WATER QUALITY SURVEY

of the

SOUTH, MIDDLE, ALUM and NORTH FORKS

of the

SALINE RIVER

ARKANSAS DEPARTMENT OF ENVIRONMENTAL QUALITY

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Introduction

Basis for the Study

This project was developed by the Water Quality Management Planning Section of the Arkansas Department of Pollution Control & Ecology to determine the current water quality of the upper Saline River during different climatic events and to provide evidence that the water quality of the North Fork Saline River is meeting all designated uses. Also, water quality data from the North Fork, South Fork, Middle Fork, Alum Fork, and ecoregion reference streams were compared to determine if there are any significant differences between them. Historical water quality data from the North Fork of the Saline River and from the Ouachita Mountain ecoregion reference streams was compared to determine if there has been any water quality changes over time.

It has been speculated by several environmentally concerned groups that the water quality of the North Fork of the Saline River does not support current designated uses and it has been requested that the Extraordinary Resource Waters and the Ecologically Sensitive Waterbody designated uses be removed from the stream.

Social issues related to this study include the water supply for the City of Benton, Arkansas and surrounding areas, land development in and around the project area, economic development in the area, private land ownership, and future environmental decisions. Also, the presence of an endangered mussel species, the fatmucket mussel, *Lampsilis powelli*, and a distribution-limited species, the Ouachita madtom, *Noturus lachneri*, are considerations.

The study objectives were to answer the following questions:

1) Is the water quality of the South, Middle, Alum, and North Forks of the Saline River protective of all designated uses?

2) Is the water quality of the South, Middle, Alum, and North Forks of the Saline River significantly different than that of the Ouachita Mountain Ecoregion reference streams?

3) Is the water quality of the North Fork of the Saline River comparable to that of the South, Middle, and Alum Forks of the Saline River?

WATERSHED DESCRIPTION

Geography/Geology

The Saline River arises on the east end of the Ouachita Mountains as four distinctive branches; the South Fork, which drains the southern most part of the watershed and flows in an easterly direction; the Middle Fork, which is north of the South Fork and is the most westward drainage; the Alum Fork, which flows south from Lake Winona; and the North Fork, which drains the eastern edge of the watershed. All of these forks are located in the Ouachita Mountains (OM) ecoregion and come together just north of Benton, Arkansas, just before the Saline River enters the Gulf Coastal Plains ecoregion. Their combined watershed is 776 mi^2. Below is a list of the individual watershed sizes:

Alum Fork	405 mi^2*
Middle Fork	107 mi^2
South Fork	129 mi^2
North Fork	135 mi^2
Total	776 mi^2

* Approximately 11% is above Lake Winona

Womble Shales comprise the majority of the geologic formations within this watershed. Blakley Sandstone Formations are located along the fringes of the watershed, and a Jackfork Sandstone Formation underlies the upper Alum Fork area. These formations are the foundations for the eight major soil units within the watershed which range from soils that are poorly drained to excessively drained, gravelly, stony to loamy soils, and steep sloped to nearly level soils. Elevations range from a high of around 1,800 feet above mean sea level near Lake Winona, to a low of 270 feet near Benton, Arkansas.

Watershed Land Uses

Silviculture is the dominant land use within these watersheds, with some pasture land primarily in the lower portion of each fork. The South Fork and Middle Fork have some poultry production operations (approximately 2.5 million birds per year combined). There is no evidence of confined animal operations in the North Fork or Alum Fork drainage basins. There are two major impoundments within the Saline River Forks' watershed. These are Lake Winona on the Alum Fork, and Lake Norrell on Brushy Branch, a tributary to the North Fork.

Designated Uses

The current designated uses of the upper forks of the Saline River include:

1) Extraordinary Resource Waters
2) Ecologically Sensitive Waterbodies
3) Primary and Secondary Contact Recreation
4) Domestic, Industrial and Agricultural Water Supply
5) Seasonal and Perennial Ouachita Mountain Ecoregion Fisheries.

MATERIALS/METHODS

Water Quality Sampling

The following equipment was used to collect water samples and take the in-situ measurements:

1) Orion Model 840A portable dissolved oxygen meter
2) Orion SA Model 230 portable pH meter
3) water & bacteria sampling containers
4) Winkler titration kit

Stream samples were collected, preserved, and analyzed according to the 16th Edition of Standard Methods for the Examination of Water and Wastewater. Analyses were conducted under ADPC&E's Quality Assurance Project Plan for the Upper Saline River Water Quality Sampling Plan. Table 1 list the parameters analyzed for and the in-situ measurements taken. The dissolved oxygen meter was calibrated prior to use in accordance with manufacture's guidelines. The pH meter was calibrated prior to use and every four hours thereafter using buffer solutions of pH 4, pH 7, and pH 10.

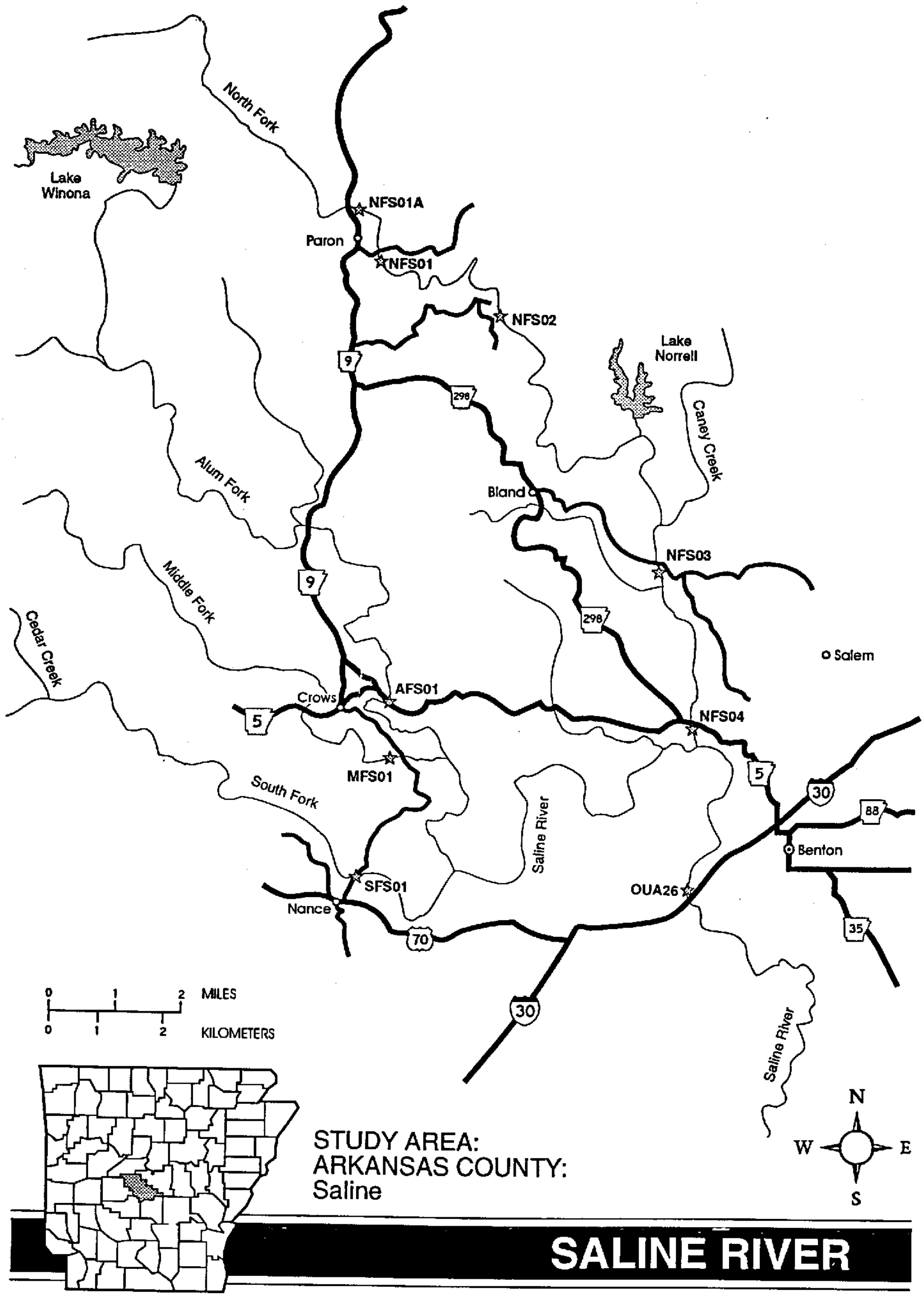
TABLE 1 - Water Quality Parameters Measured

LAB ANALYSES	In Situ Measurements
Nitrogen -- Ammonia, Nitrite+Nitrate	Dissolved Oxygen
Phosphorus -- Ortho, Total	Water Temperature
Total Solids -- Dissolved, Suspended	pH
Total Hardness, Turbidity	Flow as % of Bank-Full Capacity
Chloride, Sulfate	Atmospheric cond.
Biochemical Oxygen Demand$_{(5\text{-day})}$	Air Temperature
Total Organic Carbon	
Fecal Coliform Bacteria	

Station Locations

SFS01	South Fork Saline River approx. 0.25 mi. N. of U.S. Hwy 70 near Nance, Ar. (Sec 18, T2S, R16W).
MFS01	Middle Fork Saline River approx. 2 mi. S of Ark. Hwy. 5 near Crows, Ar. (Sec 32, T1S, R16W).
AFS01	Alum Fork Saline River at Ar. Hwy 5 bridge approx. 1.2 mi. E. of Crows, Ar. (Sec 29, T1S, R16W).
NFS01A	North Fork Saline River at Ar. Hwy 9 bridge approx. 0.2 mi. N. of Paron, Ar. (Sec 36, T2N, R17W).
NFS01	North Fork Saline River approx. 0.5 mi. E. of Ar. Hwy 9 near Paron, Ar. (Sec 31, T2N, R16W).
NFS02	North Fork Saline River approx. 4 mi. E of Ar. Hwy 9 SE. of Paron, Ar. (Sec 10, T1N, R16W).
NFS03A	North Fork Saline River approx. 4 mi. E. of Ar. Hwy. 298, E. of Bland, Ar., above bridge (Sec 5, T1S, R15W).
NFS03	North Fork Saline River approx. 4 mi. E. of Ar. Hwy. 298, E. of Bland, Ar., below bridge (Sec 8, T1S, R15W).
NFS04	North Fork Saline River downstream of Ar. Hwy 5 bridge, west of Benton, Ar. (Sec 28, T1S, R15W).

Figure 1 is a map of the study area depicting the locations of the sample sites.



SALINE RIVER

RESULTS/DISCUSSION

Water Quality

Eleven sampling events were conducted from July 1993 to September 1994 in an attempt to obtain water samples during different climatic and seasonal occurrences. Bridge construction at the NFS01 site prompted an additional station, NFS01A, to be established upstream of the influence of the construction site. Also, another sample site (NFS03A) was established in August 1993 just above the NFS03 site because of the construction of a temporary bridge. This site was collected in August and September 1993; construction was completed by October 1993. The NFS01 and NFS01A sites were not collected during the September 1993 sample event due to a lack of water in the stream beds. All other sites were collected during the eleven sampling events.

Temperatures ranged from 5.5° C at several sample stations on January 11, 1993 to 28.8° at the NFS04 station on July 17, 1993. Ouachita Mountain (OM) ecoregion summertime average temperature is 25.5° C, and the water temperature standard for Ouachita Mountains streams is 30° C as an allowable maximum. All sample stations were well below the standard.

The NFS01A site had the lowest recorded pH of 6.28 on February 22, 1994 and MFS01 had the highest recorded pH of 7.95 on September 27, 1994. Water quality standards state that pH values may not fluctuate below 6.0 or above 9.0 standard units. Ouachita Mountain ecoregion spring and summer values are between 6.1 and 7.6 standard units. Only a few pH values were slightly higher than 7.6 during this survey.

Dissolved oxygen (DO) concentrations were recorded below 5.0 mg/L only twice during this survey. On August 24, 1994 concentrations of 4.8 mg/L at NFS01A and 3.5 mg/L at NFS01 were measured. A stream flow characterization of less than 10% bank-full capacity during this sampling event may be the reason for these low DO concentrations. This is technically a violation of the DO standard which allows only a 1 mg/L diurnal fluctuation below 6.0 mg/L when temperatures are above 22° C for watersheds greater than 10 mi^2. The $7Q_{10}$ flow for these two stations is zero. The highest DO concentration was recorded at MFS01 as 12.6 mg/L on January 11, 1994. Most winter dissolved oxygen concentrations were above 10 mg/L.

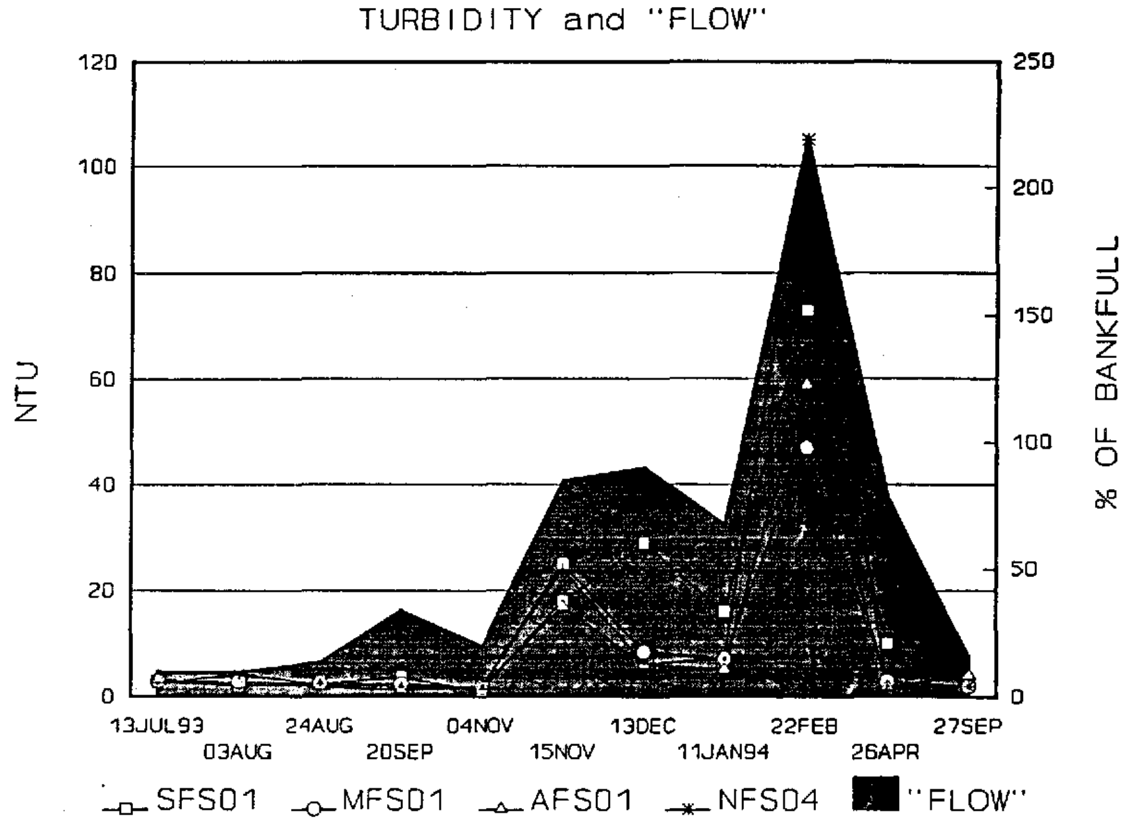
The turbidity standard for OM ecoregion streams is 10 NTUs. All sites exceeded this standard by 3 to 10 times on February 22, 1994 during a major storm event; flows were estimated to be between 140% to 250% of bank-full capacity (an indicator of the magnitude of stream flow). Additional turbidity standard exceedances and high total suspended solids (TSS) concentrations occurred during other large storm events, indicating that there are nonpoint source pollutants originating within the watershed. Generally, however, TSS and turbidity concentrations were extremely low during low to moderate flow conditions. Figure 2 is a plot of the turbidity values for all samples taken at the station nearest the mouth of each Saline River fork. These data are compared to the average percentage of bank-full capacity for these stations on each sample date. The significant influence that increased flows has in increasing turbidity in the stream is apparent from this figure. The excessive turbidity values during high flow events indicates widespread disruption within the watershed.

Another noticeable increase in turbidity concentrations was during the first major storm event after the summer low flow season. Elevated turbidity concentrations were five to twelve times greater at all stations on November 15, 1993 than at low flow concentrations. Also on this date, biochemical oxygen demand was above typical background concentrations (discussed in greater detail later). These increases in turbidity levels could be caused by the initial flushing of plant and animal matter from the watershed after the summer growing season and from streambank erosion as water levels increase from very low flow to very high levels. Bank-full capacities during this sampling event were estimated to be 50% to 105%. In contrast is the turbidity levels from the next storm event sampled on December 13, 1993. Bank-full capacities were estimated to be 75% to 105%; however, turbidity levels were generally about half of what they were during the November 15, 1994 storm event. The SFS01 site did experience a higher turbidity concentration on December 13, 1993; but unlike the other stations, SFS01 had a greater increase in flow, indicating that there was more rainfall in this watershed during the December storm event.

The turbidity value at NFS01 was 890 NTUs on July 13, 1993 when the stream flow was less than 10% of bank-full capacity. Also, the turbidity was 98 NTUs on August 3, 1993 and 24 NTUs on August 24, 1993. The bank-full capacity on these dates was estimated to be less than 10%. Upstream concentrations (NFS01A) for samples on these dates were all less than 6 NTUs, and downstream (NFS02) concentrations were less than 14 NTUs. Bridge construction activities above NFS01 was the reason for these excessive values. The turbidity values had returned to background levels by November, 1993 after the completion of the bridge.

During the survey, chloride concentrations never exceeded 5.0 mg/L, sulfate concentrations were generally less than 10.0 mg/L, total dissolved solids (TDS) were usually less than 100.0 mg/l and total hardness values were normally less than 70.0 mg/L. Average TDS and total hardness values for SFS01, MFS01, AFS01, and NFS04 were all quite similar. The highest concentrations occurred during the summer low flow sampling events and during storm events. Ouachita Mountains ecoregion summertime low-flow averages are 4.0 mg/L for

FIGURE 2 - SALINE RIVER FORKS



chlorides, 6.0 mg/L for sulfates, 63.0 mg/L for TDS, and 45.0 mg/L for total hardness. Water quality standards in the Saline River forks for chlorides, sulfates, and TDS are 15.0 mg/L, 20.0 mg/L, and 128.0 mg/L. They were never exceeded. The highest TDS concentration occurred on July 13, 1993 at NFS01, probably due to the bridge construction.

Ammonia nitrogen (NH_3-N), nitrite+nitrate nitrogen (NO_2+NO_3-N), ortho-phosphorus (O-Phos), and total phosphorus (T-Phos) concentrations were very low at all sites during all sampling events. Many samples were at or below detection levels. Concentrations of NH_3-N were greatest during the summer low flow sampling events and/or during the largest storm event. Cool weather sampling events generally had NH_3-N concentrations at or below the detection limit of 0.05 mg/L. The NFS01 site had the highest NH_3-N concentration of 0.33 mg/L on July 13, 1993. Seven of the other nine samples (78%) collected at this site had NH_3-N concentrations at or below the detection limit. The high concentration on July 13, 1993 was probably due to the organic substances being washed into the river and the topsoil disturbances associated with the bridge construction activities.

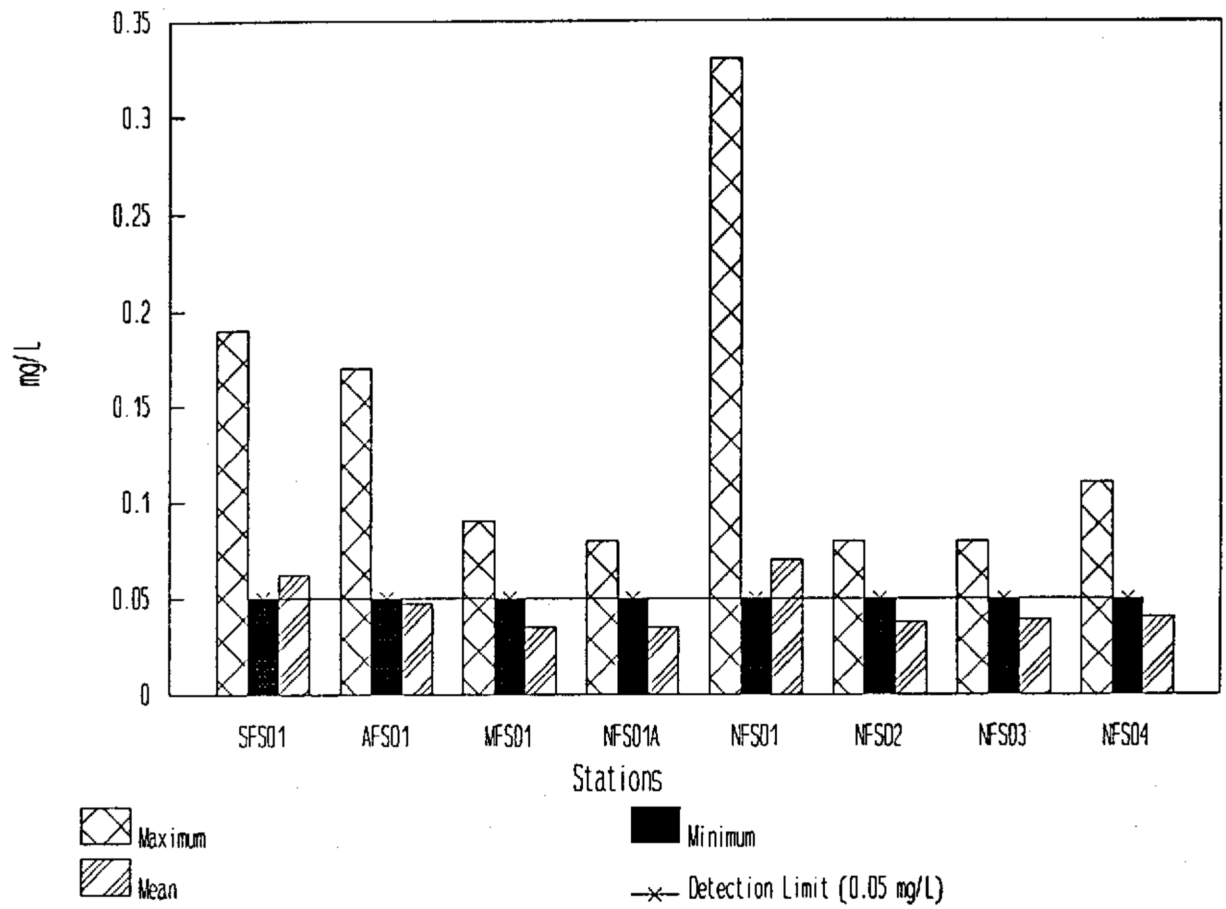
Ouachita Mountain ecoregion data indicated that average NH_3-N concentrations were 0.02 mg/L. The average NH_3-N concentration for the Saline River ecoregion reference stream site was 0.01 mg/L. Figure 3 depicts the NH_3-N maximum, minimum, and mean concentrations for all of the sites during the current survey. It should be noted that the laboratory detection levels were lower for this parameter during the ecoregion study than during this study. Numbers in parentheses after the minimum values represent the number of samples that were at or below the detection limit for the parameter depicted.

Nitrite+nitrate nitrogen (NO_2+NO_3-N) concentrations ranged from the detection limit of 0.02 mg/L to 0.29 mg/L throughout the survey area. The highest concentration occurred at NFS01 on July 13, 1993. Eight of the other nine samples (89%) collected at NFS01 had NO_2+NO_3-N at or below the detection limit. The North Fork of the Saline River generally had more samples below the detection limit for NO_2-NO_3-N than the other sampling stations within the study area. Many of the stations displayed a slight increase in NO_2+NO_3-N concentration during one of the winter sampling events, most on December 13, 1993. Many of these increases were two to nine times above the summertime levels. The upper North Fork stations did not show this increase in NO_2+NO_3-N concentration, and NFS02 and NFS03 had only a two fold increase.

Ecoregion averages for NO_2+NO_3-N concentrations was 0.04 mg/L, and the Saline River reference stream site average concentration was 0.02 mg/L. The average NO_2+NO_3-N concentration at all of the North Fork sites was at or below 0.02 mg/L, while the SFS01 and MFS01 site had average concentrations of 0.066 mg/L and 0.061 mg/L, respectively. This indicates that the North Fork of the Saline River may be less likely to experience nuisance algae growth because of excessive nitrogen concentrations as compared to the South Fork or Alum Fork of the Saline River. Figure 4 depicts the NO_2+NO_3 nitrogen concentration data for each station in the survey.

Total phosphorus (TPhos) concentrations ranged from 0.19 mg/L at SFS01, to below the detection limit. The greatest percentage of samples at all stations were at or below the detection limit. The highest concentration at all stations, excluding the NFS01 site, occurred on February 22, 1994, during a major storm event. These concentrations coincided with the greatest TSS and turbidity concentrations, indicating that most of the phosphorus is entering the river from nonpoint sources of pollution. The station that was least affected by this storm event was NFS01A, which only experienced a two fold increase in TPhos concentration. All other stations experienced between a three to six fold increase (data from NFS01 was excluded from the above discussion because of bridge construction impacts).

FIGURE 3 - Ammonia Nitrogen



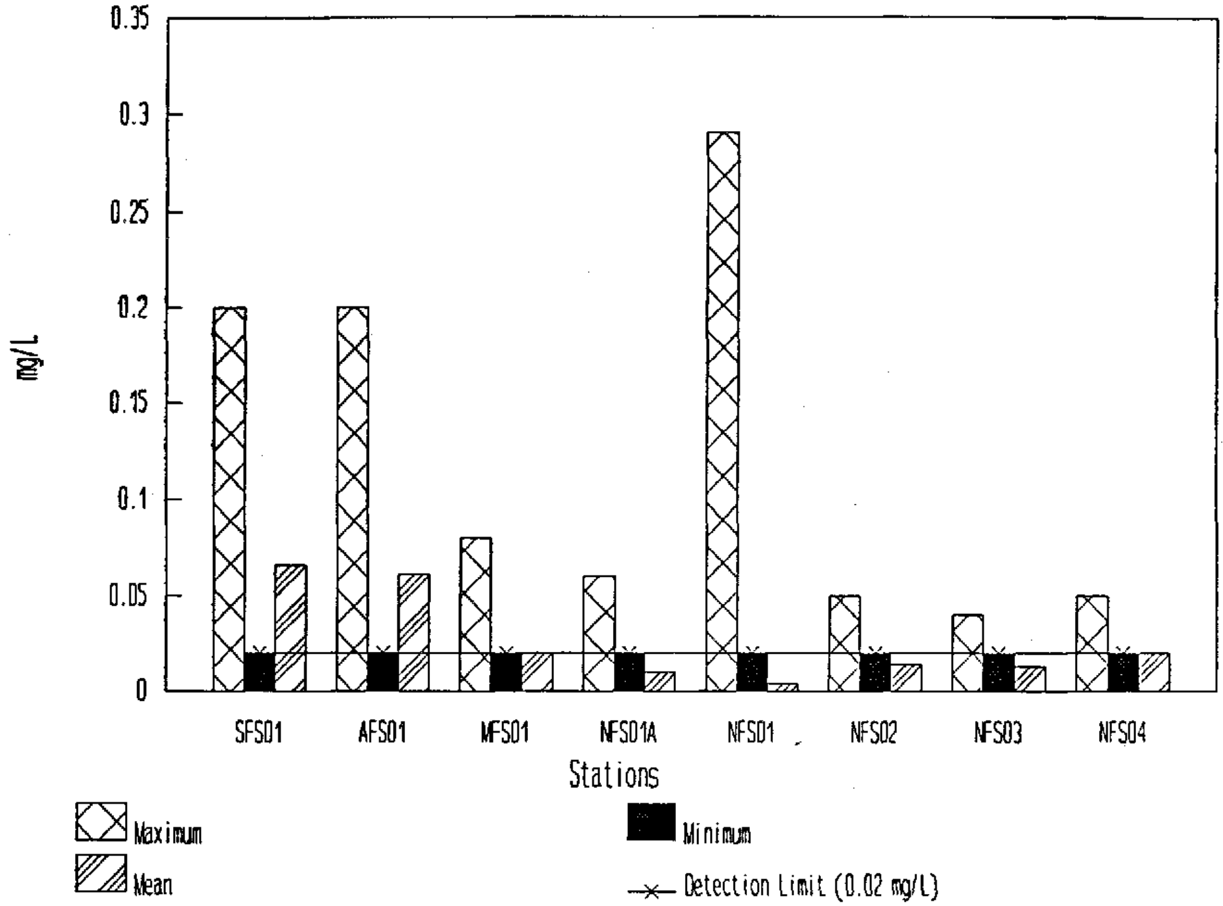
STATION	Maximum	Minimum*	Mean	# of Samples
SFS01	0.19	<0.05(6)	0.062	11
MFS01	0.17	<0.05(8)	0.047	11
AFS01	0.09	<0.05(9)	0.035	11
NFS01A	0.08	<0.05(7)	0.035	9
NFS01#	0.33	<0.05(7)	0.070	10
NFS02	0.08	<0.05(8)	0.038	11
NFS03	0.08	<0.05(8)	0.039	11
NFS04	0.11	<0.05(8)	0.041	11

* Figures in parentheses represent the number of samples that were at or below the detection limit of 0.05 mg/L.

\# NFS01 excluding the 07/13/93 data -- Max 0.18 mg/L, Mean 0.048 mg/L

Mean values were calculated using ½ the detection limit for all values at or below the detection limit. This, in some cases, will give a calculated mean value less than the minimum when the detection level is used as the minimum value.

FIGURE 4 - NO_2+NO_3 Nitrogen



STATION	Maximum	Minimum*	Mean	# of Samples
SFS01	0.20	<0.02 (5)	0.066	11
MFS01	0.20	<0.02 (6)	0.061	11
AFS01	0.08	<0.02 (7)	0.020	11
NFS01A	0.02	<0.02 (9)	0.010	9
NFS01#	0.29	<0.02 (8)	0.040	10
NFS02	0.05	<0.02(10)	0.014	11
NFS03	0.04	<0.02(10)	0.013	11
NFS04	0.05	<0.02 (8)	0.020	11

* Figures in parentheses represent the number of samples that were at or below the detection limit of 0.02 mg/L.

\# NFS01 excluding the 07/13/93 data -- Max 0.03 mg/L, Mean 0.012 mg/L

Mean values were calculated using ½ the detection limit for all values at or below the detection limit. This, in some cases, will give a calculated mean value less than the minimum when the detection level is used as the minimum value.

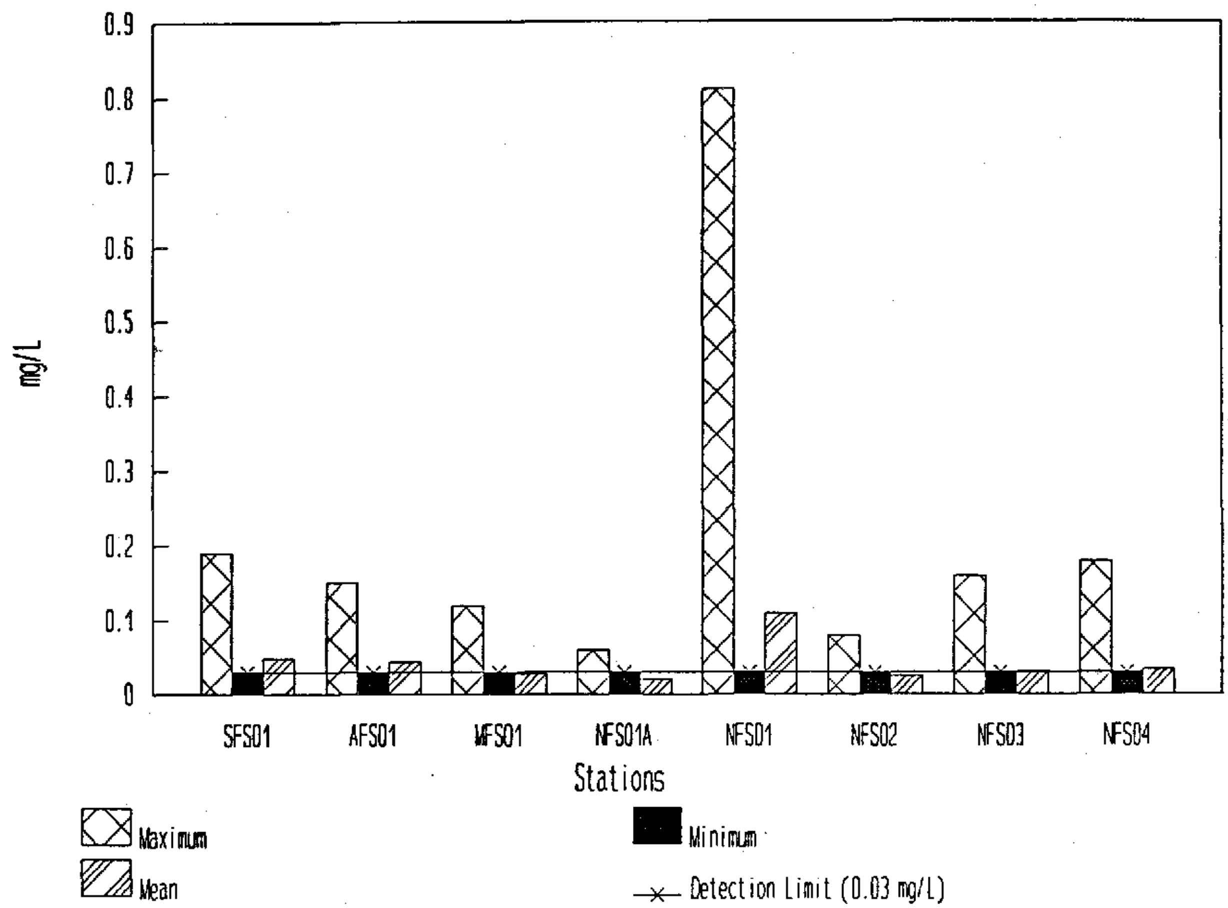
At the NFS01 site, TPhos concentrations ranged between 0.03 mg/L to 0.81 mg/L. The maximum value occurred on July 13, 1993 when flows were estimated to be less than 10% of bank-full capacity. Total phosphorus concentrations at the NFS01A site and the NFS02 site on this same date were 0.03 mg/L. This same sampling event produced TSS and turbidity concentrations of 868 mg/L and 890 NTUs, respectively at NFS01. All of the elevated TPhos concentrations are a direct result of construction activities, one of which was the rinsing of the rip-rap placed along the bank beneath the bridge to remove any excess soil between the pieces of rip-rap. Seven of the nine sampling events (78%) at this site, excluding the July 13, 1993 sample, had TPhos concentrations at or below the detection limit, and the mean of these nine samples was 0.028 mg/L. This indicates that the high TPhos concentration was probably only a one time event caused by activities at the bridge construction site. Total phosphorus concentrations are depicted in Figure 5.

Ortho-phosphorus (OPhos) concentrations display similar trends as the total phosphorus concentrations, except that smaller increases were noticeable during the storm events. Ortho-phosphorus concentrations ranged from 0.03 mg/L to 0.23 mg/L at NFS04. The maximum value occurred on February 22, 1994 during a major storm event when flows were estimated to be 140% to 250% of bank-full capacity. Throughout most of the study, ortho-phosphorus increases were less than three times the low flow values, except at the NFS04 site where the increase was approximately eight fold. The greatest percentage of samples from all stations were at or below the detection limit of 0.03 mg/L. The upper North Fork stations - NFS01A, NFS01, and NFS02 - were least affected by the February 22, 1994 storm event. Ortho-phosphorus maximum, minimum, and mean concentrations for the survey are depicted in Figure 6.

The NFS01 site had an OPhos concentration of 0.14 mg/L on July 13, 1994 during reconstruction of an upstream county road bridge, an approximate 5 fold increase over non-construction influenced sites. Also, there was a 27 fold increase in TPhos concentration at this site during bridge construction versus non-construction influenced samples. This indicates that the increased phosphorus concentration at this site was a direct result of the bridge construction and that most of the phosphorus was probably associated with soil particles.

The TPhos and OPhos concentrations measured during this survey indicate that the North Fork is generally less impacted than the other forks. Approximately 85% of all samples collected from all North Fork sites were at or below the detection limit. Approximately 73% of the phosphorus values from the other forks were at or below the detection limit. This indicates that there is generally less phosphorus in the North Fork than in the other forks, thus less of a chance for excessive algae growth.

FIGURE 5 - Total Phosphorus



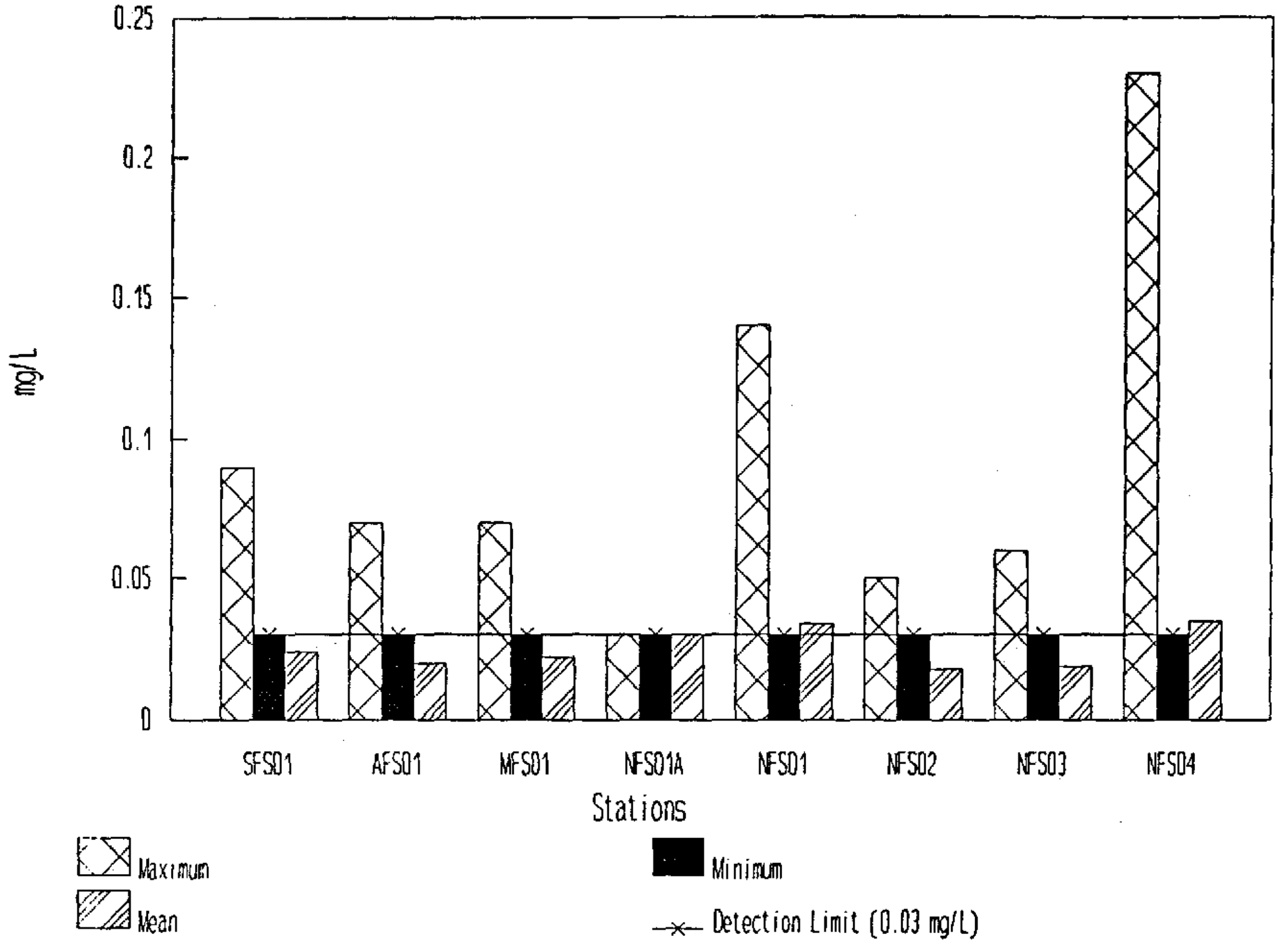
STATION	Maximum	Minimum*	Mean	# of Samples
SFS01	0.19	<0.03(6)	0.049	11
MFS01	0.15	<0.03(5)	0.044	11
AFS01	0.12	<0.03(9)	0.028	11
NFS01A	0.06	<0.03(8)	0.020	9
NFS01#	0.81	<0.03(7)	0.109	10
NFS02	0.10	<0.03(9)	0.025	11
NFS03	0.16	<0.03(9)	0.031	11
NFS04	0.18	<0.03(9)	0.033	11

* Figures in parentheses represent the number of samples that were at or below the detection limit of 0.03 mg/L.

\# NFS01 excluding the 07/13/93 data -- Max 0.10 mg/L, Mean 0.031 mg/L

Mean values were calculated using ½ the detection limit for all values at or below the detection limit. This, in some cases, will give a calculated mean value less than the minimum when the detection level is used as the minimum value.

FIGURE 6 - Ortho-Phosphorus



STATION	Maximum	Minimum*	Mean	# of Samples
SFS01	0.09	<0.03 (9)	0.024	11
MFS01	0.07	<0.03(10)	0.020	11
AFS01	0.07	<0.03 (9)	0.022	11
NFS01A	0.03	<0.03 (9)	0.030	9
NFS01#	0.14	<0.03 (7)	0.034	10
NFS02	0.05	<0.03(10)	0.018	11
NFS03	0.06	<0.03(10)	0.019	11
NFS04	0.23	<0.03(10)	0.035	11

* Figures in parentheses represent the number of samples that were at or below the detection limit of 0.03 mg/L.

\# NFS01 excluding the 07/13/93 data -- Max 0.05 mg/L, Mean 0.022 mg/L

Mean values were calculated using ½ the detection limit for all values at or below the detection limit. This, in some cases, will give a calculated mean value less than the minimum when the detection level is used as the minimum value.

Least-disturbed Ouachita Mountain ecoregion stream data for TPhos and OPhos indicated average concentrations of 0.02 mg/L for both parameters. Average TPhos concentrations for the North Fork sites were between 0.025 mg/L and 0.033 mg/L. Average OPhos concentrations were between 0.018 mg/L and 0.035 mg/L.

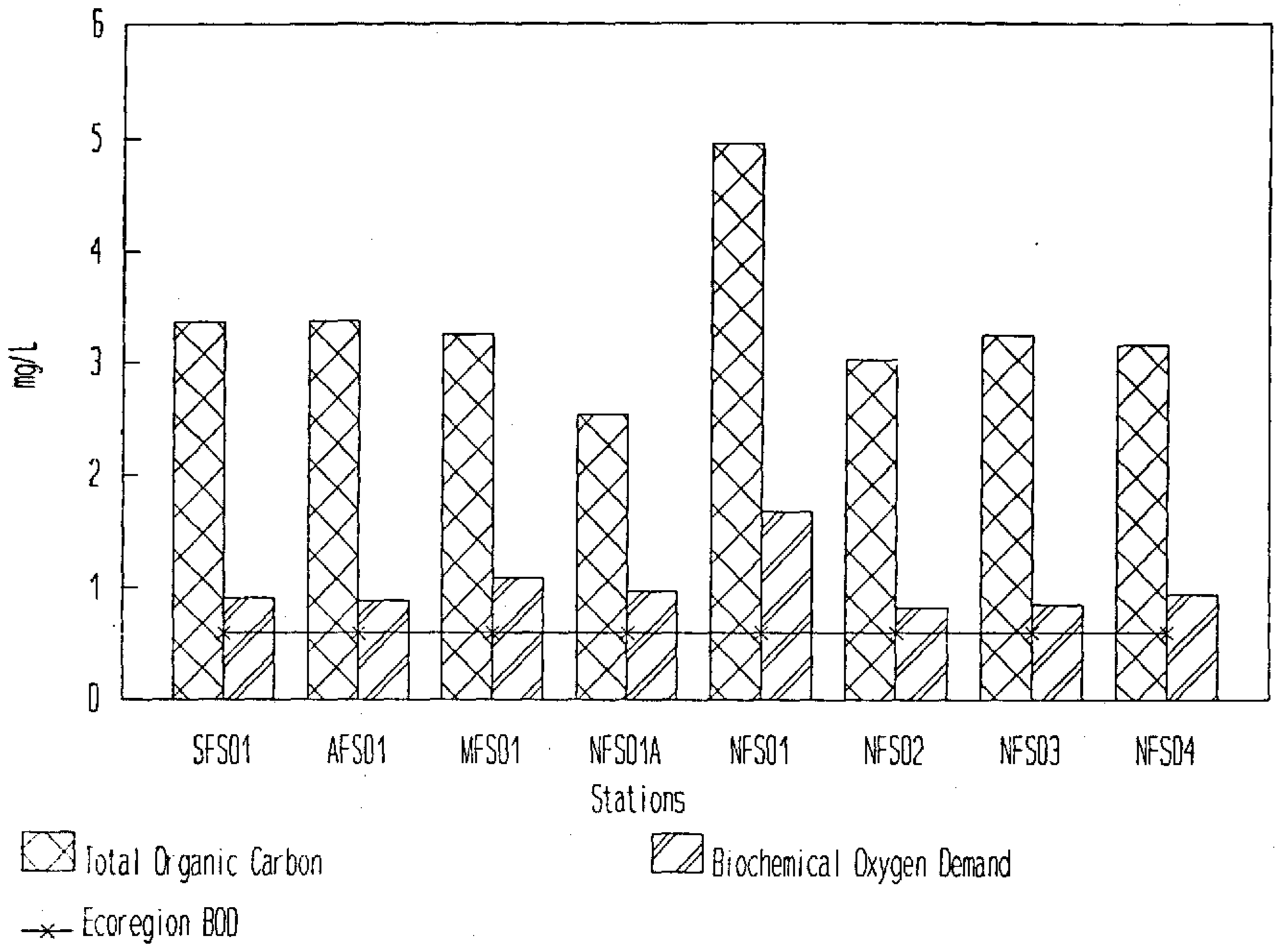
Total organic carbon (TOC) concentrations from all sites ranged from 1.4 mg/L to 24.9 mg/L. Biochemical oxygen demand (BOD_5) values ranged from <1.0 mg/l to 7.4 mg/L. The highest concentrations occurred on July 13, 1994 at NFS01. All other concentrations during the study were less than 7.0 mg/L TOC and less than 2.0 mg/L BOD. Mean TOC and BOD concentrations are depicted in Figure 7, where it is demonstrated that mean TOC concentrations were generally less than 4.0 mg/L and BOD concentrations were generally about 1.0 mg/L. The OM ecoregion mean BOD concentrations is 0.6 mg/L. This indicates that there has not been a significant change in either of these concentrations from historical levels and that there is not a large organic carbon load or biochemical oxygen demand.

Fecal coliform concentrations from all stations ranged from 10 col/100 ml, during low flow sampling events, to 7700 col/100 ml during storm events. The NFS02 site had the lowest average concentration, followed by NFS01 and NFS01A. This is probably because these are small, mostly forested watersheds. SFS01 had the highest average concentration of 1161 col/100 ml, but the geometric mean at this site was 270 col/100 ml. The NFS04 site had the highest one time event concentration of 7700 col/100 ml during a major storm event. This site is located next to a general-store, gas-station facility which also includes a small, private day-park use area. Also, storm flow runoff from upstream agriculture areas is perhaps the reason for the elevated bacteria concentrations at NFS04. All peak concentrations occurred on February 22, 1994, during a major storm event. The high fecal coliform bacteria concentrations measured on this date correspond to the highest turbidity concentrations measured during the survey. The bacteria standard for secondary contact waters states that at no time shall fecal coliform bacteria content exceed 2000 col/100 ml in more than ten percent (10%) of the samples taken in any 30-day period. This regulation was violated at SFS01, AFS01, MFS01, NFS03, and NFS04 on February 22, 1994. It was also violated at SFS01 on May 26, 1994. Both of these events took place during storm events indicating that the bacteria are entering the river system from nonpoint source pollutants. Maximum, minimum, and mean fecal coliform bacteria concentrations are depicted in Figure 8.

A tabulation of the water quality data collected during this survey is included as Appendix "A".

FIGURE 7 - Total Organic Carbon/Biochemical Oxygen Demand

Mean Concentrations

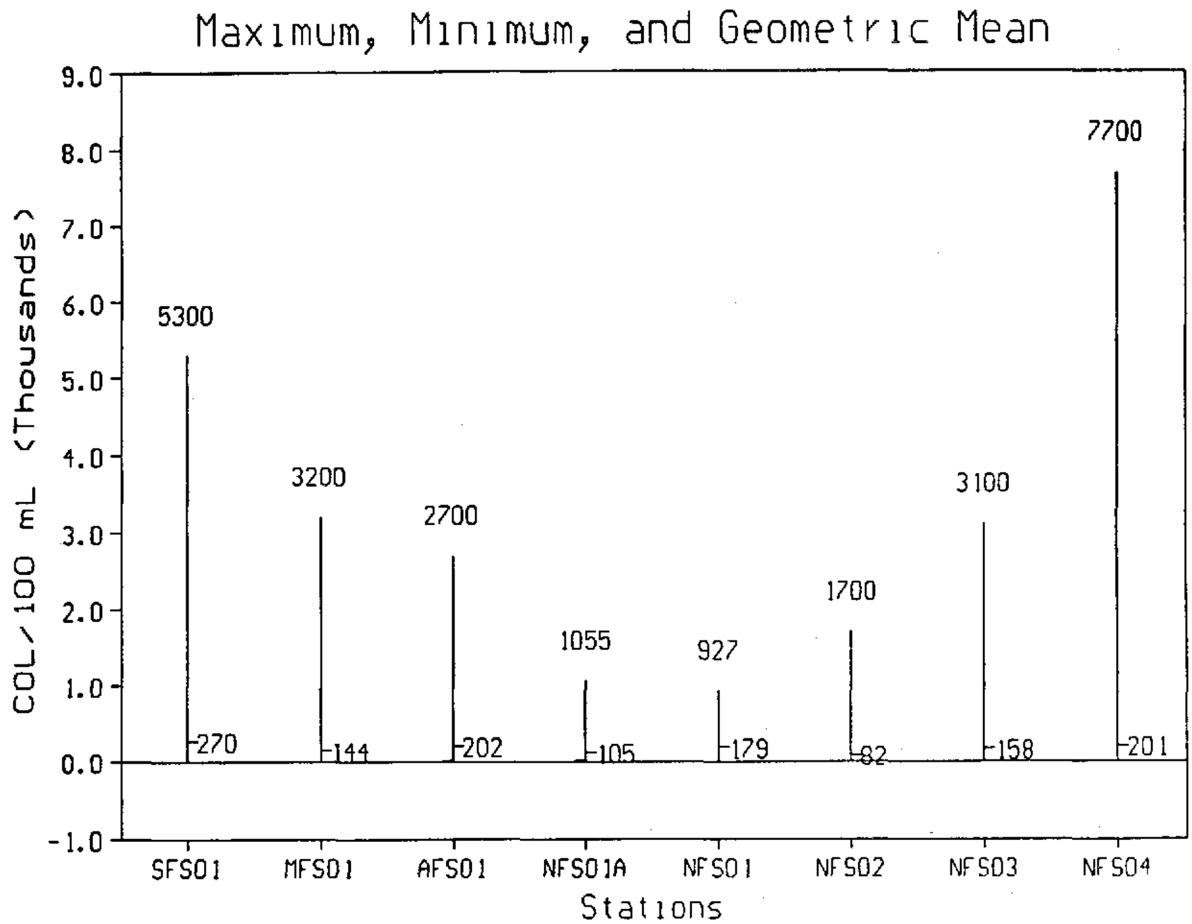


STATION	Mean TOC	Mean BOD	# of Samples
SFS01	3.36	0.91	11
MFS01	3.37	0.89	11
AFS01	3.25	1.09	11
NFS01A	2.53	0.97	9
NFS01#	4.95	1.67	10
NFS02	3.02	0.82	11
NFS03	3.24	0.85	11
NFS04	3.15	0.94	11

Ouachita Mountains Ecoregion BOD - 0.6 mg/L

#NFS01 excluding the 07/13/93 data - TOC 2.73 mg/L, BOD 1.03 mg/L.

FIGURE 8 - Fecal Coliform Bacteria



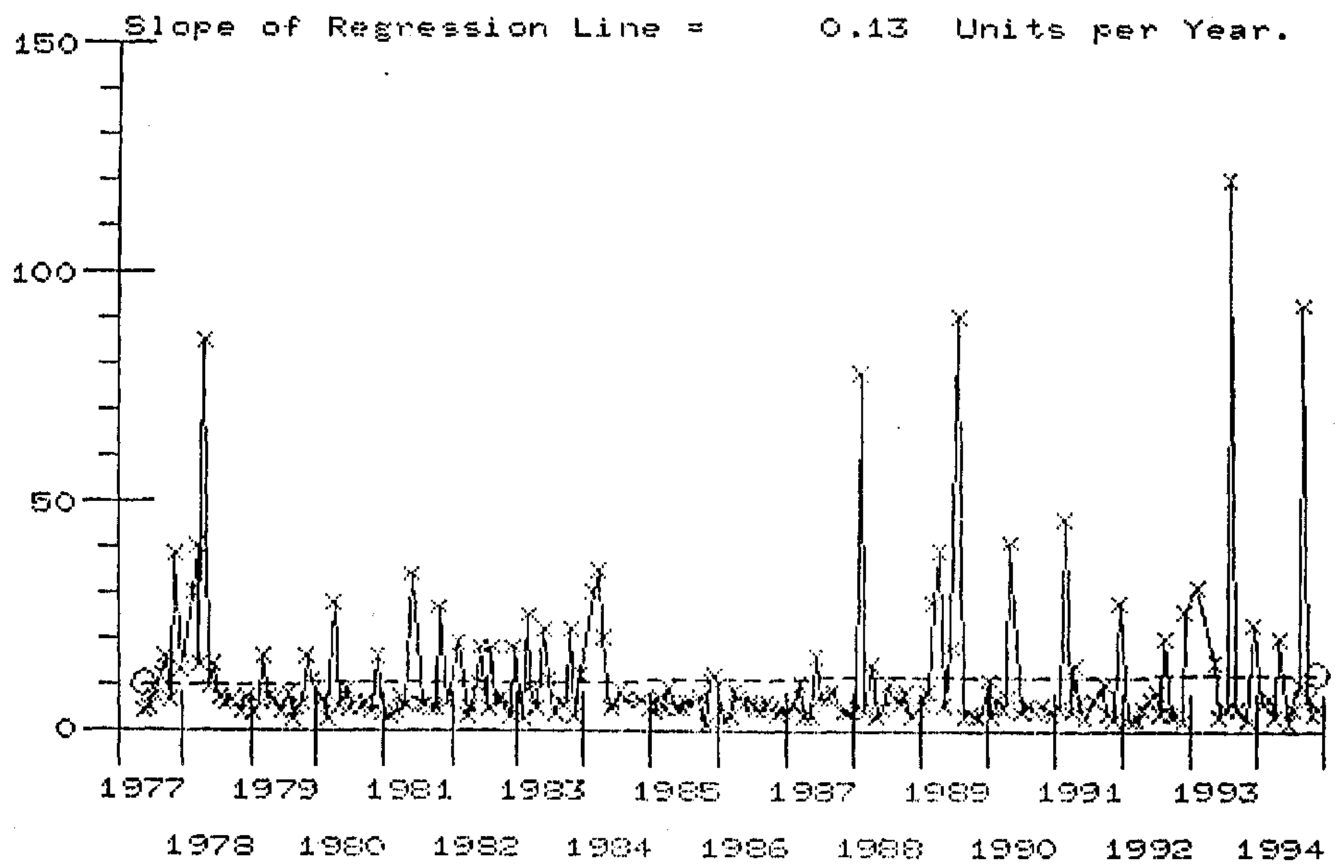
Historical Water Quality Data

The Department of Pollution Control and Ecology has maintained a monthly water quality monitoring station on the Saline River near the Interstate Highway 30 bridge, south of Benton, since 1974. The station is downstream from the confluence of the main Saline River forks, and it provides a long-term record of water quality of the upper Saline River. Historical plots of selected parameters from this station (OUA 26) are included in the following:

Figure 9 -- Turbidity
Figure 10 -- Residue TOT NFLT (Total Suspended Solids)
Figure 11 -- Total Phosphorus
Figure 12 -- NO_2+NO_3-N (Nitrite + Nitrate Nitrogen)

1116APCC 050158 OUA26 USGS073630 34 33 46.0 092 36 55.0
SALINE RIVER NR BENTON ARK 05125 ARKANSAS
S
OUACHITA RIVER SW LOWER MISSISSIPPI

82079 TURBIDTY LAB NTU



1977-1994

FIGURE 9

1116APCC 050158 OUA26 USGS073630 34 33 46.0 092 36 55.0
SALINE RIVER NR BENTON ARK 05125 ARKANSAS
S
OUACHITA RIVER SW LOWER MISSISSIPPI

530 RESIDUE TOT NFLT MG/L

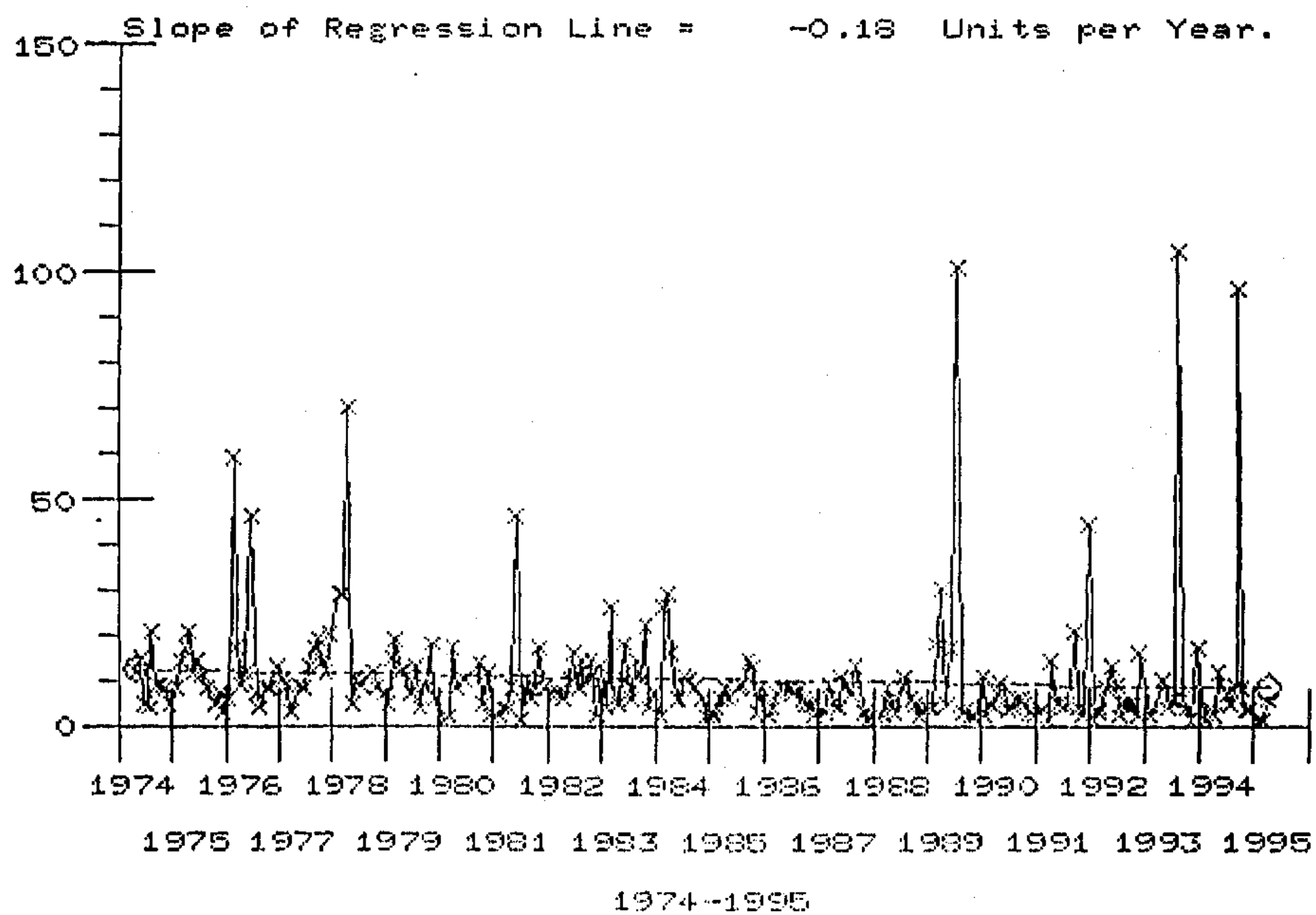
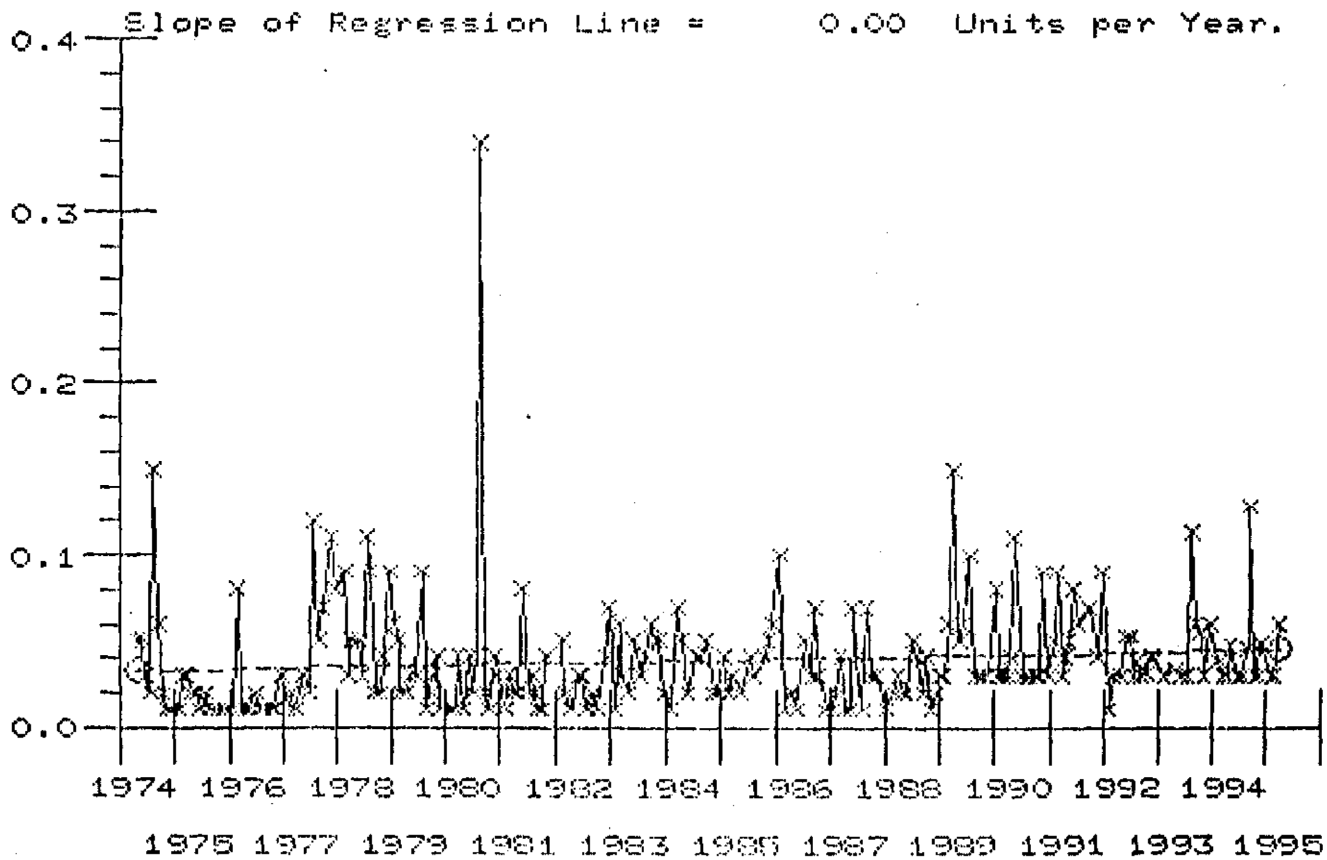


FIGURE 10

1116APCC 050158 OUA26 USGS073630 34 33 46.0 092 36 55.0
SALINE RIVER NR BENTON ARK 05125 ARKANSAS
S
OUACHITA RIVER SW LOWER MISSISSIPPI

665 PHOS-TOT MG/L P



1974--1995

FIGURE 11

1116APCC 050158 OUA26 USGS073630 34 33 46.0 092 36 55.0
SALINE RIVER NR BENTON ARK 05125 ARKANSAS
S
OUACHITA RIVER SW LOWER MISSISSIPPI

630 NO2&NO3 N-TOTAL MG/L

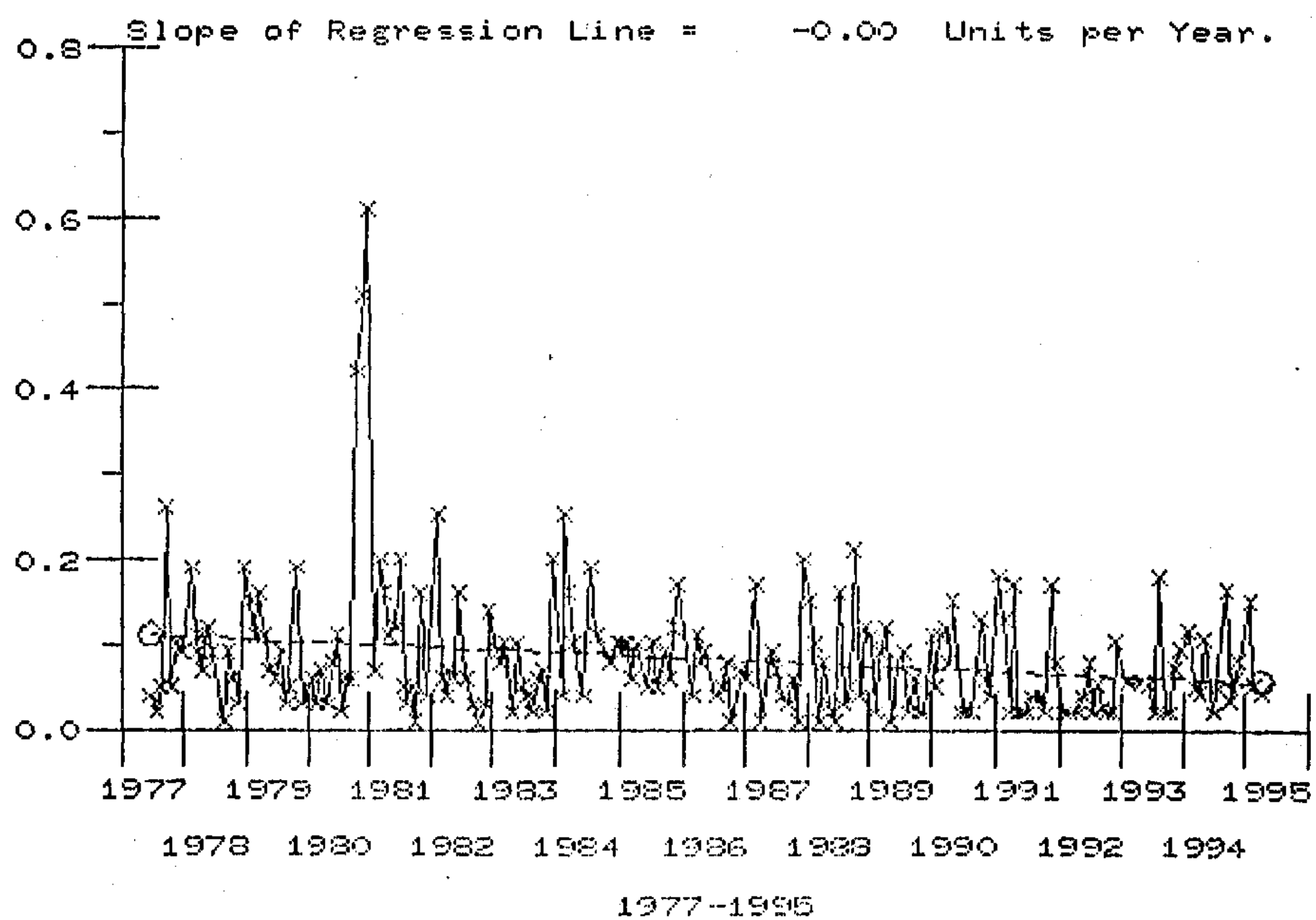


FIGURE 12

Historical turbidity values indicate an increased frequency of occurrence of peak values and an increased magnitude of turbidity values over the last seven years. The total suspended solids plot shows an extremely similar pattern, since most of the high turbidity values are caused by increases in suspended silt particles. In addition, a close evaluation of the total phosphorus data reflects a comparable trend. This also indicates that phosphorus levels are associated with the suspended silt particles and turbidity from runoff of the landscape. Since NO_2+NO_3-N occurs primarily in a dissolved form and is often associated with organic matter decomposition, the historical data of this parameter at OAU 26 does not demonstrate the same pattern as turbidity, TSS and TPhos. In fact, there seems to be a slight trend of decreasing values of NO_2+NO_3-N.

The historical data from the entire upper Saline River drainage substantiates the findings of the current study that the primary impacts in the upper Saline River forks is from nonpoint source runoff associated with landscape disturbances in the watershed. These disturbances cause high turbidity values and increase suspended solids in the streams during high runoff events.

Macroinvertebrates

Assessment of the macroinvertebrate community was conducted at five sites within the project area (NFS02, NFS03, NFS04, MFS01, and SFS01) on August 4, 1993. While it is recognized that this is a limited number of samples, it is possible to use these data to help characterize these streams' overall quality.

Samples were collected in riffles using a 1 m^2 kick seine. In each case, a 1 - 2 m^2 area was "kicked" upstream of the net position and dislodged organisms were subsequently transported into the net by the flow. The sample was then deposited into a porcelain tray and an approximately 100 organism sub-sample was randomly collected (Rapid Bioassessment Technique). The sub-sample was preserved with 70% ethanol and transported to the lab for identification. The organisms were identified to the lowest taxonomic level feasible, normally the genus level.

The samples from each site were assessed using both qualitative and semi-quantitative analysis tools. Table 2 is a list of the calculated metric values used in the assessment of the macroinvertebrate communities of the sampled sites. Each sample was considered independently in order to characterize the macroinvertebrate community at that particular site. Comparisons between sites are not applicable due to the small number of samples, watershed drainage areas, and physical habitat differences. Metrics used in the assessment of the samples included the Shannon - Weaver Mean Diversity Index (d),

Table 2. Metric values used in the assessment of the macroinvertebrate community.

SITE	# TAXA	d	e	HBI
NFS02	19	3.54	0.89	3.53
NFS03	10	2.36	0.70	3.01
NFS04	16	2.98	0.68	3.88
MFS01	14	2.95	0.78	3.41
SFS01	12	3.02	1.00	3.61

Equitability index (e), and the family level Hilsenhoff Biotic Index (HBI) (Table 2). The Shannon - Weaver index is affected by the richness of species and the distribution of individuals among the species. Equitability is the ratio of species collected to the expected number of species based on the "d" calculation.

Equitability is sensitive to slight community structure changes and can be used to determine if communities are affected by depressed oxygen concentrations. Values range from 0 to 1 with values greater than 0.5 being indicative of unstressed communities. Even slight levels of degradation have been found to reduce "e" to 0.3.

The HBI is an index based on the community's tolerance to organic enrichment. The resulting value is indicative of overall water quality. The breakdown of values are as follows: 0.00-3.75 (excellent), 3.76-4.25 (very good), 4.25-5.00 (good), 5.01-5.75 (fair), 5.76-7.25 (poor), and 7.26-10.00 (very poor).

The methods used in this survey are acceptable for identifying communities which have been altered due to organic enrichment, but may not identify increases in productivity which may occur prior to changes in community structure.

The community present at each site is indicative of very good water quality and consistent with the type of community expected within the extraordinary resource waters. The HBI values and corresponding water quality rankings of four of the sites are excellent (NFS02, NFS03, MFS01, SFS01), while the remaining site (NFS04) is ranked as very good. Equitability values are all indicative of unstressed communities.

The diversity index (d) and number of taxa at NFS03 are somewhat lower than the other values, but may be attributed largely to field error. All sub-samples were "picked" by the same individual with the exception of NFS03. The metrics used indicate that the NFS03 community is relatively intolerant of organic pollutants as its HBI value is the lowest of all sites sampled, and "e" is well above the critical 0.5 value.

Appendix B is a list of the taxa collected at each sample site, the number of individuals collected, and their percent community composition.

CONCLUSIONS

The water quality in the upper Saline River forks was found to be of excellent quality. Except for turbidity standard violations during high flow events and during localized in-stream construction activities, there does not seem to be any indication of continuous degradation of the water quality. Below is a list of significant findings from this survey.

1) Dissolved oxygen concentrations were below the 5.0 mg/L standard only on one date, and this was most likely due to a "no flow" condition at the headwater sites on the North Fork.

2) The turbidity standard of 10 NTU was violated throughout the survey area during storm events. The highest turbidity and TSS concentrations occurred when stream flows were out-of-bank. Also, these parameters increased substantially during the first storm event after the summer low-flow season. However, a turbidity value of near 900 NTU was measured below a bridge construction site.

3) The majority of the nutrient concentrations were at or below detection levels. The North Fork had more NO_2+NO_3-N samples below the detection level than any of the other forks. Total phosphorus concentrations were slightly elevated during storm events and associated with increased TSS values, indicating a nonpoint source pollution input.

4) A comparison of the survey data with the ecoregion data indicates slightly higher nutrient concentrations in the upper Saline River watershed, but none of the values were considered to be in the problematic range.

5) A review of 20 years of historical data from the upper Saline River basin substantiates the findings of this study that turbidity and TSS levels have increased in magnitude and frequency of occurrence of peak values during the last seven to eight years.

6) TOC and BOD concentrations in the study area were similar to ecoregion data from least-disturbed reference streams.

7) The macroinvertebrate community within the survey area is of excellent quality and is indicative of the community expected to be present in an extraordinary resource waterbody.

8) The water quality in the South, Middle, Alum and North Forks of the Saline River are currently meeting all of their designated uses. Except for an occasional high turbidity concentration during storm events, the water quality within these waterbodies is generally similar to those of Ouachita Mountain Ecoregion reference streams. Furthermore, the water quality of the North Fork seems to be the best of the Saline River Forks.

APPENDIX A

Water Quality Data

The following appendix lists the water quality data collected from each of the sampling sites during this survey. Units of measure are in mg/L except for; temperature - degrees Celsius, pH - standard units, Turbidity - NTU, Fecal coliform bacteria - col/100 ml, flow - percent (%) bank-full capacity.

Table A-1 Water Quality Data

SFS01

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	27.0	5.3	6.89	0.08	0.07	<0.03	0.04	3	2.9	66	49.0	3.26	5.3	0.6	4.1	180	10
08/03/93	26.4	5.3	6.78	<0.05	0.20	<0.03	<0.03	3	2.2	82	53.9	2.69	4.9	0.7	3.9	30	10
08/24/93	27.5	6.0	7.71	0.08	<0.02	<0.03	<0.03	1	2.5	70	44.0	3.31	7.8	0.2	2.2	104	10
09/20/93	22.5	7.3	6.86	<0.05	<0.02	0.04	<0.03	6	3.8	46	27.3	2.70	4.8	0.9	3.5	>600	50
11/04/93	11.2	9.6	7.35	<0.05	0.08	<0.03	<0.03	1	1.2	62	40.0	2.69	8.6	0.5	2.8	10	10
11/15/93	14.7	8.6	6.58	<0.05	0.08	0.08	<0.03	12	18.0	56	22.9	2.73	7.7	1.2	---	300	75
12/13/93	9.6	10.3	7.58	0.09	0.16	0.10	<0.03	38	29.0	56	31.7	3.61	8.8	1.0	4.4	>600	100
01/11/94	6.2	11.2	7.41	<0.05	<0.02	0.04	<0.03	10	16.0	78	51.6	3.60	10.3	1.5	3.9	1218	80
02/22/94	10.0	10.2	7.15	0.19	0.09	0.19	0.09	143	73.0	62	20.4	4.75	8.1	1.7	6.8	5300	250
04/26/94	19.0	7.6	7.27	<0.05	<0.02	<0.03	<0.03	7	10.0	46	47.7	2.68	8.3	1.3	3.9	4400	90
09/27/94	17.4	8.1	7.78	0.10	<0.02	<0.03	<0.03	2	2.0	70	48.3	2.97	6.7	0.4	1.5	32	10

MFS01

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	27.2	5.5	7.05	0.06	<0.02	<0.03	<0.03	4	3.0	81	66.6	2.97	4.1	0.7	4.6	10	10
08/03/93	26.8	5.1	7.14	<0.05	0.07	<0.03	<0.03	4	2.8	88	72.2	2.89	4.9	0.8	5.0	10	10
08/24/93	27.7	5.6	7.64	0.17	<0.02	0.04	<0.03	2	2.6	91	69.1	3.99	6.6	0.5	3.8	24	10
09/20/93	20.8	7.4	6.89	<0.05	<0.02	0.04	<0.03	2	2.5	96	72.9	4.29	5.8	0.7	3.2	520	40
11/04/93	10.0	9.7	7.62	<0.05	0.20	0.05	<0.03	1	1.8	89	70.0	3.00	7.6	0.5	2.4	50	10
11/15/93	14.9	8.9	7.09	<0.05	0.11	0.09	<0.03	16	25.0	65	28.5	2.63	6.5	1.3	---	1300	95
12/13/93	8.7	10.6	7.56	<0.05	0.18	0.04	<0.03	8	8.4	66	45.7	3.00	7.6	0.8	3.2	560	100
01/11/94	5.5	12.6	7.68	<0.05	<0.02	<0.03	<0.03	3	7.1	80	62.1	3.37	8.2	1.3	2.9	300	50
02/22/94	9.9	10.2	7.12	<0.05	0.05	0.15	0.07	86	47.0	70	30.9	3.49	8.1	1.6	6.3	3200	180
04/26/94	20.0	7.4	7.47	<0.05	<0.02	<0.03	<0.03	4	3.0	69	61.5	2.53	6.1	0.8	3.3	230	85
09/27/94	16.5	7.5	7.95	0.09	<0.02	<0.03	<0.03	1	2.0	79	56.4	2.41	4.3	0.8	2.4	56	10

AFS01

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	28.0	5.1	7.36	0.07	<0.02	<0.03	0.04	6	3.3	80	64.2	3.04	7.7	1.6	5.7	370	10
08 03/93	28.5	5.1	7.19	<0.05	<0.02	<0.03	<0.03	3	2.4	83	73.2	2.56	3.5	1.4	4.1	270	10
08/24/93	28.4	6.3	7.70	<0.05	<0.02	<0.03	<0.03	4	2.0	81	62.1	2.36	5.3	1.6	3.8	64	10
09/20/93	23.4	8.3	7.68	<0.05	<0.02	<0.03	<0.03	1	1.5	85	67.7	2.84	3.7	1.2	2.8	40	25
11/04/93	10.2	9.1	7.46	<0.05	<0.02	<0.03	<0.03	1	2.1	76	57.4	2.81	7.6	0.5	4.7	70	10
11/15/93	14.7	8.8	7.22	<0.05	0.04	0.05	<0.03	8	17.0	56	22.9	2.36	5.1	1.1	---	440	90
12/13/93	8.7	10.3	7.31	<0.05	0.08	<0.03	<0.03	4	6.1	53	36.6	2.97	6.3	0.8	2.7	720	80
01/11/94	5.5	12.0	7.68	<0.05	<0.02	<0.03	<0.03	4	5.2	75	58.2	3.17	5.8	1.2	2.3	220	60
02/22/94	10.0	10.5	7.09	<0.05	0.03	0.12	0.07	97	59.0	69	29.1	3.71	7.1	1.4	5.5	2700	200
04/26/94	20.0	7.4	7.47	<0.05	<0.02	<0.03	<0.03	4	2.0	62	54.9	2.06	5.0	0.7	2.2	127	90
09/27/94	17.7	8.5	7.86	0.09	0.06	<0.03	<0.03	2	4.0	94	72.3	2.93	5.5	0.5	2.0	62	25

Table A-1 Water Quality Data

NFS01A

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
08/03/93	24.6	5.4	6.92	<0.05	<0.02	<0.03	<0.03	4	4.2	26	24.4	1.22	1.9	0.7	3.8	40	10
08/24/93	25.2	4.8	7.39	0.07	<0.02	<0.03	<0.03	6	5.5	27	23.2	1.93	2.0	2.2	5.1	36	10
09/20/93																	dry
11/04/93	10.1	8.9	6.83	<0.05	<0.02	<0.03	<0.03	1	3.8	23	10.9	1.90	3.5	0.9	2.6	180	10
11/15/93	13.7	9.6	6.85	<0.05	<0.02	<0.03	<0.03	1	8.3	28	5.3	2.07	1.9	0.7	---	210	50
12/13/93	8.1	10.7	6.49	<0.05	<0.02	<0.03	<0.03	2	5.8	16	10.2	2.12	1.8	0.5	2.0	230	75
01/11/94	5.7	11.8	7.20	<0.05	<0.02	<0.03	<0.03	1	4.5	18	12.6	2.36	1.5	1.0	1.5	64	40
02/22/94	9.0	10.1	6.28	<0.05	<0.02	<0.06	<0.03	50	35.0	30	8.1	2.66	4.9	1.3	3.9	1055	140
04/26/94	19.5	7.7	6.87	<0.05	<0.02	<0.03	<0.03	1	4.0	16	14.7	1.82	2.5	0.5	1.5	64	30
09/27/94	17.8	7.4	7.36	0.08	<0.02	<0.03	<0.03	1	2.0	26	18.0	2.07	1.7	0.9	2.4	28	10

NFS01

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	24.7	5.1	6.95	0.33	0.29	0.81	0.14	868	890.0	103	40.7	4.81	12.9	7.4	24.9	>600	10
08/03/93	25.3	5.4	6.89	<0.05	0.03	0.07	0.05	42	98.0	94	17.4	2.19	4.9	1.5	5.6	500	10
08/24/93	25.2	3.5	7.11	0.18	<0.02	<0.03	<0.03	22	24.0	34	19.5	2.31	3.8	1.9	4.8	44	10
09/20/93																	dry
11/04/93	9.9	9.3	6.84	<0.05	<0.02	<0.03	<0.03	1	4.6	24	5.0	2.45	3.5	0.8	3.0	120	10
11/15/93	13.8	9.8	6.75	<0.05	<0.02	<0.03	<0.03	1	9.3	29	5.0	1.97	1.0	0.7	---	110	50
12/13/93	7.9	10.8	6.67	<0.05	<0.02	<0.03	<0.03	4	11.0	23	5.3	2.26	1.8	0.6	1.8	740	105
01/11/94	5.5	12.2	7.19	<0.05	<0.02	<0.03	<0.03	2	5.6	19	8.3	2.19	1.5	0.8	1.4	118	40
02/22/94	9.0	11.1	6.14	<0.05	<0.02	<0.10	0.04	73	62.0	35	5.7	2.82	4.9	1.2	4.0	927	150
04/26/94	19.0	7.9	6.87	<0.05	<0.02	<0.03	<0.03	4	6.0	18	10.5	1.52	2.5	0.6	1.4	164	30
09/27/94	18.0	5.9	7.12	0.08	<0.02	<0.03	<0.03	5	8.0	29	11.4	2.42	1.7	1.2	2.6	15	10

NFS02

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	25.1	6.4	7.29	0.06	<0.02	<0.03	<0.03	1	2.0	35	24.5	2.50	6.5	0.9	3.3	30	10
08/03/93	24.9	6.5	7.03	<0.05	<0.02	<0.03	<0.03	2	2.8	42	24.4	1.97	4.9	0.7	4.5	10	10
08/24/93	26.1	6.7	7.35	0.08	<0.02	<0.03	<0.03	1	14.0	43	21.4	2.33	7.8	0.4	3.1	56	10
09/20/93	21.9	8.0	7.55	<0.05	<0.02	<0.03	<0.03	2	2.4	49	39.9	2.95	7.7	1.1	2.0	>600	25
11/04/93	10.6	9.6	7.13	<0.05	<0.02	<0.03	<0.03	1	2.8	40	13.4	2.15	7.7	0.6	2.9	10	10
11/15/93	14.0	9.5	6.85	<0.05	<0.02	0.10	<0.03	3	12.0	35	5.3	2.06	1.9	0.8	---	270	90
12/13/93	7.9	10.5	6.78	<0.05	<0.02	<0.03	<0.03	9	8.8	34	12.2	2.06	4.9	0.7	3.0	360	105
01/11/94	5.5	11.6	7.85	<0.05	<0.02	<0.03	<0.03	2	4.3	38	20.4	6.14	5.8	1.1	3.4	73	60
02/22/945	9.3	10.6	6.87	<0.05	0.05	0.10	0.05	99	65.0	44	5.7	2.66	6.0	1.2	5.6	1700	250
04/26/94	20.5	7.9	7.19	<0.05	<0.02	<0.03	<0.03	1	5.0	28	14.7	1.73	5.0	0.7	2.9	27	40
09/27/94	16.3	8.5	7.35	0.08	<0.02	<0.03	<0.03	1	2.0	48	21.3	2.49	6.7	0.8	2.5	33	10

Table A-1 Water Quality Data

NFSO3A

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
08/24/93	28.2	6.1	7.36	0.06	0.03	<0.03	<0.03	30	1.8	56	45.4	1.73	7.8	0.5	3.6	28	10
09/20/93	24.2	8.2	7.14	<0.05	<0.02	<0.03	<0.03	2	2.1	69	51.7	2.18	6.8	0.9	2.3	160	40

NFSO3

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	27.2	5.7	7.56	0.07	<0.02	<0.03	<0.03	2	2.4	55	45.0	2.36	6.5	1.2	4.7	250	10
08/03/93	27.0	6.1	7.12	<0.05	<0.02	<0.03	<0.03	14	5.6	58	45.0	1.61	6.1	0.8	5.6	40	10
08/24/93	28.3	5.8	7.80	0.08	<0.02	<0.03	<0.03	6	6.6	56	36.7	1.94	7.8	0.7	3.6	84	10
09/20/93	23.9	7.7	7.59	<0.05	<0.02	<0.03	<0.03	3	2.6	58	42.7	2.00	6.8	0.8	2.5	240	40
11/04/93	11.2	9.1	7.27	<0.05	<0.02	<0.03	<0.03	1	2.4	63	43.1	2.27	10.5	0.5	3.9	30	10
11/15/93	14.7	9.0	7.04	<0.05	0.04	0.05	<0.03	12	18.0	50	16.9	2.17	5.1	1.3	---	350	70
12/13/93	8.5	10.4	7.05	<0.05	<0.02	<0.03	<0.03	3	6.3	47	31.7	2.29	7.6	0.7	2.3	310	80
01/11/94	5.7	11.8	7.60	<0.05	<0.02	<0.03	<0.03	8	16.0	72	48.9	2.81	10.3	1.1	3.1	782	80
02/22/94	9.5	10.5	7.12	<0.05	<0.02	0.16	0.06	216	89.0	68	25.8	3.48	7.1	1.2	6.4	3100	250
04/28/94	20.0	8.0	7.55	<0.05	<0.02	<0.03	<0.03	1	2.0	58	46.2	1.82	7.2	0.5	2.7	73	30
09/27/94	18.0	6.6	7.48	0.08	<0.02	<0.03	<0.03	2	2.0	74	48.3	2.65	6.7	0.5	1.8	13	10

NFSO4

DATE	Temp	DO	pH	NH_3-N	NO_3-N	T-Phos	O-Phos	TSS	TURB	TDS	T-Hard	Cl	SO_4	BOD	TOC	Bact	Flow
07/13/93	28.8	6.0	7.54	<0.05	<0.02	<0.03	<0.03	2	2.5	82	67.7	2.58	6.5	0.8	4.5	40	10
08/03/93	26.8	6.3	7.23	<0.05	<0.02	<0.03	<0.03	5	4.2	65	53.9	1.63	6.1	1.0	4.7	1800	10
08/24/93	27.8	6.1	7.39	0.06	<0.02	<0.03	<0.03	7	2.4	68	53.4	1.94	7.8	0.5	3.4	28	10
09/20/93	23.8	8.0	7.65	<0.05	<0.02	<0.03	<0.03	2	2.0	63	42.7	1.97	6.8	0.8	2.4	310	25
11/04/93	11.4	8.9	7.38	<0.05	<0.02	<0.03	<0.03	1	2.1	74	56.0	2.63	8.6	0.9	4.5	10	20
11/15/93	14.9	9.0	7.11	<0.05	0.05	0.05	<0.03	18	24.0	57	20.9	2.21	5.1	1.1	---	170	50
12/13/93	8.7	10.3	7.07	<0.05	0.05	<0.03	<0.03	3	6.3	47	41.2	2.15	7.6	0.7	2.5	740	80
01/11/94	5.7	11.7	7.47	<0.05	<0.02	<0.03	<0.03	7	7.2	76	57.0	2.94	8.2	1.3	2.3	270	80
02/22/94	9.6	10.5	7.29	0.08	0.04	0.18	0.23	233	105.0	70	30.9	3.53	6.0	1.6	6.6	7700	250
04/26/94	20.0	8.2	7.62	<0.05	<0.02	<0.03	<0.03	1	2.0	66	58.8	1.92	7.2	0.7	1.6	310	50
09/27/94	21.1	10.5	7.86	0.11	<0.02	<0.03	<0.03	2	2.0	88	66.3	2.69	5.5	0.9	2.1	42	20

APPENDIX B

Macroinvertebrate Taxa Collected

The following tables in Appendix B list the macroinvertebrate taxa collected and the number of individuals and percent (%) community composition from the North Fork (NFS02, NFS03, NFS04), South Fork (SFS01), and Middle Fork (MFS01) of the Saline River during the survey.

Table B-1 Macroinvertebrate data for North Fork of Saline River (NFS02) collected August 8, 1993.

TAXA	NUMBER OF INDIVIDUALS	PERCENT COMPOSITION
Stenelmis - adult	18	17.6
Stenelmis - larvae	15	14.7
Neoperla	14	13.7
Stenonema	14	13.7
Psephenus	10	9.8
Baetis	5	4.9
Cheumatopsyche	5	4.9
Isonychia	5	4.9
Corydalus cornutus	3	2.9
Helicopsyche borealis	2	2
Chimarra	2	2
Gastropoda	2	2
Argia	1	1
Cambarinae	1	1
Hexatoma	1	1
Stylogomphus albistylus	1	1
Oligochaeta	1	1
Petrophila	1	1
Chironomidae	1	1
TOTAL TAXA = 19	102	100.0 %

Table B-2 Macroinvertebrate data for North Fork of Saline River (NFS03) collected August 8, 1993.

TAXA	NUMBER OF INDIVIDUALS	PERCENT COMPOSITION
Chimarra	43	43.4
Isonychia	16	16.2
Stenonema	16	16.2
Corydalus cornutus	13	13.1
Gastropoda	5	5.1
Oligochaeta	2	2.0
Neoperla	1	1.0
Psephenus	1	1.0
Chironomidae	1	1.0
Corbicula	1	1.0
TOTAL TAXA = 10	99	100.0 %

Table B-3 Macroinvertebrate data for North Fork of Saline River (NFS04) collected August 8, 1993.

TAXA	NUMBER OF INDIVIDUALS	PERCENT COMPOSITION
Isonychia	28	31.1
Stenonema	18	20
Chimarra	13	14.4
Gastropoda	10	11.1
Oligochaeta	6	6.7
Corydalus cornutus	3	3.3
Corbicula	3	3.3
Cheumatopsyche	1	1.1
Helicopsyche borealis	1	1.1
Stenacron interpunctatum	1	1.1
Cura foremanii	1	1.1
Neoperla	1	1.1
Psephenus	1	1.1
Polycentropus	1	1.1
Lirceus	1	1.1
Stenelmis - adult	1	1.1
TOTAL TAXA = 16	90	100.0 %

Table B-4 Macroinvertebrate data for Middle Fork of Saline River (MFS01) collected August 8, 1993.

TAXA	NUMBER OF INDIVIDUALS	PERCENT COMPOSITION
Chimarra	30	30.3
Stenonema	26	26.3
Isonychia	10	10.1
Corydalus	6	6.1
Stenelmis - adult	6	6.1
Baetis	4	4.0
Neoperla	4	4.0
Gastropoda	4	4.0
Cheumatopsyche	3	3.0
Corbicula	2	2.0
Dineutus	1	1.0
Hirudinidae	1	1.0
Oligochaeta	1	1.0
Stenelmis - larvae	1	1.0
TOTAL TAXA = 14	99	100.0 %

Table B-5 Macroinvertebrate data for South Fork of Saline River (SFS01) collected August 8, 1993.

TAXA	NUMBER OF INDIVIDUALS	PERCENT COMPOSITION
Isonychia	19	20.4
Chimarra	18	19.4
Stenonema	17	18.3
Cheumatopsyche	12	12.9
Gastropoda	8	8.6
Baetis	5	5.4
Corydalus	5	5.4
Stenelmis - adult	5	5.4
Caenis	1	1.1
Tricorythodes	1	1.1
Oligochaeta	1	1.1
Petrophila	1	1.1
TOTAL TAXA = 12	93	100.0 %