Mississippi Water Resources Research Institute
Annual Technical Report
FY 2006

Introduction

The Mississippi Water Resources Research Institute (MWRRI) provides a statewide center of expertise in water and associated land use and services as a repository of knowledge for use in education, research, planning, and community service.

The MWRRI goals are to serve public and private interests in the conservation, development, and use of water resources; to provide training opportunities in higher education whereby skilled professionals become available to serve the government and private sectors alike; to assist planning and regulatory bodies at the local, state, regional, and federal levels; to communicate research findings to potential users in a form that encourages quick comprehension and direct application to water-related problems; to assist state agencies in the development and maintenance of a state water management plan; and to facilitate and stimulate planning and management that:

deals with water policy issues supports state water agencies' mission with research on problems encountered and expected provides water planning and management organizations with tools to increase efficiency and effectiveness

Research Program

The Mississippi Water Resources Research Institute (MWRRI) conducts an annual, state-wide competitive grants program to solicit research proposals. Proposals are prioritized by their ability to obtain Letters of Support or External Cost Share from non-federal sources in Mississippi. The MWRRI's External Advisory Board then evaluates all proposals.

Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity

Basic Information

Title:	Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity
Project Number:	2006MS44B
Start Date:	3/1/2006
End Date:	2/28/2008
Funding Source:	104B
Congressional District:	3rd
Research Category:	Water Quality
Focus Category:	Wetlands, Water Quality, Management and Planning
Descriptors:	
Principal Investigators:	Gary N. Ervin, Todd Tietjen

Publication

1. Ervin, G.N., M.J. Linville. 2006. The landscape context of plant invasions in Mississippi wetlands. Pages 34-41 in Proceedings of the 36th Annual Mississippi Water Resources Conference, Jackson, MS.

SECTION I: Contact Information

Project Title: Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity.

Principal Investigator: Gary N. Ervin & Todd Tietjen
Institution: Mississippi State University
Address: PO Box GY
Mississippi State, MS 39762
Phone/Fax: Tel.: (662) 325-1203 Fax.: (662) 325-7939
E-Mail: email: gervin@biology.msstate.edu

SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal: $18,898 Non-Federal: $44,212, Cost Share: $44,212

Equipment (and cost) purchased during reporting period: none

Progress Report (Where are you at in your work plan):

This report covers two quarters. During the present reporting period, data collection focused exclusively on water quality monitoring along the Sunflower River. A range of water quality parameters were sampled in support of the Sunflower River Augmentation project. These data (See attached powerpoint presentation) were collected to assess the benefits of enhanced flow in this river system, but they also demonstrated the importance of traditional measures of water quality. The wide range in variability continues to be evident at any of the sampling sites across the dates presented and along the entire length of the river from Indianola to North of Clarksdale. In general there is some evidence that supplemental flows have improved water quality in the river. There is a visual correlation between periods with increased streamflow, decreased water temperatures and higher dissolved oxygen concentrations. A complete data set will be necessary before statistical assessments are attempted.

The Yazoo-Mississippi Delta Joint Water Management District has found the water quality data collected to be of considerable benefit. As a consequence, they have continued and expanded this collaboration and supported a follow-up proposal with a similar level of in-kind cost-share. This second year of funding, provided through another WRRI grant, is being managed by Dr. Tietjen because of its greater focus on water quality data monitoring.

Problems Encountered:

Discharge in the Sunflower River and rainfall/runoff in the broader region have made sampling at some sites more difficult than anticipated. Some upstream sites have not had sufficient water present to collect data. In general all sites south of Clarksdale have been sampled regularly.

Publications/Presentations (Please provide a citation and if possible a .PDF of the publication or PowerPoint):

Paper presented: Tietjen, T.E. and G.N. Ervin. 2007. Water Quality and Floristic Quality Assessments of the Big Sunflower River Following Streamflow Augmentation using Groundwater. Mississippi Water Resources Conference. Jackson, MS. (PDF appended)

Student Training (list all students working on or funded by this project)

Name	Level	Major
D. Christopher Holly	M.S.	Biological Sciences
Lucas C. Majure	M.S.	Biological Sciences
Dustin Whitehead	B.S.	Wildlife and Fisheries
Hawken Brackett	B.S.	Wildlife and Fisheries

Next Quarter Plans:

Water quality sampling (instrument based) will continue through the next quarter at approximately weekly intervals at 13 sampling sites. If possible storm events will be sampled during this quarter in order to address the importance of these periodic events.

Vegetation sampling will be conducted again at the same points sampled during 2006. This will give a better indication as to whether differences observed in 2006 data were real, and thus whether they are linked to real patterns in land use, stream features, or water management along the upper reaches of the Sunflower River.

Water Quality and Floristic Quality Assessments of the Big Sunflower River Following Streamflow Augmentation Using Groundwater

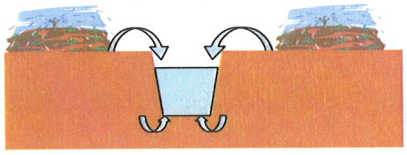
Todd Tietjen
Department of Wildlife and Fisheries
Gary N. Ervin
Department of Biological Sciences
Mississippi State University

Funding Provided by:
- Mississippi Water Resources Research Institute
- Yazoo Mississippi Delta Joint Water Management District
- Mississippi State University

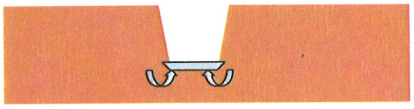
Big Sunflower River

- During the winter and spring streamflow in the Sunflower is derived primarily from precipitation runoff.

- During the summer streamflow in the Sunflower is primarily derived from irrigation runoff.



- During the fall there is insufficient groundwater to maintain stream flow

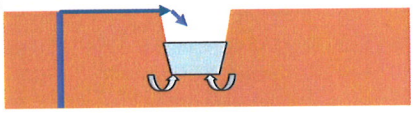


The Problem

- During the fall (September to November) period the low flows in the Big Sunflower there are severe biological limitations
  - Low flow: Reduces habitat availability and the quality of this habitat
    - Reduces critical habitat for fish
    - Reduces or eliminates areas for wetland plants
    - Reduces wildlife and waterfowl habitat
  - Low flow negatively impacts water quality
    - Clarksdale sewage treatment
    - Broader water quality concerns

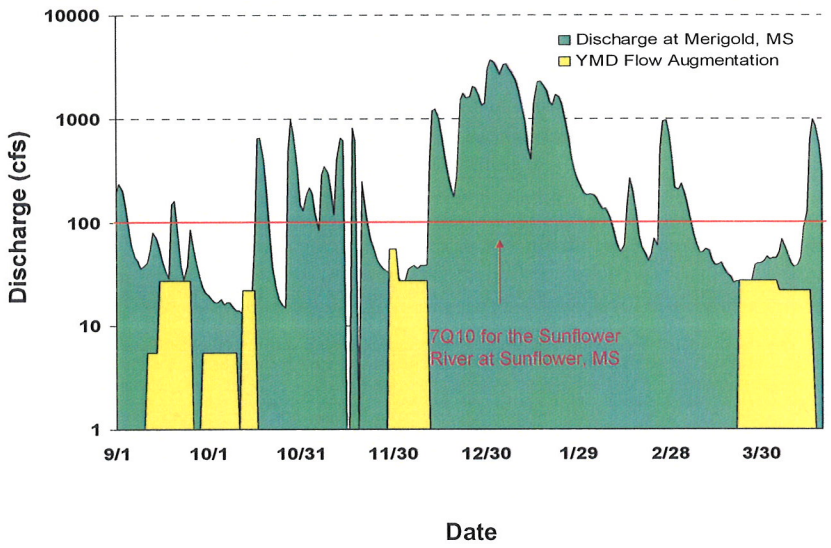
A Proposed Solution

- Increase flow in the Big Sunflower during this critical fall period by supplementing baseflow with water pumped from the Mississippi Alluvial Aquifer.



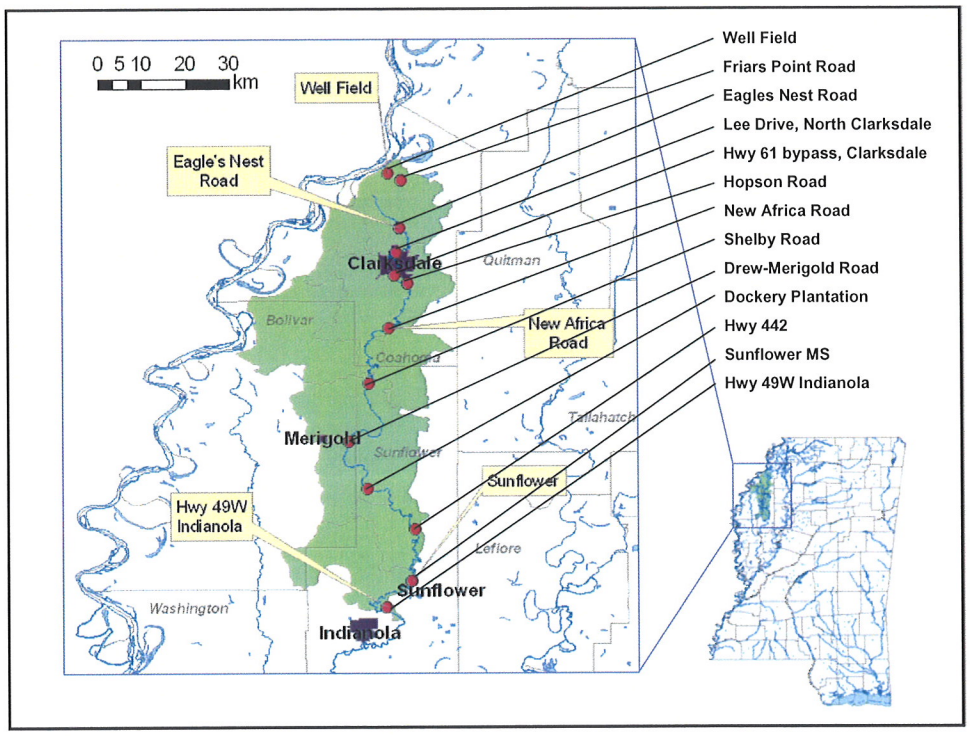
- This supplemental flow has been occurring to a limited extent south of Clarksdale
  - Power plant discharge
- Is there a demonstrable benefit to augmenting streamflow?

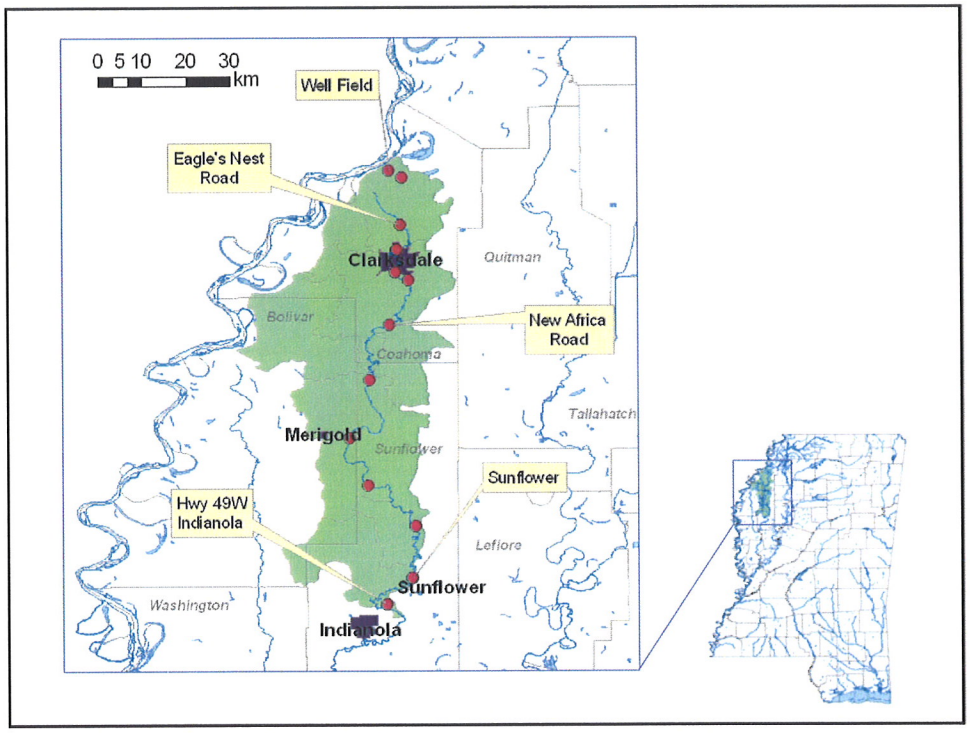
Recent Discharge History for the Big Sunflower River at Merigold, MS

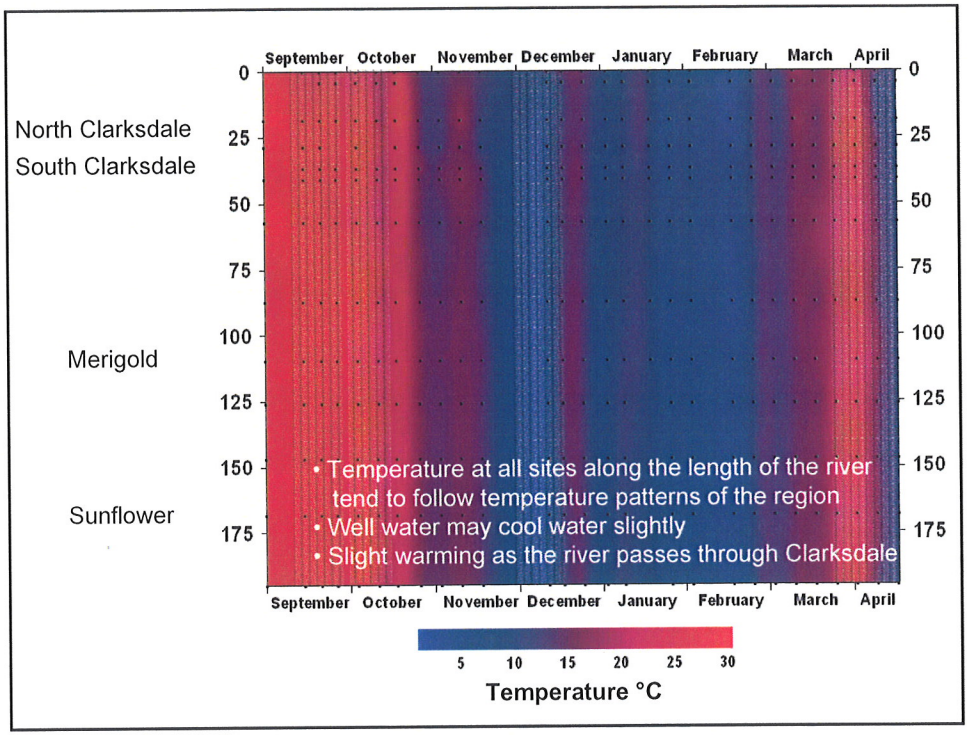


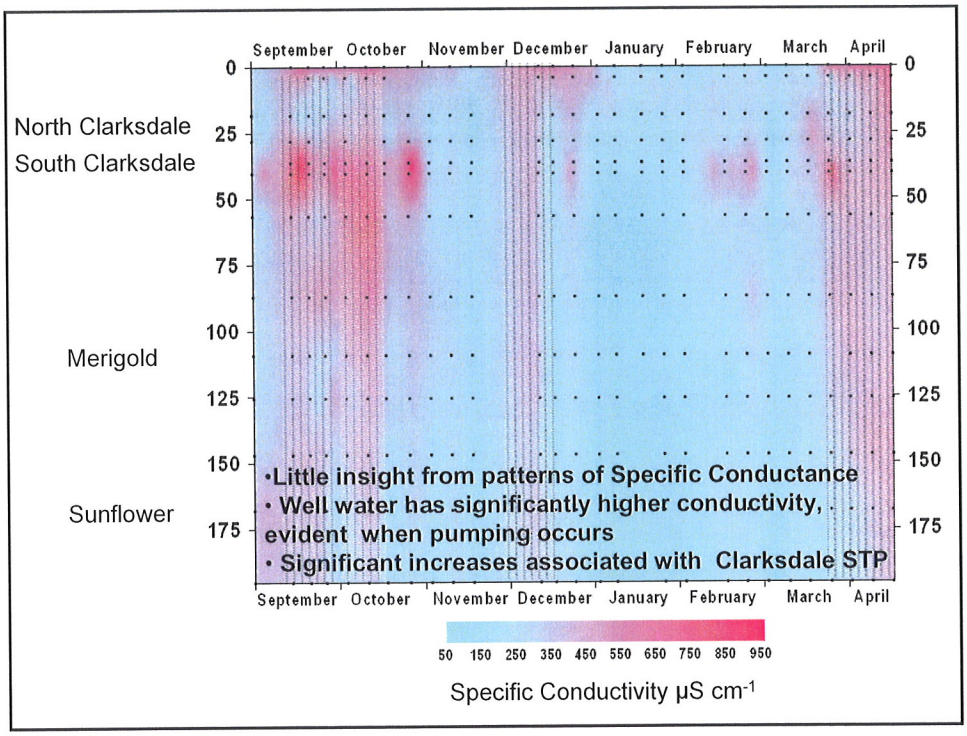
Water Quality Measurements

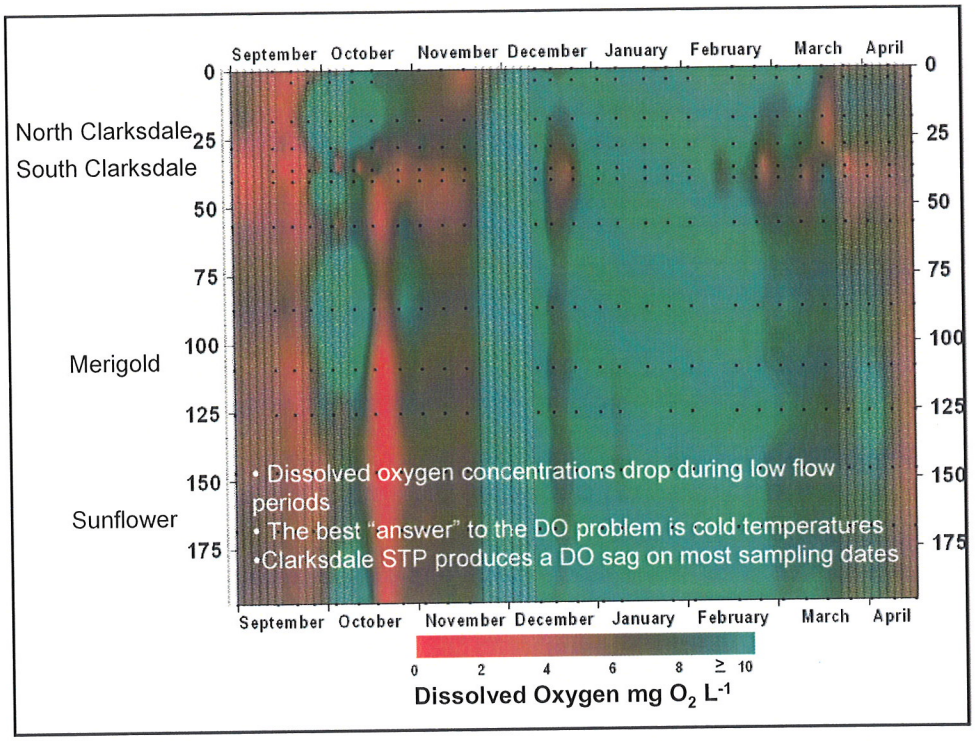
- Water quality has been measured at up to 13 locations, approximately weekly over this period.
- Water quality parameters include
  - Temperature
  - Dissolved Oxygen
  - pH
  - Specific Conductance
  - Turbidity

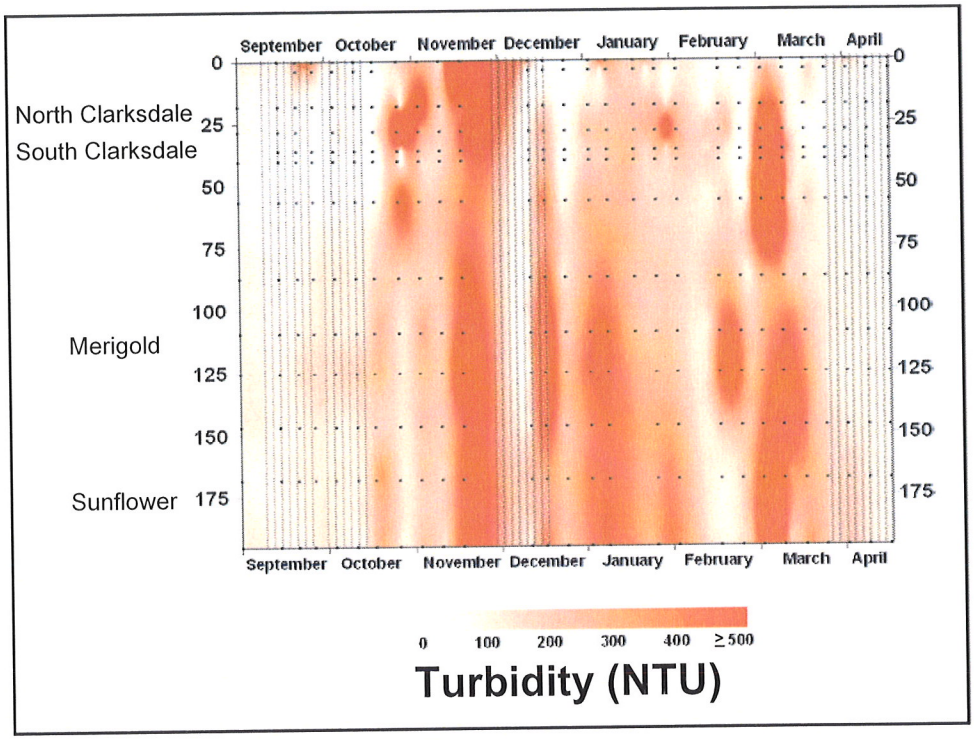

0 5 10 20 30
km
Well Field
Eagle's Nest Road
Clarksdale
Quitman
Bolivar
New Africa Road
Coahoma
Tallahatch
Merigold
Sunflower
Sunflower
Hwy 49W Indianola
Leflore
Sunflower
Washington
Indianola
Well Field
Friars Point Road
Eagles Nest Road
Lee Drive, North Clarksdale
Hwy 61 bypass, Clarksdale
Hopson Road
New Africa Road
Shelby Road
Drew-Merigold Road
Dockery Plantation
Hwy 442
Sunflower MS
Hwy 49W Indianola


0 5 10 20 30
km
Well Field
Eagle's Nest Road
Clarksdale
Quitman
Bolivar
New Africa Road
Coahoma
Tallahatch
Merigold
Sunflower
Sunflower
Hwy 49W Indianola
Leflore
Sunflower
Washington
Indianola


September October November December January February March April
0
25
50
75
100
125
150
175
North Clarksdale
South Clarksdale
Merigold
Sunflower
• Temperature at all sites along the length of the river tend to follow temperature patterns of the region
• Well water may cool water slightly
• Slight warming as the river passes through Clarksdale
5 10 15 20 25 30
Temperature °C


September October November December January February March April
0
25
50
75
100
125
150
175
North Clarksdale
South Clarksdale
Merigold
Sunflower
•Little insight from patterns of Specific Conductance
• Well water has significantly higher conductivity, evident when pumping occurs
• Significant increases associated with Clarksdale STP
50 150 250 350 450 550 650 750 850 950
Specific Conductivity µS cm-1


September October November December January February March April
North Clarksdale
South Clarksdale
Merigold
Sunflower
0 25 50 75 100 125 150 175
• Dissolved oxygen concentrations drop during low flow periods
• The best "answer" to the DO problem is cold temperatures
•Clarksdale STP produces a DO sag on most sampling dates
0 2 4 6 8 ≥ 10
Dissolved Oxygen mg O_2 L^{-1}


September October November December January February March April
North Clarksdale
South Clarksdale
Merigold
Sunflower
0 25 50 75 100 125 150 175
0 100 200 300 400 ≥500
Turbidity (NTU)

Water Quality

- There is some indication that the streamflow augmentation efforts provide some benefits to the overall water quality of the Upper Big Sunflower River
  - During mid-October when stream discharge decreased and was not supplemented by pumping Dissolved Oxygen concentrations declined despite cooling temperatures.
- Continuous monitoring during critical periods might capture other benefits

Long Term Benefits of Increased Discharge

- If short term benefits to water quality are occurring then are there long term benefits?
- Clarksdale has been "augmenting" streamflow using power generation cooling water for years
- Can we identify long term habitat or ecosystem benefits of this modest discharge enhancement

Vegetation sampling

100 meters of floodplain downstream of each point, along east bank

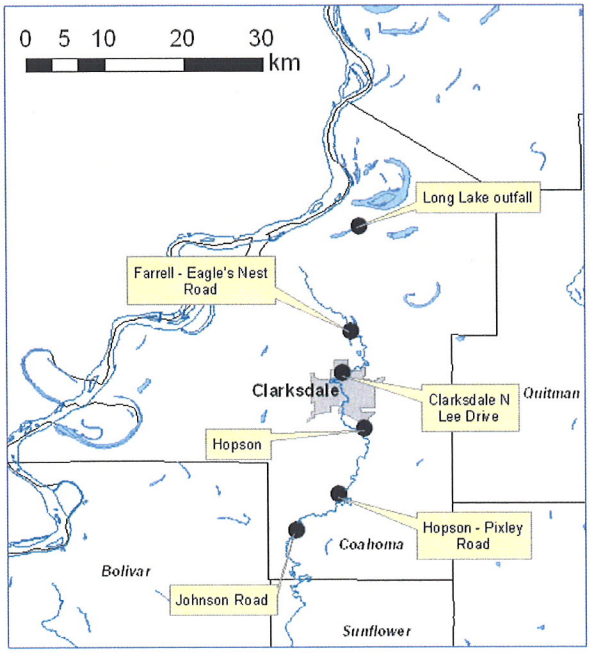
Recorded:

A) All species present and

B) Percent cover of ten 10-m transects

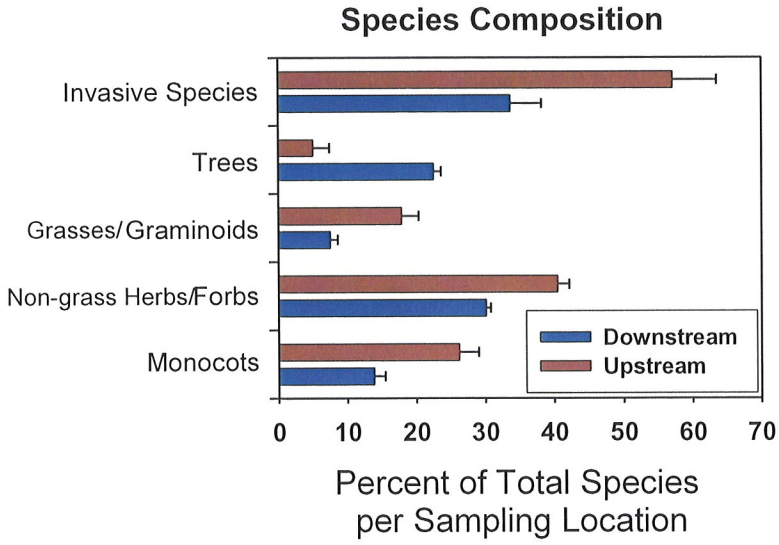
Points were selected *a priori* to balance distances north and south of the center of Clarksdale (historic pumping)

Sampling in July 2006



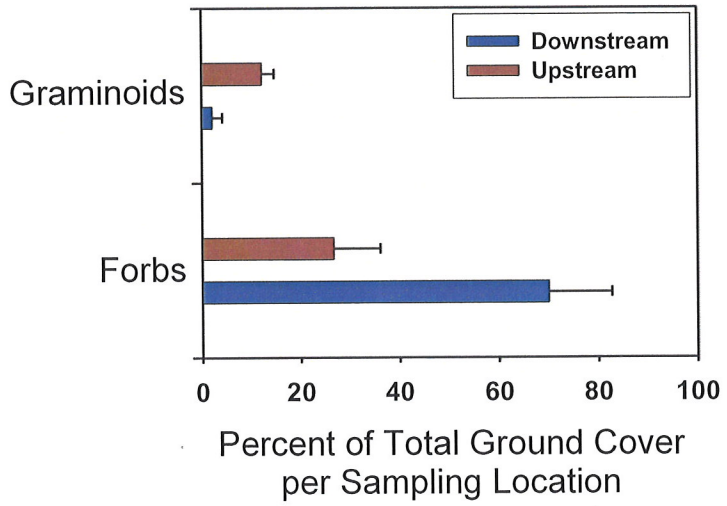
Vegetation sampling

Percent invasive species and four life history traits differed between upstream and downstream reaches



Vegetation sampling

Only two life history traits differed between upstream and downstream reaches, when evaluated by plant cover

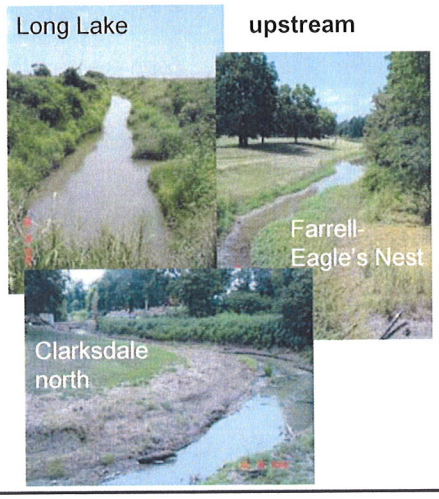


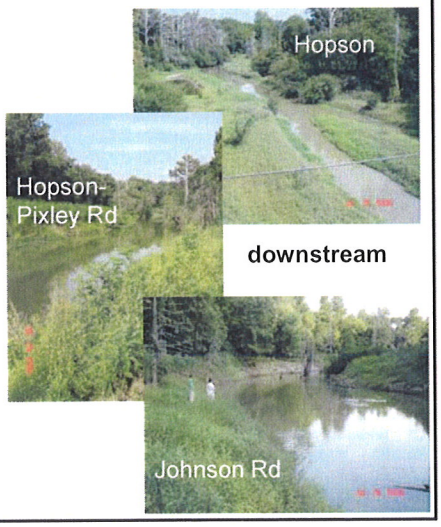
Vegetation sampling

Data indicated a weedier plant assemblage upstream from Clarksdale

This correlates with drier conditions, relative to streamflow augmentation

Upstream reaches also had a narrower floodplain, and more direct effects of human activities on riparian vegetation





Conclusions

- Streamflow augmentation provides water quality benefits
  - These benefits are somewhat limited and do not eliminate concerns
    - DO concentrations
- Longer term there are indications that the overall Big Sunflower River riparian plant community benefits from higher disharges
  - Downstream communities are less weedy, larger tree species composition

Developing a Reliable Method for Identifying Pre-settlement Wetland Sediment Accumulation Rates: 14 C Dating on Bulk Lake Sediments and Extracts

Basic Information

Title:	Developing a Reliable Method for Identifying Pre-settlement Wetland Sediment Accumulation Rates: 14 C Dating on Bulk Lake Sediments and Extracts
Project Number:	2006MS46B
Start Date:	3/1/2006
End Date:	2/28/2008
Funding Source:	104B
Congressional District:	1st
Research Category:	Water Quality
Focus Category:	Wetlands, Sediments, Methods
Descriptors:	
Principal Investigators:	Gregg R. Davidson

Publication

Developing a reliable method for identifying pre-settlement wetland sediment accumulation rates: ^{14}C dating on bulk lake sediments and extracts

May 30, 2007

Milestones

1. Cores were collected from Sky Lake in cooperation with the USDA National Sedimentation Laboratory in Oxford, MS and the Yazoo Mississippi Delta Joint Water Management District.

2. Sediment cores were sectioned and dried. Selected intervals were sieved and taken through several chemical treatment steps. Processed samples were combusted and submitted for $\delta^{13}C$ and ^{14}C analyses.

3. Results were obtained for all samples, allowing calculation of sedimentation rates for three open water cores and one wetland core.

4. Preliminary results were presented at the 19th International Radiocarbon Conference in Oxford, England.

5. A manuscript describing the use of ^{14}C from bulk sediment fractions for determining accurate sedimentation rates is in review for publication in *Radiocarbon*.

6. Particle size analyses from samples from one core are currently being processed for completion of a second manuscript detailing the full history of sediment accumulation in an oxbow lake in the Mississippi Alluvial Plain. This manuscript will be submitted in June to the *Journal of Soil and Water Conservation*.

Remaining objectives

1. Submit the second manuscript.

Narrative Summary

Carbon-14 is often used to date specific layers in lake sediments, but there are many problems that can result in erroneous calculated ages. Terrestrial macrofossils are generally the most desirable material to date, but they are often difficult to find. In the absence of macrofossils, pollen may be extracted and dated, but separation is tedious and requires use of toxic chemicals. Bulk sediment fractions contain a mixture of material of various age, and may be subject to reservoir effects that usually add apparent age to samples. A single ^{14}C measurement from a bulk sediment sample is thus unlikely to yield the true age of deposition. If inputs into the system have been relatively constant over an interval of time, however, changes in ^{14}C activity

with depth should represent accurate changes in time even if the absolute dates remain uncertain. Knowledge of changes in time and the thickness of sediment accumulated over that interval of time allows calculation of the rate of sediment accumulation.

In this study, three bulk sediment fractions have been compared with three macrofossil (or "subfossil") types.

Bulk sediment
1. untreated silt and clay size fraction, combusted at low temperature (400°C)
2. humic acid leached from silt and clay size fraction
3. undifferentiated organic material (both chemically washed and unwashed) 250-710 μm.

Macro Subfossils
1. twigs representing 1 to 2 years of growth
2. charcoal
3. wood fragments

The ^{14}C activity of all sample types have been compared from a wetland core (Figure 2). The bulk sediment fractions yield highly linear plots with respect to depth, and all yield very similar sedimentation rates (Table 1). The subfossil results are much more scattered and yield slightly lower sedimentation rates. The linearity of the bulk sediment fractions suggests they are more reliable than the subfossil samples for rate determination. This is was an unexpected, but very favorable result.

Samples from three of the cores collected from the open water area were used to test how reproducible calculated sedimentation rates are using a bulk sediment fraction. Since all three bulk sediment fractions from the wetland core produced similar results in the wetland core, only one was chosen for replicate analyses using the open water cores. The untreated silt and clay size fraction was chosen. Data from the three cores (Figure 3) demonstrated a high degree of reproducibility. Data from each core was highly linear, and all three cores show a change of slope, representing a change in sediment accumulation rate, at approximately the same depth. This data shows great promise for the use of biased ^{14}C activity from bulk sediment fractions to accurately estimate sediment accumulation rates.

Additional samples from one open-water core were processed and submitted for ^{14}C analysis to determine the complete sedimentation history of Sky Lake. The results, together with ^{210}Pb and ^{137}Cs data previously acquired, map out the history of this lake from the time it was an active channel of the Mississippi River to the present (Figure 4). Visual stratigraphy within the lake cores divides the sediment into three intervals. The bottom of each core contained coarse sands typical of channel deposits. Above the sands, a transition zone 7 to 15 cm in thickness contains sand, silt and clay. The upper 2 m of sediment are lacustrine silts and clays with no visible layering.

Carbon-14 analyses were performed on sediments within and above the transition zone. The transition zone samples are the lowermost points in Figure 4. The large scatter in ln ^{14}C activity within the transition zone with all values plotting to the left of the overlying points is consistent

with an interpretation of these sediments as channel deposits in an actively flowing system. Organic fragments deposited in a stream channel potentially include material that was living a short time earlier along with much older material that may have been exhumed upstream and redeposited at the sampling point.

Within the lacustrine silt and clay, three distinct sedimentation regimes are apparent from the radioisotope data, with steeper slopes representing higher rates of sediment accumulation. The three lacustrine intervals can be characterized, beginning with the lowest, as (1) recently abandoned oxbow with close proximity to the river, frequent flooding, and a relatively high sediment accumulation rate (1.3 mm/yr), (2) migration of the river away from the lake resulting in a reduction in flooding frequency and a much lower sediment accumulation rate (0.2 mm/yr), and (3) clearing of surrounding land for agricultural use resulting in a 50-fold increase in the rate of accumulation (10 mm/yr).

Accumulation rate over the past century was determined based on a combination of ^{14}C, ^{210}Pb and ^{137}Cs data. Changes in ^{14}C activity cannot be used as described here in sediments deposited during the last 50 years because of the large atmospheric influx of anthropogenic ^{14}C introduced by surface testing of nuclear weapons. For these recent deposits, ^{210}Pb and ^{137}Cs are well suited. The slope of excess ^{210}Pb activity vs depth, and the depth of the ^{137}Cs peak both yield a recent sedimentation rate of 10 mm/yr. A line representing changes in ^{14}C activity with an accumulation rate of 10 mm/yr is drawn in Figure 4 and projected to a depth of 110 cm. The uppermost ^{14}C samples, at depths of 79 and 99 cm, fall close to the projected line suggesting that the rate of 10 mm/yr has persisted since the land first began being cleared near the end of the 19th century.

The time interval prior to clearing of surrounding land represents at least 97% of the lake's history. This period lasted upwards of 3600 yr during which time approximately 120 cm of sediment accumulated in the lake. In the last 110 to 120 yr since land began to be cleared, an equivalent mass of sediment has been added, doubling the total sediment thickness. Radioisotope data and recent observations of sediment accumulation over the past 5 years indicate that the 50-fold increase in sediment accumulation rate continues unabated, in spite of improved agricultural practices designed to minimize soil loss.

Table 1 Linearity (r^2), slope (cm depth / ln fraction modern carbon), and calculated sediment accumulation rate based on plots of ln ^{14}C-activity verses depth for each sediment fraction.

Location and sediment fraction		r^2	slope (cm/ln fmc)	sed. rate (mm/yr)
Wetland core (Figure 2)				
twigs		0.76	428	0.52
charcoal		0.89	707	0.86
wood		0.75	506	0.61
710-250 μm (organic debris – pretreated)		0.97	810	0.98
710-250 μm (organic debris – untreated)		0.96	855	1.03
<250 μm, humic acid extract		0.98	849	1.03
<250 μm, low-temperature combustion		0.99	894	1.08
Open water cores (Figure 3)				
all <250 μm, low-temp. combustion				
Core	data points *			
1	upper 4	0.99	170	0.21
2	upper 4	0.999	133	0.16
3	upper 3	0.93	109	0.13
1	lower 2		553	0.67
2	lower 2		1376	1.66
3	lower 3	0.82	791	0.96

* "upper" and "lower" data share the transition point

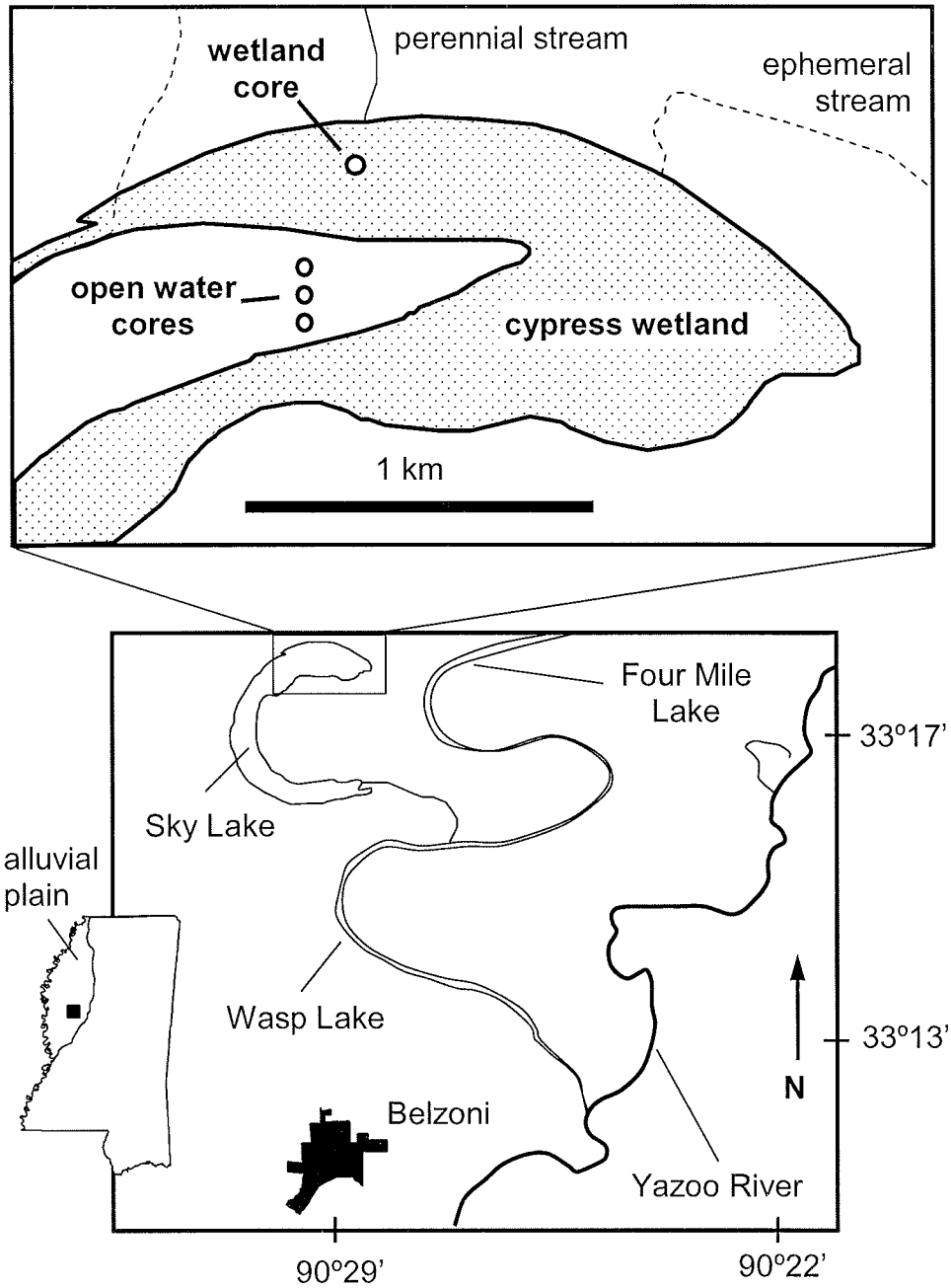


Figure 1. Study Site. The alluvial plain is the ancestral floodplain of the Mississippi-Ohio River system.

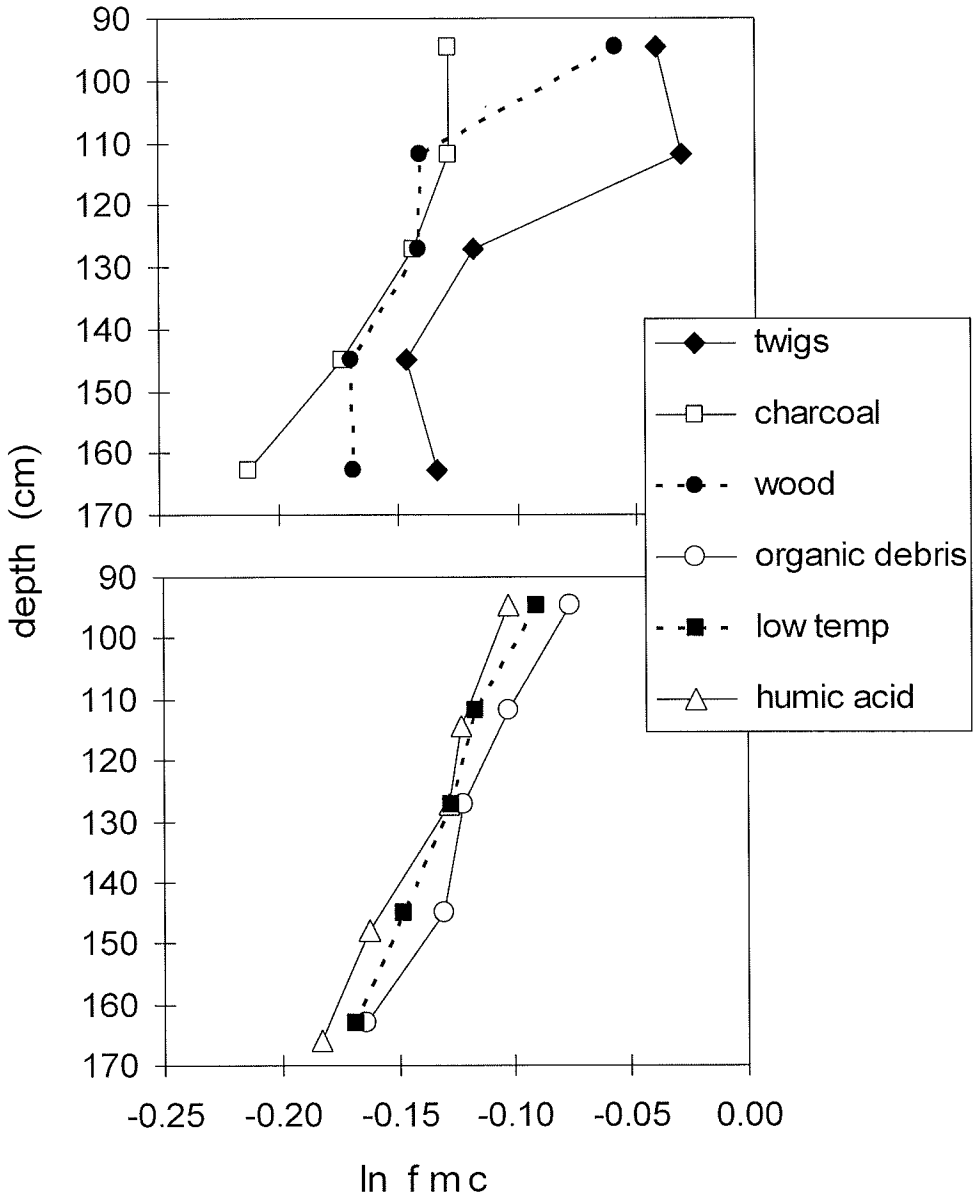


Figure 2. ^{14}C activity of samples from the wetland core (Figure 1). Data is plotted in two separate figures so all data points are visible: discrete samples (twigs, charcoal and wood fragments) are plotted in the upper graph and bulk sediment fractions (250-750 μm fraction – "organic debris"; humic acid extract from <250 μm fraction – "humic acid"; and untreated <250 μm fraction combusted at low temperature – "low temp") are plotted in the lower graph. Pretreated and untreated organic debris were not significantly different, and only the pretreated results are plotted. (ln fmc = natural logarithm of fraction modern carbon)

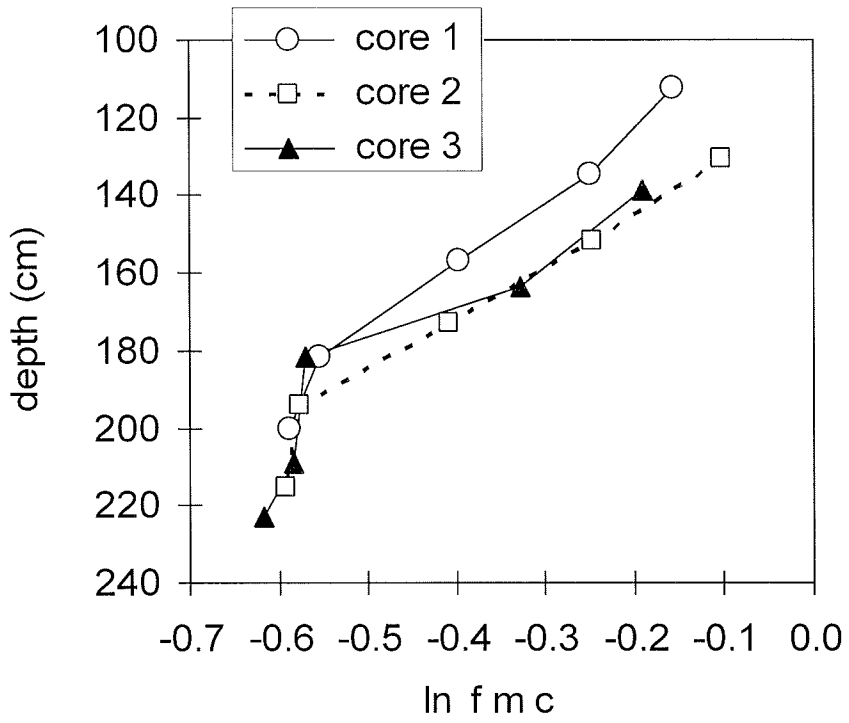


Figure 3. ^{14}C activity of samples from the three open water cores (Figure 1). All data represent the untreated <250 μm fraction combusted at low temperature. ln fmc is the natural log of the fraction modern carbon (^{14}C).

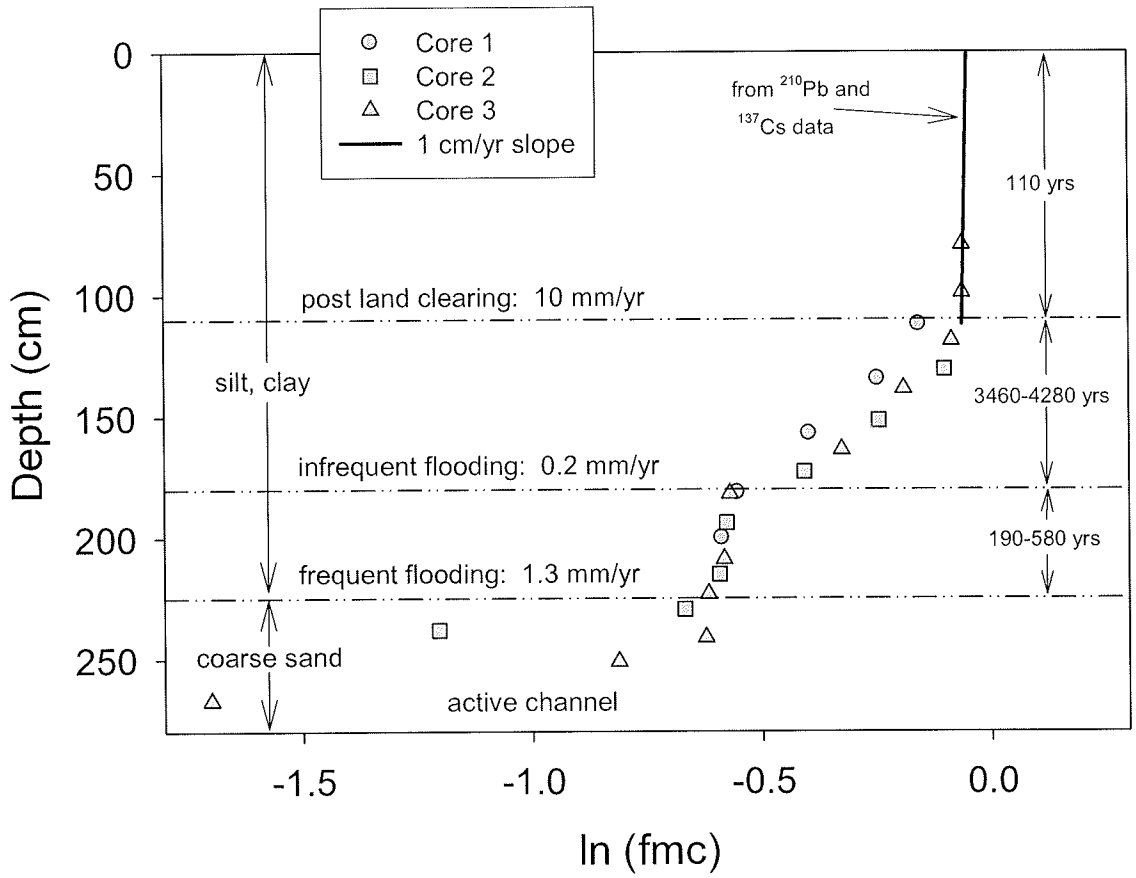


Figure 4. Sediment accumulation history of Sky Lake, Mississippi. ln (fmc) is the natural log of the fraction modern carbon (^{14}C). Sediment accumulation rates are based on the slope of a best fit line through the data for each interval. The duration of each period is based on the thickness of sediment in each interval and the sediment accumulation rate. Large ranges in time are due to uncertainty in the exact breakpoint between intervals and due to variability in interval thicknesses between the three cores.

Information Transfer Program

The Mississippi Water Resources Research Institute (MWRRI) maintains a web site (http://www.wrri.msstate.edu/) and hosts a MWRRI Water List Server for general information transfer purposes. The MWRRI also has two Information Transfer Projects: 1) an annual Mississippi Water Resources Conference, and 2) Publications.

Information Transfer Program-Publications

Basic Information

Title:	Information Transfer Program-Publications
Project Number:	2006MS69B
Start Date:	3/1/2006
End Date:	2/28/2008
Funding Source:	104B
Congressional District:	3rd
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	
Principal Investigators:	George M. Hopper

Publication

1. Mississippi Water Resources Research Institute. 2006. 2006 Annual Report. Mississippi Water Resources Research Institute. Mississippi State University, Mississippi State, MS, 24 pages.

MISSISSIPPI

WATER RESOURCES RESEARCH INSTITUTE

2006 ANNUAL REPORT

Director's notes

It has been said that water is the rarest commodity in the world. We often don't think of water as a rare commodity, especially in the U.S. where we always have clean drinking water at our fingertips. However, water is, without question, one of the most important issues facing our state and nation.

The Mississippi Water Resources Research Institute is addressing issues critical to maintaining quality water supplies in the state. This report describes research and outreach activities that address the most pressing water-related problems.

As Director, it is my desire that the Water Resources Research Institute at Mississippi State University be a premier entity in the state and region for information and expertise on water resources issues. I want the Institute to be in the forefront on water resource issues and be proactive in public outreach and education.

Plentiful supplies of clean water represent a critical natural resource to sustain economic success in our towns and cities, our fields and forests, and among our industries. Mississippi faces serious issues to ensure a plentiful supply of clean water while sustaining the vital ecological functions of our landscapes. We must provide a clear understanding of those activities that impact our water quantity and quality into the future. Thank you for your participation in these endeavors.

George M. Hopper

MISSISSIPPI

WATER RESOURCES RESEARCH INSTITUTE

2006 ANNUAL REPORT

Mississippi Water Resources Research Institute

The Mississippi Water Resources Research Institute (MWRRI) provides a statewide center of expertise in water and associated land use and serves as a repository of knowledge for use in education, research, planning, and community service.

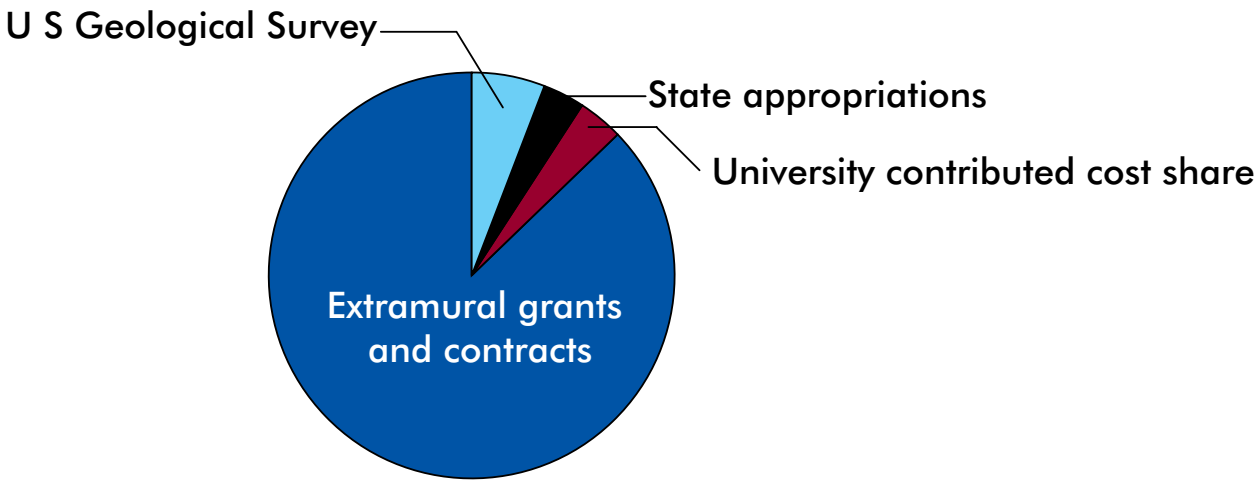
The MWRRI goals are to serve public and private interests in the conservation, development, and use of water resources; to provide training opportunities in higher education whereby skilled professionals become available to serve government and private sectors alike; to assist planning and regulatory bodies at the local, state, regional, and federal levels; to communicate research findings to potential users in a form that encourages quick comprehension and direct application to water related problems; to assist state agencies in the development and maintenance of a state water management plan; and to facilitate and stimulate planning and management that:

- deals with water policy issues,
- supports state water agencies' missions with research on problems encountered and expected,
- provides water planning and management organizations with tools to increase efficiency and effectiveness.

The Mississippi Water Resources Research Institute is a unit of the Forest and Wildlife Research Center, Mississippi State University.

Financial Summary

Program Component	Federal	Non-Federal	Total
U.S. Geological Survey grant	$123,860		$123,680
State appropriations		$75,000	$75,000
University contributed cost share		$72,888	$72,888
Extramural grants and contracts	$1,639,719	$198,999	$1,838,718
TOTAL	**$1,763,399**	**$346,887**	**$2,110,286**



MWRRI-funded projects

These projects reflect the success of the MWRRI's efforts to facilitate strong relationships between university researchers and Mississippi's state agencies and other organizations to identify and address priority water resource issues. These projects all include partial cost share from a participating non-federal agency or organization. Continuing this effort will ensure that MWRRI-sponsored research is meeting state priorities and even further leveraging scarce funding.

Analysis of stream bank erosion by lateral ground water flow

Subsurface flow is known to contribute significantly to stream flow but its contribution to streambank failure is not well known. This project investigated the contribution of concentrated, lateral subsurface flow to streambank failure and the hydraulic properties controlling seepage erosion. To predict seepage erosion effects on streambanks, detailed characterization of soil profile lithology is critical. Future research will combine an empirical sediment transport model with an existing process-based model of stream evolution. This combined model will allow for sensitivity analyses to evaluate the importance of soil, hydraulic, and geotechnical parameters on seepage erosion and mass wasting of banks.

Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity

The Big Sunflower River is listed on Mississippi's Clean Water Act § 303(d) list as an impaired waterbody. Substantial decreases in the Sunflower River's late summer/early autumn base flows, as a result of agricultural withdrawals from the Mississippi River Valley Alluvial Aquifer, likely contribute to the river's impairment. Since 1991, the Yazoo Mississippi Delta Joint Water Management District has managed surface and groundwater supplies in an effort to balance the needs of agricultural water use with broader ecosystem needs in the Sunflower River and adjacent floodplains. However, data are needed to demonstrate the responses of biotic and

abiotic ecosystem components to varying degrees of groundwater supplementation in contrast with other water sources. This project will provide a quantitative ecological evaluation of wetland and water quality impacts resulting from groundwater supplementation to a major stream in the Lower Mississippi Alluvial Valley.

Developing a reliable method for identifying pre-settlement wetland sediment accumulation rates: 14C dating on bulk lake sediments and extracts

Sediment accumulation rates in lakes and wetlands are known to increase when neighboring land is converted to agricultural use, but the magnitude of historical changes is often difficult to assess. In most areas, few records exist on natural rates before large-scale changes in land use began. This is particularly true in heavily cultivated areas such as the Mississippi Delta, where most of the land was cleared more than a century ago. Standard methods are useful to establish modern sediment accumulation rates in these areas, but not for establishing rates prior to settlement. This research is expected to yield an improved and simplified method to establish natural sediment accumulation rates in lakes and wetlands that pre-date large-scale changes in surrounding land use.

MWRRI-funded projects

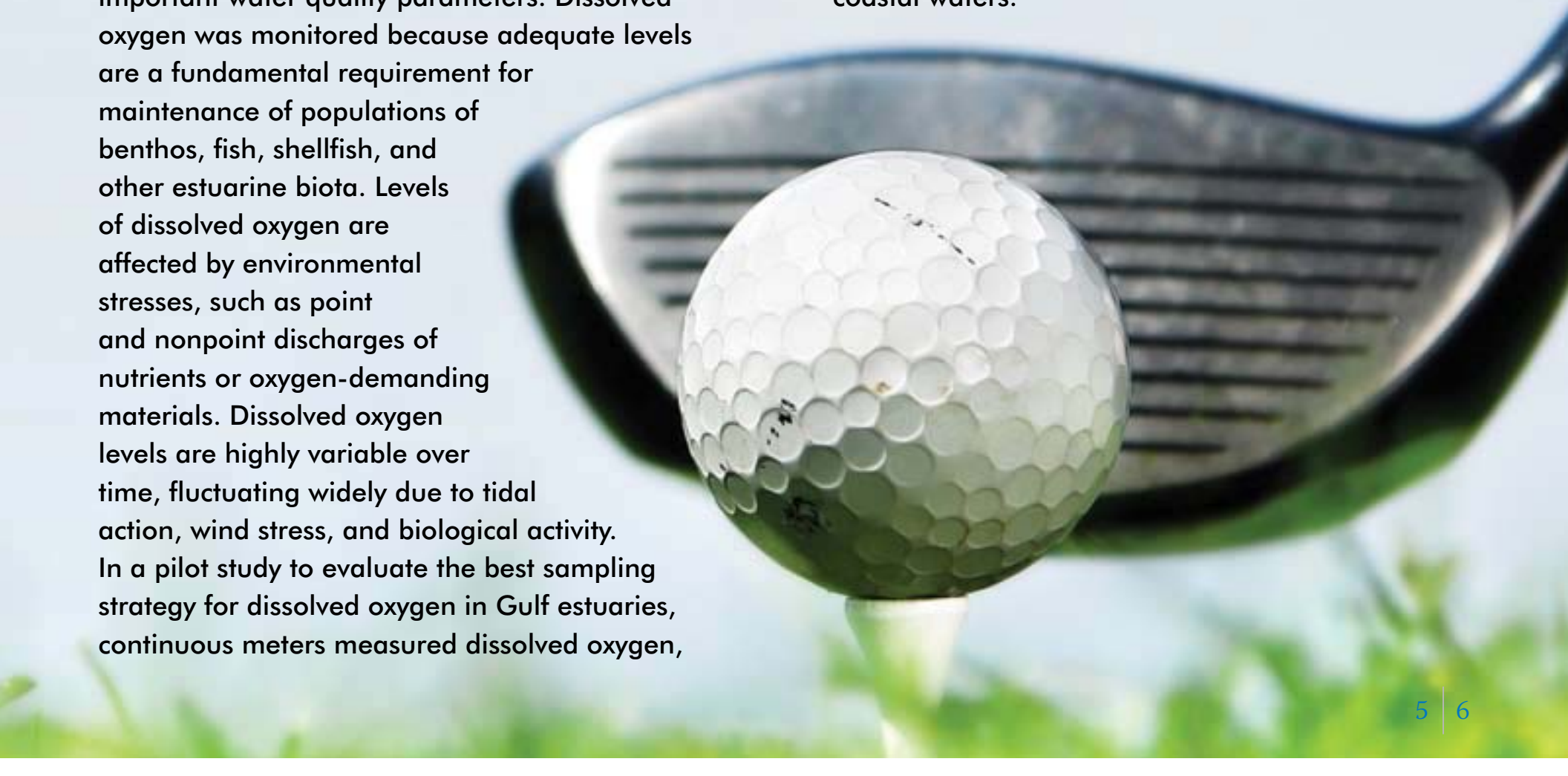
Improved estimation of nutrient and pesticide runoff losses from golf courses and residential lawns in the South Atlantic-Gulf Region

Turfgrass is the most intensively managed biological system in metropolitan areas. Currently, over 40 million acres of turf are estimated to be growing in the U.S. The intensity of pesticide and nutrient use, coupled with the anticipated continued growth in turf acreage, suggests that concerns over the impacts of turf chemicals on surface water quality will likely increase over time. This project was designed to improve the estimation of nutrient and pesticide runoff from warm-season turf managed according to conditions found on golf course fairways and residential lawns. A field protocol was developed and used to conduct runoff studies in MD, MN, MS and OK. The protocol features the use of three simultaneously-applied pesticides and rainfall simulation performed under standardized study conditions. Preliminary statistical comparisons between runoff parameters of the small and medium plot data are underway. Preliminary analyses suggest that differences in pesticide runoff from Mississippi Pride bermudagrass and Meyers zoysia grass were primarily from factors that affect the sorption/retention rather than differences in water movement that might exist between the two. These preliminary analyses indicate that future runoff estimations for pesticides having moderate to high sorption may need to account for differences in retention that exist between these grasses.

Water quality standards: Establishing nutrient criteria for Mississippi's coastal waters

Nutrient over enrichment is a common thread that ties together a diverse suite of coastal problems including harmful algal blooms (red tides), fish kills, marine mammal deaths, shellfish poisonings, loss of seagrass and bottom shellfish habitats, and hypoxia/anoxia. The "dead zone," an area in the west-central Gulf of Mexico characterized

by seasonal anoxic bottom conditions, grows in size each year and is related to nutrient runoff from the Mississippi River. Thorough assessment of coastal waters and the development of clear numerical criteria are critical to the evaluation and management of Mississippi's estuaries. This project provided data on daily and tidal variations in nutrient concentrations and other important water quality parameters. Dissolved oxygen was monitored because adequate levels are a fundamental requirement for maintenance of populations of benthos, fish, shellfish, and other estuarine biota. Levels of dissolved oxygen are affected by environmental stresses, such as point and nonpoint discharges of nutrients or oxygen-demanding materials. Dissolved oxygen levels are highly variable over time, fluctuating widely due to tidal action, wind stress, and biological activity. In a pilot study to evaluate the best sampling strategy for dissolved oxygen in Gulf estuaries, continuous meters measured dissolved oxygen, salinity, temperature, water depth, and pH at eight locations over a four-month period. Following field work, personnel worked closely with the State's Estuarine Nutrient Taskforce and the Mississippi Department of Environmental Quality to evaluate historical data, integrate current data into the database, statistically analyze the data, and propose reference conditions for Mississippi's coastal waters.



Watershed Alliances

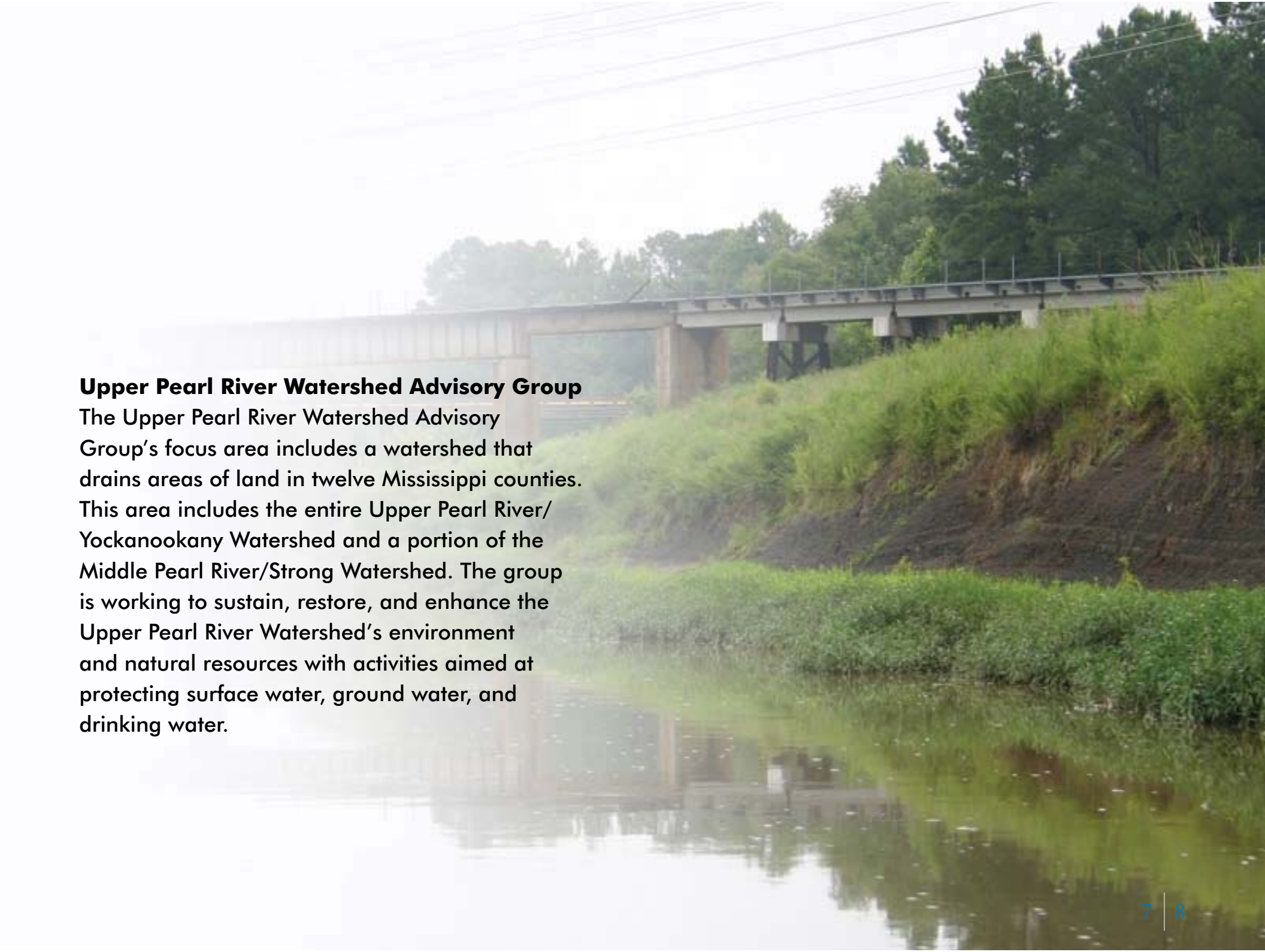
Building on the success in helping to organize the formal Upper Pearl River Watershed Advisory Group, the MWRRI is now coordinating the creation of an informal Luxapallila Creek Watershed Alliance on the Tennessee-Tombigbee (Tenn-Tom) Basin. A similar interstate effort is underway to use Geographic Information Systems (GIS) technology and geospatial data to link the upstream Tenn-Tom Waterway stakeholders with downstream coastal stakeholders in Mobile Bay.

Linking coastal and inland watersheds

The project's overall goal is to facilitate effective engagement between key inland and coastal management institutions in the Tennessee-Tombigbee/Mobile Bay Basin and to identify and integrate priority geospatial information. A sustained collaboration on data, geospatial Decision Support Systems (tools), and decision-making for the Tenn-Tom/Mobile Bay Basin is mutually beneficial to upstream and coastal communities. Mobile Bay's estuarine needs are highlighted, and the Tenn-Tom Waterway's purpose and role in regional economic development are recognized.

Luxapallila Creek Watershed Alliance

Luxapallila Creek is a multi-state watershed stretching across six counties, two in Mississippi and four in Alabama. Within these six counties, 12 subwatersheds make up the Luxapallila Watershed. The Luxapallila Creek Watershed Alliance is assisting the Mississippi Department of Environmental Quality and the Alabama Department of Environmental Management in implementing watershed protection strategies related to non-point sources of pollution in the Lux Watershed and the larger Tennessee-Tombigbee River Basin. The primary issues of concern in the Lux and Tenn-Tom are erosion, sedimentation and water quantity.



Upper Pearl River Watershed Advisory Group

The Upper Pearl River Watershed Advisory Group's focus area includes a watershed that drains areas of land in twelve Mississippi counties. This area includes the entire Upper Pearl River/ Yockanookany Watershed and a portion of the Middle Pearl River/Strong Watershed. The group is working to sustain, restore, and enhance the Upper Pearl River Watershed's environment and natural resources with activities aimed at protecting surface water, ground water, and drinking water.

Economic Development

The MWRRI continues efforts to build and expand partnerships with the private sector, county and municipal governments, and economic development agencies to identify and pursue water-related economic development opportunities in Mississippi. The MWRRI plays a key role in defining potential projects and determining their likely economic feasibility and potential. Once it is determined that a project is economically feasible and there is local or regional support, these water development projects often become long-term, multi-disciplinary efforts that utilize expertise from various departments at Mississippi State University. Similarly, the Latis Low Impact Development Tool project continues to attract interest from private and governmental economic development entities as part of a broader Smart Growth approach to satisfy stormwater runoff requirements for residential, industrial and mixed use developments. As these projects proceed, the MWRRI is being approached by local stakeholders to identify, evaluate and pursue potential economic development alternatives. The MWRRI is currently engaged in preliminary discussions on four water development projects across Mississippi.

Latis: A scaleable low impact development site assessment tool

Many federal, state and regional agencies, planners and economic development agencies continue to express a strong interest in having an easy to use tool to assess the water quality and quantity impacts of proposed developments. In 2004, with funding from the Environmental Protection Agency, the Mississippi Department of Environmental Quality and the Tennessee Valley Authority, the MWRRI organized a multi-disciplinary team of researchers from MSU to develop such

a tool to evaluate the American Eurocopter Industrial Site at the Golden Triangle Regional Airport in Lowndes County. The tool, named Latis after the Celtic goddess of clean water and ale, is intended to be useful to anyone responsible for land use planning, management, or development. Latis is used to evaluate and refine site plans after a development site has been selected. Latis can evaluate potential environmental and economic costs and benefits from incorporating Best Management Practices into the site design. Latis may also be used in conjunction with watershed-scale models to help counties develop, evaluate and adopt land use plans to direct future growth under a Smart Growth or Growth Readiness approach. Additionally, Latis was used to evaluate a "LifeStyle" development in Sumner Point, Tennessee. Most recently, Latis was used to evaluate different development alternatives for a potential, large industrial site in the Mississippi Delta.

Choctaw County multi-purpose lake project

The Choctaw County Board of Supervisors, with funding from the Natural Resources Conservation Service, is exploring a surface water impoundment as a hub for economic development. The multi-use lake will be designed to provide a surface water source for industrial water supply, an alternative high-quality surface water supply for the citizens of Choctaw County, a source of water for fire protection, and an authority-owned and operated recreational facility. This is an ongoing project in which the MWRRI is coordinating

Economic Development

civic engagement and economic feasibility/impact and geohydrologic studies to help the Supervisors move forward with a final site selection.

Northeast Madison County economic development project

Working in close cooperation with the private sector, the MWRRI is helping the Madison County Economic Development Authority (MCEDA) evaluate development alternatives for northern Madison County. As part of this project, the MWRRI hosted a stakeholder tour of the Tellico Reservoir near Knoxville, Tennessee, allowing participants from northern Madison County a first-hand look at how a successful lake project can be an economic development accelerator and a hub for various public, nonprofit and private economic and quality of life enhancements. The MWRRI also participated in a series of formal and informal public meetings in northern Madison County to develop a consensus agreement on a Statement of Purpose and Need. Finally, a multi-disciplinary team at MSU is evaluating the proposed project's economic feasibility. Assuming the project is economically feasible, MCEDA will be presented with a realistic but aggressive ten-year work plan and budget to translate the community's vision into reality.

Smith County multi-purpose lake

The MWRRI is managing a U.S. Forest Service-funded project for the Bienville Resources and Development Council (a formal, inter-local agreement between Covington, Jasper, Rankin,

Simpson, and Smith counties) to determine the feasibility of constructing an approximately 2,800-acre lake as a regional economic development hub. Approximately 60% of the preferred lake site would be on the Bienville National Forest, and the remaining 40% is on private property. In the project's current phase, the MWRRI is coordinating three main tasks: 1) a detailed geohydrologic site assessment to ensure that the preferred lake site will fill up with and hold water, 2) a regional economic impact assessment based on an economic feasibility study being conducted by PricewaterhouseCoopers, and 3) a preliminary site conceptual plan.

Invasive Species

Aquatic plant management support for the Pearl River Valley Water Supply District

The Ross Barnett Reservoir is the largest surface water impoundment in Mississippi (33,000 acres) and serves as the primary drinking water supply for the city of Jackson; Mississippi's capital city. The Reservoir is managed by the Pearl River Valley Water Supply District and is surrounded by approximately 50 residential subdivisions and over 4,600 homes. The Reservoir provides recreational opportunities in the form of five campgrounds, 16 parks, 22 boat launches, three handicapped-accessible trails, and two multi-purpose trails. In recent years, invasive species have become an increasing problem on the Reservoir by clogging navigation channels, reducing recreational fishing opportunities, and reducing access for users of the Reservoir.

A study was initiated to develop a long-term aquatic plant management plan for the Ross Barnett Reservoir. The first step in developing the management plan was to assess the Reservoir's plant community by mapping the current distribution of aquatic plant species throughout the Reservoir. A total of 19 plant species were observed during the survey, with alligatorweed located most frequently, followed by American lotus. In general, the occurrence of aquatic plants increased in the northern portion of the Ross Barnett Reservoir and in the Pelahatchie Bay area of the Reservoir where water depths were shallower. Species occurrence was low in parts of the middle and lower Reservoir where water depths were deeper.

Other components of the study included the evaluation of current management efforts as well

as the creation of geographic information systems (GIS) data layers to aid in the development and implementation of the long-term aquatic plant management plan. Future efforts will include continued monitoring of the aquatic plant distribution in the Reservoir to assess changes and spread in nuisance species populations. Techniques will also be implemented to control nuisance species and promote the growth of more desirable native plants.

Southeastern Regional Small Public Water Systems

The need to assist the region's small (10,000 or fewer customers) and smallest (3,400 or fewer customers) public water systems in developing financial, managerial and technical capacity remains a priority. Recent events have greatly expanded the reach of capacity development to encompass elements of system security and emergency preparedness; source water protection; infrastructure maintenance; and regulatory compliance.

The Southeastern Regional Small Public Water Systems Technical Assistance Center (SE-TAC) was created in 2000 to support a better understanding of small public water systems' regulatory requirements and develop capacity-building tools and programs in the southeastern United States. SE-TAC is one of eight university-based small public water system technology assistance centers nationwide. Funded by the Environmental Protection Agency under the Safe Drinking Water Act's 1996 amendments, the centers work with state and federal agencies to assist small public water systems in acquiring and maintaining the technical, financial, and managerial capacity to provide safe drinking water and meet public health protection goals. SE-TAC's region includes the states of Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, and Texas.

The SE-TAC's mission is to build partnerships among water utility organizations, state primacy agencies, technical assistance providers, and universities throughout the southeastern region of the United States to protect public health by enhancing small water systems' capacity to protect and provide safe drinking water. Since its creation,

SE-TAC has made tremendous contributions towards resolving issues faced by the region's small public water systems.

The original members of SE-TAC's Advisory Board had a shared vision that SE-TAC's activities should directly benefit the region's small public water systems. SE-TAC's main focus has been and continues to be an annual, regional competitive grants program. This approach has allowed SE-TAC to support a wide range of projects and enabled technical assistance providers to try innovative methods to develop new, targeted educational and training materials; more effectively deliver training and technical support; and purchase equipment to provide additional training or services.

In the first five years, SE-TAC has funded more than 30 projects with approximately $1 million in funding. SE-TAC projects have benefited hundreds of small systems in the region, providing technical assistance to more than 97 systems; training more than 2,000 water system personnel; and saving water associations more than $3 million in water loss and energy costs.

Publications

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Ballweber, J.A., M.L. Tagert, K.C. Griffin. 2005. Watershed advisory groups for comprehensive watershed management: Linking coastal and upstream waters. Proceedings of the 14th Biennial Coastal Zone Conference, New Orleans, LA.

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McAnally, W.H., J.A. Ballweber. 2005. Linking coastal watersheds. Proceedings of the 14th Biennial Coastal Zone Conference, New Orleans, LA.

McAnally, W.H., G. Savant, J.A. Ballweber. 2005. Hydrologic modeling of an industrial development site. Page 194 in Proceedings of the 35th Annual Mississippi Water Resources Conference, Jackson, MS.

Publications

Perry, H., C. Trigg, J. Anderson, F. Mallette, G.A. Criss, B. Viskup. 2006. Presenting nutrient data online using a customized ArcIMS® map viewer. Page 21 in Proceedings of the 36th Annual Mississippi Water Resources Conference, Jackson, MS.

Robles, W., J.D. Madsen. 2006. Aquatic vegetation diversity in Lake Columbus, Lowndes County, MS. Pages 52-54 in Proceedings of the 36th Annual Mississippi Water Resources Conference, Jackson, MS.

Smith, M.C., J.H. Massey, E. Vories, A.B. Johnson, A.A. Andrews, P.A. Ampim, R.E. Talbert. 2005. Improved irrigation efficiency and reduced surface water contamination using intermittent plus multiple-inlet irrigation in rice production. Page 48 in Proceedings of the 35th Annual Mississippi Water Resources Conference, Jackson, MS.

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Projects

A scaleable low impact development site assessment tool
Jeff Ballweber *and* ***Mary Love Tagert****, Mississippi Water Resources Research Institute;*
Jonathan W. Pote*, Mississippi State University Department of Ag and Bio Engineering;*
James Martin *and* ***William McAnally****, Mississippi State University Civil Engineering;*
Gerald W. Wilkerson *and* ***Timothy Schauwecker****, Mississippi State University Department of Landscape Architecture*

Analysis of stream bank erosion by lateral ground water flow
Garey Fox*, University of Mississippi Department of Civil Engineering*

Aquatic plant management support for the Pearl River Valley Water Supply District
John D. Madsen *and* ***Ryan M. Wersal****, Mississippi State University GeoResources Institute;*
Mary Love Tagert*, Mississippi Water Resources Research Institute*

Assessing the effectiveness of streamflow augmentation in the Sunflower River to maintain water quality and wetland integrity
Gary N. Ervin*, Mississippi State University Department of Biology;*
Todd Tietjen*, Mississippi State University Forest and Wildlife Research Center*

Choctaw County multi-purpose surface water impoundment feasibility study
Jeff Ballweber *and* ***Mary Love Tagert****, Mississippi Water Resources Research Institute;*
Jon Rezek*, Mississippi State University Department of Finance and Economics;*
Darrel Schmitz *and* ***James May****, Mississippi State University Department of GeoSciences;*
Darren Hudson *and* ***Garen Evans****, Mississippi State University Department of Agricultural Economics;*
Steve Grado*, Mississippi State University Forest*

Projects

and Wildlife Research Center

Developing a reliable method for identifying pre-settlement wetland sediment accumulation rates: 14C dating on bulk lake sediments and extracts
***Gregg R. Davidson**, University of Mississippi Department of Civil Engineering*

Improved estimation of nutrient and pesticide runoff losses from golf courses and residential lawns in the South Atlantic-Gulf Region
***Joseph H. Massey** and **Barry R. Stewart**, Mississippi State University Plant and Soil Sciences;*
***Kevin L. Armbrust**, Mississippi State Chemical Laboratory;*
***Alton B. Johnson**, Alcorn State University*

Linking coastal and inland watersheds
***Jeff Ballweber**, Mississippi Water Resources Research Institute;*
***William McAnally**, Mississippi State University Department of Civil Engineering*

Luxapallila Creek Watershed Alliance
***Jeff Ballweber** and **Mary Love Tagert**, Mississippi Water Resources Research Institute;*
***William McAnally**, Mississippi State University Department of Civil Engineering;*
***Rita Jackson**, Mississippi State University GeoResources Institute*

Northeast Madison County economic development project
***Jeff Ballweber** and **Mary Love Tagert**, Mississippi Water Resources Research Institute;*
***Jonathan W. Pote**, Mississippi State University Department of Ag and Bio Engineering;*
***Darren Hudson** and **Garen Evans**; Mississippi State University Department of Agricultural Economics;*
***Steve Grado**, Mississippi State University Forest and Wildlife Research Center*

Projects

Smith County multi-purpose lake (Phase II)
Jeff Ballweber, *Mississippi Water Resources Research Institute;*
Steve Grado, *Mississippi State University Forest and Wildlife Research Center;*
Gerald W. Wilkerson, *Mississippi State University Department of Landscape Architecture;*
Darrel Schmitz *and* ***James May***, *Mississippi State University Department of GeoSciences;*
Darren Hudson *and* ***Garen Evans***; *Mississippi State University Department of Agricultural Economics*

Southeastern Regional Small Public Water Systems Technical Assistance Center
Jeff Ballweber *and* ***Kim Steil***, *Mississippi Water Resources Research Institute;*
Jonathan W. Pote, *Mississippi State University Department of Ag and Bio Engineering*

Water quality standards: Establishing nutrient criteria for Mississippi's coastal waters
Harriet Perry *and* ***Christine Trigg***, *University of Southern Mississippi Gulf Coast Research Laboratory;*
Barbara Viskup, *Mississippi Department of Environmental Quality*

Upper Pearl River Watershed Advisory Group
Jeff Ballweber *and* ***Mary Love Tagert***, *Mississippi Water Resources Research Institute*

Photos by:
Karen Brasher
Joe Mac Hudspeth, Jr.
Russ Houston
Rita Jackson
Matt Ladner

Advisory Board

Currently, the MWRRI is actively engaged in reorganizing its Statewide Advisory Board. The MWRRI will rely heavily on the guidance and advice of this reorganized Board to develop a new Strategic Plan. In addition, the Board will continue to serve its traditional function to review the MWRRI's water resources research priorities and to evaluate proposals received in response to the MWRRI's Request for Proposals. The consultation and collaboration with leading state and federal officials involved in water resources development or management assures that MWRRI-funded research will address important water resource issues on a timely basis.

Project Collaborators

Alabama Clean Water Partnership
Alabama Department of Conservation and Natural Resources
Bienville Resources and Development Council
Choctaw County Board of Supervisors
Environmental Protection Agency
Madison County Economic Development Authority
Madison County Engineering Group
Mississippi Department of Environmental Quality
Mississippi Development Authority
National Oceanic and Atmospheric Administration
Pearl River Valley Water Supply District
Pickering, Inc.
SmartCoast
Tennessee Tombigbee Waterway Development Authority
Tennessee Valley Authority
Tombigbee River Valley Water Management District
US Army Corps of Engineers, Mobile District
US Geological Survey
US Golf Association
USDA Forest Service
Weeks Bay Reserve
Yazoo Miss. Joint Water Management District

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Mississippi State University complies with all applicable laws regarding affirmative action and equal opportunity in all its activities and programs and does not discriminate against anyone protected by law because of age, color, disability, national origin, race, religion, sex, handicap, or status as a veteran or disabled veteran.

Information Transfer Program-Conferences

Basic Information

Title:	Information Transfer Program-Conferences
Project Number:	2006MS70B
Start Date:	3/1/2006
End Date:	2/28/2008
Funding Source:	104B
Congressional District:	3rd
Research Category:	Not Applicable
Focus Category:	None, None, None
Descriptors:	
Principal Investigators:	George M. Hopper

Publication

1. 2006, Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, CD ROM.
2. 2006, Mississippi Water Resources Conference Program and Abstracts, Mississippi Water Resources Research Institue, Mississippi State, MS.

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Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 NCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	2	0	0	0	2
Masters	4	0	0	0	4
Ph.D.	0	0	0	0	0
Post-Doc.	0	0	0	0	0
Total	6	0	0	0	6

Notable Awards and Achievements

Ballweber, Jeff. 2006. Chairman of the Board. Mississippi Water Resources Association.

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1. 2001MS2601B ("Spatial Pattern in Lan Use: Its Role in Determining Surface Water Quality") - Articles in Refereed Scientific Journals - Schweizer, Peter and Glenn Matlack, 2005, Annual Variation in Fish Assemblages of Watersheds with Stable and Changing Land Use, American Midland Naturalist, 153(2):298-308.
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