LOUISIANA NUTRIENT MANAGEMENT STRATEGY

PROTECTION, IMPROVEMENT, AND RESTORATION OF WATER QUALITY IN LOUISIANA'S WATER BODIES

May 2014

Developed through the joint efforts of the Coastal Protection and Restoration Authority of Louisiana, Louisiana Department of Agriculture and Forestry, Louisiana Department of Environmental Quality and Louisiana Department of Natural Resources

EXECUTIVE SUMMARY

Background

Excess nutrients such as nitrogen and phosphorus are a nationwide concern for water quality. Nutrient water quality concerns for Louisiana originate locally and from upriver as the state is partially located within the large watershed of the Mississippi-Atchafalaya River Basin (MARB) which drains 41% of the contiguous United States and parts of two Canadian Provinces to the Gulf of Mexico (GOM). Thus, nutrient solutions to address water quality within the state of Louisiana will be needed from upriver states as well as locally.

State of Louisiana

At the state level, Louisiana state agencies of the Coastal Protection and Restoration Authority of Louisiana (CPRA), Louisiana Department of Agriculture and Forestry (LDAF), Louisiana Department of Environmental Quality (LDEQ), and Louisiana Department of Natural Resources (LDNR) have developed this Louisiana Nutrient Management Strategy for the purpose of managing nitrogen and phosphorus to protect, improve, and restore water quality in Louisiana's inland and coastal waters. Other state and federal agencies as well as stakeholders from the watershed community will also play a major role in implementing this strategy. The state of Louisiana must comprehensively evaluate the nutrient management activities that are already occurring within the state to leverage the best use of existing resources and future planned activities regarding nutrients and water quality in Louisiana.

Framework

A ten component framework for outlining and accomplishing action items is utilized in this strategy for nutrient management. These ten components are: 1) Stakeholder Engagement; 2) Decision Support Tools; 3) Regulations, Policies, and Programs; 4) Management Practices and Restoration Activities; 5) Status and Trends; 6) Watershed Characterization, Source Identification, and Prioritization; 7) Incentives, Funding, and Economic Impact Analyses; 8) Targets and Goals, 9) Monitoring, and 10) Reporting. This framework allows for multiple components to be implemented simultaneously and incorporates adaptive management practices as inherent in the process. The strategic action items schedule (Appendix A) outlines a timeframe from 2012 to 2018 for this strategy, after which an assessment of progress to date will be made to allow for newer information to be incorporated into strategic planning and nutrient management activities beyond 2018.

Implementation

Implementation of the Louisiana Nutrient Management Strategy will focus on key areas that include: 1) river diversions, 2) nonpoint source management, 3) point source management, 4) incentives, 5) leveraging opportunities, and 6) new science-based technologies/applications. These focus areas are specific to the state of Louisiana and the implementation measures that the state may employ for water quality improvements.

River Diversions

River diversions constructed for the purposes of rebuilding and sustaining Louisiana's coastal wetlands have the value-added benefit of assimilating and removing nutrients that have already entered the river system either from within Louisiana or from upbasin states. CPRA models predict potential nitrogen and phosphorus assimilation capacity of existing diversions (Davis Pond, Caernarvon, Naomi, and West Pointe a la Hache) of total annual removals of 4,381 tons of total nitrogen (TN) and 129 tons of total phosphorus (TP). Models also predict future planned diversions (West Maurepas and the Mid-Barataria) with potential annual removals of 10,187 tons of TN and 124 tons of TP. As long-term future plans (5-50 years) for CPRA's 2012 Coastal Master Plan include the implementation of eight (8) additional river diversion projects, annual removal of an additional 53,749 tons of TN and 1,088 tons of TP from the Mississippi and Atchafalaya Rivers is predicted.

Thus implementation of all planned diversions constructed and fully operational as outlined in the 2012 Coastal Master Plan, Louisiana has the potential in an average river-year to remove over 68,000 tons of TN and over 1,300 tons of TP, which in turn prevents these nutrient loads from reaching the GOM. Extrapolating based on USGS watershed modeling estimates of the MARB, TN and TP contributions from Louisiana (estimated at only 1.7% of TN and 2.4% of the TP reaching the GOM) suggests that river diversions could remove 256% of Louisiana's modeled TN input (which is more than double the estimated contribution from Louisiana) and 41% of Louisiana's modeled TP input (which is nearly half the estimated contribution) from MARB to GOM. These extrapolations suggest that river diversions in Louisiana could remove more nitrogen than it contributes and a significant portion of phosphorus, thereby mitigating some of the nutrient loads from upbasin states.

Nonpoint Source Management

Nonpoint source management in Louisiana will focus on best management practices (BMPs) and conservation practices (CPs) to address runoff water quality in agriculture, forest, and urban settings; those for individual home sewage systems; and through floodplain reconnection. LDAF, LDEQ, and LDNR all work in collaboration with watershed partners through the Nonpoint Source Pollution Prevention Program through the Clean Water Act (CWA) Section 319 program to address nonpoint sources in select watersheds throughout the state, and develop and implement plans specifying appropriate BMPs and CPs. Several manuals on guidance for BMPs have been developed by LDAF, LDEQ, LDNR and the Louisiana State University Agricultural Center (LSU AgCenter) that are specific to commodities within the state, such as rice, poultry, dairy, sugar cane, and swine and for addressing nonpoint source from urban storm water runoff and individual home sewage systems.

Conservation practices (CPs) recommended by the U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS) in Louisiana are the backbone for nonpoint source management efforts on the field. These conservation practices are designed to be effective as a systems approach to avoid, control, or trap runoff before it leaves the field. Over 90 conservation practices have been utilized in Louisiana in an effort to improve water quality

(Appendices B and C). Implementation of these conservation practices are largely focused in agricultural and forestry areas in Louisiana. Forestry practices within Louisiana boast a 96% compliance rate in BMP implementation by Louisiana foresters.

Reviews of BMP efficiency indicate their effectiveness in nutrient removal and in limiting water quality degradation. A recent review for the Lower Mississippi Alluvial Valley agriculture found that many BMPs result in fewer nutrients leaving a field, with efficiencies ranging 15 to 100% nutrient removal, and that consideration of environmental factors such as rainfall should be evaluated when demonstrating BMP effectiveness. Further, studies on the effectiveness of forestry BMPs also indicate they are effective in limiting water quality degradation in Louisiana.

Hydrologically modified water bodies, such as the Mississippi River in Louisiana, are disconnected by levees from their historical floodplain. The natural process of overbank flooding which allowed nutrients and sediment to be removed from the water body channel was discontinued. Reconnecting a river to its floodplain will allow for the natural process of nutrient removal to occur, thereby enhancing water quality. Floodplain reconnection projects within Louisiana such as Mollicy Farms on the Ouachita River in northeast Louisiana are one such effort to reestablish this connection. Small scale flood plain reconnection projects in non-coastal floodplains such as Mollicy Farms and the larger river diversion projects proposed in coastal Louisiana discussed later in this document play an important role in nutrient removal and improved water quality.

Point Source Management

Louisiana's Water Quality Regulations (LAC 33:Chapter IX) require permits for the discharge of pollutants from any point source into waters of the state of Louisiana. The Louisiana Pollutant Discharge Elimination System (LPDES) Permit Program is regulated by the LDEQ. There are over 14,000 permitted dischargers within the state. More specific to nutrients entering surface waters of the state, LDEQ discharge water permits address sanitary wastewater; storm water through industrial, construction, or Municipal Separate Storm Sewer Systems (MS4) permits; Concentrated Animal Feeding Operation (CAFO) permits; wetland assimilation; and biosolids management. These activities are regulated through LDEQ and permitted through the LPDES and state permitting programs.

Specifically, permitted point source wetland assimilation projects in Louisiana provide an opportunity for wetland restoration and nutrient removal. In Louisiana, wetlands have been experiencing degradation due to reduced supplies of fresh water which introduce nutrients and sediments needed for plant growth. Through point source wetland assimilation projects, wetlands receive nutrient rich treated effluent that not only act to bring water to a wetland area that needs it but also introduces nutrients into the wetlands. As wetland plants uptake nutrients, wetland health is promoted and nutrients are also removed from the water, thus decreasing the amount of nutrients that would have been discharged into a water body. There are currently ten point source wetland assimilation projects permitted in Louisiana and more are proposed. Recent nutrient removal efficiencies in these wetlands average 53% for nitrate-

nitrite nitrogen, 68% for total Kjeldahl nitrogen, and 65% for TP on average over a five year period; nutrient removal efficiencies may range up to 100% for nitrogen and phosphorus compounds in some years.

Incentives

Incentive-based programs within the state of Louisiana offer stakeholders the opportunity to participate in environmental stewardship activities. Voluntary stewardship programs exist for both nonpoint and point source community groups thus offering nearly all stakeholders within a watershed community an opportunity to participate in water quality protection, improvement, and restoration.

Nonpoint source stewardship in Louisiana is largely through programs aimed at agriculture and forestry. Through the USDA NRCS Farm Bill programs, such as the Environmental Quality Incentives Program (EQIP), Conservation Reserve Program (CRP), and Conservation Reserve Enhancement Program (CREP), total funding averaged nearly $100 million annually from 2005 through 2012 for implementation of conservation practices in Louisiana. This funding has allowed for a steady annual increase in acres receiving conservation practices in Louisiana from nearly 250,000 acres in 2005 to approximately 1 million acres in 2012.

Another nonpoint source-focused voluntary program vital to Louisiana's conservation efforts is the Louisiana Master Farmer Program led by the LSU AgCenter. Over 2,500 farmers within Louisiana are enrolled in this three phase training program that features classroom and field training and development of a farm-specific management plan. Louisiana Master Farmer program participation covers 96% of the parishes in the state with the state's major agricultural and forestry areas demonstrating the most participation. The recently implemented Louisiana Master Farmer University combines the first two phases of the classroom and field training into a 2-day back-to-back event that aims to recruit additional farmers to its ranks and promote this environmental stewardship opportunity to farmers. Other tracks of the Louisiana Masters Program include the Louisiana Master Logger Program aimed at loggers and the Louisiana Master Gardner and Louisiana Master Naturalist Program aimed at citizens within Louisiana.

The Louisiana Environmental Leadership Program (ELP) provides the point source community an opportunity for voluntary stewardship. While the ELP promotes and supports stewardship for many aspects of pollution prevention and reduction, voluntary efforts related to nutrient management have received special attention in recent years. Industries such as BASF, ExxonMobil, Marathon, Mosaic, and Nalco have been recipients of ELP awards for their voluntary nutrient management and reduction efforts. Louisiana cities including Carencro, Denham Springs, and Ruston have also received leadership awards for nutrient management efforts. These Louisiana companies and cities serve as leaders in their respective groups and models for ways to achieve voluntary nutrient reductions.

Entities within the state of Louisiana rely upon economic incentives to support water quality projects. Such programs include the LDAF Agriculture Economic Development Assistance

Program, Clean Water Act Section 319 Program administered through the LDEQ Nonpoint Pollution Prevention Program, Community Development Block Grants, and others specific to the coastal areas of Louisiana through the LDNR Coastal and Estuarine Land Conservation Program (CELCP) and CPRA Coastal Forest Conservation Initiative (CFCI) that provide financial support for conservation that may result in water quality improvement. Additionally, the Clean Water State Revolving Fund Program (CWSRF) supports municipalities in achieving water quality improvement.

The state of Louisiana is interested in exploring other incentive avenues such as through water quality credit trading and through business forces. Trading is a market-based tool that connects different sources of pollutants to achieve a cost-effective solution to water quality improvement. While a trading program is currently not operated in Louisiana, the potential exists for such a market. Business forces are also becoming an incentive driver through committing to do business with other businesses in the supply chain that employ sustainable practices. In Louisiana, Kellogg Co. is a leader in this relatively new approach by committing to buy rice produced through sustainable business practices from Louisiana farmers.

Leveraging Opportunities

It is widely acknowledged that leveraging resources and creating opportunities for collaboration will be essential to this strategy. Many stakeholders with vested interest in a watershed community are actively developing or implementing projects to protect, improve, or restore the water quality in their watersheds. The ability to leverage with these groups in ongoing projects and to engage them for creating partnerships on new projects is a factor that will result in improved water quality within the state of Louisiana. Over 30 leveraging opportunities have been identified to date and many more are anticipated in the future (Appendix D).

New Science-Based Technologies/Applications

Incorporating the current state of the science and cutting edge technologies and applications will be needed for nutrient management within Louisiana. Areas of focus for Louisiana include agricultural production, wastewater treatment, in-stream assimilation and removal, and river diversion research.

Globally, the human population is currently over 7 billion and is projected to increase 32% to 9.1 billion by 2050. By 2030 as the human population tops 8.3 billion, the demand for food and energy will rise 50% and the demand for fresh water by 30%. Science-based technologies abound in agriculture as the industry seeks ways to simultaneously increase production to meet the future demands and to improve water quality.

The USDA NRCS Conservation Effects Assessment Project (CEAP) aims to quantify environmental effects of conservation practices and to develop science-based management for agriculture. The Lower Mississippi River Basin (LMRB) CEAP Project released in August 2013 estimated that implemented conservation practices resulted in an average reduction of 35% in

sediment, 21% in nitrogen, and 52% in phosphorus delivered to rivers and streams from cultivated cropland in the LMRB.

Fertilizer application is another technology that aims to optimize nutrient use while at the same time minimizing water quality impacts. The use of the 4R nutrient stewardship philosophy involving the **r**ight timing, **r**ight source, **r**ight rate, and **r**ight place of fertilizer application promotes efficiency in fertilizer use. Enhanced efficiency fertilizers can also reduce nutrient losses while increasing nutrient availability to plants. Application methods such as variable rate technology can ensure that fertilizers are applied to maximize application to areas that need them and minimize application to areas that are already nutrient rich.

Wastewater treatment technologies and advances in this science will aid in nutrient removal from some point source dischargers. These wastewater technologies can aid in reducing the amount of nutrients that enter water bodies in the state.

Once nutrients enter a water body, other technologies and applications may aid in assimilation or removal of nutrients from in-stream. Two such in-stream technologies involve flotant treatment wetlands and utilizing removable algal mats to remove nutrients.

Research involving nutrient assimilation and removal through river diversions in coastal Louisiana is a developing science. CPRA is partnering with The Water Institute of the Gulf to develop a research strategy to identify and resolve critical diversion-related uncertainties.

Nutrient Solutions

The state of Louisiana has prepared this Nutrient Management Strategy through collaboration with state and federal agencies and through engagement with stakeholders within Louisiana. It is evident that nutrient solutions for Louisiana are not a one-size-fits-all approach as implementation methods will involve coastal restoration, nonpoint source and point source management, incentives, leveraging opportunities, and science-based technologies/applications to varying degrees depending on the specific characteristics such as land use and hydrology and primary suspected nutrient sources within subwatersheds in the state. Further, nutrient solutions employed in upbasin states will be needed and are being implemented in order to address nutrients and water quality in the larger MARB.

Within Louisiana, several state and federal agencies and stakeholder groups are implementing nutrient solutions; unfortunately, this information is typically not stored or reported in a central area. The ability to document, track, and report on existing efforts and share that information within the watershed community underscores the desire for more coordinated and collaborative endeavor under this Louisiana Nutrient Management Strategy.

LOUISIANA NUTRIENT MANAGEMENT STRATEGY INTERAGENCY TEAM

The Louisiana Nutrient Management Strategy was developed by an interagency team from the Coastal Protection and Restoration Authority of Louisiana, the Louisiana Department of Agriculture and Forestry, the Louisiana Department of Environmental Quality, the Louisiana Department of Natural Resources and led by Richard Raynie.

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Louisiana Agriculture and Forestry Nutrient Management Task Force

Louisiana Association of Business and Industry (LABI)

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Louisiana Hypoxia Working Group

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A. PREFACE

A.1 Nutrient Management

Nutrient pollution from excess nitrogen and phosphorus is an issue for many water bodies within the United States, including those that drain to and are within the state of Louisiana. While nutrients are essential components of natural ecological functions, excess nutrients in water bodies may disrupt the balance of these natural processes, disrupting nutrient assimilation and degrading water quality resulting in significant impacts to fish and other aquatic life inhabiting those water bodies.

Nutrients come from various sources including nonpoint sources, such as agriculture and urban runoff, and point sources, such as municipal and industrial discharges, and may be transported far downstream from the original input. Additionally, as the state of Louisiana contains both inland and coastal environments that border the Gulf of Mexico (GOM), non-local nutrient sources affecting offshore waters may encroach upon Louisiana's coastal water bodies and may affect inland waters through upstream sources.

Strategies to manage nutrient pollution in Louisiana waters and in other upstream states are critical to addressing excess nutrients and protecting, improving, and restoring Louisiana's water quality (see Box 1). The Louisiana Nutrient Management Strategy will guide the development and implementation of nutrient management activities. The Coastal Protection and Restoration Authority of Louisiana (CPRA), Louisiana Department of Agriculture and Forestry (LDAF), Louisiana Department of Environmental Quality (LDEQ), and the Louisiana Department of Natural Resources (LDNR) comprise an interagency team developing and implementing this statewide nutrient management strategy to address nutrient pollution issues impacting water bodies within the state. Through the collaborative and voluntary participation of stakeholders within the Louisiana watershed community, this Louisiana Nutrient Management Strategy will build upon the existing programs and initiatives to protect, improve, and restore the water quality within the state of Louisiana.

On a national level many entities including the Mississippi River Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force), Gulf of Mexico Alliance (GOMA), U.S. Environmental Protection Agency (USEPA), U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS), U.S. Fish and Wildlife Service (USFWS), and the Gulf Coast Ecosystem Restoration Task Force (GCERTF) recognize the need to address excess nutrients within the nation's water bodies and coastal systems. The incidence of hypoxia or low dissolved oxygen in offshore waters such as the GOM has been the focus of nationwide efforts to preserve and restore water quality, habitat, and fisheries.

BOX 1: WHY A NUTRIENT MANAGEMENT STRATEGY?

A strategy focused on the nitrogen and phosphorus loads to the Gulf of Mexico (GOM) will determine what improvements are necessary for Louisiana to contribute to nutrient management throughout the Mississippi-Atchafalaya River Basin (MARB). In addition to identifying the appropriate level of nutrients in the MARB, this strategy requires an assessment of the way nutrients are **managed** at the individual watershed and statewide scales. The management tools to be studied for implementation include, but are not limited to, managing nutrients on the field, at the edge of field (USDA NRCS and LDAF OSWC), and intercepting nutrients that have already entered the river system either from Louisiana sources or from sources up-river from Louisiana (CPRA).

Louisiana, situated at the bottom of the large watershed that drains 41% of the contiguous U.S., bears the full brunt of effects from nutrients introduced to the MARB system from up-river states. However, in addition to controlling and capturing our own nutrients through local nonpoint and point source management, Louisiana is uniquely positioned to also contribute to removing nutrients that have entered the system from up-river states. This "intercepting" of nutrients is a key part of **Louisiana's Nutrient Management Strategy** (Figure 1).

With the full implementation of river diversion projects in Louisiana's Coastal Master Plan, Louisiana wetlands will have the potential to remove nearly double the 1.7% nitrogen load and almost half the 2.4% phosphorus load USGS SPARROW models estimate that Louisiana contributes to the system under average Mississippi River conditions. Existing and additional voluntary nonpoint and point source measures could further improve these efforts. The added benefit is that this coastal wetland assimilation process will also help restore and sustain Louisiana's coastal wetlands, which have suffered catastrophic losses during the last century. By reconnecting the Mississippi River to the deltaic wetlands, Louisiana will build and maintain coastal wetlands that will protect and preserve nationally significant ecosystem services (oil and gas production, navigation, fisheries, wildlife habitat), provide storm protection for coastal communities, and achieve improved water quality.

The spatial extent of Louisiana's Nutrient Management Strategy is not limited to just those areas that drain into the MARB. Louisiana is focused on assessing the appropriate nitrogen and phosphorus loads and their impacts on water quality throughout the state. Whether a basin drains into the GOM through the MARB or whether a basin drains directly into coastal bays or lakes, such as Lake Pontchartrain, Louisiana is committed to protecting, improving, and restoring quality in all state waters.

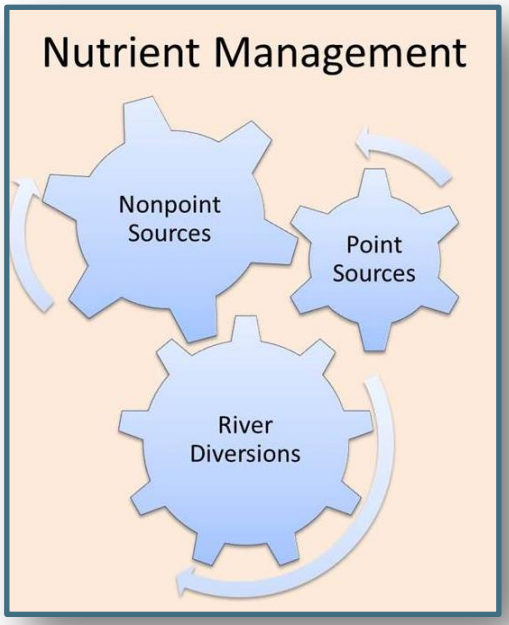


Figure 1. Louisiana's Nutrient Management Strategy focuses statewide on improving the management of nonpoint and point sources of nutrients and also leverages the capacity of river diversions to intercept nutrients that have already entered the river system locally from Louisiana or from upbasin sources and preventing those nutrients from reaching the Gulf of Mexico.

A.2 Gulf of Mexico Hypoxia and Impacts

Hypoxia is a condition where sustained dissolved oxygen concentrations in the water decrease to a level that can no longer support living aquatic organisms. Hypoxic areas (also known as "dead zones") can be found in many areas around the world and have increased in duration and frequency since first being noted in the 1970s. In the northern GOM, hypoxia was first documented in 1972 and its severity and extent have been surveyed annually since 1985 (Rabalais et al. 2001; Turner et al. 2005; LUMCON 2013; Figure 2).

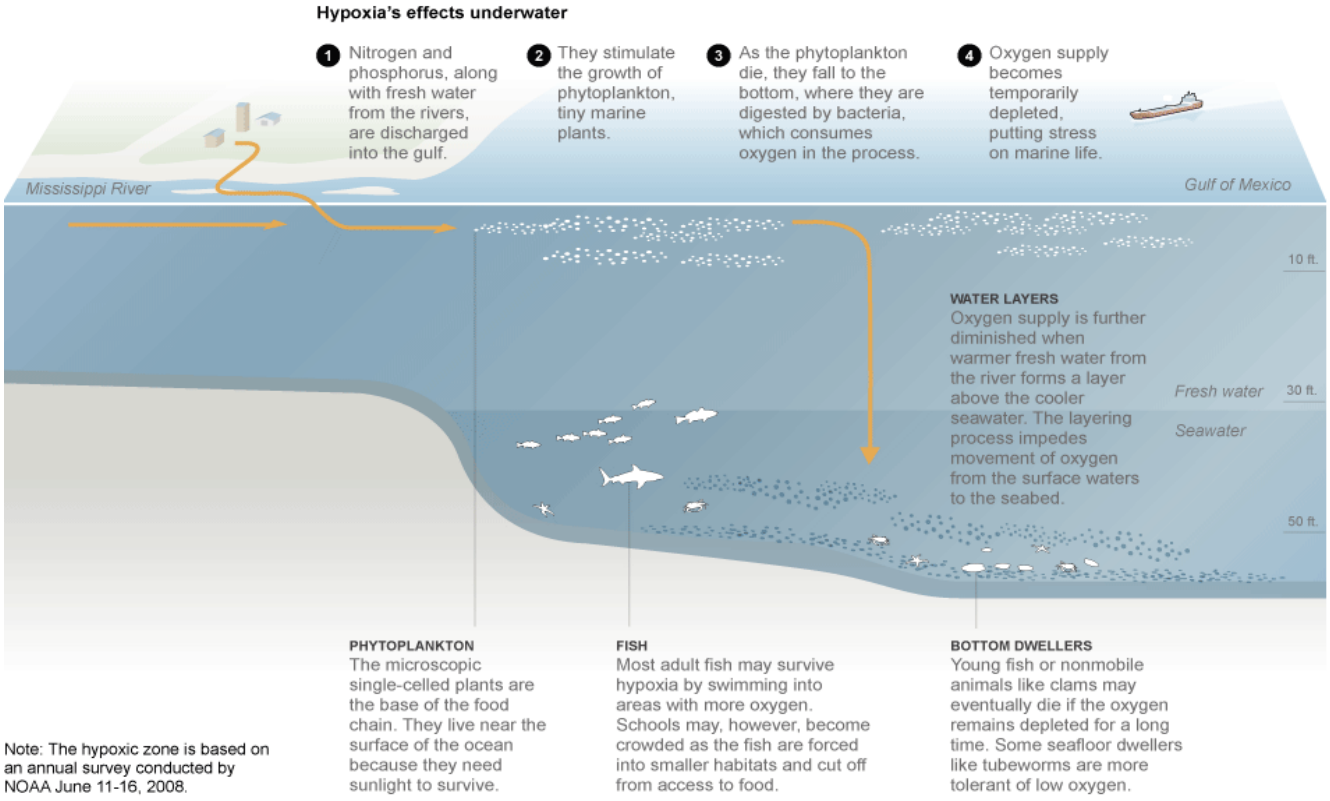
In the northern GOM, hypoxia generally occurs in bottom waters off the Louisiana and Texas coasts during the summer months of June, July, and August. It is a transient condition that forms primarily as a result of excess nutrients carried in the Mississippi and Atchafalaya Rivers and freshwater stratification (layering) of waters in the GOM (Bianchi et al. 2010; Rabalais et al. 2010; USEPA 2012a).

Understanding direct effects of hypoxia on commercial fisheries in the northern Gulf of Mexico is of critical concern. Coastal waters off Louisiana provide essential habitat for nationally important commercial fisheries and effects of hypoxia can include fish kills, which can deplete valuable fish populations and disrupt ecosystems. More common effects of hypoxia, however, include population shifts in spatial distribution and community structure through mortality and emigration. It has been well documented that bottom-dwelling Gulf species such as the Atlantic croaker and brown shrimp are displaced by hypoxia from physiologically optimal foraging and breeding habitat along the Louisiana shelf (Craig and Crowder 2005). The impacts of hypoxia in these instances are likely to be more indirect with changes in food web structure and sub-lethal

reproductive effects. For example, evidence indicates that Atlantic croakers, which are generally considered hypoxia-tolerant, are exhibiting a suite of sub-physiological impacts resulting in endocrine disruption and impaired reproduction when they aggregate around the edges of a hypoxic zone (Craig 2012; Thomas et al. 2007). Craig (2012) and Craig and Bosman (2013) suggest that such effects likely extend to the broader demersal and possibly pelagic fish communities, in northern GOM waters.

Research into the socioeconomic impacts of hypoxia on Gulf commercial fisheries has to date focused primarily on the brown shrimp fishery and the results are preliminary. However, a broader analysis of the Gulf shrimp and menhaden fisheries is underway, including development of economic models (Craig 2012). This potential impact of hypoxia on northern GOM fisheries is of critical concern because Louisiana's commercial landings are significant and exceeded 1,217 million pounds in 2012 with a dockside value of $331.2 million. This accounted for approximately 29% of the total catch by weight in the lower 48 States (NOAA 2013).

Figure 2. Schematic showing how hypoxia can develop at depth in the water column. Freshwater from rivers such as the Mississippi River carry and deposit nutrients which promote phytoplankton growth in the surface waters of the Gulf of Mexico. When phytoplankton, which feed on the nutrients, are eaten by zooplankton or die, they sink to the bottom. When the organic material sinks to the bottom, it decomposes, a process which consumes oxygen. Due to natural salinity and temperature stratification, oxygen flux from the surface water to the bottom waters is blocked and oxygen in the bottom waters becomes depleted. As a result, animals that cannot move to waters with higher oxygen levels may die (graphic reproduced from Park et al. 2010).



Sources: Nancy N. Rabalais, Louisiana Universities Marine Consortium; R. Eugene Turner, Department of Oceanography and Coastal Sciences, Louisiana State University; Charles G. Crawford and Dale M. Robertson, U.S. Geological Survey; Margot Stiles, Oceana; National Marine Fisheries Service, NOAA

A.3 Significance to the State of Louisiana

The Mississippi-Atchafalaya River Basin (MARB) drains approximately 41% of the contiguous United States and includes several major river systems (Figure 3). According to modeling studies conducted by the U.S. Geological Survey (USGS), approximately 98% of the nutrient loading into the MARB comes from sources upstream of Louisiana; and of this nutrient loading, approximately 90% is associated with agricultural sources, natural sources, and atmospheric deposition (Alexander et al. 2008a).

Within Louisiana, approximately 43% of the land area drains into the MARB (Figure 4) and according to USGS models, contributes 1.7% of the nitrogen and 2.4% of the phosphorus load into these rivers (Alexander et al. 2008b; Table 1). The remaining 57% of the state land area drains directly to the GOM through coastal bays and lakes, such as Lake Pontchartrain. Therefore, it is important to address water quality and nutrient management throughout the state. This statewide nutrient management strategy will address all watersheds in Louisiana including those that drain into the GOM through the MARB or those that drain directly into coastal bays or lakes and the GOM.

Figure 3. The Mississippi-Atchafalaya River Basin (MARB) drains approximately 41% of the contiguous United States that includes all or part of 31 states and 2 Canadian provinces. Map scale is approximately 2,000 miles across (reproduced from GOMA 2012).

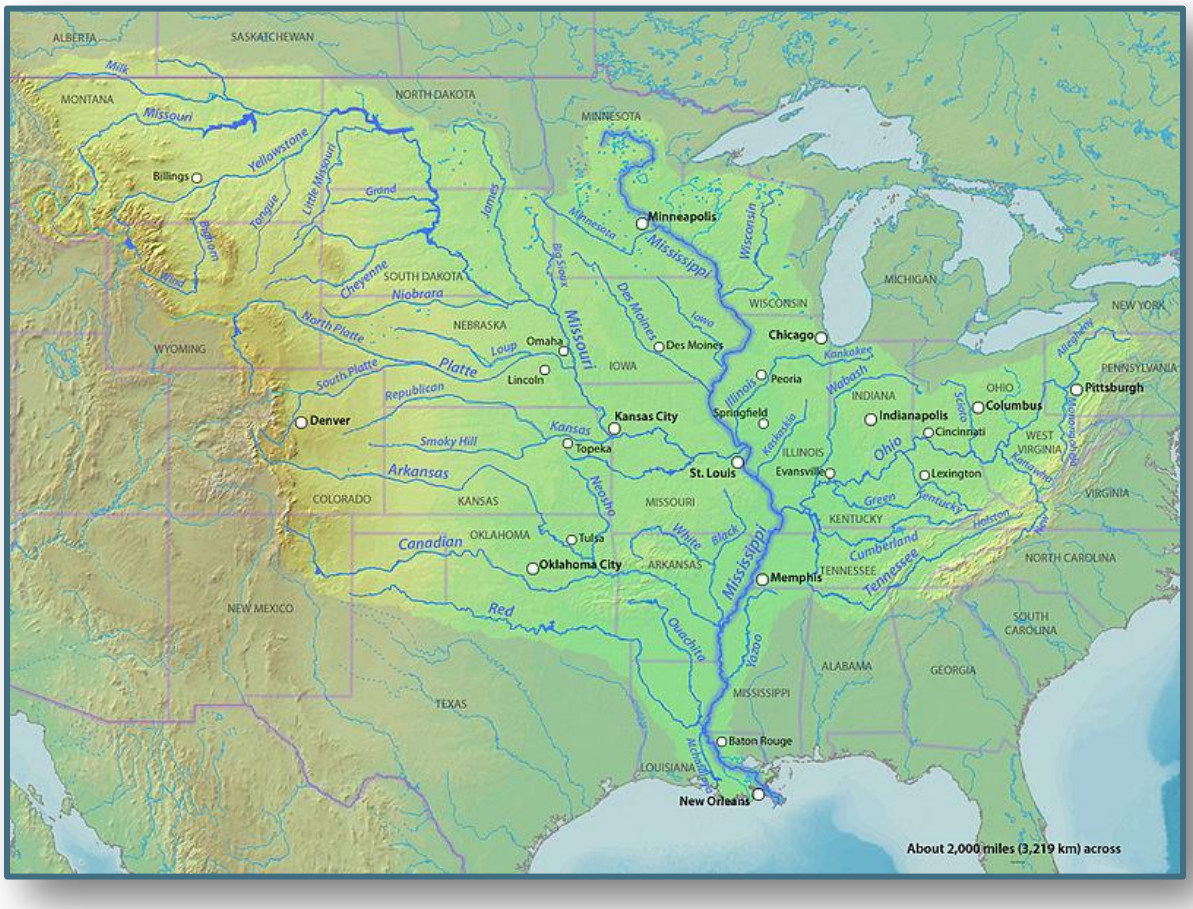


Figure 4. Approximately 43% of Louisiana's land area drains into the Mississippi-Atchafalaya River Basin (MARB) and eventually into the Gulf of Mexico (GOM). According to USGS models, Louisiana contributes 1.7% of the nitrogen and 2.4% of the phosphorus load into these rivers (Alexander et al. 2008a, 2008b).The remaining 57% of the land area in the state drains into the GOM either directly or through coastal bays or lakes.

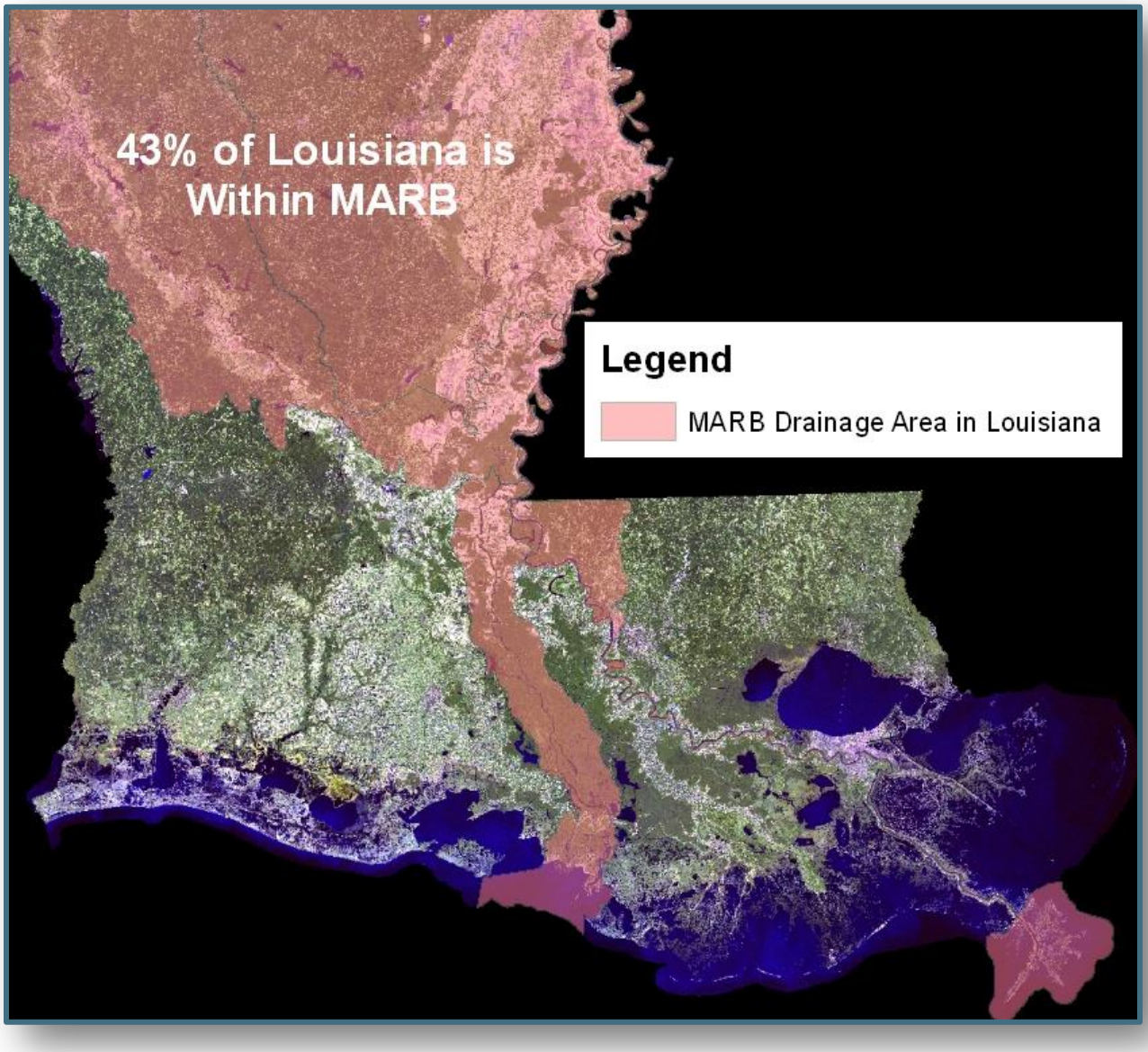


Table 1. Percent share of nutrient flux (mass per time) delivered to the Gulf of Mexico (GOM) from States within the Mississippi-Atchafalaya River Basin (MARB). States which are not members of the Hypoxia Task Force are reported under "other" (reproduced from Alexander et al. 2008b).

Total Nitrogen			Total Phosphorus		
State	***Percent of Total Flux***	***Delivered Yield (kg km^2 yr^1)***	***State***	***Percent of Total Flux***	***Delivered Yield (kg km^2 yr^1)***
Illinois	16.8	1734.9	Illinois	12.9	117.4
Iowa	11.3	1167.2	Missouri	12.1	89.4
Indiana	10.1	1806.6	Iowa	9.8	89.2
Missouri	9.6	800.5	Arkansas	9.6	94.6
Arkansas	6.9	750.1	Kentucky	9.0	113.4
Kentucky	6.1	879.5	Indiana	8.4	132.3
Tennessee	5.5	757.7	Tennessee	5.3	61.9
Ohio	5.4	1082.3	Mississippi	4.4	101.6
Mississippi	3.4	863.5	Ohio	4.1	72.1
Minnesota	2.9	340.7	Louisiana	2.4	67.4
Wisconsin	2.7	406.8	Wisconsin	2.4	31.7
Louisiana	1.7	513	Minnesota	2.0	20.1
Other	17.4		Other	17.7	
Total	100		**Total**	100	

Although Louisiana's contribution to the overall nutrients entering the GOM is small, Louisiana is at the terminus of all nutrient impacts resulting from nutrient loads upstream. For this reason, Louisiana is committed to protecting and improving water quality within its inland and coastal waters, and cooperating with upstream states to reduce nutrient loads in the MARB. Specifically, river diversions built as a part of the 2012 Coastal Master Plan (CPRA 2012) will provide a means of intercepting nutrients from the mainstem of the Mississippi River and reducing the amount of nutrients reaching the Gulf of Mexico. In addition to the regulatory requirements under the Clean Water Act (CWA), this comprehensive strategy includes an incentives-based approach for participation of all stakeholders within the watershed community involved in agricultural management practices, wastewater treatment technologies, and coastal programs and restoration activities. A commitment to the development of a Nutrient Management Strategy for Louisiana is a strong indication of the state's continued dedication to protect, improve, and restore water quality of the state's water bodies.

B. VISION

The overarching vision of the Louisiana Nutrient Management Strategy is that through its implementation:

- Nutrient levels in Louisiana's surface waters, both inland and coastal, will be managed to ensure support of healthy aquatic communities, clean water for public, agricultural and industrial use, including but not limited to recreation in and on the water, drinking water supplies, irrigation and livestock watering;
- Stakeholders will be involved in nutrient management at the local level to actively support water quality protection, improvement, and restoration of Louisiana's water bodies and will be encouraged through participation in voluntary, innovative, and incentive-based approaches; and
- Nutrient management for water quality protection, improvement, and restoration at the local level may have a cumulative and positive impact on the health of the receiving water bodies both within the state and within the Gulf of Mexico.

C. PURPOSE

The purpose of the Louisiana Nutrient Management Strategy is to manage nitrogen and phosphorus to protect, improve, and restore the nutrient-related water quality in Louisiana's inland and coastal waters.

D. STAKEHOLDERS AND PARTNERS

All stakeholders within a watershed community will play a role in nutrient management for Louisiana's water bodies. Stakeholders include state and federal agencies, academic institutions, nonprofit, non-governmental organizations (NGOs), private industry, private landowners and members of the watershed community, and parishes and municipalities among others. Participation by and partnerships among these stakeholder entities is necessary for the success of the Louisiana Nutrient Management Strategy for protection, improvement, and restoration of water quality within Louisiana's watershed communities.

E. FRAMEWORK FOR LOUISIANA'S NUTRIENT MANAGEMENT STRATEGY

Strategy features, strategic components, and strategic actions are outlined below that support the vision and purpose of the Louisiana Nutrient Management Strategy.

Strategy features includes those essential elements desired in a nutrient management strategy. Strategic components are the framework for organizing and accomplishing the goal. Strategic actions are those action items to be accomplished through employing the nutrient management methods described therein.

E.1 Strategy Features

The Nutrient Management Strategy for the state of Louisiana will address sources of nutrients including point and nonpoint sources within the water bodies of the state. This implies that all nutrient sources will be considered for management, assimilation, and reduction. Thus, the Nutrient Management Strategy will be **goal oriented** where specific actions are identified along with **measurable environmental outcomes.** The Nutrient Management Strategy utilizes a **watershed approach** where all activities within a watershed, including natural environmental and human activities, are assessed and taken into account. Therefore, it is imperative that **watershed leaders** who are the most familiar with the local conditions and needs within a watershed be the vanguard for these efforts.

Accordingly, efforts will be **broadly collaborative** with watershed partnerships formed among state and federal agencies, academic institutions, private landowners and industry, and other groups to leverage strategies. Watersheds throughout Louisiana will be included in nutrient management activities through the connectivity of water bodies statewide culminating in **comprehensive statewide water quality improvements**.

The Nutrient Management Strategy will rely on **strategic planning including macro-, meso-, and micro-watershed approaches** that will allow objectives and measureable outcomes to be scalable from watershed level (micro) to state (meso) and possibly even nationwide (macro). Programs implemented for water quality improvements through this Nutrient Management Strategy will be routinely evaluated and **improvement projects tracked** in order to measure the environmental outcome. Continued and routine **progress monitoring and reporting** will aid in identifying successes as well as identifying programs that may require adjustments or re-evaluation in order to achieve the desired outcome of nutrient management within Louisiana's water bodies. Performance measures and tracking will be a key part to strategy implementation.

All available 'tools in the toolbox' will be identified and used in this nutrient management effort. These decision support tools may include existing data sources, modeling efforts, and mapping applications originating from a wide array of watershed community stakeholders. While current knowledge of the watersheds will be incorporated into this Nutrient Management Strategy, it may also be important to **leverage new technologies** to manage and reduce nutrients.

E.2 Strategic Components

The Louisiana Nutrient Management Strategy is composed of a framework of ten strategic components to support the vision and purpose of the strategy. These ten strategic components (Table 2) represent common themes for nutrient management and illustrate the process taken to develop and implement this Nutrient Management Strategy to protect, improve, and restore the nutrient water quality within water bodies of the state of Louisiana.

Further, the ten strategic components for the Louisiana Nutrient Management Strategy align with common components or elements of a nutrient strategy envisioned by such entities as the Gulf of Mexico Alliance (GOMA 2010), the Mississippi River/Gulf of Mexico Watershed Nutrient Task Force, and USEPA (2011).

Table 2. Framework of ten strategic components of the Louisiana Nutrient Management Strategy.

Component	Description
1. Stakeholder Engagement	Identify, engage, and involve stakeholders within the watershed community in water quality solutions
2. Decision Support Tools	Identify and evaluate tools that may be utilized in evaluating and assessing nutrients in watersheds
3. Regulations, Policies, & Programs	Examine current regulations, policies, and programs that may guide nutrient management activities
4. Management Practices & Restoration Activities	Identify and document appropriate management practices and restoration activities
5. Status & Trends	Examine status and trends of information related to nutrient management
6. Watershed Characterization, Source Identification & Prioritization	Characterize watersheds and subsegments, identify nutrient sources, and prioritize watersheds for nutrient management efforts
7. Incentives, Funding, & Economic Impact Analyses	Utilize voluntary incentives or funding to promote participation in stewardship activities and evaluate economic impact of nutrient management activities
8. Targets & Goals	Document agency commitments, timelines, and milestones for nutrient management activities
9. Monitoring	Utilize effective monitoring programs to document nutrient levels or other associated data
10. Reporting	Develop reporting mechanisms for communicating with stakeholders and tracking strategy progress

E.3 Strategic Actions

A series of strategic actions will guide the implementation of the Louisiana Nutrient Management Strategy. These strategic actions fall under the framework of the ten strategic components described above. Completing these strategic actions, as well as adapting, modifying, or identifying additional strategic actions, will be part of the strategy implementation process.

E.3.1 Stakeholder Engagement

Stakeholder participation is essential to accomplishing the vision of the Louisiana Nutrient Management Strategy. Stakeholders have a vested interest in the protection, improvement, and restoration of water quality within their watershed community and are the stewards of their local landscapes. Engaging and communicating with stakeholders will be key to the success of the Louisiana Nutrient Management 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. Working with local watershed and industry leaders, 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 will be critical to further engage stakeholder communities as the Louisiana Nutrient Management Strategy is implemented.

The strategic actions for Stakeholder Engagement under the Louisiana Nutrient Management Strategy are to:

- Identify stakeholders with interest in strategy
- Engage stakeholders in strategy development
- Perform outreach/education on strategy activities
- Identify and promote partnerships/leveraging opportunities

Timelines and milestones for these strategic actions are given in Appendix A.

In 2012, the Interagency Team identified over 200 stakeholder groups in Louisiana with water quality interest as a part of their mission. These stakeholder groups included state and federal agencies, agricultural producers, academic institutions, nonprofit organizations, non-governmental organizations (NGOs), private industry, private landowners, parishes, and municipalities, among others. Louisiana is fortunate to have a broad base of existing stakeholder groups with interest in water quality management as these stakeholders are routinely engaged in water quality discussions through a variety of programs managed by agencies developing and implementing the Louisiana Nutrient Management Strategy.

In late 2012 and early 2013, key stakeholder interest groups including agriculture, business/industry/municipality, non-governmental organizations, and academic/research institutions were targeted and engaged to solicit input that represented a wide array of

nutrient management activities for improving the quality of inland and coastal water bodies of the state. In addition, the Interagency Team was able to engage representatives from over 130 stakeholder affiliations through presentations at local and regional level meetings at more than 30 events from November 2012 through June 2013 (Figure 5).

Figure 5. Engaging stakeholders is essential to the success of the Louisiana Nutrient Management Strategy.

E.3.2 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.

Web-based data access tools such as the LDEQ Louisiana Environmental Data Access Center (LDEQ 2013a), the USEPA Nitrogen and Phosphorus Data Access Tool (USEPA 2013; Figure 6), and the Water Quality Portal (USGS et al. 2013) may provide access to available information on nutrient levels within the state's water bodies.

Water quality models, such as the USGS Spatially Referenced Regressions On Watershed attributes or SPARROW model (USGS 2013a; Figure 7), may provide information on potential sources of nitrogen and phosphorus and nutrient loads in surface waters. Additionally, Geographic Information Systems (GIS) based tools that allow visualization of watershed features, such as land use and elevation, and identification of potential nutrient sources will be important in supporting decisions on nutrient management activity and aid in watershed prioritization.

The strategic actions for Decision Support Tools under the Louisiana Nutrient Management Strategy are to:

- Identify available tools
- Evaluate available tools
- Select available tools
- Document selected tools

Timelines and milestones for these strategic actions are given in Appendix A.

During 2012 and 2013, the Interagency Team conducted a broad review of available decision support tools in support of the Louisiana Nutrient Management Strategy. Over 200 tools were identified, evaluated, and their applicability or utility to nutrient management determined. Applicable tools included best management practices, data access portals, mapping applications, modeling tools, and reports. As the strategy is implemented, newly identified tools will continue to be evaluated and documented as they are useful to the Louisiana Nutrient Management Strategy.

Figure 6. The USEPA Nitrogen and Phosphorus Pollution Data Access Tool provides downloadable data layers and key information on the extent and magnitude of nitrogen and phosphorus pollution and potential sources of these pollutants (USEPA 2013).

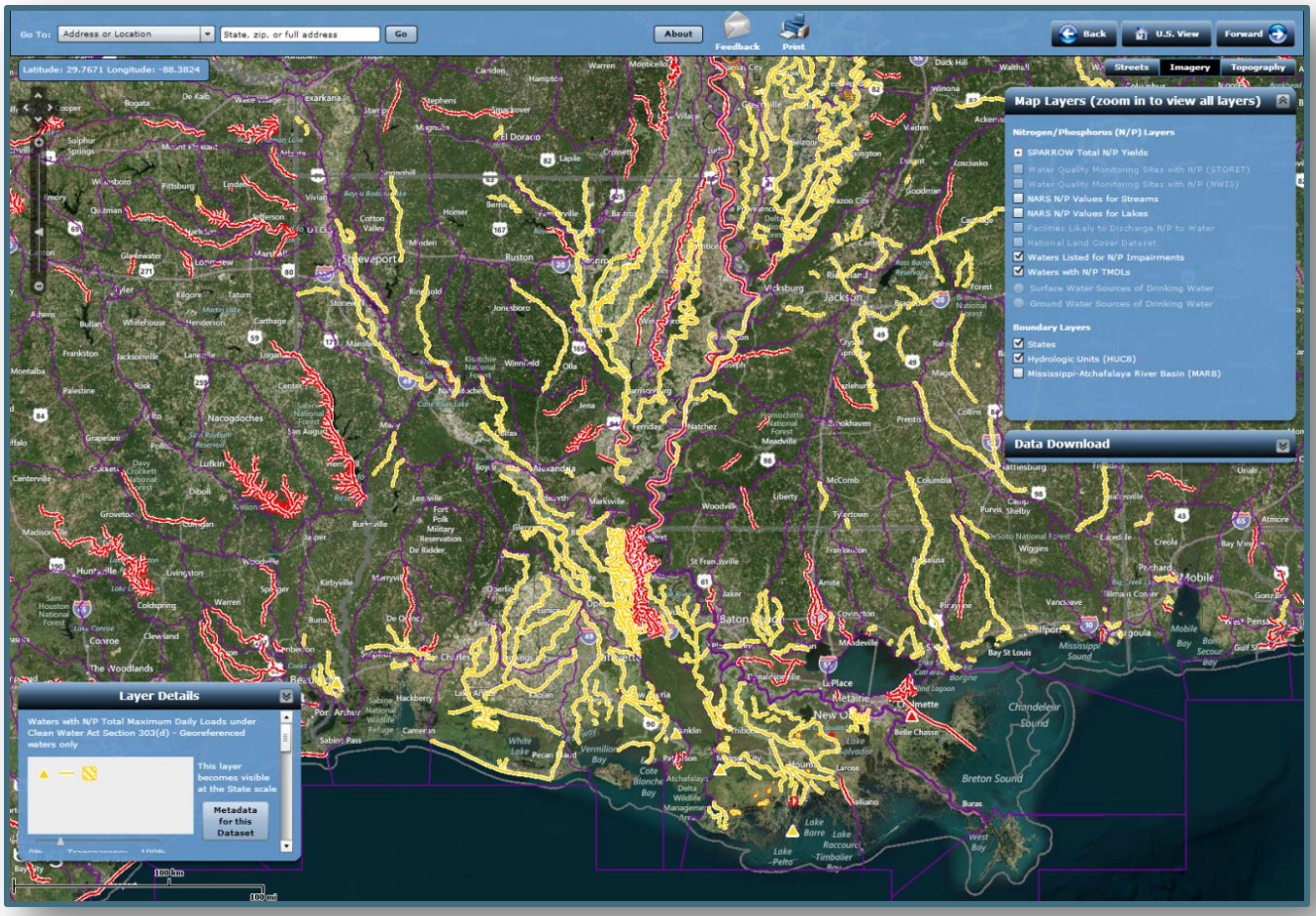
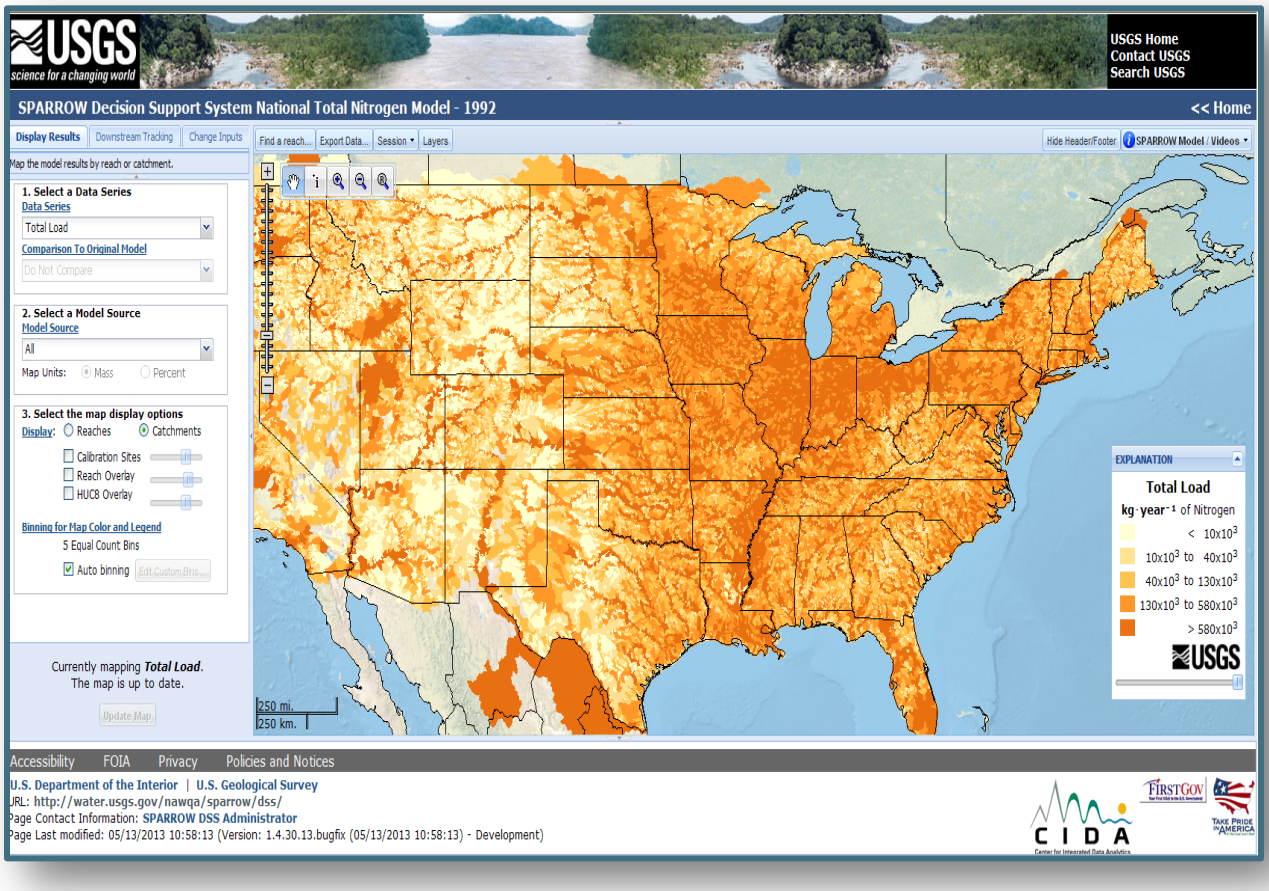


Figure 7. The USGS SPARROW Online Decision Support System is one of the many tools that may aid the Louisiana Nutrient Management Strategy. The SPARROW model, based on 2002 data, estimates nitrogen and phosphorus loads within the state of Louisiana as well the larger Mississippi-Atchafalaya River Basin and other parts of the nation (USGS 2013a).



E.3.3 Regulations, Policies, & Programs

Numerous efforts are underway within the state of Louisiana as well as nationally that address a multitude of nutrient management activities such as those aimed toward outreach, monitoring, or agricultural incentives. These programs may assist with nutrient management activities within the state of Louisiana. Agricultural production in Louisiana has benefitted from Farm Bill programs that offer financial incentives and technical assistance with implementation of conservation practices (Figure 8).

The strategic actions for Regulations, Policies, & Programs under the Louisiana Nutrient Management Strategy are to:

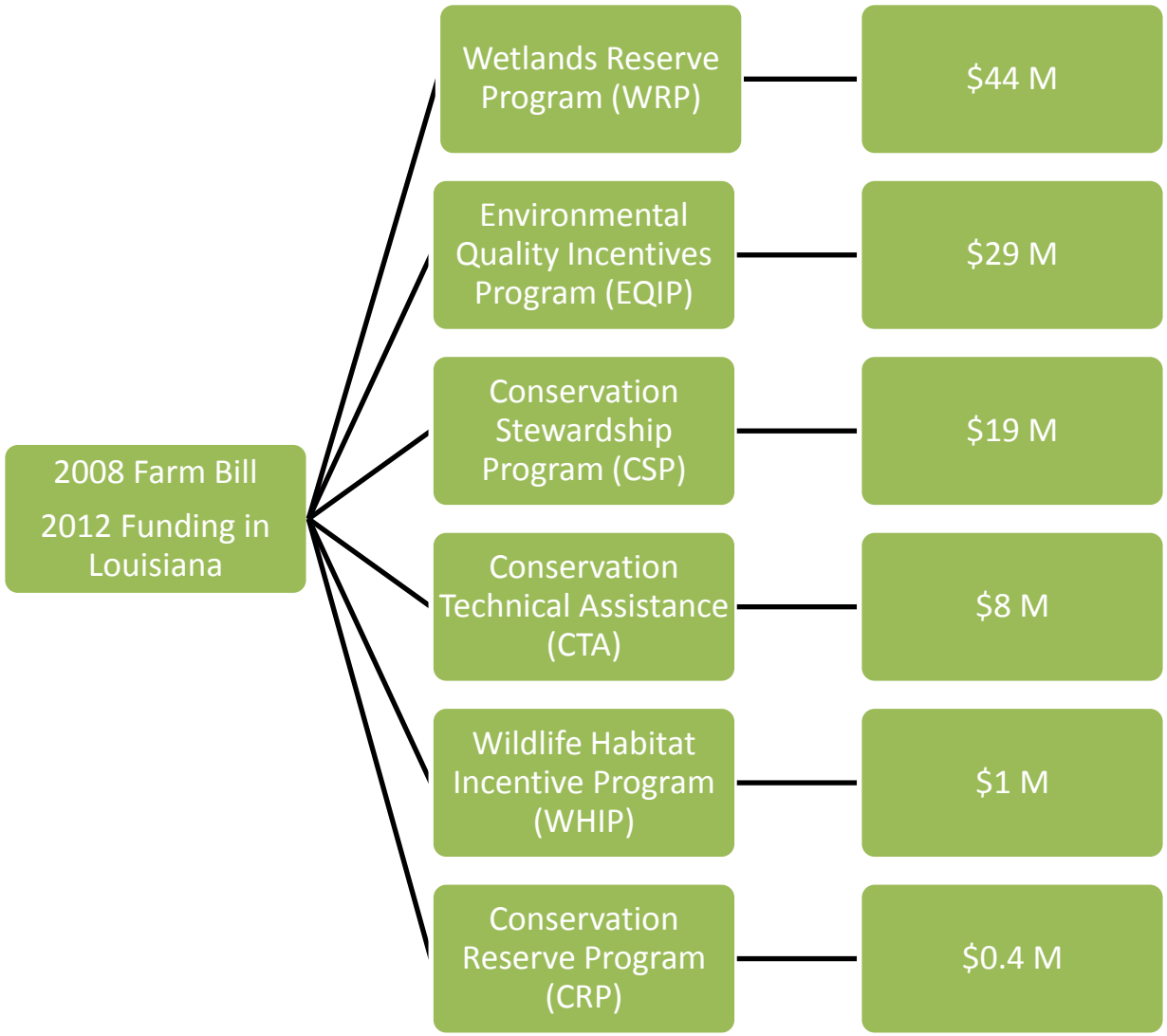
- Identify current regulations, policies and programs
- Identify gaps in regulations, policies and/or programs
- Propose or establish new regulations, policies and/or programs

Timelines and milestones for these strategic actions are given in Appendix A.

During 2012 and 2013 in the development of the Louisiana Nutrient Management Strategy, current regulations, policies, and programs were inventoried and perceived gaps were noted. Stakeholders also expressed interest in voluntary incentive-based programs such as exploring water quality credit trading options in Louisiana. In addition, regional collaborations through the Lower Mississippi River Valley Nutrient Compact and the Mississippi Rivers and Cities Initiative were created in 2013. Within the state of Louisiana, the Louisiana Agriculture and Forestry Nutrient Management Task Force (2012; see Box 2) with representation from major agriculture groups and the Louisiana Water Synergy Project (2012; see Box 3) with representation from major industrial groups were created and both groups aim to improve water quality through stakeholder participation and voluntary efforts.

More recently in October 2013, an Interagency Agreement through the USEPA Gulf of Mexico Program Office and the USDA NRCS in Louisiana was signed to increase measurement efforts at edge-of-field to show how conservation practices are working on farms. This agreement also helps the Louisiana Master Farmer Program implement conservation practices as recommended in existing regional strategies that USEPA has supported with partners. A program coordinator is being supported as well to help make sure the measurable environmental results are reported back to USEPA and USDA for on-farm conservation practices from the Louisiana Master Farmer Program participants in Louisiana who conduct edge-of-field monitoring. Objectives include: 1) increase the number of farms in Louisiana participating in the Master Farmer Program; 2) regional partnership to support Master Farmer conservation efforts and the implementation of the Gulf of Mexico Regional Ecosystem Restoration Strategy, Gulf Hypoxia Action Plan and the Gulf of Mexico Alliance's Governors' Action Plan; 3) facilitate a coordinator position for the Master Farmer Program in cooperation with Louisiana State University Agricultural Center; and 4) use edge of field monitoring to evaluate conservation practices effect on water quality at selected cooperator farms.

Figure 8. Regulations, policies, and programs such as these made possible through the 2008 Farm Bill provide financial and technical assistance for implementation of best management conservation practices that may result in improved water quality are necessary for the success of the Louisiana Nutrient Management Strategy (USDA NRCS et al. 2012).



BOX 2: LOUISIANA AGRICULTURE AND FORESTRY NUTRIENT MANAGEMENT TASK FORCE

In 2012, the Louisiana Department of Agriculture and Forestry created a Louisiana Agriculture and Forestry Nutrient Management Task Force to study the topics related to agricultural nutrient issues and evaluate their impact on our agricultural industries. The Task Force will eventually be charged to support the agency in multiple water-related issues, but the immediate priority is to review and make recommendations on the following topics:

- The need for research, education and training in the selection and application of agricultural fertilizer and soil nutrients in the state;
- Identifying 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;
- Identifying state level agriculture certainty certification programs that encourage the implementation of best management practices in the generation, handling or land application of nutrients in Louisiana;
- Formulating a systematic and economically viable nutrient management program that will both maintain agricultural profitability and improve water quality in Louisiana.

This Task Force is an excellent example of producers, industry, universities and state governments working together to address nutrient concerns and will continue to do so in a manner that is consistent with sound science and practical application. Task Force members include representatives from Louisiana agriculture and forestry stakeholders and industry. Representatives are from the following organizations:

- Louisiana Cooperative Extension Service
- Louisiana Agriculture Experiment Station
- Louisiana Association of Conservation Districts
- Louisiana Farm Bureau Federation
- Louisiana Soybean and Grain Association
- Louisiana Forestry Association
- Louisiana Landowners Association
- Louisiana Agriculture Consultants Association
- Louisiana fertilizer industry
- Louisiana Cattleman's Association
- Louisiana poultry industry
- American Sugarcane League
- Louisiana Rice Growers Association

BOX 3: LOUISIANA WATER SYNERGY PROJECT

The U.S. Business Council for Sustainable Development (US BCSD) launched the Louisiana Water Synergy Project in May 2012. Since then, 21 companies have been working together with local and state governments and other stakeholders to find mutually beneficial solutions to address water quality, quantity, and storm water challenges in southeastern Louisiana. The project goals are to achieve tangible water synergy benefits in the region, link the efforts of the private sector with those underway in the public sector, establish a long-term collaboration plan for this region, and develop a replicable process that can be taken to other watersheds/regions.

Project activities are focused in five working groups: Wetlands, Nutrients Management Issues, Groundwater Sustainability, Water System Sharing, and Alternative Levee Materials.

Nutrients Management Issues Working Group
This working group links the efforts of the private sector with those underway in the public sector to address nutrient impacts in the water bodies of Louisiana. Current and planned activities include:

- Collaborating with LDEQ and LDAF to provide input to the Louisiana Statewide Nutrient Management Strategy.
- Updating the report entitled: "Nutrient Releases to the Mississippi River in Louisiana Industrial Corridor", University of New Orleans, Knecht (2000), to provide a current baseline of point source nutrient discharges.
- Exploring the opportunities to create a nutrient trading program in Louisiana.
- Working with LDEQ, LDAF, and agricultural industry representatives to implement alternatives to reduce nitrogen and phosphorus discharges.
- Defining alternative methods of nutrient removal, for example, diverting water through vegetative wetlands for nutrient removal.

E.3.4 Management Practices & Restoration Activities

Developing, documenting, and leveraging appropriate management practices, including nonpoint source, point source, and restoration activities for a given watershed, will be essential to the Louisiana's nutrient management efforts. Louisiana's land use is diverse which requires solutions to regional nutrient issues be location-specific. Opportunities to leverage management practices and restoration activities within a selected watershed will allow for a more holistic approach to nutrient management resulting in more informed decision-making with multi-layered beneficial effects.

Currently, management practices which control the sources, transformation, and delivery of nutrients are widely applied in various state and federal programs in Louisiana. Watershed management programs have been effective tools for addressing water quality in Louisiana's water bodies. Some of the most effective application of these includes controlling land use, restoring and maintaining the landscape, and utilizing conservation practices (CPs) (see Appendix B). For example, conservation technical assistance and financial assistance funded through the Farm Bill promotes implementation of conservation practices such as the 590 Nutrient Management Plan within Louisiana's watersheds (Figure 9).

Point source wetland assimilation projects which introduce nutrient-rich wastewater to natural wetlands can achieve tertiary levels of sewage treatment and stimulate wetland productivity. The state has adopted policy guidelines and regulations for utilizing wetlands to assimilate nutrients in municipal effluent (LDEQ 2013b, 2013c).

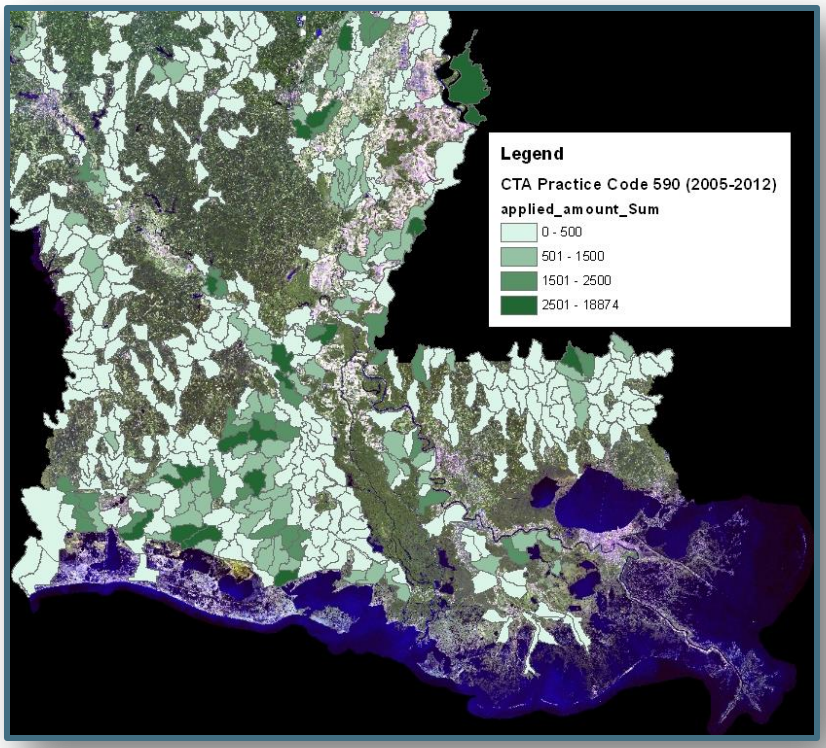
Many coastal programs within Louisiana are focused on combating coastal erosion and salt water intrusion. However, the 2012 Coastal Master Plan (CPRA 2012) focuses on projects that not only reduce risk from storms and flooding but also restore ecosystems and ecological functions (Figure 10). CPRA evaluated ecosystem services such as nutrient uptake potential in various habitats; the evaluation indicated that the management of existing and proposed Mississippi and Atchafalaya River diversions within the MARB could allow for substantial nutrient removal (Rivera-Monroy et al. 2013).

The strategic actions for Management Practices & Restoration Activities under the Nutrient Management Strategy are to:

- Document current practices related to nutrient management
- Identify areas where practices are being implemented
- Model nutrient removal estimated through riverine diversions
- Identify case studies/model watersheds
- Integrate science-based nutrient management approaches

Timelines and milestones for these strategic actions are given in Appendix A.

Figure 9. Conservation practice 590 Nutrient Management Plan coverage (in acres) in Louisiana from 2005 to 2012 through Conservation Technical Assistance (CTA) and Financial Assistance (FA) (USDA NRCS 2013a).



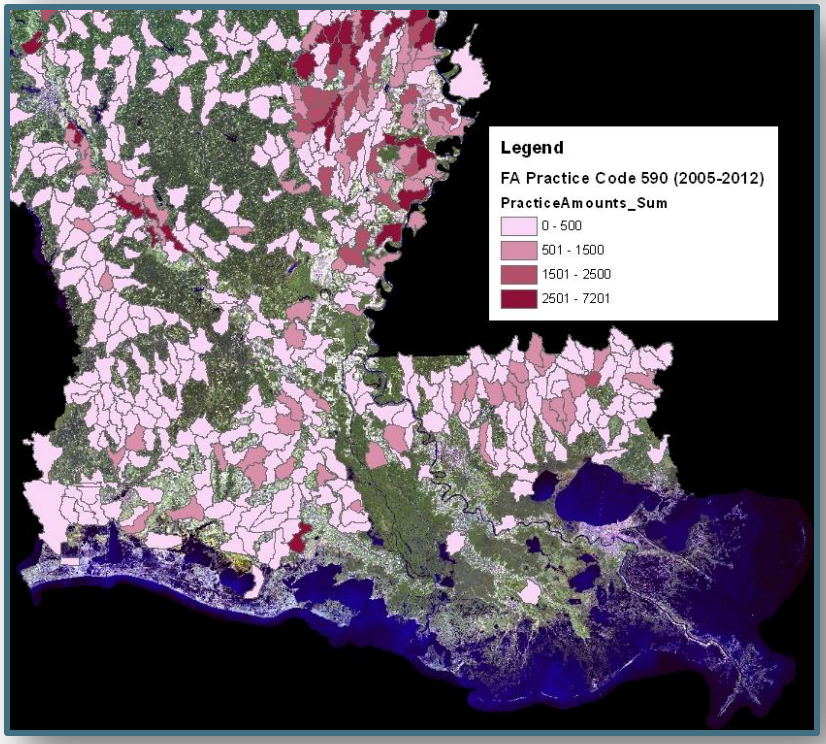
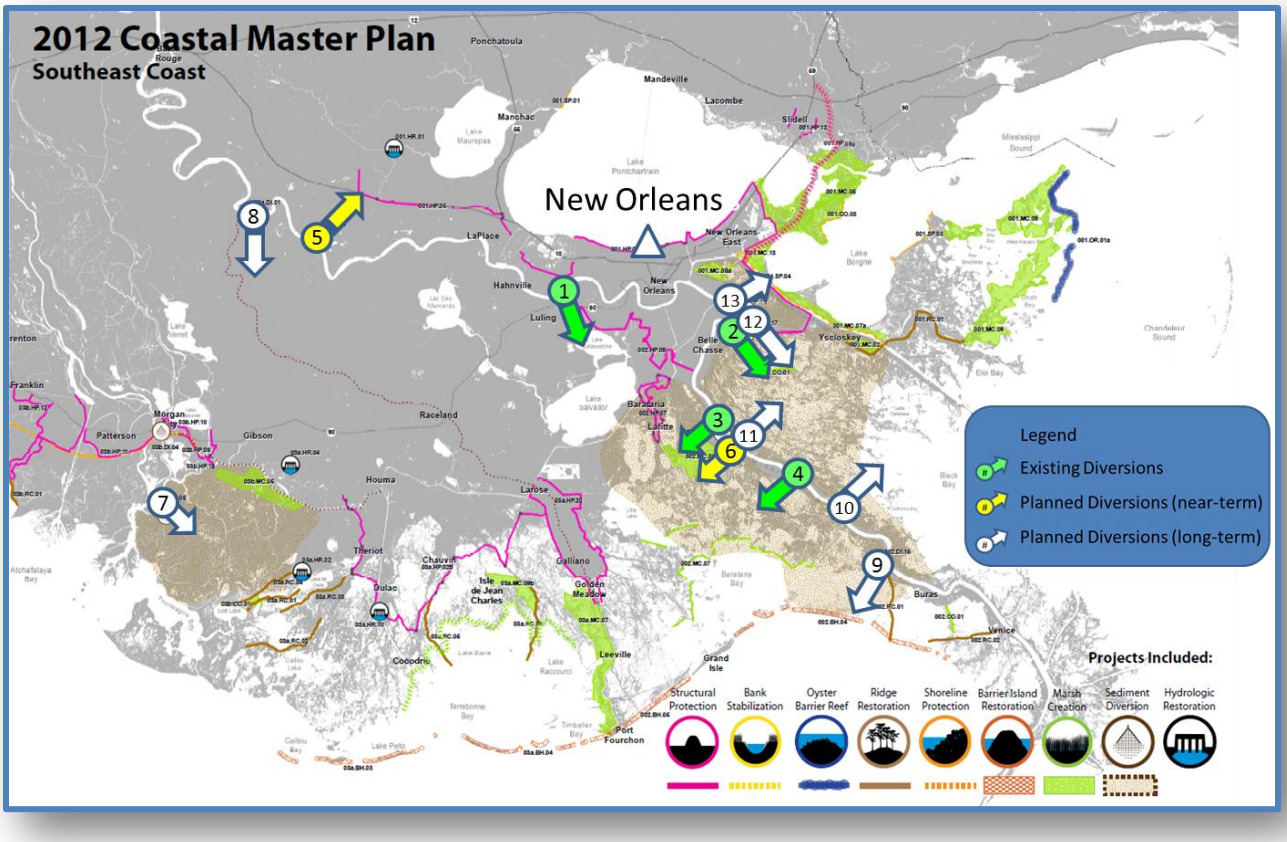


Figure 10. Restoration activities authorized by the Coastal Protection and Restoration Authority (CPRA) within the state of Louisiana are necessary to restore and protect the fragile and degrading coastal marshes (see Table 5).



E.3.5 Status & Trends

Documenting the current status of nutrients and determining changes over time is a critical part of evaluating the success of nutrient management efforts in Louisiana. Water quality data collected as part of the LDEQ Ambient Water Quality Monitoring Network (AWQMN) provides data on nutrient levels within the state's water bodies. Watershed Implementation Plans (WIPs) developed through the LDEQ Nonpoint Source Program include an evaluation of the status and trends of historical water quality data for each priority water body that is targeted for partial and/or full restoration. This evaluation of status and trends provides an indication of whether water quality is improving as a result of WIP implementation. Preliminary assessments also suggest that in some watersheds where WIPs have been developed and implemented, water quality improvements are occurring (LDEQ 2013d). In addition as Louisiana's Nutrient Management Strategy is implemented, available case studies for nutrient management activities will be identified and evaluated to assist with determining watershed status and trends.

Information in the coastal zone related to historic land loss, future projected land loss, habitat type, salinity and water level data are routinely collected by CPRA through the Coastwide Reference Monitoring System (CRMS)-*Wetlands* and the Barrier Island Comprehensive Monitoring (BICM) programs (CRMS 2013; BICM 2013).

Nonpoint source pollution may be a factor of not only environmental conditions but also individual behavior. Social Indicators provide a means to measure social change and may be an important management tool in understanding effectiveness of management strategies (Genskow and Prokopy 2011). Within Louisiana, the LSU AgCenter has conducted surveys to document Social Indicators associated with implementation of conservation practices and attitudes on water quality for specific agricultural interest groups within the state (LSU AgCenter 2013a; Figure 11). Documenting current behavior and determining changes over time may be valuable in guiding nutrient management decisions within a given watershed.

The strategic actions for Status & Trends under the Nutrient Management Strategy are to:

- Model nutrient loading estimated within Louisiana watersheds
- Document in-stream nutrient water quality
- Document Social Indicators of nutrient management behavior
- Document Best Management Practice (BMP) and conservation practice (CP) implementation in watersheds
- Document permitted discharger inventories
- Document riverine diversions
- Document coastal protection and restoration activities
- Determine trends in nutrient water quality at long-term monitoring stations
- Determine trends in Social Indicators
- Determine trends in BMP/CP implementation
- Determine trends in permitted discharger inventories
- Determine trends in nutrients related to riverine diversions

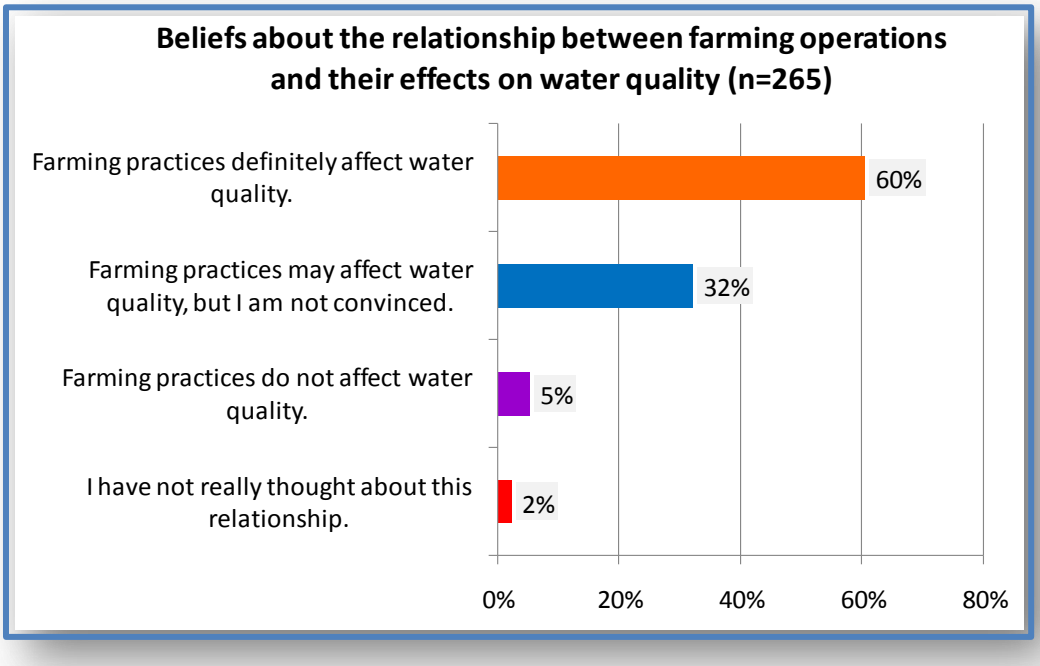
- Determine trends in coastal protection and restoration activities

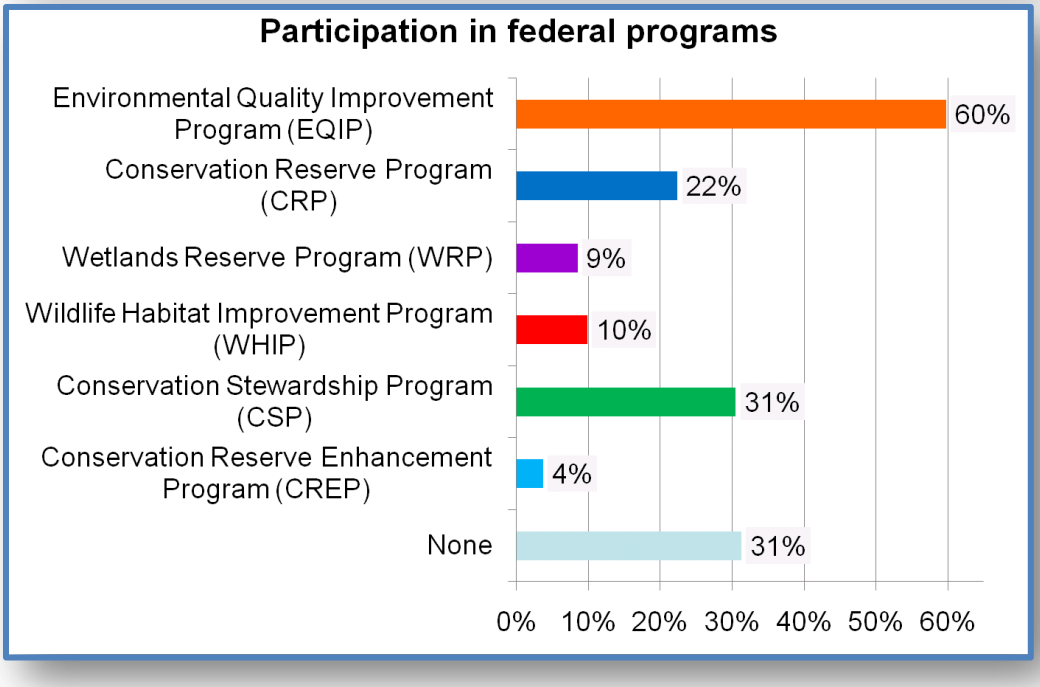
Timelines and milestones for these strategic actions are given in Appendix A.

These efforts described above in addition to others identified through the Louisiana Nutrient Management Strategy process will be evaluated together to give an overall view of the current status and future trend of nutrients. This information can be utilized to inform decision-makers and to guide management efforts within a watershed.

During the Louisiana Nutrient Management Strategy development process, Louisiana worked with USGS to acquire nutrient loading model output from the SPARROW model. However, the input data used for that model was based on 2002 data which may not account for more recent improvements in water quality; therefore, Louisiana proposes to work with the USGS to update the regional SPARROW model using more recent water quality data for the state of Louisiana.

Figure 11. Status and trends of Social Indicators focused on water quality and nutrient management such as those developed by the LSU AgCenter (2013a) may assist in determining stakeholder awareness and attitude regarding nutrient management. These Social Indicators can be documented and tracked over time to indicate nutrient management behavior changes. Documenting current status and tracking future trends resulting from protection, improvement, or restoration of nutrient water quality are important to the success of the Louisiana Nutrient Management Strategy.





E.3.6 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.

Watershed characterization of such attributes as land use, elevation, and nutrient sources include factors related to the physical, chemical, and biological properties of the water bodies within a watershed. Watershed characterization involves delineating the watershed that will be the focal management unit addressed by the Nutrient Management Strategy and determining the attributes and characteristics of the watersheds that are relevant to nutrient water quality. The LDEQ *Water Quality Management Plan, Volume 4 Basins and Subsegment Boundaries* (LDEQ 2008) describes the delineations of LDEQ water management units Basins/Subsegments and the primary water body types within those units. There are 12 basins within the state that are subdivided into 481 subsegments that fall within these basins. Additionally, the USGS delineates Hydrologic Units (HUCs) that are also subdivided into successively smaller units (Seaber et al. 1987; USGS 2013b). HUCs are another set of water management units that may be utilized in nutrient management activities; within the state of Louisiana there are four HUC2 watersheds, 12 HUC4, 21 HUC6, 59 HUC8, 276 HUC10, and 1274 HUC12 level watersheds delineated.

The National Land Cover Database (NLCD 2006) geographically categorizes the land use/land cover within the state of Louisiana as well as that of the nation. The land use/land cover statewide in Louisiana is categorized as 30% wetlands, 19% forests, 17% open water, 15% cultivated crops, 6% developed areas, 6% shrub/scrub, and 5% pasture/hay (Table 3). The distribution of these land use/land covers differ among basins and regions of Louisiana (Figure 12). Wetlands occur largely within the coastal area and Mississippi and Atchafalaya River delta regions of the state; whereas forests mainly occur in the central to northwestern portions as well as the eastern part of the state. Crops are mainly located within the northeastern and southwestern part of the state. Developed areas are typically associated with larger cities within Louisiana and occur interspersed throughout the state. Other data sets including Geographic Information Systems (GIS) based data such as hydrology and elevation and water quality monitoring data will also be useful in characterizing watersheds for nutrient management activities.

Source identification involves identifying suspected sources of pollution within a given water body or watershed. Source identification may be accomplished through desktop analyses or rapid assessment utilizing a multitude of GIS-based and water quality data to look at the land surrounding the water body to help determine potential impacts. Windshield surveys, performed by driving around the watershed of interest, may also help acquire information on potential sources of nutrients. Through LDEQ's Compliance Monitoring Strategy (LDEQ 2013e), the agency outlines approaches for monitoring permit compliance to aid in addressing potential

point source issues. Additionally, LDEQ performs watershed sweeps to identify nonpoint sources and to identify unpermitted point source dischargers within a selected basin or watershed. Watershed sweeps or inspections have been performed in watersheds of the Pontchartrain, Terrebonne, and Vermilion-Teche Basins in Louisiana (Beckstrom 2009, 2011, 2013a; Kelly 2007; Mallett 2008, 2009, 2012a).

Utilizing watershed characterization and source identification information allows for informed prioritization of water bodies for protection, improvement, and restoration of nutrient water quality. Using information on nonpoint sources and water body impairments on the CWA 303(d) list, LDEQ and partners have prioritized water bodies through 2016 for targeting activities to address nonpoint source activities that may be the cause of the impairments (LDEQ 2011). These priority water bodies are located throughout the state but are largely located in the Mermentau and Ouachita River Basins. Nutrients are among some of the suspected causes of impairments that also include fecal coliforms, suspended sediment, and turbidity (LDEQ 2012).

Several USDA initiatives within Louisiana have prioritized watersheds within the state for restoration activities associated with conservation practices. The Gulf of Mexico Initiative (GoMI), National Water Quality Initiative (NWQI), and the Mississippi River Basin Initiative (MRBI) target watersheds across the state for implementation of BMPs to address suspected nonpoint sources through conservation practices (USDA NRCS 2013b, c, d; Table 4; Figure 13).

In an effort to best utilize available resources, leveraging with these current programs and initiatives that are working in priority watersheds will be essential under this strategy. In addition using available watershed characterization and source identification information will allow for the screening and prioritization of watersheds to help select those as priority nutrient management activities.

The strategic actions for Watershed Characterization, Source Identification, & Prioritization under the Nutrient Management Strategy are to:

- Characterize watersheds by land use/cover and geographic features
- Characterize water bodies by type such as streams, bayous, rivers, and lakes
- Characterize watersheds within the coastal zone
- Characterize watersheds with existing or planned riverine diversions
- Identify potential sources through Desktop Analysis/Windshield Survey
- Identify unpermitted point sources
- Identify priority watersheds from leveraging programs
- Determine priority watershed basins
- Develop priority watershed scheme for basin subwatersheds
- Determine priority subwatersheds
- Develop/leverage Watershed Nutrient Management Projects for priorities

Timelines and milestones for these strategic actions are given in Appendix A.

Table 3. National Land Cover Database land use/land cover (LULC) classifications within watershed basins and statewide for state of Louisiana (NLCD 2006). Statewide, wetlands account for nearly 30%, forests 19%, open water 17%, cultivated crops 15%, developed areas 6%, shrub/scrub 6%, and pasture/hay 5% of the LULC within Louisiana.

		Land Use/Land Cover, Percent														
	Hectares	Open water	Developed, Open Space	Developed, Low Intensity	Developed Medium Intensity	Developed, High Intensity	Barren land	Deciduous Forest	Evergreen Forest	Mixed Forest	Shrub/Scrub	Grassland/ Herbaceous	Pasture/Hay	Cultivated Crops	Woody Wetlands	Emergent Herbaceous Wetlands
Atchafalaya River Basin	576,281	22.4	0.9	1.0	0.0	0.0	2.1	0.0	0.0	0.0	0.1	0.2	2.6	10.6	53.2	6.8
Barataria Basin	671,466	36.2	0.9	3.7	0.6	0.5	0.5	0.0	0.0	0.0	0.2	0.1	1.4	8.2	17.9	29.8
Calcasieu River Basin	1,051,403	7.0	2.2	4.4	0.5	0.3	0.2	0.1	26.8	2.4	12.1	5.6	8.4	6.7	16.0	7.4
Lake Pontchartrain Basin	1,959,604	38.9	3.5	3.4	1.2	0.5	0.3	0.1	9.3	0.2	6.0	1.8	4.5	2.2	17.2	10.8
Mermentau River Basin	1,009,474	13.8	1.0	3.8	0.3	0.1	0.2	0.0	2.2	0.3	1.3	1.3	8.1	37.0	10.2	20.4
Vermilion-Teche Basin	1,055,841	17.5	2.9	4.7	0.4	0.2	0.3	0.2	3.2	0.7	1.9	1.0	9.5	27.5	19.4	10.4
Mississippi River Basin	514,859	42.8	1.9	1.2	0.4	0.3	2.0	5.4	1.8	2.9	2.3	1.0	3.5	5.5	21.5	7.5
Ouachita River Basin	2,590,882	2.4	4.0	1.6	0.2	0.1	0.0	2.6	26.3	4.7	6.5	1.2	1.4	30.5	17.6	0.9
Pearl River Basin	235,250	3.1	5.2	1.3	0.4	0.1	0.7	0.0	20.6	1.2	12.4	5.4	8.4	2.8	34.9	3.5
Red River Basin	1,995,013	3.9	3.8	2.6	0.5	0.2	0.1	5.0	29.8	6.7	10.9	1.2	7.6	10.2	16.8	0.8
Sabine River Basin	755,635	12.0	2.6	1.6	0.2	0.0	0.4	0.6	26.3	4.3	12.2	6.1	4.6	0.9	16.4	11.8
Terrebonne Basin	1,012,065	32.7	1.2	2.6	0.3	0.2	0.4	0.0	0.0	0.0	0.2	0.1	3.4	11.0	22.6	25.3
State Total	**13,427,774**	**17.3**	**2.8**	**2.8**	**0.5**	**0.2**	**0.4**	**1.5**	**15.3**	**2.6**	**6.0**	**1.8**	**5.1**	**15.2**	**19.2**	**9.5**

**Percents may not add up to 100 due to rounding.*

Figure 12. Land use/land cover (LULC) plays a major role in watershed characterization in Louisiana, where apparent regional differences exist throughout the state (NLCD 2006). Wetlands occur largely within the coastal area and Mississippi and Atchafalaya River delta regions of the state; whereas forests mainly occur in the central to northwestern portions as well as the eastern part of the state. Crops are mainly located within the northeastern and southwestern part of the state.

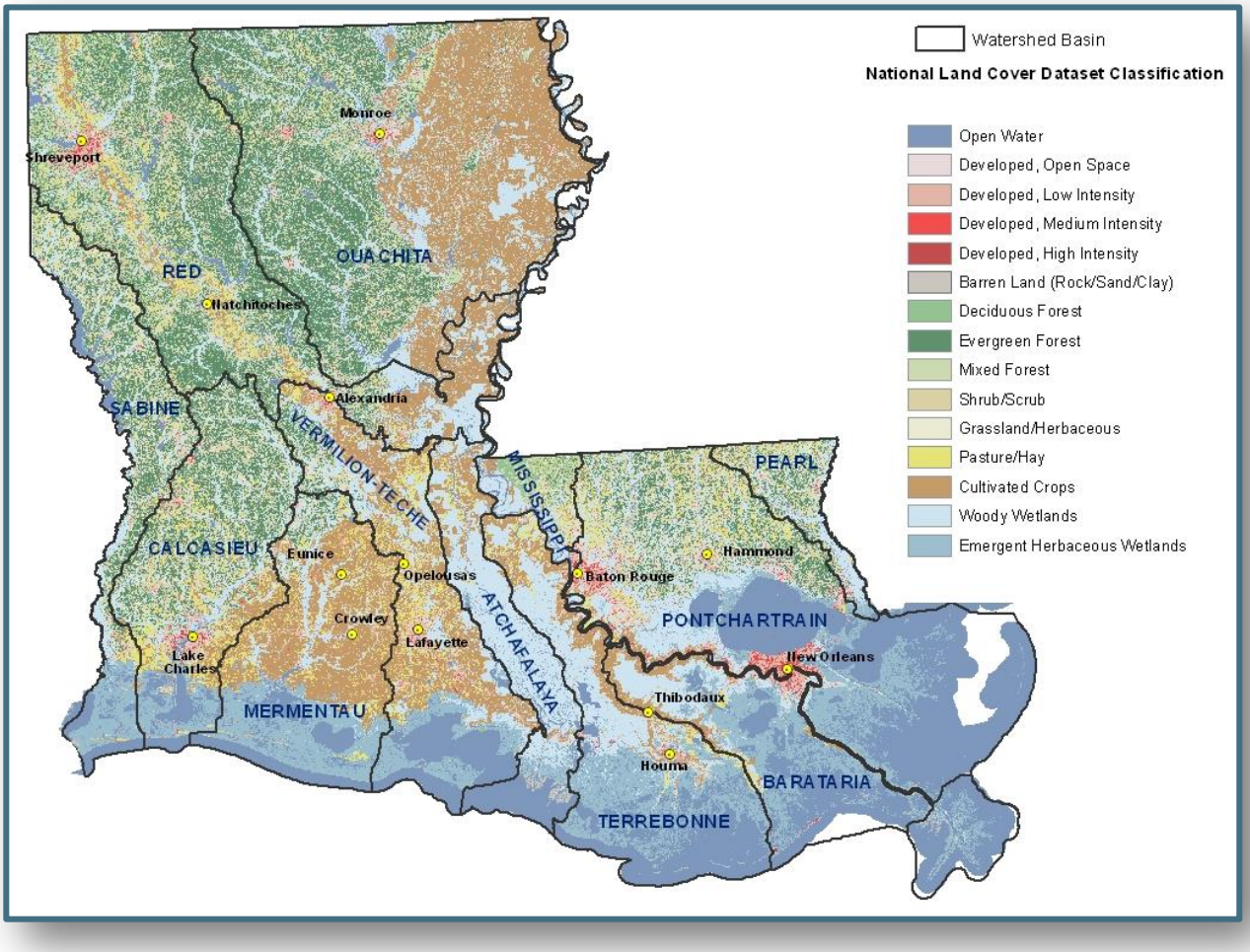
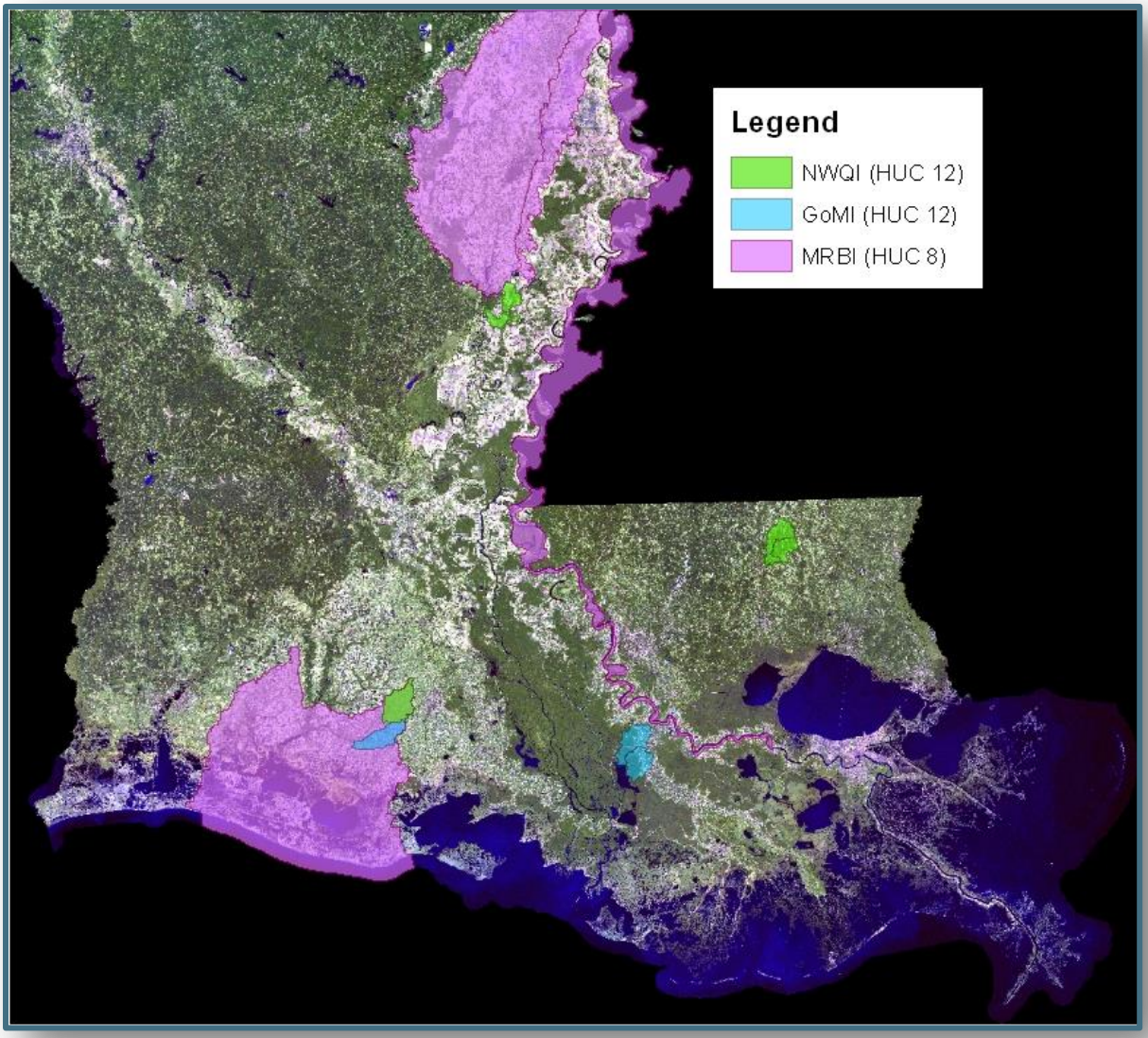


Table 4. Priority watersheds for conservation through USDA initiatives in Louisiana: Gulf of Mexico Initiative, GoMI; Mississippi River Basin Initiative, MRBI; and the National Water Quality Initiative, NWQI (USDA NRCS 2013b, c, d).

Program	Name of HUC	HUC Level	HUC Code
GoMI	Bayou Corne-Grand Bayou	12	080903020302
	Bayou Grand Marais	12	080802020103
	Bayou St. Vincent-Little Grand Bayou	12	080903020304
MRBI	Bayou Macon	8	08050002
	Boeuf River	8	08050002
	Lower Mississippi-Baton Rouge	8	08070100
	Lower Mississippi-Greenville	8	08030100
	Lower Mississippi-Natchez	8	08060100
	Mermentau	8	08080202
NWQI	Big Creek	12	080702050203
	East Fork Big Creek	12	080702050202
	Indian Bayou-Bayou Queue De Tortue	12	080802020101
	Lake Louis-Bayou Louis	12	080402070303

Figure 13. Watershed characterization, source identification, and prioritization are essential to the success of the Louisiana Nutrient Management Strategy. USDA NRCS programs including the Gulf of Mexico Initiative (GoMI), Mississippi River Basin Initiative (MRBI), and National Water Quality Initiative (NWQI) have utilized watershed level characteristics and identification of potential sources to prioritize watersheds at the HUC 8 and 12 level within the state of Louisiana for water quality improvement through implementation of best management and conservation practices.



E.3.7 Incentives, Funding, & Economic Impact Analyses

Ensuring that adequate technical assistance and funding are available for the implementation of voluntary nutrient management strategies will improve participation and minimize any economic losses associated with strategy implementation. Taking advantage of leveraging opportunities among programs and providing incentives for nutrient strategy implementation will encourage voluntary participation. Leveraging funds from LDEQ, LDAF, USDA, USEPA, and local parish governments has resulted in economic incentives, technical support, and funding sources for implementation of conservation practices (CPs) in priority watersheds.

Economic impact analyses may be necessary in order to determine the relative costs associated with improving water quality through nutrient management for point as well as nonpoint source inputs to Louisiana's water bodies. Determining economic impacts is of interest to the regulatory and non-regulatory stakeholders. Thus, specific economic impact analyses may be warranted to determine costs associated with various nutrient management activities and implementation (Figure 14).

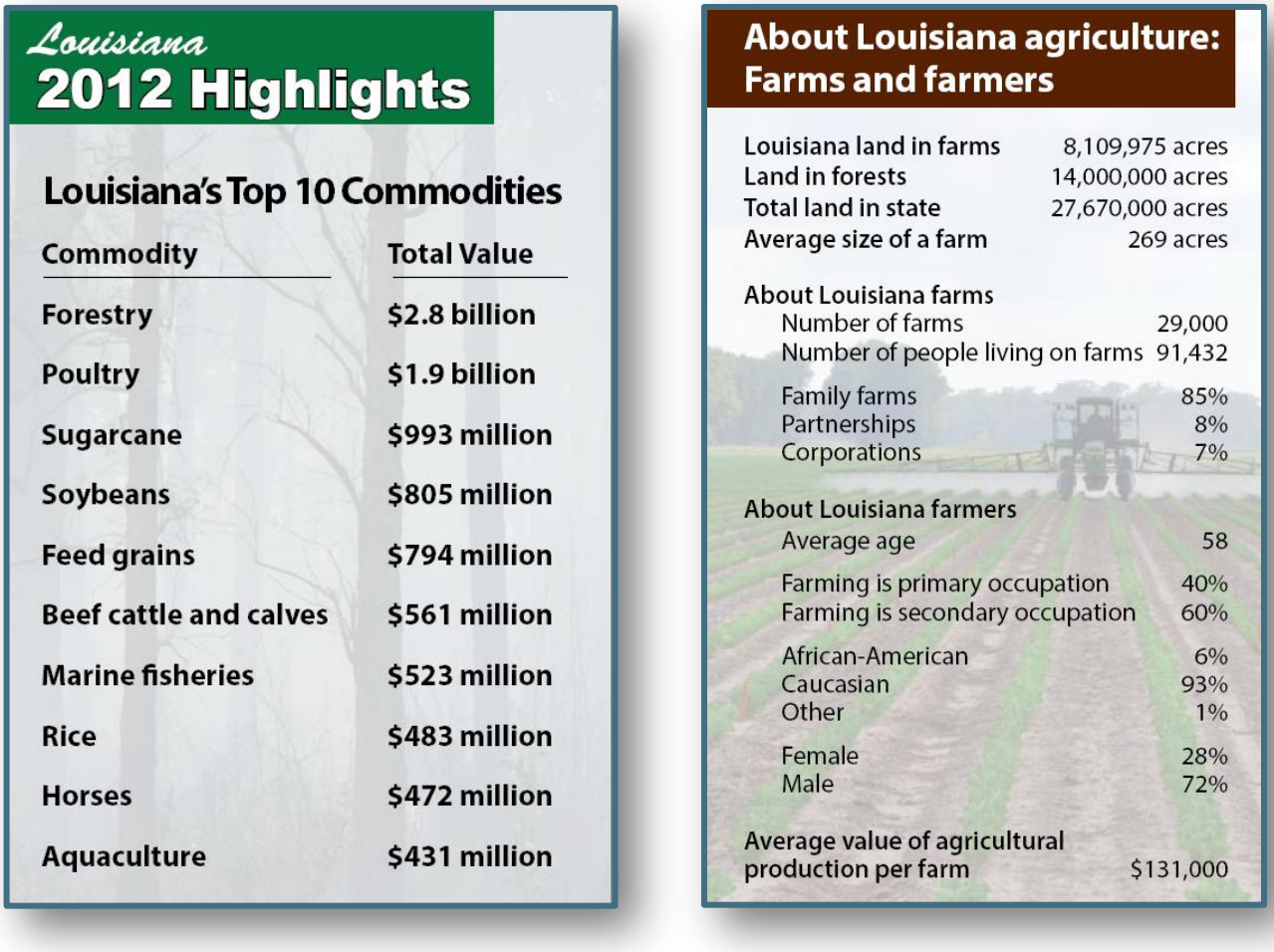
Economics of nutrient management play a large role in whether or not stakeholders participate in voluntary programs. Two notable voluntary programs in Louisiana are the Master Farmer program administered by LDAF and the Environmental Leadership Program (ELP) administered by LDEQ. These programs educate and certify agricultural producers (Master Farmer) and recognize industries (ELP) for taking voluntary steps to improve water quality through nutrient management. The Master Farmer program requires classroom education and the development of a nutrient management plan for their specific operations. The ELP recognizes industry leaders that take the initiative to make voluntary reductions in nutrient discharge above and beyond their permit requirements. These voluntary programs will be promoted, opportunities for financial and technical assistance will be pursued, and synergies and partnering opportunities will be sought for leveraging nutrient management projects with other programs.

The strategic actions for Incentives, Funding, & Economic Impact Analyses under the Nutrient Management Strategy are to:

- Promote voluntary participation in incentive-based programs
- Identify and communicate available funding support
- Promote assistance (financial or technical) for BMP/CP implementation
- Promote assistance (financial or technical) for point sources
- Document economic impacts from available sources
- Explore feasibility for credit trading
- Identify gaps

Timelines and milestones for these strategic actions are given in Appendix A.

Figure 14. Economics play an important role in agricultural production. Agricultural production within the state of Louisiana totaled more than 9.7 billion in 2012 for the top ten commodities. With the average value produced by a farm in Louisiana valued at $131K among 29,000 farms within the state, Louisiana has a major stake in agriculture production (reproduced from Westra and Niu, 2013, LSU AgCenter *Highlights of Louisiana Agriculture 2012*).



Louisiana
2012 Highlights

Louisiana's Top 10 Commodities

Commodity	Total Value
Forestry	$2.8 billion
Poultry	$1.9 billion
Sugarcane	$993 million
Soybeans	$805 million
Feed grains	$794 million
Beef cattle and calves	$561 million
Marine fisheries	$523 million
Rice	$483 million
Horses	$472 million
Aquaculture	$431 million

About Louisiana agriculture: Farms and farmers

Louisiana land in farms	8,109,975 acres
Land in forests	14,000,000 acres
Total land in state	27,670,000 acres
Average size of a farm	269 acres
About Louisiana farms	
Number of farms	29,000
Number of people living on farms	91,432
Family farms	85%
Partnerships	8%
Corporations	7%
About Louisiana farmers	
Average age	58
Farming is primary occupation	40%
Farming is secondary occupation	60%
African-American	6%
Caucasian	93%
Other	1%
Female	28%
Male	72%
Average value of agricultural production per farm	$131,000

Source: Westra and Niu. 2013. LSU AgCenter *Highlights of Louisiana Agriculture 2012*.

E.3.8 Targets & Goals

Targets and Goals under the Louisiana Nutrient Management 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. Commitments from agencies on programs and available resources are necessary to accomplishing these actions. A timeline from 2012 to 2018 is presented, which allows for interim milestones charting progress toward this nutrient management collaboration for protecting, improving, and restoring water quality in Louisiana's water bodies. All strategic actions for Targets and Goals including agency commitments, timelines, and milestones are presented in Appendix A. Several strategic actions have already been completed in 2012 and 2013.

In 2018, an assessment of the strategy will be conducted to allow for indication of progress to date and updates based on new information that has become available. Amendments or adjustments to strategic actions may occur as necessary. As multiple entities are committed to the protection, improvement, and restoration of Louisiana's water quality, this adaptive management approach is integral to the Louisiana Nutrient Management Strategy. An adaptive management approach allows us to capitalize on the successes, incorporate new science as it becomes available, and reconsider management activities that are found to be less effective.

While in many cases resolving water quality issues including nutrient concerns is a long-term challenge, a short-term assessment of progress to date allows Louisiana entities to chart progress, make needed adjustments based on newly available information, and integrate new research, technologies, and opportunities into the Louisiana Nutrient Management Strategy. Other Louisiana programs such as the LDEQ Nonpoint Source Program (LDEQ 2011) and CPRA 2012 Coastal Master Plan (CPRA 2012) utilize a 5-year timeline for program evaluation that incorporates adaptive management. This adaptive management approach is crucial to ensuring that the methods for managing nutrient remain effective and that results that demonstrate successful nutrient management within Louisiana and the larger MARB are communicated. The Targets and Goals schedule for strategic actions under all strategic components of the Louisiana Nutrient Management Strategy is presented in Appendix A, and includes agency commitments, timelines, and milestones from 2012 to 2018.

E.3.9 Monitoring

Monitoring will allow for documentation of nutrient levels and other relevant information regarding nutrient management activities. Monitoring will facilitate the demonstration and verification that nutrient management measures are having the desired effect on water quality. In the event that water quality has not improved, monitoring data will guide improvements in the application of more robust and effective nutrient management actions.

Currently LDEQ conducts monitoring through its Ambient Water Quality Monitoring Network (AWQMN) (Figure 15). LDEQ currently monitors over 400 water bodies statewide on a four-year rotating cycle where each water body is monitored monthly for one year out of the four-year cycle; thus, approximately 25% of the surface water bodies are monitored within a given year. LDEQ also currently monitors 21 stations located on larger water bodies in the state as part of long-term monitoring; these stations are monitored monthly every year. The LDEQ NPS Program monitors watersheds where Watershed Implementation Plans (WIPs) were developed to address water body impairments through implementation of conservation practices (LDEQ 2011).

Through the LDEQ Louisiana Pollutant Discharge Elimination System (LPDES) Permit Program, LDEQ has collected nutrient effluent monitoring data from major facilities discharging to the Mississippi River. Additionally, nutrient monitoring requirements have been added to many individual and general permits in the Lake Pontchartrain Basin based on Total Maximum Daily Load (TMDL) conditions. Point source wetland assimilation and Concentrated Animal Feed Operation (CAFO) permittees must monitor nutrients in their effluent. Municipal Separate Storm Sewer (MS4) storm water permittees discharging to waters with dissolved oxygen/nutrient TMDLs are required to develop monitoring programs to demonstrate best management practices (BMPs) are controlling pollutants in runoff. The multi-sector general permit requires nutrient (e.g. nitrogen and phosphorus) and/or nutrient-related parameter (e.g. nitrate/nitrite-nitrogen) monitoring for specific sectors and subsectors within each of the following industry categories: chemical and allied products, metal mining, mineral mining and dressing, food and kindred products, and fabricated metal products.

CPRA currently conducts monitoring within the coastal zone of Louisiana through its Coastwide Reference Monitoring System (CRMS)-*Wetlands* (2013) with future planned monitoring to be expanded to include more robust water variables. A System Wide Assessment and Monitoring Program (SWAMP) is in the development stage at CPRA which will provide leveraging of resources and may provide a mechanism for monitoring across several data types including physical, chemical, and biological data within Louisiana's coastal zone (The Water Institute of the Gulf 2013).

Louisiana will investigate opportunities to leverage monitoring resources with the USEPA, USDA, and USGS through the Mississippi River Monitoring Collaborative joint effort. A tiered approach to monitoring at edge-of-field, in-stream, and watershed level may provide necessary information on the effectiveness of conservation practices on the farm as well transport of

nutrients and sediment in-stream and downstream. Edge-of-field monitoring may become more important especially as lag times in water quality improvements from implementation of conservation practices are recognized (Figure 16).

The strategic actions for Monitoring under the Louisiana Nutrient Management Strategy are to:

- Monitor in-stream nutrient water quality
- Monitor relative to BMP/CP implementation
- Monitor nutrients associated with riverine diversions
- Monitor nutrients in point sources
- Evaluate compliance with point source permits
- Identify gaps

Timelines and milestones for these strategic actions are given in Appendix A.

Figure 15. The Louisiana Department of Environmental Quality (LDEQ) performs routine water quality monitoring within the state's water bodies through its Ambient Water Quality Monitoring Network (AWQMN).

Figure 16. Edge-of-field monitoring of implemented agricultural best management practices (BMPs) and conservation practices (CPs) may provide valuable data on the effectiveness of a practice at the farm level to address nutrients while acknowledging that short and long-term effects may differ and that results could vary with environmental conditions such as rainfall or drought.

E.3.10 Reporting

Reporting is a critical component of Louisiana's Nutrient Management Strategy. Communication to all stakeholders is important to learn from the practices that are implemented. Reporting can take many forms including traditional reports, websites, presentations, and meetings.

The strategic actions for Reporting under the Nutrient Management Strategy are to:

- Develop a Louisiana Nutrient Management Strategy
    - Review draft strategy
    - Final strategy
- Report annually on strategy activities
- Disseminate information through strategy website (Figure 17)
- Present information geospatially using web-based viewer (Figure 18)
- Document spotlight(s) of nutrient management

Timelines and milestones for these strategic actions are given in Appendix A.

The *Review Draft (December 2013)* of the *Louisiana Nutrient Management Strategy: Protection, Improvement, and Restoration of Water Quality in Louisiana's Water Bodies* was released for public comment on December 20, 2013 (as made available on the Louisiana Nutrient Management Strategy website). The public comment period ended January 31, 2014 and response to public comments are presented in Appendix F.

Figure 17. Reporting nutrient management strategy activities and results is important to the success of the Louisiana Nutrient Management Strategy. Through accessing the website http://lanutrientmanagement.org, stakeholders can learn more about current and planned nutrient management activities within Louisiana.

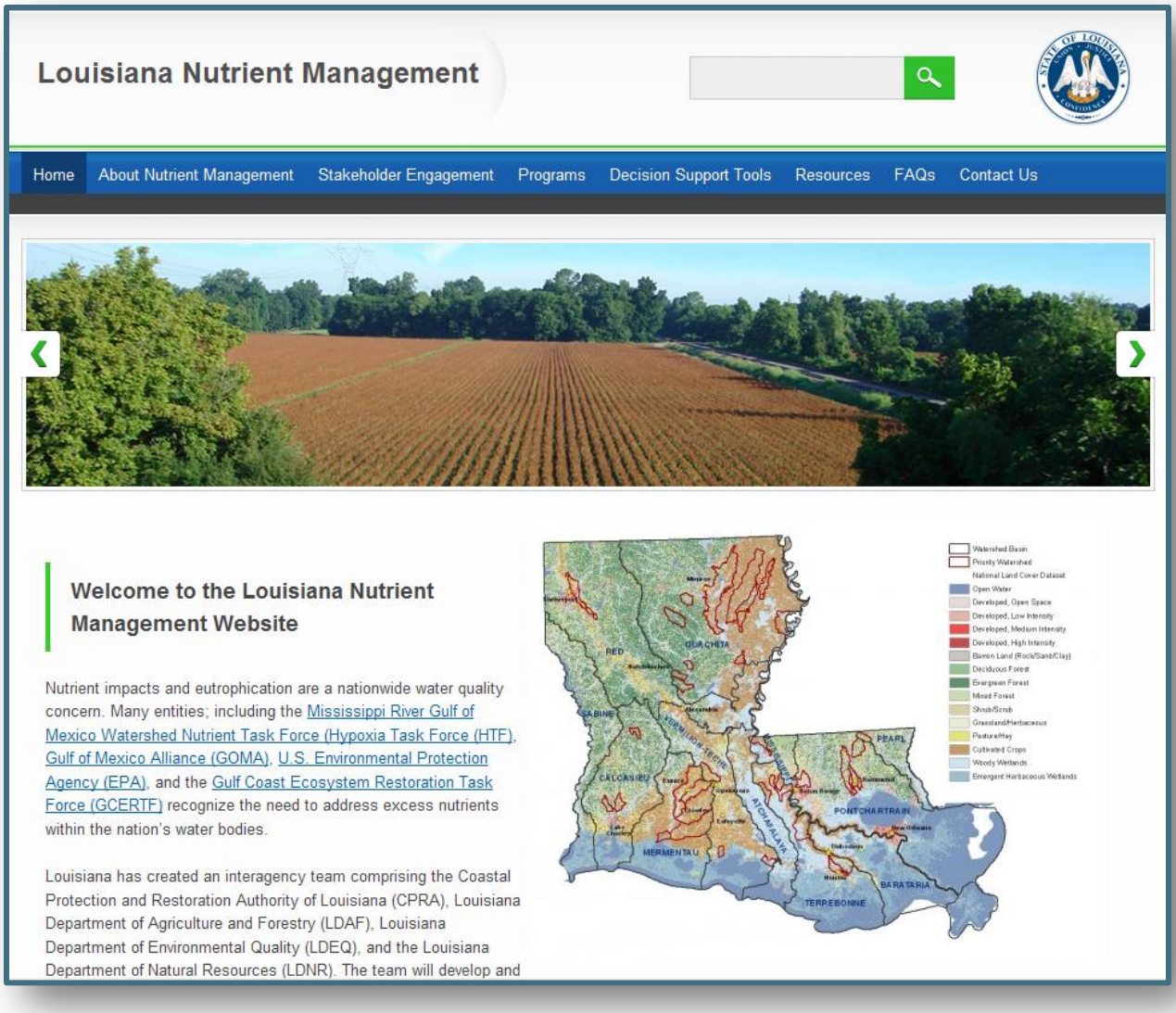
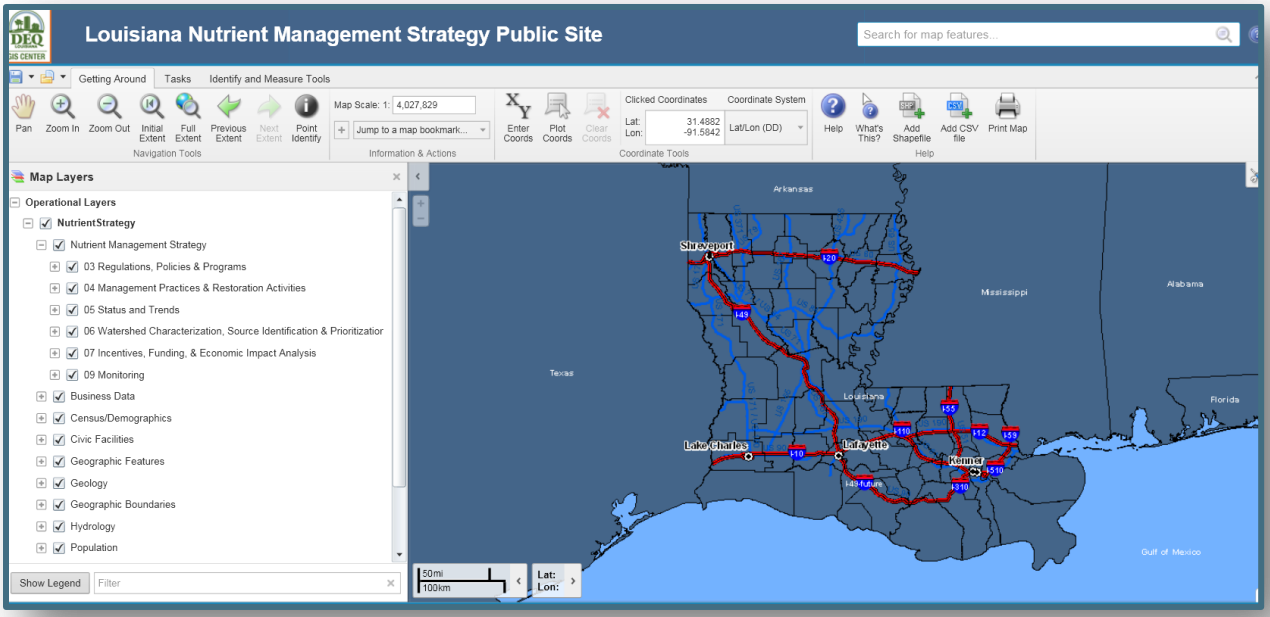


Figure 18. Web-based geospatial information for the Louisiana Nutrient Management Strategy is available through the LDEQ Interactive Mapping Application (LIMA). To access visit http://map.ldeq.org/, go to GIS Projects on left hand menu, and navigate to the Nutrient Management Strategy link.



F. IMPLEMENTATION OF LOUISIANA'S NUTRIENT MANAGEMENT STRATEGY

Nutrient management within Louisiana's water bodies relies on methods for control and capture of nutrients to ensure the receiving water body maintains nutrient levels suitable to maintain biogeochemical processes and productive ecosystems (Figure 19). Methods that promote incentives may foster voluntary participation, and opportunities for leveraging among programs, partnerships, and stakeholders will be necessary for ultimate water quality protection, improvement, and restoration within Louisiana's water bodies.

Nutrient management methods will be appropriate for watersheds regionally and temporally based on land use practices. A one-size-fits-all approach is not appropriate for the state of Louisiana given the unique geographic features located within the state (uplands, alluvial plains, coastal wetlands and deltas, etc.) and associated variety of land uses (cultivated crops, forests, pasture, wetlands, etc.). Appropriate conservation and management practices may differ among watersheds and the timing within the year for nutrient water quality impacts may differ depending on when those management and conservation practices are implemented.

The Louisiana Nutrient Management Strategy will utilize river diversions, nonpoint source and point source management, and voluntary incentive-based programs to address nutrient issues within the state. Additionally, leveraging opportunities are being identified that will allow for multi-entity collaboration on watershed scale projects to engage all stakeholders and promote enhanced participation in order to protect, improve, and restore Louisiana's water bodies.

River diversions are a large component of *Louisiana's Comprehensive Master Plan for a Sustainable Coast* (2012 Coastal Master Plan, CPRA 2012). These projects reconnect the Mississippi River to the adjacent deltaic wetlands and estuaries to re-establish land-building and land-sustaining processes that have been disrupted by river management and flood protection projects over the past century. In addition to building and sustaining coastal land, diversions have the added benefit of assimilating nutrients that are carried in the water and by the sediment. By removing nutrients, river diversion projects have a great potential to mitigate the amount of nutrients that reach the Gulf of Mexico.

Louisiana has an active and effective Nonpoint Source (NPS) program that operates through a NPS Management Plan for 2011-2016 (LDEQ 2011). One of the important aspects of this NPS Management Plan is inclusion of statewide and watershed annual milestones where state and federal agencies worked in collaboration with watershed stakeholders to select and prioritize water bodies to partially or fully restore by 2016. Additionally, assistance programs through the USDA NRCS and LDAF Office of Soil and Water Conservation (OSWC) aid with the identification and implementation of appropriate nonpoint source Best Management Practices (BMPs) and conservation practices (CPs) for a given watershed in the state.

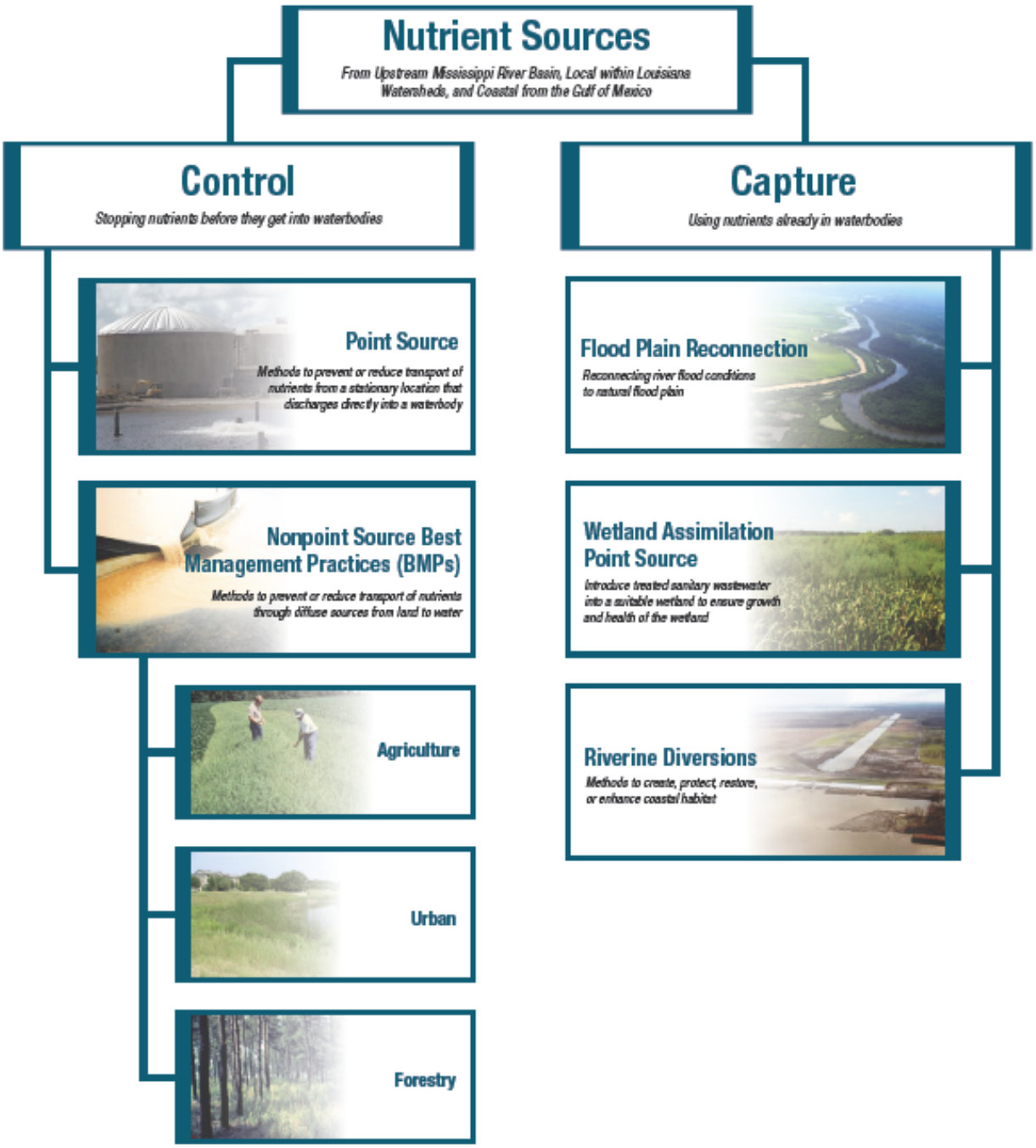
Managing point source nutrient discharges is also an important component of overall nutrient management. Since the creation of the Clean Water Act in 1972, the National Pollutant

Discharge Elimination Systems (NPDES) program has been a major force in the nation's efforts to protect and restore the quality of our rivers, lakes, and coastal waters. Louisiana's Water Quality Regulations (LAC 33:Chapter IX) require permits for the discharge of pollutants from point source into waters of the state of Louisiana. This surface water discharge permitting system is administered under the Louisiana Pollutant Discharge Elimination System (LPDES) Permit Program.

Methods that incorporate sustainability and innovation to ensure nutrient water quality protection, improvement, and restoration will be developed based on specific diagnoses of the true nutrient issues within a watershed. Whether watersheds are nutrient-rich, nutrient-starved, or currently at an appropriate nutrient-level, Louisiana's Nutrient Management Strategy will identify and encourage the most appropriate solution to be identified and implemented.

Figure 19. Conceptual model of nutrient sources entering Louisiana water bodies locally, from upbasin, or even from the coastal area. Methods for nutrient control or capture specific to Louisiana land form, geography, and agricultural and industrial production will aid in managing nutrients within Louisiana water bodies.

Photos provided by CPRA, LDAF, LDEQ, and USDA NRCS.



F.1 River Diversions

Louisiana is situated at the bottom of the Mississippi-Atchafalaya River Basin (MARB) watershed, where watersheds that drain from far upriver terminate. Once nutrients have entered the Mississippi River system, they are on a highway to the Gulf of Mexico (GOM) where they contribute to Gulf Hypoxia. However, river diversions constructed by the Coastal Protection and Restoration Authority of Louisiana (CPRA) for the purposes of rebuilding and sustaining coastal wetlands also have the benefit of assimilating and removing nutrients that have already entered the river system. Diversions from the Mississippi and Atchafalaya rivers play an important role in sustaining Louisiana's coast. By re-establishing deltaic processes that have been disrupted by historical river management and flood protection measures, river diversions will maintain existing wetlands and build new land while dramatically increasing the nutrient assimilation capacity of Louisiana's wetlands to combat hypoxia in the GOM.

Louisiana's 2012 Coastal Master Plan (CPRA 2012) prescribes a variety of projects to reduce storm damage risk and to restore coastal ecosystems to a sustainable condition. The 2012 Coastal Master Plan utilized decision criteria to assess risk reduction and restoration potential and identified 109 projects that maximize these benefits (CPRA 2013a). Ecosystem services were a part of the project selection consideration. Nutrient uptake potential was evaluated as one of the ecosystem services provided by projects in the 2012 Coastal Master Plan, specifically the plan evaluated restoration and protection project effects on nitrogen removal in open water, sediment, and wetland areas. Louisiana's coastal wetlands have a tremendous capacity to trap and assimilate nutrients that are carried in river water (Rivera-Monroy et al. 2013).

Reconnecting the river with the coastal wetlands through diversion projects is a restoration strategy that has been proposed in Louisiana for decades and a number of diversion projects have already been constructed and are operating (Figure 20). River diversion projects have been a significant component of every coastal planning effort since the 1990s and are a keystone project of the master plan that will help rebuild some of the nearly 4,900 square kilometers (1,900 square miles) of coastal wetlands that have been lost between the early 1930s and 2010 (Couvillion et al. 2011) and sustain those that have not been lost. In addition, diversions will sustain some of the projected 4,500 square kilometers (1,750 square miles) of land that could be lost in the next 50 years without any action (CPRA 2012).

Research suggests that estuaries have a number of biotic and abiotic pathways to remove nutrients from the water column, including denitrification, burial, plant uptake, and assimilation into the food web. Thus, the overall amount of nitrogen and phosphorus reaching the GOM can be reduced by reconnecting the Mississippi River to coastal estuaries (DeLaune et al. 2005; Lane et al. 2004).

Figure 20. Example of an existing diversion Davis Pond Freshwater Diversion connecting the Mississippi River (foreground) with coastal wetlands (background).

A tremendous amount of research has been done over recent decades to investigate nutrient transformation and assimilation in areas receiving diverted Mississippi River water. This research includes empirical studies in a variety of habitats including coastal swamps, wetlands, and estuaries.

To estimate the potential nitrogen and phosphorus assimilation capacity of existing and future planned diversion projects, CPRA used a first order, area-based model (known as P-k-C*) following Kadlec and Knight (1996), and updated in Kadlec and Wallace (2009). The river diversion operational strategies used in the model were those used in CPRA project planning efforts or were based on actual operations (for existing diversions). These operational scenarios considered average river hydrographs, climate variables, diversion capacity, river nutrient load variations and receiving basin characteristics (CH2M Hill 2013). The model utilizes conservative inputs, considering the existing landscape, and does not account for future added benefits and synergies with increased land-building from future projects under the 2012 Coastal Master Plan (CPRA 2012).

Existing river diversions in Louisiana that were modeled during this study include the gated structures at Davis Pond and Caernarvon (both authorized under the Water Resources Development Act) and siphons at Naomi and West Pointe a la Hache (Figure 21; Table 5). Incorporating the actual operations of these diversions over the past 5 years into the nutrient

model and assuming average river conditions, resulted in a total annual removal of 4,381 tons of total nitrogen (TN) and 129 tons of total phosphorus (TP) (Figure 22).

CPRA also investigated the potential for future planned diversions to assimilate nutrients. Under current projections, it is anticipated that CPRA will begin construction of two of these planned diversions, the West Maurepas and the Mid-Barataria diversions, within the next 5 years. These diversion projects will dramatically increase the nutrient removal capacity within coastal Louisiana. The modeled annual nutrient removal capacity of these two projects is 10,187 tons of TN and 124 tons of TP during an average river year.

Long-term future plans for CPRA's 2012 Coastal Master Plan include the implementation of the remaining eight planned river diversion projects. Construction of these additional river diversions will increase the nutrient removal capacity of Louisiana's river diversion projects dramatically. With all of the planned diversions constructed and fully operational, Louisiana has the potential in an *average* river-year to remove 68,317 tons of TN and 1,341 tons of TP, preventing these loads from reaching the GOM (Table 5).

USGS developed a Spatially Referenced Regressions on Watershed Attributes (SPARROW) model which reported contributions of each state to the average annual loading in the MARB. For Louisiana, the model reported contributions of 1.7% of the total loading for total nitrogen (26,654 tons/year) and 2.4% of the total phosphorus (3,276 tons/year) (Alexander et al. 2008a). Evaluating these modeled estimates in the context of river diversions suggests that existing and planned river diversion projects in Louisiana could remove a significant portion, if not all, of the nutrient loads attributed to Louisiana in these models.

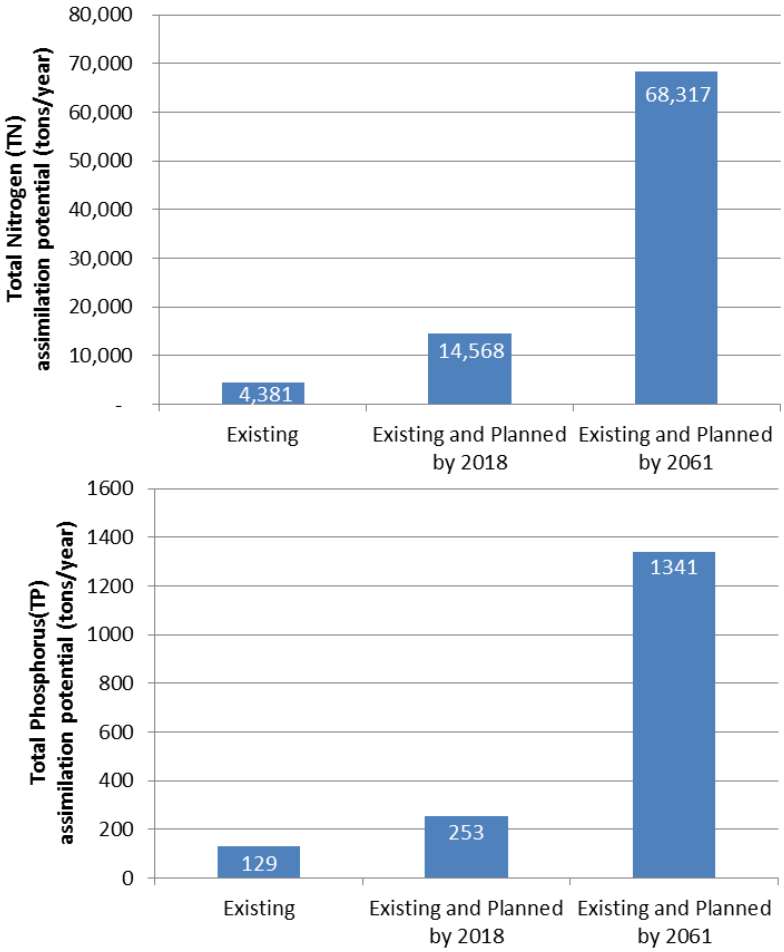
Estimating the nutrient removal capacity of Louisiana's estuaries with large river diversions is a developing science. However, with a fully implemented 2012 Coastal Master Plan, Louisiana could potentially remove more nitrogen from the MARB than it contributes, thereby mitigating nitrogen loads from upbasin states. As the planning process continues and the supporting science builds, landscape and project-level nutrient reductions estimates are being refined and future updates to this Nutrient Management Strategy will reflect the most current scientific updates.

Figure 21. Location of existing and planned river diversions in Louisiana (see Table 5).

Table 5. Estimates of total nitrogen (TN) and total phosphorus (TP) assimilation potential for existing and planned river diversion projects in Louisiana.

Existing Diversion Projects		TN Assimilation Potential (tons/year)	TP Assimilation Potential (tons/year)
1	Davis Pond	1,635	60
2	Caernarvon	1,656	45
3	Naomi	401	8
4	West Point a la Hache	689	16
Total Potential for Existing Projects		**4,381**	**129**
Planned Diversions (0-5 years)			
5	West Maurepas	1,677	23
6	Mid-Barataria	8,510	101
Total Potential for Near-Term Projects		**10,187**	**124**
Planned Diversions (6-50 years)			
7	Atchafalaya Diversion	16,556	168
8	Bayou Lafourche	460	9
9	Lower Barataria	6,233	85
10	Lower Breton	3,805	110
11	Mid-Breton	1,457	10
12	Upper Breton	22,332	629
13	Central Wetlands	2,906	77
Total Potential for Long-Term Projects		**53,749**	**1,088**
GRAND TOTAL Assimilation Potential		***68,317***	***1,341***

Figure 22. Total nitrogen (top) and total phosphorus (bottom) assimilation potential for existing and planned river diversions in Louisiana.



Existing Diversions	Existing and Planned by 2018	Existing and Planned by 2061	
Davis Pond	Davis Pond	Davis Pond	Atchafalaya Diversion
Caernarvon	Caernarvon	Caernarvon	Bayou Lafourche
Naomi	Naomi	Naomi	Lower Barataria
West Point a la Hache	West Point a la Hache	West Point a la Hache	Lower Breton
	West Maurepas	West Maurepas	Mid-Breton
	Mid-Barataria	Mid-Barataria	Upper Breton
			Central Wetlands

F.2 Nonpoint Source Management

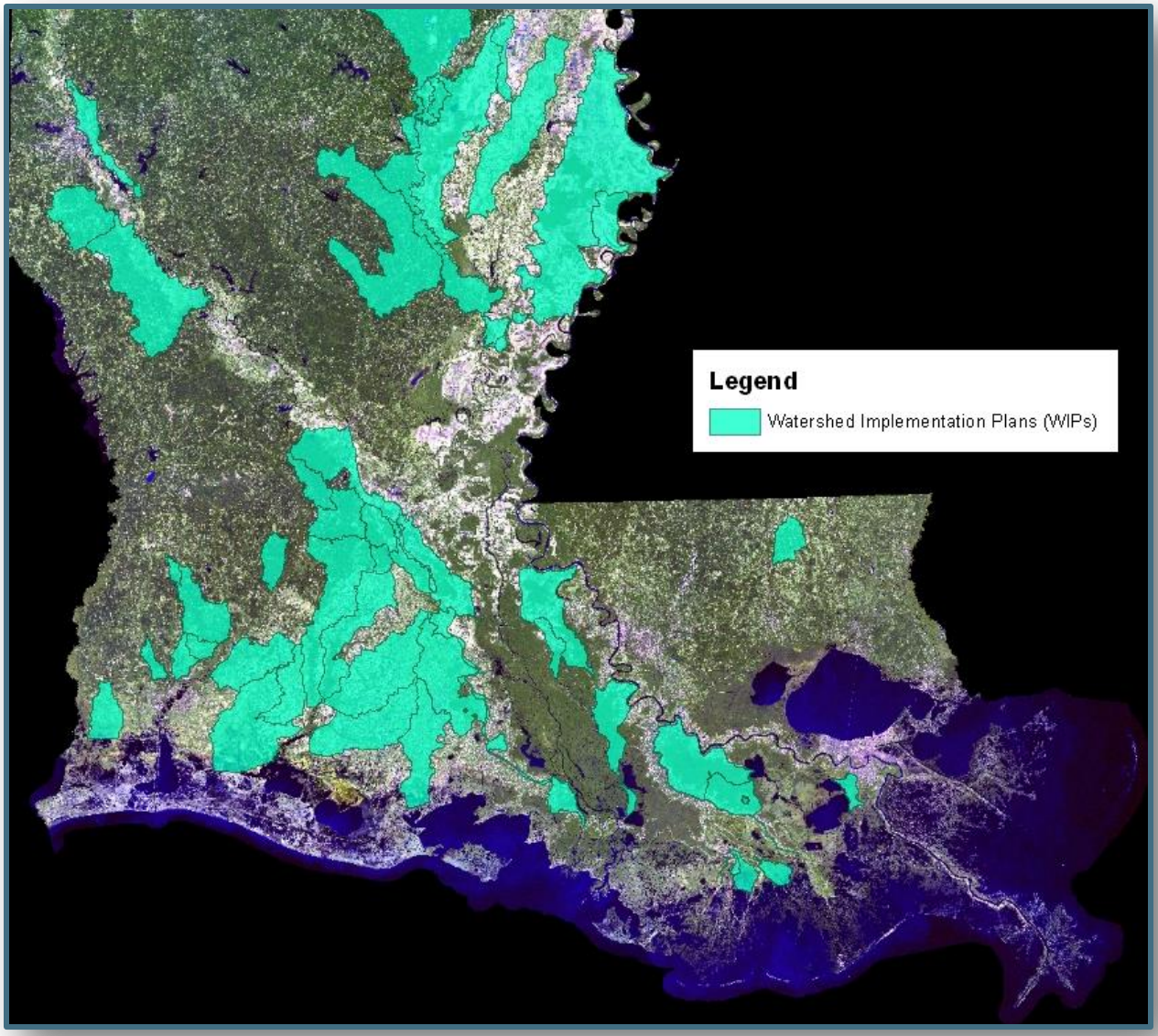
Nonpoint source pollution (NPS) is a type of water pollution that is not generated from a discrete conveyance, such as a discharge pipe, but is generated during rainfall events. Nonpoint sources include agricultural and urban runoff. Section 319 of the Clean Water Act (CWA) required that the states develop a NPS Management Plan to reduce and control nonpoint sources of pollution from the various types of land-uses that contribute to water quality problems across the United States.

The Louisiana Department of Agriculture and Forestry (LDAF), the Louisiana Department of Environmental Quality (LDEQ), and the Louisiana Department of Natural Resources (LDNR) developed a NPS Management Plan for the state of Louisiana which includes nonpoint source prevention and implementation measures for both inland and coastal water bodies of Louisiana (LDEQ 2011). Through NPS projects, additional agencies and other entities including the USDA, collaborate and leverage to develop and implement Watershed Implementation Plans (WIPs) that describe the BMPs and CPs, management programs, and milestones to address NPS issues within a given watershed. LDEQ (2011) recognized that 264 water body impairments of various suspected sources were removed from the CWA 303(d) list between 2006 and 2010, reflecting Louisiana's efforts in improving water quality.

Watershed Implementation Plans (WIPs) have been developed and implemented for over 50 subsegments in Louisiana (LDEQ 2013f; Figure 23). An analysis of nutrient data collected through LDEQ's Ambient Water Quality Monitoring Network indicates nutrient water quality is improving in many of these watersheds where a WIP has been developed and implemented through the CWA Section 319 program (LDEQ 2013d). In 15 subsegments in the Ouachita River Basin in northeast Louisiana with WIPs developed and implemented, 11 (73% of the subsegments) show decreasing nitrate-nitrite (NO3NO2) trends, 13 (87%) show decreasing total Kjeldahl nitrogen (TKN) trends, 12 (80%) show decreasing total phosphorus (TP) trends. Further of seven subsegments with a WIP in the Mermentau River Basin in southwestern portion of Louisiana, seven (100%) show decreasing NO3NO2, six (86%) show decreasing TKN, and four (57%) show decreasing TP trends (LDEQ 2013d).

In the state of Louisiana agriculture, forestry, urban storm water runoff, and home sewage systems contribute to nonpoint source pollution issues and may be a source of nutrients into Louisiana's water bodies. Nonpoint source issues can be addressed through BMPs or CPs specific to the suspected source of pollution. Another method for nonpoint source management is floodplain reconnection which is a management practice where hydrologically modified areas are reconnected to the natural floodplain. BMPs, CPs, and floodplain reconnection that may be used to help address nonpoint source pollution in Louisiana's water bodies are discussed below.

Figure 23. The LDEQ Nonpoint Source Program has developed and implemented Watershed Implementation Plans (WIPs) in over 50 subsegments in Louisiana to address water quality impairments. Improvements in water quality are being observed in such watersheds.



F.2.1 Best Management Practices (BMPs) and Conservation Practices (CPs)

For nonpoint source pollution that originates from diffuse sources through runoff, best management practices (BMPs) and conservation practices (CPs) are key to addressing suspected sources of nutrients. These practices are specific to the source of the suspected pollutant and those for agricultural, forestry, urban storm water runoff, and home sewage systems may help to address nutrients within Louisiana's water bodies.

F.2.1.1 Agricultural

Agricultural practices associated with crops, pastures, dairies, and aquaculture may result in nonpoint sources of nutrients into Louisiana's water bodies. The LSU AgCenter has developed a series of BMP guidance documents for these major agricultural activities within Louisiana (LSU AgCenter 2013b). BMPs specific to aquaculture, beef, crawfish, dairy, poultry, rice, sweet potato, sugarcane, and swine are available through the LSU AgCenter (Table 6).

Through the LDAF, there are several agricultural-based programs regarding management practices currently in place. These agricultural programs include Louisiana Master Farmer Program, Louisiana Master Poultry Producer Program, Louisiana Master Rice Grower Program, Master Cattle Producer Certification, Prescribed Agriculture Burning Management Certification, Prescribed Forest Burning Management Certification, Master Gardener Certification, Louisiana Yards & Neighborhood Initiative - Best Practices Education & Outreach, Louisiana Master Naturalist, and the Pesticide Safety Applicator Certification.

USDA NRCS recommends a 'systems approach' to nonpoint source management that targets core and supporting conservation practices and management techniques to address water quality concerns due to sediment and nutrient runoff (USDA NRCS and LDAF OSWC 2012; USDA NRCS 2013e). This systems approach concept is referred to as Avoiding, Controlling, and Trapping (ACT). Primarily agriculture-based, ACT provides an approach to help producers avoid pollution by reducing the amount of agricultural nutrients available in runoff or leaching into water bodies; to control by preventing the loss of pollutants; and to trap as a last line of defense against potential pollutants at edge of field, or in facilities to trap and assimilate nutrients before entering water bodies. Core and supporting practices for water quality that are part of the ACT are listed in described in Table 7. Additionally, see Appendix B for description of USDA NRCS conservation practices in Louisiana, and Appendix C for recent USDA NRCS conservation practice implementation by acres within the state.

Table 6. Best Management Practice (BMP) manuals produced specifically for Louisiana (LDAF 2009; LDNR 2013a, b, c; LSU AgCenter 2013b).

1	Hydromodification	**8**	Swine
2	Rice	**9**	Beef
3	Poultry	**10**	Aquaculture
4	Agronomic Crops	**11**	Crawfish
5	Dairy	**12**	Urban Storm water
6	Sweet Potato	**13**	Urban Storm water: Highways, Roads, Bridges
7	Sugar Cane	**14**	Forestry

Table 7. USDA NRCS core and supporting conservation practices (CPs) for water quality in Louisiana (reproduced from USDA NRCS and LDAF OSWC 2012).

	CORE PRACTICES		SUPPORTING PRACTICES	
	Code	***Practice Name***	***Code***	***Practice Name***
AVOIDING	328[a]	Conservation Crop Rotation[2]	327	Conservation Cover[4]
	340	Cover Crop[2]	381	Silvopasture Establishment[5]
	528	Prescribed Grazing[1]	382[c]	Fence[0]
	590[b]	Nutrient Management[5]	464	Irrigation Land Leveling[2]
	633	Waste Utilization[0]	472	Access Control[2]
			511	Forage Harvest Management[1]
			561	Heavy Use Area Protection[1]
			612	Tree & Shrub Planting[2]
CONTROLLING	329	Residue & Tillage Management[4]	324	Deep Tillage[1]
	330	Contour Farming[2]	342[d]	Critical Area Planting[1]
	345	Residue & Tillage Management[2]	362	Diversion[0]
	346	Residue & Tillage Management[4]	386	Field Border[2]
	412	Grassed Waterway[2]	410	Grade Stabilization Structure[0]
	512	Pasture & Hayland Planting[1]	430[e]	Irrigation Water Conveyance, Pipeline[1]
	554	Drainage Water Management[1]	447	Tailwater Recovery[2]
	643	Restoration & Management of Declining Habitats[0]	449	Irrigation Water Management[2]
	645	Upland Wildlife Habitat Management[0]	468	Lined Waterway or Outlet[0]
	Conservation Practices Physical Effects (CPPE) factors for Water Quality Degradation - Nutrients in Surface Water (superscripts match color formatting): [5]Substantial Improvement; [4]Moderate to Substantial Improvement, [3]Moderate Improvement, [2]Slight to Moderate Improvement; [1]Slight Improvement; [0]No effect; [-1]Slight Worsening; [-2]Slight to Moderate Worsening.		484	Mulching[2]
			533	Pumping Plant[0]
			558	Roof Runoff[2]
			587	Structure for Water Control[0]
			606	Subsurface Drainage[-2]
			607	Surface Drainage[-2]
			620[f]	Underground Outlet[-1]
			638	Water & Sediment Control Basin[0]
TRAPPING	332	Contour Buffer Strips[2]	350	Sediment Basin[5]
	342	Critical Area Planting[1]	356	Dike[0]
	390	Riparian Herbaceous Cover[5]	436[g]	Irrigation Storage Reservoir[0]
	391	Riparian Forest Buffer[5]	490[h]	Forest Site Preparation[0]
	393	Filter Strip[4]	533	Pumping Plant[0]
	601	Vegetative Barriers[2]	587	Structure for Water Control[0]
	635	Vegetated Treatment Area[4]	629	Waste Treatment[2]
	656	Constructed Wetland[4]	638	Water & Sediment Control Basin[0]
	657	Wetland Restoration[3]	646	Shallow Water Development & Management[1]
	658	Wetland Creation[3]		
	659	Wetland Enhancement[3]		
Conservation Activity Plans	102	Comprehensive Nutrient Management Plan	a. minimum of 3 different crops must be used and/or at least 2 years in perennial vegetation; b. Fall application will give lowest ranking; c. Only use with 511, 512, and 528; d. As a component of wetlands, construction, or earth-disturbing practices; e. In conjunction with Waste Transfer (634); f. As a supplement to terraces and sediment basins; g. Only to be used with Tailwater Recovery (447); h. For use with 612, 381, and 391	
	118	Irrigation Water Management Plan		
	130	Drainage Water Management Plan		

Kröger et al. (2012) conducted a review of agricultural BMP efficiency specific to the Lower Mississippi Alluvial Valley, which includes a significant portion of the state of Louisiana including the eastern portion of the Ouachita River Basin and the Atchafalaya and Mississippi River Basins (Table 8). The review of agricultural BMPs in the Lower Mississippi Alluvial Valley indicated that total nitrogen (TN) and total phosphorus (TP) reduction efficiency ranged from 15 to 100%, with some variability noted depending on practice type and site specific conditions. In the southern portion of Louisiana, one study reported the effectiveness on sugarcane agriculture of BMPs and wetland assimilation in reducing nutrient loads by up to 100% (LeBlanc 2008).

USEPA (2010) reviewed agriculture BMP effects on nutrient loads, and a national agricultural BMP database is also available that evaluates BMP performance (Geosyntec Consultants 2013). Studies of the short- and long-term effects of conservation practices and studies that can tie practices to water quality improvement will be essential.

Table 8. Review by Kröger et al. 2012 of efficiency of agricultural best management practices (BMPs) in the Lower Mississippi Alluvial Valley (LMAV) which includes the Atchafalaya, Mississippi, and Ouachita River Basins in Louisiana (reproduced from Kröger et al. 2012).

Reference	Study Location	BMP type	Nitrogen reduction efficiency (%)	Phosphorus reduction efficiency (%)	Control
Anders et al. 2004[1]	Arkansas LMAV	No-till/conservation tillage	-	TP: 45 DP: -96	Conventional tillage
Bengston et al. 1995	Louisiana LMAV	Subsurface drainage	TN: 17	TP: 31	Surface drained field
Blanco-Canqui et al. 2004	Missouri	Vegetated filter strip	TN: 77 NO_3: 51 NH_4: 58	PP: 68 DP: 62	Continuous cultivated fallow
Cullum et al. 2010[2]	Mississippi LMAV	Conservation Reserve Program (CRP)	TN: 60 NO_3: 71 NO_2: 83 NH_4: 35 TKN: 54	TP: 52 DP: 36	Row crop
DeLaune et al. 2005	Louisiana LMAV	Wetland	NO_3: 38	-	Inflow - outflow
Kovacic et al. 2000	Illinois	Constructed wetland	TN: 37 NO_2: 28	TP: 2	Inflow - outflow
Kröger et al. 2007[3]	Mississippi	Drainage ditches	DIN: 57 NO_3: 42 NH_4: 59	-	Inflow/runoff-outflow
Kröger et al. 2008[3]	Mississippi	Drainage ditches	-	DP: 44 PP: 44 TP: 44	Inflow/runoff-outflow

Reference	Study Location	BMP type	Nitrogen reduction efficiency (%)	Phosphorus reduction efficiency (%)	Control
Manley et al. 2009	Mississippi LMAV	Winter rice field Management (stubble residual left standing and field flooded over winter)	NH_4: 26 NO_3: 100	SRP: 0	Control field(rice straw disked into field, no flooding)
McDowell and McGregor 1980	Mississippi LMAV	No-till/conservation tillage	TN: 90	TP: 84	Conventional tillage
McDowell and McGregor 1984	Mississippi	No-till/conservation tillage	Reduced till: TN: 71 No-till: TN: 75	Reduced till: TP: 82 No-till: TP: 84	Conventional tillage
Mitsch 1992	Illinois LMAV	Wetland: constructed and natural	-	Constructed: TP: 75 Natural: TP: 7	Inflow-outflow
Mitsch et al. 2005	Louisiana LMAV	Wetland	NO_3: 46	-	Inflow-outflow
Moore et al. 2010[4]	Mississippi LMAV	Drainage ditches	TN: 31 NO_3: 76 NH_4: 66 TKN: 85 NO_2: -68	TP: 91	Inflow-outflow
Rebich 2004	Mississippi LMAV	Slotted board riser	TN: 26 NO_3: 41 NH_4: 44	DIP: -105 TP: 24	Control watershed
Rebich 2004	Mississippi LMAV	No-till/conservation tillage	TN: 66 NO_3: 79 NH_4: 44	DIP: -230 TP: 46	Control watershed

Reference	Study Location	BMP type	Nitrogen reduction efficiency (%)	Phosphorus reduction efficiency (%)	Control
Udawatta et al. 2002	Missouri	Contour buffer strips	TN: 20 NO_3: 39 NH_4: 32	TP: 26	Control watershed
Zhu et al. 1989[5]	Missouri	Cover crops-brome, Canada bluegrass and chickweed	NO_3: 75 NH_4: 37	DP: 37	No cover crop plot

[1]Percentage reductions estimated from figure in manuscript and not from raw/published data; [2]Data averaged over four years, and three CRP treatments; [3]Data averaged between two different drainage ditches, over two years; [4]Averaged between vegetated and nonvegetated treatments; and [5]Nutrient reduction efficiencies averaged across cover crop treatments.

Notes: TP = total phosphorus; DP = dissolved inorganic phosphorus; PP = particulate phosphorus; SRP = soluble reactive phosphorus; DIP = dissolved inorganic phosphorus; TN = total nitrogen; NO3 = nitrate; NH4 = ammonium; TKN = total Kjeldahl nitrogen; NO2 = nitrite; DIN = dissolved inorganic nitrogen.

F.2.1.2 Forestry

Forestry practices can help ensure water quality during forestry operations from forestry landowners, logging contractors, and forest industry (LDAF 2009). Forestry BMPs and CPs include those aimed at managing forest roads, timber harvesting, site preparation/reforestation, silvicultural chemicals such as fertilizers or pesticides, fire management, and forest wetlands.

Studies conducted in Gulf Coastal Plain area of Louisiana which is characterized by low flow and intermittent streams, reported that current forestry BMPs for timber harvesting are effective in mitigating sediment runoff and limiting water quality degradation (Brown 2010; DaSilva 2012; DaSilva et al. 2013). Since 2000, BMP compliance rates averaged 96% and over 95% of individually rated BMPs met or exceeded minimum BMP requirements (Ice et al. 2010; Stich et al. 2013).

The Louisiana Forestry Association (LFA) works with various forestry industries across the state to implement training workshops for loggers on forestry BMPs. The U.S. Forest Service (USFS) has become more involved in water quality monitoring on water bodies that run through Forest Service lands. Both LFA and the USFS work closely with LDEQ on forestry educational programs that help Louisiana meet goals and objectives of Section 319 of the CWA.

F.2.1.3 Urban Storm Water Runoff

Urban storm water runoff is a source of pollution to water bodies. Some urbanized areas are covered by Municipal Storm Sewer System (MS4) permits (see Section F.3.1); however, many urban areas remain unregulated sources of pollution. Storm sewers collect and convey the urban runoff to surface waters. While nutrient concentrations in urban runoff are generally not as high as concentrations in urban point sources, such as municipal wastewater discharges, or nonpoint agricultural sources, urban areas are often not designed with consideration for their effects on nutrient export. Consideration of the complex interactions urban development has on water quality during the design and planning process can reduce negative impacts. An approach that includes strategies to plan construction and conserve natural areas can reduce the impact of urbanization on stormwater transport of nutrients to adjacent water bodies.

Best management practices to address urban storm water runoff include those aimed at site design, biofiltration, permeable pavement and media filtration, rooftop/building, and retention and detention (Geosyntec Consultants and Wright Water Engineers 2010). Specifically, an urban storm water BMP manual has been developed for New Orleans and Jefferson Parishes in south Louisiana (Geosyntec Consultants 2010).

LDEQ partners with several landscape architects on design manuals for green infrastructure and urban BMPs that can be applied in residential, commercial and light industrial areas (LDEQ 2013g). When new areas in Louisiana come under development, developers are confronted with making decisions regarding landscape design. The local landscape ordinances or local landscape codes provide guidance for landscape design. Landscape ordinances dictate how the

landscape should be designed, which may not recognize Louisiana's need for managing high volumes of storm water runoff and flooding. Considering the overwhelming influence of water in Louisiana, landscape ordinances should emphasize BMPs and instructions for preserving natural features in the landscape, particularly the native fauna and flora.

In addition, the Louisiana Yards & Neighborhood Initiative Program through the LSU AgCenter aims to encourage homeowners to create and maintain landscapes in ways that minimize environmental damage (LSU AgCenter 2013c). This is accomplished by focusing on water quality and conservation, reducing stormwater runoff and decreasing nonpoint source pollution of surface water, enhancing desirable wildlife habitats and creating functional, attractive landscapes.

F.2.1.4 Individual Home Sewage Systems

Nonpoint source nutrients from home sewage systems may also impact Louisiana's water bodies. LDEQ partners with Louisiana Department of Health and Hospitals (LDHH) on more efficient ways to coordinate inspections and field work on home sewage systems in impaired waters that are listed for fecal coliform bacteria. Individual home sewage system BMPs are available for homeowners to address this type of nonpoint source pollution (USEPA 2005; Hendrick 2007).

F.2.2 Floodplain Reconnection

Restoring the natural hydrology of a stream can be an important factor in improving water quality. Upriver (non-coastal) diversions where river water is reintroduced to the floodplain and then channeled back into the river may act to reduce sediment and nutrients loads in that diverted water. Floodplain reconnection projects involve reverting human-altered drainage patterns toward more historic and natural floodplain drainage patterns in an attempt to address problems associated with artificially altered hydrology. On a large scale, this technique may involve locks or gates on major navigation channels; on a smaller scale, it may involve blocking dredged canals or cutting gaps in levee banks that were created by canal dredging. Such floodplain reconnection projects located within Louisiana include Mollicy Farms, Atchafalaya River Basin (ARB), Cat Island National Wildlife Refuge, and Three Rivers Wildlife Management Area.

Mollicy Farms, which covers a 17,000-acre tract, is a floodplain reconnection project located in the Upper Ouachita National Wildlife Refuge in the Ouachita River Basin of Louisiana (The Nature Conservancy 2012, 2013; The Conservation Fund 2013). This project is the largest floodplain restoration effort in the Lower Mississippi Alluvial Valley. The Nature Conservancy (TNC), USFWS and partners have initiated strategic levee removal and floodplain restoration at Mollicy Farms to reestablish functional internal hydrology and restore natural floodplain functions and processes. Recently completed in October 2013, a 2.5-mile reconstructed Mollicy Bayou reconnects the area with the Ouachita River (Wold 2013).

The Atchafalaya River is the largest distributary of the Mississippi River. The Atchafalaya River Basin (ARB) receives 30% of the flow from the Mississippi and Red Rivers and new deltas are actively forming at the mouth of the Atchafalaya River and at Wax Lake Outlet. The ARB may act as a nutrient sink and retain and remove nutrients as they enter the ARB from the Mississippi and Red Rivers and flow out into the Gulf of Mexico. The ability of the ARB to remove and sequester nutrients has been previously evaluated (Mitsch et al. 1999; Committee on Environment and Natural Resources 2010; Scaroni 2011). Studies estimate the ARB removes on average 27% of the organic nitrogen (TKN) (Xu 2006), 43% of TN, and 82% of TP (Perez et al. 2011) from water that flows through the basin. Another study by Xu (2013) found that the ARB acted as a significant sink for TKN (annual retention: 24%), TP (41%), and TOC (12%). Further, nutrient removal and retention may be related to habitat type within the ARB, underscoring the need for habitat restoration projects within the basin (Scaroni et al. 2010, 2011). In flood conditions such as in May through July 2011, water was diverted through the Morganza Spillway into the ARB to alleviate impacts of flooding downstream on the Mississippi River. In that 2011 flood event, the ARB acted as a nitrate sink and retained nearly 4% nitrate that entered the basin (Bryant-Mason and Xu 2011).

The Atchafalaya River Basin Program managed by the Louisiana Department of Natural Resources (LDNR) focuses on water quality/water management as a key category for management projects within the ARB (LDNR 2013d). A sediment and water budget for the ARB was completed in 2013 to aid in management of those resources to be best utilized for coastal restoration efforts (CPRA 2013b).

Seasonal flooding at unleveed areas reconnects the floodplain at some wildlife management areas in Louisiana. The Cat Island National Wildlife Refuge located in St. Francisville, Louisiana is adjacent to an unleveed area of the Mississippi River, while the Three Rivers Wildlife Management Area located near Vidalia, Louisiana is subjected to seasonal flooding from the Mississippi and Red Rivers.

F.3 Point Source Management

Point sources are those that originate from a stationary location or fixed facility from which pollutants are discharged directly into a water body. Point source discharges into Louisiana waters are managed through the Louisiana Pollutant Discharge Elimination System (LPDES) Program through permits regulated by the Louisiana Department of Environmental Quality (LDEQ) under Louisiana's Water Quality Regulations (LAC 33:Chapter IX) (LDEQ 2013b). Permits may contain effluent limitations requiring control and treatment equivalent to secondary treatment, best practicable control technology currently available (BPT), best conventional technology (BCT) for conventional pollutants, best available control technology economically achievable (BAT) for nonconventional or toxic pollutants, and/or water quality based effluent limits (WQBELs). Point source management regarding nutrients in Louisiana is primarily addressed through water permits, wetland assimilation projects, and biosolids land application. In the past, nutrient limits in Louisiana focused primarily on ammonia-nitrogen; however,

Louisiana has recently implemented total nitrogen (TN) and total phosphorus (TP) monitoring requirements for selected facilities.

F.3.1 Wastewater Permits

Louisiana's Water Quality Regulations (LAC 33:Chapter IX) require permits for the discharge of pollutants from any point source into waters of the state of Louisiana. This surface water discharge permitting system is administered under the Louisiana Pollutant Discharge Elimination System (LPDES) program (LDEQ 2013h). LDEQ became the state agency delegated to administer the National Pollutant Discharge Elimination System (NPDES) Program in August of 1996.There are over 14,000 LPDES permitted dischargers within the state of Louisiana. Related to nutrients, input from point sources may include industrial and municipal wastewater, industrial or construction storm water, and Concentrated Animal Feeding Operation (CAFO) permits. In addition the Louisiana Small Business/Small Community Assistance Program (SB/SCAP) provides free technical assistance to small business related to permits.

Wastewater permits for discharge of industrial and treated sanitary wastewater are based on volumes of discharge (flow) in accordance with regulations and outline limitations and monitoring requirements designed to support water quality standards and other conditions set forth in the permit. Storm water permits may be needed for industrial or construction activities. Industrial stormwater permits are sector-specific and are required for industry types that may contribute to nutrient runoff, such as the agricultural chemical industry. These permits require the permit-holder to monitor storm water discharges for nitrogen and/or phosphorus, minimize exposure, and implement BMPs in order to achieve benchmark pollutant levels. While these nutrient-related BMPs are required for industrial storm water permits, they are not required in construction storm water permits. For permitted construction storm water discharges, required BMPs are primarily intended to reduce and/or eliminate discharges of sediments, debris, paints, fuel, etc.

Storm water permits may also be required for Municipal Separate Storm Sewer Systems (MS4) (LDEQ 2013i). An MS4 is a conveyance or system of conveyances designed or used for collecting or conveying storm water from urbanized areas. An urbanized area is a densely settled core of census tracts and/or census blocks that have a population of at least 50,000, along with adjacent territory containing non-residential urban land uses as well as territory with low population density included to link outlying densely settled territory with the densely settled core. It is a calculation used by the Bureau of the Census to determine the geographic boundaries of the most heavily developed and dense urban areas. An MS4, which by definition is a government entity, is considered “regulated” and is required to obtain a LPDES permit when 1) the MS4 met the population threshold of the 1990 US Census (Phase I); 2) all or a portion of the jurisdictional area is located within an urbanized area according to the latest US Census (Phase II); or 3) the MS4 is designated by the permitting authority. However, only the governmental entity and the infrastructure owned and/or operated by that entity is considered “regulated.” The point source is where the outfall of a regulated MS4 discharges urban storm

water into a water of the state. Individual permits and the master general permit for small regulated MS4s require that the Storm Water Management Plan (SWMP) include certain minimum storm water control measures. Flexibility in development and implementation of control measures is included in the permits so that each MS4 may address water quality management issues unique to its area. The required control measures may include targeting residential or non-industrial areas in order to control the discharge of certain pollutants in storm water (such as fertilizers, pesticides, trash, pet waste, etc.), if such pollutants are determined to be a potential source of water quality impairment. Control of pollutants from residential or non-industrial areas normally occur as part of community education programs or local ordinances. However, storm water discharges from a single privately owned building is not defined as a point source and is addressed through LDEQ's nonpoint source pollution program.

Permits are required for any Concentrated Animal Feeding Operation (CAFO) that discharges pollutants to waters of the state. Louisiana operations are typically designed to land apply wastes. As long as the operation's Nutrient Management Plan (NMP) is in compliance with technical standards and there is no discharge of pollutants to state waters, a LPDES permit is not required.

The Louisiana Small Business/Small Community Assistance Program (SB/SCAP) provides free technical assistance to small businesses in understanding and complying with wastewater permits and environmental regulations (LDEQ 2013j). SB/SCAP operates in accordance with the Confidentiality option provided by the EPA Enforcement Response Policy, effective August 12, 1994, regarding Section 507 of the Clean Air Act; under this policy, violations detected through assistance will be kept confidential.

F.3.2 Point Source Wetland Assimilation

A specific type of permit under the LPDES Program is the point source wetland assimilation permit (LAC 33:IX.1109.J and LAC 33:IX.1113.B.12.b) (LDEQ 2013c). Many wetlands have been cut off from a supply of fresh water and are degrading. Wetlands areas naturally act as biological filters for pollutants including nitrogen wastes from sewage pollutants and nutrients which are trapped in the soils where they are taken up by the roots of wetland plants thus promoting wetland health. Point source wetland assimilation projects facilitate the efficient capture and removal of nutrients in wastewater by flowing treated wastewater through a wetland area. This type of project provides nutrients to the wetland to promote growth, and also removes a majority of the nutrients in the wastewater. Environmental benefits of point source wetland assimilation projects include removing direct discharges of treated wastewater into rivers, lakes or streams; helping to prevent saltwater intrusion into the wetland; adding an abundance of needed nutrients into the wetland to stimulate plant growth; and carbon sequestration.

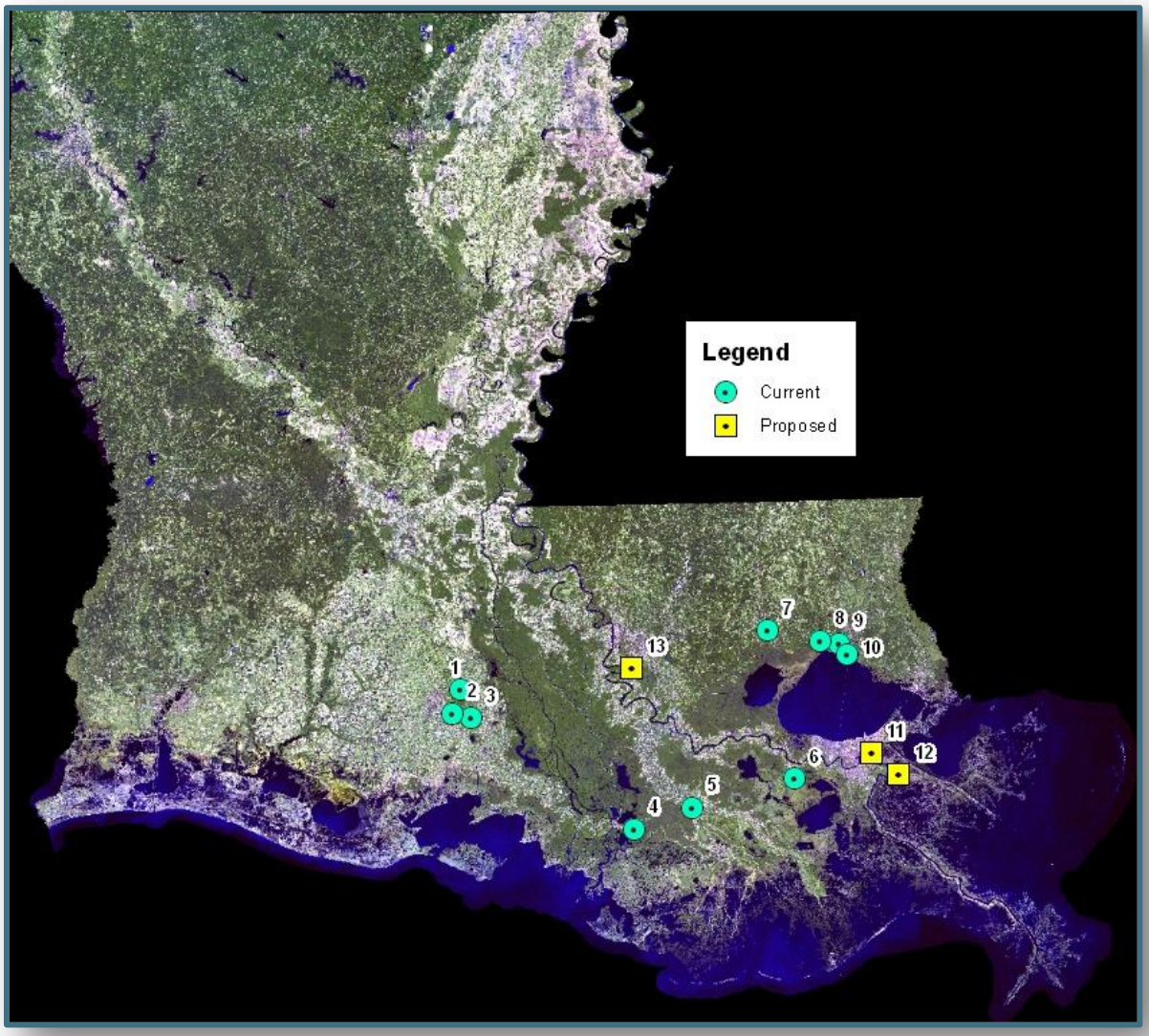
There are currently ten point source wetland assimilation projects in south Louisiana and more are proposed (Figure 24). Mean nutrient removal efficiencies for assimilation wetlands in

Louisiana have been reported as 96% for TN, 75% for TKN, 97% for nitrate-nitrite nitrogen, 85% for TP, and 74% for phosphate (Day et al. 2004; Hunter et al. 2009a,b). Thus the nutrient removal observed in assimilation wetlands is considerable. Further, Hunter et al. (2009b) observed that freshwater forested wetlands receiving secondarily treated effluent can reduce nutrient concentrations to background concentrations present in relatively undisturbed wetlands.

F.3.3 Biosolids Management

Biosolids, or sewage sludge, are also regulated and permitted through the LDEQ's permit program (LDEQ 2013k). Biosolids are nutrient-rich organic matter obtained from wastewater treatment that can be recycled and used beneficially. One such use is for fertilizer as the biosolids contain nutrients such as nitrogen and phosphorus that can be applied to the land (USEPA 2000; Water Environment Federation 2010). Biosolids applied to agricultural land, forest, a public contact site, or a reclamation site are done so in accordance with agronomic rates and slope requirements.

Figure 24. Locations of point source wetland assimilation projects in Louisiana. Mean nutrient removal efficiencies through point source wetland assimilation has been reported as 96% for TN, 75% for TKN, 97% for nitrate-nitrite nitrogen, 85% for TP, and 74% for phosphate (Day et al. 2004; Hunter et al. 2009a,b).



Current Projects: 1 - City of Breaux Bridge-Cypriere Perdue Swamp (design capacity 1.27 MGD); 2 - City of Broussard-Cote Gelee (1 MGD); 3 - City of St. Martinville-Cypress Island Coulee (1.5 MGD); 4 - St. Mary Parish-Ramos Wetland (0.9 MGD); 5 - City of Thibodaux (6 MGD); 6 - St. Charles Parish-Luling Oxidation Pond (2.6 MGD); 7 - City of Hammond-South Slough (8 MGD); 8 - Guste Island Utility in Mandeville (0.175 MGD); 9 - Tchefuncta Club Estates in Covington (0.3 MGD); 10 - City of Mandeville-Chinchuba Swamp and East Tchefuncte Marsh (4 MGD). Proposed Projects: 11 - City of New Orleans East Bank Sewage Treatment Plant (STP) Central Wetlands (122 MGD); 12 - St. Bernard Parish-Poydrus-Verret Marsh-Forested Wetlands (0.35 MGD); and 13 - Longwood Green Initiative, LLC in East Baton Rouge Parish (0.875 MGD).

F.4 Incentives

Incentive-based programs involving watershed stakeholders are an integral part of Louisiana's water quality protection, improvement, and restoration efforts. Incentive-based programs and activities may aid to foster stewards to the environment to support nutrient management in Louisiana.

F.4.1 Voluntary Stewardship

Voluntary stewardship activities are foundational to nutrient management within Louisiana's water bodies. Louisiana is fortunate to have very active participation in both nonpoint source and point source programs. Nonpoint source stewardship initiatives in the state of Louisiana areas are coordinated with federal agencies, such as the USDA, USEPA, and USGS; state agencies, such as CPRA, LDAF, LDEQ, and LDNR; and additional stakeholder groups. These efforts facilitate implementation and coordination of management strategies to effectively manage nonpoint source nutrients to protect, improve, and restore the water quality in Louisiana's water bodies and to subsequently, along with similar efforts in upbasin states, aid in prevention and reduction of nutrient inputs to the GOM. In addition, Louisiana has created a voluntary point source stewardship program which recognizes industries and other groups for voluntary nutrient reductions. These nonpoint and point source programs are discussed below.

F.4.1.1 Nonpoint Source Stewardship

Nonpoint source stewardship programs include federal and state level programs designed to promote voluntary participation in conservation practice implementation. Federal level nonpoint source stewardship programs include USDA NRCS Farm Bill programs. State level nonpoint source stewardship programs include Louisiana Master Farmer, Louisiana Master Gardner, and Louisiana Master Naturalist Programs through the LSU AgCenter, and the Louisiana Master Logger program administered by the Louisiana Forestry Association (LFA).

Agriculture and forestry organizations agree that environmental stewardship programs maintain a strong agriculture and a healthy environment. Core principles of these organizations:

- Focus on private lands and encourage leadership from the agricultural community, commodity and trade organizations and entities
- Support policies and programs necessary to maintain the economic viability of agriculture allowing farmers to utilize the land for production while promoting conservation and being environmental stewards
- Utilize non-regulatory/voluntary approaches
- Develop and implement locally led projects through accelerated technical and financial assistance and share the results across states in the Mississippi-Atchafalaya River Basin
- Provide technical assistance based on decisions derived from sound science
- Solicit, promote and achieve wide public and governmental support with ongoing coordination
- Enhance the research and extension capacity of the Land Grant University systems
- Forge partnerships with nonagricultural agencies and organizations to promote, develop

and implement cost effective, scientifically based conservation programs and site specific practices

F.4.1.1.1 Farm Bill Programs

The conservation provisions in the Food, Conservation, and Energy Act of 2008 (2008 Farm Bill) provide conservation opportunities for farmers and ranchers (USDA NRCS 2013f), and these conservation programs have benefited Louisiana. From 2005 through 2012, annual funding ranged from $70.9 million to $135.8 million that included annual financial, technical, and reimbursable assistance (Figure 25, Table 9). Acreage of conservation practices through these programs has steadily increased from nearly 250,000 acres in 2005 to close to 1,000,000 acres in 2011 and 2012 (Figure 26).

Specifically, the Conservation Reserve Program (CRP), Conservation Reserve Enhancement Program (CREP), Conservation Stewardship Program (CSP), Environmental Quality Incentives Program (EQIP), Grassland Reserve Program (GRP), and Wetlands Reserve Program (WRP) are discussed more below. These programs vary in their applicability and are all utilized in Louisiana to encourage and support voluntary stewardship in the most appropriate circumstances.

Figure 25. USDA NRCS programs in Louisiana from 2005 through 2012 (reproduced from USDA NRCS et al. 2012).

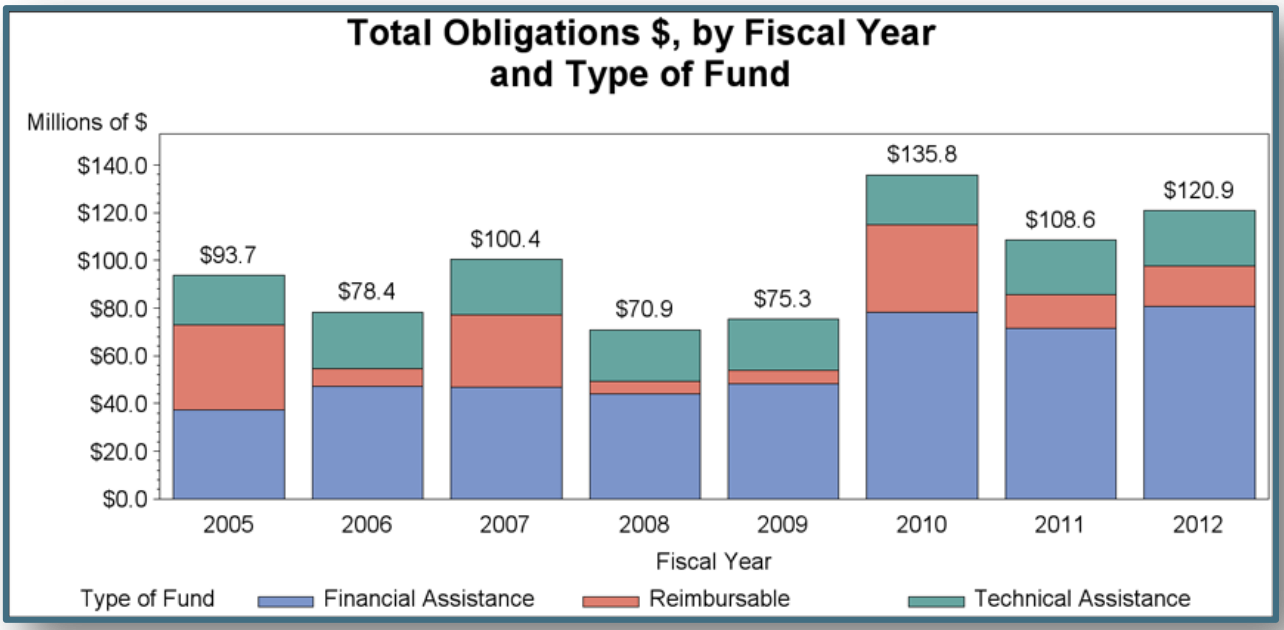


Figure 26. Acres receiving conservation through USDA NRCS in Louisiana from 2005 through 2012 (reproduced from USDA NRCS et al. 2012).

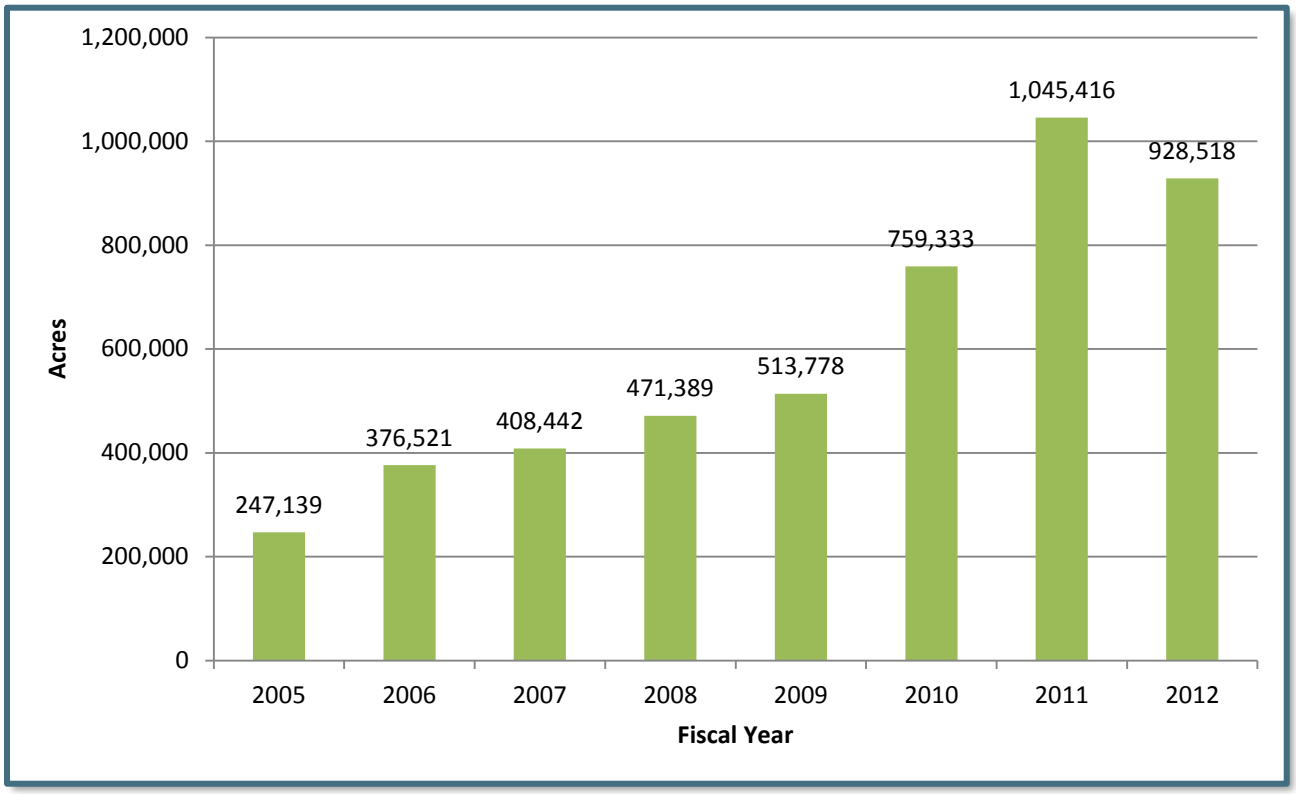


Table 9. Funding for USDA NRCS Conservation Programs in Louisiana from 2005 to 2012.Total Obligations, by Program Fund and Fiscal Year, includes Technical and Financial Assistance and Reimbursable Fund Types, in thousands of dollars (reproduced from USDA NRCS et al. 2012).

Fund Name	2005	2006	2007	2008	2009	2010	2011	2012
Conservation Reserve Program (CRP)	$988.7	$949.5	$1,043.8	$813.8	$634.5	$304.0	$439.3	$475.5
Conservation Security Program (CSP)	$449.1	$515.9	$396.3	$420.1	$319.4	$188.1	$250.5	$214.0
Conservation Stewardship Program (CSP)					$130.9	$6,448.1	$14,408.1	$19,946.9
Conservation Technical Assistance (CTA)	$12,608.8	$9,670.1	$10,817.5	$9,983.9	$9,950.0	$10,256.3	$11,149.0	$8,164.4
Environmental Quality Incentives Program (EQIP)	$20,577.1	$18,778.9	$17,891.6	$26,061.0	$19,695.7	$28,438.4	$21,283.1	$29,036.5
Farm and Ranch Lands Protection Program (FRPP)	$16.4	$1.4	$6.3					
Grassland Reserve Program (GRP)	$43.8	$0.7	$2.7	$4.2	$25.0	$66.3	$71.2	$48.8
Plant Materials Center (PMC)	$432.4	$526.9	$355.4	$279.5	$356.6	$359.5	$356.0	$309.9
Resource Conservation and Development Program (RCD)	$910.4	$959.8	$1,021.1	$926.2	$925.3	$919.4	$433.0	
Soil Survey (SOIL)	$937.6	$857.8	$822.0	$802.5	$781.9	$797.7	$874.6	$698.2
Watershed Surveys and Planning (WSP)	$155.7	$71.1	$91.8	$13.0				
Watershed Protection and Flood Prevention Program (WFPO)	$35,279.7	$4,384.9	$27,709.2	$4,204.2	$6,704.8	$39,594.7	$13,116.6	$16,409.3
Watershed Rehabilitation (WRHB)	$25.0	$14.9	$-0.1		$29.9			

Fund Name	2005	2006	2007	2008	2009	2010	2011	2012
Emergency Watershed Protection Program (EWP)	$4,604.1	$36,033.3	$37,452.9	$22,841.4	$28,693.2	$5,794.4	$18.9	$28.4
Wetlands Reserve Program (WRP)	$16,072.7	$5,289.2	$2,385.1	$3,090.4	$6,027.9	$38,429.8	$43,567.0	$44,503.6
Wildlife Habitat Incentive Program (WHIP)	$634.4	$417.1	$432.4	$1,488.1	$1,055.7	$4,227.3	$2,595.0	$1,051.4
Other	$-62.9	$-63.1						
Total	$93,673.1	$78,408.5	$100,428.2	$70,928.4	$75,330.9	$135,824.1	$108,562.4	$120,886.7

Table 9 Notes: Data Source: USDA-NRCS, 2012 data from Financial Management Modernization Initiative (FMMI), April 2013; 2005-2011 data from Foundation Financial Information System (FFIS), December 2011. Totals may not exactly match sum over funds due to rounding. Negative numbers reflect fund adjustments made throughout the year. For GRP, except for the minor amount of due diligence funds administered by NRCS, the Farm Service Agency (FSA) administers the majority of GRP funds for both easements and rental contracts. CRP only includes reimbursable technical assistance funds used to plan and apply conservation practices. Data shown here do not include financial obligations made by the Farm Service Agency to landowners. EWP, WRHB, and WFPO include American Recovery and Reinvestment Act funds in FY 2009 and FY 2010. EQIP includes General, Ground and Surface Water Conservation, Klamath Basin, and 1996 Farm Bill funds. Other includes Biomass R&D, Colorado River Basin Salinity Control, Forestry Incentives Program, Fund for Rural America, Great Plains Conservation, Rural Abandoned Mine, SWCA, Waterbank Program, and other accounting and adjustment funds.

F.4.1.1.1.1. Conservation Reserve Program (CRP)

The Conservation Reserve Program (CRP) was signed into law by President Ronald Reagan in 1985 and is the country's largest private-lands environmental improvement program, is run through USDA's Farm Service Agency (FSA), and is a voluntary program for agricultural landowners. In exchange for a yearly rental payment, farmers enrolled in the program agree to remove environmentally sensitive land from agricultural production and plant species that will improve environmental health and quality. Contracts for land enrolled in CRP are 10-15 years in length. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat.

F.4.1.1.1.2. Conservation Reserve Enhancement Program (CREP)

The Conservation Reserve Enhancement Program is an offshoot of the Conservation Reserve Program (CRP) and targets high-priority conservation issues identified by local, state, or tribal governments or non-governmental organizations. It is also a voluntary land retirement program that helps agricultural producers protect environmentally sensitive land, decrease erosion, restore wildlife habitat, and safeguard ground and surface water. Through this program, eligible land owners may receive financial incentives to remove environmentally sensitive cropland and grazing land from production for up to 15 years; these areas are then converted to native grasses or trees. Like CRP, CREP is administered by the USDAFSA. By combining CRP resources with state, tribal, and private programs, CREP provides farmers and ranchers with a sound financial package for conserving and enhancing the natural resources of farms. CREP addresses high-priority conservation issues of both local and national significance, such as impacts to water supplies, loss of critical habitat for threatened and endangered wildlife species, soil erosion, and reduced habitat for fish populations. CREP is a community-based, results-oriented effort centered on local participation and leadership. In addition to contributing to improvement of the environment in multiple ways, those enrolled in CREP receive an annual rental payment for their enrolled acres. FSA also provides cost-sharing and other incentives to help offset the costs associated with putting these practices in place.

In 2012 in Louisiana, nearly 50,000 acres of such marginal cropland in the Boeuf River and Bayou Macon watersheds in northeast Louisiana have been enrolled in CREP, reducing soil erosion and nonpoint source pollution, improving water quality in rural drinking water sources and improving critical wildlife habitat (Table 10).

Table 10. Conservation Reserve Enhancement Program (CREP) acres enrolled in 2012 in northeast Louisiana (LDAF OSWC 2013).

Practice Code	Practice Description	Parish Office	Acres	Totals
CP1	Establishment of Introduced Grasses and Legumes	Franklin	131.3	
		Ouachita	1.7	133
CP2	Establishment of Native Grasses	Franklin	12.5	
		West Carroll	474.3	486.8
CP3	Tree Planting	Morehouse	178.8	
		Richland	624.3	803.1
CP3A	Hardwood Tree Planting	East Carroll	38.3	
		Franklin	1870.2	
		Richland	179.2	2087.7
CP4D	Permanent Wildlife Habitat, Noneasement	Catahoula	474.2	
		East Carroll	991	
		Franklin	6271.1	
		Madison	1857.4	
		Morehouse	6653.5	
		Ouachita	208.8	
		Richland	7961.1	
		West Carroll	8657.4	33074.5
CP9	Shallow Water Areas for Wildlife	Franklin	63.2	
		Morehouse	26	
		Richland	125.1	214.3
CP12	Wildlife Food Plot	East Carroll	1.9	
		Franklin	12.1	
		Morehouse	2.5	
		Ouachita	15	31.5
CP22	Riparian Buffer	Caldwell	38.5	
		Catahoula	9.8	
		Franklin	141.5	
		Ouachita	36	
		Richland	32.7	
		West Carroll	232.8	491.3
CP23A	Wetland Restoration, non-floodplain	Franklin	4	4
CP31	Bottomland Hardwood Restoration	Catahoula	471.6	
		East Carroll	1646.7	
		Franklin	1471.1	
		Madison	1362.5	
		Morehouse	1509.7	
		Ouachita	508.9	
		Richland	4529.8	
		West Carroll	534.6	12034.9
Totals			**49361.1**	**49361.1**

F.4.1.1.1.3. Conservation Stewardship Program (CSP)

The Conservation Stewardship Program (CSP) is a voluntary conservation program that encourages producers to address resource concerns in a comprehensive manner by undertaking additional conservation activities; and improving, maintaining, and managing existing conservation activities.

F.4.1.1.1.4. Environmental Quality Incentives Program (EQIP)

The Environmental Quality Incentives Program (EQIP) is a voluntary program that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland. In addition, a purpose of EQIP is to help producers meet Federal, State, Tribal and local environmental regulations.

F.4.1.1.1.5. Grassland Reserve Program (GRP)

The Grassland Reserve Program (GRP) is a voluntary conservation program that emphasizes support for working grazing operations, enhancement of plant and animal biodiversity, and protection of grassland under threat of conversion to other uses. Participants voluntarily limit future development and cropping uses of the land while retaining the right to conduct common grazing practices and operations related to the production of forage and seeding, subject to certain restrictions during nesting seasons of bird species that are in significant decline or are protected under Federal or State law. A grazing management plan is required for participants.

F.4.1.1.1.6. Wetlands Reserve Program (WRP)

The Wetlands Reserve Program (WRP) is a voluntary program offering landowners the opportunity to protect, restore, and enhance wetlands on their property. The USDA NRCS provides technical and financial support to help landowners with their wetland restoration efforts. The program goal is to achieve the greatest wetland functions and values, along with optimum wildlife habitat, on every acre enrolled in the program. This program offers landowners an opportunity to establish long-term conservation and wildlife practices and protection.

F.4.1.1.2 Louisiana Master Farmer Program

To offer Louisiana farmers a voluntary education option to improve environmental stewardship, in 2001 the Louisiana State University Agricultural Center developed an Environmental Stewardship educational module in an agricultural proficiency "Master Farmer" program (Oldham and Castille 2003; LSU AgCenter 2013d). Another component of this program is the incentive-based financial assistance portion of the program. For this environmental stewardship module, state agencies and advocacy groups developed a three-phase program (Figure 27):

Phase 1. Eight hour environmental stewardship training
Phase 2. Model Farm field day/Virtual Model Farm workshops
Phase 3. Development and implementation of a farm-specific conservation plan

The classroom instruction in Phase 1 presents material on the Clean Water Act, national and Louisiana water quality standards, TMDLs, impacts of nonpoint source pollution in the coastal zone, BMPs, role of Conservation Districts, the Natural Resources Conservation Service planning process, and current conservation programs. Phase 2 of the Master Farmer certification process consists of a visit to a commodity specific model farm that demonstrates environmental BMPs 'on-the-ground.' In addition, implementation videos and other materials on BMP utilization are being developed. Phase 3 is the development of farm-specific conservation plans in cooperation with local Natural Resource Conservation Service and/or Soil and Water Conservation District.

The Louisiana Master Farmer Program also includes three specialized tracks for Master Poultry Producer Program, Master Rice Grower Program, and Master Cattle Producer Program. In July 2002, a significant piece of legislation unanimously passed the Louisiana legislature, called Act 145 which certifies that producers successfully completing all phases of the Louisiana Master Farmer Program will be presumed in compliance with the Louisiana soil and water conservation requirements. This legislation allows for reasonable assurance that producers are being educated to make better decisions on research-based BMPs, that these BMPs are being implemented, and that producers will verify the implementation of these practices by developing and implementing a comprehensive conservation plan (Oldham and Castille 2003). Administration of the certification is supervised by LDAF.

As of October 2013, the LSU AgCenter has launched a new format for Phases 1 and 2 of the training. This Master Farmer University is a 2-day training event that maximizes 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. After completion of the Master Farmer University, a farmer must then only complete Phase 3 to receive certification. This streamlined format is hoped to encourage increased participation in the program and result in more farmers becoming certified.

Over 2,500 farmers have participated in the educational phase of the program and are continuing in the subsequent phases (Figure 28). These participants span 96% of the parishes

within the state (62/64 parishes), and of these participants, over 160 farmers have completed the three phase training program to become Certified Master Farmers. Certified Master Farmers are located in 73% of the parishes in the state (47/64 parishes) (Figure 28). Table 11 lists the partnering agencies and organizations in the Louisiana Master Farmer Program.

Table 11. Sponsors of the Louisiana Master Farmer Program.

Louisiana State University AgCenter
Natural Resources Conservation Service – Louisiana
Louisiana Department of Agriculture and Forestry
National Oceanic and Atmosphere Administration
Louisiana Department of Natural Resources
Louisiana Department of Environmental Quality
Louisiana Soybean Association
Louisiana Cattlemen's Association
Louisiana Rice Growers Association
Louisiana Farm Bureau Federation
Potash and Phosphate Institute
American Sugar Cane League
Louisiana Association of Conservation Districts

Zhong (2003) studied the effectiveness in the participation of the Master Farmer Program as it relates to the adoption and production of Best Management Practices (BMPs) in the Louisiana sugarcane industry. The study concluded that awareness of the Master Farmer program had a positive impact in the implementation of sugarcane BMPs for soil erosion and sediment control practice and using vegetative field borders or filter strips around fields and along ditches and streams. Since the Master Farmer Program was created in 2001 and was relatively new when the study was conducted, the variable of having participated in the Master Farmer training curriculum was only significant in one model. However, knowledge of the existence of the Master Farmer program was significant in four models. The study showed that by Extension personnel stressing the importance of the Master Farmer program has added to its recognition.

Results also indicate that those who had knowledge of the Master Farmer Program for sugarcane were more likely to adopt two, three, or four best management practices within the soil erosion and sediment control measure, which had a positive impact on the producers. Producers who owned large, individual operations were more likely to adopt four best management practices after being exposed to the Master Farmer program for sugarcane.

Zhong (2003) concluded that 74% of respondents were aware of the Master Farmer program for sugarcane; of this seventy-four percent, 34% had participated in the training curriculum which at the time was only two years old. Zhong recommended continuing education programs, such as the Master Farmer program, to promote BMP adoption by Louisiana

sugarcane producers. It was also recommended that additional educational programs through the LSU AgCenter and the continued reliance on the Louisiana Cooperative Extension Service should be supported to promote BMPs to producers across the state.

Initiated in June 2012, the Louisiana Master Rice Grower Program was developed as a collaboration of Kellogg Co., Louisiana Rice Mill, and LSU AgCenter. The voluntary program provides incentives to qualified farmers for sustainable production practices. Through the Louisiana Master Rice Grower Program, participants go through the process of becoming a Louisiana Master Farmer. Financial incentives are offered through this program, including 15 cents per barrel for completion of Phase II of Master Farmer that includes participation at a rice production model farm field day and documentation of farming practices (silver level), 25 cents per barrel for participation in Phase III Master Farmer through development and completion of an approved conservation plan (gold level), and 50 cents per barrel for completion of Phase III Master Farmer and implementing the conservation plan (platinum level). Kellogg Co. is committed to buying rice produced in Louisiana through sustainable practices (Schultz 2012).

Figure 27. Louisiana Master Farmer Program is a voluntary incentive-based program in Louisiana where participating agricultural producers learn about water quality and conservation practices and develop a management plan specific to their commodity needs.

Upon completion of all three phases of the Louisiana Master Farmer Program, producers are presumed to be in compliance with Louisiana's soil and water conservation requirements.

Louisiana Master Farmer Program

Phase I

Producer attends classroom instruction on environmental stewardship issues related to:

- The Clean Water Act (CWA) of 1972
- National and Louisiana water quality standards
- Total maximum daily loads (TMDLs)
- Effects of nonpoint source pollution on the coastal zone and the Gulf of Mexico
- Best management practices, also known as BMPs
- Role of conservation districts in conservation planning and implementation
- Resource conservation planning processes
- Farm bill conservation programs
- Spill prevention control and counter measures (SPCC)

Phase II

Producer attends a conservation-based field day where specific best management practices are demonstrated and discussed. This also may include pasture walks, soil quality workshops and other commodity-specific demonstrations.

Phase III

Option 1 – The producer may request a state resource conservation plan through the LSU AgCenter. This plan was developed primarily for rice producers who are enrolled in the Master Rice Grower Program through the Kellogg Company.

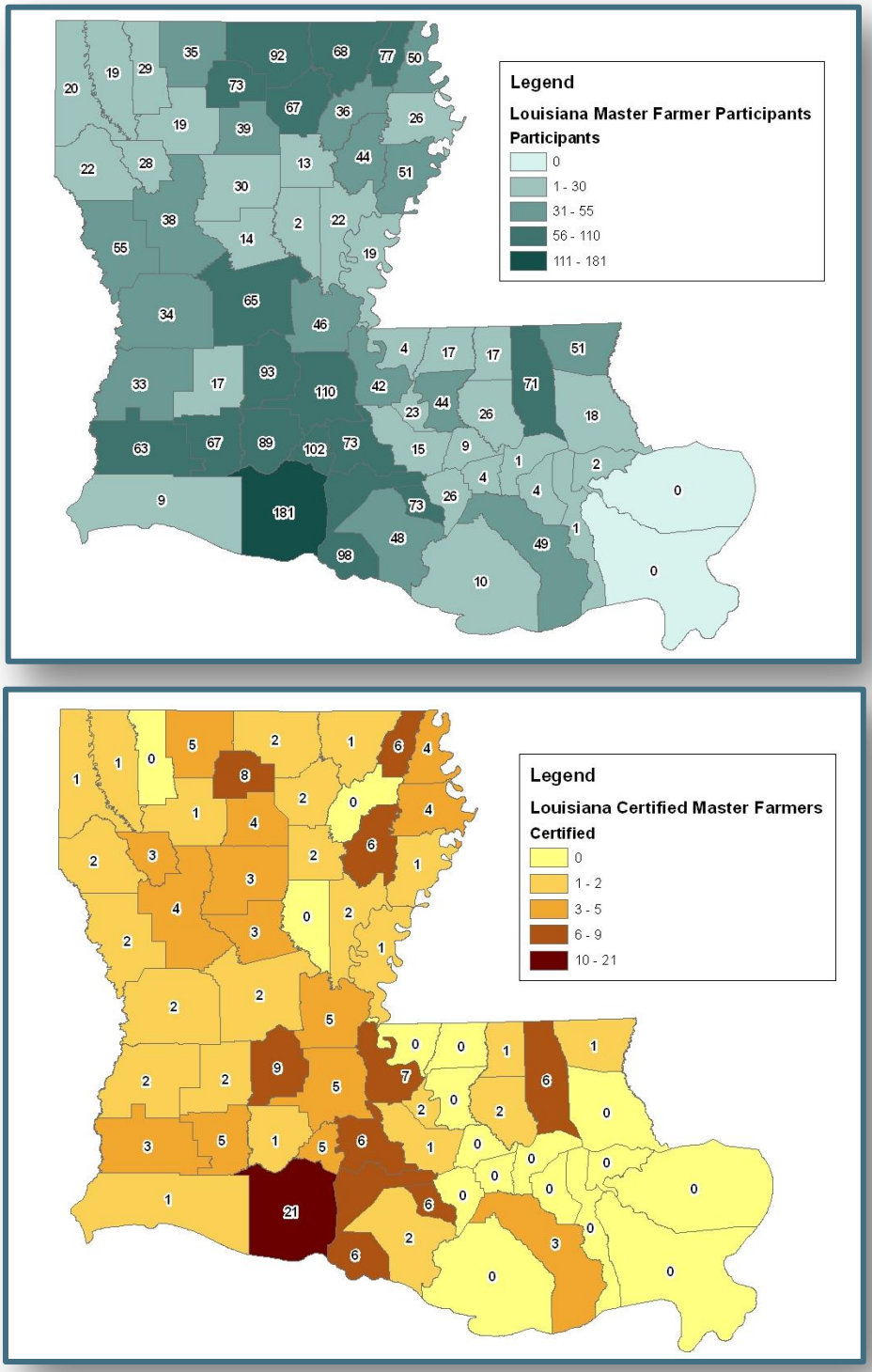
Option 2 – The producer may request a resource management system plan through the U.S. Department of Agriculture's Natural Resources Conservation Service and local Soil and Water Conservation District.

Continuing Education

Certification is granted for five years, with six hours of continuing education credits required per year.

Voluntary – Stewardship – Conservation – Sustainability

Figure 28. The Louisiana Master Farmer Program has more than 2,500 participants in various phases of the program (top), and has fully certified 168 farmers who have completed all three phases of the training (bottom). Participation covers 96% of the parishes in Louisiana (62/64 parishes), and certified farmers are located in over 73% of the parishes (47/64 parishes).



F.4.1.1.3 Louisiana Master Gardener Program

The Louisiana Master Gardener Program through the LSU AgCenter offers home gardeners opportunities to develop their skills and share their knowledge with others (LSU AgCenter 2013e). Volunteer participants in the Master Gardener program must attend at least 80% of scheduled instruction, pass an open-book examination and volunteer a minimum of 40 hours of service to earn the title of Louisiana Master Gardener. Certification is restricted to one year and new certifications are issued each year only to those individuals who make a commitment to participate for the coming year. Master Gardener's perform outreach in the community to share horticultural knowledge.

F.4.1.1.4 Louisiana Master Naturalist Program

The Louisiana Master Naturalist Program (LMNP) is a voluntary certification program sponsored by the LSU AgCenter where citizens can expand their natural history knowledge base of Louisiana resources (LSU AgCenter 2013f). The primary purpose of the LMNP is to offer a statewide program that educates Louisiana citizens about their precious flora and fauna, as well as other aspects of their environment and ecosystems. To become certified, citizens will complete training requirements of 46-58 hours of class and field training, 20 hours volunteer service, 8 hours advanced training, and successful completion of an exam. Attending annual educational programs (8 hours) and continued volunteer opportunities are needed for annual recertification. Certified Louisiana Master Naturalists are required to use their talents to educate others or assist programs that promote and protect Louisiana's natural heritage.

F.4.1.1.5 Louisiana Master Logger Program

Awareness of forestry issues has been promoted through various programs that concentrate on sustainable forestry (USDA 2000; Louisiana Forestry Association 2013). Sustainable forestry practices are based on a stewardship ethic that includes all of the values of forestland such as aesthetics, water quality and conservation of wildlife habitat (Makuch and Muth 2008).

One of the most recognized expressions of this ethic is the Sustainable Forestry Initiative (SFI). The forestry community of Louisiana has developed a comprehensive 30-hour program to provide training to loggers, foresters, and forest landowners in the management and harvesting of trees. The program covers safety requirements, environmental concerns, sustainable forestry practices, and business management. This program aims at enhancing professionalism among foresters, timber harvesters, and others that participate in the forestry industry. A key component of the training program is the effective implementation of Louisiana's forestry BMPs for the protection of water quality.

The Louisiana Master Logger designation recognizes logging contractors and others who have completed 30 hours of instruction in five Professional Logger Education and Training Seminars. Master Loggers must also complete six hours of continuing education annually to maintain their certificates. There are currently 1,589 certified Louisiana Master Loggers.

F.4.1.2 Point Source Stewardship

The primary and most comprehensive voluntary point source stewardship program in Louisiana which recognizes point source contributors for voluntary improvements in water quality, pollution prevention and waste reduction is the Louisiana Environmental Leadership Program (ELP). This program was established in 1995 as a voluntary incentive program sponsored by Louisiana professional, environmental, industrial, and municipal associations to improve the quality of the state's environment through pollution prevention, community outreach and environmental management (LDEQ 2013l). Financial and logistical support for the program is provided by LDEQ and USEPA Region 6.

The ELP supports water quality pollution prevention and reduction including nutrient management. Several industrial and municipal facilities and others have been recognized for their pollution prevention and reduction efforts specific to nutrients and water quality (Table 12). Participants are recognized by the Secretary of LDEQ, and if selected by the Steering Committee, may be recognized at an annual award ceremony hosted by the Governor of Louisiana.

The ELP also commissioned a review of point source nutrient reductions in the Mississippi River Industrial Corridor (MRIC) from a baseline year of 1987 (when Toxic Release inventory [TRI] reporting initiated) through 1998. The findings were published in a report entitled *Nutrient Releases to the Mississippi River in the Louisiana Industrial Corridor* (Knecht 2000). This report highlighted significant voluntary reductions in nitrogenous and phosphatic compounds achieved by Louisiana industries along the MRIC, an area covering 12 parishes (West Feliciana Parish, East and West Baton Rouge, Iberville, Ascension, St. James, St. John, St. Charles, Jefferson, Orleans, St. Bernard and Plaquemines parishes) along the lower Mississippi River. At the time of this report, the 12-parish region of the state contained approximately 48% of the TRI reporting facilities, and accounted for 77% of the total discharges and 97% of discharges to surface waters within the state. The report documented that TRI discharges in this region showed an overall 75% reduction in discharges when compared to the baseline year of 1987.

Knecht (2000) reported that industrial release of nitrate into the Mississippi River decreased 7% between 1995 and 1998 within the MRIC as a result of voluntary improvements in nutrient management from point sources. One example highlighted in this report was that BASF Corporation was at the time modifying their biological treatment system to include bio-denitrification. It was anticipated that this upgrade would have a significant effect on nitrate releases. The modification was subsequently completed and resulted in a 2.3 million pound annual reduction of NO_3 from their wastewaters beginning in 2001, for which they received an ELP award (Table 12).

Relating to phosphorus reductions, Knecht (2000) reported that one of the largest nutrient reductions was accomplished by IMC-Phosphates (formerly IMC-Agrico). In 1994, IMC-Phosphates finished a project that by 1998 had reduced phosphoric acid, the major phosphatic compound, discharges to the river by over 80 million pounds per year, or 91%. IMC-Phosphates

voluntarily spent $27 million on their phosphate reduction project, and later received an ELP award for this reduction (Table 12). The fertilizer industry in the MRIC likewise reduced phosphoric acid releases into the Mississippi River by 80% between 1987 and 1998.

Table 12. Voluntary point source management stewardship recognized for water quality improvement measures or nutrient reductions through the Louisiana Environmental Leadership Program (ELP).

Entity	Location	Year	Stewardship
BASF Corporation	Geismar, Louisiana	2001	Developed a biological treatment system that converts over 2.3 million pounds of nitrates annually in their waste water to atmospheric nitrogen and non-nutrient parameters.
IMC Phosphates, now Mosaic Fertilizer	Uncle Sam & Faustina plants, St. James, Louisiana	2001	Special Recognition for Outstanding Nutrient Reductions. At Uncle Sam and Faustina Plants resulted in 80% reduction in average annual phosphorus discharges to the Mississippi River or over 100 million pounds of nutrient loads.
ExxonMobil	Baton Rouge, Louisiana	2003	Recognized by both the ELP program and Gulf of Mexico (GOM) Program's Gulf Guardian Award in 2004 for reducing nitrate discharges to the Mississippi River. Nitrate was reduced from 4.1 million pounds per year in 1999 to 1.47 million pounds in 2003.
Marathon Petroleum Company	Garyville, Louisiana	2009	Special Recognition Award for Nitrate Reduction. Marathon Louisiana Refinery Division committed to bringing the Garyville Major Expansion Project online with no increase in permitted effluent limits as the expanded refinery will be totally self-sufficient for water supply, treatment, and disposal. Wastewater treatment plant (WWTP) modifications include installation of a biological reactor train, consisting of an Induced Gas Flow Unit, a Closed Circuit Cooling Tower, an Advent Integrated System (AIS), Biological Reactor and an Integral Clarifier. These Biological Reactors have the ability to remove between 85-90% of dissolved nitrates, a common nutrient in treated refinery effluent.

Entity	Location	Year	Stewardship
City of Ruston	Ruston, Louisiana	2009	Municipality Achievement Award in Pollution Prevention for expansion and upgrades to the city wastewater treatment plant including improvements to the collection, transmission and treatment systems. These changes have resulted in discharge reductions that far exceed regulatory requirements, which include nutrient management, and the city is also better able to collect data on every part of the system through implementation of a Global Positioning System (GPS)/Geographic Information System (GIS) mapping program. All of the waste sludge generated at the WWTP is pumped to a city-owned Beneficial Use Facility where sludge is land applied at the 100 acre hayfarm site that is commercially available for non-dairy use, thus eliminating disposal of sludge offsite.
Nalco Industries	Garyville, Louisiana	2010	Special nutrient reduction recognition award for Outfall Nitrate Reduction Program. Nalco has reduced nitrate compounds in its plant effluent by maintaining a low dissolved oxygen concentration in the effluent prior to discharge to the environment. Analytical results at the company indicated that this process reduced the nitrate compound concentration in the effluent by 50%. An additional 25% reduction was achieved with the installation of an online meter. The reductions from the company help to reduce hypoxia in the GOM.
City of Denham Springs	Denham Springs, Louisiana	2010	Municipality Recognition Award in Pollution Prevention for building a new sewage treatment facility that also included in the treatment facility design, nutrient removal (nitrogen and phosphorus), tertiary treatment (sand filters), odor control and exceptional quality sludge processes. The new sewage treatment facility will decrease the total contaminant discharge by approximately 1 ton per day, and will remove an additional 2.3 tons per day of contaminants once operating at full capacity.

Entity	Location	Year	Stewardship
City of Carencro	Carencro, Louisiana	2012	Municipality Recognition Award in Pollution Prevention for improving the efficiency of its wastewater treatment system, which includes nutrient management, and installing over 2,000 automatic meter reading devices on water meters throughout the city.
Martin Ecosystems	Baton Rouge, Louisiana	2013	Special Recognition Award in Pollution Prevention. Installed BioHaven® Floating Islands at Elayn Hunt Correctional Facility to optimize habitat and improve water quality and managing nutrients by transforming pollution into healthy biological diversity through a vegetative and microbial foundation.

F.4.2 Economic Incentives

Incentives that provide financial support for water quality improvement projects are necessary in accomplishing nutrient management in the state of Louisiana. Such economic incentives in Louisiana include those targeted toward agricultural producers, coastal groups and communities, both point and nonpoint sources within watersheds.

F.4.2.1 Agricultural Economic Development Assistance, LDAF

The LDAF Agricultural Economic Development Assistance program assists by linking agricultural/forestry related businesses with financial resources (including loans and grants), identifying raw material supplies and directing such entities to various state sponsored business incentives (LDAF 2013). Assistance is available to local and out of state business interests as well as through community and economic development organizations. Staff may assist in the identification of financial resources outside of the programs offered by the LDAF and also provides assistance to businesses by making them aware of USDA grant opportunities and helping complete grant applications. The following entities offer financial assistance: USDA Rural Development and Farm Service Agency, Ag Credit Corporations First South Farm Credit and Louisiana Ag Credit, the Louisiana Economic Development Corporation at Louisiana Department of Economic Development as well as commercial banks.

F.4.2.2 Clean Water Act Section 319, LDEQ

The LDAF works with LDEQ, the USDA NRCS, and local Soil and Water Conservation Districts (SWCDs) to coordinate the planning and voluntary implementation of Agricultural Best Management Practices (BMPs) and conservation practices (CPs) on farms in priority watersheds to reduce the amount of nonpoint source pollutants entering water bodies. These BMPs and CPs comprise various structures and methods of operation whereby sediment, pesticides, nutrients and organic matter are stabilized or beneficially utilized on the landscape with lessened susceptibility of runoff. This program is closely coordinated with LDEQ's water quality protection efforts (LDEQ 2013f).

F.4.2.3 Coastal and Estuarine Land Conservation Program (CELCP), LDNR

The National Oceanographic and Atmospheric Administration (NOAA) established the Coastal and Estuarine Land Conservation Program (CELCP) in 2002 to protect coastal and estuarine lands considered important for their ecological, conservation, recreational, historical or aesthetic values. The LDNR, Interagency Affairs, Field Services, & Compliance Division is the state lead coastal management agency (LDNR 2013e). The program provides state and local governments with matching funds to purchase significant coastal and estuarine lands, or conservation easements on such lands, from willing sellers. Lands or conservation easements acquired with CELCP funds are protected in perpetuity so that they may be enjoyed by future generations. There are currently five projects funded within Louisiana, four projects bordering Lake Pontchartrain and one south of the City of New Orleans.

F.4.2.4 Coastal Forest Conservation Initiative (CFCI), CPRA

Coastal forests in Louisiana have long been recognized as valuable for the goods and services that they provide. More recently, their importance as buffers to hurricane storm surge and winds has been increasingly appreciated. However, since coastal forests have become increasingly vulnerable to pressures from natural and anthropogenic forces, these critical habitats are in danger of being lost.

The goal of the CFCI is to conserve and protect in perpetuity coastal forest resources in Louisiana which provide a significant benefit to the citizens of Louisiana from multiple perspectives. The primary objective of the CFCI is to acquire land rights (fee title or conservation servitude) from willing landowners of properties that meet at least one of the following criteria: 1) provide direct storm damage reduction potential or protection of hurricane/storm protection features and measures (e.g., levees, cheniers, etc.); 2) areas of high ecological significance; or 3) tracts that are in danger of conversion to non-forested uses.

The CFCI is a voluntary program, and as such is committed to exploring opportunities to benefit landowners while simultaneously achieving program conservation objectives. Enrollment in the CFCI program offers numerous benefits to landowners, although the nature of the benefits would vary depending on the method of acquisition.

To date, the CFCI program has negotiated the purchase of a servitude on a 4,728-acre property in St. Mary Parish that includes high quality baldcypress/tupelo swamp as well as bottomland hardwoods, and also provides protection to a hurricane protection levee. The program was also the major contributor to the acquisition of 29,630 acres of baldcypress/tupelo and bottomland hardwood forest in the Maurepas Swamp. This acquisition increased the size of the Maurepas Swamp Wildlife Management Area to over 100,000 acres, thereby conserving the property and expanding recreational opportunities (CPRA 2013c).

F.4.2.5 Community Development Block Grants (CDBG)

The Community Development Block Grant (CDBG) program is another economic incentive that may be utilized within the state of Louisiana. The federal U.S. Housing and Urban Development

(USHUD) and CDBG Disaster Recovery Assistance programs are incentives available within Louisiana.

F.4.2.5.1 U.S. Housing and Urban Development (USHUD) CDBG

The U.S. Housing and Urban Development's (USHUD) Community Development Block Grant (CDBG) program that began in 1974 is a flexible program that provides communities with resources to address a wide range of unique community development needs. The CDBG program provides annual grants on a formula basis to 1209 general units of local government and States (USHUD 2013a). In Louisiana, these funds are administered through the Division of Administration, Office of Community Development.

The primary objective of Louisiana's CDBG Program is to provide assistance to local governments for the development of viable communities by providing decent housing and a suitable living environment and expanding economic opportunities, principally for persons of low and moderate income (LDOA 2013).

One of the four eligible activity areas established for the distribution of these funds is for Public Infrastructure, which includes: sewer systems primarily involving collection lines; sewer systems involving collection and treatment; sewer treatment only; water systems addressing potable water; water systems primarily for fire protection purposes (including fire stations); and new construction of graveled residential streets, rehabilitation, and/or reconstruction of residential streets [no asphaltic surface treatment].

Public Infrastructure Community Development Block Grant funds in Louisiana have routinely been used for new sewer systems (one community awarded grant in 2012), sewer system rehabilitation (seven communities awarded grants in 2012, six communities awarded grants in 2013), sewer treatment (two communities awarded grants in 2012, and two communities awarded grants in 2013). These grants for 2012 and 2013 totaled over $10.5M for wastewater-related improvements.

F.4.2.5.2 CDBG Disaster Recovery Assistance

In addition to these annual CDBG grants, USHUD also administers Disaster Recovery Assistance to provide flexible grants to help cities, counties, and States recover from Presidentially declared disasters (USHUD 2013b). These funds are also administered by Louisiana's Division of Administration Office of Community Development. In the wake of the hurricanes Katrina and Rita in 2005, Gustav and Ike in 2008, and Isaac in 2011, CDBG Disaster Recovery Assistance funds were made available to Louisiana to assist with recovery from these disasters. The vast majority of CDBG Disaster Recovery Assistance funds were allocated to the 19 coastal parishes for use in protecting their communities and infrastructure. However, some of these Disaster Recovery Assistance funds were allocated to the CPRA for hurricane levee and pump station repair and rehabilitation.

F.4.2.6 Clean Water State Revolving Fund Program (CWSRF)

The Clean Water State Revolving Fund (CWSRF) Program was established pursuant to Title VI of the Clean Water Act, as amended in 1987 (the Act). The CWSRF program presently operates under R.S. 30:2301-2306 (Act 296 of the 2010 Regular Session of the Louisiana Legislature). This statute established a state revolving loan fund capitalized by federal grants (Capitalization Grants for Clean Water State Revolving Funds, CFDA 66:458), by state funds when required or available, and by any other funds generated by the operation of the clean water revolving loan fund. LDEQ is authorized to engage in activities regarding the sums on deposit in, credited to, or to be received by the state revolving loan fund (LDEQ 2004).

The Financial Services Division and Business Community Outreach and Incentives Division within LDEQ are responsible for the operations of the CWSRF Program in the State of Louisiana. These divisions within LDEQ provide assistance to municipalities in the development, financing and implementation of wastewater treatment management plans and plants. Engineering oversight, design review and inspection services as well as environmental assessment services and program administration are provided by the Business Community Outreach and Incentives Division; and grant management, loan coordination and accounting functions are provided by the Financial Services Division on eligible wastewater treatment projects. All efforts are directed toward improving water quality by assisting communities in providing wastewater treatment processes that meet established effluent limits and achieve the goals of the Clean Water Act. For example, in 2012 the City of Zachary, Louisiana closed a loan for $9.3 million, and the City of Baton Rouge, Louisiana received a loan for $45 million for sewage upgrades (Mallett 2012b; Beckstrom 2013b).

F.4.3 Trading

Trading is a market-based tool where water quality goals are achieved through connecting different sources of pollutants, such as nonpoint and point sources (USEPA 2012b). The pollutant control costs of these different sources may differ significantly within a watershed thus allowing for trading as a cost-effective means to achieve water quality goals (CTIC 2006). It's possible that trading programs may connect nonpoint to point, nonpoint to nonpoint, or point to point sources within a watershed. While there is currently not a trading program within Louisiana, evaluation of new programs and activities that explore or support water quality nutrient credit trading for activities such as river diversions, nonpoint sources, and for municipal and industrial point sources may provide a cost-effective means for nutrient management.

CPRA has conducted preliminary evaluation of water quality credit trading as an innovative means for nutrient management associated with coastal restoration activities, and expansion of trading between point and nonpoint source stakeholders is possible (CH2M Hill 2011).Further, a recent study by 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 GOM.

F.4.4 Business Forces

Businesses desiring the use of sustainable practices in production are becoming a driver for environmental stewardship (Schultz 2010, 2012; Growing Georgia 2011; Burgess 2013).Kellogg Co. is committed to buying rice produced through sustainable business practices from Louisiana farmers. A collaborative partnership of Kellogg Co., Louisiana Rice Mill, and LSU AgCenter created the Louisiana Master Rice Grower Program which is a training track under the Louisiana Master Farmer Program to promote voluntary implementation of conservation practices related to producing rice through incentives (Schultz 2012). In fact, the Louisiana Rice Grower Program is now called the Kellogg Certified Rice Grower Program.

It is anticipated that business forces will continue to be a driver for sustainable practices and thus likely that opportunities for producers in Louisiana, such as Kellogg Co., will increase.

F.5 Leveraging Opportunities

Nutrient management projects and activities are the focus of many programs within Louisiana as well as up-basin in the larger Mississippi-Atchafalaya River Basin (MARB). In addition to those numerous programs already discussed above, opportunities of leveraging with existing programs will be pursued as a means to collaborate and share information regarding nutrient management. These leveraging opportunities are a chance to combine or expand benefits from these multi-faceted programs that may be working within the same watershed.

The stakeholder groups and programs currently identified where leveraging may be beneficial to nutrient management within Louisiana are given in Appendix D (listed alphabetically by group/program). It is anticipated that more leveraging opportunities will continue to be identified as the Louisiana Nutrient Management Strategy progresses.

F.6 Science-based New Technologies/Applications

Science-based methods must be employed in order to realize improvements in nutrient management. Development and utilization of advancing and new technologies are an integral part of improving nutrient management within Louisiana's water bodies. These science-based new technologies and applications may be implemented close to the source of nutrients such as through agricultural production or wastewater treatment, or may be implemented in-stream or further downstream in order to improve water quality.

F.6.1 Agricultural Production

Globally, the human population currently over 7 billion is projected to increase 32% to 9.1 billion by 2050 and it is estimated that the demand for food and energy will rise 50% by 2030 and demand for fresh water by 30% as the human population tops 8.3 billion (Strain 2013a). Within Louisiana, agriculture and forestry combined make up one of the state's largest and economically dependent industries.

Science-based technologies and applications for agricultural production will be necessary to meet future demand of production as human population continues to increase exponentially

and while efforts are ongoing to protect, improve, and restore water quality. The Conservation Effects Assessment Project (CEAP) of the USDA NRCS provides an assessment of the agricultural production and effectiveness of conservation practices in place. Fertilizer application methods and technologies promote the most effective means to apply fertilizers to maximize uptake by the plants that need them and to minimize loss from runoff.

F.6.1.1 Conservation Effects Assessment Project (CEAP)

The Conservation Effects Assessment Project (CEAP) was created in 2003 to help USDA NRCS better understand and optimize environmental benefits of conservation practices and programs. The program aims to quantify the environmental effects of conservation practices and programs. Additionally, CEAP aims to develop science-based management for agricultural environments to help inform decision and policy-makers and farmers alike. CEAP produces regional and watershed based assessment of conservation practices. Currently available CEAP assessments include cropland, wetlands, grazing land, and wildlife. Independent assessments such as the CEAP report provide high-level validation that conservation practices are working.

The CEAP report for the Lower Mississippi River Basin which includes most of Louisiana and parts of Arkansas, Kentucky, Mississippi, Missouri, and Tennessee (USDA NRCS 2013g) indicated that voluntary, incentives-based conservation approaches are effective and should be expanded. Model simulations in the Lower Mississippi River Basin of conservation practices in use on cultivated cropland in 2003-2006, including land in long-term conserving cover, show reduced sediment and nutrient loads delivered to rivers and streams and to the Gulf of Mexico from cultivated cropland sources per year. Conservation practice implementation resulted in an average of 35% reduction for sediment, 21% for nitrogen, and 52% for phosphorus delivered to rivers and streams; and 4% reduction for sediment, 17% for nitrogen, and 22% for phosphorus reaching the Gulf of Mexico. It is estimated that implementation of further conservation practices could result in potentially more reduction in sediment and nutrient loading (USDA NRCS 2013g). While not modeled in the CEAP report, 'legacy phosphorus' that may result from the over-application of phosphorus on farm fields in past years was indicated as an important contributor to current levels of in-stream phosphorus loads to be considered.

F.6.1.2 Fertilizer Application

The fertilizer industry endorses a concept known as 4R nutrient stewardship (The Fertilizer Institute 2013a). The 4R philosophy is an innovative and science-based approach that enhances environmental protection, expands production, increases farmer profitability and improves sustainability. The concept is to use the right fertilizer source, at the right rate, at the right time, with the right placement. 4R nutrient stewardship requires the implementation of best management practices (BMPs) that optimize the efficiency of fertilizer use. The goal of fertilizer BMPs is to match nutrient supply with crop requirements and to minimize nutrient losses from fields. Selection of BMPs varies by location, and those chosen for a given farm are dependent on local soil and climatic conditions, crop, management conditions and other site specific factors. Other agronomic and conservation practices, such as no-till farming and the use of

cover crops, play a valuable role in supporting 4R nutrient stewardship. As a result, fertilizer BMPs are most effective when applied with other agronomic and conservation practices.

Management practices that control the fate of fertilizer treatments, whether commercial or residential, or use practices that promote the efficient use of nutrients by plants will minimize the amount of nutrients that could potentially be lost from the application site. In addition, applying controls to prevent runoff and erosion will help maintain fertilizers in the areas where they are applied.

Enhanced Efficiency Fertilizers (EEF) are those that can reduce nutrient losses to the environment while increasing nutrient availability for the plant or the crop. These fertilizers can either slow the release of nutrients for uptake or alter the conversion of nutrients to other forms that may be less susceptible to losses. Categories of EEFs include slow and controlled release nitrogen fertilizers, nitrogen stabilizers and phosphate management products (The Fertilizer Institute 2013b). Further, the precision agriculture method of variable rate technology (VRT) provides the means to change the rate of fertilizer application through mapping the soil characteristics of a farm and determining the appropriate rate and amount of application for a given area of land. These and other means of managing fertilizer application are useful and necessary in managing nutrients applied to a field and in minimizing nutrients lost through runoff.

F.6.2 Wastewater

Treating nutrients in wastewater at the source is an effective method for ensuring excess nutrients do not enter water bodies. Primary treatment involves physical removal of floatable or settable solids. Secondary treatment involves the biological removal of dissolved solids. Advanced treatment methods may allow for tertiary treatment that includes processes to remove nutrients.

Biological nutrient removal (BNR) removes TN and TP from wastewater through the use of microorganisms under different environmental conditions in the treatment process (USEPA 2007). BNRs for nitrogen and/or phosphorus include 4- and 5-stage Bardenpho processes; Step-feed activated sludge process; Concentric oxidation ditches; Denitrification filters with carbon sources; Modified Ludzack-Ettinger (MLE) Process; Sequencing Batch Reactor (SBR) Process; Rotating Biological Contactor (RBC) Process; Biological phosphorus removal (without filters or chemical addition); Trident filter; Dynasand D2 advanced filtration system; Membrane filtration processes; Land application of tertiary effluent through soil; A/O Process-MLE process preceded by an initial anaerobic stage; Modified Bardenpho Process-Bardenpho process with addition of an initial anaerobic zone; Modified University of Cape Town (UCT) Process; and Oxidation Ditch.

F.6.3 In-Stream

Once excess nutrients enter a water body, technologies that can assimilate or remove nutrients in-stream can help to improve water quality. Two such technologies are flotant treatment

wetlands and algal turf scrubbers, which are discussed below. In addition to these identified technologies, others likely exist that can benefit water quality improvement in-stream.

F.6.3.1 Flotant Treatment Wetlands

Martin Ecosystems BioHaven® Flotant Treatment Wetlands (BFTW) are suitable for the treatment of runoff and drainage including urban stormwater, agricultural runoff and other nonpoint source applications. In addition to reducing total suspended solids and biological oxygen demand, BFTWs help reduce nitrates, phosphates, ammonia, and other nutrients (Martin Ecosystems 2013).

F.6.3.2 Algal Turf Scrubber®

Algal Turf Scrubber® (ATS®) grows native algae in an engineered environment that removes excess nutrients from rivers, lakes and streams (HydroMentia Inc. 2013). The algae is harvested every 7-14 days and can be converted into commercially viable byproducts that can help allay operations cost. This is a proven, commercially available technology that does not introduce chemicals, polymers or other foreign substances to the water body.

F.6.4 River Diversion Research

Constructing projects in Louisiana that divert Mississippi River water into surrounding wetlands is not a new concept. Such projects have been in place since the 1930s. The first river diversion projects were constructed for flood control. Later, various diversions and siphons were constructed to combat salt water intrusion and improve fish and wildlife habitat. The most recently planned diversions are aimed at diverting sediment to build wetlands.

Understanding deltaic geology and the land-building processes, such as those that built the Mississippi River Delta, are critical to the effective engineering, design, and construction of river diversions that are capable of building and sustaining land. Likewise, understanding the effects of river diversions on the receiving basins containing coastal wetlands and estuaries is also important. CPRA has commissioned scientists over the years to study the effects of existing river diversions on coastal wetlands and estuaries to better understand and predict what will happen when the river is reconnected to coastal areas after decades of being isolated from riverine inputs. Even though this body of science has grown exponentially, there are still uncertainties to be resolved.

Researchers such as Mitsch et al. (1999) emphasized the importance of targeting wetland creation and restoration in areas where nitrogen concentrations and loads were highest as a means of removing nutrients from local rivers and streams as a method of nonpoint source control. Perez et al. (2011) also said that based on their research, diversions from the Mississippi River into shallow estuarine systems can result in significant reductions in nutrients, especially nitrogen, prior to reaching offshore waters. Additional research suggests that estuaries have a number of biotic and abiotic pathways to remove nutrients from the water column, including denitrification, burial, plant uptake, and assimilation into the food web. Thus, reconnecting the Mississippi River to the coastal estuaries in Louisiana can assimilate

nutrients through several pathways, thereby reducing the overall amount of nitrogen and phosphorus exported from the system before they reach the GOM (DeLaune et al. 2005; Lane et al. 2004). Studies conducted over the past 1-2 decades have reported that Breton Sound wetlands receiving Mississippi River water through the Caernarvon Diversion act as a sink for nitrogen (Day et al. 2009; Lane et al. 1999).

CPRA is developing a research strategy to identify and resolve critical diversion-related uncertainties as CPRA moves forward with engineering and design of diversion projects. The strategy involves partnering with The Water Institute of the Gulf, a not-for-profit, independent research institute, dedicated to advancing the understanding of coastal, deltaic, river and water resource systems, both within the Gulf Coast and around the world, to:

- Convene a River Diversion Expert Panel which will provide independent advise on the planning and implementation of diversion projects and,
- Improve analytical tools by developing a robust nutrient modeling component to predict the transport and fate of nutrients delivered to coastal wetlands and estuaries from river diversion sources.

In addition to working with The Water Institute of the Gulf, CPRA is working to identify and synthesize the relevant and current state of the knowledge with respect to hydrologic basins receiving riverine diversion flows of freshwater. A technical guidance document containing a summary of the use of diversions as component of the Master Plan and an analysis of available data regarding a set of priority topics will be presented. Among other issues, the fate and transport of the associated nutrients and sediments will be included as a technical topic in the guidance document.

LIST OF APPENDICES

APPENDIX A: STRATEGIC ACTIONS SCHEDULE

8. Targets and goals for strategic actions 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 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	--	--	O	O	O	O	O
1.d. Identify and promote partnerships/leveraging opportunities	Interagency Team Stakeholders	--	--	O	O	O	O	O
2. Decision Support Tools								
2.a. Identify available tools	Interagency Team	X	X	O	O	O	O	O
2.b. Evaluate available tools	Interagency Team	X	X	O	O	O	O	O
2.c. Select available tools	Interagency Team	X	X	O	O	O	O	O
2.d. Document selected tools	Interagency Team	--	X	O	O	O	O	O
3. Regulations, Programs, & Policies								
3.a. Identify current	Interagency Team	X	X	O	O	O	O	O
3.b. Identify gaps	Interagency Team	X	X	O	O	O	O	O
3.c. Propose or establish new	Interagency Team	--	X	O	O	O	O	O
4. Management Practices & Restoration Activities								
4.a. Document current practices related to nutrient management	Interagency Team	X	X	O	O	O	O	O

Strategic Action	Agency Commitment(s)	2012	2013	2014	2015	2016	2017	2018
4.b. Identify areas where practices being implemented	Interagency Team	X	X	O	O	O	O	O
4.c. Model nutrient removal estimated through riverine diversions	CPRA	O	O	O	T	--	--	--
4.d. Identify case studies/model watersheds	Interagency Team	X	X	O	O	O	O	O
4.e. Integrate science-based nutrient management approaches	Interagency Team	--	--	O	O	O	O	O
4.f. Promote BMP/CP implementation by farm in priority watersheds	USDA NRCS LDAF OSWC LSU AgCenter	--	--	O	O	O	O	O
5. Status & Trends								
5.a. Model nutrient loading estimated within Louisiana watersheds	USGS Interagency Team	X	--	O	O	O	O	T
5.b. Document in-stream nutrient water quality	LDEQ	X	X	O	O	O	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	O	O	O	O	O	O
5.e. Document permitted discharger inventories	LDEQ	--	--	O	O	O	O	O
5.f. Document riverine diversions	CPRA	--	--	O	O	O	O	T
5.g. Document coastal protection and restoration activities	CPRA	--	--	O	O	O	O	T
5.h. Determine trends in nutrient water quality at long-term monitoring stations	LDEQ	--	O	O	T	--	--	--
5.i. Determine trends in Social Indicators	LSU AgCenter	--	--	O	O	O	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	--	--	O	O	O	O	T
5.k. Determine trends in permitted discharger inventories	LDEQ	--	--	O	O	O	O	O
5.l. Determine trends in nutrients related to riverine diversions	CPRA	--	--	O	O	O	O	T
5.m. Determine trends in coastal protection and restoration activities	CPRA	--	--	O	O	O	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	O	O	O	O	O	O
6.d. Characterize watersheds with existing or planned riverine diversions	CPRA	--	X	O	O	O	O	O
6.e. Identify potential sources through Desktop Analysis/Windshield Survey	Interagency Team	--	--	O	O	O	O	O
6.f. Identify unpermitted point sources	LDEQ	X	X	O	O	O	O	O
6.g. Identify priority watersheds from leveraging programs	USDA GoMI USDA MRBI USDA NWQI LDAF/LDEQ/LDNR NPS	X	X	O	O	O	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	--	--	O	T	--	--	--
6.k. Develop/leverage Watershed Nutrient Management Projects for priorities	Interagency Team Stakeholders	--	--	--	O	O	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 Gardner Louisiana Master Naturalist Louisiana Environmental Leadership	--	X	O	O	O	O	O
7.b. Identify and communicate available funding support	Interagency Team Stakeholders	--	--	O	O	O	O	O
7.c. Promote assistance (financial or technical) for BMP/CP implementation	LDAF/LDEQ/LDNR NPS USDA NRCS LDAF OSWC	X	X	O	O	O	O	O
7.d. Promote assistance (technical) for point sources	SB/SCAP	X	X	O	O	O	O	O
7.e. Document economic impacts from available sources	Interagency Team LSU AgCenter Stakeholders	--	X	O	O	O	O	O
7.f. Explore feasibility for credit trading	Interagency Team Stakeholders	--	--	O	O	O	O	T
7.g. Identify gaps	Interagency Team Stakeholders	--	--	O	O	O	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	O	O	O	O	O
9.b. Monitor relative to BMP/CP implementation	USDA GoMI USDA MRBI USDA NWQI LDAF/LDEQ/LDNR NPS	--	--	O	O	O	O	O
9.c. Monitor nutrients associated with riverine diversions	CPRA	--	--	--	O	O	O	O
9.d. Monitor nutrients in point sources	LDEQ LPDES Permitted Dischargers	X	X	O	O	O	O	O
9.e. Evaluate compliance with point source permits	LDEQ	X	X	O	O	O	O	O
9.f. Identify gaps	Interagency Team Stakeholders	--	--	O	O	T	--	--
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	--	--	O	O	O	O	O
10.f. Present information through strategy website	Interagency Team	--	X	O	O	O	O	O
10.g. Present information geospatially through web-based viewer	Interagency Team	--	X	O	O	O	O	O
10.h. Document spotlight(s) of nutrient management	Interagency Team Stakeholders	--	--	O	O	O	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.

Abbreviations: *BMP*: Best Management Practice; *CP*: Conservation Practice; *CPRA*: Coastal Protection and Restoration Authority; *LDAF OSWC*: Louisiana Department of Agriculture and Forestry, Office of Soil and Water Conservation; *LDEQ*: Louisiana Department of Environmental Quality; *LDNR*: Louisiana Department of Natural Resources; *LPDES*: Louisiana Pollutant Discharge Elimination System Permit Program; *NPS*: Nonpoint Source Program; *LSU AgCenter*: Louisiana State University Agricultural Center; *SB/SCAP*: Louisiana Small Business/Small Community Assistance Program; *USDA GoMI*: U.S. Department of Agriculture, Gulf of Mexico Initiative; *USDA MRBI*: U.S. Department of Agriculture, Mississippi River Basin Initiative; *USDA NRCS*: U.S. Department of Agriculture, Natural Resources Conservation Service; *USDA NWQI*: U.S. Department of Agriculture, National Water Quality Initiative; *USGS*: U.S. Geological Survey.

APPENDIX B: CONSERVATION PRACTICES IN LOUISIANA

U.S. Department of Agriculture Natural Resources Conservation Service USDA NRCS) conservation practices applicable to Louisiana watersheds (USDA NRCS 2013e).

Unit abbreviations: Ac, acre; Ft, feet; No, number; Sq ft, square feet.

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
312	WASTE MANAGEMENT SYSTEM	no	A planned system in which all necessary components are installed for properly managing liquid and solid waste including runoff from concentrated waste areas.	To manage waste in rural areas in a manner that prevents or minimizes degradation of air, soil, animal, plant and water resources and protects public health and safety. Such systems are planned to preclude excess discharge of pollutants to surface or ground water and to recycle waste through soil and plants to the fullest extent practicable.	ftp://ftp-fc.sc.egov.usda.gov/NY/eFOTG/Section_4/Practice_Standards/nyps312.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
313	WASTE STORAGE FACILITY	no	A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure.	To temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system. This standard establishes the minimum acceptable requirements for planning, designing, constructing, and operating and maintaining waste storage facilities. Storage tanks are used for liquid and slurry wastes and may be open or covered; within or outside an enclosed housing; or beneath slotted floors. This standard also applies to the structural component of composting and stacking facilities. Stacking facilities are used for wastes that behave as a solid. This standard does not apply to, "Waste Treatment Lagoons."	http://efotg.sc.egov.usda.gov/references/public/LA/313_Waste_Storage_Facility.pdf
314	BRUSH MANAGEMENT	ac	The management or removal of woody (non-herbaceous or succulent) plants including those that are invasive and noxious.	To create the desired plant community consistent with the ecological site; restore or release desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality or enhance stream flow; maintain, modify, or enhance fish and wildlife habitat; improve forage accessibility, quality and quantity for livestock and wildlife; manage fuel loads to achieve desired conditions.	http://efotg.sc.egov.usda.gov/references/public/LA/Brush_Management_(AC)_(314)_1-12.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
316	ANIMAL MORTALITY FACILITY	no	An on-farm facility for the treatment or disposal of livestock and poultry carcasses.	This practice may be applied as part of a conservation management system to support one or more of the following purposes: decrease non-point source pollution of surface and groundwater resources; reduce the impact of odors that result from improperly handled animal mortality; decrease the likelihood of the spread of disease or other pathogens that result from the interaction of animal mortality and predators; and provide contingencies for normal and catastrophic mortality events.	http://efotg.sc.egov.usda.gov/references/public/LA/316-Animal_Mortality_Facility.pdf
317	COMPOSTING FACILITY	no	A facility to process raw manure or other raw organic by-products into biologically stable organic material.	To reduce the pollution potential of organic agricultural wastes to surface and ground water.	http://efotg.sc.egov.usda.gov/references/public/LA/fotg_composting_facility_(317)_standard.pdf
324	DEEP TILLAGE (CHISELING AND SUBSOILING)	ac	Performing tillage operations below the normal tillage depth to modify adverse physical or chemical properties of a soil.	To bury or mix soil deposits from wind or water erosion or flood overwash, to reduce concentration of soil contaminants, which inhibit plant growth, and to fracture restrictive soil layers.	http://efotg.sc.egov.usda.gov/references/public/LA/DeepTillage_324_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
327	CONSERVATION COVER	ac	Establishing and maintaining permanent vegetative cover.	This practice may be applied to accomplish one or more of the following: reduce soil erosion and sedimentation; improve water quality; improve air quality; enhance wildlife habitat and pollinator habitat; improve soil quality; and manage plant pests.	http://efotg.sc.egov.usda.gov/references/public/LA/ConsCover_327_Standard.pdf
328	CONSERVATION CROP ROTATION	ac	Growing crops in a planned sequence on the same field.	Plan and apply this practice to support one or more of the following purposes: reduce rill and interrill or wind erosion; improve soil quality; manage the balance of plant nutrients; supply nitrogen through biological nitrogen fixation to reduce energy use; conserve water; manage saline seeps; manage plant pests (weeds, insects and diseases); provide feed for domestic livestock; provide annual crops for bioenergy feedstocks; and provide food and cover for wildlife including pollinator forage, cover, and nesting.	http://efotg.sc.egov.usda.gov/references/public/LA/ConsCropRotation_328_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
329	RESIDUE AND TILLAGE MANAGEMENT NO TILL/STRIP TILL/DIRECT SEED	ac	Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.	To reduce sheet/rill erosion; reduce wind erosion and particulate matter less than 10 micrometers in diameter - PM 10; improve soil organic matter content; reduce CO2 losses from the soil; reduce energy use; increase plant-available moisture; and provide food and escape cover for wildlife.	http://efotg.sc.egov.usda.gov/references/public/LA/ResidueMgmt_Notill_329_Standard.pdf
330	CONTOUR FARMING	ac	Using ridges and furrows formed by tillage, planting and other farming operations to change the direction of runoff from directly downslope to around the hillslope.	This practice is applied to achieve one or more of the following: reduce sheet and rill erosion; reduce transport of sediment, other solids and the contaminants attached to them; and increase water infiltration.	http://efotg.sc.egov.usda.gov/references/public/LA/ContourFarming_330_Standard.pdf
332	CONTOUR BUFFER STRIPS	ac	Narrow strips of permanent, herbaceous vegetative cover established around the hill slope, and alternated down the slope with wider cropped strips that are farmed on the contour.	This practice is applied to achieve one or more of the following: Reduce sheet and rill erosion; reduce transport of sediment and other water-borne contaminants downslope; and increase water infiltration.	http://efotg.sc.egov.usda.gov/references/public/LA/ContourBufferStrips_332_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
338	PRESCRIBED BURNING	ac	Controlled fire applied to a predetermined area.	To control undesirable vegetation; prepare sites for harvesting, planting or seeding; control plant disease; reduce wildfire hazards; improve wildlife habitat; improve plant production quantity and/or quality; remove slash and debris; enhance seed and seedling production; facilitate distribution of grazing and browsing animals; and restore and maintain ecological sites.	http://efotg.sc.egov.usda.gov/references/public/LA/Prescribed_Burning_338_Standard_9-2012.pdf
340	COVER CROP	ac	Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.	To reduce erosion from wind and water; increase soil organic matter content; capture and recycle or redistribute nutrients in the soil profile; promote biological nitrogen fixation and reduce energy use; increase biodiversity; suppress weeds; manage soil moisture; and minimize and reduce soil compaction.	http://efotg.sc.egov.usda.gov/references/public/LA/CoverCrop_340_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
342	CRITICAL AREA PLANTING	ac	Establishing permanent vegetation on sites that have or are expected to have high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices.	To stabilize areas with existing or expected high rates of soil erosion by water; restore disturbed or degraded sites that cannot be stabilized through normal methods; and stabilize coastal areas, such as sand dunes and riparian areas.	http://efotg.sc.egov.usda.gov/references/public/LA/342standard.pdf
344	RESIDUE MANAGEMENT, SEASONAL	ac	Managing the amount, orientation, and distribution of crop and other plant residues on the soil surface during a specified period of the year.	To reduce sheet and rill erosion; reduce soil erosion from wind and associated airborne particulate matter; manage snow to increase plant available moisture; harvest and utilize renewable bioenergy feedstocks; and provide food and escape cover for wildlife.	http://efotg.sc.egov.usda.gov/references/public/LA/ResidueMgmt_Seasonal_344_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
345	RESIDUE AND TILLAGE MANAGEMENT MULCH TILL	ac	Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round while limiting the soil-disturbing activities used to grow and harvest crops in systems where the field surface is tilled prior to planting.	To reduce sheet and rill erosion; reduce wind erosion and particulate matter less than 10 micrometers in diameter - PM 10; maintain or improve soil quality; increase plant-available moisture; and reduce energy use.	http://efotg.sc.egov.usda.gov/references/public/LA/ResidueMgmt_MulchTill_345_Standard.pdf
346	RESIDUE AND TILLAGE MANAGEMENT RIDGE TILL	ac	Managing the amount, orientation, and distribution of crop and other plant residues on the soil surface year-round, while growing crops on pre-formed ridges alternated with furrows protected by crop residue.	To reduce sheet and rill erosion; reduce wind erosion and particulate matter less than 10 micrometers in diameter - PM 10; maintain or improve soil quality; reduce energy use; manage snow to increase plant-available moisture; modify cool wet site conditions; provide food and escape cover for wildlife.	http://efotg.sc.egov.usda.gov/references/public/LA/ResidueMgmt_Ridgetill_346_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
350	SEDIMENT BASIN	no	A basin constructed to collect and store debris or sediment.	To preserve the capacity of reservoirs, ditches, canals, diversion, waterways, and streams; to prevent undesirable deposition on bottom lands and developed areas; to trap sediment originating from construction sites; and to reduce or abate pollution by providing basins for deposition and storage of silt, sand, gravel, stone, agricultural wastes, and other detritus.	http://efotg.sc.egov.usda.gov/references/public/LA/350.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
351	WELL DECOMMISSIONING	no	The sealing and permanent closure of a water well no longer in use.	To preserve the quality of the groundwater resources, protect the public health, avoid unsafe conditions and restore (to the extent practical) the hydrogeological conditions that existed before the well was drilled. This practice serves to: prevent entry of vermin, debris, or other foreign substances into the well or well bore hole; eliminate the physical hazard of an open hole to people, animals, and farm machinery; prevent entry of contaminated surface water into well and migration of contaminants into unsaturated (vadose) zone or saturated zone; and prevent the commingling of chemically or physically different ground waters between separate water bearing zones.	http://efotg.sc.egov.usda.gov/references/public/LA/WellDecommissioningStandard2009.pdf
356	DIKE	ft	A barrier constructed of earth or manufactured materials.	To protect people and property from floods; to control water level in connection with crop production; fish and wildlife management; or wetland maintenance, improvement, restoration, or construction.	http://efotg.sc.egov.usda.gov/references/public/LA/DikeStandard2009.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
359	WASTE TREATMENT LAGOON	no	A waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout.	To biologically treat waste, such as manure and wastewater, and thereby reduce pollution potential by serving as a treatment component of a waste management system.	http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026002.pdf
360	WASTE FACILITY CLOSURE	no	The decommissioning of facilities, and/or the rehabilitation of contaminated soil, in an environmentally safe manner, where agricultural waste has been handled, treated, and/or stored and is no longer used for the intended purpose.	To protect the quality of surface water and groundwater resources; mitigate air emissions; eliminate a safety hazard for humans and livestock; and safeguard the public health.	http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1046941.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
362	DIVERSION	ft	A channel constructed across the slope generally with a supporting ridge on the lower side.	This practice may be applied as part of a resource management system to support one or more of the following purposes: break up concentrations of water on long slopes, on undulating land surfaces, and on land that is generally considered too flat or irregular for terracing; divert water away from farmsteads, agricultural waste systems, and other improvements; collect or direct water for water-spreading or water-harvesting systems; increase or decrease the drainage area above ponds; protect terrace systems by diverting water from the top terrace where topography, land use, or land ownership prevents terracing the land above; intercept surface and shallow subsurface flow; reduce runoff damages from upland runoff; reduce erosion and runoff on urban or developing areas and at construction or mining sites; divert water away from active gullies or critically eroding areas; and supplement water management on conservation cropping or stripcropping systems.	http://efotg.sc.egov.usda.gov/references/public/LA/362_Diversion.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
378	POND	no	A water impoundment made by constructing an embankment or by excavating a pit or dugout. In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method are referred to as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at the auxiliary spillway elevation is 3 feet or more.	To provide water for livestock, fish and wildlife, recreation, fire control, and other related uses, and to maintain or improve water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/PondStandard2009.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
381	SILVOPASTURE ESTABLISHMENT	ac	An application establishing a combination of trees or shrubs and compatible forages on the same acreage.	To provide forage for livestock and the production of wood products; increase carbon sequestration; improve water quality; reduce erosion; enhance wildlife habitat; reduce fire hazard; provide shade for livestock; and develop renewable energy systems.	http://efotg.sc.egov.usda.gov/references/public/LA/Silvopasture_Establishment_381_Standard_9-2012.pdf
382	FENCE	ft	A constructed barrier to animals or people.	This practice facilitates the accomplishment of conservation objectives by providing a means to control movement of animals and people, including vehicles.	http://efotg.sc.egov.usda.gov/references/public/LA/Fence_(FT)_(382)_1-12.pdf
386	FIELD BORDER	ac	A strip of permanent vegetation established at the edge or around the perimeter of a field.	This practice may be applied to accomplish one or more of the following: reduce erosion from wind and water; protect soil and water quality; manage pest populations; provide wildlife food and cover and pollinator habitat; increase carbon storage; and improve air quality.	http://efotg.sc.egov.usda.gov/references/public/LA/FieldBorder_386_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
390	RIPARIAN HERBACEOUS COVER	ac	Grasses, grass-like plants and forbs that are tolerant of intermittent flooding or saturated soils and that are established or managed in the transitional zone between terrestrial and aquatic habitats.	To provide the following functions: 1) provision of food, shelter, shading substrate, access to adjacent habitats, nursery habitat and pathways for movement by resident and nonresident aquatic, semi-aquatic and terrestrial organisms; 2) improve and protect water quality by reducing the amount of sediment and other pollutants, such as pesticides, organic materials, and nutrients in surface runoff as well as nutrients and chemicals in shallow ground water flow; 3) help stabilize stream bank and shorelines; 4) increase net carbon storage in the biomass and soil; and 5) restore a diversity of riparian flowering plants.	http://efotg.sc.egov.usda.gov/references/public/LA/390standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
391	RIPARIAN FOREST BUFFER	ac	An area predominantly trees and/or shrubs located adjacent to and up-gradient from watercourses or water bodies.	To create shade to lower or maintain water temperatures to improve habitat for aquatic organisms; create or improve riparian habitat and provide a source of detritus and large woody debris; reduce excess amounts of sediment, organic material, nutrients and pesticides in surface runoff and reduce excess nutrients and other chemicals in shallow ground water flow; reduce pesticide drift entering the water body; restore riparian plant communities; and increase carbon storage in plant biomass and soils.	http://efotg.sc.egov.usda.gov/references/public/LA/Riparian_Forest_Buffer_391_Standard_9-2012.pdf
393	FILTER STRIP	ac	A strip or area of herbaceous vegetation that removes contaminants from overland flow.	To reduce suspended solids and associated contaminants in runoff; reduce dissolved contaminant loadings in runoff; and reduce suspended solids and associated contaminants in irrigation tailwater.	http://efotg.sc.egov.usda.gov/references/public/LA/FilterStrip_393_Standard.pdf
394	FIREBREAK	ft	A permanent or temporary strip of bare or vegetated land planned to retard fire.	To reduce the spread of wildfire; and contain prescribed burns.	http://efotg.sc.egov.usda.gov/references/public/LA/Firebreak_394_Standard_9-2012.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
399	FISHPOND MANAGEMENT	no	Managing impounded water for the production of fish or other aquatic organisms.	To provide favorable habitat for fish and other aquatic organisms; to develop and maintain a desired species composition and ratio; and to develop and maintain a desired level of production.	http://efotg.sc.egov.usda.gov/references/public/LA/399standard.pdf
409	PRESCRIBED FORESTRY	ac	Manage forested areas for forest health, wood and/or fiber, water, recreation, aesthetics, wildlife habitat and plant biodiversity.	To maintain or improve forest health; protect soil quality and condition; maintain or enhance water quality and quantity; maintain or improve forest productivity; maintain or improve plant diversity; improve aesthetic and recreational values; improve wildlife habitat; and achieve or maintain a desired understory plant community for forest products, grazing, and browsing.	http://efotg.sc.egov.usda.gov/references/public/LA/409_Prescribed_Forestry_Standard.pdf
410	GRADE STABILIZATION STRUCTURE	no	A structure used to control the grade and head cutting in natural or artificial channels.	To stabilize the grade and control erosion in natural or artificial channels, to prevent the formation or advance of gullies, and to enhance environmental quality and reduce pollution hazards.	http://efotg.sc.egov.usda.gov/references/public/LA/410.pdf
412	GRASSED WATERWAY	ac	A shaped or graded channel that is established with suitable vegetation to carry surface water at a non-erosive velocity to a stable outlet.	To convey runoff from terraces, diversions, or other water concentrations without causing erosion or flooding; to reduce gully erosion; and to protect/improve water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/412standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
430	IRRIGATION PIPELINE	ft	A pipeline and appurtenances installed to convey water for storage or application, as part of an irrigation water system.	Convey of water from a source of supply to an irrigation system or storage reservoir.	http://efotg.sc.egov.usda.gov/references/public/LA/Irrigation_Pipeline-430.pdf
436	IRRIGATION STORAGE RESERVOIR	no and ac-ft	An irrigation water storage structure made by constructing a dam, embankment, or pit.	Conserve water by holding it in storage until it is used to meet crop irrigation requirements.	http://efotg.sc.egov.usda.gov/references/public/LA/436-Irrigation_Storage_Reservoir_Standard-101405.pdf
441	IRRIGATION SYSTEM, MICROIRRIGATION	no and ac	An irrigation system for distribution of water directly to the plant root zone by means of surface or subsurface applicators.	This practice may be applied as part of a conservation management system to support one or more of the following purposes: to efficiently and uniformly apply irrigation water and maintain soil moisture for optimum plant growth; and to apply chemicals.	http://efotg.sc.egov.usda.gov/references/public/LA/441.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
442	IRRIGATION SYSTEM, SPRINKLER	no and ac	An irrigation system in which all necessary equipment and facilities are installed for efficiently applying water by means of nozzles operated under pressure.	This practice may be applied as part of a conservation management system to achieve one or more of the following: efficiently and uniformly apply irrigation water to maintain adequate soil water for the desired level of plant growth and production without causing excessive water loss, erosion, or water quality impairment; climate control and/or modification; applying chemicals, nutrients, and/or waste water; leaching for control or reclamation of saline or sodic soils; and reduction in particulate matter emissions to improve air quality.	http://efotg.sc.egov.usda.gov/references/public/LA/442-Irrigation_System_Sprinkler_Standard-121405.pdf
447	IRRIGATION SYSTEM, TAILWATER RECOVERY	no	A planned irrigation system in which all facilities utilized for the collection, storage, and transportation of irrigation tailwater for reuse have been installed.	This practice may be applied as part of a conservation management system to support one or more of the following: conserve irrigation water supplies; and improve offsite water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/447_Irrigation_System_Tailwater_Recovery.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
449	IRRIGATION WATER MANAGEMENT	ac	Irrigation water management is the process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner.	Irrigation water management is applied as part of a conservation management system to support one or more of the following: manage soil moisture to promote desired crop response; optimize use of available water supplies; minimize irrigation induced soil erosion; decrease non-point source pollution of surface and groundwater resources; manage salts in the crop root zone; manage air, soil, or plant microclimate; and chemigation.	http://efotg.sc.egov.usda.gov/references/public/LA/449_Irrigation_Water_Management.pdf
462	PRECISION LAND FORMING	ac	Reshaping the surface of land to planned grades.	To improve surface drainage and control erosion.	http://efotg.sc.egov.usda.gov/references/public/LA/462-Precision_Land_Forming_Standard-121405.pdf
464	IRRIGATION LAND LEVELING	ac	Reshaping the surface of land to be irrigated to planned grades.	To permit uniform and efficient application of irrigation water to the leveled land.	http://efotg.sc.egov.usda.gov/references/public/LA/464-Irrigation_Land_Leveling.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
466	LAND SMOOTHING	ac	Removing irregularities on the land surface by use of special equipment.	Improve surface drainage, provide for more effective use of precipitation, obtain more uniform planting depths, provide for more uniform cultivation, improve equipment operation and efficiency, improve terrace alignment, and facilitate contour cultivation.	http://efotg.sc.egov.usda.gov/references/public/LA/466.pdf
468	LINED WATERWAY OR OUTLET	ft	A waterway or outlet having an erosion-resistant lining of concrete, stone, synthetic turf reinforcement fabrics, or other permanent material.	This practice may be applied as part of a resource management system to support one or more of the following purposes: provide for safe conveyance of runoff from conservation structures or other water concentrations without causing erosion or flooding; stabilize existing and prevent future gully erosion; and protect and improve water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/468.pdf
472	ACCESS CONTROL	ac	The temporary or permanent exclusion of animals, people, vehicles, and/or equipment from an area.	To achieve and maintain desired resource conditions by monitoring and managing the intensity of use by animals, people, vehicles, and/or equipment in coordination with the application schedule of practices, measures and activities specified in the conservation plan.	http://efotg.sc.egov.usda.gov/references/public/LA/Access_Control_472_Standard_9-2012.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
484	MULCHING	ac	Applying plant residues or other suitable materials produced off site, to the land surface.	To conserve soil moisture; reduce energy use associated with irrigation; moderate soil temperature; provide erosion control; suppress weed growth; facilitate the establishment of vegetative cover; improve soil quality; and reduce airborne particulates.	http://efotg.sc.egov.usda.gov/references/public/LA/Mulching_484_Standard.pdf
490	TREE/SHRUB SITE PREPARATION	ac	Treatment of areas to improve site conditions for establishing trees and/or shrubs.	To encourage natural regeneration of desirable woody plants; and permit artificial establishment of woody plants.	http://efotg.sc.egov.usda.gov/references/public/LA/Tree-Shrub_Site_Preparation_490_9-2012.pdf
500	OBSTRUCTION REMOVAL	ac	Removal and disposal of unwanted, unsightly or hazardous buildings, structures, vegetation, landscape features, and other materials.	To safely remove and dispose of unwanted obstructions and materials in order to apply conservation practices or facilitate planned use of abandoned mine lands, farms, ranches, construction sites, and recreation areas.	http://efotg.sc.egov.usda.gov/references/public/LA/500_Obstruction_Removal.pdf
511	FORAGE HARVEST MANAGEMENT	ac	The timely cutting and removal of forages from the field as hay, green-chop or ensilage.	To optimize yield and quality of forage at the desired levels; promote vigorous plant re-growth; manage for the desired species composition; use forage plant biomass as a soil nutrient uptake tool; control insects, diseases and weeds; and maintain and/or improve wildlife habitat.	http://efotg.sc.egov.usda.gov/references/public/LA/Forage_Harvest_Management_(AC)_(511)_1-12.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
512	FORAGE AND BIOMASS PLANTING	ac	Establishing adapted and/or compatible species, varieties, or cultivars of herbaceous species suitable for pasture, hay, or biomass production.	To improve or maintain livestock nutrition and/or health; provide or increase forage supply during periods of low forage production; reduce soil erosion; improve soil and water quality; and produce feedstock for biofuel or energy production.	http://efotg.sc.egov.usda.gov/references/public/LA/Forage_and_Biomass_Planting_(512)_1-12.pdf
516	PIPELINE	ft	Pipeline having an inside diameter of 8 inches or less.	To convey water from a source of supply to points of use for livestock, wildlife, or recreation.	http://efotg.sc.egov.usda.gov/references/public/LA/Pipeline_(FT)_(516)_LA_9-11.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
528	PRESCRIBED GRAZING	ac	Managing the harvest of vegetation with grazing and/or browsing animals.	This practice may be applied as a part of conservation management system to achieve one or more of the following: improve or maintain desired species composition and vigor of plant communities; improve or maintain quantity and quality of forage for grazing and browsing animals' health and productivity; improve or maintain surface and/or subsurface water quality and quantity; improve or maintain riparian and watershed function; reduce accelerated soil erosion, and maintain or improve soil condition; improve or maintain the quantity and quality of food and/or cover available for wildlife; and manage fine fuel loads to achieve desired conditions.	http://efotg.sc.egov.usda.gov/references/public/LA/Prescribed_Grazing_(AC)_(528)_1-12.pdf
533	PUMPING PLANT FOR WATER CONTROL	no	A pumping facility installed to transfer water for a conservation need, including removing excess surface or ground water; filling ponds, ditches or wetlands; or pumping from wells, ponds, streams, and other sources.	To provide a dependable water source or disposal facility for water management on wetlands or to provide a water supply for such purposes as irrigation, recreation, livestock, or wildlife.	http://efotg.sc.egov.usda.gov/references/public/LA/533standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
548	GRAZING LAND MECHANICAL TREATMENT	ac	Modifying physical soil and/or plant conditions with mechanical tools by treatments such as pitting, contour furrowing, and chiseling, ripping or subsoiling.	To fracture compacted soil layers and improve soil permeability; reduction in water runoff and increased infiltration; break up root-bound conditions and thatch to increase plant vigor; and renovation and stimulation of plant community for greater productivity and yield.	http://efotg.sc.egov.usda.gov/references/public/LA/Grazing_Land_Mechanical_Treatment_(AC)_(548)_1-12.pdf
550	RANGE/SEED PLANTING	ac	Establishment of adapted perennial or self-sustaining vegetation such as grasses, forbs, legumes, shrubs and trees.	To restore a plant community similar to the Ecological Site Description reference state for the site or the desired plant community; provide or improve forages for livestock; provide or improve forage, browse or cover for wildlife; reduce erosion by wind and/or water; improve water quality and quantity; and increase carbon sequestration.	http://efotg.sc.egov.usda.gov/references/public/LA/Range_Planting_(AC)_(550)_1-12.pdf
552	IRRIGATION REGULATING RESERVOIR	no	A small storage reservoir constructed to regulate an irrigation water supply.	To collect and store water for a relatively short period of time to: improve irrigation water management by regulating fluctuating flows in streams, canals, or from pumping plants; provide storage for tailwater recovery and reuse; and improve offsite water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/552-Irrigation_Regulating_Reservoir.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
554	DRAINAGE WATER MANAGEMENT	ac	Control of water surface elevations and discharge from surface and subsurface drainage systems.	To improve water quality; improve the soil environment for vegetative growth; reduce the rate of oxidation of organic soils; prevent wind erosion; and enable seasonal shallow flooding.	http://efotg.sc.egov.usda.gov/references/public/LA/554_Drainage_Water_Management.pdf
558	ROOF RUNOFF STRUCTURE	no	Structures that collect, control, and transport precipitation from roofs.	This practice may be applied as a part of a resource management system to support one or more of the following purposes: improve water quality; reduce soil erosion; increase infiltration; protect structures; and increase water quantity.	http://efotg.sc.egov.usda.gov/references/public/LA/558_Roof_Runoff_Structure.pdf
560	ACCESS ROAD	ft	A travel way constructed as part of a conservation plan.	To provide a fixed route for travel for moving livestock, produce, equipment, and supplies; and to provide access for proper operation, maintenance, and management of conservation enterprises while controlling runoff to prevent erosion and maintain or improve water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/560.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
561	HEAVY USE AREA PROTECTION	ac	The stabilization of areas frequently and intensively used by people, animals or vehicles by establishing vegetative cover, surfacing with suitable materials, and/or installing needed structures.	To provide a stable, non-eroding surface for areas frequently used by animals, people or vehicles; and to protect and improve water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/LA561_HUA_Standard.pdf
578	STREAM CROSSING	no	A stabilized area or structure constructed across a stream to provide a travel way for people, livestock, equipment, or vehicles.	Improve water quality by reducing sediment, nutrient, organic, and inorganic loading of the stream; reduce streambank and streambed erosion; provide crossing for access to another land unit.	http://efotg.sc.egov.usda.gov/references/public/LA/578-Stream_Crossing.pdf
580	STREAMBANK AND SHORELINE PROTECTION	ft	Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.	To prevent the loss of land or damage to land uses, or other facilities adjacent to the banks, including the protection of known historical, archeological, and traditional cultural properties; to maintain the flow or storage capacity of the water body or to reduce the offsite or downstream effects of sediment resulting from bank erosion; to improve or enhance the stream corridor for fish and wildlife habitat, aesthetics, recreation.	http://efotg.sc.egov.usda.gov/references/public/LA/580.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
587	STRUCTURE FOR WATER CONTROL	no	A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation or measures water.	The practice may be applied as a management component of a water management system to control the stage, discharge, distribution, delivery or direction of water flow.	http://efotg.sc.egov.usda.gov/references/public/LA/587-Structure_For_Water_Control.pdf
590	NUTRIENT MANAGEMENT	ac	Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.	To budget, supply, and conserve nutrients for plant production; to minimize agricultural nonpoint source pollution of surface and groundwater resources; to properly utilize manure or organic by-products as a plant nutrient source; to protect air quality by reducing odors, nitrogen emissions (ammonia, oxides of nitrogen), and the formation of atmospheric particulates; and to maintain or improve the physical, chemical, and biological condition of soil.	http://efotg.sc.egov.usda.gov/references/public/LA/LA590Standard_2012.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
595	INTEGRATED PEST MANAGEMENT	ac	A site-specific combination of pest prevention, pest avoidance, pest monitoring, and pest suppression strategies.	To prevent or mitigate off-site pesticide risks to water quality from leaching, solution runoff and adsorbed runoff losses; prevent or mitigate off-site pesticide risks to soil, water, air, plants, animals and humans from drift and volatilization losses; prevent or mitigate on-site pesticide risks to pollinators and other beneficial species through direct contact; and prevent or mitigate cultural, mechanical and biological pest suppression risks to soil, water, air, plants, animals and humans.	http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_025930.pdf
601	VEGETATIVE BARRIER	ft	Permanent strips of stiff, dense vegetation established along the general contour of slopes or across concentrated flow areas.	To reduce sheet and rill erosion; reduce ephemeral gully erosion; manage water flow; stabilize steep slopes; and trap sediment.	http://efotg.sc.egov.usda.gov/references/public/LA/VegBarrier_601_Standard.pdf
606	SUBSURFACE DRAINAGE	ft	A conduit installed beneath the ground surface to collect and/or convey excess water.	This practice may be applied as part of a resource management system to achieve one or more of the following purposes: remove or distribute excessive soil water; and remove salts and other contaminants from the soil profile.	http://efotg.sc.egov.usda.gov/references/public/AL/tg606.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
607	SURFACE DRAINAGE	ft	A graded ditch for collecting excess water in afield.	To drain surface depressions; collect or intercept excess surface water, such as sheetflow, from natural and graded land surfaces or channel flow from furrows and carry it to an outlet; and collect or intercept excess subsurface water and carry it to an outlet.	http://efotg.sc.egov.usda.gov/references/public/LA/607standard.pdf
612	TREE/SHRUB ESTABLISHMENT	ac	Establishing woody plants by planting seedlings or cuttings, direct seeding, or natural regeneration.	Establish woody plants for: forest products such as timber, pulpwood, etc.; wildlife habitat; long-term erosion control and improvement of water quality; treating waste; storing carbon in biomass; reduce energy use; develop renewable energy systems; improving or restoring natural diversity; and enhancing aesthetics.	http://efotg.sc.egov.usda.gov/references/public/LA/Tree-Shrub_Establishment_612_Standard_9-2012.pdf
614	WATERING FACILITY	no	A permanent or portable device to provide an adequate amount and quality of drinking water for livestock and or wildlife.	To provide access to drinking water for livestock and/or wildlife in order to: meet daily water requirements; and improve animal distribution.	http://efotg.sc.egov.usda.gov/references/public/LA/Watering_Facility_NO_(614)_LA_5-30-12.pdf
620	UNDERGROUND OUTLET	ft	A conduit or system of conduits installed beneath the surface of the ground to convey surface water to a suitable outlet.	To carry water to a suitable outlet from terraces, water and sediment control basins, diversions, waterways, surface drains, other similar practices or flow concentrations without causing damage by erosion or flooding.	http://efotg.sc.egov.usda.gov/references/public/LA/Underground_Outlet_LA620_11-12.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
629	WASTE TREATMENT	no	The mechanical, chemical or biological treatment of agricultural waste.	To use mechanical, chemical, or biological treatment facilities and/processes as part of an agricultural waste management system: to improve ground and surface water quality by reducing the nutrient content, organic strength, and/or pathogen levels of agricultural waste; to improve air quality by reducing odors and gaseous emissions; to produce value added byproducts; and to facilitate desirable waste handling, storage, or land application alternatives.	http://efotg.sc.egov.usda.gov/references/public/LA/Waste_Treatment-629.pdf
633	WASTE RECYCLING	tons	The use of the by-products of agricultural production or the agricultural use of non-agricultural by-products.	To protect or improve the quality of natural resources and the environment; and provide or reduce energy use.	http://efotg.sc.egov.usda.gov/references/public/LA/LA633Standard_WasteRecycling_2012.pdf
634	WASTE TRANSFER	no	A system using structures, conduits, or equipment to convey byproducts (wastes) from agricultural operations to points of usage.	To transfer agricultural material associated with production, processing, and/or harvesting through a hopper or reception pit, a pump (if applicable), a conduit, and/or hauling equipment to: a storage/treatment facility, a loading area, and/or, agricultural land for final utilization as a resource.	http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026000.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
635	VEGETATED TREATMENT AREA	ac	An area of permanent vegetation used for agricultural wastewater treatment.	To improve water quality by reducing loading of nutrients, organics, pathogens, and other contaminants associated with livestock, poultry, and other agricultural operations.	http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_014858.pdf
638	WATER & SEDIMENT CONTROL BASIN	ft	An earth embankment or a combination ridge and channel generally constructed across the slope and minor watercourses to form a sediment trap and water detention basin.	A water and sediment control basin may be established to: improve farmability of sloping land; reduce watercourse and gully erosion; trap sediment; reduce and manage onsite and downstream runoff; and improve downstream water quality.	http://efotg.sc.egov.usda.gov/references/public/LA/638.pdf
642	WATER WELL	no	A hole drilled, dug, driven, bored, jetted or otherwise constructed to an aquifer.	This practice may be applied as part of a conservation management system to support one or more of the following purposes: to provide water for livestock, wildlife, irrigation, human, and other uses; to provide for general water needs of farming/ranching operations; and to facilitate proper use of vegetation on rangeland, pastures, and wildlife areas.	http://efotg.sc.egov.usda.gov/references/public/LA/Water_Well_(NO)_(642)_LA_9-11.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
643	RESTORATION & MANAGEMENT OF DECLINING HABITATS	ac	Restoring and managing rare and declining habitats and their associated wildlife species to conserve biodiversity.	Provide habitat for rare and declining species.	http://efotg.sc.egov.usda.gov/references/public/LA/643standard.pdf
644	WETLAND HABITAT WILDLIFE MANAGEMENT	ac	Retaining, developing or managing wetland habitat for wetland wildlife.	To maintain, develop, or improve wetland habitat for waterfowl, shorebirds, fur-bearers, or other wetland dependent or associated flora and fauna.	http://efotg.sc.egov.usda.gov/references/public/LA/644standard.pdf
645	UPLAND WILDLIFE HABITAT MANAGEMENT	ac	Provide and manage upland habitats and connectivity within the landscape for wildlife.	Treating upland wildlife habitat concerns identified during the conservation planning process that enable movement, or provide shelter, cover, food in proper amounts, locations and times to sustain wild animals that inhabit uplands during a portion of their life cycle.	http://efotg.sc.egov.usda.gov/references/public/LA/645standard.pdf
646	SHALLOW WATER DEVELOPMENT AND MANAGEMENT	ac	The inundation of lands to provide habitat for fish and/or wildlife.	To provide habitat for wildlife such as shorebirds, waterfowl, wading birds, mammals, fish, reptiles, amphibians and other species that require shallow water for at least a part of their life cycle.	http://efotg.sc.egov.usda.gov/references/public/LA/ShallowWaterDevMgmt_Standard.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
655	FOREST HARVEST TRAILS AND LANDINGS	ac and ft	A temporary or infrequently used route, path or cleared area.	To provide routes for temporary or infrequent travel by people or equipment for management activities; and provide periodic access for removal and collection of forest products.	http://efotg.sc.egov.usda.gov/references/public/LA/Forest_Trails_and_Landings_655_Standard_9-2012.pdf
656	CONSTRUCTED WETLAND	no	A constructed shallow water ecosystem designed to simulate natural wetlands.	To reduce the pollution potential of runoff and wastewater from agricultural lands to water resources.	http://efotg.sc.egov.usda.gov/references/public/LA/656.pdf
657	WETLAND RESTORATION	ac	The rehabilitation of a degraded wetland or the reestablishment of a wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition that existed prior to modification to the extent practicable.	To restore wetland function, value, habitat, diversity, and capacity to a close approximation of the pre-disturbance by: 1. restoring hydric soil, 2. restoring hydrology (depth duration and season of inundation, and/or duration and season of soil saturation), 3. restoring native vegetation (including the removal of undesired species, and/or seeding or planting of desired species).	http://efotg.sc.egov.usda.gov/references/public/LA/657standard.pdf
658	WETLAND CREATION	ac	The creation of a wetland on a site that was historically non-wetland.	To create wetland functions and values.	http://efotg.sc.egov.usda.gov/references/public/LA/658standard1.pdf

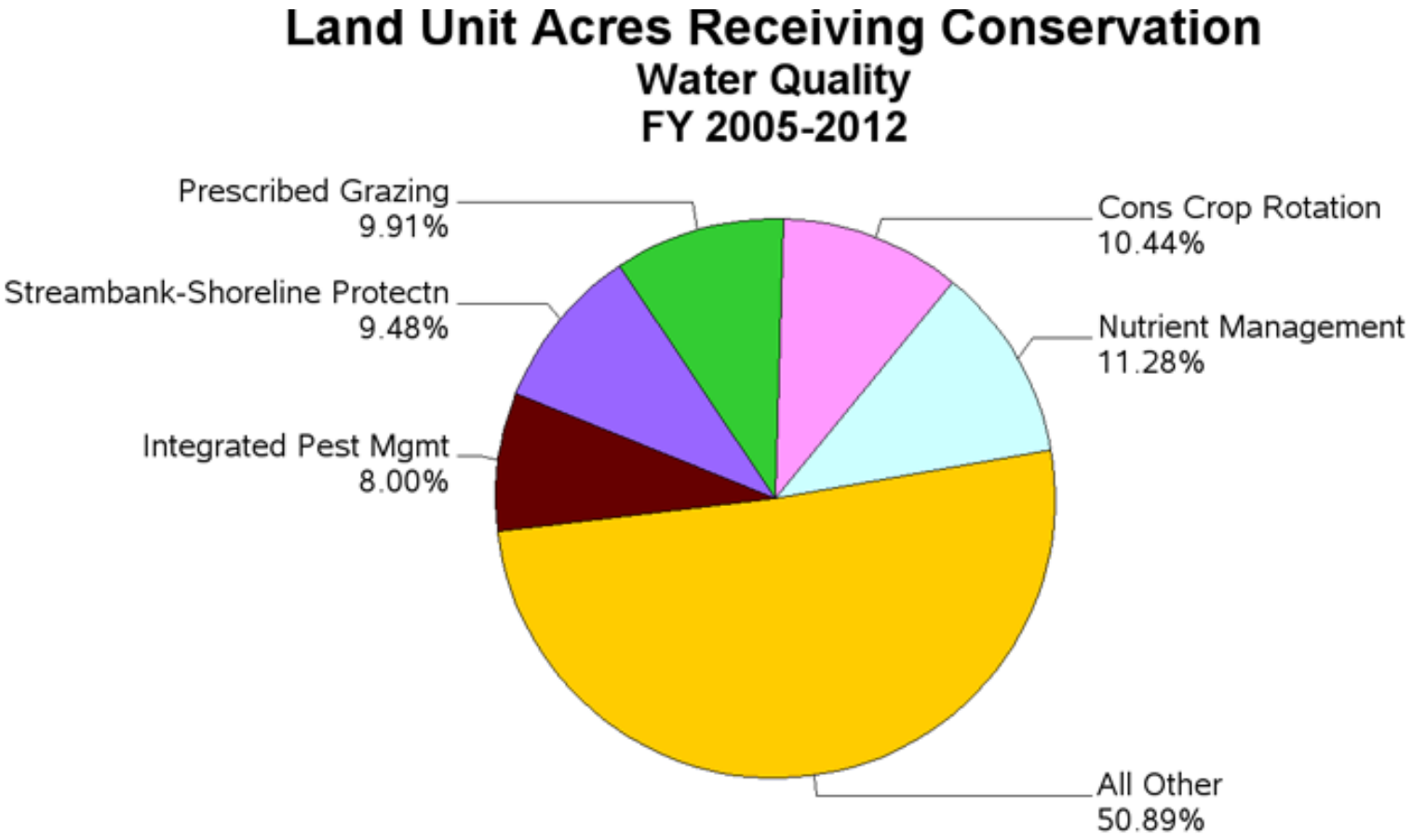
Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
659	WETLAND ENHANCEMENT	ac	The rehabilitation or re-establishment of a degraded wetland, and/or the modification of an existing wetland, which augments specific site conditions for specific species or purposes; possibly at the expense of other functions and other species.	To provide specific wetland conditions to favor specific wetland functions and targeted species by: 1. hydrologic enhancement (depth duration and season of inundation, and/or duration and season of soil saturation). 2. vegetative enhancement (including the removal of undesired species, and/or seeding or planting of desired species).	http://efotg.sc.egov.usda.gov/references/public/LA/659standard.pdf
666	FOREST STAND IMPROVEMENT	ac	The manipulation of species composition, stand structure and stocking by cutting or killing selected trees and understory vegetation.	Increase the quantity and quality of forest products by manipulating stand density and structure; timely harvest of forest products; development of renewable energy systems; initiate forest stand regeneration; reduce wildfire hazard; improve forest health reducing the potential of damage from pests and moisture stress; restore natural plant communities; achieve or maintain a desired native understory plant community for special forest products, grazing, and browsing; Improve aesthetic and recreation, values; improve wildlife habitat; alter water yield; and increase carbon storage in selected trees.	http://efotg.sc.egov.usda.gov/references/public/LA/Forest_Stand_Improvement_666_Standard_9-2012.pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
710	AGRICULTURAL SECONDARY CONTAINMENT FACILITY	no	Permanently located above ground facilities designed to provide secondary containment of on-farm oil products.	To minimize the risk of accidental release of stored oil products used in agricultural operations to support one or more of the following purposes: control excessive release of organics into groundwater and surface waters; and control excessive suspended sediment and turbidity into surface water.	http://efotg.sc.egov.usda.gov/references/public/LA/Agricultural_secondary_containment_facility_NO_(710)_LA_9-26-12.pdf
717	LIVESTOCK SHADE STRUCTURE	no	A permanent or portable framed structure with a mesh fabric roof to provide shade for livestock.	This practice may be applied as part of a resource management system to provide shade areas for livestock, helping protect surface waters from pollution and the livestock from excessive heat.	http://efotg.sc.egov.usda.gov/references/public/LA/Livestock_Shade_Structure_(NO)_(717)_LA_9-11.pdf
798	SEASONAL HIGH TUNNEL SYSTEM FOR CROPS	sq ft	A seasonal polyethylene covered structure that is used to cover crops to extend the growing season in an environmentally safe manner.	Improve plant quality; improve soil quality; reduced nutrient and pesticide transport; improve air quality through reduced transportation inputs; reduce energy use through local consumption.	http://efotg.sc.egov.usda.gov/references/public/LA/Seasonal_High_Tunnel_System_for_Crops-Standard(10-2010).pdf

Practice Code	Practice Name	Unit	Definition	Purpose	Standard Practice Documentation
799	MONITORING AND EVALUATION	no	Monitoring and evaluation are the actions and activities, using acceptable tools and protocols, to measure the effectiveness of conservation systems on reducing contaminants in ground and/or surface water quality.	Sample and measure water quality parameters to evaluate conservation system performance.	http://efotg.sc.egov.usda.gov/references/public/LA/799_Interim_Monitoring_and_Evaluation_Standard_Rev_April_21_2011_ver5.pdf

APPENDIX C: USDA NRCS LAND UNIT ACRES RECEIVING CONSERVATION FOR PRACTICES RELATED TO WATER QUALITY IN LOUISIANA, 2005-2012

Reproduced from USDA NRCS et al. 2012, *NRCS Conservation Programs: Louisiana 2005-2012*.



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 NRCS et al. 2012).

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
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
Access Road	560	1,761	20	2,360	60	324	9	190	4	1,099	14	405	11	173	3	3,505	22
Animal Mortality Facility	316											36	1			13	1
Composting Facility	317	102	40	247	30	225	31	202	11	44	4	60	4	44	4	60	4
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
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
Contour Farming	330					71	2					239	11				
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
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
Diversion	362			31	1			200	5	103	3	49	1			78	2
Filter Strip	393	261	7	1,411	29	603	18	192	5	519	11	181	8	201	2		
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
Grassed Waterway	412	420	11	966	46	1,603	19	1,698	34	1,413	18	283	6	34	1	96	2
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

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
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
Irrigation System, Microirrigation	441					436	9			94	1	21	2	13	3	3,523	7
Irrigation System, Tailwater Recovery	447			206	3			562	1	243	2						
Irrigation Water Management	449	17,118	507	18,906	490	24,774	622	30,224	721	32,892	724	35,200	730	23,817	337	96,280	1,528
Mulching	484	1,540	81	5,325	292	2,978	101	2,690	40	2,375	53	2,020	53	2,329	49	3,202	70
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
Prescribed Grazing	528	30,650	1,093	72,625	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
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
Residue and Tillage Management, No Till/Strip Till/Direct Seed	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
Residue and Tillage Management, Ridge Till	346	4,742	154	4,759	148	7,871	190	5,919	132	6,365	209	3,830	72	11,125	248	3,951	144
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
Riparian Herbaceous Cover	390													6	1		
Roof Runoff Structure	558													88	1		
Stream Crossing	578			370	2	37	3	183	1	20	2	18	1	56	2	10	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

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
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
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
Waste Facility Closure	**360**			14	1	42	3			2	1	66	8				
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
Waste Storage Facility	**313**	125	54	244	38	237	27	191	13	110	7	23	2	212	5	18	2
Waste Transfer	**634**					55	3	39	6	25	2	0	1	160	9	19	1
Waste Treatment Lagoon	**359**					4	1	2	1	3	1	44	5	17	2	13	2
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
Wetland Creation	**658**	6	1	781	40	2,019	17	2,166	16	148	3	1,955	10	362	10	1	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
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
Total		**402,926**	**9,459**	**848,531**	**15,839**	**440,039**	**13,155**	**450,928**	**13,364**	**477,773**	**13,115**	**470,931**	**14,405**	**642,606**	**12,972**	**605,884**	**15,272**

Notes: Data Source USDA-NRCS, National Conservation Planning Database, November 2012. Land unit acres may be counted multiple times across practices, practice groupings, and fiscal years. Totals may not exactly match sum over practices due to rounding.

APPENDIX D: LEVERAGING OPPORTUNITIES

Leveraging opportunities for nutrient management within Louisiana may exist through collaboration with numerous and diverse stakeholder groups such as these described below.

Stakeholder Group	Description	Web Resource
4R Nutrient Stewardship	4R Nutrient Stewardship is an innovative and science-based approach that offers enhanced environmental protection, increased production, increased farmer profitability, and improved sustainability. The 4R concept is the use of the right fertilizer source, at the right rate, at the right time, with the right placement.	http://www.nutrientstewardship.com/
American Farmland Trust	American Farmland Trust is working with farmers, planners and policy makers to ensure a regionally diverse structure for agriculture and more favorable economic conditions to keep farmers and ranchers on the land.	http://www.farmland.org/
America's Watershed Initiative	This initiative seeks to build and implement a vision based on collaboration and mutually beneficial outcomes in contrast to single purpose advocacy. It builds upon strong leadership present in many tributary watersheds. America's Watershed also seeks to link and augment these efforts, creating a broader partnership that can serve as a unified voice for the whole system, and support the effective resolution of issues that span multiple regions and issues such as energy, transportation, water quality and floodplain management.	http://www.greatriverspartnership.org/en-us/NorthAmerica/Mississippi/Pages/America's-Great-Watershed-Initiative.aspx
Amphibian Research Monitoring Initiative (ARMI), USGS	ARMI research is currently being conducted on projects designed to monitor amphibians on Federal lands in the south-central region; that includes the States of Texas, Oklahoma, Arkansas, Mississippi, and Louisiana; and to research possible causes of declines in amphibian populations. Potential threats include loss or degradation of habitat, disease, and contamination or pollution.	http://www.nwrc.usgs.gov/sc_armi/index.html

Stakeholder Group	Description	Web Resource
Atchafalaya Basin Program (ABP)	The Louisiana Department of Natural Resources (LDNR) oversees the management of the state master plan for the Atchafalaya Basin Floodway System. The ABP operates under the authority of Act 3 of 1998 and Act 920 of 1999. LDNR, the federal U.S. Army Corps of Engineers, and the basin parishes work together in creating projects by executing cooperative endeavors or agreements that protect and enhance the basin.	http://dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=494&pnid=0&nid=273
Barataria-Terrebonne National Estuary Program (BTNEP)	BTNEP is one of 28 National Estuary Programs throughout the United States and its territories. The National Estuary Program was established by Congress through section 320 of the Clean Water Act of 1987 and BTNEP became a National Estuary in 1990. Priority areas for BTNEP include hydrologic modification, sediment reduction, habitat loss, eutrophication, pathogens, toxic substances, and changes in living resources.	http://www.btnep.org/BTNEP/home.aspx
Delta REACH (Research and Education to Advance Conservation and Habitat)	The REACH program will be a Mississippi state-wide, producer driven, "hands on" delivery vehicle, that will provide coordination and support for documenting the benefits of conservation efforts to natural resources and agriculture on specific farms. Similar land use and conservation practices within the Mississippi delta region are found in Louisiana, and this REACH effort could inform Louisiana producers.	http://www.ctic.org/media/Reach%20Flyer%20Visual.pdf
Ducks Unlimited (DU)	DU works on conservation programs within Louisiana through restoring grasslands, replanting forests, restoring watersheds, working with landowners and partners, acquiring land, conservation easements, and management agreements. These efforts by DU aimed at restoring habitat for waterfowl also act to improve water quality.	http://www.ducks.org/louisiana/louisiana-projects.

Stakeholder Group	Description	Web Resource
Field To Market	Field To Market is a nonprofit organization of a diverse alliance working to create opportunities across the agricultural supply chain for continuous improvements in productivity, environmental quality, and human well-being. Field to Market provides collaborative leadership that is engaged in industry-wide dialogue, grounded in science, and open to the full range of technology choices. Currently 50 organizations participate in Field to Market and this participation includes growers, conservation, agribusiness, and academic/research groups.	http://www.fieldtomarket.org/
Gulf Coast Ecosystem Restoration Task Force (GCERTF)	GCERTF was formed as a result of the 2010 BP Deepwater Horizon Oil Spill. In order to restore lost services from the oil spill along the northern coastline of the Gulf of Mexico, GCERTF identified the types of water resource management projects that could be implemented to include implementation of watershed best management practices; improved agricultural and silvicultural management practices; enhanced storm water and/or wastewater management; improved quality and quantity of freshwater flows, discharges, and withdrawals; sediment runoff management, and other foundational water quality concerns.	http://epa.gov/gcertf/
Gulf Hypoxia Restoration Incentive Program	The Gulf Hypoxia Restoration Incentive Program is being proposed by the Eastern Tallgrass Prairie and Big Rivers Landscape Conservation Cooperative (ETPBR LLC) to reduce nutrient inputs to the Gulf of Mexico hypoxic zone and provide benefits to people and wildlife. The ETPBR LLC is one of a network of 22 LCCs and covers the large geographic area commonly referred to as "America's Cornbelt," including the primary agricultural producing states contributing to the Gulf Hypoxic Zone.	NA

Stakeholder Group	Description	Web Resource
Gulf of Mexico Alliance (GOMA)	GOMA is composed of state and federal agencies along with partners and covers the five Gulf states of Alabama, Florida, Louisiana, Mississippi, and Texas. The goal of GOMA is to increase regional collaboration to enhance the ecological and economic health of the Gulf of Mexico. Six priority issue areas have been identified and include water quality, habitat conservation and restoration, ecosystems and assessment, nutrient and nutrient impacts, coastal community resilience, and environmental education and outreach.	http://www.gulfofmexicoalliance.org/index.php
Gulf of Mexico Initiative (GoMI)	GoMI is designed to help producers in Alabama, Florida, Louisiana, Mississippi, and Texas improve water quality and ensure sustainable production of food and fiber. GoMI will deliver up to $50 million in financial and easement assistance over 3 years in 16 priority watersheds. Assistance will help producers apply sustainable agricultural and wildlife habitat management systems that maintain agricultural productivity; avoid, control, and trap nutrient runoff; and reduce sediment transport. GoMI also will reduce current over-use of water resources and prevent saltwater from entering the habitats of many threatened and endangered species. NRCS programs supporting GoMI are the Environmental Quality Incentives Program, Wildlife Habitat Incentive Program, Conservation Stewardship Program, Wetlands Reserve Program, Grassland Reserve Program, and Farm and Ranch Lands Protection Program.	http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/farmbill/initiatives/?&cid=stelprdb1046039
Healthy Watersheds Initiative, USEPA	This USEPA initiative launched in 2009 has been encouraging local and state agencies to be proactive and place a stronger emphasis on protecting their remaining healthy watersheds as a way to save money and the environment.	http://water.epa.gov/polwaste/nps/watershed/index.cfm

Stakeholder Group	Description	Web Resource
Lake Pontchartrain Basin Foundation (LPBF)	The LPBF is dedicated to restoring and preserving the water quality, coast, and habitats of the entire Pontchartrain Basin. The Lake Pontchartrain Basin is a 10,000 square mile watershed encompassing 16 Louisiana parishes. Through coordination of restoration activities, education, advocacy, monitoring of the regulatory process, applied scientific research, and citizen action, LPBF works in partnership with all segments of the community to reclaim the Basin for this and future generations.	http://www.saveourlake.org/
Louisiana Agriculture and Forestry Nutrient Management Task Force	This Task Force was formed in 2012 by the Louisiana Department of Agriculture (LDAF) to study topics related to agricultural nutrient issues and evaluate their impact on our agricultural industries. The Task Force members include representatives from Louisiana agriculture and forestry stakeholders and industry:. Louisiana Cooperative Extension Service, Louisiana Agriculture Experiment Station, Louisiana Association of Conservation Districts, Louisiana Farm Bureau Federation, Louisiana Soybean and Grain Association, Louisiana Forestry Association, Louisiana Landowner's Association, Louisiana Agricultural Consultants Association, Louisiana fertilizer industry, Louisiana Cattleman's Association, Louisiana poultry industry, American Sugar Cane League, and Louisiana Rice Grower's Association. This Task Force is an excellent example of producers, industry, universities and state governments working together to address nutrient concerns and will continue to do so in a manner that is consistent with sound science and practical application (Strain 2013b).	NA
Louisiana Universities Marine Consortium (LUMCON)	LUMCON was formed in 1979 to coordinate and stimulate Louisiana's activities in marine research and education. LUMCON provides coastal laboratory facilities to Louisiana universities, and conducts in-house research and educational programs in the marine sciences. Monitoring and research on the Gulf of Mexico seasonal hypoxic zone is performed by LUMCON.	http://www.lumcon.edu/

Stakeholder Group	Description	Web Resource
Louisiana Water Synergy Project, U.S. Council of Sustainable Development	The Water Synergy Project creates an industry forum for regional collaboration to address water quality, quantity, and storm water challenges in southern Louisiana, with a focus on the New Orleans to Baton Rouge Mississippi River Corridor. In this structured forum, business leaders from multiple industries will work together to identify water management issues, identify solutions that work, and implement.	http://water-synergy.org/
Lower Mississippi River Conservation Committee (LMRCC)	The LMRCC is a coalition of 12 state natural resource conservation and environmental quality agencies in Arkansas, Kentucky, Louisiana, Mississippi, Missouri and Tennessee. It provides the only regional forum dedicated to conserving the natural resources of the Mississippi River's floodplain and focuses on habitat restoration, long-term conservation planning and nature-based economic development.	http://www.lmrcc.org/
Lower Mississippi River Sub-basin Committee (LMRSBC)	The LMRSBC is composed of representatives from of five states including Arkansas, Louisiana, Mississippi, Missouri, and Tennessee. Key to the mission of the LMRSBC are 1) support and coordinated implementation of the Gulf Hypoxia Action Plan, and 2) compiling nutrient loading information and assessing impacts of current programs, coordinating interstate watershed programs, promoting and coordinating regional programs, and establishing open process for stakeholder engagement.	http://www.epa.gov/gmpo/lmrsbc/
Lower Mississippi Valley Initiative (LMVI)	The LMVI began in 2000 by the USDA NRCS and eight states (Arkansas, Kentucky, Louisiana, Missouri, Mississippi, Tennessee, and Texas) to promote agriculture-led initiatives in areas where agriculture is deemed of most concern to water quality issues. Through agriculture-led initiatives nonpoint source loadings can be address through non-regulatory means.	NA

Stakeholder Group	Description	Web Resource
McKnight Foundation	This Minnesota-based family foundation, seeks to improve the quality of life for present and future generations. The Mississippi River Program goal is to use resources to restore the water quality and resilience of the Mississippi River and strategies include: restoring and protecting floodplains and wetlands; reducing agricultural pollution in four states along the northern half of the river (Minnesota, Wisconsin, Iowa, and Illinois); focusing on farmland and operations with high levels of nitrogen and phosphorus runoff; and in the 10-state Mississippi River corridor, achieving cross-boundary and interagency coordination (among government agencies) that improves the river's water quality and resilience.	http://www.mcknight.org/grant-programs/mississippi-river/
Migratory Bird Habitat Initiative (MBHI), USDA NRCS	Through the MBHI, NRCS will work with farmers, ranchers and other landowners to manage portions of their land to enhance habitat for migrating birds. Participating states are: Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, Missouri, and Texas. Eligible areas for FY 2012 MBHI include portions of 22 parishes across southern Louisiana. Funding will be provided through the Environmental Quality Incentives Program and will be used for protecting, restoring, and enhancing migratory bird habitat.	http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/farmbill/initiatives/?&cid=stelprdevb1027669

Stakeholder Group	Description	Web Resource
Mississippi River Basin Healthy Watershed Initiative (MRBI), USDA NRCS	Through the MRBI, NRCS and partners work with producers and landowners to implement voluntary conservation practices that improve water quality, restore wetlands, enhance wildlife habitat and sustain agricultural profitability in the Mississippi River Basin. NRCS has identified the Mississippi River Basin as a top priority due to water quality concerns, primarily related to the effects of nutrient loading on the health of local water bodies and, eventually, the Gulf of Mexico. The 13-state Initiative builds on the cooperative work of NRCS and its conservation partners in the basin, and offers agricultural producers in priority watersheds the opportunity for voluntary technical and financial assistance. The participating States are Arkansas, Kentucky, Illinois, Indiana, Iowa, Louisiana, Minnesota, Mississippi, Missouri, Ohio, South Dakota, Tennessee and Wisconsin.	http://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/programs/farmbill/initiatives/?&cid=stelprdb1048200
Mississippi River Cities and Towns Initiative (MRCTI)	The MRCTI was created by the Northeast-Midwest Institute (NEMWI) through a grant from the Walton Foundation. The goal of the MRCTI is to create a new and influential voice for the Mississippi River and to demand effective river protection, restoration, and management in Washington, D.C. MRCTI is a local government-lead effort empowering the ten states and over one hundred cities that border the Mississippi River to act for its continued prosperity, sustainability, and economic growth. As of August 2013, there are 47 cities and towns along the length of the Mississippi River participating in the initiative, including the Louisiana cities of Vidalia, Baton Rouge, and New Orleans.	NA
Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force)	The Hypoxia Task Force consists of 5 federal agencies, 12 states and the tribes within the Mississippi-Atchafalaya River Basin (MARB). The Task Force was established in 1997 to reduce and control hypoxia in the Gulf of Mexico.	http://water.epa.gov/type/watersheds/named/msbasin/index.cfm

Stakeholder Group	Description	Web Resource
National Water Quality Initiative (NWQI), USDA NRCS	The NWQI will work in priority watersheds to help farmers, ranchers and forest landowners improve water quality and aquatic habitats in impaired streams. NRCS will help producers implement conservation and management practices through a systems approach to control and trap nutrient and manure runoff. Qualified producers will receive assistance for installing conservation practices such as cover crops, filter strips and terraces.	http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/financial/eqip/?cid=stelprdb1047761
Office of Soil & Water Conservation (OSWC), LDAF	The Office of Soil & Water Conservation provides financial assistance, administrative support, centralized direction and coordination to Louisiana's 44 Soil & Water Conservation Districts (SWCDs) which provide conservation planning services to landowners within their individual districts. SWCDs are local units of state government with capabilities very unique to any other form of state or local government, due mainly to their capability of entering private property at the request of landowners to plan and/or construct various conservation systems. Each of Louisiana's 44 SWCDs are assisted by the USDA NRCS.	http://www.ldaf.state.la.us/portal/Offices/SoilWaterConservation/ConservationDistricts/tabid/267/Default.aspx
Source Water Protection Program (SWPP), LDEQ	LDEQ manages the SWPP to protect the state's ground water aquifers and surface waters utilized as drinking water supplies. The SWPP builds upon the Source Water Assessment Program (SWAP) that was completed by LDEQ in 2003 that determined the susceptibility of public water supplies to contamination after assessing nearby type, number and location of potential sources of contamination and hydrogeologic sensitivity factors.	http://www.deq.louisiana.gov/portal/DIVISIONS/BusinessandCommunityOutreach/AquiferEvaluationandProtection.aspx
Southeast Aquatic Resources Partnership (SARP)	SARP is a regional collaboration of natural resource and science agencies, conservation organizations and private interests developed to strengthen the management and conservation of aquatic resources in the southeastern U.S.	http://www.sarpaquatic.org/

Stakeholder Group	Description	Web Resource
The Conservation Fund	This program boasts 205,000 acres saved in the state of Louisiana. Selected projects in Louisiana include the Upper Ouachita National Wildlife Refuge, Maurepas Swamp Wildlife Management Area, and the Joyce Wildlife Management Area.	http://www.conservationfund.org/
The Nature Conservancy (TNC), Louisiana	Within the state of Louisiana, TNC has protected more than 285,000 acres of crucial habitats for people and nature. TNC has helped create or significantly expand 9 State Wildlife Management Areas, 13 National Wildlife Refuges, and 2 State Conservation Areas.	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/louisiana/index.htm
U.S. Environmental Protection Agency (USEPA)	The USEPA is the federal agency responsible for protecting and improving water quality. USEPA provides programs related to both nonpoint and point source management activities.	http://water.epa.gov/
U.S. Fish and Wildlife Service (USFWS)	The USFWS is active in environmental projects within the state of Louisiana and the Mississippi-Atchafalaya River Basin that can impact water quality of the state's waters. The USFWS recently released a vision document for the GOM (USFWS 2013) which addresses focal areas of the Mississippi River Delta, Coastal Wetlands and Barrier Islands; Mississippi River Alluvial Valley; and Atchafalaya River Basin in Louisiana for gulf restoration priorities.	http://www.fws.gov/
USGS National Water-Quality Assessment (NAWQA) Program, USGS	The USGS NAWQA program provides information that can help managers tailor protection strategies to fit a given need, providing high quality water while minimizing costs. Examples of two significant projects driven by the NAWQA program include the Nutrients National Synthesis and the SPARROW model.	http://water.usgs.gov/nawqa/
Water Environment Research Federation (WERF)	WERF, formed in 1989, is an independent scientific research organization dedicated to wastewater and storm water issues.	http://www.werf.org/
Resource Conservation & Development (RCD), USDA	There are seven RCDs located within Louisiana: Acadiana, Bayou Land, Capitol, Imperial Calcasieu, Northeast Delta, Trailblazer, and Twin Valley. These RCDs work on implementation of watershed level plans to improve and restore water quality.	http://www.la.nrcs.usda.gov/partnerships/RCD/

Stakeholder Group	Description	Web Resource
Walton Family Foundation (WFF)	The WFF invests in conservation solutions and focuses its environmental giving through two initiatives: Freshwater conservation, which includes the Mississippi River Basin (MRB); and Marine conservation including the Gulf of Mexico (GOM). Funding in 2012 totaled more than $14 million for MRB and more than $3 million for GOM.	http://www.waltonfamilyfoundation.org/

APPENDIX E: REFERENCES

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APPENDIX F: RESPONSE TO PUBLIC COMMENTS ON REVIEW DRAFT (DECEMBER 2013)

The State of Louisiana released a *Review Draft* of the *Louisiana Nutrient Management Strategy: Protection, Improvement, and Restoration of Water Quality in Louisiana's Water Bodies* for public comment on December 20, 2013 (as made available on the Louisiana Nutrient Management Strategy website at http://lanutrientmanagement.org/). The public comment period ended January 31, 2014. The release of the *Review Draft* followed an 18-month development process which included interaction and engagement with representatives from over 130 stakeholder affiliations at more than 30 events.

This strategy promotes 1) incentives which foster voluntary participation, and 2) opportunities for leveraging among programs, partners, and stakeholder groups. Input from representatives of key stakeholder groups, including agriculture, business/industry/municipality, non-governmental organizations, and academic/research institutions informed content of this strategy.

During the public comment period, 15 unique comments and 119 form letter responses were received by January 31, 2014. Additional 22 form letter responses were received after the January 31, 2014 requested timeframe for public comment. Many responders recognized that the Louisiana Nutrient Management Strategy is a living strategy that is specific to Louisiana and Louisiana's nutrient water quality concerns, and will continue to evolve to continue to improve water quality within the state of Louisiana.

Comments were categorized into the following: 1) Overall/General, 2) River Diversions, 3) Nonpoint Sources, and 4) Point Sources. Key topics within each category are presented and discussed. Responses to comments are presented below by key topic.

1. ***Overall/General Comments***

1.A. Comprehensive approach

Some responders lauded the State for utilizing a very comprehensive, multi-faceted, and stakeholder-engaged process to develop the Louisiana Nutrient Management Strategy (Strategy) that represents a bold "first step" to improve nutrient water quality throughout the state. It was also recognized that additional work may be needed, that the Strategy will evolve, and that the process has started off on the right foot.

The "Ten Strategic Components" approach taken by the state was recognized as a sound approach to the multi-disciplinary nature of the nutrient issue, and one that appropriately covers the broad spectrum of science, regulation, community engagement, and prioritization in a goal-oriented format. Appendix A of the Strategy was recognized as the heart of the "strategy", presenting action items and timelines.

The Strategy established a process that the State will follow through its establishment of nutrient-related priorities and actions. As indicated in Section E.3.10 (Reporting), reporting is a critical component of the Strategy and will take many forms including annual reports documenting progress on Strategy activities; utilization of the Nutrient Management Strategy website for dissemination of information; providing geospatial information through a web-based viewer; and documenting spotlights/highlights of nutrient management activities. Continued feedback and input will help improve the effectiveness of these reporting tools.

1.B. Management inclusive of reduction

The Strategy included a section on page 2 (Box 1: Why a Nutrient Management Strategy?) that presents the logic at taking a more holistic and comprehensive view of nutrients through nutrient management, rather than just on nutrient reduction. The purpose of the Strategy is to manage nitrogen and phosphorus to protect, improve, and restore the nutrient-related water quality in Louisiana's inland and coastal waters. Achieving water quality improvements will take a combination of activities, including river diversions, nonpoint source and point source management, and voluntary incentive-based programs to address nutrient issues within the state.

The use of the term "nutrient management" reflects Louisiana's commitment to improving water quality through a variety of means, which may include actions such as: reductions of nutrient applications; utilizing best management or conservation practices which improve the utilization efficiency and conservation of nutrients on fields; and intercepting nutrients that have already entered the river system through wetland assimilation or diversion projects. While Louisiana is a small contributor to the nutrient problem within the larger Mississippi-Atchafalaya River Basin, Louisiana can make significant contributions to reducing the amount of nutrients that eventually enter the Gulf of Mexico through a variety of actions that collectively define the term "management". Utilizing the term "reduction", while perhaps may be more consistent with some guidance documents, limits the realm of activities that would lead to improvements in nutrient-related water quality in Louisiana.

1.C. Quantitative targets

Nutrients are naturally occurring and are essential for aquatic life; water quality problems can occur when nutrients are either in excess or at inadequate levels. As stated in the Louisiana Nutrient Management Strategy vision on page 9, nutrient levels in Louisiana's surface waters, both inland and coastal, will be managed to ensure support of healthy aquatic communities, clean water for public, agricultural and industrial use, including but not limited to recreation in and on the water, drinking water supplies, irrigation, and livestock watering. For instance, LDEQ's ambient water quality monitoring program is collecting nutrient water quality information, and implementation of this Strategy will aid to enhance the reporting of that information. Through enhanced monitoring and reporting it will be possible to assess nutrient levels in the state's surface waters to help determine the appropriate nutrient levels necessary to support healthy aquatic ecosystems. With appropriate data, specific nutrient-related goals and priorities may begin to be appropriately determined.

1.D. General constructive feedback

Several recommendations were made for improvements of the formatting of the Louisiana Nutrient Management Strategy. These recommendations that may be considered for incorporation into the Strategy over time include:

1) Providing additional links on the Louisiana Nutrient Management Strategy website to agencies, programs, key documents, and procedures.
2) Adding a Summary/Conclusions section at the end of the document to reiterate the major points of the entire document and the strategy, explain future documents to be released as part of the strategy, and discuss the path forward.
3) Refining Appendix A to clarify some of the timelines.
4) Considering partnerships with up-stream watersheds (both within Louisiana, and in upriver states) to improve the management of nutrients and the amount of nutrients that reach Louisiana waters.
5) Providing additional information about current Municipal Separate Storm Sewer Systems (MS4s) and their storm water plans to provide a more complete local and regional picture of nutrient inputs and active plans/regulations. Urban areas have the potential to contribute greatly to nutrient levels in local streams. With MS4 requirements in place for a growing number of large and small EPA-designated "Urban Areas", managing nutrients in these areas is a quickly evolving and dynamic topic.
6) Including a plan for gaining additional funding. There are questions about whether current programs have sufficient funding to meet their goals and needs (and about the prospects for funding of those programs reliant on federal dollars), and it seems reasonable to assume that additional resources will be needed for future progress.
7) Looking for opportunities to leverage Louisiana's Strategy with the Hypoxia Task Force Action Plan goals. The Review Draft's components are standard and have value in themselves. The "Strategy Features" described on Page 10 can lend themselves to this approach, as can the regional collaboration and initiatives cited on Page 17. This can be done in part by seeing where the targets and goals for local water quality improvements overlap with those that apply to aiding the reduction of the Gulf Hypoxic Zone.
8) Adding some discussion about federal, state, and local laws and regulations and perhaps even some data from the LDEQ Impaired Waterbodies List would elaborate on local stream contributions and concerns.
9) Incorporating information at the watershed scale related to urban issues (regulations, policies, and programs), such as wastewater and MS4s. This should include assessments to investigate: A) whether current local and state regulations are adequate to meet MS4 requirements or (Total Maximum Daily Load) TMDL load reductions (where nutrients are cited as a contributing factor); B) how recently have these regulations been reviewed; and C) do they reference current technology (especially in terms of wastewater treatment)?

Recommendations that were based on increases in regulations or regulatory authority were also received; however, since one of the foundational principals of the Strategy is that it is a voluntary approach to improving water quality, recommendations to increase regulations are

duly noted, but have not been incorporated into the Strategy at this time. Opportunities to incorporate the spirit of the recommendations in a non-regulatory manner will be explored.

These comments include:

1) Adding regulatory mechanisms as a part of this plan, including: requiring basic technology limits on major sewage treatment plants; adopting techniques evidenced in the Environmental Leadership Program as best available technology for industrial N and P dischargers that are new, expanding, and/or renovating; adopting narrative nutrient criteria into permits as water quality based effluent limits; and including actual N and P reduction goals in future TMDLs.
2) Adding numeric goals and timelines to voluntary participation in incentive-based programs.

1.E. General questions

In addition to the general feedback discussed above, several questions were posed which we are offering responses to below.

1. How will monitoring improve and how will it be used?
   As discussed in Section E.3.9 Monitoring, on pages 36-37, there are several monitoring programs that will be utilized to evaluate changes in nutrient concentrations over time, such as the LDEQ Ambient Water Quality Monitoring Network and monitoring of nutrients and nutrient assimilation relative to river diversions. These datasets may provide more robust information to guide watershed-scale nutrient strategy evaluation and implementation.

2. Specifically, how were the comments at the Stakeholder Meetings incorporated?
   The Stakeholder Meetings conducted from November 2012 through June 2013 provided stakeholders an opportunity to share 1) their perspectives on nutrient management; 2) their experiences about what has worked and what has not worked; 3) technical and policy challenges and recommendations for implementing nutrient management strategies on-the-ground; and 4) what they would like to see in the Louisiana Nutrient Management Strategy. Stakeholder feedback guided the state's development of the Louisiana Nutrient Management Strategy.

3. It would be helpful to have an organizational chart of agencies/entities involved including how they interact and responsibilities of each. Is there one agency in particular that holds ultimate responsibility in the success of the strategy?
   The Strategy was developed by an Interagency Team consisting of the Coastal Protection and Restoration Authority of Louisiana (CPRA), Louisiana Department of Agriculture and Forestry (LDAF), Louisiana Department of Environmental Quality (LDEQ), and Louisiana Department of Natural Resources (LDNR). These agencies are the primary agencies within the state of Louisiana that deal directly with water monitoring and water quality, and the agencies that would primarily be responsible for implementing the Strategy. Although all four agencies were involved in developing the Strategy, CPRA was the lead

agency in development based on their involvement and representation on the Hypoxia Task Force. LDEQ, which also participates in the Hypoxia Task Force, will lead implementation.

4. Discussions and planning within the Gulf Hypoxia Task Force and Coordinating Committee have generally been informed by the conclusion of the 2007 EPA Science Advisory Board Report about the importance of proceeding in a "directionally correct fashion to manage factors affecting hypoxia" (Action Plan, page 9). This leads to a key question that arises when reviewing the "Draft Review" – how can its components (primarily the programs and projects described as well as further efforts) be organized or integrated in a directional way?
   Implementation of the Strategy, as outlined in Appendix A, has already started. Collaboration and coordination of efforts will be instrumental. Information gathered will aid in identifying priority watersheds for nutrients management activities. As priority watersheds are identified, partnering and leveraging opportunities will be pursued to make implementation most efficient and cost-effective. This approach represents a "directionally correct" approach.

5. What is the potential for expanded joint action between Arkansas and Louisiana on shared watersheds?
   There is great potential for such partnering between Louisiana and other states. During the development of the Strategy, Louisiana, Mississippi, and Arkansas discussed the potential for leveraging among all three states as our respective Strategies move into implementation. Now that the Strategies are moving into implementation, pursuit of partnering opportunities will continue.

2. River Diversions

Many comments were received supporting river diversions as a means of intercepting nutrients from the Mississippi River before they reach the Gulf of Mexico. The dual utilization of river diversions for ecosystem restoration and nutrient removal was supported by many responders. Specific feedback on the Louisiana Nutrient Management Strategy related to river diversions centered on two main areas: 1) the timing of when diversions could be constructed; and 2) scientific uncertainties regarding diversion effects on wetlands.

2.A. Timing of construction for riverine diversions

Louisiana's Coastal Master Plan (CPRA 2012) identifies a number of large river diversions which models suggest will be able to divert water from the Mississippi and/or Atchafalaya Rivers into coastal wetlands that have the ability to assimilate nitrogen and phosphorus. These diversion projects have planning schedules that span years, and some stakeholders were concerned that construction would not happen soon enough. The State recognizes the lengthy planning, engineering, and design work that is necessary to construct these diversion projects. The State also does not rely entirely on river diversions to manage nutrients. The Louisiana Nutrient Management Strategy promotes nonpoint source and point source management strategies

which will contribute to improving nutrient water quality within Louisiana's waters. River diversions represent a part of the overall nutrient management strategy. While river diversion projects are being designed, progress will be made in other areas to improve nutrient water quality.

2.B. Uncertainties regarding river diversions

Scientific and technical uncertainties exist which will affect how river diversions are operated. CPRA is working very closely with The Water Institute of the Gulf to develop and execute improved nutrient models for the receiving basins of the proposed diversion projects to predict the wetland response and nutrient assimilation rates. In addition, data collection and specific research projects are being pursued which will address the dominant research uncertainties. CPRA's project teams are also investigating various scaling and operational scenarios for these projects which will maximize their benefits. The state is aware of the scientific and technical uncertainties surrounding river diversions and is working to resolve them.

3. Nonpoint Source

Several comments were related to nonpoint sources. These comments focused on examples of voluntary actions, such as the Louisiana Master Farmer Program and the Coastal Forest Conservation Initiative. Commenters also recognized that there are still issues to be addressed in some watersheds regarding nonpoint sources.

It was suggested that opportunities be pursued to leverage the Louisiana Master Farmer Program with one of the incentive programs as a required course. It was also suggested that although the Coastal Forest Conservation Initiative has been very successful, the scale and funding available for the program should be increased. In addition, despite a number of areas where significant improvements are being made and programs are being leveraged (such as the Ouachita River Basin), there remains a need for additional nonpoint actions in some areas.

4. Point Source

Several comments were related to point sources. These comments focused on: A) requirements for wastewater discharge permits; B) maintaining appropriate level of control over the expanding Mississippi River industrial corridor; and C) encouraging and expanding the Environmental Leadership Program and facilitating the adoption of those successful technologies by more companies in Louisiana, as well as upriver states.

4.A. Wastewater discharge permits

It was commented that requirements for water discharge permits could be improved, such as that for car washes. Nutrient monitoring for permitted dischargers is being implemented in areas as directed by a TMDL, such as for those in the Lake Pontchartrain Basin. In addition, LDEQ has included a requirement for facilities to use low-phosphate, low-surfactant products in Part 1A. of the carwash general permit to adequately address concern regarding nutrients, and this decision is based on other states' general permits and the availability and common use of low-phosphate and phosphate free soaps and detergents.

4.B. Mississippi River Industrial Corridor (MRIC)

It was commented that the expanding industrial corridor (Mississippi River) was a concern. A report by Knecht 2000 presented an inventory of nutrient releases in the Lower Mississippi River Industrial Corridor (MRIC) to demonstrate nutrient levels and voluntary reductions by from major dischargers. Through the Environmental Leadership Program (ELP) several entities along the MRIC have voluntarily implemented nutrient management activities to reduce nutrients (such as ExxonMobil, BASF, and Marathon). In addition, monitoring by LDEQ along the MRIC at three long-term ambient monitoring stations documents the nutrient levels in the MRIC. Preliminary evaluations of that information reveal that nutrient levels have not significantly increased in the MRIC over the last 30 years. Continued monitoring of ambient nutrient levels will aid in documenting improvements in ambient conditions in the MRIC.

4.C. Environmental Leadership Program (ELP)

It was suggested that the voluntary Environmental Leadership Program (ELP) be expanded to include awards for use of nutrient-reduction technologies.

The state's Environmental Leadership Program (ELP) is a very effective tool to encourage industrial improvements in nutrient discharge. Commenters suggested that the program be expanded and that successful technologies developed through his program be shared with other industrial leaders within Louisiana and upstream. Additionally, with the current planned expansion of many facilities along the industrial corridor, it was suggested that more up-to-date information on industries and discharges be made available.

The ELP Program has awarded nutrient-specific awards to point sources for the voluntary and proactive implementation nutrient management activities. Since 2001, an ELP award has been presented to nine entities for their voluntary nutrient management activities. Uses of nutrient-reduction technologies were included in some of those activities (such as BASF Corporation and Martin Ecosystems).

5. Conclusion

Louisiana appreciates all of the feedback received through the public comment period and through all of the stakeholder meetings and input sessions conducted during the development of the Louisiana Nutrient Management Strategy. As was noted by several commenters, this Strategy represents the beginning of a dynamic and evolving process for improving nutrient management within state waters. The strategy is a living document that provides for continual feedback and interaction with stakeholders and also for re-assessment in 5 years. Future strategy activities may reflect improvements in nutrient management technologies, policies, and partnerships which will result in improvements in water quality across Louisiana.