2021 Annual Report

Louisiana Nutrient Reduction and Management Strategy Implementation

Baton Rouge, Louisiana

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With collaboration:
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

2021 Nutrient Reduction and Management Strategy Annual Report

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 (as amended).

Louisiana continues to support the HTF and its goals. Collective efforts in the Mississippi River Basin will ultimately be responsible for achieving the 5,000 square kilometers hypoxia zone target by 2035, and the 25% nutrient reduction targets by 2025, as studies show the majority of nutrient inputs occur upstream.

The HTF and member states meet bimonthly to discuss progress and opportunities. In 2021, significant funding was made available to Louisiana from the USEPA ($100K), and through the Bipartisan Infrastructure Law ($5 M over 5 years via the USEPA).

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.

2021 HIGHLIGHTS

18 NEW TOOLS were released or updated to assist a wide audience concerning nutrient related topics

The Draft Environmental Impact Statement for the Mid-Barataria Sediment Diversion project was released

The Louisiana Trustee Implementation Group developed a Monitoring and Adaptive Management Strategy

2020 Integrated Report is now available with interactive viewing

HTF states submitted letters to USDA and USEPA leadership under the Biden Administration to support the Task Force

Congress approved the Bipartisan Infrastructure Law in 2021- billions in funds to water infrastructure and improvements

LSU researchers continue to partner with farmers and state/federal agencies to study (and publish results) on farming practices that benefit water quality

SWCDs, LDAF and NRCS partnered for stakeholder outreach and input in statewide SWCDs, and implemented Farm Bill Conservation Programs on approximately 400,000 acres of farmland

LDEQ Trends study indicates nutrient concentrations primarily decreasing

Louisiana Watershed Initiative River and Rain Gauge Network is underway; 44 new stations established

Natural channel design\nature-based solutions are being promoted for flood control and water quality

LDEQ Environmental Leadership Program welcomed 13 new members for FY21

LDAF and LDEQ's combined CWA Section 319 efforts have decreased N, P and Sediment loads by ~**15,000**, **3,100**, and **1,000,000** pounds, respectively, in 2021 according to models

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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
MRB	Mississippi 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
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 Strategic Actions Schedule is found in Appendix A.

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 2021, the Executive Assistant in GOCA and staff partnered with the Interagency Strategy Team to coordinate implementation of the NRMS and develop a winter 2021 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. Quarterly 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 2021 to support HTF actions to reach nutrient reduction and management goals.

  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 were already long-standing* within the Task Force. Each group's priorities and progress through 2021 are as follows:

HTF Work Groups continue progress and reporting; highlights were provided in Winter 2021 HTF meeting

- **Research Needs:** Identify key research needs that effectively support state implementation of nutrient reduction strategies. This group identified 14 needs or data gaps and conducted a survey among HTF members to identify the top 7 research needs, which were transmitted by letter to the HTF; a literature review for these priorities was undertaken to provide information to the states which will be provided via excel spreadsheet and access to research papers. Work is ongoing.
- **Water Quality Trends*:** Evaluate new metrics to complement current metrics for evaluating water quality trends in the basin. The workgroup collaborated with National Great Rivers Research and Education Center (NGRREC) to finalize the approach and site criteria to be used for the project, compiled and harmonized data, and identified a subset of the data to display trend results on the GRREC visual dashboard. Work is ongoing for displaying trend results, success stories, public discrimination, and recommendations to improve data accessibility and consistency.
- **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 help states evaluate progress toward meeting nutrient reduction goals and to support adaptive management of nutrient reduction strategies. This group finalized inventory of existing monitoring stations within each state and identified high priority new sites, identified baseline set of monitoring approaches, estimated funding, and communicated findings by letter to the HTF. This group will reengage as needed and will continue to support future efforts concerning the WQX Data Portal.
- **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. In 2021, funding priorities were identified by each state and results will be reported out to HTF members, information concerning how to use Clean Water State Revolving Funds was distributed to states via a webinar, and existing and new funding sources were discussed in how to maximize utility. Work is ongoing.
- **Ecosystems/Social Metrics:** Identify potential metrics that will help illuminate ecosystem changes/success due to implementation of nutrient reduction strategies in the MARB. In 2021, this group was divided into two targeted groups: Social Indicators (SI) and Conversation Tracking Tools Assessment (CT). The SI subgroup provided $25,000 to University of Wisconsin to support the HTF in gaining insight into collective social indicator action through 2023, and CT group conducted an assessment of conservation tracking tools in the MARB using the Compendium of Tools to Track Conservation in an effort to recommend tools to provide values for ecosystem services. Work is ongoing to engage with partners in this effort.
- **Adoption of Innovative BMPs:** Explore opportunities for states to use federal funds to implement innovative BMPs. This group gathered and defined the NRCS process for adopting CPs into interim state standards and will conduct a survey regarding innovative practices moving forward.
- **Communications:** Explore opportunities to enhance public awareness of HTF accomplishments and promote and support actions that reduce nutrient inputs and improve water quality. This group developed an HTF event calendar to allow for coordinated planning of press releases for collaborative events and general awareness for HTF members. The calendar is updated throughout the year and website analytics

are tracked concerning HTF and related websites. Moving forward, communication group will focus of notable events (e.g., HTF meetings and NOAA hypoxia area press releases).

- **Environmental Mitigation for Restoration Projects**: Further develop examples in individual states where mitigation challenges are causing impacts to projects. This workgroup conducted discussions concerning flexibility in regulations and environmental improvements and engagement with federal agencies to ensure projects move forward when improvements are involved.
- **Nonpoint Source Metrics*:** Focus on strategies, challenges and opportunities for documenting and analyzing data related to nonpoint source nutrient reductions; produce periodic progress reports. EPA drafting next Point Source Progress Report and is coordinating with WG members for initial data review and feedback.
- **Point Source Metrics*:** Focus on tracking progress in reducing nutrient loads from point sources in the Mississippi River Basin; produce periodic progress reports. This group is continuing analyses and reporting on metrics, including regional or smaller-scale applications where available. They're also exploring, through deep-dive analyses and discussion, improvement to the larger framework that supports HTF states reporting on nonpoint source progress.

Progress on each work group was reported to the task force committee members during the (virtual) Winter HTF Meeting in December 2021. More information on the 2021 winter meeting and materials may be found here: https://water-meetings.tetratech.com/StaticPublic/materialstf.htm.

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 2022.

- LDEQ NPS Section continues to coordinate with the Vermilion, Lafayette, St. Martin and LaSalle SWCDs, 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 2021, 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 Team attends or hosts over 240 professional and public nutrient related activities in 2021

Strategy Interagency Team members did continue to communicate with their stakeholders concerning nutrient reduction and management activities within their respective areas during 2021; nearly 240 outreach activities were performed across various sectors such as media, school visits/education events, and meetings (Table 1). This year, LDEQ has included the US EPA and associated environmental programs/groups in the tally and CPRA meetings include outreach to advisory committees, regional working groups, and the public. Not all event could be documented, particularly public tours, so this count is an underestimate. Many events remained virtual in 2021 as the pandemic continued. Details on the events attended may be found in Appendix B.

Table 1. Outreach Activities performed by Strategy Team Members in 2021 (some values estimated from descriptors).

Outreach/Stakeholder Event Description										
Organization	Meeting	Presentation	Public Event	Workshop/ Training	School	Tour	Symposium	Press	Field Day	TOTAL
CPRA	31	5								36
LSU Ag				7					13	20
LDEQ TMDL	6		1							7
LDEQ NPS/Standards	155	1	2	13	1		2			174
LDEQ Permits	1		1							2
									TOTAL	239

LDEQ videos to educate the public that are posted on LDEQ's YouTube Channel:

- EnviroSchool- LDEQ's New Vision 2021: An Evolving Approach to the TMDL Program; October 14, 2021
- EnviroSchool- Understanding Industrial Water Permitting; July 15, 2021
- EnviroSchool- An Overview of Water Quality Standards: September 22, 2021

The New Vision and Onsite Sewage videos may also be found on the TMDL webpage: https://deq.louisiana.gov/page/newvisionprogram.

The Louisiana Watershed Initiative hosted several training webinars on 'Working with Nature' to promote nature-based solutions for flood control, which is linked to improved water quality.

The USDA NRCS outreach includes:

- Webinars on how to apply for an Agriculture Innovation Center Grant: Aug 25th and 26th, 2021
- Monthly ongoing webinar series on Conservation Outcomes every fourth Thursday at 2:00 central time via Adobe Connect at: https://nrcs.adobeconnect.com/ceap2/
- YouTube video entitled Introduction Wetland Reserve Easement (WRE) Management Video Series Nov 2021
- Conservation at Work video series on YouTube and featured on farmers.gov highlights 30 conservation practices

- GovDelivery provides emails and text messages to producers, owners and others interested in NRCS program information while on the go

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 though the webpage.

- Indigenous Perspectives on Water and Conservation webinar was recorded on Feb 17, 2021
- From Research to Innovation to Implementation Examples of Conservation Finance in Action webinar was recorded on May 12, 2021
- Using Social Norms to Promote Conservation Adoption webinar was recorded on June 9, 2021
- Getting the Green Light for Green Infrastructure webinar was recorded on Sept 16, 2021
- Carbon Markets and Carbon Credit Agreements webinar was recorded on Oct 13, 2021
- Building Human Capital in Conservation and Watershed Work webinar was recorded on Nov 11, 2021

USEPA outreach includes:

- Updates to EPA's Storm Water Management Model (SWMM)
- USEPA endorsed Web Standard: Story Maps in 2020, which are map-centric data presentation tools that include ESRI and ArcGIS StoryMaps, and provided training using Proctor Creek in 2021

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 ongoing outreach components. The HTF webpage continues to offer reports and other published documents as well (HTF 2022). More information on HTF related activities is found in Sections 1a, 1c, and 5.

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 2021, 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 2021 included:

- A Memorandum of Understanding (MOA) between Minnesota and the Barataria-Terrebonne National Estuary Program (BTNEP) and has continued through 2021. 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 2019). The Minnesota Department of Agriculture reports biennially on their BMP Loan Program, with the next report due in fall 2021.
  - Over $12.5 million in loans were allocated in 2021 by the Minnesota Dept. of Ag. as part of the MOA under the BTNEP 320 CCMP, most allocated through the loan to Concentrated Animal Feeding Operations (CAFOs) and repayment process (~13 million per year).
  - 107 CAFOs practices have been completed, totaling $8 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

USEPA HTF funds in 2020-2021 support nutrient reduction efforts and monitoring in LA waters

- 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 state. Up to 15 of the gauges may include equipment to monitor selected water quality parameters. Forty-four gages are now operational in 2021 (LWI 2022). 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, Forestry, Conservation & Waste 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 formed a Beginning Farmer Program, awarded a $491,212 multi-year grant to Louisiana Central in 2021.
- LDEQ solicits public input for major plans, to promulgated rules, and during some aspects of the permitting process. Public participation will occur with revisions to Water Quality Management Plan, Volume 3 during 2022.
- Chevron awarded Ducks Unlimited $500,000 for Gulf Coast Projects, including funding for the Cameron Prairie National Wildlife Refuge Moist Soil Enhancement Project to help manage 1,200 acres of wetlands in Cameron Parish, while the Port Fourchon Terracing and Living Shoreline Project will restore and protect 650 acres in Lafourche Parish.

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

18
New &/or updated tools concerning nutrient related topics added to website

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 2021 include:

- LDEQ Integrated Report Interactive Assessment Map (updated 2021)
- USGS SPARROW model updates: study results and the accompanying online mapping tools enable water-quality mangers to identify the locations of the largest sources of nutrients throughout the Mississippi/Atchafalaya River Basin, which will aid actions to reduce nutrient loading that contributes to hypoxia in the Gulf of Mexico (USGS 2019, 2020)

- USDA Agriculture Innovation Strategy Dashboard (2021) for solutions and barriers to agriculture innovation
- An educational website, river-runner by Sam Learner, was developed to help visualize how a drop of rainwater travels through American waterways utilizing USGS's NLDI API and NHDPlus data 2021
- American Farmland Trust provided a Guide to Outcome Estimation Tools in 2021, the guide features 14 tools and two methods that provide quantitative estimates of outcomes associated with farm conservation practices and is available in print
- USEPA updated the Climate Change Indicators in the United States website (2021), which includes resources, reports, and story maps; Twelve new indicators and several years of data have been added to EPA's indicator suite
- USEPA updated the Storm Water Management Model (SWMM) in 2021
- USEPA updated the Recovery Potential Screening (RPS) to be state specific (2021) and provided training
- COMET-Planner Tool (2021) can evaluate potential carbon sequestration and greenhouse gas reductions from adopting USDA NRCS conservation practices
- R Tools for data mining: dataRetrieval package (updated 2022)
    - This package was created to simplify the process of loading hydrologic data into the R environment and is designed to retrieve the major data types of U.S. Geological Survey (USGS) hydrologic data that are available on the Web, as well as data from the Water Quality Portal (WQP), which currently houses water quality data from the Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), and USGS— Direct USGS data is obtained from a service called the National Water Information System (NWIS)
- USDA's Natural Resources Conservation Service (NRCS) provides extensive data on the Nation's conservation program activities through its RCA Data Viewer (2021) and data visualizations have been added to the tool, making the data easier to interpret, sort, and download for the previous conservation year.
- USGS National Water Dashboard (2021) is now operational for real-time water data across the country & The National Water Information System (NWIS) was updated and modernized
- The USDA NRCS National Water and Climate Center has been updated and the website address has changed (2021)
- American Farmland Trust Soil Health Tool Kit was updated in July 2021
- Illinois Drainage Research and Outreach Program (I-DROP) Conservation Practices Tracking is an interactive mapping (and tabular) tool that summarizes USDA NRCS activities within the HTF states, as compiled by R. Christianson (2021)
- USGS StreamStats, and GIS interactive tool, was released in 2021. Louisiana is visible on the application, but is still undergoing updates; application can be used to delineate watershed and subwatersheds, used the USDA/SCS digital soil mapper, mapping and quantification of land use; compute monthly precipitation and evapotranspiration data suing local climate data, and synthesize data using pollutant loading and trophic state models
- The report Enduring Arches: Building Conservation Finance Projects for Impact (2021) concerning conservation finance was released by Gordian Knot Strategies in collaboration

with The Conservation Finance Network to identify strategies and considerations needed to improve conservation outcomes
- USEPA updated the Storm Water Management Model (SWMM) in 2021, and provided training for its use: https://www.youtube.com/watch?v=U8jv2pauo5Q
- USEPA published the *CWSRF Best Practices Guide for Financing Nonpoint Source Solutions* in Dec 2021

LDEQ continues to implement the Point Source Reduction Strategy by including TN and TP report requirements in permits, as appropriate. Water Permits also implements TMDLs with TN and TP waste load allocations.

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 2022). 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 or 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. Projects that will increase the amount of impervious surface (i.e., concrete, asphalt, foundations, roofing etc.) installed on the property thus reducing the permeability of the property. Also, 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.

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 (2022): **https://www.deq.louisiana.gov/page/nutrient-management-strategy.**

Ongoing regulations, policies, and programs of note in 2021 include:

- The Infrastructure Investment and Jobs Act (H.R.3684), also known as the Bipartisan Infrastructure Law (BIL), was passed in Nov 2021 and will provide more than $1 trillion in public investment, of which water-related services will receive significant allocated funds.
  - $60 million was made available for actions under the Hypoxia Action Plan. These funds will be made available to the twelve states of the HTF (Arkansas, Iowa, Illinois, Indiana, Kentucky, Louisiana, Minnesota, Missouri, Mississippi, Ohio, Tennessee, and Wisconsin) in support of their nutrient reduction strategies, and will be distributed in equal amounts of $1 million per year, from 2022 to 2026.
  - The Gulf of Mexico and Lake Pontchartrain will receive $53 million each.
  - $132 million was allocated for the National Estuary Program grants under section 320(g)(2) of the CWA and for ecosystem services.
  - US Fish and Wildlife Service and the National Marine Fisheries Service may receive money from the above funds to continue to uphold the Endangered Species Act of 1973.
  - Several billion dollars have been allocated to address flooding and coastal erosion under the climate actions category.
  - Drinking water, plastics and trash, recycling, human health protection, carbon capture, environmental justice, and reduction of hazardous contaminants, all relating to water, are also addressed in this bill.
- Freshwater numeric criteria for ammonia (which is treated as a toxin) was promulgated in the state surface water quality standards (LAC 33:IX.1113) through WQ097 rulemaking in November 2020 and approved by EPA in January 2021.
  - LDEQ Permits has established a preliminary chronic and acute criteria calculation method, utilizing ambient Temperature and pH data. The calculated criteria are input into the established water quality screening tool to determine the need for Water Quality Based Effluent Limitations (WQBELs):
    - Revisions to Volume 3 of the WQMP, *Permitting Guidance Document for Implementing Louisiana Surface Water Quality Standards*, are in progress to describe the criteria calculation method and other considerations, such as effluent-domination and compliance schedules.
    - The preliminary criteria calculation method and proposed revisions to the WQMP are subject to change, pending EPA approval and public participation requirements.
  - Prior to the promulgation of freshwater numeric criteria for ammonia, revisions to Volume 3 of the WQMP have been drafted to include 1) updated stream flow calculation methodology; 2) guidance for permitting discharges into impaired waters or waters subject to a TMDL; and 3) revisions to the wetland assimilation

permitting requirements which will help ensure the longevity and appropriate management of the wetland assimilation systems.
    - Public notice and further updates will occur in 2022

- A new National Estuarine Research Reserve (2021) will be established in Louisiana to join the other 29 existing reserves across the country. NOAA provides funding and guidance to each estuary; the search for location and partners has begun via Louisiana Sea Grant.
- USEPA released a memo on 9/27/21 to §319 Grant recipients that encourages state actions to advance delivery of NPS benefits to disadvantaged communities and commits EPA to take a number of actions in support of this goal in FY 22.
- LDEQ initiated next cycle of Triennial Review with public notice in 2021.
- WQ097 Water Quality Standards Revision was promulgated in late 2020 and approved by USEPA in 2021.
- In April 2021, USDA & RESTORE Council announced $31 million in funding to advance restoration work and improve water quality in the Gulf Coast states impacted by the Deepwater Horizon oil spill. The funds will support three priority programs and related project work approved by the Gulf Coast Ecosystem Restoration (RESTORE) Council as part of a multi-year process of collaborative planning and public engagement throughout the Gulf.
- A 2021 USDA Conservation Innovation Grant (CIG) for urban gardens applying conservation practices was awarded to *Campti Field of Dreams, Inc*., a nonprofit organization that will create a model that can be scaled to support a diversified urban food system that has the potential to build soil health, increase climate resilience and improve the economic well-being of the producer.
- USDA investment in NRCS Equity Conservation Agreements for 2022 were released
    - The KKAC Organization – Equity in Conservation Programs for Socially Disadvantaged Producers through Outreach
    - Morehouse Parish Black Farmers & Landowner Assoc.-- Leveling the Playing Field: Conserving the Ark-LA-Miss Delta's Natural Resources
    - National Center for Appropriate Technology (NCAT) – Investing in Underserved Farmers to Regenerate Their Farms' Ecologies
    - Federation of Southern Cooperatives/Land Assistance Fund – Facilitating Racial Equity and Justice Conservation for Historically Underserved Southern Ranchers and Forest Landowners
    - Uncle Jerry's Farms, Inc. – Outreach to historically underserved farmers and ranchers to provide access to information via drone technology to increase economic yield, adapt to changing weather patterns, and enroll additional participation in NRCS programs.
    - Winston County Self Help Cooperative – Stronger Together: Assisting Historically Undeserved Farmers & Ranchers Implement Natural Resources Conservation Practices Across the Rural Southern Black Belt
- USDA Expands and Renews Conservation Reserve Program in effort to boost enrollment and address climate change: USDA's goal is to enroll up to 4 million new acres in CRP by raising rental payment rates and expanding the number of incentivized environmental practices allowed under the program in 2021-2023.

- In 2021, CRP is capped at 25 million acres, and currently 20.8 million acres are enrolled. Furthermore, the cap will gradually increase to 27 million acres by 2023. To help increase producer interest and enrollment, FSA is:
  - Adjusting soil rental rates. This enables additional flexibility for rate adjustments, including a possible increase in rates where appropriate.
  - Increasing payments for Practice Incentives from 20% to 50%. This incentive for continuous CRP practices is based on the cost of establishment and is in addition to cost share payments.
  - Increasing payments for water quality practices; rates are increasing from 10% to 20% for certain water quality benefiting practices available through the CRP continuous signup, such as grassed waterways, riparian buffers, and filter strips.
  - Establishing a CRP Grassland minimum rental rate. This benefits more than 1,300 counties with rates currently below the minimum.

❖ 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.

- 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. 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 2022, 2022a). 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.
- 44 new stream gages have been installed across the state (as of 3/1/2022)

❖ 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.
- One new and six renewed Master Farmer certifications will occur in April 2022.

- USDA NRCS projects and policies in 2021 include:
  - NB 300-19-34 LTP – Mississippi River Basin Healthy Watersheds Initiative ended in 2021; the final report is in prep.
  - HUC 12 Names of the FY 2020 Implementation Watersheds are Bayou Blanc, Bayou Plaquemine Brule and Bayou Plaquemine Brule-Estherwood, and these watersheds remain active through 2022
    - https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/initiatives/?cid=nrcseprd1431052
- 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 hosted an inaugural Lower Mississippi River Science Symposium March 10, 2021. The forum connects academic, government, and NGO scientists and managers to share research, ideas, and needs. The meeting included presentations and discussion on optimizing the data collection network, strategizing the next generation of models, and outlining key applications for management decisions. http://ssearchive.tulane.edu/LMSRSS-2021/home/.

Lower Mississippi River Science Symposium established in 2021 by Tulane University's *new* River-Coastal Science and Engineering Department

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 2022b); 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 issued a report on nonpoint source collaborative efforts in 2018, with an update ongoing (HTF 2018), while the USEPA has released a new document entitled Progress Report: Urban Water Program in January 2021 (USEPA 2021a).

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. 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.

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. To conclude the grant, approximately 130 participants attended three soil health meetings and events in 2021 in Newelton, New Roads, and Napoleonville, LA. 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 on-going 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 LSU AgCenter and Louisiana Master Farmer Program were awarded another USDA NRCS grant through the National Wildlife Federation *"The Right Message, The Right Messenger: Growing Conservation Leaders in Louisiana"* for $19,500. This grant will focus on promoting conservation (including cover crops, residue management, nutrient management, etc.) to non or late-adopters of sustainable practices. It will include training teams of conservation leaders to reach out to producers and landowners through non-conventional methods and promoting sustainable agriculture. Activities will be recorded and updated on social media and websites.

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 includes a new nutrient component 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.

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

10 new papers from Louisiana researchers concerning nutrient management and/or agriculture in the state

- *Risk Aversion and Timber Harvest Strategies: A Case Study of Nonindustrial Private Forest Management in Louisiana*. H Wang, N Adusumilli, M Blazier, S Pathak. 2021.
- *Impact of the Federal Conservation Program Participation on Conservation Practice Adoption Intensity in Louisiana, USA*. S Pathak, K Paudel, N Adusumilli. Environmental Management. 2021
- *The Role of Farmer Heterogeneity in Nutrient Management: A Farm-Level Analysis*. H Wang, Adusumilli, Naveen, Shannon, Keith, Fromme, Daniel. Journal of Applied Farm Economics 4 (1), 1-9. 2021.
- *Economic and Stochastic Efficiency Analysis of Alternative Cover Crop Systems in Louisiana*. H Wang, N Adusumilli, D Gentry, L Fultz. Experimental Agriculture 56 (5), 651-661. 2020.
- *Compliance of Conservation Contracts in Louisiana*. Adusumilli, N. Staff report 2021-61.
- *Nitrification Inhibitors Reduce Nitrogen Losses and Improve Soil Health in a Subtropical Pastureland*. Y Meng, J Wang, Z Wei, S Dodla, L Fultz, L Gaston, R Xiao, J Park, and G Scaglia Geoderma 388: 15 April 2021, 114947.

- *Quantifying the Dynamics of Agricultural Conservation Practices in the Mississippi Delta Region*. S Pathak, H Wang, and N Adusumilli. Selected Paper prepared for presentation at the 2021 Agricultural & Applied Economics Association Annual Meeting, Austin, TX, August 2021.
- *Willingness of Non-Industrial Private Forest Landowners to Obtain A Private Versus Public Consultation*. E Largacha. LSU Master's Thesis, 2021.
- *Integrated Nutrient Management and Cover Cropping Practices in Louisiana Sugarcane Production Systems*. D Forestieri Doctoral Dissertation, 2021.
- *Assessing the Educational Needs of New and Beginning Urban Farmers in New Orleans, Louisiana*. Editor: Donald A. Llewellyn, Journal of the NACAA. 2021.

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.

Additionally, through the Ducks Unlimited Rice Stewardship Initiative, Chevron awarded the program $500,000 to support projects along the Gulf Coast of Louisiana. These funds will help manage 1,200 acres of wetlands in Cameron Parish through the Cameron Prairie National Wildlife Refuge Moist Soil Enhancement Project, while the Port Fourchon Terracing and Living Shoreline Project will restore and protect 650 acres in Lafourche Parish.

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 20 events in 2021 that included seven Phase I environmental/soil health trainings, 10 Phase II research station field days, and three cover crop/soil health/BMP field tours to increase voluntary participation in the program (Gentry, 2022). Recorded virtual field days are available on the LA Master Farmer Program website for those who could not participate in person.

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)

- *Progress Report on coordination for Nonpoint Source Measures in Hypoxia Task Force States* (2018), which 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 2022).

The HTF Water Quality Monitoring Workgroup was established to evaluate funding needs to support existing and potential new monitoring in the MARB, particularly to track loads and trends in large rivers to help states evaluate progress toward meeting nutrient reduction goals and to support adaptive management of nutrient reduction strategies. The monitoring workgroup consists of representatives with relevant expertise from HTF member states, the U.S. Environmental Protection Agency, the U.S. Geological Survey, and the U.S. Department of Agriculture. The workgroup evaluated funding needed to support a baseline nutrient monitoring network to quantify loads and trends from large rivers in HTF states. This evaluation was submitted to the full HTF for consideration of potential next steps.

The Illinois Drainage Research and Outreach Program (I-DROP) website provides information on Conservation Practice Tracking from HTF states as supplied by the USDA NRCS. Data were extended through a grant by the Walton Family Foundation to include information suggested by the HTF Nonpoint Measures Workgroup in their May 2018 report (Christianson, 2019).

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 mappers have been released and are fully functional with new mappers and reports available.

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 2021 water sampling year (October 2020 through September 2021), the LDEQ monitored 121 sites in 118 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 2022h). Information on nutrient impairments for the 2021 Integrated Report cycle can be found on LDEQ's Water Quality Integrated Report website and/or Mapper (LDEQ 2022a, 2022n).

2021 LDEQ *Trends Report* indicates significant decreases in two nutrient parameters (TKN and TP) for most of the sites examined

LDEQ has updated the *Nitrogen and Phosphorus Trends of Long-Term Ambient Water Quality Monitoring Sites in Louisiana* document, initially released in 2015 (LDEQ 2022q). In 2021, analyses were performed on long-term and seasonal trends and land-use correlations for concentrations of total Kjeldahl nitrogen (TKN), nitrate-nitrite nitrogen (NOx), and total phosphorous (TP) from Louisiana's 21 long-term Ambient Water Quality Monitoring sites from October 1, 1978 through September 30, 2020. The results found TKN was decreasing significantly overall at 95% of sites;

NOx was decreasing overall at 48% of sites and increasing at 5%; and TP was decreasing overall at 52% of sites and increasing at 10%; all other long-term trends were not significant. Land-use correlation analyses found higher TKN and TP concentrations were significantly correlated with increases in agricultural land use, while higher forest cover was significantly correlated with lower TKN and TP values, all other correlations were not significant. The full report can be found on the LDEQ Nutrient Reduction and Management Strategy webpage.

LDAF assists LDEQ with surface water monitoring in critical project watersheds as part of the EPA/Agricultural Nonpoint Source Abatement Program (LDAF 2022).

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). The workgroup recommended 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. The EPA provided a grant to the University of Wisconsin to support the HTF in gaining insight into collective social indicator action through 2023.

The workgroup also conducted an assessment of conservation tracking tools in the MRB, which was published: Compendium of Tools to Track Conservation. The workgroup narrowed in on OpTIS, Tillage and Erosion Survey Program, COMET-Farm and COMET-Planner, with the intention of determining the tools that the workgroup will recommend the HTF use to provide a value for ecosystem services of practices that also have a nutrient reduction benefit. A literature review was undertaken by CPRA to further assess the tools by identifying studies that used conservation tracking tools to characterize the impact of agricultural conservation practices on nitrogen and phosphorous reductions, and carbon sequestration. The OpTIS tool has the potential to be highly effective in addressing basin-scale questions given its large spatial scale and focus on carbon, nitrogen, and phosphorous.

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 2021 (Oct 2020 to Sep 2021), 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 21, USDA NRCS applied conservation practices to improve water quality on nearly 300,000 acres. An additional ~211,000 acres in FY21 received CPs from affiliated agencies including conservation districts, technical service providers, and partnerships with multiple state agencies.

511,000 acres received CP efforts in 2021 from USDA, LDAF, LDEQ and partners

In FY 21, LDAF provided technical assistance and BMP implementation on 18,335 acres in 8 priority watersheds within the Ouachita River, Mermentau River, and Vermilion-Teche Basins.

Nearly 15,000 pounds of nitrogen, 3,100 pounds of phosphorus, and 488 tons of sediment were prevented from entering Louisiana waterways (as estimated by STEP-L) at the watershed scale level due to LDAF and LDEQ collaborative efforts (Table 2).

Table 2. LDAF NPS total reductions by parameter and watershed based on STEP-L estimation (2021).

SUBSEGMENT	TOTAL STEPL ANNUAL REDUCTIONS		
	Nitrogen (lb/yr)	Phosphorus (lb/yr)	Sediment (t/yr)
Big Creek North	0.35	0.11	0.01
Upper Bayou Lafourche	146.51	45.92	8.96
Bayou Chene	0.00	0.00	0.00
Bayou des Cannes	6627.74	1408.79	228.72
Bayou Mallet	4927.72	1011.04	186.04
Bayou du Portage	773.11	95.31	5.21
Bayou Queue de Tortue	2389.72	592.60	59.42
TOTAL	**14865.14**	**3153.76**	**488.38**

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 2022c). At the end of Federal FY20 (from October 2020 to September 2021), there were 13,143 permitted dischargers in the LPDES Permit Program. Of these 13,143 permitted dischargers in FY20, 9,739 were general permit authorizations (non-stormwater), 2,084 were stormwater general permit authorizations, 1,196 were individual permits, and 4 were individual storm water (MS4) permits. The LPDES permits issued in 2021 can be found on the LDEQ Permit Program website (LDEQ 2022b).

5.f. Document/trends for riverine diversion efforts

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.

Mid-Barataria Sediment Diversion Draft Environmental Impact Statement was released in 2021

The Mid-Barataria Sediment Diversion and Mid-Breton Sediment Diversion planning processes are being further developed and refined. The Mid-Barataria and Mid-Breton Sediment Diversions are designed to reconnect the Mississippi River to wetlands and open water bodies by mimicking natural land building processes using an "engineering with nature" approach. The Delft3D water quality model, D-WAQ, is being used to simulate dissolved nutrient dynamics in the Barataria and Breton receiving basins. CPRA has conducted feasibility and engineering and design analyses that projected the Mid-Barataria Sediment Diversion would create and sustain 28 square miles of land. The Mid-Barataria Sediment Diversion Draft Environmental Impact Statement (DEIS) was released in March 2021, and public comments were received. The DEIS evaluates potential impacts of the project on numerous factors including water quality, socioeconomics, fisheries, and storm surge/flooding, and reasonable alternatives to those actions. The Corps is working toward a final Environmental Impact Statement in 2022. The Mid-Breton Sediment Diversion project is in the early stages of the federal permitting process.

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 FY 2021 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 (WQMP) "Volume 4 Basins and Subsegment Boundaries" (LDEQ 2021). This document describes the watershed basins and water quality assessment units, referred to as subsegments, which are part of the LDEQ water programs. Appendix A of Volume 4 lists the subsegment codes and descriptions by basin.

LDEQ identifies several features pertinent to watersheds, such as boundary delineations, land use, and elevations, through GIS-based products (e.g., the USGS National Hydrography and Watershed Datasets, the National Land Cover Database, statewide LiDAR, and NAIP imagery). Updates and new GIS technologies are implemented as they become available. As part of these efforts, LDEQ continues to utilize GIS to improve the accuracy of the subsegments and contribute to the state's National Hydrography Dataset (NHD). The NHD provides a national framework of flowlines 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 subsegments undergo periodic revisions utilizing available GIS layers, such as the latest topography, imagery, hydrography (i.e., NHD), and elevation (i.e., LiDAR) data.

LDEQ modified the WQMP Volume 4 in 2021 to include 142 subsegment updates proposed in the water quality Triennial Revision 2019 rule. 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 January 28, 2021 (LDEQ 2022p). 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. These updates are documented in Appendix A of the WQMP Volume 4 and the LDEQ Subsegment GIS layer (LDEQ 2021). The current triennial review cycle was initiated on March 20, 2021 with a public hearing on April 28, 2021. LDEQ is preparing the Report of Findings in 2022 to identify priorities for water quality standards revision efforts.

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 2021, 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. LDEQ is

working to integrate these coastal updates into the NHD Model in 2022. 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 been an essential mapping tool to display water quality data for the public. 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 2021. 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 2022o). The newest online web map is the 2020 Louisiana Water Quality Inventory: Integrated Report (Appendix A-Assessments; LDEQ 2022a)," 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. The web map will be updated with the 2022 Integrated Report results and will be released with additional features in the pop-up, such as a link to a subsegment's site data page. In the previous years, ArcGIS Online 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. The map continues to be used for ongoing site creation and replacement needs. 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, and such applications will be a useful resource for future emergency events.

> LDEQ continues to improve web-based mapping tools to share data with the public.

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.

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.

Implementation efforts have occurred in 100% of TMDL priority watersheds

In regard to the New Vision of the §303d Program, LDEQ identified priority watersheds for restoration and protection in Louisiana (below and Appendix C). 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%.

- The watersheds include:
  - Tunica Bayou- final report was approved by EPA on October 5, 2020.
  - Natalbany River- draft report is under development and citizen outreach is ongoing.
  - Yellow Water River- draft report under development and citizen outreach is ongoing
  - Bayou Sara- draft report is under development.
  - New River- monitoring initiated in July 2021.
  - Blind River- monitoring expected to begin in February 2022.

6.c. Identify unpermitted point sources

The LDEQ Compliance Monitoring Strategy (LDEQ 2022d) 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 2021 calendar year, the LDEQ Surveillance Division conducted 111 Watersheds Sweeps in five subsegments (Table 2).

Table 3. Louisiana Department of Environmental Quality (LDEQ) Surveillance Division Watershed Sweeps in 2021.

Subsegment No.	Water Body Segment Description	Inventory/ Inspections	Notice of Deficiency (NOD)
LA080904	Bayou Lafourche	35	33
LA060801	Vermillion River	51	1
LA040912	Bayou Lacombe	9	7*

*Some NODs were resolved

6.d. Identify priority watersheds from leveraging programs

There are several state and federal programs focused on watershed restoration and protection in Louisiana. These programs prioritized watersheds in Louisiana to target for restoration and protection activities, 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 (Table 3). The LDEQ

and LDAF NPS Programs prioritized watersheds for implementation activities through 2021, and proposed watersheds through 2023 (LDEQ 2018). In FY 2021, water quality monitoring continued in 17 watersheds (1 concluded in 2021) with BMP implementation on 18,334.89 acres in 8 watersheds. Three priority watersheds began baseline monitoring within this reporting period.

LDAF watersheds include: Bieler Bayou – Tensas Rover (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), with $1.5 million allocated for FY 2021.

The Mississippi River Basin Initiative projects wrapped up in 2020, with one year of post-implementation monitoring completed in October 2021. The final report is due in 2022.

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

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

To provide technical assistance and best management practices (BMPs) through cost-share and incentive payments LDAF expended approximately $868,900 on watershed implementation within multiple watersheds around the state. Implementation, Planning and/or Technical Assistance was conducted on approximately 18,334.89 acres of private farmland in an effort to restore or partially restore surface water quality in eight priority watersheds within the Ouachita River, Mermentau River, and Vermilion-Teche Basins. Table 4 illustrates LDAF Section 319 grant expenditures.

Table 5. Louisiana expenditures on BMPs through incentives for 2021.

Grant Year	LDAF (Federal)
2015	$ 242,658.23
2016	$ 250,461.01
2017	$ 7,507.50
2018	$ 288,268.01
2019	$ 79,093.17
TOTAL	**$867,987.92**

These BMPs were carried out through the traditional conservation partnership cooperation between the USDA-NRCS, the LDAF and participating Soil and Water Conservation District (SWCD). These local SWCDs included Acadia, Vermilion, Jefferson Davis, Morehouse, St. Landry, LaSalle, Evangeline, and Bouef River. Signed contracts establish the participant's BMP payment schedules and implementation requirements, defining the relationship between

themselves and the Federal-State-Local conservation delivery team. To attain Section 319 water quality crop rotation objectives, an array of proven conservation practices such as grade stabilization, conservation, prescribed grazing, heavy use area protection, critical area planting, irrigation land leveling, tillage and residue management and others were cost-shared through this program. Participants are required to implement a total RMS plan through which additional BMPs are prescribed. These additional BMPs further ensure reduction of water quality impairments and exceed the participants required matching funds. To ensure effective delivery of these necessary BMPs, LDEQ provides water quality data, watershed modeling, targeted sampling, mapping and other critical logistical assistance to ensure maximum effectiveness for our collective efforts in restoring water quality in agricultural settings.

LDAF provided technical assistance and BMP implementation on 18,334.89 acres in eight watersheds, see Table 5.

Table 6. LDAF technical assistance and BMP implementation areas for 2021.

Watershed	**Acres Implemented**	**Basin**
Bayou Queue De Tortue	1,470.5	Mermentau River
Bayou Des Cannes	2,175.5	Mermentau River
Bayou Chene	1,572.67	Mermentau River
Bayou Mallet	5,718	Mermentau River
Hemphill Creek	465	Ouachita River
Big Creek (North)	3,482	Ouachita River
Bayou Du Portage	151.6	Vermilion Teche
Bayou Lafourche	3,299.62	Ouachita River
TOTAL	**18,334.89**	

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).

- For 2021, The Lower Batture, led by the Mississippi River Trust, seeks to enroll 2,000 acres. A minimum of 250 acres (approximately 12.5%) will be specifically targeted for historically underserved landowner enrollment. This additional funding will expand the original project area along the lower Mississippi River to continue more sustainable land and water management in the river's active floodplain and nearby flood-prone lands in Arkansas, Louisiana and Mississippi.
- In addition, a tri-state partnership, led by the Nature Conservancy, enrolled an additional 1,500 acres of wetlands as part of a multi-year effort in the project area. A minimum of 750 acres (50%) will be specifically targeted for enrollment of historically underserved landowners. This project focuses on restoration of forested wetlands within priority portions of the Mississippi Alluvial Valley in Arkansas, Louisiana and Mississippi.
- Bayou du Chien: The Nature Conservancy-This project seeks to enroll 2500 acres over the next three years to improve wildlife habitat through the development of large, contiguous blocks of protected land to benefit priority species. It also aims to improve water quality in both local watersheds and the greater Mississippi River basin by directly reducing excess nutrients and sediments through floodplain reconnection and restoration. NRCS will invest $3.15 million for the first year.

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 2021.

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.

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

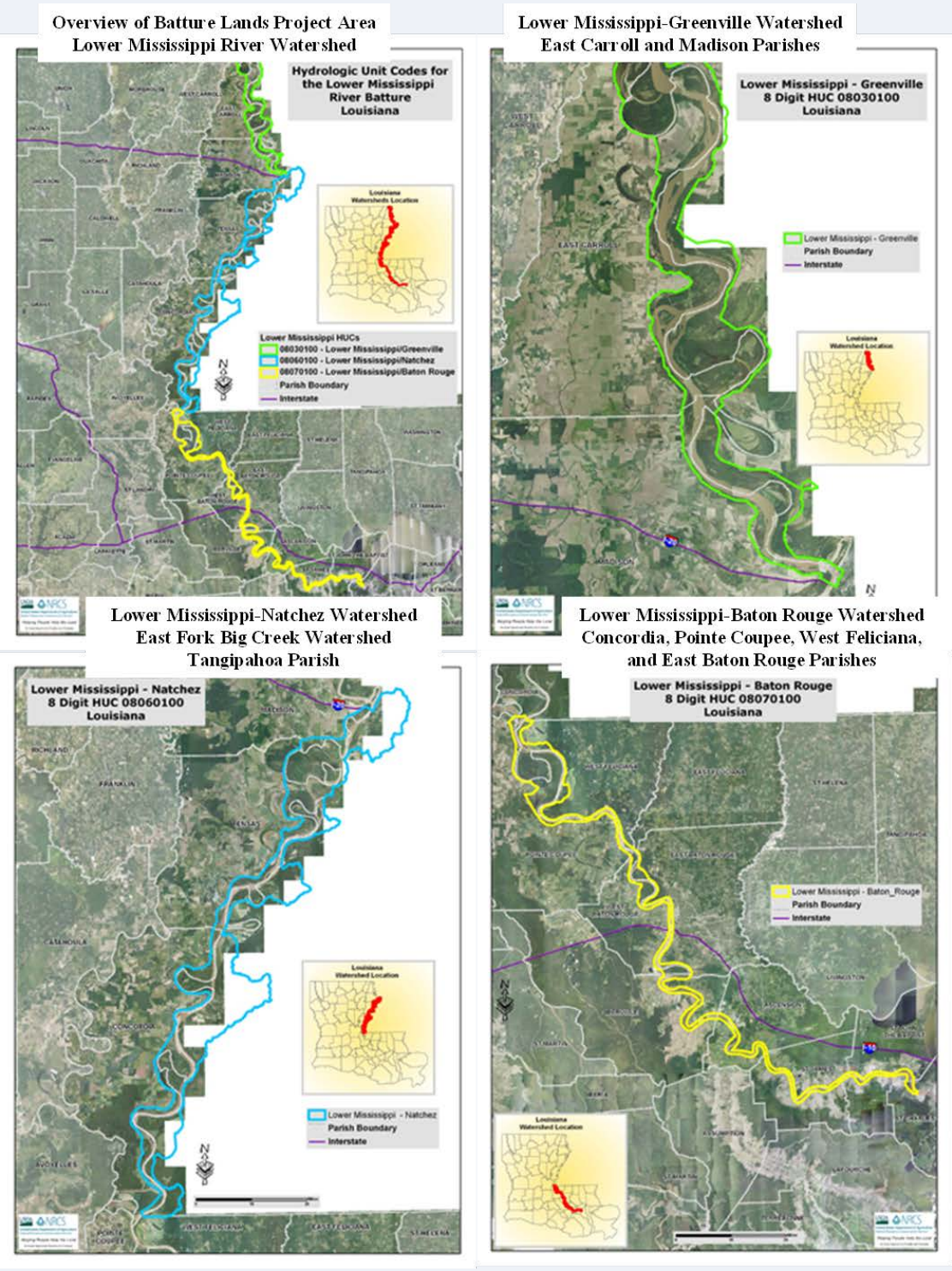

Figure 1. USDA Mississippi River Basin Initiative- Wetlands Reserve Enhancement Program Project Projects

100 % implementation for LDEQ New Vision projects in 2021

In regard to the New Vision of the §303d Program, LDEQ identified priority watersheds for restoration and protection in Louisiana (left and Appendix C). 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%.

- 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 17 watersheds prioritized in Louisiana for implementation of CPs, some of which overlap with those watersheds in the USDA initiatives. Priority watersheds for these leveraging programs are provided in Appendix C.

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 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). The Deepwater Horizon Oil Spill Final Programmatic Damage Assessment and Restoration Plan (PDARP) includes restoration goals and restoration types, including restoring water quality. The Louisiana Trustee Implementation Group (LA-TIG) undertook a process to clarify decision making processes to guide future spending of Management and Adaptive Management (MAM) funds, outlined in the LA-TIG Monitoring and Adaptive Management Strategy. Fundamental and SMART (specific, measurable, achievable, relevant, time-bound) objectives were developed to assess progress toward PDARP restoration goals, and the LA-TIG process for screening and approval of LA-TIG MAM activities is summarized. Priorities in the strategy for nutrient reduction focused on agriculture-related conservation measures. 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 (LSU AgCenter 2022).

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.

Participation in the Master Farmer program increased to 4,250 members in 2021

The Louisiana Master Farmer Program (LMFP) is an environmental stewardship educational program aimed at agricultural producers in the state. Since the end of 2021, participation in the Master Farmer program increased to 4,250. One producer received certification, with 6 receiving re-certification. There are currently 360 certified and re-certified Master Farmers in Louisiana representing 51 of the 64 parishes (79.7% of the parishes in the state; Gentry 2022).

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 2020/2021 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 2022f). Due to COVID-19 complications, no new ELP awards were presented in 2020 or 2021 (2019 saw 12 new ELP awards and recognized 17 new members (LDEQ 2020). However, thirteen new members were added in 2021. Some members: Ernest N. Morial New Orleans Convention Center, Caddo Lake Institute, Glass Half Full, Schmelly's, Woodlands Conservancy, Shreveport Green. LDEQ welcomes these new members.

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 2022a)

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, 2021 trainings and in-person assistance were scaled down or canceled. LDEQ Water permits staff assisted with the planning of the 2021 Region 6 Storm Water Conference, held in New Orleans August 8-12, 2021, including leading the Storm Water 101 sessions. This event was available both in person and virtually for attendees. In addition, Stormwater Pollution Prevention Plans (SWP3) guidance and documents are available on LDEQ's Storm Water Permit Resources website (LDEQ 2022j).

In 2021, 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 LDEQs CDX/NetDMR Training website (LDEQ 2022k).

The LDEQ Outreach and Small Business Assistance Program (OSBA) provides free and confidential technical assistance to small businesses in understanding and complying with water permits and environmental regulations. The Outreach and Small Business Assistance Program provided approximately 3,340 assistance requests including 1,146 compliance consultations, 66 newly permitted assistance, 304 permit applications, 1,690 water assists, and 134 referrals from internal LDEQ enforcement, permitting or surveillance. Information is found on the OSBS website (LDEQ 2022l.)

LDEQ *Outreach and Small Business Program* provided over 3,000 assistance requests in 2021

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.

Louisiana State University researchers investigated the economic feasibility of variable cover crop strategies and multiple seeding rates within a soybean production system in Louisiana (Wang, et al. 2020). Conservations motives differ, and are based on individual risk behavior. The study found that as the risk-bearing capacity of a landowner increases, the current level of voluntary incentive programs does not motivate the landowner to implement conservation. The economic and risk assessment framework developed improves understanding of the temporal dynamics of different practices, and can inform policy that promotes agricultural systems that are economically, environmentally, and socially sustainable.

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

Louisiana developed a Water Quality Trading Program in 2017-2019 (LDEQ 2022g), 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 2022e). Through the LDEQ AWQMN, the agency monitors in-stream water column water quality in water bodies across the state. During the 2020/2021 water sampling year (October 2020 through September

2021), LDEQ monitored 121 sites in 118 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 2022h). 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- 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 Natalbany River. Monitoring for New River began in July 2021. Monitoring for Blind River will commence in February 2022.

9.b. Monitor relative to BMP/CP implementation

In 2021, LDEQ in conjunction with LDAF and USDA NRCS, conducted water quality monitoring for nutrients and other parameters in 8 watersheds where BMPs were implemented (Appendix C and D). In addition to direct monitoring for BMPs, LDEQ also initiates monitoring to help target BMP locations within a watershed and to rank applications.

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., nutrient 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.

SWAMP water quality monitoring and nutrient sampling has been implemented coast-wide. The 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 (Hermmerling, et al. 2019). Water quality data are collected to understand system conditions and dynamics at the basin scale. Water quality data can be accessed at: https://cims.coastal.la.gov/monitoring-data/.

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 2022m) and is now available for all facility types through the USEPA Integrated Compliance Information System (ICIS) (USEPA 2022b). 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

Nutrient monitoring expanded to 92% for Individual Sanitary Treatment Plants; 100% anticipated in 2022

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 began reporting TN and TP on a quarterly basis, and the reporting requirement is now added to new and renewal permits. Other types of dischargers may undergo a nutrient review to determine if reporting requirements will be included in their new or renewal permit (LDEQ 2017). As of January 2021, nutrient monitoring requirements have been established in approximately 92% 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 2022. In addition, the following facilities are required to monitor for nutrients, based on TMDL requirements or reasonable potential to discharge TN and/or TP: 1,122 facilities covered under general sanitary permits, and 569 individual sanitary, MS4 and industrial permits. Reported numbers may be affected by new and terminated permits in the program. 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 2022i).

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 87,858 data records for TN or TP in DMRs available through ICIS from January 1, 2001 to December 31, 2021, compliance with point source permits in regard to completion of DMRs for TN or TP was about 93.1% whereas about 6.9% of DMR submissions resulted in data violations that may have been related to overdue reporting or non-receipt. Of the 5,428 records for TN or TP with limits, less than 0.6% 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 LDPES Permit Program: increasing the water quality variables, including nutrients, monitored relative to implementation of coastal restoration and protection projects by CPRA; and monitoring for nutrient water quality in NPS watershed CP implementation projects by the LDEQ, LDAF, and USDA NRCS.

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. In addition, Tulane is hosting Lower Mississippi River Science Symposiums (inaugural in 2021) to establish a recurring forum to connect academic, government and NGO scientists and managers in the region to share their research, ideas, and needs with a goal of building synergy.

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. LDEQ staff are providing expert advice regarding water quality issues to support the selection of the most effective projects chosen for the initial Community Development Block Grant project awards. 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.

CPRA's System-Wide Assessment and Monitoring Program (SWAMP) extended in-state monitoring (including nutrients) to include stations across the LA coast beginning in 2020; monitoring throughout the coast is ongoing (Hijuelos and Hemmerling, 2016; Hemmerling, et al. 2019). In addition, LDEQ and CPRA are collaborating, with funding from the USEPA/HTF, on a study designed to expand sampling from inshore to offshore Louisiana waters. The *Pilot Expansion of Water Quality Monitoring from Inshore to Offshore Project* will continue through 2022. Data is used to inform restoration models and for assessment.

USEPA/HTF funds are also supporting monitoring for LDEQs NPS Program. The *Nutrient Reduction Strategies Supporting Section 319 Clean Water Act (CWA) Louisiana Nonpoint Source (NPS) Water Quality Analysis 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).

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 2021 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.

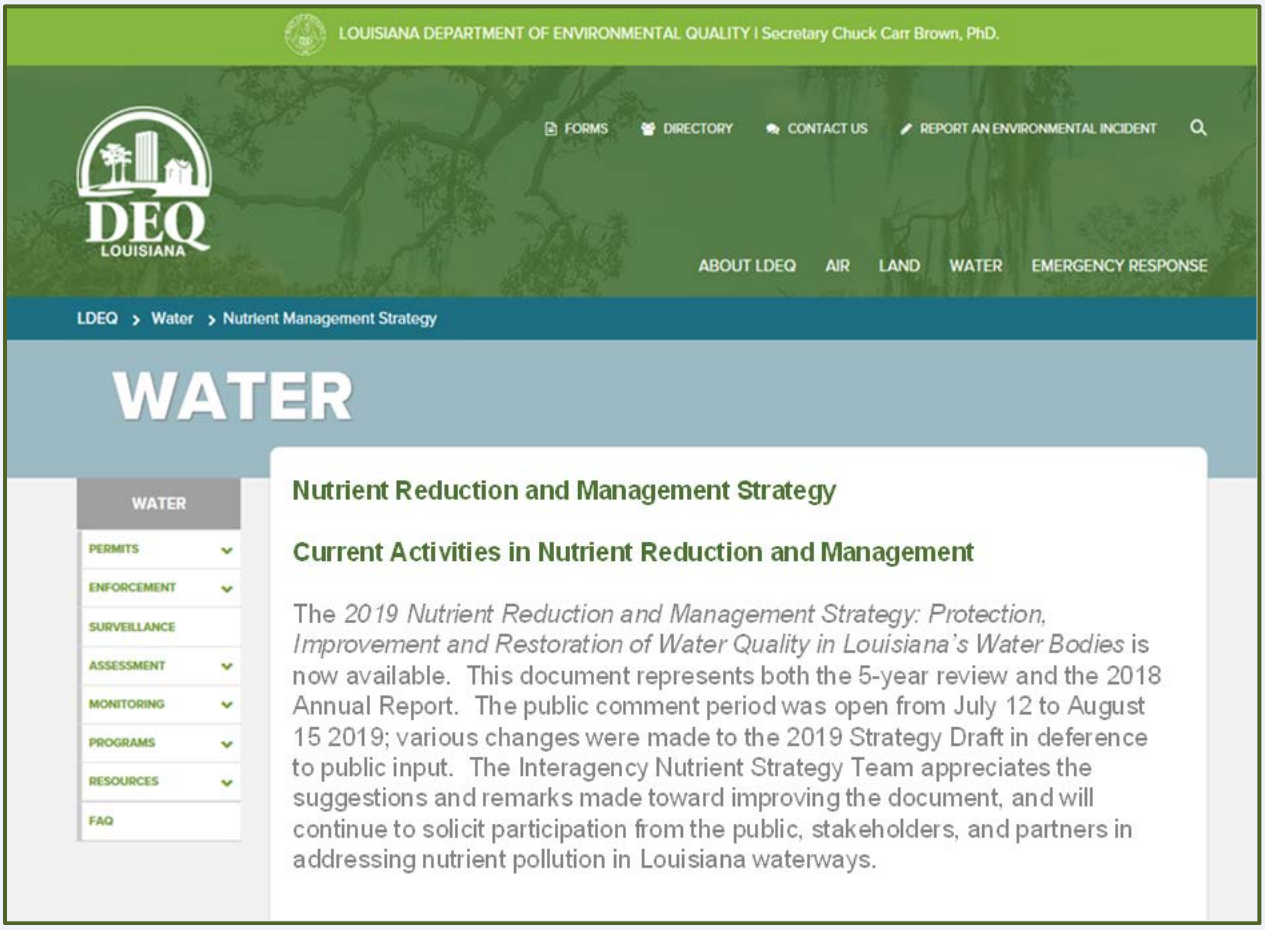

Figure 2. Louisiana Nutrient Reduction and Management Strategy website located at https://www.deq.louisiana.gov/page/nutrient-management-strategy.

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 2021 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. In addition, EPA recognized full implementation of restoration practices in Lake Providence, Louisiana (USEPA 2022). 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 2021, 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

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 provided in 2021
	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 completed in 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	New round of funding in 2022
	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)

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 OSWC*: Louisiana Department of Agriculture and Forestry, Office of Soil and Water Conservation; *LDEQ*: Louisiana Department of Environmental Quality; *LDNR*: Louisiana Department of Natural Resources; *LPDES*: Louisiana Pollutant Discharge Elimination System Permit Program; *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: DETAILED OUTREACH ACTIVITIES BY STRATGY TEAM MEMBERS (where available).

Multi-Program Outreach and Education:

Hypoxia Task Force Activities-

- CPRA, GOCA, and LDEQ participation in the Hypoxia Task Force (HTF) Winter Public Meeting December 14, 2021
- CPRA and LDEQ participation on HTF Coordinating Committee Bimonthly Conference Calls
- CPRA, LDEQ, LDAF, GOCA bimonthly to quarterly calls concerning NRMS activities

Gulf of Mexico Alliance Activities-

- CPRA and LDEQ participation on Gulf of Mexico Alliance (GOMA) Priority Issues Team (Water Quality and Monitoring) meetings and conference calls
- CPRA and LDEQ participation in GOMA GOMCON Virtual Meeting April 14, 2021
- CPRA and LDEQ participation in GOMA Gulf Mapping Network July 26 and 28, 2021
- CPRA and LDEQ participation in New Governors' Action Plan IV and Data Portal Webinar Dec 8, 2021

LDEQ Standards:

Association of Clean Water Administrators (ACWA) Activities-

- ACWA Board of Directors and Executive Committee
- ACWA Mid-Year Virtual Meeting, March 17-18, 2021
- ACWA Annual Virtual Meeting August 4-5, 2021
- ACWA Committee conference calls
- ACWA Innovative Nutrient Removal Technologies Webinar September 14, 2021
- ACWA 2021 ACWA Water Quality Modeling Workshop September 20-22, 2021
- ACWA Nutrients Permitting Workshop Virtual Meeting October 26-28, 2021

Harmful Algal Bloom Activities-

- Harmful Algal Blooms (HABs) Research Symposium January 6-7, 2021
- Cyanobacteria Monitoring Collaborative (CMC) 2021 Mini-Conference and Workshop March 23-24, 2021
- Harmful Cyanobacterial Blooms (HCBs) Strategies for Preventing and Managing Harmful Cyanobacteria Blooms, April 29, 2021
- National Oceanic and Atmospheric Administration (NOAA) Harmful Algal Blooms and Ocean Acidification Webinar June 17, 2021
- U.S. Army Corps of Engineers (USACE) Protecting Drinking Water From Harmful Algal Blooms Webinars July 7 and 14, 2021
- CLA (Clean Lakes Alliance) Cyanobacteria and Our Lakes Webinar July 14, 2021
- Sea Grant Marine Extension Understanding Algal Blooms: State of the Science 2021 Virtual Conference September 8, 2021
- Pontchartrain Conservancy Algal Bloom Coordination Call August 26, 2021
- NOAA Satellite-based cyanobacteria bloom detection algorithm validation with field microcystin data Webinar September 8, 2021
- International Society for the Study of Harmful Algae (ISSHA) 19th International Conference on Harmful Algae Mexico (ICHA) October 15, 2021
- Complexities in Predicting Harmful Algal Blooms Webinar November 3, 2021
- North American Lakes Management Society (NALMS) 2021 Virtual Conference Workshop - November 15-19, 2021
- NOAA HAB Observing Group Webinar-Emerging Data Science Tools for Managers and Scientists Webinar December 1, 2021
- NOAA Protect Harvested Shellfish from Harmful Algal Bloom Toxins Webinar September 16, 2021

Ag Related-

- Louisiana Master Farmer Partners Group Meetings March 4, 2021 and October 27, 2021
- Lake Providence Watershed Council

- Illinois Sustainable Ag Partnership Water Quality Markets and Additional Potential Revenue Streams for Ecosystem Services Webinar July 15 ,2021
- EPA Improving Watershed Health through Agricultural-Municipal Partnerships Webinar July 15, 2021
- Soil Health Institute (SHI) 6th Annual Meeting - Soil Health: Enriching Soil, Enhancing Life Webinar August 12, 2021
- Iowa Learning Farms Edge of Field Practices: Water Quality Solutions for Farmers and Landowners August 12, 2021
- American Farmland Trust (AFT) Nutrient Management Workshop Webinar August 18, 2021
- North American Manure Expo-Professionalism in Nutrient Management Webinar August 26, 2021
- Iowa Learning Farms Iowa Department of Agriculture and Land Stewardship Wetland Initiatives Webinar October 13, 2021
- Iowa Learning Farms Environmental Impacts of Poorly Drained Agricultural Soil Webinar November 3, 2021
- Purdue University Manure Management and Utilization Technologies – Applications and Safety Webinar November 4, 2021
- Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) Phosphorus and Manure Webinar December 6, 2021
- University of Missouri - Missouri State Conference on Cover Crops and Soil Health – Webinar December 15, 2021
- American Society of Agronomy (ASA) Utilizing 4R Nutrient Management Best Practices Webinar August 3, 2021

Carbon and Trading Related-

- North Dakota Corn Council (NDCC) Catching Carbon: Improving Soil, Navigating Markets Webinar July 22, 2021
- EcoMetrics Environmental Credits - How to Create Them, How to Sell Them Webinar July 29, 2021
- CLA Clean Lakes 101 - Farm, Energy, Water, & Carbon Markets August 11, 2021
- University of Nebraska (UN) Ag Carbon Credit Organizations: Panel Discussion Webinar August 12, 2021
- Wisconsin Land and Water Conservation Association (WLWCA) Introduction to Carbon Farm Planning Webinar November 16, 2021
- Water Quality Trading Discussion with American Biocarbon June 29, 2021
- University of Nebraska (UN) Ag Carbon Credit Organizations: Panel Discussion Webinar August 12, 2021

Miscellaneous-

- GOMA Gulf Mapping Network July 26 and 28, 2021
- Mississippi River Cities and Towns Initiative (MRCTI) 9th Annual Virtual Capitol Meeting March 3-4, 2021 and 10th Annual Digital Conference September 14, 2021
- Lower Mississippi River Conservation Committee (LMRCC)
- Louisiana Watershed Initiative through the Technical Advisory Groups and Nature Based Solutions Group
- Association of State Wetland Managers webinars
- America's Watershed Initiative Report Card– Lower Mississippi Webinar April 15 ,2021
- Lower Mississippi River Science Symposium March 10, 2021
- National Recreational Water Quality Workshop April 7-8, 2021
- Interstate Technology and Regulatory Council (ITRC) 2021 Virtual Spring Meeting April 13, 2021
- National Water Quality Monitoring Council (NWQMC) 12th National Monitoring Conference April 21-23, 2021
- Mississippi River Sampling Network Meeting May 27, 2021
- Louisiana Chapter of the American Fisheries Society (Virtual) Annual Meeting May 27-28, 2021
- National Clean Water Act (CWA) 303(d) and Data Management Training Workshop June 7-10, 2021
- Facilitated Brain Storming Session for the Lower Miss July 21, 2021
- Discussions with Lillianah Technologies
- EPA Nutrients Treatment Life Cycle Cost Assessment Webinar August 18, 2021
- University of Wisconsin (UW) FEWscapes discussion: Hypoxia Task Force (HTF) Coordinating Committee and SERA-46 September 10, 2021

- EPA Working Together to Improve Citizen Science Data Quality: A Webinar for Government Agencies Webinar September 14, 2021
- NASA ARSET Monitoring Coastal and Estuarine Water Quality: Transitioning from MODIS to VIIRS Webinar September 16, 2021
- The Nature Conservancy (TNC) Mississippi River Monitoring Design Sprint Call September 20, 2021
- TNC Mississippi River Basin Monitoring Design Group September 29, 2021
- EPA Freshwater Explorer: Interactive Map of Water Quality Webinar October 20, 2021
- EPA Using EnviroAtlas and Recovery Potential Screening Tools to Support Sound Decision Making Webinar October 20, 2021
- EPA Effects of Total Nitrogen and Total Phosphorous on Chlorophyll-a Concentrations in Flowing Waters Webinar October 27, 2021
- Wildland Hydrology Applied Fluvial Geomorphology Training November 5-10, 2021
- EPA Navigating Federal Funding for Green Infrastructure and Nature-Based Solutions Webinar November 2, 2021
- FEWscapes Lunch & Learn: Comparing the models Webinar November 2, 2021
- UI Nutrient Loss Reduction Strategy Conference 2021 Webinar November 10, 2021
- EcoMetrics Nature Based Solutions Finance #5: Data and Models Webinar November 10, 2021
- FEWscapes Lunch & Learn: Data sources Webinar November 16, 2021
- LDWFs White Lake Wetlands Conservation Area WLWCA Conservation Partnership Training Webinar November 30-December 3, 2021
- EPA Smart Sewer Systems and Smart Data Infrastructure Webinar December 7, 2021
- NOAA Balancing Environmental Stewardship With Economic Development Webinar December 9, 2021
- EPA Nutrient Inventory Tool Listening Session December 15, 2021

LDEQ Nonpoint Source:

- Enviroschool – LDEQ NPS staff gave a presentation on Nonpoint Source Pollution and how the NPS unit operates and works to protect and restore waterbodies. June 10, 2021
- Louisiana Rural Water Association Annual Conference in Lafayette at the Cajun Dome. Approximately 1,100 attendees and over 150 vendors participated in the conference, promoting various demonstrations, equipment and training. LDEQ personnel provided water quality information to attendees. July 19-22, 2021
- Master Farmer – event in Crowley; LDEQ NPS staff gave a presentation on Nonpoint Source Pollution. June 29, 2021.
- Master Farmer – event in Bossier; LDEQ NPS staff gave a presentation on Nonpoint Source Pollution. September 30, 2021.
- Master Cattleman – event in Lafayette; LDEQ NPS staff gave a presentation on Nonpoint Source Pollution. October 11, 2021.
- Master Farmer – event in Alexandria; LDEQ NPS staff gave a presentation on Nonpoint Source Pollution. October 14, 2021.
- Additional outreach included the following: DWPP staff gave both remote and in-person presentations or worked booths at the following locations/events; LRWA USDA/FSA SWAP Workshop, LRWA Mini-Conference, SWAP States Meeting, BTNEP Symposium, Bains Elementary, and Centenary Currents reaching over 1,600 people.

LSUAg:

- Phase I crop/soil health trainings
- Field days/tours
- Phase II research station field days

APPENDIX C: 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). Bold 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	40101
LDEQ NPS	Middle Amite River[4,6]	Subsegment	40302
LDEQ NPS	Natalbany River[1,5,6]	Subsegment	40503
LDEQ NPS	Yellow Water River[1, 4,6]	Subsegment	40504
Mermentau River Basin (05)			
LDAF, Evangeline SWCD, LDEQ NPS	Bayou Des Cannes	Subsegment	**50101**
LDAF, St. Landry SWCD, LDEQ NPS	Bayou Mallet	Subsegment	**50103**
LDAF, Acadia SWCD, LDEQ NPS, USDA NRCS	Bayou Queue de Tortue[3]	Subsegment	**50501**
LDAF, Jefferson Davis SWCD, LDEQ NPS	Bayou Chene	Subsegment	**50603**
Vermilion-Teche River Basin (06)			
LDAF, St. Martin SWCD, LDEQ NPS, USDA NRCS	Bayou Du Portage[3]	Subsegment	60703
LDAF, Lafayette SWCD, LDEQ NPS	Vermilion River[4]	Subsegment	060801/060802
Mississippi River Basin (07)			
LDEQ NPS	Thompson Creek[4]	Subsegment	70502
Ouachita River Basin (08)			
LDAF, LDEQ NPS, NRCS	Big Creek (North) [8]	Subsegment	80903
LDAF, Morehouse SWCD, LDEQ NPS	Bayou Lafourche	Subsegment	80904
LDEQ NPS, USDA NRCS-concluded 2021	Lake Providence[2]	Subsegment	81101
LDAF, LaSalle SWCD, LDEQ NPS	Hemphill Creek	Subsegment	81609

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**

[1]New Vision
[2]Mississippi River Basin Initiative (MRBI)
[3]National Water Quality Initiative (NWQI)
[4]Monitoring Supporting Education & Outreach (OSDS Inspections)
[5]On-Site Disposal System Inspections (OSDS) only
[6]Coastal Zone Act Reauthorization Amendments (CZARA)
[7]Natural Resource Damage Assessment (NRDA)
[8]United States Department of Agriculture/Natural Resources Conservation Service (USDA/NRCS)

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 *in-situ*
Bayou Mallet[4] (050103)	8	Dissolved Oxygen, Total Dissolved Solids, Fecal Coliform	Turbidity, TDS, and *in-situ*
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 *in-situ*
Bayou Chene[4] (050603)	9	Dissolved Oxygen, Mercury-Fish Consumption Advisory, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Turbidity, Fecal, and *in-situ*
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 *in-situ*

Water Body Name	**Number of Stations Monitored**	**Impairment**	**Parameters sampled**
Vermilion River[1] (060801)— **A**waiting approval	36	Dissolved Oxygen, Nitrite + Nitrate as N, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Fecal, and *in-situ*
Bayou Louis/Lake Louis[3] (080202/080203)— Completed	4	Mercury-Fish Consumption Advisory, Turbidity, Fecal Coliform	Turbidity and *in-situ*
Big Creek [4] (080903)	14	Atrazine, Dissolved Oxygen, Methyl Parathion, Turbidity	Turbidity, and *in-situ*
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 *in-situ*
Hemphill Creek[4] (081609)	9	Mercury-Fish Consumption Advisory, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Fecal, and *in-situ*
Bayou Grosse Tete[1] (120104)— Awaiting approval	22	Dissolved Oxygen, Nitrite + Nitrate as N, Total Phosphorus, Total Dissolved Solids	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Fecal, and *in-situ*

Water Body Name	Number of Stations Monitored	Impairment	Parameters sampled
Bayou Maringouin[1] (120111)— Awaiting approval	15	Total Dissolved Solids, Fecal Coliform	Nitrate/Nitrite Nitrogen, Total Kjeldahl Nitrogen, Total Phosphorus, Total Dissolved Solids, Turbidity, Fecal, and *in-situ*

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

[2]WIP EPA-Accepted – LDAF Implementation TBD

[3]LDAF Implementation Complete. One-year post monitoring occurring.

APPENDIX E-1: Hypoxia related literature 2019-2021. Selected list updated using search terms 'hypoxia' and the phrase 'Gulf of Mexico' in Harzing's Publish or Perish© for 2021. Application on February 22, 2022.

Authors	*Title*	Year	Source	Quick Link
V Sanial, WS Moore, AM Shiller	*Does a bottom-up mechanism promote hypoxia in the Mississippi Bight?*	2021	Marine Chemistry	https://www.sciencedirect.com/science/article/pii/S030442032100092X
M Armandei, AC Linhoss, RA Camacho	*Hydrodynamic modeling of the Western Mississippi Sound using a linked model system*	2021	Regional Studies in Marine …	https://www.sciencedirect.com/science/article/pii/S2352485521000773
TR Steube, ME Altenritter, BD Walther	*Distributive stress: individually variable responses to hypoxia expand trophic niches in fish*	2021	Ecology	https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8244237/
LT Frankel, MAM Friedrichs, P St-Laurent…	*Nitrogen reductions have decreased hypoxia in the Chesapeake Bay: Evidence from empirical and numerical modeling*	2021	Science of The Total …	https://www.sciencedirect.com/science/article/pii/S0048969721078013
ML Parsons, AL Brandt, RE Turner, WL Morrison…	*Characterization of common phytoplankton on the Louisiana shelf*	2021	Marine Pollution …	https://www.sciencedirect.com/science/article/pii/S0025326X21004926
WJ Huang, WJ Cai, X Hu	*Seasonal Mixing and Biological Controls of the Carbonate System in a River-Dominated Continental Shelf Subject to Eutrophication and Hypoxia in the Northern Gulf of Mexico*	2021	Frontiers in Marine Science	https://www.frontiersin.org/articles/10.3389/fmars.2021.621243/full?&utm_source=Email_to_authors_&utm_medium=Email&utm_content=T1_11.5e1_author&utm_campaign=Email_publication&field=&journalName=Frontiers_in_Marine_Science&id=621243
ED LaBone, KA Rose, D Justic, H Huang…	*Effects of spatial variability on the exposure of fish to hypoxia: a modeling analysis for the Gulf of Mexico*	2021	Biogeosciences	https://bg.copernicus.org/preprints/bg-2020-51/
BM Jarvis, RM Greene, Y Wan, JC Lehrter…	*Contiguous Low Oxygen Waters between the Continental Shelf Hypoxia Zone and Nearshore Coastal Waters of Louisiana, USA: Interpreting 30 Years of Profiling …*	2021	Environmental Science & Technology	https://pubs.acs.org/doi/abs/10.1021/acs.est.0c05973

A Katin	Bayesian Modeling of Coastal Eutrophication to Inform Management Solutions for Hypoxia and Algal Blooms	2021	North Carolina State University Dissertation	https://search.proquest.com/openview/2235aefe37cf6cb2569c288d71d3d4cd/1?pq-origsite=gscholar&cbl=18750&diss=y
NN Rabalais, RE Turner	*Gulf of Mexico hypoxia: Past, present, and future*	2019	Limnology and Oceanography …	https://aslopubs.onlinelibrary.wiley.com/doi/abs/10.1002/lob.10351
F Große, K Fennel, A Laurent	*Quantifying the relative importance of riverine and open-ocean nitrogen sources for hypoxia formation in the northern Gulf of Mexico*	2019	Journal of Geophysical …	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019JC015230
D Scavia, D Justić, DR Obenour…	*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*	2019	Environmental Research	https://iopscience.iop.org/article/10.1088/1748-9326/aaf938/meta
A Laurent, K Fennel	*Time-evolving, spatially explicit forecasts of the northern Gulf of Mexico hypoxic zone*	2019	Environmental science & technology	https://pubs.acs.org/doi/abs/10.1021/acs.est.9b057900
M Khanna, BM Gramig, EH DeLucia, X Cai…	*Harnessing emerging technologies to reduce Gulf hypoxia*	2019	Nature …	https://www.nature.com/articles/s41893-019-0381-4
Y Feng, SF DiMarco, K Balaguru…	*Seasonal and Interannual Variability of Areal Extent of the …*	2019	Journal of Geophysical …	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018JG004745
K Fennel, JM Testa	*Biogeochemical controls on coastal hypoxia*	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…	*Mississippi River diversions and phytoplankton dynamics in deltaic Gulf of Mexico estuaries: a review*	2019	Estuarine, Coastal and …	https://www.sciencedirect.com/science/article/pii/S0272771418305316

N Trifonova, M Karnauskas, C Kelble	*Predicting ecosystem components in the Gulf of Mexico and their responses to climate variability with a dynamic Bayesian network model*	2019	PloS one	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0209257
TC Ballard, AM Michalak, GF McIsaac…	*Comment on "Legacy nitrogen may prevent achievement of water quality goals in the Gulf of Mexico"*	2019	Science	https://www.science.org/doi/10.1126/science.aar4462#:~:text=It%20has%20been%20estimated%20that,on%20achieving%20water%20quality%20goals.
V Thipparthi	*Breaking Coastal Hypoxia: Destratification of Gulf of Mexico Deadzone to Encourage Oxygen Transport Downwards to …*	2019	Louisiana State University Master's Thesis	https://digitalcommons.lsu.edu/gradschool_theses/5040/
NA Ghaisas, K Maiti, JR White	*Coupled iron and phosphorus release from seasonally…*	2019	Estuarine, Coastal and Shelf Science	https://www.sciencedirect.com/science/article/pii/S0272771418305146
A Katin, D Del Giudice, DR Obenour	*Modeling biophysical controls on hypoxia in a shallow estuary using a Bayesian mechanistic approach*	2019	Environmental Modelling & Software	https://www.sciencedirect.com/science/article/pii/S1364815218311320
V Sanial, AM Shiller, DJ Joung, P Ho	*Extent of Mississippi River water in the Mississippi Bight and Louisiana Shelf based on water isotopes*	2019	Estuarine, Coastal and Shelf …	https://www.sciencedirect.com/science/article/pii/S0272771418305018
KJ Van Meter, P Van Cappellen, NB Basu	*Response to Comment on "Legacy nitrogen may prevent achievement of water quality goals in the Gulf of Mexico"*	2019	Science	https://www.science.org/doi/10.1126/science.aav3851
S Fournier, JT Reager, B Dzwonkowski …	*Statistical mapping of freshwater origin and fate signatures as land/ocean "regions of influence" in the Gulf of Mexico*	2019	Journal of …	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018JC014784

LG Campbell	*Analysis of Microbial Abundance, Metabolic Potential, and Transcriptional Activity in the Gulf of Mexico" Deadzone" Reveals an …*	2019		https://diginole.lib.fsu.edu/islandora/object/fsu%3A709068/
WF Ritter, SR Chitikela	*The Mississippi River Basin Phosphorus Problem: Past History and Future Challenges to Solve It*	2019	World Environmental and Water Resources …	https://ascelibrary.org/doi/abs/10.1061/9780784482339.036
CL Cardinaux	*Improving Green and Blue Economy with Nitrogen Management and Hypoxia in the Gulf of Mexico Region*	2019		
D Justic, D Scavia, DR Obenour, K Craig…	*Hypoxic volume in the northern Gulf of Mexico is ecologically more …*	2019	2019 CERF Biennial …	https://cerf.confex.com/cerf/2019/meetingapp.cgi/Paper/5088
RT Munnelly, DB Reeves, EJ Chesney…	*Summertime hydrography of the nearshore Louisiana Continental Shelf: Effects of riverine outflow, shelf …*	2019	Continental Shelf …	https://www.sciencedirect.com/science/article/pii/S0278434318305326
M Le Moal, C Gascuel-Odoux, A Ménesguen…	*Eutrophication: a new wine in an old bottle?*	2019	Science of the Total …	https://www.sciencedirect.com/science/article/pii/S0048969718335836
LD Wright, JPM Syvitski, CR Nichols	*Coastal Systems in the Anthropocene*	2019	Tomorrow's Coasts: Complex and …	https://link.springer.com/chapter/10.1007/978-3-319-75453-6_6
J Zalasiewicz	*5.4 Nitrogen and Phosphorus*	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=UtUlOl3nNIxpC-NJXqF8vGBKIHU

GP Oelsner, EG Stets	*Recent trends in nutrient and sediment loading to coastal areas of the conterminous US: Insights and global context*	2019	Science of the Total Environment	https://www.sciencedirect.com/science/article/pii/S0048969718343377
WA Wurtsbaugh, HW Paerl…	*Nutrients, eutrophication and harmful algal blooms along the …*	2019	Wiley Interdisciplinary …	https://onlinelibrary.wiley.com/doi/abs/10.1002/wat2.1373
D Del Giudice, VRR Matli…	*Bayesian mechanistic modeling characterizes Gulf of Mexico hypox…*	2020	Ecological …	https://esajournals.onlinelibrary.wiley.com/doi/abs/10.1002/eap.2032
H Tian, R Xu, S Pan, Y Yao, Z Bian…	*Long-term trajectory of nitrogen loading and delivery from Mississippi River Basin to the Gulf of Mexico*	2020	Global …	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2019GB006475
C Lu, J Zhang, H Tian, WG Crumpton…	*Increased extreme precipitation challenges nitrogen load …*	2020	… Earth & Environment	https://www.nature.com/articles/s43247-020-00020-7
W Zhang, RD Hetland, V Ruiz, SF DiMarco…	*Stratification duration and the formation of bottom hypoxia over the Texas-Louisiana shelf*	2020	Estuarine, Coastal and …	https://www.sciencedirect.com/science/article/pii/S0272771419309655
VI Ruiz Xomchuk	*Intraseasonal Variability in Northern Gulf of Mexico Hypoxia: Impacts of Baroclinic Instability, Rough Topography, and Exposure Duration*	2020		https://oaktrust.library.tamu.edu/handle/1969.1/192583
P Okwan, Y Zhen, H Feng, S Yoo, MS Kambhampati …	*Statistical Analysis of Nutrient Loads from the Mississippi-Atchafalaya River Basin (MARB) to the Gulf of Mexico*	2020	Environments	https://www.mdpi.com/2076-3298/7/1/8
KE Limburg, D Breitburg, DP	*Ocean deoxygenation: a primer*	2020	One Earth	https://www.sciencedirect.com/science/article/pii/S2590332220300014

Swaney, G Jacinto				
DA González-Rivas, FO Tapia-Silva…	*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 …*	2020	Frontiers in Marine …	https://www.frontiersin.org/articles/10.3389/fmars.2020.00316/full
V Thipparthi, LJ Thibodeaux…	*Breaking Coastal Hypoxia: Destratification of Gulf of Mexico Deadzone Through Artificially Enhancing Oxygen Transport Downwards to Maintain Marine …*	2020	Ocean Sciences Meeting …	https://agu.confex.com/agu/osm20/meetingapp.cgi/Paper/657770
D Justic, L Wang, ZG Xue, Z Zang, DS Ko…	*Development of Long Range Hypoxia Forecasts for the Northern Gulf of Mexico*	2020	Ocean Sciences …	https://agu.confex.com/agu/osm20/meetingapp.cgi/Paper/641538
MT Ogle, SD Howden, B Williams	*Closing the Gaps: A Public/Private Partnership for Coastal HF Radar Coverage along the Louisiana Coast*	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	*Estimating nitrogen inputs, storage, and exports for a small watershed in the upper Mississippi river basin, USA*	2020	Int J Hydro	https://medcraveonline.com/IJH/IJH-04-00249.pdf
SQ Foster, RW Fulweiler	*–Long-term trends in the frequency and phenology of coastal hypoxia vary with estuary type*	2020		https://search.proquest.com/openview/69356f972dbd2905883dfdebc11601ee/1.pdf?pq-origsite=gscholar&cbl=18750&diss=y#page=128

B Parthum, AW Ando	*Overlooked Benefits of Nutrient Reductions in the Mississippi River Basin*	2020	Land Economics	http://le.uwpress.org/content/96/4/589.short
A Bailey, L Meyer, N Pettingell, M Macie…	*Agricultural Practices Contributing to Aquatic Dead Zones*	2020	Ecological and Practical …	https://link.springer.com/chapter/10.1007/978-981-15-3372-3_17
TC Malone, A Newton	*The globalization of cultural eutrophication in the coastal ocean: causes and consequences*	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
Baeumler, SC Gupta	*Precipitation as the primary driver of variability in river nitrogen loads in the Midwest United States*	2020	JAWRA Journal of the American …	https://onlinelibrary.wiley.com/doi/abs/10.1111/1752-1688.12809
B Dzwonkowski, J Coogan, S Fournier…	*Compounding impact of severe weather events fuels marine heatwave in the coastal ocean*	2020	Nature …	https://www.nature.com/articles/s41467-020-18339-2
O'Boyle	*Oxygen Depletion in Coastal Waters and the Open Ocean*	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: Policy related literature 2019-2021. Selected list updated using search terms such as 'Louisiana', 'Water Policy', and 'Agriculture' in Harzing's Publish or Perish© for 2021. Application on February 22, 2022.

AUTHORS	*TITLE*	YEAR	SOURCE	QUICK LINK
MP Miller, SM Eberts, LA Sprague	Water priorities for the Nation—USGS Integrated Water Science basins	2021	pubs.er.usgs.gov	https://pubs.er.usgs.gov/publication/fs20213041
S Giri	*Water quality prospective in Twenty First Century: Status of water quality in major river basins, contemporary strategies and impediments: A review*	2021	Environmental Pollution	https://www.sciencedirect.com/science/article/pii/S0269749120370214
J Paudel, CL Crago	*Environmental externalities from agriculture: evidence from water quality in the united states*	2021	American Journal of Agricultural …	https://onlinelibrary.wiley.com/doi/abs/10.1111/ajae.12130
KM Ferin, L Chen, J Zhong, S Acquah…	*Water quality effects of economically viable land use change in the Mississippi river basin under the Renewable Fuel Standard*	2021	Environmental …	https://pubs.acs.org/doi/abs/10.1021/acs.est.0c04358
CC Anderson, FG Renaud	*A review of public acceptance of nature-based solutions: The 'why','when', and 'how'of success for disaster risk reduction measures*	2021	Ambio	https://link.springer.com/article/10.1007/s13280-021-01502-4
SL King, MK Laubhan, P Tashjian, J Vradenburg…	*Wetland conservation: challenges related to water law and farm policy*	2021	Wetlands	https://link.springer.com/article/10.1007/s13157-021-01449-y
DM Robertson, DA Saad	*Nitrogen and phosphorus sources and delivery from the Mississippi/Atchafalaya River basin: An update using 2012 SPARROW models*	2021	… Journal of the American Water …	https://onlinelibrary.wiley.com/doi/abs/10.1111/1752-1688.12905
JD Aiken	*The Biden Climate Plan*	2021		https://digitalcommons.unl.edu/agecon_cornhusker/1093/
AM Freeman, JW Pahl, ED White, S Langlois…	*A review of how uncertainties in management decisions are addressed in coastal Louisiana restoration*	2021	Water	https://www.mdpi.com/2073-4441/13/11/1528

S Ahuja	*Water quality worldwide*	2021	Handbook of Water Purity and Quality	https://www.sciencedirect.com/science/article/pii/B9780128210574000033
JA Nyman	*An overview of the history and breadth of wetland management practices*	2021	Wetland carbon and environmental management	https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1002/9781119639305.ch4
CK May	*Coastal Community Resilience and Power in the United States: A Comparative Analysis of Adaptability in North Carolina and Louisiana*	2021	Environmental Management	https://link.springer.com/article/10.1007/s00267-021-01482-x
M Robertson, SM Galatowitsch…	*Wetland Compensation and Landscape Change in a Rapidly Urbanizing Context*	2021	Environmental …	https://link.springer.com/article/10.1007/s00267-020-01380-8
M Kelly-Quinn, M Christie, JM Bodoque…	*Ecosystem Services Approach and Natures Contributions to People (NCP) Help Achieve SDG6*	2021	Clean Water and …	http://www.waterjpi.eu/implementation/thematic-activities/water-jpi-tap-action/kelly-quinn2021_ecosystemservicesapproachand-sdg6ppaper.pdf
M Flagg, A Garg	*Science Policy From the Ground Up*	2021	Issues in Science and Technology	https://issues.org/wp-content/uploads/2021/10/51-55-Flagg-Garg-Science-Policy-From-the-Ground-Up-Fall-2021.pdf
MP Allain Jr	*Assessing US Soil Law and Policy for an Uncertain Future*	2021	Tul. Envtl. LJ	https://heinonline.org/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/tulev34&section=10
RC Brears	*Coastal Water Resources Management*	2021	Developing the Blue Economy	https://link.springer.com/chapter/10.1007/978-3-030-84216-1_8
SC Picou, AB Calvin, T Tolford	*Strategies for Funding Watershed Management and Flood-Risk Reduction in Louisiana*	2021	watershed.la.gov	http://planacadiana.org/wp-content/uploads/2021/03/LWI_WhitePaper_FundingStrategies.pdf

S Secchi, M Mcdonald	*The state of water quality strategies in the Mississippi River Basin: Is cooperative federalism working?*	2019	Science of the Total Environment	https://www.sciencedirect.com/science/article/pii/S0048969719319266
KA Whitaker	*What Is a State to Do: When Pollution Law and Policy Solutions Seem Dead in the Water*	2019	Loy. Mar. LJ	https://heinonline.org/hol-cgi-bin/get_pdf.cgi?handle=hein.journals/loymarlj18&section=10
ANEWKOF WILD	*Thinking About the Future of Restoration in the Gulf of Mexico*	2019		http://chesapeakebayssc.org/wp-content/uploads/2019/02/B_Kraft_Marsh_conf_Feb_6_final.pdf
K Konyar, G Frisvold	*Climate Policies as Water Policies*	2019	Applied Methods for Agriculture and Natural …	https://link.springer.com/chapter/10.1007/978-3-030-13487-7_11
WF Ritter, S Rao Chitikela	*The Mississippi River Basin Nitrogen Problem: Past History and Future Challenges to Solve It*	2020	Watershed Management 2020	https://ascelibrary.org/doi/abs/10.1061/9780784483060.010
FY Cheng, KJ Van Meter, DK Byrnes, NB Basu	*Maximizing US nitrate removal through wetland protection and restoration*	2020	Nature	https://www.nature.com/articles/s41586-020-03042-5
KR Salk, RCH Denny, J Greif	*The role of policy in social–ecological interactions of nitrogen management in the Mississippi River basin*	2020		https://acsess.onlinelibrary.wiley.com/doi/abs/10.1002/jeq2.20042
Boehm, R.[1]	*Reviving the Dead Zone: Solutions to Benefit both Gulf Coast Fishers and Midwest Farmers*	2020	Union of Concerned Scientists	https://www.ucsusa.org/resources/reviving-dead-zone

APPENDIX E-3: Agriculture related literature 2019-2021. Selected list updated using 'Louisiana' and words such as 'conservation', 'water quality', and 'tillage' for year 2021 from Harzing's Publish or Perish© application on February, 2022.

Authors	*Title*	Year	Source	Quick Link
E Largacha	*Willingness of non-industrial private forest landowners to obtain a private versus public consultation*	2021	Digitalcommons.lsu.edu	https://digitalcommons.lsu.edu/gradschool_theses/5454/
F Jiang, PJ Drohan, R Cibin, HE Preisendanz…	*Reallocating crop rotation patterns improves water quality and maintains crop yield*	2021	Agricultural …	https://www.sciencedirect.com/science/article/pii/S0308521X20308763
LMM da Silva	*Nutrient Load Modeling in the US: Novel Considerations for Future Management*	2021	AZ State University	https://search.proquest.com
DE Forestieri	*Integrated nutrient management and cover cropping practices in louisiana sugarcane production systems*	2021	Digitalcommons.lsu.edu	https://digitalcommons.lsu.edu/gradschool_dissertations/5665/
H Wang, N Adusumilli, D Ffromme…	*The role of farmer heterogeneity in nutrient management: a farm-level analysis*	2021	Docs.lib.purdue.edu	https://docs.lib.purdue.edu/jafe/vol4/iss1/1/
S Pathak, KP Paudel, NC Adusumilli	*Impact of the federal conservation program participation on conservation practice adoption intensity in Louisiana, USA*	2021	Springer	https://link.springer.com/article/10.1007/s00267-021-01477-8
H Tallis, S Polasky, J Hellmann, NP Springer…	*Five financial incentives to revive the Gulf of Mexico dead zone and Mississippi basin soils*	2019	Journal of environmental …	https://www.sciencedirect.com/science/article/pii/S0301479718314051
MD Ruffatti, RT Roth, CG Lacey…	*Impacts of nitrogen application timing and cover crop inclusion on subsurface drainage water quality*	2019	Agricultural Water …	https://www.sciencedirect.com/science/article/pii/S0378377418313738
JM Baker, R Felton, TJ Griffis	*Tracking Water Parcels as They Move Through Agricultural Watersheds*	2019	AGU Fall Meeting Abstracts	https://ui.adsabs.harvard.edu/abs/2019AGUFM.H43Q2309B/abstract
AA Keller, J Fox	*Giving credit to reforestation for water quality benefits*	2019	PloS one	https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0217756

BR Hanrahan	*inter cover crops reduce nitrate loss from an agricultural watershed in the midwestern us 4*	2019	… Land Cover And Other Controls On …	https://search.proquest.com/openview/613be9215bca40358b220c62698486aa/1.pdf?pq-origsite=gscholar&cbl=18750&diss=y#page=183
CS Jones, KE Schilling…	*Using in situ Water Quality Sensors on Stream Banks and Boats to Characterize US Cornbelt Stream Conditions and …*	2019	AGU Fall Meeting …	https://ui.adsabs.harvard.edu/abs/2019AGUFM.H44D..07J/abstract
BM McGill, AJ Burgin, WD Hively…	*Farming for human health and a smaller dead zone: how agricultural conservation practices, climate change, and subsurface drainage intensification affect nitrate …*	2019	AGU Fall Meeting …	https://ui.adsabs.harvard.edu/abs/2019AGUFMGC33D..03M/abstract
GSW Hoselton	*Illinois Corn Farmers' Concerns About Nutrient Loss and the Adoption of Best Management Practices*	2019		https://search.proquest.com/openview/54b5aef4f1da22c03149dd7ca6fbe072/1?pq-origsite=gscholar&cbl=51922&diss=y
LS Sarkadi	*Effects of Fertilizer on Food Supply*	2019	Chemistry's Role in Food Production and …	https://pubs.acs.org/doi/abs/10.1021/bk-2019-1314.ch009
G Johnson	*Factors Affecting Adoption of Agricultural Best Management Practices in Iowa*	2019	Iowa State	https://lib.dr.iastate.edu/honors_posters/201904/projects/53/
EK Zimmerman, JC Tyndall, LA Schulte…	*Farmer and farmland owner views on spatial targeting for soil conservation and water quality*	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	*Prairie Strips*	2019	MoPraire Journal	https://www.nrem.iastate.edu/research/STRIPS/files/publication/Schulte%202014%20MoPrairieJournal%20--%20Prairie%20Strips.pdf
JT Piske	*Nitrate Concentrations In Streams …Crop Cover In .. Corn And Soybeans*	2019	Illinois State	https://ir.library.illinoisstate.edu/etd/1108/
JA Delgado, NM Short Jr, DP Roberts…	*Big Data analysis for sustainable agriculture on a geospatial cloud framework*	2019	Frontiers in Sustainable …	https://www.frontiersin.org/articles/10.3389/fsufs.2019.00054/full
S Sellars, L Gentry, G	*Cost and Returns from Different Nitrogen Application Timing in Illinois*	2019	farmdoc daily	https://ageconsearch.umn.edu/record/302040/files/fdd121119.pdf

Schnitkey, D Lattz				
AR Mittelstet, TE Gilmore, T Messer, DR Rudnick…	*Evaluation of selected watershed characteristics to identify best management practices to reduce Nebraskan nitrate …*	2019	Agriculture, Ecosystems …	https://www.sciencedirect.com/science/article/pii/S0167880919300507
KE Schilling, MT Streeter, A Seeman, CS Jones…	*Total phosphorus export from Iowa agricultural watersheds: Quantifying the scope and scale of a regional condition*	2020	Journal of …	https://www.sciencedirect.com/science/article/pii/S0022169419311321
JT Piske, EW Peterson	*The role of corn and soybean cultivation on nitrate export from Midwestern US agricultural watersheds*	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…	*The urgency of transforming the Midwestern US landscape into more than corn and soybean*	2020	Agriculture and Human …	https://link.springer.com/content/pdf/10.1007/s10460-020-10077-x.pdf
S Pericherla, MK Karnena, S Vara	*A review on impacts of agricultural runoff on freshwater resources*	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/5eb138aaa6fdcc7050a9981f/A-Review-on-Impacts-of-Agricultural-Runoff-on-Freshwater-Resources.pdf
ML Reba, N Aryal, TG Teague…	*Initial findings from agricultural water quality monitoring at the edge-of-field in Arkansas*	2020	Journal of Soil and Water …	https://www.jswconline.org/content/75/3/291.abstract
GV Tagne, C Dowling	*Land-use controls on nutrient loads in aquifers draining agricultural and …*	2020	Environmental monitoring and assessment	https://link.springer.com/article/10.1007/s10661-020-8126-4
K Gesch, A Kiel, T Sutphin, R Wolf	*Integrating farmer input and Agricultural Conservation Planning Framework results to develop…*	2020	Journal of Soil and Water …	https://www.jswconline.org/content/75/4/101A.abstract
DD Etler	*The Iowa Initiative, Matching Wetlands to Drainage Improvements–Dealing with the Regulations*	2020	2020 ASABE Annual International Virtual Meeting	https://elibrary.asabe.org/abstract.asp?aid=51414

JD Perez-Gutierrez	*Water quality monitoring and modeling studies of on-farm water storage systems in a Mississippi Delta agricultural watershed*	2020	MS State	https://scholarsjunction.msstate.edu/cgi/viewcontent.cgi?article=5978&context=td
AP Sanchez Bustamante Bailon	*Dissolved phosphorus removal in denitrifying bioreactors: field and laboratory studies*	2020	Illinois IDEALS	https://www.ideals.illinois.edu/handle/2142/108627
K Chen	*Evaluating Remote Sensing Techniques to Rapidly Estimate Winter Cover Crop Adoption in the Big Pine Watershed, Indiana*	2020	Purdue	http://pstorage-purdue-258596361474.s3.amazonaws.com/24123767/ChenThesis.pdf
MT Moore, MA Locke	*Experimental evidence for using vegetated ditches for mitigation of complex contaminant mixtures in agricultural runoff*	2020	Water, Air, & Soil Pollution	https://link.springer.com/article/10.1007/s11270-020-04489-y
R Malone, J Garbrecht, P Busteed, J Hatfield, D Todey…	*Drainage N Loads Under Climate Change with Winter Rye Cover Crop in a Northern Mississippi River Basin Corn-Soybean Rotation*	2020	Sustainability	https://www.mdpi.com/2071-1050/12/18/7630
TA Groh, TM Isenhart, RC Schultz	*Long-term nitrate removal in three riparian buffers: 21 years of data from the Bear Creek watershed in central Iowa, USA*	2020	Science of the Total Environment	https://www.sciencedirect.com/science/article/pii/S0048969720336354
GL Wilson, DJ Mulla, J Galzki, A Laacouri, J Vetsch…	*Effects of fertilizer timing and variable rate N on nitrate–N losses from a tile drained corn-soybean rotation simulated using DRAINMOD-NII*	2020	Precision …	https://link.springer.com/article/10.1007/s11119-019-09668-4
R McDaniel, L Ahiablame, U Thapoa, C Partheeban…	*Evaluation of Woodchip Bioreactors and Nutrient Reduction*	2020	SD State	https://openprairie.sdstate.edu/sdwri_data/1/
ER Waring, A Lagzdins, C Pederson, MJ Helmers	*Influence of no-till and a winter rye cover crop on nitrate losses from tile-drained row-crop agriculture in Iowa*	2020	J of Env Quality	https://acsess.onlinelibrary.wiley.com/doi/abs/10.1002/jeq2.20056

MR Arenberg, X Liang, Y Arai	*Immobilization of agricultural phosphorus in temperate …*	2020	Biogeochemistry	https://link.springer.com/article/10.1007/s10533-020-00696-1
L Nowatzke, J Benning	*Measuring Conservation and Nutrient Reduction in Iowa Agriculture*	2020	Iowa State	https://lib.dr.iastate.edu/cropnews/2642/
S Upadhaya, JG Arbuckle, LA Schulte	*Developing farmer typologies to inform conservation outreach in agricultural landscapes*	2020	Land Use Policy	https://www.sciencedirect.com/science/article/pii/S0264837720324959
RL Kirmeyer III	*Characterization and Monitoring of On-Farm Water Storage Systems in Porter Bayou Watershed, Mississippi*	2020		https://ir.library.msstate.edu/handle/11668/1946
L Hayes	*Assessment and valuation of nitrogen mitigation ecosystem services in natural and restored wetlands …*	2020	MS State	https://tamucc-ir.tdl.org/handle/1969.6/89230
NM Schmadel, JW Harvey, RB Alexander…	*Low threshold for nitrogen concentration saturation in headwaters increases regional and coastal delivery*	2020	Environmental …	https://iopscience.iop.org/article/10.1088/1748-9326/ab751b/meta
K Greer, C Martins, M White, CM Pittelkow	*Assessment of high-input soybean management in the US Midwest: Balancing crop production …*	2020	Agriculture, Ecosystems & …	https://www.sciencedirect.com/science/article/pii/S0167880919304281
Y Kuwayama, SM Olmstead, DC Wietelman…	*Trends in nutrient-related pollution as a source of potential water quality damages: A case study of Texas, USA*	2020	Science of The Total …	https://www.sciencedirect.com/science/article/pii/S0048969720314753
M Daniels, P Webb, L Riley, A Sharpley, M Fryer…	*Runoff Water Quality from Corn Production: A Summary of Results from the Arkansas Discovery Program*	2020	Arkansas	https://core.ac.uk/download/pdf/344937843.pdf#page=96
M Daniels, A Sharpley, B Robertson…	*Seasonal Nutrient Losses in Runoff from Cotton*	2020	… of Arkansas Cotton …	https://pdfs.semanticscholar.org/320e/b6f025c69a2054fc690e894e7b42239cb8ce.pdf
Mengistu, S., Golden, H., Lane, C. …1	*Wetland Flowpaths Mediate Nitrogen and Phosphorus Concentrations across the Upper…*	2020	J. of the American Water Resources Assc.	https://onlinelibrary.wiley.com/doi/abs/10.1111/1752-1688.12885