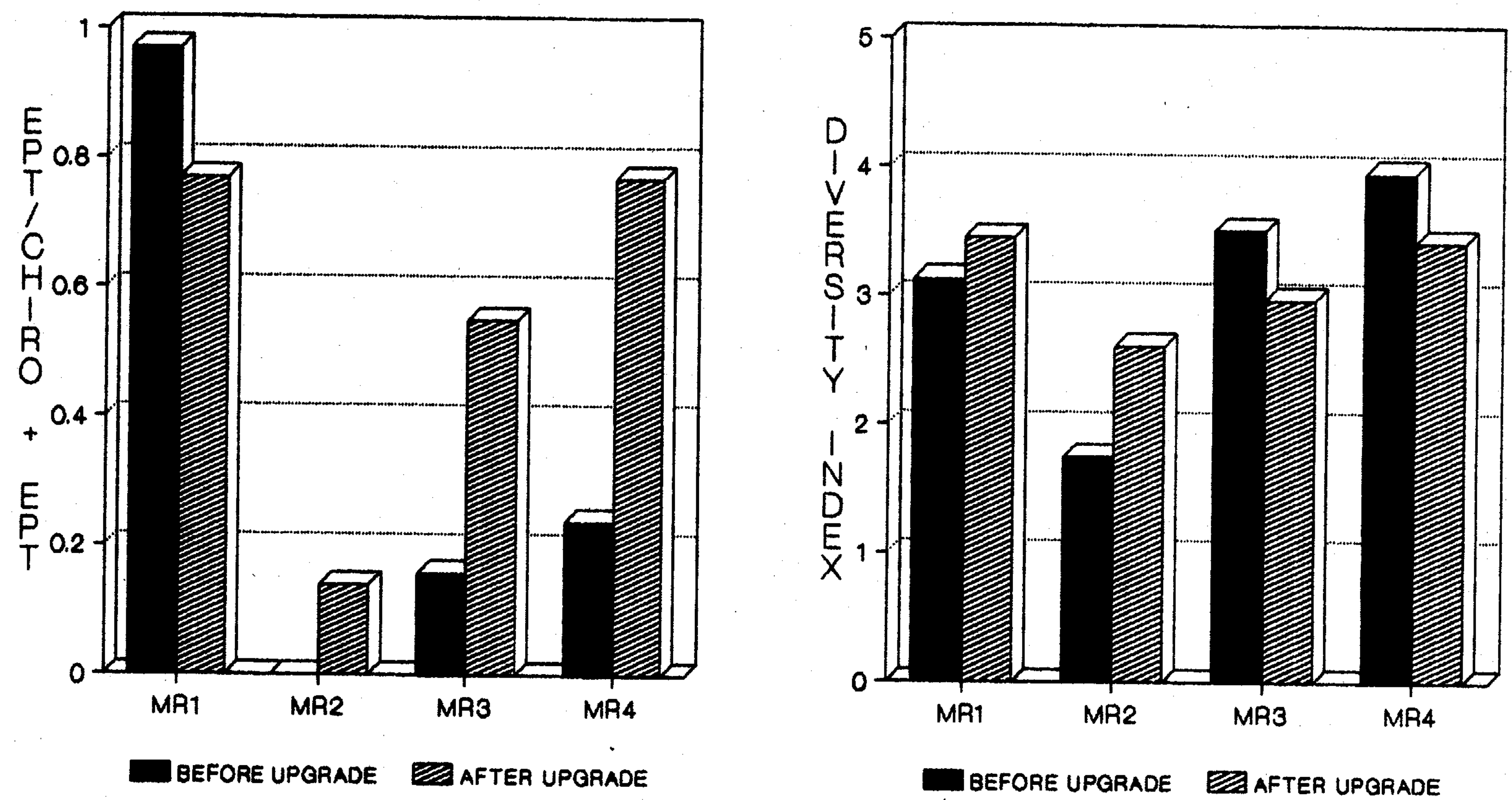


FIGURE 7
MOORE CREEK
BIOMETRIC INDICES



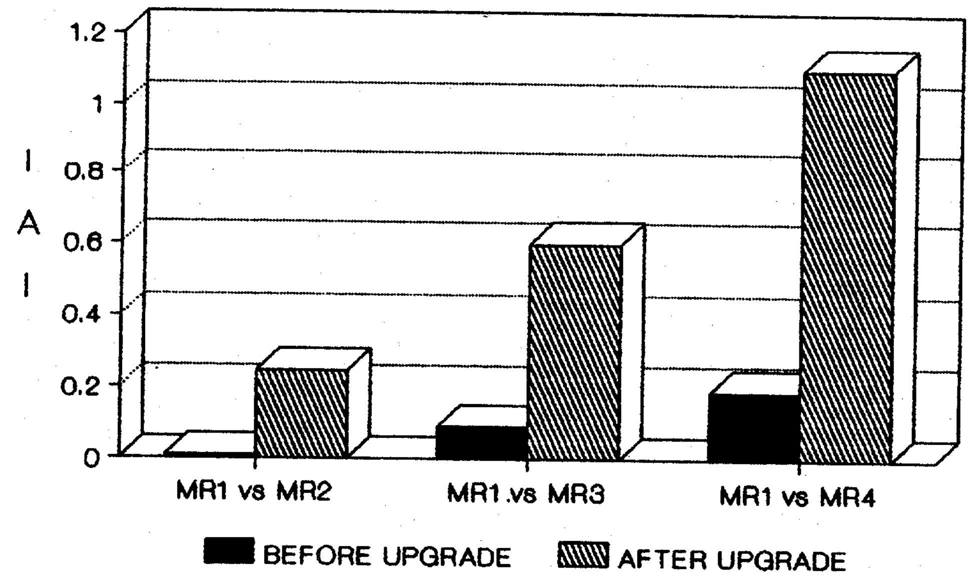
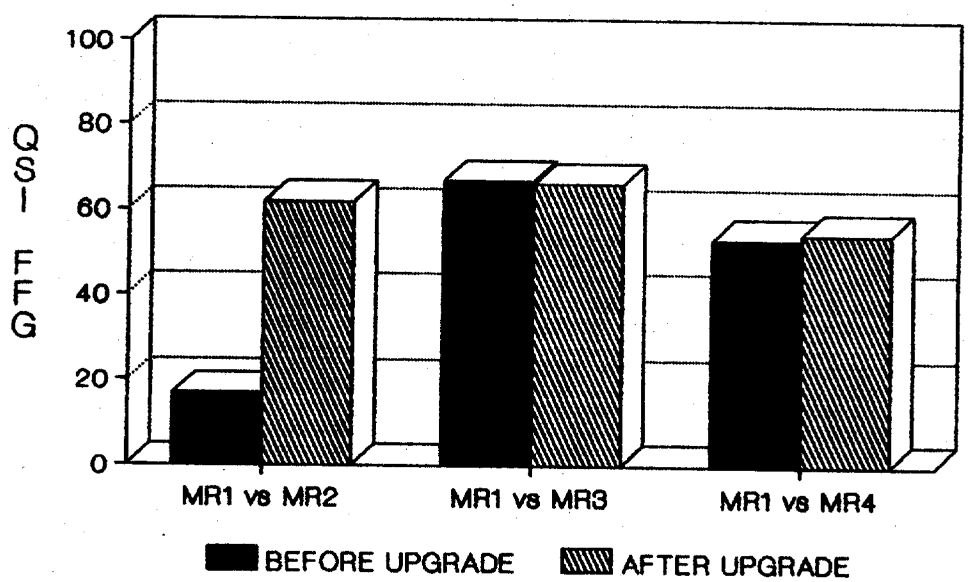


FIGURE 8
MOORE CREEK
BIOMETRIC INDICES



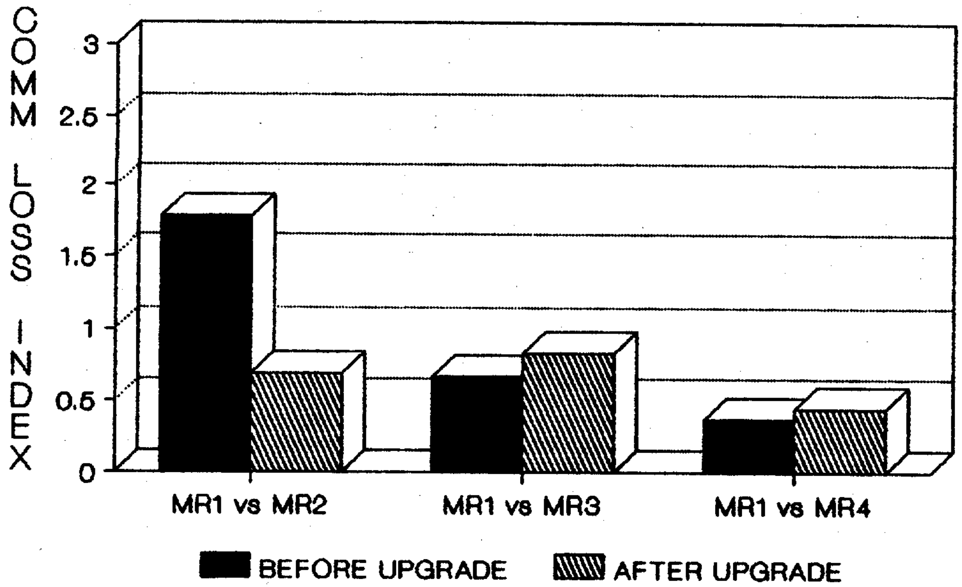


FIGURE 9
MOORE CREEK
BIOMETRIC INDICES

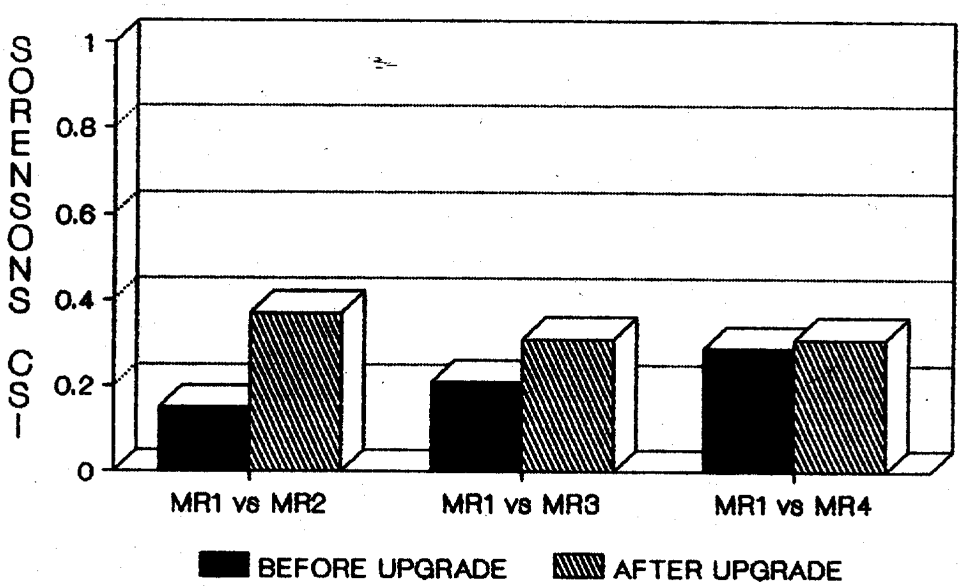
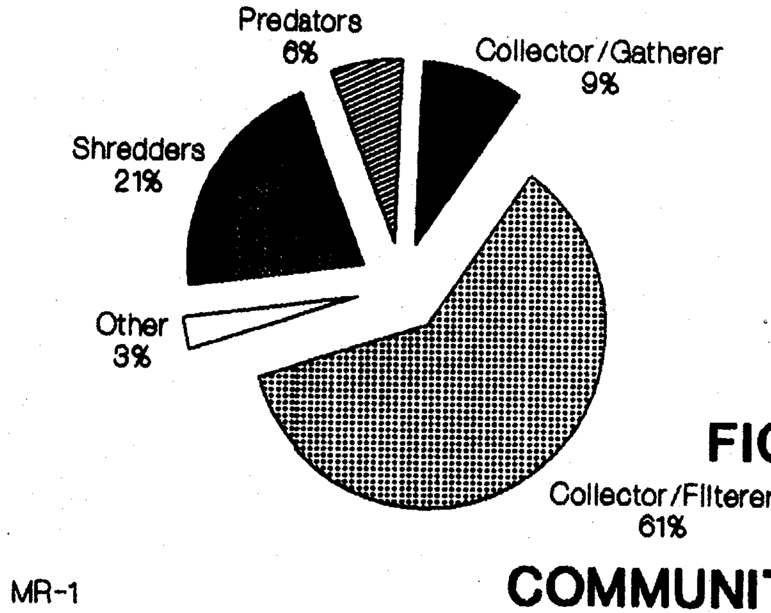
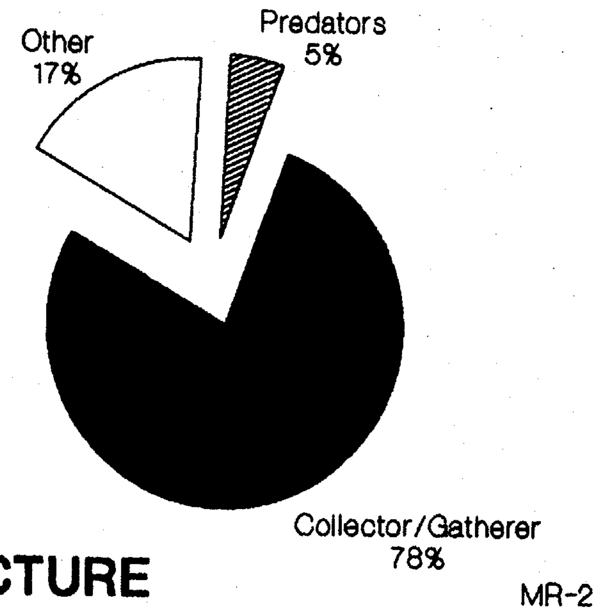


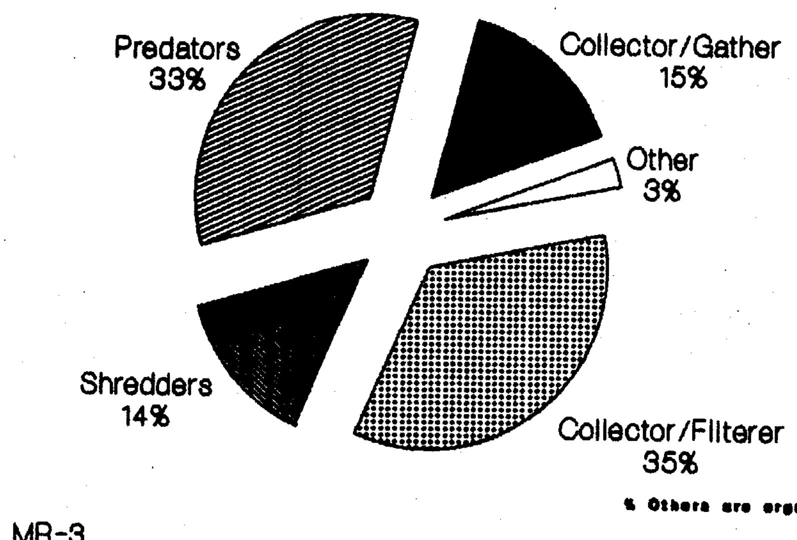
FIGURE 10

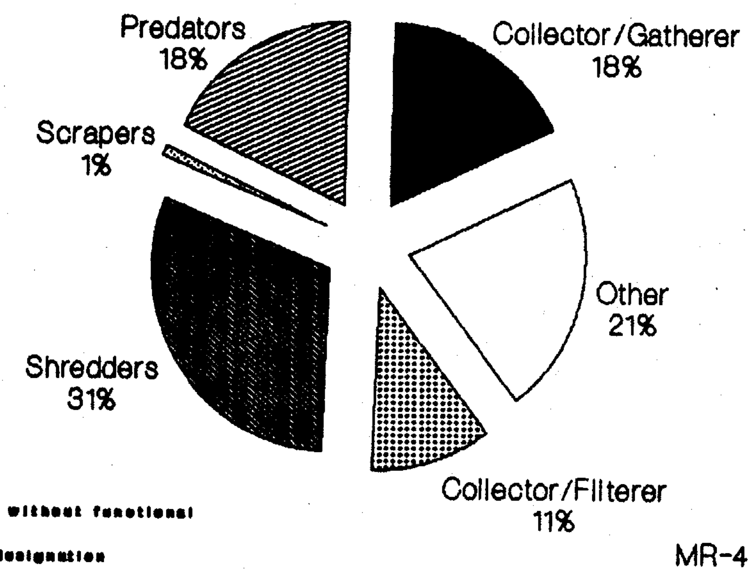
COMMUNITY STRUCTURE

BEFORE UPGRADE









% Others are organisms without functional feeding group designation

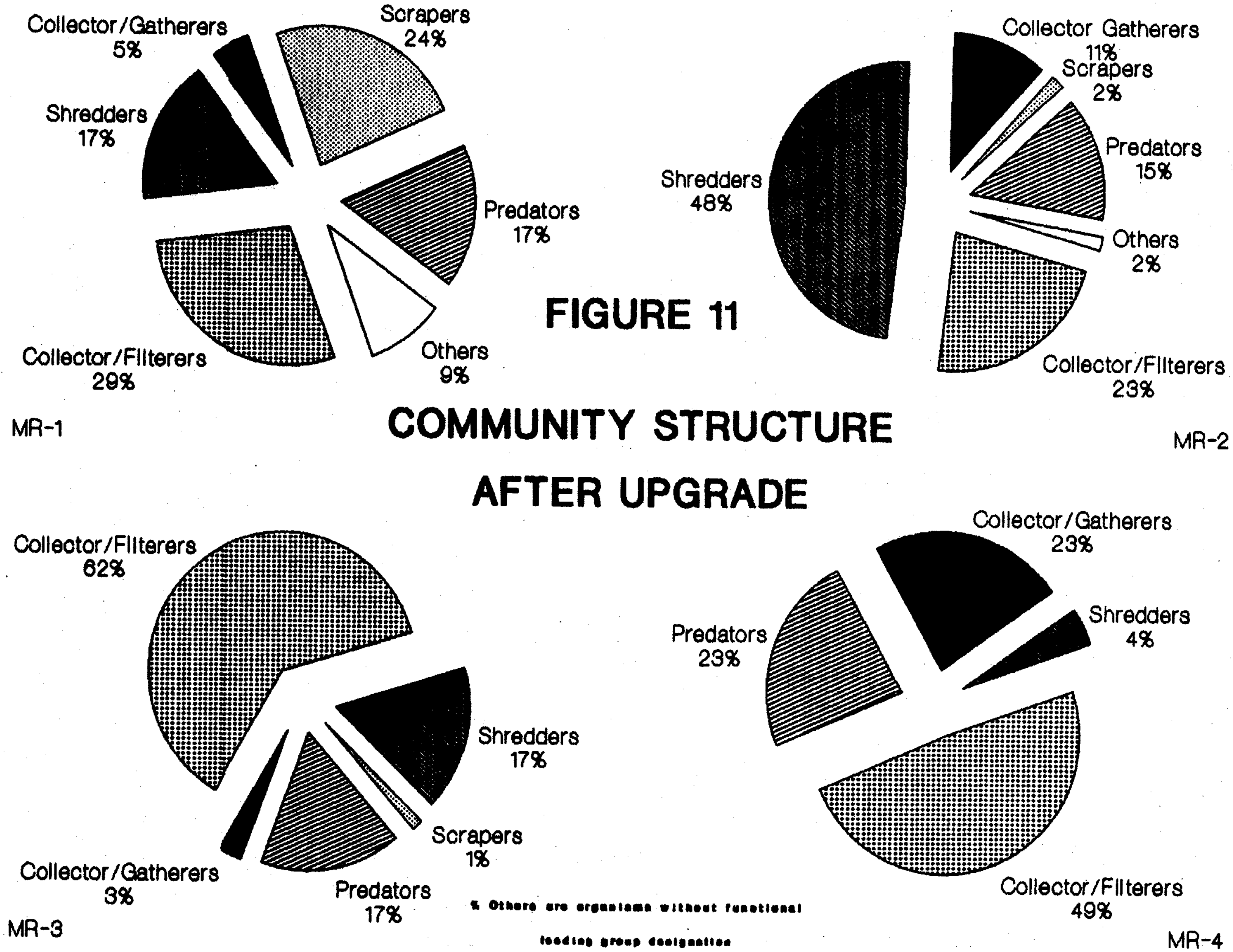


FIGURE 11

COMMUNITY STRUCTURE AFTER UPGRADE

% Others are organisms without functional feeding group designation

TABLE 1

WATER QUALITY DEMONSTRATION STUDY
MOORE CREEK AT HALEYVILLE, ALABAMA
DATA COLLECTED PRIOR TO UPGRADE OF WWTP

DATE	LOCATION	TIME	AIR TEMP	WATER TEMP	D.O.	pH	SPECIFIC COND	BOD 5	TSS	NO -N 3	NH -N 3	TKN	TON	PHOS TOT	FLOW	BACTERIA
05/10/89	MR-1	16:05	21.1	17.8	9.5	7.9	35	0.2	3	0.54	0.3	0.4	0.1	<0.02	----	14
07/19/89		11:30	22.8	20	8.6	7.8	40	1	16	0.21	<0.2	<0.4	<0.2	<0.02		
07/20/89		09:29	21.1	19.4	8.6	7.8	35	0.3	3	0.25	<0.2	<0.4	<0.2	<0.02		53
08/22/89		14:30	31.1	26.1	7.8	7	50	1.1	18	0.51	<0.2	<0.4	<0.2	<0.02	<0.1	
08/23/89		06:20	22.8	21.7	8.6	6.8	50	0.3	16	0.58	<0.2	0.85	0.65	<0.2		330
09/28/89		11:43	13	15	9.7	7.3	40	1.1	75	0.35	<0.2	<0.4	<0.2	0.06		
AVERAGE			22.0	20.0	8.8	7.4	42	0.7	22	0.41	----	----	----	----	----	132.3
05/10/89	MR-2	16:05	21.1	21.7	7.5	7.9	5000	18	84	0.46	3.2	8	5.8	27	0.45	<10
07/19/89		11:41	23.3	21.7	8.2	7.1	380	2.5	74	6.73	<0.2	1.91	1.71	1.22	0.16	
07/20/89		09:39	21.7	23.3	7.9	7.1	2900	2.5	9	2.73	<0.2	1.91	1.71	2.06		<1
08/22/89		15:25	29.4	30	5.6	8.1	7000	10	28	0.3	1.43	11.28	9.85	7.2	0.6	
08/23/89		06:30	22.2	27.8	5.7	8	5300	11	23	0.12	1.12	8.72	7.6	7.5		>600
09/28/89		11:51	13	22	8	8	4200	>8.3	38	0.1	<0.2	6.37	6.17	4.5		
AVERAGE			21.8	24.4	7.2	7.7	4130	---	43	1.74	----	6.4	5.5	8.2	0.40	---
05/10/89	MR-3	16:15	21.1	20.6	3.2	7.6	3000	19	38	0.2	4.8	18.4	13.6	4		143
07/19/89		12:01	23.3	20.6	7.8	7.1	160	3.5	12	2.11	<0.2	0.85	0.65	0.42		
07/20/89		09:55	21.7	21.1	7.5	7.2	1450	3.5	6	2.28	<0.2	1.48	1.28	1.02		23
08/22/89		16:00	26.7	26.7	4.4	7.8	5000	7	18	0.63	1.12	7.66	6.54	5.25		
08/23/89		06:50	23.3	23.9	4.6	7.7	3000	5	7	0.72	0.82	4.04	3.22	3.75		766.7
09/28/89		12:07	15	18	6.9	7.8	2500	6.2	22	0.43	0.32	2.2	1.88	2.7		
AVERAGE			21.9	21.8	5.7	7.5	2518	7.4	17	1.06	----	5.8	4.5	2.9	----	310.9
04/26/89	MR-4	11:30			9.6										5.83	
05/10/89		15:35	21.1	18.9	8.6	7.4	490	1.9	9	0.72	0.6	<0.4	0	0.42	5.26	19
07/19/89		10:45	22.8	20	8.5	7.3	70	1.4	50	0.68	<0.2	<0.4	<0.2	0.13	12.48	
07/20/89		09:00	22.2	20	8.5	7.3	220	0.4	9	0.93	<0.2	<0.4	<0.2	0.2		113
08/22/89		13:20	29.4	24.4	8.3	7.7	1200	1.6	4	0.86	<0.2	0.85	0.65	0.84	2.49	
08/23/89		07:25	21.1	22.2	7.2	7.4	1000	1	6	0.93	<0.2	0.64	0.44	0.89		46.5
09/28/89		11:15	14	17	8.8	7.3	500	1.1	3	0.59	<0.2	<0.4	<0.2	0.55	5.11	
AVERAGE			21.8	20.4	8.5	7.4	580	1.2	14	0.79	----	----	----	0.51	6.23	59.5
			C	C	mg/L	SU	umho/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	cfs	org/ 100 mL

TABLE 2

WATER QUALITY DEMONSTRATION STUDY
MOORE CREEK AT HALEYVILLE, ALABAMA
DATA COLLECTED AFTER UPGRADE OF WWTP

DATE	LOCATION	TIME	AIR TEMP	WATER TEMP	D.O.	pH	SPECIFIC COND	BOD 5	TSS	Cl	NO_3-N	NH_3-N	TKN	TON	PHOS TOT	FLOW	BACTERIA
05/15/90	MR-1	13:45	25	19	8.9	6.8	45	1.1	1		0.46	<0.20	<0.40	0	<0.02	<0.1	
05/16/90		07:20	20	17	9	6.9	35	0.4	<1		0.46	<0.20	8.1	4.9	<0.02		19
07/11/90		17:22	27	23	8.3	7.1	55	0.5	2	4	0.58	<0.20	<0.40	0	<0.02	<0.1	
07/12/90		10:20	24	21.5	8.6	6.9	45	0.4	2	4	0.6	<0.20	<0.40	0	<0.02		41
09/12/90		12:40	27	24	7.8	7.6	50	1.2	<1	5.5	0.81	<0.20	<0.40	0	<0.02	<0.1	
AVERAGE			24.6	20.9	8.5	7.1	46	0.7	---	5	0.58	----	----	1.0	----	----	30
05/15/90	MR-2	13:25	24	25	6.8	7.6	2650	5.5	9		0.5	0.3	3	2.7	2.9	1.12	
05/16/90		07:07	19	23	6.7	7.7	2400	5.5	15		0.08	0.3	2.2	1.9	4		103
07/11/90		17:10	27	25	7.6	7.9	1750	2.2	4	365	0.82	9.9	10.9	1	0.93	0.87	
07/12/90		08:46	23	26	7.4	7.8	1750	2	2	375	0.53	11	12.7	1.7	1.2		<1
09/12/90		12:25	26	28	6.9	7.7	2100	1.6	5	410	15.2	<0.20	1.1	1.1	3.8	0.97	
AVERAGE			23.8	25.4	7.1	7.7	2130	3.4	7	383	3.43	----	6.0	1.7	2.6	0.99	----
05/15/90	MR-3	13:10	25	23	6.7	7.5	2100	2.4	7		0.72	0.2	2.4	2.2	2.2	----	
05/16/90		06:49	18	21	6.7	7.5	1700	4	11		0.4	0.3	1.4	1.1	2.7	----	117
07/11/90		15:29	30	25	6.3	7.7	1400	6.4	5	288	2.47	6.6	7.6	1	0.83	----	
07/12/90		07:30	24	23	6.6	7.7	1350	7	7	288	1.19	7.6	8.4	0.8	0.94	----	>600
09/12/90		12:11	26	26	6.9	7.8	1650	1.7	6	360	13.18	<0.20	0.8	0.8	3.2	----	
AVERAGE			24.6	23.6	6.6	7.6	1640	4.3	7	312	3.59	----	4.1	1.2	1.97	----	----
05/15/90	MR-4	12:00	22	19	9.1	7.2	690	1	7		0.78	<0.2	1	0.8	0.58	6.37	
05/16/90		06:11	18	18	8.4	7.2	570	1	10		0.68	<0.2	0.6	0.4	0.73		58
07/11/90		12:12	29	24	8.2	7.4	195	1.5	1	45	2.75	0.8	1.2	0.4	0.27	4.44	
07/12/90		07:02	22	21	7.6	7.3	435	3.2	<1	97	1.6	1.7	2.1	0.4	0.25		13
09/12/90		11:15	26	23	8.4	7.8	650	1.4	1	118	4.46	<0.2	1.1	1.1	0.85	5.02	
AVERAGE			23.4	21.0	8.3	7.4	508	1.6	---	87	2.05	----	1.2	0.6	0.54	5.28	36
			C	C	mg/L	SU	umho/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	cfs	org/ 100 mL

TABLE 3A
MACROINVERTEBRATE
DATA SUMMARY SHEET

Waterbody Name: Moore Creek
Aquatic Ecoregion: 68
Location/ City: Haleyville
County: Marion
State: AL
Investigators: Bauer, Diggs
Date: 08-21-89 (Before Upgrade)

Habitat Assess.	-	-	-	-
Station Number	MR-1	MR-2	MR-3	MR-4
Total No. Org.	109	104	78	190
Taxa Richness	18	9	21	30
EPT Index	8	0	3	8
Biotic Index	3.14	9.60	5.74	5.25
% Dom. Taxa	30.3%	47.2%	26.9%	24.2%
Dominant Taxa	Prosimulium	Chironomus	Prosimulium	Cricotopus
Dom. Taxa Tol. Val.	4	10	4	7
% Shredders	21.1%	0%	14.1%	37.9%
% Scrapers	0%	0%	0%	1.1%
% Predators	6.4%	4.8%	33.3%	22.6%
% Collect-Gath.	9.2%	77.9%	15.4%	22.1%
% Collect-Fil.	60.6%	0%	34.6	13.7
% Macro-Piercer	0%	0%	0%	0%
% Other	2.7	17.3%	2.6%	26.6
Scrap/Scrap+C-F	0	0	0	0.07
Shredder/Total	0.21	0	0.14	0.38
EPT/EPT+Chiro.	0.97	0	0.16	0.24
Hydrop/Trichop	0	0	0	0
S.W. Diversity	3.13	1.75	3.51	3.96
Equitability	0.69	0.48	(0.78)	0.76

Station Comparison	MR-1 vs MR-2	MR-1 vs MR-3	MR-1 vs MR-4
IAI	0.01	0.09	0.19
DIC (>5%)	0	1	0
QSI-Taxa	1.8%	31.3%	12.4%
QSI-FFG	16.7	66.9%	53.1%
Comm. Loss Index	1.78	0.67	0.37
Jaccard Comm. Sim.	0.08	0.11	0.17
Sorenson's CSI	0.15	0.21	0.29

* Data in () cannot be evaluated due to <100 organisms in sample.

TABLE 3B
MACROINVERTEBRATE
DATA SUMMARY SHEET

Waterbody Name: Moore Creek — Aquatic Ecoregion: 68
Location/ City: Haleyville — County: Marion — State: AL
Investigators: Cooner, Leslie — Date: 7-12-90 (After Upgrade)

Habitat Assess.	75	89	87	109
Station Number	MR-1	MR-2	MR-3	MR-4
Total No. Org.	42	62	71	90
Taxa Richness	14	13	12	18
EPT Index	7	2	2	5
Biotic Index	3.00	5.13	3.70	3.79
% Dom. Taxa	19%	48%	25%	21%
Dominant Taxa	Chimarra	Polypedilum	Prosimulium	Ceratopsyche
Dom. Taxa. Tol. Val.	2	6	4	3
% Shredders	16.7%	48.4%	16.9%	4.4%
% Scrapers	23.8%	1.6%	1.5%	0%
% Predators	16.7%	14.5%	16.9%	23.3%
% Collect-Gath.	4.8%	11.3%	2.8%	23.3%
% Collect-Fil.	28.6%	22.6%	62.0%	48.9%
% Macro-Piercer	0%	0%	0%	0%
% Other	9.4%	1.6%	0%	0%
Scrap/Scrap+C-F	0.45	0.07	0.02	0
Shredder/Total	0.17	0.48	0.17	0.04
EPT/EPT+Chiro.	0.77	0.14	0.55	0.77
Hydrop/Trichop	0	0	0	0
S.W. Diversity	3.45	2.61	2.97	3.42
Equitability	(1.12)	(0.65)	(0.92)	(0.85)

Station Comparison	MR-1 vs MR-2	MR-1 vs MR-3	MR-1 vs MR-4
IAI	0.25	0.60	1.10
DIC (>5%)	1	2	0
QSI-Taxa	20.0%	19.4%	11.3%
QSI-FFG	62.0%	66.2%	54.5%
Comm. Loss Index	0.69	0.83	0.44
Jaccard Comm. Sim.	0.23	0.18	0.19
Sorenson's CSI	0.37	0.31	0.31

*Data in () cannot be interpreted due to <100 organisms in sample.

TABLE 4
BIOMETRIC INTERPRETATION

METRIC	RANGE	INTERPRETATION
HABITAT ASSESSMENT	104-135 71-103 35-70 0-34	EXCELLENT GOOD FAIR POOR
a). TAXA RICHNESS b). EPT INDEX c). SHANNON-WEAVER SPECIES DIVERSITY d). EQUITABILITY		GENERALLY INCREASES WITH INCREASING WATER QUALITY.
a). BIOTIC INDEX b). % DOMINANT TAXA c). TOLERANCE VALUE OF DOM TAXA		GENERALLY INCREASES WITH DECREASING WATER QUALITY.
a). % SHREDDERS b). % SCRAPERS c). % PREDATORS d). % COLLECTOR-GATHERERS e). % COLLECTOR-FILTERERS f). % MACROPHYTE PIERCERS g). % OTHERS		PERCENTAGES AND COMPOSITION SHOULD BE SIMILAR TO BACKGROUND STATION FOR SIMILAR STREAM SIZES AND HABITAT COMPOSITION.
a). SCRAPERS/SCRAPERS+C-F b). SHREDDERS/TOTAL c). HYDROPTILIDAE/TRICHOPTERA		NO SIGNIFICANT CHANGE AS COMPARED TO BACKGROUND.
a). EPT/EPT+CHIRONOMIDAE		GENERALLY INCREASING WATER QUALITY AS APPROACHES 1.0.
SIMILARITY INDICES		
a). INDICATOR ASSEMBLAGE INDEX (IAI) b). JACCARD COMMUNITY SIMILARITY c). SORENSON'S CSI		INCREASING SIMILARITY AS APPROACHES 1.0.
a). DOMINANTS IN COMMON b). QUANTITATIVE SIMILARITY INDEX (QSI)-TAXA c). QSI-FUNCTIONAL FEEDING GROUP (FFG)		GENERALLY INCREASING WITH INCREASING SIMILARITY.
a). COMMUNITY LOSS INDEX		GENERALLY INCREASING WITH INCREASING DISSIMILARITY

TABLE 5
MACROINVERTEBRATE
METRIC SUMMARY SHEET

Waterbody Name: Moore Creek
Location/ City: Haleyville
Investigators: Bauer, Diggs
Cooner, Leslie

Aquatic Ecoregion: 68
County: Marion State: AL
Dates: Before 08-21-89
After 07-12-90

+....improvement
0....no change
-....deterioration
*....see comments below

Habitat Assess. / Station Number	* MR-1	* MR-2	* MR-3	* MR-4
Taxa Richness	-	+	-	-
EPT Index	-	+	-	-
Biotic Index	0	+	+	+
% Dom. Taxa	+	+	0	+
Dom. Taxa Tol. Val.	+	+	0	+
Scrap/Scrap+C-F	+	+	+	-
EPT/EPT+Chiro.	-	+	+	+
Hydrop/Trichop	0	0	0	0
S.W. Diversity	+	+	-	-
Equitability	*	*	*	*

Station Comparisons	MR-1 vs MR-2	MR-1 vs MR-3	MR-1 vs MR-4
IAI	+	+	+
DIC	+	+	0
QSI-Taxa	+	-	0
QSI-FFG	+	0	0
Comm. Loss Index	+	0	0
Jaccard Comm. Sim.	+	+	0
Sorenson's CSI	+	+	0

* Equitability calculations are not valid for samples with less than 100 organisms.

TAXA LIST
MACROINVERTEBRATE DATA
MOORE CREEK - HALEYVILLE, AL
BEFORE UPGRADE 08-21-89

TAXA	MR-1	MR-2	MR-3	MR-4
ANNELIDA				
OLIGOCHAETA	-	18	-	2
ARTHROPODA				
Asellus	-	-	-	2
INSECTA				
COLEOPTERA				
Agabetes	-	-	1	-
Ancyronyx	-	-	-	1
Hydroporus	3	-	-	-
Hydrovatus	-	-	1	-
Microcylloepus	3	-	-	-
DIPTERA				
Antocha	-	-	-	7
Atherix	2	-	-	-
Bezzia	-	1	-	1
Limonia	-	-	-	3
Prosimulium	33	-	21	1
Tabanus	-	-	1	-
Tipula	1	1	-	-
CHIRONOMIDAE				
Chironomus	-	59	9	-
Corynoneura	-	-	-	1
Cricotopus	1	-	-	46
Cryptochironomus	-	-	-	5
Goeldichironomus	-	21	3	-
Polypedilum	-	-	11	8
Psectrotanypus	-	-	1	-
Rheocricotopus	-	-	-	1
Rheotanytarsus	-	-	-	5
Synorthocladius	1	-	-	-
Tanytarsus	-	-	-	4
Thienemanniella	-	-	-	27
Thienemannimyia Grp	-	1	5	18
Xylotopus	-	-	1	-
Zavrelymia	-	-	1	-
UNID-ORTHOCLADINAE	-	-	-	3
UNID-CHIRONOMINAE	-	1	-	-
UNID-CHIRONOMIDAE	-	-	1	-
EPHEMEROPTERA				
Baetis	6	-	-	3
Stenonema	-	-	-	2
HEMIPTERA				
Gerris	1	-	-	-
Microvelia	-	-	1	-

TAXA LIST CONT.
MOORE CREEK
BEFORE UPGRADE 08-21-89

TAXA	MR-1	MR-2	MR-3	MR-4
MEGALOPTERA				
Chauliodes	-	-	1	-
Corydalus	-	1	-	-
Nigronia	1	1	2	2
ODONATA				
Basiaeschna	-	-	-	1
Boyeria	-	-	1	10
Calopteryx	-	-	9	4
Chromagrion	-	1	-	-
Cordulegaster	-	-	1	-
Stylogomphus	-	-	1	1
PLECOPTERA				
Acroneuria	-	-	-	1
Leuctra	16	-	-	9
Tallaperla	4	-	-	1
TRICHOPTERA				
Ceratopsyche	24	-	2	6
Cheumatopsyche	1	-	3	-
Chimarra	5	-	-	-
Diplectrona	-	-	1	-
Hydropsyche	-	-	-	10
Lepidostoma	1	-	-	-
Potamyia	3	-	-	-
Pychnopsyche	-	-	-	5
MISCELLANEOUS				
Planaria	3	-	-	-

TAXA LIST
MACROINVERTEBRATE DATA
MOORE CREEK - HALEYVILLE, AL
AFTER UPGRADE 07-12-90

TAXA	MR-1	MR-2	MR-3	MR-4
ANNELIDA				
OLIGOCHAETA	2	1	-	-
INSECTA				
COLEOPTERA				
Dineutus	-	-	1	-
Stenelmis	-	1	-	-
DIPTERA				
Atherix	-	-	-	1
Prosimulium	-	6	18	13
Simulium	3	2	10	2
Tipula	-	-	-	1
CHIRONOMIDAE				
Chironomus	-	6	-	-
Cricotopus	-	-	-	1
Cryptochironomus	1	-	-	-
Parametriocnemus	1	-	-	-
Polypedilum	5	30	6	2
Rheocricotopus	-	-	1	3
Rheotanytarsus	-	-	-	3
Thienemanniella	-	-	-	1
Thienemannimyia Grp	1	1	6	3
Tribelos	-	1	-	-
EPHEMEROPTERA				
Baetis	1	-	-	17
Stenonema	4	-	-	-
MEGALOPTERA				
Chauliodes	-	1	-	-
Corydalus	-	1	-	-
Nigronia	-	6	7	6
Sialis	-	-	-	1
ODONATA				
Boyeria	-	-	4	10
PLECOPTERA				
Leuctra	2	-	-	-
Beloneuria	5	-	-	-
TRICHOPTERA				
Ceratopsyche	-	5	15	19
Cheumatopsyche	-	-	-	5
Chimarra	8	-	-	-
Diplectrona	1	1	1	1
Neophylax	6	-	-	-
Potamyia	-	-	-	1
MOLLUSCA				
GASTROPODA				
Physella	-	-	1	-
MISCELLANEOUS				
Planaria	2	-	-	-
Nematoda	-	-	1	-