The Mississippi River Basin Initiative (MRBI) Watershed Water Quality Monitoring In Bayou Chene Project, SUBSEGMENT 050603 Draft Final Report

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THE MISSISSIPPI RIVER BASIN INITIATIVE (MRBI) WATERSHED WATER QUALITY MONITORING IN BAYOU CHENE PROJECT, SUBSEGMENT 050603

CFMS NO. 710234 AND OCR NO. 850-200080

DRAFT FINAL REPORT

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1.0 INTRODUCTION

In 1999, Bayou Chene first appeared on the 303(d) list of impaired water bodies. The suspected causes of impairment were organic enrichment and low DO (LDEQ, 1999 court ordered 303(d) list). Effective management of surface water quality in this agricultural watershed requires an understanding of natural and anthropogenic impacts. In watersheds where agriculture is a suspected source of impairment, BMPs may be implemented in hopes of removing the waterbody from the 303(d) list. In watersheds where a natural source is a suspected source of impairment, special water quality criteria may be adopted, leading to removal from the 303(d) list.

In Federal Fiscal Years (FFYs) 2010-2013, the United States Department of Agriculture (USDA) allocated approximately $80 million in federal funds for twelve states in the Mississippi River Basin Initiative (MRBI) to implement best management practices (BMPs) to address nutrient loads that affect local and gulf coast waters. In Louisiana, the eleven 12-digit Hydrologic Unit Codes (HUCs) included Crew Lake, Steep Bayou, Halfway Bayou in Bayou Lafourche, subsegment 080904; Turkey Creek, Little Turkey Creek, West Turkey Creek and Turkey Creek Lake in Turkey Creek, subsegment 080906; Bayou Chene in subsegment (050603); East Bayou Lacassine, West Bayou Lacassine, and Thornwell Drainage Canal in Bayou Lacassine, subsegment 050601. The MRBI Watershed Water Quality in Bayou Chene Project, CFMS No. 710234 and OCR No. 850-200080 started on March 1, 2012 and ended on June 14, 2015. The project covered Bayou Chene, subsegment 050603.

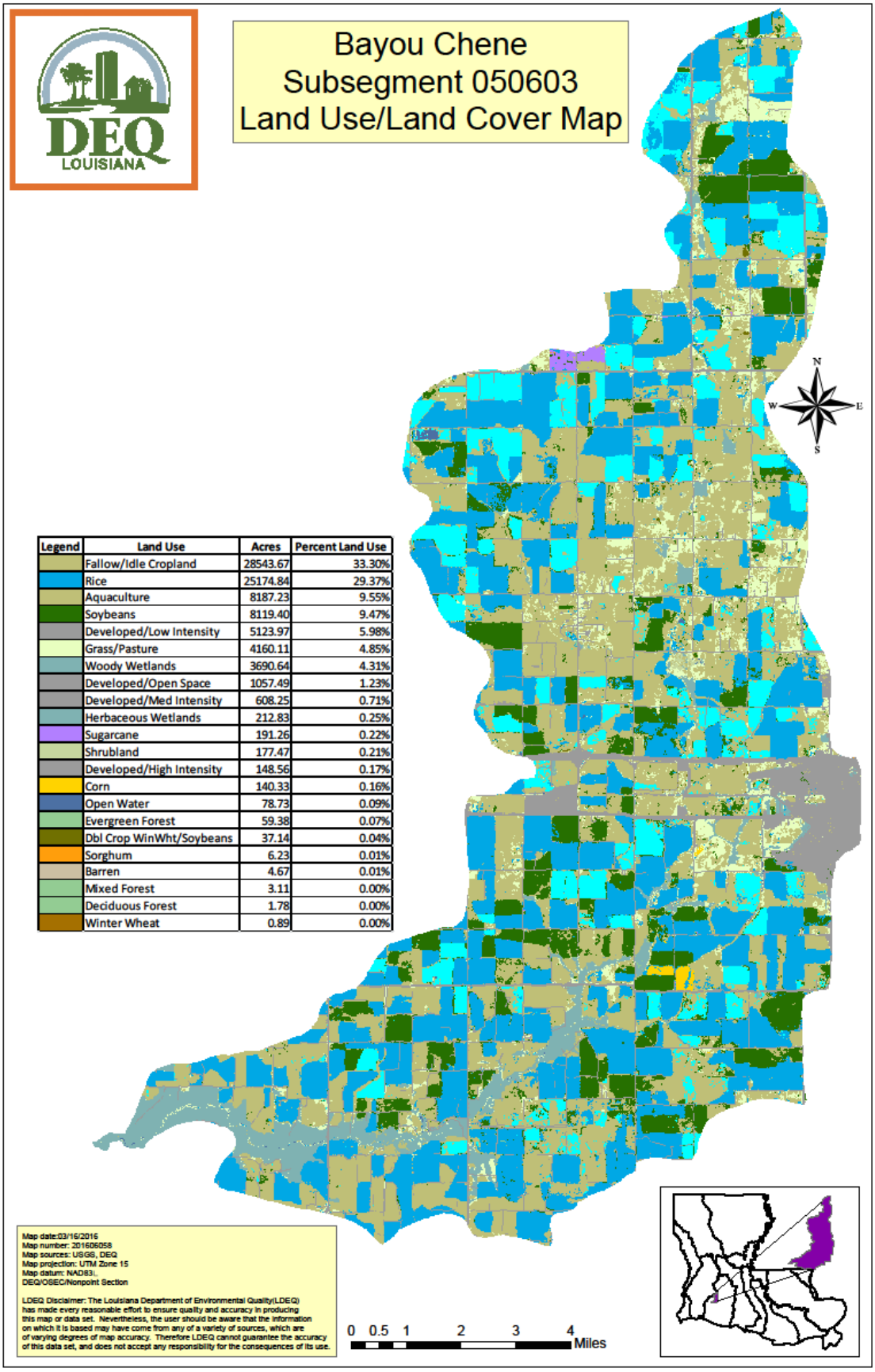
Bayou Chene flows for 33 miles from the headwaters to Lacassine Bayou and includes Bayou Grand Marais. There are three Grand Marais waterbodies: East Bayou Grand Marais, Middle Bayou Grand Marais, and West Bayou Grand Marais. Bayou Chene merges into Bayou Lacassine below Welsh Louisiana crossing Hwy 90. While the headwater of the Middle Bayou Grand Marais ends just before Hwy 26 north of Jennings and the East Bayou Grand Marais ends to the west of Jennings at W. Division St., the headwater of the West Bayou Grand Marias continues north crossing I-10 between Roanoke and Jennings. As it travels north, a small bayou Gum Gully merges at Koll Rd. It continues north crossing Hwy 102 (Pine Island Road or Par Rd. 599) between Raymond and Hathaway. West Bayou Grand Marais continues north and forks to the east at Arbon Rd., and the main stream continues straight north following Hwy 395, and crosses Hwy 395 to the west, crosses back to the east and stops at Linscomb Rd. at Hwy 26, just south of the town of Elton on Hwy 190. Land use distribution in the total area of 86,107 acres of Bayou Chene includes approximately: 33 percent fallow/idle cropland, 29 percent rice, 9 percent aquaculture, 9 percent soybeans, 6 percent developed/low intensity, 5 percent grass/pasture, 4 percent woody wetlands, and 1 percent developed/open space (Figure 1). Irrigation of rice and other crops has a significant impact on water quality in this area. The lower end of Bayou Chene is affected by tidal flux from the Gulf of Mexico and occasionally experiences reverse flows.

Water quality sampling and laboratory analysis were performed to generate water quality data from ten (10) sampling sites in the Bayou Chene watershed. Field parameters were measured in situ, water chemistry samples were collected on a weekly basis for the duration of the project, and biological samples were collected twice a year (May-June and September-October) for two years and were

analyzed for species diversity and abundance. All data was collected and analyzed according to approved quality assurance/quality control (QA/QC) procedures.

The objectives of this project included:

- To document water quality changes following BMP implementation completed through funding from the USDA NRCS under the MRBI and incremental Section 319 funds provided to LDAF for BMP implementation to reduce nutrient loads in the Bayou Chene watershed in south Louisiana;
- If monitoring data supports the conclusion that BMPs have been effective in reducing the targeted parameters, the waterbody may be delisted for DO and other parameters targeted in this project; and
- A success story will be prepared, based on water quality improvements and/or delisting of the waterbody for targeted parameters.



Legend	Land Use	Acres	Percent Land Use
	Fallow/Idle Cropland	28543.67	33.30%
	Rice	25174.84	29.37%
	Aquaculture	8187.23	9.55%
	Soybeans	8119.40	9.47%
	Developed/Low Intensity	5123.97	5.98%
	Grass/Pasture	4160.11	4.85%
	Woody Wetlands	3690.64	4.31%
	Developed/Open Space	1057.49	1.23%
	Developed/Med Intensity	608.25	0.71%
	Herbaceous Wetlands	212.83	0.25%
	Sugarcane	191.26	0.22%
	Shrubland	177.47	0.21%
	Developed/High Intensity	148.56	0.17%
	Corn	140.33	0.16%
	Open Water	78.73	0.09%
	Evergreen Forest	59.38	0.07%
	Dbl Crop WinWht/Soybeans	37.14	0.04%
	Sorghum	6.23	0.01%
	Barren	4.67	0.01%
	Mixed Forest	3.11	0.00%
	Deciduous Forest	1.78	0.00%
	Winter Wheat	0.89	0.00%

Figure 1 Bayou Chene Landuse/Land Cover Map

2.0 Sampling and Laboratory Determination

The first quality assurance project plan (QAPP) was approved effective June 13, 2012, and the second QAPP, with revision, was approved effective July 16, 2014. The QAPP end date was changed from September 30, 2014 to March 31, 2015, to allow for additional sampling in the waterbody. The purpose of the monitoring was to determine effectiveness of agricultural BMPs in reducing nutrients (phosphorus and nitrogen), sediment (solids and turbidity), and biological oxygen-demanding substances (BOD_5) entering the bayou. All data for the project has been uploaded into LDEQ's database, Environmental Quality Information System (EQuIS), (http://deq-svrequis.deq.louisiana.gov/equis/welcome.aspx), and USEPA's database, STORage and RETrieval (STORET) database/ Water Quality Exchange (WQX) (https://oaspub.epa.gov/storpubl/DW_stationcriteria_STN).

2.1 Water Quality Sampling

The Bayou Chene watershed is comprised of three (3) 12-digit HUCs, 080802020201, 080802020203, and 080802020205. Water quality sampling was collected in the lower two HUCs (080802020203, and 080802020205) where it was anticipated that BMP implementation would occur (Figure 3). Water quality sampling involved the weekly collection of surface water samples from ten (10) locations by grab using a Van Dorn sampler (Figure 2). These samples were brought to the LSU AgCenter Callegari Lab for laboratory determination of total suspended solids (TSS), total dissolved solids (TDS), total solids (TS), biochemical oxygen demand (BOD_5), nitrate/nitrite/nitrogen (NO_3/NO_2-N), total kjeldahl nitrogen (TKN), total phosphorus (TP), Chloride (CL), soluble reactive phosphate (SRP), Fluoride (F-), and sulfate (SO_4) using standard methods. Surface water temperature, DO, turbidity, conductivity and pH were determined in the field using YSI Sonde. Biological sampling for fish and macroinvertebrates was performed twice a year (May-June and September-October) for two years and the data was analyzed for species diversity and abundance. All data was collected and analyzed according to approved quality assurance/quality control (QA/QC) procedures. Equipment purchased for field sampling in this project included: YSI Sonde, YSI probes, two Van Dorn samplers, ice chests, sample bottles, and YSI standards.

Figure 2 Water Quality Sampling Using a Van Dorn Sampler, and Determining Field Parameters Using an YSI Sonde

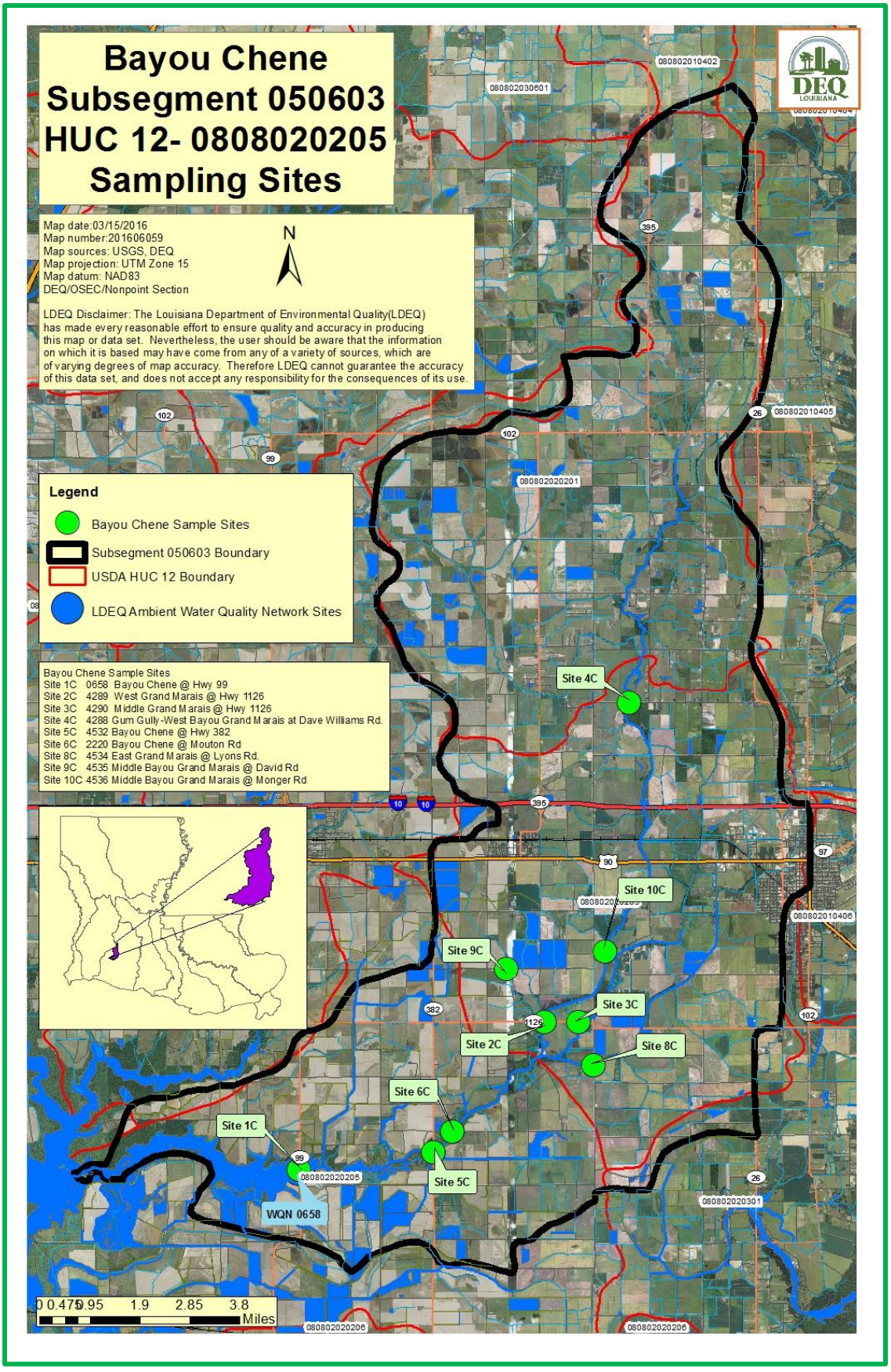


Figure 3 Water Quality Monitoring Sites in Bayou Chene

2.2 Fish and Macroinvertebrate Sampling

Biological sampling was conducted for benthic organisms and for fish. Both groups of organisms were collected at four (4) sites in Bayou Chene during four sampling periods. These sampling periods covered two seasons (summer and fall), during each of two years (2012 and 2013). Summer samples were collected during May and/or June, while the fall samples were collected during September and/or October. It generally required three days of sampling to collect all benthos and fish samples for a specific sampling period. Fish samples consisted of cast net and dipnet samples while benthic samples were taken with a petite Ponar grab, and sieved in the field (500 micron screen).

Figure 4 Fish and Macroinvertebrate Sampling in Bayou Chene and Lacassine Bayou watersheds

2.3 Flow Measurement and Load Calculation

The LDEQ surveys team collected the flow data for select monitoring locations in Bayou Chene. Depending on the stream conditions, three separate flow measurement techniques were used: discharge measurement using a Son Tek RiverCAT from a stationary boat, discharge measurement taken by a moving boat ADCP, and discharge measurement taken by a wading Flow Tracker. Discharge measurements were performed on the following days at the specified sites:

- 12/19/2012 (site 1C, 2C, 3C)

- 1/24/13 (site 1C, 2C, 3C)
- 2/14/13 (site 1C, 2C, 3C)
- 3/7/13 (site 1C, 2C, 3C)
- 3/21/13 (site 1C and 4C)
- 4/4/13 (site 1C)
- 4/18/13 (site 1C, 2C, 3C)
- 5/16/13 (Site 1C, 3C, 4C)
- 5/23/13 (site 2C)
- 6/13/13 (site 1C)
- 6/20/13 (site 1C)
- 7/18/13 (site 1C)
- 8/15/13 (site 1C)
- 9/26/13 (site 1C)

Site 1C showed negative discharge rates on 12/19/2012, 1/24/2013, 2/14/2013, 5/16/2013, and 8/15/2013 out of a total 13 flow measurements. Site 3C had negative flow on 3/7/2013 and on 5/16/2013 out of 6 measurements. Negative flows were quite common in some sites where water quality monitoring was performed.

To establish load estimates from the flow data, average discharge rates and average sediment and nutrient concentrations for respective sites, were calculated, and sediment and nutrient loads were calculated as Load = Q x C, where Q = discharge and C = concentration. Average sediment and nutrient concentrations for each site were calculated from all data collected for the site.

3.0 Effectiveness of Watershed Implementation

During the Bayou Chene MRBI sampling period, implementation was concentrated in one (1) of the three HUCs, HUC 080802020205. There were two (2) practices implemented in 2012, nineteen in 2014, and twenty-one in 2015 (Table 1). Various BMPs implemented in the watershed included residue management, grade stabilization structures, irrigation water conveyance, irrigation water management, irrigation land leveling, nutrient management, integrated pest management, and shallow water area management. In implementing the above BMPs, water quality and the fish and benthic sampling results showed much improvement towards the end of the project.

3.1 Improvement of Surface Water Quality

HUC 0808020205 is located downstream in the watershed, and some effects of the BMPs implemented were evident. There have been small improvements in turbidity, TSS, TDS, TS, NO_3-N, NO_2-N, FL, SO4, SRP, and TP; however, LDEQ does not currently have standards for nutrients. Analysis of monthly values for sites 1 thru 4 showed peak values for turbidity (611.1 NTU) and TSS (151 mg) in March and peak values for TDS (612 mg), TS (773 mg), TP (0.63 mg), TKN (2.94 mg), and BOD_5 (5.79 mg) in April. These results indicate that the impairment of surface water quality in this watershed is correlated with agricultural activities that begin in March. An increasing trend of TKN and BOD_5 suggest that water quality impairment due to oxygen demanding substances is still a major problem in the watershed. Except for DO and BOD_5, the results indicate there has been improvement in surface water quality in Bayou Chene. However, this watershed still requires further implementation of BMPs to continue the reduction in sediments and nutrient pollution and to reverse the decreasing DO and increasing BOD_5 trends.

Based on the loading results (Figures 5and 6), the nonpoint source pollution hotspots (Figure 7) are identified in the upper parts of the watershed. Site 1C, the outlet of Bayou Chene, exhibited lower loading rates, as well as lower average concentration for sediment and nutrients. In contrast, the upstream sites, 2C and 3C, displayed higher loading rates in sediment and nutrient concentrations, as compared to the downstream site. It was therefore concluded that these two sites represent the nonpoint source pollution hotspots in the watershed. Site 2C receives headwaters from 9C, 10C, and 4C; therefore, these three sites are also included in the list of hotpot sites for Bayou Chene. Within Bayou Chene, the fish community data indicated that the water quality was higher at the downstream sites than the upstream sites – though this pattern was not clearly reflected in the benthos data. Just as 1C does not appear to be a hotspot site, sites 5C, 6C, 7C, and 8C that drain into 1C also do not appear to be hotspots for sediment and nutrients.

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Practice Code	Practice Name	Measurement Unit	2012	2014	2015
328	Conservation Crop Rotation	acre	983.7	19399.7	9236.4
329	Residue and Tillage Management, No-Till	acre		744.5	479
344	Residue Management, Seasonal	acre		4930.2	1722.3
345	Residue and Tillage Management, Reduced Till	acre			5850.7
449	Irrigation Water Management	acre		5900.9	2360
464	Irrigation Land Leveling	acre	544.1	74.7	
528	Prescribed Grazing	acre		279.1	310.4
561	Heavy Use Area Protection	acre		73.2	
590	Nutrient Management	acre		7704.6	788.6
595	Integrated Pest Management (IPM)	acre		7919.6	1339.2
644	Wetland Wildlife Habitat Management	acre		198.4	313.9
645	Upland Wildlife Habitat Management	acre		469.1	
646	Shallow Water Development and Management	acre		292.4	1068.9
666	Forest Stand Improvement	acre			69.4
AIR04	Use drift reducing nozzles, low pressures, lower boom height and adjuvants to reduce pesticide drift	acre		6665.1	13418.7
AIR07	GPS, targeted spray application (SmartSprayer), or other chemical application electronic control tec	acre		6665.1	13418.7
AIR08	Nitrification inhibitors or urease inhibitors	acre		229.1	3830.4
ANM11	Patch-burning to enhance wildlife habitat	acre		110	
ANM25	Stockpiling Forages to Extend the Grazing Season	acre			40
ANM29	On-farm forage based grazing system	acre			165
WQL03	Rotation of supplement and feeding areas	acre			165.4
WQL05	Apply nutrients no more than 30 days prior to planned planting date	acre		1344	4945.3
WQL06	Apply controlled release nitrogen fertilizer	acre		237.3	
WQL07	Split nitrogen applications 50% after crop/pasture emergence/green up	acre		887.8	650.5
WQT03	Irrigation pumping plant evaluation	no			1
ANM38	Retrofit watering facility for wildlife escape and enhanced access for bats and bird species	no			2

Table 1 BMPs Implemented in the Bayou Chene HUC 080802020205, 2012-2015

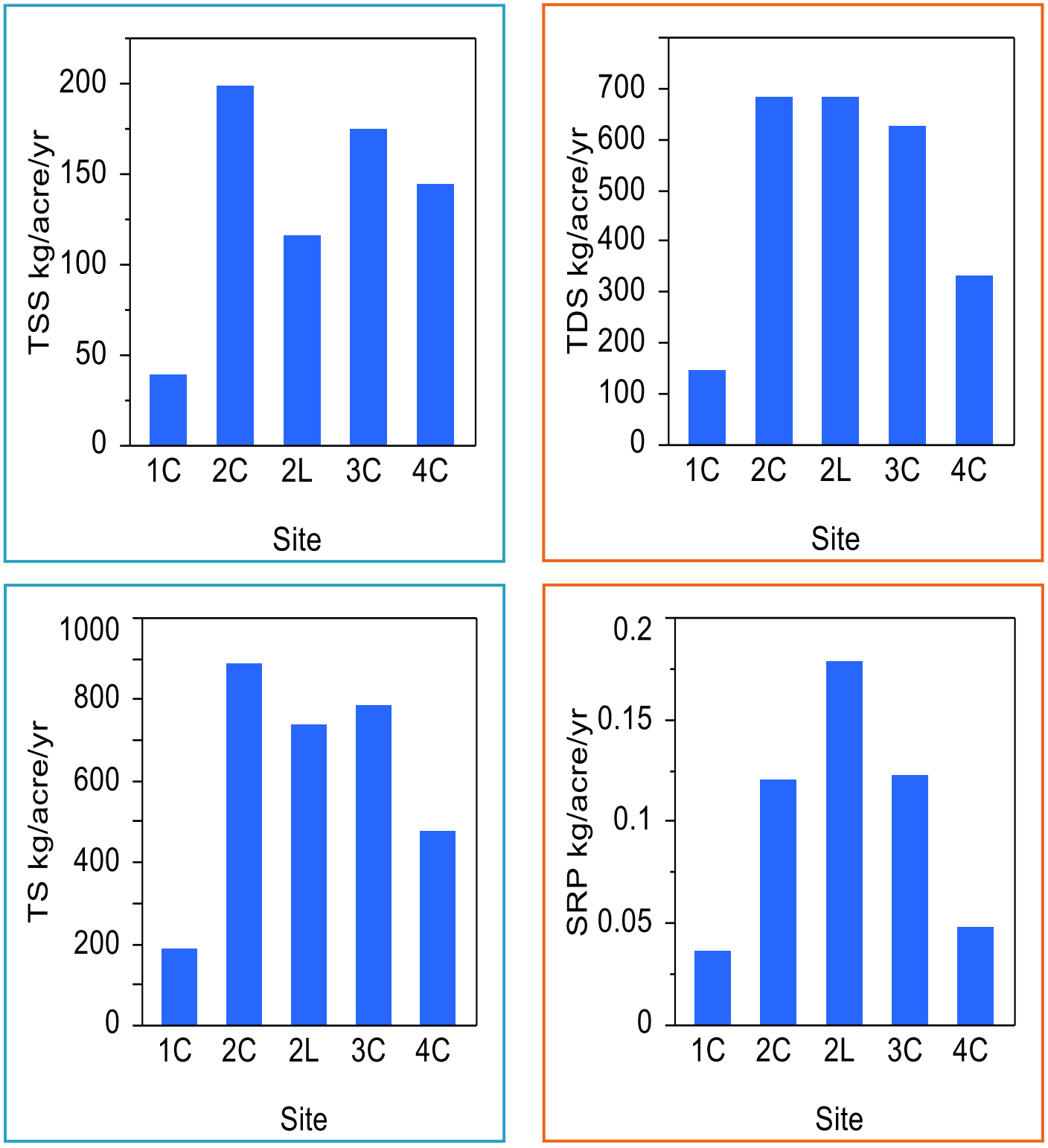
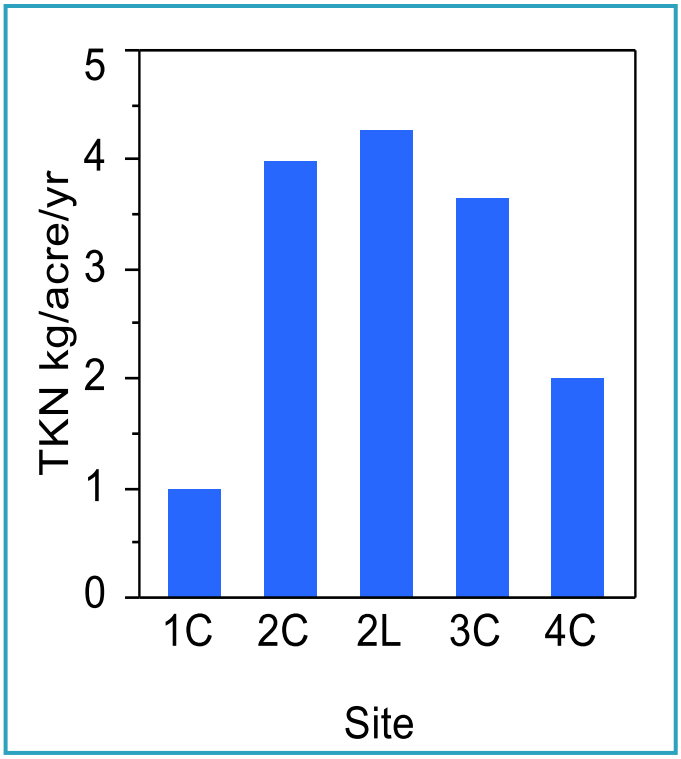
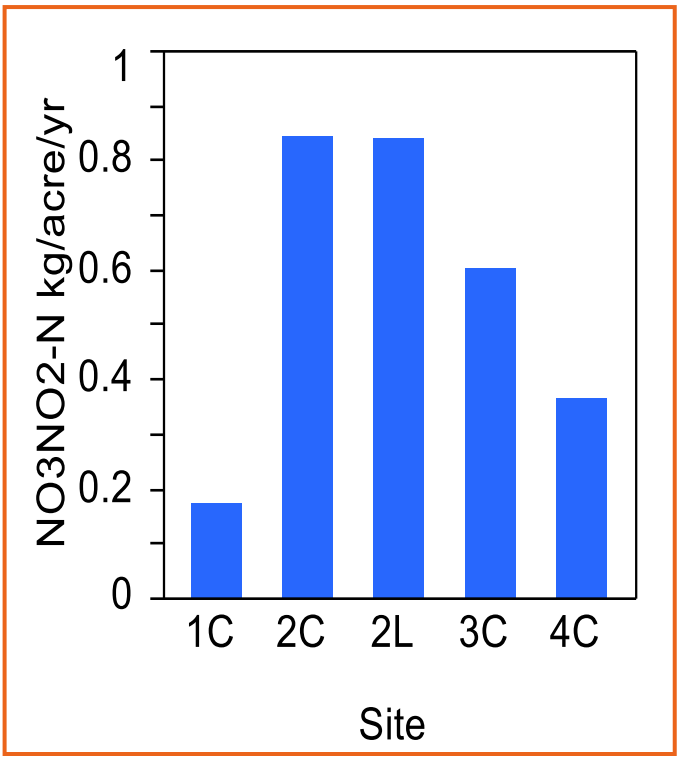


Figure 5 TSS, TDS, TS, and SRP Loadings kg/acre/yr for Select Water Quality Monitoring Sites in Bayou Chene and One Site (2L) in Lacassine Bayou Watershed Where Site 2C Drains





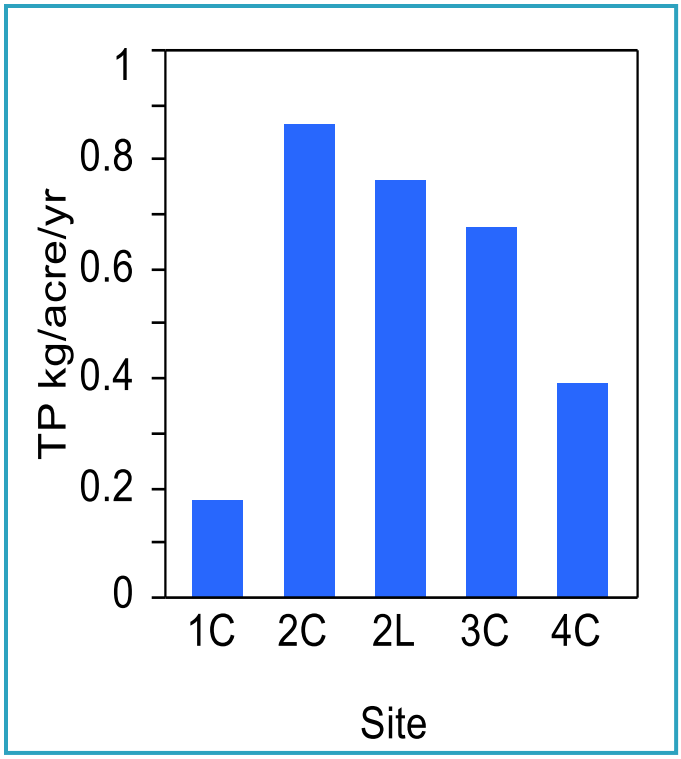


Figure 6 TKN, NO_3NO_2N, and TP loadings kg/acre/yr For Select Water Quality Monitoring Sites in Bayou Chene and One Site (2L) in Lacassine Bayou Where Site 2C drains.

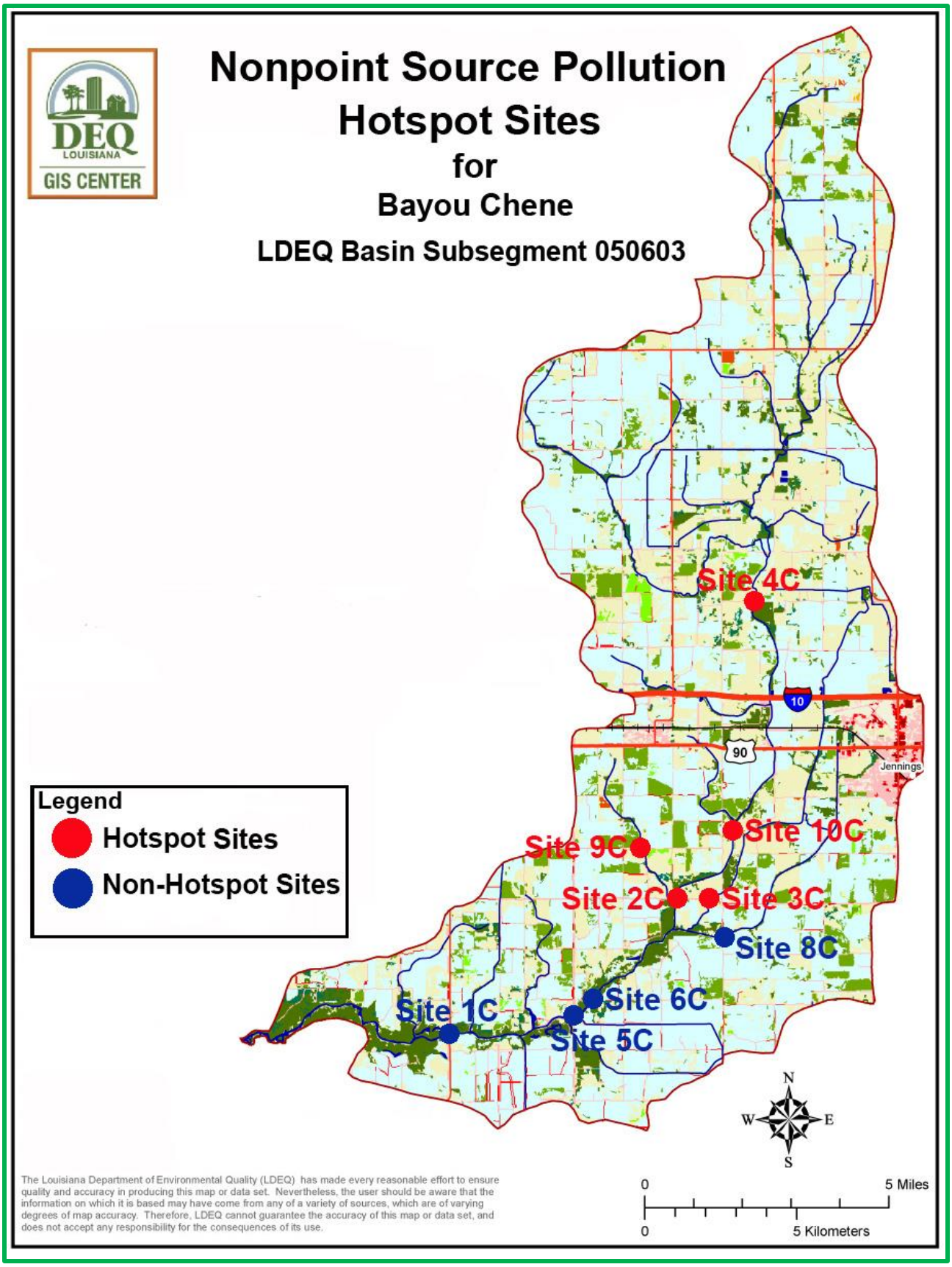


Figure 7 Critical and Non-Critical Areas in Bayou Chene

3.2 IMPROVEMENT ON BENTHIC AND FISH COMMUNITIES

There were significant differences among the sampling sites for all of the three variables measured in Bayou Chene (Table 3). While there was again an overall trend of an increase in values over time (with a clear 2012 versus 2013 contrast for the number of orders represented in the samples), there were some minor deviations from this pattern for the other two variables.

	Su. 2012	Fall 2012	Su. 2013	Fall 2013	S. E.	*p* value
Density (#/m^2)	1116.8^{A}	1701.1^{AB}	2937.5^{B}	1500.0^{AB}	459.5	0.0404
No. of orders	3.813^{A}	3.813^{A}	5.875^{B}	5.813^{B}	0.404	<0.0001
Div. index H'	0.9127^{AB}	0.7648^{A}	1.1822^{AB}	1.2469^{B}	0.1150	<0.0132

Table 2 Macrobenthos density (individuals per m^2) and diversity (number of taxonomic orders present and the diversity index H') during each of the four sampling periods, for Bayou Chene**. Values shown are least square means, with standard error (S.E.) and the p value for the analysis of variance comparing the sampling periods. Means with a different letter as superscript differed in posthoc Tukey HSD pairwise comparisons.**

For the diversity variables at the Bayou Chene sites, there seemed to be a distinct upstream-downstream gradient, with values highest at the downstream sites (Table 4). There was not such a clear upstream-downstream gradient for the abundance-related variables.

	1C	**2C**	**3C**	**4C**	***p* value**
Number of species	2.000 ^{A}	0.250 ^{AB}	-0.500 ^{AB}	-1.750 ^{B}	0.0103
Div. index H' (all spp.)	0.439 ^{A}	0.023 ^{AB}	-0.246 ^{B}	-0.216 ^{B}	0.0042
Div. index H' (w/o *G.a.**)	0.327	0.279	-0.099	-0.507	0.1034
# fish per cast net throw	0.431 ^{A}	-0.056 ^{AB}	-0.144 ^{B}	-0.231 ^{B}	0.0165
# fish per min. dipnetting	-3.288 ^{B}	-1.775 ^{AB}	3.55 ^{A}	1.513 ^{AB}	0.0410
# fish/min dipn. w/o *G.a.*	0.056	-0.044	-0.019	0.006	0.3315

Table 3 The (least square) mean deviations, p value for the ANOVA comparing the Bayou Chene sites, and result of post-hoc comparisons using Tukey-HSD (with means accompanied by different letters differing significantly from each other), for each of the 6 variables that were quantified for the fish collections.

4.0 SEASONAL VARIATION IN SURFACE WATER QUALITY

Dissolved oxygen concentrations begin declining in March, reach a minimum during the summer and start increasing in October in the watershed. Although these lower DO levels coincide with increased summer temperatures, lower DO values also coincide with the agricultural activities occurring in Bayou Chene. The months of March and April showed very high levels of sediment and nutrient concentrations and elevated turbidity and BOD_5 values in the watershed. Lower DO levels during these months is a combined effect of high temperatures and increased sediment and nutrient loads in the waterbody. In March, rice fields are chopped using disc plows, they are flooded, and tractors pull grading blades. This grading activity creates slurry. The fields are then drained and the slurry self-levels the field. This drainage water potentially brings high sediment loads to the bayou. Through field observations ULL staff has noticed that higher turbidity levels during these months may in part be due to water leveling techniques used in preparation for rice planting. Also wet planting of rice requires drainage from rice fields during these months, which contributes to sediment loads and turbidity. Fertilizer application in rice fields and subsequent drainage water from rice fields will also contribute to nutrient loads in the downstream waterways.

Elevated nitrate/nitrite-N concentrations especially in the months of November – December indicated that fall season agricultural activities (especially drainage water from ratoon rice fields, fertilizer application in rice fields prepared for spring planting, drainage water from crawfish ponds and similar other agricultural activities that occur in the watershed in late fall) are responsible for these elevated nitrate/nitrite-N concentrations. The first rice crop is harvested in July and August; the rice fields are fertilized, and are left for ratoon crop. The ratoon rice is harvested in October and November and the fields are drained.

Monthly analysis results for the water quality parameters suggest that sediment and nutrient load reduction strategies, especially when performed in the months of March and April, will improve surface water quality significantly in this watershed. Late February to March is also a period with many rain events in the region. These rain events also bring additional pollutants from non-agricultural lands as surface runoff.

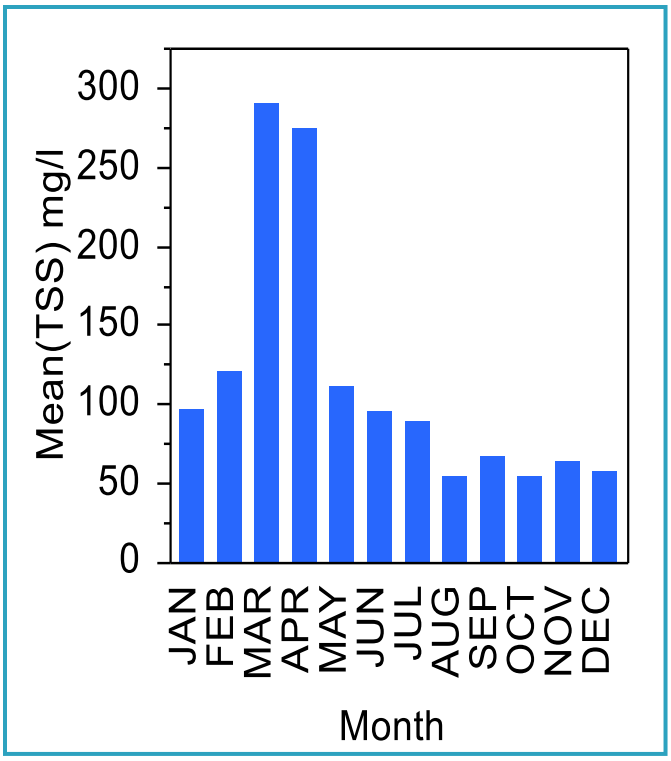


Figure 8 Bayou Chene TSS Monthly Average

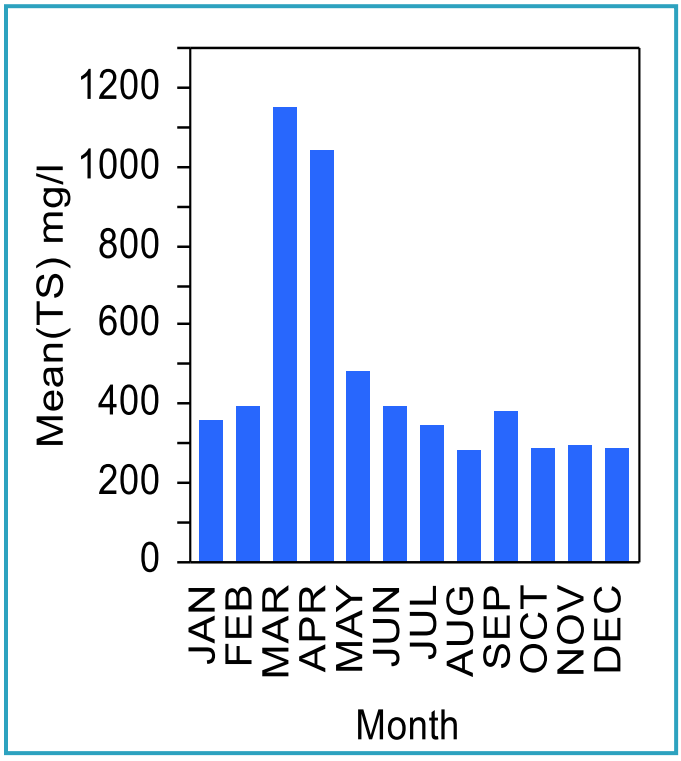


Figure 9 Bayou Chene TS Monthly Average

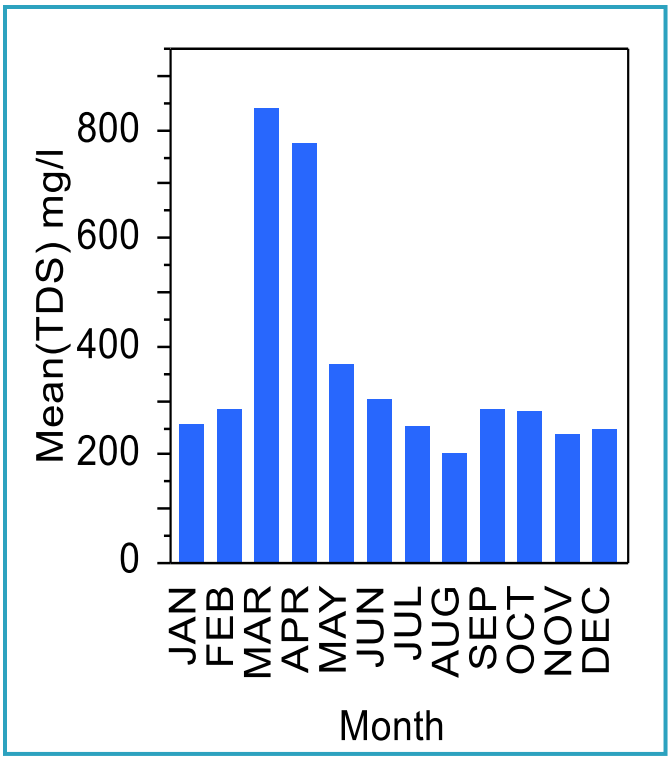


Figure 10 Bayou Chene TDS Monthly Average

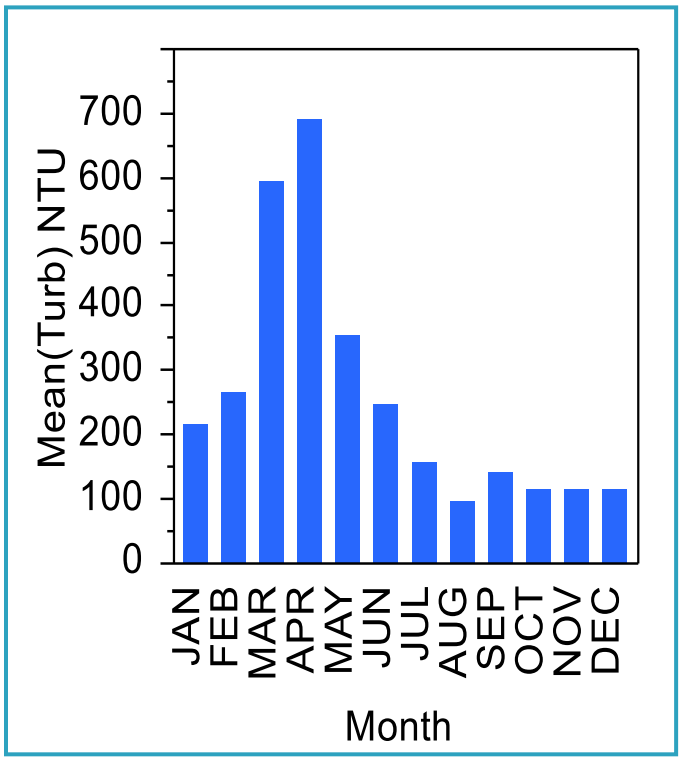


Figure 11 Bayou Chene Turbidity Monthly Average

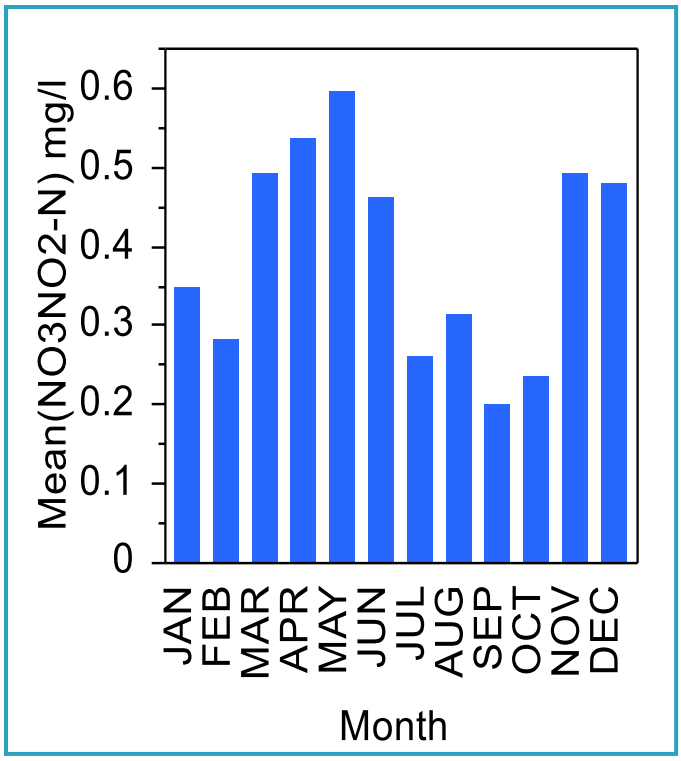


Figure 12 Bayou Chene NO_3NO_2-N Monthly Average

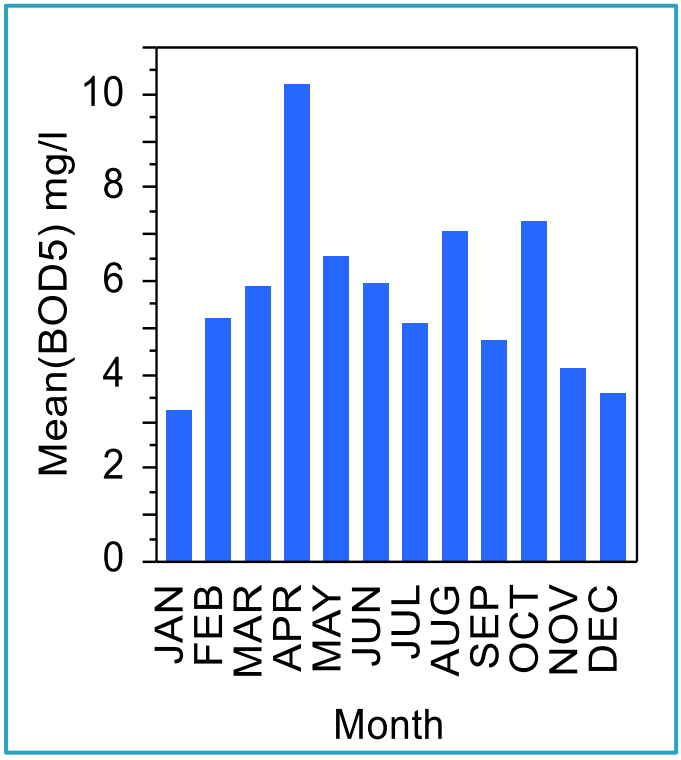


Figure 13 Bayou Chene BOD_5 Monthly Average

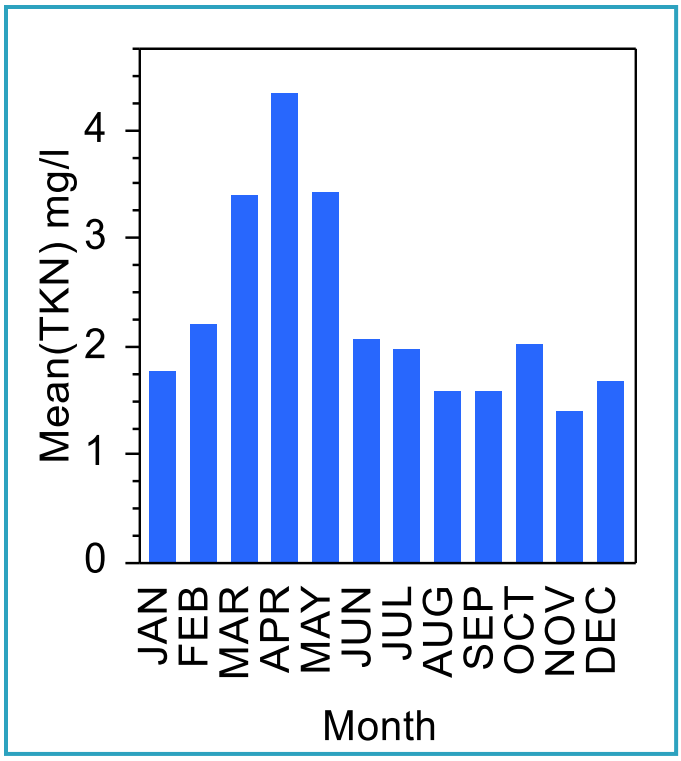


Figure 14 Bayou Chene TKN Monthly Average

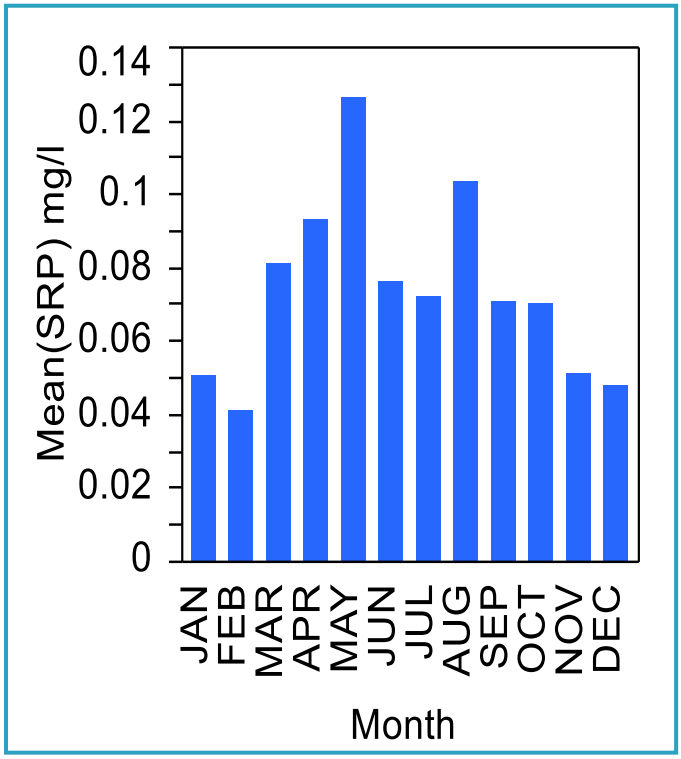


Figure 15 Bayou Chene SRP Monthly Average

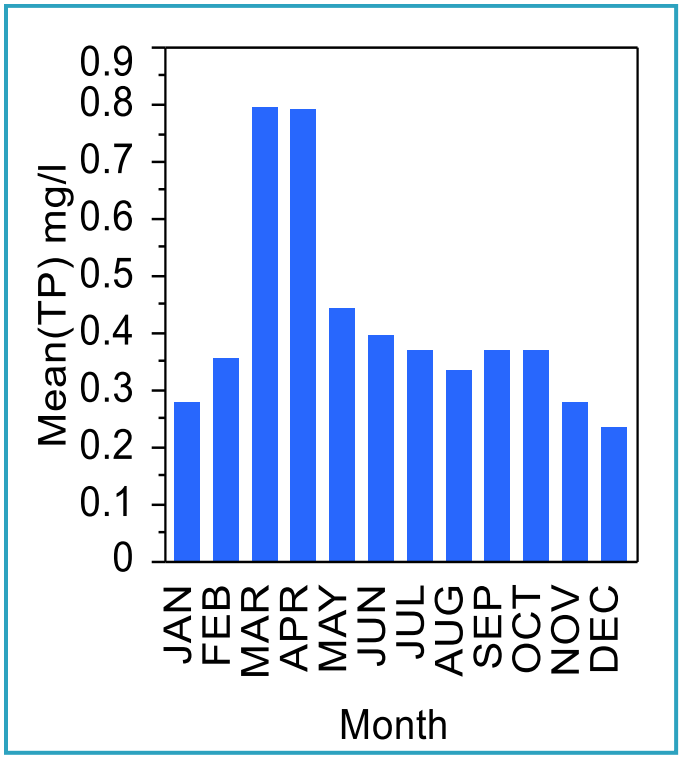


Figure 16 Bayou Chene TP monthly average

5.0 Field Observations

Obstructions

Obstructions in Bayou Chene due to large amounts of litter, debris, and aquatic vegetation were observed at sites 1C, 2C and 3C. Aquatic vegetation, such as water hyacinth, alligator grass, salvinia, and cutgrass were noticed year round. Concerned authorities cleaned and dredged the areas occasionally; however, they became re-established quickly.

Figure 17 Severe Obstructions in Water Flow Due to Debris and Aquatic Vegetation in the Bayou Chene Watershed

Sheen

ULL staff regularly observed sheens on the surface of the water at various sites. The origins and the impacts of these sheens are not clear.

Figure 18 Oil sheens observed at site 3C in Bayou Chene

Backflows

ULL Staff occasionally observed backflow of surface water in all the sampling sites, but most frequent observations were at 1C, 2C and 3C. These backflows might have affected surface water quality to some extent.

Flooding

Flooding events on 1/10/2013 and 5/29/2014 caused an overflow of the banks at site 4C. ULL staff could not sample due to inaccessibility during these events.

Figure 19 Flooding at sampling site in Bayou Chene

Construction

The Jefferson Davis Parish Police Jury began working on the replacement of the bridge at site 4C on 4/25/13. The old concrete surface sections and pilings were removed by crane. New

pilings were driven; the old concrete surface sections were placed back and tied together. On 5/02/13, the bridge was temporarily inaccessible, so the sample was obtained at the next adjacent upstream bridge less than a half-mile away. The bridge construction was finalized by the 5/09/13 sample event.

Figure 20 Replacement of the Bridge at site 4C in Bayou Chene

6.0 Outreach

The scope of services for the Bayou Chene MRBI project did not have a clearly stated task with proposed activities for outreach in the project area. In addition, federal funds were not used to pay for stakeholder events and outreach and education activities. ULL staff conducted small outreach activities such as giving presentations in national conferences, speaking with and answering questions from citizens during sampling, and engaging students in class projects whenever possible. The continuation of sampling in Bayou Chene under grant C9-99610219, FFY 12, project#11, "Water Quality Sampling in Bayou Chene" has a task dedicated to outreach and education. A stakeholders' meeting was held in Jennings in September 2015, and another is scheduled for July 14, 2016. Water quality results have been stored in LDEQs water quality database, EQUIS, and also EPA's water quality database, STORET; therefore, LDEQs division in charge of Louisiana's Nutrient Management Strategy has access to the data collected during the project period. Stakeholders and/or citizens, who may be interested in obtaining the data, may do so through STORET request. LDEQ is currently in the development of the 2018 Nutrient Management Plan (NMP). Data gathered during the Bayou Chene Project will be utilized in the development process. Once complete, the 2018 NMP will be shared with GOMA and the Hypoxia Task Force. The following outreach/education activities were completed, and project results were presented at following meetings, and were shared with professional associates in various programs across the nation:

1) There has been some public awareness through individual contacts while sampling in the watersheds. It is estimated that about 25-30 people have come into contact with the ULL sampling crew during the sampling events, and have discussed water quality issues in the bayou. Citizens were spoken to about BMPs, nonpoint source pollution control, and surface water quality in the watershed.
2) Stakeholder meetings held:
    a. April 27, 2012 WA Callegari for Laboratory analyses – Javed Iqbal (WA Callegari), Durga Poudel (ULL) and Brian Kibbe (ULL).
    b. May 4, 2012, Hamilton Hall, ULL. Scott Edwards (NRCS), Gwen Berthelot (LDEQ), Jan Boydstun (LDEQ), Durga Poudel (ULL), and Brian Kibbe (ULL). Project design.
3) Annual NPS Project Review Meeting, 2012. LDEQ, Baton Rouge, December 12, 2012. *Poudel, D.D., The Mississippi River Basin Initiative (MRBI) Watershed Water Quality Monitoring in Bayou Chene and Lacassine Bayou Project (Oral)*
4) LSU, LDEQ Baton Rouge, 2013. Louisiana Nutrient Management Strategy Stakeholder Engagement Meeting, March 21, 2013. *Poudel, D.D., The Mississippi River Basin Initiative (MRBI) Watershed Water Quality Monitoring in Bayou Chene and Lacassine Bayou Project (Oral). [Invited Presentation]*
5) LDEQs Annual NPS Project Review Meeting, December 10, 2013, LDEQ, Baton Rouge. *Poudel, D.D., The Mississippi River Basin Initiative (MRBI) Watershed Water Quality Monitoring in Bayou Chene and Lacassine Bayou Project (Oral)*.
6) Hydrogeology and water quality in Bayou Chene and Lacassine Bayou in southwestern Louisiana, by Keith D. Moore (graduate student at UL), Durga D. Poudel, and Tim W. Duex. Poster presentation at GCAGS 2014, 64th Annual Convention in Lafayette, LA. October 5-7, 2014.
7) 70th SWCS International Annual Conference, Putting Science into Practice, July 26-29, 2015, Sheraton Four Seasons Hotel, Greensboro, NC. Poudel, D.D. and Paul Klerks. Water Quality Monitoring in Bayou Chene and Lacassine Bayou in Louisiana (Oral).
8) A thesis work by Keith Moore, graduate student at ULL (in progress). Particle-size distribution of Pleistocene-derived soils and its influence on surface water quality in the Bayou Chene and Lacassine Bayou watersheds in southwestern Louisiana.

7.0 Lessons Learned

Fish sampling was a challenging task. While seining for fish, sampling was not possible due to the depth of the water, and/or the banks were too steep to safely enter the water from shore. In addition, electrofishing was not a viable option, due the differences in depth and accessibility. This would require both backpack-electrofishing and boat-electrofishing approaches - making the costs exorbitant for this project and making results not fully comparable among sites. Using a trawl net from a boat would have been an option were it not for limited accessibility by boat and excessive amounts of woody debris in the bayou, especially near the bridges where sampling was to be conducted. It was therefore decided to use a combination of fishing with a cast net and fishing by dipnet from the shore. While it was realized that this may not provide a totally comprehensive picture of the fish communities at

the site, combining these two approaches yielded a comparative survey for the larger species (by using a 12ft radius cast net with 3/8th inch mesh size) and the smaller species (by using a dipnet with very small mesh size). Both methods were conducted at all of the sampling sites. For each castnet sample, the fish from five (5) cast net throws were combined. Each dipnet sample was sampled five (5) minutes. This method was carried out four (4) times per site (resulting in the four (4) replicates) for a total of 20 cast net throws and 20 minutes of dipnetting per site. Collecting the fish and benthic samples took 2.5 to 3 hours per site, for a crew of three (3) people. It should also be pointed out that, by necessity, limited sampling of the biota – twice yearly – is apt to provide an imprecise picture of the bayou's environmental health. This holds especially true for the fish community, as many fish are likely to move among sites and could move into and out of the sampled region of the bayou.

LDEQ surveys staff was able to obtain flow data; however, it was very limited. Even so, the data helped in identifying nonpoint source pollution hotspots, and in calculating loads at some of the sites in Bayou Chene. It will be advisable to collect flow data for each of the monitoring sites and then calculate loadings on a daily basis so that more accurate loadings may be obtained. It should also be noted that flow measurements should be collected on an outgoing tide. Due to limited numbers of flow data the average flow and average concentrations for each site were used to calculate loadings, which may not be very accurate; however, there were no other options.

8.0 Conclusion

There were minimal BMPs implemented by USDA-NRCS during the Bayou Chene MRBI project term (2012-2015). During the sampling period, implementation was concentrated in HUC 080802020205. There were two (2) practices implemented in 2012, nineteen in 2014, and twenty-one in 2015. Various BMPs implemented in the watershed include: residue management, grade stabilization structures, irrigation water conveyance, irrigation water management, irrigation land leveling, nutrient management, integrated pest management, and shallow water area management. It is unknown if the BMPs were implemented on one continuous area (larger area of the watershed), or if multiple BMPs were implemented on numerous farms (smaller areas of the watershed). LDEQ is committed to working with NRCS to ensure the number of BMPs reported as implemented are not counted more than once. The project determined that there have been small improvements in turbidity, TSS, TDS, TS, NO_3-N, NO_2-N, FL, SO_4, SRP, and TP; in spite of this, LDEQ does not currently have standards for nutrients; however, the number of BMPs implemented were not enough to increase DO concentrations in Bayou Chene; therefore, Bayou Chene did not maintain the state's DO standard of 5 mg/L year round from 2012-2015. Since DO concentrations in Bayou Chene did not attain the state's standard of 5.0 mg/L year round, the waterbody will not be delisted for DO and other parameters at this time; consequently, a success story will not be written. Criteria for the designated uses will be used to determine whether NPS loads are being reduced and progress is being made towards meeting water quality standards for Bayou Chene. This will be determined by the WQN site. Bayou Chene remains listed as not supporting its designated use of fish and wildlife propagation, with the suspected cause of impairment being dissolved

oxygen due to agriculture, according to LDEQ's 2014 and 2016 Integrated Reports. Based on water quality analysis and consultations with LDAF, it was determined that additional BMPs would need to be implemented in the watershed, in hopes of furthering efforts for improving water quality in the bayou. In the long run, the data gathered from weekly monitoring of surface water quality data, flow measurements, and fish and macroinvertebrate sampling, will aid in documenting water quality changes following BMP implementation completed through funding from the USDA Natural Resources Conservation Service (NRCS) to reduce nutrient loading into the Bayou Chene watershed; however, in the short term, there were not enough BMPs implemented in Bayou Chene to conclude that the implementation had a significant effect on water quality.

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LDEQ and LDAF remain dedicated to improving the water quality in the Bayou Chene watershed. Water quality analysis results made it evident that additional BMP implementation was needed. In an effort to pinpoint additional critical areas where BMPS could be implemented in Bayou Chene, after the closing of the MRBI project, LDEQ NPS section and ULL personnel entered into a new contract in which ULL continues to collect weekly water quality data and is conducting analysis in the watershed. In consulting with LDAF, it was decided that in addition to the BMPs currently being implemented in HUC 080802020205, BMPs would also need to be implemented in 080802020203 and 080802020201, under the FFYs 2015 and 2016 grants, in hopes of furthering efforts for improving water quality in the bayou.

LDEQ staff was able to strategically begin the new project on June 15, 2015, so that there was no break in water quality sampling. The project is titled "Water Quality Sampling in Bayou Chene", and is currently being supported by 319 nonpoint source funds. Water quality data is currently being collected in two (2) of the three (3) twelve digit HUCs in Bayou Chene (080808020205 and 080808020203) where LDAF will be implementing BMPs. Water quality data collection will continue through September 2017. In the future, LDEQ will begin to collect data in the upper HUC (08080802020201), once BMP implementation commences. Flow data continues to be collected at LDEQ's WQN site 0658, with the help of LDEQ surveys group. The purpose of the water quality monitoring is to evaluate the changes in water quality, before, during, and after watershed implementation to reduce nutrient loading into the Bayou Chene subsegment. The goals of this project include:

- To continue to document water quality changes following BMP implementation originally started through funding from the USDA NRCS under the MRBI and incremental Section 319 funds provided to LDAF for BMP implementation in this watershed to reduce nutrient loads in the Bayou Chene watershed in south Louisiana.
- If monitoring data supports that BMPs have been effective in reducing the targeted parameters, Bayou Chene may be delisted for DO;
- A success story may be prepared, based on water quality improvements and/or delisting of the waterbody for DO.
- The data collected during this project will be used to determine if BMPs have been effective in reducing targeted parameters for Bayou Chene. Results will be incorporated in Louisiana's Nutrient Reduction Strategy and with USDA and stakeholders implementing the WIP in Bayou Chene in Mermentau Basin.

- This data will be used to determine critical areas of high levels of NO_2/NO_3, TKN, TP, TS, TSS, TDS, BOD_5, Turbidity, Sulfate, Chloride, Phosphate, Fluoride, and low DO concentrations.
- This data will be used for water quality assessment.

Future recommendations for implementation in the Bayou Chene watershed include:

1) Continuing implementation of BMPs and monitoring of surface water quality in Bayou Chene, focusing on high priority areas selected;
2) Integrating efforts currently being implemented by project partners;
3) Increasing implementation within the critical areas in the watershed;
4) Help producers voluntarily implement conservation practices that avoid, control, and trap nutrient runoff;
5) Improving wildlife habitat;
6) Maintaining agricultural productivity and the local economy by providing financial incentives;
7) Increasing community awareness against littering of the waterways and finding ways for regular clearance of the obstructions; and
8) Developing a more aggressive outreach component for Bayou Chene, reaching all stakeholders in the watershed.

Working collaboratively with USDA-NRCS Alexandria and its field offices, LDAF, NRCS, FSA, LSU AgCenter, and closely with LDEQ were helpful in project implementation and helping to meet the objectives of the project, which were:

1) *To document water quality changes following BMP implementation completed through funding from the USDA NRCS under the MRBI and incremental Section 319 funds provided to LDAF for BMP implementation in this watershed.* This task has been completed. Water quality changes from June 2012 to June 2015 have been documented and fully discussed in this report. During the Bayou Chene MRBI sampling period, implementation was concentrated in HUC 080802020205. There were two (2) practices implemented in 2012, nineteen in 2014, and twenty-one in 2015. Despite the implementation of BMPs in the watershed, DO, in the bayou, did not improve. There were not enough BMPs implemented, to be able to conclude that they were effective in improving water quality.
2) *If monitoring data support that BMPs have been effective in reducing the targeted parameters, the waterbody may be delisted for dissolved oxygen (DO) and other parameters targeted in this project.* The monitoring data collected does not show that BMPs were effective in reducing the targeted parameters. During the Bayou Chene MRBI project, forty two BMPs were implemented in HUC 080802020205, and improvements in nutrient concentrations were noted; however, DO concentrations did not attain the state's standard of 5.0 mg/L year round; Bayou Chene, subsegment 050603, remains listed on LDEQ's 2016 IR for Bayou not supporting its designated use of fish and wildlife propagation, with the suspected cause of impairment being dissolved oxygen due to agriculture. Therefore, the waterbody was not delisted for DO.

3) *A success story will be prepared, based on water quality improvements and/or delisting of the water body for targeted parameters.* An analysis of the water quality in Bayou Chene, after project completion does not show an improvement in DO; in addition, the subsegment remains listed for not supporting its designated use of FWP due to low concentrations of DO with the suspected source being agriculture. For these reasons, a success story will not be developed.

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