

2020 Annual Report

Louisiana Nutrient Reduction and Management Strategy Implementation

Baton Rouge, Louisiana

**Prepared by the
Louisiana Nutrient Reduction and Management Strategy Interagency Team**

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Governor's Office of Coastal Activities (GOCA)
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Louisiana Department of Environmental Quality (LDEQ)
Louisiana Department of Natural Resources (LDNR)
Louisiana State University Agricultural Center (LSU AgCenter)

With collaboration of the
U.S. Business Council for Sustainable Development, Louisiana Water Synergy Group
U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS)
U.S. Environmental Protection Agency (USEPA)

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THE HYPOXIA TASK FORCE

The Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force, HTF) was established in 1997 to address eutrophication and hypoxia in the Gulf of Mexico.

The first Action Item of the 2008 Action Plan called for the development and implementation of state nutrient reduction strategies for each of the 12 member states. Louisiana fulfilled that directive in 2014. Annual Reports and 5-year updates have been ongoing since development.

Currently, The Louisiana Governor's Office of Coastal Activities is the Louisiana state member of the HTF. The HTF reports to Congress biennially as part of the Harmful Algal Blooms and Hypoxia Research and Control Amendments Act of 2014 (since amended).

Louisiana continues support of the HTF and its goals. Collective efforts in the basin will ultimately be responsible for achieving the 5,000 square kilometers target, as it has been shown that upriver states contribute to nutrient pollution within the MARB and the Gulf.

Within Louisiana, nutrient reduction and management occurs at the local level through a variety of efforts involving nonpoint and point sources. Long-term and large-scale projects, such as river diversions, are also included as viable solutions to nutrient management.

STRATEGY PURPOSE:

This Strategy presents a framework of **TEN Strategic Components** underlying actions that guide implementation of nutrient reduction and management activities across the state. Completing these strategic actions, in addition to adapting, modifying, and/or identifying additional actions is part of the Strategy implementation process.

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ABBREVIATIONS

ACWA	Association of Clean Water Administrators
AIA	Agriculture Innovation Agenda
AWQMN	Ambient Water Quality Monitoring Network
BMP	Best Management Practice
CB	Conventional Burning
CDBG	Community Development Block Grants
CDOM	Chromophoric Dissolved Organic Matter
CELCP	Coastal and Estuarine Land Conservation Program
CFCI	Coastal Forest Conservation Initiative
CIAP	Coastal Impact Assistance Program
CIG	Conservation Innovation Grant
COMB	Compost Application with Burning
CP	Conservation Practice
CMAP	Council Monitoring and Assessment Program
CPRA	Coastal Protection and Restoration Authority of Louisiana
CRMS	Coastwide Reference Monitoring System
CTA	Conservation Technical Assistance
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund Program
DRP	Dissolved Reactive Phosphorus
EDMS	Electronic Document Management System
ELP	Environmental Leadership Program
EQIP	Environmental Quality Incentives Program
FWP	Fish and Wildlife Propagation
GCTB	Green Cane Trash Blanketing
GIS	Geographic Information System
GOCA	Governor's Office of Coastal Activities
GOMA	Gulf of Mexico Alliance
HTF	Mississippi River/Gulf of Mexico Watershed Nutrient Task Force (Hypoxia Task Force)
HUC	Hydrologic Unit Code
ICIS	Integrated Compliance Information System
LDAF	Louisiana Department of Agriculture and Forestry
LDEQ	Louisiana Department of Environmental Quality
LDNR	Louisiana Department of Natural Resources
LGU	Land Grant Universities
LMFP	Louisiana Master Farmer Program
LPDES	Louisiana Pollutant Discharge Elimination System
LPWC	Lake Providence Watershed Council
LSU AgCenter	Louisiana State University Agricultural Research Center
MARB	Mississippi/Atchafalaya River Basin
MGD	Million Gallons per Day
MRBI	Mississippi River Basin Initiative
N	Nitrogen
NEPA	National Environmental Policy Act

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

STRATEGIC ACTIONS

The Louisiana Nutrient Management Strategy was released in May 2014 (Louisiana Nutrient Management Strategy Interagency Team 2014), and underwent the scheduled 5-year update in 2019 (Louisiana Nutrient Reduction and Management Strategy Interagency Team; ‘Strategy’). The 2019 update constituted the 2018 Annual Report and may be found, along with this document, on the Nutrient Reduction and Management Strategy (NRMS) website: <https://www.deq.louisiana.gov/page/nutrient-management-strategy>.

The Strategy Interagency Team is comprised of representatives from the Louisiana state agencies of the Coastal Protection and Restoration Authority of Louisiana (CPRA), the Louisiana Department of Agriculture and Forestry (LDAF), the Louisiana Department of Environmental Quality (LDEQ), the Louisiana Department of Natural Resources (LDNR), and the Louisiana State University Agricultural Research Center (LSU AgCenter).

In this year, the Interagency Team began close coordination with the Governor’s Office of Coastal Activities (GOCA), the Louisiana member organization on the Hypoxia Task Force. Partnerships with other governmental and non-governmental entities have been established with The Nature Conservancy (TNC); the U.S. Business Council for Sustainable Development (US BCSD), Louisiana Water Synergy Group; the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS); and the U.S. Environmental Protection Agency (USEPA) to enhance success of the Interagency Team. These partnerships form a well-rounded team best suited to set Louisiana on a path to achieve nutrient reduction and management goals outlined in the Strategy.



This Annual Report describes the accomplishments in implementation of the Strategy during 2020. Completed and ongoing strategic actions are identified, and results and advancements made are discussed. Covid-19 measures and hurricanes in 2020 have set back progress in some areas, such as engagement and monitoring activities. However, each agency/partner has moved forward with nutrient reduction and management activities during this period as highlighted below.

1. STAKEHOLDER ENGAGEMENT

Stakeholder participation is essential to accomplishing the vision of the Strategy. Stakeholders are the stewards of their local landscapes and have a vested interest in the protection, improvement, and restoration of water quality within their watershed community. Engaging and communicating with stakeholders is crucial to the success of the Strategy. Engaging stakeholders and educating the public concerning nutrient matters remains high priority for the Strategy team and partners.

1.a. Identification and Engagement of Stakeholders

Stakeholder identification was initiated early during the initial stage of Strategy development (2013-2014), and has been an ongoing for each agency/program since inception. This action continues to focus on identifying and engaging stakeholders with interest in nutrient reduction and management in Louisiana. Stakeholders include groups such as local state and federal agencies, agricultural producers, academic institutions, nonprofit organizations, non-governmental

organizations (NGOs), private industry, private landowners, parishes, municipalities, and Soil & Water Conservation Districts. There are currently over 200 identified stakeholders.

Recent additions include:

- ❖ The Governor’s Office of Coastal Activities (GOCA). The Deputy Director at GOCA serves as the Louisiana member of the HTF. Throughout 2020, the Executive Assistant in GOCA and staff partnered with the Interagency Strategy Team to coordinate implementation of the NRMS and develop a Fall 2020 update for the Hypoxia Task Force. To supplement the scientific and technical work of the Team, GOCA provides a multi-agency and multi-stakeholder perspective on statewide, Gulf Coast, Task Force, and national concerns relevant to policy, legislative, and community impacts. Monthly calls with the Interagency Strategy Team ensured GOCA’s continued coordination with and expansion of the NRMS scope in its approach to these impacts.
- ❖ Strategy partners boosted collaboration efforts in 2020 to support HTF actions to reach nutrient reduction and management goals.

HTF creates 7 workgroups to boost states efforts

As part of HTF efforts in early 2020, seven workgroups were developed to enhance collaboration towards reducing nutrients in the Mississippi-Atchafalaya River Basin (MARB), three of which have been long-standing* within the Task Force. Each group and progress through 2020 is as follows:

- **Research Needs:** Identify key research needs that effectively support state implementation of nutrient reduction strategies.
- **Water Quality Trends*:** Evaluate new metrics to complement current metrics for evaluating water quality trends in the basin.
- **Water Quality Monitoring:** Evaluate funding needs to support existing and potential new monitoring in the MARB, particularly to track loads and trends in large rivers to determine if states are meeting nutrient reduction goals and provide data that states can use to tailor implementation of their nutrient management strategies.
- **Funding:** Explore available programs and synergy with federal funding sources (Farm Bill, CWA, FEMA, WRDA, etc.) with a focus on near-term increases in nutrient reduction practice adoption, versus large program or policy changes, and identify potential long-term actions.
- **Ecosystems/Social Metrics:** Identify potential metrics that will help illuminate ecosystem changes/success due to implementation of nutrient reduction strategies in the MARB.
- **Adoption of Innovative BMPs:** Explore opportunities for states to use federal funds to implement innovative BMPs.
- **Communications:** Explore opportunities to enhance public awareness of HTF accomplishments and promote and support actions that reduce nutrient inputs and improve water quality.
- **Environmental Mitigation for Restoration Projects:** Further develop examples in individual states where mitigation challenges are causing impacts to projects.

- **Nonpoint Source Metrics*:** Focus on strategies, challenges and opportunities for documenting and analyzing data related to nonpoint source nutrient reductions; produce periodic progress reports.
- **Point Source Metrics*:** Focus on tracking progress in reducing nutrient loads from point sources in the Mississippi River Basin; produce periodic progress reports.

Progress on each work group was reported during the (virtual) Fall HTF Meeting in October 2020. More information on the 2020 fall meeting may be found here: <https://www.epa.gov/ms-htf/hypoxia-task-force-meeting-agendas-and-related-information>.

Ongoing stakeholder activities of note include:

- ❖ LDEQ TMDL New Vision activities are currently at different stages in the following watersheds: Tunica Bayou, Bayou Sara, Yellow Water River, Natalbany River, New River and Blind River. Local parish government stakeholders were identified in each watershed. Local citizen advisors/stakeholders have been identified in the Natalbany River and Yellow Water River watersheds. LDEQ plans to identify local citizen advisors/stakeholders in the New River and Blind River watersheds in 2021.
- ❖ LDEQ NPS Section continues to coordinate with the Capital Resource Conservation & Development Council (RC&D), Louisiana Rural Water Association (LRWA), Bayou Vermilion District (BVD) and Barataria-Terrebonne National Estuary Program (BTNEP) to inspect and educate homeowners concerning bacteria as well as nutrient issues related to sewage systems. These activities are also coordinated with LDEQ's TMDL program.

1.b. Perform outreach/education on Strategy Activities

Outreach/education on Strategy activities is ongoing. This action is focused on outreach to stakeholders to inform, promote participation, and report results on Strategy activities. In 2020, the Strategy Interagency Team participated in many events related to nutrient reduction and management in Louisiana as well as other areas of the Mississippi/Atchafalaya River Basin (MARB). However, due to Covid-19 protocols, events were initially cancelled as the state was on lock down or diminished while under restrictive engagement with the public during the pandemic.

Strategy Interagency Team members did continue to communicate with their stakeholders concerning nutrient reduction and management activities within their respective areas during 2020. Nearly 350 outreach activities were performed in 2020 across various sectors such as media, school visits/education events, and meetings by the Strategy Interagency Team (Table 1). This year, LDEQ has included the US EPA and associated environmental programs/groups in the tally; 130 calls, meetings, and/or webinars were conducted over 2020 concerning nutrient related activities with other professionals. This represents 38% of LDEQ stakeholder and outreach metrics. CPRA meetings also included outreach to advisory committees, regional working groups, and the public representing 33% of

Strategy team
attends or hosts 341
professional and
public nutrient
related activities in
2020

non-tour related outreach. Many to most events turned virtual during the 2020 pandemic as agencies adapted.

Table 1. Outreach Activities performed by Strategy Team Members in 2020 (some values estimated from descriptors).

Outreach/Stakeholder Event Description										
Organization	Meeting	Presentation	Public Event	Workshop /Training	School	Tour	Symposium	Press	Field Day	TOTAL
CPRA	17	3	1			63				84
LSU Ag	3			2					6	11
LDEQ TMDL	6		1		6					13
LDEQ NPS/Standards	211		8	2	10		1			232
LDEQ Permits	1									1
									TOTAL	341

LDEQ's NPS and TMDL Sections created videos to educate the public that are posted on LDEQ's YouTube Channel:

- Nonpoint Source Pollution-Featuring Enviroscape-; October 26, 2020
- EnviroSchool-Water Quality in Louisiana; September 16, 2020
- EnviroSchool-Onsite Sewage Treatment System Maintenance, Health, and the Environment; September 16, 2020
- New Vision Program; September 4, 2019

<https://www.youtube.com/c/LouisianaDepartmentofEnvironmentalQuality/videos>. The New Vision and Onsite Sewage videos may also be found on the TMDL webpage: <https://deq.louisiana.gov/page/newvisionprogram>.

The USDA NRCS provided a webinar to Lower Mississippi River Sub-basin committee members entitled: *USDA Programs Aiding Gulf Hypoxia Action Plan in the Lower Mississippi River Sub-basin* on December 10, 2020. In addition, the *NRCS Conservation Outcomes Webinar Series* are one-hour, live webinars that occur every fourth Thursday at 3:00 p.m. Eastern Time (ET) via Adobe Connect at <https://nrcs.adobeconnect.com/ceap2/>. Webinars are archived on the webpage. The USDA Agricultural [Research Service](#) also hosted [Listening Sessions: Water Availability and Watershed Management \(NP211\)](#) concerning NP211 objectives, with the sessions archived on the website.

[The Current Webinar Series](#) is a speed networking webinar series for professionals engaged in water-related extension, research, and conservation activities. The North Central Region Water Network and Extension Directors from all 12 North Central states are sponsoring this series to highlight the best water-related research and Extension programming in the region. Webinars run for 60 minutes, with three 10-minute project snapshots and 30 minutes of QA/peer-to-peer interaction. Archived webinars can be found through the webpage.

The HTF held meetings in February (in-person) and September (virtual) to discuss ongoing activities with member states, federal partners, and the public concerning nutrient reduction activities. In addition, HTF Quarterly Newsletters and HTF Nutrient Success Stories are new outreach components for 2020 (HTF 2021a, HTF 2021b). The HTF webpage offers all current reports and published documents as well (HTF 2021c). More information on HTF related activities is found in Sections 1a, 1c, and 5.

Additional information on outreach events for Louisiana Strategy members in 2020 include the following:

- CPRA, GOCA, and LDEQ participation in the Hypoxia Task Force (HTF) Winter (February 4, 2020) and Fall (October 1, 2020) Public Meetings
- CPRA and LDEQ participation on HTF Coordinating Committee Monthly Conference Calls
- CPRA and LDEQ participation on Gulf of Mexico Alliance (GOMA) Priority Issues Team meetings and conference calls
- CPRA seminar presentation to LSU College of the Coast and Environment class
- CPRA Resilience Information Exchange
- CPRA modeling webinar/s
- CPRA Community Engagement Meetings
- CPRA workshops concerning Chenier Plain, Terrebonne, Barataria, and Pontchartrain/Breton Sound
- LDEQ participation at the Association of Clean Water Administrators (ACWA) Mid-Year Virtual Meeting, March 17-18, 2020
- LDEQ participation at the ACWA Annual Virtual Meeting August 4-5, 2020
- LDEQ participation on ACWA Board of Directors and Executive Committee
- LDEQ participation on ACWA conference calls
- LDEQ participation in the Louisiana Water Synergy Group Meeting June 30, 2020
- LDEQ participation in the Mississippi River Cities and Towns Initiative (MRCTI) Virtual Conference, 9th Annual Meeting September 16, 2020
- LDEQ participation in the Louisiana Master Farmer Partners Group Meetings, June 30, 2020 and September 15, 2020
- LDEQ participation in the Lake Providence Watershed Council
- LDEQ participation in the Lower Mississippi River Conservation Committee (LMRCC)
- LDEQ participation in the Water-Carbon Nexus Workgroup
- LDEQ participation in the Louisiana Watershed Initiative through the Technical Advisory Groups and Nature Based Solutions Group
- LDEQ participation in the Gulf of Mexico Ecosystem Services Logic Models & Socio-Economic Indicators (GEM) Regional Workshop
- LDEQ participation in the American Fisheries Society Virtual Spring Conference
- LDEQ participation in the Association of State Wetland Managers webinars
- LDEQ participation in the Louisiana Coastal Forest Workshop
- LDEQ participation in the North American Lake Management Society Virtual Conference
- LDEQ participation in the Bays and Bayous Symposium
- LDEQ participation in the America's Watershed Initiative Report Card Preview

- LDEQ Nonpoint Source participation at the:
- SMAMS Science Fair Judging
- Port Allen High School JAG Class
- Westdale Science Night
- Mandeville Community STEM Café
- Glen Oaks Park Elementary Science Fair
- Region 8 Science Fair Annual Event
- Girl Scouts Believe In Girl (B.I.G.)
- Wild Things
- 3rd Annual New Orleans Saints & Pelicans STEM FEST
- LATM & LSTA Joint Conference
- LDEQ Envirothon Blitz
- Bolton High School Envirothon Blitz
- Delta Gems Envirothon Blitz
- Port Allen High School Science Fair Mentoring and Judging

1.c. Identify and promote partnerships/leveraging opportunities

The ongoing identification and promotion of partnerships and leveraging opportunities is vital to the success of the Strategy. Participation of and collaboration with all stakeholder groups in a watershed is not only key to the implementation of the Strategy, but is also fundamental to the success of water quality protection and restoration activities as a whole. Government agency agreements and/or partnerships with other agencies and outside programs, including non-profits, often leverage various aspects of programs (e.g., funds, personnel, equipment, data collection and reporting) and offer incentives to improve performance. Partnerships and leveraging among agencies like LDAF, LDEQ NPS Program, and USDA NRCS are routine and continued through 2020, with dollars provided through 319 funding and/or Farm Bill provisions. These programs are often coordinated and/or leveraged through US EPA Region 6 Nonpoint Source Group and LSU Ag Center. Further, partnership with the Louisiana Governor’s Office of Coastal Activities (GOCA) encouraged a broader basin-wide Task Force focus on strategy implementation and nutrient abatement.

Collaboration and leveraging opportunities in 2020 included:

- ❖ A Memorandum of Understanding (MOA) between Minnesota and the Barataria-Terrebonne National Estuary Program (BTNEP) and has continued through 2020. Under the National Estuary Program, Comprehensive Coastal Management Plans (CCMPs) are put into place to direct research and restoration activities for each NEP (BTNEP 2018). The MOA allows implementation of pollution prevention and restoration best management practices listed in the BTNEP CCMP within parts of Minnesota inside of the Mississippi River watershed, which is the watershed of BTNEP. Improvement of water quality in the watershed is a direct implementation of the BTNEP CCMP, which in turn promotes improved water quality at the terminus of the Mississippi River watershed (MDA

BTNEP assists in the release of over \$25 million for conservation practices in Minnesota to improve water quality in LA

- 2019). The Minnesota Department of Agriculture reports biennially on their BMP Loan Program, with the next report due in fall 2021.
- Over \$25 million in loans were allocated in 2020 by the Minnesota Dept. of Ag. as part of the MOA under the BTNEP 320 CCMP. All future loans will be allocated through the loan to Concentrated Animal Feeding Operations (CAFOs) and repayment process (~13 million per year).
 - 101 CAFOs practices have been completed, totaling \$7.7 million in loans, which would not have been completed if not for the MOU.
- ❖ The USEPA released funds (100k each), to Hypoxia Task Force states in support of nutrient reduction efforts outlined in state strategies (USEPA 2019, 2020). Two projects were funded in Louisiana:
- *Pilot Expansion of Water Quality Monitoring from Inshore to Offshore*-this project continues to monitor a historic coastal transect to collect data to inform restoration models
 - Partnerships include LDEQ, CPRA and USEPA/HTF to support the continuation of a study initially performed with funds provided by the Gulf of Mexico Alliance Water Resource Team (Gulf Star initial award in 2018)
 - *Nutrient Reduction Strategies Supporting Section 319 Clean Water Act (CWA) Louisiana Nonpoint Source (NPS) Water Quality Analysis*-this project collects nutrient data to provide support for implementation activities in four Basins: Mermentau, Vermillion Teche, and Quachita River and Terrebonne. The priority waters within each basin currently undergoing monitoring include Bayous Maringouin (120111), Du Portage (060703), Grosse Tete (120104) and the Vermilion River (060801).
 - Collaboration with LDEQ Water Planning and Assessment Division (WPAD), LDEQ NPS, and LDEQ's Water Surveys (WS) staff
- ❖ In 2018, LDEQ partnered with the Louisiana Watershed Initiative (LWI) to address flood mitigation and resiliency throughout the state. To support that effort, LDEQ has partnered with the Louisiana Office of Community Development (OCD) and the United States Geologic Survey (USGS) to install, operate and maintain 100 new river and rain gauges throughout the states. Up to 15 of the gauges may include equipment to monitor selected water quality parameters. The first gauges are expected to be installed in 2021 (LWI 2021). The program is initially planned to last 6 years, but efforts are planned to conduct long-term sustainability.
- ❖ [Louisiana Climate Initiatives Task Force](#)
- Recommendations for the reduction of greenhouse gas emissions originating in Louisiana will improve coastal resilience, and Agriculture and Land Use components will have water quality connections.
- ❖ RESTORE Act Louisiana Center of Excellence Research Grants Program
- Two research projects completed that increase understanding of river diversions and nutrient influences on wetlands and soils.
- ❖ Lower Mississippi River Nutrient Comparison
- USGS is working with CPRA to develop a work plan to determine the scope of a comparison of various water quality parameters at multiples sites in the lower Mississippi River to understand factors and influences on nutrient transport.

- ❖ The USDA has formed a new team that will lead department-wide effort focused on serving beginning farmers and ranchers. Derrick Johnson was selected as the USDA Beginning Farmer Rancher state coordinator in Louisiana. Others on the team coordinating Louisiana’s beginning farmer and rancher efforts include: Ervin Norwood, Program Technician with the Farm Service Agency; Stephanie Paul, District Conservationist with the Natural Resource Conservation Service; and Lee Jones, Assistant to the State Director with Rural Development. This is a collateral duty for all team members.
 - Each state coordinator will receive training and develop tailored beginning farmer outreach plans for their state. Coordinators will help field employees’ better reach and serve beginning farmers and ranchers and will also be available to assist beginning farmers who need help navigating the variety of resources USDA has to offer.

USDA developing
new team for
Beginning Farmers

2. DECISION SUPPORT TOOLS

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

2.a. Identify, evaluate, and document selected tools

During early Strategy development, the Strategy Interagency Team conducted a broad review of available decision support tools. In all, over 200 tools were identified and evaluated. This effort continues and available tools have expanded by ~40. The most applicable tools include best management practices, data access portals, mapping applications, modeling tools, and reports.

A list of all identified tools may be found on the LDEQ NRMS tools webpage: <https://www.deq.louisiana.gov/page/nutrient-management-decision-support-tools>.

Updated or expanded tools identified 2019-2020 include:

- [The Nature Conservancy Global Map of Water Funds](#) (2020) addresses water insecurity world wide
- USEPA’s Recovery Potential Screening Tool-[Downloadable RPS Tools for Comparing Watersheds](#) (2020)
- [USGS SPARROW Model](#) modifications and updates (2019-2021)
 - A new [mapping tool](#) created with SPARROW Model data enables water-quality managers to identify the locations of the largest sources of nutrients throughout the Mississippi/Atchafalaya River Basin
 - [RSPARROW](#) now available of USGS GitLab repository to provide open source version of the USGS SPARROW water-quality model
- [LDEQ Integrated Report Interactive Assessment Map](#) (2021)
- [Hypoxia Task Force Success Stories website and interactive map](#) (2020)
- [STEPL](#) by the USEPA is used by LDAF for targeting their CWA Section 319 efforts at the HUC12 and tract levels (updated 2020)

- [LSU AgCenter’s Cover Crop Decision Making Tool](#) (2019)
- [OpTIS](#) (Operational Tillage Information System) Tool. Conservation Technology Information Center, Dagan, and The Nature Conservancy partnered to provide an automated system to map tillage, residue cover, winter cover, and soil health practices using remote sensing data (CTIS 2020a)
- [USDA Agriculture Innovation Strategy Dashboard](#) (2021) for solutions and barriers to agriculture innovation
- [The Soil Health Nexus digital soil health toolbox](#) (2020) digital repository of soil health resources that can help you improve your soil health knowledge and equip you to teach soil health to producers and other stakeholders once you are back in the field
- [Gulf Coast Monitoring & Assessment Portal](#) (2020) digital inventory of Gulf Coast habitat monitoring, mapping, and water quality programs and assessments compiled by the RESTORE Council Monitoring and Assessment Program (CMAP) with the assistance of the Gulf of Mexico Alliances’ (GOMA) Monitoring Community of Practice
- [Harmful Algal Bloom \(HAB\) Economic Impacts Data Dashboard](#) (2020) was released by The Balmoral Group to track economic losses due to HABs from Florida’s Gulf Coast in 2018, and can be used as a baseline for other states
- USDA [Conservation Concerns Tool](#) is available for farmers and ranchers to identify and get help with conservation issues (2020)

As part of LDNR’s responsibilities, the Office of Coastal Management’s (OCM) goal is to achieve a balance between conservation of coastal resources and development of the coastal zone. Development in the coastal zone is encouraged but avoidance and minimization of impacts to coastal resources is essential in order to protect those resources for future generations. To accomplish this goal, OCM reviews every Coastal Use Permit (CUP) application with the objective of avoiding and/or minimizing adverse impacts wherever possible. Pursuant to La. RS 49:214.27.B and C., OCM uses the Coastal Use Guidelines, found in LAC Title 43, Part I, Chapter 7, Subpart B, §701-719, to determine the type of information needed to fully evaluate a particular use and the adverse impacts that must be avoided to the maximum extent practicable. All coastal uses must be in conformance with all applicable Coastal Use Guidelines in order to receive approval from OCM.

In support of this effort, OCM utilizes the Hydrologic Modification Impact Analysis (HMIA) which investigates the pre- and post-development surface water conditions at a site proposed for development to determine if adverse impacts to adjacent lands and/or waterways will occur as a result of the proposed use (LDNR OCM 2020). During HMIA, OCM aims to minimize adverse impacts from proposed uses that modify existing hydrologic conditions (i.e., quantity, movement, distribution, and quality of water). Projects that may require a HMIA include those which reduce the stormwater retention capabilities (i.e. permeability, storage, etc.) of the property proposed for development. Permeability of the land will decrease as the amount of impervious surface (i.e., concrete, asphalt, foundations, roofing etc.) installed on the property increases. Projects involving fill that result in an overall increase in post-development ground elevation that meets or exceeds 6 inches above pre-development ground elevations also may require a HMIA. Projects that result in an overall increase in the quantity, frequency and/or duration of stormwater runoff into an adjacent property or waterway will require a HMIA.

3. REGULATIONS, PROGRAMS, & POLICIES

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

3.a. Propose new regulations, policies and programs

Regulations, programs, and policies were identified early in Strategy development, and documentation and distribution continues. Numerous efforts are underway within the state of Louisiana as well as nationally that address a multitude of nutrient reduction and management activities such as those aimed toward outreach, monitoring, or agricultural incentives. Agricultural production in Louisiana has benefitted from Farm Bill programs that offer financial incentives and technical assistance with implementation of conservation practices. A list of regulations, policies and programs may be found on the Louisiana Nutrient Reduction and Management Strategy website (2021): <https://www.deq.louisiana.gov/page/nutrient-management-strategy>.

Ongoing regulations, policies, and programs of note in 2020 include:

- ❖ Freshwater numeric criteria for ammonia was promulgated through the water quality group in 11/2020 under LAC 33:IX.1113. LDEQ Permits have started implementation of the new criteria.
- ❖ House Appropriations Bill 7608 was passed in June 2020:
 - The total budget for agricultural research is \$3.3 billion, \$92 million higher than the FY-2020 level. An additional investment of \$990 million for rural broadband through the [ReConnect](#) program. The total budget for farm programs is \$1.835 billion, \$30 million higher than the FY-2020 level, which includes \$1 billion is for conservation programs, which includes \$167 million for infrastructure for watershed and flood prevention and watershed rehabilitation projects. \$5 million for resolving farmland succession issues.
- ❖ The Louisiana State Legislature passed HCR64 in June 2020: To express support for the annual Gulf Hypoxia Mapping Cruise conducted by the Louisiana Universities Marine Consortium and to memorialize congress to provide continued funding.
 - The annual hypoxia cruise is currently supported by NOAA, and took place from July 25-Aug 1, 2020 with Covid-19 restrictions. Tropical storms influenced the size of the dead zone in 2020.
- ❖ The Louisiana Watershed Initiative (LWI) was established by Governor Edwards in 2016 to address statewide flood risk reduction through an innovative watershed-based floodplain management approach. Members of the Interagency Strategy Team work alongside the LWI to align state agency programs and operations around watershed management, as it pertains to coastal management, water quality, and natural solutions. In its establishment of provisional watershed boundaries and regional steering committees, the Initiative has made great strides over the past year to develop stronger regional entities that manage flood risk comprehensively across natural watersheds instead of political boundaries.
 - In addition to the collaboration among interagency activities and regional entities, the LWI is continuing to develop its statewide watershed modeling program, intended to develop scientific models of major watersheds throughout the state.

Total budget for Farm Bill programs is \$1.8 billion for 2021

These models will support greater regional collaboration around shared water management challenges and build an objective, science-based understanding of how projects, policies, and other measures will reduce flood risk. Additionally, the LWI, in partnership with LDEQ and USGS, signed a \$15 million cooperative endeavor agreement to install and operate up to 100 new river and rain gauges throughout the state alongside an addition of 15 water quality monitors (LWI 2021a). The gauge network will provide better information for the development of watershed models and for the use of natural floodplain functions by increasing statewide coverage for monitoring rainfall and river flows in real time.

- Further programmatic progress is anticipated for 2021 through the development of watershed models, regional watershed-based governance structures, and statewide interagency coordination around flood risk management. Member agencies of the Strategy Team, GOCA, and other NRMS partners will continue to work alongside LWI as these programs advance in the coming years.
- ❖ The Louisiana Master Farmer Program helps agricultural producers voluntarily address the environmental concerns related to production agriculture, as well as to enhance their production and resource management skills that will be critical for the continued viability of Louisiana agriculture. The LMF program involves producers becoming more knowledgeable about environmental stewardship, resource-based production and resource management through a voluntary producer certification process.
 - The Master Farmer Program began in 2001 as a way for farmers to learn up-to-date, research-based conservation practices in a comprehensive manner. It is a partnership of five agricultural entities – NRCS, LSU Ag Center, Louisiana Farm Bureau, Louisiana Cattlemen’s Association, LA Dept. Agriculture and Forestry, which approves the Master Farmer certifications and recertification. To be certified as a LA Master Farmer, producers must
 - Attend at least 6 hours of classroom instruction on conservation needs, concerns and initiatives,
 - Take part in an instructional tour of a working conservation farm, and
 - Develop and implement a total Resource Management System (RMS)-level conservation plan for each farm.
 - New and renewed Master Farmers occurred throughout 2020
- ❖ USDA NRCS projects and policies in 2020 include:
 - NB 300-19-34 LTP – Mississippi River Basin Healthy Watersheds Initiative (MRBI) Project Funding for Fiscal Year (FY) 2020 and Opportunity for Readiness Phase for New Watershed Projects.
 - For continuation of funding, and proposing new priority watersheds for targeted conservation efforts in MRBI.
 - <https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=43727>
 - Priority Area Names of MRBI Implementation Watersheds are Macon-Baxter, Tensas Bayou and Tiger Bayou.
 - <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=nrcseprd412623>
 - NB 300-19-33 LTP – National Water Quality Initiative (NWQI) Watershed and Source Water Protection Area Selection and Criteria for Implementation and Readiness Phases of NWQI – Fiscal Year (FY) 2020

- For continuing currently approved NWQI watersheds, selecting new watersheds, submitting justification to withdraw existing NWQI watersheds, and proposing new areas for drinking water protection for FY 2020.
 - <https://directives.sc.egov.usda.gov/ViewerFS.aspx?hid=43715>
- HUC 12 Names of the FY 2020 Implementation Watersheds are Bayou Blanc, Bayou Plaquemine Brule and Bayou Plaquemine Brule-Estherwood.
 - <https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=nrcseprd1431052>
- Source Water Protection
 - Language in the [2018 Farm Bill](#) (Section 1244(n): *Source Water Protection Through Targeting of Agricultural Practices*) encourages the protection of drinking water sources through the following methods:
 - Identify local priority areas for drinking water protection in each state in collaboration with State Technical Committees and community water systems.
 - Provide increased incentives for practices that relate to water quality and quantity and protect drinking water sources while also benefitting producers.
 - Dedicate at least 10% of funds available for conservation programs (with the exception of CRP), each year beginning in FY 2019-FY 2023, to be used for source water protection (not the same as NWQI).
 - Priorities waters in Louisiana include the Cameron Parish area
 - Factors used for the selection of this area related to nutrient reduction and management included:
 - Nutrients, sediment, pathogens, pesticides – identified water quality resource concerns at watershed/area scale
 - Reported or likelihood of Harmful Algal Blooms (HABs)
 - Water system violations
 - Highly erodible soils, degraded habitats and livestock access to surface waters
 - Projects will continue through 2023
 - In November 2020, USDA NRCS completed and published updates to its set of [National Conservation Practice Standards](#), which include 58 updated or revised standards. The 2018 Farm Bill required USDA’s Natural Resources Conservation Service (NRCS) to review all 169 of its national conservation practices to seek opportunities to increase flexibility and incorporate new technologies.
- ❖ In 2020, the USDA released a Request for Information Request to develop a US [Agriculture Innovation Agenda](#) (AIA). By the end of the year, feedback was received and compiled to form the USDA Agriculture Innovation Agenda. The goal is to stimulate innovation so that American agriculture can increase agricultural production by 40 percent,

while cutting the environmental footprint of U.S. agriculture in half by 2050. The [Year One Status Report](#) was released in Jan 2021.

- ❖ Tulane University received funding from Charlotte Hubbell to establish a new department chair and River-Coastal Science and Engineering Excellence Fund in 2020. As part of this endowment, new equipment and support will be dedicated to coastal research. A network of Lower Mississippi River Experimental Stations is to be established and results distributed.

New Network of
Experimental
Stations to be
established by
Tulane University

4. MANAGEMENT PRACTICES & RESTORATION ACTIVITIES

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

4.a. Document current practices related to nutrient management

The documentation of current practices related to nutrient reduction and management is ongoing. Within Louisiana, current practices include implementation of the LDEQ NPS Program in collaboration with LDAF, USDA NRCS, and LDNR (LDEQ 2018); LDEQ implementation of the Louisiana Pollutant Discharge Elimination System (LPDES) Permit Program (LDEQ 2021b); and CPRA implementation of the Comprehensive Master Plan for a Sustainable Coast (Coastal Master Plan, CPRA 2017).

4.b. Identify areas where practices are being implemented

The LDEQ NPS Program and the LPDES Permit Program are implemented statewide. The LDEQ NPS Program selected priority watersheds targeted for implementation activities, these priority watersheds are identified in Strategic Action 6.e. The LPDES Permit Program is implemented in facilities throughout the state within all water bodies. The CPRA Coastal Master Plan is focused within coastal areas of the state. The USDA NRCS conservation practices (CPs) are implemented statewide based on appropriate practices with consideration of watershed characteristics and land uses. An updated list of [USDA NRCS Conservation Practice Standards](#) was released in 2020 (USDA NRCS 2020a).

A new annual survey was designed and released in 2020 by the USDA to measure areas for improvement across agricultural activities (USDA 2020b). The survey of farmers, ranchers and private forestland owners will help USDA understand what it is doing well and where improvements are needed, specifically at the Farm Service Agency (FSA), Natural Resources Conservation Service (NRCS) and Risk Management Agency (RMA).

The Hypoxia Task Force has issued a [report](#) on nonpoint source collaborative efforts in 2018, with an update due in 2021 (HTF 2018), while the USEPA has released a new document entitled [Progress Report: Urban Water Program](#) in January 2021 (USEPA 2021).

4.c. Identify case studies and model watersheds

The identification of case studies/model watersheds in Louisiana is an ongoing Strategic Action. Efforts that successfully combine restoration and protection activities with stakeholder participation and leadership may champion other groups doing the same.

In 2019, Dr. Ronnie Levy, Dr. Lisa Fultz, Allen Hogan, James Hendrix, Donna Morgan, Randall Mallette, Dr. Naveen Adusumilli, and Dr. Brenda Tubaña were awarded a Conservation Innovation Grant (CIG) for Education and Outreach to improve knowledge of soil health and implementation of agronomic BMPs, including cover crops (USDA NRCS 2021a). As part of this effort, participants learned about the adoption of soil health management systems and management strategies relative to the regional resource concerns pertinent to two areas of the state. Participants also learned about the impact of cover crops and the influence of grazing and other cultural practices on soil health parameters and soil microbial properties, and received copies of Conservation Practice or Best Management Practice literature pertinent to the management of agricultural products. Field events that highlighted on-farm cover crop plantings and/or agricultural equipment associated with soil health management systems also took place on Patrick F. Taylor model farms (Dugas and Hardwick Planting Company); these model farms are currently under study and will result in publication. Field activities are recorded and videoed at regular intervals and updated on the [Facebook page](#) and on the [LSU AgCenter website](#). Studies are ongoing and data will be published at the completion of the grant.

Another Conservation Innovation Grant was awarded through the USDA NRCS CIG Program in 2020. LSU AgCenter received \$595,172 for *A comprehensive demonstration of using agricultural tailwater irrigation for southern crop production* (USDA NRCS 2021a). This project will focus on recycling tailwater using agriculture return flows.

The Council Monitoring and Assessment Program (CMAP) produced an *Inventory of Existing Habitat and Water Quality Monitoring, and Mapping Metadata for Gulf of Mexico Programs* (RESTORE CMAP 2020). The [mapper](#) for this project is highlighted in Section 2.a.

Louisiana/CPRA was given the opportunity to identify a watershed and applied science questions for the CMAP use the database to query available data and address. CPRA identified the Sabine-Neches Watershed, and the questions: 1) how does water move through the canal system in the Calcasieu-Sabine Basin? 2) what additional data are needed for water quality baseline assessment? The CMAP team undertook a metadata gap assessment and queried the inventory, extracted all monitoring programs that collect parameters specific to the questions, and summarized the information to understand spatially where the monitoring stations are, over what time periods were the records collected at what frequency, and how complete the information records are associated with those programs. This gap assessment helped identify data rich and data poor areas, where temporal records are adequate or inadequate, and where informational documentation is robust or less robust.

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

4.d. Integrate science-based nutrient reduction and management approaches

The integration of science-based nutrient management approaches is ongoing. The CPRA is conducting research on modeling for river diversions that will allow for the addition of a new nutrient component to the model to evaluate nutrient dynamics in response to a river diversion (see Strategic Action 5.f.). For NPS management, the LSU AgCenter is forefront in researching and applying science-based approaches for nutrient reduction and management in Louisiana and research is ongoing within the state, for example the Patrick F. Taylor model farm projects. As new scientific information becomes available, integration will allow for improved nutrient management activities to be implemented in Louisiana.

LSU AgCenter projects and published literature enhance knowledge for the scientific community and the public

Some select literature concerning BMPs and other related nutrient reduction practices in Louisiana and/or by Louisiana authors include:

- *Artificially Enhanced Transport of Atmospheric Oxygen into Gulf of Mexico to Eliminate Hypoxia*. L. Thibodaux, Louisiana Agriculture, Winter 2020.
- *RESEARCH BRIEF: Identifying Fertilizer Management Practices of Louisiana Homeowners*. N. Levy, Louisiana Agriculture, Winter 2020.
- *Providing Tools for Productivity and Sustainability*, L. Fultz, Louisiana Agriculture, Fall 2020.
- Cover Crop Special Topics in Louisiana Agriculture, Fall 2020:
 - *Planting Date Effect on Cover Crops Biomass Yield and Nutrient Turnover*. Tubaña, et al.
 - *Cover Cropping Enriches Soil*. B. Tubaña, et al.
 - *Cover Crop Comeback: Push for Sustainable Agriculture Revives Centuries-Old Practice*. K. Peveto.
 - *Can Sugarcane Production Be Improved with Cover Crops?* Orgeron, A. et al.
 - *Effect of Cover Crop and Seed Treatment on Stand Establishment in Corn, Cotton and Soybeans*. Brown, S. et al.
 - *Cover Crop Economics: Analysis from Studies across Louisiana*. N. Adusumilli and H. Wang.
- *Soil Biological Response to Integration of Cover Crops and Nitrogen Rates in a Conservation Tillage Corn Production System*. Sanchez, et al., Soil Science Society of America 2019.
- *Exploring anaerobic CO₂ production response to elevated nitrate levels in Gulf of Mexico coastal wetlands: Phenomena and relationships*. Wei, et al., Science of the Total Environment, 2020.
- *Cover Crops Impacts of Louisiana Corn Production and Soil Properties*. Sanchez, et al., Agrosystems, 2019.
- *Estimating risk premiums for adopting no-till and cover crops management practices in soybean production system using stochastic efficiency approach*. Adusumilli, et al., Agricultural Systems, 2020.
- *Economic and stochastic efficiency analysis of alternative cover crop systems in Louisiana*. Wang, et al., Experimental Agriculture, 2020.

- *Effect of cost-sharing federal programs on adoption of water conservation practices: results from propensity score matching approach.* Adusumilli, et al., Water Economics and Policy, 2020.
- *Conservation Adoption among Owners and Tenant Farmers in the Southern United States.* Adusumilli et al., 2019.
- *Additionality in Agricultural Conservation Programs and Extension Services.* Wang, et al., J. of Natural Resources Policy Research, 2019.
- *Regional Conservation Partnership Program: A Tool for Natural Resources Management across Watersheds.* N. Adusumilli, Journal of Extension, 2019.

A [Special Section of the Journal of Soil and Water Conservation \(JSWC\)](#) that focuses on [Conservation Effects Assessment Project \(CEAP\)](#) Wetlands studies was released in 2020.

The six CEAP-Wetlands research papers in this JSWC Special Section present recent study findings from regional wetlands assessments. Specific developments and findings from these studies include:

- Remote sensing, hydrologic modeling, and geospatial analysis tools were developed that help quantify multiple ecosystem services accruing from wetland restorations and support land management decisions.
- Methods were identified to simulate depressional wetlands within agricultural fields in the CEAP National Cropland Assessment, improving our ability to predict outcomes of conservation practices.
- Information was gained to incorporate wetland plant growth and functional groups into models that improve simulation of within-wetland processes.
- Modeling of nutrient flows was enhanced for water management scenarios in wetlands of California's Central Valley.
- Use of remotely sensed data was shown to have promise for assessing wetland function at the landscape scale.
- A remote classification system for wetlands was developed to better facilitate ecosystem service quantifications.

The USGS released a new study entitled: [Nitrogen and Phosphorus Sources and Delivery from the Mississippi/Atchafalaya River Basin: An Update Using 2012 SPARROW Models](#). This study uses SPARROW modeling to estimate total nitrogen (N) and total phosphorus (P) yields for potential use in nutrient reduction strategies in the MARB (Robertson and Saad 2021).

The [sixth survey from optis](#), USDA's Sustainable Agriculture Research and Education (SARE) program and the American Seed Trade Association (ASTA) was released in 2020 (CTIC 2020). This report is the first to go into detail on "planting green," a practice employed by 52% of the respondents. Among farmers who planted green, 71% reported better weed control and 68% said soil moisture management improved. Despite the record-setting wet spring, yields after cover crops increased 5% in soybeans, 2% in corn and 2.6% in spring wheat.

Finally, a literature pull was performed for scientific papers relevant to nutrient practices and/or hypoxia in the Louisiana and/or gulf waters. A select, abbreviated list is included in **Appendix E**.

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

Through the NPS Program, LDEQ, LDAF, USEPA Nonpoint Source, and other partners collaborate on setting priority watersheds for implementation of BMP and CPs. LDAF expended approximately \$1.0 million on watershed implementation within multiple watersheds around the state. Implementation, planning and/or technical assistance was conducted on approximately 20,514 acres of private farmland in an effort to restore or partially restore surface water quality in nine priority watersheds within the Ouachita River, Mermentau River, and Vermilion-Teche Basins.

Additionally, through the Ducks Unlimited Rice Stewardship Initiative, the following practices were implemented in rice producing areas of the Mermentau and Ouachita River basins in 2020 in cooperation with LDAF. This is an RCPP-CSP multi-year project with 50% nonfederal match provided by DU, and technical assistance provided by participating SWCDs:

- Conservation Crop Rotation 1,464 ac.
- Cover Crop 1,495 ac.
- Shallow Water for Wildlife 25,640 ac.
- Nutrient Management 34,585 ac.

LDAF partnerships
with non-profits
and management
districts promote
conservation

The LDAF and participating SWCDs, through the Agricultural CWA Section 319 program have implemented the following practices in their 319 priority watersheds:

- Dry Seeding Rice 1023.5
- Conservation Crop Rotation 1722.1
- Residue Management 2022.3
- Cover Crop 18.8
- Shallow Water for Wildlife 1416.3
- Nutrient Management 10,450.6

The LSU AgCenter conducts field days throughout the state to perform outreach and promote BMPs/CPs that are most appropriate for the various commodity groups within Louisiana. The LSU AgCenter conducted 11 events in 2020 that included three Phase I environmental trainings, six Phase II research station field days, and two cover crop/soil health/BMP field tours to increase voluntary participation in the program (Gentry, 2021). A virtual Phase 1 training was also held for the first time in October, 2020 to increase participation from those unable to attend in-person trainings.

5. STATUS & TRENDS

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

AgCenter developed social indicators of public behavior regarding nutrient management in Louisiana.

Three reports have been released from HTF working groups have been released to inform nutrient partners on the status of point and nonpoint sources within the 12 member states: *Report on Point Source Progress in Hypoxia Task Force States* (2016), *Second Report on Point Source Progress in Hypoxia Task Force States* (2019), and *Progress Report on coordination for Nonpoint Source Measures in Hypoxia Task Force States* (2018). The Nonpoint Source document is currently undergoing updates. These documents represent steps necessary to improve tracking and progress in nutrient reduction and management within the MARB, and may be found on the Hypoxia Task Force webpage (HTF 2021c).

5.a. Model nutrient loading estimated within Louisiana watersheds

Modeling of nutrient loading within Louisiana watersheds is ongoing. The USGS SPATIally Referenced Regressions On Watershed attributes (SPARROW) surface-water quality models for nitrogen and phosphorus are available for the Mississippi and Atchafalaya River Basin for 2002 and 2012 data (USGS 2020). The updated website and products have been released and are fully functional with new mappers and reports available.

In addition, the USGS and research partners have published several technical papers/documents concerning nutrient and sediment loads into the MARB and/or relevant watersheds during 2018 to early 2021:

- *An Evaluation of Methods for Computing Annual Water-Quality Loads* by Lee et al. 2019
- *Network Controls on Mean and Variance of Nitrate Loads from the Mississippi River to the Gulf of Mexico* by Crawford, et al. 2019
- *Recent Trends in Nutrient and Sediment Loading to Coastal Areas of the Conterminous U.S.: Insights and Global Context* by Oelsner and Stets 2019
- *Suspended-Sediment Concentrations and Loads in the Lower Mississippi and Atchafalaya Rivers Decreased by Half Between 1980 and 2015* by Mize, et al. 2018
- *Multivariate Analyses of Water Quality Dynamics Over Four Decades in the Barataria Basin, Mississippi Delta* by Day et al. 2020
- *Response of the coastal systems to freshwater input with emphasis on Mississippi River deltaic plain river diversions: Synthesis of the state of the science* by Pahl et al., 2020
- *Spatially Referenced Models of Streamflow and Nitrogen, Phosphorus, and Suspended-Sediment Loads in Streams of the Midwestern United States* by Robertson, et al. 2019
- *Nitrogen and Phosphorus Sources and Delivery from the Mississippi/Atchafalaya River Basin: An Update Using 2012 SPARROW Models* by Robertson and Saad 2021

5.b. Document/trends for in-stream nutrient water quality

Through the LDEQ AWQMN, the agency monitors in-stream water quality in water bodies across the state. In the 2020 water sampling year (October 2019 through September 2020), the LDEQ monitored 150 sites in 146 subsegments for in-stream concentrations of nitrogen (nitrate-nitrite and TKN) and phosphorus (TP). Results of the LDEQ ambient water quality monitoring are available through LDEQ's *Ambient Water Quality Monitoring Network* [LEAU Web Portal](#) (LDEQ 2021h). Information on nutrient impairments for the 2020 Integrated Report cycle can be found on LDEQ's [Water Quality Integrated Report](#) website and/or [Mapper](#) (LDEQ 2021a, 2021n). In

addition, LDEQ is currently updating the *Nitrogen and Phosphorus Trends of Long-Term Ambient Water Quality Monitoring Sites in Louisiana* document developed in 2015. These analyses will examine water quality concentrations observed at 21 active long-term monitoring stations located in the throughout the state. This report is anticipated to be released in 2021.

LDAF assists LDEQ with surface water monitoring in critical project watersheds as part of the EPA/Agricultural Nonpoint Source Abatement Program (LDAF 2020).

LDEQ is updating 2015 nutrient trends report for ambient water quality sites

5.c. Document/trends for Social Indicators of nutrient reduction and management behavior

The charge of the Hypoxia Task Force Ecosystem and Social Metrics Workgroup is to identify potential metrics that will help illuminate ecosystem changes/success due to implementation of nutrient reduction strategies in the Mississippi River Basin (MRB). After considerable inquiry into large-scale datasets for ecosystem and social indicators, the workgroup determined that these datasets were not available, and shifted to exploring the varied conservation tracking tools available in the MARB. The workgroup is working to assess these tools to understand common metrics that can be adopted at the MARB scale. The workgroup recommends that a social indicator variable be incorporated into federal and state conservation program reporting so that a basin-wide metric can be developed in the future.

5.d. Document/trends BMP/CP implementation in watersheds

The LDAF Office of Soil and Water Conservation (OSWC), in collaboration with the LDEQ NPS Program, implemented CPs that aid in improving water quality in watersheds across the state. In the Federal Fiscal Year 2020 (Oct 2019 to Sep 2020), the LDAF OSWC implemented CPs in 9 LDEQ subsegment watersheds. These watersheds included Bayou Queue de Tortue, Bayou des Cannes, Bayou Chene, Bayou Mallet, Hemphill Creek, Big Creek (North), Bayou du Portage and Bayou Lafourche (north), and work there continues through 2021. In addition, recent amendments include Bayou Maringouin, Bayou Gosse Tete and Vermilion River. Conservation Plans include various practices like nutrient management, cover crops, irrigation water management, crop residue management, conservation tillage, grade stabilization and irrigation land leveling among others.

In FY 20, USDA NRCS applied nutrient management CPs on over 460,000 acres of cropland through its staff and partners in Louisiana. An additional 150,000 acres in FY20 received CPs from affiliated agencies including conservation districts, technical service providers, and partnerships with multiple state agencies. In FY 20, LDAF provided technical assistance and BMP implementation on 20,514 acres in seven watersheds (Bayou Queue de Tortue, Bayou des Cannes, Bayou Chene, Bayou Mallet, Hemphill Creek, Big Creek (North), and Bayou Lafourche).

610,000 acres received CP efforts in 2020 from NRCS, LDAF, LDEQ and partners

5.e. Document/trends permitted discharger inventories

Point source discharges into Louisiana waters are managed through the LPDES Permit Program by the LDEQ under Louisiana's Water Quality Regulations (LAC 33:Chapter IX) (LDEQ 2021c). At the end of Federal FY20 (from October 2019 to September 2020), there were 15,588 permitted dischargers in the LPDES Permit Program. Of these 15,588 permitted dischargers in FY20, 11,600 were general or individual permits (non-stormwater) and 3,988 were stormwater permits. The LPDES permits issued in 2020 can be found on the [LDEQ Permit Program](#) website (LDEQ 2021b).

5.f. Document/trends for riverine diversion efforts

CPRA Coastal
Master Plan is under
review for 2023
revision

Louisiana's Coastal Master Plan is revised and updated on a 6-year cycle to incorporate new information and lessons learned. In developing the 2023 Coastal Master Plan, projects are being reevaluated, including the river diversion projects which were included in the 2017 version of the plan. All of the proposed sediment diversion projects are intended to divert freshwater and sediment from the Mississippi or Atchafalaya rivers into adjacent coastal wetlands in an effort to restore land-building processes

that were interrupted by the construction of levees on the river and to reverse the trend of land loss that has plagued coastal Louisiana since at least the 1930s (CPRA 2017). A key component of the implementation process is to more fully investigate technical uncertainties to maximize the benefits of these projects while minimizing trade-offs and unintended consequences. To this end, CPRA conducted planning-level landscape modeling, basin-level modeling, and project-specific modeling to help define project location, size, operations, and other key project attributes.

The River Reintroduction into Maurepas Swamp project, which is projected to benefit approximately 45,000 acres of wetlands by reconnecting one of the largest forested wetland complexes in the nation to the Mississippi River, is projected to receive \$130 million in funding from BP oil spill fines, through a grant to CPRA from the Gulf Coast Ecosystem Restoration Council. The project goal is to introduce river water into the swamp, designed to ensure water retention long enough to benefit woody vegetation from fresh flowing water, nutrients, and fine sediments. During early project design, hydrodynamic modeling was used to ensure that these objectives can be met. It is estimated that the project will be ready for construction in approximately three years.

The Barataria Diversion and Breton Diversion planning processes are being further developed and refined. The Delft3D water quality model, D-WAQ, is being used to simulate dissolved nutrient dynamics in the Barataria and Breton receiving basins.

5.g. Document coastal protection and restoration activities

The CPRA develops an annual plan that is submitted to the Louisiana Legislature during the spring session each year. This annual plan documents activities from the previous fiscal year, and project activities and budgets for the upcoming fiscal year. The FY2021 Annual Plan is currently in development. Once finalized, Annual Plans are posted on the [CPRA website](#). In addition, quarterly progress reports with information about construction status on individual projects are also posted on the CPRA website.

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 reduction and management activities.

6.a. Maintain watersheds and water body characterization

LDEQ maintains the Water Quality Management Plan, Volume 4 Basins and Subsegments which describes the watershed basins and subsegments that are part of the LDEQ water programs; Volume 4 (LDEQ 2014). Changes to the appendices of this document have been under review since 2017, and will likely be modified in 2021 to include subsegment updates.

Main features such as watershed delineations by LDEQ and USGS, National Land Cover Data on land cover/land use, and elevations have been identified through GIS-based products, with updates and new technologies being implemented as they become available. As part of these efforts, LDEQ continues to utilize GIS to improve the accuracy of the water quality assessment units and contribute to the state's National Hydrography Dataset (NHD). The NHD provides a national framework for assigning stream reach addresses to water quality related entities, such as dischargers, drinking water supplies, streams effected by fish consumption advisories, wild and scenic rivers, Clean Water Act Section 305(b) and 303(d) water bodies, Designated Uses, etc. LDEQ's water quality assessment units, also referred to as subsegment boundaries, undergo periodic revisions utilizing available GIS layers, such as the latest topography, imagery, and elevation (i.e., LiDAR) data.

LDEQ continues to attend the USGS NHD Technical Exchange meetings and training courses to integrate advanced GIS capabilities for the improvement of Louisiana's water drainage network through the NHD Update Toolbar—an editing tool utilized within ArcMap software. In 2020, LDEQ continued work through an EPA grant for contractor assistance on revisions and corrections to the NHD model for Louisiana. These revisions and corrections of NHD flowlines, water body areas, water body features, and feature attributes are within the area southward of the Louisiana Intracoastal Waterway, which is a region that requires frequent review and revisions. Currently, 92% of the LDEQ subsegments utilize at least one of the NHD feature classes to estimate the assessed water body size. The NHD also provides representative geometry for the subsegment's assessed rivers, lakes, wetlands, or estuaries, and LDEQ staff utilizes GIS to extract the appropriate features.

The ArcGIS Online collaborative web platform has played a critical role in updating the Ambient Water Quality Network's (AWQN) site accuracy and responding to hurricane events. Through an editing web mapping application, over 700 ambient water quality sites were reviewed by regional and department staff to quality check the site's positional accuracy between 2017 and 2020. In 2020, an editing web map application aided the department staff's need for organizing and displaying water quality sampling priorities in response to Hurricane Laura. In 2019, the water quality Triennial Revision rule was proposed which included updates to 142 subsegments. Updates included those to standardize language of descriptions and typographical corrections, as

well as adjustments to subsegment boundaries to align with natural features and NHD flowlines, among others. This triennial review for the Surface Water Quality Standards of Louisiana began on January 20, 2016 and the results of these triennial review efforts were developed into a rule (WQ097) which updated portions of the water quality standards found in LAC 33:IX.Chapter 11. The final rule for WQ097 was published in the November 2020 edition of the Louisiana Register and approved by EPA on February 1, 2021 (LDEQ 2021p). These updates will be documented in the Water Quality Management Plan (WQMP), Volume 4 Basins and Subsegments and the LDEQ Subsegment GIS layer. In addition, the current triennial review cycle initiated on March 20, 2021.

ArcGIS Online has allowed the creation and use of an online web map for regional staff to access the site map through multiple devices, in addition to traditional software. This web-based GIS option has provided improved collaboration to ongoing site creation and replacement needs. For public use, LDEQ developed two online web maps that also have corresponding phone applications. The “[Fishing Consumption and Swimming Advisories](#)” map was released in 2018 and has received advisory updates through 2020. The fish advisory map displays the areas of the state affected by fish consumption or swimming advisories due to mercury or organic chemical contamination and provides the corresponding health recommendations for the water body (LDEQ 2021o). The newest online web map is the “[2020 Louisiana Water Quality Inventory: Integrated Report](#) (Appendix A-Assessments; LDEQ 2021a),” which displays the water quality assessment information for three designated uses (i.e., swimming, boating, and fishing). LDEQ developed this dashboard style map to display the water quality data for the state’s surface water in an interactive and more user-friendly format.

LDEQ continues to develop GIS tools to better understand LA waterways

6.b. Identify potential pollution sources through Desktop Analysis/Windshield Survey

The identification of potential pollution sources can be accomplished through various means. By performing desktop analyses and windshield surveys, potential pollution sources can be evaluated in the initial stages of project planning, which will help to best utilize resources for actual water quality monitoring and target implementation of best management and conservation practices. In this manner, LDEQ continued efforts to investigate and track sources in the Yellow Water River and Natalbany River. Further, outreach and education are a critical part of the effort in these two New Vision watersheds. GIS capabilities described above assist in this effort.

6.c. Identify unpermitted point sources

The LDEQ Compliance Monitoring Strategy (LDEQ 2021d) outlines approaches for monitoring permit compliance to aid in addressing potential point source issues. The LDEQ Surveillance Division performs ‘Watershed Sweeps’ under the Compliance Monitoring Strategy to identify nonpoint sources and unpermitted point source dischargers within targeted subsegments. In the 2020 calendar year, the LDEQ Surveillance Division conducted 111 Watershed Sweeps in five subsegments (Table 2).

Table 2. Louisiana Department of Environmental Quality (LDEQ) Surveillance Division Watershed Sweeps in 2020.

Subsegment No.	Water Body Segment Description	Inventory/ Inspections	Notice of Deficiency (NOD)
LA120605	Pointe Au Chien	12	4
LA081203	Lake Bruin	4	4
LA080904	Bayou Pointe Au Chien – from headwaters to St. Louis Canal	7	2

6.d. Identify priority watersheds from leveraging programs

Monitoring and/or BMP implementation occurred in 11 LA watersheds in 2020

There are several state and federal programs focused on watershed restoration and protection in Louisiana. These programs prioritized watersheds in Louisiana to target for restoration and protection activities, and several USDA NRCS initiatives employed restoration activities associated with CPs. These USDA NRCS initiatives include the [Mississippi River Basin Initiative](#) (MRBI) and [National Water Quality Initiative](#) (NWQI), which target watersheds across the state to address suspected nonpoint sources through the implementation of CPs.

The LDEQ and LDAF NPS Programs prioritized watersheds for implementation activities through 2020, and proposed watersheds through 2023 (LDEQ 2018). For FY20, baseline monitoring occurred in 4 priority watersheds, BMP implementation in 7 watersheds.

LDAF watersheds include: Bieler Bayou – Tensas River (Tensas Parish), Wildhorse Bayou – Tensas River (Tensas parish), Baxter Bayou (East Carroll Parish), Hill Bayou – Bayou Macon (East Carroll Parish and West Carroll Parish), Tiger Bayou (Catahoula Parish) \$372,108.00 for 2,476 acres allocated in FY 2020, with \$1.5 million allocated for FY 2021.

Table 3. Louisiana Mississippi River Basin Initiative (MRBI) projects for FY20.

Watershed Name	FY16	FY17	FY18	FY19	Total
Tiger Bayou	\$180,754	\$162,626	\$166,357	\$249,026	\$758,763
Upper Deer Creek	\$ 182,282	\$350,776	\$166,633	\$49,920	\$749,611
Total	\$363,036	\$513,402	\$332,990	\$298,946	\$1,508,374

Table 4. Louisiana submitted two new NWQI watershed projects that will extend through FY 2023.

Watershed Name	Parish	HUC 12
Bayou Du Portage	Iberia	8081020801
	St. Martin	80802010206
Plaquemine Brule	Acadia	80802010208

Under the “Long-Term Vision for Assessment, Restoration, and Protection” under the Clean Water Act Section 303(d) Program, Louisiana plans to implement nutrient reduction and management strategies in 5 of 7 priority New Vision watersheds (those that have suspected nutrient impairments). LDEQ is in the reporting stage for 3 of these watersheds, and in the planning and/or monitoring phase of the additional two. Investigation of sources continues. Outreach and education activities are ongoing. Detailed information can be found in Section 6e below.

The Wetlands Reserve Enhancement Program Project (WREP) between NRCS and the Mississippi River Trust focuses on the “batture” land floodplains to provide flood protection, reduce soil erosion, and improve water quality for local areas and neighboring communities, as well as restore migration and winter habitat for neotropical songbirds, shorebirds, and waterfowl species (USDA NRCS 2020d). The Batture Lands-MRBI-WREP Project will work in 9 parishes. Maps can be seen in Figure 1 (page 33).

6.e. Determining Priority Watershed & Subwatershed Basins

This Strategic Action focuses on selecting priority watershed basins and subwatersheds for nutrient reduction and management in Louisiana. Through the collection of information during the Strategy development phase it became apparent that combined with the Ouachita River Basin’s location in northeast Louisiana within the larger MARB, and the ongoing water quality and nutrient reduction and management efforts, that this basin should undergo development and implementation of on-the-ground nutrient management activities. Water quality improvements and participation by partners to support further improvement progress in nutrient reduction and management in the Ouachita River Basin has been successful and work continued until 2020.

The LDEQ, LDAF, and USDA NRCS worked together in the Ouachita River Basin in Louisiana to make progress in improving water quality in 3 LDEQ priority watersheds to 2020: Big Creek (080903), Bayou Lafourche (080904), and Hemphill Creek (081609). Work in two of the priority watersheds has been completed. Furthermore, the Lake Providence (081101) area in the Ouachita Basin has been featured as an EPA success story for 100% BMP implementation around the lake, with removal of the total dissolved solids impairment in LDEQs 2020 Integrated Report (USEPA 2020; LDEQ 2021n). Reduction in TDS in the water column occurred via reduction of soil erosion, which in turn reduces nutrients washed into receiving waterbodies.

Factors in selection of the priority waters for nutrient reduction and management in the state include consideration of the current water quality, implementation activities, and participation of local, state, and federal programs within the basin to manage nutrients. LDEQ NPS group updated identification of priority subwatersheds to maximize success in 2018 and work continues. LDAF and LDEQ NPS may, have slightly different watersheds identified in any given year due to selection processes and/or immediate needs that arise that require remediation.

6.f. Develop/leverage watershed nutrient reduction and management projects for priorities

Following the selection of priority subwatersheds under the Strategy, watershed nutrient management projects or other implementation mechanisms can be leveraged or developed for nutrient reduction and management activities. Such programs where projects to address nutrient

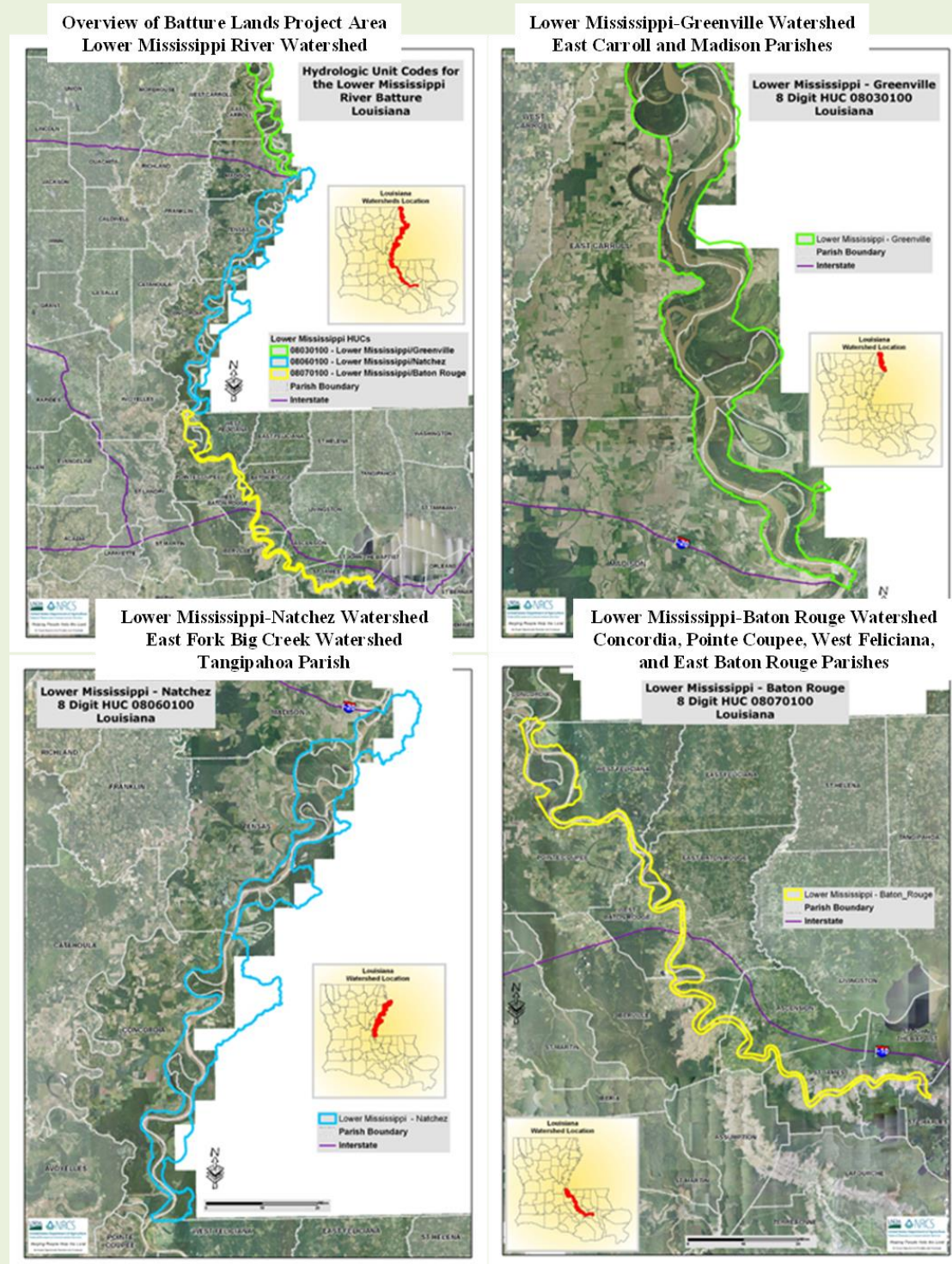
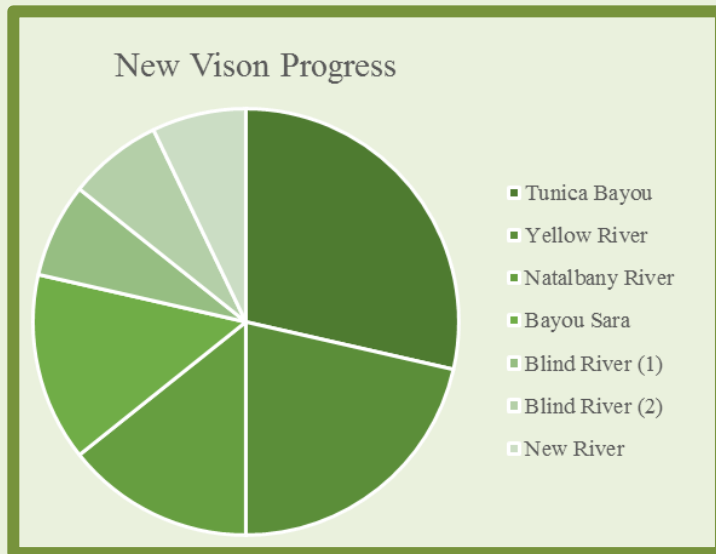


Figure 1. USDA Mississippi River Basin Initiative- Wetlands Reserve Enhancement Program Project Projects

reduction and management can be leveraged include the LDEQ Nonpoint Source Program, the New Vision of §303d Program, and the BP *Deepwater Horizon* restoration.



In regard to the New Vision of the §303d Program, LDEQ identified priority watersheds for restoration and protection in Louisiana (left and Appendix B). In these New Vision priority waters, alternatives to TMDL plans are being developed in collaboration with stakeholders with a vested interest in the watershed restoration. Of the total 7 watersheds, implementation efforts have occurred in 100%. Progress is rated, with the darkest color indicating the most accomplished per waterbody.

- ❖ The watersheds include:
 - Bayou Sara- draft report is under development
 - Tunica Bayou- final report was approved by EPA on October 5, 2020.
 - Yellow Water River- draft report under development and citizen outreach is ongoing
 - Natalbany River- ongoing monitoring and citizen outreach
 - Blind River- monitoring sites are being established
 - New River- monitoring sites are being established

The LDEQ NPS Program currently has 19 watersheds prioritized in Louisiana for implementation of CPs, some of which overlap with those watersheds in the USDA initiatives. LDAF shares all LDEQ priority waters. These watersheds and the leveraging programs are provided in Appendix B.

In 2017, the BP Deepwater Horizon Oil Spill Trustees in Louisiana released a Notice of Solicitation (NOS) in July 2017 to request ideas from the public to address lost recreational opportunities and nutrient reduction (nonpoint source). All funds and projects are administered through the U.S. Department of the Interior's (DOI) Natural Resource Damage Assessment and Restoration Program (NRDA Restoration Program), as the mission of NRDA is to restore natural resources injured as a result of oil spills or hazardous releases into the environment. Development of a draft restoration plan and environmental assessment for nutrient reduction and recreational use activities was initiated by the LA Trustee Implementation Group (TIG) in fall 2017. The TIG released the draft plan of *LA TIG Restoration Plan #4: Provide and Enhance Recreational Opportunities and Nutrient Reduction* for public review in April 2018. Following

LA TIG identified, released funds, and/or completed 4 nutrient related projects in 2020

consideration of public comments received on the draft, the final restoration plan and environmental assessment was released in July 2018, with project completion in 2019 (LA TIG 2019). This project funded \$163,424 in nutrient reduction activities. The LA TIG is currently working to reconcile the budgets for these restoration planning efforts so that the remaining funds can be reallocated for future nutrient reduction and recreational use restoration activities. Furthermore, three other LA TIG projects concerning nutrient reduction are in progress: (1) Nutrient Reduction on Cropland and Grazing Land in Bayou Folse; (2) Nutrient Reduction on Dairy Farms in St. Helena and Tangipahoa Parishes; and (3) Nutrient Reduction on Dairy Farms in Washington Parish. Information on all projects concerning restoration activities after the BP oil spill may be found on the [Gulf Spill Restoration website](#).

The LDEQ, in coordination with LSU AgCenter, was tasked to develop producer-specific master programs and nutrient management plans to be utilized by beef cattle, dairy, and poultry producers for the purpose of reducing pollution, such as excess nutrients, into the environment through improved farm practices specific to producer needs and funded by an LDEQ Beneficial Environmental Project (BEP). An interagency contract entered by LDEQ and LSU AgCenter on July 10, 2019 and was identified as *Educational Programs to Improve Nutrient Management and Water Quality Protection Practices Implementation in Animal Operations across Louisiana*. The proposed project will address soil health and water quality resource concerns within Louisiana watersheds. Education and outreach efforts are expected to improve conservation implementation, consequently providing economic benefit to the farmers. The core strategy will be to promote the implementation of an enhanced and comprehensive conservation system that integrates recommended EQIP conservation practices and technical support. Assistance with conservation plan development will be accomplished by an interdisciplinary team that will work to integrate soil health management practices, water-quality improvement practices that emphasize nutrients among others, and wildlife enhancement practices. An economic evaluation of conservation practices promoted will be conducted to provide a cost-benefit analysis to address profitability concerns. The total project cost shall not exceed \$249,606.00 and will be fulfilled before June 30, 2022.

7. INCENTIVES, FUNDING & ECONOMIC IMPACT ANALYSIS

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

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

Voluntary, science-based conservation practices offered through targeted initiatives or a suite of programs utilizing financial incentives or cost-share opportunities to encourage participation by stakeholders in nutrient reduction and management activities is key to the Strategy. Current incentive-based programs in Louisiana provide a means for voluntary participation that will aid in improving water quality in the state. Voluntary incentive-based programs highlighted in the Strategy include the Environmental Quality Incentives Program, Conservation Stewardship

Program and the Agricultural CWA Section 319 Program, each creating enhanced opportunities for participants of the Louisiana Master Farmer Program, the Advanced Master Gardener Program, and the Environmental Leadership Program to complete program certification requirements.

To reduce the amount of nutrients entering rivers and reaching the Gulf of Mexico, the Patrick F. Taylor Foundation has awarded the LSU AgCenter \$1.4 million to fund a four-year project to study the issue (Patrick Taylor Foundation 2020). The goal is to provide a reduction of nutrients into the Gulf of Mexico to reduce impacts on the dead zone. All of other agricultural states along the Mississippi River (and other rivers) could benefit from this study and model farms.

80% of LA parishes
have certified
Master Farmers
through LSU Ag
Center

The Louisiana Master Farmer Program (LMFP) is an environmental stewardship educational program aimed at agricultural producers in the state. Since the end of 2020, participation in the Master Farmer program increased to 4,100. Five producers received new certification, with 14 receiving re-certification in 2020. There are currently 353 certified and re-certified Master Farmers in Louisiana representing 51 of the 64 parishes (79.7% of the parishes in the state; Gentry 2021).

In 2014, the LSU AgCenter announced an Advanced Master Gardener Program (LSU AgCenter 2021). The purpose of this program is for Certified Advanced Louisiana Master Gardener volunteers to extend the educational outreach capacity of the Louisiana Cooperative Extension Service in areas such as home, school and community gardens, emphasizing environmental sustainability and nutrient management. The Advanced Louisiana Master Gardener Program is open to current Louisiana Master Gardeners in good standing who have completed at least a year of volunteer service and all initial coursework. As with other Master Programs offered by the LSU AgCenter, the Advanced Master Gardener Program is in three phases and certification comes through the completion of all three program phases, demonstrating mastery of concepts by passing exams with a score of 70% or higher, presenting information to public (master gardener groups, civic organizations, etc.), and maintaining required volunteer and continuing education hours. More details on this program including a 2019/2020 course schedule can be found on the [Advanced Master Gardener Program webpage](#) (LSU AgCenter 2021).

The LDEQ Environmental Leadership Program (ELP) aims to promote a cleaner and better environment for Louisiana through voluntary pollution prevention, waste reduction and/or other environmental stewardship efforts (LDEQ 2021f). In 2019, the LDEQ presented 12 new ELP awards and recognized 17 new members (LDEQ 2020). ELP membership is now well over 200 including businesses, federal entities, municipalities, non-governmental organizations, schools and universities. No new ELPs were awarded in 2020 due to Covid-19.

7.b. Identify and communicate new funding initiatives/projects

This Strategic Action is to identify and communicate available funding support related to nutrient reduction and management activities. Many funding programs provide continued opportunities for participation.

Programs previously identified in the Strategy remain relevant as available support, and include:

- Agricultural Economic Development Assistance, LDAF
- Clean Water Act §319, LDAF & LDEQ
- Coastal and Estuarine Land Conservation Program (CELCP), LDNR
- Community Development Block Grants (CDBG)
- U.S. Housing and Urban Development (USHUD) CDBG
- CDBG Disaster Recovery Assistance
- Clean Water State Revolving Fund Program (CWSRF)
- Conservation Innovation Grant (CIG) Program, USDA NRCS (2021a)
- Regional Conservation Partnership Program, USDA NRCS (2021b)
- Coastal Vegetative Planting Program, LDAF, CPRA
- Agricultural Solid Waste Management Program, LDAF, LDEQ
- Urban Waters, USEPA–New Report in Jan 2021 (2021)
- Gulf Coast Ecosystem Restoration Council (RESTORE Council)
- LWI River and Rain Gauge Network

Additional funding initiatives begun in 2019 include:

- Patrick F. Taylor Foundation (2020; McClure 2019)
- EPA Water Infrastructure and Resiliency Finance Center (USEPA 2020c)

Additional funding initiatives begun in 2020 include:

- US EPA grant to support HTF member state’s nutrient reduction efforts (USEPA 2019, 2020)
- USDA NRCS CIG grant: *A comprehensive demonstration of using agricultural tailwater irrigation for southern crop production* was awarded to LSU AgCenter

NRCS Conservation Innovation Grants that support partners working to reduce nutrient excess in the environment include:

- Software to support decision making in agricultural landscapes for nutrient reduction. The Nature Conservancy. 2017-2020.
- Evaluation of cover crop mixture in row crops. LSU AgCenter. 2017-2020.
- Cover crops evaluation in rice soybean rotation. LSU AgCenter. 2018-2020.
- Evaluate Haney Soil Test to assess nutrient pools in rice ecosystems. LSU AgCenter 2018-2020.
- Managing pasture buffers to capture dissolved Phosphorus in runoff. LSU AgCenter 2018-2021.

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

The USDA NRCS, LDAF, and LSU AgCenter promote voluntary participation in financial and technical assistance programs for BMP and CP implementation. The LMFP has increased participation each year with more producers in all three phases of the program. The Phase 1 environmental education provides an awareness of state and federal regulations, water and soil conservation issues, point and nonpoint source pollution, coastal zone issues and conservation planning to document stewardship of the on-farm natural resources. Phase 2 requires a producer to attend a conservation-based field day or workshop where specific best management practices

(BMPs) are demonstrated and discussed. In Phase 3 the producer must request a farm-specific RMS-level conservation plan on their entire farming operation with USDA NRCS.

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

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

LDEQ provides technical assistance for point sources. The LDEQ conducts technical trainings and information sharing sessions for point sources. However, due to Covid-19 restrictions, 2020 trainings and in-person assistance were scaled down or canceled. LDEQ Water permits staff did participate in a virtual MS4 meeting with EPA and Region 6 states on August 11-13, 2020. In addition, Stormwater Pollution Prevention Plans (SWP3) guidance and documents are available on [LDEQ's Storm Water Permit Resources](#) website (LDEQ 2021j).

In 2020, LDEQ performed outreach to communities, businesses, and other organizations through online EnviroSchool training sessions, focusing on nonpoint source pollution, onsite sewage systems, and New Vision activities (See Section 1b). These videos are posed on [LDEQ's YouTube Channel](#). Due to Covid-19, NetDMR trainings were canceled. Information on NetDMRs (Discharge Monitoring Reports) may be found on LDEQ's [CDX/NetDMR Training](#) website (LDEQ 2021k).

LDEQ Small
Business/
Community
Assistance Program
responded to 2,800
requests in 2020

The LDEQ Small Business/Community Assistance Program (SB/CAP) provides free technical assistance to small businesses in understanding and complying with wastewater permits and environmental regulations (LDEQ 2021i). The LDEQ SB/CAP provided approximately 2800 assistance requests including 895 compliance consultations, 71 newly permitted assistance, 206 permit applications, 1,441 water assists, and 133 referrals from internal LDEQ enforcement, permitting or surveillance.

7.e. Document economic impacts from available sources

The documentation of economic impacts of nutrient reduction and management is ongoing. This documentation of economic impacts is essential to implementation of cost-effective nutrient management practices in Louisiana.

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

The Gulf of Mexico Alliance, Water Resources Team funded a project in 2018 to address economic costs related to water quality issues in the Gulf of Mexico. The award was given to The Balmoral Group, who documented economic impacts in Florida associated with Harmful Algal Blooms in 2018 through scientific and digital media (The Balmoral Group 2020). This base study can be extended to other areas of the gulf that experience, or have experienced, similar issues that ultimately are linked with nutrient pollution. The [Economic Impacts Data Dashboard](#) illustrates findings for Florida's gulf coast.

7.f. Develop and implement a water quality credit trading program

Louisiana developed a [Water Quality Trading Program](#) in 2017-2019 (LDEQ 2021g), with promulgation in 2019. Implementation of this activity is ongoing. An effective WQT program could lead to greater nutrient reductions in the lower Mississippi River Basin and the Gulf of Mexico more quickly and at a lower overall cost than traditional regulatory approaches. In addition, WQT is a cost-effective approach for reducing nutrients and improving water quality that could provide some point sources and agriculture businesses the opportunity to generate revenues, and offer local regulators more policy options for improving water quality.

8. TARGETS AND GOALS

Targets and goals under the Strategy will focus on the strategic actions outlined in the other nine strategic components and the agency commitments, timelines, and milestones to accomplishing these strategic actions. The targets and goals schedule for all strategic components and actions of the Strategy is presented in Appendix A, and includes agency commitments, timelines, and milestones from 2019 to 2023.

9. MONITORING

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

9.a. Monitor in-stream nutrient water quality

The LDEQ routinely monitors in-stream water column nutrient water quality in the state's water bodies through the LDEQ Ambient Water Quality Monitoring Network (LDEQ 2021e). Through the LDEQ AWQMN, the agency monitors in-stream water column water quality in water bodies across the state. During the 2019/2020 water sampling year (October 2019 through September 2020), LDEQ monitored 150 sites in 146 subsegments for in-stream water column concentrations of nitrogen (nitrate-nitrite and TKN) and phosphorus (TP). Results of the LDEQ ambient water quality monitoring are available through the AWQMN [LEAU Web Portal](#) (LDEQ 2021h). No water quality monitoring is performed by LDNR OCM. The OCM coordinates with LDEQ on Coastal Use Permits (CUP) and conditions CUP applications if appropriate (LDNR 2020).

Under the New Vision approach for the TMDL program, TMDL alternative plans have been completed for or are planned for Tunica Bayou (070505), Bayou Sara (070501), Yellow Water River (040504), Natalbany River (040503, 040507), New River (040404) and Blind River (040401, 040403). The plans for Tunica Bayou and Bayou Sara address fecal coliform. The plans for Yellow Water River, Natalbany River, New River and Blind River will address nutrients in addition to fecal coliform and dissolved oxygen. Monitoring has been completed for Yellow Water River and it continues for Natalbany River. Monitoring for New River and Blind River is expected to begin in 2021.

9.b. Monitor relative to BMP/CP implementation

In 2020, LDEQ in conjunction with LDAF and USDA NRCS, conducted water quality monitoring for nutrients and other parameters in 12 watersheds where BMPs were implemented (Appendix B and D). Watershed groups monitored an additional 6 watersheds. In addition to direct monitoring for BMPs, LDEQ also initiates monitoring to help target BMP locations within a watershed and to rank applications. LDEP NPS manages the 319 program, while LDAF initiates agriculture implementation practices; priority waters primarily overlap.

The Patrick F. Taylor Foundation Grant project has developed model farms on commercial agricultural operations to demonstrate science-backed best management practices as components of overall conservation programs for grain crops and sugarcane. The overall goals of the demonstrated BMPs are to be economically and environmentally efficient. The best management practices are occurring at Sugarcane Model Farm in Napoleonville and Cotton & Grain Crops Model Farm in Somerset. A production field under producer's standard practices (Producer Farm) has been established adjacent to each of these model farms. Both the Model and Producer Farms at each location have installed with flume and automated water sampler for water quality monitoring and total nutrient load estimation. Plant data including main crop yield and cover crops biomass will be collected. Full analysis of elemental composition of these collected plant parts will be performed to estimate nutrient (i.e., nitrogen and phosphorus) use efficiency and nutrients recovered from the soil. Soil samples will be collected at critical growth stages during the growth of main crop and cover crops to monitor nutrient cycling, biological activity, soil physical properties, and organic matter accumulation. These metrics will be used to evaluate the performance of the proposed Model Farm and Producer Farm in terms on agronomic, economic, and environmental sustainability.

A portfolio of practices that are economically profitable and environmentally sustainable will be identified. The marginal impact of any conservation practice is an important component of conservation benefits measurement. Focusing solely on a system of practices deters some from adopting the whole suite of conservation methods due to challenges from an implementation standpoint and a financial standpoint. Identifying practices that maximize nutrient loss reduction benefits, either through one practice and/or combining with one or more practice is an unmet need of the farmer in Louisiana. Through the Model Farms project, researchers will be able to identify the value of conservation practices individually and in combination with other conservation practices. Relying on the results generated through the project and the literature, we will be able to value the ecosystem services that are generated, consequently mitigation of the Hypoxia Zone in the Gulf. A conservation practices budget will be generated that will include the practice, its marginal impact on nutrient reduction and/or nutrient losses to bodies of water, and overall profitability. Outreach activities included a Soil Health/Cover Crop Field day and a Best Management Practices in Sugarcane Production Field Day in February and October, 2020, respectively. Approximately 100 producers, university faculty, and state and federal agency personnel attended the events. The field days highlighted water and soil health monitoring projects, as well as cover crops and conservation practices.

9.c. Monitor nutrients associated with riverine diversions

The CPRA has developed a System Wide Assessment and Monitoring Program ([SWAMP](#)) to monitor and assess both natural and human systems in coastal Louisiana. In light of its growing restoration and protection programs, CPRA has worked to ensure that a comprehensive network of coastal data collection activities is in place to support the development, implementation, and adaptive management of the coastal protection and restoration program within coastal Louisiana (Hemmerling, et al., 2019). The focus of this new monitoring program is to obtain repeated long-term (e.g., years to decades) measurements that can be analyzed to detect changes that may result from a variety of sources, including large-scale restoration and protection projects, environmental disturbances, and other major drivers that impact the system.

Through SWAMP, a regional water quality monitoring pilot was planned and implemented in Barataria Basin, east of the Mississippi River, and in the western part of the state (east of Bayou Lafourche), Louisiana. The regional SWAMP water quality network leverages existing long-term water quality programs (LDEQ, LDWF, and USGS), combined with the implementation of new water quality stations for a total of 120 water quality stations. Water quality parameters measured include nitrogen [(total Kjeldahl nitrogen (TKN), nitrate+nitrite nitrogen (NO₃NO₂), and ammonia (NH₃)], phosphorus [(total phosphorus (TP), orthophosphate (PO₄)], silica (SiO₂), chlorophyll a, total suspended solids (TSS), turbidity, dissolved oxygen (DO), dissolved oxygen percent saturation, temperature, salinity, and pH. The monitoring data collection was implemented in Barataria starting in 2015 and in the basin east of the Mississippi River starting in 2017, based on recommendations in Hijuelos and Hemmerling (2016). Implementation in the western basins started in 2020, and was based on recommendations in The Water Institute of the Gulf (Hemmerling, et al. 2019). Water quality data are collected to understand system conditions and dynamics at the basin scale.

CPRA SWAMP
program extended
nutrient sampling to
western LA in 2020

9.d. Monitor nutrients in point sources

Monitoring for nutrients in point sources is documented through the LPDES Permit Program. LDEQ is responsible for the LPDES Permit Program whereby dischargers to waters of the state are permitted for such water discharge activity. Through the LPDES Permit Program, LDEQ is able to locate and track the number of permitted dischargers to water bodies in Louisiana. Nutrient monitoring of permitted dischargers aids in gathering necessary data on nutrient discharges in Louisiana. Nutrient monitoring information from the LPDES Permit Program is available through the LDEQ EDMS system (LDEQ 2021m) and is now available for all facility types through the USEPA Integrated Compliance Information System (ICIS) (USEPA 2020d). In addition, permitted wetland assimilation sites are evaluated annually by LDEQ to determine if the permitted nutrient loading rates are appropriate. These evaluations are available for review in EDMS under the assigned AI number for each permitted facility.

In 2014 to 2015, the HTF formed a Point Source Measures Workgroup to identify and evaluate potential point source measures for tracking progress on nutrients in the Task Force states, and this effort has continued. The HTF Point Source Workgroup initially identified two measures for point sources: 1) the number of major Publicly Owned Treatment Works (POTW) permits with monitoring requirements for N and P; and 2) the number of major POTW permits with total N and P limits (HTF 2016). The October 2019 report outlines the increases in both monitoring requirements and discharge limits in permits for nutrients since the 2016 report (HTF 2019). This report also includes a newly completed analysis that summarizes nitrogen and phosphorus loads from all major sewage treatment plants in the 12 Hypoxia Task Force states discharging to the MARB. LDEQ was involved in reviewing and verifying data for permitted dischargers in the state that was a part of these measures. The HTF prepared details on all elements of the measures reporting and tracking process including information input and error correction, establishment of baselines, and direct access of the information using USEPA's data reporting tools to complete the reports provided below:

- 2016 Report
<https://www.epa.gov/ms-htf/reports-point-source-progress-hypoxia-task-force-states>
- 2019 Report
<https://www.epa.gov/ms-htf/reports-point-source-progress-hypoxia-task-force-states>

LDEQ developed a Point Source Implementation Strategy for Nutrients in Louisiana with consideration of monitoring under this Louisiana Nutrient Reduction and Management Strategy and TMDLs previously developed in the Lake Pontchartrain Basin. LDEQ began implementation of the Point Source Implementation Strategy in May 2016. In this point source strategy, major and minor sanitary permitted dischargers will begin reporting TN and TP on a quarterly basis and the reporting requirement will be added to new and renewal permits. Other types of dischargers

Nutrient monitoring
expanded to 80%
for LDEQ
Individual Sanitary
Treatment Plants

may undergo a nutrient review to determine if reporting requirements will be included in their new or renewal permit (LDEQ 2016). As of January 2021, nutrient monitoring requirements have been established in 80.7% of all individual sanitary treatment plant LPDES permits. It is projected nutrient monitoring requirements will be established in all individual sanitary treatment plant permits by the end of 2021. In addition, the following facilities are required to monitor for nutrients,

based on TMDL requirements or reasonable potential to discharge TN and/or TP: 1,135 facilities covered under general sanitary permits; 116 individual industrial permits; and 394 individual sanitary permits. Industrial permits with TN/TP monitoring or limits are most often based on Effluent Limit Guidelines promulgated by EPA.

9.e. Evaluate compliance with point source permits

The evaluation of compliance with point source permits is ongoing. The LDEQ Enforcement Division leads the effort on compliance with point source permits through the LPDES Permit Program. Enforcement actions issued by LDEQ for any permitted activity, including point source water permits, are available for viewing on the LDEQ webpages (LDEQ 2021i).

In regard to nutrients, a review of Discharge Monitoring Reports (DMRs) that are submitted to LDEQ online through the NetDMR system to ICIS was conducted for parameters for TN (STORET code 00600) and TP (STORET code 00665). In a review of 69,876 data records for TN or TP in DMRs available through ICIS from January 1, 2000 to December 31, 2020, compliance with point source permits in regard to completion of DMRs for TN or TP was about 92.6% whereas about 7.4% of DMR submissions resulted in data violations that may have been related to overdue reporting or non-receipt. Of the 5,136 records for TN or TP with limits, less than 0.5% of the DMR submissions were effluent violations.

9.f. Identify and communicate new monitoring projects/initiative

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

Tulane is to develop new experimental stations from support provided by an endowment provided by Charlotte Beyer Hubble (Tulane News 2020). Part of the established Excellence Fund will be used to expand and support the development of a network of Lower Mississippi River Experimental Stations. Tulane will purchase and install the necessary equipment and establish an online infrastructure to house data collection and broadcast it to the community and will use the network to support student initiatives in community outreach.

Two new monitoring initiatives are underway. 1) Louisiana Watershed Initiative (LWI), with LDEQ, USGS, and the Louisiana Office of Community Development (OCD), have partnered to install, operate and maintain 100 new river and rain gauges throughout the state. Up to 15 of the gauges may include equipment to monitor selected water quality parameters. The first gauges are expected to be installed in 2021, with initial funding for the program to last 6 years. 2) The HTF is reviewing the need and potential to add new nutrient monitoring stations within each member state to improve load estimation and to fill potential data gaps.

New rain gauges with water quality parameters expected for up to 15 sites via the LWI and partners

The Gulf of Mexico Alliance sponsors the Gulf of Mexico Monitoring Community of Practice (MCoP), an effort to provide a forum for sharing and coordinating monitoring knowledge with the larger restoration community that is an action item under the [Governors' Action Plan III](#). The [Gulf Coast Monitoring & Assessment Portal](#) was completed in 2020, and provides access to an inventory of Gulf Coast habitat monitoring, mapping, and water quality programs and assessments compiled by the RESTORE Council Monitoring and Assessment Program (CMAP 2020).

CPRA's SWAMP program has extended in-state monitoring to include stations across the LA coast beginning in 2020.

The Patrick F. Taylor Foundation Grant project will develop model farms on commercial agricultural operations with demonstrations of science-backed best management practices as components of overall conservation programs for grain crops and sugarcane. Relying on the results generated through the project and the literature, researchers will be able to value the ecosystem services that are generated, consequently mitigation of the Hypoxia Zone in the Gulf. A conservation practices budget will be generated that will include the practice, its marginal impact on nutrient reduction and/or nutrient losses to bodies of water, and overall profitability.

LDNR has no new funding initiatives and projects planned, however, the Office of Coastal Management continues to be committed to reducing and minimizing adverse impacts on water quality, and supports state and local partnerships in improving monitoring projects.

10. REPORTING

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

10.a. Conduct 5-year strategy review

The Strategy team reviewed and updated the Strategy in 2018 as part of the Strategy timeline. This five year timeframe from 2013 to 2018 for Strategy review is similar to that of other Louisiana programs such as the LDEQ NPS Management Plan from 2018 to 2022 (LDEQ 2018) and the CPRA 2017 Coastal Master Plan (CPRA 2017) from 2012 to 2017. Both programs utilize a five or six year timeline for program evaluation that incorporates adaptive management.

10.b. Report annually on strategy activities

This present document represents the 2020 Annual Report on Louisiana Nutrient Reduction and Management Strategy activities.

10.c. Disseminate information through strategy website

The updated Strategy was released in Dec 2019 (Louisiana Nutrient Reduction and Management Strategy Interagency Team 2019) and is available on the Strategy website. The LDEQ website was redesigned in early 2017, and appears as shown (Figure 2). The Strategy website contains information related to nutrient reduction and management activities in Louisiana. Content includes information on nutrient reduction and management, resources, reports, decision support tools,

programs, and frequently asked questions. As new and updated information are made available, it will be accessible to the public through the website.

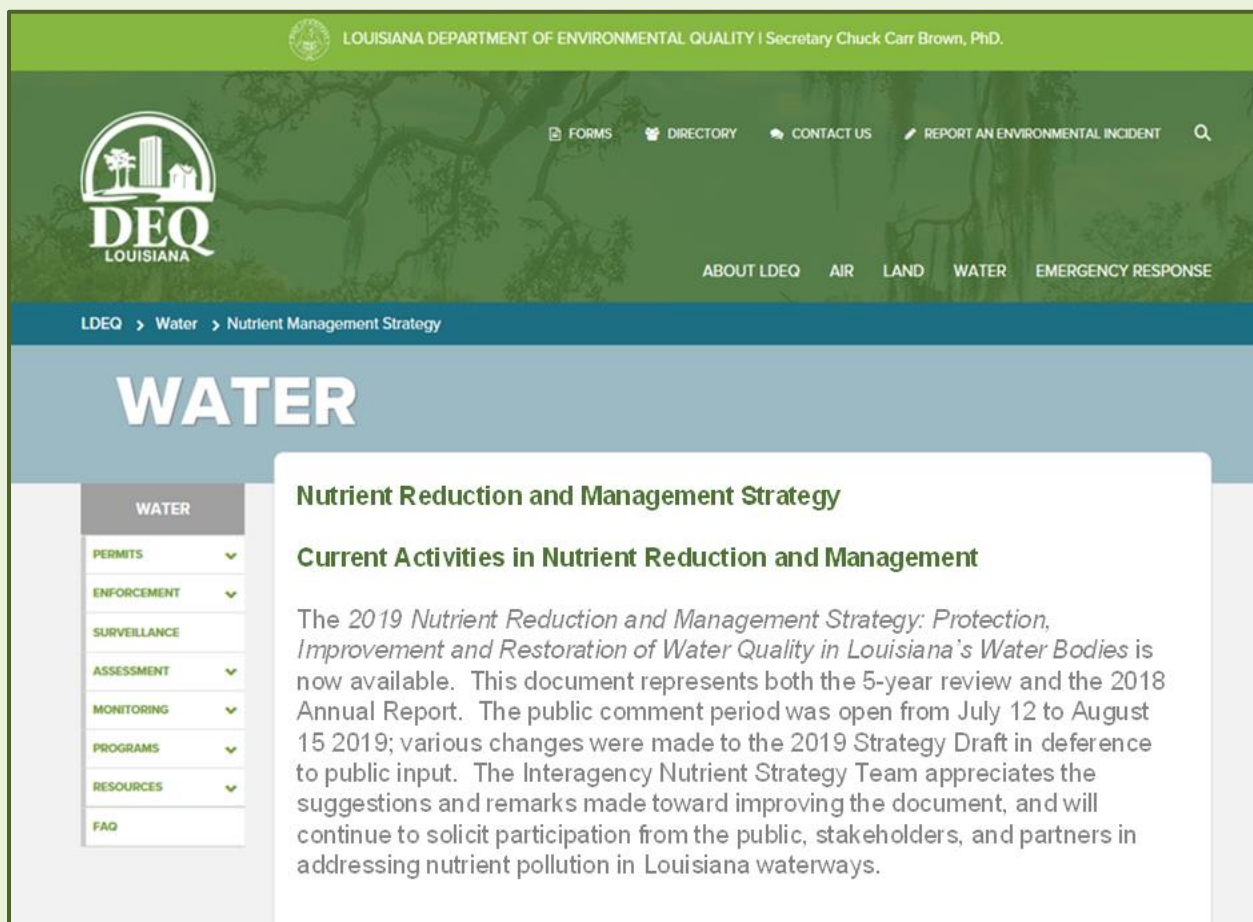


Figure 2. Louisiana Nutrient Reduction and Management Strategy website located at <https://www.deq.louisiana.gov/page/nutrient-management-strategy>.

10.d. Document spotlight(s) of nutrient reduction and management successes

The LDEQ NPS Program aims to partially or fully restore impaired water bodies in Louisiana. According to the NPS Management Plan Addendum (LDEQ 2018), the LDEQ will average two success stories every other year in conjunction with the Integrated Report to document use support restoration. As the Integrated Report is developed on even numbered years, the LDEQ NPS Program will be preparing success stories in 2020 and will be reported as publication occurs.

The LDEQ NPS Program (or §319 Program) in coordination with LDAF and USDA NRCS published two success stories for Bayou Sara and Bayou des Cannes. These §319 Program success stories focused on water quality improvements in previously impaired watersheds in Louisiana, where agency collaboration on planning and development and implementation of BMPs resulted in the watersheds being removed from the §303(b) assessment. These success stories have been highlighted on the new Hypoxia Task Force Success Stories webpage (HTF 2021b). In addition, EPA recognized full implementation of restoration practices in Lake Providence, Louisiana (USEPA 2020b). While this project focused on Total Dissolved Solids, reducing runoff into

receiving water bodies has the added benefit of also reducing nutrient loading, as nutrients are washed downstream along with sediment and other parameters. From October 2016 through 2020, NRCS cooperated with the East Carroll SWCD, LDEQ, and LDAF to garner 100 percent producer participation in BMP implementation on cropland draining to the lake, which restored water quality.

Under the New Vision approach to the TMDL program, LDEQ is conducting activities that are expected to restore each of the priority waterbodies. Based on current assessments, the primary contact recreation designated use for Bayou Sara has been restored.

In addition to LDEQ NPS success story documentation, the USDA NRCS has adopted a new reporting system called Conservation Desktop that promises to quantify the levels of soil and nutrient loss prevented by the over 50,000 acres of nutrient management practices implemented in Louisiana for 2019 (USDA NRCS 2019; USDA NRCS Louisiana Office personal communication). For FY 2020, reporting to the desktop was ongoing.

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APPENDIX A: STRATEGIC ACTIONS SCHEDULE 2019 TO 2023

Strategic actions targets and goals (Component 8) from 2019 through 2023 for the Louisiana Nutrient Reduction and Management Strategy (“Strategy”). *Activities may be dependent on resource availability.*

Strategic Action	Agency Commitment(s)	Schedule 2019 to 2023
1. Stakeholder Engagement		
1.a. Identification and engagement of stakeholders	Strategy Interagency Team	Ongoing
1.b. Perform outreach/education on Strategy	Strategy Interagency Team	Ongoing
1.c. Identify and promote partnerships/leveraging opportunities	Strategy Interagency Team	Ongoing
	Stakeholders	As needed, notify Strategy Interagency Team of opportunities (contact nutrient.management@la.gov)
2. Decision Support Tools		
2.a. Identify, evaluate, and document selected tools	Strategy Interagency Team	Ongoing
	Stakeholders	Ongoing, notify Strategy Interagency Team of potential tools (contact nutrient.management@la.gov)
3. Regulations, Programs, & Policies		
3.a. Propose new regulations, policies and programs	Strategy Interagency Team	As needed
	Stakeholders	As needed, notify Strategy Interagency Team of new items (contact nutrient.management@la.gov)
4. Management Practices & Restoration Activities		
4.a. Document current practices related to nutrient reduction and management	LDEQ, LDAF, USDA NRCS and LDNR for NPS Program	Annual
	LDEQ LPDES Program	Annual
	CPRA	See Coastal Master Plan
4.b. Identify areas where practices being implemented	LDEQ, LDAF, USDA NRCS and LDNR for NPS Program	Annual, see NPS Program
	LDEQ LPDES Program	Quarterly, see LPDES Program
	CPRA	Annual, see Coastal Master Plan

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Strategic Action	Agency Commitment(s)	Schedule 2019 to 2023
4.c. Identify case studies and model watersheds	LDEQ, LDAF, USDA NRCS and LDNR for NPS Program	Annual
	LSU AgCenter	Annual
	CPRA	Annual
4.d. Integrate science-based nutrient reduction and management approaches	CPRA	Ongoing, see Coastal Master Plan
	LSU AgCenter	Ongoing
	LDEQ LPDES	Ongoing
4.e. Promote BMP/CP implementation by farm in priority watersheds	USDA NRCS	Ongoing, see Farm Bill Programs
	LDAF OSWC	Ongoing
	LSU AgCenter	Ongoing
5. Status & Trends		
5.a. Model nutrient loading estimated within Louisiana watersheds	USGS, LDEQ, CPRA	SPARROW modeling availability anticipated late 2019
	CPRA	Ongoing, see Coastal Master Plan
5.b. Document/trends for in-stream nutrient water quality	LDEQ	Annual documentation, Long-term ambient stations trends update targeted for 2021
5.c. Document/trends for Social Indicators of nutrient reduction and management behavior	SERA-46 and Land Grant Universities (LGU)	See SERA-46 and LGU
5.d. Document/trends for BMP/CP implementation in watersheds	USDA NRCS, LDAF OSWC, LSU AgCenter, LDEQ	Annual documentation
5.e. Document/trends for permitted discharger inventories	LDEQ LPDES Program	Annual documentation
5.f. Document/trends for river diversion efforts	CPRA	See Coastal Master Plan
5.g. Document coastal protection and restoration activities	CPRA	See Coastal Master Plan

Strategic Action	Agency Commitment(s)	Schedule 2019 to 2023
6. Watershed Characterization, Source Identification, & Prioritization		
6.a. Maintain watersheds and water body characterization	LDEQ	Ongoing, National Hydrography Dataset (NHD) & Watershed Boundary Dataset (WBD); Water Quality Management Plan (WQMP) Volume 4 Basins & Subsegments
	LDNR, CPRA	As needed, coastal zone boundary
	USGS, USDA	Ongoing, national datasets
6.b. Identify potential pollution sources through Desktop Analysis/Windshield Survey/Stakeholder input	LDEQ New Vision LDEQ Surveillance LDEQ NPS	Ongoing, project specific
6.c. Identify unpermitted point sources	LDEQ Surveillance	Ongoing
6.d. Identify priority watersheds from leveraging programs	USDA GOMI	Project funded through 2019
	USDA MRBI	Ongoing
	USDA NWQI	Extended through 2023
	LDEQ/LDAF/LDNR NPS	See NPS Program
	LDEQ New Vision	See New Vision Program
	Stakeholders	Ongoing, notify Strategy Interagency Team of priority watersheds (contact nutrient.management@la.gov)
6.e. Determine priority watershed & subwatershed basins	Strategy Interagency Team	Ongoing
	LDEQ WPAD	Evaluate nutrient translators.
6.f. Develop/leverage watershed nutrient reduction and management projects for priorities	Strategy Interagency Team	Ongoing
	LSU AgCenter	2019 through 2022, focus on educational programs and plans for animal operations
	NRDA Louisiana TIG	See BP Deepwater Horizon Restoration
	Stakeholders	Ongoing, notify Strategy Interagency Team of projects (contact nutrient.management@la.gov)

Strategic Action	Agency Commitment(s)	Schedule 2019 to 2023
7. Incentives, Funding, & Economic Impact Analysis		
7.a. Promote voluntary participation in incentive-based programs	Louisiana Master Farmer	Ongoing, see LSU AgCenter
	Louisiana Master Poultry Producer	
	Louisiana (Kellogg) Master Rice Grower	
	Louisiana Master Cattlemen	
	Louisiana Master Gardener	
	Louisiana Master Naturalist	
	Louisiana Environmental Leadership Program (ELP)	Ongoing, see ELP Program
7.b. Identify and communicate new funding initiatives/projects	Strategy Interagency Team	Ongoing
	Stakeholders	Ongoing, notify Strategy Interagency Team of projects (contact nutrient.management@la.gov)
7.c. Promote assistance (financial or technical) for BMP/CP implementation	USDA NRCS	Ongoing
	LDAF OSWC	
7.d. Promote assistance (financial or technical) for point sources	LDEQ SB/SCAP	Ongoing
	LDEQ Enforcement	Ongoing
7.e. Document economic impacts from available sources	Strategy Interagency Team	As available
	LSU AgCenter	Monthly, Commodities and Conservation
	Stakeholders	As available, notify Strategy Interagency Team of sources (contact nutrient.management@la.gov)
7.f. Develop and implement a water quality credit trading program	LDEQ	Final rule in October 2019; Ongoing implementation
	Stakeholders	Ongoing, notify LDEQ of interest in participating in water quality trading (contact wq.trading@la.gov)

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Strategic Action	Agency Commitment(s)	Schedule 2019 to 2023
9. Monitoring		
9.a. Monitor in-stream nutrient water quality	LDEQ Surveillance	Ambient stations monthly for a year, every 4 years; Long-term ambient stations monthly each year
	LDEQ WPAD	Monitor select inland lakes 2019 to 2022
9.b. Monitor water quality relative to BMP/CP implementation	LDEQ NPS Program	Project specific, bi-weekly or monthly
9.c. Monitor nutrients associated with riverine diversions	CPRA	Project specific, see Coastal Master Plan
9.d. Monitor nutrients in point sources	LDEQ LPDES Permitted Dischargers	Performed by permittees quarterly or other frequency as specified in permit
9.e. Evaluate compliance with point source permits	LDEQ	Annual
9.f. Identify and communicate new monitoring projects/initiatives	Strategy Interagency Team	Ongoing
	Stakeholders	As needed, notify Strategy Interagency Team of new monitoring projects and initiatives (contact nutrient.management@la.gov)
10. Reporting		
10.a. Conduct 5-year Strategy review	Strategy Interagency Team	Initiate in 2022, Complete in 2023
10.b. Report annually on Strategy activities	Strategy Interagency Team	Annual
10.c. Disseminate information through Strategy website	LDEQ	Ongoing
10.d. Document spotlight(s) of nutrient reduction and management successes	Strategy Interagency Team	Ongoing
	Stakeholders	Ongoing, notify Strategy Interagency Team of spotlights (contact nutrient.management@la.gov)

Abbreviations: *BMP*: Best Management Practice; *CP*: Conservation Practice; *CPRA*: Coastal Protection and Restoration Authority; *LDAF*: 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; *LSU AgCenter*: Louisiana State University Agricultural Center; *NRDA*: Natural Resource Damage Assessment; *NPS*: Nonpoint Source Program; *SB/SCAP*: Louisiana Small Business/Small Community Assistance Program; *TIG*: Trustee Implementation Group; *WPAD*: Water Planning and Assessment Division; *USDA GoMI*: U.S. Department of Agriculture (USDA), Gulf of Mexico Initiative; *USDA MRBI*: USDA, Mississippi River Basin Initiative; *USDA NRCS*: USDA, Natural Resources Conservation Service; *USDA NWQI*: USDA, National Water Quality Initiative; *USGS*: U.S. Geological Survey.

APPENDIX B: PRIORITY WATERSHEDS--LEVERAGING PROGRAMS IDENTIFIED

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

Program	Watershed Name	Watershed Level	Watershed Code
Lake Pontchartrain Basin (04)			
LDEQ NPS	Comite River ⁴	Subsegment	040101
LDEQ NPS	Upper Amite River ⁴	Subsegment	040301
LDEQ NPS	Middle Amite River ^{4,6}	Subsegment	040302
LDEQ NPS	Natalbany River ^{1,5,6}	Subsegment	040503
LDEQ NPS	Yellow Water River ^{1,4,6}	Subsegment	040504
Mermentau River Basin (05)			
LDAF, Evangeline SWCD, LDEQ NPS	Bayou Des Cannes	Subsegment	050101
LDAF, St. Landry SWCD, LDEQ NPS	Bayou Mallet	Subsegment	050103
LDAF, Acadia SWCD, LDEQ NPS, USDA NRCS	Bayou Queue de Tortue ³	Subsegment	050501
LDAF, Jefferson Davis SWCD, LDEQ NPS	Bayou Chene	Subsegment	050603
Vermilion-Teche River Basin (06)			
LDAF, St. Martin SWCD, LDEQ NPS, USDA NRCS	Bayou Du Portage ³	Subsegment	060703
LDAF, Lafayette SWCD, LDEQ NPS	Vermilion River ⁴	Subsegment	060801/060802
Mississippi River Basin (07)			
LDEQ NPS	Bayou Sara ^{1,5}	Subsegment	070501
LDEQ NPS	Thompson Creek ⁴	Subsegment	070502
Ouachita River Basin (08)			
LDAF, LDEQ NPS, NRCS	Big Creek (North) ⁸	Subsegment	080903
LDAF, Morehouse SWCD, LDEQ NPS	Upper Bayou Lafourche	Subsegment	080904
LDEQ NPS, USDA NRCS	Lake Providence ²	Subsegment	081101
LDAF, LaSalle SWCD, LDEQ NPS	Hemphill Creek	Subsegment	081609
Terrebonne Basin (12)			
LDAF, Upper Delta SWCD, LDEQ NPS	Bayou Grosse Tete	Subsegment	120104
LDAF, Upper Delta SWCD LDEQ NPS	Bayou Maringouin	Subsegment	120111
DU, Lafourche-Terrebonne SWCD, LDEQ NPS	Bayou Folse ^{6,7}	Subsegment	120302

¹New Vision

²Mississippi River Basin Initiative (MRBI)

³National Water Quality Initiative (NWQI)

⁴Monitoring Supporting Education & Outreach (OSDS Inspections)

⁵On-Site Disposal System Inspections (OSDS) only

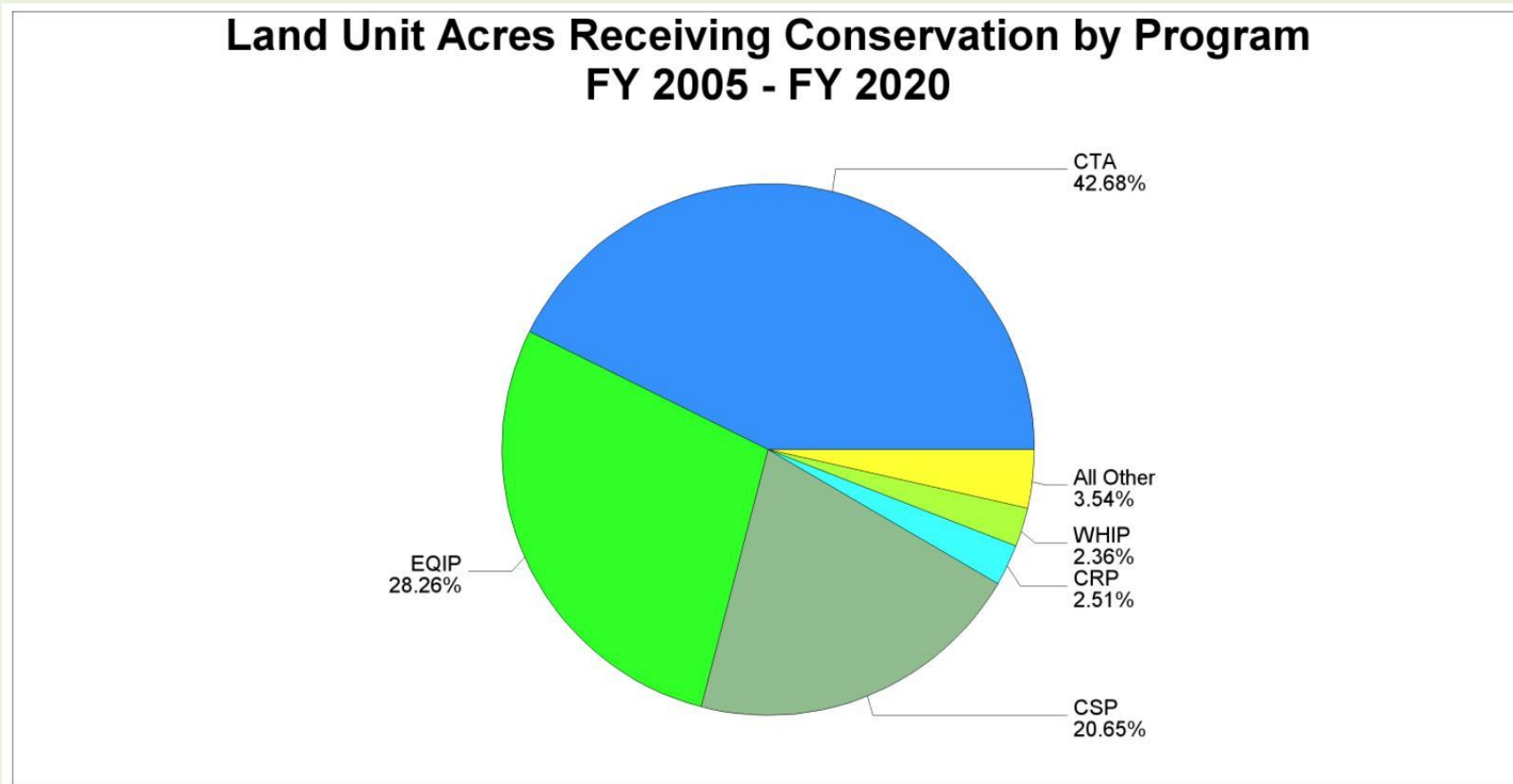
⁶Coastal Zone Act Reauthorization Amendments (CZARA)

⁷Natural Resource Damage Assessment (NRDA)

⁸United States Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS)

APPENDIX C: USDA NRCS LAND UNIT ACRES RECEIVING CONSERVATION FOR PRACTICES RELATED TO WATER QUALITY IN LOUISIANA, 2005-2020

As reproduced from USDA et al. 2020, the following chart and table includes practices that are related to Water Quality. USDA et al. (2020) states that “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.”



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USDA NRCS Land Unit Acres Receiving Conservation (including practice count) by Fiscal Year, Water Quality Practices in Louisiana (USDA 2020).

Practice Name	Practice Code	2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020		
		Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*			
Conservation Cover	327	7,665	351	35,718	1,685	20,140	1,118	15,781	778	8,393	391	8,973	450	20,070	1,052	15,064	723	8,988	433	1,044	54	10,447	485	8,238	339	4,822	289	3,356	177	5,683	227	4,125	196	
Conservation Cover - Enhancements	E327																									7	2	9	3	124	7			
Conservation Crop Rotation	328	32,349	755	29,450	772	47,004	1,147	44,940	1,764	63,907	3,784	65,854	3,538	92,310	2,822	76,021	2,310	112,284	2,932	107,517	2,864	74,087	2,538	132,236	3,444	138,888	13,180	97,341	2,529	143,058	3,413	88,995	2,159	
Conservation Crop Rotation - Enhancements	E328																									5,110	86	11,315	259	15,983	321			
Contour Farming	330					71	2					239	11				123	9																
Controlled Traffic Farming	334																												2,873	72	2,719	69		
Controlled Traffic Farming - Enhancements	E334																											7,284	168	11,027	274			
Cover Crop	340	3,092	72	2,358	44	6,718	145	5,529	160	2,357	42	1,119	12	3,796	62	1,750	44	4,817	76	3,634	83	7,527	112	7,387	153	19,993	409	42,541	992	53,380	1,155	86,177	2,004	
Cover Crop - Enhancements	E340																												3,339	98	12,400	311	17,036	388
Critical Area Planting	342	1,929	36	2,298	55	4,297	82	6,855	100	6,277	103	6,277	111	3,852	84	3,526	57	4,434	71	3,739	75	3,914	80	5,476	97	5,884	121	5,270	85	2,704	62	4,891	101	
Deep Tillage	324	1,737	43	218	16	2,192	44	4,175	382	9,146	923	11,512	1,903	5,104	375	7,958	1,001	2,192	82	1,457	33	10	1	1,273	28					495	3			
Diversion	362			31	1			196	3	101	2	49	1					54	2	301	4	3	1						3	1				
Field Border	386	3,712	123	2,794	71	2,274	57	4,010	111	4,086	135	1,002	20	1,116	43	1,022	35	893	37	930	19	2,425	41	2,734	73	1,580	25	2,772	80	1,707	52	1,022	27	
Field Border - Enhancements	E386																										169	10	445	3	877	7		
Forage and Biomass Planting	512	150	7	1,660	101	2,099	78	709	34	279	14	513	34	676	23	1,025	37	924	36	396	20	213	12	355	10	274	13	314	17	403	17	198	14	
Forage and Biomass Planting - Enhancements	E512																														53	5		
Grade Stabilization Structure	410	16,859	345	23,512	398	33,163	633	42,561	667	40,690	762	23,463	546	34,769	598	30,474	542	26,276	683	23,937	407	22,935	684	25,435	555	25,558	546	43,252	574	28,643	337	32,453	473	
Grassed Waterway	412	389	8	851	40	1,576	17	1,687	33	1,383	17	283	6		96	2	135	2																
Integrated Pest Management (IPM)	595	30,776	665	26,732	648	24,216	678	27,016	750	15,249	385	18,128	518	24,387	391	46,127	1,495	62,341	4,330	55,032	5,766	26,771	1,428	41,250	2,988	48,161	6,793	59,809	2,029	53,397	2,459	166,942	5,941	
Integrated Pest Management (IPM) - Enhancements	E595																										44,087	1,276	98,447	2,847	227,299	7,076		

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Practice Name	Practice Code	2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
		Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*
Irrigation Water Management	449	17,118	507	18,906	490	24,620	618	30,115	709	32,721	721	35,186	727	23,813	336	96,229	1,520	75,418	1,523	41,598	1,056	28,736	795	30,107	761	37,863	904	35,321	925	29,917	688	42,686	1,016
Irrigation Water Management - Enhancements	E449																										1,054	34	254	9	8,325	181	
Lined Waterway or Outlet	468																							126	3	19	2	7	1	72	1		
Mulching	484	66	1	765	20	1,216	24	2,466	30	1,893	34	1,187	17	1,740	24	2,269	41	1,020	23	2,154	44	2,550	57	2,795	59	3,447	72	2,725	45	2,094	48	4,669	98
Nutrient Management	590	29,514	662	24,623	588	25,134	752	40,730	922	48,517	992	37,485	963	44,932	868	65,637	1,379	54,655	1,219	45,700	1,352	44,892	1,290	40,541	1,097	51,051	1,842	73,612	2,011	120,414	1,361	85,648	2,444
Nutrient Management - Enhancements	E590																										45,901	1,163	98,735	2,476	170,660	4,167	
Residue Management, Seasonal	344	38,679	757	27,955	753	54,067	1,916	52,172	2,313	48,620	2,163	64,169	2,972	56,238	2,439	59,280	2,092	96,498	2,591	85,369	4,123	53,893	1,897	43,369	1,200	19,374	473	10,123	344				
Residue and Tillage Management, Mulch Till	345	550	9	2,588	38	624	10	1,475	42	3,647	69	394	17	886	23	3,870	90	1,349	27	1,242	27	10,676	647	16,386	417	21,909	788	49,057	1,424	84,861	2,264	75,357	1,297
Residue and Tillage Management, Mulch Till - Enhancements	E345																										17,522	436	41,676	1,042	75,410	1,669	
Residue and Tillage Management, No-Till/Strip Till/Direct Seed	329	3,796	83	11,233	189	8,400	178	5,972	133	4,808	85	3,169	119	4,602	69	1,456	34	3,473	74	1,608	38	3,384	84	2,437	61	6,178	111	22,072	297	6,895	122	4,061	85
Residue and Tillage Management, No-Till/Strip Till/Direct Seed - Enhancements	E329																										801	24	44	3	1,274	35	
Residue and Tillage Management, Ridge Till	346	4,742	154	4,759	148	7,871	190	5,898	131	6,358	208	3,830	72	11,125	248	3,759	137	5,482	182	4,526	280	1,183	52	584	11	484	33	3,198	28				
Riparian Forest Buffer	391	217	31	678	55	1,222	31	332	31	34	2	486	27	1,549	33	231	4	332	9							16	2						
Row Arrangement	557	168	9		71	6	768	131	497	91	366	29	950	107	1,194	131	1,033	35	1,120	53			178	48	139	22	49	14	417	67			
Silvopasture Establishment	381																															2	1

- Data Source: USDA-NRCS, National Planning and Agreements Database (NPAD), October 2020.
- Land unit acres may be counted multiple times across practices and fiscal years.
- CSP practices and enhancements are applied under the CSP program or the CSP component of the RCPP program starting in FY 2017.
- CSP enhancements associated with a specific conservation practice are aggregated onto one line.
- Refer to Enhancement Summary at top of document for additional information on enhancements.

To learn more about CSP bundles and enhancements, please see [CSP FY 2019 Enhancements and Bundles](#).

As reproduced from USDA et al. 2020, the following table includes unique land unit acres for practices related to Water Quality. Land unit acres may be counted multiple times across fiscal years, but are only counted once per fiscal year.

	2005		2006		2007		2008		2009		2010		2011		2012		2013		2014		2015		2016		2017		2018		2019		2020	
	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*	Acres	Count*		
Land Unit Acres treated by at least one practice	179,128	9,459	279,378	15,839	270,906	13,155	292,117	13,364	343,169	13,115	314,673	14,405	412,792	12,972	389,776	15,272	376,799	18,628	285,720	15,864	215,447	11,684	254,392	13,912	250,740	27,752	385,641	19,692	461,990	24,170	593,812	35,147

Data Source: USDA-NRCS, National Planning and Agreements Database (NPAD), October 2020; Land unit acres may be counted Multiple times across programs

APPENDIX D: LDEQ AND LDAF NONPOINT SOURCE IMPLEMENTATION IN 2020*

Water Body Name	Number of Stations Monitored	Impairment	Parameters sampled
Bayou des Cannes ⁴ (050101)	9	Dissolved Oxygen, Mercury-Fish Consumption Advisory, Nitrite + Nitrate as N, Total Phosphorus, Turbidity	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Solids, Turbidity, and <i>in-situ</i>
Bayou Mallet ⁴ (050103)	8	Dissolved Oxygen, Total Dissolved Solids, Fecal Coliform	Turbidity, TDS, and <i>in-situ</i>
Bayou Queue de Tortue ⁴ (050501)	13	Dissolved Oxygen, Mercury-Fish Consumption Advisory, Nitrite + Nitrate as N, Phosphorus Total, Turbidity	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Turbidity, and <i>in-situ</i>
Bayou Chene ⁴ (050603)	9	Dissolved Oxygen, Mercury-Fish Consumption Advisory, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Turbidity, Fecal, and <i>in-situ</i>
Bayou du Portage ² (060703)	14	Dissolved Oxygen, Turbidity, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Solids, Turbidity, Fecal, and <i>in-situ</i>

Water Body Name	Number of Stations Monitored	Impairment	Parameters sampled
Vermilion River ¹ (060801)	36	Dissolved Oxygen, Nitrite + Nitrate as N, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Fecal, and <i>in-situ</i>
Bayou Louis/Lake Louis ³ (080202/080203)	4	Mercury-Fish Consumption Advisory, Turbidity, Fecal Coliform	Turbidity and <i>in-situ</i>
Big Creek ⁴ (080903)	14	Atrazine, Dissolved Oxygen, Methyl Parathion, Turbidity	Turbidity, and <i>in-situ</i>
Bayou Lafourche ⁴ (080904)	12	2,3,7,8-tetrachlorodibenzofuran, 2,3,7,8-Tetrachlorodibenzo-P-Dioxin, Dissolved Oxygen, Turbidity, Fecal Coliform,	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Solids, Turbidity, and <i>in-situ</i>
Hemphill Creek ⁴ (081609)	9	Mercury-Fish Consumption Advisory, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Fecal, and <i>in-situ</i>
Bayou Grosse Tete ¹ (120104)	22	Dissolved Oxygen, Nitrite + Nitrate as N, Total Phosphorus, Total Dissolved Solids	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Fecal, and <i>in-situ</i>

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Water Body Name	Number of Stations Monitored	Impairment	Parameters sampled
Bayou Maringouin ¹ (120111)	15	Total Dissolved Solids, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Solids, Turbidity, Fecal, and <i>in-situ</i>

¹LDAF Implementation TBD - Pending Watershed Implementation Plan (WIP) EPA-Acceptance

²WIP EPA-Accepted – LDAF Implementation TBD

³LDAF Implementation Complete. One year post monitoring occurring.

APPENDIX E-1: Hypoxia related literature 2019-2020. Selected list from search using ‘hypoxia’ and the phrase ‘Gulf of Mexico’ in Harzing’s Publish or Perish© Application on March 11, 2021.

Authors	Title	Year	Source	Quick Link
NN Rabalais, RE Turner	<i>Gulf of Mexico hypoxia: Past, present, and future</i>	2019	Limnology and Oceanography ...	https://aslopubs.onlinelibrary.wiley.com/doi/abs/10.1002/lob.10351
F Große, K Fennel, A Laurent	<i>Quantifying the relative importance of riverine and open-ocean nitrogen sources for hypoxia formation in the northern Gulf of Mexico</i>	2019	Journal of Geophysical ...	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019JC015230
D Scavia, D Justić, DR Obenour...	<i>Hypoxic volume is more responsive than hypoxic area to nutrient load reductions in the northern Gulf of Mexico—and it matters to fish and fisheries</i>	2019	Environmental ...	https://iopscience.iop.org/article/10.1088/1748-9326/aaf938/meta
A Laurent, K Fennel	<i>Time-evolving, spatially explicit forecasts of the northern Gulf of Mexico hypoxic zone</i>	2019	Environmental science & technology	https://pubs.acs.org/doi/abs/10.1021/acs.est.9b05790
M Khanna, BM Gramig, EH DeLucia, X Cai...	<i>Harnessing emerging technologies to reduce Gulf hypoxia</i>	2019	Nature ...	https://www.nature.com/articles/s41893-019-0381-4

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Authors	Title	Year	Source	Quick Link
Y Feng, SF DiMarco, K Balaguru...	<i>Seasonal and Interannual Variability of Areal Extent of the ...</i>	2019	Journal of Geophysical ...	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018JG004745
K Fennel, JM Testa	<i>Biogeochemical controls on coastal hypoxia</i>	2019	Annual review of marine science	https://www.annualreviews.org/doi/abs/10.1146/annurev-marine-010318-095138
S Bargu, D Justic, JR White, R Lane, J Day...	<i>Mississippi River diversions and phytoplankton dynamics in deltaic Gulf of Mexico estuaries: a review</i>	2019	Estuarine, Coastal and ...	https://www.sciencedirect.com/science/article/pii/S0272771418305316
N Trifonova, M Karnauskas, C Kelble	<i>Predicting ecosystem components in the Gulf of Mexico and their responses to climate variability with a dynamic Bayesian network model</i>	2019	PloS one	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0209257
TC Ballard, AM Michalak, GF McIsaac...	<i>Comment on “Legacy nitrogen may prevent achievement of water quality goals in the Gulf of Mexico”</i>	2019		https://science.sciencemag.org/content/365/6455/eaau8401.abstract

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Authors	Title	Year	Source	Quick Link
V Thipparthi	<i>Breaking Coastal Hypoxia: Destratification of Gulf of Mexico Deadzone to Encourage Oxygen Transport Downwards to ...</i>	2019		https://digitalcommons.lsu.edu/gradschool_theses/5040/
NA Ghaisas, K Maiti, JR White	<i>Coupled iron and phosphorus release from seasonally...</i>	2019	Estuarine, Coastal and Shelf Science	https://www.sciencedirect.com/science/article/pii/S0272771418305146
A Katin, D Del Giudice, DR Obenour	<i>Modeling biophysical controls on hypoxia in a shallow estuary using a Bayesian mechanistic approach</i>	2019	Environmental Modelling & Software	https://www.sciencedirect.com/science/article/pii/S1364815218311320
V Sanial, AM Shiller, DJ Joung, P Ho	<i>Extent of Mississippi River water in the Mississippi Bight and Louisiana Shelf based on water isotopes</i>	2019	Estuarine, Coastal and Shelf ...	https://www.sciencedirect.com/science/article/pii/S0272771418305018
KJ Van Meter, P Van Cappellen, NB Basu	<i>Response to Comment on “Legacy nitrogen may prevent achievement of water quality goals in the Gulf of Mexico”</i>	2019	Science	https://science.sciencemag.org/content/365/6455/eaav3851.abstract

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Authors	Title	Year	Source	Quick Link
S Fournier, JT Reager, B Dzwonkowski ...	<i>Statistical mapping of freshwater origin and fate signatures as land/ocean "regions of influence" in the Gulf of Mexico</i>	2019	Journal of ...	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018JC014784
LG Campbell	<i>Analysis of Microbial Abundance, Metabolic Potential, and Transcriptional Activity in the Gulf of Mexico "Deadzone" Reveals an ...</i>	2019		https://diginole.lib.fsu.edu/islandora/object/fsu%3A709068/
WF Ritter, SR Chitikela	<i>The Mississippi River Basin Phosphorus Problem: Past History and Future Challenges to Solve It</i>	2019	World Environmental and Water Resources ...	https://ascelibrary.org/doi/abs/10.1061/9780784482339.036
CL Cardinaux	<i>Improving Green and Blue Economy with Nitrogen Management and Hypoxia in the Gulf of Mexico Region</i>	2019		https://books.google.com/books/about/Improving_Green_and_Blue_Economy_with_Ni.html?id=AdNczQEACAAJ
D Justic, D Scavia, DR Obenour, K Craig...	<i>Hypoxic volume in the northern Gulf of Mexico is ecologically more ...</i>	2019	2019 CERF Biennial ...	https://cerf.confex.com/cerf/2019/meetingapp.cgi/Paper/5088

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Authors	Title	Year	Source	Quick Link
RT Munnelly, DB Reeves, EJ Chesney...	<i>Summertime hydrography of the nearshore Louisiana Continental Shelf: Effects of riverine outflow, shelf ...</i>	2019	Continental Shelf ...	https://www.sciencedirect.com/science/article/pii/S0278434318305326
M Le Moal, C Gascuel- Odoux, A Ménesguen...	<i>Eutrophication: a new wine in an old bottle?</i>	2019	Science of the Total ...	https://www.sciencedirect.com/science/article/pii/S0048969718335836
LD Wright, JPM Syvitski, CR Nichols	<i>Coastal Systems in the Anthropocene</i>	2019	Tomorrow's Coasts: Complex and ...	https://link.springer.com/chapter/10.1007/978-3-319-75453-6_6
J Zalasiewicz	<i>5.4 Nitrogen and Phosphorus</i>	2019	The Anthropocene as a Geological Time Unit: A ...	https://books.google.com/books?hl=en&lr=&id=U7-GDwAAQBAJ&oi=fnd&pg=PA168&dq=(hypoxia)+%22%27Gulf+of+Mexico%27%22&ots=Z5bdjvZq77&sig=UtU1O13nNlxC-NJXqF8vGBKIHU
GP Oelsner, EG Stets	<i>Recent trends in nutrient and sediment loading to coastal areas of the conterminous US: Insights and global context</i>	2019	Science of the Total Environment	https://www.sciencedirect.com/science/article/pii/S0048969718343377
WA Wurtsbaugh, HW Paerl...	<i>Nutrients, eutrophication and harmful algal blooms along the ...</i>	2019	Wiley Interdisciplinary ...	https://onlinelibrary.wiley.com/doi/abs/10.1002/wat2.1373
D Del Giudice, VRR Matli...	<i>Bayesian mechanistic modeling characterizes Gulf of Mexico hypox...</i>	2020	Ecological ...	https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/eap.2032

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Authors	Title	Year	Source	Quick Link
H Tian, R Xu, S Pan, Y Yao, Z Bian...	<i>Long-term trajectory of nitrogen loading and delivery from Mississippi River Basin to the Gulf of Mexico</i>	2020	Global ...	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GB006475
C Lu, J Zhang, H Tian, WG Crumpton...	<i>Increased extreme precipitation challenges nitrogen load ...</i>	2020	... Earth & Environment	https://www.nature.com/articles/s43247-020-00020-7
W Zhang, RD Hetland, V Ruiz, SF DiMarco...	<i>Stratification duration and the formation of bottom hypoxia over the Texas-Louisiana shelf</i>	2020	Estuarine, Coastal and ...	https://www.sciencedirect.com/science/article/pii/S0272771419309655
VI Ruiz Xomchuk	<i>Intraseasonal Variability in Northern Gulf of Mexico Hypoxia: Impacts of Baroclinic Instability, Rough Topography, and Exposure Duration</i>	2020		https://oaktrust.library.tamu.edu/handle/1969.1/192583
P Okwan, Y Zhen, H Feng, S Yoo, MS Kambhampati ...	<i>Statistical Analysis of Nutrient Loads from the Mississippi-Atchafalaya River Basin (MARB) to the Gulf of Mexico</i>	2020	Environments	https://www.mdpi.com/2076-3298/7/1/8

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Authors	Title	Year	Source	Quick Link
KE Limburg, D Breitburg, DP Swaney, G Jacinto	<i>Ocean deoxygenation: a primer</i>	2020	One Earth	https://www.sciencedirect.com/science/article/pii/S2590332220300014
DA González- Rivas, FO Tapia-Silva...	<i>Estimating Nitrogen Runoff From Agriculture to Coastal Zones by a Rapid GIS and Remote Sensing- Based Method for a Case Study From the Irrigation District ...</i>	2020	Frontiers in Marine ...	https://www.frontiersin.org/articles/10.3389/fmars.2020.00316/full
V Thipparthi, LJ Thibodeaux...	<i>Breaking Coastal Hypoxia: Destratification of Gulf of Mexico Deadzone Through Artificially Enhancing Oxygen Transport Downwards to Maintain Marine ...</i>	2020	Ocean Sciences Meeting ...	https://agu.confex.com/agu/osm20/meetingapp.cgi/Paper/657770
D Justic, L Wang, ZG Xue, Z Zang, DS Ko...	<i>Development of Long Range Hypoxia Forecasts for the Northern Gulf of Mexico</i>	2020	Ocean Sciences ...	https://agu.confex.com/agu/osm20/meetingapp.cgi/Paper/641538

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Authors	Title	Year	Source	Quick Link
MT Ogle, SD Howden, B Williams	<i>Closing the Gaps: A Public/Private Partnership for Coastal HF Radar Coverage along the Louisiana Coast</i>	2020	Ocean Sciences Meeting 2020	https://agu.confex.com/agu/osm20/mediafile/Handout/Paper652420/Ogle_poster_CP44A-1308.pdf
H Manifold, J Magner, J Sweeten	<i>Estimating nitrogen inputs, storage, and exports for a small watershed in the upper Mississippi river basin, USA</i>	2020	Int J Hydro	https://www.researchgate.net/profile/Joe_Magner/publication/345137441_20_Manifold_N_Budget/links/5f9eb6f2299bf1b53e565458/20-Manifold-N-Budget.pdf
SQ Foster, RW Fulweiler	<i>–Long-term trends in the frequency and phenology of coastal hypoxia vary with estuary type</i>	2020		https://search.proquest.com/openview/69356f972dbd2905883dfdebc11601ee/1.pdf?pq-origsite=gscholar&cbl=18750&diss=y#page=128
B Parthum, AW Ando	<i>Overlooked Benefits of Nutrient Reductions in the Mississippi River Basin</i>	2020	Land Economics	http://le.uwpress.org/content/96/4/589.short
A Bailey, L Meyer, N Pettingell, M Macie...	<i>Agricultural Practices Contributing to Aquatic Dead Zones</i>	2020	Ecological and Practical ...	https://link.springer.com/chapter/10.1007/978-981-15-3372-3_17
TC Malone, A Newton	<i>The globalization of cultural eutrophication in the coastal ocean: causes and consequences</i>	2020	Frontiers in Marine Science	https://www.frontiersin.org/articles/10.3389/fmars.2020.00670/full?utm_source=fweb&utm_medium=nblog&utm_campaign=ba-sci-fmars-coastal-eutrophication-review

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Authors	Title	Year	Source	Quick Link
NW Baeumler, SC Gupta	<i>Precipitation as the primary driver of variability in river nitrogen loads in the Midwest United States</i>	2020	JAWRA Journal of the American ...	https://onlinelibrary.wiley.com/doi/abs/10.1111/1752-1688.12809
B Dzwonkowski, J Coogan, S Fournier...	<i>Compounding impact of severe weather events fuels marine heatwave in the coastal ocean</i>	2020	Nature ...	https://www.nature.com/articles/s41467-020-18339-2
S O'Boyle	<i>Oxygen Depletion in Coastal Waters and the Open Ocean</i>	2020	Coastal and Deep Ocean Pollution	https://books.google.com/books?hl=en&lr=&id=I9LVDwAAQBAJ&oi=fnd&pg=PA38&dq=(hypoxia)+%22%27Gulf+of+Mexico%27%22&ots=9F3aV5FuXq&sig=jeUCYssznoB-6oyeRTb875ontLU

APPENDIX E-2: Agriculture related literature 2019-2020. Selected list from search using ‘hypoxia’ and the phrase ‘Gulf of Mexico’ in Harzing’s Publish or Perish© Application on March 11, 2021.

Authors	Title	Year	Source	Quick Link
H Tallis, S Polasky, J Hellmann, NP Springer...	<i>Five financial incentives to revive the Gulf of Mexico dead zone and Mississippi basin soils</i>	2019	Journal of environmental ...	https://www.sciencedirect.com/science/article/pii/S0301479718314051
MD Ruffatti, RT Roth, CG Lacey...	<i>Impacts of nitrogen application timing and cover crop inclusion on subsurface drainage water quality</i>	2019	Agricultural Water ...	https://www.sciencedirect.com/science/article/pii/S0378377418313738
JM Baker, R Felton, TJ Griffis	<i>Tracking Water Parcels as They Move Through Agricultural Watersheds</i>	2019	AGU Fall Meeting Abstracts	https://ui.adsabs.harvard.edu/abs/2019AGUFM.H43Q2309B/abstract
AA Keller, J Fox	<i>Giving credit to reforestation for water quality benefits</i>	2019	PloS one	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217756
WCCRN LOSS	<i>WINTER COVER CROPS REDUCE NITRATE LOSS FROM AN AGRICULTURAL WATERSHED IN THE MIDWESTERN US 4</i>	2019	... LAND COVER AND OTHER CONTROLS ON ...	https://search.proquest.com/openview/613be9215bca40358b220c62698486aa/1.pdf?pq-origsite=gscholar&cbl=18750&diss=y#page=183

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Authors	Title	Year	Source	Quick Link
CS Jones, KE Schilling...	<i>Using in situ Water Quality Sensors on Stream Banks and Boats to Characterize US Cornbelt Stream Conditions and ...</i>	2019	AGU Fall Meeting ...	https://ui.adsabs.harvard.edu/abs/2019AGUFM.H44D..07J/abstract
BM McGill, AJ Burgin, WD Hively...	<i>Farming for human health and a smaller dead zone: how agricultural conservation practices, climate change, and subsurface drainage intensification affect nitrate ...</i>	2019	AGU Fall Meeting ...	https://ui.adsabs.harvard.edu/abs/2019AGUFMGC33D..03M/abstract
GSW Hoselton	<i>Illinois Corn Farmers' Concerns About Nutrient Loss and the Adoption of Best Management Practices</i>	2019		https://search.proquest.com/openview/54b5aef4f1da22c03149dd7ca6fbe072/1?pq-origsite=gscholar&cbl=51922&diss=y
LS Sarkadi	<i>Effects of Fertilizer on Food Supply</i>	2019	Chemistry's Role in Food Production and ...	https://pubs.acs.org/doi/abs/10.1021/bk-2019-1314.ch009
G Johnson	<i>Factors Affecting Adoption of Agricultural Best Management Practices in Iowa</i>	2019		https://lib.dr.iastate.edu/honors_posters/201904/projects/53/

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Authors	Title	Year	Source	Quick Link
EK Zimmerman, JC Tyndall, LA Schulte...	<i>Farmer and farmland owner views on spatial targeting for soil conservation and water quality</i>	2019	Water Resources ...	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018WR023230@10.1002/(ISSN)1944-7973.LANDSCAPES1
LS Moore, S Bradbury, M O'Neal, A Toth, J Tyndall	<i>Prairie Strips</i>	2019		https://www.nrem.iastate.edu/research/STRIPS/files/publication/Schulte%202014%20MoPrairieJournal%20--%20Prairie%20Strips.pdf
JT Piske	<i>Nitrate Concentrations In Streams ...Crop Cover In .. Corn And Soybeans</i>	2019		https://ir.library.illinoisstate.edu/etd/1108/
JA Delgado, NM Short Jr, DP Roberts...	<i>Big Data analysis for sustainable agriculture on a geospatial cloud framework</i>	2019	Frontiers in Sustainable ...	https://www.frontiersin.org/articles/10.3389/fsufs.2019.00054/full
S Sellars, L Gentry, G Schnitkey, D Lattz	<i>Cost and Returns from Different Nitrogen Application Timing in Illinois</i>	2019	farmdoc daily	https://ageconsearch.umn.edu/record/302040/files/fdd121119.pdf
AR Mittelstet, TE Gilmore, T Messer, DR Rudnick...	<i>Evaluation of selected watershed characteristics to identify best management practices to reduce Nebraskan nitrate ...</i>	2019	Agriculture, Ecosystems ...	https://www.sciencedirect.com/science/article/pii/S0167880919300507

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Authors	Title	Year	Source	Quick Link
KE Schilling, MT Streeter, A Seeman, CS Jones...	<i>Total phosphorus export from Iowa agricultural watersheds: Quantifying the scope and scale of a regional condition</i>	2020	Journal of ...	https://www.sciencedirect.com/science/article/pii/S0022169419311321
JT Piske, EW Peterson	<i>The role of corn and soybean cultivation on nitrate export from Midwestern US agricultural watersheds</i>	2020	Environmental Earth Sciences	https://link.springer.com/content/pdf/10.1007/s12665-020-08964-x.pdf
LS Prokopy, BM Gramig, A Bower, SP Church...	<i>The urgency of transforming the Midwestern US landscape into more than corn and soybean</i>	2020	Agriculture and Human ...	https://link.springer.com/content/pdf/10.1007/s10460-020-10077-x.pdf
S Pericherla, MK Karnena, S Vara	<i>A review on impacts of agricultural runoff on freshwater resources</i>	2020	Int. J. Em. Tech	https://www.researchgate.net/profile/Manoj_Kumar_Karnena/publication/341151832_A_Review_on_Impacts_of_Agricultural_Runoff_on_Freshwater_Resources/links/5eb138aaa6fdec7050a9981f/A-Review-on-Impacts-of-Agricultural-Runoff-on-Freshwater-Resources.pdf
ML Reba, N Aryal, TG Teague...	<i>Initial findings from agricultural water quality monitoring at the edge-of-field in Arkansas</i>	2020	Journal of Soil and Water ...	https://www.jswconline.org/content/75/3/291.abstract
GV Tagne, C Dowling	<i>Land-use controls on nutrient loads in aquifers draining agricultural and ...</i>	2020	Environmental monitoring and assessment	https://link.springer.com/article/10.1007/s10661-020-8126-4

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Louisiana Nutrient Reduction and Management Strategy Implementation

Authors	Title	Year	Source	Quick Link
K Gesch, A Kiel, T Sutphin, R Wolf	<i>Integrating farmer input and Agricultural Conservation Planning Framework results to develop...</i>	2020	Journal of Soil and Water ...	https://www.jswnonline.org/content/75/4/101A.abstract
DD Etlar	<i>The Iowa Initiative, Matching Wetlands to Drainage Improvements– Dealing with the Regulations</i>	2020	2020 ASABE Annual International Virtual Meeting	https://elibrary.asabe.org/abstract.asp?aid=51414
JD Perez- Gutierrez	<i>Water quality monitoring and modeling studies of on-farm water storage systems in a Mississippi Delta agricultural watershed</i>	2020		https://ir.library.msstate.edu/handle/11668/20128
AP Sanchez Bustamante Bailon	<i>Dissolved phosphorus removal in denitrifying bioreactors: field and laboratory studies</i>	2020		https://www.ideals.illinois.edu/handle/2142/108627
K Chen	<i>Evaluating Remote Sensing Techniques to Rapidly Estimate Winter Cover Crop Adoption in the Big Pine Watershed, Indiana</i>	2020		http://pstorage-purdue-258596361474.s3.amazonaws.com/24123767/ChenThesis.pdf

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Authors	Title	Year	Source	Quick Link
MT Moore, MA Locke	<i>Experimental evidence for using vegetated ditches for mitigation of complex contaminant mixtures in agricultural runoff</i>	2020	Water, Air, & Soil Pollution	https://link.springer.com/article/10.1007/s11270-020-04489-y
R Malone, J Garbrecht, P Busted, J Hatfield, D Today...	<i>Drainage N Loads Under Climate Change with Winter Rye Cover Crop in a Northern Mississippi River Basin Corn-Soybean Rotation</i>	2020	Sustainability	https://www.mdpi.com/2071-1050/12/18/7630
TA Groh, TM Isenhardt, RC Schultz	<i>Long-term nitrate removal in three riparian buffers: 21 years of data from the Bear Creek watershed in central Iowa, USA</i>	2020	Science of the Total Environment	https://www.sciencedirect.com/science/article/pii/S0048969720336354
GL Wilson, DJ Mulla, J Galzki, A Laacouri, J Vetsch...	<i>Effects of fertilizer timing and variable rate N on nitrate-N losses from a tile drained corn-soybean rotation simulated using DRAINMOD-NII</i>	2020	Precision ...	https://link.springer.com/article/10.1007/s11119-019-09668-4
R McDaniel, L Ahiablame, U Thapoa, C Partheeban...	<i>Evaluation of Woodchip Bioreactors and Nutrient Reduction</i>	2020		https://openprairie.sdstate.edu/sdwri_data/1/

Authors	Title	Year	Source	Quick Link
ER Waring, A Lagzdins, C Pederson, MJ Helmert	<i>Influence of no-till and a winter rye cover crop on nitrate losses from tile-drained row- crop agriculture in Iowa</i>	2020		https://access.onlinelibrary.wiley.com/doi/abs/10.1002/jeq2.20056
MR Arenberg, X Liang, Y Arai	<i>Immobilization of agricultural phosphorus in temperate ...</i>	2020	Biogeochemis try	https://link.springer.com/article/10.1007/s10533-020-00696-1
L Nowatzke, J Benning	<i>Measuring Conservation and Nutrient Reduction in Iowa Agriculture</i>	2020		https://lib.dr.iastate.edu/cropnews/2642/
S Upadhaya, JG Arbuckle, LA Schulte	<i>Developing farmer typologies to inform conservation outreach in agricultural landscapes</i>	2020	Land Use Policy	https://www.sciencedirect.com/science/article/pii/S0264837720324959
RL Kirmeyer III	<i>Characterization and Monitoring of On-Farm Water Storage Systems in Porter Bayou Watershed, Mississippi</i>	2020		https://ir.library.msstate.edu/handle/11668/19463
L Hayes	<i>Assessment and valuation of nitrogen mitigation ecosystem services in natural and restored wetlands ...</i>	2020		https://tamucc-ir.tdl.org/handle/1969.6/89230

Authors	Title	Year	Source	Quick Link
NM Schmadel, JW Harvey, RB Alexander...	<i>Low threshold for nitrogen concentration saturation in headwaters increases regional and coastal delivery</i>	2020	Environmental ...	https://iopscience.iop.org/article/10.1088/1748-9326/ab751b/meta
K Greer, C Martins, M White, CM Pittelkow	<i>Assessment of high-input soybean management in the US Midwest: Balancing crop production ...</i>	2020	Agriculture, Ecosystems & ...	https://www.sciencedirect.com/science/article/pii/S0167880919304281
Y Kuwayama, SM Olmstead, DC Wietelman...	<i>Trends in nutrient-related pollution as a source of potential water quality damages: A case study of Texas, USA</i>	2020	Science of The Total ...	https://www.sciencedirect.com/science/article/pii/S0048969720314753
M Daniels, P Webb, L Riley, A Sharpley, M Fryer...	<i>Runoff Water Quality from Corn Production: A Summary of Results from the Arkansas Discovery Program</i>		Arkansas	https://core.ac.uk/download/pdf/344937843.pdf#page=96
M Daniels, A Sharpley, B Robertson...	<i>Seasonal Nutrient Losses in Runoff from Cotton</i>		... of Arkansas Cotton ...	https://scholarworks.uark.edu/cgi/viewcontent.cgi?article=1155&context=aaesser#page=99
Mengistu, S., Golden, H., Lane, C. ... ¹	<i>Wetland Flowpaths Mediate Nitrogen and Phosphorus Concentrations across the Upper...</i>		J. of the American Water Resources Assc.	https://onlinelibrary.wiley.com/doi/abs/10.1111/1752-1688.12885

¹ Citation not found in search criteria, but known to be relevant

APPENDIX E-3: Policy related literature 2019-2020. Selected list from search using ‘hypoxia’ and the phrase ‘Gulf of Mexico’ in Harzing’s Publish or Perish© Application on March 11, 2021.

Authors	Title	Year	Source	Quick Link
S Secchi, M Mcdonald	<i>The state of water quality strategies in the Mississippi River Basin: Is cooperative federalism working?</i>	2019	Science of the Total Environment	https://www.sciencedirect.com/science/article/pii/S0048969719319266
KA Whitaker	<i>What Is a State to Do: When Pollution Law and Policy Solutions Seem Dead in the Water</i>	2019	Loy. Mar. LJ	https://heinonline.org/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/loymarlj18&section=10
ANEWKOF WILD	<i>Thinking About the Future of Restoration in the Gulf of Mexico</i>	2019		http://chesapeakebayssc.org/wp-content/uploads/2019/02/B_Kraft_Marsh_conf_Feb_6_final.pdf
K Konyar, G Frisvold	<i>Climate Policies as Water Policies</i>	2019	Applied Methods for Agriculture and Natural ...	https://link.springer.com/chapter/10.1007/978-3-030-13487-7_11

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Authors	Title	Year	Source	Quick Link
WF Ritter, S Rao Chitikela	<i>The Mississippi River Basin Nitrogen Problem: Past History and Future Challenges to Solve It</i>	2020	Watershed Management 2020	https://ascelibrary.org/doi/abs/10.1061/9780784483060.010
FY Cheng, KJ Van Meter, DK Byrnes, NB Basu	<i>Maximizing US nitrate removal through wetland protection and restoration</i>	2020	Nature	https://www.nature.com/articles/s41586-020-03042-5
KR Salk, RCH Denny, J Greif	<i>The role of policy in social–ecological interactions of nitrogen management in the Mississippi River basin</i>	2020		https://access.onlinelibrary.wiley.com/doi/abs/10.1002/jeq2.20042
Boehm, R. ¹	<i>Reviving the Dead Zone: Solutions to Benefit both Gulf Coast Fishers and Midwest Farmers</i>	2020	Union of Concerned Scientists	https://www.ucsusa.org/resources/reviving-dead-zone

¹ Citation not found in search criteria, but known to be relevant