2016 Annual Report

Louisiana Nutrient Management Strategy Implementation

FINAL

April 28, 2017

Baton Rouge, Louisiana

Prepared by the
Louisiana Nutrient Management Strategy Interagency Team

Coastal Protection and Restoration Authority (CPRA)
Louisiana Department of Agriculture and Forestry (LDAF)
Louisiana Department of Environmental Quality (LDEQ)
Louisiana Department of Natural Resources (LDNR)

With collaboration of the

Louisiana State University Agricultural Research Center (LSU AgCenter)
The Nature Conservancy (TNC)
U.S. Business Council for Sustainable Development, Louisiana Water Synergy Group
U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS)
U.S. Environmental Protection Agency (USEPA)

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This Annual Report for 2016 developed in support of the Louisiana Nutrient Management Strategy, Strategic Action *10.e. Report annually on strategy activities*.

Suggested Citation:
Louisiana Nutrient Management Strategy Interagency Team. 2017. *2016 Annual Report Louisiana Nutrient Management Strategy Implementation.* Coastal Protection & Restoration Authority, Louisiana Department of Agriculture and Forestry, Louisiana Department of Environmental Quality, and Louisiana Department of Natural Resources. Baton Rouge, Louisiana.

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ABBREVIATIONS

ACWA	Association of Clean Water Administrators
AWQMN	Ambient Water Quality Monitoring Network
BMP	Best Management Practice
CB	Conventional Burning
CDBG	Community Development Block Grants
CDOM	Chromophoric dissolved organic matter
CELCP	Coastal and Estuarine Land Conservation Program
CFCI	Coastal Forest Conservation Initiative
CIAP	Coastal Impact Assistance Program
CIG	Conservation Innovation Grant
COMB	Compost Application with Burning
CP	Conservation Practice
CPRA	Coastal Protection and Restoration Authority of Louisiana
CRMS	Coastwide Reference Monitoring System
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund Program
DRP	Dissolved Reactive Phosphorus
ELP	Environmental Leadership Program
FWP	Fish and Wildlife Propagation
GCSAA	Golf Course Superintendents Association of America
GCTB	Green Cane Trash Blanketing
GIS	Geographic Information System
GOMA	Gulf of Mexico Alliance
GoMI	Gulf of Mexico Initiative
HTF	Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force)
HUC	Hydrologic Unit Code
ICIS	Integrated Compliance Information System
LDAF	Louisiana Department of Agriculture and Forestry
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LGU	Land Grant Universities
LMFP	Louisiana Master Farmer Program
LMGCSA	Louisiana-Mississippi Chapter of Golf Course Superintendents Association of America
LPDES	Louisiana Pollutant Discharge Elimination System
LPWC	Lake Providence Watershed Council
LSU AgCenter	Louisiana State University Agricultural Research Center
MARB	Mississippi/Atchafalaya River Basin
MGD	Million gallons per day
MRBI	Mississippi River Basin Initiative
NEPA	National Environmental Policy Act
NGO	Non-governmental Organizations
NOAA	National Oceanographic Atmospheric Administration
NOx	Nitrate + Nitrite Nitrogen

NPDAT	Nitrogen and Phosphorus Data Access Tool
NPDES	National Pollutant Discharge Elimination System
NPS	Nonpoint Source
NWQI	National Water Quality Initiative
OSWC	Office of Soil and Water Conservation
P	Phosphorus
PCR	Primary Contact Recreation
PDARP	Programmatic Damage Assessment and Restoration Plan
PEIS	Programmatic Environmental Impact Statement
POTW	Publicly Owned Treatment Works
PP	Particulate Phosphorus
RCPP	Regional Conservation Partnership Program
SB/CAP	Small Business/Community Assistance Program
SCR	Secondary Contact Recreation
SERA-46	Southern Extension and Research Activities Committee Number 46
SPARROW	SPAtially Referenced Regressions On Watershed attributes
STORET	Storage and Retrieval Database
SWAMP	System-wide Assessment and Monitoring Program
SWAT	Sanitary Wastewater Compliance Assistance Training
TKN	Total Kjeldahl Nitrogen
TMDL	Total Maximum Daily Loads
TN	Total Nitrogen
TNC	The Nature Conservancy
TP	Total Phosphorus
US BCSD	U.S. Business Council for Sustainable Development
USDA NRCS	U.S. Department of Agriculture Natural Resources Conservation Service
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USHUD	U.S. Housing and Urban Development
WIP	Watershed Implementation Plan
WQT	Water Quality Trading
WWTP	Waste Water Treatment Plants

STRATEGIC ACTIONS

The Louisiana Nutrient Management Strategy ('Strategy') was released May 2014 (Louisiana Nutrient Management Strategy Interagency Team 2014). The Strategy presents a framework of ten strategic components with underlying actions that guide implementation of nutrient management activities across the state. Completing these Strategic Actions, in addition to adapting, modifying, and/or identifying additional actions is part of the Strategy implementation process.

The Strategy Interagency Team is comprised of representatives from the Louisiana state agencies of the Coastal Protection and Restoration Authority of Louisiana (CPRA), the Louisiana Department of Agriculture and Forestry (LDAF), the Louisiana Department of Environmental Quality (LDEQ), and the Louisiana Department of Natural Resources (LDNR). Partnerships with other agencies and groups including the Louisiana State University Agricultural Research Center (LSU AgCenter); The Nature Conservancy (TNC); the U.S. Business Council for Sustainable Development (US BCSD), Louisiana Water Synergy Group; the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS); and the U.S. Environmental Protection Agency (USEPA) form a well-rounded team to achieve these nutrient management efforts outlined in the Strategy for Louisiana.

This Annual Report describes the accomplishments in implementation of the Strategy during 2016. Completed and ongoing Strategic Actions are identified and results and progress made during 2016 are discussed.

1. STAKEHOLDER ENGAGEMENT

Stakeholder participation is essential to accomplishing the vision of the Strategy. Stakeholders are the stewards of their local landscapes and have a vested interest in the protection, improvement, and restoration of water quality within their watershed community. Engaging and communicating with stakeholders is crucial to the success of the Strategy.

One of the many benefits of a robust stakeholder engagement process is increased awareness and participation from all sectors within a watershed in activities that are more nutrient-responsible. Future stakeholder engagement efforts will focus on performing ongoing and additional outreach and education, and identifying and promoting partnerships and leveraging opportunities. Leveraging existing programs is critical to further engage stakeholder communities as the Strategy is further implemented.

1.a. Identify stakeholders with interest in the strategy

Stakeholder identification was initiated and completed in 2012 during the initial stage of Strategy development. This action focused on identifying stakeholders with interest in nutrient management in Louisiana. Over 200 stakeholder groups in Louisiana were identified, and stakeholder groups included state and federal agencies, agricultural producers, academic institutions, nonprofit organizations, non-governmental organizations (NGOs), private industry, private landowners, parishes, and municipalities.

1.b. Engage stakeholders in strategy development

Stakeholder engagement was initiated in 2012 and completed in 2013. This action focused on outreach regarding the development of the Strategy. The Strategy Interagency Team engaged representatives from over 130 stakeholder affiliations through presentations delivered at local and regional level meetings. From November 2012 through June 2013, Strategy Interagency Team members targeted more than 30 events to interact with stakeholders.

1.c. Perform outreach/education on strategy activities

Outreach/education on strategy activities is ongoing. This action is focused on outreach to stakeholders to inform, promote participation, and report results on Strategy activities. In 2016, the Strategy Interagency Team participated in many events related to nutrient management in Louisiana as well as other areas of the Mississippi/Atchafalaya River Basin (MARB). At these events, Strategy Interagency Team members communicate with stakeholders on Strategy activities specific to Louisiana and learn from other states and partners on the nutrient management activities occurring within their respective areas.

These outreach events for 2016 included the following:

- CPRA conducted a Kickoff & Chartering Meeting for the CPRA Sediment Diversion Implementation Program, January 12, 2016
- LDEQ presentation to and participation in the Louisiana Solid Waste Conference, March 17, 2016 in Lafayette, Louisiana
- CPRA and LDEQ participation at the Gulf Hypoxia Workshop, March 9, 2016 in Baton Rouge, Louisiana
- LDEQ presentation to and participation in the USEPA R6 Regional Technical Advisory Group (RTAG) Meeting, April 6-7, 2016 in Dallas, Texas
- CPRA and LDEQ participation at the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force, (HTF)) Spring Meeting, April 25-27, 2016 in St. Louis, Missouri
- LDEQ and CPRA participation at the Gulf of Mexico Alliance (GOMA) All-Hands meeting, June 14-17, 2016 in Baton Rouge, Louisiana
- LDEQ and LDAF participation in the CPRA led 2017 Coastal Master Plan State Steering Committee Meeting, July 21, 2016
- CPRA participation in the 6th Annual National Oceanographic Atmospheric Administration (NOAA)/Northern Gulf Institute Hypoxia Research Coordination Workshop, September 12-13, 2016 in Stennis Space Center, Mississippi
- CPRA participation and presentation at the Oyster Task Force meeting September 21, 2016
- LDEQ participation at USEPA R6 National Pollutant Discharge Elimination System (NPDES) Program Managers Meeting, November 1-2, 2016 in Dallas, Texas
- CPRA and LDEQ participation at the HTF Fall Meeting, December 5-7, 2016 in New Orleans, Louisiana
- LDEQ participation in Louisiana Water Synergy Group Quarterly Meetings, February 17, 2016; May 19, 2016; and November 9, 2016
- CPRA and LDEQ participation in the Louisiana Water Quality Trading Workgroup conference calls

- CPRA and LDEQ participation on GOMA Priority Issues Team meetings and conference calls
- CPRA and LDEQ participation on HTF Coordinating Committee Monthly Conference Calls
- LDEQ participation on Association of Clean Water Administrators (ACWA) conference calls
- LDEQ Nonpoint Source participation at the:
    - The Louisiana Environmental Education Symposium
    - Keep Louisiana Beautiful State Conference
    - Bayou Vermilion Earth Day
    - Louisiana Earth Day
    - Louisiana Rural Water Association Annual Training and Technical Conference
- CPRA presentation at various meetings and briefings regarding the 2017 Coastal Master Plan, including:
    - Nine (9) presentations to various community groups
    - Four (4) presentations to the CPRA Board (public meetings)
    - Three (3) presentations to the Governors' Advisory Board (public meetings)
- CPRA presentation at various meetings regarding sediment diversion program updates, including:
    - Stage Gate Review September 8, 2016
    - Governor's Advisory Commission Diversions Subcommittee October 4, 2016
    - US Army Corps of Engineers New Orleans District October 4, 2016
    - Coalition To Restore Coastal Louisiana Board Meeting October 13, 2016
    - Sportsman's Briefing October 25, 2016
    - Federal Agency Workshop November 15-16, 2016
    - Oyster Task Force December 13, 2016
    - Governor's Advisory Commission Diversions Subcommittee December 14, 2016
    - Coastal Connections December 21, 2016

1.d. Identify and promote partnerships/leveraging opportunities

The ongoing identification and promotion of partnerships and leveraging opportunities is vital to the success of the Strategy. Participation of and collaboration with all stakeholder groups in a watershed is not only key to the implementation of the Strategy, but is also fundamental to the success of water quality protection and restoration activities as a whole.

2. DECISION SUPPORT TOOLS

Decision support tools are essential to evaluating and assessing various aspects of nutrient management activities. Numerous tools exist that may be utilized for this purpose. Available tools include water quality data, water quality models, and management actions and assessments.

2.a. Identify available tools

During 2012 and 2013 strategy development, the Strategy Interagency Team conducted a broad review of available decision support tools in support of the Strategy and identified and evaluated over 200 tools. Most applicable tools included best management practices, data access portals, mapping applications, modeling tools, and reports.

The Freshwater Network, developed by TNC, is an online network for freshwater resource assessments, including the Mississippi River (TNC 2016a, TNC 2017a). Through the Freshwater Network, information on the Louisiana Freshwater Assessment and those for other states and regions can be viewed. TNC developed a Water Quality app that features regions of Louisiana. TNC considered the Water Quality app as the first effort at attempting to help target areas for conservation programs to reduce nutrient loading. The Water Quality app uses nutrient concentration information available from LDEQ. The HydroFlows app uses a TNC developed statewide water flow model for Louisiana and Mississippi. TNC suggests that their next step is to link the flow model with nutrient information to estimate loading rates statewide and also test different conservation scenarios at fine scales.

Many of the tools identified in the Strategy development phase are still applicable. These previously identified tools include the web-based data access including LDEQ Louisiana Environmental Data Access Center (LDEQ 2017a), the USEPA Nitrogen and Phosphorus Data Access Tool (NPDAT) (USEPA 2017a), and the Water Quality Portal (USGS et al. 2016), modeling tools including the U.S. Geological Survey (USGS) SPAtially Referenced Regressions On Watershed attributes (SPARROW) surface-water quality models (USGS 2017), Geographic Information Systems (GIS)-based tools, the USEPA Recovery Potential Screening Tool (USEPA 2017b), USDA-USEPA Water Quality Trading Roadmap (USDA 2017a), EnviroAtlas (USEPA 2017c), Nutrient Tracking Tool (USDA 2017b), and the USDA environmental markets website (USDA Office of the Chief Economist 2017).

2.b. Evaluate available tools

The decision support tools are evaluated for applicability to the nutrient management strategy. The tools developed by TNC are applicable to the nutrient management strategy effort.

2.c. Select available tools

The decision support tools evaluated are considered valuable tools for the nutrient management strategy in Louisiana. The tools developed by TNC provide information for Louisiana that is useful to the nutrient management strategy.

2.d. Document selected tools

The Freshwater Network, Water Quality app, and HydroFlows app developed by TNC provide information that is useful to the nutrient management strategy. New features and updates are available in some of the previously identified decision support tools. In the USEPA NPDAT web tool, newly updated information includes facilities likely to discharge nitrogen/phosphorus (N/P) to waters, waters listed for N/P impairments, waters with N/P Total Maximum Daily Loads (TMDLs), and drinking water sources. Information that is coming soon is nutrient-related Clean Water Act (CWA) §319 projects (USEPA 2017a).

3. REGULATIONS, PROGRAMS, & POLICIES

This component of the Strategy recognizes that regulations, programs and policies will assist with nutrient management activities within the state of Louisiana as well as benefit activities within the larger MARB watershed.

3.a. Identify current

Current regulations, programs, and policies were identified during the Strategy development phase in 2012 and 2013. Ongoing efforts of the Louisiana Agricultural Nutrient Task Force, the LSU AgCenter task force on fertilizer effectiveness, the Louisiana Water Synergy Group, the USDA-USEPA expanded partnership on water quality trading, and TNC's Mississippi River Basin and the Louisiana Atchafalaya River Basin Initiative projects continue to aid in leading the way to improvement in nutrient management in Louisiana.

Created by the Louisiana Commissioner of Agriculture and Forestry, the Louisiana Agricultural Nutrient Task Force (Task Force) will study topics related to agricultural nutrient issues. The Task Force is then charged with reviewing and making recommendations on at least the following topics and practices:

- To address the need for research, education and training in the selection and application of agricultural fertilizer and soil nutrients in the state;
- To identify practices that apply to the selection, purchase, storage, and application of agricultural fertilizer and soil nutrients, including the reasonableness of rules for their on-farm storage;
- To identify state level agricultural certainty certification programs that encourages the implementation of best management practices in the generation, handling or land application of nutrients in Louisiana;
- To establish a nutrient management planning program;
- To formulate a systematic and economically viable nutrient management program that will both maintain agricultural profitability and improve water quality in Louisiana.

Another agricultural leader in nutrient management is the LSU AgCenter. The LSU AgCenter created a Task Force to study the effectiveness of fertilizers on major row crops and forages grown in Louisiana (McClure 2014). The Task Force is made up of ten members, including LSU AgCenter agronomists and specialists for different crops. The Task Force will work to ensure the recommended fertilizer application rates are up to date based on current research. The rate recommendations should strive to minimize such problems in water quality where there is an overabundance of nutrients. The LSU AgCenter Task Force hopes to produce a booklet listing nutrient deficiencies in various crops along with appropriate fertilizer rates.

The Louisiana Water Synergy Group, managed by the U.S. Business Council for Sustainable Development, provides a forum for business leaders with infrastructure investments in southern Louisiana, state and local leaders, academic institutions, and NGOs to take collective actions to help protect wetlands and improve water quality in the region. The project has been underway since May 2012. The 21 companies participating represent a wide range of industrial sectors, including oil and gas, utilities, chemicals, manufacturing, beverages, and services. Participants also include representatives from the Lake Pontchartrain Basin Foundation, TNC, LDEQ, and LDAF. Working Groups are in place to address: Nutrients, Wetlands Restoration and Protection, Sustainable Water Supplies, and Alternative Levee Construction Materials.

In late 2013, the USDA and the USEPA announced an expanded partnership to support water quality trading and other market-based approaches (USDA and USEPA 2013, 2015). The

purpose of this USDA and USEPA policy is to support states, interstate agencies and tribes as they develop and implement water quality trading programs for nutrients, sediments and other pollutants where opportunities exist to achieve water quality improvements at reduced costs. Through expanded partnership the USDA and the USEPA will coordinate and enhance communications and outreach to states, agricultural producers, regulated sources, and interested third parties on water quality trading; engage expertise across agencies in the review of grants, loans or technical assistance programs focused on water quality trading; share information on the development of rules and guidance that have the potential to affect water quality trading; collaborate on developing tools and information resources for states and credit generators to guide decision making, reduce costs in program design and implementation, improve environmental performance, and foster consistency and integrity across regional initiatives; and co-host a workshop by 2015 to share tools and resources available to assist in stakeholder decision making and opportunities. The Strategy Interagency Team has expressed interest to both the USDA and USEPA regarding the development of a water quality trading program for Louisiana.

The Mississippi River Basin, Healthy River, Healthy Gulf is a whole-systems project by TNC that is focused on reducing nutrients and improving our way of life (TNC 2017b). This project was formerly known as America's Great River project. Through this effort, TNC is working with farmers, agribusiness, policy makers and others to target science-based solutions in places contributing the highest levels of nutrients (TNC 2017b).

The Louisiana Atchafalaya River Basin Initiative by TNC targets the key geographic area of the Atchafalaya River Basin as part of the whole-system approach (TNC 2016b). This initiative has three main strategies involving land acquisition and restoration, scientific monitoring and research programs, and development of a community conservation learning center. The TNC considers that this effort may improve water quality in the Atchafalaya River Basin through hydrologic restoration, and may increase nitrate removal through increased regeneration (TNC 2016b).

3.b. Identify gaps

The identification of gaps in current regulations, programs, and policies is ongoing. Identified gaps include nutrient monitoring in point sources and implementation of water quality credit trading in Louisiana.

Dischargers to waters of the state are permitted for such activity through the Louisiana Pollutant Discharge Elimination System (LPDES) Permit Program. Historically nutrient monitoring in point sources may occur to address specific facility types, through implementation of TMDLs, and in wetland assimilation projects. LDEQ addressed the gap in nutrient monitoring in point sources by developing a Point Source Implementation Strategy for Nutrients. In May 2016, LDEQ began to include reporting requirements for nutrients (total nitrogen and total phosphorus monitoring on a quarterly basis) in new and renewal permits for major and minor sanitary permitted dischargers and in other permits based on facility type. Refer to Strategic Action 9.d. for further discussion on nutrient monitoring in point sources.

The Louisiana Nutrient Management Strategy suggests that incentives such as water quality trading may provide opportunities for nutrient reduction and assimilation. Expanded policies or programs related to water quality trading may be warranted to advance trading as a cost-effective means for nutrient management and general water quality protection and restoration. Currently there is not an implemented program for water quality trading in Louisiana. Existing law (R.S. 30:2074 B.9; Louisiana 2000) allows LDEQ to establish an effluent reduction credit program. However, it is limited to point source trading in watersheds where TMDL limitations are in place. Currently it is believed that no trades have occurred under this statute. A broader water quality trading program would allow stakeholders such as municipal storm water management, agricultural producers, and coastal protection restoration activities (nonpoint sources) an opportunity to implement best management practices (BMPs) to reduce nutrient discharges by trading credits with point sources (industrial or municipal) that may need credits for future growth. Thus, expanded regulations, programs, or policies related to water quality credit trading may be warranted for stakeholders in Louisiana to advance trading as a cost-effective means for nutrient management and general water quality protection and restoration.

Nutrient management activities under the Strategy are being performed within current programs. Yet dedicated funding may be necessary to realize improvements in nutrient management in Louisiana, as well as in other parts of the MARB.

3.c. Proposed or establish new

Proposing or establishing new regulations, policies, or programs is an ongoing action of the Strategy. Proposed or new regulations, policies, or programs for 2016 include USEPA National Pollutant Discharge Elimination System (NPDES) Electronic Reporting Rule.

The USEPA NPDES Electronic Reporting Rule was effective December 21, 2015 (USEPA 2017d). This rule requires electronic reporting instead of current paper-based NPDES reports (EPA-HQ-OECA-2009-0274). The rule will result in LDEQ requiring electronic reporting from LPDES permitted dischargers. LDEQ developed an implementation plan to prioritize the e-reporting effort for Louisiana and submitted the plan to USEPA in December 2016. LDEQ utilizes a web-based tool called NetDMR that allows facilities to electronically sign and submit LPDES discharge monitoring reports (DMRs) to the LDEQ. Use of NetDMR would allow for improved availability and access to DMR results of all parameters that are part of the dischargers permit, including nutrient monitoring results.

4. MANAGEMENT PRACTICES & RESTORATION ACTIVITIES

Management practices and restoration activities in Louisiana encompass activities focused on nonpoint source (NPS) management, point source management, and coastal restoration and protection efforts. This multi-prong approach to the management of nutrients in Louisiana allows for a more holistic approach to nutrient management where true nutrient sources can be identified and appropriate solutions tailored to addressing the source.

4.a. Document current practices related to nutrient management

The documentation of current practices related to nutrient management is ongoing. Within Louisiana, current practices include implementation of the LDEQ NPS Program in collaboration

with LDAF, USDA NRCS, and LDNR (LDEQ 2011); LDEQ implementation of the Louisiana Pollutant Discharge Elimination System (LPDES) Permit Program (LDEQ 2017b); and CPRA implementation of the Comprehensive Master Plan for a Sustainable Coast (Coastal Master Plan, CPRA 2012).

The Louisiana-Mississippi Chapter of Golf Course Superintendents Association of America (LMGCSAA), along with the LSU AgCenter and LDEQ has formed a committee to assist in the development of a Best Management Practice (BMP) manual for golf courses. This BMP manual is intended to tailor specific BMPs that separate unprofessional from professional care for lawns to Louisiana ecoregions or regional zones of the state. Currently the committee is working on proposals to secure grant funding to prepare this manual. A primary objective in establishing BMPs would be nutrient management of silts or nutrients upstream and overall water quality.

On a national scale, the Golf Course Superintendents Association of America produced a document on nutrient use and management practices in the United States (GCSAA 2016). According to the GCSAA report which covered 2006 to 2014, in the Southeast Region total nitrogen and phosphate use decreased by 42% and 45%, respectively. Further a decrease was observed in both rates of these nutrients and in the total number of acres treated with fertilizer. The GCSAA report cites these nutrient use patterns are likely a result of conservation efforts, facility closures, restrictions, and climate.

4.b. Identify areas where practices are being implemented

The LDEQ NPS Program and the LPDES Permit Program are implemented statewide. The LDEQ NPS Program selected priority watersheds targeted for implementation activities through 2016; these priority watersheds are identified in Strategic Action 6.g. The LPDES Permit Program is implemented in facilities throughout the state within all water bodies. The CPRA Coastal Master Plan is focused within coastal areas of the state. The USDA NRCS conservation practices (CPs) are implemented statewide based on appropriate practices with consideration of watershed characteristics and land uses.

4.c. Model nutrient removal estimated through riverine diversions

In 2014, CPRA commissioned The Water Institute of the Gulf (Water Institute) to develop a model describing the effects of proposed diversions from the Mississippi River into coastal receiving basins on the west and east sides of the Mississippi River. This model includes modifying existing Delft3D modeling tools developed by Deltares (The Netherlands) and also developing new tools to integrate new capacity into the model. This model includes four main components (hydrodynamics, nutrient dynamics, morphodynamics, and vegetation) which describe the performance of the proposed sediment diversions in coastal Louisiana under various operational strategies.

The nutrient component of this model contains new code that had not previously been developed. Along with the new code development, the Water Institute collected field data in both receiving basins (west and east sides of the Mississippi River) for the purposes of calibrating and validating the nutrient dynamics and morphodynamics model components. The field work component began in 2014 and was completed in 2015.

During 2015, the coupled models were calibrated and validated utilizing pre-existing datasets and data collected during the 2014-2015 field campaign. Overall, the calibrated and validated models compared well to the observations, and the seasonal patterns of key processes were reproduced. For example, the hydrodynamics and morphodynamics model represented the upper and lower basin salinity differences well, and the interaction between river and receiving basins were well captured. The nutrient dynamics model captured the general temporal and spatial nutrient dynamics patterns and the model compared well to most of the field observations. In addition, the vegetation modules were parameterized through field observations, extensive review of the literature, and best professional assessment. They performed well, especially considering the integration of the physical and biological dynamics of the marsh ecosystems. There are still some discrepancies between modeled and observed data that will require further model refining, but some of these likely originate from lack of observations for the loadings at the boundaries and in the interior of the receiving basins. A second, refined version (V2) of the model will be produced utilizing field observations collected after this initial modeling effort.

This action was originally expected to be completed in 2015; however during 2016, CPRA continued to refine models and potential operational scenarios for river diversion projects. The refinements to the operational scenarios are maximizing land-building benefits while minimizing other potential ecosystem changes. Options being explored will affect the timing and duration of river input into the receiving basin, which will ultimately affect the opportunity for nutrient removal. Once the most favorable operational strategies are identified, model runs will be updated to include estimates of nutrient removal. This strategic action is ongoing.

4.d. Identify case studies/model watersheds

The identification of case studies/model watersheds in Louisiana is an ongoing Strategic Action. Efforts that successfully combine restoration and protection activities with stakeholder participation and leadership may champion other groups doing the same. The Lake St. Joseph watershed located in northeast Louisiana in the Ouachita River Basin is one such area in Louisiana where studies have demonstrated water quality improvement following implementation of best management practices.

In 2016, LSU AgCenter researchers Dr. Lisa Fultz, along with James Hendrix and Dr. Donnie Miller, conducted Phase III of the Lake St. Joseph Monitoring Project. This Lake St. Joseph Monitoring Project, which began March 2016 and ended August 2016, collected data to be utilized in determining the effectiveness of BMPs that were initiated in the watershed in fall 2012 and modified as a result of resource inventories conducted. Original monitoring began in 2013 as Phase I. The 2016 Integrated Report noted that the water body was being delisted for suspended solids, which can be attributed to soil erosion. As a result of this study, the implementation of best management practices around Lake St. Joseph had improved water quality sufficiently to remove the lake from the state's impaired §303d water body list.

Also occurring in the Lake St. Joseph watershed, Dr. Lisa Fultz, James Hendrix and Dr. Donnie Miller were awarded a Conservation Innovation Grant for 'Winter Wheat Filter Strip for In-Field Ditches to Reduce Nutrient and Sediment Runoff – A New Best Management Practice.' The work under the grant, initiated in September 2013, collects water samples post rain events to evaluate the effects on soil erosion and nutrient loss from cropland via drainage "spin" ditches

vegetated with wheat as modified filter strips. As a result over 3 years, implementation of best management practices, like vegetated ”spin” ditches, aided in the decrease of total dissolved solids, total suspended soils, total solids, and total phosphorus (TP) across Lake St. Joseph. Further, in 2014 planting covers across ditches decreased total suspended solids by 57%, orthophosphate-P by 37%, and Total Kjeldahl Nitrogen (TKN) by 39%. In 2015, due to fall drought followed by excessive rainfall, wheat germination was delayed; however, planting wider filter strips reduced nitrate-N by 122%. The study concluded that providing cover in the “spin” ditches significantly reduced total suspended solids, orthophosphate-P, and nitrate-N concentrations.

The ongoing identification of case studies/model watersheds in Louisiana will aid in demonstrating and promoting effective and successful nutrient management in the state.

4.e. Integrate science-based nutrient management approaches

The integration of science-based nutrient management approaches is ongoing. The CPRA is conducting research on modeling for river diversions that will allow for the addition of a new nutrient component to the model to evaluate nutrient dynamics in response to a river diversion (see Strategic Action 4.c.). For NPS management, the LSU AgCenter is forefront in researching and applying science-based approaches for nutrient management in Louisiana and research is ongoing within the state. As new scientific information becomes available, integration will allow for improved nutrient management activities to be implemented in Louisiana.
The Louisiana State University (LSU) and LSU AgCenter have two such projects examining best management practices for runoff management for rice-soybean and sugarcane fields.

Dr. Ernest Girouard, Coordinator, Louisiana Master Farmer Program, Louisiana State University with co-author Changyoon Jeong led a project titled ‘Development of best management practices for the reuse of agricultural runoff as irrigation water in rice-soybean production systems’. Water resources for irrigation purposes have been recognized for increasing efficiencies in crop management and yields. Surface runoff water and effluents are reused for irrigation purposes in many countries around the world including the United States. Although a number of countries have developed guidelines on effluent quality criteria and on how effluents should be reused for irrigation purposes, there is little information on the reuse of surface runoff in terms of water use efficiency and management. In reuse of surface runoff as an irrigation source, water once drained from rice paddies or runoff from agricultural fields after rain events, is collected in a constructed pond, and then used again to irrigate rice fields and soybeans as a rotational crop. In addition, reuse water from runoff can be used as an additional nutrient source, and rice paddies can act as bio-filters through a combination of various physical, chemical, and biological functions and are capable of removing excess nutrients and sediments from irrigated water.

The main goal of this study was to develop best management practice for re-using field runoff water collected from the constructed pond to provide an additional irrigation water supply to agricultural fields including rice and soybean fields. The research site was located in a farmer’s rice and soybean fields northwest of Kaplan, Louisiana. The constructed pond for runoff water collection was located at the edge of the 523 acre farm. Results of this study provided a more complete understanding of the efficiency in reuse of agricultural runoff as irrigation water for

rice and soybean fields as a best management practice to recycle nutrients and save fresh water from aquifers, as well as, reduce nonpoint source pollution in watersheds.

Another study conducted by Girouard and Jeong is titled 'Edge of field study on phosphorus runoff losses from sugarcane fields under different management practices'. Phosphorus (P) losses in runoff from sugarcane fields can contribute to nonpoint source pollution of surface and subsurface waters. The objective of this study was to evaluate the effects of three different management practices on P losses in surface runoff and subsurface leaching from sugarcane (*Saccharum officinarum* L.) fields. Field experiments with treatments including conventional burning (CB), compost application with burning (COMB), and remaining green cane trash blanketing (GCTB) treatments were carried out to assess these management practice effects on P losses from sugarcane fields. In the CB treatment, sugarcane residue was burned after harvest. The COMB treatment consisted of compost applied at "off bar" with sugarcane residue burned immediately after harvest. Compost was applied in the amount of 13.4 Mg ha^{-1} annually, 8 weeks before planting. In the GCTB treatment, sugarcane residue was raked off from the row tops and remained in the wheel furrow after harvest. Surface runoff was collected with automatic refrigerated samplers, and subsurface leachate was collected with pan lysimeters over a period of 3 years. Measured concentrations of total P (TP), dissolved reactive P (DRP), and particulate P (PP) in surface runoff from the COMB treatment were significantly higher than concentrations from the CB and GCTB treatments. The mean losses of P (TP and DRP) after burning (postharvest, years 2 and 3) were significantly greater than the no-burn treatment (preharvest, year 1) in the CB, COMB, and CB/COMB/GCTB combined options. Additionally, the mean losses of total suspended solid and total combustible solids in residue burning were, on average, 2.7 and 2.2 times higher than the no-burn practices, respectively (preharvest and GCTB treatment). Annual P losses from surface runoff in the third year of study were 12.90%, 6.86%, and 10.23% of applied P in CB, COMB, and GCTB treatments, respectively. However, the percent of annual DRP losses from applied P in COMB and GCTB treatments was similar in magnitude, and their values were less than 50% compared to the value from CB treatment. In the leaching study, percent of monthly mean TP and DRP losses in the COMB and GCTB treatments were greatly reduced. Based on these results, the COMB and GCTB procedures were equally recommended as sugarcane management practices that improve water quality in both surface runoff and subsurface leachate.

4.f. Promote BMP/CP implementation by farm in priority watersheds

Through the NPS Program, LDEQ and LDAF collaborate on setting priority watersheds for implementation of BMP and CPs. Further, the LSU AgCenter is instrumental in working with producers to implement appropriate BMPs/CPs. The LSU AgCenter conducts field days throughout the state to perform outreach and promote BMPs/CPs that are most appropriate for the various commodity groups within Louisiana. The LSU AgCenter conducted 29 events in 2016 that included 3 Phase I environmental trainings and 26 Phase II field days BMP implementation (Girouard 2017).

5. STATUS & TRENDS

The Strategy aims to document the current status and determine trends over time for nutrient management efforts in Louisiana's water bodies. The status and trends will be documented for water quality monitoring efforts of the LDEQ Ambient Water Quality Monitoring Network (AWQMN); implementation of LDEQ NPS Program projects by LDEQ, LDAF, and USDA NRCS; implementation of LPDES Permit Program; modeling efforts of the CPRA, LDEQ, and USGS; implementation of coastal protection and restoration projects by CPRA; and LSU AgCenter developed social indicators of public behavior regarding nutrient management in Louisiana.

5.a. Model nutrient loading estimated within Louisiana watersheds

Modeling of nutrient loading within Louisiana watersheds is ongoing. The USGS SPAtially Referenced Regressions On Watershed attributes (SPARROW) surface-water quality models for nitrogen and phosphorus are available for use through an online web tool in a Decision Support System (USGS 2015). Currently nitrogen and phosphorus models for the Mississippi River Basin are available for data from 2002 (Robertson and Saad 2013). The USGS is in progress of updating the nutrient models for data from 2012 and anticipates publishing the data used to calibrate the 2012 models in 2016 to 2017. These updated models are expected to give improved information about stream reach and lake characteristics and improved capability of evaluating their effect on nutrient transport. It is anticipated that model results will be served on a web-based mapping and scenario evaluation tool similar to what is available for the 2002 models (USGS 2017).

5.b. Document in-stream nutrient water quality

Through the LDEQ AWQMN, the agency monitors in-stream water quality in water bodies across the state. In the 2016 water sampling year (October 2015 through September 2016), the LDEQ monitored 137 sites in 130 subsegments for in-stream concentrations of nitrogen (nitrate-nitrite and TKN) and phosphorus (TP). Results of the LDEQ ambient water quality monitoring are available through the Louisiana Environment Data Access Center (LDEQ 2017a).

5.c. Document Social Indicators of nutrient management behavior

During the Strategy development phase in 2013, the LSU AgCenter conducted surveys with producers to document current behavior on nutrient management in Louisiana. This survey of nutrient management behavior can provide a social indicator associated with implementation of CPs and attitudes on water quality for specific agricultural interest groups within the state (LSU AgCenter 2013).

In addition, the Southern Extension and Research Activities committee number 46 (SERA-46) group plans to utilize Social Indicators to guide, evaluate and advance implementation of strategies to reduce nutrient loss from agricultural lands across the 12 HTF states (HTF and LGU SERA-46 2015). SERA-46 envisions the process would consider the input of numerous stakeholders, as well issues derived from hypoxia- and water resource management-related literature, such as the Social Indicator Planning and Evaluation System (SIPES) Handbook (Genskow and Prokopy 2011). The collection of baseline data will be used to inform education and outreach in high priority watersheds [HTF and Land Grant Universities (LGU) SERA-46

2015]. In 2016, the SERA-46 group began to form a Social Indicators/Civic Engagement Measures Workgroup with interested state and federal partners through the HTF.

5.d. Document BMP/CP implementation in watersheds

The LDAF Office of Soil and Water Conservation (OSWC), in collaboration with the LDEQ NPS Program, implemented CPs that aid in improving water quality in watersheds across the state. In the Federal Fiscal Year 2016 (October 2015 through September 2016), the LDAF OSWC implemented CPs in 11 LDEQ subsegment watersheds. These watersheds included Natalbany River, Bayou Queue de Tortue, Bayou des Cannes, Bayou Chene, Boston Canal, Bayou Mallet, Lake St. Joseph, Big Creek (South), Big Creek (North), Bayou Louis/Lake Louis, and Bayou Lafourche. Conservation Plans included various Conservation Practices like nutrient management, cover crops, irrigation water management, and irrigation land leveling among others.

The USDA NRCS also implemented CPs in watersheds across the state of Louisiana. In Federal Fiscal Year for 2015, CPs were certified or planned for over 215,000 acres in Louisiana (USDA 2017; Appendix C). The CPs included nutrient management, irrigation land leveling, conservation crop rotation, and cover crop among others.

5.e. Document permitted discharger inventories

Point source discharges into Louisiana waters are managed through the LPDES Permit Program by the LDEQ under Louisiana's Water Quality Regulations (LAC 33:Chapter IX) (LDEQ 2017b). At the end of Federal FY16 (regularly ending September 2016, but extended to October 2016 due to emergency flooding in the state), there were 13,388 permitted dischargers in the LPDES Permit Program. Of these 13,338 permitted dischargers in FFY15, 11,052 were general or individual permits (non-stormwater) and 2,336 were stormwater permits. The LPDES permits issued in 2016 can be found on the LDEQ website (LDEQ 2017c).

5.f. Document riverine diversions

Louisiana's Coastal Master Plan is revised and updated on a 5-year cycle to incorporate new information and lessons learned. In preparing the 2017 Coastal Master Plan, the river diversion projects which were included in the 2012 version of the plan were explored and re-evaluated. Some are included in the 2017 plan and some are not. In addition, a few new river diversion projects are included in the 2017 plan. All of these proposed river diversion projects are intended to divert freshwater and sediment from the Mississippi or Atchafalaya rivers into adjacent coastal wetlands in an effort to restore land-building processes that were interrupted by the construction of levees on the river and to reverse the trend of land loss that has plagued coastal Louisiana since at least the 1930s (CPRA 2012). A key component of the implementation process is to more fully investigate technical uncertainties to maximize the benefits of these projects while minimizing trade-offs and unintended consequences. To this end, CPRA conducted planning-level landscape modeling, basin-level modeling, and project-specific modeling to help define project location, size, operations, and other key project attributes.

Because diversions are an essential restoration tool in coastal Louisiana, CPRA has worked with the Water Institute to establish and convene an independent Diversion Advisory Panel to provide

expert advice and guidance on key issues that pertain to river diversions. The 12 panel members have backgrounds in a broad range of physical and biological sciences, social science, and engineering and convened four meetings in 2015 and 2016.

5.g. Document coastal protection and restoration activities

The CPRA develops an annual plan that is submitted to the Louisiana Legislature in March of each year. This annual plan documents activities from the previous fiscal year, and project activities and budgets for the upcoming fiscal year. The FY2018 Annual Plan is currently in development. Once finalized, Annual Plans are posted on the CPRA website (http://coastal.la.gov). In addition, quarterly progress reports with information about construction status on individual projects are also posted on the CPRA website.

5.h. Determine trends in nutrient water quality at long-term monitoring stations

This action was completed in 2015. In 2015, the LDEQ determined trends in nutrient water quality concentrations observed at 21 active long-term monitoring stations located in the LDEQ AWQMN throughout the state (LDEQ 2015). This trend analysis examined nitrogen [including TKN and nitrate + nitrite (NOx)] and phosphorus [as TP] concentrations observed at long-term stations in Louisiana. The results of the Mann-Kendall trend tests for TKN, NOx, and TP from 1978 to 2014 revealed that the majority of trends (73%) to be decreasing. All sites had a decreasing trend for TKN, twelve sites showed a decreasing trend for NOx, and thirteen sites showed a decreasing trend for TP. Only one trend, NOx for the Bogue Chitto River, was found to be increasing. The land use for the watershed of the eleven rivers included in this analysis was calculated and then analyzed along with the median nutrient value in a Kendall tau correlation analysis. Agriculture was found to be significantly correlated with higher concentrations of TKN and TP ($p<0.01$), while forested lands were found to be significantly correlated with lower concentrations of TKN and TP ($p<0.05$). Even though agriculture was found to be associated with higher nutrient concentrations, basins with the most agriculture also showed the most improvement in nutrient management as evidenced by decreasing or no observable increasing trends in nutrients. Overall, increasing trends in nitrogen and phosphorus in-stream concentrations are not being observed in major Louisiana water bodies, and in fact nutrient concentrations are either on the decline or stable in over the past 30 years.

The LSU AgCenter also examined nutrient trends over time in Louisiana water bodies, specifically in the Mermentau and Vermilion Rivers (He and Xu 2015), and the results complimented those from the LDEQ analysis. The LSU AgCenter utilized the LDEQ long-term data as well as data from the USGS. In their review of nutrient trends by decade from 1980 to 2010 in the Mermentau and Vermilion Rivers, the researchers observed that there was an overall steady decline of nitrogen and phosphorus concentrations in both rivers, mainly in the 1990s. Researchers noted that the Vermilion River showed a higher concentration of both total nitrogen and total phosphorus as compared to the Mermentau River. And that on average annually, the Vermilion River delivered a total of 1,829 metric tons of nitrogen, while the Mermentau River delivered a total of 3,925 metric tons of nitrogen because of its higher discharge. Similar to the concentration trend, the rivers showed a decline in total nitrogen and total phosphorus loads to the Gulf of Mexico. While the researchers did not report on actual implementation of Best Management Practices (BMPs) they speculate that it is likely that the agricultural BMPs for irrigation management and nutrient management in these two rivers basins may have contributed

to the nutrient reduction because of intensive rice cultivation that occurs in these areas (He and Xu 2015).

5.i. Determine trends in Social Indicators

This Strategic Action for determining trends in Social Indicators will build upon those results as indicated under action 5.c. The SERA-46 group plans to utilize Social Indicators for nutrient management across the 12 HTF states (HTF and LGU SERA-46 2015) to inform education and outreach in high priority watersheds. SERA-46 anticipates that "post-programming" data collection will follow to evaluate program impact and inform the next generation of outreach (HTF and LGU SERA-46 2015).

5.j. Determine trends in BMP/CP implementation

This Strategic Action is focused on determining trends in BMP/CP implementation. The USDA NRCS Conservation Program reports on water quality (USDA 2017; Appendix C) indicate that the land unit acres receiving conservation practices related to water quality for the practice of nutrient management (practice code 590) generally increased from 50,746 acres in 2005 to 51,738 acres in 2015 in Louisiana. Further, for land unit acres treated by at least one conservation practice related to water quality, a general increase was also observed from 179,375 acres in 2005 to 215,447 acres in 2015.

5.k. Determine trends in permitted discharger inventories

In the LPDES Permit Program, there were 8,736 permitted point-source dischargers at the end of FY09 (ending September 2009), 10,443 permitted point-source dischargers at the end of FY14 (ending September 2014), 10,639 permitted point-source dischargers in FY15 (ending September 2015), and 11,052 permitted point-source dischargers in FY16 (ending October 2016). This represents an increase of 1,707 permitted point-source dischargers, or a 19.5% increase, from FY09 to FY14; and an increase of 1,903 permitted point-source dischargers, or 21.8% increase, from FY09 to FY15; and an increase of 413 permitted point-source dischargers, or 26.5% increase from FY09 to FY16. The increase in permitted point-source dischargers from FY15 to FY16 was 3.7%.

5.l. Determine trends in nutrients related to riverine diversions

As a part of the model development described under Strategic Action 4.c., CPRA and the Water Institute collected nutrient-related data in the Barataria (west of the Mississippi River) and Breton Sound (east of the Mississippi River) basins in 2014 and 2015 to serve as baseline for new diversion projects, as well as provide data for the calibration and validation of the models. In addition, CPRA continues to develop and implement the System-Wide Assessment and Monitoring Program (SWAMP) which is a comprehensive monitoring program to serve predictive models as well as program assessment. SWAMP includes water quality parameters, such as nitrogen, phosphorus, chlorophyll, and dissolved oxygen and began in Barataria Basin (west of the Mississippi River) in 2015. Work will continue in future years to expand into the Breton Sound Basin (east of the Mississippi River) and to investigate and evaluate trends in nutrients as diversion projects move through engineering and design to construction, and finally to operation.

5.m. Determine trends in coastal protection and restoration activities

Activities under this Strategic Action are ongoing. After Hurricanes Katrina and Rita in 2005, the Louisiana Legislature directed the state to respond to the land loss crisis in a new way. Act 8 of the First Extraordinary Session of 2005 created the CPRA of Louisiana and required CPRA to develop a plan for a safe and sustainable coast. The Louisiana Legislature required that this plan be updated every five years to ensure that the state was building on success and taking maximum advantage of new science and innovation. The Louisiana Legislature further directed that the plan include large scale projects and take the needs of the entire coast into account. Most importantly, the plan had to prepare the way for action. The 2007 Coastal Master Plan was the first such plan, and it helped support the many protection and restoration projects that have since been implemented.

In the five years between the 2007 Coastal Master Plan and the 2012 update to the Coastal Master Plan, the state has exponentially increased its financial commitment to the coast. Some of these dollars provided the state's match for repairs and revisions to the Greater New Orleans area levees, allowing the state to leverage over $14 billion in federal dollars for this vital hurricane protection system. In addition, the federal Coastal Impact Assistance Program (CIAP) is providing approximately $496 million to Louisiana to mitigate impacts from Outer Continental Shelf oil and gas production. Many of the CIAP projects address coastal restoration needs through shoreline protection, marsh creation, and other strategies. Approximately 90% of the CIAP program's projects are underway or complete.

Developed using the best available science and engineering, the 2017 Coastal Master Plan moves us toward our collective goals of reducing economic losses to homes and business from storm surge flooding, promoting sustainable ecosystems, providing habitats for a variety of commercial and recreational activities coast wide, strengthening communities, and supporting business and industry. The 2017 Coastal Master Plan builds on the past and establishes a clear vision for the future. It carries the 2007 and 2012 plans forward by improving our methods to ensure projects are completed as efficiently and effectively as possible.

The updated 2017 Coastal Master Plan includes several key advancements:

- *Improving the science*. The 2012 plan was founded on state of the art science and analysis, and the 2017 effort builds further upon this basis. The modeling process provides a holistic understanding of our coastal environment today and the changes we can expect over the next 50 years. Recent advancements include incorporating a larger geographic area and increasing spatial details of land loss and flood risk.
- *Expanding collaboration and partnerships*. A successful plan is built on local knowledge, input from a diverse range of coastal stakeholders, and extensive dialogue with the public. The 2017 plan is continuing the many partnerships we developed for the 2012 plan and adding additional representation for landowners and community advocates. We continue to reach out to the public in new ways to better share information on increasing flood risk.
- *Focus on flood risk reduction & resilience*. We need to use all of the tools available to reduce communities' flood risk. We are exploring multiple types of nonstructural options and refining policies to help communities become more resilient. In addition, we are also

creating new interactive tools to help citizens understand their flood risk now and in the future.

As a part of the development of the SWAMP discussed under Strategic Action 9.c., CPRA is planning to utilize these data to evaluate the extent to which the Coastal Master Plan is reaching its overall objectives. This will include the assessment of changes in the priority performance measures, which are linked to overall program performance. Specific to diversion projects, this will include changes in water quality parameters as a result of the introduction of nutrients from the Mississippi River to the coastal wetland receiving basins.

6. WATERSHED CHARACTERIZATION, SOURCE IDENTIFICATION, & PRIORITIZATION

Watershed characterization, source identification, and prioritization involve identifying the natural characteristics of land and water bodies found within watersheds, and identifying the possible suspected sources of nutrients to a given water body. This information on watershed characteristics and suspected sources will allow for prioritization of water bodies for nutrient management activities.

6.a. Characterize watersheds by land use/cover and geographic features

This action was completed in 2013. Main features such as watershed delineations by LDEQ and USGS, National Land Cover Data on land cover/land use, and elevations have been identified through GIS-based products.

6.b. Characterize water bodies by type such as streams, bayous, rivers and lakes

This action was completed in 2012. LDEQ maintains the Water Quality Management Plan, Volume 4 Basins and Subsegments which describes the watershed basins and subsegments that are part of the LDEQ water programs; Volume 4 was updated in 2014 (LDEQ 2014a).

6.c. Characterize watersheds within the coastal zone

This action was completed in 2013. Coastal watersheds in Louisiana can be described as areas where water is generally distributed broadly from streams rather than as in upland watersheds where water is shed from headlands to one outlet. The main stem water body can be higher than the surrounding areas, and that in flood stage, water leaves the main channel, over the banks and down the natural levees to the back swamps; thus, water is shed to the land rather than from it. Flow in these coastal areas may also be bidirectional within the channel due to tides and winds dependent on prevailing conditions including slope.

LDEQ maintains the Water Quality Management Plan, Volume 4 Basins and Subsegments (LDEQ 2014a) which describes the watershed basins and subsegments that are part of the LDEQ water programs. Additionally under the CPRA Coastal Master Plan 2012, the CPRA jurisdictional boundary is described in the Louisiana Revised Statues 49:214.2 as '"Coastal area" means the Louisiana Coastal Zone and contiguous areas subject to storm or tidal surge and the area comprising the Louisiana Coastal Ecosystem as defined in Section 7001 of P.L. 110-114' of the Water Resources Development Act.

6.d. Characterize watersheds within existing or planned riverine diversions

As discussed under Strategic Action 5.f., a critical component of the development and implementation of river diversions in Louisiana will be the development of decision support tools to estimate the most appropriate location, size, and operational strategy for a given river diversion project. An additional critical piece will be the necessary environmental compliance (National Environmental Policy Act, NEPA) documentation, which provides a characterization of the existing conditions of the receiving basins, along with the anticipated changes as a result of a river diversion project. As the selected projects move towards implementation in the next five years, the environmental documents will be developed.

In addition, the receiving basins are being characterized as a part of the development of predictive models discussed under Strategic Action 4.c. by the collection of empirical data for the purpose of model calibration and validation. Long-term nutrient constituent monitoring, which will allow for the evaluation of trends in nutrients within the receiving basins, will be conducted as a part of SWAMP discussed in Strategic Action 9.c.

6.e. Identify potential sources through Desktop Analysis/Windshield Survey

This Strategic Action will aid in documenting sources in watersheds. Potential sources can be identified through desktop analyses such as GIS-based tools including Google Earth or maps, and through on-the-ground reconnaissance.

The Lake Providence watershed is located in the most northeastern part of the state in the Ouachita River Basin. In 2016, the Lake Providence Watershed Council prepared an interim report to the Louisiana Legislature for managing the watershed resources of the lake (LPWC 2016). In that effort, a council member utilized a drone to perform an aerial reconnaissance of the watershed during a rain event in March of 2016. As shown in Appendix E of LPWC (2016), aerial photos show heavy sediment laden runoff into the lake during the storm event. In contrast, one photo shows relatively clear water that is flowing over a cover crop before entering the lake. These aerial images taken with a drone provided documentation of sources into the lake and can help with planning future activities for watershed management.

6.f. Identify unpermitted point sources

The LDEQ Compliance Monitoring Strategy (LDEQ 2017d) outlines approaches for monitoring permit compliance to aid in addressing potential point source issues. In 2016, the LDEQ Surveillance Division conducted 937 water inspections within 231 subsegments in Louisiana.

Additionally, the LDEQ Surveillance Division performs Watershed Sweeps under the Compliance Monitoring Strategy to identify nonpoint sources and unpermitted point source dischargers within targeted subsegments. In 2016, the LDEQ Surveillance Division conducted Watersheds Sweeps in the five subsegments (see Table 1).

Table 1. Louisiana Department of Environmental Quality (LDEQ) Surveillance Division Watershed Sweeps in 2016.

Subsegment No.	Water Body Segment Description	Inspections	Notice of Deficiency (NOD)
LA020601	Intracoastal Waterway - From Bayou Villars to Mississippi River	118	29
LA030201	Calcasieu River - From Marsh Bayou to saltwater barrier	1	1
LA080906	Turkey Creek - From Turkey Creek Cutoff to Turkey Creek Lake	19	19
LA081001	Bayou Macon - From Arkansas state line to Tensas River	26	23
LA081611	Hemphill Creek - From headwaters to Catahoula Lake; includes Hair Creek	1	1

6.g. Identify priority watersheds from leveraging programs

There are several state and federal programs focused on watershed restoration and protection in Louisiana. These programs prioritized watersheds in Louisiana to target for restoration and protection activities. Several USDA NRCS initiatives within Louisiana prioritized watersheds within the state for restoration activities associated with CPs. These USDA NRCS initiatives that include the Gulf of Mexico Initiative (GoMI), Mississippi River Basin Initiative (MRBI), and National Water Quality Initiative (NWQI) target watersheds across the state to address suspected nonpoint sources through the implementation of CPs. Additionally, the LDEQ NPS Program prioritized watersheds for implementation activities through 2016 (LDEQ 2011).

USDA announced additional investment in improving the Mississippi River Basin water quality for 2016 (USDA NRCS and LDAF OSWC 2015). In Louisiana, 6 new Mississippi River Basin Healthy Watershed Initiative (MRBI) projects were funded starting in the Federal Fiscal Year 2016. Total funding in Louisiana over the 3 year life span of the initiative is $3,689,966 (see Table 2). Louisiana has 6 new watersheds and 2 existing hydrologic unit code (HUC) 12 level MRBI projects for a total of 8 HUC 12 level MRBI watershed projects. All MRBI watersheds are located in Northeast Louisiana within the Ouachita River Basin that is identified as a priority area in the Louisiana Nutrient Management Strategy.

Overall goals of MRBI in Louisiana include reducing fall tillage and keeping the soil covered by increasing the use of cover crops and or increasing residue to reduce soil loss. USDA NRCS will also assist producers to improve nutrient management techniques above their current level to increase nutrient utilization. USDA NRCS along with LDAF Soil and Water Conservation Districts and other partners will develop targeted outreach plans to reach every producer within the watershed. Conservation planning and technical assistance will be offered at no charge to help producers address the watershed goals and improve water quality.

The current list of MRBI watersheds in Louisiana (USDA NRCS and LDAF OSWC 2015) are:

1. **Lake St. Joseph-Clark Bayou** (HUC 080500030406) is located in the LDEQ subsegment of Lake St. Joseph 081202 in the upper Mississippi River alluvial plain located in Tensas Parish. This watershed has numerous partners and activities including a 3 year USEPA §319 Implementation Project. As a part of this project, LDEQ has written a Watershed Implementation Plan (WIP) with extensive sampling and analysis. There is $585,782 dollars of targeted funding for this project; this is an existing MRBI watershed in 2015.
2. **Cane Bayou-Little Creek** (HUC 080500011010) is located in the LDEQ subsegment of Big Creek 080903 in the upper Mississippi River alluvial plains in Richland Parish. This watershed has a WIP written by the state and an ambient sampling site. There is $923,970 dollars of targeted funding for this project; this is an existing MRBI watershed in 2015.
3. **Alligator Bayou** (HUC 080500020503) is located in the LDEQ subsegment of Bayou Macon 081001 in the upper Mississippi River alluvial plains along the southeast corner of West Carroll Parish. There are 21,058 total acres in the watershed; this is a new MRBI watershed added for 2016.
4. **Little Creek** (HUC 080500011001) is located in the LDEQ subsegment of Big Creek 080903 in the upper Mississippi River alluvial plains in Richland Parish. This watershed has a WIP written by the LDEQ and an ambient sampling site for each LDEQ Subsegment. There are 22,030 total acres in the watershed.
5. **Lake Providence-Tensas Bayou** (HUC 080500030101) is located in the LDEQ subsegment of Lake Providence 081101 and Tensas River 081201 in the upper Mississippi River alluvial plains in East Carroll Parish. This watershed has a WIP written by the LDEQ. The Louisiana legislature passed a law in 2015 forming the Lake Providence Watershed Council (Louisiana 2015). This council is made up of local, state and federal representatives as partners for implementation; LDAF, LDEQ, LDNR, and USDA NRCS are among the partner agencies. In April 2016, the council developed a plan for restoration of the lake (LPWC 2016). There are 34,953 total acres in the watershed.
6. **Lake Bruin and Van Buren Bayou** (HUC 080500030503 and 080500030501 are located in the LDEQ subsegments of Tensas River 081201 and Lake Bruin 081203 in the upper Mississippi River alluvial plains within Tensas Parish. Tensas River has a WIP written by the LDEQ. There was also a previous USEPA §319 project in the Lake St. Joseph watershed adjacent to Lake Bruin. There are 51,777 total acres within these 2 watersheds.
7. **Little Tensas Bayou-Bull Bayou** (HUC 080500030105) is located in the LDEQ subsegment of Tensas River 081201 in the upper Mississippi River alluvial plains within Madison Parish. Tensas River has a WIP written by the LDEQ and an ambient sampling site for each LDEQ subsegment. There are 28,952 total acres in the watershed.
8. **Upper Deer Creek** (HUC 080500011601) is located in the LDEQ subsegment of Deer Creek 081003 in the upper Mississippi River alluvial plains within Franklin Parish. There are 26,671 total acres in the watershed.

Table 2. Louisiana Mississippi River Basin Initiative (MRBI) projects newly added for 2016, including funding amounts by fiscal year (USDA NRCS and LDAF OSWC 2015).

Watershed Name	FY16	FY17	FY18	Total
Alligator Bayou	$164,151	$227,920	$167,435	**$559,506**
Little Creek	$200,000	$241,661	$177,429	**$619,090**
Lake Providence-Tensas Bayou	$200,000	$418,041	$217,107	**$835,148**
Lake Bruin/Van Buren Bayou	$125,452	$205,937	$135,405	**$466,794**
Little Tensas Bayou-Bull Bayou	$180,754	$162,626	$166,357	**$509,737**
Upper Deer Creek	$ 182,282	$350,776	$166,633	**$699,691**
Total	**$1,052,639**	**$1,606,961**	**$1,030,366**	**$3,689,966**

Overall for priority watersheds in Louisiana through leveraging programs, the USDA NRCS prioritized three HUC 12 watersheds in GoMI, eight HUC 8 watersheds in MRBI, and four HUC 12 watersheds in NWQI. The LDEQ NPS Program prioritized 21 watersheds in Louisiana for implementation of CPs, some of which overlap with those watersheds in the USDA initiatives. Priority watersheds for these leveraging programs are provided in Appendix B.

In 2014, the USDA NRCS initiative Regional Conservation Partnership Program (RCPP) was launched (USDA NRCS 2017a). The RCPP promotes coordination between USDA NRCS and its partners to deliver conservation assistance to producers and landowners. USDA NRCS provides assistance to producers through partnership agreements and program contracts or easement agreements. As of 2016, there are currently three projects in Louisiana: The Earth Partners LP project for restoring coastal prairie through biofuels, the Rice Stewardship Program led by Ducks Unlimited and Target Conservation Delivery to Improve Soil Health, Water Quantity and Quality led by LDAF, and the Shifttail Canal watershed project led by Caddo Soil and Water Conservation District (USDA NRCS 2017b).

The Earth Partners LP project will address the issues of conversion of the Gulf coastal prairie ecoregion to rice, sugarcane, pasture and Chinese Tallow through restoration of native perennial grasses (USDA NRCS 2017b). This restoration can support increased natural vegetation communities, increase water filtration ecosystem services and also head off further invasion of exotic species.

The Rice Stewardship Program in southwest Louisiana led by Ducks Unlimited RCPP project will work with rice producers to improve and sustain their operations through the conservation of natural resources. The CPs will address the primary resource concerns of southwest Louisiana by improving water quality, as well as improving wetland habitat for wintering waterfowl and other wildlife species (USDA NRCS 2017b).

The LDAF OSWC leads the Shifttail Canal watershed project to address water quality, soil health, wildlife habitat, water quantity and energy conservation concerns within a working farm using highly effective approaches (USDA NRCS 2017b). These detailed assessments will identify resource concerns that can contribute to the degradation of the soil health and water quality and quantity within each watershed. The primary focus is to work in the identified 12 digit HUC to determine the accelerated funding needs to treat priority resource concerns.

6.h. Determine priority watershed basins

This Strategic Action focuses on selecting priority watershed basins for nutrient management in Louisiana. Through the collection of information during the Strategy development phase, it became apparent that combined with this basins location within the larger MARB and ongoing water quality and nutrient management efforts, the Ouachita River Basin in northeast Louisiana served as a model for development and implementation of on-the-ground nutrient management activities. Water quality improvements and participation by partners to support further improvement progress in nutrient management in the Ouachita River Basin make it an ideal model basin.

The LDEQ ambient water quality monitoring data analyzed in 15 subsegments in the Ouachita River Basin; where the LDEQ NPS, LDAF, and USDA NRCS have partnered, developed, and implemented WIPs; illustrates that partnerships can lead to improved water quality. This is demonstrated in the basin as decreasing nitrate-nitrite nitrogen trends were observed in 11 subsegments; decreasing total Kjeldahl nitrogen trends observed in 13; and decreasing total phosphorus trends observed in 12 of the 15 watersheds where WIPs were developed and implemented. Further preliminary water quality trend analysis (see Strategic Action 5.h.) indicates that trends in nutrient concentrations in the Ouachita River Basin are not increasing and are in some cases decreasing.

The LDEQ, LDAF, and USDA NRCS are actively working together in the Ouachita River Basin in Louisiana to continue to make progress in improving water quality. Of the LDEQ NPS priority watersheds, 12 are within the Ouachita River Basin (see Appendix B). Additionally, both the USDA NRCS MRBI and NWQI programs contain priority watersheds within the Ouachita River Basin. Continuing water quality improvements and nutrient management efforts in the Ouachita River Basin are a priority for Louisiana. The Ouachita River Basin is identified as a priority basin for nutrient management efforts in Louisiana.

6.i. Develop priority watershed scheme for basin subwatersheds

This Strategic Action was completed in 2014. The focus of this Strategic Action was to develop a priority watershed scheme for basin subwatersheds in Louisiana, allowing for further prioritization within the selected priority watershed basin in Louisiana. Factors in selection of the priority watershed basins for nutrient management include consideration of the current water quality, implementation activities, and participation of local, state, and federal programs within the basin to manage nutrients. In 2014, the Strategy Interagency Team developed a priority watershed scheme that includes the following considerations for selecting priority subwatersheds:

- Current water quality;
- Water quality trends;
- Degree of impairment;
- Degree of success;
- Overlap with monitoring activities (such as the LDEQ Ambient Water Quality Monitoring Network sampling schedule);
- Participation of current or planned local, state, and federal programs within a subwatershed; and

- Data gaps, information gaps, and areas in need of additional improvements within the subwatershed.

6.j. Determine priority subwatersheds

In 2015, priority subwatersheds for nutrient management were selected. The selection of subwatersheds involved utilizing the priority scheme developed in Strategic Action 6.i and in collaboration with partner agencies. Through this collaboration of the Louisiana state and federal agencies, the USDA NRCS selected 5 watersheds in the Ouachita River Basin as priority areas for funding in 2016 for nutrient management. Further, through the new long term vision of the CWA §303(d) Program, Louisiana selected a priority area in the Ouachita River Basin. See Appendix B for listings of priority watersheds of leveraging programs in Louisiana.

6.k. Develop/leverage Watershed Nutrient Management Projects for priorities

Following the selection of priority subwatersheds under the Strategy, Watershed Nutrient Management Projects or other implementation mechanisms can be leveraged or developed for nutrient management activities within the priority subwatersheds. Such programs where projects to address nutrient management can be leveraged include the LDEQ Nonpoint Source Program, the New Vision of §303d Program, and the BP *Deepwater Horizon* restoration.

The LDEQ Nonpoint Source Program prioritizes water bodies throughout the state to address nonpoint sources that may be causing issues in water quality (see Appendix B). In coordination with LDAF, LDEQ considers nutrients in several of their priority watersheds and plans are in development for sampling and implementation of BMPs/CPs to address the nonpoint sources (Appendix D).

In regard to the New Vision of the §303d Program, LDEQ identified priority watersheds for restoration and protection in Louisiana (Appendix B). In these New Vision priority watersheds, alternatives to TMDL plans are being developed in collaboration with stakeholders with a vested interest in the watershed restoration.

In early 2016, the BP *Deepwater Horizon* Oil Spill: Programmatic Damage Assessment and Restoration Plan (PDARP) and Programmatic Environmental Impact Statement (PEIS) plan was released (*Deepwater Horizon* Natural Resource Damage Assessment Trustees 2016). The Trustees reached settlement with BP to resolve BP's liability for natural resource injuries from the *Deepwater Horizon* Oil Spill which allocates up to $8.8 billion for restoration (NOAA 2017). The state of Louisiana is set to receive $5 billion of these funds, with $20 million of the funds the state of Louisiana will use to focus on nutrient reduction from nonpoint sources.

7. INCENTIVES, FUNDING & ECONOMIC IMPACT ANALYSIS

The Strategy aims to ensure that adequate technical and financial assistance are available for the implementation of voluntary nutrient management strategies to improve participation with Strategy implementation. Advantageous leveraging opportunities among programs and incentives provisions for nutrient management strategy implementation will encourage voluntary participation. Leveraging from LDEQ, LDAF, USDA NRCS, USEPA, and local parish government, among many others, has resulted in economic incentives, technical support, and funding for implementation of CPs in priority watersheds.

7.a. Promote voluntary participation in incentive-based programs

Voluntary participation by stakeholders in nutrient management activities is key to the Strategy. Current incentive-based programs in Louisiana provide a means for voluntary participation that will aid in improving water quality in the state. Voluntary incentive-based programs highlighted in the Strategy include the Louisiana Master Farmer Program, the Advanced Master Gardener Program, and the Environmental Leadership Program. Another voluntary incentive-based program is the more recently launched Tulane Nitrogen Reduction Challenge.

The Louisiana Master Farmer Program (LMFP) is an environmental stewardship educational program aimed at agricultural producers in the state. Louisiana Master Farmer participation increased from 3,326 participants in 2015, to 3,666 in 2016. Further, the LMFP added 14 certified Master Farmers in 2016. As of January 12, 2017, there are 239 Certified Master Farmers in Louisiana representing 51 of the 64 parishes (79.7% of the parishes in the state) with 33 farmers currently re-certified for an additional 5 years (Girouard 2017).

In 2014, Master Farmer University sessions aided to maximize a farmer's time and effort spent in the training program by offering Phase 1 and Phase 2 training in a back-to-back format. In 2016, the LMFP conducted 3 Phase 1 trainings and 26 Phase 2 Field Days for a total of 29 events across the state with 1,463 producers in attendance, which resulted in 220 producers voluntarily becoming participants in the LMFP (Girouard 2017). The increased interest in the Louisiana Master Farmer Program demonstrates producers are being proactive in protecting the natural resources by implementing Best Management Practices to prevent nutrient and sediment loss.

The Advanced Master Gardener Program through the LSU AgCenter is a program for Certified Advanced Louisiana Master Gardener volunteers to extend the educational outreach capacity of the Louisiana Cooperative Extension Service in areas such as home, school and community gardens, emphasizing environmental sustainability and nutrient management (LSU AgCenter 2017). The Advanced Louisiana Master Gardener Program is open to current Louisiana Master Gardeners in good standing who have completed at least a year of volunteer service and all initial coursework. As with other Master Programs offered by the LSU AgCenter, the Advanced Master Gardener Program is in three phases and certification comes through the completion of all three program phases, demonstrating mastery of concepts by passing exams with a score of 70% or higher, presenting information to public (master gardener groups, civic organizations, etc.), and maintaining required volunteer and continuing education hours. More information on this program can be found on the Advanced Master Gardener Program webpage (LSU AgCenter 2017).

The LDEQ Environmental Leadership Program (ELP) aims to promote a cleaner and better environment for Louisiana through voluntary pollution prevention, waste reduction and/or other environmental stewardship efforts (LDEQ 2017e). ELP membership includes large, medium and small businesses, municipalities, non-governmental organizations and schools/universities. In 2016, the LDEQ presented 11 ELP awards and recognized 15 new members that joined in 2015 to 2016 (Kelly 2016a, LDEQ 2016a). ExxonMobil Refinery of Baton Rouge received the ELP Large Business Achievement Award in Pollution Prevention for its development of Biox basins with new Biox tanks for denitrification. The "tank-in-tank" design helps to reduce nitrate in wastewater discharges to the Mississippi River. As a result of the voluntary project, the refinery was able to reduce nitrate emissions by 1.4 million pounds in 2015, greater than 80 percent nitrate removal compared to the previous year (LDEQ 2016a, Wold 2016).

The Tulane Nitrogen Reduction Challenge is an innovative incentive based program funded by Mrs. Phyllis Taylor. Under the program a team or individual could be awarded a $1 million prize for their solution to address hypoxia (Dunaway 2016, Tulane University 2017). Applications were accepted and reviewed by a Science Advisory Board and in December 2016 five finalist teams were selected. These five teams include ADAPT-N, AgDNA, Cropsmith, PIVOT and Stable'N. In 2017, the five teams will compete in Phase 2 which involves in-field trials on a plot of farmland in Tensas Parish in northeast Louisiana. In December 2017, the prize is expected to be awarded to a team based on the impact their solution has on crop yield, management of nutrient runoff, and cost (Dunaway 2016).

7.b. Identify and communicate available funding support

This Strategic Action is to identify and communicate available funding support related to nutrient management activities. Many funding programs provide continued opportunities for participation. Programs previously identified in the Strategy remain relevant as available support, and include:

- Agricultural Economic Development Assistance, LDAF
- Clean Water Act §319, LDEQ
- Coastal and Estuarine Land Conservation Program (CELCP), LDNR
- Coastal Forest Conservation Initiative (CFCI), CPRA
- Community Development Block Grants (CDBG)
- U.S. Housing and Urban Development (USHUD) CDBG
- CDBG Disaster Recovery Assistance
- Clean Water State Revolving Fund Program (CWSRF)
- Conservation Innovation Grant (CIG) Program, USDA NRCS (2017c)
- Regional Conservation Partnership Program (RCPP), USDA NRCS (2017a,b)
- Urban Waters, USEPA (2017e)

7.c. Promote assistance (financial or technical) for BMP/CP Implementation

The USDA NRCS, LDAF, and LSU AgCenter promote voluntary participation in financial and technical assistance programs for BMP and CP implementation. The LMFP has increased participation each year with more producers in all three phases of the program. The Phase 1 environmental education provides an awareness of state and federal regulations, water and soil conservation issues, point and nonpoint source pollution, coastal zone issues and conservation

planning to document stewardship of the on-farm natural resources. Phase 2 requires a producer to attend a conservation-based field day or workshop where specific BMPs are demonstrated and discussed. In Phase 3 the producer must request a farm-specific Resource Management System (RMS) level conservation plan on their entire farming operation with USDA NRCS.

The LSU AgCenter recognizes that in order for educational efforts to be successful in mitigating water quality impairments in state water bodies, we must address the sources of these pollutants regardless of their geographical location. Therefore, educational programs have been directed towards non-traditional audiences such as youth, homeowners, and other land owners. To improve citizen awareness about these important dynamics, the AgCenter developed several programs to educate and encourage land-owners about the impacts of runoff from various sources. Sources include marina activities, urban/suburban lawn care, individualized sewage treatment, management of aquaculture ponds, and diminishing healthy ecosystems. Youth in various communities are often engaged as a part of these various outreach strategies. General water quality programs educated students, teachers, and volunteers. Teacher workshops and field trips have provided classroom teachers with knowledge and techniques to significantly enhance education on Louisiana ecosystem topics. Trained teachers have reached about 20,000 students in the classroom. Educational efforts for local parish governments have promoted recommendations based on on-site research to improve hydrology and recreational opportunities.

7.d. Promote assistance (technical) for point sources

LDEQ provides technical assistance for point sources. The LDEQ conducts technical trainings and information sharing sessions for point sources that include Enviroschool (LDEQ 2017f), Sanitary Wastewater Compliance Assistance Training (SWAT) (LDEQ 2017g), and NetDMR (LDEQ 2017h) training throughout the year.

In 2016, LDEQ performed outreach to communities, businesses, and other organizations through four free Enviroschool training sessions throughout the state, focusing on nonpoint source pollution. These sessions provided an overview of nonpoint source pollution, how LDEQ works to reduce it, who the stakeholders are, and what citizens can do to reduce nonpoint source pollution (Kelly 2016b, LDEQ 2016a, LDEQ 2016b).

LDEQ also held six sessions in 2016 on NetDMR and the EPA Electronic Reporting Rule. The sessions provided an overview of the requirements of the electronic reporting rule and compliance dates (discharge monitoring reports in December 2016 and notices of intent, notices of termination, and other program reports in December 2020) (LDEQ 2016c).

Additionally, the LDEQ Small Business/Community Assistance Program (SB/CAP) provides free technical assistance to small businesses in understanding and complying with wastewater permits and environmental regulations (LDEQ 2017i). In 2016, the LDEQ SB/CAP provided 2,303 water assists which included 743 compliance consultations, 269 newly permitted assistance, 445 permit applications, 2 pollution prevention audits, 270 referrals from internal LDEQ enforcement, permitting or surveillance, and 574 other water assists.

7.e. Document economic impacts from available sources

The documentation of economic impacts of nutrient management is ongoing. This documentation of economic impacts is essential to implementation of cost-effective nutrient management practices in Louisiana. In 2014, the LSU AgCenter, through funding provided by LDEQ, began working to evaluate the costs and benefits of nutrient management to both point and nonpoint sources in Louisiana (Westra and Qushim 2016). Specifically for Louisiana, nutrient management activities are implemented by both point and nonpoint source stakeholders through technology or CPs. Economic impact analyses are necessary in order to determine the relative costs associated with improving water quality through nutrient management.

In 2016, the LSU AgCenter completed an economic cost and benefit study for nutrient management. The study estimated costs for implementing nutrient reduction strategies for point and nonpoint sources of pollution. For nonpoint source (NPS) pollution, various best management practices (BMPs) were evaluated according to land use, such as agriculture/farming, and residential areas utilizing on-site wastewater treatment systems. Farmers have dozens of BMPs proven to reduce nutrient loadings available to them via USDA subsidies; costs and USDA cost-share rates vary greatly per BMP. For example, contour buffer strips have an average total nitrogen and total phosphorus removal efficiency of 57% and 70%, respectively. It costs $429.56/acre to implement this BMP. Implementation of effective BMPs is dependent upon each farmer's ability to pay for their share of the costs (Westra and Qushim 2016).

On-site wastewater treatment systems are primarily designed for disinfection, not nutrient control. Most technologies could cost individual homeowners hundreds to thousands of dollars to implement and yield low to moderate (<50%) nutrient removal efficiencies. Technological controls for point sources, such as municipal wastewater treatment plants and industrial facilities, were also evaluated. Point source technologies include retrofitting treatment units with a new process unit and/or utilization of media filters. Nutrient reduction costs largely depend on design capacity and flow rate. Based on 4.9 mg/L ammonia effluent limitation, average ammonia effluent concentration before treatment at 5 million gallons per day (MGD) and 7 MGD waste water treatment plants (WWTPs) were 392.83 lb/day and 406.92 lb/day, respectively. Average costs for decreasing ammonia effluent from 27.2 mg/L to 4.9 mg/L were $576,400.72 and $173,776.66, respectively, at 5 MGD and 7 MGD WWTPs (Westra and Qushim 2016).

7.f. Explore feasibility for credit trading

The exploration of the feasibility of credit trading is ongoing. Previous work described in the Strategy highlighted two areas of research into water quality credit trading for Louisiana. In the first area of research, CPRA conducted preliminary evaluation of water quality credit trading as an innovative means for nutrient management associated with coastal restoration activities. Through that effort it was determined that expansion of trading between point and nonpoint source stakeholders is possible (CH2M Hill 2011). For the second area of research, the World Resources Institute (2013) reported that nutrient trading in the MARB is an economically feasible approach to reduce the costs of meeting water quality goals in the Gulf of Mexico.

Water quality credit trading remains an area of great interest for not only nutrient management but for management of other water pollutants. The Strategy Team, in coordination with

Louisiana Water Synergy Group members, is continuing to explore the feasibility of implementing a Water Quality Trading (WQT) Program in Louisiana as a voluntary, market-based approach for improving water quality in Louisiana. The Louisiana Water Synergy Group members are planning to develop a WQT Program as a market-based, voluntary approach for improving water quality in Louisiana. An effective WQT program could lead to greater nutrient reductions in the lower Mississippi River Basin and the Gulf of Mexico more quickly and at a lower overall cost than traditional regulatory approaches. In addition, water quality trading could provide some point sources and agriculture businesses the opportunity to generate revenues, and offer local regulators more policy options for improving water quality. The desired outcome of this project is to implement a WQT program and demonstrate that water quality trading is a cost-effective approach for reducing nutrients and improving water quality.

In late 2015, LDEQ, CPRA, and LDAF in conjunction with the Water Synergy Group formed a small workgroup to review options and considerations for the state of Louisiana for water quality credit trading. The workgroup is reviewing the document produced by the National Network on Water Quality Trading in summer of 2015 to evaluate options and considerations for a water quality trading program in Louisiana (National Network on Water Quality Trading 2015). Findings from this review may aid Louisiana in identifying options and considerations that could be helpful in designing and implementing a water quality trading program for Louisiana.

In July 2016, LDEQ executive staff heard from this small workgroup on their interest in water quality credit trading. Workgroup members from the Louisiana Water Synergy Group, CPRA, LDAF, LDEQ and USDA NRCS expressed their interest in such a trading program that could connect both nonpoint and point source stakeholders to address water quality improvement. In December 2016 at the HTF Fall Meeting in New Orleans, LA, the Secretary of LDEQ Dr. Chuck Carr Brown expressed that such a program would be a creative and encouraging solution to address water quality improvement (LDEQ 2016d). Dialogue on the topic of water quality trading among Louisiana stakeholders will continue in 2017.

In 2016 the Association of Clean Water Administrators (ACWA) and the Willamette Partnership made available a water quality trading toolkit that provides a blueprint for states seeking to create a water quality trading program (ACWA and Willamette Partnership 2016). The water quality trading toolkit consists of five templates [1) state guidance, 2) watershed framework, 3) state rule, 4) NPDES permit, and 5) program annual report] that can be used as a starting point for trading and can be customized based on a state's needs. ACWA also formed a workgroup for state and federal representatives to participate in discussions on water quality trading; LDEQ is participating in this workgroup.

7.g. Identify gaps

Identifying gaps in incentives, funding, and economic impact analyses may aid in future Strategy efforts. The SERA-46 group is considering economic factors along with environmental and social ones to understand nutrient management in the MARB (North Central Region Water Network 2017). As noted in section 7.a, in 2016 new approaches such as the Tulane Nitrogen Reduction Challenge are being proposed as innovative means for voluntary participation to address water quality. Such approaches may help to fill in gaps related to incentives, funding, and economic impacts.

8. TARGETS AND GOALS

Targets and goals under the Strategy will focus on the Strategic Actions outlined in the other nine strategic components and the agency commitments, timelines, and milestones to accomplishing these Strategic Actions. The targets and goals schedule for all strategic components and actions of the Strategy is presented in Appendix A, and includes agency commitments, timelines, and milestones from 2012 to 2018.

9. MONITORING

Monitoring related to nutrient management in Louisiana allows for the documentation of nutrient levels observed and in documenting other relevant information regarding planning and implementation of nutrient management activities. Monitoring will facilitate the demonstration and verification that nutrient management measures are having the desired impact on water quality. In the event that water quality has not improved, monitoring data guide improvements in the application of more robust and effective nutrient management actions.

9.a. Monitor in-stream nutrient water quality

The LDEQ routinely monitors in-stream nutrient water quality in the state's water bodies through the LDEQ Ambient Water Quality Monitoring Network (AWQMN) (LDEQ 2014b). For the 2016 Water Sampling Year (from October 2015 through September 2016), 137 stations were monitored monthly for nutrients that included nitrogen (as nitrate-nitrite and total Kjeldahl nitrogen) and phosphorus (as total phosphorus).

In 2016 LDEQ completed an USEPA Region 6 supported pilot project for use of a real-time nitrate sensor. The LDEQ utilized a SUNA V2 Nitrate Sensor to collect real-time 'grab' nitrate + nitrite (NO_x) readings in the field (Sea-Bird Scientific 2017). This pilot project was performed alongside routine ambient monitoring at 75 sites in the LDEQ AWQMN (LDEQ 2016e). As the typical turnaround time for a routine grab NO_x sample collected for laboratory analysis is three months, the ability to collect a real-time NO_x sample in the field is beneficial to future monitoring of nitrate in Louisiana waters. From July 2015 to May 2016, LDEQ sampled sites in the Atchafalaya River, Lake Pontchartrain, Mermentau River, Pearl River, Ouachita River, and Vermilion-Teche River Basins. The LDEQ evaluated results from routine grab samples that were collected in the field and analyzed in a laboratory as compared to those samples collected in real-time. In general, the *in situ* NO_x data did not correlate well with the laboratory data which may be explained by interferences from increased turbidity and chromophoric dissolved organic matter (CDOM). Temperatures greater than 25ºC can cause instability in sensor readings and temperatures greater than 35ºC can cause the sensor to be inoperable. Provided users take into account the effect of high turbidity, CDOM, and temperature on the measurement of real-time *in situ* NO_x the sensor can provide an estimate that could assist in nitrate source identification (LDEQ 2016e).

9.b. Monitor relative to BMP/CP implementation

In 2016, LDEQ and LDAF in conjunction with USDA NRCS conducted water quality monitoring for nutrients and other parameters in 16 watersheds where BMPs were implemented (Appendix D). Of these 10 watersheds, nutrient monitoring was conducted in 7.

9.c. Monitor nutrients associated with riverine diversions

In 2015, CPRA began monitoring nutrients as a part of the SWAMP. CPRA has historically conducted monitoring within the coastal zone of Louisiana through its Coastwide Reference Monitoring System (CRMS)-*Wetlands* (CPRA 2017) and has worked with The Water Institute of the Gulf to design SWAMP to build on its historic monitoring program. In light of its growing restoration and protection programs, CPRA has also worked to ensure that a comprehensive network of coastal data collection activities is in place to support the development, implementation, and adaptive management of the coastal protection and restoration program within coastal Louisiana (The Water Institute of the Gulf 2013; Hijuelos et al. 2013). The focus of this new monitoring program is to obtain repeated long-term (e.g., years to decades) measurements that can be analyzed to detect changes that may result from a variety of sources, including large-scale restoration and protection projects, environmental disturbances, and other major drivers that impact the system.

Initial steps in developing the SWAMP program included development of a framework to identify drivers of change, create an inventory of existing and ongoing data collection efforts which could offer leveraging opportunities, and develop priority performance metrics/variables to focus limited resources on the most important and relevant data needs. Nutrient constituents (primarily nitrogen, phosphorus, and silica) were identified as one of the priority water quality variables of the SWAMP program.

CPRA began implementation of SWAMP in Barataria Basin (west side of the Mississippi River) in 2015 following recommendations in Hijuelos and Hemmerling (2015) and also completed a SWAMP monitoring plan for the Breton Sound, Pontchartrain, and Mississippi River Delta Basins (east side of the Mississippi River). It is anticipated that implementation of SWAMP on the east side of the Mississippi River will begin in 2017.

9.d. Monitor nutrients in point sources

Monitoring for nutrients in point sources is documented through the LPDES Permit Program. LDEQ is responsible for the LPDES Permit Program whereby dischargers to waters of the state are permitted for such water discharge activity. Through the LPDES Permit Program, LDEQ is able to locate and track the number of permitted dischargers to water bodies in Louisiana. Nutrient monitoring may be included in LPDES permits to address specific facility types, through implementation of dissolved oxygen TMDL recommendations in several subsegments in the Lake Pontchartrain Basin, and as part of permitted wetland assimilation projects. Nutrient monitoring of permitted dischargers aids in gathering necessary data on nutrient discharges in Louisiana. Nutrient monitoring information from the LPDES Permit Program is available through the LDEQ EDMS system (LDEQ 2017j) and may also be available for specific facility types through the USEPA Integrated Compliance Information System (ICIS) (USEPA 2017f).

In 2014 to 2015, the HTF formed a Point Source Measures Workgroup to identify and evaluate potential point source measures for tracking progress on nutrients in the Task Force states. The HTF Point Source Workgroup identified two measures for point sources: 1) the number of major Publicly Owned Treatment Works (POTW) permits with monitoring requirements for nitrogen and phosphorus; and 2) the number of major POTW permits with nitrogen and phosphorus limits. LDEQ was involved in reviewing and verifying data for permitted dischargers in the state

that would be part of these measures. The HTF prepared details on all elements of the measures reporting and tracking process including information input and error correction, establishment of baselines, and direct access of the information using USEPA's data reporting tool. This information became available in early 2016 (HTF 2016).

LDEQ developed a Point Source Implementation Strategy for Nutrients in Louisiana with consideration of monitoring under this Louisiana Nutrient Management Strategy. LDEQ began implementation of the Point Source Implementation Strategy in May 2016. In this point source strategy, major and minor sanitary permitted dischargers will begin reporting total nitrogen and total phosphorus on a quarterly basis and the reporting requirement will be added to new and renewal permits. Other types of dischargers may undergo a nutrient review to determine if reporting requirements will be included in their new or renewal permit (LDEQ 2016f).

9.e. Evaluate compliance with point source permits

The evaluation of compliance with point source permits is ongoing. The LDEQ Enforcement Division leads the effort on compliance with point source permits through the LPDES Permit Program. Enforcement actions issued by LDEQ for any permitted activity, including point source water permits, are available for viewing on the LDEQ webpages (LDEQ 2017k).

In regard to nutrients, a review of Discharge Monitoring Reports (DMRs) that are submitted to LDEQ online through the NetDMR system to ICIS was conducted for parameters for Total Nitrogen (TN, STORET code 00600) and Total Phosphorus (TP, STORET code 00665). In a review of 25,024 data records for TN or TP in DMRs available through ICIS from January 1, 2000 to December 31, 2016, compliance with point source permits in regard to completion of DMRs for TN or TP was about 91%, whereas about 9% of DMR submissions resulted in data violations that may have been related to overdue reporting or non-receipt. Of the 3,995 records for TN or TP with limits, less than 0.5% of the DMR submissions were effluent violations.

9.f. Identify gaps

Monitoring programs within Louisiana continue to improve. Monitoring programs improvements include increased number of permitted dischargers monitoring for nutrients through the LDPES Permit Program, increasing the water quality variables including nutrients monitored relative to implementation of coastal restoration and protection projects by CPRA, and monitoring for nutrient water quality in NPS watershed CP implementation projects by the LDEQ, LDAF, and USDA NRCS.

An area previously identified as a potential gap is the monitoring of stream flow in receiving water bodies. Quantitative measurements for flow that are correlated with nutrient monitoring are lacking; thus, a potential exists to collect quantitative flow data. Correlated nutrient monitoring and quantitative flow measurements allow for loading determinations, which will aid in improving our understanding of nutrient loadings from various sources in Louisiana water bodies.

10. REPORTING

Reporting is a critical component of Louisiana's Nutrient Management Strategy. Reporting actions include public outreach, dissemination of strategy documents and resources through the Strategy website, and availability of geospatial information.

10.a. Review of draft strategy December 2013

The review draft of the strategy was made available to the public December 23, 2013.

10.b. Public comment period

A public comment period occurred from December 23, 2013 through January 31, 2014, following the release of the review draft of the Strategy. Comments on the review draft of the strategy were received from the public. A Response to Public Comments on Review Draft was prepared and included as Appendix F in the Nutrient Strategy document (Louisiana Nutrient Management Strategy Interagency Team 2014).

10.c. Final strategy

The final Strategy was released in May 2014 (Louisiana Nutrient Management Strategy Interagency Team 2014) and is available on the Strategy website.

10.d. Strategy review

The Strategy team will review the Strategy in 2018. This five year timeframe from 2013 to 2018 for strategy review is similar to that of other Louisiana programs such as the LDEQ NPS Management Plan from 2011 to 2016 (LDEQ 2011) and the CPRA 2012 Coastal Master Plan (CPRA 2012) from 2012 to 2017. Both programs utilize a five year timeline for program evaluation that incorporates adaptive management.

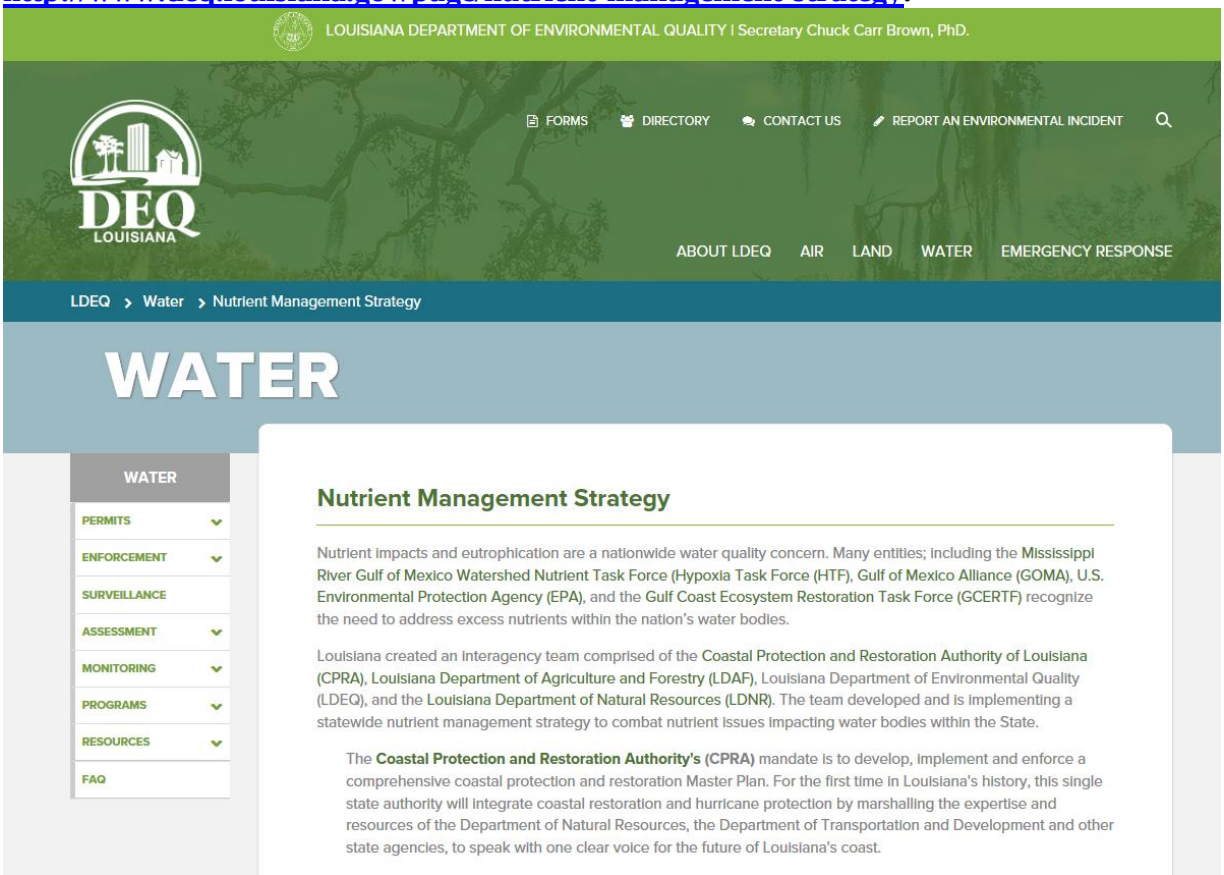
10.e. Report annually on strategy activities

This present document represents the 2015 Annual Report on Louisiana Nutrient Management Strategy activities.

10.f. Present information through strategy website

The LDEQ website was redesigned in early 2017 and the Louisiana Nutrient Management Strategy website is now located at http://www.deq.louisiana.gov/page/nutrient-management-strategy (see Figure 1). The Strategy website contains information related to nutrient management activities in Louisiana. Content includes information on nutrient management, resources, reports, decision support tools, programs, and frequently asked questions. Information added to the website in 2016 includes reports for long-term nutrient trends (LDEQ 2015) and the LDEQ Point Source Implementation Strategy (LDEQ 2016f). As other new information is made available it will be accessible to the public through the website.

Figure 1. Louisiana Nutrient Management Strategy website located at http://www.deq.louisiana.gov/page/nutrient-management-strategy.

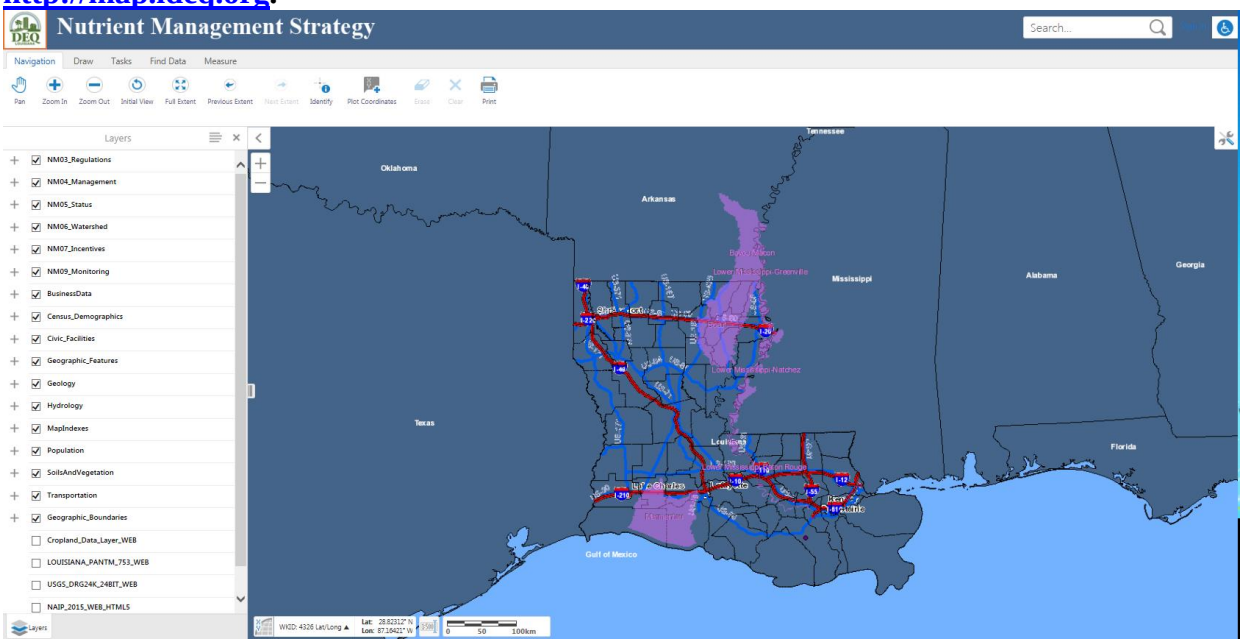


10.g. Present information geospatially through web-based viewer.

The LDEQ website provides public access to a web-based geospatial mapping application called the LDEQ Interactive Mapping Application (LIMA). A GIS Project was designed for the Strategy which is available through the LDEQ LIMA site (see Figure 2). To access the Strategy geospatial information visit http://map.ldeq.org/, go to 'GIS Projects' on left hand menu, and navigate to the 'Nutrient Management Strategy' link, then navigate to the thumbnail for the 'Public Nutrient Management LIMA map'.

The LIMA application contains basic geospatial layers related to business data, census/demographics, civic facilities, geographic features, geology, geographic boundaries, hydrology, population, soils and vegetation, and transportation. Background layers are available for crop data and satellite imagery. Specific content for the Strategy is subgrouped by Strategy Component and currently includes content for Component 3 Regulations, Policies, and Programs; and Component 4 Management Practices & Restoration Alternatives; Component 5 Status and Trends; Component 6 Watershed Characterization, Source Identification & Prioritization; Component 7 Incentives, Funding & Economic Impact Analysis; and Component 9 Monitoring. Additional geospatial content will be added as new information becomes available.

Figure 2. Geospatial viewer for Louisiana Nutrient Management Strategy located at http://map.ldeq.org.



Layers

☑ NM03_Regulations
☑ NM04_Management
☑ NM05_Status
☑ NM06_Watershed
☑ NM07_Incentives
☑ NM09_Monitoring
☑ BusinessData
☑ Census_Demographics
☑ Civic_Facilities
☑ Geographic_Features
☑ Geology
☑ Hydrology
☑ MapIndexes
☑ Population
☑ SoilsAndVegetation
☑ Transportation
☑ Geographic_Boundaries
☐ Cropland_Data_Layer_WEB
☐ LOUISIANA_PANTM_753_WEB
☐ USGS_DRG24K_24BIT_WEB
☐ NAIP_2015_WEB_HTML5

Lat: 28.82312° N
Lon: 87.16421° W

10.h. Document spotlight(s) of nutrient management

Many projects and programs have been highlights during 2016. The LDEQ NPS Program (or §319 Program) in coordination with LDAF and USDA NRCS published three success stories in 2016 for Lake St. Joseph, Bayou Mallet, and Big Creek. These §319 Program success stories focused on water quality improvements in previously impaired watersheds in Louisiana, where agency collaboration on planning and development and implementation of BMPs resulted in the watersheds being removed from the §303(d) list of impaired waters.

Lake St. Joseph is located in the Ouachita River Basin in Tensas Parish. The lake lies within an agricultural row crop area. Cotton, corn, wheat and soybeans are typically grown in close proximity to the lake. Production of these types of crops disturbs topsoil, transporting sediments via runoff during rainfall events into the lake. Runoff from agricultural fields in the Lake St. Joseph watershed caused a high sediment influx into the lake, resulting in the lake not meeting its designated use for fish and wildlife propagation (FWP). As a result, the LDEQ added Lake St. Joseph to the state's 2002 CWA §303(d) list of impaired waters for turbidity. LDEQ and LDAF began an initiative in 2006 assisting landowners in implementing best management practices (BMPs) to decrease sediment runoff primarily from corn, soybean and cotton fields. Water quality sampling verifies that the lake now meets the standard for turbidity; therefore, this parameter has been removed from the state's 2016 list of impaired waters (USEPA 2016a).

Another §319 Program success story occurred in Bayou Mallet located in the Mermentau River Basin in Acadia, Evangeline, and St. Landry parishes in Louisiana. Pollution from agricultural runoff entering Louisiana's Bayou Mallet caused dissolved oxygen levels to fall below water quality standards, which impaired the bayou's fish and wildlife propagation (FWP) designated use. As a result, Bayou Mallet was listed on the 2002 modified court-ordered CWA §303(d) list

of impaired waters. Since 2005, local landowners have implemented agricultural best management practices (BMPs) within the watershed to reduce runoff of sediment and fertilizer. Dissolved oxygen levels have improved, prompting the LDEQ to remove the dissolved oxygen impairment from the CWA §303(d) list in 2010. Dissolved oxygen levels continue to trend upward (USEPA 2016b).

Big Creek is located in the Pontchartrain basin in northern Tangipahoa parish and is a tributary to the Tangipahoa River which flows into Lake Pontchartrain. Polluted runoff from pasture grazing and dairy farms entering Louisiana's Big Creek caused fecal coliform bacteria counts to exceed state water quality standards for the creek's primary contact recreation (PCR) and secondary contact recreation (SCR) designated uses. As a result, the LDEQ listed Big Creek on the 2002 CWA §303(d) list of impaired waters. Since 2008, cattle and dairy farmers have implemented best management practices (BMPs) within the watershed to decrease polluted runoff. As a result, fecal coliform bacteria counts have been reduced and now attain water quality standards, prompting LDEQ to remove the PCR and SCR impairments of Big Creek from its 2016 CWA §303(d) list (USEPA 2016c).

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APPENDIX A: STRATEGIC ACTIONS SCHEDULE (MAY 2014)

Strategic Action 8. Targets and goals for Strategic Actions 1 to 7, 9 and 10 from 2012 through 2018 for the Louisiana Nutrient Management Strategy ("strategy").

X = Completed activity; O = Ongoing activity; T = Target date for completion of activity; -- = Activity not initiated during that period.

Activities may be dependent on resource availability.

Strategic Action	Agency Commitment(s)	2012	2013	2014	2015	2016	2017	2018
1. Stakeholder Engagement								
1.a. Identify stakeholders with interest in the strategy	Interagency Team	X	--	--	--	--	--	--
1.b. Engage stakeholders in strategy development	Interagency Team	X	X	--	--	--	--	--
1.c. Perform outreach/education on strategy activities	Interagency Team	--	--	X	X	X	O	O
1.d. Identify and promote partnerships/leveraging opportunities	Interagency Team Stakeholders	--	--	X	X	X	O	O
2. Decision Support Tools								
2.a. Identify available tools	Interagency Team	X	X	X	X	X	O	O
2.b. Evaluate available tools	Interagency Team	X	X	X	X	X	O	O
2.c. Select available tools	Interagency Team	X	X	X	X	X	O	O
2.d. Document selected tools	Interagency Team	--	X	X	X	X	O	O
3. Regulations, Programs, & Policies								
3.a. Identify current	Interagency Team	X	T	--	--	--	--	--
3.b. Identify gaps	Interagency Team	X	X	X	X	X	O	O
3.c. Propose or establish new	Interagency Team	--	X	X	X	X	O	O
4. Management Practices & Restoration Activities								
4.a. Document current practices related to nutrient management	Interagency Team	X	X	X	X	X	O	O

Strategic Action	Agency Commitment(s)	2012	2013	2014	2015	2016	2017	2018
4.b. Identify areas where practices are being implemented	Interagency Team	X	X	X	X	X	O	O
4.c. Model nutrient removal estimated through riverine diversions	CPRA	X	X	X	X	X	--	--
4.d. Identify case studies/model watersheds	Interagency Team	X	X	X	X	X	O	O
4.e. Integrate science-based nutrient management approaches	Interagency Team	--	--	X	X	X	O	O
4.f. Promote BMP/CP implementation by farm in priority watersheds	USDA NRCS LDAF OSWC LSU AgCenter	--	--	X	X	X	O	O
5. Status & Trends								
5.a. Model nutrient loading estimated within Louisiana watersheds	USGS Interagency Team	X	--	X	X	X	O	T
5.b. Document in-stream nutrient water quality	LDEQ	X	X	X	X	X	O	O
5.c. Document Social Indicators of nutrient management behavior	LSU AgCenter	--	X	--	--	--	--	--
5.d. Document BMP/CP implementation in watersheds	USDA NRCS LDAF OSWC LSU AgCenter LDEQ	X	X	X	X	X	O	O
5.e. Document permitted discharger inventories	LDEQ	--	--	X	X	X	O	O
5.f. Document riverine diversions	CPRA	--	--	X	X	X	O	T
5.g. Document coastal protection and restoration activities	CPRA	--	--	X	X	X	O	T
5.h. Determine trends in nutrient water quality at long-term monitoring stations	LDEQ	--	X	X	T	--	--	--
5.i. Determine trends in Social Indicators	LSU AgCenter	--	--	--	--	X	O	T

Strategic Action	Agency Commitment(s)	2012	2013	2014	2015	2016	2017	2018
5.j. Determine trends in BMP/CP implementation	USDA NRCS LDAF OSWC LSU AgCenter LDEQ	--	--	X	X	X	O	T
5.k. Determine trends in permitted discharger inventories	LDEQ	--	--	X	X	X	O	O
5.l. Determine trends in nutrients related to riverine diversions	CPRA	--	--	X	X	X	O	T
5.m. Determine trends in coastal protection and restoration activities	CPRA	--	--	X	X	X	O	T
6. Watershed Characterization, Source Identification, & Prioritization								
6.a. Characterize watersheds by land use/cover and geographic features	LDEQ USDA	X	X	--	--	--	--	--
6.b. Characterize water bodies by type such as streams, bayous, rivers, and lakes	LDEQ	X	--	--	--	--	--	--
6.c. Characterize watersheds within the coastal zone	LDNR	X	X	X	X	X	O	O
6.d. Characterize watersheds with existing or planned riverine diversions	CPRA	--	X	X	X	X	O	O
6.e. Identify potential sources through Desktop Analysis/Windshield Survey	Interagency Team	--	--	X	X	X	O	O
6.f. Identify unpermitted point sources	LDEQ	X	X	X	X	X	O	O
6.g. Identify priority watersheds from leveraging programs	USDA GoMI USDA MRBI USDA NWQI LDAF/LDEQ/LDNR NPS	X	X	X	X	X	O	O
6.h. Determine priority watershed basins	Interagency Team	--	X	T	--	--	--	--

Strategic Action	Agency Commitment(s)	2012	2013	2014	2015	2016	2017	2018
6.i. Develop priority watershed scheme for basin subwatersheds	Interagency Team	--	--	T	--	--	--	--
6.j. Determine priority subwatersheds	Interagency Team	--	--	X	T	--	--	--
6.k. Develop/leverage Watershed Nutrient Management Projects for priorities	Interagency Team Stakeholders	--	--	--	X	X	O	O
7. Incentives, Funding, & Economic Impact Analysis								
7.a. Promote voluntary participation in incentive-based programs	Louisiana Master Farmer Louisiana Master Poultry Producer Louisiana (Kellogg) Master Rice Grower Louisiana Master Cattlemen Louisiana Master Gardener Louisiana Master Naturalist Louisiana Environmental Leadership	--	X	X	X	X	O	O
7.b. Identify and communicate available funding support	Interagency Team Stakeholders	--	--	X	X	X	O	O
7.c. Promote assistance (financial or technical) for BMP/CP implementation	LDAF/LDEQ/LDNR NPS USDA NRCS LDAF OSWC	X	X	X	X	X	O	O
7.d. Promote assistance (technical) for point sources	SB/SCAP	X	X	X	X	X	O	O
7.e. Document economic impacts from available sources	Interagency Team LSU AgCenter Stakeholders	--	X	X	X	X	O	O
7.f. Explore feasibility for credit trading	Interagency Team Stakeholders	--	--	X	X	X	O	T
7.g. Identify gaps	Interagency Team Stakeholders	--	--	X	X	X	O	O

Strategic Action	Agency Commitment(s)	2012	2013	2014	2015	2016	2017	2018
9. Monitoring								
9.a. Monitor in-stream nutrient water quality	LDEQ	X	X	X	X	X	O	O
9.b. Monitor relative to BMP/CP implementation	USDA GoMI USDA MRBI USDA NWQI LDAF/LDEQ/LDNR NPS	--	--	X	X	X	O	O
9.c. Monitor nutrients associated with riverine diversions	CPRA	--	--	--	X	X	O	O
9.d. Monitor nutrients in point sources	LDEQ LPDES Permitted Dischargers	X	X	X	X	X	O	O
9.e. Evaluate compliance with point source permits	LDEQ	X	X	X	X	X	O	O
9.f. Identify gaps	Interagency Team Stakeholders	--	--	X	X	X	--	--
10. Reporting								
10.a. Review draft strategy December 2013	Interagency Team	--	X	--	--	--	--	--
10.b. Public comment period	Interagency Team	--	--	X	--	--	--	--
10.c. Final strategy	Interagency Team	--	--	X	--	--	--	--
10.d. Strategy review	Interagency Team	--	--	--	--	--	--	T
10.e. Report annually on strategy activities	Interagency Team	--	--	X	X	X	O	O
10.f. Present information through strategy website	Interagency Team	--	X	X	X	X	O	O
10.g. Present information geospatially through web-based viewer	Interagency Team	--	X	X	X	X	O	O
10.h. Document spotlight(s) of nutrient management	Interagency Team Stakeholders	--	--	X	X	X	O	O

X = Completed activity; O = Ongoing activity; T = Target date for completion of activity; -- = Activity not initiated during that period.
Activities may be dependent on resource availability.

APPENDIX B: PRIORITY WATERSHEDS OF LEVERAGING PROGRAMS

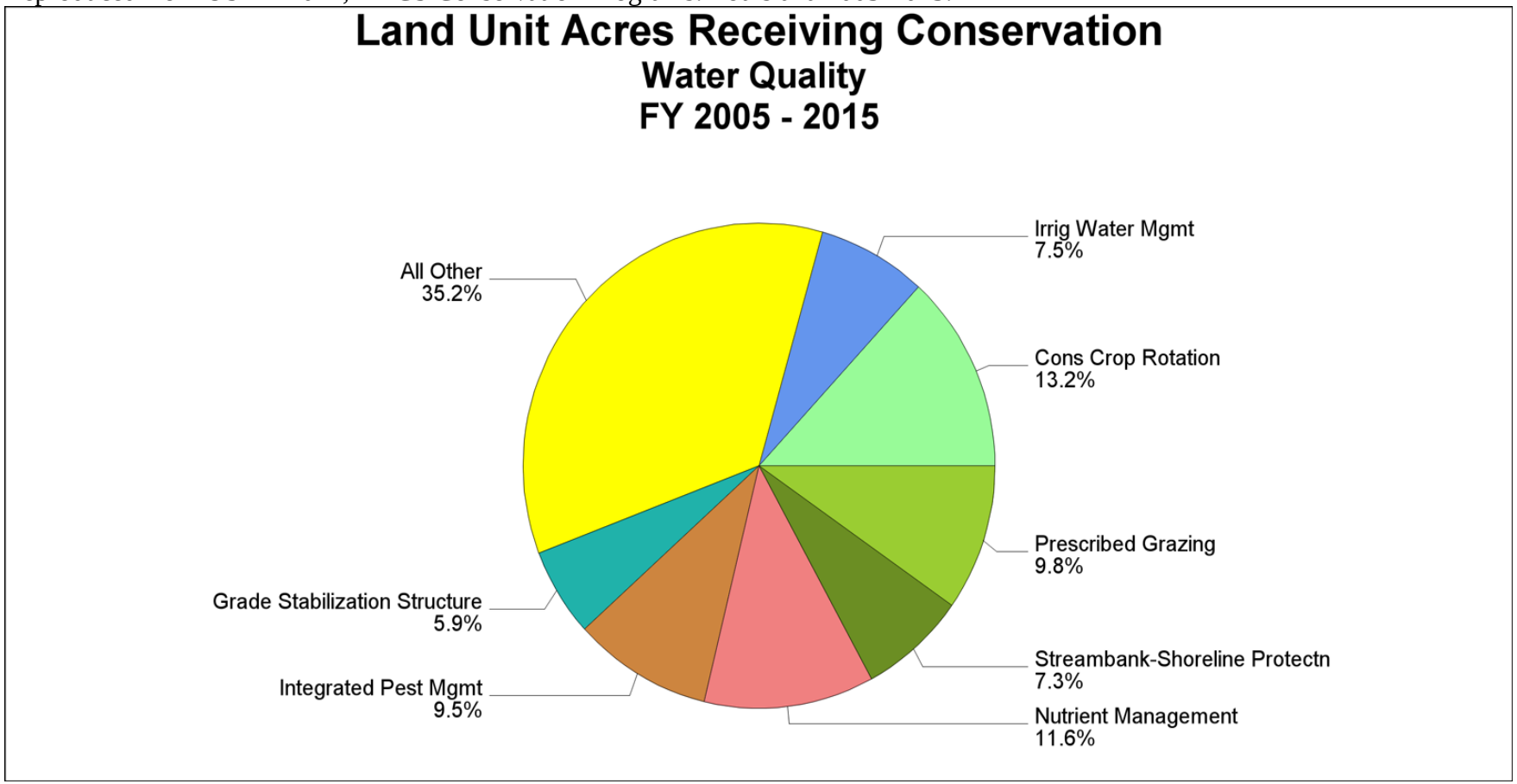
Priority watersheds in Louisiana through USDA initiatives including Gulf of Mexico Initiative (GoMI), Mississippi River Basin Initiative (MRBI), and the National Water Quality Initiative (NWQI), and through the LDEQ Nonpoint Source (NPS) Program and the New Vision §303(d) Program. * indicates priority water body in more than one program.

Program	Watershed Name	Watershed Level	Watershed Code
USDA-GoMI	Bayou Corne-Grand Bayou	HUC 12	080903020302
USDA-GoMI	Bayou Grand Marais	HUC 12	080802020103
USDA-GoMI	Bayou St. Vincent-Little Grand Bayou	HUC 12	080903020304
USDA-MRBI	Bayou Macon	HUC 8	08050002
USDA-MRBI	Boeuf River	HUC 8	08050002
USDA-MRBI	Lower Mississippi-Baton Rouge	HUC 8	08070100
USDA-MRBI	Lower Mississippi-Greenville	HUC 8	08030100
USDA-MRBI	Lower Mississippi-Natchez	HUC 8	08060100
USDA-MRBI	Mermentau	HUC 8	08080202
USDA-MRBI	Lake St. Joseph-Clark Bayou	HUC 12	080500030406
USDA-MRBI	Cane Bayou-Little Creek	HUC 12	080500011010
USDA-MRBI	Alligator Bayou	HUC 12	080500020503
USDA-MRBI	Little Creek	HUC 12	080500011001
USDA-MRBI	Lake Providence-Tensas Bayou	HUC 12	080500030101
USDA-MRBI	Lake Bruin and Van Buren Bayou	HUC 12	080500030503 and 080500030501
USDA-MRBI	Little Tensas Bayou-Bull Bayou	HUC 12	080500030105
USDA-MRBI	Upper Deer Creek	HUC 12	080500011601
USDA-NWQI	Big Creek	HUC 12	080702050203
USDA-NWQI	East Fork Big Creek	HUC 12	080702050202
USDA-NWQI	Indian Bayou-Bayou Queue De Tortue	HUC 12	080802020101
USDA-NWQI	Lake Louis-Bayou Louis	HUC 12	080402070303
LDEQ New Vision §303d	Tunica Bayou	Subsegment	070505
LDEQ New Vision §303d	Bayou Sara	Subsegment	070501
LDEQ New Vision §303d	Turkey Creek*	Subsegment	080905
LDEQ New Vision §303d	Yellow Water River*	Subsegment	040504
LDEQ New Vision §303d	Natalbany River*	Subsegment	040503
LDEQ New Vision §303d	Blind River	Subsegment	040403/040401
LDEQ New Vision §303d	New River	Subsegment	040404
LDEQ NPS	Comite River	Subsegment	040101
LDEQ NPS	Blind River*	Subsegment	040401/040103
LDEQ NPS	New River*	Subsegment	040404
LDEQ NPS	Natalbany River*	Subsegment	040503
LDEQ NPS	Yellow Water*	Subsegment	040504
LDEQ NPS	Bayou Des Cannes	Subsegment	050101
LDEQ NPS	Bayou Mallet	Subsegment	050103
LDEQ NPS	Bayou Queue de Tortue	Subsegment	050501
LDEQ NPS	Lake Fausse Point and Dauterive Lake	Subsegment	060702
LDEQ NPS	Bayou Du Portage	Subsegment	060703
LDEQ NPS	Vermilion River	Subsegment	060801/060802

Program	Watershed Name	Watershed Level	Watershed Code
LDEQ NPS	Bayou Sara	Subsegment	070501
LDEQ NPS	Tunica Bayou	Subsegment	070505
LDEQ NPS	Big Creek (North)	Subsegment	080903
LDEQ NPS	Turkey Creek*	Subsegment	080905
LDEQ NPS	Lake Providence	Subsegment	081101
LDEQ NPS	Lake St. Joseph	Subsegment	081202
LDEQ NPS	Lake Bruin	Subsegment	081203
LDEQ NPS	Hemphill Creek	Subsegment	081609
LDEQ NPS	Bayou Maringouin	Subsegment	120111
LDEQ NPS	Bayou Folse	Subsegment	120302

APPENDIX C: USDA NRCS LAND UNIT ACRES RECEIVING CONSERVATION FOR PRACTICES RELATED TO WATER QUALITY IN LOUISIANA, 2005-2015

Reproduced from USDA 2017, NRCS Conservation Programs: Louisiana 2005-2015.



As reproduced from USDA 2017, the following chart and table includes practices that are related to Water Quality. Water quality is an indicator of the health of our environment and reflects what occurs on the land. The primary water quality issues from agriculture are sediment, nutrients, pesticides, pathogens, and in some parts of the country, salinity. Using conservation practices to improve land in an environmentally sound manner will result in better water quality for drinking, recreation, wildlife, fisheries and industry. Only practices representing a significant portion of the total for the period are included. Practices not included are summed into the All Other category.

USDA NRCS Land Unit Acres Receiving Conservation (including practice count) by Fiscal Year, Water Quality Practices in Louisiana (USDA 2017).

Practice Name	Practice Code	2005 Acres	2005 Count	2006 Acres	2006 Count	2007 Acres	2007 Count	2008 Acres	2008 Count	2009 Acres	2009 Count	2010 Acres	2010 Count	2011 Acres	2011 Count	2012 Acres	2012 Count	2013 Acres	2013 Count	2014 Acres	2014 Count	2015 Acres	2015 Count
Access Control	**472**	16,351	652	33,422	1,528	17,781	850	38,733	1,546	8,872	381	14,025	672	24,110	911	31,031	726	31,003	947	7,649	214	25,357	644
Access Road	**560**	1,761	20	2,360	60	324	9	190	4	1,099	14	405	11	173	3	3,505	22	1,492	21	2	1		
Animal Mortality Facility	**316**											36	1			13	1	7	1	18	2	54	2
Composting Facility	**317**	102	40	247	30	225	31	202	11	44	4	60	4	44	4	60	4	53	6	13	2		
Conservation Cover	**327**	7,832	378	38,007	1,775	21,508	1,183	18,790	928	12,497	567	13,065	557	23,685	1,186	19,678	893	12,318	568	3,962	110	13,006	605
Conservation Crop Rotation	**328**	32,421	756	29,450	772	47,127	1,149	45,063	1,769	64,401	3,797	65,983	3,542	92,471	2,826	76,123	2,316	113,194	2,950	108,921	2,896	75,246	2,552
Contour Farming	**330**					71	2					239	11					126	10				
Cover Crop	**340**	3,341	85	2,358	44	6,718	145	5,814	169	2,357	42	1,119	12	3,796	62	1,750	44	4,952	77	3,965	89	7,527	112
Critical Area Planting	**342**	4,185	171	9,628	397	9,794	227	9,589	180	12,712	190	9,055	221	5,914	168	5,787	134	8,104	173	4,584	126	5,458	127
Diversion	**362**			31	1			200	5	103	3	49	1			78	2	44	2	54	2	407	7
Filter Strip	**393**	261	7	1,411	29	603	18	192	5	519	11	181	8	201	2			421	12	78	1		
Grade Stabilization Structure	**410**	18,778	409	26,322	497	34,703	681	44,783	728	43,265	838	24,536	588	35,702	633	31,743	599	27,281	733	24,452	427	24,686	757

Practice Name	Practice Code	2005 Acres	2005 Count	2006 Acres	2006 Count	2007 Acres	2007 Count	2008 Acres	2008 Count	2009 Acres	2009 Count	2010 Acres	2010 Count	2011 Acres	2011 Count	2012 Acres	2012 Count	2013 Acres	2013 Count	2014 Acres	2014 Count	2015 Acres	2015 Count
Grassed Waterway	**412**	420	11	966	46	1,603	19	1,698	34	1,413	18	283	6	34	1	96	2	140	3	22	1		
Heavy Use Area Protection	**561**	3,676	151	4,721	254	6,788	322	12,251	465	11,506	418	16,854	646	17,952	684	14,129	675	12,939	496	10,264	575	22,941	678
Integrated Pest Management (IPM)	**595**	45,439	1,265	40,065	1,454	44,792	1,224	38,174	1,310	30,896	886	40,029	1,361	39,836	794	67,783	2,399	90,826	5,299	68,273	6,316	34,984	1,693
Irrigation System, Microirrigation	**441**					436	9			94	1	21	2	13	3	3,523	7	18	7	142	11	81	5
Irrigation System, Tailwater Recovery	**447**			206	3			562	1	243	2							74	1				
Irrigation Water Management	**449**	17,118	507	18,906	490	24,774	622	30,224	721	32,892	724	35,200	730	23,818	337	96,280	1,528	75,582	1,528	41,692	1,059	29,837	801
Mulching	**484**	1,540	81	5,325	292	2,977	101	2,690	40	2,375	53	2,020	53	2,329	49	3,202	70	2,871	65	2,485	67	3,568	86
Nutrient Management	**590**	50,746	1,668	47,536	1,891	42,651	1,660	62,272	1,936	76,000	1,943	63,764	2,076	59,130	1,449	87,433	2,107	69,365	1,704	52,161	1,756	51,738	1,527
Prescribed Grazing	**528**	30,650	1,093	72,626	2,809	56,313	2,374	58,218	1,994	46,226	2,016	55,635	2,212	58,715	2,117	51,793	2,052	62,807	2,265	39,536	1,265	23,204	772
Residue Management, No-Till/Strip Till	**329**	3,879	84	11,233	189	8,400	178	6,018	137	4,808	85	3,222	123	4,602	69	1,456	34	3,519	78	1,608	38	3,422	85
Residue and Tillage Management, Mulch Till	**345**	550	9	2,588	38	624	10	1,475	42	3,908	85	394	17	886	23	4,013	97	1,897	53	1,270	29	10,686	649

Practice Name	Practice Code	2005 Acres	2005 Count	2006 Acres	2006 Count	2007 Acres	2007 Count	2008 Acres	2008 Count	2009 Acres	2009 Count	2010 Acres	2010 Count	2011 Acres	2011 Count	2012 Acres	2012 Count	2013 Acres	2013 Count	2014 Acres	2014 Count	2015 Acres	2015 Count
Residue and Tillage Management, Ridge Till	**346**	4,742	154	4,759	148	7,871	190	5,918	132	6,365	209	3,830	72	11,125	248	3,951	144	5,482	182	4,526	280	1,186	53
Riparian Forest Buffer	**391**	4,313	236	2,104	128	2,440	115	2,094	59	812	21	1,159	62	3,301	60	2,340	48	1,480	66	577	17	452	19
Riparian Herbaceous Cover	**390**													6	1			118	3				
Roof Runoff Structure	**558**													88	1								
Stream Crossing	**578**			370	2	37	3	183	1	20	2	18	1	56	2	10	1	83	5	109	2	12	1
Streambank and Shoreline Protection	**580**	29,573	13	307,249	8	3,490	10	3,729	5	8,357	7	8,345	1	41,247	7	9,434	9	214	1	4,428	1	1,870	1
Structure for Water Control	**587**	26,155	61	5,138	147	4,088	79	1,327	43	2,613	50	9,708	37	2,455	63	1,453	40	1,649	43	1,199	35	2,137	53
Tree/Shrub Establishment	**612**	30,862	799	136,170	1,630	39,523	1,190	13,199	454	10,422	298	17,128	638	16,467	522	13,106	410	16,227	680	9,499	184	13,645	234
Waste Facility Closure	**360**			14	1	42	3			2	1	66	8					29	2			3	1
Waste Recycling	**633**	2,413	142	6,997	387	4,919	235	4,818	222	3,903	181	5,719	248	5,537	228	6,033	196	7,002	291	3,633	168	761	34
Waste Storage Facility	**313**	125	54	244	38	237	27	191	13	110	7	23	2	212	5	18	2	104	10	7	1	63	4
Waste Transfer	**634**					55	3	39	6	25	2	0	1	160	9	19	1	59	5	1,871	57	490	29

Practice Name	Practice Code	2005 Acres	2005 Count	2006 Acres	2006 Count	2007 Acres	2007 Count	2008 Acres	2008 Count	2009 Acres	2009 Count	2010 Acres	2010 Count	2011 Acres	2011 Count	2012 Acres	2012 Count	2013 Acres	2013 Count	2014 Acres	2014 Count	2015 Acres	2015 Count
Waste Treatment Lagoon	**359**					4	1	2	1	3	1	44	5	17	2	13	2	112	7	23	3	39	5
Water Well Decommissioning	**351**	456	7	380	17	55	13	1,480	36	3,788	73	2,965	57	1,863	33	1,291	30	563	15	4,824	16	569	13
Wetland Creation	**658**	6	1	781	40	2,019	17	2,166	16	148	3	1,955	10	362	10	1	1	28	1				
Wetland Enhancement	**659**	36,369	23	12,545	32	21,390	10	23,848	3	28,113	22	28,288	6	112,505	38	30,826	375	11,939	61	1,042	7	3,710	3
Wetland Restoration	**657**	28,863	582	24,374	662	25,657	445	14,796	348	56,866	160	45,508	403	53,793	422	37,910	301	18,484	257	8,222	106	4,585	132

Notes: Data Source: USDA-NRCS, National Conservation Planning Database, November 2015. Land unit acres may be counted multiple times across practices and fiscal years.

As reproduced from USDA 2017, the following table includes program information under which the above practices related to Water Quality were applied. These data reflect the geographic extent of land treated with water quality practices by each conservation program during a fiscal year. Land unit acres may be counted multiple times across programs and fiscal years, but are only counted once per program per fiscal year.

Land Unit Acres Receiving Conservation (including practice count) by Program and Fiscal Year
Water Quality Practices

Program	2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count
Conservation Reserve Program (CRP)	11,460	1,396	37,548	4,583	27,900	2,977	31,580	2,715	11,587	927	15,345	1,432	22,022	2,001	11,921	1,130	6,548	902	2,158	108	4,041	331
Conservation Technical Assistance (CTA)	65,565	1,337	138,812	5,048	116,738	4,180	151,977	5,997	202,074	7,135	202,467	8,280	292,345	6,546	266,398	9,515	284,590	13,541	210,533	12,856	134,454	7,861
Environmental Quality Incentives Program (EQIP)	86,504	4,959	94,702	4,666	123,543	5,079	109,020	4,251	135,724	4,703	108,536	4,241	103,113	3,945	92,768	3,488	98,226	3,431	74,683	2,591	79,786	3,147
Grassland Reserve Program (GRP)	4,550	174	1,267	79	459	74					1,129	135	580	44			573	24	69	7	149	14
Watershed Protection and Flood Prevention Program (WFPO)	622	52	251	9	179	6	479	16	533	16	440	13	956	35					40	2		
Wetlands Reserve Program (WRP)	19,540	1,380	16,541	1,344	18,947	689	10,415	277	7,593	156	4,257	172	7,670	264	29,926	924	13,177	644	5,444	267	4,046	325
Wildlife Habitat Incentive Program (WHIP)	1,165	148	1,536	110	3,092	130	3,837	104	3,293	178	3,370	129	3,346	131	7,078	215	3,441	86	1,379	33	128	5
Other	461	13			6	20	185	4			91	3	56	6							92	1

Notes: Data Source: USDA-NRCS, National Conservation Planning Database, November 2015. Land unit acres may be counted multiple times across programs and fiscal years, but are only counted once per program per fiscal year.

As reproduced from USDA 2017, the following table includes unique land unit acres for practices related to Water Quality. Land unit acres may be counted multiple times across fiscal years, but are only counted once per fiscal year.

Land Unit Acres Receiving Conservation (including practice count) by Fiscal Year
Water Quality Practices - Land Unit Acres treated by at least one practice

2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015	
Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count	Acres	Count
179,375	9,459	279,429	15,839	272,093	13,155	293,345	13,364	346,422	13,115	316,828	14,405	414,898	12,972	393,049	15,272	382,745	18,628	289,096	15,864	215,447	11,684

Notes: Data Source: USDA-NRCS, National Conservation Planning Database, November 2015. Land unit acres may be counted multiple times across fiscal years.

APPENDIX D: LDEQ AND LDAF NONPOINT SOURCE IMPLEMENTATION IN 2016

Water Body Name	Number of Stations Monitored	Number of Conservation Plans being Implemented	Impairment	Parameters sampled
Big Creek (North)	30	10	Turbidity	Turbidity and *in-situ*
Big Creek (South)	16	25	Fecal Coliform	Fecal Coliform and *in-situ*
Bayou Louis/Lake Louis	29	6	Fecal Coliform and Turbidity	Fecal Coliform, Turbidity and *in-situ*
Bayou Lafourche	12	62	Dissolved Oxygen and Turbidity	Dissolved Oxygen, Turbidity and *in-situ*
Natalbany River	6	2	Fecal Coliform	Fecal Coliform and *in-situ*
Bayou Queue de Tortue	22	38	Nitrate/Nitrite, Dissolved Oxygen, Phosphate and Turbidity	pH, Temperature, Secchi, Specific Conductivity, Salinity, Dissolved Oxygen, Dissolved Oxygen Percent Saturation, Turbidity, Total Kjeldahl Nitrogen, Nitrate/Nitrite Nitrogen, and Total Phosphorus
Hemphill Creek	11	NA	Fecal Coliform	Fecal Coliform and *in-situ*
Vermilion River	7	NA	Nitrate/Nitrite, Dissolved Oxygen, and Fecal Coliform	Fecal Coliform and *in-situ*
Boston Canal	14	9	Turbidity	Ammonia-Nitrogen, Nitrate/Nitrite Nitrogen, Phosphate, Total Dissolved Solids, Turbidity, and *in-situ*
Comite River	17	2[a]	Fecal Coliform	Fecal Coliform and *in-situ*
Bayou Folse	12	NA	Nitrate/Nitrite (Nitrite + Nitrate as N), Dissolved Oxygen, Total Phosphorus, Fecal Coliform	Fecal Coliform, Total Phosphorus, Ammonia-Nitrogen, Nitrate/Nitrite Nitrogen, and *in-situ*

Water Body Name	Number of Stations Monitored	Number of Conservation Plans being Implemented	Impairment	Parameters sampled
Bayou Chene	9	14	Fipronil, Mercury in Fish Tissue, Dissolved Oxygen, Sulfates, Fecal Coliform	Nitrate/Nitrite Nitrogen, Ammonia-Nitrogen, Phosphate, Total Solids, Total Suspended Solids, Total Dissolved Solids, 5-day Biological Oxygen Demand, Turbidity, Sulfate, Chloride, Phosphate, Fluoride, and *in-situ*
Bayou Sara	8[c]	3[b]	Fecal Coliform	Fecal Coliform, *in-situ*
Lake Fausse Pointe	17	NA	Dissolved Oxygen and Turbidity	Turbidity, Total Kjeldahl Nitrogen, Total Phosphorus, Nitrite as Nitrogen, Nitrate Nitrogen NO3N, and *in-situ*
Bayou des Cannes	7	22	Mercury in Fish Tissue, Nitrate/Nitrite (Nitrite + Nitrate as N), Oxygen, Dissolved, Total Phosphorus, Total Dissolved Solids, Turbidity	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Solids, Turbidity, *in-situ*
Bayou Mallet	4	15	Turbidity	
Lake St. Joseph	10	8	Turbidity	Total Dissolved Solids, Total Suspended Solids, Total Solids, Turbidity, Total Kjeldahl Nitrogen, Ammonia-Nitrogen, Nitrate/Nitrite Nitrogen, Chloride, Sulfate, Fluoride, Bromide, Phosphate, Total Phosphorus, 5-day Biological Oxygen Demand, and *in-situ*

[a] Education and outreach/inspections
[b] Education and outreach/inspections/assessing point source discharges
[c] To begin once sampling plan approved by USEPA
NA Not Available