November 3, 2016

Via Certified U.S. Mail and Email
Gina McCarthy, Administrator
U.S. Environmental Protection Agency
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Via Certified U.S. Mail and Email
Lilian Dorka, Acting Director
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RE: Response to Georgia-Pacific Letter re Ouachita Riverkeeper and Louisiana Environmental Action Network's Complaint under Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d, and 40 C.F.R. Part 7 against Arkansas Department of Environmental Quality
EPA File No. 27R-16-R6

Dear Ms. McCarthy and Ms. Dorka:

Ouachita Riverkeeper and Louisiana Environmental Action Network submit this response to Georgia-Pacific LLC's July 20, 2016 letter[1] regarding the organizations' complaint against the Arkansas Department of Environmental Quality ("ADEQ") under Title VI of the Civil Rights Act of 1964, 42 U.S.C. § 2000d, and the EPA's implementing regulations, 40 C.F.R. Part 7 ("Complaint"). EPA Office of Civil Rights accepted the complaint for investigation and that investigation is ongoing.

Georgia-Pacific asserts without providing a shred of evidence that its wastewater treatment system is separate from Coffee Creek. This assertion conflicts with U.S. Geological Survey topographical maps, satellite images, a Use Attainability Analysis, and statements made by the former owner of the mill. Furthermore, Georgia-Pacific consistently claims that the upper segment Coffee Creek is somewhere else—that it is the creek that runs from a pond over a mile south of the plant or that it is some other stream. Georgia-Pacific even asked the U.S. Geological Survey to change the location of the upper segment of Coffee Creek on its topographical maps. All of the evidence, however, shows that Coffee Creek begins at the Georgia-Pacific plant and that Georgia-Pacific uses the creek to treat and transport 45 million gallons of its wastewater per day. Furthermore, Georgia-Pacific's assertion that Coffee Creek is ephemeral also contradicts USGS topographical maps, the opinion of an environmental scientist who analyzed the creek,

[1]Letter from Traylor Champion, Georgia-Pacific Sr. V.P. Envtl. Affairs and Product Safety, to Gina McCarthy, EPA Administrator and Lilian Dorka, Acting Dir. Office of Civil Rights, July 20, 2016 ("G-P Response").

and a statement by an executive of the former owner of the plant that Coffee Creek is "fast moving."

Additionally, Georgia-Pacific's claim that hydrogen sulfide monitoring indicates no potential risk for residents near its wastewater treatment system is wrong. The monitor that is in a West Crossett neighborhood shows that Georgia-Pacific's hydrogen sulfide emissions regularly exceed safe thresholds.

1. The wastewater treatment system is not separate from Coffee Creek.

Georgia-Pacific's assertion that the wastewater treatment system for its facility in Crossett is "entirely separate and distinct" from Coffee Creek (G-P Response at 2) contradicts evidence to the contrary and the conclusions reached by environmental scientist and wastewater discharge expert, Barry Sulkin. *See* Affidavit of Barry W. Sulkin, Oct. 31, 2016 ("Sulkin Aff."), attached and incorporated as Ex. A.

Mr. Sulkin describes in detail the location and flow of Coffee Creek from its headwaters to its confluence with the Ouachita River. *See* Sulkin Aff. ¶¶ 17-27. Mr. Sulkin's description is consistent with a 1956 article from the Southern Pulp and Paper Manufacturer Magazine that describes how the previous operators of the plant used the creek to dilute and treat wastewater from the paper mill and transport it to the Ouachita River. *See id.*, ¶ 32, Attachment 4. The article explains how the company tries to avoid polluting the Ouachita River by treating its wastewater in Coffee Creek: "The Company has the answer in fast moving Coffee Creek that winds its way for 15 miles across the countryside before it finally enters the big Ouachita River; in man-made impoundment basins, flumes and gates constructed along the creek's circuitous route." *Id.* at 54. The article goes on to describe the treatment process: "On the trip down Coffee Creek from the mills and in the basins the dissolved materials have had ample opportunity to feed on oxygen until almost all of the appetite is satisfied." *Id.* at 60. In addition, Mr. Sulkin has personally surveyed Coffee Creek and the surrounding area, reviewed USGS topographical maps and inspection reports, and has concluded that the wastewater enters Coffee Creek a half mile downstream from Highway 82, which is just southwest of the plant. Sulkin Aff., ¶¶ 27, 28. In 2011, Mr. Sulkin was able to observe and photograph the points where Georgia-Pacific's wastewater discharges to Coffee Creek. These points are near the "clarifier," which is approximately five miles upstream of the point where Georgia-Pacific claims its wastewater discharges to Coffee Creek and where its current National Pollutant Discharge Elimination System ("NPDES") incorrectly designates its outfall. *Id.* at ¶¶ 28-29. There is no longer access to the area so it is no longer possible for the public to observe the discharge points. *Id*. at ¶¶ 19, 20.

Georgia-Pacific has altered Coffee Creek over many years for the purpose of treating and transporting its wastewater. *Id*. at ¶ 28. A 1984 Use Attainability Analysis (UAA) of Coffee Creek states that, among other things, the creek has been blasted and dammed, and a stabilization pond with aerators (i.e., Mill Pond) was constructed within the stream. *Id.* at ¶ 30. A series of Google Earth images from 1994 to 2016 show more physical changes that Georgia-Pacific has made to the creek, piping it underground in the area of the clarifier where its discharge points are located. *Id.* at ¶ 29.

2. Georgia-Pacific consistently claims that Coffee Creek is somewhere else.

Georgia-Pacific tries to conceal the fact that it uses Coffee Creek to treat and transport its wastewater by claiming that the creek is somewhere else. Sulkin Aff., ¶¶ 33-37. In its 2013 Use Attainability Analysis of Coffee Creek and in its 2015 application to renew its NPDES permit, Georgia-Pacific claims that Coffee Creek originates at Lucas Pond, two miles south of the plant and southeast of the actual Coffee Creek. *See id.* at ¶¶ 32-33. And more recently, Georgia-Pacific petitioned USGS to change its maps to show Coffee Creek at yet another location. *Id.* at ¶ 34. Both supposed locations contradict the all available maps, the 1984 UAA, Google images, statements from a representative of the previous plant owner, and observations made by Mr. Sulkin. *See id*. at ¶¶ 17-26, 34-36, Attachment 4. Indeed, all evidence shows that the actual path of Coffee Creek flows directly from the mill through in-stream treatment units (i.e., settling basins), Mill Pond, and onto its permitted outfall location (i.e., Outfall 001). *Id.*

Because Georgia-Pacific claims that Coffee Creek is somewhere other than where it really is, its claims about keeping its wastewater separate from the actual coffee creek has no relevance here.

3. The evidence shows that Coffee Creek is not an "ephemeral" stream and that it supports fish.

Because Georgia-Pacific does not recognize the upper segment Coffee Creek, its unsupported claim that Coffee Creek is ephemeral lacks credibility. Furthermore, the evidence shows that Coffee Creek is a perennial stream with permanent flow from Highway 82 to its confluence with the Ouachita River. USGS topographical maps show Coffee Creek below Highway 82 with solid blue line, which is the USGS's a symbol for perennial streams.[2] Sulkin Aff., ¶ 23; *see also* USGS Publication Symbols, section 6-8.[3] In addition, Mr. Sulkin's observed Coffee Creek just below the mill and his opinion is that "it contributes continuous flow to the Ouachita River by way of Mossy Lake. *Id.* at ¶ 23. Moreover, the a representative of the former mill owner described the segment of the Coffee Creek adjacent to the plant as "fast moving" and reliable for moving wastewater away from the mill and down to the holding basin (i.e., Mill Pond). *Id.* at Attachment 4, 54-55.

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[2] Following are links to different views of the a Crossett topo map:
https://www.topoquest.com/map.php?lat=33.13333&lon=-91.98292&datum=nad27&zoom=8&map=auto&coord=d&mode=zoomin&size=m

https://www.topoquest.com/map.php?lat=33.10862&lon=-91.97845&datum=nad27&zoom=16&map=auto&coord=d&mode=zoomout&size=m

[3] http://nationalmap.gov/standards/pdf/6psym403.pdf

Furthermore, Georgia-Pacific's claim that Coffee Creek is not useful for fish (G-P Response at 2) contradicts Mr. Sulkin's observations. Mr. Sulkin attests that he "found permanent flow, along with fish in the upper section of Coffee Creek at Highway 82 crossing which could not exist if not for the presence of permanent water." *Id.* Moreover, Georgia-Pacific's claim that the community cannot use Coffee Creek because it is "entirely on private property owned by Georgia-Pacific" ignores the fact that people fish from road bridges and there is at least one a bridge that crosses Coffee Creek.

4. The monitor in a residential section of West Crossett shows that Georgia-Pacific's hydrogen sulfide emissions regularly exceed health screening thresholds.

The hydrogen sulfide data collected for the ambient air monitoring program in West Crossett contradicts Georgia-Pacific's claim that "monitoring to date indicates there is nothing to suggest that emissions from the wastewater treatment system are creating unsafe or harmful conditions." G-P Response at 2. The table below shows that Georgia-Pacific's hydrogen sulfide emissions regularly exceed health screening levels. That is, these emissions regularly exceed the 70 ppb acute community exposure threshold set by the Agency for Toxic Substance Registry ("ATSDR"). *See* ATSDR, *Draft Toxicological Profile on Hydrogen Sulfide and Carbonyl Sulfide*, 22 (2014) ("An MRL of 0.07 ppm [i.e., 70 ppb] has been derived for acute-duration inhalation exposure to hydrogen sulfide.").[4] As shown below, hydrogen sulfide emissions on February 27, 2016 were nearly triple the acute exposure limit. And on September 25, 2016 and November 23, 2015 hydrogen sulfide emissions were double the acute exposure limit. Over the past two months, there have been multiple exceedances of the acute exposure limits in the same week.

Date	Exceedance of Acute 70 ppb Health Threshold (averaged over 30 minutes)	Cause or Suspected Cause
10/25-26/16	80 ppb (approx.)[5]	cause not determined
10/22/16	110 ppb (approx.)[6]	cause not determined

[4] https://www.atsdr.cdc.gov/toxprofiles/tp114.pdf

[5] Biweekly report with precise data figures is not yet available, but graph shows monitored H2S level of at least 80 ppb.

[6] Biweekly report with precise data figures is not yet available, but graph shows monitored H2S level of at least 110 ppb.

9/30/16	113.98 ppb	lower than normal target pH levels in the wastewater
9/28/16	83.62 ppb	lower than normal pH levels in the wastewater
9/25/16	148.29 ppb	cause not determined
7/1/16	120 ppb	cause not determined
6/26/16	85 ppb	cause not determined
4/4/16	89.4 ppb	process wastewater with elevated sulfides entered the mill's wastewater treatment system
2/29/16	97.3 ppb	additional sulfide-containing process streams in wastewater treatment system
2/27/16	217.4 ppb	additional sulfide-containing process streams in wastewater treatment system
2/7/2016	70.5 ppb	cause not reported
2/5/2016	134.2 ppb	cause not determined
11/23/15	140 ppb	lower than normal pH levels in the wastewater treatment system
8/10/15	75 ppb	High rate of biological activity in the East Ash Settling Basin at

		the wastewater treatment facility
6/28/15	80 ppb	cause not determined
3/30-3/31/15	120 ppb	odor control compound at effluent (i.e., wastewater) sewers due to loss of power

See ADH Special Data Review Announcements and TRC Biweekly Reports for dates specified.[7]

Indeed, the monitoring data show that Georgia-Pacific hydrogen sulfide emissions have also exceeded an ambient air limit for hydrogen sulfide set by Arkansas, which provides: "no person shall cause or permit emissions from any facility that result in predicted ambient hydrogen sulfide concentrations at any place beyond the facility's perimeter property boundary greater than eighty parts per billion (80 ppb) for any eight-hour averaging period for residential areas." Ark. Code §8-3-103(a)(1). Monitoring results show that Georgia-Pacific's hydrogen sulfide emissions exceeded the state limit on 2/27/16 at 141 ppb (averaged over an 8-hour period) and on 2/27/16 at 141 ppb (averaged over an 8-hour period). *See id.*

The reports show that Georgia-Pacific's wastewater is the cause (where reported) of every hydrogen sulfide exceedance. This is consistent with EPA's finding that "[t]he great majority of the fugitive air releases of hydrogen sulfide are coincidentally manufactured in the aeration and stabilization basins of the wastewater treatment plant. The hydrogen sulfide coincidentally manufactured is released to the atmosphere." *See* EPA Region 6, Emergency Planning and Community Right to Know Act (EPCRA) Section 313 Inspection Report (June 23, 2014) (rev. July 23, 2014), at 31, attached as Ex. B to Complaint.

Georgia-Pacific's attempts to downplay its hydrogen sulfide exceedances by claiming that the elevated periods account for a small percentage of the total hours monitored. G-P Response at 3. But Georgia-Pacific's assertion ignores the fact that ATSDR has determined that acute exposures at greater than 70 ppb are a health concern. *See ATSDR, Draft Toxicological Profile on Hydrogen Sulfide and Carbonyl Sulfide*, 22-24 (2014) (discussing health studies on which ATSDR based its acute threshold of 70 ppb). This means any one of Georgia-Pacific's exceedances may have exposed West Crossett residents to risk of harm. ATSDR has described exposure to elevated levels of hydrogen sulfide as follows:

> [R]espiratory tract and nervous system are the most sensitive targets of hydrogen sulfide toxicity. Exposure to low concentrations of hydrogen sulfide may cause

[7] https://www.adeq.state.ar.us/air/compliance/georgia_pacific.aspx

> irritation to the eyes, nose, or throat. It may also cause difficulty in breathing for some asthmatics. Respiratory distress or arrest has been observed in people exposed to very high concentrations of hydrogen sulfide. Exposure to low concentrations of hydrogen sulfide may cause headaches, poor memory, tiredness, and balance problems.

ATSDR Hydrogen Sulfide Fact Sheet.[8]

For the foregoing reasons, the EPA should not determine that any Georgia-Pacific's response undermines any of the claims and allegations set forth in the complaint.

Respectfully submitted by:

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[8] ATSDR *Toxic Substances Portal - Hydrogen Sulfide / Carbonyl Sulfide,* https://www.atsdr.cdc.gov/toxfaqs/tf.asp?id=388&tid=67

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AFFIDAVIT OF BARRY W. SULKIN, M.S.

BEFORE ME, the undersigned authority, personally came and appeared, Barry W. Sulkin, M.S., who, after being duly sworn, did depose and say:

QUALIFICATIONS

1. My name is Barry W. Sulkin. I am an expert in the field of environmental science and wastewater discharge permits under the federal Clean Water Act's National Pollutant Discharge Elimination System ("NPDES") and related state programs. This expertise includes, among other things, water sampling, identification of water bodies, the use of topographic and other maps for identification of water bodies, and wastewater discharge effects on water bodies and their ability to attain water quality standards.

2. I received my Bachelor of Arts in Environmental Science in 1975 from the University of Virginia where I received a du Pont Scholarship. During my undergraduate years, I worked as a Lab Technician and Research Assistant at the University of Virginia and Memphis State University conducting water and soil/sediment sampling and analyses.

3. In 1976 I joined the staff of what is now called the Tennessee Department of Environment and Conservation as a Water Quality Specialist. I worked in the Chattanooga, Knoxville, and Nashville field offices and the central office of the Division of Water Pollution Control in positions that included field inspector, scientist, enforcement coordinator, assistant field office manager, and assistant manager of the Enforcement Section. My duties included compliance inspections of water systems, wastewater systems under the NPDES permit program, enforcement coordination for the water pollution and drinking water programs, as well as work with the drinking water, dam safety, underground storage tank, and solid/hazardous waste programs. I also conducted investigations regarding fish kills, spills, and general complaints, including problems and complaints of stream alteration and water pollution.

4. In 1984 I was promoted within the Division to Special Projects Assistant to the Director, and in 1985 I became state-wide manager of the Enforcement and Compliance Section for the Division of Water Pollution Control. In this capacity I was responsible for investigating and preparing enforcement cases, supervising the inspection programs, participating in developing NPDES permits, permit compliance tracking and evaluation, and field studies involving stream alterations and water quality impacts.

5. While in this position I received a joint State of Tennessee and Vanderbilt scholarship and took an educational leave to obtain my Masters of Science in Environmental Engineering in 1987 from Vanderbilt University. My thesis was "Harpeth River Below Franklin, Dissolved Oxygen Study," which was a field and laboratory study and computer analysis of stream water quality and impacts of pollutants from an NPDES permitted facility. I returned to my position as manager of the Enforcement and Compliance Section in 1987, where I remained until 1990.

6. Since 1990 I have engaged in a private consulting practice regarding environmental problems and solutions, regulatory assistance, permits, stream surveys, and various environmental investigations primarily related to water.

7. I am currently also the Director of the Tennessee office of Public Employees for Environmental Responsibility ("PEER"), which is a position I have held since 1998.

8. My work as a consultant has included projects related to federal Clean Water Act permits and related state programs. During my employment at the state agency, as well as in private practice since, I have had extensive experience and training regarding all aspects of NPDES permits under the federal Clean Water Act and related state programs.

9. An accurate copy of my curriculum vitae is attached to and incorporated into this Statement at Attachment 1.

10. This Statement contains my expert opinions, which I hold to a reasonable degree of scientific certainty. My opinions are based on my application of professional judgment, training and expertise to the facts and data that I have reviewed and analyzed in this matter. These are facts and data typically and reasonably relied upon by experts in my field.

SUMMARY OF OPINION

11. I have been asked by counsel for Ouachita Riverkeeper, Arkansas Public Policy Panel, and Louisiana Environmental Action Network to identify the location of Coffee Creek in Crossett, Arkansas and the location at which Georgia-Pacific, LLC ("G-P") discharges wastewater from its Crossett operations ("mill") into Coffee Creek.

12. Coffee Creek is a tributary of the Ouachita River that begins just northeast of the intersection of Hancock Rd and US Highway 82 (aka West 1st Ave) near West Crossett, Arkansas and flows about 16 miles to the Ouachita River.

13. G-P discharges its wastewater into Coffee Creek downstream of Highway 82 near the "Purification Tank", which is upstream of the aeration pond and in-stream settling basins.

14. G-P misidentifies the location of Coffee Creek.

15. G-P misidentifies the points at which it discharges its wastewater to Coffee Creek.

BASIS OF OPINION

16. I relied on the following information to form my opinion:

- United States Geological Service ("USGS") topographical maps
- Satellite and aerial imagery of Crossett, Arkansas and area waterbodies
- 1984 Coffee Creek—Mossy Lake Use Attainability Analysis (UAA)
- 2007 UAA by EPA
- 2013 Coffee Creek UAA by G-P
- G-P's renewal application dated May 4, 2015 for its National Pollutant Discharge Elimination System ("NPDES") permit no. AR0001210 for its mill discharges ("application")
- EPA Multimedia Compliance Investigation report of August 2015 of inspection February 3 through 12, 2015
- Arkansas Department of Environmental Quality ("ADEQ") report of inspection on March 16, 2011
- 1956 article in Southern Pulp and Paper Manufacturer magazine: "A Story of Water for Crossett Pulp and Paper Mill" by Ramon Greenwood, Director of Public Relations for what was then known as The Crossett Company.
- Personal observations that I made while visiting Crossett and the surrounding area to investigate the location of waterbodies and G-P's discharges on July 26, 2007; November 15, 2010; April 27 & 28, 2011; April 12, 2014; August 16, 2016

- Tests and sampling that I conducted of Coffee Creek and tributary above and below the G-P discharges and wastewater units while surveying Crossett and the surrounding area.

- Photographs that I took while in Crossett and the surrounding area.

DETAILED OPINION

A. ***Coffee Creek Begins Near the Intersection of Hancock Road and US Highway 82, near GP's Mill.***

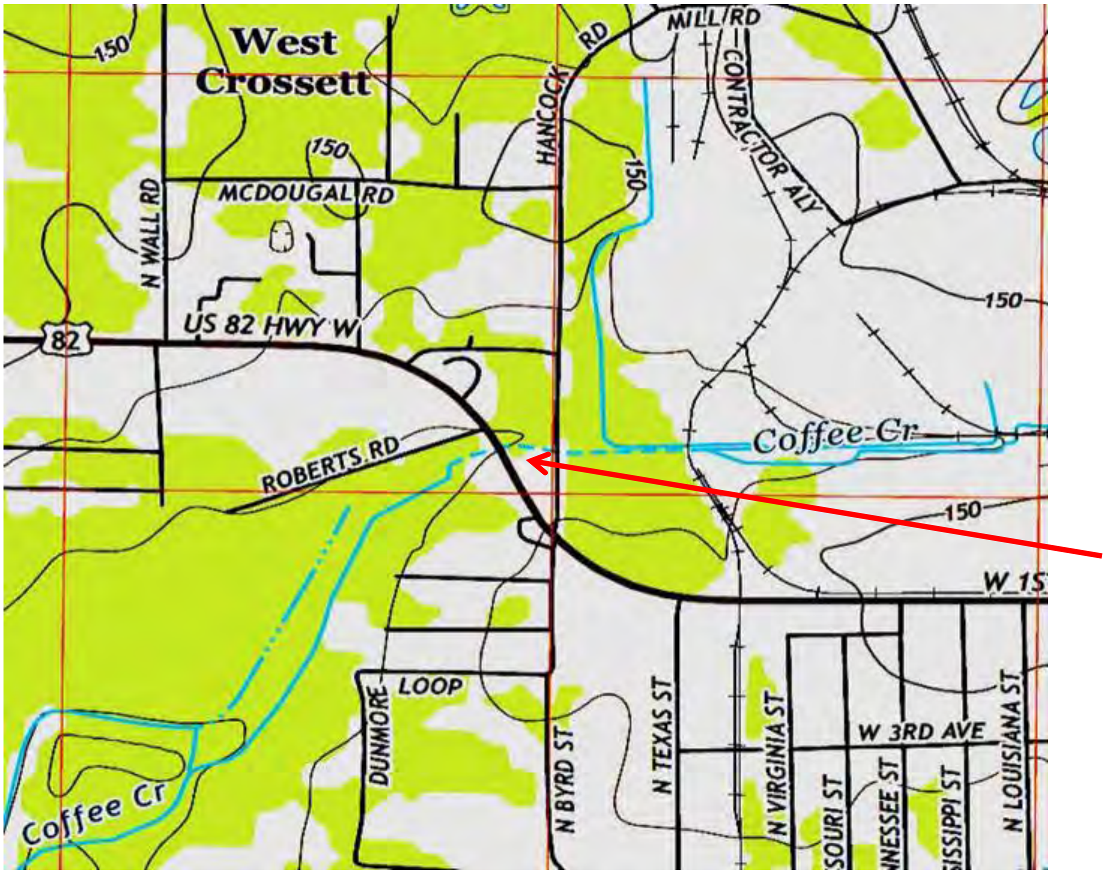
17. Coffee Creek begins just northeast of the intersection of Hancock Rd and US Highway 82 (aka West 1st Ave) near West Crossett and flows west under Hancock Road through a wooded area before passing under Highway 82 and flowing southwest.

I observed Coffee Creek by walking along the stream in the wooded area between Hancock Road and Highway 82 on April 27, 2011, where I took the following photographs of Coffee Creek. I observed fish in the stream by the Highway 82 bridge on this occasion and again on an inspection August 16, 2016, indicating permanent presence of water. Here Coffee Creek has continuous flow and typical bed and banks of a natural stream. Coordinates of this location are located at approximate latitude and longitude of 33°08'19.93"N 91°58'54.86"W.

Coffee Creek about midway between Hancock Rd & Hwy 82 April 27, 2011

Coffee Creek looking downstream from Hwy 82 crossing April 27, 2011

18. The USGS 2014 Crossett North topographic map clearly shows Coffee Creek at the point where I observed and photographed the creek on April 27, 2011. Below is an accurate image of a portion of the North Crossett topo map with a red arrow I inserted showing the segment of Coffee Creek that I observed, followed by a Google Earth satellite image showing the same spot with a red circle that I drew around the area.


West Crossett
MILL RD
CONTRACTOR ALY
HANCOCK RD
150
MCDOUGAL RD
N WALL RD
US 82 HWY W
82
ROBERTS RD
Coffee Cr
W 1ST
DUNMORE LOOP
N BYRD ST
N TEXAS ST
N VIRGINIA ST
W 3RD AVE
N LOUISIANA ST
Coffee Cr


169
82
O Rd

EXHIBIT A

19. I was unable to observe Coffee Creek as it flows southwest through the area beyond US Highway 82 (aka West 1st Ave) because the land along the stream is fenced and posted by G-P, preventing public access.

20. Coffee Creek flows along and under several public roads. However, G-P recently closed off some of these roads to further restrict access, although I did visit and photograph some of these areas prior to closure. Much of Coffee Creek has been straightened, widened, re-routed, and damned to accommodate and treat approximately 45 million gallons a day of wastewater that G-P discharges from the mill into the creek. I have personally inspected Coffee Creek between Hancock Rd. and Highway 82, below the discharges by the "Purification Tank", at Ramsour Rd. (aka Ashley County 11 or Ashley 11 Rd.), over the out flow from the Mill Pond, and along sections of the stream where it has been diverted and channelized along county roads (Cremer 88 Trail and Ashley Rd 246) between the Mill Pond and Mossy Lake. I have also personally inspected Coffee Creek at its confluence with the Ouachita River.

21. Based on USGS topographic maps, other area maps, aerial photography, and personal observations, approximate reach lengths of Coffee Creek are follows:

From the headwaters to the Highway 82 crossing is about one mile. Coffee Creek continues flowing southwest another 4.8 miles to a damned basin referred to as the Mill Pond. Coffee Creek then flows over a dam or weir at the western end of the Mill Pond and then generally south for 6 miles to the upper reaches of Mossy Lake (also referred to as Coffee Lake). Coffee Creek flows through Mossy Lake, which is about 3 miles long, and then flows another mile to the Ouachita River.

22. The total length of Coffee Creek is approximately 15.8 miles. From the mouth of Coffee Creek, it is about 1.2 miles downstream on the Ouachita River to the Louisiana boarder.

23. Coffee Creek is a tributary of the Ouachita River. At Hwy. 82, I observed that Coffee Creek has a bed and banks and an ordinary high water marks and it is my opinion that it contributes continuous flow to the Ouachita River by way of Mossy Lake in its lower section. I base this on personal field investigations, published studies, and my training and experience as an environmental scientist and former regulator where my duties included such determinations. I found permanent flow, along with fish in the upper section of Coffee Creek at the Highway 82 crossing which could not exist if not for the presence of permanent water.

Fish I caught in Coffee Creek adjacent to Hwy 82 crossing April 27, 2011

Fish have also been document in the lower reaches of the stream and in Mossy Lake in a study conducted for EPA. *See* Use Attainability Analysis and Water Quality Assessment of Coffee Creek, Mossy Lake, and the Ouachita River, 2007; prepared for USEPA Region 6 by Parsons Corp. of Austin, TX and University of Arkansas, Ecological Engineering Group of Fayetteville, AR, and available at http://cars.uark.edu/ourwork/Water-Quality-Quantity-Management/final-report_ouachita_dec07.pdf.

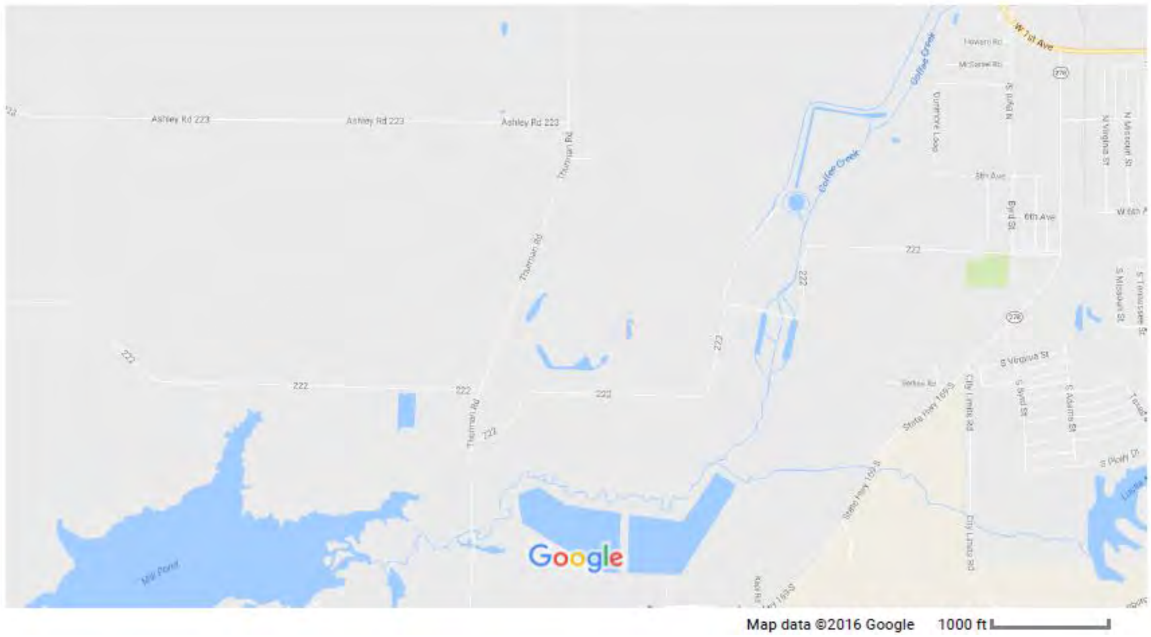
24. My description of locations of Coffee Creek from its headwaters just northeast of the intersection of Hancock Rd and US Highway 82 to the confluence with the Ouachita River is consistent with the location of Coffee Creek as shown on all editions of the topographical maps of the area created by the U.S. Department of the Interior Geological Survey "USGS" since 1934 through the most recent edition in 2014. Attachment 2 is a compilation of four topo maps[1] that I created to show the flow of Coffee Creek from its headwaters to below the Mill Pond. Coffee Creek spans multiple topo maps so it was necessary for me to paste the four maps together in order to see the area. Attachment 2 is an accurate image of this compilation.

[1] The USGS topo maps that I compiled in Attachment 2 to show the flow of Coffee Creek are as follows: Upper left map is an image of Marais Saline, Ark., 1981; Upper right map is an image of Crossett North, Ark., 1973; Lower left map is Felsenthal Dam, Ark.-La., 1981; and Lower right map is Crossett South, Ark.-La., 1973.

25. Below is an accurate image of a portion of the Crossett North topo map showing Coffee Creek flowing to the southwest under Hwy 82 then past the purification tank, which is part of G-P's wastewater treatment system.

Portion of Crossett North 1973 topo map with small black squares indicating residential structures

26. The locations of Coffee Creek shown in the USGS maps also match the locations shown in Google Maps and Google Earth satellite images. Below are true and accurate images copied from Google Maps and Google Earth.



Google Maps showing Coffee Creek just west of W. 1st Ave. and flowing southeast past the clarifyer, through settling basins, and to the Mill Pond (i.e., the aeration basin)

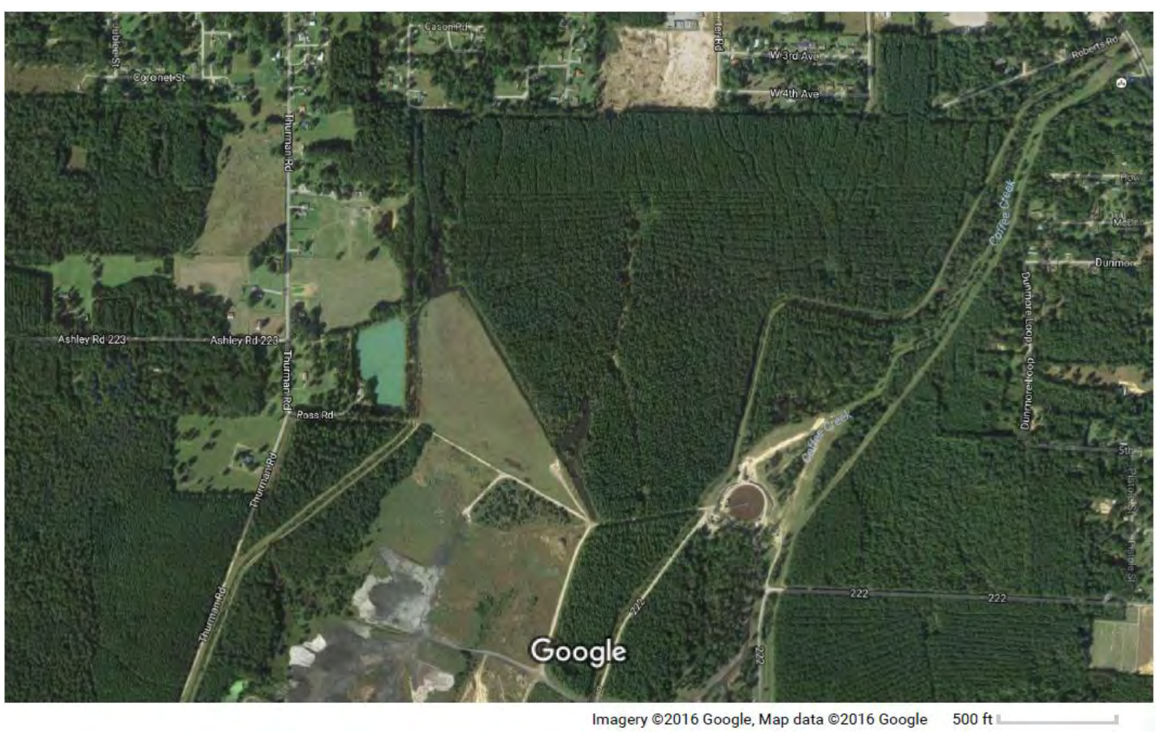
Google Earth satellite image showing same area as map image above

Google Maps image showing closer view of the area in which the path of Coffee Creek flows under Hwy 82 in West Crossett. This area of Coffee Creek is surrounded by residential subdivisions

Google Earth image of that same intersection of Coffee Creek and Hwy 82 illustrating how the creek is currently underground just past Hwy 82 crossing

EXHIBIT A

Google Maps image showing closer view of the area where Coffee Creek flows just past the clarifier and between residential subdivisions in West Crossett



Google Earth image of the exact same view showing the buried portion of Coffee Creek flowing underground to just past the clarifier and then emerging

Closer view in Google Earth showing emergence of buried portion of Coffee Creek

B. <u>G-P Discharges its Wastewater from Pipes into Coffee Creek Approximately 5 files Upstream of the Mill Pond.</u>

27. Based on information from review of maps, aerials, state and EPA inspection reports and other documents, and several visits to the area, it is my knowledge and opinion that the discharge from G-P is released from at least two outfalls located about one-half mile downstream of Highway 82 between the words "Coffee Creek" on the Crossett North USGS topo map (*see* paragraph 24) near coordinates 33º 07' 44" N 91º 59' 30" W. This location is approximately 14 miles above the mouth of Coffee Creek at the Ouachita River and about five miles upstream of where the current permit describes the discharges. I visited this location on April 28, 2011 before the road was closed and observed these discharges.

28. G-P uses sections of the natural, modified, and diverted channels of Coffee Creek as its wastewater transport and treatment system. Below Highway 82 sections of the stream appear to have been channelized and buried as it flows past the Purification Tank and on to the two parallel settling basins (just north of the "Sewage Disposal Pond") as shown on the topographic maps above, and maps & images above and below. Coffee Creek is then dammed to form the large aeration basin called the Mill Pond. The effluent from this aeration basin is diverted to an artificial channel, bypassing portions of the historic channel for several miles as it flows to Mossy Lake and on to the Ouachita River. Mossy Lake has also been altered by a dam, with the outlet previously claimed and permitted incorrectly as G-P's outfall.

One pipe discharges **here** and flows to the clarifier
("Purification Tank") before flowing to Coffee Creek

Another pipe discharges **here**
and flows directly into Coffee Creek

Effluent from clarifier reaches Coffee Creek
here where photo below was taken

Photo I took April 28, 2011 of actual discharge (from clarifier on left) to Coffee Creek flowing from right containing other discharge

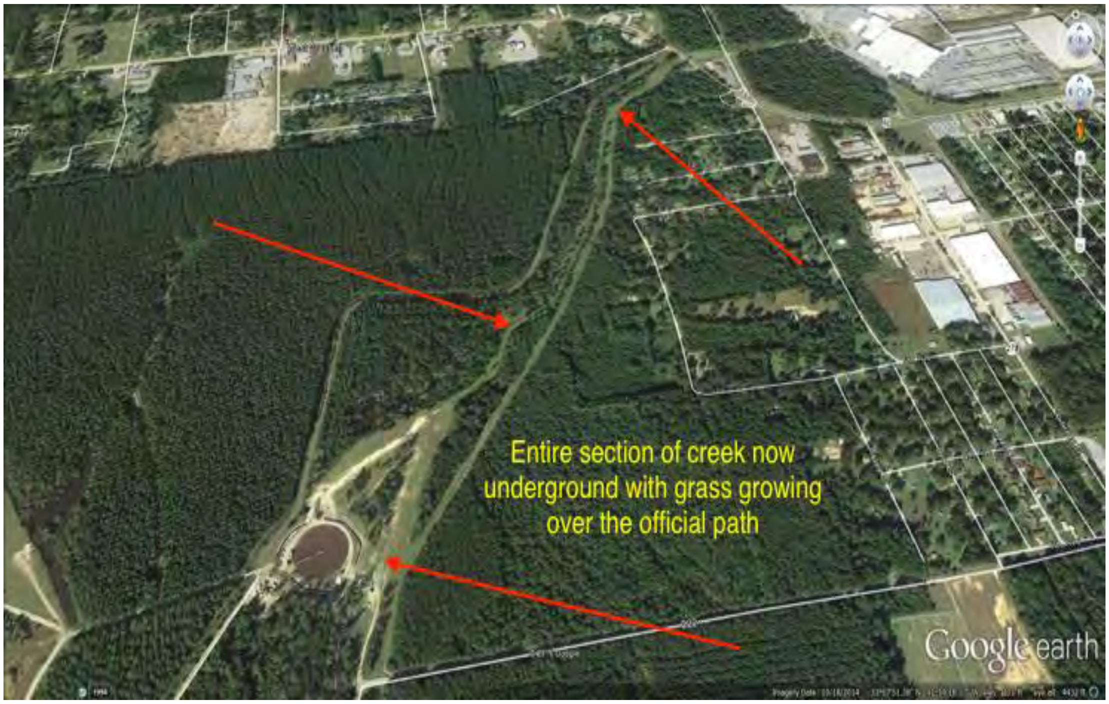
29. The following aerial images show how Georgia-Pacific modified the path of Coffee Creek and buried it underground in the area of the clarifier in stages after 1994 and in the years since I took the April 2011 photo.

1994 Image shows Coffee Creek (unburied) as dark flow from Hwy 82 past the round clarifier in the lower left; arrows point out the path of Coffee Creek and distinguish it from the stormwater diversion channel that has two elbow bends to the west

2010 image of same area now showing two discharges, one to clarifier then Coffee Creek and one directly to Coffee Creek to the right; image shows the upper portion of the creek now buried

2012 image showing that the two discharges and another portion of Coffee Creek now buried

EXHIBIT A



2016 image showing buried portions now with grass cover

30. G-P's alterations and use of Coffee Creek as a wastewater treatment system are discussed in a 1984 report obtained from ADEQ, entitled "Coffee Creek – Mossy Lake Use Attainability Analysis," Attachment 3.[2] The report states the following:

The Mossy Lake/Coffee Creek System has been used as an integral part of the wastewater treatment system of the Georgia-Pacific manufacturing complex in Crossett, AR since the turn of the century. Additionally, effluent from the city of Crossett's wastewater treatment system is discharged through Coffee Creek and Mossy Lake. Since 1937 many modifications have been made by Georgia-Pacific to provide a wastewater treatment system including primary and secondary treatment. A chronology of these changes is provided below:

Year	*Description*
1937	*Blasting to widen, straighten, and deepen creek*
1940's	*Discharge gates and canal at Mossy Lake installed*
1950	*Dams on Fish Slough at edge of Ouachita River installed to prevent river from changing course through Mossy Lake*

[2] In response to a records request, ADEQ stated that it could only find the first 24 pages of the report.

1950's	*Dams on Slough connecting Cooly* [sic] *Lake and Mossy Lake installed to isolate Cooly Lake from the System*
1956	*Stabilization basin (R-l) [i.e., Mill Pond] installed to upgrade wastewater treatment*
1956-57	*Settling basins installed upstream of R-l to reduce solids loading and improve treatment efficiency*
1963	*Levee at Mossy Lake raised to 62' MSL to increase detention time of effluent and provide more efficient treatment*
1968	*Primary clarifier and sludge storage basin installed adjacent to settling basins. Two separate parallel ditches from the mill to the clarifier installed. Mechanical aerators installed in R-l*
1968	*Discharge gates replaced with new weir at Mossy Lake*
1970	*A new channel from R-l to the abandoned railroad just upstream of Mossy Lake was installed. This channel is described in detail by the attached drawings*
1981	*Stormwater diversion ditch installed along south side of the oxidation pond to its outfall. New effluent ditch from settling basin to R-l installed*

Coffee Creek – Mossy Lake Use Attainability Analysis, pdf p. 2-3, Attachment 3.

31. This report also contains a map showing the location of Coffee Creek to be the same as the USGS maps, flowing from the mill area through waste treatment unit(s) and Mill Pond (aerated lagoon), Mossy Lake, and to the Ouachita River.

Id. at pdf p. 18.

32. Much of this same information is described in an article found in the December 10, 1956 issue of Southern Pulp and Paper Manufacturer magazine: "A Story of Water for Crossett Pulp and Paper Mill." A true and accurate copy of this article is attached as Attachment 4. At the time the company was apparently known as The Crossett Company, and the article was written by Ramon Greenwood, Director of Public Relations for the company. This article boasts about all the things they are doing in and to Coffee Creek to use it to

treat their wastewater. This article explains how they looked for a way to solve mill wastewater problems by using Coffee Creek as follows:

> *"Fortunately, The Company has the answer in fast moving Coffee Creek that winds its way for 15 miles across the countryside before it finally enters the big Ouachita River; in man-made impounding basins, flumes and gates constructed along the creek's circuitous route, and in a staff of highly skilled scientists who practice the art of river medicine."*

Attachment 4, p. 54.

> *"On the trip down Coffee Creek from the mills and in the basins the dissolved materials have had ample opportunity to feed on oxygen until almost all of the appetite is satisfied."*

Attachment 4, p. 60.

C. G-P Has Misidentified the Headwaters & Location of Coffee Creek.

In February 2009, when G-P applied for its current NPDES permit that was issued in September 2010, G-P does not acknowledge that Coffee Creek exists until after the Mill Pond, even though it has been using Coffee Creek to transport and treat its wastewater for several miles by the time it reaches the Mill Pond. G-P stated: "Wastewater exiting the aeration stabilization basin enters an earthen tributary identified as Coffee Creek, flows to a polishing pond identified as Mossy Lake, then flows to the Ouachita River." *See* G-P 2009 NPDES Renewal Application, at 97 of 103, available at https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PermitInformation/AR0001210_Renewal_20090304.pdf

33. In 2013, G-P produced a report for ADEQ called a Use Attainability Analysis of Coffee Creek and Mossy Lake, which claims that a different stream is Coffee Creek. While this report included the USGS topographic maps showing Coffee Creek in agreement with the location in my descriptions and above maps, it also included labels inserted on maps and aerials depicting a different tributary as Coffee Creek.

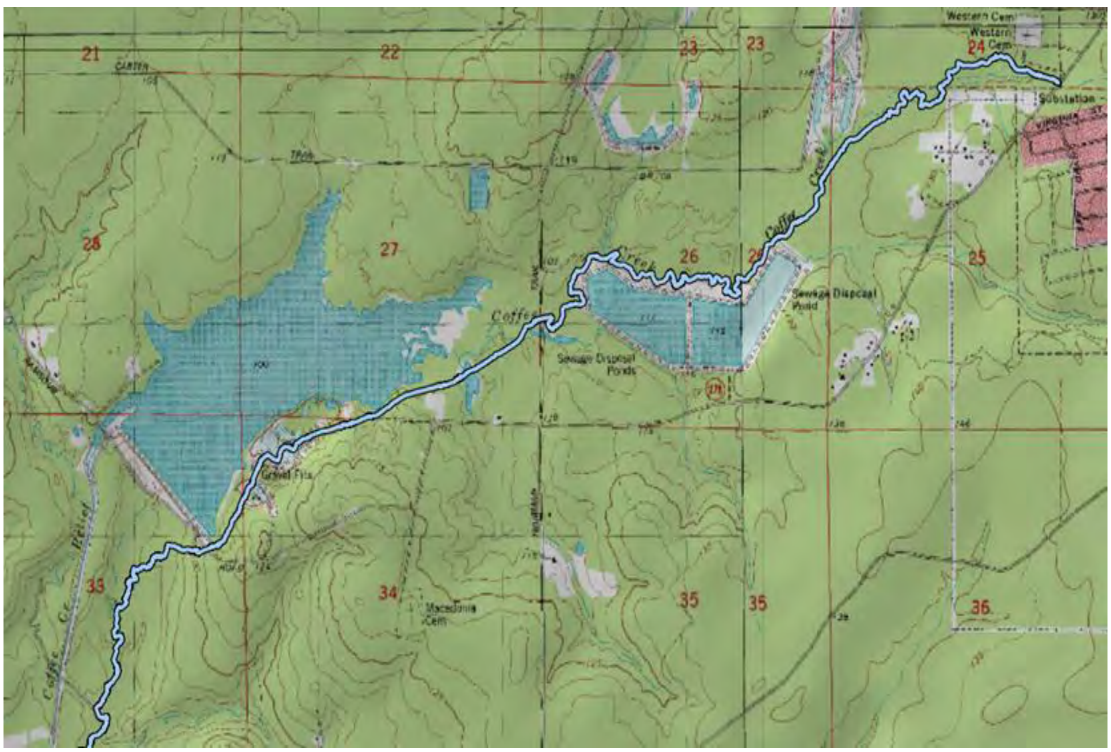
For instance, G-P included the following aerial photo in this report misidentifying the headwaters of Coffee Creek by showing "Site 1 Coffee Creek Headwaters" as the overflow from Lucas Pond in the city park. This is an accurate and true copy of the image as it appears in Georgia-Pacific's 2013 report. This stream is shown on the USGS topographic maps as an unnamed tributary to Coffee Creek, and begins a couple of miles upstream of the Lucas Pond dam. I have inspected this tributary to the east that flows into and forms Lucas Pond, upstream of the city park, along the pond, at the overflow and immediately downstream from the dam forming the pond, and where this tributary crosses under State Highway 169 S.

Image of Figure 4 in Work Plan by AquAeTer, Inc., for Use Attainability Analysis of Coffee Creek and Mossy Lake, Nov. 2014

34. In G-P's pending NPDES permit renewal application, G-P misidentifies Coffee Creek indicated with a blue line, which the legend identifies as "= Coffee Creek", drawn in the location of the unnamed tributary to Coffee Creek that flows from Lucas Pond in the City Park. The figure shows Coffee Creek flowing around the southeast side of the Mill Pond (also shown as "Aeration Stabilization Basin") by the eastern end of pond dam, and crossing under the intersection of Ashley County Road 11 and Ramsour Road. *See*. G-P 2015 NPDES Permit Renewal Application, G-P Crossett Paper Operations, NPDES Permit # AR0001210, May 4, 2015, at 116 of 130, available at https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PermitInformation/AR0001210_Complete%20Renewal%20Application_20150513.PDF

As discussed and shown in paragraph 35 below, before the company closed off this road, I went to this location and found a large human-made ditch and pool of water there, but no stream. This figure in the application is inconsistent with the official USGS topographic and state maps, and what I have found at the site.

35. In January of 2016, G-P filed a request with the USGS to have the topographic maps changed to alter the location of Coffee Creek on the topo maps. G-P told the USGS that Coffee Creek is to the east of the currently mapped location of the upper portion of the actual Coffee Creek. However this is another small unnamed tributary to the actual Coffee Creek. In their submittal to the USGS they claim Coffee Creek flows in a route which misses all wastewater units including the large Mill Pond, as shown on the following figure included in their request:



Map from Appendix C of 2016 request to USGS

36. I have been to the location where this map shows Coffee Creek flowing around the southeast corner of the Mill Pond. I found a large ditch there with a pool of water, but no flowing stream, as seen in the photograph below:

Photograph taken November 15, 2010 at ditch by southeast corner of the Mill Pond

37. G-P's claim in its USGS map change request is inconsistent with the information and documents discussed above including: the 1984 UAA by the state, the 1956 magazine article, and my personal inspections.

D. <u>G-P's NPDES Permit Places G-P's Outfall to Coffee Creek at the Wrong Location.</u>

38. In G-P's 2009 NPDES renewal application that resulted in the permit under which G-P is currently operating and which has been administratively continued by ADEQ, G-P misidentified the receiving stream (i.e., the point at which it discharges to a stream) as follows: "Polishing Pond (Mossy Lake), thence into Coffee Creek, then into Ouachita River." *See* G-P 2009 NPDES Renewal Application, at Section B, Facility & Outfall Location, 4 of 103, available at https://www.adeq.state.ar.us/downloads/WebDatabases/PermitsOnline/NPDES/PermitInformation/AR0001210_Renewal_20090304.pdf

39. As a result of this misinformation, ADEQ located G-P's outfall below the Mill Pond and before Mossy Lake. This is about 5 miles after G-P's effluent has mixed with Coffee Creek.

BARRY SULKIN

SWORN TO AND SUBSCRIBED
BEFORE ME, THIS 3 DAY
OF November, 2016.

NOTARY PUBLIC

DAVID LEE STEPHENS
STATE OF TENNESSEE NOTARY PUBLIC
WILLIAMSON COUNTY

My Commission Expires October 3, 2018

BARRY SULKIN
ENVIRONMENTAL CONSULTANT
4443 PECAN VALLEY ROAD
NASHVILLE, TN 37218
PHONE (615) 255-2079 FAX (615) 251-0111

CURRICULUM VITA

Born: May 3, 1953, Memphis, TN

EDUCATION

1987 M.S., **Vanderbilt University** - Nashville, Tennessee
Major: Environmental Engineering
Master's Thesis: "HARPETH RIVER BELOW FRANKLIN DISSOLVED OXYGEN STUDY"- Field and lab study, QUAL2E computer modeling of river hydrology, water quality, and impacts of a sewage treatment plant.

1975 B.A., **University of Virginia** - Charlottesville, Virginia
Major: Environmental Science

Additional undergraduate courses: math and engineering at University of Tennessee - Knoxville 1982-1984

HONORS

Conservationist of the Year, 2011, Wild South's Roosevelt-Ash Society, Ashville, NC, March 23, 2012
River Hero Award, River Network 2006
Lifetime Achievement Award, Tennessee Environmental Council, 1990
Water Conservationist of the Year, Tennessee Conservation League, 1989
State of Tennessee/Vanderbilt University
Environmental Engineering Graduate School Scholarship, 1985 - 1987
duPont Scholarship, University of Virginia, 1971 - 1975
Eagle Scout, 1967

PROFESSIONAL EXPERIENCE - CURRENT

Sept. 1990 - Present **Environmental Consultant**
Self-employed

Investigator, consultant, and scientist serving clients such as attorneys, environmental/citizen organizations, cities, individuals, businesses, media, and sub-contractor for other consultants/engineers. Activities include research projects, field studies/sampling, site evaluations, stream/wetland determinations, permit negotiations, information and file research, photography, and expert witness presentations concerning water quality, TMDL, erosion, landfills, NEPA, FERC, NRC, and other environmental issues; also TN Director of Public Employees for Environmental Responsibility (PEER). Employed by EPA as special expert for Federal Advisory Committee for Detection and Quantitaion and Uses in the Clean Water Act representing environmental groups (June 2005- Dec 2007).

PROFESSIONAL EXPERIENCE - PREVIOUS

1987-June 1990 and 1985 — **Manager**
Enforcement and Compliance Section
Division of Water Pollution Control
Tennessee Dept. of Health and Environment
Nashville, Tennessee

Responsibilities: Statewide manager of enforcement investigations and legal referrals for water pollution programs under the federal Clean Water Act and the Tennessee Water Quality Act; witness for hearings before the Water Quality Control Board, and local and state courts; data processing and analysis for wastewater permit discharges; field research projects regarding water quality problems, as well as field work involving various stream, river, lake, and wetland issues.

1989 — **Instructor**
Graduate School of Engineering
University of Tennessee, Knoxville (Nashville campus)

Responsibilities: Assistant instructor for graduate course in environmental engineering- wastewater treatment.

Sept.-Nov.1986 and 1981 — **Assistant Manager**
Regional Field Office
Division of Water Pollution Control
Tennessee Dept. of Health and Environment
Nashville, Tennessee

Responsibilities: Coordinated inspections, complaint investigations, field studies, and enforcement for wastewater programs in 41 county region.

Sept. 1985 - Aug. 1986 — Education leave to attend graduate school

1984-1985 — **Special Projects Assistant**
Director's Office - Elmo Lunn, Director
Division of Water Pollution Control
Tennessee Dept. of Health and Environment
Nashville, Tennessee

Responsibilities: Provided statewide coordination and technical assistance on deep well waste injection regulations, clear- cutting forestry problem investigations, animal waste problems, public relations and media presentations, state planning and policy, enforcement and field office coordination.

1982-1984 — **Enforcement Coordinator**

Regional Field Office
Division of Water Pollution Control
Tennessee Dept. of Health and Environment
Knoxville, Tennessee

Responsibilities: Coordinated enforcement action in municipal and industrial drinking water and wastewater programs in 24 county region, including fish kills, spills, complaint investigations, and stream studies.

1981-1982 **Assistant Manager**
Enforcement Section
Division of Water Pollution Control
Tennessee Dept. of Health and Environment
Nashville, Tennessee

Responsibilities: Coordinated statewide investigations and legal actions for drinking water, wastewater, and safe dam programs.

1977-1981 **Water Quality Specialist**
Regional Field Office
Division of Water Pollution Control
Tennessee Department of Health and Environment
Nashville, Tennessee

Responsibilities: Inspected drinking water, and municipal and industrial wastewater systems for 41 county area; investigated spills, underground storage tanks, fish kills, and citizen complaints; conducted stream studies; coordinated enforcement program.

1976-1977 **Water Quality Specialist**
Regional Field Office
Division of Water Pollution Control
Tennessee Dept. of Health and Environment
Chattanooga, Tennessee

Responsibilities: Inspected public drinking water systems for nine county area; investigated spills and citizen complaints.

1975 **Research Assistant/Lab Technician**
Department of Environmental Science
University of Virginia
Charlottesville, Virginia

Responsibilities: Analyzed soil and sediment from Chesapeake Bay and marsh/wetland sites for Corps of Engineers dredge spoils study.

1974 **Research Assistant**
Department of Environmental Science
University of Virginia
Charlottesville, Virginia

Responsibilities: Weather research project data processing.

1974 **Research Assistant/Lab Technician**
Department of Civil Engineering
Water Quality Lab
Memphis State University
Memphis, Tennessee

Responsibilities: Field sampling and lab analyses of water for study of urbanization impacts of watershed streams.

PROFESSIONAL/CIVIC ORGANIZATIONS & CERTIFICATIONS (Past & Present)

Community Engagement Committee, Nashville Planning Department, 2013 to present

Beaman Park to Bells Bend Conservation Corridor community organization,
Board of Directors, 2012 to present

Certified Erosion Prevention and Sedimentation Control Professional (TN), Aug. 2004

Davidson County Grand Jury, Oct. - Dec. 1998, Nashville, TN

Nashville and Davidson County - Floodplain Review Committee, Oct. - Dec. 1998

National Environmental Health Association
*Registered Environmental Health Specialist,*1994

State of Tennessee - *Registered Professional Environmentalist*, 1982

American Society of Civil Engineers

Water Environment Federation

Tennessee Environmental Council, *Board of Directors & Advisory Board, 1994 to present*

International Erosion Control Association

Tennessee Scenic Rivers Association

American Water Resources Association

ADDITIONAL TRAINING

“Fundamentals of Erosion Prevention and Sediment Control” certification course by the University of Tennessee and the Tennessee Department of Environment and Conservation, August 26, 2004; Recertification October 9, 2007

“BASINS Training” short course of EPA supported computer mapping and water quality modeling techniques, Utah State Univ., Logan UT, August 6 - 10, 2001

"Wetland Mitigation Techniques" workshop by Tennessee Tech. Univ., Cookeville, TN April 26, 1999

"Pulp and Paper Cluster Rule and Clean Water Act Permits", by Clean Water Network with EPA, Seattle, Washington, February 18-19, 1998

"Bioengineering Techniques for Streambank and Lakeshore Erosion Control", by Wendy Goldsmith, International Erosion Control Association, April 27, 1995

"Fundamentals of Hydrogeology, Karst Hydrogeology, and the Monitoring, Containment, and Treatment of Contaminated Ground Water", by Albert Ogden and Gerald Cox, January 6-7, 1994

"Ground Water Hydrogeology and Dye Tracing in Karst Terrains", by James Quinlan, April 2, 1992

"NPDES Permit Writers Course" by the Environmental Protection Agency (EPA), April 1988

"Sediment Oxygen Demand Workshop", by EPA, U.S. Environmental Research Laboratory, Gulf Breeze, Florida, September, 1987

"Compliance Monitoring for NPDES Permits", by EPA, October, 1978

"Hazardous Materials Tactical Workshop", by Tennessee Civil Defense, April 1978

"Troubleshooting O & M Problems at Municipal Wastewater Treatment Facilities", by EPA, March, 1978

PRESENTATIONS/PUBLICATIONS

November 2015

“*Evidence For Leaking Of Two Coal Ash Storage Ponds To Local Surface Water And Groundwater In Tennessee*”, Harkness, Jennifer S.[1], Sulkin, Barry[2] and Vengosh, Avner[1], ([1]Division of Earth and Ocean Sciences, Nicholas School of the Environment, Duke University, Durham, NC; [2]Environmental Consultant, Nashville, TN); Abstract & Presentation at 2015 Geological Society of America Annual Meeting in Baltimore, MD

October 2010 & January 2015

Water Quality Sampling & Testing for Litigation Uses, Western Carolina University, Environmental Chemistry Class, Cullowhee, NC

April 2014 & March 2015

Environmental Regulatory Programs in State and Federal Government, Middle Tennessee State University, Murfreesboro, TN

June 2013

NPDES Permits & Cases Presentation at International WaterKeeper Alliance annual meeting, Calloway Gardens, Pine Mountain, GA

October 2012

Appalachian Public Interest Environmental Law Conference, University of Tennessee College of Law, *"Transportation Planning for the 21st Century"* panel, Knoxville, TN

March 2012

Alabama Rivers Alliance – *"How Winning Is Possible"* Keynote address for annual conference awards, Fairhope, AL

May 2001 – May 2013

River Rally, annual national training conference held in: California, North Carolina, Washington, Virginia, Colorado, New Hampshire, Ohio, Maryland, Utah, South Carolina, Oregon; taught various seminars each year on: Clean Water Act, NPDES Permits, Anti-degradation, Stormwater, TMDLs, Enforcement, Wetlands & Mitigation; conference by River Network based in Portland, OR

July 2005

"The Clean Water Act Owner's Manual", second edition, contributing writer & editor, River Network, Portland, OR

December 2003

"Stream Flow and the Clean Water Act", Atlanta, GA, with River Network, Portland, OR

February 2003 & December 2004

"Clean Water Act - Train the Trainer", Denver, CO & Madison, WI, with River Network, Portland, OR

May 2002

"Tracking TMDLs", contributing writer & editor, National Wildlife Federation, Montpelier, VT & River Network, Portland, OR

February 2002

"A Protocol for Establishing Sediment TMDLs", contributing writer & editor, developed for the Georgia Conservancy & University of Georgia Institute of Ecology by the Sediment TMDL Technical Advisory Group, Athens, GA

March 2001

"The Ripple Effect - How to Make Waves in the Turbulent World of Watershed Cleanup Plans", contributing writer & editor, Clean Water Network, Washington, D.C.

October 1999 - April 2001

"Clean Water Act Workshop", presenter for three-day training conferences - Vermont, Georgia, Tennessee, Colorado, New Mexico, Ohio, and Alaska, with River Network, Portland, OR

October 2000

"TMDL Workshop", presenter for training in San Diego, CA, with River Network, Portland, OR

April 1999

"*U.S. Environmental Laws & Regulations Compliance - Understanding Your Obligations Under the Clean Water Act*", session on Clean Water Act for course sponsored by Government Institutes, Inc. of Rockville, MD, given in Nashville, TN

March 1999

"*NPDES and State Water Quality Permits*" and "*The TMDL Process*", presentations at the Tenn. Clean Water Network conference; March 27, 1999, Bethany Hills Camp, Kingston Springs, TN

March 1999

"*State of the Rivers: Tennessee*" presentation at World Wildlife Fund "*State of the Rivers Conference*", March 15, 1999, Chattanooga, TN, with co-author of Tenn. section of "*A Conservation Potential Assessment of the Mobile and Tennessee/Cumberland River Basins in Alabama, Georgia, and Tennessee*" by WWF

December 1998

"America's Animal Factories", contributing writer & editor, National Resources Defense Council, Washington, D.C.

December 1998

"*The TMDL Process*", presentation with NRDC attorney at national Sierra Club state leaders conference, Santa Fe, New Mexico, December 11,1998

October 1998

"*Clean Water Act Permits, Modeling, and TMDLs*" presentation at national conference of clean water organizations & attorneys, by Clean Water Network/NRDC, Oct. 16, 1998, Washington, DC

May 1998

"*Impacts of State Route 840 Upon the Human and Biophysical Environment"* NEPA, ISTEA, and Public Participation in Transportation Projects, Dept. of Environmental Geography guest lecture, Austin Peay State University, May 1, 1998, Clarksville, TN

March 1998

"*The State, EPA, Citizens - How the System Works*" Tennessee Clean Water Conference, Opening Plenary Presentation, March 28, 1998, Nashville, TN

March 1998

"*Total Maximum Daily Loads (TMDL) The Science, Process, & Controversy*" American Water Resources Association 1988 Tennessee Conference; paper presentation as part of panel with EPA representatives on TMDLs, March 3, 1998, Nashville, TN.

February 1997

International Erosion Control Association, on panel of speakers for session on practical applications of erosion controls at annual IECA national conference, Nashville, TN

October 1994

"*Stream Ecology, BMPs, and Compliance"*, environmental impacts of road building, Sierra Club Southern Appalachian Highlands Ecosystem Taskforce, Transportation Workshop, Banner Elk, NC

June 1994

"*Fundamentals of Tennessee Environmental Law*", presentation on Water Pollution Control and Compliance Strategies, for course sponsored by Government Institutes, Inc. of Rockville, MD, given in Knoxville, TN

June 1994

University of Tennessee Law School, guest lecture on water pollution and the related state and federal laws, Knoxville, TN

October 1992

"*Storm Water Regulations for Saw Mills*" - Seminar sponsored by the Tennessee Association of Forestry and the Univ. of TN, Nashville.

August 1992

"*Storm Water Regulations for Industry*" - Seminars sponsored by the Tennessee Association of Business and the Univ. of TN, Chattanooga, Knoxville, Jackson, and Nashville.

July 1992

Storm Water in Tennessee - A Training Manual for Manufacturers, University of Tennessee Center for Industrial Services

April 1992

"*Dissolved Oxygen Study - Sewage Treatment Impacts and Assessments*", VA Water Pollution Control Assoc. 46th Annual Conference, Roanoke, VA

October 1990

"*The Tainted Waters of the Cumberland*"; Cumberland Journal, v.1, no. 1, pp. 16-20; Nashville, Tennessee.

November 1988

"*A Rapid Bioassessment of Richland Creek, Davidson County*", by M. Browning, B. Sulkin, T. Merritt, TN Div. of Water Pollution Control

June 1988

"*Assimilative Capacity of the Obed River at Crossville, Tennessee*"; U.S. Geological Survey 1st Annual Hydrology Symposium, Nashville, TN

March 1987 - 1994

Vanderbilt University Graduate School of Engineering and Law School; guest lectures on water quality topics and computer modeling of river waste assimilative capacity.

July 1983

Testimony on the pollution at the Oak Ridge nuclear weapons facilities before Congressional hearing chaired by then Congressman Albert Gore.

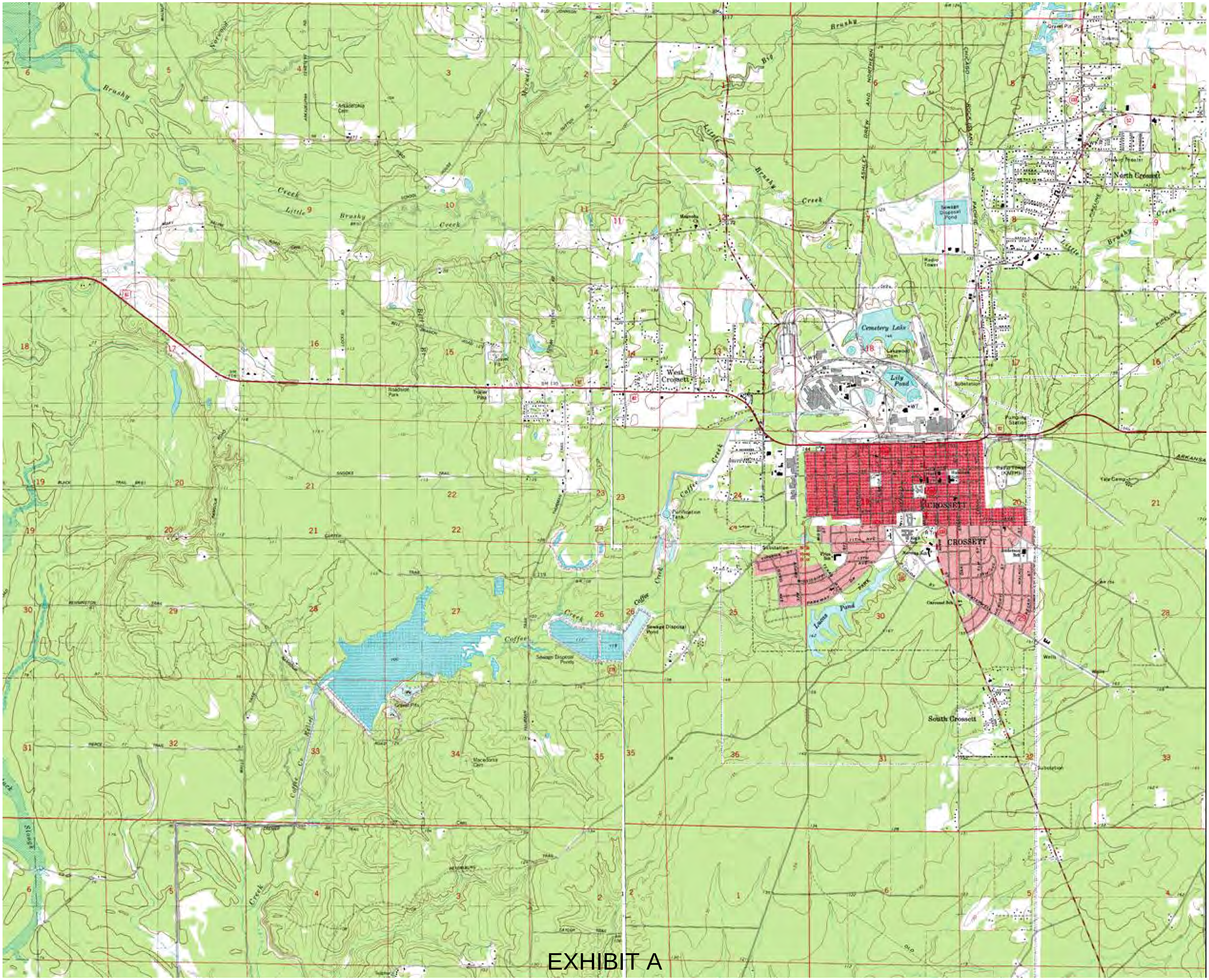


EXHIBIT A
Attachment 2

COFFEE CREEK -MOSSY LAKE

USE ATTAINABILITY ANALYSIS

Section I- introduction

A. Site Description

B. Problem definition

C. Approach to Use Attainability

Section II- Analyses Conducted

A. Physical Factors

1. Coffee Creek

2. Mossy Lake

B. Chemical Factors

1. Coffee Creek

2. Mossy Lake

C. Biological Factors

1. Coffee Creek

2. Mossy Lake

Section III- Findings

Section IV -Summary and Conclusions

EXHIBIT A
Attachment 3

SECTION I -INTRODUCTION

A. Site Description

Coffee Creek is a minor tributary of the Ouachita River with its headwaters originating within the City of Crossett, Arkansas. It meanders some 12 miles through Mossy Lake and one additional mile into the river near the Arkansas - Louisiana line. The creek area is heavily wooded with a mixture of pine and hardwood. The topography is nearly flat with only a gradual slope toward the river. The area is comprised of silty sedimentary soils with occasional deposits of clay/gravel bordering the creek lowlands.

The Mossy Lake/Coffee Creek System has been used as an integral part of the wastewater treatment system of the Georgia-Pacific manufacturing complex in Crossett, AR since the turn of the century. Additionally, effluent from the city of Crossett's wastewater treatment system is discharged through Coffee Creek and Mossy Lake. Since 1937 many modifications have been made by Georgia-Pacific to provide a wastewater treatment system including primary and secondary treatment. A chronology of these changes is prov1ded below:

Year	Description
1937	Blasting to widen, straighten, and deepen creek.
1940's	Discharge gates and canal at Mossy Lake installed.
1950	Dams on Fish Slough at edge of Ouachita River installed to prevent river from changing course through Mossy Lake.
1950's	Dams on Slough connecting Cooly Lake and Mossy Lake installed to isolate Cooly Lake from the System.
1956	Stabilization basin (R-l) installed to upgrade wastewater treatment.
1956-57	Settling basins installed upstream of R-l to reduce solids loading and improve treatment efficiency.
1963	Levee at Mossy Lake raised to 62' MSL to increase detention time of effluent and provide more efficient treatment.
1968	Primary clarifier and sludge storage basin installed adjacent to settling basins. Two separate parallel ditches from the mill to the clarifier installed. Mechanical aerators installed in R-l.
1968	Discharge gates replaced with new weir at Mossy Lake.
1970	A new channel from R-l to the abandoned railroad just upstream of Mossy Lake was installed. This channel is described in detail by the attached drawings.

1981	Stormwater diversion ditch installed along south side of the oxidation pond to its outfall. New effluent ditch from settling basin to R-l installed.

A topographic map of the area indicating these changes is provided in Appendix I of this report. A smaller map showing the general layout of the system is provided in Figure I.

Mossy Lake and Coffee Creek are subject to annual flooding from the Ouachita River during the rainy season (typically November-June). Data from a typical year (1980) is summarized in Table I. Annual flood stages of the river from ~912-1955 indicate that the 62 foot MSL of Mossy Lake was exceeded in every year except one (1936). This flood stage data is provided in the bar graph. In addition, Table II illustrates the flood period from more recent years. The flow data from Mossy Lake is reported for all months from August 1979 through June 1985, where insignificant flooding occurred and flow measurements could be made. In all other months within this time period Mossy Lake was flooded (i.e., out of 70 months Mossy Lake was flooded approximately 43 months or over 60% of the time).

Coffee Creek between R-l and Mossy Lake in the absence of effluent is intermittent in nature. Runoff from the surrounding area southeast of the creek makes up the majority of the flow. While no direct measurements of f19f through Coffee Creek have been made, documentation of periods of zero flow is provided by two methods.

First the drainage area of Coffee creek is approximately 15 square miles. This area includes an approximately four square mile area draining through Indian Creek and a one square mile area located immediately north of Mossy Lake. By comparison, Moro Creek which is located approximately 50 miles north of Coffee Creek has a drainage area of 216 square miles. U.S.G.S. data (I) for this stream shows at least one month of zero flow for five consecutive years. Because of the much smaller drainage area of Coffee Creek and expected rain fall comparable to the Moro Creek area, it can be inferred that Coffee Creek also experiences extended periods of zero flow.

A second approach to confining the intermittent nature of Coffee Creek is to examine flow monitoring data from the outfall of R-l and outfall of Mossy Lake. Flow data is available for 27 months from August 1979 through June 1985, and is summarized in Table 4. Since effluent from the city and Georgia-Pacific and rainfall runoff are the only sources flowing into Mossy Lake, the average monthly flow excluding effluent in Coffee Creek can be easily be calculated. The Figure 4 data shows many periods of near zero flow in Coffee Creek. Therefore, the seven day ten year flow condition for Coffee Creek is zero.

(1) U.S.G.S. Open File Report 84-727.

B. <u>Problem Definition</u>

The following use classifications have been designated for Coffee Creek (including Mossy Lake):

- Industrial water supply.
- Agr1culiural water supply.

In addition, the stream system is exempt from state water quality standards for color, flow, temperature, turbidity, pH, dissolved oxygen, radioactivity, bacteria, toxic substances (specific standards), nutrients and mineral quality. The system is subject to general water quality standards for nuisance, taste and odor, solids, floating material and deposits, *oil* and grease and toxic substances.

This study was conducted to determine if there is an existing fishery use in Coffee Creek/Mossy Lake and what uses are potentially attainable in the absence of effluent or at some higher level of effluent treatment

C. Approach to Use Attainability

The majority of data used in this report was taken from existing data available from:

- Georgia - Pacific Corporation unpublished reports.
- United States Geological Survey.
- Arkansas Department of Pollution Control and Ecology.

New data collected as part of this study was a biological evaluation of Mossy Lake conducted by __________ , and additional analyses necessary to complete a chemical evaluation of Coffee Creek/Mossy Lake.

Even though Mossy Lake is considered to be a portion of Coffee Creek, the physical, chemical, and biological evaluations are addressed separately for the lake and the creek.

SECTION II -ANALYSES CONDUCTED

A. Physical Evaluation

1. Coffee Creek

The spillway dam at the discharge of R-l and the dominance of effluent prevents fishing development upstream of this point.

The effluent ditch from R-l to Mossy Lake is man made and has a width of *12-15* feet and depth of about three feet. At typical flows of 45 MGD (69 cfs) of effluent the velocity is approximately 2 ft/sec. This ditch was completely stripped of vegetation when it was constructed in 1970 and remains mostly clear of any protective covering. Temperature of the effluent ranges from less than 50 degrees F in winter to over 90 degrees in summer. For a detailed description of this section, see Appendix ?? With the high velocity, no substrate, sparse cover, and dark color of the effluent, this segment of the system is totally unsuitable as a habitat for aquatic life or for any type recreation.

2. Mossy Lake

Mossy Lake is approximately 200 acres in area and is fed by the wastewater effluent ditch from R-l, drainage from Indian Creek and runoff from an approximately one square mile area immediately north of the lake. The only discharge from the lake is from a man made weir through an approximately one mile stretch of Coffee Creek to the Ouachita River. As noted in Section I of this report, several modifications have been made to the lake since the 1940's including installation of dams and levees. The primary purpose of these modifications was to reduce the amount of natural influent and increase the retention time in the lake (i.e., improve the wastewater treatment efficiency and protect water quality in the Ouachita River).

The lake is approximately 62 ft. MSL and floods annually for a period of 6-7 months in the winter-spring season. The area around the lake is heavily vegetated with bottomland hardwood and cypress. The bottom is covered with several inches of tree stumps and cypress knees. Temperatures in the lake are generally 25-30 degrees C° during low flow periods. When flooded, the lake temperature would be approximately the same as the river temperature. River temperature ranges from less than 5 degrees C° in January/February up to 30 degrees C° in June/July.

This water body is not satisfactory for direct contact recreation because the entire surface is occasionally covered with duck weed. When the weed dies it sinks and becomes bottom deposit material. The perimeter of the lake is covered with vegetation making it relatively inaccessible and snake infested. The appearance of the effluent is dark causing the aesthetics to be undesirable for body contact.

B. Chemical Evaluation

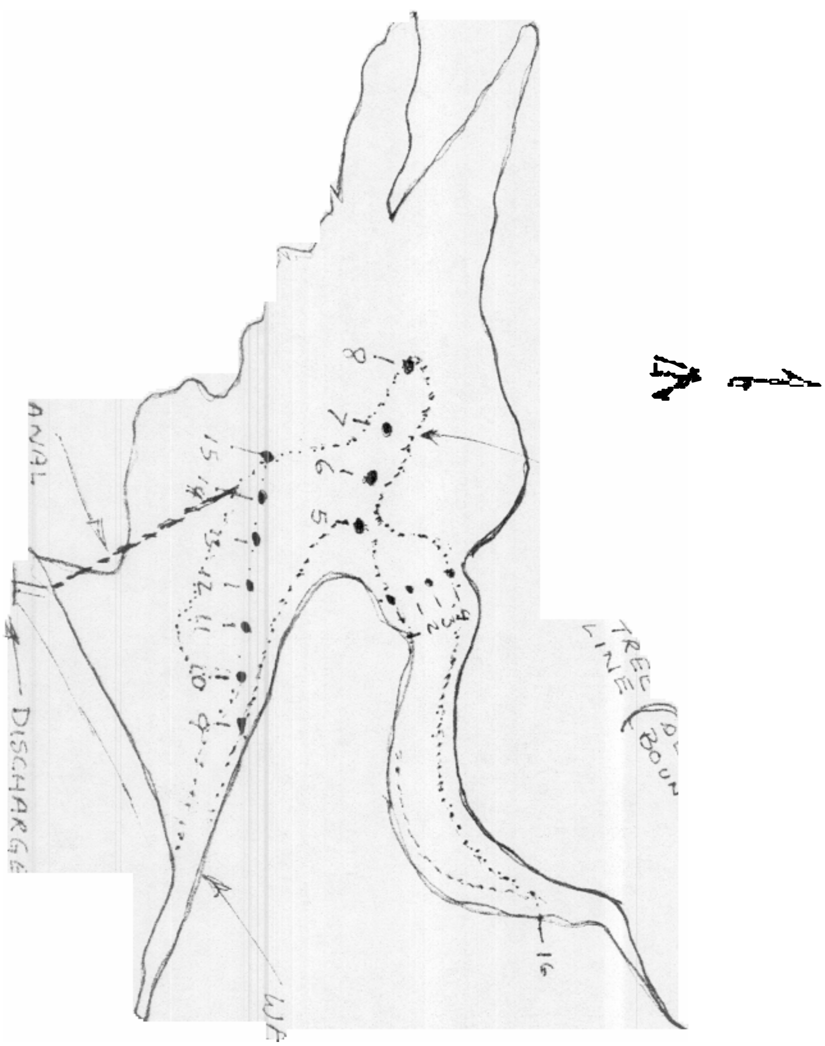
1. Coffee Creek

Chemical analysis data for Coffee Creek in the absence of effluent would be comparable to that found in the abandoned creek channel along the effluent system. A summary for the water quality is presented below:

Parameter	Typical Values	Data Source
Dissolved Oxygen	less than 2.0 ppm	July 1977 and October 1979
BOD	3.0- 10 ppm	July 1977 data
pH	7.5	July 1977 data
Hardness		
Suspended Solids		
Dissolved Solids		
Nitrogen		
Sediment Oxygen Demand		
COD	370- 500 ppm	July *1977* data

In addition, data for the man made portion of Coffee Creek is also provided:

Parameter	Typical Values	Data Source
Dissolved Oxygen	less than 0.5 ppm	November 1983 R-1 survey
BOD	20 -40 ppm	1982- 1984 DMR's
pH	7- 8	1982- 1984 DMR's
Hardness		
Suspended Solids	30- 50 ppm	1982- 1984 DMR's
Dissolved Solids		
Ammonia Nitrogen	0.5- 2.5 ppm	July *1977* data (6 samples)
Sediment Oxygen	350- 550 ppm	July 1977 data and March 1984 data



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A summary of chemical analyses data for Mossy Lake during low flow conditions is provided below:

Parameter	Typical Value	Data Source
Dissolved Oxygen	0- 2.5 ppm	Were Data 1982-1984
BOD	10- 15 ppm	1982-1984 DMRS
pH	7- 8	1982-1984 DMRS
(Hardness)		
Suspended Solids	10- 20 ppm	1982-1984 DMRS
Dissolved Solids		
Sediment Oxygen Penal		
COD	350 ppm	July 1977 date
Ammonia Nitrogen	1- 2 ppm	July 1977 (9 samples)

This data primarily reflects Georgia-Pacific’s effluent quality as it is discharged from Mossy Lake to the Ouachita River. Over the past several years water quality surveys in the river basin show that the effluent has little or no impact on water quality during flood conditions.

The headwaters of the Ouachita River originate in the Ouachita Mountains of central Arkansas, near the Oklahoma border. The river flows in a southeast direction, past the City of Camden (MP 330) and Smackover Creek (MP 300), and enters Louisiana at MP 221, about one mile downstream of Coffee Creek. The Ouachita River has a drainage area of 10835 square miles at the state line of Arkansas and Louisiana and a total drainage area of 18,864 square miles at the point where the Tensas joins the Ouachita to form the Black River. The confluence of the Black River and the Red River is located approximately 221 river miles downstream of the Arkansas state line. The river mile point system which is conventionally used, and which will be followed herein, is referenced with respect to the distance from the Red River. This reach of the Ouachita River is illustrated in Figure 4.

Georgia-Pacific Corporation operated a 1500 ton per day pulp and paper mill, chemical plant and plywood mill in Crossett, Arkansas. The mill obtains about 75% of its raw water supply from the Saline River and 25% from groundwater, and discharges its biologically treated process wastewater to the Ouachita River. The effluent enters the river about 1 mile north of the Arkansas-Louisiana State line, and there are no other significant point source loads entering the river for a distance downstream of almost 30 miles to the confluence with Bayou Bartholomeu. Downstream of Bayou Bartholomeu, a number of industrial and municipal loads enter the Ouachita, including the discharges from Olinkraft, IMC, and the City of Monroe.

The Georgia-Pacific Paper Mill is located in Crossett, Arkansas, 12 miles northwest of where the Ouachita River enters Louisiana. The process wastewater undergoes primary clarification followed by extended aeration.

The 625 million gallon aerated lagoon, which also treats the domestic wastewater from Crossett, provides on the order of 2 weeks detention time at wastewater flow rate of 45 mgd. The effluent from the lagoon (R-l) flows via Coffee Creek to Mossy Lake where additional treatment is obtained, after which it discharges to the Ouachita River. The entire Coffee Creek watershed is located on land owned by Georgia-Pacific, and historically has been considered part of the mill's treatment system.

Coffee Creek enter# the Ouachita River slightly more than one mile downstream of Lock and Dam No.6 at Felsenthal. The United States Geological Survey (USGS) maintains a continuous recording gage near Lock 6, providing daily estimates of river flow throughout most of the year. A number of relatively small tributaries enter the river between the dam and Bayou Bartholomeu, but the intervening drainage area over this distance represents an increase of less than 4% relative to the *10,850* square ml1es at Lock 6. Hence, the river flow can be considered to be relatively constant over this reach of the river. Bayou Bartholomeu does account for a significant increase in flow to the Ouachita River. Downstream from this point a number of additional waste loads enter the river, and the system becomes increasingly complex.

The Ouachita River is a hydrologically unique river system which regularly experiences the extremes of both very low flow and flood conditions. During most of the year, the river is within its banks, and flow is regulated by a series of lock and dams. Of particular interest here are the dams at Columbia and Felsenthal. The Corp of Engineers is obligated by existing regulations to maintain prescribed water surface levels (pool depth) in order to maintain navigable waterways. As a result, during low flow periods of the year, the gates at the dams are raised in order to minimize water losses from the upstream pools. The presences of these dams and the associated gate manipulations have several important ramifications on the water quality of the river. First, restricting flow over the dam necessarily reduces flow to the downstream reach, there by exacerbating what may already be critically low flow conditions. This problem is compounded by the fact that the dam at Columbia creates impoundment of water which has a very low hydraulic gradient, and hence diminished capacity for reaeration.

At the other extreme, the Ouachita River regularly experiences periods when the river stage rises and water inundates a 5 mile wide flood plain for a distance more than 60 miles upstream of Alabama Landing (HP 208). This flood plain comprised almost entirely of forest lands. Historical water quality data, which will be discussed in detail in subsequent section of this report, has demonstrated that the dissolved oxygen level in the river becomes severely depressed when this condition occurs.

Georgia-Pacific Corporation has been conducting routine water quality surveys on the Ouachita River since about 1978. These surveys were usually conducted between State Highway 82 in Arkansas and Sterlington, Louisiana (La MP 234.5-189.5, or 1939 COE MP 250-205). The data includes measurements of temperature, dissolved oxygen and color at stations located every 5 miles throughout the aforementioned reach of the Ouachita River. Prior to 1978, the surveys were usually performed once per week during the period of the year when the river was within its banks. Since 1978, however, data has been collected during both the low flow and high flow flood conditions.

Since *1978* it has been consistently observed that depressed dissolved oxygen levels are associated with flooded river conditions. In order to gain a better understanding of this relationship, the dissolved oxygen concentration and Ouachita River stage from the 1978-79 and 1979-80 water years have been p1otted chronologically, as shown in Figure 2. The Lock 6 stage is present~~ in the upper graph, rather than flow, due to the fact that flows are not reported when the river is out of its banks. Since zero stage corresponds to an elevation of 44.09 feet above mean sea level, the water surface elevation may be obtained directly by adding the stage to this datum. Thus, the water surface elevation that corresponds to the reported river stages is shown on the right axis of the upper graph. The lower pool stage, downstream of Lock 6, is usually at approximately 8.0 feet during low flow conditions of 1000-2000 cfs. The river is out of its banks, or "bank full" at a stage of about 19 feet which corresponds to a flow of approximately 13,000 cfs. The lower graphs of Figure 2 present the dissolved oxygen concentration and deficit at the upstream and downstream ends of the reach of the river over which the routine surveys were performed. Dissolved oxygen deficit is the difference between the maximum or dissolved oxygen saturation concentration that could exist in the river at any given temperature and the observed river dissolved oxygen concentration. The middle graph presents data collected at what is considered to be a background station, near Highway 82, more than 12 miles upstream of the Georgia-Pacific discharge. The lower graph presents data collected near Sterlington, approximately 33 miles downstream of the Georgia-Pacific discharge.

As shown on the chronological plot of river stage, the river was at a very low flow condition in October *1978.* Dissolved oxygen concentrations of 6-7 mg/l and deficits of 2-3 mg/l were observed at both the upstream and downstream stations. After the river overflowed its banks in December, dissolved oxygen concentrations increased steadily toward a maximum of about 11 mg/L in February 1979. This increase was primarily a reflection of the lower temperatures and higher dissolved oxygen saturation concentration, since the background and downstream deficits of 2-3 mg/l remained relatively constant. At this time, the water temperature was 3 degrees C and the river stage was 31 feet, corresponding to a water surface elevation of 75 feet. The Ouachita River flood plain, primarily forest land, was inundated with 10-15 feet of water for 2-3 miles on both sides of the river, over most of the survey area. During the next 2-3 months, the water temperature increased steadily. The river stage peaked at almost 38 feet, and the dissolved oxygen deficit, at both the background and downstream stations, increased to 7 mg/l. With the accompanying decrease in the saturation concentration, minimum dissolved oxygen concentrations of 1.0 and 1.6 mg/l were reported at the background and downstream stations respectively.

It was not until the middle of June that the flood waters began to recede. At this time deficits of 6-7 mg/l had been sustained for a period of 12 weeks. Hence, it is apparent that the depressed dissolved oxygen levels cannot be attributed to the effects of the receding flood waters. To the contrary, as the flood waters receded, the deficits responded immediately by decreasing to 2 mg/l, as observed during the period of time while preceded the *1978-79* flooding. The river was within its banks by mid-July, and shortly thereafter the dissolved oxygen concentration recorded from a minimum of 1 mg/l at low temperature and high flow conditions to about 5-6 mg/l, even though the flow was much lower and the wate~1 temperature had increased to 27 degrees C°.

It should be noted that the 1978-79 flood represented the most extreme level of flooding which has occurred in recent years. The river stage approached a height of 38 feet, corresponding to a water surface elevation of 82 feet above mean sea level, and the onset of flooding began in the vicinity of MP

265 to 270, or 30 to 35 miles upstream of the first routine survey sampling station. Inspection of Figure 2 for the 1979-80 water year shows a very similar if not quite as dramatic pattern of events occurred as the river flooded and receded. During this water year, the river stage rose to about 32 feet, and the limits of the flooding extended as far as MP 255, 15 miles upstream of the Saline River. A review o data which was collected from 1970-1977 suggests that similar conditions occurred whenever the river flooded. Although surveys were not usually preformed when the river was flooded during these earlier years, observed deficits during the first 2-3 weeks after the flood waters receded consistently showed a decreasing trend.

The spatial profiles of dissolved oxygen during selected periods of time during 1979 are shown in Figure 3. Four time intervals, a-d, as indicated on the under chronological plot of river stage, have been selected to illustrate the dissolved oxygen profile of the river under different river temperature and flow conditions. During period (a), the river was near its maximum 1979 stage at an estimated flow of 50,000 cfs and the average water temperature of 20 degrees C corresponds to a saturation concentration of 9 mg/l. Background dissolved oxygen levels averaged 3-4 mg/l throughout the 12 mile reach upstream of Coffee Creek. Although slightly lower average dissolved oxygen levels did occur downstream, it is apparent that the rather large deficit of approximately 6 mg/l was dominated by the upstream conditions. Over time interval (b), just prior to the time when the flood waters receded, similar conditions occurred. Here, dissolved oxygen levels were generally les than 2 mg/l. Time interval (c) took place shortly after the river was back within its banks. Although the water temperature of 28 degrees C° was higher and river flow lower, average dissolved oxygen concentrations of 5-6 mg/l represented a marked improvement relative to the preceding time interval. The average dissolved oxygen deficit was bout 1.9 mg/l upstream of Lock and Dam 6; and 2.6 mg/1 in the vicinity of La. MP 195. Finally, spatial profile (d) illustrates the dissolved oxygen profile at a flow of 6850 cfs and a temperature of 12 degrees C°, as observed on November 15, 1979. Here, the spatial profile was again quite uniform, with dissolved oxygen concentrations of about 9 mg/l and deficits of 1-2 mg/l throughout the study area.

The preceding review of the routine survey data illustrates several important points. First, during the period of time when the river was within its banks, the background deficit in the vicinity of MP 234 was typically 2 mg/l. Second, when the river was flooded, background deficits as high as 6-7 mg/l were observed a considerable distance upstream of Georgia – Pacific's discharge, and these deficit prorogated throughout the survey area. The high background deficit was generally observed after a period of sustained flood conditions, and usually dissipated as the flood water receded to the main channel. The dissolved oxygen profile during flooded conditions was as low as 1 to 2 mg/l, and for extended period of time, lasting as long as several months, the dissolved oxygen standard of 5 mg/l was not achieved.

As shown previously on Figure 2, the Ouachita River entered a sustained period of flooding in December of 1979. Initially the stage at Lock 6 remained less than 25 feet and on several occasions, the water receded to within the river banks. Finally, on March 11, 1978, the water level began a steady rise to a stage of more than 30 feet, where it remained for the next 9 weeks. Due to the paucity of data available for the purpose of characterizing flood plain water quality, a sampling program was implemented On April 22, 1980, in order to establish such a data base.

Figure 4 illustrates the spatial extent of the flood plain and the approximately location of the flood plain sampling stations. The 75 foot contour line represents the approximate fringe of the flood waters which would correspond to a 30 foot stage. As shown, the flooded forest land covers a 5 mile wi4~ area of land which begins about 15 river miles upstream of the Saline River and ends downstream of Alabama Landing, in the vicinity of MPI 210. A levee which begins near MP 217 prevents the river from flooding the bean fields on the eastern shore, thereby limiting the eastern flood plain to a relatively narrow strip of land for a considerable distance downstream from this location. The flood plain sampling stations are located along an east-west transect which crossed the main channel of the Ouachita River, 10-12 river miles upstream of Coffee Creek. Two stations were located approximately 1 and 2 miles away from the main channel, on both east (Stations 1E and 2E) and west (Stations 1W and 2W) sides of the river. These stations, as well as a main channel station (MC) located near HP 234 were usually sampled once per week from April 22, 1980, 6 weeks after the river was last within its banks, until the water receded from the flood plain in the latter part of June. Temperature and dissolved oxygen were measured at each station, and surface and bottom composite samples were analyzed by Georgia-Pacific for pH, BODS, COD and color.

Spatial plots of the BOD5 and dissolved oxygen profiles along the flood plain transect are presented in Figure 5. The average and range of data collected during the 8 week period of the flood plain sampling program is shown for each station. Observed BODS levels of 1 to 3 mg/l were representative of natural occurring background concentrations and tended to be somewhat higher with increasing distance from the main channel. Station 2W, location the western side of the flood plain and furthest from Georgia-Pacific had the highest average BODS concentration of almost 2.5 mg/l. The dissolved oxygen profile shown in the lower graph of Figure 6 had the opposite shape, with the highest average dissolved oxygen concentration of 4.5 mg/l occurring at the main channel station. Dissolved oxygen levels decrease in the direction of the fringes of the flood plain, having average concentrations of 2.8 and 3.5 mg/l at stations 2Wand 2E respectively. The wide ranges in the dissolved oxygen concentration reflect the temporal decrease in dissolved oxygen that was observed over the course of the flood plain sampling program. One additional measurement of 1.2 mg/l at the western edge of the flood plain represents the minimum depth averaged dissolved oxygen concentration that was observed.

The temporal variation of the data collected during the flood plain sampling program is summarized in Figure 6. When possible, the data is supplemented with routine survey data and intensive water quality survey data from the Ouachita River. The abscissae shows the duration of flooding referenced to March 11, 1980, when the river overflowed its banks. Flood plain sampling took place from 6 to 13 weeks after the river was experiencing flood conditions, as indicated on the graph of river stage. During this time, the river stage was usually 28-30 feet. Sampling was necessarily terminated when the flood waters receded. Over the period of time shown on the graphs, the water temperature increased from 12.0 degrees C° to 23.5 degrees C°. The BOD5 data, although quite variable relative to the low concentrations which were measured, tended to increase gradually throughout most of the sampling period, increasing from 1.4 mg/l (average of all stations) in the sixth week to 2.1 mg/l at the time of the July 2-3, 1980, Ouachita River survey. Thirteen weeks after the initial flooding of the river, a lower BOD5 concentration of 1.3 mg/1 was measured.

The final graph in figure 6 presents the change in the average dissolved oxygen concentration with time and includes both the flood plain data and routine river survey data at MP 234. The main channel dissolved oxygen concentration was 9.5 mg/l at the onset of flooding, but decreased steadily to 3.5 mg/l. The average flood plain concentrations followed the same trend, but were consistently lower. Average deficits of about 5 mg/l were observed during this period of time. Fourteen weeks after the initiation flooding, the river was back within its banks, and the main channel dissolved oxygen concentration responded by increasing to 4.8 mg/l in slightly more than one week. Shortly thereafter, background deficits were once again about 2 mg/l in the vicinity of HP 234.

C. Biological Evaluation

1. Coffee Creek

2. Mossy Lake

TABLE___

Flow Data (Million Gallons per Day)

	R-1 Lagoon Coffee Creek	Coffee Creek to Ouachita River	Difference
Aug.1979	47.4	48.0	+0.6
Sept.1979	47.9	48.5	+0.6
Oct. 1979	46.5	45.6	-0.5
Nov. 1979	51.4	53.5	+2.1
Aug. 1980	45.2	42.1	-3.1
Sept.1980	47.3	43.6	-3.7
Oct.1980	48.7	51.5	+2.8
Nov.1980	49.8	56.1	+4.3
Aug.1981	50.8	45.0	-5.8
Sept.1981	51.7	46.6	-5.1
Oct.1981	51.1	52.1	+1.0
Nov. 1981	51.0	50.4	-0.6
Dec. 1981	47.7	51.2	+3.5
Jan.1982	46.7	53.1	+5.4
June 1982	46.5	54.3	+7.8
July 1982	40.5	34.8	-5.7
Aug.1982	45.8	47.4	+1.6
Sept.1982	44.6	41.1	-3.1
Oct. 1982	45.4	51.7	+6.3
Nov. 1982	45.8	45.7	-0.1
Aug. 1983	40.5	37.7	-2.8
Sept. 1983	41.3	39.9	-1.4
Oct. 1983	40.8	41.6	+0.8
Nov. 1983	42.4	44.6	+2.2
July 1984	40.4	38.7	-1.7
June 1985	37.2	36.3	-0.9

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	R-1	Mossy lake
1/82	38.8	18.0
2/82	56.0	----
3/82	69.4	----
4/82	57	----
5/82	43.4	----
6/82	44.8	31.3
7/82	37	34.8
8/82	43	32
9/82	28	24
10/82	21	15
11/82	34	11.2
12/82	44	20
1/83	35	5
2/83	49	10
3/83	34	7.3
4/83	42	10
5/83	43	12
6/83	42	8
7/83	32	17
8/83	29	12
9/83	24	17
10/83	31	11
11/83	31	15
12/83	54	--
1/84	63	23
2/84	59	19
3/84	49	--
4/84	49	--
5/84	40	17
6/84	45	23
7/84	37	13

8/84	42	13
9/84	50	18
10/84	67	--
11/84	52	--
12/84	82	--

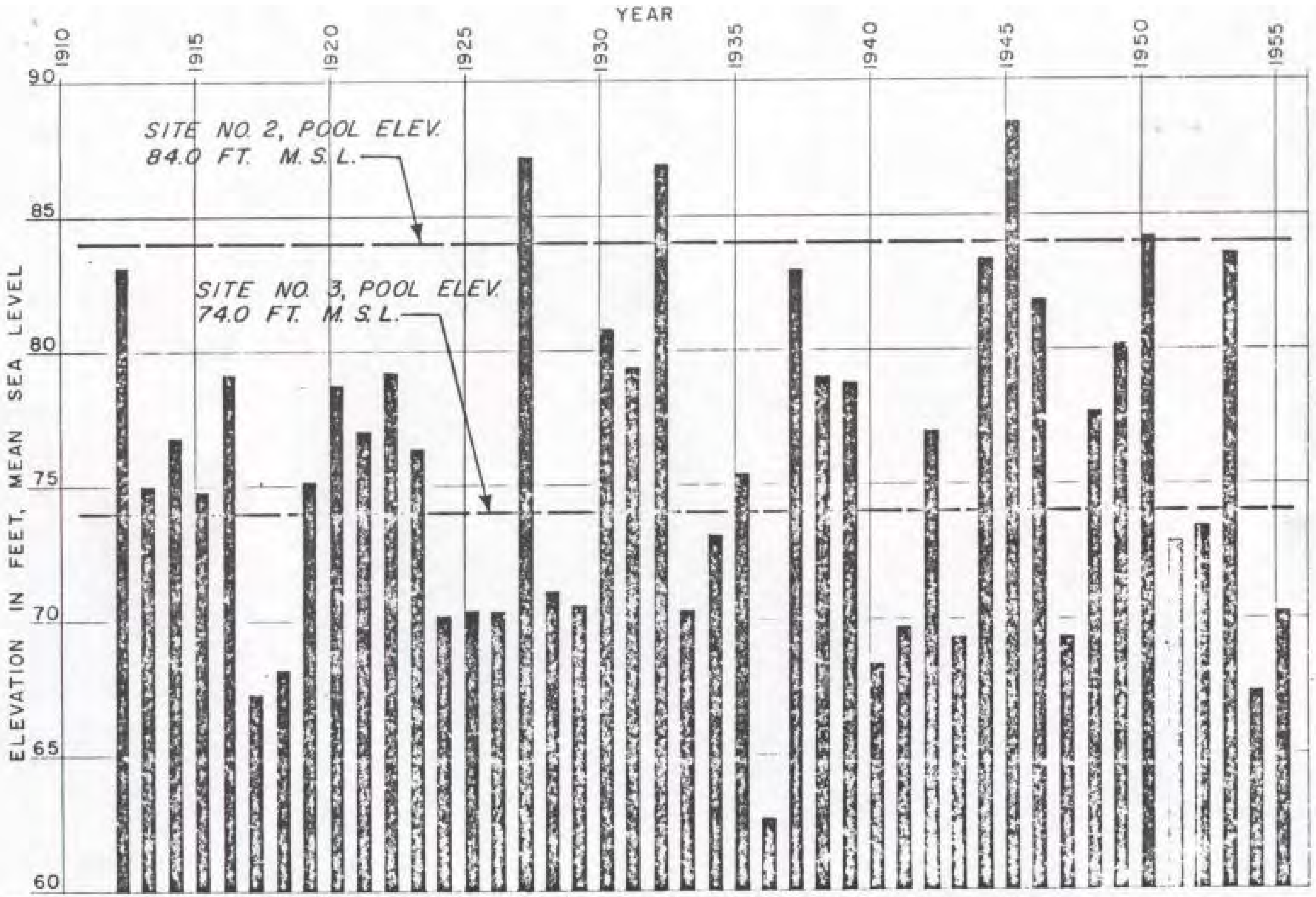
R-l Coliform Tests

	Total	Feed
5/4/78	1360 mg/1	1230 mg/1

Mossy Lake

DOB Data

1/82	20/9 ppm	1/83	--	1/84	--
2/82	--	2/83	--	2/84	--
3/82	--	3/83	--	3/84	--
4/82	--	4/83	--	4/84	--
5/82	--	5/83	--	5/84	--
6/82	16.2	6/83	--	6/84	5.5
7/82	18.9	7/83	--	7/84	12.0
8/82	14.0	8/83	9.0	8/84	8.0
9/82	9.0	9/83	11.0	9/84	12.0
10/82	9.0	10/83	15.0	10/84	--
11/82	9.8	11/83	12.0	11/84	--
12/82	--	12/83	--	12/84	--



NOTE:
1. RECORD FLOOD LEVELS HAVE NEVER REACHED POOL LEVEL OF SITE NO. 1.
2. RECORDS INDICATE THAT FLOOD LEVELS WILL REACH SITE NO. 2 POOL LEVEL ONCE EVERY 12 YEARS.
3. RECORDS INDICATE THAT FLOOD LEVELS WILL REACH SITE NO. 3 POOL LEVEL ONCE EVERY

HIGHEST ANNUAL FLOOD STAGES
OUACHITA RIVER

RECORDS FROM U. S. CORPS OF ENGINEERS
OUACHITA RIVER, LOCK & DAM NO. 6
FOR
COFFEE CREEK RESERVOIR STUDY

AREA 216 SQ. MI.

r	NOV	DEC
01	3.15	98.4
	20.2	34.7
	0	1.04
	0.007	10.6
9	0.16	0.70
	0.69	1.33
5	768	585
7	22.8	18
77	2.01	233

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Table 8.--Mean-daily discharge for 1981 water year, in cubic feet per second, at Moro Creek near Fordyce (07362500)

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	313	58	213	36	59	130	110	13	210	134	66	6.0
2	315	47	224	34	147	120	100	11	307	343	37	6.2
3	313	35	207	32	219	110	95	9.9	883	260	15	6.1
4	351	26	165	30	292	100	90	9.4	956	109	7.6	5.1
5	394	20	118	27	330	120	180	11	1170	54	4.5	4.2
6	353	17	87	29	312	130	270	14	3680	47	3.2	3.6
7	184	16	69	39	240	150	370	12	3400	42	2.7	3.0
8	67	14	59	48	180	160	568	10	2470	45	2.8	2.7
9	35	13	105	59	160	140	673	18	1680	41	2.6	2.3
10	23	12	233	61	150	120	602	66	1210	28	1.9	1.9
11	17	12	328	57	160	100	323	81	984	19	1.3	1.7
12	13	11	387	52	190	85	157	110	686	13	1.0	1.4
13	11	11	490	47	220	80	98	120	337	9.2	.86	1.3
14	9.3	12	702	44	250	70	71	103	147	6.5	.72	2.8
15	8.1	24	912	38	300	70	54	100	84	5.0	.63	23
16	7.0	34	814	35	340	60	44	126	54	4.1	.55	27
17	8.9	69	530	32	360	55	37	726	37	3.3	.56	11
18	12	201	300	29	320	50	30	1390	29	2.7	.72	5.3
19	15	335	181	27	250	45	25	2080	26	2.2	.89	3.4
20	16	398	124	28	200	40	22	1990	51	2.0	50	2.5
21	34	456	98	30	160	40	20	1490	53	1.8	137	1.9
22	63	540	79	32	150	40	18	1090	34	1.5	207	1.7
23	52	619	68	37	160	50	17	824	22	1.3	228	1.7
24	35	613	60	41	170	60	15	515	16	1.1	135	1.5
25	23	455	54	45	160	70	17	229	12	.87	51	1.3
26	16	284	50	47	150	80	34	262	9.9	.75	25	1.1
27	18	201	47	46	130	90	47	203	7.9	.59	16	.91
28	35	193	46	43	130	95	36	173	6.1	1.1	11	.82
29	58	197	43	39	---	90	23	210	4.9	59	8.4	.72
30	69	198	40	36	---	80	16	249	6.9	197	6.4	.66
31	69	---	38	33	---	100	---	265	---	109	5.2	---

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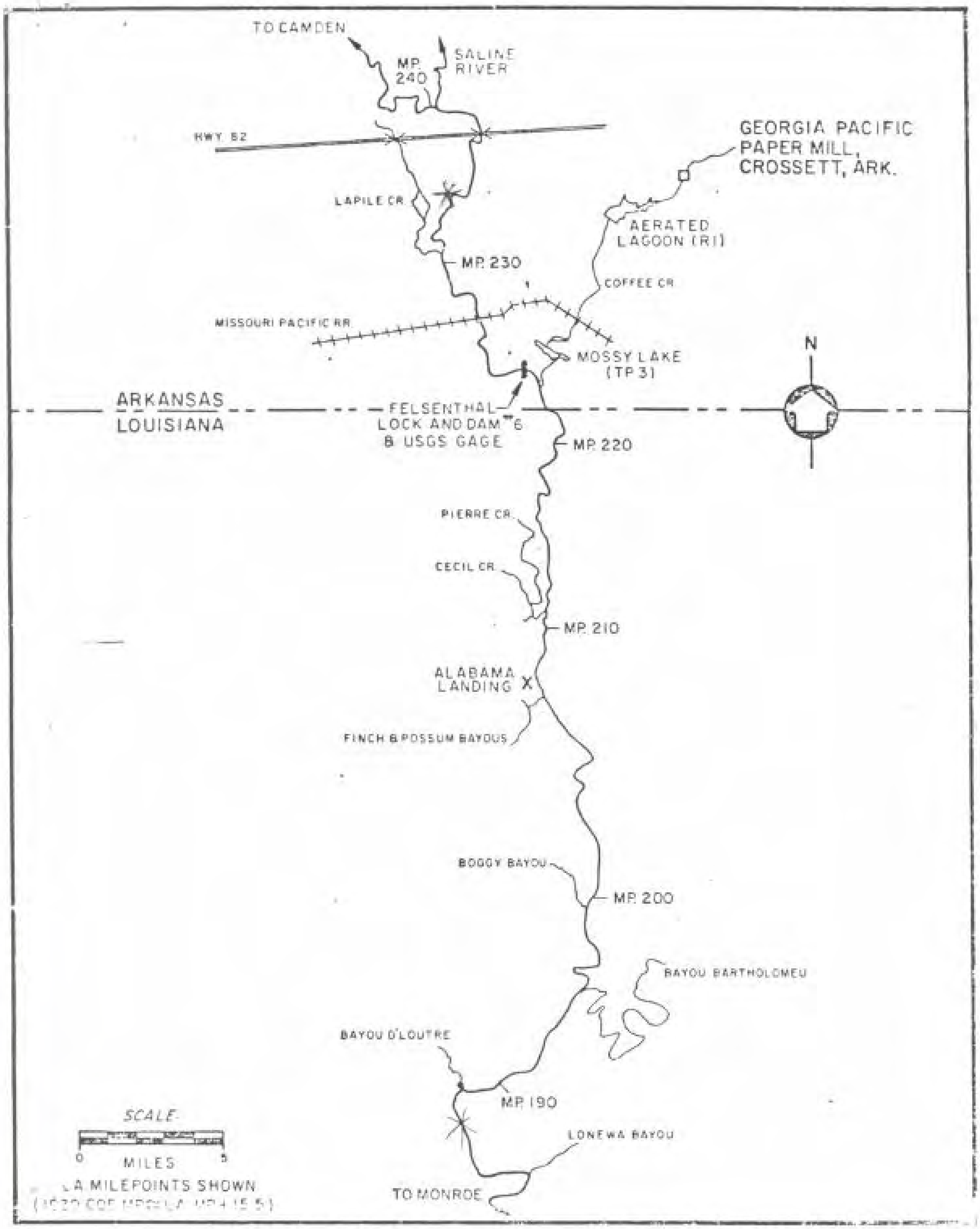

FIGURE I

OUACHITA RIVER STUDY AREA

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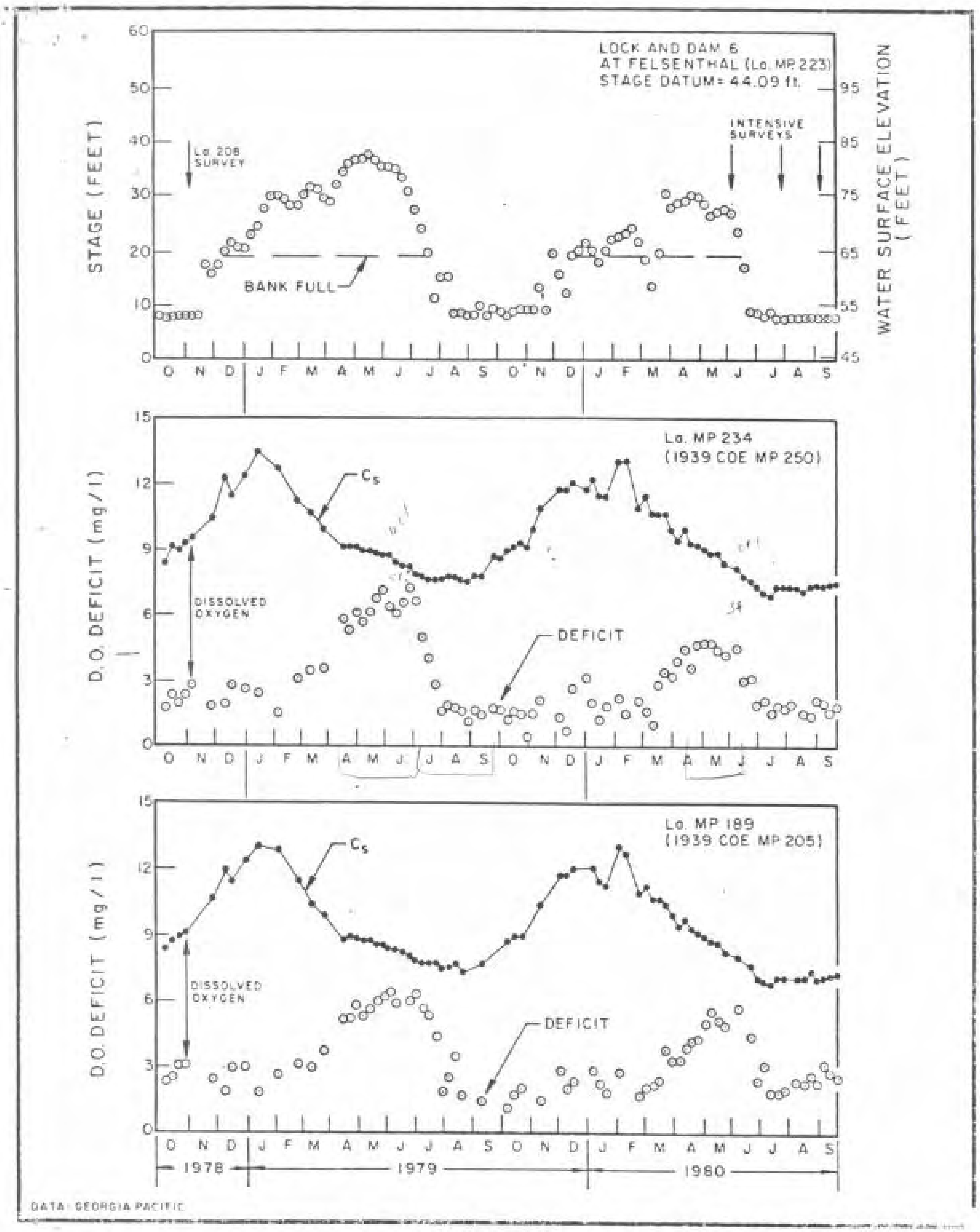

FIGURE 2

CHRONOLOGY OF QUACHITA RIVER STAGE AND D.O. DEFICIT, ROUTINE SURVEY DATA, 10/1/78 – 9/31/80

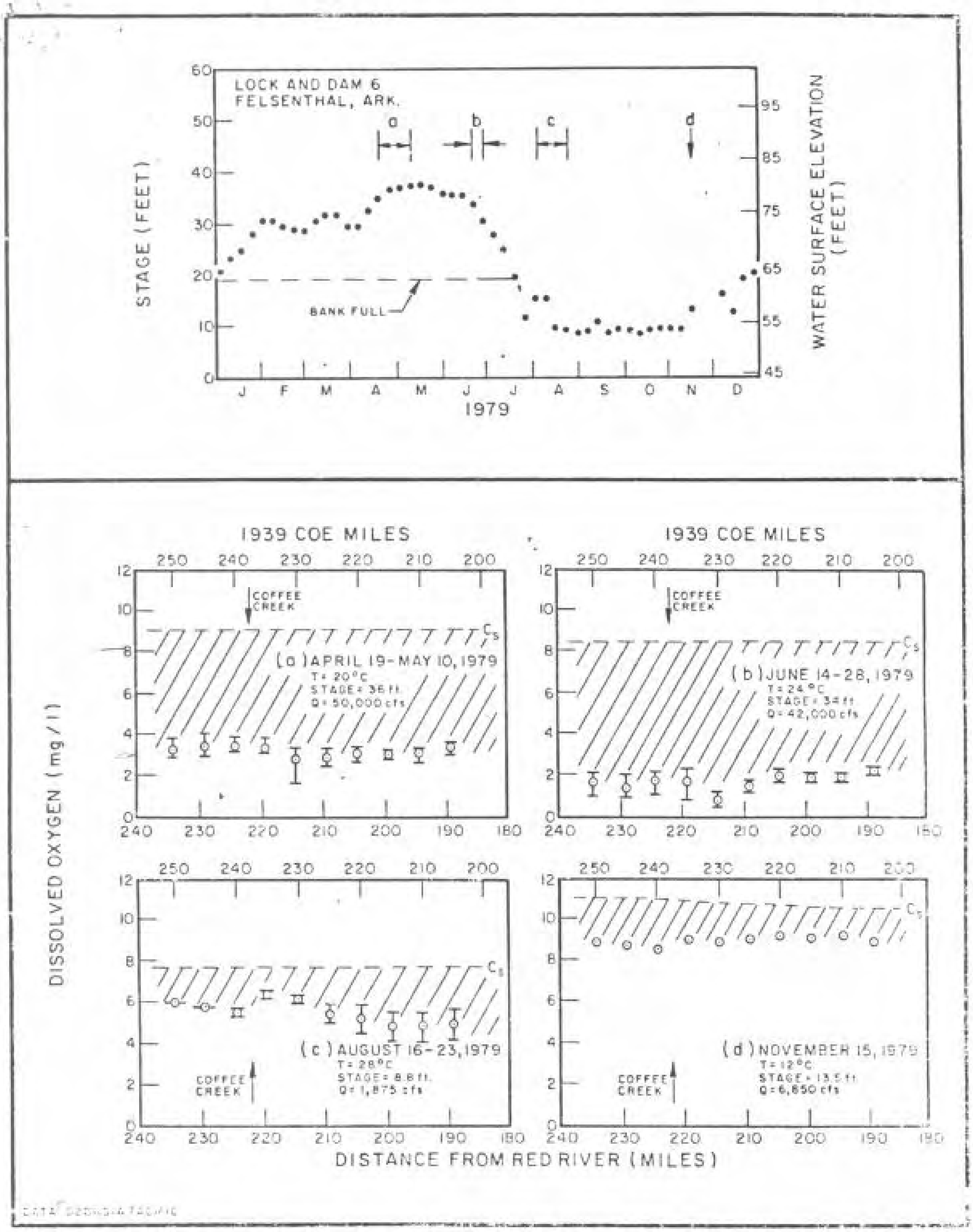

FIGURE 3

SPATIAL PROFILES OF DISSOLVED OXYGEN IN OUACHITA RIVER
1979 ROUTINE SURVEY DATA

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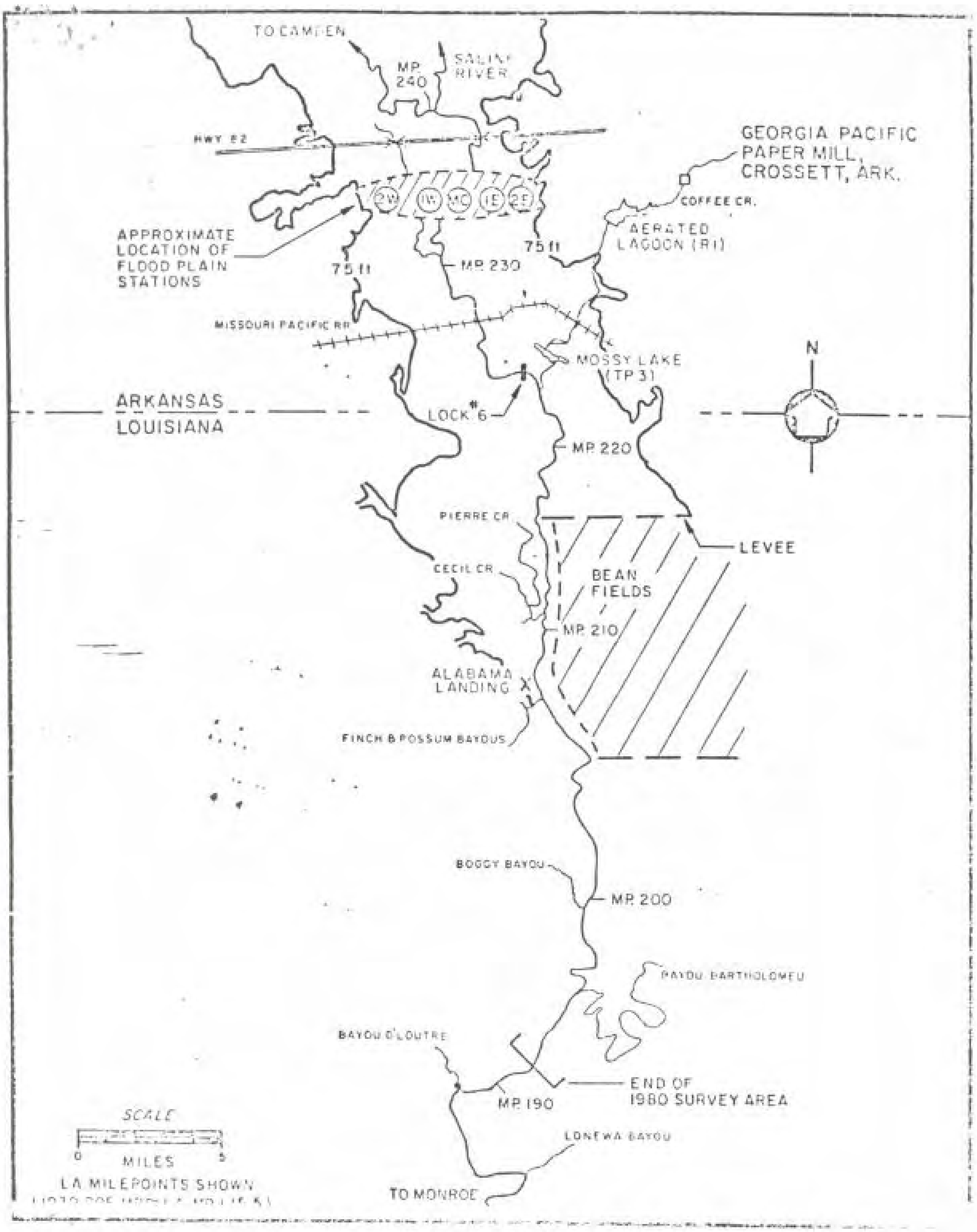

FIGURE 4

LOCATION OF FLOOD PLAIN SAMPLING STATIONS

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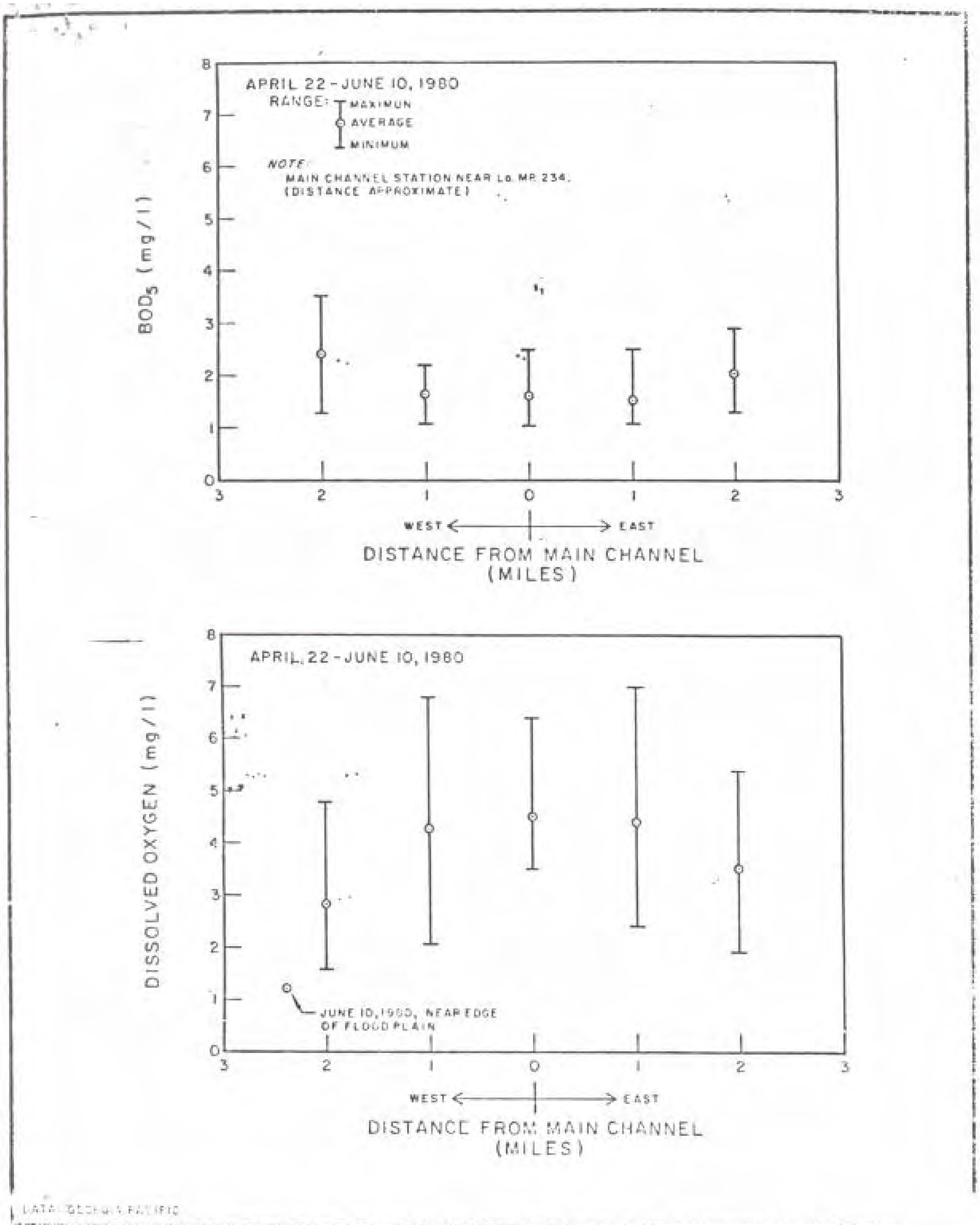

FIGURE 5

SPATIAL PROFILES OF BOD_5 AND DISSOLVED OXYGEN
EAST-WEST FLOOD PLAIN TRANSECT

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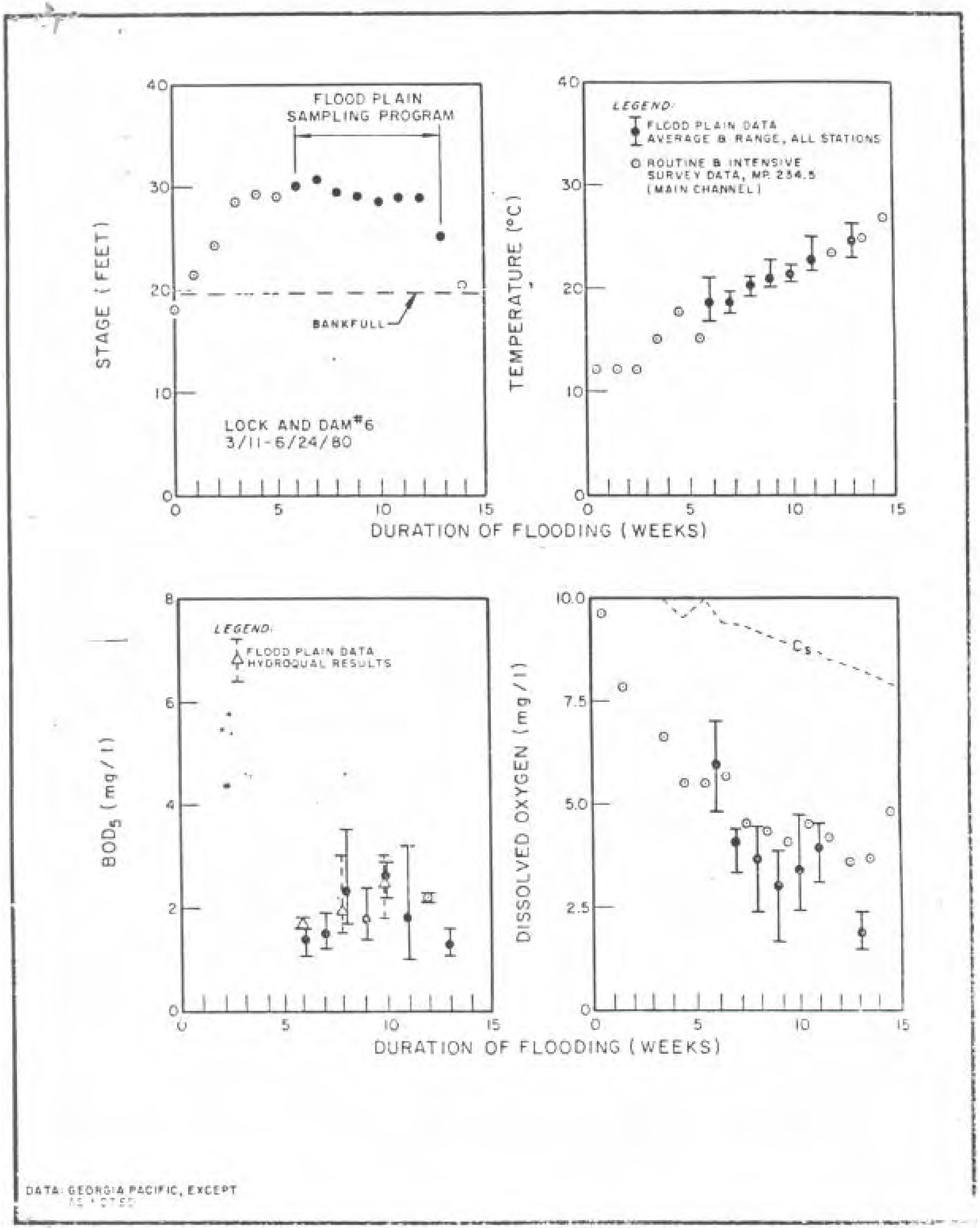

FIGURE 6

CHRONOLOGICAL PLOT OF FLOOD PLAIN SURVEY DATA, MARCH 11 TO JUNE 24, 1980

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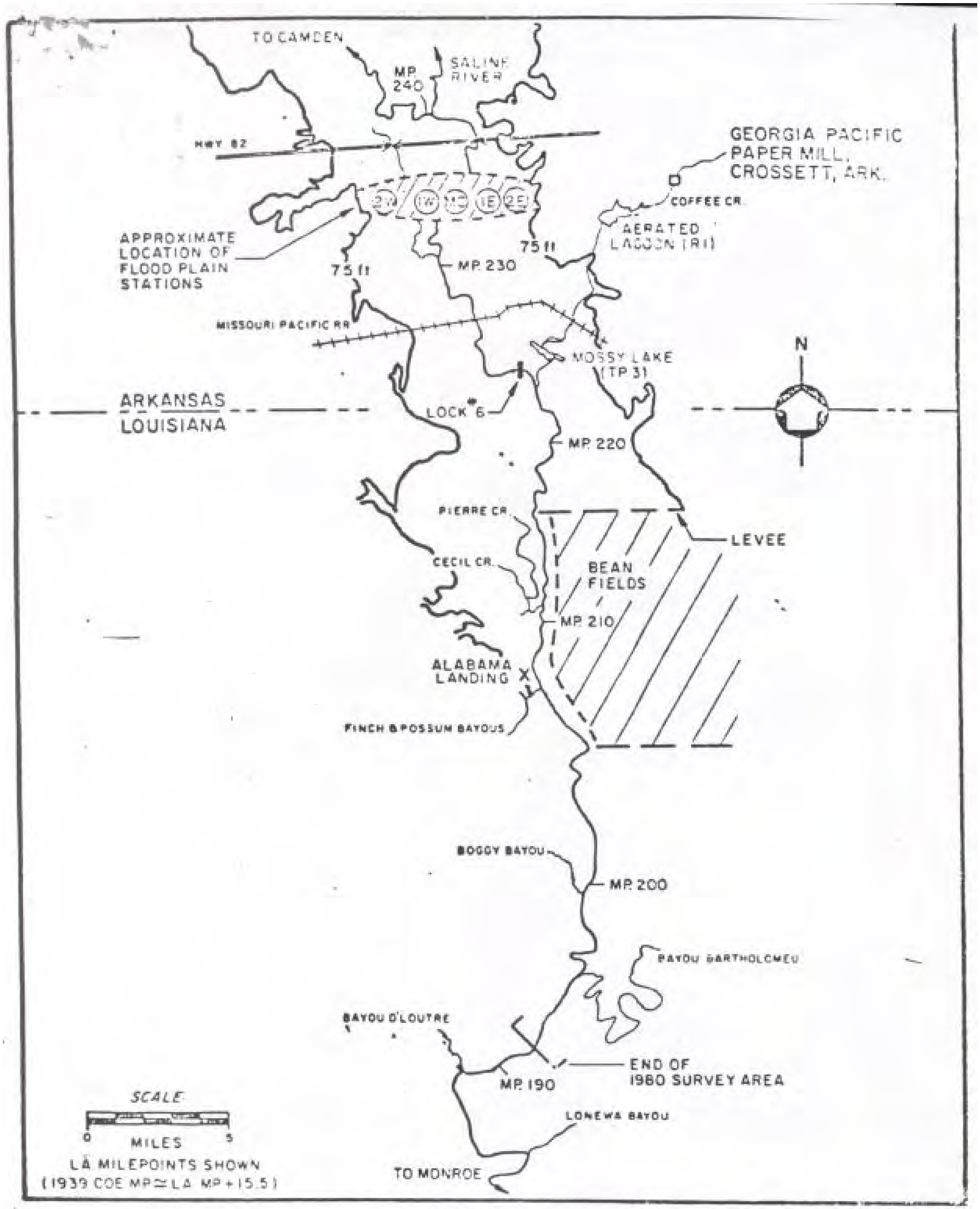

FIGURE 5

LOCATION OF FLOOD PLAIN SAMPLING STATIONS

EXHIBIT A
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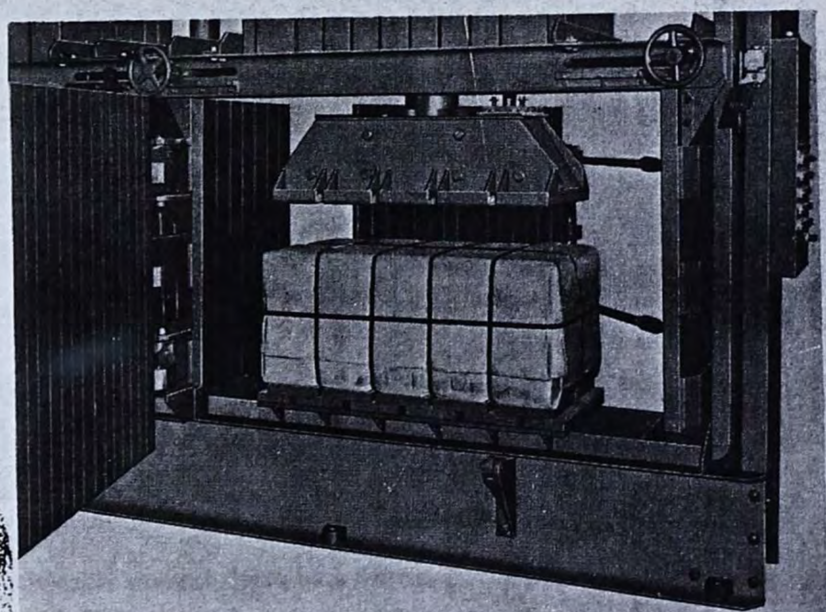

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Write today for further information to—

EXHIBIT A
Attachment 4

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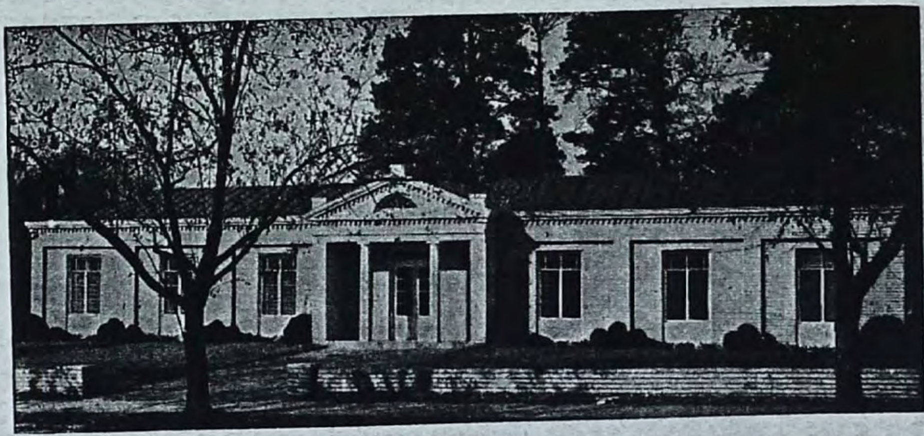

Executive and Editorial Offices
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Merry Christmas — *Happy New Year*

DECEMBER 10, 1956

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In This Issue

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EXHIBIT A
Attachment 4

A Story of Water for Crossett Pulp and Paper Mills

By RAMON GREENWOOD
Director of Public Relations
The Crossett Company, Crossett, Arkansas

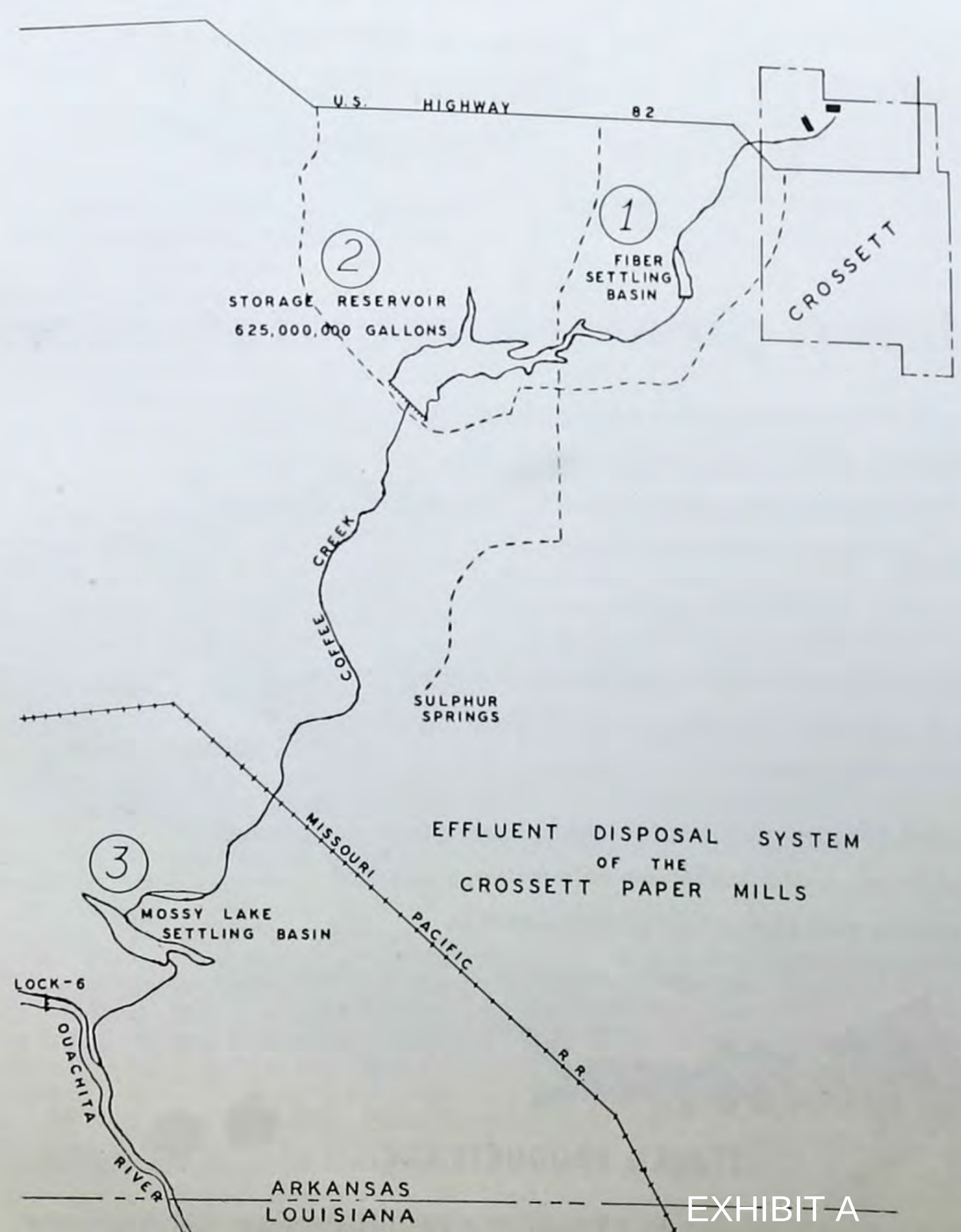
Water is perhaps the most necessary one of nature's many lavish bounties enjoyed by man. Without water, life would be a great deal different than we know it today—if life could exist at all.

Water means food, power, transportation, industry, recreation.

Americans drink more than 40 million gallons each day. The entire national requirement averages 170 billion gallons of water each 24 hour period. For each glass we drink, the economy needs 250 gallons to keep rolling.

Fifteen gallons of water go into your Sunday newspaper. Your favorite television hour costs a few pennies worth of electricity, but 80 gallons of water are used to generate that electricity.

On your Sunday drive, you average two miles to each gallon of water used in making your gasoline.



Water for Paper

But nowhere in our life today is water more essential than in the pulp and paper industry. Paper cannot be made without water.

This fact means that The Crossett Company's paper mills require about 27 million gallons of water each day to produce 415 tons of kraft paper and 150 tons of bleached food board. It means that Crossett Paper Mills must have a steady source of water if production is to be maintained; it is just as certain that the mills must have a place to dispose of a like amount of waste water. To meet these realities, The Crossett Company devotes a great deal of time, money and effort.

The source for this 27 million gallons daily requirement is 21 company owned water wells located in two well fields within a few miles of the plants. The production of these wells range from 500 to 600 gallons per minute each for some of the "old" wells, which were brought in during the 1930's to provide water for the Kraft Paper Mill, to the 2,000 gallons per minute production each of seven new wells established with the advent of the new Bleached Food Board Mill. These wells are from 135 to 227 feet deep. Both fields draw on what experts call a "great reserve of water."

Water from these two fields is piped to Crossett Paper Mills where it is run through giant reservoirs that hold almost two million gallons. Water for the Kraft process goes into the mill just as it comes from the ground, but about 75 per cent of that used in the bleached board production is processed through a huge water softening plant.

Once in the mills, water is used principally to wash the unbleached and bleached pulps and as a carrying agent.

The Kraft Mill requires about 12 million gallons of water each day or about 30,000 gallons for each ton of paper produced. Forty thousand gallons are required in the bleaching process for each ton of food board. Daily requirements for the Board Mill are 15 million gallons or about 100,000 gallons for each ton of bleached food board produced.

To be more specific, the water demanded at the Kraft Mill, for example, is used in two principal ways. More than 30,000 gallons of water are used to wash and remove the spent cooking liquor,

This aerial view shows in detail the layout of The Crossett Company's new $125,000 water impounding basin just completed on Coffee Creek. This basin, which will hold up to 625 million gallons of water, will provide an additional margin of safety in The Company's stream improvement program. To the right is the concrete spillway which will take care of overflow. Down the center can be seen the earth filled dam which stands about 20 feet high and 12 feet wide at the top. In the center of this dam are boxed culvert and gates to control the flow of water.

Samples collected from the river must be put in cold storage until tests are made to determine the amount of oxygen being demanded by organisms in the water.

lignin and some cellulose from the eight tons of pine chips "cooked" into pulp in each digester batch. This washing is repeated on each of about 75 "cooks" a day.

Water is used as a carrying agent for pulp from this point until the wood fibers are joined together in strong enough bond to stand alone as paper.

When pulp has been washed it is diluted to one part pulp and 99 parts water so that everything but the perfect single fibers can be screened out for the paper machines. Following this screening process water is removed from the pulp which is then transported to the paper machines. At the machines, the pulp is diluted again to a 99 to one consistency and carried into the Fourdrinier machines. Water is removed from the pulp mixture in succeeding manufacturing steps until the fibers are joined in the form of paper.

The same water is used over and over, but ultimately some 27 million gallons of soiled water must be discharged from the mills each day.

Meanwhile, The Crossett Chemical Company, Crossett Lumber Company and city of Crossett are also requiring more than three million gallons of water. Some one million gallons are discharged from The Chemical Company to be carried away with the effluent from the paper mills.

Disposal of Water

At this point, The Crossett Company's concern with the water it brings into its manufacturing plants is far from dismissed, for now must be faced the problem of how and where to safely dispose of 27 million gallons of soiled water each day. The concern is now pollution control or stream improvement on the Ouachita River into which the disposal is made. It's a matter of river health.

The major problem in stream improvement is the maintenance of a proper balance of oxygen in the water. The river, just as man, must have oxygen, but only in very small quantities when compared with our demand. A river in the best of health may contain no more than one pound of oxygen in 60 tons of water. By comparison, each of us inhales as much oxygen in a day as a million gallons of water contains. Actually, men live in an atmosphere in which one part in every five is oxygen, while a river's atmosphere has its free oxygen measured in parts per million.

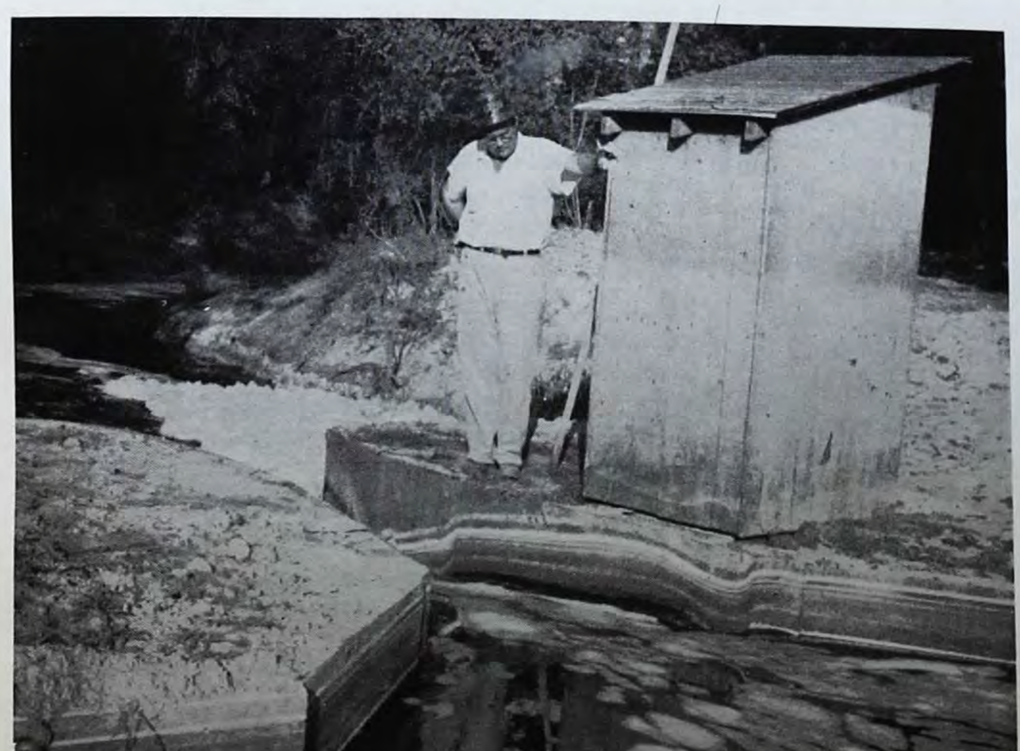
The water discharged from The Crossett Company's plants carries suspended and dissolved materials which eat up large amounts of oxygen from the water. If water containing these materials should be dumped into the river with no thought to stream improvement, some of the oxygen would be used up, endangering the health of the river and ultimately aquatic life. The idea is to satisfy as much of the appetite of these materials for oxygen as possible before the water is released into the river.

The Answer

Fortunately, The Company has the answer in fast moving Coffee Creek that winds its way for 15 miles across the countryside before it finally enters the big Ouachita River; in man-made impounding basins, flumes and gates constructed along the creek's circuitous route, and in a staff of highly skilled scientists who practice the art of river medicine.

These extensive facilities have just been further improved with the construction of a new $125,000 water hold-

(Please turn to Page 60)



Mr. Sadler is checking one of several flumes built along Coffee Creek. At these flumes his specialists are able to measure the flow of water and secure samples for testing.

A Story of Water . . .

(Continued from Page 54)

Jack W. Sadler, who heads a team of six stream improvement specialists for The Crossett Company, is shown adjusting the gates which control the flow of water out of Mossy Lake into the Ouachita River.

ing basin. This basin, which was completed early this month, will hold up to 625 million gallons of water in a 264 acre site about three and one-half miles from the mills. Plans also call for a fiber settling pool about the size of a football field to be located nearby.

In announcing the construction of these new facilities, The Company said that its anti-stream pollution facilities, "provide more than adequate effluent disposal service for existing production installations," and that the new facilities were constructed "because we want to assure the people of this area and ourselves of an additional margin of safety in our pollution control system."

The successful pollution control system works like this: The suspended materials which demand oxygen begin to settle out of the water just as soon as it leaves the mills. Almost all of the remaining materials leave the water in the first settling pool. The water is then allowed to flow into the impounding basin where it can be held up to 25 days. On the trip down Coffee Creek from the mills and in the basin the dissolved materials have had ample opportunity to feed on oxygen until almost all of the appetite is satisfied. Water is then released on a schedule determined by stream improvement specialists into Coffee Creek for the trip to Mossy Lake, a 175 acre holding basin near the Ouachita River which has been in operation since The Company first entered the pulp and paper business in 1937.

After further settling in Mossy Lake, the water is released into the river.

The River Doctors

The responsibility for the successful operation of this system is in the capable hands of scientists in The Company's Research Division. Six highly trained men under the direction of Jack W. Sadler, Research Chemist, conduct a running series of tests both on the river and in laboratories to determine the health of the water and to make certain that no materials released into the river can cause damage.

Three times a week, Mr. Sadler's crew makes a trip 29 miles down the broad, slow running river to Sterlington, La., to probe the river and gather samples for intensive study back in the laboratories. These tests, which amount to a taking of the river pulse, are made about two miles apart all the way down to Sterlington. They consist of examinations made on the spot to determine the amount of oxygen in the water and tests conducted in the laboratories to ascertain the amount of oxygen being demanded by organisms in the water.

River Doctor Jack W. Sadler is pictured making a test to determine the amount of oxygen in the water during one of the regular trips down the Ouachita River.

From these tests, the river doctors can determine the health of the river and how much water should be released from Mossy Lake. Findings are also supplied to federal and state authorities concerned with river health.

The Crossett Company concerns itself with more than the blessings and responsibilities of the best use of water in its own operating area. It has joined with the other paper producers of America to finance the progressive work of the National Council for Stream Improvement. This organization is devoted to the purpose of developing solutions to the industry's waste disposal and water utilization problems.

Some 12 million gallons of water are discharged from the Kraft Paper Mill through this gate each day. Stream improvement tests begin at this point.

Mississippi Pulp and Paper Co. Asks for Water Intake Permit

The Mississippi Pulp and Paper Co., of Columbus, Miss., has announced location of a $30,000,000 plant near here last summer, and has now made application to the U. S. Corps of Engineers for a water intake structure on the Tombigbee River.

Application for a permit for the structure was made to the Mobile office, and calls for a structure on the east bank, at mean low water line and dredging an area 10 feet deep, fronting the structure.

The plant is to be located on the river between Columbus and the Air Force base, approximately six miles northeast of the city.