USE ATTAINABILITY ANALYSIS AND WATER QUALITY ASSESSMENT OF COFFEE CREEK, MOSSY LAKE, AND THE OUACHITA RIVER

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December 2007 (version 1.1)

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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
ADEQ	Arkansas Department of Environmental Quality
AGFC	Arkansas Game and Fish Commission
BOD_5	5-day biochemical oxygen demand
cfs	cubic feet per second
CPOM	coarse particulate organic matter
DO	dissolved oxygen
DQO	data quality objective
GCER	Gulf Coast Eco-region
GP	Georgia-Pacific paper mill, Crossett, Arkansas
IHI	Ichthyofauna Habitat Index
mg/L	milligrams per liter
MGD	million gallons per day
msl	mean sea level
NPDES	National Pollutant Discharge Elimination System
QA	quality assurance
QC	quality control
RBP	Rapid Bioassessment Protocol
SMS	stream monitoring station
SVOC	semi-volatile organic compound
SWQS	surface water quality standards
TSS	total suspended solids
UAA	use attainability analysis
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey

EXECUTIVE SUMMARY

The purpose of this investigation was to perform a water quality assessment of the Ouachita River, which is the receiving water of the Georgia-Pacific (GP) Crossett paper mill discharge, and to determine if the current "no aquatic life use designation" for Coffee Creek and Mossy Lake is appropriate. The area of the Ouachita River for this study is located in southern Arkansas below the Felsenthal Lock and Dam and upstream of the Louisiana state line. The study area consists of Coffee Creek, Mossy Lake, and a portion of the Ouachita River, a short distance upstream and downstream of the confluence with Coffee Creek.

This study performed an analysis of water samples, sediment samples, aquatic species, and aquatic habitat. The study area contains six sampling stations:

- a Reference Site that is a tributary of Coffee Creek,
- Coffee Creek downstream of the confluence with Georgia-Pacific's (GP) manmade effluent ditch and the Reference Site tributary,
- Mossy Lake,
- Coffee Creek downstream of Mossy Lake,
- Ouachita River upstream of the Coffee Creek below Mossy Lake confluence, and
- Ouachita River downstream of Coffee Creek below Mossy Lake.

Three biological and habitat assessments were also performed at Coffee Creek downstream of Mossy Lake. No water or sediment samples were collected within Coffee Creek below Mossy Lake. No biological or habitat assessments were performed within the Ouachita River.

There were three series of biota assessments (habitat, fish, and macroinvertebrates) starting in June 2005, one in February 2006 and ending in June 2006. The June 2005 biological and habitat assessment was supplemented with biological and habitat data at other stations in August 2005. The study included five water sampling events that occurred in August, October, and December 2005 and May and June 2006. Two sediment sampling events occurred and coincided with the August 2005 and May 2006 water sampling events. Flooding by the seasonal monsoon prevented sampling from February through April 2006.

The water and sediment samples were analyzed for a comprehensive list of potential pollutants. These included general field measurements such as dissolved oxygen and pH, conventional pollutants such as ammonia-nitrogen and sulfate, toxic metals, semi-volatile organic compounds, and pesticides. Additionally, sensitive aquatic species were exposed to the water samples and elutriate water from sediment samples to determine toxicity.

Coffee Creek and Mossy Lake have been exempt from Arkansas' Regulation 2, Chapter 5 specific standards and color since 1984 due to the "no aquatic life use" designation. Therefore, the laboratory analysis results were compared to the generic Gulf Coast Ecoregion (GCER) surface water quality standards (SWQS) for these water bodies.

Applicable Arkansas SWQSs were compared to the laboratory analysis results for samples collected from the Ouachita River.

Conclusions

The purpose of this investigation was to determine if the current "no aquatic life use designation" for Coffee Creek and Mossy Lake is appropriate. From the biological data collected it is apparent there is a diverse and abundant, though seasonal, aquatic community in the Reference Site stream. The fish and macroinvertebrate samples from the Reference Site are indicative of an aquatic community that is seasonally variable and tied to flood flows from the Ouachita River. Coffee Creek had very few fish and was dominated by a highly pollution-tolerant macroinvertebrate community. The same was true for the Mossy Lake biological community with the exception of a slightly more diverse macroinvertebrate assemblage. The Coffee Creek site below Mossy Lake had higher numbers of large predatory fish, due to the proximity of the Ouachita River, but otherwise exhibited an aquatic community much like the other effluent-dominated sites.

Aside from the fish and macroinvertebrate communities using Coffee Creek and Mossy Lake, other wildlife live in or frequently contact the GP effluent. Muskrat, beaver, nutria, turtles, and ducks are known to use Coffee Creek and Mossy Lake, sometimes in very large numbers. Other animals, including deer, turkeys, raccoons, and other large mammals are likely to come into contact with the GP effluent on a frequent basis.

The waters of Coffee Creek and Mossy Lake have the potential to support aquatic life indicative of streams in the ecoregion. They also show evidence of degradation from the effluent of the Georgia Pacific Outfall 001. There were exceedances of several numeric GCER standards in these water bodies, and signs of ecological impairment, including loss of habitat and toxicity to aquatic organisms from both the water column and sediment.

The water quality of all the sites showed deviations from the applied standards, including the Reference Site.

Reference Site

The Reference Site stream does not meet the GCER standards for DO, mercury, and water and sediment toxicity. The deviations from the GCER standards at the Reference Site may have been caused by local pollution, such as the dumping of trash at the road crossings, non-point source pollution, and possibly by natural processes associated with seasonally low flow systems.

Coffee Creek, Mossy Lake, and Coffee Creek below Mossy Lake

The water quality observed in Coffee Creek, Mossy Lake, and Coffee Creek below Mossy Lake was not of high enough quality to support a viable and diverse aquatic community year-round. However, an aquatic life use is potentially attainable in Coffee Creek and Mossy Lake downstream of the Georgia Pacific discharge based upon the habitat and reference site data collected during the study. Without the GP discharge, Coffee Creek and Mossy Lake may be able to sustain a diverse aquatic community during

and after inundation by the Ouachita River and a limited aquatic community during the annual dry seasons. Coffee Creek below Mossy Lake is likely to sustain a viable and diverse aquatic community within the back waters of the Ouachita River

Ouachita River

The sample reach of the Ouachita River where Coffee Creek converges is maintained as a barge canal. The field crew noted dredging occurring upstream of the sampling sites during Event 4. Sediment samples from each station for that event were toxic to sensitive species in the laboratory. Turbidity also exceeded the SWQS for this event.

Two out of five water samples taken from the upstream site exhibited toxicity. Both sediment samples from this site were toxic. Water from the downstream station exhibited toxicity in the laboratory for two out of five sampling events. Again, both sediment samples were toxic.

Recommendation

Part 3 (Streams) of designated use F (Fisheries) on page 3-2 of Arkansas Regulation 2 states: Water which is suitable for the protection and propagation of fish or other forms of aquatic life adapted to flowing water systems whether or not the flow is perennial. The presence of indicator species [Reg 2.302(F)(3)(e)] within the Reference Site, and occasionally within the sites downstream of the outfall, supports an aquatic life use designation for Coffee Creek and Mossy Lake. Data collected in this survey indicate that the aquatic life in the Mossy Lake and Coffee Creek systems is impaired. The source of that impairment is likely the outfall from the Georgia Pacific facility in Crossett, AR.

Please note that our recommendation that Coffee Creek and Mossy Lake support an aquatic life use designation is based upon the physical, chemical, or biological sampling results presented in this report. As described in EPA's *Technical Support Manual: Waterbody Survey and Assessments for Conducting Use Attainability Analyses* (1983), the assessment of potential (*i.e.*, attainable) uses may require additional study beyond these physical, chemical, or biological sampling results.

SECTION 1
INTRODUCTION

1.1 SCOPE AND OBJECTIVES

The purpose of this investigation was to perform a water quality assessment of the Ouachita River, which is the receiving water of the Georgia-Pacific (GP) Crossett paper mill discharge, and to determine if the current "no aquatic life use designation" for Coffee Creek and Mossy Lake is appropriate. The area of the Ouachita River for this study is located in southern Arkansas below the Felsenthal Lock and Dam and upstream of the Louisiana state line. The study area consists of Coffee Creek, Mossy Lake, and the Ouachita River, a short distance upstream and downstream of the confluence with Coffee Creek. Figure 1.1 shows the area of investigation, including Crossett, Arkansas and the GP Crossett Facility.

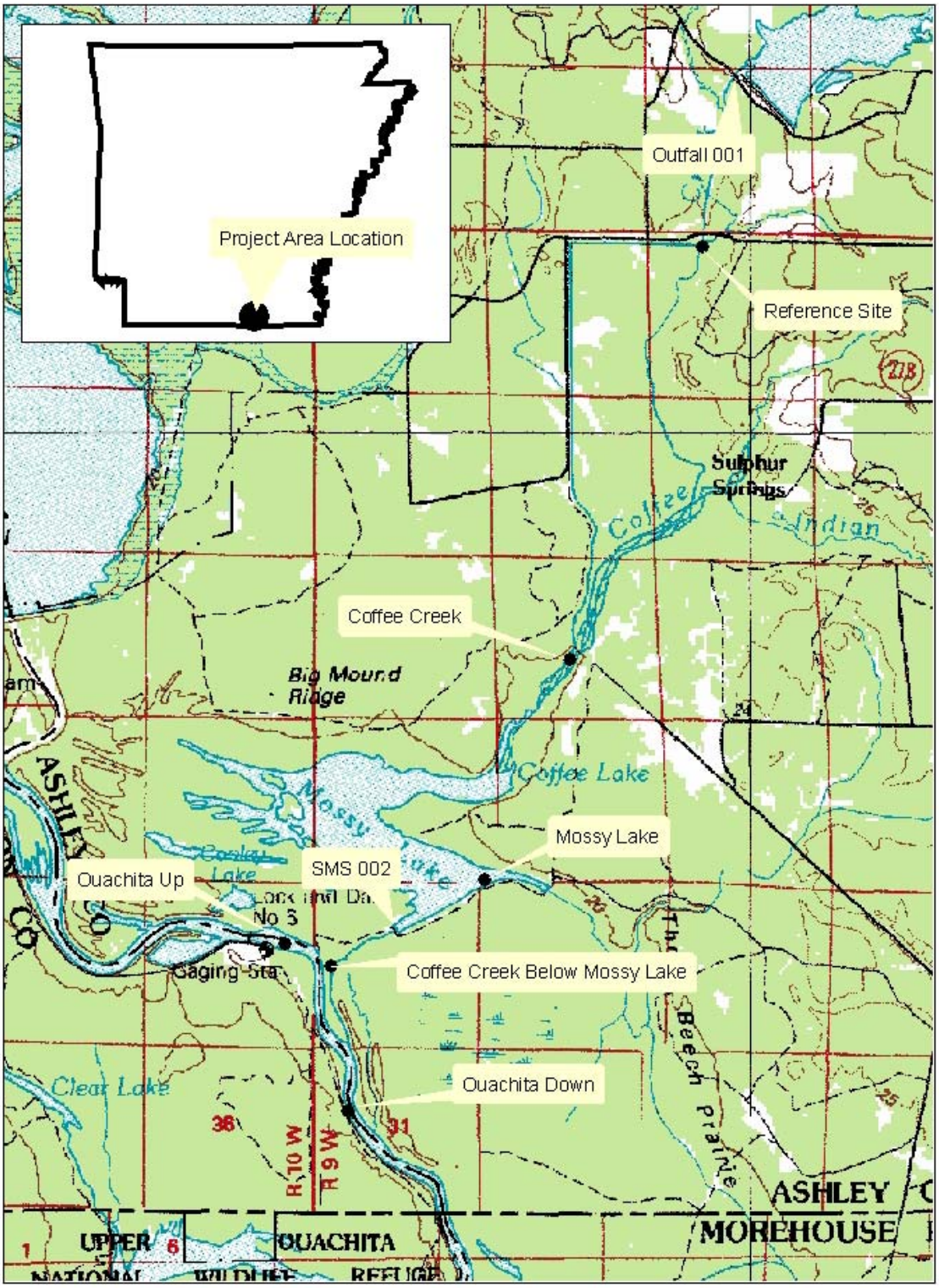
In a March 2002 letter, Louisiana Congressman John Cooksey requested that the U.S. Environmental Protection Agency (USEPA) assess the impact of the GP discharge on the Ouachita River. In response, the USEPA contracted with Parsons to assess existing data. Parsons published the *Water Quality Data Assessment for the Ouachita River, Between Felsenthal Reservoir Lock and Dam, Arkansas and Sterlington, Louisiana* in January 2003. A major finding of this initial review was that available data on water quality in Mossy Lake and Coffee Creek were very limited. Thus, an additional project was needed to address the data gaps to assess potential aquatic life uses of Coffee Creek and Mossy Lake, and assess water quality in Coffee Creek, Mossy Lake, and the Ouachita River.

Given the need for additional data, USEPA Region 6 contracted with Parsons to conduct a water quality assessment of Coffee Creek, Mossy Lake, and the Ouachita River upstream and downstream of the Coffee Creek confluence. This project included collecting field measurements and water and sediment sample data for conventional pollutants and toxic substances (see QAPP, Appendix A). The second goal of this project was to determine if the designation of "no aquatic life uses" in Coffee Creek and Mossy Lake were appropriate. This project only covered the water quality components of a Use Attainability Analysis (UAA), including investigations of habitat, macro-invertebrate, and fish characteristics at the Coffee Creek and Mossy Lake locations, and a reference site on Coffee Creek upstream of the point where GP's Outfall 001 effluent enters Coffee Creek.

1.2 EXISTING INFORMATION

The headwaters of the Ouachita River are in the Ouachita Mountains near Eagleton, in western Arkansas. The water flows southeast to form Lake Ouachita near Hot Springs, Arkansas. The river then continues south through a series of lakes, including Felsenthal Reservoir, which is approximately 6 miles upstream from the Arkansas-Louisiana border (see Figure 1.1). The Ouachita River then flows through northeast Louisiana and joins the Tensas River to form the Black River. The Black River is a large tributary of the Red River, which is a tributary of the Mississippi River.

Figure 1.1 Area of Investigation



A chain of locks and dams on the Ouachita River was initiated by the Vicksburg District, U.S. Army Corps of Engineers in the 1960s with the objective being to link the ports along the Ouachita River to the Gulf of Mexico. This was achieved in 1984 with completion of the H.K. Thatcher and Felsenthal locks and dams in southern Arkansas. These locks, along with Columbia and Jonesville locks in Louisiana, now provide year-round 9-foot navigation to Camden, Arkansas. The 6 miles of the Ouachita River between Felsenthal Dam and the state line has a flat gradient (<0.5 feet/mile), steep cut sandy banks, deep channel, no riffle areas, a heavy sediment load, and a bottom characterized as shifting sand and silt (LORWG 1993).

1.2.1 Coffee Creek and Mossy Lake

The upper-most site in the sample strategy was the Reference Site, located upstream of the manmade ditch that receive effluent from the Georgia Pacific Outfall 001. The Reference Site has a natural historic watershed area of approximately 11.5 square miles. Due to the redirection of flow by GP the current watershed size at the reference site is estimated as approximately 2 square miles. The Coffee Creek site has an approximate watershed area of 25 square miles. Mossy Lake is approximately 550 acres in size. The area of the watershed at the Coffee Creek site below Mossy Lake site is difficult to determine because of the low gradient nature of the system. The available digital elevation data does not provide an accurate representation of the true conditions. Though we cannot be certain of the size of the entire watershed of Coffee Creek below Mossy Lake we can be certain that it would be significantly larger than the 25 square miles of the Coffee Creek above Mossy Lake site.

Before development occurred in the area, Coffee Creek was a typical small watershed stream in the lowlands of the Gulf Coast Plain, with water being reduced to a series of small pools during low flow periods. Mossy Lake and the lower end of Coffee Creek are inundated by the Ouachita River most years during the late winter through the early spring. Coffee Creek above the confluence with the GP discharge and at the upper end of Mossy Lake is an intermittent stream. That part of Coffee Creek was used as a reference site for this project.

1.2.2 Georgia-Pacific, Crossett, Arkansas

GP's Crossett, Arkansas paper mill permit (National Pollutant Discharge Elimination System [NPDES] permit number AR 0001210) limits are partially based on a maximum average daily discharge rate of 45 million gallons per day (MGD) to the Ouachita River via Coffee Creek and Mossy Lake. According to the provisions of its permit, GP is allowed to discharge effluent to Coffee Creek and Mossy Lake via Outfall 001. The effluent is primarily composed of wastewater from paper production operations, including the plant's sanitary facilities. Other internal wastewater discharges from the facility include approximately 1.6 MGD added by its building products operations, 0.4 MGD resulting from its chemical plant operations, and an additional 1.0 MGD of treated sanitary wastewater contributed by the City of Crossett. Prior to discharge, the effluent is treated by screening, primary clarification, settling, and stabilization in an aerated basin, which occupies a former channel of Coffee Creek. The aerated basin

discharges via Outfall 001 to a man-made channel, then to Coffee Creek at the upper reaches of Mossy Lake.

Since the review of existing data (December 2002), the Arkansas Department of Environmental Quality (ADEQ) issued a new NPDES permit to GP. Permit limits no longer apply at the now former Outfall 002, which was the discharge from Mossy Lake to Coffee Creek and then the Ouachita River. Outfall 002 was renamed Stream Monitoring Station (SMS) 002, since Mossy Lake is considered waters of the state. SMS 002 has quantitative permit limits for 5-day biochemical oxygen demand (BOD_5), total suspended solids (TSS), and pH. GP Outfall 001 remains at the discharge from the aeration basin.

1.3 EXISTING DATA

Parsons published the *Water Quality Data Assessment for the Ouachita River, between Felsenthal Reservoir Lock and Dam, Arkansas and Sterlington, Louisiana* in January 2003 (Parsons, 2003). The report contained a summary of water quality data for two stations between the lock and dam and the state line.

ADEQ monitoring station number OUA00008B located at the Felsenthal Lock and Dam on the Ouachita River has a period of record from August 1993 through May 2002. The U.S. Geological Survey (USGS) Station 330255092064301 is located on the Ouachita River, upstream of the Coffee Creek confluence, and has a period of record from October 27, 1997 through September 25, 2000. Outfall location 001 is the discharge monitoring point for the outfall of the GP Crossett paper mill wastewater treatment system.

Tables 1.1 and 1.2 provide a comparison of historical water quality data to the ADEQ water quality standards. Comparison of conventional water quality parameters in Table 1.1 indicates that the stream standard for turbidity is occasionally exceeded at Station OUA00008B. Table 1.2 compares laboratory results for pollutants from Station OUA00008B to the water quality standards for the protection of aquatic life and human health. Water samples collected from USGS Station 330255092064301 were not analyzed for pollutants toxic to aquatic species. Data collected for pollutants listed in the water quality standards is limited. No conclusions or trends about the potential impacts these types of pollutants may be having on water quality can be ascertained from this data set. Please see the current publication of the state's 305(b) or 303(d) list for complete analysis of this data, exceedances, and attainment of water quality standards.

Table 1.1 Arkansas Water Quality Comparisons for the Ouachita River Between Felsenthal Reservoir and the Louisiana State Line

Parameter	Limit	Unit of Measurement	Suface Water Quality Standard Comment	Station OUA0008B			Station 330255092064301		
				Max	Avg	Exc	Max	Avg	Exc
Bacteria	200	CFU/100 ml	April - September, geometric mean with no more than 10% of samples > 400.	290	55**	NO	Not Available		
Cl	160	mg/l		Not Available			Not Available		
Dissolved Oxygen	3	mg/l	June and July for Ouachita River Miles (ORM) 223 to ORM 221.1(Louisiana border).	6.2 (min)	7.2	NO		6.4***	NO
"	4.5	mg/l	August for ORM 223 - 221.1	4.7 (min)	6.5	NO	7.7 (min)	8.3	NO
"	5	mg/l	September through May for ORM 223 - 221.1	5.7 (min)	7.6	NO	5.3 (min)	7.5	NO
"	No Limit	mg/l	River stage above 65 feet measured at Station No. 89-o (above Coffee Creek Confluence) and 2-weeks following flooding for ORM 223 - 221.1	Not Available			Not Available		
"	6.5	mg/l	March - May, Ouachita River above ORM 223 to Felsenthal Reservoir.	5.9 (min)	7.4	**2/15**	5.3 (min)	6.3	**1/3**
"	5	mg/l	June - February, Ouachita River above ORM 223 to Felsenthal Reservoir with water temperature ≤ 22 degrees C.	Not Available			6.4 (min)	7.9	NO
"	4	mg/l	June - February, Ouachita River above ORM 223 to Felsenthal Reservoir with water temperature >22 degrees C, 8-hours maximum.	4.7* (min)	7.4	NO	Not Available		
pH	6.0 - 9.0	SU	Must not fluctuate in excess of 1.0 unit over a period of 24 hours.	8.1	6.2 (min)	NO	6.7	5.8 (min)	**2/16**
Radioactivity	3	pc/l	Dissolved Radium-226	Not Available			Not Available		
"	10	pc/l	Dissolved Strontium-90	Not Available			Not Available		
"	1000	pc/l	Gross Beta Concentration	Not Available			Not Available		
SO_4	40	mg/l		Not Available			21	10.6	NO
TDS	350	mg/l		132	80.2	NO	Not Available		
Temperature	32	^{o}C (89.6 F)		32	20	NO	32	19	NO
Turbidity	21	NTU		59	13	**10/76**	`		

* Water temperature >22 degrees C
** Geometric mean
*** Single measurement on 6/5/2000

Period of Record for the ADEQ Monitoring Station OUA00008B is 8/1/93 through 5/28/02 and the Period of Record for USGS Station 330255092064301 is 10/27/97 through 9/25/00.

Table 1.2 Comparison Ambient Monitoring Data to Arkansas Numerical Water Quality Standards Criteria

Toxic Substance	Aquatic Life Protection Freshwater (µg/L)		Human Health Protection Drinking Water Supply (ng/L)	OUA0008B			
	Acute	Chronic		Max	Avg	Exc	% Exc
Pesticides and PCB's							
PCB's	--	0.014	0.4		ND[e]		
Aldrin	3	--	--		ND[e]		
Dieldrin	2.5	0.0019	1.2		ND[e]		
DDT (& metabolites)	1.1	0.001	--		ND[e]		
Endrin	0.18	0.0023	--		ND[e]		
Toxaphene	0.73	0.0002	6.3		Unav		
Chlordane	2.4	0.0043	5		ND[e]		
Endosulfan[a]	0.22	0.056	--		ND[e]		
Heptachlor	0.52	0.0038	--		ND[e]		
Hexachlorocyclohexane	2[a]	0.08[a]	37.3[b]		Unav		
Chloropyrifos	0.083	0.041	--		Unav		
Acid – Extractable Organic Chemicals							
Pentachlorophenol (pH = 6.84)	7.43	5.7	--		Unav		
Other Organics							
Dioxin (2,3,7,8 TCDD)			0.001		Unav		
Metals and Inorganics							
Cadmium[c] (d)	0.86	0.38	--		ND		
Chromium, Trivalent[c] (d)	182.07	59.06	--	0.85	0.68	NO	0%
Chromium, Hexavalent (d)	15.71	10.56	--		Unav		
Copper[c] (d)	4.78	3.59	--	5.70	1.78	2/31	6%
Lead[c] (d)	14.51	0.57	--		ND		
Mercury, Total Recoverable	2.04	0.012	--		Unav		
Nickel[c] (d)	452.84	50.29	--		ND		
Selenium, Total Recoverable	20	5	--		ND		
Silver[c] (d)	0.340	--	--		Unav		
Zinc[c] (d)	36.55	33.38	--	43.3	17.28	3/30	10%
Cyanide, Total Recoverable	22.36	5.2	--		Unav		
Beryllium	--	--	76		ND		

Period of Record - 8/01/93 through 5/28/02
a. Total of all isomers
b. Human health standard is for a-hexachlorocyclohexane
c. Metals concentration calculated based on total hardness of 26 mg/L
unav = Database indicated data were not available
d. Mercury based on bioaccumulation of residues in aquatic organisms rather than toxicity.
e. Only one sample 8/26/97
f. (d) = dissolved concentration

SECTION 2
METHODS AND MATERIALS

2.1 SAMPLE SITE DESCRIPTIONS

The following general guidelines were followed during selection of the sites:

1. Sites chosen were to be representative of the area being sampled.
2. Overall consideration was to be given to the accessibility and safety of the sites.
3. The upstream Ouachita River site was to be located upstream of the mixing zone at the confluence of the Mossy Lake/Coffee Creek discharge.

2.1.1 Station 1 – Reference Site (Coffee Creek above the Confluence with GP Effluent)

The Reference Site is located at the crossing of the historical channel of Coffee Creek by Ashley County Road 221 with coordinates of approximately 33º05.659'N 92º02.356'W (see Figure 2.1). The Reference Site has a natural historic watershed area of approximately 11.5 square miles. Due to the redirection of flow by GP the current watershed size at the reference site is estimated as approximately 2 square miles. Pool areas are located just upstream and downstream of the road crossing due to the influence of the road. These pool areas were not sampled for fish or benthics but were sampled for water and sediment when the stage was too low for sampling in the rest of the stream. The sampling area was in a portion of the stream that had previously been rerouted because of the road. The channel was fairly uniform in nature with a hardpan clay bottom and steep banks on the outside bends. The channel was filled with logs and other organic material. This site is above the confluence with the GP 001 outfall, however, when the Ouachita River reaches 75 feet msl the backwaters of the flooded Ouachita River cause the GP discharge waters to potentially mix with the upper reach of Coffee Creek, including the Reference Site. This means there may be episodic influences on this site from the GP 001 outfall. This site was selected because it was the only site that provided reasonable expectation of the condition of an undisturbed stream in this system. Moving farther upstream to avoid the potential impact from GP 001 outfall was not practical due to the low flow in the system.

2.1.2 Station 2 – Coffee Creek Upstream of Mossy Lake (Coffee Creek)

Coffee Creek upstream of Mossy Lake is abbreviated to "Coffee Creek" in the remainder of this report. The site on Coffee Creek below GP Outfall 001 is located approximately 109 yards downstream of the large burned out trestles on the Union-Pacific Railroad Tram Road, with coordinates of approximately 33º03.455'N 92º03.292'W (see Figure 2.2). The site has an approximate watershed area of 25 square miles. Coffee Creek at this point is a braided channel with multiple large braids. The area between the braids consists of dense vegetation with pockets of shallow water through most of the year. Biological samples were collected from the westernmost braid, while sediment and water quality samples were split between the westernmost channel and the next dominant channel. The channel substrate was mostly black muck with large amounts of leaves and other plant material.

Figure 2.1 Reference Site Stream

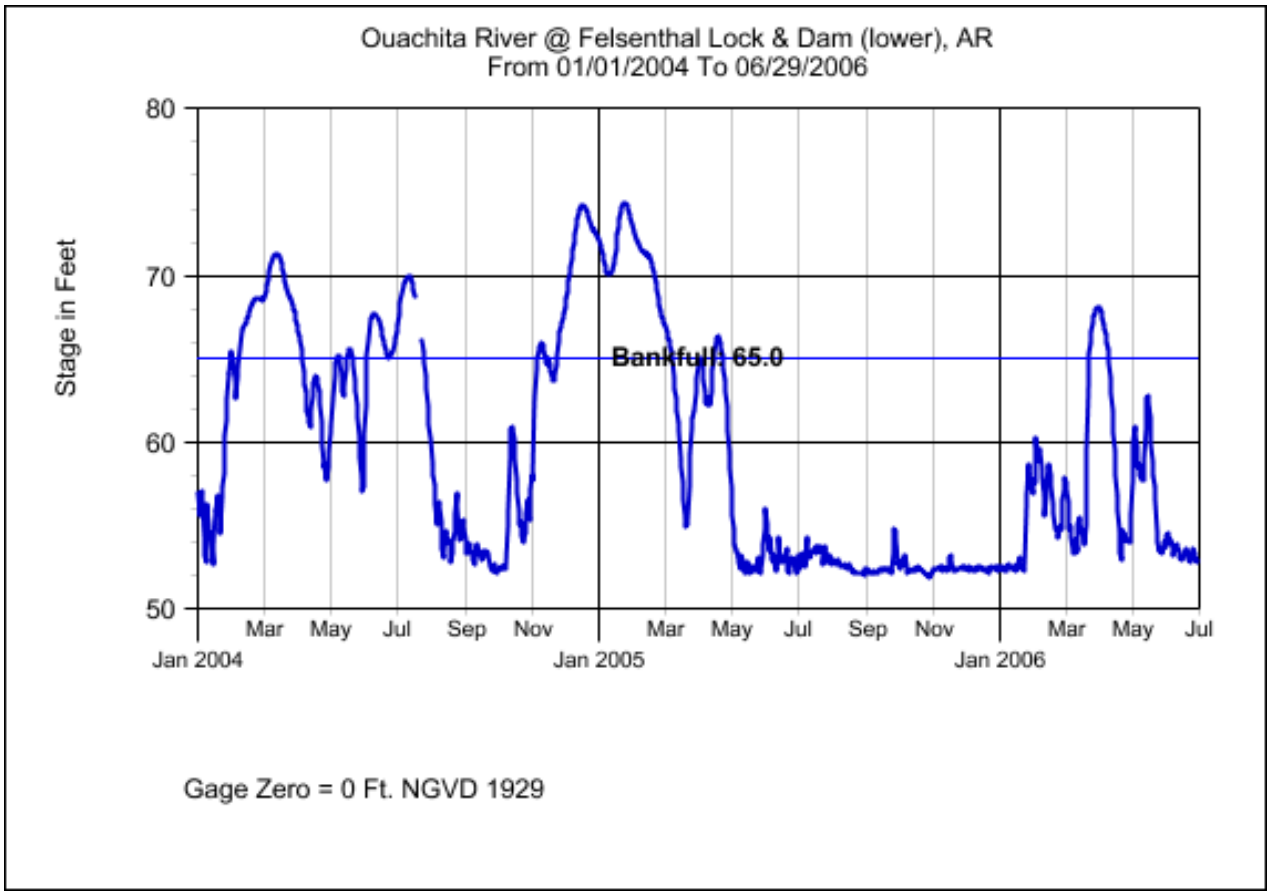
Figure 2.2 Coffee Creek

2.1.3 Station 3 - Mossy Lake

Mossy Lake is a natural depression floodplain lake that has been impounded further by GP with a weir at the outlet. The lake is a high organic load, shallow water system that floods seasonally from the Ouachita River. Mossy Lake varies in size widely with stage but was estimated to be approximately 550 acres from aerial photos. Mossy Lake floods almost every year under current conditions. The maintained levees around Mossy Lake are approximately 65 feet msl. During all biological sampling events the water level was well below this level. From the water surface during biological collections some portions of the lake were over 10 feet deep. This was observed when deploying the nets used for fish collection. This puts

the lake bottom at below 55 feet msl, likely below 52 feet msl. The record low stage at the Felsenthal Lock and Dam is 51 feet msl. This indicates that portions of Mossy Lake would be a perennial lake during most years. Figure 2.3 shows river stage below Felsenthal Lock and Dam for the period of the study. Water and sediment samples in Mossy Lake were taken from the bank at approximately 33º02.247'N 92º03.776'W (see Figure 2.4). Benthics were taken along the shore in the same area. Fish were sampled with nets along the eastern shore of the lake and along cypress roots across open water from the shore.

Figure 2.3 Ouachita River Stage



2.1.4 Station 4 – Ouachita River near USGS Station 330255092064301 (Approximately 100 Yards Upstream of Coffee Creek Confluence)

The upstream site on the Ouachita River is located at approximately 33°01.936'N 92°05.132'W. Samples were taken near mid-stream next to the Coast Guard channel buoy (see Figure 2.5).

Figure 2.4 Mossy Lake

Figure 2.5 Ouachita River

2.1.5 Station 5 - Ouachita River Approximately 1 Mile Downstream of Coffee Creek Confluence

The downstream site on the Ouachita River is located at approximately 33°00.896'N 92°04.599'W. Samples were taken near mid-stream next to the Coast Guard channel buoy (see Figure 2.6). Figure 2.7 is a photograph of the confluence of Coffee Creek and the Ouachita River. The water from Coffee Creek has the characteristic coffee color.

Figure 2.6 Ouachita River

Figure 2.7 Confluence of Coffee Creek with the Ouachita River

2.1.6 Station 6 - Coffee Creek below Mossy Lake

In addition to the water quality/habitat assessment stations described above, two habitat assessments and fish and macroinvertebrate identifications were performed within Coffee Creek below Mossy Lake (above the Ouachita River confluence). This site is located at 33° 01' 47"N, 92° 04' 48"W (Figure 2.8). The area of the watershed at the Coffee Creek below Mossy Lake site is difficult to determine because of the low gradient nature of the system. The available digital elevation data does not provide an accurate representation of the true conditions. Though we cannot be certain of the size of the entire watershed of Coffee Creek below Mossy Lake we can be certain that it would be significantly larger than the 25 square miles of the Coffee Creek above Mossy Lake site.

Figure 2.8 Coffee Creek below Mossy Lake

2.2 SAMPLE COLLECTION METHODS

Table 2.1 provides a list of the sampling and handling procedures used by the field crew.

Table 2.2 provides a list of the parameter analyses performed in the field or the laboratory. Descriptions of sampling techniques at each station follow.

2.2.1 Sample Collection, Water and Sediment Samples

Field water quality samples were collected using grab sample methods. Samples were collected in an area undisturbed by the field team, with samples being collected facing upstream (when wadeable) to minimize disturbance of water conditions. When flow conditions were extremely low, samples were taken from the bank to avoid disturbance of the sediment. Samples were collected 1-foot under the water surface unless conditions were deemed otherwise by the field team manager. Composite water samples at the Coffee Creek site were collected from the two main channel braids.

Ultra clean metals water samples were collected following the Ultra Clean Metals Sampling Procedure in Appendix A (QAPP – Appendix C).

Table 2.1 Field Sampling and Handling Procedures

Parameter	Matrix	Container/Volume	Preservation	Holding Time
Laboratory Parameters; (Water)				
Nitrite, Chloride, Sulfate, TSS, TDS	Water	1 liter HDPE	Cool 4°C	48 hours (NO-2), 7 days TSS & TDS, anions 28 days
Chlorophyll-a	Water	1 liter cubitainer	Cool 4°C	2 days
Total Phosphorus, Nitrate	Water	1 liter cubitainer	pH<2 H2SO4, Cool 4°C	2 days (NO-3), TP 28 days
Ammonia, TKN	Water	1 liter HDPE	pH<2 H2SO4, Cool 4°C	28 days
TOC	Water	250 ml HDPE	pH<2 H2SO4, Cool 4°C	28 days
Pesticides	Water	3 - 1 liter amber glass	Cool 4°C	7 days
Color, True & Apparent	Water	500 m1 HDPE or glass	Cool 4°C	24 hours
E. coli	Water	100 ml sterile plastic	Cool 4°C, dark	6 hours
Ultra Clean Metals	Water	Hg 125 ml glass, Diss. 60 ml LDPE, Totals 125 ml LDPE	Preserved in Ultra Clean Laboratory, Cool 4 oC, sealed in ziplock bags	6 months 28-days Hg
Laboratory Parameters; (Sediment)				
TOC/Grain Size	Sediment	1-8 oz glass	Cool 4°C	28 days
Total Metals	Sediment	1 - 8 oz glass	Cool 4°C	6 months 28-days Hg
Semi-volatiles	Sediment	1-8 oz glass	Cool 4°C	14 days
Pesticides/ PCBs	Sediment	1-8 oz glass	Cool 4°C	14 days
Acute/Chronic Toxicity Testing				
Toxicity	Water	1 gallon cubitainer	Cool 4°C	36 hours
Toxicity	Sediment	1 liter glass	Cool 4°C	14 days

Table 2.2 Sample Analyses

Location	RBP	Analytical Parameters in Water	Field Parameters in Water	Analytical Parameters in Sediment
	Events: 3	**Events: 5**	**Events: 5**	**Events: 2**
Ouachita River, >= 100 feet upstream of Coffee Creek confluence. At or near USGS Station 07364100	Not Applicable	Conventional parameters (including *E. coli*), specialty parameters, color, pesticides, ultra clean metals, and toxicity	DO, pH, conductivity, turbidity, and temperature	Conventional parameters, grain size, TOC, pesticides/ herbicides, PCBs, semivolatiles, metals, and toxicity
Ouachita River, 1-mile downstream of Coffee Creek confluence	Not Applicable	Same as above	Same as above	Same as above
Mossy Lake, upstream of SMS 002	Habitat, macroinvertebrates, fish in Mossy Lake	Same as above (excluding *E. coli*).	Same as above	Same as above
Coffee Creek below Mossy Lake and upstream of confluence with Ouachita River	Habitat, macroinvertebrates, and fish	Not Applicable	Not Applicable	Not Applicable

Table 2.2 Sample Analyses (*continued*)

Location	RBP	Analytical Parameters in Water	Field Parameters in Water	Analytical Parameters in Sediment
	Events: 3	Events: 5	Events: 5	Events: 2
Coffee Creek below abandoned railroad crossing, in braided channel upstream of Mossy Lake	Habitat, macroinvertebrate, and fish	Same as above (excluding *E. coli*).	Same as above	Same as above
Reference Site on Coffee Creek	Habitat, macroinvertebrate, and fish	Same as above (excluding *E. coli*).	Same as above	Same as above

Composite sediment samples in the stream and lake sites were collected using a shovel, plastic tubs, and stainless steel spoons. An Eckman sediment sampler was used at the river sample sites. Sediment from approximately the top 1 inch of sediment was homogenized for the composite sample.

2.2.2 Sample Collection, Benthic Macroinvertebrates

Macroinvertebrates were collected using the traveling kick method as required by the ADEQ method for the Gulf Coastal Plain ecoregion (Davidson undated). The kick net was placed downstream while the substrate was disturbed upstream. A 5-minute kick sample was conducted using approximately 3-foot jabs incorporating a proportional amount of each of four habitat types: woody debris, macrophytes, undercut banks, and root wads. The samples were cleaned of larger debris in the field before preservation. The samples were preserved in 70 percent ethanol and labeled with the appropriate identifying information.

For lentic ecosystems (Mossy Lake), net sweeps were used to collect coarse particulate organic matter (CPOM). These samples were collected using an upward sweeping motion from under the CPOM. At least five CPOM collections were made during each event. After collection, the CPOM was preserved in 70 percent ethanol, transported to the laboratory, and picked for benthic macroinvertebrates.

It was attempted to collect at least 400 organisms at each of the four sample locations. A subsample of approximately 200 organisms was picked in the laboratory when there were enough organisms available. A 4-inch diameter metal ring was randomly tossed into the tray and organisms within the ring removed for the subsample. Subsampling continued until a minimum of 200 organisms was removed. Subsamples were identified to the minimum practical levels for taxonomic resolution as listed below (Merritt and Cummins 1996). Many of the samples did not contain 200 organisms due to the low number of organisms in the stream. In these cases all organisms were identified. The groups within each taxonomic level are shown in Table 2 3.

Table 2.3 Minimum Taxonomic Resolution

Taxonomic Level	Groups
Genus	*Plecoptera, Ephemeroptera, Odonata, Trichoptera, Megaloptera, Neuroptera, Lepidoptera, Coleoptera, Hemiptera, Diptera* (in part), *Crustacea, Mollusca*
Tribe	*Chironominae*
Family	*Diptera* (in part)
Order	Other non-insect groups

2.2.3 Sample Collection, Fish

The following describes fish collection at the Reference Site, Coffee Creek, Mossy Lake, and Coffee Creek below Mossy Lake. For all the sites, there were sampling events where a limited number of fish were caught, identified and measured for length and weight. Although it is considered a deviation from the QAPP, the field biologist often made a judgment decision to not record the associated length and/or weight during sampling events with limited fish collection. In some cases, only the fish species was recorded and neither the weight nor length was recorded.

2.2.3.1 Reference Site

Electro-fishing and seining were used for fish collection at the Reference Site. Natural channel barriers and seines were used to create reach limits. For seining efforts, a minimum of 10 passes were used. A level of effort appropriate to capture a substantial number of fish present was employed for electro-fishing.

2.2.3.2 Coffee Creek and Coffee Creek below Mossy Lake

Sampling fish in areas receiving effluent and exhibiting extremely high conductivities precluded the use of conventional electro-fishing gear. Alternative methods were employed to capture fish in such areas. Gear types used in areas receiving effluent were selected based on physical habitat conditions such as depth, velocity, and the presence of snags. Seining was attempted but did not produce the number of fish expected due to problems with underwater debris interference. Hoop nets and Mini-fyke nets were deployed after seining attempts were unsuccessful.

The hoop nets consisted of a series of seven 4-foot diameter hoops with throats that prevent exit once fish have entered the net. Nets are placed with openings facing downstream. Fish moving upstream enter the first chamber and continue to move deeper into the net, passing through a series of throats to the back chamber. These nets consist of 1-1/2–inch bar mesh, and are effective in capturing most medium to large fish moving upstream. Nets are anchored upstream and held open by the current. A photograph of a hoop net is provided in Figure 2.9.

Mini-fyke nets were deployed to capture smaller fish such as sunfish, minnows, and darters. Mini-fyke nets were used in eddies and slack water. These nets consisted of very small mesh similar to seines and were set perpendicular to the shoreline or vegetation lines. The nets are composed of a lead tied or staked to the shoreline. When fish encounter the lead, they follow it as if it were the shoreline, which directs them into the net-trap. The trap is very much like a hoop net but with rectangular frames rather than circular. The rear of the trap is anchored to keep the net open in deeper water. Fish swim into the throats and enter rear

chambers of the apparatus where they cannot escape. All sizes of fish can be captured using this technique along shorelines with little or no current. A photograph of a mini-fyke net is provided in Figure 2.10.

Figure 2.9 Hoop Net

Figure 2.10 Mini-Fyke Net

The position of each net was recorded after deployment, and fish retrieved from each net were recorded and released back to the water. Nets were left over night and collected the next day. The nets were deployed in the area corresponding to the habitat assessment reach at each site.

2.2.3.3 Mossy Lake

Mossy Lake was also characterized by high conductivities. Gear types often used on lakes were employed to assess the lake fish. An experimental gill net consisting of three 100-foot panels of 2, 3, and 4-inch bar mesh composed of monofilament webbing was placed across a cove or neck of the lake. Mini-fyke nets were used near shorelines and vegetation lines to capture smaller fish and larger fish that follow shoreline habitats.

2.2.4 Sample Collection, Field Water Quality Parameters

Data sondes were deployed at each site for each water quality event for a minimum of 48 hours capturing data at 15 minute intervals. DO, pH, conductivity, and temperature were recorded with data sondes. Turbidity was not recorded with data sondes but with a portable turbidimeter. At the river sites the sondes were attached to Coast Guard channel marker buoys. At creek sites the data sondes were attached to t-posts driven into the channel bottom. At Mossy Lake the sonde was attached to a float that was subsequently attached to a cypress stump. All sondes were secured as near as possible to 1-foot below water surface. Turbidity was measured with a portable turbidimeter at each site during water sampling activities. The sonde data and graphs of the diurnal dissolved oxygen curves are located in Appendix L. The turbidity data is presented in Chapter 3.

2.2.5 Habitat Assessment Method for Streams and Lakes

The ADEQ method for physical habitat assessment of Gulf Coastal Plains Ecoregion streams was used for the Reference Site, Coffee Creek, and Coffee Creek below Mossy Lake (modified from Barbour et al., 1999). This is a two-part approach used to develop a habitat profile for each sample reach. The first part is a qualitative visual assessment of the structure of the surrounding physical habitat that influences the quality of the water resource and the condition of the resident aquatic community (Barbour et al., 1996). It consists of ten broad habitat parameters which were rated on a scale of zero to 20. The scores fall into one of four categories, optimal (20-16), sub-optimal (15-11), marginal (10-6), and poor (5-0). The scores for the habitat parameters were then added together to give an overall rating score from zero to 200, with 200 being the highest (see Appendix I for Rapid Habitat Assessment (RHA) scores). The scores are then compared to a reference condition to provide a final habitat ranking. Scores increase as habitat quality increases. The ratio between the score for the test station and the score for the reference condition provides a percent comparability measure for each station. The station of interest is then classified on the basis of its similarity to expected conditions (reference condition), and its apparent potential to support an acceptable level of biological health (Barbour et al., 1999).

The second part is a quantitative assessment to evaluate the suitability of the habitat to support a fish community. For the quantitative assessment, five parameters consisting of three to seven variables were measured or estimated. These parameters included: habitat type, habitat quantity, quantity of substrate based on fish use, quantity of in-stream cover, and sediment on substrate. Each parameter for substrate type and in-stream cover was given a score depending on its abundance. The scores given to the substrate parameters were multiplied by a factor to adjust these scores based on how they relate to fish habitat quality. Habitat type length, depth, and width measurements were estimated for each habitat type. The sediment on substrate parameter was scored according to the degree of embededness. A total score for each habitat type was calculated by summing the scores for the substrate type, in stream cover, and

sediment on substrate. The scores from like habitats were averaged for each sampling station. The lengths of each habitat type were also summed. 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) (see Appendix J for IHI scores). The IHI scores can be used to demonstrate any significant differences in habitat between sampling reaches, such as presence/absence of run/riffle/pool habitat, availability of in-stream cover (woody debris, undercut banks), and substrate composition. The scores are not used to determine impairment of sites due to lack of habitat, only to assist in the analysis of fish community data.

For the wetland area of Mossy Lake, a modified version of the State of Washington Wetland Assessment Method (Hruby, 2004) was used. This method employs a habitat rating metric similar to the RBP method. The method begins by classifying the wetland into a general class; lake fringe, slope, riverine, or depressional. After being classified, the wetland is scored using a point system that rates the water quality, hydrologic, and habitat functions. These points are added together to give an overall rating score from one to four with one being the highest. Category one wetlands are defined as those that represent a unique or rare wetland type, are more sensitive to disturbance than most wetlands, are relatively undisturbed and contain ecological attributes that are impossible to replace within a human lifetime, or provide a high level of functions (score >70). Category two wetlands are defined as those that are difficult, though not impossible, to replace, and provide high levels of some functions (score from 51-69). Category three wetlands are defined as vernal pools that are isolated or wetlands with a moderate level of functions (score from 30-50). Category four wetlands have the lowest level of functions (score <30). The method was modified in sections where the objectives of the study were targeting local flora and fauna that were not applicable to south Arkansas, such as appearance of aspen groves.

2.3 LABORATORY ANALYSIS METHODS

Table 2.4 includes the list of parameters and associated data quality objectives (DQO) that were performed in this investigation. Table 2.4 also includes parameter group headings for analysis and associated DQOs performed by the USEPA Region 6 Laboratory. USEPA Region 6 Laboratory (Houston) used laboratory quality control (QC) precision/accuracy that was either equivalent to that listed in the methods, or was more stringent.

2.4 DATA QUALITY REVIEW

2.4.1 Water Quality and Sediment Samples

Data Quality Verification Reports for all the water and sediment analysis are provided in Appendix B. The appendix contains five Data Quality Verification Reports that correspond to the five sampling events.

2.4.2 Field Water Quality Parameters

Field notes describing conditions, unexpected situations, and equipment failures during each event are noted below.

Table 2.4 Data Quality Objectives for Field, Special Parameters, and Clean Metals

Parameter	Units	Matrix	Method	Storet	Reporting Limit	Precision of Laboratory Duplicates RPD	Accuracy Of Lab Matrix Spikes %Rec.	Complete %	Responsible Agency
Field Measurement Parameters (Water)									
pH	Standard units	water	EPA 150.1	00400	0.1	NA	NA	90	UofA
DO	mg/L	water	EPA 360.1	00300	0.1	NA	NA	90	UofA
Turbidity	NTU	water	SM 2130B	82079	.5	NA	NA	90	UofA
Conductivity	µS/cm	water	EPA 120.1	00094	1	NA	NA	90	UofA
Temperature	°C	water	EPA 170.1	00010	NA	NA	NA	90	UofA
Laboratory Parameters; Conventional Parameters (Water)									
Ammonia-N	mg/L	water	EPA 350.1	00610	0.02	±20%	±20%	90	USEPA Houston
Chlorine-*a*	mg/L	water	SM10200H	13855*	0.01	±20%	±20%	90	USEPA Houston
Chloride	mg/L	water	EPA 300.1	00940	1.0	±20%	±20%	90	USEPA Houston
Sulfate	mg/L	water	EPA 300.1	00945	3.0	±20%	±20%	90	USEPA Houston
Nitrite N	mg/L	water	EPA 353.2	00615	0.04	±20%	±20%	90	USEPA Houston
Nitrate-N	mg/L	water	EPA 353.2	00620	0.02	±20%	±20%	90	USEPA Houston
Total Kjeldahl N	mg/L	water	EPA 351.2	00625	0.02	±20%	±20%	90	USEPA Houston
Total N	mg/L	water	Calculation	00630	--	--	--	--	USEPA Houston
Total P (TPO_4)	mg/L	water	EPA 365.4	00665	0.01	±20%	±20%	90	USEPA Houston
TOC	mg/L	water	EPA 415.2	00680	0.1	±20%	±20%	90	USEPA Houston
TDS	mg/L	water	EPA 160.1	70300	0.1	±20%	±20%	90	USEPA Houston
TSS	mg/L	water	EPA 160.2	00530	4.0	0-10 mg/L: 30 10-100 mg/L: 20 >100 mg/L: 10	NA	90	USEPA Houston

Table 2.4 Data Quality Objectives for Field, Special Parameters, and Clean Metals (*continued*)

Parameter	Units	Matrix	Method	Storet	Reporting Limit	Precision of Laboratory Duplicates RPD	Accuracy Of Lab Matrix Spikes %Rec.	Complete %	Responsible Agency
Laboratory Parameters; Special Parameters (Water)									
Color, True & Apparent	Platinum-cobalt units	water	EPA 110.2	00080	5	NA	NA	90	Albion
Color, Apparent	Color units	water	EPA 110.3	00081	1	NA	NA	90	Albion
E. coli	MPN/100 ml	water	SM 9223 B	31699	1	1*	NA	90	Sorrells Research Associates, Inc.
Laboratory Parameters; Ultra Clean Metals (Water)									
Mercury, total	µg/L	water	EPA 1631e	71900	0.0005	25	NA	90	Albion
Selenium, total	µg/L	water	EPA 1632 (mod)	01147	0.1	25	NA	90	Albion
Silver, dissolved	µg/L	water	EPA 1638/200.8	01075	0.1	25	NA	90	Albion
Cadmium, dissolved	µg/L	water	EPA 1638/200.8	01025	0.1	25	NA	90	Albion
Chromium, total dissolved	µg/L	water	EPA 200.8	01030	1.0	25	NA	90	Albion
Copper, dissolved	µg/L	water	EPA 1638/200.8	01040	0.3	25	NA	90	Albion
Nickel, dissolved	µg/L	water	EPA 1638/200.8	01065	1.0	25	NA	90	Albion
Lead, dissolved	µg/L	water	EPA 1638/200.8	01049	0.1	25	NA	90	Albion
Zinc, dissolved	µg/L	water	EPA 1638/200.8	01090	0.5	25	NA	90	Albion

Table 2.4 Data Quality Objectives for Field, Special Parameters, and Clean Metals (*continued*)

Parameter	Units	Matrix	Method	Storet	Reporting Limit	Precision of Laboratory Duplicates RPD	Accuracy Of Lab Matrix Spikes %Rec.	Complete %	Responsible Agency
Laboratory Parameters; Toxicity (Water)									
Acute Toxicity (*C dubia & P promelas)*	Lethal	water	600/4/90/027F	89808, 89809	NA	NA	NA	90	USEPA Houston
Chronic Toxicity (*Ceriodaphnia dubia and Pimephales promelas)*	Sublethal	water	821-R-02-013	89802, 89803	NA	NA	NA	90	USEPA Houston
Laboratory Parameters; Pesticides (Water)									
Pesticides: Approximately 17 common pesticide analytes.	µg/L	water	8081A,8141A, 505	NA	NA	NA	NA	90	USEPA Houston
Laboratory Parameters; Conventional Parameters (Sediment)									
Sieve Analysis (Grain Size)	% Particle size	Sediment	EPA 600/2-78-054	89991, 82009, 82008, 80256	NA	NA	NA	90	USEPA Houston
TOC	mg/L	Sediment	415.2	NA	NA	NA	NA	90	USEPA Houston
Laboratory Parameters; Metals (Sediment)									
Metals: Approximately 22 common metals analytes.	mg/L	Sediment	7000A,6010B,7470A/7471A	NA	NA	NA	NA	90	USEPA Houston

Table 2.4 Data Quality Objectives for Field, Special Parameters, and Clean Metals (*continued*)

Parameter	Units	Matrix	Method	Storet	Reporting Limit	Precision of Laboratory Duplicates RPD	Accuracy Of Lab Matrix Spikes %Rec.	Complete %	Responsible Agency
Laboratory Parameters; Pesticides/Herbicides/PCBs (Sediment)									
Pesticides: Approximately 20 common pesticide analytes.	µg/L	Sediment	8081A,8141A	NA	NA	NA	NA	90	USEPA Houston
PCBs: Approximately 7 common PCB analytes.	µg/L	Sediment	8082	NA	NA	NA	NA	90	USEPA Houston
Laboratory Parameters; Semivolatiles (Sediment)									
Semivolatiles: Approximately 70 common semivolatile analytes.	µg/L	Sediment	8270	NA	NA	NA	NA	90	USEPA Houston
Laboratory Parameters; Toxicity (Sediment)									
Acute Toxicity (*Ceriodaphnia dubia and Pimephales promelas)*	Lethal	Sediment	600/R-94/024	NA	NA	NA	NA	90	USEPA Houston
Chronic Toxicity (*Ceriodaphnia dubia and Pimephales promelas)*	Sublethal	Sediment	600/R-94/024	NA	NA	NA	NA	90	USEPA Houston

2.4.2.1 Event 1

Data sondes were deployed at the Reference Site, Mossy Lake, Ouachita River Up, and Ouachita River Down sites on July 5, 2005 and retrieved on July 7, 2005. Data sondes were deployed again on August 8-10, 2005. The sites deployed at were Ouachita River Up and Down, the Reference Site, Coffee Creek, and Mossy Lake. The Reference Site stream had divided pools with no flow. The Mossy Lake data sonde remained deployed until August 11, 2005. Water and sediment samples were collected at all five sites on the 9th and 10th of August.

2.4.2.2 Event 2

Data sondes were deployed October 17th at the five sites. The downstream Ouachita data sonde was deployed one-half mile upstream of actual site. It is not believed this had an adverse affect on the data.

The water in Coffee Creek (upstream of Mossy Lake) was black and had a stagnant smell. The water in Mossy Lake was also black, had a bad smell, and had little aquatic vegetation. Nothing unusual was noted in the Ouachita River.

2.4.2.3 Event 3

The third event for data sonde deployment was from December 12-14, 2005. The data sonde for the Reference Site stream was moved upstream of the bridge due to the lack of water in the normal sampling pool. Trash had been dumped from the bridge into the creek.

The water in Coffee Creek was black and had a strong smell. Nevertheless, ducks were observed in the creek. The water in the creek was rising and moving into adjacent swampy areas. The water in Mossy Lake was also black and had a bad smell. There were few aquatic vegetation species in the lake.

The Ouachita River water samples were collected in cool weather with light to medium rain. The water was slightly turbid. Duckweed was observed across the entire river at the downstream station.

2.4.2.4 Event 4

The fourth event for data sonde deployment was from May 15-17, 2006. The water at the Reference Site was slightly turbid, but fish were observed in the water. The water in Coffee Creek was dark and had a slight smell. The water was dark and duckweed was observed in Mossy Lake. Dredging was occurring in the Ouachita River upstream of both stations resulting in elevated turbidity and suspended solids and depressed DO.

The downstream Ouachita data sonde lost or stolen during Event 4; no data retrieved. The Coast Guard buoy that it was attached to was not found when we searched for it on the 17th. The data taken with handheld multi-probes at the time of water quality sampling may work to fill in for the missing data. The upstream handheld readings corresponded closely with the upstream data sonde and the downstream handheld readings suggested a

similar patter to previous deployments. The pattern is of slightly elevated conductivity, slightly depressed DO, and nominal change in pH.

2.4.2.5 Event 5

The fifth event for data sonde deployment was June 5-7, 2006. Water was not flowing in the Reference Site stream and contained a surface film and elevated turbidity. The water in Coffee Creek was dark, and some black slime was observed on the banks. The water in Mossy Lake was dark, an abundance of duckweed was observed near the shore, and there was a surface film most probably due to algae. No unusual observations were recorded for the Ouachita River.

The downstream Ouachita data sonde experienced calibration problems with pH and dissolved oxygen (DO). The upstream Ouachita data sonde experienced a pH malfunction. Both Coffee Creek and the Reference Site experienced DO failures.

2.4.3 Fish Collection

No known quality assurance (QA) issues.

2.4.4 Macroinvertebrate Collection

2.4.4.1 Event 1 (June 21 and August 11, 2005)

The projected 200 count of organisms was not reached at the Coffee Creek site; only 139 organisms were collected.

2.4.4.2 Event 2 (February 7, 2006)

The projected 200 count of organisms was not collected from any site. The maximum number of organisms collected was 179 from the Reference Site. Only 43 organisms were collected from Coffee Creek below Mossy Lake.

2.4.4.3 Event 3 (June 6 and 8, 2006)

Only Coffee Creek reached the goal of a 200 organism count. The Reference Site only produced 10 organisms.

2.4.5 Habitat Assessment

2.4.5.1 Event 1 (June 21-22 and August 11, 2005)

Reference Site: The stream had no flow with water present in shallow separated pools. Habitat measurements were taken by University of Arkansas field crew.

2.4.5.2 Event 2 (February 2, 2006)

In-stream values at Coffee Creek below Mossy Lake were estimated due to the elevated stage of the creek.

2.4.5.2 Event 3 (June 6 and 8, 2006)

Coffee Creek flow data were not measured. Pictures show that the stage was approximately the same as the first two events when flow was calculated at approximately 15 cubic feet per second (cfs).

Coffee Creek below Mossy Lake flow data were not measured. Pictures show that the stage was close to the first event.

SECTION 3
RESULTS AND DISCUSSION

3.1 USE ATTAINABILITY ANALYSIS RESULTS

The field data sheets for the macroinvertebrate and fish collection are located in Appendices I and J, respectively.

Reference Site

A. Fish Data

The first event for fish at the Reference Site occurred on June 21, 2005 and produced the most number and highest diversity of any site for the entire sampling period. Fish were collected using a backpack electro-shocker by Layher Biologics field crew. Fish were field identified and released on site. The field data sheets, located in Appendix J, provide species name, total length, and weight. For the three sampling events, there were a limited number of fish caught, identified and measured for length and weight. Although it is considered a deviation from the QAPP, the field biologist often made a judgment decision to not record the associated length and/or weight during sampling events with limited fish collection. In some cases, only the fish species was recorded and neither the weight nor length was recorded. The recorded fish measurements are provided in Appendix J on the field data sheets.

There were 301 total fish from 15 different species. The majority of fish, 202, were mosquito fish (Figure 3.1). The other species with high numbers were grass pickerel, 25, Mississippi silvery minnow, 16, bantam sunfish, 14, and golden topminnow, 13. There were two key species (grass pickerel and longear sunfish) and two indicator species (pirate perch and banded pygmy sunfish) collected. There was also a species of concern, the bluehead shiner (*Pteronotropis hubbsi*), four of which were captured (AGFC, personal correspondence). The bluehead shiner is of concern because it occurs in the Ouachita and Red River basins in Arkansas, and has been listed as imperiled in Louisiana and other states. The bluehead shiner is thought to spawn in the sloughs and oxbows of the Ouachita River and to use the main channel of the river for migratory movement.

Figure 3.1 Mosquito Fish

The second event for fish at the Reference Site occurred on February 2, 2006 after a long dry period, but shortly after a rain that had filled the creek. Only two fish were collected during the second event, and both were mosquito fish. The extremely low number of fish collected during the second event was likely due to the dry weather leading up to the sampling period. There was not enough time for fish to come back into the sampling area after the area had dried out completely.

The third event for fish at the Reference Site occurred on June 8, 2006. The numbers and diversity were lower than the first event but higher than the second event, with 23 individuals and five species. The sample included 14-fliers, 5-mosquito fish, 2-pugnose minnows, a chain pickerel (Figure 3.2), and a golden top minnow.

Figure 3.2 Chain Pickerel

B. Macroinvertebrate Data

The first event for macroinvertebrates at the Reference Site occurred on June 21, 2005 and, like the first fish collection, produced the highest taxa richness of the entire study. Taxa richness was 13. A total of 200 organisms were selected by ring toss for identification. The sample was dominated by two groups. The most dominant was *Diptera chironomidae tanypodinae*, a blood worm. The second most dominant was *Coleoptera gyrinidae gyrinus*, better known as a whirligig beetle. These two taxa comprised 47.5 percent and 40.5 percent of the sample, respectively. Lists of macroinvertebrate collected are in Appendix I.

The second event for macroinvertebrates at the Reference Site occurred on February 7, 2006. The sample in this event was dominated by amphipods, scuds, which comprised 82 percent of the sample. The overall numbers in the sample were too low to get the targeted 200 organisms, so the sample was completely picked and 179 organisms were identified. Taxa richness was eight.

The third event for macroinvertebrates at the Reference Site occurred on June 6, 2006. The distinguishing factor in this sampling event was the low number of individuals recovered. A normal and thorough sampling of the reach produced only 10 individual organisms. For having only 10 individuals, the sample was rather diverse with a taxa richness of six.

C. Habitat Data

The first event for habitat at the Reference Site occurred on June 21, 2005. The stream was very low with no flow, and water was only present in divided pools less than approximately 20 inches deep. The Rapid Habitat score was 94 out of a possible 200. The low water level contributed to the low habitat score, but the lack of bank stability and protection and instream habitat also contributed to the low score. The ADEQ fish habitat method produced a habitat score of 16.1, which is low, and an Ichthyofauna Habitat Index (IHI) of 57.2 for pools. No riffle or run habitat was identified.

The second event for habitat at the Reference Site occurred on February 7, 2006. This event represented the highest habitat scores for the Reference Site. The presence of flow at the site brought about an increase in all of the Rapid Habitat parameters, resulting in a score of 139. The ADEQ fish habitat method produced a habitat score of 46.7 for pool habitat and 40.2 for run habitat, with a pool IHI score of 87.3 and a run IHI score of 19.8. Flow was recorded as 0.92 cfs.

The third event for habitat at the Reference Site occurred on June 6, 2006. The flow at the site was non-existent, with water present in divided pools. The Rapid Habitat score was 116. The ADEQ fish habitat method produced a habitat score of 21.5 for pool habitat, and 22.5 for run habitat, with a pool IHI score of 91 and a run IHI score of 1.5.

More details on habitat scores are included in Appendix J.

Coffee Creek

A. Fish Data

The first event at the Coffee Creek site occurred from August 10 to August 11, 2005. The electro-shocking could not be used due to the high conductivity of the water, so seining was initially attempted. After 12 seine-passes no fish had been captured, so two hoop nets were set overnight. One spotted gar was collected with the two hoop nets. DO data from the data sonde in the days leading up to the sampling were near 0 milligrams per liter (mg/L), so the small number of fish collected was not unexpected. All fish sampling efforts were conducted by Layher Biologics field crew.

The second event at the Coffee Creek site occurred from February 7 to February 8, 2006. Two hoop nets were deployed along with two fyke nets to capture smaller fish. One bullhead catfish (Figure 3.3) and one red-ear slider turtle were collected with the two hoop nets. The two fyke nets produced six Mosquito Fish and one Bluegill Sunfish.

The third event at the Coffee Creek site occurred from June 7 to June 8, 2006. Two hoop nets and two fyke nets were deployed and left overnight. One spotted gar (Figure 3.4) was captured in the two hoop nets, and three mosquito fish were captured in the two fyke nets.

For the three sampling events, a limited number of fish were caught, identified and measured for length and weight. Although it is considered a deviation from the QAPP, the field biologist often made a judgment decision to not record the associated length and/or weight during sampling events with limited fish collection. In some cases, only the fish species was recorded and neither the weight nor length was recorded. The recorded fish measurements are provided in Appendix J on the field data sheets.

Figure 3.3 Bullhead Catfish

Figure 3.4 Spotted Gar

B. Macroinvertebrate Data

The first event for macroinvertebrates at the Coffee Creek site occurred on August 11, 2006. The diversity of the sample was second highest for the first sampling event among the sites. The sample was dominated by *Diptera chironomidae tanypodinae*, a blood worm, which comprised 83 percent of the sample. The target number was 200; however, even though the sample was picked completely, only 139 individuals were found. Taxa richness was nine.

The second event for macroinvertebrates at the Coffee Creek site occurred on February 7, 2006. Numbers and diversity in the sample were lower than the first event. Again *Diptera chironomidae tanypodinae* dominated the sample, comprising 78 percent. The next dominant group in the sample was *Annelid oligochaeta*, a sludge worm, comprising 14 percent of the sample. Taxa richness was six.

The third event for macroinvertebrates at the Coffee Creek site occurred on June 6, 2006. *Diptera chironomidae tanypodinae* again dominated the sample, comprising 97 percent. The only other groups present were snails (*Physidae*) at 2 percent, and *Oligochaets* at 1 percent. A total of 223 individuals were collected and identified.

C. Habitat Data

The first habitat event at the Coffee Creek Site occurred on August 11, 2005. The creek at this site is a braided channel with two main channels and multiple small channels. Fish, macroinvertebrate, and habitat measurements were taken from one of the main braids. The Rapid Habitat score was 149 out of 200. Because of the volume of water contributed by the GP discharge, the creek flowed at bankfull at all times, which contributed to the high habitat score. The ADEQ fish habitat method produced a run

habitat score of 45.5 and a run IHI of 97.1. Flow was calculated as 15.7 cfs, and seemed to be constant throughout the project time period.

The second habitat event at the Coffee Creek site occurred on February 7, 2006. The Rapid Habitat score was 167 out of 200. The ADEQ fish habitat method produced a run habitat score of 47.5 and a run IHI of 94.1. Flow was calculated as 15.5 cfs. See Figure 3.5.

The third habitat event at the Coffee Creek site occurred on June 6, 2006. The Rapid Habitat score was 164 out of 200. The ADEQ fish habitat method produced a run habitat score of 38.5 and a run IHI of 63.1. Stage was approximately the same as the first two events. Figures 3.5 and 3.6 are the same site, but during midwinter and late spring, respectively.

Figure 3.5 Coffee Creek Braids Mid-Winter

Figure 3.6 Coffee Creek Braids Late-Spring

Mossy Lake

A. Fish Data

The first fish event at Mossy Lake occurred from August 10 to August 11, 2005. Three fyke nets and one gill net were deployed. The gill net produced zero fish and two of the fyke nets were also empty. The third fyke net contained five spotted gar and two turtles. The data sonde deployment that occurred the days leading up to the fish collection showed extremely variable DO that held below 0.3 mg/L most of the time.

The second fish event at Mossy Lake occurred from February 7 to February 8, 2006. Fyke nets and a gill net were again deployed. The variability of the species was higher than the second event, although the total number of fish was the same. There were five fish and five different species: bluegill, warmouth (key specie), dollar sunfish, swamp darter, mosquito fish. Figure 3.7 is a photo of a warmouth (lower left) and a dollar sunfish.

The third fish event at Mossy Lake occurred from June 7 to June 8, 2006. Fyke nets and a gill net were again deployed. The total number of fish was the same as the first two events, five, with two different species: four spotted gar and one common carp.

For the three sampling events, there were a limited number of fish caught, identified and measured for length and weight. Although it is considered a deviation from the QAPP, the field biologist often made a judgment decision to not record the associated length and/or weight during sampling events with limited fish collection. In some cases, only the fish species was recorded and neither the weight nor length was recorded. The recorded fish measurements are provided in Appendix J on the field data sheets.

Figure 3.7 Warmouth

B. Macroinvertebrate Data

The first event for macroinvertebrates at Mossy Lake occurred on August 11, 2005. When random sampling by ring toss was completed, 210 individuals were selected. The dominant group in the sample was *Diptera chironomidae tanypodinae*, a blood worm, which comprised 95.2 percent of the sub-sample. Taxa richness was six.

The second event for macroinvertebrates at Mossy Lake occurred on February 7, 2006. A total of 119 organisms were collected and identified. Despite finding a lower-than-targeted number of organisms, the diversity of the sample was comparatively high. Taxa richness was 11 with the dominant group, an Isopod, comprising 33.6 percent of the sample. Other common groups were: *Coleoptera dytiscida*e or predaceous diving beetles, 16.8 percent, *Diptera stratiomyidae* or soldier flies, 15.1 percent, and *Diptera chironomidae tanypodinae*, 12.6 percent.

The third event for macroinvertebrates at Mossy Lake occurred on June 8, 2006. A total of 96 individuals were collected on this event. *Tanypodinae* made up 82.3 percent of the sample, while *Physidae* snails made up 11.5 percent. Taxa richness was five.

C. Habitat Data

Mossy Lake habitat was assessed using a wetlands rapid assessment method. Also, observations were made as to the animals utilizing the area under its current conditions. With the wetland rating used, Mossy Lake was classified as a riverine wetland and ranked as a two on a scale from one to four, with one being the highest. There is a large portion of the lake that appears to be an old oxbow lake. There are also remnants of a large area of cypress trees that are now mostly dead and dying. See Figure 3.8.

Figure 3.8 Mossy Lake

Coffee Creek below Mossy Lake

A. Fish Data

The first event for fish at Coffee Creek below Mossy Lake occurred from June 21 to June 22, 2005. Due to the high conductivity of the water, electro-shocking could not be used to collect fish. Seining also proved to be difficult because of high water velocity and the large number of submerged logs. Six hoop nets were deployed and left over night. A total of 35 fish were collected and comprised six different species. The most abundant was the blue catfish, with 14 individuals. Gar, bowfin (Figure 3.9), and mosquito fish comprised the rest of the sample. One species of concern was collected, a young alligator gar (AGFC, personal correspondence). The individual was of special interest because it was very small for an alligator gar, which means that the species is reproducing in that area of the Ouachita River.

The second event for fish at Coffee Creek below Mossy Lake occurred from February 7 to February 8, 2006. River stage was high so deployment of the nets was limited to near-bank. Three hoop nets and two fyke nets were deployed. A total of 33 fish and eight different species were collected. This was the most diverse sample from this site. Again, blue catfish dominated the sample with nine individuals. White crappies were second in abundance with seven individuals. Gizzard shad were next with five, bowfin and black crappie each had four individuals. From the fyke nets, one flier (indicator specie), one slough darter (key specie), and two Mississippi silvery minnows were collected.

The third event for fish at Coffee Creek below Mossy Lake occurred from June 7 to June 8, 2006. Three hoop nets and two fyke nets were deployed. There were 21 individuals in the sample and three species. Blue catfish dominated the sample with 11 individuals; common carp were second with eight, and there were two spotted gar.

For the three sampling events, there were a limited number of fish caught, identified and measured for length and weight. Although it is considered a deviation from the QAPP, the field biologist often made a judgment decision to not record the associated length and/or weight during sampling events with limited fish collection. In some cases, only the fish species was recorded and neither the weight nor length was recorded.

Figure 3.9 Bowfin

B. Macroinvertebrate Data

The first event for macroinvertebrates at Coffee Creek below Mossy Lake occurred on June 21, 2005. A 200 individual sub-sample was taken. *Diptera chironomidae tanypodinae* comprised 98.5 percent of the sample. Two other organisms were present in the sub-sample; two *Annelid hirudinea*, and one *Coleoptera gyrinidae gyrinus*.

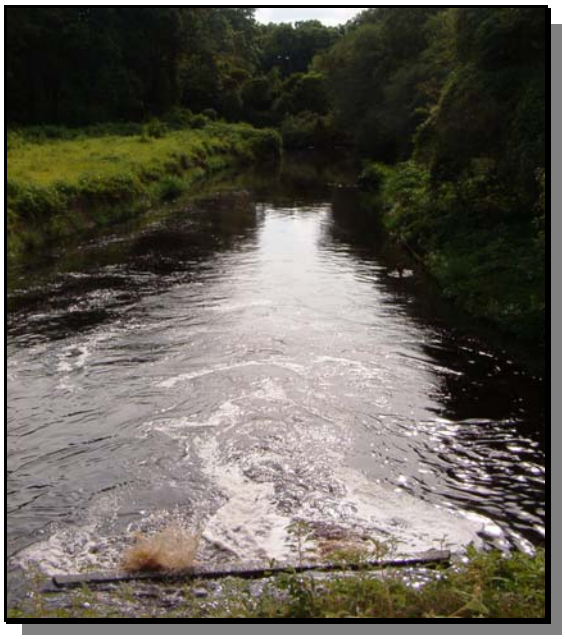
The second event for macroinvertebrates at Coffee Creek below Mossy Lake occurred on February 7, 2007. Because the Ouachita River stage was elevated, samples were taken from the bank. The same sampling effort was used as for other events. Only 43 individuals were found when the sample was picked in the lab. Despite the low numbers, the diversity was much higher than the first event with a taxa richness of nine. The dominant taxa were *Coleoptera dytiscidae*, 44.2 percent. *Diptera chironomidae tanypodinae* comprised 20.9 percent of the sample, and *Diptera stratiomyidae* comprised 11.6 percent.

The third event for macroinvertebrates at Coffee Creek below Mossy Lake occurred on June 8, 2006. A total of 147 individuals were collected. There were only three different taxa, and all three were *Diptera*. The most abundant was *Diptera chironomidae tanypodinae* with 93.2 percent of the sample. The other two were *Diptera stratiomyidae*, 6.1 percent, and *Diptera culicidae*, 0.7 percent.

C. Habitat Data

The first event for habitat at the Coffee Creek below Mossy Lake site occurred on June 22, 2005 (Figure 3.10). The habitat along the reach was fairly homogenous with high banks and constant flow. The Rapid Habitat score was 123 out of a possible 200. ADEQ fish habitat method produced a habitat score of 30.3 for pool habitat and 36.2 for run habitat, with a pool IHI score of 63.3 and a run IHI score of 119.1. Flow was calculated as 41.7 cfs.

Figure 3.10 Coffee Creek below Mossy Lake Discharge



The second event for habitat at the Coffee Creek below Mossy Lake site occurred on February 7, 2006. The Rapid Habitat score was 132. The ADEQ fish habitat method produced a habitat score 44.3 and an IHI of 79.9 for run habitat. Stage was elevated from the Ouachita River so instream values were estimated.

The third event for habitat at the Coffee Creek below Mossy Lake site occurred on June 8, 2006. The Rapid Habitat score was 131. ADEQ fish habitat method produced a habitat score of 39.5 for pool habitat and 33.5 for run habitat, with a pool IHI score of 19.4 and a run IHI score of 65.4.

3.1.1 Summary Results of Biotic and Habitat Data

The biotic sampling and habitat monitoring results suggested that these sites have the potential to support aquatic life (Table 3.1). The results indicate that the sites were strongly influenced by seasonal flows, especially flooding, and that the high biotic measurements in the first event were likely the residual of recruitment to Coffee Creek and Mossy Lake from the receding floodwaters of the Ouachita River (Table 3.1). The Mossy Lake/Coffee Creek system is complex hydrologically because of the yearly flood pulse of the Ouachita River. This pulse dominates the habitat availability and is what typically dictates the viability of the aquatic community. The analysis of topographic maps with the Ouachita River stage data shows that Mossy Lake and Coffee Creek up to

the abandoned railroad trestle would be inundated almost every year by flood water. Many years in the past decade there have been flood waters that have reached all of the way up to the Reference Site. Apart from the frequency of flood waters the watershed size of Coffee Creek indicates that in the absence of GP effluent there would likely be water and subsequently aquatic life present throughout most of the year.

The RBP habitat scores for both Coffee Creek and Coffee Creek below Mossy Lake were higher than the scores at the Reference Site for all events with the exception of Coffee Creek below Mossy Lake during Event 2. The elevation of habitat scores in relation to the Reference Site was due primarily to the amount of flow provided by the GP discharge. In the absence of the GP discharge, the habitat scores at the two sites would have been slightly lower yet still comparable to the Reference Site scores.

The RBP habitat score Comparability Measure (%) shown in Table 3.1 below compares the habitat quality of Coffee Creek and Coffee Creek below Mossy Lake to the habitat quality in the Reference Site stream for each of the three field survey events. The Reference Site is given a Comparability Measure score of 100 percent. Comparability Measures for the other two sites indicate a relatively better (above 100%) habitat quality primarily due to more stream flow. Higher quality bank stability and vegetative protection within the riparian zone of Coffee Creek relative to the Reference Site stream also contributed Coffee Creek's higher habitat score. Coffee Creek below Mossy Lake received a lower habitat score in Event 2 than the Reference Site stream partially due to poorer bank stability and vegetative protection scores.

Table 3.1 Summary of Biotic Data and Scores from the Habitat Assessments

Event	Metric	Ref	CC	ML	CCBML
1	# Fish (individuals)	301	1	5	35
	Fish Taxa Richness	15	1	1	6
	# Macroinvertebrates (individuals)	200	139	210	200
	Macroinvertebrate Taxa Richness	13	9	6	3
	Flow (cfs)	0	15.7	NA	41.7
	RBP Habitat Score	94	149	NA	123
	RBP Comparability Measure (%)	100	159	NA	131
	Wetland Score	NA	NA	55	NA
	ADEQ IHI Score (Pool)	57.2	NA	NA	63.3
	ADEQ IHI Score (Riffle)	NA	NA	NA	NA
	ADEQ IHI Score (Run)	NA	97.1	NA	119.1
2	# Fish (individuals)	2	8	5	33
	Fish Taxa Richness	1	3	5	8
	# Macroinvertebrates (individuals)	179	95	119	43
	Macroinvertebrate Taxa Richness	8	6	11	9
	Flow (cfs)	0.92	15.5	NA	NR
	RBP Habitat Score	139	167	NA	132
	RBP Comparability Measure (%)*	100	120	NA	95
	Wetland Score	NA	NA	56	NA
	ADEQ IHI Score (Pool)	87.3	NA	NA	NA
	ADEQ IHI Score (Riffle)	NA	NA	NA	NA
	ADEQ IHI Score (Run)	19.8	94.1	NA	79.9
3	# Fish (individuals)	23	4	5	21
	Fish Taxa Richness	5	2	2	3
	# Macroinvertebrates (individuals)	10	223	96	147
	Macroinvertebrate Taxa Richness	6	3	5	3
	Flow (cfs)	0	~ 15	NA	NR
	RBP Habitat Score	116	164	NA	131
	RBP Comparability Measure (%)*	100	141	NA	113
	Wetland Score	NA	NA	52	NA
	ADEQ IHI Score (Pool)	91.0	NA	NA	19.4
	ADEQ IHI Score (Riffle)	NA	NA	NA	NA
	ADEQ IHI Score (Run)	1.5	63.1	NA	65.4

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3.2 WATER QUALITY ASSESSMENT RESULTS

Results for the Ouachita River were compared to the numeric criteria in Arkansas Pollution Control and Ecology Commission Regulation 2 (SWQS), amended April 28, 2006. The Reference Site, Coffee Creek, and Mossy Lake are exempt from Regulation 2, Chapter 5 specific standards, and the color standard. Nevertheless, laboratory results from these three water bodies were compared to the Gulf Coast Eco-Region (GCER) surface water quality standard. Parameters that did not conform to

criteria as defined by Regulation 2 are shown in Tables 3.2, 3.5, 3.7, 3.9, and 3.12. Laboratory results using the sediment samples were compared to either the USEPA's *Toxicology Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment-Associated Biota: 1997 Revision* or *National Sediment Quality Survey 2004*.

A summary of all results is included in Appendix C, Water and Sediment Laboratory Results Summary. The complete laboratory reports for the five sampling events are included in Appendices D through H.

3.2.1 Sample Event One

Event 1 occurred from August 8 through 11, 2005. The water surface elevation downstream of the Felsenthal Lock and Dam on the Ouachita River ranged from 52.67 to 52.60 feet mean sea level (msl).

During Sample Event 1, twenty-six test parameter results were outside of Arkansas' SWQS or the GCER SWQS (Table 3.2). These exceedances were:

- Dissolved Oxygen (DO) in the Reference Site stream, Coffee Creek, Mossy Lake, and the downstream site of the Ouachita River;
- Temperature in Coffee Creek, Mossy Lake, and the Ouachita River upstream and downstream;
- Turbidity, chloride, and total dissolved solids (TDS) in Coffee Creek, and Mossy Lake;
- Sulfate in the Reference Site, Coffee Creek, and Mossy Lake
- Mercury in Coffee Creek;
- *P. promelas* chronic water toxicity test failure for the Reference Site and the downstream Ouachita site.
- Sediment cadmium in Mossy Lake;
- the semivolatile organics anthracene and fluoranthene in the sediments of Coffee Creek; and
- *C. dubia* reproduction toxicity tests for Coffee Creek and the Ouachita River, both upstream and downstream sites.

Table 3.2 Water and Sediment Chemistry Parameters Outside Regulatory Constraints in the Ouachita River/Coffee Creek/Mossy Lake System, Sample Event 1, August 9, 2005

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/ SWQS
DO	mg/L	0.1	0.0	0.2		3.8	2/3/4.5[a]
Temperature	°C		34.5	38.4	32.8	33.1	30/32[b]
Turbidity	NTU		64.4	117.0			21 (32[c])
Chloride	mg/L		194	203			14/160
Sulfate	mg/L		461	384			31/40
TDS	mg/L	165	1900	1580			123/350
Mercury	µg/L		0.016				0.012
Water Chronic Toxicity Test Failure:	NA	X				X	Failure

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/ SWQS
P. promelas							
Sediment: Cadmium	mg/kg			1.0			0.592[d]
SVOC: Anthracene	µg/kg		371				31.62[d]
SVOC: Fluoranthene	µg/kg		150				64.23[d]
Sediment: Chronic Toxicity: *C. dubia* Reproduction	NA		X		X	X	Failure

[a] *The 2 mg/L DO criterion applies to data collected from the Reference Site. The 3 mg/L DO criterion applies to data collected from the Coffee Creek and Mossy Lake sites. The 4.5 mg/L DO criterion applies to data collected from the two Ouachita River sites.*
[b] *The temperature criterion of 30ºC applies to data collected from the reference and Coffee Creek sites. The temperature criterion of 32ºC applies to data collected from the Mossy Lake and two Ouachita River sites.*
[c] *SWQS - base flow criterion (21 NTU) and a storm flow criterion (32 NTU)*
[d] *Benchmark screening value for sediment.*

Color and bacteria samples were also collected. The laboratory results are provided in Table 3.3.

Table 3.3 Color and *E. coli* Data

Sampling Site	True Color (units)	Apparent Color (units)	*E. coli* (cfu/10 mL)
Reference Site	49	227	NA
Coffee Creek	853	1483	NA
Mossy Lake	700	1306	NA
Ouachita River Upstream	21.9	58.7	90
Ouachita River Downstream	38.6	85.2	68

The color data indicates the Georgia Pacific discharge increases the river water color at the downstream Ouachita River station. Conversely, the *Escherichia coli* (*E. coli)* bacteria count is diluted by the Georgia Pacific discharge.

Sediment samples were partitioned by sieve to determine the percent silt, sand, and clay. The results are presented in Table 3.4. No gravel was detected.

Table 3.4 Sediment Sample Sieve Analysis

Sampling Site	% Silt	% Sand	% Clay
Reference Site	45.37	25.68	28.95
Coffee Creek	4.47	85.78	9.75
Mossy Lake	59.77	8.96	31.27
Ouachita River Upstream	4.38	94.03	1.59
Ouachita River Downstream	14.22	80.25	3.53

Sand was the dominate sediment in Coffee Creek and the two Ouachita River sites. Silt was the dominate sediment in the Reference Site and Mossy Lake.

3.2.2 Sample Event Two

Event 2 occurred from October 17 through 20, 2005. The Ouachita River water surface elevation downstream of the Felsenthal Lock and Dam ranged from 52.54 to

52.37 feet msl. The weather was cool and clear. Water in the Reference Site stream was slightly turbid, cool, and contained abundant aquatic vegetation.

During Sample Event 2, nineteen test parameter results were outside regulatory acceptable ranges (Table 3.5). These were:

- DO in the Reference Site stream, Coffee Creek, and Mossy Lake;
- Turbidity in Coffee Creek and Mossy Lake;
- Ammonia-nitrogen in Coffee Creek
- Chloride in the Reference site stream, Coffee Creek and Mossy Lake;
- TDS in the Reference Site, Coffee Creek, and Mossy Lake;
- Sulfate in Coffee Creek and Mossy Lake;
- *C. dubia* reproduction toxicity tests in the Ouachita River, both upstream and downstream; and
- *P. promelas* chronic toxicity tests in the Reference Site stream, Coffee Creek, and the Ouachita River downstream site.

Table 3.5 Water Chemistry Parameters Outside Regulatory Constraints in the Ouachita River/Coffee Creek/Mossy Lake System, Sample Event Two, October 17-20, 2005

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/ SWQS
DO	mg/L	0.29	0.05	0.00			3/5[a]
Turbidity	NTU		56	84.5			21 (32[b])
Ammonia-N	mg/L		4.62				1.56 (pH = 8.93)
Chloride	mg/L	16	199	198			14 / 160
Sulfate	mg/L		345	400			31 / 40
TDS	mg/L	242	1460	1720			123 / 350
Chronic Toxicity: *C. dubia* Reproduction	NA				X	X	Failure
Chronic Toxicity: *P. promelas*	NA	X	X			X	Failure

[a] *The 3 mg/L DO criterion applies to data collected from the Coffee Creek and Mossy Lake sites. The 5 mg/L DO criterion applies to data collected from the Reference Site and the two Ouachita River sites.*

[b]*SWQS - base flow criterion (21 NTU) and a storm flow criterion (32 NTU)*

Color and bacteria laboratory results are provided in Table 3.6.

Table 3.6 Color and *E. coli* Data

Sampling Site	True Color (units)	Apparent Color (units)	*E. coli* (cfu/10 mL)
Reference Site	112	187	NA
Coffee Creek	796	1440	NA
Mossy Lake	726	1457	NA
Ouachita River Upstream	19.4	36.6	<10
Ouachita River Downstream	41.1	88.6	<10

The color data indicates the Georgia Pacific discharge increases the river water color at the downstream Ouachita River station.

3.2.3 Sample Event Three

Event 3 occurred from December 12 through 14, 2005. The Ouachita River water surface elevation downstream of the Felsenthal Lock and Dam ranged from 52.40 to 52.41 feet msl.

During Sample Event 3, twenty-one test parameter results were outside regulatory acceptable ranges (Table 3.7). These were:

- DO in the Reference Site stream, Coffee Creek, and Mossy Lake;
- Turbidity in Coffee Creek and in Mossy Lake;
- Chloride in the Reference Site, Coffee Creek, and Mossy Lake;
- Sulfate in the Reference Site stream, Coffee Creek, and Mossy Lake;
- TDS in the Reference Site, Coffee Creek, and Mossy Lake.
- Mercury in Coffee Creek;
- *C. dubia* reproduction toxicity tests in Coffee Creek, Mossy Lake, and the upstream Ouachita River site; and
- *P. promelas* chronic toxicity tests in Coffee Creek, Mossy Lake, and the upstream Ouachita River site.

Table 3.7 Water Chemistry Parameters Outside Regulatory Constraints in the Ouachita River/Coffee Creek/Mossy Lake System, Sample Event Three, December 13-14, 2005

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/ SWQS
DO	mg/L	1.69	0.15	0.01			5
Turbidity	NTU		73	88			21 (32*)
Chloride	mg/L	16	167	184			14/160
Sulfate	mg/L	79	413	381			31/40
TDS	mg/L	358	1650	1640			123/350
Mercury	µg/L		0.0169				0.012
Chronic Toxicity: *C. dubia* Reproduction	NA		X	X	X		Failure
Chronic Toxicity: *P. promelas*	NA		X	X	X		Failure

**SWQS - base flow criterion (21 NTU) and a storm flow criterion (32 NTU)*

Color and bacteria laboratory results are provided in Table 3.8.

Table 3.8 Color and *E. coli* Data

Sampling Site	True Color (units)	Apparent Color (units)	*E. coli* (cfu/10 mL)
Reference Site	91	136	NA
Coffee Creek	825	1220	NA
Mossy Lake	690	1318	NA
Ouachita River Upstream	15.6	41	<10
Ouachita River Downstream	21.5	55.4	<10

The color data indicates the Georgia Pacific discharge increases the river water color at the downstream Ouachita River station.

3.2.4 Sample Event Four

The Ouachita River elevation during Event 4 from May 15 through 16, 2006 was 62.81 to 62.35 feet. The river begins flowing into Mossy Lake through the outfall structure at 62 feet msl. Figure 3.11 depicts the river with the water elevation above 70 ft. msl. The photo was taken the previous year during reconnaissance.

Figure 3.11 River Water Flowing into Mossy Lake

Thirty-eight test parameter results from samples taken during Event 4 were outside regulatory acceptable ranges (Table 3.9). These were:

- DO in Reference Site stream, Coffee Creek, and Mossy Lake;
- Turbidity in Coffee Creek, Mossy Lake, and Ouachita River (downstream);
- Ammonia-nitrogen in Coffee Creek;
- Chloride in the Reference Site stream, Coffee Creek, and in Mossy Lake;
- Sulfate in Coffee Creek and Mossy Lake;

- TDSs in Reference Site stream, Coffee Creek and Mossy Lake;
- Mercury in Reference Site stream;
- Cadmium in the sediment taken from the Reference Site stream, Coffee Creek, Mossy Lake, and the upstream Ouachita River;
- Mercury in the sediment taken from the Reference Site stream;
- Fluoranthene in the sediment taken from the Coffee Creek site;
- *C. dubia* reproduction water toxicity tests failures in Reference Site stream and Mossy Lake;
- *P. promelas* chronic water toxicity tests failure in Coffee Creek and Mossy Lake;
- *C. dubia* reproduction sediment toxicity tests failures for all sites;
- *C. dubia* mortality sediment toxicity tests failures in Coffee Creek, Mossy Lake, and the Ouachita River upstream and downstream sites; and
- *P. promelas* chronic sediment toxicity tests failures in Coffee Creek, Mossy Lake, and the Ouachita River downstream sites.

Table 3.9 Water and Sediment Chemistry Parameters Outside Regulatory Constraints in the Ouachita River/Coffee Creek/Mossy Lake System, Sample Event Four, May 15-16, 2006

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/ SWQS
DO	mg/L	1.5	0.13	0.08			2/3/5[a]
Turbidity	NTU		65	45.5		24	21 (32[b])
Ammonia-N	mg/L		6.55				5.11 (pH= 8.26)
Chloride	mg/L	55	161	154			14/160
Sulfate	mg/L		348	284			31/40
TDS	mg/L	332	1600	1330			123/350
Mercury	µg/L	0.0189					0.012
Sediment: Cadmium	mg/kg	0.9	1.0	1.4	1.0[c]		0.592[d]
Sediment: Mercury	mg/kg	0.8					0.2[d]
Sediment: Fluoranthene	µg/kg		76.9				64.23[d]
Water Toxicity: *C. dubia* Reproduction	NA	X	e	X	e	e	Failure
Water Toxicity: *P. promelas* chronic	NA		X	X	e		Failure
Sediment Chronic Toxicity: *C. dubia* Reproduction	NA	X	X	X	X	X	Failure

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/ SWQS
Sediment Acute Toxicity: *C. dubia* Mortality	NA		X	X	X	X	Failure
Sediment Chronic Toxicity: *P. promelas*	NA		X	X		X	Failure

[a]*The 2 mg/L DO criterion applies to data collected from the reference site. The 3 mg/L DO criterion applies to data collected from the Coffee Creek and Mossy Lake sites. The 5 mg/L DO criterion applies to data collected from the two Ouachita River sites.*

[b]*SWQS - base flow criterion (21 NTU) and a storm flow criterion (32 NTU).*

[c]*The cadmium concentration was lower in the downstream Ouachita site than in the up stream site. The samples may have been mislabeled or misreported.*

[d]*Benchmark screening value for sediment.*

[e] *.# The EPA Houston Lab determined the sample was toxic. The data was re-analyzed using ToxStat 3.5 that found the sample to be non-toxic. Therefore, the result is reported as inconclusive..*

Color and bacteria laboratory results are provided in Table 3.10.

Table 3.10 Color and *E. coli* Data

Sampling Site	True Color (units)	Apparent Color (units)	*E. coli* (cfu/10 mL)
Reference Site	82	193.7	NA
Coffee Creek	1031.9	1160.3	NA
Mossy Lake	822.6	882.6	NA
Ouachita River Upstream	99.1	148.6	3.0
Ouachita River Downstream	108.1	136.6	4.0

The color data indicates the Georgia Pacific discharge increases the river water color at the downstream Ouachita River station. Conversely, the *E. coli* bacteria count is diluted by the Georgia Pacific discharge.

Sediment samples were partitioned by sieve to determine the percent silt, sand, and clay. The results are presented in Table 3.11. No gravel was detected.

Table 3.11 Sediment Sample Sieve Analysis

Sampling Site	% Silt	% Sand	% Clay
Reference Site	42.35	38.88	18.78
Coffee Creek	11.81	77.21	11.61
Mossy Lake	29.97	50.18	19.84
Ouachita River Upstream	21.0	57.59	21.41
Ouachita River Downstream	14.45	74.72	10.83

Sand was the dominate sediment in Coffee Creek, Mossy Lake, and the two Ouachita River sites. Silt was the dominate sediment in the Reference Site.

3.2.5 Sample Event Five

The Ouachita River water surface elevation during Event 5 from June 4 through 6, 2006 was 54.15 to 53.82 feet. During Sample Event 5, twenty-three test parameter results were outside regulatory acceptable ranges (Table 3.12). These were:

- DO in the Reference Site stream Coffee Creek, and Mossy Lake;
- Temperature in Coffee Creek and Mossy Lake;
- Turbidity in the Reference Site stream, Coffee Creek, and Mossy Lake;
- Ammonia-nitrogen in Mossy Lake;
- Chloride in the Reference Site stream, Coffee Creek and Mossy Lake;
- Sulfate in Coffee Creek and Mossy Lake;
- TDSs in Reference Site stream, Coffee Creek and Mossy Lake;
- Mercury in the Reference Site stream;
- Zinc in Coffee Creek;
- *C. dubia* reproduction toxicity tests in Coffee Creek;
- *C. dubia* mortality toxicity tests in Coffee Creek; and
- *P. promelas* chronic toxicity tests in Coffee Creek and Mossy Lake.

Table 3.12 Water Chemistry Parameters Outside Regulatory Constraints in the Ouachita River/Coffee Creek/Mossy Lake System, Sample Event Five, June 6, 2006

Parameter	Unit	Reference Site	Coffee Creek	Mossy Lake	Ouachita (Upstream)	Ouachita (Downstream)	GCER/SWQS
pH	S.U.					[a]	6-9
DO	mg/L	0.0	0.0	0.23		[a]	2/3[b]
Temperature	°C		32.49	39.44			30/32[c]
Turbidity	NTU	24	40	49.7			21 (32[d])
Ammonia-N	mg/L			5.73			3.88 (pH=8.38)
Chloride	mg/L	50	160	147			14/160
Sulfate	mg/L		442	584			31/40
TDS	mg/L	320	1640	1840			123/350
Mercury	µg/L	0.0407					0.012
Zinc	ng/L		263				221 (hardness=242)
Chronic Toxicity: *C. dubia* Reproduction	NA		X				Failure
Acute Toxicity: *C. dubia* Mortality	NA		X				Failure
Chronic Toxicity: *P. promelas*	NA		X	X			Failure

[a]*Instrument failure produced arbitrary results.*

[b]*The 2 mg/L DO criterion applies to data collected from the reference site. The 3 mg/L DO criterion applies to data collected from the Coffee Creek, Mossy Lake, and the two Ouachita River sites.*

[c]*The temperature criterion of 30ºC applies to data collected from the reference and Coffee Creek sites. The temperature criterion of 32ºC applies to data collected from the Mossy Lake and two Ouachita River sites.*

[d]*SWQS - base flow criterion (21 NTU) and a storm flow criterion (32 NTU).*

Color and bacteria samples were also collected. The laboratory results are provided in Table 3.13.

Table 3.13 Color and *E. coli* Data

Sampling Site	True Color (units)	Apparent Color (units)	*E. coli* (cfu/10 mL)
Reference Site	156.3	131.3	NA
Coffee Creek	1075	922	NA
Mossy Lake	1273	932	NA
Ouachita River Upstream	64.9	48.7	32
Ouachita River Downstream	106.2	64.9	27

The color data indicates the Georgia Pacific discharge increases the river water color, with the exception of apparent color, at the downstream Ouachita River station. Conversely, the *E. coli* bacteria count is diluted by the Georgia Pacific discharge.

3.3 INTERPRETATION OF FINDINGS

Use attainability is assessed as a function of discrete chemical or biological events combined with trends based upon multiple events. There were both significant excursions from regulatory standards and trends supporting the interpretation of impairment during the sample events included in this study. Subsections 3.3.1 through 3.3.6 discuss the results of (1) the water and sediment chemistry analyses conducted, (2) the toxicity tests conducted, and (3) the biological and habitat data collected at each sampling station. Please note that the interpretations of lethal and sublethal effects on surrogate species is best described by event. Any connection of a specific chemical exceedance to toxicity events is not possible with the limited data collected under this scope of work. There are explicit methods for identifying probable toxicants within an environmental media, and those methods were outside the scope of this project.

3.3.1 Reference Site

Water and Sediment Chemistry

The primary water quality issue observed at the Reference Site was low DO. DO was typically above 3.0 mg/L, but was observed at less than 1.0 mg/L during three sample deployments. There were sporadic exceedances of chloride, sulfate, and TDS. Mercury was also detected above state water quality standards twice. Turbidity was above the state standard once due to rain events.

The most likely source of these contaminants is non-point source pollution or the GP effluent which can backup into the creek during flooding events where floodwaters exceed 75 feet msl. Sampling during Event 4 was during a flooding event. The small watershed contains a paved road and at least two houses, while most the land-use is managed pine forest (aerial photograph). The Reference Site stream also contained an over abundance of algae. The source of the nutrients may be from fertilizer or human/animal waste. Trash dumped into the creek may have contained some of these contaminants. The implication is non-point source pollution will likely continue into the future.

Toxicity Analysis

Toxicity tests indicated measurable toxic levels during three sampling events. Water from Event 1 was found to be chronically toxic to *P. promelas*. Field measurements and laboratory analysis of the water from the Reference Site did not identify a potential toxic concentration of any of the contaminants. The source of toxicity is unknown. Water from Event 2 was found to be acutely toxic to *P. promelas*. Again, no contaminant exceeded the GCER standards.

Sediment collected during Event 4 was found to be chronically toxic (reproduction) to *C. dubia*. The toxicity may have been caused by cadmium. Cadmium in the sediment was found above the benchmark value at all the sites except possibly the upstream Ouachita site. It appears the sample bottle labels or laboratory results for the two Ouachita River sites were reversed. All of the metals detected in the upper Ouachita Site were higher than the downstream Ouachita Site, which is inconsistent with the other event results. Therefore, the cadmium sediment benchmark exceedance is believed to have occurred at the downstream Ouachita Site.

Biological and Habitat

It is apparent from the biological and habitat data collected at the Reference Site that there was a viable biological community present. This biological community was highly dependent upon habitat that exhibits extreme seasonal variability (inundation flooding in the winter followed by dry conditions in the summer). The first event produced more individuals and higher diversity than subsequent events. This is likely due to the availability of habitat from seasonal variations in rainfall and the level of the Ouachita River. In the months leading up to the first event, the Ouachita River was flooded a majority of the time. For approximately 2 months, the river was over 70 feet msl and twice peaked close to 75 feet msl, which would have put the flood waters up to the Reference Site sampling reach. This shows that river species have the opportunity to use the area for breeding habitat and as a feeding ground during floods. This type of habitat is especially important to species like the bluehead shiner, which are restricted in their habitat and use the type of habitat provided by Coffee Creek for breeding.

3.3.2 Coffee Creek

Water and Sediment Chemistry

In Coffee Creek, DO was a major issue with levels rarely rising above 3 mg/L and mostly staying near 0 mg/L. Turbidity was also over state standards during all sampling events. Chloride, sulfate, and TDS were all over state standards for all samples. Temperature was above the state standard for two of the five sampling events. Ammonia and mercury were both above state standards during two sampling events. Zinc was also found above the state standard on one sampling event. Fluoranthene exceeded sediment benchmark values for sample Events 1 and 4, whereas anthracene exceeded sediment benchmark values for only sample Event 1. Cadmium exceeded its sediment benchmark value during sample Event 4.

Toxicity Analysis

There were negative toxicity results for either water or sediment for every sampling event conducted. The sediment sample from Event 1 exhibited sublethal effects to *C. dubia* (reproduction). Concentrations above sediment benchmarks of anthracene and fluoranthene were detected and may be the cause of this toxicity. The water sample from Event 2 was acutely toxic to *P. promelas*. The ammonia concentration, among others, may be the cause of this toxicity.

Water from Event 3 was acutely toxic to *P. promelas* and produced sublethal toxicity to *C. dubia*. The most probable cause of the toxicity is unknown.

Water from Event 4 produced sublethal toxicity to *C. dubia*. Ammonia in the water sample may be the cause of the sublethal effect to *C. dubia.* The sediment was acutely toxic to *P. promelas* and acutely and chronically toxic to *C. dubia,* which may have been caused by cadmium, but is uncertain.

Water from Event 5 was acutely toxic to both species. The data did not identify an obvious toxic parameter.

Biological and Habitat

The aquatic community in Coffee Creek exhibits the expected characteristics of an impaired system. Low fish numbers and diversity were not out of place given the quality of water at the site. The macroinvertebrate community was also what would be expected from an impaired system, with tolerant species, *Diptera* and *Annelid*, making up the bulk of the population. It is difficult to conjecture on the probable state of the system in the absence of the GP effluent since the effluent is the dominant input to the stream at almost all times. It can be assumed that due to the low gradient nature of the system and the size of the watershed compared to the upstream Reference Site, there would be residual pools throughout the dry portions of the year that would allow for organisms to recruit out of these areas when flows were higher. Also, this area would be regularly inundated by the Ouachita River and provide areas for spawning and feeding by species such as the bluehead shiner.

3.3.3 Mossy Lake

Water and Sediment Chemistry

Dissolved oxygen standards were exceeded during all sampling events. Turbidity was also exceeded in all sample events. Temperature was exceeded in two of the five sampling events, and during periods of intense sunshine reached peaks of over 35 degrees Celsius (°C) and almost reached 40°C during two events. Chloride, TDS and sulfate standards were exceeded in all samples. The ammonia standard was exceeded once and sediment cadmium twice.

Toxicity Analysis

The water sample from Events 3 and 4 produced chronic toxicity to *C. dubia* and *P. promelas*. Water from Event 4 produced chronic *C. dubia* and P. promelas. No obvious cause of the toxicity was observed in the data. Sediment from Event 4 also produced lethal effects to *C. dubia* and chronic toxicity to *C. dubia* and *P. promelas,* which may

have been caused by cadmium. The water sample from Event 5 was chronically toxic to *P. promelas*. The concentration of ammonia-nitrogen was 5.73 mg/l and could have been the source of the water column toxicity during Event 5.

Biological and Habitat

Mossy Lake under natural conditions would be a highly productive area because of frequent flooding that would occur from the Ouachita River. Oxbow lakes and wetlands areas adjacent to large rivers that flood frequently provide excellent habitat for riverine fish and are many times more productive than the main channel of the river. As conditions currently exist in Mossy Lake, many different fish, reptiles, birds, and mammals are using the area as habitat. Multiple turtles were seen and captured in fish nets. Muskrats, beaver, and nutria are known to frequent the area. Ducks use the lake in large numbers in the winter, and the area was a favorite area for GP personnel to duck hunt until the area was recently closed. Many fish were observed hitting the surface near the GP outfall, and a large alligator gar was reportedly landed by a bow fisherman at the drawdown structure. It is apparent that Mossy Lake is a "sink" for at least some species of fish. A "sink" is false habitat or habitat that fish or animals will be attracted to but that will actually cause the creatures harm, often killing them. This is apparently happening with at least common carp in Mossy Lake. One large die-off of carp was recorded during summer 2005, and a few dead individuals were seen during summer 2006. There were likely not as many in 2006 because the river did not flood for an extended period of time to allow the fish to enter the lake.

3.3.4 Coffee Creek below Mossy Lake

Water and sediment samples were not taken at Coffee Creek below Mossy Lake because this task was outside the scope of work.

Biological and Habitat

The proximity of the Ouachita River allows for larger fish that were captured to be traveling up the creek for short periods of time and then return back to the river. During certain times of the year it is likely that fish will travel up the creek to Mossy Lake when the river is backing up into the lake. The macroinvertebrate community at this site is representative of a highly impaired community. The samples were dominated by *chironomids* which are highly tolerant to low DO/high organic carbon conditions. It is difficult to conjecture what the community structure would be for fish or macroinvertebrates without the GP effluent, but it would likely include many riverine fish along with a more diverse macroinvertebrate community.

3.3.5 Ouachita River Upstream

Water and Sediment Chemistry

The Ouachita upstream site had one water chemistry issue. The highest recorded water temperature was 32.8º C at this site during the first event. According to the Sonde data (Appendix L) the water temperature never went below 30º C during the 48-hour period. The SWQS is 30º C for this reach of the Ouachita.

Cadmium was detected above the benchmark value in the sediment sample, but it is believed that this sediment sample was actually sediment from the Ouachita down stream site based on an analysis of the results. The two Ouachita sediment sample may have been switched during labeling or analysis.

Toxicity Analysis

Water from Events 2 and 3 produced chronic toxicity to *C. dubia.* Water from Event 3 also produced chronic toxicity to *P. promelas*. Sediment from Event 1 produced chronic toxicity to *C. dubia*. Sediment from Event 4 produced acute and chronic toxicity to *C. dubia*. No obvious cause of the toxicity was observed from the analytical data. Please note that reagent grade water (toxic) was used as a field blank during Event 1.

Biological and Habitat

Biological and habitat data were not collected for the Ouachita River upstream site.

3.3.6 Ouachita River Downstream

Water and Sediment Chemistry

The lowest dissolved oxygen concentration (3.8 mg/L) over 48-hours was recorded during Event 1. The dissolved oxygen concentration followed a diurnal pattern and ranged from 3.8 to 6.3 mg/L (Appendix L). The highest water temperature for the same period was 33.1º C. The water temperature never went below 30º C during Event 1. There were no other water and sediment chemistry issues.

Toxicity Analysis

Water from the downstream station exhibited toxicity in the laboratory for two out of five sampling events. Both sediment samples were toxic. Toxicity was observed in water from Event 1 (*P. promelas*) and Event 2 (*C. dubia* and *P. promelas*). Toxicity in sediment was observed in sediment collected during Event 1 (*C. dubia*) and Event 4 (both species). No obvious cause was observed in the laboratory data.

Biological and Habitat

Biological and habitat data were not collected for the Ouachita River downstream site.

SECTION 4
CONCLUSIONS

4.1 USE ATTAINABILITY ANALYSIS

The purpose of this investigation was to determine if the current "no aquatic life use designation" for Coffee Creek and Mossy Lake is appropriate. From the biological data collected it is apparent there is a diverse and abundant, though seasonal, aquatic community in the Reference Site stream. The fish and macroinvertebrate samples from the Reference Site are indicative of an aquatic community that is seasonally variable and tied to flood flows from the Ouachita River. Coffee Creek had very few fish and was dominated by a highly pollution-tolerant macroinvertebrate community. The same was true for the Mossy Lake biological community with the exception of a slightly more diverse macroinvertebrate assemblage. The Coffee Creek site below Mossy Lake had higher numbers of large predatory fish, due to the proximity of the Ouachita River, but otherwise exhibited an aquatic community much like the other effluent-dominated sites.

Aside from the fish and macroinvertebrate communities using Coffee Creek and Mossy Lake, other wildlife live in or frequently contact the GP effluent. Muskrat, beaver, nutria, turtles, and ducks are known to use Coffee Creek and Mossy Lake, sometimes in very large numbers. Other animals, including deer, turkeys, raccoons, and other large mammals are likely to come into contact with the GP effluent on a frequent basis.

The waters of Coffee Creek and Mossy Lake have the potential to support aquatic life indicative of streams in the ecoregion. They also show evidence of degradation from the effluent of the Georgia Pacific Outfall 001. There were exceedances of several numeric GCER standards in these water bodies, and signs of ecological impairment, including loss of habitat and toxicity to aquatic organisms from both the water column and sediment.

4.2 WATER QUALITY ASSESSMENT

The water quality of all the sites showed deviations from the applied standards, including the Reference Site.

Reference Site

The Reference Site stream does not meet the GCER standards for DO, mercury, and water and sediment toxicity. The deviations from the GCER standards at the Reference Site may have been caused by local pollution, such as the dumping of trash at the road crossings, non-point source pollution, and possibly by natural processes associated with seasonally low flow systems.

Coffee Creek, Mossy Lake, and Coffee Creek below Mossy Lake

The water quality observed in Coffee Creek, Mossy Lake, and Coffee Creek below Mossy Lake was not of high enough quality to support a viable and diverse aquatic community year-round. However, an aquatic life use is potentially attainable in Coffee

Creek and Mossy Lake downstream of the Georgia Pacific discharge based upon the habitat and reference site data collected during the study. Without the GP discharge, Coffee Creek and Mossy Lake may be able to sustain a diverse aquatic community during and after inundation by the Ouachita River and a limited aquatic community during the annual dry seasons. Coffee Creek below Mossy Lake is likely to sustain a viable and diverse aquatic community within the back waters of the Ouachita River

Ouachita River

The sample reach of the Ouachita River where Coffee Creek converges is maintained as a barge canal. Figure 4.1 shows spoils dumped on the shoreline near the project area. The field crew noted dredging occurring upstream of the sampling sites during Event 4. Both water and sediment samples from each station for that event were toxic to sensitive species in the laboratory. Turbidity also exceeded the SWQS for this event.

Figure 4.1 Dredge Material on Bank of Ouachita River

Four out of five water samples taken from the upstream site exhibited toxicity. Both sediment samples from this site were toxic. Water from the downstream station exhibited toxicity in the laboratory for three out of five sampling events. Again, both sediment samples were toxic.

The toxicity data indicates this part of the Ouachita River may be impaired, though there were concerns over QA criteria with these analyses. Toxicity data from Event 2 (October 18, 2005) had failures in the fathead minnow and *Ceriodaphnia dubia* field blank tests. These are likely due to osmotic stress from testing organisms in reagent grade water (the field blank) rather than QA problems with the tests themselves. However, the Ouachita River was consistently toxic to these indicator organisms. Mossy Lake and Coffee Creek downstream showed episodically toxic responses, as did the Reference Site stream.

SECTION 5
RECOMMENDATIONS

Part 3 (Streams) of designated use F (Fisheries) on page 3-2 of Arkansas Regulation 2 states: Water which is suitable for the protection and propagation of fish or other forms of aquatic life adapted to flowing water systems whether or not the flow is perennial. The presence of indicator species [Reg 2.302(F)(3)(e)] within the Reference Site, and occasionally within the sites downstream of the outfall, supports an aquatic life use designation for Coffee Creek and Mossy Lake. Data collected in this survey indicate that the aquatic life in the Mossy Lake and Coffee Creek systems is impaired. The source of that impairment is likely the outfall from the Georgia Pacific facility in Crossett, AR.

Please note that our recommendation that Coffee Creek and Mossy Lake support an aquatic life use designation is based upon the physical, chemical, or biological sampling results presented in this report. As described in EPA's *Technical Support Manual: Waterbody Survey and Assessments for Conducting Use Attainability Analyses* (1983), the assessment of potential (*i.e.*, attainable) uses may also require additional study beyond these physical, chemical, or biological sampling results.

SECTION 6
REFERENCES

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APPENDIX A

Quality Assurance Project Plan (QAPP)

APPENDIX B

Data Verification Reports

APPENDIX C

Water and Sediment Laboratory Results Summary

APPENDIX D

Event 1 Laboratory Data

APPENDIX E

Event 2 Laboratory Data

APPENDIX F

Event 3 Laboratory Data

APPENDIX G

Event 4 Laboratory Data

APPENDIX H

Event 5 Laboratory Data

APPENDIX I

Macroinvertebrate Data

APPENDIX J

Fish Data and Habitat Scores

APPENDIX K

Photographs

APPENDIX L

Diurnal Field Data and Dissolved Oxygen Graphs