



# MWRRI Newsletter

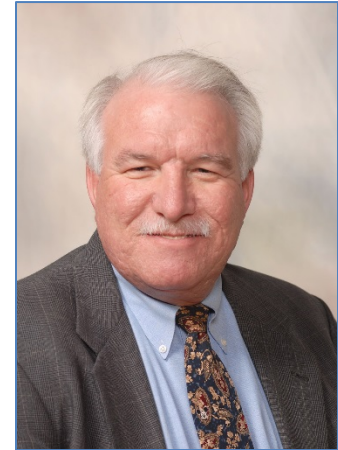
MWRRI Newsletter

Fall 2015

## From the Director's Desk ...

It's hard to believe that fall is here and we are fast approaching the end of the semester and calendar year! We have been very busy at MWRRI developing and supporting new collaborative projects and initiatives as well as facilitating numerous recurring activities which are the foundation of our Institute.

The Catalpa Creek Watershed Restoration and Protection Project achieved a milestone in September with the completion of a comprehensive water resources management plan that focuses on ecosystem/habitat, water quality, and stream function/structure. This management plan, developed by teams of over 40 university and agency staff, will guide future restoration and protection activities and will be leveraged into the new Watershed D.R.E.A.M.S. (Demonstration, Research, Education, Application, Management and Sustainability) Center which is in the conceptual development stage. These efforts are our current focus as a designated Center of Excellence of Watershed Management by the Mississippi Department of Environmental Quality and the U.S. Environmental Protection Agency.



Working with our Advisory Board, this summer MWRRI updated our water resources research priorities. These priorities guide the development and selection process for our 104b Water Research Program as well as collaborative projects which we facilitate with state and federal agencies, nongovernmental organizations, Mississippi's institutions of higher learning, and other stakeholders. Recently, our Advisory Board recommended the funding of two new research projects for 2016.

MWRRI has been providing support for MAFES and Extension with the Hypoxia Task Force's Land Grant University Initiative (also known academically as SERA-46). A key part of MWRRI's support is facilitating the development and submission of a social indicators project. The basinwide project is co-led by MSU's Social Science Research Center and the University of Wisconsin-Extension.

MWRRI is also supporting the Gulf of Mexico Alliance's Water Resources Team and Steering Team as it works to develop a new water resources plan for the entire Gulf coast. The multi-state and federal agency team is led by the Mississippi Department of Environmental Quality.

Earlier this year, MSU through MWRRI, the University of Alabama Water Policy and Law Institute, and the Auburn University Water Center signed a memorandum of agreement creating a new long-term partnership to advance interdisciplinary water science, policy and law research, economic development, ecosystem management, and capacity building. We are currently working on economic development concepts.

We are also hard at work in the planning phase for the 2016 Mississippi Water Resources Conference scheduled for the Jackson Hilton on April 5-6. We are very excited about some of the opportunities and program sessions that are being discussed. Included with this newsletter are a *Call for Abstracts* and a *Sponsor and Exhibitor Reply Form*. Your support is essential for a successful conference.

Together, let's make a difference!

Respectfully,

*Bill Herndon*

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## 104b Water Research Project Recommendations

During a meeting of the MWRRI Advisory Board on November 20, 2015, recommendations were made to seek funding through USGS' 2016 104b Water Resources Research Program for the following projects:

*Oxbow Lake Wetland Systems as a Source of Recharge to the Mississippi River Valley Alluvial Aquifer* – Dr. Greg Davidson, Dr. Andrew O'Reilly, Department of Geology and Geological Engineering, University of Mississippi

*Wastewater Management in Mississippi Coastal Communities* – Dr. Veera Ganeswar Gude, Dr. James Martin, Dr. Dennis Truax, Department of Civil & Environmental Engineering, Mississippi State University

## 2016 Mississippi Water Resources Conference

April 5-6, 2016 | Hilton Jackson | Jackson, MS

### CALL FOR ABSTRACTS

The 2016 Mississippi Water Resources Research Institute (MWRRI) annual conference promises to be an exciting event. This year's event will be held in Jackson, MS, April 5-6, 2016 and will be the water conference in Mississippi that you will not want to miss. We hope you will attend. Abstracts are now being accepted for presentations and posters.

Abstracts may relate to any water related topic and they should contain 200-400 words. Submit your abstract to Jessie Schmidt ([jessie.schmidt@msstate.edu](mailto:jessie.schmidt@msstate.edu)) by Friday, January 15, 2016. Authors agree to present their paper, and pay the conference registration fee should their abstract be accepted. Authors who cancel attendance after March 1, 2016 will be responsible for payment of the registration fee. Papers/posters presented at the conference will be published in the Proceedings. The registration fee of \$225.00 (\$275.00 late registration) will cover all conference activities. The full-time student registration fee is \$50.00 (\$100.00 late registration). A special one-day registration will be available for Tuesday, April 5. The one-day registration fee is \$150 or \$30 for students.

Manuscripts will be the sole responsibility of the authors as the MWRRI does not edit manuscripts for the Proceedings. Authors will be expected to adhere to guidelines for proceedings and submit papers prior to the established deadlines. The proceedings timetable and guidelines will be provided at a later date.

#### All submissions must include the following information:

- Paper Title
- Key Words (3-5 from list below)
- Oral presentation, poster presentation, both
- Presenter's name, title and affiliation
- Presenter's address, phone, fax and e-mail
- Any co-author/s and affiliation
- Are you a student, and if yes, name of major advisor
- Presenter's business address, phone, fax and e-mail
- Abstract

Abstracts that address current water resources issues in all areas of Mississippi are solicited—from the Gulf of Mexico to the Mississippi Delta to the Tenn-Tom. These include presentations and posters on the following categories:

- Climatic Water Trends and Water Harvesting
- Groundwater Quality and Quantity
- Surface Water Quality and Quantity
- Ecosystem Restoration and Protection
- Watershed Management Approaches
- Social Sciences and Economics of Water
- Drinking Water and Waste Water Management
- Coastal Restoration
- Emerging and Innovative Technologies

**STUDENTS:** Enter your poster for a chance to win the Student Poster Competition

**Abstracts due by January 15, 2016  
to Jessie Schmidt at [jessie.schmidt@msstate.edu](mailto:jessie.schmidt@msstate.edu)**

Sponsored by: Mississippi Department of Environmental Quality, Mississippi Water Resources Research Institute, and the U.S. Geological Survey

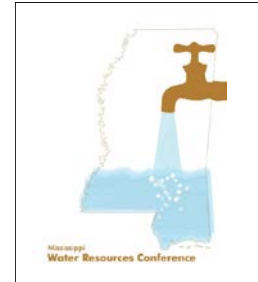


## 2016 Annual Mississippi Water Resources Conference

Hilton Jackson, Jackson, MS

April 5-6, 2016

### Sponsor & Exhibitor Reply Form



**Yes** \_\_\_\_\_ **I would like to sponsor a conference event**

**Name:** \_\_\_\_\_

**Title:** \_\_\_\_\_

**Company/Organization:** \_\_\_\_\_

**Address:** \_\_\_\_\_

**City/State/Zip:** \_\_\_\_\_

**Phone:** \_\_\_\_\_ **Fax:** \_\_\_\_\_ **Email:** \_\_\_\_\_

**There are multiple opportunities to become a sponsor or co-sponsor. Please indicate your preference below. In order to be included in the program book, all payments must be received no later than Monday, February 29, 2016.**

**Tuesday, April 5**

|  | <u>Full Sponsor</u> | <u>Co-sponsor</u> |
|--|---------------------|-------------------|
| Breakfast - \$750 (full sponsor) or \$375 (co-sponsor)           | _____               | _____             |
| Morning break - \$700 (full sponsor) or \$350 (co-sponsor)       | _____               | _____             |
| Luncheon - \$1,000 (full sponsor) or \$500 (co-sponsor)          | _____               | _____             |
| Afternoon break - \$700 (full sponsor) or \$350 (co-sponsor)     | _____               | _____             |
| Welcome Reception - \$1,000 (full sponsor) or \$500 (co-sponsor) | _____               | _____             |

**Wednesday, April 6**

|   |       |       |
|---|-------|-------|
| Breakfast - \$750 (full sponsor) or \$375 (co-sponsor)        | _____ | _____ |
| Morning break - \$700 (full sponsor) or \$350 (co-sponsor)    | _____ | _____ |
| Luncheon - \$1,000 (full sponsor) or \$500 (co-sponsor)       | _____ | _____ |
| Poster Session - \$1,000 (full sponsor) or \$500 (co-sponsor) | _____ | _____ |

**Exhibitor table/space only - \$500** (please indicate preference below)

**Yes** \_\_\_\_\_ **I would like an exhibitor table** \_\_\_\_\_ **or space (for standup exhibits)** \_\_\_\_\_.

- Sponsorships of \$500 and above will receive one (1) complimentary registration. A second person from the same agency can register for \$150.
- All sponsors and exhibitors will be recognized on the 2016 MWRC poster (company logo), from the podium, at luncheons, and in the program book as well as online conference website.
- Sponsorship Questions: Please contact Jessie Schmidt, [jessie.schmidt@msstate.edu](mailto:jessie.schmidt@msstate.edu)

**Please email this form to Jessie Schmidt, [jessie.schmidt@msstate.edu](mailto:jessie.schmidt@msstate.edu)  
Or mail to MWRRI, Box 9547, Mississippi State, MS 39762**

## Catalpa Creek Water Resources Management Plan: Executive Summary

The Catalpa Creek Watershed is located in Oktibbeha, Lowndes, and Clay counties in the northeast region of Mississippi and is part of the larger Tombigbee River Basin. The 28,928 acre watershed contains 31 miles of mainstream perennial stream length. The stream network empties into Tibbee Creek which flows into Columbus Lake on the Tennessee-Tombigbee Waterway north of Columbus, MS. At the HUC-12 level, the watershed includes part of the Mississippi State University Campus, the MSU South Farm research facility and dairy farm, as well as a number of privately owned lands. Lands in the watershed were originally primarily prairie. Current land use includes 44% in hay production/pasture land, 10% in cultivated crops, 9% in developed land, and 8% in wetlands or open water. Research activities of the university and continued development and construction of university lands appear to be a primary driver of stream, ecosystem, and water quality degradation. Catalpa Creek is currently listed by the Mississippi Department of Environmental Quality (MDEQ) as impaired by sedimentation and a TMDL has been developed that sets challenging targets for sediment load reductions. Two MSU facilities on the South Farm are permitted point sources – the Poultry Science Research Center and the Ag Center and Horse Park. The agency has ranked the watershed as having a high stressor potential, which means compared to other watersheds in the area Catalpa Creek is a watershed in need of restoration. MDEQ supports four sites in the watershed to monitor its biological health.

A comprehensive suite of management practices has been selected to address the agricultural resource concerns identified for the watershed – sedimentation, grazing lands, sustainable forestry, and declining wildlife habitats. The management practices to mitigate sedimentation range from grade stabilization structures, sediment basins, and grassed waterways to critical area plantings, field borders, and terraces. Management practices to address protect grazing lands include fencing, pond construction, prescribed grazing, heavy use protection, livestock shelters, and watering facilities. Practices to foster sustainable forestry include land clearing, forest site preparation, and tree and shrub establishment. Practices to restore declining wildlife include water control structures, forage and biomass planting, and forest stand improvement. Some of these practices address multiple resource concerns.

In addition to the agricultural resource concerns, urban storm water management is a key need for the watershed and a focus of this restoration and protection plan. MSU's Master Plan contains numerous urban storm water management techniques and approaches, and will be leveraged with this water resources management plan. These include: design and implementation of low impact development (LID) solutions in future campus planning and development; on-site storm water treatment (where feasible) on all newly constructed campus buildings and landscape projects; 100-foot buffers on all campus streams;

protecting and re-vegetating landscape areas around existing creeks and drainage ways; directing storm water flow from existing creek beds to water receiving landscapes that are designed to allow for infiltration and slow discharge; enhancing landscapes around existing on-site water resources with vegetated filters and water absorbent plantings at storm water discharge points; and construction of storm water retention basins.

The project has a number of unique features. These include an education, experiential learning, and outreach approach that begins by better understanding the behaviors, perceptions, and beliefs of watershed stakeholders. This will be addressed by pre and post implementation surveys. Creation of experiential learning opportunities for students will also be a focus of the project. A comprehensive monitoring and assessment approach will be implemented for this project, including traditional physical/chemical water quality monitoring, macroinvertebrate habitat assessments, use of indicator species to evaluate ecosystem restoration progress, and social indicators to understand improvements in stakeholder behaviors and perceptions and the effectiveness of educational and outreach activities. Another unique feature includes a focus on watershed sustainability from several perspectives – habitat/ecosystem health, water quality and quantity, and the continuance of concerted, collaborative efforts to involve local watershed champions and businesses to foster “collective ownership” of the watershed. Such an approach supports MSU’s Vision 20/20 and will tie-in MSU’s Office of Sustainability.

Probably, the most ambitious component of the project is to leverage these restoration and protection activities into the establishment of a Watershed D.R.E.A.M.S. (Demonstration, Research, Education, Application, Management and Sustainability) Center. Supported by the highest administrative levels of the university and throughout its faculty, the Watershed D.R.E.A.M.S. Center is envisioned as an ongoing collaborative campus-wide project that links together and is supported by over 18 university departments, institutes, programs (i.e., units). Demonstrating innovative applied research, sustainable water resources management, and effective and quantifiable education and experiential learning is the overarching mission of the D.R.E.A.M.S. Center. It is also envisioned that the D.R.E.A.M.S. Center will provide effective training opportunities for state and federal conservation agencies and organizations through demonstrations of best management practices, pollutant reduction strategies, water management applications, and more.

## Researcher Profile: Dr. Kevin Dillon

Associate Professor, Department of Coastal Sciences, Gulf Coast Research Laboratory, University of Southern Mississippi

**Tell us a little bit about your background and your current position.**



I graduated from the University of West Florida in 1991 with a bachelor's degree in Marine Biology. While I was an undergraduate student there I was fortunate enough to get a student employee position at the Environmental Protection Agency's Gulf Breeze lab. I worked as a general student aid initially helping researchers with basic laboratory grunt work such as washing dishes and ordering supplies but was soon pulled into Dr. Richard Coffin's research group where they were investigating biogeochemical cycling of carbon and nutrients and the role that bacteria play in these processes. It was an exciting time to be at the Gulf Breeze EPA lab as many of the research groups were heavily involved in bioremediation work related to the Exxon Valdez oil spill and the labs were always buzzing with activity. I never got to go to Alaska but we conducted a lot of work studying microbial activity in the

coastal zone of Florida from Pensacola to Key West as well as in offshore waters in the northern Gulf of Mexico. It was here that I learned a wide berth of analytical techniques, participated in several research cruises and became intrigued with the field of chemical oceanography. Around that same time I began thinking of attending graduate school we conducted some bacterial incubation experiments with Dr. Jeff Chanton at Florida State University's Department of Oceanography and he recruited me into his lab investigating the delivery of nutrients to coastal waters via groundwater seepage. For my MS degree, I used natural and artificial tracers to trace groundwater on barrier islands and in the Florida Keys to investigate the fate of nutrients surrounding septic tanks and wastewater treatment plants. I continued some of this work for my PhD in addition to a project that examined storm water nutrient loadings to Sarasota Bay. After graduating from FSU, I had a 2 year post doc at Florida A&M University and then accepted a faculty position in USM's Department of Coastal Sciences at the Gulf Coast Research Lab and officially started the same day that Hurricane Katrina slammed into the Gulf Coast. My first month or so was spent shoveling marsh out of GCRL's library and doing as much as we could to help the lab get back in business. It was interesting (and exhausting) times but the resiliency of the folks at GCRL was truly amazing and I quickly got to know people well by working under these harsh conditions. Since starting at USM I have been able to conduct studies examining biogeochemical cycling of carbon and nutrients in natural waters, storm water and

aquaculture systems. I have also become heavily involved in many food webs studies with colleagues at GCRL and beyond. There is still much to learn about ecosystems in the northern Gulf of Mexico and I look forward to the future scientific opportunities that will help us learn more about hydrology and biogeochemical cycling in the region.

### **What are your current research activities (include MWRRI-funded projects)?**

Tracing excess nutrient loads from different pollution sources is a major focus of my research program. Our current MWRRI project is a collaborative effort with co-PIs Dr. Jane Caffrey (UWF), Dr. Ruth Carmichael (DISL), Dr. Mark Woodrey (MSU/GBNERR) and Kim Cressman (GBNERR) examining the fate of phosphate spills into Bangs Lake from the nearby Mississippi Phosphates Corporation in Pascagoula. This project has had a large undergraduate intern component and it has been very rewarding to work with these enthusiastic young scientists as they begin their professional careers. My lab is also just beginning a National Fish and Wildlife Foundation funded study examining nutrients and food web dynamics for reef fish in Mississippi waters.



### **How does the Water Resources Research Institute fit into your future plans? How can we help you be more successful?**



Our funding from the WRRRI has allowed us to address some basic questions regarding industrial phosphate spills into a local estuary and has also allowed me to work with some outstanding scientists on this important environmental issue. We hope to continue these collaborations as we move forward conducting this work. Presenting results of this study last year at the MWRRI conference also allowed me to make more scientific contacts throughout much of Mississippi and I think future collaborations examining practical environmental problems within the state of Mississippi will develop from these interactions.



## 2016 MWRRI Water Resources Research Topics (Short List)

### Climatic Water Research Topics

- Predictions of Future Water Needs in Various Regions of the State under Various Climatic and/or Pumping Scenarios
- Innovative Water Harvesting 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
- Innovative and Affordable Wastewater Treatment for Small Communities
- Identification of Appropriate Response Measures for Mississippi's Waters and Linkage between Nutrient Concentrations and the Identified Response Measures
- Analysis of Nutrient Loading Trends
- Innovative Water Reuse and Conservation Applications
- Protection of Source Water Resources
- Coastal-specific Research

### 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)

## (Full Descriptions)

### Climatic Water Research Topics

- Predictions of Future Water Needs in Various Regions of the State under Various Climatic and/or Pumping Scenarios
  - Changes have occurred in the amount of rainfall, variability, and recurrence in the past and will occur in the future. Comparison of past climate trends to variations in groundwater and surface water pumpage for all beneficial uses and projections of future climatic conditions can be used to help predict future water needs.
- Innovative Water Harvesting Techniques and Applications
  - Rain is the first form of water that we know in the hydrological cycle, hence it is a primary source of water for us. Rivers, lakes and groundwater are all secondary sources of water; however, today we depend almost entirely on these secondary sources. Water harvesting seeks first to understand the value of rain, and to make optimum use of the rainwater at the place where it falls. Mississippi's abundant rainfall presents numerous opportunities to achieve sustainability of our water resources through innovative water harvesting techniques and applications that include providing irrigation water; increasing groundwater recharge; reducing storm water discharges, urban flooding and overloading of sewage treatment plants; and reducing seawater ingress in coastal areas.

### Groundwater Research Topics

- Innovative Approaches to Estimate Aquifer Recharge
  - Groundwater is recharged naturally by rain and to a smaller extent by surface water (rivers and lakes). Rates of groundwater recharge are difficult to quantify, since other related processes, such as evapotranspiration and infiltration processes must first be measured or estimated to determine the balance. There is a need for innovative approaches to estimate recharge for all aquifers of the state as there are few scientifically defensible methods to determine recharge at this time. Having a more thorough knowledge of recharge would be invaluable in determining water budgets for the various aquifers in the state. Advances in our understanding of groundwater-surface water interaction is especially needed currently in the Delta and along streams in South Mississippi.
- Development of Water Budgets
  - A water budget is an accounting of inflows (recharge) to and outflows (pumpage/use) from a groundwater system. Ideally, under equilibrium conditions, when water levels are not changing, inflows should equal outflows. However, this is not the case in some areas of Mississippi where pumpage/use is exceeding recharge. As Mississippi's population grows and shifts within the state and its economy expands, knowledge of water availability throughout the state is vital as is the

understanding of past and prediction of future trends related to demographics, industrial and agricultural water use, infrastructure needs, etc., especially in areas of competing water use.

- **Determining Aquifer Transmissivities and Characteristics**
  - Transmissivity is defined as a measure of how much water can be transmitted horizontally, such as to a pumping well. Transmissivity of a confined aquifer is determined by pump tests. While many pump tests have been conducted throughout the state of Mississippi, the hydrogeology of an aquifer can vary significantly from place to place. Additional information (transmissivities or ranges of transmissivities and other aquifer properties) is needed to determining how much water can be pumped in a particular location.
  - Naturally occurring aquifer characteristics such as color, high iron content, and low pH, among others, can affect the taste, color, odor, and use of water from different aquifers. This information is very useful in determining where and how deep groundwater wells should be drilled and what type of treatment would be necessary.

### **Surface Water Research Topics**

- **Evaluation of BMP Effectiveness, Site Placement, Reliability, and Maintenance**
  - Reliable performance data for established and innovative best management practices (BMPs) in Mississippi is needed to develop effective responses to existing and evolving regulations and requirements regarding nutrients, fecal indicator bacteria, solids, metals, runoff volume and urban storm water. Public and private storm water dischargers will be spending substantial sums of money on these issues, primarily in the form of planning, designing, constructing, and maintaining structural and nonstructural BMPs. Research on BMP effectiveness, site placement, reliability, and maintenance (especially costs) continues to be a serious need. Specific applications of these BMPs include:
    - Implementing the load reductions identified by Total Maximum Daily Loads (TMDLs);
    - Implementing the requirements of numeric nutrient criteria;
    - Reducing nutrient loadings;
    - Reducing bacteria levels in water bodies used by the public for recreation; and
    - Reducing storm water runoff volume.
- **Research and Development to Support Water Quality and Ecosystem Health Assessment Applications**
  - Water quality and ecosystem health assessment applications are needed for more efficient management of Mississippi's water resources. Research and development needs to support these applications include:

- Investigation of the use of percent saturation of dissolved oxygen in waters as an indicator of aquatic life support;
  - Investigation of the use of diurnal flux as an indicator of water quality degradation;
  - Development of a simplified approach for ecosystem stressor identification;
  - Development of a fisheries index for Mississippi waters;
  - Study of algal community structure in Mississippi waters (especially within the Mississippi River Alluvial Plain);
  - Further analysis of the potential use of DNA speciation of periphyton as a potential indicator of nutrient pollution; and
  - Development of methods to measure and understand the impacts of pharmaceuticals, microplastics and other contaminants on aquatic ecosystems, agriculture and drinking water.
  - Stream flow is an important habitat variable and research is needed to support water quality and ecosystem health assessment applications.
  - Analysis and documentation of elements of hydrologic restoration (i.e., stream structure, sinuosity, etc.) and their effects on ecosystem health.
- Innovative and Affordable Wastewater Treatment for Small Communities
    - Approximately 180 communities in Mississippi are facing the challenges of having to upgrade or enhance wastewater treatment in order to meet new or more stringent effluent limitations. It is estimated that the potential cost of wastewater treatment upgrades necessary to come into compliance with new effluent standards in Mississippi alone could exceed one billion dollars. Grant funds dedicated to wastewater improvements are becoming increasingly difficult to obtain. Many of Mississippi's smaller communities have difficulty servicing debt on even low or no interest loans; therefore innovative and affordable technologies in wastewater treatment and/or disposal for small communities are increasingly needed.
  - Identification of Appropriate Response Measures for Mississippi's Waters and Linkage between Nutrient Concentrations and the Identified Response Measures
    - Nutrients, nitrogen (N) and phosphorus (P), are essential for plant growth, which then supports healthy aquatic ecosystems and provides habitat. In addition to natural sources, nutrients also come from anthropogenic sources related to agriculture, storm water discharges, wastewater discharges, etc. Excessive amounts of nitrogen and/or phosphorus (referred to as nutrient pollution) can lead to significant impacts on public health, aquatic ecosystems, and the economy. The link between nutrient concentrations and environmental impacts is well-supported by scientific literature; however, the ecosystem response to nutrient pollution can be variable due to the presence of confounding factors at a particular site, such as canopy cover, water column stratification, flow, turbidity, and others. These factors may inhibit a response at a particular site, but the effects of nutrient pollution may be observed where and when these factors subside. Existing research has shown that indicators (i.e., response parameters or assessment endpoints) that are most

sensitive to nutrient pollution and most predictive of impacts to higher trophic levels were TN/TP concentrations, measures of primary production and algal assemblage, and, to a lesser extent, measures of ecosystem function (e.g., dissolved oxygen and pH). To develop appropriate and protective nutrient criteria for Mississippi, the following research is needed:

- Identify the appropriate response measures for Mississippi's waters; and
  - Identification of linkage between nutrient concentrations and the identified response measures.
- **Analysis of Nutrient Loading Trends**
    - For several years now, MDEQ has gathered nutrient data with respect to NPDES point dischargers. With the ongoing work related to the development of numeric nutrient criteria and ongoing work related to implementation of the State's nutrient reduction strategies, a detailed analysis of nutrient loading trends from point sources would be of great value.
  - **Innovative Water Reuse and Conservation Applications**
    - In an effort to help meet growing demands being placed on available water supplies, many communities throughout the U.S. are turning to water reclamation and reuse. Water reclamation and reuse offers an effective means of conserving supplies while helping to meet the ever growing demands for water. The investment in treatment technologies required to meet restrictive discharge limits has led an increasing number of industries and communities to consider other uses for their treated wastewater effluents. Further, as sources of water supplies have become limited, there has been greater use and acceptance of reclaimed wastewater effluents as an alternative source of water for a wide variety of applications, including landscape and agricultural irrigation, industrial processing, power plant cooling, and wetland habitat creation, restoration and maintenance.
    - Research aimed to utilize more practical, ecological, and economically feasible strategies in growing agricultural crops is a necessity. Research can include ways to identify best management practices aimed at preservation of water resources such as increases in efficiency of irrigation.
  - **Protection of Source Water Resources**
    - Drinking water in Mississippi comes from groundwater and surface water sources. Protecting these source waters from contaminants is a major national priority in protecting public health by providing safe drinking water to the public. Continued work is needed with some of our State's water systems to perform the following tasks:
      - Delineate the source water protection areas;
      - Identify known and potential sources of contamination;
      - Develop protection measures; and
      - Address emergency contingency planning.

- Coastal-specific Research
  - A variety of research is needed in our coastal areas that addresses both surface water and groundwater quality and quantity. Following is a list of specific research that is needed:
    - Submarine groundwater discharge;
    - Fresh water inputs and the relationship to oysters, microplastics, and constructed wetlands for nutrient reduction;
    - Understanding and predicting Vibrio risks for swimmers and seafood consumers;
    - Research to inform oyster restoration siting; and
    - Impacts of ocean acidification on coastal waters, animals and industries.

### **Modeling and Tool Development**

- Development of Models and Tools
  - Models and tools are needed to predict future impacts of climatologic change (including extreme meteorological events), water use changes, social drivers, and proposed infrastructure on water resource availability and costs. The following applications have been identified as needs:
    - Options for simplified nutrient modeling;
    - WASP setup tools;
    - Methodologies, indicators, and decision support tools to inform decisions related to water quality and ecosystem health;
    - Predictive models to support beach actions (bacterial, algae, and storm water-related closures and advisories) as part of Mississippi's Beach Monitoring Program;
    - Model and predict frequency and magnitude of freshwater input to coastal areas; and
    - Prediction of storm water flooding.

### **Social Sciences Research**

- Development of Social Indicators
  - Most water quality impairments in Mississippi are anthropogenic. Because of this, the development and use of social indicators to assist in the prioritization, planning, implementation, and evaluation of the effectiveness of water resources projects and programs is important to track progress in the social aspects of water resources management.
- Development of Social Science Applications to Advance Water Resources Management
  - Social science applications can inform the education and outreach processes, reveal water resources champions at various scales, and identify potential opportunities and incentives to engage the business community. To accomplish this, a better understanding of stakeholder behaviors, perceptions and beliefs is of great importance.

### Economics Research

- Economic Analysis of Reducing Nutrient Loadings
  - Decisions affecting the use of our water resources are driven by economics. An example of this can be found in the rapid increase in agricultural irrigation permit applications, especially in the Delta. Economic analyses conducted by MSU during 2010 and 2012 revealed an increase in yield of 68-70% of some irrigated crops over dryland farming. The following research need is identified in Mississippi's nutrient reduction strategies:
    - What are the costs of nutrient reduction? What are the benefits/values? The answers and analyses of these questions are vital to inform the state's adaptive management implementation process. Specifically, analyses of the costs and benefits of selected BMPs designed to reduce nutrient content and improve/enhance water quality are needed to estimate impacts of various BMPs on agricultural productivity, values and uses of land, and tax revenues generated at the local, regional and state levels.

### Emerging and Innovative Technologies

- Current and Potential Use of Unmanned Aerial Vehicles (UAVs)
  - Interest in potential UAV applications is very high. Current research interest that has been identified is listed below:
    - Help with the identification of unpermitted/undocumented surface mining activities;
    - Potential for use in environmental emergency response;
    - As a tool to document existing or potential BMP locations;
    - As a tool to provide habitat mapping and data collection at remote locations;
    - Exploring potential opportunities and applications to collect environmental/water resource-related data and images.

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## About the Mississippi Water Resources Research Institute (MWRRI)

The institute exists as both a federal and a state research unit. Established in 1964, the MWRRI is one of 54 institutes (one in each state, The District of Columbia, Guam, Puerto Rico, and the Virgin Islands) that form a national network to solve water problems of state, regional, or national significance. In 1983, the Mississippi legislature formally designated the MWRRI as a state research institute. Federal funds designated for the institute are used to consult with state water officials to develop coordinated research, technology transfer and training programs that apply academic expertise to water and related land-use problems. These various activities are funded through an annual grant from the United States Geological Survey (USGS). Mississippi state appropriations provide additional funds for cost share. The institute also assists state agencies in the development of a state water

management plan, maintaining a technology transfer program, and serves as a liaison between Mississippi and federal funding agencies.

If you or someone that you know would like to receive this publication please email [jessie.schmidt@msstate.edu](mailto:jessie.schmidt@msstate.edu) to be added to the MWRRI listserv.



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