

**Mississippi Water Resources Research Institute
Annual Technical Report
FY 2016**

Introduction

Background. The Mississippi Water Resources Research Institute (MWRRI), established by the Mississippi legislature in 1984, is a quasi-state agency located at Mississippi State University (MSU) created to provide a statewide center of expertise in water resources and associated land uses that incorporates all of Mississippi's Institutions of Higher Learning in its activities. MWRRI's diverse statutory responsibilities are: 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; and 7) facilitate and stimulate planning and management activities that address water policy issues facing the state of Mississippi, support state water agencies' missions with research on encountered and expected problems, and provide water planning and management organizations with tools to increase their efficiency and effectiveness.

MWRRI staff work with departments and programs from Institutions of Higher Learning across Mississippi, state and federal agencies, and stakeholder organizations willing to participate in its collaborative approach in a team environment to develop approaches and projects to address the state's water resources management and research priorities.

Advisory Board. The legislation that established MWRRI also created a strong and diverse Advisory Board. The Advisory Board's role is to provide input on current and emerging priority state, regional and national water and water-related land research problems; identify opportunities to effectively collaborate with local and state governments and agencies, water user associations, other universities, federal government agencies, and the legislature in formulating MWRRI's research program; assist on the selection of research projects to be funded from USGS funds; and advise on disseminating and transferring information and technology produced by research. Designated Advisory Board members include representatives from the Mississippi Public Service Commission, Mississippi Department of Environmental Quality, Mississippi Department of Marine Resources, U.S. Army Corps of Engineers Engineering Research and Design Center, Mississippi/Alabama Sea Grant Consortium, University of Mississippi, University of Southern Mississippi, Jackson State University, Delta Council, USDA Natural Resources Conservation Service, Mississippi Soil & Water Conservation Commission, U.S. Geological Survey, USDA National Sedimentation Laboratory, and the Mississippi Water Resources Association. Five at large seats representing water stakeholders/users in private sector business and regional water management/waterway districts also serve on the Advisory Board.

Center of Excellence for Watershed Management. On April 9, 2013, MWRRI was designated by Region 4 of the U.S. Environmental Protection Agency (EPA Region 4) and the Mississippi Department of Environmental Quality (MDEQ) as a Center of Excellence for Watershed Management with the formal signing of a Memorandum of Understanding (MOU) by these parties. The MOU acknowledges that the MWRRI had demonstrated to the satisfaction of EPA and MDEQ that it has the capacity and capability to identify and address the needs of local watershed stakeholders and that it has support at the appropriate levels of MSU. It also specifies the Center of Excellence to serve as the point of contact and primary coordinating entity for colleges and universities in Mississippi. The primary purpose of the Center of Excellence is to utilize the diverse talent and expertise of colleges and universities by providing hands on practical products and services to help communities identify watershed-based problems and develop and implement locally-sustainable solutions. The MOU also guides the Center of Excellence to actively seek out watershed-based stakeholders that need assistance with project development and management, research and monitoring, education and

outreach, engineering design, computer mapping, legal and policy review, and other water resource planning and implementation needs. Annual commitments of the MWRRI are also identified in the MOU.

Research Program Introduction

Background. 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.

External Review Process. MWRRI's approach to integrated water resources research seeks to explore the linkages among natural science, engineering, and the dynamics of social and economic systems that underpin water management decisions. As one of its core functions, MWRRI facilitates an annual, statewide competitive grants program to solicit research proposals for potential USGS 104b funding support. Proposals are prioritized as they relate to the research priorities established/affirmed annually by MWRRI's Advisory Board and by the ability of proposing parties to obtain letters of support and external cost share support from non-federal sources in Mississippi. MWRRI's Advisory Board consists of 20 members with water-related missions/programs – 5 state agencies, 4 federal agencies, 4 major research universities, 3 NGOs, 1 water management district, and 3 industry representatives. As mentioned previously, a major activity of this Board is to review and recommend 104b proposals for potential funding. Each year, Advisory Board members are distributed all proposals submitted for potential 104b funding along with review criteria and individual proposal grading forms. After self-reviews are conducted, the full Advisory Board convenes to discuss the merits of each proposal, individual proposal grades, and then develops funding recommendations through consensus.

Water Research Priorities MWRRI and 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. During the 2016 104b funding cycle, the research priorities recommended by the Advisory Board and adopted by MWRRI 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 • Various topics (see Full Descriptions)

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

Research Program Introduction

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)

All 2016 104b proposal submittals were required to address at least one of these priorities. These priorities also guided MWRRI staff efforts to develop collaborative multi-agency project proposals for submission to other external funding sources.

2016 104b Funded Proposals. Two projects were funded during 2016 that addressed some of the most pressing water resources issues in Mississippi. These projects were:

1. Oxbow Lake-Wetland Systems as a Source of Recharge to the Mississippi River Valley Alluvial Aquifer
2. Wastewater Management in Mississippi Coastal Communities

In addition to the 104b-funded projects, MWRRI received external grant award notices for the following projects: 1. Using Social and Civic Engagement Indicators to Advance Nutrient Reduction Efforts in the Mississippi/Atchafalaya River Basin – Phase 1 2. Using Social Indicators and Civic Engagement to Advance Nutrient Reduction Initiatives throughout the Mississippi River/Gulf of Mexico Watershed

Using Social and Civic Engagement Indicators to Advance Nutrient Reduction Efforts in the Mississippi/Atchafalaya River Basin – Phase 1. MWRRI received from EPA a notice of \$194,100 for this phased project. Grant monies have been made available for Phase 1 which address the development of social indicators in support of the Hypoxia Task Force through SERA-46. This project, developed in collaboration with MSU's Social Science Research Center, began implementation during the December 5-7, 2016 meetings of the Hypoxia Task Force (HTF) and Southern Region Extension and Research Activities Committee 46 (SERA-46) in New Orleans.

Abstract. 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, improvements to the database of social indicators will be accomplished by directly engaging Hypoxia Task Force members,

Research Program Introduction

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. MWRRI also 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.

Oxbow Lake-Wetland Systems as a Source of Recharge to the Mississippi River Valley Alluvial Aquifer

Basic Information

Title:	Oxbow Lake-Wetland Systems as a Source of Recharge to the Mississippi River Valley Alluvial Aquifer
Project Number:	2016MS205B
Start Date:	3/1/2016
End Date:	2/28/2017
Funding Source:	104B
Congressional District:	MS-001
Research Category:	Ground-water Flow and Transport
Focus Categories:	Groundwater, Wetlands, Hydrology
Descriptors:	None
Principal Investigators:	Gregg R. Davidson, Andrew Michael O'Reilly

Publication

1. Quarterly reports submitted to Mississippi Water Resources Research Institute.

Mississippi Water Resources Research Institute (MWRRI)

Quarterly Report – (From) MM/DD/YY – (To) MM/DD/YY

Reports due: 1st (March 31); 2nd (June 30); 3rd (Sept. 30); 4th (Dec. 31)

Note: Please complete form in 11 point font and do not exceed two pages. You may reference and append additional material to the report.

SECTION I: Contact Information

Project Title: Oxbow Lake-Wetland Systems as a Source of Recharge to the Mississippi River

Principal Investigator: Gregg Davidson and Andrew O'Reilly

Institution: University of Mississippi

Address: Geology & Geological Engineering, Carrier 120, University, MS 38677

Phone/Fax: 662-915-5824 / 662-915-5998

E-Mail: davidson@olemiss.edu; aoreilly@olemiss.edu

SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal: \$22,117.96, Non-Federal (MWRRI): \$21,772.50, Non-Federal (Dept.): \$12,014.37,
In-Kind: \$0, Total Cost Share: \$33,786.87

Equipment (and cost) purchased during reporting period:

A WINK vibracorer was purchased and field tested in preparation for deploying at Sky lake later this summer when water levels are expected to be lower. The actual cost of the system was \$22,724, \$14,000 of which was used as matching funds toward the project.

Twelve data-logging pressure transducers and a telemetry station have been ordered, but not yet invoiced or delivered.

Twelve data-logging pressure transducers and a telemetry station from *In Situ*; \$12,620

Twenty one 15-m thermocouples from *Dynamax*; \$2,844

62 submersible temperature data loggers (*ibWetland*); \$4,973

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

All well sites have been selected, and permissions obtained from state, federal, and private land owners. The vibracorer for collecting wetland cores has been received and field tested.

A new graduate student working on the project has registered for the short course *Techniques for Stream-Groundwater Investigations*, taking place August 7-12 at the Rocky Mountain Biological Laboratory in Crested Butte, CO.

The WINK vibracorer (purchased as part of the cost share) was used to collect two 8-m cores from sites in the Sky Lake wetland. Cores penetrated through the clay bed down into sands and gravels. Drive-point piezometers were placed in the aquifer at the same locations using an

adaptor on the vibracorer. Data logging pressure transducers were installed to keep track of

groundwater at both sites, and lake level at one site.

A suite of thermocouples was placed on each side of the boardwalk at depths of 30 and 60 cm in preparation to wire to a Dnynamax data logger.

Michael Gratzler, a graduate student working on the project, completed a week-long short course *Techniques for Stream-Groundwater Investigations*, August 7-12 at the Rocky Mountain Biological Laboratory in Crested Butte, CO. Dr. Davidson completed a related one-day course on using heat as a tracer at the annual meeting of the Geological Society of America, Sept 24.

MDEQ completed all eight wells to add to one existing perimeter well and two piezometers inside the Sky Lake wetland. All wells were outfitted with data-logging pressure transducers before the drought ended, which will allow a unique opportunity to record the groundwater response when as water in the wetland rises over the winter.

Two arrays of temperature sensors were installed at two depths in the wetland when it was dry and connected to a data logging system on the boardwalk.

The predominant activity this quarter was collecting water level and temperature data from 11 wells, and temperature data from a shallow array of wetland soil sensors. Preliminary data is now available showing a groundwater ridge or mound beneath the oxbow lake, consistent with vertical recharge to the aquifer from the lake. Temperature sensors in the wetland also show evidence of preferential flow pathways at isolated sites. YMD also surveyed the elevation of each well to allow accurate mapping of the groundwater potentiometric surface. (Most of the expense reporting for this quarter is related to recovery of indirects.)

Problems Encountered:

Most of the Spring was too wet to get the MDEQ drill rig to the well sites, and water levels in the wetland too high to core. The ground is now dry enough to begin drilling, and water level in the wetland will soon be low enough to core.

The MDEQ drill rig broke down and was sequestered for repairs, so the wells have not yet been drilled. The rig just came back on line, and is scheduled to begin drilling on October 10. MDEQ estimates completing two to three wells per week.

The telemetry system was set up, but could not get a sufficient signal. A better antennae was ordered and the company is working with us to get it set up.

The MDEQ drill rig was down for several months which placed us behind schedule. All wells are now completed. A six month no-cost extension was formally requested.

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The project is partially dependent on seasonal water-level rise in the wetland. An unusually dry summer season was good for establishing low-water conditions, but levels never significantly rose over the winter. The water is now rising, and is expected to yield valuable data, though later than anticipated. We are still on schedule, however, for completion within the six-month extension period.

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

Michael Gratzler will be presenting our results to date at the upcoming Water Resources conference in Jackson, MS. A pdf will be provided in the report for the next quarter.

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

Name	Level	Major
Michael Gratzler	Master's	Hydrology

Next Quarter Plans:

MDEQ drilling of nine wells.
Core at wetland sites.
Set up telemetry system.

MDEQ drilling of wells.
Set up telemetry system.
Wire the thermocouples to the data logger.

Installation of submersible temperature data loggers in the wells.
Monitoring water levels and temperatures. Data analysis.\

Collection of high-water data and analysis of results. Two new water level sensors are being purchased for piezometers in areas where water level is uncertain

Section III. Signatures

Project Manager

Date



Wastewater Management in Mississippi Coastal Communities

Basic Information

Title:	Wastewater Management in Mississippi Coastal Communities
Project Number:	2016MS206B
Start Date:	3/1/2016
End Date:	2/28/2017
Funding Source:	104B
Congressional District:	MS-003
Research Category:	Not Applicable
Focus Categories:	Nutrients, Water Quality, Wastewater
Descriptors:	None
Principal Investigators:	Veera Gnaneswar Gude, James Martin

Publications

1. Quarterly reports submitted to Mississippi Water Resources Research Institute.
2. Rainey, B., Gude, V.G., Truax, D.D., Martin, J.L. Wastewater Management in Small Communities in the Jourdan River Watershed, Proceedings of Mississippi Water Resources Annual Conference, April 5-6, 2016.
3. Gude, V., Rainey, B. Decentralized and onsite wastewater management issues of small communities in Jourdan River Watershed, Mississippi. In Proceedings of the 1st Int. Electron, Conf. Water Sci., 15-29 November 2016; Sciforum Electronic Conference Series, Vol. 1, 2016, a007; doi: 10.3390/ecws-1-a-007.

Mississippi Water Resources Research Institute (MWRRI)

Quarterly Report – (From) 07//01/16 – (To) 09/30/16

Reports due: 1st (March 31); 2nd (June 30); 3rd (Sept. 30); 4th (Dec. 31)

Note: Please complete form in 11 point font and do not exceed two pages. You may reference and append additional material to the report.

SECTION I: Contact Information

Project Title: Wastewater Management in Mississippi Coastal Communities

Principal Investigator: Veera Gnaneswar Gude

Institution: Mississippi State University

Address: 501 Hardy Rd. 235 Walker Hall, Mississippi State, MS 39762

Phone/Fax: 662-325-0345/662-325-7189

E-Mail: gude@ceee.msstate.edu

SECTION II: Programmatic Information

Approximate expenditures during reporting period:

Federal: \$24,589.43, Non-Federal (MWRRI): \$24,589.43, Non-Federal (Dept.): \$23,100.00,
In-Kind: _____, Total Cost Share: \$47,689.43

Equipment (and cost) purchased during reporting period: None

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

Evaluation of centralized & decentralized wastewater treatment plants in the Jourdan River watershed

Within the area of study, only two municipal wastewater treatment plants are of concern when analyzing the waste load on the water bodies. The Diamondhead Water and Sewer treatment plant and the Hancock County Utility Authority Northern Kiln treatment plant discharge into the Jourdan River. While the Northern Kiln treatment plant regularly complies with the discharge limits set by the NPDES permit, the Diamondhead Water and Sewer treatment plant frequently violates the discharge limits set for the facility. This was determined using data retrieved from U.S. Environmental Protection Agency's (USEPA) discharge monitoring reports (DMR) and Enforcement and Compliance History Online (ECHO) reports.

Definition of sampling parameters

Based on TMDL reports for the watershed and common nutrient contaminants present in wastewater effluent, the sampling parameters for the study have been defined. These parameters include alkalinity, ammonia, biological oxygen demand (BOD), chemical oxygen demand (COD), dissolved oxygen (DO) levels and saturation, fecal coliform bacteria, kjeldahl nitrogen, nitrate, nitrite, pH, temperature, total phosphorus, total suspended solids (TSS), total dissolved solids (TDS), and turbidity. Samples will be collected and analyzed every two weeks, starting October 8, 2016.

Identification of priority areas in watershed

Through literature research and communications with the Mississippi Department of Health, Orphan Creek, Bayou Bacon, and Bayou LaTerre were defined as tributaries of interest for this study. While TMDL reports exist for Rotten Bayou, there are currently efforts and projects to improve the quality of watershed; therefore, it was excluded as an area of interest. The areas chosen lie mostly outside of established sewer service boundaries, leaving no option but to treat wastewater by means of on-site units. The soils in this area, however, are not suitable for such systems and likely reduce effluent quality.

Delineation of priority representative sample sites

Due to difficulty in obtaining information on the locations of individual on-site systems in the areas of interest, representative sample sites have been defined as upstream and downstream of communities outside

of established sewer service boundaries. These sample sites are located at public access points along the tributaries of interest. These seven sampling sites aim to show the effects of on-site systems in five separate communities within the watershed. These communities contain 25 to 95 homes and lie near Jourdan River tributaries. Maps of each community are attached (See Figure 1 in Appendix). Efforts are still being made to obtain information regarding specific on-site systems within these communities.

Bayou Bacon Community (Downstream)

This community of about 40 homes lies outside of the Kiln Utility service area, but the treatment methods used by the community are unknown. It lies less than half a mile from Bayou Bacon, which is a direct tributary of the Jourdan River (**Figure 1A**).

Orphan Creek Community 1 (Upstream)

This 33-acre subdivision contains approximately 40 homes is serviced by an above ground package wastewater treatment plant (NPDES Permit MS0060984) which discharges into Orphan Creek (then into Bayou Bacon, then the Jourdan River). The treatment for the subdivision was constructed by Daniel Ladner with Amy Lea Construction. Effluent data and discharge monitoring reports (DMR) were found for this “plant”. From the data, it was discovered that the system frequently does not comply with the effluent limitations set in the NPDES permit (**Figure 1B**). It is currently noncompliant.

Orphan Creek Community 2 (Midstream)

This is a relatively small community of approximately 25 homes near Orphan Creek (**Figure 1C**). From communications with a resident, it is known that the area is not served by a municipality, and the majority of homes in the community treat wastewater with a septic tank and leaching field.

Orphan Creek Community 3 (Downstream)

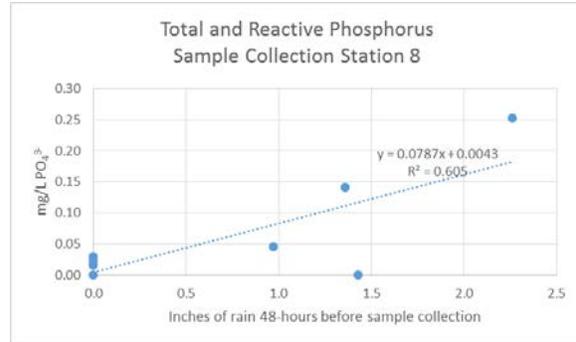
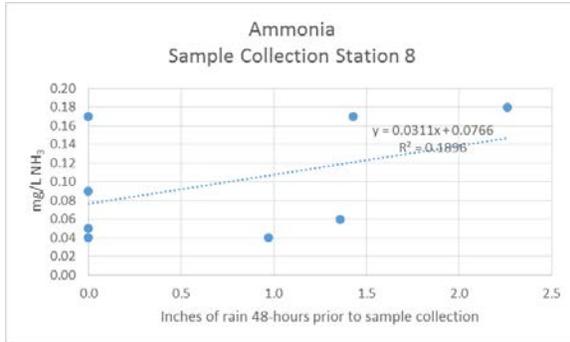
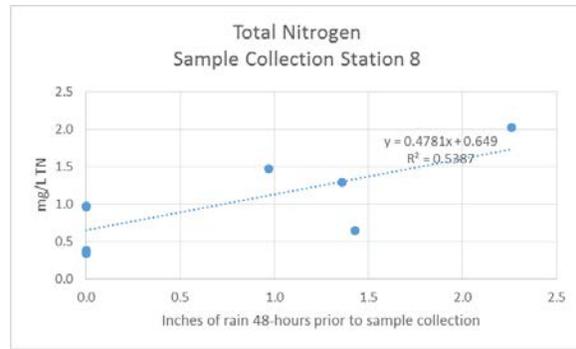
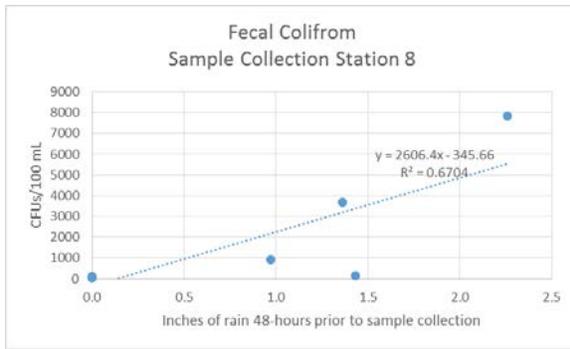
This subdivision contains approximately 65 homes (**Figure 1D**). The treatment practices for the subdivision are not known, but it is outside of the Kiln Utility service area.

Bayou Laterre Community (Downstream)

This community contains roughly 90 scattered homes which lie within 1 mile of Bayou La Terre. The treatment practices of the community are currently unknown (**Figure 1E**).

Sample collection and analysis began November 7, 2016. Samples from two collection trips have been analyzed (November 13 and December 11). The results are being compared against rainfall in order to determine if there is any change in parameter concentration as a result of stormwater runoff. The results from sample locations upstream and downstream of representative communities are also being compared in order to determine if there is any decline in the water quality downstream of those communities. There is no evident trend present in the current data, but a trend may develop with additional data. The results are shown in the attached tables, and the intended analysis and comparison methods for these results are illustrated in the attached charts in **Appendix**. The comparison charts are only shown for results of the fecal coliform testing because the intended comparison methods may be altered as more data is obtained.

Sample collection and analysis has continued throughout the quarter. Nine sample collection trips have been completed. The water samples have been tested and are being analyzed against rainfall data, and the water quality parameters are being compared amongst themselves to identify any possible correlations. The results from water quality parameters at sample collection locations upstream of representative communities are still being compared to results downstream of those communities to determine if there is any decline in water quality in the stream possibly caused by the community. Of the seven representative communities, none consistently have better or worse water quality conditions at the upstream location versus the downstream location. However, there does appear to be a correlation between rainfall levels and elevated water quality parameter concentrations.



During this quarter, general information regarding the site conditions, types of systems, and estimated failure rates in the representative communities was obtained from the Mississippi Department of Health.

Problems Encountered:

The main obstacle was encountered during the definition of representative sample sites. The goal of this project is to determine the effects of failing on-site systems on the water quality in the watershed. This goal cannot be accomplished without information or data on specific decentralized systems in the area. If this information remains unknown, it cannot be deduced that the failing systems are the main cause of impairment in the watershed. It is important to understand the treatment practices employed by the communities of interest in order to determine the effects, if any, these systems have on the watershed.

The distance and travel time among the sample sites themselves and between the watershed on the Mississippi Gulf Coast and the sample testing facilities at Mississippi State University have also created challenges. Viable samples were not obtained until more than a month after sample collection began. Initially, the problems were due to sample collection equipment malfunctions. After the resolution of that issue, we encountered problems with sample preservation. These problems have also been resolved, and there have since been two successful sampling trips. Obtaining information on the location, age, and type of onsite septic systems used in the representative sample area is still posing problems. We still have not been able to get any information from the Department of Health, but attempts are still being made, and we have reached out to other sources in order to obtain the information.

The distance from Mississippi State University to the sample collection points on the Mississippi Gulf Coast still caused a problem. Sample collection trips had to be planned days in advance to ensure everyone involved had the available time required to participate. This sometimes limited our ability to collect water samples following rain events. If a sample collection trip were planned to coordinate with a storm event and that event was different than forecast, we were unable to get the samples we had planned for.

Publications/Presentations

Rainey, B., Gude, V.G., Truax, D.D., Martin, J.L. Wastewater Management in Small Communities in the Jourdan River Watershed, Proceedings of MRRI Annual Conference, April 5-6, 2016.

Gude, V.; Rainey, B. Decentralized and onsite wastewater management issues of small communities in Jourdan River Watershed, Mississippi. *In Proceedings of the 1st Int. Electron. Conf. Water Sci.*, 15–29 November 2016; Sciforum Electronic Conference Series, Vol. 1, 2016, a007; doi:10.3390/ecws-1-a007

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

<i>Name</i>	<i>Level</i>	<i>Major</i>
Bailey Rainey	MS	Civil and Environmental Engineering
Cayla Cook	BS	Civil and Environmental Engineering
Jeff Steinwinder	BS	Civil and Environmental Engineering

Next Quarter Plans:

During the next quarter, sample collection and analysis will begin. Additionally, efforts will continue to obtain information on the location, age, and performance of specific on-site treatment systems within the communities of interest.

During the next quarter, sample collection and analysis will continue. Samples will be collected and analyzed every two weeks. Additionally, efforts will continue to obtain information on the location, age, and performance of specific on-site treatment systems within the communities of interest.

During the next quarter, no additional sample collection trips are planned. The project focus will shift towards data analysis and literature research.

Section III. Signatures

Project Manager

Veera Gnaneswar Gude

Date

Appendix

Figure 1 shows representative sampling sites for high priority areas in the Jourdan River watershed.

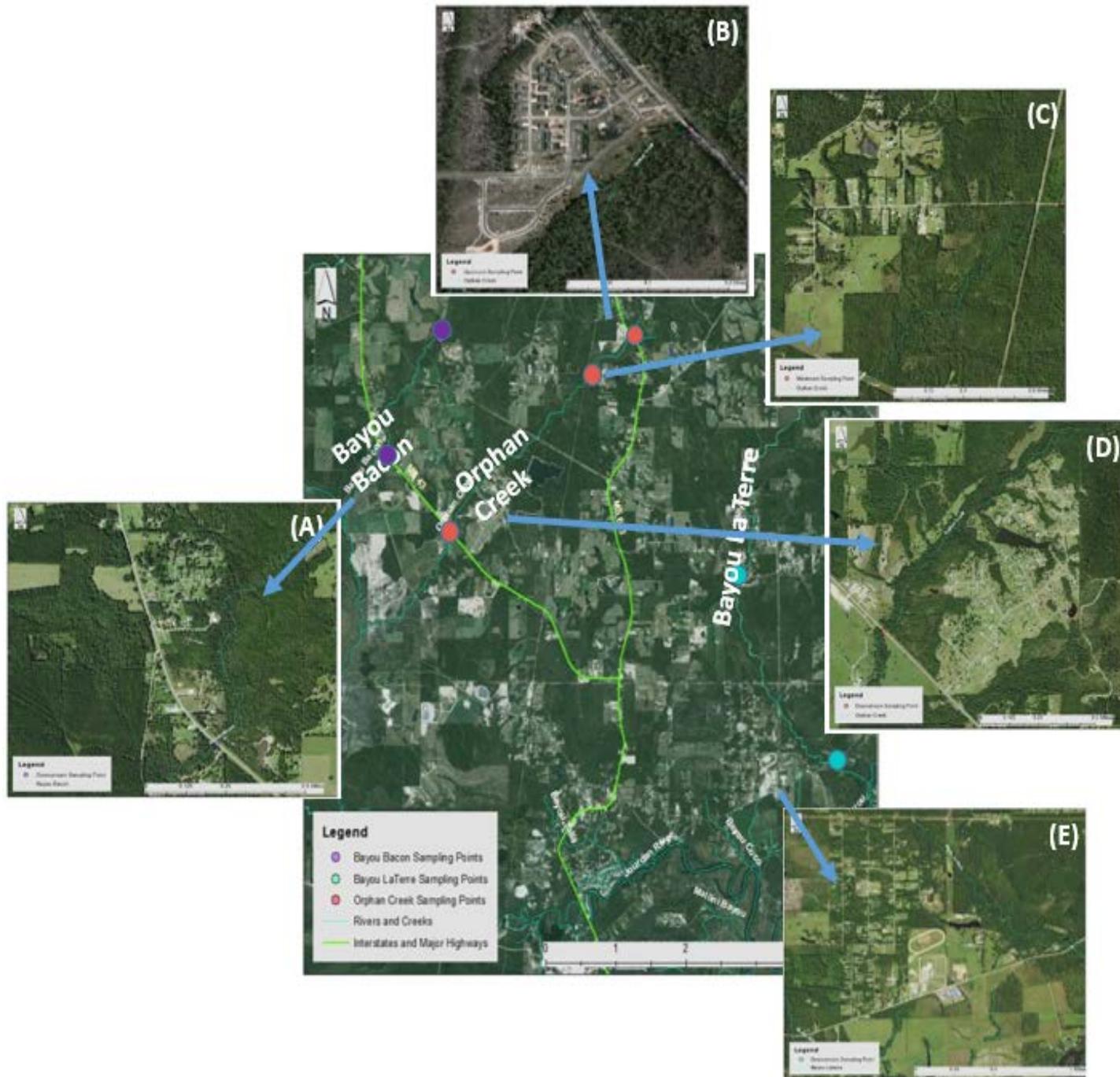
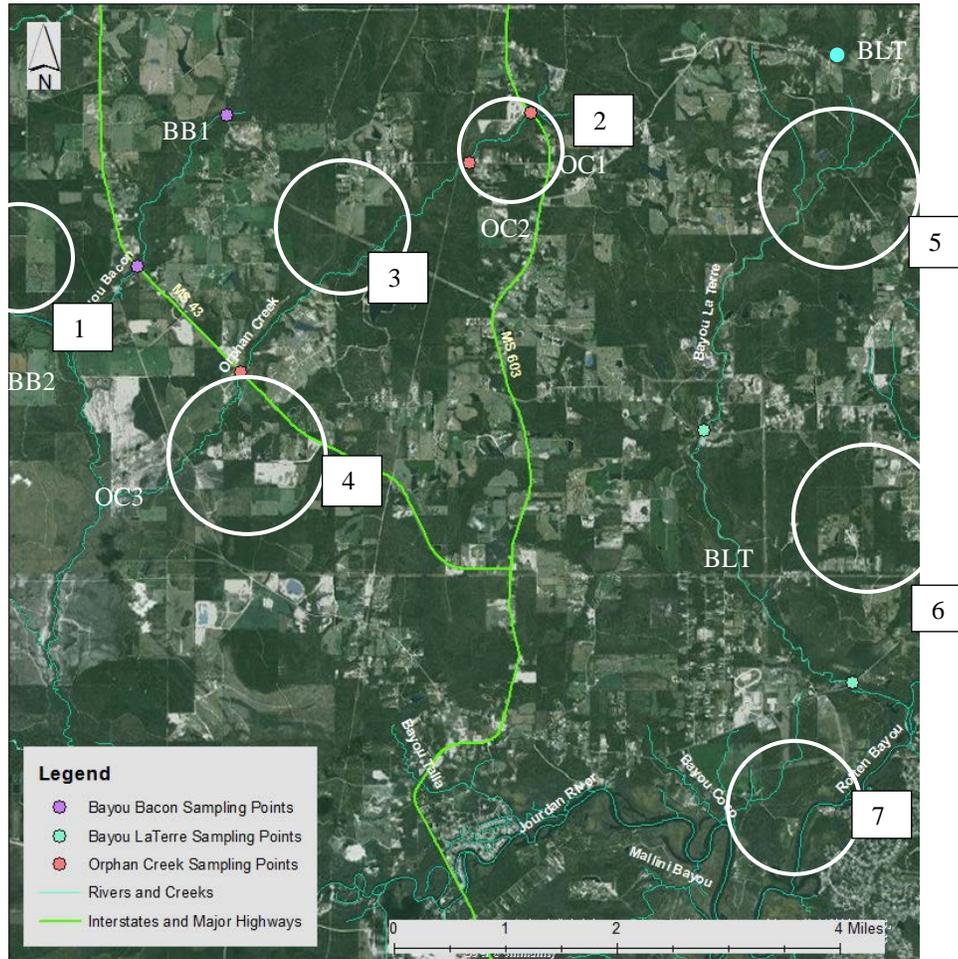


Figure 1. Representative sampling sites: (A) Bayou Bacon downstream community; (B) Orphan Creek upstream community; (C) Orphan Creek midstream community; (D) Orphan Creek downstream community; (E) Bayou La Terre downstream community

Appendix



Sample stations are abbreviated as follows: Bayou Bacon – BB, Orphan Creek – OC, Bayou LaTerre – BLT, and are numbered from north to south. The following tables report the sample results from the two successful sample collection trips. Sample were tested for total Kjeldahl nitrogen, nitrate, nitrite, and total phosphorous, but concentrations for these parameters have been below detection limits. Turbidity, dissolved oxygen concentration, and dissolved oxygen saturation were measured both in the field and upon returning to the lab, but significant differences have unveiled calibration problems with the field equipment. Results for these parameters are not shown in this report.

	Temp (°C)	
	13-Nov	11-Dec
OC1	16.07	9.54
OC2	14.38	9.49
OC3	15.36	10.25
BLT1	16.68	11.69
BLT2	16.58	12.61
BLT3	15.08	10.86
BB1	14.00	9.76
BB2	15.59	11.35

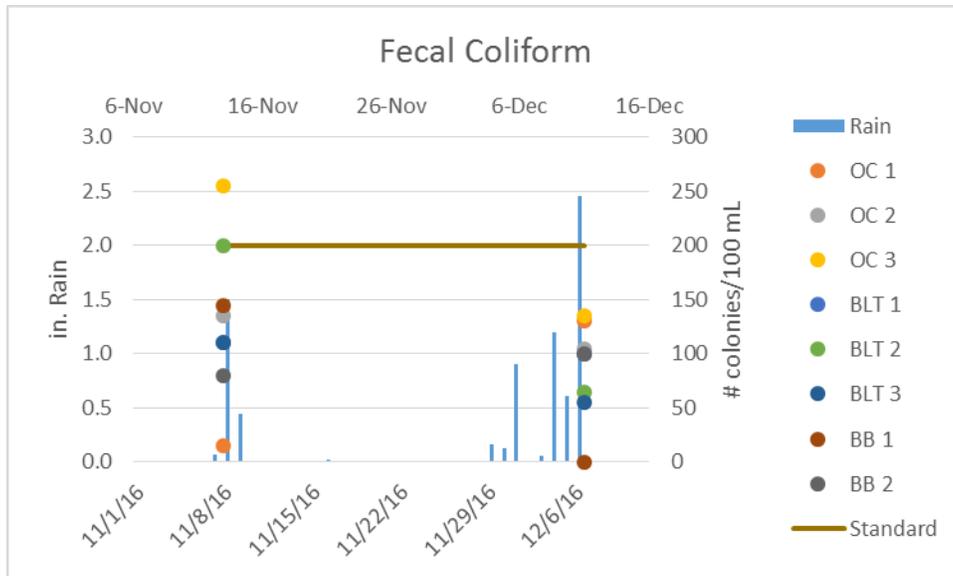
	pH	
	13-Nov	11-Dec
OC1	6.82	6.48
OC2	6.50	6.46
OC3	6.55	6.76
BLT1	6.72	6.51
BLT2	6.87	6.66
BLT3	6.69	6.76
BB1	6.70	6.37
BB2	6.59	6.71

	Salinity (ppt)	
	13-Nov	11-Dec
OC1	0.03	0.03
OC2	0.10	0.03
OC3	0.03	0.03
BLT1	0.03	0.03
BLT2	0.02	0.03
BLT3	0.03	0.03
BB1	0.01	0.02
BB2	0.02	0.02

Ammonia (mg/L NH ₃ -N)		
	13-Nov	11-Dec
OC1	0.24	0.11
OC2	0.13	0.03
OC3	0.09	0.09
BLT1	0.04	0.10
BLT2	0.05	0.06
BLT3	0.14	0.08
BB1	0.05	0.15
BB2	0.04	0.07
TDS (mg/L)		
	13-Nov	11-Dec
OC1	40	32.3
OC2	130	31.6
OC3	38	28.7
BLT1	37	26.8
BLT2	34	24.5
BLT3	47	27.2
BB1	22	22.3
BB2	27	22.4

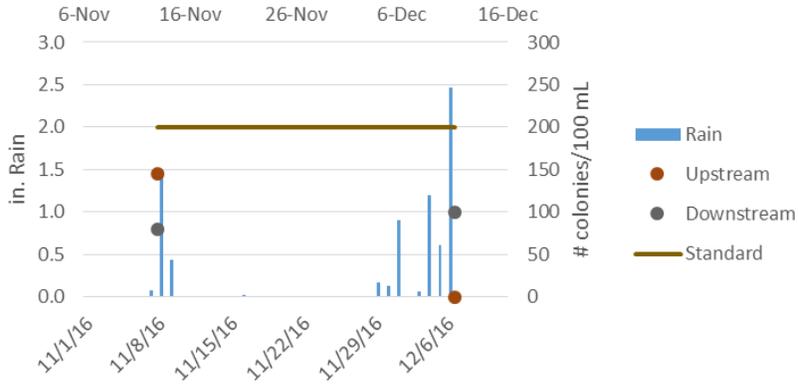
Total Nitrogen (mg/L TN)		
	13-Nov	11-Dec
OC1	0.59	0.42
OC2	0.51	0.39
OC3	0.82	0.36
BLT1	0.82	0.76
BLT2	0.87	0.41
BLT3	0.81	0.33
BB1	0.84	0.32
BB2	0.83	0.38
TSS (mg/L)		
	13-Nov	11-Dec
OC1	1.0	4.0
OC2	0.0	2.0
OC3	0.0	1.5
BLT1	0.0	4.5
BLT2	0.0	2.0
BLT3	0.0	5.5
BB1	1.0	0.0
BB2	3.0	0.0

COD (mg/L COD)		
	13-Nov	11-Dec
OC1	20	66
OC2	33	54
OC3	0	54
BLT1	22	54
BLT2	10	48
BLT3	0	50
BB1	12	63
BB2	5	61
Fecal (#colonies/100mL)		
	13-Nov	11-Dec
OC1	15	130
OC2	135	105
OC3	255	135
BLT1	110	100
BLT2	200	65
BLT3	110	55
BB1	145	0
BB2	80	100



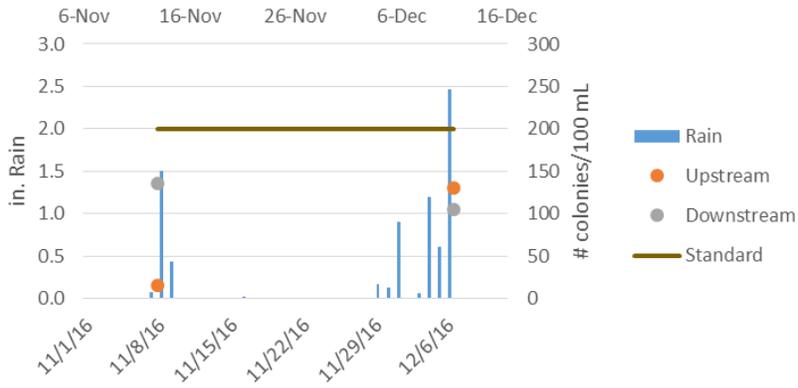
The following charts illustrate the intended comparison methods for the collected water samples. Because there are currently only two sets of data to compare, these methods may be altered after additional data has been collected. The fecal coliform counts upstream and downstream of each of the seven representative communities are compared to show any change in water quality resulting from the community that lies between the two sampling points. There is no evident trend among the current results.

Fecal Coliform - Bayou Bacon Community 1



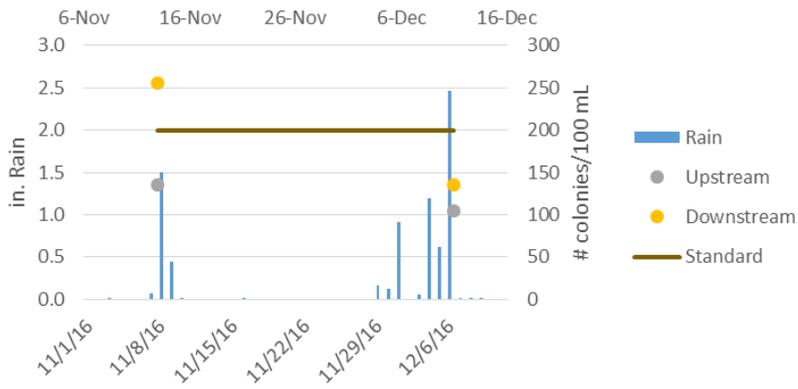
Fecal (#colonies/100mL)		
	13-Nov	11-Dec
BB1	145	0
BB2	80	100

Fecal Coliform - Orphan Creek Community 2



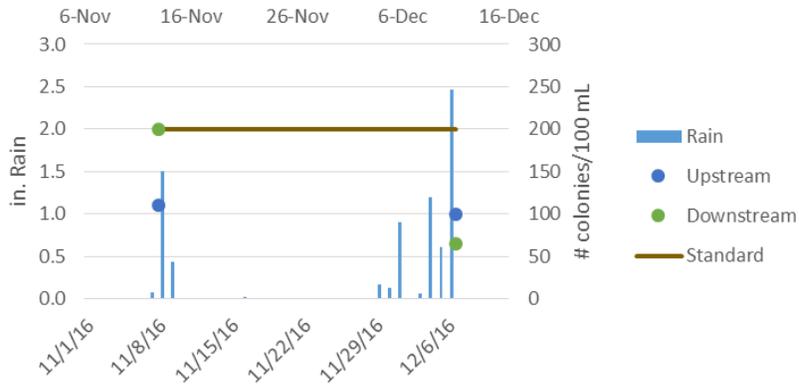
Fecal (#colonies/100mL)		
	13-Nov	11-Dec
OC1	15	130
OC2	135	105

Fecal Coliform - Orphan Creek Communities 3 and 4



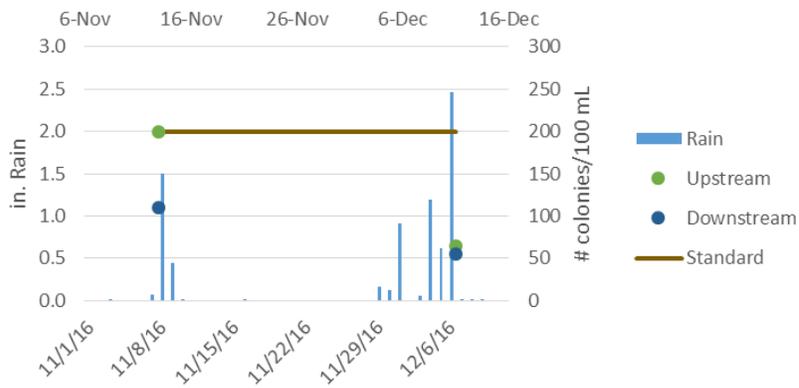
Fecal (#colonies/100mL)		
	13-Nov	11-Dec
OC2	135	105
OC3	255	135

Fecal Coliform - Bayou LaTerre Communities 5 and 6



Fecal (#colonies/100mL)		
	13-Nov	11-Dec
BLT1	110	100
BLT2	200	65

Fecal Coliform - Bayou LaTerre Community 7



Fecal (#colonies/100mL)		
	13-Nov	11-Dec
BLT2	200	65
BLT3	110	55

Information Transfer Program Introduction

MWRRI has a robust information transfer program that includes the following components:

1. 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 onsite. 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 sponsorships, a student oral presentation competition was re-instated during this year's conference. Of the 30 students registered for the conference, 27 gave 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.

2. MWRRI website (<http://www.wrri.msstate.edu/about.asp>) is maintained by MSU's Agricultural Communications Department, and is constantly updated with information on water resources research and management activities.

3. MWRRI Listserv contains over 900 members who regularly receive updates on water resources information.

4. MWRRI staff present numerous presentations throughout the year and participate in water resources-related meetings throughout the state.

5. MWRRI reports to MSU's Vice Presidents of Economic Development and Agriculture, Forestry, and Veterinary Science and closely collaborates with MSU Extension and Mississippi Agriculture and Forestry Experiment Stations

6. MWRRI's DREAMS (Demonstration, Research, Education, Application, Management and Sustainability) Center, when established, will be primarily focused on technology transfer.

USGS Summer Intern Program

None.

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

Notable Awards and Achievements

Implementation Plan for the Red Bud-Catalpa Creek Watershed – Phase 1. During 2016, MWRI 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 Environmental 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 (\$274,726 award with a match requirement of \$182,971), the Mississippi Agriculture and Forestry Experiment Station and its Strategic Research Initiative (\$17,980 in awards with a match total of \$33,300). The total investment to implement the Phase 1 plan is \$620,471 with all funding secured.

Watershed DREAMS (Demonstration, Research, Education, Application, Management and Sustainability) Center. 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 its South Farm (H.H. Leveck Animal Research Center) are located in the headwaters of the Catalpa Creek Watershed which presents numerous opportunities for leveraging numerous MSU activities and assets. Of all the land grant universities in the United States, the South Farm is one of the largest land reserves adjacent to a university campus. It encompasses about 1,600 acres used for cattle, equine and poultry management research. The South Farm also hosts a NRCS Grazing Lands Conservation Initiative demonstration site, 18 acres of aquaculture ponds, and various water quality research projects. These projects

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. Even prescribed burning will be used in portions just as it once was used throughout the local Blackbelt Prairie. MSU's Master Plan provides guidance for building placement, architectural standards, landscape vision, and required infrastructure. Incorporating MSU's Master Plan into the Catalpa Creek Watershed planning efforts will synthesize urban, rural, agricultural, and academic research land uses within the watershed, thus presenting a unique opportunity for demonstrating multiple concepts and approaches.

DW3 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.

Publications from Prior Years

1. 2016MS-ADMIN (") - Water Resources Research Institute Reports - 2016 Mississippi Water Resources Conference Proceedings, 138 pgs., www.wrri.msstate.edu/pdf/2016_wrri_proceedings.pdf
All presentation abstracts and those submitting full papers are included with this publication.
2. 2016MS-ADMIN (") - Water Resources Research Institute Reports - The annual report includes information on all funded projects, collaborators, partners, student training, information transfer, and relevant findings. Any other projects or potential funded projects will be listed also.