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MISSISSIPPI  
**WATER RESOURCES  
RESEARCH INSTITUTE**

MISSISSIPPI STATE UNIVERSITY™

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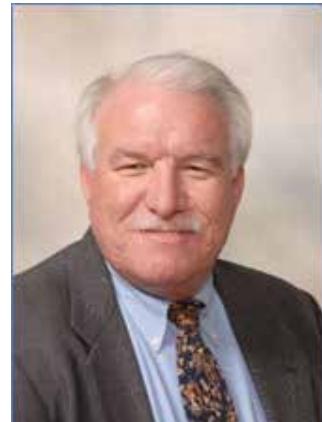
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# DIRECTOR'S UPDATE



The Mississippi Water Resources Research Institute (MWRRI) had another eventful year in 2016. Additional funding provided by the State Legislature will allow us to hire a full-time, permanent director. MWRRI is interviewing candidates now and hope to make an announcement of a director later this spring.

The annual Mississippi Water Resources Conference was held in Jackson on April 5-6, 2016, and significant enhancements and participation were evidenced. These include a 20% increase in participants over the previous year, a significant growth in our sponsorships, the expansion of our student competition and awards to cover both posters and oral presentations.

Working with our Advisory Board this past summer, MWRRI updated our water resources research priorities and released a Request for Proposals to address these priorities. In mid-November, the Board met to discuss and develop funding recommendations for our 2017 104b water research grant program. We received a total of 11 excellent and very deserving proposals and plan to fund a total of four.

As an EPA and MDEQ-designated Center of Excellence for Watershed Management, MWRRI-led efforts to develop the *Implementation Plan for the Red Bud-Catalpa Creek Watershed Phase 1* which was submitted to MDEQ for funding consideration. MDEQ has informed MWRRI that it will fully fund eligible components of the plan, which will result in an investment of nearly \$460,000 by MDEQ and MSU. Four additional monitoring and modeling projects contained in the plan were funded from other sources. Including these projects, cumulative investment in the project has reached over \$600,000. A comprehensive Phase 2 plan will be developed during the spring of

2017 and efforts will be made to secure additional resources for the water quality, ecosystem, and stream restoration and protection project. Efforts also continue to leverage this project into the establishment of a Watershed DREAMS (Demonstration, Research, Education, Application, Management and Sustainability) Center at MSU.

MWRRI also received notice from EPA headquarters of an award totaling more than \$194,000 for the development of social indicators and civic engagement measures in support of the activities of the Mississippi River/Gulf of Mexico Watershed Nutrient (Hypoxia) Task Force, which has representation from 12 states and six federal agencies. Additionally, we were awarded \$13,500 from the Gulf of Mexico Alliance's Gulf Star program that allows us to expand this project across the Gulf Coast. For this 15-state project, we partnered with the Social Science Research Center here at MSU.

We are also hard at work in facilitating the establishment of a regional forum of our sister WRRIs in the southeastern United States to work collaboratively on multi-state and regional water resources issues. Implementation of this concept will begin during 2017.

This annual report will provide details on these projects and activities, as well as others that MWRRI is actively leading or supporting.

Together with state and federal agencies, along with our colleagues from MSU and other universities, and neighboring states, we are making a difference!

***Bill Herndon***





**WHO  
WE  
ARE**

# OUR MISSION

The Mississippi Water Resources Research Institute (MWRRI) was authorized by Mississippi's Governor Paul B. Johnson in 1964 and is one of 54 institutes in the United States that form a network of coordinated research programs to solve water problems of state, regional, or national significance. In 1983, the Mississippi Legislature formally designated MWRRI as a state research institute. Federal legislation specifies that each institute consult with leading water officials of the state in developing a coordinated research technology transfer and training program that applies academic expertise to water and related land-use problems. These activities are funded in large part through an annual grant from the U.S. Geological Survey. MWRRI's state authorization charges it with carrying out the responsibilities listed to the right:

1. Assist state agencies in developing and maintaining a state water management plan;
2. Consult with state and local agencies, water management districts, water user associations, the Mississippi legislature, and other potential users to identify and establish water research, planning, policy, and management priorities.
3. Negotiate and administer contracts with local, regional, state, and federal agencies and other Mississippi universities to mitigate priority water and related problems;
4. Report to the appropriate state agencies each year on research projects' progress and findings;
5. Disseminate new information and facilitate transfer and application of new technologies as they are developed;
6. Be a liaison between Mississippi and funding agencies as an advocate for Mississippi water research, planning, policy, and management needs;
7. Facilitate and stimulate planning and management that:
  - Deals with water policy issues facing the state of Mississippi;
  - Supports state water agencies' missions with research on encountered and expected problems; and
8. Provides water planning and management organizations with tools to increase their efficiency and effectiveness.

# CENTER OF EXCELLENCE

The U.S. Environmental Protection Agency has designated Mississippi State University as a Center of Excellence for Watershed Management, becoming the 10th such institution in the Southeast.

Representatives from the EPA's Region 4, the Mississippi Department of Environmental Quality, and the university signed a memorandum of understanding in 2013 to help communities identify watershed-based problems and develop and implement locally sustainable solutions.

The new center is housed at Mississippi State, in the Mississippi Water Resources Research Institute, where it serves as a resource for universities throughout the state.

"Mississippi State University is extraordinarily pleased to partner with the EPA on this Center of Excellence," said David Shaw, MSU's vice president for research and economic development. "Research in water quality and quantity is one of the highest priority areas for our university, and the center utilizes the breadth of capacity from the entire campus to address these needs."

To become a recognized Center of Excellence, an institution must demonstrate technical expertise in identifying and addressing watershed needs; involvement of students, staff and faculty in watershed planning, protection,

and restoration; capability to involve the full suite of disciplines needed for all aspects of watershed management; financial ability to become self-sustaining; ability to deliver and account for results; willingness to partner with other institutions; and support from the highest levels of the organization.

"A watershed approach is one of the most effective frameworks to engage communities and address today's water resource challenges," said EPA Regional Administrator Gwen Keyes Fleming. "Ultimately, this designation helps fulfill our mutual goals to protect and restore water quality and improve the quality of life in our local communities."

Located on the campus of Mississippi State, MWRRI administers and coordinates research programs dealing with water and related resources. It is one of the state institutes authorized by Section 104 of The Water Resources Research Act of 1984. Its activities are developed in close consultation and collaboration between the institute and leading water resources officials within the state.

Started in 2007, the EPA Region 4 Centers of Excellence for Watershed Management Program works with colleges and universities from across the Southeast to provide hands-on, practical products and services for communities to identify watershed problems and solve them.

# ADVISORY BOARD

## **Mr. Sam Britton**

Mississippi Public Service Commission

## **Mr. Tom Bryant**

Pickering Firm, Inc.

## **Dr. Pat Deliman**

Environmental Laboratory, U.S. Army Corps of Engineers

## **Mr. Mike Freiman**

Surface Water Division, Office of Pollution Control, Mississippi Department of Environmental Quality

## **Mr. W. Scott Gain**

U.S. Geological Survey

## **Mr. Mark Gilbert**

Mississippi Soil & Water Conservation Commission

## **Dr. Martin Locke**

Agricultural Research Service National Sedimentation Laboratory

## **Mr. Kirby Mayfield**

Mississippi Rural Water Association

## **Mr. Jamie Miller**

Mississippi Department of Marine Resources

## **Mr. Chip Morgan**

Delta Council

## **Dr. Jami Nettles**

Weyerhaeuser Company

## **Mr. James Palmer, Jr.**

Yazoo Mississippi Delta Joint Water Management District

## **Mr. Kurt Readus**

USDA Natural Resources Conservation Service

## **Mr. Thomas Richardson**

Jackson State University

## **Ms. Leslie Royals**

Mississippi State Department of Health

## **Dr. Alan Shiller**

University of Southern Mississippi

## **Dr. LaDon Swann**

Mississippi-Alabama Sea Grant Consortium

## **Mr. Andy Whittington**

Mississippi Farm Bureau Federation

## **Ms. Kay Whittington**

Mississippi Department of Environmental Quality

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# INTEGRATED APPROACH TO WATER RESOURCES RESEARCH



Effective environmental planning and water resources management must first be informed and supported by scientifically-accepted research, the development of which is MWRRI's primary function. For over 30 years, MWRRI through its member Institutions of Higher Learning has worked with agencies and organizations in Mississippi and beyond to support and advance water resources research. Today, more than ever, research is vitally needed in Mississippi to advance our understanding of the science and dynamics of multiple interconnected and interdependent water-related issues and to inform our water resources planners, managers, users, and stakeholders. Since its creation and as part of its statutory responsibility, MWRRI has identified water resources research priorities through its Advisory Board and, supported by the U.S. Geological Survey through the 1984 Water Resources Research Act, has provided funding for selected research proposals that address these priorities.

Through its Advisory Board, three topical areas are pursued for MWRRI research consideration: 1) common problems and challenges, 2) strategic research, and 3) transferring and applying knowledge. These are discussed briefly below:

## **1. Common Problems and Challenges.**

Today, significant research is needed across the water resources spectrum to address common problems and challenges in Mississippi. These include developing a better understanding of the impacts of increasing population growth, changing land uses and demands on our ground and surface water resources, and improving projections of water availability throughout the state. Research is needed to better understand groundwater recharge as well as the potential benefits and challenges of alternative surface and ground water supplies. More research is needed to better understand the water quality challenges identified by Total Maximum Daily Load studies; to document the impacts of innovative management practices and approaches designed to improve water quality; and to better understand the source, fate, and transport of nutrients at variable spatial and temporal scales across the state to inform decision-makers on what nutrient reductions are achievable and when. Additional research is needed on our climate and its historic variability to better understand what the future may hold. Social science research is needed to develop a better understanding of stakeholder perceptions and beliefs for a variety of water resources issues across the state in order to develop effective outreach and education designed to change behaviors. These issues are only a subset of the type of research needed to address the common water resources problems and challenges facing Mississippi. The desire for more economic research related to the value and costs of water has also been identified by water managers as a current need.

## **2. Strategic Research for Integrated Water Resources Management.**

Emphasis on stand-alone water resources research is diminishing due to recognition of the inter-relationships of multiple water resources issues, the expanding scale of research needs, and limitations on fiscal resources available for research. While advancing research to address the common water resources problems and challenges in Mississippi, attention should be given to how this research can advance integrated water resources management in Mississippi. MWRRI's approach to strategic research for integrated water resources management seeks to explore the linkages among natural science, engineering, and the dynamics of social and economic systems that underpin water management decisions. Understanding the interconnected and interdependent relationships of diverse water resource issues while developing research project concepts will be vital to support the coordinated planning, development, protection, and management of our water, land, and related resources.

## **3. Transferring and Applying Knowledge.**

This research approach is designed to inform water resources planners and managers by providing them with the scientific information and understanding that they need. Also, the effective transfer of knowledge to water users and stakeholders is essential for a well-informed public in order to realize the over arching goal of sustainable water resources and ecosystems of good quality and ample quantity while sustaining a good economy and quality of life for current and future generations. MWRRI, working with our partners, is uniquely positioned to advance and sustain the transfer and application of knowledge gained through the integrated water resources research approach.

# INTEGRATED APPROACH TO WATER RESOURCES MANAGEMENT



The concept of integrated water resources management can be traced to early basin planning efforts in the United States in the 1920s. However, it was not until the late 1990s that acceptance of the concept began to become widespread. In Mississippi, the concept of integrated water resources management was identified in § 51-3-1 of the 1985 Water Law that states: "...to the fullest extent possible, the ground and surface water resources within the state shall be integrated in their use, storage, allocation and management." This approach is emphasized by the Mississippi Department of Environmental Quality (MDEQ) which has jurisdiction over the water resources of the state.

What is integrated water resources management? Integrated water resources management has been defined in numerous ways by numerous entities over time with a great deal of common language among the various definitions. In an effort to standardize a definition, the American Water Resources Association in 2011 defined integrated water resources management as "the coordinated planning, development, protection, and management of water, land, and related resources in a manner that fosters sustainable economic activity, improves or sustains environmental quality, ensures public health and safety, and provides for the sustainability of communities and ecosystems." Numerous entities have accepted this definition since it was established. In this context, key considerations of integrated water resources management include:

1. **Water resources are all connected** and recognizing the interconnected and interdependent relationships of climatic, ground and surface waters; water quality and quantity; freshwater and coastal waters; and rivers, streams, lakes and the land they share within a watershed or basin is foundational for effective integrated water resources management.
2. **Water must be managed sustainably** for current and future generations by balancing the multiple objectives of different interests with consideration for the environment, economic development, and social equity.
3. **Coordination is required for integration** and coordinating water management activities (e.g., planning, management, research, et al) between and within levels of governmental and other organizations, with recognition of the respective roles of each, is vital for effective collaborative planning and leveraging of resources.
4. **Participation must be actively encouraged** by continually engaging and involving the local public and stakeholders from all water use sectors.

In its application, integrated water resources management can be employed at virtually all watershed scales – from small watersheds to a broader basin. This concept directly supports the management approach called for in Mississippi’s Water Law, embraces the Basin Management Approach established by MDEQ, and avails itself to the use of EPA’s widely-accepted, ‘9 Key Elements of Watershed Planning.’ Indeed, integrated water resources management is the standard for Mississippi.

In support of this approach, MWRRI staff work diligently with departments and programs from Institutions of Higher Learning across Mississippi, state and federal agencies, and stakeholder organizations willing to participate in this collaborative approach in a team environment to develop research concepts and detailed project proposals to address Mississippi’s water resources research and management priorities.



# SPONSORED RESEARCH

# WATER RESEARCH PRIORITIES

MWRRI and its Advisory Board annually work together to review and update MWRRI's research priorities. These priorities guide research for the MWRRI/USGS 104b Water Research Program and collaborative proposals developed for external funding. MWRRI's current priority research areas and topics are listed below:

## Climatic Water Research Topics

- Predictions of future water needs in various regions of the state under various climatic and/or pumping scenarios
- Innovative water capture techniques and applications

## Groundwater Research Topics

- Innovative approaches to estimate aquifer recharge
- Development of water budgets
- Determining aquifer transmissivities and characteristics

## Surface Water Research Topics

- Evaluation of BMP effectiveness, site placement, reliability, and maintenance
- Research and development to support water quality and ecosystem health assessment applications
- Identification of appropriate response measures for Mississippi's waters and linkage between nutrient concentrations and the identified response measures
- Analysis of nutrient loading trends

## Coastal-specific Research Topics

- Harmful algal bloom and early pathogen detection research for Mississippi coastal waters

## Water Use Efficiency and Water Reuse Research Topics

- Water reclamation and reuse
- Water use efficiency

## Drinking Water and Waste Water Research Topics

- Mitigation of lead corrosion in PWSs
- Protection of source water resources
- Innovative and affordable waste water treatment for small communities

## Modeling and Tool Development

- Development of models and tools

## Social Sciences Research

- Development of social indicators
- Development of social science applications to advance water resource management

## Economics Research

- Economic analysis of reducing nutrient loadings

## Emerging and Innovative Technologies

- Current and potential use of Unmanned Aerial Vehicles (UAVs)

# **MWRRI/USGS 104B WATER RESEARCH PROGRAM**

The 104B Water Research Program was established under the provisions of section 104 of the Water Resources Research Act of 1984 (Public Law 98-242), as amended by Public Laws 101-397, 104-147, 106-374, and 109-471. Section 104 of the Water Resources Research Act directs the Secretary of the Interior to administer program grants to Institutes and Centers established under the provisions of section 104(a) of the Act. Water Resources Institutes or Centers have been established in each of the 50 states, the District of Columbia, Puerto Rico, the U.S. Virgin Islands, and Guam. Responsibility for administration of the State Water Resources Research Institute program has been delegated to the U.S. Geological Survey (USGS).

MWRRI's Advisory Board met on November 16, 2016 to discuss proposals received in response to MWRRI's 2017 RFP. Considering input received by its Advisory Board during the meeting, MWRRI recommended the following projects , MWRRI recommended the following projects for anticipated funding through USGS' 2017 104b Water Resources Research Program:

## **Assessing the Effectiveness of Community-based Research Strategies to Analyze Risk of Lead Contamination in Public Water Supplies in the Mississippi Delta**

Dr. Kristi Willett, Department of Biomolecular Sciences, School of Pharmacy, University of Mississippi; Stephanie Otts, J.D., SeaGrant Legal Program, University of Mississippi; Dr. John Green, Center for Population Studies, University of Mississippi

## **Study of Sediments and Nutrients in Pelahatchie Bay and Upland Mill-Pelahatchie Creek Watershed**

Dr. Xiaobo Chao, Dr. Yaxin Zhang, National Center for Computational Hydroscience and Engineering, University of Mississippi; Dr. Ron Bingner, Dr. Lindsey Yasarer, Watershed Physical Processes Research Unit, Agricultural Research Service, National Sedimentation Laboratory

## **Assessing and Predicting In-Stream Processes in the Catalpa Creek Watershed**

Dr. John Ramirez-Avila, Ms. Sandra Ortega-Achury, Department of Civil and Environmental Engineering, Mississippi State University

## **Applied Use of Unmanned Aerial Vehicles in Surface Water Quality Protection**

Dr. Joby Czarnecki, Geosystems Research Institute, Mississippi State University; Dr. John Ramirez-Avila, Department of Civil and Environmental Engineering, Mississippi State University

# MWRRI/USGS 104B WATER RESEARCH PROGRAM

## Assessing the Effectiveness of Community-based Research Strategies to Analyze Risk of Lead Contamination in Public Water Supplies in the Mississippi Delta

Dr. Kristi Willett, Department of Biomolecular Sciences, School of Pharmacy, University of Mississippi; Stephanie Ott, J.D., SeaGrant Legal Program, University of Mississippi; Dr. John Green, Center for Population Studies, University of Mississippi

The Project Team, drawing upon complementary expertise within the University of Mississippi (UM) Schools of Pharmacy, Law, and the College of Liberal Arts, proposes to conduct community-based participatory research and an assessment of residential drinking water supplies and water supply infrastructure in the Mississippi Delta. This interdisciplinary research will assess multiple social science approaches to engage stakeholders and influence policy on the current state of lead contamination in drinking water in Mississippi. Specifically, the project team proposes to engage participants in the New Pathways to Health Initiative and Right! From the Start Initiative to:

1. Conduct training and outreach on the public health risks associated with lead contamination in drinking water, proper water sampling and testing methods, exposure prevention options, and regulatory requirements;
2. Collect and analyze residential water samples and gather information about plumbing materials from sampled homes in seven Delta counties (Bolivar, Coahoma, Panola, Leflore, Quitman, Sunflower, and Tallahatchie);
3. Assess the demographic and socio-economic characteristics of communities at risk of experiencing elevated lead levels in drinking water based on the results of the sampling data;

4. Compare five different approaches to community engagement to evaluate stakeholder perceptions, beliefs and participation in citizen science;
5. Conduct an analysis of the legal framework in Mississippi governing contaminants in drinking water to identify gaps in environmental or public health monitoring and oversight and need for legal reform; and
6. Draft a final report summarizing and integrating the research findings to guide public health interventions by project partners, public water systems, and state and local health agencies within the Delta and throughout the state.

Ultimately, this project has the potential to fundamentally safeguard public health because survey and sampling results will help assess the risks of lead contamination in the Mississippi Delta, assist with the identification of lead service lines and lead plumbing within the distribution systems, and design and guide scalable research and outreach efforts to minimize lead exposure through use of filters and/or behavioral changes.

## **Study of Sediments and Nutrients in Pelahatchie Bay and Upland Mill-Pelahatchie Creek Watershed**

Dr. Xiaobo Chao, Dr. Yaxin Zhang, National Center for Computational Hydroscience and Engineering, University of Mississippi; Dr. Ron Bingner, Dr. Lindsey Yasarer, Watershed Physical Processes Research Unit, Agricultural Research Service, National Sedimentation Laboratory

Fresh water is one of the most important natural resources on earth. However, deterioration of water quality has been frequently observed in many rivers, lakes and coastal waters, which greatly affects human lives and economic development. Water quality is generally the result of the physical, chemical and bio-chemical processes in water bodies; and is also strongly influenced by human and natural activities in the surrounding watersheds that produce a significant amount of sediment, nutrients, pathogen and other pollutants. Best Management Practices (BMPs), such as constructed-wetlands, establishment of grassed buffers, sediment erosion control, reduced-tillage, no-tillage, etc., have been applied to reduce the loads of sediment and nutrients in watersheds, resulting in the improvement of water quality in surface water bodies. However, these measures often have limitations and the water quality of the downstream waterbody may still have problems. Evaluating the effectiveness of these practices by analyzing the response of water quality in surface waters to the BMPs implemented in the upland watersheds is critical to the success of watershed management and restoration plans.

This project studies the response of water quality in a Mississippi reservoir to incoming sediment and pollutant loads from upland watersheds. The hydrodynamics, sediment transport, and water quality processes will be studied using numerical simulations. The effectiveness of implemented BMPs in the upland watershed on the reservoir water quality will be evaluated. The Mill-Pelahatchie Creek Watershed (MCW) in Rankin County, Mississippi, is selected as the study site due to high sediment yield production there. The water, sediment and nu-

trients in this watershed flow into Pelahatchie Bay (PB) of the Ross Barnett Reservoir (RBR), the largest drinking water source in the state of Mississippi. The Annualized Agricultural Non-Point Source (AnnAGNPS) pollutant loading watershed management model, developed at the USDA ARS, National Sedimentation Laboratory (NSL), will be applied to simulate the loads of runoff, sediment and nutrients from the upland watershed. The simulated results will be used as boundary conditions for CCHE, a free surface flow, sediment and water quality model developed at the National Center for Computational Hydroscience and Engineering (NCCHE), to simulate flow, sediment transport and water quality processes in the Pelahatchie Bay. The concentration distributions of sediment and nutrients (nitrogen and phosphorus), and their variations in time due to the influence of loading, wind, and the operation of the Ross Barnett Reservoir will be simulated.

Several tasks are proposed, including (1) Application of the AnnAGNPS watershed model to simulate runoff, sediment and nutrient loads in the upland watershed MCW; (2) Modeling flow, sediment and nutrient concentrations in PB; (3) Analyzing the response of sediment and nutrient concentrations in PB to alternative BMPs implemented within MCW. The proposed research is anticipated to help understand the water quality process affected by many human and natural factors in the Pelahatchie Bay, to evaluate the implemented/planned BMPs, and to provide information for improving the water quality and recreation of the Pelahatchie Bay.

# MWRRI/USGS 104B WATER RESEARCH PROGRAM

## Assessing and Predicting In-Stream Processes in the Catalpa Creek Watershed

Dr. John Ramirez-Avila, Ms. Sandra Ortega-Achury, Department of Civil and Environmental Engineering, Mississippi State University

Excessive erosion and the transport and deposition of sediment in surface waters are major water-quality problems in Mississippi. Researchers in the state have shown that a significant portion of sediment loads exported from the watershed are contributed by streambeds and mostly from active unstable streambanks. The main channel of the Catalpa Creek has been listed as Impaired due to sediments from headwaters to the outlet. The Water Resources Management Plan for the Red Bud-Catalpa Creek Watershed was formulated to restore and protect the ecosystem health, ecosystem services and quality of life, and water resources within the watershed; and create experiential learning activities for students, educators, and practitioners. To develop remedial measures and future BMPs within the Catalpa Creek Watershed for reducing water quality impairment, and a stream restoration design to improve stream morphology, biological integrity and function of the main stream and tributaries, it is necessary to identify stressors, sediment sources and loads currently transported, and

critical zones for upland and in-stream management and/or restoration within the entire watershed. Hypothesizing in-stream processes are important mechanisms driving sediment supply into the streams and an important portion of the sediment budget for the Catalpa Creek Watershed, this research will focus on the identification, assessment, evaluation and prediction of in-stream processes within the study watershed. To address the research objectives three sub-studies will be undertaken using a combination of methods including field reconnaissance and detailed data collection, laboratory analysis, and channel modeling. Modeling results can help to determine critical areas to be potentially considered for future management and restoration activities, as well as to optimize a design for a desired outcome and to understand what results might be expected. Project results will be transferred to a broad group of academic, technical and research stakeholders, supported in collaboration with private, federal and state agencies.

## **Applied Use of Unmanned Aerial Vehicles in Surface Water Quality Protection**

Dr. Joby Czarnecki, Geosystems Research Institute, Mississippi State University; Dr. John Ramirez-Avila, Department of Civil and Environmental Engineering, Mississippi State University

Erosion represents a significant detriment to Mississippi's surface waters, as a source of both chemical (i.e., phosphorus) and physical (i.e., sediments) pollutants. Accordingly, erosion control will be necessary for maintaining the quality of Mississippi's surface water resources, and identifying and monitoring erosion in critical areas will enable stakeholders to better manage the State's water resources by addressing a key source of degradation. The objective of this research is to evaluate the accuracy of erosion calculations derived from Structure from Motion (SfM) captured with unmanned aerial vehicles (UAVs). The research project will combine results from SfM assessments of erosion with ground-truthed measurements of erosion to determine the accuracy of this approach for use in calculating erosion values, and extend this approach to evaluate the ability of SfM to monitor erosion over time. Derived values will be incorporated into existing models (e.g., BSTEM, CAESAR-Lisflood) to determine if SfM data are a valid model input. Data will be collected from Mississippi State University owned and managed research properties where significant erosion has been identified; some of these sites are within an EPA-designated 319(h) priority watershed.

The result of this research is a scientific validation of the accuracy of erosion calculations derived from UAV-collected SfM assessments. When used appropriately, UAVs have the potential to enable rapid assessment of landscapes with reduced labor costs. The research serves as a proof-of-concept project to develop a method by which UAVs could be employed to identify, quantify, and monitor erosion in drainage channels and other eroded areas. This would enable federal, state, and local agencies to utilize this technology to more efficiently monitor, remediate, and regulate degradation of surface waters. Outputs from this research project include transfer of information on the appropriate data collection strategies for UAV-based SfM assessments, as well as best practices, along with methods, estimates of accuracy, and any necessary cautions. This data will be communicated to stakeholders through scientific exchange and interaction, in addition to the established University Extension network.

# EXTERNALLY-FUNDED RESEARCH

## Using Social and Civic Engagement Indicators to Advance Nutrient Reduction Efforts in the Mississippi/Atchafalaya River Basin – Phase 1

Richard Ingram, Mississippi Water Resources Research Institute, Mississippi State University; Ronald Cossman and Sandra Guzman, Social Science Research Center, Mississippi State University

Water quality problems that have accumulated over many decades often take decades to correct. This is the case when considering the complexity, scale, causes, and impacts of Gulf of Mexico hypoxia. The social dimension plays a key role. Every individual, community and culture has a set of beliefs and attitudes that guide decision-making and influence behavior. Because the success of nutrient reduction strategy implementation in state-designated priority watersheds depends upon a large percentage of watershed stakeholders understanding both the water quality impacts of their land use activities and the importance of conservation, an important measure of progress should include confirming that awareness and attitudes are changing and behaviors are being adopted that serve to mitigate the problem. Social indicators provide consistent measures of social change and can be used by planners and managers at the national, state, and local levels to estimate the impacts of their efforts and resources even while a lag exists for monitored improvements in water and habitat quality. In addition, social indicators can inform planners and managers of changes needed to their nutrient reduction strategies to increase the effectiveness of their efforts.

The goal of this project is to refine social indicators for agricultural and water management with an emphasis on nutrient reduction, and establish a foundation for an active social indicators users community among policy researchers and regulatory agencies throughout the Mississippi/Atchafalaya River Basin (MARB). One of the tasks of this project includes the expansion of the existing Social Indicators Data Management and Analysis Tool (SIDMA) and the Social Indicators Planning and Evaluation System (SIPES). In addition, im-

provements to the database of social indicators will be accomplished by directly engaging Hypoxia Task Force members, the social science research community, and appropriate stakeholders to gather all available studies on social responses that address water management projects in the MARB, including published and unpublished information. This information includes: reports, surveys, gray (non-published reports) and white (peer-reviewed) literature, and conference presentations.

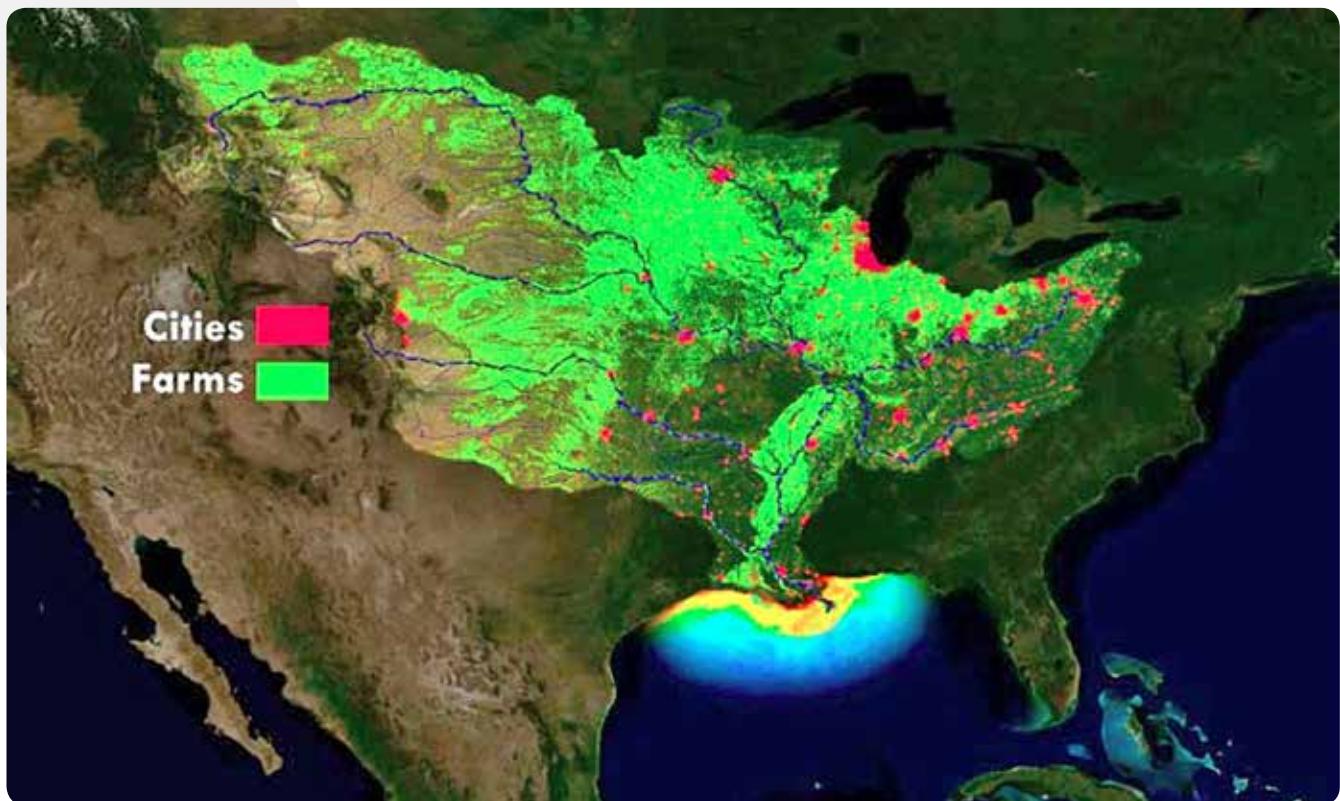
The rationale for this approach is threefold. First, a large amount of intellectual capital has been invested in the development, refinement, and maintenance of SIDMA and SIPES which were developed by land grant university faculty and staff working closely with state and federal agencies, and local stakeholders for use with nonpoint source water quality management projects. This project is designed to build upon that successful base of primary research and tools to ensure relevance across MARB states and to extend our body of knowledge. Second, despite the recognized importance of addressing nutrient contributions to the MARB from agriculture, a meta-review of relevant published literature noted, "...environmental awareness and farmer attitudes have been inconsistently used and measured across the literature." Inconsistent measures make it nearly impossible to compare pre - and post-intervention changes in beliefs, attitudes, motivations, and constraints associated with project activities, and makes it equally impossible to make comparisons across regions, states and basins. The third rationale for this particular initiative recognizes the wide variations across the basin in landscapes, agricultural management systems, and institutional structures supporting natural resources and environmental management.

## **Using Social Indicators and Civic Engagement to Advance Nutrient Reduction Initiatives throughout the Mississippi River/Gulf of Mexico Watershed**

Richard Ingram, Mississippi Water Resources Research Institute, Mississippi State University; Ronald Cossman, Social Science Research Center, Mississippi State University

MWRRI recently received a grant award from the Gulf of Mexico Alliance's Gulf Star Program in the amount of \$13,500. This grant award will provide resources for Gulf States that are not members of the Hypoxia Task Force to participate in the effort to develop social indicators and civic engagement measures. This award

will allow activities of the EPA award to be leveraged among all Hypoxia Task Force and Gulf of Mexico Alliance member states within the Mississippi River/Gulf of Mexico Watershed, facilitate the development of correlatable metrics across the entire region, and advance cooperation between these two organizations.





# **WATERSHED MANAGEMENT ACTIVITIES**

# IMPLEMENTATION PLAN FOR THE RED BUD-CATALPA CREEK WATERSHED – PHASE 1

During 2016, MWRRI led development of the Implementation Plan for the Red Bud–Catalpa Creek Watershed Phase 1. The Phase 1 implementation plan builds upon the comprehensive Water Resources Management Plan for the Red Bud–Catalpa Creek Watershed developed collaboratively by 18 University units during 2015, and describes specific water quality and habitat restoration activities recommended for the headwaters of the Red Bud–Catalpa Creek Watershed in the proximity of MSU’s H.H. Leveck Animal Research Center (South Farm). The comprehensive plan calls for the installation of 24 best management practices (BMPs) in three delineated critical management areas, details an information and education program, describes a monitoring program to quantify the effectiveness of the installed BMPs, establishes an implementation schedule with measurable milestones and project outcomes, and contains a detailed budget. The plan also includes the coordination and leveraging of four complementary monitoring and modeling projects.

The plan was developed by numerous contributors from Mississippi State University’s Agricultural and Forestry Experiment Station; Department of Animal and Dairy Sciences; Department of Fisheries, Wildlife, and Aquaculture; Department of Civil and Environmen-

tal Engineering; Department of Landscape Architecture; Extension Service; Geosystems Research Institute; REACH (Research and Education to Advance Conservation and Habitat) Program; Mississippi Water Resources Research Institute as well as staff from the Mississippi Department of Environmental Quality, Mississippi Soil & Water Conservation Commission, and USDA’s Natural Resources Conservation Service.

Funding to support implementation of the plan is being awarded from the Mississippi Department of Environmental Quality and USEPA through the 319(h) Nonpoint Source Program (\$264,002 award with a match requirement of \$176,001), the Mississippi Agriculture and Forestry Experiment Station and its Strategic Research Initiative (\$17,980 in awards with a match total of \$33,300), and MWRRI’s Water Research Grant Program (\$36,916 in awards with a match total of \$74,578). The total investment to implement the Phase 1 plan is \$602,778 with all funding secured.

During 2017, a comprehensive Phase 2 plan to address the entire watershed will be developed and funding to implement the plan will be solicited.

# WATERSHED DREAMS CENTER

(DEMONSTRATION, RESEARCH, EDUCATION, APPLICATION, MANAGEMENT AND SUSTAINABILITY)

The establishment of a Watershed Demonstration, Research, Education, Application, Management and Sustainability (DREAMS) Center on the South Farm will serve as a showcase for watershed management throughout the state and southeast through the watershed-based restoration and protection activities affiliated with the Catalpa Creek Watershed Project. This center will be useful to state and federal agencies, water management districts, stakeholder and community service organizations, university departments and programs, secondary education teachers and students, local governments, and others. Beyond complementing the Catalpa Creek project, the center will focus generally on water resources, watersheds, and the ecosystem services they provide in a hands-on interactive way. It is envisioned that the Center will:

- Demonstrate the effectiveness of innovative and established sediment, nutrient, pathogen and other Best Management Practices (BMPs);
- Demonstrate innovative water management approaches;
- Advance innovative concepts and applications that address water resources and watershed management research needs;
- Provide for technology transfer of applications developed by MSU researchers to water resources planners, managers, water users, and other stakeholders;
- Educate water resources and watershed planners, managers, policy-makers, and other stakeholders about important watershed concepts; and
- Demonstrate MSU's capacity to effectively address a wide range of water resources and watershed issues occurring throughout the state and region.

MSU's campus and the MS Agricultural and Forestry Experiment Station's H.H. Leveck Animal Research Center (South Farm) are located in the headwaters of the Catalpa Creek Watershed which presents numerous opportunities for leveraging numerous MSU activities and assets. Various water quality research projects on South Farm include monitoring nutrient and sediment runoff under varying climatic conditions and cattle management scenarios, comparison of hydrologic modeling outcomes to evaluate pre- and post-BMP implementation related to dairy and poultry management, identification of potential environmental problem areas throughout South Farm that could impact Catalpa Creek, and development of baseline water quality information and a monitoring plan for Catalpa Creek.

The Wetland Education Theater (WET) is a collaborative effort between MSU's College of Forest Resources and Department of Landscape Architecture. WET, soon to be constructed, endeavors to develop functional wetland ecosystems and associated upland plant communities in the heart of MSU's campus. Numerous covered structures will dot the site, providing interpretive displays for visitors. These will be connected by a serpentine walk and bridge network over the wetland. Unique "council squares" and an impressive outdoor classroom will provide spaces for small group discussions or large gatherings. The entire site will showcase native plant species in natural wetland, slope, and upland settings.



# OTHER ACTIVITIES

# Hypoxia Task Force/SERA-46 Committee

The Mississippi River/Gulf of Mexico Water-shed Nutrient (Hypoxia) Task Force was established in the fall of 1997 to understand the causes and effects of eutrophication in the Gulf of Mexico; coordinate activities to reduce the size, severity, and duration; and ameliorate the effects of hypoxia. The Task Force includes five federal and twelve state agencies and the National Tribal Council. During 2014, the Hypoxia Task Force and its twelve state members formed a partnership with land grant universities in each of the member states through a non-funded cooperative agreement developed to support implementation of state-level strategies and actions to reduce nutrient loadings and mitigate Gulf hypoxia. These Land Grant Universities organized through the establishment of a multi-state research coordinating committee and information exchange group referred to as SERA-46. MWRRI, MAFES, and MSU's College of Forest Resources have representatives that serve on this committee. Three broad objectives were identified for the SERA-46 Committee:

**Objective 1:** Establish and strengthen relationships that can serve the missions of multiple organizations addressing nutrient movement and environmental quality.

**Objective 2:** Expand the knowledge base through the discovery of new tools and practices as well as the continual validation of recommended practices.

**Objective 3:** Improve the coordination and delivering of educational programming and increase the implementation effectiveness of nutrient management strategies that reduce nutrient movement for agricultural and non-agricultural audiences.

MWRRI actively participates in Hypoxia Task Force and SERA-46 Committee meetings and activities, and serves as the lead for the EPA-funded project *Using Social and Civic Engagement Indicators to Advance Nutrient Reduction Efforts in the Mississippi/Atchafalaya River Basin* discussed in this report.

# GULF OF MEXICO ALLIANCE WATER RESOURCES STEERING TEAM

The Gulf of Mexico Alliance was established in 2004 by the Gulf State Governors in response to the President's Ocean Action Plan. Strongly supported by the White House's Council on Environmental Quality, 13 Federal agencies led by EPA and NOAA, were identified to work with and support the effort. The mission of the Gulf of Mexico Alliance is to enhance the ecological and economic health of the Gulf of Mexico through increased regional collaboration.

The five U.S. Gulf States (of Alabama, Florida, Louisiana, Mississippi, and Texas) face similar challenges and concerns regarding the Gulf Coast and its waters. Through the Alliance, the Gulf States collaborate to address the needs of the Gulf through a comprehensive, ecosystem approach. GOMA's structure allows a focus on the funding of priority projects to address these needs. Equally important, the Alliance also provides a forum to share knowledge and expertise as well as an opportunity to collaborate to reduce duplication of effort.

GOMA's Water Resources Team, and its steering team, have four goals:

- Protect human health, aquatic health, and economic health within the Gulf of Mexico by applying and advancing science and technology, improving education and overall environmental awareness, and enhancing partnerships.
- Identify, prioritize, and pursue additional data and research needed to better characterize, understand, and reduce potential threats to human health or aquatic life
- Identify linkages between water quality, water quantity, water resource sustainability, human health, aquatic health, and economic health
- Support ongoing local, regional, national, and international efforts related to protecting and/or improving water resources within the Gulf of Mexico

The GOMA Water Resources Team is led by the State of Mississippi, but has active participation from all five Gulf States and federal agencies working in the region, as well as academia, businesses, and non-profit organizations. MWRRI actively participates on the Gulf of Mexico Alliance (GOMA) Water Resources Steering Team, and serves as the lead for the GOMA Gulf Star Program-funded project *Using Social Indicators and Civic Engagement to Advance Nutrient Reduction Initiatives throughout the Mississippi River/Gulf of Mexico Watershed* discussed in this report.

# DW<sup>3</sup> Team

(Drinking Water-Wastewater)

During April 2016, staff of the U.S. Environmental Protection Agency (EPA) Region 4 staff contacted the Mississippi Water Resources Research Institute (MWRRI) for the purpose of understanding the capacity of Mississippi State University (MSU) to provide support for two current water priorities – 1) EPA's Lead and Copper Rule, and 2) EPA's Waste Water Treatment Plant (WWTP) Energy Optimization Initiative. Mississippi had been identified as a State that had needs related to Lead & Copper Rule training. As a result of this inquiry, MWRRI organized a multi-disciplinary team to address these issues and developed a document that describes the team's capacity to provide support, its ideas of how these issues could be supported, potential leveraging opportunities with MSU programs, resources needed for the support, and opportunities for external resources that potentially could be solicited to help fund these efforts.

EPA Region 4's team assembled to support this effort is Paul Lad (Region 4 Lead & Copper Rule Lead), Brian Thames (Region 4 Drinking Water Program Manager), and Darryl Williams (Region 4 Communities and Watershed Liaison for Mississippi). Bob Freeman leads the Region 4 effort to address the WWTP Energy Optimization Initiative. The DW3 Team has also engaged the Mississippi State Department of Health (MSDH) and the Mississippi Rural Water Association (MRWA) in this effort

which included identifying the support needs and research interests of these organizations. Recognizing the importance of their needs and interests, during August 2016 MWRRI invited both of these organizations to participate on its Advisory Board. Both MSDH and MRWA accepted the invitations. Also during August 2016 in response to EPA's invitation, MSU staff and MDEQ Wastewater Operator Certification Program staff participated in site visits to the wastewater treatment plants for the cities of Batesville, Tunica, and Starkville, Mississippi for the purpose of gathering information for an evaluation of the energy savings and nutrient reduction potential for these facilities.

MSU's multi-disciplinary team includes faculty and staff of MSU's Extension Center for Government and Community Development; Department of Civil and Environmental Engineering; David Swalm School of Chemical Engineering; Department of Agricultural and Biological Engineering; Department of Wildlife, Fisheries, and Aquaculture; Social Science Research Center; and Water Resources Research Institute. Depending upon the support needed, other University units could be added as team members.

Currently project concepts are in development to guide the team's efforts and serve as a basis for funding proposals. Additionally, a watershed-based project for the team is in the planning stage.





# WATER CONFERENCES

# 2016 MISSISSIPPI WATER RESOURCES CONFERENCE

April 5-6, 2016

The annual Mississippi Water Resources Conference, hosted by MWRRI, was held at the Jackson Hilton on April 5-6, 2016. Over 150 pre-registered to attend the conference – a 20% increase over 2015 – and numerous participants registered on site. Student participation also increased significantly.

Researchers and students from colleges and universities as well as water resources planners, managers, and policy-makers from state and federal agencies, industry, and other backgrounds presented 54 oral presentations on the following topics:

- Water Treatment/Management
- Delta Water Resources I and II (2 sessions)
- Water Quality I and II (2 sessions)
- Outputs and Outcomes
- Tools and Models
- Agricultural Water Management
- Mississippi Water Resources
- Ecology/Hydrology I and II (2 sessions)
- Water Use
- Collaborative Initiatives
- Policy/Planning

Additionally, 22 posters were presented.

The opening plenary speaker was Marc Wyatt, director of the Office of Oil Spill Restoration with Mississippi Department of Environmental Quality (MDEQ). Marc spoke about the

RESTORE Act and the Gulf Coast Restoration Plan, and provided an update on planning and implementation activities. The lunch plenary speaker on Tuesday, April 5 was Chris Wells, chief of staff of MDEQ. Chris spoke about MDEQ's priorities including Delta groundwater declines, development of numeric nutrient criteria, 303(d) List of Impaired Waters, as well as potential budgeting impacts to the agency. Wednesday's lunch speaker was Mike McCormick, president of Mississippi Farm Bureau Federation. Mr. McCormick discussed Farm Bureau's role in water resources, including its statewide and national perspective of the Waters of the United States (WOTUS) issue.

Through a Weyerhauser sponsorship, the student oral presentation competition was reinstated during this year's conference. Also, an anonymous gift in honor of Mr. James R. Kilgore III, sponsored the continuation of the student poster competition. Of the 30 students registered for the conference, 27 participated with either oral or poster presentations. Cash prizes of \$100 for 1st place, \$75 for 2nd place, and \$50 for 3rd place were awarded to the winners in both categories.

MWRRI recognizes Ms. Patricia Wilson, Department of Geosciences, who volunteered with conference planning, set up, and operations for several years. Her presence will be missed.

## **Winners of the student poster presentation competition**

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First Place

**Emily Mealins, MSU**

*Potential Solutions for Dealing with High Iron Content in Filter Backwash Water of a Municipal Water Treatment System*

Second Place

**Tadesse Sinshaw, UM**

*Prioritizing the Restorability of Impaired Water Bodies: A Case Study of Four Watersheds in the Delta Region of Mississippi*

Third Place

**Katy Limpert, MSU**

*Ecological Significance of Phyllosphere Leaf Traits on Throughfall Hydrology, Biogeochemistry and Leaf Litter among Quercus Species in the Southeastern United States*

## **Winners of the student oral presentation competition**

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First Place

**Cory Shoemaker, MSU**

*Effects of Land Use on Wetland Plant Diversity in Mississippi*

Second Place

**Juan Perez-Gutierrez, MSU**

*Towards an Improved Understanding of On-Farm Water Storage Systems in Mississippi: How Much Water is Lost from These Systems?*

Third place

**Xiaojing Ni, MSU**

*Evaluation of Crop Rotation and BMPs on Water Quality and Quantity using SWAT*

## **Special thanks to our sponsors, exhibitors, and/or organizers**

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Eureka Water Probes

MS Department of Environmental Quality

Mississippi Farm Bureau Federation

Mississippi State University Division of  
Agriculture, Forestry, and Veterinary  
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# SEC WATER CONFERENCE PLANNING

A significant focus of MWRRI activities during 2016 was planning for the “The Future of Water: Regional Collaboration on Shared Climate, Coastlines, and Watersheds,” was a significant focus of MWRRI’s activities during 2016.

Held at The Mill on March 27-28, 2017, Mississippi State University is the first Southeastern Conference institution to host the new academic event focused on SEC university research collaboration.

“As president of both Mississippi State University and the Southeastern Conference, I’m extremely proud to see MSU take the lead in hosting the first SEC Academic Conference,” said MSU President Mark E. Keenum.

“This represents a significant opportunity for Mississippi State and the City of Starkville to showcase our campus facilities and our community for a large and distinguished group of our colleagues from the other 13 universities around the league. MSU is particularly well-suited to host an academic conference on the topic of The Future of Water – a topic that dovetails with our established university priority of improving global food security and battling world hunger,” Keenum added.

“We are looking forward to working with Mississippi State University on this first SEC Academic Conference,” said Greg Sankey, SEC Commissioner. “Under the leadership of President Keenum, Provost Judy Bonner, and Vice President for Research and Economic Development David Shaw, we know the faculty and administrators in Starkville will provide a challenging and thoughtful program on the critically important issue of water conservation.”

MSU officials making preparations for the March conference said increased climate variability and water demand are bringing water issues to the forefront. Drought, declines in aquifers used for irrigation, and sea-level rise are among core topics of interest. The conference is designed to stimulate communication and collaboration toward sustainable and resilient water resource management in the Southeast, with over arching themes to include shared inland waters and aquifers, coastlines, climate and regional policy.

The conference aims to identify the dominant economic, community and ecosystem challenges to sustainable water resources in the southeastern U.S.; identify policy and practice paths to maximize the health and vitality of the region through water stewardship; and engage the best and brightest scientists in the SEC with other national and international experts in water resources.

“This conference is going to be a very important opportunity to interact with inter-disciplinary colleagues to discuss cutting-edge water resource science and opportunities for collaborative research,” said MSU Vice President for Research and Economic Development David Shaw.

Students from all SEC universities were encouraged to participate and compete in the Campus Water Matters Challenge under the guidance of faculty from their respective universities. Designed to engage students to innovate interdisciplinary water solutions, the challenge also encourages student-faculty collaboration.

## **SEC Water Conference**

### **Establishing a Southeast Regional Water Research Institute Forum**

Water Resources Research Institutes (WRRIs), established by the Federal Water Resources Research Act of 1984, operate in 54 states and territories of the United States. These Institutes are charged with arranging for research that addresses water problems or expands understanding of water and water-related phenomena, aiding the entry of new professionals into the water resources fields, helping to train future water scientists and engineers, and transmitting research results to water managers and the public. However, in this era of regional and multi-state water challenges only limited collaboration and coordination are occurring among the Institutes.

Recognizing this situation, significant interest has been generated among WRRIs to establish a regional forum to promote collaboration and coordination on regional and multi-state water resources priorities in the southeastern United States. Building upon and working within the existing structures and programs of individual WRRIs in the southeastern U.S., MWRRI is leading an effort to establish a regional forum to promote multi-state collaboration and coordination on regional and multi-state water resources priorities. It is envisioned that the forum will initially identify 4-5 over arching needs on which to focus its shared interest. It is anticipated that such a shared focus will be more likely to result in real progress toward understanding and addressing the regional water resources priorities.

Desired outcomes of a southeast regional WRRI forum could include:

1. Collaboratively identify and address multi-state and/or regional water resources research and management priorities in the southeastern U.S.;
2. Establish and coordinate regional communities of practice;
3. Significantly increase collaboration and coordination among WRRIs in the southeast on research proposals and projects;
4. Create and manage a collaborative regional RFP through increased funding to WRRIs;
5. Share and provide access to innovative programs housed in individual WRRIs;

6. Develop and formalize relationships with appropriate regional offices of EPA, USGS, NOAA, USACE, USDA (NRCS, NIFA), and other water resource-related agencies as well as regional forums such as SERA-43, Landscape Conservation Cooperatives, the Gulf of Mexico Alliance, et al;
7. Develop a relationship with the National Water Center (housed at the University of Alabama); and
8. Facilitate recurring conference calls/webinars and an annual meeting to share information and discuss collaboration and leveraging opportunities.

As a component of the SEC conference MWRRI will facilitate a series of four 1-hour breakout workshops that will focus on establishing a southeast regional WRRI forum to address multi-state and regional water resources priorities. Four panels are being organized to address the following foundational issues relevant to this effort:

#### **Session 1**

What should be the objectives/desired outcomes and scope of the forum? What regional partnering opportunities should be explored? What benefits might accrue to individual WRRIs and the region?

#### **Session 2**

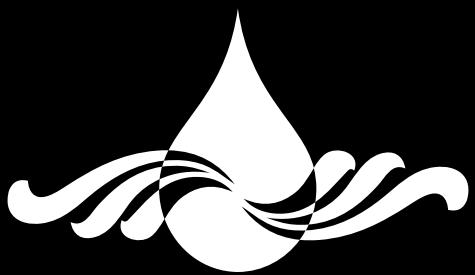
What do you see as existing/emerging regional and multi-state water resources research and management issues that impact the southeastern U.S.? Which research and management issues for which regional/multi-state collaboration are needed should receive the highest focus?

#### **Session 3**

Presentations on recognized projects/programs implemented by southeastern WRRIs that could be transferred to other states or across the region

#### **Session 4**

What organizational issues need to be considered for planning and implementation of this regional forum concept? What resource opportunities for WRRIs can be created through this concept? What do you see as next steps (activities and milestones)?



[wrri.msstate.edu](http://wrri.msstate.edu)



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