TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

TMDL INVESTIGATION
OF
WATER QUALITY IMPAIRMENTS TO
ROLLING FORK RIVER, POLK COUNTY, ARKANSAS

INTRODUCTION

The total maximum daily load (TMDL) process was established by Section 303(d) of the Clean Water Act and promulgated in 40 CFR 130.7(b). A TMDL is a process where parameters which result in an impairment are identified and quantified, and an implementation program is developed to remediate the impairment. The primary steps in the TMDL process include: (1) identification of water quality limited water bodies, (2) priority ranking and targeting such waters for TMDL activities, (3) development of TMDL, implementation of control actions, and assessment of water quality-based control actions.

Data collected at the ambient water quality monitoring station on Rolling Fork River (RED 30), indicated concentrations of nutrients sufficient to promote algal blooms and perhaps result in degradation of the water quality of Rolling Fork River and DeQueen Reservoir.

Rolling Fork River is the receiving stream of the Tyson Foods wastewater treatment facility (WWTF) at Grannis, Arkansas. This facility discharges under permit number AR0003018 at a permit design flow of 0.54 MGD (million gallons/day). Wastewater effluent discharge limits are 10/15/3/6 ($CBOD_5$/TSS/NH_3N/Eff.D.O.) for the months of May through October and 10/15/12/6 during November through April. When the water temperature exceeds 22° C, a 1 mg/L diurnal D.O. depression is allowed for no more than 8 hours during a 24 hour period. A TMDL investigation was conducted in order to determine the level of impact this discharge is having on the water quality and aquatic inhabitants of the receiving streams. This investigation was conducted on August 10-12, 1998 and consisted of water quality sampling, fish and macroinvertebrate collection, and the deployment of Hydrolab continuous dissolved oxygen recorders. Sampling was performed at four sites in Rolling Fork River, one site at the WWTF discharge and one site in the unnamed tributary to Rolling Fork River that initially receives the WWTF effluent.

HISTORICAL DATA

Waterway Description

Rolling Fork River has its origin in south-west Polk County near the City of Bog Springs, and it flows south for approximately eleven miles, bordered predominantly by forested land, before receiving the effluent from the Tyson WWTF. The river then flows for another 10 miles before entering DeQueen Reservoir. Its watershed size is approximately 46 mi^2 at the ambient water

quality station (RED 30) and approximately 38 mi^2 at the confluence of the effluent tributary. Rolling Fork River has a stream gradient of approximately 30 feet/mile west of Grannis. The substrate composition of the river consists mainly of bedrock and boulders upstream of the WWTF with mud, silt and boulders dominating the downstream pools. It has an abundance of in-stream habitat in the form of woody debris, large boulders, and over-hanging vegetation available to macroinvertebrates and fish. Rolling Fork River is in the Ouachita Mountains ecoregion and is classified as a perennial Ouachita Mountains fishery. The dissolved oxygen standard for this stream for the primary and critical seasons is 6 mg/L.

Designated beneficial uses of Rolling Fork River, in addition to the previously mentioned fishery use, consist of primary and secondary contact recreation and source water for industrial and agricultural uses. Through the third-party rulemaking process, the domestic drinking water use designation was removed from this stream between the confluence of the effluent tributary and DeQueen Reservoir.

Historical Water Quality

Water quality data collected between January 1994 and May 1998 at the ambient water quality station (RED 30) was retrieved for this study. These data indicated an average total phosphorus concentration of 0.4 mg/L and ranged from 0.03 mg/L to 2.05 mg/L. Ortho-phosphorus concentrations during this period averaged 0.37 mg/L and ranged from 0.007 mg/L to 1.9 mg/L. The average ammonia-nitrogen concentration was 0.068 mg/L and ranged from 0.005 mg/L to 0.33 mg/L. The average nitrate-nitrogen concentration was 0.59 mg/L and ranged from 0.01 mg/L to 10.2 mg/L. It is important to note that the most elevated concentrations of these nutrients were recorded during the warmer, low-flow months of June, September and October. Figures 1 and 2 show the monthly values of nitrate-nitrogen and total phosphorus at this station between 1991 and 1997.

CURRENT STUDY

Data Acquisition

The Rolling Fork River survey was initiated on the morning of August 10, 1998 when continuous dissolved oxygen meters were deployed at five stations. Also on the 10th of August, macroinvertebrate community samples were collected at three stations. On August 11, fish community samples were collected at two stations, physical habitat assessments were conducted and fluorescein dye was used to establish time of travel in the effluent tributary. Also on August 11, a Sigma automatic sampler was deployed to collect hourly effluent samples from the Tyson-Grannis discharge for a period of 24 hours. On August 12, the automatic sampler and continuous dissolved oxygen meters were retrieved and water grab samples were collected at all stations.

Figure 1

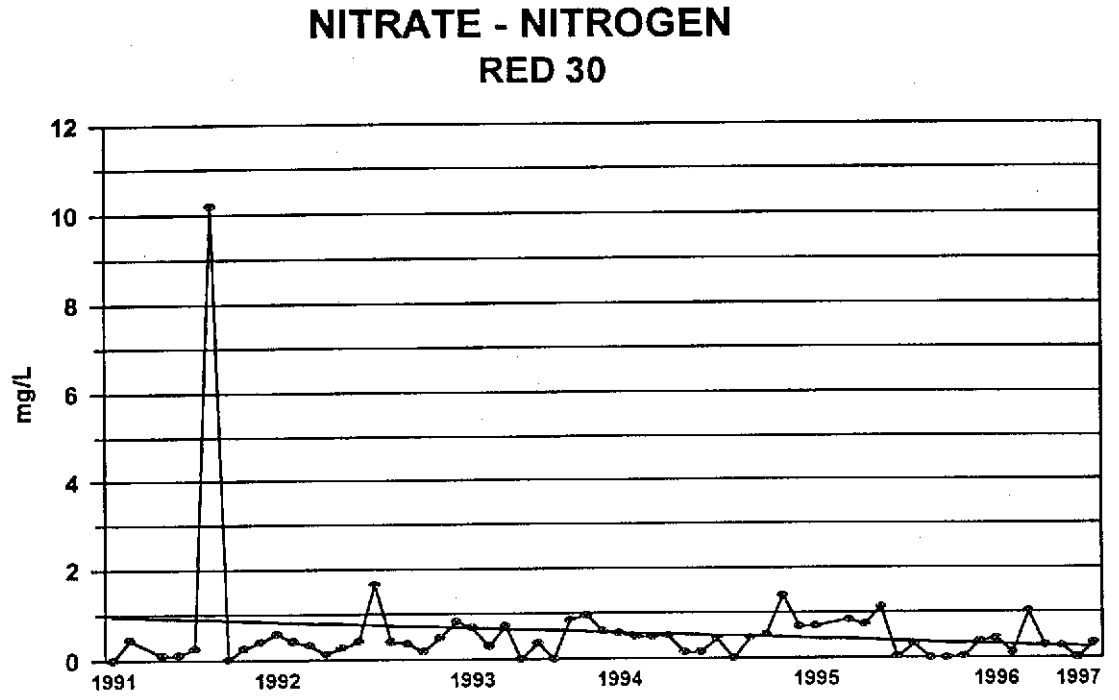
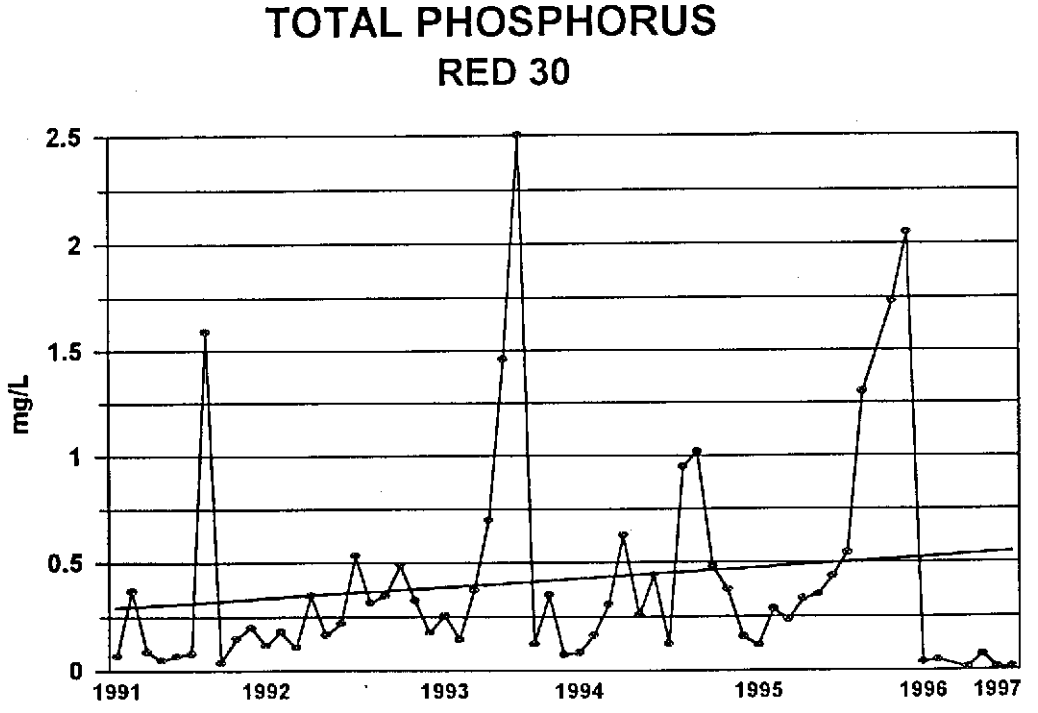


Figure 2



Parameters

In addition to the biological samples, the water analyses included dissolved oxygen, temperature, pH, flow, thirty day biochemical oxygen demand (BOD_{30}), total organic carbon (TOC), total suspended solids (TSS), total dissolved solids (TDS), nitrite+nitrate nitrogen (NO_2 + NO_3-N), orthophosphorus, total phosphorus, total kjeldahl nitrogen (TKN) and turbidity. Samples collected with the automatic sampler were analyzed for nitrite+nitrate nitrogen (NO_2 + NO_3), orthophosphorus, total phosphorus, and total organic carbon (TOC). An ADPC&E laboratory error resulted in the omission of analyses for chloride, sulfate, and ammonia. The dissolved metals sampling included aluminum, arsenic, boron, barium, beryllium, calcium, cadmium, cobalt, chromium, copper, iron, potassium, magnesium, manganese, selenium, sodium, nickel, lead, vanadium, zinc and hardness. Discharge Monitoring Reports (DMR) data from the WWTF were also retrieved for the previous five years. The evaluation of this data did not reveal any significant periods of excursion from permit limitations.

Collection, Preservation and Measurements

Water quality grab samples were collected, preserved and analyzed according to the 18th Edition of Standard Methods for Examination of Water and Wastewater. Analysis was conducted under ADPC&E's existing Quality Assurance Program. Dissolved oxygen and stream temperature were measured using an Orion Model 840 portable dissolved oxygen meter, which was calibrated according to the manufacturers instructions prior to use.

Five Hydrolab continuous dissolved oxygen recorders were used to determine diurnal variation in the dissolved oxygen concentration in the Rolling Fork River study area. One meter was deployed in the tributary that receives the discharge of the Tyson WWTF, another was placed in Rolling Fork River 100 m upstream of the tributary confluence, and a third meter was place in Rolling Fork River approximately 300 m below the tributary confluence. Meter #4 was deployed in Rolling Fork River approximately 300 m downstream of the county road below the confluence. Meter #5 was placed in Rolling Fork River approximately 40 m downstream of ambient water monitoring station RED 30.

Stream pH was measured with an Orion Model 230A portable pH meter, which was calibrated using buffer solutions of pH 4, 10 and 7. Stream flow was measured with a Marsh-McBirney Model 2000 Flow Mate meter by obtaining a representative number of velocities and depths across suitable stream locations. Water grab samples were taken in Rolling Fork River and in the unnamed tributary at the stations listed below and shown in Figure 3.

Biological samples were collected in Rolling Fork River upstream and downstream of its confluence with the effluent tributary. Macroinvertebrate samples were also taken in the effluent tributary. Macroinvertebrates were collected using a Turtox Indestructible benthos net. An attempt was made to sample similar structure and habitat at each location so that data collected would be comparable. The fish community was sampled by use of a Smith-Root Model 15-B

DC backpack electrofisher. Riffle areas were sampled by driving the fish into a seine, while the fish in the pools were collected by electroshocking favorable habitat areas. The smaller specimens and those unidentifiable in the field were preserved in a ten percent (10%) formalin solution and returned to the lab for identification.

Station Description

A total of six water chemistry stations were established in the Rolling Fork River study area. The station descriptions and type of sampling are as follows:

Station

RFK0001A- Rolling Fork River approximately 100 m upstream of the confluence with the tributary that carries the Tyson effluent. Water quality, dissolved metals, Hydrolab recorder deployed and biological collection.

RFK0001E- Tyson WWTF effluent at the end of the pipe. Water quality, dissolved metals and point of deployment of the Sigma automatic sampler for the collection of 24 hourly samples.

RFK0001T- Mouth of tributary to Rolling Fork River that carries the effluent discharge of Tyson WWTF. Samples were collected in the tributary approximately 10 m upstream from the confluence. Water quality, Hydrolab recorder deployed, dissolved metals, and macroinvertebrate community were sampled.

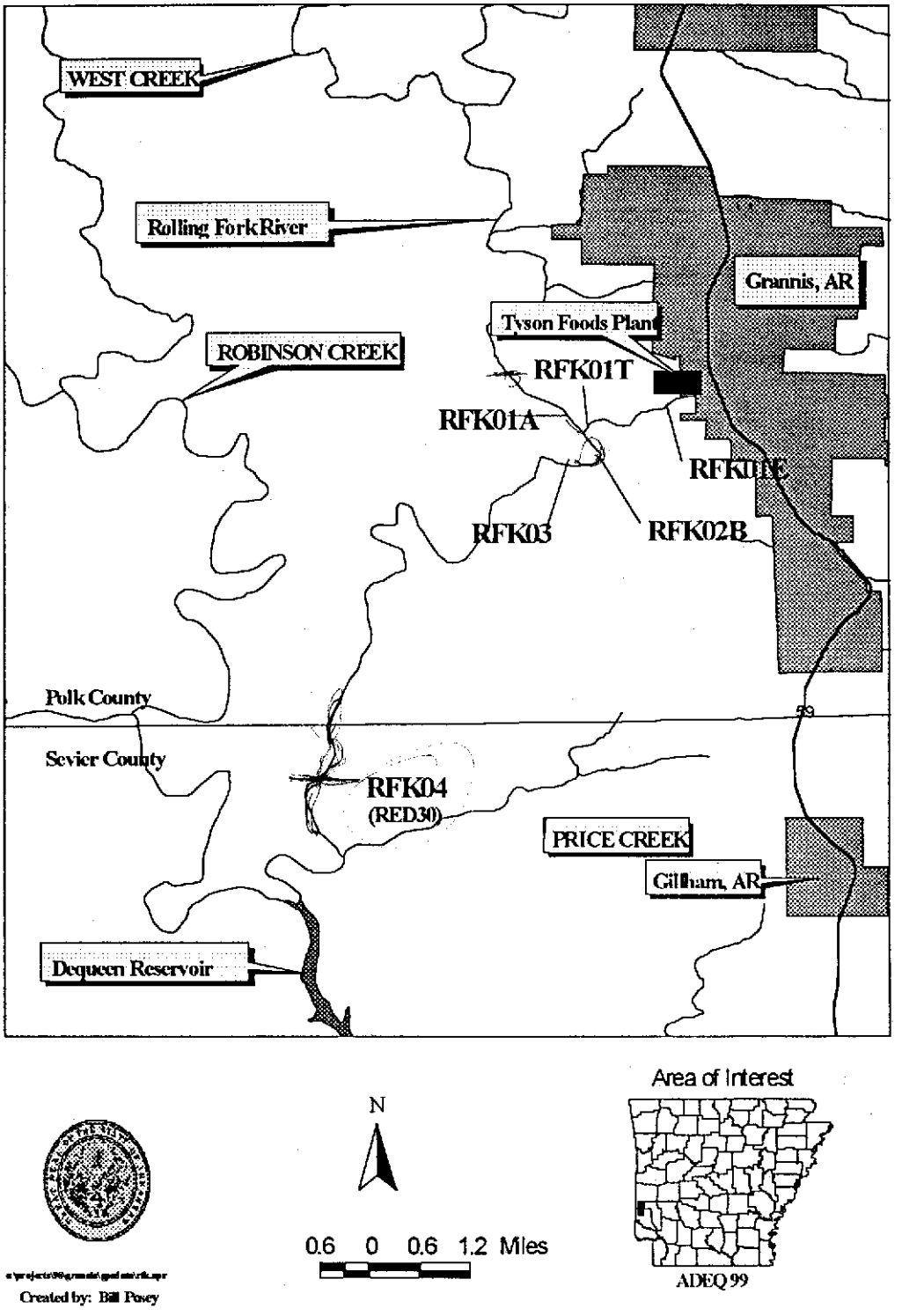
RFK0002B- Rolling Fork River at the county road bridge approximately 300 m downstream of the confluence of the effluent tributary. Water quality, dissolved metals, Hydrolab recorder deployed, and biological collection.

RFK0003- Rolling Fork River approximately 600 m downstream of the confluence of the discharge tributary. Samples were collected near an unmarked campsite accessible from the RFK002B county road. Water quality, Hydrolab recorder deployed, and dissolved metals.

RED0030- Located in Sevier County on Rolling Fork River at the first county road crossing of Rolling Fork in northern Sevier County. Approximately four miles below the discharge. Water quality, Hydrolab recorder deployed, dissolved metals, and macroinvertebrate community were sampled.

Figure 3 provides a map of the location of sampling stations.

Figure 3


WEST CREEK
Rolling Fork River
Grannis, AR
Tyson Foods Plant
ROBINSON CREEK
RFK01T
RFK01A
RFK01E
RFK03
RFK02B
Polk County
59
Sevier County
RFK04
(RED30)
PRICE CREEK
Gillham, AR
Dequeen Reservoir
N
0.6 0 0.6 1.2 Miles
Area of Interest
ADEQ 99
Created by: Bill Posey

DATA RESULTS

Diel Dissolved Oxygen, pH and Temperature

Hydrolab recorder, multi-parameter water quality sampling meters were used to measure the diel fluctuation of D.O., temperature and pH. On August 10, 1998, meter #1 was placed in the tributary (RFK0001T) that receives the effluent of Tyson Foods, meter #2 was deployed upstream of the confluence of Rolling Fork River and the discharge tributary (RFK0001A), meter #3 was deployed downstream at (RFK0002B), meter #4 was deployed further downstream at RFK0003 and meter #5 was at the last downstream station (RED0030). All samplers were deployed for approximately 48 hours collecting data at 30 minute intervals. Table 1 is a summary of the temperature and D.O. data collected.

Table 1- Diel D.O. and Temperature Summary

Station ID	Date 12pm - 12pm	Dissolved Oxygen (mg/L)			Temperature (°C)		
		Max	Min	M.D.F.*	Max	Min	M.D.F.
RFK01A	8-10/11	8.0	5.4	2.6	29.7	25.8	3.9
	8-11/12	7.8	6.0	1.8	27.7	25.4	2.3
RFK01T	8-10/11	8.0	7.1	0.9	28.9	24.3	4.6
	8-11/12	7.7	7.2	0.5	27.7	25.5	2.2
RFK02B	8-10/11	9.6	5.7	3.9	30.1	25.5	4.6
	8-11/12	9.3	6.1	3.1	27.7	25.3	2.4
RFK03	**						
RED030	8-10/11	10.8	5.3	5.4	29.9	27.0	2.9
	8-11/12	9.8	5.1	4.7	28.8	26.7	2.1

* Maximum Daily Fluctuation

** Meter failure- no data recorded.

The maximum daily D.O. fluctuation was noticeably lower in the tributary stream (RFK01T) compared to stations in Rolling Fork. Although nutrient values were much higher in the tributary, it is a very small high gradient stream with near 100 % canopy cover resulting in limited periphyton production and low diel variations of D.O. In addition, the MDF at all sites was lower on the second day of data collection. This was caused by an overnight storm event between day 1 and day 2 and a mostly cloudy day 2. However, even with the noticeable climatological effects on D.O. and water temperature, the MDF of D.O. was much greater both days in the two Rolling Fork stations below the effluent tributary. The supersaturated dissolved oxygen concentration (Figure 4) and the elevated daily D.O. fluctuation at the downstream stations (RFK02B and RED 30) is in part the result of the photosynthetic activity of the dense growth of filamentous and periphytic algae at these stations. This algal growth can be attributed to the elevated concentrations of nutrients discharged from the Tyson-Grannis WWTF.

There were no water quality standard violations of minimum D.O. at any station. However, Figure 5 shows the comparative differences in the maximum daily D.O. and the daily D.O. fluctuation at all stations. The influence of excessive algae photosynthesis activity is apparent at stations RFK02B and RED 30. Figures 6 thru 9 depicts the diel D.O. and temperature data from RFK01A, RFK01T, RFK02B and RED 30.

Figure 4

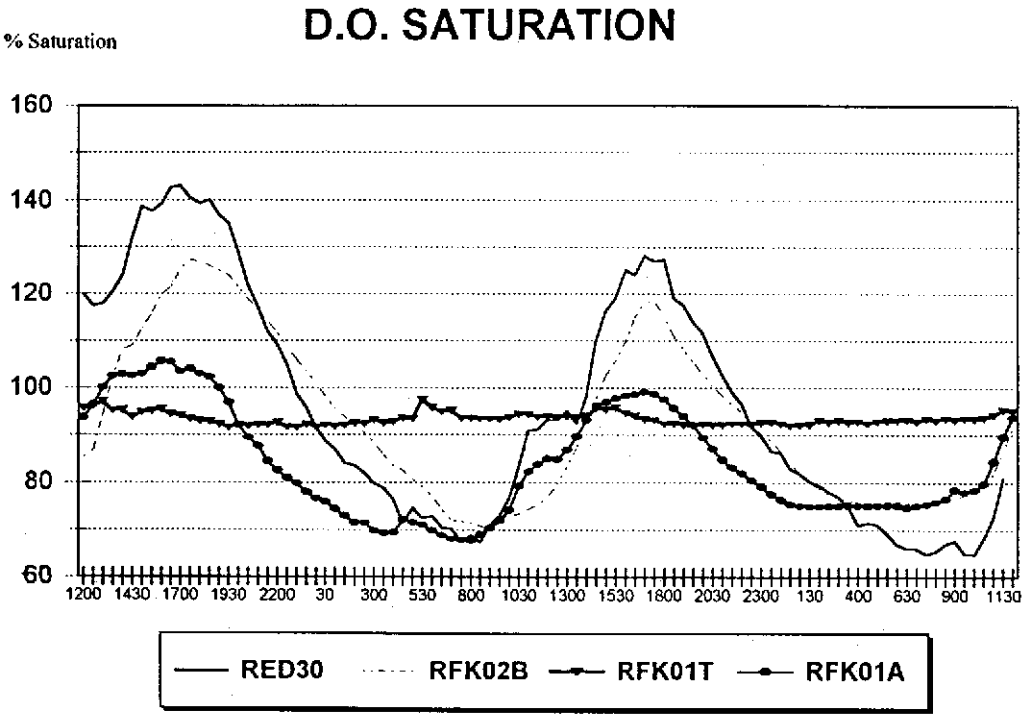


Figure 5

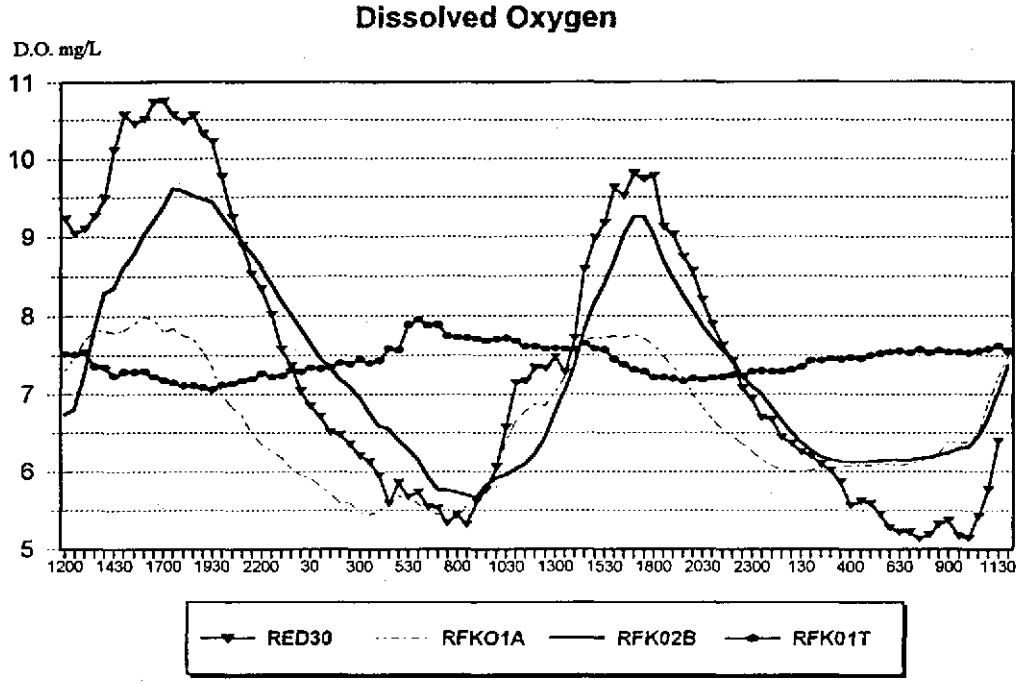


Figure 6

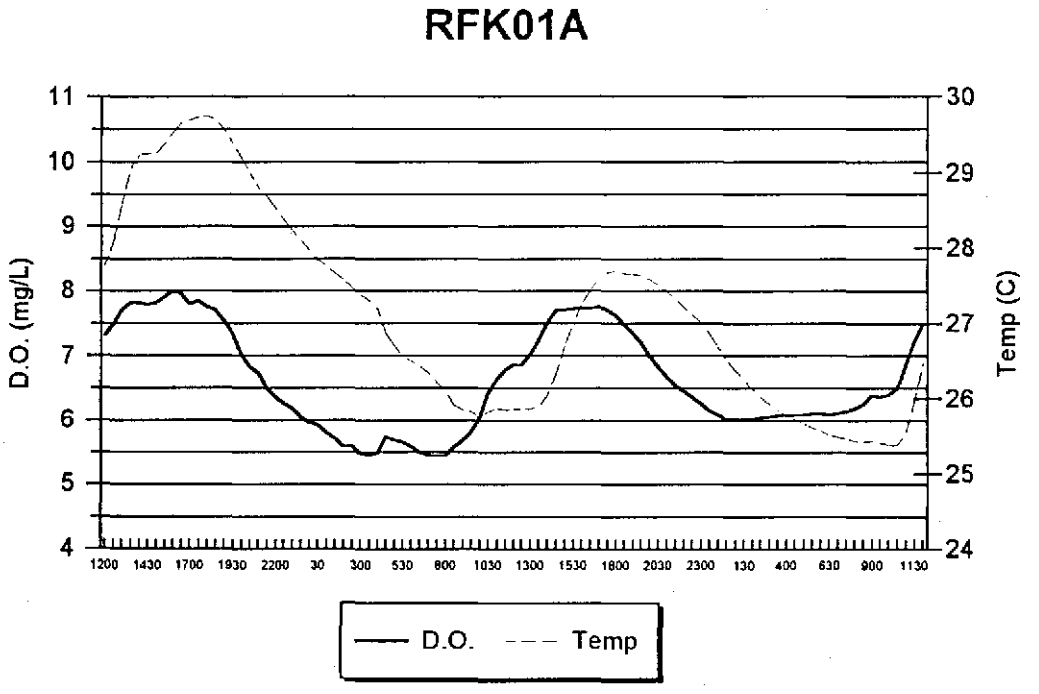


Figure 7

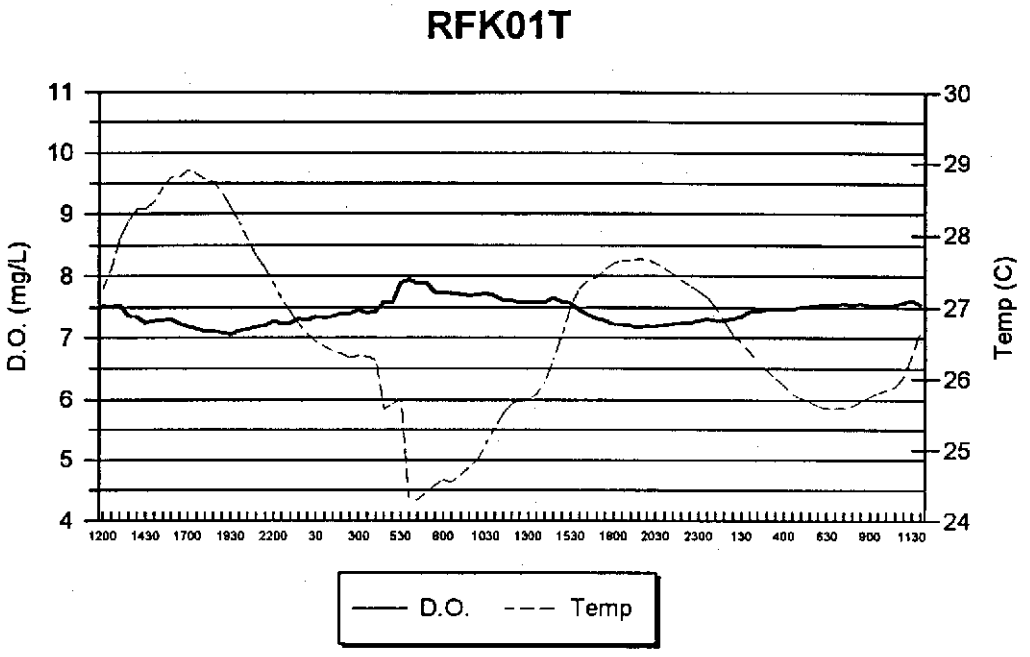


Figure 8

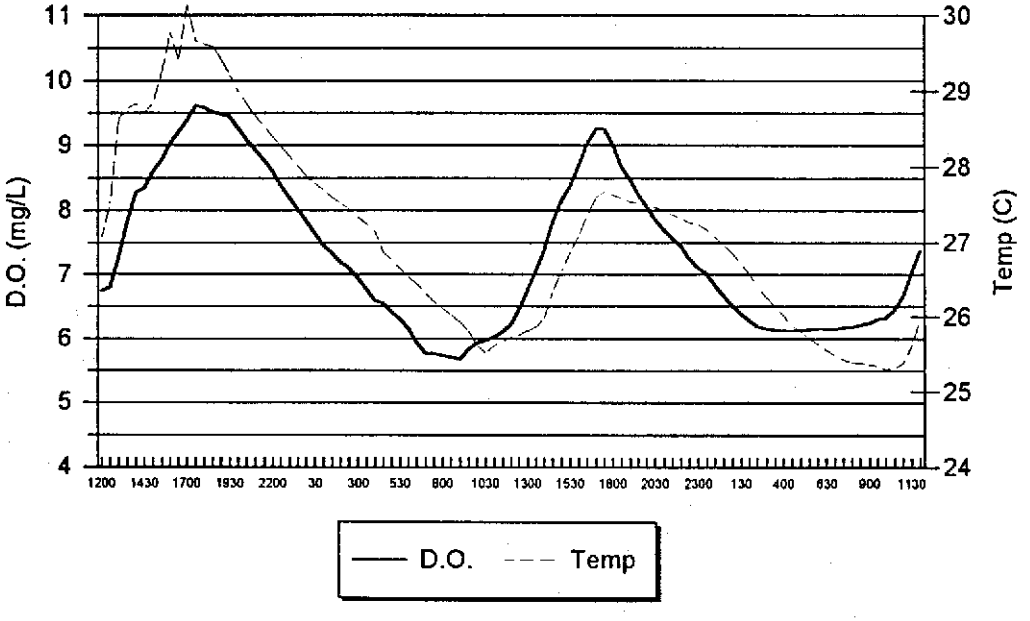
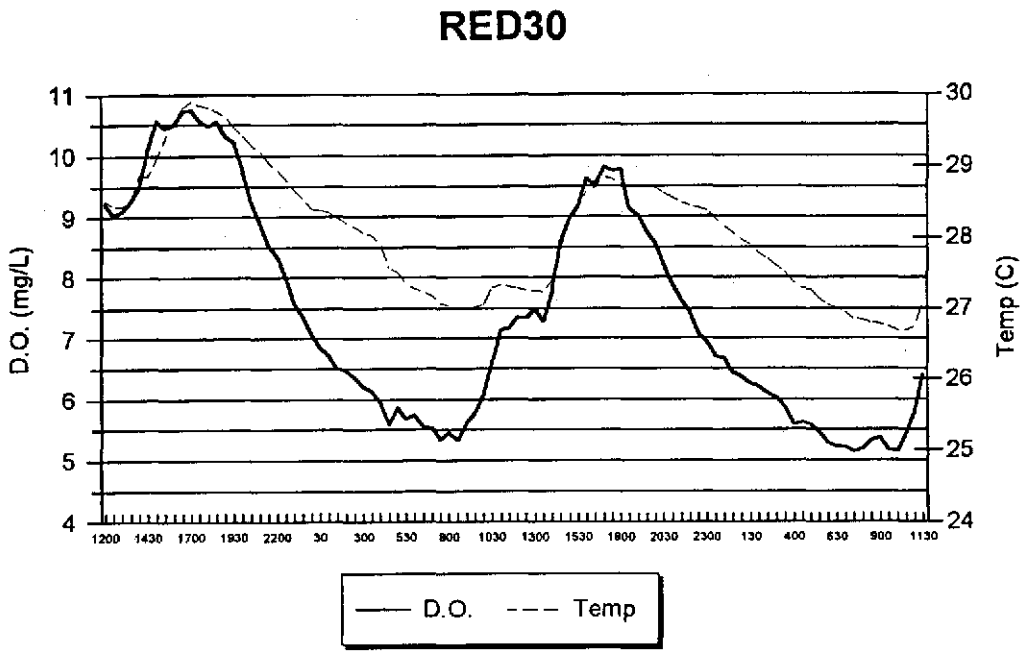


Figure 9



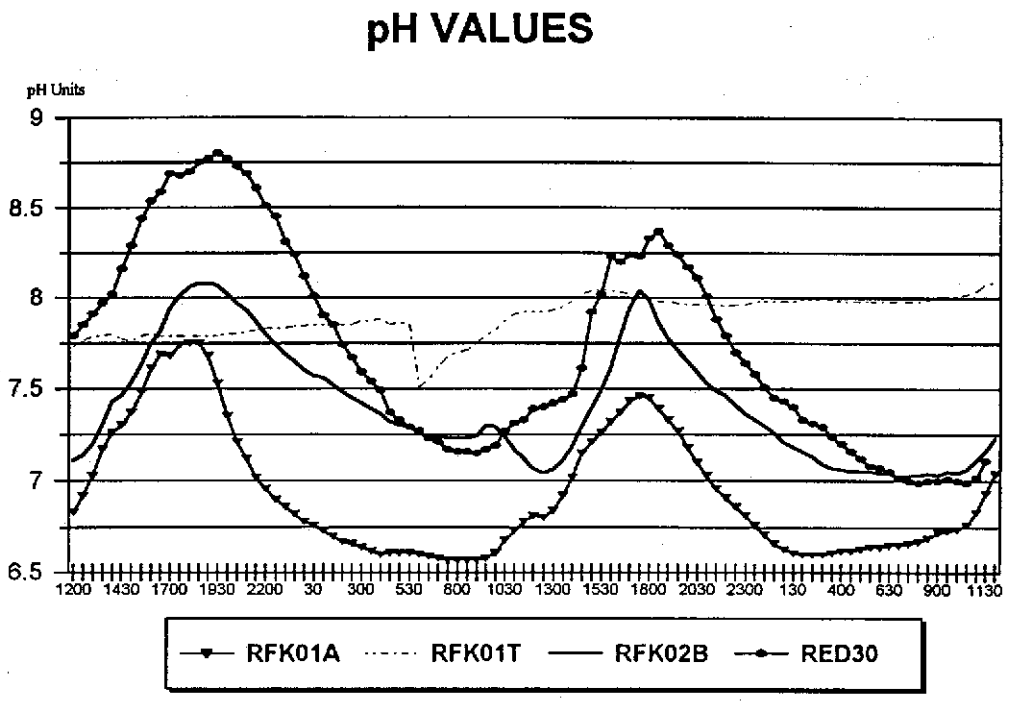
Diel stream pH values were also measured using Hydrolab continuous recorders (Figure 10). The maximum variation of pH values recorded during this study were as follows: RFK01A had a range of 6.57 to 7.74 which is a difference of 1.18; RFK02B ranged from 7.02 to 8.08, a difference of 1.06; at RED 30 the range was 6.99 to 8.8 with a difference of 1.81; and, in the tributary, RFK01T, the range was 8.09 to 7.51, a difference of 0.58. The greater daily fluctuation and higher pH values recorded downstream of the discharge tributary supports the conclusions from the dissolved oxygen data. Nutrient discharge from the Tyson WWTF has promoted the growth of filamentous and periphytic algae in Rolling Fork below the effluent tributary. The algal respiration/photosynthesis process produces substantial fluctuation of in-stream pH values.

TSS, TDS, BOD and Nutrients

Least disturbed, ecoregion stream data indicates an average "background" level of 2 mg/L for TSS for streams in the Ouachita Mountains ecoregion. The water quality sample taken during this study at the upstream station (RFK01A) indicated a TSS concentration of 4.5 mg/L. Downstream of the discharge at RFK02B, the TSS concentration had increased to 12.5 mg/L. Further downstream at the ambient station RED 30 the TSS concentration had corrected to 2.0 mg/L. Elevated TSS concentrations at station RFK02B is most likely attributed to heavy rains two evenings previous to the sample collection.

The concentration of TDS at RFK01A was 48.0 mg/L. This is near the average concentration indicated by ecoregion data of 63 mg/L. Water samples collected from the effluent of the Tyson WWTF indicated a TDS concentration of 574.0 mg/L. This contributed to an increase of TDS

Figure 10



at RFK02B to 77.0 mg/L. At RED 30 the TDS concentration was 73.0 mg/L.

An electrical power failure in the ADPC&E laboratory resulted in the premature termination of the BOD_{30} analyses. Therefore, the BOD data in this study is represented as BOD_{27}. The BOD_{27} concentration upstream at RFK01A was 0.90 mg/L. It was only slightly higher downstream of the discharge at RFK02B (1.28 mg/L). Further downstream at RED 30, the BOD_{27} concentration had adjusted to 0.89 mg/L, the approximate level of the upstream value.

The nitrite+nitrate nitrogen concentration at RFK01A, above the discharge, was 0.73 mg/L. This was noticeably higher than typical ecoregion values. Downstream of the discharge at RFK02B the nitrate concentration was elevated to 3.88 mg/L. This is a five fold increase above the upstream concentration. The nitrate concentration at RED 30, approximately four miles downstream of the discharge, was 1.54 mg/L. The WWTF effluent sample collected on August 12 indicated a nitrate concentration of 39.2 mg/L (Figure 11). Data generated from samples taken with the automatic samplers indicated average effluent nitrate concentrations of 40.8 mg/L for the 24 hour sampling period. The range of nitrate concentrations collected with the automatic sampler was 39.0 mg/L to 42.6 mg/L.

Total phosphorus concentrations were also significantly elevated in the Tyson effluent. The effluent grab sample collected on August 12 had a total phosphorus concentration of 13.37 mg/L. The downstream stations (RFK02B, RFK03, and RED30) had total phosphorus concentrations of 0.97 mg/L, 1.02 mg/L, and 1.44 mg/L, respectively (Figure 12). The total phosphorus concentration at the upstream station RFK01A was 0.08 mg/L which is near typical ecoregion

Figure 11

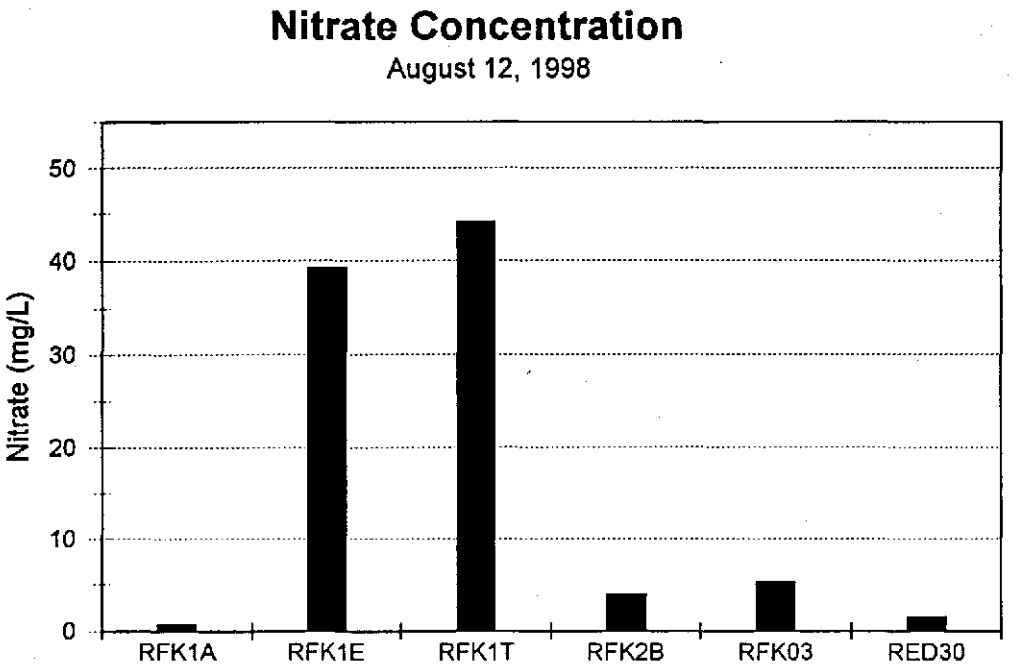
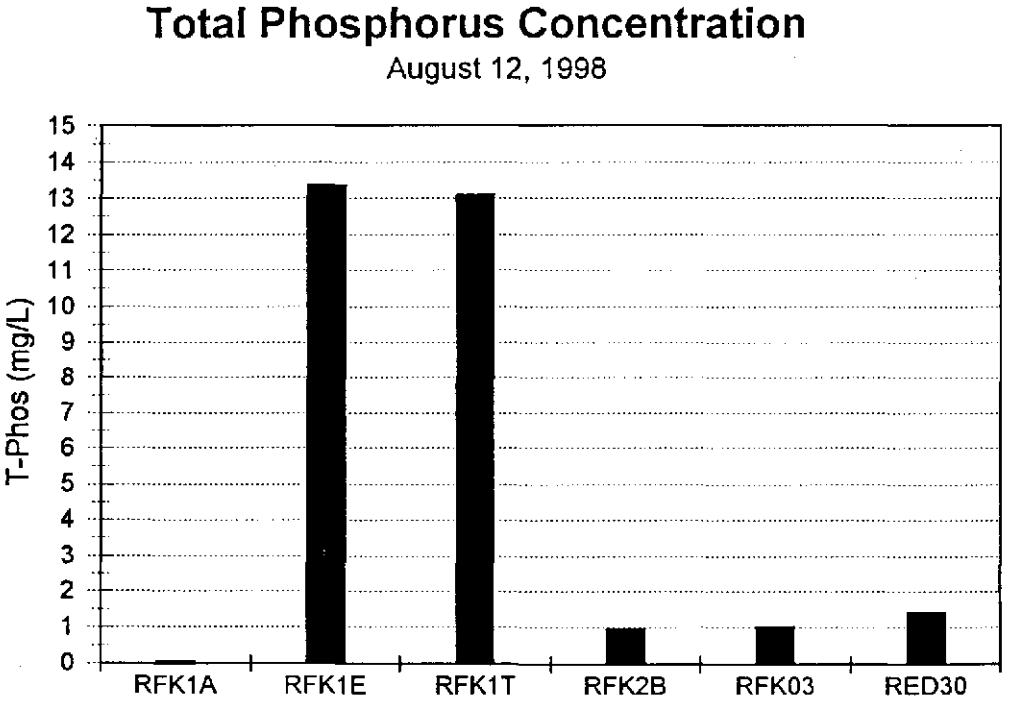


Figure 12



values. Data from the automatic sampler indicated consistent total phosphorus concentrations near 13 mg/L for the 24 hour sampling period. Those hourly samples averaged 13.3 mg/L and ranged from 12.8 mg/L to 13.9 mg/L. Complete water quality data can be found in Appendix A.

Dissolved Metals

Samples were analyzed from each of the water quality sampling stations for dissolved metals. Complete metals data can be found in Appendix B. Some metals were elevated in the WWTF discharge. Zinc was found in the discharge (RFK01E) at a concentration of 24.3 μg/L. This contrasts with the concentration upstream in Rolling Fork River (RFK01A) of 2.7 μg/L. The zinc concentrations below the effluent tributary were similar to background values, except RFK03 which had a zinc concentration of 6.3 μg/L. The zinc concentration approximately four miles downstream of the effluent at RED 30 was 1.9 μg/L.

Copper was detected at RFK01E at a concentration of 9.9 μg/L. Below the discharge (RFK02B) the concentration of copper was 2.4 μg/L which was slightly elevated over the background concentration of 1.7 μg/L at RFK01A. At RED 30 the copper concentration remained at 2.4 μg/L. Calculation of acutely toxic metals values was accomplished using the metals criteria from Regulation No. 2 which were previously promulgated in the National Toxics Rule. Using ecoregion hardness values for calculating toxic levels as prescribed in the implementation procedure, acute copper toxicity could occur at a concentration of 4.6 μg/L. The effluent sample collected indicated an acutely toxic concentration of copper (9.9 μg/L). However, the in-stream samples collected in Rolling Fork River did not indicate metals toxicity.

Arsenic was present in the Tyson effluent at a concentration of 2.9 μg/L and remained detectable downstream at RFK02B, RFK03 and RED 30 at concentrations of 1.1 μg/L, 1.1 μg/L and 1.5 μg/L, respectively. Arsenic was not detected upstream of the Tyson effluent. Nickel and vanadium were detected in the effluent at concentrations of 4.0 μg/L and 1.5 μg/L, respectively, however neither were detected at the downstream stations. Boron and sodium were also found in elevated concentrations in the effluent. The concentration of boron in the effluent (24.7 μg/L) can likely be attributed to cleaning agents used in the facility. Although elevated concentrations of sodium are typical in WWTF effluents, a rather high value of 161 mg/L was detected in the Tyson discharge. Substantially elevated potassium levels, which are good indicators of poultry waste, were found in the effluent stream.

AQUATIC MACROINVERTEBRATE ANALYSIS

Collection Sites

Macroinvertebrate community samples were collected above the effluent tributary (RFK01A), in the effluent tributary approximately 50 m upstream of the mouth (RFK01T) and in the next riffle below the effluent tributary (RFK02B). Additionally, a sample was collected at the ambient monitoring site (RED30) to determine effects downstream.

Methodology

Rapid bioassessment (RBA) techniques were employed for collection of aquatic macroinvertebrate communities in the Rolling Fork River and tributary. These techniques are described in Rapid Bioassessment Protocols for Use in Streams and Rivers (Plafkin et al., 1989). A modified version of Protocol III was utilized to determine if there were any water quality impairments.

Five minute samples were collected by placing a 55.9 X 25.5 cm D-shaped dip net randomly on the substrate and disturbing the substrate with the feet (kicking) to allow water to carry suspended materials into the net. The collector traveled diagonally across the channel, moving downstream to sample the maximum number of habitats. After collecting, the sample was washed through a sieve and all large debris was removed. The sample was placed in a 1.0 L jar and preserved with 70% ethanol to be transported to the lab for identification and enumeration.

In the lab, the sample was placed in a white 9" x 13" dissecting pan. The pan was swirled to evenly distribute the sample, and a 10 cm ring was randomly placed on the sample. Organisms were removed from the ring until the ring was depleted of organisms. If fewer than 95 organisms were encountered in the ring, the sample was swirled again and the ring replaced on the sample. The same procedure was followed until a minimum of 95 organisms was removed from the sample. In cases where more than 100 organisms were encountered in a ring, the entire ring was picked to comprise the subsample. In cases where fewer than 100 organisms were collected in the sample, all organisms were removed from the sample.

Taxonomic determinations were conducted by one person to reduce bias. Organisms were identified to the lowest feasible taxonomic level using keys by Merrit and Cummins (1996). Taxa determinations were checked against regional data to ensure accurate determinations. Taxa and raw tallies were recorded on a bench sheet before enumerating and entering into a spreadsheet for further analysis. Data analyses were performed using a spreadsheet program from EPA Region 6. Modifications were made to use genus-level identifications.

Community comparisons were made using the multi-metric approach. Metrics utilized are listed in Table M-1. These were the most appropriate metrices for this Ouachita Mountain Ecoregion stream and have been utilized in other ADPC&E documents concerning biological integrity and

water quality. Community comparison scores are made by comparing a site's score with a reference site to determine a percent comparable estimate (%BCE) and determine the impairment status. The spreadsheet program scores each metric and gives it a score of 0-6. These are summed and the resulting number is divided by the reference score and reported as a percent. Impairment categories are found in Table M-2.

Table M-1 - Metrics Utilized for Determination of Water Quality Impairments

METRIC	DESCRIPTION
Taxa Richness	Number of taxa at each site. Higher values result in higher scores.
EPT Index	Number of taxa belonging to the orders Ephemeroptera, Plecoptera and Trichoptera. Higher values result in higher scores.
Hilsenhoff Biotic Index (HBI)	Index used to describe tolerance to organic pollution. It ranges from 0-5 with 5 as the most tolerant. Lower values result in higher scores.
% Contribution of Dominant Taxa (%DT)	Percent of the dominant taxon at each site. Lower percentages result in higher scores.
EPT/(Chironomidae +EPT) Abundances	Ratio of number of EPT taxa to the number of chironomids plus EPT taxa. Higher values result in higher scores.
Community Loss Index (CLI)	Measures loss of taxa between reference and station of comparison. Lower values result in higher scores.

Table M-2 - Impairment Categories and Scores Used to Determine Water Quality Impairments.

BIOLOGICAL CONDITION	% Comparable to reference	ATTRIBUTES
No significant impairment	> 83%	Comparable to the best situation in an ecoregion.
Slight Impairment	54-79%	Community structure less than reference site. Taxa richness lower and tolerant forms are more prevalent.
Moderate Impairment	21-50%	Obvious decline in community structure with loss of intolerant forms. EPT index reduced.
Severe Impairment	< 20%	Community dominated by 1 or 2 taxa, few taxa present.

Scores falling into the range between impairment categories are left to professional judgment to determine impairment status. Raw metric scores are utilized to determine impairment status of sites with scores falling between impairment categories (i.e. 80). Raw scores and metric analysis scores are found in Appendix M-1.

Rapid bioassessments also include physical site evaluations. Physical evaluations are necessary to ensure each site can physically support the community found at the reference or "least impacted" site. Some parameters are difficult to assess and are based on the sampler's experience. Physical parameters are scored and scores are compared with the reference. A percent comparable to reference is calculated to decide comparability of stations to the reference. Percent comparable estimates and assessment categories are found in Table M-3.

Multiple factors are used to determine physical characteristics. Substrate, substrate embeddedness, and flow are the most critical factors and are conducted along a transect in the reach. Ten points are used along a transect and intervals represent 1/10th of the width of the reach. These variables are weighted heavier than the others due to their relevance to the available habitat. These parameters are also the most consistent to determine since these are taken along a transect at each site. Channel alteration and bottom scour and deposition are weighted less but are still important in the quality and quantity of available habitats. These data are collected over a larger area than the previous three but within the sample site. Bank stability, vegetative cover and stream side cover are weighted less since they play a much smaller role in quantity and quality of habitats and these data are derived from approximately 100 m upstream and downstream of the sample site. After evaluation, the values are summed for the reference and sites in question to decide the percent physical comparable estimate (%PCE). Habitat parameter scores are found in Appendix M-2.

Bottom substrate is divided into eight categories. Bedrock is the largest substrate particle size and is one of the most poor habitat types. Large boulder is greater than 24" in diameter but is not part of the bedrock. Small boulder ranges from greater than 12" up to 24" in diameter. Cobble ranges from 3"-12" while gravel is from 0.75" to 2.9". Pea gravel is less than 0.75". Sand and silt are the smallest sized particles.

Table M-3 - Macroinvertebrate Habitat Criteria

ASSESSMENT CATEGORY	% COMPARABLE TO REFERENCE
Comparable to Reference	≥90%
Supporting	75-88%
Partially Supporting	60-73%
Non-Supporting	≤58%

Results

Thirty-one taxa were identified from the four sites during this survey. Of these, 10 belonged to the orders Ephemeroptera (6) and Trichoptera (4). No Plecoptera were found during this survey and the reason for their absence is unclear since different taxa become terrestrial at different times of the year and some taxa may be found in nutrient enriched streams. All communities were average or higher in tolerance to organic pollution according to their respective HBI scores. Bioassessment metrics and bioassessment scores are found in Appendix M-2. A list of taxa is found in Appendix M-1.

The reference site (RFK01A) contained 16 taxa and seven of these were EPT taxa. Its HBI value was 2.9 which shows a community that is somewhat tolerant to pollution. This site had the highest %DT of all sites sampled and was dominated by the elmid beetle, *Stenelmis*. The ratio of EPT taxa to EPT plus chironomids was 0.89. This community contained three feeding groups, and members of the scraper feeding group dominated the community comprising 83% of the organisms.

Habitat found at the reference was different from all other sites. Although this site contained many of the features of all other sites, the reference site consisted of many small riffles divided by large portions of bedrock. Each area was more similar to each other than would be found in a normal high or low gradient riffle and may have limited collecting a diverse community because of the partitioned areas. This site consisted of 30% bedrock, 30% large boulder, 20% cobble and 20% gravel. Periphyton was noted at 5 transect points and emergent vegetation was noted at 6 points. Stream velocities ranged from 0.2 ft/s to 1.67 ft/s with a mean of 0.79 ft/s. Habitat metrics and scores are found in Appendix M-3.

Site RFK01T showed some signs of impairment when compared to the reference (RFK01A). Taxa richness was higher than the reference but EPT taxa was lower and resulted in a low metric score for this parameter. Additionally, the percent of collectors, organisms which utilize course organic particulate matter (CPOM) was higher than the reference. All other raw values were better than the reference. Therefore, this site should be considered as not significantly impaired. Substrate particle sizes for this site were 40% small boulder, 20% each of cobble, gravel and pea gravel. Current velocities ranged from 0.25 ft/s to 2.73 ft/s with a mean of 0.84 ft/s.

The sample from RFK02B contained 18 taxa and six were EPT taxa. Community loss was lower at this site than RFK01T and this community was more intolerant to pollution than both sites previously discussed. The %DT was almost as high as the reference but the metric score was the same and the community was dominated by an Ephemeroptera (*Tricorythodes*). A higher number of chironomids was expressed by a lower value for EPT/(Chironomid+EPT) abundances. The percent collectors was higher than the reference which suggests an increase in (CPOM).

The habitat at this site was the best habitat sampled. It consisted of 40% large boulder, 20% small boulder, 20% cobble, 20% gravel and 10% pea gravel. Periphyton was found on 30% of the

substrate particles and had a 94% canopy coverage. Some of the larger particles were embedded up to 40% in the finer substrate particles. Current velocities ranged from 0.23 ft/s to 1.50 ft/s with a mean of 1.07 ft/s.

Collection of samples at RED30 showed no significant impairment when compared to the reference. Taxa richness and EPT taxa were higher and HBI and %DT were lower than values found at the reference. However, the CLI was 36% which suggests a different community than that found at the reference. This site also contained three feeding groups. Members of the scraper feeding group comprised 45% of the community while collectors comprised 44%.

The habitat found at this site consisted of 40% large boulder, 10% small boulder, 10% cobble, and 40% gravel. Periphyton and filamentous algae covered all substrate types and the site had a canopy cover of 14%. Average velocities ranged from 0.24 ft/s to 1.75 ft/s and the mean was 1.18 ft/s.

Discussion

To perform a good rapid bioassessment, a good reference site is critical. A reference must be as close to all other sites as is possible. During this survey, the perfect reference was not found and the best of what was available was utilized.

Taxa richness was higher at all stations downstream of the reference but EPT taxa were reduced downstream except at RED30 (Figure M-1). Community loss index, which relates to community similarity, increased while moving downstream and was highest at RED30 showing a different community than found at the reference (Figure M-2). Pollution intolerance increased downstream of the reference site and may be related to the habitat found in the reference and the high number of facultative *Stenonema* nymphs and facultative *Stenelmis* adults found in the reference. These two relatively pollution tolerant taxa contributed greater than 50% of the total community found at the reference. Since the HBI scores are determined from the percent contribution of each taxa and its respective HBI value, a high number of facultative organisms will cause this score to be high. Mean current velocity was also lowest at the reference due partially to the fragmented habitat. This lower current velocity may also explain the community found at this site.

The reference site did not contain a high number of organisms from the collector feeding group. All sites downstream of the reference site showed a dramatic increase in the percent collectors. Collectors are organisms which feed on CPOM which may be leaves or other organic matter from outside of the stream. Since the reference site is in the same stream, the CPOM must be generated within the stream. The reference site favored the accumulation of organic material as much or more than the other sites due to its characteristics. The only water chemistry factor not common to the reference and other sites is the effluent tributary which carries high concentrations of nutrients which may cause an increase in periphyton and filamentous algal growth.

Figure M-1.

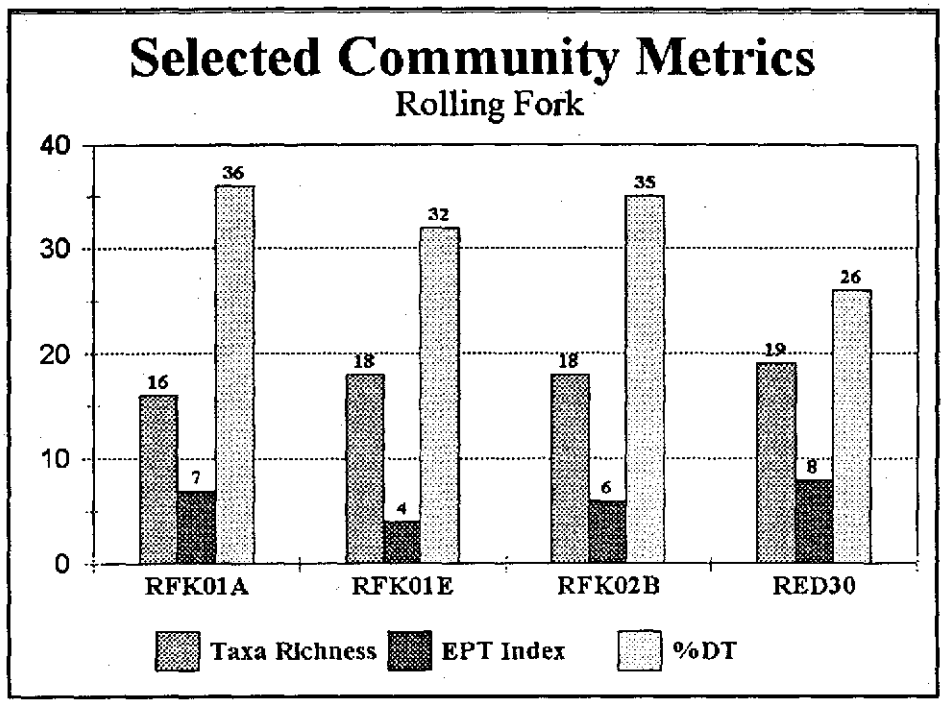
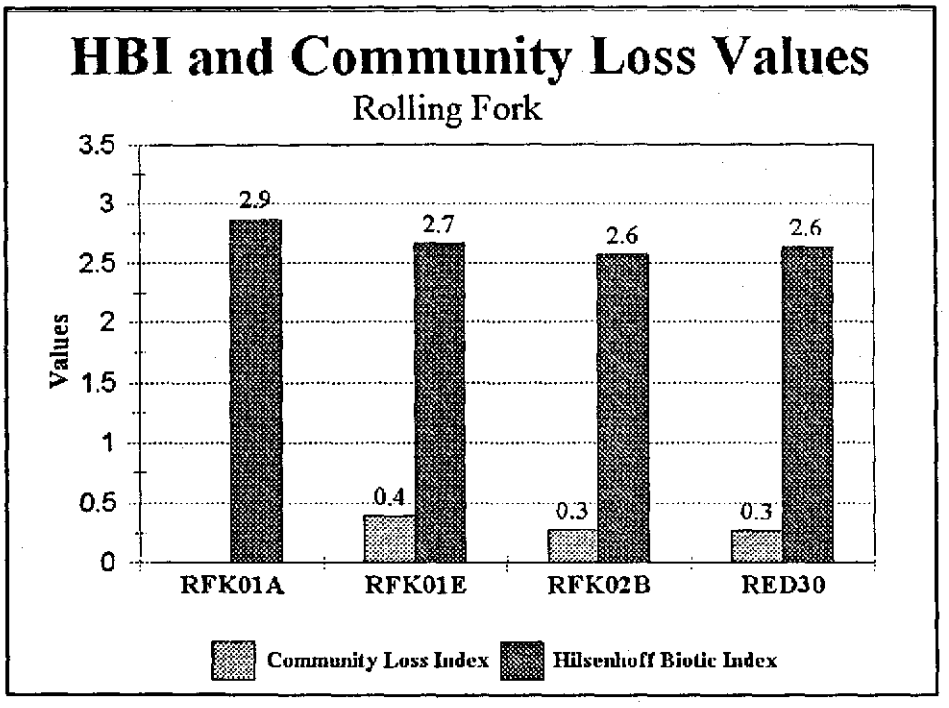


Figure M-2.



Conclusion

While no impairments were determined for this survey, a better reference situation may have resulted in other conclusions. The habitat and current velocities found at the reference may have reduced the probability of a more diverse community existing at this site. Additionally, the increased percentage of collectors below the reference seem to support an organic enrichment problem which may need to be addressed.

FISH COMMUNITY

On August 11, 1998, fish community samples were conducted at the stations listed below:

Station Description

RFK01A (1C002) - Rolling Fork River upstream from unnamed tributary from Tyson-Grannis treatment plant

RFK02B (1C003) - Rolling Fork River downstream from unnamed tributary from Tyson-Grannis treatment plant

Methodology

A Smith-Root model 15-B backpack electrofishing device with pulsed DC current was used to collect fish from these sites. The device was used in the shallow pools and along the pool edges while wading upstream and dipping the stunned fishes from the water with dip nets. The riffles were collected by posting a twenty foot seine near the toe of the riffle and while working the electrofisher in a downstream direction through the riffle, the bottom substrate was overturned and the fish were herded into the seine or washed in by the current.

Fish species of all types were collected from all available habitat within the sample area until a fully representative sample of the species in the area was obtained. Larger specimens were field identified and released. The smaller specimens and those needing verification of identification were preserved in a ten percent formalin solution and returned to the lab.

Habitat Evaluation

Habitat evaluations were performed at all sites and were comprised of five parameters each consisting of three to seven variables. These parameters included: 1) habitat type; 2) habitat quantity; 3) quantity of substrate type based on fish use; 4) quantity of instream cover; and 5) sediment on substrate. Each parameter for substrate type and instream cover was given a score

depending on its abundance. The scores given to the substrate parameters were multiplied by a factor to adjust scores based on their value as fish habitat. Habitat type length, depth and width measurements were estimated for each habitat type and recorded in feet. The sediment on substrate parameter was scored according to the degree of embeddedness.

A total score for each habitat type was calculated by summing the scores for the substrate type, instream cover and sediment on substrate. The scores from like habitat types were averaged for each sampling station. The lengths of each habitat type were also summed giving a total length of habitat type sampled per sampling station. The total habitat type lengths were then divided by 100 and multiplied by the average habitat type score. This score is the Ichthyofauna Habitat Index (IHI). Figures F-1 and F-2 compares habitat type scores and IHI between stations. Appendix F-1 provides a fish habitat summary for each station.

The site downstream of the unnamed tributary from the Tyson-Grannis treatment plant had higher habitat scores for pool and riffle habitats but lower run habitat scores. Similarly, this site had much higher IHI scores for pool and riffle habitats, primarily due to the greater lengths of pool and riffle habitats that were sampled downstream. Run habitat was more abundant upstream and had a higher score than the downstream area. The significantly greater quantity of pool habitat sampled downstream is reflected in the fish community structure.

Figure F-1

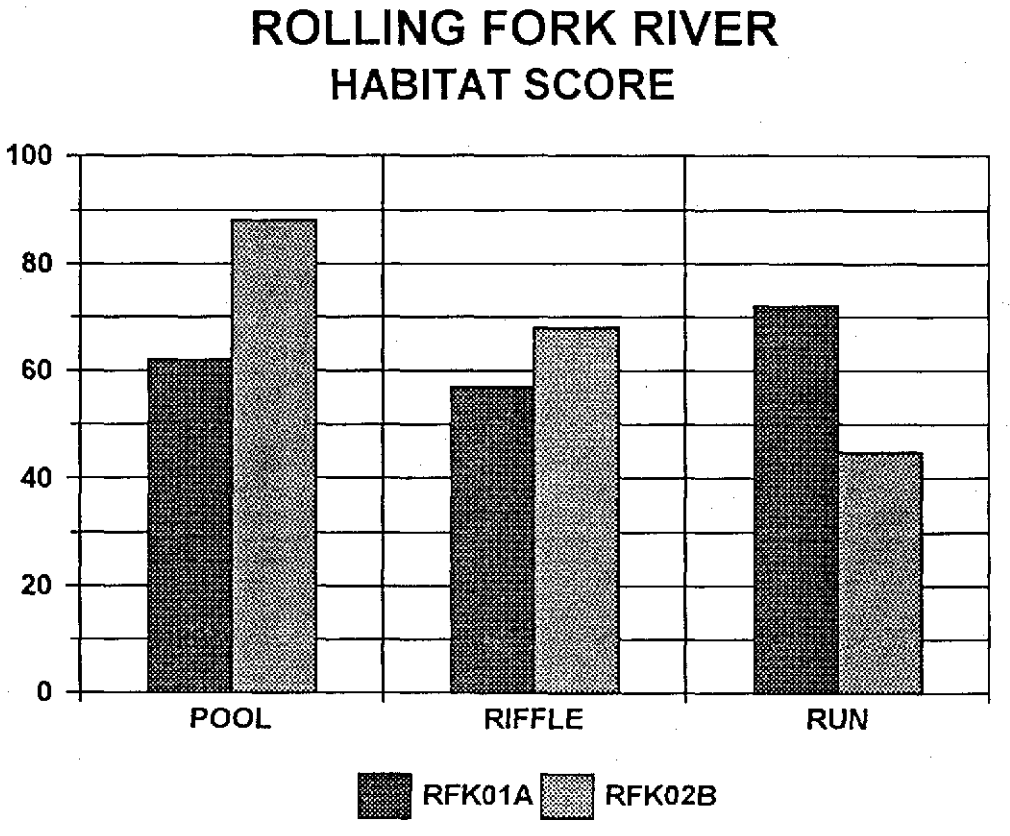
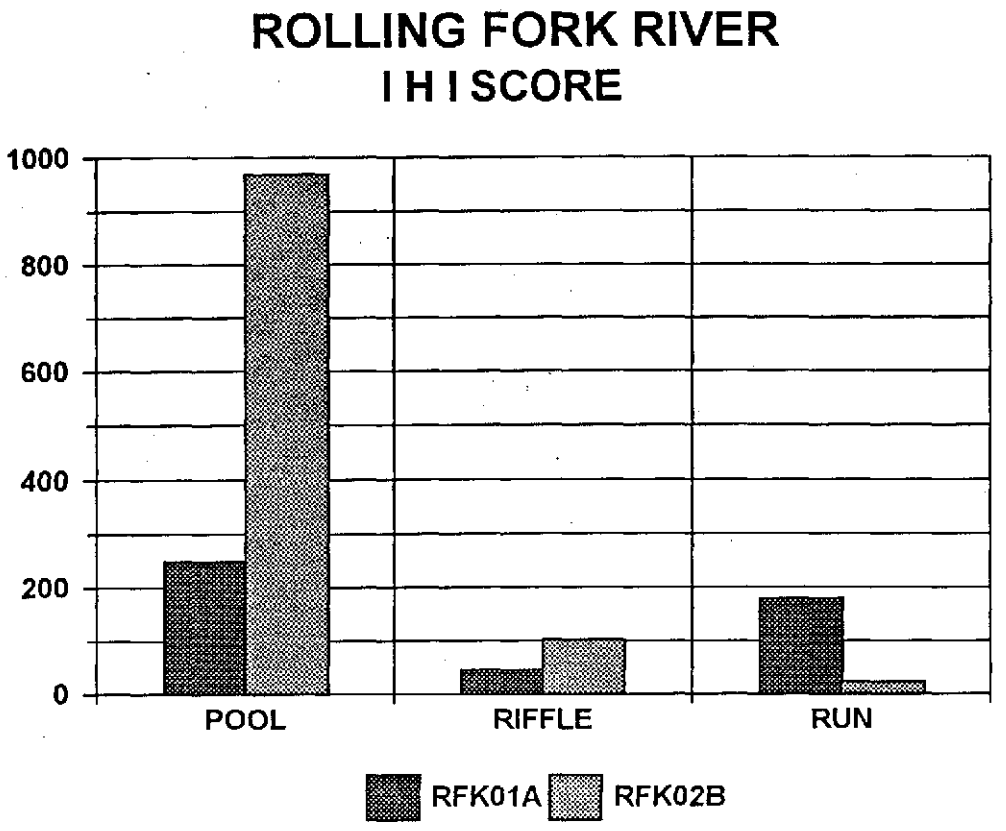


Figure F-2



Fish Community

Fish collection reports for both sites are included in Appendix F-2. Table F-1 summarizes and compares the upstream and downstream fish communities by comparing key metrics. Several of these metrics are scored against ecoregion values for least-disturbed streams. The ecoregion scoring matrix is also included in Appendix F-3. The maximum metric score possible is 32. Scores from 25 to 32 indicate a fish community fully supporting its designated use; scores from 24 to 17 are generally supporting the fishery use; 16 to 9 are impaired and less than 9 are not supporting the fishery use. Both samples in this study scored 20.

Both upstream and downstream communities were very similar. The species similarity index was 93 and the relative abundance similarity index was 78 (maximum value of 100). There were, however, some notable differences in the communities. The downstream station was distinctly dominated by Cyprinidae, specifically the Bigeye shiner, *Notropis boops*, Stonerollers, *Campostoma anomalum* and the Bluntnose minnow, *Pimephales notatus*. The Bigeye shiner and the Bluntnose minnow were particularly abundant in the pool habitat. The upstream community was co-dominated by Cyprinidae and Certrarchidae. The dominant centrarchid was the Longear sunfish, *Lepomis megalotis*. The abundance of fish was much greater in the downstream sample as indicated by the catch per unit of effort which was 29.3 fish per minute downstream and 14.5 upstream.

The metric scores at the downstream site for % sensitive species and % key species was greatly enhanced by the abundance of Bigeye shiner. This species is both a sensitive species and a Ouachita Mountains key species. In contrast, there was an atypically abundant population of Yellow bullhead, *Ameiurus natalis,* downstream. This was very likely caused by the nutrient enrichment at this site from the tributary discharge of effluent from the Tyson- Grannis plant. This was also the likely cause of the greater abundance of fish in the total community. Both sites had poor Percidae (darters) communities. The riffle habitat in the upstream site was limited in the type and abundance to support good darter communities; however, some excellent darter habitat existed downstream. The metric score for the % Centrarchidae at the upstream site was zero due to the much greater abundance of sunfishes, particularly Longear, than is typical for least-disturbed Ouachita Mountains streams. This may have been skewed by site habitat restricting other species or the habitat impeding the efficient collection of other species.

Table F-1. Fish Community Summary and Metric Scoring

		RFK01A	METRIC SCORE	RFK02B	METRIC SCORE
TOTAL SPECIES		15		15	
TOTAL NUMBERS		849		1656	
NO. SENSITIVE SPECIES		4		4	
NO.SENSITIVE INDIVIDUALS		147		548	
% SENSITIVE INDIVIDUALS		17.31	2	33.09	4
% CYPRINIDAE		48.41	4	66.55	2
% ICTALURIDAE		1.88	4	6.76	0
% CENTRARCHIDAE		47.00	0	24.94	4
% PERCIDAE		1.41	0	1.45	0
NO. PRIMARY TFL		287		580	
% PRIMARY TFL		33.80	4	35.02	4
NO. KEY INDIVIDUALS		539		1054	
% KEY INDIVIDUALS		63.49	4	63.65	4
DIVERSITY INDEX		2.26	2	2.51	2
TOTAL			**20**		**20**
SPECIES SIMILARITY INDEX			0.93		
RELATIVE ABUNDANCE SIMILARITY INDEX			0.78		
CATCH (NO./MIN.)		14.5		29.3	

The primary indicator of impact on the fish community of the Rolling Fork River from the effluent discharge was the large population of Yellow bullheads which is an indicator of nutrient-rich and stressed environments. Further indication of nutrient enrichment was apparent by the

much larger numbers of the most common species. Otherwise, the two communities were, structurally, very similar. This condition could have been enhanced by the substantial, localized rainfall that occurred the night before the sampling event. The stream flow was very low prior to the rainfall and increased noticeably after the rain event. This may have stimulated many fishes from the dense community below the effluent discharge to move upstream during the increased flows.

CONCLUSIONS

A review of the water chemistry analyses of permitted constituents in the Tyson-Grannis wastewater effluent discharge indicates an adequate removal of BOD and TSS; however, several of the non-permitted constituents produce a substantial change in water quality due to the wastewater discharge. There was a five-fold increase in the nitrate concentrations and a twelve-fold increase in the total phosphorus concentration from the upstream Rolling Fork station to the first station below the Tyson-Grannis effluent. Samples collected with the automatic sampler indicated an average nitrate concentration of 40.8 mg/L and an average total phosphorus concentration of 13 mg/L in the effluent. Grab samples also indicated elevated concentrations of dissolved metals. Zinc was present at RFK01E at a concentration of 24.3 μg/L. This is a nine-fold increase in the concentration of zinc from the upstream station. Effluent samples had a copper concentration of 9.9 μg/L, nearly six times the concentration of copper upstream. Manganese and arsenic were also found to be elevated in effluent samples. Using ecoregion hardness values for calculating toxic levels as prescribed in the implementation procedure, acute copper toxicity levels would be exceeded in the effluent tributary. However, the in-stream samples collected from Rolling Fork did not indicate metals toxicity. The fish community in Rolling Fork below the effluent tributary was generally supporting the fishery use; however, an abundance of yellow bullheads and a high density of fishes indicates nutrient impacts from the discharge. The high level of nutrients discharged from the WWTF has resulted in substantial growth of filamentous algae in the Rolling Fork River to near DeQueen Reservoir. This causes substantial daily fluctuations in D.O. and pH during the growing season and much higher daytime values of these parameters than for typical streams in this ecoregion. Although the water quality standards were being met for D.O. and pH during this survey, the maintenance was aided by upstream flows of almost 14 cfs; however, when summertime flows reach their lowest levels, violations of the standards very likely do occur and the potential exists for significant fish kills.

RECOMMENDATIONS

It is recommended that the NPDES discharge permit for the Tyson-Grannis wastewater treatment facility include a discharge limit of 10 mg/L nitrate-nitrogen, that routine monitoring for total phosphorus and orthophosphorus be required and a technology limit for total phosphorus be determined for the facility.

APPENDIX A- ROLLING FORK SURVEY WATER QUALITY

Station_ID	Date	Time	Flow	DO	pH	Water Temp	NO3-N	O-PHOS	T-PHOS	TKN	TOC	BOD_{27*}	Turbidity	TSS	TDS
			cfs	mg/L	std units	C	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	mg/L
RFK1A	980812	815	13.7	7.15	7.05	25.3	0.73	0.04	0.08	0.45	5.40	0.90	7.80	4.50	48.00
RFK1E	980812	900	0.96	6.70	7.58	31.5	39.20	13.70	13.37	void	11.20	3.09	1.50	4.50	574.00
RFK1T	980812	831	1.14	8.27	8.31	25.6	44.10	15.20	13.10	void	10.40	0.95	3.50	4.50	545.00
RFK2B	980812	840	14.6	6.89	7.41	25.3	3.88	1.09	0.97	0.74	6.10	1.28	12.00	12.50	77.00
RFK03	980812	930		5.80	7.01	25.6	5.24	0.97	1.02	0.90	7.00	1.46	14.00	7.50	76.00
RED30	980812	820	7.15**	6.30	7.05	26.7	1.54	1.40	1.44	0.68	7.80	0.89	3.50	2.00	73.00
RFK0001E	980811	1200					40.10	14.20	13.90		11.90				
RFK0001E	980811	1300					39.10	13.60	13.50		11.80				
RFK0001E	980811	1400					39.20	13.90	13.50		11.60				
RFK0001E	980811	1500					39.00	13.80	13.30		11.40				
RFK0001E	980811	1600					39.50	13.90	13.50		11.90				
RFK0001E	980811	1700					40.00	13.90	13.80		11.60				
RFK0001E	980811	1800					39.90	13.80	13.30		11.40				
RFK0001E	980811	1900					40.90	13.80	13.30		11.70				
RFK0001E	980811	2000					41.50	13.80	13.30		11.90				
RFK0001E	980811	2100					42.30	13.90	13.00		11.90				
RFK0001E	980811	2200					42.10	13.70	13.10		13.00				
RFK0001E	980811	2300					42.60	13.80	13.20		11.60				
RFK0001E	980811	2400					41.90	13.70	13.00		12.60				
RFK0001E	980812	100					42.00	13.70	13.00		11.80				
RFK0001E	980812	200					41.60	13.60	12.80		11.80				
RFK0001E	980812	300					41.30	13.70			11.70				
RFK0001E	980812	400					39.10	13.60			11.50				
RFK0001E	980812	500					40.50	13.70	12.80		11.90				
RFK0001E	980812	600					41.30	14.00	12.90		11.50				
RFK0001E	980812	700					40.60	13.80	13.30		11.80				
RFK0001E	980812	800					41.20	13.80	13.40		11.80				
RFK0001E	980812	900					40.80	13.90	13.20		11.90				
RFK0001E	980812	1000					40.90	13.70	13.20		11.70				
RFK0001E	980812	1100					40.60	13.80	13.20		11.90				
* Laboratory equipment failure resulted in a 27 day BOD result instead of a 30 day BOD.															
** Flow taken on Aug. 11 before rainfall of that evening. Others taken on Aug. 12.															

APPENDIX B- ROLLING FORK SURVEY DISSOLVED METALS

Station_ID	units	RFK0001A	RFK0001E	RFK0001T	RFK0002B	RFK0003	RED0030
Collect_Date	980812						
Collect_Time	hrs	815	900	831	840	930	820
Flow		13.7	0.96	1.14	14.6		7.15*
DO	mg/L	7.15	6.7	8.27	6.89	5.8	6.3
pH	std units	7.05	7.58	8.31	7.41	7.01	7.05
Water Temp	C	25.3	31.5	25.6	25.3	25.6	26.7
Aluminum (Al)	ug/L	<127	<127	<127	<127	<127	<127
Arsenic (As)	ug/L	<1.0	2.89	2.95	1.06	1.12	1.5
Barium (Ba)	ug/L	19.73	<8.8	<8.8	18.62	16.76	15.27
Beryllium (Be)	ug/L	<0.11	<0.11	<0.11	<0.11	<0.11	<0.11
Boron (B)	ug/L	11.1	24.69	24.17	13.01	10.74	16.59
Cadmium (Cd)	ug/L	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14
Calcium (Ca)	mg/L	4.66	9.11	9.91	4.66	4.96	4.27
Chromium (Cr)	ug/L	<0.4	0.79	0.56	<0.4	<0.4	<0.4
Cobalt (Co)	ug/L	<0.50	0.72	0.76	<0.50	<0.50	<0.50
Copper (Cu)	ug/L	1.73	9.86	11.05	2.43	2.58	2.45
Iron (Fe)	ug/L	110	30	20	101	85	74
Lead (Pb)	ug/L	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
Magnesium (Mg)	mg/L	1.67	4.12	4.43	1.93	1.83	1.86
Manganese (Mn)	ug/L	7.44	22.97	2.11	11.82	6.94	12.99
Nickel (Ni)	ug/L	<2	4.03	3.59	<2	<2	<2
Potassium (K)	mg/L	2.74	46.2	43.3	6.02	6.07	6.78
Selenium (Se)	ug/L	<3	<3	<3	<3	<3	<3
Sodium (Na)	mg/L	3.65	161	151	15.1	12.9	12.6
Vanadium (V)	ug/L	<1.0	1.5	1.87	<1.0	<1.0	<1.0
Zinc (Z)	ug/L	2.68	24.26	15.71	2.72	6.3	1.91
Hardness	mg/L	19	40	43	20	20	18
* Flow taken on Aug. 11 before rainfall of that evening. Others taken on Aug. 12.							

Appendix M-1. Bioassessment Metrics and Bioassessment Scores for samples collected in Rolling Fork River, Polk and Sevier County, Arkansas.

Bioassessment Metrics	RFK01A	RFK01E	RFK02B	RED30
Taxa Richness	16	18	18	19
EPT Index	7	4	6	8
Community Loss Index (CLI)	N/A	0.4	0.3	0.3
Hilsenhoff Biotic Index (HBI)	2.9	2.7	2.6	2.6
%Contribution of Dominant Taxa	36%	32%	35%	26%
EPT/(Chironomidae + EPT) Abundances	0.89	0.92	0.82	0.89

Bioassessment Scores	RFK01A	RFK01E	RFK02B	RED30
Taxa Richness (GENUS)	6	6	6	6
EPT Index (GENUS)	6	0	4	6
CLI	6	6	6	6
Hilsenhoff Biotic Index (GENUS)	6	6	6	6
%Contribution of Dominant Taxa	2	2	2	4
EPT/(Chironomidae + EPT) Abundances	6	6	6	6
Total Score	32	26	30	34
% Comparison to Reference		81%	94%	106%
Impairment Status	Reference	None	None	None

Appendix M-2. Taxa list and enumeration of samples collected from Rolling Fork River, Polk and Sevier county, Arkansas.

HBI	GROUP	ept	TAXON	RFK01A	RFK01E	RFK02B	RED30
3	COL	N	Cambaridae	1			
2.5	COL	Y	*Baetis*	1	33	2	2
2	COL	Y	*Isonychia*				3
2	SCR	Y	*Stenacron*	1			
3	SCR	Y	*Stenonema*	20		10	3
2	COL	Y	*Tricorythodes*		1	39	33
3.5	COL	Y	*Caenis*	5		4	14
3	PRE	N	*Argia*	2	3	2	1
2	PRE	N	*Erpetogomphus*		1		
4.8	PRE	N	*Libellula*				1
4	PRE	N	*Sialis*	1			
3	PRE	N	*Corydalus*		4	2	
1	PRE	N	*Nigronia*		4		
3	COL	Y	*Cheumatopsyche*		12	11	3
2	COL	Y	*Hydropsyche*	1			
2	COL	Y	*Chimarra*	1	2		5
2	SCR	Y	*Helicopsyche*	3		4	7
2.5	SCR	N	*Petrophila*		4	1	
3.7	COL	N	*Laccobius*		1		
2	SCR	N	*Psephenus*	3	3	6	1
2.5	SCR	N	*Neoelmis (L)*				15
2.5	SCR	N	*Ordobrevia (A)*	6	5	6	7
2.5	SCR	N	*Ordobrevia (L)*	6	9	2	10
3	SCR	N	*Stenelmis (A)*	35	3	3	
3	SCR	N	*Stenelmis (L)*	6	10	1	8
4	PRE	N	Tanypodinae		2		
4	PRE	N	*Ablabesmyia*			2	4
2.9	PRE	N	*Polypedilum*	4	2	13	5
4	SCR	N	*Physa*		4	3	6
3.7	SCR	N	*Promenetus*				1
3.5	PRE	N	*Helobdella*			1	
			Total	96	103	112	129

Appendix M-3. Habitat Parameters and metric scores for sites in Rolling Fork River, Polk and Sevier counties, Arkansas.

Habitat Parameter	RFK01A	RFK01E	RFK02B	RED30
Bottom Subs.	17	18	18	18
Embeddedness	16	16	16	15
Flow	16	16	17	18
Channel Alteration	15	15	15	15
Bot. scour/deposit	15	15	15	15
Bank Stability	9	10	10	9
Bank Vegetative Stability	10	8	9	9
Streamside Cover	8	8	8	8
Total	106	106	108	107
% Score	R	100%	102%	101%

Appendix F-1

Fish Habitat Summary Report

Station	Location	Habitat Type	Habitat Number	Length (FT.)	Habitat Score	IHI
1C002	Rolling Fork above effluent trib.					
		Pool				
			1	120	72.2	
			2	200	58.8	
			4	80	55.2	
			Sum/Avg.	400.0	~~62.1~~	~~248.3~~
		Riffle				
			5	80	57	
			Sum/Avg.	80.0	~~57.0~~	~~45.6~~
		Run				
			3	250	72	
			Sum/Avg.	250.0	~~72.0~~	~~180.0~~

Fish Habitat Summary Report

Station	Location	Habitat Type	Habitat Number	Length (FT.)	Habitat Score	IHI
1C003	Rolling Fork below effluent trib.					
		Pool				
			1	1100	88	
			Sum/Avg.	1100.0	88.0	968.0
		Riffle				
			2	150	68	
			Sum/Avg.	150.0	68.0	102.0
		Run				
			3	50	44.8	
			Sum/Avg.	50.0	44.8	22.4

Appendix F-2

Fish Collection Report

Station ID: 1C002 **Rolling Fork above effluent stream** **Collection Date:** 8/11/98

Family_Species	Common Name	Key	Sen.	T.F.L.	#	% Com
Atherinidae						
Labidesthes sicculus	Brook silversides				2	0.24%
			Totals for Atherinidae		**2**	**0.24%**
Catostomidae						
Moxostoma duquesnei	Black redhorse	BMT	S		9	1.06%
			Totals for Catostomidae		**9**	**1.06%**
Centrarchidae						
Lepomis cyanellus	Green sunfish				27	3.18%
Lepomis megalotis	Longear	B/A/O/S			359	42.33%
Lepomis microlophus	Redear				1	0.12%
Micropterus dolomieu	Smallmouth bass	O/B/O	S		7	0.83%
Micropterus punctulatus	Spotted bass	ARV			4	0.47%
			Totals for Centrarchidae		**398**	**46.93%**
Cyprinidae						
Campostoma anomalum	Stoneroller			P	245	28.89%
Lythrurus umbratilis	Redfin shiner				5	0.59%
Notropis boops	Bigeye shiner	BMT/OUM	S		119	14.03%
Pimephales notatus	Bluntnose minnow	ARV		P	42	4.95%
			Totals for Cyprinidae		**411**	**48.47%**
Ictaluridae						
Ameiurus natalis	Yellow bullhead	A/T/L			14	1.65%
Pylodictis olivaris	Flathead catfish				2	0.24%
			Totals for Ictaluridae		**16**	**1.89%**
Percidae						
Etheostoma radiosum	Orangebelly darter	OUM	S		11	1.30%
Percina caprodes	Logperch				1	0.12%
			Totals for Percidae		**12**	**1.42%**

Total Numbers	**848**
Total Species	15
Level of Effort (sec)	3516
Catch/Effort (No./min.)	14.47

Fish Collection Report

Station ID: 1C003 **Rolling Fork below effluent stream** **Collection Date:** 8/11/98

Family_Species	Common Name	Key	Sen.	T.F.L.	#	% Com
Atherinidae						
Labidesthes sicculus	Brook silversides				2	0.12%
			Totals for Atherinidae		**2**	**0.12%**
Catostomidae						
Moxostoma duquesnei	Black redhorse	BMT	S		3	0.18%
			Totals for Catostomidae		**3**	**0.18%**
Centrarchidae						
Lepomis cyanellus	Green sunfish				55	3.33%
Lepomis macrochirus	Bluegill				1	0.06%
Lepomis megalotis	Longear	B/A/O/S			338	20.46%
Micropterus dolomieu	Smallmouth bass	O/B/O	S		7	0.42%
Micropterus punctulatus	Spotted bass	ARV			8	0.48%
			Totals for Centrarchidae		**409**	**24.76%**
Cyprinidae						
Campostoma anomalum	Stoneroller			P	409	24.76%
Lythrurus umbratilis	Redfin shiner				5	0.30%
Notropis boops	Bigeye shiner	BMT/OUM	S		517	31.30%
Pimephales notatus	Bluntnose minnow	ARV		P	171	10.35%
			Totals for Cyprinidae		**1102**	**66.71%**
Ictaluridae						
Ameiurus natalis	Yellow bullhead	A/T/L			110	6.66%
Pylodictis olivaris	Flathead catfish				2	0.12%
			Totals for Ictaluridae		**112**	**6.78%**
Percidae						
Etheostoma radiosum	Orangebelly darter	OUM	S		17	1.03%
Percina caprodes	Logperch				7	0.42%
			Totals for Percidae		**24**	**1.45%**

Total Numbers	**1652**
Total Species	15
Level of Effort (sec)	3397
Catch/Effort (No./min.)	29.18

Appendix F - 3

FISH COMMUNITY BIOCRITERIA

Ouachita Mountains Streams

METRIC	4	2	0
% Sensitive Individuals Avg. = 33.8 Std. = 7.3	>24	16-24	<16
% Cyprinidae (minnows) Avg. = 51.7 Std. = 7.0	45-60	36-46 or 60-67	<36 or >67
% Ictaluridae (Catfishes) Avg. = 3.0 Std. = 1.7	>1[1]	<1 - 0.5[1]	<0.5 or >2 bullheads
% Centrarchidae (Sunfishes) Avg. = 18.9 Std. = 7.1	8-26[2]	3-8 or 26-33[2]	<3 or >33 or >7 Green sunfish
% Percidae (darters) Avg. = 20.0 Std. = 5.4	>14	8-14	<8
% Primary Feeders Avg. = 37.3 Std. = 9.6	<48	48-58	>58
% "Key" Individuals Avg. = 36.0 Std. = 11.8	>23	10-23	<10
Diversity Avg. = 3.15 Std. = 0.52	>2.63	2.63-2.11	<2.11

Total Score

25-32 Fully Supporting
24-17 Generally Supporting
16-9 Impaired
0-8 Not Supporting

[1]no more than 2% bullheads
[2]no more than 7% Green sunfish